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Evaluation Report No. TRPVP01087/23E/01

Grid-tied PV Inverter Qualification
according to NRS 097-2-1:2017 Edition 2.1

Applicant: **Jinko Solar Co., Ltd.**

No.1, Yingbin Road, Economic Development Zone, Shangrao City, 334100
Jiangxi, P.R. China

File No.: PVP01087/23E-07

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Evaluation Report



File No.: PVP01087/23E-07

Report No.: TRPVP01087/23E/01

Applicant	Jinko Solar Co., Ltd. No.1, Yingbin Road, Economic Development Zone, Shangrao City, 334100 Jiangxi, P.R. China
Manufacturer	Jinko Solar Co., Ltd. No.1, Yingbin Road, Economic Development Zone, Shangrao City, 334100 Jiangxi, P.R. China
Factory1	Shenzhen INVT Electric Co., Ltd. Bao'an Branch Factory F1-F4, No.3 Building, Emerson Industrial Park, Fengtang Road, Tangwei Community, Fuhai, Bao'an District, Shenzhen City, Guangdong Province, 518103, P.R. China
Order No.	QT-PVP01087/23E
Date of Application	01/30/2023
Product(s)	Hybrid Inverter
Model type(s)	JKH30LTA, JKH50LTA, JKH100LTA, JKH150LTA
Type of examination	Parallel certification
Certification program:	BOS-P-01 Rev. 00
Certification fundamental(s)	NRS 097-2-1:2017 Edition 2.1
Testing Period	02/16/2022 - 05/11/2022
Testing Laboratory	Dongguan BALUN Testing Technology Co., Ltd. Room 104, 204, 205, Building 1, No. 6, Industrial South Road, Songshan Lake District, Dongguan, Guangdong, China
Annex(es)	Annex 1: Test report no. BL-DG2330057-B01 (160 pages)

Test results listed in this test report refer exclusively to the mentioned test sample.

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The submitted test samples as described in the reports are tested in accordance with the requirements:
NRS 097-2-1:2017 Edition 2.1 "Grid interconnection of embedded generation
Part 2: Small-scale embedded generation
Part: Utility interface

According to the inquiry of the applicant, based on certificate no. COCPVP11037/21E-01 and evaluation report no. TRPVP11037/21E/01_R1, issue parallel certificate.



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TESTING
CNAS L14701

TEST REPORT

Application number: PVP01087/23E-07

Applicant: Jinko Solar Co., Ltd.

Address: No.1, Yingbin Road, Economic Development Zone,
Shangrao City, 334100 Jiangxi, P.R. China

Equipment Type: Hybrid Inverter

Model Name: JKH30LTA, JKH50LTA, JKH100LTA, JKH150LTA

Brand Name: 

Ratings: See copy of marking label and model list.

Test Standard: NRS 097-2-1:2017 Edition 2.1

Sample Arrival Date: Nov. 22, 2021

Test Date: Feb. 16, 2022 to May 11, 2022

Date of Issue: Mar. 07, 2023

ISSUED BY:

Dongguan BALUN Testing Technology Co., Ltd.

Tested by: Leo Sun

Leo Sun

Checked by: Xingzhen Man

Xingzhen Man

Approved by: Simon Qi



Revision History

Version	Issue Date	Revisions Content
<u>Rev. 01</u>	<u>Mar. 07, 2023</u>	<u>Initial Issue</u>

List of Attachments:

Attachment 1 - EMC test report TW202302-025-2 ☆.

Summary of testing:

-Note: The only difference between the EUT (test samples in this report) and testing sample of report BL-DG21B0788-B01 (Rev. 02), which was issued by Dongguan BALUN Testing Technology Co., Ltd. on Jun. 24, 2022 as below:

1. Update applicant, manufacturer, trademark, model, label and appearance.

And others hardware circuit and software were all the same. So all test data originate from the report BL-DG21B0788-B01 (Rev. 02), which was issued by Dongguan BALUN Testing Technology Co., Ltd. on Jun. 24, 2022.

Tests performed (name of test and test clause):

- ☒ 4.1.5 Voltage fluctuations and Flicker
- ☒ 4.1.6 Voltage unbalance
- ☒ 4.1.10 Harmonics and waveform distortion
- ☒ 4.1.11.3 Power factor (no controllable reactive power)
- ☒ 4.1.11.3 Power factor (Fixed $\cos \varphi$)
- ☒ 4.1.12 Synchronization
- ☒ 4.2.2 Safety disconnect from utility network
- ☒ 4.2.2.3.2 Over voltage and under voltage
- ☒ 4.2.2.3.3 Over-frequency and under-frequency
- ☒ 4.2.2.3.3 Active power feed-in for over-frequency
- ☒ 4.2.2.4 Preventing of islanding

Testing location:

Dongguan BALUN Testing Technology Co., Ltd.
Room 104, 204, 205, Building 1, No. 6, Industrial South Road, Songshan Lake District, Dongguan, Guangdong, China

- ☒ **The product fulfils the requirements of NRS 097-2-1:2017 Edition 2.1.**

Copy of marking plate:

JinkO^{Solar}

Hybrid Inverter	JKH30LTA
PV input parameters	
Max. Input Power:	60/120kWp
Mppt Input Voltage:	250-850d.c.V
Vmax. PV Input Voltage:	1000d.c.V
Max. Input Current:	120A*1/120A*2
Isc PV:	130A*1/130A*2
AC output parameters (On-grid)	
Max. Output Apparent Power:	33kVA
Max. Output Current:	48A
Rated Voltage:	400a.c.V,3W+N+PE
Rated Frequency:	50/60Hz
Power Factor Range:	【-0.99,0.99】
Transformer ratio:	100:400
AC output parameters(off-grid)	
Max. Output Apparent Power:	33kVA
Max. Output Current:	48A
Rated Voltage:	400a.c.V,3W+N+PE
Rated Frequency (Optional):	50/60Hz
Battery parameters	
Battery type:	Lead acid and lithium battery
Battery voltage range:	250V-850V
Cut Off Voltage :	250V
Max. charging Voltage:	850V
Max. charging Current:	140A
Max. Discharging Current:	140A
System	
Ingress Protection:	IP20
Protective class@(I,II, or III) class I	
Dimensions(W*D*H):	800*800*1900mm
Weight:	620kg/650kg
Max. Efficiency:	95%



Made in China

JinkO^{Solar}

Hybrid Inverter	JKH50LTA
PV input parameters	
Max. Input Power:	60/120kWp
Mppt Input Voltage:	250-850d.c.V
Vmax. PV Input Voltage:	1000d.c.V
Max. Input Current:	120A*1/120A*2
Isc PV:	130A*1/130A*2
AC output parameters (On-grid)	
Max. Output Apparent Power:	55kVA
Max. Output Current:	80A
Rated Voltage:	400a.c.V,3W+N+PE
Rated Frequency:	50/60Hz
Power Factor Range:	【-0.99,0.99】
Transformer ratio:	200:400
AC output parameters(off-grid)	
Max. Output Apparent Power:	55kVA
Max. Output Current:	80A
Rated Voltage:	400a.c.V,3W+N+PE
Rated Frequency (Optional):	50/60Hz
Battery parameters	
Battery type:	Lead acid and lithium battery
Battery voltage range:	320V-850V
Cut Off Voltage :	320V
Max. charging Voltage:	850V
Max. charging Current:	178A
Max. Discharging Current:	178A
System	
Ingress Protection:	IP20
Protective class@(I,II, or III) class I	
Dimensions(W*D*H):	800*800*1900mm
Weight:	720kg/750kg
Max. Efficiency:	96.5%



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Hybrid Inverter	JKH100LTA
PV input parameters	
Max. Input Power:	120/180/240kWp
Mppt Input Voltage:	250-850d.c.V
Vmax. PV Input Voltage:	1000d.c.V
Max. Input Current:	120A*2/120A*3/120A*4
Isc PV:	130A*2/130A*3/130A*4
AC output parameters (On-grid)	
Max. Output Apparent Power:	110kVA
Max. Output Current:	158A
Rated Voltage:	400a.c.V,3W+N+PE
Rated Frequency:	50/60Hz
Power Factor Range:	【-0.99,0.99】
Transformer ratio:	270:400
AC output parameters(off-grid)	
Max. Output Apparent Power:	110kVA
Max. Output Current:	158A
Rated Voltage:	400a.c.V,3W+N+PE
Rated Frequency (Optional):	50/60Hz
Battery parameters	
Battery type:	Lead acid and lithium battery
Battery voltage range:	420V-850V
Cut Off Voltage :	420V
Max. charging Voltage:	850V
Max. charging Current:	270A
Max. Discharging Current:	270A
System	
Ingress Protection:	IP20
Protective class@(I,II, or III) class I	
Dimensions(W*D*H):	1200*800*2050mm
Weight:	1120kg/1150kg/1180kg
Max. Efficiency:	96.8%


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Hybrid Inverter	JKH150LTA
PV input parameters	
Max. Input Power:	120/180/240kWp
Mppt Input Voltage:	250-850d.c.V
Vmax. PV Input Voltage:	1000d.c.V
Max. Input Current:	120A*2/120A*3/120A*4
Isc PV:	130A*2/130A*3/130A*4
AC output parameters (On-grid)	
Max. Output Apparent Power:	165kVA
Max. Output Current:	238A
Rated Voltage:	400a.c.V,3W+N+PE
Rated Frequency:	50/60Hz
Power Factor Range:	【-0.99,0.99】
Transformer ratio:	270:400
AC output parameters(off-grid)	
Max. Output Apparent Power:	165kVA
Max. Output Current:	238A
Rated Voltage:	400a.c.V,3W+N+PE
Rated Frequency (Optional):	50/60Hz
Battery parameters	
Battery type:	Lead acid and lithium battery
Battery voltage range:	420V-850V
Cut Off Voltage :	420V
Max. charging Voltage:	850V
Max. charging Current:	405A
Max. Discharging Current:	405A
System	
Ingress Protection:	IP20
Protective class@(I,II, or III) class I	
Dimensions(W*D*H):	1200*800*2050mm
Weight:	1250kg/1280kg/1310kg
Max. Efficiency:	96.8%


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Test item particulars..... :	
Equipment mobility..... :	Permanent connection
Operating condition..... :	Continuous
Class of equipment..... :	Class I
Mass of equipment (kg)..... :	See model list.
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 was not evaluated for the requirement:	N/E
- test object does not meet the requirement..... :	F (Fail)

General remarks:

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

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

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

The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided.....:

- ☐ Yes
☒ Not applicable

When differences exist; they shall be identified in the General product information section.

Name and address of Manufacturer (ies)..... : **Jinko Solar Co., Ltd.**
 No.1, Yingbin Road, Economic Development Zone,
 Shangrao City, 334100 Jiangxi, P.R. China

Name and address of factory (ies)..... : **Shenzhen INVT Electric Co., Ltd. Bao'an Branch Factory**
 F1-F4, No.3 Building, Emerson Industrial Park,
 Fengtang Road, Tangwei Community, Fuhai, Bao'an
 District, Shenzhen City, Guangdong Province,
 518103, P.R. China

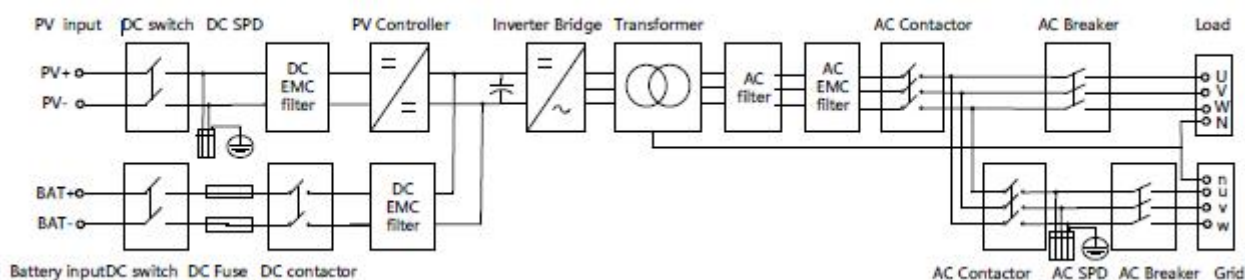
General product information:

The PCE under test (EUT) is Hybrid Inverter. During inverter, which convert the variable DC power generated from the Photovoltaic combiner box (with MPPT function) or Batteries to the stable utility AC power which can be fed into the commercial electrical grid or off-grid load, the photovoltaic combiner box will give priority to the power to the battery.

Unless otherwise stated, all tests were performed on the JKH150LTA. All models have same PCB layout, communication port, electric circuits, electronic control circuits, and have similar software protection designed, the difference lies in the software limiting the output power and the use of some components.

Hardware version: V9

Software version: V9

Block diagram of the utility interactive inverter:

Model list:

Model or Type designation	JKH30LTA	JKH50LTA	JKH100LTA	JKH150LTA
PV Input Parameters				
V _{max} PV [V d.c.]	1000			
MPPT Voltage Range [V d.c.]	250-850			
Isc PV [A d.c.]	130A*1/130A*2		130A*2/130A*3/130A*4	
Max. Input Current [A d.c.]	120A*1/120A*2		120A*2/120A*3/120A*4	
Battery port parameters:				
Voltage range [V d.c.]	250-850	320-850	420-850	
Max. charging Current [A d.c.]	140	178	270	405
Max. Discharging Current [A d.c.]	140	178	270	405
Grid Output Parameters				
Rated Output Voltage [V a.c.]	400, 3W/N/PE			
Rated Output Frequency [Hz]	50/60			
Rated Output Power [kW]	30	50	100	150
Max. Output Power [kW]	33	55	110	165
Max. Apparent Output Power [VA]	33	55	110	165
Max. Output Current [A a.c.]	48	80	158	238
Power Factor cosφ [λ]	(±0.99 adjustable)			
Off Grid Output Parameters				
Rated Output Voltage [V a.c.]	400, 3W/N/PE			
Rated Output Frequency [Hz]	50/60			
Rated Output Power [kW]	30	50	100	150
Max. Output Power [kW]	33	55	110	165
Max. Apparent Output Power [VA]	33	55	110	165
Max. Output Current [A a.c.]	48	80	158	238
Others				
Protective Class	Class I			
Inverter Topology	isolated			
Separated by	Transformer			
Operation Temperature Range	-30~60°C			
Ingress Protection	IP20			
Size [W*H*D mm]	800*1900*800		1200*2050*800	
Max. Weight [kg]	650	750	1180	1310
Overvoltage Category	DC II, AC III			

NRS 097-2-1			
Clause	Requirement – Test	Result – Remark	Verdict
4.1	Utility compatibility		P
4.1.1	General		P
4.1.1.1	This clause describes the technical issues and the responsibilities related to interconnecting an embedded generator to a utility network,	Noticed	P
4.1.1.2	The quality of power provided by the embedded generator in the case of the on-site a.c, loads and the power delivered to the utility is governed by practices and standards on voltage, flicker, frequency, harmonics and power factor, Deviation from these standards represents out-of-bounds conditions, The embedded generator is required to sense the deviation and might need to disconnect from the utility network,	Noticed	P
4.1.1.3	All power quality parameters (voltage, flicker, frequency and harmonics) shall be measured at the POC, unless otherwise specified	Inverter units approved by Dongguan BALUN Testing Technology Co., Ltd. in accordance with EMC test report TW202302-025-2 ☆.	P
	The power quality to be supplied to customers and influenced by SSEG shall comply with NRS 048-2, This implies that the combined voltage disturbances caused by the specific EG and other customers, added to normal background voltage disturbances, may not exceed levels stipulated by NRS 048-2, The maximum emission levels that may be contributed by SSEG are provided in this document (see 4.1.5 to 4.1.10),	Noticed	P
	The customer can expect power quality at the POC in line with NRS 048-2, As such, the generator may not contribute significant disturbances to the voltage supplied at the POC, Typical contributions for small customer installations (total installation) are provided in Annex D of NRS 048-4, NOTE 1 The frequency cannot be changed by a SSEG,	Must be taken under consideration for the installation	N/A

NRS 097-2-1			
Clause	Requirement – Test	Result – Remark	Verdict
	NOTE 2 The utility is responsible for the power quality at the POC, however, the EG is responsible to mitigate power quality exceedances should it be shown to cause excessive power quality levels,		
4.1.1.4	The embedded generator's a.c. voltage, current and frequency shall be compatible with the utility at the POC,	Noticed	P
4.1.1.5	The embedded generator shall be type approved, unless otherwise agreed upon with the utility,	Notice	P
4.1.1.6	The maximum size of the embedded generator is limited by the rating of the supply point on the premises, NOTE Also see NRS097-2-3,	Noticed	N/A
4.1.1.7	The utility will approve the size of the embedded generator and will decide on the connection point and conditions, In some cases it may be required to create a separate supply point,	Must be taken under consideration for the installation	N/A
4.1.1.8	Embedded generators larger than 13.8 kVA shall be of the balanced three-phase type unless only a single-phase network supply is available, in which case NRS 097-2-3 recommendations can be applied based on the NMD, NOTE 1 This value refers to the maximum export potential of the generation device/system, NOTE 2 In the case of long feeder spurs the maximum desired capacity of the EG might require approval by the utility and might result in the requirement for a three-phase connection for smaller units,	Three-phase type of SSEG	N/A
4.1.1.9	A customer with a multiphase connection shall split the embedded generator in a balanced manner over all phases if the EG is larger than 4.6 kVA, NOTE Balancing phases in a multiphase embedded generator is deemed desirable,		P

NRS 097-2-1			
Clause	Requirement – Test	Result – Remark	Verdict
4.1.1.10	Embedded generators or generator systems larger than 100 kVA may have additional requirements, for example, they must be able to receive communication signals for ceasing generation/disconnection from the utility supply, if the utility requires such, Communication facilities shall be provided to utility at no charge for integration with SCADA or other system when required, See Annex G (G,1), NOTE The RPP Grid Code requires category A3 units to be able to interface with the utility in order to receive stop and start signals,	Must be taken under consideration for the installation	N/A
4.1.1.11	In line with the current Renewable Power Plant Grid Code. embedded generators smaller than 1000 kVA connected to low-voltage form part of Category A generators. with the following subcategories:		P
	a) Category A1: 0 – 13.8 kVA; This sub-category includes RPPs of Category A with rated power in the range from 0 to 13.8 kVA. inclusive of 13.8 kVA.		N/A
	b) Category A2: 13.8 kVA – 100 kVA; and This sub-category includes RPPs of Category A with rated power in the range greater than 13.8 kVA but less than 100 kVA.	See appended test table	P
	c) Category A3: 100 kVA – 1 MVA, This sub-category includes RPPs of Category A with rated power in the range from 100 kVA but less than 1 MVA NOTE 1 These sub-categories must be cross-checked with the Renewable Power Plant Grid Code (or other part of the Grid Code where applicable); where applicable, requirements will apply per sub-category and not per sizes defined here, NOTE 2 Until a separate Grid Code for non-renewable technologies have been compiled and published, relevant categories from this document will apply to		P

NRS 097-2-1			
Clause	Requirement – Test	Result – Remark	Verdict
	non-renewable SSEG,		
4.1.1.12	In accordance with SANS 10142-1, all generators shall be wired permanently, NOTE 1 Some international companies are distributing so-called “plug-in” generators, where a small PV panel and inverter is connected to the supply circuit via a standard (load) plug, At present such installations are not regarded as safe and in contravention of SANS 10142-1, NOTE 2 This option will be reviewed when internationally accepted norms are finalised to ensure plugs and plug points are safe when feeding power into the grid as well as additional requirements for such generators or plugs,		P
4.1.1.13	Any UPS/generating device that operates in parallel with the grid may only connect to the grid when it complies fully with the requirements of this part of NRS 097, This includes UPS configurations with or without EG, NOTE The requirement is applicable irrespective of the duration of parallel operation,	No UPS	N/A
4.1.1.14	Standby-generators are covered by SANS 10142-1,		N/A
4.1.1.15	All generators larger than 100 kVA will be controllable, i.e, be able to control the active output power dependent on network conditions/abnormal conditions, This includes several smaller units that totals more than 100 kVA at a single POC	Noticed	N/A
4.1.1.16	Maximum DC Voltage may not exceed 1000V, This is the voltage on the DC side of the inverter, for example when no load is taken and maximum source energy is provided, e.g, peak solar radiation occurs on the solar panels,	Considered	P
4.1.2	Normal voltage operating range		P

NRS 097-2-1			
Clause	Requirement – Test	Result – Remark	Verdict
4.1.2.1	In accordance with IEC 61727, utility-interconnected embedded generators do not normally regulate voltage, they inject current into the utility, Therefore the voltage operating range for embedded generators is designed as protection which responds to abnormal utility network conditions and not as a voltage regulation function,	Derived from tests	P
4.1.2.2	The embedded generator shall synchronise (see 4.1.12) with the utility network before a connection is established. The embedded generator shall not control the voltage. unless agreed to by the utility (see annex A),	See appended table	P
4.1.2.3	An embedded generator that operates in parallel with the utility system shall operate within the voltage trip limits defined in 4.2.2.3.2,		P
4.1.3	Reference source impedance and short-circuit levels (fault levels)		P
4.1.3.1	The impact of the generator on the network voltage and quality of supply levels is directly linked to the (complex) source impedance and short-circuit level, The minimum short-circuit level to which a generator can be connected should be based on the size of the generator as well as the design criteria,		P
4.1.3.2	For general purposes of testing and design for potential worst case conditions. a minimum network strength of the following may be assumed: $Z_{\text{source}} = 1.05 + j 0.32 \text{ ohm}$. i.e. $I_{\text{SC}} = 210 \text{ A}$ and $S_{\text{SC}} = 146 \text{ kVA}$ (three-phase). NOTE This does not imply a guarantee that the fault level will be more than this at all times. Fault levels less than this may be sufficient for small loads in certain applications.		P
4.1.3.3	The maximum network strength will be		P

NRS 097-2-1			
Clause	Requirement – Test	Result – Remark	Verdict
	assumed to be no more than 33 times the rated active power of the generator. The R/X ratio will be assumed between 0.33 to 3, NOTE 1 In practice, the generators will connect to the network at a wide range of short-circuit ratios, The assumption of a maximum ratio of 33 will allow safe connection of the SSEG in most practical situations, NOTE 2 The minimum fault level at which the generator may be connected is at the discretion of the manufacturer, provided that the requirements of this specification is met at the specified fault level,		
4.1.3.4	The relevant utility will advise whether equipment may be connected at other network characteristics, i.e, for weaker parts of the network,		P
4.1.3.5	The generator documentation and nameplate shall state the reference impedance (complex impedance) and fault level that was used for design and certification and that it is not intended to connect the generator to a network with a higher network impedance than specified for the certification, NOTE See Annex C (Network Impedance), for more information,		P
4.1.4	General QOS requirements		P
4.1.4.1	Embedded generators can expect QOS levels on networks to be in line with NRS 048-2, It is expected that the embedded generator will be able to operate continuously under worst-case conditions,		P
4.1.4.2	Notwithstanding this, the embedded generator must protect itself from potential excursions beyond NRS 048-2 and ensure fail-safe conditions, Should the embedded generator be unable to operate according to requirements of this document for such excursions, it shall disconnect and cease generation onto the network,		P

NRS 097-2-1			
Clause	Requirement – Test	Result – Remark	Verdict
4.1.5	Flicker and voltage changes	See appended table	P
4.1.5.1	When connected to a network impedance equal to the reference impedance used during certification. no SSEG may generate flicker levels higher than the following: a) short-term flicker severity (P_{st}) = 0.35; and b) long-term flicker severity (P_{lt}) = 0.30.		P
4.1.5.2	It is anticipated that the utility will plan the connections in line with acceptable flicker limits, i.e, the ratio of the size of the generator to the network strength at the point of connection,		P
4.1.5.3	According to VDE-AR-N 4105, no generator shall be connected to a system where generation rejection (i.e, tripping of SSEG while generating at full capacity, regardless of reason) will lead to a voltage change of 3 % or more at the PCC, thereby minimising the potential to exceed rapid voltage change limits, NOTE 1 A voltage change of 3 % aligns to a ratio of the network fault level to generator size of 33 (ignoring network impedance angle and load power factor), NOTE 2 Standard connection conditions for customers typically include a maximum flicker contribution in line with annex D of NRS 048-4, Should these flicker levels be exceeded, the customer will be required to put mitigating measures in place as and when required by the utility,		P
4.1.6	Voltage unbalance	Three-phase inverter	P
4.1.6.1	Under normal circumstances. for single and dual-phase EG. the unbalanced generation may not exceed 4.6 kVA connected between any two or different phases at an installation. Units larger than 4.6 kVA will be split evenly over the available phase connections so that this can be maintained,		P

NRS 097-2-1			
Clause	Requirement – Test	Result – Remark	Verdict
4.1.6.2	Three-phase generators may not contribute more than 0.2 % voltage unbalance when connected to a network with impedance equal to the reference impedance, NOTE Standard connection conditions for customers typically include a maximum voltage unbalance contribution in line with NRS 048-4, Annex D, Should a three-phase customer exceed these voltage unbalance levels, the customer will be required to put mitigating measures in place as and when required by the utility,		P
4.1.7	Commutation notches		P
	The relative depth of commutation notches due to line-commutated inverters shall not exceed 5 % of nominal voltage at the POC for any operational state,		P
4.1.8	DC injection	The unit has isolation transformer.	N/A
4.1.8.1	The average d.c. current injected by the embedded generator shall not exceed 0.5 % of the rated a.c. output current over any 1-minute period. into the utility a.c. interface under any operating condition,		N/A
4.1.8.2	According to section 4.2.2.5. the generator(s) must disconnect within 500 ms when the d.c. current exceeds this value,		N/A
4.1.9	Normal frequency operating range		P
	An embedded generator that operates in parallel with the utility system shall operate within the frequency trip limits defined in 4.2.2.3.3.	See appended table	P
4.1.10	Harmonics and waveform distortion	See appended table	P
4.1.10.1	Only devices that inject low levels of current and voltage harmonics will be accepted; the higher harmonic levels increase the potential for adverse effects on connected equipment.		P
4.1.10.2	Acceptable levels of harmonic voltage and current depend upon distribution system		P

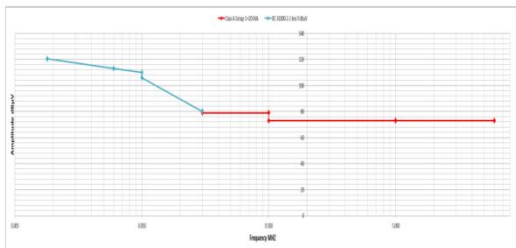
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Clause	Requirement – Test	Result – Remark	Verdict
	characteristics. type of service. connected loads or apparatus. and established utility practice.		
4.1.10.3	The embedded generator output shall have low current-distortion levels to ensure that no adverse effects are caused to other equipment connected to the utility system.		P
4.1.10.4	The harmonic and inter-harmonic current distortion shall comply with the relevant emission limits in accordance with IEC 61727, reproduced in table 1,		P
4.1.10.5	The harmonic and inter-harmonic distortion applies up to 3 kHz (60th harmonic), NOTE The harmonic limits above 2,5 kHz and all inter-harmonic limits refer to limits measured in accordance with IEC 61000-4-7,	See appended table	P
4.1.11	Power factor	See test results	P
4.1.11.1	Irrespective of the number of phases to which an embedded generator is connected. it shall comply with the power factor requirements in accordance with 4.1.11.2 to 4.1.11.12 on each phase for system normal conditions when the output power exceeds 20 % of rated active power.		P
4.1.11.2	For static power converter embedded generators and synchronous embedded generators of sub-categories A1 and A2. the power factor shall remain above 0.98 as shown in Figure 1. The embedded generator shall operate anywhere in the shaded area of figure 1. NOTE At the time of publication. this is in contradiction with the RPP Grid Code.		P
4.1.11.3	For asynchronous embedded generators of sub-categories A1 and A2. which cannot control the power factor over any range. the power factor shall reach the shaded area of figure 1 within 60 s. The power factor shall remain above 0.98 as shown in figure 1. The		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	embedded generator shall operate anywhere in the shaded area. NOTE At the time of publication. this is in contradiction with the RPP Grid Code.		
4.1.11.4	For static power converter embedded generators and synchronous embedded generators of sub-category A3, the power factor shall remain above 0,95 as shown in Figure 2, The embedded generator shall operate anywhere in the shaded area of Figure 2,		P
4.1.11.5	For asynchronous embedded generators of sub-category A3, which cannot control the power factor over any range, the power factor shall reach the shaded area of Figure 2 within 60 s, The power factor shall remain above 0,95 as shown in Figure 2, The embedded generator shall operate anywhere in the shaded area,		P
4.1.11.6	Where the EG is capable of controlling the power factor at the POC, the EG should improve the power factor at the POC towards unity,		P
4.1.11.7	Unless otherwise agreed with the utility, the standard power factor setting shall be unity for the full power output range,		P
4.1.11.8	The maximum tolerance on the reactive power setting is 5 % of the rated active power,		P
4.1.11.9	For embedded generators of sub-category A3, the power factor shall be settable to operate according to a characteristic curve provided by the utility, if required by the utility, within the range 0.95 leading and 0.95 lagging; An example of a standard characteristic curve is shown in figure 3,		P
4.1.11.10	These limits apply, unless otherwise agreed upon with the utility (see annex A),		P
4.1.11.11	Equipment for reactive power compensation shall either:		P

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Clause	Requirement – Test	Result – Remark	Verdict
	a) be connected or disconnected with the embedded generator, or		P
	b) operated via automatic control equipment for disconnection when not required,		P
4.1.11.12	The requirement for and type of detuning for reactive power compensation devices will be agreed upon by the owner of the generator and utility, NOTE Detuning is highly recommended for all reactive power compensation devices to prevent (a) potential current overloading of capacitors due to existing voltage harmonics, (b) potential voltage transient amplification at the POC due to upstream switching conditions, and (c) potential resonance with the network impedance that may lead to excessive harmonic amplification,		P
4.1.12	Synchronization		P
4.1.12.1	All embedded generators shall synchronize with the utility network before the parallel connection is made, This applies to all embedded generators where a voltage exists at the generator terminals before connection with the utility network,		P
4.1.12.2	Automatic synchronization equipment shall be the only method of synchronization,		P
4.1.12.3	For a synchronous generator, the limits for the synchronizing parameters for each phase are: a) frequency difference: 0.3 Hz, b) voltage difference: 5 % of nominal voltage per phase, and c) phase angle difference: 20 ° (degrees),		N/A
4.1.12.4	Mains excited generators do not need to synchronise when the generator is started as a motor before generation starts,		N/A
4.1.12.5	Mains excited generators may require soft-starting when the start-up voltage change is anticipated to be more than 3 %,		P

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Clause	Requirement – Test	Result – Remark	Verdict
4.1.12.6	The start-up current for static power converters shall not exceed the full-power rated current of the generator,	Noticed	P
4.1.12.7	Also refer to 4.2.4 for re-synchronising conditions,	Noticed	P
4.1.12.8	The embedded generator shall synchronize with the utility network only when the voltage and frequency has been stable within the ranges provided in 4.2.2.3 for at least 60 seconds, NOTE Some utilities may require this to be longer than 60 seconds,	See appended table	P
4.1.13	Electromagnetic compatibility (EMC)	Inverter units approved by Dongguan BALUN Testing Technology Co., Ltd in accordance with NRS 097-2-1:2017 Edition 2.1 (Contents 4.1.13). Report No.: EMC test TW202302-025-2 ☆.	P
4.1.13.1	Electromagnetic compatibility (EMC) refers to the ability of equipment or a system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment. EMC comprises two components, namely a radiated and conducted component. Significant attention is given to radiated EMC due to the potential impact over larger distances. However, with advances in smart grids and business management systems, the potential impacts from conducted EMI must be considered. The conditions in 4.1.13.2 and 4.1.13.6 below apply to conducted unintentional signals, while clause 4.1.13.7 applies to radiated unintentional emissions from generating equipment.		P
4.1.13.2	All unintentional conducted emissions from generating equipment, in the frequency band 30 kHz to 150 kHz, shall be 9 dB μ V lower than		p

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Clause	Requirement – Test	Result – Remark	Verdict
	the compatibility levels specified in clause 4.12.3 of IEC 61000-2-2:2000+A2:2019 when measured in unsymmetrical voltage mode (i.e. between any phase or neutral and the earth) using a quasi-peak detector. An illustration of the limits is provided in Figure 4, below.		
4.1.13.3	The test method and set up for verifying compliance with 4.1.13.1, herein, shall be according to clause 7 of CISPR 16-2-1. The test receiver used for verification shall comply with clauses 4 and 5 of CISPR 16-1-1:2019, and the AMN or LISN used for verification shall comply with clause 4 of CISPR 16- 1-2. NOTE When measuring conducted emissions at high currents, for example at ≥ 25 A, during testing, the AMN or LISN can be connected as a voltage probe. See clause A.5 in Annexure A of CISPR 16-1-1.		P
4.1.13.4	All unintentional conducted emissions from generating equipment, in the frequency band above 150 kHz to 30 MHz, shall comply with SANS 211 (CISPR11), in particular limits for Class A group 1 (< 20 kVA).		P
4.1.13.5	The conducted emission requirement applies to all ports or connections to the utility supply, whether the connection is intended for monitoring, communication, power transfer or any other reason for connecting to the utility supply.		P
4.1.13.6	In the event of susceptibility to electromagnetic interference, the unit shall be fail-safe, i.e. any deviation from intended performance must comply with all relevant specifications, both in terms of safety (i.e. disconnection) and impact on the network.		P
4.1.13.7	Notwithstanding this, should any interference be experienced to existing or new ripple-control, building management system equipment and/or other PLC-based communication, the owner of the embedded		P

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Clause	Requirement – Test	Result – Remark	Verdict
	generator should take the necessary remedial action to prevent further interference as will be agreed with the utility or the other affected party.		
4.1.13.8	All radiated emissions from generating equipment shall comply with ICASA requirements.  Figure 4 — NRS 097-2-1 emission limits		P
4.1.14	Mains signalling (e.g, PLC and ripple control)	No such device	N/A
4.1.14.1	Mains signaling refers to intentional signals induced into the utility supply network, where the intention is to facilitate data transfer from one component to another,		N/A
4.1.14.2	All intentional emissions (communication signals) from generating equipment shall comply with limits for intentional emissions in SANS 50065-1, limited to an acceptable band as prescribed by SANS 50065-1,		N/A
4.1.14.3	Notwithstanding this, should any interference be experienced to existing or new ripple control, building management system equipment and/or other PLC-based communication, the owner of the embedded generator shall take the necessary remedial action to prevent further interference as will be agreed with the utility or the other affected party,		N/A
4.2	Safety protection and control		P
4.2.1	General The safe operation of the embedded generator in conjunction with the utility network shall be	Noticed	P

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Clause	Requirement – Test	Result – Remark	Verdict
	ensured at all times, Safe operation includes people and equipment safety		
	a) People safety: i) owner (including personnel and /or inhabitants of the property) of the embedded generator, ii) general public safety : iii) utility personnel; iv) general emergency response personnel, e.g, fire brigade should a fire arise at the embedded generator,	Noticed	P
	b) Equipment safety: i) Utility equipment; ii) Other customer's equipment connected to the same network(s);and iii) Generator own equipment,	Noticed	P
4.2.2	Safety disconnect from utility network		P
4.2.2.1	General	Derived from tests,	P
4.2.2.1.1	All SSEG shall comply with the safety requirements in accordance with SANS/IEC 62109-1 and IEC 62109-2, NOTE In principle, IEC 62109 documents only apply to PV inverters, However, other SSEG shall prove compliance to these safety requirements to the satisfaction of the utility,	Inverter units approved by Dongguan BALUN Testing Technology Co., Ltd. in accordance with IEC 62109-1:2010 and IEC 62109-2:2011. Report No.: BL-DG2250134-B01	P
4.2.2.1.2	The embedded generator shall automatically and safely disconnect from the grid in the event of an abnormal condition, Abnormal conditions include:	The inverters meet the requirements of IEC 62109-1:2010 and IEC 62109-2:2011	P
	a) network voltage or frequency out-of-bounds conditions,	See appended table	P
	b) loss-of-grid conditions,	See appended table	P
	c) d, c, current injection threshold exceeded (per phase),,	See appended table	P
	d) and residual d, c, current (phase and neutral currents summated),		P

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Clause	Requirement – Test	Result – Remark	Verdict
4.2.2.2	Disconnection device (previously disconnection switching unit)		P
4.2.2.2.1	The embedded generator shall be equipped with a disconnection device, which separates the embedded generator from the grid due to abnormal conditions, The disconnection unit may be integrated into one of the components of the embedded generator (for example the PV utility interconnected inverter) or may be an independent device installed between the embedded generator and the utility interface,		P
4.2.2.2.2	The disconnection switching unit shall be able to operate under all operating conditions of the utility network, NOTE It is the responsibility of the embedded generator owner to enquire about the operating conditions of the utility network, e, g, fault levels for the foreseeable future,	The disconnection switching unit was tested according the single fault safety of the IEC 62109-1:2010, See appended table	P
4.2.2.2.3	A failure within the disconnection device shall lead to disconnection of the generator from the utility supply and indication of the failure condition,	The disconnection switching unit was tested according the single fault safety of the IEC 62109-1:2010, See appended table	P
4.2.2.2.4	A single failure within the disconnection switching unit shall not lead to failure to disconnect, Failures with one common cause shall be taken into account and addressed through adequate redundancy,	The disconnection switching unit was tested according the single fault safety of the IEC 62109-1:2010, See appended table	P
4.2.2.2.5	The disconnection device shall disconnect the generator from the network by means of two series connected robust automated load disconnect switches,	The disconnection switching unit was tested according the single fault safety of the IEC 62109-1:2010, See appended table	P
4.2.2.2.6	Both switches shall be electromechanical switches,	Complied,	P
4.2.2.2.7	Each electromechanical switch shall disconnect the embedded generator on the neutral and the live wire(s),		P

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Clause	Requirement – Test	Result – Remark	Verdict
	NOTE The switching unit need not disconnect its sensing circuits,		
4.2.2.2.8	All rotating generating units, e.g, synchronous or asynchronous generating units shall have adequate redundancy in accordance with 4.2.2.2.5.	Not such type of SSEG,	N/A
4.2.2.2.9	A static power converter without simple separation shall make use of two series connected electromechanical disconnection switches,		P
4.2.2.2.10	The current breaking capacity of each disconnecting switch shall be appropriately sized for the application, In cases where the disconnecting device is an electromechanical switching device such as a contactor, this requires suitable coordination with the upstream short circuit protection device (circuit breaker),		P
4.2.2.2.11	Any programmable parameters of the disconnection switching unit shall be protected from interference by third-parties, i.e, password protected or access physically sealed,	Protected by password	P
4.2.2.2.12	In order to allow customers to supply their own load in isolated operation (islanded) where this is feasible and required, the disconnection device may be incorporated upstream of part of or all of a customers' loads, provided that none of the network disconnection requirements in this document are violated,	Rely in the responsibility of the installer	N/A
4.2.2.2.13	All EG installations larger than 30 kVA shall have a central disconnection device, NOTE 1 This requirement may be amended by the utility, i, e, the utility may require a central disconnection switch unit for any size and type of generator, NOTE 2 This requirement may be amended by the utility, The central disconnection switch unit will typically be waived only when a lockable disconnection switch, accessible to	Rely in the responsibility of the installer	N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	the utility, is installed, NOTE 3 This is an interim requirement based on requirements of VDE AR 4105 and will be revisited as more information becomes available,		
4.2.2.2.14	The network and system grid protection voltage and frequency relay for the central disconnection device will be type-tested and certified on its own (stand-alone tested), All clauses of 4,2,2, except 4,2,2,4 (anti-islanding) apply,	Rely in the responsibility of the installer	N/A
4.2.2.3.1	General		P
	The accuracy for voltage trip values shall be within 0 % to +1 % of the nominal voltage from the upper boundary trip setting. and within -1% to 0% of the nominal voltage from the lower boundary trip setting.	Noticed	P
	The accuracy for frequency trip values shall be within 0 to +0.1 % of the fundamental frequency from the upper boundary trip setting. and within -0.1 % to 0 % of the fundamental frequency from the lower boundary the trip setting.	Noticed	P
4.2.2.3.2	Overvoltage and undervoltage		P
	The embedded generator in sub-category A1 and A2 shall cease to energize the utility distribution system should the network voltage deviate outside the conditions specified in table 2. The following conditions shall be met. with voltages in r.m.s. and measured at the POC. NOTE 1 All discussions regarding system voltage refer to the nominal voltage. NOTE 2 At the time of publication. these settings are in contradiction to the RPP Grid Code. These may only be applied with exemption to the relevant clause or after the RPP Grid Code has been suitably amended. NOTE 3 Measurements at the generator terminals will generally be sufficient for the	See appended table	P

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Clause	Requirement – Test	Result – Remark	Verdict
	overvoltage settings. If the expected voltage drop across the cable connecting the EG to the POC is too high. undervoltage settings might have to be adjusted.		
	The purpose of the allowed time delay is to ride through short-term disturbances to avoid excessive nuisance tripping, The generator does not have to cease to energize if the voltage returns to the normal utility continuous operating condition within the specified trip time, NOTE Induction/synchronous generators need to be mindful of synchronisation issues and may have to apply faster trip times,	Noticed	P
	A customer with a multiphase connection shall monitor all phases for out-of-bounds voltage conditions, The EG shall be disconnected if an out-of-bounds voltage condition is detected on any of the phases,	Noticed	P
	In line with NRS 048-2, it is recommended that A1 and A2 SSEG be able to ride through at least Y and X1 type dips, i.e, not disconnect for these events, The purpose is to avoid excessive nuisance tripping,		N/A
	Category A3 SSEG shall be able to ride through low and/or high voltage events in accordance with the RPP Grid Code,		P
	The generator shall maintain the pre-dip current during any dip event for which it remains connected,	Noticed	P
	The ride-through and trip times are shown graphically in figure 4,	Noticed	P
4.2.2.3.3	Over-frequency and under-frequency		P
	This requirement is in line with the RPP Grid Code (version 2.8) and applies to all EG in category A.		P
	The embedded generation system shall cease to energize the utility network when the utility frequency deviates outside the specified	Noticed	P

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Clause	Requirement – Test	Result – Remark	Verdict
	conditions, Both over- and under-frequency conditions indicate system abnormal conditions and all generators are expected to assist in stabilising the system during such periods,		
	When the utility frequency is less than 47 Hz. the embedded generator shall disconnect from the utility network within 0.2 s.	See appended table	P
	While the utility frequency is in the range of 47 Hz and 50.5 Hz. the system shall operate normally. In order to prevent hysteresis switching (on-off toggling) during over-frequency conditions. the output power shall be reduced as follows: When the utility frequency exceeds 50.5 Hz. the active power available at the time shall be stored as the maximum power value PM; this value PM shall not be exceeded until the frequency has stabilized below 50.5 Hz for at least 4 seconds. The EG system shall control the output power as a function of PM at a gradient of 50 % per Hertz as illustrated in figure 5. The power generation shall follow the curve shown in figure 5 up and down while the system frequency is in the range 50.5 Hz to 52 Hz. When the utility frequency is more than 52 Hz for longer than 4 seconds. the embedded generator shall cease to energise the utility line within 0.5 s.	See appended table	P
4.2.2.3.3.1	Relaxation for non-controllable generators	See appended table	P
	Non-controllable generators may disconnect randomly within the frequency range 50.5 Hz to 52 Hz. The disconnect frequency for non-controllable generators will each be set at a random value by the manufacturer. with the option of changing this to a utility provided setting. The random disconnect frequency shall be		P

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Clause	Requirement – Test	Result – Remark	Verdict
	selected so that all generators from any specific manufacturer will disconnect uniformly over the range with 0.1 Hz increments.		
	When the utility frequency is more than the non-controllable generator over-frequency setpoint for longer than 4 seconds, the non-controllable generator shall cease to energise the utility line within 0,5 s, NOTE At the time of publication, this is in contradiction with the RPP Grid Code,		P
4.2.2.4	Prevention of islanding		P
4.2.2.4.1	A utility distribution network can become de-energized for several reasons: for example, a substation breaker that opens due to a fault condition or the distribution network might be switched off for maintenance purposes, Should the load and (embedded) generation within an isolated network be closely matched, then the voltage and frequency limits may not be triggered, If the embedded generator control system only made use of passive voltage and frequency out-of-bounds detection, this would result in an unintentional island that could continue beyond the allowed time limits,	See appended table	P
4.2.2.4.2	In order to detect an islanding condition, the embedded generator shall make use of at least one active islanding detection method, An active islanding detection method intentionally varies an output parameter and monitors the response or it attempts to cause an abnormal condition at the utility interface to trigger an out-of-bounds condition, If the utility supply is available, the attempt to vary an output parameter or cause an abnormal condition will fail and no response will be detected, However, if the utility supply network is de-energized, there will be a response to the change which can be detected, This signals	See appended table	P

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Clause	Requirement – Test	Result – Remark	Verdict
	an island condition to the embedded generator upon detection of which the embedded generator shall cease to energize the utility network within a specific time period,		
4.2.2.4.3	Active island detection shall be used in all cases where the EG interfaces with the utility network,	Noticed	P
4.2.2.4.4	An islanding condition shall cause the embedded generator to cease to energize the utility network within 2 s, irrespective of connected loads or other embedded generators, The embedded generator employing active islanding detection shall comply with the requirements of IEC 62116 (ed,1), NOTE Prevention of islanding measures is only considered on the embedded generator side, i.e, no utility installed anti-islanding measures are considered,	See appended table	P
4.2.2.4.5	All rotating generators shall use a minimum of two islanding detection methods (e.g, rate of-change-of-frequency and voltage vector shift detection due to the dead bands (slow detection) of islands in both methods), NOTE It is possible for a condition to exist, where a mains-excited generator becomes self-excited due to capacitance of the network (either cable capacitance or power factor correction), Under such conditions, the mains-excited generator will not disconnect from an island, hence effective islanding detection is required for all rotating generators,		P
4.2.2.4.6	Passive methods of islanding detection shall not be the sole method to detect an island condition, When used, passive methods of islanding detection shall be done by three-phase voltage detection and shall be verified by an AC voltage source,	Both methods of active and passive island detection are used	P
4.2.2.4.7	The embedded generator shall physically disconnect from the utility network in	See 4.2.2.2.	P

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Clause	Requirement – Test	Result – Remark	Verdict
	accordance with the requirements in 4.2.2.2.		
4.2.2.5	DC current injection		P
	The embedded generator shall not inject d.c. current greater than 0.5 % of the rated a.c. output current into the utility interface under any operating condition. measured over a 1-minute interval. The EG shall cease to energize the utility network within 500 ms if this threshold is exceeded.	See appended table,	P
4.2.3	No requirements for emergency personnel safety (e.g, fire brigade) existed at the time of publication, It is expected that such issues will be dealt with in other documents, e,g, OHS Act, SANS 10142-1,	Rely in the responsibility of the installer	N/A
4.2.4	Response to utility recovery		P
4.2.4.1	The embedded generator shall ensure synchronisation before re-energizing at all times in accordance with 4.1.12.	Complied	P
4.2.4.2	After a voltage or frequency out-of-range condition that has caused the embedded generator to cease energizing the utility network, the generator shall not re-energize the utility network until the utility service voltage and frequency have remained within the specified ranges for a continuous and uninterrupted period of 60 s, The reconnection shall commence as follows:	See appended table	P
4.2.4.2.1	Non-controllable generators may connect randomly within the 1 minute to 10 minute period after voltage and frequency recovery (period includes the 60 s to confirm recovery). The delay for non-controllable generators will each be set at a random value by the manufacturer. with the option of changing this to a utility provided setting. The random value shall be selected so that no more than 2 % of generators from any specific manufacturer will reconnect within 10s of each other.	Not such type of SSEG	N/A
4.2.4.2.2	Controllable generators may reconnect	See appended table,	P

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Clause	Requirement – Test	Result – Remark	Verdict
	immediately after the 60 s delay confirming recovery of the system voltage and frequency at a maximum rate of 10 % of rated power per minute, i.e, full power output will only be reached after 10 minutes, This ramp rate may be modified at the request of the utility or in consultation with the utility,		
4.2.5	Isolation		N/A
4.2.5.1	In line with SANS 10142-1 (as amended), each energy source should have its own, appropriately rated, isolation device,		N/A
4.2.5.2	It is expected that isolation requirements will be dealt with in more detail in future in e.g. SANS 10142-1/3. Such requirements shall supersede 4.2.5,		N/A
4.2.5.3	The embedded generator shall provide a means of isolating from the utility interface in order to allow for safe maintenance of the EG, The disconnection device shall be a double pole for a single-phase EG, a three-pole for a three-phase delta-connected EG, and a four-pole for a three-phase star-connected EG, The grid supply side shall be wired as the source	The installation instructions specify a disconnection device for the final installation, The correct assembling is part of the installer	N/A
4.2.5.4	The breaking capacity of the isolation circuit-breaker closest to the point of utility connection shall be rated appropriately for the installation point in accordance with SANS 60947-2, This disconnection device does not need to be accessible to the utility	Rely in the responsibility of the installer and is stated in the installation instruction of the manufacturer	N/A
4.2.5.5	For dedicated supplies. a means shall be provided of isolating from the point of supply in order to allow for safe maintenance of the utility network. The disconnection device shall be a double pole for a single-phase EG. a three-pole for a three-phase delta-connected EG. and a four-pole for a three-phase star-connected EG.		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	This disconnection device shall be lockable and accessible to the utility. NOTE 1 A device inside a lockable box is deemed a lockable device. NOTE 2 This disconnection device may become the new point of control as defined by SANS10142-1.		
4.2.5.6	The requirement for the utility accessible disconnection device may only be waived by the utility where the risk to the network is deemed acceptable to the utility, Such permission shall be provided in writing, NOTE Full verification form to be signed off and accepted by the utility,		N/A
4.2.6	Earthing		P
4.2.6.1	The electrical installation shall be earthed in accordance with SANS 10142-1 (as applicable), The earthing requirements for different embedded generation configurations in conjunction with the customer network are described in annex B for the most common earthing systems, NOTE SANS 10142-1 applies to EG feeding a UPS and no connection to the utility supply (see table B5),		N/A
4.2.6.2	Installations with utility-interconnected inverters without simple separation shall make use of earth leakage protection which are able to respond to d.c. fault currents including smooth d.c. fault currents (i.e. without zero crossings) according to IEC 62109-2 unless the inverter can exclude the occurrence of d.c. earth fault currents on any phase. neutral or earth connection through its circuit design¹). This function may be internal or external to the inverter. NOTE IEC 62109-2. Edition 2011. section 4.8.3.5 gives selection criteria for RCD sensitivities.		P
4.2.6.3	Where an electrical installation includes a PV	The RCD protection is provided	N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	power supply system without at least simple separation between the AC side and the DC side. an integrated RCD function shall be present to provide fault protection by automatic disconnection of supply shall be type B according to IEC/TR 60755. amendment 2. Where the PV inverter by construction is not able to feed DC fault currents into the electrical installation. an RCD of type B according to IEC/TR 60755 amendment 2 is not required. NOTE 1 Consideration must also be given to ensure that any d.c. currents do not impair the effectiveness of any other RCD'S installed throughout the a.c. system. NOTE 2 The earth leakage unit may also fulfil the requirement of the all-pole disconnection device as stated in 4.2.6. NOTE 3 The function of this RCD is not to provide protection against circulating d.c. currents in the inverter and a.c. supply. i.e. does not override 4.1.8.	integral to the unit.	
4.2.7	Short-circuit protection		N/A
4.2.7.1	The embedded generator shall have suitably rated short-circuit protection at the connection to the AC mains in accordance with SANS 10142-1 and 3,	Rely in the responsibility of the installer and is stated in the installation instruction of the manufacturer,	N/A
4.2.7.2	The short-circuit characteristics for the SSEG shall be supplied to the utility,	Rely in the responsibility of the installer and is stated in the installation instruction of the manufacturer,	N/A
4.2.8	Maximum short-circuit contribution		P
	Embedded generators have the potential to increase the fault level of the network to which it is connected, In order to limit the fault level changes in low voltage networks and allow coordination of fault levels with the utility, no generator will exceed the following fault level contribution: NOTE At the time of installation, the	See below,	P

NRS 097-2-1			
Clause	Requirement – Test	Result – Remark	Verdict
	short-circuit capacity of all existing equipment should be confirmed and upgraded where necessary, Suitable fault current limiting devices may be required to ensure a safe installation, The potential impact on neighbouring installations should also be considered to ensure that those installations remain safe,		
	a) for synchronous generators: 8 times the rated current;		N/A
	b) for asynchronous generators: 6 times the rated current; and		N/A
	c) for generators with inverters: 1 times the rated current,		P
4.2.9	Labelling		P
4.2.9.1	A label on the distribution board of the premises where the embedded generator is connected shown in figure 6, shall state: “WARNING: ON-SITE EMBEDDED GENERATION , DO NOT WORK ON THIS EQUIPMENT UNTIL IT IS ISOLATED FROM BOTH MAINS AND ON-SITE GENERATION SUPPLIES,” or similar warning, Disconnection points for all supplies shall be indicated,		P
4.2.9.2	The label shall be permanent with lettering of height at least 8 mm,		P
4.2.9.3	The label shall comply to requirements of SABS 1186-1, 		P
4.2.9.4	The absence of emergency shutdown capabilities will be indicated on signage in accordance with 4.2.2. 		P
4.2.10	Robustness requirements		P
	According to 4.2.2.1 all SSEG shall comply	Inverter is tested according to	P

NRS 097-2-1			
Clause	Requirement – Test	Result – Remark	Verdict
	with safety requirements in accordance to SANS/IEC 62109-1 and IEC 62109-2. NOTE This section will be expanded in future revisions.	IEC 62109-1:2010 and IEC 62109-2:2011	
4.3	Metering	Rely in the responsibility of the installer and is stated in the installation instruction of the manufacturer	N/A
Annex A	Notes to purchase	Rely in the responsibility of the installer and is stated in the installation instruction of the manufacturer	N/A
Annex B	Earthing system	Rely in the responsibility of the installer and is stated in the installation instruction of the manufacturer	N/A
Annex C	Network impedance	Rely in the responsibility of the installer and is stated in the installation instruction of the manufacturer	N/A
Annex D	(Annex A of VDE-AR-N 4105) Explanations (normative)	Noticed	P
Annex E	(Annex B of VDE-AR-N 4105) Connection examples (normative)	Rely in the responsibility of the installer and is stated in the installation instruction of the manufacturer,	N/A
Annex F	(Annex C of VDE-AR-N 4105) Example of meter panel configurations (normative)	Rely in the responsibility of the installer and is stated in the installation instruction of the manufacturer	N/A
Annex G	Generation management network security management (normative)	Noticed	P

Clause	Test	Result
4.	Type test:	
4.1.5	Voltage fluctuations and Flicker	P
4.1.6	Voltage unbalance	P
4.1.8	DC injection	N/A
4.1.10	Harmonics and waveform distortion	P
4.1.11.3	Power factor (no controllable reactive power)	P
4.1.11.3	Power factor (Fixed $\cos \varphi$)	P
4.1.11.9	Test for a displacement factor/active power characteristic curve $\cos \varphi$ (P) (For embedded generators of sub-category A3)	P
4.1.12	Synchronization	P
4.2.2	Safety disconnect from utility network Response to protection operation - fault condition tests (according VDE AR-N 4105:2018 and VDE0124-100:2020)	P
4.2.2.3.2	Over voltage and under voltage	P
4.2.2.3.2	Low voltage fault Ride through capability	P
4.2.2.3.3	Over-frequency and under-frequency	P
4.2.2.3.3	Active power feed-in for over-frequency	P
4.2.2.4	Preventing of islanding	P

4.1.5 Voltage fluctuation and flicker					P
Test conditions:		Maximum permissible voltage fluctuation (expressed as a percentage of nominal voltage at 100 % power) and flicker as per EN 61000-3-11			
		Starting	Stopping	Running	
Limit		3.3%	3.3%	P _{st} =0.35	P _{lt} =0.30
Test value	L1 Phase	0.06	0.02	0.17	0.17
	L2 Phase	0.04	0.04	0.16	0.16
	L3 Phase	0.01	0.01	0.16	0.17
inverter >16A					
Limit		dc% = 3.3		P _{st} =0.35	P _{lt} =0.30
Test value	L1 Phase	0.034		0.053	0.030
	L2 Phase	0.031		0.030	0.028
	L3 Phase	0.037		0.059	0.038
Note: Mains Impedance according EN61000-3-11: R _{max} = 0.24Ω; jX _{max} = 0.15Ω @50Hz (Z _{max} = 0.283/0.4717Ω) for single phase inverter use also R _n = 0.16Ω; jX _n = 0.1Ω Calculation of the maximum permissible grid impedance at the point of common coupling based on d _c : Z _{max} = Z _{ref} * 3.3% / d _c (P _n) The tests should be based on the limits of the EN 61000-3-11 for more than 16A.					

Rapid voltage changes			P
The purpose of the test is to determine k_i and k_{imax} .			
The following three cases must be tested to VDE-AR-N 4105. Annex F.3 (where applicable).			
- Switch-on for any capacity - Unfavourable case when switching the generator step - Switch-on for nominal capacity			
Note: For PV-plants the inverter is the generator			
Switch-off for nominal capacity (no emergency shutdown. but operative shutdown)			
Test conditions:			
Frequency: 50 Hz ± 0.5%			
THD of the voltage supply: ≤ 3 %			
Voltage rise of the PGU at 100 P_{Emax} %: ≤ 3 %			
Model: JKH30LTA			
Switch-on for any capacity (10% P_{Emax})			
Single period effective values of the current [A]	16.10	11.94	16.57
Single period effective values of the voltage [V]	229.01	229.04	229.21
k_i value	0.371	0.275	0.381
k_{imax} value	0.381		
Switch-on for nominal capacity			
Single period effective values of the current [A]	18.43	17.11	16.65
Single period effective values of the voltage [V]	229.37	229.49	230.09
k_i value	0.424	0.394	0.383
k_{imax} value	0.424		
Switch-off for nominal capacity			
Single period effective values of the current [A]	18.88	18.69	18.67
Single period effective values of the voltage [V]	230.12	230.57	229.98
k_i value	0.434	0.430	0.429
k_{imax} value	0.434		
Highest k_{imax} value for all switching operations			
0.434			

Model: JKH50LTA			
Switch-on for any capacity (10% P_{Emax})			
Single period effective values of the current [A]	18.40	13.32	16.46
Single period effective values of the voltage [V]	230.80	229.57	229.55
k_i value	0.254	0.184	0.227
k_{imax} value	0.254		
Switch-on for nominal capacity			
Single period effective values of the current [A]	18.19	14.09	12.48
Single period effective values of the voltage [V]	229.44	228.95	228.98
k_i value	0.251	0.194	0.172
k_{imax} value	0.251		
Switch-off for nominal capacity			
Single period effective values of the current [A]	18.68	18.23	19.74
Single period effective values of the voltage [V]	229.87	238.75	229.415
k_i value	0.258	0.252	0.272
k_{imax} value	0.272		
Highest k_{imax} value for all switching operations			
0.272			

Model: JKH100LTA			
Switch-on for any capacity (10% P_{Emax})			
Single period effective values of the current [A]	20.68	19.61	18.03
Single period effective values of the voltage [V]	232.02	229.50	229.46
k_i value	0.143	0.135	0.124
k_{imax} value	0.143		
Switch-on for nominal capacity			
Single period effective values of the current [A]	15.87	17.44	15.69
Single period effective values of the voltage [V]	229.91	232.09	229.28
k_i value	0.110	0.120	0.108
k_{imax} value	0.120		
Switch-off for nominal capacity			
Single period effective values of the current [A]	14.80	16.51	20.00
Single period effective values of the voltage [V]	228.98	229.25	229.53
k_i value	0.102	0.114	0.138
k_{imax} value	0.138		
Highest k_{imax} value for all switching operations			
0.143			

Model: JKH150LTA			
Switch-on for any capacity (10% P_{Emax})			
Single period effective values of the current [A]	20.35	18.69	23.18
Single period effective values of the voltage [V]	229.48	229.54	230.97
k_i value	0.094	0.086	0.107
k_{imax} value	0.107		
Switch-on for nominal capacity			
Single period effective values of the current [A]	20.80	16.88	18.24
Single period effective values of the voltage [V]	228.97	229.56	231.52
k_i value	0.096	0.078	0.084
k_{imax} value	0.096		
Switch-off for nominal capacity			
Single period effective values of the current [A]	24.90	17.79	18.04
Single period effective values of the voltage [V]	228.62	228.74	229.99
k_i value	0.115	0.082	0.083
k_{imax} value	0.115		
Highest k_{imax} value for all switching operations			
0.115			

Flicker

These tests are designed to provide evidence that the requirements of VDE-AR-N 4105. 5.4.3 are met.

The purpose of the test is to determine long-term flicker strength P_{lt} .

For power generation systems with rated currents of up to 75 A. reactions are deemed to be limited sufficiently. if the power generation units comply with the limit values given in DIN EN 61000-3-3 (VDE 0838-3) or DIN EN 61000-3-11 (VDE 0838-11). respectively.

Test conditions:

Voltage: 86% U_n to 109% U_n

Frequency: 50 Hz $\pm$ 0.5%

THD of the voltage supply: $\leq 3\%$

Voltage rise of the PGU at 100 P_{Emax} %: $\leq 3\%$

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

Flicker to:		Result:		
		P_{lt}	P_{st}	dc%
DIN EN 61000-3-11	L1 Phase	0.03	0.03	0.01
	L2 Phase	0.03	0.03	0.01
	L3 Phase	0.04	0.03	0.01
	Limit	0.65	1.00	3.30

Flicker to DIN EN 61400-21 (VDE 0127-21) (or FGW TR3)

Grid impedance angle ψ_k	32°
Flicker coefficient $c(\psi_k)$	0.756
Short-term flicker P_{st}	0.031

Assessment criterion:

Determination of the flicker coefficient:

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

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

$$R_A = 0.24\Omega \quad j_{XA} = 0.15\Omega$$

$$R_N = 0.16\Omega \quad j_{XN} = 0.10\Omega$$

4.1.6 Calculation of asymmetry						P
Setting values	cos φ = 1:			1.000		
	cos φ over-excited:			-0.800		
	cos φ under-excited:			0.800		
1-min mean value	L1	L2	L3	L1 – L2	L2 – L3	L3 – L1
a) cos φ = 1 at 100 % P _n ± 5 % P _n						
S _{E60} [VA]:	50619.08	48459.46	50303.50	2159.62	-1844.04	-315.58
	50596.97	48445.86	50341.23	2151.11	-1895.37	-255.74
	50639.59	48509.70	50236.47	2129.89	-1726.77	-403.12
	50622.62	48395.72	50351.96	2226.90	-1956.24	-270.66
	50666.06	48418.59	50298.94	2247.48	-1880.35	-367.13
cos φ _{E60} :	0.9977					
Max. asymmetry [VA]:	2247.48					
U ₆₀ [V]:	230.11	230.15	230.13	-0.04	0.02	0.02
	230.11	230.16	230.14	-0.05	0.02	0.03
	230.11	230.17	230.13	-0.06	0.04	0.02
	230.12	230.15	230.16	-0.03	-0.01	0.04
	230.12	230.16	230.14	-0.04	0.02	0.02
Max. asymmetry [V]:	-0.06					
Max. asymmetry [%]:	-0.026					
b) maximum under-excited (i) at 100 % P _n ± 5 % P _{Emax}						
S _{E60} [VA]:	63282.46	60923.49	62365.66	2358.97	-1442.17	-916.80
	63251.36	60842.97	62457.77	2408.39	-1614.80	-793.58
	63346.10	60785.45	62415.02	2560.65	-1629.57	-931.08
	63244.13	60849.91	62449.01	2394.21	-1599.10	-795.12
	63268.24	60791.72	62511.90	2476.52	-1720.18	-756.34
cos φ _{E60} :	-0.802					
Max. asymmetry [VA]:	2560.65					
U ₆₀ [V]:	229.46	229.42	229.28	0.05	0.13	-0.18
	229.47	229.42	229.25	0.05	0.17	-0.22
	229.47	229.41	229.29	0.06	0.12	-0.17
	229.48	229.41	229.30	0.07	0.12	-0.18

	229.48	229.43	229.29	0.05	0.14	-0.19
Max. asymmetry [V]:	-0.22					
Max. asymmetry [%]:	-0.096					
c) maximum over-excited (c) at 100 % P _n ± 5 % P _{Emax}						
S _{E60} [VA]:	63120.19	60284.60	62575.95	2835.59	-2291.35	-544.25
	63021.58	60353.31	62582.43	2668.27	-2229.12	-439.15
	63027.70	60364.95	62548.70	2662.74	-2183.75	-479.00
	63097.54	60281.96	62584.33	2815.58	-2302.37	-513.21
	63106.32	60266.09	62581.86	2840.23	-2315.77	-524.46
cos φ _{E60} :	0.801					
Max. asymmetry [VA]:	2840.23					
U ₆₀ [V]:	230.91	230.83	230.85	0.08	-0.02	-0.05
	230.90	230.83	230.83	0.07	0.01	-0.07
	230.90	230.83	230.82	0.08	0.00	-0.08
	230.90	230.83	230.86	0.08	-0.03	-0.05
	230.91	230.84	230.85	0.06	-0.01	-0.06
Max. asymmetry [V]:	0.08					
Max. asymmetry [%]:	0.035					
d) cos φ = 1 at 50 % P _n ± 5 % P _{Emax}						
S _{E60} [VA]:	25307.64	24147.39	25114.40	1160.25	-967.01	-193.24
	25322.90	24163.75	25081.55	1159.15	-917.80	-241.36
	25336.73	24158.16	25072.11	1178.58	-913.95	-264.62
	25337.85	24151.13	25078.48	1186.72	-927.35	-259.37
	25334.27	24159.26	25084.36	1175.01	-925.10	-249.90
cos φ _{E60} :	0.997					
Max. asymmetry [VA]:	1186.72					
U ₆₀ [V]:	230.17	230.13	230.19	0.04	-0.05	0.01
	230.18	230.13	230.19	0.05	-0.06	0.01
	230.17	230.15	230.18	0.02	-0.03	0.01
	230.18	230.14	230.17	0.04	-0.03	-0.01
	230.17	230.13	230.18	0.04	-0.05	0.01
Max. asymmetry [V]:	-0.06					
Max. asymmetry [%]:	0.026					
e) maximum under-excited (i) at 50 % P _n ± 5 % P _{Emax}						

S _{E60} [VA]:	31782.57	30409.10	31124.58	1373.47	-715.48	-657.99
	31732.11	30450.84	31183.76	1281.27	-732.92	-548.35
	31685.80	30452.76	31176.00	1233.04	-723.24	-509.80
	31707.24	30419.25	31183.52	1287.99	-764.27	-523.72
	31749.68	30384.97	31189.05	1364.70	-804.08	-560.62
cos φ _{E60} :	-0.801					
Max. asymmetry [VA]:	1373.47					
U ₆₀ [V]:	229.49	229.49	229.28	0.00	0.22	-0.22
	229.49	229.47	229.31	0.02	0.15	-0.18
	229.51	229.46	229.33	0.06	0.13	-0.18
	229.50	229.46	229.32	0.04	0.13	-0.18
	229.51	229.46	229.30	0.05	0.17	-0.21
Max. asymmetry [V]:	0.22					
Max. asymmetry [%]:	0.096					
f) maximum over-excited (c) at 50 % P _n ± 5 % P _{Emax}						
S _{E60} [VA]:	31651.47	30100.90	31281.13	1550.57	-1180.23	-370.34
	31665.01	30052.41	31307.08	1612.60	-1254.67	-357.93
	31613.12	30118.86	31287.61	1494.26	-1168.75	-325.51
	31648.75	30057.39	31316.75	1591.36	-1259.36	-332.00
	31634.49	30100.90	31289.46	1533.59	-1188.56	-345.03
cos φ _{E60} :	0.801					
Max. asymmetry [VA]:	1612.60					
U ₆₀ [V]:	230.83	230.85	231.04	-0.02	-0.18	0.20
	230.83	230.83	231.04	0.01	-0.21	0.21
	230.83	230.82	231.06	0.00	-0.23	0.23
	230.83	230.86	231.02	-0.03	-0.17	0.20
	230.84	230.85	231.03	-0.01	-0.18	0.18
Max. asymmetry [V]:	-0.23					
Max. asymmetry [%]:	-0.1					
Power Limit [VA]:	4600					
Voltage Limit [%]:	0.2					

4.1.8 DC-Injection				N/A	
Test conditions:					
DC Injection [A]	Limits	Trip Time [ms]			
L1 Phase					
+1A	I _{DC} :>0.5% than disconnection within 0.5 sec	--	--	--	
-1A		--	--	--	
L2 Phase					
+1A	I _{DC} :>0.5% than disconnection within 0.5 sec	--	--	--	
-1A		--	--	--	
L3 Phase					
+1A	I _{DC} :>0.5% than disconnection within 0.5 sec	--	--	--	
-1A		--	--	--	
Note: The unit has isolation transformer.					

4.1.8 DC-Injection (Monitoring)				N/A
Limit:		0.5% of I _{nom} (mA)		
Output power:		25%	50%	100%
max test value:	L1 Phase [mA]	--	--	--
	L2 Phase [mA]	--	--	--
	L3 Phase [mA]	--	--	--
Note: The unit has isolation transformer.				

4.1.10 Harmonics and waveform distortion**P**

The currents of the interharmonics to 2 kHz must be measured in accordance with IEC 61000-4-7, Annex A, The measurements of higher-frequency harmonic currents between 2 kHz and 9 kHz must be conducted in line with IEC 61000-4-7, Annex B,

Model: JKH150LTA**Harmonics**

P/P _n [%]	0/5	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2	0.354	0.253	0.290	0.403	0.571	0.539	0.601	0.524	0.524	0.681	0.464
3	3.191	2.626	2.604	2.794	2.416	2.886	2.643	3.151	3.324	3.137	3.227
4	0.705	0.371	0.667	0.925	0.128	0.781	0.307	0.849	0.844	0.335	0.384
5	2.919	3.264	3.995	4.085	3.661	3.379	2.887	2.849	2.666	2.271	2.141
6	0.237	0.170	0.264	0.296	0.627	0.257	0.603	0.286	0.274	0.563	0.553
7	1.307	1.651	1.396	1.759	1.758	2.012	1.751	1.791	1.644	1.397	1.285
8	0.028	0.173	0.120	0.053	0.381	0.071	0.409	0.060	0.058	0.403	0.390
9	0.354	0.352	0.372	0.380	0.323	0.450	0.299	0.490	0.474	0.283	0.271
10	0.144	0.130	0.150	0.191	0.121	0.141	0.070	0.169	0.172	0.070	0.065
11	0.370	0.404	0.523	0.326	0.341	0.404	0.255	0.431	0.438	0.304	0.306
12	0.030	0.055	0.033	0.035	0.099	0.036	0.059	0.034	0.049	0.071	0.046
13	0.214	0.285	0.161	0.196	0.207	0.228	0.157	0.152	0.171	0.205	0.252
14	0.122	0.147	0.110	0.073	0.076	0.081	0.064	0.091	0.100	0.065	0.060
15	0.065	0.096	0.100	0.059	0.119	0.047	0.077	0.031	0.046	0.054	0.041
16	0.083	0.098	0.112	0.102	0.163	0.112	0.160	0.150	0.143	0.152	0.150
17	0.132	0.140	0.131	0.202	0.103	0.169	0.247	0.230	0.195	0.145	0.087
18	0.027	0.035	0.038	0.046	0.083	0.045	0.069	0.044	0.053	0.086	0.115
19	0.049	0.103	0.178	0.167	0.130	0.085	0.096	0.234	0.279	0.199	0.155
20	0.146	0.155	0.098	0.096	0.078	0.095	0.094	0.113	0.128	0.103	0.124
21	0.089	0.082	0.060	0.040	0.046	0.049	0.068	0.099	0.098	0.096	0.104
22	0.123	0.150	0.121	0.122	0.149	0.187	0.167	0.215	0.210	0.158	0.153
23	0.068	0.072	0.064	0.080	0.067	0.050	0.068	0.084	0.144	0.278	0.325
24	0.035	0.032	0.030	0.054	0.105	0.062	0.043	0.052	0.071	0.077	0.078
25	0.204	0.198	0.223	0.206	0.239	0.199	0.235	0.191	0.194	0.240	0.250
26	0.062	0.083	0.060	0.052	0.042	0.047	0.071	0.071	0.074	0.098	0.105
27	0.040	0.031	0.036	0.055	0.033	0.038	0.028	0.032	0.036	0.039	0.035
28	0.070	0.082	0.081	0.077	0.060	0.073	0.058	0.061	0.067	0.072	0.076
29	0.056	0.054	0.060	0.054	0.084	0.050	0.047	0.048	0.043	0.065	0.048
30	0.076	0.082	0.077	0.103	0.114	0.117	0.097	0.061	0.054	0.061	0.075
31	0.030	0.018	0.052	0.067	0.038	0.062	0.041	0.030	0.040	0.028	0.031
32	0.047	0.055	0.052	0.050	0.045	0.046	0.051	0.048	0.045	0.050	0.043
33	0.020	0.020	0.029	0.034	0.024	0.023	0.025	0.022	0.028	0.021	0.025
34	0.058	0.074	0.090	0.103	0.103	0.060	0.080	0.096	0.101	0.106	0.116

35	0.024	0.018	0.017	0.020	0.038	0.018	0.040	0.024	0.018	0.022	0.020
36	0.118	0.122	0.113	0.126	0.132	0.176	0.155	0.145	0.123	0.097	0.019
37	0.022	0.028	0.018	0.026	0.028	0.039	0.021	0.026	0.025	0.020	0.019
38	0.039	0.039	0.032	0.033	0.038	0.027	0.035	0.025	0.023	0.028	0.029
39	0.019	0.025	0.019	0.013	0.015	0.019	0.019	0.016	0.016	0.015	0.016
40	0.023	0.025	0.025	0.033	0.037	0.027	0.031	0.028	0.031	0.037	0.038
41	0.021	0.023	0.019	0.020	0.024	0.017	0.023	0.019	0.027	0.029	0.027
42	0.024	0.024	0.022	0.025	0.027	0.031	0.031	0.031	0.032	0.031	0.029
43	0.020	0.024	0.013	0.020	0.019	0.018	0.016	0.016	0.016	0.016	0.016
44	0.028	0.031	0.028	0.025	0.029	0.020	0.022	0.017	0.017	0.030	0.020
45	0.015	0.023	0.020	0.010	0.014	0.014	0.016	0.012	0.014	0.017	0.016
46	0.049	0.048	0.047	0.056	0.055	0.050	0.052	0.049	0.049	0.052	0.053
47	0.016	0.018	0.016	0.016	0.019	0.016	0.019	0.018	0.019	0.018	0.019
48	0.047	0.048	0.045	0.052	0.057	0.053	0.056	0.052	0.050	0.053	0.053
49	0.023	0.029	0.016	0.019	0.021	0.026	0.025	0.024	0.024	0.022	0.022
50	0.011	0.011	0.020	0.014	0.019	0.014	0.014	0.014	0.013	0.014	0.016
51	0.054	0.064	0.062	0.056	0.066	0.058	0.067	0.058	0.057	0.066	0.067
52	0.035	0.035	0.035	0.036	0.037	0.036	0.037	0.035	0.035	0.037	0.037
53	0.008	0.009	0.008	0.009	0.011	0.010	0.010	0.011	0.011	0.011	0.012
54	0.042	0.043	0.043	0.042	0.046	0.042	0.046	0.042	0.042	0.046	0.046
55	0.305	0.305	0.312	0.313	0.321	0.306	0.316	0.306	0.305	0.315	0.315
56	0.041	0.052	0.037	0.030	0.045	0.033	0.041	0.034	0.034	0.040	0.040
57	0.244	0.251	0.246	0.248	0.268	0.250	0.271	0.251	0.251	0.271	0.137
58	0.034	0.034	0.033	0.034	0.035	0.034	0.035	0.035	0.035	0.035	0.035
59	0.009	0.009	0.009	0.009	0.010	0.010	0.010	0.010	0.011	0.011	0.011
60	0.020	0.020	0.021	0.021	0.023	0.021	0.023	0.021	0.021	0.023	0.023

Interharmonics at continuous operation

P/P _n [%]	0	10	20	30	40	50	60	70	80	90	100
f [Hz]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]
75	0.582	0.469	0.564	0.664	0.766	0.760	0.770	0.776	0.782	0.803	0.764
125	0.503	0.472	0.538	0.565	0.611	0.550	0.593	0.569	0.569	0.611	0.563
175	0.331	0.307	0.396	0.412	0.418	0.385	0.417	0.394	0.400	0.414	0.384
225	0.291	0.341	0.336	0.303	0.324	0.296	0.318	0.304	0.311	0.316	0.301
275	0.239	0.296	0.293	0.252	0.257	0.240	0.255	0.250	0.249	0.256	0.242
325	0.147	0.147	0.185	0.177	0.191	0.167	0.175	0.161	0.157	0.165	0.147
375	0.129	0.124	0.168	0.163	0.158	0.144	0.146	0.139	0.136	0.139	0.126
425	0.107	0.134	0.122	0.118	0.123	0.116	0.122	0.118	0.121	0.123	0.116
475	0.098	0.116	0.111	0.106	0.113	0.105	0.113	0.108	0.109	0.114	0.107
525	0.079	0.082	0.090	0.102	0.096	0.079	0.090	0.086	0.090	0.100	0.088
575	0.074	0.085	0.087	0.096	0.091	0.077	0.089	0.082	0.085	0.101	0.083
625	0.071	0.086	0.088	0.093	0.094	0.077	0.084	0.072	0.077	0.090	0.081
675	0.072	0.081	0.085	0.096	0.085	0.075	0.077	0.072	0.075	0.081	0.082
725	0.058	0.069	0.073	0.067	0.070	0.065	0.066	0.064	0.066	0.068	0.065

775	0.058	0.066	0.070	0.067	0.072	0.065	0.070	0.072	0.069	0.071	0.072
825	0.065	0.069	0.076	0.085	0.076	0.078	0.088	0.090	0.083	0.078	0.075
875	0.064	0.065	0.077	0.080	0.082	0.076	0.094	0.083	0.079	0.084	0.072
925	0.069	0.074	0.095	0.089	0.103	0.078	0.101	0.089	0.098	0.109	0.089
975	0.084	0.091	0.116	0.131	0.113	0.103	0.102	0.095	0.101	0.099	0.086
1025	0.075	0.080	0.090	0.086	0.091	0.082	0.088	0.082	0.081	0.092	0.082
1075	0.093	0.101	0.138	0.124	0.124	0.136	0.122	0.149	0.155	0.125	0.137
1125	0.103	0.106	0.106	0.116	0.132	0.120	0.129	0.113	0.120	0.135	0.111
1175	0.174	0.172	0.176	0.169	0.127	0.172	0.118	0.173	0.176	0.119	0.181
1225	0.181	0.170	0.172	0.180	0.217	0.183	0.222	0.180	0.183	0.216	0.183
1275	0.378	0.373	0.350	0.357	0.435	0.358	0.435	0.352	0.349	0.432	0.350
1325	0.084	0.081	0.092	0.090	0.088	0.081	0.094	0.080	0.078	0.097	0.075
1375	0.092	0.083	0.126	0.116	0.098	0.110	0.109	0.130	0.138	0.131	0.140
1425	0.055	0.059	0.062	0.061	0.072	0.060	0.066	0.058	0.059	0.068	0.059
1475	0.073	0.071	0.079	0.077	0.076	0.073	0.066	0.077	0.079	0.070	0.079
1525	0.055	0.053	0.061	0.063	0.073	0.064	0.072	0.060	0.063	0.072	0.059
1575	0.053	0.057	0.075	0.063	0.072	0.059	0.068	0.070	0.081	0.096	0.082
1625	0.048	0.052	0.055	0.054	0.055	0.051	0.054	0.050	0.051	0.057	0.051
1675	0.065	0.061	0.075	0.081	0.083	0.082	0.087	0.078	0.073	0.080	0.065
1725	0.061	0.064	0.065	0.065	0.070	0.064	0.071	0.066	0.066	0.069	0.063
1775	0.061	0.053	0.058	0.063	0.058	0.065	0.057	0.065	0.060	0.056	0.062
1825	0.044	0.045	0.045	0.046	0.061	0.048	0.063	0.051	0.050	0.061	0.046
1875	0.040	0.041	0.048	0.042	0.052	0.042	0.053	0.047	0.047	0.052	0.044
1925	0.041	0.043	0.043	0.042	0.049	0.044	0.050	0.044	0.045	0.051	0.045
1975	0.053	0.050	0.054	0.055	0.068	0.053	0.064	0.053	0.054	0.074	0.062
2025	0.038	0.040	0.038	0.040	0.047	0.040	0.048	0.042	0.043	0.048	0.042
2075	0.046	0.045	0.043	0.045	0.047	0.044	0.048	0.045	0.045	0.052	0.049
2125	0.034	0.034	0.033	0.034	0.046	0.035	0.047	0.037	0.038	0.047	0.039
2175	0.031	0.032	0.032	0.030	0.035	0.031	0.037	0.032	0.032	0.039	0.043
2225	0.029	0.029	0.028	0.031	0.040	0.034	0.043	0.037	0.038	0.037	0.032
2275	0.035	0.036	0.036	0.035	0.041	0.035	0.042	0.035	0.035	0.044	0.042
2325	0.031	0.030	0.031	0.034	0.040	0.036	0.043	0.037	0.038	0.039	0.034
2375	0.109	0.109	0.107	0.105	0.116	0.106	0.117	0.107	0.106	0.117	0.106
2425	0.029	0.030	0.028	0.029	0.034	0.030	0.035	0.030	0.031	0.036	0.029
2475	0.026	0.025	0.024	0.025	0.033	0.026	0.034	0.027	0.027	0.035	0.029
2525	0.025	0.026	0.024	0.025	0.031	0.026	0.032	0.027	0.027	0.033	0.026
2575	0.031	0.029	0.032	0.032	0.039	0.032	0.039	0.033	0.033	0.041	0.033
2625	0.030	0.030	0.033	0.033	0.034	0.033	0.035	0.034	0.034	0.035	0.034
2675	0.036	0.036	0.036	0.035	0.037	0.037	0.039	0.039	0.039	0.040	0.039
2725	0.030	0.030	0.029	0.030	0.037	0.031	0.038	0.032	0.032	0.039	0.033
2775	0.024	0.024	0.022	0.023	0.030	0.024	0.031	0.025	0.025	0.031	0.026
2825	0.023	0.023	0.022	0.023	0.028	0.024	0.029	0.025	0.026	0.030	0.026
2875	0.029	0.028	0.028	0.029	0.036	0.030	0.037	0.031	0.031	0.038	0.032

2925	0.029	0.029	0.028	0.028	0.032	0.030	0.032	0.031	0.032	0.034	0.032
2975	0.027	0.028	0.026	0.027	0.030	0.028	0.031	0.029	0.029	0.032	0.030
Higher Frequencies components											
P/P _n [%]	0	10	20	30	40	50	60	70	80	90	100
f [kHz]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]
2.1	0.446	0.153	0.139	0.152	0.167	0.177	0.186	0.179	0.182	0.188	0.182
2.3	0.394	0.363	0.348	0.400	0.421	0.386	0.406	0.377	0.375	0.399	0.380
2.5	0.532	0.347	0.351	0.359	0.372	0.355	0.370	0.355	0.354	0.368	0.353
2.7	0.458	0.430	0.430	0.423	0.463	0.426	0.466	0.427	0.428	0.468	0.430
2.9	0.027	0.399	0.396	0.398	0.419	0.403	0.422	0.405	0.406	0.425	0.426
3.1	0.106	0.124	0.120	0.129	0.135	0.124	0.127	0.118	0.118	0.123	0.120
3.3	0.078	0.078	0.069	0.073	0.082	0.073	0.086	0.078	0.081	0.093	0.085
3.5	0.071	0.058	0.053	0.056	0.067	0.058	0.067	0.060	0.061	0.069	0.063
3.7	0.073	0.049	0.047	0.047	0.059	0.051	0.061	0.052	0.053	0.063	0.054
3.9	0.071	0.049	0.047	0.048	0.062	0.050	0.065	0.052	0.053	0.068	0.053
4.1	0.070	0.048	0.046	0.046	0.059	0.051	0.060	0.052	0.053	0.061	0.053
4.3	0.072	0.046	0.046	0.047	0.058	0.050	0.059	0.051	0.052	0.061	0.055
4.5	0.079	0.049	0.046	0.047	0.056	0.050	0.059	0.054	0.055	0.061	0.055
4.7	0.714	0.088	0.079	0.074	0.068	0.077	0.071	0.078	0.079	0.073	0.080
4.9	0.155	0.629	0.605	0.592	0.467	0.598	0.475	0.613	0.621	0.492	0.634
5.1	0.113	0.109	0.112	0.115	0.107	0.118	0.108	0.118	0.118	0.106	0.115
5.3	0.356	0.081	0.081	0.086	0.100	0.090	0.102	0.093	0.094	0.105	0.096
5.5	0.360	0.302	0.300	0.301	0.336	0.304	0.338	0.305	0.306	0.338	0.307
5.7	0.087	0.251	0.252	0.250	0.301	0.248	0.299	0.246	0.245	0.296	0.243
5.9	0.067	0.064	0.063	0.064	0.076	0.066	0.077	0.067	0.067	0.077	0.068
6.1	0.067	0.045	0.042	0.043	0.054	0.046	0.056	0.047	0.048	0.058	0.049
6.3	0.067	0.045	0.042	0.043	0.055	0.046	0.057	0.048	0.048	0.058	0.049
6.5	0.067	0.043	0.042	0.043	0.054	0.046	0.056	0.047	0.047	0.057	0.049
6.7	0.066	0.044	0.041	0.042	0.054	0.046	0.056	0.047	0.048	0.057	0.049
6.9	0.066	0.043	0.041	0.042	0.054	0.045	0.056	0.047	0.047	0.057	0.048
7.1	0.066	0.044	0.042	0.043	0.054	0.046	0.056	0.047	0.047	0.057	0.049
7.3	0.065	0.043	0.040	0.042	0.053	0.045	0.056	0.046	0.047	0.057	0.048
7.5	0.066	0.042	0.040	0.041	0.052	0.044	0.055	0.045	0.046	0.056	0.047
7.7	0.068	0.043	0.040	0.041	0.053	0.044	0.055	0.046	0.046	0.056	0.047
7.9	0.068	0.048	0.046	0.047	0.063	0.048	0.094	0.052	0.052	0.092	0.053
8.1	0.078	0.060	0.057	0.057	0.062	0.059	0.064	0.059	0.060	0.064	0.060
8.3	0.070	0.058	0.056	0.057	0.067	0.061	0.070	0.062	0.063	0.072	0.064
8.5	0.065	0.069	0.067	0.067	0.064	0.068	0.066	0.068	0.068	0.066	0.068
8.7	0.066	0.043	0.039	0.041	0.051	0.044	0.054	0.045	0.045	0.054	0.046
8.9	0.446	0.042	0.039	0.040	0.052	0.043	0.055	0.044	0.045	0.056	0.045

4.1.10 Harmonics and waveform distortion**P**

The currents of the interharmonics to 2 kHz must be measured in accordance with IEC 61000-4-7, Annex A, The measurements of higher-frequency harmonic currents between 2 kHz and 9 kHz must be conducted in line with IEC 61000-4-7, Annex B,

Model: JKH100LTA**Harmonics**

P/P _n [%]	0/5	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2	0.628	0.491	0.284	0.428	0.563	0.623	0.822	0.893	0.868	0.831	0.867
3	0.426	1.449	1.194	1.317	1.415	1.429	1.242	1.237	1.299	1.341	1.400
4	0.233	0.167	0.090	0.196	0.286	0.274	0.038	0.085	0.098	0.087	0.155
5	1.162	1.508	1.890	2.003	2.027	2.003	1.828	1.686	1.558	1.454	1.369
6	0.283	0.352	0.159	0.388	0.453	0.451	0.918	0.917	0.922	0.878	0.907
7	1.383	2.317	2.344	2.111	2.252	2.937	2.639	2.776	2.749	2.636	2.546
8	0.200	0.133	0.239	0.180	0.078	0.064	0.557	0.617	0.616	0.593	0.616
9	0.279	0.513	0.688	0.569	0.610	0.576	0.479	0.433	0.435	0.446	0.461
10	0.296	0.179	0.173	0.223	0.253	0.275	0.181	0.111	0.096	0.111	0.120
11	0.531	0.563	0.549	0.781	0.358	0.580	0.516	0.438	0.389	0.380	0.393
12	0.077	0.070	0.046	0.049	0.048	0.051	0.145	0.091	0.085	0.086	0.063
13	0.271	0.428	0.448	0.240	0.286	0.429	0.313	0.311	0.274	0.231	0.206
14	0.163	0.234	0.184	0.168	0.171	0.120	0.115	0.122	0.102	0.095	0.100
15	0.066	0.115	0.142	0.144	0.115	0.059	0.179	0.167	0.137	0.119	0.101
16	0.140	0.133	0.147	0.166	0.087	0.172	0.245	0.239	0.236	0.240	0.252
17	0.146	0.215	0.195	0.199	0.254	0.212	0.154	0.208	0.318	0.371	0.406
18	0.052	0.052	0.051	0.052	0.053	0.074	0.125	0.088	0.087	0.102	0.120
19	0.115	0.093	0.187	0.265	0.186	0.337	0.194	0.156	0.102	0.144	0.211
20	0.157	0.231	0.186	0.150	0.172	0.102	0.117	0.157	0.142	0.141	0.151
21	0.104	0.133	0.108	0.088	0.056	0.100	0.071	0.079	0.086	0.103	0.135
22	0.167	0.163	0.192	0.173	0.204	0.239	0.227	0.257	0.244	0.246	0.255
23	0.049	0.101	0.097	0.094	0.103	0.109	0.103	0.129	0.112	0.106	0.110
24	0.061	0.048	0.044	0.043	0.056	0.087	0.158	0.158	0.109	0.066	0.080
25	0.309	0.300	0.315	0.335	0.316	0.319	0.364	0.355	0.351	0.350	0.351
26	0.099	0.099	0.087	0.088	0.077	0.065	0.067	0.081	0.087	0.106	0.119
27	0.053	0.050	0.041	0.059	0.083	0.091	0.060	0.044	0.037	0.042	0.047
28	0.120	0.102	0.123	0.118	0.132	0.124	0.091	0.099	0.085	0.089	0.087
29	0.094	0.076	0.080	0.089	0.077	0.076	0.126	0.112	0.086	0.070	0.072
30	0.118	0.116	0.119	0.113	0.134	0.154	0.170	0.187	0.175	0.145	0.110
31	0.052	0.035	0.037	0.078	0.112	0.095	0.065	0.072	0.071	0.061	0.046
32	0.075	0.072	0.076	0.079	0.082	0.073	0.068	0.069	0.071	0.078	0.083
33	0.035	0.027	0.031	0.047	0.052	0.052	0.039	0.036	0.042	0.038	0.036
34	0.138	0.091	0.125	0.132	0.151	0.169	0.154	0.131	0.109	0.124	0.143

35	0.047	0.031	0.027	0.027	0.028	0.029	0.059	0.047	0.034	0.057	0.073
36	0.043	0.037	0.038	0.034	0.042	0.042	0.040	0.047	0.048	0.046	0.043
37	0.046	0.035	0.027	0.028	0.036	0.037	0.047	0.038	0.038	0.033	0.029
38	0.066	0.059	0.050	0.045	0.052	0.050	0.058	0.052	0.050	0.052	0.053
39	0.045	0.036	0.031	0.031	0.028	0.025	0.031	0.029	0.030	0.030	0.028
40	0.051	0.034	0.037	0.038	0.041	0.053	0.056	0.052	0.049	0.048	0.049
41	0.028	0.030	0.030	0.030	0.029	0.031	0.036	0.025	0.029	0.034	0.029
42	0.054	0.037	0.036	0.033	0.036	0.042	0.040	0.044	0.046	0.046	0.047
43	0.033	0.033	0.027	0.021	0.035	0.027	0.030	0.029	0.026	0.023	0.020
44	0.054	0.041	0.047	0.043	0.041	0.032	0.033	0.030	0.031	0.032	0.029
45	0.033	0.031	0.022	0.029	0.017	0.018	0.021	0.026	0.025	0.024	0.024
46	0.088	0.070	0.074	0.071	0.081	0.082	0.083	0.081	0.078	0.077	0.077
47	0.031	0.027	0.027	0.024	0.024	0.024	0.030	0.027	0.028	0.028	0.026
48	0.009	0.007	0.007	0.007	0.007	0.008	0.009	0.009	0.008	0.008	0.018
49	0.037	0.039	0.034	0.024	0.036	0.030	0.032	0.036	0.038	0.038	0.037
50	0.032	0.020	0.019	0.029	0.019	0.022	0.028	0.022	0.021	0.021	0.020
51	0.020	0.017	0.020	0.018	0.016	0.017	0.020	0.020	0.020	0.020	0.099
52	0.059	0.052	0.052	0.053	0.054	0.054	0.056	0.056	0.056	0.055	0.055
53	0.018	0.014	0.018	0.013	0.015	0.015	0.017	0.016	0.016	0.015	0.015
54	0.079	0.063	0.064	0.064	0.063	0.063	0.069	0.069	0.069	0.069	0.069
55	0.101	0.092	0.092	0.094	0.095	0.094	0.096	0.095	0.095	0.095	0.159
56	0.058	0.073	0.082	0.057	0.047	0.046	0.068	0.064	0.062	0.061	0.060
57	0.153	0.125	0.126	0.123	0.123	0.124	0.135	0.135	0.135	0.135	0.135
58	0.056	0.051	0.051	0.050	0.050	0.051	0.052	0.052	0.052	0.053	0.053
59	0.017	0.014	0.014	0.014	0.014	0.013	0.015	0.015	0.015	0.016	0.016
60	0.038	0.030	0.030	0.031	0.031	0.031	0.034	0.034	0.034	0.034	0.034

Interharmonics at continuous operation

P/P _n [%]	0	10	20	30	40	50	60	70	80	90	100
f [Hz]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]
75	0.459	0.441	0.391	0.521	0.576	0.607	0.683	0.710	0.686	0.692	0.667
125	0.766	0.710	0.692	0.824	0.834	0.811	0.893	0.901	0.884	0.893	0.828
175	0.541	0.486	0.484	0.612	0.615	0.595	0.622	0.620	0.618	0.620	0.574
225	0.455	0.496	0.484	0.511	0.436	0.447	0.476	0.471	0.474	0.479	0.445
275	0.394	0.412	0.384	0.453	0.376	0.361	0.385	0.374	0.383	0.381	0.368
325	0.245	0.244	0.224	0.286	0.239	0.273	0.284	0.283	0.269	0.264	0.242
375	0.210	0.209	0.206	0.254	0.216	0.250	0.238	0.237	0.226	0.220	0.210
425	0.174	0.176	0.210	0.185	0.169	0.173	0.184	0.187	0.181	0.184	0.179
475	0.154	0.152	0.174	0.168	0.157	0.156	0.170	0.168	0.168	0.166	0.162
525	0.131	0.123	0.133	0.136	0.152	0.138	0.142	0.131	0.135	0.136	0.129
575	0.127	0.116	0.134	0.132	0.140	0.125	0.135	0.122	0.131	0.133	0.119
625	0.117	0.114	0.129	0.134	0.114	0.151	0.142	0.133	0.131	0.127	0.109
675	0.112	0.106	0.115	0.130	0.115	0.150	0.127	0.123	0.117	0.115	0.107
725	0.094	0.097	0.102	0.109	0.099	0.101	0.104	0.104	0.101	0.099	0.096

775	0.095	0.094	0.107	0.106	0.105	0.099	0.107	0.107	0.105	0.104	0.109
825	0.101	0.102	0.108	0.115	0.118	0.116	0.114	0.122	0.128	0.134	0.134
875	0.104	0.100	0.101	0.115	0.113	0.106	0.121	0.125	0.131	0.142	0.121
925	0.116	0.114	0.118	0.145	0.119	0.151	0.151	0.140	0.142	0.151	0.132
975	0.119	0.133	0.147	0.175	0.183	0.202	0.169	0.162	0.156	0.154	0.146
1025	0.112	0.121	0.126	0.134	0.130	0.130	0.136	0.136	0.134	0.132	0.121
1075	0.140	0.146	0.157	0.205	0.181	0.198	0.182	0.184	0.182	0.181	0.216
1125	0.120	0.156	0.156	0.160	0.172	0.174	0.191	0.202	0.199	0.189	0.169
1175	0.292	0.255	0.255	0.263	0.251	0.254	0.190	0.193	0.181	0.175	0.259
1225	0.294	0.265	0.259	0.256	0.259	0.270	0.331	0.330	0.327	0.326	0.270
1275	0.338	0.337	0.328	0.315	0.321	0.322	0.391	0.393	0.394	0.392	0.317
1325	0.125	0.128	0.131	0.134	0.132	0.128	0.127	0.129	0.131	0.133	0.113
1375	0.168	0.128	0.135	0.189	0.180	0.170	0.147	0.147	0.154	0.163	0.192
1425	0.092	0.085	0.089	0.092	0.092	0.094	0.108	0.109	0.102	0.101	0.086
1475	0.121	0.111	0.113	0.117	0.111	0.110	0.112	0.113	0.106	0.101	0.109
1525	0.104	0.083	0.086	0.090	0.088	0.086	0.101	0.104	0.102	0.099	0.084
1575	0.089	0.084	0.105	0.113	0.099	0.094	0.107	0.102	0.105	0.111	0.103
1625	0.089	0.074	0.077	0.081	0.076	0.077	0.080	0.079	0.079	0.080	0.070
1675	0.122	0.102	0.096	0.113	0.119	0.124	0.125	0.127	0.131	0.134	0.123
1725	0.095	0.092	0.095	0.095	0.095	0.100	0.107	0.105	0.102	0.104	0.098
1775	0.110	0.092	0.091	0.090	0.092	0.097	0.085	0.086	0.085	0.088	0.097
1825	0.105	0.066	0.067	0.067	0.068	0.067	0.088	0.092	0.091	0.091	0.075
1875	0.092	0.061	0.065	0.072	0.065	0.062	0.078	0.080	0.081	0.083	0.069
1925	0.084	0.062	0.064	0.063	0.060	0.061	0.071	0.070	0.071	0.070	0.058
1975	0.117	0.078	0.081	0.081	0.079	0.079	0.090	0.092	0.091	0.090	0.077
2025	0.070	0.058	0.057	0.057	0.057	0.064	0.081	0.074	0.076	0.078	0.071
2075	0.090	0.069	0.066	0.066	0.066	0.063	0.064	0.065	0.067	0.068	0.063
2125	0.075	0.051	0.051	0.050	0.050	0.050	0.069	0.066	0.069	0.071	0.060
2175	0.064	0.048	0.047	0.044	0.044	0.047	0.055	0.056	0.058	0.058	0.052
2225	0.062	0.045	0.043	0.044	0.045	0.052	0.065	0.066	0.067	0.067	0.058
2275	0.075	0.053	0.052	0.051	0.053	0.053	0.063	0.063	0.064	0.065	0.053
2325	0.065	0.049	0.048	0.048	0.049	0.054	0.065	0.065	0.066	0.066	0.057
2375	0.210	0.164	0.162	0.159	0.158	0.158	0.174	0.175	0.175	0.175	0.159
2425	0.061	0.044	0.043	0.043	0.042	0.043	0.052	0.052	0.052	0.053	0.046
2475	0.056	0.039	0.039	0.037	0.036	0.037	0.049	0.051	0.051	0.050	0.041
2525	0.054	0.039	0.039	0.036	0.036	0.038	0.047	0.048	0.049	0.048	0.041
2575	0.065	0.047	0.047	0.049	0.047	0.047	0.058	0.059	0.059	0.060	0.050
2625	0.060	0.045	0.045	0.048	0.047	0.048	0.050	0.051	0.051	0.052	0.050
2675	0.069	0.054	0.053	0.051	0.053	0.053	0.055	0.057	0.058	0.058	0.057
2725	0.061	0.045	0.044	0.042	0.043	0.044	0.055	0.056	0.056	0.057	0.048
2775	0.052	0.036	0.034	0.033	0.033	0.034	0.044	0.045	0.045	0.045	0.037
2825	0.051	0.035	0.034	0.033	0.033	0.034	0.042	0.043	0.043	0.044	0.037
2875	0.059	0.044	0.043	0.042	0.042	0.044	0.054	0.055	0.056	0.056	0.047

2925	0.057	0.044	0.043	0.042	0.041	0.042	0.047	0.048	0.049	0.048	0.046
2975	0.056	0.043	0.041	0.039	0.039	0.040	0.046	0.046	0.046	0.047	0.043
Higher Frequencies components											
P/P _n [%]	0	10	20	30	40	50	60	70	80	90	100
f [kHz]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]
2.1	0.321	0.227	0.225	0.210	0.222	0.248	0.252	0.265	0.275	0.279	0.269
2.3	0.668	0.531	0.556	0.522	0.578	0.604	0.633	0.627	0.616	0.609	0.568
2.5	0.590	0.522	0.517	0.526	0.541	0.536	0.559	0.557	0.556	0.556	0.533
2.7	0.797	0.641	0.650	0.645	0.634	0.636	0.695	0.696	0.698	0.699	0.641
2.9	0.687	0.600	0.597	0.594	0.595	0.599	0.629	0.631	0.632	0.633	0.608
3.1	0.202	0.180	0.182	0.179	0.192	0.194	0.202	0.198	0.195	0.191	0.179
3.3	0.159	0.117	0.113	0.104	0.115	0.107	0.124	0.125	0.126	0.128	0.115
3.5	0.118	0.088	0.084	0.079	0.081	0.085	0.099	0.099	0.100	0.101	0.088
3.7	0.107	0.077	0.073	0.071	0.071	0.072	0.088	0.090	0.090	0.091	0.078
3.9	0.109	0.076	0.073	0.070	0.070	0.073	0.091	0.090	0.095	0.098	0.078
4.1	0.107	0.074	0.072	0.068	0.069	0.072	0.087	0.089	0.089	0.090	0.078
4.3	0.105	0.072	0.070	0.069	0.070	0.072	0.086	0.087	0.088	0.088	0.076
4.5	0.108	0.077	0.072	0.069	0.069	0.071	0.085	0.086	0.088	0.089	0.080
4.7	0.118	0.129	0.130	0.119	0.114	0.114	0.101	0.102	0.104	0.104	0.118
4.9	1.070	0.964	0.943	0.919	0.902	0.896	0.708	0.713	0.719	0.722	0.921
5.1	0.233	0.167	0.167	0.170	0.174	0.176	0.162	0.163	0.163	0.163	0.178
5.3	0.169	0.124	0.122	0.121	0.127	0.132	0.151	0.152	0.152	0.153	0.138
5.5	0.533	0.454	0.452	0.450	0.451	0.453	0.504	0.505	0.507	0.507	0.458
5.7	0.540	0.377	0.378	0.378	0.376	0.375	0.451	0.450	0.449	0.448	0.369
5.9	0.131	0.097	0.095	0.095	0.095	0.097	0.114	0.115	0.115	0.116	0.100
6.1	0.100	0.069	0.066	0.063	0.064	0.066	0.081	0.083	0.083	0.084	0.071
6.3	0.100	0.068	0.065	0.063	0.063	0.065	0.081	0.083	0.084	0.084	0.071
6.5	0.100	0.069	0.065	0.063	0.064	0.065	0.081	0.083	0.083	0.084	0.070
6.7	0.100	0.068	0.065	0.061	0.062	0.065	0.080	0.082	0.083	0.083	0.070
6.9	0.099	0.067	0.064	0.061	0.062	0.064	0.081	0.083	0.083	0.084	0.070
7.1	0.098	0.068	0.065	0.062	0.063	0.065	0.081	0.083	0.084	0.085	0.071
7.3	0.098	0.066	0.063	0.060	0.061	0.064	0.080	0.081	0.082	0.083	0.070
7.5	0.098	0.066	0.063	0.060	0.060	0.063	0.080	0.081	0.082	0.083	0.068
7.7	0.099	0.067	0.063	0.060	0.060	0.063	0.079	0.081	0.082	0.082	0.068
7.9	0.102	0.074	0.073	0.067	0.069	0.069	0.092	0.121	0.135	0.138	0.073
8.1	0.103	0.090	0.087	0.086	0.085	0.086	0.092	0.093	0.094	0.095	0.089
8.3	0.117	0.090	0.087	0.084	0.086	0.088	0.102	0.103	0.105	0.105	0.093
8.5	0.105	0.106	0.102	0.100	0.100	0.101	0.096	0.098	0.099	0.099	0.103
8.7	0.097	0.066	0.062	0.059	0.060	0.063	0.077	0.079	0.080	0.081	0.068
8.9	0.099	0.066	0.062	0.058	0.058	0.061	0.077	0.081	0.081	0.081	0.066

4.1.10 Harmonics and waveform distortion**P**

The currents of the interharmonics to 2 kHz must be measured in accordance with IEC 61000-4-7, Annex A, The measurements of higher-frequency harmonic currents between 2 kHz and 9 kHz must be conducted in line with IEC 61000-4-7, Annex B,

Model: JKH50LTA**Harmonics**

P/P _n [%]	0/5	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2	0.091	0.230	0.275	0.353	0.373	0.388	0.391	0.405	0.411	0.416	0.421
3	0.496	0.725	0.874	1.144	1.597	1.501	1.543	1.590	1.643	1.690	1.808
4	0.046	0.064	0.097	0.129	0.189	0.111	0.112	0.132	0.149	0.165	0.221
5	0.063	0.314	0.179	0.179	0.298	0.119	0.141	0.172	0.202	0.223	0.241
6	0.058	0.046	0.045	0.060	0.085	0.185	0.186	0.184	0.180	0.171	0.170
7	0.074	0.134	0.026	0.061	0.054	0.107	0.173	0.202	0.229	0.245	0.221
8	0.027	0.017	0.026	0.036	0.054	0.044	0.044	0.052	0.057	0.068	0.091
9	0.076	0.033	0.023	0.027	0.039	0.098	0.112	0.129	0.139	0.144	0.182
10	0.016	0.024	0.035	0.044	0.065	0.046	0.049	0.052	0.055	0.061	0.061
11	0.047	0.035	0.047	0.037	0.081	0.059	0.035	0.054	0.087	0.115	0.142
12	0.016	0.008	0.011	0.014	0.023	0.036	0.034	0.024	0.020	0.030	0.041
13	0.026	0.030	0.062	0.071	0.113	0.124	0.090	0.062	0.035	0.032	0.051
14	0.007	0.015	0.024	0.029	0.043	0.032	0.029	0.026	0.029	0.035	0.032
15	0.012	0.017	0.023	0.028	0.044	0.042	0.036	0.033	0.031	0.032	0.031
16	0.003	0.022	0.016	0.015	0.025	0.048	0.051	0.048	0.044	0.038	0.042
17	0.006	0.038	0.014	0.031	0.031	0.104	0.101	0.085	0.063	0.047	0.041
18	0.008	0.009	0.013	0.020	0.026	0.036	0.034	0.030	0.032	0.035	0.032
19	0.005	0.028	0.011	0.017	0.015	0.029	0.039	0.036	0.031	0.028	0.033
20	0.003	0.007	0.007	0.012	0.017	0.016	0.016	0.016	0.016	0.020	0.023
21	0.005	0.008	0.007	0.011	0.015	0.016	0.016	0.016	0.015	0.015	0.022
22	0.002	0.008	0.009	0.015	0.020	0.020	0.016	0.016	0.017	0.018	0.021
23	0.005	0.009	0.006	0.008	0.013	0.015	0.027	0.034	0.037	0.037	0.031
24	0.009	0.005	0.006	0.008	0.014	0.014	0.019	0.023	0.023	0.019	0.021
25	0.006	0.008	0.009	0.009	0.018	0.019	0.016	0.018	0.021	0.022	0.022
26	0.002	0.006	0.007	0.010	0.015	0.016	0.017	0.017	0.016	0.015	0.011
27	0.011	0.005	0.007	0.007	0.014	0.015	0.015	0.015	0.013	0.013	0.012
28	0.002	0.007	0.007	0.009	0.014	0.015	0.017	0.016	0.014	0.013	0.011
29	0.006	0.004	0.004	0.007	0.011	0.016	0.015	0.014	0.014	0.015	0.011
30	0.003	0.005	0.005	0.006	0.011	0.015	0.014	0.013	0.011	0.013	0.011
31	0.011	0.005	0.005	0.009	0.012	0.014	0.014	0.013	0.011	0.012	0.012
32	0.001	0.005	0.005	0.006	0.012	0.014	0.013	0.013	0.011	0.012	0.011
33	0.005	0.004	0.004	0.007	0.011	0.013	0.012	0.012	0.011	0.011	0.013
34	0.001	0.007	0.006	0.008	0.014	0.014	0.014	0.013	0.012	0.014	0.020

35	0.003	0.004	0.005	0.006	0.011	0.014	0.013	0.013	0.011	0.012	0.014
36	0.002	0.007	0.007	0.010	0.015	0.020	0.017	0.014	0.011	0.011	0.013
37	0.004	0.007	0.007	0.008	0.015	0.016	0.017	0.018	0.015	0.015	0.015
38	0.001	0.004	0.005	0.006	0.012	0.013	0.013	0.013	0.010	0.011	0.013
39	0.003	0.006	0.006	0.008	0.014	0.015	0.014	0.014	0.013	0.013	0.014
40	0.001	0.008	0.011	0.012	0.021	0.019	0.016	0.014	0.011	0.011	0.014
41	0.005	0.004	0.004	0.006	0.010	0.013	0.013	0.014	0.012	0.012	0.01
42	0.002	0.012	0.006	0.010	0.014	0.022	0.028	0.033	0.034	0.035	0.040
43	0.005	0.005	0.004	0.005	0.010	0.013	0.013	0.013	0.011	0.011	0.012
44	0.009	0.004	0.005	0.007	0.011	0.014	0.013	0.013	0.011	0.011	0.011
45	0.006	0.005	0.005	0.007	0.011	0.014	0.014	0.014	0.012	0.012	0.011
46	0.002	0.022	0.027	0.038	0.053	0.062	0.067	0.069	0.070	0.070	0.072
47	0.011	0.008	0.009	0.012	0.018	0.024	0.024	0.022	0.021	0.019	0.021
48	0.002	0.026	0.026	0.031	0.048	0.048	0.044	0.040	0.036	0.033	0.032
49	0.006	0.007	0.006	0.009	0.013	0.016	0.017	0.015	0.013	0.013	0.014
50	0.003	0.006	0.004	0.006	0.011	0.015	0.015	0.015	0.014	0.014	0.014
51	0.011	0.009	0.008	0.010	0.016	0.020	0.020	0.019	0.017	0.017	0.021
52	0.001	0.028	0.027	0.034	0.051	0.059	0.060	0.061	0.060	0.061	0.02
53	0.005	0.005	0.005	0.007	0.011	0.016	0.015	0.014	0.013	0.013	0.014
54	0.001	0.443	0.441	0.561	0.083	0.092	0.092	0.093	0.094	0.096	0.071
55	0.003	0.011	0.011	0.014	0.022	0.026	0.027	0.027	0.027	0.027	0.281
56	0.002	0.011	0.008	0.012	0.018	0.022	0.023	0.025	0.025	0.027	0.030
57	0.004	0.131	0.132	0.167	0.251	0.279	0.283	0.281	0.285	0.291	0.291
58	0.001	0.050	0.051	0.066	0.098	0.012	0.012	0.013	0.013	0.013	0.021
59	0.003	0.006	0.005	0.007	0.013	0.017	0.016	0.016	0.015	0.015	0.021
60	0.001	0.021	0.022	0.024	0.043	0.049	0.049	0.05-	0.051	0.052	0.071

Interharmonics at continuous operation

P/P _n [%]	0	10	20	30	40	50	60	70	80	90	100
f [Hz]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]
75	0.005	0.248	0.212	0.311	0.764	0.419	0.286	0.559	0.541	1.264	1.319
125	0.004	0.069	0.046	0.062	0.120	0.087	0.071	0.114	0.118	0.174	0.184
175	0.004	0.047	0.032	0.042	0.092	0.061	0.050	0.082	0.084	0.129	0.133
225	0.004	0.033	0.022	0.029	0.061	0.047	0.038	0.061	0.061	0.094	0.097
275	0.005	0.030	0.020	0.028	0.055	0.043	0.037	0.058	0.058	0.084	0.086
325	0.004	0.020	0.014	0.018	0.038	0.031	0.028	0.037	0.036	0.053	0.053
375	0.004	0.019	0.014	0.018	0.036	0.030	0.027	0.036	0.035	0.049	0.051
425	0.004	0.016	0.012	0.016	0.033	0.028	0.025	0.033	0.031	0.043	0.044
475	0.004	0.014	0.012	0.015	0.030	0.027	0.025	0.031	0.029	0.038	0.039
525	0.003	0.013	0.011	0.014	0.030	0.026	0.025	0.029	0.027	0.037	0.038
575	0.003	0.012	0.011	0.013	0.027	0.025	0.024	0.027	0.025	0.035	0.036
625	0.003	0.011	0.011	0.014	0.029	0.025	0.024	0.026	0.024	0.032	0.035
675	0.003	0.011	0.011	0.014	0.029	0.025	0.024	0.026	0.024	0.030	0.032
725	0.003	0.010	0.009	0.012	0.024	0.024	0.024	0.025	0.023	0.027	0.029

775	0.003	0.010	0.009	0.012	0.023	0.024	0.023	0.025	0.022	0.027	0.028
825	0.003	0.010	0.009	0.011	0.022	0.024	0.023	0.024	0.021	0.027	0.028
875	0.003	0.009	0.008	0.011	0.021	0.024	0.023	0.023	0.021	0.026	0.026
925	0.002	0.009	0.008	0.010	0.020	0.022	0.022	0.022	0.020	0.024	0.024
975	0.002	0.009	0.008	0.010	0.020	0.022	0.021	0.021	0.019	0.022	0.023
1025	0.002	0.008	0.007	0.010	0.019	0.021	0.021	0.021	0.018	0.020	0.021
1075	0.002	0.007	0.007	0.009	0.019	0.021	0.021	0.020	0.018	0.020	0.020
1125	0.002	0.007	0.007	0.009	0.018	0.021	0.021	0.020	0.018	0.021	0.020
1175	0.002	0.007	0.007	0.009	0.017	0.021	0.020	0.021	0.018	0.020	0.020
1225	0.002	0.007	0.007	0.008	0.017	0.021	0.020	0.020	0.017	0.020	0.020
1275	0.002	0.007	0.006	0.009	0.017	0.021	0.020	0.020	0.017	0.019	0.019
1325	0.002	0.006	0.006	0.008	0.017	0.021	0.020	0.020	0.017	0.018	0.018
1375	0.002	0.006	0.006	0.008	0.016	0.020	0.020	0.019	0.017	0.018	0.018
1425	0.002	0.006	0.006	0.008	0.016	0.021	0.019	0.019	0.017	0.018	0.018
1475	0.002	0.006	0.006	0.008	0.016	0.020	0.020	0.019	0.017	0.018	0.018
1525	0.001	0.006	0.006	0.008	0.016	0.020	0.020	0.019	0.016	0.017	0.018
1575	0.001	0.006	0.006	0.008	0.016	0.020	0.020	0.020	0.016	0.017	0.017
1625	0.001	0.006	0.006	0.008	0.016	0.020	0.019	0.019	0.016	0.017	0.017
1675	0.001	0.006	0.006	0.008	0.016	0.020	0.019	0.019	0.016	0.017	0.017
1725	0.001	0.006	0.006	0.008	0.016	0.020	0.019	0.019	0.016	0.017	0.017
1775	0.001	0.006	0.006	0.008	0.016	0.020	0.019	0.019	0.016	0.017	0.017
1825	0.001	0.006	0.006	0.008	0.016	0.020	0.020	0.020	0.016	0.016	0.017
1875	0.001	0.006	0.006	0.008	0.016	0.020	0.019	0.019	0.016	0.016	0.017
1925	0.001	0.006	0.006	0.008	0.016	0.020	0.020	0.020	0.016	0.016	0.017
1975	0.001	0.006	0.006	0.008	0.016	0.020	0.020	0.020	0.016	0.016	0.017
2025	0.005	0.006	0.007	0.009	0.016	0.021	0.021	0.021	0.017	0.017	0.018
2075	0.004	0.006	0.006	0.008	0.016	0.020	0.020	0.019	0.016	0.016	0.017
2125	0.004	0.008	0.008	0.011	0.019	0.020	0.020	0.020	0.016	0.017	0.017
2175	0.004	0.006	0.006	0.008	0.015	0.020	0.020	0.020	0.016	0.016	0.016
2225	0.005	0.006	0.006	0.008	0.016	0.021	0.021	0.021	0.016	0.016	0.016
2275	0.004	0.006	0.006	0.008	0.016	0.020	0.020	0.019	0.016	0.016	0.016
2325	0.004	0.006	0.006	0.008	0.015	0.020	0.020	0.019	0.016	0.016	0.016
2375	0.004	0.006	0.006	0.008	0.016	0.020	0.020	0.020	0.016	0.016	0.016
2425	0.004	0.006	0.006	0.008	0.016	0.021	0.021	0.020	0.016	0.016	0.016
2475	0.003	0.006	0.006	0.008	0.016	0.020	0.020	0.019	0.016	0.016	0.016
2525	0.003	0.006	0.006	0.008	0.016	0.020	0.020	0.020	0.016	0.016	0.016
2575	0.003	0.007	0.007	0.009	0.017	0.021	0.021	0.021	0.018	0.018	0.019
2625	0.003	0.007	0.007	0.009	0.017	0.022	0.021	0.021	0.018	0.018	0.018
2675	0.003	0.008	0.008	0.010	0.018	0.023	0.022	0.022	0.020	0.020	0.021
2725	0.003	0.008	0.007	0.010	0.019	0.023	0.025	0.022	0.021	0.020	0.021
2775	0.003	0.006	0.006	0.009	0.016	0.020	0.020	0.020	0.017	0.017	0.017
2825	0.003	0.007	0.006	0.008	0.017	0.021	0.022	0.020	0.018	0.017	0.018
2875	0.002	0.009	0.008	0.012	0.019	0.025	0.025	0.028	0.023	0.022	0.023

2925	0.002	0.009	0.009	0.011	0.020	0.026	0.025	0.024	0.024	0.024	0.026
2975	0.002	0.009	0.008	0.011	0.019	0.025	0.023	0.023	0.022	0.022	0.023
Higher Frequencies components											
P/P _n [%]	0	10	20	30	40	50	60	70	80	90	100
f [kHz]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]
2.1	0.005	0.020	0.017	0.054	0.042	0.052	0.056	0.058	0.052	0.053	0.054
2.3	0.005	0.037	0.041	0.344	0.082	0.094	0.095	0.093	0.089	0.088	0.088
2.5	0.006	0.280	0.272	0.580	0.515	0.599	0.602	0.606	0.610	0.614	0.622
2.7	0.008	0.458	0.457	0.890	0.866	0.963	0.969	0.976	0.984	1.003	1.011
2.9	0.016	0.676	0.695	0.086	1.324	1.612	1.632	1.652	1.669	1.686	1.703
3.1	0.024	0.071	0.065	0.098	0.129	0.210	0.213	0.215	0.213	0.209	0.205
3.3	0.018	0.047	0.075	0.052	0.148	0.149	0.144	0.136	0.124	0.119	0.111
3.5	0.008	0.047	0.044	0.034	0.087	0.088	0.086	0.086	0.083	0.083	0.084
3.7	0.004	0.022	0.029	0.027	0.062	0.056	0.057	0.058	0.056	0.055	0.056
3.9	0.003	0.023	0.020	0.025	0.050	0.051	0.049	0.048	0.042	0.043	0.047
4.1	0.002	0.019	0.019	0.023	0.047	0.053	0.053	0.050	0.044	0.043	0.044
4.3	0.002	0.017	0.018	0.025	0.044	0.049	0.048	0.047	0.040	0.040	0.040
4.5	0.001	0.018	0.020	0.027	0.047	0.051	0.051	0.050	0.043	0.044	0.043
4.7	0.001	0.021	0.022	0.027	0.050	0.054	0.053	0.051	0.043	0.042	0.043
4.9	0.016	0.023	0.022	0.036	0.051	0.056	0.053	0.051	0.044	0.042	0.044
5.1	0.002	0.036	0.030	0.065	0.063	0.065	0.059	0.057	0.049	0.046	0.048
5.3	0.001	0.087	0.059	1.323	0.110	0.086	0.081	0.081	0.077	0.080	0.084
5.5	0.001	0.197	0.206	0.077	0.392	0.215	0.218	0.222	0.228	0.238	0.246
5.7	0.001	0.058	0.060	0.009	0.116	0.217	0.219	0.222	0.228	0.244	0.251
5.9	0.001	0.047	0.037	0.029	0.075	0.076	0.074	0.069	0.064	0.061	0.062
6.1	0.001	0.029	0.024	0.028	0.052	0.053	0.055	0.050	0.043	0.041	0.042
6.3	0.001	0.025	0.024	0.028	0.049	0.051	0.054	0.049	0.041	0.040	0.039
6.5	0.001	0.023	0.022	0.023	0.048	0.051	0.053	0.048	0.040	0.040	0.039
6.7	0.001	0.018	0.018	0.021	0.042	0.048	0.050	0.047	0.039	0.038	0.037
6.9	0.001	0.016	0.017	0.021	0.041	0.048	0.049	0.048	0.038	0.037	0.037
7.1	0.001	0.016	0.017	0.020	0.041	0.049	0.049	0.050	0.038	0.037	0.037
7.3	0.001	0.015	0.015	0.022	0.042	0.049	0.048	0.050	0.038	0.037	0.037
7.5	0.002	0.016	0.017	0.027	0.047	0.050	0.050	0.052	0.040	0.038	0.039
7.7	0.002	0.020	0.021	0.022	0.055	0.057	0.057	0.059	0.050	0.051	0.052
7.9	0.012	0.016	0.016	0.045	0.049	0.049	0.049	0.049	0.040	0.038	0.039
8.1	0.004	0.032	0.035	0.047	0.074	0.068	0.068	0.068	0.063	0.060	0.061
8.3	0.004	0.034	0.037	0.063	0.076	0.081	0.081	0.081	0.078	0.080	0.081
8.5	0.001	0.051	0.050	0.020	0.098	0.091	0.090	0.091	0.088	0.088	0.089
8.7	0.001	0.015	0.015	0.019	0.039	0.052	0.048	0.047	0.039	0.037	0.038
8.9	0.001	0.014	0.014	0.054	0.037	0.055	0.048	0.046	0.038	0.035	0.037

4.1.10 Harmonics and waveform distortion**P**

The currents of the interharmonics to 2 kHz must be measured in accordance with IEC 61000-4-7, Annex A, The measurements of higher-frequency harmonic currents between 2 kHz and 9 kHz must be conducted in line with IEC 61000-4-7, Annex B,

Model: JKH30LTA**Harmonics**

P/P _n [%]	0/5	10	20	30	40	50	60	70	80	90	100
Order	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2	0.063	0.214	0.252	0.522	0.517	0.586	0.700	0.907	0.922	0.911	0.728
3	0.099	0.227	0.268	0.455	0.474	0.622	0.643	0.928	0.948	0.966	2.714
4	0.044	0.063	0.095	0.159	0.180	0.224	0.243	0.325	0.340	0.352	0.206
5	0.109	0.268	0.133	0.295	0.194	0.293	0.235	0.496	0.410	0.368	0.204
6	0.022	0.040	0.038	0.083	0.078	0.093	0.101	0.144	0.147	0.152	0.314
7	0.027	0.104	0.039	0.044	0.106	0.110	0.191	0.108	0.199	0.275	0.259
8	0.016	0.016	0.024	0.042	0.045	0.056	0.060	0.084	0.088	0.090	0.081
9	0.027	0.028	0.019	0.039	0.035	0.045	0.045	0.070	0.068	0.064	0.195
10	0.013	0.024	0.030	0.061	0.058	0.071	0.079	0.113	0.108	0.111	0.083
11	0.021	0.038	0.030	0.082	0.033	0.062	0.032	0.121	0.070	0.046	0.052
12	0.006	0.008	0.010	0.021	0.020	0.025	0.026	0.036	0.035	0.037	0.056
13	0.020	0.015	0.052	0.097	0.081	0.117	0.083	0.194	0.163	0.132	0.159
14	0.013	0.015	0.020	0.042	0.041	0.048	0.052	0.076	0.074	0.074	0.049
15	0.008	0.014	0.021	0.033	0.035	0.047	0.045	0.075	0.069	0.069	0.058
16	0.006	0.021	0.009	0.028	0.024	0.025	0.032	0.032	0.044	0.051	0.086
17	0.009	0.034	0.020	0.020	0.045	0.051	0.061	0.061	0.085	0.091	0.165
18	0.006	0.009	0.013	0.025	0.027	0.035	0.035	0.047	0.051	0.052	0.058
19	0.005	0.029	0.009	0.025	0.030	0.029	0.050	0.024	0.056	0.072	0.057
20	0.005	0.007	0.007	0.012	0.018	0.019	0.024	0.026	0.030	0.035	0.043
21	0.007	0.006	0.007	0.012	0.017	0.020	0.019	0.023	0.030	0.029	0.028
22	0.005	0.007	0.011	0.012	0.020	0.027	0.025	0.035	0.038	0.037	0.040
23	0.004	0.007	0.005	0.010	0.015	0.015	0.026	0.018	0.025	0.037	0.049
24	0.004	0.005	0.006	0.010	0.012	0.015	0.015	0.020	0.020	0.021	0.026
25	0.003	0.007	0.007	0.015	0.011	0.016	0.014	0.028	0.018	0.019	0.029
26	0.003	0.005	0.007	0.011	0.015	0.018	0.018	0.025	0.027	0.027	0.025
27	0.005	0.005	0.006	0.011	0.011	0.014	0.010	0.021	0.017	0.015	0.017
28	0.004	0.006	0.007	0.011	0.015	0.017	0.020	0.023	0.026	0.028	0.029
29	0.003	0.004	0.005	0.008	0.012	0.014	0.013	0.016	0.019	0.018	0.018
30	0.003	0.004	0.005	0.009	0.011	0.013	0.012	0.016	0.017	0.017	0.017
31	0.003	0.004	0.006	0.008	0.014	0.016	0.016	0.019	0.024	0.024	0.022
32	0.003	0.005	0.005	0.008	0.010	0.012	0.010	0.017	0.017	0.015	0.015
33	0.003	0.004	0.005	0.007	0.011	0.013	0.013	0.016	0.018	0.018	0.018
34	0.004	0.006	0.006	0.010	0.012	0.015	0.011	0.022	0.020	0.016	0.015

35	0.003	0.004	0.004	0.008	0.011	0.012	0.010	0.016	0.015	0.014	0.015
36	0.004	0.006	0.007	0.010	0.015	0.018	0.016	0.024	0.025	0.023	0.021
37	0.005	0.006	0.006	0.011	0.013	0.016	0.016	0.022	0.021	0.023	0.024
38	0.003	0.004	0.005	0.009	0.011	0.012	0.011	0.017	0.016	0.016	0.017
39	0.005	0.006	0.006	0.011	0.012	0.014	0.013	0.021	0.019	0.019	0.019
40	0.007	0.009	0.009	0.018	0.015	0.021	0.015	0.033	0.027	0.023	0.021
41	0.003	0.004	0.004	0.007	0.011	0.011	0.010	0.014	0.014	0.014	0.015
42	0.006	0.011	0.007	0.011	0.016	0.017	0.023	0.021	0.027	0.032	0.038
43	0.003	0.005	0.004	0.007	0.010	0.012	0.010	0.014	0.014	0.014	0.016
44	0.004	0.004	0.005	0.008	0.012	0.013	0.012	0.016	0.017	0.017	0.016
45	0.004	0.005	0.005	0.008	0.012	0.013	0.012	0.016	0.017	0.016	0.017
46	0.019	0.020	0.027	0.042	0.050	0.063	0.069	0.091	0.098	0.102	0.105
47	0.007	0.008	0.009	0.015	0.018	0.022	0.023	0.030	0.033	0.033	0.032
48	0.020	0.023	0.022	0.041	0.039	0.052	0.048	0.079	0.076	0.072	0.068
49	0.004	0.007	0.006	0.010	0.015	0.016	0.016	0.020	0.023	0.023	0.022
50	0.010	0.005	0.004	0.008	0.011	0.012	0.010	0.015	0.015	0.014	0.015
51	0.008	0.008	0.007	0.012	0.016	0.018	0.018	0.024	0.026	0.026	0.026
52	0.230	0.251	0.245	0.429	0.429	0.571	0.572	0.857	0.857	0.859	0.862
53	0.005	0.004	0.005	0.008	0.012	0.016	0.013	0.018	0.019	0.018	0.017
54	0.357	0.400	0.400	0.697	0.701	0.934	0.938	1.399	1.403	1.407	1.413
55	0.099	0.105	0.106	0.184	0.186	0.249	0.249	0.370	0.371	0.373	0.376
56	0.026	0.009	0.008	0.014	0.018	0.022	0.021	0.028	0.030	0.032	0.032
57	0.097	0.119	0.120	0.209	0.209	0.281	0.280	0.418	0.419	0.419	0.423
58	0.442	0.454	0.468	0.810	0.826	1.096	1.108	1.633	1.649	1.661	1.671
59	0.009	0.005	0.005	0.009	0.011	0.013	0.012	0.018	0.018	0.017	0.019
60	0.313	0.393	0.413	0.522	0.729	0.586	0.981	1.436	1.455	1.468	1.480

Interharmonics at continuous operation

P/P _n [%]	0	10	20	30	40	50	60	70	80	90	100
f [Hz]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]
75	0.178	0.404	0.237	0.605	0.282	0.420	0.375	0.650	0.577	0.642	0.951
125	0.043	0.063	0.044	0.094	0.066	0.100	0.082	0.135	0.128	0.144	0.214
175	0.032	0.047	0.030	0.074	0.048	0.073	0.058	0.103	0.094	0.105	0.160
225	0.025	0.029	0.021	0.046	0.035	0.051	0.041	0.069	0.066	0.072	0.113
275	0.023	0.027	0.019	0.042	0.033	0.048	0.037	0.063	0.058	0.068	0.104
325	0.013	0.022	0.013	0.030	0.025	0.033	0.027	0.043	0.042	0.045	0.059
375	0.013	0.020	0.013	0.028	0.023	0.032	0.026	0.042	0.041	0.043	0.057
425	0.012	0.015	0.011	0.024	0.022	0.029	0.024	0.039	0.036	0.038	0.053
475	0.010	0.014	0.011	0.023	0.021	0.028	0.023	0.036	0.035	0.038	0.047
525	0.010	0.013	0.010	0.022	0.020	0.026	0.021	0.034	0.032	0.034	0.043
575	0.008	0.012	0.010	0.021	0.019	0.025	0.021	0.033	0.032	0.032	0.038
625	0.008	0.011	0.010	0.022	0.019	0.025	0.020	0.034	0.032	0.032	0.039
675	0.008	0.012	0.010	0.022	0.019	0.025	0.021	0.033	0.031	0.032	0.037
725	0.007	0.010	0.009	0.018	0.019	0.023	0.019	0.029	0.029	0.030	0.033

775	0.007	0.010	0.009	0.018	0.019	0.023	0.020	0.029	0.029	0.030	0.032
825	0.006	0.012	0.008	0.017	0.018	0.022	0.019	0.028	0.028	0.028	0.032
875	0.006	0.010	0.008	0.016	0.018	0.021	0.018	0.027	0.027	0.027	0.030
925	0.006	0.010	0.007	0.015	0.017	0.020	0.017	0.025	0.025	0.025	0.028
975	0.005	0.010	0.007	0.014	0.017	0.020	0.017	0.025	0.025	0.025	0.027
1025	0.005	0.007	0.007	0.013	0.017	0.019	0.016	0.024	0.024	0.023	0.025
1075	0.005	0.008	0.007	0.013	0.016	0.019	0.016	0.024	0.023	0.022	0.024
1125	0.005	0.007	0.007	0.012	0.016	0.018	0.015	0.023	0.022	0.021	0.024
1175	0.005	0.007	0.006	0.012	0.016	0.018	0.015	0.022	0.022	0.021	0.023
1225	0.005	0.007	0.006	0.012	0.015	0.018	0.015	0.022	0.022	0.021	0.023
1275	0.004	0.007	0.006	0.012	0.015	0.018	0.015	0.021	0.022	0.021	0.022
1325	0.004	0.006	0.006	0.012	0.015	0.017	0.014	0.021	0.021	0.020	0.022
1375	0.004	0.006	0.006	0.011	0.015	0.018	0.014	0.021	0.021	0.020	0.022
1425	0.004	0.006	0.006	0.011	0.015	0.017	0.014	0.021	0.021	0.021	0.021
1475	0.004	0.006	0.006	0.011	0.015	0.018	0.015	0.021	0.021	0.020	0.021
1525	0.004	0.006	0.006	0.011	0.015	0.018	0.014	0.021	0.021	0.020	0.021
1575	0.004	0.006	0.006	0.011	0.015	0.017	0.014	0.021	0.021	0.020	0.021
1625	0.004	0.006	0.006	0.011	0.015	0.017	0.014	0.021	0.021	0.020	0.021
1675	0.004	0.006	0.006	0.011	0.015	0.017	0.014	0.021	0.021	0.020	0.020
1725	0.004	0.006	0.006	0.011	0.016	0.017	0.014	0.021	0.021	0.020	0.021
1775	0.004	0.006	0.006	0.011	0.015	0.017	0.014	0.021	0.021	0.020	0.020
1825	0.004	0.006	0.006	0.011	0.016	0.017	0.014	0.021	0.021	0.020	0.020
1875	0.004	0.006	0.006	0.011	0.015	0.017	0.014	0.021	0.020	0.020	0.020
1925	0.004	0.006	0.006	0.011	0.016	0.017	0.014	0.021	0.021	0.020	0.020
1975	0.004	0.006	0.006	0.011	0.016	0.017	0.014	0.021	0.020	0.019	0.020
2025	0.005	0.006	0.006	0.012	0.016	0.018	0.015	0.023	0.022	0.022	0.022
2075	0.004	0.006	0.006	0.011	0.017	0.017	0.014	0.021	0.020	0.019	0.020
2125	0.004	0.008	0.008	0.014	0.019	0.022	0.020	0.028	0.028	0.028	0.029
2175	0.004	0.006	0.006	0.011	0.016	0.017	0.014	0.020	0.020	0.019	0.020
2225	0.004	0.006	0.006	0.011	0.016	0.018	0.015	0.021	0.021	0.020	0.021
2275	0.004	0.006	0.006	0.011	0.016	0.017	0.015	0.021	0.020	0.019	0.020
2325	0.004	0.006	0.006	0.011	0.017	0.017	0.014	0.021	0.021	0.020	0.020
2375	0.004	0.006	0.006	0.011	0.016	0.017	0.014	0.021	0.021	0.020	0.020
2425	0.004	0.006	0.006	0.011	0.016	0.017	0.014	0.020	0.020	0.020	0.020
2475	0.005	0.006	0.006	0.011	0.016	0.017	0.014	0.021	0.021	0.020	0.020
2525	0.005	0.006	0.006	0.011	0.016	0.018	0.014	0.021	0.021	0.020	0.020
2575	0.006	0.007	0.007	0.012	0.017	0.021	0.015	0.023	0.022	0.023	0.023
2625	0.006	0.007	0.007	0.012	0.016	0.021	0.016	0.024	0.024	0.022	0.022
2675	0.008	0.007	0.008	0.013	0.018	0.023	0.018	0.027	0.027	0.026	0.025
2725	0.009	0.008	0.008	0.014	0.018	0.025	0.017	0.026	0.026	0.025	0.029
2775	0.007	0.006	0.006	0.011	0.017	0.020	0.015	0.022	0.022	0.022	0.021
2825	0.008	0.007	0.006	0.012	0.016	0.019	0.015	0.022	0.022	0.020	0.024
2875	0.012	0.008	0.008	0.014	0.021	0.022	0.020	0.029	0.029	0.033	0.029

2925	0.012	0.009	0.009	0.015	0.018	0.022	0.020	0.030	0.030	0.027	0.030
2975	0.009	0.008	0.008	0.015	0.018	0.021	0.019	0.029	0.030	0.027	0.028
Higher Frequencies components											
P/P _n [%]	0	10	20	30	40	50	60	70	80	90	100
f [kHz]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]	I _h [%]
2.1	0.012	0.019	0.017	0.030	0.043	0.047	0.044	0.058	0.061	0.062	0.067
2.3	0.030	0.035	0.038	0.066	0.075	0.093	0.093	0.132	0.136	0.137	0.138
2.5	0.231	0.251	0.245	0.430	0.431	0.573	0.574	0.859	0.859	0.861	0.864
2.7	0.372	0.414	0.414	0.722	0.727	0.968	0.972	1.449	1.453	1.457	1.464
2.9	0.552	0.612	0.635	1.098	1.122	1.487	1.507	2.215	2.239	2.257	2.273
3.1	0.076	0.062	0.061	0.104	0.114	0.147	0.147	0.213	0.218	0.221	0.226
3.3	0.041	0.048	0.071	0.119	0.127	0.167	0.161	0.245	0.246	0.242	0.233
3.5	0.036	0.044	0.039	0.073	0.070	0.092	0.087	0.137	0.129	0.128	0.133
3.7	0.017	0.021	0.026	0.046	0.051	0.063	0.055	0.092	0.084	0.080	0.084
3.9	0.013	0.021	0.020	0.033	0.047	0.053	0.047	0.069	0.070	0.068	0.065
4.1	0.013	0.018	0.018	0.032	0.043	0.051	0.044	0.063	0.064	0.063	0.064
4.3	0.011	0.017	0.017	0.030	0.041	0.047	0.041	0.059	0.059	0.056	0.057
4.5	0.012	0.018	0.019	0.034	0.044	0.049	0.043	0.064	0.063	0.060	0.059
4.7	0.014	0.020	0.020	0.037	0.044	0.054	0.045	0.070	0.068	0.065	0.064
4.9	0.018	0.022	0.020	0.037	0.048	0.053	0.045	0.070	0.067	0.064	0.064
5.1	0.028	0.033	0.026	0.050	0.053	0.065	0.058	0.094	0.089	0.086	0.083
5.3	0.055	0.076	0.048	0.097	0.082	0.111	0.097	0.173	0.157	0.145	0.140
5.5	0.359	0.898	0.942	1.624	1.664	2.196	2.237	3.283	3.321	3.351	3.382
5.7	0.659	0.266	0.278	0.480	0.495	0.654	0.665	0.967	0.982	0.995	1.009
5.9	0.058	0.041	0.033	0.060	0.063	0.081	0.076	0.116	0.114	0.113	0.114
6.1	0.039	0.026	0.021	0.040	0.044	0.056	0.047	0.075	0.072	0.069	0.067
6.3	0.019	0.023	0.020	0.037	0.044	0.053	0.047	0.071	0.072	0.068	0.067
6.5	0.013	0.021	0.020	0.037	0.044	0.054	0.046	0.071	0.069	0.067	0.066
6.7	0.011	0.017	0.017	0.030	0.041	0.046	0.038	0.058	0.057	0.055	0.055
6.9	0.010	0.015	0.016	0.028	0.041	0.045	0.037	0.056	0.055	0.053	0.052
7.1	0.010	0.015	0.016	0.028	0.041	0.044	0.037	0.056	0.055	0.053	0.053
7.3	0.010	0.014	0.015	0.026	0.040	0.043	0.035	0.052	0.052	0.050	0.050
7.5	0.013	0.016	0.016	0.028	0.041	0.045	0.038	0.056	0.057	0.054	0.054
7.7	0.019	0.019	0.020	0.035	0.046	0.053	0.047	0.069	0.071	0.068	0.068
7.9	0.013	0.015	0.016	0.028	0.040	0.045	0.038	0.056	0.058	0.054	0.055
8.1	0.027	0.030	0.032	0.056	0.063	0.079	0.075	0.112	0.112	0.111	0.112
8.3	0.040	0.032	0.034	0.058	0.065	0.082	0.080	0.118	0.118	0.118	0.120
8.5	0.039	0.046	0.045	0.079	0.083	0.108	0.106	0.157	0.157	0.157	0.158
8.7	0.023	0.014	0.015	0.026	0.037	0.043	0.036	0.051	0.051	0.049	0.050
8.9	0.013	0.014	0.015	0.026	0.037	0.041	0.036	0.049	0.049	0.047	0.047

4.1.10 Harmonics and waveform distortion In accordance with IEC 61727							P
Model: JKH150LTA							
Output Power [W]				150123.82			
Grid-Voltage [V]				230.65			
Output current [A]				217.51			
Grid-Frequency [Hz]				50.00			
THD [%]				1.467			
Harmonics	Current Magnitude [A]			Fundamental [%]			Harmonic Current Limits [%]
	Phase L1	Phase L2	Phase L3	Phase L1	Phase L2	Phase L3	
-	-	--	--	--	--	--	--
2nd	1.009	0.627	0.667	0.464	0.289	0.307	1.00
3rd	7.016	2.631	7.901	3.227	1.210	3.635	4.00
4th	0.835	2.090	1.905	0.384	0.961	0.877	1.00
5th	4.654	3.614	5.322	2.141	1.663	2.448	4.00
6th	1.201	0.702	0.654	0.553	0.323	0.301	1.00
7th	2.794	2.261	2.941	1.285	1.040	1.353	4.00
8th	0.849	0.352	0.144	0.390	0.162	0.066	1.00
9th	0.588	0.335	0.904	0.271	0.154	0.416	4.00
10th	0.141	0.478	0.393	0.065	0.220	0.181	1.00
11th	0.665	0.711	0.945	0.306	0.327	0.435	2.00
12th	0.100	0.083	0.067	0.046	0.038	0.031	0.50
13th	0.548	0.613	0.572	0.252	0.282	0.263	2.00
14th	0.130	0.201	0.246	0.060	0.092	0.113	0.50
15th	0.090	0.158	0.144	0.041	0.072	0.066	2.00
16th	0.325	0.252	0.318	0.150	0.116	0.146	0.50
17th	0.189	0.095	0.186	0.087	0.044	0.085	1.50
18th	0.249	0.211	0.185	0.115	0.097	0.085	0.38
19th	0.336	0.390	0.442	0.155	0.179	0.203	1.50
20th	0.270	0.229	0.273	0.124	0.105	0.126	0.38
21th	0.226	0.151	0.243	0.104	0.070	0.112	1.50
22th	0.333	0.365	0.362	0.153	0.168	0.167	0.38
23th	0.707	0.488	0.511	0.325	0.224	0.235	0.60
24th	0.169	0.188	0.184	0.078	0.087	0.085	0.15
25th	0.543	0.481	0.481	0.250	0.221	0.221	0.60
26th	0.228	0.190	0.154	0.105	0.087	0.071	0.15
27th	0.076	0.093	0.076	0.035	0.043	0.035	0.60
28th	0.166	0.204	0.182	0.076	0.094	0.084	0.15
29th	0.104	0.121	0.058	0.048	0.056	0.027	0.60
30th	0.164	0.163	0.165	0.075	0.075	0.076	0.15
31th	0.067	0.102	0.094	0.031	0.047	0.043	0.60

32th	0.093	0.083	0.074	0.043	0.038	0.034	0.15
33th	0.053	0.048	0.064	0.025	0.022	0.029	0.60
34th	0.253	0.253	0.220	0.116	0.116	0.101	0.15
35th	0.044	0.053	0.034	0.020	0.025	0.016	0.30
36th	0.041	0.055	0.048	0.019	0.026	0.022	0.08
37th	0.041	0.055	0.049	0.019	0.025	0.023	0.30
38th	0.064	0.063	0.055	0.029	0.029	0.025	0.08
39th	0.034	0.050	0.032	0.016	0.023	0.015	0.30
40th	0.082	0.083	0.072	0.038	0.038	0.033	0.08
41th	0.058	0.067	0.059	0.027	0.031	0.027	0.30
42th	0.063	0.089	0.066	0.029	0.041	0.031	0.08
43th	0.035	0.052	0.046	0.016	0.024	0.021	0.30
44th	0.044	0.051	0.037	0.020	0.023	0.017	0.08
45th	0.034	0.037	0.035	0.016	0.017	0.016	0.30
46th	0.116	0.127	0.112	0.053	0.059	0.052	0.08
47th	0.041	0.046	0.038	0.019	0.021	0.017	0.30
48th	0.116	0.136	0.108	0.053	0.063	0.050	0.08
49th	0.049	0.066	0.048	0.022	0.030	0.022	0.30
50th	0.034	0.038	0.031	0.016	0.017	0.014	0.08
51th	0.145	0.153	0.122	0.067	0.070	0.056	0.30
52th	0.080	0.087	0.077	0.037	0.040	0.035	0.08
53th	0.026	0.028	0.022	0.012	0.013	0.010	0.30
54th	0.101	0.117	0.092	0.046	0.054	0.042	0.08
55th	0.685	0.745	0.663	0.315	0.343	0.305	0.30
56th	0.086	0.058	0.075	0.040	0.027	0.035	0.08
57th	0.343	0.373	0.332	0.137	0.159	0.126	0.30
58th	0.077	0.083	0.076	0.035	0.038	0.035	0.08
59th	0.023	0.030	0.024	0.011	0.014	0.011	0.30
60th	0.050	0.057	0.045	0.023	0.026	0.021	0.08

4.1.10 Harmonics and waveform distortion In accordance with IEC 61727							P
Model: JKH100LTA							
Output Power [W]				99405.60			
Grid-Voltage [V]				230.47			
Output current [A]				145.59			
Grid-Frequency [Hz]				50.00			
THD [%]				1.467			
Harmonics	Current Magnitude [A]			Fundamental [%]			Harmonic Current Limits [%]
	Phase L1	Phase L2	Phase L3	Phase L1	Phase L2	Phase L3	
1st	--	--	--	--	--	--	--
2nd	1.257	0.884	1.159	0.867	0.610	0.799	1.00
3rd	2.030	0.599	2.286	1.400	0.413	1.576	4.00
4th	0.225	0.670	0.605	0.155	0.462	0.417	1.00
5th	1.985	1.606	2.154	1.369	1.107	1.486	4.00
6th	1.315	0.748	0.606	0.907	0.516	0.418	1.00
7th	3.691	3.230	4.052	2.546	2.228	2.794	4.00
8th	0.893	0.353	0.146	0.616	0.244	0.101	1.00
9th	0.669	0.353	1.079	0.461	0.243	0.744	4.00
10th	0.174	0.431	0.357	0.120	0.297	0.246	1.00
11th	0.569	0.649	0.924	0.393	0.447	0.637	2.00
12th	0.091	0.084	0.068	0.063	0.058	0.047	0.50
13th	0.298	0.368	0.325	0.206	0.254	0.224	2.00
14th	0.145	0.191	0.197	0.100	0.132	0.136	0.50
15th	0.147	0.142	0.058	0.101	0.098	0.040	2.00
16th	0.365	0.234	0.315	0.252	0.161	0.217	0.50
17th	0.588	0.405	0.499	0.406	0.279	0.344	1.50
18th	0.174	0.091	0.102	0.120	0.063	0.070	0.38
19th	0.305	0.362	0.469	0.211	0.249	0.323	1.50
20th	0.218	0.167	0.234	0.151	0.115	0.161	0.38
21th	0.196	0.213	0.207	0.135	0.147	0.143	1.50
22th	0.370	0.395	0.461	0.255	0.273	0.318	0.38
23th	0.159	0.083	0.173	0.110	0.057	0.120	0.60
24th	0.116	0.108	0.096	0.080	0.075	0.066	0.15
25th	0.509	0.427	0.419	0.351	0.294	0.289	0.60
26th	0.173	0.152	0.150	0.119	0.105	0.104	0.15
27th	0.068	0.107	0.079	0.047	0.074	0.055	0.60
28th	0.127	0.156	0.137	0.087	0.107	0.095	0.15
29th	0.104	0.128	0.108	0.072	0.088	0.075	0.60
30th	0.160	0.180	0.147	0.110	0.124	0.102	0.15
31th	0.066	0.096	0.068	0.046	0.066	0.047	0.60

32th	0.121	0.116	0.107	0.083	0.080	0.074	0.15
33th	0.052	0.051	0.045	0.036	0.035	0.031	0.60
34th	0.207	0.172	0.199	0.143	0.119	0.137	0.15
35th	0.106	0.072	0.057	0.073	0.049	0.040	0.30
36th	0.063	0.083	0.066	0.043	0.057	0.045	0.08
37th	0.042	0.068	0.047	0.029	0.047	0.032	0.30
38th	0.077	0.078	0.057	0.053	0.054	0.040	0.08
39th	0.040	0.047	0.039	0.028	0.033	0.027	0.30
40th	0.071	0.070	0.058	0.049	0.049	0.040	0.08
41th	0.043	0.044	0.038	0.029	0.030	0.026	0.30
42th	0.068	0.093	0.068	0.047	0.064	0.047	0.08
43th	0.028	0.046	0.032	0.020	0.032	0.022	0.30
44th	0.043	0.038	0.032	0.029	0.026	0.022	0.08
45th	0.034	0.033	0.024	0.024	0.023	0.016	0.30
46th	0.111	0.100	0.106	0.077	0.080	0.073	0.08
47th	0.038	0.043	0.037	0.026	0.030	0.026	0.30
48th	0.092	0.094	0.091	0.018	0.019	0.018	0.08
49th	0.054	0.068	0.055	0.037	0.047	0.038	0.30
50th	0.029	0.037	0.029	0.020	0.025	0.020	0.08
51th	0.144	0.154	0.126	0.099	0.107	0.087	0.30
52th	0.080	0.087	0.077	0.055	0.060	0.053	0.08
53th	0.021	0.029	0.024	0.015	0.020	0.017	0.30
54th	1.004	1.104	0.920	0.693	0.763	0.634	0.08
55th	0.230	0.247	0.222	0.159	0.170	0.153	0.30
56th	0.087	0.063	0.076	0.060	0.043	0.052	0.08
57th	0.196	0.230	0.182	0.135	0.159	0.125	0.30
58th	0.076	0.082	0.075	0.053	0.057	0.052	0.08
59th	0.023	0.031	0.023	0.016	0.021	0.016	0.30
60th	0.050	0.056	0.045	0.034	0.039	0.031	0.08

4.1.10 Harmonics and waveform distortion In accordance with IEC 61727							P
Model: JKH50LTA							
Output Power [W]				50653.92			
Grid-Voltage [V]				231.78			
Output current [A]				72.85			
Grid-Frequency [Hz]				50.00			
THD [%]				3.26			
Harmonics	Current Magnitude [A]			Fundamental [%]			Harmonic Current Limits [%]
	Phase L1	Phase L2	Phase L3	Phase L1	Phase L2	Phase L3	
1st	--	--	--	--	--	--	--
2nd	0.58	0.66	0.57	0.42	0.91	0.79	1.00
3rd	1.31	0.39	1.28	1.81	0.54	1.76	4.00
4th	0.16	0.14	0.20	0.22	0.20	0.28	1.00
5th	0.18	0.29	0.12	0.24	0.40	0.16	4.00
6th	0.13	0.04	0.07	0.17	0.06	0.10	1.00
7th	0.16	0.20	0.23	0.22	0.28	0.31	4.00
8th	0.07	0.03	0.04	0.09	0.04	0.06	1.00
9th	0.13	0.06	0.04	0.18	0.09	0.05	4.00
10th	0.05	0.05	0.05	0.06	0.06	0.07	1.00
11th	0.10	0.10	0.11	0.14	0.14	0.15	2.00
12th	0.03	0.03	0.03	0.04	0.04	0.04	0.50
13th	0.03	0.04	0.05	0.05	0.06	0.07	2.00
14th	0.02	0.02	0.03	0.03	0.03	0.04	0.50
15th	0.02	0.02	0.02	0.03	0.03	0.03	2.00
16th	0.03	0.03	0.03	0.04	0.04	0.04	0.50
17th	0.03	0.03	0.03	0.04	0.04	0.03	1.50
18th	0.02	0.02	0.02	0.03	0.03	0.03	0.38
19th	0.02	0.02	0.02	0.03	0.03	0.03	1.50
20th	0.01	0.02	0.02	0.02	0.02	0.03	0.38
21th	0.01	0.01	0.01	0.02	0.02	0.02	1.50
22th	0.01	0.01	0.02	0.02	0.02	0.02	0.38
23th	0.02	0.02	0.03	0.03	0.03	0.04	0.60
24th	0.01	0.01	0.01	0.02	0.01	0.02	0.15
25th	0.02	0.02	0.02	0.02	0.02	0.03	0.60
26th	0.01	0.01	0.01	0.01	0.01	0.01	0.15
27th	0.01	0.01	0.01	0.01	0.01	0.02	0.60
28th	0.01	0.01	0.01	0.01	0.01	0.01	0.15
29th	0.01	0.01	0.01	0.01	0.01	0.01	0.60
30th	0.01	0.01	0.01	0.01	0.01	0.01	0.15
31th	0.01	0.01	0.01	0.01	0.01	0.01	0.60

32th	0.01	0.01	0.01	0.01	0.01	0.01	0.15
33th	0.01	0.01	0.01	0.01	0.01	0.01	0.60
34th	0.01	0.01	0.01	0.02	0.02	0.02	0.15
35th	0.01	0.01	0.01	0.01	0.01	0.01	0.30
36th	0.01	0.01	0.01	0.01	0.01	0.01	0.08
37th	0.01	0.01	0.01	0.01	0.01	0.01	0.30
38th	0.01	0.01	0.01	0.01	0.01	0.01	0.08
39th	0.01	0.01	0.01	0.01	0.01	0.01	0.30
40th	0.01	0.01	0.01	0.01	0.01	0.01	0.08
41th	0.01	0.01	0.01	0.01	0.01	0.01	0.30
42th	0.03	0.02	0.02	0.04	0.03	0.03	0.08
43th	0.01	0.01	0.01	0.01	0.01	0.01	0.30
44th	0.01	0.01	0.01	0.01	0.01	0.01	0.08
45th	0.01	0.01	0.01	0.01	0.01	0.01	0.30
46th	0.05	0.05	0.05	0.07	0.07	0.07	0.08
47th	0.01	0.01	0.01	0.02	0.02	0.02	0.30
48th	0.02	0.02	0.02	0.03	0.03	0.03	0.08
49th	0.01	0.01	0.01	0.01	0.01	0.01	0.30
50th	0.01	0.01	0.01	0.01	0.01	0.01	0.08
51th	0.01	0.01	0.01	0.02	0.01	0.01	0.30
52th	0.01	0.01	0.01	0.02	0.02	0.03	0.08
53th	0.01	0.01	0.01	0.01	0.01	0.01	0.30
54th	0.06	0.05	0.05	0.07	0.06	0.06	0.08
55th	0.20	0.18	0.17	0.28	0.25	0.23	0.30
56th	0.02	0.01	0.02	0.03	0.01	0.03	0.08
57th	0.21	0.17	0.19	0.29	0.23	0.26	0.30
58th	0.01	0.01	0.01	0.02	0.01	0.01	0.08
59th	0.01	0.01	0.01	0.02	0.01	0.01	0.30
60th	0.06	0.06	0.06	0.07	0.07	0.07	0.08

4.1.10 Harmonics and waveform distortion In accordance with IEC 61727							P
Model: JKH30LTA							
Output Power [W]				29991.23			
Grid-Voltage [V]				229.91			
Output current [A]				17.43			
Grid-Frequency [Hz]				50.00			
THD [%]				1.467			
Harmonics	Current Magnitude [A]			Fundamental [%]			Harmonic Current Limits [%]
	Phase L1	Phase L2	Phase L3	Phase L1	Phase L2	Phase L3	
1st	43.203	43.735	44.285	--	--	--	--
2nd	0.330	0.265	0.241	0.728	0.548	0.512	1.00
3rd	1.180	0.350	1.296	2.714	0.805	2.980	4.00
4th	0.089	0.099	0.162	0.206	0.228	0.372	1.00
5th	0.089	0.193	0.140	0.204	0.443	0.322	4.00
6th	0.137	0.045	0.066	0.314	0.103	0.152	1.00
7th	0.113	0.127	0.141	0.259	0.292	0.325	4.00
8th	0.035	0.020	0.040	0.081	0.047	0.092	1.00
9th	0.085	0.066	0.025	0.195	0.153	0.057	4.00
10th	0.036	0.036	0.047	0.083	0.082	0.108	1.00
11th	0.023	0.024	0.028	0.052	0.055	0.065	2.00
12th	0.024	0.020	0.018	0.056	0.046	0.042	0.50
13th	0.069	0.051	0.039	0.159	0.118	0.091	2.00
14th	0.021	0.021	0.029	0.049	0.049	0.068	0.50
15th	0.025	0.019	0.027	0.058	0.043	0.062	2.00
16th	0.037	0.030	0.019	0.086	0.068	0.044	0.50
17th	0.072	0.068	0.038	0.165	0.156	0.087	1.50
18th	0.025	0.020	0.022	0.058	0.047	0.050	0.38
19th	0.025	0.035	0.033	0.057	0.081	0.077	1.50
20th	0.010	0.016	0.019	0.023	0.037	0.043	0.38
21th	0.010	0.017	0.012	0.023	0.039	0.028	1.50
22th	0.010	0.015	0.017	0.023	0.035	0.040	0.38
23th	0.019	0.019	0.021	0.044	0.044	0.049	0.60
24th	0.012	0.011	0.011	0.027	0.024	0.026	0.15
25th	0.010	0.009	0.013	0.022	0.020	0.029	0.60
26th	0.011	0.010	0.011	0.025	0.024	0.025	0.15
27th	0.008	0.007	0.007	0.018	0.015	0.017	0.60
28th	0.010	0.010	0.013	0.023	0.023	0.029	0.15
29th	0.008	0.007	0.008	0.019	0.016	0.018	0.60
30th	0.008	0.007	0.008	0.019	0.017	0.017	0.15
31th	0.008	0.008	0.009	0.019	0.018	0.022	0.60

32th	0.007	0.006	0.007	0.016	0.014	0.015	0.15
33th	0.006	0.006	0.008	0.014	0.014	0.018	0.60
34th	0.007	0.006	0.006	0.016	0.014	0.015	0.15
35th	0.007	0.007	0.006	0.016	0.016	0.015	0.30
36th	0.010	0.010	0.009	0.024	0.022	0.021	0.08
37th	0.010	0.013	0.010	0.024	0.030	0.024	0.30
38th	0.006	0.007	0.007	0.014	0.017	0.017	0.08
39th	0.008	0.010	0.008	0.019	0.022	0.019	0.30
40th	0.009	0.009	0.009	0.022	0.021	0.021	0.08
41th	0.007	0.006	0.007	0.016	0.014	0.015	0.30
42th	0.019	0.017	0.017	0.044	0.039	0.038	0.08
43th	0.007	0.006	0.007	0.015	0.013	0.016	0.30
44th	0.006	0.006	0.007	0.014	0.014	0.016	0.08
45th	0.007	0.007	0.007	0.017	0.016	0.017	0.30
46th	0.024	0.022	0.023	0.061	0.051	0.052	0.08
47th	0.016	0.013	0.014	0.036	0.029	0.032	0.30
48th	0.031	0.030	0.030	0.072	0.070	0.068	0.08
49th	0.009	0.008	0.009	0.021	0.019	0.022	0.30
50th	0.008	0.006	0.006	0.019	0.014	0.015	0.08
51th	0.012	0.009	0.011	0.028	0.020	0.026	0.30
52th	0.021	0.019	0.016	0.056	0.048	0.041	0.08
53th	0.008	0.008	0.008	0.018	0.017	0.017	0.30
54th	0.034	0.030	0.030	0.074	0.069	0.069	0.08
55th	0.098	0.085	0.082	0.241	0.198	0.196	0.30
56th	0.014	0.007	0.014	0.033	0.017	0.032	0.08
57th	0.102	0.097	0.092	0.235	0.201	0.199	0.30
58th	0.035	0.031	0.030	0.074	0.069	0.069	0.08
59th	0.010	0.008	0.008	0.022	0.019	0.019	0.30
60th	0.036	0.029	0.033	0.076	0.062	0.073	0.08

4.1.11.3 Power factor (no controllable reactive power)					P
Test conditions:	JKH150LTA				
Output power [W]	~10%	~25%	~50%	~75%	~100%
	14809.52	36991.52	73666.91	112325.09	145589.06
Test voltage [Vac]					
230	0.9699c	0.9964c	0.9982c	0.9959c	0.9992c

Test conditions:	JKH30LTA				
Output power [W]	~10%	~25%	~50%	~75%	~100%
	3243.11	7451.76	15181.64	22496.52	29732.75
Test voltage [Vac]					
230	0.9871c	0.9873c	0.9872c	0.9783c	0.9771c

Note:

The PV system shall have a lagging power factor greater than 0.98 when the output is greater than 20% of the rated inverter output power,

The letter “i” is short for “inductive” and indicates inductive power factor, In case of capacitive power factor the letter “c” is used instead,

4.1.11.3 Power factor (Fixed cos φ)				P
Test: JKH150LTA				
Test condition: over-excited (c) (cos φ = 0.95)				
Rating power [%]	Active power [W]	Reactive power [Var]	Power factor [cos φ]	Voltage [V]
0%	1174.18	248.89	0.5937	230.10
10%	15153.23	5586.0	0.9344	230.21
20%	31814.03	10885.27	0.9449	230.30
30%	45703.52	14947.35	0.9497	230.38
40%	60035.17	19897.49	0.9487	230.49
50%	74382.48	24291.22	0.9501	230.61
60%	89620.66	28914.95	0.9514	230.73
70%	104898.80	33454.13	0.9560	230.81
80%	119223.41	37651.72	0.9567	230.90
90%	135430.91	42364.37	0.9542	230.01
100%	148733.14	46824.30	0.9537	231.12
Test condition: under-excited (i) (cos φ = 0.95)				

Rating power [%]	Active power [W]	Reactive power [Var]	Power factor [cos ϕ]	Voltage [V]
0%	940.91	252.83	0.5065	230.07
10%	15246.77	-4808.55	0.9501	230.13
20%	31527.35	-10027.70	0.9521	230.17
30%	45874.03	-14791.69	0.9513	230.21
40%	61179.31	-19915.22	0.9506	230.26
50%	75513.54	-24756.50	0.9501	230.32
60%	90776.97	-30013.77	0.9493	230.35
70%	106005.91	-35378.79	0.9483	230.39
80%	120226.26	-40438.10	0.9477	230.41
90%	134475.62	-45579.61	0.9470	230.44
100%	149686.65	-48312.03	0.9516	230.48

Test condition: power factor (cos ϕ = 1)

Rating power [%]	Active power [W]	Reactive power [Var]	Power factor [cos ϕ]	Voltage [V]
0%	4396.74	210.16	0.7968	230.02
10%	14809.53	258.74	0.9699	230.07
20%	29629.03	356.19	0.9912	230.14
30%	43999.46	358.00	0.9958	230.21
40%	58860.21	238.46	0.9971	230.28
50%	73666.91	68.39	0.9982	230.35
60%	88502.35	-153.76	0.9986	230.42
70%	103259.59	-474.63	0.9989	230.49
80%	118061.37	-802.63	0.9990	230.56
90%	132814.52	-1262.50	0.9991	230.63
100%	145589.06	-1674.20	0.9992	230.69

Assessment criterion:

The power factor resulting in each of the measurement points greater than between 20 % of the nominal power is equal to or lower than 0.98 for SSEG categories A1/A2 and 0.95 for SSEG categories A3 both in over excited and under excited operation.

The maximum tolerance on the reactive power setting is 5 % of the rated active power or ± 0.01 of power factor.

Note:

- a) 1 min-average-values were calculated using measurements at the basic frequency in a period of 200 ms.
- b) For each of the 10 active power levels. at least 3 under excited and 3 over excited reactive power levels were recorded.
- c) 1 min-average-values were calculated using voltage measurements at the basic frequency in a period of 200 ms.

4.1.11.3 Power factor (Fixed $\cos \varphi$)				P
Test: JKH30LTA				
Test condition: over-excited (c) ($\cos \varphi = 0.95$)				
Rating power [%]	Active power [W]	Reactive power [Var]	Power factor [$\cos \varphi$]	Voltage [V]
0%	238.25	1185.13	0.5937	232.81
10%	3237.35	1064.10	0.9441	232.21
20%	5958.04	2356.52	0.9429	233.44
30%	9372.64	3040.89	0.9474	233.80
40%	12279.04	3982.98	0.9495	234.02
50%	15101.05	4899.69	0.9509	234.27
60%	18029.31	5823.52	0.9514	234.25
70%	21417.87	7126.22	0.9488	233.89
80%	24327.58	8208.11	0.9475	234.26
90%	27251.43	9058.21	0.9489	233.93
100%	30213.59	9930.78	0.9499	234.77
Test condition: under-excited (i) ($\cos \varphi = 0.95$)				
Rating power [%]	Active power [W]	Reactive power [Var]	Power factor [$\cos \varphi$]	Voltage [V]
0%	243.48	1362.48	0.5065	230.90
10%	3049.35	-961.71	0.9501	230.13
20%	5944.52	-1556.45	0.9471	235.22
30%	9356.13	-2610.48	0.9493	234.26
40%	12251.02	-3705.66	0.9545	234.58
50%	15141.05	-4842.37	0.9524	234.76
60%	18049.05	-5822.22	0.9516	232.56
70%	21423.93	-3978.26	0.9478	232.35
80%	24321.96	-8071.76	0.9481	231.43
90%	27229.28	-7606.97	0.9484	231.86
100%	30129.07	-8683.01	0.9487	232.61
Test condition: power factor ($\cos \varphi = 1$)				
Rating power [%]	Active power [W]	Reactive power [Var]	Power factor [$\cos \varphi$]	Voltage [V]
0%	226.81	1347.39	0.7968	233.04
10%	3243.11	1239.47	0.9699	232.01
20%	5961.41	711.76	0.9901	232.95
30%	9380.77	576.35	0.9910	232.88
40%	12279.46	475.67	0.9930	232.48
50%	15181.64	263.34	0.9945	232.95

60%	18081.17	120.58	0.9914	235.35
70%	20996.75	-163.66	0.9936	235.10
80%	23902.44	-430.72	0.9952	235.07
90%	27301.94	-608.56	0.9960	235.82
100%	29732.75	-856.16	0.9965	235.39

Assessment criterion:

The power factor resulting in each of the measurement points greater than between 20 % of the nominal power is equal to or lower than 0.98 for SSEG categories A1/A2 and 0.95 for SSEG categories A3 both in over excited and under excited operation.

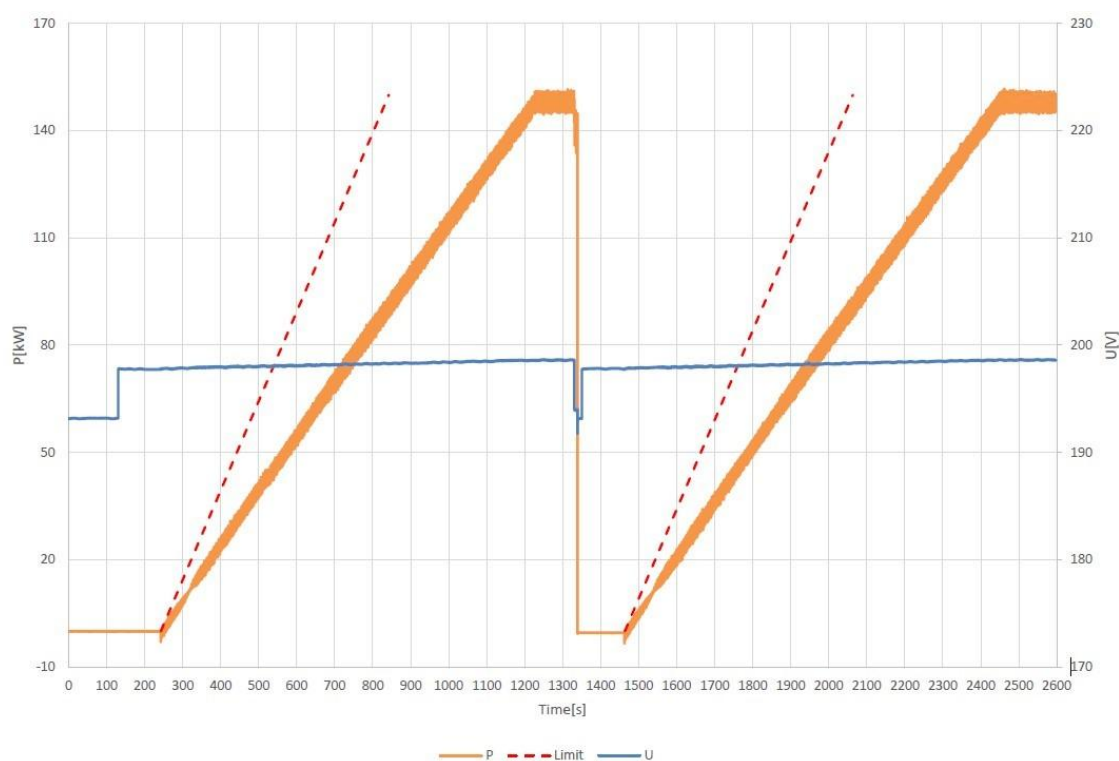
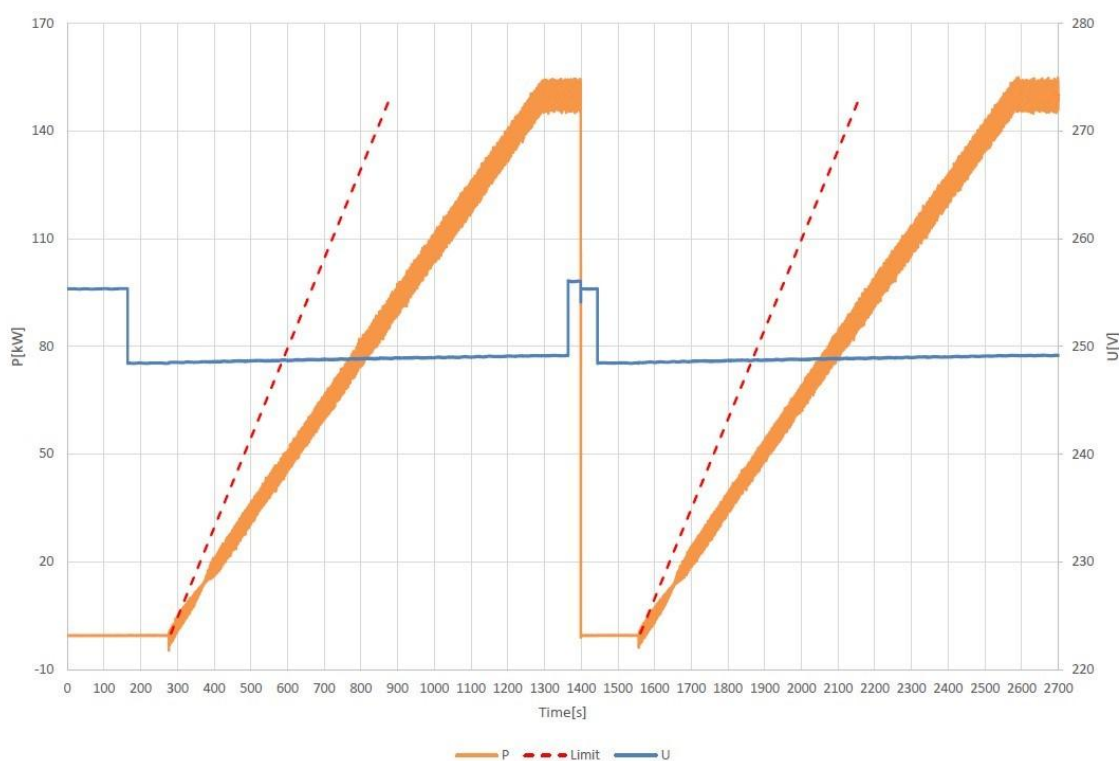
The maximum tolerance on the reactive power setting is 5 % of the rated active power or ± 0.01 of power factor.

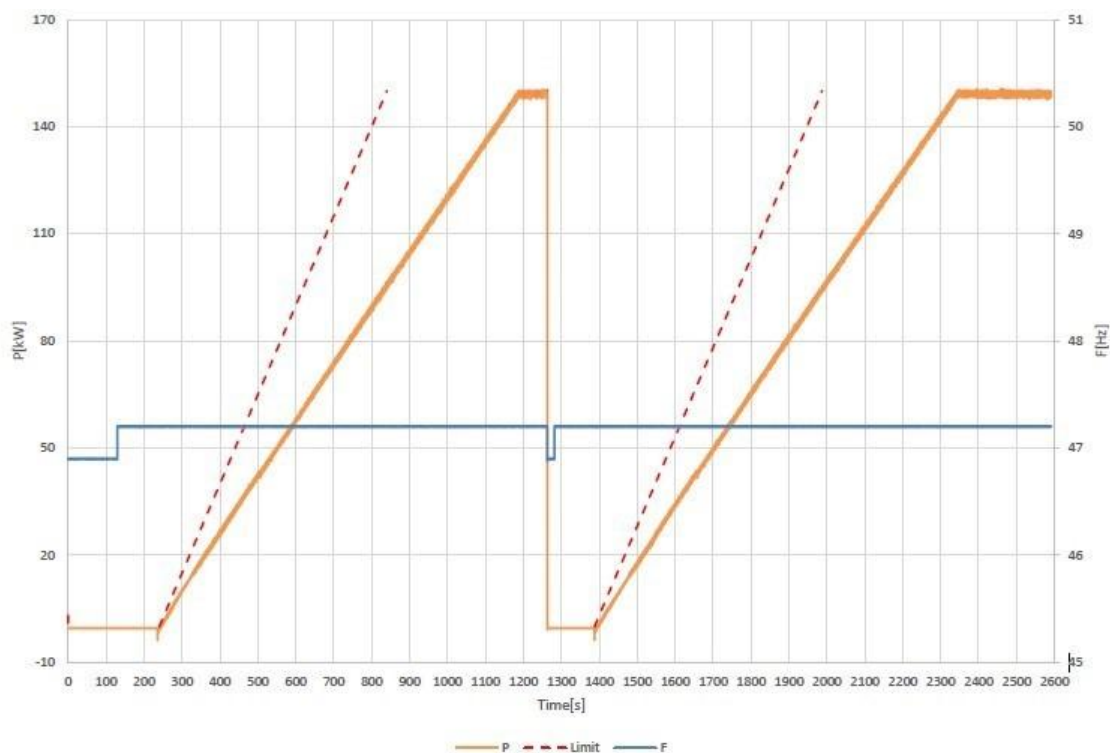
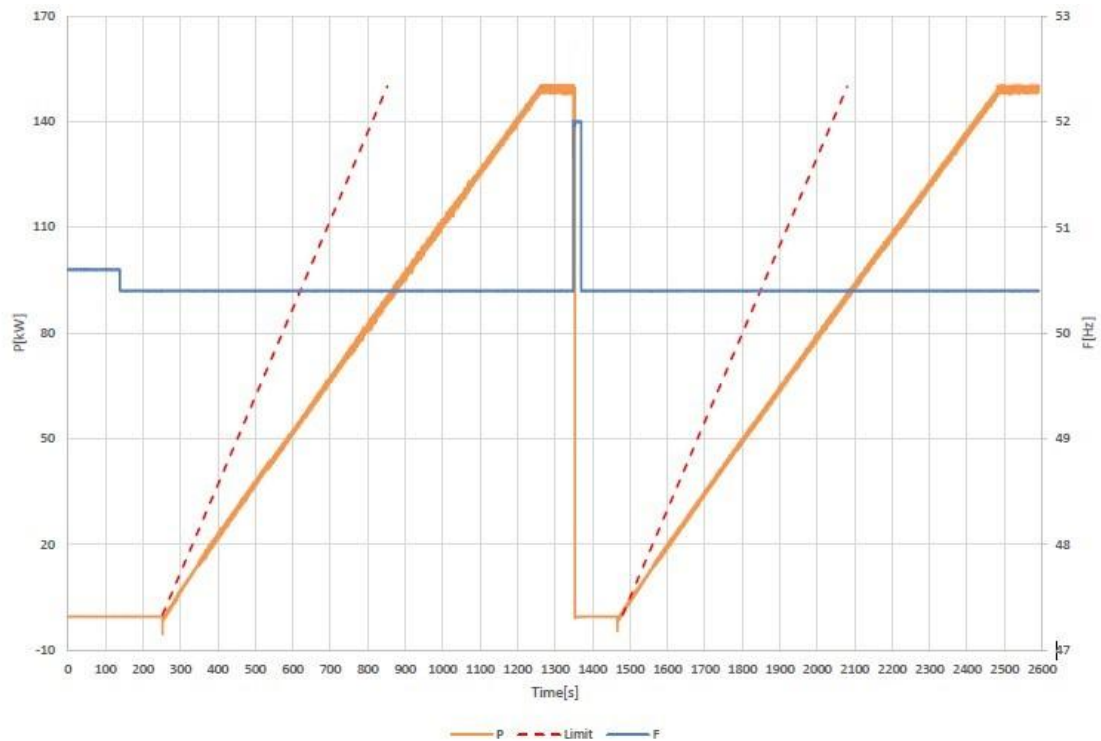
Note:

- a) 1 min-average-values were calculated using measurements at the basic frequency in a period of 200 ms.
- b) For each of the 10 active power levels. at least 3 under excited and 3 over excited reactive power levels were recorded.
- c) 1 min-average-values were calculated using voltage measurements at the basic frequency in a period of 200 ms.

4.1.12	Synchronization	P
4.2.4	Response to utility recovery	
Model: JKH150LTA		
Test:		
Voltage conditons		
a) Out of voltage range	<85% U _n for twice of observation time	>110% U _n for twice of observation time
Connection:	No connection	No connection
Limit	No connection allowed	
b) In voltage range at start-up	≥85% U _n within twice setting observation time	≤110% U _n within twice setting observation time
Reconnection time [s]	102.3	103.4
Limit:	Connected after setting observation time (≥60s)	
Gradient:	The maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%P _n /min. The connection after trip of the interface protection is delayed by a randomized value between 1 min and 10 min. For recorded gradient see diagram underneath.	
c) In voltage range after voltage failture	≥85% U _n for twice of setting observation time	≤110% U _n for twice of setting observation time
Reconnection time [s]	99.92	96.6
Limit:	Reconnection after setting observation time (≥60s)	
Gradient:	The maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%P _n /min. The connection after trip of the interface protection is delayed by a randomized value between 1 min and 10 min. For recorded gradient see diagram underneath.	
Frequency conditions		
d) Out of frequency range	<47Hz for twice of setting observation time	>50.5Hz for twice of setting observation time
Connection:	No connection	No connection
Limit	No connection allowed	
e) In frequency range at start-up	≥47Hz within twice of setting observation time	≤50.5Hz within twice of setting observation time
Reconnection time [s]	99.26	113.04

Limit:	Connected after setting observation time (≥60s)	
Gradient:	The maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%P _n /min. The connection after trip of the interface protection is delayed by a randomized value between 1 min and 10 min. For recorded gradient see diagram underneath.	
f) In frequency range after frequency failure	≥47Hz for twice of setting observation time	≤50.5Hz for twice of setting observation time
Reconnection time [s]	99.96	99.54
Limit:	Reconnection after setting observation time (≥60s)	
Gradient:	The maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%P _n /min, The connection after trip of the interface protection is delayed by a randomized value between 1 min and 10 min, For recorded gradient see diagram underneath,	
Test: Test condition b) and c) : voltage within the limits of 85% to 110%U _n Test condition e) and f) : frequency within the limits of 47.0Hz to 50.5Hz In order to avoid continuous starting and disengaging operations of the interface protection relay. the disengaging value of frequency and voltage functions shall be above 0.2%F _n and 2%U _n deviating from the operate value. Controllable generators may reconnect immediately after the 60 s delay confirming recovery of the system voltage and frequency at a maximum rate of 10 % of rated power per minute. i.e. full power output will only be reached after 10 minutes.		

Graph of the gradual power supply: Test for $\geq 84\%U$ Graph of the gradual power supply : Test for $\leq 111\%U$ 

Graph of the gradual power supply: Test for ≥ 47.00 Graph of the gradual power supply : Test for ≤ 50.15 

4.2.2. Response to protection operation - fault condition tests							P
No.	component No.	fault	test voltage (V)	test time	fuse No.	fuse current (A)	result
1.	Fan	Blocked	PV850 AC230	5min	--	--	Fault indication: PCS over temp. No danger, no damage.
2.	Output	o-l (110%)	PV850 AC230	10min	--	--	EUT working normal. No danger, no damage.
3.	Output	s-c	PV850 AC230	10min	--	--	Output short circuit, converter fault, return to normal after removing the short circuit.
4.	Output	Phase sequence	PV850 AC230	10min	--	--	EUT working normal. No danger, no damage.
5.	Output	A-phase mis-wiring grid connection	PV850 AC230	10min	--	--	If the phase sequence of A and B is reversed, a Power grid voltage reversal fault is reported, the machine cannot operate normally, and the machine is not damaged.
6.	Output	B-phase mis-wiring grid connection	PV850 AC230	10min	--	--	If the phase sequence of B and C is reversed, a Power grid voltage reversal fault is reported, the machine cannot operate normally, and the machine is not damaged.
7.	Output	C-phase mis-wiring grid connection	PV850 AC230	10min	--	--	If the phase sequence of A and C is reversed, a Power grid voltage reversal fault is reported, the machine cannot operate normally, and the machine is not damaged.
8.	DC input: DC+ and DC-	Reversed	PV850 AC230	10min	--	--	The positive and negative terminals of the battery input are reversed, the machine reports Battery reverse fault, and the machine is not damaged.
9.	DC Current detector	o-c	PV850 AC230	10min	--	--	The machine runs normally, the DC sampling current is zero, and the machine is not damaged.
10.	DC Voltage	o-c	PV850 AC230	10min	--	--	After unplugging the DC voltage sampling, the DC voltage sampling

	detector						shows 0V, the machine reports Low battery voltage failure, and the machine is not damaged.
11.	Grid/AC Current detector	o-c	PV850 AC230	10min	--	--	After unplugging the grid-connected current sampling line, the grid-connected current sampling shows 0A, the machine reports Converter overcurrent failure, and the machine is not damaged.
12.	Grid/AC Voltage detector	o-c	PV850 AC230	10min	--	--	After unplugging the grid-connected voltage sampling line, the machine reported Undervoltage of Grid failure, and the machine was not damaged.
13.	Grid/AC mains frequency detector	o-c	PV850 AC230	10min	--	--	The machine reports Frequency anomaly of power grid failure, and the machine is not damaged.
14.	Contactor function detector	o-c	PV850 AC230	10min	--	--	After unplugging the output AC contactor signal line, the machine reported a Grid contactor short circuit failure, and the machine was not damaged.
15.	IGBT temperature detector	o-c	PV850 AC230	10min	--	--	After unplugging the IGBT temperature sampling line, the machine reports Converter over temperature failure, and the machine is not damaged.
16.	Transformer temperature detector	o-c	PV850 AC230	10min	--	--	After unplugging the temperature sampling line of the transformer, the machine reported Converter over temperature failure, and the machine was not damaged.
17.	Reactor temperature detector	s-c	PV850 AC230	10min	--	--	When the IGBT temperature reaches 47°C, the fan starts, and the IGBT temperature drops to 35°C and the fan stops.
18.	Ambient temperature detector	o-c	PV850 AC230	10min	--	--	The machine is running normally without any damage to the device.
19.	Power supply transformer	s-c	PV850 AC230	10min	--	--	The machine can't start and run, it returns to normal after removing the short circuit.

	(T2)						
20.	Power supply unit	s- c	PV850 AC230	10min	--	--	Auxiliary power protection, no voltage output, no damage to the machine.
21.	IGBT A1(D-S)	s-c	PV850 AC230	10min	--	--	Converter overcurrent, no danger.
22.	IGBT A1 (G-S)	s-c	PV850 AC230	10min	--	--	Converter overcurrent, no danger.
23.	IGBT A1 (G-D)	s-c	PV850 AC230	10min	--	--	Converter overcurrent, no danger.
24.	DC input E-capacitor (DC_CAP)	s-c	PV850 AC230	10min	--	--	Bus short circuit fault, no danger.
25.	LC filter capacitor (AC_CAP)	s-c	PV850 AC230	10min	--	--	Output short circuit, no danger.
26.	Capacitor (C58) on PE1810_C T1	s-c	PV850 AC230	10min	--	--	Converter fault, no danger.
27.	Capacitor (C195) on PE1810_D T1	s-c	PV850 AC230	10min	--	--	Converter overcurrent, no danger.
28.	Capacitor (C15) on PE1810_D R2	s-c	PV850 AC230	10min	--	--	Fault of DC auxiliary power supply, there is no display on the black screen after that.
29.	Relay K1	s-c	PV850 AC230	10min	--	--	Grid contactor short circuit.
30.	Relay K2	s-c	PV850 AC230	10min	--	--	The relay is not used and will not be affected.
31.	Relay K3	s-c	PV850 AC230	10min	--	--	The fan started immediately after power-on, and there was no fault.
32.	Relay K4	s-c	PV850 AC230	10min	--	--	The relay is not used and will not be affected.

33.	Relay K5	s-c	PV850 AC230	10min	--	--	Grid contactor short circuit.
34.	Relay K15	s-c	PV850 AC230	10min	--	--	Grid contactor short circuit.
35.	Transformer T1 pin1-pin2 (PE1810_P W1_B)	s-c	PV850 AC230	10min	--	--	After Transformer T1 pin1-pin2 short-circuit output: DC6.85V, the screen flickers.
36.	Transformer T1 pin3-pin4 (PE1810_P W1_B)	s-c	PV850 AC230	10min	--	--	After Transformer T1 pin3-pin4 short-circuit output: DC7.97V, the screen flickers.
37.	Transformer T1 pin13-pin14 (PE1810_P W1_B)	s-c	PV850 AC230	10min	--	--	After Transformer T1 pin13-pin14 short-circuit output: DC2.462V, the screen flickers.
38.	Transformer T1 pin9-pin10 (PE1810_P W1_B)	s-c	PV850 AC230	10min	--	--	After Transformer T1 pin9-pin10 short-circuit output: DC12.30V, the screen flickers.
39.	Q1 pinG-pinS (PE1810_P W1_B)	s-c	PV850 AC230	10min	--	--	Q1 pinG-pinS short circuit output: DC10.81V, the screen flickers.
40.	Q1 pinG-pinD (PE1810_P W1_B)	s-c	PV850 AC230	10min	--	--	Q1 pinG-pinD short circuit output: DC5.35V, the screen flickers.
41.	Q1 pinD-pinS (PE1810_P W1_B)	s-c	PV850 AC230	10min	--	--	After Q1 pinD-pinS short-circuit output: DC74.6V, the machine reports Converter overcurrent failure.
42.	U2 pin1-pin2 (PE1810_P	s-c	PV850 AC230	10min	--	--	After U2 pin1-pin2 short-circuit output: DC11.79V, the screen flickers.

	W1_B)						
43.	U2 pin3-pin4 (PE1810_P W1_B)	s-c	PV850 AC230	10min	--	--	After U2 pin3-pin4 short-circuit output: DC8.4V, the screen flickers.
44.	U2 pin1 (PE1810_P W1_B)	o-c	PV850 AC230	10min	--	--	After U2 pin1 open circuit output: DC67.3V, the machine reports Grid contactor short circuit failure.
45.	U2 pin3 (PE1810_P W1_B)	o-c	PV850 AC230	10min	--	--	After U2 pin3 open circuit output: DC65.9V, the machine reports Converter overcurrent failure.

Legend

FID	Fault Indication	MT	Max. Temperature
SD	PCE Shut Down:	DG	Disconnection To Grid
RO	Recovered to Operate after removing the single fault setting	NCD	No Comp. or parts Damaged
NH	No Hazards occurred	PEST	Pass the Electric Strength Test.
BI	Basic insulation	SI	Supplementary insulation
DI	Double insulation	RI	Reinforced insulation
FI	Functional insulation	O.V.C	Overvoltage category
s-c	short-circuited	o-c	open-circuited
o-l	Over-load.	DST	Dielectric strength test

Addendum – Shutdown device

Each active phase can be switched, (L and N)	Confirmed
If no galvanic separation between AC and DC (PV): Two relays in series on each active phase are necessary to fulfil the basic insulation or simple separation based on the PV working voltage,	Confirmed
Note: The errors in the control circuit simulate that the safety is even under one error ensured	

4.2.2.3.2 Overvoltage and undervoltage					P
Test conditions: L1-N					
First Level					
	Under Voltage		Over Voltage		
Parameter		Voltage [V]		Voltage [V]	
Set value		195.5		253.0	
Measured trip value [V]	Phase	Line to Neutral	Phase	Line to Neutral	
		194.64		252.55	
		194.55		252.79	
		194.37		252.77	
Parameter		Time [s]		Time [s]	
Limit		≤ 10.0		≤ 40.0	
Disconnection time [s]	200V to 190V	4.40	248V to 258V	34.38	
		4.37		34.51	
		4.37		34.56	
Second Level					
	Under Voltage		Over Voltage		
Parameter		Voltage [V]		Voltage [V]	
Set value		115.0		264.5	
Measured trip value [V]	Phase	Line to Neutral	Phase	Line to Neutral	
		114.32		263.59	
		114.57		263.14	
		114.31		263.59	
Parameter		Time [s]		Time [s]	
Limit		≤ 0.2		≤ 2.0	
Disconnection time [s]	200V to 113V	0.078	248V to 270V	1.18	
		0.078		1.18	
		0.078		1.18	
Third Level					
	--		Over Voltage		
Parameter		--		Voltage [V]	
Set value				276	
Measured trip	--		Phase	Line to Neutral	

value [V]				275.95
				275.94
				275.47
Parameter				Time [s]
Limit				<= 0.16
Disconnection time [s]	--		248V to 280V	0.08
				0.10
				0.14

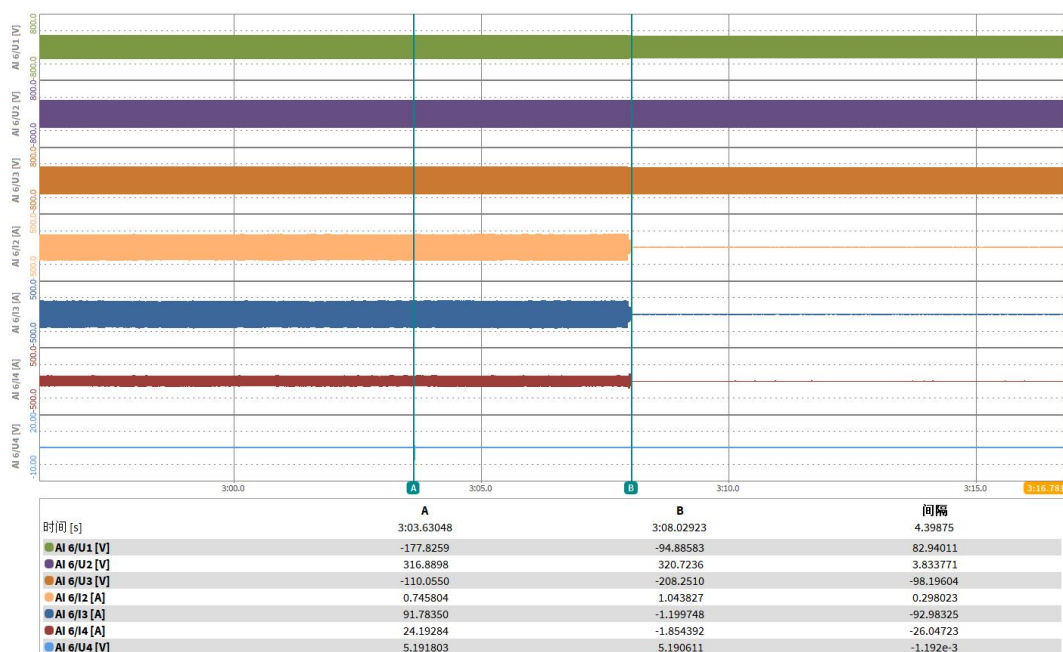
Note:

The NRS 097-2-1 provide limits of accuracy for the utility voltage and frequency measurement of the power system. The values for tolerances given in Table 2 are used.

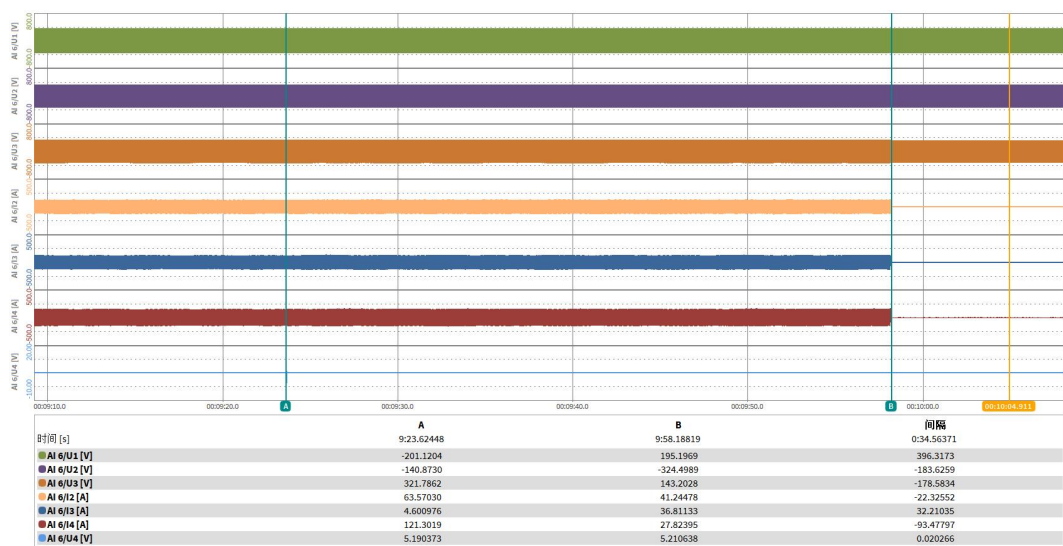
The accuracy for voltage trip values shall be within 0 % to +1 % of the nominal voltage from the upper boundary trip setting. and within -1% to 0% of the nominal voltage from the lower boundary trip setting.

If multi-voltage control settings are not possible. the more stringent trip time should be implemented. e.g. 2 s between 110% and 120% of voltage.

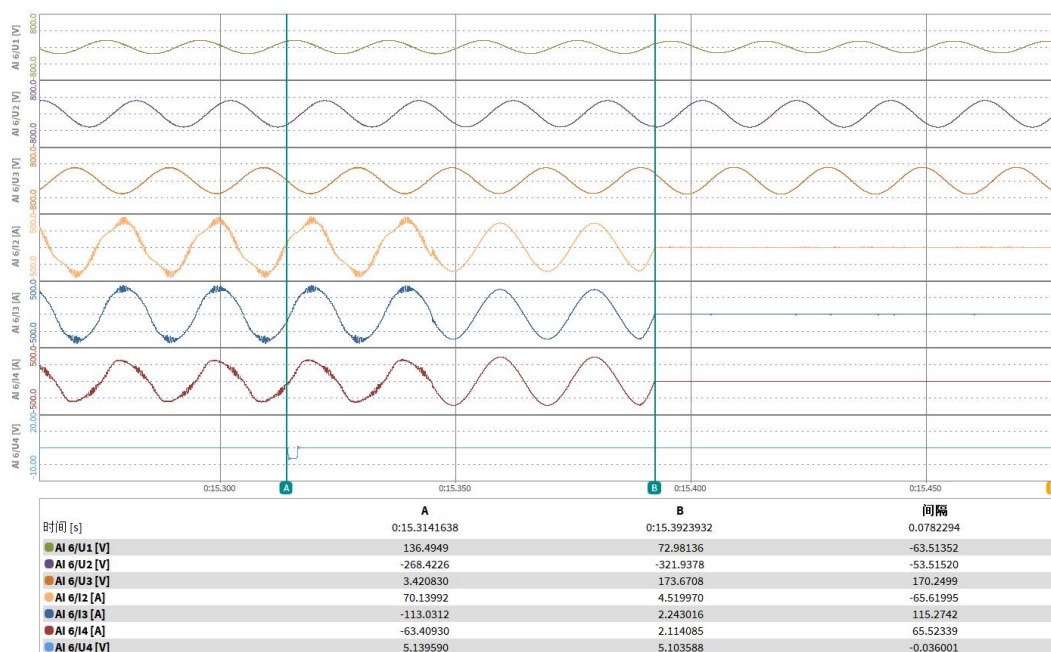
Under Voltage: First Level



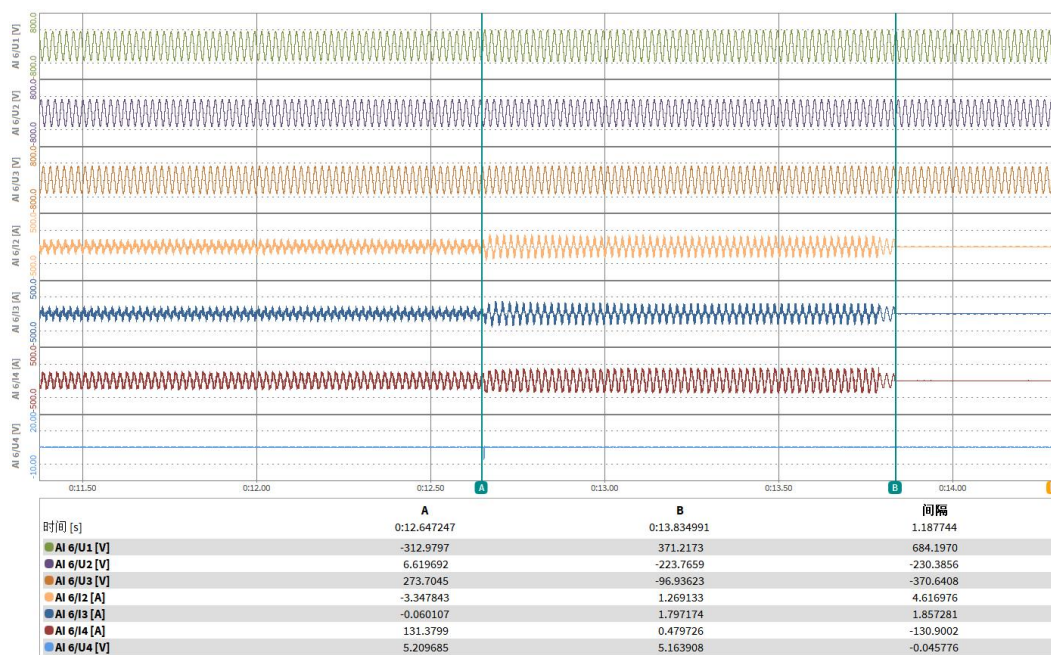
Over Voltage: First Level



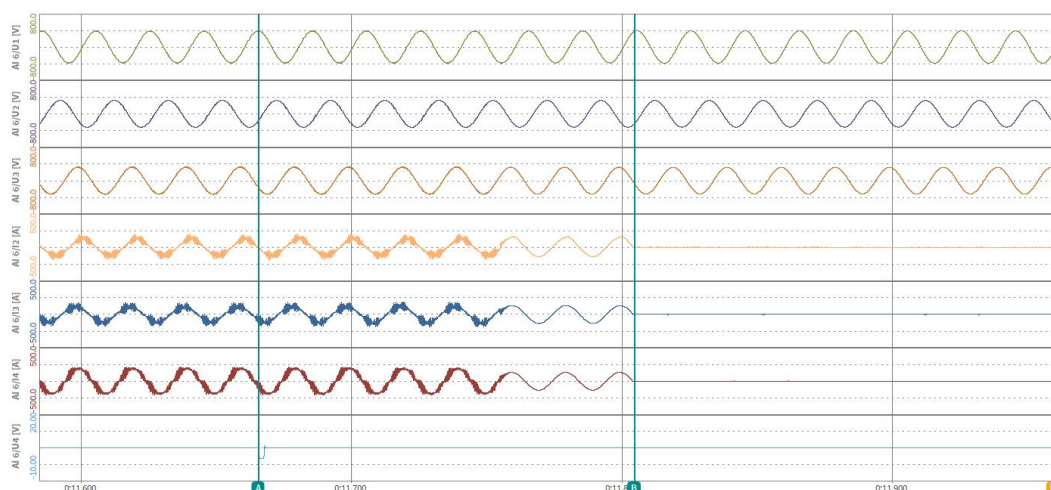
Under Voltage: Second Level



Over Voltage: Second Level



Over Voltage: Third Level



时间 [s]	A	B	间隔
AI 6/U1 [V]	387.4943	379.9138	-7.580519
AI 6/U2 [V]	-153.6043	-233.0823	-79.47803
AI 6/U3 [V]	-183.4445	-84.73516	98.70935
AI 6/I2 [A]	-8.331984	1.434834	9.766818
AI 6/I3 [A]	-107.0302	-0.839736	106.1904
AI 6/I4 [V]	-68.61398	-0.098439	68.51554
AI 6/U4 [V]	4.070997	5.125285	1.054287

4.2.2.3.2 Overvoltage and undervoltage					P
Test conditions: L2-N					
First Level					
	Under Voltage		Over Voltage		
Parameter		Voltage [V]		Voltage [V]	
Set value		195.5		253.0	
Measured trip value [V]	Phase	Line to Neutral	Phase	Line to Neutral	
		194.42		251.52	
		194.93		251.49	
		194.49		252.85	
Parameter		Time [s]		Time [s]	
Limit		≤ 10.0		≤ 40.0	
Disconnection time [s]	200V to 190V	4.57	248V to 258V	27.09	
		4.38		14.95	
		4.39		34.47	
Second Level					
	Under Voltage		Over Voltage		
Parameter		Voltage [V]		Voltage [V]	
Set value		115.0		264.5	
Measured trip value [V]	Phase	Line to Neutral	Phase	Line to Neutral	
		114.41		262.48	
		114.64		263.11	
		114.49		263.07	
Parameter		Time [s]		Time [s]	
Limit		≤ 0.2		≤ 2.0	
Disconnection time [s]	200V to 113V	0.087	248V to 270V	1.18	
		0.072		1.18	
		0.074		1.18	
Third Level					
	--		Over Voltage		
Parameter		--		Voltage [V]	
Set value				276	
Measured trip	--		Phase	Line to Neutral	

value [V]				274.18
				274.41
				274.72
Parameter				Time [s]
Limit				<= 0.16
Disconnection time [s]	--		248V to 280V	0.08
				0.07
				0.07

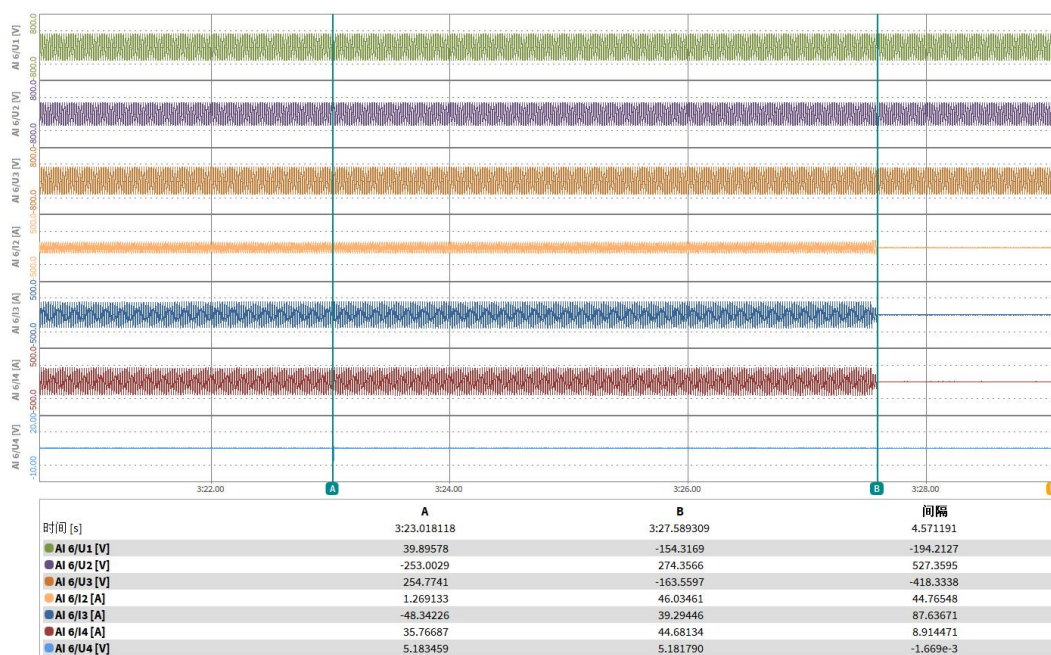
Note:

The NRS 097-2-1 provide limits of accuracy for the utility voltage and frequency measurement of the power system. The values for tolerances given in Table 2 are used.

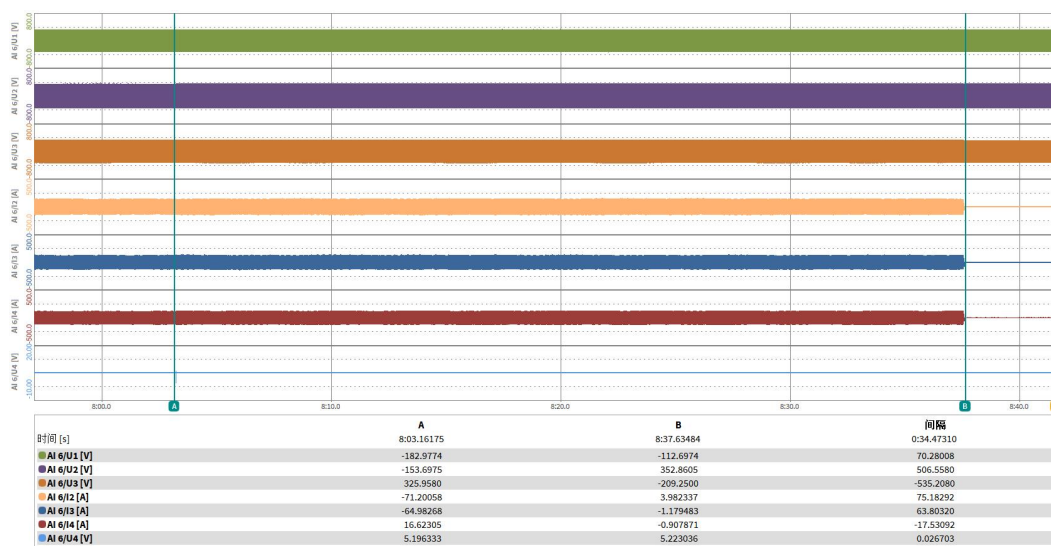
The accuracy for voltage trip values shall be within 0 % to +1 % of the nominal voltage from the upper boundary trip setting. and within -1% to 0% of the nominal voltage from the lower boundary trip setting.

If multi-voltage control settings are not possible. the more stringent trip time should be implemented. e.g. 2 s between 110% and 120% of voltage.

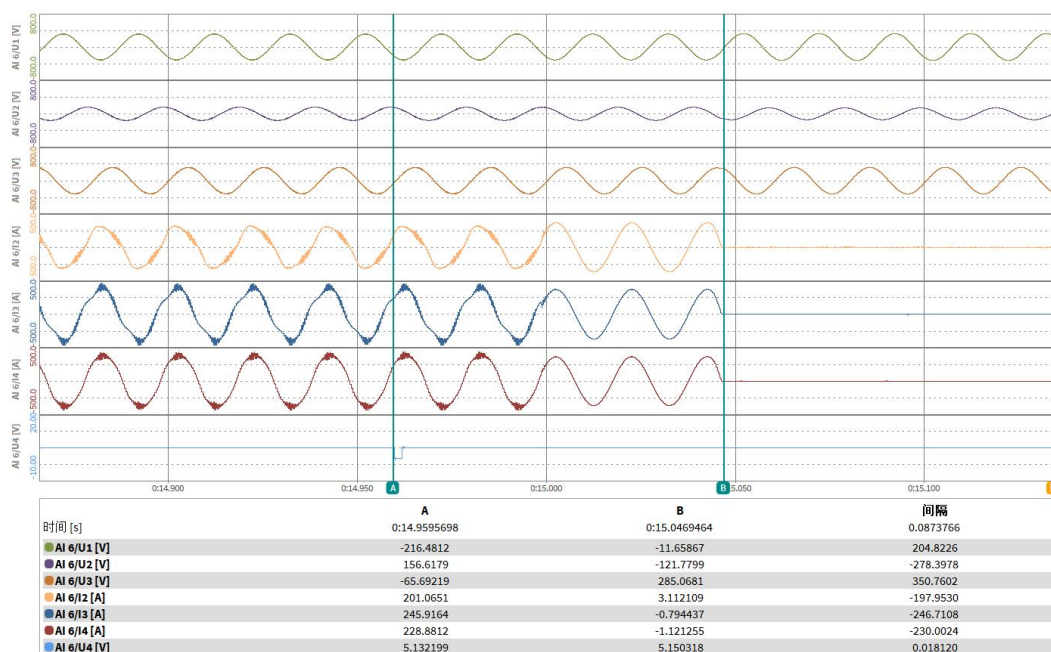
Under Voltage: First Level



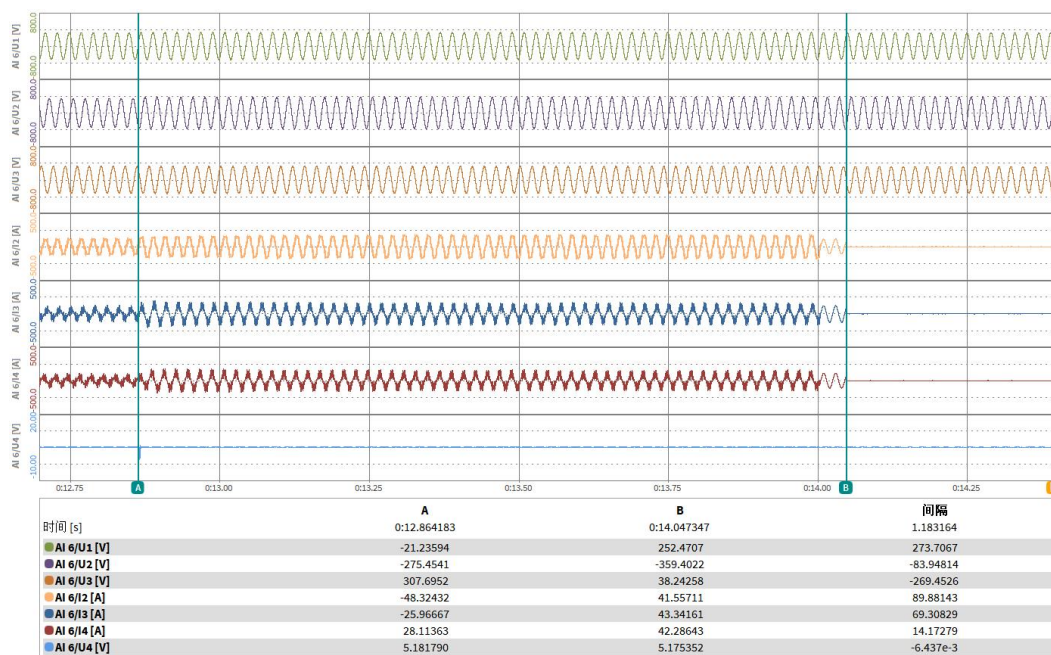
Over Voltage: First Level



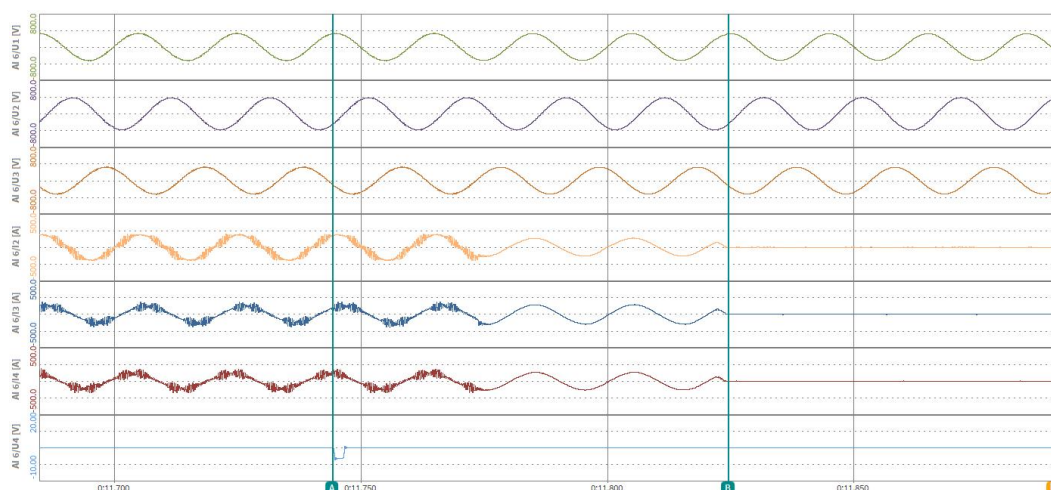
Under Voltage: Second Level



Over Voltage: Second Level



Over Voltage: Third Level



时间 [s]	A	B	间隔
AI 6/U1 [V]	0:11.7442761	0:11.8245234	0.0802472
AI 6/U2 [V]	321.6593	320.7464	-0.912905
AI 6/U3 [V]	-260.0825	-240.3221	19.76037
AI 6/I2 [A]	-94.20968	-123.4312	-29.22154
AI 6/I3 [A]	167.1191	2.857001	-164.2621
AI 6/I4 [A]	68.81783	-0.774171	-69.59200
AI 6/U4 [V]	142.5057	-1.179668	-143.6853
AI 6/U4 [V]	5.127669	5.120278	-7.391e-3

4.2.2.3.2 Overvoltage and Undervoltage					P
Test conditions: L3-N					
First Level					
	Under Voltage			Over Voltage	
Parameter		Voltage [V]			Voltage [V]
Set value		195.5			253.0
Measured trip value [V]	Phase	Line to Neutral		Phase	Line to Neutral
		194.65			251.91
		195.08			251.54
		194.61			252.28
Parameter		Time [s]			Time [s]
Limit		≤ 10.0			≤ 40.0
Disconnection time [s]	200V to 190V	4.37		248V to 258V	34.40
		4.40			23.99
		4.35			34.38
Second Level					
	Under Voltage			Over Voltage	
Parameter		Voltage [V]			Voltage [V]
Set value		115.0			264.5
Measured trip value [V]	Phase	Line to Neutral		Phase	Line to Neutral
		115.09			262.51
		115.01			262.86
		114.13			262.51
Parameter		Time [s]			Time [s]
Limit		≤ 0.2			≤ 2.0
Disconnection time [s]	200V to 113V	0.079		248V to 270V	1.18
		0.080			1.18
		0.073			1.19
Third Level					
	--			Over Voltage	
Parameter		--			Voltage [V]
Set value					276
Measured trip	--			Phase	Line to Neutral

value [V]				275.22
				274.31
				274.29
Parameter				Time [s]
Limit				<= 0.16
Disconnection time [s]	--		248V to 280V	0.08
				0.07
				0.07

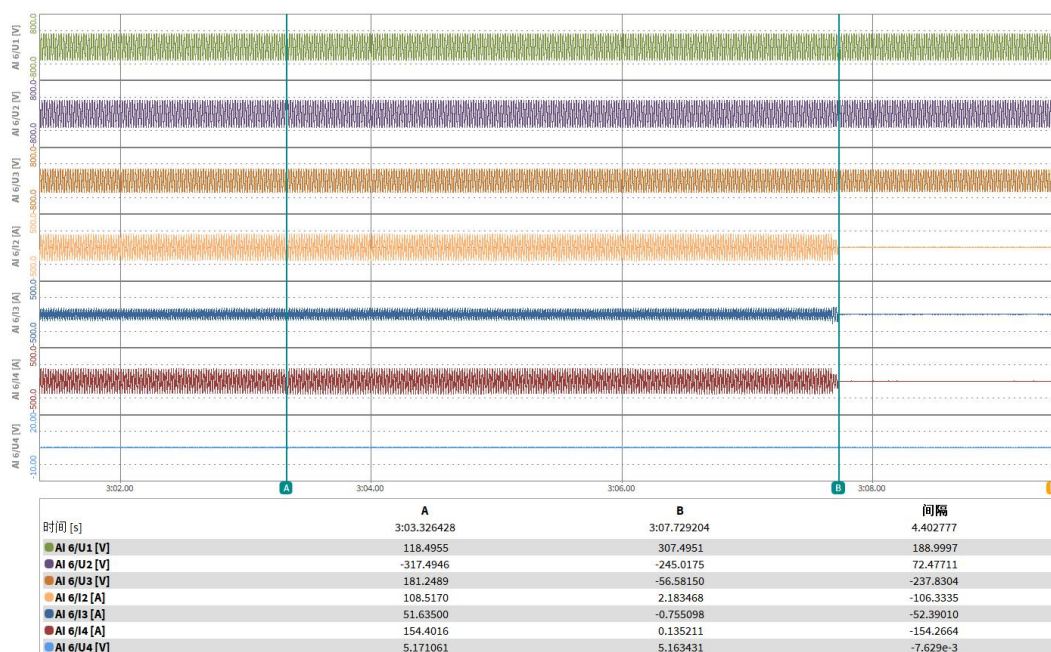
Note:

The NRS 097-2-1 provide limits of accuracy for the utility voltage and frequency measurement of the power system. The values for tolerances given in Table 2 are used.

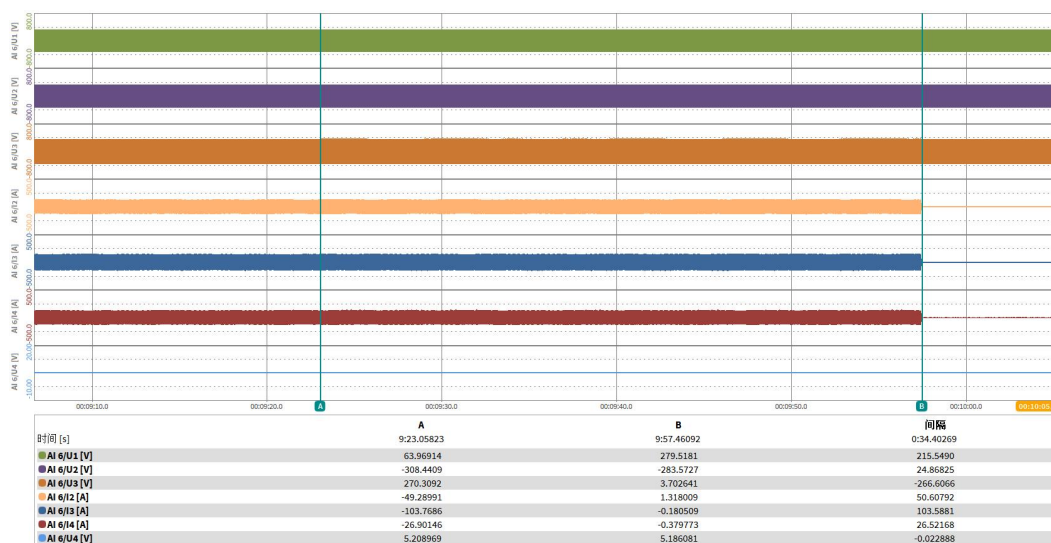
The accuracy for voltage trip values shall be within 0 % to +1 % of the nominal voltage from the upper boundary trip setting. and within -1% to 0% of the nominal voltage from the lower boundary trip setting.

If multi-voltage control settings are not possible. the more stringent trip time should be implemented. e.g. 2 s between 110% and 120% of voltage.

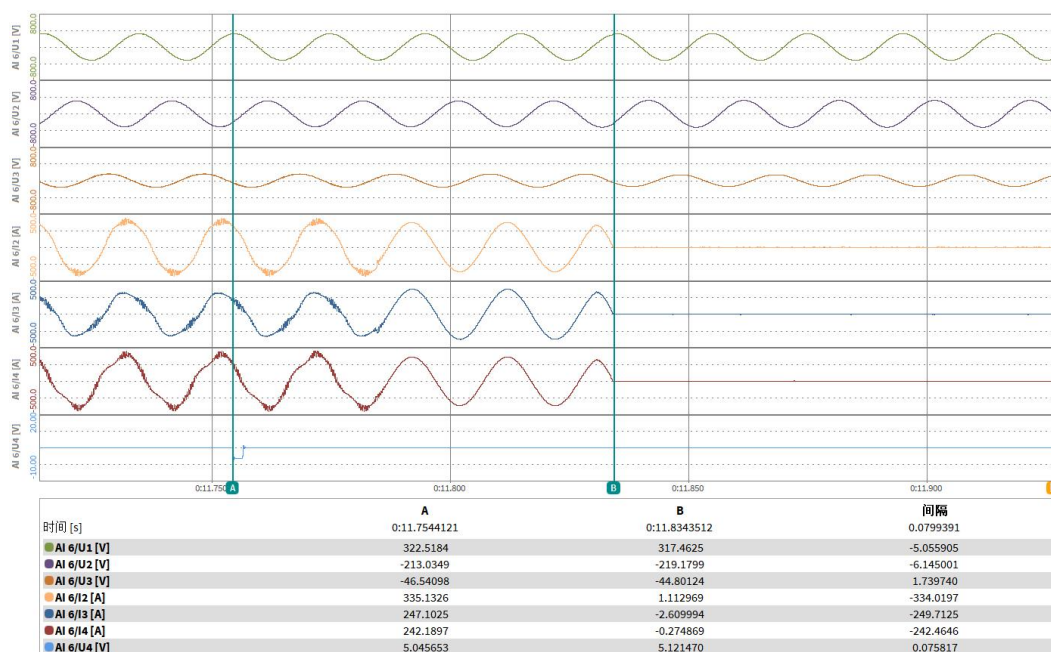
Under Voltage: First Level



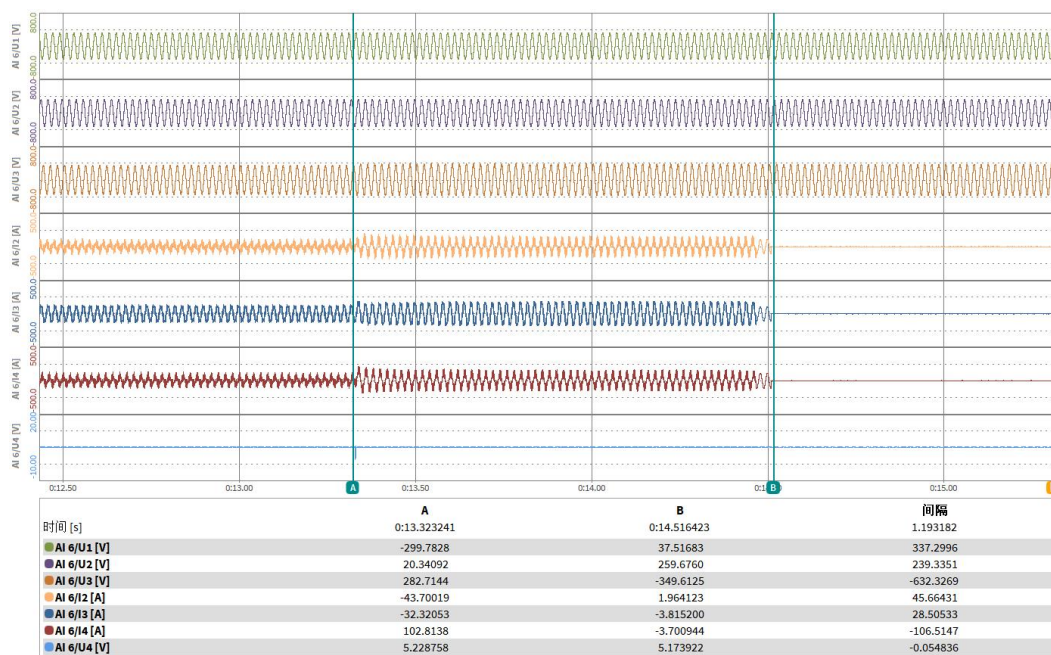
Over Voltage: First Level



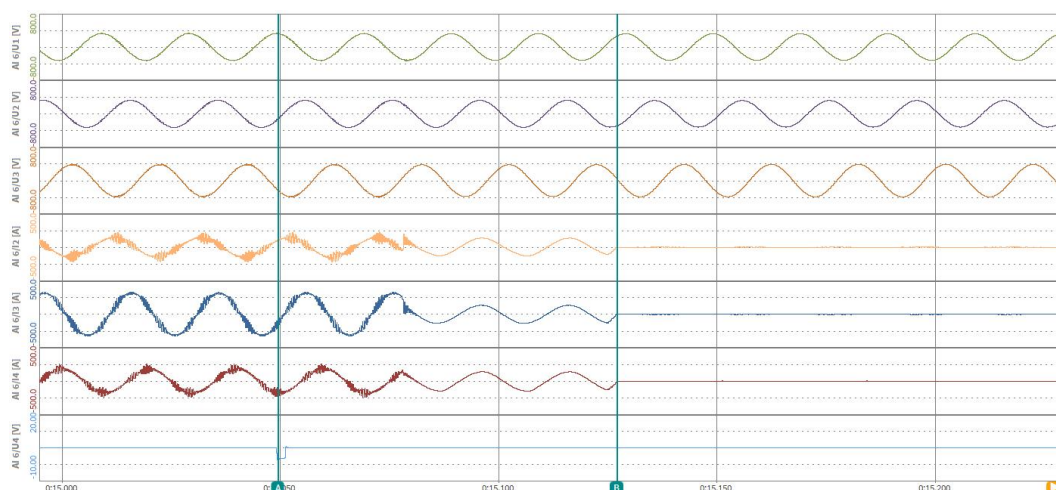
Under Voltage: Second Level



Over Voltage: Second Level



Over Voltage: Third Level



时间 [s]	A	B	间隔
AI 6/U1 [V]	0:15.0495379	0:15.1271485	0.0776106
AI 6/U2 [V]	325.5980	263.9191	-61.67889
AI 6/U3 [V]	-112.2792	-293.1724	-180.8932
AI 6/U4 [V]	-249.6803	44.69276	294.3731
AI 6/I1 [A]	100.6790	-0.524967	-101.2039
AI 6/I2 [A]	-139.8020	0.897143	140.6992
AI 6/I3 [A]	-187.3834	1.295117	188.6785
AI 6/I4 [A]	0.481129	5.140305	4.659176

4.2.2.3.2 Low voltage fault Ride through capability (Category A1 and A2)

N/A

General:

The purpose of these tests is to ensure that the converter, which in category A1 and A2, is insensitive to voltage dips according to the time-amplitude profile shown in the diagram,

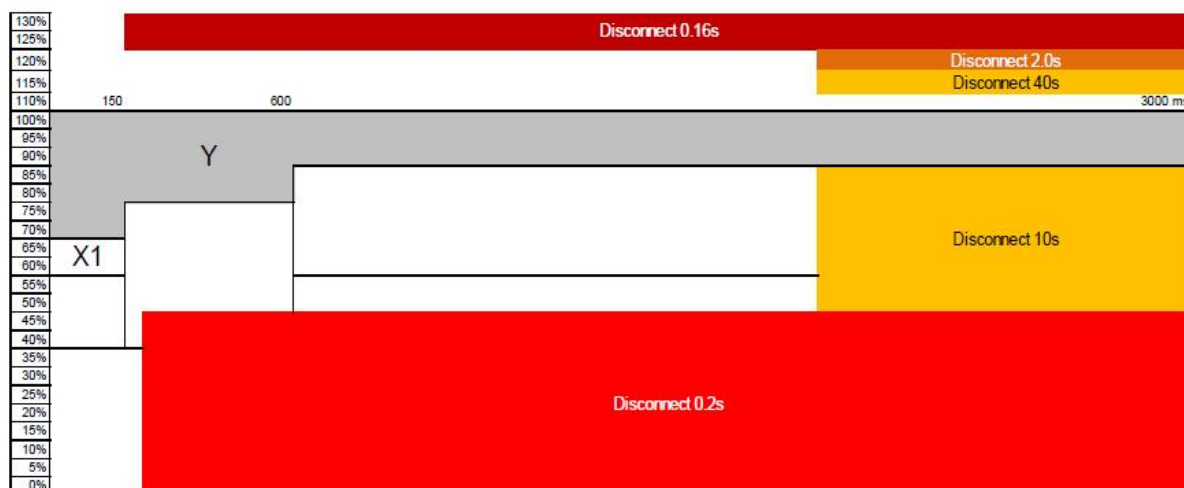


Figure 4 — Graphical representation of voltage-ride-through and voltage disconnect requirements for A1 and A2 EG

List of tests	Residual amplitude of phase-to-phase voltage V/V_{nom}	Tolerance	Duration [ms]	Form (*)
1 - three-phase symmetrical fault	0.60	$\pm 0.05 (V1/V_{nom})$	150 ± 20	
2 - three-phase symmetrical fault	0.70	$\pm 0.05 (V2/V_{nom})$	150 ± 20	
3 - three-phase symmetrical fault	0.80	$\pm 0.05 (V3/V_{nom})$	600 ± 20	
4 - two-phase asymmetrical fault	0.60	$\pm 0.05 (V4/V_{nom})$	150 ± 20	
5 - two -phase asymmetrical fault	0.70	$\pm 0.05 (V5/V_{nom})$	150 ± 20	
6 - two -phase asymmetrical fault	0.80	$\pm 0.05 (V6/V_{nom})$	600 ± 20	
7 - single-phase symmetrical fault	0.60	$\pm 0.05 (V7/V_{nom})$	150 ± 20	
8 - single-phase symmetrical fault	0.70	$\pm 0.05 (V8/V_{nom})$	150 ± 20	
9 - single-phase symmetrical fault	0.80	$\pm 0.05 (V9/V_{nom})$	600 ± 20	

Assessment criterion:

The SSEG shall be able to withstand voltage drops without disconnecting, as shown in Figures 4 for Area X1 and Y, SSEGs of category A1 and A2 should not inject any reactive current into the network,

The test conditions are performed as worst case conditions, The inverter feeds maximal active and reactive

power during the complete test.

Graph of LVRT test one

List of tests	Residual amplitude of phase-to-phase voltage V/V_{nom}	Duration limit of Voltage dips [ms]	Duration measured [ms]	Result
1 – three-phase symmetrical fault (P = 0.1 - 0.3)	0.60	150 + 20	--	--
1 – three-phase symmetrical fault (P > 0.9)	0.60	150 + 20	--	--
2 – three-phase symmetrical fault (P = 0.1 - 0.3)	0.70	150 + 20	--	--
2 – three-phase symmetrical fault (P > 0.9)	0.70	150 + 20	--	--
3 – three-phase symmetrical fault (P = 0.1 - 0.3)	0.80	600 + 20	--	--
3 – three-phase symmetrical fault (P > 0.9)	0.80	600 + 20	--	--
4 – two-phase asymmetrical fault (P = 0.1 - 0.3)	0.60	150 + 20	--	--
4 – two-phase asymmetrical fault (P > 0.9)	0.60	150 + 20	--	--
5 – two-phase asymmetrical fault (P = 0.1 - 0.3)	0.70	150 + 20	--	--
5 – two-phase asymmetrical fault (P > 0.9)	0.70	150 + 20	--	--
6 – two-phase asymmetrical fault (P = 0.1 - 0.3)	0.80	600 + 20	--	--
6 – two-phase asymmetrical fault (P > 0.9)	0.80	600 + 20	--	--
7 – single-phase symmetrical fault (P = 0.1 - 0.3)	0.60	150 + 20	--	--
7 – single-phase symmetrical fault (P > 0.9)	0.60	150 + 20	--	--
8 – single-phase symmetrical fault (P = 0.1 - 0.3)	0.70	150 + 20	--	--
8 – single-phase symmetrical fault	0.70	150 + 20	--	--

(P > 0.9)				
9 –single-phase symmetrical fault (P = 0.1 - 0.3)	0.80	600 + 20	--	--
9 –single-phase symmetrical fault (P > 0.9)	0.80	600 + 20	--	--
Test conditions: Voltage simulator fall and rise time: < 10ms				

4.2.2.3.2 Low voltage fault Ride through capability (Category A3 (For RPP Grid Code))

P

General:

The purpose of these tests is to ensure that the converter, which in category A3, is insensitive to voltage dips according to the time-amplitude profile shown in the diagram. (Area B)

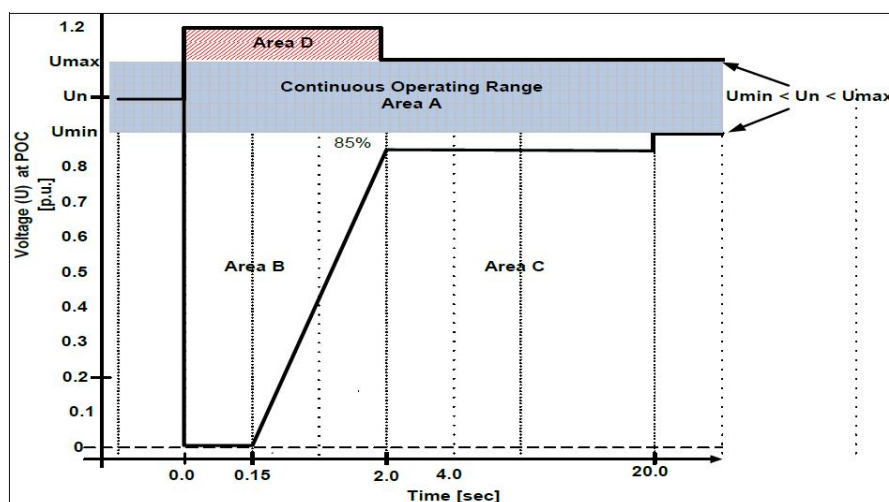
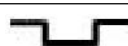


Figure 4: Voltage Ride through Capability for the RPPs of Category A3. B and C utilising non-synchronous machines

List of tests	Residual amplitude of phase-to-phase voltage V/V_{nom}	Tolerance	Duration [ms]	Form (*)
1 - three-phase symmetrical fault	0.00-0.05	$(V1/V_{nom})$	150 + 20	
2 - three-phase symmetrical fault	0.40	$\pm 0.05(V2/V_{nom})$	1075 + 20	
3 - three-phase symmetrical fault	0.75	$\pm 0.05(V3/V_{nom})$	1780 + 20	
4 - three-phase symmetrical fault	0.85	$\pm 0.05(V4/V_{nom})$	20000 + 20	
5 - two-phase asymmetrical fault	0.00-0.05	$(V5/V_{nom})$	150 + 20	
6 - two -phase asymmetrical fault	0.40	$\pm 0.05(V6/V_{nom})$	1075 + 20	
7 - two -phase asymmetrical fault	0.75	$\pm 0.05(V7/V_{nom})$	1780 + 20	
8 - two -phase asymmetrical fault	0.85	$\pm 0.05(V8/V_{nom})$	20000 + 20	
9 - single-phase symmetrical fault	0.00-0.05	$(V9/V_{nom})$	150 + 20	
10 - single-phase symmetrical fault	0.40	$\pm 0.05(V10/V_{nom})$	1075 + 20	
11 - single-phase symmetrical fault	0.75	$\pm 0.05(V11/V_{nom})$	1780 + 20	
12 - single-phase symmetrical fault	0.85	$\pm 0.05(V12/V_{nom})$	20000 + 20	

Assessment criterion:

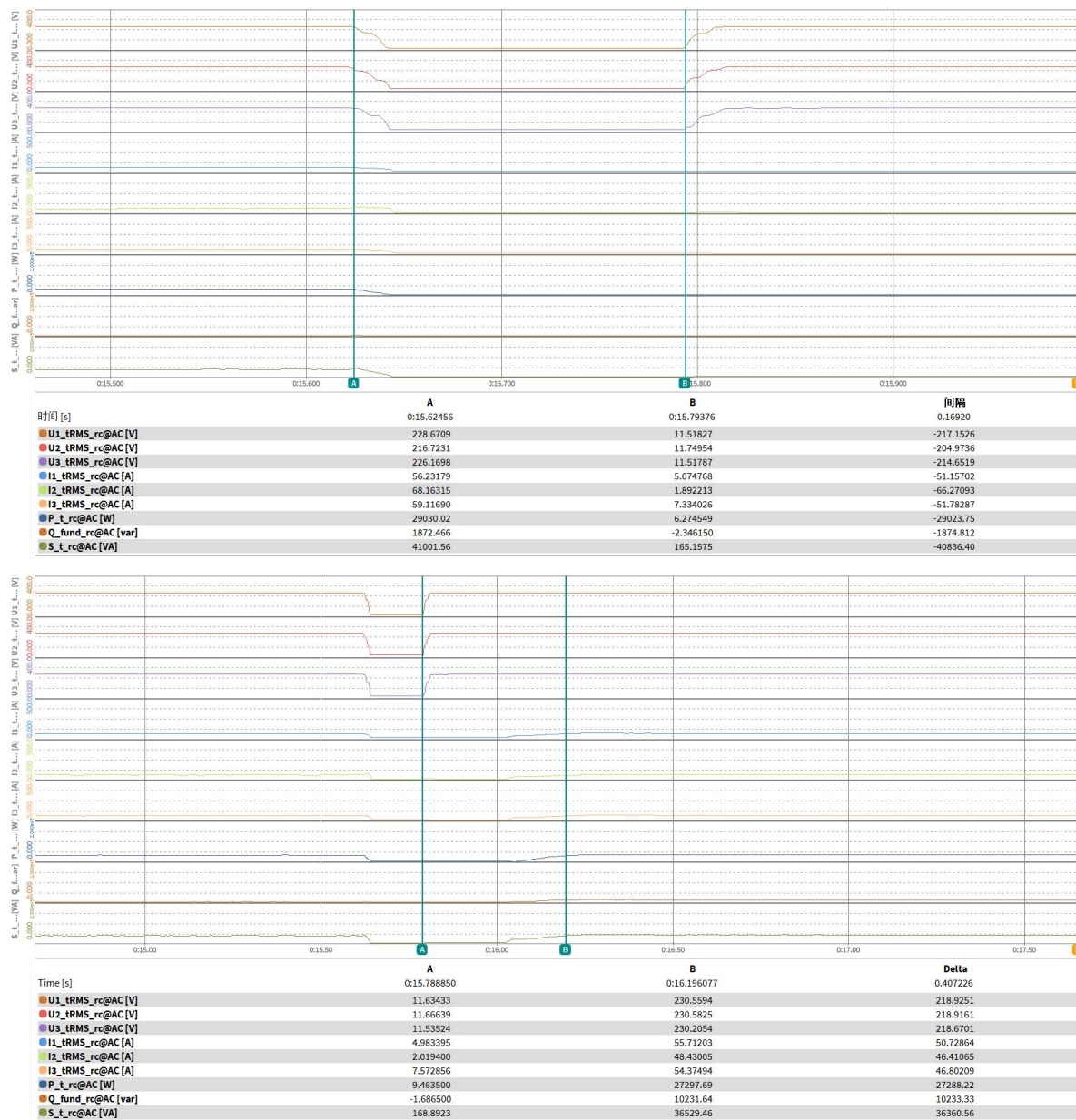
The SSEG shall be able to withstand voltage drops without disconnecting, as shown in Figures 4 for Area B. SSEGs of category A3 should not inject any reactive current into the network.

The test conditions are performed as worst case conditions. The inverter feeds maximal active and reactive power during the complete test.

Graph of LVRT test one

List of tests	Residual amplitude of phase-to-phase voltage V/V_{nom}	Duration limit of Voltage dips [ms]	Duration measured [ms]	Result
1 – three-phase symmetrical fault (P = 0.1 - 0.3)	0.00-0.05	150	169	P
1 – three-phase symmetrical fault (P > 0.9)	0.00-0.05	150	170	P
2 – three-phase symmetrical fault (P = 0.1 - 0.3)	0.40	1075	1090	P
2 – three-phase symmetrical fault (P > 0.9)	0.40	1075	1089	P
3 – three-phase symmetrical fault (P = 0.1 - 0.3)	0.75	1780	1796	P
3 – three-phase symmetrical fault (P > 0.9)	0.75	1780	1798	P
4 – three-phase symmetrical fault (P = 0.1 - 0.3)	0.85	20000	20071	P
4 – three-phase symmetrical fault (P > 0.9)	0.85	20000	20012	P
5 – two-phase asymmetrical fault (P = 0.1 - 0.3)	0.00-0.05	150	170	P
5 – two-phase asymmetrical fault (P > 0.9)	0.00-0.05	150	169	P
6 – two-phase asymmetrical fault (P = 0.1 - 0.3)	0.40	1075	1102	P
6 – two-phase asymmetrical fault (P > 0.9)	0.40	1075	1103	P
7 – two-phase asymmetrical fault (P = 0.1 - 0.3)	0.75	1780	1803	P
7 – two-phase asymmetrical fault (P > 0.9)	0.75	1780	1801	P

8 – two-phase asymmetrical fault (P = 0.1 - 0.3)	0.85	20000	20009	P
8 – two-phase asymmetrical fault (P > 0.9)	0.85	20000	20011	P
9 –single-phase symmetrical fault (P = 0.1 - 0.3)	0.00-0.05	150	169	P
9 –single-phase symmetrical fault (P > 0.9)	0.00-0.05	150	169	P
10 –single-phase symmetrical fault (P = 0.1 - 0.3)	0.40	1075	1093	P
10 –single-phase symmetrical fault (P > 0.9)	0.40	1075	1087	P
11 –single-phase symmetrical fault (P = 0.1 - 0.3)	0.75	1780	1789	P
11 –single-phase symmetrical fault (P > 0.9)	0.75	1780	1799	P
12 –single-phase symmetrical fault (P = 0.1 - 0.3)	0.85	20000	20014	P
12 –single-phase symmetrical fault (P > 0.9)	0.85	20000	20005	P
Test conditions: Voltage simulator fall and rise time: < 10ms				



1 – three-phase symmetrical fault
(P = 0.1 - 0.3)

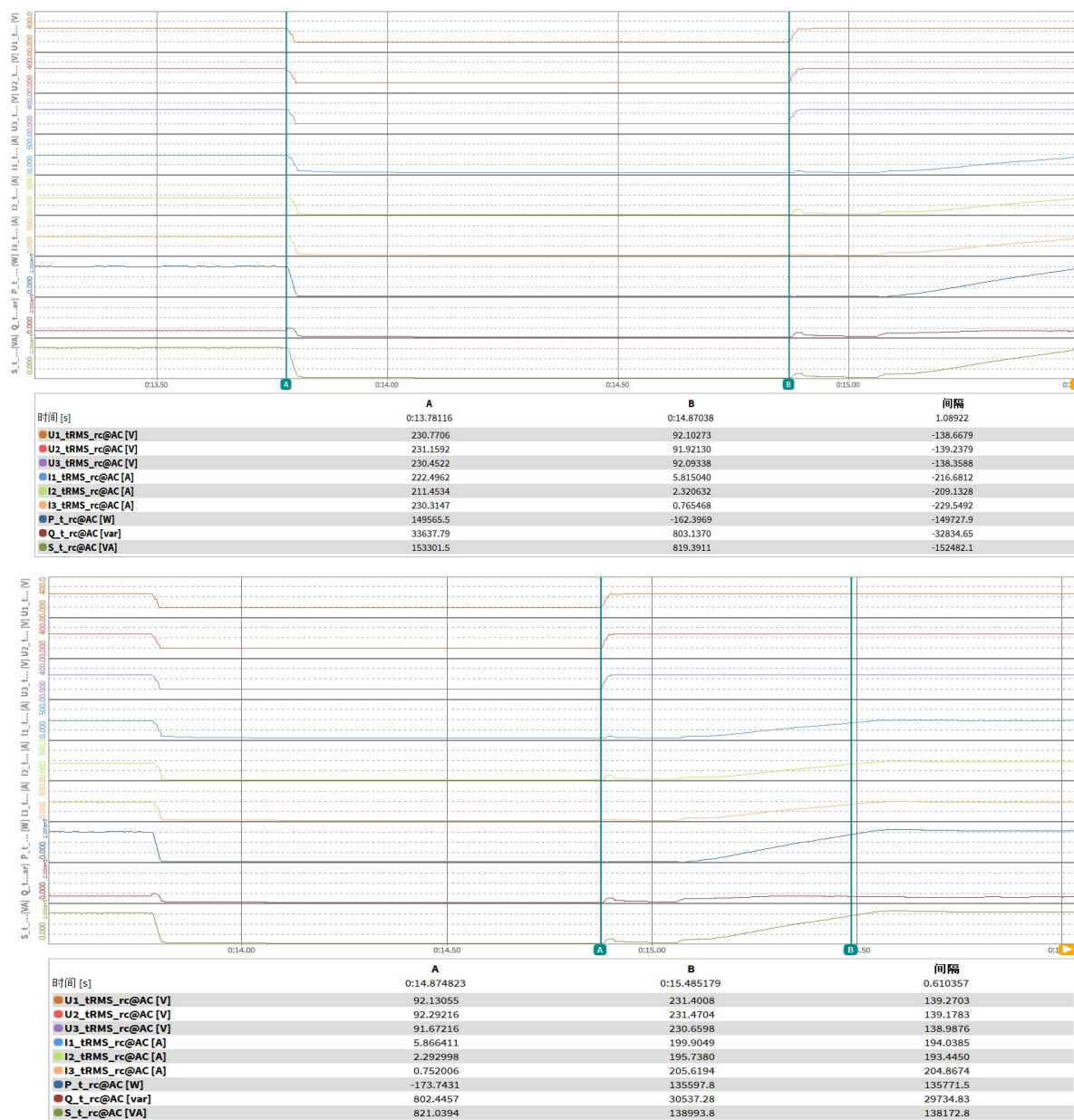


1 – three-phase symmetrical fault
(P = 0.1 - 0.3)



2 – three-phase symmetrical fault

(P = 0.1 - 0.3)

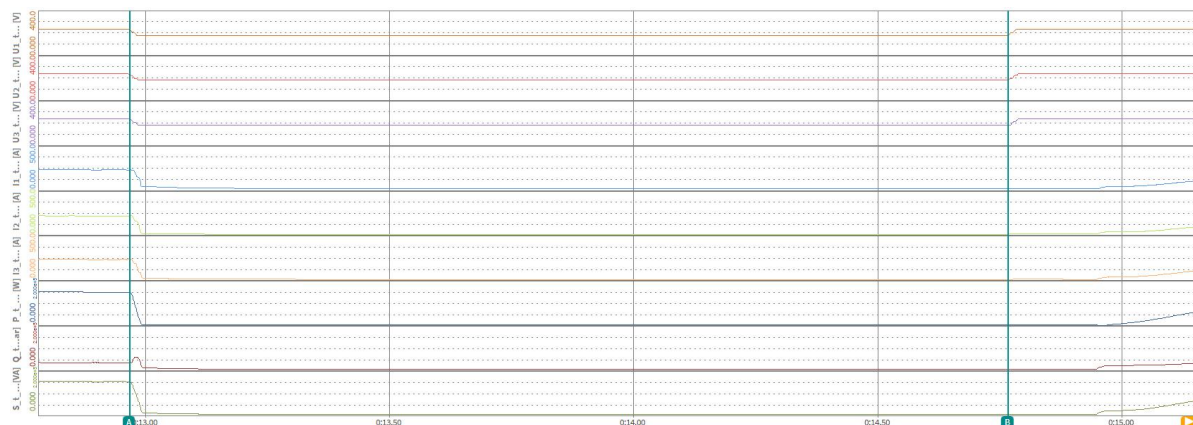


2 – three-phase symmetrical fault
($P > 0.9$)

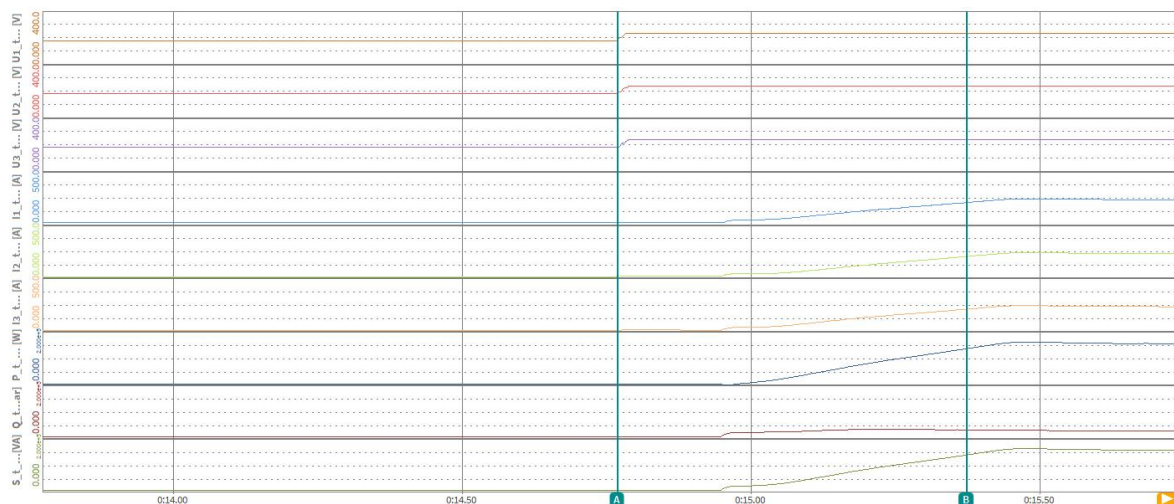


3 – three-phase symmetrical fault

(P = 0.1 - 0.3)



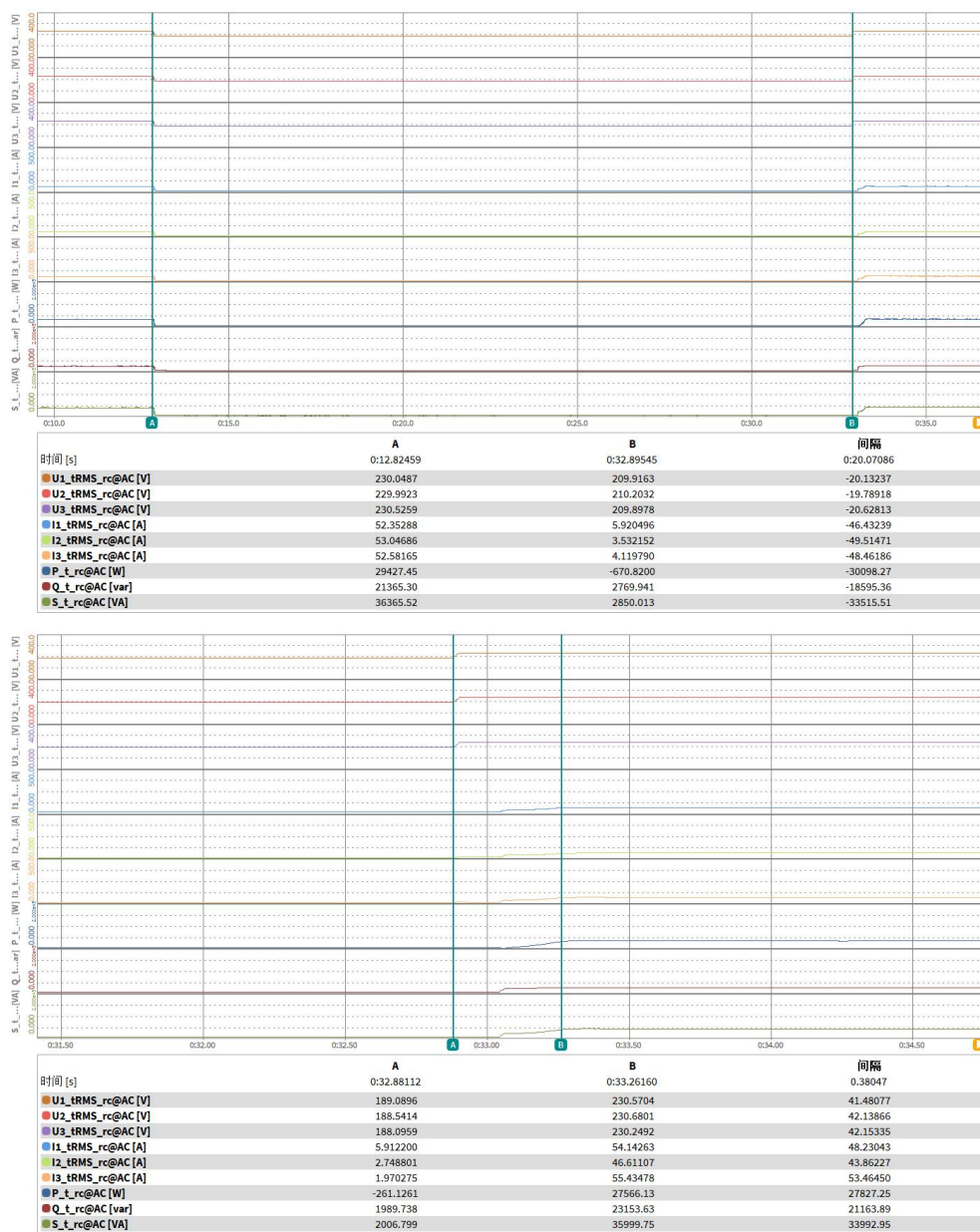
时间 [s]	A	B	间隔
0:12.967802	0:14.766060	1.798258	
U1_trms_rc@AC [V]	230.6963	172.1727	-58.52357
U2_trms_rc@AC [V]	231.1944	172.6152	-58.57925
U3_trms_rc@AC [V]	230.5549	172.8212	-57.73366
I1_trms_rc@AC [A]	221.5861	5.798840	-215.7873
I2_trms_rc@AC [A]	211.8664	3.734369	-208.1321
I3_trms_rc@AC [A]	229.9563	1.770772	-228.1856
P_t_rc@AC [W]	149430.1	-518.5329	-149948.7
Q_t_rc@AC [var]	33407.60	1878.796	-31528.81
S_t_rc@AC [VA]	153119.0	1949.038	-151170.0



时间 [s]	A	B	间隔
0:14.769011	0:15.372662	0.603651	
U1_trms_rc@AC [V]	173.2144	231.3784	58.16396
U2_trms_rc@AC [V]	173.8919	231.4809	57.58905
U3_trms_rc@AC [V]	173.0446	230.7887	57.74413
I1_trms_rc@AC [A]	5.985546	199.3689	193.3834
I2_trms_rc@AC [A]	4.697637	196.0218	191.3242
I3_trms_rc@AC [A]	2.307509	203.7277	201.4202
P_t_rc@AC [W]	-687.7539	135198.9	135886.6
Q_t_rc@AC [var]	2145.425	30164.47	28019.05
S_t_rc@AC [VA]	2252.966	138523.0	136270.1

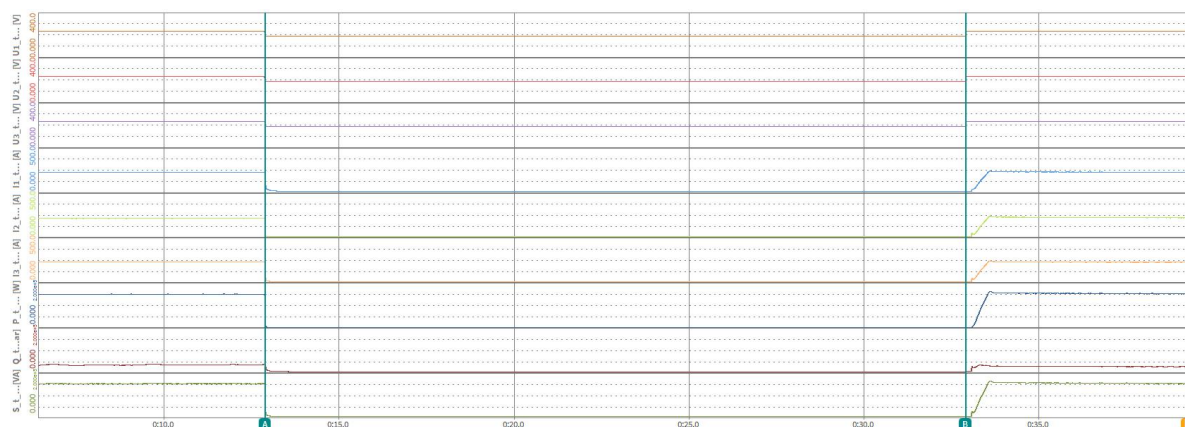
3 – three-phase symmetrical fault

(P > 0.9)

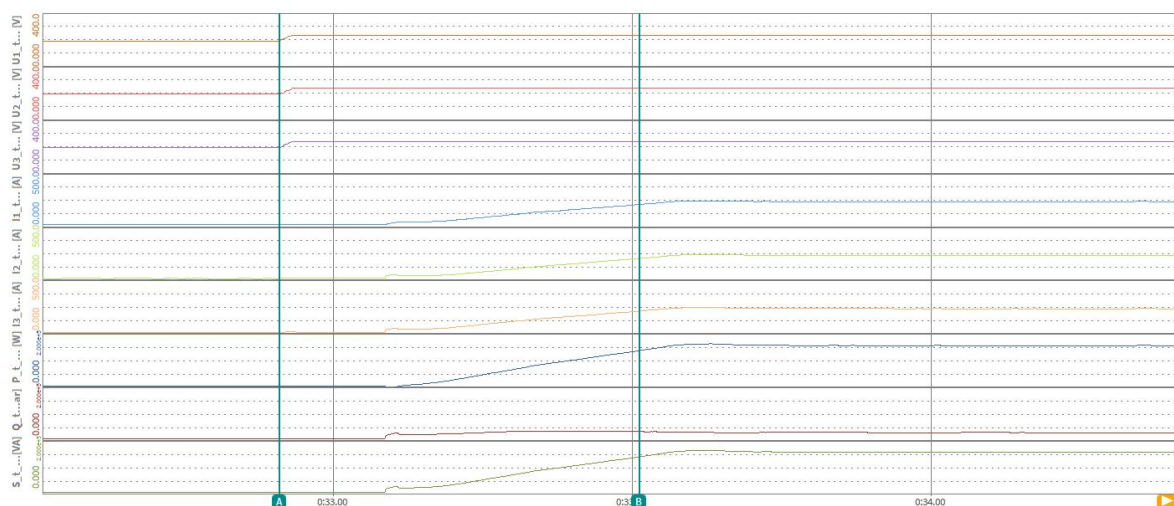


4 – three-phase symmetrical fault

(P = 0.1 - 0.3)



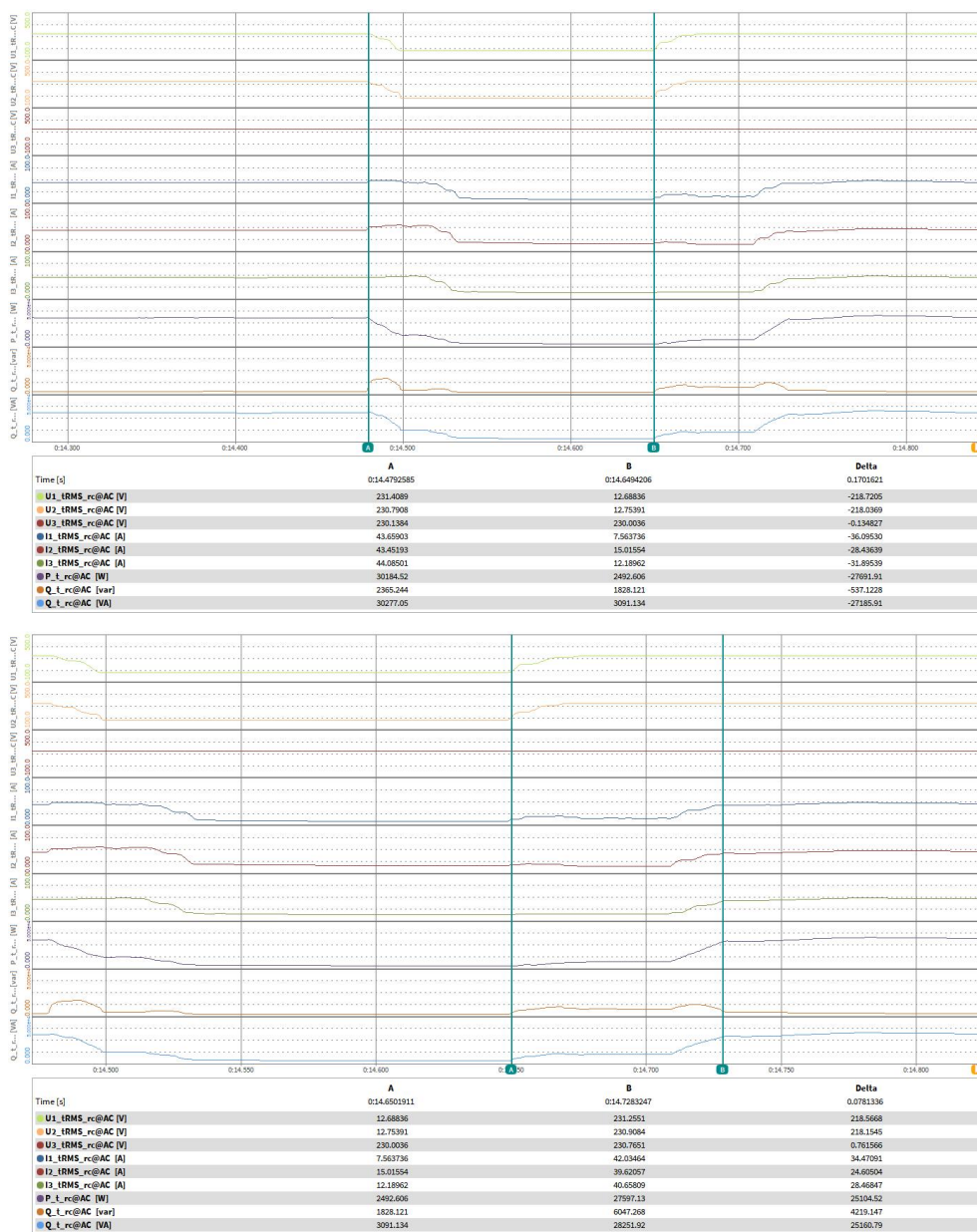
时间 [s]	A	B	间隔
0:12.89962	0:32.91184	0:20.01222	
U1_trms_rc@AC [V]	211.4886	188.6299	-22.85867
U2_trms_rc@AC [V]	214.9834	188.7035	-26.27989
U3_trms_rc@AC [V]	212.8434	188.5101	-24.33330
I1_trms_rc@AC [A]	230.5024	6.052623	-224.4497
I2_trms_rc@AC [A]	213.6496	3.992088	-209.6575
I3_trms_rc@AC [A]	240.4047	1.932221	-238.4725
P_t_rc@AC [W]	141696.9	-628.7001	-142325.6
Q_t_rc@AC [var]	34550.21	2170.031	-32380.18
S_t_rc@AC [VA]	145848.3	2259.270	-143589.0



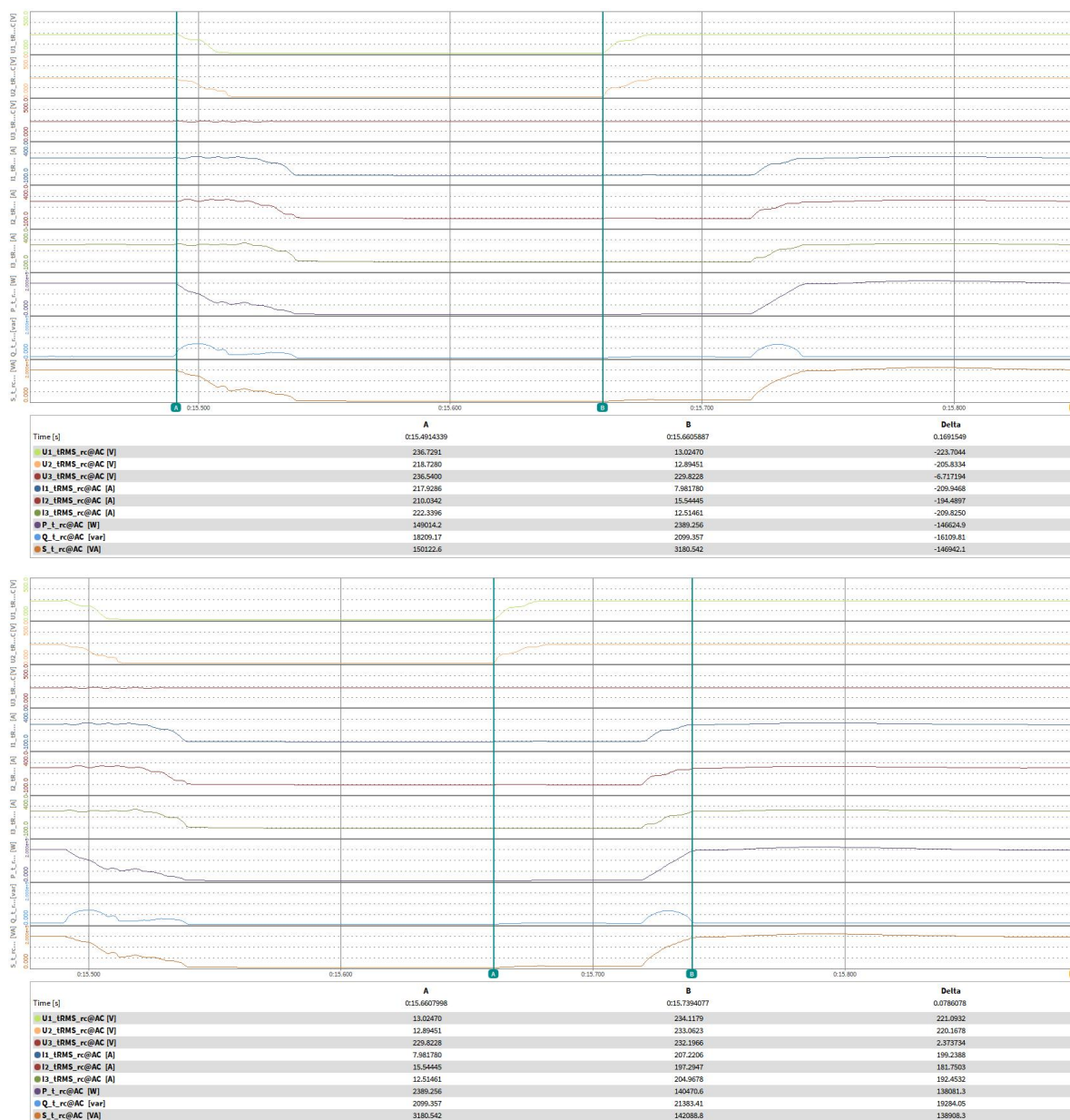
时间 [s]	A	B	间隔
0:32.91031	0:33.51204	0:60173	
U1_trms_rc@AC [V]	188.6206	231.3841	42.76349
U2_trms_rc@AC [V]	188.7068	231.4458	42.73900
U3_trms_rc@AC [V]	188.5132	230.7705	42.25737
I1_trms_rc@AC [A]	6.057821	199.7594	193.7016
I2_trms_rc@AC [A]	3.990862	197.2842	193.2934
I3_trms_rc@AC [A]	1.990956	204.9443	202.9533
P_t_rc@AC [W]	-631.2543	135664.1	136295.4
Q_t_rc@AC [var]	2181.560	31071.66	28890.10
S_t_rc@AC [VA]	2271.054	139176.9	136905.8

4 – three-phase symmetrical fault

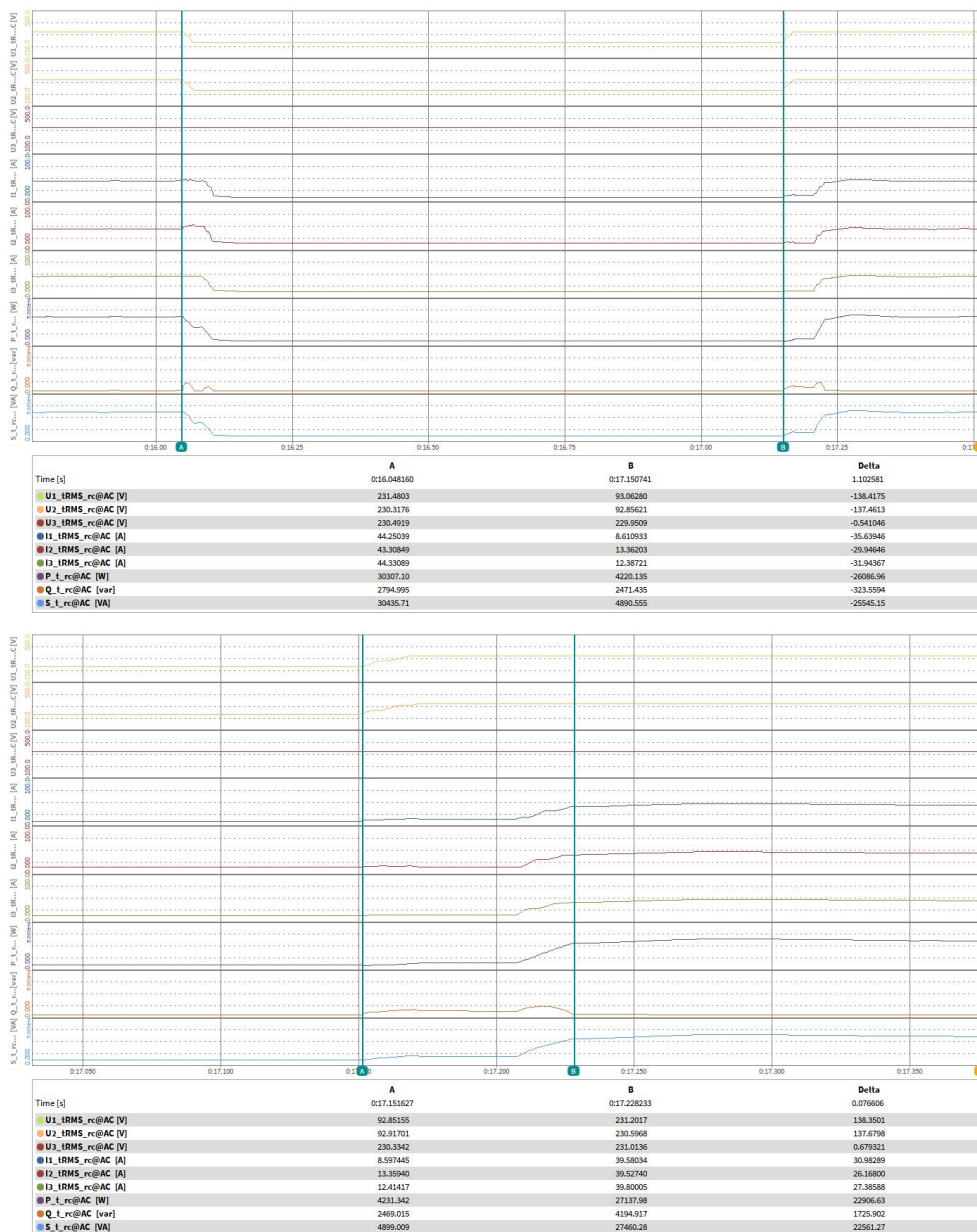
(P > 0.9)



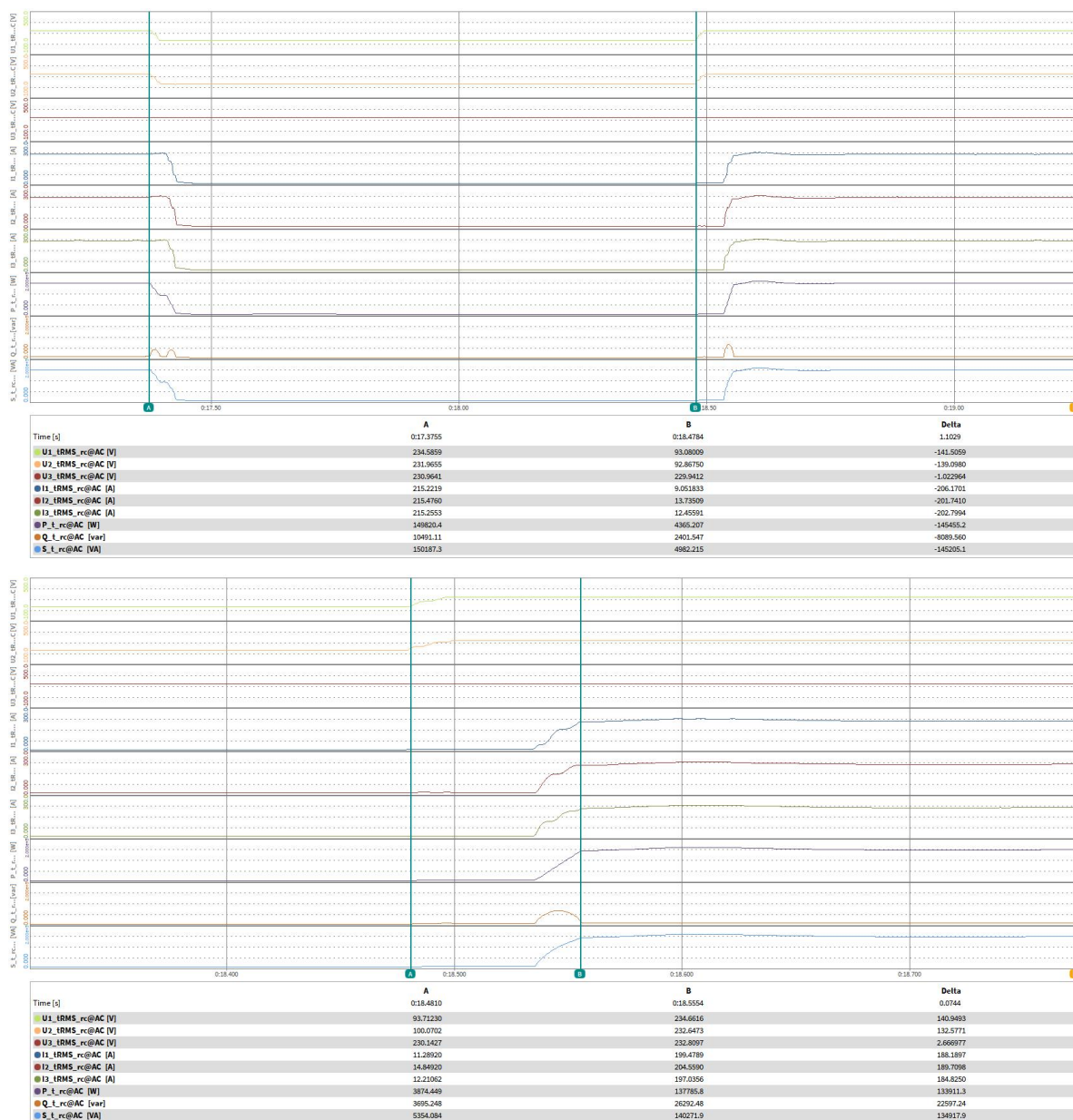
5 – two-phase asymmetrical fault
(P = 0.1 - 0.3)



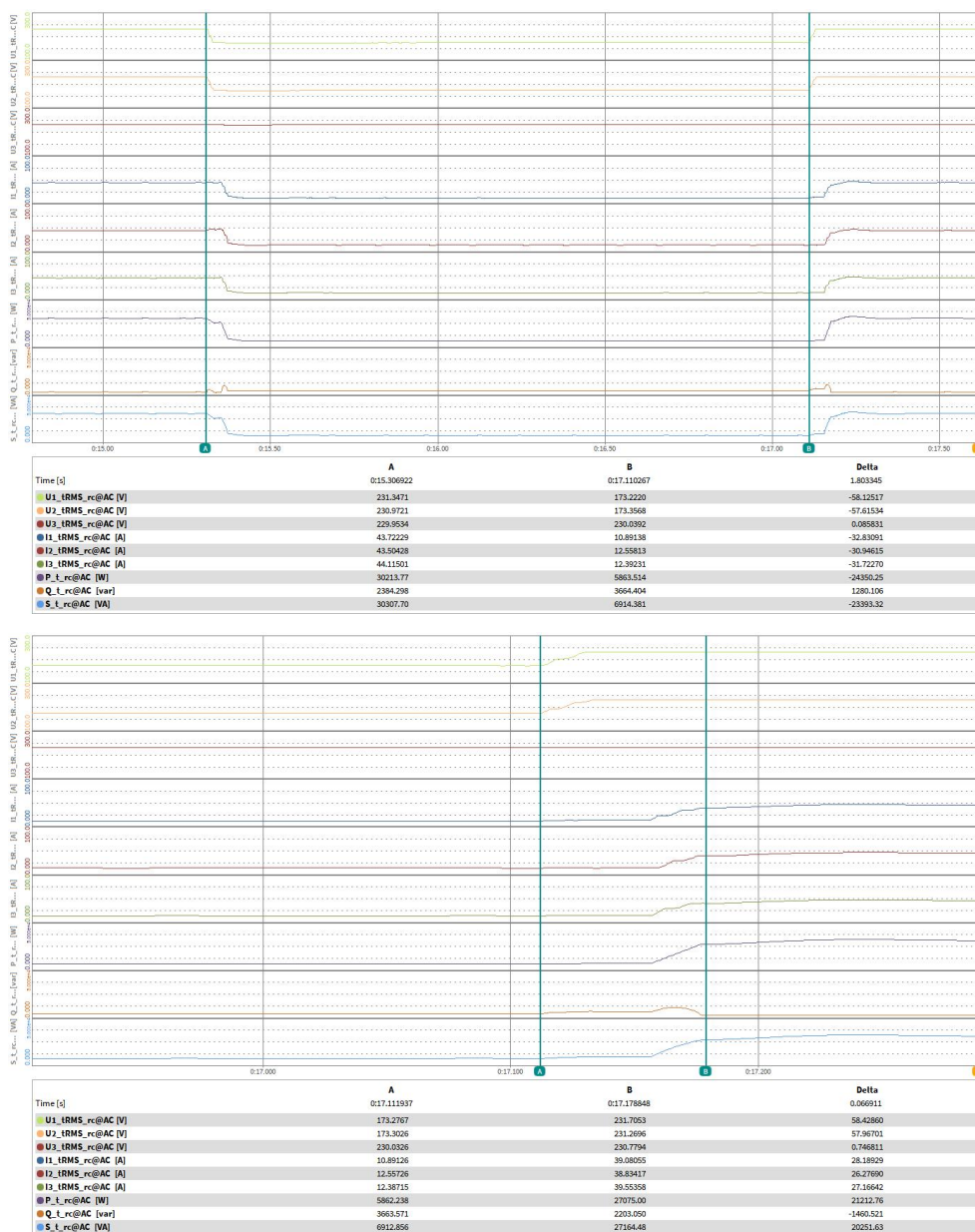
5 – two-phase asymmetrical fault
($P > 0.9$)



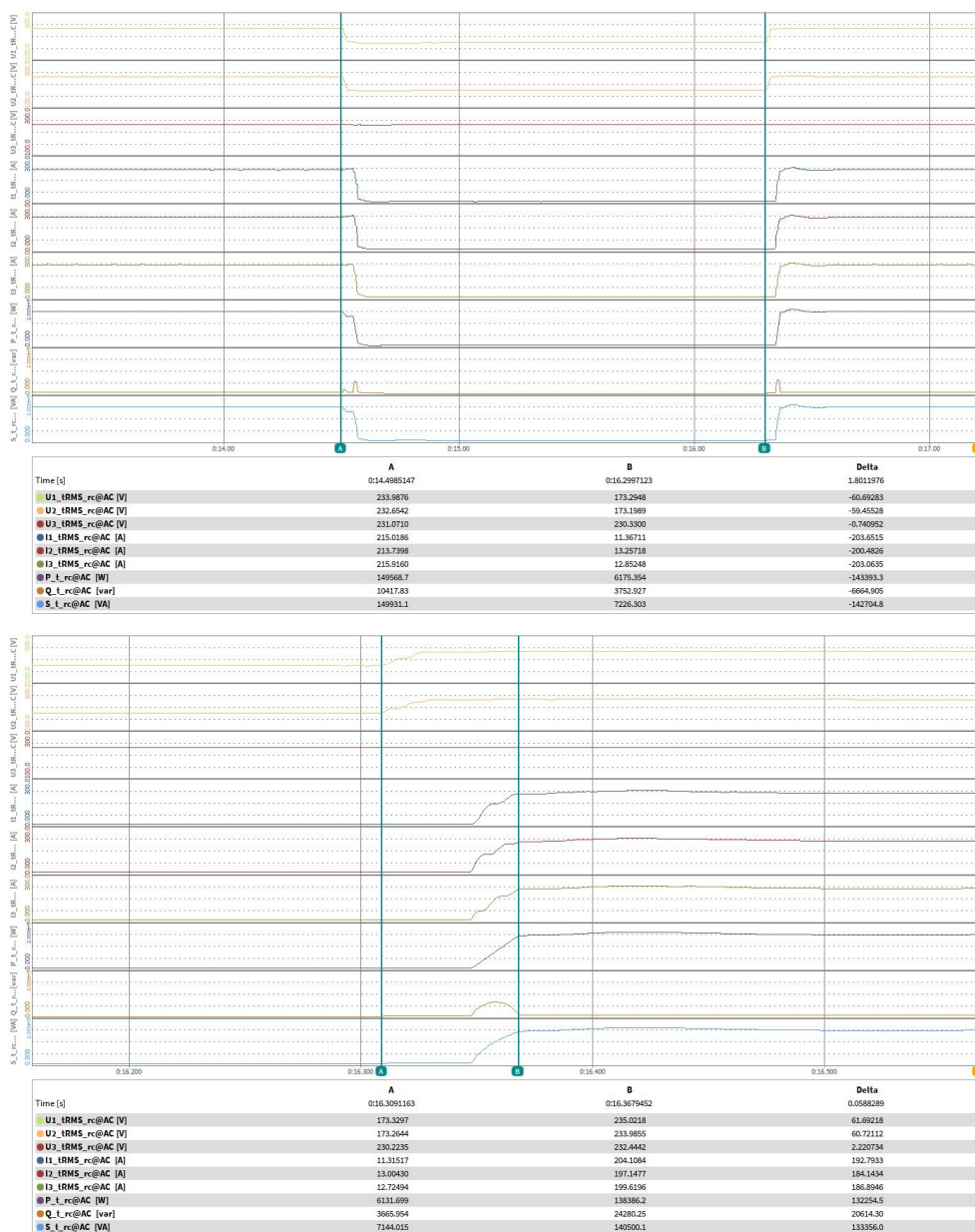
6 – two-phase asymmetrical fault
(P = 0.1 - 0.3)



6 – two-phase asymmetrical fault
($P > 0.9$)



7 – two-phase asymmetrical fault
(P = 0.1 - 0.3)

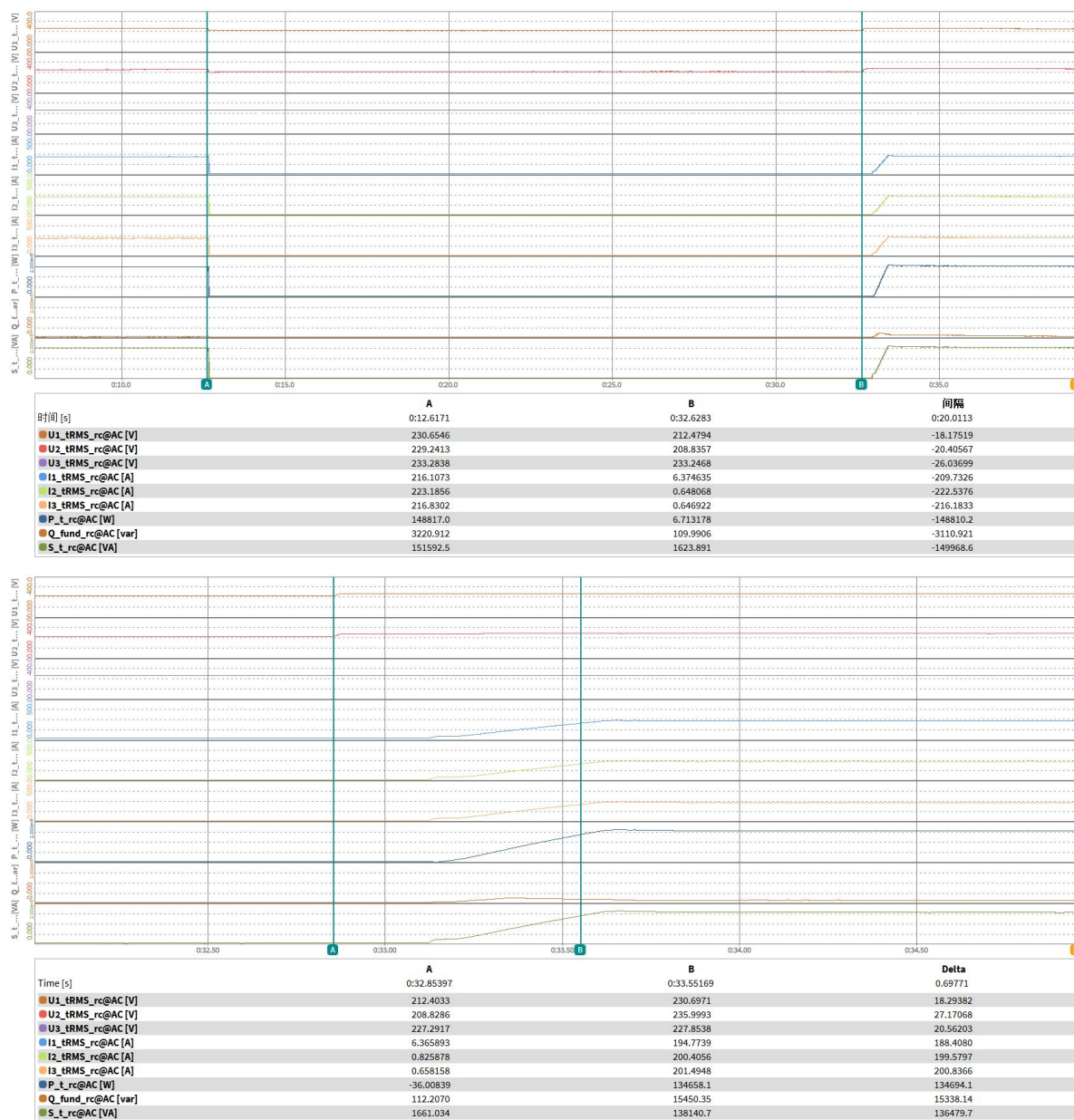


7 – two-phase asymmetrical fault
($P > 0.9$)



8 – two-phase asymmetrical fault

(P = 0.1 - 0.3)



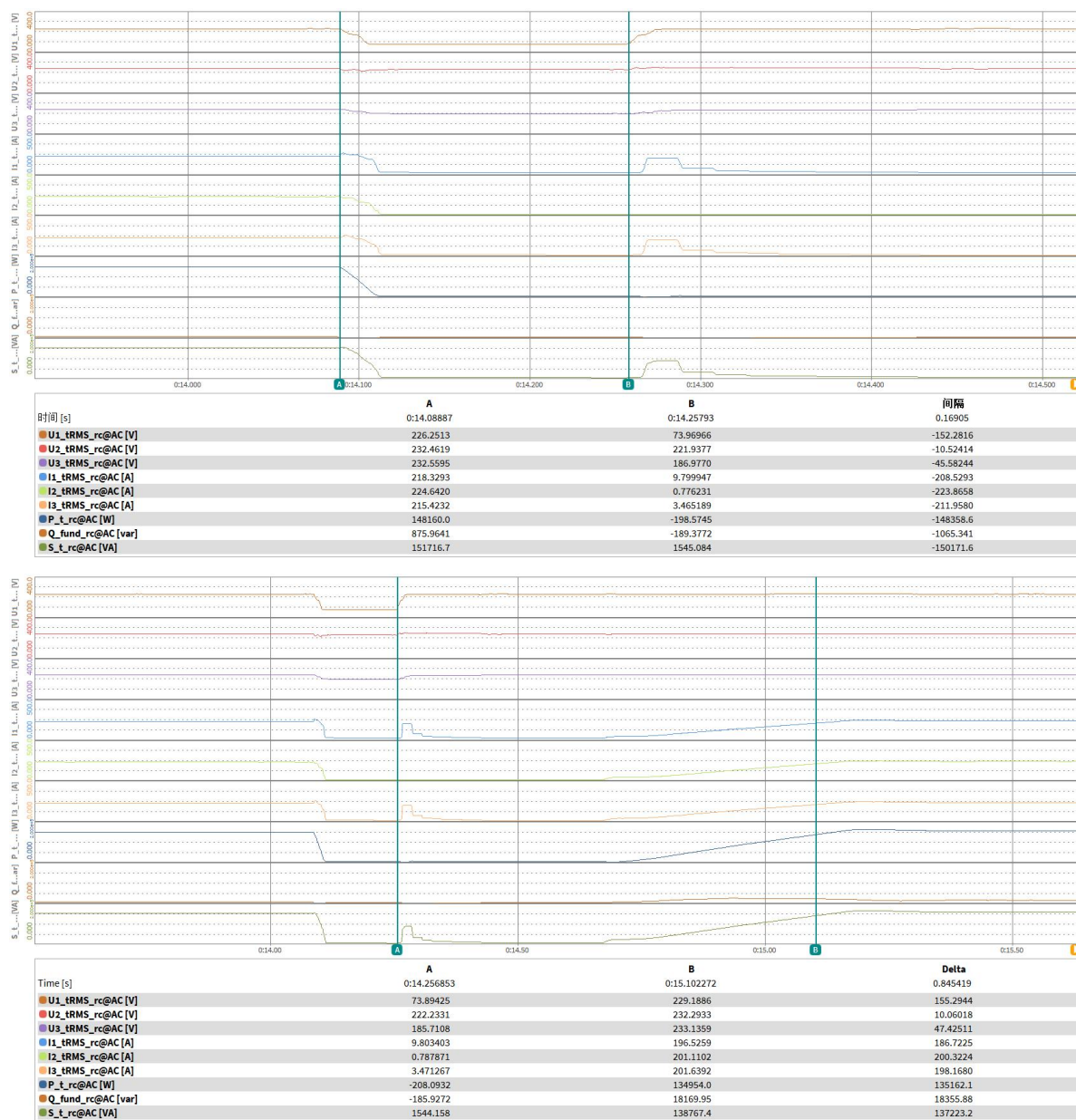
8 – two-phase asymmetrical fault

(P > 0.9)



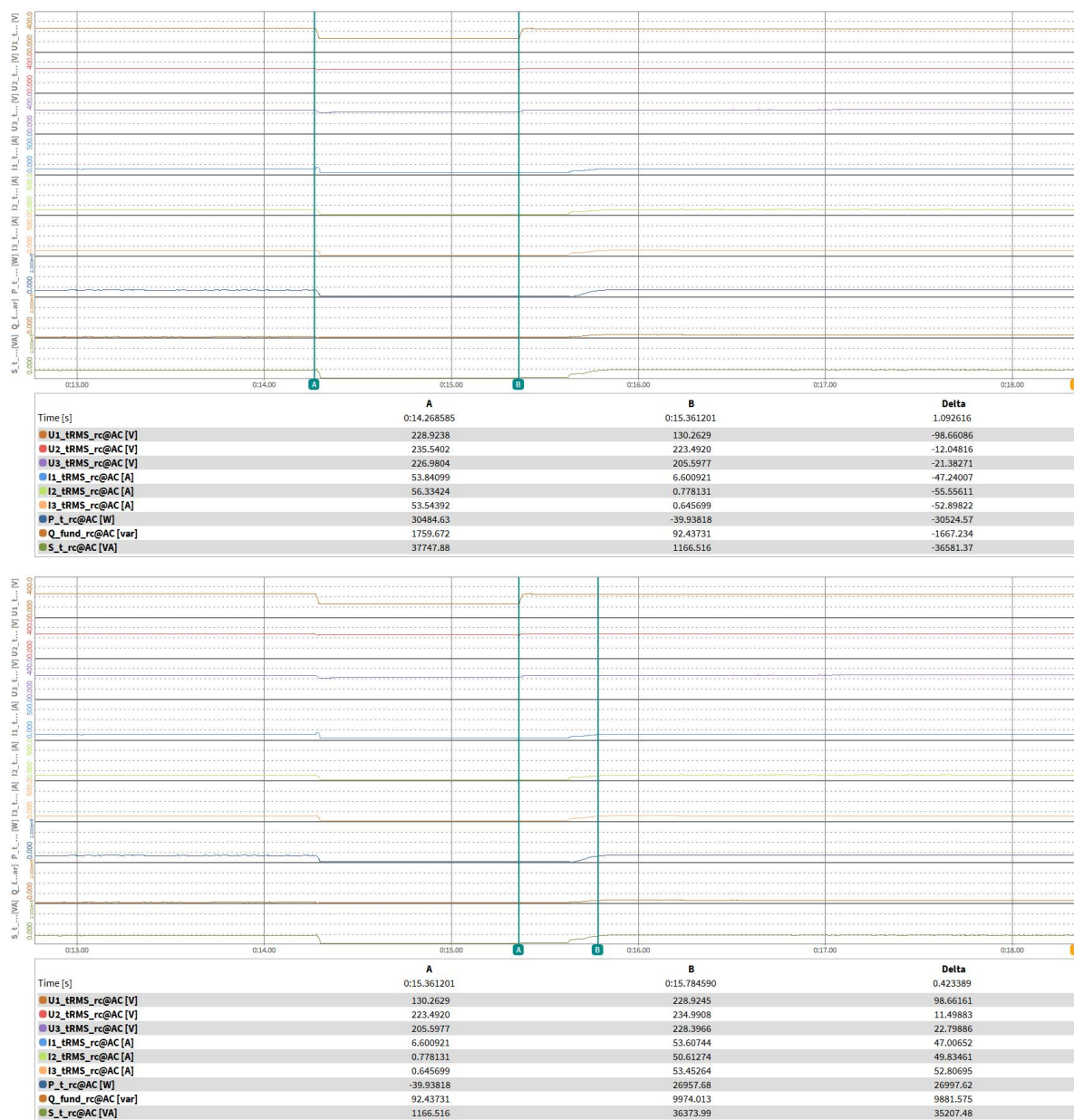
9 –single-phase symmetrical fault

(P = 0.1 - 0.3)



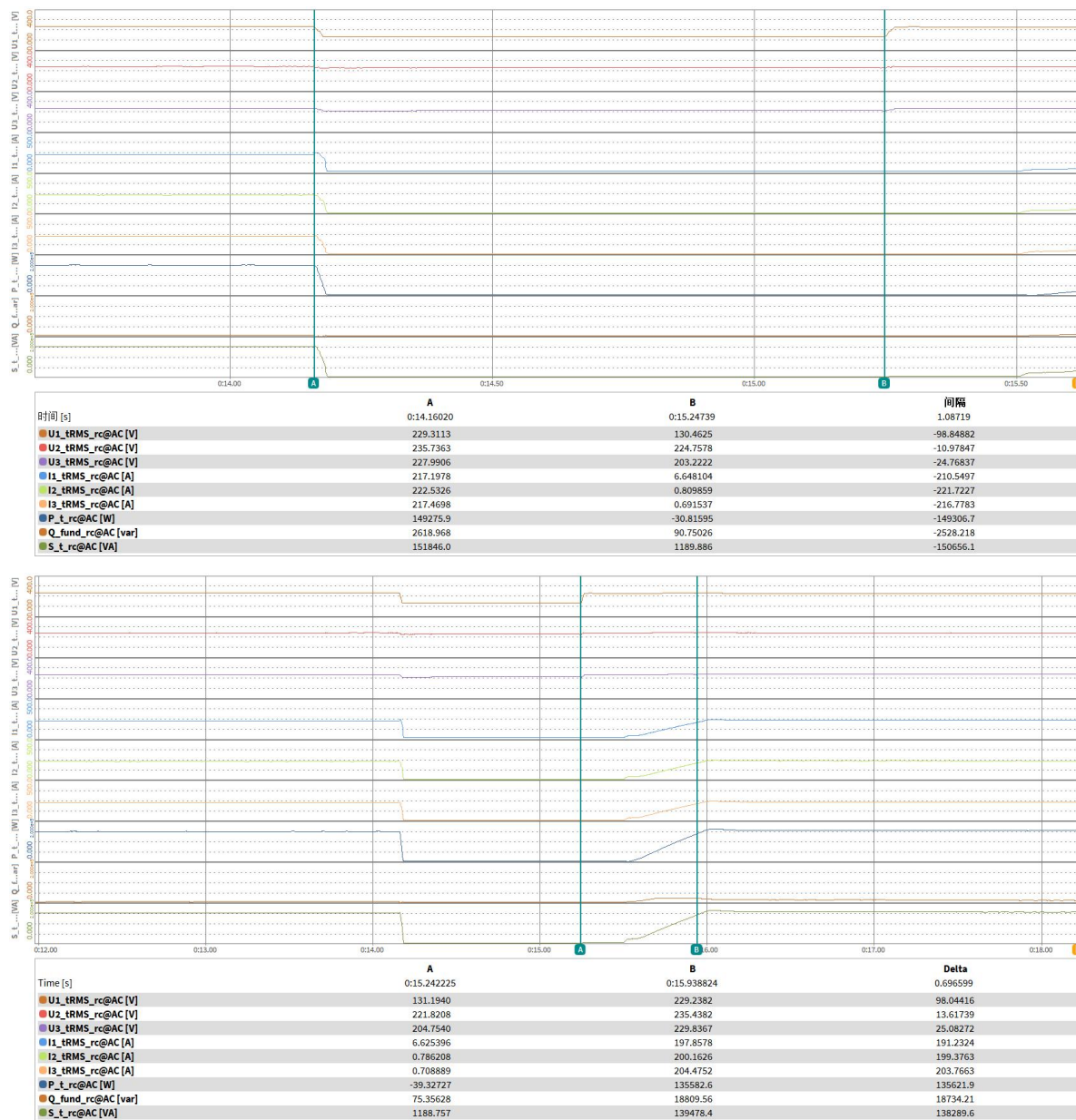
9 –single-phase symmetrical fault

(P > 0.9)



10 –single-phase symmetrical fault

(P = 0.1 - 0.3)



10 –single-phase symmetrical fault
(P > 0.9)



11 –single-phase symmetrical fault

(P = 0.1 - 0.3)



11 –single-phase symmetrical fault

(P > 0.9)



12 –single-phase symmetrical fault

(P = 0.1 - 0.3)

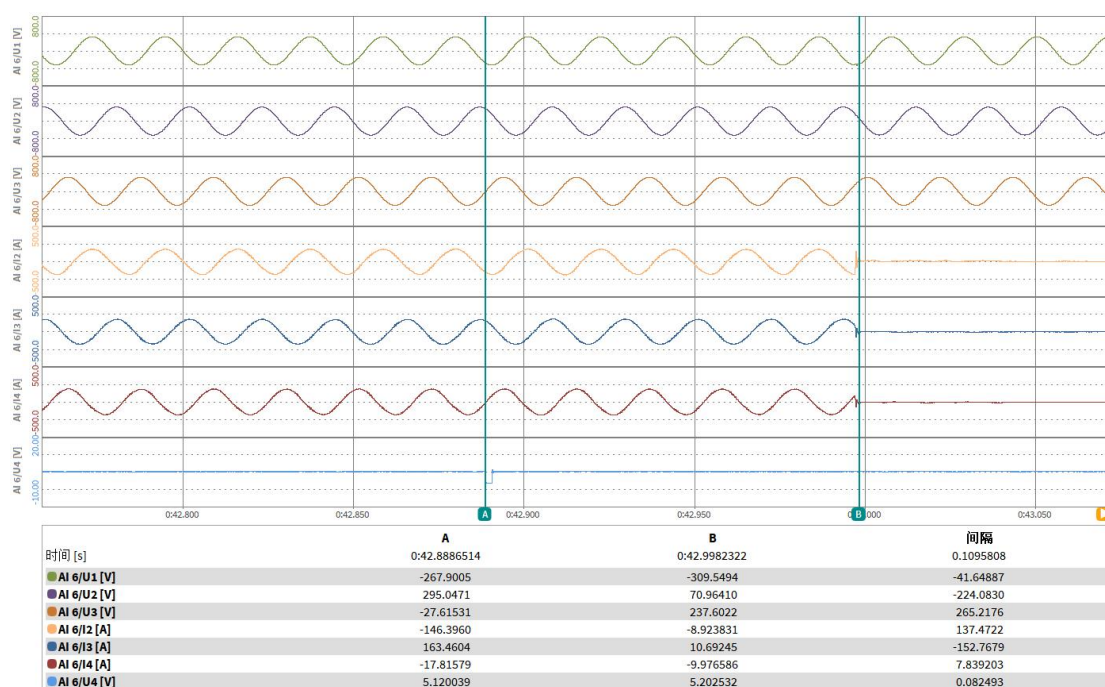


12 –single-phase symmetrical fault

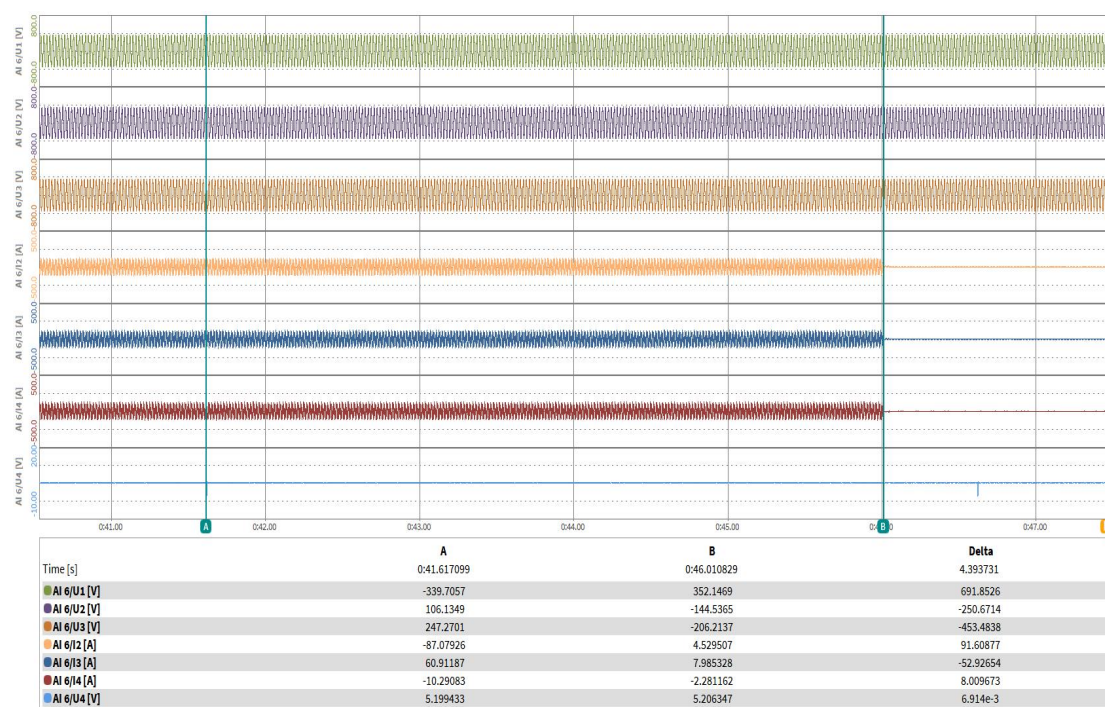
(P > 0.9)

4.2.2.3.3 Overfrequency and underfrequency								P
	Under frequency				Over frequency			
Parameter		Frequency [Hz]				Frequency [Hz]		
Output Voltage		85%U _N	U _N	110%U _N		85%U _N	U _N	110%U _N
Limit [s]	47.00Hz	0.2s			52.00 Hz	4 ≤ t ≤ 4.5s		
Measured trip value [Hz]		46.98	46.92	46.98		52.05	52.03	52.0
Disconnection time [s]	48.0 Hz to 46.5 Hz	0.1079	0.1068	0.1096	51.0 Hz to 52.5 Hz	4.362	4.352	4.394
Note: Method for trip: The frequency which inverter stops feeding power to electrical system in each test must be in the range of the frequency trip setting +/- 0.1Hz and the time it takes to cut off the power must be within limit value. The accuracy for frequency trip values shall be within 0 % to +1 % of the nominal frequency from the upper boundary trip setting. and within -1% to 0% of the nominal frequency from the lower boundary trip setting.								

Under frequency:



Over frequency:



4.2.2.3.3 Active power feed-in for over-frequency

P

Model : JKH150LTA

Test:

1-min mean value [Hz]	a)	b)	c)	c)	d)	e)	g)	h)	i)
	49.00	50.40	50.50	50.60	51.00	51.50	51.95	50.55	50.45

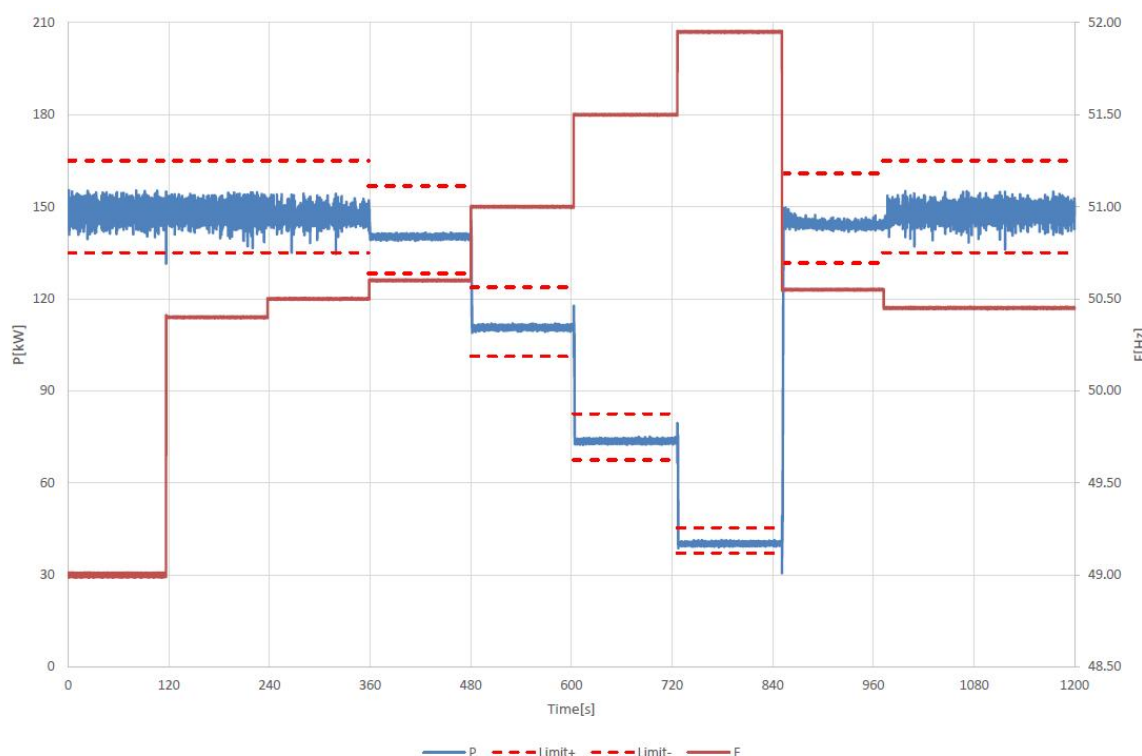
1. Measurement a) to g): Active power output > 80% P_n

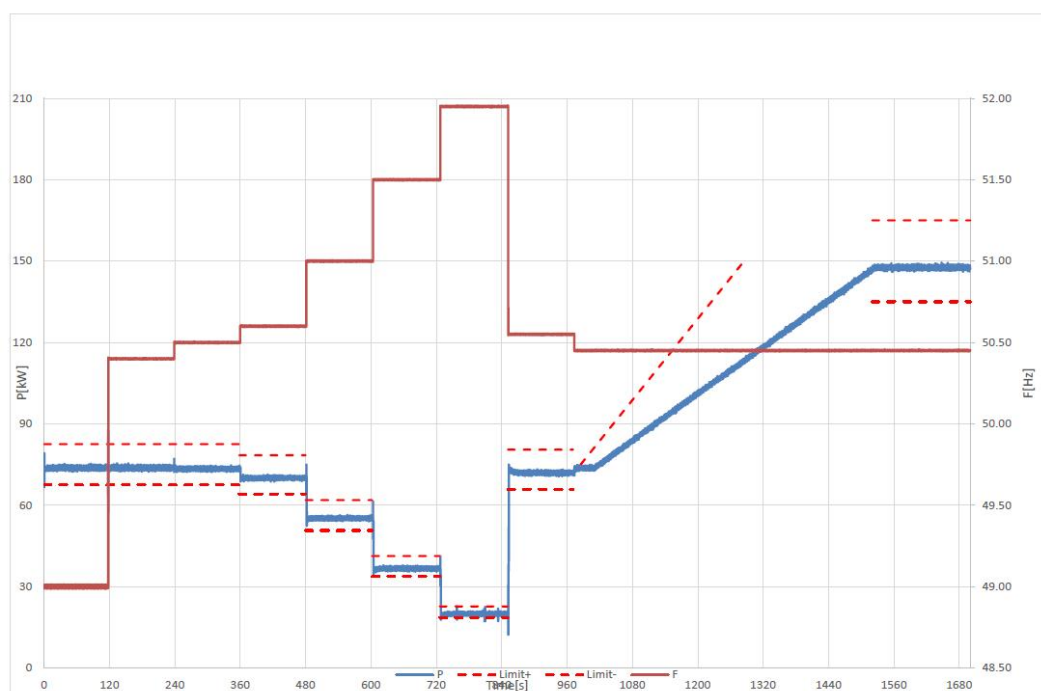
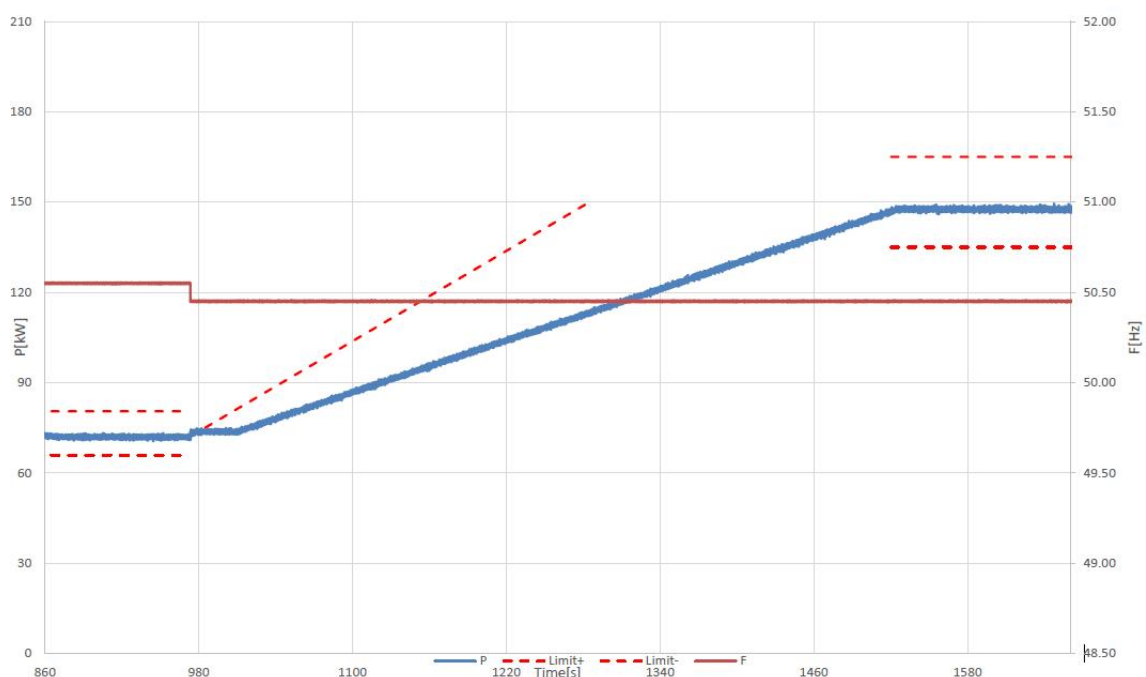
Frequency [Hz]:	49.0	50.4	50.5	50.6	51.0	51.5	51.95	50.55	50.45
P _{setpoint} [kW]:	150	150	150	142.5	112.5	75	41.25	146.25	150
P _{E60} [kW]:	150	150	150	140.90	109.46	73.56	39.74	143.10	150
$\Delta P_{E60}/P_{Setpoint}$ [%]:	0.00	0.00	0.00	-1.07	-2.03	-0.96	-0.10	2.1	0.00

2. Measurement a) to i): Active power output 40% and 60% after freezing > 80% P_n

Frequency [Hz]:	49.0	50.4	50.5	50.6	51.0	51.5	51.95	50.55	50.45
P _{setpoint} [kW]:	75	75	75	71.25	56.25	37.5	20.625	73.125	150
P _{E60} [kW]:	73.60	73.59	72.49	70.01	55.15	36.59	19.90	71.92	147.55
$\Delta P_{E60}/P_{Setpoint}$ [%]:	-1.90	-1.88	-3.35	-1.65	-1.47	-1.21	-0.97	-1.61	-3.27

Limit

 $\Delta P_{E60}/P_{Setpoint}$: $\pm 10\%$ of P_{E_{max}}Graph of Measurement 1.: Active power output > 80% P_n

Graph of Measurement 2.:Active power output 40% and 60% after freezing > 80% P_n **Graph of power gradient:****Test:**

The test is conducted for two powers. First, the test must start at a power > 80% P_n ("Measurement 1"). and in a second test, for a power between 40% to 60% P_n ("Measurement 2"). In the second test, after freezing of the PM, the available active power output must be increased to a value > 80% P_n , and after the network frequency of 50.5 Hz is fallen below, the rise of the active power gradient must be recorded.

Assessment criterion:

For $f=50.5$ Hz. the value of the PM active power currently being generated is "frozen".

For adjustable PGUs when:

- 1) the active power reduces between measuring points c) and g) given above with a gradient of 50% P_M per Hz for a decreasing frequency (or rises for a frequency decreasing again).
- 2) the reaction value of the setpoint determined by the gradient characteristic curve does not differ from P_n by more than $\pm 10\%$.

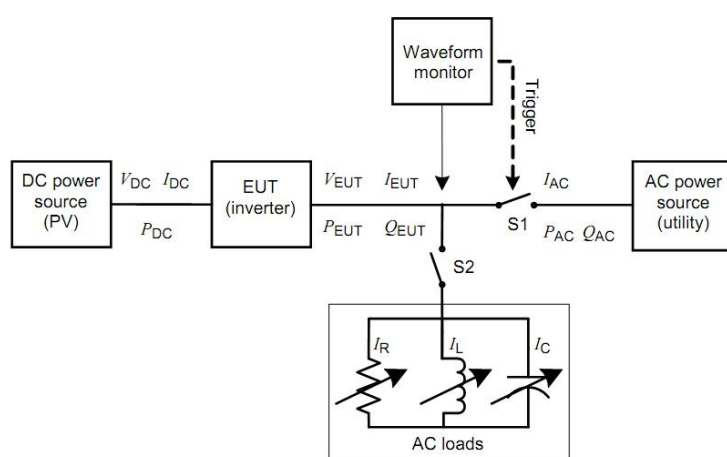
When the utility frequency exceeds 50.5 Hz. the active power available at the time shall be stored as the maximum power value P_M ; this value P_M shall not be exceeded until the frequency has stabilised below 50.5 Hz for at least 4 seconds.

4.2.2.4 Preventing of islanding

Test circuit and parameters

Parameter	Symbol	Units
EUT DC Input		
DC voltage	V_{DC}	V
DC Current	I_{DC}	A
DC Power	P_{DC}	W
EUT AC output		
AC voltage	V_{EUT}	V
AC current	I_{EUT}	A
Real power	P_{EUT}	W
Reactive power	Q_{EUT}	VA _r
Test Load		
Resistive load current	I_R	A
Inductive load current	I_L	A
Capacitive load current	I_C	A
AC (utility) power source		
Utility real power	P_{AC}	W
Utility reactive power	Q_{AC}	VA _r
Utility current	I_{AC}	A

Block diagram test circuit IEC 62116:2014



IEC 1567/08

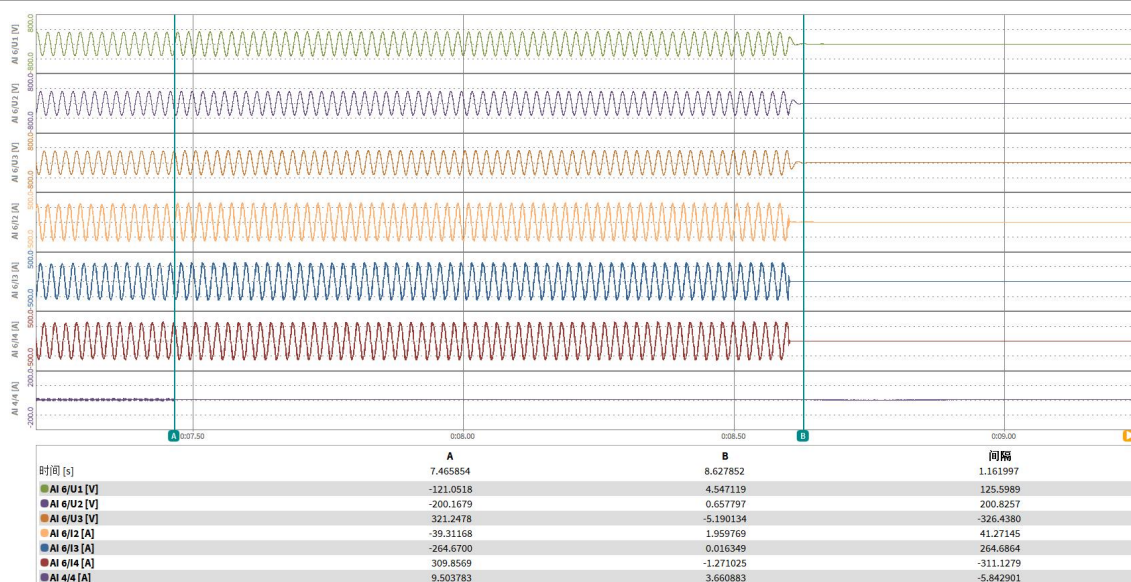
Figure 1 – Test circuit for islanding detection function in a power conditioner (inverter)

4.2.2.4 Islanding protection according IEC 62116 table 6									P
Load imbalance (real. reactive load) for test condition A									
(EUT ouput = 100%)									
Model: JKH150LTA									
Test conditions			Frequency: 50+/-0.1Hz U _N =230 +/-3Vac Distortion factor of chokes < 2% Quality = 1						
Disconnection limit			2s						
No	P _{EUT} ¹⁾ [% of EUT rating]	Reactive load [% of Q _L in 6.1.d] ¹⁾	P _{AC} ²⁾ [% of nominal]	Q _{AC} ³⁾ [% of nominal]	Run on Time [ms]	PEUT [kW]	Actual Q _f	V _{DC} [V]	Remarks ⁴⁾
1	100	100	0	0	1162	148.77	1.000	677.64	Test A at BL
2	100	100	0	5	214	148.58	1.026	677.59	Test A at IB
3	100	100	0	-5	149	148.56	0.975	677.65	Test A at IB
4	100	100	5	0	318	148.71	0.947	677.71	Test A at IB
5	100	100	-5	0	734	148.95	1.048	677.68	Test A at IB
6	100	100	5	5	234	148.38	0.971	677.68	Test A at IB
7	100	100	5	-5	161	148.71	0.926	677.75	Test A at IB
8	100	100	-5	5	222	148.81	1.078	677.73	Test A at IB
9	100	100	-5	-5	131	148.82	1.023	677.65	Test A at IB
Parameter at 0% per phase			L=	42.12	mH	R=	13.23	Ω	C= 240.81 μF
Note: RLC is adjusted to min, +/-1% of the inverter rated output power ¹⁾ P _{EUT} : EUT output power ²⁾ P _{AC} : Real power flow at S1 in Figure 1, Positive means power from EUT to utility, Nominal is the 0 % test condition value, ³⁾ Q _{AC} : Reactive power flow at S1 in Figure 1, Positive means power from EUT to utility, Nominal is the 0 % test condition value, ⁴⁾ BL: Balance condition, IB: Imbalance condition, Condition A: EUT output power P _{EUT} = Maximum ⁵⁾ EUT input voltage ⁶⁾ = >90% of rated input voltage range ⁵⁾ Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.									

6) Based on EUT rated input operating range. For example. If range is between X volts and Y volts. 90 % of range = $X + 0.75 \times (Y - X)$. Y shall not exceed $0.8 \times$ EUT maximum system voltage (i.e.. maximum allowable array open circuit voltage). In any case. the EUT should not be operated outside of its allowable input voltage range.

Scope pictures of the disconnection time

Disconnection at No. 1



Note:

Curve 1 to 3: EUT output voltage signal

Curve 4 to 6: EUT output current signal

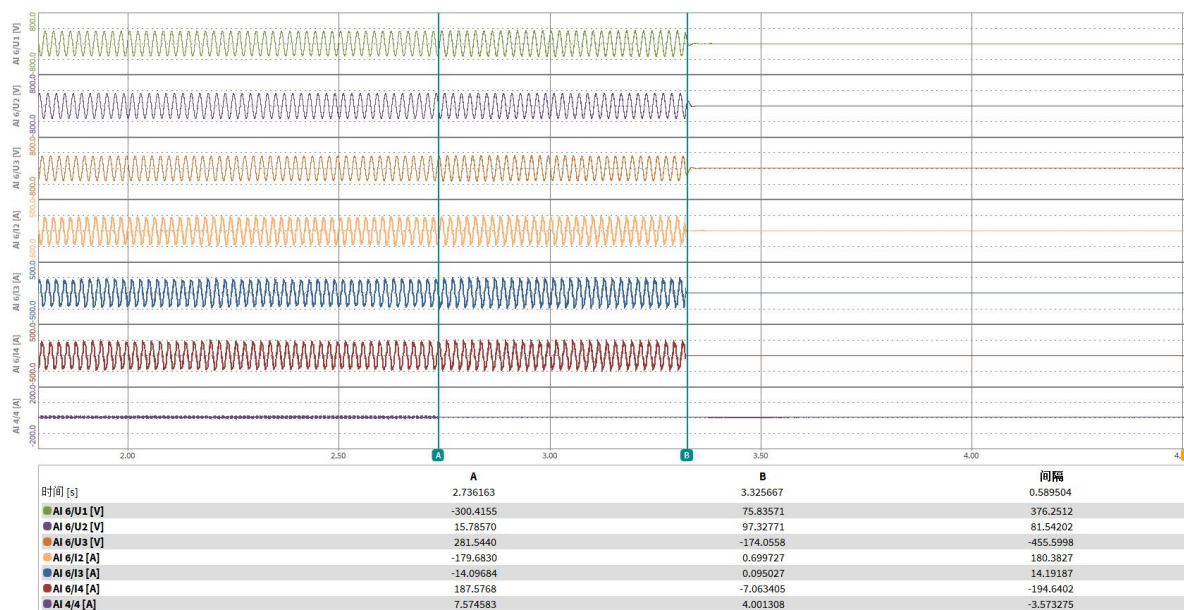
Curve 7: Grid side current

4.2.2.4 Islanding protection according IEC 62116 table 6									P
Load imbalance (real. reactive load) for test condition B									
(EUT output = 50% – 66%)									
Model: JKH150LTA									
Test conditions			Frequency: 50+/-0.1Hz U _N =230 +/-3Vac Distortion factor of chokes < 2% Quality = 1						
Disconnection limit			2s						
No	P _{EUT} ¹⁾ [% of EUT rating]	Reactive load [% of Q _L in 6.1.d] ¹⁾	P _{AC} ²⁾ [% of nominal]	Q _{AC} ³⁾ [% of nominal]	Run on Time [ms]	P _{EUT} [kW]	Actual Q _f	V _{DC} [V]	Remarks ⁴⁾
1	66	66	0	-5	193	100.79	1.001	543.51	Test B at IB
2	66	66	0	-4	249	100.64	0.971	543.26	Test B at IB
3	66	66	0	-3	300	100.78	0.981	542.99	Test B at IB
4	66	66	0	-2	405	100.53	0.989	543.19	Test B at IB
5	66	66	0	-1	428	100.73	0.992	543.22	Test B at IB
6	66	66	0	0	590	100.49	1.005	543.33	Test B at BL
7	66	66	0	+1	245	100.48	1.009	543.29	Test B at IB
8	66	66	0	+2	234	101.0	1.007	543.28	Test B at IB
9	66	66	0	+3	221	100.68	1.013	543.34	Test B at IB
10	66	66	0	+4	203	100.56	1.018	543.17	Test B at IB
11	66	66	0	+5	188	100.65	1.024	543.15	Test B at IB
Parameter at 0% per phase			L=	63.81	mH	R=	20.04	Ω	C= 158.93 μF
Note: RLC is adjusted to min. +/-1% of the inverter rated output power ¹⁾ P _{EUT} : EUT output power ²⁾ P _{AC} : Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value. ³⁾ Q _{AC} : Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value. ⁴⁾ BL: Balance condition. IB: Imbalance condition. Condition B: EUT output power P _{EUT} = 50 % – 66 % of maximum EUT input voltage ⁵⁾ = 50 % of rated input voltage range. ±10 %									

5) Based on EUT rated input operating range. For example. If range is between X volts and Y volts. 50 % of range = $X + 0.5 \times (Y - X)$. Y shall not exceed $0.8 \times$ EUT maximum system voltage (i.e.. maximum allowable array open circuit voltage). In any case. the EUT should not be operated outside of its allowable input voltage range.

Scope pictures of the disconnection time

Disconnection at No. 6



Note:

Curve 1 to 3: EUT output voltage signal

Curve 4 to 6: EUT output current signal

Curve 7: Grid side current

4.2.2.4 Islanding protection according IEC 62116 table 6									P
Load imbalance (real. reactive load) for test condition C									
(EUT output = 25% – 33%)									
Model: JKH150LTA									
Test conditions			Frequency: 50+/-0.1Hz U _N =230 +/-3Vac Distortion factor of chokes < 2% Quality = 1						
Disconnection limit			2s						
No	P _{EUT} ¹⁾ [% of EUT rating]	Reactive load [% of Q _L in 6.1.d] ¹⁾	P _{AC} ²⁾ [% of nominal]	Q _{AC} ³⁾ [% of nominal]	Run on Time [ms]	P _{EUT} [kW]	Actual Q _f	V _{DC} [V]	Remarks ⁴⁾
1	33	33	0	-5	170	50.76	0.974	489.07	Test B at IB
2	33	33	0	-4	295	50.79	0.977	489.11	Test B at IB
3	33	33	0	-3	314	50.83	0.984	489.05	Test B at IB
4	33	33	0	-2	396	51.14	0.987	489.05	Test B at IB
5	33	33	0	-1	432	50.87	0.994	489.10	Test B at IB
6	33	33	0	0	494	50.98	1.000	489.03	Test B at BL
7	33	33	0	+1	241	50.87	1.004	489.04	Test B at IB
8	33	33	0	+2	212	50.87	1.010	489.13	Test B at IB
9	33	33	0	+3	223	50.89	1.014	489.13	Test B at IB
10	33	33	0	+4	273	50.89	1.023	489.23	Test B at IB
11	33	33	0	+5	124	50.99	1.030	489.13	Test B at IB
Parameter at 0% per phase			L=	127.63	mH	R=	40.08	Ω	C= 79.47 μF
Note: RLC is adjusted to min. +/-1% of the inverter rated output power ¹⁾ P _{EUT} : EUT output power ²⁾ P _{AC} : Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value. ³⁾ Q _{AC} : Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value. ⁴⁾ BL: Balance condition. IB: Imbalance condition. Condition C: EUT output power P _{EUT} = 25 % – 33 % ⁵⁾ of maximum									

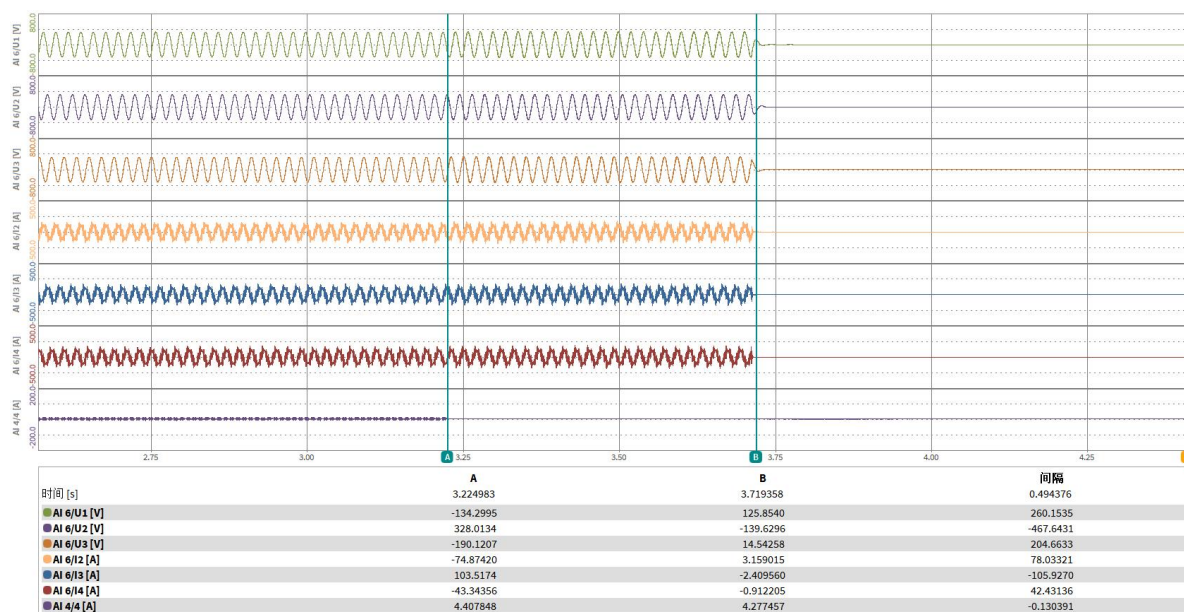
EUT input voltage ⁶⁾ = <10 % of rated input voltage range

⁵⁾ Or minimum allowable EUT output level if greater than 33 %.

⁶⁾ Based on EUT rated input operating range. For example. If range is between X volts and Y volts. 10 % of range = $X + 0.1 \times (Y - X)$. Y shall not exceed $0.8 \times$ EUT maximum system voltage (i.e.. maximum allowable array open circuit voltage). In any case. the EUT should not be operated outside of its allowable input voltage range.

Scope pictures of the disconnection time

Disconnection at No. 6



Note:

Curve 1 to 3: EUT output voltage signal

Curve 4 to 6: EUT output current signal

Curve 7: Grid side current

Pictures of the unit



Figure 1. Over view (JKH30LTA & JKH50LTA)



Figure 2. Over view II (JKH30LTA & JKH50LTA)

Pictures of the unit



Figure 3. Over view III (JKH30LTA & JKH50LTA)



Figure 4. Over view IV (JKH30LTA & JKH50LTA)

Pictures of the unit

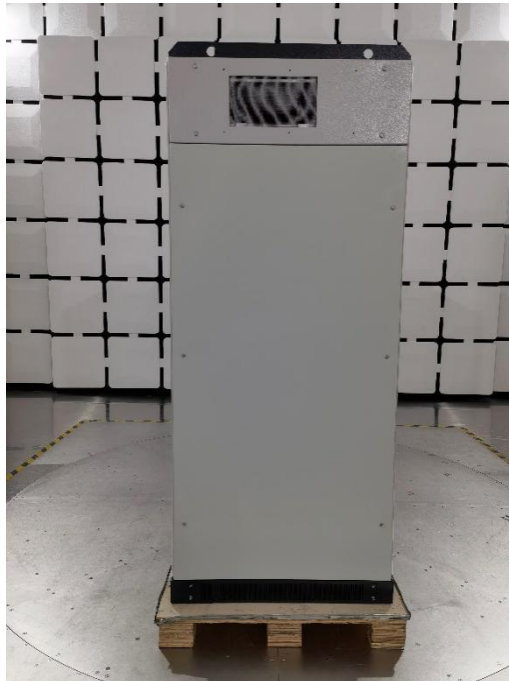


Figure 5. Over view V (JKH30LTA & JKH50LTA)



Figure 6. Over view VI (JKH30LTA & JKH50LTA)

\Pictures of the unit



Figure 7. Over view VII (JKH100LTA & JKH150LTA)



Figure 8. Over view VIII (JKH100LTA & JKH150LTA)

Pictures of the unit



Figure 9. Over view IX (JKH100LTA & JKH150LTA)



Figure 10. Power module over view

Pictures of the unit

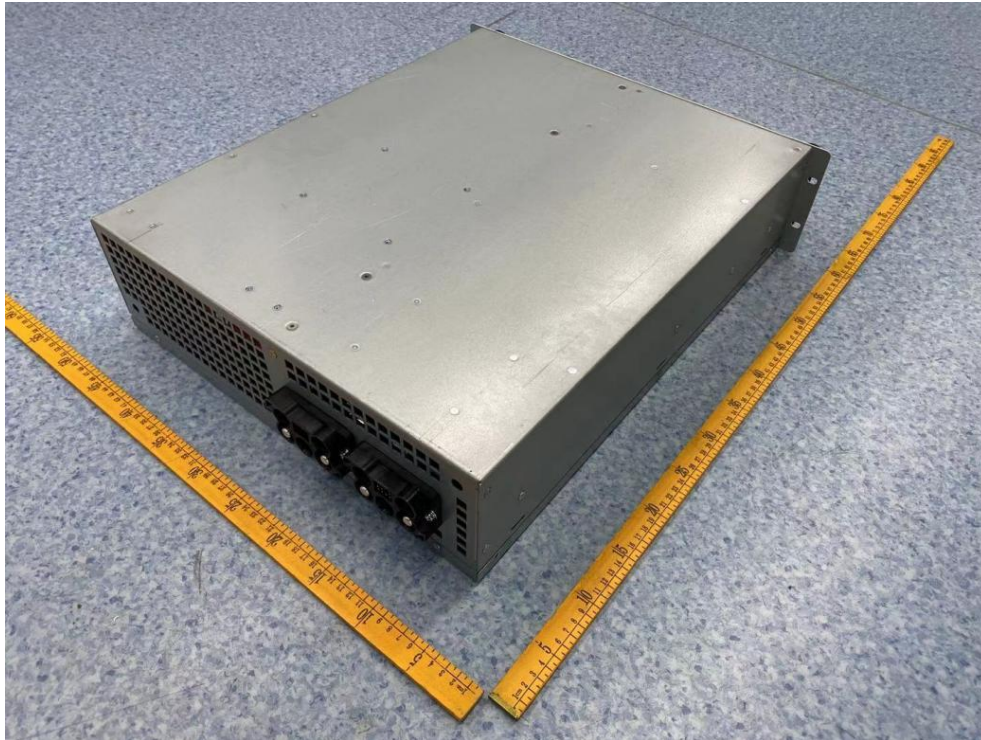


Figure 11. Power module over view II

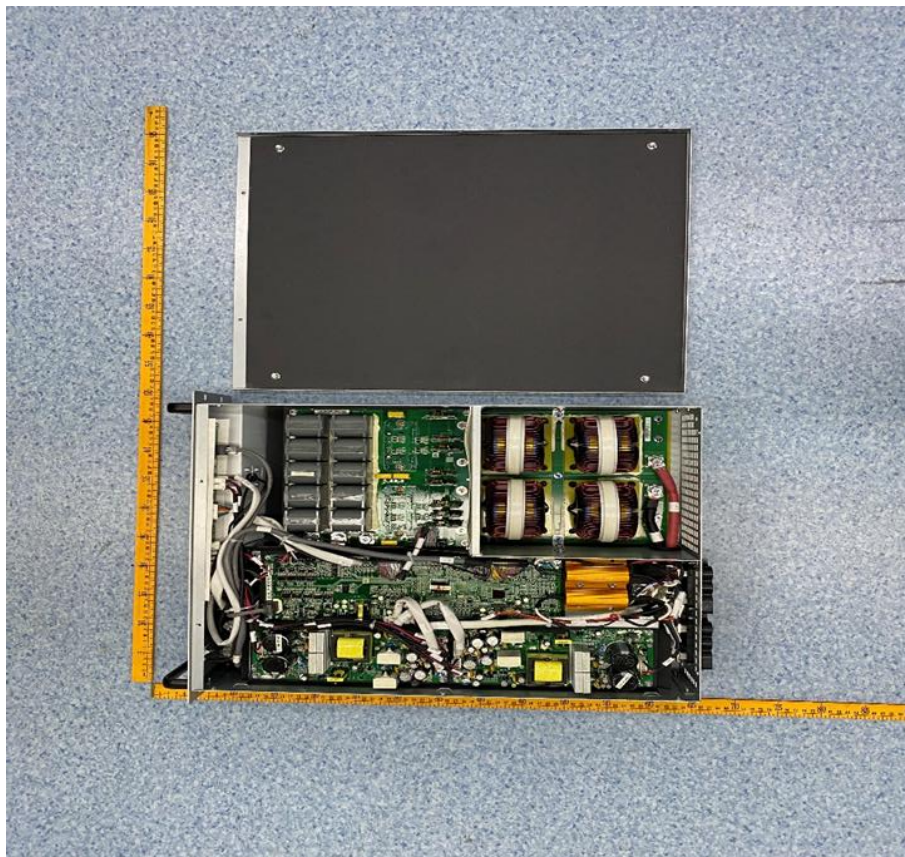


Figure 12. Power module over view III

Pictures of the unit

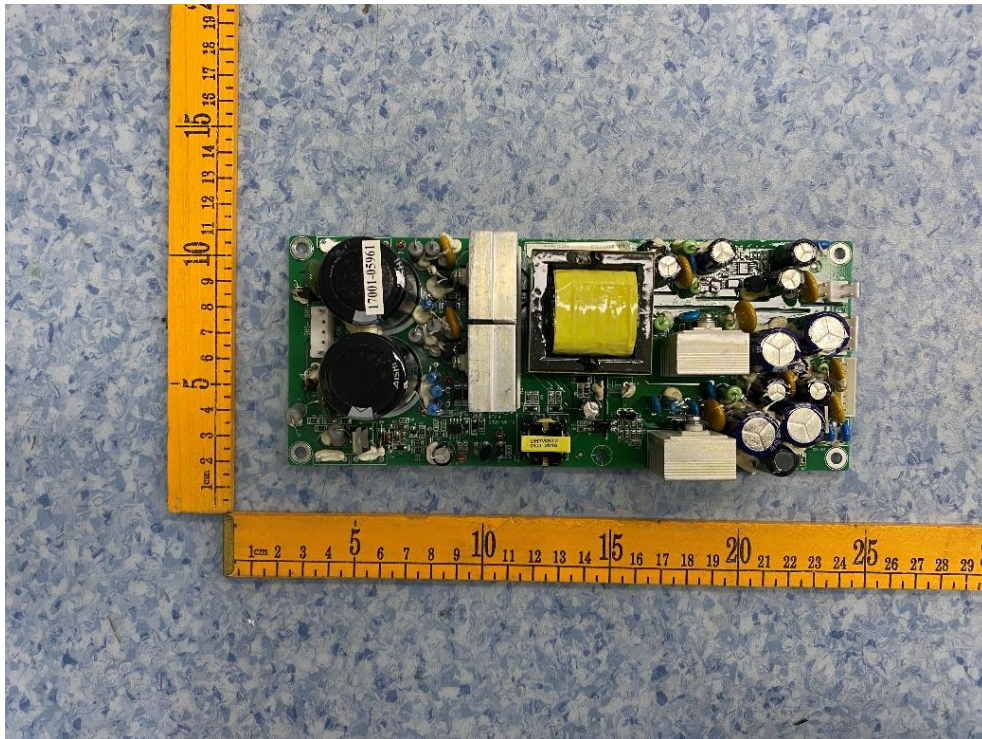


Figure 13. Power module board

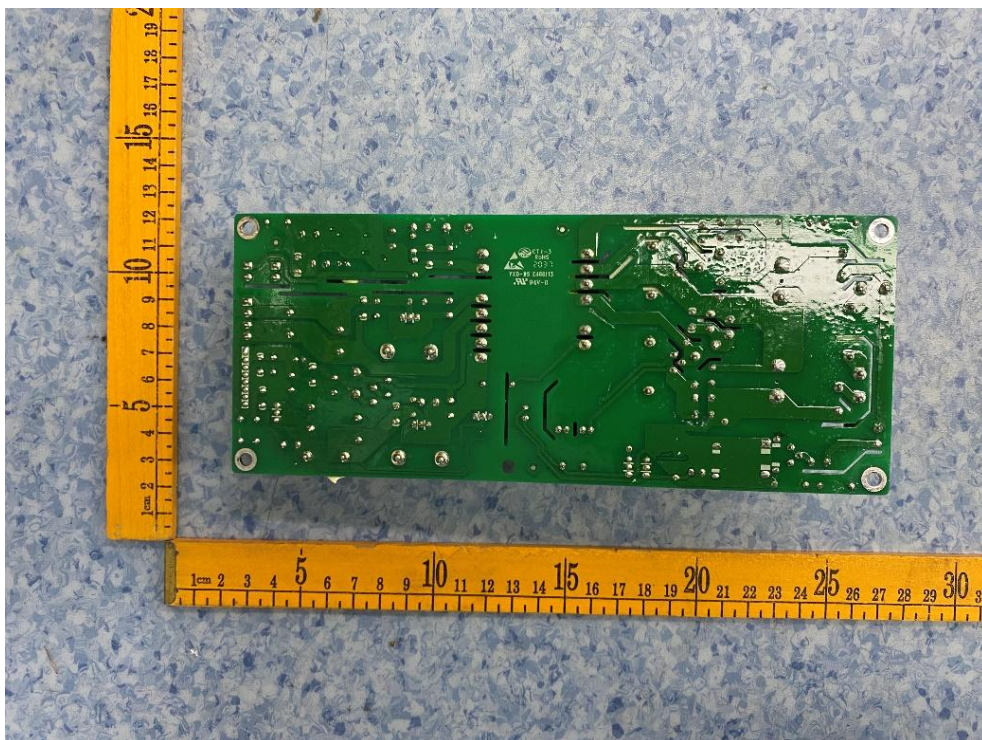


Figure 14. Power module board II

Pictures of the unit

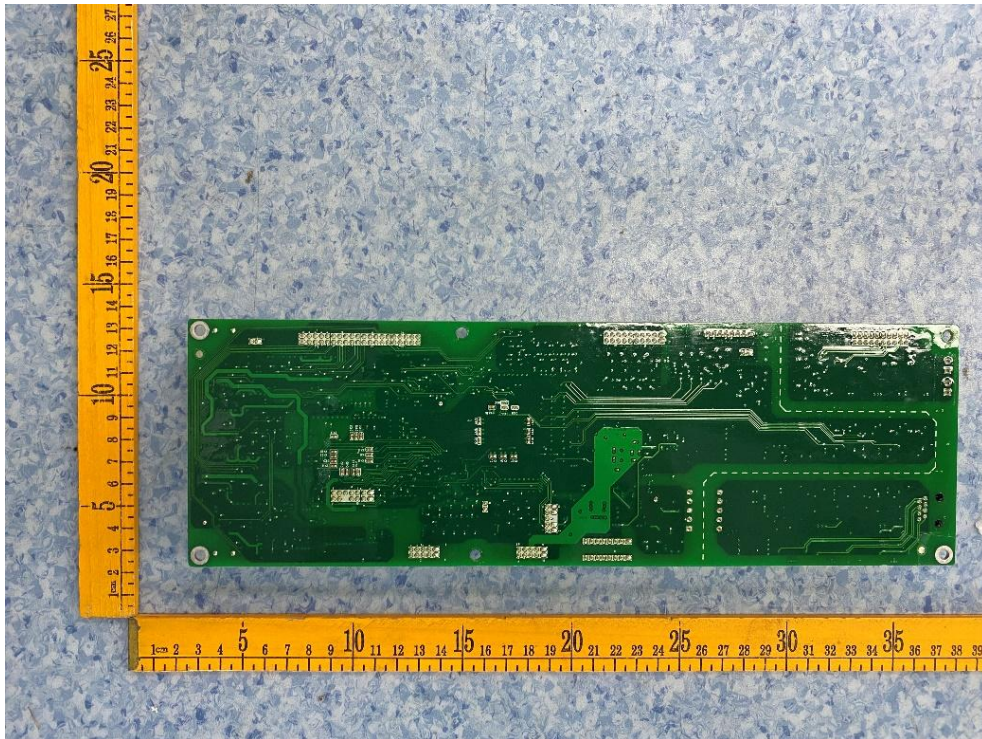


Figure 15. Power module board III

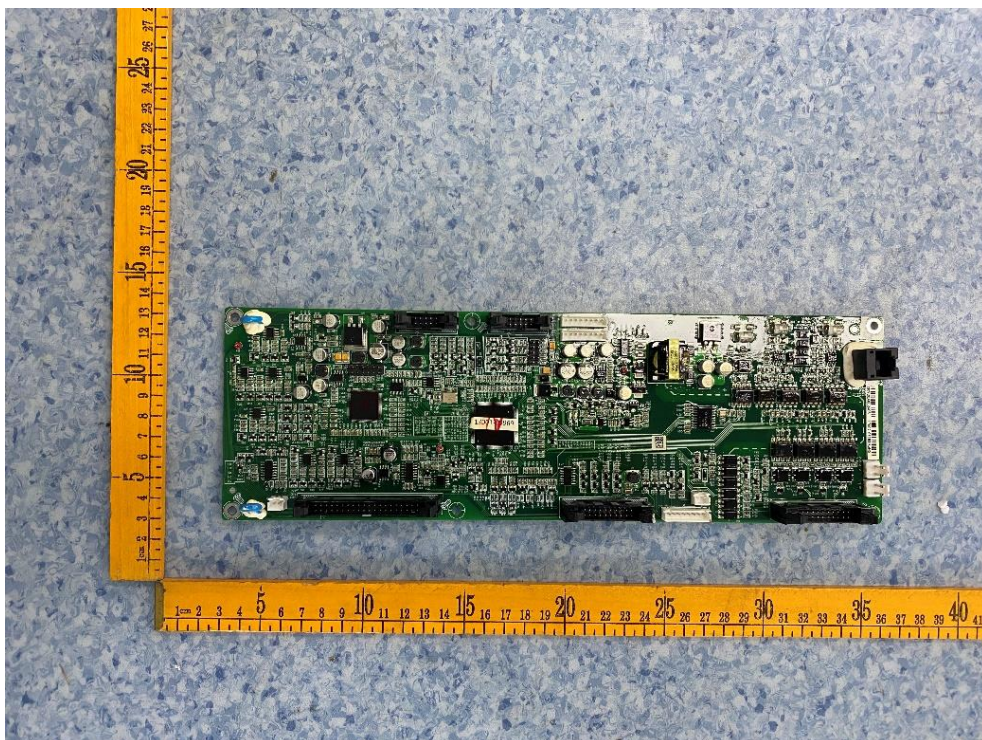


Figure 16. Power module board IV

Pictures of the unit

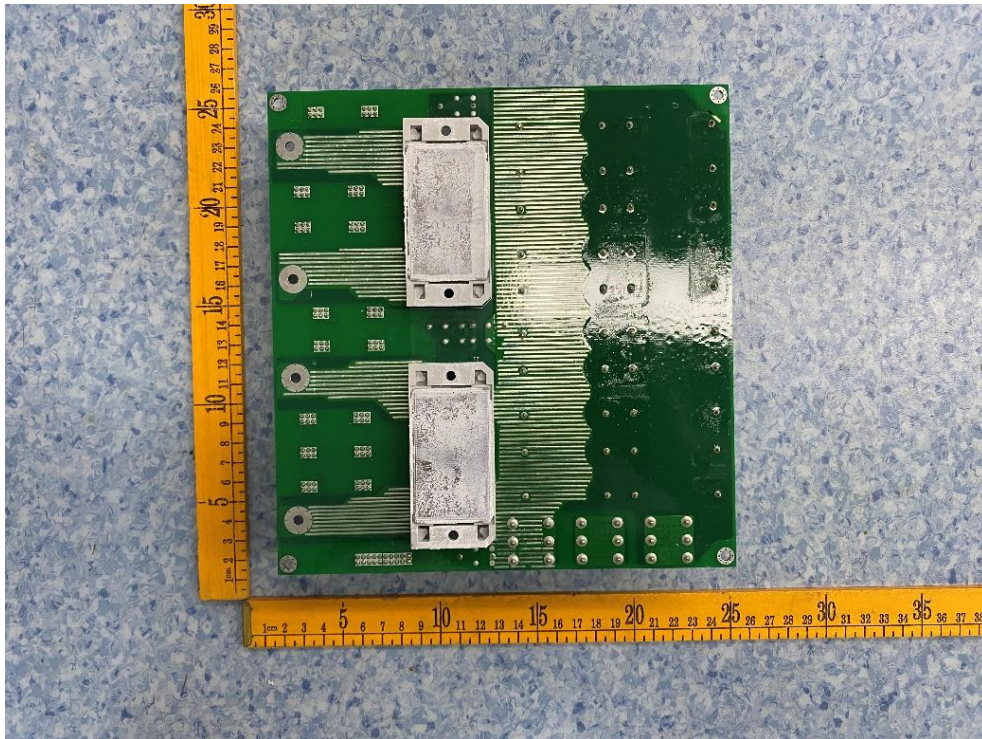


Figure 17. Power module board V

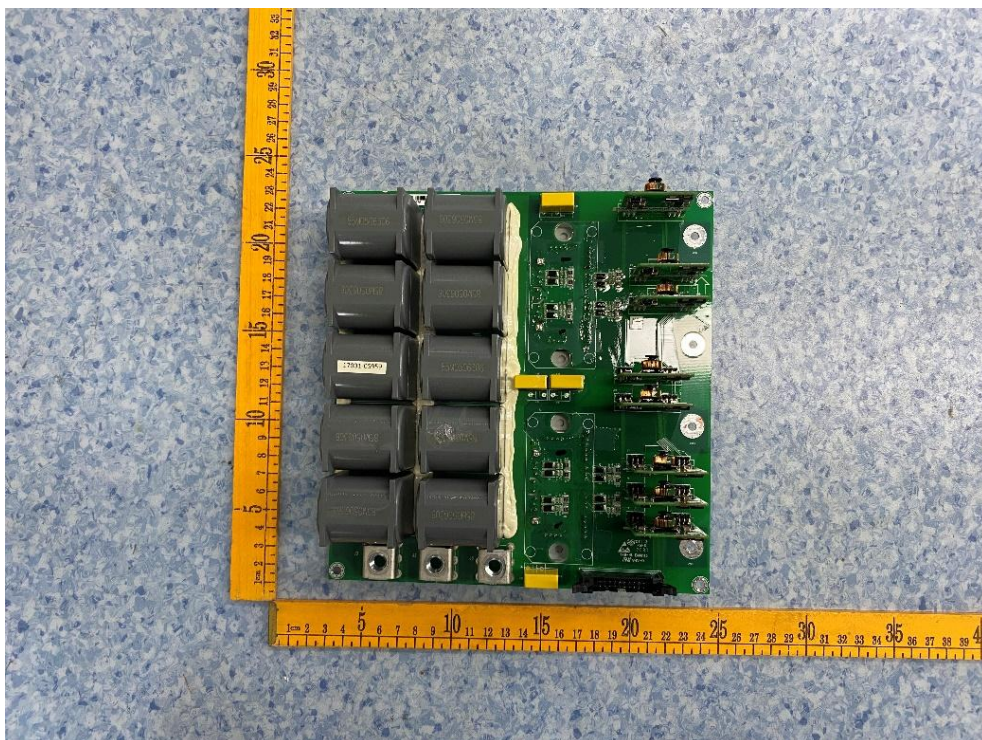


Figure 18. Power module board VI

Pictures of the unit

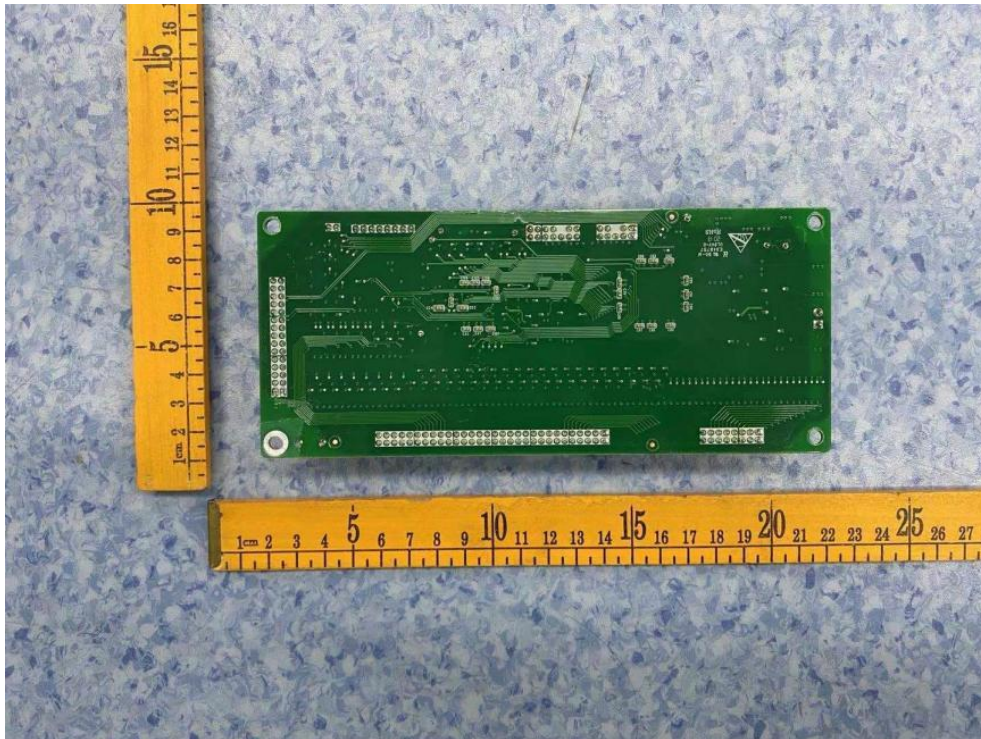


Figure 19. Back view of Control board (PE1810-CT1)

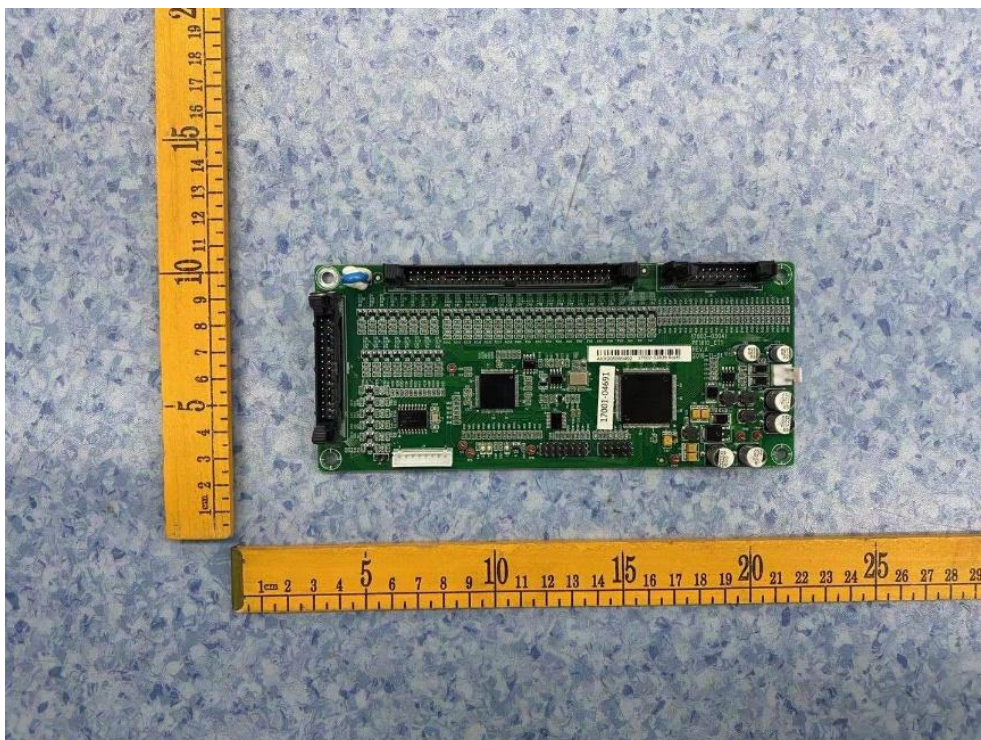


Figure 20. Front view of Control board (PE1810-CT1)

Pictures of the unit

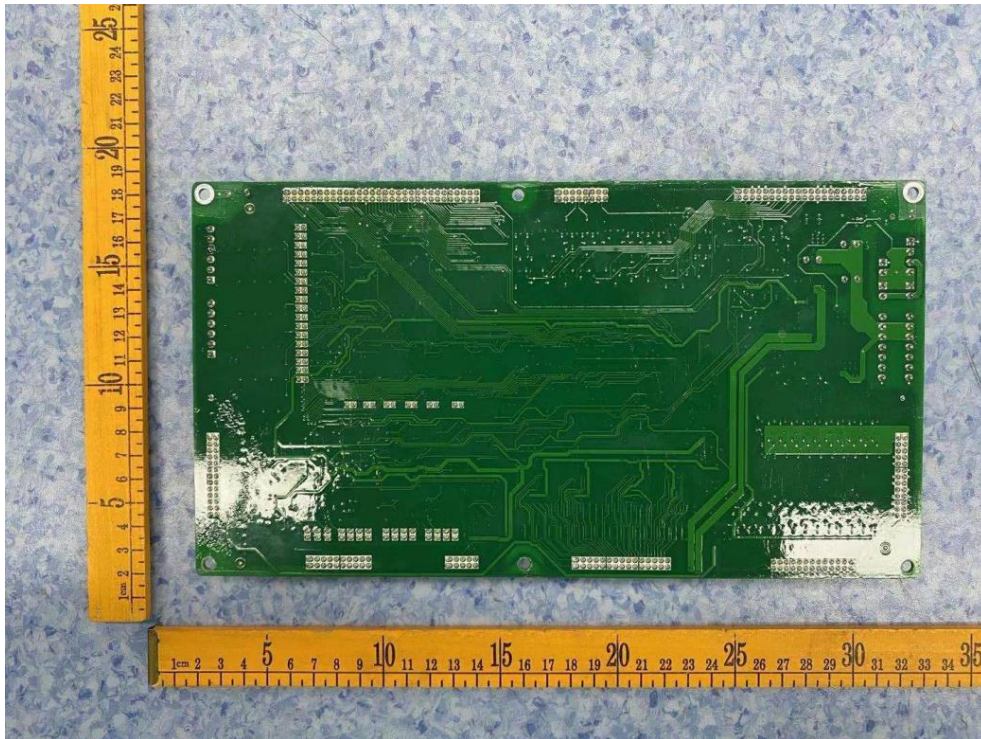


Figure 21. Back view of Detection board (PE1810-DT1)

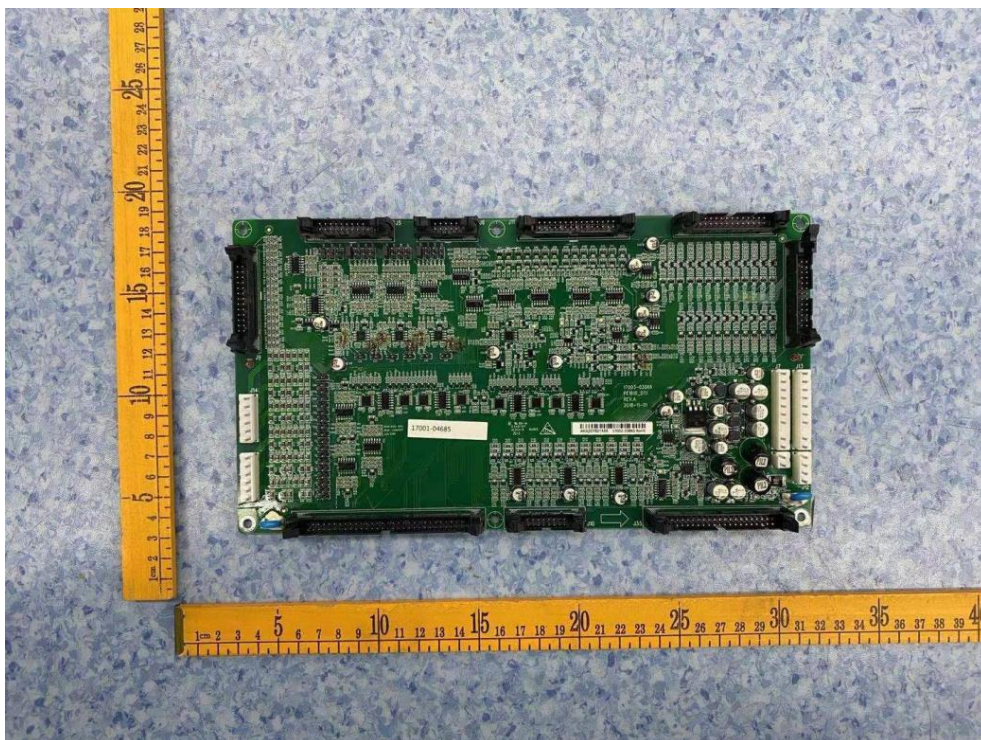


Figure 22. Front view of Detection board (PE1810-DT1)

Pictures of the unit

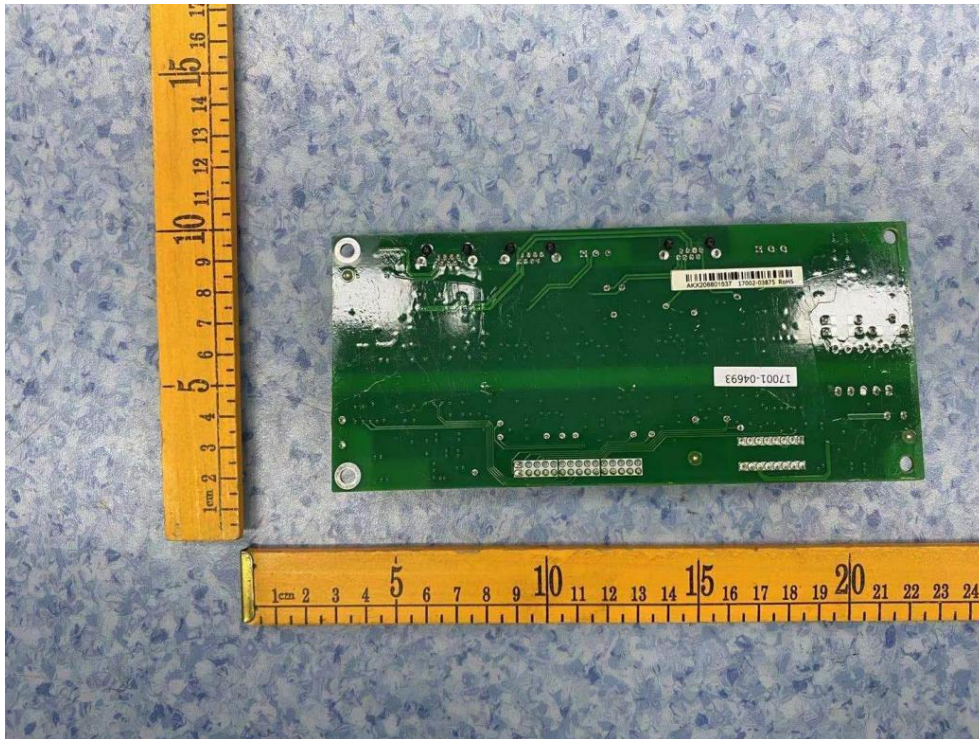


Figure 23. Back view of Communication board (PE1810-CM1)

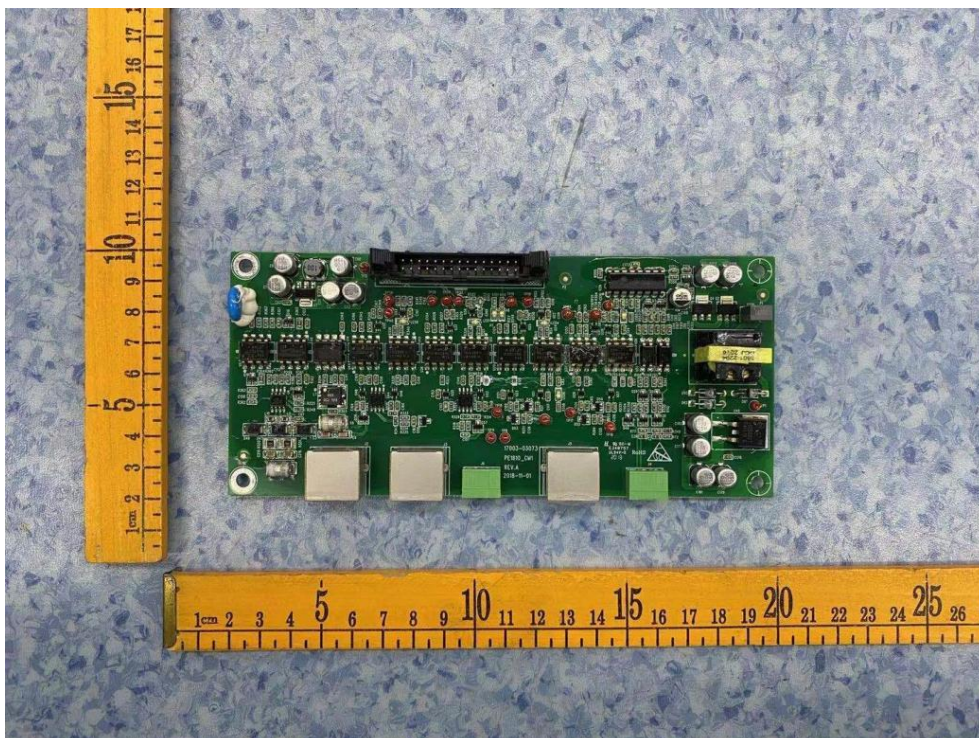


Figure 24. Front view of Communication board (PE1810-CM1)

Pictures of the unit

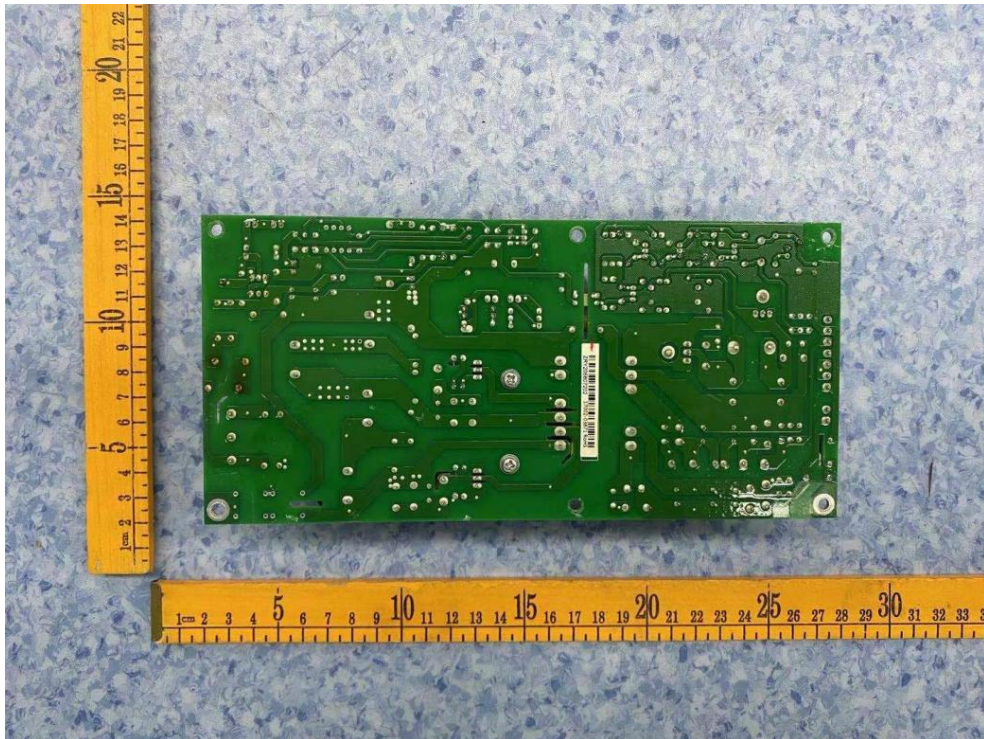


Figure 25. Back view of Auxiliary power board (PE1810-PW1)

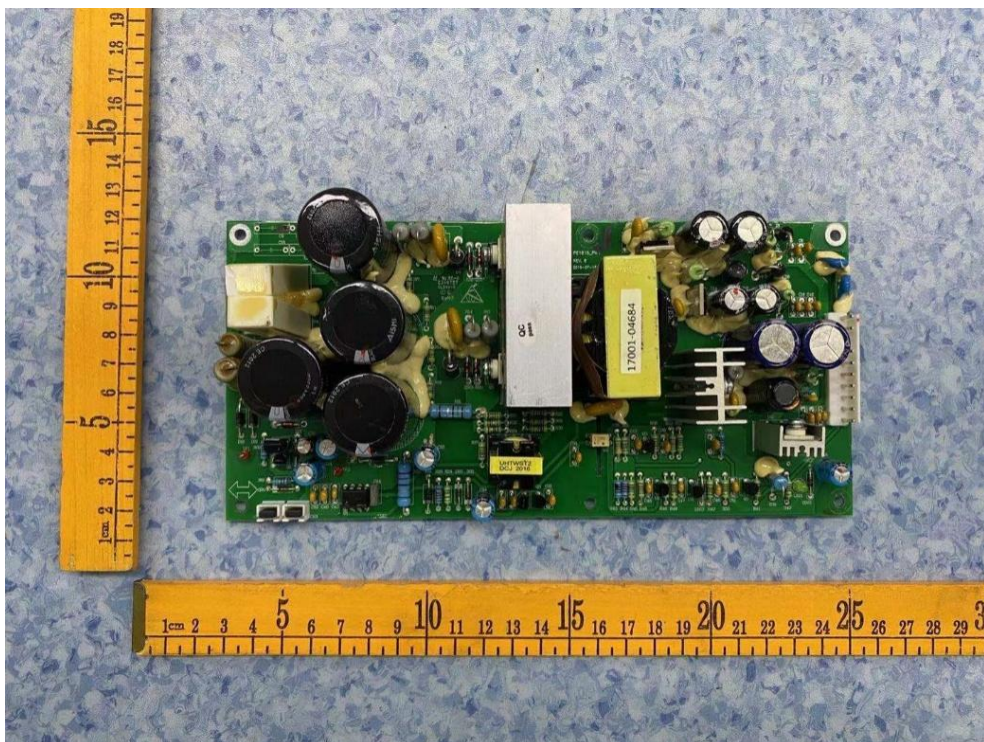


Figure 26. Front view of Auxiliary power board (PE1810-PW1)

Pictures of the unit



Figure 27. Front view of Contactor drive board (PE1810-TF1)

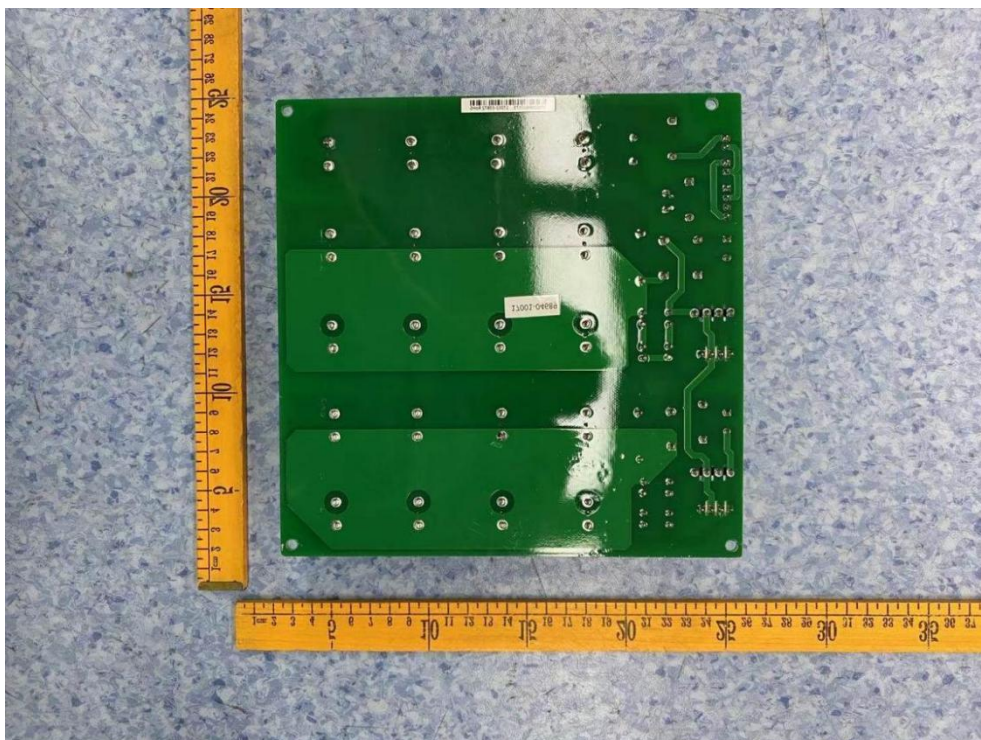


Figure 28. Back view of Contactor drive board (PE1810-TF1)

Pictures of the unit

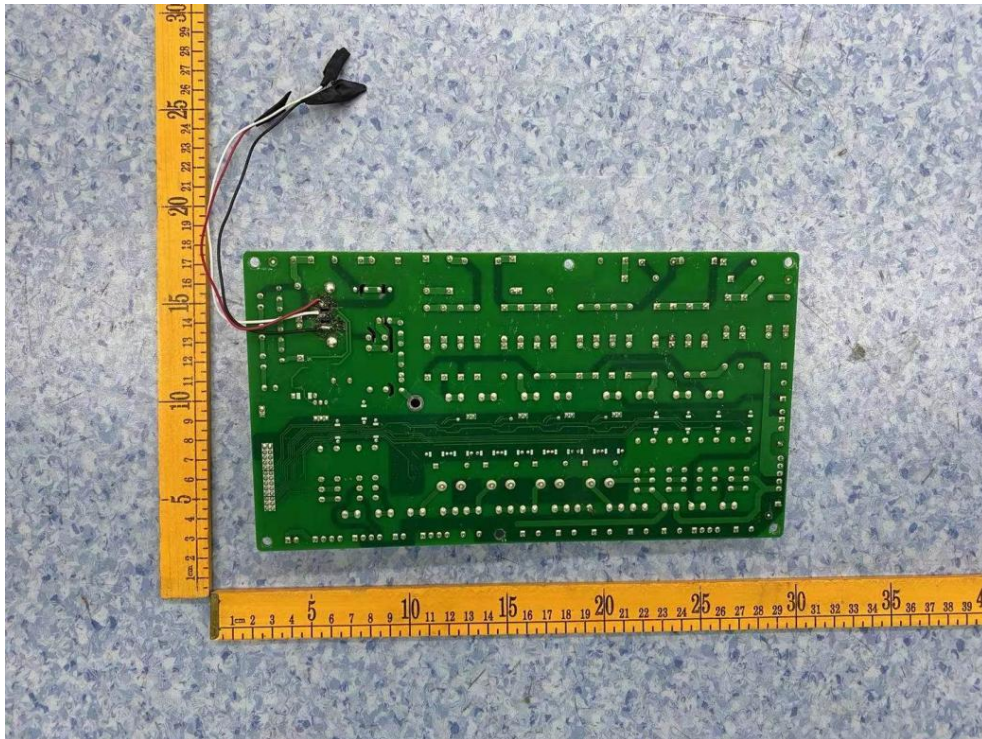


Figure 29. Back view of Electric control board (PE1810-DR2)

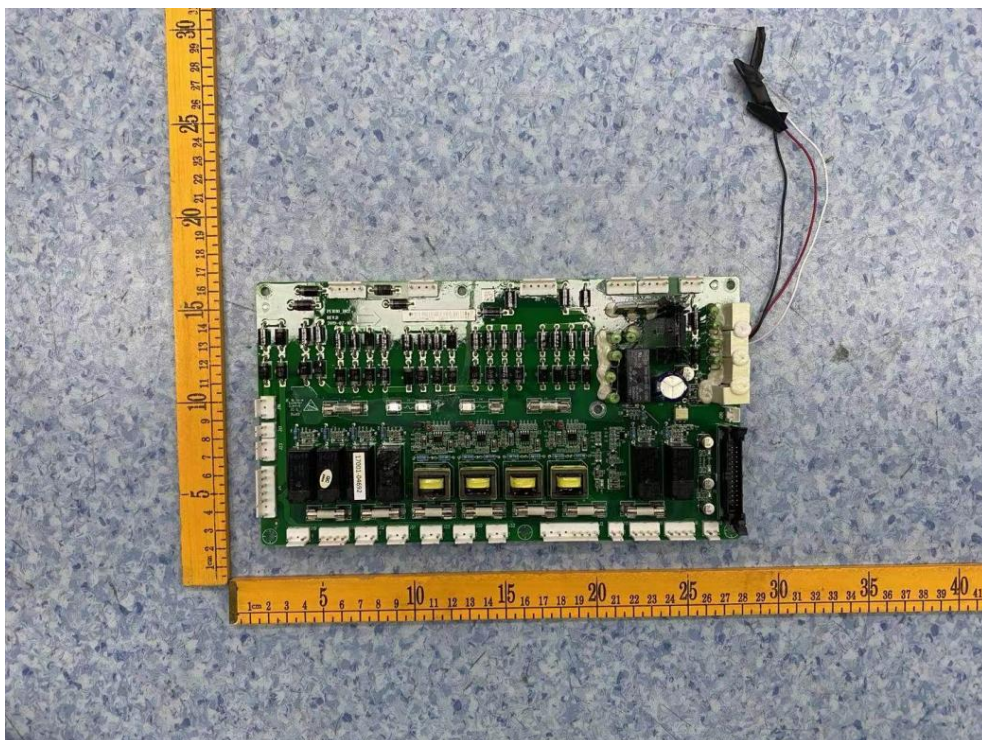


Figure 30. Front view of Electric control board (PE1810-DR2)

Pictures of the unit

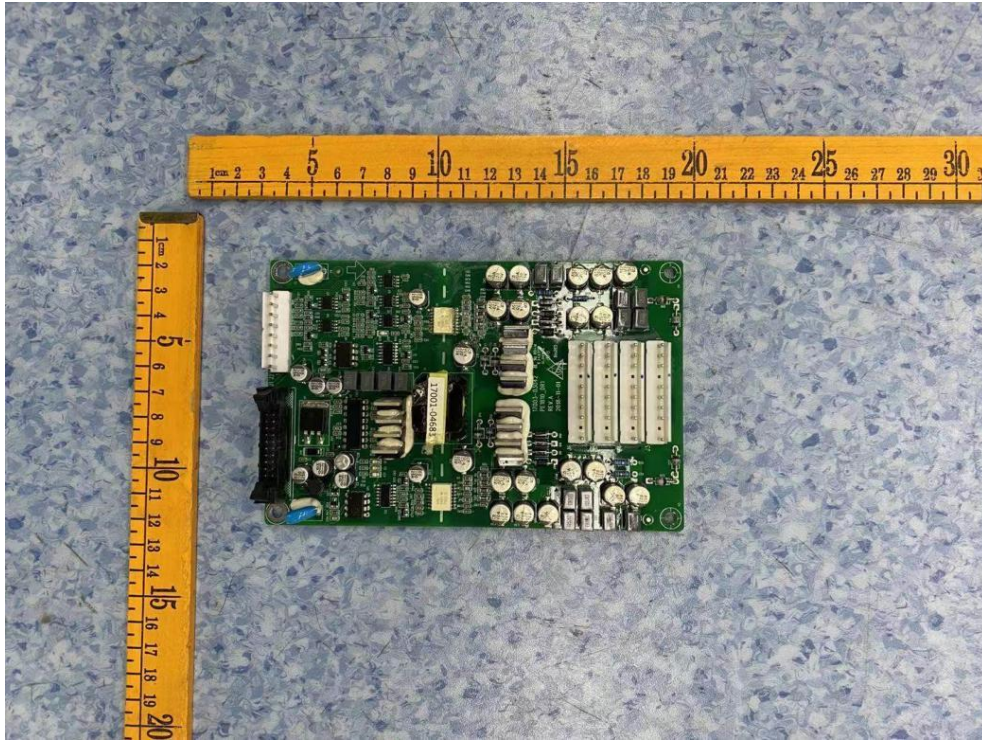


Figure 31. Front view of Driver board (PE1810-DR1)

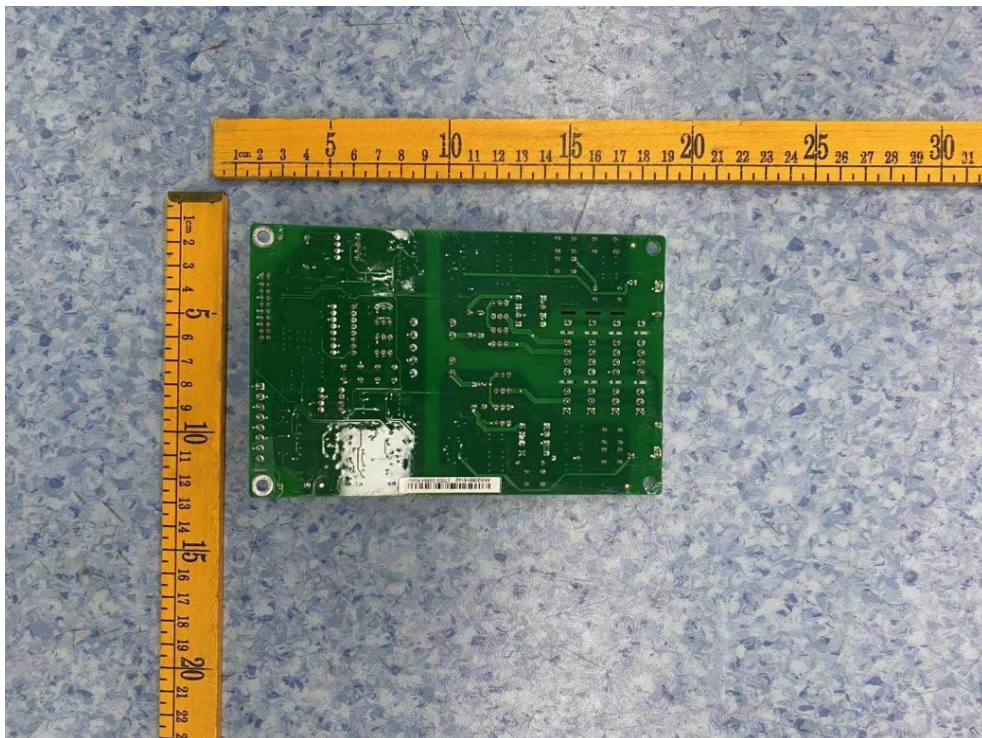


Figure 32. Back view of Driver board (PE1810-DR1)

Test Equipment list				
No	Test Equipment	Equipment model	Equipment No.	Calibration due date
1	DC power source	WPLA-150KW	BZ-DGD-L013	2022/11/03
2	AC power source	WPLA-330200KVA	BZ-DGD-L204	2022/06/28
3	Power analyzer	DEWE2-PA7	BZ-DGD-L119	2022/11/03
4	AC/DC current sensor	CT9693-10	BZ-DGD-L027-1	2023/02/22
5	AC/DC current sensor	CT6863-05	BZ-DGD-L027-2	2022/12/19
6	AC/DC current sensor	CT6863-05	BZ-DGD-L027-3	2023/02/22
7	AC/DC current sensor	CT6863-05	BZ-DGD-L027-4	2023/02/22
8	Anti-islanding test detection device	ACLT-38160H	BZ-DGD-L003	2022/11/07

Statement

1. The laboratory guarantees the scientificity, accuracy and impartiality of the test, and is responsible for all the information in the report, except the information provided by the customer. The customer is responsible for the impact of the information provided on the validity of the results.
2. The report without China inspection body and laboratory Mandatory Approval (CMA) mark has no effect of proving to the society.
3. For the report with CNAS mark, the items marked with "☆" are not within the accredited scope.
4. This report is invalid if it is altered, without the signature of the testing and approval personnel, or without the "inspection and testing dedicated stamp" or test report stamp.
5. The test data and results are only valid for the tested samples provided by the customer.
6. This report shall not be partially reproduced without the written permission of the laboratory.
7. Any objection shall be raised to the laboratory within 30 days after receiving the report.

--- End of test report---

Attachment 1 - EMC test report TW202302-025-2 ☆



TEM-Wave



中国认可
国际互认
检测
TESTING
CNAS L15153

Report No: TW202302-025-2

EMC TEST REPORT

Report Number: TW202302-025-2

Sample Name: Energy Storage Converter

Test Model: JKH500LTA

Application Model: JKH30LTA, JKH50LTA, JKH100LTA, JKH150LTA,
JKH250LTA, JKH500LTA

Applicant: Jinko Solar Co., Ltd.



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1. Abbreviation and definition

No.	Abbreviation	Definition	No.	Abbreviation	Definition
1	H/V	Horizontal and vertical polarization	2	AM	Amplitude modulation
3	EUT	Equipment Under Test	4	AV	Average
5	QP	Quasi-Peak	6	N/A	Not Applicable
7	dB μ V	Decibel microvolts	8	dB μ V/m	Decibel microvolts per meter
9	deg	Degree	/	/	/



2. Summary

2.1 Sample description

Name:	Energy Storage Converter	Test Model:	JKH500LTA
Sample No.:	S20221222-03	Serial No.:	/
Rated:	MAX. Input Voltage:1000VDC Rated Output Voltage: 320V-460V 3W+PE	Operating condition:	Full load
Application Model:	JKH30LTA, JKH50LTA, JKH100LTA, JKH150LTA, JKH250LTA, JKH500LTA		
Applicant:	Jinko Solar Co., Ltd.		
Address:	No.1, Yingbin Road, Economic Development Zone, Shangrao City, 334100 Jiangxi, P.R. China		
Manufacturer:	Jinko Solar Co., Ltd.		
Address:	No.1, Yingbin Road, Economic Development Zone, Shangrao City, 334100 Jiangxi, P.R. China		
Remark:	/		



2.2 Auxiliary equipment information

No	Name	Quantity	Specification/model	Cable length
1	/	/	/	/

2.3 Test result

No	Test items	According to	Result
1	Conducted emission	NRS 097-2-1:2017 Edition 2.1 IEC 61000-2-2:2002+AMD1:2017 +AMD2:2018	Pass
Result description: 1) The test results meet the standard requirements. Pass 2) The test results doesn't meet the standard requirements. Fail			
Release Date		2022.12.26	

Sijia Wang

Prepared by

Xue Jia

Reviewed by

[Signature]

Released by



3. Test equipment

3.1 Conducted emission

No	Name	Type	Parameter	Manufacturer	Cal to
TW/C-003	Receiver	ESR7	9kHz-7GHz	R&S	2023.09.25
TW/C-040	Voltage probe	TK9420	9kHz-30MHz	Schwarzbeck	2023.03.17

4. Test

4.1 Conducted emission

4.1.1. Test environment

Location	10 m anechoic room	Time	2022-12-22
Test by	Wang Sijia	Temperature and humidity	25°C/55%

4.1.2. Test requirements

1) According to
NRS 097-2-1:2017 Edition 2.1
IEC 61000-2-2:2002+AMD1:2017 +AMD2:2018

2) Test requirements:

Frequency(MHz)	Limit(dBμV)		
	PK	QP	AV
0.009-0.03	/	120.5-113	/
0.03-0.05	/	113-110	/
0.05-0.15	/	104-80	/
0.15-0.5	/	79	/
0.5-30	/	73	/

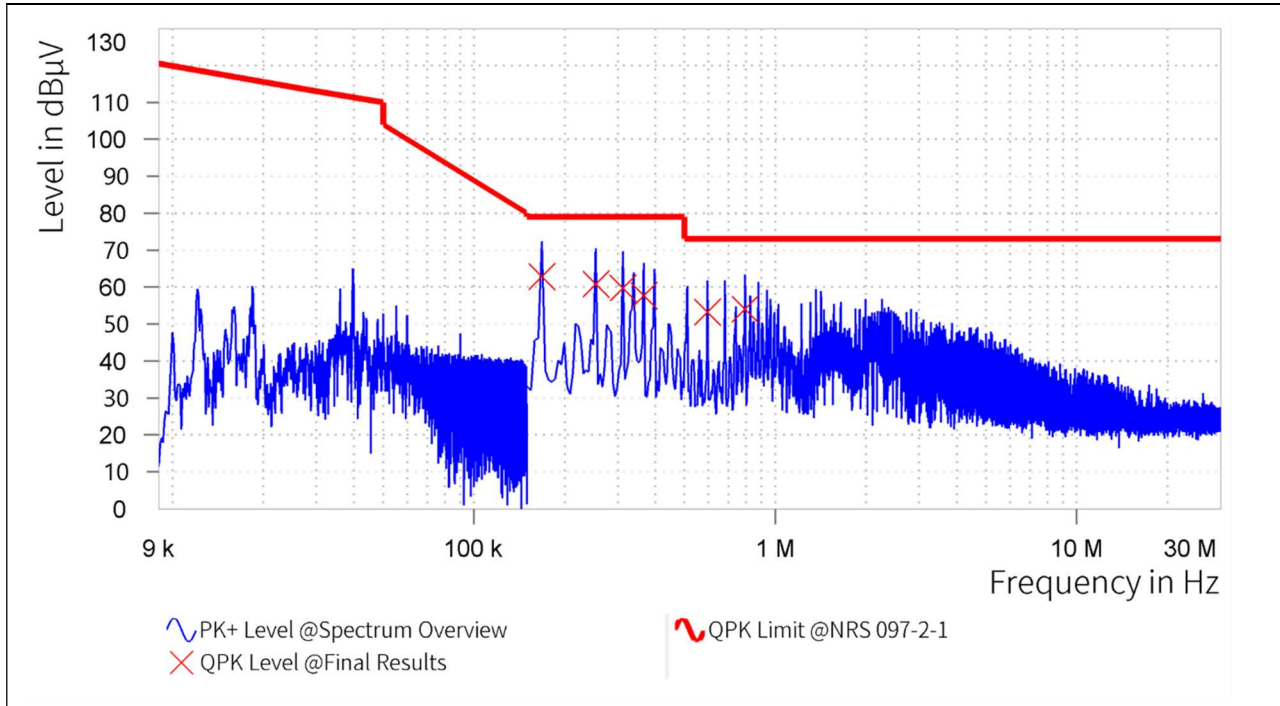
3) Test method:

Test setup and method according to EN 55016-2-1:2014.



4.1.3. Test record

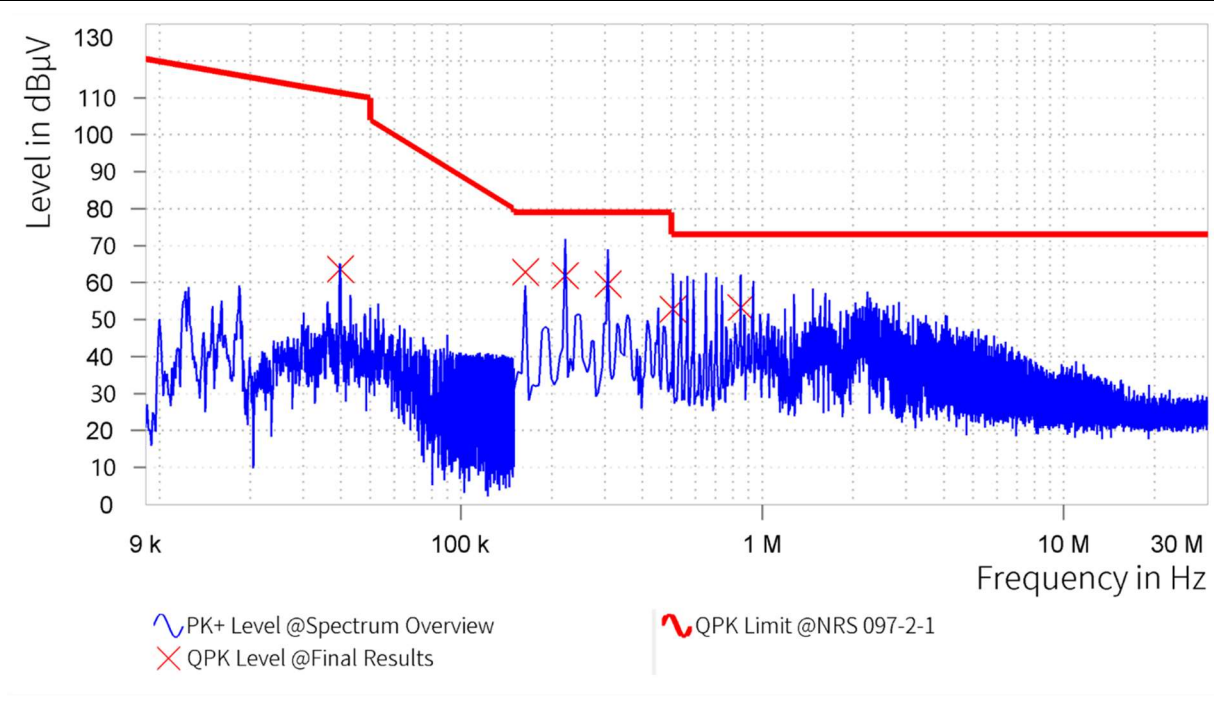
1) L1



Frequency (MHz)	QP (dBμV)	Limit (dBμV)	Margin (dBμV)	Bandwidth (kHz)	Polarity
0.168	62.86	79.00	16.14	9.000	L1
0.254	60.88	79.00	18.12	9.000	L1
0.312	59.76	79.00	19.24	9.000	L1
0.366	57.74	79.00	21.26	9.000	L1
0.596	53.27	73.00	19.73	9.000	L1
0.794	54.11	73.00	18.89	9.000	L1



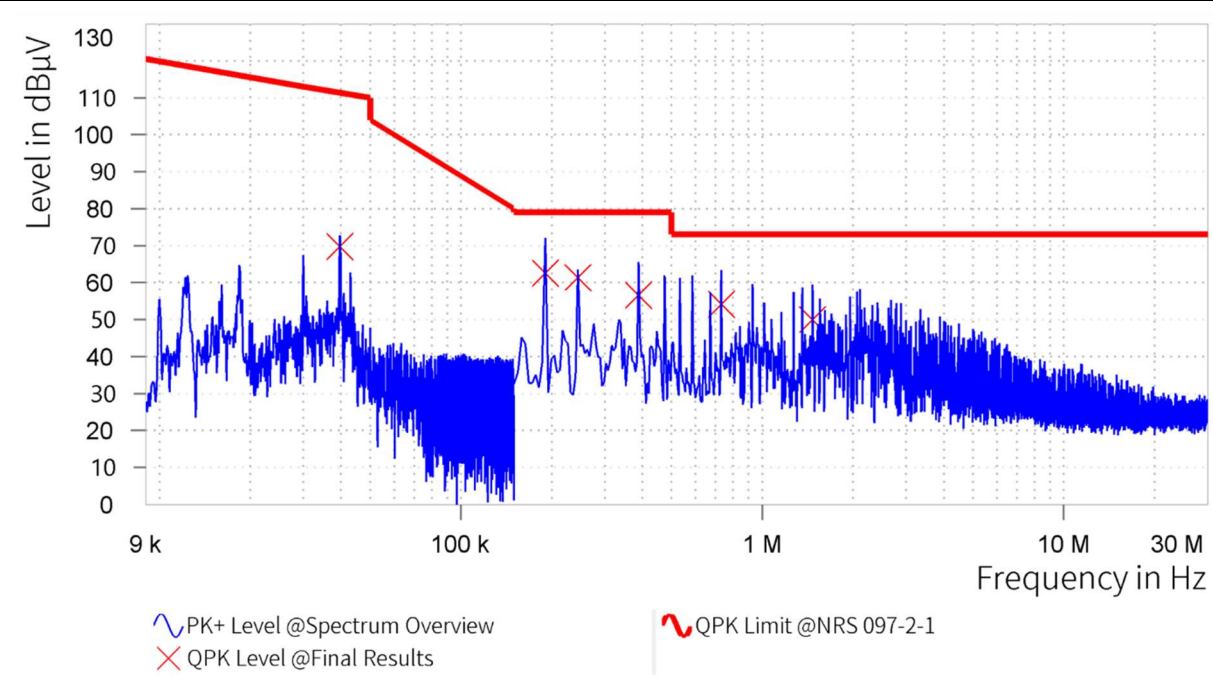
2) L2



Frequency (MHz)	QP (dBµV)	Limit (dBµV)	Margin (dBµV)	Bandwidth (kHz)	Polarity
0.040	63.72	111.34	47.62	0.200	L2
0.164	62.88	79.00	16.12	9.000	L2
0.222	61.92	79.00	17.08	9.000	L2
0.308	59.65	79.00	19.35	9.000	L2
0.506	52.90	73.00	20.10	9.000	L2
0.848	53.30	73.00	19.70	9.000	L2



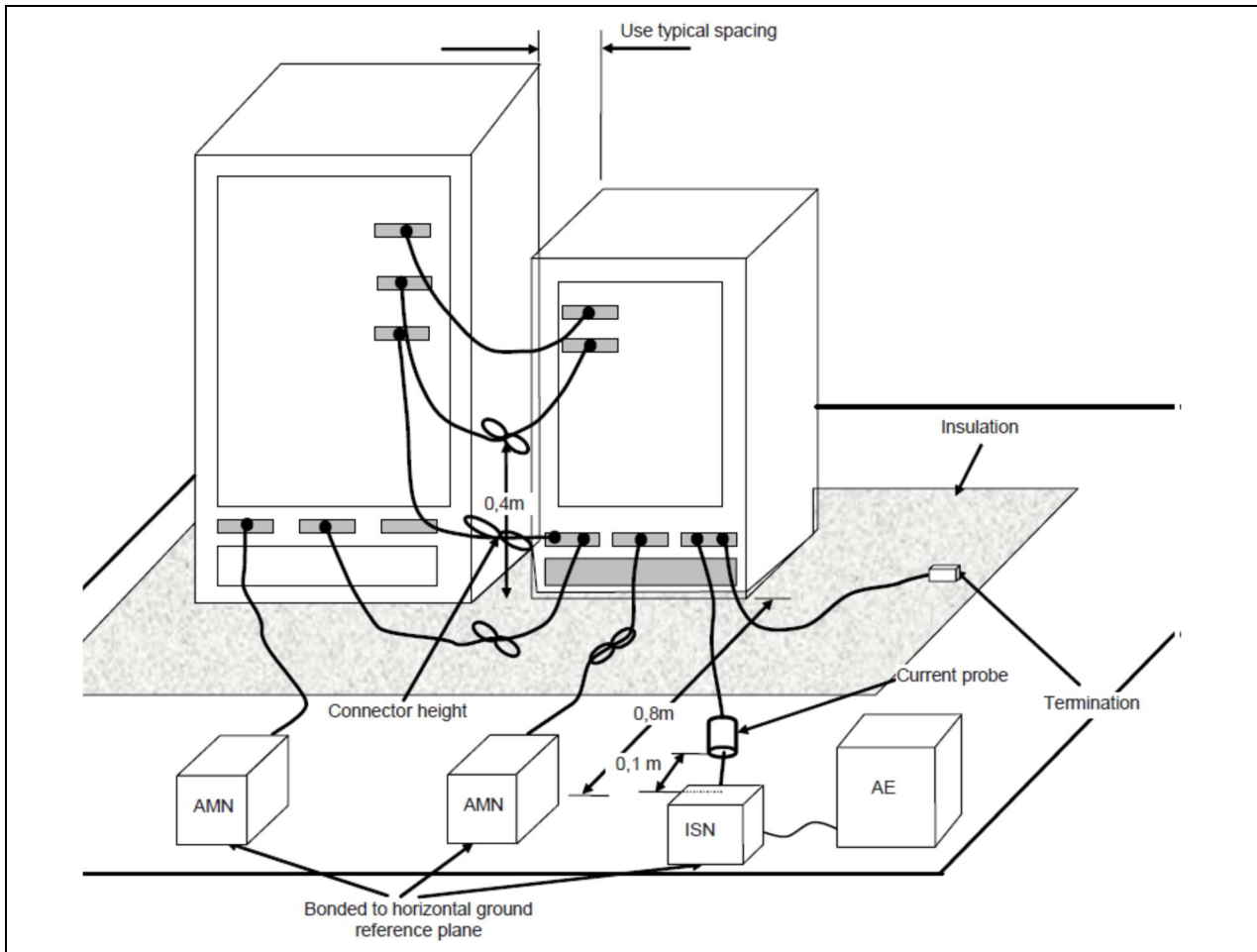
3) L3



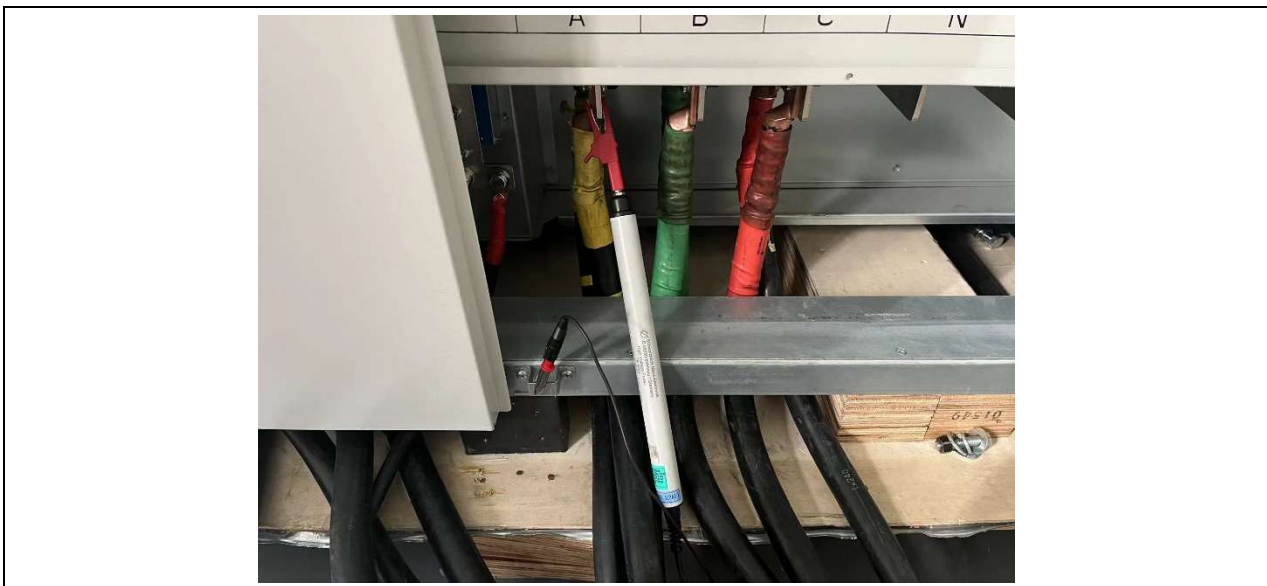
Frequency (MHz)	QP (dBµV)	Limit (dBµV)	Margin (dBµV)	Bandwidth (kHz)	Polarity
0.040	69.83	111.37	41.54	0.200	L3
0.191	62.58	79.00	16.42	9.000	L3
0.245	61.47	79.00	17.53	9.000	L3
0.389	56.66	79.00	22.34	9.000	L3
0.731	54.21	73.00	18.79	9.000	L3
1.469	50.06	73.00	22.94	9.000	L3



4.1.4. Test setup



4.1.5. Test photograph





5. Statement

1. 1 Report statement

If the report without "stamp only for testing" or "official seal" is invalid.

If the copy report without "stamp only for testing" or "official seal" is invalid.

If the Report without signatures of "prepared", "reviewed" and "released" are invalid.

The Report Is Invalid If Altered.

The Report is only responsible for the sample.

1. 2 Statement of measurement uncertainty

The data and Result referenced in this document are true and accurate.

The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for measurements listed in this test report according to CISPR16-4:2002 " Uncertainty in EMC measurements " and is documented in Jiangsu TEM-Wave Testing Service Ltd. Product Service Quality System according to ISO/IEC 17025.

Furthermore, variability of component and process may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the product.

1. 3 Statement of performance criterion

Performance Criterion A:

The EUT shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the EUT is used as intended. If the performance level is not specified by the manufacturer, this may be derived from the product description and documentation and what the user may reasonably expect from the equipment if used as intended.

Performance Criterion B:

The EUT shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the EUT is used as intended. The performance level may be replaced by a permissible loss of performance. However, during the test degradation of performance is allowed but no change of actual operating state or stored data is allowed. If the minimum performance



level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the equipment if used as intended.

Performance Criterion C:

Temporary loss of function is allowed during the test, provided the function is self-recoverable or can be restored by the operation of the controls.

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