TEST REPORT

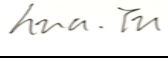
EN 50549-1:2019

Requirements for micro-generating plants to be connected in parallel with public low-voltage distribution networks

Part 1: Connection to a LV distribution network - Generating plants up to and including Type B

Report	
Report Number. ..... :	6098561.50
Date of issue ..... :	2021-04-02
Total number of pages	232
Testing Laboratory ..... :	DEKRA Testing and Certification (Suzhou) Co., Ltd.
Address ..... :	No.99, Hongye Road, Suzhou Industrial Park, Suzhou, Jiangsu, P.R. China
Applicant's name ..... :	Soltaro Pty. Ltd. ATF Soltaro Unit Trust
Address ..... :	Level 9/440 Collins Street, Melbourne VIC, 3000, Australia
Test specification:	
Standard ..... :	EN 50549-1:2019
Test procedure ..... :	Type test
Non-standard test method ..... :	N/A
Test Report Form No. ..... :	EN 50549-1_V1.0
Test Report Form(s) Originator ..... :	DEKRA Testing and Certification (Suzhou) Co., Ltd.
Master TRF ..... :	Dated 2019-05-31
Test item description ..... :	Hyper inverter
Trade Mark ..... :	SOLTARO
Manufacturer ..... :	Soltaro Pty. Ltd. ATF Soltaro Unit Trust Level 9/440 Collins Street, Melbourne VIC, 3000, Australia
Model/Type reference ..... :	AIO2-INS-3000, AIO2-INS-3680, AIO2-INS-4600, AIO2-INS-5000

Ratings ..... :	Operating temperature range: - 10°C to + 60°C Protective class: I Ingress protection rating: IP65 Power factor range (adjustable): 0.8 leading…0.8 lagging AIO2-INS-3000: PV input: Max. 600 Vdc, MPPT voltage range: 125-500 Vdc, max 12 A, Isc PV: 15 A Battery: Type: Lithium battery, voltage range: 40-60 Vdc, rated voltage: 48 Vdc, max charge/discharge current: 60 A Output: 230 Vac, 50 Hz, 3000 VA, max 13 A AIO2-INS-3680: PV input: Max. 600 Vdc, MPPT voltage range: 125-500 Vdc, max 2x12 A, Isc PV: 2x15 A Battery: Type: Lithium battery, voltage range: 40-60 Vdc, rated voltage: 48 Vdc, max charge/discharge current: 80 A Output: 230 Vac, 50 Hz, 3680 VA, max 16 A AIO2-INS-4600: PV input: Max. 600 Vdc, MPPT voltage range: 125-500 Vdc, max 2x12 A, Isc PV: 2x15 A Battery: Type: Lithium battery, voltage range: 40-60 Vdc, rated voltage: 48 Vdc, max charge/discharge current: 100 A Output: 230 Vac, 50 Hz, 4600 VA, max 20 A AIO2-INS-5000: PV input: Max. 600 Vdc, MPPT voltage range: 125-500 Vdc, max 2x12 A, Isc PV: 2x15 A Battery: Type: Lithium battery, voltage range: 40-60 Vdc, rated voltage: 48 Vdc, max charge/discharge current: 100 A Output: 230 Vac, 50 Hz, 5000 VA, max 21.7 A

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):			
☒	Testing Laboratory:	DEKRA Testing and Certification (Suzhou) Co., Ltd.	
Testing location/ address:		No.99, Hongye Road, Suzhou Industrial Park, Suzhou, Jiangsu, P.R. China	
☐	~~Associated Testing Laboratory:~~		
~~Testing location/ address ..... :~~			
Tested by (name, function, signature):		Hua Yu	
Approved by (name, function, signature):		Jason Guo	
☐	~~Testing procedure: CTF Stage 1:~~		
~~Testing location/ address ..... :~~			
~~Tested by (name, function, signature) ..... :~~			
~~Approved by (name, function, signature) ..... :~~			
☐	~~Testing procedure: CTF Stage 2:~~		
~~Testing location/ address ..... :~~			

~~Tested by (name + signature).....:~~		
~~Witnessed by (name, function, signature).....:~~		
~~Approved by (name, function, signature).....:~~		
☐ ~~Testing procedure: CTF Stage 3:~~		
☐ ~~Testing procedure: CTF Stage 4:~~		
~~Testing location/ address .....:~~		
~~Tested by (name, function, signature) .....:~~		
~~Witnessed by (name, function, signature).....:~~		
~~Approved by (name, function, signature).....:~~		
~~Supervised by (name, function, signature).....:~~		

Rating label:

SOLTARO ONE 2 ALL IN

Hybrid Inverter

AIO2-INS-3000

Max. PV Panel Power	4500W
Max. PV Voltage	600V d.c.
MPPT Voltage Range	125~500V d.c.
Max. PV Current	12A d.c.
PV Isc	15A d.c.
PV Inverter Topology	Non-isolated
Rated AC Voltage	230V a.c.
Rated AC Frequency	50Hz
Rated AC Power	3000VA
Max. Output Current	13.0A a.c.
Power Factor Range	-0.8~+0.8
Battery Type	Lithium
Rated Battery Voltage	48V d.c.
Battery Voltage Range	40~60V d.c.
Max. Charge Current	60A d.c.
Max. Discharge Current	60A d.c.
Galvanic Isolation for Bat.	Yes
AC Overvoltage-Category	III
DC Overvoltage-Category	II
IP Protection	IP65
Protective Class	Class I

Grid Regulations:

AS/NZS4777.2; G98; G100; EN50549;
C10/11; UTE C 15-712-1; NRS 097-2-1;

Serial Number

Soltaro Pty. Ltd.
Level 9/440 Collins Street, Melbourne
VIC, 3000, Australia
www.soltaro.com

MADE IN CHINA
L_HYPER-S-3000_SOLTARO_02

DRM0	DRM1	DRM2	DRM3	DRM4	DRM5	DRM6	DRM7	DRM8
☒	☒	☒	☒	☒	☒	☒	☒	☒

SOLTARO ONE 2 ALL IN

Hybrid Inverter

AIO2-INS-3680

Max. PV Panel Power	5500W
Max. PV Voltage	600V d.c.
MPPT Voltage Range	125~500V d.c.
Max. PV Current	12A / 12A d.c.
PV Isc	15A / 15A d.c.
PV Inverter Topology	Non-isolated
Rated AC Voltage	230V a.c.
Rated AC Frequency	50Hz
Rated AC Power	3680VA
Max. Output Current	16.0A a.c.
Power Factor Range	-0.8~+0.8
Battery Type	Lithium
Rated Battery Voltage	48V d.c.
Battery Voltage Range	40~60V d.c.
Max. Charge Current	80A d.c.
Max. Discharge Current	80A d.c.
Galvanic Isolation for Bat.	Yes
AC Overvoltage-Category	III
DC Overvoltage-Category	II
IP Protection	IP65
Protective Class	Class I

Grid Regulations:

AS/NZS4777.2; G98; G100; EN50549;
C10/11; UTE C 15-712-1; NRS 097-2-1;

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DRM0	DRM1	DRM2	DRM3	DRM4	DRM5	DRM6	DRM7	DRM8
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SOLTARO ONE 2 ALL IN

Hybrid Inverter

AIO2-INS-4600

Max. PV Panel Power	6900W
Max. PV Voltage	600V d.c.
MPPT Voltage Range	125~500V d.c.
Max. PV Current	12A / 12A d.c.
PV Isc	15A / 15A d.c.
PV Inverter Topology	Non-isolated
Rated AC Voltage	230V a.c.
Rated AC Frequency	50Hz
Rated AC Power	4600VA
Max. Output Current	20.0A a.c.
Power Factor Range	-0.8~+0.8
Battery Type	Lithium
Rated Battery Voltage	48V d.c.
Battery Voltage Range	40~60V d.c.
Max. Charge Current	100A d.c.
Max. Discharge Current	100A d.c.
Galvanic Isolation for Bat.	Yes
AC Overvoltage-Category	III
DC Overvoltage-Category	II
IP Protection	IP65
Protective Class	Class I

Grid Regulations:

AS/NZS4777.2; G99; G100; EN50549;
C10/11; UTE C 15-712-1; NRS 097-2-1;

Serial Number

Soltaro Pty. Ltd.
Level 9/440 Collins Street, Melbourne
VIC, 3000, Australia
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MADE IN CHINA
L_HYPER-S-5000_SOLTARO_05

DRM0	DRM1	DRM2	DRM3	DRM4	DRM5	DRM6	DRM7	DRM8
☒	☐	☐	☐	☒	☐	☐	☐	☐

SOLTARO ONE 2 ALL IN

Hybrid Inverter

AIO2-INS-5000

Max. PV Panel Power	7500W
Max. PV Voltage	600V d.c.
MPPT Voltage Range	125~500V d.c.
Max. PV Current	12A / 12A d.c.
PV Isc	15A / 15A d.c.
PV Inverter Topology	Non-isolated
Rated AC Voltage	230V a.c.
Rated AC Frequency	50Hz
Rated AC Power	5000VA
Max. Output Current	21.7A a.c.
Power Factor Range	-0.8~+0.8
Battery Type	Lithium
Rated Battery Voltage	48V d.c.
Battery Voltage Range	40~60V d.c.
Max. Charge Current	100A d.c.
Max. Discharge Current	100A d.c.
Galvanic Isolation for Bat.	Yes
AC Overvoltage-Category	III
DC Overvoltage-Category	II
IP Protection	IP65
Protective Class	Class I

Grid Regulations:

AS/NZS4777.2; G99; G100; EN50549;
C10/11; UTE C 15-712-1; NRS 097-2-1;

Serial Number

Soltaro Pty. Ltd.
Level 9/440 Collins Street, Melbourne
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www.soltaro.com

MADE IN CHINA
L_HYPER-S-5000_SOLTARO_05

DRM0	DRM1	DRM2	DRM3	DRM4	DRM5	DRM6	DRM7	DRM8
☒	☐	☐	☐	☒	☐	☐	☐	☐

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

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
IT testing, phase-phase voltage (V) ..... :	N/A
Class of equipment ..... :	Class I Class II Class III Not classified
Mass of equipment (kg) ..... :	34 kg for AIO2-INS-4600, AIO2-INS-5000 29 kg for AIO2-INS-3680 27 kg for AIO2-INS-3000
Pollution degree ..... :	Outside PD3; Inside PD2
IP protection class ..... :	IP65
Possible test case verdicts:	
- test case does not apply to the test object ..... :	N/A
- test object does meet the requirement ..... :	P (Pass)
- test object does not meet the requirement ..... :	F (Fail)
- this clause is information reference for installation ... :	Info.
Testing:	
Date of receipt of test item ..... :	2021-03-02 (samples provided by applicant)
Date (s) of performance of tests ..... :	2021-03-05 to 2021-03-25

General remarks:

"(see appended table)" refers to a table appended to the report.
"(see Appendix #)" refers to additional information appended to the report.
The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.
The measurement result is considered in conformance with the requirement if it is within the prescribed limit, It is not necessary to account the uncertainty associated with the measurement result.
The information provided by the customer in this report may affect the validity of the results, the test lab is not responsible for it.
This report is only for reference and is not used for legal proof function in China market.
Throughout this report a ☐ comma / ☒ point is used as the decimal separator.

Name and address of factory (ies):

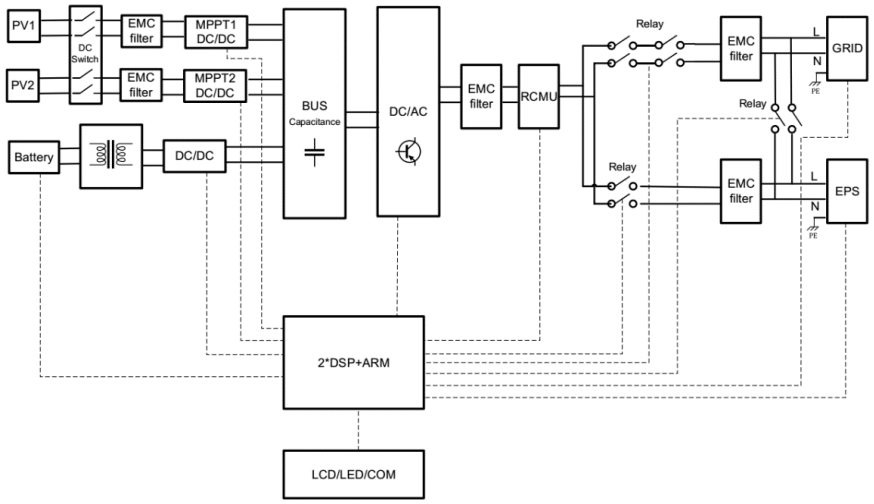
Hangzhou livoltek power Co., Ltd.
1418-35 Moganshan Road, Shangcheng Industrial Zone, Hangzhou, P.R. China

General product information:

The products are single phase multiple functional hybrid inverter converts DC power from the photovoltaic (PV) arrays as well as batteries to AC power. The battery port is able to be charged by the energy from either PV port or AC grid port. The PCE does not provide galvanic separation between the PV input and AC output circuit. The battery circuit is galvanic isolation from the PV input or AC output circuit. The hybrid inverter also can operate under standalone mode.

The unit is providing EMC filtering at the input and output towards mains. The output was switched off redundant by the high power switching bridge and two relays in series. This assures that the opening of the output circuit will also operate in case of one error.

AIO2-INS Series Block Diagram:



Description of the electrical circuit and functional safety (redundancy control):

The internal control is redundant built. It consists out of two Microcontrollers (master DSP U1, slave DSP U21 and ARM U34), the master DSP can control the relays, sample the PV voltage, current and BUS voltage, measures grid voltage, frequency, AC current with injected DC, insulation resistance to ground and residual current. The slave CPU is redundant controller, it is using for control the relay, sample grid voltage, frequency and current. Both microcontrollers communicate with each other.

The voltage and frequency measurement were performed with resistors in serial that were connected directly to line and neutral. Both controllers get these signals and analyze the data.

The unit provides two relays in series in each line and neutral. The relays are test before each start-up. When single-fault applied to one relay, an error code will appear on display panel, another redundant relay provides basic insulation maintained between the PV array and the mains.

The passive LoM protection principles RoCoF and active methods reactive power injection was employed in hybrid inverter.

The AIO2-INS series are single phase storage inverters suitable for both on-grid and off-grid operation that use conjunction with Lithium batteries pack, PV panels and a smart meter.

Model difference:

The models AIO2-INS-3000, AIO2-INS-3680, AIO2-INS-4600, AIO2-INS-5000 are similar with each other in hardware except bus capacitor number, AC choke rating, IGBT number and electrical ratings differences. AIO2-INS-3000 has singe channel MPP tracker function PV input while AIO2-INS-3680, AIO2-INS-4600 and AIO2-INS-5000 have dual channel MPP tracker function PV inputs.

The product was tested on:

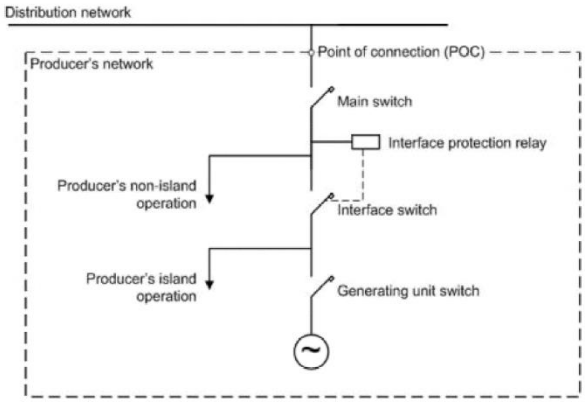
Unless otherwise specified, all tests were performed on the representative model of AIO2-INS-5000 and applicable for other models since they are similar in hardware and just power derating by software.

Hardware version: 2.0

Software version: 2.0

The product operating temperature range: -10°C to +60°C.

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
4	**Technical requirements**		P
4.1	General		P
	This clause defines the requirements on generating plants to be operated in parallel with the distribution network. Where settings or a range of configurability is provided and respecting the legal framework the configurations and settings may be provided by the DSO. Where no settings are provided by the DSO, the specified default settings shall be used; if no default settings are provided, the producer shall propose settings and inform the DSO.		P
	The requirements of Clause 4 apply during normal operation of the generating units and do not apply in case of maintenance or units out of operation. The provisions apply to EESS in generation mode. In charging mode EESS should have the same characteristics, unless stated otherwise in the clauses of this European Standard.		P
	The applicability is independent of the duration the generating unit operates in parallel with the distribution network. It is the responsibility of the DSO to relax, if deemed appropriate, the requirements for an individual generating unit or plant whose operation in parallel only lasts for a short time (temporary operation in parallel). The relaxed requirements shall be agreed between the DSO and the producer, along with the maximum allowable duration of the temporary operation in parallel.		P
	If different requirements on the generating plant interfere with each other, the following hierarchy in descending order shall be applied:		P
	1. Generating unit protection, including regarding the prime mover; 2. interface protection (see 4.9) and protection against faults within the generating plant; 3. voltage support during faults and voltage steps (see 4.7.4); 4. the lower value of: remote control command on active power limitation for distribution grid security (see 4.11) and local response to overfrequency (see 4.6.1); 5. local response to underfrequency if applicable (see 4.6.2); 6. reactive power (see 4.7.2) and active power (P(U) see 4.7.2) controls; 7. other control commands on active power set point for e.g. market, economic reasons, selfconsumption optimization.		P
	The system shall be so designed that under foreseeable conditions no self-protection trips prior to the fulfilment of the requirements of this European Standard and all settings provided by the DSO or responsible party.		P

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
	For cogeneration plants embedded in industrial sites, active power requirements shall be agreed between the responsible party and the producer. In such a case the priority list is adapted accordingly.		P
	Besides the requirements of Clause 4, additional requirements apply for connecting a generating plant to the distribution network, e.g. assessment of the point of connection. However, this is excluded from the scope of this European Standard but some guidance is provided in the informative Annex A.		P
4.2	Connection scheme		Info.
	The connection scheme of the generating plant shall be in compliance with the requirements of the DSO. Different requirements may be subject to agreement between the producer and the DSO depending on the power system needs.	It's depended on installer.	Info.
	Inter alia, the generating plant shall ensure the following:		Info.
	• synchronization, operation and disconnection under normal network operating conditions, i.e. in the absence of faults or malfunctions; • faults and malfunctions within the generating plant shall not impair the normal functioning of the distribution network; • coordinated operation of the interface switch with the generating unit switch, the main switch and switches in the distribution network, for faults or malfunctions within the generating plant or the DSO network during operation in parallel with the distribution network; and • disconnection of the generating plant from the distribution network by tripping the interface switch according to 4.9.		Info.
	In order to satisfy the above functions, coordinated but independent switches and protection equipment may be applied in the generating plant, as shown in the example in Figure 2.  **Figure 2 — Example of an generating plant connected to a distribution network (schematic view of switches)**	It's depended on installer.	Info.

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
4.3	Choice of switchgear		P
4.3.1	General		P
	Switches shall be chosen based on the characteristics of the power system in which they are intended to be installed. For this purpose, the short circuit current at the installation point shall be assessed, taking into account, inter alia, the short circuit current contribution of the generating plant.		P
4.3.2	Interface switch		P
	Switches shall be power relays, contactors or mechanical circuit breakers each having a breaking and making capacity corresponding to the rated current of the generating plant and corresponding to the short circuit contribution of the generating plant.	Two power relays in series installed each phase on the mains side of the unit to separate it from the grid.	P
	The short-time withstand current of the switching devices shall be coordinated with rated short circuit power at the point of connection.		P
	In case of loss of auxiliary supply power to the switchgear, a secure disconnection of the switch is required immediately.		P
	Where means of isolation (according to HD 60364-5-551) is not required to be accessible to the DSO at all times, automatic disconnection with single fault tolerance according to 4.13 shall be provided.		P
	NOTE 1 For PV-inverters, further requirements are stated in EN 62109-1 and EN 62109-2 with respect to the interface switch.	See separate EN 62109-1 test report no. 6091935.50A and EN 62109-2 test report no. 6091935.50B issued by DEKRA for reference.	P
	The function of the interface switch might be combined with either the main switch or the generating unit switch in a single switching device. In case of a combination, the single switching device shall be compliant to the requirements of both, the interface switch and the combined main switch or generating unit switch. As a consequence, at least two switches in series shall be present between any generating unit and the POC.		P
	NOTE 2 This does not refer to the number of series-connected switches in order to ensure single fault tolerance as required in 4.13 but to the number of different switching devices itself.		P
4.4	Normal operating range		P
4.4.1	General		P
	Generating plants when generating power shall have the capability to operate in the operating ranges specified below regardless of the topology and the settings of the interface protection.		P

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
4.4.2	Operating frequency range		P
	The generating plant shall be capable of operating continuously when the frequency at the point of connection stays within the range of 49 Hz to 51 Hz. In the frequency range from 47 Hz to 52 Hz the generating plant should be capable of operating until the interface protection trips. Therefore, the generating plant shall at least be capable of operating in the frequency ranges, for the duration and for the minimum requirement as indicated in Table 1.	(See appended table)	P
	This permission does not affect the requirements for interface protection according to clause 4.9. In this case over and under frequency machine protection might trip prior to interface protection. If an integrated interface protection device is used, the reduction of the configuration range of the interface protection in clause 4.9 is acceptable.		P
4.4.3	Minimal requirement for active power delivery at underfrequency		P
	A generating plant shall be resilient to the reduction of frequency at the point of connection while reducing the maximum active power as little as possible. The admissible active power reduction due to underfrequency is limited by the full line in Figure 5 and is characterized by a maximum allowed reduction rate of 10 % of P_{max} per 1 Hz for frequencies below 49.5 Hz.	(See appended table)	P

Table 1 — Minimum time periods for operation in underfrequency and overfrequency situations

Frequency Range	Time period for operation Minimum requirement	Time period for operation stringent requirement
47,0 Hz – 47,5 Hz	not required	20 s
47,5 Hz – 48,5 Hz	30 min [a]	90 min
48,5 Hz – 49,0 Hz	30 min [a]	90 min [a]
49,0 Hz – 51,0 Hz	Unlimited	Unlimited
51,0 Hz – 51,5 Hz	30 min [a]	90 min
51,5 Hz – 52,0 Hz	not required	15 min

[a] Respecting the legal framework, it is possible that longer time periods are required by the responsible party in some synchronous areas.

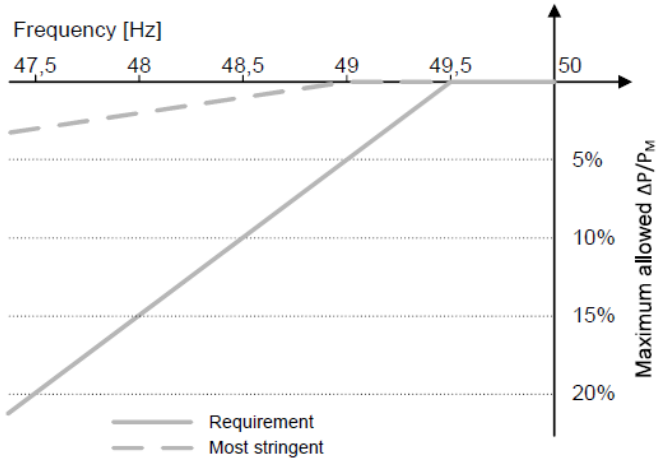
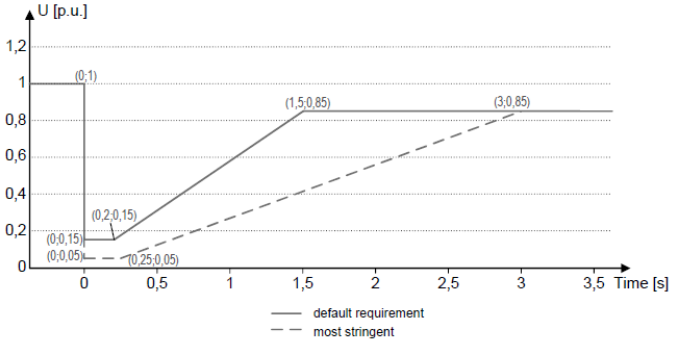


Figure 5 — Maximum allowable power reduction in case of underfrequency

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
	It is possible that a more stringent power reduction characteristic is required by the responsible party. Nevertheless this requirement is expected to be limited to an admissible active power reduction represented by the dotted line in Figure 5 which is characterised by a reduction rate of 2 % of the maximum power P_{max} per 1 Hz for frequencies below 49 Hz.		P
	If any technologies intrinsic design or ambient conditions have influence on the power reduction behaviour of the system, the manufacturer shall specify at which ambient conditions the requirements can be fulfilled and eventual limitations. The information can be provided in the format of a graph showing the intrinsic behaviour of the generating unit for example at different ambient conditions. The power reduction and the ambient conditions shall comply with the specification given by the responsible party. If the generating unit does not meet the power reduction at the specified ambient conditions, the producer and the responsible party shall agree on acceptable ambient conditions.		P
4.4.4	Continuous operating voltage range		P
	When generating power, the generating plant shall be capable of operating continuously when the voltage at the point of connection stays within the range of 85 % U_n to 110 % U_n. Beyond these values the under and over voltage ride through immunity limits as specified in clause 4.5.3 and 4.5.4 shall apply.	(see appended table)	P
	In case of voltages below U_n, it is allowed to reduce the apparent power to maintain the current limits of the generating plant. The reduction shall be as small as technically feasible.		P
	For this requirement all phase to phase voltages and in case a neutral is connected, additionally all phase to neutral voltages shall be evaluated.		P
	The producer shall take into account the typical voltage rise and voltage drop within the generating plant.		Info.
4.5	Immunity to disturbances		P
4.5.1	In general, generating plants should contribute to overall power system stability by providing immunity towards dynamic voltage changes unless safety standards require a disconnection.		P
	The following clauses describe the required immunity for generating plants taking into account the connection technology of the generating modules.		P
	The following withstand capabilities shall be provided regardless of the settings of the interface protection.		P
4.5.2	Rate of change of frequency (ROCOF) immunity	(see appended table)	P

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
	ROCOF immunity of a power generating plant means that the generating modules in this plant stay connected with the distribution network and are able to operate when the frequency on the distribution network changes with a specified ROCOF. The generating units and all elements in the generating plant that might cause their disconnection or impact their behaviour shall have this same level of immunity.		P
	The generating modules in a generating plant shall have ROCOF immunity for a ROCOF equal or exceeding the value specified by the responsible party. If no ROCOF immunity value is specified, the following ROCOF immunity shall apply, making distinction between generating technologies:		P
	Non-synchronous generating technology: at least 2 Hz/s		P
	Synchronous generating technology: at least 1 Hz/s		N/A
	The ROCOF immunity is defined with a sliding measurement window of 500 ms.		P
	NOTE 1 For control action based on frequency measurement shorter measurement periods are expected to be necessary.		P
	NOTE 2 For small isolated distribution networks (typically on islands) higher ROCOF immunity values may be required.		P
	NOTE 3 ROCOF is used as a means to detect loss of mains situations in some countries. The ROCOF immunity requirement is independent of the interface protection settings. Disconnection settings of the interface protection relay always overrule technical capabilities. So, whether the generating plant will stay connected or not will also depend upon those settings.		P
4.5.3	Under-voltage ride through (UVRT)	Refer to the testing guide line DIN VDE V 0124-100:2020-06	P
	Generating modules classified as type B modules according to COMMISSION REGULATION 2016/631 shall comply with the requirements of 4.5.3.2 and 4.5.3.3.	Type A Generating modules	N/A
	Generating modules classified as type A and smaller according to COMMISSION REGULATION 2016/631 should comply with these requirements.		P
	The actual behaviour of type A modules and smaller shall be specified in the connection agreement.		P
	NOTE 1 Based on the chosen banding threshold it is considered necessary to include generating modules classified as type A. Exemption is only acceptable for CHP and generating units based on rotating machinery below 50 kW as EN 50465 for gas appliance requests disconnection in case of under voltage.		P

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
	NOTE 2 A more distinctive differentiation for 1ph, 2ph and 3ph faults is under consideration.		N/A
	NOTE 3 These requirements are independent of the interface protection settings. Disconnection settings of the interface protection relay will always overrule technical capabilities. So, whether the generating plant will stay connected or not will also depend upon those settings.		P
	NOTE 4 The FRT curves in Figure 6, Figure 7 and Figure 8 describe the minimum requirements for continued connection of the generating plant to the grid. They are not designed for parameterising the interface protection.		P
4.5.3.2	Generating plant with non-synchronous generating technology		P
	Generating modules shall be capable of remaining connected to the distribution network as long as the voltage at the point of connection remains above the voltage-time curve of Figure 6. The voltage is relative to U_n. The smallest phase to neutral voltage, or if no neutral is present, the smallest phase to phase voltage shall be evaluated.  **Figure 6 — Under-voltage ride through capability for non-synchronous generating technology**		P
	The responsible party may define a different UVRT characteristic. Nevertheless, this requirement is expected to be limited to the most stringent curve as indicated in Figure 6.		P
	This means that the whole generating module has to comply with the UVRT requirement. This includes all elements in a generating plant: the generating units and all elements that might cause their disconnection.		P
	For the generating unit, this requirement is considered to be fulfilled if it stays connected to the distribution grid as long as the voltage at its terminals remains above the defined voltage-time diagram.		P
	After the voltage returns to continuous operating voltage range, 90 % of pre-fault power or available power whichever is the smallest shall be resumed as fast as possible, but at the latest within 1 s unless the DSO and the responsible party requires another value.		P
4.5.3.3	Generating plant with synchronous generating technology		P

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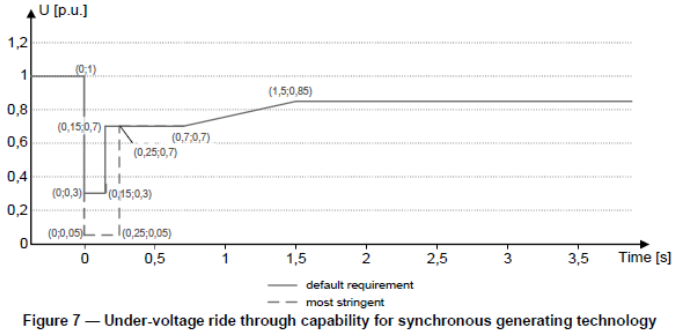
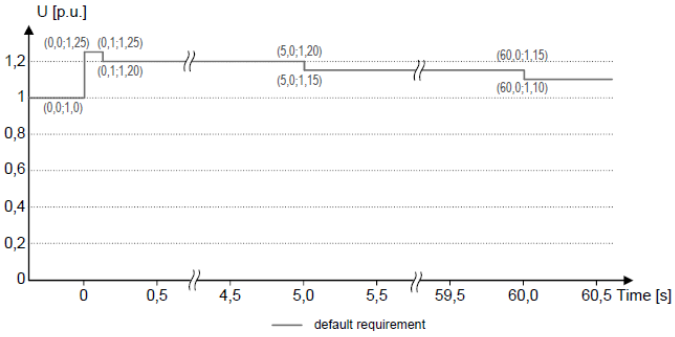
Clause	Requirement - Test	Result - Remark	Verdict
	Generating modules shall be capable of staying connected to the distribution network as long as the voltage at the point of connection remains above the voltage-time curve of Figure 7. The voltage is relative to Un. The smallest phase to neutral voltage or if no neutral is present the smallest phase to phase voltage shall be evaluated.  Figure 7 — Under-voltage ride through capability for synchronous generating technology		P
4.5.4	Over-voltage ride through (OVRT)	Refer to the testing guide line DIN VDE V 0124-100:2020-06	P
	Generating modules, except for micro-generating plants, shall be capable of staying connected to the distribution network as long as the voltage at the point of connection remains below the voltage-time curve of Figure 8.  Figure 8 — Over-voltage ride through capability		P
	The highest phase to neutral voltage or if no neutral is present the highest phase to phase voltage shall be evaluated.		P
	This means that not only the generating units shall comply with this OVRT requirement but also all elements in a generating plant that might cause its disconnection.		P
	NOTE 1 Based on the chosen banding threshold it is considered necessary to include generating modules classified as type A. Exemption is only acceptable for CHP and generating units based on rotating machinery below 50 kW as EN 50465 for gas appliance requests disconnection in case of over voltage.		P

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Clause	Requirement - Test	Result - Remark	Verdict
	NOTE 2 These requirements are independent of the interface protection settings. Disconnection settings of the interface protection relay will always overrule technical capabilities. So, whether the generating plant will stay connected or not will also depend upon those settings.		P
	NOTE 3 This is a minimum requirement. Further power system stability aspects might be relevant. The technical discussion is still ongoing. A voltage jump of +10% of Un from any stable point of operation is considered. In case of steady state voltages near the maximum voltage before the event, this will result in an over voltage situation for many seconds. In later editions of this document, more stringent immunity might be required.		P
4.6	Active response to frequency deviation		P
4.6.1	Power response to over-frequency		P
	Generating plants shall be capable of activating active power response to over-frequency at a programmable frequency threshold f1 at least between and including 50,2 Hz and 52 Hz with a programmable droop in a range of at least s=2 % to s=12 %. The droop reference is P ref. Unless defined differently by the responsible party		P
	• $P_{ref} = P_{max}$, in the case of synchronous generating technology and electrical energy storage systems		P
	• $P_{ref} = P_M$, the actual AC output power at the instant when the frequency reaches the threshold f1, in the case of all other non-synchronous generating technology		P
	The power value calculated according to the droop is a maximum power limit. If e.g. the available primary power decreases during a high frequency period below the power defined by the droop function, lower power values are permitted.		P
	The maximum power limit is: $P_{max-limit} = P_M + \Delta P$ with $\Delta P = \frac{1}{s} \cdot \frac{(f_1 - f)}{f_n} \cdot P_{ref}$ with f the actual frequency		P
	NOTE 1 In other documents power response to overfrequency can also be described as frequency control or Limited Frequency Sensitive Mode - Overfrequency (LFSM-O).		Info.

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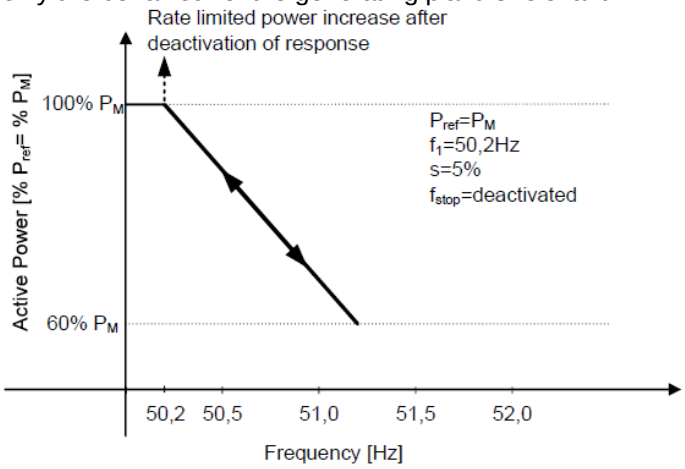
Clause	Requirement - Test	Result - Remark	Verdict
	NOTE 2 The active power droop relative to the reference power might also be defined as an active power gradient relative to the reference power. A droop in the range of 2 % to 12 % represents a gradient of 100 % to 16,7 % P_{ref} /Hz so with g defined by $g\left[\frac{P}{P_{ref}} / Hz\right] = \frac{1}{s \cdot f_n}$ we get $\Delta P = g \cdot P_{ref} \cdot (f_1 - f)$.		P
	The generating plant shall be capable of activating active power response to over-frequency as fast as technically feasible with an intrinsic dead time that shall be as short as possible with a maximum of 2 s and with a step response time of maximum 30 s, unless another value is defined by the relevant party. An intentional delay shall be programmable to adjust the dead time to a value between the intrinsic dead time and 2 s.		P
	NOTE 3 The following response times are considered feasible, for PV and battery inverter below 1 s for P of 100% ΔP_{max} and for wind turbines 2 s for $\Delta P < 50\% P_{max}$		P
	After activation, the active power frequency response shall use the actual frequency at any time, reacting to any frequency increase or decrease according to the programmed droop with an accuracy of ± 10 % of the nominal power (see Figure 9). The resolution of the frequency measurement shall be ± 10 mHz or less. The accuracy is evaluated with a 1 min average value. At POC, loads if present in the producer's network might interfere with the response of the generating plant. The effect of loads is not considered for the evaluation of the accuracy, only the behaviour of the generating plant is relevant.  **Figure 9 — Example of Active power frequency response to overfrequency**	(see appended table)	P
	NOTE 4 With the provision above, the intentional delay is only active for the activation of the function, once the function is operating, the established control loop is not intentionally delayed.		P

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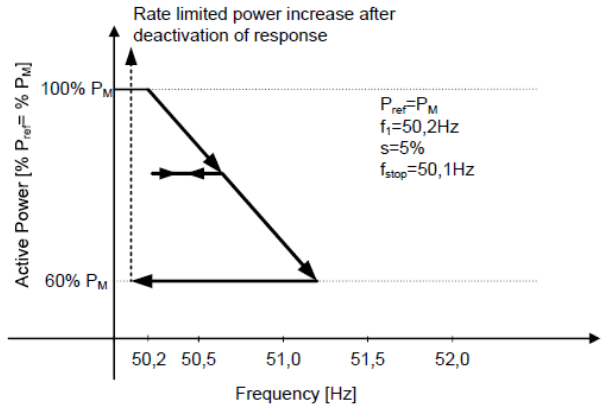
Clause	Requirement - Test	Result - Remark	Verdict
	NOTE 5 The option of an intentional delay is required since a very fast and undelayed active power frequency response in case of loss of mains would correct any excess of generation leading to a generation-consumption balance. In these circumstances, an unintended islanding situation with stable frequency would take place, in which the correct behaviour of any loss of mains detection based on frequency might be hindered.		P
	NOTE 6 The intentional delay is considered relevant for power system stability. For that reason, legal regulations might require a mutual agreement on the setting between DSO, responsible party and TSO.		P
	Generating plants reaching their minimum regulating level shall, in the event of further frequency increase, maintain this power level constant unless the DSO and the responsible party requires to disconnect the complete plant or if the plant consists of multiple units by disconnecting individual units.		P
	The active power frequency response is only deactivated if the frequency falls below the frequency threshold f_1.		P
	If required by the DSO and the responsible party an additional deactivation threshold frequency f_{stop} shall be programmable in the range of at least 50 Hz to f_1. If f_{stop} is configured to a frequency below f1 there shall be no response according to the droop in case of a frequency decrease (see Figure 10). The output power is kept constant until the frequency falls below f_{stop} for a configurable time t_{stop}.  Figure 10 — Example of active power frequency response to overfrequency with configured deactivation threshold	(see appended table)	P
	If at the time of deactivation of the active power frequency response the momentary active power PM is below the available active power PA, the active power increase of the generating plant shall not exceed the gradient defined in 4.10.2.		P

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Clause	Requirement - Test	Result - Remark	Verdict
	Settings for the threshold frequency f_1, the droop and the intentional delay are provided by the DSO and the responsible party. If no settings are provided, the default settings in Table 2 should be applied. **Table 2 — Standard settings for frequency response to overfrequency** **Parameter / Range / Default setting** **Threshold frequency f_1** / **50,2 Hz to 52 Hz** / **50,2 Hz** **Deactivation threshold f_{stop}** / **50,0 Hz to f_1** / **Deactivated** **Deactivation time t_{stop}** / **0 to 600 s** / **30s** **Droop** / **2 % to 12 %** / **5 %** **Intentional delay** / **0 s to 2 s** / **0 s**		P
	NOTE 7 When applying active power response to over-frequency, the frequency threshold f_1 should be set to a value from 50,2 Hz up to 50,5 Hz. Setting the frequency threshold f_1 to 52 Hz is considered as deactivating this function.		P
	The enabling and disabling of the function and its settings shall be field adjustable and means shall be provided to protect these from unpermitted interference (e.g. password or seal) if required by the DSO and the responsible party.		P
	NOTE 8 PV generating units are considered to have the ability to reduce power over the full droop range.		P
	NOTE 9 Protection setting overrules this behaviour.		P
	Alternatively for the droop function described above, the following procedure is allowed for generating modules if permitted by the DSO and the responsible party:		P
	• the generating units shall disconnect at randomized frequencies, ideally uniformly distributed between the frequency threshold f_1 and 52 Hz;		P
	NOTE 10 The usage of a disconnection limit above 51,5Hz does not necessarily imply the requirement to operate at this frequency. Operating range is defined in clause 4.4.4. If the randomized disconnection value is above the operating range and interface protection setting, the unit is disconnected according to chapter 4.9 at the value set by the interface protection.		P
	• in case the frequency decreases again, the generating unit shall start its reconnection procedure once the frequency falls below the specific frequency that initiated the disconnection; for this procedure, the connection conditions described in 4.10 do not apply;		P
	• the randomization shall either be at unit level by changing the threshold over time, or on plant level by choosing different values for each unit within a plant, or on distribution system level if the DSO specifies a specific threshold for each plant or unit connected to its distribution system.		P

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Clause	Requirement - Test	Result - Remark	Verdict
	NOTE 11 This procedure could be applied for generating modules for which it is technically not feasible to reduce power with the required accuracy in the required time or for reasons within the distribution network for example to prevent unintentional island operation.		P
	NOTE 12 The behaviour will, for a part of the network with many such units, result in a similar droop as specified above for controllable generating units and hence will provide for the necessary power system stability. Due to its fast reaction capability it contributes significantly to the avoidance of a frequency overshoot.		P
	EES units that are in charging mode at the time the frequency passes the threshold f1 shall not reduce the charging power below P_M until frequency returns below f_1. Storage units should increase the charging power according to the configured droop. In case the maximum charging capacity is reached or to prevent any other risk of injury or damage of equipment, a reduction of charging power is permitted.		P
4.6.2	Power response to under-frequency		P
	EES units shall be capable of activating active power response to under-frequency. Other generating units/plants should be capable of activating active power response to under-frequency. If active power to under-frequency is provided by a generating plant/unit, the function shall comply with the requirements below.		P
	NOTE 1: In other documents power response to under-frequency is also described as frequency control or Limited Frequency Sensitive Mode – Under-frequency (LFSM-U).		P
	Active power response to under-frequency shall be provided when all of the following conditions are met:		P
	• when generating, the generating unit is operating at active power below its maximum active power P_{max};		P
	• when generating, the generating unit is operating at active power below the available active power P_A;		P
	NOTE 2 In case of EES units, the available power includes the state of charge of the storage.		P
	• the voltages at the point of connection of the generating plant are within the continuous operating voltage range; and		P
	• when generating, the generating unit is operating with currents lower than its current limit.		P
	NOTE 3 These conditions apply to each generating unit individually since the specified conditions need to be met by each generating unit individually to allow the unit to increase power.		P

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Clause	Requirement - Test	Result - Remark	Verdict
	In the case of EES units, active power frequency response to under-frequency shall be provided in charging and generating mode.		P
	NOTE 4 In the case of EES units, the charging is regarded as a point of operation with negative active power. In charging mode the active power consumption is reduced according to the configured droop. Depending on the depth of the under-frequency event a change to generating mode will happen. In this case the state of charge of the storage is part of the conditions above.		P
	NOTE 5 This clause provides additional detail to the network code on emergency and restoration (Regulation (EU) 2017/2196) and more precisely on its Article 15.3 (a).		P
	The active power response to under-frequency shall be delivered at a programmable frequency threshold f1 at least between and including 49,8 Hz and 46,0 Hz with a programmable droop in a range of at least 2 % to 12 %. The droop reference Pref is Pmax. If the available primary power or a local set value increases during an under-frequency period above the power defined by the droop function, higher power values are permitted. The power value calculated according to the droop is therefore a minimum limit. The minimum power limit is, $P_{min-limit} = P_M + \Delta P$ with $\Delta P = \frac{1}{s} \times \frac{(f1 - f)}{fn} \times Pref$ with f the actual frequency		P
	NOTE 6 In the case of active power response to under-frequency, P_{max} is used as P ref to allow for system support even in case of low power output in the moment the event begins.		P
	NOTE 7 The active power droop relative to the reference power might also be defined as an active power gradient relative to the reference power. A droop in the range of 2 % to 12 % represents a gradient of 100 % to 16,7 % P_{ref} /Hz so with g defined by $g\left[\frac{P}{P_{ref}} / Hz\right] = \frac{1}{s \cdot f_n}$ we get $\Delta P = g \cdot P_{ref} \cdot (f_1 - f)$.		P
	NOTE 8 In the case of an increase of active power generation, the hierarchy of requirements in clause 4.1 apply.		P

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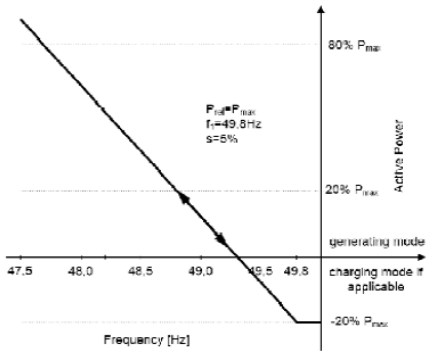
Clause	Requirement - Test	Result - Remark	Verdict
	The generating unit shall be capable of activating active power response to under-frequency as fast as technically feasible with an intrinsic dead time that shall be as short as possible with a maximum of 2 s and with a step response time of maximum 30 s unless another value is defined by the relevant party.		P
	An intentional initial delay shall be programmable to adjust the dead time to a value between the intrinsic dead time and 2 s.  Figure 11 — Example of active power frequency response to underfrequency in case of storage device with 20 % power charging at passing of threshold frequency f_1		P
	After activation, the active power frequency response shall use the actual frequency at any time, reacting to any frequency increase or decrease according to the programmed droop with an accuracy of ± 10 % of the nominal power. The accuracy is evaluated with a 1 min average value. The resolution of the frequency measurement shall be ± 10 mHz or less. At POC loads, if present in the producer's network, might interfere with the response of the generating plant. The effect of loads is not considered for the evaluation of the accuracy, only the behaviour of the generating plant is relevant.		P
	NOTE 9 With the provision above, the intentional delay is only active for the activation of the function, once the function is operating, the established control loop is not intentionally delayed.		P
	NOTE 10 The option of an intentional delay is required since a very fast and undelayed active power frequency response in case of loss of mains would correct any shortage of generation leading to a generation-consumption balance. In these circumstances, an unintended islanding situation with stable frequency would take place, in which the correct behaviour of any loss of mains detection based on frequency might be hindered.		P
	NOTE 11 The intentional delay is considered relevant for power system stability. For that reason, legal regulations might require a mutual agreement on the setting between DSO, responsible party and TSO.		P

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Clause	Requirement - Test	Result - Remark	Verdict
	Generating modules reaching any of the conditions above during the provision of active power frequency response shall, in the event of further frequency decrease, maintain this power level constant.		P
	The active power frequency response is only deactivated if the frequency increases above the frequency threshold f_1.		P
	Settings for the threshold frequency f_1, the droop and the intentional delay are defined by the DSO and the responsible party, if no settings are provided, the function shall be disabled.		P
	NOTE 12 When applying active power response to under-frequency, the frequency threshold f_1 should be set to a value from 49,8 Hz up to 49,5 Hz. Setting the frequency threshold f_1 to 46 Hz is considered as deactivating this function.		P
	The activation and deactivation of the function and its settings shall be field adjustable and means shall be provided to protect these from unpermitted interference (e.g. password or seal) if required by the DSO and the responsible party.		P
4.7	Power response to voltage changes		P
4.7.1	General		P
	When the contribution to voltage support is required by the DSO and the responsible party, the generating plant shall be designed to have the capability of managing reactive and/or active power generation according to the requirements of this clause.		P
4.7.2	Voltage support by reactive power		P
4.7.2.1	General		P
	Generating plants shall not lead to voltage changes out of acceptable limits. These limits should be defined by national regulation. Generating units and plants shall be able to contribute to meet this requirement during normal network operation.		P
	Throughout the continuous operating frequency (see 4.4.2) and voltage (see 4.4.4) range, the generating plant shall be capable to deliver the requirements stipulated below. Outside these ranges, the generating plant shall follow the requirements as good as technically feasible although there is no specified accuracy required.		P
4.7.2.2	Capabilities		P

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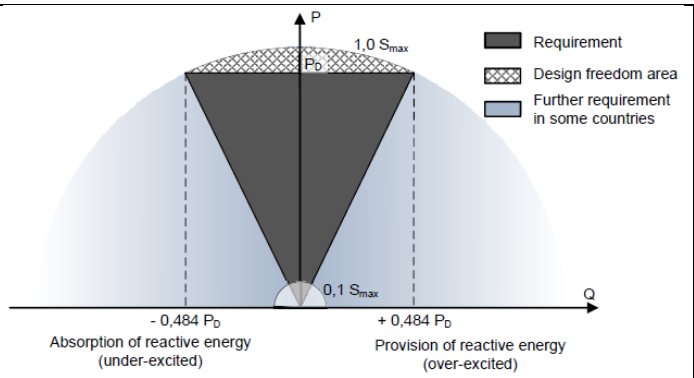
Clause	Requirement - Test	Result - Remark	Verdict
	 **Figure 12 — Reactive power capability at nominal voltage**	(see appended table)	P
	Figure 12 gives a graphical representation of the minimum and optional capabilities at nominal voltage.		P
	Unless specified differently below, for specific generating technologies, generating plants shall be able to operate with active factors as defined by the DSO and the responsible party from active factor = $0{,}90_{underexcited}$ to active factor= $0{,}90_{overexcited}$.		P
	The reactive power capability shall be evaluated at the terminals of the/each generating unit.		P
	CHP generating units with a capacity <150KVA shall be able to operate with active factors as defined by DSO from cos φ = $0{,}95_{underexcited}$ to cos φ = $0{,}95_{underexcited}$ to cos φ = $0{,}95_{overexcited}$		P
	Generating units with an induction generator coupled directly to the grid and used in generating plants above micro generating level, shall be able to operate with active factors as defined by the DSO from cos φ = $0{,}95_{underexcited}$ to cos = 1 at the terminals of the unit. Deviating from 4.7.2.3 point mode is required. Deviating from the accuracy requirements below, the accuracy is only required at active power P_D.		P
	Generating units with an induction generator coupled directly to the grid and used in micro generating plants shall operate with an active factor above 0,95 at the terminals of the generating unit. A controlled voltage support by reactive power is not required from this technology.		P
	Generating units with linear generators, coupled directly and synchronously to the grid shall operate with an active factor above 0,95 at the terminals of the generating unit, and therefore a controlled voltage support by reactive power is not required from this technology.		P
	In case of different generating technologies with different requirements in one generating plant, each unit shall provide voltage support by reactive power as required for its specific technology. A compensation of one technology to reach the general plant requirement is not expected.		P

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Clause	Requirement - Test	Result - Remark	Verdict
	The DSO and the responsible party may relax the above requirements. This relaxation might be general or specific for a certain generating plant or generating technology.		P
	NOTE 1 The generating unit manufacturer has a certain freedom in the sizing of the output side of the generating unit considering the advantages and drawbacks in the practical use of the generating unit when evaluating the need to reduce active output power (e.g. due to voltage changes or reactive power exchange) in order to respond to the requirements of this European Standard. This is indicated by the Design freedom area in Figure 12.		P
	All involved parties can expect to have access to information documenting the actual choices regarding active power capabilities relative to reactive power requirements and related to the power rating in the operating voltage range (see further in this clause). A P-Q Diagram shall be included in the product documentation of a generating unit.		P
	NOTE 2 For additional network support an optional extended reactive power capability according to Figure 12 might be provided by the generating plant, if agreed on between the DSO and the producer and is generally required in some countries for some technologies by legal regulations.		P
	NOTE 3 Additional requirements (e.g. continuous Var compensation or continuous reactive power operation disregarding the availability of the primary energy) might be provided by the generating plant, if agreed between the DSO and the producer.		P
	NOTE 4 In case of overvoltage, additional reactive power might be exchanged up to the rated current (increasing the apparent power as a consequence), if agreed on between the DSO and the producer.		P
	When operating above the apparent power threshold S_{min} equal to 10 % of the maximum apparent power S_{max} or the minimum regulating level of the generating plant, whichever is the higher value, the reactive power capability shall be provided with an accuracy of ± 2 % S_{max}. Up to this apparent power threshold S_{min}, deviations above 2 % are permissible; nevertheless the accuracy shall always be as good as technically feasible and the exchange of uncontrolled reactive power in this low-power operation mode shall not exceed 10 % of the maximum apparent power S_{max}. At POC loads, if present in the producer's network might interfere with the response of the generating plant. The effect of loads is not considered for the evaluation of the accuracy, only the behaviour of the generating plant is relevant.		P

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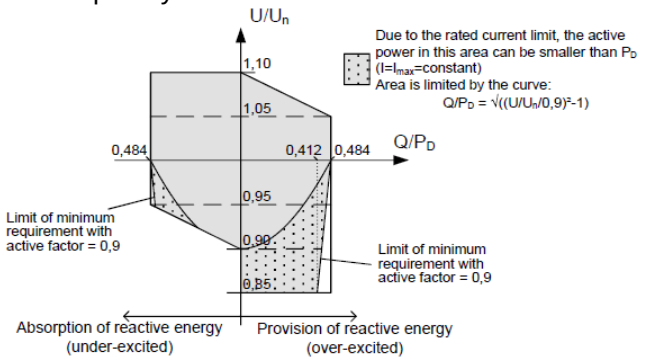
Clause	Requirement - Test	Result - Remark	Verdict
	For generating units with a reactive power capability according Figure 12 the reactive power capability at active power P_D shall be at least according Figure 13. For generating units with a reduced reactive power capability Figure 13 is only applicable up to the maximum reactive power capability.  **Figure 13 — Reactive power capability at active power P_D in the voltage range (positive sequence component of the fundamental)**		P
	NOTE 5 Depending on the P-Q characteristic of the generating plant/unit, the reactive power at active powers below P_D might be lower respecting the requirements above. If no or less than 0,484 Q/P_D reactive power is required, the active power might increase above P_D as indicated in Figure 12.		P
	For voltages below Un it is allowed to reduce apparent power according to 4.4.4		P
	NOTE 6 Whether there is a priority given to P or Q or the active factor when reaching the maximum apparent power this is not defined in this European Standard. Risks and benefits of different priority approaches are under consideration.		P
4.7.2.3	Control modes		P
4.7.2.3.1	General		P
	The control shall refer to the terminals of the generating units The generating plant/unit shall be capable of operating in the control modes specified below within the limits specified in 4.7.2.2. The control modes are exclusive; only one mode may be active at a time.		P
	• Q set-point mode	(see appended table)	P
	• Q (U)	(see appended table)	P
	• Cos φ set-point mode	(see appended table)	P
	• Cos φ (P)	(see appended table)	P
	For mass market products, it is recommended to implement all control modes. In case of site specific generating plant design, only the control modes required by the DSO need to be implemented.		P

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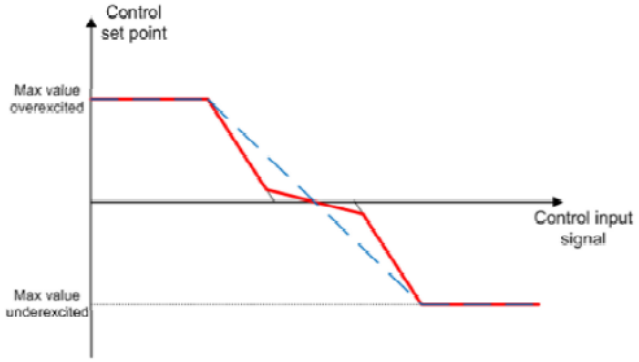
Clause	Requirement - Test	Result - Remark	Verdict
	The configuration, activation and deactivation of the control modes shall be field adjustable. For field adjustable configurations and activation of the active control mode, means shall be provided to protect the settings from unpermitted interference (e.g. password or seal) if required by the DSO. Which control modes are available in a product and how they are configured shall be stated in the product documentation.		P
4.7.2.3.2	Set-point control modes	(see appended table)	P
	Q set-point mode and cos φ set-point mode control the reactive power output and the cos φ of the output respectively, according to a set point set in the control of the generating plant/unit. In the case of change of the set point local or by remote control the settling time for the new set point shall be less than one minute.		P
4.7.2.3.3	Voltage related control mode	(see appended table)	P
	It is the responsibility of the generating plant designer to choose a method. One of the following methods should be used:		P
	• the positive sequence component of the fundamental;		P
	• the average of the voltages measured independently for each phase to neutral or phase to phase;		P
	• phase independently the voltage of every phase to determine the reactive power for every phase.		P
	For voltage related control modes, a characteristic with a minimum and maximum value and three connected lines according to Figure 16 shall be configurable.  **Figure 16 — Example characteristics for Q respectively cos φ control mode**		P
	In addition to the characteristic, further parameters shall be configurable:		P
	• The dynamics of the control shall correspond with a first order filter having a time constant that is configurable in the range of 3 s to 60 s		P

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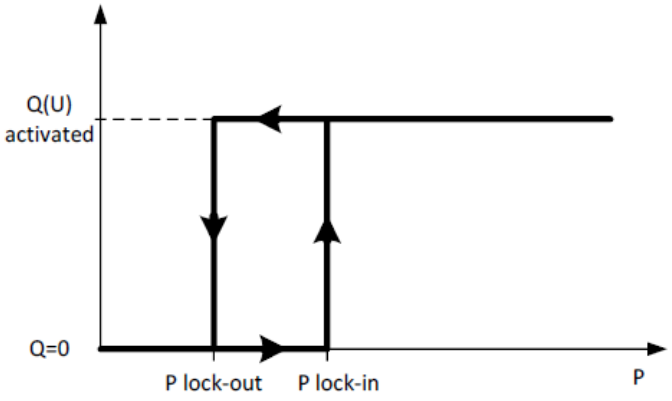
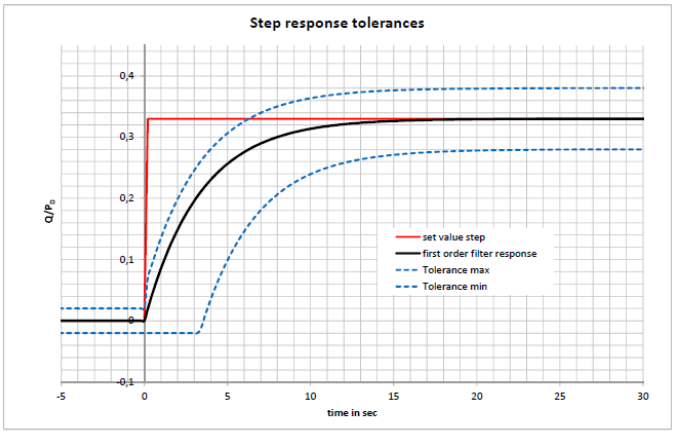
Clause	Requirement - Test	Result - Remark	Verdict
	NOTE 1 The time to perform 95 % of the changed set point due to a change in voltage will be 3 times the time constant.		P
	NOTE 2 The dynamic response of the generating units to voltage changes is not considered here. The response to disturbances as in 4.5 and short circuit current requirements as in 4.7.4 is not included in this clause.		P
	NOTE 3 An intentional delay is under consideration.		P
	To limit the reactive power at low active power two methods shall be configurable:		P
	• a minimal cos shall be configurable in the range of 0-0.95;		P
	• two active power levels shall be configurable both at least in the range of 0 % to 100 % of P_D. The lock-in value turns the Q(U) mode on, the lock-out value turns Q(U) off. If lock-in is larger than lock-out a hysteresis is given. See also Figure 14.  **Figure 14 – Example of lock-in and lock-out values for Q(U) mode**		P
	The static accuracy shall be in accordance with 4.7.2.2. The dynamic accuracy shall be in accordance with Figure 15 - 5% of P_D plus a time delay of up to 3 seconds deviating from an ideal first order filter response.  **Figure 15 — Example of dynamic control response and tolerance band for a step from Q=0 to Q= 33%P_D with τ=3,33s**		P

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
4.7.2.3.4	Power related control mode	(see appended table)	P
	The power related control mode cos φ (P) controls the output as a function of the active power output.		P
	For power related control modes, a characteristic with a minimum and maximum value and three connected lines shall be configurable in accordance with Figure 16.		P
	Resulting from a change in active power output a new cos φ set point is defined according to the set characteristic .The response to a new cos φ set value shall be as fast as technically feasible to allow the change in reactive power, The new reactive power set value shall be reached at the latest within 10 s after the end value of the active power is reached, the static accuracy of each cos set point shall be according to 4.7.2.2		P
4.7.3	Voltage related active power reduction		P
	In order to avoid disconnection due to overvoltage protection (see 4.9.3.3 and 4.9.3.4), generating plants/units are allowed to reduce active power output as a function of this rising voltage. The final implemented logic can be chosen by the manufacturer. Nevertheless, this logic shall not cause steps or oscillations in the output power. The power reduction caused by such a function may not be faster than an equivalent of a time constant tau = 3 s (= 33%/s at a 100% change). The enabling and disabling of the function shall be field adjustable and means have to be provided to protect the setting from unpermitted interference (e.g. password or seal) if required by the DSO.	(see appended table)	P
4.7.4	Short circuit current requirements on generating plants		P
4.7.4.1	General		P
	The following clauses describe the required short circuit current contribution for generating plants taking into account the connection technology of the generating modules.		P
	Generating modules classified as type B modules according to COMMISSION REGULATION 2016/631 shall comply with the requirements of 4.7.4.2 and 4.7.4.3.	Type A generating modules	N/A
	Generating modules classified as type A according to COMMISSION REGULATION 2016/631 should comply with these requirements. The actual behaviour of type A modules shall be specified in the connection agreement.		P
	NOTE Based on the chosen banding threshold it is considered necessary to include generating modules classified as type A if connected to medium voltage distribution grids. Exemption is only acceptable for CHP and generating units based on rotating machinery below 50 kW as EN 50465 for gas appliance requests disconnection in case of under voltage.		P

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
4.7.4.2	Generating plant with non-synchronous generating technology		P
4.7.4.2.1	Voltage support during faults and voltage steps		N/A
	In general no voltage support during faults and voltage steps is required from generating plants connected in LV distribution networks as the additional reactive current is expected to interfere with grid protection equipment. If the responsible party requires voltage support during faults and voltage steps for generating plants of type B connected to LV distribution grids, the clause 4.7.4 of EN 50549-2 applies		N/A
4.7.4.2.2	Zero current mode for converter connected generating technology		P
	If UVRT capability (see 4.5.3) is provided additional to the requirements of 4.5, generating units connected to the grid by a converter shall have the capability to reduce their current as fast as technically feasible down to or below 10 % of the rated current when the voltage is outside of a static voltage range. Generating units based on a doubly fed induction machine can only reduce the positive sequence current below 10 % of the rated current. Negative sequence current shall be tolerated during unbalanced faults. In case this current reduction is not sufficient, the DSO should choose suitable interface protection settings.		P
	The static voltage range shall be adjustable from 20 % to 100 % of Un for the under-voltage boundary and from 100 % to 130 % of Un for the overvoltage boundary. The default setting shall be 50% of Un for the under-voltage boundary and 120% of Un for the overvoltage boundary. Each phase to neutral voltage or if no neutral is present each phase to phase voltage shall be evaluated. At voltage re-entry into the voltage range, 90% of pre-fault power or available power, whichever is the smallest, shall be resumed as fast as possible, but at the latest according to 4.5.3 and 4.5.4.		P
	All described settings are defined by the DSO and the responsible party. If no settings are provided, the function shall be disabled. The enabling and disabling and the settings shall be field adjustable and means have to be provided to protect these from unpermitted interference (e.g. password or seal) if required by the DSO.		P
4.7.4.2.3	Induction generator based units	The unit was not induction generator.	N/A

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
	In general no voltage support during faults and voltage steps is required from generating plants connected in LV distribution networks as the additional reactive current is expected to interfere with grid protection equipment. If the responsible party requires voltage support during faults and voltage steps for generating plants of type B connected to LV distribution grids, the clause 4.7.4 of EN50549-2 applies.		N/A
4.7.4.3	Generating plant with synchronous generating technology - Synchronous generator based units	The inverter is not synchronous generating technology.	N/A
	In general no voltage support during faults and voltage steps is required from generating plants connected in LV distribution networks as the additional reactive current is expected to interfere with grid protection equipment. If the responsible party requires voltage support during faults and voltage steps for generating plants of type B connected to LV distribution grids, the clause 4.7.4 of EN50549-2 applies.		N/A
4.8	EMC and power quality		P
	Similar to any other apparatus or fixed installation, generating units shall comply with the requirements on electromagnetic compatibility established in Directive 2014/30/EU or 2014/53/EU, whichever applies.		P
	EMC limits and tests, described in EN 61000 series, have been traditionally developed for loads, without taking into account the particularities of generating units, such as their capability to create overvoltages or high frequency disturbances due to the presence of power converters, which were either impossible or less frequent in case of loads.		Info.
	NOTE 1 Currently, IEC SC 77A are reviewing all their existing standards to include, where necessary, specific requirements for generating units/plants. For dispersed generating units in LV networks, the Technical Report IEC/TR 61000–3-15 is addressing gaps in the existing EMC standards making recommendations on the following aspects: • Harmonic emissions; • Flicker and voltage fluctuations; • DC injection; • Short and long duration overvoltages emission; • Switching frequency emission; • Immunity to voltage dips and short interruptions; • Immunity to frequency variation; • Immunity to harmonics and inter-harmonics; • Unbalance.		Info.

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
	As long as specific tests for generating units are not available for immunity and/or emission, generic EMC standards and/or any relevant EU harmonized EMC standard should be applied.	See separate EMC test report No. 2070319R-PV-CE-P01V01 prepared by DEKRA	P
	NOTE 2 Besides the compliance with EN 61000 Series, in most countries power quality characteristic according to standards such as for example EN 61400-21 or VDE V 0124-100 are required as part of the connection agreement.		P
	Additional phenomena need to be addressed specifically to generating plants and their integration in the power system.		P
	• ROCOF: See 4.5.2	(see appended table)	P
	• UVRT: See 4.5.3		P
	• OVRT: See 4.5.4		P
	• DC injection: Generating plants shall not inject direct currents.	(see appended table)	P
	NOTE 3 The DC injection clause is considered to be passed when for all generating units within the generating plant the measured DC injection of a type-tested unit is below the testing threshold.		P
	Generating plants can also disturb mains signalling (ripple control or power line carrier systems). EMC requirements on inter-harmonics and on conducted disturbances in the frequency range between 2 kHz and 150 kHz are under development. In case of electromagnetic interferences to mains signalling systems due to the connection of a generating plant, mitigation measures should be taken and national requirements may apply.		P
	Generating units are also expected to be compatible with voltage characteristics at the point of connection, as described in EN 50160 or in national regulations; however no compliance test is required due to the scope of EN 50160.		P
4.9	Interface protection		P
4.9.1	General		P
	According to HD 60364-5-551:2010, 551.7.4, means of automatic switching shall be provided to disconnect the generating plant from the distribution network in the event of loss of that supply or deviation of the voltage or frequency at the supply terminals from values declared for normal supply.		P
	This automatic means of disconnection has following main objectives:		P

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
	• prevent the power production of the generating plant to cause an overvoltage situation in the distribution network it is connected to. Such over-voltages could result in damages to the equipment connected to the distribution network as well as the distribution network itself;		P
	• detect unintentional island situations and disconnect the generating plant in this case. This is contributing to prevent damage to other equipment, both in the producers' installations and the distribution network due to out of phase re-closing and to allow for maintenance work after an intentional disconnection of a section of the distribution network;		P
	NOTE 1 It is pointed out that checking the absence of voltage on all the live conductors is anyway mandatory before accessing a site for (maintenance) work.		P
	• assist in bringing the distribution network to a controlled state in case of voltage or frequency deviations beyond corresponding regulation values.		P
	It is not the purpose of the interface protection system to:		P
	• disconnect the generating plant from the distribution network in case of faults internal to the power generating plant. Protection against internal faults (short-circuits) shall be coordinated with network protection, according to DSO protection criteria. Protection against e.g. overload, electric shock and against fire hazards shall be implemented additionally according to HD 60364-1 and local requirements;		P
	• prevent damages to the generating unit due to incidents (e.g. short circuits) on the distribution network		P
	Interface protections may contribute to preventing damage to the generating units due to out-of-phase reclosing of automatic reclosing which may happen after some hundreds of ms. However, in some countries some technologies of generating units are explicitly required to have an appropriate immunity level against the consequences of out-of-phase reclosing.		P
	The type of protection and the sensitivity and operating times depend upon the protection and the characteristics of the distribution network.		P
	A wide variety of approaches to achieve the above mentioned objectives is used throughout Europe. Besides the passive observation of voltage and frequency other active and passive methods are available and used to detect island situations. The requirements given in this clause are intended to provide the necessary functions for all known approaches as well as to give guidance in their use. Which functions are available in a product shall be stated in the product documentation.		P

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
	The interface protection system shall comply with the requirements of this European Standard, the available functions and configured settings shall comply with the requirements of the DSO and the responsible party. In any case, the settings defined shall be understood as the values for the interface protection system, i.e. where there is a wider technical capability of the generation module, it shall not be withheld by the settings of the protections (other than the interface protection).		P
	For micro generating plants, the interface protection system and the point of measurement might be integrated into the generating units. For generating plants with nominal current above 16 A the DSO may define a threshold above which the interface protection system shall be realized as a dedicated device and not integrated into the generating units.		P
	NOTE 2 Example thresholds are 11,08 kW per generating plant (Italy), 30 kVA per generating plant (Germany, Austria) and 50 kW per generating unit (GB)		Info.
	NOTE 3 Integrated interface protection systems might not be possible for two different reasons:		P
	• to place the protection system as close to the point of connection as possible, to avoid tripping due to overvoltages resulting from the voltage rise within the producer's network;		P
	• to allow for periodic field tests. In some countries periodic field tests are not required if the protection system meets the requirements of single fault safety.		P
	The interface protection relay acts on the interface switch. The DSO may require that the interface protection relay acts additionally on another switch with a proper delay in case the interface switch fails to operate.		P
	In case of failure of the power supply of the interface protection, the interface protection shall trigger the interface switch without delay. An uninterruptible power supply may be required by the DSO, for instance in case of UVRT capability, delay in protection etc.		P
	In case of field adjustable settings of threshold and operation time, means shall be provided to protect the settings from unpermitted interference (e.g. password or seal) if required by the DSO.		P
4.9.2	Void		N/A
4.9.3	Requirements on voltage and frequency protection		P
4.9.3.1	General		P
	Part or all of the following described functions may be required by the DSO and the responsible party.		P

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
	NOTE 1 In the following the headings of the clause sections contain ANSI device numbers according to IEEE/ANSI C37.2 in square brackets e.g. [27].		P
	The protection functions shall evaluate at least all phases where generating units, covered by this protection system, are connected to.		P
	In case of three phase generating units/plants and in all cases when the protection system is implemented as an external protection system in a three phase power supply system, all phase to phase voltages and, if a neutral conductor is present, all phase to neutral voltages shall be evaluated.		P
	NOTE 2 It is possible to calculate the phase to phase voltages based on phase-neutral measurements.		P
	The frequency shall be evaluated on at least one of the voltages.		P
	If multiple signals (e.g. 3 phase to phase voltages) are to be evaluated by one protection function, this function shall evaluate all of the signals separately. The output of each evaluation shall be OR connected, so that if one signal passes the threshold of a function, the function shall trip the protection in the specified time.		P
	The minimum required accuracy for protection is:		P
	• for frequency measurement ± 0,05 Hz;		P
	• for voltage measurement ± 1 % of Un.		P
	• The reset time shall be ≤ 50 ms		P
	• The interface protection relay shall not conduct continuous starting and disengaging operations of the interface protection relay. Therefore a reasonable reset ratio shall be implemented which shall not be zero but be below 2% of nominal value for voltage and below 0,2Hz for frequency.		P
	NOTE 3 If the interface protection system is external to the generating unit, it is preferably located as close as possible to the point of connection. The voltage rise between the point of connection and the measurement input of the interface protection system is then kept as small as possible to avoid nuisance tripping of the overvoltage protection.		P
4.9.3.2	Under-voltage protection [27]	(see appended table)	P
	The protection shall comply with EN 60255-127. The evaluation of the r.m.s. or the fundamental value is allowed.		P
	Under-voltage protection may be implemented with two completely independent protection thresholds, each one able to be activated or not. The standard adjustment ranges are as follows.		P

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Under-voltage threshold stage 1 [27 <]:		P
	• Threshold (0,2 – 1) Un adjustable by steps of 0,01 Un		P
	• Operate time (0,1 – 100) s adjustable in steps of 0,1 s		P
	Under-voltage threshold stage 2 [27 < <]:		P
	• Threshold (0,2 – 1) Un adjustable by steps of 0,01 Un		P
	• Operate time (0,1 – 5) s adjustable in steps of 0,05 s		P
	The under-voltage threshold stage 2 is not applicable for micro-generating plants		P
4.9.3.3	Overvoltage protection	(see appended table)	P
	The protection shall comply with EN 60255-127. The evaluation of the r.m.s. or the fundamental value is allowed.		P
	Overvoltage protection may be implemented with two completely independent protection thresholds, each one able to be activated or not. The standard adjustment ranges are as follows.		P
	Overvoltage threshold stage 1 [59 >]:		P
	• Threshold (1,0 – 1,2) Un adjustable by steps of 0,01 Un		P
	• Operate time (0,1 – 100) s adjustable in steps of 0,1 s		P
	Overvoltage threshold stage 2 [59 > >]:		P
	• Threshold (1,0 – 1,30) Un adjustable by steps of 0,01 Un		P
	• Operate time (0,1 – 5) s adjustable in steps of 0,05 s		P
4.9.3.4	Overvoltage 10 min mean protection	(see appended table)	P
	The calculation of the 10 min value shall comply with the 10 min aggregation of EN 61000-4-30 Class S, but deviating from EN 61000-4-30 as a moving window is used. Therefore the function shall be based on the calculation of the square root of the arithmetic mean of the squared input values over 10 min. The calculation of a new 10 min value at least every 3 s is sufficient, which is then to be compared with the threshold value.		P
	• Threshold (1,0 – 1,15) Un adjustable by steps of 0,01 Un		P
	• Start time 3s not adjustable		P
	• Time delay setting = 0 ms		P
	NOTE 1 This function evaluates the r.m.s value.		P
	NOTE 2 More information can be found in EN 50160.		P
4.9.3.5	Under-frequency protection [81 <]	(see appended table)	P

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Under frequency protection may be implemented with two completely independent protection thresholds, each one able to be activated or not. The standard adjustment ranges are as follows.		P
	Under-frequency threshold stage 1 [81 <]:		P
	• Threshold (47,0 – 50,0) Hz adjustment by steps of 0,1 Hz		P
	• Operate time (0,1 – 100) s adjustable in steps of 0,1 s		P
	Under-frequency threshold stage 2 [81 < <]:		P
	• Threshold (47,0 – 50,0) Hz adjustment by steps of 0,1 Hz		P
	• Operate time (0,1 – 5) s adjustable in steps of 0,05 s		P
	In order to use narrow frequency thresholds for islanding detection (see 4.9.3.3) it may be required to have the ability to activate and deactivate a stage by an external signal.		P
	The frequency protection shall function correctly in the input voltage range between 20 % Un and 120 % Un and shall be inhibited for input voltages of less than 20 % Un. Under 0,2 Un the frequency protection is inhibited. Disconnection may only happen based on under-voltage protection.		P
4.9.3.6	Over-frequency protection [81 >]	(see appended table)	P
	Over-frequency protection may be implemented with two completely independent protection thresholds, each one able to be activated or not. The standard adjustment ranges are as follows.		P
	Over-frequency threshold stage 1 [81 >]:		P
	• Threshold (50,0 - 52,0) Hz adjustment by steps of 0,1 Hz		P
	• Operate time (0,1 – 100) s adjustable in steps of 0,1 s		P
	Over-frequency threshold stage 2 [81 > >]:		P
	• Threshold (50,0 - 52,0) Hz adjustment by steps of 0,1 Hz		P
	• Operate time (0,1 - 5) s adjustable in steps of 0,05 s		P
	In order to use narrow frequency thresholds for islanding detection (see4.9.3.3) it may be required to have the ability to activate and deactivate a stage by an external signal.		P
	The frequency protection shall function correctly in the input voltage range between 20 % Un and 120 % Un and shall be inhibited for input voltages of less than 20 % Un.		P
4.9.4	Means to detect island situation		P
4.9.4.1	General		P

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Besides the passive observation of voltage and frequency further means to detect an island may be required by the DSO. Detecting islanding situations shall not be contradictory to the immunity requirements of 4.5.	ROCOF tripping	P
	Commonly used functions include: • Active methods tested with a resonant circuit; • ROCOF tripping; • Switch to narrow frequency band; • Vector shift • Transfer trip.		P
	Only some of the methods above rely on standards. Namely for ROCOF tripping and for the detection of a vector shift, also called a vector jump, currently no European Standard is available.		P
4.9.4.2	Active methods tested with a resonant circuit		P
	These are methods which pass the resonant circuit test for PV inverters according to EN 62116.		P
4.9.4.3	Switch to narrow frequency band (see Annex E and Annex F)		P
	In case of local phenomena (e.g. a fault or the opening of circuit breaker along the line) the DSO in coordination with the responsible party may require a switch to a narrow frequency band to increase the interface protection relay sensitivity. In the event of a local fault it is possible to enable activation of the restrictive frequency window (using the two under-frequency/over-frequency thresholds described in 4.9.2.5 and 4.9.2.6) correlating its activation with another additional protection function.		P
	If required by the DSO, a digital input according to 4.9.4 shall be available to allow the DSO the activation of a restrictive frequency window by communication. NOTE An additional gateway to ensure communication with the DSO communication system might be required.		P
4.9.5	Digital input to the interface protection		P
	If required by the DSO, the interface protection shall have at least two configurable digital inputs. These inputs can for example be used to allow transfer trip or the switching to the narrow frequency band.		P
4.10	Connection and starting to generate electrical power		P
4.10.1	General		P
	Connection and starting to generate electrical power is only allowed after voltage and frequency are within the allowed voltage and frequency ranges for at least the specified observation time. It shall not be possible to overrule these conditions.		P

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Within these voltage and frequency ranges, the generating plant shall be capable of connecting and starting to generate electrical power.		P
	The setting of the conditions depends on whether the connection is due to a normal operational startup or an automatic reconnection after tripping of the interface protection. In case the settings for automatic reconnection after tripping and starting to generate power are not distinct in a generating plant, the tighter range and the start-up gradient shall be used.		P
	The frequency range, the voltage range, the observation time and the power gradient shall be field adjustable.		P
	For field adjustable settings, means shall be provided to protect the settings from unpermitted interference (e.g. password or seal) if required by the DSO.		P
4.10.2	Automatic reconnection after tripping		P
	The frequency range, the voltage range, the observation time shall be adjustable in the range according to Table 3 column 2. If no settings are specified by the DSO and the responsible party, the default settings for the reconnection after tripping of the interface protection are according to Table 3 column 3. **Table 3 — Automatic reconnection after tripping** Parameter / Range / Default setting Lower frequency / 47,0Hz – 50,0Hz / 49,5Hz Upper frequency / 50,0Hz – 52,0Hz / 50,2Hz Lower voltage / 50% – 100%U_n / 85 % U_n Upper voltage / 100% – 120% U_n / 110 % U_n Observation time / 10s – 600s / 60s Active power increase gradient / 6% – 3000%/min / 10%/min	(see appended table)	P
	After reconnection, the active power generated by the generating plant shall not exceed a specified gradient expressed as a percentage of the active nominal power of the unit per minute. If no gradient is specified by the DSO and the responsible party, the default setting is 10 % Pn /min. Generating modules for which it is technically not feasible to increase the power respecting the specified gradient over the full power range may connect after 1 min to 10 min (randomized value, uniformly distributed) or later.		P
4.10.3	Starting to generate electrical power		P

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
	The frequency range, the voltage range, the observation time shall be adjustable in the range according to Table 4 column 2. If no settings are specified by the DSO and the responsible party, the default settings for connection or starting to generate electrical power due to normal operational startup or activity are according to Table 4 column 3.	(see appended table)	P
	If applicable, the power gradient shall not exceed the maximum gradient specified by the DSO and the responsible party. Heat driven CHP generating units do not need to keep a maximum gradient, since the start up is randomized by the nature of the heat demand.		P
	For manual operations performed on site (e.g. for the purpose of initial start-up or maintenance) it is permitted to deviate from the observation time and ramp rate.		P
4.10.4	Synchronization		P
	Synchronizing a generating plant/unit with the distribution network shall be fully automatic i.e. it shall not be possible to manually close the switch between the two systems to carry out synchronization.		P
4.11.1	Ceasing active power		P
	Generating plants with a maximum capacity of 0,8 kW or more shall be equipped with a logic interface (input port) in order to cease active power output within five seconds following an instruction being received at the input port. If required by the DSO and the responsible party, this includes remote operation.	(see appended table)	P
4.11.2	Reduction of active power on set point		P
	For generating modules of type B, a generating plant shall be capable of reducing its active power to a limit value provided remotely by the DSO. The limit value shall be adjustable in the complete operating range from the maximum active power to minimum regulating level.		P
	The adjustment of the limit value shall be possible with a maximum increment of 10% of nominal power.		P

Table 4 — Starting to generate electrical power

Parameter	Range	Default setting
Lower frequency	47,0Hz – 50,0Hz	49,5Hz
Upper frequency	50,0Hz – 52,0Hz	50,1Hz
Lower voltage	50% – 100% U_n	85 % U_n
Upper voltage	100% – 120% U_n	110 % U_n
Observation time	10s – 600s	60s
Active power increase gradient	6% – 3000%/min	disabled

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
	A generation unit/plant shall be capable of carrying out the power output reduction to the respective limit within an envelope of not faster than 0,66 % P_n / s and not slower than 0,33 % P_n / s with an accuracy of 5 % of nominal power. Generating plants are permitted to disconnect from the network at a limit value below it minimum regulating level. If required by the DSO, this includes remote operation.	(see appended table)	P
	NOTE Besides the requirements of this clause there might be other systems in place to control active power for reasons of market participation or local optimisation.		P
4.12	Remote information exchange		P
	Generating plants whose power is above a threshold to be determined by the DSO and the responsible party shall have the capacity to be monitored by the DSO or TSO control centre or control centres as well as receive operation parameter settings for the functions specified in this European Standard from the DSO or TSO control centre or control centres.		P
	It should not interact directly with the power generation equipment and the switching devices of the generating plant. It should interact with the operation and control system of the generating plant.		P
	In principle, standardized communication should be used. It is recommended that in case of using protocols for signal transmission used between the DSO or TSO control centre or control centres and the generating plant, relevant technical standards (e.g. EN 60870-5-101, EN 60870-5-104, EN 61850 and in particular EN 61850-7-4, EN 61850-7-420, IEC/TR 61850-90-7, as well as EN 61400-25 for wind turbines and relevant parts of IEC 62351 for relevant security measures) are recognized.		P
	Alternative protocols can be agreed between the DSO and the producer. These protocols include hardwired digital input/output and analogue input/output provided locally by DSO. The information needed for remote monitoring and the setting of configurable parameters are specific to each distribution network and to the way it is operated.		N/A
4.13	Requirements regarding single fault tolerance of interface protection system and interface switch	(see appended table)	P
	If required in 4.3.2, the interface protection system and the interface switch shall meet the requirements of single fault tolerance.		P
	A single fault shall not lead to a loss of the safety functions.		P
	NOTE This requirement for the detection of individual faults does not mean that all faults are detected. Accumulation of undetected faults can therefore lead to an unintentional output signal and result in a hazardous condition.		P

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Series-connected switches shall each have a independent breaking capacity corresponding to the rated current of the generating unit and corresponding to the short circuit contribution of the generating unit.		P
	The short-time withstand current of the switching devices shall be coordinated with maximum short circuit power at the connection point.		P
	At least one of the switches shall be a switch-disconnector suitable for overvoltage category 2. For single-phase generating units, the switch shall have one contact of this overvoltage category for both the neutral conductor and the line conductor. For poly-phase generating units, it is required to have one contact of this overvoltage category for all active conductors. The second switch may be formed of electronic switching components from an inverter bridge or another circuit provided that the electronic switching components can be switched off by control signals and that it is ensured that a failure is detected and leads to prevention of the operation at the latest at the next reconnection.		P
	For PV-inverters without simple separation between the network and the PV generating unit (e.g. PV Inverter without transformer) both switches mentioned in the paragraph above shall be switch disconnectors with the requirements described therein, although one switching device is permitted to be located between PV array and PV inverter.		P
Annex A	Interconnection guidance		P
Annex B	Void		Info.
Annex C	Parameter Table		P
Annex D	List of national requirements applicable for generating plants		Info.
Annex E	Loss of Mains and overall power system security		P
Annex F	Examples of protection strategies		Info.
Annex G	Abbreviations		Info.
Annex H	Relationship between this European standard and the COMMISSION REGULATION (EU) 2016/631		P
	Generating plants compliant with the clauses of this European Standard are considered to be compliant with the relevant Article of COMMISSION REGULATION (EU) 2016/631, provided, that all settings as provided by the DSO and the responsible party are complied with.		P

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
	Table H.1 – Correspondence between this European standard and the COMMISSION REGULATION (EU) 2016/631		P

Article	Clause(s) / subclause(s) of this EN
13.1(a)	4.4.2 Operating frequency range
13.1(b)	4.5.2 Rate of change of frequency (ROCOF) immunity
13.2	4.6.1 Power response to overfrequency
13.3	4.4.3 Minimal requirement for active power delivery at underfrequency
13.4	4.4.3 Minimal requirement for active power delivery at underfrequency
13.5	4.4.3 Minimal requirement for active power delivery at underfrequency
13.6	4.11.1 Ceasing active power
13.7	4.10 Connection and starting to generate electrical power
14.1	4.4.2, 4.5.2, 4.6.1, 4.4.3, 4.11.1 and 4.10
14.2(a)	4.11.2 Reduction of active power on set point
14.2(b)	4.12 Remote information exchange
14.3	4.5.3 Under-voltage ride through (UVRT)
14.4.	4.10 Connection and starting to generate electrical power
14.5(a)	4.6, 4.7, 4.9, 4.10, 4.11, 4.12
14.5(b)	4.9 Interface protection,
14.5(c)	4.1 General
14.5(d)	4.12 Remote information exchange
17.1	4. as applicable above
17.2	4.7.2 Voltage support by reactive power
17.3	4.5.3 Under-voltage ride through (UVRT)
20.1	4. as applicable above
20.2 (a)	4.7.2 Voltage support by reactive power
20.2 (b) (c)	4.7.4.2 Short circuit current requirements on generating plants
20.3	4.5.3 Under-voltage ride through (UVRT)

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test overview:		
EN 50549-1:2019		
4.4.2	Operating frequency range	P
4.4.3	Minimal requirement for active power delivery at under-frequency	P
4.4.4	Continuous operating voltage range	P
4.5.2	Rate of change of frequency (ROCOF) immunity	P
4.5.3	Under-voltage ride through (UVRT)	P
4.5.4	Over-voltage ride through (OVRT)	P
4.6.1	Power response to under-frequency	P
4.6.2	Power response to over-frequency	P
4.7.2	Voltage support by reactive power	P
4.7.2.3.2	Setpoint control modes – Q setpoint mode	P
4.7.2.3.2	Setpoint control modes – Cos φ setpoint mode	P
4.7.2.3.3	Voltage related control mode – Q(U)	P
4.7.2.3.4	Power related control mode – cos φ (P)	P
4.7.3	Voltage related active power reduction	P
4.7.4	Short circuit current requirements on generating plants	N/A
4.8	EMC and power quality	P
4.9.3	Requirements on voltage and frequency protection	P
4.9.3.2	Under-voltage protection	P
4.9.3.3	Overvoltage protection	P
4.9.3.4	Overvoltage 10 min mean protection	P
4.9.3.5	Underfrequency protection	P
4.9.3.6	Overfrequency protection	P
4.9.4	Means to detect island situation	P
4.9.5	Digital input to the interface protection	P
4.10.2	Automatic reconnection after tripping	P
4.10.3	Starting to generate electrical power	P
4.11.1	Ceasing active power	P
4.11.2	Reduction of active power on set point	P
4.13	Requirements regarding single fault tolerance of interface protection system	P

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.4.2	**TABLE: Operating frequency range – B: Stringent requirement**				**P**
Model	AIO2-INS-5000				
Test sequence	Frequency [Hz]	Voltage [V]	Output power [W]	Time period measured	Time period Required
Test 1	47.1Hz	223.68	5006.78	30 s	> 20 s
Test 2	47.6Hz	233.77	5007.26	100min	> 90 min
Test 3	48.6Hz	233.76	5006.33	106.4min	> 90 min
Test 4	49.1Hz	233.72	4950.44	125.8min	Unlimited
Test 5	50.9Hz	233.73	4946.18	134.93min	Unlimited
Test 6	51.4Hz	233.74	5011.44	102.47min	> 90 min
Test 7	51.9Hz	233.77	5007.63	20min	> 15 min

Note:

Respecting the legal framework, it is possible that longer time periods are required by the responsible party in some synchronous areas.

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.4.3	**TABLE: Minimal requirement for active power delivery at under-frequency**			**P**
Model	AIO2-INS-5000			
Voltage	230Vac			
Test sequence	Frequency [Hz]	Output power [W]	$\Delta P/P_M$ per 1 Hz	Reduction rate limits
Test a)	50.0Hz	4953.81	0%	0%
Test b)	49.6Hz	4956.76	0%	0%
Test c)	47.6Hz	4956.09	0%	10%

Test:

The test must be carried out at 100% P_n,
Measurements are carried out at the following operating points:
a) nominal frequency$\pm$0.01 Hz;
b) a point between the nominal frequency -0.4 Hz to -0.5 Hz;
c) a point between the nominal frequency -2.4 Hz to -2.5 Hz.
The operating point b) and c) shall be maintained for at least 5 min, sample rate: 1 s.

Assessment criterion:

The test is regarded as passed if:

- the inverter does not disconnect from the network at the operating Points a) to c) when the network frequency is changed and
- the inverter does not reduce output energy at Point b) and
- the power reduction in point c) is less or equal to the allowed power reduction according to 4.4.3.

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.4.4	**TABLE: Continuous operating voltage range**			P
Model	AIO2-INS-5000			
Operation range	85% ~ 110%			
Frequency	50Hz			
Test 1	1.10Un			
Test sequence	Voltage(V)	Output power(W)	Time period measured	Time period Limited
Single Phase	253.16	4989.05	> 30 min	Operating continuously
Test 2	0.85Un			
Test sequence	Voltage(V)	Output power(W)	Time period measured	Time period Limited
Single Phase	195.47	4379.48	> 30 min	Operating continuously

Note:

I In case of voltages below Un, it is allowed to reduce the active power due to the current limits of the generator.

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.5.2	**TABLE: Rate of change of frequency (ROCOF) immunity**					P
Model	AIO2-INS-5000					
Voltage(V)	230 Vac					
Primary Power(W)	5000					
	Frequency		Change time	Result (disconnect or not)	Requirement	
	Begin	End				
a)	47.50 Hz	51.5 Hz	2.0 s	Not disconnect	Stay connected	
b)	51.50 Hz	47.5 Hz	2.0 s	Not disconnect	Stay connected	
Note: The ROCOF immunity is defined with a sliding measurement window of 500 ms.						

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

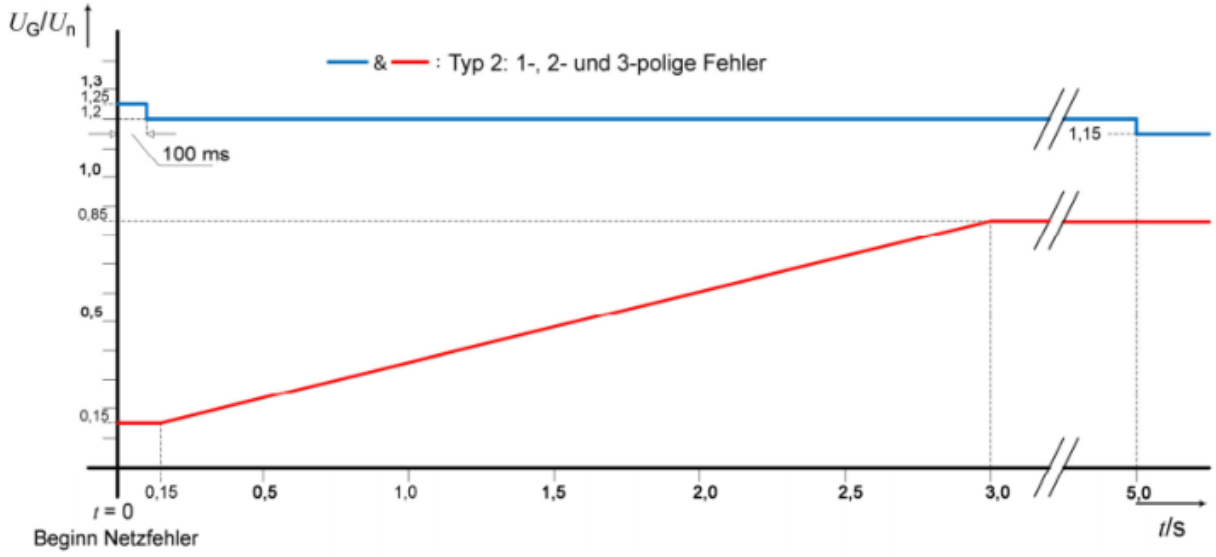
4.5.3 & 4.5.4	**TABLE: Under-voltage ride through (UVRT)& Over-voltage ride through (OVRT)-Refer to the testing guide line DIN VDE V 0124-100:2020-06**						**P**
Test number	Type of the fault	Required fault depth /duration [p.u.], [ms]	Measured fault duration [ms]	Average remaining voltage [p.o.s]	Percent of current after fault 60 ms [%Ir]	Percent of current after fault 100 ms [%Ir]	Duration of restoring [ms]
1.1	three-phase SC	0.15 / 150	158.59	34.45	0.14	0.14	238.71
1.2	three-phase SC	0.15 / 150	150.15	34.60	0.14	0.14	501.98
1.3	two-phase SC	0.15 / 150	150.47	98.30	0.55	0.55	238.32
1.4	two-phase SC	0.15 / 150	153.19	98.26	0.55	0.55	518.74
1.5	two-phase SC	0.15 / 150	169.29	98.07	0.54	0.54	249.29
2.1	three-phase SC	0.50 / 1500	1574.66	115.81	0.44	0.44	274.25
2.2	three-phase SC	0.50 / 1500	1564.14	115.72	0.44	0.44	524.87
2.3	two-phase SC	0.50 / 1500	1500.50	153.08	0.67	0.67	243.94
2.4	two-phase SC	0.50 / 1500	1570.01	152.99	0.67	0.67	512.02
3.1	three-phase SC	0.50 / 1500	1569.28	114.91	0.44	0.44	264.42
3.2	three-phase SC	0.50 / 1500	1571.29	114.97	0.44	0.44	535.59
3.3	two-phase SC	0.50 / 1500	1501.62	152.19	0.67	0.67	244.44
3.4	two-phase SC	0.50 / 1500	1574.66	152.47	0.67	0.67	307.17
4.1	three-phase SC	0.85 / 60000	60075.64	195.54	--	--	--
4.2	three-phase SC	0.85 / 60000	60132.25	195.46	--	--	--
4.3	two-phase SC	0.85 / 60000	60107.53	207.57	--	--	--
4.4	two-phase SC	0.85 / 60000	60048.13	207.54	--	--	--
5.1	three-phase SC	1.25 / 100	100.01	286.74	1.09	1.13	252.43
5.2	three-phase SC	1.25 / 100	101.28	286.79	1.09	1.13	304.74
5.3	two-phase SC	1.25 / 100	100.59	258.93	--	--	--
5.4	two-phase SC	1.25 / 100	101.01	257.39	6.02	5.95	237.28
5.5	two-phase SC	1.25 / 100	100.85	258.95	--	--	--
6.1	three-phase SC	1.20 / 5000	5149.57	275.48	1.05	1.05	240.84
6.2	three-phase SC	1.20 / 5000	5162.39	274.48	1.05	1.05	500.25

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.5.3 & 4.5.4	TABLE: Under-voltage ride through (UVRT)& Over-voltage ride through (OVRT)-Refer to the testing guide line DIN VDE V 0124-100:2020-06						P
6.3	two-phase SC	1.20 / 5000	5162.06	253.12	--	--	--
6.4	two-phase SC	1.20 / 5000	5163.50	253.07	--	--	--
7.1	three-phase SC	1.15 / 60000	60112.81	264.34	--	--	--
7.2	three-phase SC	1.15 / 60000	60095.96	264.10	--	--	--
7.3	two-phase SC	1.15 / 60000	60118.02	247.40	--	--	--
7.4	two-phase SC	1.15 / 60000	60154.35	247.29	--	--	--

Note: The following conditions apply to all Type 2 power generation units and storage systems:

As long as the line-to-neutral voltages at the generator terminals applied to the power generation unit or the storage are within the limit curves shown in Figure 12 (red for the under -voltage limit curve and blue for the over-voltage limit curve), there must be no instability of the power generation unit and the storage system in the entire operating range of the power generation unit or the storage system and no disconnection from the network.



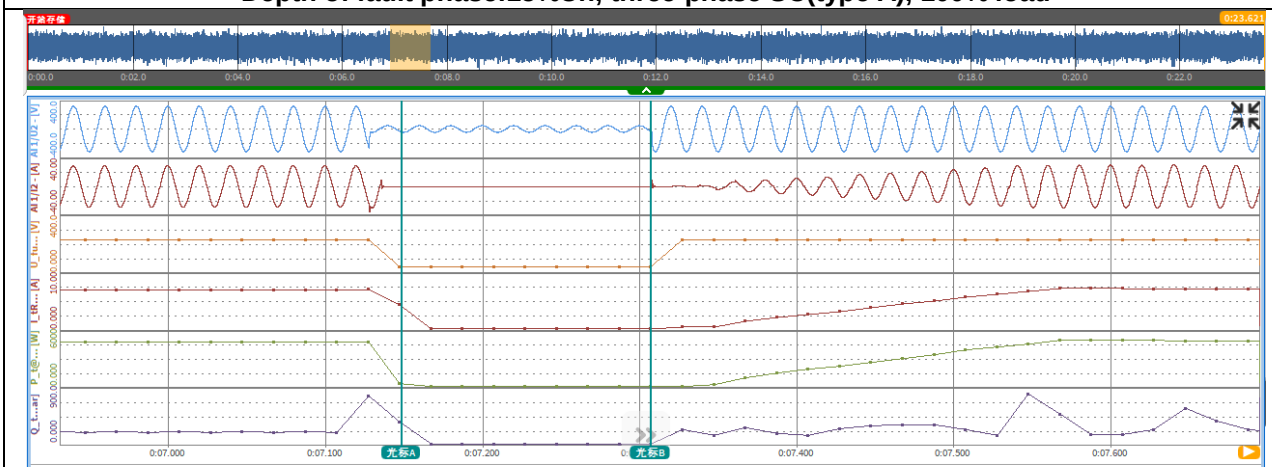
To assess the curves, the smallest of the line-to-neutral voltages applied to the power generation unit and/or the storage system must be used in case of a voltage drop, and the largest of the line-to-neutral voltages applied to the power generation unit or the storage must be used in case of a rise-in-voltage.
If the setting values for NS protection according to Table 2 (column inverter) anticipate the requirements according to Figure 12 in certain working points, only the NS protection setting values at these working points need to be checked in the verification procedure.
If the voltage at the generator terminals falls below 0.8 U n and if the voltage at the generator terminals exceeds 1.15 U n (start of fault), Type 2 power generation units and storage systems must operate through voltage drops without feeding a current into the network of the network operator (limited dynamic network support).
This requirement is fulfilled if a voltage drop below 0.8 U n and/or in the event of a rise-in-voltage above 1.15 U n the fed in power by the power generation unit(s) and/or storage system(s) does not exceed 20% of the rated current I_r in any individual line 60 ms after the occurrence of this voltage drop and does not exceed 10% after 100 ms I_r in any individual line.
Performance after the end of the fault:

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict
4.5.3 & 4.5.4	**TABLE: Under-voltage ride through (UVRT)& Over-voltage ride through (OVRT)-Refer to the testing guide line DIN VDE V 0124-100:2020-06**		**P**

If the mains voltage after the end of the fault is again within the voltage range of -15% U n to +10% U n and the active current of the power generation unit and/or the storage system has been reduced during the network fault, it must be increased to the pre-fault value as soon as possible after the end of the fault. The response time must not exceed 1 s. The reactive power provision follows the time performance according to 5.7.2.5. For rotating machines, the response time must not exceed 6 s.
Up to 60 s after the fault has started, the power generation units and storage systems must not disconnect from the network at voltages up to 1.15 Un. If tripping of the self-protection of the power generation units and/or the storage systems is imminent, then these power generation units and storage systems may adapt their reactive power performance to such an extent that a tripping of the self-protection is avoided.
REMARK By controlling the transformer phase position on the upstream HS/MS transformer of the network operator, it can be assumed that the operating voltage of the low-voltage network after 60 s at the latest is within the voltage range of -15% Un to +10 % Un.
Note: A change of the instantaneous voltage from 90% to 10% of the pre-fault voltage should be made with UVRT within a period of max. 4 ms.(DIN VDE V 0124-100:2020-06 Appendix A)

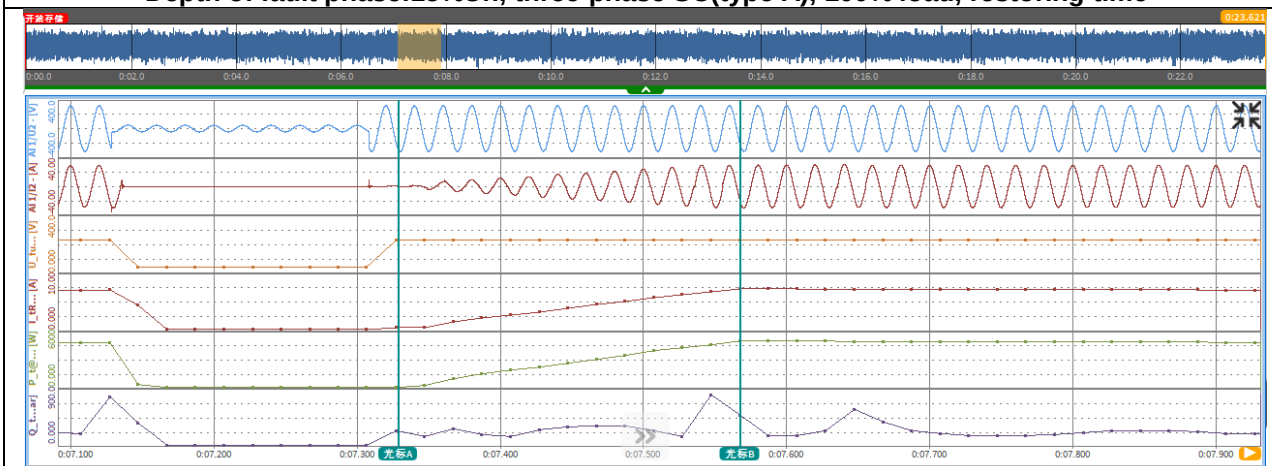
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1.1A
Depth of fault phase:15%Un, three-phase SC(type A), 100% load



	A	B	间隔
时间 [s]	7.1484368	7.3070367	0.1585999
AI 1/U2 [V]	-43.39052	-29.49023	13.90028
AI 1/I2 [A]	0.045824	0.098038	0.052214
U_fundRMS_SYM+@POWER/0 [V]	34.45176	34.48640	0.034645
I_tRMS@POWER/0 [A]	4.371390	0.030503	-4.340886
P_t@POWER/0 [W]	279.3563	-0.016890	-279.3732
Q_t@POWER/0 [var]	351.8412	3.156365	-348.6848

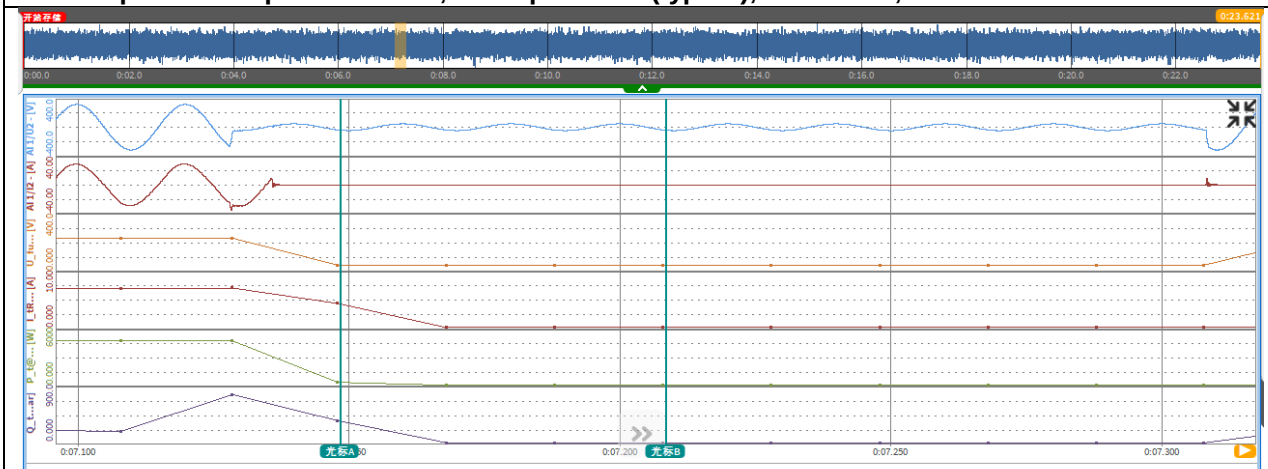
Test 1.1A
Depth of fault phase:15%Un, three-phase SC(type A), 100% load, restoring time



	A	B	间隔
时间 [s]	7.3289214	7.5676410	0.2387196
AI 1/U2 [V]	-303.0324	-234.7663	68.26616
AI 1/I2 [A]	0.308323	-22.21055	-22.51887
U_fundRMS_SYM+@POWER/0 [V]	226.1559	230.1988	4.042816
I_tRMS@POWER/0 [A]	0.339336	6.722025	6.382689
P_t@POWER/0 [W]	-15.65518	4584.346	4600.001
Q_t@POWER/0 [var]	231.2509	807.0782	575.8274

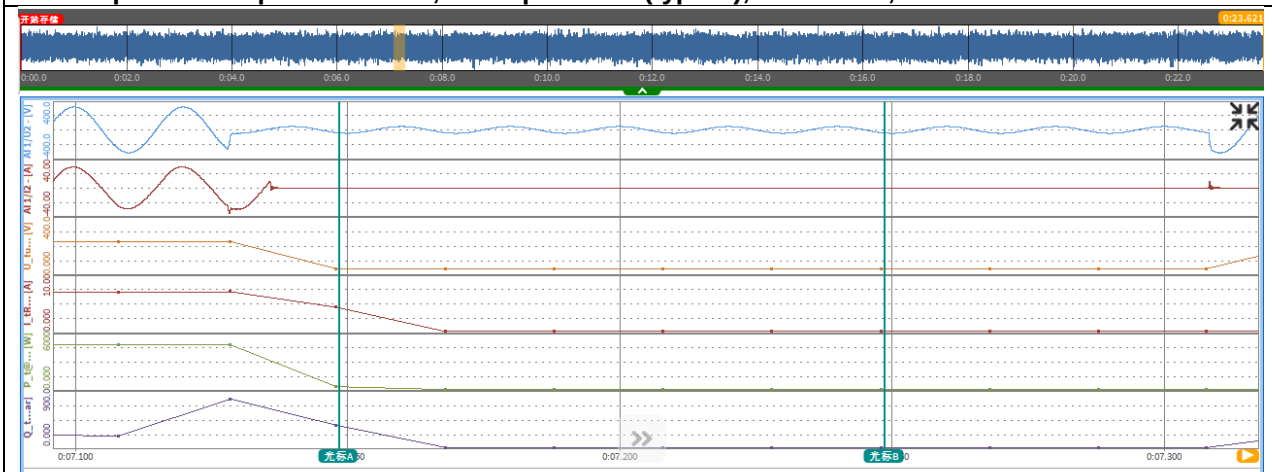
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1.1A
Depth of fault phase:15%Un, three-phase SC(type A), 100% load, current after fault 60ms



	A	B	间隔
时间 [s]	7.1484247	7.2085031	0.0600784
AI 1/U2 [V]	-43.39052	-44.05141	-0.660896
AI 1/I2 [A]	0.045824	0.048161	2.337e-3
U_fundRMS_SYM+@POWER/0 [V]	34.45176	34.48469	0.032932
I_tRMS@POWER/0 [A]	4.371390	0.030503	-4.340887
P_t@POWER/0 [W]	279.3563	-0.024446	-279.3808
Q_t@POWER/0 [var]	351.8412	3.155847	-348.6853

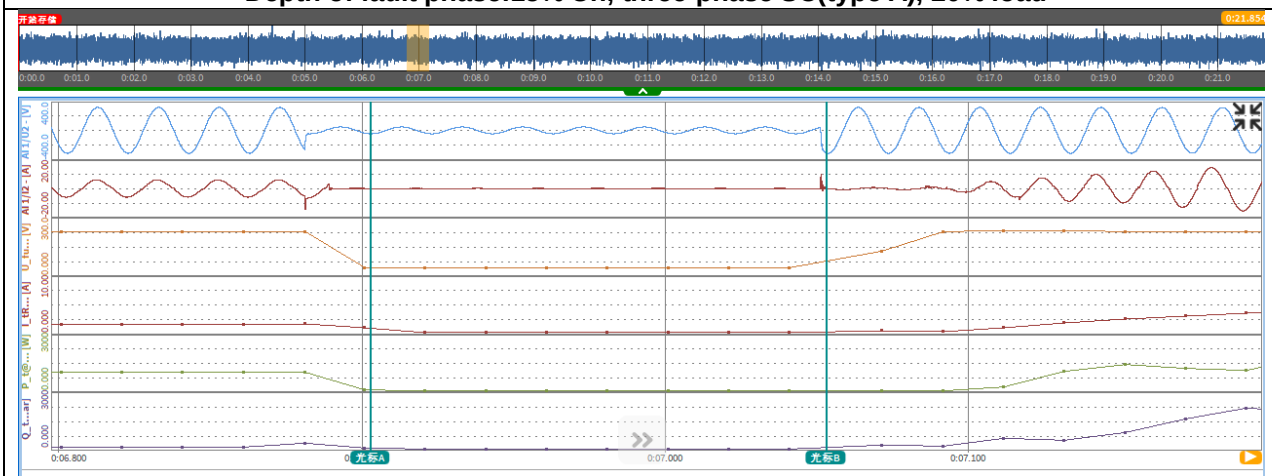
Test 1.1A
Depth of fault phase:15%Un, three-phase SC(type A), 100% load, current after fault 100ms



	A	B	间隔
时间 [s]	7.1484247	7.2485677	0.1001430
AI 1/U2 [V]	-43.39052	-44.14511	-0.754595
AI 1/I2 [A]	0.045824	0.082588	0.036764
U_fundRMS_SYM+@POWER/0 [V]	34.45176	34.48595	0.034199
I_tRMS@POWER/0 [A]	4.371390	0.030578	-4.340812
P_t@POWER/0 [W]	279.3563	-0.031031	-279.3874
Q_t@POWER/0 [var]	351.8412	3.163872	-348.6773

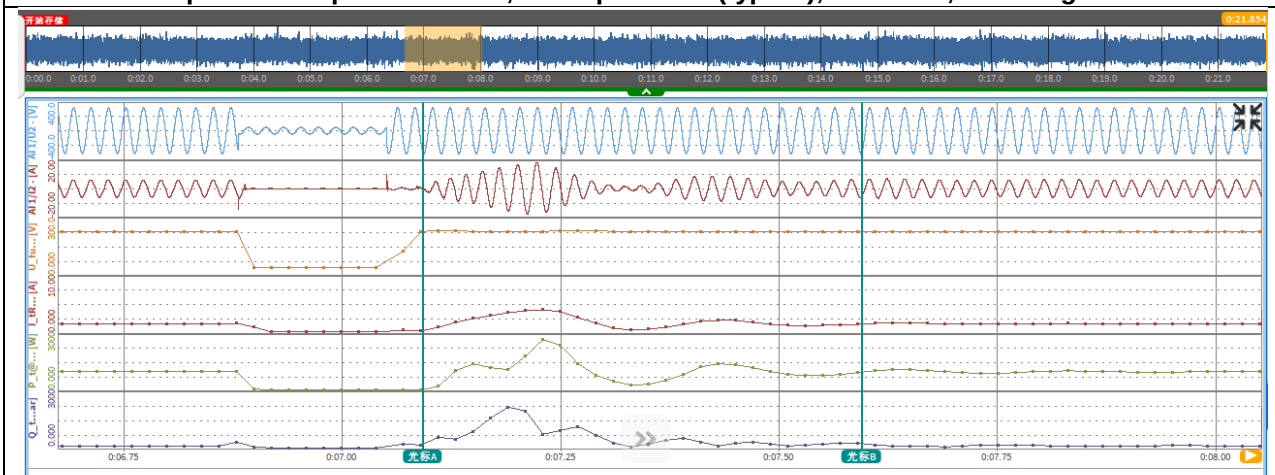
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1.2
Depth of fault phase:15% Un, three-phase SC(type A), 20% load



	A	B	间隔
时间 [s]	6.9029699	7.0531239	0.1501540
AI 1/U2 [V]	-48.59495	-318.3828	-269.7878
AI 1/I2 [A]	0.024080	0.044155	0.020075
U_fundRMS_SYM+@POWER/0 [V]	34.60572	34.48672	-0.118999
I_tRMS@POWER/0 [A]	0.899062	0.030332	-0.868730
P_t@POWER/0 [W]	57.88752	-7.450e-3	-57.89497
Q_t@POWER/0 [var]	72.86678	3.138710	-69.72807

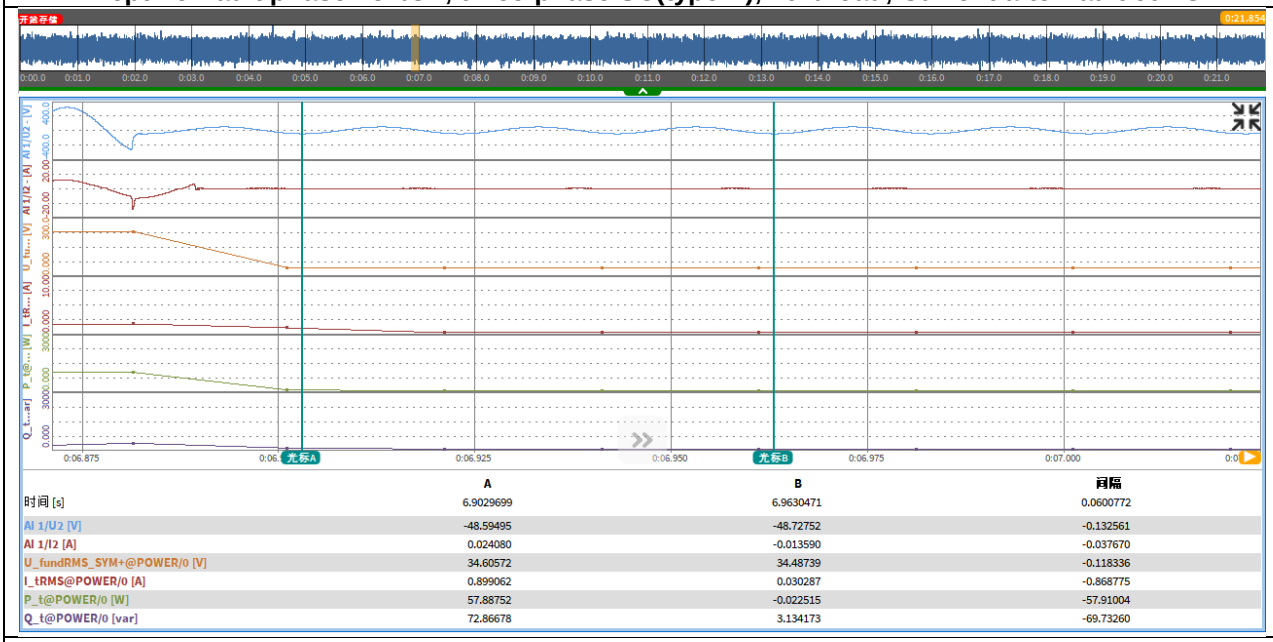
Test 1.2
Depth of fault phase:15%Un, three-phase SC(type A), 20% load, restoring time



	A	B	间隔
时间 [s]	7.0927840	7.5947656	0.5019816
AI 1/U2 [V]	-306.9759	-309.4232	-2.447367
AI 1/I2 [A]	0.450134	-5.559111	-6.009245
U_fundRMS_SYM+@POWER/0 [V]	230.0946	230.0353	-0.059341
I_tRMS@POWER/0 [A]	0.214268	1.420143	1.205875
P_t@POWER/0 [W]	20.47475	948.5328	928.0581
Q_t@POWER/0 [var]	146.5487	247.5041	100.9554

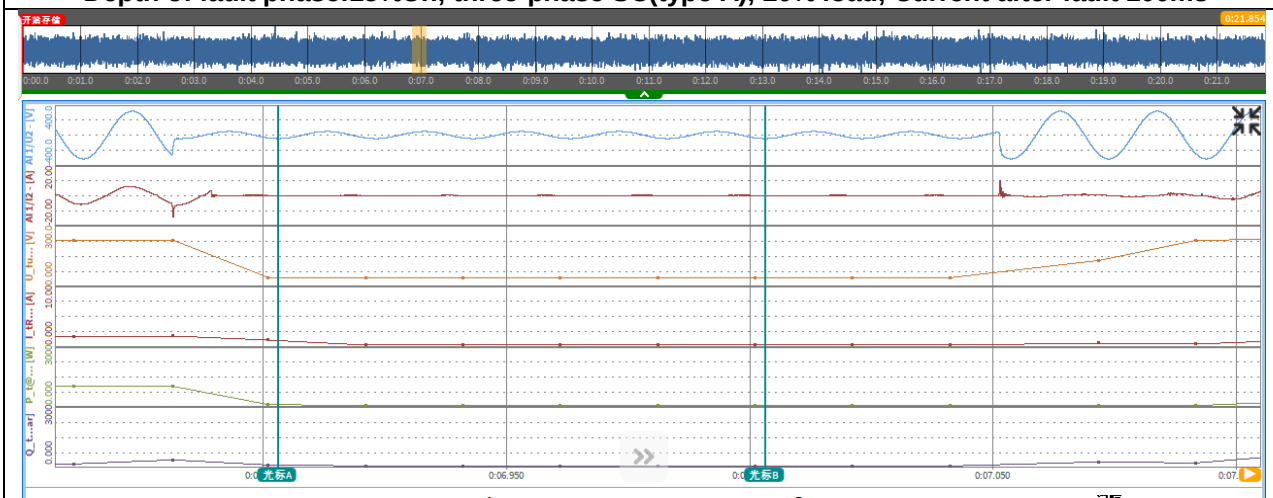
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1.2
Depth of fault phase:15%Un, three-phase SC(type A), 20% load, Current after fault 60ms



	A	B	间隔
时间 [s]	6.9029699	6.9630471	0.0600772
AI 1/U2 [V]	-48.59495	-48.72752	-0.132561
AI 1/I2 [A]	0.024080	-0.013590	-0.037670
U_fundRMS_SYM+@POWER/0 [V]	34.60572	34.48739	-0.118336
I_tRMS@POWER/0 [A]	0.899062	0.030287	-0.868775
P_t@POWER/0 [W]	57.88752	-0.022515	-57.91004
Q_t@POWER/0 [var]	72.86678	3.134173	-69.73260

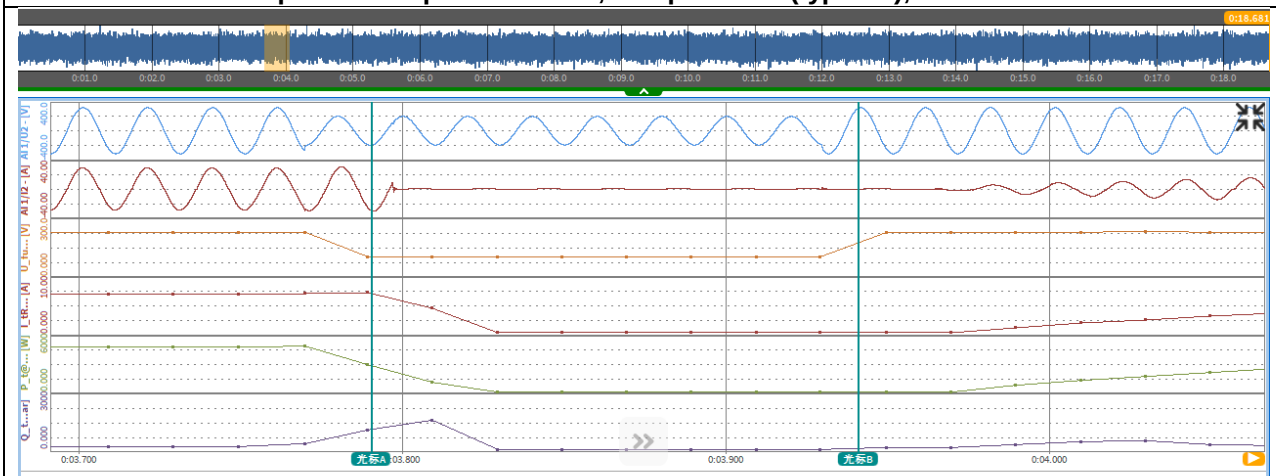
Test 1.2
Depth of fault phase:15%Un, three-phase SC(type A), 20% load, Current after fault 100ms



	A	B	间隔
时间 [s]	6.9029699	7.0030935	0.1001236
AI 1/U2 [V]	-48.59495	-48.85531	-0.260353
AI 1/I2 [A]	0.024080	3.576e-3	-0.020504
U_fundRMS_SYM+@POWER/0 [V]	34.60572	34.48877	-0.116959
I_tRMS@POWER/0 [A]	0.899062	0.030206	-0.868856
P_t@POWER/0 [W]	57.88752	-8.377e-3	-57.89590
Q_t@POWER/0 [var]	72.86678	3.125808	-69.74097

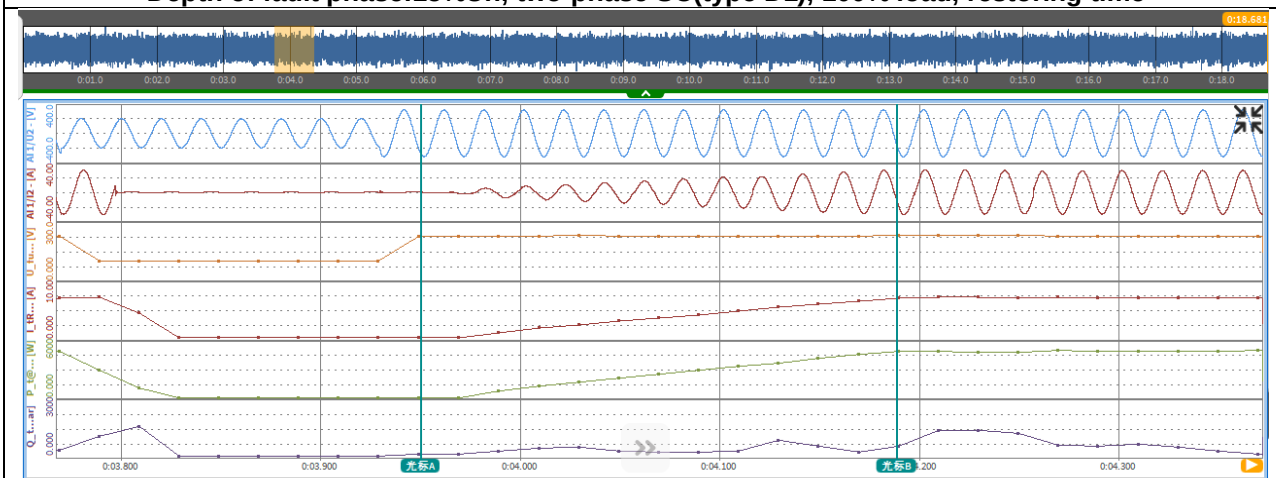
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1.3
Depth of fault phase:15%Un, two-phase SC(type D1), 100% load



	A	B	间隔
时间 [s]	3.7905868	3.9410606	0.1504739
AI 1/U2 [V]	-202.8978	314.8868	517.7846
AI 1/I2 [A]	-30.32689	-0.214481	30.11241
U_fundRMS_SYM+@POWER/0 [V]	98.30151	98.37451	0.073006
I_tRMS@POWER/0 [A]	7.213766	0.119701	-7.094066
P_t@POWER/0 [W]	2890.957	0.163343	-2890.793
Q_t@POWER/0 [var]	1086.956	50.75713	-1036.199

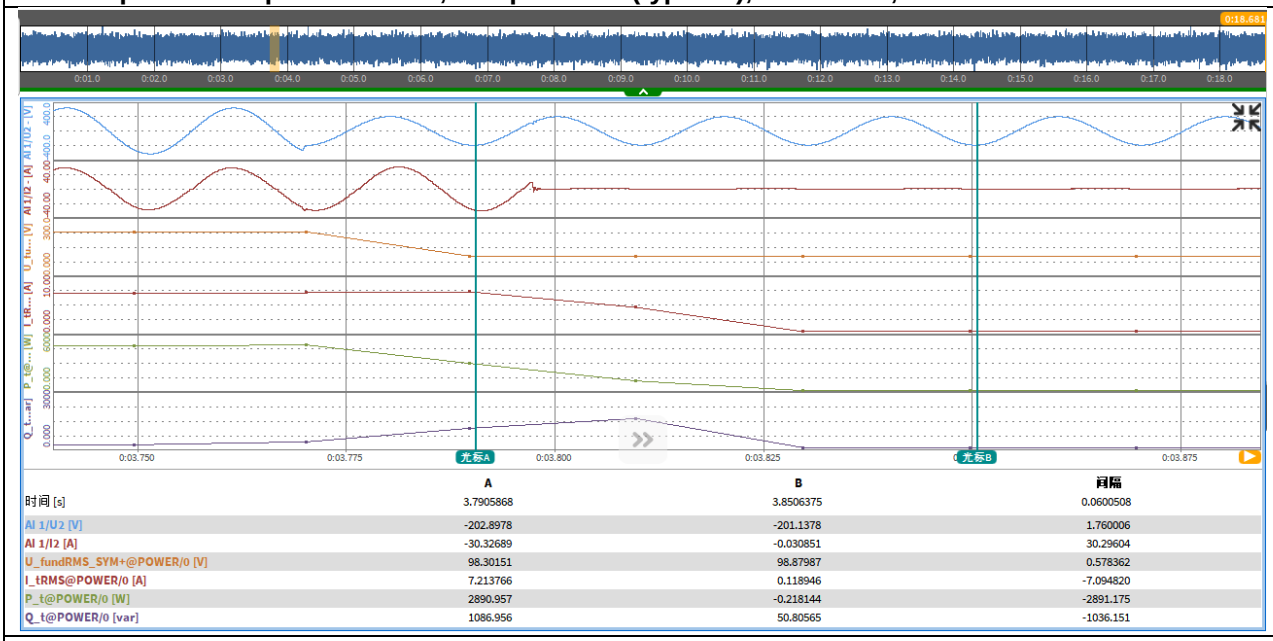
Test 1.3
Depth of fault phase:15%Un, two-phase SC(type D1), 100% load, restoring time



	A	B	间隔
时间 [s]	3.9502918	4.1886192	0.2383274
AI 1/U2 [V]	-284.2734	-177.5112	106.7622
AI 1/I2 [A]	0.420284	-12.64229	-13.06257
U_fundRMS_SYM+@POWER/0 [V]	228.5205	230.1147	1.594177
I_tRMS@POWER/0 [A]	0.210896	6.619823	6.408928
P_t@POWER/0 [W]	-8.070308	4571.413	4579.483
Q_t@POWER/0 [var]	145.0676	239.9404	94.87280

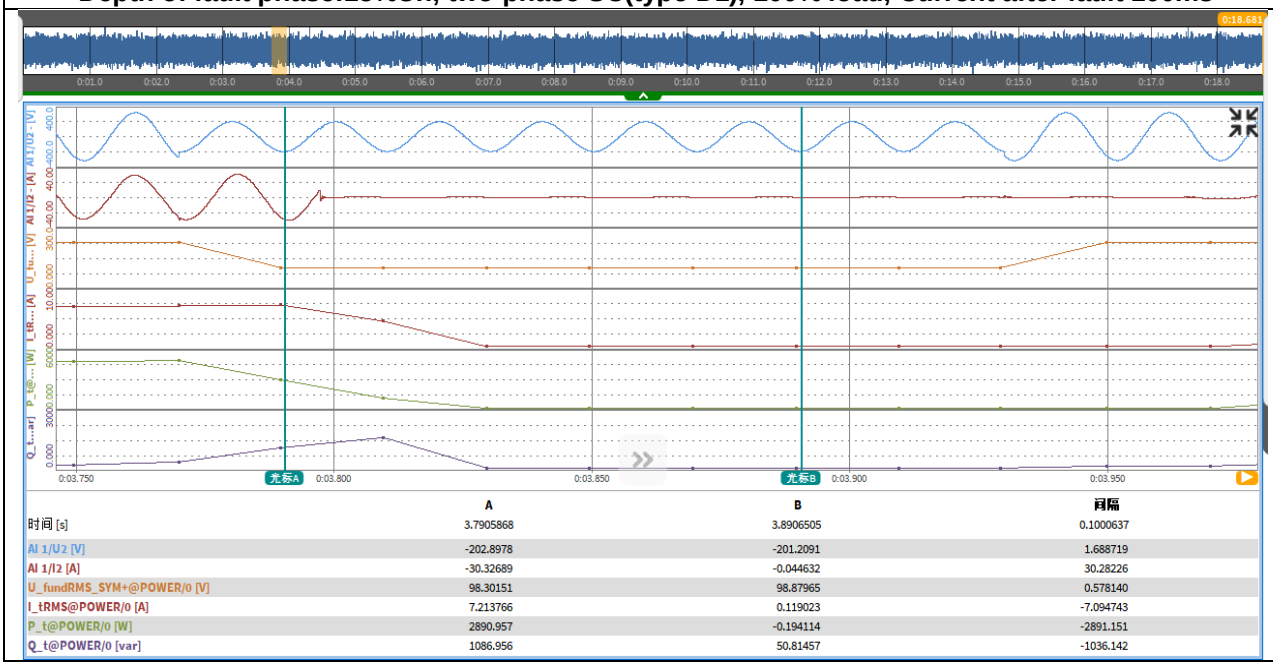
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1.3
Depth of fault phase:15%Un, two-phase SC(type D1), 100% load, Current after fault 60ms



	A	B	间隔
时间 [s]	3.7905868	3.8506375	0.0600508
AI 1/U2 [V]	-202.8978	-201.1378	1.760006
AI 1/I2 [A]	-30.32689	-0.030851	30.29604
U_fundRMS_SYM+@POWER/0 [V]	98.30151	98.87987	0.578362
I_tRMS@POWER/0 [A]	7.213766	0.118946	-7.094820
P_t@POWER/0 [W]	2890.957	-0.218144	-2891.175
Q_t@POWER/0 [var]	1086.956	50.80565	-1036.151

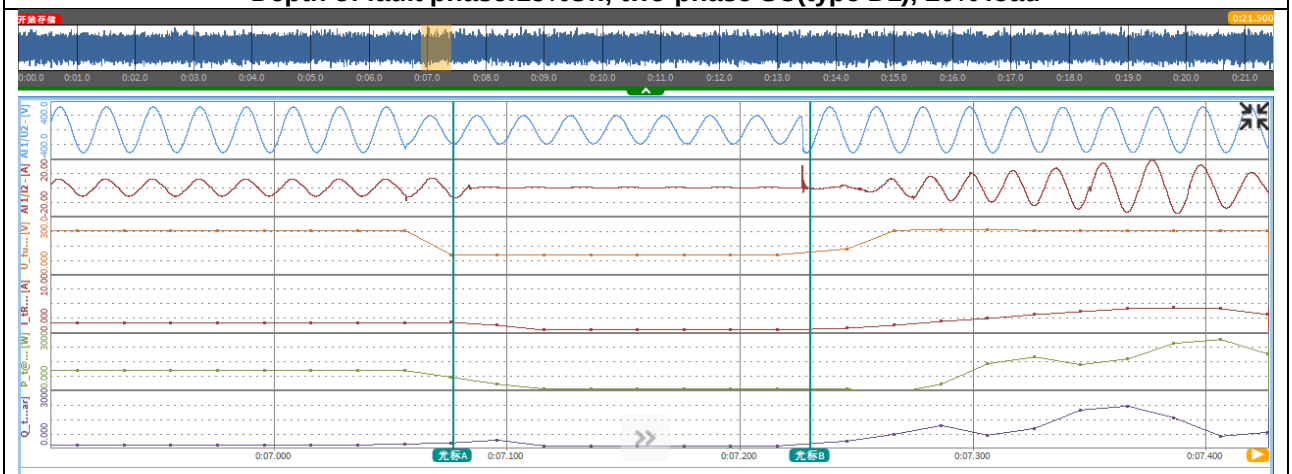
Test 1.3
Depth of fault phase:15%Un, two-phase SC(type D1), 100% load, Current after fault 100ms



	A	B	间隔
时间 [s]	3.7905868	3.8906505	0.1000637
AI 1/U2 [V]	-202.8978	-201.2091	1.688719
AI 1/I2 [A]	-30.32689	-0.044632	30.28226
U_fundRMS_SYM+@POWER/0 [V]	98.30151	98.87965	0.578140
I_tRMS@POWER/0 [A]	7.213766	0.119023	-7.094743
P_t@POWER/0 [W]	2890.957	-0.194114	-2891.151
Q_t@POWER/0 [var]	1086.956	50.81457	-1036.142

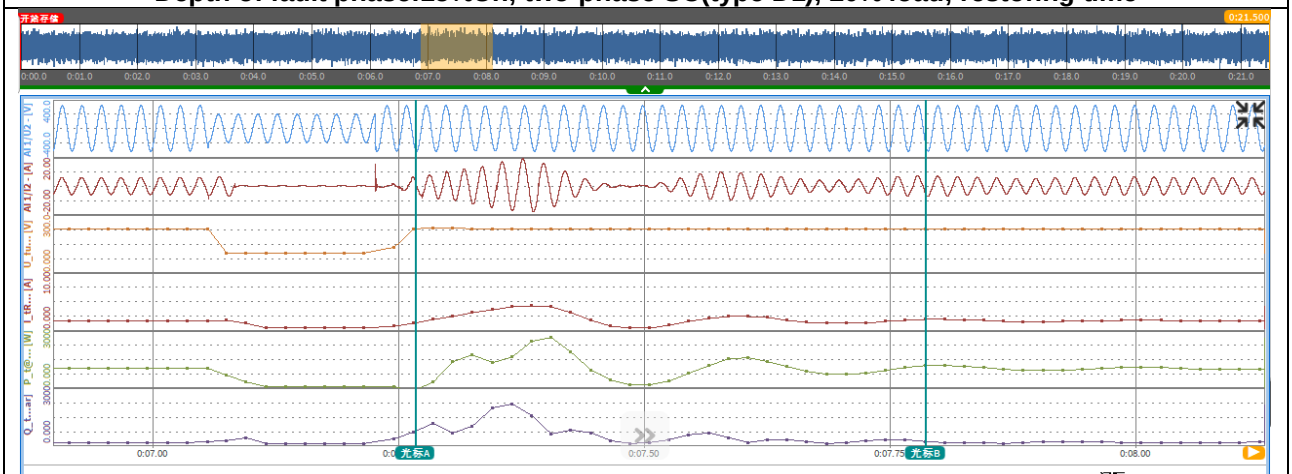
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1.4
Depth of fault phase:15%Un, two-phase SC(type D1), 20% load



	A	B	间隔
时间 [s]	7.0768926	7.2300849	0.1531923
AI 1/U2 [V]	-200.7268	-288.5046	-87.77786
AI 1/I2 [A]	-6.859923	-0.299311	6.560612
U_fundRMS_SYM+@POWER/0 [V]	98.26350	98.91703	0.653526
I_tRMS@POWER/0 [A]	1.560507	0.119064	-1.441442
P_t@POWER/0 [W]	636.5107	-0.175519	-636.6862
Q_t@POWER/0 [var]	183.6622	50.84949	-132.8127

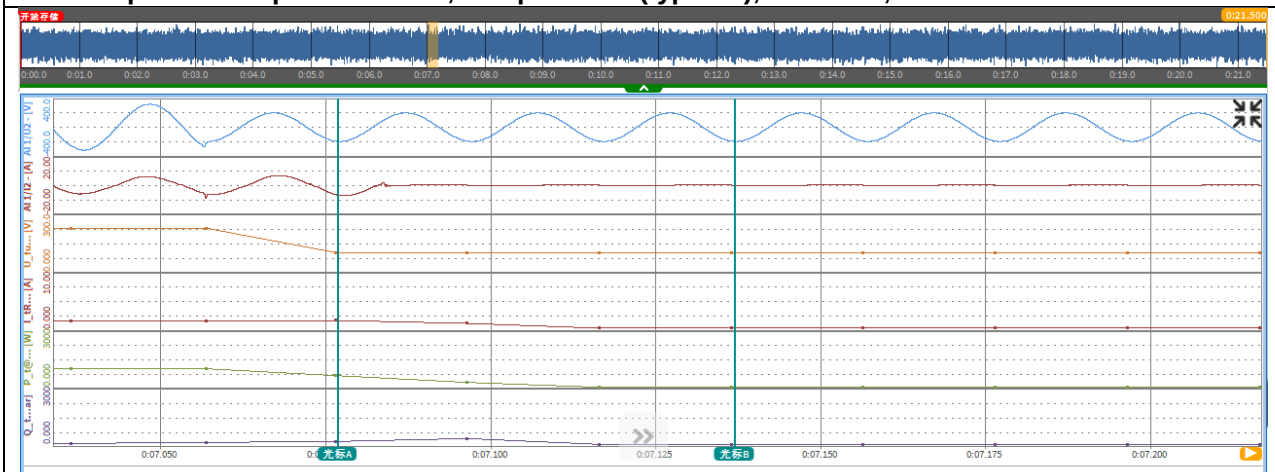
Test 1.4
Depth of fault phase:15%Un, two-phase SC(type D1), 20% load, restoring time



	A	B	间隔
时间 [s]	7.2672007	7.7859499	0.5187492
AI 1/U2 [V]	-300.0381	-225.3323	74.70584
AI 1/I2 [A]	3.612900	-5.462981	-9.075881
U_fundRMS_SYM+@POWER/0 [V]	230.1318	230.0296	-0.102173
I_tRMS@POWER/0 [A]	1.024015	1.536035	0.512020
P_t@POWER/0 [W]	-216.2613	1026.413	1242.674
Q_t@POWER/0 [var]	673.5925	264.7480	-408.8446

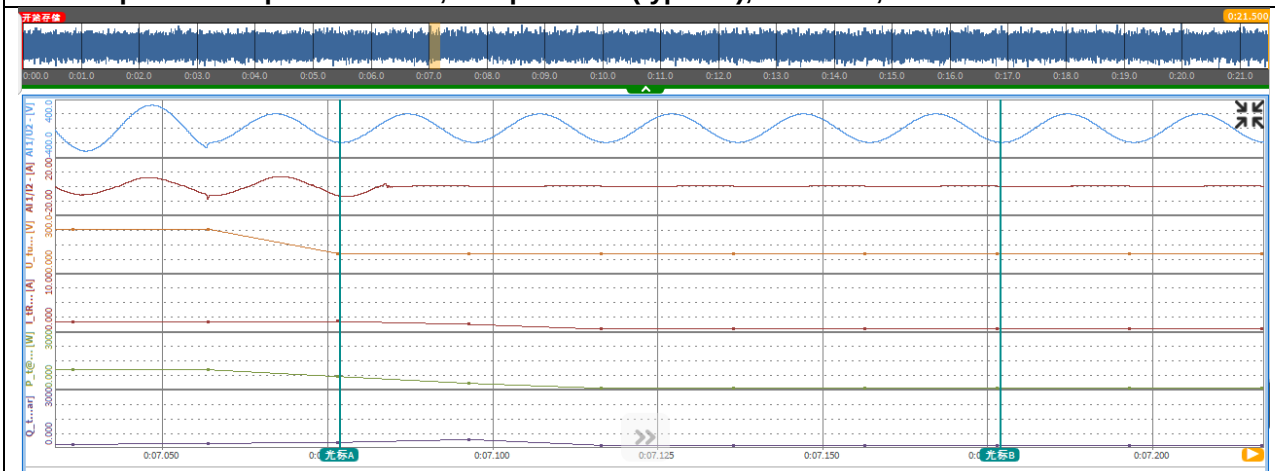
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1.4
Depth of fault phase:15%Un, two-phase SC(type D1), 20% load, Current after fault 60ms



	A	B	间隔
时间 [s]	7.0768926	7.1370032	0.0601106
AI 1/U2 [V]	-200.7268	-201.2913	-0.564575
AI 1/I2 [A]	-6.859923	0.027084	6.887007
U_fundRMS_SYM+@POWER/0 [V]	98.26350	98.87349	0.609985
I_tRMS@POWER/0 [A]	1.560507	0.119096	-1.441411
P_t@POWER/0 [W]	636.5107	-0.269741	-636.7804
Q_t@POWER/0 [var]	183.6622	50.86054	-132.8017

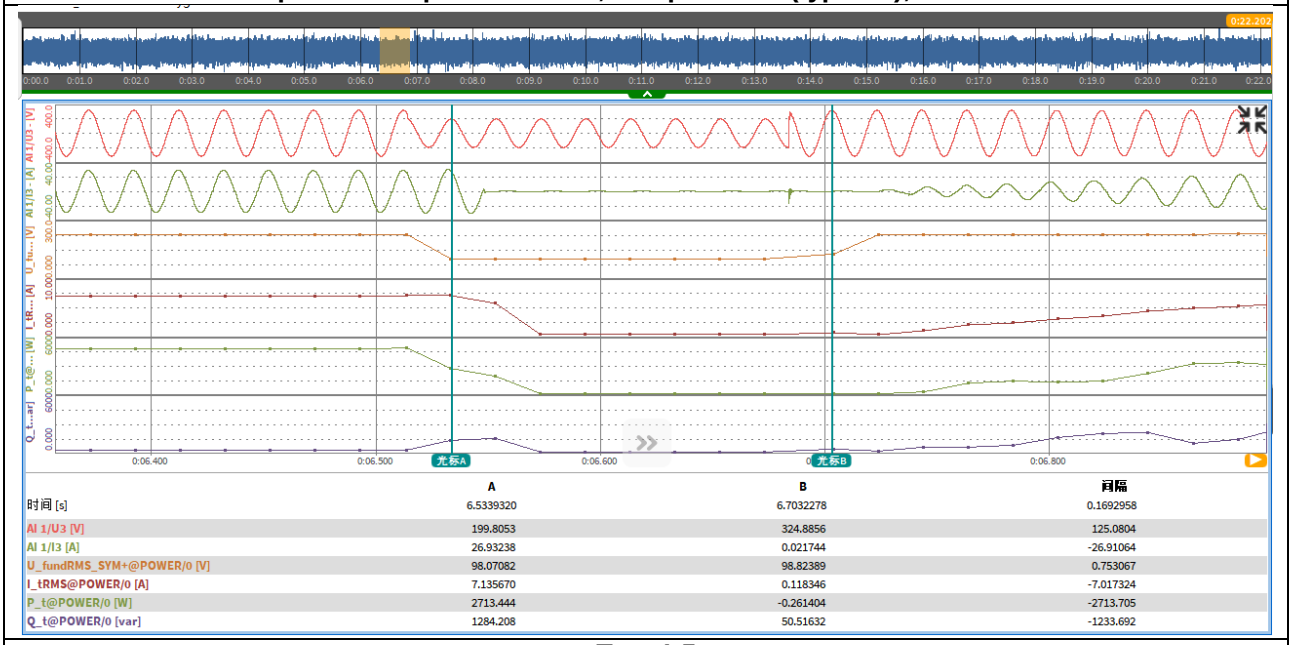
Test 1.4
Depth of fault phase:15%Un, two-phase SC(type D1), 20% load, Current after fault 100ms



	A	B	间隔
时间 [s]	7.0768926	7.1769329	0.1000403
AI 1/U2 [V]	-200.7268	-200.9509	-0.224113
AI 1/I2 [A]	-6.859923	0.048542	6.908465
U_fundRMS_SYM+@POWER/0 [V]	98.26350	98.87257	0.609062
I_tRMS@POWER/0 [A]	1.560507	0.119044	-1.441463
P_t@POWER/0 [W]	636.5107	-0.210433	-636.7211
Q_t@POWER/0 [var]	183.6622	50.84352	-132.8187

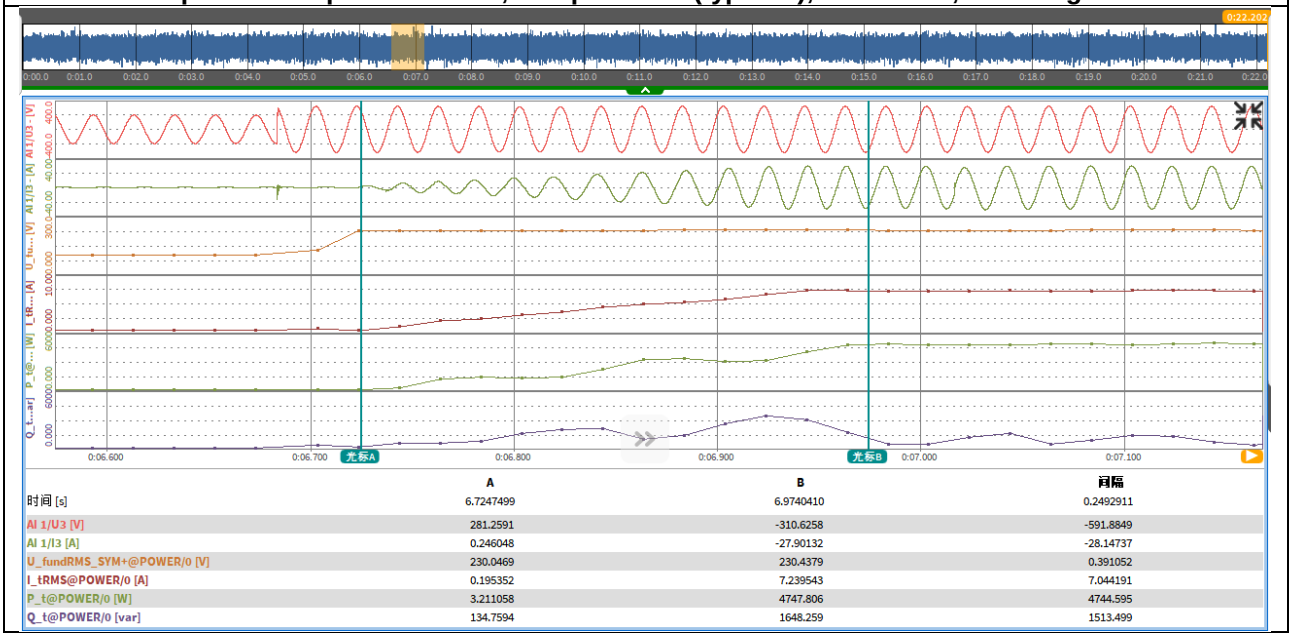
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1.5
Depth of fault phase:15%Un, two-phase SC(type D2), 100% load



	A	B	间隔
时间 [s]	6.5339320	6.7032278	0.1692958
AI 1/U3 [V]	199.8053	324.8856	125.0804
AI 1/I3 [A]	26.93238	0.021744	-26.91064
U_fundRMS_SYM+@POWER/0 [V]	98.07082	98.82389	0.753067
I_tRMS@POWER/0 [A]	7.135670	0.118346	-7.017324
P_t@POWER/0 [W]	2713.444	-0.261404	-2713.705
Q_t@POWER/0 [var]	1284.208	50.51632	-1233.692

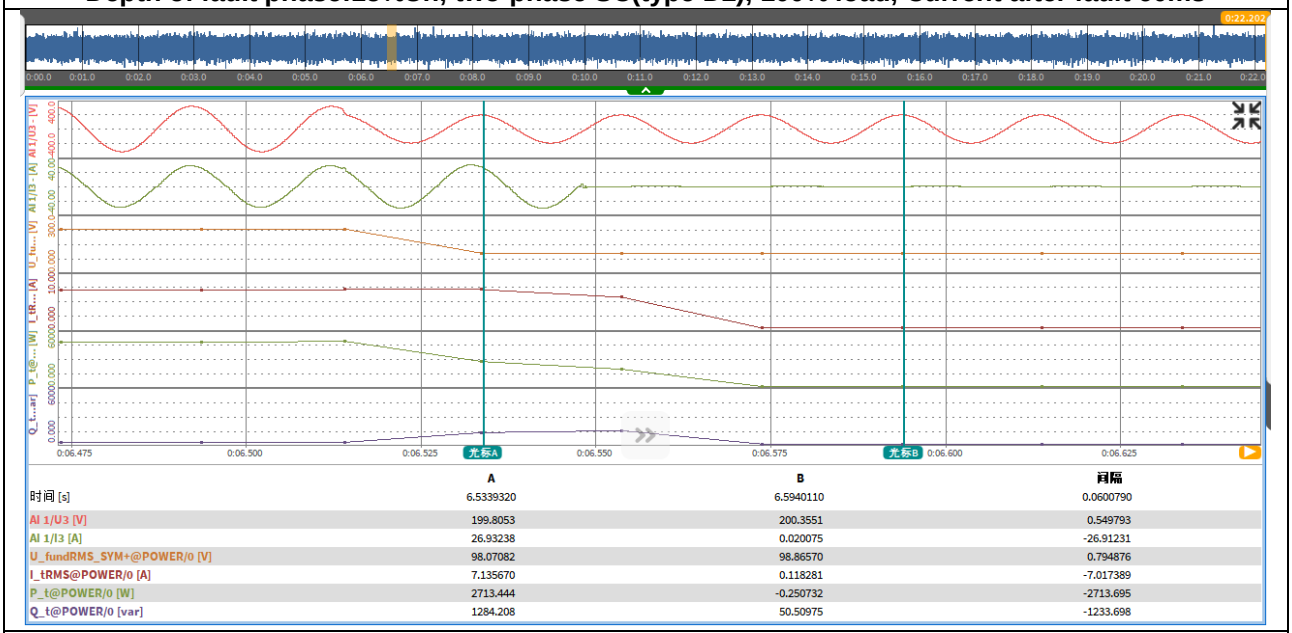
Test 1.5
Depth of fault phase:15%Un, two-phase SC(type D2), 100% load, restoring time



	A	B	间隔
时间 [s]	6.7247499	6.9740410	0.2492911
AI 1/U3 [V]	281.2591	-310.6258	-591.8849
AI 1/I3 [A]	0.246048	-27.90132	-28.14737
U_fundRMS_SYM+@POWER/0 [V]	230.0469	230.4379	0.391052
I_tRMS@POWER/0 [A]	0.195352	7.239543	7.044191
P_t@POWER/0 [W]	3.211058	4747.806	4744.595
Q_t@POWER/0 [var]	134.7594	1648.259	1513.499

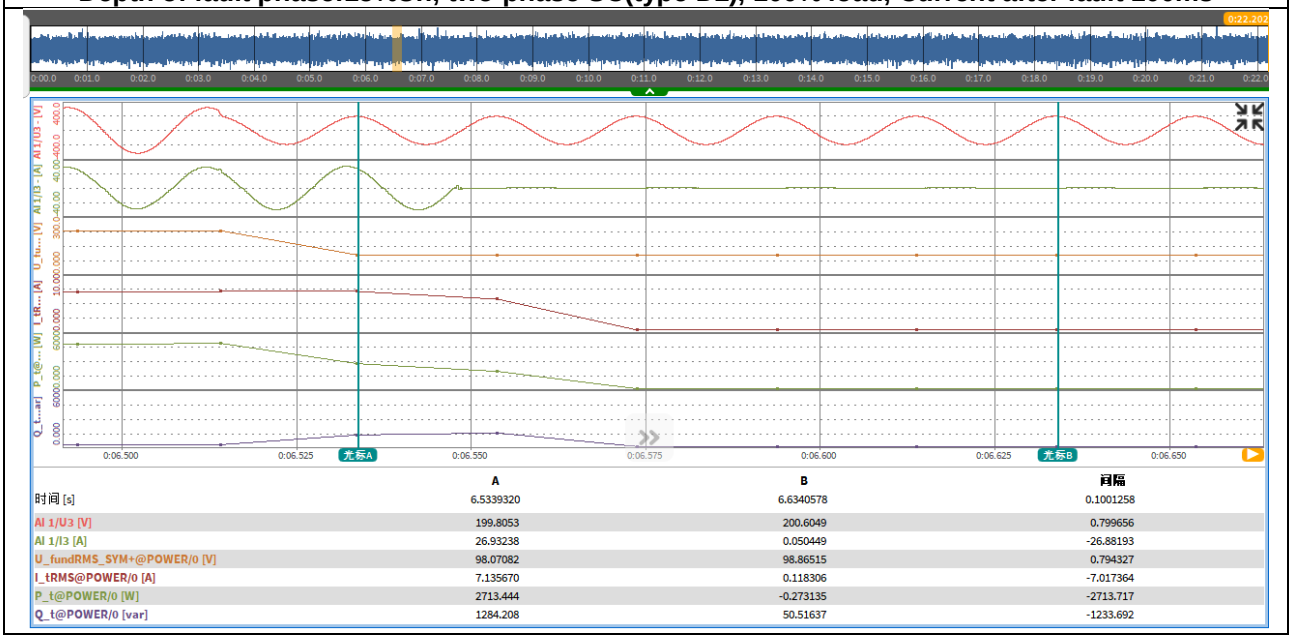
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 1.5
Depth of fault phase:15%Un, two-phase SC(type D2), 100% load, Current after fault 60ms



	A	B	间隔
时间 [s]	6.5339320	6.5940110	0.0600790
AI 1/U3 [V]	199.8053	200.3551	0.549793
AI 1/I3 [A]	26.93238	0.020075	-26.91231
U_fundRMS_SYM+@POWER/0 [V]	98.07082	98.86570	0.794876
I_tRMS@POWER/0 [A]	7.135670	0.118281	-7.017389
P_t@POWER/0 [W]	2713.444	-0.250732	-2713.695
Q_t@POWER/0 [var]	1284.208	50.50975	-1233.698

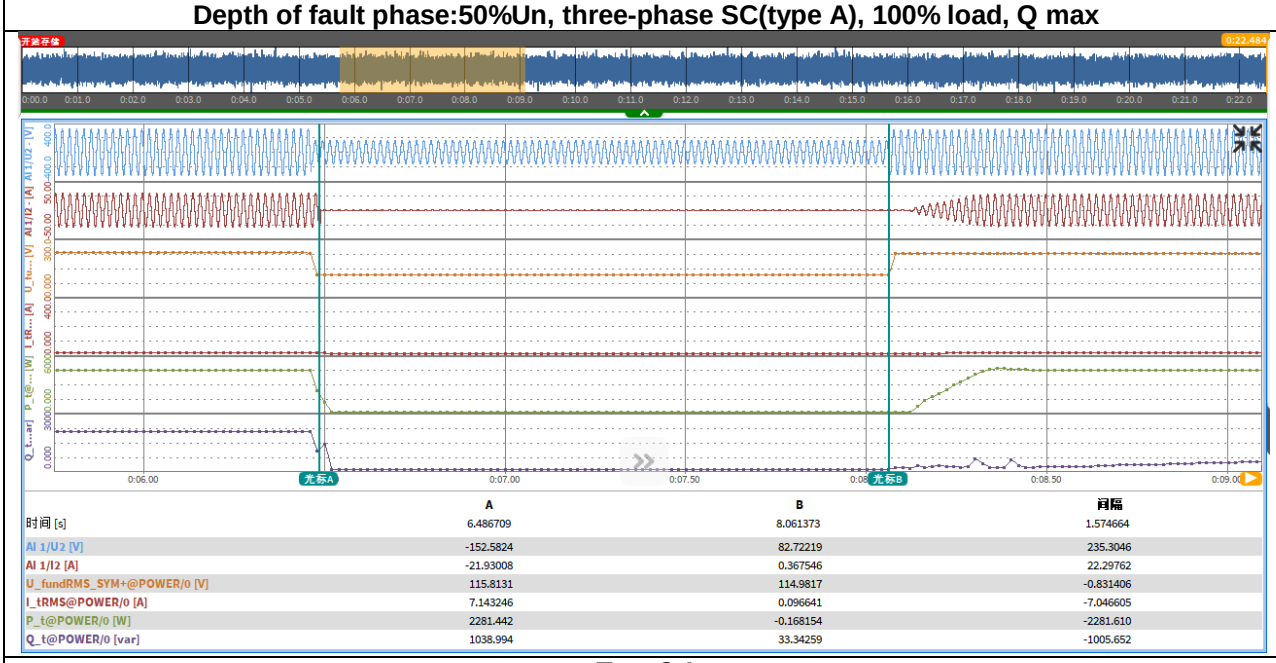
Test 1.5
Depth of fault phase:15%Un, two-phase SC(type D2), 100% load, Current after fault 100ms



	A	B	间隔
时间 [s]	6.5339320	6.6340578	0.1001258
AI 1/U3 [V]	199.8053	200.6049	0.799656
AI 1/I3 [A]	26.93238	0.050449	-26.88193
U_fundRMS_SYM+@POWER/0 [V]	98.07082	98.86515	0.794327
I_tRMS@POWER/0 [A]	7.135670	0.118306	-7.017364
P_t@POWER/0 [W]	2713.444	-0.273135	-2713.717
Q_t@POWER/0 [var]	1284.208	50.51637	-1233.692

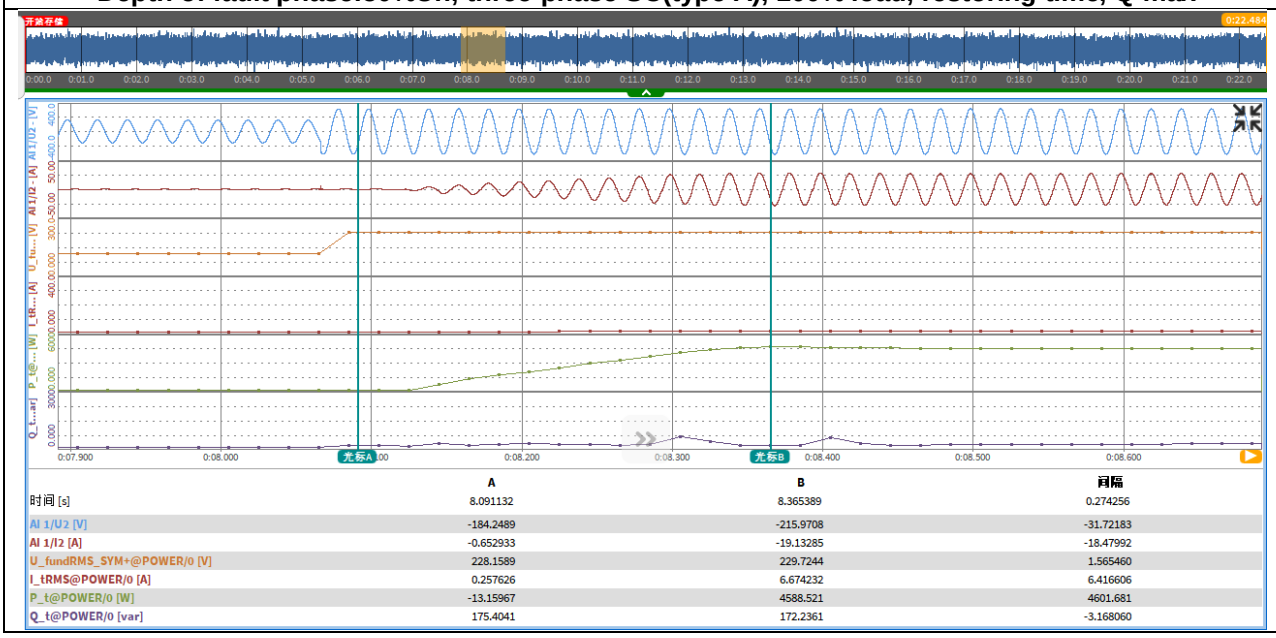
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 2.1
Depth of fault phase:50%Un, three-phase SC(type A), 100% load, Q max



	A	B	间隔
时间 [s]	6.486709	8.061373	1.574664
AI 1/U2 [V]	-152.5824	82.72219	235.3046
AI 1/I2 [A]	-21.93008	0.367546	22.29762
U_fundRMS_SYM+@POWER/0 [V]	115.8131	114.9817	-0.831406
I_tRMS@POWER/0 [A]	7.143246	0.096641	-7.046605
P_t@POWER/0 [W]	2281.442	-0.168154	-2281.610
Q_t@POWER/0 [var]	1038.994	33.34259	-1005.652

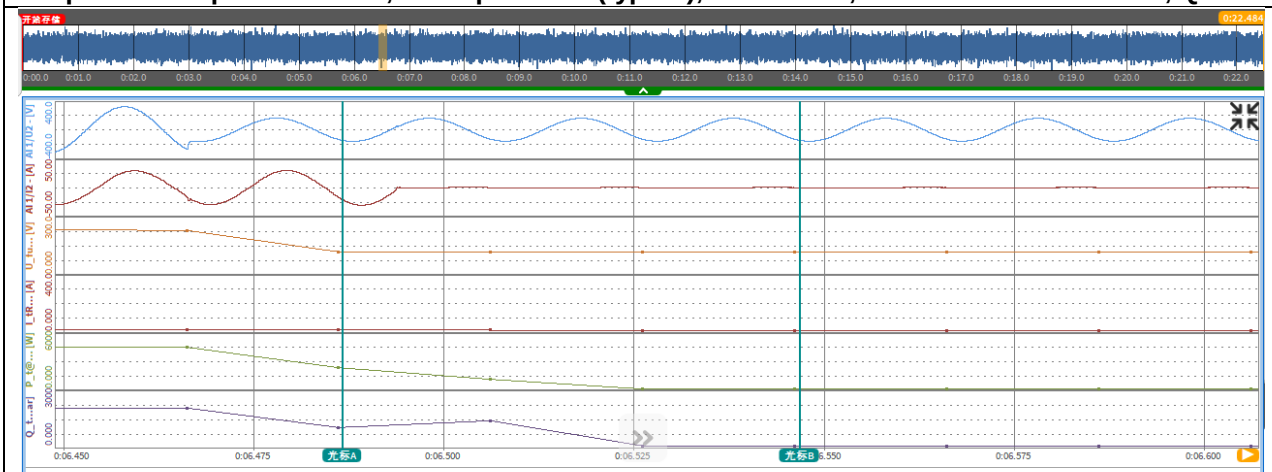
Test 2.1
Depth of fault phase:50%Un, three-phase SC(type A), 100% load, restoring time, Q max



	A	B	间隔
时间 [s]	8.091132	8.365389	0.274256
AI 1/U2 [V]	-184.2489	-215.9708	-31.72183
AI 1/I2 [A]	-0.652933	-19.13285	-18.47992
U_fundRMS_SYM+@POWER/0 [V]	228.1589	229.7244	1.565460
I_tRMS@POWER/0 [A]	0.257626	6.674232	6.416606
P_t@POWER/0 [W]	-13.15967	4588.521	4601.681
Q_t@POWER/0 [var]	175.4041	172.2361	-3.168060

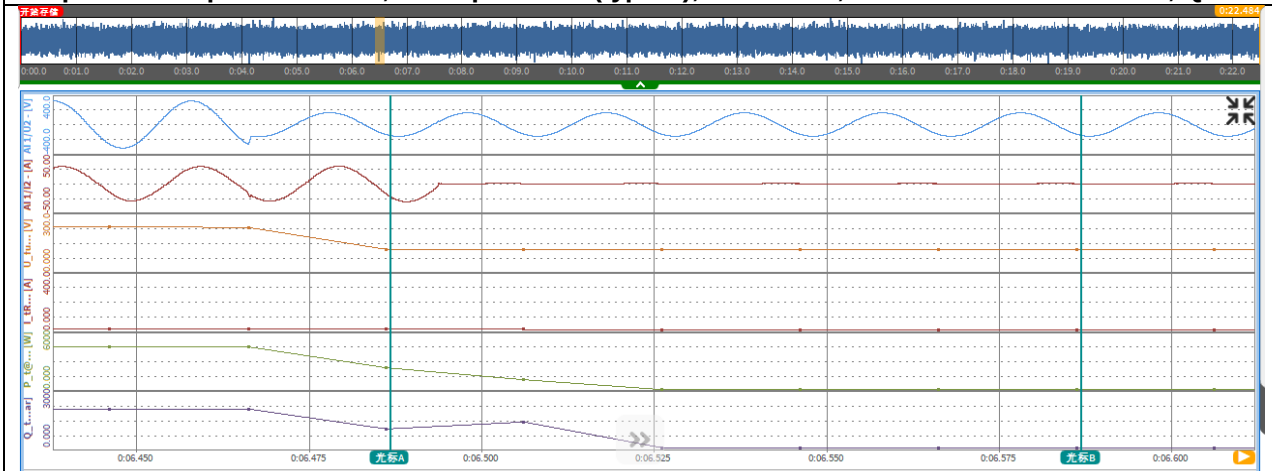
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 2.1
Depth of fault phase:50%Un, three-phase SC(type A), 100% load, Current after fault 60ms, Q max



	A	B	间隔
时间 [s]	6.486709	6.546793	0.060084
AI 1/U2 [V]	-152.5824	-149.1149	3.467560
AI 1/I2 [A]	-21.93008	0.145054	22.07513
U_fundRMS_SYM+@POWER/0 [V]	115.8131	114.9832	-0.829941
I_tRMS@POWER/0 [A]	7.143246	0.096435	-7.046811
P_t@POWER/0 [W]	2281.442	-0.129535	-2281.571
Q_t@POWER/0 [var]	1038.994	33.27290	-1005.721

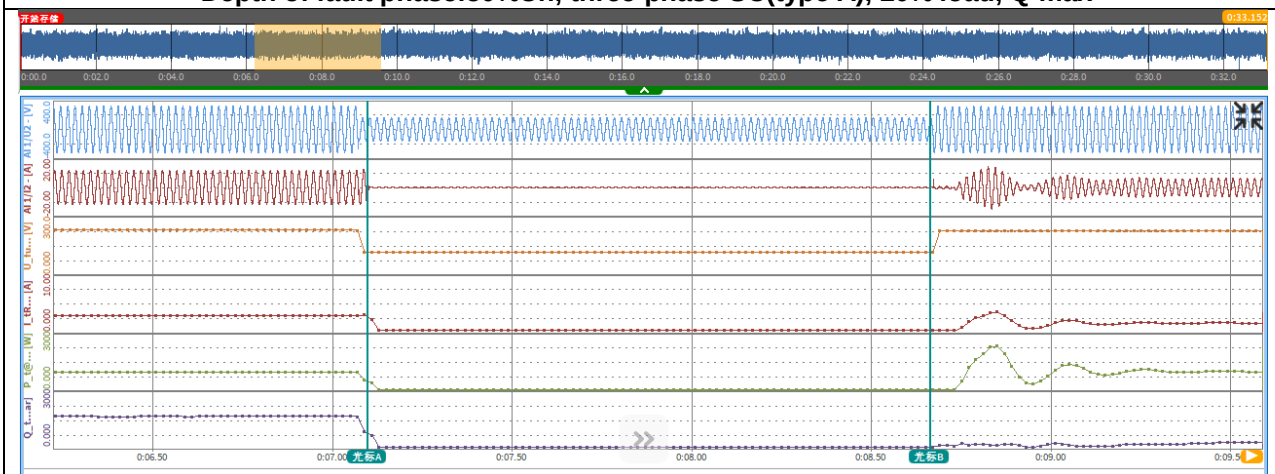
Test 2.1
Depth of fault phase:50%Un, three-phase SC(type A), 100% load, Current after fault 100ms, Q max



	A	B	间隔
时间 [s]	6.486709	6.586792	0.100084
AI 1/U2 [V]	-152.5824	-149.2255	3.356934
AI 1/I2 [A]	-21.93008	0.176477	22.10655
U_fundRMS_SYM+@POWER/0 [V]	115.8131	114.9814	-0.831741
I_tRMS@POWER/0 [A]	7.143246	0.096472	-7.046774
P_t@POWER/0 [W]	2281.442	-0.174198	-2281.616
Q_t@POWER/0 [var]	1038.994	33.28371	-1005.711

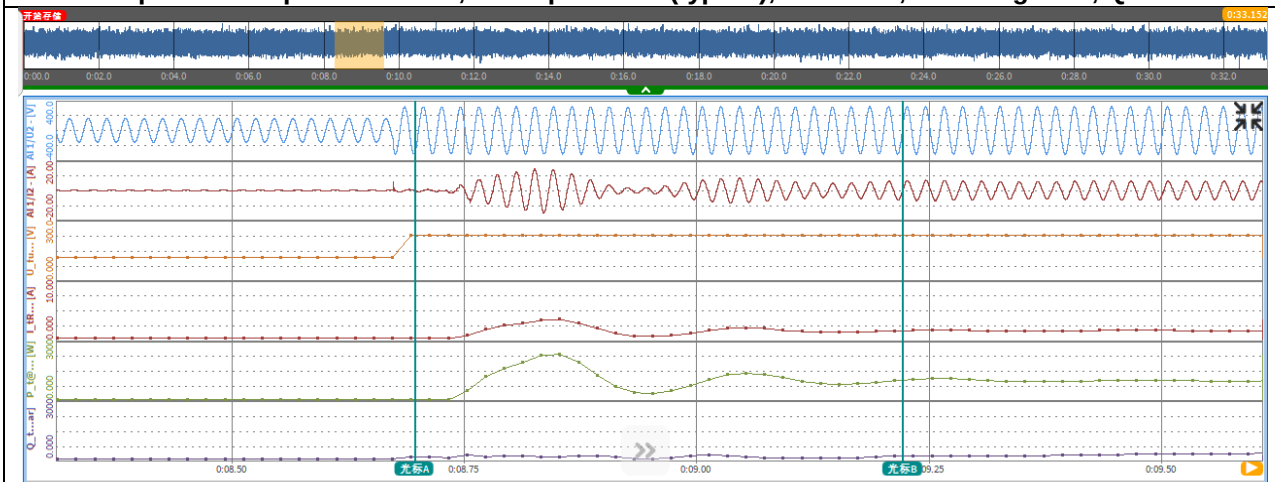
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 2.2
Depth of fault phase:50%Un, three-phase SC(type A), 20% load, Q max



	A	B	间隔
时间 [s]	7.097417	8.661565	1.564149
AI 1/U2 [V]	-158.0627	0.018120	158.0808
AI 1/I2 [A]	-10.14466	-0.408411	9.736252
U_fundRMS_SYM+@POWER/0 [V]	115.7244	114.9888	-0.735672
I_tRMS@POWER/0 [A]	2.914819	0.096276	-2.818543
P_t@POWER/0 [W]	521.3647	-0.149739	-521.5145
Q_t@POWER/0 [var]	874.8517	33.22082	-841.6309

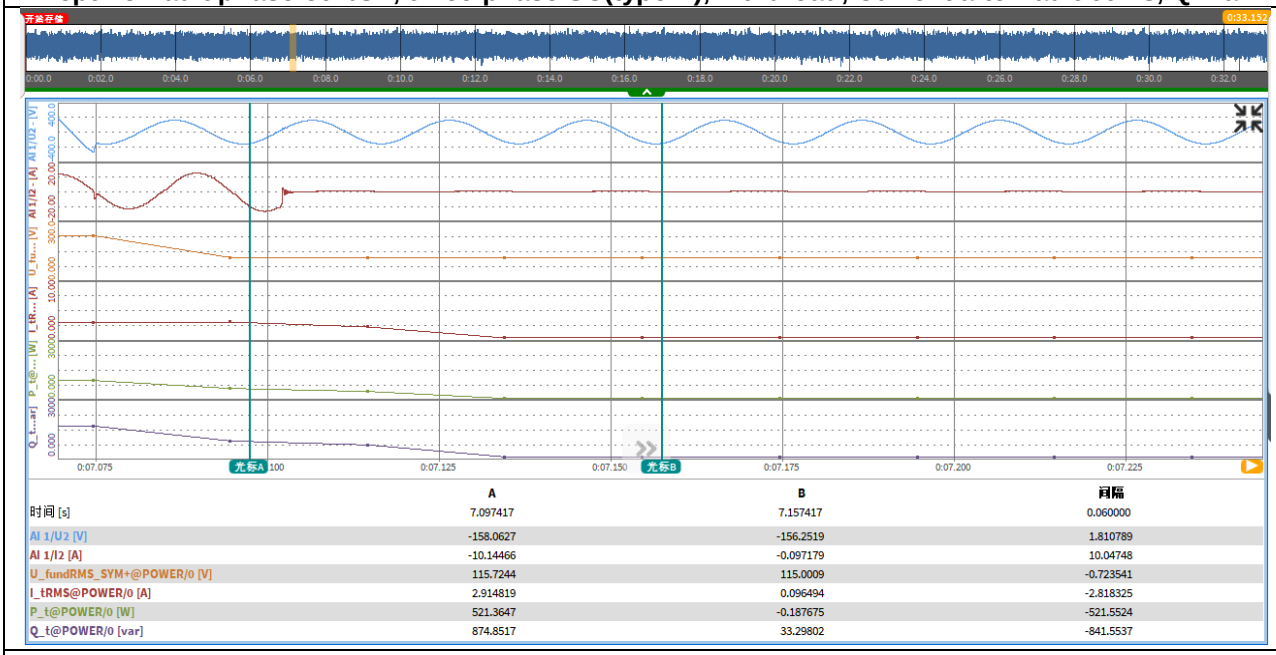
Test 2.2
Depth of fault phase:50%Un, three-phase SC(type A), 20% load, restoring time, Q max



	A	B	间隔
时间 [s]	8.696850	9.221720	0.524870
AI 1/U2 [V]	-323.2529	15.29813	338.5511
AI 1/I2 [A]	-0.072718	-0.857687	-0.784969
U_fundRMS_SYM+@POWER/0 [V]	228.1642	229.7603	1.596054
I_tRMS@POWER/0 [A]	0.256805	1.426263	1.169458
P_t@POWER/0 [W]	-12.87918	961.6628	974.5420
Q_t@POWER/0 [var]	174.9700	194.0301	19.06003

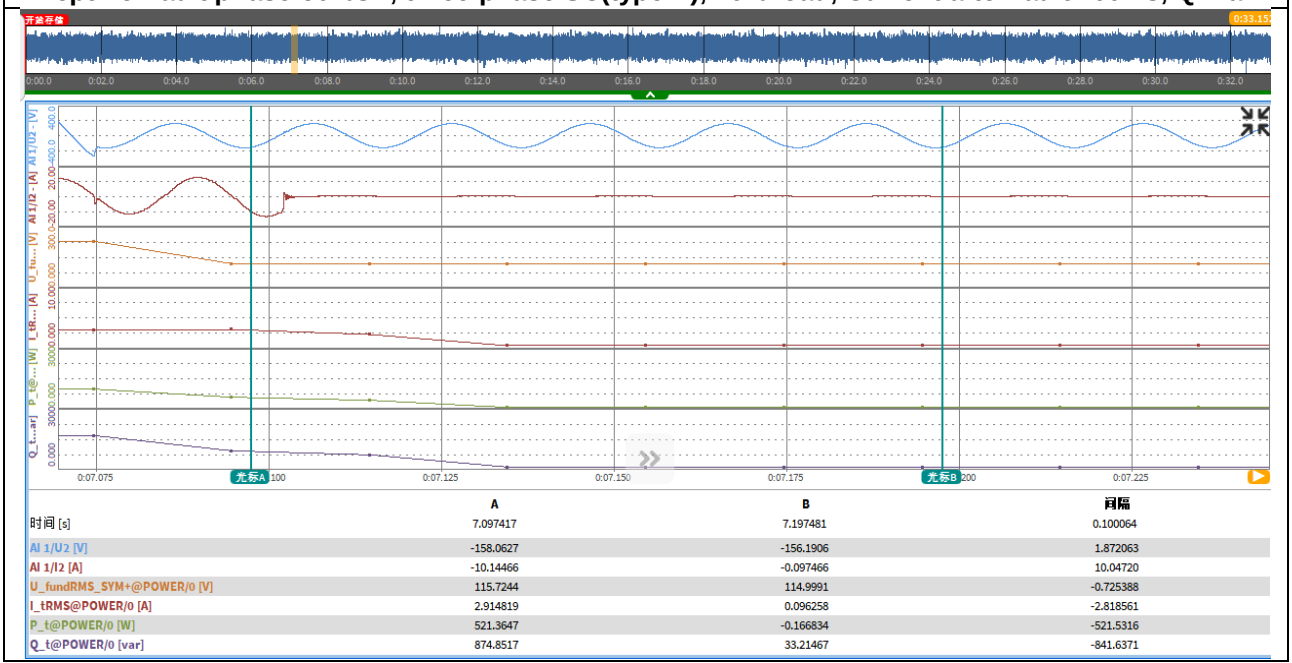
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 2.2
Depth of fault phase:50%Un, three-phase SC(type A), 20% load, Current after fault 60ms, Q max



	A	B	间隔
时间 [s]	7.097417	7.157417	0.060000
AI 1/U2 [V]	-158.0627	-156.2519	1.810789
AI 1/I2 [A]	-10.14466	-0.097179	10.04748
U_fundRMS_SYM+@POWER/0 [V]	115.7244	115.0009	-0.723541
I_tRMS@POWER/0 [A]	2.914819	0.096494	-2.818325
P_t@POWER/0 [W]	521.3647	-0.187675	-521.5524
Q_t@POWER/0 [var]	874.8517	33.29802	-841.5537

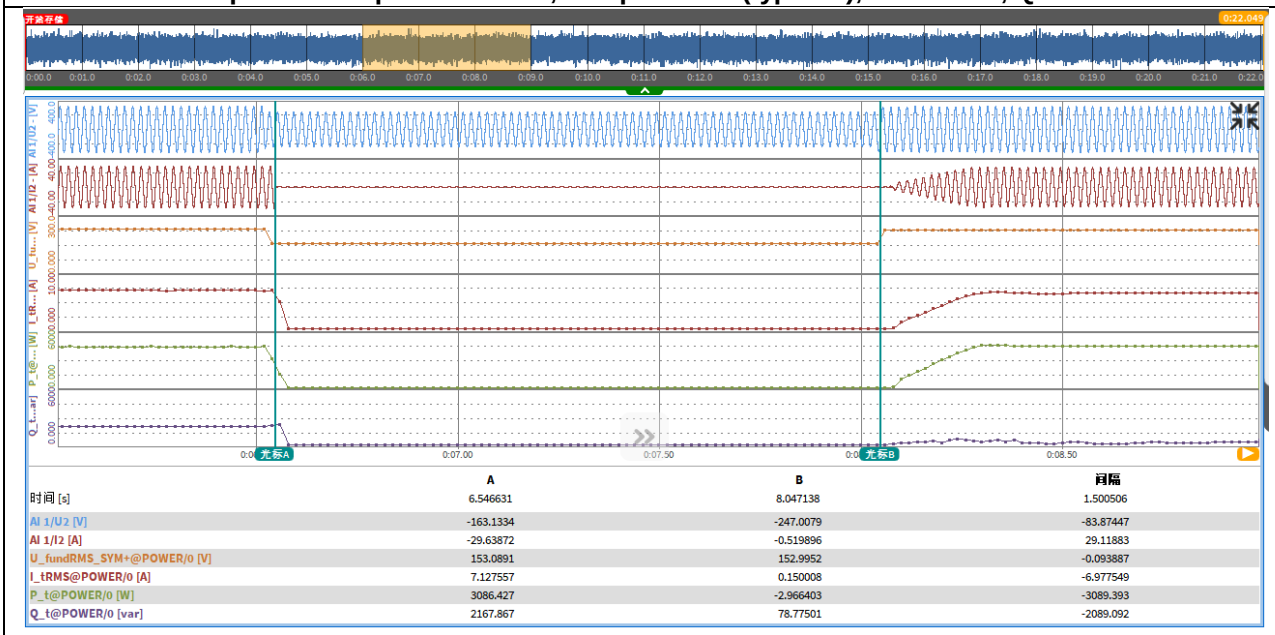
Test 2.2
Depth of fault phase:50%Un, three-phase SC(type A), 20% load, Current after fault 100ms, Q max



	A	B	间隔
时间 [s]	7.097417	7.197481	0.100064
AI 1/U2 [V]	-158.0627	-156.1906	1.872063
AI 1/I2 [A]	-10.14466	-0.097466	10.04720
U_fundRMS_SYM+@POWER/0 [V]	115.7244	114.9991	-0.725388
I_tRMS@POWER/0 [A]	2.914819	0.096258	-2.818561
P_t@POWER/0 [W]	521.3647	-0.166834	-521.5316
Q_t@POWER/0 [var]	874.8517	33.21467	-841.6371

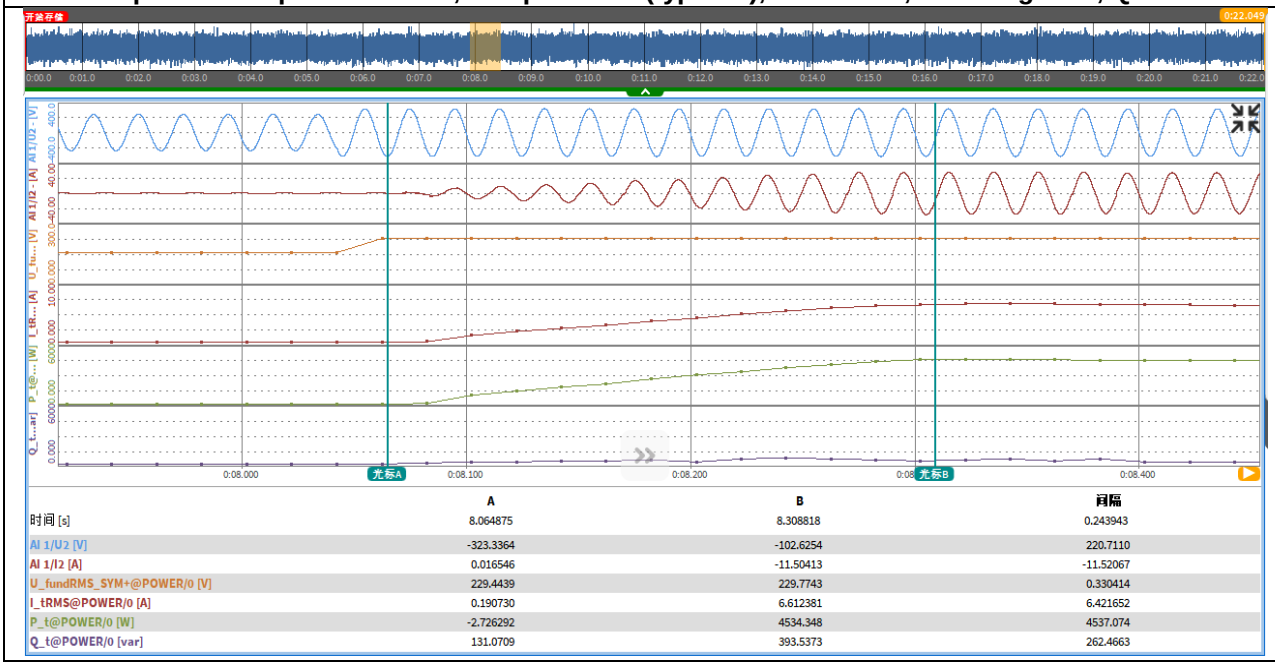
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 2.3
Depth of fault phase:50%Un, two-phase SC(type D1), 100% load, Q max



	A	B	间隔
时间 [s]	6.546631	8.047138	1.500506
AI 1/U2 [V]	-163.1334	-247.0079	-83.87447
AI 1/I2 [A]	-29.63872	-0.519896	29.11883
U_fundRMS_SYM+@POWER/0 [V]	153.0891	152.9952	-0.093887
I_tRMS@POWER/0 [A]	7.127557	0.150008	-6.977549
P_t@POWER/0 [W]	3086.427	-2.966403	-3089.393
Q_t@POWER/0 [var]	2167.867	78.77501	-2089.092

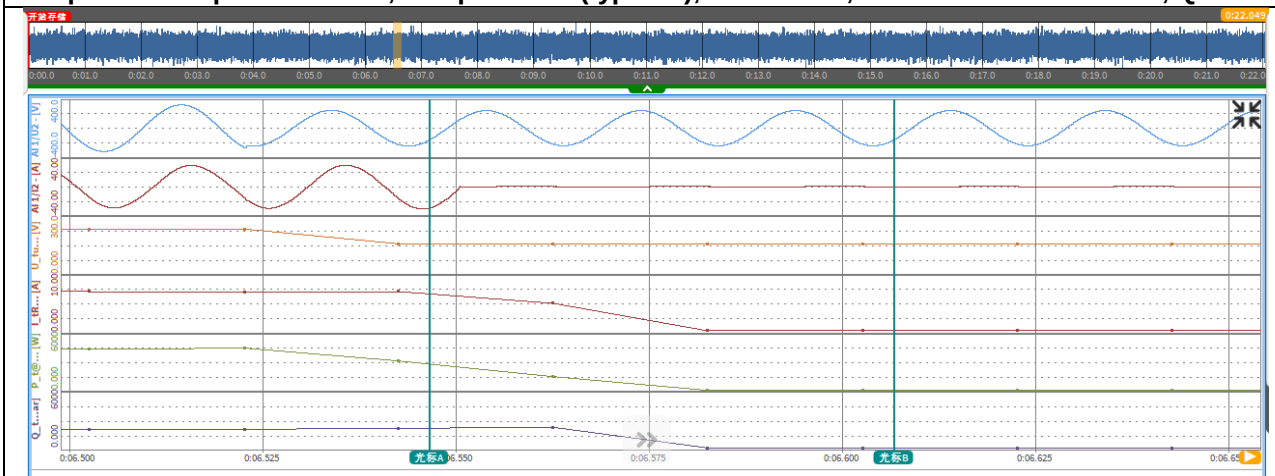
Test 2.3
Depth of fault phase:50%Un, two-phase SC(type D1), 100% load, restoring time, Q max



	A	B	间隔
时间 [s]	8.064875	8.308818	0.243943
AI 1/U2 [V]	-323.3364	-102.6254	220.7110
AI 1/I2 [A]	0.016546	-11.50413	-11.52067
U_fundRMS_SYM+@POWER/0 [V]	229.4439	229.7743	0.330414
I_tRMS@POWER/0 [A]	0.190730	6.612381	6.421652
P_t@POWER/0 [W]	-2.726292	4534.348	4537.074
Q_t@POWER/0 [var]	131.0709	393.5373	262.4663

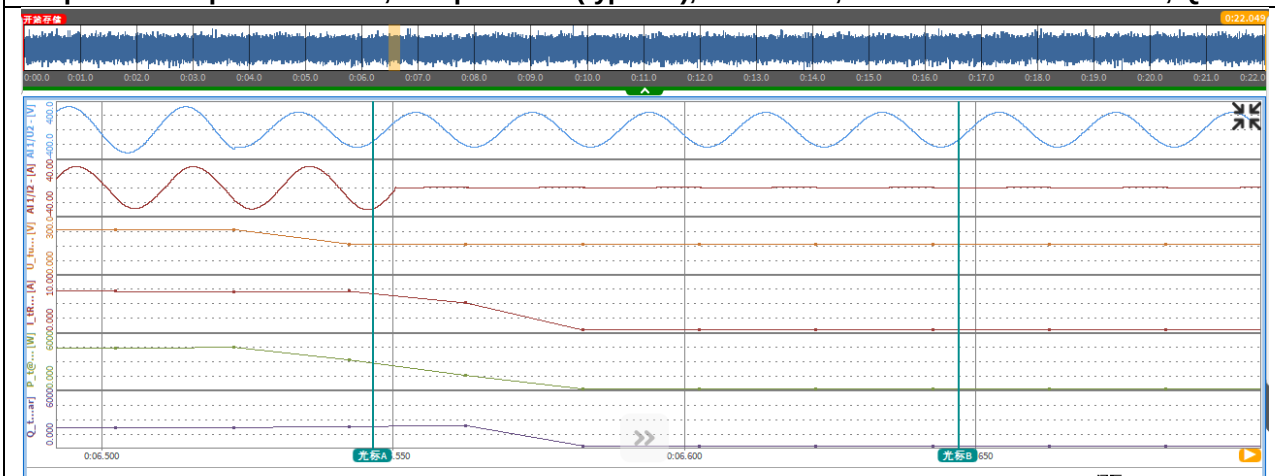
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 2.3
Depth of fault phase:50%Un, two-phase SC(type D1), 100% load, Current after fault 60ms, Q max



	A	B	间隔
时间 [s]	6.546631	6.606688	0.060056
AI 1/U2 [V]	-163.1334	-163.8649	-0.731468
AI 1/I2 [A]	-29.63872	-0.432158	29.20656
U_fundRMS_SYM+@POWER/0 [V]	153.0891	152.7151	-0.373947
I_tRMS@POWER/0 [A]	7.127557	0.145357	-6.982201
P_t@POWER/0 [W]	3086.427	-0.261740	-3086.688
Q_t@POWER/0 [var]	2167.867	76.18039	-2091.687

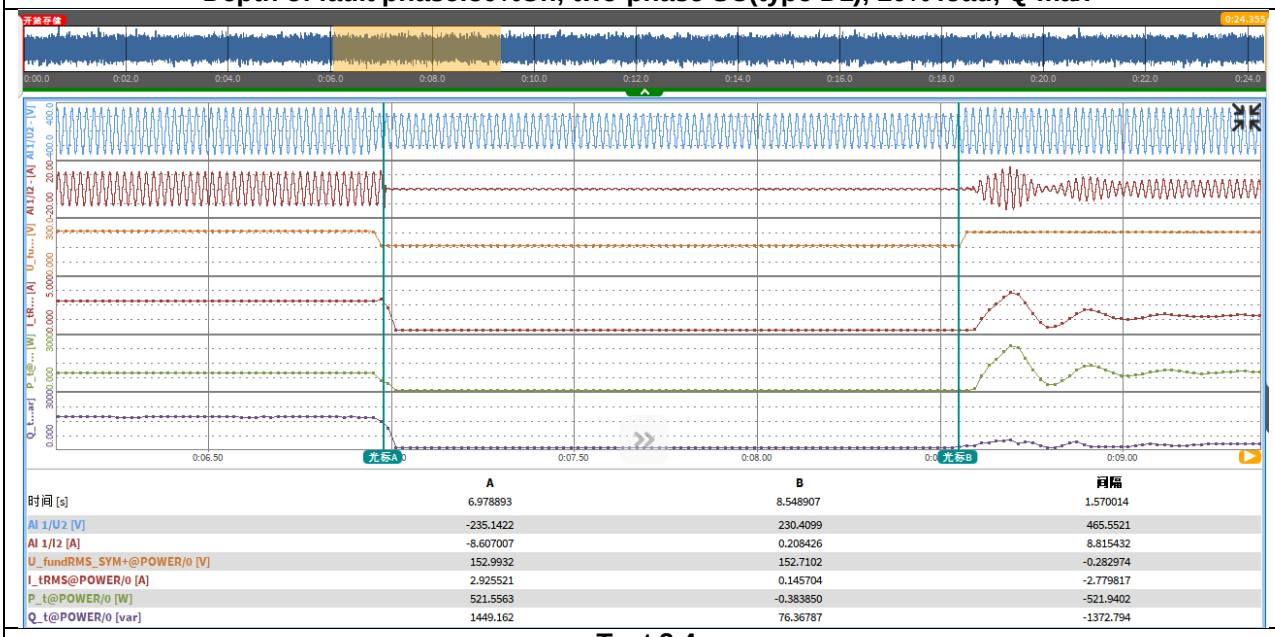
Test 2.3
Depth of fault phase:50%Un, two-phase SC(type D1), 100% load, Current after fault 100ms, Q max



	A	B	间隔
时间 [s]	6.546631	6.646976	0.100345
AI 1/U2 [V]	-163.1334	-145.7419	17.39144
AI 1/I2 [A]	-29.63872	-0.484419	29.15430
U_fundRMS_SYM+@POWER/0 [V]	153.0891	152.7105	-0.378601
I_tRMS@POWER/0 [A]	7.127557	0.145479	-6.982078
P_t@POWER/0 [W]	3086.427	-0.232283	-3086.659
Q_t@POWER/0 [var]	2167.867	76.23543	-2091.632

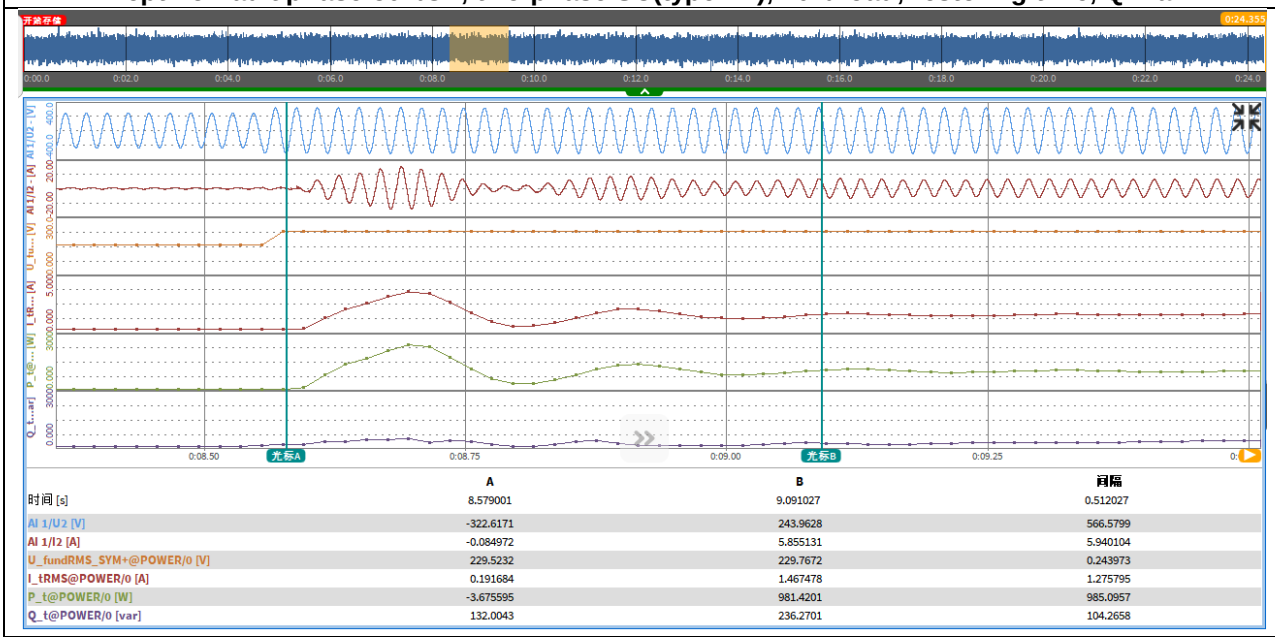
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 2.4
Depth of fault phase:50%Un, two-phase SC(type D1), 20% load, Q max



	A	B	间隔
时间 [s]	6.978893	8.548907	1.570014
AI 1/U2 [V]	-235.1422	230.4099	465.5521
AI 1/I2 [A]	-8.607007	0.208426	8.815432
U_fundRMS_SYM+@POWER/0 [V]	152.9932	152.7102	-0.282974
I_tRMS@POWER/0 [A]	2.925521	0.145704	-2.779817
P_t@POWER/0 [W]	521.5563	-0.383850	-521.9402
Q_t@POWER/0 [var]	1449.162	76.36787	-1372.794

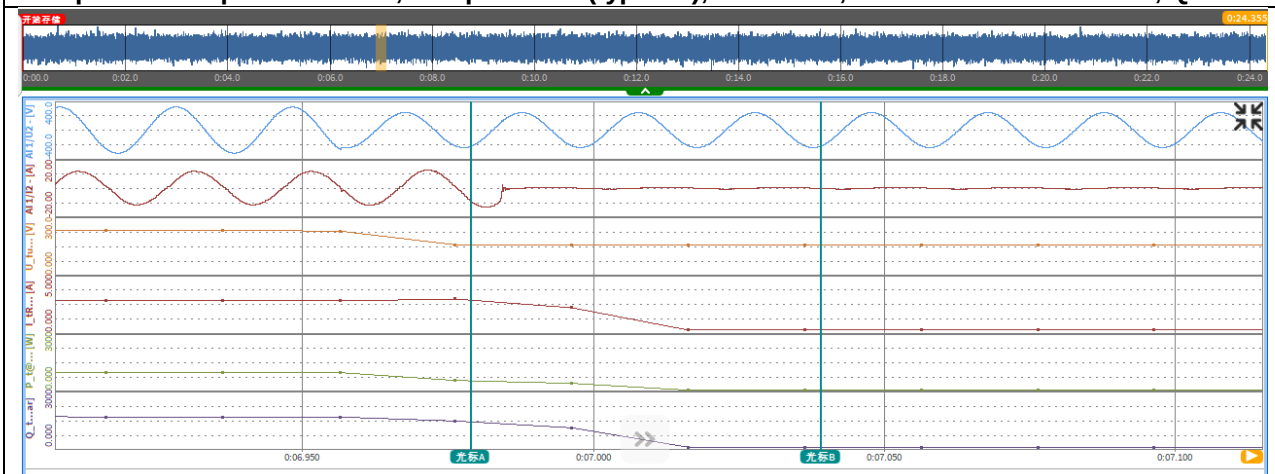
Test 2.4
Depth of fault phase:50%Un, two-phase SC(type D1), 20% load, restoring time, Q max



	A	B	间隔
时间 [s]	8.579001	9.091027	0.512027
AI 1/U2 [V]	-322.6171	243.9628	566.5799
AI 1/I2 [A]	-0.084972	5.855131	5.940104
U_fundRMS_SYM+@POWER/0 [V]	229.5232	229.7672	0.243973
I_tRMS@POWER/0 [A]	0.191684	1.467478	1.275795
P_t@POWER/0 [W]	-3.675595	981.4201	985.0957
Q_t@POWER/0 [var]	132.0043	236.2701	104.2658

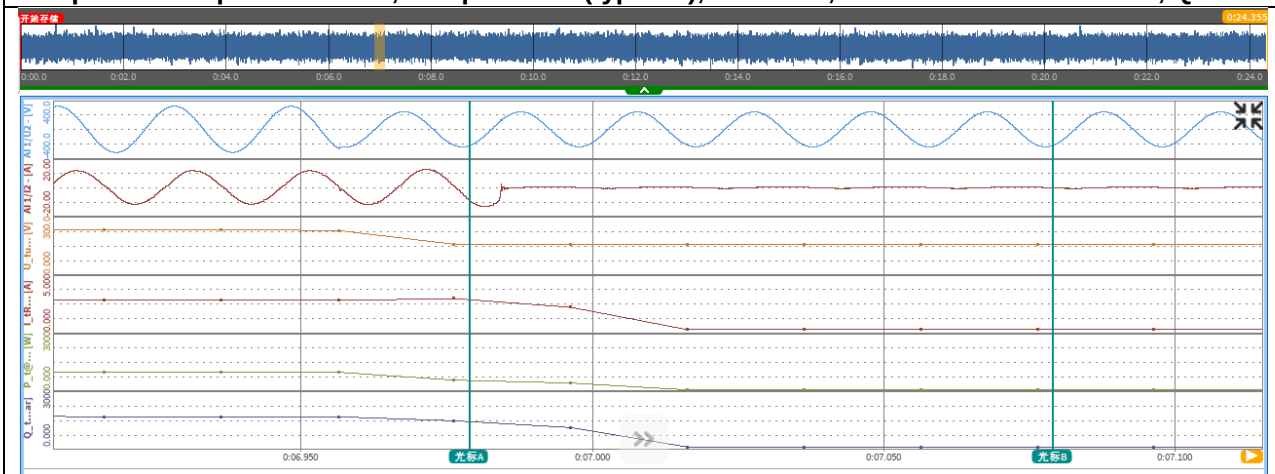
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 2.4
Depth of fault phase:50%Un, two-phase SC(type D1), 20% load, Current after fault 60ms, Q max



	A	B	间隔
时间 [s]	6.978893	7.039084	0.060191
AI 1/U2 [V]	-235.1422	-227.7861	7.356167
AI 1/I2 [A]	-8.607007	-0.285530	8.321476
U_fundRMS_SYM+@POWER/0 [V]	152.9932	152.7197	-0.273453
I_tRMS@POWER/0 [A]	2.925521	0.145781	-2.779740
P_t@POWER/0 [W]	521.5563	-0.454703	-522.0110
Q_t@POWER/0 [var]	1449.162	76.38712	-1372.775

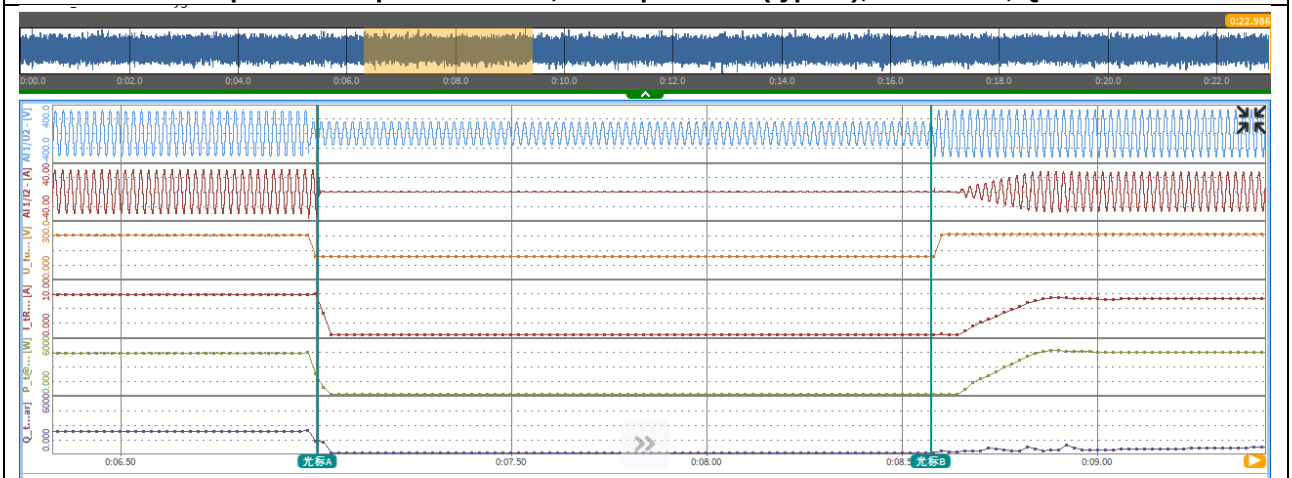
Test 2.4
Depth of fault phase:50%Un, two-phase SC(type D1), 20% load, Current after fault 100ms, Q max



	A	B	间隔
时间 [s]	6.978893	7.078933	0.100040
AI 1/U2 [V]	-235.1422	-230.7918	4.350424
AI 1/I2 [A]	-8.607007	-0.192928	8.414078
U_fundRMS_SYM+@POWER/0 [V]	152.9932	152.7183	-0.274841
I_tRMS@POWER/0 [A]	2.925521	0.145747	-2.779773
P_t@POWER/0 [W]	521.5563	-0.417982	-521.9743
Q_t@POWER/0 [var]	1449.162	76.37159	-1372.790

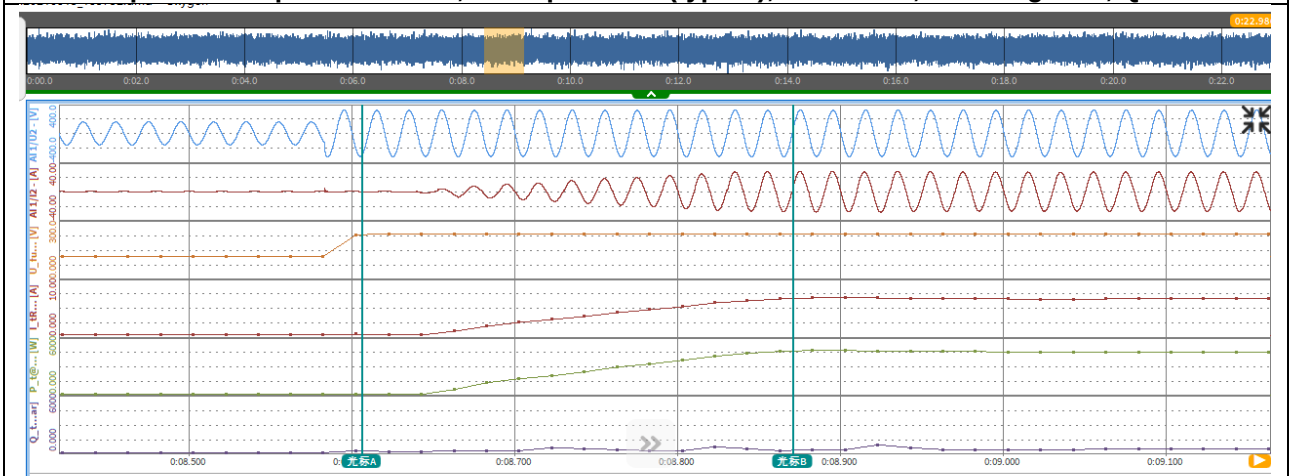
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 3.1
Depth of fault phase:50%Un, three-phase SC(type A), 100% load, Q min



	A	B	间隔
时间 [s]	7.005622	8.574902	1.569280
AI 1/U2 [V]	-160.8017	156.6243	317.4260
AI 1/I2 [A]	-27.70858	-0.099087	27.60949
U_fundRMS_SYM+@POWER/0 [V]	114.9161	114.9910	0.074875
I_tRMS@POWER/0 [A]	7.362544	0.096271	-7.266273
P_t@POWER/0 [W]	2218.125	-0.199592	-2218.324
Q_t@POWER/0 [var]	1203.074	33.21584	-1169.858

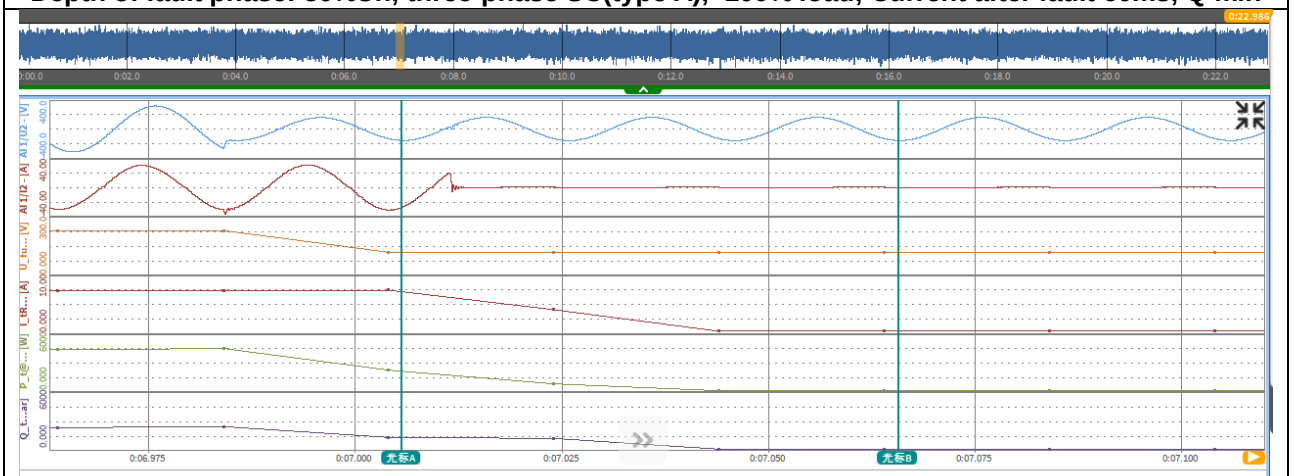
Test 3.1
Depth of fault phase: 50%Un, three-phase SC(type A), 100% load, restoring time, Q min



	A	B	间隔
时间 [s]	8.606625	8.871046	0.264421
AI 1/U2 [V]	-317.3433	22.58968	339.9329
AI 1/I2 [A]	-0.219202	2.570725	2.789927
U_fundRMS_SYM+@POWER/0 [V]	229.0454	230.5334	1.488007
I_tRMS@POWER/0 [A]	0.263636	6.584245	6.320609
P_t@POWER/0 [W]	-13.66190	4570.543	4584.205
Q_t@POWER/0 [var]	181.5108	253.2734	71.76262

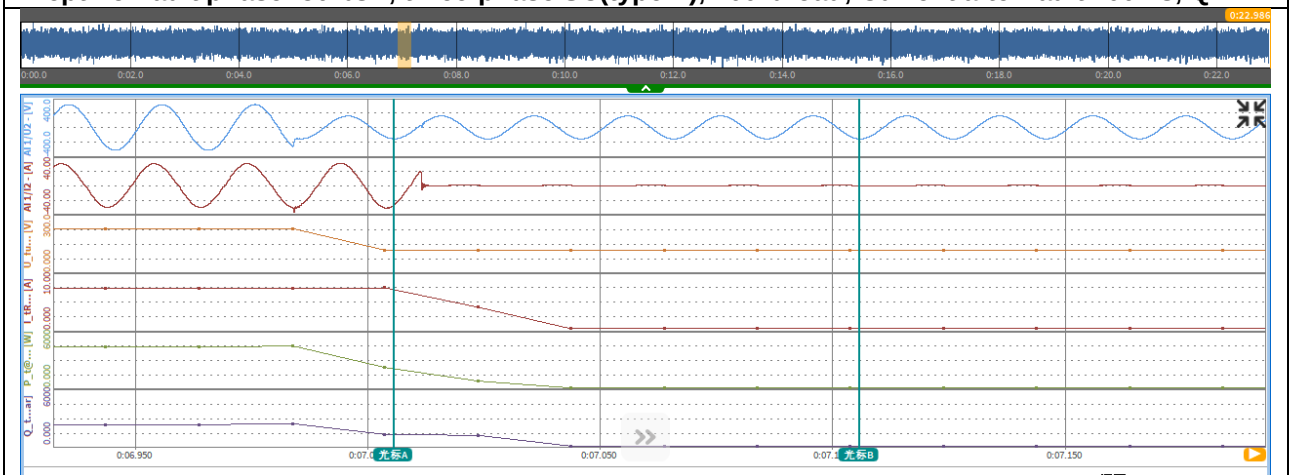
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 3.1
Depth of fault phase: 50%Un, three-phase SC(type A), 100% load, Current after fault 60ms, Q min



	A	B	间隔
时间 [s]	7.005622	7.065664	0.060042
AI 1/U2 [V]	-160.8017	-162.4131	-1.611471
AI 1/I2 [A]	-27.70858	0.012779	27.72136
U_fundRMS_SYM+@POWER/0 [V]	114.9161	114.9806	0.064476
I_tRMS@POWER/0 [A]	7.362544	0.096340	-7.266204
P_t@POWER/0 [W]	2218.125	-0.149821	-2218.274
Q_t@POWER/0 [var]	1203.074	33.23516	-1169.839

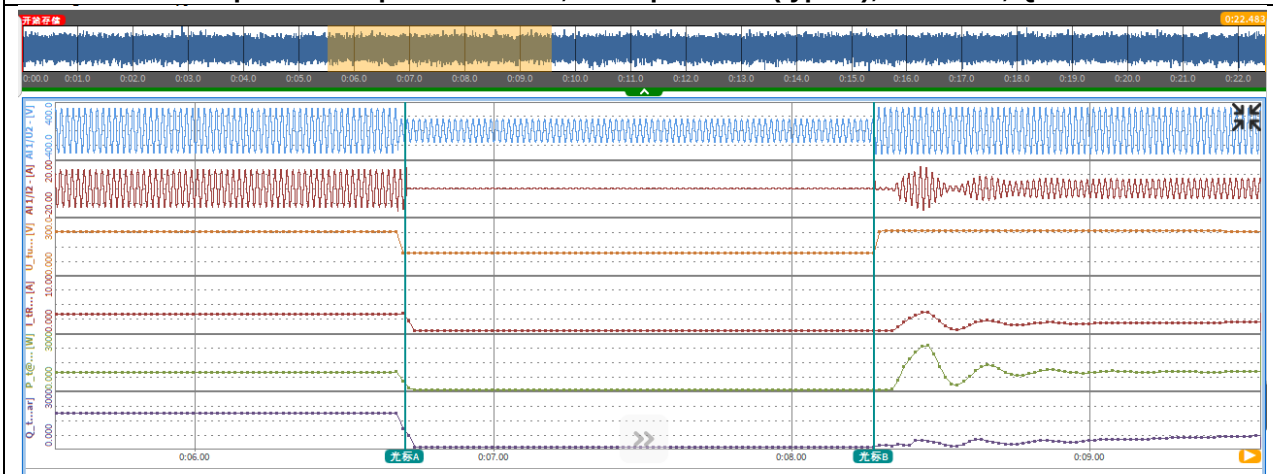
Test 3.1
Depth of fault phase: 50%Un, three-phase SC(type A), 100% load, Current after fault 100ms, Q min



	A	B	间隔
时间 [s]	7.005622	7.105645	0.100023
AI 1/U2 [V]	-160.8017	-162.2701	-1.468420
AI 1/I2 [A]	-27.70858	0.026226	27.73481
U_fundRMS_SYM+@POWER/0 [V]	114.9161	114.9780	0.061920
I_tRMS@POWER/0 [A]	7.362544	0.096427	-7.266116
P_t@POWER/0 [W]	2218.125	-0.199648	-2218.324
Q_t@POWER/0 [var]	1203.074	33.26228	-1169.812

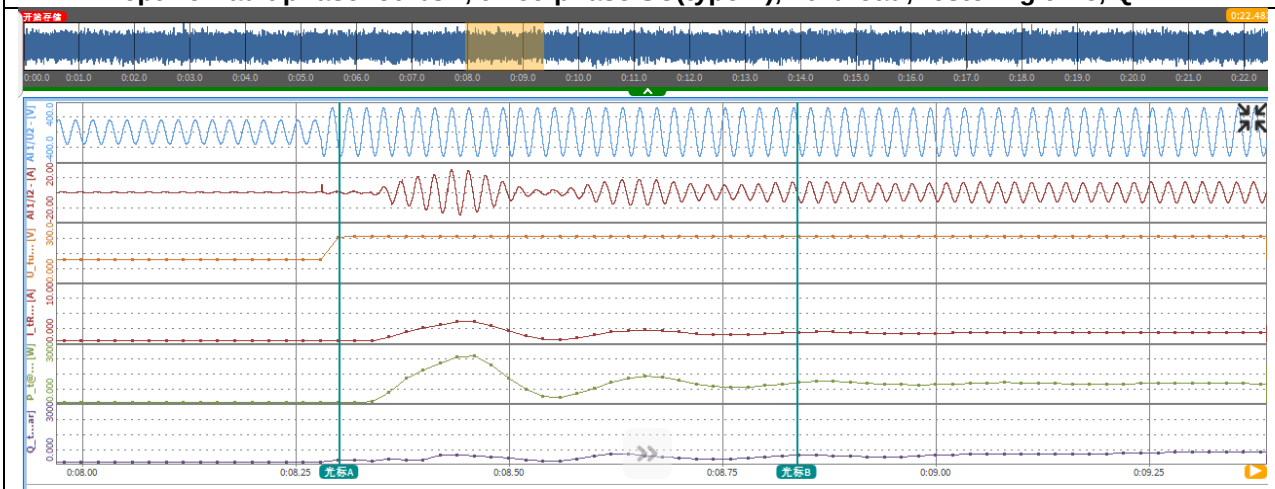
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 3.2
Depth of fault phase: 50%Un, three-phase SC(type A), 20% load, Q min



	A	B	间隔
时间 [s]	6.704256	8.275552	1.571296
AI 1/U2 [V]	-145.7236	107.8992	253.6228
AI 1/I2 [A]	-0.031805	0.313711	0.345516
U_fundRMS_SYM+@POWER/0 [V]	114.9732	114.9924	0.019173
I_tRMS@POWER/0 [A]	3.268707	0.096363	-3.172344
P_t@POWER/0 [W]	485.4940	-0.200042	-485.6941
Q_t@POWER/0 [var]	1009.262	33.25126	-976.0110

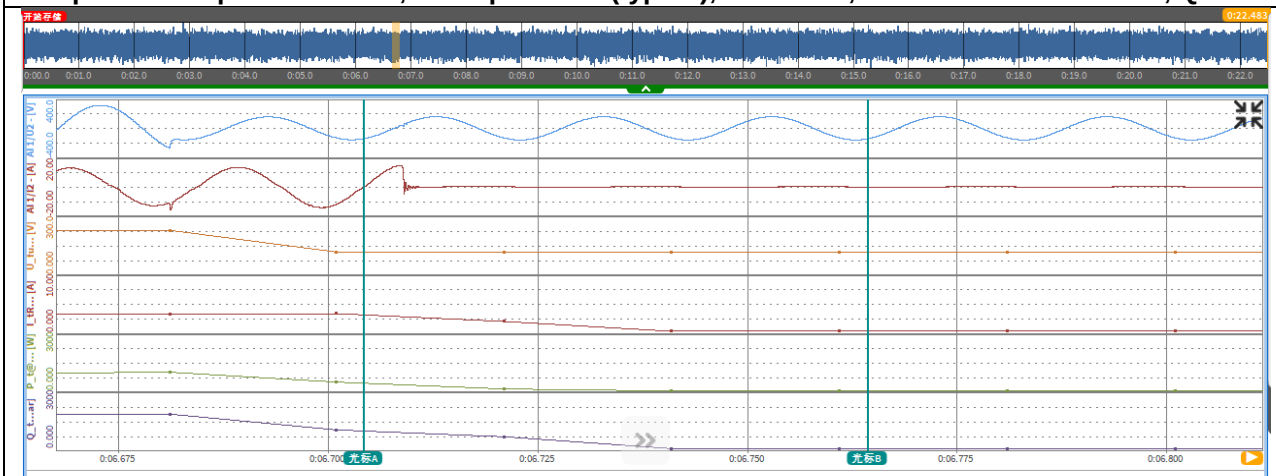
Test 3.2
Depth of fault phase: 50%Un, three-phase SC(type A), 20% load, restoring time, Q min



	A	B	间隔
时间 [s]	8.301759	8.837351	0.535592
AI 1/U2 [V]	-290.8361	90.98721	381.8233
AI 1/I2 [A]	0.385809	-0.036144	-0.421953
U_fundRMS_SYM+@POWER/0 [V]	230.0830	230.3896	0.306625
I_tRMS@POWER/0 [A]	0.201758	1.467926	1.266168
P_t@POWER/0 [W]	-4.924084	949.5047	954.4288
Q_t@POWER/0 [var]	140.1159	367.4447	227.3288

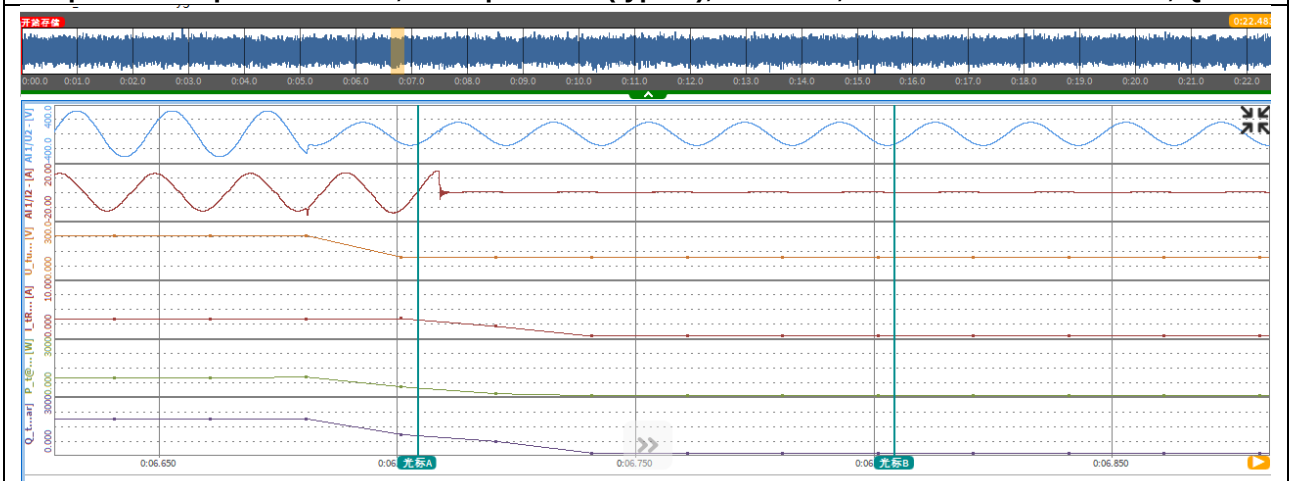
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 3.2
Depth of fault phase: 50%Un, three-phase SC(type A), 20% load, Current after fault 60ms, Q min



	A	B	间隔
时间 [s]	6.704256	6.764336	0.060080
AI 1/U2 [V]	-145.7236	-145.3426	0.380993
AI 1/I2 [A]	-0.031805	-0.197411	-0.165606
U_fundRMS_SYM+@POWER/0 [V]	114.9732	114.9877	0.014526
I_tRMS@POWER/0 [A]	3.268707	0.096394	-3.172313
P_t@POWER/0 [W]	485.4940	-0.132523	-485.6266
Q_t@POWER/0 [var]	1009.262	33.25899	-976.0033

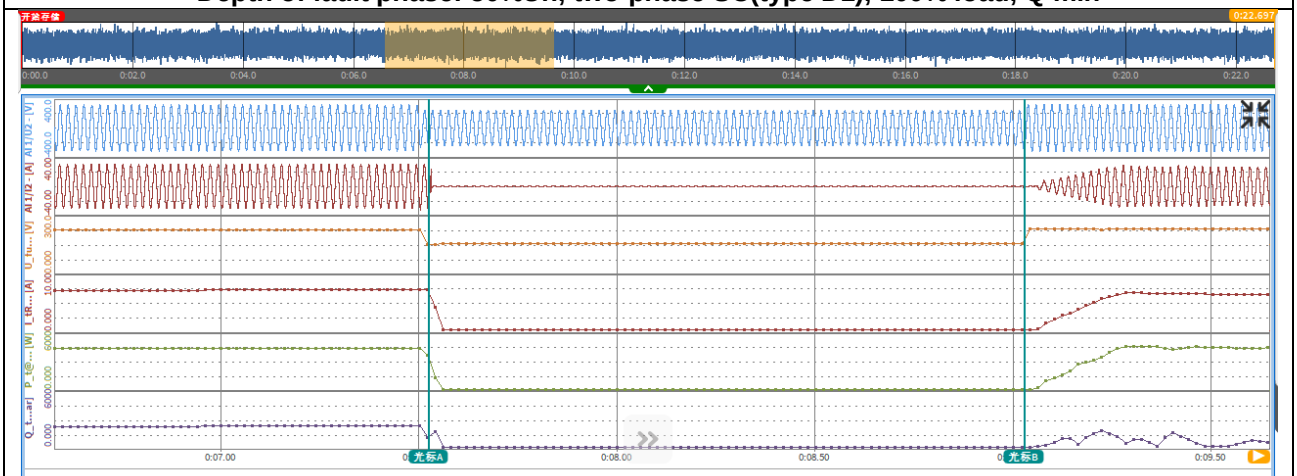
Test 3.2
Depth of fault phase: 50%Un, three-phase SC(type A), 20% load, Current after fault 100ms, Q min



	A	B	间隔
时间 [s]	6.704256	6.804320	0.100064
AI 1/U2 [V]	-145.7236	-145.5329	0.190735
AI 1/I2 [A]	-0.031805	-0.176907	-0.145102
U_fundRMS_SYM+@POWER/0 [V]	114.9732	114.9878	0.014618
I_tRMS@POWER/0 [A]	3.268707	0.096378	-3.172329
P_t@POWER/0 [W]	485.4940	-0.138392	-485.6324
Q_t@POWER/0 [var]	1009.262	33.25325	-976.0090

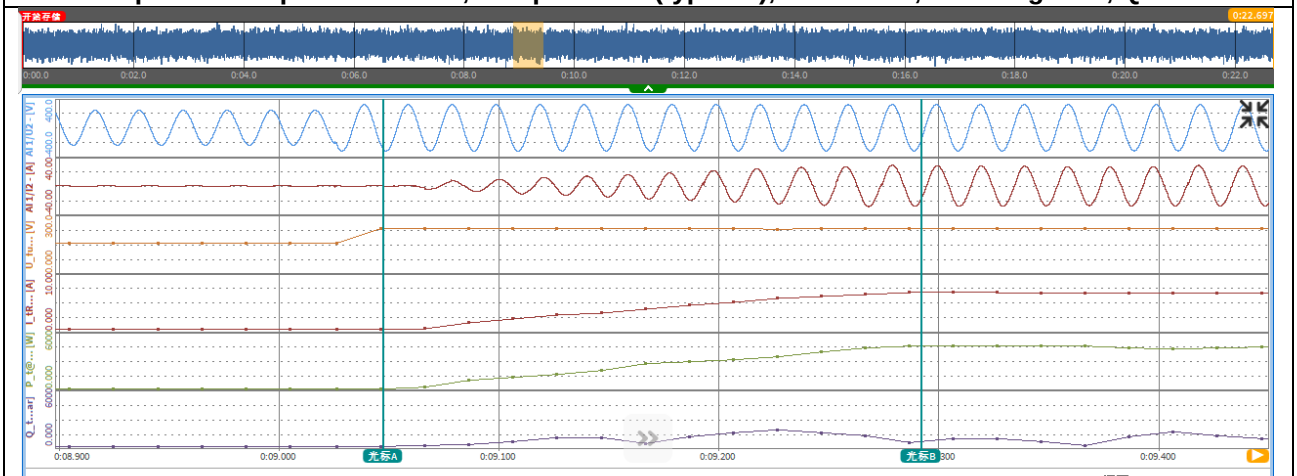
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 3.3
Depth of fault phase: 50%Un, two-phase SC(type D1), 100% load, Q min



	A	B	间隔
时间 [s]	7.526325	9.027951	1.501626
AI 1/U2 [V]	-244.2920	-309.2179	-64.92591
AI 1/I2 [A]	-30.71103	0.269365	30.98040
U_fundRMS_SYM+@POWER/0 [V]	152.1998	155.3458	3.145935
I_tRMS@POWER/0 [A]	7.288840	0.157386	-7.131454
P_t@POWER/0 [W]	3614.953	-5.396951	-3620.350
Q_t@POWER/0 [var]	1178.370	84.69641	-1093.674

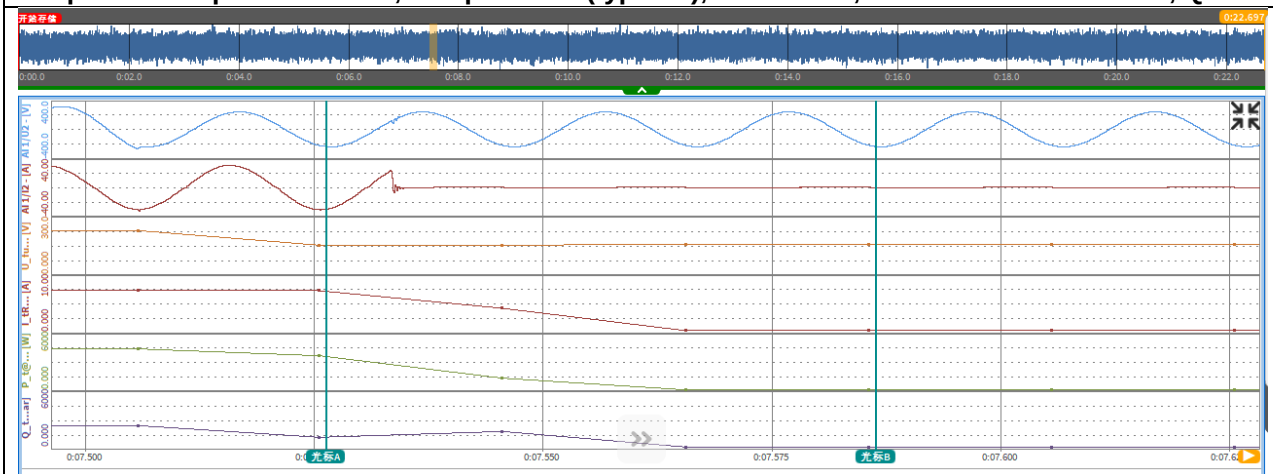
Test 3.3
Depth of fault phase: 50%Un, two-phase SC(type D1), 100% load, restoring time, Q min



	A	B	间隔
时间 [s]	9.047493	9.291935	0.244442
AI 1/U2 [V]	-288.5926	-194.7370	93.85563
AI 1/I2 [A]	0.384426	-19.74878	-20.13321
U_fundRMS_SYM+@POWER/0 [V]	230.4456	230.4912	0.045609
I_tRMS@POWER/0 [A]	0.192383	6.663238	6.470854
P_t@POWER/0 [W]	-0.371207	4596.568	4596.940
Q_t@POWER/0 [var]	133.3359	561.3099	427.9740

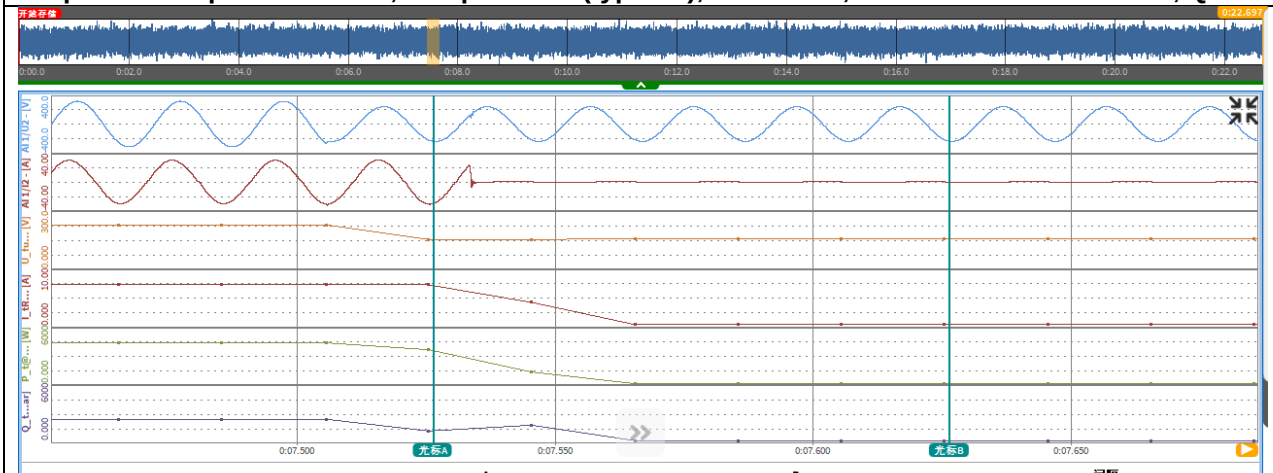
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 3.3
Depth of fault phase: 50%Un, two-phase SC(type D1), 100% load, Current after fault 60ms, Q min



	A	B	间隔
时间 [s]	7.526325	7.586399	0.060074
AI 1/U2 [V]	-244.2920	-244.2470	0.045061
AI 1/I2 [A]	-30.71103	0.099325	30.81036
U_fundRMS_SYM+@POWER/0 [V]	152.1998	152.7171	0.517288
I_tRMS@POWER/0 [A]	7.288840	0.145627	-7.143213
P_t@POWER/0 [W]	3614.953	-0.423997	-3615.377
Q_t@POWER/0 [var]	1178.370	76.33154	-1102.039

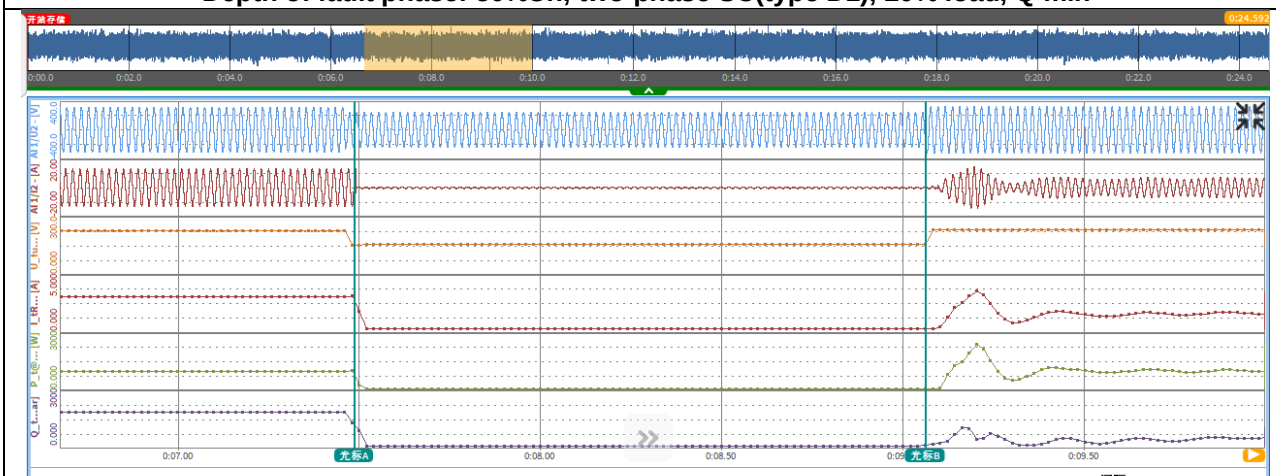
Test 3.3
Depth of fault phase: 50%Un, two-phase SC(type D1), 100% load, Current after fault 100ms, Q min



	A	B	间隔
时间 [s]	7.526325	7.626429	0.100104
AI 1/U2 [V]	-244.2920	-245.1415	-0.849485
AI 1/I2 [A]	-30.71103	0.041485	30.75252
U_fundRMS_SYM+@POWER/0 [V]	152.1998	152.7093	0.509491
I_tRMS@POWER/0 [A]	7.288840	0.145506	-7.143334
P_t@POWER/0 [W]	3614.953	-0.402179	-3615.355
Q_t@POWER/0 [var]	1178.370	76.25951	-1102.111

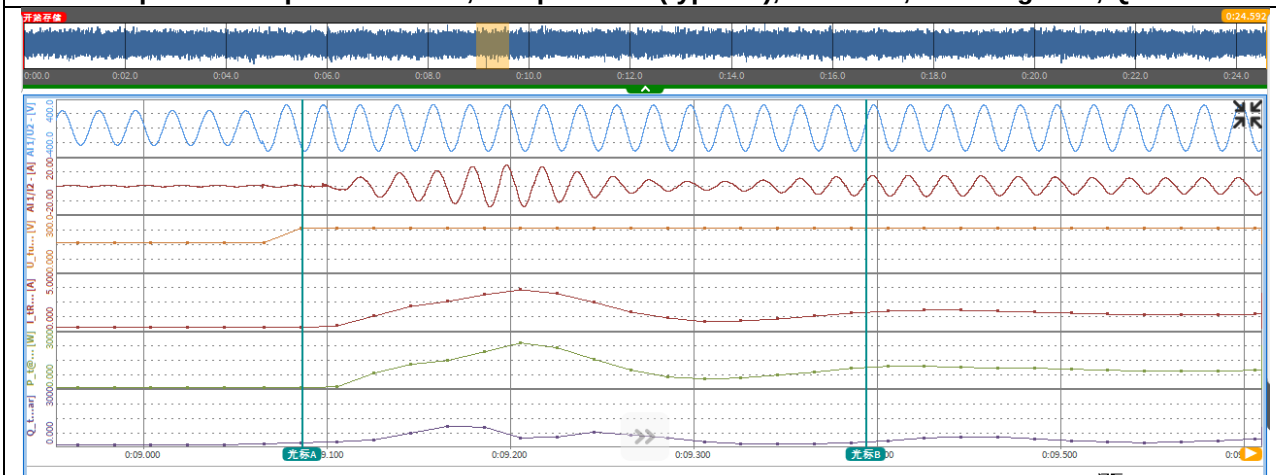
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 3.4
Depth of fault phase: 50%Un, two-phase SC(type D1), 20% load, Q min



	A	B	间隔
时间 [s]	7.487565	9.062230	1.574665
AI 1/U2 [V]	-221.3647	-86.58910	134.7756
AI 1/I2 [A]	-1.714277	0.580263	2.294541
U_fundRMS_SYM+@POWER/0 [V]	152.4700	152.6996	0.229523
I_tRMS@POWER/0 [A]	3.069378	0.145732	-2.923646
P_t@POWER/0 [W]	966.9800	-0.394438	-967.3745
Q_t@POWER/0 [var]	1274.559	76.38572	-1198.174

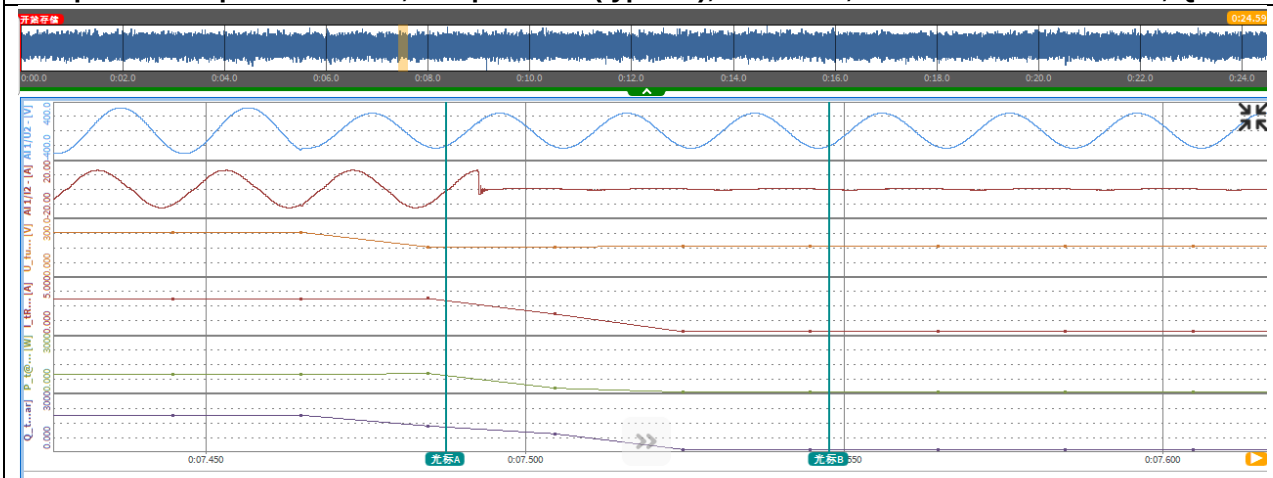
Test 3.4
Depth of fault phase: 50%Un, two-phase SC(type D1), 20% load, restoring time, Q min



	A	B	间隔
时间 [s]	9.086871	9.394042	0.307171
AI 1/U2 [V]	-291.2252	71.95020	363.1754
AI 1/I2 [A]	0.368071	2.453518	2.085447
U_fundRMS_SYM+@POWER/0 [V]	230.4428	230.4371	-5.737e-3
I_tRMS@POWER/0 [A]	0.192655	1.493980	1.301325
P_t@POWER/0 [W]	-0.384727	1025.927	1026.311
Q_t@POWER/0 [var]	133.4897	147.4212	13.93158

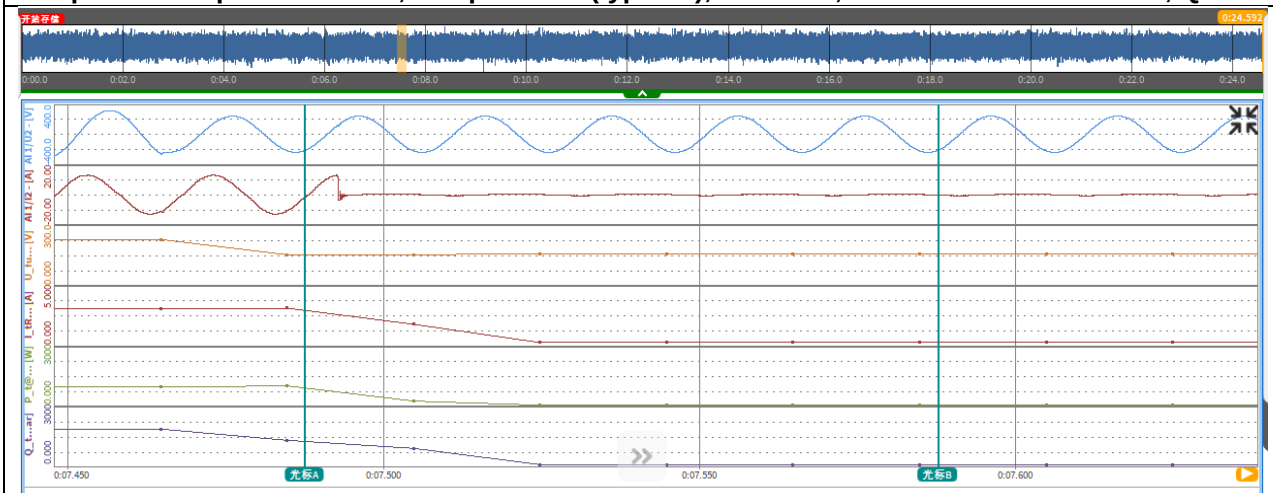
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 3.4
Depth of fault phase: 50%Un, two-phase SC(type D1), 20% load, Current after fault 60ms, Q min



	A	B	间隔
时间 [s]	7.487565	7.547664	0.060099
AI 1/U2 [V]	-221.3647	-219.4150	1.949787
AI 1/I2 [A]	-1.714277	-0.293446	1.420832
U_fundRMS_SYM+@POWER/0 [V]	152.4700	152.7197	0.249695
I_tRMS@POWER/0 [A]	3.069378	0.145654	-2.923724
P_t@POWER/0 [W]	966.9800	-0.346302	-967.3263
Q_t@POWER/0 [var]	1274.559	76.33519	-1198.224

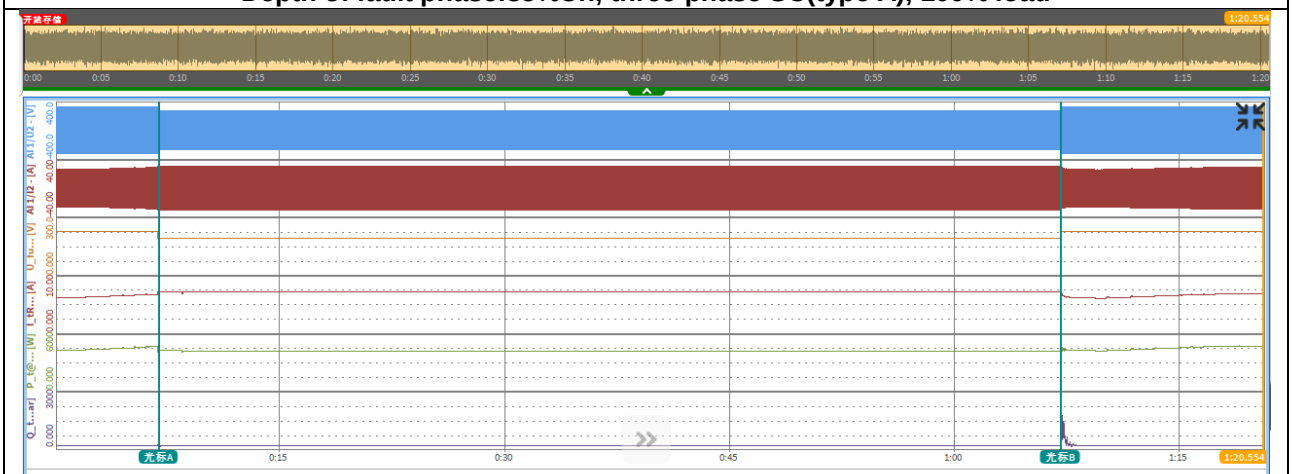
Test 3.4
Depth of fault phase: 50%Un, two-phase SC(type D1), 20% load, Current after fault 100ms, Q min



	A	B	间隔
时间 [s]	7.487565	7.587651	0.100086
AI 1/U2 [V]	-221.3647	-219.1928	2.171993
AI 1/I2 [A]	-1.714277	-0.307131	1.407147
U_fundRMS_SYM+@POWER/0 [V]	152.4700	152.7235	0.253464
I_tRMS@POWER/0 [A]	3.069378	0.145610	-2.923768
P_t@POWER/0 [W]	966.9800	-0.323442	-967.3035
Q_t@POWER/0 [var]	1274.559	76.33120	-1198.228

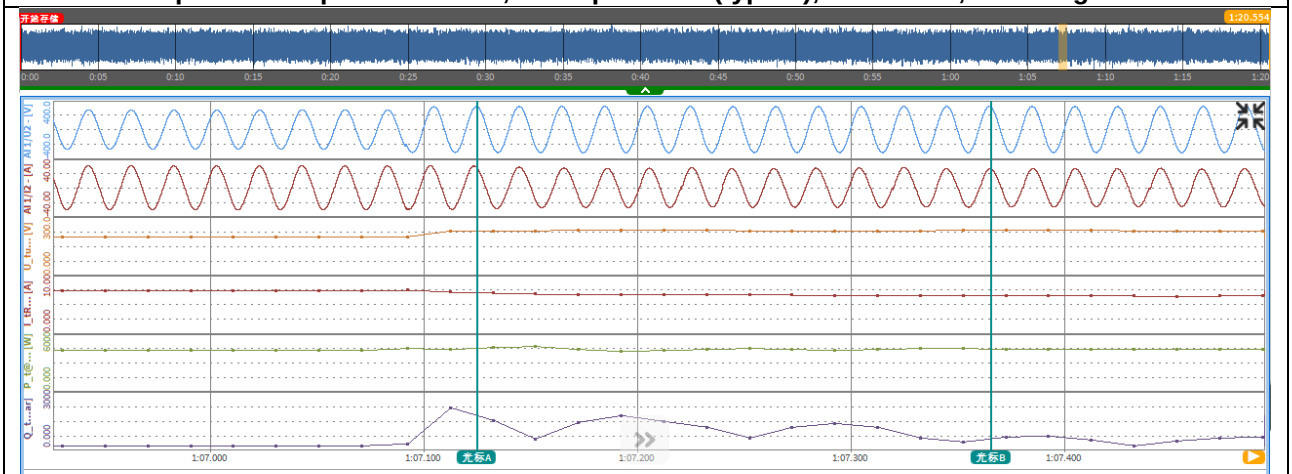
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 4.1
Depth of fault phase:85%Un, three-phase SC(type A), 100% load



	A	B	间隔
时间 [s]	6.99910	1:07.07474	1:00.07564
AI 1/U2 [V]	44.61623	-247.7856	-292.4018
AI 1/I2 [A]	4.827786	-26.56903	-31.39682
U_fundRMS_SYM+@POWER/0 [V]	195.5411	195.5388	-2.289e-3
I_tRMS@POWER/0 [A]	7.293203	7.228008	-0.065196
P_t@POWER/0 [W]	4285.100	4245.476	-39.62354
Q_t@POWER/0 [var]	163.8047	168.8593	5.054611

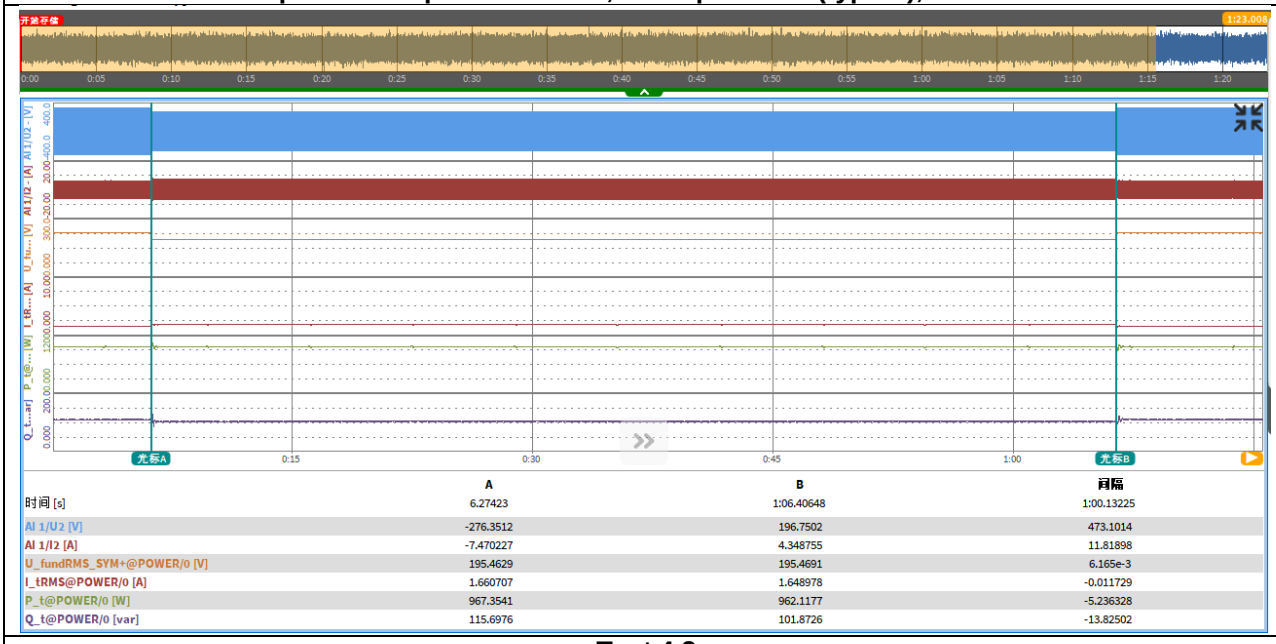
Test 4.1
Depth of fault phase: 85%Un, three-phase SC(type A), 100% load, restoring time



	A	B	间隔
时间 [s]	1:07.12472	1:07.36540	0.24068
AI 1/U2 [V]	325.0203	318.1274	-6.892920
AI 1/I2 [A]	29.06060	26.83048	-2.230120
U_fundRMS_SYM+@POWER/0 [V]	229.6784	230.1783	0.499954
I_tRMS@POWER/0 [A]	7.094099	6.403241	-0.690858
P_t@POWER/0 [W]	4354.817	4417.393	62.57568
Q_t@POWER/0 [var]	2195.975	348.5542	-1847.421

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 4.2
Depth of fault phase: 85%Un, three-phase SC(type A), 20% load



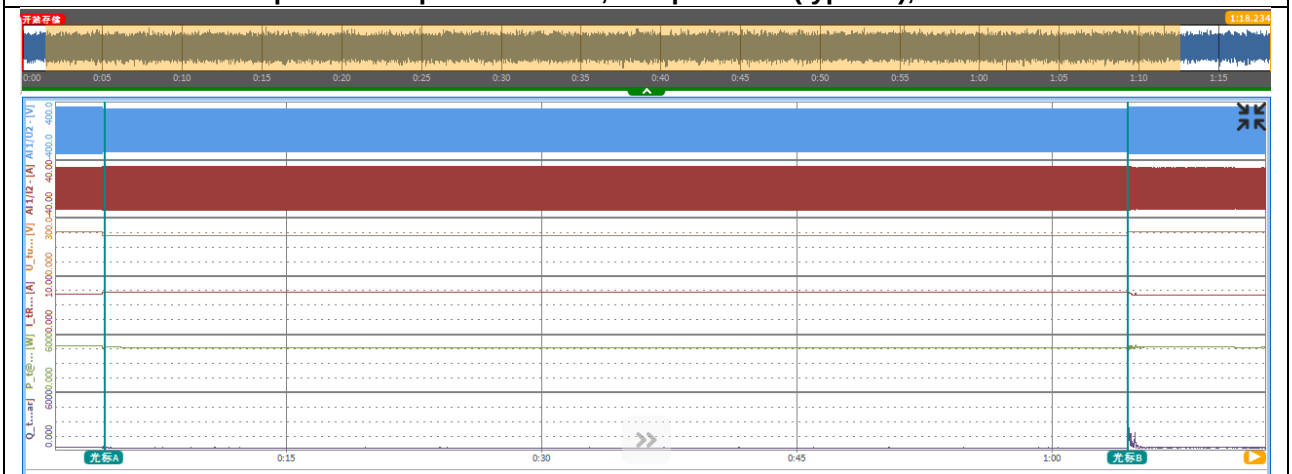
	A	B	间隔
时间 [s]	6.27423	1:06.40648	1:00.13225
AI 1/U2 [V]	-276.3512	196.7502	473.1014
AI 1/I2 [A]	-7.470227	4.348755	11.81898
U_fundRMS_SYM+@POWER/0 [V]	195.4629	195.4691	6.165e-3
I_tRMS@POWER/0 [A]	1.660707	1.648978	-0.011729
P_t@POWER/0 [W]	967.3541	962.1177	-5.236328
Q_t@POWER/0 [var]	115.6976	101.8726	-13.82502

Test 4.2
Depth of fault phase: 85%Un, three-phase SC(type A), 20% load, restoring time

	A	B	间隔
时间 [s]	1:06.44180	1:07.00340	0.56160
AI 1/U2 [V]	251.5845	318.0764	66.49185
AI 1/I2 [A]	5.414582	6.278706	0.864124
U_fundRMS_SYM+@POWER/0 [V]	229.8565	230.0596	0.203094
I_tRMS@POWER/0 [A]	1.593104	1.411722	-0.181382
P_t@POWER/0 [W]	1093.205	968.3876	-124.8174
Q_t@POWER/0 [var]	122.6046	111.5351	-11.06955

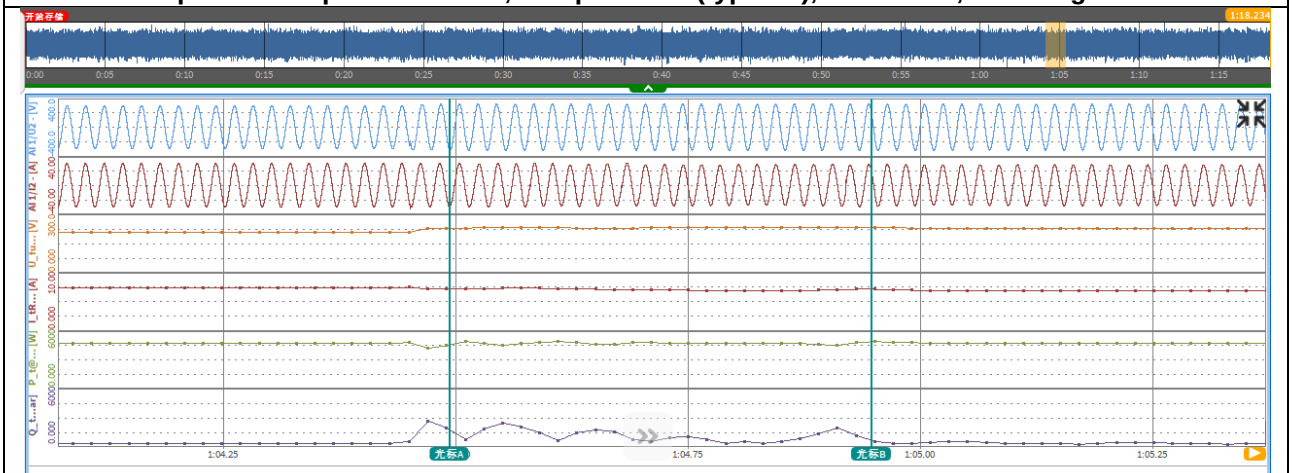
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 4.3
Depth of fault phase: 85%Un, two-phase SC(type D1), 100% load



	A	B	间隔
时间 [s]	4.34285	1:04.45038	1:00.10753
AI 1/U2 [V]	302.7661	-235.2088	-537.9749
AI 1/I2 [A]	31.01797	-24.48878	-55.50676
U_fundRMS_SYM+@POWER/0 [V]	207.5786	207.6159	0.037354
I_tRMS@POWER/0 [A]	7.254918	7.204579	-0.050338
P_t@POWER/0 [W]	4654.146	4629.543	-24.60303
Q_t@POWER/0 [var]	294.3144	185.2474	-109.0670

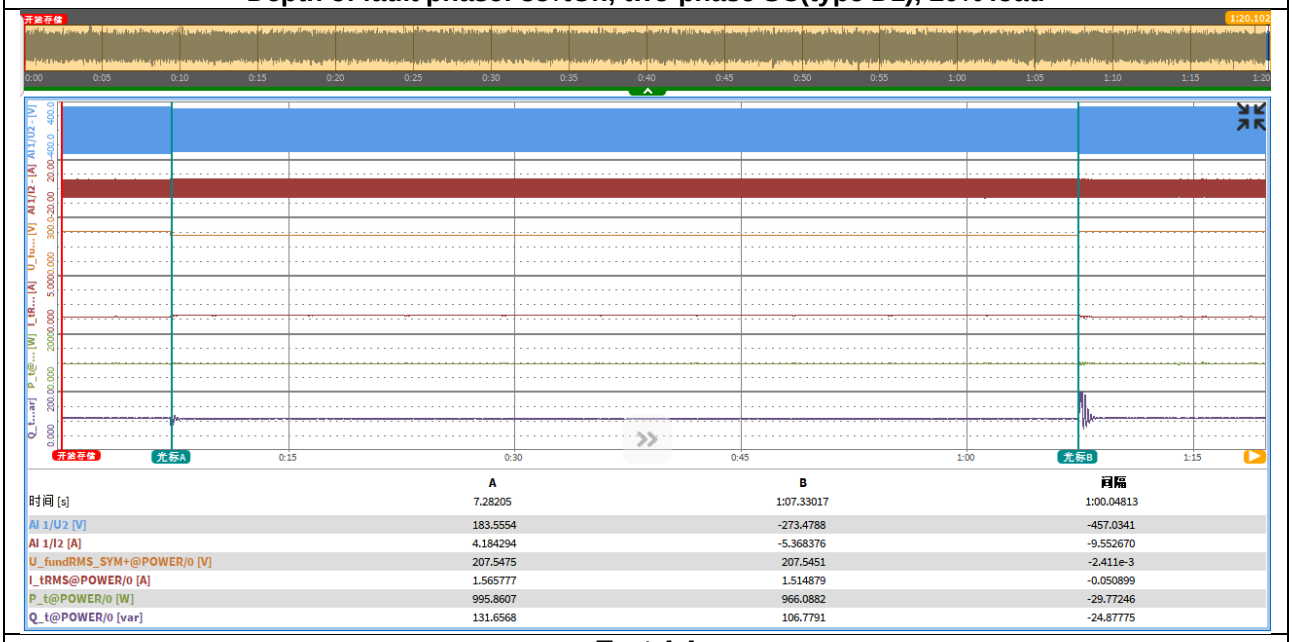
Test 4.3
Depth of fault phase: 85%Un, two-phase SC(type D1), 100% load, restoring time



	A	B	间隔
时间 [s]	1:04.49409	1:04.94762	0.45353
AI 1/U2 [V]	-324.5990	157.1834	481.7825
AI 1/I2 [A]	-30.17225	15.42945	45.60170
U_fundRMS_SYM+@POWER/0 [V]	229.8014	230.3699	0.568573
I_tRMS@POWER/0 [A]	7.003714	7.085281	0.081568
P_t@POWER/0 [W]	4467.897	4795.504	327.6069
Q_t@POWER/0 [var]	1812.071	1076.228	-735.8422

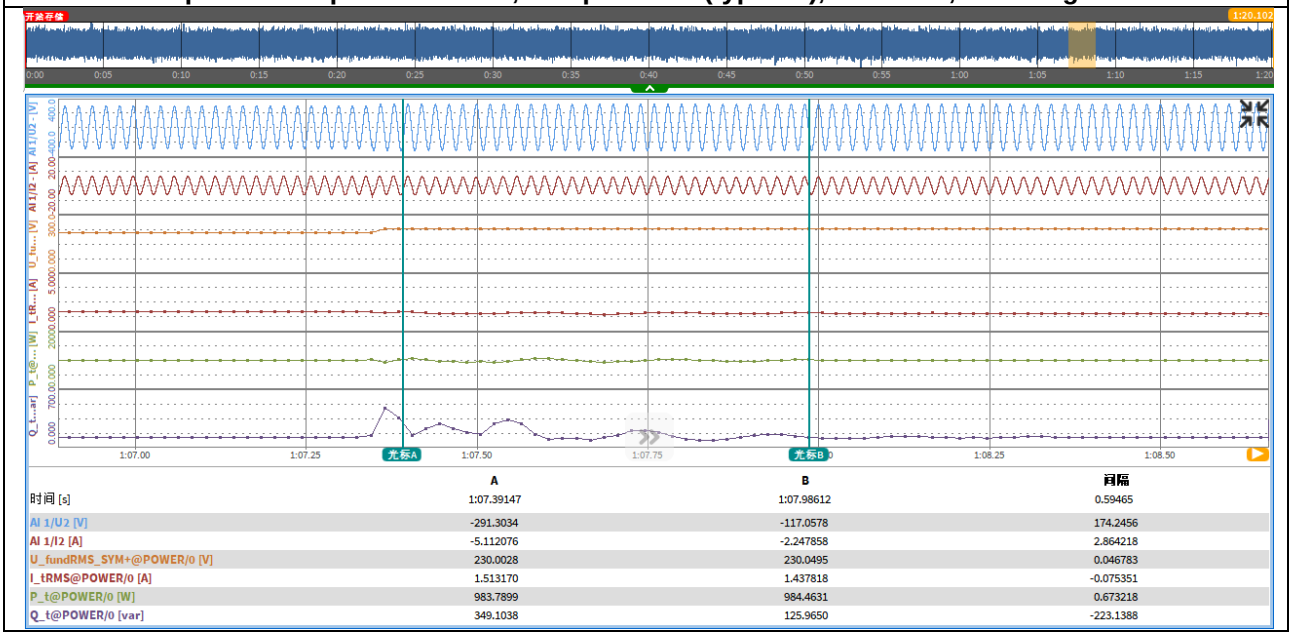
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 4.4
Depth of fault phase: 85%Un, two-phase SC(type D1), 20% load



	A	B	间隔
时间 [s]	7.28205	1:07.33017	1:00.04813
AI 1/U2 [V]	183.5554	-273.4788	-457.0341
AI 1/I2 [A]	4.184294	-5.368376	-9.552670
U_fundRMS_SYM+@POWER/0 [V]	207.5475	207.5451	-2.411e-3
I_tRMS@POWER/0 [A]	1.565777	1.514879	-0.050899
P_t@POWER/0 [W]	995.8607	966.0882	-29.77246
Q_t@POWER/0 [var]	131.6568	106.7791	-24.87775

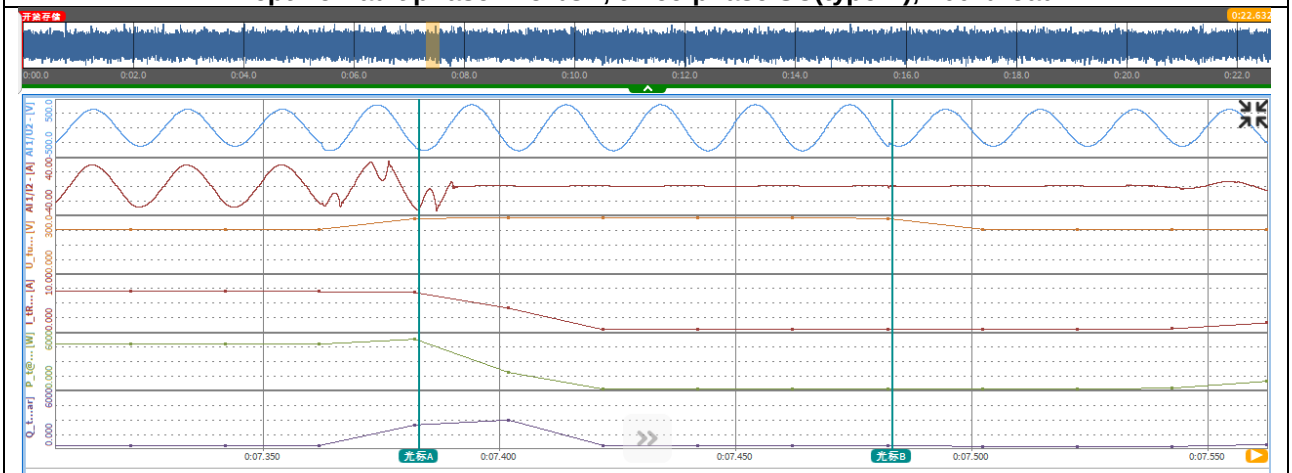
Test 4.4
Depth of fault phase: 85%Un, two-phase SC(type D1), 20% load, restoring time



	A	B	间隔
时间 [s]	1:07.39147	1:07.98612	0.59465
AI 1/U2 [V]	-291.3034	-117.0578	174.2456
AI 1/I2 [A]	-5.112076	-2.247858	2.864218
U_fundRMS_SYM+@POWER/0 [V]	230.0028	230.0495	0.046783
I_tRMS@POWER/0 [A]	1.513170	1.437818	-0.075351
P_t@POWER/0 [W]	983.7899	984.4631	0.673218
Q_t@POWER/0 [var]	349.1038	125.9650	-223.1388

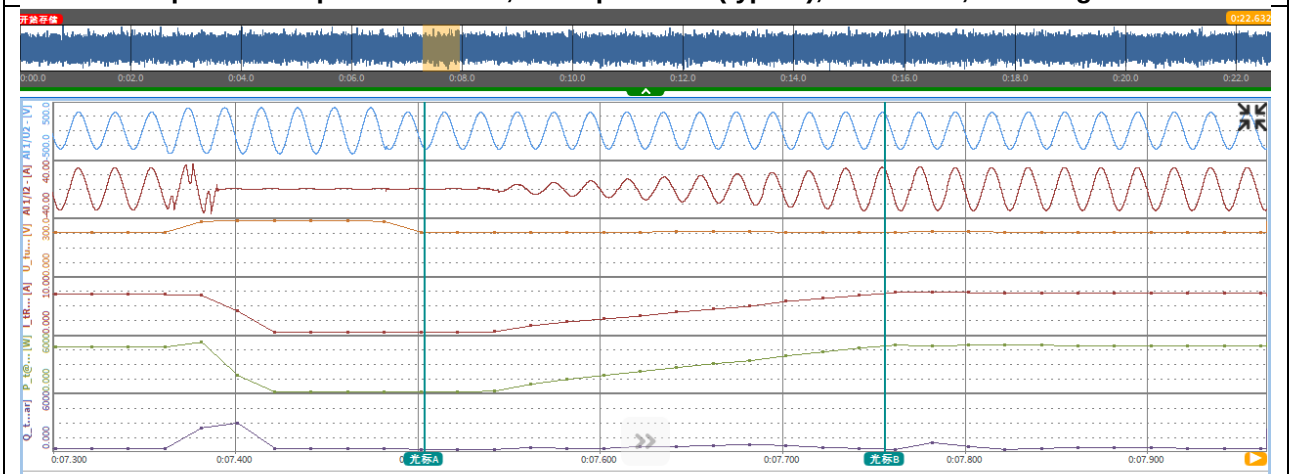
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 5.1
Depth of fault phase:125%Un, three-phase SC(type A), 100% load



	A	B	间隔
时间 [s]	7.3831111	7.4831216	0.1000105
AI 1/U2 [V]	-384.6960	-295.2116	89.48446
AI 1/I2 [A]	-31.25053	0.201845	31.45237
U_fundRMS_SYM+@POWER/0 [V]	286.7471	286.9016	0.154510
I_tRMS@POWER/0 [A]	6.722993	0.248325	-6.474668
P_t@POWER/0 [W]	5291.999	6.982740	-5285.016
Q_t@POWER/0 [var]	2351.362	213.9734	-2137.389

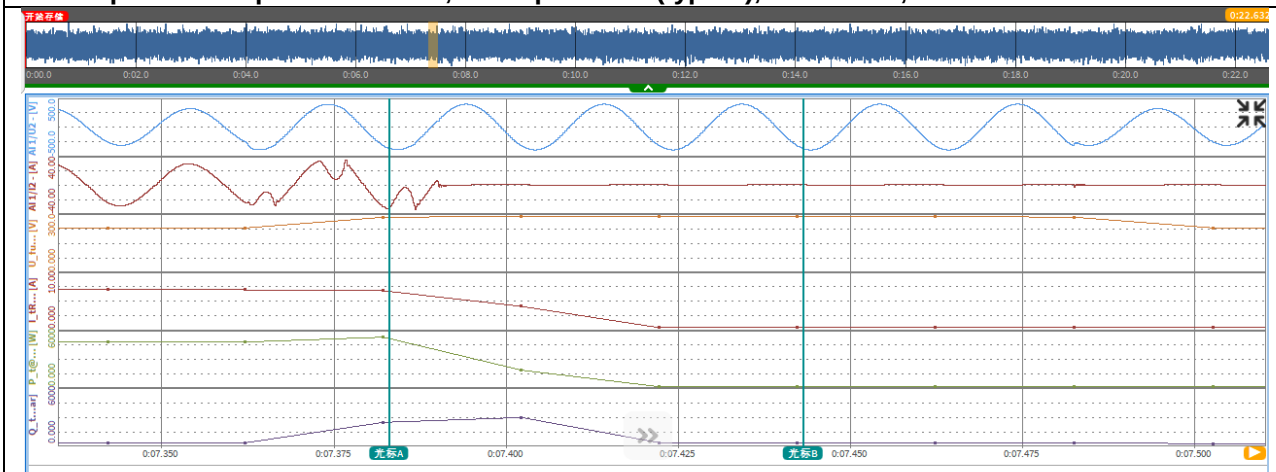
Test 5.1
Depth of fault phase:125%Un, three-phase SC(type A), 100% load, restoring time



	A	B	间隔
时间 [s]	7.5034536	7.7558869	0.2524333
AI 1/U2 [V]	-308.7475	294.4966	603.2441
AI 1/I2 [A]	0.258493	27.68002	27.42152
U_fundRMS_SYM+@POWER/0 [V]	230.1393	230.1352	-4.120e-3
I_tRMS@POWER/0 [A]	0.195288	6.744338	6.549050
P_t@POWER/0 [W]	6.352e-3	4660.911	4660.905
Q_t@POWER/0 [var]	135.0368	222.5311	87.49428

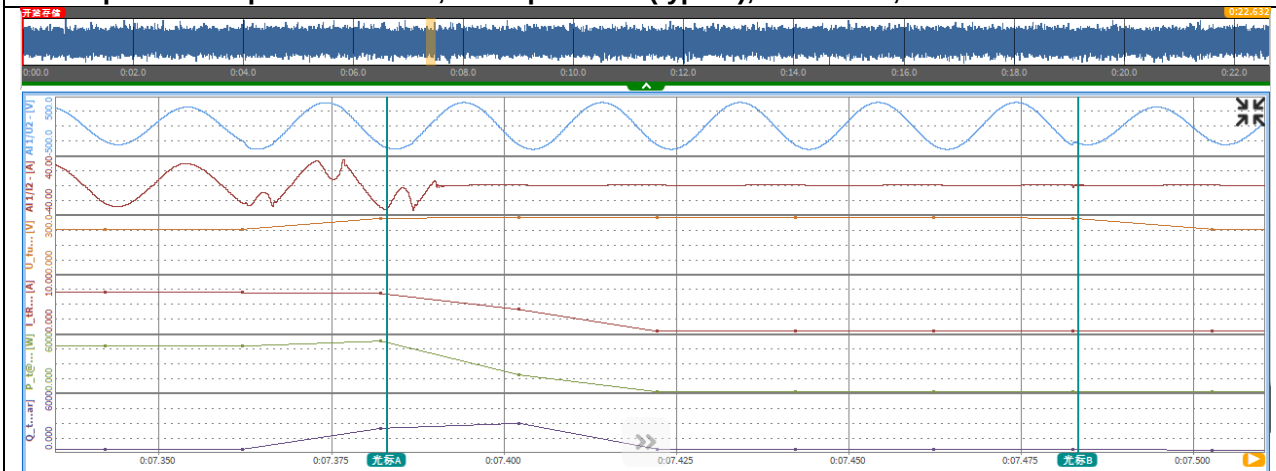
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 5.1
Depth of fault phase:125%Un, three-phase SC(type A), 100% load, Current after fault 60ms



	A	B	间隔
时间 [s]	7.3831111	7.4431642	0.0600532
AI 1/U2 [V]	-384.6960	-387.3389	-2.642870
AI 1/I2 [A]	-31.25053	0.311375	31.56190
U_fundRMS_SYM+@POWER/0 [V]	286.7471	287.4712	0.724091
I_tRMS@POWER/0 [A]	6.722993	0.238503	-6.484490
P_t@POWER/0 [W]	5291.999	-0.823453	-5292.822
Q_t@POWER/0 [var]	2351.362	205.7319	-2145.630

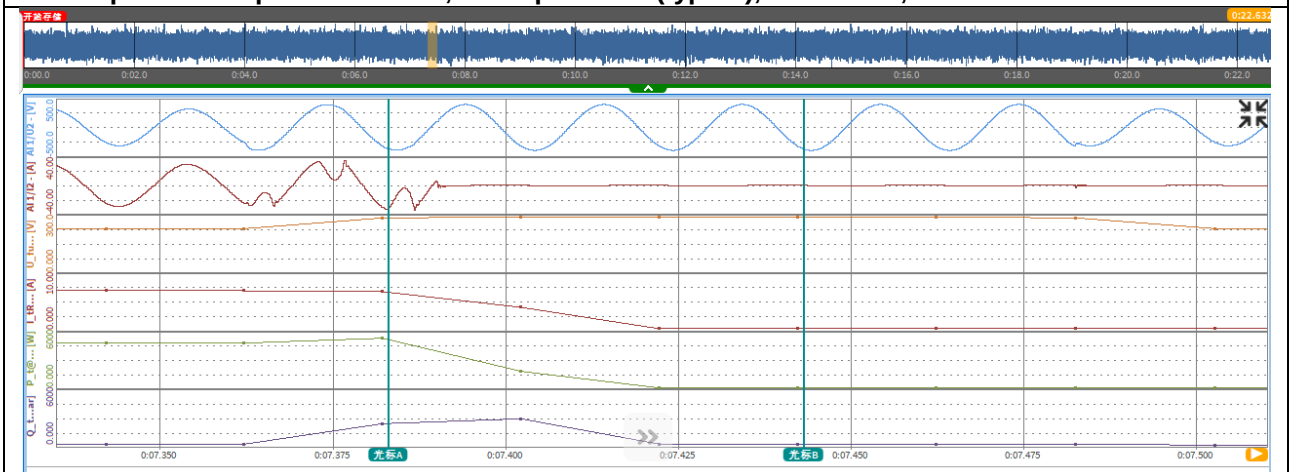
Test 5.1
Depth of fault phase:125%Un, three-phase SC(type A), 100% load, Current after fault 100ms



	A	B	间隔
时间 [s]	7.3831111	7.4831732	0.1000621
AI 1/U2 [V]	-384.6960	-295.2116	89.48446
AI 1/I2 [A]	-31.25053	0.201845	31.45237
U_fundRMS_SYM+@POWER/0 [V]	286.7471	286.9016	0.154510
I_tRMS@POWER/0 [A]	6.722993	0.248325	-6.474668
P_t@POWER/0 [W]	5291.999	6.982740	-5285.016
Q_t@POWER/0 [var]	2351.362	213.9734	-2137.389

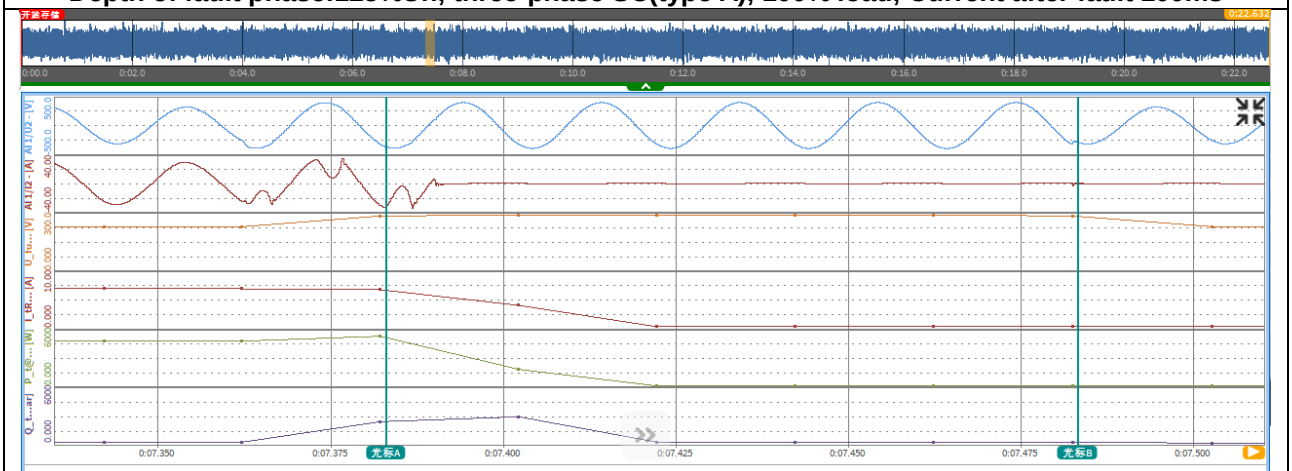
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 5.1
Depth of fault phase:125%Un, three-phase SC(type A), 100% load, Current after fault 60ms



	A	B	间隔
时间 [s]	7.3831111	7.4431642	0.0600532
AI 1/U2 [V]	-384.6960	-387.3389	-2.642870
AI 1/I2 [A]	-31.25053	0.311375	31.56190
U_fundRMS_SYM+@POWER/0 [V]	286.7471	287.4712	0.724091
I_tRMS@POWER/0 [A]	6.722993	0.238503	-6.484490
P_t@POWER/0 [W]	5291.999	-0.823453	-5292.822
Q_t@POWER/0 [var]	2351.362	205.7319	-2145.630

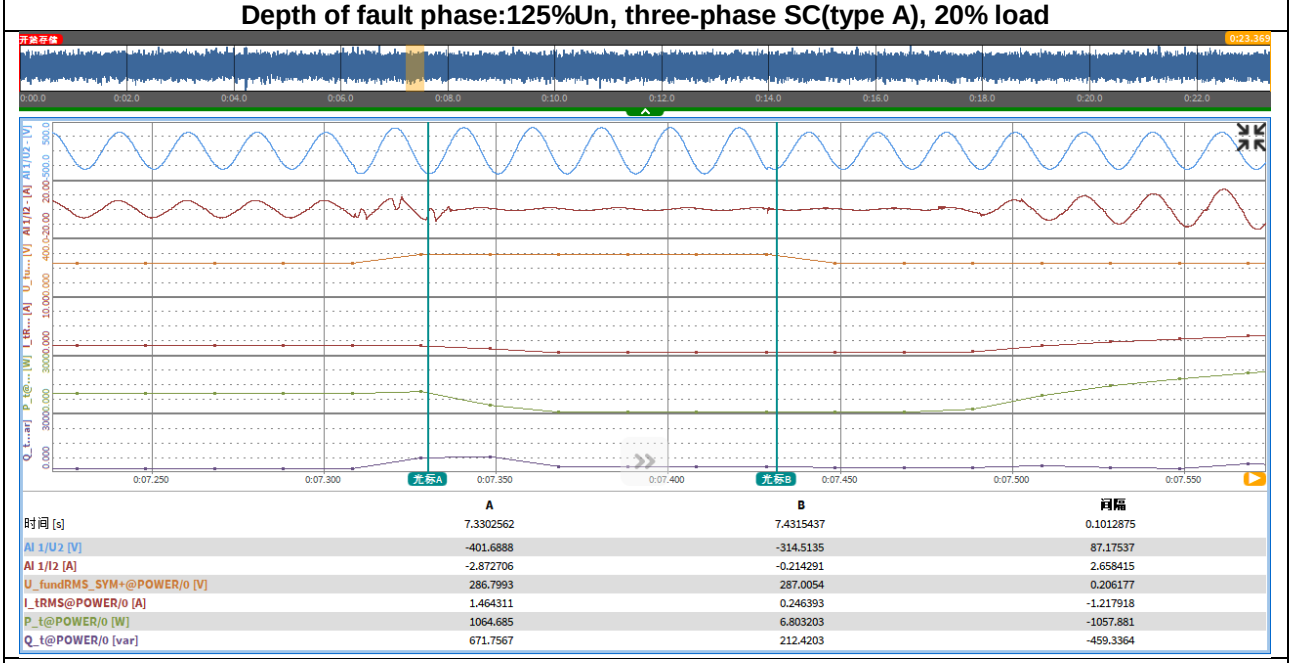
Test 5.1
Depth of fault phase:125%Un, three-phase SC(type A), 100% load, Current after fault 100ms



	A	B	间隔
时间 [s]	7.3831111	7.4831732	0.1000621
AI 1/U2 [V]	-384.6960	-295.2116	89.48446
AI 1/I2 [A]	-31.25053	0.201845	31.45237
U_fundRMS_SYM+@POWER/0 [V]	286.7471	286.9016	0.154510
I_tRMS@POWER/0 [A]	6.722993	0.248325	-6.474668
P_t@POWER/0 [W]	5291.999	6.982740	-5285.016
Q_t@POWER/0 [var]	2351.362	213.9734	-2137.389

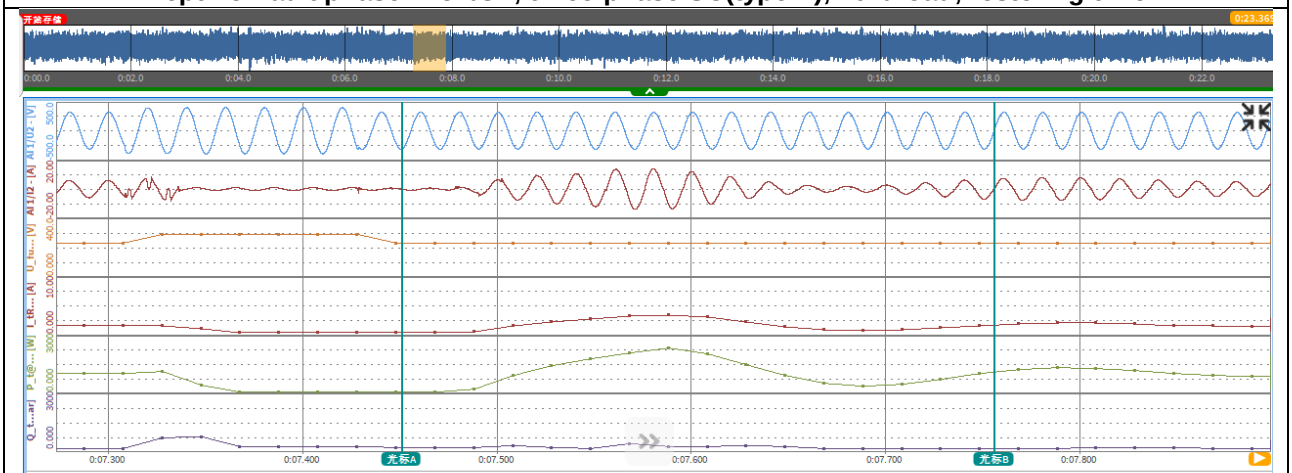
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 5.2
Depth of fault phase:125%Un, three-phase SC(type A), 20% load



	A	B	间隔
时间 [s]	7.3302562	7.4315437	0.1012875
AI 1/U2 [V]	-401.6888	-314.5135	87.17537
AI 1/I2 [A]	-2.872706	-0.214291	2.658415
U_fundRMS_SYM+@POWER/0 [V]	286.7993	287.0054	0.206177
I_tRMS@POWER/0 [A]	1.464311	0.246393	-1.217918
P_t@POWER/0 [W]	1064.685	6.803203	-1057.881
Q_t@POWER/0 [var]	671.7567	212.4203	-459.3364

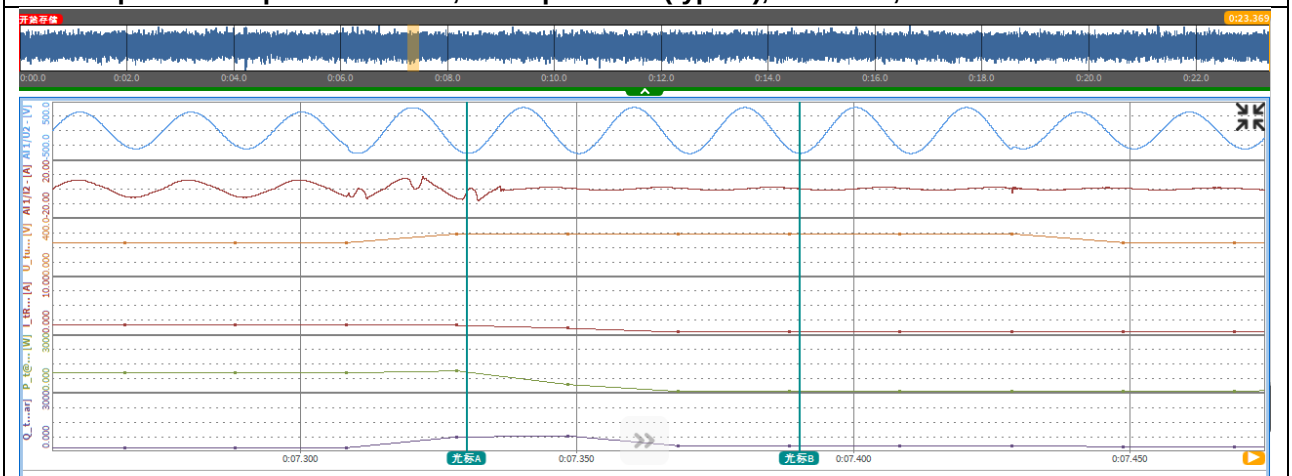
Test 5.2
Depth of fault phase:125%Un, three-phase SC(type A), 20% load, restoring time



	A	B	间隔
时间 [s]	7.4510787	7.7558281	0.3047493
AI 1/U2 [V]	-323.7443	14.01639	337.7607
AI 1/I2 [A]	-0.082016	0.078249	0.160265
U_fundRMS_SYM+@POWER/0 [V]	230.1596	230.0747	-0.084915
I_tRMS@POWER/0 [A]	0.195249	1.397250	1.202001
P_t@POWER/0 [W]	-0.448924	958.0075	958.4564
Q_t@POWER/0 [var]	135.0486	117.5577	-17.49092

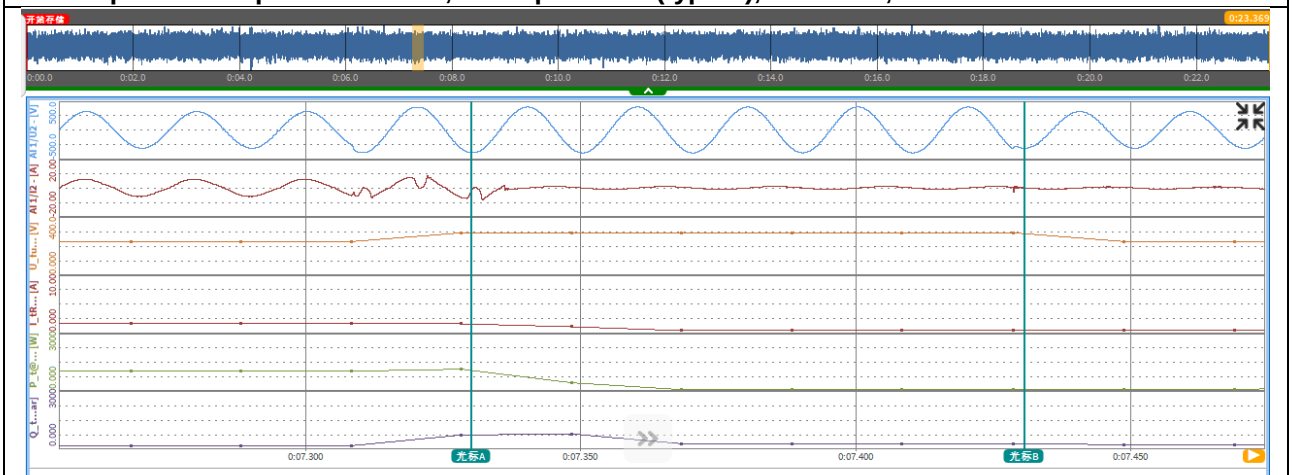
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 5.2
Depth of fault phase:125%Un, three-phase SC(type A), 20% load, Current after fault 60ms



	A	B	间隔
时间 [s]	7.3302562	7.3903028	0.0600466
AI 1/U2 [V]	-401.6888	-406.2534	-4.564524
AI 1/I2 [A]	-2.872706	8.678e-3	2.881384
U_fundRMS_SYM+@POWER/0 [V]	286.7993	287.4388	0.639496
I_tRMS@POWER/0 [A]	1.464311	0.238443	-1.225868
P_t@POWER/0 [W]	1064.685	-0.911042	-1065.596
Q_t@POWER/0 [var]	671.7567	205.6475	-466.1092

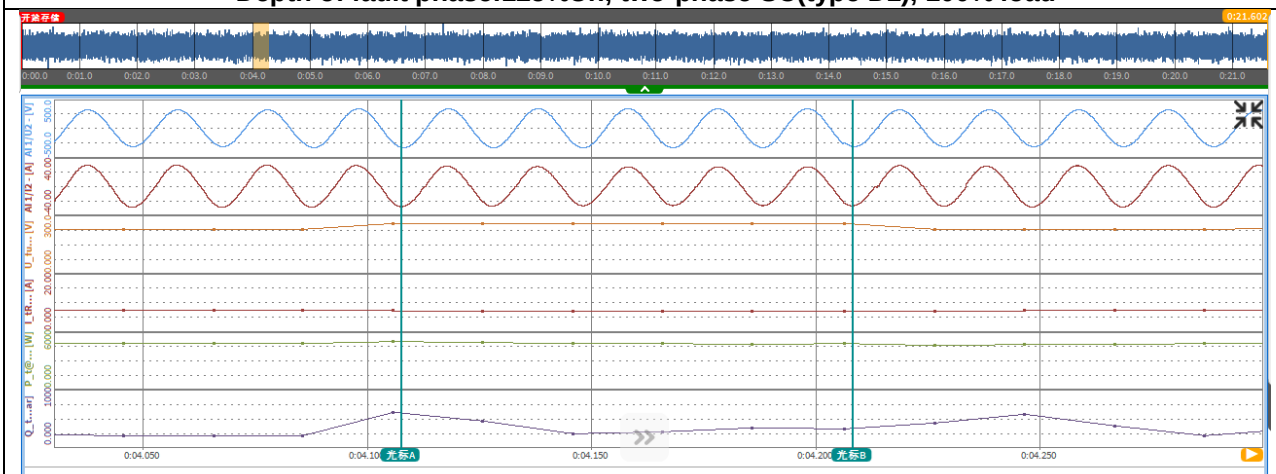
Test 5.2
Depth of fault phase:125%Un, three-phase SC(type A), 20% load, Current after fault 100ms



	A	B	间隔
时间 [s]	7.3302562	7.4305929	0.1003367
AI 1/U2 [V]	-401.6888	-325.3708	76.31803
AI 1/I2 [A]	-2.872706	0.034809	2.907515
U_fundRMS_SYM+@POWER/0 [V]	286.7993	287.0054	0.206177
I_tRMS@POWER/0 [A]	1.464311	0.246393	-1.217918
P_t@POWER/0 [W]	1064.685	6.803203	-1057.881
Q_t@POWER/0 [var]	671.7567	212.4203	-459.3364

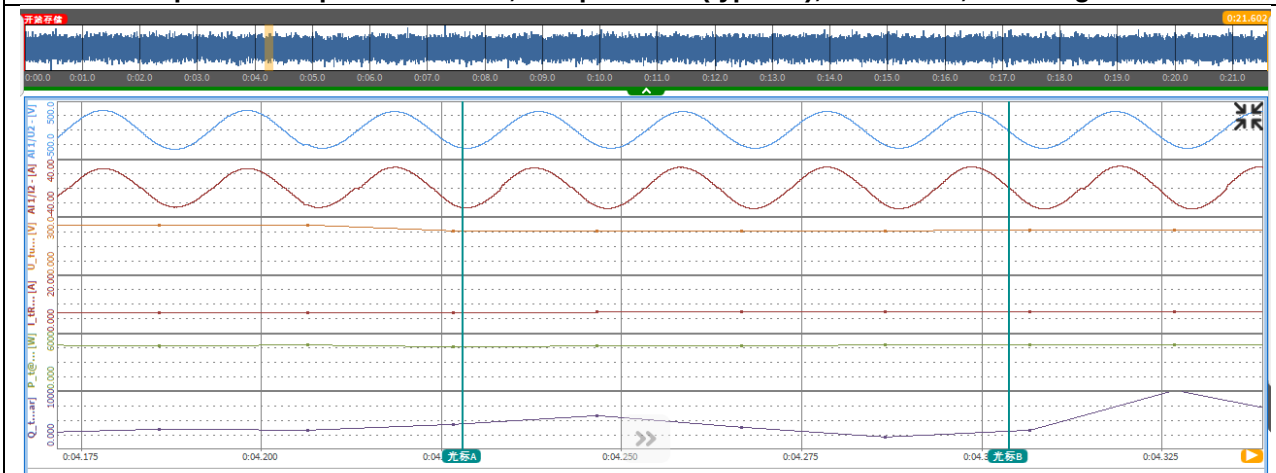
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 5.3
Depth of fault phase:125%Un, two-phase SC(type D1), 100% load



	A	B	间隔
时间 [s]	4.1074828	4.2080772	0.1005944
AI 1/U2 [V]	-337.4980	-321.5962	15.90180
AI 1/I2 [A]	-28.86963	-27.70906	1.160574
U_fundRMS_SYM+@POWER/0 [V]	258.9376	258.5307	-0.406860
I_tRMS@POWER/0 [A]	6.875079	6.499400	-0.375679
P_t@POWER/0 [W]	4998.078	4759.555	-238.5229
Q_t@POWER/0 [var]	599.7954	308.0694	-291.7260

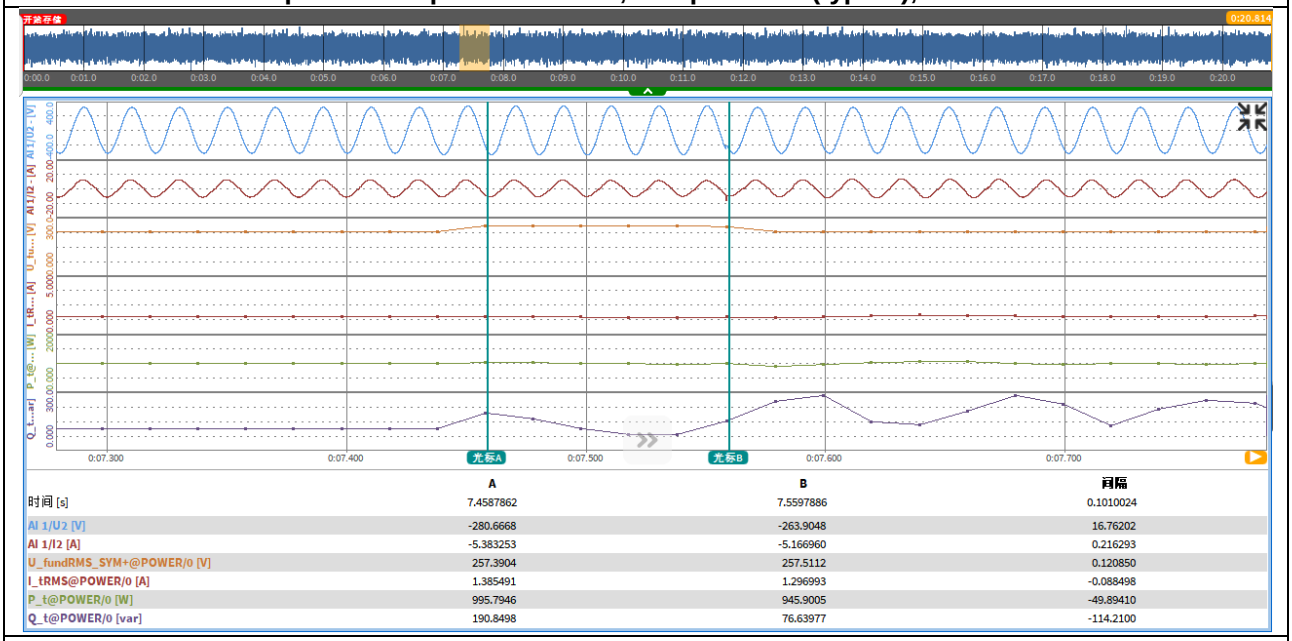
Test 5.3
Depth of fault phase:125%Un, two-phase SC(type D1), 100% load, restoring time



	A	B	间隔
时间 [s]	4.2279296	4.3036913	0.0757616
AI 1/U2 [V]	-320.0727	-11.16371	308.9090
AI 1/I2 [A]	-28.02100	1.107693	29.12870
U_fundRMS_SYM+@POWER/0 [V]	230.0801	230.1290	0.048874
I_tRMS@POWER/0 [A]	6.592239	6.863275	0.271036
P_t@POWER/0 [W]	4547.275	4742.337	195.0615
Q_t@POWER/0 [var]	418.9648	184.1689	-234.7960

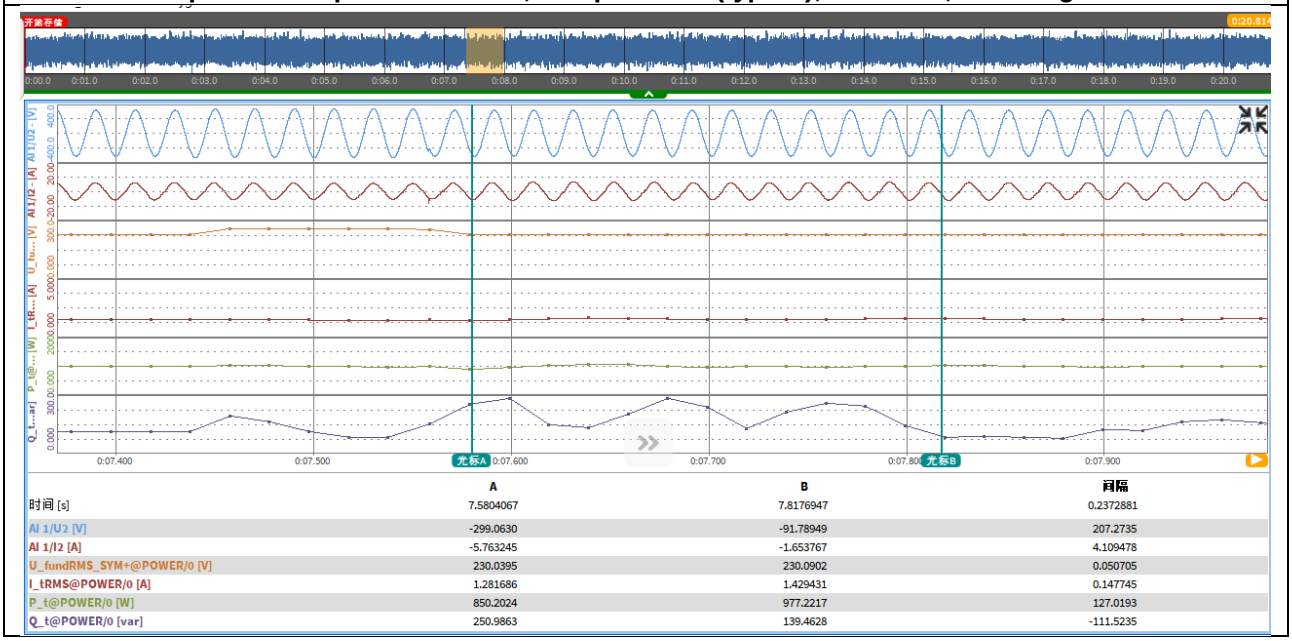
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 5.4
Depth of fault phase:125%Un, two-phase SC(type D), 20% load



	A	B	间隔
时间 [s]	7.4587862	7.5597886	0.1010024
AI 1/U2 [V]	-280.6668	-263.9048	16.76202
AI 1/I2 [A]	-5.383253	-5.166960	0.216293
U_fundRMS_SYM+@POWER/0 [V]	257.3904	257.5112	0.120850
I_tRMS@POWER/0 [A]	1.385491	1.296993	-0.088498
P_t@POWER/0 [W]	995.7946	945.9005	-49.89410
Q_t@POWER/0 [var]	190.8498	76.63977	-114.2100

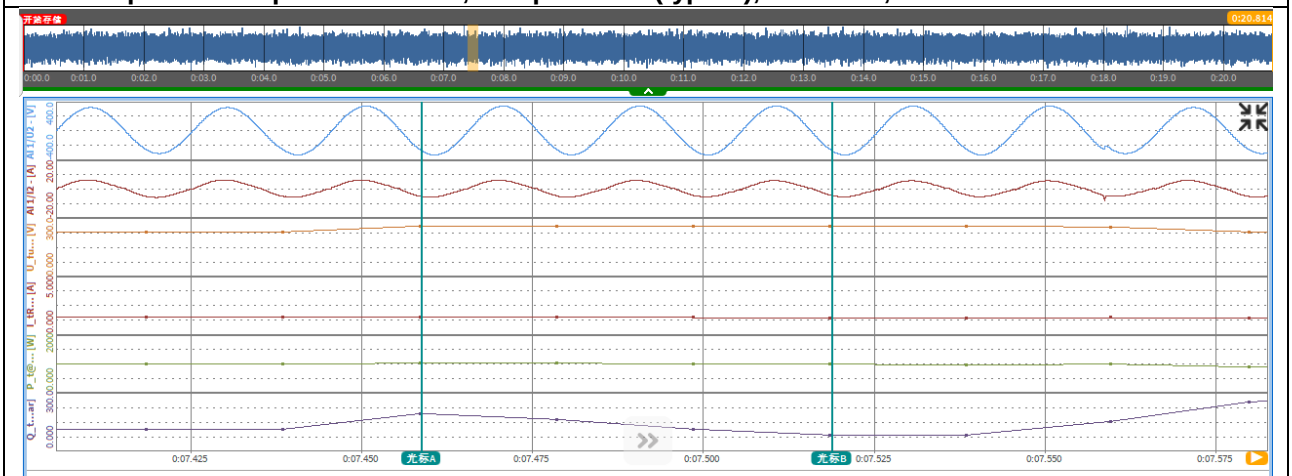
Test 5.4
Depth of fault phase:125%Un, two-phase SC(type D), 20% load, restoring time



	A	B	间隔
时间 [s]	7.5804067	7.8176947	0.2372881
AI 1/U2 [V]	-299.0630	-91.78949	207.2735
AI 1/I2 [A]	-5.763245	-1.653767	4.109478
U_fundRMS_SYM+@POWER/0 [V]	230.0395	230.0902	0.050705
I_tRMS@POWER/0 [A]	1.281686	1.429431	0.147745
P_t@POWER/0 [W]	850.2024	977.2217	127.0193
Q_t@POWER/0 [var]	250.9863	139.4628	-111.5235

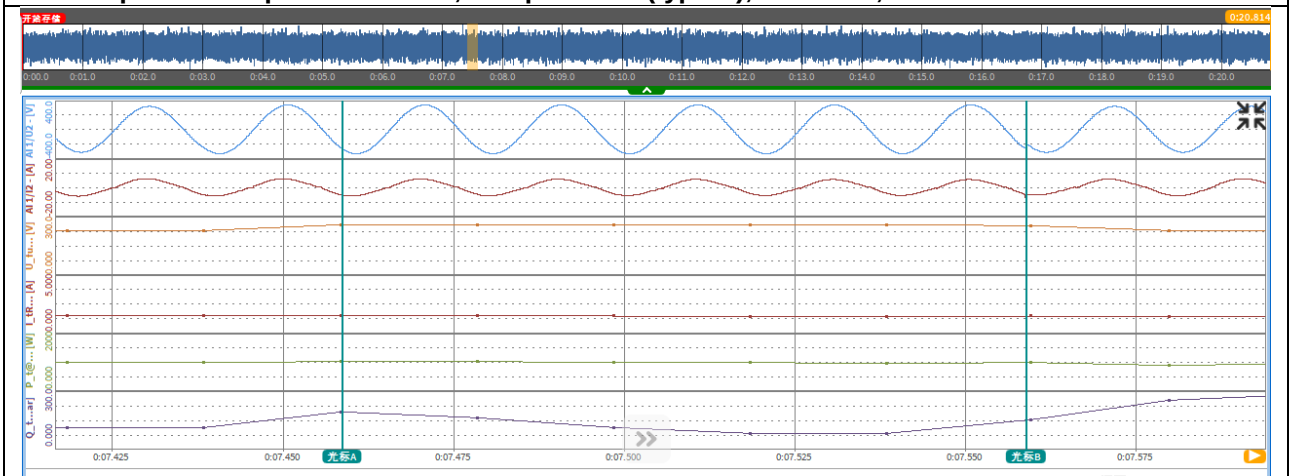
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 5.4
Depth of fault phase:125%Un, two-phase SC(type D), 20% load, Current after fault 60ms



	A	B	间隔
时间 [s]	7.4587862	7.5188303	0.0600441
AI 1/U2 [V]	-280.6668	-287.1809	-6.514073
AI 1/I2 [A]	-5.383253	-4.751730	0.631523
U_fundRMS_SYM+@POWER/0 [V]	257.3904	257.5054	0.115051
I_tRMS@POWER/0 [A]	1.385491	1.312445	-0.073046
P_t@POWER/0 [W]	995.7946	956.9556	-38.83899
Q_t@POWER/0 [var]	190.8498	79.44749	-111.4023

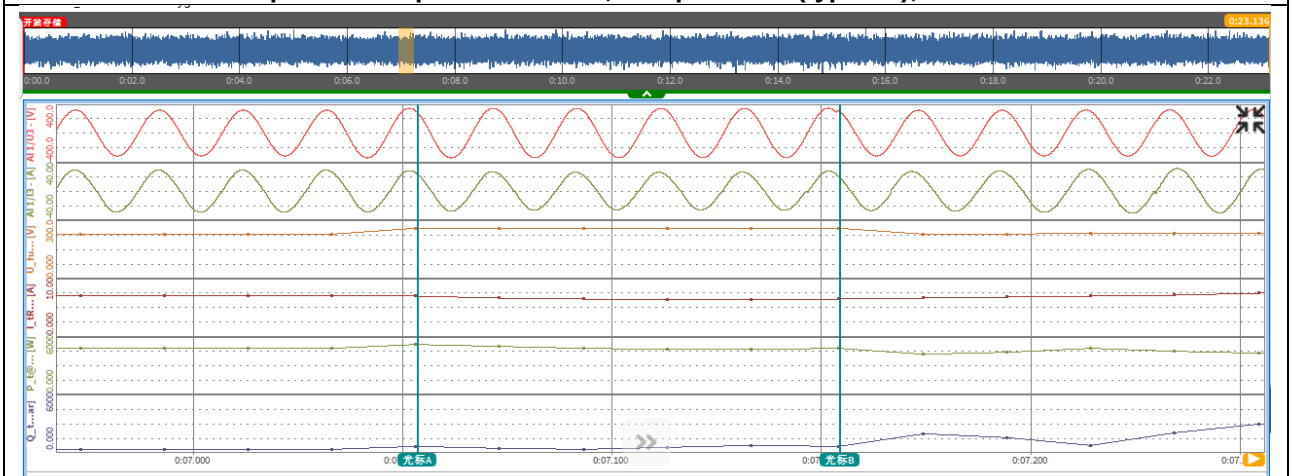
Test 5.4
Depth of fault phase:125%Un, two-phase SC(type D), 20% load, Current after fault 100ms



	A	B	间隔
时间 [s]	7.4587862	7.5589125	0.1001263
AI 1/U2 [V]	-280.6668	-221.5991	59.06773
AI 1/I2 [A]	-5.383253	-4.728651	0.654602
U_fundRMS_SYM+@POWER/0 [V]	257.3904	257.5112	0.120850
I_tRMS@POWER/0 [A]	1.385491	1.296993	-0.088498
P_t@POWER/0 [W]	995.7946	945.9005	-49.89410
Q_t@POWER/0 [var]	190.8498	76.63977	-114.2100

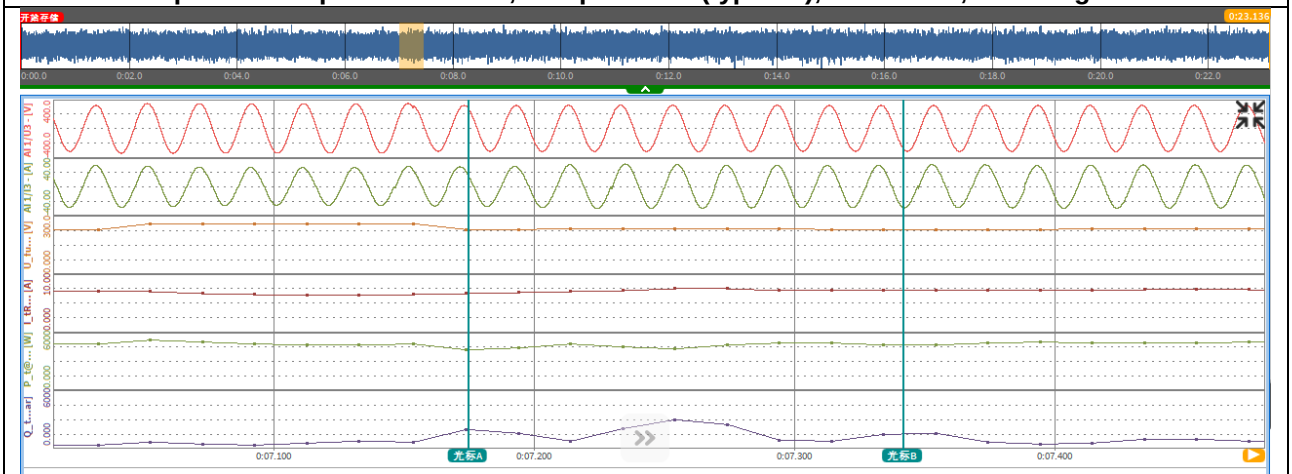
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 5.5
Depth of fault phase:125%Un, two-phase SC(type D2), 100% load



	A	B	间隔
时间 [s]	7.0536852	7.1545390	0.1008538
AI 1/U3 [V]	284.9345	292.3274	7.392884
AI 1/I3 [A]	23.85969	18.13598	-5.723715
U_fundRMS_SYM+@POWER/0 [V]	258.9555	257.3453	-1.610168
I_tRMS@POWER/0 [A]	6.874902	6.393175	-0.481727
P_t@POWER/0 [W]	5121.244	4794.874	-326.3701
Q_t@POWER/0 [var]	472.9753	533.8918	60.91650

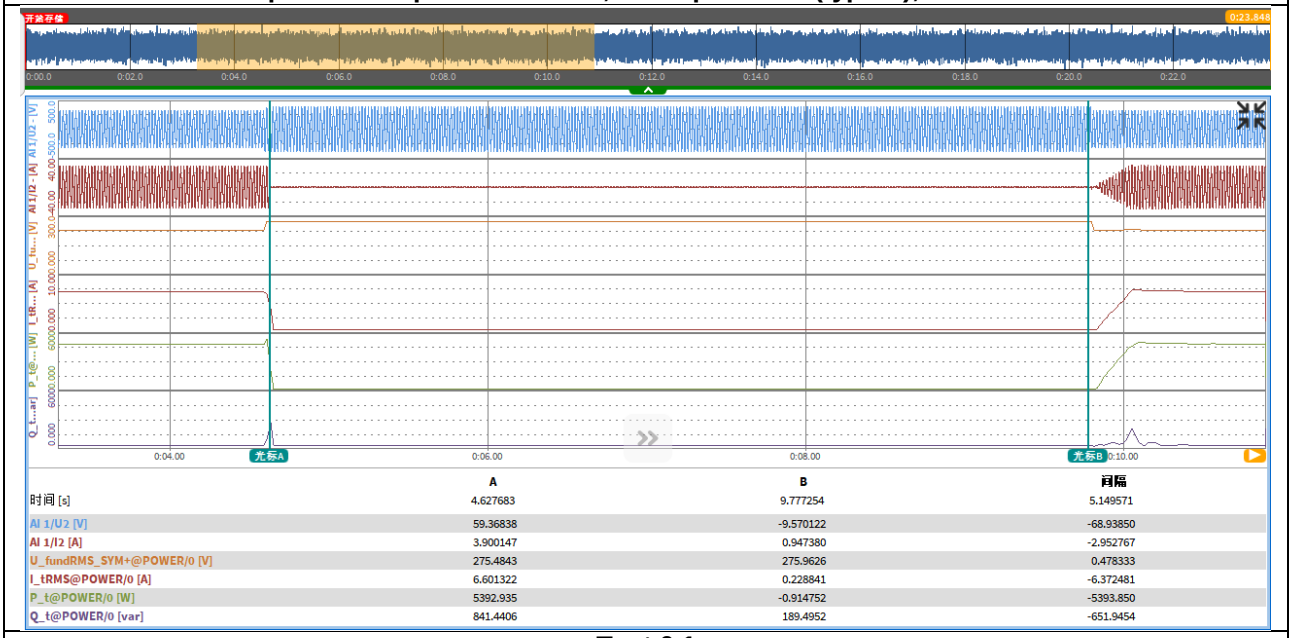
Test 5.5
Depth of fault phase:125%Un, two-phase SC(type D2), 100% load, restoring time



	A	B	间隔
时间 [s]	7.1747394	7.3414585	0.1667191
AI 1/U3 [V]	282.6436	-280.9243	-563.5679
AI 1/I3 [A]	15.70387	-29.75187	-45.45574
U_fundRMS_SYM+@POWER/0 [V]	229.6881	229.8320	0.143906
I_tRMS@POWER/0 [A]	6.532673	7.011269	0.478595
P_t@POWER/0 [W]	4121.536	4641.252	519.7163
Q_t@POWER/0 [var]	1822.998	1336.983	-486.0148

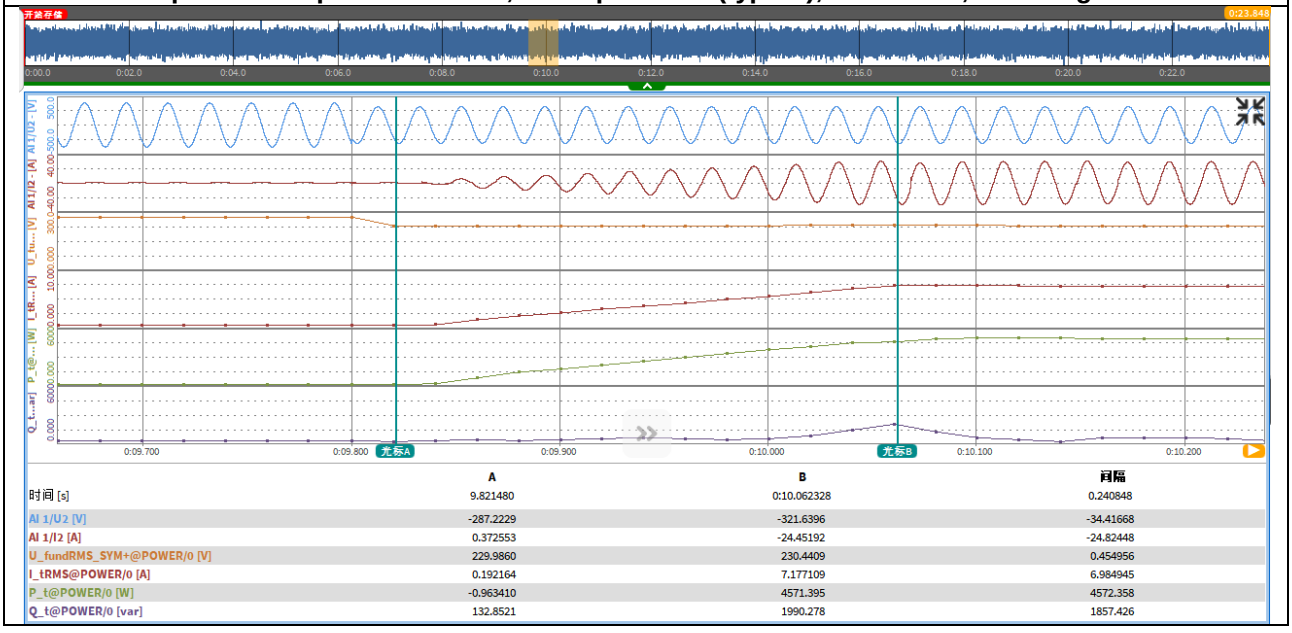
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 6.1
Depth of fault phase:120%Un, three-phase SC(type A), 100% load



	A	B	间隔
时间 [s]	4.627683	9.777254	5.149571
AI 1/U2 [V]	59.36838	-9.570122	-68.93850
AI 1/I2 [A]	3.900147	0.947380	-2.952767
U_fundRMS_SYM+@POWER/0 [V]	275.4843	275.9626	0.478333
I_tRMS@POWER/0 [A]	6.601322	0.228841	-6.372481
P_t@POWER/0 [W]	5392.935	-0.914752	-5393.850
Q_t@POWER/0 [var]	841.4406	189.4952	-651.9454

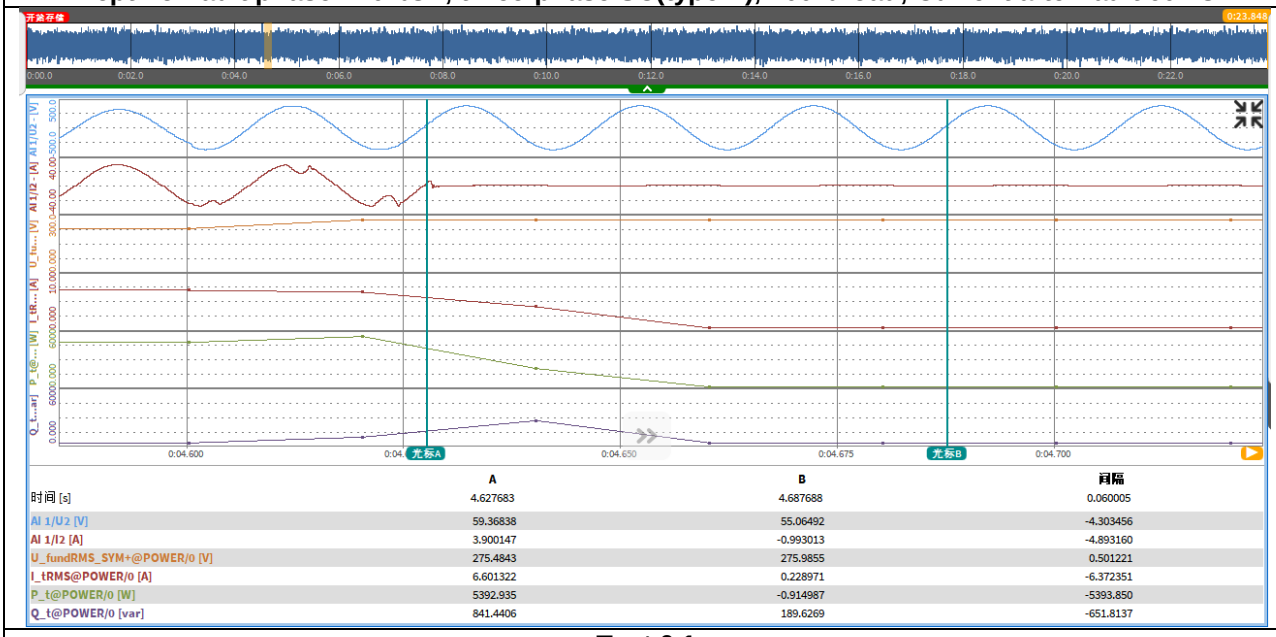
Test 6.1
Depth of fault phase:120%Un, three-phase SC(type A), 100% load, restoring time



	A	B	间隔
时间 [s]	9.821480	0:10.062328	0.240848
AI 1/U2 [V]	-287.2229	-321.6396	-34.41668
AI 1/I2 [A]	0.372553	-24.45192	-24.82448
U_fundRMS_SYM+@POWER/0 [V]	229.9860	230.4409	0.454956
I_tRMS@POWER/0 [A]	0.192164	7.177109	6.984945
P_t@POWER/0 [W]	-0.963410	4571.395	4572.358
Q_t@POWER/0 [var]	132.8521	1990.278	1857.426

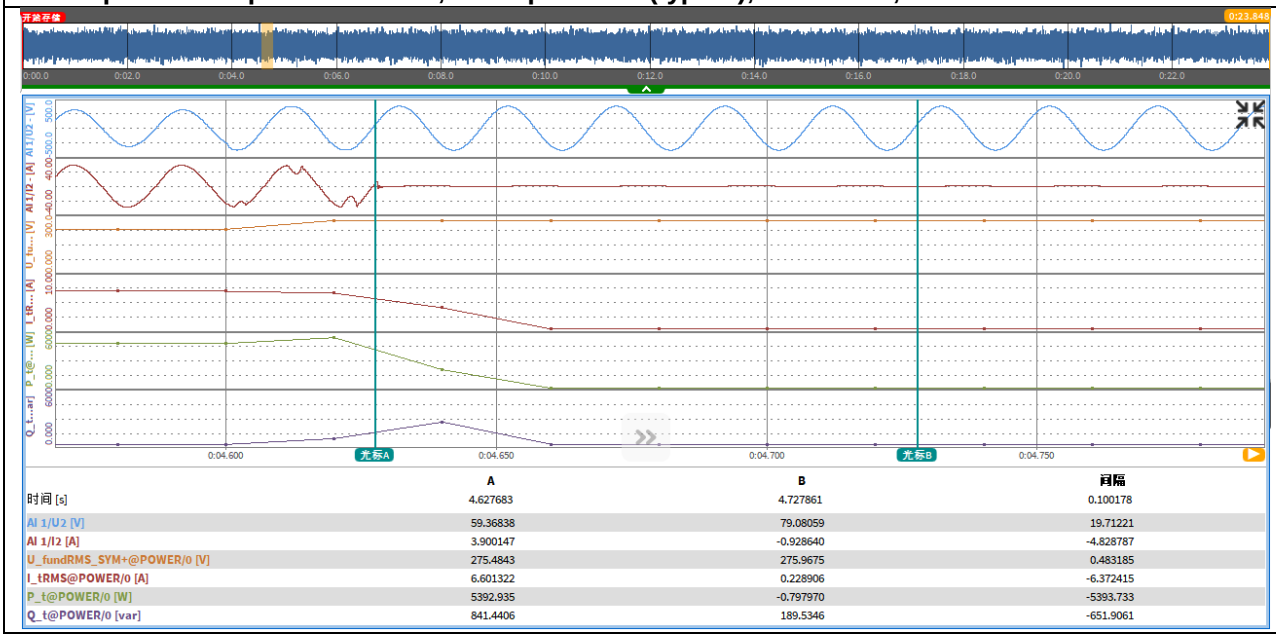
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 6.1
Depth of fault phase:120%Un, three-phase SC(type A), 100% load, Current after fault 60ms



	A	B	间隔
时间 [s]	4.627683	4.687688	0.060005
AI 1/U2 [V]	59.36838	55.06492	-4.303456
AI 1/I2 [A]	3.900147	-0.993013	-4.893160
U_fundRMS_SYM+@POWER/0 [V]	275.4843	275.9855	0.501221
I_tRMS@POWER/0 [A]	6.601322	0.228971	-6.372351
P_t@POWER/0 [W]	5392.935	-0.914987	-5393.850
Q_t@POWER/0 [var]	841.4406	189.6269	-651.8137

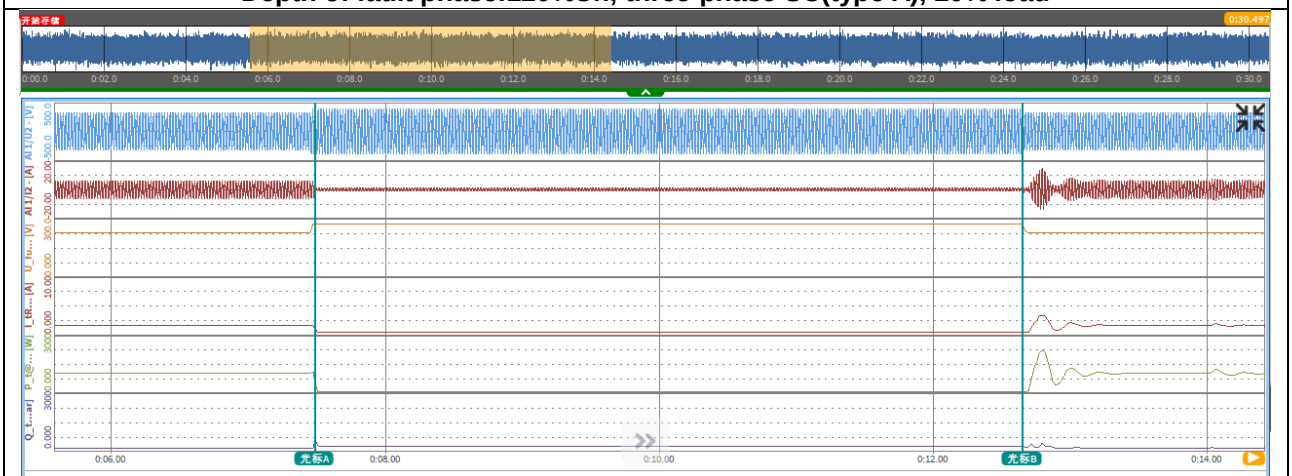
Test 6.1
Depth of fault phase:120%Un, three-phase SC(type A), 100% load, Current after fault 100ms



	A	B	间隔
时间 [s]	4.627683	4.727861	0.100178
AI 1/U2 [V]	59.36838	79.08059	19.71221
AI 1/I2 [A]	3.900147	-0.928640	-4.828787
U_fundRMS_SYM+@POWER/0 [V]	275.4843	275.9675	0.483185
I_tRMS@POWER/0 [A]	6.601322	0.228906	-6.372415
P_t@POWER/0 [W]	5392.935	-0.797970	-5393.733
Q_t@POWER/0 [var]	841.4406	189.5346	-651.9061

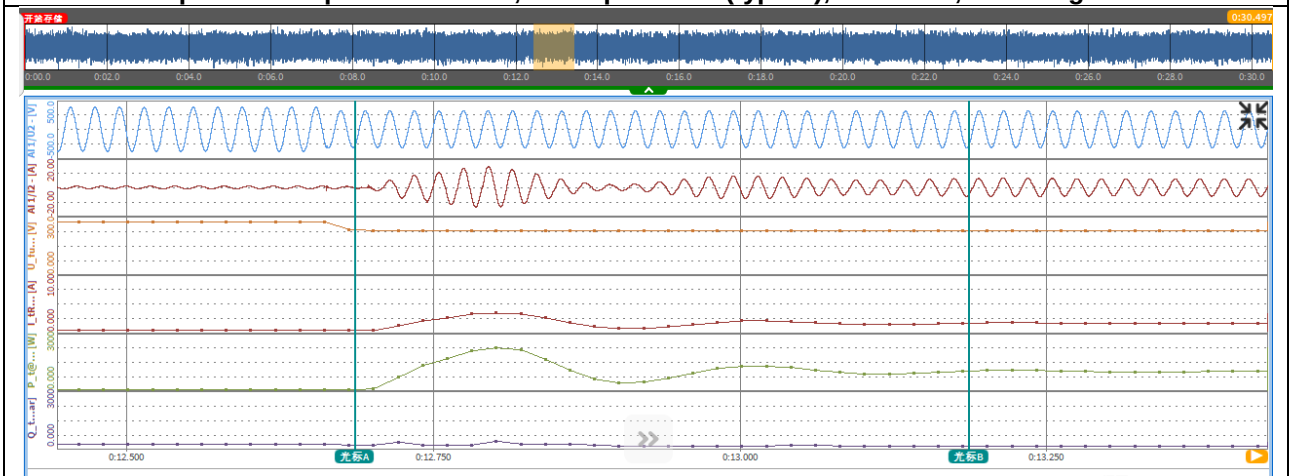
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 6.2
Depth of fault phase:120%Un, three-phase SC(type A), 20% load



	A	B	间隔
时间 [s]	7.486743	0:12.649138	5.162395
AI 1/U2 [V]	-309.5668	-60.30679	249.2600
AI 1/I2 [A]	-3.775692	-0.924444	2.851248
U_fundRMS_SYM+@POWER/0 [V]	275.4868	275.9844	0.497559
I_tRMS@POWER/0 [A]	1.348485	0.228912	-1.119573
P_t@POWER/0 [W]	1108.230	-0.866990	-1109.097
Q_t@POWER/0 [var]	112.3232	189.5810	77.25780

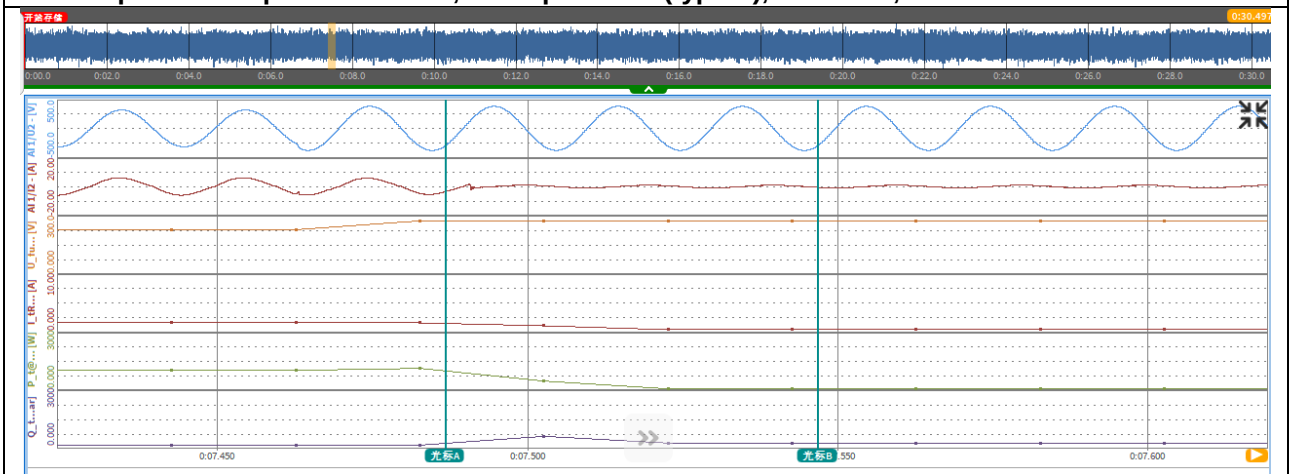
Test 6.2
Depth of fault phase:120%Un, three-phase SC(type A), 20% load, restoring time



	A	B	间隔
时间 [s]	0:12.686466	0:13.186717	0.500251
AI 1/U2 [V]	-282.3787	-265.2323	17.14635
AI 1/I2 [A]	-0.403881	-4.509640	-4.105759
U_fundRMS_SYM+@POWER/0 [V]	230.2046	230.0694	-0.135239
I_tRMS@POWER/0 [A]	0.194039	1.426172	1.232133
P_t@POWER/0 [W]	0.870540	979.4111	978.5405
Q_t@POWER/0 [var]	134.0998	104.6495	-29.45030

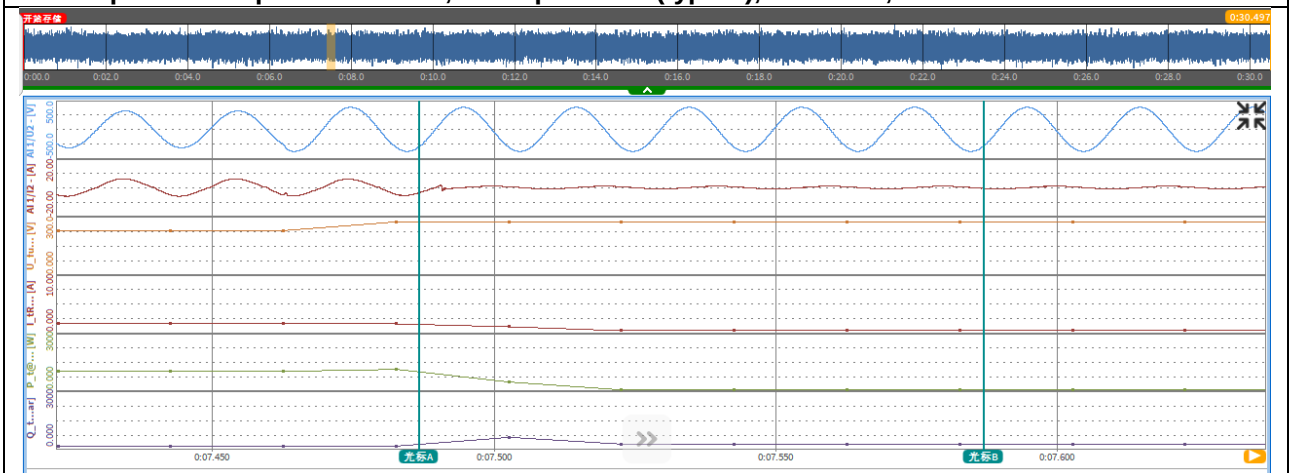
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 6.2
Depth of fault phase:120%Un, three-phase SC(type A), 20% load, Current after fault 60ms



	A	B	间隔
时间 [s]	7.486743	7.546819	0.060076
AI 1/U2 [V]	-309.5668	-302.6407	6.926060
AI 1/I2 [A]	-3.775692	-0.578260	3.197432
U_fundRMS_SYM+@POWER/0 [V]	275.4868	275.9872	0.500336
I_tRMS@POWER/0 [A]	1.348485	0.229003	-1.119482
P_t@POWER/0 [W]	1108.230	-1.026217	-1109.256
Q_t@POWER/0 [var]	112.3232	189.6572	77.33405

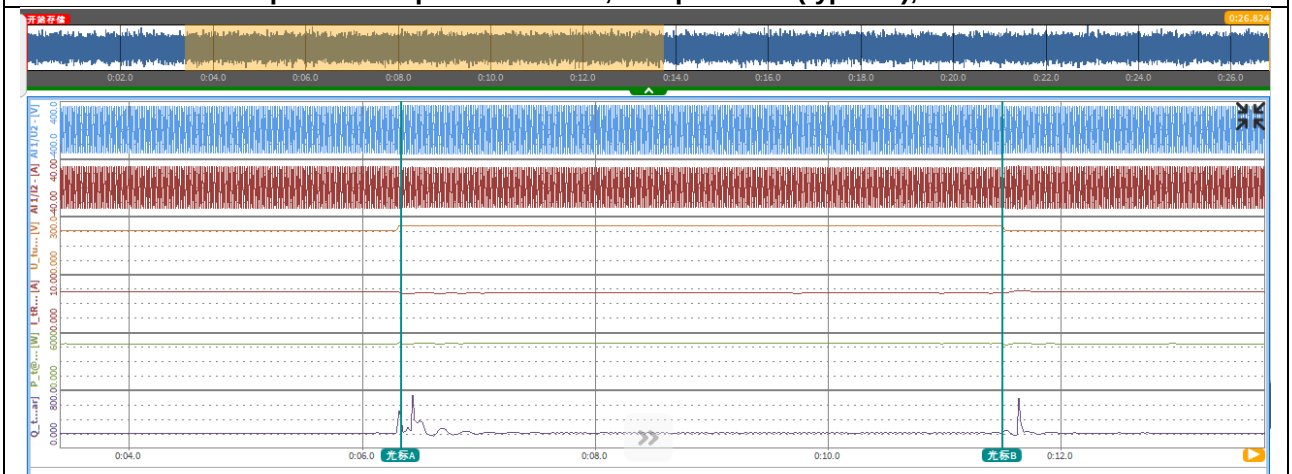
Test 6.2
Depth of fault phase:120%Un, three-phase SC(type A), 20% load, Current after fault 100ms



	A	B	间隔
时间 [s]	7.486743	7.586910	0.100167
AI 1/U2 [V]	-309.5668	-294.4796	15.08713
AI 1/I2 [A]	-3.775692	-0.661135	3.114557
U_fundRMS_SYM+@POWER/0 [V]	275.4868	275.9824	0.495514
I_tRMS@POWER/0 [A]	1.348485	0.228944	-1.119541
P_t@POWER/0 [W]	1108.230	-0.916827	-1109.147
Q_t@POWER/0 [var]	112.3232	189.6021	77.27895

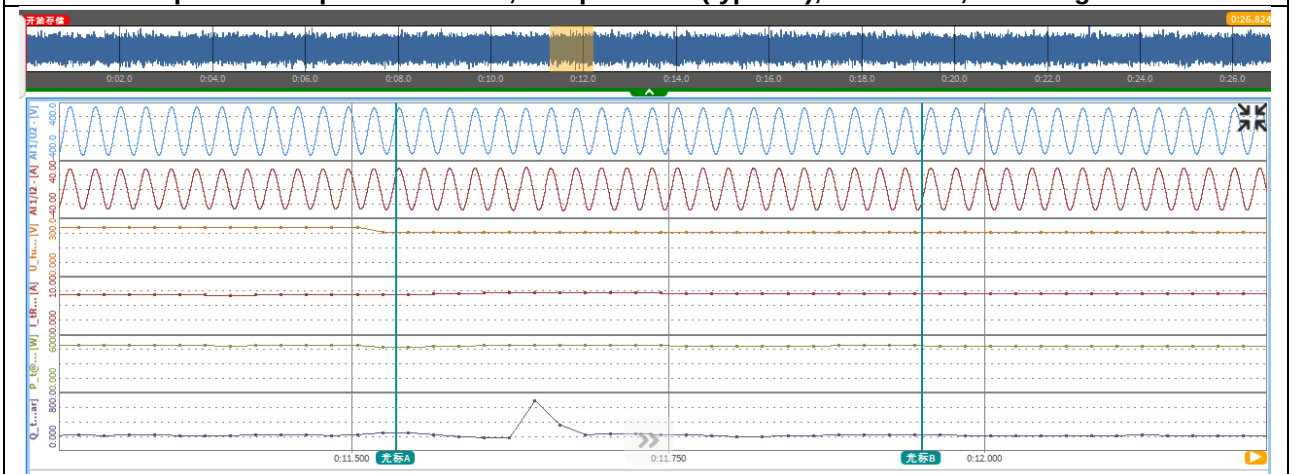
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 6.3
Depth of fault phase:120%Un, two-phase SC(type D1), 100% load



	A	B	间隔
时间 [s]	6.33391	0:11.49597	5.16206
AI 1/U2 [V]	145.6292	300.7829	155.1538
AI 1/I2 [A]	14.04905	25.78035	11.73129
U_fundRMS_SYM+@POWER/0 [V]	253.1259	253.2643	0.138351
I_tRMS@POWER/0 [A]	6.885921	6.643539	-0.242382
P_t@POWER/0 [W]	4969.068	4816.278	-152.7900
Q_t@POWER/0 [var]	516.0496	196.5384	-319.5111

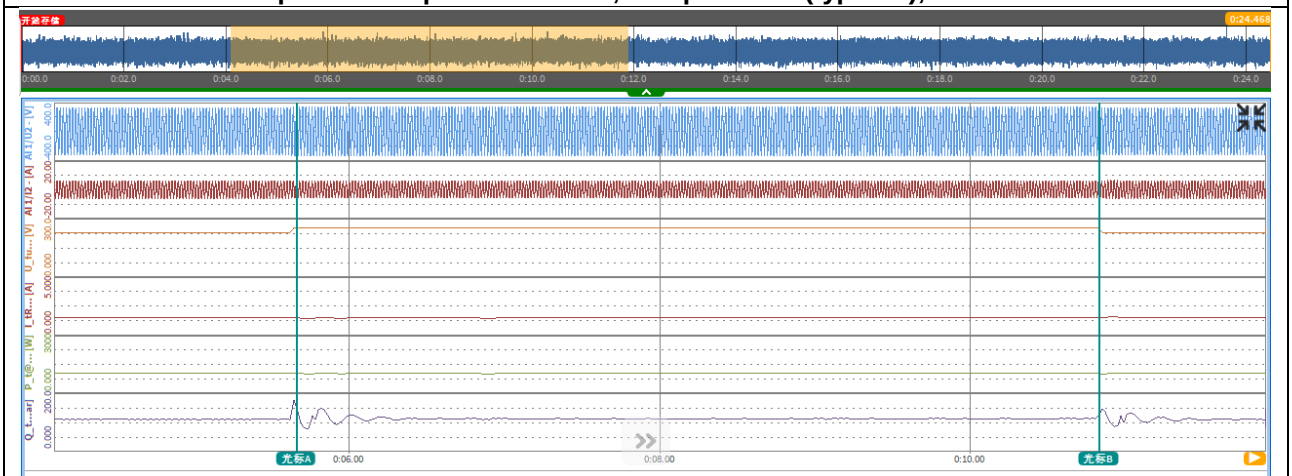
Test 6.3
Depth of fault phase:120%Un, two-phase SC(type D1), 100% load, restoring time



	A	B	间隔
时间 [s]	0:11.53483	0:11.95006	0.41523
AI 1/U2 [V]	214.5178	-231.0078	-445.5257
AI 1/I2 [A]	20.26091	-19.87271	-40.13362
U_fundRMS_SYM+@POWER/0 [V]	230.0552	230.1106	0.055450
I_tRMS@POWER/0 [A]	6.706768	6.965361	0.258593
P_t@POWER/0 [W]	4628.336	4811.823	183.4863
Q_t@POWER/0 [var]	240.7671	200.6826	-40.08447

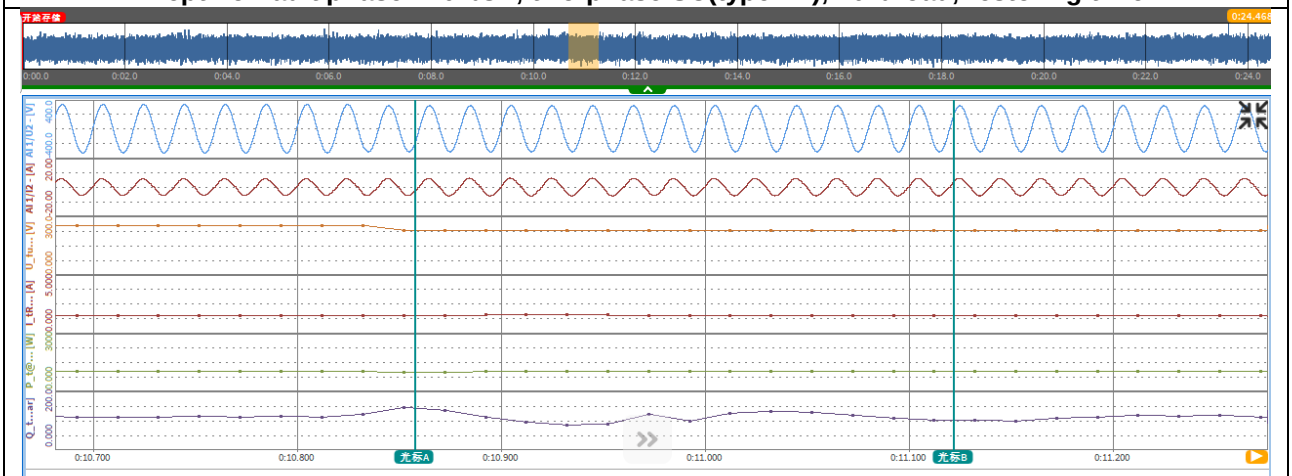
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 6.4
Depth of fault phase:120%Un, two-phase SC(type D1), 20% load



	A	B	间隔
时间 [s]	5.66358	0:10.82708	5.16350
AI 1/U2 [V]	316.9139	255.0156	-61.89824
AI 1/I2 [A]	6.006241	3.636408	-2.369833
U_fundRMS_SYM+@POWER/0 [V]	253.0706	253.1771	0.106506
I_tRMS@POWER/0 [A]	1.391475	1.346929	-0.044546
P_t@POWER/0 [W]	993.3403	969.7468	-23.59357
Q_t@POWER/0 [var]	175.2835	109.8982	-65.38538

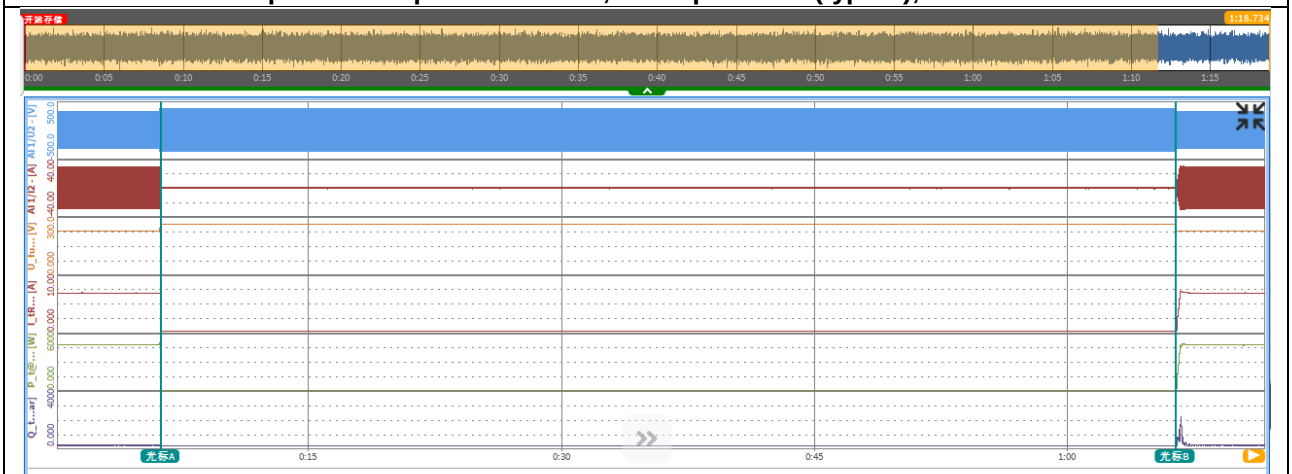
Test 6.4
Depth of fault phase:120%Un, two-phase SC(type D1), 20% load, restoring time



	A	B	间隔
时间 [s]	0:10.85752	0:11.12179	0.26427
AI 1/U2 [V]	-217.1385	181.2747	398.4132
AI 1/I2 [A]	-2.874708	3.706408	6.581116
U_fundRMS_SYM+@POWER/0 [V]	230.0560	230.0798	0.023849
I_tRMS@POWER/0 [A]	1.357275	1.415233	0.057958
P_t@POWER/0 [W]	926.9302	972.1917	45.26147
Q_t@POWER/0 [var]	144.6459	98.91586	-45.73006

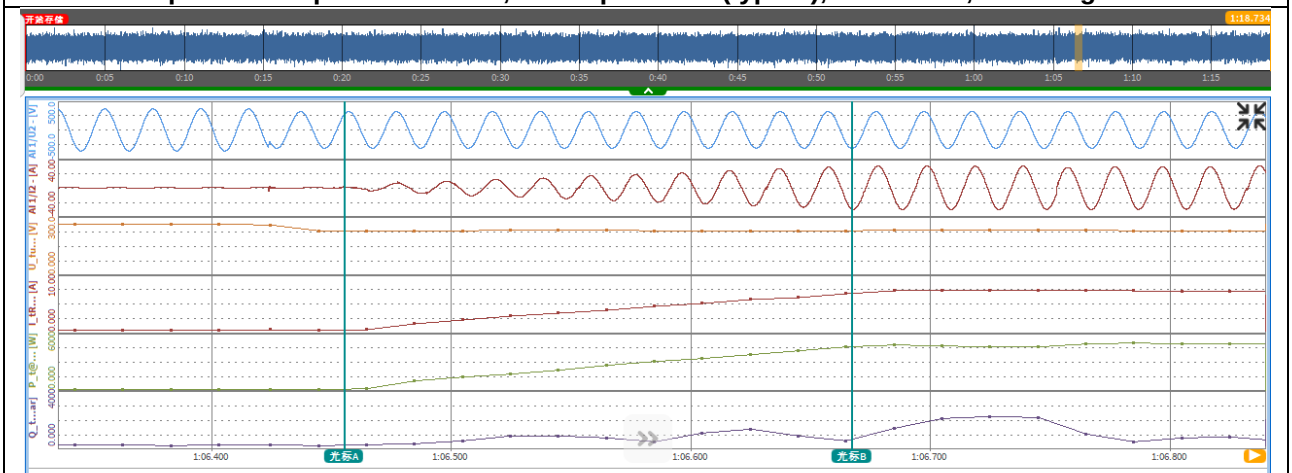
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 7.1
Depth of fault phase:115%Un, three-phase SC(type A), 100% load



	A	B	间隔
时间 [s]	6.26985	1:06.38266	1:00.11281
AI 1/U2 [V]	-126.8518	-226.4123	-99.56051
AI 1/I2 [A]	-0.848246	0.696516	1.544762
U_fundRMS_SYM+@POWER/0 [V]	264.3415	264.4669	0.125366
I_tRMS@POWER/0 [A]	4.048218	0.219433	-3.828785
P_t@POWER/0 [W]	2039.424	-0.821707	-2040.246
Q_t@POWER/0 [var]	2477.730	174.1321	-2303.598

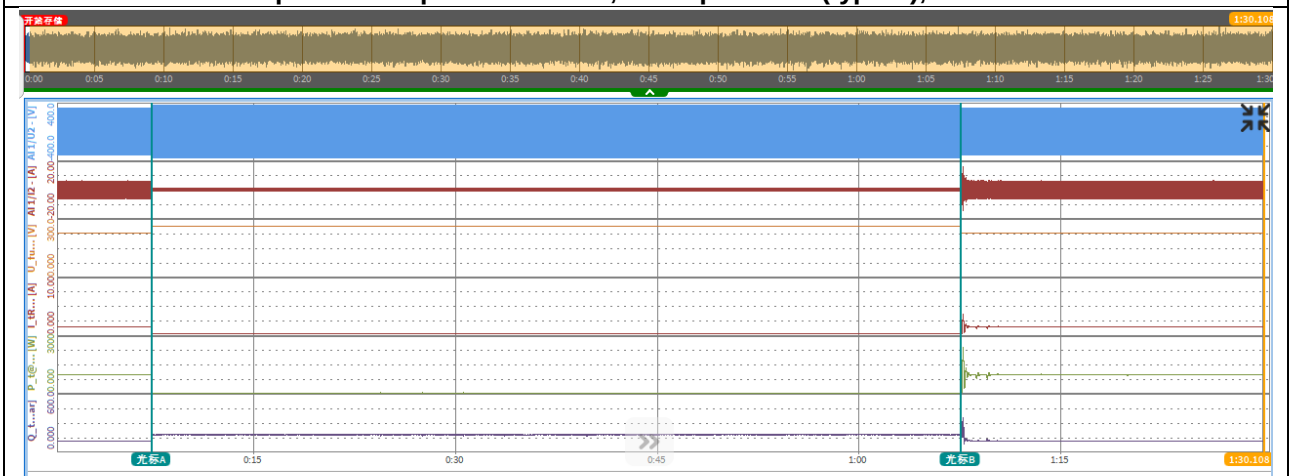
Test 7.1
Depth of fault phase:115%Un, three -phase SC(type A), 100% load, restoring time



	A	B	间隔
时间 [s]	1:06.45549	1:06.66730	0.21181
AI 1/U2 [V]	277.7250	-326.2527	-603.9777
AI 1/I2 [A]	1.561403	-30.36690	-31.92830
U_fundRMS_SYM+@POWER/0 [V]	230.0246	230.1319	0.107361
I_tRMS@POWER/0 [A]	0.191240	6.685314	6.494074
P_t@POWER/0 [W]	-0.614990	4600.680	4601.295
Q_t@POWER/0 [var]	131.9674	480.3938	348.4264

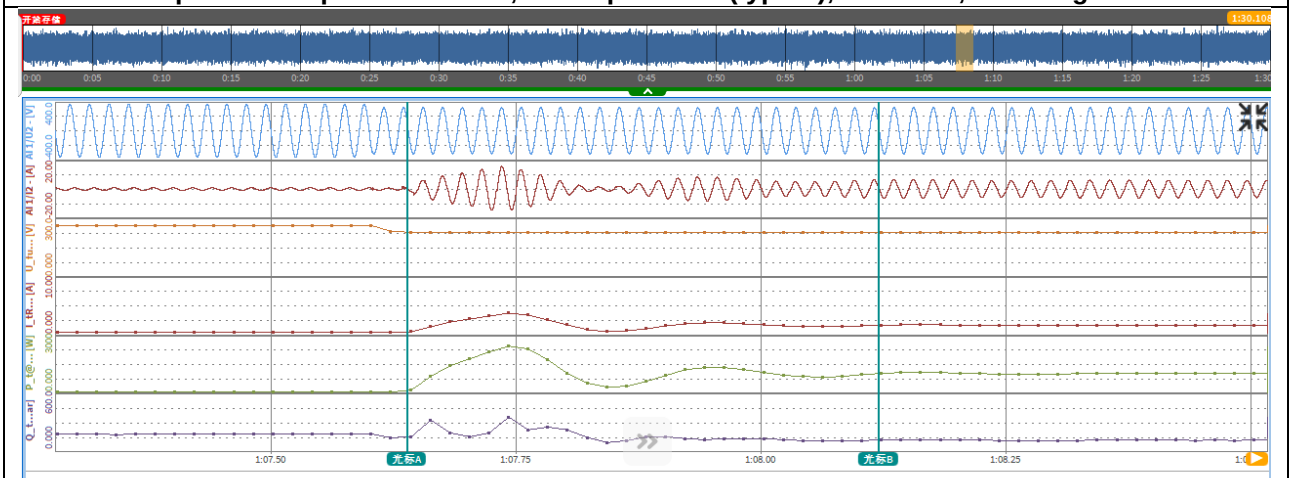
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 7.2
Depth of fault phase:115%Un, three-phase SC(type A), 20% load



	A	B	间隔
时间 [s]	7.43249	1:07.52845	1:00.09596
AI 1/U2 [V]	115.1559	-275.5060	-390.6620
AI 1/I2 [A]	1.683760	-0.644827	-2.328587
U_fundRMS_SYM+@POWER/0 [V]	264.1072	264.4745	0.367371
I_tRMS@POWER/0 [A]	1.365383	0.219514	-1.145869
P_t@POWER/0 [W]	1075.285	-0.943619	-1076.228
Q_t@POWER/0 [var]	112.9796	174.1920	61.21239

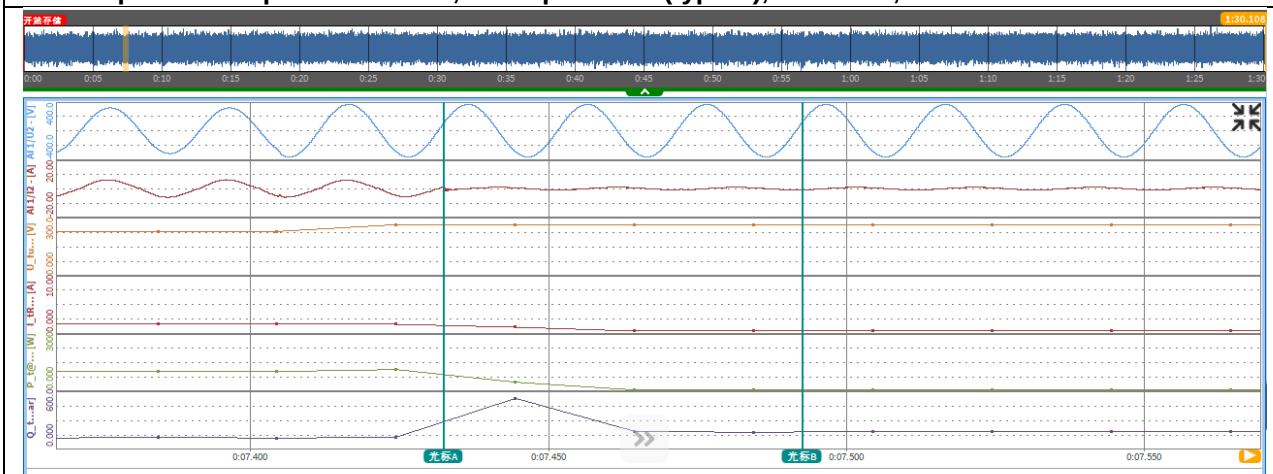
Test 7.2
Depth of fault phase:115%Un, three -phase SC(type A), 20% load, restoring time



	A	B	间隔
时间 [s]	1:07.63927	1:08.12015	0.48088
AI 1/U2 [V]	179.4314	97.00442	-82.42703
AI 1/I2 [A]	0.506067	1.500177	0.994110
U_fundRMS_SYM+@POWER/0 [V]	230.1856	230.0389	-0.146713
I_tRMS@POWER/0 [A]	0.192836	1.350142	1.157305
P_t@POWER/0 [W]	1.210680	925.8841	924.6734
Q_t@POWER/0 [var]	133.2263	107.5503	-25.67591

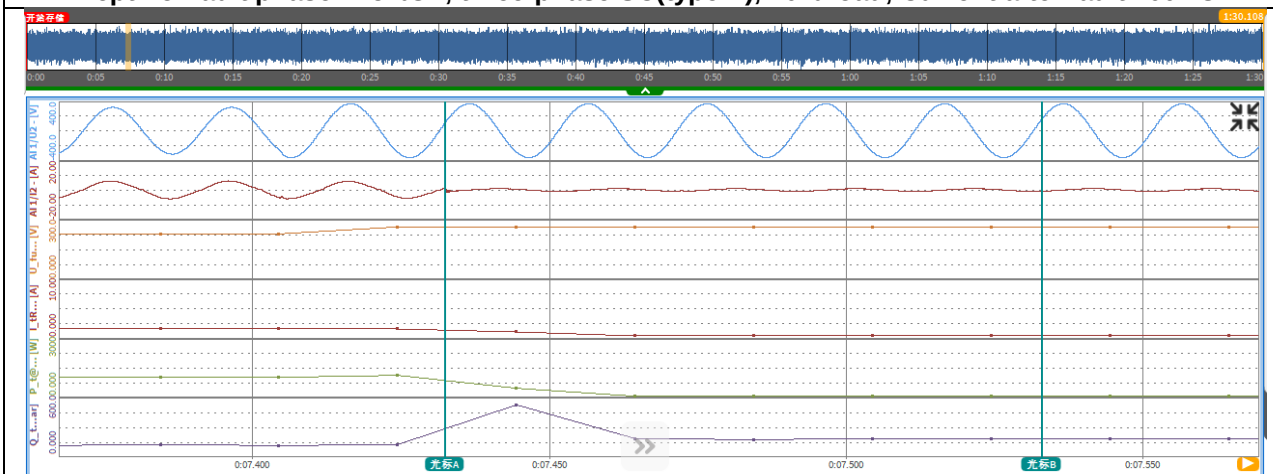
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 7.2
Depth of fault phase:115%Un, three-phase SC(type A), 20% load, Current after fault 60ms



	A	B	间隔
时间 [s]	7.43249	7.49261	0.06012
AI 1/U2 [V]	115.1559	137.1248	21.96884
AI 1/I2 [A]	1.683760	-0.892878	-2.576637
U_fundRMS_SYM+@POWER/0 [V]	264.1072	264.4681	0.360901
I_tRMS@POWER/0 [A]	1.365383	0.214496	-1.150886
P_t@POWER/0 [W]	1075.285	0.417662	-1074.867
Q_t@POWER/0 [var]	112.9796	170.2069	57.22734

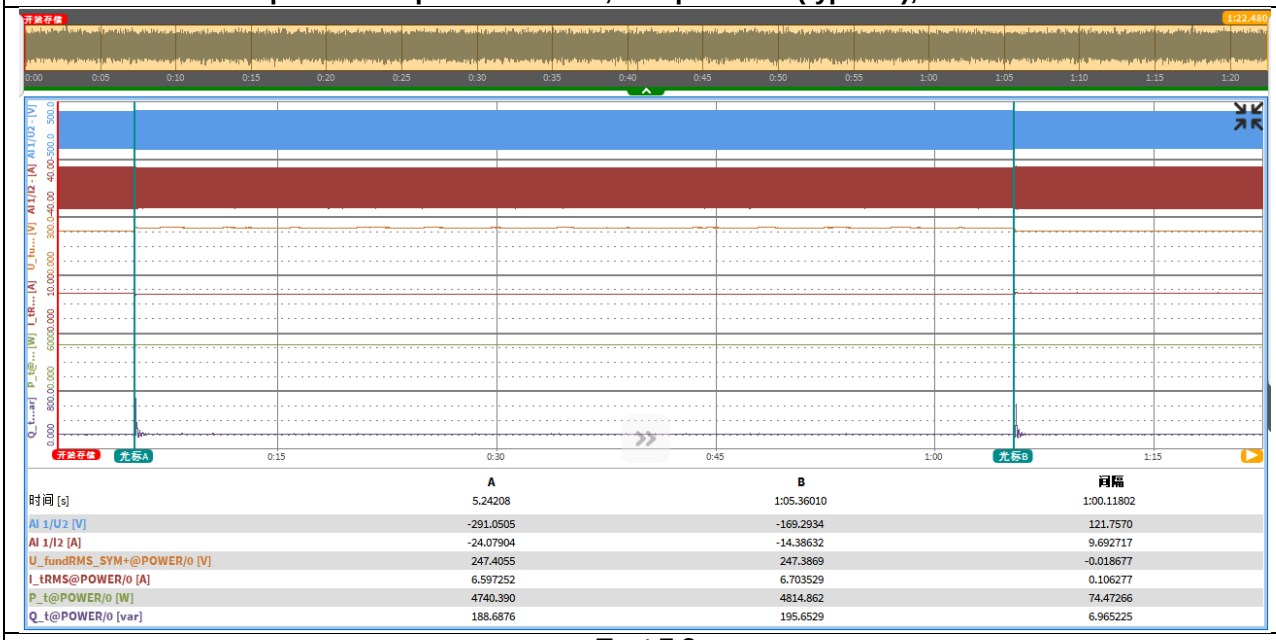
Test 7.2
Depth of fault phase:115%Un, three-phase SC(type A), 20% load, Current after fault 100ms



	A	B	间隔
时间 [s]	7.43249	7.53294	0.10045
AI 1/U2 [V]	115.1559	169.0619	53.90597
AI 1/I2 [A]	1.683760	-0.833130	-2.516890
U_fundRMS_SYM+@POWER/0 [V]	264.1072	264.4643	0.357117
I_tRMS@POWER/0 [A]	1.365383	0.219253	-1.146130
P_t@POWER/0 [W]	1075.285	-0.725041	-1076.010
Q_t@POWER/0 [var]	112.9796	173.9737	60.99411

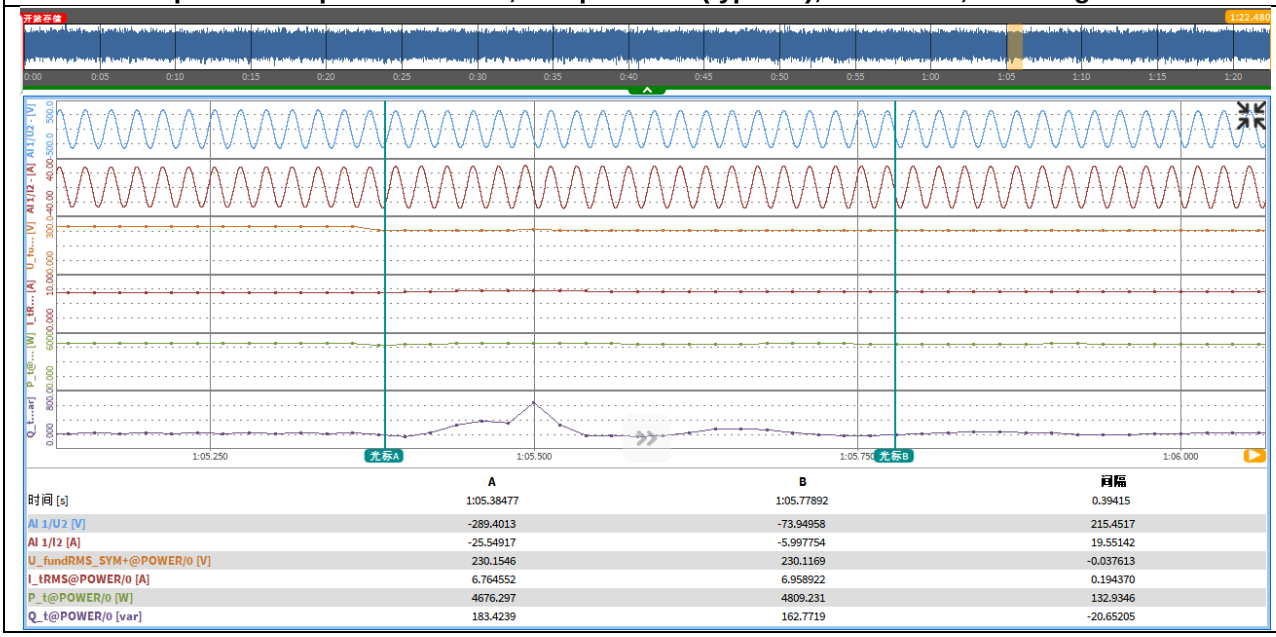
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 7.3
Depth of fault phase:115%Un, two-phase SC(type D1), 100% load



	A	B	间隔
时间 [s]	5.24208	1:05.36010	1:00.11802
AI 1/U2 [V]	-291.0505	-169.2934	121.7570
AI 1/I2 [A]	-24.07904	-14.38632	9.692717
U_fundRMS_SYM+@POWER/0 [V]	247.4055	247.3869	-0.018677
I_tRMS@POWER/0 [A]	6.597252	6.703529	0.106277
P_t@POWER/0 [W]	4740.390	4814.862	74.47266
Q_t@POWER/0 [var]	188.6876	195.6529	6.965225

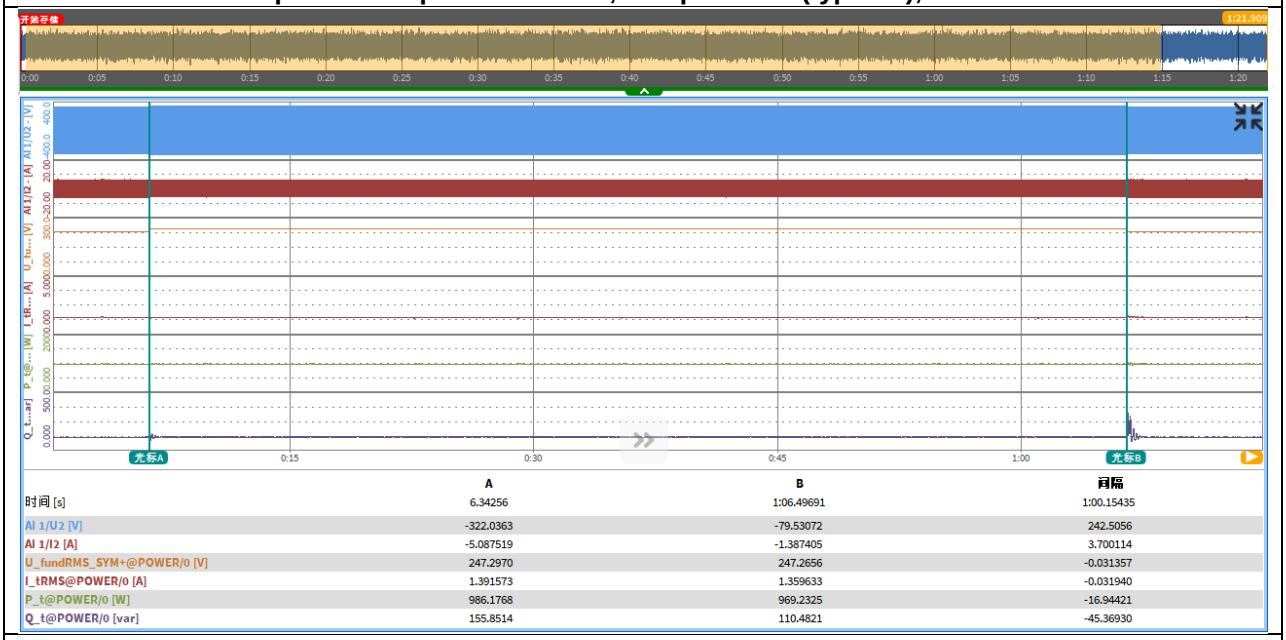
Test 7.3
Depth of fault phase:115%Un, two-phase SC(type D1), 100% load, restoring time



	A	B	间隔
时间 [s]	1:05.38477	1:05.77892	0.39415
AI 1/U2 [V]	-289.4013	-73.94958	215.4517
AI 1/I2 [A]	-25.54917	-5.997754	19.55142
U_fundRMS_SYM+@POWER/0 [V]	230.1546	230.1169	-0.037613
I_tRMS@POWER/0 [A]	6.764552	6.958922	0.194370
P_t@POWER/0 [W]	4676.297	4809.231	132.9346
Q_t@POWER/0 [var]	183.4239	162.7719	-20.65205

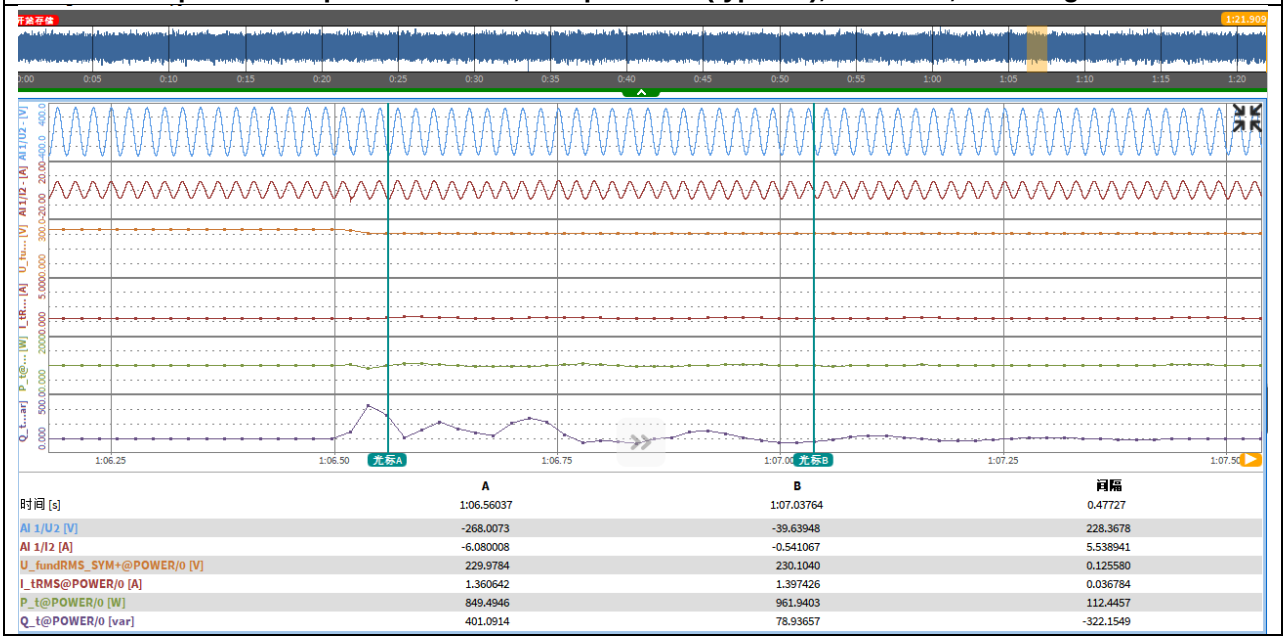
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Test 7.4
Depth of fault phase:115%Un, two-phase SC(type D1), 20% load



	A	B	间隔
时间 [s]	6.34256	1:06.49691	1:00.15435
AI 1/U2 [V]	-322.0363	-79.53072	242.5056
AI 1/I2 [A]	-5.087519	-1.387405	3.700114
U_fundRMS_SYM+@POWER/0 [V]	247.2970	247.2656	-0.031357
I_tRMS@POWER/0 [A]	1.391573	1.359633	-0.031940
P_t@POWER/0 [W]	986.1768	969.2325	-16.94421
Q_t@POWER/0 [var]	155.8514	110.4821	-45.36930

Test 7.4
Depth of fault phase:115%Un, two-phase SC(type D1), 20% load, restoring time



	A	B	间隔
时间 [s]	1:06.56037	1:07.03764	0.47727
AI 1/U2 [V]	-268.0073	-39.63948	228.3678
AI 1/I2 [A]	-6.080008	-0.541067	5.538941
U_fundRMS_SYM+@POWER/0 [V]	229.9784	230.1040	0.125580
I_tRMS@POWER/0 [A]	1.360642	1.397426	0.036784
P_t@POWER/0 [W]	849.4946	961.9403	112.4457
Q_t@POWER/0 [var]	401.0914	78.93657	-322.1549

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

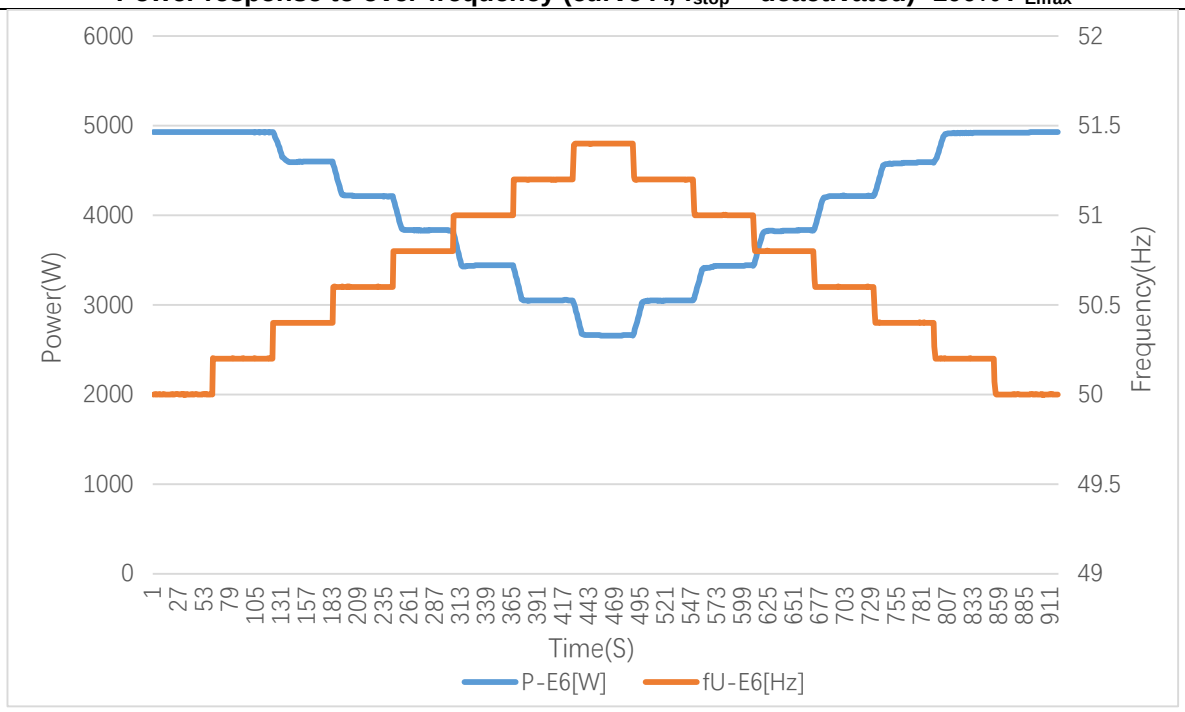
4.6.1	**TABLE: Power response to over-frequency (curve A, f_{stop} = deactivated)**				**P**
Model	AIO2-INS-5000@Working in photovoltaic grid-connected mode				
1. Starting active power = 100% P_{Emax}			P_M [W]	5000	
s = 5%		f_1 = 50.2 Hz	$P_{ref} = P_M$		
Frequency set point [Hz]		Measured frequency [Hz]	Power output [W]	Measured $\Delta P/P_{ref}$ [%]	Target $\Delta P/P_{ref}$ [%]
Frequency increase step	50.00	50.00	4927.99	-1.44	0
	50.20	50.20	4927.54	-1.45	0
	50.40	50.40	4600.73	-7.99	-8
	50.60	50.60	4213.11	-15.74	-16
	50.80	50.80	3832.86	-23.34	-24
	51.00	51.00	3443.64	-31.13	-32
	51.20	51.20	3049.79	-39.00	-40
	51.40	51.40	2658.86	-46.82	-48
Frequency restore step	51.40	51.40	2658.86	-46.82	-48
	51.20	51.20	3049.18	-39.02	-40
	51.00	51.00	3437.47	-31.25	-32
	50.80	50.80	3831.71	-23.37	-24
	50.60	50.60	4216.76	-15.66	-16
	50.40	50.40	4589.68	-8.21	-8
	50.20	50.20	4920.62	-1.59	0
	50.00	50.00	4927.12	-1.46	0

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

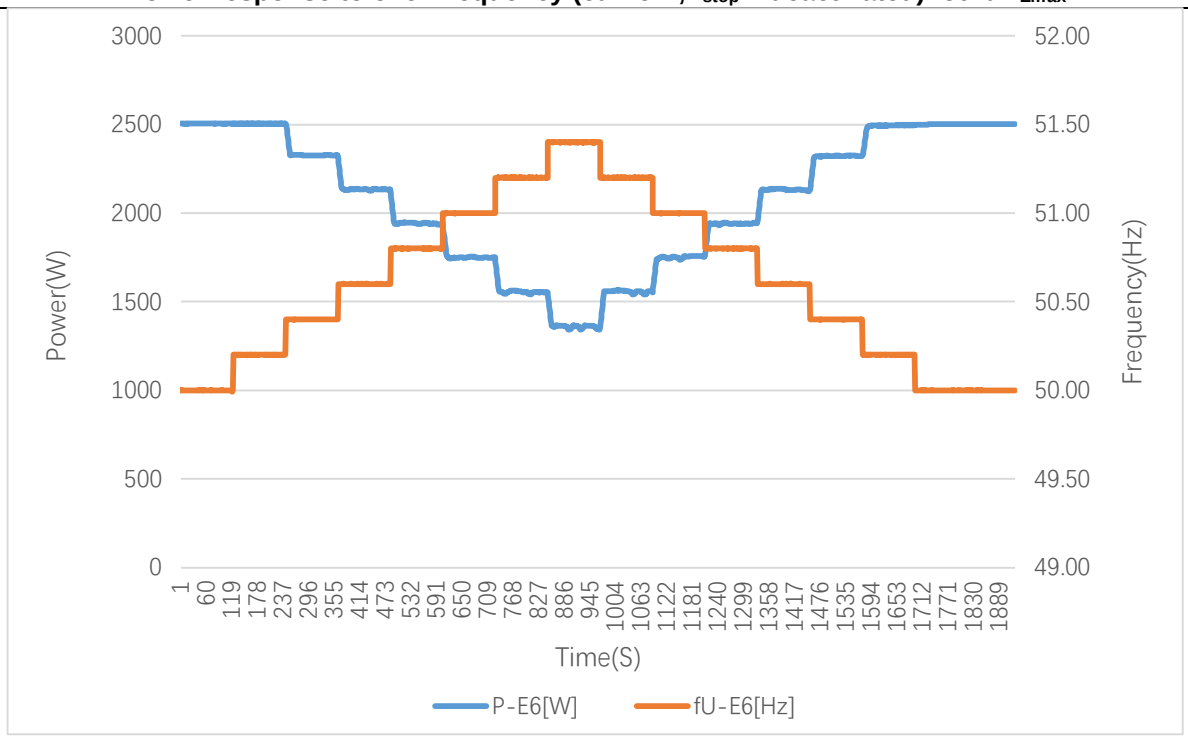
4.6.1	**TABLE: Power response to over-frequency (curve A, f_{stop} = deactivated)**				**P**
Model	AIO2-INS-5000@Working in photovoltaic grid-connected mode				
2. Starting active power between 40% P_{Emax} and 60% P_{Emax}			P_M [W]	2500	
s = 5%		f_1 = 50.2 Hz		$P_{ref} = P_M$	
Frequency set point [Hz]		Measured frequency [Hz]	Power output [W]	Measured $\Delta P/P_{ref}$ [%]	Target $\Delta P/P_{ref}$ [%]
Frequency increase step	50.00	50.00	2504.78	0.19	0
	50.20	50.20	2504.72	0.19	0
	50.40	50.40	2326.79	-6.93	-8
	50.60	50.60	2133.59	-14.66	-16
	50.80	50.80	1940.82	-22.37	-24
	51.00	51.00	1750.07	-30.00	-32
	51.20	51.20	1552.73	-37.89	-40
	51.40	51.40	1358.41	-45.66	-48
Frequency restore step	51.40	51.40	1358.41	-45.66	-48
	51.20	51.20	1553.72	-37.85	-40
	51.00	51.00	1754.48	-29.82	-32
	50.80	50.80	1941.71	-22.33	-24
	50.60	50.60	2131.28	-14.75	-16
	50.40	50.40	2323.55	-7.06	-8
	50.20	50.20	2496.48	-0.14	0
	50.00	50.00	2502.12	0.09	0

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Power response to over-frequency (curve A, f_{stop} = deactivated) -100% P_{Emax}



Power response to over-frequency (curve A, f_{stop} = deactivated) -50% P_{Emax}



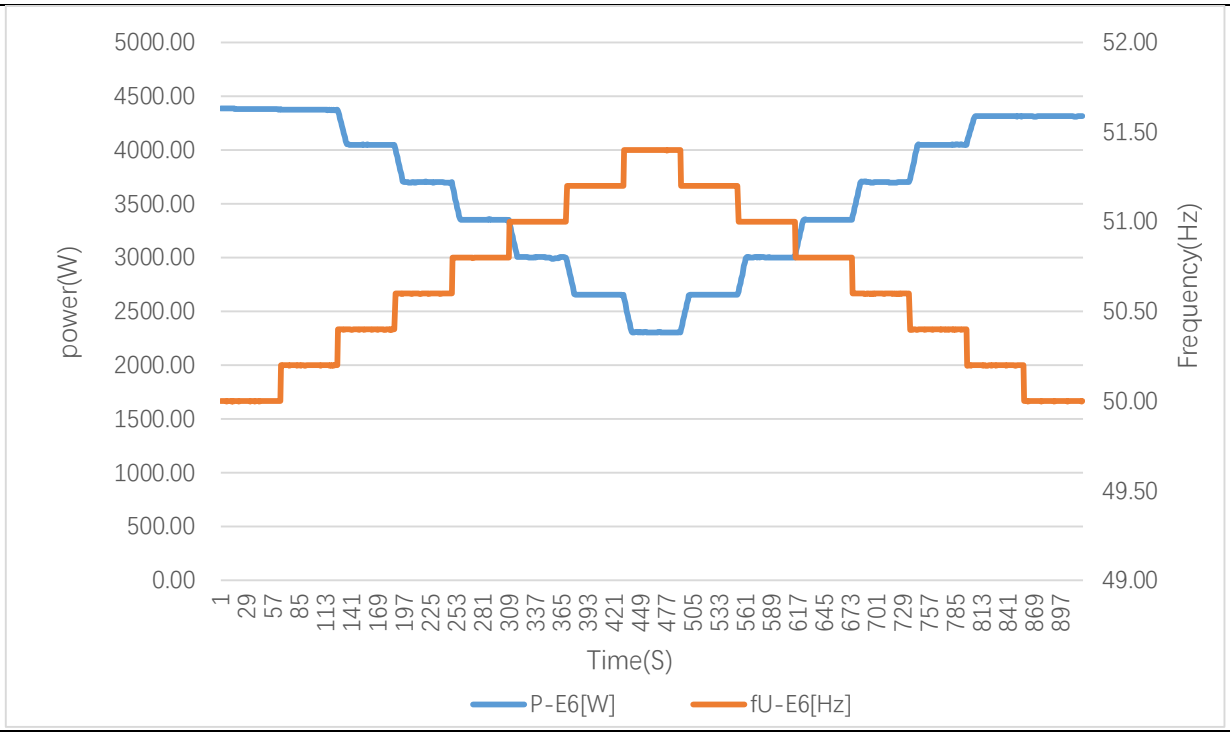
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

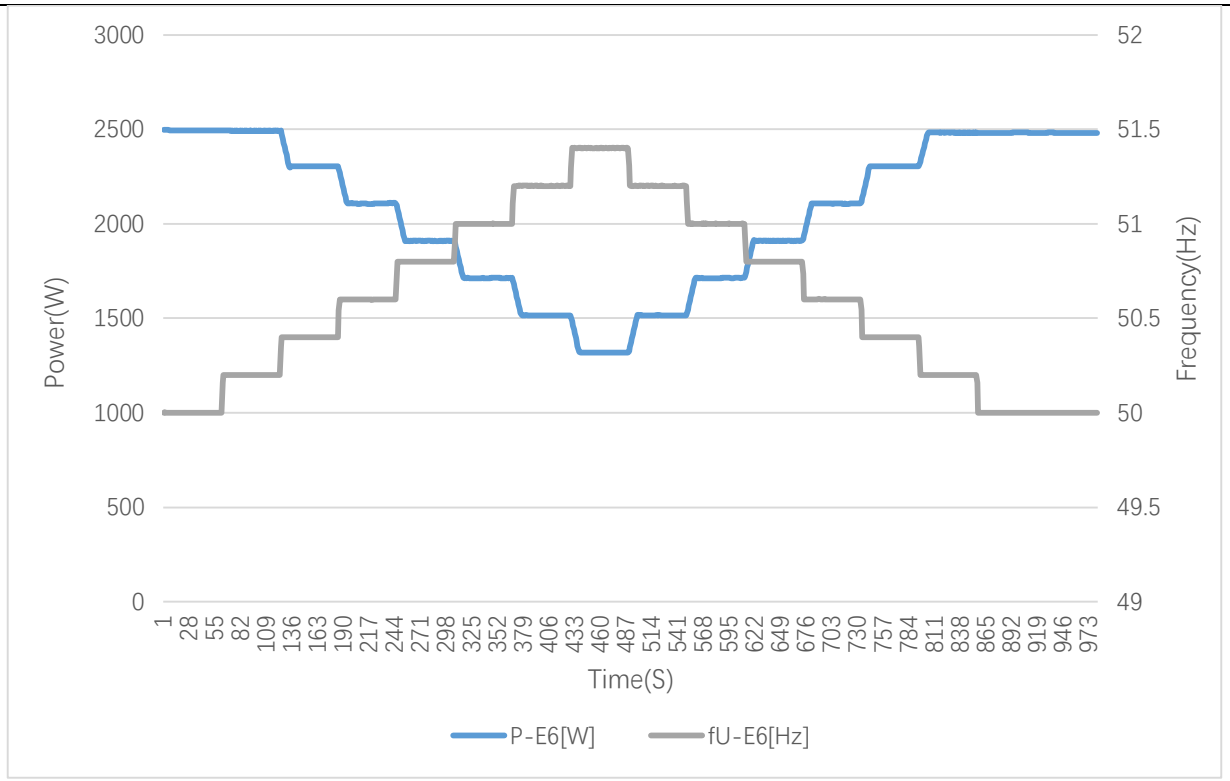
4.6.1	**TABLE: Power response to over-frequency (curve A, f_{stop} = deactivated)**				**P**
Model	AIO2-INS-5000@Working in battery discharge and grid connection mode				
3. Starting active power = 100% P_{Emax}				P_M [W]	4379.89
s = 5%		f_1 = 50.2 Hz		$P_{ref} = P_M$	
Frequency set point [Hz]		Measured frequency [Hz]	Power output [W]	Measured $\Delta P/P_{ref}$ [%]	Target $\Delta P/P_{ref}$ [%]
Frequency increase step	50.00	50.00	4379.89	0	0
	50.20	50.20	4373.60	-0.14	0
	50.40	50.40	4049.24	-7.55	-8
	50.60	50.60	3701.20	-15.50	-16
	50.80	50.80	3353.34	-23.44	-24
	51.00	51.00	3000.66	-31.49	-32
	51.20	51.20	2655.16	-39.38	-40
	51.40	51.40	2307.35	-47.32	-48
Frequency restore step	51.40	51.40	2307.35	-47.32	-48
	51.20	51.20	2655.48	-39.37	-40
	51.00	51.00	3003.23	-31.43	-32
	50.80	50.80	3353.01	-23.45	-24
	50.60	50.60	3701.11	-15.50	-16
	50.40	50.40	4050.37	-7.52	-8
	50.20	50.20	4314.64	-1.49	0
	50.00	50.00	4314.85	-1.48	0

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.6.1	**TABLE: Power response to over-frequency (curve A, f_{stop} = deactivated)**				**P**
Model	AIO2-INS-5000@Working in battery discharge and grid connection mode				
4. Starting active power between 40% P_{Emax} and 60% P_{Emax}				P_M [W]	2493.85
s = 5%		f_1 = 50.2 Hz		$P_{ref} = P_M$	
Frequency set point [Hz]		Measured frequency [Hz]	Power output [W]	Measured $\Delta P/P_{ref}$ [%]	Target $\Delta P/P_{ref}$ [%]
Frequency increase step	50.00	50.00	2493.85	0	0
	50.20	50.20	2492.05	-0.07	0
	50.40	50.40	2304.07	-7.61	-8
	50.60	50.60	2107.87	-15.48	-16
	50.80	50.80	1909.80	-23.42	-24
	51.00	51.00	1713.40	-31.30	-32
	51.20	51.20	1515.59	-39.23	-40
	51.40	51.40	1319.46	-47.09	-48
Frequency restore step	51.40	51.40	1319.46	-47.09	-48
	51.20	51.20	1516.37	-39.20	-40
	51.00	51.00	1713.53	-31.29	-32
	50.80	50.80	1910.00	-23.41	-24
	50.60	50.60	2106.74	-15.52	-16
	50.40	50.40	2304.54	-7.59	-8
	50.20	50.20	2482.12	-0.47	0
	50.00	50.00	2481.04	-0.51	0

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict





EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

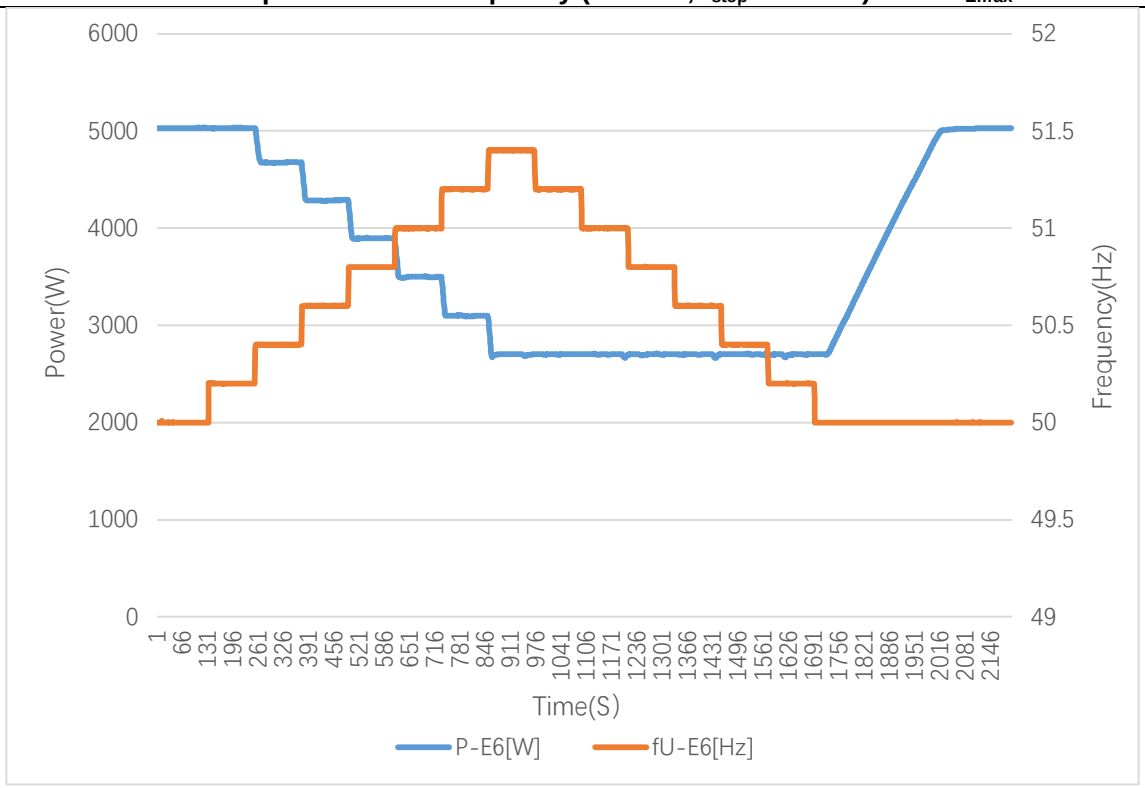
4.6.1	**TABLE: Power response to over-frequency (curve B, f_{stop} = 50.1Hz)**				**P**
Model	AIO2-INS-5000@Working in photovoltaic grid-connected mode				
5. Starting active power = 100% P_{Emax}				P_M [W]	5000
s = 5%		f_1 = 50.2 Hz		t_{stop} = 30 s	
Frequency set point [Hz]		Measured frequency [Hz]	Power output [W]	Measured $\Delta P/P_{ref}$ [%]	Target $\Delta P/P_{ref}$ [%]
Frequency increase step	50.00	50.00	5031.31	0.63	0
	50.20	50.20	5030.45	0.61	0
	50.40	50.40	4677.59	-6.45	-8
	50.60	50.60	4286.96	-14.26	-16
	50.80	50.80	3896.15	-22.08	-24
	51.00	51.00	3499.10	-30.02	-32
	51.20	51.20	3096.20	-38.08	-40
	51.40	51.40	2699.94	-46.00	-48
Frequency restore step	51.40	51.40	2699.94	-46.00	-48
	51.20	51.20	2702.39	-45.95	-48
	51.00	51.00	2697.08	-46.06	-48
	50.80	50.80	2703.52	-45.99	-48
	50.60	50.60	2696.74	-46.07	-48
	50.40	50.40	2701.59	-45.97	-48
	50.20	50.20	2701.54	-45.97	-48
	50.00	50.00	5029.34	0.59	-48% -> 0

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

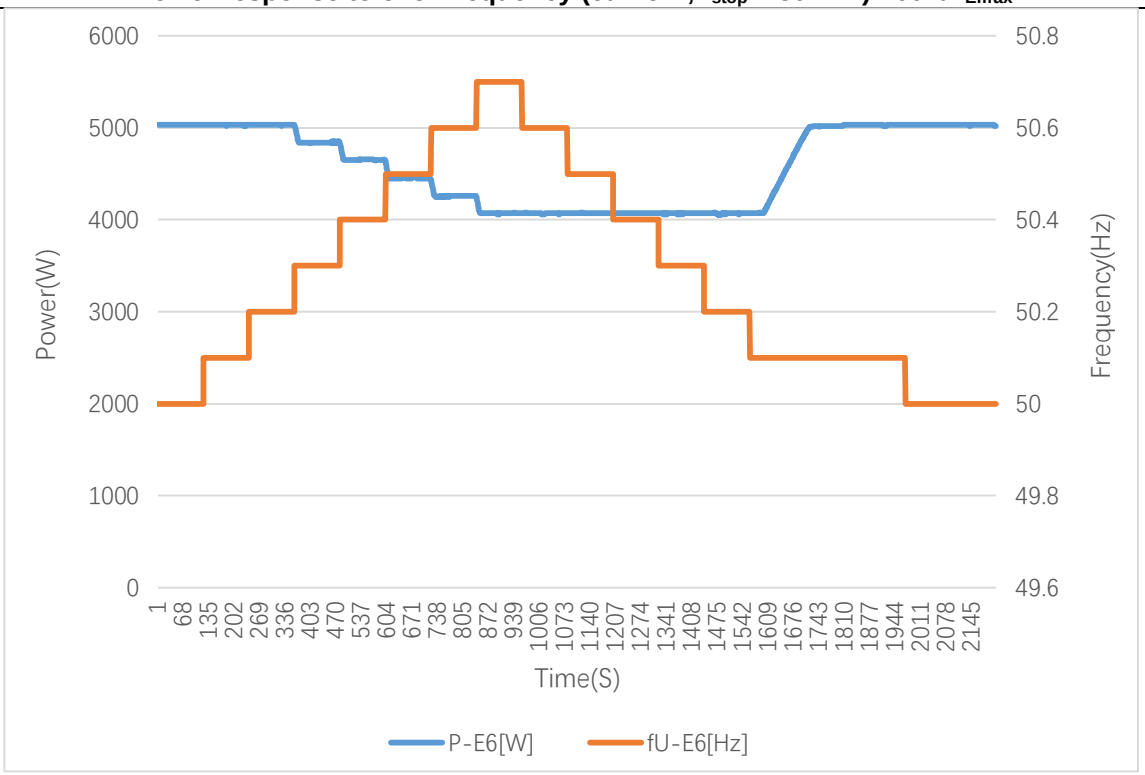
4.6.1	**TABLE: Power response to over-frequency (curve B, f_{stop} = 50.1Hz)**				**P**
Model	AIO2-INS-5000@Working in photovoltaic grid-connected mode				
6. Starting active power = 100% P_{Emax}				P_M [W]	5000
s = 5%		f_1 = 50.2 Hz		t_{stop} = 30 s	
Frequency set point [Hz]		Measured frequency [Hz]	Power output [W]	Measured $\Delta P/P_{ref}$ [%]	Target $\Delta P/P_{ref}$ [%]
Frequency increase step	50.00	50.00	5030.16	0.60	0
	50.10	50.10	5026.88	0.54	0
	50.20	50.20	5028.55	0.57	0
	50.30	50.30	4843.12	-3.14	-4
	50.40	50.40	4654.60	-6.91	-8
	50.50	50.50	4453.43	-10.93	-12
	50.60	50.60	4259.45	-14.81	-16
	50.70	50.70	4070.56	-18.56	-20
Frequency restore step	50.70	50.70	4070.56	-18.56	-20
	50.60	50.60	4067.65	-18.65	-20
	50.50	50.50	4068.74	-18.63	-20
	50.40	50.40	4070.65	-18.59	-20
	50.30	50.30	4068.21	-18.64	-20
	50.20	50.20	4069.52	-18.61	-20
	50.10	50.10	5025.96	0.52	-20*
	50.00	50.00	5027.59	0.55	-20 -> 0
Note: *value for first 30 s					

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Power response to over-frequency (curve B, f_{stop} = 50.1Hz)-100%P_{Emax}



Power response to over-frequency (curve B, f_{stop} = 50.1Hz)-100%P_{Emax}



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

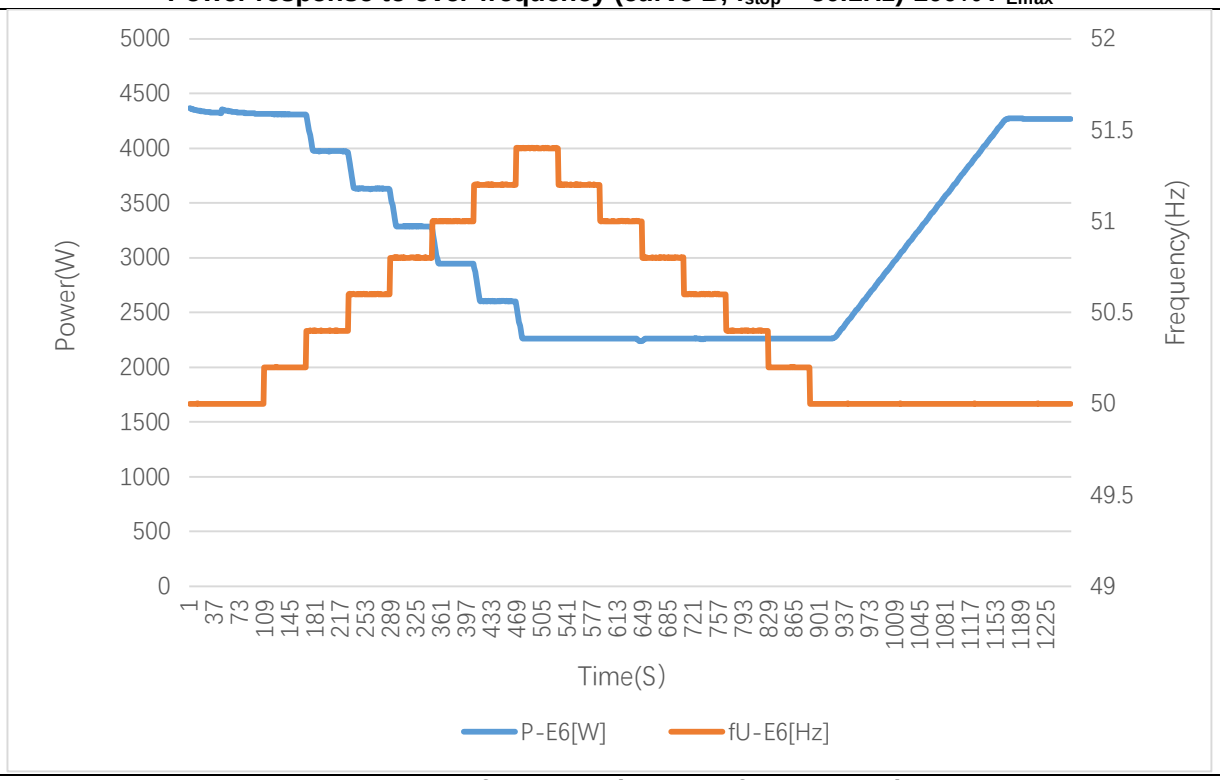
4.6.1	**TABLE: Power response to over-frequency (curve B, f_{stop} = 50.1Hz)**				**P**
Model	AIO2-INS-5000@Working in battery discharge and grid connection mode				
7. Starting active power = 100% P_{Emax}			P_M [W]	4326.26	
s = 5%		f_1 = 50.2 Hz		t_{stop} = 30 s	
Frequency set point [Hz]		Measured frequency [Hz]	Power output [W]	Measured $\Delta P/P_{ref}$ [%]	Target $\Delta P/P_{ref}$ [%]
Frequency increase step	50.00	50.00	4326.26	0	0
	50.20	50.20	4310.04	-0.38	0
	50.40	50.40	4000.68	-7.53	-8
	50.60	50.60	3652.98	-15.56	-16
	50.80	50.80	3309.64	-23.50	-24
	51.00	51.00	2970.03	-31.35	-32
	51.20	51.20	2626.58	-39.29	-40
	51.40	51.40	2285.97	-47.16	-48
Frequency restore step	51.40	51.40	2285.97	-47.16	-48
	51.20	51.20	2262.85	-47.70	-48
	51.00	51.00	2260.37	-47.75	-48
	50.80	50.80	2261.83	-47.72	-48
	50.60	50.60	2261.45	-47.73	-48
	50.40	50.40	2262.65	-47.70	-48
	50.20	50.20	2262.72	-47.70	-48
	50.00	50.00	4267.09	-1.37	-48% -> 0

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

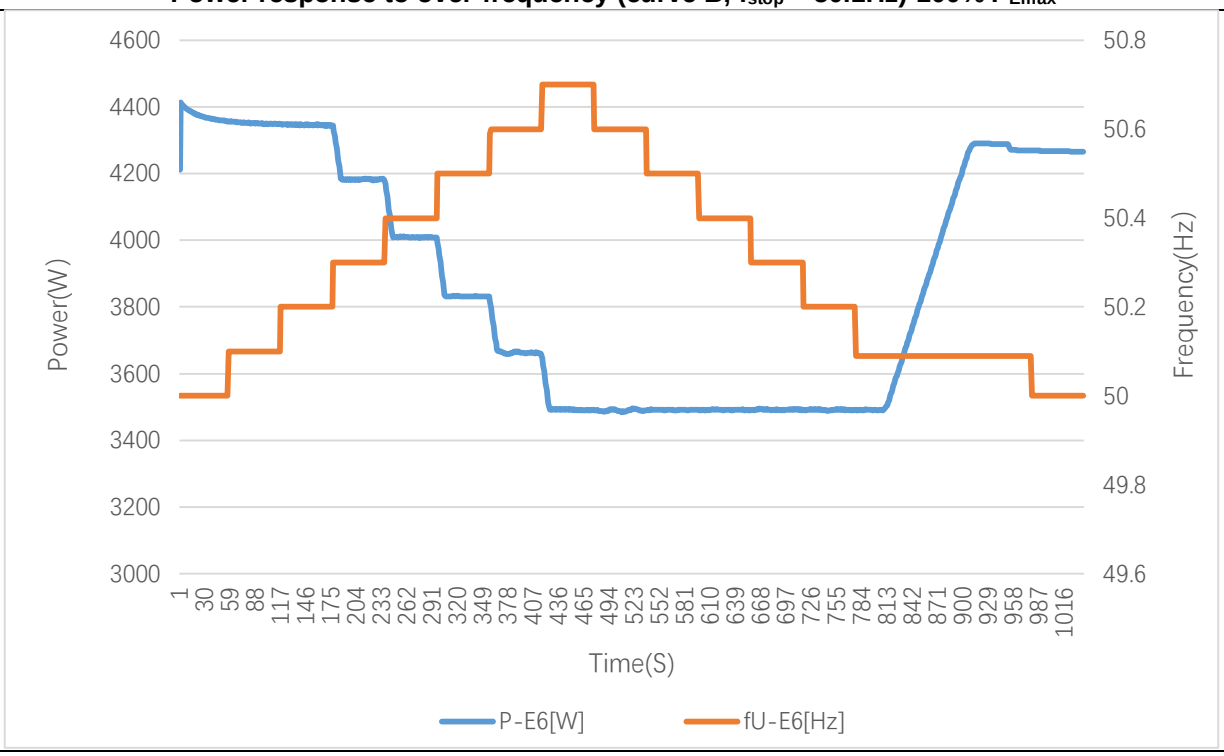
4.6.1	**TABLE: Power response to over-frequency (curve B, f_{stop} = 50.1Hz)**				**P**
Model	AIO2-INS-5000@Working in battery discharge and grid connection mode				
8. Starting active power = 100% P_{Emax}				P_M [W]	4363.02
s = 5%		f_1 = 50.2 Hz		t_{stop} = 30 s	
Frequency set point [Hz]		Measured frequency [Hz]	Power output [W]	Measured $\Delta P/P_{ref}$ [%]	Target $\Delta P/P_{ref}$ [%]
Frequency increase step	50.00	50.00	4363.02	0	0
	50.10	50.10	4349.49	-0.31	0
	50.20	50.20	4345.28	-0.41	0
	50.30	50.30	4182.91	-4.13	-4
	50.40	50.40	4008.65	-8.12	-8
	50.50	50.50	3831.64	-12.18	-12
	50.60	50.60	3662.64	-16.05	-16
	50.70	50.70	3490.83	-19.99	-20
Frequency restore step	50.70	50.70	3490.83	-19.99	-20
	50.60	50.60	3489.92	-20.01	-20
	50.50	50.50	3490.89	-19.99	-20
	50.40	50.40	3491.38	-19.98	-20
	50.30	50.30	3491.78	-19.97	-20
	50.20	50.20	3491.49	-19.98	-20
	50.10	50.10	4272.84	-2.07	-20*
	50.00	50.00	4266.22	-2.98	-20 -> 0
Note: *value for first 30 s					

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Power response to over-frequency (curve B, f_{stop} = 50.1Hz)-100% P_{Emax}



Power response to over-frequency (curve B, f_{stop} = 50.1Hz)-100% P_{Emax}



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

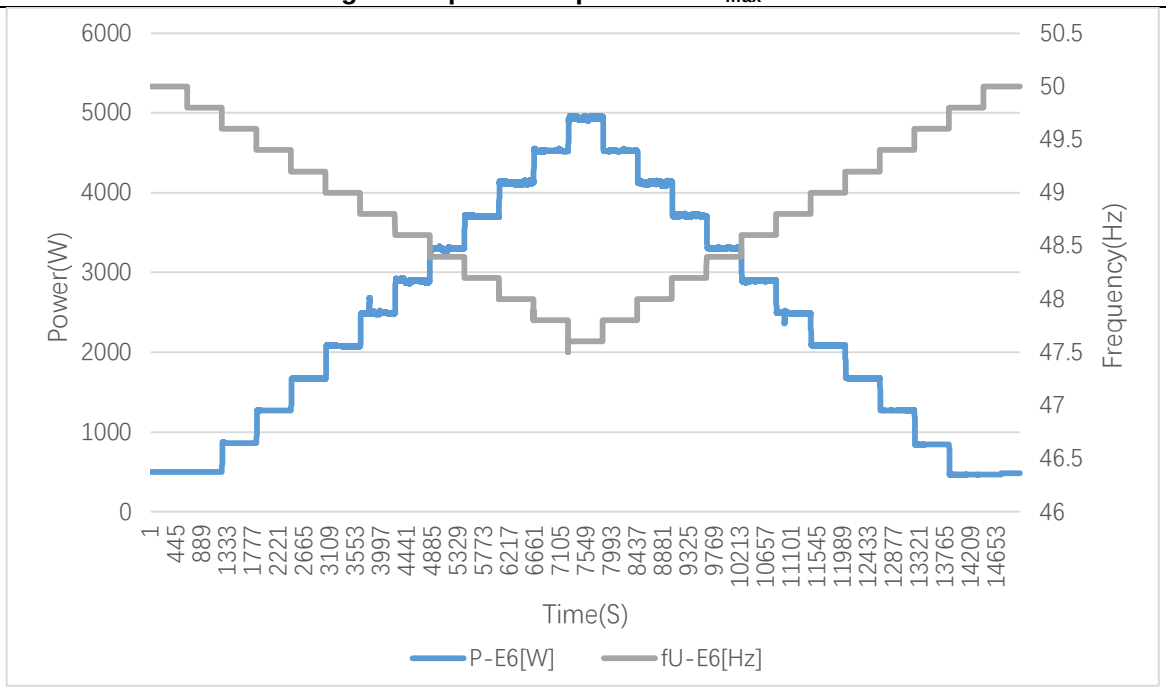
4.6.2	**TABLE: Power response to under-frequency**					**P**
Model	AIO2-INS-5000@Working in battery discharge and PV mode					
Measurement: Starting active power output = 10% P_{max} for inverter						
s = 5 %		f_1 = 49.8 Hz		P_{ref} [W]: 500		
Frequency set point [Hz]		Measured frequency [Hz]	Power output [W]	Measured $\Delta P/_{Pref}$ [%]	Target $\Delta P/P_{ref}$ [%]	Disconnect or not
Frequency decrease step	50.00	50.00	499.55	0	-0.01	No
	49.80	49.80	499.36	0	-0.01	No
	49.60	49.60	860.26	-8	-7.21	No
	49.40	49.40	1270.53	-16	-15.41	No
	49.20	49.20	1662.49	-24	-23.25	No
	49.00	49.00	2077.67	-32	-31.55	No
	48.80	48.80	2490.06	-40	39.80	No
	48.60	48.60	2893.31	-48	-47.87	No
	48.40	48.40	3305.29	-56	-56.11	No
	48.20	48.20	3701.54	-64	-64.03	No
	48.00	48.00	4123.42	-72	-72.47	No
	47.80	47.80	4523.96	-80	-80.48	No
	47.60	47.60	4935.40	-88	-88.71	No
Frequency restore step	47.60	47.60	4935.40	-88	-88.71	No
	47.80	47.80	4528.60	-80	-80.57	No
	48.00	48.00	4118.97	-72	-72.38	No
	48.20	48.20	3712.41	-64	-64.25	No
	48.40	48.40	3302.71	-56	-56.05	No
	48.60	48.60	2896.54	-48	-47.93	No
	48.80	48.80	2488.01	-40	-39..76	No
	49.00	49.00	2085.50	-32	-31.71	No
	49.20	49.20	1676.36	-24	-23.53	No
	49.40	49.40	1273.86	-16	-15.48	No
	49.60	49.60	844.07	-8	-6.88	No
	49.80	49.80	465.50	0	-0.69	No
	50.00	50.00	482.68	0	-0.35	No
Limit $\Delta P_{E60}/P_{ref}$:		± 10% of P_{ref}				

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

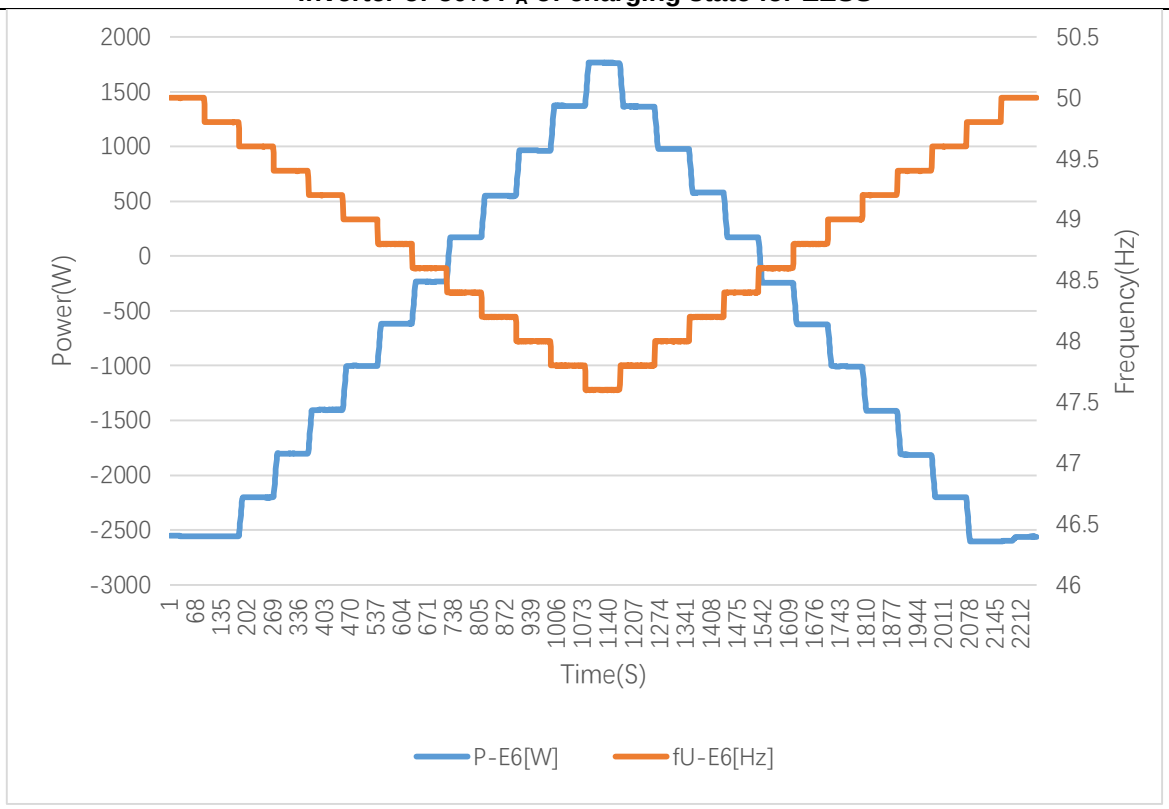
4.6.2	**TABLE: Power response to under-frequency**					**P**
Model	AIO2-INS-5000@Work from the grid charge the battery mode to battery discharge mode					
Measurement: Starting active power output = 50% P_A of charging state for EESS.						
s = 5 %		f_1 = 49.8 Hz		P_{ref} [W]: 2560.56		
Frequency set point [Hz]		Measured frequency [Hz]	Power output [W]	Measured $\Delta P/P_{ref}$ [%]	Target $\Delta P/P_{ref}$ [%]	Disconnect or not
Frequency decrease step	50.00	50.00	-2555.90	0	0	No
	49.80	49.80	-2558.34	0	0.05	No
	49.60	49.60	-2203.15	-8	-7.06	No
	49.40	49.40	-1801.52	-16	-15.09	No
	49.20	49.20	-1403.28	-24	-23.05	No
	49.00	49.00	-1000.75	-32	-31.10	No
	48.80	48.80	-615.77	-40	-38.80	No
	48.60	48.60	-233.75	-48	-46.44	No
	48.40	48.40	170.32	-56	-54.52	No
	48.20	48.20	549.25	-64	-62.10	No
	48.00	48.00	962.95	-72	-70.38	No
	47.80	47.80	1369.54	-80	-78.51	No
	47.60	47.60	1763.93	-88	-86.40	No
Frequency restore step	47.60	47.60	1763.93	-88	-86.40	No
	47.80	47.80	1365.20	-80	-78.42	No
	48.00	48.00	976.42	-72	-70.65	No
	48.20	48.20	578.71	-64	-62.69	No
	48.40	48.40	170.70	-56	-54.53	No
	48.60	48.60	-242.35	-48	-46.27	No
	48.80	48.80	-622.15	-40	-38.68	No
	49.00	49.00	-1006.68	-32	-30.98	No
	49.20	49.20	-1412.41	-24	-22.87	No
	49.40	49.40	-1814.10	-16	-14.84	No
	49.60	49.60	-2199.74	-8	-7.12	No
	49.80	49.80	-2604.81	0	0.98	No
	50.00	50.00	-2562.35	0	0.13	No
Limit $\Delta P_{E60}/P_{ref}$:		± 10% of P_{ref}				

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Starting active power output = 10% P_{max} for inverter



Inverter or 50% P_A of charging state for EESS



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.7.2.2 **4.7.2.3.2**	**TABLE: Setpoint control modes – Q setpoint mode**	**P**
Model	AIO2-INS-5000	

Inductive supply reactive power

Rating power [%]	Active power [W]	Reactive Power [Var]	Setpoint-Q/P_D [%]	Power factor [cos φ]	Voltage [V]
0% - 10%	524.83	2165.06	48.11	0.52	230.40
10% - 20%	996.32	2162.78	48.06	0.51	230.55
20% - 30%	1498.72	2111.57	46.92	0.58	230.55
30% - 40%	1999.46	2122.23	47.16	0.69	230.53
40% - 50%	2506.79	2122.77	47.17	0.76	230.44
50% - 60%	3003.61	2125.22	47.23	0.82	230.31
60% - 70%	3500.60	2124.09	47.20	0.85	230.36
70% - 80%	3994.37	2122.41	47.16	0.88	230.49
80% - 90%	4494.25	2120.01	47.11	0.90	230.79
90% - 100%	4581.87	2140.39	47.56	0.91	230.30

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Clause	Requirement - Test	Result - Remark	Verdict

Capacitive supply reactive power					
Rating power [%]	Active power [W]	Reactive Power [Var]	Setpoint-Q/P_D [%]	Power factor [cos φ]	Voltage [V]
0% - 10%	522.49	-2178.29	-48.41	0.51	230.12
10% - 20%	993.45	-2149.82	-47.77	0.50	230.38
20% - 30%	1496.18	-2137.39	-47.50	0.57	230.14
30% - 40%	1997.86	-2150.41	-47.79	0.68	230.47
40% - 50%	2506.71	-2157.70	-47.95	0.76	230.48
50% - 60%	3002.99	-2169.30	-48.21	0.81	230.22
60% - 70%	3501.78	-2182.73	-48.51	0.85	230.31
70% - 80%	3997.56	-2196.86	-48.82	0.88	230.47
80% - 90%	4494.06	-2202.91	-48.95	0.90	230.18
90% - 100%	4583.19	-2206.34	-49.03	0.90	230.14

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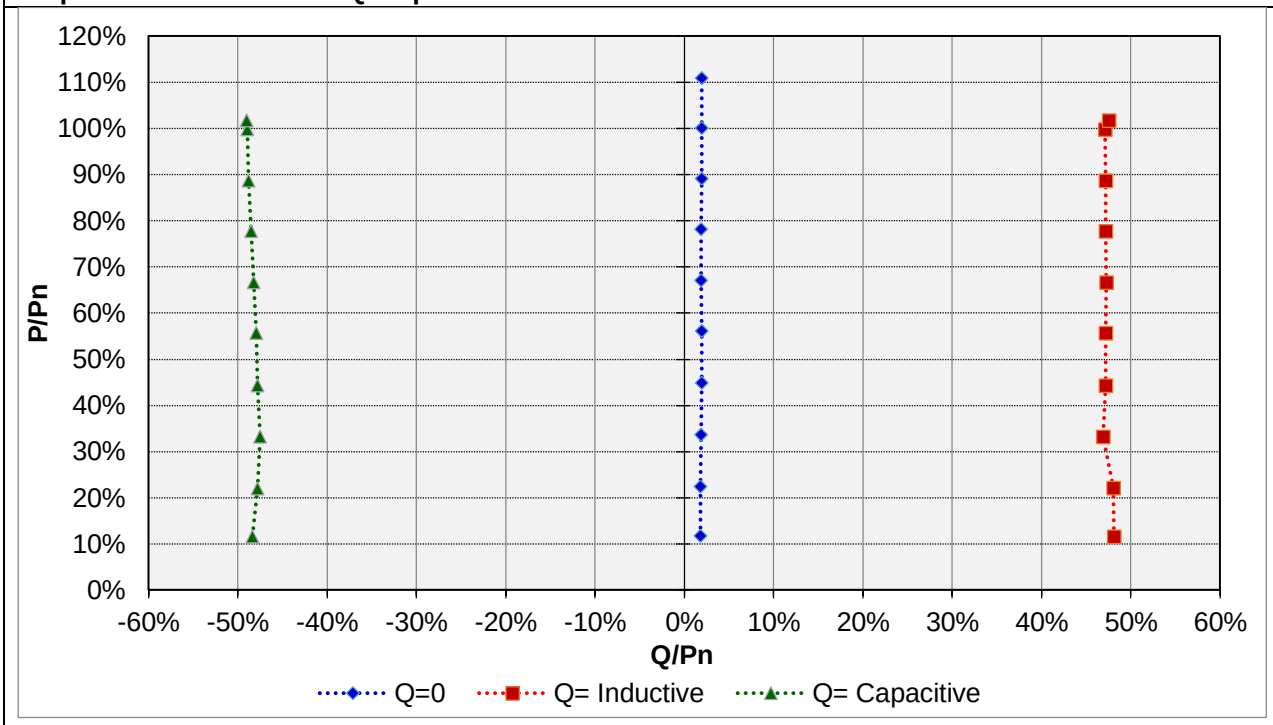
Clause	Requirement - Test	Result - Remark	Verdict

Cos phi = 1 no reactive power supply					
Rating power [%]	Active power [W]	Reactive Power [Var]	Setpoint-Q/P_D [%]	Power factor [cos φ]	Voltage [V]
0% - 10%	529.39	82.73	1.84	0.99	230.30
10% - 20%	1012.25	81.10	1.80	1.00	230.45
20% - 30%	1515.13	83.96	1.87	1.00	230.35
30% - 40%	2019.40	88.71	1.97	1.00	229.57
40% - 50%	2525.59	86.20	1.92	1.00	230.30
50% - 60%	3022.12	85.17	1.89	1.00	230.47
60% - 70%	3520.93	85.50	1.90	1.00	232.56
70% - 80%	4014.39	86.38	1.92	1.00	230.47
80% - 90%	4508.57	89.08	1.98	1.00	230.38
90% - 100%	4994.23	88.98	1.98	1.00	230.51

Note:
When operating above the apparent power threshold S_{min} equal to 10 % of the maximum apparent power S_{max} or the minimum regulating level of the generating plant, whichever is the higher value, the reactive power capability shall be provided with an accuracy of ± 2 % S_{max}. Up to this apparent power threshold S_{min}, deviations above 2 % are permissible.

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Setpoint control modes – Q setpoint mode



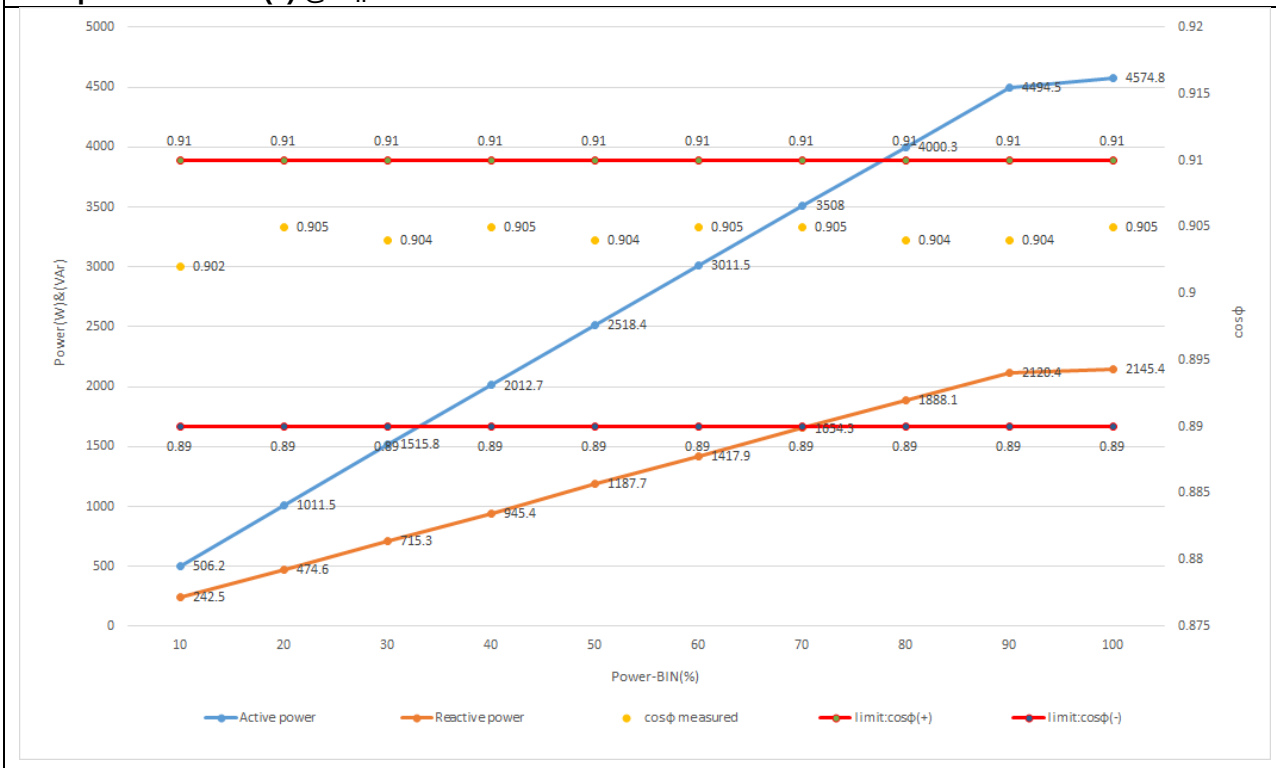
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.7.2.2 **4.7.2.3.2**	**TABLE: Setpoint control modes – Cos φ setpoint mode**									**P**
Model	AIO2-INS-5000									
Setting values	cos φ over-excited:	+0.90								
	cos φ under-excited:	-0.90								
P/P_n [%]	10	20	30	40	50	60	70	80	90	100
30 s mean value	cos φ over-excited (c) @ U_n									
U [V]:	230.4	230.3	230.4	230.3	230.4	230.3	230.4	230.4	230.4	230.1
P_{E30} [W]:	506.2	1011.5	1515.8	2012.7	2518.4	3011.5	3508.0	4000.3	4494.5	4574.8
Q_{E30} [VAr]:	242.5	474.6	715.3	945.4	1187.7	1417.9	1654.3	1888.1	2120.4	2145.4
cos $\varphi_{E30\text{-over-excited}}$:	0.902	0.905	0.904	0.905	0.904	0.905	0.905	0.904	0.904	0.905
30 s mean value	cos φ over-excited (c) @ 1.09 U_n									
U [V]:	250.7	250.6	250.6	250.7	250.7	250.8	250.9	250.9	250.7	250.4
P_{E30} [W]:	524.3	1012.8	1520.8	2021.0	2524.7	3021.3	3517.4	4014.4	4509.4	4552.9
Q_{E30} [VAr].	268.1	501.6	739.7	974.5	1215.1	1446.9	1684.7	1918.9	2151.3	2157.0
cos $\varphi_{E30\text{-over-excited}}$:	0.890	0.896	0.899	0.901	0.901	0.902	0.902	0.902	0.903	0.904
30 s mean value	cos φ under-excited (i) @ U_n									
U [V]:	230.2	230.2	230.2	230.1	230.1	230.0	230.1	230.1	230.2	230.0
P_{E30} [W]:	494.6	1009.2	1515.5	2013.5	2516.7	3010.3	3503.7	3996.8	4489.2	4540.3
Q_{E30} [VAr]:	243.2	499.2	747.3	994.4	1245.6	1492.8	1741.3	1989.4	2238.7	2250.3
cos $\varphi_{E30\text{-under-excited}}$:	0.897	0.896	0.897	0.897	0.896	0.896	0.896	0.895	0.895	0.896
30 s mean value	cos φ under-excited (i) @ 1.09 U_n									
U [V]:	250.7	250.6	250.6	250.7	250.7	250.6	250.6	250.7	250.7	250.6
P_{E30} [W]:	526.9	1009.9	1516.7	2017.1	2523.0	3018.0	3509.7	4007.9	4493.4	4530.8
Q_{E30} [VAr]:	262.9	497.0	750.0	994.2	1247.0	1495.5	1743.7	1990.8	2232.8	2238.8
cos $\varphi_{E30\text{-under-excited}}$:	0.895	0.897	0.896	0.897	0.896	0.896	0.896	0.896	0.896	0.897
Limit cos φ_{E30}:	cos φ= 0.89 to 0.91 (c) and cos φ= 0.89 to 0.91 (i)									

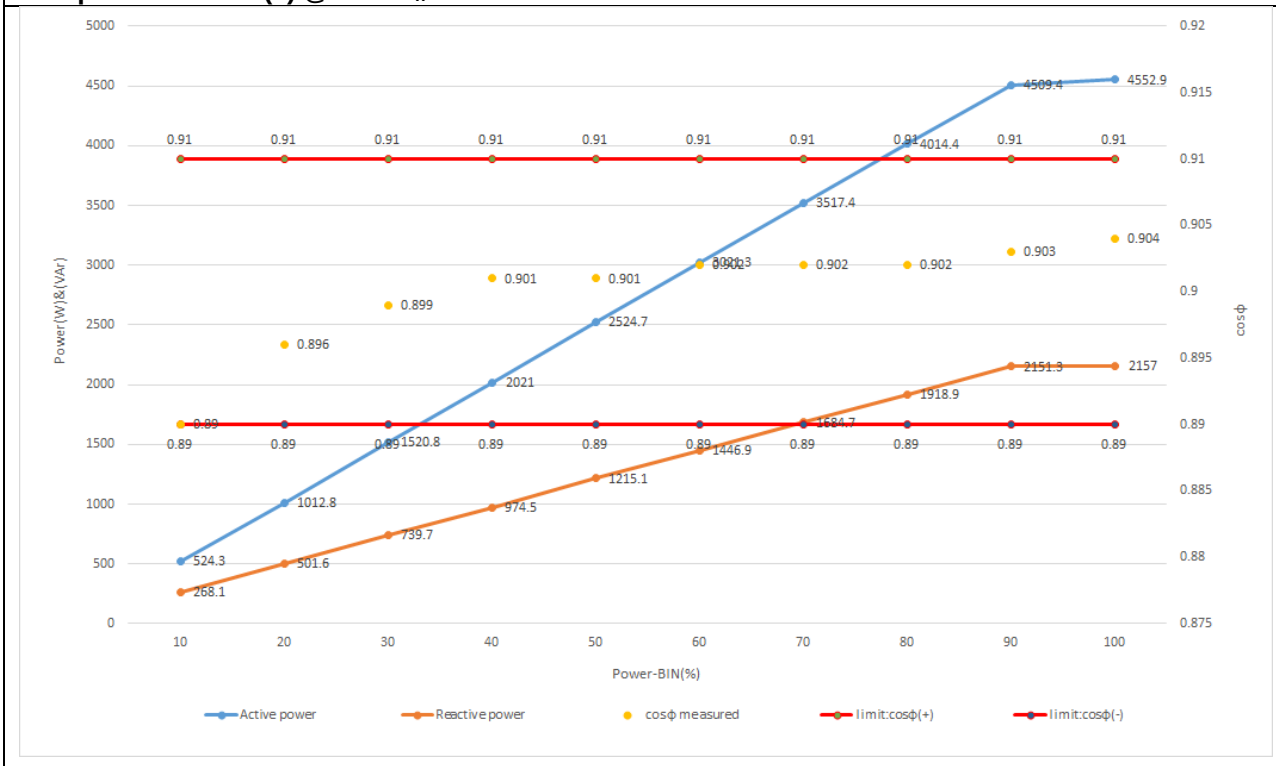
Note:
When operating above the apparent power threshold Smin equal to 10 % of the maximum apparent power Smax or the minimum regulating level of the generating plant, whichever is the higher value, the reactive power capability shall be provided with an accuracy of ± 2 % Smax. Up to this apparent power threshold Smin, deviations above 2 % are permissible.
The tests were performed on model AIO2-INS-5000 also applicable for all other models stated in this report.

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

cos φ over-excited (c) @ U_n

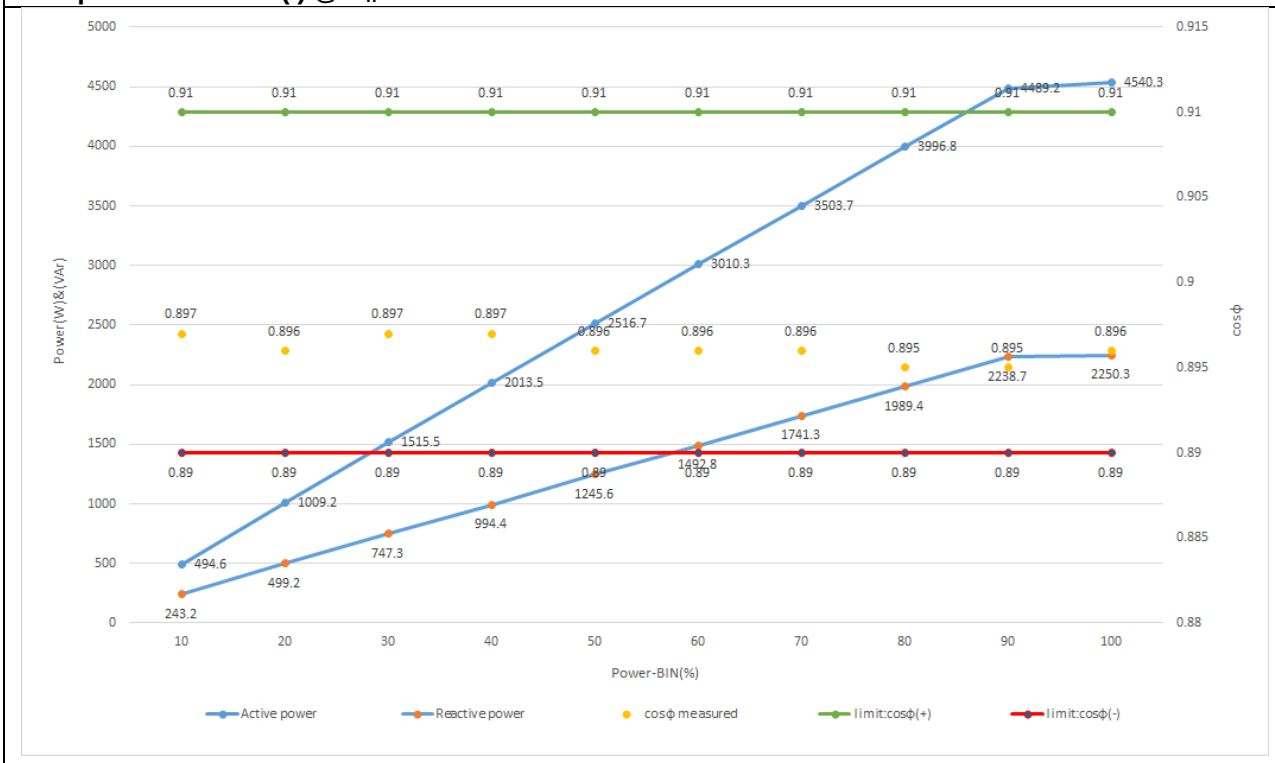


cos φ over-excited (c) @ 1.09 U_n

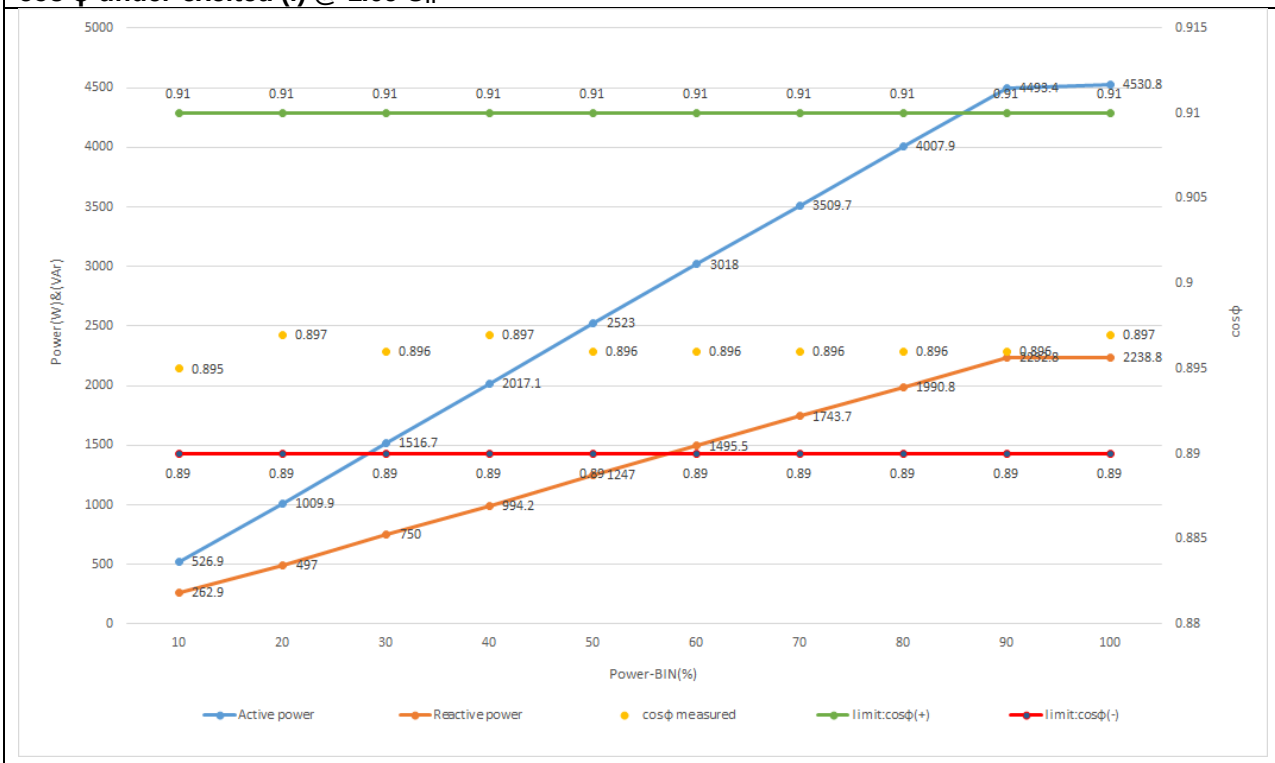


EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

cos φ under-excited (i) @ U_n



cos φ under-excited (i) @ 1.09 U_n



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.7.2.2 **4.7.2.3.3**	**TABLE: Voltage related control mode – Q(U)**	**P**
Model	AIO2-INS-5000	
Setting of the PCE		
Time constant range	3 s ~ 60 s	
Lock-in value setting	20% P_D	
Lock-out value setting	5% P_D	
Test result:		

Capacitive reactive power supply

P/P_n Set-point	Vac [V] Set point	P/P_n [%] measured	Vac [V] measured	Q [Var] measured	Q [Var] expected	ΔQ [Var] [≤±2% P_n]
< 20%	1,07 V_n	10.62	246.11	90.65	≈0(<±2%P_n)	90.65
< 20%	1,09 V_n	10.62	250.58	93.43	≈0(<±2%P_n)	93.43
<20% ->30%	1,09 V_n	25.28	250.76	-1167.03	-0.5 Q_{max} (within 10s)	102.97
40%	1,09 V_n	40.41	250.69	-1109.60	-0.5 Q_{max}	100.4
50%	1,09 V_n	50.56	250.74	-1110.01	-0.5 Q_{max}	99.99
60%	1,09 V_n	60.49	250.70	-1113.77	-0.5 Q_{max}	96.23
70%	1,09 V_n	70.49	250.66	-1116.81	-0.5 Q_{max}	93.19
80%	1,09 V_n	80.48	250.63	-1133.73	-0.5 Q_{max}	76.27
90%	1,09 V_n	90.48	250.71	-1140.83	-0.5 Q_{max}	69.17
100%	1,09 V_n	97.75	250.71	-1124.85	-0.5 Q_{max}	85.15
100%	1,1 V_n	90.52	253.02	-2360.45	- Q_{max}	59.55
100% ->10%	1,1 V_n	50.28	252.95	-2345.37	- Q_{max}	74.63
10% -> ≤5%	1,1 V_n	8.21	252.89	93.82	≈0(<±2%P_n)	93.82

Inductive reactive power absorption/

P/P_n Set-point	Vac [V] Set point	P/P_n [%] measured	Vac [V] measured	Q [Var] measured	Q [Var] expected	ΔQ [Var] [≤±2%P_n]
< 20%	0,93 V_n	10.61	213.83	75.43	≈0 (<±2%P_n)	75.43
< 20%	0,91 V_n	10.59	209.33	73.75	≈0 (<±2%P_n)	73.75
< 20% ->30%	0,91 V_n	25.05	209.44	1112.19	0.5 Q_{max} (within 10s)	-97.81
40%	0,91 V_n	40.26	209.27	1109.69	0.5 Q_{max}	-100.31
50%	0,91 V_n	50.33	209.37	1121.48	0.5 Q_{max}	-88.52
60%	0,91 V_n	60.26	209.20	1123.02	0.5 Q_{max}	-86.98
70%	0,91 V_n	70.158	209.22	1127.89	0.5 Q_{max}	-82.11
80%	0,91 V_n	80.02	209.25	1109.83	0.5 Q_{max}	-100.17

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Clause	Requirement - Test				Result - Remark	Verdict

90%	0,91 V_n	89.92	209.33	1133.38	0.5 Q_{max}	-76.62
100%	0,91 V_n	92.05	209.27	1124.20	0.5 Q_{max}	-85.8
100%	0,90 V_n	83.03	206.92	2321.18	Q_{max}	-98.82
100%-> 10%	0,90 V_n	49.82	206.92	2324.16	Q_{max}	-95.84
10% ->5%	0,90 V_n	8.17	206.99	71.43	≈0(<±2%P_n)	71.43

Note:
The test method reference CEI 0-21:2019-04, Annex B1.2.6 as below:
The parameters V_{1i}, V_{2i}, V_{1s} and V_{1s} should be set in the range between 0.9 V_n and 1.1 V_n with 0.01 V_n steps. In order to facilitate execution of the type tests, the characterizing parameters are conventionally set as follows:
V_{1s} = 1,08 V_n; V_{2s} = 1,1 V_n
V_{1i} = 0,92 V_n; V_{2i} = 0,9 V_n
and the active power lock-in value (default value P = 0.2 P_n).

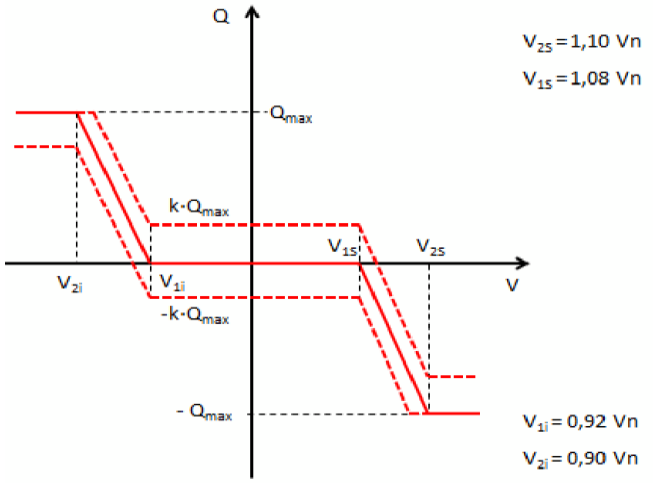
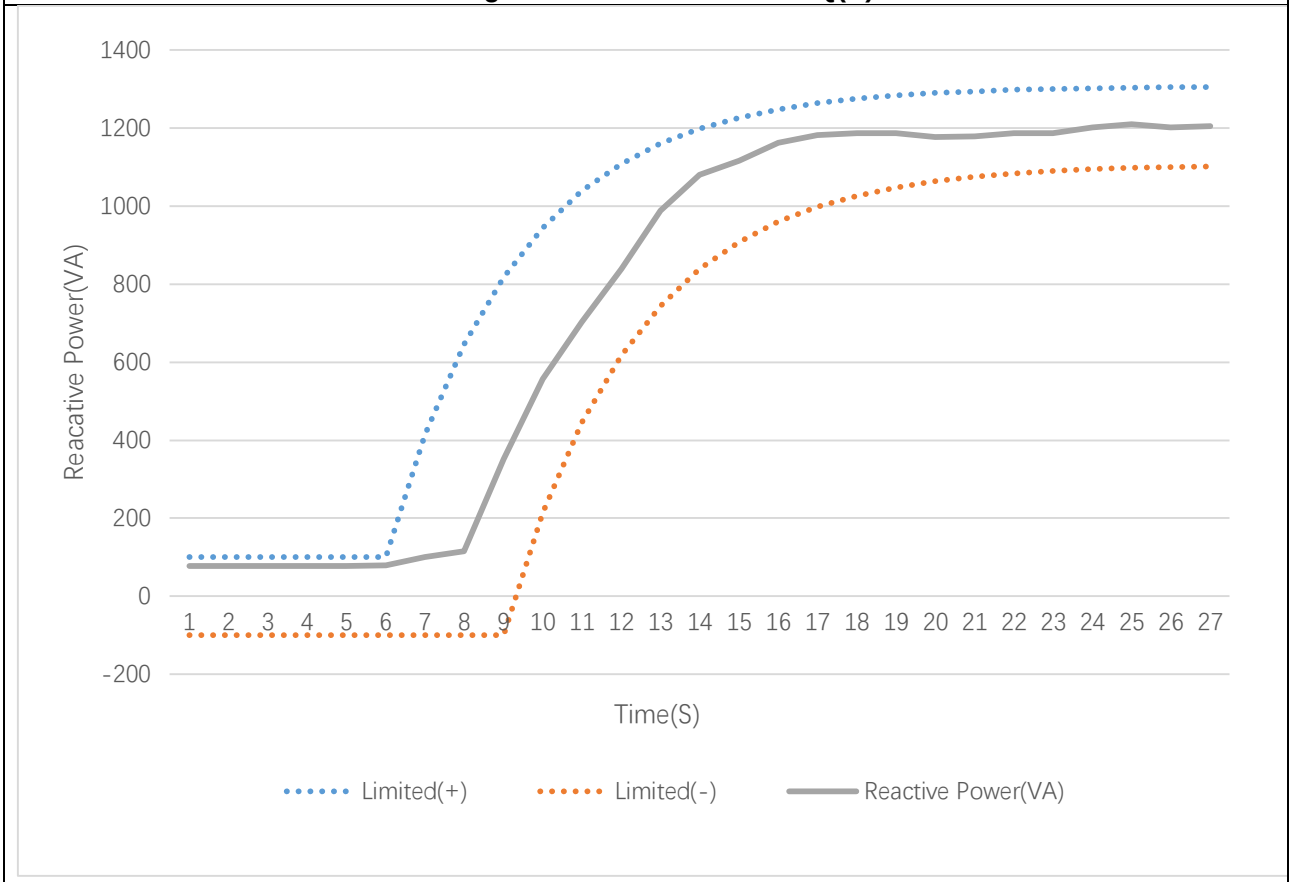


Figure 5 – Standard characteristic curve Q= f(V)

When operating above the apparent power threshold S_{min} equal to 10 % of the maximum apparent power S_{max} or the minimum regulating level of the generating plant, whichever is the higher value, the reactive power capability shall be provided with an accuracy of ± 2 % S_{max}. Up to this apparent power threshold S_{min}, deviations above 2 % are permissible.

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Voltage related control mode – Q(U)



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.7.2.2 4.7.2.3.4	**TABLE: Power related control mode – cos φ (P)**									**P**
Model	AIO2-INS-5000									
Test a): displacement factor active power characteristic curve cos φ (P)										
30 s mean value	10% → 100% P_{Emax}									
P/P_n [%]	10	20	30	40	50	60	70	80	90	100
U [V]:	230.28	230.69	231.03	231.45	231.78	232.12	232.41	232.74	233.05	233.17
P_{E30} [W]:	515.03	1024.21	1533.49	2035.07	2543.93	3040.43	3531.92	4025.87	4527.58	4651.13
P_{E30} of P_{Emax} [%]:	10.30	20.48	30.66	40.70	50.87	60.80	70.63	80.51	90.55	93.02
Q_{E30} [VAr]:	82.07	80.52	82.25	87.94	160.10	671.79	1082.63	1515.68	1993.29	2248.25
cos φ_{E30}:	0.991	0.997	0.999	0.999	0.998	0.976	0.956	0.936	0.91	0.901
cos $\varphi_{setpoint}$:	1.0	1.0	1.0	1.0	1.0	0.98	0.96	0.94	0.92	0.90
30 s mean value	100% →10% P_{Emax}									
P/P_n [%]	100	90	80	70	60	50	40	30	20	10
U [V]:	233.17	233.09	232.75	232.45	232.11	231.81	231.45	231.08	230.69	230.27
P_{E30} [kW]:	4649.52	4523.66	4031.04	3536.04	3039.70	2543.64	2036.23	1531.70	1021.25	512.69
P_{E30} of P_{Emax} [%]:	92.99	90.47	80.62	70.72	60.79	50.87	40.72	30.63	20.42	10.25
Q_{E30} [kVAr]:	2258.49	1990.21	1522.86	1085.94	655.66	177.54	87.56	81.60	79.25	81.43
cos φ_{E30}:	0.899	0.915	0.935	0.955	0.976	0.997	0.999	0.998	0.996	0.991
cos $\varphi_{setpoint}$:	0.90	0.92	0.94	0.96	0.98	1.0	1.0	1.0	1.0	1.0
Limit cos φ_{E30}:	cos $\varphi_{setpoint}$ ± 0.01									
Note:										

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Clause	Requirement - Test	Result - Remark	Verdict

Test b): Response time			
30 s mean value	10% → 50% → 100% P_{Emax}		
P/P_n [%]	10	50	100
U [V]:	230.27	231.78	233.14
P_{E30} [kW]:	512.82	2542.59	4648.75
P_{E30} of P_{Emax} [%]	10.25	50.85	92.97
Q_{E30} [kVAr]:	81.56	170.54	2261.25
cos φ_{E30}:	0.987	0.997	0.899
cos $\varphi_{setpoint}$:	1.0	1.0	0.90
ΔT [s]:	10% →50% P_{Emax}:	8	
	50% → 100% P_{Emax}:	9	
30 s mean value	100% → 50% → 10% P_{Emax}		
P/P_n [%]	100	50	10
U [V]:	233.17	231.78	230.27
P_{E30} [kW]:	4646.15	2504.68	513.48
P_{E30} of P_{Emax} [%]:	92.92	50.09	10.26
Q_{E30} [kVAr]:	2249.75	155.59	82.28
cos φ_{E30}:	0.900	0.982	0.987
cos $\varphi_{setpoint}$:	0.90	1.0	1.0
ΔT [s]:	100% → 50% P_{Emax}:	7	
	50% → 10% P_{Emax}:	8	
Limit T_0 [s]:	10		
Limit cos φ_{E30}:	cos $\varphi_{setpoint}$ ± 0.02		
Note: When cos φ noise is superimposed due to island grid detection, and the cos φ tolerance band ±0.02 is violated for the nominal value after transient due to this noise, then this parasitic induction caused by island grid detection can be neglected.			

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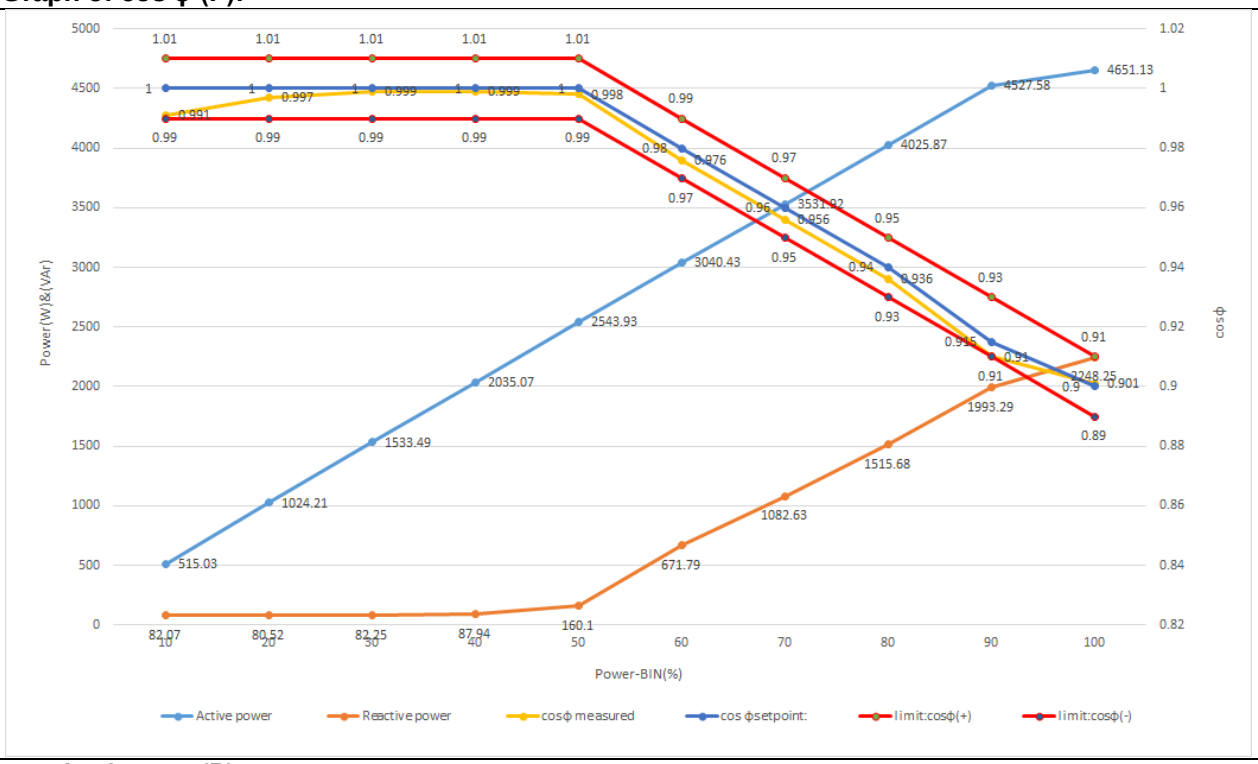
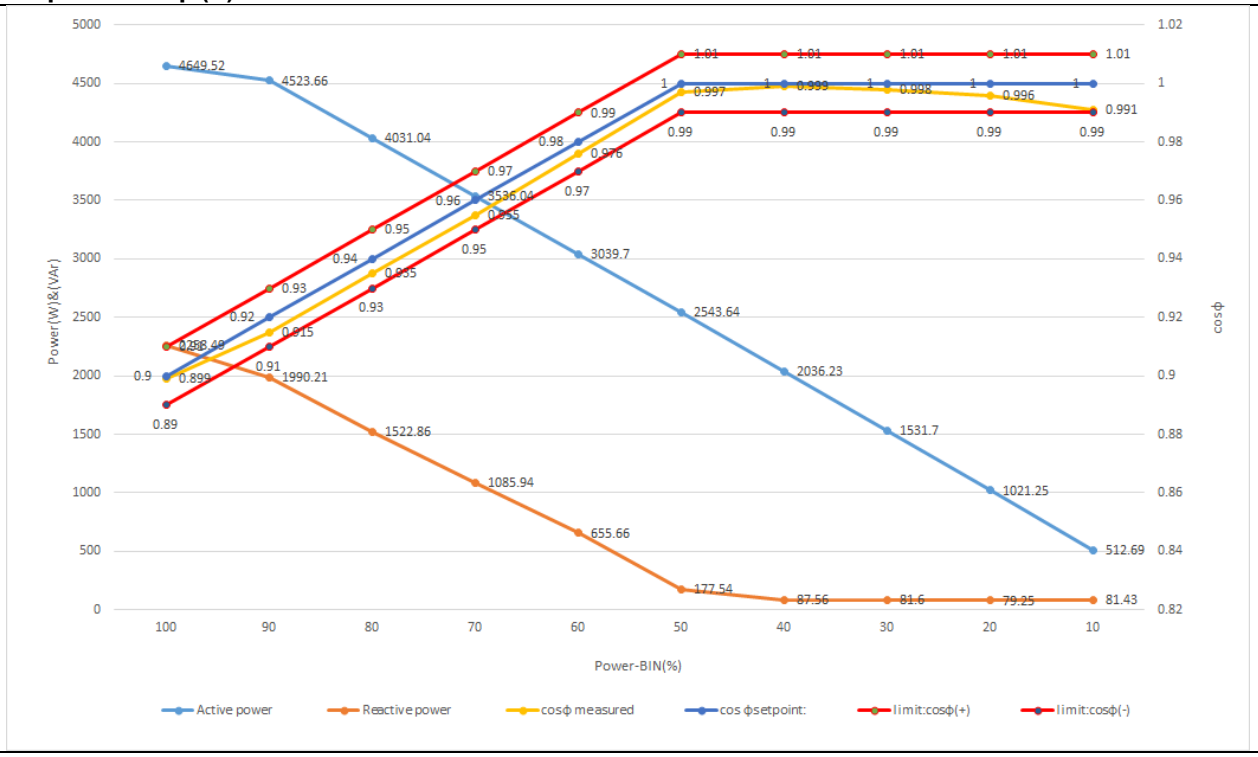
Clause	Requirement - Test	Result - Remark	Verdict

Graph of cos φ (P):



Graph of cos φ (P):



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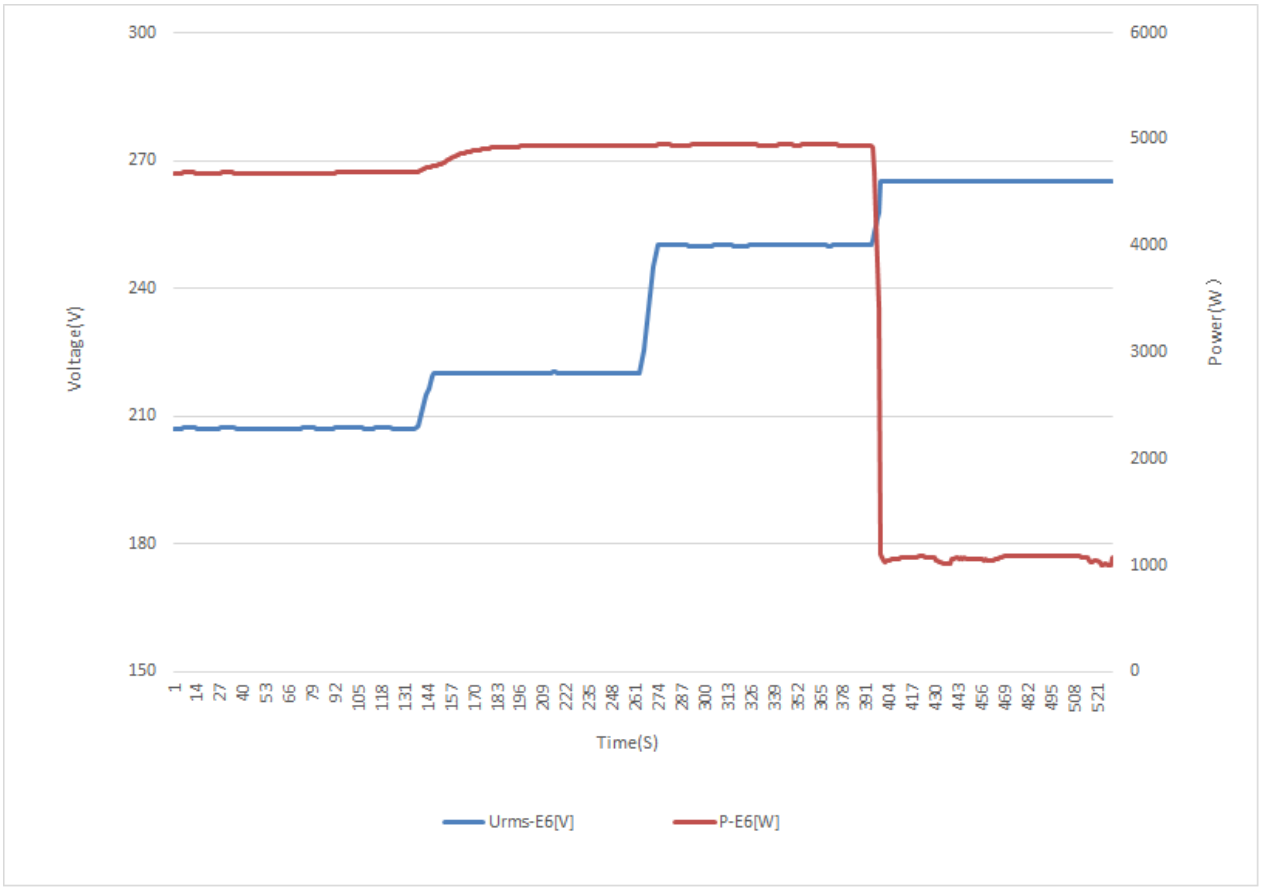
Clause	Requirement - Test	Result - Remark	Verdict

4.7.3	**Voltage related active power reduction (Optional)**		**P**
Model	AIO2-INS-5000		
Setting of the PCE			
Threshold of reduction	115.28%U_n		
Reduction method	Δ P%/ Δ U:	5.18%	
Primary power	100% Available power		
Fault (Threshold + 10%Un)			

Test condition	Voltage level (V)	Measured voltage (V)	Measured active power (W)	Measured time [s]	Limit / a time constant Tau
1	207	207.19	4686.75	0	> 3 s
2	220	220.18	4940.06	9	> 3 s
3	250	250.10	4946.55	10	> 3 s
4	265	265.05	1073.21	6	> 3 s



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

8.2.4	**TABLE: Harmonic and inter-harmonics**	**P**

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

Current harmonics

Model: AIO2-INS-5000@Working in photovoltaic grid-connected mode

P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2nd	0.017	0.016	0.015	0.010	0.009	0.010	0.010	0.009	0.009	0.012
3rd	0.267	0.268	0.267	0.268	0.272	0.278	0.285	0.287	0.284	0.283
4th	0.021	0.021	0.020	0.022	0.024	0.023	0.022	0.023	0.024	0.024
5th	0.028	0.029	0.027	0.022	0.018	0.014	0.014	0.015	0.014	0.013
6th	0.009	0.008	0.010	0.009	0.009	0.008	0.009	0.008	0.007	0.008
7th	0.015	0.012	0.011	0.008	0.007	0.007	0.006	0.007	0.006	0.005
8th	0.005	0.007	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.005
9th	0.010	0.008	0.008	0.007	0.007	0.006	0.006	0.005	0.005	0.006
10th	0.008	0.008	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
11th	0.012	0.012	0.012	0.011	0.011	0.011	0.011	0.011	0.011	0.011
12th	0.008	0.006	0.007	0.007	0.007	0.007	0.007	0.006	0.006	0.007
13th	0.006	0.005	0.005	0.005	0.005	0.005	0.004	0.004	0.004	0.004
14th	0.005	0.005	0.006	0.005	0.005	0.005	0.005	0.004	0.004	0.004
15th	0.002	0.004	0.004	0.003	0.003	0.003	0.003	0.004	0.004	0.003
16th	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.004
17th	0.008	0.008	0.007	0.007	0.007	0.006	0.005	0.004	0.003	0.004
18th	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.004
19th	0.007	0.006	0.006	0.006	0.006	0.005	0.005	0.004	0.004	0.004
20th	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
21th	0.007	0.007	0.007	0.007	0.006	0.006	0.005	0.005	0.004	0.004
22th	0.003	0.002	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.002
23th	0.005	0.005	0.005	0.006	0.005	0.005	0.005	0.004	0.004	0.004
24th	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
25th	0.005	0.005	0.005	0.005	0.005	0.005	0.004	0.004	0.004	0.004
26th	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
27th	0.005	0.005	0.005	0.006	0.006	0.006	0.005	0.005	0.005	0.005
28th	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
29th	0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.006	0.005	0.005
30th	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003
31th	0.002	0.003	0.003	0.003	0.004	0.004	0.004	0.005	0.005	0.006
32th	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.002
33th	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.006	0.006	0.006
34th	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.002
35th	0.003	0.003	0.003	0.003	0.004	0.004	0.005	0.005	0.006	0.006
36th	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003
37th	0.003	0.003	0.003	0.003	0.003	0.004	0.005	0.005	0.006	0.006
38th	0.002	0.002	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.002
39th	0.003	0.003	0.003	0.003	0.004	0.004	0.005	0.005	0.006	0.006
40th	0.003	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002

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Clause	Requirement - Test	Result - Remark	Verdict

Inter-harmonics											
Model	AIO2-INS-5000@Working in photovoltaic grid-connected mode										
P/P_n [%]	Frequency	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	[Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1st	75	0.342	0.611	0.535	0.360	0.376	0.303	0.283	0.260	0.243	0.150
2nd	125	0.414	0.658	0.571	0.380	0.381	0.312	0.290	0.263	0.246	0.152
3rd	175	0.416	0.265	0.904	0.705	0.586	0.510	0.454	0.415	0.389	0.356
4th	225	0.044	0.165	0.840	0.665	0.555	0.491	0.439	0.404	0.382	0.355
5th	275	0.680	0.997	0.565	0.497	0.327	0.305	0.255	0.232	0.215	0.269
6th	325	0.068	0.100	0.628	0.548	0.365	0.339	0.285	0.261	0.243	0.320
7th	375	0.136	0.120	0.795	0.591	0.489	0.405	0.350	0.307	0.274	0.244
8th	425	0.348	0.257	0.890	0.690	0.569	0.485	0.423	0.375	0.341	0.294
9th	475	0.821	0.366	0.280	0.200	0.177	0.145	0.128	0.114	0.104	0.086
10th	525	0.758	0.424	0.331	0.231	0.208	0.162	0.140	0.117	0.100	0.072
11th	575	0.299	0.141	0.099	0.079	0.066	0.054	0.044	0.036	0.030	0.024
12th	625	0.146	0.078	0.054	0.035	0.028	0.023	0.019	0.018	0.016	0.018
13th	675	0.180	0.081	0.054	0.038	0.030	0.023	0.019	0.018	0.017	0.018
14th	725	0.139	0.072	0.048	0.039	0.033	0.027	0.023	0.020	0.017	0.018
15th	775	0.134	0.068	0.044	0.033	0.027	0.023	0.019	0.016	0.014	0.022
16th	825	0.137	0.073	0.047	0.038	0.030	0.025	0.021	0.018	0.016	0.038
17th	875	0.124	0.064	0.043	0.034	0.027	0.023	0.020	0.019	0.016	0.112
18th	925	0.146	0.072	0.048	0.037	0.031	0.024	0.020	0.017	0.016	0.129
19th	975	0.131	0.069	0.048	0.036	0.030	0.025	0.021	0.019	0.017	0.131
20th	1025	0.138	0.076	0.051	0.041	0.033	0.027	0.023	0.021	0.020	0.031
21th	1075	0.131	0.070	0.048	0.036	0.029	0.025	0.022	0.019	0.018	0.021
22th	1125	0.135	0.074	0.050	0.043	0.035	0.030	0.026	0.024	0.020	0.022
23th	1175	0.138	0.074	0.050	0.038	0.031	0.026	0.023	0.020	0.018	0.020
24th	1225	0.141	0.076	0.051	0.041	0.034	0.029	0.025	0.022	0.021	0.022
25th	1275	0.160	0.081	0.052	0.039	0.030	0.026	0.023	0.021	0.019	0.019
26th	1325	0.145	0.077	0.058	0.043	0.033	0.029	0.025	0.023	0.021	0.021
27th	1375	0.143	0.077	0.053	0.041	0.033	0.030	0.024	0.022	0.019	0.019
28th	1425	0.143	0.078	0.052	0.042	0.032	0.030	0.026	0.022	0.020	0.020
29th	1475	0.145	0.081	0.053	0.042	0.033	0.029	0.025	0.022	0.021	0.021
30th	1525	0.152	0.082	0.057	0.045	0.036	0.030	0.026	0.023	0.022	0.022
31th	1575	0.150	0.081	0.057	0.043	0.035	0.030	0.026	0.023	0.021	0.022
32th	1625	0.167	0.089	0.060	0.050	0.038	0.034	0.029	0.027	0.024	0.024
33th	1675	0.152	0.082	0.057	0.043	0.036	0.031	0.027	0.024	0.022	0.023
34th	1725	0.179	0.092	0.064	0.048	0.041	0.035	0.029	0.027	0.024	0.028
35th	1775	0.163	0.085	0.057	0.046	0.035	0.032	0.027	0.025	0.022	0.047
36th	1825	0.163	0.087	0.059	0.048	0.039	0.034	0.030	0.028	0.025	0.031
37th	1875	0.162	0.090	0.056	0.045	0.035	0.030	0.026	0.023	0.021	0.023
38th	1925	0.212	0.094	0.063	0.053	0.042	0.038	0.031	0.030	0.028	0.028
39th	1975	0.166	0.086	0.060	0.049	0.038	0.035	0.030	0.027	0.024	0.023
40th	2025	0.220	0.129	0.083	0.066	0.050	0.043	0.036	0.030	0.026	0.028

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Clause	Requirement - Test	Result - Remark	Verdict

Higher Frequencies										
Model	AIO2-INS-5000@Working in photovoltaic grid-connected mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.112	0.101	0.054	0.067	0.048	0.029	0.036	0.031	0.042	0.028
2.3	0.418	0.193	0.136	0.095	0.075	0.064	0.050	0.044	0.044	0.044
2.5	0.252	0.134	0.059	0.033	0.026	0.022	0.019	0.034	0.036	0.036
2.7	0.435	0.291	0.167	0.130	0.137	0.082	0.080	0.077	0.073	0.092
2.9	0.146	0.113	0.051	0.037	0.032	0.021	0.022	0.015	0.015	0.017
3.1	0.072	0.062	0.031	0.024	0.023	0.017	0.020	0.020	0.020	0.015
3.3	0.104	0.056	0.035	0.027	0.024	0.018	0.021	0.016	0.013	0.018
3.5	0.084	0.041	0.030	0.022	0.019	0.016	0.017	0.014	0.015	0.011
3.7	0.114	0.062	0.043	0.034	0.025	0.021	0.018	0.017	0.014	0.013
3.9	0.217	0.190	0.115	0.087	0.072	0.063	0.058	0.051	0.046	0.042
4.1	0.222	0.156	0.088	0.068	0.058	0.050	0.047	0.042	0.038	0.036
4.3	0.167	0.088	0.063	0.050	0.042	0.036	0.029	0.025	0.022	0.021
4.5	0.091	0.049	0.033	0.027	0.024	0.022	0.019	0.016	0.014	0.014
4.7	0.080	0.043	0.028	0.022	0.019	0.017	0.015	0.013	0.011	0.011
4.9	0.061	0.031	0.021	0.016	0.015	0.014	0.011	0.010	0.009	0.009
5.1	0.052	0.028	0.018	0.014	0.012	0.011	0.010	0.008	0.007	0.007
5.3	0.052	0.028	0.018	0.014	0.012	0.010	0.009	0.008	0.007	0.007
5.5	0.044	0.022	0.015	0.011	0.010	0.009	0.007	0.007	0.006	0.006
5.7	0.044	0.021	0.014	0.011	0.009	0.008	0.007	0.007	0.006	0.006
5.9	0.047	0.021	0.014	0.012	0.010	0.009	0.007	0.007	0.006	0.006
6.1	0.055	0.028	0.018	0.014	0.011	0.009	0.007	0.007	0.005	0.005
6.3	0.045	0.022	0.015	0.012	0.009	0.007	0.006	0.006	0.005	0.004
6.5	0.034	0.018	0.012	0.008	0.007	0.006	0.005	0.004	0.004	0.004
6.7	0.030	0.015	0.009	0.007	0.006	0.005	0.004	0.004	0.003	0.004
6.9	0.029	0.016	0.010	0.007	0.006	0.005	0.004	0.004	0.003	0.003
7.1	0.037	0.019	0.012	0.009	0.007	0.006	0.005	0.004	0.004	0.004
7.3	0.032	0.016	0.010	0.008	0.006	0.005	0.004	0.004	0.004	0.003
7.5	0.028	0.014	0.010	0.007	0.006	0.005	0.004	0.004	0.003	0.003
7.7	0.028	0.015	0.010	0.007	0.006	0.005	0.004	0.004	0.003	0.003
7.9	0.029	0.022	0.017	0.009	0.007	0.006	0.005	0.004	0.004	0.004
8.1	0.030	0.022	0.018	0.010	0.007	0.006	0.005	0.004	0.005	0.004
8.3	0.032	0.016	0.010	0.008	0.006	0.005	0.004	0.004	0.004	0.003
8.5	0.033	0.016	0.011	0.008	0.007	0.006	0.005	0.004	0.004	0.004
8.7	0.030	0.015	0.010	0.007	0.006	0.005	0.004	0.004	0.003	0.003
8.9	0.030	0.016	0.010	0.008	0.006	0.005	0.004	0.004	0.004	0.003

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Current harmonics										
Model	AIO2-INS-5000@Work in the grid to charge the battery mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2nd	0.017	0.016	0.015	0.010	0.009	0.010	0.010	0.009	0.009	0.012
3rd	0.267	0.268	0.267	0.268	0.272	0.278	0.285	0.287	0.284	0.283
4th	0.021	0.021	0.020	0.022	0.024	0.023	0.022	0.023	0.024	0.024
5th	0.028	0.029	0.027	0.022	0.018	0.014	0.014	0.015	0.014	0.013
6th	0.009	0.008	0.010	0.009	0.009	0.008	0.009	0.008	0.007	0.008
7th	0.015	0.012	0.011	0.008	0.007	0.007	0.006	0.007	0.006	0.005
8th	0.005	0.007	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.005
9th	0.010	0.008	0.008	0.007	0.007	0.006	0.006	0.005	0.005	0.006
10th	0.008	0.008	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
11th	0.012	0.012	0.012	0.011	0.011	0.011	0.011	0.011	0.011	0.011
12th	0.008	0.006	0.007	0.007	0.007	0.007	0.007	0.006	0.006	0.007
13th	0.006	0.005	0.005	0.005	0.005	0.005	0.004	0.004	0.004	0.004
14th	0.005	0.005	0.006	0.005	0.005	0.005	0.005	0.004	0.004	0.004
15th	0.002	0.004	0.004	0.003	0.003	0.003	0.003	0.004	0.004	0.003
16th	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.004
17th	0.008	0.008	0.007	0.007	0.007	0.006	0.005	0.004	0.003	0.004
18th	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.004
19th	0.007	0.006	0.006	0.006	0.006	0.005	0.005	0.004	0.004	0.004
20th	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
21th	0.007	0.007	0.007	0.007	0.006	0.006	0.005	0.005	0.004	0.004
22th	0.003	0.002	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.002
23th	0.005	0.005	0.005	0.006	0.005	0.005	0.005	0.004	0.004	0.004
24th	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
25th	0.005	0.005	0.005	0.005	0.005	0.005	0.004	0.004	0.004	0.004
26th	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
27th	0.005	0.005	0.005	0.006	0.006	0.006	0.005	0.005	0.005	0.005
28th	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
29th	0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.006	0.005	0.005
30th	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003
31th	0.002	0.003	0.003	0.003	0.004	0.004	0.004	0.005	0.005	0.006
32th	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.002
33th	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.006	0.006	0.006
34th	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.002
35th	0.003	0.003	0.003	0.003	0.004	0.004	0.005	0.005	0.006	0.006
36th	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003
37th	0.003	0.003	0.003	0.003	0.003	0.004	0.005	0.005	0.006	0.006
38th	0.002	0.002	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.002
39th	0.003	0.003	0.003	0.003	0.004	0.004	0.005	0.005	0.006	0.006

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Inter-harmonics											
Model	AIO2-INS-5000@Work in the grid to charge the battery mode										
P/P_n [%]	Frequency	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	[Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1st	75	0.360	0.702	0.450	0.340	0.266	0.221	0.192	0.168	0.146	0.138
2nd	125	0.430	0.673	0.460	0.353	0.276	0.226	0.194	0.167	0.142	0.128
3rd	175	0.401	0.232	0.864	0.697	0.578	0.500	0.447	0.402	0.360	0.326
4th	225	0.287	0.156	0.799	0.636	0.523	0.451	0.404	0.366	0.328	0.296
5th	275	0.863	0.958	0.675	0.535	0.441	0.384	0.347	0.316	0.285	0.257
6th	325	0.051	0.051	0.750	0.612	0.516	0.452	0.409	0.373	0.338	0.301
7th	375	0.304	0.121	0.768	0.594	0.471	0.387	0.331	0.287	0.258	0.234
8th	425	0.418	0.231	0.851	0.673	0.536	0.439	0.373	0.318	0.281	0.255
9th	475	0.736	0.357	0.238	0.183	0.142	0.117	0.104	0.096	0.085	0.074
10th	525	0.877	0.407	0.250	0.174	0.123	0.097	0.089	0.088	0.082	0.070
11th	575	0.185	0.113	0.083	0.067	0.049	0.037	0.030	0.023	0.020	0.016
12th	625	0.195	0.084	0.044	0.039	0.035	0.030	0.023	0.016	0.017	0.019
13th	675	0.151	0.073	0.046	0.036	0.029	0.025	0.023	0.021	0.018	0.015
14th	725	0.112	0.065	0.047	0.036	0.030	0.030	0.030	0.028	0.022	0.021
15th	775	0.110	0.064	0.043	0.034	0.029	0.024	0.020	0.018	0.016	0.015
16th	825	0.121	0.071	0.050	0.043	0.037	0.030	0.023	0.020	0.021	0.019
17th	875	0.112	0.065	0.043	0.033	0.026	0.021	0.018	0.017	0.015	0.014
18th	925	0.125	0.069	0.044	0.033	0.026	0.022	0.021	0.019	0.016	0.015
19th	975	0.117	0.065	0.044	0.034	0.028	0.023	0.019	0.017	0.016	0.015
20th	1025	0.123	0.069	0.044	0.035	0.028	0.024	0.019	0.017	0.016	0.014
21th	1075	0.116	0.064	0.044	0.035	0.028	0.023	0.020	0.018	0.016	0.015
22th	1125	0.124	0.068	0.046	0.036	0.028	0.024	0.020	0.018	0.016	0.015
23th	1175	0.122	0.068	0.046	0.036	0.029	0.025	0.021	0.019	0.017	0.015
24th	1225	0.125	0.067	0.047	0.037	0.030	0.025	0.021	0.019	0.017	0.016
25th	1275	0.122	0.067	0.048	0.038	0.030	0.025	0.021	0.019	0.017	0.015
26th	1325	0.127	0.072	0.049	0.039	0.032	0.026	0.024	0.021	0.019	0.017
27th	1375	0.128	0.071	0.050	0.039	0.031	0.028	0.023	0.021	0.019	0.017
28th	1425	0.131	0.071	0.050	0.040	0.032	0.027	0.023	0.021	0.020	0.018
29th	1475	0.130	0.075	0.052	0.041	0.034	0.027	0.024	0.021	0.020	0.018
30th	1525	0.139	0.076	0.052	0.041	0.033	0.029	0.026	0.022	0.020	0.019
31th	1575	0.137	0.076	0.054	0.043	0.035	0.030	0.026	0.024	0.021	0.018
32th	1625	0.138	0.081	0.058	0.045	0.039	0.033	0.029	0.025	0.024	0.021
33th	1675	0.137	0.077	0.054	0.042	0.035	0.032	0.028	0.024	0.022	0.020
34th	1725	0.169	0.085	0.060	0.047	0.040	0.033	0.029	0.026	0.024	0.021
35th	1775	0.157	0.089	0.059	0.045	0.037	0.031	0.027	0.025	0.023	0.021
36th	1825	0.157	0.092	0.062	0.049	0.041	0.034	0.030	0.027	0.024	0.023
37th	1875	0.150	0.080	0.054	0.042	0.036	0.032	0.027	0.025	0.022	0.021
38th	1925	0.148	0.094	0.064	0.051	0.042	0.037	0.033	0.030	0.028	0.026
39th	1975	0.151	0.084	0.056	0.045	0.038	0.033	0.029	0.026	0.024	0.024
40th	2025	0.178	0.125	0.083	0.067	0.057	0.050	0.046	0.040	0.037	0.035

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Higher Frequencies										
Model	AIO2-INS-5000@Work in the grid to charge the battery mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.170	0.083	0.074	0.053	0.068	0.048	0.037	0.027	0.034	0.029
2.3	0.109	0.069	0.055	0.053	0.027	0.020	0.036	0.041	0.027	0.028
2.5	0.192	0.119	0.059	0.037	0.023	0.030	0.030	0.021	0.019	0.026
2.7	0.125	0.053	0.028	0.028	0.025	0.037	0.026	0.019	0.023	0.030
2.9	0.086	0.039	0.026	0.025	0.025	0.028	0.024	0.014	0.022	0.021
3.1	0.059	0.033	0.025	0.022	0.024	0.025	0.017	0.013	0.012	0.017
3.3	0.083	0.048	0.031	0.020	0.018	0.018	0.012	0.011	0.011	0.013
3.5	0.063	0.034	0.021	0.015	0.012	0.012	0.011	0.011	0.009	0.008
3.7	0.055	0.030	0.021	0.017	0.014	0.012	0.010	0.009	0.008	0.007
3.9	0.055	0.029	0.021	0.017	0.013	0.010	0.009	0.008	0.007	0.007
4.1	0.049	0.025	0.018	0.014	0.011	0.010	0.009	0.008	0.007	0.007
4.3	0.051	0.028	0.019	0.014	0.012	0.010	0.009	0.007	0.006	0.006
4.5	0.049	0.026	0.019	0.015	0.012	0.010	0.009	0.007	0.007	0.006
4.7	0.051	0.027	0.019	0.015	0.012	0.011	0.008	0.007	0.006	0.006
4.9	0.052	0.028	0.020	0.016	0.013	0.011	0.010	0.007	0.006	0.006
5.1	0.050	0.026	0.018	0.015	0.012	0.010	0.009	0.007	0.006	0.006
5.3	0.051	0.027	0.019	0.014	0.012	0.011	0.009	0.007	0.006	0.006
5.5	0.055	0.030	0.021	0.017	0.014	0.012	0.009	0.008	0.007	0.006
5.7	0.066	0.032	0.021	0.017	0.013	0.010	0.009	0.007	0.006	0.006
5.9	0.047	0.025	0.018	0.015	0.013	0.011	0.009	0.007	0.007	0.006
6.1	0.045	0.025	0.018	0.014	0.011	0.010	0.008	0.007	0.006	0.006
6.3	0.046	0.023	0.016	0.013	0.010	0.009	0.008	0.006	0.006	0.005
6.5	0.045	0.024	0.016	0.013	0.010	0.009	0.007	0.006	0.005	0.005
6.7	0.040	0.021	0.014	0.012	0.010	0.008	0.007	0.006	0.006	0.005
6.9	0.043	0.021	0.015	0.012	0.010	0.008	0.007	0.006	0.006	0.005
7.1	0.043	0.021	0.015	0.012	0.009	0.008	0.007	0.006	0.005	0.005
7.3	0.039	0.019	0.014	0.011	0.009	0.007	0.006	0.006	0.005	0.004
7.5	0.039	0.019	0.014	0.011	0.008	0.007	0.006	0.005	0.005	0.004
7.7	0.038	0.019	0.014	0.011	0.009	0.007	0.006	0.005	0.005	0.004
7.9	0.041	0.020	0.014	0.011	0.008	0.007	0.006	0.005	0.005	0.004
8.1	0.038	0.020	0.014	0.011	0.008	0.007	0.006	0.005	0.005	0.004
8.3	0.038	0.019	0.013	0.010	0.008	0.007	0.006	0.005	0.004	0.004
8.5	0.037	0.018	0.013	0.010	0.008	0.007	0.006	0.005	0.004	0.004
8.7	0.039	0.020	0.014	0.011	0.008	0.007	0.006	0.005	0.005	0.004
8.9	0.038	0.019	0.013	0.010	0.008	0.007	0.006	0.005	0.005	0.004

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Current harmonics										
Model	AIO2-INS-5000@Working in battery discharge and grid connection mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2nd	0.012	0.012	0.012	0.011	0.010	0.011	0.011	0.010	0.009	-*
3rd	0.299	0.288	0.287	0.291	0.289	0.276	0.283	0.288	0.287	-*
4th	0.022	0.023	0.022	0.023	0.024	0.024	0.024	0.025	0.026	-*
5th	0.008	0.012	0.013	0.015	0.014	0.014	0.012	0.014	0.014	-*
6th	0.008	0.009	0.009	0.009	0.009	0.009	0.010	0.009	0.009	-*
7th	0.006	0.008	0.008	0.007	0.007	0.007	0.006	0.007	0.007	-*
8th	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	-*
9th	0.005	0.005	0.006	0.006	0.006	0.007	0.006	0.005	0.005	-*
10th	0.010	0.012	0.011	0.011	0.011	0.011	0.011	0.011	0.010	-*
11th	0.007	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	-*
12th	0.002	0.003	0.005	0.004	0.004	0.006	0.005	0.005	0.004	-*
13th	0.006	0.005	0.006	0.006	0.006	0.006	0.006	0.005	0.005	-*
14th	0.004	0.004	0.003	0.003	0.003	0.003	0.003	0.004	0.003	-*
15th	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.003	-*
16th	0.003	0.003	0.005	0.004	0.003	0.005	0.005	0.004	0.004	-*
17th	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	-*
18th	0.003	0.002	0.004	0.004	0.004	0.005	0.005	0.005	0.005	-*
19th	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	-*
20th	0.002	0.002	0.003	0.003	0.003	0.005	0.006	0.005	0.005	-*
21th	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	-*
22th	0.002	0.002	0.003	0.003	0.004	0.005	0.006	0.006	0.006	-*
23th	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	-*
24th	0.002	0.002	0.002	0.002	0.002	0.004	0.004	0.004	0.005	-*
25th	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	-*
26th	0.003	0.003	0.002	0.003	0.003	0.003	0.004	0.005	0.005	-*
27th	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	-*
28th	0.002	0.002	0.003	0.003	0.003	0.005	0.005	0.006	0.006	-*
29th	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	-*
30th	0.002	0.002	0.002	0.002	0.003	0.003	0.004	0.005	0.006	-*
31th	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.002	-*
32th	0.002	0.002	0.002	0.002	0.003	0.004	0.005	0.005	0.006	-*
33th	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	-*
34th	0.010	0.012	0.011	0.011	0.011	0.011	0.011	0.011	0.010	-*
35th	0.002	0.002	0.002	0.002	0.002	0.003	0.004	0.005	0.005	-*
36th	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	-*
37th	0.002	0.002	0.002	0.002	0.003	0.003	0.004	0.005	0.006	-*
38th	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	-*
39th	0.002	0.002	0.002	0.002	0.003	0.003	0.004	0.005	0.005	-*
40th	0.003	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.002	-*
Note:*The grid current is limited by the battery charging and discharging current.										

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Inter-harmonics											
Model	AIO2-INS-5000@Working in battery discharge and grid connection mode										
P/P_n [%]	Frequency	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	[Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1st	75	0.620	0.836	0.577	0.455	0.385	0.328	0.300	0.280	0.267	-*
2nd	125	0.676	0.855	0.594	0.461	0.385	0.329	0.300	0.278	0.266	-*
3rd	175	0.663	0.328	0.938	0.720	0.599	0.522	0.469	0.427	0.402	-*
4th	225	0.324	0.236	0.881	0.686	0.574	0.509	0.460	0.423	0.401	-*
5th	275	0.581	0.834	0.583	0.436	0.350	0.301	0.263	0.233	0.214	-*
6th	325	0.032	0.953	0.655	0.491	0.396	0.340	0.297	0.264	0.245	-*
7th	375	0.360	0.195	0.826	0.624	0.505	0.420	0.364	0.319	0.291	-*
8th	425	0.667	0.331	0.936	0.715	0.586	0.503	0.441	0.392	0.361	-*
9th	475	0.944	0.435	0.291	0.219	0.177	0.149	0.131	0.116	0.107	-*
10th	525	0.906	0.488	0.342	0.258	0.206	0.168	0.143	0.122	0.108	-*
11th	575	0.289	0.122	0.091	0.072	0.060	0.053	0.044	0.037	0.033	-*
12th	625	0.124	0.084	0.051	0.036	0.027	0.024	0.021	0.019	0.019	-*
13th	675	0.172	0.076	0.049	0.038	0.030	0.022	0.020	0.018	0.017	-*
14th	725	0.125	0.063	0.044	0.036	0.030	0.027	0.023	0.020	0.017	-*
15th	775	0.113	0.059	0.041	0.031	0.025	0.022	0.019	0.019	0.016	-*
16th	825	0.113	0.058	0.042	0.032	0.026	0.022	0.019	0.017	0.017	-*
17th	875	0.116	0.058	0.040	0.031	0.025	0.022	0.020	0.019	0.017	-*
18th	925	0.131	0.062	0.043	0.033	0.027	0.022	0.020	0.018	0.017	-*
19th	975	0.115	0.071	0.043	0.033	0.027	0.023	0.022	0.019	0.018	-*
20th	1025	0.125	0.066	0.051	0.036	0.030	0.026	0.022	0.019	0.019	-*
21th	1075	0.117	0.063	0.045	0.041	0.030	0.025	0.022	0.019	0.018	-*
22th	1125	0.130	0.067	0.047	0.038	0.034	0.028	0.023	0.021	0.021	-*
23th	1175	0.128	0.067	0.047	0.036	0.030	0.026	0.024	0.020	0.019	-*
24th	1225	0.128	0.067	0.050	0.040	0.033	0.028	0.025	0.024	0.022	-*
25th	1275	0.130	0.069	0.049	0.037	0.030	0.026	0.023	0.020	0.021	-*
26th	1325	0.131	0.068	0.049	0.037	0.032	0.029	0.026	0.023	0.023	-*
27th	1375	0.132	0.070	0.050	0.037	0.031	0.027	0.025	0.021	0.020	-*
28th	1425	0.133	0.071	0.049	0.038	0.032	0.028	0.025	0.023	0.021	-*
29th	1475	0.136	0.071	0.052	0.039	0.032	0.028	0.025	0.022	0.020	-*
30th	1525	0.142	0.075	0.055	0.042	0.035	0.029	0.026	0.025	0.022	-*
31th	1575	0.147	0.076	0.055	0.042	0.034	0.029	0.026	0.024	0.022	-*
32th	1625	0.165	0.081	0.058	0.045	0.037	0.032	0.029	0.027	0.025	-*
33th	1675	0.147	0.075	0.054	0.041	0.034	0.031	0.027	0.024	0.023	-*
34th	1725	0.171	0.087	0.063	0.047	0.038	0.033	0.030	0.025	0.024	-*
35th	1775	0.151	0.080	0.056	0.044	0.037	0.032	0.028	0.026	0.025	-*
36th	1825	0.154	0.081	0.057	0.045	0.038	0.033	0.029	0.026	0.025	-*
37th	1875	0.150	0.074	0.054	0.042	0.035	0.030	0.027	0.025	0.023	-*
38th	1925	0.178	0.082	0.062	0.050	0.042	0.038	0.034	0.030	0.028	-*
39th	1975	0.153	0.077	0.057	0.044	0.037	0.033	0.028	0.025	0.024	-*
40th	2025	0.252	0.126	0.089	0.068	0.055	0.048	0.041	0.034	0.031	-*
Note:*The grid current is limited by the battery charging and discharging current.											

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Higher Frequencies										
Model	AIO2-INS-5000@Working in battery discharge and grid connection mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.198	0.078	0.050	0.047	0.046	0.041	0.035	0.028	0.029	-*
2.3	0.213	0.104	0.077	0.062	0.050	0.033	0.027	0.019	0.018	-*
2.5	0.108	0.075	0.047	0.035	0.025	0.020	0.018	0.027	0.027	-*
2.7	0.123	0.059	0.035	0.024	0.023	0.024	0.031	0.029	0.027	-*
2.9	0.100	0.050	0.031	0.024	0.021	0.021	0.021	0.019	0.019	-*
3.1	0.066	0.038	0.023	0.016	0.013	0.016	0.018	0.019	0.017	-*
3.3	0.081	0.043	0.028	0.019	0.016	0.019	0.020	0.018	0.014	-*
3.5	0.061	0.032	0.022	0.017	0.014	0.011	0.010	0.009	0.009	-*
3.7	0.066	0.035	0.021	0.015	0.012	0.011	0.010	0.008	0.007	-*
3.9	0.060	0.028	0.020	0.016	0.014	0.011	0.009	0.009	0.008	-*
4.1	0.054	0.028	0.017	0.012	0.010	0.009	0.008	0.007	0.007	-*
4.3	0.057	0.026	0.017	0.014	0.011	0.009	0.007	0.007	0.006	-*
4.5	0.052	0.027	0.018	0.013	0.010	0.009	0.007	0.007	0.006	-*
4.7	0.055	0.027	0.018	0.013	0.011	0.009	0.008	0.007	0.006	-*
4.9	0.057	0.029	0.020	0.014	0.010	0.010	0.008	0.007	0.006	-*
5.1	0.050	0.028	0.019	0.013	0.010	0.009	0.008	0.006	0.006	-*
5.3	0.051	0.028	0.018	0.012	0.010	0.009	0.008	0.007	0.006	-*
5.5	0.058	0.031	0.021	0.014	0.011	0.010	0.008	0.007	0.006	-*
5.7	0.065	0.030	0.021	0.016	0.013	0.010	0.009	0.008	0.007	-*
5.9	0.051	0.029	0.019	0.013	0.010	0.010	0.008	0.007	0.006	-*
6.1	0.047	0.026	0.018	0.012	0.010	0.008	0.007	0.006	0.005	-*
6.3	0.049	0.025	0.017	0.012	0.009	0.008	0.007	0.006	0.006	-*
6.5	0.048	0.025	0.016	0.012	0.010	0.008	0.007	0.006	0.006	-*
6.7	0.044	0.024	0.015	0.010	0.008	0.008	0.006	0.005	0.005	-*
6.9	0.046	0.024	0.015	0.011	0.008	0.008	0.006	0.005	0.005	-*
7.1	0.046	0.023	0.015	0.011	0.009	0.007	0.006	0.006	0.005	-*
7.3	0.041	0.021	0.014	0.010	0.008	0.007	0.006	0.005	0.005	-*
7.5	0.042	0.020	0.014	0.010	0.008	0.007	0.006	0.005	0.005	-*
7.7	0.042	0.021	0.013	0.010	0.008	0.007	0.006	0.005	0.004	-*
7.9	0.043	0.020	0.014	0.010	0.008	0.007	0.006	0.005	0.005	-*
8.1	0.041	0.022	0.014	0.011	0.008	0.007	0.006	0.005	0.005	-*
8.3	0.043	0.021	0.013	0.009	0.008	0.007	0.005	0.005	0.004	-*
8.5	0.040	0.021	0.013	0.009	0.007	0.006	0.005	0.005	0.004	-*
8.7	0.043	0.021	0.014	0.010	0.008	0.007	0.006	0.005	0.005	-*
8.9	0.041	0.020	0.013	0.010	0.008	0.007	0.006	0.005	0.004	-*
Note:*The grid current is limited by the battery charging and discharging current.										

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Current harmonics										
Model	AIO2-INS-4600@Working in photovoltaic grid-connected mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2nd	0.011	0.012	0.011	0.011	0.010	0.010	0.010	0.010	0.009	0.013
3rd	0.296	0.294	0.291	0.287	0.284	0.289	0.288	0.285	0.287	0.287
4th	0.020	0.021	0.022	0.022	0.022	0.022	0.023	0.024	0.025	0.025
5th	0.007	0.014	0.014	0.013	0.013	0.015	0.014	0.013	0.015	0.014
6th	0.008	0.008	0.008	0.008	0.008	0.009	0.009	0.008	0.009	0.009
7th	0.005	0.009	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.006
8th	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.005
9th	0.004	0.004	0.005	0.006	0.006	0.005	0.005	0.005	0.005	0.005
10th	0.006	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
11th	0.008	0.008	0.009	0.010	0.010	0.010	0.010	0.011	0.011	0.011
12th	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.006	0.007	0.007
13th	0.002	0.002	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.003
14th	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.004	0.005	0.004
15th	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.003
16th	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.004
17th	0.006	0.005	0.004	0.004	0.006	0.006	0.005	0.004	0.004	0.005
18th	0.002	0.003	0.003	0.003	0.002	0.003	0.003	0.003	0.003	0.004
19th	0.004	0.004	0.004	0.003	0.006	0.005	0.004	0.004	0.005	0.004
20th	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
21th	0.003	0.003	0.003	0.003	0.005	0.005	0.005	0.005	0.005	0.005
22th	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
23th	0.003	0.003	0.003	0.003	0.005	0.005	0.005	0.005	0.005	0.005
24th	0.004	0.004	0.004	0.003	0.004	0.004	0.004	0.004	0.004	0.004
25th	0.002	0.002	0.002	0.003	0.004	0.004	0.004	0.004	0.004	0.005
26th	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
27th	0.003	0.003	0.003	0.004	0.004	0.004	0.005	0.005	0.005	0.006
28th	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
29th	0.002	0.002	0.002	0.003	0.004	0.004	0.005	0.005	0.006	0.006
30th	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
31th	0.002	0.002	0.002	0.002	0.003	0.003	0.004	0.005	0.005	0.006
32th	0.002	0.002	0.002	0.002	0.003	0.002	0.002	0.002	0.002	0.003
33th	0.002	0.002	0.002	0.002	0.003	0.004	0.005	0.006	0.006	0.007
34th	0.002	0.003	0.002	0.002	0.003	0.003	0.003	0.002	0.003	0.003
35th	0.001	0.002	0.002	0.002	0.003	0.003	0.004	0.005	0.005	0.007
36th	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003
37th	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.005	0.005	0.006
38th	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
39th	0.002	0.002	0.002	0.003	0.003	0.003	0.005	0.005	0.005	0.006
40th	0.003	0.002	0.003	0.002	0.003	0.002	0.002	0.002	0.002	0.002

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Inter-harmonics

Model: AIO2-INS-4600@Working in photovoltaic grid-connected mode

P/P_n [%]	Frequency	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	[Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1st	75	0.638	0.727	0.617	0.400	0.381	0.328	0.283	0.270	0.255	0.091
2nd	125	0.745	0.805	0.633	0.405	0.389	0.333	0.287	0.274	0.260	0.090
3rd	175	0.786	0.417	0.967	0.759	0.633	0.547	0.489	0.444	0.412	0.347
4th	225	0.378	0.271	0.878	0.696	0.596	0.520	0.470	0.433	0.409	0.345
5th	275	0.738	0.022	0.576	0.538	0.377	0.325	0.300	0.257	0.230	0.319
6th	325	0.138	0.143	0.674	0.608	0.424	0.367	0.340	0.293	0.265	0.388
7th	375	0.480	0.247	0.859	0.649	0.528	0.444	0.381	0.337	0.300	0.261
8th	425	0.720	0.379	0.950	0.733	0.612	0.520	0.455	0.408	0.371	0.301
9th	475	0.936	0.423	0.316	0.218	0.188	0.158	0.134	0.121	0.113	0.086
10th	525	0.921	0.479	0.347	0.241	0.216	0.176	0.142	0.126	0.110	0.080
11th	575	0.326	0.156	0.099	0.077	0.067	0.054	0.044	0.039	0.032	0.026
12th	625	0.147	0.082	0.063	0.036	0.028	0.023	0.021	0.020	0.019	0.018
13th	675	0.188	0.088	0.055	0.038	0.030	0.026	0.022	0.019	0.018	0.017
14th	725	0.138	0.078	0.051	0.037	0.033	0.029	0.025	0.022	0.020	0.020
15th	775	0.127	0.068	0.049	0.034	0.027	0.023	0.020	0.017	0.016	0.015
16th	825	0.134	0.071	0.049	0.040	0.030	0.025	0.023	0.021	0.020	0.023
17th	875	0.123	0.068	0.047	0.037	0.029	0.025	0.022	0.019	0.017	0.027
18th	925	0.146	0.076	0.054	0.040	0.032	0.027	0.021	0.019	0.017	0.029
19th	975	0.128	0.072	0.052	0.037	0.030	0.026	0.022	0.021	0.018	0.020
20th	1025	0.143	0.078	0.054	0.039	0.032	0.029	0.026	0.023	0.021	0.018
21th	1075	0.127	0.071	0.050	0.037	0.031	0.027	0.024	0.021	0.019	0.019
22th	1125	0.139	0.079	0.053	0.043	0.036	0.032	0.028	0.025	0.021	0.020
23th	1175	0.146	0.075	0.054	0.041	0.032	0.028	0.024	0.021	0.020	0.019
24th	1225	0.153	0.080	0.054	0.041	0.035	0.031	0.027	0.025	0.023	0.023
25th	1275	0.138	0.076	0.059	0.043	0.033	0.028	0.025	0.022	0.020	0.020
26th	1325	0.148	0.081	0.055	0.042	0.036	0.031	0.027	0.024	0.023	0.021
27th	1375	0.143	0.079	0.055	0.043	0.035	0.030	0.027	0.023	0.022	0.021
28th	1425	0.147	0.081	0.056	0.043	0.035	0.030	0.027	0.024	0.022	0.023
29th	1475	0.146	0.082	0.055	0.045	0.034	0.030	0.027	0.023	0.022	0.021
30th	1525	0.152	0.087	0.060	0.046	0.038	0.033	0.027	0.025	0.022	0.023
31th	1575	0.151	0.085	0.061	0.046	0.038	0.032	0.028	0.024	0.023	0.024
32th	1625	0.168	0.092	0.062	0.051	0.041	0.035	0.032	0.028	0.026	0.028
33th	1675	0.156	0.085	0.058	0.045	0.038	0.032	0.028	0.025	0.023	0.026
34th	1725	0.189	0.093	0.069	0.051	0.042	0.037	0.032	0.028	0.025	0.042
35th	1775	0.161	0.088	0.058	0.047	0.038	0.033	0.030	0.026	0.024	0.030
36th	1825	0.165	0.095	0.062	0.051	0.040	0.036	0.032	0.029	0.026	0.029
37th	1875	0.160	0.091	0.057	0.047	0.037	0.033	0.028	0.024	0.023	0.025
38th	1925	0.208	0.099	0.064	0.053	0.044	0.039	0.036	0.031	0.029	0.032
39th	1975	0.167	0.092	0.061	0.051	0.041	0.036	0.033	0.029	0.026	0.027
40th	2025	0.242	0.128	0.087	0.069	0.055	0.047	0.040	0.035	0.030	0.034

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Higher Frequencies										
Model	AIO2-INS-4600@Working in photovoltaic grid-connected mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.172	0.088	0.083	0.050	0.052	0.033	0.030	0.035	0.040	0.026
2.3	0.471	0.218	0.144	0.103	0.077	0.068	0.061	0.049	0.042	0.051
2.5	0.318	0.190	0.082	0.041	0.037	0.037	0.019	0.023	0.024	0.035
2.7	0.654	0.320	0.183	0.130	0.146	0.095	0.079	0.081	0.072	0.086
2.9	0.180	0.111	0.072	0.039	0.035	0.027	0.025	0.017	0.021	0.016
3.1	0.090	0.066	0.043	0.022	0.027	0.022	0.015	0.021	0.020	0.013
3.3	0.113	0.060	0.043	0.029	0.027	0.022	0.019	0.020	0.017	0.020
3.5	0.088	0.043	0.036	0.025	0.023	0.021	0.017	0.016	0.016	0.013
3.7	0.119	0.060	0.046	0.036	0.028	0.023	0.020	0.018	0.015	0.014
3.9	0.192	0.192	0.122	0.093	0.077	0.066	0.062	0.055	0.049	0.046
4.1	0.221	0.163	0.095	0.075	0.061	0.055	0.049	0.045	0.041	0.037
4.3	0.181	0.095	0.069	0.055	0.044	0.037	0.032	0.027	0.024	0.022
4.5	0.102	0.052	0.038	0.030	0.025	0.022	0.020	0.017	0.015	0.015
4.7	0.080	0.045	0.030	0.024	0.020	0.018	0.016	0.013	0.013	0.012
4.9	0.068	0.034	0.023	0.018	0.015	0.014	0.013	0.010	0.009	0.009
5.1	0.057	0.030	0.019	0.015	0.012	0.011	0.010	0.009	0.008	0.008
5.3	0.057	0.030	0.019	0.014	0.012	0.011	0.010	0.008	0.008	0.008
5.5	0.047	0.025	0.016	0.013	0.010	0.009	0.008	0.007	0.007	0.006
5.7	0.046	0.025	0.016	0.013	0.009	0.009	0.008	0.007	0.007	0.006
5.9	0.048	0.028	0.018	0.015	0.010	0.009	0.009	0.008	0.007	0.007
6.1	0.045	0.022	0.015	0.011	0.009	0.007	0.007	0.008	0.007	0.007
6.3	0.042	0.021	0.014	0.010	0.008	0.007	0.006	0.006	0.006	0.006
6.5	0.033	0.016	0.011	0.008	0.007	0.005	0.005	0.005	0.004	0.004
6.7	0.033	0.016	0.011	0.008	0.007	0.005	0.005	0.004	0.004	0.004
6.9	0.031	0.016	0.010	0.008	0.006	0.005	0.004	0.004	0.004	0.004
7.1	0.035	0.020	0.014	0.010	0.008	0.006	0.005	0.005	0.004	0.004
7.3	0.036	0.018	0.012	0.008	0.007	0.006	0.005	0.004	0.004	0.004
7.5	0.032	0.015	0.010	0.008	0.006	0.005	0.004	0.004	0.003	0.003
7.7	0.032	0.015	0.011	0.008	0.006	0.005	0.005	0.004	0.004	0.004
7.9	0.033	0.022	0.022	0.011	0.008	0.006	0.005	0.004	0.004	0.004
8.1	0.032	0.021	0.022	0.011	0.008	0.006	0.005	0.005	0.005	0.004
8.3	0.035	0.017	0.011	0.009	0.007	0.006	0.005	0.004	0.004	0.004
8.5	0.036	0.018	0.011	0.008	0.007	0.006	0.005	0.005	0.004	0.004
8.7	0.033	0.017	0.010	0.008	0.007	0.005	0.005	0.004	0.004	0.004
8.9	0.034	0.017	0.011	0.008	0.007	0.006	0.005	0.004	0.004	0.004

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Current harmonics										
Model	AIO2-INS-4600@Work in the grid to charge the battery mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2nd	0.012	0.013	0.013	0.013	0.014	0.014	0.018	0.019	0.017	0.023
3rd	0.307	0.313	0.313	0.306	0.299	0.294	0.290	0.289	0.284	0.281
4th	0.021	0.022	0.021	0.022	0.023	0.023	0.021	0.024	0.027	0.023
5th	0.010	0.011	0.008	0.009	0.011	0.015	0.018	0.021	0.023	0.024
6th	0.008	0.008	0.009	0.009	0.009	0.010	0.012	0.010	0.010	0.013
7th	0.009	0.011	0.012	0.012	0.013	0.013	0.013	0.012	0.011	0.012
8th	0.005	0.006	0.006	0.005	0.005	0.005	0.004	0.005	0.004	0.004
9th	0.003	0.004	0.004	0.004	0.005	0.005	0.006	0.007	0.009	0.010
10th	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.007	0.007	0.005
11th	0.009	0.009	0.008	0.007	0.007	0.007	0.007	0.007	0.008	0.009
12th	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.006	0.008	0.009
13th	0.003	0.002	0.003	0.003	0.003	0.003	0.004	0.005	0.005	0.007
14th	0.006	0.005	0.005	0.006	0.006	0.006	0.005	0.005	0.004	0.005
15th	0.004	0.005	0.004	0.004	0.005	0.004	0.005	0.005	0.004	0.005
16th	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
17th	0.004	0.004	0.005	0.006	0.007	0.007	0.008	0.008	0.008	0.008
18th	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
19th	0.002	0.002	0.002	0.003	0.004	0.004	0.004	0.004	0.005	0.005
20th	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
21th	0.002	0.002	0.002	0.003	0.004	0.005	0.005	0.005	0.006	0.006
22th	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003
23th	0.002	0.003	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003
24th	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
25th	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003
26th	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
27th	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003
28th	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
29th	0.002	0.002	0.002	0.002	0.003	0.004	0.005	0.005	0.006	0.006
30th	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
31th	0.002	0.002	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.002
32th	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
33th	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.004	0.005
34th	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.002	0.003
35th	0.002	0.002	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002
36th	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
37th	0.002	0.002	0.002	0.001	0.002	0.002	0.002	0.002	0.003	0.003
38th	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
39th	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
40th	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Inter-harmonics											
Model	AIO2-INS-4600@Work in the grid to charge the battery mode										
P/P_n [%]	Frequency	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	[Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1st	75	0.352	0.748	0.511	0.373	0.290	0.241	0.205	0.182	0.158	0.142
2nd	125	0.452	0.717	0.494	0.376	0.299	0.247	0.210	0.185	0.158	0.137
3rd	175	0.489	0.338	0.952	0.753	0.620	0.537	0.470	0.429	0.384	0.349
4th	225	0.373	0.256	0.875	0.684	0.566	0.490	0.433	0.395	0.356	0.324
5th	275	0.971	0.029	0.726	0.572	0.473	0.409	0.363	0.334	0.303	0.276
6th	325	0.049	0.141	0.828	0.660	0.555	0.487	0.437	0.402	0.367	0.334
7th	375	0.346	0.214	0.848	0.646	0.516	0.429	0.363	0.319	0.279	0.257
8th	425	0.520	0.345	0.937	0.725	0.584	0.484	0.405	0.351	0.300	0.273
9th	475	0.723	0.389	0.269	0.200	0.156	0.129	0.110	0.099	0.091	0.080
10th	525	0.925	0.436	0.267	0.188	0.137	0.107	0.092	0.089	0.087	0.081
11th	575	0.189	0.124	0.082	0.066	0.052	0.041	0.034	0.027	0.023	0.020
12th	625	0.183	0.077	0.048	0.038	0.036	0.034	0.028	0.021	0.017	0.019
13th	675	0.152	0.075	0.048	0.037	0.031	0.028	0.024	0.022	0.020	0.017
14th	725	0.117	0.069	0.047	0.037	0.031	0.031	0.032	0.033	0.028	0.023
15th	775	0.111	0.068	0.045	0.035	0.030	0.025	0.022	0.020	0.018	0.016
16th	825	0.119	0.078	0.057	0.045	0.041	0.034	0.026	0.021	0.020	0.020
17th	875	0.115	0.068	0.046	0.033	0.027	0.024	0.020	0.018	0.017	0.015
18th	925	0.123	0.071	0.049	0.035	0.028	0.025	0.022	0.021	0.019	0.017
19th	975	0.117	0.070	0.048	0.036	0.029	0.025	0.021	0.019	0.017	0.016
20th	1025	0.130	0.073	0.048	0.037	0.032	0.026	0.022	0.019	0.017	0.016
21th	1075	0.116	0.068	0.046	0.036	0.030	0.026	0.021	0.019	0.017	0.016
22th	1125	0.130	0.072	0.051	0.038	0.030	0.026	0.023	0.020	0.018	0.016
23th	1175	0.122	0.073	0.050	0.038	0.032	0.027	0.022	0.020	0.018	0.017
24th	1225	0.127	0.072	0.051	0.040	0.033	0.028	0.023	0.021	0.019	0.017
25th	1275	0.125	0.074	0.052	0.041	0.033	0.027	0.024	0.022	0.019	0.017
26th	1325	0.130	0.075	0.052	0.040	0.033	0.029	0.025	0.023	0.020	0.019
27th	1375	0.128	0.075	0.053	0.041	0.033	0.029	0.025	0.023	0.020	0.018
28th	1425	0.129	0.076	0.054	0.042	0.034	0.030	0.025	0.023	0.021	0.019
29th	1475	0.130	0.077	0.054	0.043	0.035	0.030	0.025	0.023	0.020	0.019
30th	1525	0.137	0.079	0.056	0.044	0.037	0.031	0.028	0.024	0.022	0.020
31th	1575	0.139	0.083	0.058	0.045	0.036	0.032	0.028	0.025	0.022	0.020
32th	1625	0.140	0.085	0.060	0.047	0.039	0.035	0.031	0.027	0.025	0.023
33th	1675	0.138	0.084	0.059	0.044	0.037	0.033	0.029	0.026	0.023	0.021
34th	1725	0.173	0.093	0.064	0.049	0.041	0.036	0.032	0.028	0.025	0.023
35th	1775	0.154	0.092	0.064	0.048	0.039	0.034	0.029	0.026	0.025	0.023
36th	1825	0.156	0.099	0.067	0.053	0.044	0.037	0.032	0.029	0.026	0.024
37th	1875	0.154	0.087	0.060	0.046	0.038	0.033	0.029	0.026	0.024	0.023
38th	1925	0.155	0.102	0.071	0.055	0.045	0.039	0.034	0.031	0.030	0.027
39th	1975	0.153	0.091	0.061	0.048	0.042	0.037	0.032	0.028	0.026	0.025
40th	2025	0.187	0.135	0.091	0.070	0.059	0.054	0.048	0.045	0.038	0.036

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Higher Frequencies										
Model	AIO2-INS-4600@Work in the grid to charge the battery mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.141	0.126	0.119	0.082	0.062	0.070	0.049	0.029	0.030	0.033
2.3	0.101	0.129	0.065	0.049	0.047	0.039	0.029	0.050	0.038	0.025
2.5	0.186	0.171	0.108	0.082	0.050	0.026	0.035	0.029	0.020	0.022
2.7	0.120	0.127	0.055	0.033	0.026	0.030	0.033	0.020	0.018	0.024
2.9	0.085	0.117	0.045	0.028	0.024	0.027	0.027	0.018	0.015	0.022
3.1	0.061	0.079	0.036	0.023	0.019	0.022	0.021	0.012	0.012	0.014
3.3	0.071	0.082	0.045	0.026	0.020	0.018	0.014	0.013	0.011	0.010
3.5	0.064	0.075	0.034	0.024	0.016	0.013	0.011	0.011	0.010	0.010
3.7	0.051	0.058	0.030	0.023	0.016	0.013	0.010	0.010	0.009	0.008
3.9	0.053	0.058	0.029	0.020	0.015	0.013	0.009	0.008	0.007	0.007
4.1	0.046	0.052	0.027	0.017	0.014	0.011	0.009	0.008	0.008	0.007
4.3	0.048	0.055	0.028	0.019	0.014	0.011	0.009	0.007	0.007	0.006
4.5	0.048	0.058	0.028	0.018	0.014	0.012	0.009	0.008	0.007	0.007
4.7	0.047	0.055	0.029	0.020	0.015	0.013	0.009	0.007	0.007	0.007
4.9	0.046	0.052	0.028	0.020	0.016	0.012	0.009	0.008	0.007	0.006
5.1	0.045	0.050	0.026	0.018	0.015	0.012	0.009	0.008	0.007	0.006
5.3	0.047	0.053	0.027	0.018	0.014	0.013	0.009	0.008	0.007	0.007
5.5	0.048	0.053	0.029	0.020	0.017	0.013	0.009	0.008	0.008	0.007
5.7	0.059	0.067	0.033	0.021	0.016	0.013	0.009	0.008	0.007	0.006
5.9	0.047	0.051	0.027	0.019	0.015	0.012	0.009	0.008	0.007	0.007
6.1	0.046	0.052	0.027	0.018	0.014	0.012	0.008	0.007	0.007	0.006
6.3	0.043	0.051	0.026	0.017	0.013	0.011	0.008	0.007	0.006	0.006
6.5	0.042	0.047	0.025	0.016	0.012	0.010	0.007	0.006	0.006	0.005
6.7	0.038	0.043	0.021	0.014	0.012	0.010	0.007	0.007	0.006	0.006
6.9	0.037	0.042	0.023	0.015	0.012	0.010	0.007	0.007	0.006	0.005
7.1	0.039	0.044	0.023	0.015	0.012	0.010	0.007	0.006	0.006	0.005
7.3	0.037	0.042	0.022	0.014	0.010	0.009	0.007	0.006	0.006	0.005
7.5	0.036	0.041	0.021	0.013	0.010	0.009	0.006	0.006	0.005	0.005
7.7	0.036	0.039	0.020	0.014	0.011	0.009	0.006	0.006	0.005	0.005
7.9	0.040	0.043	0.022	0.015	0.011	0.009	0.006	0.006	0.005	0.005
8.1	0.035	0.040	0.021	0.013	0.010	0.008	0.006	0.005	0.005	0.004
8.3	0.036	0.040	0.021	0.013	0.010	0.008	0.006	0.005	0.005	0.004
8.5	0.034	0.038	0.019	0.013	0.010	0.008	0.006	0.005	0.005	0.005
8.7	0.034	0.040	0.021	0.014	0.010	0.008	0.006	0.006	0.005	0.004
8.9	0.035	0.039	0.021	0.013	0.010	0.008	0.006	0.006	0.005	0.005

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Current harmonics										
Model	AIO2-INS-4600@Working in battery discharge and grid connection mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2nd	0.142	0.012	0.012	0.011	0.011	0.010	0.011	0.010	0.010	0.010
3rd	0.290	0.280	0.286	0.291	0.290	0.273	0.280	0.287	0.288	0.287
4th	0.055	0.023	0.022	0.022	0.024	0.024	0.024	0.024	0.025	0.026
5th	0.042	0.013	0.012	0.015	0.014	0.016	0.013	0.014	0.014	0.014
6th	0.033	0.009	0.009	0.009	0.009	0.009	0.009	0.010	0.009	0.009
7th	0.028	0.009	0.007	0.007	0.007	0.006	0.006	0.007	0.007	0.007
8th	0.024	0.006	0.006	0.006	0.005	0.005	0.006	0.005	0.005	0.005
9th	0.021	0.006	0.006	0.006	0.006	0.007	0.006	0.005	0.005	0.005
10th	0.020	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
11th	0.019	0.009	0.009	0.010	0.011	0.011	0.011	0.011	0.011	0.011
12th	0.017	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
13th	0.014	0.003	0.004	0.003	0.003	0.006	0.005	0.004	0.004	0.003
14th	0.014	0.006	0.006	0.006	0.005	0.006	0.006	0.005	0.005	0.005
15th	0.013	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.004	0.004
16th	0.012	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
17th	0.013	0.006	0.006	0.005	0.004	0.006	0.005	0.005	0.004	0.004
18th	0.010	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
19th	0.011	0.005	0.005	0.004	0.004	0.006	0.005	0.005	0.004	0.004
20th	0.010	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
21th	0.010	0.005	0.004	0.004	0.003	0.006	0.006	0.005	0.005	0.005
22th	0.009	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
23th	0.008	0.003	0.003	0.003	0.003	0.005	0.005	0.005	0.005	0.005
24th	0.008	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
25th	0.008	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.004
26th	0.007	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
27th	0.007	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.005	0.005
28th	0.007	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
29th	0.007	0.004	0.004	0.004	0.004	0.006	0.005	0.006	0.006	0.006
30th	0.006	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
31th	0.006	0.002	0.002	0.002	0.003	0.003	0.004	0.005	0.005	0.005
32th	0.006	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.002	0.002
33th	0.006	0.002	0.002	0.003	0.003	0.004	0.005	0.005	0.005	0.006
34th	0.006	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003
35th	0.005	0.002	0.002	0.002	0.003	0.004	0.004	0.005	0.005	0.006
36th	0.005	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
37th	0.005	0.002	0.002	0.003	0.003	0.004	0.004	0.005	0.006	0.006
38th	0.005	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003
39th	0.005	0.002	0.002	0.003	0.003	0.003	0.004	0.005	0.005	0.005
40th	0.005	0.003	0.003	0.003	0.002	0.003	0.003	0.002	0.002	0.002

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Inter-harmonics											
Model	AIO2-INS-4600@Working in battery discharge and grid connection mode										
P/P_n [%]	Frequency	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	[Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1st	75	0.848	0.871	0.617	0.480	0.401	0.339	0.304	0.283	0.267	0.285
2nd	125	0.817	0.904	0.619	0.485	0.407	0.351	0.315	0.291	0.276	0.289
3rd	175	0.513	0.449	0.985	0.762	0.633	0.553	0.489	0.445	0.415	0.402
4th	225	0.686	0.327	0.914	0.719	0.603	0.538	0.482	0.441	0.415	0.404
5th	275	0.155	0.881	0.596	0.457	0.375	0.326	0.284	0.251	0.230	0.222
6th	325	0.701	0.053	0.691	0.518	0.417	0.356	0.308	0.272	0.250	0.240
7th	375	0.854	0.296	0.871	0.663	0.540	0.455	0.389	0.341	0.308	0.291
8th	425	0.515	0.450	0.984	0.756	0.618	0.535	0.464	0.413	0.378	0.361
9th	475	0.006	0.487	0.316	0.233	0.186	0.155	0.132	0.118	0.107	0.103
10th	525	0.993	0.516	0.356	0.275	0.223	0.185	0.157	0.136	0.121	0.112
11th	575	0.203	0.138	0.099	0.076	0.061	0.055	0.047	0.040	0.035	0.033
12th	625	0.331	0.078	0.050	0.040	0.031	0.026	0.022	0.021	0.020	0.021
13th	675	0.188	0.085	0.053	0.042	0.033	0.025	0.021	0.019	0.017	0.019
14th	725	0.207	0.075	0.047	0.040	0.033	0.029	0.025	0.022	0.019	0.019
15th	775	0.157	0.068	0.044	0.034	0.027	0.023	0.021	0.018	0.017	0.017
16th	825	0.155	0.067	0.046	0.037	0.029	0.024	0.021	0.019	0.018	0.018
17th	875	0.164	0.067	0.045	0.035	0.028	0.024	0.022	0.019	0.017	0.018
18th	925	0.153	0.069	0.047	0.038	0.030	0.024	0.021	0.019	0.018	0.018
19th	975	0.168	0.070	0.048	0.037	0.030	0.026	0.023	0.020	0.018	0.018
20th	1025	0.158	0.074	0.052	0.040	0.033	0.028	0.024	0.022	0.020	0.019
21th	1075	0.166	0.073	0.048	0.038	0.031	0.026	0.023	0.020	0.019	0.018
22th	1125	0.165	0.080	0.051	0.041	0.034	0.030	0.027	0.023	0.022	0.021
23th	1175	0.167	0.076	0.050	0.040	0.032	0.028	0.024	0.022	0.020	0.020
24th	1225	0.165	0.081	0.054	0.043	0.034	0.031	0.027	0.024	0.022	0.022
25th	1275	0.187	0.086	0.053	0.041	0.033	0.028	0.025	0.022	0.020	0.019
26th	1325	0.168	0.081	0.057	0.044	0.037	0.034	0.029	0.026	0.024	0.023
27th	1375	0.162	0.080	0.054	0.042	0.034	0.030	0.026	0.024	0.022	0.021
28th	1425	0.166	0.083	0.056	0.042	0.034	0.031	0.027	0.024	0.022	0.022
29th	1475	0.180	0.082	0.056	0.043	0.035	0.030	0.026	0.024	0.022	0.021
30th	1525	0.186	0.085	0.061	0.046	0.039	0.033	0.029	0.026	0.024	0.024
31th	1575	0.185	0.084	0.059	0.046	0.037	0.032	0.028	0.025	0.023	0.022
32th	1625	0.195	0.089	0.063	0.049	0.040	0.036	0.032	0.029	0.027	0.027
33th	1675	0.185	0.089	0.058	0.046	0.038	0.033	0.029	0.026	0.024	0.024
34th	1725	0.205	0.099	0.068	0.053	0.043	0.037	0.031	0.028	0.026	0.025
35th	1775	0.192	0.088	0.059	0.047	0.039	0.034	0.030	0.027	0.025	0.026
36th	1825	0.189	0.091	0.063	0.048	0.040	0.035	0.031	0.028	0.027	0.025
37th	1875	0.203	0.089	0.060	0.047	0.037	0.033	0.030	0.027	0.025	0.025
38th	1925	0.229	0.094	0.066	0.053	0.045	0.041	0.036	0.033	0.031	0.029
39th	1975	0.207	0.091	0.064	0.048	0.039	0.034	0.032	0.027	0.026	0.024
40th	2025	0.313	0.139	0.095	0.073	0.060	0.053	0.045	0.038	0.034	0.032

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Higher Frequencies										
Model	AIO2-INS-4600@Working in battery discharge and grid connection mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.237	0.093	0.063	0.040	0.041	0.048	0.037	0.037	0.027	0.029
2.3	0.284	0.104	0.087	0.064	0.059	0.035	0.032	0.026	0.024	0.023
2.5	0.125	0.089	0.056	0.037	0.033	0.025	0.021	0.021	0.025	0.027
2.7	0.141	0.071	0.042	0.029	0.021	0.022	0.029	0.031	0.026	0.028
2.9	0.114	0.061	0.041	0.028	0.020	0.019	0.025	0.017	0.018	0.019
3.1	0.074	0.042	0.028	0.019	0.014	0.016	0.016	0.019	0.020	0.017
3.3	0.089	0.040	0.033	0.023	0.017	0.018	0.018	0.020	0.018	0.014
3.5	0.069	0.032	0.026	0.019	0.015	0.013	0.011	0.010	0.009	0.009
3.7	0.070	0.032	0.023	0.016	0.013	0.012	0.011	0.009	0.008	0.007
3.9	0.067	0.030	0.021	0.016	0.014	0.012	0.011	0.008	0.007	0.007
4.1	0.063	0.026	0.018	0.015	0.011	0.009	0.008	0.007	0.007	0.007
4.3	0.062	0.028	0.019	0.015	0.012	0.009	0.008	0.007	0.007	0.006
4.5	0.056	0.027	0.021	0.015	0.012	0.010	0.009	0.007	0.006	0.006
4.7	0.059	0.027	0.021	0.015	0.012	0.010	0.009	0.008	0.007	0.007
4.9	0.064	0.030	0.020	0.015	0.011	0.011	0.009	0.008	0.006	0.006
5.1	0.054	0.027	0.020	0.014	0.010	0.010	0.009	0.007	0.006	0.006
5.3	0.055	0.027	0.020	0.014	0.010	0.010	0.008	0.007	0.006	0.006
5.5	0.064	0.029	0.022	0.016	0.011	0.010	0.009	0.007	0.006	0.006
5.7	0.072	0.033	0.023	0.017	0.014	0.011	0.009	0.008	0.007	0.007
5.9	0.054	0.025	0.020	0.014	0.010	0.011	0.009	0.008	0.006	0.006
6.1	0.053	0.025	0.019	0.013	0.010	0.009	0.008	0.007	0.006	0.006
6.3	0.053	0.025	0.018	0.013	0.010	0.009	0.008	0.007	0.006	0.006
6.5	0.049	0.024	0.018	0.013	0.010	0.009	0.007	0.006	0.006	0.006
6.7	0.049	0.024	0.017	0.012	0.009	0.008	0.007	0.006	0.005	0.005
6.9	0.047	0.023	0.017	0.013	0.009	0.009	0.007	0.006	0.005	0.005
7.1	0.047	0.021	0.016	0.012	0.009	0.008	0.007	0.006	0.005	0.005
7.3	0.043	0.020	0.015	0.011	0.008	0.008	0.006	0.006	0.005	0.005
7.5	0.044	0.020	0.015	0.011	0.009	0.008	0.006	0.006	0.005	0.005
7.7	0.042	0.020	0.015	0.011	0.008	0.008	0.006	0.005	0.005	0.005
7.9	0.042	0.020	0.016	0.012	0.009	0.008	0.007	0.006	0.005	0.005
8.1	0.044	0.020	0.015	0.011	0.008	0.007	0.006	0.005	0.005	0.005
8.3	0.042	0.020	0.014	0.010	0.008	0.007	0.006	0.005	0.005	0.004
8.5	0.039	0.020	0.015	0.011	0.008	0.007	0.006	0.005	0.005	0.005
8.7	0.041	0.019	0.015	0.011	0.008	0.008	0.006	0.005	0.005	0.005
8.9	0.042	0.021	0.015	0.011	0.008	0.007	0.006	0.005	0.005	0.004

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Current harmonics										
Model	AIO2-INS-3680@Working in photovoltaic grid-connected mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2nd	0.018	0.027	0.025	0.023	0.021	0.019	0.019	0.017	0.017	0.016
3rd	0.175	0.149	0.146	0.163	0.180	0.199	0.222	0.247	0.271	0.256
4th	0.012	0.009	0.008	0.009	0.007	0.006	0.004	0.005	0.006	0.006
5th	0.029	0.043	0.045	0.044	0.047	0.050	0.051	0.051	0.054	0.065
6th	0.005	0.011	0.006	0.008	0.006	0.004	0.006	0.004	0.004	0.005
7th	0.042	0.044	0.046	0.049	0.055	0.062	0.068	0.071	0.072	0.076
8th	0.006	0.003	0.009	0.012	0.006	0.003	0.002	0.008	0.003	0.003
9th	0.032	0.037	0.049	0.048	0.048	0.052	0.056	0.059	0.064	0.065
10th	0.003	0.005	0.007	0.007	0.005	0.004	0.003	0.003	0.003	0.002
11th	0.020	0.029	0.039	0.043	0.041	0.041	0.044	0.046	0.051	0.050
12th	0.003	0.003	0.004	0.009	0.006	0.005	0.004	0.005	0.005	0.003
13th	0.021	0.023	0.033	0.039	0.036	0.035	0.038	0.040	0.040	0.041
14th	0.002	0.003	0.003	0.005	0.005	0.003	0.003	0.007	0.003	0.002
15th	0.014	0.018	0.025	0.033	0.035	0.034	0.034	0.036	0.039	0.038
16th	0.001	0.002	0.003	0.002	0.005	0.005	0.005	0.005	0.007	0.003
17th	0.009	0.015	0.018	0.028	0.031	0.031	0.032	0.035	0.035	0.035
18th	0.002	0.002	0.002	0.003	0.004	0.004	0.002	0.005	0.004	0.003
19th	0.011	0.012	0.018	0.023	0.030	0.033	0.033	0.035	0.036	0.036
20th	0.003	0.002	0.003	0.006	0.004	0.004	0.005	0.004	0.003	0.004
21th	0.008	0.011	0.015	0.021	0.025	0.029	0.030	0.032	0.034	0.032
22th	0.002	0.003	0.002	0.004	0.003	0.006	0.004	0.004	0.004	0.002
23th	0.006	0.010	0.010	0.016	0.022	0.029	0.032	0.034	0.034	0.036
24th	0.002	0.003	0.004	0.003	0.004	0.002	0.004	0.003	0.003	0.004
25th	0.008	0.009	0.012	0.016	0.022	0.026	0.030	0.032	0.035	0.034
26th	0.004	0.003	0.006	0.003	0.005	0.005	0.008	0.006	0.006	0.006
27th	0.007	0.010	0.011	0.014	0.018	0.023	0.028	0.031	0.033	0.034
28th	0.004	0.004	0.003	0.004	0.004	0.006	0.003	0.003	0.003	0.003
29th	0.006	0.010	0.012	0.015	0.018	0.023	0.028	0.032	0.034	0.038
30th	0.003	0.003	0.002	0.004	0.003	0.003	0.006	0.003	0.004	0.005
31th	0.006	0.008	0.010	0.013	0.015	0.019	0.023	0.027	0.030	0.034
32th	0.003	0.004	0.004	0.004	0.005	0.004	0.003	0.005	0.006	0.006
33th	0.005	0.009	0.008	0.009	0.013	0.018	0.023	0.026	0.030	0.035
34th	0.004	0.004	0.005	0.003	0.007	0.004	0.005	0.007	0.005	0.003
35th	0.005	0.008	0.010	0.011	0.014	0.017	0.021	0.026	0.030	0.036
36th	0.004	0.003	0.003	0.003	0.004	0.006	0.007	0.005	0.006	0.008
37th	0.007	0.009	0.011	0.011	0.013	0.015	0.020	0.021	0.022	0.030
38th	0.003	0.004	0.003	0.006	0.004	0.006	0.007	0.008	0.005	0.005
39th	0.008	0.008	0.009	0.011	0.012	0.014	0.018	0.021	0.024	0.029
40th	0.004	0.004	0.006	0.006	0.006	0.005	0.003	0.006	0.006	0.004

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Inter-harmonics											
Model	AIO2-INS-3680@Working in photovoltaic grid-connected mode										
P/P_n [%]	Frequency	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	[Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1st	75	0.715	0.301	0.163	0.131	0.113	0.097	0.085	0.076	0.066	0.067
2nd	125	0.219	0.166	0.087	0.072	0.061	0.052	0.048	0.044	0.041	0.040
3rd	175	0.138	0.077	0.163	0.114	0.088	0.073	0.062	0.054	0.050	0.044
4th	225	0.129	0.073	0.153	0.109	0.079	0.064	0.054	0.049	0.045	0.038
5th	275	0.114	0.066	0.075	0.053	0.048	0.043	0.038	0.033	0.030	0.044
6th	325	0.113	0.069	0.076	0.054	0.050	0.045	0.040	0.034	0.031	0.045
7th	375	0.122	0.066	0.121	0.085	0.070	0.058	0.051	0.046	0.042	0.037
8th	425	0.153	0.092	0.110	0.081	0.064	0.054	0.048	0.043	0.039	0.035
9th	475	0.130	0.065	0.074	0.045	0.037	0.030	0.025	0.022	0.020	0.017
10th	525	0.198	0.114	0.083	0.065	0.048	0.040	0.034	0.030	0.026	0.026
11th	575	0.125	0.068	0.052	0.036	0.029	0.022	0.019	0.017	0.015	0.014
12th	625	0.182	0.101	0.078	0.061	0.047	0.041	0.035	0.031	0.027	0.028
13th	675	0.150	0.074	0.049	0.037	0.029	0.024	0.021	0.018	0.016	0.017
14th	725	0.186	0.106	0.067	0.047	0.035	0.029	0.024	0.019	0.018	0.018
15th	775	0.126	0.076	0.052	0.040	0.030	0.025	0.021	0.018	0.016	0.021
16th	825	0.133	0.083	0.061	0.046	0.036	0.028	0.023	0.020	0.017	0.136
17th	875	0.125	0.079	0.055	0.041	0.031	0.026	0.022	0.019	0.017	0.165
18th	925	0.134	0.078	0.057	0.045	0.035	0.028	0.024	0.021	0.018	0.138
19th	975	0.139	0.078	0.055	0.042	0.032	0.026	0.023	0.020	0.018	0.021
20th	1025	0.138	0.080	0.056	0.045	0.034	0.028	0.024	0.021	0.018	0.019
21th	1075	0.157	0.092	0.058	0.042	0.033	0.028	0.025	0.022	0.019	0.019
22th	1125	0.191	0.104	0.068	0.050	0.037	0.029	0.025	0.022	0.020	0.019
23th	1175	0.250	0.098	0.062	0.046	0.036	0.030	0.026	0.023	0.020	0.021
24th	1225	0.307	0.129	0.079	0.055	0.039	0.030	0.026	0.024	0.021	0.021
25th	1275	0.409	0.185	0.125	0.098	0.076	0.061	0.052	0.046	0.041	0.038
26th	1325	0.383	0.191	0.086	0.056	0.046	0.038	0.034	0.030	0.026	0.026
27th	1375	0.911	0.449	0.277	0.191	0.157	0.126	0.108	0.095	0.083	0.080
28th	1425	0.283	0.159	0.079	0.059	0.047	0.040	0.034	0.031	0.027	0.028
29th	1475	0.502	0.293	0.163	0.114	0.087	0.070	0.060	0.053	0.047	0.045
30th	1525	0.516	0.202	0.098	0.064	0.048	0.038	0.034	0.029	0.026	0.026
31th	1575	0.242	0.173	0.094	0.066	0.051	0.042	0.036	0.031	0.027	0.028
32th	1625	0.362	0.204	0.115	0.074	0.056	0.043	0.036	0.031	0.027	0.027
33th	1675	0.207	0.129	0.088	0.061	0.050	0.042	0.036	0.032	0.028	0.030
34th	1725	0.259	0.152	0.103	0.076	0.056	0.044	0.037	0.031	0.028	0.036
35th	1775	0.226	0.129	0.088	0.061	0.050	0.043	0.038	0.033	0.028	0.032
36th	1825	0.262	0.144	0.100	0.078	0.063	0.053	0.045	0.039	0.035	0.037
37th	1875	0.230	0.141	0.086	0.063	0.053	0.046	0.040	0.035	0.032	0.035
38th	1925	0.301	0.174	0.101	0.080	0.063	0.053	0.045	0.040	0.036	0.040
39th	1975	0.247	0.134	0.089	0.065	0.055	0.046	0.040	0.036	0.032	0.037
40th	2025	0.253	0.156	0.095	0.068	0.056	0.046	0.039	0.035	0.031	0.036

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Higher Frequencies										
Model	AIO2-INS-3680@Working in photovoltaic grid-connected mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.240	0.130	0.085	0.052	0.051	0.039	0.045	0.036	0.034	0.037
2.3	0.556	0.300	0.181	0.141	0.103	0.084	0.069	0.057	0.052	0.059
2.5	0.545	0.296	0.108	0.064	0.037	0.042	0.051	0.024	0.029	0.022
2.7	1.030	0.571	0.249	0.166	0.137	0.142	0.106	0.090	0.082	0.097
2.9	0.229	0.188	0.099	0.054	0.043	0.035	0.030	0.028	0.022	0.018
3.1	0.139	0.078	0.065	0.032	0.026	0.026	0.024	0.026	0.020	0.014
3.3	0.156	0.080	0.051	0.037	0.032	0.029	0.020	0.020	0.022	0.016
3.5	0.121	0.064	0.040	0.029	0.024	0.024	0.024	0.019	0.017	0.015
3.7	0.150	0.077	0.059	0.044	0.034	0.030	0.024	0.022	0.020	0.018
3.9	0.233	0.104	0.160	0.112	0.093	0.079	0.070	0.064	0.059	0.055
4.1	0.256	0.117	0.131	0.089	0.069	0.061	0.055	0.051	0.048	0.045
4.3	0.222	0.106	0.084	0.063	0.054	0.047	0.042	0.035	0.031	0.028
4.5	0.125	0.064	0.044	0.034	0.029	0.027	0.024	0.021	0.019	0.018
4.7	0.097	0.050	0.035	0.027	0.022	0.021	0.019	0.016	0.015	0.015
4.9	0.082	0.044	0.028	0.022	0.018	0.016	0.015	0.012	0.012	0.012
5.1	0.077	0.041	0.024	0.018	0.015	0.013	0.012	0.010	0.010	0.010
5.3	0.076	0.045	0.026	0.019	0.015	0.013	0.011	0.010	0.009	0.009
5.5	0.059	0.034	0.020	0.014	0.013	0.011	0.009	0.009	0.008	0.008
5.7	0.057	0.028	0.019	0.014	0.013	0.011	0.009	0.009	0.008	0.008
5.9	0.057	0.027	0.019	0.015	0.014	0.013	0.011	0.010	0.009	0.008
6.1	0.048	0.025	0.019	0.014	0.014	0.011	0.010	0.010	0.009	0.009
6.3	0.052	0.025	0.018	0.014	0.012	0.010	0.009	0.008	0.007	0.007
6.5	0.042	0.022	0.014	0.010	0.009	0.008	0.006	0.006	0.005	0.005
6.7	0.043	0.022	0.014	0.010	0.008	0.007	0.006	0.005	0.005	0.004
6.9	0.041	0.021	0.014	0.010	0.008	0.007	0.006	0.005	0.004	0.004
7.1	0.040	0.021	0.016	0.012	0.009	0.008	0.007	0.006	0.005	0.005
7.3	0.046	0.022	0.015	0.011	0.009	0.007	0.006	0.005	0.005	0.005
7.5	0.041	0.021	0.013	0.010	0.008	0.007	0.006	0.005	0.004	0.004
7.7	0.040	0.021	0.015	0.010	0.008	0.007	0.006	0.005	0.004	0.004
7.9	0.042	0.022	0.040	0.018	0.011	0.009	0.007	0.006	0.005	0.005
8.1	0.041	0.023	0.037	0.016	0.011	0.009	0.007	0.006	0.005	0.005
8.3	0.043	0.022	0.017	0.011	0.009	0.008	0.006	0.005	0.005	0.005
8.5	0.042	0.023	0.016	0.011	0.009	0.008	0.006	0.005	0.005	0.005
8.7	0.043	0.023	0.014	0.010	0.008	0.007	0.006	0.005	0.004	0.004
8.9	0.041	0.023	0.014	0.010	0.008	0.007	0.006	0.005	0.005	0.004

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Current harmonics										
Model	AIO2-INS-3680@Work in the grid to charge the battery mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2nd	0.011	0.009	0.005	0.008	0.009	0.007	0.006	0.006	0.005	0.005
3rd	0.121	0.225	0.266	0.261	0.286	0.304	0.324	0.348	0.371	0.385
4th	0.005	0.006	0.005	0.004	0.004	0.003	0.003	0.003	0.008	0.007
5th	0.025	0.061	0.094	0.117	0.132	0.140	0.147	0.152	0.162	0.169
6th	0.005	0.007	0.012	0.009	0.008	0.008	0.009	0.011	0.013	0.012
7th	0.052	0.024	0.061	0.085	0.101	0.108	0.111	0.113	0.109	0.105
8th	0.005	0.005	0.007	0.004	0.005	0.005	0.006	0.009	0.006	0.005
9th	0.039	0.009	0.024	0.037	0.044	0.048	0.051	0.052	0.057	0.058
10th	0.003	0.003	0.003	0.003	0.005	0.003	0.003	0.003	0.004	0.004
11th	0.011	0.008	0.003	0.009	0.019	0.025	0.030	0.036	0.038	0.041
12th	0.003	0.004	0.004	0.003	0.005	0.005	0.004	0.004	0.003	0.004
13th	0.006	0.006	0.008	0.008	0.012	0.015	0.020	0.023	0.028	0.029
14th	0.005	0.006	0.006	0.007	0.007	0.008	0.008	0.007	0.006	0.007
15th	0.011	0.014	0.004	0.009	0.016	0.020	0.022	0.026	0.025	0.025
16th	0.003	0.004	0.004	0.005	0.004	0.005	0.006	0.005	0.004	0.004
17th	0.007	0.013	0.005	0.010	0.017	0.018	0.018	0.018	0.021	0.023
18th	0.002	0.003	0.003	0.003	0.004	0.004	0.003	0.003	0.003	0.004
19th	0.005	0.009	0.008	0.009	0.015	0.016	0.017	0.018	0.018	0.018
20th	0.004	0.004	0.004	0.004	0.005	0.004	0.005	0.006	0.007	0.007
21th	0.006	0.005	0.009	0.006	0.012	0.015	0.015	0.014	0.011	0.011
22th	0.003	0.005	0.005	0.004	0.005	0.004	0.003	0.003	0.003	0.003
23th	0.008	0.008	0.010	0.006	0.011	0.012	0.011	0.011	0.010	0.010
24th	0.003	0.004	0.006	0.004	0.004	0.004	0.005	0.004	0.004	0.004
25th	0.006	0.010	0.010	0.004	0.009	0.010	0.011	0.012	0.011	0.009
26th	0.003	0.002	0.003	0.004	0.003	0.005	0.003	0.004	0.003	0.003
27th	0.008	0.009	0.008	0.005	0.007	0.011	0.014	0.016	0.015	0.014
28th	0.005	0.005	0.005	0.005	0.004	0.005	0.004	0.004	0.005	0.005
29th	0.010	0.007	0.008	0.008	0.007	0.011	0.015	0.015	0.016	0.016
30th	0.002	0.003	0.003	0.004	0.004	0.005	0.008	0.006	0.005	0.004
31th	0.009	0.005	0.005	0.007	0.005	0.009	0.012	0.013	0.013	0.013
32th	0.004	0.003	0.004	0.003	0.003	0.004	0.004	0.003	0.006	0.006
33th	0.008	0.006	0.003	0.006	0.003	0.007	0.009	0.010	0.009	0.009
34th	0.002	0.005	0.005	0.007	0.006	0.007	0.004	0.003	0.004	0.004
35th	0.011	0.009	0.006	0.007	0.004	0.007	0.011	0.011	0.011	0.009
36th	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.005	0.004	0.004
37th	0.012	0.009	0.009	0.009	0.004	0.008	0.012	0.012	0.011	0.011
38th	0.004	0.004	0.004	0.004	0.004	0.003	0.004	0.005	0.005	0.005
39th	0.012	0.006	0.009	0.007	0.005	0.008	0.011	0.012	0.011	0.011
40th	0.002	0.004	0.004	0.004	0.004	0.003	0.004	0.004	0.006	0.007

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Inter-harmonics											
Model	AIO2-INS-3680@Work in the grid to charge the battery mode										
P/P_n [%]	Frequency	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	[Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1st	75	0.806	0.978	0.631	0.467	0.354	0.291	0.250	0.219	0.195	0.183
2nd	125	0.931	0.466	0.619	0.467	0.366	0.306	0.263	0.228	0.201	0.187
3rd	175	0.821	0.282	0.078	0.902	0.733	0.638	0.567	0.510	0.466	0.441
4th	225	0.539	0.422	0.991	0.819	0.664	0.578	0.515	0.465	0.425	0.403
5th	275	0.367	0.492	0.851	0.686	0.556	0.482	0.429	0.389	0.358	0.341
6th	325	0.576	0.601	0.953	0.780	0.641	0.564	0.508	0.464	0.430	0.410
7th	375	0.727	0.495	0.989	0.801	0.631	0.534	0.462	0.404	0.357	0.331
8th	425	0.987	0.546	0.067	0.879	0.707	0.603	0.521	0.454	0.398	0.366
9th	475	0.956	0.123	0.322	0.253	0.197	0.163	0.137	0.119	0.106	0.100
10th	525	0.059	0.141	0.346	0.257	0.187	0.145	0.116	0.098	0.089	0.087
11th	575	0.273	0.090	0.100	0.081	0.068	0.057	0.048	0.040	0.034	0.031
12th	625	0.218	0.093	0.082	0.052	0.040	0.037	0.036	0.034	0.030	0.026
13th	675	0.208	0.082	0.063	0.046	0.037	0.032	0.029	0.026	0.024	0.023
14th	725	0.165	0.089	0.064	0.048	0.038	0.031	0.030	0.030	0.032	0.033
15th	775	0.155	0.084	0.058	0.045	0.035	0.031	0.028	0.026	0.023	0.022
16th	825	0.158	0.093	0.063	0.051	0.044	0.044	0.040	0.034	0.027	0.023
17th	875	0.150	0.083	0.059	0.044	0.034	0.029	0.025	0.022	0.020	0.019
18th	925	0.160	0.088	0.063	0.048	0.036	0.030	0.027	0.023	0.022	0.022
19th	975	0.149	0.086	0.058	0.045	0.036	0.030	0.027	0.023	0.022	0.021
20th	1025	0.155	0.090	0.060	0.047	0.039	0.035	0.030	0.027	0.022	0.020
21th	1075	0.144	0.091	0.058	0.047	0.037	0.032	0.028	0.025	0.021	0.020
22th	1125	0.156	0.097	0.061	0.047	0.038	0.033	0.028	0.025	0.024	0.022
23th	1175	0.157	0.090	0.068	0.053	0.041	0.035	0.031	0.026	0.024	0.022
24th	1225	0.163	0.093	0.061	0.049	0.039	0.034	0.031	0.027	0.023	0.021
25th	1275	0.150	0.097	0.063	0.049	0.042	0.035	0.030	0.027	0.024	0.022
26th	1325	0.153	0.096	0.064	0.051	0.041	0.035	0.031	0.028	0.026	0.024
27th	1375	0.157	0.097	0.067	0.053	0.041	0.036	0.032	0.028	0.025	0.023
28th	1425	0.156	0.102	0.065	0.052	0.042	0.037	0.032	0.029	0.026	0.024
29th	1475	0.156	0.105	0.068	0.053	0.043	0.037	0.032	0.029	0.025	0.024
30th	1525	0.168	0.106	0.069	0.055	0.045	0.039	0.034	0.031	0.027	0.026
31th	1575	0.170	0.102	0.071	0.058	0.046	0.040	0.035	0.030	0.028	0.026
32th	1625	0.170	0.104	0.071	0.059	0.045	0.039	0.034	0.031	0.028	0.026
33th	1675	0.166	0.113	0.073	0.059	0.046	0.040	0.036	0.032	0.030	0.028
34th	1725	0.168	0.118	0.072	0.059	0.046	0.040	0.038	0.033	0.031	0.028
35th	1775	0.182	0.113	0.079	0.063	0.048	0.041	0.036	0.033	0.029	0.027
36th	1825	0.197	0.115	0.082	0.067	0.051	0.044	0.040	0.037	0.032	0.030
37th	1875	0.181	0.108	0.073	0.059	0.046	0.040	0.036	0.031	0.029	0.027
38th	1925	0.192	0.129	0.077	0.063	0.051	0.045	0.039	0.035	0.031	0.029
39th	1975	0.207	0.978	0.074	0.059	0.046	0.040	0.035	0.033	0.030	0.028
40th	2025	0.206	1.466	0.093	0.073	0.059	0.051	0.048	0.041	0.039	0.038

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Higher Frequencies										
Model	AIO2-INS-3680@Work in the grid to charge the battery mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.129	0.125	0.087	0.067	0.057	0.062	0.055	0.049	0.041	0.035
2.3	0.128	0.074	0.054	0.047	0.048	0.042	0.027	0.025	0.031	0.042
2.5	0.138	0.117	0.094	0.075	0.050	0.027	0.023	0.033	0.029	0.029
2.7	0.163	0.066	0.040	0.031	0.025	0.026	0.031	0.037	0.028	0.026
2.9	0.130	0.051	0.034	0.029	0.022	0.026	0.027	0.027	0.025	0.024
3.1	0.097	0.045	0.031	0.022	0.020	0.021	0.023	0.022	0.023	0.017
3.3	0.100	0.061	0.036	0.028	0.020	0.018	0.018	0.018	0.014	0.012
3.5	0.078	0.047	0.027	0.022	0.015	0.014	0.012	0.011	0.011	0.010
3.7	0.071	0.038	0.026	0.020	0.016	0.015	0.014	0.011	0.010	0.009
3.9	0.074	0.036	0.025	0.019	0.016	0.013	0.011	0.010	0.009	0.009
4.1	0.063	0.031	0.021	0.017	0.013	0.011	0.010	0.009	0.008	0.008
4.3	0.064	0.034	0.023	0.019	0.014	0.012	0.010	0.009	0.008	0.008
4.5	0.065	0.034	0.023	0.018	0.015	0.012	0.010	0.010	0.009	0.008
4.7	0.065	0.035	0.024	0.019	0.015	0.013	0.011	0.009	0.009	0.008
4.9	0.065	0.034	0.023	0.018	0.016	0.014	0.011	0.010	0.009	0.008
5.1	0.062	0.031	0.022	0.018	0.015	0.012	0.011	0.010	0.009	0.008
5.3	0.063	0.033	0.022	0.018	0.014	0.013	0.011	0.010	0.009	0.009
5.5	0.064	0.033	0.024	0.020	0.016	0.014	0.012	0.010	0.009	0.008
5.7	0.078	0.040	0.026	0.020	0.016	0.013	0.011	0.010	0.009	0.008
5.9	0.063	0.032	0.023	0.018	0.015	0.013	0.012	0.010	0.009	0.009
6.1	0.062	0.030	0.022	0.018	0.014	0.012	0.010	0.009	0.008	0.007
6.3	0.061	0.030	0.021	0.017	0.014	0.012	0.010	0.009	0.008	0.007
6.5	0.057	0.028	0.020	0.016	0.012	0.010	0.009	0.007	0.007	0.006
6.7	0.053	0.026	0.018	0.014	0.012	0.010	0.009	0.008	0.007	0.007
6.9	0.052	0.027	0.019	0.015	0.012	0.010	0.009	0.008	0.007	0.007
7.1	0.054	0.028	0.018	0.015	0.012	0.010	0.008	0.008	0.007	0.007
7.3	0.050	0.026	0.018	0.014	0.011	0.009	0.008	0.007	0.006	0.006
7.5	0.052	0.025	0.017	0.013	0.010	0.009	0.008	0.007	0.006	0.006
7.7	0.050	0.024	0.017	0.013	0.011	0.009	0.008	0.007	0.006	0.006
7.9	0.055	0.028	0.019	0.014	0.011	0.009	0.008	0.007	0.006	0.006
8.1	0.051	0.025	0.017	0.014	0.010	0.008	0.007	0.006	0.006	0.006
8.3	0.051	0.024	0.017	0.013	0.010	0.008	0.007	0.006	0.006	0.005
8.5	0.051	0.024	0.017	0.013	0.010	0.008	0.007	0.006	0.006	0.005
8.7	0.051	0.024	0.017	0.013	0.011	0.009	0.007	0.006	0.006	0.005
8.9	0.052	0.025	0.016	0.013	0.010	0.008	0.007	0.006	0.006	0.005

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Current harmonics										
Model	AIO2-INS-3680@Working in battery discharge and grid connection mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2nd	0.019	0.022	0.024	0.022	0.023	0.023	0.025	-*	-*	-*
3rd	0.063	0.116	0.152	0.173	0.182	0.198	0.219	-*	-*	-*
4th	0.006	0.003	0.005	0.005	0.004	0.003	0.004	-*	-*	-*
5th	0.013	0.046	0.082	0.099	0.102	0.104	0.103	-*	-*	-*
6th	0.007	0.007	0.012	0.007	0.007	0.008	0.006	-*	-*	-*
7th	0.049	0.036	0.060	0.077	0.085	0.088	0.092	-*	-*	-*
8th	0.006	0.002	0.003	0.004	0.004	0.006	0.005	-*	-*	-*
9th	0.032	0.021	0.042	0.053	0.061	0.066	0.069	-*	-*	-*
10th	0.004	0.002	0.003	0.006	0.004	0.003	0.002	-*	-*	-*
11th	0.015	0.026	0.027	0.039	0.045	0.049	0.053	-*	-*	-*
12th	0.003	0.002	0.003	0.003	0.004	0.004	0.003	-*	-*	-*
13th	0.015	0.020	0.020	0.030	0.033	0.037	0.040	-*	-*	-*
14th	0.004	0.007	0.007	0.005	0.007	0.008	0.008	-*	-*	-*
15th	0.010	0.014	0.015	0.023	0.029	0.031	0.033	-*	-*	-*
16th	0.003	0.003	0.004	0.004	0.004	0.005	0.005	-*	-*	-*
17th	0.008	0.012	0.013	0.021	0.026	0.029	0.030	-*	-*	-*
18th	0.003	0.004	0.004	0.003	0.006	0.005	0.003	-*	-*	-*
19th	0.009	0.010	0.015	0.019	0.025	0.028	0.030	-*	-*	-*
20th	0.005	0.004	0.004	0.006	0.003	0.003	0.005	-*	-*	-*
21th	0.007	0.010	0.015	0.016	0.021	0.024	0.027	-*	-*	-*
22th	0.004	0.003	0.002	0.003	0.002	0.004	0.003	-*	-*	-*
23th	0.004	0.009	0.010	0.014	0.017	0.022	0.024	-*	-*	-*
24th	0.002	0.003	0.004	0.003	0.005	0.004	0.004	-*	-*	-*
25th	0.005	0.006	0.010	0.012	0.018	0.020	0.023	-*	-*	-*
26th	0.003	0.002	0.004	0.004	0.004	0.004	0.007	-*	-*	-*
27th	0.005	0.007	0.010	0.011	0.016	0.019	0.021	-*	-*	-*
28th	0.003	0.003	0.004	0.005	0.004	0.006	0.005	-*	-*	-*
29th	0.005	0.008	0.010	0.014	0.017	0.020	0.023	-*	-*	-*
30th	0.006	0.005	0.005	0.005	0.003	0.006	0.005	-*	-*	-*
31th	0.005	0.006	0.008	0.011	0.014	0.017	0.021	-*	-*	-*
32th	0.004	0.005	0.004	0.005	0.006	0.005	0.004	-*	-*	-*
33th	0.004	0.006	0.007	0.009	0.011	0.015	0.017	-*	-*	-*
34th	0.002	0.003	0.003	0.003	0.004	0.003	0.004	-*	-*	-*
35th	0.007	0.007	0.007	0.009	0.011	0.014	0.018	-*	-*	-*
36th	0.004	0.004	0.004	0.003	0.003	0.004	0.004	-*	-*	-*
37th	0.010	0.008	0.011	0.012	0.013	0.014	0.019	-*	-*	-*
38th	0.003	0.003	0.003	0.004	0.003	0.003	0.003	-*	-*	-*
39th	0.009	0.007	0.010	0.011	0.013	0.013	0.015	-*	-*	-*
40th	0.007	0.006	0.007	0.006	0.007	0.008	0.006	-*	-*	-*
Note:*The grid current is limited by the battery charging and discharging current.										

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Inter-harmonics											
Model	AIO2-INS-3680@Working in battery discharge and grid connection mode										
P/P_n [%]	Frequency	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	[Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1st	75	0.093	0.550	0.379	0.286	0.237	0.207	0.176	-*	-*	-*
2nd	125	0.702	0.361	0.237	0.181	0.150	0.131	0.112	-*	-*	-*
3rd	175	0.715	0.852	0.558	0.407	0.329	0.281	0.243	-*	-*	-*
4th	225	0.679	0.353	0.244	0.187	0.158	0.136	0.121	-*	-*	-*
5th	275	0.637	0.336	0.215	0.159	0.132	0.112	0.097	-*	-*	-*
6th	325	0.789	0.381	0.255	0.186	0.150	0.126	0.109	-*	-*	-*
7th	375	0.915	0.454	0.308	0.228	0.190	0.161	0.140	-*	-*	-*
8th	425	0.750	0.374	0.250	0.186	0.154	0.130	0.113	-*	-*	-*
9th	475	0.402	0.189	0.125	0.090	0.072	0.060	0.051	-*	-*	-*
10th	525	0.261	0.144	0.095	0.071	0.060	0.050	0.044	-*	-*	-*
11th	575	0.163	0.085	0.056	0.042	0.035	0.029	0.027	-*	-*	-*
12th	625	0.142	0.078	0.053	0.040	0.035	0.029	0.026	-*	-*	-*
13th	675	0.144	0.080	0.054	0.041	0.033	0.031	0.027	-*	-*	-*
14th	725	0.142	0.076	0.053	0.040	0.033	0.030	0.025	-*	-*	-*
15th	775	0.148	0.078	0.052	0.039	0.035	0.033	0.027	-*	-*	-*
16th	825	0.141	0.077	0.053	0.041	0.033	0.029	0.025	-*	-*	-*
17th	875	0.149	0.077	0.054	0.040	0.035	0.031	0.031	-*	-*	-*
18th	925	0.146	0.079	0.055	0.041	0.034	0.030	0.027	-*	-*	-*
19th	975	0.154	0.081	0.055	0.041	0.036	0.030	0.031	-*	-*	-*
20th	1025	0.151	0.082	0.057	0.043	0.035	0.032	0.029	-*	-*	-*
21th	1075	0.155	0.085	0.058	0.043	0.037	0.031	0.029	-*	-*	-*
22th	1125	0.169	0.089	0.061	0.046	0.039	0.034	0.031	-*	-*	-*
23th	1175	0.163	0.090	0.063	0.047	0.040	0.032	0.029	-*	-*	-*
24th	1225	0.165	0.089	0.062	0.046	0.040	0.034	0.031	-*	-*	-*
25th	1275	0.169	0.093	0.063	0.048	0.040	0.035	0.030	-*	-*	-*
26th	1325	0.173	0.094	0.068	0.049	0.042	0.036	0.031	-*	-*	-*
27th	1375	0.174	0.097	0.068	0.050	0.041	0.036	0.032	-*	-*	-*
28th	1425	0.175	0.099	0.068	0.052	0.044	0.037	0.032	-*	-*	-*
29th	1475	0.179	0.098	0.068	0.051	0.043	0.037	0.033	-*	-*	-*
30th	1525	0.192	0.103	0.073	0.054	0.047	0.042	0.038	-*	-*	-*
31th	1575	0.190	0.101	0.072	0.055	0.046	0.039	0.035	-*	-*	-*
32th	1625	0.196	0.103	0.072	0.055	0.049	0.041	0.042	-*	-*	-*
33th	1675	0.192	0.105	0.073	0.057	0.048	0.041	0.037	-*	-*	-*
34th	1725	0.207	0.113	0.085	0.064	0.056	0.047	0.046	-*	-*	-*
35th	1775	0.202	0.105	0.074	0.057	0.049	0.043	0.039	-*	-*	-*
36th	1825	0.231	0.134	0.091	0.068	0.055	0.048	0.043	-*	-*	-*
37th	1875	0.204	0.139	0.091	0.064	0.055	0.047	0.044	-*	-*	-*
38th	1925	0.212	0.125	0.083	0.061	0.053	0.045	0.040	-*	-*	-*
39th	1975	0.236	0.121	0.082	0.062	0.054	0.047	0.046	-*	-*	-*
40th	2025	0.267	0.121	0.098	0.076	0.062	0.055	0.049	-*	-*	-*
Note:*The grid current is limited by the battery charging and discharging current.											

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Higher Frequencies										
Model	AIO2-INS-3680@Working in battery discharge and grid connection mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.334	0.104	0.079	0.054	0.047	0.042	0.049	-*	-*	-*
2.3	0.331	0.132	0.106	0.085	0.068	0.061	0.056	-*	-*	-*
2.5	0.145	0.094	0.062	0.049	0.038	0.029	0.024	-*	-*	-*
2.7	0.155	0.081	0.048	0.042	0.029	0.021	0.020	-*	-*	-*
2.9	0.132	0.083	0.048	0.037	0.025	0.020	0.017	-*	-*	-*
3.1	0.084	0.056	0.034	0.022	0.020	0.016	0.015	-*	-*	-*
3.3	0.104	0.057	0.039	0.028	0.024	0.022	0.020	-*	-*	-*
3.5	0.092	0.045	0.029	0.022	0.018	0.015	0.014	-*	-*	-*
3.7	0.078	0.042	0.030	0.020	0.017	0.014	0.012	-*	-*	-*
3.9	0.089	0.041	0.027	0.020	0.016	0.014	0.013	-*	-*	-*
4.1	0.071	0.033	0.023	0.017	0.014	0.013	0.011	-*	-*	-*
4.3	0.077	0.036	0.024	0.017	0.014	0.012	0.010	-*	-*	-*
4.5	0.079	0.034	0.024	0.017	0.015	0.012	0.010	-*	-*	-*
4.7	0.077	0.036	0.024	0.017	0.015	0.012	0.010	-*	-*	-*
4.9	0.072	0.035	0.026	0.019	0.015	0.014	0.011	-*	-*	-*
5.1	0.067	0.033	0.024	0.017	0.015	0.013	0.011	-*	-*	-*
5.3	0.064	0.032	0.024	0.017	0.014	0.012	0.011	-*	-*	-*
5.5	0.073	0.037	0.028	0.019	0.016	0.013	0.011	-*	-*	-*
5.7	0.088	0.043	0.028	0.020	0.015	0.013	0.011	-*	-*	-*
5.9	0.069	0.032	0.026	0.018	0.016	0.013	0.011	-*	-*	-*
6.1	0.066	0.033	0.023	0.017	0.014	0.011	0.010	-*	-*	-*
6.3	0.066	0.031	0.022	0.016	0.012	0.011	0.009	-*	-*	-*
6.5	0.064	0.033	0.022	0.015	0.013	0.011	0.009	-*	-*	-*
6.7	0.055	0.030	0.021	0.015	0.014	0.011	0.009	-*	-*	-*
6.9	0.061	0.030	0.021	0.014	0.013	0.011	0.009	-*	-*	-*
7.1	0.059	0.029	0.020	0.014	0.012	0.010	0.009	-*	-*	-*
7.3	0.056	0.028	0.019	0.014	0.012	0.010	0.009	-*	-*	-*
7.5	0.056	0.027	0.019	0.013	0.011	0.010	0.008	-*	-*	-*
7.7	0.056	0.026	0.019	0.013	0.011	0.010	0.008	-*	-*	-*
7.9	0.056	0.026	0.018	0.014	0.011	0.009	0.008	-*	-*	-*
8.1	0.053	0.026	0.019	0.014	0.012	0.009	0.008	-*	-*	-*
8.3	0.051	0.025	0.018	0.013	0.011	0.009	0.007	-*	-*	-*
8.5	0.050	0.025	0.018	0.013	0.010	0.009	0.008	-*	-*	-*
8.7	0.053	0.024	0.019	0.014	0.011	0.009	0.008	-*	-*	-*
8.9	0.051	0.026	0.018	0.013	0.011	0.009	0.008	-*	-*	-*
Note:*The grid current is limited by the battery charging and discharging current.										

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Current harmonics										
Model	AIO2-INS-3000@Working in photovoltaic grid-connected mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2nd	0.011	0.030	0.030	0.028	0.025	0.024	0.023	0.022	0.022	0.019
3rd	0.176	0.153	0.144	0.153	0.163	0.179	0.198	0.215	0.230	0.214
4th	0.015	0.017	0.006	0.007	0.008	0.008	0.007	0.005	0.005	0.003
5th	0.026	0.046	0.045	0.045	0.047	0.048	0.049	0.052	0.055	0.060
6th	0.006	0.005	0.008	0.004	0.004	0.006	0.007	0.005	0.004	0.003
7th	0.047	0.035	0.045	0.047	0.052	0.055	0.061	0.065	0.069	0.074
8th	0.004	0.002	0.006	0.004	0.004	0.006	0.007	0.005	0.003	0.004
9th	0.029	0.039	0.048	0.048	0.048	0.050	0.051	0.054	0.060	0.059
10th	0.003	0.004	0.002	0.005	0.003	0.005	0.004	0.003	0.004	0.003
11th	0.023	0.028	0.033	0.043	0.040	0.041	0.043	0.044	0.044	0.045
12th	0.002	0.002	0.003	0.006	0.006	0.005	0.007	0.006	0.003	0.003
13th	0.017	0.021	0.024	0.034	0.039	0.038	0.037	0.038	0.040	0.038
14th	0.001	0.002	0.002	0.002	0.005	0.004	0.004	0.003	0.003	0.003
15th	0.009	0.016	0.021	0.028	0.034	0.036	0.037	0.036	0.035	0.035
16th	0.002	0.001	0.002	0.003	0.004	0.004	0.004	0.004	0.003	0.003
17th	0.013	0.012	0.016	0.022	0.029	0.032	0.033	0.033	0.032	0.032
18th	0.003	0.002	0.003	0.004	0.003	0.003	0.003	0.002	0.002	0.002
19th	0.010	0.012	0.013	0.017	0.026	0.031	0.032	0.033	0.034	0.033
20th	0.002	0.002	0.002	0.003	0.003	0.003	0.002	0.002	0.002	0.003
21th	0.006	0.011	0.013	0.016	0.020	0.024	0.029	0.031	0.030	0.032
22th	0.002	0.003	0.002	0.002	0.003	0.003	0.003	0.004	0.003	0.002
23th	0.008	0.010	0.013	0.014	0.020	0.023	0.025	0.029	0.033	0.032
24th	0.002	0.003	0.002	0.003	0.003	0.004	0.005	0.004	0.004	0.005
25th	0.005	0.008	0.010	0.011	0.015	0.021	0.024	0.028	0.031	0.032
26th	0.002	0.004	0.004	0.003	0.004	0.004	0.003	0.004	0.005	0.004
27th	0.004	0.008	0.010	0.009	0.014	0.017	0.020	0.024	0.029	0.032
28th	0.003	0.003	0.006	0.002	0.006	0.004	0.007	0.006	0.003	0.004
29th	0.007	0.009	0.011	0.013	0.015	0.018	0.021	0.024	0.030	0.031
30th	0.003	0.003	0.002	0.003	0.003	0.004	0.004	0.005	0.004	0.005
31th	0.004	0.007	0.008	0.012	0.012	0.015	0.018	0.021	0.025	0.028
32th	0.003	0.003	0.002	0.004	0.003	0.003	0.005	0.003	0.003	0.004
33th	0.004	0.006	0.009	0.008	0.010	0.013	0.015	0.019	0.025	0.031
34th	0.002	0.005	0.003	0.004	0.004	0.006	0.005	0.007	0.005	0.003
35th	0.007	0.006	0.009	0.010	0.009	0.013	0.015	0.019	0.022	0.026
36th	0.004	0.003	0.004	0.003	0.005	0.005	0.005	0.005	0.005	0.005
37th	0.005	0.008	0.009	0.010	0.012	0.014	0.015	0.017	0.020	0.025
38th	0.004	0.003	0.005	0.004	0.005	0.005	0.003	0.004	0.007	0.008
39th	0.007	0.007	0.009	0.011	0.012	0.011	0.014	0.016	0.020	0.025
40th	0.004	0.006	0.003	0.007	0.003	0.003	0.006	0.004	0.004	0.005

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Inter-harmonics											
Model	AIO2-INS-3000@Working in photovoltaic grid-connected mode										
P/P_n [%]	Frequency	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	[Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1st	75	0.841	0.366	0.232	0.164	0.144	0.122	0.108	0.094	0.086	0.085
2nd	125	0.715	0.249	0.115	0.084	0.065	0.057	0.052	0.049	0.044	0.048
3rd	175	0.572	0.362	0.206	0.146	0.113	0.089	0.074	0.065	0.059	0.048
4th	225	0.651	0.300	0.193	0.134	0.100	0.081	0.069	0.060	0.053	0.041
5th	275	0.435	0.147	0.098	0.063	0.060	0.050	0.042	0.038	0.037	0.055
6th	325	0.336	0.124	0.093	0.066	0.062	0.052	0.044	0.040	0.040	0.055
7th	375	0.519	0.220	0.161	0.112	0.086	0.069	0.061	0.055	0.049	0.042
8th	425	0.524	0.254	0.139	0.100	0.077	0.064	0.056	0.050	0.046	0.038
9th	475	0.330	0.151	0.092	0.068	0.049	0.036	0.030	0.027	0.023	0.019
10th	525	0.278	0.177	0.110	0.076	0.058	0.048	0.042	0.036	0.032	0.030
11th	575	0.172	0.100	0.058	0.048	0.036	0.027	0.023	0.020	0.018	0.017
12th	625	0.203	0.130	0.091	0.069	0.056	0.047	0.042	0.037	0.034	0.032
13th	675	0.169	0.091	0.056	0.043	0.035	0.028	0.024	0.021	0.020	0.019
14th	725	0.199	0.130	0.083	0.058	0.044	0.034	0.028	0.024	0.021	0.021
15th	775	0.147	0.081	0.059	0.046	0.036	0.029	0.025	0.022	0.020	0.019
16th	825	0.145	0.086	0.067	0.055	0.043	0.035	0.031	0.025	0.022	0.038
17th	875	0.136	0.077	0.060	0.046	0.037	0.032	0.026	0.023	0.021	0.040
18th	925	0.145	0.084	0.062	0.049	0.042	0.035	0.031	0.026	0.023	0.037
19th	975	0.161	0.085	0.063	0.047	0.038	0.033	0.027	0.023	0.021	0.021
20th	1025	0.146	0.085	0.063	0.048	0.040	0.035	0.030	0.026	0.023	0.022
21th	1075	0.170	0.106	0.071	0.055	0.040	0.033	0.028	0.025	0.023	0.022
22th	1125	0.192	0.111	0.078	0.057	0.045	0.039	0.032	0.028	0.023	0.023
23th	1175	0.311	0.150	0.077	0.056	0.043	0.036	0.031	0.027	0.024	0.024
24th	1225	0.398	0.197	0.099	0.065	0.049	0.041	0.034	0.030	0.027	0.025
25th	1275	0.455	0.237	0.160	0.114	0.088	0.074	0.063	0.054	0.048	0.043
26th	1325	0.288	0.283	0.129	0.073	0.055	0.046	0.038	0.034	0.030	0.031
27th	1375	1.070	0.620	0.375	0.253	0.195	0.159	0.134	0.117	0.104	0.101
28th	1425	0.329	0.246	0.109	0.066	0.053	0.048	0.041	0.039	0.033	0.034
29th	1475	0.477	0.415	0.229	0.140	0.106	0.088	0.075	0.064	0.056	0.053
30th	1525	0.591	0.298	0.140	0.085	0.060	0.050	0.040	0.037	0.032	0.031
31th	1575	0.270	0.170	0.119	0.082	0.064	0.051	0.043	0.037	0.033	0.033
32th	1625	0.414	0.244	0.151	0.100	0.074	0.058	0.045	0.038	0.033	0.033
33th	1675	0.224	0.141	0.110	0.076	0.061	0.050	0.042	0.037	0.033	0.034
34th	1725	0.286	0.172	0.124	0.089	0.070	0.057	0.046	0.039	0.035	0.034
35th	1775	0.257	0.149	0.101	0.075	0.061	0.050	0.043	0.038	0.035	0.036
36th	1825	0.303	0.174	0.121	0.090	0.079	0.066	0.057	0.050	0.044	0.047
37th	1875	0.244	0.140	0.101	0.075	0.064	0.053	0.045	0.040	0.037	0.039
38th	1925	0.308	0.197	0.127	0.088	0.074	0.063	0.055	0.048	0.043	0.047
39th	1975	0.276	0.147	0.105	0.073	0.063	0.054	0.046	0.041	0.038	0.042
40th	2025	0.276	0.165	0.125	0.083	0.066	0.056	0.048	0.040	0.037	0.041

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Higher Frequencies										
Model	AIO2-INS-3000@Working in photovoltaic grid-connected mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.314	0.120	0.083	0.063	0.0579	0.057	0.046	0.050	0.034	0.035
2.3	0.696	0.325	0.216	0.164	0.1227	0.100	0.086	0.079	0.065	0.070
2.5	0.494	0.201	0.183	0.085	0.0623	0.041	0.028	0.022	0.046	0.038
2.7	0.674	0.330	0.307	0.200	0.1567	0.131	0.112	0.115	0.104	0.122
2.9	0.217	0.100	0.116	0.084	0.0590	0.044	0.034	0.032	0.026	0.029
3.1	0.126	0.067	0.067	0.052	0.0374	0.027	0.021	0.026	0.022	0.019
3.3	0.183	0.083	0.059	0.044	0.0410	0.032	0.026	0.025	0.023	0.018
3.5	0.146	0.067	0.044	0.037	0.0303	0.025	0.021	0.019	0.022	0.017
3.7	0.193	0.091	0.063	0.053	0.0385	0.033	0.030	0.028	0.023	0.023
3.9	0.328	0.213	0.193	0.140	0.1109	0.092	0.082	0.073	0.067	0.065
4.1	0.352	0.202	0.172	0.110	0.0807	0.072	0.066	0.060	0.055	0.053
4.3	0.269	0.137	0.096	0.077	0.0596	0.055	0.048	0.041	0.038	0.035
4.5	0.152	0.078	0.057	0.043	0.0347	0.031	0.028	0.024	0.023	0.022
4.7	0.129	0.065	0.044	0.034	0.0271	0.023	0.022	0.019	0.018	0.018
4.9	0.101	0.052	0.035	0.026	0.0215	0.018	0.016	0.015	0.014	0.013
5.1	0.087	0.045	0.030	0.024	0.0187	0.016	0.014	0.012	0.012	0.011
5.3	0.087	0.046	0.031	0.023	0.0179	0.015	0.013	0.011	0.011	0.011
5.5	0.067	0.034	0.024	0.017	0.0135	0.012	0.010	0.009	0.008	0.008
5.7	0.062	0.032	0.021	0.016	0.0125	0.010	0.009	0.008	0.007	0.007
5.9	0.056	0.029	0.020	0.015	0.0115	0.010	0.008	0.008	0.007	0.007
6.1	0.063	0.033	0.023	0.018	0.0137	0.011	0.010	0.009	0.008	0.007
6.3	0.061	0.034	0.025	0.017	0.0128	0.011	0.009	0.008	0.007	0.007
6.5	0.051	0.029	0.025	0.017	0.0113	0.009	0.007	0.006	0.006	0.005
6.7	0.049	0.024	0.017	0.012	0.0094	0.008	0.007	0.006	0.005	0.005
6.9	0.047	0.024	0.016	0.012	0.0092	0.007	0.007	0.006	0.005	0.005
7.1	0.057	0.028	0.019	0.014	0.0114	0.010	0.008	0.007	0.006	0.006
7.3	0.053	0.027	0.018	0.013	0.0103	0.009	0.007	0.006	0.006	0.006
7.5	0.046	0.023	0.015	0.012	0.0090	0.008	0.007	0.006	0.005	0.005
7.7	0.047	0.023	0.015	0.012	0.0096	0.008	0.007	0.006	0.005	0.005
7.9	0.047	0.024	0.019	0.028	0.0162	0.011	0.008	0.007	0.006	0.006
8.1	0.049	0.023	0.018	0.028	0.0169	0.011	0.008	0.007	0.006	0.006
8.3	0.052	0.026	0.017	0.014	0.0105	0.009	0.007	0.007	0.006	0.006
8.5	0.056	0.029	0.020	0.013	0.0099	0.009	0.007	0.007	0.006	0.006
8.7	0.048	0.025	0.016	0.012	0.0093	0.008	0.007	0.006	0.005	0.006
8.9	0.047	0.026	0.017	0.013	0.0097	0.008	0.007	0.006	0.006	0.007

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Current harmonics										
Model	AIO2-INS-3000@Work in the grid to charge the battery mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2nd	0.012	0.010	0.004	0.005	0.006	0.006	0.005	0.005	0.006	0.005
3rd	0.050	0.157	0.201	0.242	0.263	0.282	0.299	0.315	0.333	0.352
4th	0.008	0.007	0.006	0.005	0.005	0.005	0.005	0.004	0.004	0.006
5th	0.046	0.057	0.073	0.103	0.120	0.130	0.137	0.144	0.148	0.153
6th	0.007	0.008	0.009	0.010	0.007	0.006	0.006	0.007	0.007	0.012
7th	0.078	0.054	0.053	0.075	0.089	0.100	0.106	0.110	0.112	0.112
8th	0.005	0.007	0.005	0.004	0.004	0.005	0.006	0.007	0.006	0.010
9th	0.032	0.021	0.014	0.031	0.038	0.043	0.047	0.050	0.051	0.053
10th	0.003	0.004	0.003	0.004	0.003	0.004	0.003	0.003	0.003	0.003
11th	0.010	0.007	0.012	0.003	0.011	0.018	0.023	0.028	0.032	0.036
12th	0.004	0.004	0.004	0.004	0.003	0.004	0.004	0.004	0.004	0.004
13th	0.004	0.009	0.007	0.008	0.009	0.012	0.014	0.018	0.022	0.025
14th	0.007	0.007	0.008	0.008	0.006	0.006	0.007	0.007	0.007	0.006
15th	0.006	0.014	0.007	0.004	0.010	0.016	0.019	0.021	0.023	0.024
16th	0.003	0.004	0.003	0.004	0.005	0.004	0.004	0.006	0.005	0.006
17th	0.008	0.012	0.013	0.006	0.012	0.016	0.018	0.018	0.018	0.019
18th	0.002	0.003	0.003	0.003	0.003	0.003	0.005	0.004	0.003	0.004
19th	0.007	0.007	0.014	0.005	0.011	0.015	0.016	0.016	0.017	0.018
20th	0.004	0.003	0.003	0.004	0.003	0.005	0.004	0.004	0.005	0.006
21th	0.007	0.009	0.012	0.006	0.006	0.011	0.014	0.015	0.015	0.013
22th	0.004	0.005	0.003	0.005	0.003	0.005	0.003	0.003	0.003	0.003
23th	0.009	0.012	0.009	0.008	0.007	0.011	0.011	0.011	0.011	0.011
24th	0.003	0.004	0.003	0.004	0.004	0.005	0.004	0.005	0.005	0.004
25th	0.009	0.009	0.005	0.008	0.004	0.009	0.010	0.010	0.012	0.012
26th	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.003	0.004
27th	0.007	0.006	0.005	0.010	0.005	0.006	0.010	0.013	0.015	0.016
28th	0.006	0.005	0.005	0.004	0.005	0.004	0.005	0.005	0.003	0.004
29th	0.009	0.008	0.010	0.011	0.006	0.006	0.009	0.013	0.015	0.016
30th	0.003	0.003	0.003	0.004	0.004	0.005	0.004	0.007	0.007	0.006
31th	0.011	0.008	0.010	0.009	0.006	0.004	0.009	0.011	0.012	0.013
32th	0.003	0.003	0.003	0.004	0.003	0.003	0.004	0.004	0.003	0.005
33th	0.009	0.006	0.008	0.006	0.005	0.003	0.005	0.007	0.010	0.010
34th	0.003	0.005	0.005	0.006	0.008	0.006	0.006	0.006	0.004	0.003
35th	0.011	0.006	0.008	0.007	0.007	0.004	0.006	0.008	0.011	0.011
36th	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004
37th	0.013	0.008	0.006	0.005	0.009	0.004	0.007	0.011	0.012	0.012
38th	0.004	0.005	0.004	0.005	0.003	0.003	0.004	0.004	0.005	0.005
39th	0.013	0.009	0.007	0.006	0.008	0.006	0.006	0.011	0.013	0.012
40th	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Inter-harmonics											
Model	AIO2-INS-3000@Work in the grid to charge the battery mode										
P/P_n [%]	Frequency	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	[Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1st	75	0.904	0.914	0.765	0.553	0.441	0.360	0.303	0.263	0.233	0.210
2nd	125	0.280	0.145	0.736	0.540	0.442	0.373	0.321	0.282	0.251	0.226
3rd	175	0.933	0.439	0.372	0.042	0.864	0.748	0.663	0.597	0.545	0.502
4th	225	0.857	0.389	0.296	0.957	0.791	0.682	0.604	0.545	0.497	0.458
5th	275	0.670	0.325	0.037	0.793	0.663	0.573	0.508	0.461	0.423	0.393
6th	325	0.265	0.125	0.219	0.904	0.756	0.656	0.583	0.528	0.484	0.448
7th	375	0.251	0.556	0.294	0.939	0.767	0.647	0.558	0.489	0.435	0.389
8th	425	0.720	0.331	0.366	0.023	0.846	0.727	0.636	0.561	0.500	0.447
9th	475	0.233	0.574	0.410	0.302	0.241	0.201	0.168	0.144	0.126	0.113
10th	525	0.924	0.433	0.458	0.312	0.243	0.196	0.161	0.134	0.114	0.099
11th	575	0.310	0.178	0.122	0.094	0.082	0.074	0.065	0.056	0.046	0.039
12th	625	0.362	0.148	0.100	0.061	0.046	0.041	0.040	0.038	0.035	0.031
13th	675	0.246	0.124	0.084	0.056	0.044	0.039	0.035	0.032	0.028	0.025
14th	725	0.266	0.127	0.076	0.055	0.045	0.037	0.032	0.030	0.029	0.030
15th	775	0.238	0.125	0.073	0.053	0.042	0.036	0.034	0.032	0.030	0.025
16th	825	0.226	0.118	0.079	0.060	0.050	0.046	0.043	0.040	0.036	0.033
17th	875	0.242	0.121	0.073	0.052	0.041	0.035	0.030	0.027	0.025	0.022
18th	925	0.215	0.113	0.081	0.058	0.046	0.038	0.032	0.028	0.026	0.024
19th	975	0.227	0.116	0.071	0.054	0.043	0.037	0.033	0.029	0.027	0.024
20th	1025	0.221	0.116	0.076	0.056	0.045	0.039	0.035	0.032	0.028	0.025
21th	1075	0.219	0.118	0.074	0.056	0.043	0.039	0.033	0.029	0.027	0.023
22th	1125	0.223	0.117	0.076	0.056	0.045	0.039	0.035	0.030	0.028	0.025
23th	1175	0.227	0.130	0.079	0.059	0.048	0.041	0.035	0.031	0.028	0.026
24th	1225	0.219	0.121	0.078	0.057	0.046	0.039	0.034	0.032	0.030	0.026
25th	1275	0.227	0.124	0.080	0.058	0.048	0.042	0.038	0.033	0.029	0.026
26th	1325	0.229	0.125	0.077	0.058	0.048	0.041	0.037	0.032	0.029	0.027
27th	1375	0.227	0.127	0.083	0.061	0.050	0.043	0.037	0.034	0.030	0.028
28th	1425	0.224	0.124	0.081	0.060	0.049	0.043	0.038	0.034	0.030	0.028
29th	1475	0.240	0.129	0.083	0.061	0.051	0.044	0.039	0.034	0.031	0.027
30th	1525	0.247	0.131	0.089	0.064	0.054	0.046	0.040	0.035	0.032	0.029
31th	1575	0.246	0.139	0.089	0.066	0.054	0.047	0.040	0.037	0.033	0.030
32th	1625	0.252	0.138	0.089	0.066	0.054	0.046	0.040	0.036	0.034	0.030
33th	1675	0.245	0.136	0.088	0.068	0.056	0.047	0.041	0.037	0.034	0.032
34th	1725	0.244	0.138	0.090	0.069	0.055	0.046	0.042	0.039	0.035	0.033
35th	1775	0.265	0.148	0.100	0.073	0.059	0.048	0.043	0.038	0.035	0.032
36th	1825	0.296	0.153	0.103	0.079	0.064	0.052	0.046	0.042	0.040	0.035
37th	1875	0.290	0.148	0.092	0.067	0.055	0.047	0.042	0.038	0.035	0.031
38th	1925	0.289	0.155	0.098	0.073	0.060	0.052	0.045	0.041	0.039	0.034
39th	1975	0.311	0.149	0.091	0.067	0.055	0.046	0.041	0.037	0.035	0.033
40th	2025	0.331	0.169	0.116	0.089	0.070	0.062	0.055	0.049	0.046	0.041

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Higher Frequencies										
Model	AIO2-INS-3000@Work in the grid to charge the battery mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.218	0.143	0.121	0.088	0.074	0.055	0.063	0.075	0.052	0.053
2.3	0.182	0.096	0.064	0.052	0.051	0.048	0.043	0.030	0.027	0.025
2.5	0.183	0.145	0.115	0.081	0.068	0.050	0.028	0.023	0.023	0.030
2.7	0.204	0.102	0.061	0.044	0.030	0.025	0.029	0.030	0.034	0.033
2.9	0.168	0.082	0.043	0.030	0.026	0.028	0.023	0.023	0.029	0.029
3.1	0.139	0.063	0.036	0.030	0.022	0.020	0.021	0.023	0.022	0.024
3.3	0.133	0.071	0.045	0.033	0.025	0.021	0.019	0.018	0.016	0.016
3.5	0.127	0.060	0.038	0.028	0.019	0.017	0.014	0.013	0.012	0.011
3.7	0.107	0.052	0.030	0.022	0.018	0.017	0.015	0.014	0.012	0.010
3.9	0.112	0.054	0.030	0.023	0.020	0.018	0.015	0.013	0.010	0.009
4.1	0.101	0.050	0.026	0.019	0.016	0.014	0.013	0.011	0.010	0.008
4.3	0.104	0.050	0.027	0.021	0.017	0.014	0.013	0.012	0.010	0.009
4.5	0.106	0.050	0.029	0.021	0.018	0.015	0.013	0.011	0.010	0.010
4.7	0.107	0.052	0.030	0.023	0.019	0.016	0.014	0.012	0.010	0.010
4.9	0.101	0.050	0.028	0.022	0.018	0.016	0.014	0.012	0.010	0.010
5.1	0.097	0.047	0.027	0.021	0.018	0.015	0.014	0.012	0.011	0.010
5.3	0.104	0.051	0.028	0.021	0.017	0.014	0.013	0.012	0.011	0.010
5.5	0.103	0.050	0.028	0.022	0.019	0.017	0.015	0.013	0.011	0.010
5.7	0.122	0.056	0.034	0.024	0.019	0.016	0.014	0.012	0.011	0.010
5.9	0.100	0.049	0.028	0.021	0.018	0.016	0.014	0.012	0.011	0.010
6.1	0.103	0.050	0.027	0.020	0.017	0.015	0.013	0.011	0.010	0.009
6.3	0.103	0.049	0.026	0.020	0.017	0.014	0.012	0.011	0.009	0.009
6.5	0.101	0.049	0.025	0.018	0.015	0.013	0.011	0.009	0.008	0.007
6.7	0.124	0.060	0.022	0.017	0.014	0.012	0.010	0.009	0.009	0.007
6.9	0.098	0.046	0.023	0.017	0.015	0.013	0.011	0.010	0.009	0.008
7.1	0.099	0.048	0.023	0.017	0.014	0.012	0.011	0.009	0.008	0.007
7.3	0.097	0.048	0.022	0.016	0.013	0.011	0.010	0.008	0.008	0.007
7.5	0.098	0.047	0.021	0.016	0.013	0.011	0.009	0.008	0.008	0.007
7.7	0.101	0.049	0.021	0.016	0.013	0.011	0.009	0.008	0.007	0.007
7.9	0.107	0.050	0.023	0.017	0.014	0.012	0.010	0.008	0.008	0.007
8.1	0.100	0.049	0.020	0.015	0.012	0.011	0.009	0.008	0.007	0.006
8.3	0.104	0.049	0.021	0.016	0.013	0.011	0.009	0.008	0.007	0.006
8.5	0.104	0.049	0.020	0.015	0.013	0.011	0.009	0.008	0.007	0.006
8.7	0.106	0.051	0.022	0.015	0.013	0.011	0.009	0.008	0.007	0.006
8.9	0.107	0.052	0.020	0.015	0.013	0.011	0.009	0.008	0.007	0.006

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Current harmonics										
Model	AIO2-INS-3000@Working in battery discharge and grid connection mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2nd	0.015	0.025	0.028	0.023	0.022	0.021	0.021	0.022	0.023	-*
3rd	0.078	0.103	0.139	0.156	0.171	0.183	0.197	0.211	0.223	-*
4th	0.004	0.008	0.003	0.006	0.006	0.004	0.004	0.004	0.004	-*
5th	0.015	0.031	0.067	0.088	0.098	0.103	0.103	0.104	0.103	-*
6th	0.006	0.010	0.008	0.009	0.006	0.004	0.004	0.005	0.004	-*
7th	0.054	0.028	0.047	0.065	0.077	0.083	0.088	0.089	0.091	-*
8th	0.005	0.005	0.006	0.002	0.004	0.005	0.006	0.007	0.006	-*
9th	0.021	0.025	0.030	0.045	0.052	0.059	0.062	0.065	0.067	-*
10th	0.005	0.005	0.003	0.002	0.006	0.004	0.003	0.003	0.002	-*
11th	0.014	0.024	0.023	0.031	0.038	0.043	0.047	0.050	0.052	-*
12th	0.004	0.004	0.004	0.004	0.003	0.004	0.004	0.004	0.004	-*
13th	0.012	0.016	0.016	0.020	0.030	0.033	0.035	0.039	0.041	-*
14th	0.005	0.007	0.006	0.008	0.005	0.007	0.008	0.009	0.008	-*
15th	0.007	0.010	0.015	0.017	0.023	0.028	0.030	0.032	0.033	-*
16th	0.003	0.003	0.003	0.005	0.004	0.004	0.004	0.004	0.005	-*
17th	0.009	0.011	0.017	0.015	0.021	0.025	0.028	0.030	0.031	-*
18th	0.003	0.004	0.003	0.004	0.003	0.005	0.004	0.003	0.003	-*
19th	0.007	0.010	0.013	0.013	0.019	0.024	0.026	0.027	0.029	-*
20th	0.003	0.004	0.005	0.004	0.006	0.004	0.003	0.004	0.005	-*
21th	0.004	0.010	0.011	0.014	0.016	0.019	0.023	0.025	0.026	-*
22th	0.003	0.003	0.004	0.003	0.003	0.002	0.004	0.004	0.004	-*
23th	0.008	0.008	0.010	0.013	0.014	0.017	0.020	0.022	0.024	-*
24th	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.004	-*
25th	0.002	0.004	0.006	0.010	0.011	0.016	0.018	0.020	0.022	-*
26th	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.005	0.006	-*
27th	0.002	0.005	0.007	0.010	0.011	0.015	0.018	0.020	0.021	-*
28th	0.003	0.003	0.003	0.004	0.005	0.004	0.006	0.005	0.005	-*
29th	0.008	0.009	0.011	0.013	0.014	0.016	0.019	0.021	0.023	-*
30th	0.005	0.005	0.005	0.004	0.005	0.004	0.005	0.006	0.004	-*
31th	0.003	0.006	0.008	0.009	0.012	0.013	0.016	0.018	0.020	-*
32th	0.003	0.005	0.005	0.005	0.005	0.005	0.006	0.005	0.005	-*
33th	0.005	0.004	0.005	0.007	0.009	0.010	0.013	0.015	0.017	-*
34th	0.002	0.002	0.003	0.003	0.003	0.004	0.004	0.004	0.004	-*
35th	0.008	0.006	0.008	0.008	0.010	0.012	0.013	0.016	0.018	-*
36th	0.003	0.003	0.003	0.004	0.003	0.004	0.004	0.004	0.004	-*
37th	0.008	0.008	0.008	0.009	0.012	0.013	0.014	0.017	0.019	-*
38th	0.002	0.003	0.003	0.003	0.004	0.004	0.003	0.004	0.003	-*
39th	0.009	0.008	0.008	0.009	0.011	0.012	0.012	0.015	0.016	-*
40th	0.005	0.006	0.006	0.007	0.006	0.006	0.008	0.006	0.006	-*
Note:*The grid current is limited by the battery charging and discharging current.										

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Inter-harmonics											
Model	AIO2-INS-3000@Working in battery discharge and grid connection mode										
P/P_n [%]	Frequency	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Order	[Hz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
1st	75	0.725	0.526	0.440	0.349	0.284	0.241	0.212	0.188	0.173	-*
2nd	125	0.456	0.345	0.284	0.223	0.179	0.154	0.134	0.119	0.114	-*
3rd	175	0.071	0.747	0.684	0.519	0.414	0.342	0.296	0.262	0.241	-*
4th	225	0.029	0.041	0.284	0.223	0.182	0.155	0.136	0.123	0.116	-*
5th	275	0.955	0.535	0.257	0.200	0.162	0.135	0.118	0.105	0.098	-*
6th	325	1.027	0.545	0.307	0.235	0.184	0.155	0.132	0.116	0.108	-*
7th	375	0.964	0.405	0.365	0.285	0.228	0.191	0.164	0.147	0.136	-*
8th	425	0.990	0.436	0.299	0.233	0.185	0.155	0.133	0.119	0.110	-*
9th	475	0.479	0.275	0.155	0.116	0.090	0.075	0.064	0.056	0.051	-*
10th	525	0.020	0.510	0.114	0.089	0.072	0.060	0.051	0.047	0.044	-*
11th	575	0.364	0.267	0.066	0.053	0.042	0.035	0.029	0.027	0.026	-*
12th	625	0.505	0.290	0.063	0.050	0.042	0.035	0.030	0.029	0.027	-*
13th	675	0.335	0.213	0.063	0.050	0.041	0.033	0.031	0.029	0.027	-*
14th	725	0.317	0.189	0.062	0.048	0.040	0.034	0.029	0.026	0.024	-*
15th	775	0.262	0.169	0.062	0.049	0.040	0.033	0.033	0.028	0.027	-*
16th	825	0.232	0.143	0.063	0.050	0.041	0.034	0.030	0.026	0.024	-*
17th	875	0.287	0.168	0.064	0.051	0.041	0.035	0.032	0.030	0.032	-*
18th	925	0.246	0.146	0.063	0.049	0.040	0.035	0.030	0.028	0.026	-*
19th	975	0.258	0.159	0.065	0.051	0.043	0.036	0.031	0.030	0.031	-*
20th	1025	0.228	0.141	0.068	0.054	0.042	0.036	0.033	0.030	0.028	-*
21th	1075	0.214	0.151	0.069	0.054	0.044	0.038	0.032	0.030	0.028	-*
22th	1125	0.218	0.133	0.072	0.058	0.046	0.039	0.035	0.032	0.032	-*
23th	1175	0.253	0.137	0.073	0.057	0.047	0.040	0.033	0.031	0.028	-*
24th	1225	0.223	0.124	0.072	0.058	0.045	0.040	0.034	0.031	0.031	-*
25th	1275	0.209	0.121	0.076	0.059	0.047	0.040	0.034	0.031	0.028	-*
26th	1325	0.213	0.120	0.076	0.060	0.049	0.042	0.035	0.031	0.030	-*
27th	1375	0.220	0.124	0.079	0.062	0.051	0.042	0.036	0.032	0.031	-*
28th	1425	0.214	0.122	0.080	0.062	0.050	0.043	0.039	0.033	0.031	-*
29th	1475	0.228	0.130	0.080	0.063	0.052	0.043	0.038	0.034	0.032	-*
30th	1525	0.229	0.133	0.086	0.068	0.054	0.046	0.044	0.038	0.037	-*
31th	1575	0.240	0.129	0.083	0.065	0.054	0.046	0.040	0.036	0.034	-*
32th	1625	0.242	0.135	0.084	0.069	0.055	0.047	0.043	0.040	0.044	-*
33th	1675	0.249	0.134	0.086	0.068	0.056	0.048	0.043	0.038	0.037	-*
34th	1725	0.276	0.143	0.096	0.079	0.065	0.054	0.048	0.045	0.047	-*
35th	1775	0.269	0.139	0.087	0.068	0.055	0.049	0.044	0.041	0.040	-*
36th	1825	0.328	0.162	0.109	0.086	0.066	0.057	0.050	0.046	0.043	-*
37th	1875	0.326	0.176	0.106	0.084	0.065	0.055	0.051	0.044	0.044	-*
38th	1925	0.285	0.158	0.095	0.076	0.060	0.051	0.044	0.039	0.038	-*
39th	1975	0.406	0.201	0.103	0.076	0.063	0.055	0.048	0.046	0.047	-*
40th	2025	0.362	0.186	0.116	0.089	0.076	0.063	0.055	0.051	0.049	-*
Note:*The grid current is limited by the battery charging and discharging current.											

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Higher Frequencies										
Model	AIO2-INS-3000@Working in battery discharge and grid connection mode									
P/P_n [%]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
f [kHz]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.281	0.129	0.086	0.062	0.055	0.040	0.037	0.040	0.046	-*
2.3	0.270	0.125	0.104	0.087	0.083	0.058	0.058	0.058	0.107	-*
2.5	0.155	0.086	0.093	0.059	0.050	0.036	0.032	0.027	0.032	-*
2.7	0.134	0.070	0.072	0.048	0.041	0.033	0.022	0.021	0.068	-*
2.9	0.117	0.062	0.064	0.055	0.038	0.027	0.023	0.024	0.053	-*
3.1	0.104	0.054	0.041	0.032	0.023	0.020	0.016	0.015	0.059	-*
3.3	0.099	0.048	0.045	0.038	0.028	0.023	0.020	0.018	0.035	-*
3.5	0.093	0.046	0.036	0.027	0.023	0.019	0.017	0.014	0.061	-*
3.7	0.092	0.044	0.033	0.026	0.021	0.017	0.014	0.013	0.027	-*
3.9	0.091	0.045	0.032	0.025	0.021	0.018	0.015	0.014	0.052	-*
4.1	0.088	0.043	0.028	0.022	0.017	0.014	0.015	0.012	0.045	-*
4.3	0.088	0.044	0.028	0.023	0.017	0.015	0.013	0.012	0.041	-*
4.5	0.100	0.049	0.029	0.022	0.017	0.015	0.012	0.011	0.019	-*
4.7	0.092	0.045	0.030	0.023	0.018	0.015	0.012	0.011	0.037	-*
4.9	0.094	0.045	0.029	0.024	0.019	0.015	0.012	0.011	0.033	-*
5.1	0.094	0.047	0.027	0.022	0.018	0.014	0.011	0.011	0.054	-*
5.3	0.093	0.045	0.027	0.022	0.018	0.014	0.012	0.010	0.019	-*
5.5	0.092	0.045	0.030	0.026	0.020	0.016	0.013	0.011	0.028	-*
5.7	0.088	0.042	0.035	0.026	0.021	0.017	0.015	0.013	0.021	-*
5.9	0.089	0.043	0.027	0.023	0.019	0.015	0.012	0.010	0.022	-*
6.1	0.098	0.047	0.026	0.021	0.017	0.013	0.011	0.010	0.014	-*
6.3	0.089	0.044	0.026	0.021	0.016	0.013	0.011	0.010	0.035	-*
6.5	0.118	0.055	0.026	0.020	0.016	0.013	0.011	0.010	0.024	-*
6.7	0.089	0.044	0.025	0.018	0.014	0.012	0.010	0.009	0.035	-*
6.9	0.090	0.046	0.023	0.019	0.014	0.012	0.010	0.009	0.018	-*
7.1	0.105	0.048	0.023	0.020	0.015	0.012	0.011	0.009	0.019	-*
7.3	0.088	0.041	0.022	0.018	0.014	0.011	0.010	0.008	0.019	-*
7.5	0.083	0.040	0.022	0.018	0.014	0.011	0.010	0.008	0.016	-*
7.7	0.081	0.039	0.022	0.017	0.014	0.011	0.009	0.008	0.015	-*
7.9	0.082	0.040	0.021	0.018	0.014	0.011	0.009	0.008	0.029	-*
8.1	0.083	0.039	0.021	0.018	0.014	0.012	0.010	0.008	0.014	-*
8.3	0.081	0.040	0.022	0.017	0.013	0.010	0.009	0.008	0.028	-*
8.5	0.085	0.041	0.021	0.016	0.013	0.011	0.009	0.008	0.011	-*
8.7	0.088	0.044	0.021	0.017	0.014	0.011	0.009	0.008	0.029	-*
8.9	0.086	0.042	0.022	0.017	0.013	0.011	0.009	0.008	0.013	-*
Note:*The grid current is limited by the battery charging and discharging current.										

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.8	**Power quality - Voltage fluctuations and flicker**		**P**
Model	AIO2-INS-5000@Working in photovoltaic grid-connected mode		
Parameter		Limits	Test Value
			Single Phase
P_{st}		1.0	0.119
P_{lt}		0.65	0.108
d(t) – 500ms		3.3%	0
dc%		3.3%	0.443
d_{max}		4%	0.497
Note: Maximum permissible flicker and voltage fluctuation as per EN 61000-3-11 (>16A)			

4.8	**Power quality - Voltage fluctuations and flicker**		**P**
Model	AIO2-INS-3000@Working in photovoltaic grid-connected mode		
Parameter		Limits	Test Value
			Single Phase
P_{st}		1.0	0.145
P_{lt}		0.65	0.117
d(t) – 500ms		3.3%	0
dc%		3.3%	0.256
d_{max}		4%	0.542
Note: Maximum permissible flicker and voltage fluctuation as per EN 61000-3-3 (<16A)			

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.8	**Power quality - Voltage fluctuations and flicker**		**P**
Model	AIO2-INS-5000@Work in the grid to charge the battery mode		
Parameter		Limits	Test Value
			Single Phase
P_{st}		1.0	0.313
P_{lt}		0.65	0.156
d(t) – 500ms		3.3%	0
dc%		3.3%	0.592
d_{max}		4%	1.393
Note: Maximum permissible flicker and voltage fluctuation as per EN 61000-3-11 (>16A)			

4.8	**Power quality - Voltage fluctuations and flicker**		**P**
Model	AIO2-INS-3000@Work in the grid to charge the battery mode		
Parameter		Limits	Test Value
			Single Phase
P_{st}		1.0	0.142
P_{lt}		0.65	0.140
d(t) – 500ms		3.3%	0
dc%		3.3%	0.136
d_{max}		4%	0.220
Note: Maximum permissible flicker and voltage fluctuation as per EN 61000-3-3 (<16A)			

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

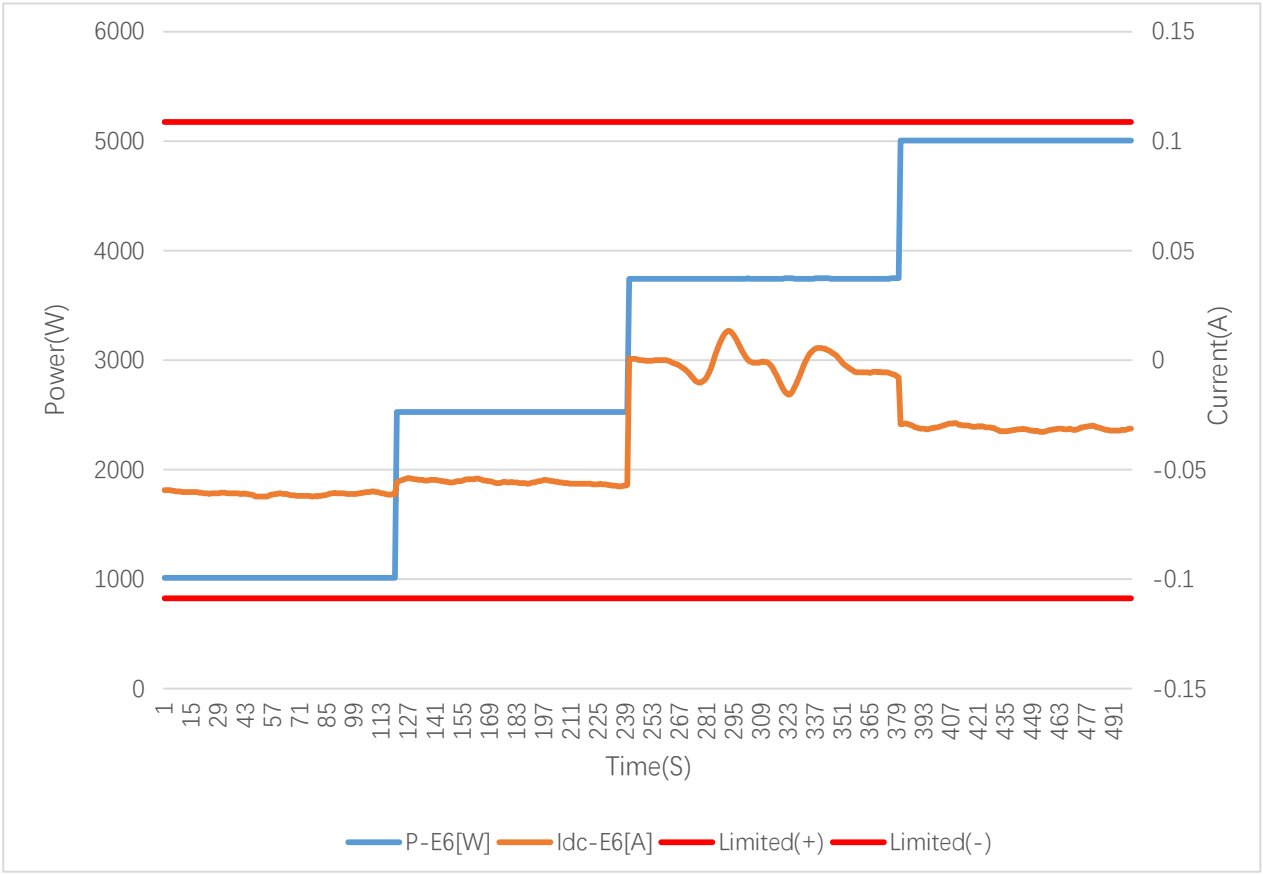
4.8	**Power quality - Voltage fluctuations and flicker**		**P**
Model	AIO2-INS-5000@Working in battery discharge and grid connection mode		
Parameter		Limits	Test Value
			Single Phase
P_{st}		1.0	0.111
P_{lt}		0.65	0.099
d(t) – 500ms		3.3%	0
dc%		3.3%	0.247
d_{max}		4%	0.734
Note: Maximum permissible flicker and voltage fluctuation as per EN 61000-3-11(>16A)			

4.8	**Power quality - Voltage fluctuations and flicker**		**P**
Model	AIO2-INS-3000@Working in battery discharge and grid connection mode		
Parameter		Limits	Test Value
			Single Phase
P_{st}		1.0	0.101
P_{lt}		0.65	0.085
d(t) – 500ms		3.3%	0
dc%		3.3%	0.446
d_{max}		4%	0.486
Note: Maximum permissible flicker and voltage fluctuation as per EN 61000-3-3(<16A)			

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.8	TABLE: Power quality - DC injection			P
Model	AIO2-INS-5000@Working in photovoltaic grid-connected mode			
EN 50549-1 Limit:	0.5 % of I_{nom} (108.69 mA)			
Power level	20%	50%	75%	100%
Output power (VA)	1013.94	2528.85	3746.09	5009.06
DC inject current L1 (mA)	62.28	57.44	15.56	32.74

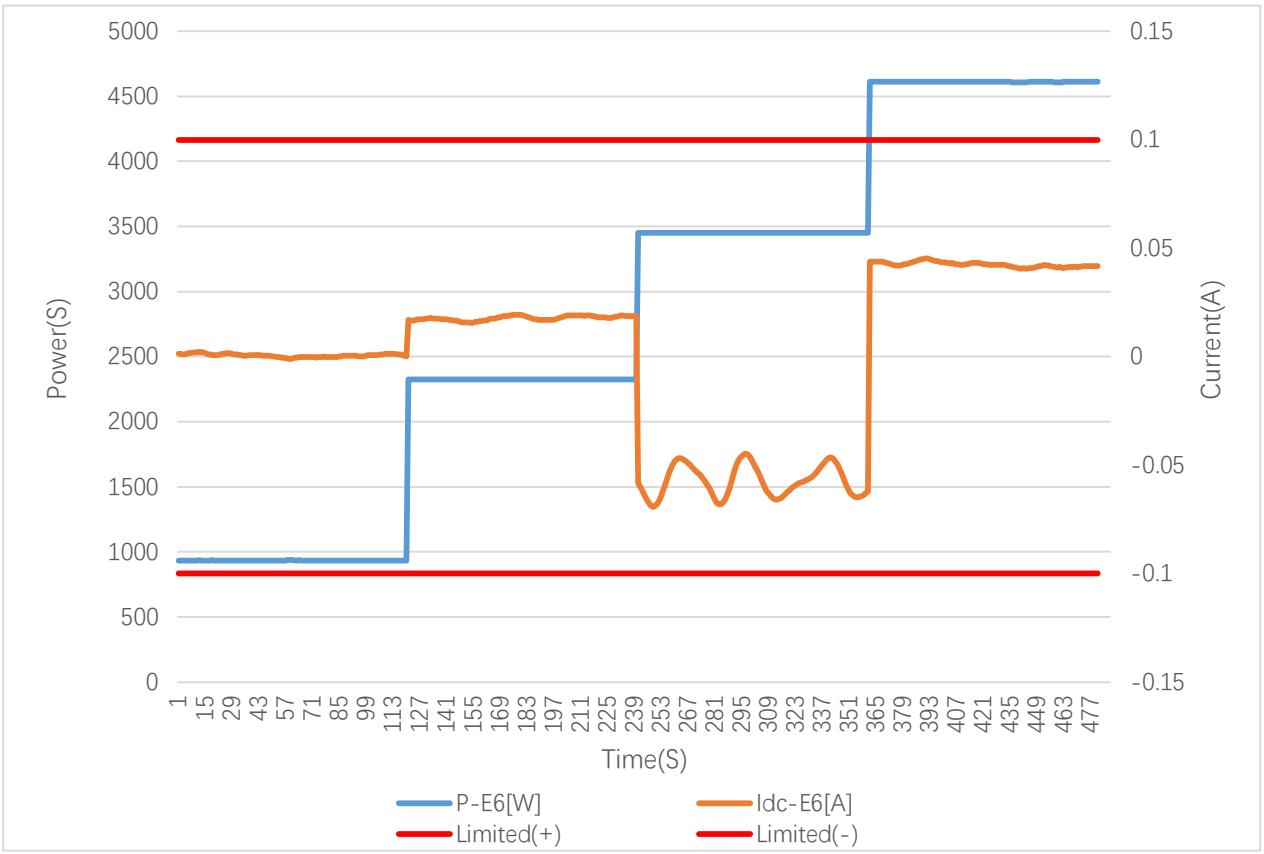
Note:



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.8	TABLE: Power quality - DC injection				P
Model	AIO2-INS-4600@Working in photovoltaic grid-connected mode				
EN 50549-1 Limit:	0.5 % of I_{nom} (100 mA)				
Power level	20%	50%	75%	100%	
Output power (VA)	934.33	2326.48	3451.33	4610.31	
DC inject current L1 (mA)	2.14	19.39	69.27	45.14	

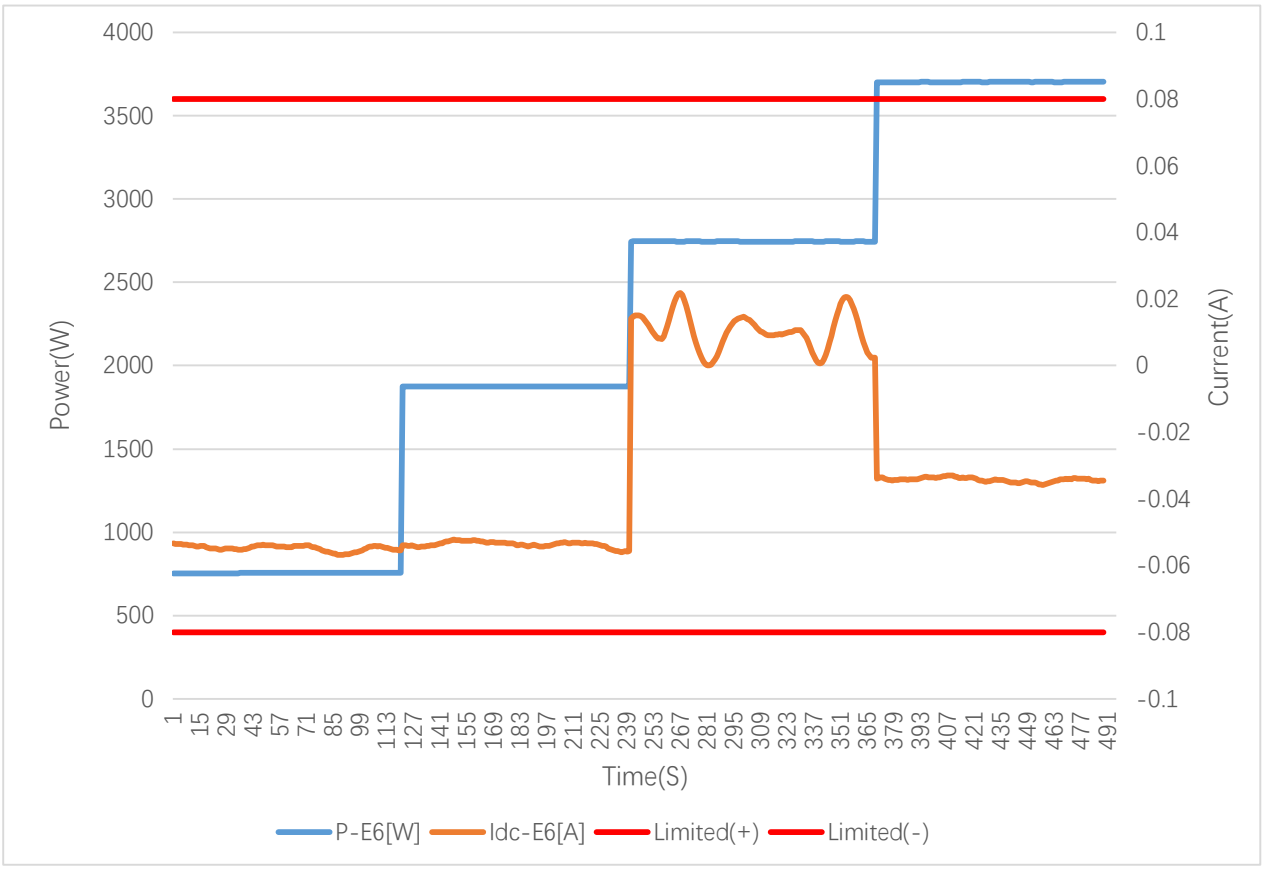
Note:



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.8	TABLE: Power quality - DC injection				P
Model	AIO2-INS-3680@Working in photovoltaic grid-connected mode				
EN 50549-1 Limit:	0.5 % of I_{nom} (80 mA)				
Power level	20%	50%	75%	100%	
Output power (VA)	755.02	1874.64	2745.63	3702.79	
DC inject current L1 (mA)	56.76	56.04	21.79	35.82	

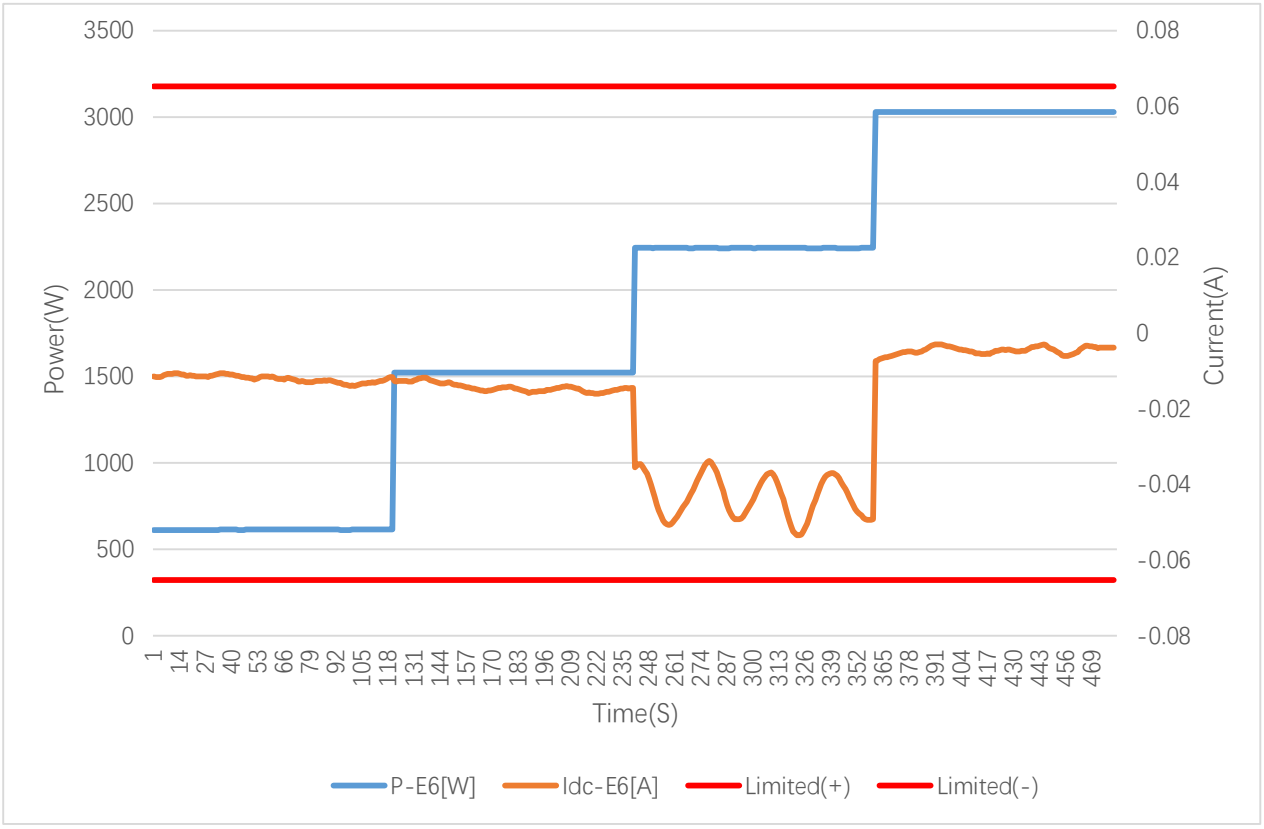
Note:



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.8	TABLE: Power quality - DC injection				P
Model	AIO2-INS-3000@Working in photovoltaic grid-connected mode				
EN 50549-1 Limit:	0.5 % of I_{nom} (65.21 mA)				
Power level	20%	50%	75%	100%	
Output power (VA)	613.19	1521.88	2243.14	3028.37	
DC inject current L1 (mA)	13.94	16.03	33.83	7.35	

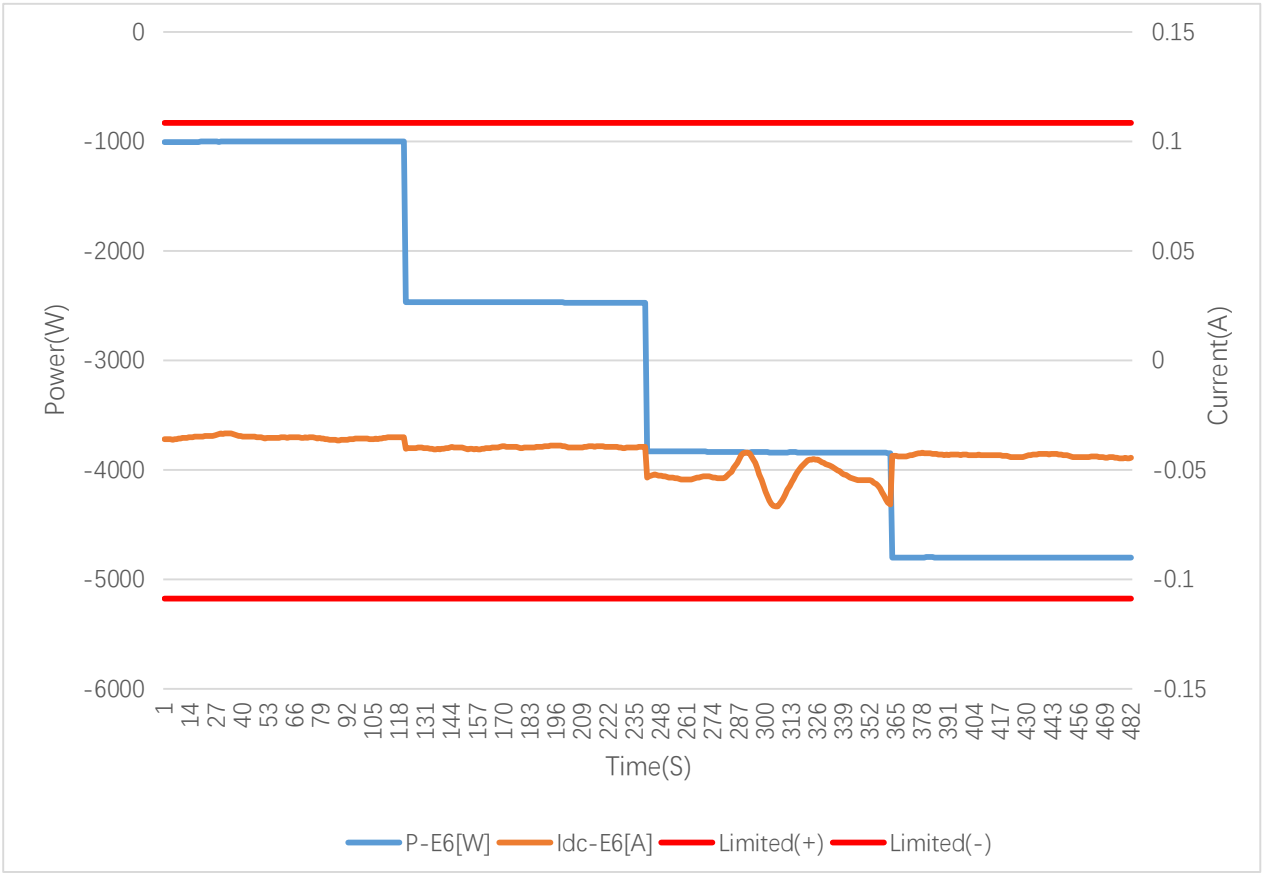
Note:



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.8	TABLE: Power quality - DC injection				P
Model	AIO2-INS-5000@Work in the grid to charge the battery mode				
EN 50549-1 Limit:	0.5 % of I_{nom} (108.69 mA)				
Power level	20%	50%	75%	100%	
Output power (VA)	-1000.90	-2468.29	-3835.30	-4797.92	
DC inject current L1 (mA)	36.30	40.50	66.66	44.53	

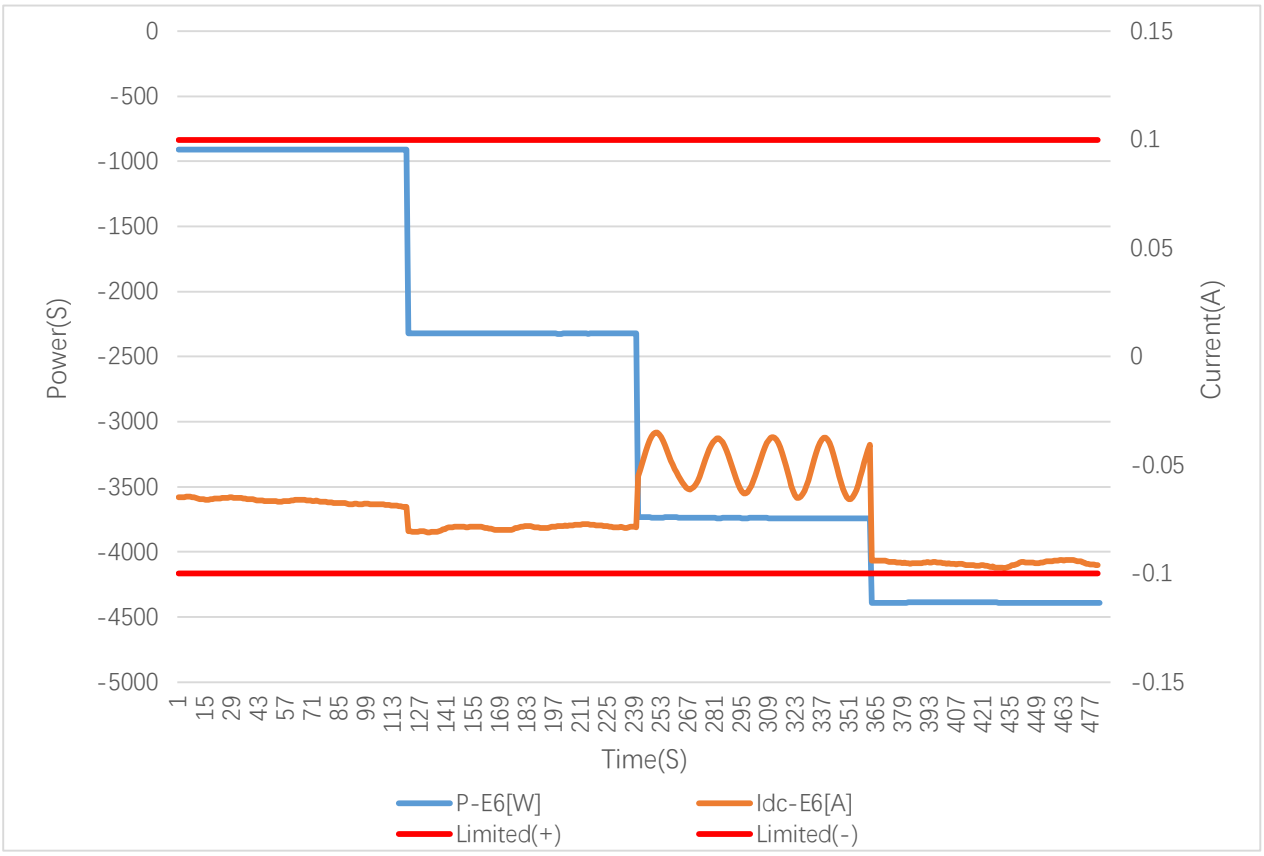
Note:



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.8	TABLE: Power quality - DC injection				P
Model	AIO2-INS-4600@Work in the grid to charge the battery mode				
EN 50549-1 Limit:	0.5 % of I_{nom} (100 mA)				
Power level	20%	50%	75%	100%	
Output power (VA)	-901.76	-2323.12	-3739.99	-4390.18	
DC inject current L1 (mA)	69.22	81.11	65.65	97.52	

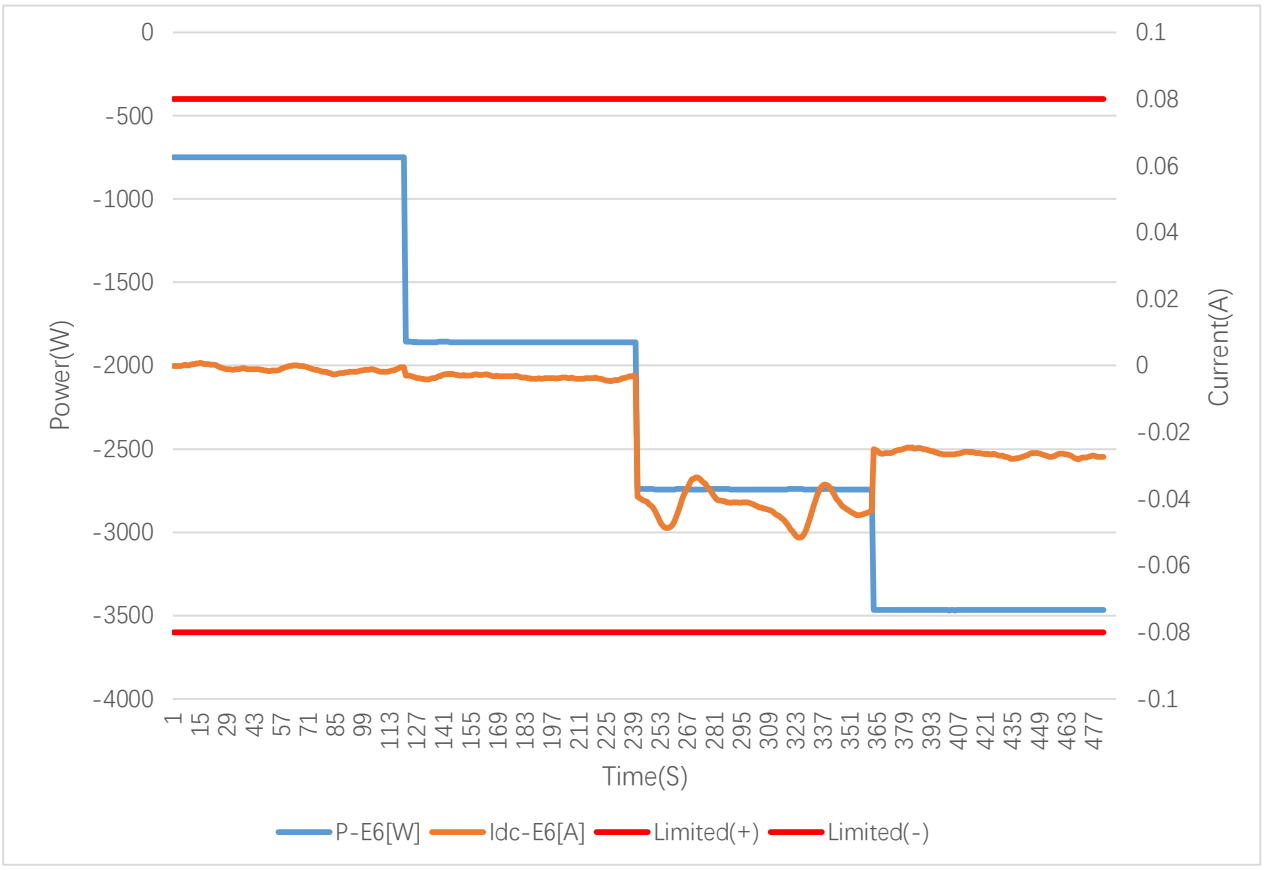
Note:



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.8	TABLE: Power quality - DC injection				P
Model		AIO2-INS-3680@Work in the grid to charge the battery mode			
EN 50549-1 Limit:		0.5 % of I_{nom} (80 mA)			
Power level		20%	50%	75%	100%
Output power (VA)		-750.06	-1858.76	-2742.41	-3467.91
DC inject current L1 (mA)		2.66	4.62	51.64	28.09

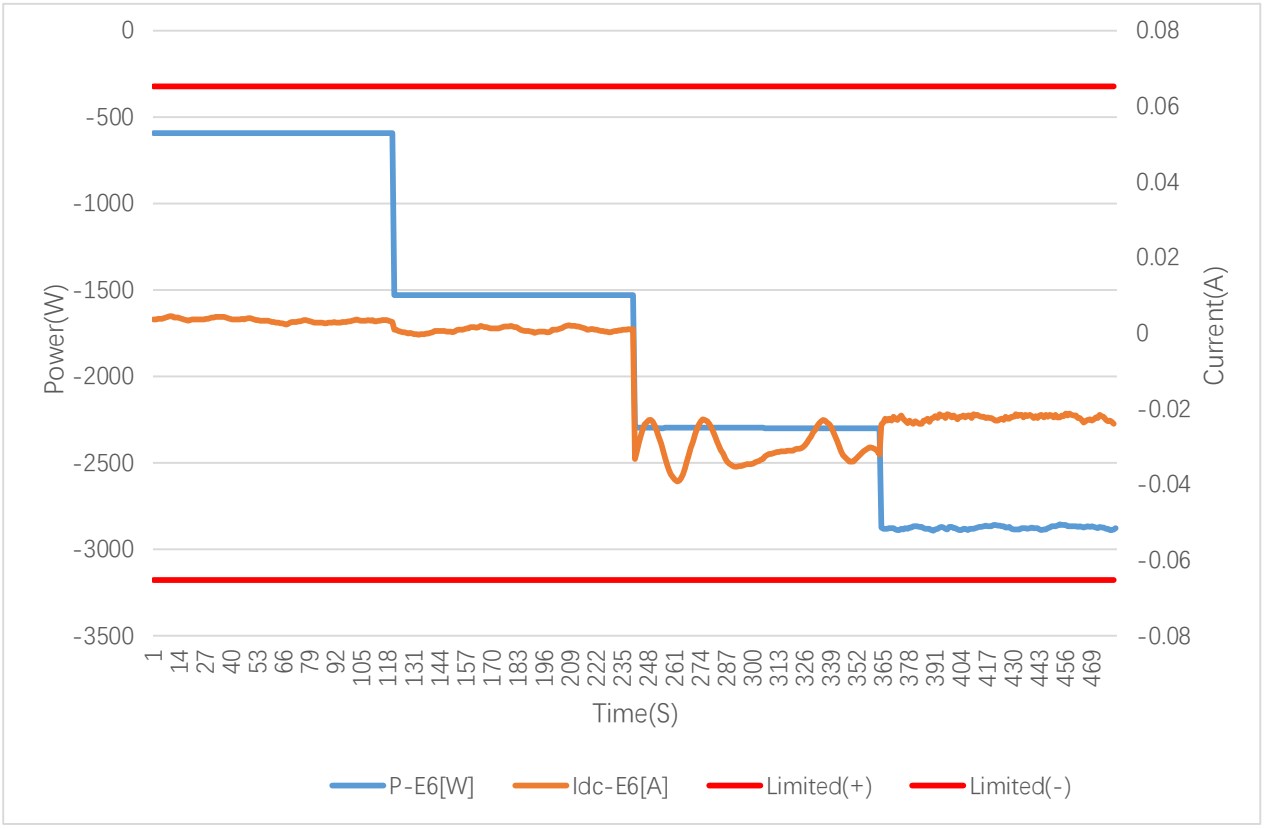
Note:



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.8	TABLE: Power quality - DC injection				P
Model	AIO2-INS-3000@Work in the grid to charge the battery mode				
EN 50549-1 Limit:	0.5 % of I_{nom} (65.21 mA)				
Power level	20%	50%	75%	100%	
Output power (VA)	-591.91	-1529.81	-2297.64	-2875.19	
DC inject current L1 (mA)	4.43	2.15	39.14	24.18	

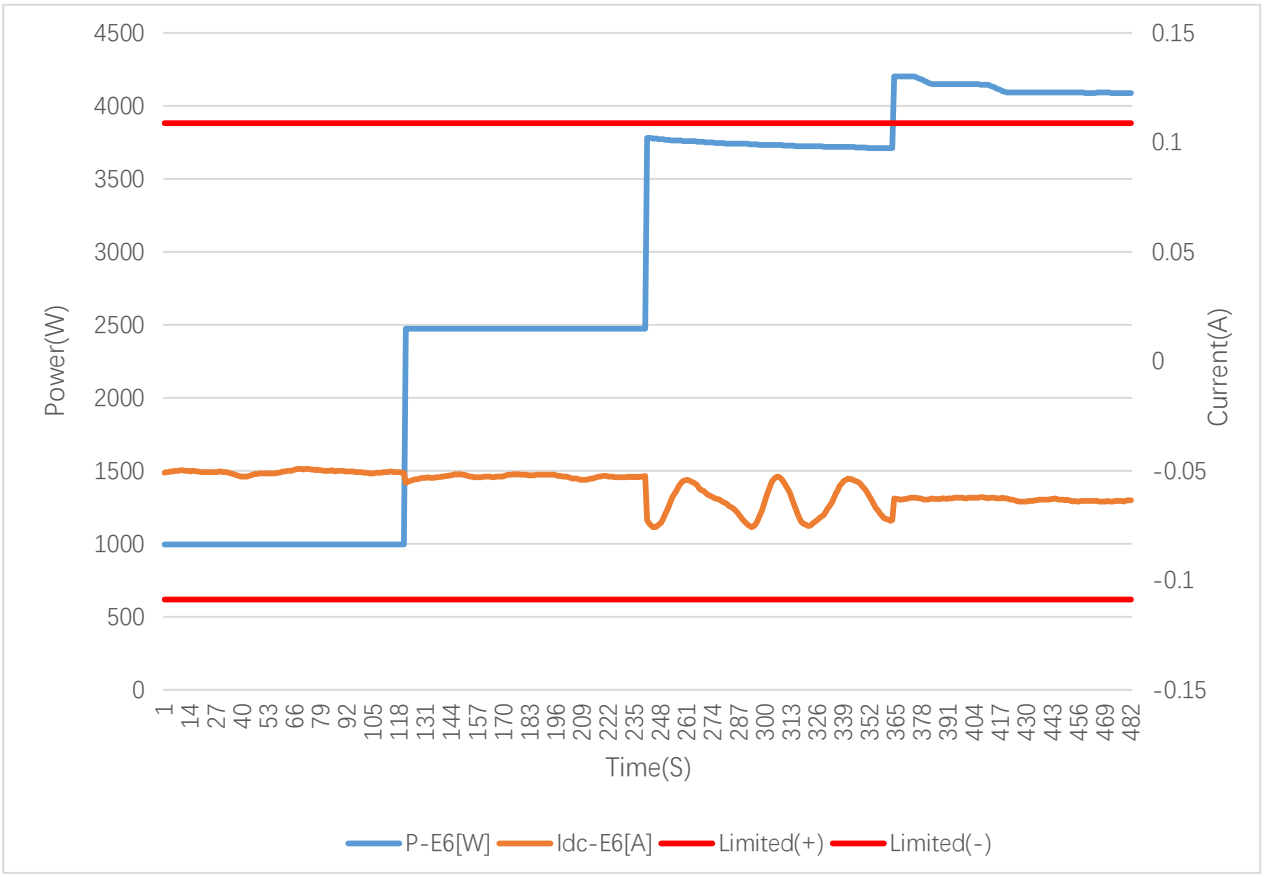
Note:



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.8	TABLE: Power quality - DC injection			P
Model	AIO2-INS-5000@Working in battery discharge and grid connection mode			
EN 50549-1 Limit:	0.5 % of I_{nom} (108.69 mA)			
Power level	20%	50%	75%	100%
Output power (VA)	995.02	2472.89	3735.91	4121.71
DC inject current L1 (mA)	52.58	55.51	75.73	64.08

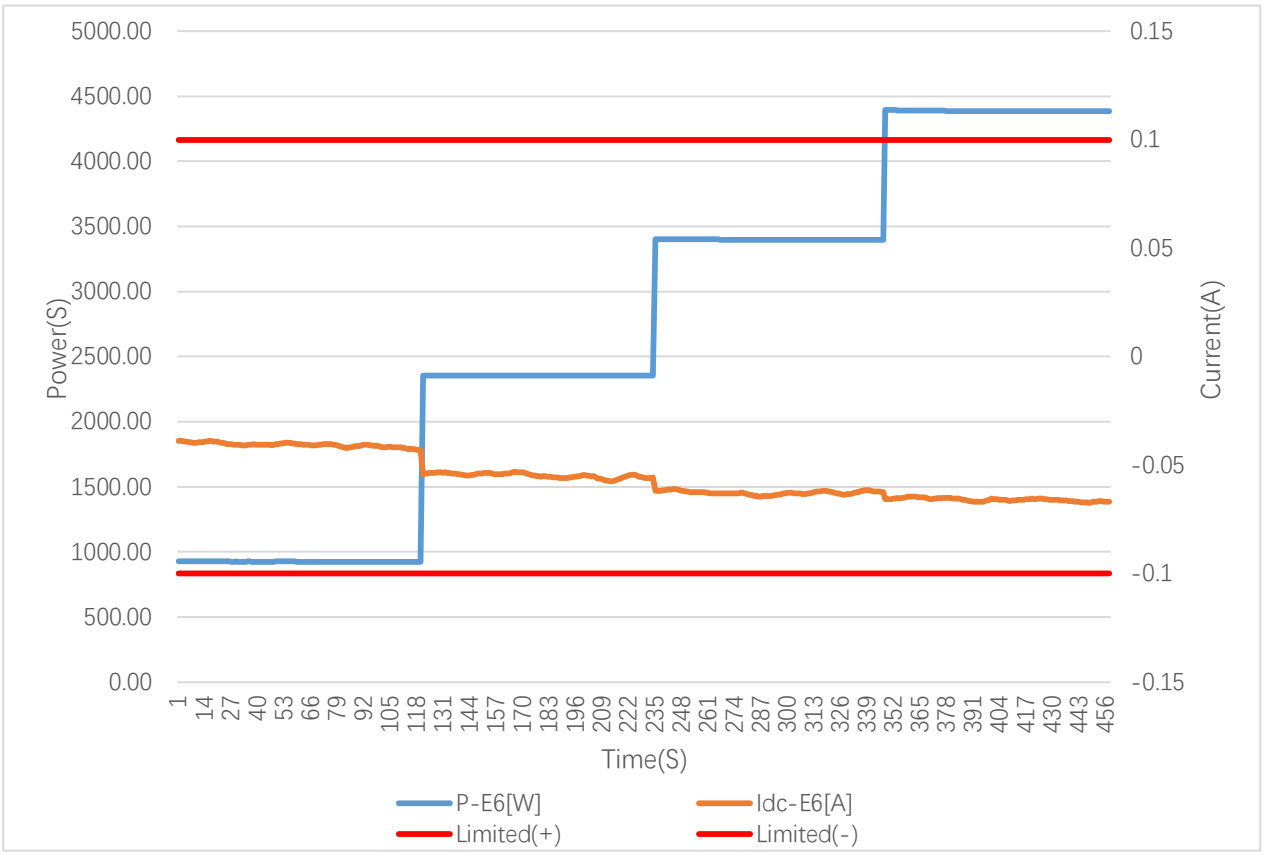
Note:



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.8	TABLE: Power quality - DC injection				P
Model	AIO2-INS-4600@Working in battery discharge and grid connection mode				
EN 50549-1 Limit:	0.5 % of I_{nom} (100 mA)				
Power level	20%	50%	75%	100%	
Output power (VA)	924.79	2355.01	3398.75	4386.55	
DC inject current L1 (mA)	42.92	57.48	64.58	67.38	

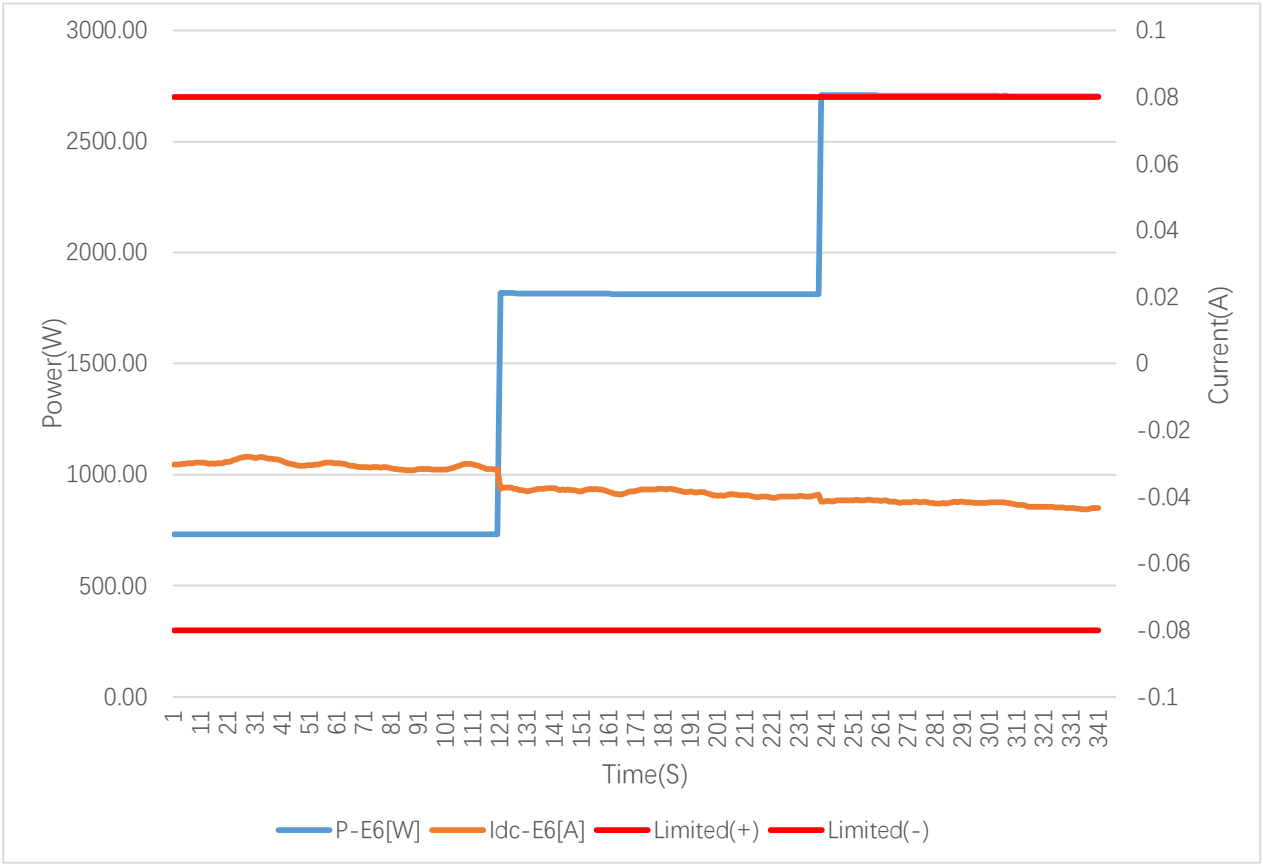
Note:



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.8	TABLE: Power quality - DC injection				P
Model		AIO2-INS-3680@Working in battery discharge and grid connection mode			
EN 50549-1 Limit:		0.5 % of I_{nom} (80 mA)			
Power level		20%	50%	75%	100%
Output power (VA)		731.40	1813.47	2705.97	N/A
DC inject current L1 (mA)		32.08	40.25	43.79	N/A

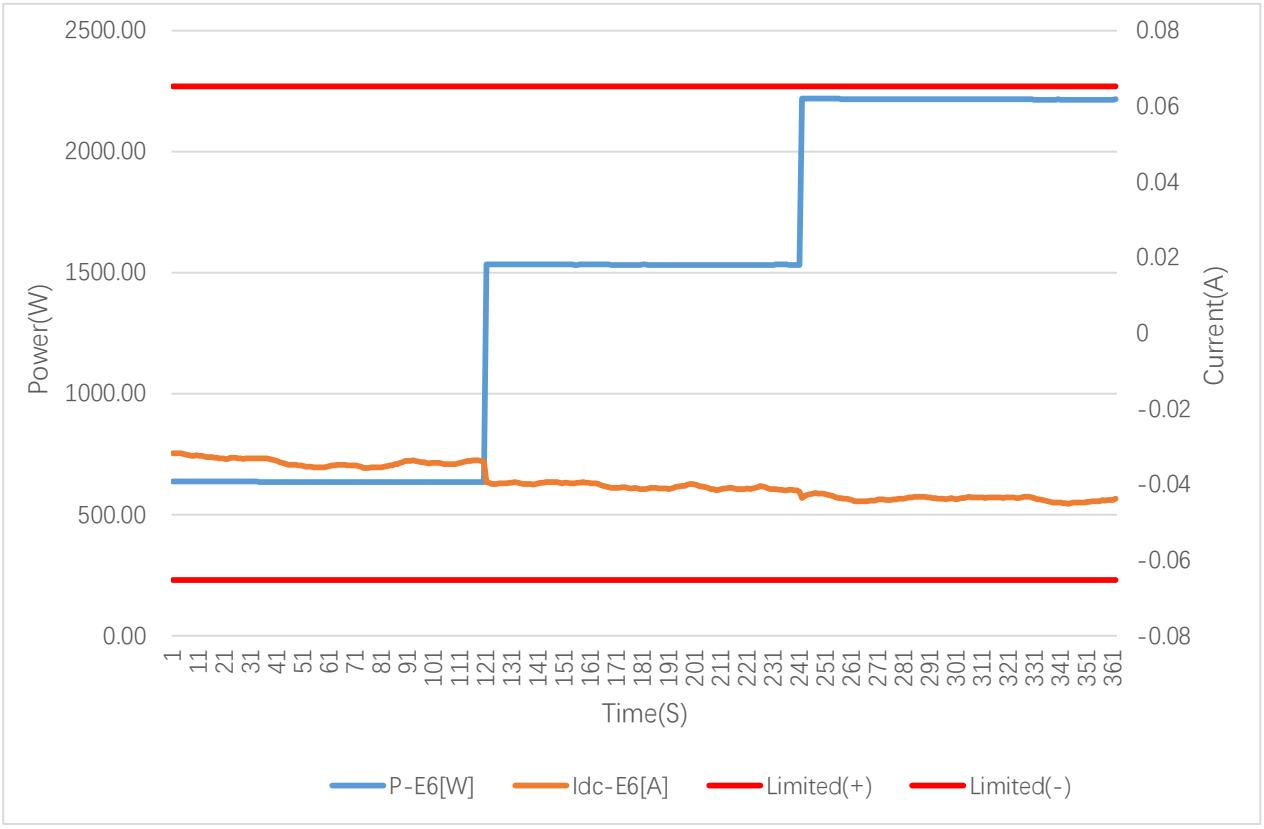
Note:



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.8	TABLE: Power quality - DC injection				P
Model		AIO2-INS-3000@Working in battery discharge and grid connection mode			
EN 50549-1 Limit:		0.5 % of I_{nom} (65.21 mA)			
Power level		20%	50%	75%	100%
Output power (VA)		635.82	1533.21	2216.34	N/A
DC inject current L1 (mA)		35.70	41.81	45.07	N/A

Note:



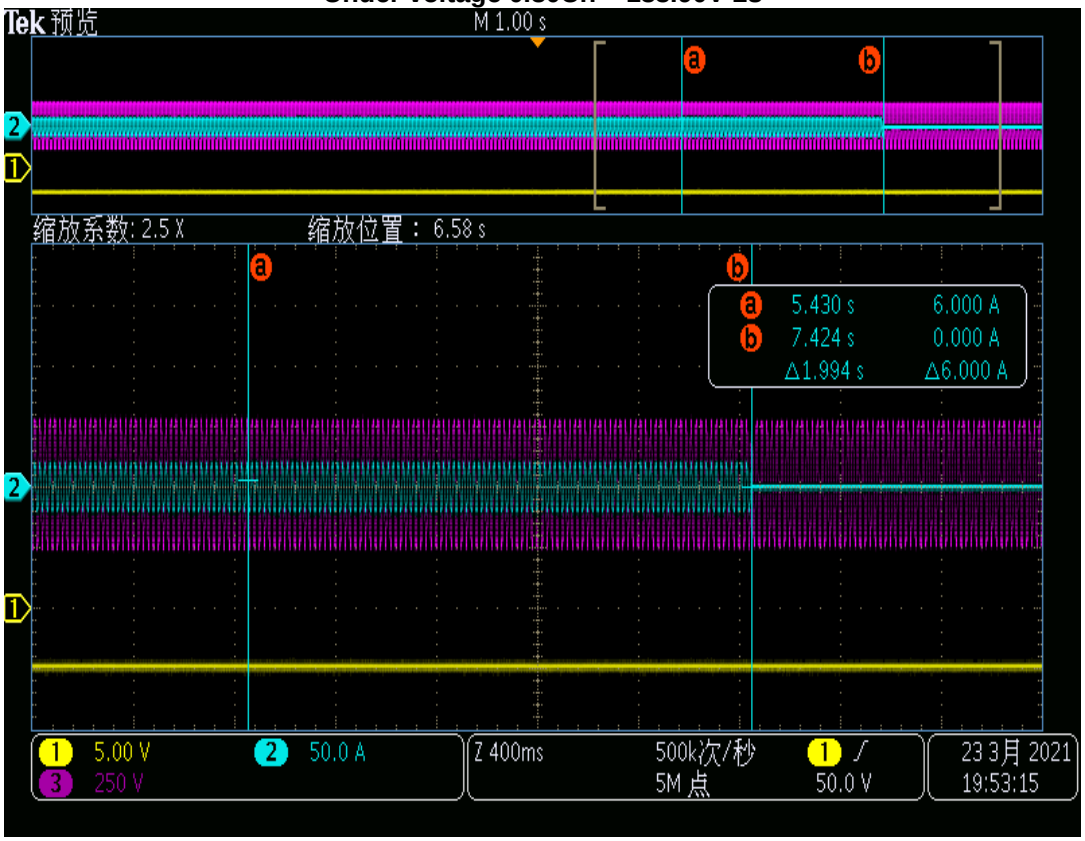
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.9.3.2	**TABLE: Under-voltage protection**	**P**
Model	AIO2-INS-5000	
Test condition:	Output level: 50 ± 5% of its rated current output Frequency: 50 Hz	

Phase	Adjustment thresholds ranges [V]	Actual thresholds setting [V]	Measured trip value [V]	Adjustment disconnection time range [s]	Actual disconnection time setting [s]	Measured disconnection time [s]
L1 Phase	0.80Un	184	183.80	2	2	1.984
L2 Phase			183.90		2	1.994
L3 Phase			183.90		2	1.975

Note:
The minimum required accuracy for protection is:
for frequency measurement ± 0,05 Hz;
for voltage measurement ± 1 % of U_n;
The reset time shall be ≤ 50 ms.

Under voltage 0.80Un – 183.90V 2s

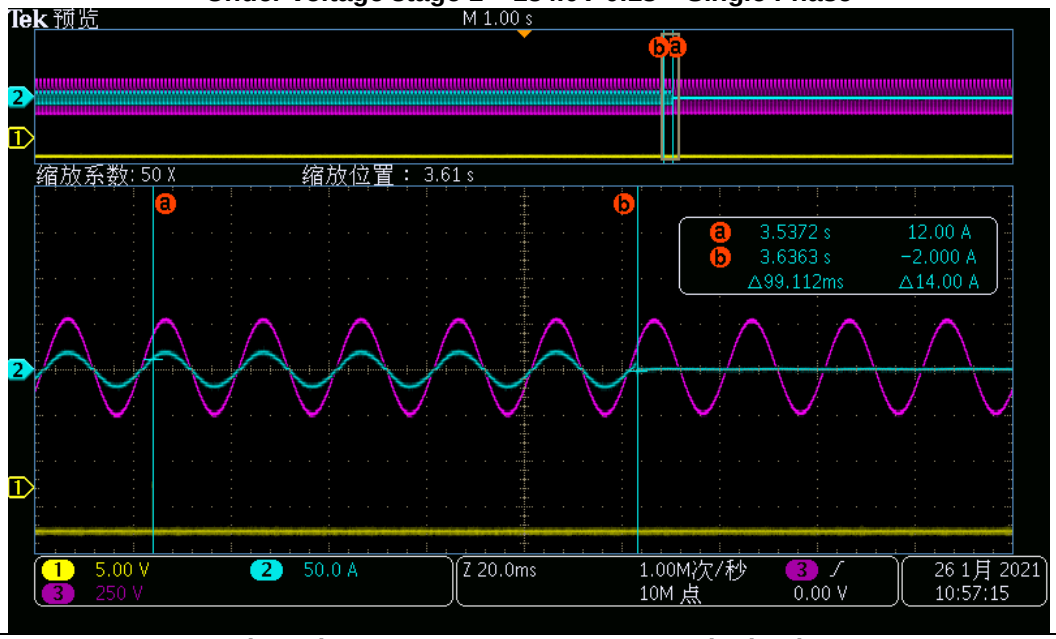


EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

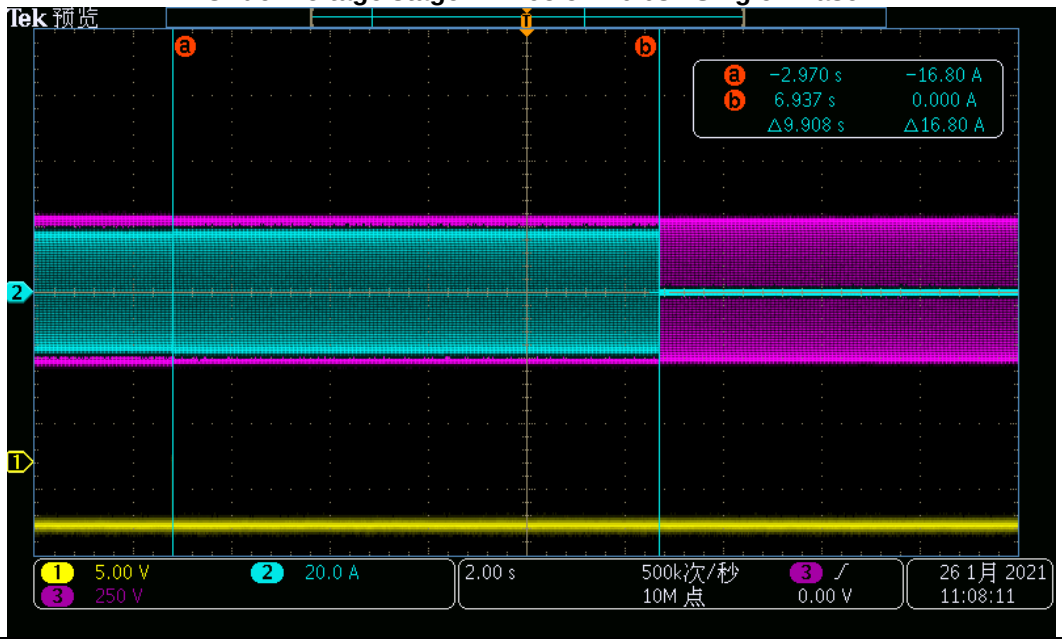
4.9.3.2	**TABLE: Under-voltage protection – Adjustable setting**					**P**
Model	AIO2-INS-5000					
Test condition:	Output level: 50 ± 5% of its rated current output Frequency: 50 Hz					
Phase	Adjustment thresholds ranges [V]	Actual thresholds setting [V]	Measured trip value [V]	Adjustment disconnection time range [s]	Actual disconnection time setting [s]	Measured disconnection time [s]
Single Phase	0.2-1.0Un (stage 1)	$0.80U_n$=184.0	183.03	0.1-100	0.1	0.099
		$0.85U_n$=195.5	194.53		10	9.908
		$0.90U_n$=203.0	202.94		100	99.79
	0.2-1.0Un (stage 2)	$0.20U_n$=46.0	45.79	0.1-5	0.1	0.073
		$0.50U_n$=115.0	114.38		1	0.985
		$0.80U_n$=184	183.01		5	4.901
Note: The minimum required accuracy for protection is: for frequency measurement ± 0,05 Hz; for voltage measurement ± 1 % of U_n; The reset time shall be ≤ 50 ms.						

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Under voltage stage 1 – 184.0V 0.1s – Single Phase

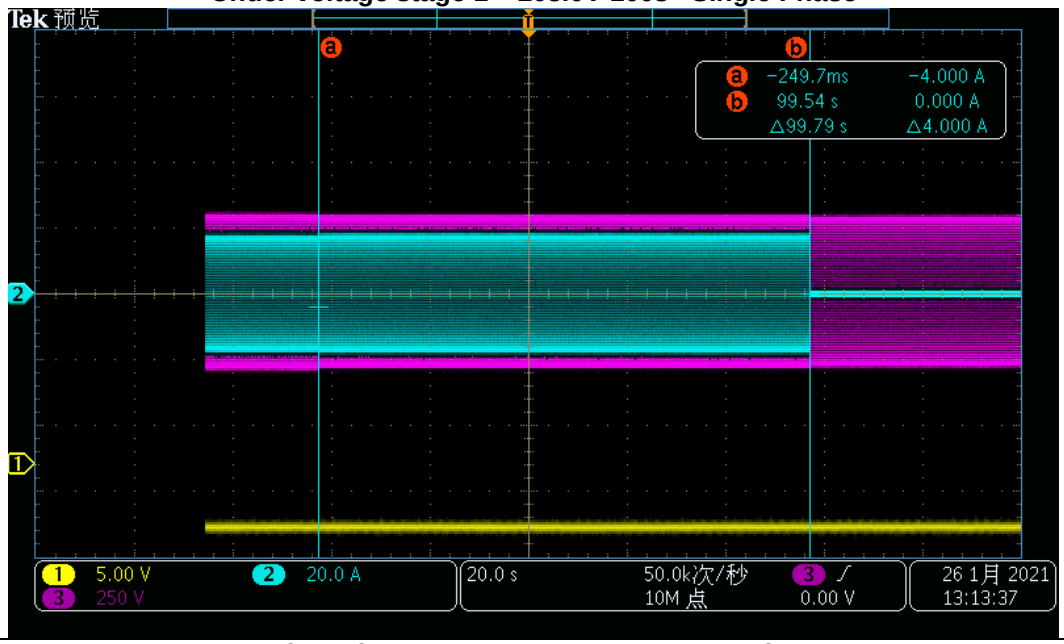


Under voltage stage 1 – 195.5V 10.0s –Single Phase

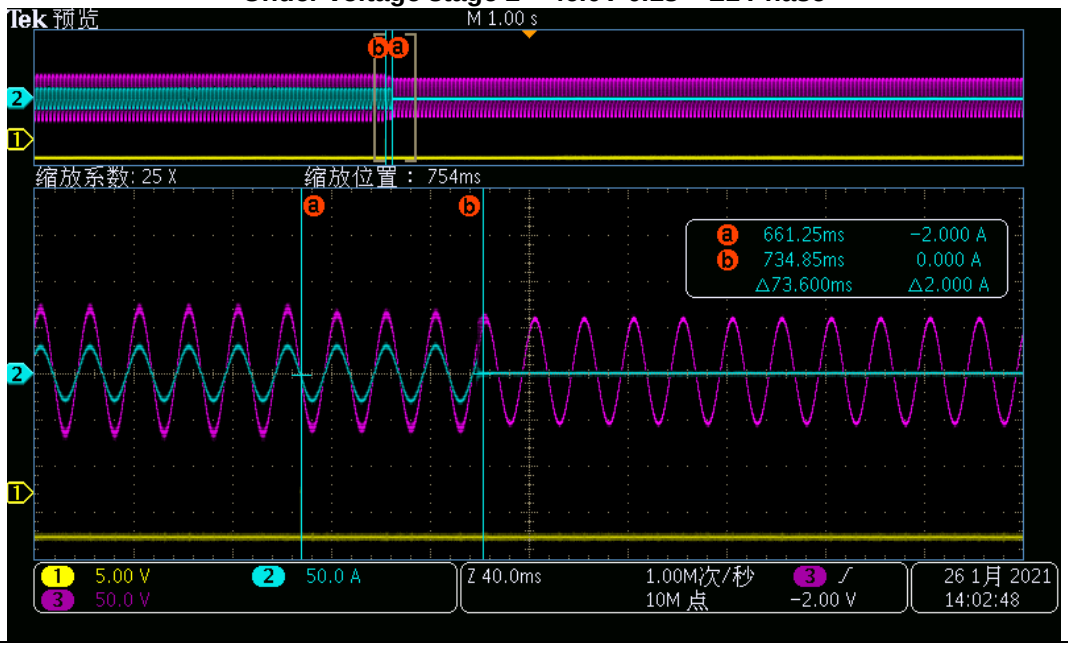


EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Under voltage stage 1 – 203.0V 100s –Single Phase

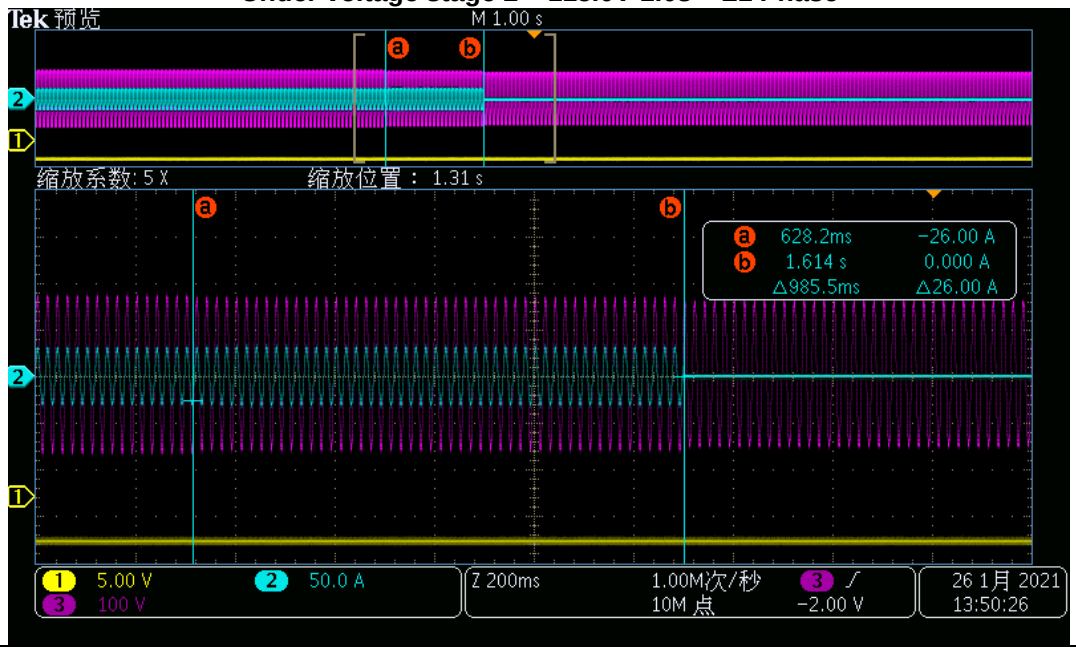


Under voltage stage 2 – 46.0V 0.1s – L1 Phase

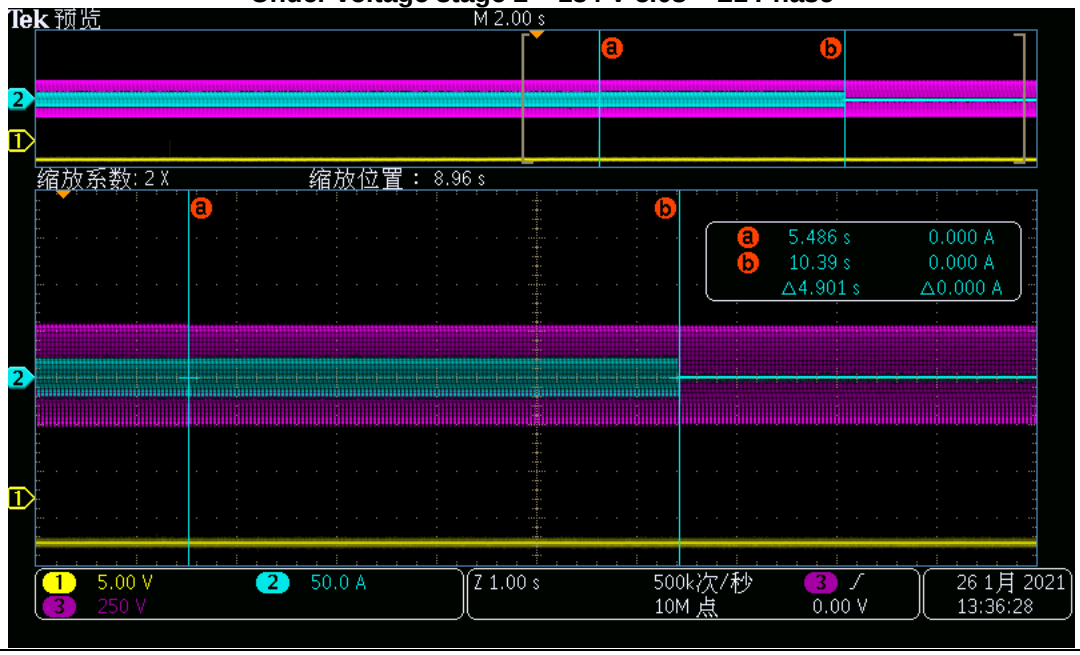


EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Under voltage stage 2 – 115.0V 1.0s – L1 Phase



Under voltage stage 2 – 184 V 5.0s – L1 Phase



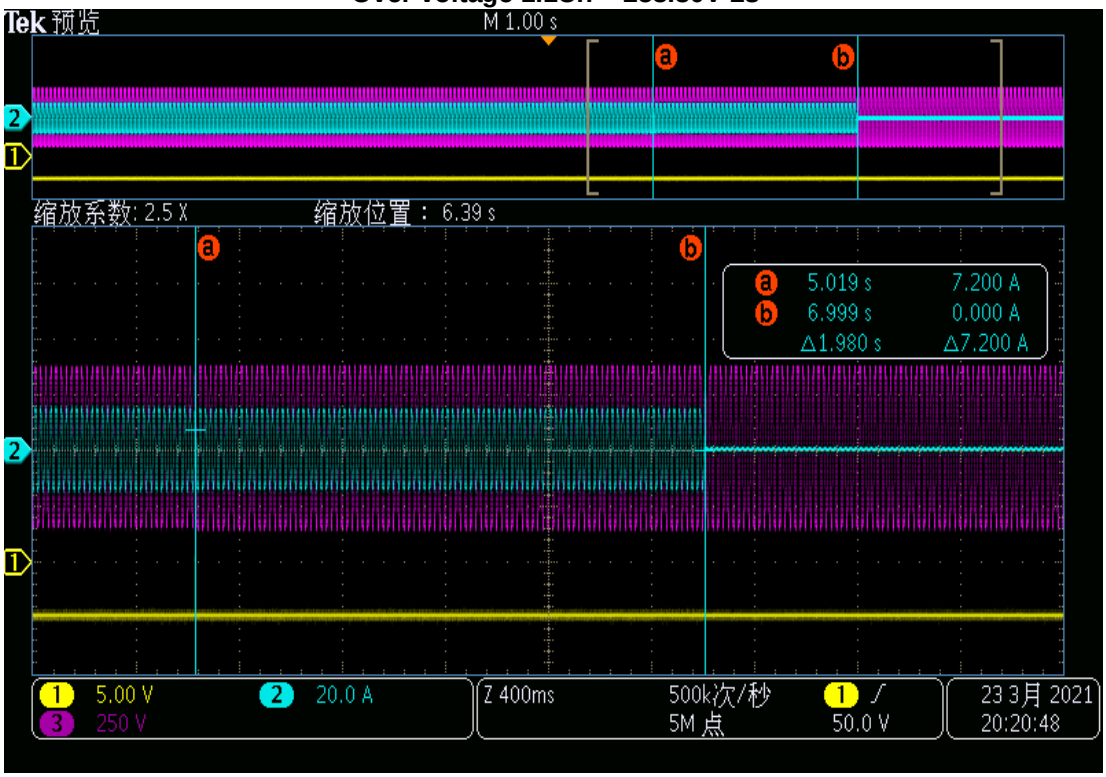
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.9.3.3	**TABLE: Overvoltage protection**	**P**
Model	AIO2-INS-5000	
Test condition:	Output level: 50 ± 5% of its rated current output Frequency: 50 Hz	

Phase	Adjustment thresholds ranges [V]	Actual thresholds setting [V]	Measured trip value [V]	Adjustment disconnection time range [s]	Actual disconnection time setting [s]	Measured disconnection time [s]
L1 Phase	1.1Un	253	253.40	2	2	1.975
L2 Phase		253	253.70		2	1.976
L3 Phase		253	253.30		2	1.980

Note:
The minimum required accuracy for protection is:
for frequency measurement ± 0,05 Hz;
for voltage measurement ± 1 % of U_n;
The reset time shall be ≤ 50 ms.

Over voltage 1.1Un – 253.30V 2s



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

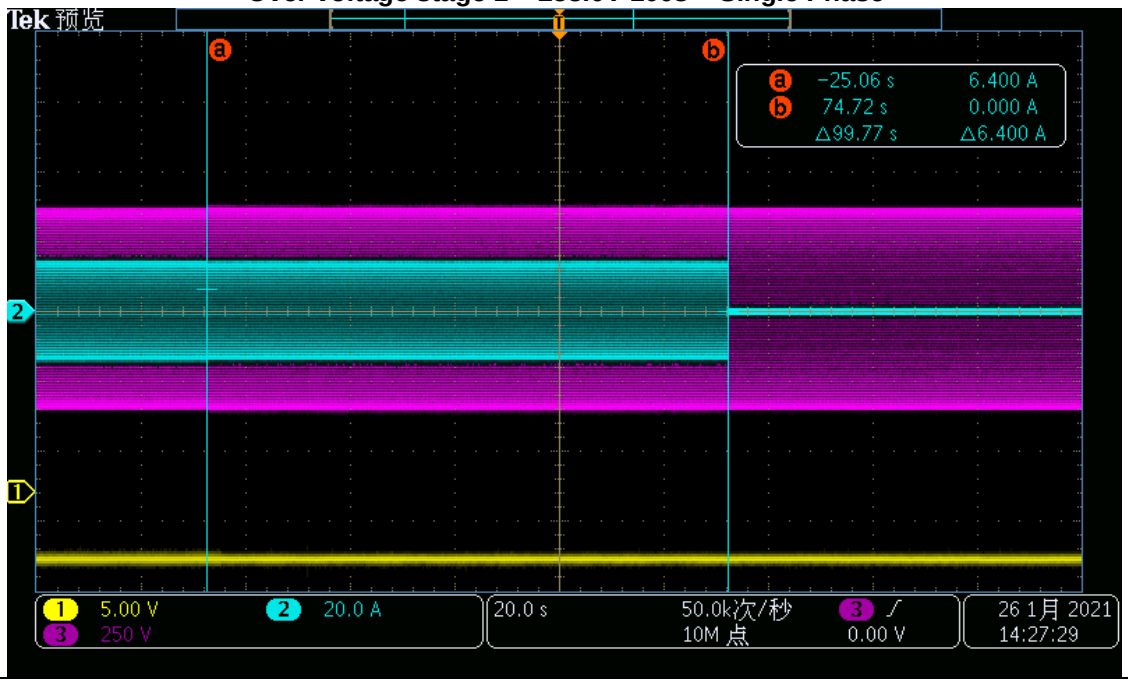
4.9.3.3	**TABLE: Overvoltage protection – Adjustable setting**	**P**
Model	AIO2-INS-5000	
Test condition:	Output level: 50 ± 5% of its rated current output Frequency: 50 Hz	

Phase	Adjustment thresholds ranges [V]	Actual thresholds setting [V]	Measured trip value [V]	Adjustment disconnection time range [s]	Actual disconnection time setting [s]	Measured disconnection time [s]
L1 Phase	1.0-1.2Un (stage 1)	1.10Un=253.0	252.53	0.1-100s	100	99.77
		1.15Un=264.5	263.23		10	9.810
		1.20Un=276.0	274.41		0.1	0.076
	1.0-1.3Un (stage 2)	1.20Un=276.0	274.68	0.1-5s	5	4.975
		1.25Un=287.5	285.24		1	0.998
		1.30Un=299.0	298.52		0.1	0.098

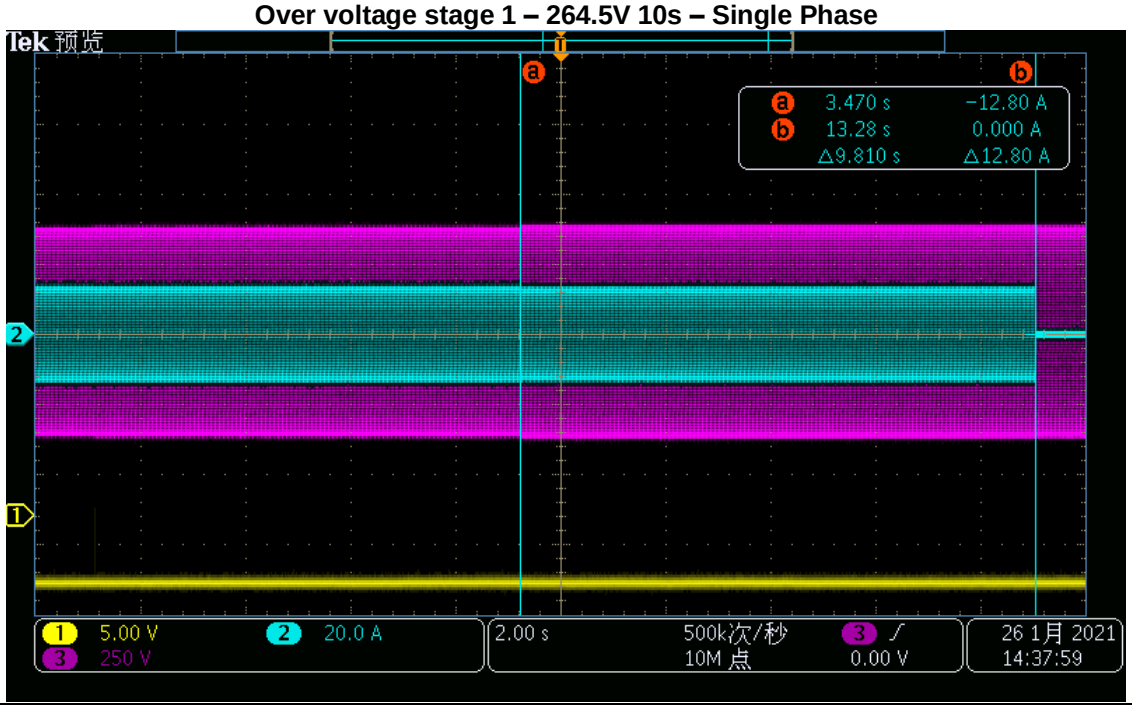
Note:
The minimum required accuracy for protection is:
for frequency measurement ± 0,05 Hz;
for voltage measurement ± 1 % of U_n;
The reset time shall be ≤ 50 ms.

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Over voltage stage 1 – 253.0V 100s – Single Phase

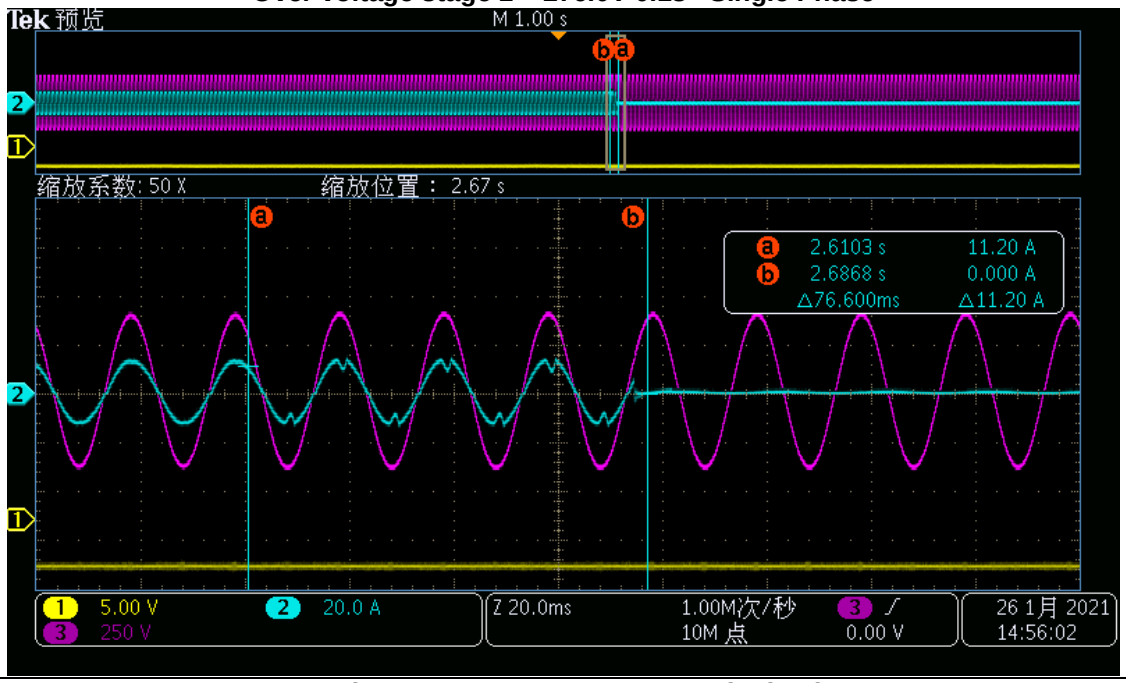


Over voltage stage 1 – 264.5V 10s – Single Phase

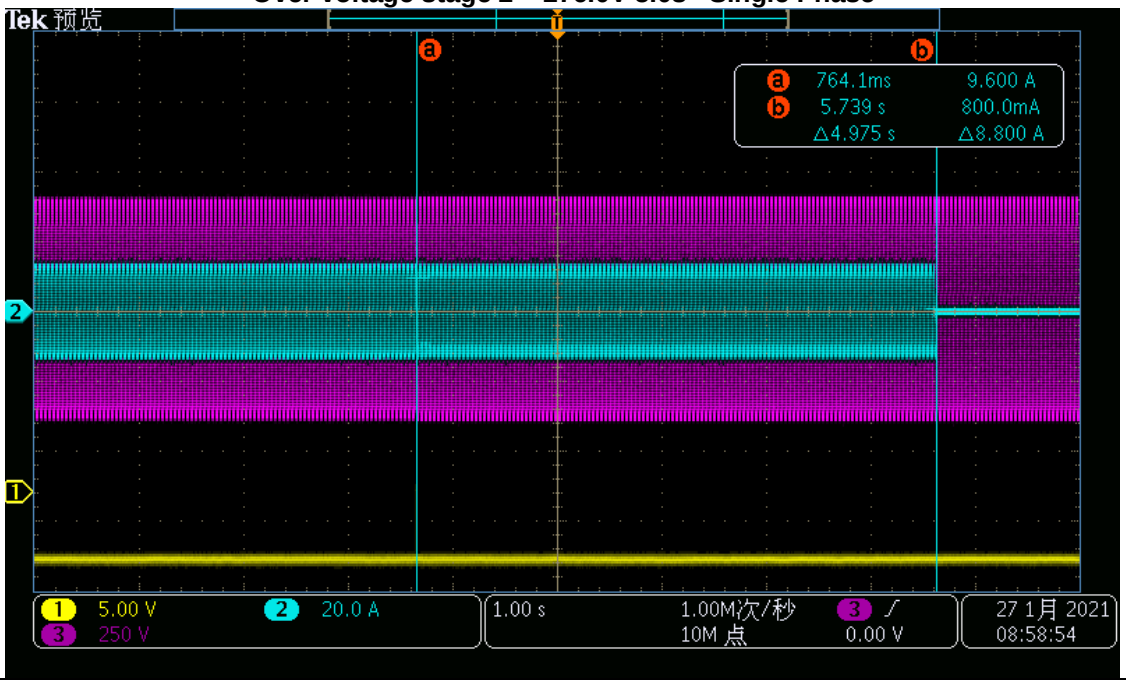


EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Over voltage stage 1 – 276.0V 0.1s –Single Phase

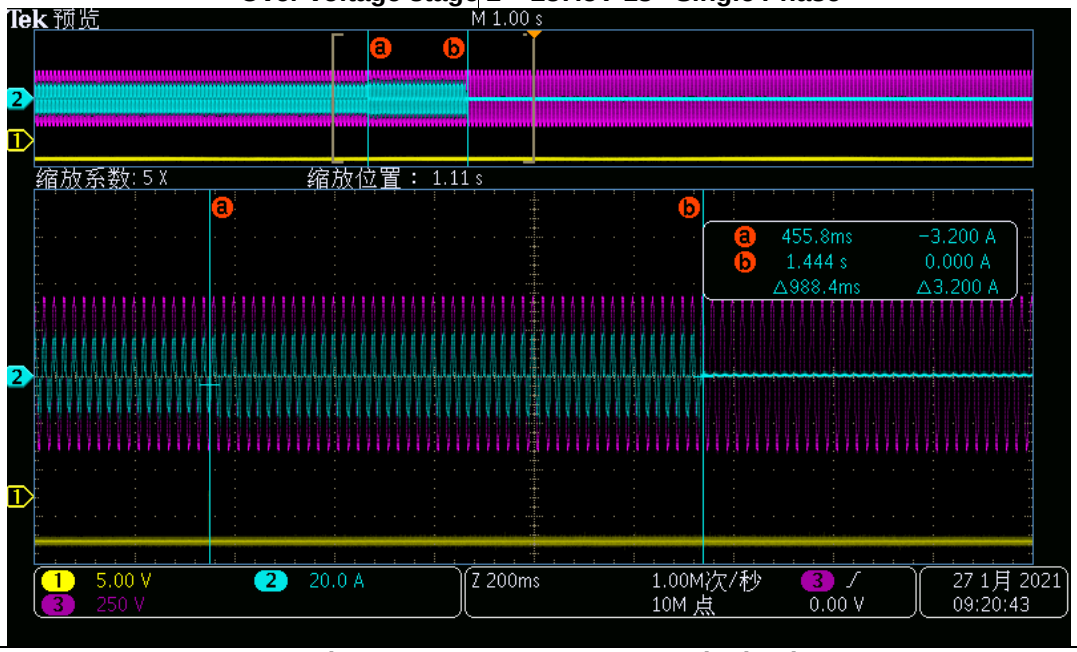


Over voltage stage 2 – 276.0V 5.0s –Single Phase

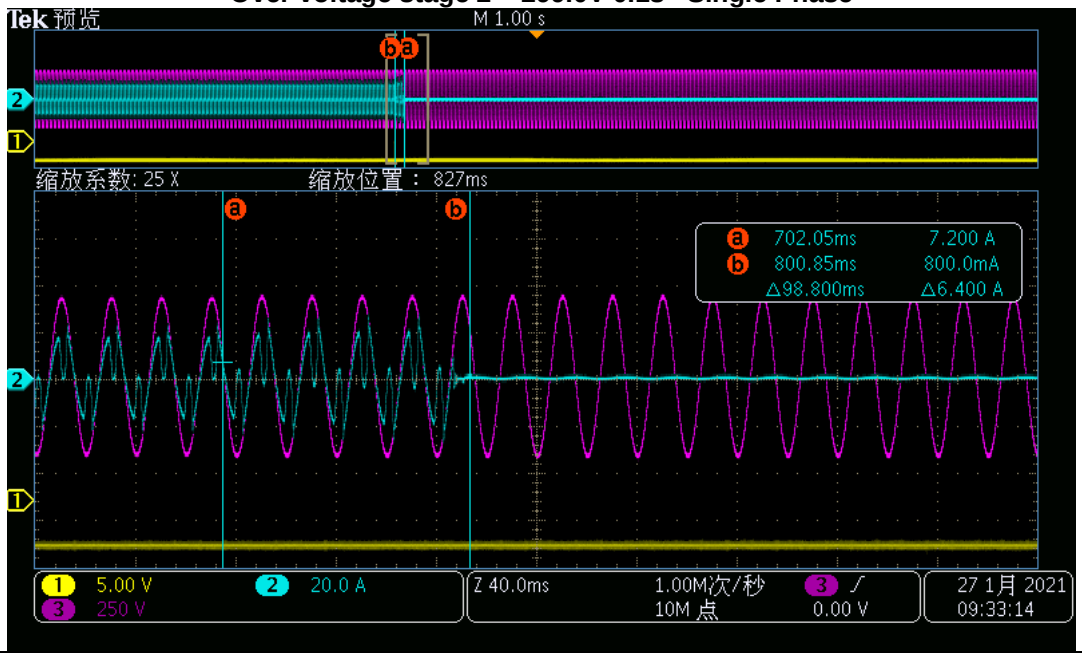


EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Over voltage stage 2 – 287.5V 1s –Single Phase



Over voltage stage 2 – 299.0V 0.1s –Single Phase



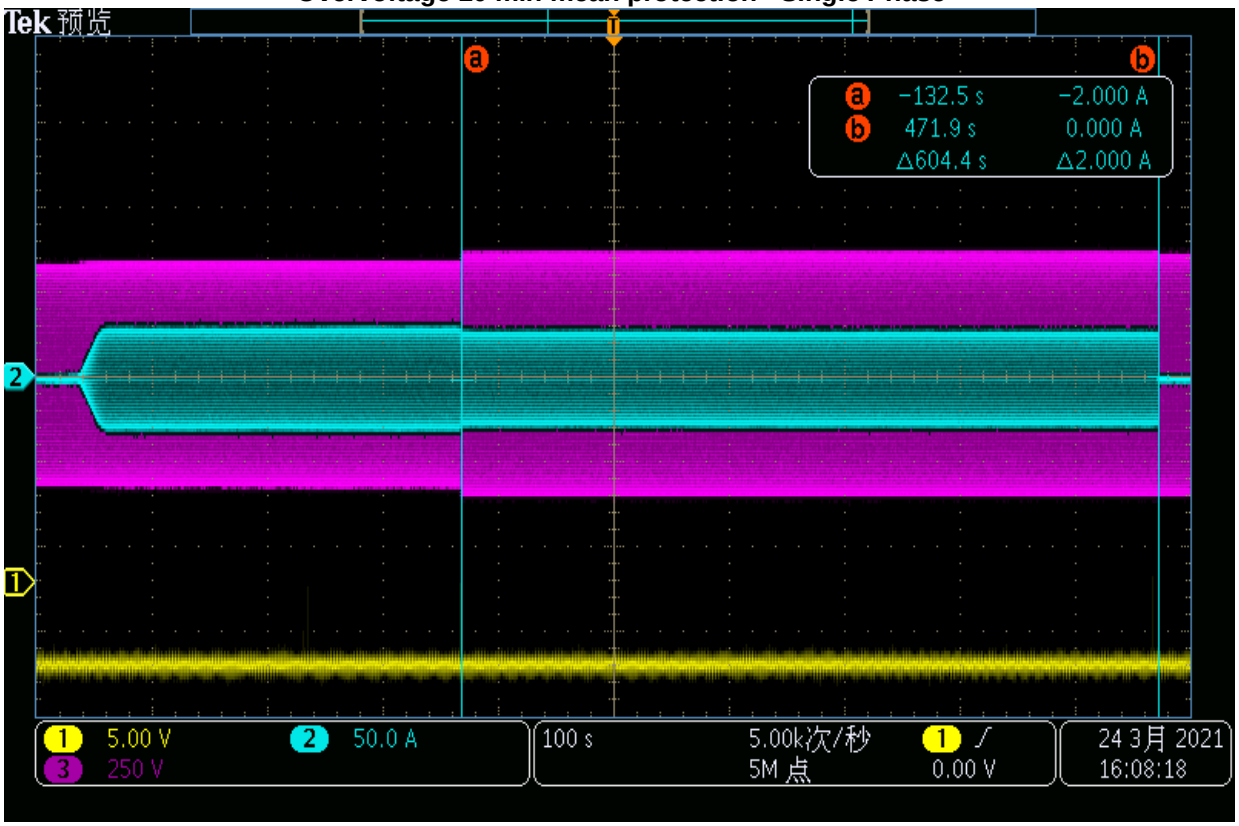
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.9.3.4	**TABLE: Overvoltage 10 min mean protection**		**P**
Model	AIO2-INS-5000		
Parameter:	Test voltage:(V)	Disconnection time:(s)	Limit:
Single Phase	253.01	604.4	10 min

Note:
Over-voltage – stage 1 Un (100% - 115 %): 10-min-value corresponding to EN 50160.
The calculation of the 10 min value shall comply with the 10 min aggregation of EN 61000-4-30, class S. The function shall be based on the calculation of the square root of the arithmetic mean of the squared input values over 10 min. In deviation from EN 61000-4-30, a moving window shall be used. The calculation of a new 10-min value at least every 3 s is sufficient, which is then to be compared with the trip value.

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Overvoltage 10 min mean protection– Single Phase



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.9.3.5	**TABLE: Under-frequency protection**					**P**
Model	AIO2-INS-5000					
Test condition:	Output level: 100 ± 5% of its rated current output					
Adjustment thresholds ranges [Hz]	Actual thresholds setting [Hz]	Test voltage [V]	Measured trip value [Hz]	Adjustment disconnection time range [s]	Actual disconnection time setting [s]	Measured disconnection time [s]
47.0-50.0Hz (Stage 1)	47.5	1.00U_n	47.50	2	2	1.967
	47.5	1.00U_n	47.50		2	1.970
	47.5	1.00U_n	47.50		2	1.974

Note:

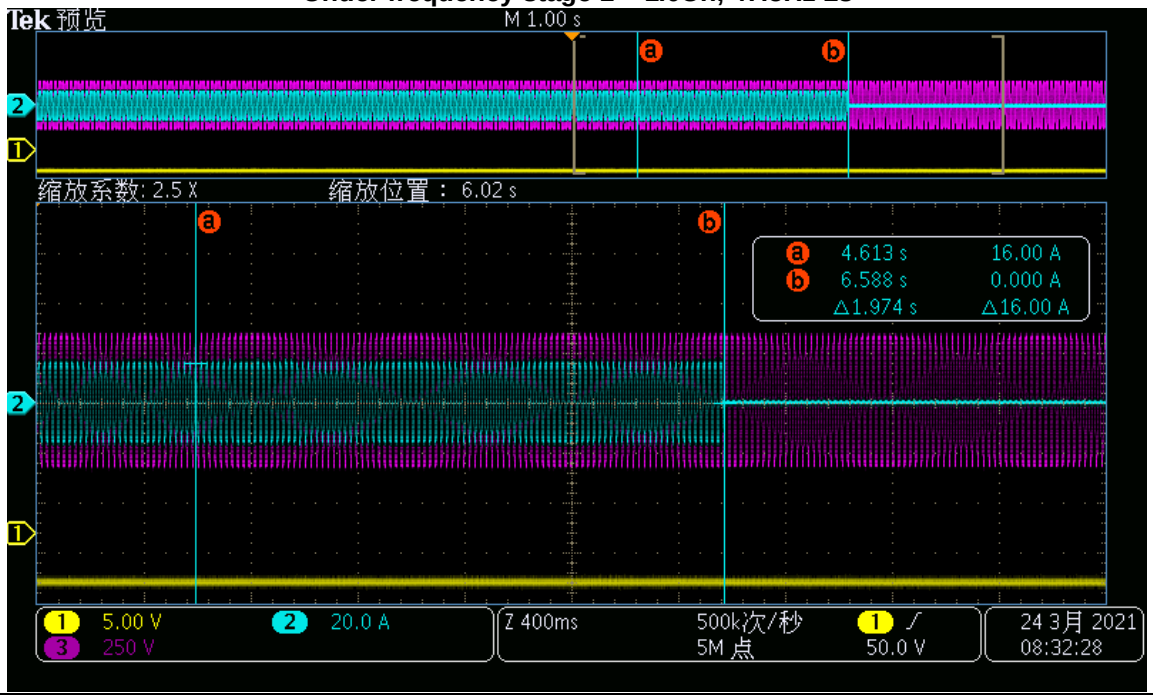
In order to use narrow frequency thresholds for islanding detection (see 4.9.3.3) it may be required to have the ability to activate and deactivate a stage by an external signal. The frequency protection shall function correctly in the input voltage range between 20 % Un and 120 % Un and shall be inhibited for input voltages of less than 20 % Un.

Under 0.2 Un the frequency protection is inhibited. Disconnection may only happen base on under voltage protection.

* the limit actual stage 1 frequency limits and stage 2 frequency limits are required of the standard, the interface protection of the product maybe required by the DSO.

** the limit time is the upper limit and the under limits of the under-frequency protect are required of the standard, the interface protection of the product maybe required by the DSO.

Under frequency stage 1 – 1.0Un, 47.5Hz 2s



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.9.3.5	**TABLE: Under-frequency protection – Adjustable setting**					**P**
Model	AIO2-INS-5000					
Test condition:	Output level: 100 ± 5% of its rated current output					
Adjustment thresholds ranges [Hz]	Actual thresholds setting [Hz]	Test voltage [V]	Measured trip value [Hz]	Adjustment disconnection time range [s]	Actual disconnection time setting [s]	Measured disconnection time [s]
47.0-50.0Hz (Stage 1)	49.5	$0.2U_n$	49.30	0.1-100s	100	99.77
	48.5	$1.0U_n$	48.54		10	9.808
	47.5	$1.2U_n$	47.48		0.1	0.095
47.0-50.0Hz (Stage 2)	48.0	$0.2U_n$	47.50	0.1-5s	5	4.094
	47.5	$1.0U_n$	47.52		1	0.997
	47.0	$1.2U_n$	46.99		0.1	0.081

Note:

In order to use narrow frequency thresholds for islanding detection (see 4.9.3.3) it may be required to have the ability to activate and deactivate a stage by an external signal. The frequency protection shall function correctly in the input voltage range between 20 % Un and 120 % Un and shall be inhibited for input voltages of less than 20 % Un.

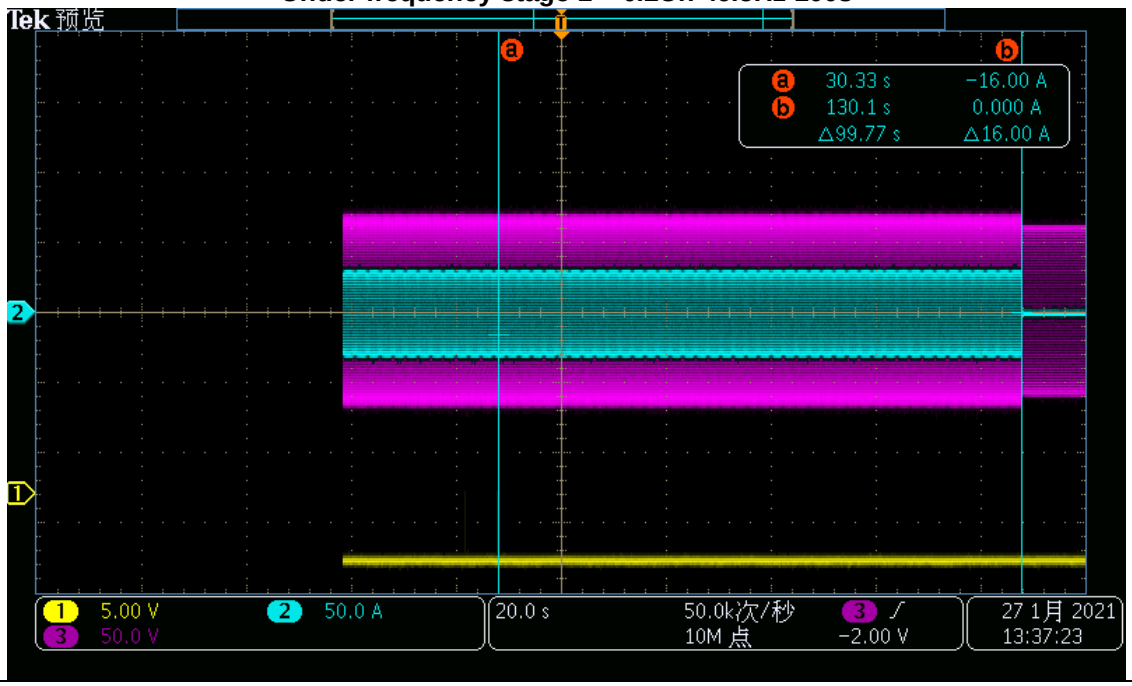
Under 0.2 Un the frequency protection is inhibited. Disconnection may only happen base on under voltage protection.

* the limit actual stage 1 frequency limits and stage 2 frequency limits are required of the standard, the interface protection of the product maybe required by the DSO.

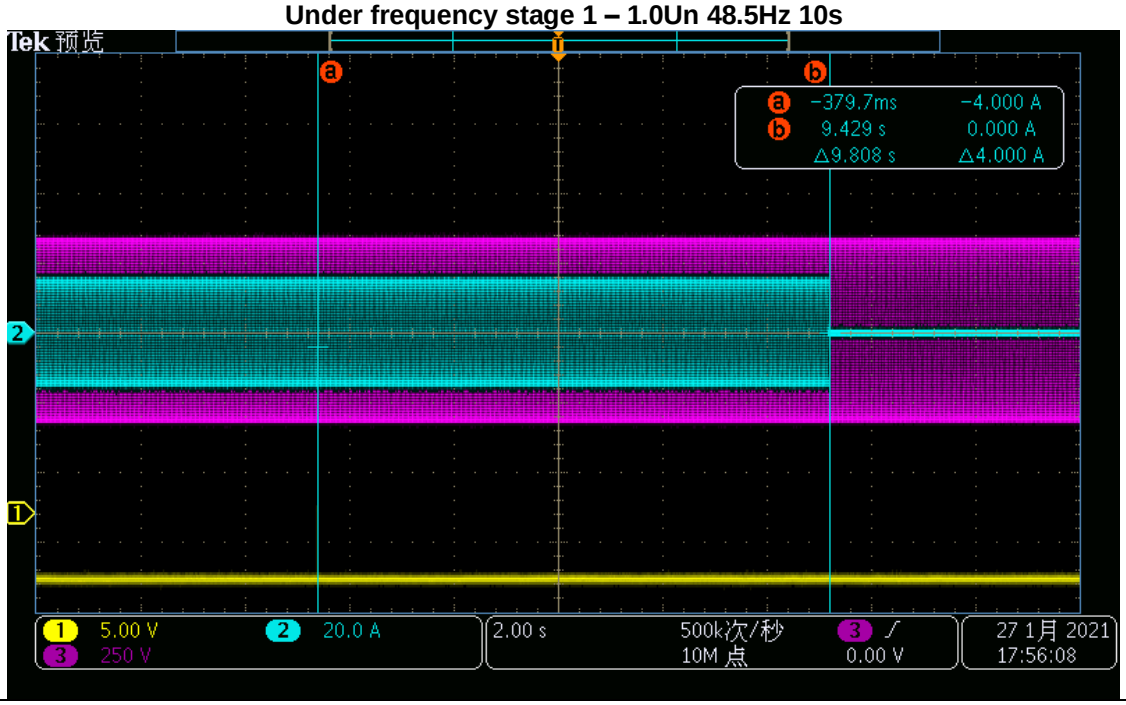
** the limit time is the upper limit and the under limits of the underfrequency protect are required of the standard, the interface protection of the product maybe required by the DSO.

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Under frequency stage 1 – 0.2Un 49.5Hz 100s

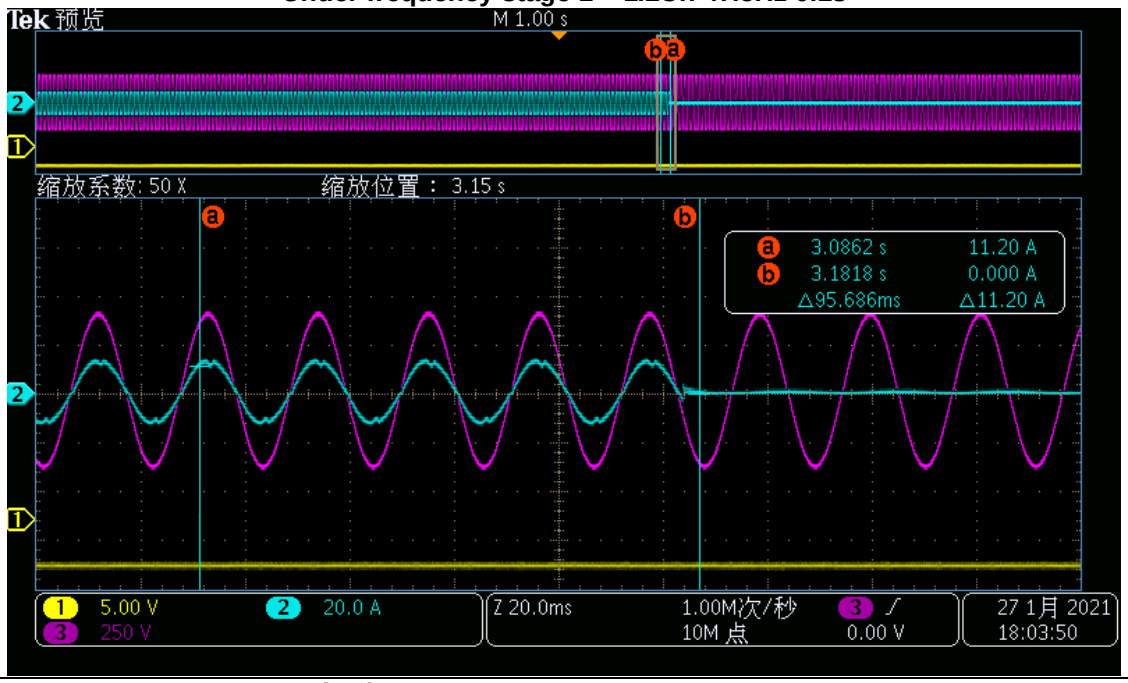


Under frequency stage 1 – 1.0Un 48.5Hz 10s

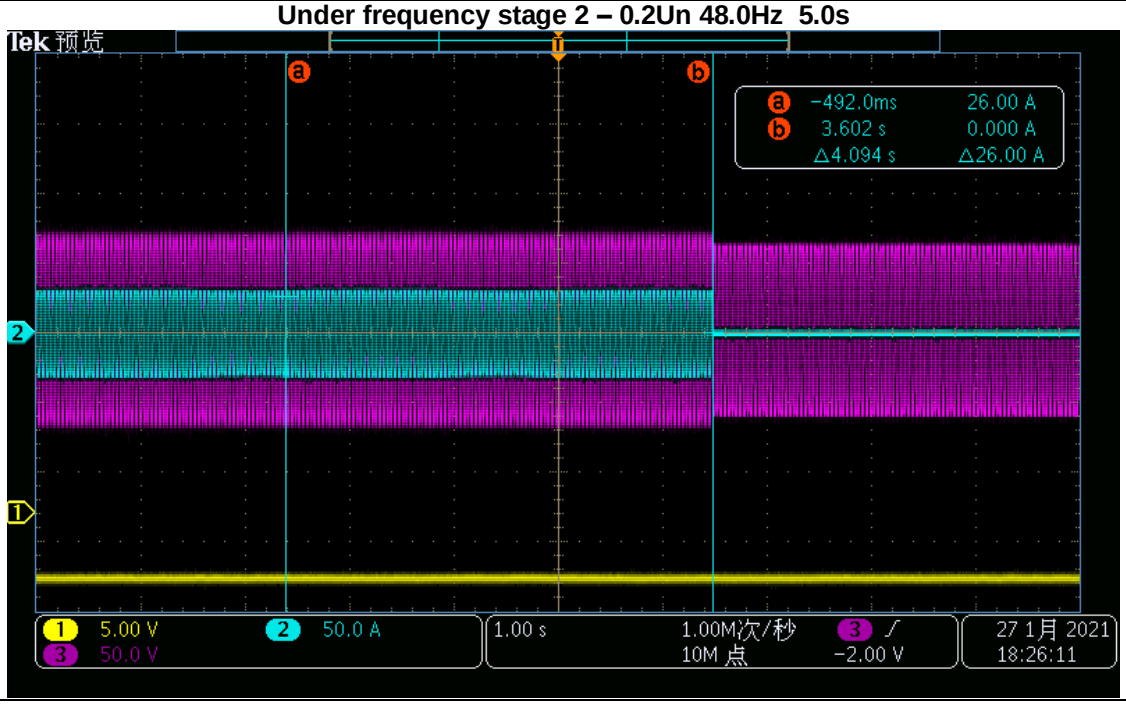


EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Under frequency stage 1 – 1.2Un 47.5Hz 0.1s

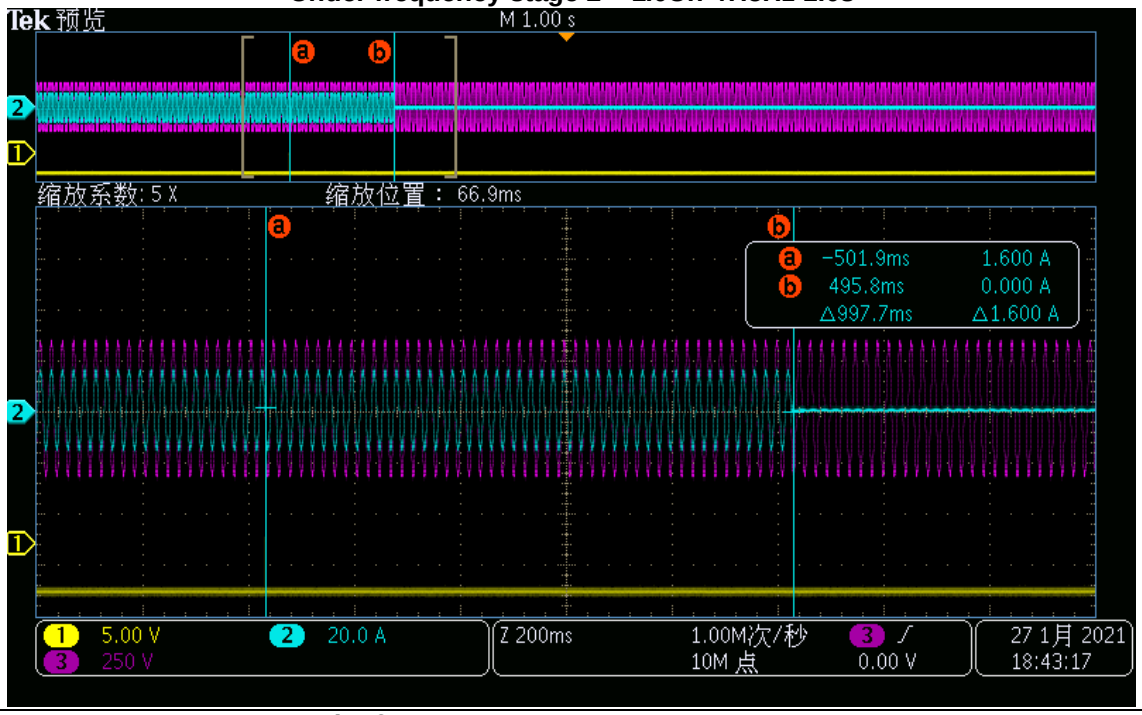


Under frequency stage 2 – 0.2Un 48.0Hz 5.0s

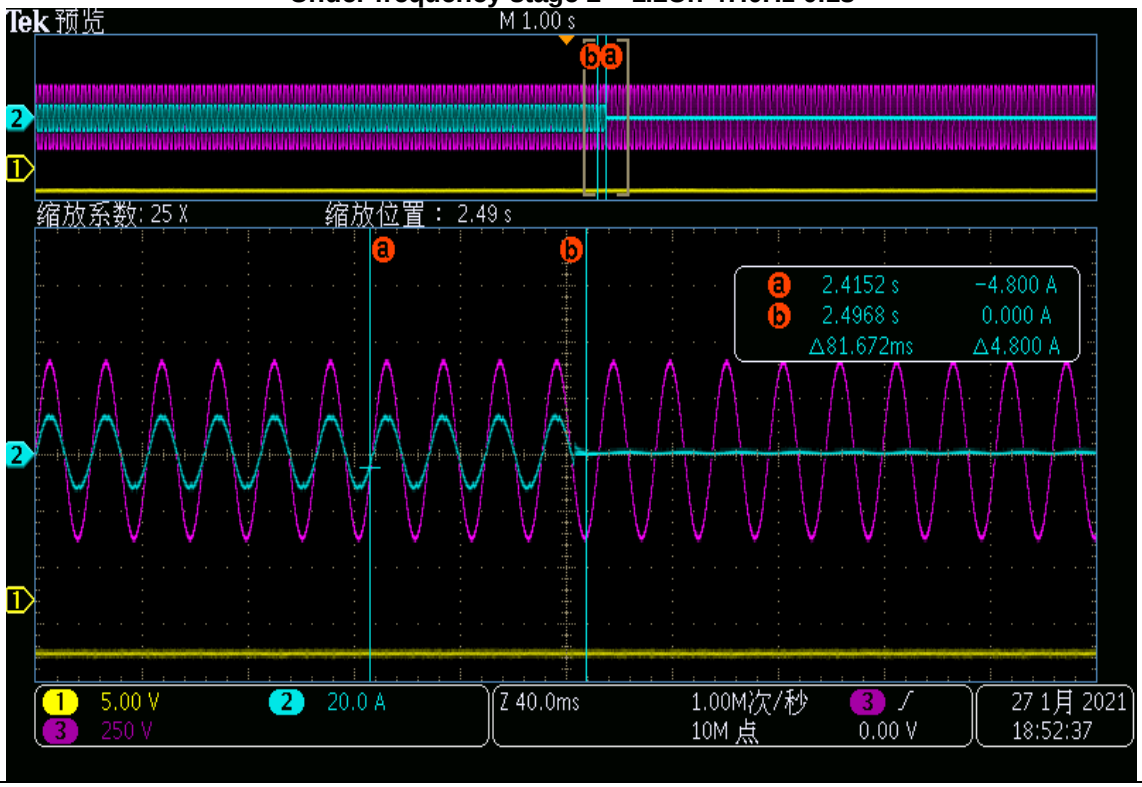


EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Under frequency stage 2 – 1.0Un 47.5Hz 1.0s



Under frequency stage 2 – 1.2Un 47.0Hz 0.1s



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.9.3.6	**TABLE: Over-frequency protection**					**P**
Model	AIO2-INS-5000					
Test condition:	Output level: 50 ± 5% of its rated current output					
Adjustment thresholds ranges [Hz]	Actual thresholds setting [Hz]	Test voltage [V]	Measured trip value [Hz]	Adjustment disconnection time range [s]	Actual disconnection time setting [s]	Measured disconnection time [s]
50.0-52.0Hz (Stage 1)	51	1.00U_n	51.02	2	2	1.947
	51	1.00U_n	51.02		2	1.948
	51	1.00U_n	51.02		2	1.952

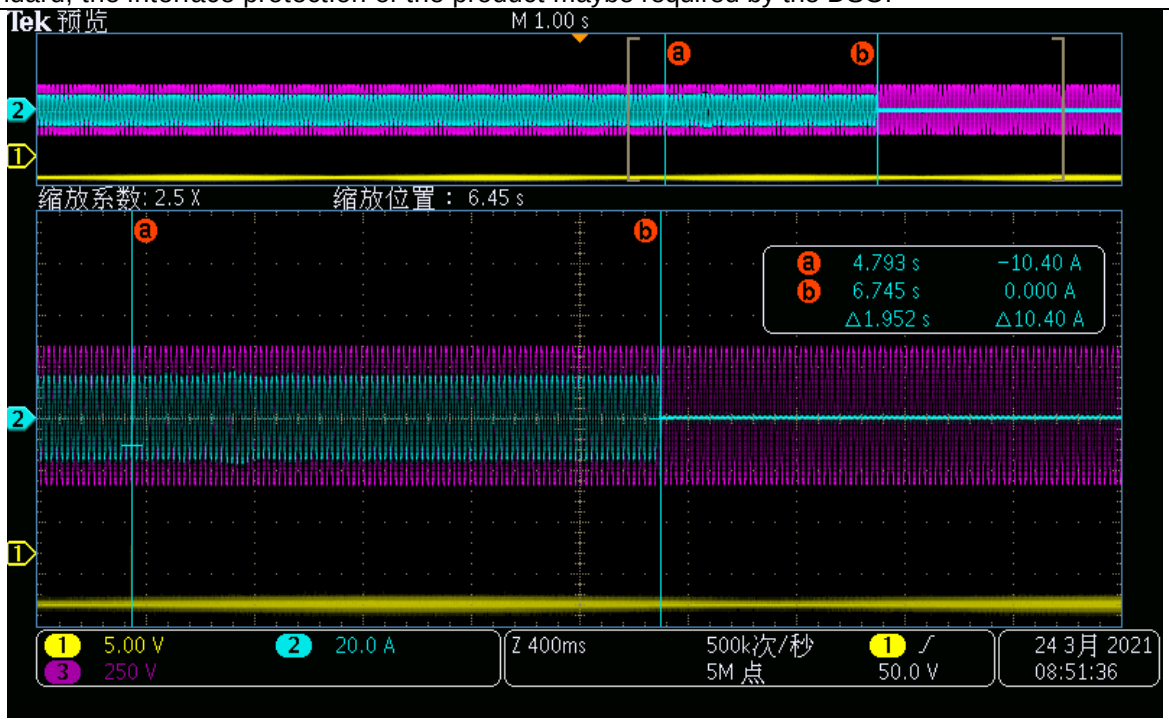
Note:

In order to use narrow frequency thresholds for islanding detection (see 4.9.3.3) it may be required to have the ability to activate and deactivate a stage by an external signal. The frequency protection shall function correctly in the input voltage range between 20 % Un and 120 % Un and shall be inhibited for input voltages of less than 20 % Un.

Under 0.2 Un the frequency protection is inhibited. Disconnection may only happen base on under voltage protection.

* the limit actual stage 1 frequency limits and stage 2 frequency limits are required of the standard, the interface protection of the product maybe required by the DSO.

** the limit time is the upper limit and the under limits of the underfrequency protect are required of the standard, the interface protection of the product maybe required by the DSO.



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.9.3.6	**TABLE: Over-frequency protection – Adjustable setting**					**P**
Model	AIO2-INS-5000					
Test condition:	Output level: 50 ± 5% of its rated current output					
Adjustment thresholds ranges [Hz]	Actual thresholds setting [Hz]	Test voltage [V]	Measured trip value [Hz]	Adjustment disconnection time range [s]	Actual disconnection time setting [s]	Measured disconnection time [s]
50.0-52.0Hz (Stage 1)	50.5	$0.2U_n$	50.54	0.1-100s	100	99.79
	51.0	$1.0U_n$	51.01		10	9.805
	51.5	$1.2U_n$	51.51		0.1	0.098
50.0-52.0Hz (Stage 2)	51.0	$0.2U_n$	51.04	0.1-5s	5	4.104
	51.5	$1.0U_n$	51.51		1	0.985
	52.0	$1.2U_n$	52.01		0.1	0.099

Note:

In order to use narrow frequency thresholds for islanding detection (see 4.9.3.3) it may be required to have the ability to activate and deactivate a stage by an external signal. The frequency protection shall function correctly in the input voltage range between 20 % Un and 120 % Un and shall be inhibited for input voltages of less than 20 % Un.

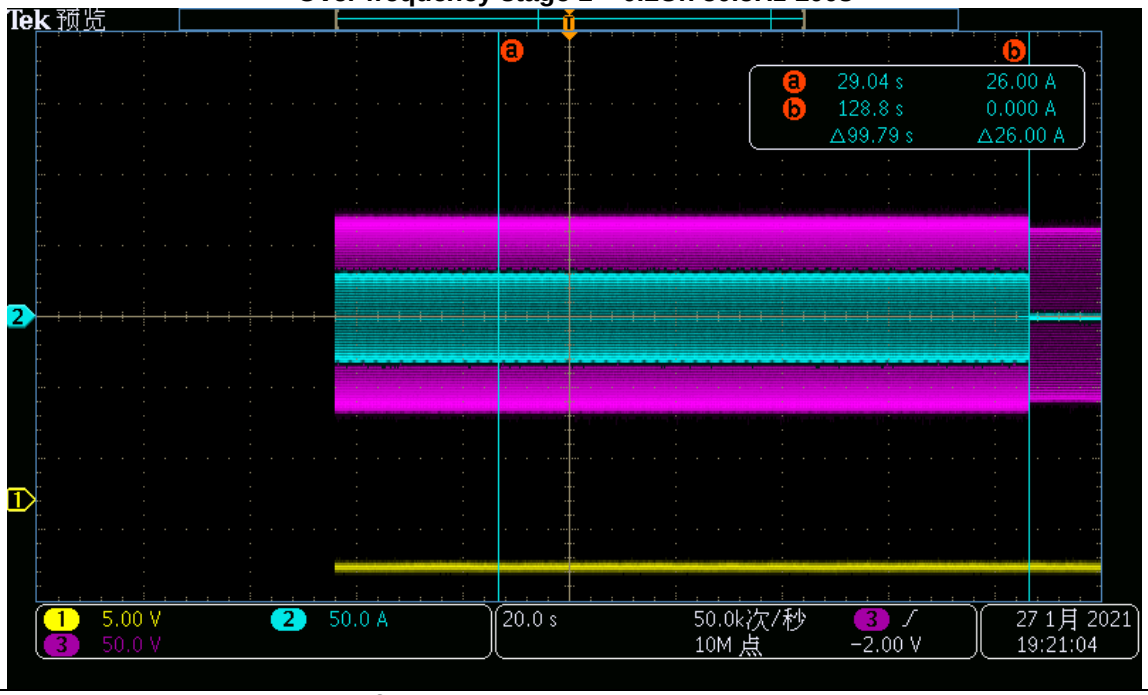
Under 0.2 Un the frequency protection is inhibited. Disconnection may only happen base on under voltage protection.

* the limit actual stage 1 frequency limits and stage 2 frequency limits are required of the standard, the interface protection of the product maybe required by the DSO.

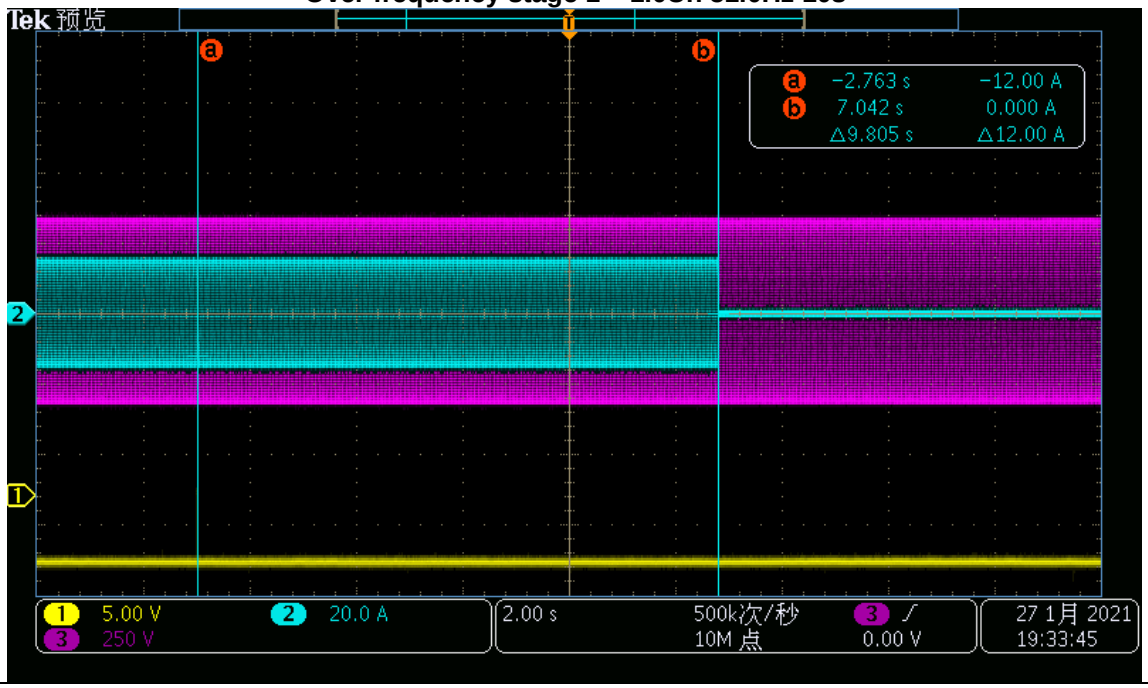
** the limit time is the upper limit and the under limits of the underfrequency protect are required of the standard, the interface protection of the product maybe required by the DSO.

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Over frequency stage 1 – 0.2Un 50.5Hz 100s

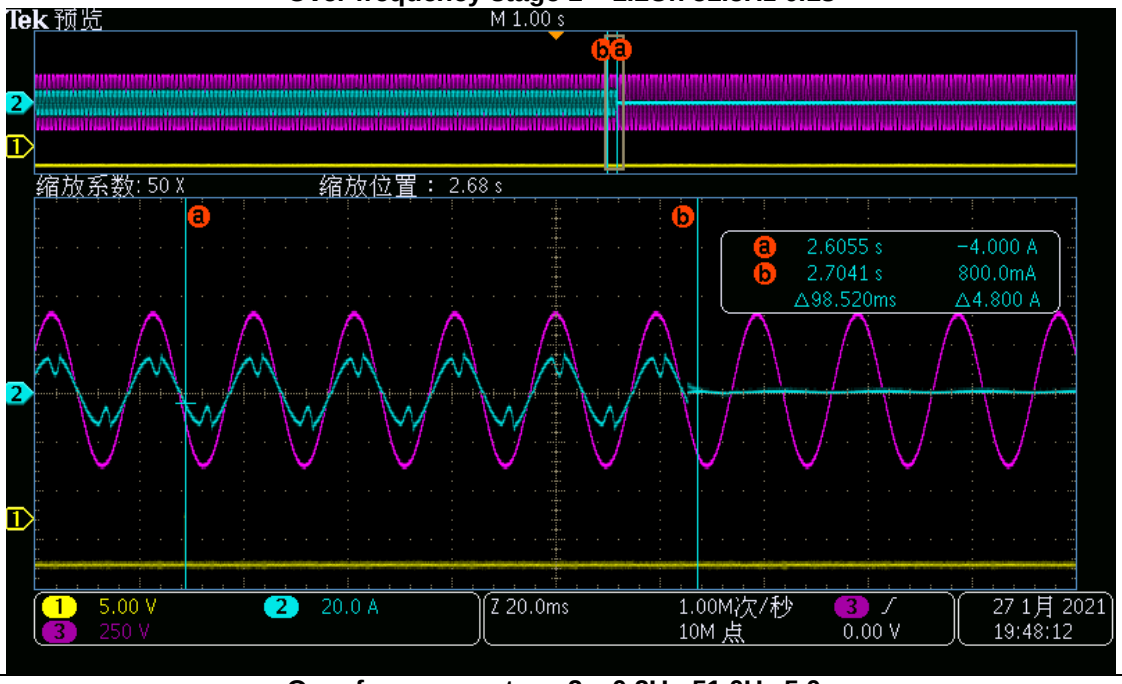


Over frequency stage 1 – 1.0Un 51.0Hz 10s

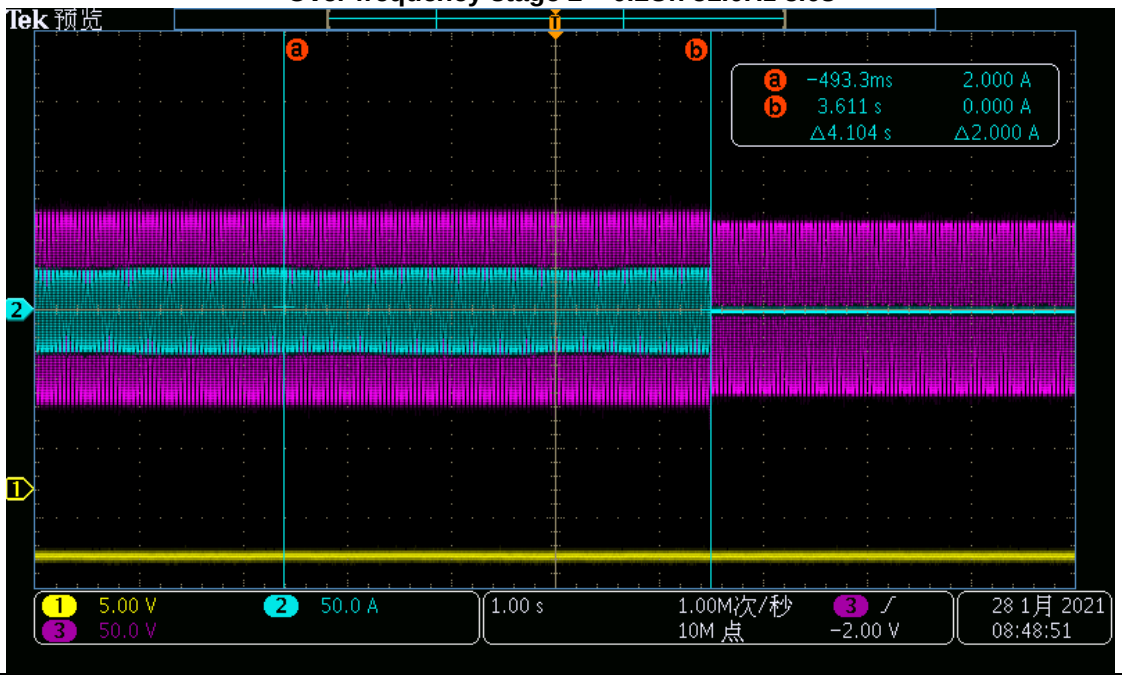


EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Over frequency stage 1 – 1.2Un 51.5Hz 0.1s

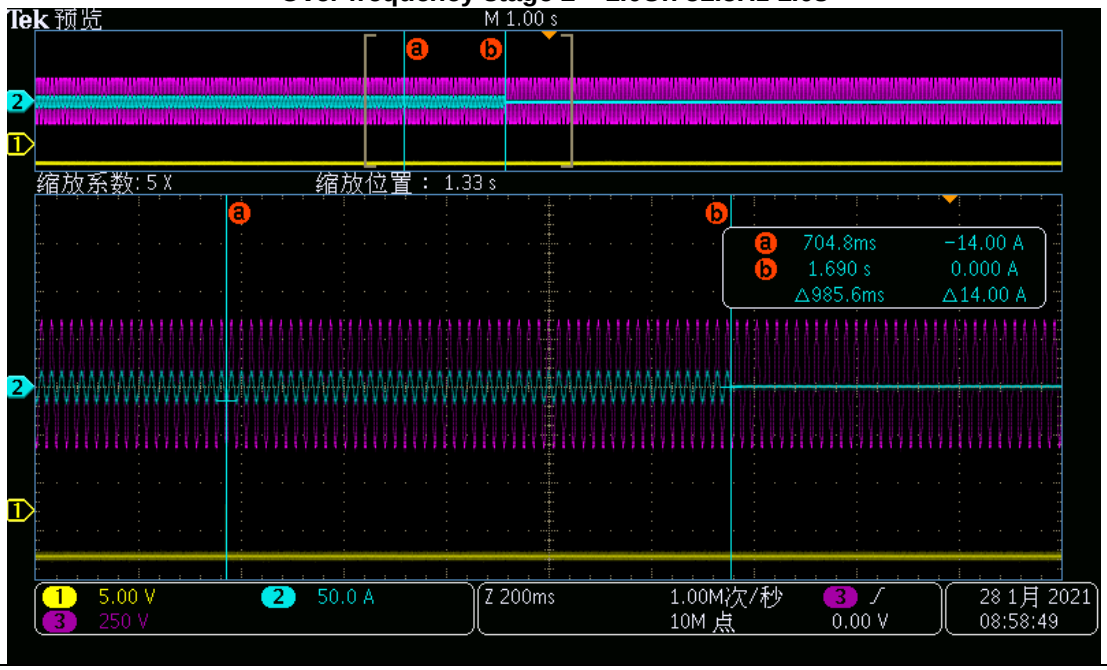


Over frequency stage 2 – 0.2Un 51.0Hz 5.0s

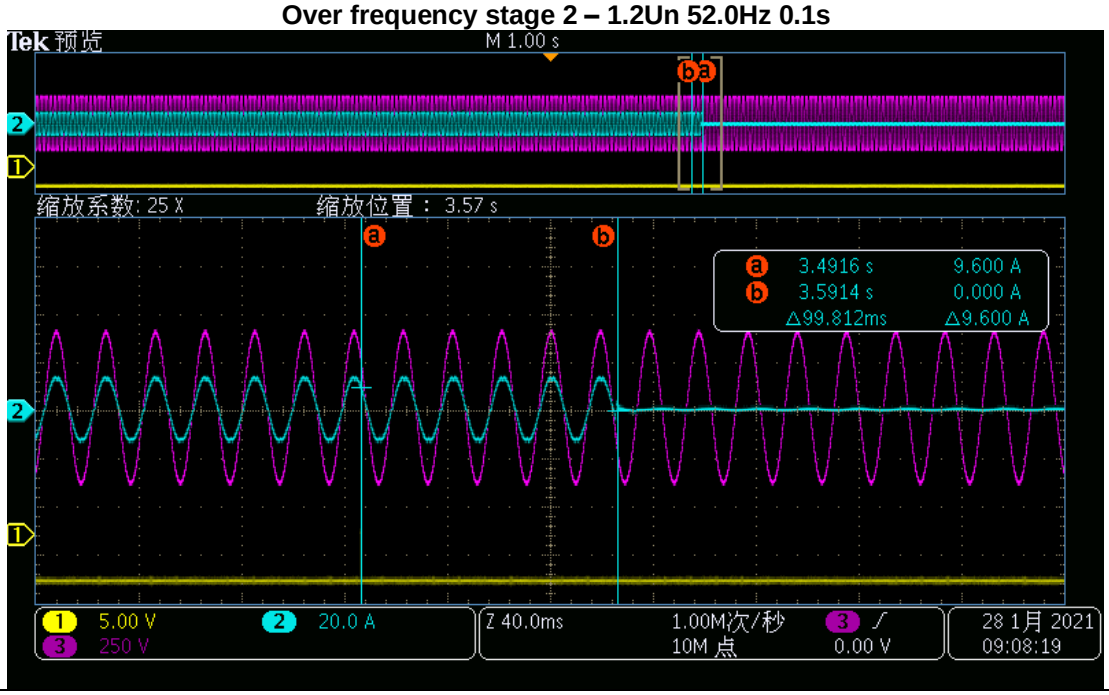


EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Over frequency stage 2 – 1.0Un 51.5Hz 1.0s



Over frequency stage 2 – 1.2Un 52.0Hz 0.1s



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.9.4.2	**Active methods tested with a resonant circuit in accordance with EN 62116 - test condition A (EUT output = 100%)**	**P**
Model	AIO2-INS-5000	

Test conditions A

Disconnection limit	2 s

No	P_{EUT} a) (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{ac} b) (% of nominal)	Q_{ac} c) (% of nominal)	Run on Time (ms)	P_{EUT} (W per phase)	Actual Q_f	V_{DC}	Remarks d)
1	100	100	0	0	421	5000	1.00	406	Test A at BL
2	100	100	0	- 5	290	5000	0.97	406	Test A at IB
3	100	100	0	+ 5	148	5000	1.02	406	Test A at IB
4	100	100	- 5	- 5	212	5000	1.03	406	Test A at IB
5	100	100	- 5	0	285	5000	1.05	406	Test A at IB
6	100	100	- 5	+ 5	298	5000	1.08	406	Test A at IB
7	100	100	+ 5	- 5	204	5000	0.93	406	Test A at IB
8	100	100	+ 5	0	234	5000	0.95	406	Test A at IB
9	100	100	+ 5	+ 5	160	5000	0.98	406	Test A at IB
10	100	100	- 5	- 10	312	5000	1.00	406	Test A at IB
11	100	100	- 5	+ 10	103	5000	1.10	406	Test A at IB
12	100	100	0	- 10	316	5000	0.95	406	Test A at IB
13	100	100	0	+ 10	249	5000	1.05	406	Test A at IB
14	100	100	+ 5	- 10	228	5000	0.90	406	Test A at IB
15	100	100	+ 5	+ 10	166	5000	1.00	406	Test A at IB
16	100	100	- 10	- 10	287	5000	1.05	406	Test A at IB
17	100	100	- 10	- 5	328	5000	1.14	406	Test A at IB
18	100	100	- 10	0	129	5000	1.11	406	Test A at IB
19	100	100	- 10	+ 5	165	5000	1.14	406	Test A at IB
20	100	100	- 10	+10	223	5000	1.16	406	Test A at IB
21	100	100	+ 10	- 10	218	5000	0.86	406	Test A at IB
22	100	100	+ 10	- 5	376	5000	0.88	406	Test A at IB
23	100	100	+ 10	0	197	5000	0.91	406	Test A at IB
24	100	100	+ 10	+ 5	134	5000	0.93	406	Test A at IB
25	100	100	+ 10	+ 10	160	5000	0.95	406	Test A at IB

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.9.4.2	**Active methods tested with a resonant circuit in accordance with EN 62116 - test condition B (EUT output = 50 % – 66 %)**	**P**
Model	AIO2-INS-5000	

Test conditions B

Disconnection limit	2.0 s

No	P_{EUT} a) (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{ac} b) (% of nominal)	Q_{ac} c) (% of nominal)	Run on Time (ms)	P_{EUT} (W per phase)	Actual Q_f	V_{DC}	Remarks d)
1	66	66	0	- 5	160	3300	0.91	312	Test B at IB
2	66	66	0	- 4	185	3300	0.94	312	Test B at IB
3	66	66	0	- 3	207	3300	0.96	312	Test B at IB
4	66	66	0	- 2	213	3300	0.96	312	Test B at IB
5	66	66	0	- 1	214	3300	0.97	312	Test B at IB
6	66	66	0	0	216	3300	1.00	312	Test B at BL
7	66	66	0	+ 1	202	3300	1.00	312	Test B at IB
8	66	66	0	+ 2	190	3300	0.99	312	Test B at IB
9	66	66	0	+ 3	172	3300	0.96	312	Test B at IB
10	66	66	0	+ 4	150	3300	0.95	312	Test B at IB
11	66	66	0	+ 5	138	3300	0.95	312	Test B at IB

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.9.4.2	**Active methods tested with a resonant circuit in accordance with EN 62116 - test condition C (EUT output = 25 %-33 %)**	**P**
Model	AIO2-INS-5000	

Test conditions C

Disconnection limit	2.0 s

No	P_{EUT} a) (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{ac} b) (% of nominal)	Q_{ac} c) (% of nominal)	Run on Time (ms)	P_{EUT} (W per phase)	Actual Q_f	V_{DC}	Remarks d)
1	33	33	0	- 5	140	1650	0.94	200	Test C at IB
2	33	33	0	- 4	148	1650	0.91	200	Test C at IB
3	33	33	0	- 3	154	1650	0.95	200	Test C at IB
4	33	33	0	- 2	119	1650	0.94	200	Test C at IB
5	33	33	0	- 1	104	1650	0.93	200	Test C at IB
6	33	33	0	0	192	1650	1.00	200	Test C at BL
7	33	33	0	+ 1	139	1650	0.93	200	Test C at IB
8	33	33	0	+ 2	192	1650	0.95	200	Test C at IB
9	33	33	0	+ 3	148	1650	0.99	200	Test C at IB
10	33	33	0	+ 4	143	1650	0.95	200	Test C at IB
11	33	33	0	+ 5	168	1650	0.98	200	Test C at IB

Note:

a) P_{EUT}: EUT output power

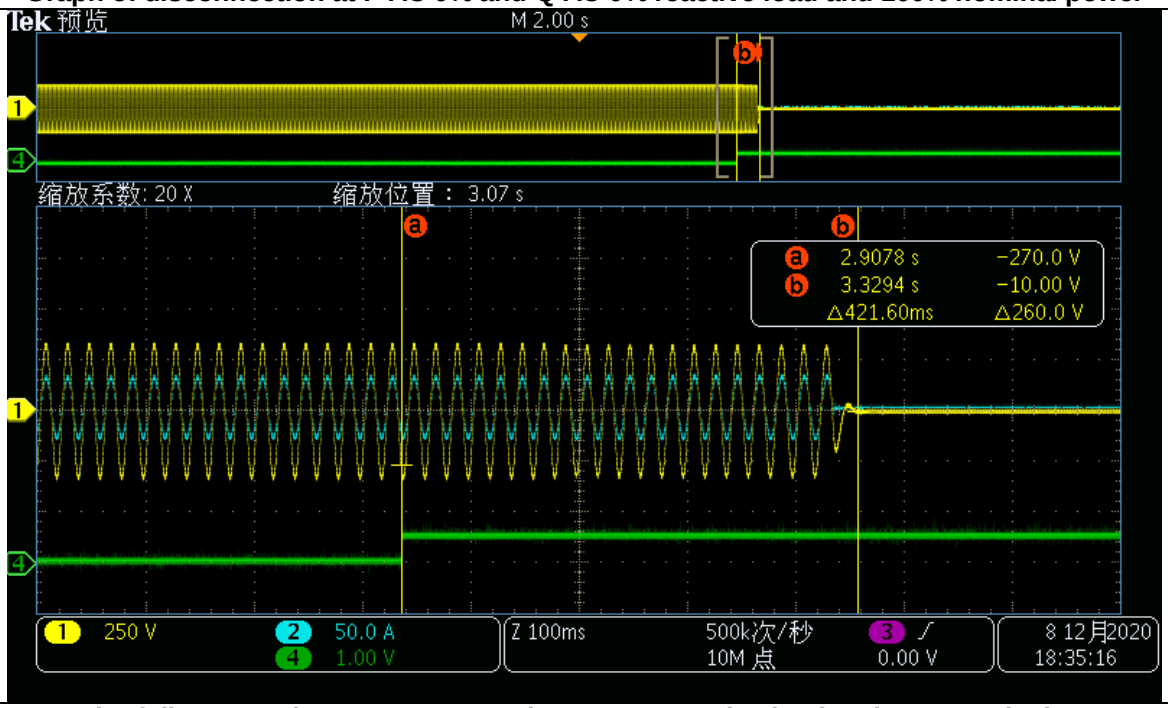
b) P_{ac}: Active power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.

c) Q_{ac}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.

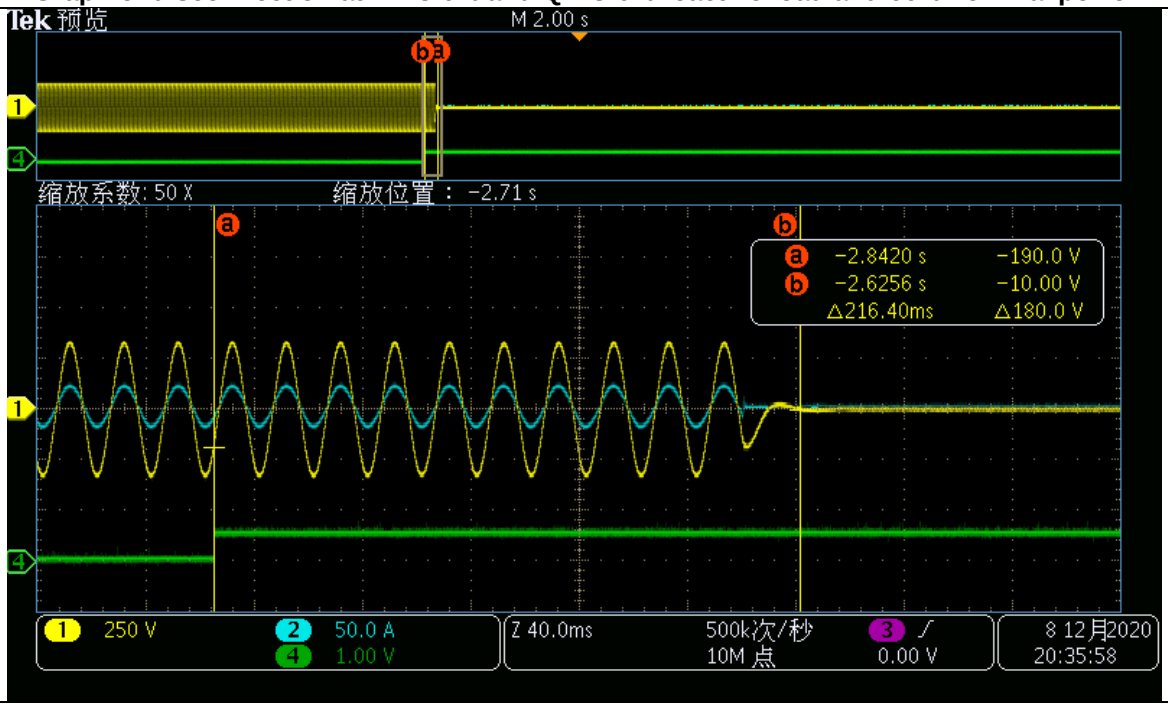
d) BL: Balance condition, IB: Imbalance condition.

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Graph of disconnection at P AC 0% and Q AC 0% reactive load and 100% nominal power

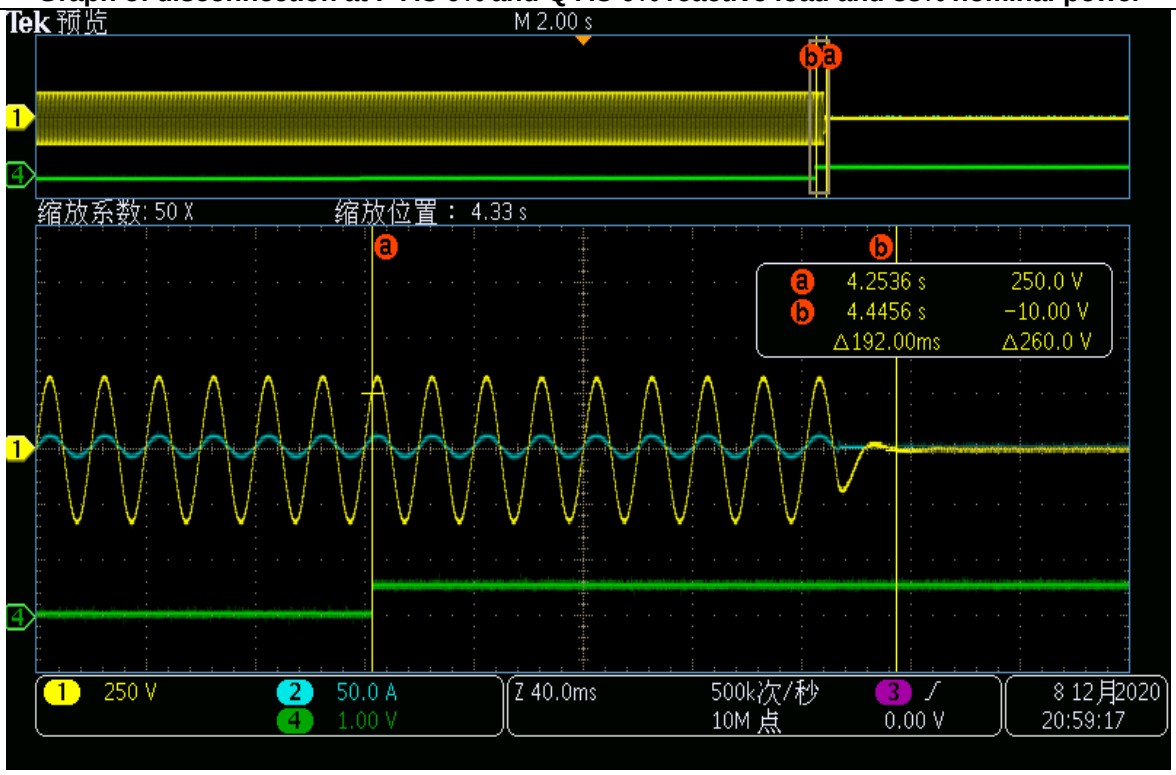


Graph of disconnection at P AC 0% and Q AC 0% reactive load and 66% nominal power



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Graph of disconnection at P AC 0% and Q AC 0% reactive load and 33% nominal power



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.10.2	**TABLE: Automatic reconnection after tripping**			**P**
Model	AIO2-INS-5000			
Setting values	Parameter	Range	Default setting	
	Lower frequency [Hz]:	47.0 – 50.0	49.5	
	Upper frequency [Hz]:	50.0 – 50.2	50.2	
	Lower voltage [V]:	115.0 – 230.0	195.5	
	Upper voltage [V]:	230.0 – 276.0	253.0	
	Observation time [s]:	10 – 600	60	
	Active power increase gradient:	6% - 3000%/min	10%/min	

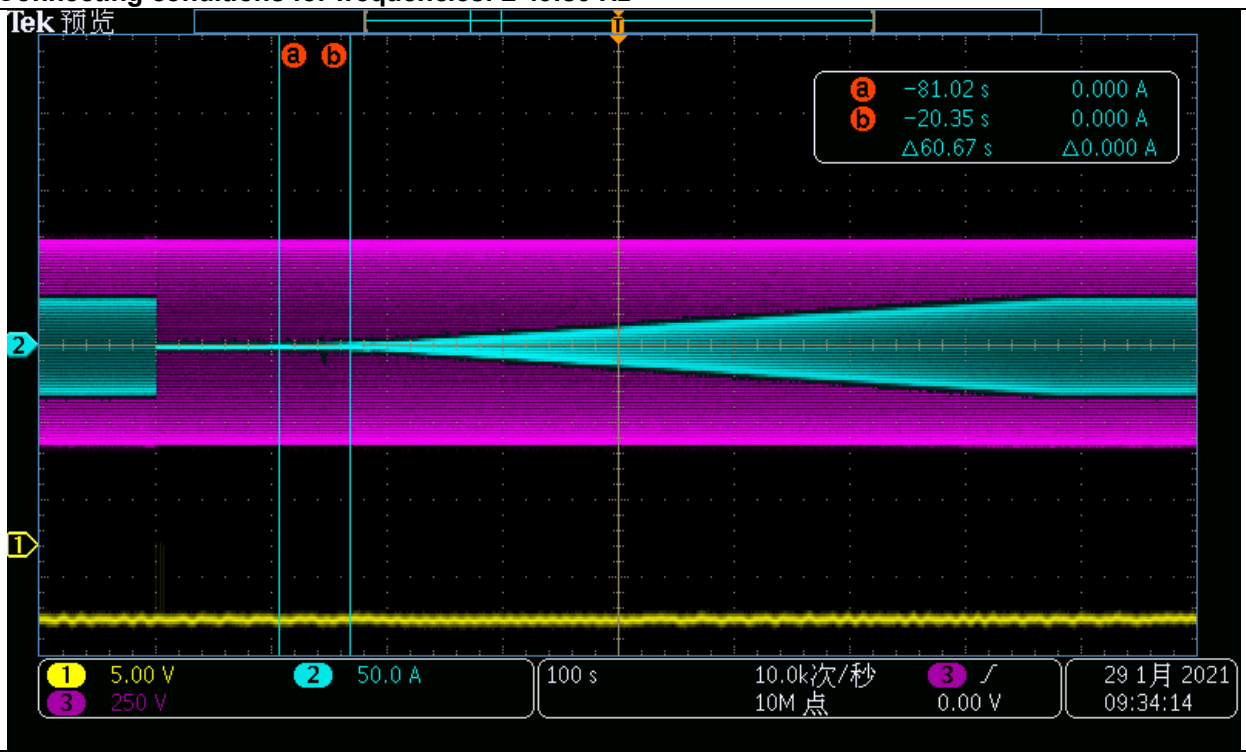
Connecting conditions for frequencies:			
	f_{act}	Reconnection time:	Limit:
a)	< 49.50 Hz	Not reconnect	No reconnection permitted
	Switch to:		
b)	≥ 49.50 Hz	60.67s	≥ 60 s(0~600s)
c)	> 50.20 Hz	Not reconnect	No reconnection permitted
	Switch to:		
d)	≤ 50.20 Hz	61.40s	≥ 60 s

Connecting conditions for voltages:				
	U_{act}			Limit:
e)	< 0.85 U_n	Not reconnect		No reconnection permitted
	Switch to:			
f)	≥ 0.85 U_n	61.03s		≥ 60 s
g)	> 1.10 U_n	Not reconnect		No reconnection permitted
	Switch to:			
h)	≤ 1.10 U_n	62.83s		≥ 60 s
After reconnection:		Active power gradient [%]	9.80	≤10 %

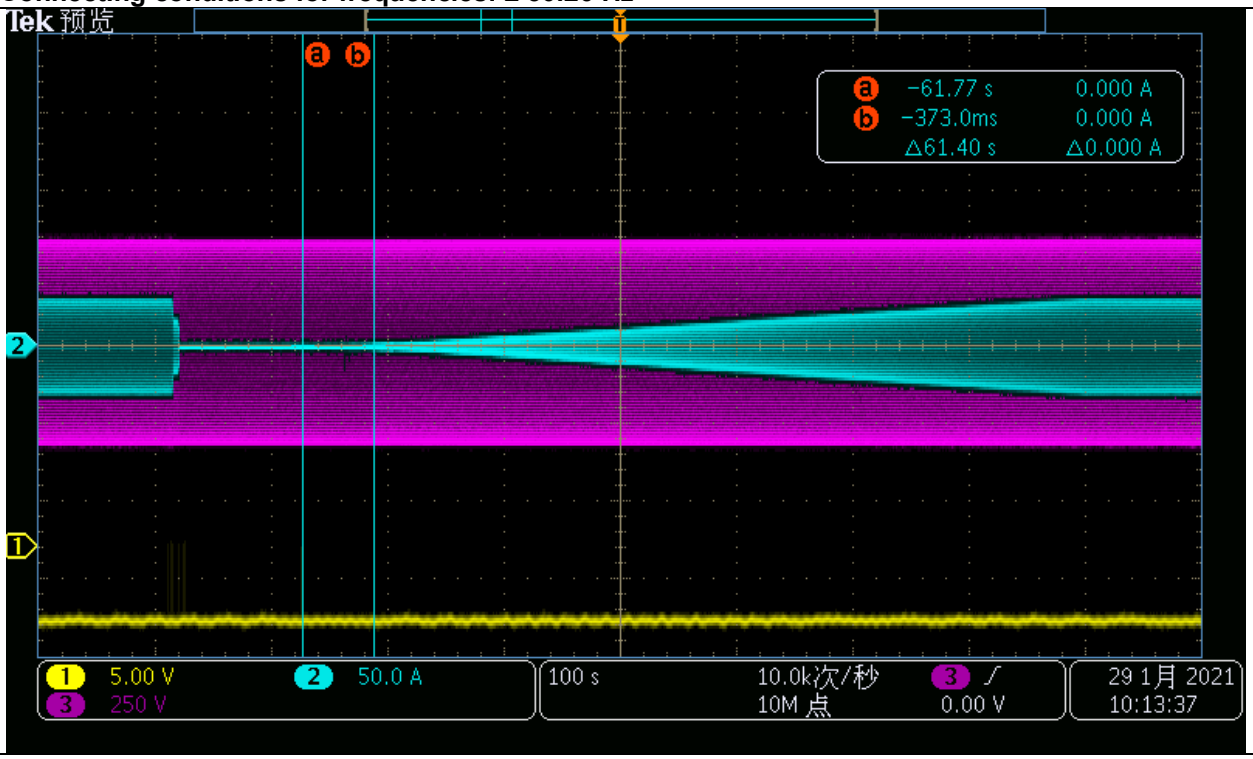
Note:
After reconnection the active power generated by the generating plant shall not exceed a specified gradient expressed as a percentage of the active nominal power of the unit per minute. If no gradient is specified by the DSO, the default setting is 10 % Pn/min. Non-adjustable or partly adjustable generating units may connect after 1 min to 10 min (randomised value) or later

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Connecting conditions for frequencies: ≥ 49.50 Hz

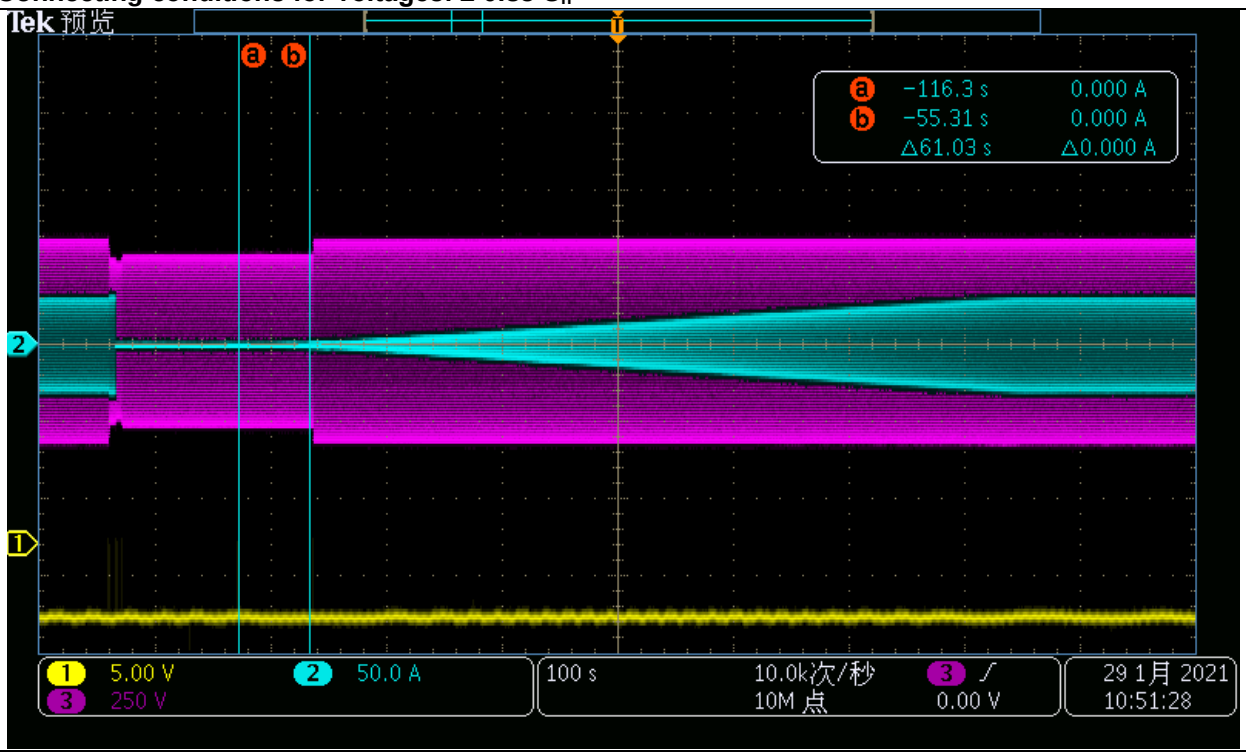


Connecting conditions for frequencies: ≤ 50.20 Hz

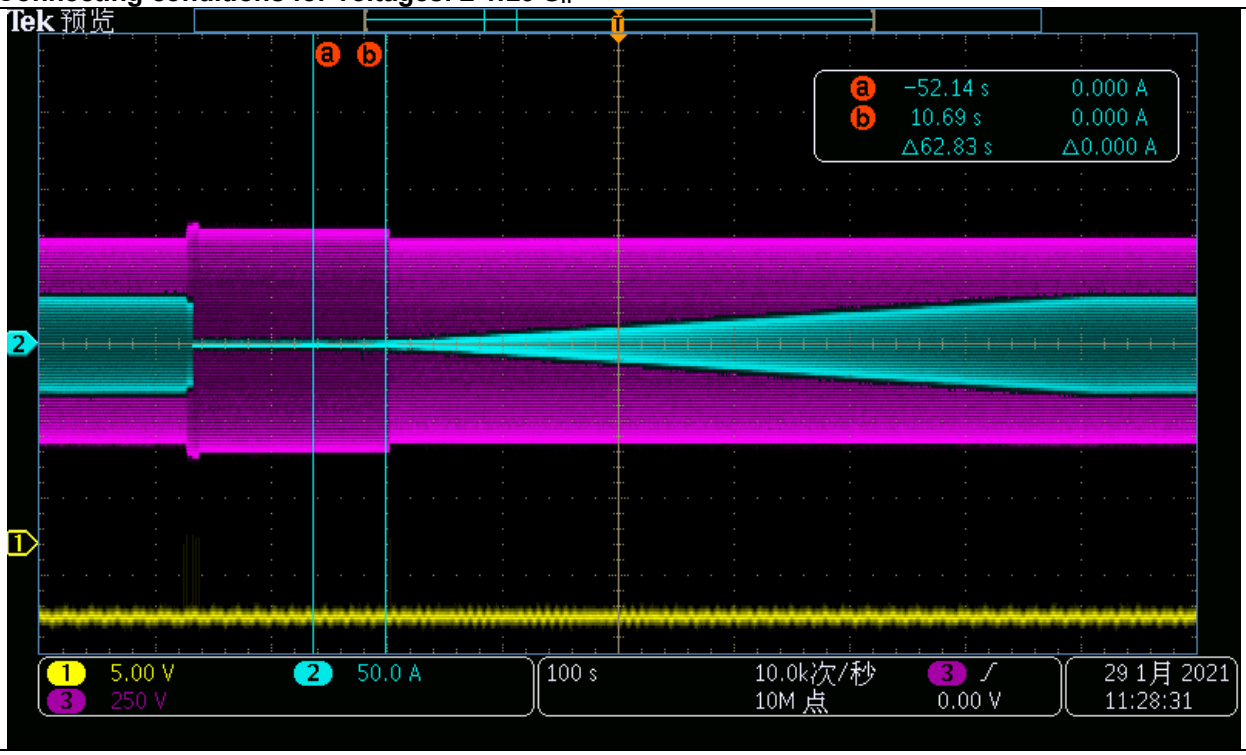


EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Connecting conditions for voltages: ≥ 0.85 U_n



Connecting conditions for voltages: ≤ 1.10 U_n



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.10.3	**TABLE: Start of generating electrical power**			**P**
Setting values	Parameter	Range	Default setting	
	Lower frequency [Hz]:	47.0 – 50.0	49.5	
	Upper frequency [Hz]:	50.0 – 50.2	50.1	
	Lower voltage [V]:	115.0 – 230.0	195.5	
	Upper voltage [V]:	230.0 – 276.0	253.0	
	Observation time [s]:	10 – 600	60	
	Active power increase gradient:	6% – 3000%/min	10%/min	

Start conditions for frequencies:

	f_{act}	Reconnection time:	Limit:
a)	< 49.50 Hz	No starting	No starting permitted
	Switch to:		
b)	≥ 49.50 Hz	61.17s	≥ 60 s
c)	> 50,10 Hz	No starting	No starting permitted
	Switch to:		
d)	≤ 50,10 Hz	60.97s	≥ 60 s

Start conditions for voltages:

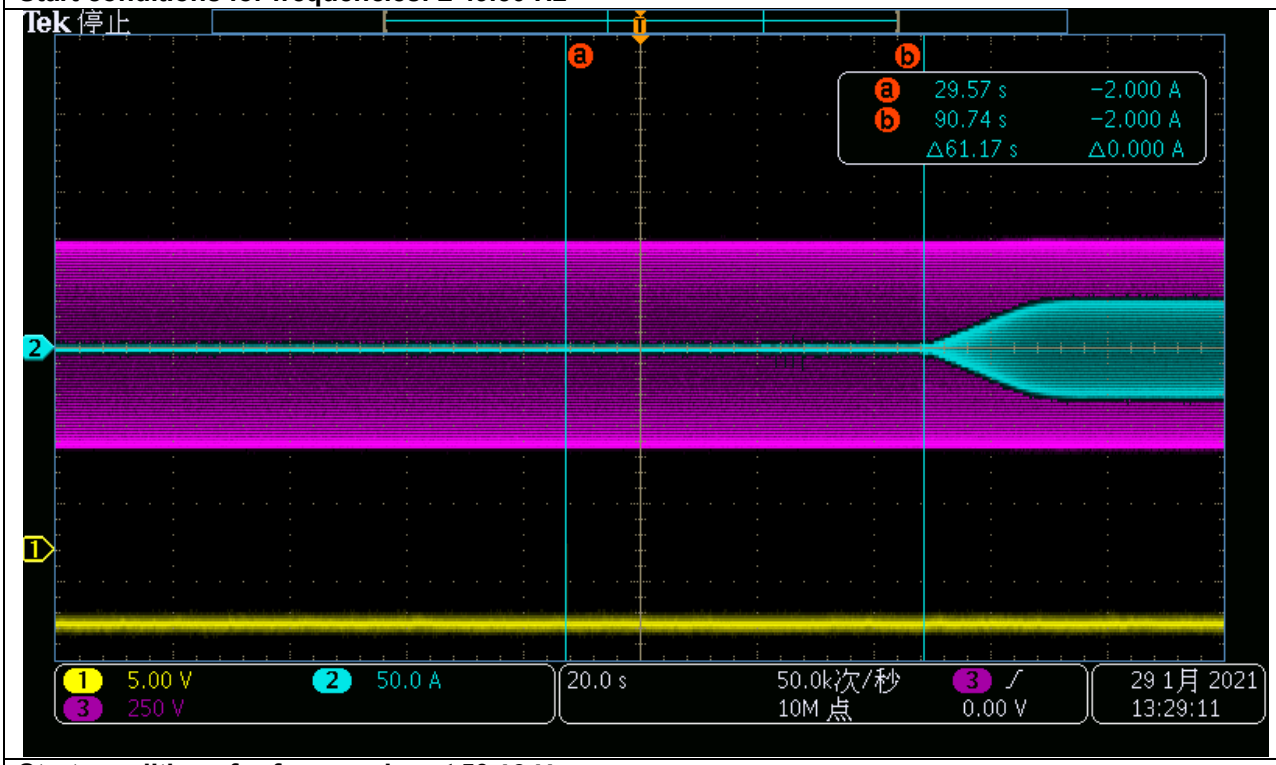
	U_{act}	Reconnection time:	Limit:
e)	< 0,85 U_n	No starting	No starting permitted
	Switch to:		
f)	≥ 0,85 U_n	62.00s	≥ 60 s
g)	> 1,10 U_n	No starting	No starting permitted
	Switch to:		
h)	≤ 1,10 U_n	61.72s	≥ 60 s
After reconnection:	Active power gradient [%]	9.77	≤10 %

Note:
If applicable, the power gradient shall not exceed the maximum gradient specified by the DSO and the responsible party.

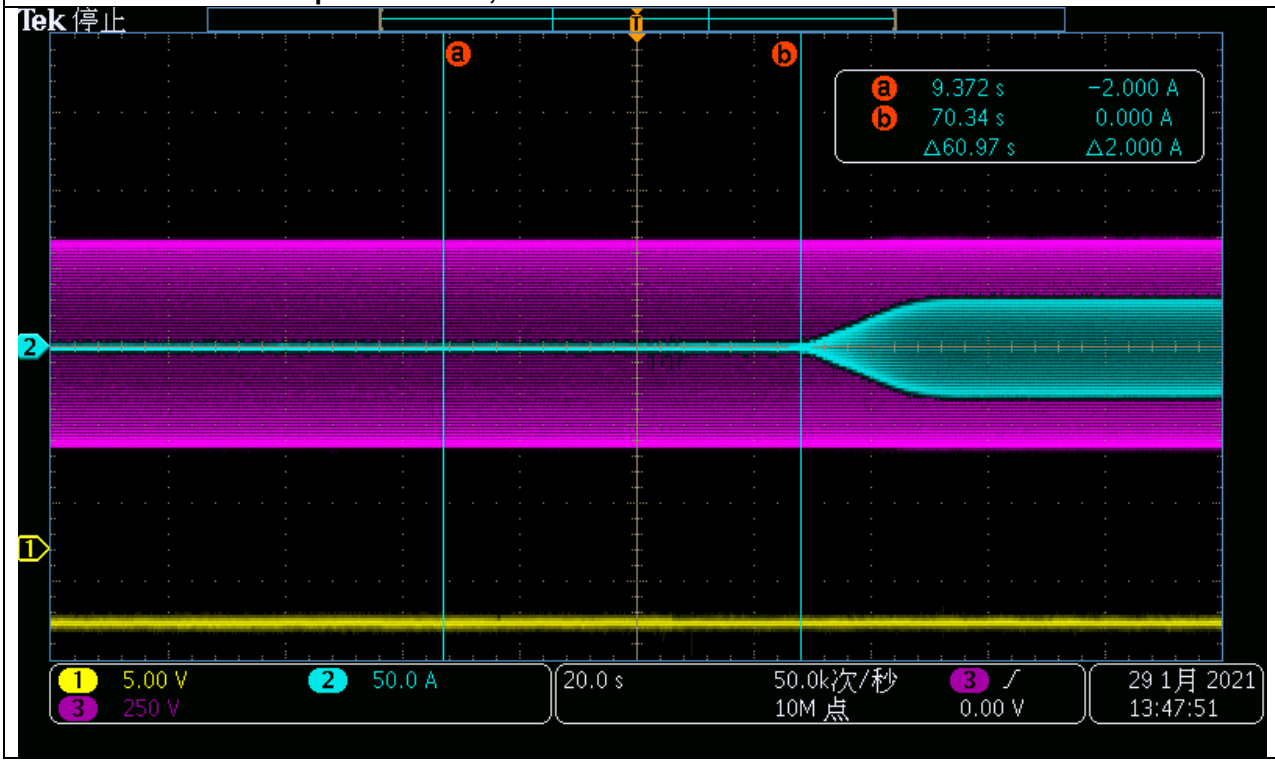
For manual operations performed on site (e.g. for the purpose of initial start-up or maintenance) it is permitted to deviate from the observation time and ramp rate.

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Start conditions for frequencies: ≥ 49.50 Hz

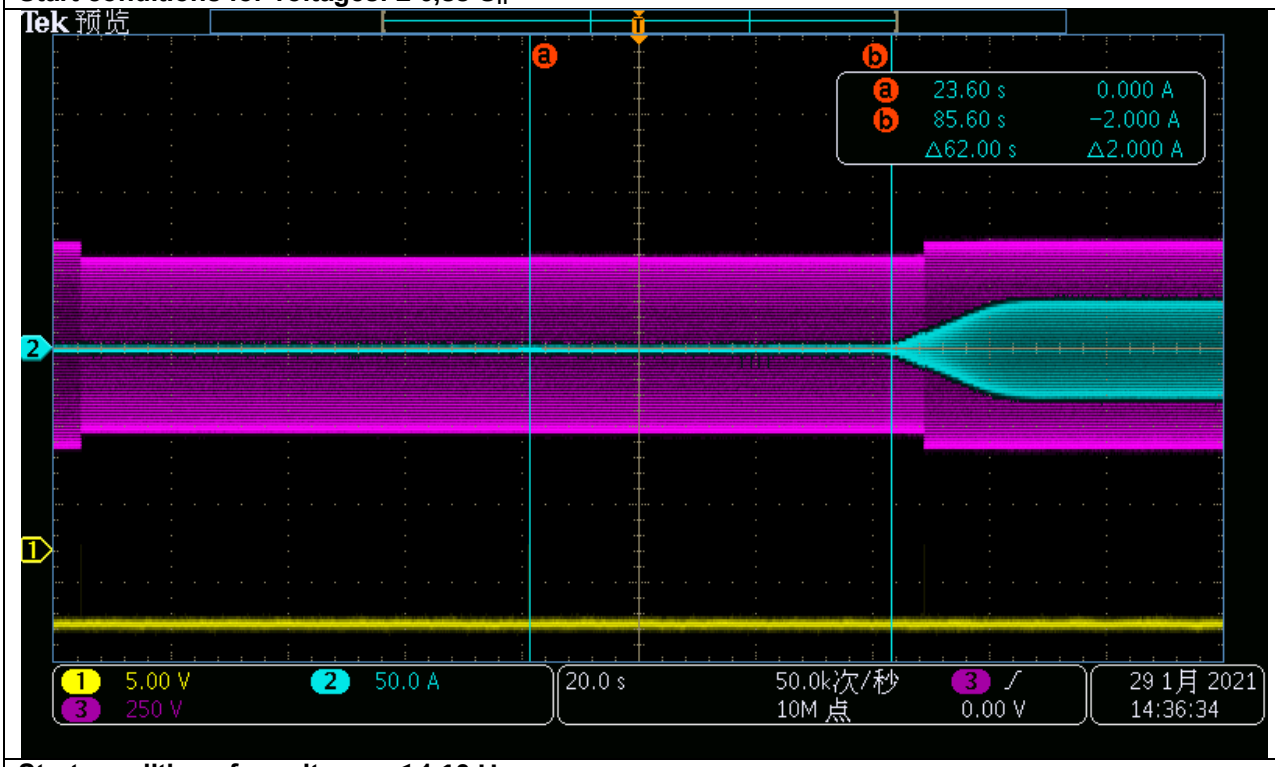


Start conditions for frequencies: ≤ 50,10 Hz

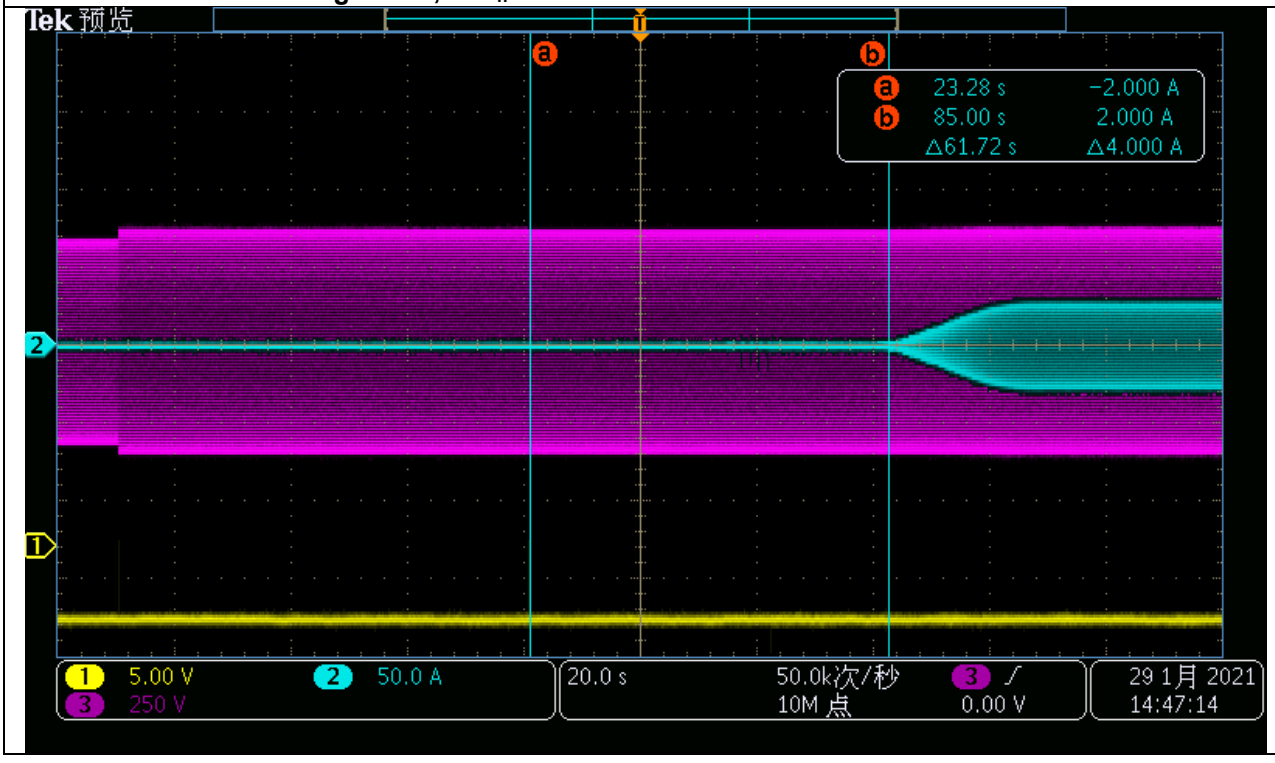


EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

Start conditions for voltages: ≥ 0,85 U_n



Start conditions for voltages: ≤ 1,10 U_n



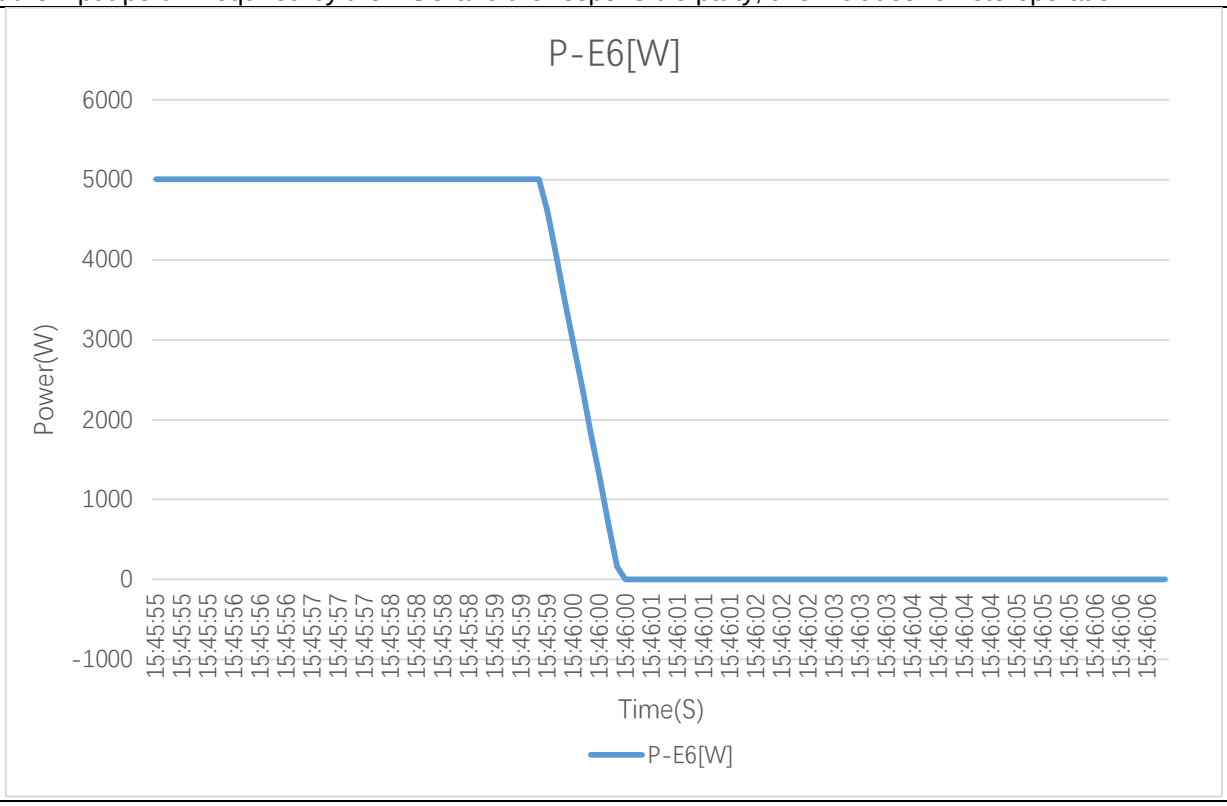
EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.11.1	**TABLE: Ceasing active power**	**P**

Reducing the active power from 100% P_n to 0

Measured max power [W]	Ceasing time [s]	Limit [s]
5007.90	1	5.0

Note:
Generating plants with a maximum capacity of 0.8 kW or more shall be equipped with a logic interface (input port) in order to cease active power output within five seconds following an instruction being received at the input port. If required by the DSO and the responsible party, this includes remote operation.



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

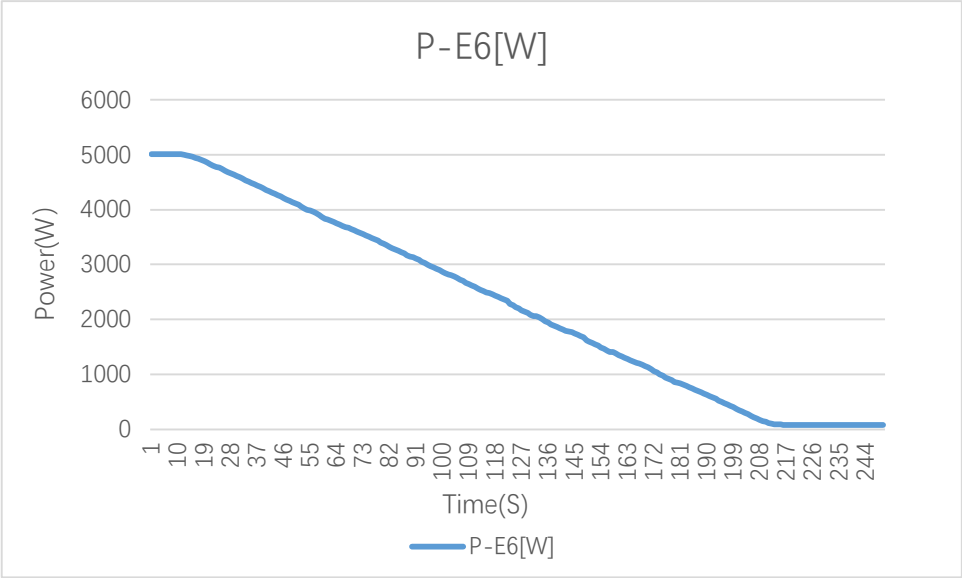
4.11.2	TABLE: Reduction of active power on set point	P

Reducing the active power from 100% P_n to 0

Actual gradient setting [%]	Measured during time [s]	Measured Gradient [%]
0.33% P_n / s - 0.66% P_n / s	201	0.49%Pn / s

Note:
A generation unit/plant shall be capable of carrying out the power output reduction to the respective limit within an envelope of not faster than 0,66 % P_n /s and not slower than 0,33 % P_n/ s with an accuracy of 5 % of nominal power. Generating plants are permitted to disconnect from the network at a limit value below it minimum regulating level. If required by the DSO, this includes remote operation.

With a programmable AC source, the PGU is operated at 100% P_n and 50±0,01 Hz, set power factor equal to 1.



EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

4.13	**Testing in single fault condition**		P
	ambient temperature (°C) .....:	25.0	-

No.	component No.	fault	test voltage (V)	test time	fuse No.	fuse current (A)	result
1	Grid Voltage detection (R1180)	Short Circuit	360Vdc 230Vac	10min	--	--	Unit shut down, error message: “Utility Grid Voltage Abnormal”. No damage, no hazard, no fire.
2	Grid Voltage detection (R1180)	Open Circuit	360Vdc 230Vac	10min	--	--	Unit shut down, error message: “Utility Grid Voltage Abnormal”. No damage, no hazard, no fire.
3	Grid Voltage detection (R1184)	Short Circuit	360Vdc 230Vac	10min	--	--	Unit shut down, error message: “Utility Grid Voltage Abnormal”. No damage, no hazard, no fire.
4	Grid Voltage detection (R1184)	Open Circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “Utility Grid Voltage Abnormal”. No damage, no hazard, no fire.
5	Grid Voltage detection (C38)	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “Utility Grid Voltage Abnormal”. No damage, no hazard, no fire.
6	Grid Frequency detection (R34)	Open circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “Utility Grid Frequency Abnormal”. No damage, no hazard, no Fire.
7	RCMU (R1046)	Open Circuit Before start up	360Vdc/ 230Vac	10min	--	--	Unit cannot start up, self-detection fail, error message: “Leakage current sensor fault” No damage, no hazard, no fire
8	RCMU (C75)	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “Leakage current over fault”. No damage, no hazard, no fire.
9	RCMU (R144)	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “Leakage current over fault”. No damage, no hazard, no fire.
10	Standalone Voltage detection (R1190)	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit work normally, no damage, no hazard, no fire.
11	Standalone Voltage detection (R1190)	Open circuit	360Vdc/ 230Vac	10min	--	--	Unit work normally, no damage, no hazard, no fire.

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

12	EPS current (C78)	Short Circuit	360Vdc/ 230Vac	10min	--	--	Unit work normally, no damage, no hazard, no fire.
13	INV current detection (C72)	short	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “Inverter current over trip”. No damage, no hazard, no fire.
14	AC relay (K1004)	Short Circuit Before start up	360Vdc/ 230Vac	10min	--	--	Unit cannot start up, self-detection fail, error message: “Grid-Tied Relay fault”. No damage, no hazard, no fire
15	AC relay (K1005)	Short Circuit Before start up	360Vdc/ 230Vac	10min	--	--	Unit cannot start up, self-detection fail, error message: “Grid-Tied Relay fault”. No damage, no hazard, no fire
16	AC relay (K1006)	Short Circuit Before start up	360Vdc/ 230Vac	10min	--	--	Unit cannot start up, self-detection fail, error message: “Grid-Tied Relay fault”. No damage, no hazard, no fire.
17	AC relay (K1007)	Short Circuit Before start up	360Vdc/ 230Vac	10min	--	--	Unit cannot start up, self-detection fail, error message: “Grid-Tied Relay fault”. No damage, no hazard, no fire.
18	Insulation Relay (K1010)	Short Circuit Before start up	360Vdc/ 230Vac	10min	--	--	Unit cannot start up, self-detection fail. No damage, no hazard, no fire
19	Bus Capacitor (C1031)	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, display dark module damaged, no hazard, no fire.
20	Transform er T900 (between +12 V and C904)	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, display dark. No damage, no hazard, no fire.
21	Transform er T900 (between -12 V and C911)	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, display dark. No damage, no hazard, no fire.
22	Transform er T900 (between +7 V and C907)	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, display dark. No damage, no hazard, no fire.
23	Transform er T1004 (between +12 V and DC)	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, display dark. No damage, no hazard, no fire.

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

24	Transformer T1004 (between +12 V and DC)	overload	360Vdc/ 230Vac	10min	--	--	Unit shut down, display dark. No damage, no hazard, no fire.
25	Q708	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “Battery voltage abnormal”. No damage, no hazard, no fire.
26	Transformer T700 (between +15 V and DR2)	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “Battery voltage abnormal”. No damage, no hazard, no fire.
27	Q700	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “Battery voltage abnormal”. No damage, no hazard, no fire.
28	Low voltage Bus Capacitor (C701)	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “Battery voltage abnormal”. No damage, no hazard, no fire.
29	Low voltage Bus Capacitor (C701)	Reversed	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “Battery voltage abnormal”. C701 damaged, no hazard, no fire
30	C19	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “DSP/ARM Communication fault”. No damage, no hazard, no fire
31	C73	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “DSP/ARM Communication fault”. No damage, no hazard, no fire.
32	R156	Open circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “Inner Communication error between MCU1 & MCU2”. No damage, no hazard, no fire.
33	C154	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “DSP/ARM Communication fault”. No damage, no hazard, no fire.

EN 50549-1			
Clause	Requirement - Test	Result - Remark	Verdict

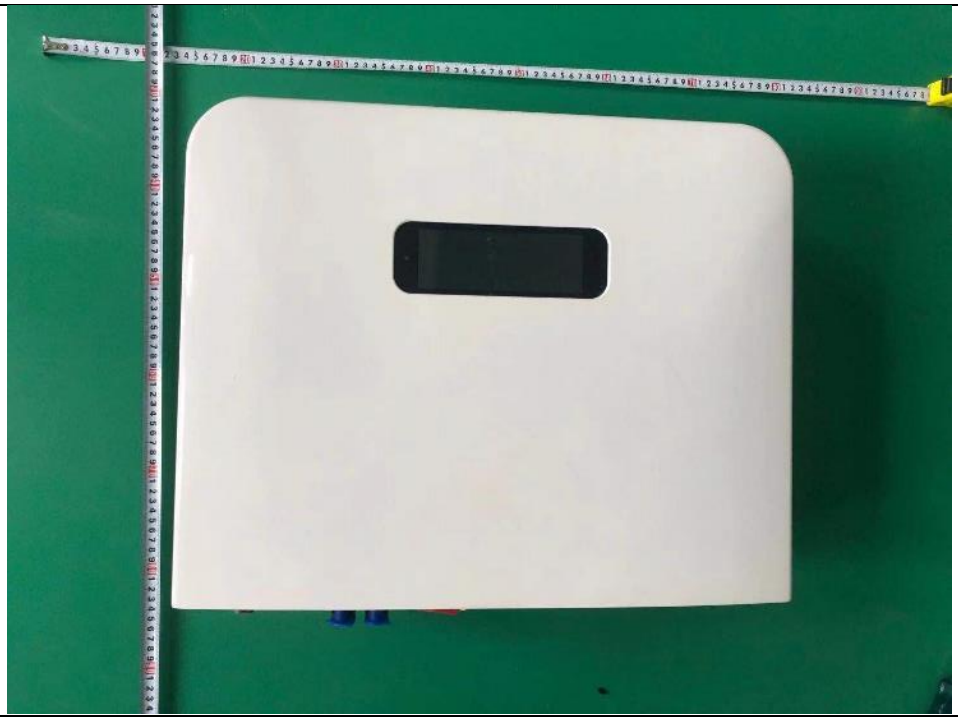
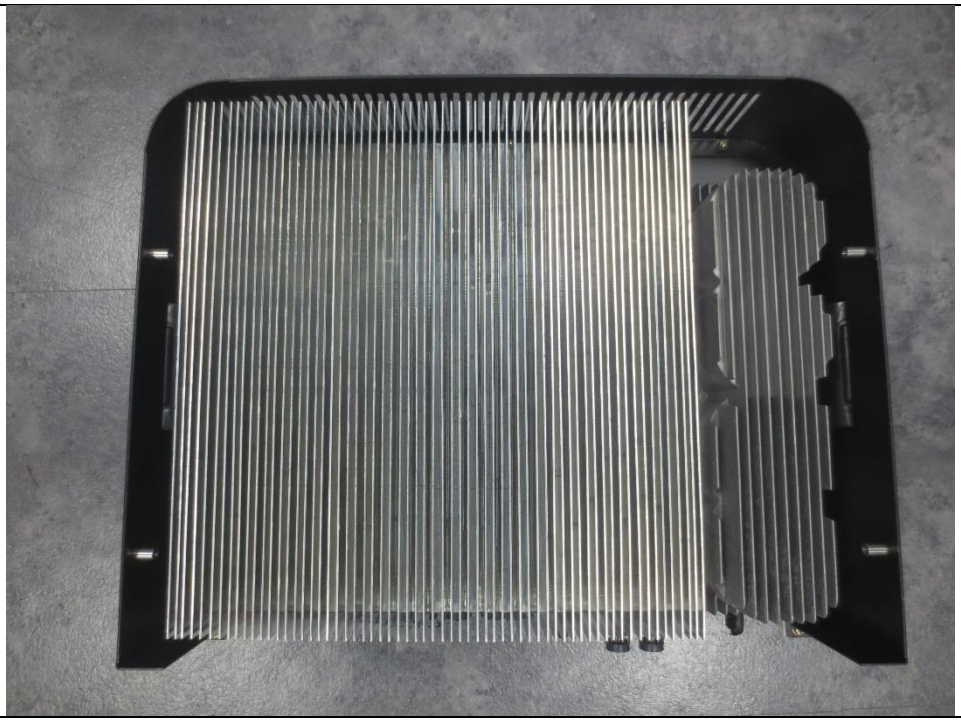
34	R168	Open circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “DC BUS over voltage”. No damage, no hazard, no fire.
35	R176	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “Battery voltage abnormal”. No damage, no hazard, no fire.
36	R180	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “Battery charge over current”. No damage, no hazard, no fire.
37	L, N	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “Inverter current over trip”. No damage, no hazard, no fire.
38	L-Ground	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “Inverter current over trip”. No damage, no hazard, no fire.
39	N-Ground	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit work normally. No damage, no hazard, no fire.
40	Ground disconnect	Open circuit	360Vdc/ 230Vac	10min	--	--	Unit cannot start up, self-detection fail, error message: “Potential from Utility Grid N Line to PE is higher than 30 Vrms”. No damage, no hazard, no fire.
41	Off grid L,N	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down, error message: “Battery charge over current”. No damage, no hazard, no fire.
42	PV+ to PV-	Short circuit	360Vdc/ 230Vac	10min	--	--	Unit shut down. No damage, no hazard, no fire.
43	PV+ to PV-	Reversed	360Vdc/ 230Vac	10min	--	--	Unit cannot start up. No damage, no hazard, no fire.

supplementary information

PCE means power conversion equipment under test in this document.

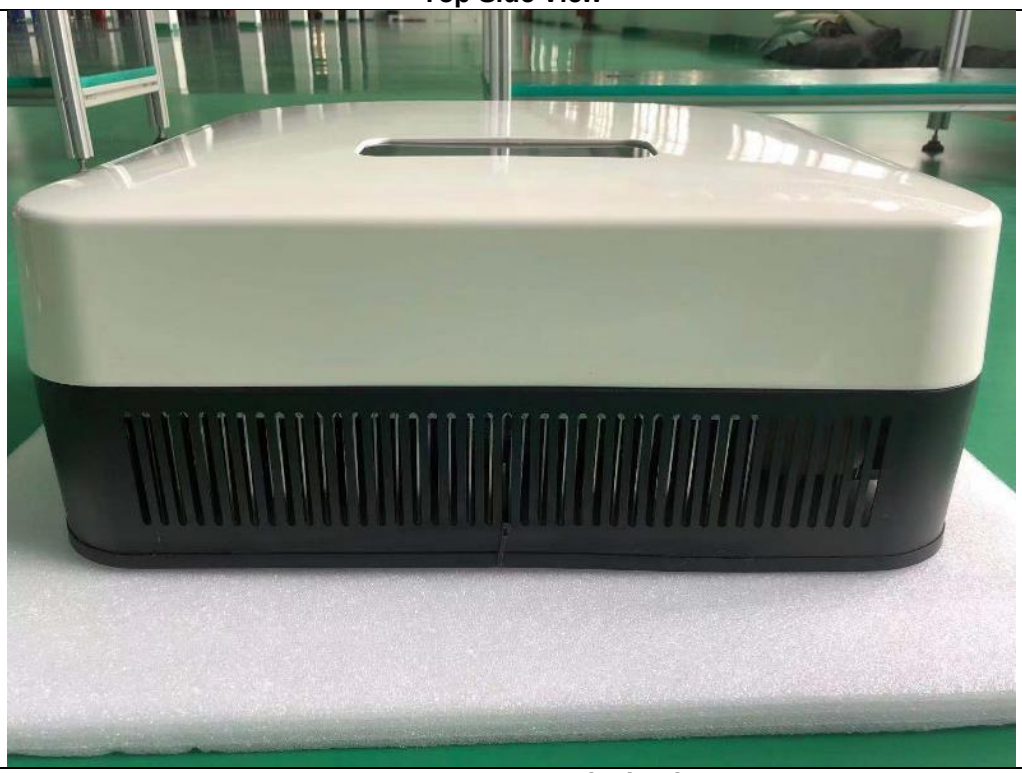
See technical documentation.

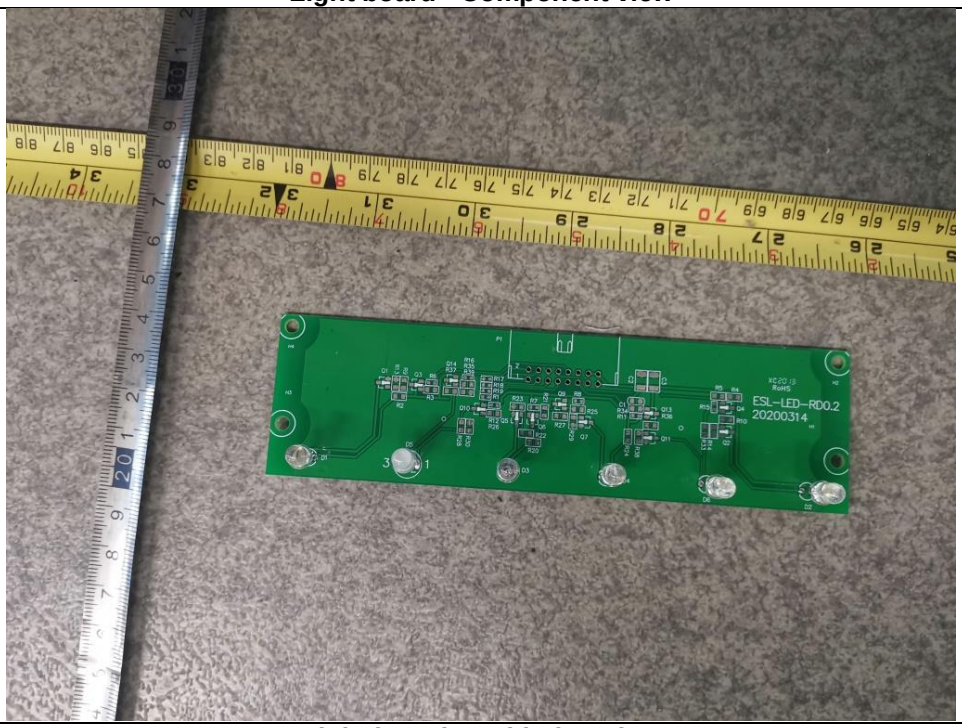
Appendix: Pictures

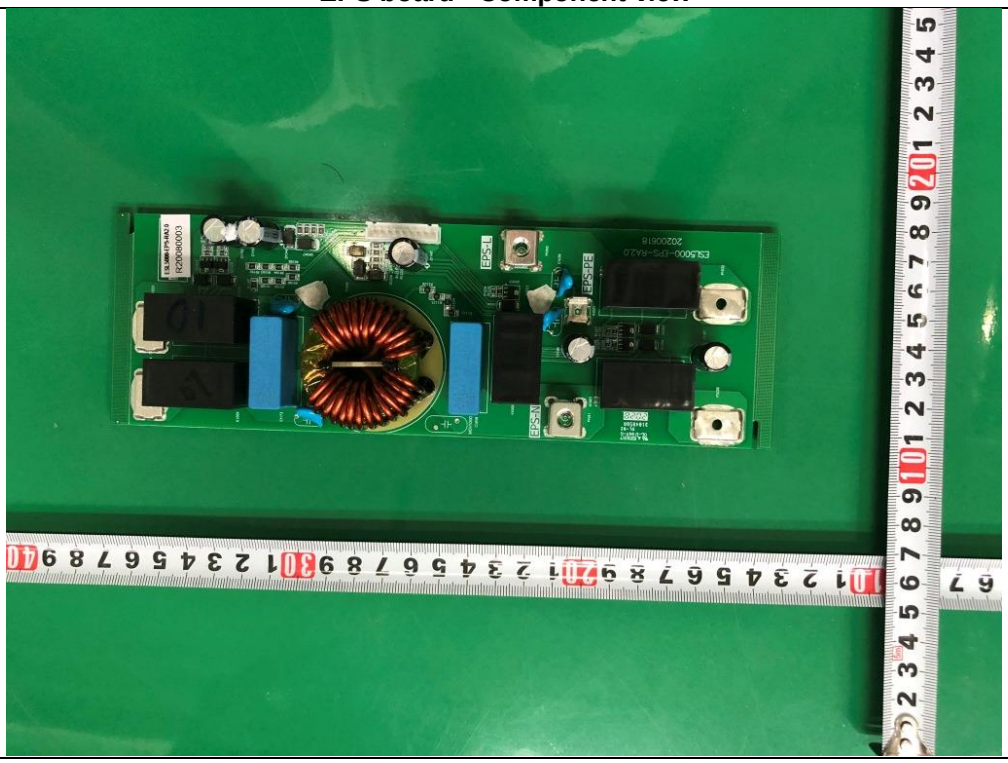
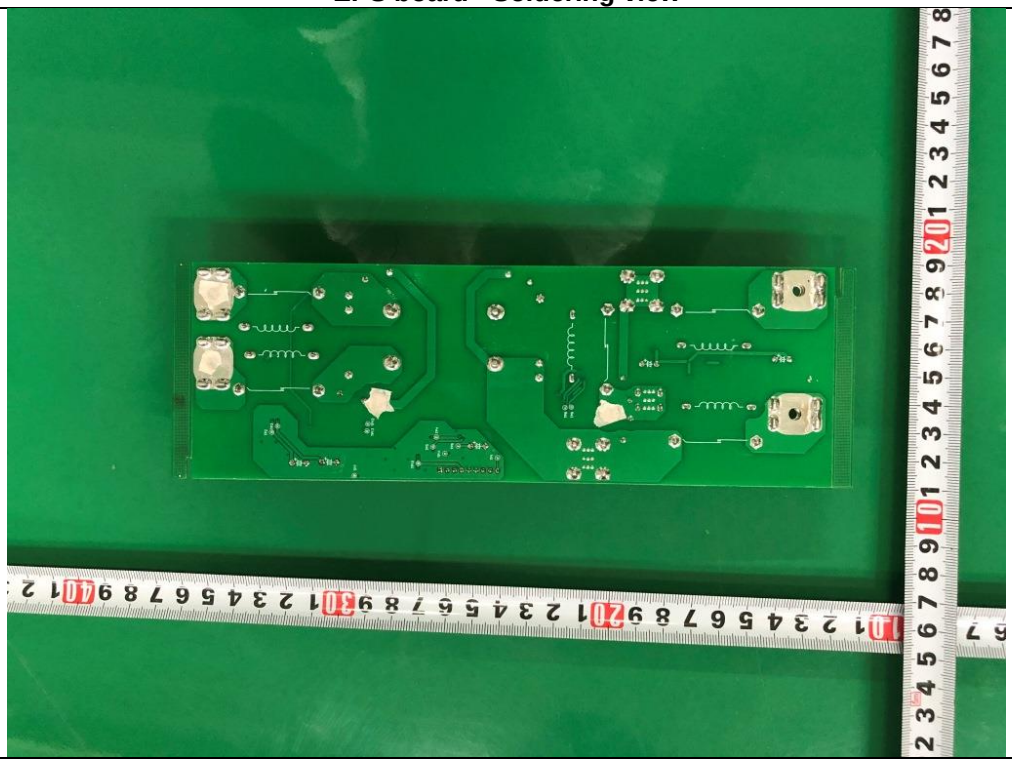
Front View

Rear View


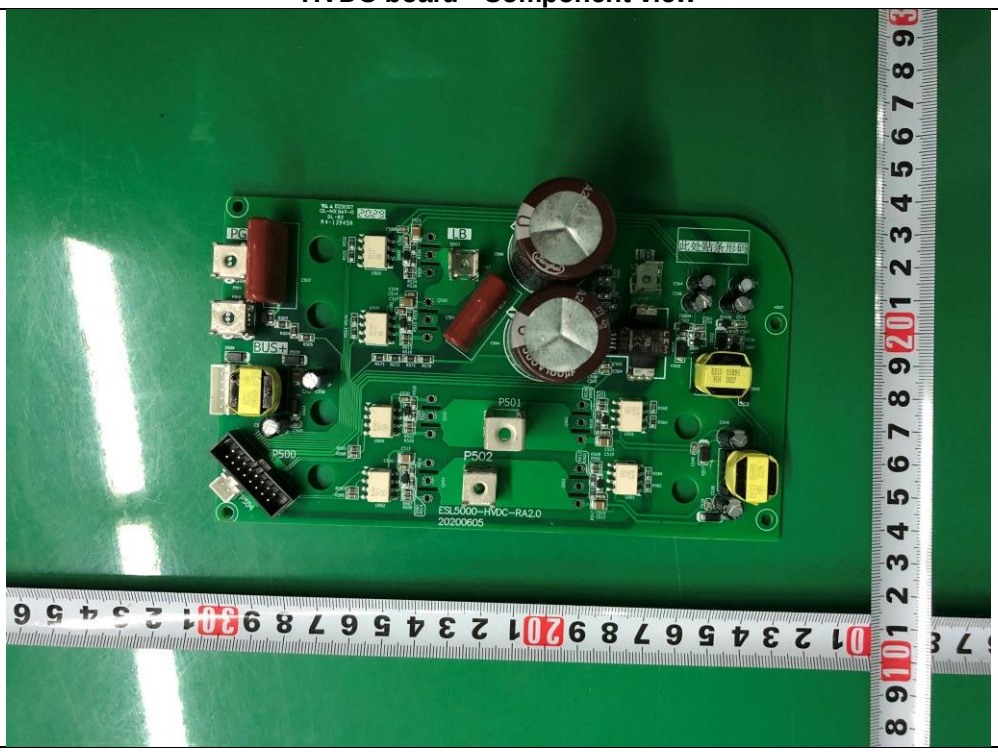
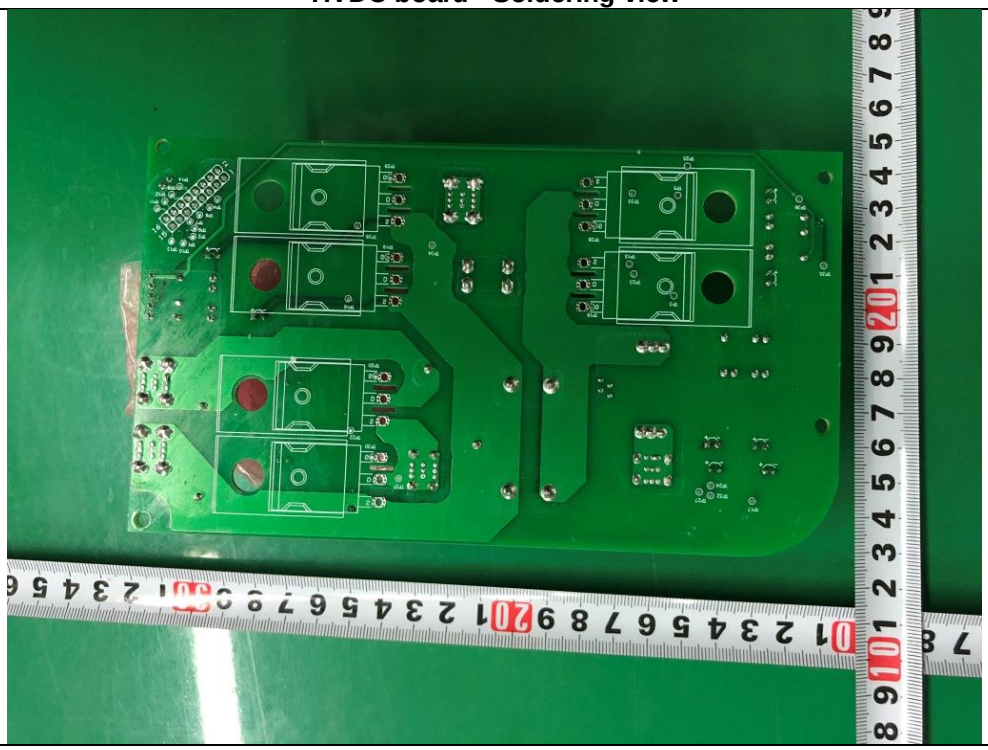
Right Side View

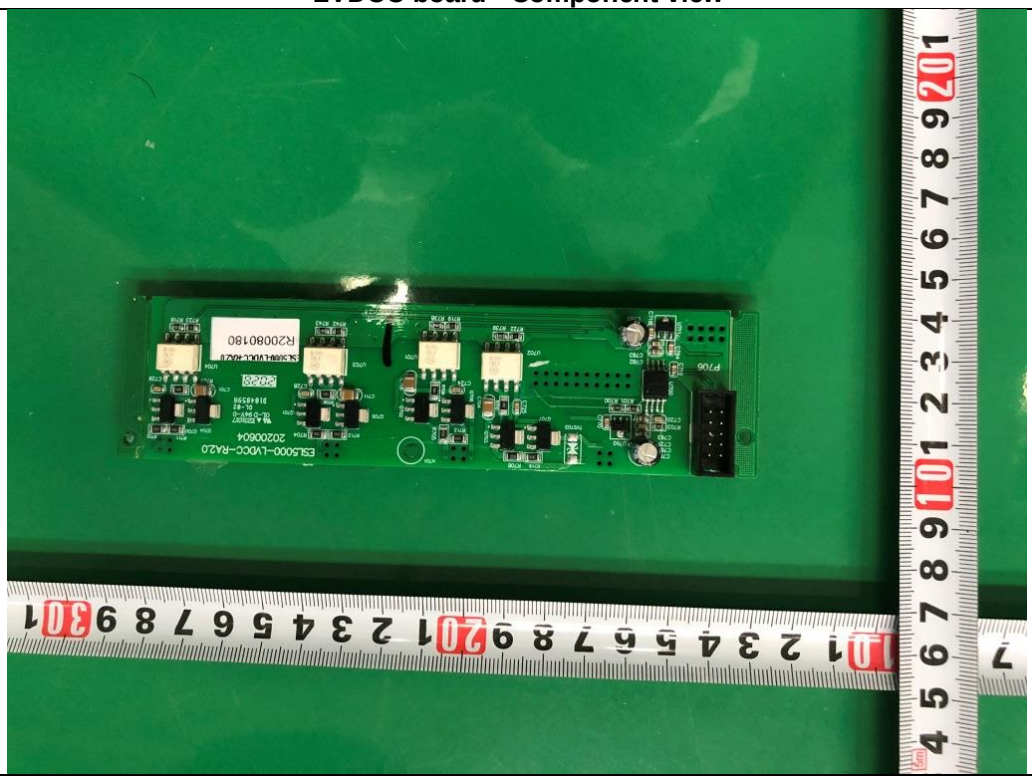
Left Side View

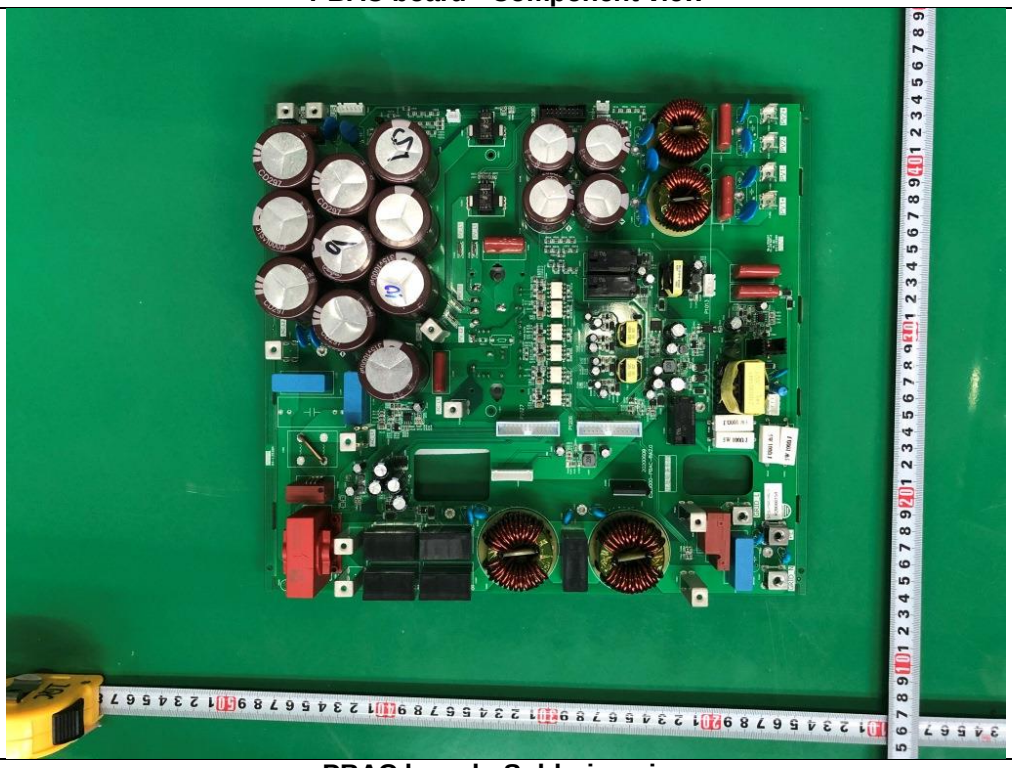
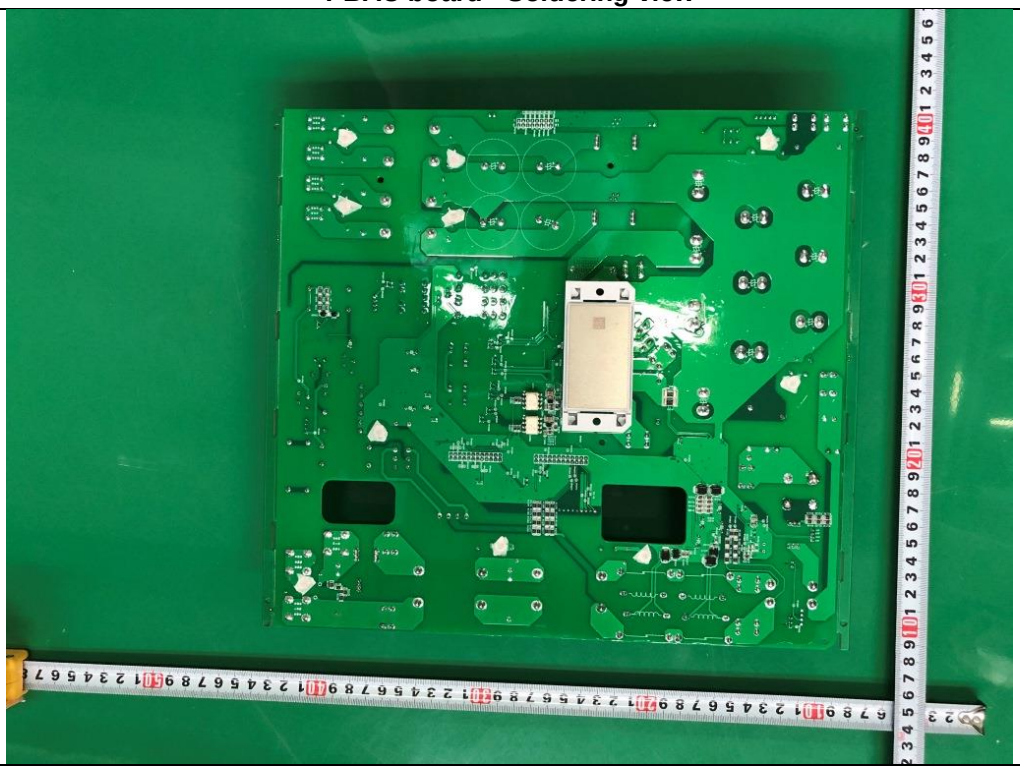

Top Side View

Bottom Connect Terminals View

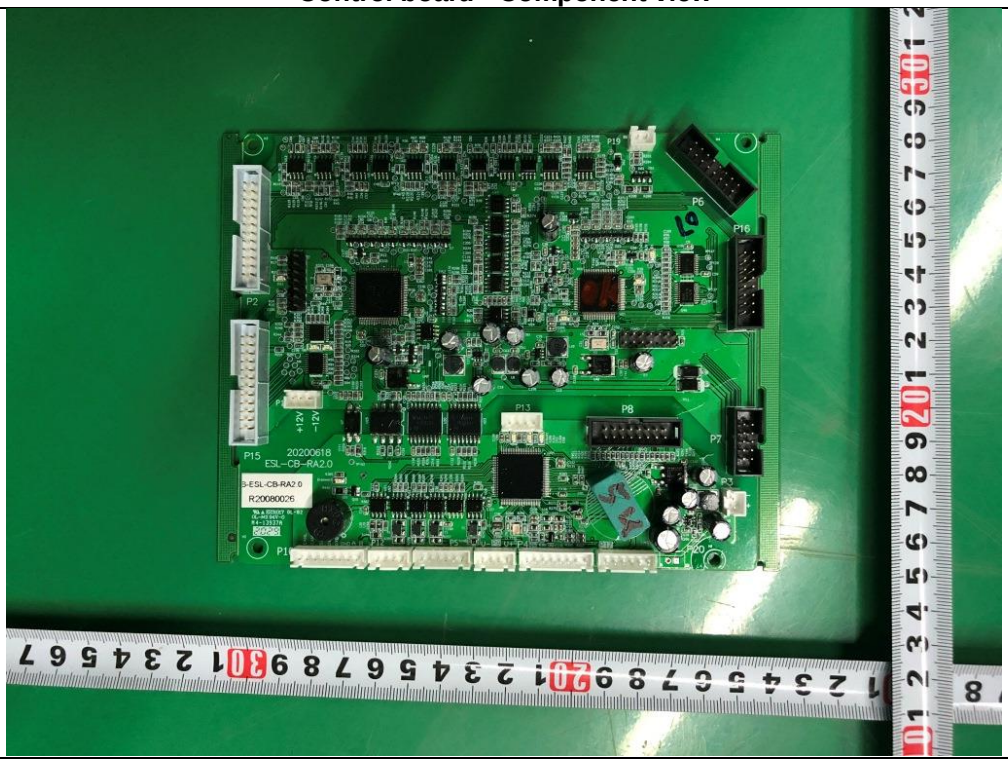
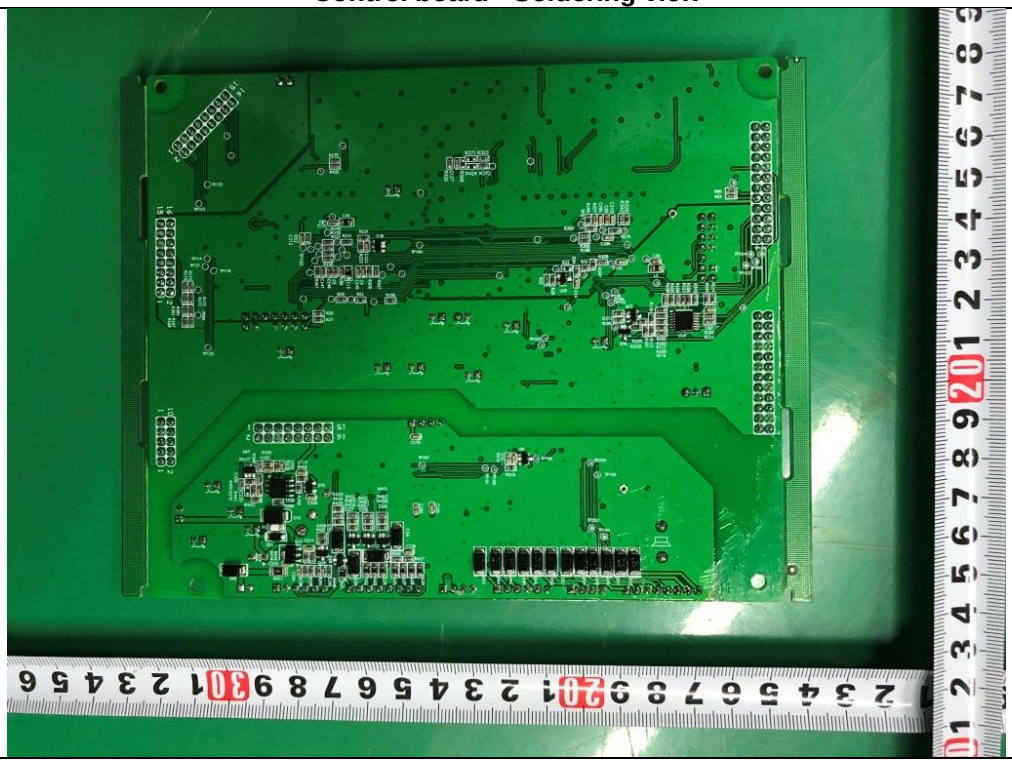

Light board - Component view

Light board - Soldering view

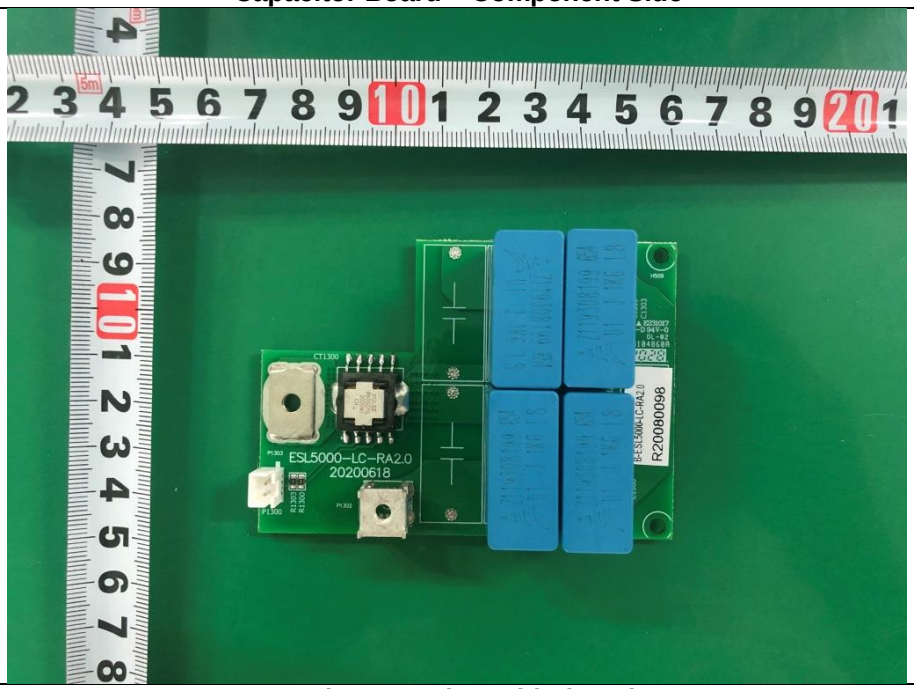
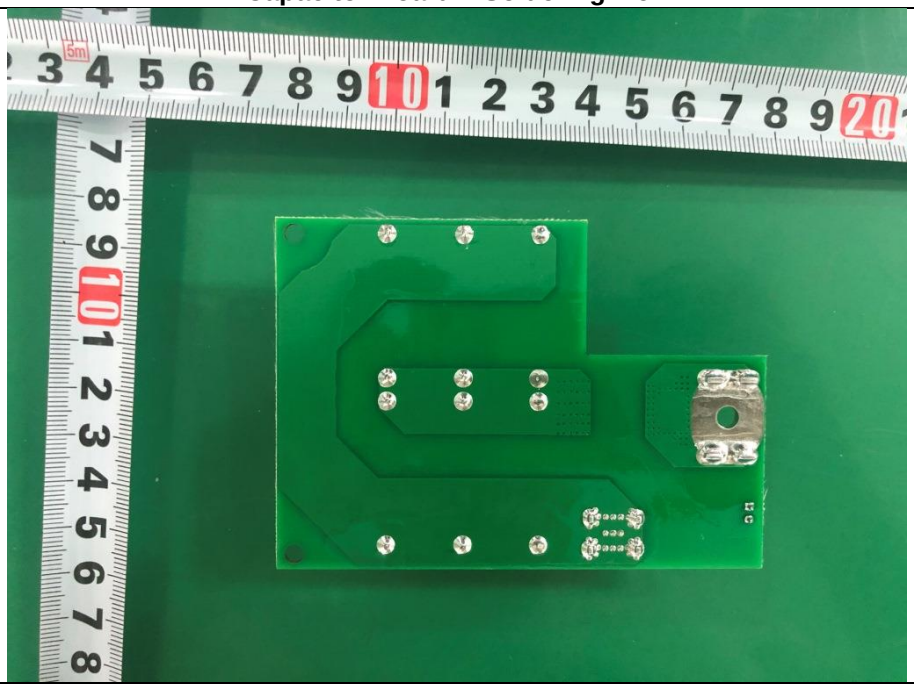

EPS board - Component view

EPS board - Soldering view


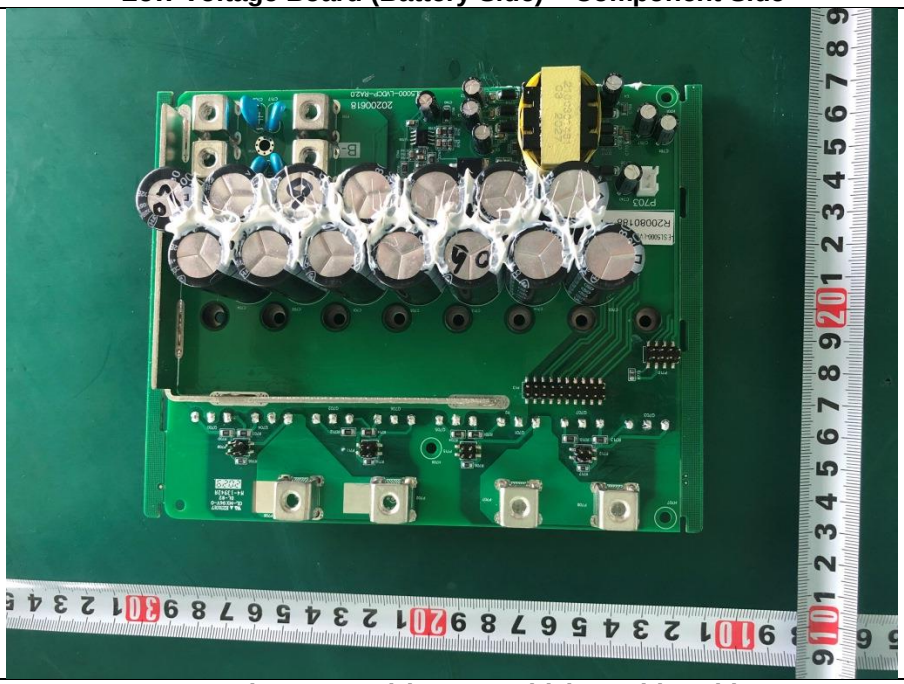
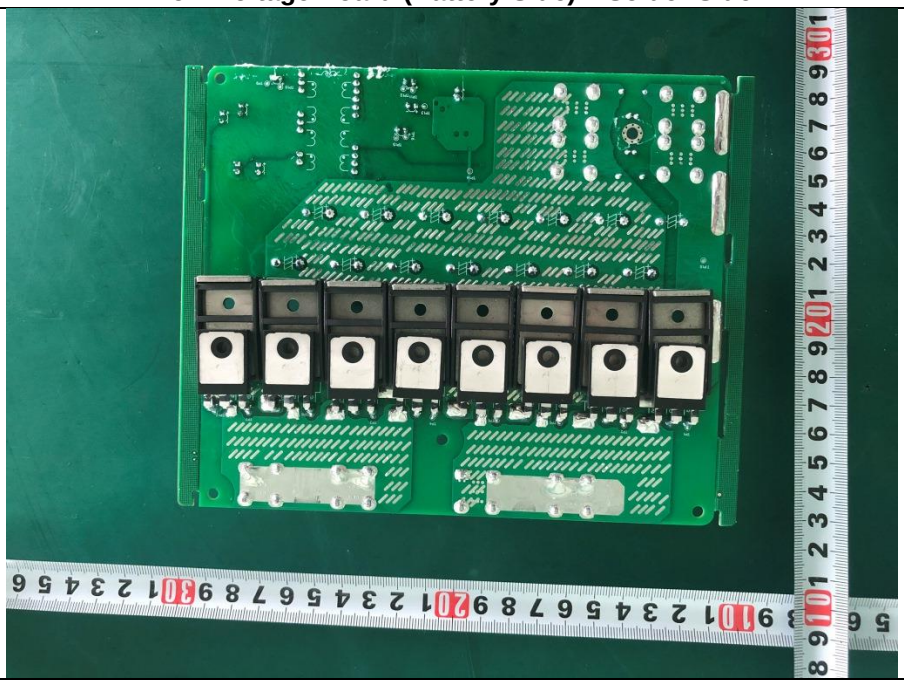
HVDC board - Component view

HVDC board - Soldering view


LVDCC board - Component view

LVDCC board - Soldering view


PBAC board - Component view

PBAC board - Soldering view


Control board - Component view

Control board - Soldering view


Capacitor Board – Component Side

Capacitor Board – Soldering view


Low Voltage Board (Battery Side) – Component Side

Low Voltage Board (Battery Side) – Solder Side


Internal view of inverter


--- End of test report---