LYNS-TCi

TEST REPORT

Engineering Recommendation G98/NI

Issue 1 April 2019

Requirements for the connection of Fully Type Tested Micro-generators (up to and including 16 A per phase) in parallel with public Low Voltage Distribution Networks in Northern Ireland on or after 27 April 2019

GD Midea Air-Conditioning Equipment Co., Ltd.

For the unit(s) **EH-3K-A-M0, EH-3.6K-A-M0**

Test report no. **HC23100801-EG-NI-002**

Date **2023-10-19**

ilac-MRA

ACCREDITED
Certificate # 5200.02

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Test report number.....:	**HC23100801-EG-NI-002**
Date of issue.....:	2023-10-19
Total number of pages.....:	69
Testing laboratory .....:	**LYNS-TCI TECHNOLOGY GUANGDONG CO., LTD.**
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Testing location / address.....:	Same as above
Applicant's name .....:	**GD Midea Air-Conditioning Equipment Co., Ltd.**
Address.....:	Lingang Road, Beijiao, Shunde, Foshan, 528311, Guangdong, China
Test specification	
Standard .....:	Engineering Recommendation G98/NI Issue 1 April 2019 Requirements for the connection of Fully Type Tested Micro-generators (up to and including 16 A per phase) in parallel with public Low Voltage Distribution Networks in Northern Ireland on or after 27 April 2019
Test report form number.....:	EREC G98/NI_v1.0
Test report form(s) originator.....:	Lyns-tci Technology Guangdong Co., Ltd.
Master TRF.....:	Dated 2023-06-13
Test item description.....:	Device Category: **Inverter** Device Type: **Hybrid Inverter (PV + DC coupled Electricity Storage)**
Trademark .....:	Midea
Model / Type reference.....:	**EH-3K-A-M0**, **EH-3.6K-A-M0**
Technical data .....:	See section 3.1 on p.8
Dates of testing.....:	2023-04-10 - 2023-06-30

Tested by

Allen

Allen Zhang (Test engineer)

Approved by

LYNS-TCi TECHNOLOGY

Lukes Lin (Project manager)

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1 General information of test report

1.1 Important Note

General disclaimer

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1.2 Revision history

Revision	Date	Editor	Modification / Change	Status
HC23100801-EG-NI-002	2023-10-19	Allen Zhang	Initial report was written	active
Supplementary information: Test results documented in this report are taken from test report no. 230331JHA068-EG-NI-002-R1, issued by Lyns-tci Technology Guangdong Co., Ltd. on 2023-08-14.				

2 General remarks for documentation

The test results presented in this report relate only to the object(**s**) tested.

Throughout this report a ☐ comma ',' / ☒ point '.' is used as decimal separator and a ☐ point '.' / ☒ comma ',' as thousands separator.

The following **suffixes/indices** are used for variables in tables and figures:

n	Nominal value
max	Maximum value
Lx	index of phase x
LxLy	phase-to-phase voltages of phase x and phase y

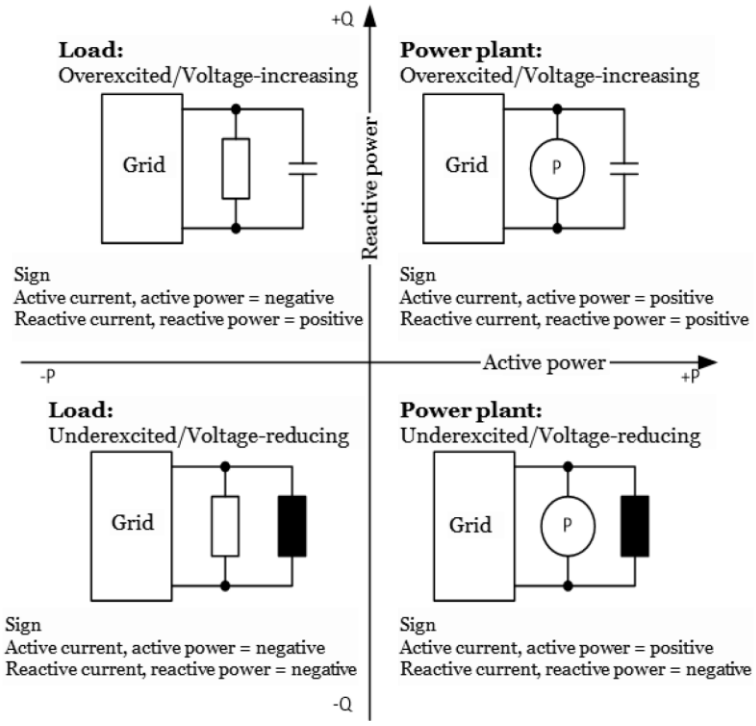
Abbreviations

AC	:	Alternating Current
DC	:	Direct Current
EUT	:	Equipment Under Test
LV	:	Low Voltage
MP	:	Measurement Point
MPP	:	Maximum Power Point
MV	:	Medium Voltage
PGF	:	Power Generating Facility
PGM	:	Power Generating Module
PGU	:	Power Generating Unit
P_{max}	:	Registered Capacity
PPM	:	Power Park Module
PWHD	:	Partial Weighted Harmonic Distortion
THD	:	Total Harmonic Distortion
PWHD	:	Partial Weighted Harmonic Distortion

Direction definition of P and Q

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

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



3 General product information

Factory's name ..... :	**Dongguan SOFAR SOLAR Co., Ltd.**
Factory address ..... :	1F-6F, Building E, No.1 JinQi Road, Bihu Industrial Park, Wulian Village, Fenggang Town, Dongguan City, Guangdong Province, China

3.1 Technical data of the unit(s)

Unit / Type ..... :	**EH-3K-A-M0**	**EH-3.6K-A-M0**
Hardware version (tested) ..... :	V001	
Software version (tested) ..... :	V000001	
MPP DC voltage range [V] ..... :	90 ~ 550	
Max. DC input voltage [V]..... :	600	
Input DC current [A]..... :	max. 13 / 13	
Battery voltage range [V] ..... :	42 ~ 58	
Battery charging current [A]..... :	max. 75	max. 80
Battery discharging current [V] ..... :	max. 75	max. 80
Nominal output AC voltage [V] ..... :	230 (L + N + PE, 50/60Hz)	
Output AC current [A] ..... :	max. 15	max. 16
Nominal active output power P_n [kW] .... :	3.0	3.68
Registered Capacity [1] P_{max} [kW]	3.0	3.68
Max. apparent power [kVA] ..... :	3.3	3.68

Note:

The Power Park Modules (Generating Units): *EH-3K-A-M0*

are designed to be capable of operating within the range ±0.95 Power Factor at Registered Capacity.

- Max. operating range of Power Factor at Registered Capacity:
  0.909 lagging to 0.909 leading

- For Power Park Modules (Generating Units):*EH-3.6K-A-M0* to meet the requirement:

  "When operating at **Registered Capacity** the **Power Generating Module** shall be capable of operating at a **Power Factor** within the range 0.95 lagging to 0.95 leading relative to the voltage waveform"
  - a semi-permanent active power reduction to a value
    - *EH-3.6K-A-M0:* ≤3.496 kW
  - can be applied by software (the parameter setting needs to follow the manufacturer's guidance).
  - or this need to be considered in the Power Generating Module design
  - or otherwise agreed with the DNO
- Setting range of the Power Factor:
  0.800 lagging to 0.800 leading

[1] In this report, the stated values of "registered capacity" related to single Generating Unit.

Datasheet of the generating units:

Note:
the units *EH-4K-A-M0* & *EH-4.6K-A-M0* & *EH-5K-A-M0* & *EH-5.5K-A-M0* & *EH-6K-A-M0* are not considered in this test report.

Datasheet	EH-3K -A-M0	EH-3.6K -A-M0	EH-4K -A-M0	EH-4.6K -A-M0	EH-5K -A-M0	EH-5.5K -A-M0	EH-6K -A-M0
Battery type	Lithium-ion, Lead-acid						
Nominal battery voltage	48V						
Battery voltage range	42-58V						
Battery capacity	50-2000Ah						
Maximum charging / discharging power	3750W	4000W	4250W	5000W	5000W	5000W	5000W
Maximum charging current	75A	80A	85A	100A	100A	100A	100A
Maximum discharging current	75A	80A	85A	100A	100A	100A	100A
Depth of discharge	0-90% DOD adjustable（Lithium-ion）						
	0-50% DOD adjustable（Lead-acid）						
Charging curve	BMS（Lithium-ion）						
	3-Stage adaptive with maintenance（Lead-acid）						
Communication	CAN(RS485)						

Datasheet	EH-3K -A-M0	EH-3.6K -A-M0	EH-4K -A-M0	EH-4.6K -A-M0	EH-5K -A-M0	EH-5.5K -A-M0	EH-6K -A-M0
Recommended Max. PV input power(Wp)	4500Wp	5400Wp	6000Wp	6900Wp	7500Wp	7500Wp	9000Wp
Max. DC power for single MPPT	3500W	3500W	3500W	3500W	3500W	3500W	3500W
Max. input voltage	600V						
Rated input voltage	360V						
Start-up voltage	100V						
MPPT operating voltage range	90-580V						
Full power MPPT voltage range(V)	160-520	180-520	200-520	230-520	250-520	250-520	300-520
Number of MPP trackers	2						
Max. input current per MPPT	13A/13A						
Max. input short circuit current per MPPT	18A/18A						

Datasheet	EH-3K -A-M0	EH-3.6K -A-M0	EH-4K -A-M0	EH-4.6K -A-M0	EH-5K -A-M0	EH-5.5K -A-M0	EH-6K -A-M0
Nominal AC power（W）	3000	3680	4000	4600	5000	5000	6000
Max. AC power output to utility grid（VA）	3300	3680	4400	4600	5000	5500	6000
Max. AC power from utility grid(VA)	6000	7360	8000	9200	10000	10000	12000
Max. AC current output to utility grid	15A	16A	20A	20.9A	21.7A	25A	27.3A
Max. AC current from utility grid	27.3A	32A	36.4A	41.8A	43.4A	43.4A	54.6A
Nominal grid voltage	L/N/PE, 220Vac, 230Vac,240Vac						
Grid voltage range	180Vac~276Vac(According to local standard)						
Nominal frequency	50/60Hz						
Grid Frequency range	45Hz~55Hz/55Hz~65Hz						
Power factor	1 default (adjustable+/-0.8)						
Output THDi (@Nominal output)	<3%						

Datasheet	EH-3K -A-M0	EH-3.6K -A-M0	EH-4K -A-M0	EH-4.6K -A-M0	EH-5K -A-M0	EH-5.5K -A-M0	EH-6K -A-M0
Rated apparent power（VA）	3000	3680	4000	4600	5000	5000	5000
Max. apparent power（VA）	3000	3680	4000	4600	5000	5000	5000
Peak output power,Duration	3600VA, 60s	4400VA, 60s	4800VA, 60s	5520VA, 60s	6000VA, 60s	6000VA, 60s	6000VA, 60s
Max. output current	13.6A	16A	18.2A	20.9A	22.7A	22.7A	22.7A
Nominal voltage,Frequency	L/N/PE, 220V/230V/240V 50/60Hz						
THDv (@Liner load)	<3%						
Switch time	10ms(default)						

Datasheet	EH-3K -A-M0	EH-3.6K -A-M0	EH-4K -A-M0	EH-4.6K -A-M0	EH-5K -A-M0	EH-5.5K -A-M0	EH-6K -A-M0
MPPT efficiency	99.9%						
European efficiency of solar inverter	97.2%	97.2%	97.2%	97.3%	97.3%	97.3%	97.5%
Max efficiency of solar inverter	97.6%	97.6%	97.6%	97.8%	97.8%	97.8%	98.0%
Max. charging efficiency of battery	94.6%						
Max. discharging efficiency of battery	94.6%						
DC switch	Yes						
PV reverse polarity protection	Yes						
Over current protection	Yes						
Over voltage protection	Yes						
PV insulation detection	Yes						
Ground fault monitoring	Yes						
Firm frequency response function	Optional						
SPD protection	MOV:Type III standard						

Datasheet	EH-3K -A-M0	EH-3.6K -A-M0	EH-4K -A-M0	EH-4.6K -A-M0	EH-5K -A-M0	EH-5.5K -A-M0	EH-6K -A-M0
Dimension	482mm×503mm×183mm						
Weight	21.5kg						
Topology	High frequency insolation (for bat)						
Standby self-consumption	<10W						
Ambient temperature range	-30℃~60℃（Above 45℃ Derating）						
Allowable relative humidity range	0~100%						
Noise	<25dB						
Max. operating altitude	<4000m						
Cooling	Natural						
Degree of protection	IP65						

Display	LCD
Communication	Bluetooth / RS485 / Wireless / GPRS (optional)
Parallel operation	YES

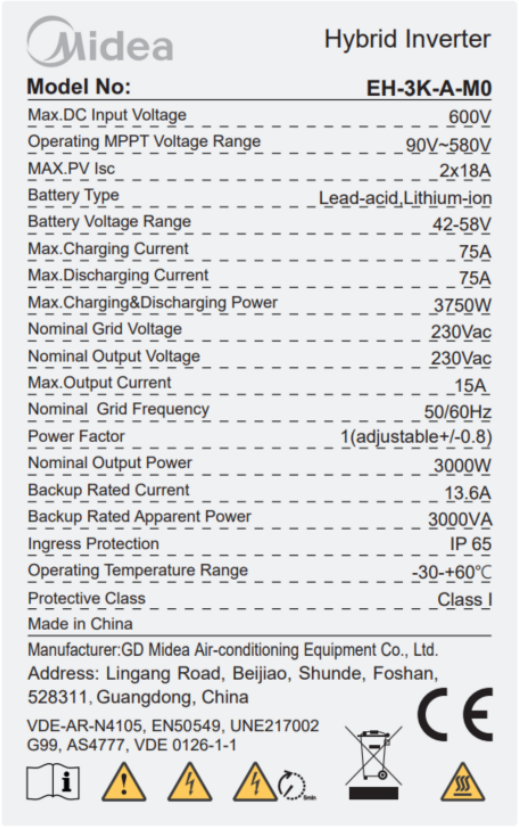
Equipment mobility	:	Permanent connection
Operating condition	:	Continuous
Class of equipment	:	Class I
Protection against ingress of water	:	IP65 according to EN 60529
Mass of equipment [kg]	:	21.5kg
Type of internal transformer	:	No internal transformer (transformerless)

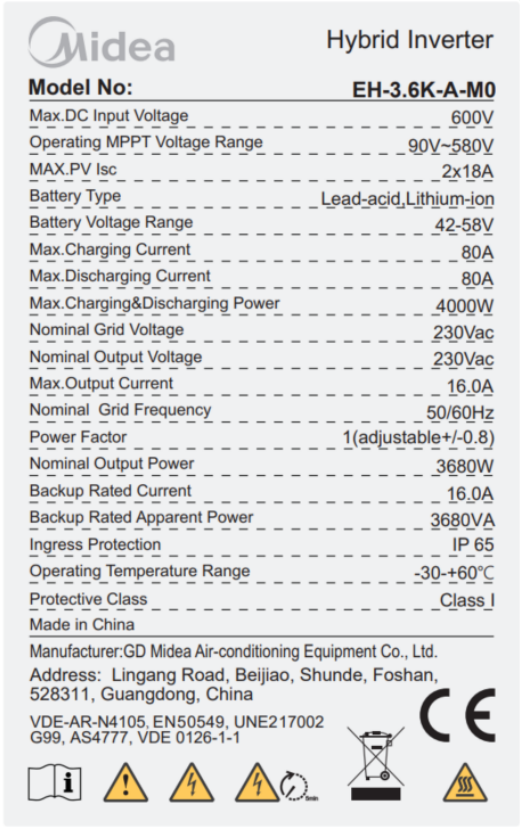
3.2 Description of the differences of the models within the product series

The units of units in der series are identical hardware platform.

The implemented control and firmware are identical in all units. There is no difference regarding AC behaviour between the PGU-types apart from the power rating deviation and current limitation of each unit.

3.3 Copy of marking plate





Note:

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

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

3.4 Description of the power circuit

The solar inverter converts DC voltage, generated by photovoltaic modules, into AC voltage.

The units are single-phase.

The input and output are protected by varistors to Earth. The unit is providing EMI filtering at the PV input and output toward mains. The unit does not provide galvanic separation from input to output (transformerless).

The output is switched off redundantly by the high-power switching bridge and two relays. This assures that the opening of the output circuit will also operate in case of a single error.

The internal control is redundant built. It consists of Microcontroller Main DSP (U4) and slave DSP (U43).

The Main DSP (U4) control the relays by switching signals; measures the Bus voltage, grid voltage, frequency, AC current with injected DC and the array insulation resistance to ground. In addition, it tests the current sensors and the RCMU circuit before each start up.

The slave DSP (U43) is measuring the grid voltage, grid frequency and residual current, also can switch off the relays independently, and communicate with Main DSP (U4) each other.

The current is measured by a current sensor. The AC current signal and the injected DC current signal are sent to the Main DSP(U4). The Main DSP(U4) tests and calibrates before each start up all current sensors.

The unit provides two relays in series in all output conductors. When single fault applied to one relay, alarm an error code in display panel, another redundant relay provides basic insulation maintained between the battery and the mains. All the relays are tested before each start up.

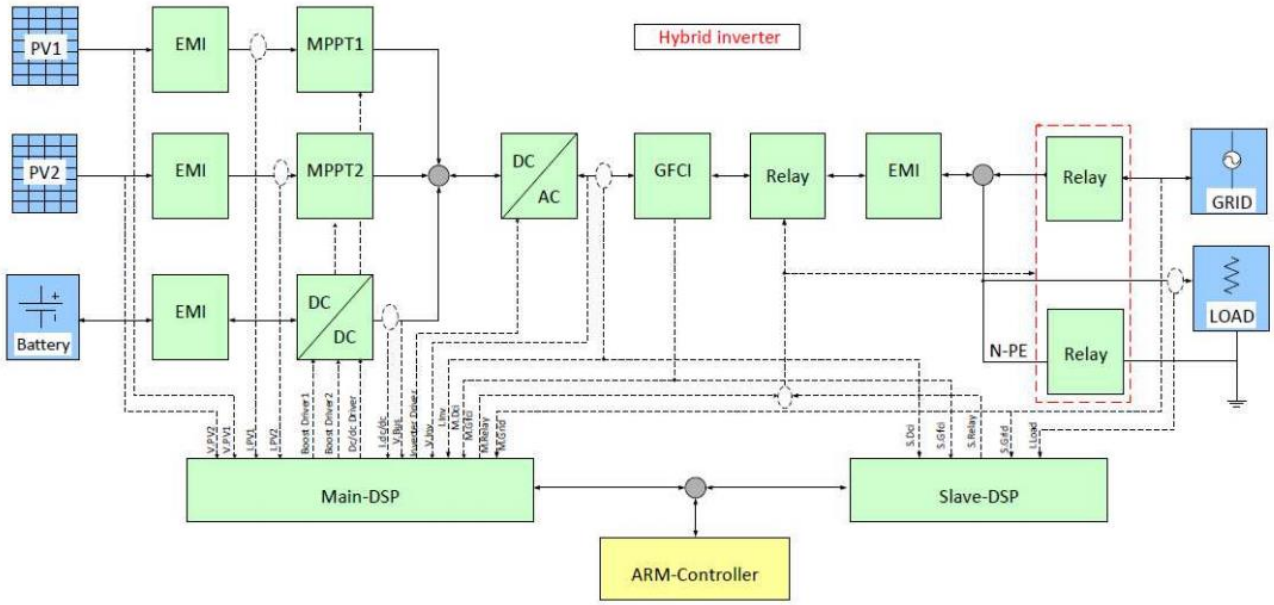


Figure 1 – Block diagram of the power circuit

4 General remarks for testing

4.1 Energy Conversion Technology

According to EREC G98/NI, Form B:

Photovoltaic (1) *	Wind (2)	Other renewable (6)	Other – battery storage (21)	Other – storage not battery (22)	Other (x)
☒	☐	☐	☒	☐	---

Numbering according to Form B. Number "x" needs to be determined when the Energy Conversion Technology of the Micro-generator defined.

Note:

* Connection scenario:

☐ Photovoltaic Power Park Module connected to the DNO's Distribution Network via an Inverter

☒ Hybrid converter:

Photovoltaic Power Park Module with DC coupled storage unit connected to the DNO's Distribution Network via an Inverter

In this case the Registered Capacity is based on the Inverter rating. The storage unit has no compliance effect, compliance based on the inverter.

4.2 Exceptions

According to EREC G98/NI, Appendix 1:

☐ **Emerging Technology**

No exceptions.

☐ **Electricity Storage devices** and/or

Micro-generating Plant with a Registered Capacity < 800 W

the following sections of EREC G98/NI do not apply:

- 9.3 (Limited Frequency Sensitive Mode – Overfrequency); and
- 9.4.2 and 9.4.3 (constant Active Power output)

☒
- **Registered Capacity of single Micro-generator < 800 W, but aggregate installed capacity ≥ 800W**
- **800 W ≤ Registered Capacity ≤ {(Registered Capacity of up to and including 16 A per phase, corresponding to 3.68 kW (single-phase, 230/400 V system) or 11.04 kW (three-phase, 230/400 V system)}**

No exceptions.

4.3 Scope of measurements

Date of receipt of test items ..... : 2023-04-10

Date(s) of performance of tests ..... : 2023-04-10 - 2023-06-30

During the test period stated above following environmental data were recorded:

- Temperature: 20.7 ~ 25.2°C
- Rel. humidity: 40.5 ~ 57.3%RH
- Air pressure: 999.2 ~ 1003.6 hPa

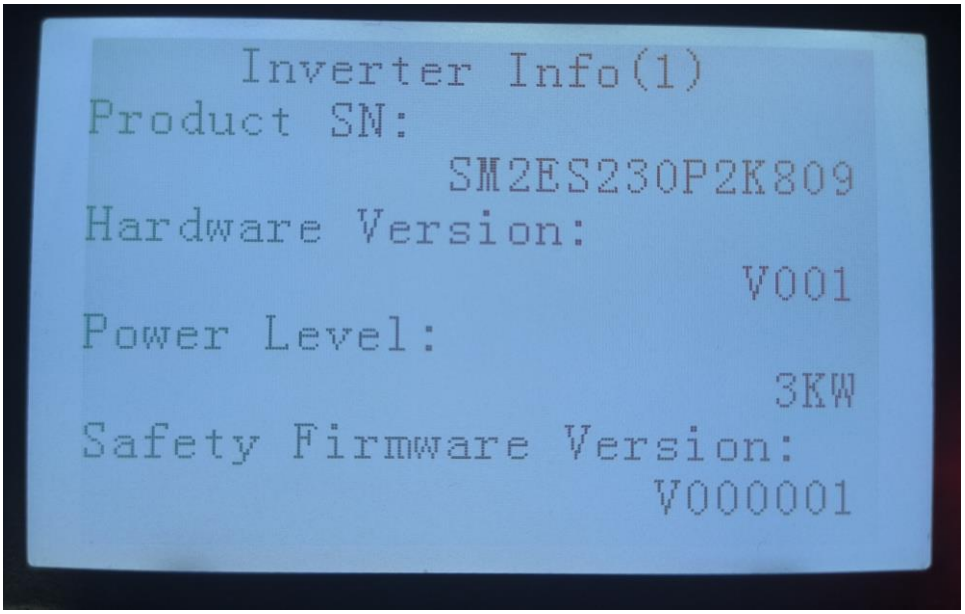
Test items	Testing requirements (Section EREC G98/NI)	Section in this test report	Tests completed
1. Operating Range	9.1, 10.1	6.1	☒
2. Harmonics	11	6.2	☒
3. Voltage Fluctuation and Flicker	11	6.3	☒
4. DC injection	11	6.4	☒
5. Power Factor (PF)	9.5	6.5	☒
6. Frequency protection trip and ride through tests	10.1	6.6.1	☒
7. Voltage protection trip and ride through tests	10.1	6.6.2	☒
8. Protection – Loss of Mains Test	10.2	6.6.3	☒
9. Protection – Frequency change, Vector Shift Stability test	10.3	6.6.4	☒
10. Protection – Frequency change, RoCoF Stability test	10.3	6.6.5	☒
11. LFSM-O Test	9.3	6.7	☒
12. Power output with falling frequency test	9.4.2	6.8	☒
13. Reconnection Timer	9.6	6.9	☒
14. Fault Level Contribution	12, A.1.3.5	6.10	☒
15. Logic Interface (input port)	9.4.3	6.11	☒
16. Self-monitoring Solid State Switch	10.1.9	6.12	☐
17. Cyber security (informative)	---	6.13	☐ [2]

Note:

- The tests were performed on EUT **EH-3.6K-A-M0** which provides the highest current / power.
- The product was tested on
    - Serial No.: SM2ES230P2K809

[2] Manufacturer's declaration provided, for details see section 6.13.

- Hardware Version: V001
- Software Version: V000001



- Measurement done at output terminals of the EUT, see Figure 3, Figure 4 and Figure 5.

Note:

in this report, ***Family approach to Type Testing*** according to **EREC G98**, section **6.3** was applied.

- According to **EREC G98**, section **6.3.1** the following applies:

  since the rated power of EH-3.6K-A-M0 is between $1/\sqrt{10}\cdot P_{n,\ EH\text{-}3K\text{-}A\text{-}M0}$ and $2\cdot P_{n,\ EH\text{-}3K\text{-}A\text{-}M0}$, a family approach to type testing is acceptable.
- A transfer of measurement results from the EH-3K-A-M0 to other units in the product series according to **EREC G98**, section **6.3.2** is allowed (for details see section *5 Assessment overview*.)
- Technical justification for transferability of measurement results:

  see section 3.2 on p.15.

4.4 Reference values

Reference values for the p.u. or percentage calculations:

	EH-3K-A-M0	EH-3.6K-A-M0
Registered Capacity [3] P_{max} [kW]	3.0	3.68*
Rated voltage (phase-to-neutral), U_n [V]	230	
Rated current, I_n [4] [A]	13.0	16.0

4.5 Measurement setup

Tests documented in this test report were performed using the following test configuration:

- ☐ Measurements in the field on real grid
- ☐ Test bench tests on real grid
- ☒ Test bench tests on an AC grid simulator

The PGU is connected on the DC-side to a PV-simulator and on the AC-side to an AC-grid simulator. The AC-grid simulator is operated with nominal conditions of U_n = 230 (phase-to-neutral) and f_n = 50 Hz unless stated otherwise by the applied test requirement.

Available primary power is modified by adapting the short circuit current (I_{sc}) value of the I-V curve. Following example shows a PV-curve (I_{sc} = 9.07 A, U_{oc} = 418.05 V) simulated according to EN50530:

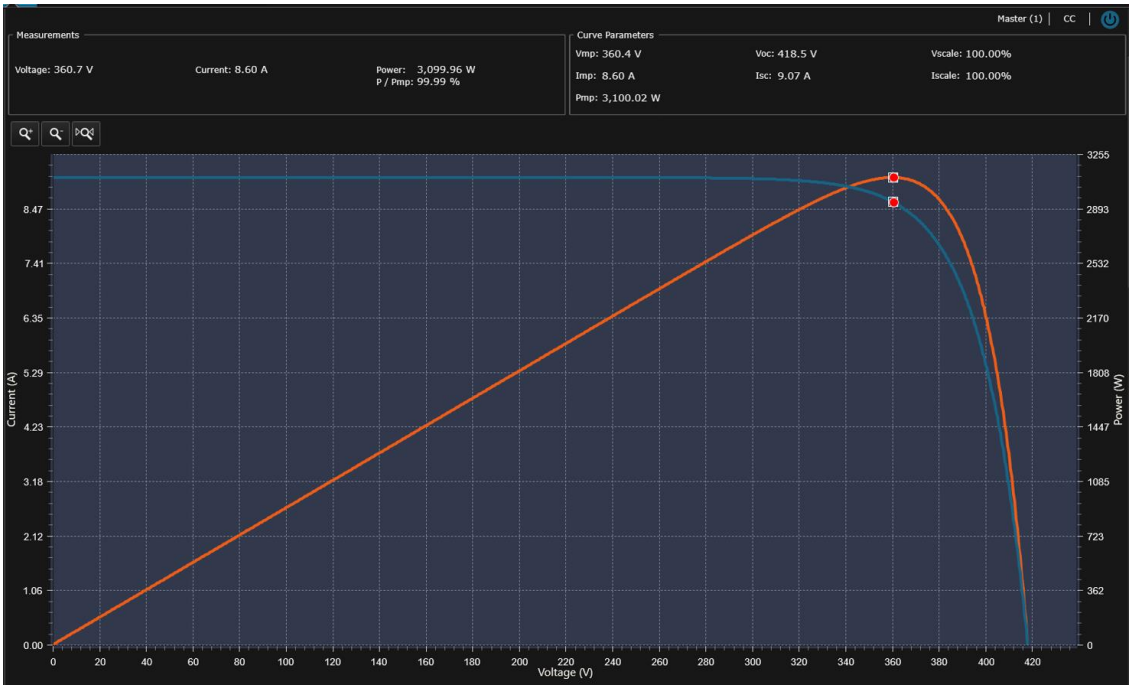


Figure 2 – DC characteristics for testing

The measurement setups are shown in Figure 3 Figure 4 and Figure 5. The specific test and measurement devices are stated in section 4.6.

[3] In this report, the stated values of "registered capacity" related to single Generating Unit.

[4] The rated current stated in this report is calculated based on the "registered capacity" and the rated voltage.

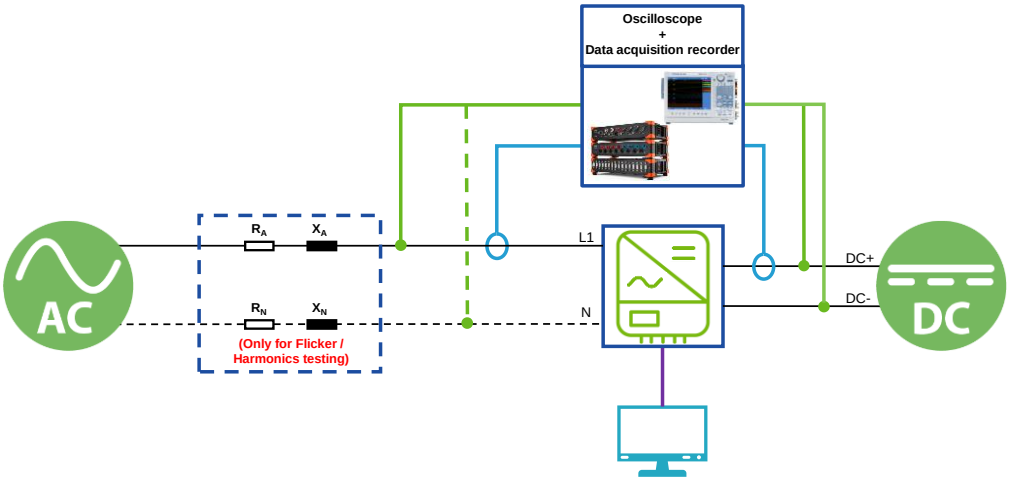


Figure 3 – Measurement setup used for tests except Loss of Mains and Short Circuit test

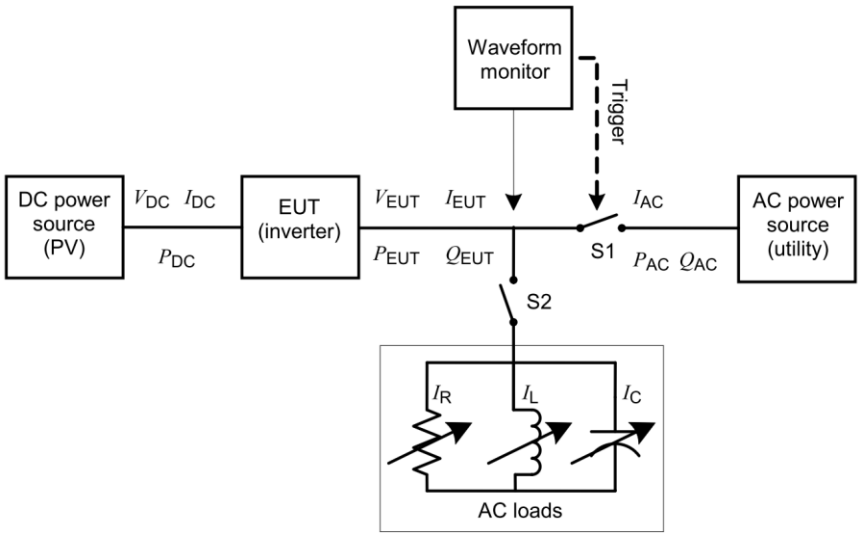


Figure 4 – Test circuit for Loss of Mains according to *IEC 62116:2014*

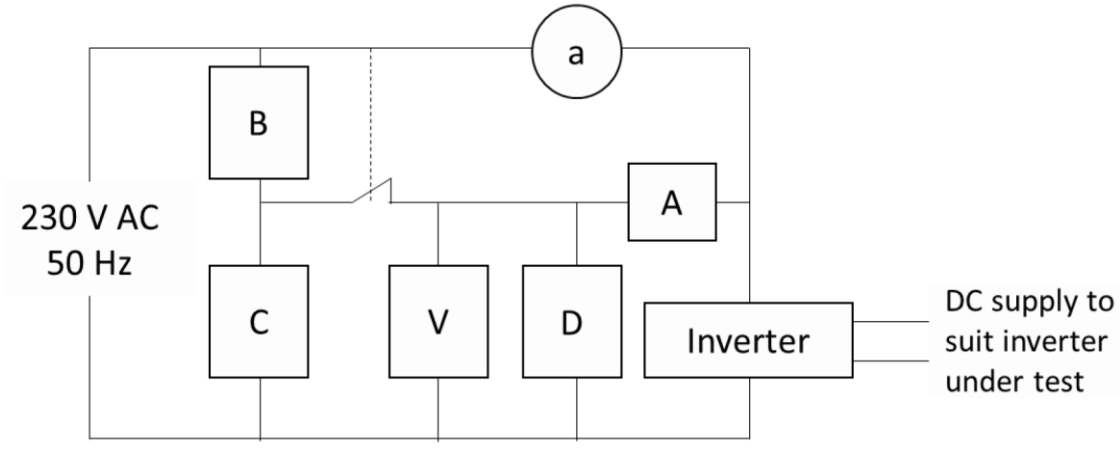


Figure 5 – Short circuit test circuit according to *EREC G98, Figure A.1.5*

4.6 Measurement equipment

Equipment	Internal No.	Manufacturer	Type	Serial No.	Next Calibration
DC power supply [5]	--	KEYSIGHT	N8957APV	DE21025954	--
AC Simulator [5]	HC-ENG-012	Chroma	61830	618303800281	--
Oscilloscope	--	KEYSIGHT	DSOX3014T	MY62160375	2023-12-01
	--	Tektronix	MDO3024	C055210	2023-12-01
Power analyser	HC-ENG-003	DEWESOFT	SIRIUSi-HS-4xHV-4xLV	DB20123915	2023-09-05
Current sensor	HC-ENG-019	LEM	IT 400-S	82021060080	2023-09-05
	HC-ENG-020	LEM	IT 400-S	82021060081	2023-09-05
	HC-ENG-021	LEM	IT 400-S	82021060082	2023-09-05
	HC-ENG-022	LEM	IT 400-S	82021060084	2023-09-05
Digital hygrometer	HC-ENG-002	Jiangsu Jingchuang Electric Co., Ltd.	GSP-8A	CMA215000031	2023-08-31

Note:

All measurement equipment was used within the calibration period. Copy of calibration certificates are available at the laboratory for reference.

[5] The AC simulator and DC sources do not need to be calibrated, since the AC voltage and current is measured and determined using the calibrated oscilloscope and power analyser.

5 Assessment overview

Possible test case verdicts:

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

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

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

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

Reference to declaration documents.....: R/D

Items	Technical requirements (Section EREC G98/NI)	Remark / Transfer of measurement results *	Verdict
1. Operating Range	9.1, 10.1	See section 6.1 / The verified operating range of the EH-3K-A-M0 can be applied to other units in the product series directly.	P
2. Harmonics	11	See section 6.2 / The percentage harmonics results of the EH-3K-A-M0 can be considered as worst case results and applied to other units in the product series directly.	P
3. Voltage Fluctuation and Flicker	11	See section 6.3 / The Flicker results of the EH-3K-A-M0 can be considered as worst case results and applied to other units in the product series directly.	P
4. DC injection	11	See section 6.4 / The percentage DC injection of the EH-3K-A-M0 can be considered as worst case results and applied to other units in the product series directly.	P
5. Power Factor (PF)	9.5	See section 6.5 / The Power Factor results of the EH-3K-A-M0 can be considered as worst case results and applied to other units in the product series directly.	P
6. Frequency protection trip and ride through tests	10.1	See section 6.6.1 / The measurement results of the EH-3K-A-M0 can be considered as worst case results and applied to other units in the product series directly.	P
7. Voltage protection trip and ride through tests	10.1	See section 6.6.2 / The measurement results of the EH-3K-A-M0 can be considered as worst case results and applied to other units in the product series directly.	P

8. Protection – Loss of Mains Test	10.2	See section 6.6.3 / The measurement results of the EH-3K-A-M0 can be considered as worst case results and applied to other units in the product series directly.	P
9. Protection – Frequency change, Vector Shift Stability test	10.3	See section 6.6.4 / The measurement results of the EH-3K-A-M0 can be considered as worst case results and applied to other units in the product series directly.	P
10. Protection – Frequency change, RoCoF Stability test	10.3	See section 6.6.5 / The measurement results of the EH-3K-A-M0 can be considered as worst case results and applied to other units in the product series directly.	P
11. LFSM-O Test	9.3	See section 6.7 / The determined droops of the EH-3K-A-M0 can be considered as worst case results and applied to other units in the product series directly.	P
12. Power output with falling frequency test	9.4.2	See section 6.8 / The measurement results of the EH-3K-A-M0 can be considered as worst case results and applied to other units in the product series directly.	P
13. Reconnection Timer	9.6	See section 6.9 / The measurement results of the EH-3K-A-M0 can be considered as worst case results and applied to other units in the product series directly.	P
14. Fault Level Contribution	12, A.1.3.5	See section 6.10 / The measurement results of the EH-3K-A-M0 can be considered as worst case results and applied to other units in the product series directly.	P
15. Logic Interface (input port)	9.4.3	See section 6.11 / The measurement results of the EH-3K-A-M0 can be considered as worst case results and applied to other units in the product series directly. The high-level description of logic interface applies to the whole product series.	P
16. Self-monitoring Solid State Switch	10.1.9	See section 6.12 / ---	N/A
17. Cyber security	---	(For information only) See section 6.13 / Manufacturer's declaration provided. See *Annex 2 - Manufacturer's declaration regarding Cyber Security*.	R/D

Note:

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

Note:

in this report, ***Family approach to Type Testing*** according to **EREC G98**, section **6.3** was applied.

* According to **EREC G98**, section **6.3.2** the following applies:

*All absolute values (e.g. operating range tests) from the tested **Micro-generator** shall be transferred directly in the compliance forms of an assumed compliant **Micro-generator** of the same family. All relative results related to design **Active Power** or current (e.g. power quality fluctuation and flicker) from the tested **Micro-generator** shall be transferred to the compliance form of a **Micro-generator** in the same family according to the ratio of the respective nameplate rating (W)of the tested **Micro-generator** and the assumed compliant Micro-generator. For the avoidance of doubt, the **Manufacturer** shall register each **Micro-generator** in the family on the Energy Networks Association Type Test register.*

Since the tests were performed on **EH-3K-A-M0** which provides the highest current / power, in this report the *relative results* of EUT **EH-3K-A-M0** are considered as worst case results and applied to other units in the product series directly.

6 Measurement results

Form C: Type Test Verification Report

6.1 Operating Range

This test should be carried out as specified in EN 50438 D.3.1.

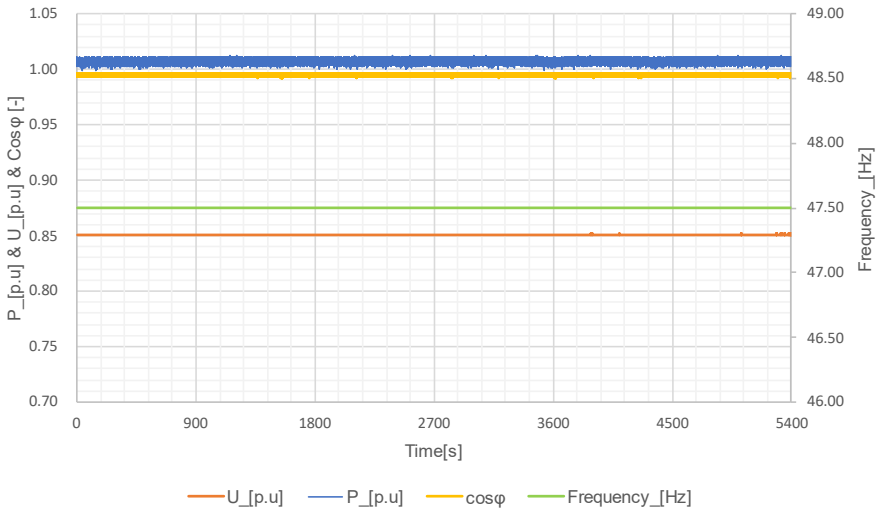
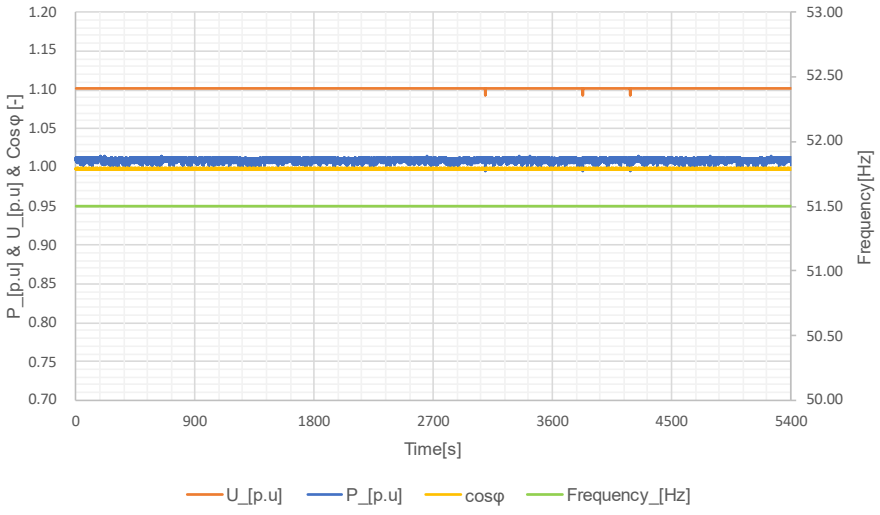
Active Power shall be recorded every second. The tests will verify that the **Micro-generator** can operate within the required ranges for the specified period of time.

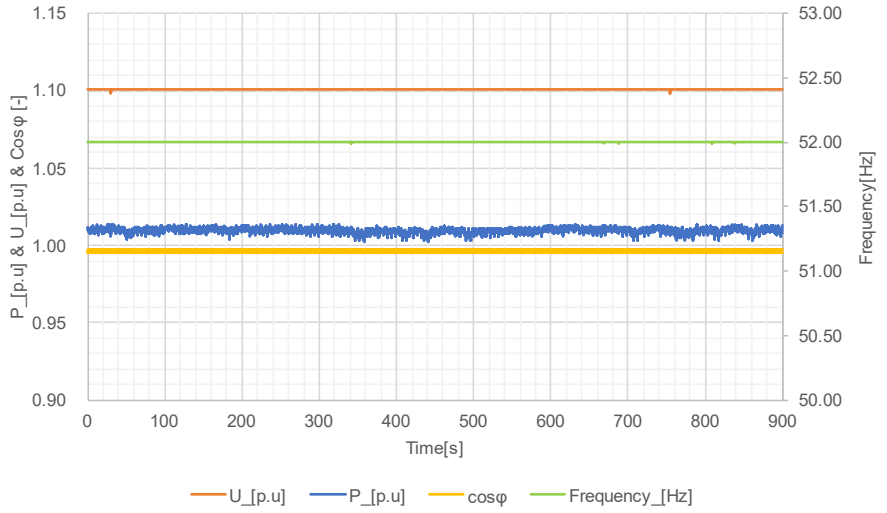
The **Interface Protection** shall be disabled during the tests.

In case of a PV **Micro-generator** the PV primary source may be replaced by a **DC** source.

In case of a full converter **Micro-generator** (eg wind) the primary source and the prime mover Inverter/rectifier may be replaced by a DC source.

In case of a DFIG **Micro-generator** the mechanical drive system may be replaced by a test bench motor.

Test 1 Voltage = 85% of nominal (195.5 V), Frequency = 47.5 Hz, Power factor = 1, Period of test 90 minutes	Pass, no disconnection occurs. 
Test 2 Voltage = 110% of nominal (253 V)., Frequency = 51.5 Hz, Power factor = 1, Period of test 90 minutes	Pass, no disconnection occurs. 
Test 3 Voltage = 110% of nominal (253 V), Frequency = 52.0 Hz,	Pass, no disconnection occurs.

Power factor = 1, Period of test 15 minutes	

6.2 Power Quality – Harmonics

These tests should be carried out as specified in BS EN 61000-3-2. The chosen test should be undertaken with a fixed source of energy at two power levels a) between 45 and 55% and b) at 100% of **Registered Capacity**. The test requirements are specified in Annex A1 A.1.3.1 (**Inverter** connected) or Annex A2 A.2.3.1 (Synchronous).

Micro-generator tested to BS EN 61000-3-2

Micro-generator rating per phase (rpp)	3.000	kW
For 3-phase **Micro-generator**s, tick this box if harmonic measurements are identical for all three phases. If the harmonics are not identical for each phase, please replicate this section with the results for each phase.	three phases	

Harmonic	At 45-55% of **Registered Capacity**			At 100% of **Registered Capacity**				
	Measured Value (MV) in Amps			Measured Value (MV) in Amps				
Order	L_1	L_2	L_3	L_1	L_2	L_3	Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2	0.0043	--	--	0.0078	--	--	1.080	
3	0.1317	--	--	0.1783	--	--	2.300	
4	0.0022	--	--	0.0020	--	--	0.430	
5	0.0591	--	--	0.1096	--	--	1.140	
6	0.0025	--	--	0.0020	--	--	0.300	
7	0.0393	--	--	0.0735	--	--	0.770	
8	0.0037	--	--	0.0020	--	--	0.230	
9	0.0241	--	--	0.0473	--	--	0.400	
10	0.0021	--	--	0.0019	--	--	0.184	
11	0.0186	--	--	0.0314	--	--	0.330	
12	0.0022	--	--	0.0018	--	--	0.153	
13	0.0133	--	--	0.0174	--	--	0.210	
14	0.0020	--	--	0.0019	--	--	0.131	

15	0.0142	--	--	0.0161	--	--	0.150	
16	0.0020	--	--	0.0015	--	--	0.115	
17	0.0122	--	--	0.0155	--	--	0.132	
18	0.0014	--	--	0.0016	--	--	0.102	
19	0.0141	--	--	0.0156	--	--	0.118	
20	0.0015	--	--	0.0014	--	--	0.092	
21	0.0140	--	--	0.0111	--	--	0.107	0.160
22	0.0012	--	--	0.0012	--	--	0.084	
23	0.0147	--	--	0.0111	--	--	0.098	0.147
24	0.0011	--	--	0.0012	--	--	0.077	
25	0.0138	--	--	0.0082	--	--	0.090	0.135
26	0.0010	--	--	0.0010	--	--	0.071	
27	0.0149	--	--	0.0095	--	--	0.083	0.124
28	0.0009	--	--	0.0010	--	--	0.066	
29	0.0138	--	--	0.0072	--	--	0.078	0.117
30	0.0009	--	--	0.0009	--	--	0.061	
31	0.0135	--	--	0.0080	--	--	0.073	0.109
32	0.0009	--	--	0.0009	--	--	0.058	
33	0.0127	--	--	0.0060	--	--	0.068	0.102
34	0.0008	--	--	0.0009	--	--	0.054	
35	0.0127	--	--	0.0071	--	--	0.064	0.096
36	0.0008	--	--	0.0008	--	--	0.051	
37	0.0121	--	--	0.0053	--	--	0.061	0.091
38	0.0007	--	--	0.0008	--	--	0.048	
39	0.0113	--	--	0.0061	--	--	0.058	0.087
40	0.0008	--	--	0.0007	--	--	0.046	

Note:

the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.

Additional comments:

6.3 Power Quality – Voltage fluctuations and Flicker

These tests should be undertaken in accordance with EREC G98/NI Annex A1 A.1.3.3 (**Inverter** connected) or Annex A2 A.2.3.3 (Synchronous).

For voltage change and flicker measurements the following formula is to be used to convert the measured values to the normalised values where the power factor of the generation output is 0.98 or above.

Normalised value = Measured value*reference source resistance/measured source resistance at test point.

Single phase units reference source resistance is 0.4 Ω

Two phase units in a three phase system reference source resistance is 0.4 Ω.

Two phase units in a split phase system reference source resistance is 0.24 Ω.

Three phase units reference source resistance is 0.24 Ω.

Where the power factor of the output is under 0.98 then the X to R ratio of the test impedance should be close to that of the Standard Impedance.

The stopping test should be a trip from full load operation.

The duration of these tests need to conform to the particular requirements set out in the testing notes for the technology under test. Dates and location of the test need to be noted below.

Test start date	2023-04-23	Test end date	2023-04-24
Test location	LYNS-TCI TECHNOLOGY GUANGDONG CO., LTD. (see *Testing location* on p.2)		

* ☐ three-phase **Micro-generators** ☐ split single phase **Micro-generators**

^ ☒ single phase **Micro-generators** ☐ **Micro-generators** using two phases on a three-phase system

	Phase no.	Starting			Stopping			Running	
		d_{max} [%]	d_c [%]	d(t) [ms]	d_{max} [%]	d_c [%]	d(t) [ms]	P_{st}	P_{lt} 2 hours
Measured Values at test impedance	L1	0.214	0.082	0.000	0.198	0.084	0.000	0.023	0.021
	L2			0.000			0.000		
	L3			0.000			0.000		
	Overall worst case	0.214	0.082	0.000	0.198	0.084	0.000	0.023	0.021
Normalised to standard impedance	L1	0.214	0.082	0.000	0.198	0.084	0.000	0.023	0.021
	L2			0.000			0.000		
	L3			0.000			0.000		
	Overall worst case	0.214	0.082	0.000	0.198	0.084	0.000	0.023	0.021
Normalised to required maximum impedance	L1	--	--	--	--	--	--	--	--
	L2	--	--	--	--	--	--	--	--
	L3	--	--	--	--	--	--	--	--
	Overall worst case	--	--	--	--	--	--	--	--
Limits set under BS EN 61000-3-11		4	3.3	500 (3.3%)	4	3.3	500 (3.3%)	1.0	0.65

Test Impedance	R:	0.4 Ω	X:	0.25 Ω
Standard Impedance	R:	☐ 0.24 * ☒ 0.4 ^ Ω	X:	☐ 0.15 * ☒ 0.25 ^ Ω
Maximum Impedance	R:	-- Ω	X:	-- Ω

6.4 Power Quality – DC injection

This test should be carried out in accordance with EN 50438 Annex D.3.10.
The % **DC** injection ("as % of rated AC current" below) is calculated as follows:
% **DC** injection = Recorded **DC** value in Amps / base current
where the base current is the **Registered Capacity** (W) / 230 V. The % **DC** injection should not be greater than 0.25%.

Test power level	20%	50%	75%	100%
Recorded DC value in Amps	0.005	0.010	0.012	0.016
as % of rated AC current	0.038	0.077	0.092	0.123
Limit [%]	0.25	0.25	0.25	0.25

Note:
* Calculation is the same for 1 phase and 3 phase devices

6.5 Power Factor

This test shall be carried out in accordance with EN 50538 Annex D.3.4.1 but with nominal voltage -6% and +10%. Voltage to be maintained within ±1.5% of the stated level during the test.

	Voltage / Test power level	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	20% of **Registered Capacity**	0.989	0.988	0.986
	50% of **Registered Capacity**	0.998	0.998	0.998
	75% of **Registered Capacity**	0.999	0.999	0.999
	100% of **Registered Capacity**	0.999	0.999	0.999
Power Factor Limit	leading	>0.95	>0.95	>0.95
	lagging	>0.98	>0.98	>0.98

Note:
See also "*Note"* on Power Factor on p.8.

6.6 Protection

The Interface Protection setting information can be displayed in one or more of the following ways:

☒ A display on a screen

☐ A display on a PC which can communicate with the Micro-generator and confirm that it is the correct Micro-generator by means of a serial number permanently fixed to the Micro-generator and visible on the PC screen at the same time as the settings

☐ Display of all Interface Protection settings and nominal voltage and current outputs, alongside the serial number of the Micro-generator, permanently fixed to the Micro-generator

☐ Other (Give a detailed description!)

Note:
The protection device considered in this report is the integrated protection relay / generating unit switch in the Power Generating Modules.

Manufacturer Data:

The integrated Interface Protection in the Power Generating Modules considered in this report is capable of measuring voltage to an accuracy of ±1.5% of the nominal value and of measuring frequency to ± 0.2% of the nominal value across its operating range of voltage, frequency and temperature (-30°C ~ +60°C).

(See also subsections 6.6.1 ~ 6.6.5 below)

6.6.1 Protection – Frequency tests

These tests should be carried out in accordance with EN 50438 Annex D.2.4 and the notes in EREC G98/NI Annex A1 A.1.2.3 (Inverter connected) or Annex A2 A.2.2.3 (Synchronous)

Function	Setting		Trip test		"No trip tests"	
	Frequency	Time delay	Frequency	Time delay	Frequency / time	Confirm no trip
U/F	48.0 Hz	0.5 s	47.99 Hz	0.524 s	48.2 Hz 25 s	No trip occurred
					47.8 Hz 0.45 s	No trip occurred
O/F	52 Hz	1.0 s	52.00 Hz	1.000 s	51.8 Hz 120.0 s	No trip occurred
					52.2 Hz 0.98 s	No trip occurred

Note:

for frequency trip tests the frequency required to trip is the setting ± 0.1 Hz. In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used. The "No trip tests" need to be carried out at the setting ± 0.2 Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

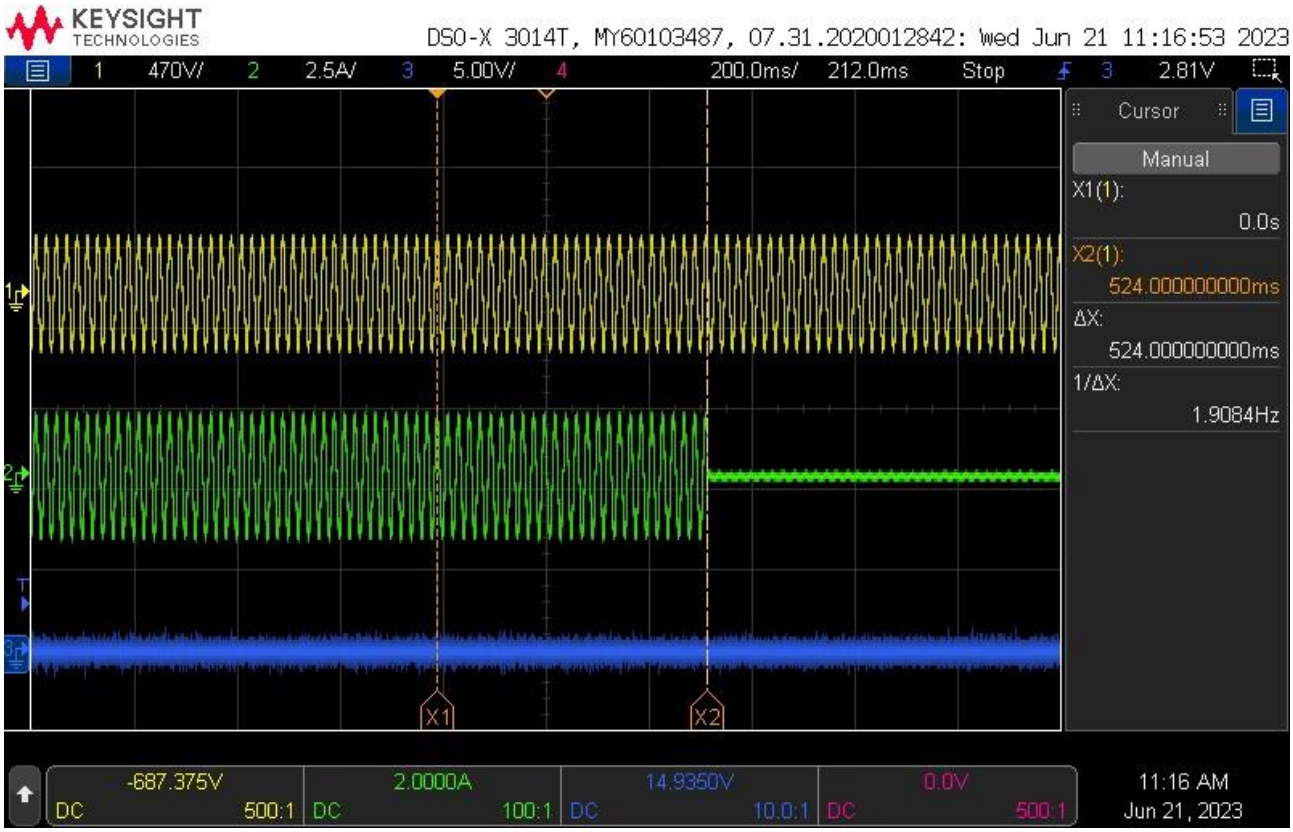


Figure 6 – Test U/F (Trip test)

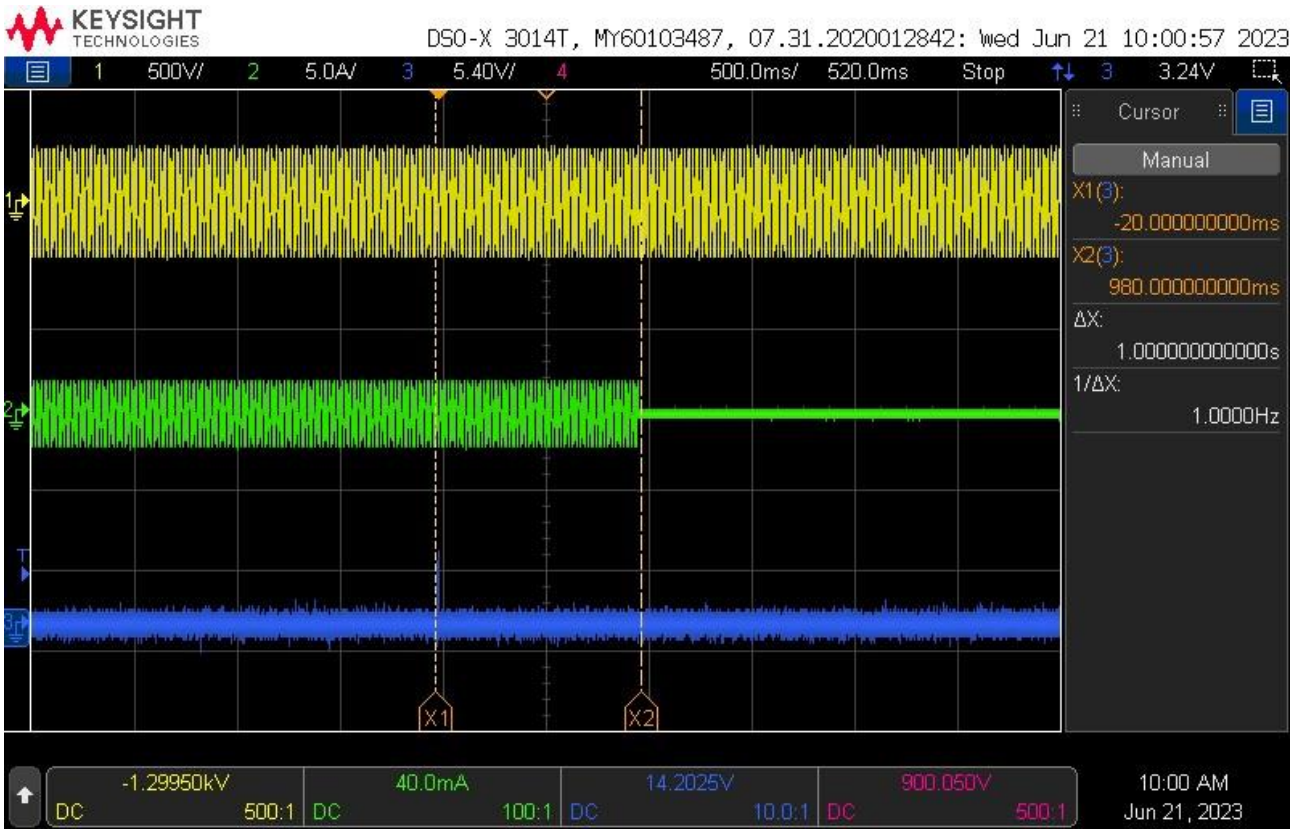


Figure 7 – Test O/F (Trip test)

6.6.2 Protection – Voltage tests

These tests should be carried out in accordance with EN 50438 Annex D.2.3 and the notes in EREC G98/NI Annex A1 A.1.2.2 (Inverter connected) or Annex A2 A.2.2.2 (Synchronous)						
Function	Setting		Trip test		"No trip tests"	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	0.85 pu (195.5 V)	3.0 s	196.46 V	3.04 s	199.5 V 5.0 s	No trip occurred
U/V stage 2	0.60 pu (138.0 V)	2.0 s	138.95 V	2.06 s	142.0 V 2.5 s	No trip occurred
					134 V 1.98 s	No trip occurred
O/V	1.10 pu (253.0 V)	0.5 s	252.92 V	0.518 s	249.0 V 5.0 s	No trip occurred
					257.0 V 0.45 s	No trip occurred

Note:

for voltage tests the Voltage required to trip is the setting ±3.45 V. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting ±4 V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

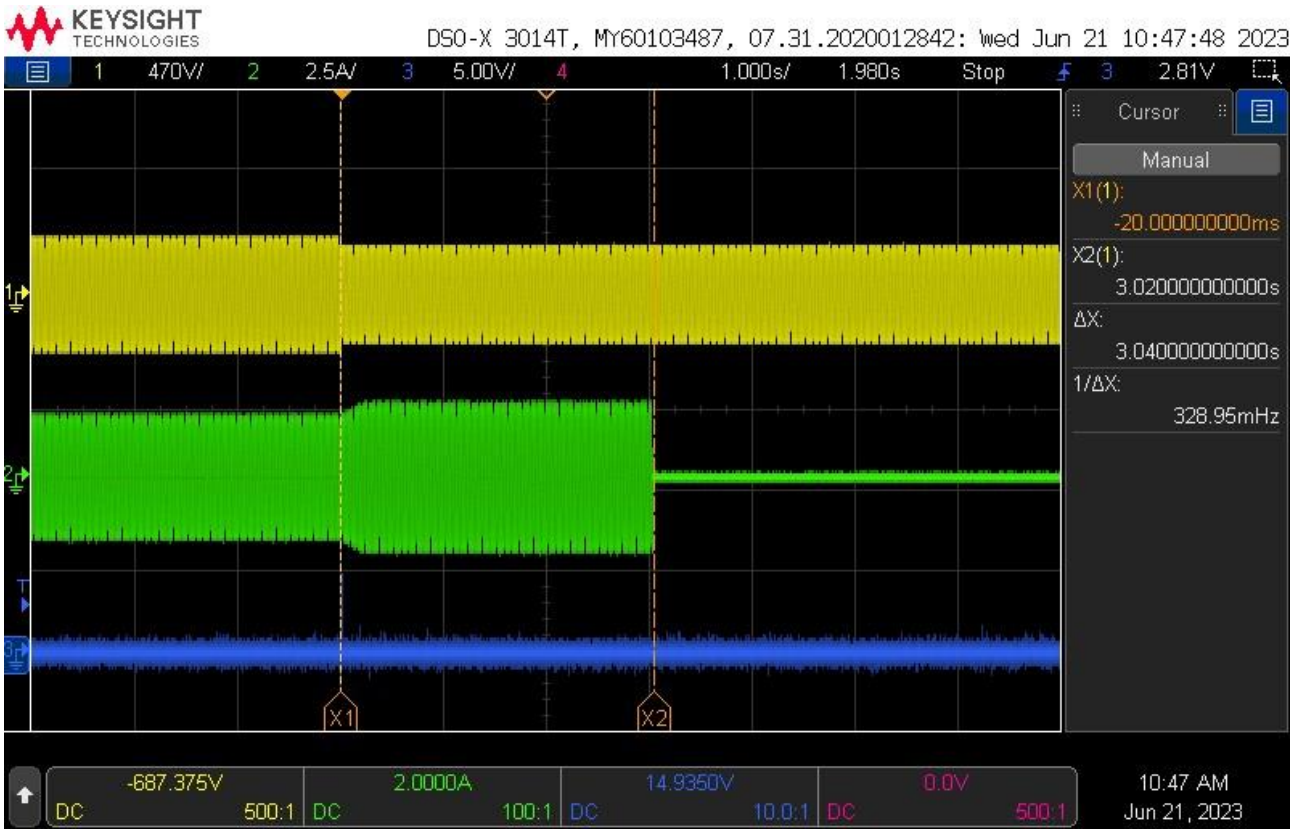


Figure 8 – Test U/V stage 1 (Trip test)

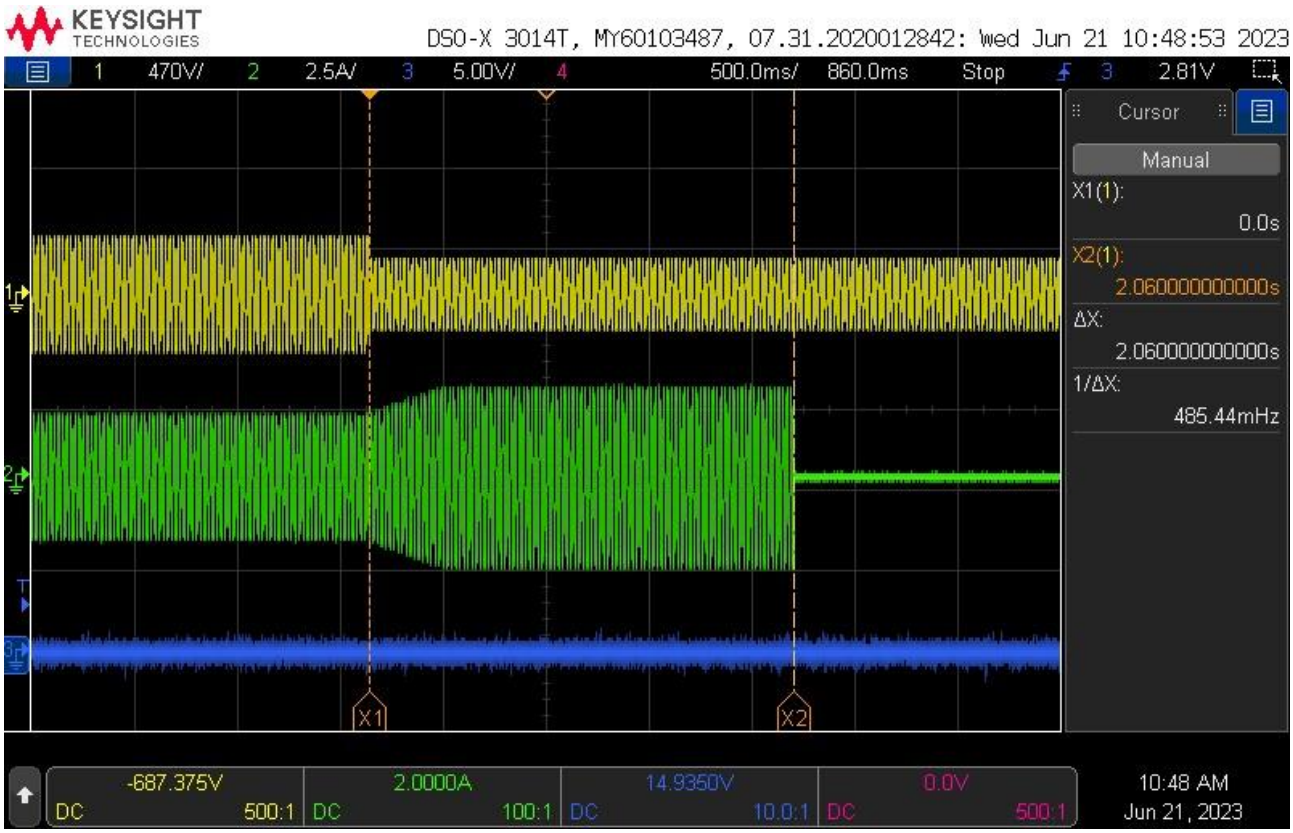


Figure 9 – Test U/V stage 2 (Trip test)

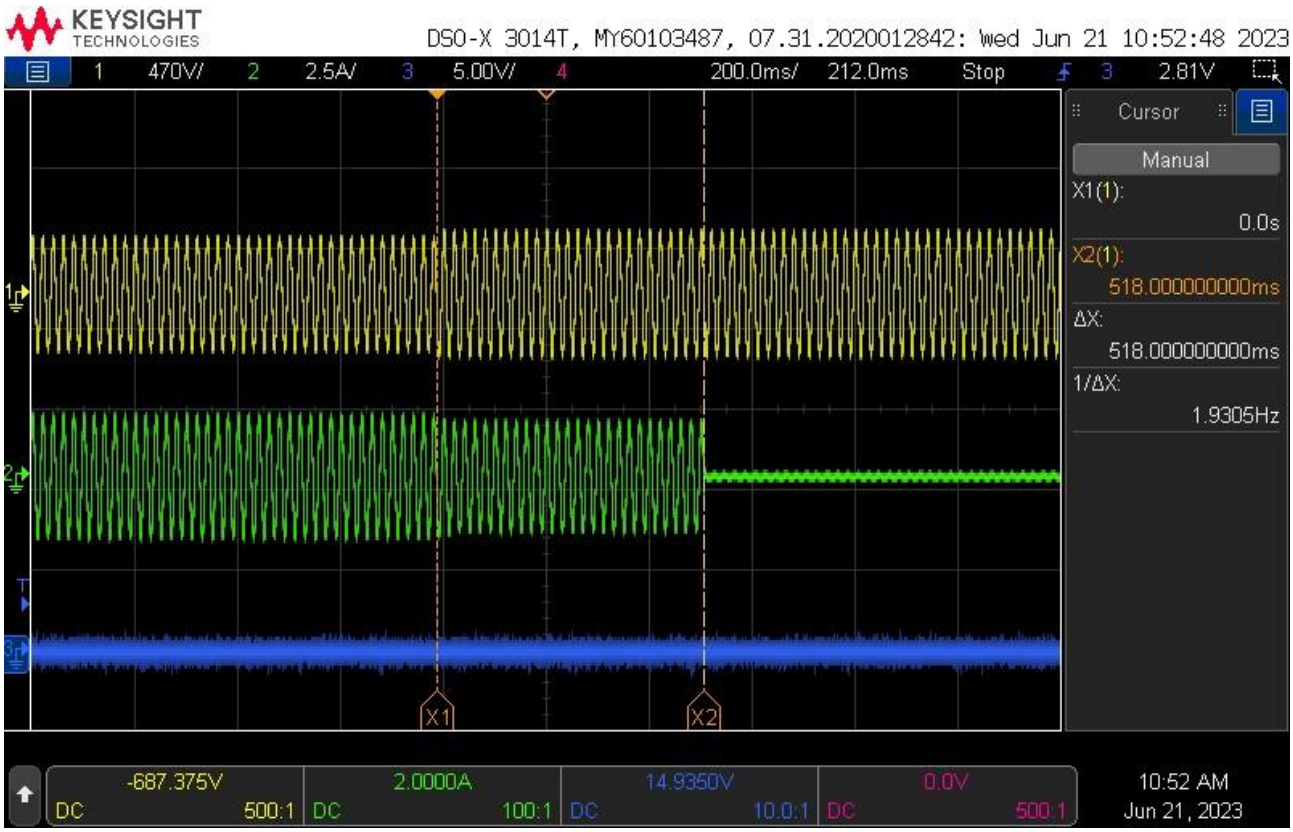


Figure 10 – Test O/V (Trip test)

6.6.3 Protection – Loss of Mains test

For PV **Inverter**s shall be tested in accordance with BS EN 62116. Other **Micro-generator**s should be tested in accordance with EN 50438 Annex D.2.5 at 10%, 55% and 100% of rated power.

☐ **Other Inverters (Describe (other than) Micro-generator type here)**

To be carried out at three output power levels with a tolerance of plus or minus 5% in Test Power levels.						
Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of **Registered Capacity**	95% of **Registered Capacity**	95% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**
Trip time [s]	---	---	---	---	---	---
Trip time limit [s]	0.5					
For Multi phase **Micro-generators** confirm that the device shuts down correctly after the removal of a single fuse as well as operation of all phases.						
Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of **Registered Capacity**	95% of **Registered Capacity**	95% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**
Trip time Ph1 fuse removed [s]	---	---	---	---	---	---
Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of **Registered Capacity**	95% of **Registered Capacity**	95% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**
Trip time Ph2 fuse removed [s]	---	---	---	---	---	---
Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of **Registered Capacity**	95% of **Registered Capacity**	95% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**
Trip time Ph3 fuse removed [s]	---	---	---	---	---	---
Trip time limit [s]	0.5					

Note: for technologies which have a substantial shut down time this can be added to the 0.5 s in establishing that the trip occurred in less than 0.5 s. Maximum shut down time could therefore be up to 1.0 s for these technologies.	
Indicate additional shut down time included in above results.	--- ms
Additional comments: ---	

☒ **Micro-generator** technology: PV **Inverter** [6]

The following sub set of tests should be recorded in the following table. **Micro-generator** technology						
Test Power and imbalance	33% -5%Q	66% -5%Q	100% -5%P	33% +5%Q	66% +5%Q	100% +5%P

[6] In this report, the PV inverter test method is applied to hybrid inverters (PV + DC-coupled energy storage).

	(Test 22)	(Test 12)	(Test 5)	(Test 31)	(Test 21)	(Test 10)
Trip time [s]	0.196	0.215	0.263	0.224	0.182	0.300
Trip time limit [s]	0.5s [7]					
Note: For full testing according to BS EN 62116 see *Annex 1 - Loss of Mains test according to BS EN 62116*.						

6.6.4 Protection – Frequency change, Vector Shift Stability test

This test should be carried out in accordance with EREC G98/NI Annex A1 A.1.2.6 (**Inverter** connected) or Annex A2 A.2.2.6 (Synchronous). Confirmation is required that the **Micro-generating Plant** does not trip under positive / negative vector shift.

The following sub set of tests should be recorded in the following table.

	Start Frequency	Change	Confirm no trip
Positive Vector Shift	49.5 Hz	+50 degrees	No trip occurred
Negative Vector Shift	50.5 Hz	- 50 degrees	No trip occurred

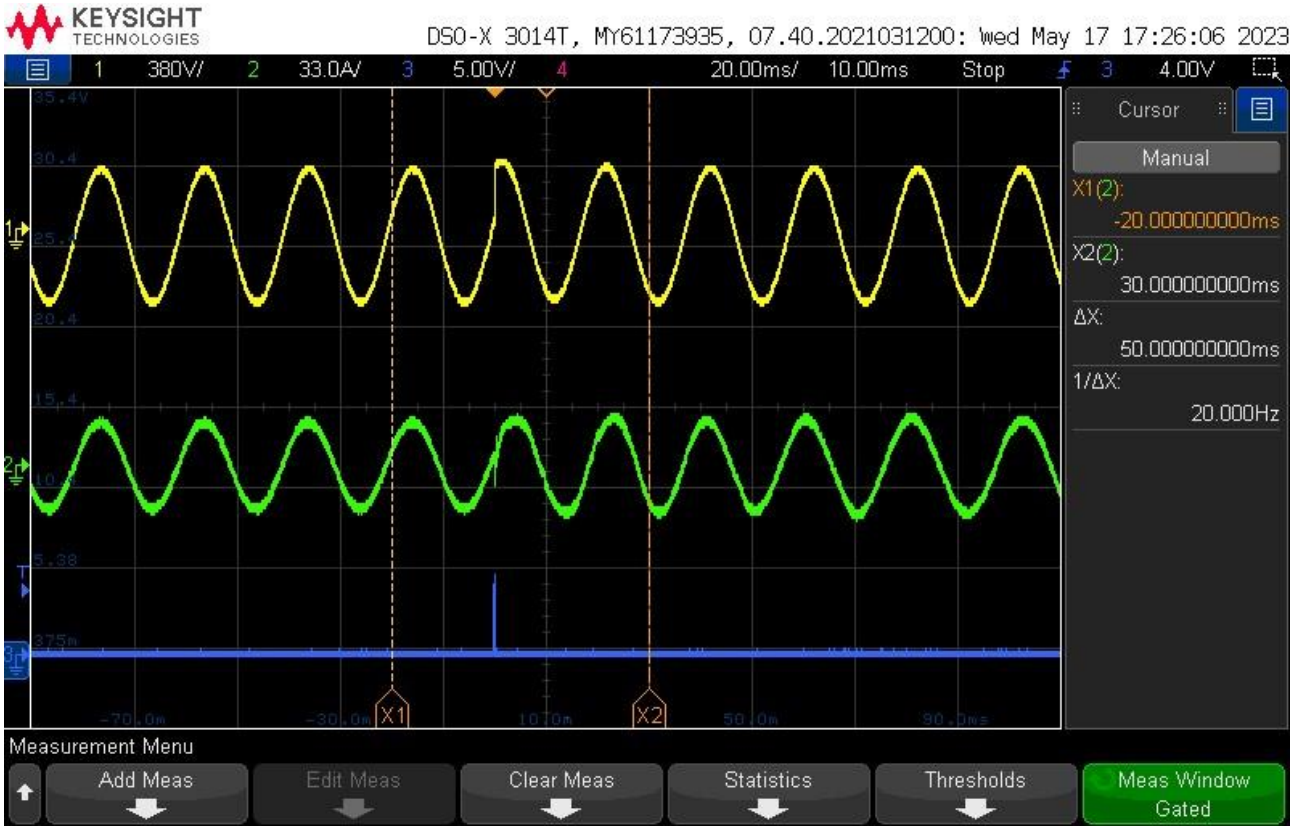


Figure 11 – Positive Step Change (+50 degrees)

[7] If the device requires additional shut down time (beyond 0.5 s but less than 1 s) then this should be stated on this form.

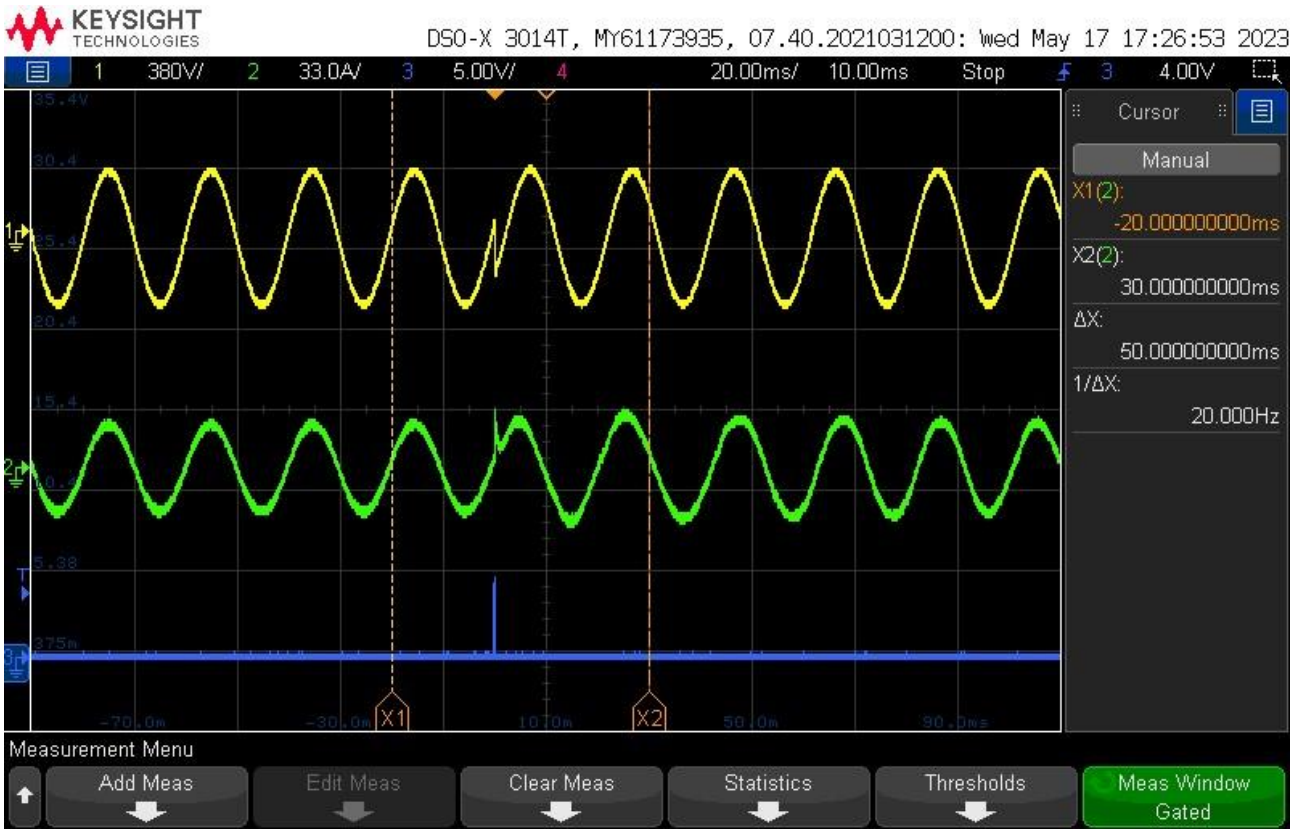


Figure 12 – Negative Step Change (-50 degrees)

6.6.5 Protection – Frequency change, RoCoF Stability test

The requirement is specified in section 11.3, test procedure in Annex A.1.2.6 (Inverter connected) or Annex A2 A.2.2.6 (Synchronous).			
The following sub set of tests should be recorded in the following table.			
Ramp range	Test frequency ramp:	Test Duration	Confirm no trip
49.0 Hz to 51.0 Hz	+0.95 Hz/s	2.1 s	No trip occurred
51.0 Hz to 49.0 Hz	-0.95 Hz/s	2.1 s	No trip occurred
Note: During the test, the LFSM-O function was activated.			

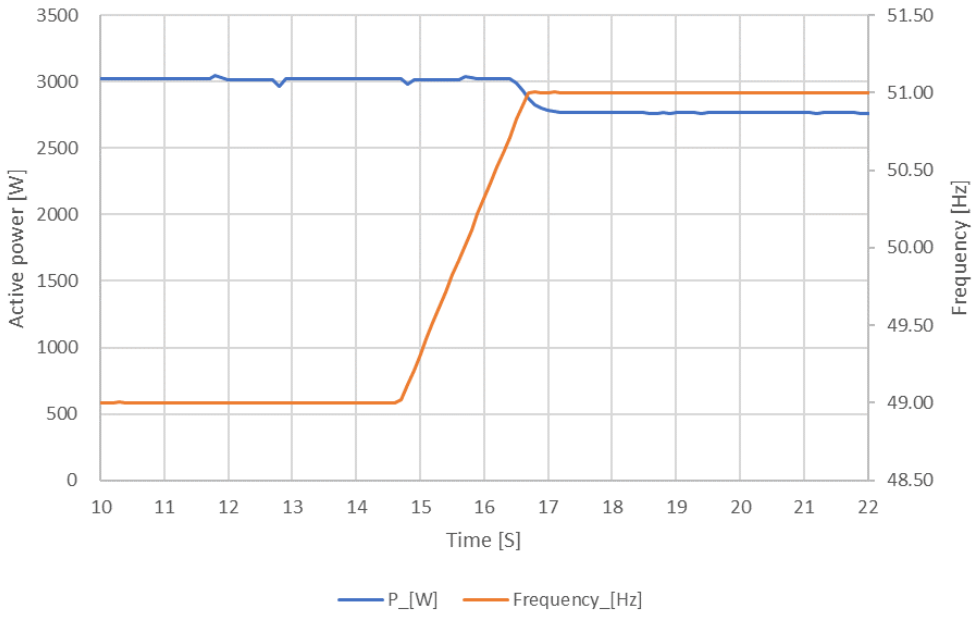


Figure 13 – Positive Frequency Drift (+0.95 Hz/s)

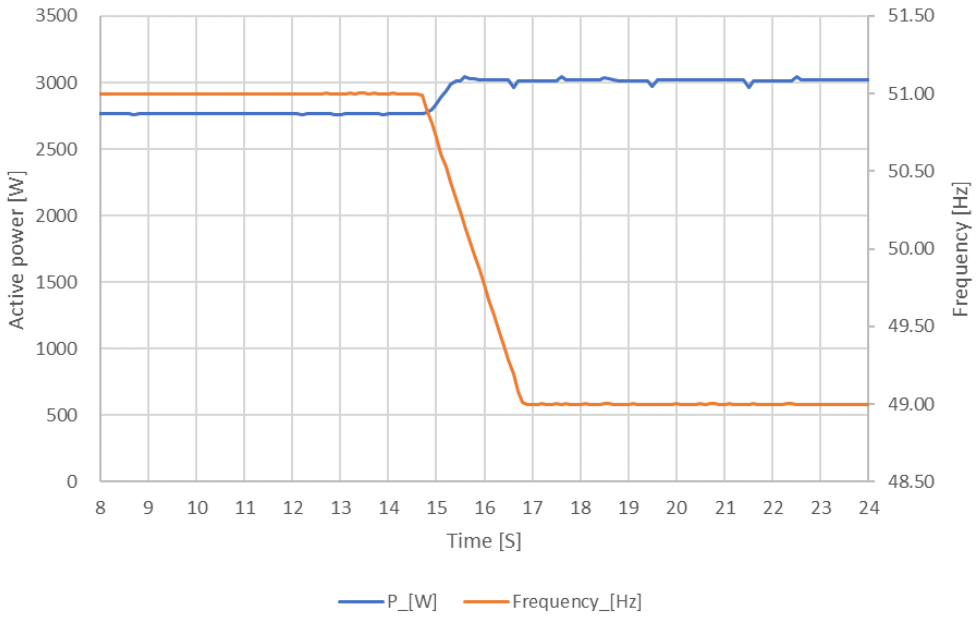


Figure 14 – Negative Frequency Drift (-0.95 Hz/s)

6.7 Limited Frequency Sensitive Mode – Overfrequency test

This test should be carried out in accordance with EN 50438 Annex D.3.3 Power response to over- frequency. The test should be carried out using the specific threshold frequency of 50.2 Hz and Droop of 4%.				
Test sequence at **Registered Capacity** >80%	Measured **Active Power** Output [W]	Frequency [Hz]	Primary Power Source [W]	**Active Power** Gradient Droop
Step a) 50.00Hz ± 0.01Hz	3026	50.00	3300	---
Step b) 50.25Hz ± 0.05Hz	2914	50.25		---
Step c) 50.70Hz ± 0.10Hz	2283	50.70		---
Step d) 51.15Hz ± 0.05Hz	1610	51.15		4.14% 1)
Step e) 50.70Hz ± 0.10Hz	2283	50.70		---
Step f) 50.25Hz ± 0.05Hz	2913	50.25		4.14% 2)
Step g) 50.00Hz ± 0.01Hz	3027	50.00		---
Test sequence at **Registered Capacity** 40% - 60%	Measured **Active Power** Output [W]	Frequency [Hz]	Primary Power Source [W]	**Active Power** Gradient Droop
Step a) 50.00Hz ± 0.01Hz	1530	50.00	1650	---
Step b) 50.25Hz ± 0.05Hz	1429	50.25		---
Step c) 50.70Hz ± 0.10Hz	796	50.70		---
Step d) 51.15Hz ± 0.05Hz	109	51.15		4.09% 1)
Step e) 50.70Hz ± 0.10Hz	796	50.70		---
Step f) 50.25Hz ± 0.05Hz	1433	50.25		4.09% 2)
Step g) 50.00Hz ± 0.01Hz	1530	50.00		---

Note:

* Test according to Annex A.7.1.3. Frequency/time plots attached (see Figure 15 & Figure 16)

1) Droop calculated using frequency and power between steps d) & b)

2) Droop calculated using frequency and power between steps f) & d)

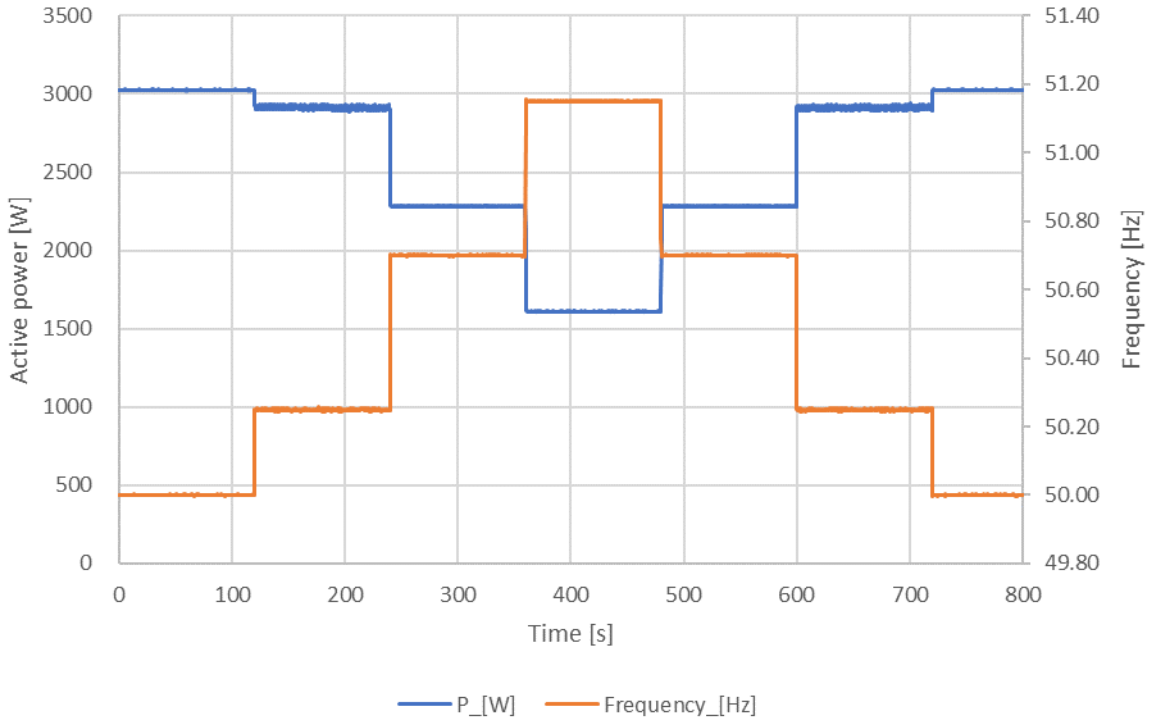


Figure 15 – Test sequence at Registered Capacity >80%

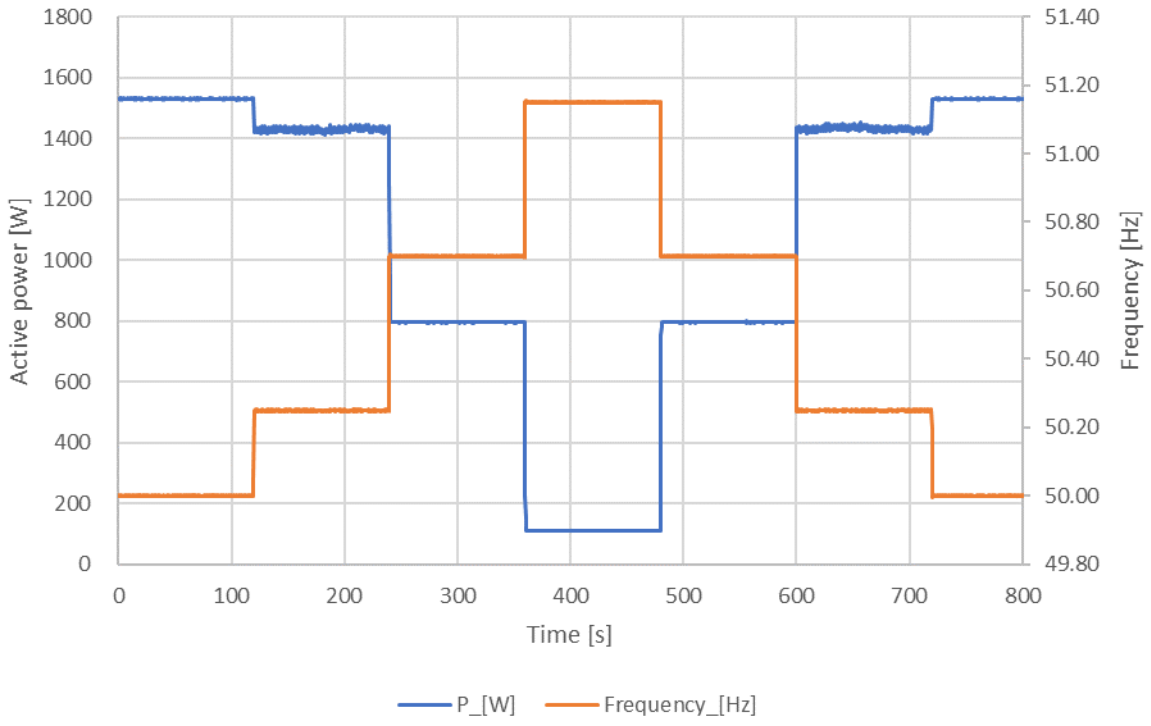


Figure 16 – Test sequence at Registered Capacity 40% - 60%

6.8 Power output with falling frequency test

This test should be carried out in accordance with EN 50438 Annex D.3.2 active power feed-in at under-frequency and under steady state conditions.

Test sequence	Measured **Active Power** Output [W]	Frequency [Hz]	Primary power source [W]
Test a) 50 Hz ± 0.01 Hz	3042	50.00	3130
Test b) Point between 49.5 Hz and 49.6 Hz	3042	49.55	3129
Test c) Point between 47.5 Hz and 47.6 Hz	3039	47.55	3127

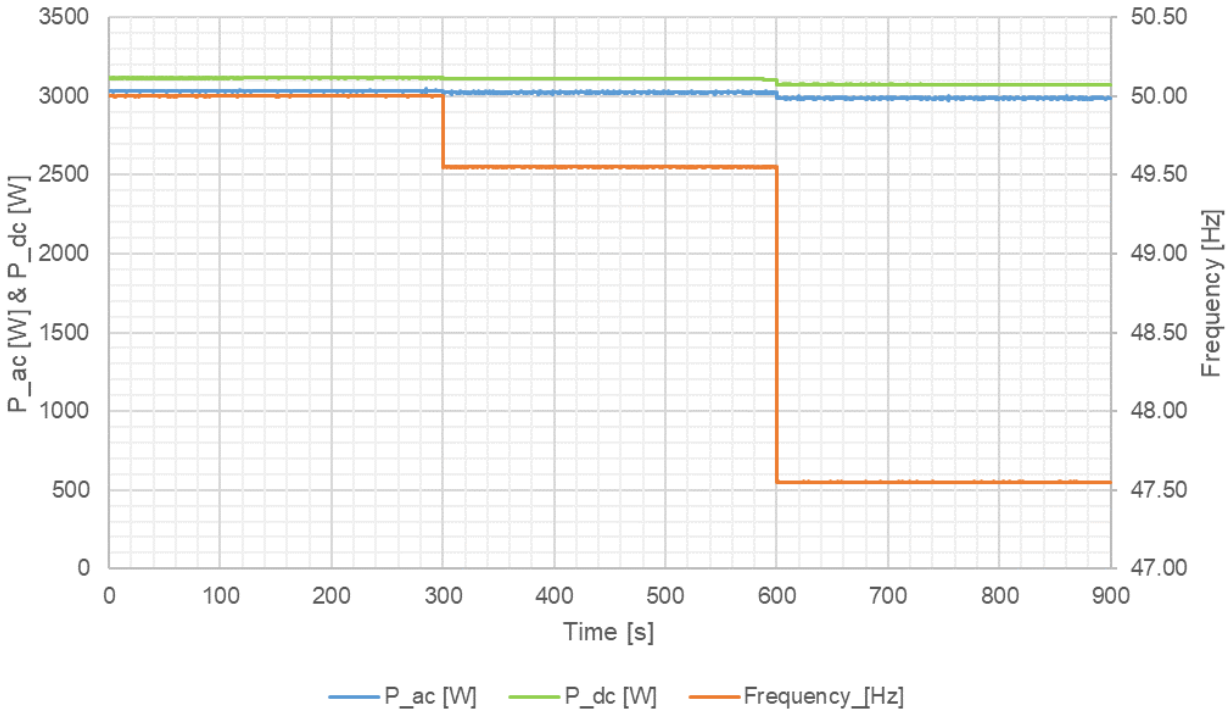


Figure 17 –Power output with falling frequency at Test a) →Test b) → Test c)

Note:
The operating point in Test (b) and (c) shall be maintained for at least 5 minutes.

6.9 Re-connection timer

Test should prove that the reconnection sequence starts after a minimum delay of 60 s for restoration of voltage and frequency to within the stage 1 settings of Table 2.

Time delay setting	Measured delay	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 2.			
60 s	70 s	At 1.12 pu (257.0 V **LV** connection)	At 0.83 pu (191.5 V **LV** connection)	At 47.9 Hz	At 52.1 Hz
Confirmation that the **Micro-generator** does not re-connect.		No reconnection occurred	No reconnection occurred	No reconnection occurred	No reconnection occurred

6.10 Fault level contribution

These tests shall be carried out in accordance with EREC G98/NI Annex A1 A.1.3.5 (**Inverter** connected) and Annex A2 A.2.3.4 (Synchronous). Please complete each entry, even if the fault contribution is zero.					
For machines with electro-magnetic output			For **Inverter** output		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	i_p	--	20 ms	39.6	11.38
Initial Value of aperiodic current	A	--	100 ms	21.0	0.77
Initial symmetrical short-circuit current*	I_k	--	250 ms	20.8	0.44
Decaying (aperiodic) component of short circuit current*	i_{DC}	--	500 ms	21.3	0.44
Reactance/Resistance Ratio of source*	X/R	--	Time to trip	0.015	In seconds
Note: For rotating machines and linear piston machines the test should produce a 0 s – 2 s plot of the short circuit current as seen at the **Micro-generator** terminals. * Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot					

6.11 Logic interface (input port)

Confirm that an input port is provided and can be used to reduce the **Active Power** output to zero	Yes
Provide high level description of logic interface, e.g. details in 9.4.3 such as AC or **DC** signal (the additional comments box below can be used)	Yes
Note: For details see “Additional comments.” Below.	

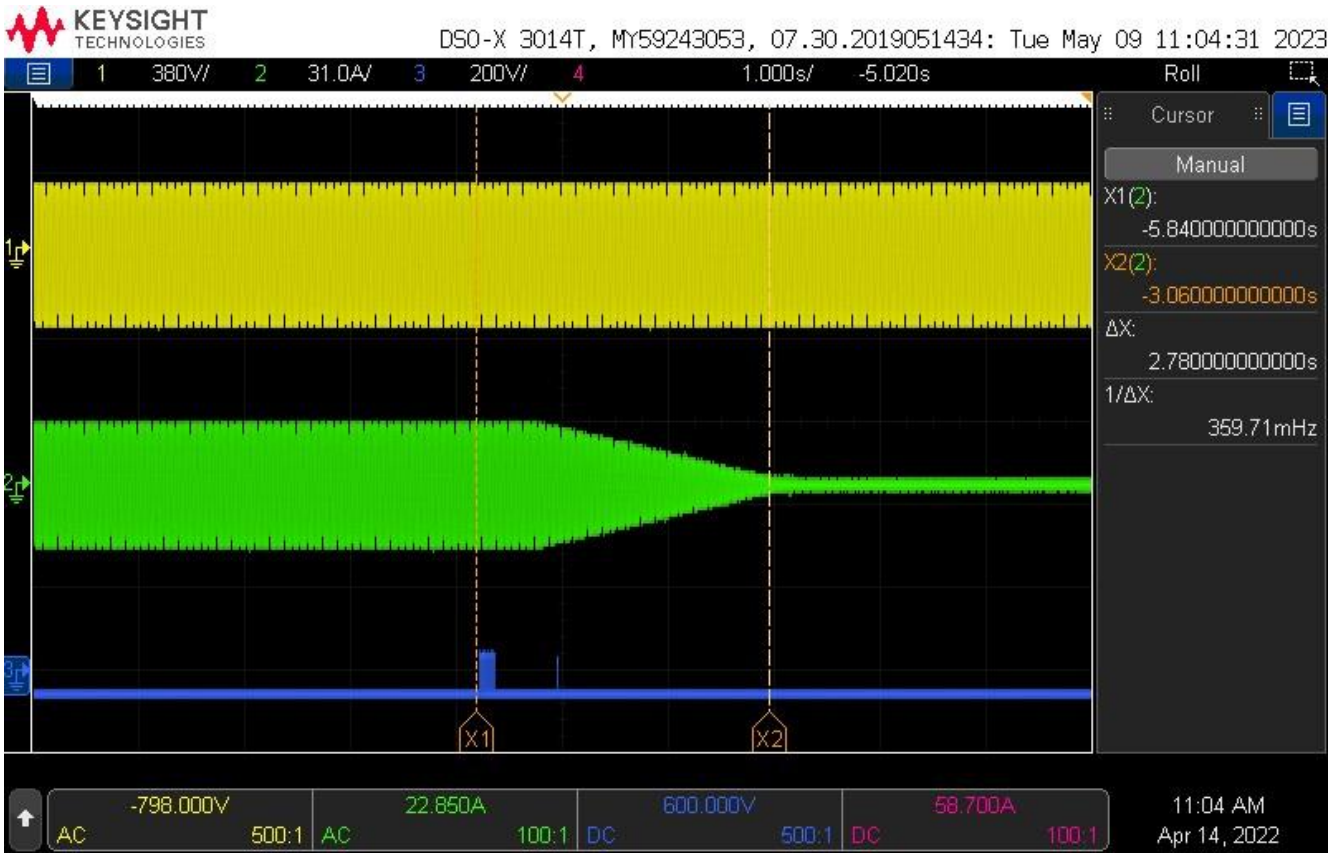


Figure 18 – Test ceasing active power output using logic interface

6.12 Self-Monitoring solid state switching

No specified test requirements. Refer to EREC G98/NI Annex A1 A.1.3.6 (**Inverter** connected).	
It has been verified that in the event of the solid state switching device failing to disconnect the **Micro-generator**, the voltage on the output side of the switching device is reduced to a value below 50 V within 0.5 s.	N/A
Note: The PGU used electromechanical relay to disconnect from the grid. No solid-state switching device available.	

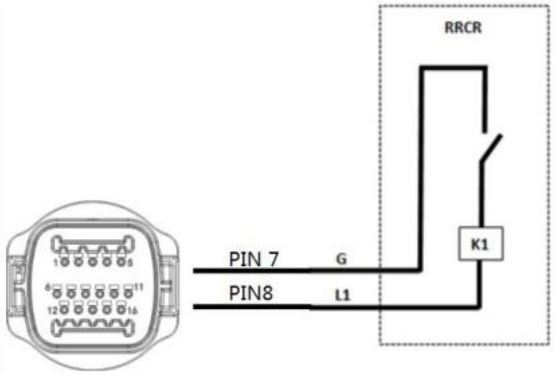
6.13 Cyber security (informative)

Confirm that the **Manufacturer** or **Installer** of the **Micro-generator** has provided a statement describing how the **Micro-generator** has been designed to comply with cyber security requirements, as detailed in 9.7.	Yes. Manufacturer's declaration provided. See *Annex 2 - Manufacturer's declaration regarding Cyber Security*.

Additional comments.

High level description of logic interface:

The PGU equipped with a logic interface for ceasing active power output within 5 s following an instruction being received. The following is a possible configuration (if another configuration is required, this can be agreed with the manufacturer):



where RRCR = Radio Ripple Control Receiver.

The signal from the Power Generating Module that is being switched can be either AC (maximum value 240 V) or DC (maximum value 110 V)

Function description of the terminal:

Pin NO.	Pin name	Description	Connected to (RRCR)
8	L1	Relay contact 1 input	K1 - Relay 1 output
7	G	GND	K1 - Relay 1 output

Relay status: close is 1, open is 0

L1	Active Power	Power drop rate	Cos(φ)
1	0%	<5 seconds	1
0	100%	/	1

Annex 1 - Loss of Mains test according to BS EN 62116

No.	P_{EUT} [a] (% of EUT rating)	Reactive load (% of Q_L in 6.1d)1))	P_{AC} [b] (% of nominal)	Q_{AC} [c] (% of nominal)	Run on time (ms)	P_{EUT} (W)	Actual Q_f	V_{DC} (V)	Remarks [d]
1	100	100	0	0	320	3003	1.001	352	Test A at BL
2	66	66	0	0	312	1988	1.000	288	Test B at BL
3	33	33	0	0	285	991	1.002	211	Test C at BL
4	100	100	-5	-5	254	3005	1.028	352	Test A at IB
5	100	100	-5	0	263	3001	1.054	352	Test A at IB
6	100	100	-5	+5	173	3002	1.080	352	Test A at IB
7	100	100	0	-5	282	3005	0.976	352	Test A at IB
8	100	100	0	+5	200	3001	1.026	352	Test A at IB
9	100	100	+5	-5	281	3003	0.930	352	Test A at IB
10	100	100	+5	0	300	3006	0.954	352	Test A at IB
11	100	100	+5	+5	267	3002	0.977	352	Test A at IB
12	66	66	0	-5	215	1991	0.975	288	Test B at IB
13	66	66	0	-4	267	1996	0.980	288	Test B at IB
14	66	66	0	-3	223	1994	0.985	288	Test B at IB
15	66	66	0	-2	253	1999	0.990	288	Test B at IB
16	66	66	0	-1	277	1994	0.995	288	Test B at IB
17	66	66	0	1	229	1993	1.005	288	Test B at IB
18	66	66	0	2	234	1996	1.010	288	Test B at IB
19	66	66	0	3	270	1994	1.015	288	Test B at IB
20	66	66	0	4	295	1995	1.020	288	Test B at IB
21	66	66	0	5	182	1998	1.025	288	Test B at IB
22	33	33	0	-5	196	991	0.977	211	Test B at IB
23	33	33	0	-4	239	994	0.982	211	Test B at IB
24	33	33	0	-3	203	993	0.987	211	Test B at IB
25	33	33	0	-2	207	995	0.992	211	Test B at IB
26	33	33	0	-1	260	997	0.997	211	Test B at IB
27	33	33	0	1	241	993	1.007	211	Test B at IB
28	33	33	0	2	251	992	1.012	211	Test B at IB
29	33	33	0	3	260	994	1.017	211	Test B at IB
30	33	33	0	4	225	995	1.022	211	Test B at IB
31	33	33	0	5	224	998	1.027	211	Test B at IB

[a] P_{EUT}: EUT output power.

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

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

[d] BL: balance condition, IB: imbalance condition.

Annex 2 - Manufacturer's declaration regarding Cyber Security (informative)

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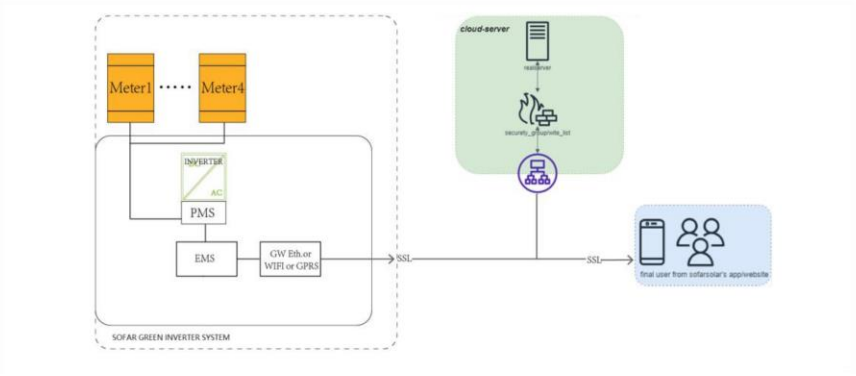
MIDEA DECLARATION

Declares the following:

1) The Midea Inverter include a system of internal and external logic communications as summarized in the following scheme:



where the main components involved and their main functions are explained in the following table:

acronym/ name	*meaning*	*function*	*location*
PMS	Power Management System	monitoring and management of power fluxes through the inverter, execution of EMS's commands or local logic functions depending on grid parameters values. Note: The PMS performs operational safety functions aimed at prevent physical damage/harm, typically by interrupting currents and/or opening contacts on some inverter ports when voltage, current or temperature limits are violated; no safety operation performed by PMS can be compromised/skypped by commands/signals originating outside the inverter.	inverter
EMS	Energy Management System	monitoring of all field's measures, calculus of power and currents for every component of the system, reception of external commands, transmission of commands to PMS. Note: No operational safety function aimed at preventing physical damage/harm is performed by the EMS; no operation performed by EMS can force the operational safety functions performed by PMS and electrical protections.	monitor board
GW	Gate-Way	transmission of data to cloud server, reception of commands/settings from external stakeholder.	Collector

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Meter	External Power Meter(s) (one to four)	*included in the supply*: meter at the PCC, and possible meter at AC port of third party generator/inverter, for power measures	PCC; third party inverter

2）All communications between internal components of the Midea Inverter, and between EMS and supplied External Power Meter(s), take place via appropriate serial lines (RS485, SCI) and are not directly connected to any device or system outside the Midea Inverter.

3）The only communication port between the device and the outside is constituted by the Gate-Way layer of a logic board on the machine, the communication between Midea Inverter and the outside world can take place via RS485 line, WiFi to the customer's request.

4）The direct recipients/senders of communications with the Midea Inverter is the in-cloud server of Midea Green Inverter - the communication is made secure by the use of TSL(Transport Layer Security) technology on collector, and by the use of SSL(Secure Sockets Layer) technology on Final User's device side and Installer/Midea service web-tools side.

5）All communications between the in-cloud server and the subjects/parties are cyber-protected by SSL technology.

6）The cyber-security assessment of the Midea Green Inverter was performed according to the ETSI EN 303 645 standard, and it is reported according to the Table B.1 form of the same standard:

EN 303 645 v2.1.1 (2020-06) Table B.1: Implementation of provisions for consumer IoT security			
Clause number and title			
Reference	Status	Support	Detail
5.1 No universal default passwords			
Provision 5.1-1	M C (1)	N/A	Device do not permit final user's login.
Provision 5.1-2	M C (2)	N/A	
Provision 5.1-3	M	N/A	
Provision 5.1-4	M C (8)	N/A	
Provision 5.1-5	M C (5)	N/A	
5.2 Implement a means to manage reports of vulnerabilities			
Provision 5.2-1	M	Y	
Provision 5.2-2	R	Y	
Provision 5.2-3	R	Y	
5.3 Keep software updated			

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Provision 5.3-1	R	Y	
Provision 5.3-2	M C (5)	Y	
Provision 5.3-3	M C (12)	Y	
Provision 5.3-4	R C (12)	Y	
Provision 5.3-5	R C (12)	N	The manufacturer manages the updates of the systems by means of remote automatisms, selectively by type of machine or by activating special functions at the request of the user
Provision 5.3-6	R C (9,12)	N	
Provision 5.3-7	M C (12)	Y	
Provision 5.3-8	M C (12)	Y	
Provision 5.3-9	R C (12)	N	See note at 5.3-5
Provision 5.3-10	M (11, 12)	Y	
Provision 5.3-11	R C (12)	Y	
Provision 5.3-12	R C (12)	N	The device failed to notify the user
Provision 5.3-13	M	Y	
Provision 5.3-14	R C (3, 4)	Y	
Provision 5.3-15	R C (3, 4)	N	
Provision 5.3-16	M	Y	
5.4 Securely store sensitive security parameters			
Provision 5.4-1	M	Y	
Provision 5.4-2	M C (10)	Y	
Provision 5.4-3	M	N/A	Hard-coded identity not used in source code
Provision 5.4-4	M	N	No unique key parameters are provided for the device
5.5 Communicate securely			
Provision 5.5-1	M	Y	
Provision 5.5-2	R	N	
Provision 5.5-3	R	N	
Provision 5.5-4	R	Y	
Provision 5.5-5	M	Y	
Provision 5.5-6	R	Y	
Provision 5.5-7	M	Y	
Provision 5.5-8	M	Y	
5.6 Minimize exposed attack surfaces			
Provision 5.6-1	M	Y	
Provision 5.6-2	M	Y	
Provision 5.6-3	R	Y	
Provision 5.6-4	M C (13)	N/A	No debug interface accessible
Provision 5.6-5	R	Y	
Provision 5.6-6	R	Y	
Provision 5.6-7	R	Y	

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Provision 5.6-8	R	N	The device don't have the access control mechanism
Provision 5.6-9	R	Y	
5.7 Ensure software integrity			
Provision 5.7-1	R	N	The device don't have the hardware root of trust
Provision 5.7-2	R	N	The device don't have the ability to be in administration mode
5.8 Ensure that personal data is secure			
Provision 5.8-1	R	N/A	No personal data transit through the device
Provision 5.8-2	M	Y	
Provision 5.8-3	M	Y	
5.9 Make systems resilient to outages			
Provision 5.9-1	R	Y	
Provision 5.9-2	R	Y	
Provision 5.9-3	R	Y	
5.10 Examine system telemetry data			
Provision 5.10-1	R C (6)	Y	
5.11 Make it easy for users to delete user data			
Provision 5.11-1	M	N/A	No user/personal data are stored in the device
Provision 5.11-2	R	N/A	
Provision 5.11-3	R	N/A	
Provision 5.11-4	R	N/A	
5.12 Make installation and maintenance of devices easy			
Provision 5.12-1	R	Y	
Provision 5.12-2	R	Y	
Provision 5.12-3	R	Y	
5.13 Validate input data			
Provision 5.13-1	M	Y	
6 Data protection provisions for consumer IoT			
Provision 6.1	M	N/A	No user/personal data are stored in the device
Provision 6.2	M C (7)	N/A	
Provision 6.3	M	N/A	
Provision 6.4	R C (6)	N/A	
Provision 6.5	M C (6)	N/A	

Conditions:
1) passwords are used; 2) pre-installed passwords are used; 3) software components are not updateable; 4) the device is constrained; 5) the device is not constrained;

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6) telemetry data being collected; 7) personal data is processed on the basis of consumers' consent; 8) the device allowing user authentication; 9) the device supports automatic updates and/or update notifications; 10) a hard-coded unique per device identity is used for security purposes; 11) updates are delivered over a network interface; 12) an update mechanism is implemented; 13) a debug interface is physically accessible.	
Status' Column:	
M	Mandatory provision
R	Recommended provision
M C	Mandatory and conditional provision
R C	Recommended and conditional provision
Support' Column:	
Y	Implemented
N	Not implemented
N/A	Not applicable

GD Midea Air-Conditioning Equipment Co., Ltd.

Singnature: Logan 数字签章专用

Date: 2023-10-08

Annex 3 - CE declaration

GL0223100700465

EU Declaration of Conformity

Product:

- **Hybird inverter**

Product models as follows:

- **EH-3K-A-M0**
- **EH-3.6K-A-M0**
- **EH-4K-A-M0**
- **EH-4.6K-A-M0**
- **EH-5K-A-M0-A**
- **EH-5.5K-A-M0**
- **EH-6K-A-M0**

Manufacturer: **GD Midea Air-Conditioning Equipment Co., Ltd.**

Address: Lingang Road, Beijiao, Shunde, Foshan, 528311, Guangdong, China

This declaration of conformity is issued under the sole responsibility of the manufacturer. In addition, the product is within the manufacturer's warranty period.

CE

The object of the declaration described above is in conformity with the relevant Union harmonisation legislation: The Low Voltage Directive (LVD)

2014/35/EU and the Electromagnetic Compatibility (EMC) Directive 2014/30/EU.

References to the relevant harmonized standards used or references to the other technical

specifications in relation to which conformity is declared:

LVD:	
IEC/EN 62109-1:2010	•
IEC/EN 62109-2:2011	•
EMC:	
EN IEC 61000-6-4:2019	•
EN IEC 61000-6-3:2021	•
EN IEC 61000-6-2:2019	•
EN IEC 61000-6-1:2021	•

Date： 2023.10.[illegible]

Name: 黄晓锋（Logan）

Charge: Manager

Signature:

Manufacture Seal

Annex 4 - Proof of conformity of the protection relay

Note:

The full version of the attached document is available at the laboratory for reference.

Relay model: AZSR250-2AE-12D

VDE Prüf- und Zertifizierungsinstitut

ZEICHENGENEHMIGUNG
MARKS APPROVAL

Zettler electronics GmbH
Junkersstraße 3
82178 Puchheim
Germany

ist berechtigt, für ihr Produkt /
is authorized to use for their product

Elektromechanisches Elementarrelais
Electromechanical elementary relay

die hier abgebildeten markenrechtlich geschützten Zeichen
für die ab Blatt 2 aufgeführten Typen zu benutzen /
the legally protected Marks as shown below for the types referred to on page 2 ff.

Geprüft und zertifiziert nach /
Tested and certified according to

DIN EN 61810-1 (VDE 0435-201):2015-10; EN 61810-1:2015
DIN EN 61810-1/A1 (VDE 0435-201/A1):2020-08; EN 61810-1:2015/A1:2020

Das Produkt erfüllt auch die Anforderungen nach /
The product also fulfills the requirements of

IEC 61810-1:2015
IEC 61810-1:2015/AMD1:2019

Aktenzeichen: 2036900-4940-0018 / 299905
File ref.:

VDE Prüf- und Zertifizierungsinstitut GmbH
VDE Testing and Certification Institute
Zertifizierungsstelle / *Certification*

Ausweis-Nr. 40033251 Blatt 1
Certificate No. *Page*

Weitere Bedingungen siehe Rückseite und Folgeblätter /
further conditions see overleaf and following pages

Offenbach, 2011-09-01
(letzte Änderung / updated 2022-10-17)

M. Tasotti

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VDE certificates are valid only when published on:

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VDE Prüf- und Zertifizierungsinstitut Zeichengenehmigung

Ausweis-Nr. / *Certificate No.* 40033251 — Blatt / *Page* 2

Name und Sitz des Genehmigungs-Inhabers / *Name and registered seat of the Certificate holder*
Zettler electronics GmbH, Junkersstraße 3, 82178 Puchheim

Aktenzeichen / *File ref.*	letzte Änderung / *updated*	Datum / *Date*
2036900-4940-0018 / 299905 / TL3 / MIM	2022-10-17	2011-09-01

Dieses Blatt gilt nur in Verbindung mit Blatt 1 des Zeichengenehmigungsausweises Nr. 40033251.
This supplement is only valid in conjunction with page 1 of the Certificate No. 40033251.

Elektromechanisches Elementarrelais
Electromechanical elementary relay

Typ(en) / *Type(s)*

AZSR235-Serie(s)
AZSR250-Serie(s)
AZSR235-L-Serie(s)

Weitere Angaben *Further information*	siehe Anlage Nr.: 100A; 200A; 200B; 200C; 300A; 500A; 500C; 1000 vom 2022-10-17 *see appendix no.: 100A; 200A; 200B; 200C; 300A; 500A; 500C; 1000 dated 2022-10-17*
Hinweis *Notice*	Prüfverfahren: A (3 Prüflinge; Gruppenmontage) *Test procedure: A (3 samples; Group mounting)*

VDE Prüf- und Zertifizierungsinstitut GmbH * Testing and Certification Institute
Merianstrasse 28, D-63069 Offenbach
Telefon +49 (0) 69 83 06-0
Telefax +49 (0) 69 83 06-555

Relay model: HF115F/012-2ZS4

VDE Prüf- und Zertifizierungsinstitut

ZEICHENGENEHMIGUNG
MARKS APPROVAL

Xiamen Hongfa
Electroacoustics Co., Ltd.
No. 91-101 Sunban South Road
Jimei North Ind. District
361021 XIAMEN
CHINA

ist berechtigt, für ihr Produkt /
is authorized to use for their product

Elektromechanisches Elementarrelais
Electromechanical elementary relay

die hier abgebildeten markenrechtlich geschützten Zeichen
für die ab Blatt 2 aufgeführten Typen zu benutzen /
the legally protected Marks as shown below for the types referred to on page 2 ff.

Geprüft und zertifiziert nach /
Tested and certified according to

DIN EN 61810-1 (VDE 0435-201):2015-10; EN 61810-1:2015
IEC 61810-1:2015

Aktenzeichen: 1812200-4940-0005 / 235396
File ref.:

VDE Prüf- und Zertifizierungsinstitut GmbH
VDE Testing and Certification Institute
Zertifizierungsstelle / *Certification*

Ausweis-Nr. 116934 Blatt 1
Certificate No. *Page*

Weitere Bedingungen siehe Rückseite und Folgeblätter /
further conditions see overleaf and following pages

Offenbach, 1999-09-13
(letzte Änderung / updated 2017-04-28)

R. Nickel

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Ausweis-Nr. / *Certificate No.* 116934 — Blatt / *Page* 2

Name und Sitz des Genehmigungs-Inhabers / *Name and registered seat of the Certificate holder*
Xiamen Hongfa Electroacoustics Co., Ltd., No. 91-101 Sunban South Road, Jimei North Ind. District, 361021 XIAMEN, Fujian, CHINA

Aktenzeichen / *File ref.*	letzte Änderung / *updated*	Datum / *Date*
1812200-4940-0005 / 235396 / CC1 / MIM	2017-04-28	1999-09-13

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This supplement is only valid in conjunction with page 1 of the Certificate No. 116934.

Elektromechanisches Elementarrelais
Electromechanical elementary relay

Typ(en) / *Type(s)*

HF115F Serie(s)
HF115F-H Serie(s)
HF115F-T Serie(s)
HF115F-TH Serie(s)
HF115F-Q Serie(s)
HF115F-A Serie(s)
HF115FP Serie(s)
HF115FD Serie(s)
HF115F-S Serie(s)
HF115F-L Serie(s)
HF115FK Serie(s)
HF115FK-T Serie(s)
HF115F-LS Serie(s)
HF115F-I Serie(s)

Weitere Angaben	siehe Anlage Nr.: 100A; 200A; 200B; 200C; 300A; 300B; 300C; 400A; 500A; 500B; 500C; 500D; 500E; 500F; 500I; 500Q; 500S; 1000 vom 2017-04-28
Further information	*see Appendix No.: 100A; 200A; 200B; 200C; 300A; 300B; 300C; 400A; 500A; 500B; 500C; 500D; 500E; 500F; 500I; 500Q; 500S; 1000 dated 2017-04-28*
Anmerkung *Remark*	Alternative Basisbezeichnung siehe Anlage Nr. 100A *Alternative basic designation see Appendix No. 100A*
Hinweis *Notice*	Prüfverfahren: A (3 Prüflinge; Gruppenmontage) *Test procedure: A (3 samples; Group mounting)*

Fortsetzung siehe Blatt 3 /
continued on page 3

Relay model: HF161F-W/12-TH(477)

VDE Prüf- und Zertifizierungsinstitut

ZEICHENGENEHMIGUNG
MARKS APPROVAL

Xiamen Hongfa
Electroacoustic Co., Ltd.
No. 91-101 Sunban South Road
Jimei North Ind. District
361021 XIAMEN
Fujian China
ist berechtigt, für ihr Produkt /
is authorized to use for their product

Elektromechanisches Elementarrelais
Electromechanical elementary relay

die hier abgebildeten markenrechtlich geschützten Zeichen
für die ab Blatt 2 aufgeführten Typen zu benutzen /
the legally protected Marks as shown below for the types referred to on page 2 ff.

Geprüft und zertifiziert nach /
Tested and certified according to

DIN EN 61810-1 (VDE 0435-201):2015-10; EN 61810-1:2015
IEC 61810-1:2015

Aktenzeichen: 1812200-4940-0038 / 271479
File ref.:

VDE Prüf- und Zertifizierungsinstitut GmbH
VDE Testing and Certification Institute
Zertifizierungsstelle / *Certification*

Ausweis-Nr. 40031410 Blatt 1
Certificate No. *Page*

Weitere Bedingungen siehe Rückseite und Folgeblätter /
further conditions see overleaf and following pages

Offenbach, 2010-11-23
(letzte Änderung / updated 2020-05-07)

M. Tasotti

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Ausweis-Nr. / *Certificate No.* 40031410 | Blatt / *Page* 2

Name und Sitz des Genehmigungs-Inhabers / *Name and registered seat of the Certificate holder*
Xiamen Hongfa Electroacoustic Co., Ltd., No. 91-101 Sunban South Road, Jimei North Ind. District, 361021 XIAMEN, Fujian, CHINA

Aktenzeichen / *File ref.*	letzte Änderung / *updated*	Datum / *Date*
1812200-4940-0038 / 271479 / TL3 / MIM	2020-05-07	2010-11-23

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This supplement is only valid in conjunction with page 1 of the Certificate No. 40031410.

Elektromechanisches Elementarrelais
Electromechanical elementary relay

Typ(en) / *Type(s)*

HF161F Serie(s)
HF161F-W Serie(s)

Weitere Angaben *Further information*	siehe Anlage Nr.: 100A; 200A; 200B; 200C; 300A; 300B; 300C; 500C; 1000 vom 2020-05-07 *see Appendix No.: 100A; 200A; 200B; 200C; 300A; 300B; 300C; 500C; 1000 dated 2020-05-07*
Hinweis *Notice*	Prüfverfahren: A (3 Prüflinge; Gruppenmontage) *Test procedure: A (3 samples; Group mounting)*

VDE Prüf- und Zertifizierungsinstitut GmbH
VDE Testing and Certification Institute
Fachgebiet TL3
Section TL3

VDE Prüf- und Zertifizierungsinstitut
Zeichengenehmigung / Gutachten mit Fertigungsüberwachung

Rubrik / *Rubric*	Ausweis-Nr. / *Certificate No.*	Anlage / *Appendix*
341	40031410	100A

Name und Sitz des Genehmigungs-Inhabers / *Name and registered seat of the Certificate holder*

Xiamen Hongfa, Electroacoustic Co., Ltd., No. 91-101 Sunban South Road, Jimei North Ind. District, 361021 XIAMEN, Fujian China

Aktenzeichen / *File ref.*	letzte Änderung / *updated*	Datum / *Date*
1812200-4940-0038/271479/TL3/MIM	2020-05-07	2010-11-23

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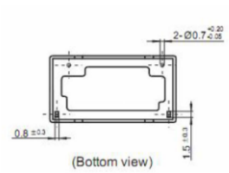
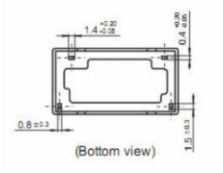
This supplement is only valid in conjunction with page 1 of the Certificate No. 40031410

Elektromechanisches Elementarrelais ***Electromechanical elementary relay***	**Typenschlüssel** ***Nomenclature***	
Beispiel: *Example:*	HF161F / 12 - H T XXX I II III IV V	
I Grundtype *Basic series*	HF161F	
II Spulenspannung *Coil voltage*	5 = 5VDC; 12 = 12VDC; 24 = 24VDC; 48 = 48VDC	
III Kontaktart *Kind of contact*	H: 1 Form A	
IV Kontaktmaterial *Contact material*	Blank: AgCdO T: $AgSnO_2$ (letter (T) may be put on behind of lot No.)	
V Spezieller Kode *Special code*	Gegebenfalls weitere Buchstaben und/oder Zahlen. Kundenvariante oder Anforderung. Hat keinen konstruktiven Einfluss ! Ausnahme: 414 = Spezieller Lötanschluß (siehe Zeichnung) 769 = Luftstrecke zwischen Kontakt und Spule 8,0 mm	*May be followed by additional letters and/or numbers.* *Customer code or requirements. „Does not affect the construction"* *Exception:* *414 = Special coil terminal (see drawing)* *769 = Coil – contact clearance gap 8.0 mm*

Standard version



Special version with 414



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Zeichengenehmigung / Gutachten mit Fertigungsüberwachung

Rubrik / *Rubric*	Ausweis-Nr. / *Certificate No.*	Anlage / *Appendix*
341	40031410	100A

Name und Sitz des Genehmigungs-Inhabers / *Name and registered seat of the Certificate holder*

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Aktenzeichen / *File ref.*	letzte Änderung / *updated*	Datum / *Date*
1812200-4940-0038/271479/TL3/MIM	2020-05-07	2010-11-23

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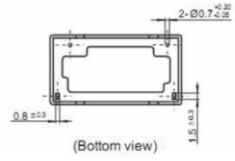
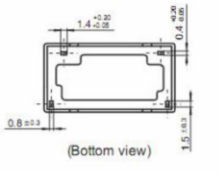
Elektromechanisches Elementarrelais ***Electromechanical elementary relay***	**Typenschlüssel** ***Nomenclature***	
Beispiel: *Example:*	HF161F-W / 12 - H T XXX I II III IV V	
I Grundtype *Basic series*	HF161F-W (Große Kontaktöffnungsweite / *Wide contact gap*)	
II Spulenspannung *Coil voltage*	9 = 9VDC; 12 = 12VDC; 18 = 18VDC; 24 = 24VDC	
III Kontaktart *Kind of contact*	H: 1 Form A	
IV Kontaktmaterial *Contact material*	T: $AgSnO_2$	
V Spezieller Kode *Special code*	Gegebenfalls weitere Buchstaben und/oder Zahlen. Kundenvariante oder Anforderung. Hat keinen konstruktiven Einfluss ! Ausnahmen: 414 = Spezieller Lötanschluß (siehe Zeichnung) 477 = Größere Kontaktöffnungsweite 1,8 mm 456 = Größere Kontaktöffnungsweite 2,0 mm 704 = Größere Kontaktöffnungsweite 2,3 mm	*May be followed by additional letters and/or numbers.* *Customer code or requirements. „Does not affect the construction"* *Exceptions:* *414 = Special coil terminal (see drawing)* *477 = Wider contact gap 1.8 mm* *456 = Wider contact gap 2.0 mm* *704 = Wider contact gap 2.3 mm*

Standard version



Special version with 414



Relay model: HFD3/5

VDE Prüf- und Zertifizierungsinstitut

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MARKS APPROVAL

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Elektromechanisches Elementarrelais
Electromechanical elementary relay
HFD3, HFD3-V

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IEC 61810-1(ed.3)

Aktenzeichen: 1812200-4940-0020 / 200166
File ref.:

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Ausweis-Nr. 40018867 Blatt 1
Certificate No. *Page*

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Aktenzeichen / *File ref.*	letzte Änderung / *updated*	Datum / *Date*
1812200-4940-0020 / 200166 / CC1 / MIM	2015-07-21	2006-09-13

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This supplement is only valid in conjunction with page 1 of the Certificate No. 40018867.

Elektromechanisches Elementarrelais
Electromechanical elementary relay
HFD3, HFD3-V

Typ(en) / *Type(s)*

1] **HFD3-.(-;V) /.(-;S;S1;S2;S3).(-;R)**
2] **HFD3-.(-;V) /..-L1.(-;S;S1;S2;S3).(-;R)**
3] **HFD3-.(-;V) /..-L2.(-;S;S1;S2;S3).(-;R)**

Weitere Angaben *Further information*	siehe Anlage Nr.: 100A; 200A; 200B; 200C; 300A; 500H vom 2015-07-21 *see Enclosure No.:* *100A; 200A; 200B; 200C; 300A; 500H dated 2015-07-21*
Anmerkung(en) *Remark(s)*	Die mit „." gekennzeichneten Stellen sind Variablen, welche in der Anlage 100A (Typenschlüssel) beschrieben sind. *Positions marked as „." are variables which are described in appendix 100A (Nomenclature).*

VDE Prüf- und Zertifizierungsinstitut GmbH
VDE Testing and Certification Institute
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Section CC1

VDE Prüf- und Zertifizierungsinstitut GmbH * Testing and Certification Institute
Merianstrasse 28, D-63069 Offenbach
Phone +49 (0) 69 83 06-0
Telefax +49 (0) 69 83 06-555

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Ausweis-Nr. / *Certificate No.* 40018867

Beiblatt / *Supplement*

Name und Sitz des Genehmigungs-Inhabers / *Name and registered seat of the Certificate holder*
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Aktenzeichen / *File ref.*	letzte Änderung / *updated*	Datum / *Date*
1812200-4940-0020 / 200166 / CC1 / MIM	2015-07-21	2006-09-13

Dieses Beiblatt ist Bestandteil des Zeichengenehmigungsausweises Nr. 40018867.
This supplement is part of the Certificate No. 40018867.

Elektromechanisches Elementarrelais
Electromechanical elementary relay
HFD3, HFD3-V

Fertigungsstätte(n)
Place(s) of manufacture

Referenz/*Reference*	
30003532	Xiamen Hongfa Electroacoustics Co., Ltd. No. 91-101 Sunban South Road Jimei North Ind. District 361021 XIAMEN Fujian CHINA

VDE Prüf- und Zertifizierungsinstitut GmbH
VDE Testing and Certification Institute
Fachgebiet CC1
Section CC1

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Ausweis-Nr. / *Certificate No.* 40018867

Infoblatt / *Info sheet*

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1812200-4940-0020 / 200166 / CC1 / MIM	2015-07-21	2006-09-13

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The approval is solely signed on the first page.

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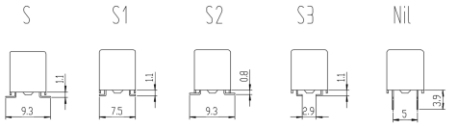
Aktenzeichen: *File reference:*	1812200-4940-0020 / 200166	Ausweis-Nr.: *Certificate No.:*	40018867	Anlage Nr.: *Appendix No.:*	100A	Seite: *Page:*	1 / 1	Datum: *Date:*	2015-07-21

Diese Anlage ist Bestandteil des Genehmigungsausweises. *This appendix is part of the certificate.*

Elektromechanisches Elementarrelais ***Electromechanical elementary relay***	
Beispiel: *Example:*	HFD3 / 12 L1 S R XXX I II III IV V VI
I Grundtype *Basic series*	HFD3 HFD3-V
II Spulenspannung *Coil voltage*	1.5=1.5VDC; 2.4 = 2.4VDC ; 3 = 3VDC ; 4.5 = 4.5VDC ; 5 = 5VDC ; 6 = 6VDC ; 9 = 9VDC ; 12 = 12VDC; 24 = 24VDC;48=48VDC
III Spulenansteuerung *Operating Function*	Blank: Single side Stable L1: 1 coil latching L2: 2 coils latching
IV Anschlüsse *Termination*	Blank: Standard PCB terminal S: Surface Mounting Terminal (Inside L 9.3x1.1mm) S1: Surface Mounting Terminal (Inside L 7.5x1.1mm) S2: Surface Mounting Terminal (Inside L 9.3x0.8mm) S3 Surface Mounting Terminal (outside L 2.9x1.1mm)
V Verpackung *Packing*	Blank: Tube packing R: Reel and Tape packing
VI Special code *Special code*	May be followed by additional letters and/or numbers Example: Customer code or requirements „Does not affect the construction“

Terminal drawing:



VDE Prüf- und Zertifizierungsinstitut GmbH Fachbereich CC1
VDE Testing and Certification Institute Department CC1

Relay model: CHZ05-S-212LC2

Zertifikat *Certificate*

TÜVRheinland®

Zertifikat Nr. *Certificate No.*
R 50212872

Blatt *Page*
0001

Ihr Zeichen *Client Reference*	Unser Zeichen *Our Reference*	Ausstellungsdatum	*Date of Issue (day/mo/yr)*
	05-YW- 16032578 001	15.09.2011	

Genehmigungsinhaber *License Holder*
Dongguan Churod Electronics
Co., Ltd.
Xinlong Road 9# Factory
Lincun District, Tangxia
Dongguan, Guangdong
P.R. China

Fertigungsstätte *Manufacturing Plant*
Dongguan Churod Electronics
Co., Ltd.
Xinlong Road 9# Factory
Lincun District, Tangxia
Dongguan, Guangdong
P.R. China

Prüfzeichen *Test Mark*
www.tuv.com TÜVRheinland ID:2000000000 • BAUART GEPRÜFT • TYPE APPROVED

Geprüft nach *Tested acc. to*
EN 61810-1:2008

Zertifiziertes Produkt (Geräteidentifikation) *Certified Product* (*Product Identification*)

Lizenzentgelte - Einheit *License Fee - Unit*

Relais (Electromechanical Elementary Relay)

Type Designation	: CHZx-y-zuvw2ab x,y,z,u,v,w,a,b = See appendix 1	15
Rated Coil Voltage	: DC 3V,5V,6V,9V,12V,18V,24V,48V	
Rated Coil Power	: 0,72W; 0,54W	
Ambient Temperature	: -40°C to +85°C	
Contact Loads	: AC 250V; DC 30V NO: 5A/NC: 3A NO: 10A/NC: 5A NO: 16A/NC: 8A see apeendix 1 for detail	
Electrical Endurance	: 100,000	
Mechanical Endurance	: 10,000,000	
Type of Interruption	: Micro-Disconnection	
Insulation System between Coil and Contact	: Basic Insulation	

The labelling requirements acc. to EU Directive 2001/95 have to be observed for distribution within the EEA.

15

ANLAGE (Appendix): 1

Dem Zertifikat liegt unsere Prüf- und Zertifizierungsordnung zugrunde und es bestätigt die Konformität des Produktes mit den oben genannten Standards und Prüfgrundlagen. Zusätzliche Anforderungen in Ländern, in denen das Produkt in Verkehr gebracht werden soll, müssen zusätzlich betrachtet werden. Die Herstellung des zertifizierten Produktes wird überwacht.
This certificate is based on our Testing and Certification Regulation and states the conformity of the product with the standards and testing requirements as indicated above. Any additional requirements in countries where the product is going to be marketed have to be considered additionally. The manufacturing of the certified product is subject to surveillance.

Zertifizierungsstelle

TÜV Rheinland LGA Products GmbH TÜVRheinland® Zertifizierungsstelle

Dipl.-Ing. (FH) T. Zimmer

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Fax: (+49/221)8 06 - 39 35 http://www.tuv.com/safety

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Certificate No. 50212872 0001 **Our Reference** 05-YW-16032578 001 **Appendix No.** 1

Type Nomenclature:

CHZx-y-zuvw2ab

Basic designation: CHZ
x=01, 02, 03 or 05, stands for rated contact loads and terminal distance, see below table
y=V or S, stands for sealed type: V means flux proof type, S means wash tight type
z=1 or 2, stands for type of poles, 1 means single-pole, 2 means double-pole
u=3, 5, 6, 9, 12, 18, 24, 48, stands for rated coil voltage (V d.c.)
v= D or L, stands for rated coil power: D means 0,72W, L means 0,54W
w=A or C, A means make contact, C means change-over contact
2 means the contact material is AgSnO
a= F or blank, stands for insulation (UL system) class: F means class 155℃, blank means class 105℃
b= letter, number or blank, stands for special parameter: blank means standard type, letter or number means special requirement which don't affect constructions.

	Contact load	Terminal distance
x=01	10A (NO) / 5A (NC), for single-pole only	3,5mm
x=02	16A (NO) / 8A (NC), for single-pole only	3,5mm
x=03	16A (NO) / 8A (NC), for single-pole only	5,0mm
x=05	5A (NO) / 3A (NC), for double-pole only	5,0mm

TÜV Rheinland
(Guangdong) Ltd.

Sep. 14, 2014 Evan Wu

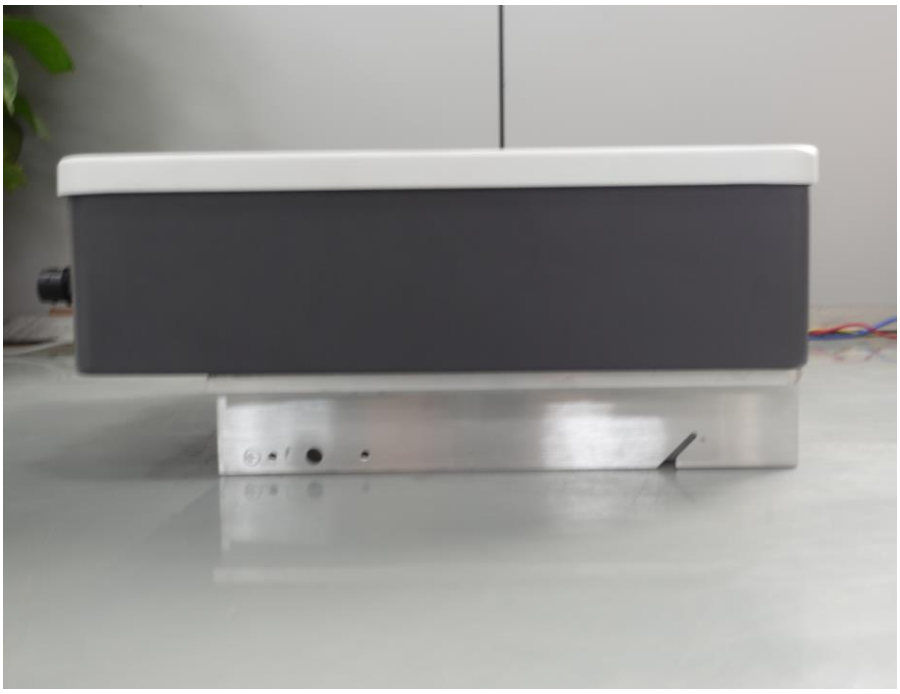
Date **Name** **Signature**

Annex 5 - Photo of the unit

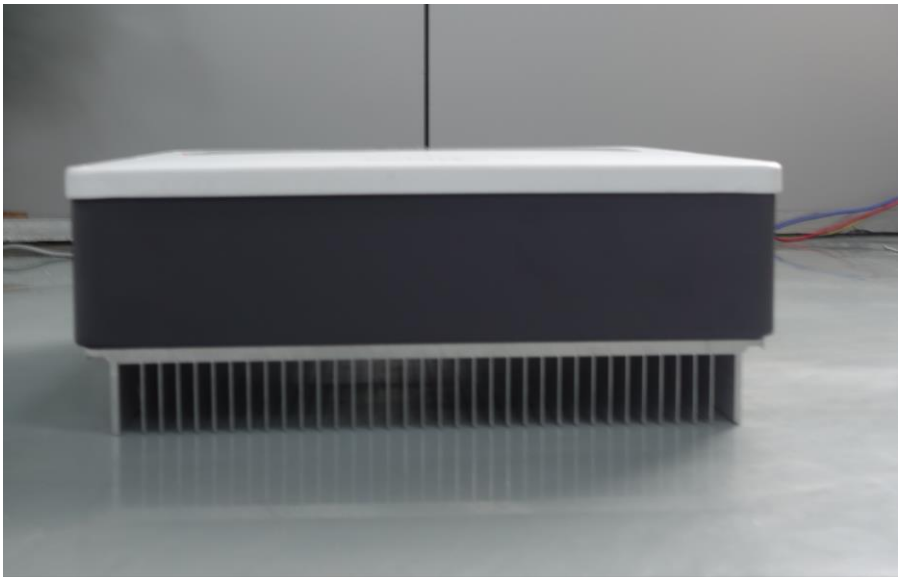
Enclosure front view

Enclosure side view-1

Enclosure side view-2



Enclosure top view



Enclosure bottom view

Enclosure rear view

>>>> End of Test Report <<<<