



TEST REPORT

IEC 61727

Photovoltaic (PV) systems
Characteristics of the utility interface

Test procedure of islanding prevention measures for
utility-interconnected photovoltaic inverters

LCIE

Report reference number: **ABRE-18SE0642FCSHP-2**

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Testing laboratory name: **Bureau Veritas
LCIE China Company Limited**

Address: Building 4, No. 518, Xinzhuan
Road, Caohejing Songjiang
High-Tech Park, Shanghai,
P.R. China (201612)



Test specification

Standard: IEC 61727:2004

Certificate: **Certificate of compliance**

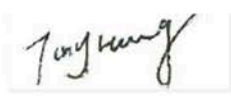

Test report form number: IEC 61727

Master TRF: Bureau Veritas Consumer Products Services Germany GmbH

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Test item description: **Grid-tied photovoltaic inverter**

| | | | | | |
|----------------------------------|----------------------|-----------------|---------------|-----------------|---------------|
| Model / Type | NAC6K-DT | NAC8K-DT | NAC10K-DT | NAC12K-DT | NAC15K-DT |
| MPP DC voltage range [V] | 250-950 | | | | |
| Max. Input DC voltage [V] | 1000 | | | | |
| Max. Input DC current [A]..... | 12,5 | 12,5/12,5 | | | 20/12,5 |
| Output AC voltage [V] | 230, 3/N/PE, 50/60Hz | | | | |
| Max. Output AC current [A] | 9,6 (per phase) | 12,8(per phase) | 16(per phase) | 19,2(per phase) | 24(per phase) |
| Max. Output power [VA] | 6600 | 8800 | 11000 | 13200 | 16500 |

| | | | |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-----------------|
| Testing Location | Bureau Veritas LCIE China Company Limited | | |
| Address | Building 4, No. 518, Xinzhuan Road, Caohejing, Songjiang High-Tech Park, Shanghai, P.R. China (201612) | | |
| Tested by (name and signature) | Tony Huang |  | Test engineer |
| Approved by (name and signature) | Harvey Wang |  | Project Manager |
| <div></div> | | | |

| Document History | | | |
|----------------------------|--------------------|--------------------------------|----------|
| Date | Internal reference | Modification / Change / Status | Revision |
| 2018-11-30 | Tony Huang | Initial report was written | 0 |
| Supplementary information: | | | |

Test items particulars

Equipment mobility : Permanent connection

Operating condition : Continuous

Class of equipment : Class I

Protection against ingress of water .. : IP65 according to EN 60529

Mass of equipment [kg] : 16kg for model NAC6K-DT, NAC8K-DT
18kg for model NAC10K-DT, NAC12K-DT
21kg for model NAC15K-DT

Test case verdicts

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

Test item does meet
the requirement : P(ass)

Test item does not meet
the requirement : F(ail)

Testing

Date of receipt of test item : 2018-09-12

Date(s) of performance test : 2018-09-12 to 2018-11-10

General remarks:

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

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

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

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

The IEC61727 does not provide any limits of accuracy for the utility voltage and frequency measurement of the PV-system. If nothing different stated at the test table the values for tolerances given in EN 50438, Table 2 are used.

Tolerances on trip values tabel 2 EN50438:

- Voltage: +/- 1% of the nominal voltage
- Frequency: +/- 0,5% of the nominal frequency
- Clearance time: +/- 10%

This Test Report consists of the following documents:






1. Test Results
2. Annex No. 1 – EMC Test Report
3. Annex No. 2 – Pictures of the unit
4. Annex No. 3 – Test equipment list

Copy of marking plate:

EMPALUX

Model: NAC6K-DT

| | | |
|-------------------------------|-----------------------------|---------------------------|
| DC | Max. DC Power | 7200W |
| | Max. Input Voltage | 1000Vdc |
| | MPP Operating Voltage Range | 250-950Vdc |
| | Rated MPP Voltage | 600Vdc |
| | Max. Input Current Per MPPT | 12.5Adc |
| | ISC | 16A |
| AC | Rated AC Power | 6000VA |
| | Max. AC Power | 6600VA |
| | Rated Grid Frequency | 50Hz/60Hz±5Hz |
| | Rated AC Voltage | 400Vac |
| | Max. AC Current | 9.6A |
| | Power Factor | 0.8(lagging)~0.8(leading) |
| Protection Class | | IP65 |
| Operating Ambient Temperature | | -25~60°C |
| Enclosure | | Class1 |






CE RoHS

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EMPALUX

Model: NAC8K-DT

| | | |
|-------------------------------|-----------------------------|---------------------------|
| DC | Max. DC Power | 9600W |
| | Max. Input Voltage | 1000Vdc |
| | MPP Operating Voltage Range | 250-950Vdc |
| | Rated MPP Voltage | 600Vdc |
| | Max. Input Current Per MPPT | 12.5Adc/12.5Adc |
| | ISC | 16A/16A |
| AC | Rated AC Power | 8000VA |
| | Max. AC Power | 8800VA |
| | Rated Grid Frequency | 50Hz/60Hz±5Hz |
| | Rated AC Voltage | 400Vac |
| | Max. AC Current | 12.8A |
| | Power Factor | 0.8(lagging)~0.8(leading) |
| Protection Class | | IP65 |
| Operating Ambient Temperature | | -25~60°C |
| Enclosure | | Class1 |






CE RoHS

42 0 0 003 3-0 0 MADE IN CHINA

EMPALUX

Model: NAC10K-DT

| | | |
|-------------------------------|-----------------------------|---------------------------|
| DC | Max. DC Power | 12000W |
| | Max. Input Voltage | 1000Vdc |
| | MPP Operating Voltage Range | 250-950Vdc |
| | Rated MPP Voltage | 600Vdc |
| | Max. Input Current Per MPPT | 12.5Adc/12.5Adc |
| | ISC | 16A/16A |
| AC | Rated AC Power | 10000VA |
| | Max. AC Power | 11000VA |
| | Rated Grid Frequency | 50Hz/60Hz±5Hz |
| | Rated AC Voltage | 400Vac |
| | Max. AC Current | 16A |
| | Power Factor | 0.8(lagging)~0.8(leading) |
| Protection Class | | IP65 |
| Operating Ambient Temperature | | -25~60°C |
| Enclosure | | Class1 |






CE RoHS

42 0 0 003 4-0 0 MADE IN CHINA

EMPALUX


Model: NAC12K-DT

| | | |
|-------------------------------|-----------------------------|---------------------------|
| DC | Max. DC Power | 14000W |
| | Max. Input Voltage | 1000Vdc |
| | MPP Operating Voltage Range | 250-950Vdc |
| | Rated MPP Voltage | 600Vdc |
| | Max. Input Current Per MPPT | 12.5Adc/12.5Adc |
| | ISC | 16A/16A |
| AC | Rated AC Power | 12000VA |
| | Max. AC Power | 13200VA |
| | Rated Grid Frequency | 50Hz/60Hz±5Hz |
| | Rated AC Voltage | 400Vac |
| | Max. AC Current | 19.2A |
| | Power Factor | 0.8(lagging)~0.8(leading) |
| Protection Class | | IP65 |
| Operating Ambient Temperature | | -25~60°C |
| Enclosure | | Class1 |


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

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Model: NAC15K-DT

| | | |
|-------------------------------|-----------------------------|---------------------------|
| DC | Max. DC Power | 18000W |
| | Max. Input Voltage | 1000Vdc |
| | MPP Operating Voltage Range | 250-950Vdc |
| | Rated MPP Voltage | 600Vdc |
| | Max. Input Current Per MPPT | 20Adc/12.5Adc |
| | ISC | 26A/16A |
| AC | Rated AC Power | 15000VA |
| | Max. AC Power | 16500VA |
| | Rated Grid Frequency | 50Hz/60Hz±5Hz |
| | Rated AC Voltage | 400Vac |
| | Max. AC Current | 24A |
| | Power Factor | 0.8(lagging)~0.8(leading) |
| Protection Class | | IP65 |
| Operating Ambient Temperature | | -25~60℃ |
| Enclosure | | Class1 |



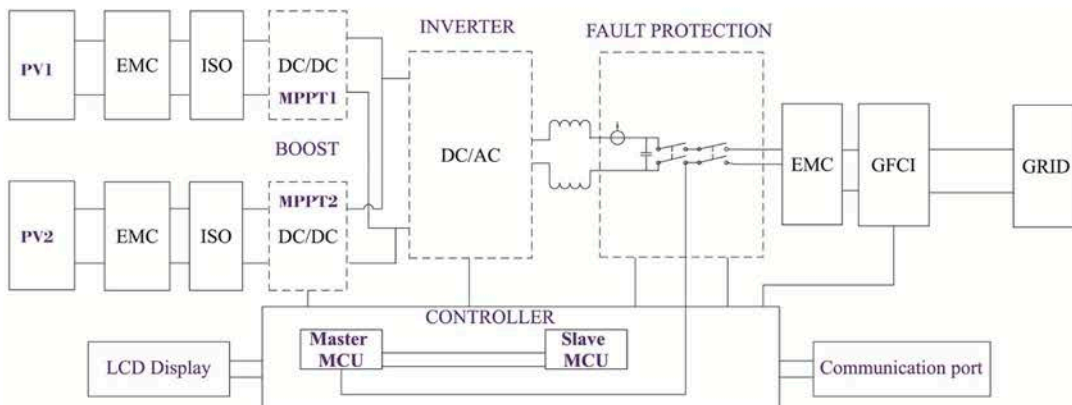



420-00035-00
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General product information:

The Solar converter converts DC voltage into AC voltage.

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

Block diagram

The internal control is redundant built, It consists of master controller(UC20) and slave controller(UC73), the master controller(UC20) can control relays, measures voltage, frequency, AC current with injected DC, insulation resistance and residual current. The slave controller (UC73) can control the relays, measures the voltage and frequency. Both controllers communicate with each other.

The voltage and frequency measurement is achieved with resistors in serial which are connected directly to line and neutral. Both controllers get these signals and calculate the data.

The unit provides two relays in series in each phase. The relays are tested before each start up. In addition the power bridge can be stopped by both controllers.

Hardware Version:

| | |
|------------------|-----------------------------------------------------|
| Model | NAC6K-DT, NAC8K-DT, NAC10K-DT, NAC12K-DT, NAC15K-DT |
| Hardware version | 01 |

Software Version:

| | |
|------------------|-----------------------------------------------------|
| Model | NAC6K-DT, NAC8K-DT, NAC10K-DT, NAC12K-DT, NAC15K-DT |
| Software version | 1.00 |

Description of the differences of the models within a series:

| Model | NAC15K-DT | NAC12K-DT | NAC10K-DT | NAC8K-DT | NAC6K-DT |
|-------------------------------------|-----------|-----------|-----------|----------|----------|
| PV Connector number | 6pcs | 4pcs | 4pcs | 4pcs | 2pcs |
| Heatsink height | 80mm | 65mm | 65mm | 50mm | 50mm |
| PV1 filter capacitor (c149) | 20uf | 12uf | 12uf | 12uf | 12uf |
| Bus filter capacitor (c38/39/41/42) | 75uf | 50uf | 50uf | 50uf | 50uf |
| Boost1 IGBT(Q1) | 40A1200V | NA | NA | NA | NA |
| Boost1 diode(D1) | 40A1200V | NA | NA | NA | NA |
| Boost1 inductor | 914uH | 1430uH | 1430uH | 1430uH | 1430uH |
| Inv IGBT (Q9/10/11/18/19/20) | 50A1200V | 40A1200V | 40A1200V | 40A1200V | 40A1200V |
| Inv IGBT (Q12/13/14/15/16/17) | 50A650V | 40A650V | 40A650V | 40A650V | 40A650V |
| Inv inductor | 973uH | 1430uH | 1430uH | 1430uH | 1430uH |

Note:
The product was tested on:

The tests had been performed on model NAC15K-DT are valid for model NAC6K-DT, NAC8K-DT, NAC10K-DT, NAC12K-DT since it is identical in hardware and just power derated by except for PV Connector number, Heatsink height, PV1 filter capacitor (c149), Bus filter capacitor (c38/39/41/42), Boost1 IGBT(Q1), Boost1 diode(D1), Boost1 inductor, Inv IGBT (Q9/10/11/18/19/20), Inv IGBT (Q12/13/14/15/16/17), Inv inductor.

Default interface protection settings according IEC 61727:2004

TNB Technical Guidebook on Grid-interconnection of Photovoltaic Power Generations System to LV and MV Networks:2013

| Parameter | Max. clearance time* | Trip setting |
|-----------------------------|------------------------------------------------|--------------------|
| Over voltage (level 2) | 0,05s | 230V +35% (310,5V) |
| Over voltage (level 1) | 2,0s | 230V +10% (253V) |
| Under voltage (level 1) | 2,0s | 230V -15% (195,5V) |
| Under voltage (level 2) | 0,1s | 230V -50% (115V) |
| Over frequency | 0,2s | 50Hz +2% (51,0Hz) |
| Under frequency | 0,2s | 50Hz -2% (49,0Hz) |
| Reconnection time | 20s to 300s | |
| Permanent DC-injection | 1% of rated inverter output current | |
| Loss of main IEC 62116:2008 | Inverter shall detect and disconnect within 2s | |

* Trip time refers to the time between the abnormal condition occurring and the inverter ceasing to energize the utility line. The PV system control circuits shall actually remain connected to the utility to allow sensing of utility electrical conditions for use by the "reconnect" feature.

| IEC61727:2004 | | | |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|----------|
| Clause | Requirement – Test | Result – Remark | Verdict |
| SECTION 4: Utility compatibility | | | |
| 4 | General The quality of power provided by the PV system for the on-site AC loads and for 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 and may require the PV system to sense the deviation and properly disconnect from the utility system. All power quality parameters (voltage, flicker, frequency, harmonics, and power factor) must be measured at the utility interface/ point of common coupling unless otherwise specified. | Noticed | P |
| 4.1 | Voltage, current and frequency The PV system AC voltage, current and frequency shall be compatible with the utility system. | Derived from tests | P |
| 4.2 | Normal voltage operating range Utility-interconnected PV systems do not normally regulate voltage; they inject current into the utility. Therefore, the voltage operating range for PV inverters is selected as a protection function that responds to abnormal utility conditions, not as a voltage regulation function. | Derived from tests | P |
| 4.3 | Flicker The operation of the PV system should not cause voltage flicker in excess of limits stated in the relevant sections of IEC 61000-3-3 for systems less than 16 A or IEC 61000-3-5 for systems with current of 16 A and above. | See table 4.3 and Annex No. 1, The test report is stored in Bureau Veritas LCIE China Company Limited. | P |
| 4.4 | DC injection The PV system shall not inject DC current greater than 1 % of the rated inverter output current, into the utility AC interface under any operating condition. | See table 4.4 | P |
| 4.5 | Normal frequency operating range The PV system shall operate in synchronism with the utility system, and within the frequency trip limits defined in 5.2.2. | See table 4.5 and 5.2.2 | P |

| IEC61727:2004 | | | |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|----------|
| Clause | Requirement – Test | Result – Remark | Verdict |
| SECTION 4: Utility compatibility | | | |
| 4.6 | Harmonics and waveform distortion Low levels of current and voltage harmonics are desirable; the higher harmonic levels increase the potential for adverse effects on connected equipment. Acceptable levels of harmonic voltage and current depend upon distribution system characteristics, type of service, connected loads/apparatus, and established utility practice. The PV system output should have low current-distortion levels to ensure that no adverse effects are caused to other equipment connected to the utility system. Total harmonic current distortion shall be less than 5 % at rated inverter output. Each individual harmonic shall be limited to the percentages listed in Table 1. Even harmonics in these ranges shall be less than 25 % of the lower odd harmonic limits listed. (see Clause 4.6 Table 1 – Current distortion limits) | See tables 4.6 and Annex No.1 | P |
| 4.7 | Power factor The PV system shall have a lagging power factor greater than 0,9 when the output is greater than 50 % of the rated inverter output power. | See table 4.7 | P |

| IEC61727:2004 | | | |
|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Clause | Requirement – Test | Result – Remark | Verdict |
| SECTION 5: Personnel safety and equipment protection | | | |
| 5 | General This Clause provides information and considerations for the safe and proper operation of the utility-connected PV systems. | Noticed | P |
| 5.1 | Loss of utility voltage To prevent islanding, a utility connected PV system shall cease to energize the utility system from a de-energized distribution line irrespective of connected loads or other generators within specified time limits. A utility distribution line can become de-energized for several reasons. For example, a substation breaker opening due to fault conditions or the distribution line switched out during maintenance. If inverters (single or multiple) have DC SELV input and have accumulated power below 1 kW then no mechanical disconnect (relay) is required. | The loss of utility voltage test report for IEC61727 according to IEC62116 is stored in archive at Bureau Veritas LCIE China Company Limited. | P |
| 5.2 | Over/under voltage and frequency Abnormal conditions can arise on the utility system that requires a response from the connected photovoltaic system. This response is to ensure the safety of utility maintenance personnel and the general public, as well as to avoid damage to connected equipment, including the photovoltaic system. The abnormal utility conditions of concern are voltage and frequency excursions above or below the values stated in this Clause, and the complete disconnection of the utility, presenting the potential for a distributed resource island. | See table 5.2.1 and 5.2.2 | P |
| 5.2.1 | Over/under voltage When the interface voltage deviates outside the conditions specified in Table 2, the photovoltaic system shall cease to energize the utility distribution system. This applies to any phase of a multiphase system. All discussions regarding system voltage refer to the local nominal voltage. The system shall sense abnormal voltage and respond. The following conditions should be met, with voltages in RMS and measured at the point of utility connection. (see clause 5.2.1 Table 2 – Response to abnormal voltages) The purpose of the allowed time delay is to ride through short-term disturbances to avoid excessive nuisance tripping. The unit does not have to cease to energize if the voltage returns to the normal utility continuous operation condition within the specified trip time. | See table 5.2.1 | P |

| IEC61727:2004 | | | |
|-------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Clause | Requirement – Test | Result – Remark | Verdict |
| SECTION 5: Personnel safety and equipment protection | | | |
| 5.2.2 | Over/under frequency When the utility frequency deviates outside the specified conditions the photovoltaic system shall cease to energize the utility line. The unit does not have to cease to energize if the frequency returns to the normal utility continuous operation condition within the specified trip time. When the utility frequency is outside the range of ± 1 Hz, the system shall cease to energize the utility line within 0,2 s. The purpose of the allowed range and time delay is to allow continued operation for short-term disturbances and to avoid excessive nuisance tripping in weak-utility system conditions. | See table 5.2.2 | P |
| 5.3 | Islanding protection The PV system must cease to energize the utility line within 2 s of loss of utility. | The loss of utility voltage test report for IEC61727 according to IEC62116 is stored in archive at Bureau Veritas LCIE China Company Limited. | P |
| 5.4 | Response to utility recovery Following an out-of-range utility condition that has caused the photovoltaic system to cease energizing, the photovoltaic system shall not energize the utility line for 20 s to 5 min after the utility service voltage and frequency have recovered to within the specified ranges. | See table 5.2 (1) and 5.2 (2) | P |
| 5.5 | Earthing The utility interface equipment shall be earthed/grounded in accordance with IEC 60364-7-712. | Stated in the manual. | P |
| 5.6 | Short circuit protection The photovoltaic system shall have short-circuit protection in accordance with IEC 60364-7-712. | Stated in the manual. | P |
| 5.7 | Isolation and switching A method of isolation and switching shall be provided in accordance with IEC 60364-7-712. | Stated in the manual. | P |

Test overview:

IEC 61727:2004

| Clause | All test performed on model NAC15K-DT | Result |
|--------|---------------------------------------------------------------------------------------|--------|
| 1 | Response to protection operation - fault condition tests (according VDE0126-1-1:2006) | P |
| 4 | Type test: | |
| 4.3 | Voltage Fluctuations and Flicker | P |
| 4.4 | Monitoring of DC-Injection | P |
| 4.5 | Normal frequency operating range (see 5.2.2 below) | P |
| 4.6 | Harmonics and waveform distortion | P |
| 4.7 | Power factor | P |
| 5.2.1 | Voltage monitoring | P |
| 5.2.2 | Frequency monitoring | P |

Test Results

| 1. Response to protection operation - fault condition tests | | | | | | | | P |
|-------------------------------------------------------------|----------------------------------|----------------------------------------------|----------------------------------|-----------|----------|-----------------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| | ambient temperature [°C] : | 24,0°C | | | | | | — |
| | model/type of power supply : | AC: type 61512 DC: type 62150H-1000S | | | | | | — |
| | manufacturer of power supply : | AC: Chroma DC: Chroma | | | | | | — |
| | rated markings of power supply : | AC: 18kW three phase DC: 15kW, 15A, 1000V | | | | | | — |
| component No. | fault | test condition | | test time | fuse No. | fault condition | | result |
| | | AC | DC | | | AC | DC | |
| PV1+ to PV1- | Short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/7, 2*3A | 0,2V/17 A,600V /8,5A | unit normal operation, no damage, no hazard, no fire |
| PV1+ to PV1- | Reverse before start up | 230V/< 0,1A | 770V/1 9,2A,77 0V/9,6 A | 3min | -- | 230V/7, 2*3A | 2V/<17 A,600V /<8,5A | unit normal operation, no damage, no hazard, no fire |
| Output L1 to N | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately , error message "utility loss, Pac=0W" ,no damage, no hazard, no fire |
| Output L2 to N | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately , error message "utility loss, Pac=0W" ,no damage, no hazard, no fire |
| Output L3 to N | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately , error message "utility loss, Pac=0W" ,no damage, no hazard, no fire |
| Output L to N | Reverse before start up | 230V/< 0,1A | 770V/1 9,2A,77 0V/9,6 A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit can not start up, error message "Vac fail, Pac=0W" ,no damage, no hazard, no fire |

| | | | | | | | | |
|-------------------------|-------------------------------|------------------|----------------------------------|-------|----|------------------|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| Output | Overload 120% | 230V/2 1,6*3A | 770V/2 3A,770 V/11,5 A | 10min | -- | 230V/2 4*3A | 670V/1 6,1A,67 0V/8A | unit normal operation, no damage, no hazard, no fire |
| RY1 | short circuit before start up | 230V/< 0,1A | 770V/1 9,2A,77 0V/9,6 A | 10min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit can not start up, error message "Relay fail, Pac=0W", no damage, no hazard, no fire |
| RY2 | short circuit before start up | 230V/< 0,1A | 770V/1 9,2A,77 0V/9,6 A | 10min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit can not start up, error message "Relay fail, Pac=0W", no damage, no hazard, no fire |
| RY3 | short circuit before start up | 230V/< 0,1A | 770V/1 9,2A,77 0V/9,6 A | 10min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit can not start up, error message "Relay fail, Pac=0W", no damage, no hazard, no fire |
| RY4 | short circuit before start up | 230V/< 0,1A | 770V/1 9,2A,77 0V/9,6 A | 10min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit can not start up, error message "Relay fail, Pac=0W", no damage, no hazard, no fire |
| RY5 | short circuit before start up | 230V/< 0,1A | 770V/1 9,2A,77 0V/9,6 A | 10min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit can not start up, error message "Relay fail, Pac=0W", no damage, no hazard, no fire |
| RY6 | short circuit before start up | 230V/< 0,1A | 770V/1 9,2A,77 0V/9,6 A | 10min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit can not start up, error message "Relay fail, Pac=0W", no damage, no hazard, no fire |
| L1 Pin 1 to Pin 2 | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | unit shut down and disconnected from grid immediately, then reconnect and normal operation, no damage, no hazard, no fire |
| L1 Pin 3 to Pin 4 | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | unit shut down and disconnected from grid immediately, then reconnect and normal operation, no damage, no hazard, no fire |
| TC1 Pin 9 to Pin 10 | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately, LCD no display, no damage, no hazard, no fire |
| TC1 Pin 11 to Pin 10 | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately, LCD no display, no damage, no hazard, no fire |

| | | | | | | | | |
|-------------------------|---------------|------------------|----------------------------|------|----|----------------|------------------------------------|------------------------------------------------------------------------------------------------------------|
| TC1 Pin 16 to Pin 14 | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately , LCD no display,no damage, no hazard, no fire |
| TC1 Pin 15 to Pin 14 | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately , LCD no display,no damage, no hazard, no fire |
| Bus cap C39 | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately , LCD no display,no damage, no hazard, no fire |
| Bus cap C41 | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately , LCD no display,no damage, no hazard, no fire |
| Q2 Pin G to Pin S | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 600V/1 7A,600 V/8,5A | unit normal operation, no damage, no hazard, no fire |
| Q2 Pin G to Pin D | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 2V/<19, 2A,770 V/<0,1 A | unit shut down and disconnected from grid immediately ,Q2 damaged, no hazard, no fire |
| Q2 Pin D to Pin S | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 0,2V/<1 9,2A,77 0V/<0,1 A | unit normal operation, no damage, no hazard, no fire |
| Q12 Pin G to Pin E | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately , error message "BusUnbalance" ,no hazard, no fire |
| Q12 Pin G to Pin C | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately , error message "BusUnbalance" ,Q12 damaged, no fire |
| Q12 Pin E to Pin C | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately , error message "BusUnbalance" ,no hazard, no fire |

| | | | | | | | | |
|-------------------------------------------------------|----------------------------------------|------------------|----------------------------|------|----|------------------|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| Q15 Pin G to Pin E | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediatly , error message "BusUnbalance" ,no hazard, no fire |
| Q15 Pin G to Pin C | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediatly , error message "BusUnbalance" ,Q15da maged, no fire |
| Q15 Pin E to Pin C | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediatly , error message "BusUnbalance" ,no hazard, no fire |
| Q17 Pin G to Pin E | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediatly , error message "BusUnbalance" ,no hazard, no fire |
| Q17 Pin G to Pin C | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediatly , error message "BusUnbalance" ,Q17 damaged, no fire |
| Q17 Pin E to Pin C | short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediatly , error message "BusUnbalance" ,no hazard, no fire |
| Insulate Optocoupler UC21 Pin 1 to Pin 2 | short circuit before start up | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | unit normal operation, no damage, no hazard, no fire |
| Drive Optocoupler U2 Pin2 to Pin3 | short circuit before start up | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | unit normal operation, no damage, no hazard, no fire |
| voltage resistance INV_N monitoring, R378 | Open circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | unit normal operation, no damage, no hazard, no fire |

| | | | | | | | | |
|--------------------------------------------|---------------|---------------|----------------------|------|----|---------------|--------------------------|-----------------------------------------------------------------------------------------------------------------------|
| voltage resistance INV_N monitoring, R378 | Short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | unit normal operation, no damage, no hazard, no fire |
| BUS voltage resistance + monitoring, R128 | Open circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately, error message"BusUnbalance",no damage, no hazard, no fire |
| BUS voltage resistance + monitoring, R128 | Short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately, error message"BusUnbalance",no damage, no hazard, no fire |
| BUS voltage resistance - monitoring, R153 | Open circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately, error message"BusUnbalance",no damage, no hazard, no fire |
| BUS voltage resistance - monitoring, R153 | Short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately, error message"BusUnbalance",no damage, no hazard, no fire |
| Grid voltage resistance R monitoring, R336 | Open circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately, error message"Grid voltage high",no damage, no hazard, no fire |
| Grid voltage resistance R monitoring, R336 | Short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately, error message"Grid voltage low",no damage, no hazard, no fire |
| Grid voltage resistance S monitoring, R342 | Open circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately, error message"Grid voltage high",no damage, no hazard, no fire |
| Grid voltage resistanceS monitoring, R342 | Short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately, error message"Grid voltage low",no damage, no hazard, no fire |

| | | | | | | | | |
|--------------------------------------------|---------------|------------------|-----------------------------------|------|----|----------------|-----------------------------------|------------------------------------------------------------------------------------------------------------------------|
| Grid voltage resistance T monitoring, R348 | Open circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately , error message"Grid voltage high",no damage, no hazard, no fire |
| Grid voltage resistance T monitoring, R348 | Short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately , error message"Grid voltage low",no damage, no hazard, no fire |
| Grid voltage resistance N monitoring, R354 | Open circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately , error message"Grid voltage high",no damage, no hazard, no fire |
| Grid voltage resistance N monitoring, R354 | Short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately , error message"Grid voltage low",no damage, no hazard, no fire |
| voltage resistance PV1- monitoring, R424 | Open circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately , error message"PV voltage high",no damage, no hazard, no fire |
| voltage resistance PV1- monitoring, R424 | Short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately ,no damage, no hazard, no fire |
| voltage resistance PV2- monitoring, R429 | Open circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately , error message"PV voltage high",no damage, no hazard, no fire |
| voltage resistance PV2- monitoring, R429 | Short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | unit shut down and disconnected from grid immediately ,no damage, no hazard, no fire |
| ISO - monitoring RC81 | Open circuit | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | 3min | -- | 230V/< 0,1A | 770V/< 0,1A,77 0V/<0,1 A | uint can not start up, error message"isolation fault, Pac=0W",no damage, no hazard, no fire |

| | | | | | | | | |
|------------------------------------|---------------------|---------------|-----------------------|------|----|------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------|
| ISO - monitoring RC81 | Short circuit | 230V/<0,1A | 770V/<0,1A,770V/<0,1A | 3min | -- | 230V/<0,1A | 770V/<0,1A,770V/<0,1A | unit can not start up, error message" isolation fault, Pac=0W",no damage, no hazard, no fire |
| GFCI monitoring RC159 | Open circuit | 230V/<0,1A | 770V/<0,1A,770V/<0,1A | 3min | -- | 230V/<0,1A | 770V/<0,1A,770V/<0,1A | unit can not start up, error message"GFC device fault, Pac=0W",no damage, no hazard, no fire |
| GFCI monitoring RC159 | Short circuit | 230V/<0,1A | 770V/<0,1A,770V/<0,1A | 3min | -- | 230V/<0,1A | 770V/<0,1A,770V/<0,1A | unit can not start up, error message"GFC device fault, Pac=0W",no damage, no hazard, no fire |
| Inverter Current monitoring - R452 | Open circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/<0,1A | 770V/<0,1A,770V/<0,1A | unit shut down and disconnected from grid immediately ,error message"AC current high, Pac=0W"no damage, no hazard, no fire |
| Inverter Current monitoring - R452 | Short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/<0,1A | 770V/<0,1A,770V/<0,1A | unit shut down and disconnected from grid immediately ,error message"BusUnbalance, Pac=0W"no damage, no hazard, no fire |
| Inverter Current monitoring + R453 | Open circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/<0,1A | 770V/<0,1A,770V/<0,1A | unit shut down and disconnected from grid immediately ,error message"AC current high, Pac=0W"no damage, no hazard, no fire |
| Inverter Current monitoring + R453 | Short circuit | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/<0,1A | 770V/<0,1A,770V/<0,1A | unit shut down and disconnected from grid immediately ,error message"BusUnbalance, Pac=0W"no damage, no hazard, no fire |
| Main CPU, UC20 | short circuit CC374 | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/<0,1A | 770V/<0,1A,770V/<0,1A | unit shut down and disconnected from grid immediately ,LCD no display, no damage, no hazard, no fire |
| Slave CPU, UC73 | short circuit CC374 | 230V/2 1,6*3A | 600V/1 7A,600 V/8,5A | 3min | -- | 230V/<0,1A | 770V/<0,1A,770V/<0,1A | unit shut down and disconnected from grid immediately ,LCD no display, no damage, no hazard, no fire |

Note:

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

Details for the error code please refer user manual.

4.3 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}=1,0

P_{lt}=0,65

Test value

*

*

*

*

inverter >16A

Limit

dc% = 3,3

P_{st}=1,0

P_{lt}=0,65

NAC15K-DT

*

*

*

Note:

*The stationary deviance of dc% is bigger than the dynamic deviance of d_{max} at starting and stopping.
Mains Impedance according EN61000-3-11: $R_{max}=0,4 \Omega$; $jX_{max}=0,25 \Omega @50Hz$ ($|Z_{max}|=0,472 \Omega$)
Bei Einphasigen Invertern Z_{max} sowie R_n und jx_n angeben $R_n=0,16 \Omega$; $jX_n=0,1 \Omega$
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 61000-3-3 for more than 16A.

NAC15K-DT L1 phase

NAC15K-DT

AnalysisDate(MeasureDate): Fri Sep 21 15:59:17 2018 (Fri Sep 21 15:58:39 2018)
Comment :

Regulation : IEC61000-3-11 Ed1.0
Interval : 10Min0Sec
Model : YOKOGAWA WT3000
Wiring : three-phase 4wire
Voltage Range : 300.00V
Voltage U1 : 231.61V
Set Frequency : 50Hz
Frequency U1 : 50.003Hz
Element : 1

PASS

Compatibility Condition : Compliance with IEC61000-3-3
Element : Pass
Total Element : Pass
dc (3.30%) : Pass
dmax (4.00%) : Pass
d(t) (500ms) : Pass
Pst (1.00%) : Pass
Plt (0.65) : Pass

| No. | dc[%] | dmax[%] | d(t)[ms] | Pst |
|-----|-----------|-----------|-----------|-----------|
| 1 | 0.42 Pass | 0.47 Pass | 0.00 Pass | 0.09 Pass |
| 2 | 0.44 Pass | 0.47 Pass | 0.00 Pass | 0.09 Pass |
| 3 | 0.40 Pass | 0.40 Pass | 0.00 Pass | 0.10 Pass |
| 4 | 0.43 Pass | 0.48 Pass | 0.00 Pass | 0.10 Pass |
| 5 | 0.45 Pass | 0.45 Pass | 0.00 Pass | 0.10 Pass |
| 6 | 0.38 Pass | 0.38 Pass | 0.00 Pass | 0.11 Pass |
| 7 | 0.42 Pass | 0.47 Pass | 0.00 Pass | 0.11 Pass |
| 8 | 0.47 Pass | 0.48 Pass | 0.00 Pass | 0.12 Pass |
| 9 | 0.64 Pass | 0.64 Pass | 0.00 Pass | 0.13 Pass |
| 10 | 0.44 Pass | 0.45 Pass | 0.00 Pass | 0.11 Pass |
| 11 | 0.42 Pass | 0.45 Pass | 0.00 Pass | 0.10 Pass |
| 12 | 0.64 Pass | 0.65 Pass | 0.00 Pass | 0.15 Pass |
| | | | Pst | |
| | | | | 0.11 Pass |

NAC15K-DT L2 phase

NAC15K-DT

AnalysisDate(MeasureDate) : Fri Sep 21 15:59:17 2018 (Fri Sep 21 15:56:39 2018)

Comment :

Regulation : IEC61000-3-11 Ed1.0
Interval : 10Min0Sec
Model : YOKOGAWA WT3000
Wiring : three-phase 4wire
Voltage Range : 300.00V
Voltage U2 : 231.45V
Set Frequency : 50Hz
Frequency U2 : Error
Element : 2

PASS

Compatibility Condition : Compliance with IEC61000-3-3
Element : Pass
Total Element : Pass
dc (3.30%) : Pass
dmax (4.00%) : Pass
d(t) (500ms) : Pass
Pst (1.00%) : Pass
Plt (0.65) : Pass

| No. | dc[%] | dmax[%] | d(t)[ms] | Pst |
|-----|-----------|-----------|-----------|-----------|
| 1 | 0.43 Pass | 0.43 Pass | 0.00 Pass | 0.09 Pass |
| 2 | 0.35 Pass | 0.38 Pass | 0.00 Pass | 0.09 Pass |
| 3 | 0.40 Pass | 0.40 Pass | 0.00 Pass | 0.10 Pass |
| 4 | 0.38 Pass | 0.39 Pass | 0.00 Pass | 0.12 Pass |
| 5 | 0.40 Pass | 0.40 Pass | 0.00 Pass | 0.12 Pass |
| 6 | 0.36 Pass | 0.36 Pass | 0.00 Pass | 0.18 Pass |
| 7 | 0.38 Pass | 0.39 Pass | 0.00 Pass | 0.19 Pass |
| 8 | 0.38 Pass | 0.39 Pass | 0.00 Pass | 0.19 Pass |
| 9 | 0.57 Pass | 0.59 Pass | 0.00 Pass | 0.19 Pass |
| 10 | 0.37 Pass | 0.37 Pass | 0.00 Pass | 0.18 Pass |
| 11 | 0.40 Pass | 0.40 Pass | 0.00 Pass | 0.14 Pass |
| 12 | 0.59 Pass | 0.63 Pass | 0.00 Pass | 0.20 Pass |
| | | | | Plt |
| | | | | 0.16 Pass |

NAC15K-DT L3 phase

NAC15K-DT

AnalysisDate(MeasureDate) : Fri Sep 21 15:59:17 2018 (Fri Sep 21 15:56:39 2018)

Comment :

Regulation : IEC61000-3-11 Ed1.0
Interval : 10Min0Sec
Model : YOKOGAWA WT3000
Wiring : three-phase 4wire
Voltage Range : 300.00V
Voltage U3 : 231.17V
Set Frequency : 50Hz
Frequency U3 : Error
Element : 3

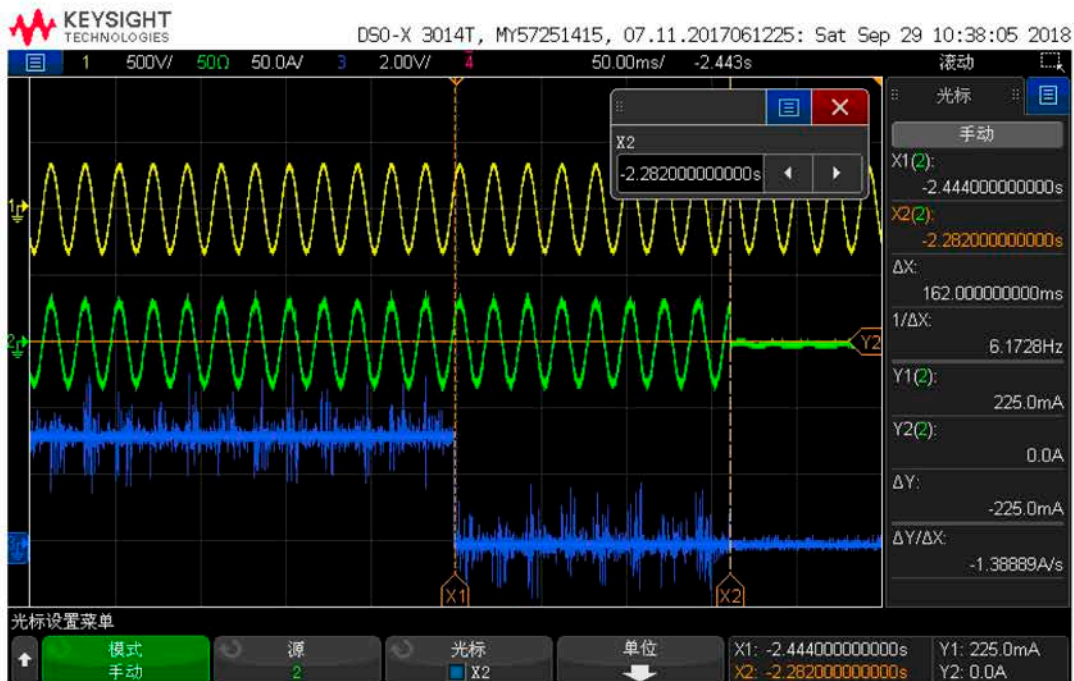
PASS

Compatibility Condition : Compliance with IEC61000-3-3
Element : Pass
Total Element : Pass
dc (3.30%) : Pass
dmax (4.00%) : Pass
d(t) (500ms) : Pass
Pst (1.00%) : Pass
Plt (0.65) : Pass

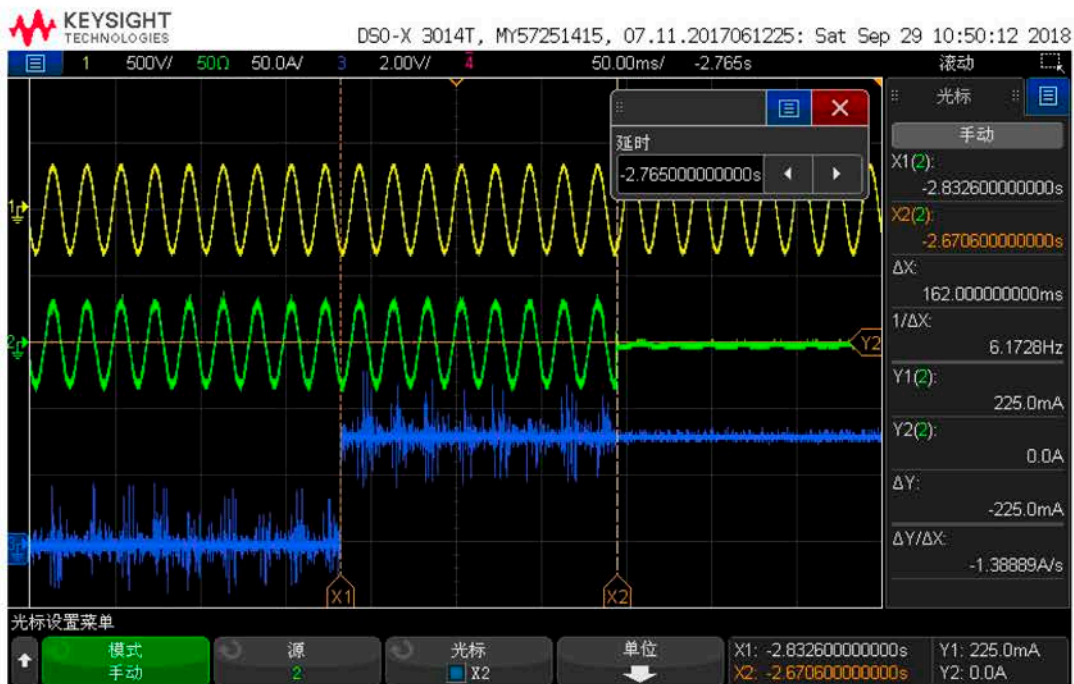
| No. | dc[%] | dmax[%] | d(t)[ms] | Pst |
|-----|-----------|-----------|-----------|-----------|
| 1 | 0.34 Pass | 0.41 Pass | 0.00 Pass | 0.18 Pass |
| 2 | 0.36 Pass | 0.41 Pass | 0.00 Pass | 0.12 Pass |
| 3 | 0.39 Pass | 0.40 Pass | 0.00 Pass | 0.12 Pass |
| 4 | 0.33 Pass | 0.40 Pass | 0.00 Pass | 0.15 Pass |
| 5 | 0.34 Pass | 0.41 Pass | 0.00 Pass | 0.16 Pass |
| 6 | 0.29 Pass | 0.33 Pass | 0.00 Pass | 0.21 Pass |
| 7 | 0.32 Pass | 0.38 Pass | 0.00 Pass | 0.23 Pass |
| 8 | 0.31 Pass | 0.39 Pass | 0.00 Pass | 0.23 Pass |
| 9 | 0.54 Pass | 0.57 Pass | 0.00 Pass | 0.23 Pass |
| 10 | 0.31 Pass | 0.36 Pass | 0.00 Pass | 0.23 Pass |
| 11 | 0.35 Pass | 0.41 Pass | 0.00 Pass | 0.18 Pass |
| 12 | 0.56 Pass | 0.59 Pass | 0.00 Pass | 0.23 Pass |
| | | | | Plt |
| | | | | 0.20 Pass |

| | | | | |
|-----------------------------------------------------------------------|----------------------------------------------------------|----------------|-----|-----|
| 4.4 Monitoring of Permanent DC-Injection IEC 61727:2004 | | | | P |
| Model: NAC15K-DT | | | | |
| Test conditions: | UN = 230 VAc Uinput =600 Vdc Rated Power:15000 W | | | |
| DC Injection (A) | Limits | Trip Time (ms) | | |
| +1,0A | I _{dc} >1A than disconnection within 0,2 sec | 123 | 162 | 162 |
| -1,0A | I _{dc} >1A than disconnection within 0,2 sec | 161 | 162 | 162 |
| Note: A dc-current of 1A is injected, disconnection time of max. 0,2s | | | | |

Positive DC-Injection :



Negative DC-Injection :



4.4 Monitoring of Permanent DC-Injection IEC 61727:2004

P

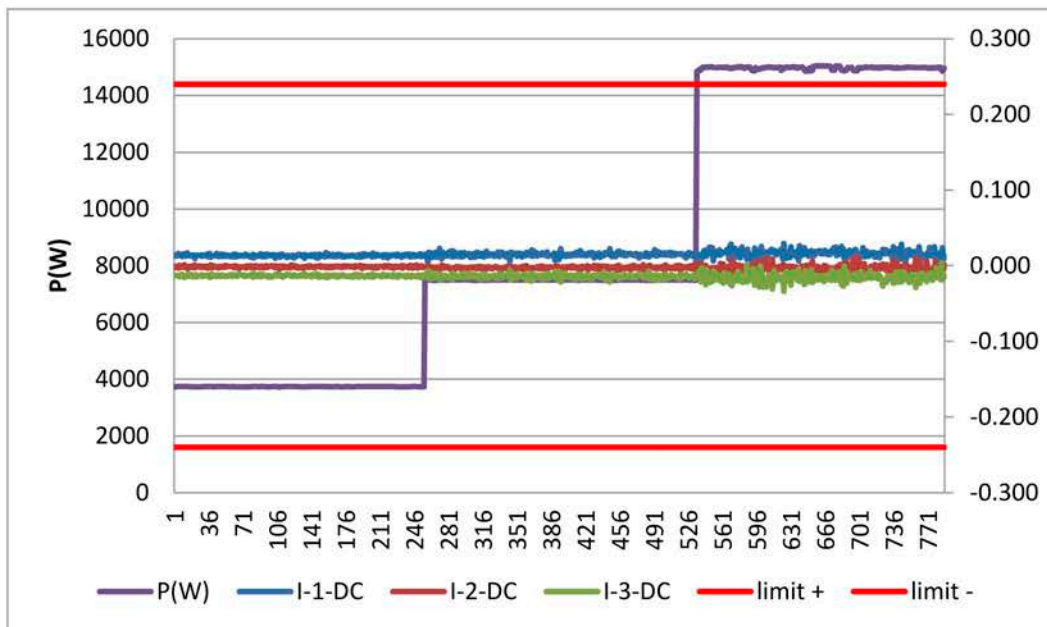
Model: NAC15K-DT

| IEC61727 Limit: | 1% of I_{nom} (240mA) | | |
|----------------------------|-------------------------|-----|------|
| Output power: | 25% | 50% | 100% |
| mean test value L1 phase : | 17 | 23 | 29 |
| mean test value L2 phase: | 5 | 7 | 18 |
| mean test value L3 phase: | 16 | 22 | 34 |

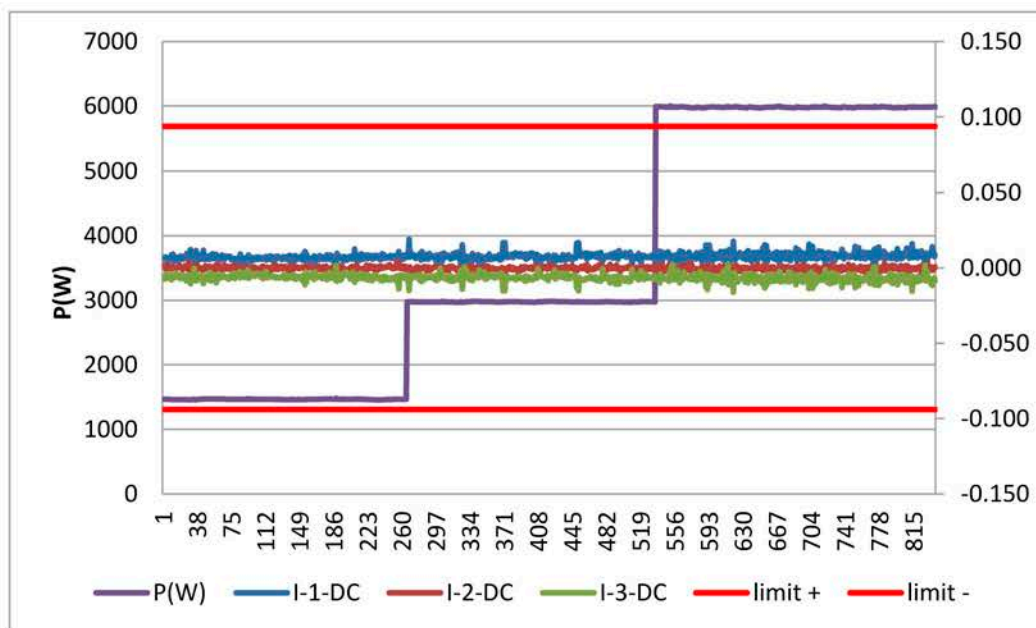
Model: NAC6K-DT

| IEC61727 Limit: | 1% of I_{nom} (96mA) | | |
|---------------------------|------------------------|-----|------|
| Output power: | 25% | 50% | 100% |
| mean test value L1 phase: | 13 | 19 | 18 |
| mean test value L2 phase: | 4 | 3 | 4 |
| mean test value L3 phase: | 14 | 15 | 16 |

NAC15K-DT: Diagram of permanent DC-Injection



NAC6K-DT: Diagram of permanent DC-Injection



4.6 Harmonic Current Limit Test IEC 61727:2004

P

Model: NAC15K-DT L1 phase

| | |
|---------------|--------|
| Watts(W) | 4852,1 |
| VA(VA) | 4864,9 |
| Vrms(V) | 231,6 |
| Arms(A) | 21,0 |
| PF | 0,9974 |
| Frequency(Hz) | 50 |
| THD(%) | 1,69 |

| Harmonics | Current Magnitude [A] | % of Fundamental | Phase | Harmonic Current Limits [%] |
|-----------|-----------------------|------------------|----------|-----------------------------|
| 1st | 20,986 | -- | L1 phase | -- |
| 2nd | 0,014 | 0,065 | L1 phase | 1% |
| 3rd | 0,087 | 0,414 | L1 phase | 4% |
| 4th | 0,025 | 0,121 | L1 phase | 1% |
| 5th | 0,239 | 1,140 | L1 phase | 4% |
| 6th | 0,009 | 0,044 | L1 phase | 1% |
| 7th | 0,167 | 0,796 | L1 phase | 4% |
| 8th | 0,030 | 0,145 | L1 phase | 1% |
| 9th | 0,010 | 0,050 | L1 phase | 4% |
| 10th | 0,027 | 0,130 | L1 phase | 0,5% |
| 11th | 0,067 | 0,319 | L1 phase | 2% |
| 12th | 0,007 | 0,032 | L1 phase | 0,5% |
| 13th | 0,081 | 0,388 | L1 phase | 2% |
| 14th | 0,004 | 0,020 | L1 phase | 0,5% |
| 15th | 0,006 | 0,030 | L1 phase | 2% |
| 16th | 0,004 | 0,019 | L1 phase | 0,5% |
| 17th | 0,070 | 0,331 | L1 phase | 1,5% |
| 18th | 0,003 | 0,015 | L1 phase | 0,5% |
| 19th | 0,036 | 0,174 | L1 phase | 1,5% |
| 20th | 0,002 | 0,011 | L1 phase | 0,5% |
| 21th | 0,002 | 0,011 | L1 phase | 1,5% |
| 22th | 0,002 | 0,009 | L1 phase | 0,5% |
| 23th | 0,027 | 0,127 | L1 phase | 0,6% |
| 24th | 0,002 | 0,011 | L1 phase | 0,5% |
| 25th | 0,022 | 0,105 | L1 phase | 0,6% |
| 26th | 0,002 | 0,009 | L1 phase | 0,5% |
| 27th | 0,004 | 0,017 | L1 phase | 0,6% |
| 28th | 0,001 | 0,007 | L1 phase | 0,5% |
| 29th | 0,018 | 0,087 | L1 phase | 0,6% |
| 30th | 0,002 | 0,009 | L1 phase | 0,5% |
| 31th | 0,013 | 0,061 | L1 phase | 0,6% |
| 32th | 0,002 | 0,011 | L1 phase | 0,5% |
| 33th | 0,002 | 0,011 | L1 phase | 0,6% |
| 34th | 0,002 | 0,008 | L1 phase | N/A |
| 35th | 0,009 | 0,044 | L1 phase | N/A |
| 36th | 0,002 | 0,007 | L1 phase | N/A |
| 37th | 0,007 | 0,031 | L1 phase | N/A |
| 38th | 0,002 | 0,008 | L1 phase | N/A |
| 39th | 0,004 | 0,017 | L1 phase | N/A |
| 40th | 0,002 | 0,008 | L1 phase | N/A |

4.6 Harmonic Current Limit Test IEC 61727:2004

P

Model: NAC15K-DT L2 phase

| | |
|---------------|--------|
| Watts(W) | 4880,9 |
| VA(VA) | 4896,7 |
| Vrms(V) | 231,4 |
| Arms(A) | 21,2 |
| PF | 0,9967 |
| Frequency(Hz) | 50 |
| THD(%) | 1,87 |

| Harmonics | Current Magnitude [A] | % of Fundamental | Phase | Harmonic Current Limits [%] |
|-----------|-----------------------|------------------|----------|-----------------------------|
| 1st | 21,138 | -- | L2 phase | -- |
| 2nd | 0,020 | 0,095 | L2 phase | 1% |
| 3rd | 0,056 | 0,265 | L2 phase | 4% |
| 4th | 0,023 | 0,109 | L2 phase | 1% |
| 5th | 0,283 | 1,339 | L2 phase | 4% |
| 6th | 0,013 | 0,062 | L2 phase | 1% |
| 7th | 0,262 | 1,242 | L2 phase | 4% |
| 8th | 0,030 | 0,143 | L2 phase | 1% |
| 9th | 0,018 | 0,084 | L2 phase | 4% |
| 10th | 0,030 | 0,142 | L2 phase | 0,5% |
| 11th | 0,022 | 0,105 | L2 phase | 2% |
| 12th | 0,006 | 0,031 | L2 phase | 0,5% |
| 13th | 0,086 | 0,406 | L2 phase | 2% |
| 14th | 0,007 | 0,035 | L2 phase | 0,5% |
| 15th | 0,006 | 0,030 | L2 phase | 2% |
| 16th | 0,003 | 0,013 | L2 phase | 0,5% |
| 17th | 0,066 | 0,311 | L2 phase | 1,5% |
| 18th | 0,004 | 0,020 | L2 phase | 0,5% |
| 19th | 0,042 | 0,198 | L2 phase | 1,5% |
| 20th | 0,004 | 0,017 | L2 phase | 0,5% |
| 21th | 0,004 | 0,020 | L2 phase | 1,5% |
| 22th | 0,002 | 0,009 | L2 phase | 0,5% |
| 23th | 0,027 | 0,126 | L2 phase | 0,6% |
| 24th | 0,003 | 0,015 | L2 phase | 0,5% |
| 25th | 0,025 | 0,117 | L2 phase | 0,6% |
| 26th | 0,002 | 0,009 | L2 phase | 0,5% |
| 27th | 0,002 | 0,008 | L2 phase | 0,6% |
| 28th | 0,001 | 0,006 | L2 phase | 0,5% |
| 29th | 0,018 | 0,084 | L2 phase | 0,6% |
| 30th | 0,002 | 0,010 | L2 phase | 0,5% |
| 31th | 0,014 | 0,067 | L2 phase | 0,6% |
| 32th | 0,002 | 0,008 | L2 phase | 0,5% |
| 33th | 0,003 | 0,012 | L2 phase | 0,6% |
| 34th | 0,002 | 0,010 | L2 phase | N/A |
| 35th | 0,008 | 0,038 | L2 phase | N/A |
| 36th | 0,001 | 0,007 | L2 phase | N/A |
| 37th | 0,006 | 0,031 | L2 phase | N/A |
| 38th | 0,002 | 0,008 | L2 phase | N/A |
| 39th | 0,004 | 0,019 | L2 phase | N/A |
| 40th | 0,002 | 0,009 | L2 phase | N/A |

4.6 Harmonic Current Limit Test IEC 61727:2004

P

Model: NAC15K-DT L3 phase

| | |
|---------------|--------|
| Watts(W) | 4888,7 |
| VA(VA) | 4901,6 |
| Vrms(V) | 231,2 |
| Arms(A) | 21,2 |
| PF | 0,9972 |
| Frequency(Hz) | 50 |
| THD(%) | 2,06 |

| Harmonics | Current Magnitude [A] | % of Fundamental | Phase | Harmonic Current Limits [%] |
|-----------|-----------------------|------------------|----------|-----------------------------|
| 1st | 21,183 | -- | L3 phase | -- |
| 2nd | 0,023 | 0,110 | L3 phase | 1% |
| 3rd | 0,025 | 0,119 | L3 phase | 4% |
| 4th | 0,012 | 0,056 | L3 phase | 1% |
| 5th | 0,280 | 1,321 | L3 phase | 4% |
| 6th | 0,010 | 0,049 | L3 phase | 1% |
| 7th | 0,223 | 1,051 | L3 phase | 4% |
| 8th | 0,030 | 0,144 | L3 phase | 1% |
| 9th | 0,024 | 0,113 | L3 phase | 4% |
| 10th | 0,028 | 0,131 | L3 phase | 0,5% |
| 11th | 0,054 | 0,255 | L3 phase | 2% |
| 12th | 0,005 | 0,025 | L3 phase | 0,5% |
| 13th | 0,073 | 0,344 | L3 phase | 2% |
| 14th | 0,008 | 0,037 | L3 phase | 0,5% |
| 15th | 0,008 | 0,038 | L3 phase | 2% |
| 16th | 0,003 | 0,014 | L3 phase | 0,5% |
| 17th | 0,064 | 0,301 | L3 phase | 1,5% |
| 18th | 0,003 | 0,014 | L3 phase | 0,5% |
| 19th | 0,038 | 0,182 | L3 phase | 1,5% |
| 20th | 0,003 | 0,013 | L3 phase | 0,5% |
| 21th | 0,008 | 0,036 | L3 phase | 1,5% |
| 22th | 0,002 | 0,009 | L3 phase | 0,5% |
| 23th | 0,025 | 0,116 | L3 phase | 0,6% |
| 24th | 0,002 | 0,010 | L3 phase | 0,5% |
| 25th | 0,023 | 0,111 | L3 phase | 0,6% |
| 26th | 0,002 | 0,008 | L3 phase | 0,5% |
| 27th | 0,004 | 0,017 | L3 phase | 0,6% |
| 28th | 0,001 | 0,007 | L3 phase | 0,5% |
| 29th | 0,019 | 0,091 | L3 phase | 0,6% |
| 30th | 0,002 | 0,009 | L3 phase | 0,5% |
| 31th | 0,013 | 0,062 | L3 phase | 0,6% |
| 32th | 0,003 | 0,012 | L3 phase | 0,5% |
| 33th | 0,003 | 0,013 | L3 phase | 0,6% |
| 34th | 0,001 | 0,006 | L3 phase | N/A |
| 35th | 0,011 | 0,052 | L3 phase | N/A |
| 36th | 0,001 | 0,007 | L3 phase | N/A |
| 37th | 0,007 | 0,032 | L3 phase | N/A |
| 38th | 0,002 | 0,010 | L3 phase | N/A |
| 39th | 0,003 | 0,013 | L3 phase | N/A |
| 40th | 0,001 | 0,006 | L3 phase | N/A |

4.6 Harmonic Current Limit Test IEC 61727:2004

P

Model: NAC6K-DT L1 phase

| | |
|---------------|--------|
| Watts(W) | 1963,2 |
| VA(VA) | 1964,6 |
| Vrms(V) | 230,7 |
| Arms(A) | 8,52 |
| PF | 0,9993 |
| Frequency(Hz) | 50 |
| THD(%) | 2,89 |

| Harmonics | Current Magnitude [A] | % of Fundamental | Phase | Harmonic Current Limits [%] |
|-----------|-----------------------|------------------|----------|-----------------------------|
| 1st | 8,534 | -- | L1 phase | -- |
| 2nd | 0,020 | 0,240 | L1 phase | 1% |
| 3rd | 0,080 | 0,937 | L1 phase | 4% |
| 4th | 0,031 | 0,363 | L1 phase | 1% |
| 5th | 0,164 | 1,917 | L1 phase | 4% |
| 6th | 0,011 | 0,134 | L1 phase | 1% |
| 7th | 0,111 | 1,296 | L1 phase | 4% |
| 8th | 0,007 | 0,076 | L1 phase | 1% |
| 9th | 0,005 | 0,062 | L1 phase | 4% |
| 10th | 0,004 | 0,048 | L1 phase | 0,5% |
| 11th | 0,077 | 0,903 | L1 phase | 2% |
| 12th | 0,007 | 0,085 | L1 phase | 0,5% |
| 13th | 0,056 | 0,660 | L1 phase | 2% |
| 14th | 0,004 | 0,042 | L1 phase | 0,5% |
| 15th | 0,014 | 0,162 | L1 phase | 2% |
| 16th | 0,002 | 0,022 | L1 phase | 0,5% |
| 17th | 0,049 | 0,570 | L1 phase | 1,5% |
| 18th | 0,002 | 0,025 | L1 phase | 0,5% |
| 19th | 0,029 | 0,345 | L1 phase | 1,5% |
| 20th | 0,001 | 0,015 | L1 phase | 0,5% |
| 21th | 0,003 | 0,036 | L1 phase | 1,5% |
| 22th | 0,001 | 0,011 | L1 phase | 0,5% |
| 23th | 0,010 | 0,115 | L1 phase | 0,6% |
| 24th | 0,003 | 0,031 | L1 phase | 0,5% |
| 25th | 0,004 | 0,051 | L1 phase | 0,6% |
| 26th | 0,001 | 0,009 | L1 phase | 0,5% |
| 27th | 0,003 | 0,036 | L1 phase | 0,6% |
| 28th | 0,001 | 0,007 | L1 phase | 0,5% |
| 29th | 0,014 | 0,161 | L1 phase | 0,6% |
| 30th | 0,001 | 0,017 | L1 phase | 0,5% |
| 31th | 0,014 | 0,167 | L1 phase | 0,6% |
| 32th | 0,001 | 0,007 | L1 phase | 0,5% |
| 33th | 0,003 | 0,031 | L1 phase | 0,6% |
| 34th | 0,001 | 0,008 | L1 phase | N/A |
| 35th | 0,013 | 0,155 | L1 phase | N/A |
| 36th | 0,001 | 0,009 | L1 phase | N/A |
| 37th | 0,010 | 0,119 | L1 phase | N/A |
| 38th | 0,001 | 0,006 | L1 phase | N/A |
| 39th | 0,002 | 0,021 | L1 phase | N/A |
| 40th | 0,001 | 0,010 | L1 phase | N/A |

4.6 Harmonic Current Limit Test IEC 61727:2004

P

Model: NAC6K-DT L2 phase

| | |
|---------------|--------|
| Watts(W) | 2009,5 |
| VA(VA) | 2010,9 |
| Vrms(V) | 230,5 |
| Arms(A) | 8,7 |
| PF | 0,9994 |
| Frequency(Hz) | 50 |
| THD(%) | 2,72 |

| Harmonics | Current Magnitude [A] | % of Fundamental | Phase | Harmonic Current Limits [%] |
|-----------|-----------------------|------------------|----------|-----------------------------|
| 1st | 8,721 | -- | L2 phase | -- |
| 2nd | 0,031 | 0,361 | L2 phase | 1% |
| 3rd | 0,021 | 0,240 | L2 phase | 4% |
| 4th | 0,014 | 0,165 | L2 phase | 1% |
| 5th | 0,197 | 2,260 | L2 phase | 4% |
| 6th | 0,005 | 0,059 | L2 phase | 1% |
| 7th | 0,049 | 0,560 | L2 phase | 4% |
| 8th | 0,008 | 0,093 | L2 phase | 1% |
| 9th | 0,018 | 0,201 | L2 phase | 4% |
| 10th | 0,004 | 0,047 | L2 phase | 0,5% |
| 11th | 0,065 | 0,751 | L2 phase | 2% |
| 12th | 0,002 | 0,024 | L2 phase | 0,5% |
| 13th | 0,061 | 0,702 | L2 phase | 2% |
| 14th | 0,003 | 0,031 | L2 phase | 0,5% |
| 15th | 0,011 | 0,132 | L2 phase | 2% |
| 16th | 0,002 | 0,019 | L2 phase | 0,5% |
| 17th | 0,051 | 0,591 | L2 phase | 1,5% |
| 18th | 0,002 | 0,017 | L2 phase | 0,5% |
| 19th | 0,030 | 0,346 | L2 phase | 1,5% |
| 20th | 0,003 | 0,033 | L2 phase | 0,5% |
| 21th | 0,003 | 0,036 | L2 phase | 1,5% |
| 22th | 0,001 | 0,013 | L2 phase | 0,5% |
| 23th | 0,011 | 0,124 | L2 phase | 0,6% |
| 24th | 0,001 | 0,012 | L2 phase | 0,5% |
| 25th | 0,003 | 0,036 | L2 phase | 0,6% |
| 26th | 0,003 | 0,029 | L2 phase | 0,5% |
| 27th | 0,005 | 0,055 | L2 phase | 0,6% |
| 28th | 0,001 | 0,012 | L2 phase | 0,5% |
| 29th | 0,012 | 0,138 | L2 phase | 0,6% |
| 30th | 0,001 | 0,008 | L2 phase | 0,5% |
| 31th | 0,010 | 0,120 | L2 phase | 0,6% |
| 32th | 0,001 | 0,010 | L2 phase | 0,5% |
| 33th | 0,004 | 0,042 | L2 phase | 0,6% |
| 34th | 0,001 | 0,007 | L2 phase | N/A |
| 35th | 0,013 | 0,149 | L2 phase | N/A |
| 36th | 0,001 | 0,008 | L2 phase | N/A |
| 37th | 0,009 | 0,106 | L2 phase | N/A |
| 38th | 0,001 | 0,011 | L2 phase | N/A |
| 39th | 0,002 | 0,027 | L2 phase | N/A |
| 40th | 0,000 | 0,006 | L2 phase | N/A |

4.6 Harmonic Current Limit Test IEC 61727:2004

P

Model: NAC6K-DT L3 phase

| | |
|---------------|--------|
| Watts(W) | 1997,5 |
| VA(VA) | 2000,4 |
| Vrms(V) | 230,5 |
| Arms(A) | 8,7 |
| PF | 0,9985 |
| Frequency(Hz) | 50 |
| THD(%) | 2,86 |

| Harmonics | Current Magnitude [A] | % of Fundamental | Phase | Harmonic Current Limits [%] |
|-----------|-----------------------|------------------|----------|-----------------------------|
| 1st | 8,675 | -- | L3 phase | -- |
| 2nd | 0,018 | 0,208 | L3 phase | 1% |
| 3rd | 0,060 | 0,697 | L3 phase | 4% |
| 4th | 0,029 | 0,335 | L3 phase | 1% |
| 5th | 0,146 | 1,683 | L3 phase | 4% |
| 6th | 0,012 | 0,142 | L3 phase | 1% |
| 7th | 0,135 | 1,560 | L3 phase | 4% |
| 8th | 0,009 | 0,109 | L3 phase | 1% |
| 9th | 0,010 | 0,118 | L3 phase | 4% |
| 10th | 0,002 | 0,028 | L3 phase | 0,5% |
| 11th | 0,097 | 1,117 | L3 phase | 2% |
| 12th | 0,007 | 0,079 | L3 phase | 0,5% |
| 13th | 0,055 | 0,635 | L3 phase | 2% |
| 14th | 0,006 | 0,064 | L3 phase | 0,5% |
| 15th | 0,004 | 0,044 | L3 phase | 2% |
| 16th | 0,002 | 0,023 | L3 phase | 0,5% |
| 17th | 0,045 | 0,520 | L3 phase | 1,5% |
| 18th | 0,002 | 0,022 | L3 phase | 0,5% |
| 19th | 0,033 | 0,385 | L3 phase | 1,5% |
| 20th | 0,003 | 0,039 | L3 phase | 0,5% |
| 21th | 0,002 | 0,022 | L3 phase | 1,5% |
| 22th | 0,002 | 0,018 | L3 phase | 0,5% |
| 23th | 0,005 | 0,060 | L3 phase | 0,6% |
| 24th | 0,002 | 0,024 | L3 phase | 0,5% |
| 25th | 0,006 | 0,075 | L3 phase | 0,6% |
| 26th | 0,003 | 0,031 | L3 phase | 0,5% |
| 27th | 0,001 | 0,017 | L3 phase | 0,6% |
| 28th | 0,002 | 0,018 | L3 phase | 0,5% |
| 29th | 0,012 | 0,143 | L3 phase | 0,6% |
| 30th | 0,001 | 0,014 | L3 phase | 0,5% |
| 31th | 0,015 | 0,174 | L3 phase | 0,6% |
| 32th | 0,001 | 0,011 | L3 phase | 0,5% |
| 33th | 0,002 | 0,021 | L3 phase | 0,6% |
| 34th | 0,001 | 0,008 | L3 phase | N/A |
| 35th | 0,011 | 0,128 | L3 phase | N/A |
| 36th | 0,001 | 0,008 | L3 phase | N/A |
| 37th | 0,011 | 0,128 | L3 phase | N/A |
| 38th | 0,001 | 0,007 | L3 phase | N/A |
| 39th | 0,001 | 0,006 | L3 phase | N/A |
| 40th | 0,001 | 0,011 | L3 phase | N/A |

| 4.7 Power factor | | | | | P |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------|---------|---------|---------|
| Model | NAC6K-DT | | | | |
| Output power [kW] | ~10% | ~20% | ~50% | ~75% | ~100% |
| Test AC voltage [V] | 0,6 | 1,2 | 3,0 | 4,5 | 6,0 |
| 230V | 0,9213i | 0,9408i | 0,9932i | 0,9956i | 0,9968i |
| Model | NAC8K-DT | | | | |
| Output power [kW] | ~10% | ~20% | ~50% | ~75% | ~100% |
| Test AC voltage [V] | 0,8 | 1,6 | 4,0 | 6,0 | 8,0 |
| 230V | 0,9314i | 0,9921i | 0,9948i | 0,9958i | 0,9965i |
| Model | NAC10K-DT | | | | |
| Output power [kW] | ~10% | ~20% | ~50% | ~75% | ~100% |
| Test AC voltage [V] | 1,0 | 2,0 | 5,0 | 7,5 | 10,0 |
| 230V | 0,9321i | 0,9935i | 0,9961i | 0,9956i | 0,9967i |
| Model | NAC12K-DT | | | | |
| Output power [kW] | ~10% | ~20% | ~50% | ~75% | ~100% |
| Test AC voltage [V] | 1,2 | 2,4 | 6,0 | 9,0 | 12,0 |
| 230V | 0,9401i | 0,9936i | 0,9965i | 0,9967i | 0,9976i |
| Model | NAC15K-DT | | | | |
| Output power [kW] | ~10% | ~20% | ~50% | ~75% | ~100% |
| Test AC voltage [V] | 1,5 | 3,0 | 7,5 | 11,3 | 15,0 |
| 230V | 0,9417i | 0,9943i | 0,9972i | 0,9975i | 0,9973i |
| Note: The PV system shall have a lagging power factor greater than 0,95 when the output is greater than 50% 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. | | | | | |

5.2.1 Voltage monitoring

P

IEC 61727: First Level

Model: NAC15K-DT L1 phase

| | Under Voltage | | | | Over Voltage | | | |
|-----------------------|-----------------|-------------------|------|------|--------------|-------------------|------|------|
| Parameter | Voltage | Time [s] | | | Voltage | Time [s] | | |
| Limit | 195,5V | <= 2,0s | | | 253V | <= 2,0s | | |
| Trip value | 194,8V | | | | 252,0 V | | | |
| Trip time(s) | 230V to 190,0 V | 1,62 | 1,63 | 1,60 | 230V to 258V | 1,63 | 1,62 | 1,61 |
| Reconnection time (s) | 20s<t<300s | 66,6 | | | 20s<t<300s | 66,4 | | |

IEC 61727: Second Level

| | Under Voltage | | | | Over Voltage | | | |
|-----------------------|---------------|--------------------|------|------|---------------|-------------------|------|------|
| Parameter | Voltage | Time [ms] | | | Voltage | Time [ms] | | |
| Limit | 115V | <= 100ms | | | 273V* | <= 50ms | | |
| Trip value | 115,6V | | | | 272,4 | | | |
| Trip time(ms) | 230V to 110V | 56,5 | 56,0 | 39,0 | 230V to 278 V | 27,0 | 38,0 | 41,0 |
| Reconnection time (s) | 20s<t<300s | 66,0 | | | 20s<t<300s | 66,6 | | |

Note:

The IEC61727 does not provide any limits of accuracy for the utility voltage and frequency measurement of the PV-system. Therefore the values for tolerances given in EN 50438, Table 2 are used.

Tolerances on trip values tabel 2 EN50438:

- Voltage: +/- 1% of the nominal voltage
- Frequency: +/- 0,5% of the nominal frequency
- Clearance time: +/- 10%

*The voltage is the biggest vaule that the manufacturer declared.

Under Voltage First Level



Over voltage First Level



[illegible]

CH2 : 40.000 /div
 : 10.000A/div
 Position : 0.08 div

Display Group
 1 2 3 4

Zoom1 : 500.0k
 Main : 10.0M

AcqMode : Normal
 500kS/s 2s/div

CH1 0.5V/div
 CH2 1.000V

<Main>

CH1 0.5V/div
 CH2 1.000V

-4.4300k
 -263.28
 -0.0000k

-20000.000ns

CH1 0.5V/div
 CH2 1.000V

<Zoom1>

0.000ns

100ms/div

-4.4300k
 -263.28
 -0.0000k

-5110.998ns

X1 -4.370498s
 X2 -4.329498s
 ΔX 41.000ms

-4110.998ns

Stopped 2
 2018/09/20 13:42:52.271953 Auto

File
 2018/09/20 13:43:09

5.2.1 Voltage monitoring

P

IEC 61727: First Level

Model: NAC15K-DT L2 phase

| | Under Voltage | | | | Over Voltage | | | |
|-----------------------|-----------------|-------------------|------|------|--------------|-------------------|------|------|
| Parameter | Voltage | Time [s] | | | Voltage | Time [s] | | |
| Limit | 195,5V | <= 2,0s | | | 253V | <= 2,0s | | |
| Trip value | 194,8V | | | | 251,8 V | | | |
| Trip time(s) | 230V to 190,0 V | 1,65 | 1,62 | 1,61 | 230V to 258V | 1,61 | 1,65 | 1,62 |
| Reconnection time (s) | 20s<t<300s | 65,5 | | | 20s<t<300s | 66,2 | | |

IEC 61727: Second Level

| | Under Voltage | | | | Over Voltage | | | |
|-----------------------|---------------|--------------------|------|------|---------------|-------------------|------|------|
| Parameter | Voltage | Time [ms] | | | Voltage | Time [ms] | | |
| Limit | 115V | <= 100ms | | | 273V* | <= 50ms | | |
| Trip value | 115,6V | | | | 272,4 | | | |
| Trip time(ms) | 230V to 110V | 37,0 | 29,0 | 41,0 | 230V to 278 V | 35,5 | 39,0 | 32,5 |
| Reconnection time (s) | 20s<t<300s | 65,8 | | | 20s<t<300s | 66,1 | | |

Note:

The IEC61727 does not provide any limits of accuracy for the utility voltage and frequency measurement of the PV-system. Therefore the values for tolerances given in EN 50438, Table 2 are used.

Tolerances on trip values tabel 2 EN50438:

- Voltage: +/- 1% of the nominal voltage
- Frequency: +/- 0,5% of the nominal frequency
- Clearance time: +/- 10%

*The voltage is the biggest vaule that the manufacturer declared.

Under Voltage First Level



Over voltage First Level





| | | | | | | | | | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------|------|------|---------------|--------------|------|------|--|---|
| 5.2.1 Voltage monitoring | | | | | | | | | | P |
| IEC 61727: First Level | | | | | | | | | | |
| Model: NAC15K-DT L3 phase | | | | | | | | | | |
| | Under Voltage | | | | | Over Voltage | | | | |
| Parameter | Voltage | Time [s] | | | Voltage | Time [s] | | | | |
| Limit | 195,5V | <= 2,0s | | | 253V | <= 2,0s | | | | |
| Trip value | 194,7V | | | | 251,8 V | | | | | |
| Trip time(s) | 230V to 190,0 V | 1,61 | 1,68 | 1,63 | 230V to 258V | 1,62 | 1,61 | 1,62 | | |
| Reconnection time (s) | 20s<t<300s | 66,0 | | | 20s<t<300s | 66,3 | | | | |
| IEC 61727: Second Level | | | | | | | | | | |
| | Under Voltage | | | | | Over Voltage | | | | |
| Parameter | Voltage | Time [ms] | | | Voltage | Time [ms] | | | | |
| Limit | 115V | <= 100ms | | | 273V* | <= 50ms | | | | |
| Trip value | 115,6V | | | | 272,4 | | | | | |
| Trip time(ms) | 230V to 110V | 34,0 | 50,0 | 56,0 | 230V to 278 V | 36,0 | 27,0 | 28,0 | | |
| Reconnection time (s) | 20s<t<300s | 65,9 | | | 20s<t<300s | 66,4 | | | | |
| Note: The IEC61727 does not provide any limits of accuracy for the utility voltage and frequency measurement of the PV-system. Therefore the values for tolerances given in EN 50438, Table 2 are used. Tolerances on trip values tabel 2 EN50438: - Voltage: +/- 1% of the nominal voltage - Frequency: +/- 0,5% of the nominal frequency - Clearance time: +/- 10% *The voltage is the biggest vaule that the manufacturer declared. | | | | | | | | | | |

Under Voltage First Level



Over voltage First Level





| | | | | | | | | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-------------------|----------------|--------------------|------------------|-------------------|----------------|--------------------|--|
| 5.2.2 Frequency monitoring | | | | | | | | P | |
| IEC 61727 | | | | | | | | | |
| Model: NAC15K-DT | | | | | | | | | |
| | Under frequency | | | | | Over frequency | | | |
| Parameter | Frequency | Time [ms] | | | Frequency | Time [ms] | | | |
| Output Voltage | | 85%U _N | U _N | 110%U _N | | 85%U _N | U _N | 110%U _N | |
| Limit | 49,00Hz | <= 200ms | | | 51,00Hz | <= 200ms | | | |
| Trip value | | 49,0 | 49,0 | 49,0 | | 51,0 | 51,0 | 51,0 | |
| Trip time(ms) | 49,5Hz to 48,5Hz | 150 | 140 | 160 | 50,5Hz to 51,5Hz | 130 | 120 | 150 | |
| Reconnection time(s) | 20s<t<300s | 60,0 | | | 20s<t<300s | 66,1 | | | |
| Note: The IEC61727 does not provide any limits of accuracy for the utility voltage and frequency measurement of the PV-system. Therefore the values for tolerances given in EN 50438, Table 2 are used. Tolerances on trip values tabel 2 EN50438: - Voltage: +/- 1% of the nominal voltage - Frequency: +/- 0,5% of the nominal frequency - Clearance time: +/- 10% | | | | | | | | | |

Under Frequency:



Over Frequency:



Annex 1

EMC Test Report

(The whole EMC test report was stored in internal of BV LCIE CHINA)



LCIE

BV LCIE CHINA
(Ningbo Branch)
Number

1899AB09AARE00122

ATTESTATION of conformity with European Directives

Product : PV inverter (Grid-tied photovoltaic inverter)

Reference : NAC6K-DT, NAC8K-DT, NAC10K-DT, NAC12K-DT, NAC15K-DT


Trade mark : --

Issued to : [REDACTED]

Address : [REDACTED]

Manufacturer : [REDACTED]



Technical characteristics : Refer to the next page

The submitted sample of the above equipment has been tested for  marking according to following European Directive and following standards:

Electromagnetic Compatibility Directive 2014/30/EU

| Standards | Report number | Report date |
|------------------------------------------------------------------------------------------|---------------------|--------------|
| EN 61000-6-3:2007+A1:2011 EN 61000-6-2:2005 EN 61000-3-2:2014 EN 61000-3-3:2013 | ABRE-18AU2506VTNBPB | Nov 28, 2018 |

The referred test report(s) show that the product complies with standard(s) recognized as giving presumption of compliance with the essential requirements in the specified European Directive

This verification does not imply assessment of the production of the product
The  marking may be affixed if all relevant and effective European Directives with  are applicable

Ningbo (P.R. China), Nov 28, 2018



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Information given in this document, are related to the tested specimen of the described electrical sample.

LCIE CHINA (Ningbo Branch)
必维欧亚电气技术咨询服务(上海)有限公司-宁波分公司
Version 1.0/2018.06.10

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LCIE

BV LCIE CHINA
(Ningbo Branch)
Number

1899AB09AARE00122

ATTESTATION

of conformity with European Directives

Technical Parameter

| | | | | | |
|----------------------------------|----------------------|-----------------|---------------|-----------------|---------------|
| Model / Type | NAC6K-DT | NAC8K-DT | NAC10K-DT | NAC12K-DT | NAC15K-DT |
| MPP DC voltage range [V] | 250-950 | | | | |
| Max Input DC voltage [V] | 1000 | | | | |
| Max Input DC current [A] | 12,5 | 12,5/12,5 | | | 20/12,5 |
| Output AC voltage [V] | 230, 3/N/PE, 50/60Hz | | | | |
| Max. Output AC current [A] | 9,6 (per phase) | 12,8(per phase) | 16(per phase) | 19,2(per phase) | 24(per phase) |
| Output power [VA] | 6000 | 8000 | 10000 | 12000 | 15000 |

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Information given in this document, are related to the tested specimen of the described electrical sample.

LCIE CHINA (Ningbo Branch)
必维欧亚电气技术咨询服务(上海)有限公司-宁波分公司

Version 1.0/2018.06.10

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Annex 2

Pictures of the unit



Enclosure front view for all model



Enclosure rear view for all model



Enclosure left view for all model



Enclosure right view for all model



Enclosure top view for all model



Enclosure bottom view for model NAC15K-DT



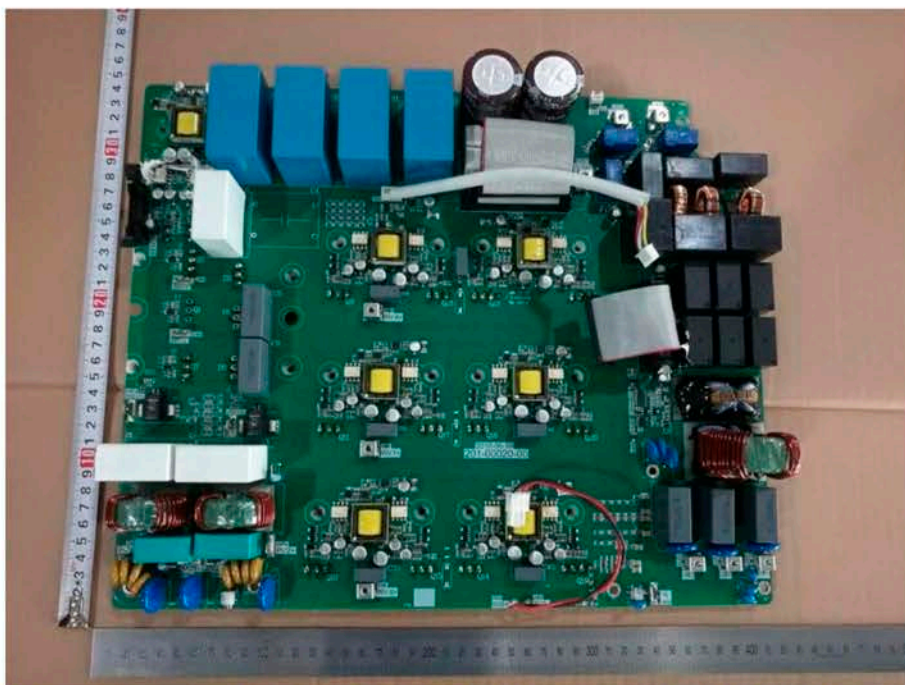
Enclosure bottom view for model NAC12K-DT, NAC10K-DT, NAC8K-DT



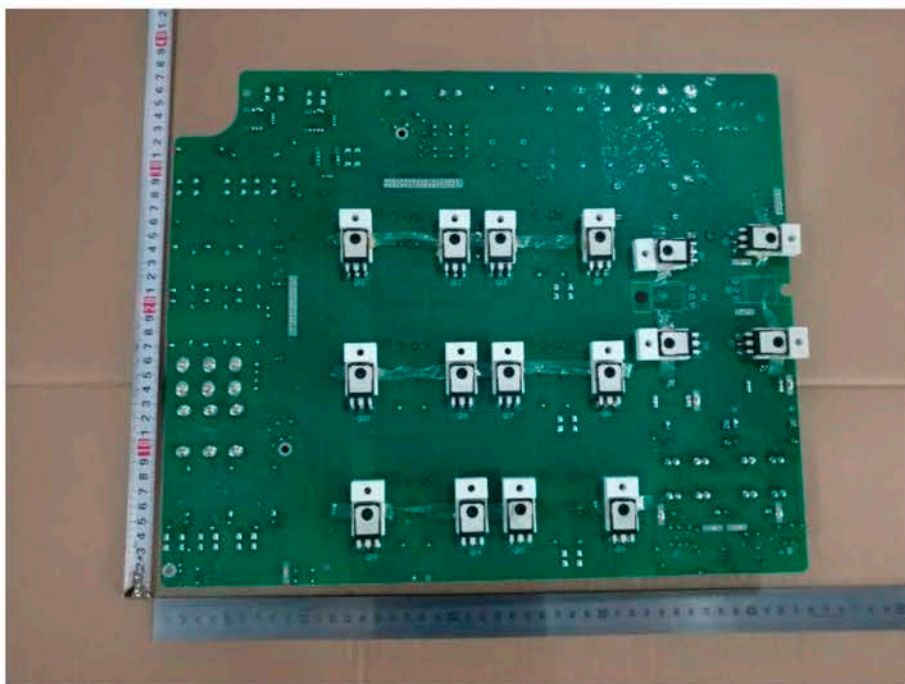
Enclosure bottom view for model NAC6K-DT



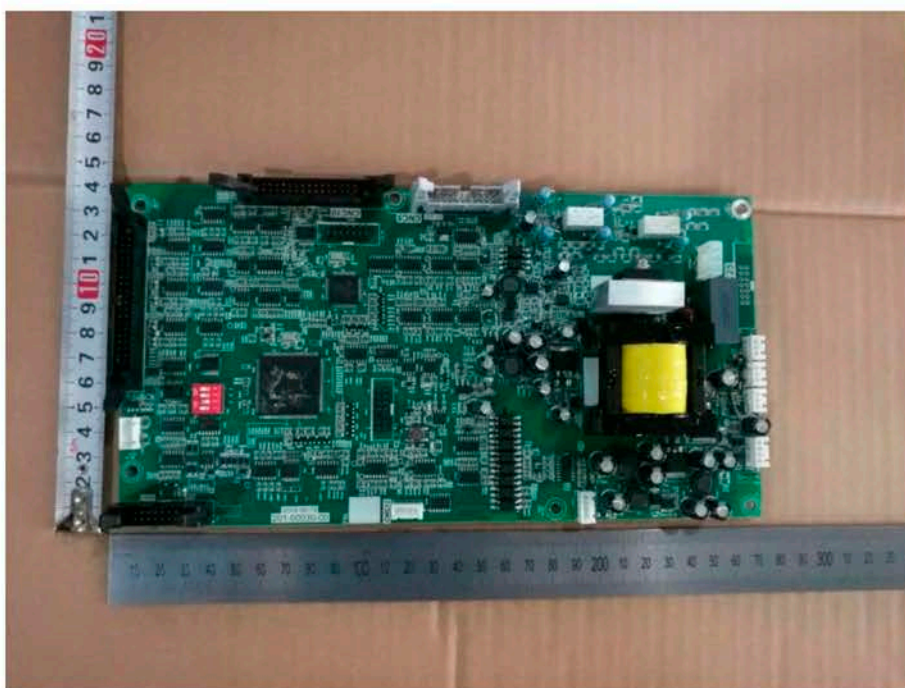
Enclosure internal view for all model



Main power supply circuit board- Component side for all model



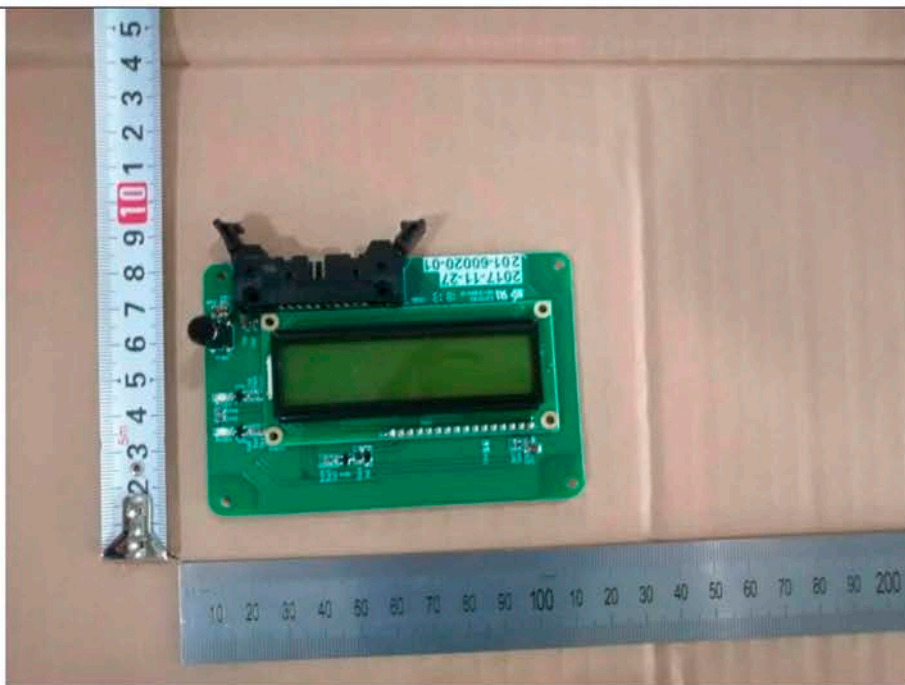
Main power supply circuit board- Solder side for all model



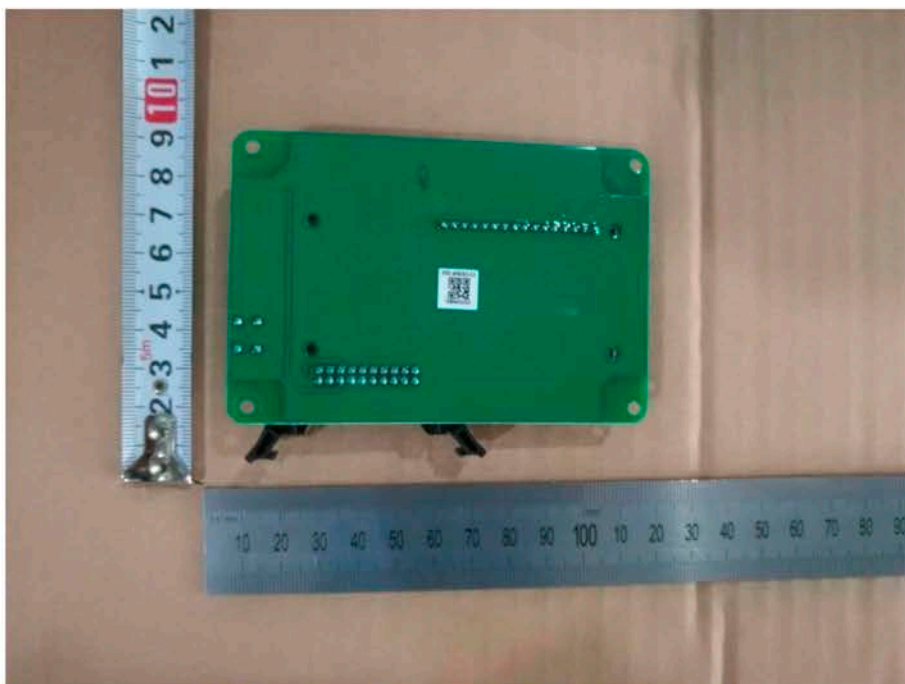
Control board- Component side for all model



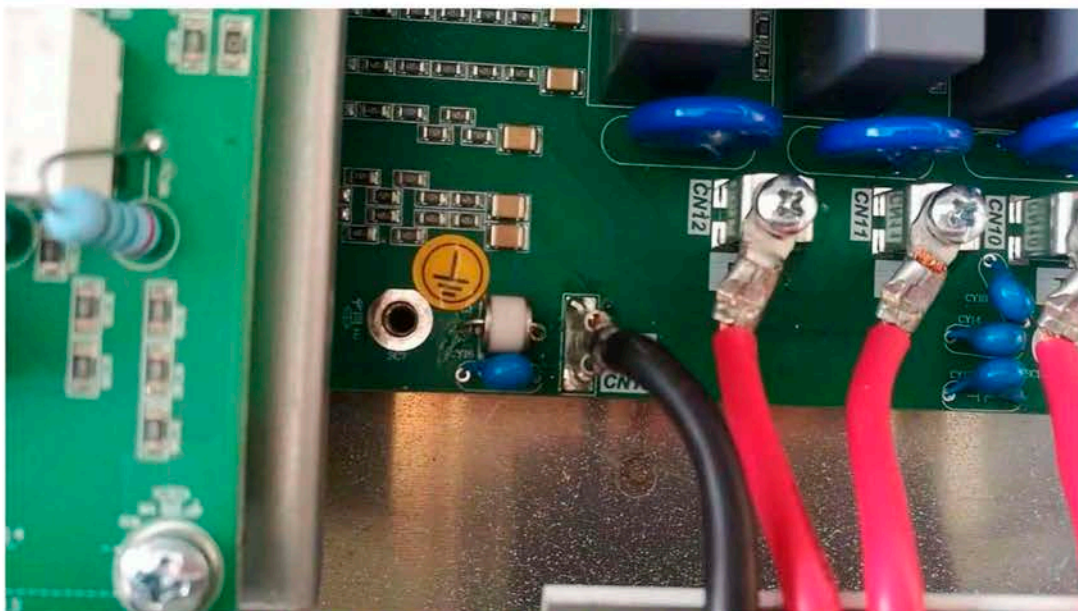
Control board- Solder side for all model



LCD board- Component side for all model



LCD board- Solder side for all model



Earthing connection view for all model

Annex 3

Test Equipment list

| No, | Equipment | Internal No, | Type/characteristics | Manufacturer | Last Calibration | Due Data |
|-----|------------------------|--------------|----------------------|--------------|------------------|-----------|
| 1 | Oscilloscope | A4089024SH | P4034B | Tektronix | 26/Jul/18 | 25/Jul/19 |
| 2 | Oscilloscope | A4089008SH | DPO3014 | Tektronix | 05/Feb/18 | 04/Feb/19 |
| 3 | Oscilloscope | A4089036SH | DL850 | YOKOGAWA | 29/Aug/18 | 28/Aug/19 |
| 4 | High Voltage probe | A4089026SH | P5200A | Tektronix | 05/Feb/18 | 04/Feb/19 |
| 5 | Voltage probe | A4089004SH | P2220 | Tektronix | 30/Oct/17 | 30/Oct/18 |
| 6 | Current probe | A4089009SH | P6139B | Tektronix | 05/Feb/18 | 04/Feb/19 |
| 7 | Current probe | A4089013SH | A622 | Tektronix | 05/Feb/18 | 04/Feb/19 |
| 8 | Current probe | A4089037SH | 960 30 | YOKOGAWA | 31/Oct/17 | 30/Oct/18 |
| 9 | Current probe | A4089038SH | 960 30 | YOKOGAWA | 31/Oct/17 | 30/Oct/18 |
| 10 | Current probe | A4089039SH | 960 30 | YOKOGAWA | 31/Oct/17 | 30/Oct/18 |
| 11 | Current probe | A4089017SH | TCP0150 | Tektronix | 26/Jul/18 | 25/Jul/19 |
| 12 | AC power supply | A7040066SH | AFC-31010T | APC | 08/Aug/18 | 31/Jul/20 |
| 13 | AC power supply | A7040071SH | 29/May/68 | Chroma | 22/Feb/18 | 21/Feb/20 |
| 14 | AC power supply | A7040057SH | 29/May/68 | Chroma | 19/Jul/17 | 18/Jul/19 |
| 15 | AC power supply | A7040077SH | MX-30 | AMETEK | - | - |
| 16 | Programmable DC source | A7040058SH | 62150H-1000S | Chroma | - | - |
| 17 | Programmable DC source | A7040059SH | 62150H-1000S | Chroma | - | - |
| 18 | Programmable DC source | A7040069SH | 62150H-1000S | Chroma | - | - |
| 19 | Programmable DC source | A7040074SH | 62150H-1000S | Chroma | - | - |
| 20 | Programmable DC source | A7040075SH | 62150H-1000S | Chroma | - | - |

| | | | | | | |
|----|----------------------------|------------|-----------------------------------|-------------------|-----------|-----------|
| 21 | Programmable DC source | A7040076SH | 62150H-1000S | Chroma | - | - |
| 22 | Programmable DC source | A7040070SH | 62150H-1000S | Chroma | - | - |
| 23 | Power Analyzer | A1240096SH | WT3000 | YOKOGAWA | 01/Dec/17 | 30/Nov/18 |
| 24 | Power Analyzer | A1240097SH | WT3000 | YOKOGAWA | 09/May/18 | 08/May/19 |
| 25 | Power Analyzer | A1240103SH | LMG500 | ZES ZIMMER | 26/Jul/18 | 25/Jul/19 |
| 26 | Power Analyzer | A1240101SH | WT3000 | YOKOGAWA | 26/Jul/18 | 25/Jul/19 |
| 27 | Anti-isolating test system | A7150074SH | ACTL-380SH | qunling | - | - |
| 28 | Load cabinet | A7150083SH | WSTF-LDJ60K/300 | shanghai wen shun | - | - |
| 29 | Load cabinet | A7150084SH | WSTF-LDJ45K/0385 | shanghai wen shun | - | - |
| 30 | Load cabinet | A7150085SH | WSTF-LDJ45K/0385 | shanghai wen shun | - | - |
| 31 | Load cabinet | A7150075SH | WSTF-RC25k/0,3D 0,001kVA-25kVA | shanghai wen shun | - | - |
| 32 | Temperature recorder | A740037SH | G820 | GRAPHIEC | 31/Oct/17 | 30/Oct/18 |
| 33 | Load cabinet(for flick) | A7150090SH | 200Ω , 250V;1200W | shanghai wen shun | - | - |
| 34 | Variable resistor | A7150076SH | BX8-67 | LingOu | - | - |