



## TEST REPORT

# Engineering Recommendation G99

Issue 1 – Amendment 10

Requirements for the connection of generation equipment in parallel with public distribution networks on or after 27 April 2019

**Ningbo AUX Solar Technology Co., Ltd.**

For the unit(s) **ASG-5TL-ZH, ASG-6TL-ZH, ASG-8TL-ZH, ASG-10TL-ZH,  
ASG-12TL-ZH, ASG-15TL-ZH, ASG-20TL-ZH**

Test report no. **HC2412240307GC05**

Date **2025-04-07**



**Test report number** .....: **HC2412240307GC05**

**Date of issue** .....: 2025-04-07

**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** .....: **Ningbo AUX Solar Technology Co., Ltd.**

**Address** .....: No. 17 Fenglin Road, Cicheng Town, Jiangbei District, Ningbo City,  
Zhejiang Province, China

**Test specification**

**Standard** .....: Engineering Recommendation G99  
Issue 1 – Amendment 10  
4 March 2024  
Requirements for the connection of generation equipment in parallel  
with public distribution networks on or after 27 April 2019

**Test report form number** .....: EREC G99\_v2.0

**Test report form(s) originator** .....: Lyns-tci Technology Guangdong Co., Ltd.

**Master TRF** .....: Dated 2024-04-01

**Test item description** .....: Device Category: **Inverter**  
Device Type: **Hybrid**  
**(PV with DC coupled Electricity Storage)**


**Trademark** .....: **AUXSOL**

**Model / Type reference** .....: ASG-5TL-ZH, ASG-6TL-ZH, ASG-8TL-ZH, ASG-10TL-ZH,  
ASG-12TL-ZH, ASG-15TL-ZH, ASG-20TL-ZH

**Technical data** .....: See section 3.1 on p.8

**Dates of testing** .....: 2025-02-06 to 2025-02-21

Tested / Report prepared by



Leslie He (Test engineer)

Approved by



Lukes Lin (Project manager)

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## 1 General information of test report

### 1.1 Important Note

#### General disclaimer

The test results presented in this report relate only to the object tested.

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### 1.2 Revision history

Report version	Date	Editor	Modification / Change	Status
HC2412240307GC05	2025-04-07	Leslie He	Initial report was written	Active

## 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

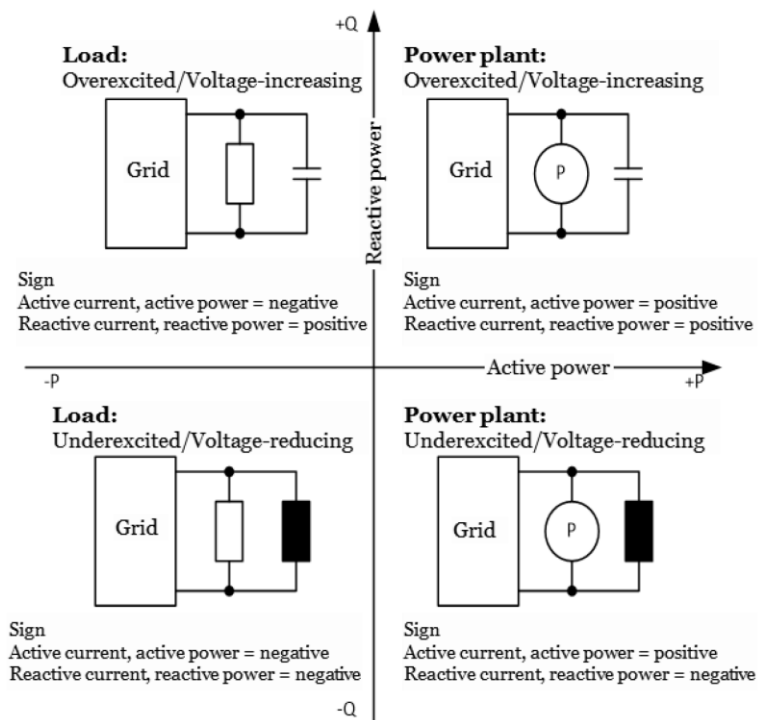
### Abbreviations

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 <sub>max</sub>	:	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 ..... : Ningbo AUX Solar Technology Co., Ltd.

Factory address ..... : No. 17 Fenglin Road, Cicheng Town, Jiangbei District, Ningbo City, Zhejiang Province, China

#### 3.1 Technical data of the unit(s)

Unit / Type .....	ASG-5TL-ZH	ASG-6TL-ZH	ASG-8TL-ZH	ASG-10TL-ZH	
Hardware version (tested) .....	A				
Software version (tested) .....	DSP;A6053/ARM;A3023				
Input DC:					
Max. input voltage [V] .....	1000				
MPPT voltage range [V] .....	170-900				
Max. input current [A] .....	16*2	16*2	26*2	26*2	
Battery input:					
Battery voltage range [V] .....	180-800				
Max. charge / discharge current [A] .....	30/30				
Battery type:	Li-ion				
Output AC (Grid side):					
Rated grid voltage [V] .....	380/400, 3/N/PE; 50 /60 Hz				
Max. output current [A] .....	11.4	13.6	18.2	22.7	
Rated output power [kW] .....	5.0	6.0	8.0	10.0	
Registered Capacity <sup>1</sup> P <sub>max</sub> [kW] .....	5.0	6.0	8.0	10.0	
Max. apparent output power [kVA] .....	5.0	6.0	8.0	10.0	
Input AC (Grid side):					
Rated input voltage [V] .....	380/400, 3/N/PE; 50 /60 Hz				
Max. input current [A] .....	15.2	18.2	24.2	30.3	
Rated input power [kW] .....	5.0	6.0	8.0	10.0	
Output AC (Back-up):					
Rated output voltage [V] .....	380/400				
Max. AC output current [A] .....	7.6	9.1	12.1	15.2	
Rated output power [KW] .....	5.0	6.0	8.0	10.0	
Unit / Type .....	ASG-12TL-ZH		ASG-15TL-ZH		ASG-20TL-ZH
Hardware version (tested) .....	A				
Software version (tested) .....	DSP;A6053/ARM;A3023				

<sup>1</sup> In this report, the stated values of "registered capacity" related to single Generating Unit.



Input DC:			
Max. input voltage [V] .....	1000		
MPPT voltage range [V] .....	170-900		
Max. input current [A] .....	26*2	36*2	36*2
Battery input:			
Battery voltage range [V] .....	180-800		
Max. charge / discharge current [A] .....	30/30	2*30/2*30	2*30/2*30
Battery type:	Li-ion		
Output AC (Grid side):			
Rated grid voltage [V] .....	380/400, 3/N/PE; 50 /60 Hz		
Max. output current [A] .....	27.3	34.1	45.5
Rated output power [kW] .....	12.0	15.0	20.0
Registered Capacity <sup>2</sup> P <sub>max</sub> [kW] .....	12.0	15.0	20.0
Max. apparent output power [kVA] .....	12.0	15.0	20.0
Input AC (Grid side):			
Rated input voltage [V] .....	380/400, 3/N/PE; 50 /60 Hz		
Max. input current [A] .....	36.4	45.5	45.5
Rated input power [kW] .....	12.0	15.0	20.0
Output AC (Back-up):			
Rated output voltage [V] .....	380/400		
Max. AC output current [A] .....	18.2	22.7	30.3
Rated output power [KW] .....	12.0	15.0	20.0
Note:			
All test items are carried out at 230V, 50Hz.			

**Note:**

For Power Park Module (Generating Unit) ASG-5TL-ZH, ASG-6TL-ZH, ASG-8TL-ZH, ASG-10TL-ZH, ASG-12TL-ZH, ASG-15TL-ZH and ASG-20TL-ZH 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:

- ASG-5TL-ZH: P<sub>max</sub> ≤ 4.750 kW
- ASG-6TL-ZH: P<sub>max</sub> ≤ 5.700 kW
- ASG-8TL-ZH: P<sub>max</sub> ≤ 7.600 kW
- ASG-10TL-ZH: P<sub>max</sub> ≤ 9.500 kW
- ASG-12TL-ZH: P<sub>max</sub> ≤ 11.400 kW
- ASG-15TL-ZH: P<sub>max</sub> ≤ 14.250 kW
- ASG-20TL-ZH: P<sub>max</sub> ≤ 19.000 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:

<sup>2</sup> In this report, the stated values of "registered capacity" related to single Generating Unit.

Equipment mobility .....	: Permanent connection
Operating condition.....	: Continuous
Class of equipment .....	: Class I
Protection against ingress of water .....	: IP66 according to EN 60529
Mass of equipment [kg] .....	: <b>ASG-5TL-ZH-ASG-12TL-ZH</b> Approximate: 35 <b>ASG-15TL-ZH-ASG-20TL-ZH</b> Approximate: 35.5
Type of internal transformer .....	: No internal transformer (transformerless)

**Datasheet of the generating units:**

Model	ASG-5TL-ZH	ASG-6TL-ZH	ASG-8TL-ZH	ASG-10TL-ZH
Input DC				
Max. input power	7.5kW	9kW	12kW	15kW
Max. input voltage		1000V		
Rated voltage		600V		
Start-up voltage		160V		
MPPT voltage range		170-900V		
MPPT number		2		
Max. input strings number	2	2	4	4
Max.input current	16A/16A	16A/16A	26A/26A	26A/26A
Max.short circuit current	20A/20A	20A/20A	32A/32A	32A/32A
Battery input				
Battery type		Li-ion		
Battery voltage range		180-800V		
Max. charge / discharge current		30A/30A		
Communication mode		CAN/RS485		
Charging Strategy for Li-Ion Battery		Self-adaption to BMS		

Model	ASG-12TL-ZH	ASG-15TL-ZH	ASG-20TL-ZH
Input DC			
Max. input power	18kW	22.5kW	30kW
Max. input voltage		1000V	
Rated voltage		600V	
Start-up voltage		160V	
MPPT voltage range		170-900V	
MPPT number		2	
Max. input strings number	4	4	4
Max.input current	26A/26A	36A/36A	36A/36A
Max.short circuit current	32A/32A	45A/45A	45A/45A
Battery input			
Battery type		Li-ion	
Battery voltage range		180-800V	
Max. charge / discharge current	30A/30A	2*30A/2*30A	2*30A/2*30A
Communication mode		CAN/RS485	
Charging Strategy for Li-Ion Battery		Self-adaption to BMS	

Model	ASG-5TL-ZH	ASG-6TL-ZH	ASG-8TL-ZH	ASG-10TL-ZH
Output AC (Grid side)				
Rated output power	5kW	6kW	8kW	10kW
Max. apparent output power	5kVA	6kVA	8kVA	10kVA
Max. output current	11.4A	13.6A	18.2A	22.7A
Grid voltage range286-498V				
Rated grid voltage3 / N / PE,380V / 400V				
Rated grid frequency50Hz / 60 Hz				
Power factor>0.99 (leading 0.8...lagging 0.8)				
THDi<3%				
Input AC (Grid side)				
Rated input power	5kW	6kW	8kW	10kW
Max. input power	10kW	12kW	16kW	20kW
Max. apparent input power	10kVA	12kVA	16kVA	20kVA
Max. input current	15.2A	18.2A	24.2A	30.3A
Rated input voltage3 / N / PE,380V / 400V				
Rated input frequency50 Hz / 60 Hz				
Output AC (Back-up)				
Rated output power	5kW	6kW	8kW	10kW
Max. output current	7.6A	9.1A	12.1A	15.2A
Back-up switch time<10ms				
Rated output voltage380V / 400V				
Rated frequency50 Hz / 60 Hz				
THDv<2%				

















Model	ASG-12TL-ZH	ASG-15TL-ZH	ASG-20TL-ZH
Output AC (Grid side)			
Rated output power	12kW	15kW	20kW
Max. apparent output power	12kVA	15kVA	20kVA
Max. output current	27.3A	34.1A	45.5A
Grid voltage range		286-498V	
Rated grid voltage		3 / N / PE,380V / 400V	
Rated grid frequency		50Hz / 60 Hz	
Power factor		> 0.99 (leading 0.8...lagging 0.8)	
THDi		<3%	
Input AC (Grid side)			
Rated input power	12kW	15kW	20kW
Max. input power	24kW	30kW	40kW
Max. apparent input power	24kVA	30kVA	40kVA
Max. input current	36.4A	45.5A	45.5A
Rated input voltage		3 / N / PE,380V / 400V	
Rated input frequency		50 Hz / 60 Hz	
Output AC (Back-up)			
Rated output power	12kW	15kW	20kW
Max. output current	18.2A	22.7A	30.3A
Back-up switch time		<10ms	
Rated output voltage		380V / 400V	
Rated frequency		50 Hz / 60 Hz	
THDv		<2%	



















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

The units in the product series:










- sharing the same control electronics.
- with the same implemented control and firmware.
- with the same construction solutions including the power part.
- with the same number of phases.
- with the same power electronics, filters, and transducers.










## Copy of marking plate










<b>AUXSOL</b> Hybrid solar inverter ASG-5TL-ZH	<b>AUXSOL</b> Hybrid solar inverter ASG-6TL-ZH
<b>PV Input</b> Max.input voltage 1000V MPPT voltage range 170-900V Max.input current 16A/16A Max.short circuit current 20A/20A	<b>PV Input</b> Max.input voltage 1000V MPPT voltage range 170-900V Max.input current 16A/16A Max.short circuit current 20A/20A
<b>Input Battery</b> Battery type Li-ion Battery voltage range 180-800V Max.charge/discharge current 30A/30A	<b>Input Battery</b> Battery type Li-ion Battery voltage range 180-800V Max.charge/discharge current 30A/30A
<b>Output AC (Grid side)</b> Rated output power 5kW Max. apparent output power 5kVA Rated grid voltage 3/N/PE,380V/400V Rated grid frequency 50/60Hz Max. output current 11.4A Power Factor >0.99 (0.8 leading...0.8 lagging) THDi <3%	<b>Output AC (Grid side)</b> Rated output power 6kW Max. apparent output power 6kVA Rated grid voltage 3/N/PE,380V/400V Rated grid frequency 50/60Hz Max. output current 13.6A Power Factor >0.99 (0.8 leading...0.8 lagging) THDi <3%
<b>Input AC (Grid side)</b> Rated input power 5kW Max. input power 10kW Max. input current 15.2A Rated input voltage 3/N/PE,380V/400V Rated input frequency 50/60Hz	<b>Input AC (Grid side)</b> Rated input power 6kW Max. input power 12kW Max. input current 18.2A Rated input voltage 3/N/PE,380V/400V Rated input frequency 50/60Hz
<b>Output AC (Back-up)</b> Rated output power 5kW Max. output current 7.6A Back-up switch time <10ms Rated output voltage 380V/400V Rated frequency 50/60Hz	<b>Output AC (Back-up)</b> Rated output power 6kW Max. output current 9.1A Back-up switch time <10ms Rated output voltage 380V/400V Rated frequency 50/60Hz
 IP66, Outdoor, -30...+60°C Overvoltage category: III[Mains], II[PV-DC]	 IP66, Outdoor, -30...+60°C Overvoltage category: III[Mains], II[PV-DC]
      	      
<b>Ningbo AUX Solar Technology Co., Ltd.</b> Address: No.17 Fenglin Road,Cicheng Town, Jiangbei District, Ningbo City, Zhejiang Province, China Tel.:86-574-8765-2201 web: www.auxsol.com Email: info@auxsol.com Postal Code:315031 Made in China	<b>Ningbo AUX Solar Technology Co., Ltd.</b> Address: No.17 Fenglin Road,Cicheng Town, Jiangbei District, Ningbo City, Zhejiang Province, China Tel.:86-574-8765-2201 web: www.auxsol.com Email: info@auxsol.com Postal Code:315031 Made in China

<b>AUXSOL</b> Hybrid solar inverter ASG-8TL-ZH	<b>AUXSOL</b> Hybrid solar inverter ASG-10TL-ZH
<b>PV Input</b> Max.input voltage 1000V MPPT voltage range 170-900V Max.input current 26A/26A Max.short circuit current 32A/32A	<b>PV Input</b> Max.input voltage 1000V MPPT voltage range 170-900V Max.input current 26A/26A Max.short circuit current 32A/32A
<b>Input Battery</b> Battery type Li-Ion Battery voltage range 180-800V Max.charge/discharge current 30A/30A	<b>Input Battery</b> Battery type Li-Ion Battery voltage range 180-800V Max.charge/discharge current 30A/30A
<b>Output AC (Grid side)</b> Rated output power 8kW Max. apparent output power 8kVA Rated grid voltage 3/N/PE,380V/400V Rated grid frequency 50/60Hz Max. output current 18.2A Power Factor >0.99 (0.8 leading...0.8 lagging) THDi <3%	<b>Output AC (Grid side)</b> Rated output power 10kW Max. apparent output power 10kVA Rated grid voltage 3/N/PE,380V/400V Rated grid frequency 50/60Hz Max. output current 22.7A Power Factor >0.99 (0.8 leading...0.8 lagging) THDi <3%
<b>Input AC (Grid side)</b> Rated input power 8kW Max. input power 16kW Max. input current 24.2A Rated input voltage 3/N/PE,380V/400V Rated input frequency 50/60Hz	<b>Input AC (Grid side)</b> Rated input power 10kW Max. input power 20kW Max. input current 30.3A Rated input voltage 3/N/PE,380V/400V Rated input frequency 50/60Hz
<b>Output AC (Back-up)</b> Rated output power 8kW Max. output current 12.1A Back-up switch time < 10ms Rated output voltage 380V/400V Rated frequency 50/60Hz	<b>Output AC (Back-up)</b> Rated output power 10kW Max. output current 15.2A Back-up switch time < 10ms Rated output voltage 380V/400V Rated frequency 50/60Hz
 IP66, Outdoor, -30...+60°C Overvoltage category: III[Mains], II[PV-DC]	 IP66, Outdoor, -30...+60°C Overvoltage category: III[Mains], II[PV-DC]
       	       
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<b>AUXSOL</b> Hybrid solar inverter <b>ASG-12TL-ZH</b>	
<b>PV Input</b>	
Max.input voltage	1000V
MPPT voltage range	170-900V
Max.input current	26A/26A
Max.short circuit current	32A/32A
<b>Input Battery</b>	
Battery type	Li-ion
Battery voltage range	180-800V
Max.charge/discharge current	30A/30A
<b>Output AC (Grid side)</b>	
Rated output power	12kW
Max. apparent output power	12kVA
Rated grid voltage	3/N/PE,380V/400V
Rated grid frequency	50/60Hz
Max. output current	27.3A
Power Factor	>0.99 (0.8 leading...0.8 lagging)
THDi	<3%
<b>Input AC (Grid side)</b>	
Rated input power	12kW
Max. input power	24kW
Max. input current	36.4A
Rated input voltage	3/N/PE,380V/400V
Rated input frequency	50/60Hz
<b>Output AC (Back-up)</b>	
Rated output power	12kW
Max. output current	18.2A
Back-up switch time	< 10ms
Rated output voltage	380V/400V
Rated frequency	50/60Hz
 IP66, Outdoor, -30...+60°C Overvoltage category: III[Mains], II[PV-DC]	
       	
<b>Ningbo AUX Solar Technology Co., Ltd.</b> Address: No.17 Fenglin Road,Cicheng Town, Jiangbei District, Ningbo City, Zhejiang Province, China Tel.:86-574-8765-2201 web: www.auxsol.com Email: info@auxsol.com Postal Code:315031	
Made in China	

<b>AUXSOL</b> Hybrid solar inverter <b>ASG-15TL-ZH</b>	
<b>PV Input</b>	
Max.input voltage	1000V
MPPT voltage range	170-950V
Max.input current	36A/36A
Max.short circuit current	45A/45A
<b>Input Battery</b>	
Battery type	Li-ion
Battery voltage range	180-800V
Max.charge/discharge current	2*30A/2*30A
<b>Output AC (Grid side)</b>	
Rated output power	15kW
Max. apparent output power	15kVA
Rated grid voltage	3/N/PE,380V/400V
Rated grid frequency	50/60Hz
Max. output current	34.1A
Power Factor	>0.99 (0.8 leading...0.8 lagging)
THDi	<3%
<b>Input AC (Grid side)</b>	
Rated input power	15kW
Max. input power	30kW
Max. input current	45.5A
Rated input voltage	3/N/PE,380V/400V
Rated input frequency	50/60Hz
<b>Output AC (Back-up)</b>	
Rated output power	15kW
Max. output current	22.7A
Back-up switch time	< 10ms
Rated output voltage	380V/400V
Rated frequency	50/60Hz
 IP66, Outdoor, -30...+60°C Overvoltage category: III[Mains], II[PV-DC], Class: I	
       	
<b>Ningbo AUX Solar Technology Co., Ltd.</b> Address: No.17 Fenglin Road,Cicheng Town, Jiangbei District, Ningbo City, Zhejiang Province, China Tel.:86-574-8765-2201 web: www.auxsol.com Email: info@auxsol.com Postal Code:315031	
Made in China	

<b>AUXSOL</b> Hybrid solar inverter ASG-20TL-ZH	
PV Input	
Max.input voltage	1000V
MPPT voltage range	170-900V
Max.input current	36A/36A
Max.short circuit current	45A/45A
Input Battery	
Battery type	Li-ion
Battery voltage range	180-800V
Max.charge/discharge current	2×30A/2×30A
Output AC (Grid side)	
Rated output power	20kW
Max. apparent output power	20kVA
Rated grid voltage	3/N/PE,380V/400V
Rated grid frequency	50/60Hz
Max. output current	45.5A
Power Factor	>0.99 (0.8 leading...0.8 lagging)
THDi	<3%
Input AC (Grid side)	
Rated input power	20kW
Max. input power	40kW
Max. input current	45.5A
Rated input voltage	3/N/PE,380V/400V
Rated input frequency	50/60Hz
Output AC (Back-up)	
Rated output power	20kW
Max. output current	30.3A
Back-up switch time	< 10ms
Rated output voltage	380V/400V
Rated frequency	50/60Hz
 IP66, Outdoor, -30...+60°C Overvoltage category: III[Mains], II[PV-DC], Class: I	
       	
<b>Ningbo AUX Solar Technology Co., Ltd.</b> Address: No.17 Fenglin Road,Cicheng Town, Jiangbei District, Ningbo City, Zhejiang Province, China Tel.:86-574-8765-2201 web: www.auxsol.com Email: info@auxsol.com Postal Code:315031 Made in China	

**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.

### 3.3 Description of the power circuit

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

The internal control is redundant built. It consists of Microcontroller slave ARM (U888) and main DSP (U666).

The main DSP 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 ARM measures the PV voltage, BAT voltage, PV current, BAT current, grid voltage, grid frequency, RMS, also can switch off the relays independently, and communicate with the main DSP 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. The main DSP 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 PV array and the mains. All the relays are tested before each start up.

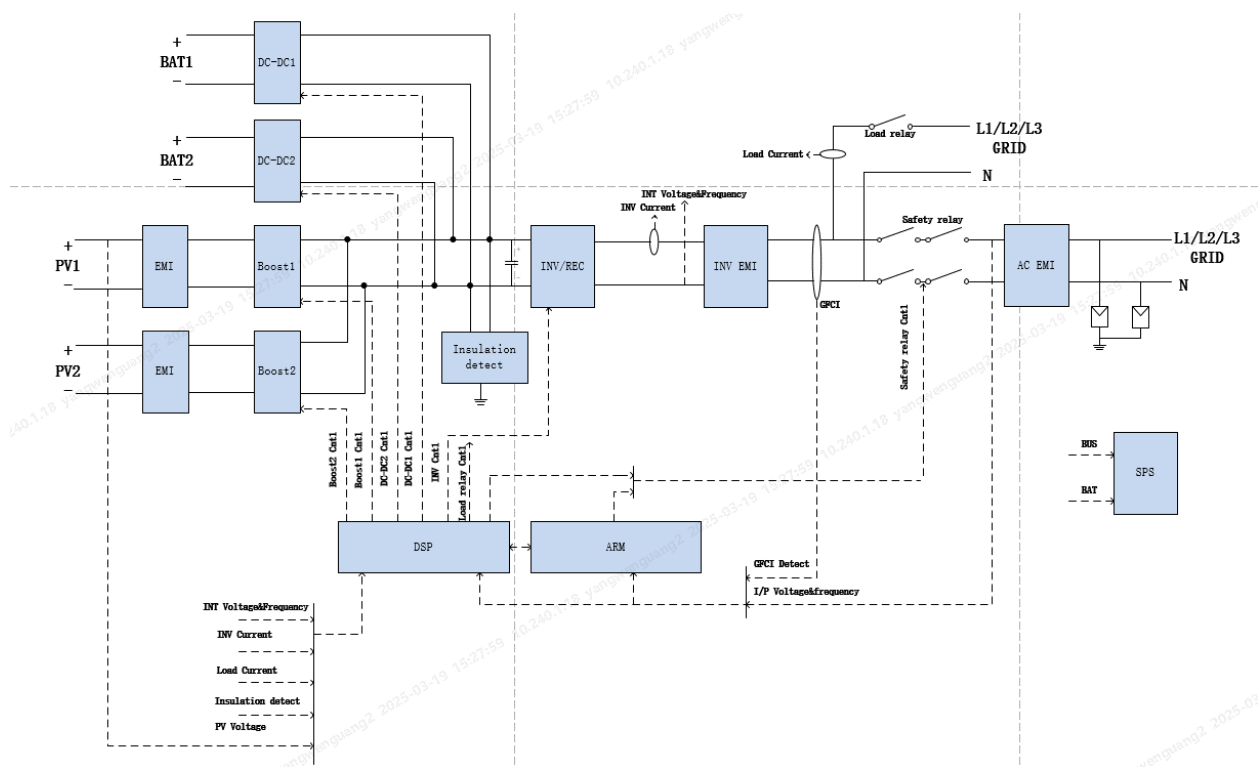


Figure 1 – Block diagram of the power circuit

## 4 General remarks for testing

### 4.1 PGM categories

According to definition of the standard the PGUs considered in this test report are Type A generating units:

Type A	Type B	Type C	Type D
Voltage level at connection point <110kV			Voltage level at connection point ≥110kV
$0.8 \text{ kW} \leq P_{\max} < 1 \text{ MW}$	$1 \text{ MW} \leq P_{\max} < 10 \text{ MW}$	$10 \text{ MW} \leq P_{\max} < 50 \text{ MW}$	$P_{\max} \geq 50 \text{ MW}$
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### 4.2 Energy Conversion Technology

Domestic CHP (1)	Photovoltaic (2) *	Fuel Cells (3)	Hydro (4)	Wind (5)	Electricity Storage devices (6) *
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Type testing was carried out according to EREC G99, Annex A.7.

The following Additional Technology Requirements according to (depending on the selection in the table above):

(1) A.7.3.1.

(2) A.7.3.2.

(3) A.7.3.3.

(4) A.7.3.4.

(5) A.7.3.5.

(6) A.7.3.6.

have been taken into account.

Measurement results documented according to EREC G99, Form A2-3.

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 (corresponding case EREC G99, Figure 6.6).

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

The Electricity Storage exceptions according to EREC G99, section A.4.2 do not apply to the Inverter.

### 4.3 Exceptions

According to EREC G99, Annex A.4:

☐ **Emerging Technology**

the following sections of EREC G99 do not apply:

- 11.2.1 (frequency withstand capability)
- 11.2.2 (rate of change of frequency)
- 11.2.3 (constant Active Power output)
- 11.2.4 (Limited Frequency Sensitive Mode – Overfrequency)
- 10.6.7 (Interface Protection settings).

☐ **Electricity Storage devices commissioned before 01 September 2022**

the following sections of EREC G99 do not apply:

- Type A - less than 1 MW
  - 11.2.3 (constant Active Power output)
  - 11.2.4 (Limited Frequency Sensitive Mode – Over frequency)
- Type B - 1 MW or greater but less than 10 MW
  - 12.2.3 (constant Active Power output)
  - 12.2.4 (Limited Frequency Sensitive Mode – Over frequency)
  - 12.3.1 – 12.3.1.7 inclusive, 12.3.4 and 12.6 (Fault Ride Through, Fast Fault Current injection)
- Type C and Type D - 10 MW or greater and / or with a Connection Point at greater than 110 kV
  - 13.2.3 (constant Active Power output)
  - 13.2.4 (Limited Frequency Sensitive Mode – Over frequency)
  - 13.2.5 (Limited Frequency Sensitive Mode – Under frequency)
  - 13.2.6 (Frequency Sensitive Mode)
  - 13.3 – 13.3.1.11 inclusive, 13.3.4 and 13.6 (Fault Ride Through, Fast Fault Current injection)

☐ **Infrequent Short-Term Parallel Operation**

the following sections of EREC G99 do not apply:

- Type A - less than 1 MW
  - All of Section 11
- Type B - 1 MW or greater but less than 10 MW
  - All of Section 12
- Type C and Type D - 10 MW or greater and / or with a Connection Point at greater than 110 kV
  - All of Section 13

☒ **Other**

No exceptions.

#### 4.4 Scope of measurements

Date of receipt of test items ..... : 2025-02-06

Date(s) of performance of tests ..... : 2025-02-06 to 2025-02-21

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

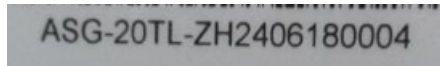
- Temperature: 20.5 ~ 25.1°C
- Rel. humidity: 39.3 ~ 58.1%RH
- Air pressure: 991.1 ~ 1001.3 hPa

Test items	Testing requirements (Section EREC G99)	Section in this test report	Tests completed
1. Operating Range	10.3.4, 11.2.1	6.1	<input checked="" type="checkbox"/>
2. Harmonics	A.7.1.4.1	6.2	<input checked="" type="checkbox"/>
3. Voltage Fluctuation and Flicker	A.7.1.4.3	6.3	<input checked="" type="checkbox"/>
4. DC injection	A.7.1.4.4	6.4	<input checked="" type="checkbox"/>
5. Power Factor (PF)	A.7.1.4.2	6.5	<input checked="" type="checkbox"/>
6. Frequency protection trip and ride through tests	A.7.1.2.1, A.7.1.2.3	6.6.1	<input checked="" type="checkbox"/>
7. Voltage protection trip and ride through tests	A.7.1.2.1, A.7.1.2.2	6.6.2	<input checked="" type="checkbox"/>
8. Protection – Loss of Mains Test, Vector Shift and RoCoF Stability Test	A.7.1.2.4, A.7.1.2.6	6.6.3, 6.6.4 and 6.6.5	<input checked="" type="checkbox"/>
9. LFSM-O Test	A.7.1.3	6.7	<input checked="" type="checkbox"/>
10. Protection – Reconnection Timer	A.7.1.2.5	6.8	<input checked="" type="checkbox"/>
11. Fault Level Contribution	A.7.1.5	6.9	<input checked="" type="checkbox"/>
12. Self-monitoring Solid State Switch	A.7.1.6	6.10	<input type="checkbox"/>
13. Wiring functional tests if required by para 15.2.1 (attach relevant schedule of tests)	15.2.1	6.11	<input type="checkbox"/>
14. Logic Interface (input port)	11.1.3	6.12	<input checked="" type="checkbox"/>
15. Cyber security	9.1.7	6.13	<input type="checkbox"/> <sup>3</sup>
Output power with falling frequency	11.2.3	Test not performed and not documented in this report.	<input type="checkbox"/>

<sup>3</sup> Manufacturer's declaration provided, for details see section 6.13.

**Note:**

- The (full) tests were performed on EUT **ASG-20TL-ZH**.
- The products were tested on:
  - **ASG-20TL-ZH** (full testing)
    - Serial No.: ASG-20TL-ZH2406180004
    - Hardware Version: A
    - Firmware Version: DSP;A6053/ARM;A3023



- Measurement done at output terminals of the EUT, see Figure 3, Figure 4 and Figure 5.
- According to EREC G99, section 15.6.1 the following applies:  
since the rated power of ASG-5TL-ZH, ASG-6TL-ZH, ASG-8TL-ZH, ASG-10TL-ZH, ASG-12TL-ZH and ASG-15TL-ZH is between  $1/\sqrt{10} \cdot P_{n, \text{ASG-20TL-ZH}}$  and  $2 \cdot P_{n, \text{ASG-20TL-ZH}}$ , a family approach to type testing is acceptable.
- A transfer of measurement results from the **ASG-20TL-ZH** to other units in the product series according to EREC G99, section 15.6.2 is allowed (for details see section 5 *Assessment overview*).
- Technical justification for transferability of measurement results:  
see section 3.2 on p.14.

## 4.5 Reference values

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

	ASG-5TL-ZH	ASG-6TL-ZH	ASG-8TL-ZH	ASG-10TL-ZH
Registered Capacity <sup>4</sup> P <sub>max</sub> [kW]	5.0	6.0	8.0	15.0
Rated voltage (phase-to-neutral), U <sub>n</sub> [V]	230			
Rated current, I <sub>n</sub> <sup>5</sup> [A]	7.25	8.70	11.60	14.50
	ASG-12TL-ZH	ASG-15TL-ZH	ASG-20TL-ZH	
Registered Capacity <sup>6</sup> P <sub>max</sub> [kW]	12.0	15.0	20.0	
Rated voltage (phase-to-neutral), U <sub>n</sub> [V]	230			
Rated current, I <sub>n</sub> <sup>7</sup> [A]	17.40	21.70	29.00	

Note:

\* see also "Note" on p.9.

## 4.6 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 ( $I_{sc} = 18.25$  A,  $U_{oc} = 705.56$  V) simulated according to EN50530:

<sup>4</sup> In this report, the stated values of "registered capacity" related to single Generating Unit.

<sup>5</sup> The rated current stated in this report is calculated based on the "registered capacity" and the rated voltage.

<sup>6</sup> In this report, the stated values of "registered capacity" related to single Generating Unit.

<sup>7</sup> The rated current stated in this report is calculated based on the "registered capacity" and the rated voltage.



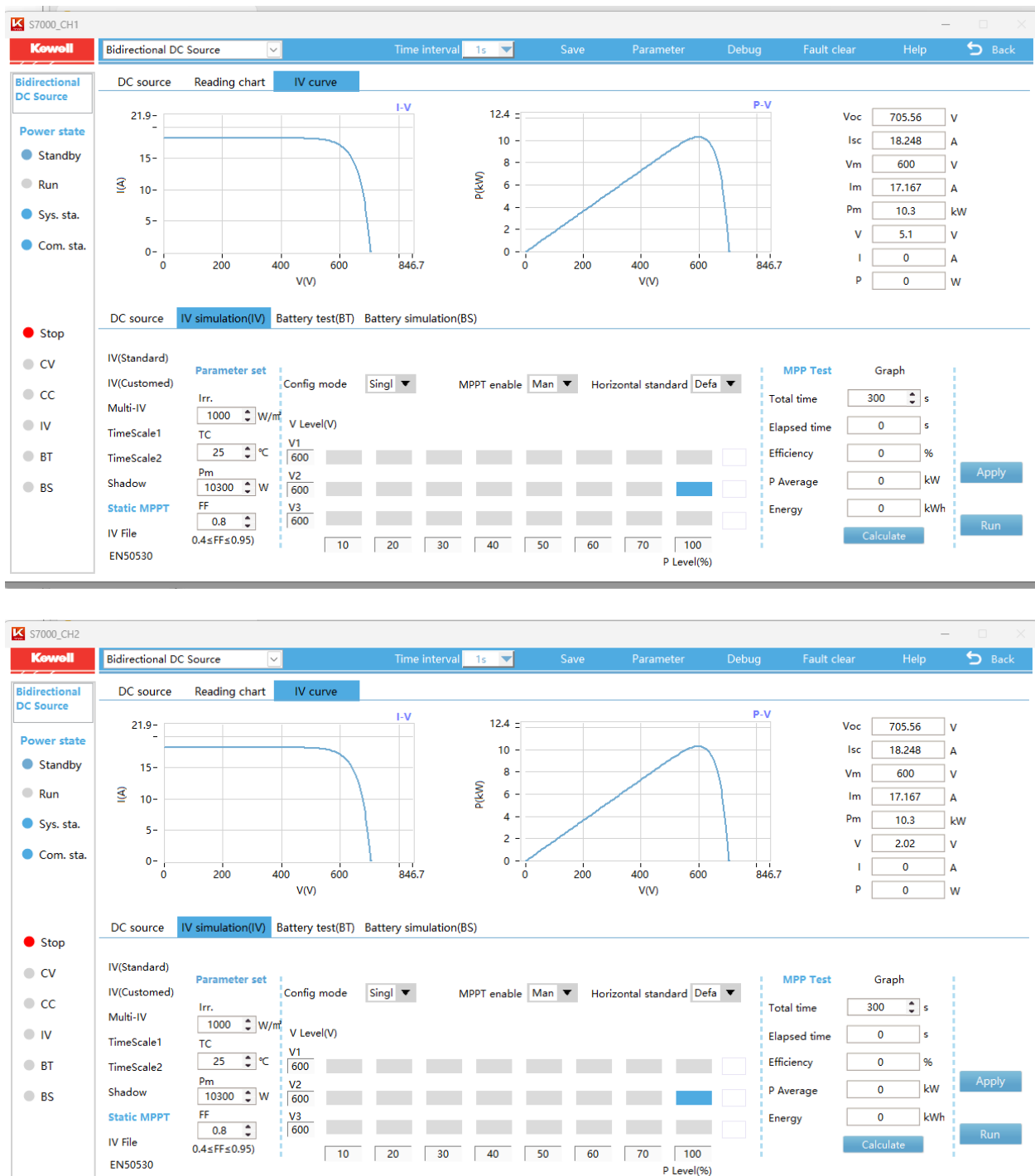


Figure 2 – DC characteristics for testing

The measurement setups are shown in Figure 3 Figure 4 and Figure 5. The specific test and measurement devices are stated in section 4.7.

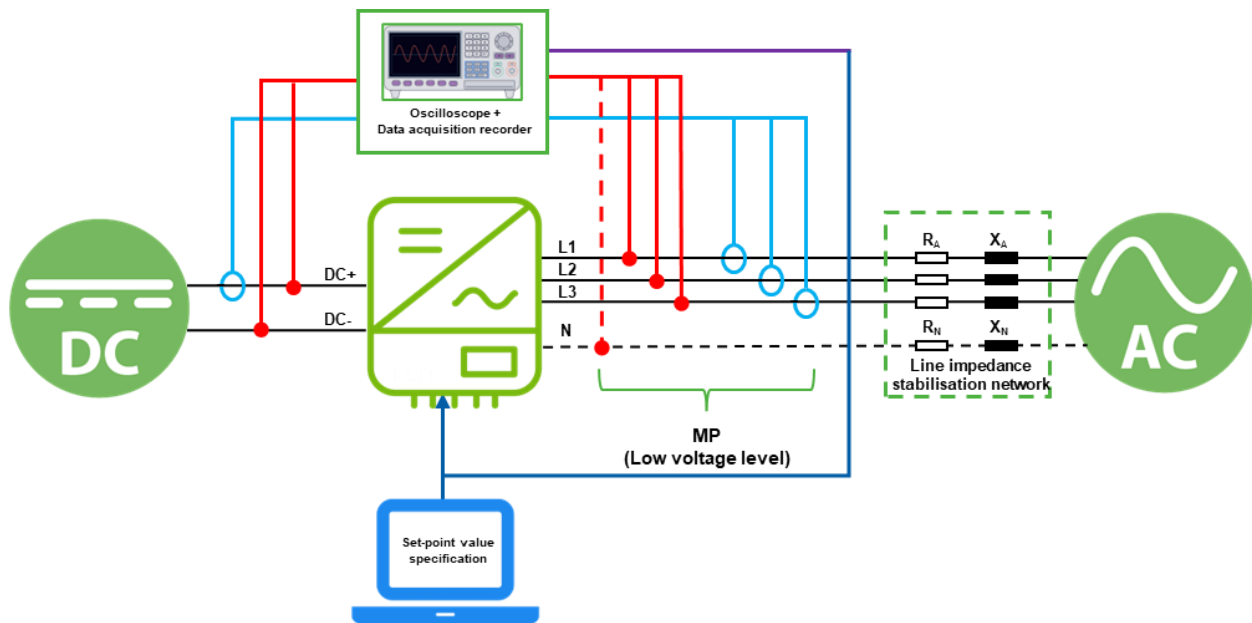


Figure 3 – Measurement setup used for tests except Loss of Mains and Short Circuit test

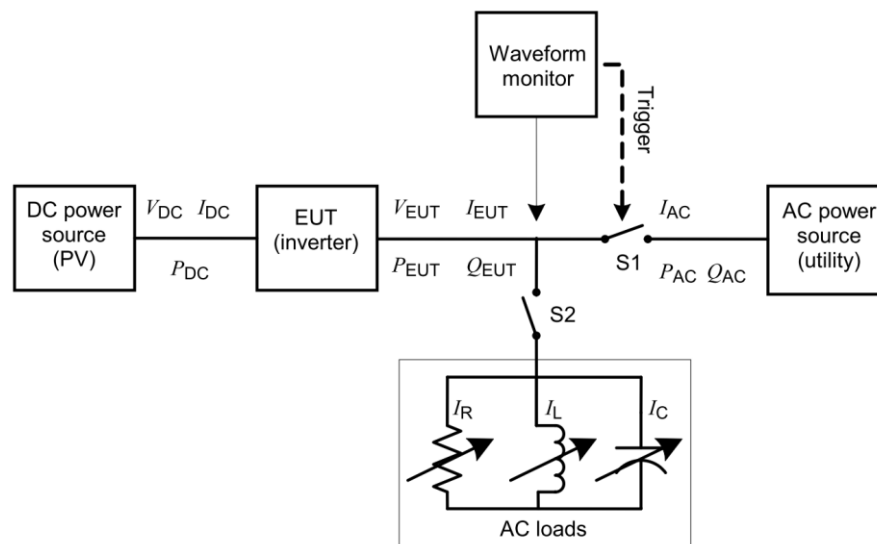


Figure 4 – Test circuit for Loss of Mains according to IEC 62116:2014

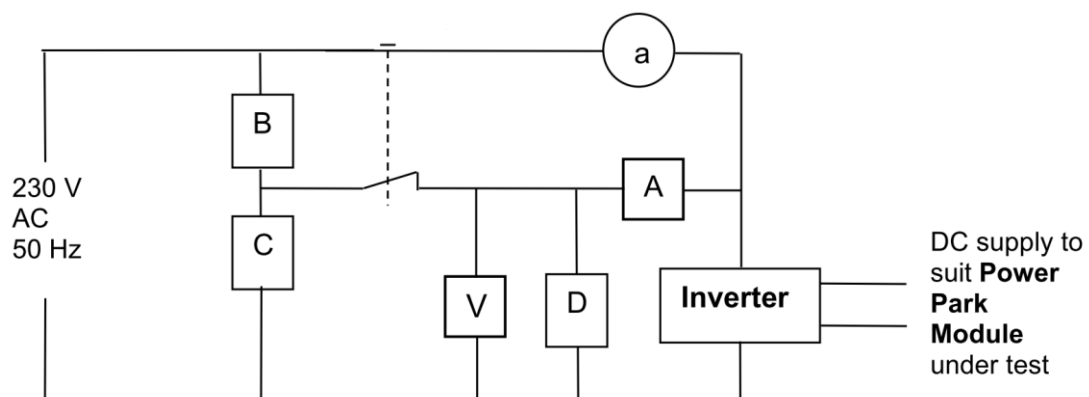


Figure 5 – Short circuit test circuit according to EREC G99, Figure A.7.5

#### 4.7 Measurement equipment

Equipment	Internal No.	Manufacturer	Type	Serial No.	Next Calibration
DC power supply <sup>8</sup>	HC-ENG-052	KEWELL	S7000-21K-2000-0040	6018888220400696	--
DC power supply <sup>9</sup>	HC-ENG-053	KEWELL	S7000-21K-2000-0040	6018888220501273	--
AC Simulator <sup>8</sup>	HC-ENG-055	KEWELL	KAC-45-345-33	6018888220903254	--
RLC load <sup>8</sup>	HC-ENG-058	Guangdong HuaChuang Technology Service Co., Ltd.	IMAX3312-120KW	20230325002	--
Data acquisition instrument	HC-ENG-046	DEWETRON	TRION-1820-POWER	A1222035/C5220875	2026/03/20
Transformer	HC-ENG-046-001	LEM	CT 400	1221300591	2026/03/20
	HC-ENG-046-002	LEM	CT 400	1221300592	2026/03/20
	HC-ENG-046-003	LEM	CT 400	1221300593	2026/03/20
	HC-ENG-046-004	LEM	CT 400	1221300594	2026/03/20
Humidity&Temperature recorder	HC-ENG-002	Elitech Technology, Inc.	GSP-8A	CMA21500031	2025/03/26
Oscilloscope	--	KEYSIGHT	DSOX 3024T	--	2025/05/19
Oscilloscope	--	YOKOGAWA	DLM3024	--	2026/01/14

**Note:**

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

<sup>8</sup> The AC simulator, DC sources and RLC load do not need to be calibrated, since the AC voltage and current is measured and determined using the calibrated oscilloscope and power analyser.

<sup>9</sup> The AC simulator, DC sources and RLC load 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 G99)	Remark / Transfer of measurement results *	Verdict
1. Operating Range	10.3.4, 11.2.1	See section 6.1 / The verified operating range of the ASG-20TL-ZH can be applied to other units in the product series directly.	P
2. Harmonics	9.4.3	See section 6.2 / The percentage harmonics results of the ASG-20TL-ZH can be applied to other units in the product series scaled by the factor $P_n, ASG-20TL-ZH / P_n, unit-not-tested$ . The transferred results are below the required limit values according to BS EN 61000-3-12.	P
3. Voltage Fluctuation and Flicker	9.4.2	See section 6.3 / The Flicker results of the ASG-20TL-ZH can be applied to other units in the product series scaled by the factor $P_n, ASG-20TL-ZH / P_n, unit-not-tested$ . The transferred results (values at test and standard impedance) are below the required limit values according to BS EN 61000-3-11.	P
4. DC injection	9.4.6	See section 6.4 / The percentage DC injection of the ASG-20TL-ZH can be considered as worst case results and applied to the ASG-5TL-ZH, ASG-6TL-ZH, ASG-8TL-ZH, ASG-10TL-ZH, ASG-12TL-ZH and ASG-15TL-ZH directly. The transferred results are below the required limit of 0.25%.	P
5. Power Factor (PF)	11.1.5	See section 6.5 / The Power Factor results of the ASG-20TL-ZH can be applied to other units in the product series directly.	P
6. Frequency protection trip and ride through tests	10.3, 10.6	See section 6.6.1 / The measurement results of the ASG-20TL-ZH can be applied to other units in the product series directly.	P

Items	Technical requirements (Section EREC G99)	Remark / Transfer of measurement results *	Verdict
7. Voltage protection trip and ride through tests	10.3, 10.6	See section 6.6.2 / The measurement results of the ASG-20TL-ZH can be applied to other units in the product series directly.	P
8. Protection – Loss of Mains Test, Vector Shift and RoCoF Stability Test	10.3, 10.4, 10.6	See section 6.6.3, 6.6.4 and 6.6.5 / The measurement results of the ASG-20TL-ZH can be applied to other units in the product series directly.	P
9. LFSM-O Test	11.2.4	See section 6.7 / The determined droops of the ASG-20TL-ZH can be applied to other units in the product series directly.	P
10. Protection – Reconnection Timer	A.7.1.2.5	See section 6.8 / The measurement results of the ASG-20TL-ZH can be applied to other units in the product series directly.	P
11. Fault Level Contribution	9.7, A.7.1.5	See section 6.9 / The measurement results of the ASG-20TL-ZH can be applied to other units in the product series directly.	P
12. Self-monitoring Solid State Switch	9.7.9	See section 6.10 / ---	N/A
13. Wiring functional tests if required by para 15.2.1 (attach relevant schedule of tests)	15.2.1	See section 6.11 / ---	N/A
14. Logic Interface (input port)	11.1.3	See section 6.12 / The measurement results of the ASG-20TL-ZH can be applied to other units in the product series directly. The high-level description of logic interface applies to the whole product series.	P
15. Cyber security	9.1.7	See section 6.13 / Manufacturer's declaration provided. See <i>Annex 2 - Manufacturer's declaration regarding Cyber Security</i> .	R/D
Output power with falling frequency	A.7.1.7, 11.2.3.3	Test not required for Power Generating Modules using inverter	N/A

## Note:

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

\* According to EREC G99, section 15.6.2 the following applies:

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

In general, the **relative results** of EUT ASG-20TL-ZH can be applied to other units in the product series scaled by the factor  $P_{n, ASG-20TL-ZH} / P_{n, unit-not-tested}$ . Exceptions are detailed in the table above.

## 6 Measurement results

### A2-3 Compliance Verification Report –Tests for Type A Inverter Connected Power Generating Modules – test record

#### 6.1 Operating Range

Tests should be carried with the Power Generating Module operating at Registered Capacity and connected to a suitable test supply or grid simulation set. The power supplied by the primary source shall be kept stable within  $\pm 5\%$  of the apparent power value set for the entire duration of each test sequence.

Frequency, voltage and Active Power measurements at the output terminals of the Power Generating Module shall be recorded every second. The tests will verify that the Power Generating Module 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 Power Park Module the PV primary source may be replaced by a DC source.

In case of a full converter Power Park Module (eg wind) the primary source and the prime mover Inverter/rectifier may be replaced by a DC source.

Pass or failure of the test should be indicated in the fields below (right hand side), for example with the statement "Pass", "No disconnection occurs", etc. Graphical evidence is preferred.

Note that the value of voltage stated in brackets assumes a LV connection. This should be adjusted for HV as required.

Note:

During the test, the LFSM-O function was deactivated.

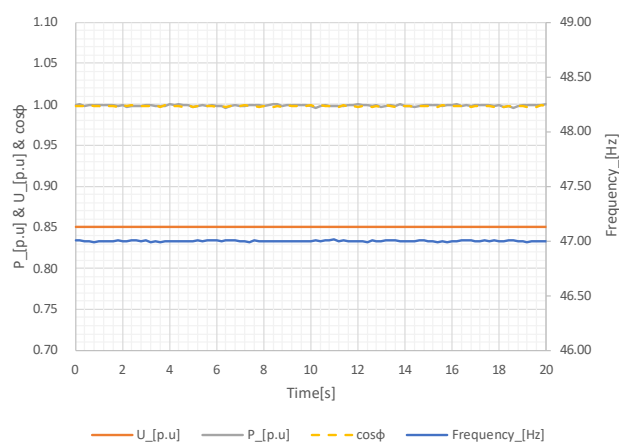
##### Test 1

Voltage = 85% of nominal (195.5 V),  
Frequency = 47 Hz,

**Power Factor** = 1,

Period of test 20 s

Pass, no disconnection occurs.



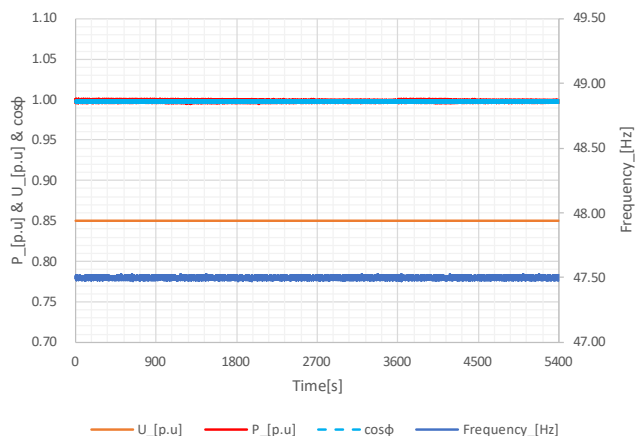
##### Test 2

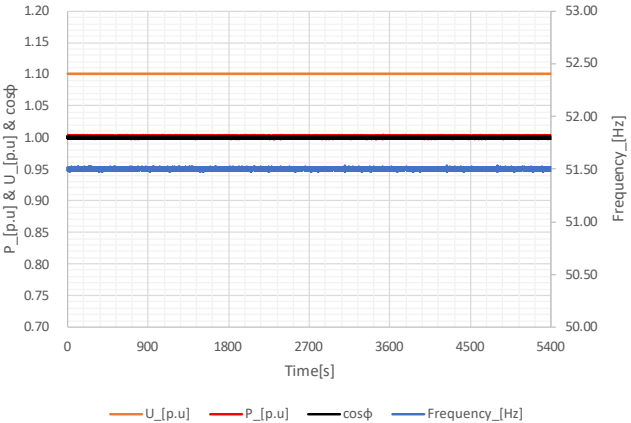
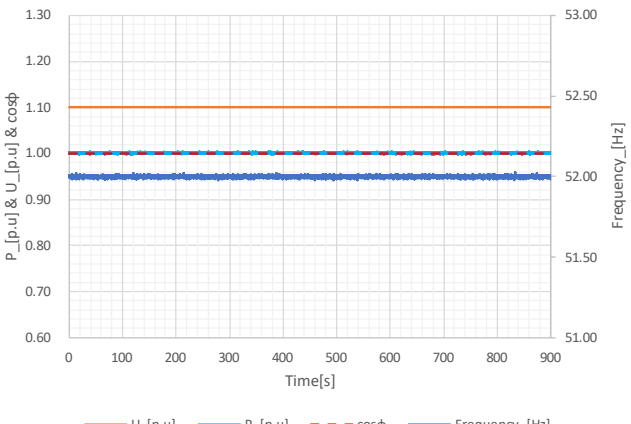
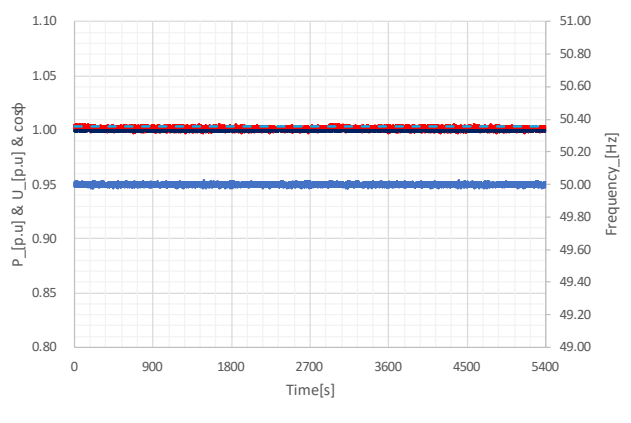
Voltage = 85% of nominal (195.5 V),  
Frequency = 47.5 Hz,

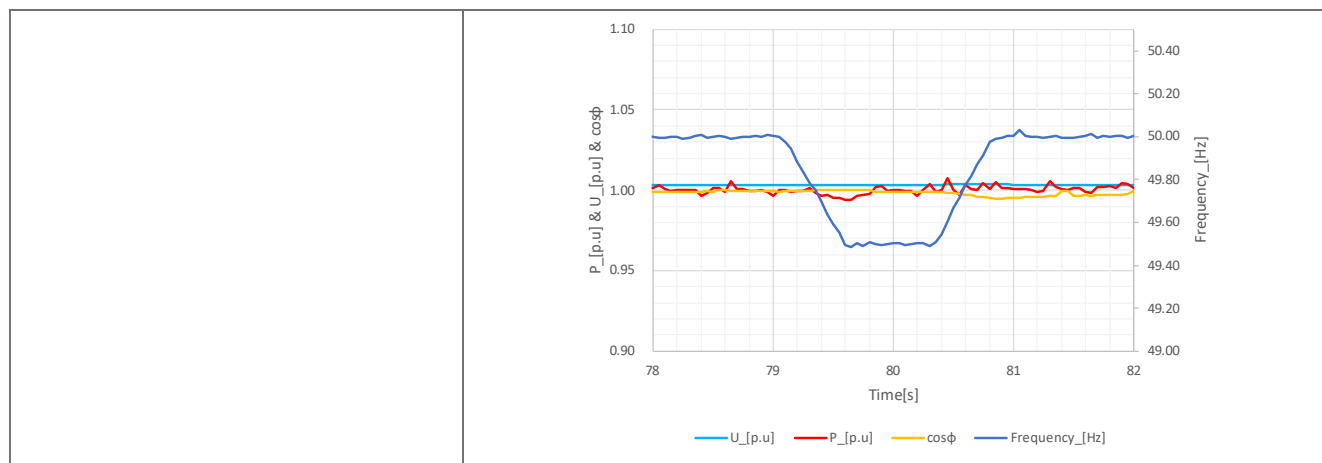
**Power Factor** = 1,

Period of test 90 minutes

Pass, no disconnection occurs.



<p>Test 3</p> <p>Voltage = 110% of nominal (253 V), Frequency = 51.5 Hz, <b>Power Factor = 1</b>, Period of test 90 minutes</p>	<p>Pass, no disconnection occurs.</p> 
<p>Test 4</p> <p>Voltage = 110% of nominal (253 V), Frequency = 52.0 Hz, <b>Power Factor = 1</b>, Period of test 15 minutes</p>	<p>Pass, no disconnection occurs.</p> 
<p>Test 5</p> <p>Voltage = 100% of nominal (230 V), Frequency = 50.0 Hz, <b>Power Factor = 1</b>, Period of test = 90 minutes</p>	<p>Pass, no disconnection occurs.</p> 
<p>Test 6 RoCoF withstand</p> <p>Confirm that the Power Generating Module is capable of staying connected to the Distribution Network and operate at rates of change of frequency up to 1 Hzs-1 as measured over a period of 500 ms. Note that this is not expected to be demonstrated on site.</p>	<p>Pass, no disconnection occurs.</p>



## 6.2 Power Quality – Harmonics

For **Power Generating Modules** of **Registered Capacity** of less than 75 A per phase (ie 50 kW) the test requirements are specified in Annex A.7.1.5. These tests should be carried out as specified in BS EN 61000-3-12, and measurements for the 2<sup>nd</sup> – 13<sup>th</sup> harmonics should be provided. The results need to comply with the limits of Table 2 of BS EN 61000-3-12 for single phase equipment and Table 3 of BS EN 610000-3-12 for three phase equipment. For three phase **Power Generating Modules**, measurements for all phases should be provided.

For **Power Generating Modules** of **Registered Capacity** of greater than 75 A per phase (ie 50 kW) the installation shall be designed in accordance with EREC G5.

The rating of the **Power Generating Module** (per phase) should be provided below, and the Total Harmonic Distortion (THD) and Partial Weighted Harmonic Distortion (PWHD) should be provided at the bottom of this section.

**Power Generating Module** tested to BS EN 61000-3-12

Power Generating Module rating per phase (rpp)				6.666		kVA	Harmonic % = Measured Value (A) x 23/rating per phase (kVA)	
Single or three phase measurements (for single phase measurements, only complete L1 columns below).				three phases				
Harmonic	At 45-55% of <b>Registered Capacity</b>						Limit in BS EN 61000-3-12	
	Measured Value (MV) in Amps			Measured Value (MV) in % <sup>10</sup>				
Order	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	1-phase	3-phases
2	0.082	0.064	0.035	0.314	0.245	0.134	8%	8%
3	0.158	0.157	0.151	0.606	0.602	0.579	21.6%	Not stated
4	0.018	0.020	0.014	0.069	0.077	0.054	4%	4%
5	0.128	0.133	0.106	0.491	0.510	0.406	10.7%	10.7%
6	0.009	0.012	0.009	0.035	0.046	0.035	2.67%	2.67%
7	0.062	0.062	0.045	0.238	0.238	0.173	7.2%	7.2%
8	0.010	0.010	0.008	0.038	0.038	0.031	2%	2%
9	0.039	0.051	0.046	0.150	0.196	0.176	3.8%	Not stated
10	0.009	0.010	0.008	0.035	0.038	0.031	1.6%	1.6%
11	0.042	0.053	0.054	0.161	0.203	0.207	3.1%	3.1%
12	0.009	0.011	0.007	0.035	0.042	0.027	1.33%	1.33%

<sup>10</sup> The percentage values of harmonic currents (for both partial load and full load tests) were calculated using the formula:

Harmonic % = Measured Value (A) x 23/rating per phase (kVA)

according to Form A2-3, which corresponding to a reference current equal to rated current of the inverter.



Order	L1	L2	L3	L1	L2	L3	1-phase	3-phases
13	0.036	0.055	0.047	0.138	0.211	0.180	2%	2%
14	0.013	0.013	0.010	0.050	0.050	0.038	---	---
15	0.056	0.066	0.059	0.215	0.253	0.226	---	---
16	0.009	0.013	0.009	0.035	0.050	0.035	---	---
17	0.060	0.071	0.069	0.230	0.272	0.265	---	---
18	0.012	0.014	0.013	0.046	0.054	0.050	---	---
19	0.079	0.080	0.085	0.303	0.307	0.326	---	---
20	0.012	0.014	0.010	0.046	0.054	0.038	---	---
21	0.049	0.073	0.062	0.188	0.280	0.238	---	---
22	0.011	0.017	0.010	0.042	0.065	0.038	---	---
23	0.051	0.065	0.056	0.196	0.249	0.215	---	---
24	0.012	0.015	0.011	0.046	0.058	0.042	---	---
25	0.058	0.065	0.068	0.222	0.249	0.261	---	---
26	0.010	0.012	0.010	0.038	0.046	0.038	---	---
27	0.032	0.043	0.035	0.123	0.165	0.134	---	---
28	0.010	0.010	0.008	0.038	0.038	0.031	---	---
29	0.030	0.027	0.028	0.115	0.104	0.107	---	---
30	0.007	0.011	0.006	0.027	0.042	0.023	---	---
31	0.025	0.030	0.024	0.096	0.115	0.092	---	---
32	0.007	0.006	0.006	0.027	0.023	0.023	---	---
33	0.023	0.024	0.025	0.088	0.092	0.096	---	---
34	0.005	0.007	0.005	0.019	0.027	0.019	---	---
35	0.016	0.021	0.017	0.061	0.081	0.065	---	---
36	0.005	0.006	0.004	0.019	0.023	0.015	---	---
37	0.015	0.017	0.015	0.058	0.065	0.058	---	---
38	0.005	0.004	0.004	0.019	0.015	0.015	---	---
39	0.015	0.015	0.016	0.058	0.058	0.061	---	---
40	0.005	0.005	0.004	0.019	0.019	0.015	---	---
THD <sup>11</sup>	---	---	---	1.108	1.187	1.064	23%	13%
PWHD <sup>12</sup>	---	---	---	2.882	3.386	3.170	23%	22%

<sup>11</sup> THD = Total Harmonic Distortion, order 2 - 40 according to BS EN 61000- 3-12 considered. The stated values in the results table are in %.

<sup>12</sup> PWHD = Partial Weighted Harmonic Distortion, order 14 - 40 according to BS EN 61000- 3-12 considered. The stated values in the results table are in %.

Harmonic	At 100% of <b>Registered Capacity</b>						Limit in BS EN 61000-3-12	
	Measured Value (MV) in Amps			Measured Value (MV) in % <sup>10</sup>				
Order	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	1-phase	3-phases
2	0.119	0.092	0.048	0.456	0.353	0.184	8%	8%
3	0.201	0.199	0.194	0.771	0.763	0.744	21.6%	Not stated
4	0.027	0.028	0.027	0.104	0.107	0.104	4%	4%
5	0.170	0.170	0.139	0.652	0.652	0.533	10.7%	10.7%
6	0.013	0.015	0.015	0.050	0.058	0.058	2.67%	2.67%
7	0.045	0.055	0.042	0.173	0.211	0.161	7.2%	7.2%
8	0.013	0.013	0.013	0.050	0.050	0.050	2%	2%
9	0.023	0.028	0.022	0.088	0.107	0.084	3.8%	Not stated
10	0.015	0.013	0.016	0.058	0.050	0.061	1.6%	1.6%
11	0.046	0.039	0.038	0.176	0.150	0.146	3.1%	3.1%
12	0.011	0.012	0.012	0.042	0.046	0.046	1.33%	1.33%
13	0.034	0.023	0.016	0.130	0.088	0.061	2%	2%
14	0.017	0.016	0.016	0.065	0.061	0.061	---	---
15	0.028	0.027	0.015	0.107	0.104	0.058	---	---
16	0.015	0.016	0.013	0.058	0.061	0.050	---	---
17	0.020	0.029	0.017	0.077	0.111	0.065	---	---
18	0.015	0.018	0.016	0.058	0.069	0.061	---	---
19	0.021	0.024	0.023	0.081	0.092	0.088	---	---
20	0.024	0.021	0.022	0.092	0.081	0.084	---	---
21	0.031	0.032	0.024	0.119	0.123	0.092	---	---
22	0.017	0.020	0.021	0.065	0.077	0.081	---	---
23	0.040	0.018	0.021	0.153	0.069	0.081	---	---
24	0.016	0.019	0.016	0.061	0.073	0.061	---	---
25	0.071	0.037	0.048	0.272	0.142	0.184	---	---
26	0.017	0.015	0.019	0.065	0.058	0.073	---	---
27	0.033	0.015	0.013	0.127	0.058	0.050	---	---
28	0.016	0.016	0.013	0.061	0.061	0.050	---	---
29	0.032	0.018	0.025	0.123	0.069	0.096	---	---
30	0.019	0.018	0.015	0.073	0.069	0.058	---	---
31	0.029	0.021	0.014	0.111	0.081	0.054	---	---
32	0.010	0.010	0.011	0.038	0.038	0.042	---	---
33	0.015	0.011	0.009	0.058	0.042	0.035	---	---
34	0.013	0.011	0.011	0.050	0.042	0.042	---	---
35	0.014	0.007	0.011	0.054	0.027	0.042	---	---
36	0.008	0.007	0.006	0.031	0.027	0.023	---	---
37	0.020	0.016	0.011	0.077	0.061	0.042	---	---
38	0.007	0.006	0.006	0.027	0.023	0.023	---	---
39	0.014	0.007	0.007	0.054	0.027	0.027	---	---
40	0.007	0.007	0.005	0.027	0.027	0.019	---	---
THD <sup>11</sup>	---	---	---	1.254	1.174	1.039	23%	13%
PWHD <sup>12</sup>	---	---	---	2.449	1.800	1.753	23%	22%

### 6.3 Power Quality – Voltage fluctuations and Flicker

For **Power Generating Modules of Registered Capacity** of less than 75 A per phase (ie 50 kW) these tests should be undertaken in accordance with Annex A.7.1.4.3. Results should be normalised to a standard source impedance, or if this results in figures above the limits set in BS EN 61000-3-11 to a suitable Maximum Impedance.

For **Power Generating Modules of Registered Capacity** of greater than 75 A per phase (ie 50 kW) the installation shall be designed in accordance with EREC P28.

The standard test impedance is 0.4  $\Omega$  for a single-phase **Power Generating Module** (and for a two-phase unit in a three-phase system) and 0.24  $\Omega$  for a three phase **Power Generating Module** (and for a two-phase unit in a split phase system). Please ensure that both test and standard impedance are completed on this form. If the test impedance (or the measured impedance) is different to the standard impedance, it must be normalised to the standard impedance as follows (where the **Power Factor** of the generation output is 0.98 or above):

$d_{\max}$  normalised value = (Standard impedance / Measured impedance) x Measured value.

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 needs to comply with the requirements set out in the testing notes for the technology under test. The test date and location must be declared.

Test start date	2025-02-21	Test end date	2025-02-21						
Test location	Lyns-tci Technology Guangdong Co., Ltd. (see <i>Testing location</i> on p.2)								
	Phase no.	Starting			Stopping			Running	
		$d_{\max}$ [%]	$d_c$ [%]	$d(t)$ [ms]	$d_{\max}$ [%]	$d_c$ [%]	$d(t)$ [ms]	$P_{st}$	$P_{it}$ 2 hours
Measured Values at test impedance	L1	0.300	0.240	0.000	0.300	0.270	0.000	0.100	0.100
	L2	0.280	0.240	0.000	0.290	0.250	0.000	0.090	0.090
	L3	0.320	0.290	0.000	0.340	0.300	0.000	0.100	0.100
	Overall worst case	0.320	0.290	0.000	0.340	0.300	0.000	0.100	0.100
Normalised to standard impedance	L1	0.300	0.240	0.000	0.300	0.270	0.000	0.100	0.100
	L2	0.280	0.240	0.000	0.290	0.250	0.000	0.090	0.090
	L3	0.320	0.290	0.000	0.340	0.300	0.000	0.100	0.100
	Overall worst case	0.320	0.290	0.000	0.340	0.300	0.000	0.100	0.100
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:	0.24 $\Omega$			X:	0.15 $\Omega$			
Standard Impedance	R:	<input checked="" type="checkbox"/> 0.24 * $\Omega$ <input type="checkbox"/> 0.4 ^ $\Omega$			X:	<input checked="" type="checkbox"/> 0.15 * $\Omega$ <input type="checkbox"/> 0.25 ^ $\Omega$			
Maximum Impedance	R:	-- $\Omega$			X:	-- $\Omega$			
* <input checked="" type="checkbox"/> three-phase <b>Power Generating Modules</b>		<input type="checkbox"/> split single phase <b>Power Generating Modules</b>							
^ <input type="checkbox"/> single phase <b>Power Generating Module</b>		<input type="checkbox"/> <b>Power Generating Modules</b> using two phases on a three-phase system							

#### 6.4 Power Quality – DC injection

The tests should be carried out on a single **Generating Unit**. Tests are to be carried out at three defined power levels  $\pm 5\%$ . At 230 V a 50 kW three phase **Inverter** has a current output of 217 A so DC limit is 543 mA. These tests should be undertaken in accordance with Annex A.7.1.4.4.

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) /  $V_{\text{phase}}$  \*. The % DC injection should not be greater than 0.25%.

ASG-20TL-ZH			
Test power level	10%	55%	100%
Recorded DC value in Amps	0.007	0.033	0.066
as % of rated AC current	0.008	0.038	0.076
Limit [%]	0.25	0.25	0.25

Note:

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

- Base current = Registered Capacity (W) / 230 (V)

- % DC injection = Recorded DC value (A) / Base current (A) \*100

## 6.5 Power Factor

The tests should be carried out on a single **Power Generating Module**. Tests are to be carried out at three voltage levels and at **Registered Capacity** and the measured **Power Factor** must be greater than 0.95 to pass. Voltage to be maintained within  $\pm 1.5\%$  of the stated level during the test. These tests should be undertaken in accordance with Annex A.7.1.4.2.

Note that the value of voltage stated in brackets assumes a **LV** connection. This should be adjusted for **HV** as required.

Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	0.999	0.999	0.999
<b>Power Factor Limit</b>	>0.95	>0.95	>0.95

### Note:

See also “*Note*” on Power Factor on p.9.

## 6.6 Protection

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

- ☒ A display on a screen which can be read
- ☒ 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 settings including nominal voltage and current outputs, alongside the identification number / name of the device, permanently fixed to the Power Generating Module
- ☒ Other (The Interface Protection setting information can be display on APP)

### Note:

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

### Manufacturer Data:

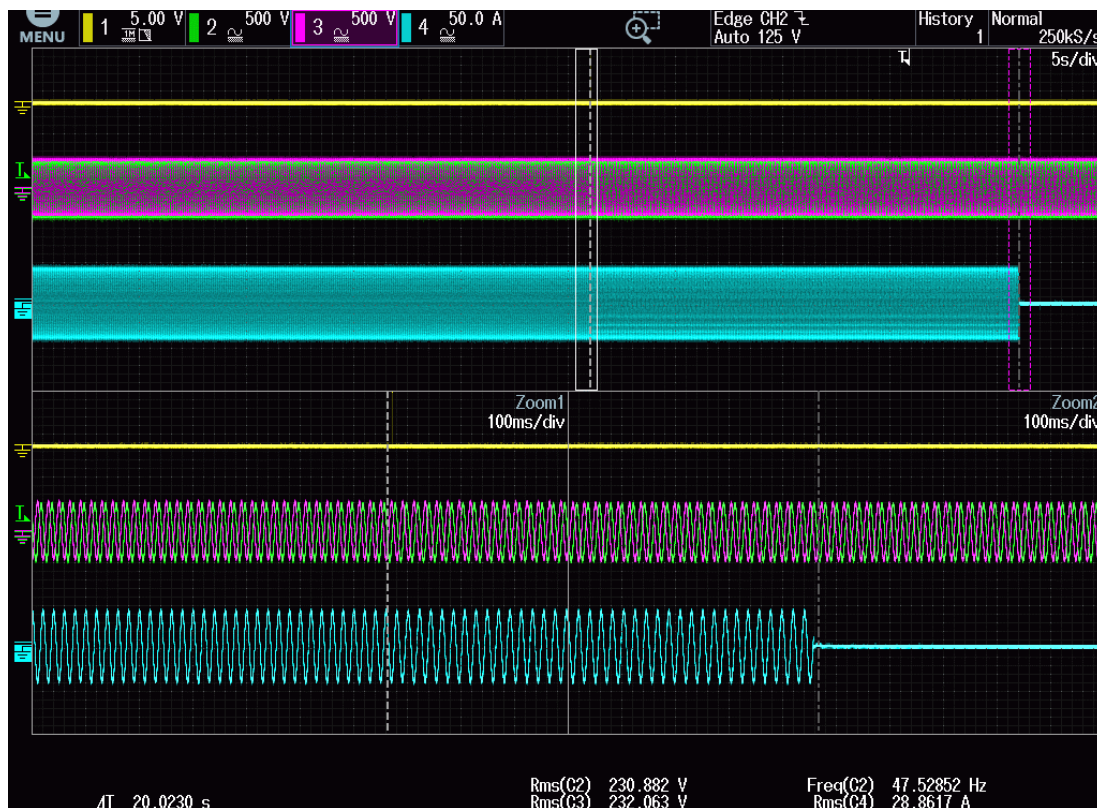
The integrated Interface Protection in the Power Generating Modules considered in this report is capable of measuring voltage to an accuracy of  $\pm 1.5\%$  of the nominal value and of measuring frequency to  $\pm 0.2\%$  of the nominal value across its operating range of voltage, frequency and temperature ( $-30^{\circ}\text{C} \sim +60^{\circ}\text{C}$ ).

(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 the Annex A.7.1.2.3. For trip tests, frequency and time delay should be stated. For “no trip tests”, “no trip” can be stated.						
Function	Setting		Trip test		“No trip tests”	
	Frequency	Time delay	Frequency	Time delay	Frequency / time	Confirm no trip
U/F stage 1	47.5 Hz	20 s	47.50 Hz	20.023 s	47.7 Hz 30 s	No trip occurred
U/F stage 2	47 Hz	0.5 s	46.99 Hz	0.530 s	47.2 Hz 19.5 s	No trip occurred
					46.8 Hz 0.45 s	No trip occurred
O/F	52 Hz	0.5 s	52.05 Hz	0.520 s	51.8 Hz 120.0 s	No trip occurred
					52.2 Hz 0.45 s	No trip occurred

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





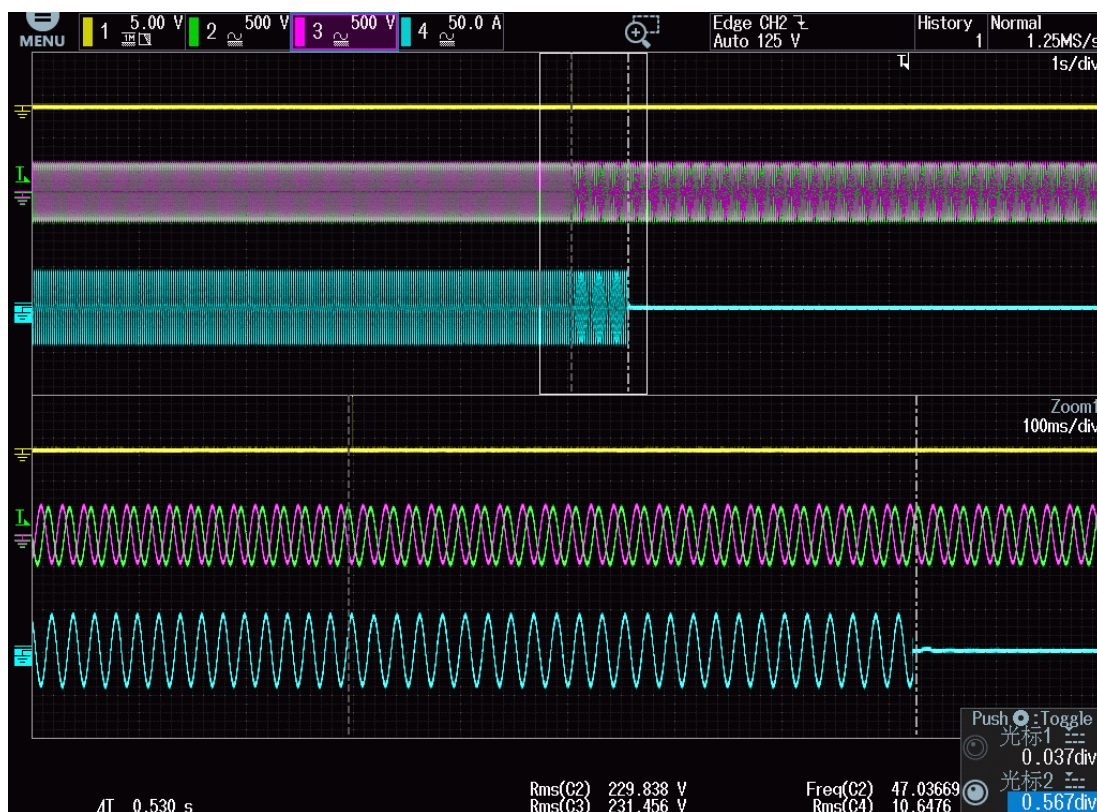


Figure 7 – Test U/F stage 2 (Trip test)

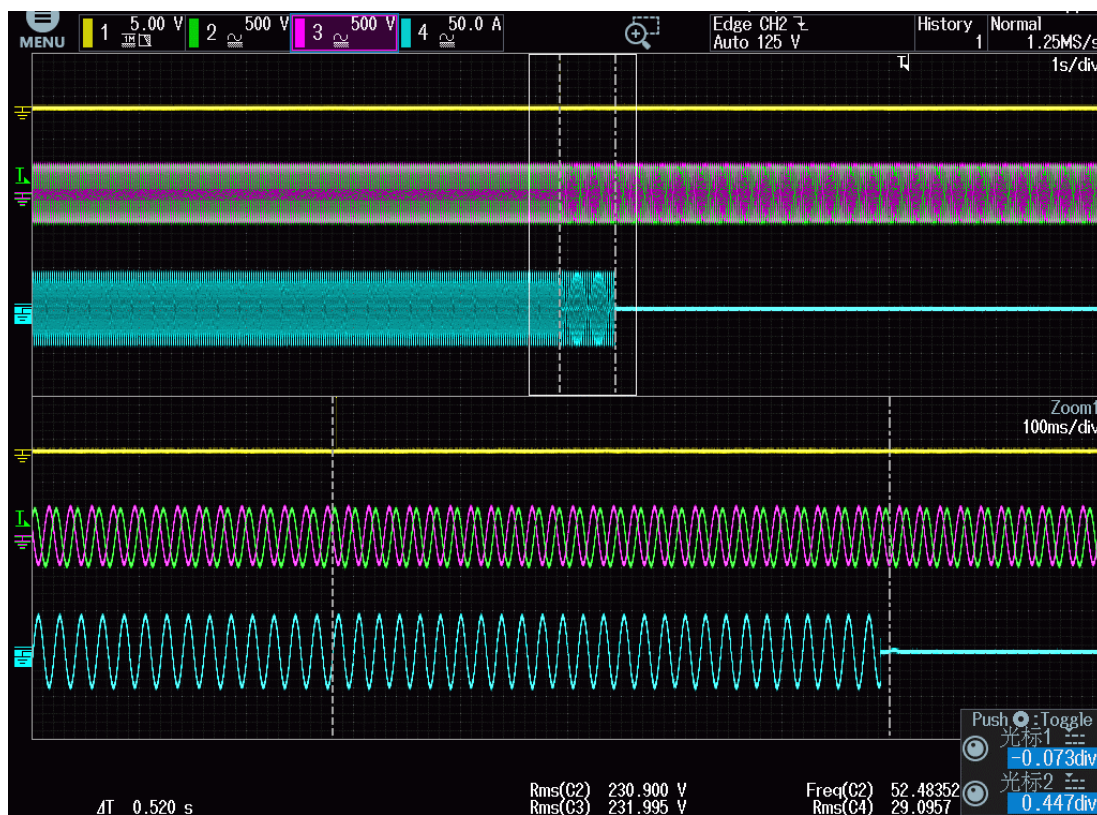


Figure 8 – Test OF (Trip test)

### 6.6.2 Protection – Voltage tests

These tests should be carried out in accordance with Annex A.7.1.2.2. For trip tests, voltage and time delay should be stated. For “no trip tests”, “no trip” can be stated.

Note that the value of voltage stated below assumes a **LV** connection This should be adjusted for **HV** taking account of the VT ratio as required.

Function		Setting		Trip test		“No trip tests”	
		Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V	L1-N	0.8 pu (184 V)	2.5 s	184.63 V	2.530 s	188 V 5.0 s	No trip occurred
	L2-N			184.03 V	2.554 s		No trip occurred
	L3-N			183.14 V	2.544 s		No trip occurred
						180 V 2.45 s	No trip occurred
O/V stage 1	L1-N	1.14 pu (262.2 V)	1.0 s	263.77 V	1.050 s	258.2 V 5.0 s	No trip occurred
	L2-N			262.66 V	1.020 s		No trip occurred
	L3-N			262.55V	1.048 s		No trip occurred
O/V stage 2	L1-N	1.19 pu (273.7 V)	0.5 s	274.37 V	0.550 s	269.7 V 0.95 s	No trip occurred
	L2-N			274.22 V	0.534 s		No trip occurred
	L3-N			273.56 V	0.534 s		No trip occurred
						277.7 V 0.45 s	No trip occurred

**Note:**

for voltage tests the Voltage required to trip is the setting  $\pm 3.45$  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  $\pm 4$  V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.



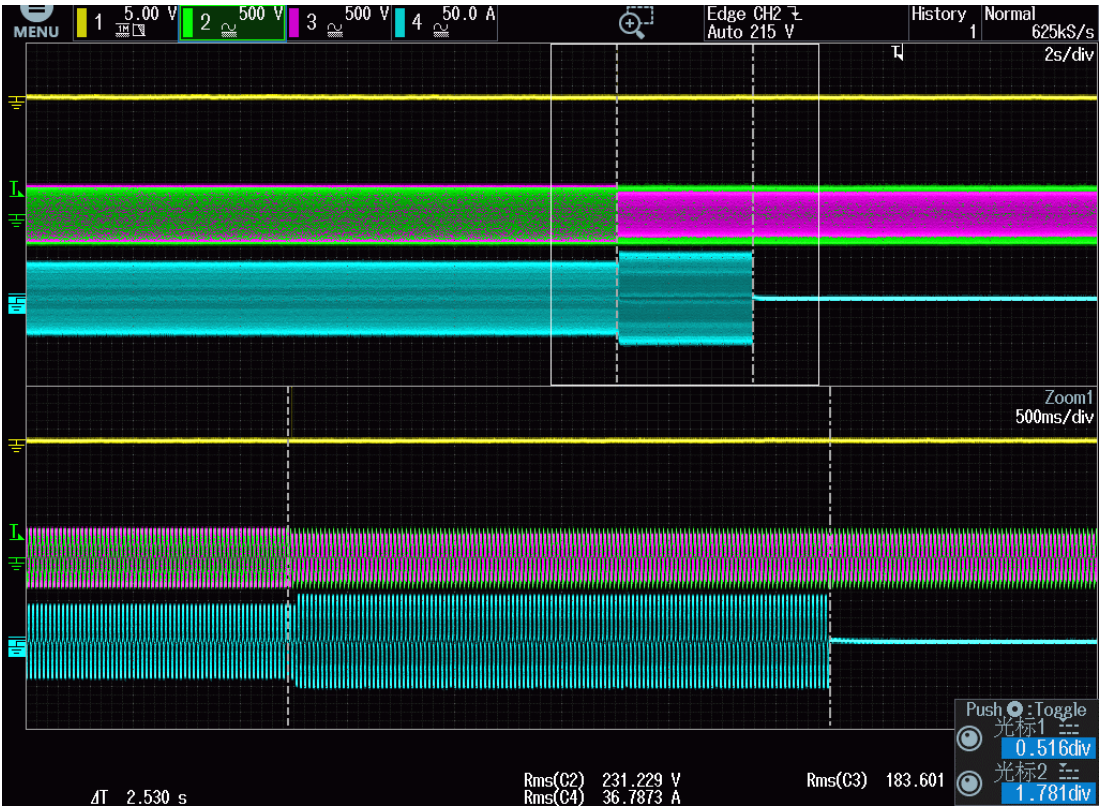


Figure 9 – Test U/V (Trip test, L1-N)

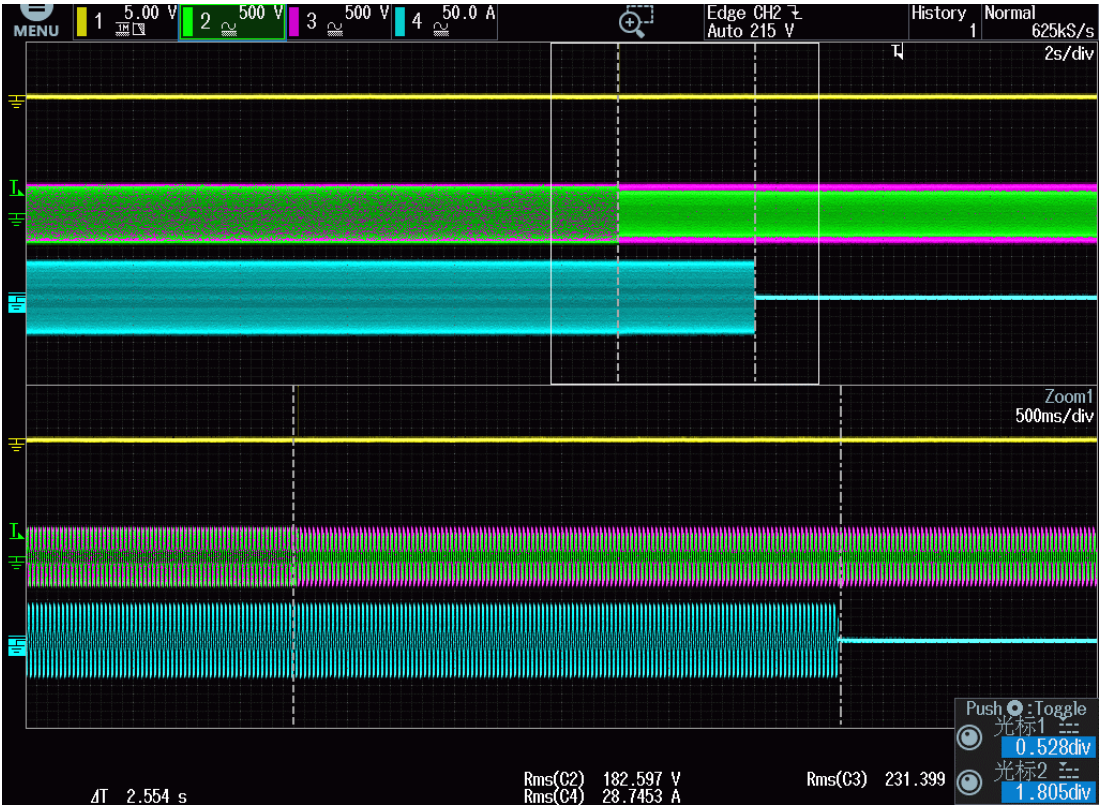


Figure 10 – Test U/V (Trip test, L2-N)

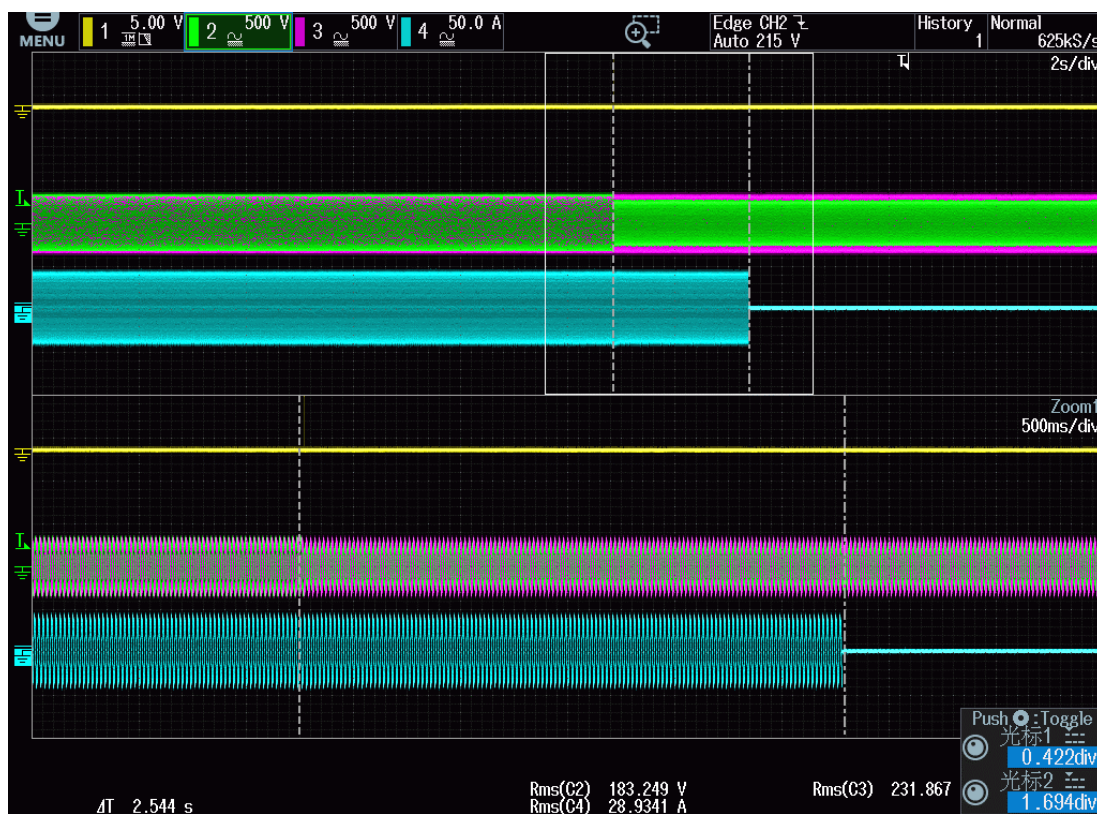


Figure 11 – Test U/V (Trip test, L3-N)

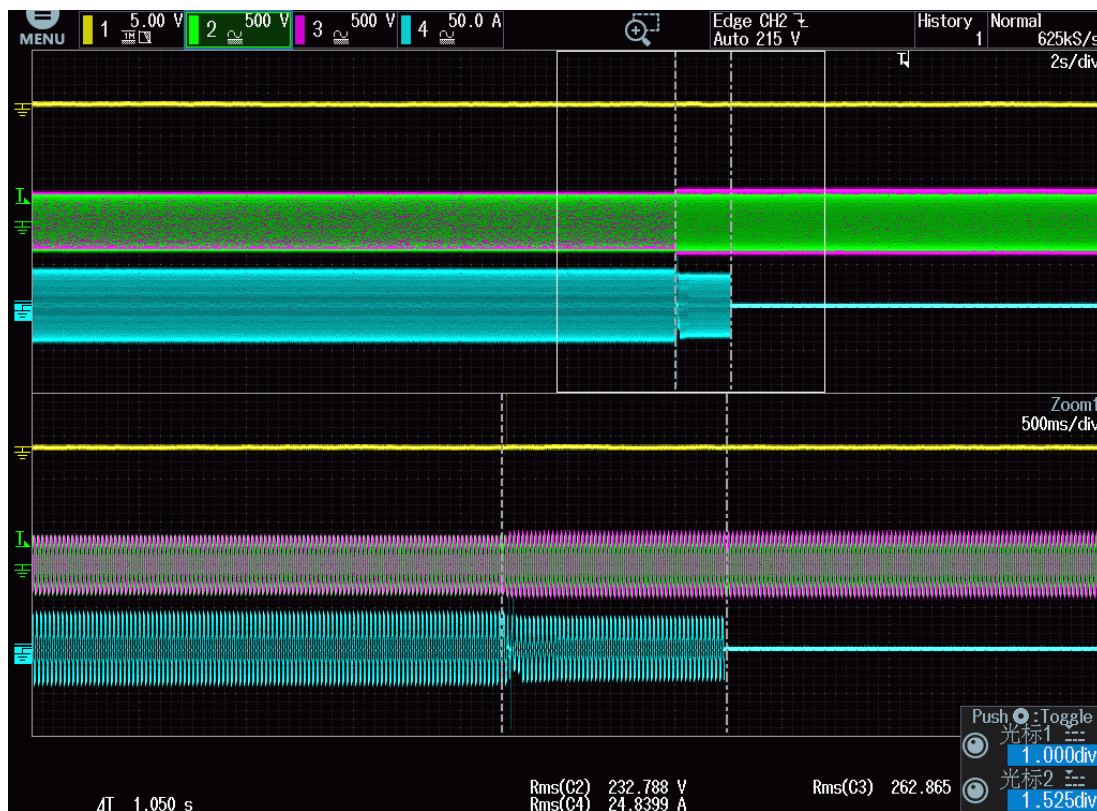


Figure 12 – Test O/V stage 1 (Trip test, L1-N)



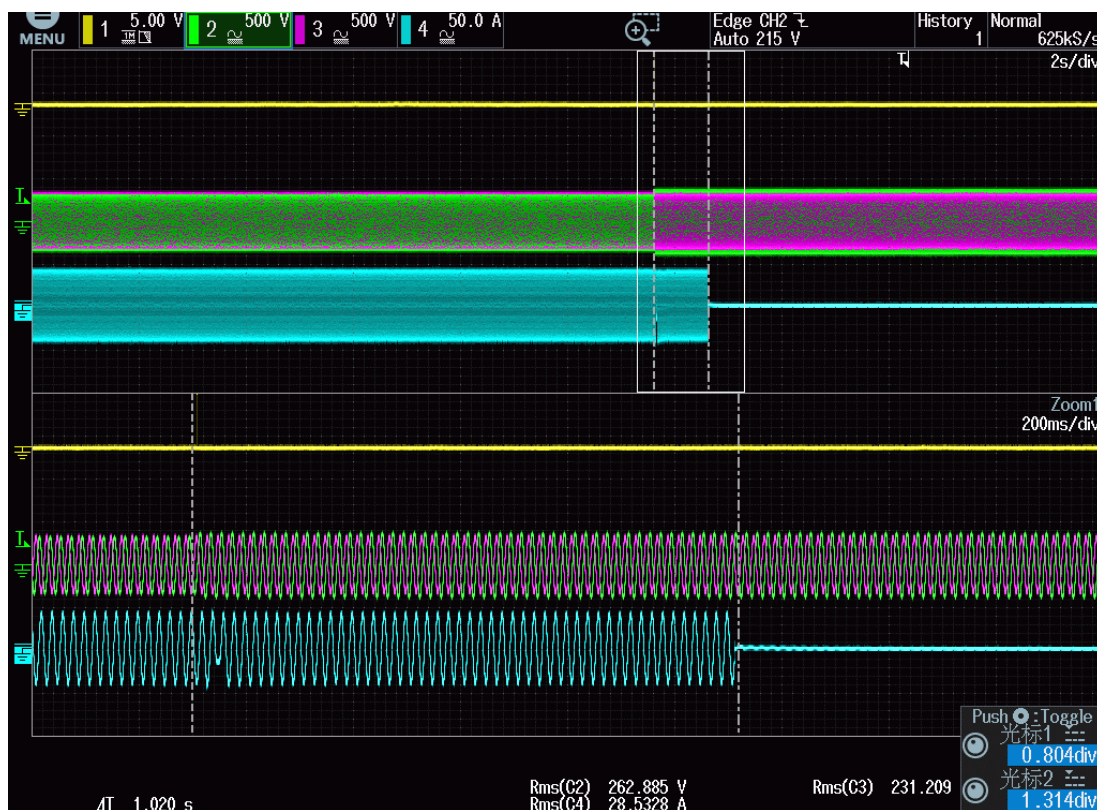


Figure 13 – Test O/V stage 1 (Trip test, L2-N)

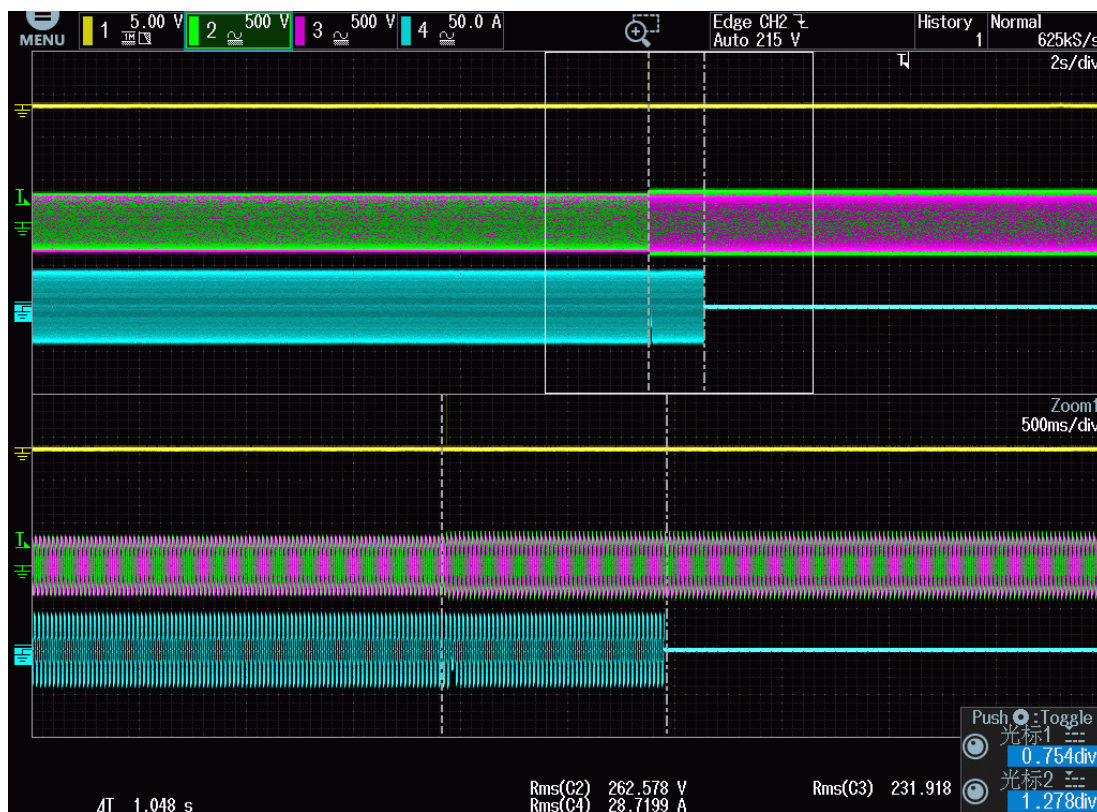


Figure 14 – Test O/V stage 1 (Trip test, L3-N)

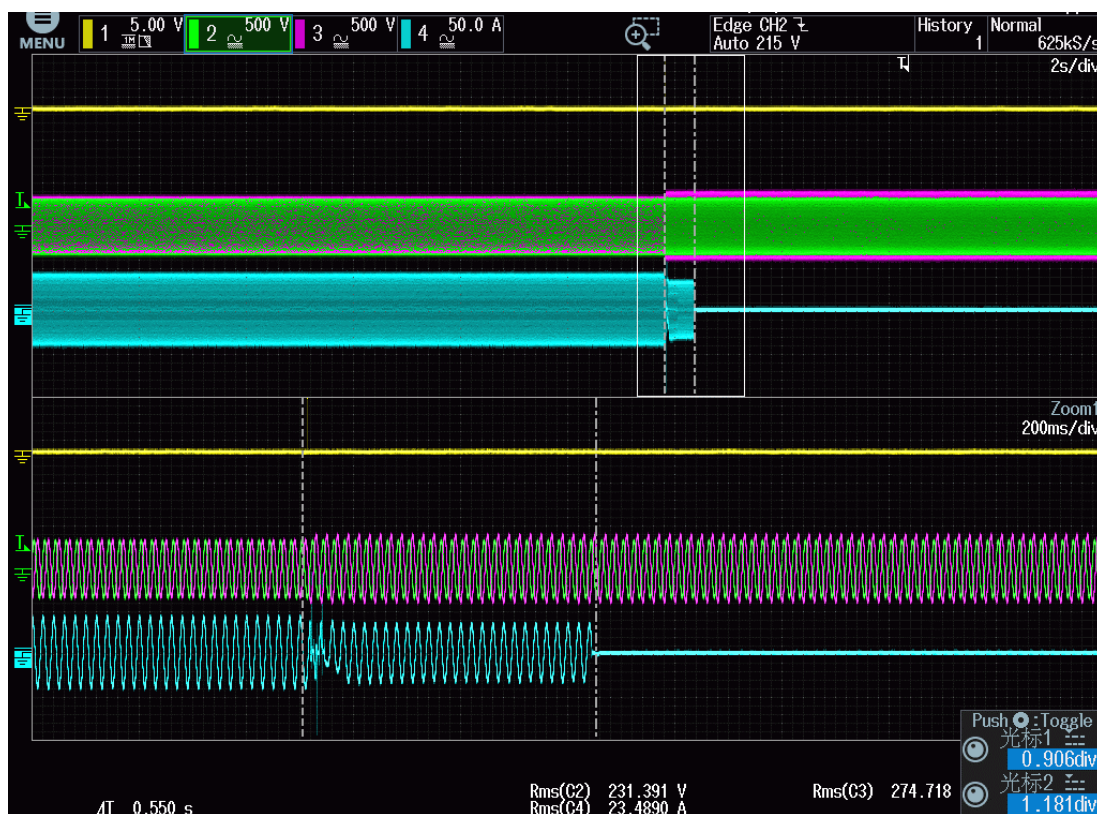


Figure 15 – Test O/V stage 2 (Trip test, L1-N)

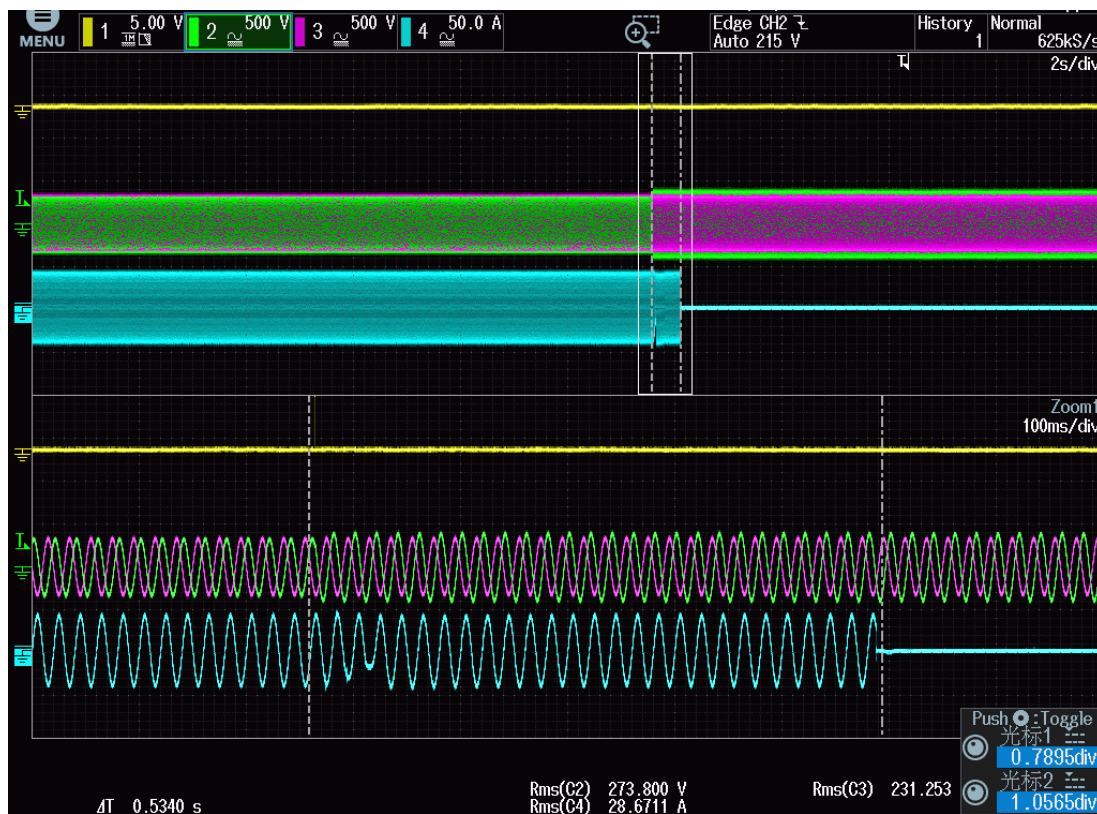
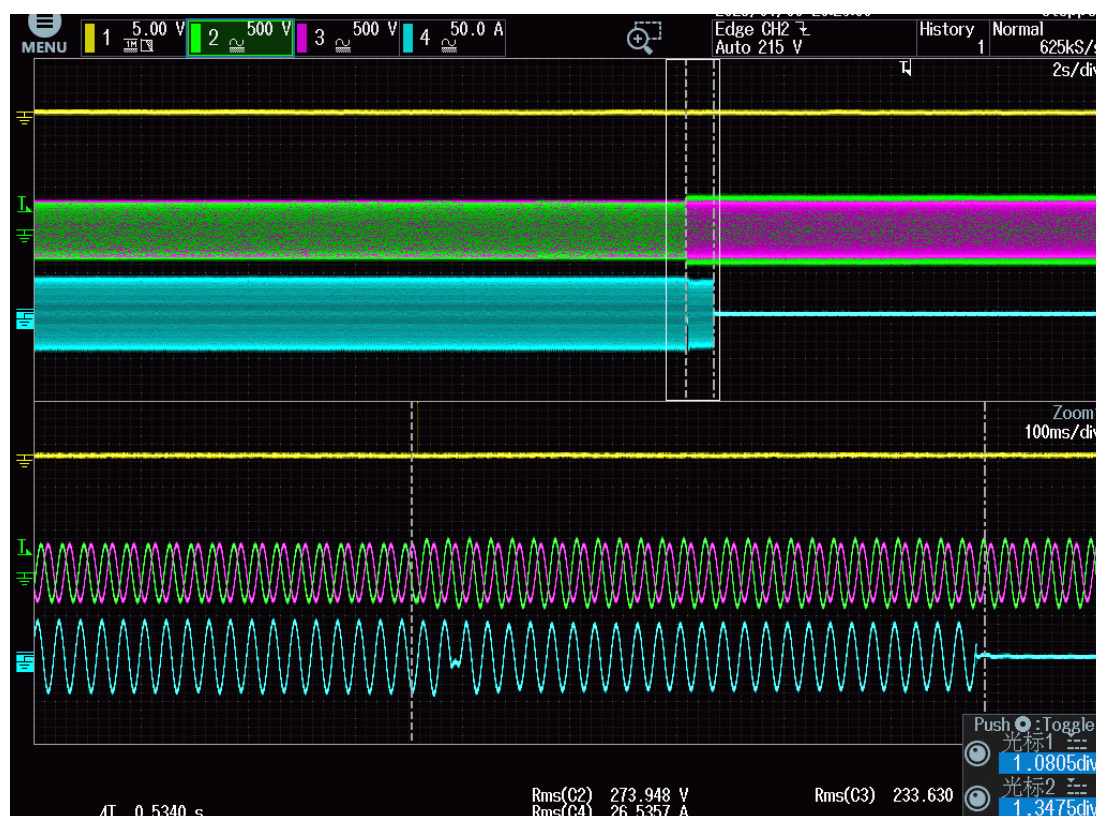


Figure 16 – Test O/V stage 2 (Trip test, L2-N)





**Figure 17 – Test O/V stage 2 (Trip test, L3-N)**

### 6.6.3 Protection – Loss of Mains test

These tests should be carried out in accordance with BS EN 62116. Annex A.7.1.2.4.

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

Test Power and imbalance	33% -5%Q (Test 22)	66% -5%Q (Test 12)	100% -5%P (Test 5)	33% +5%Q (Test 31)	66% +5%Q (Test 21)	100% +5%P (Test 10)
Trip time [s]	0.137	0.107	0.164	0.137	0.113	0.153
Trip time limit [s]	0.5 <sup>13</sup>					

Note:

For full testing according to BS EN 62116 see *Annex 1 - Loss of Mains test according to BS EN 62116*.

#### 6.6.4 Loss of Mains Protection, Vector Shift Stability test

This test should be carried out in accordance with Annex A.7.1.2.6. Confirmation is required that the **Power Generating Module** 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

<sup>13</sup> 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.

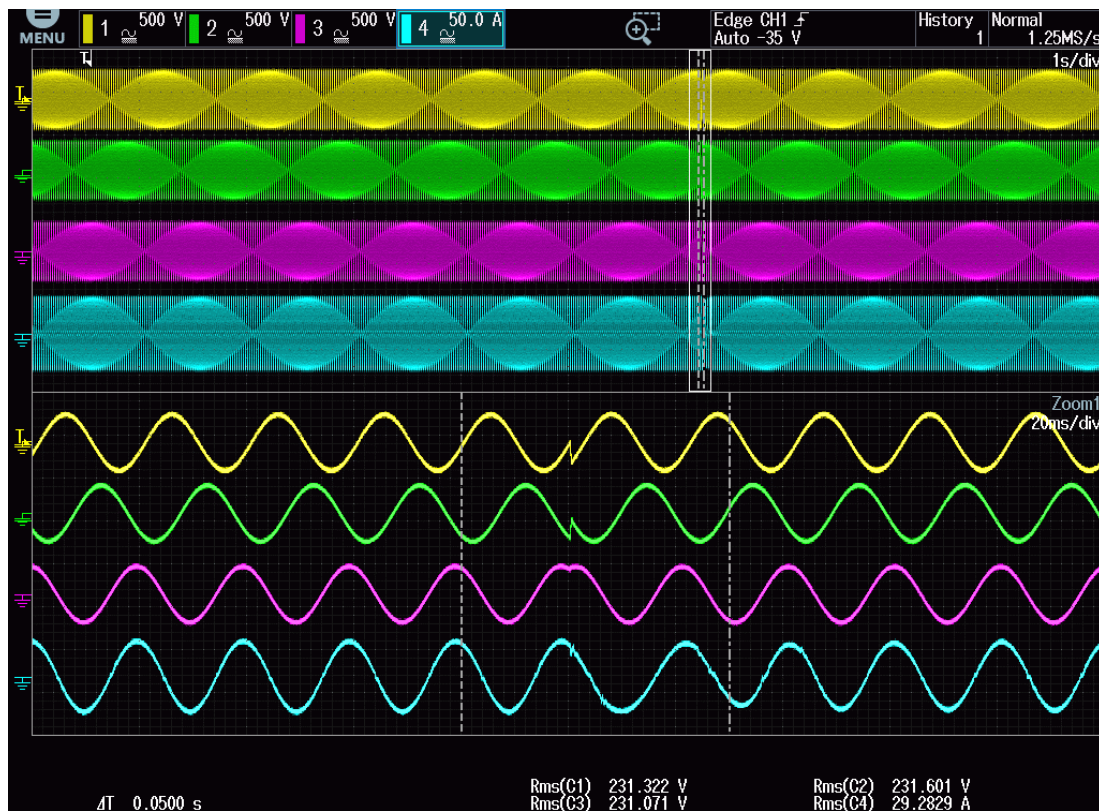


Figure 18 – Positive Step Change (+50 degrees)

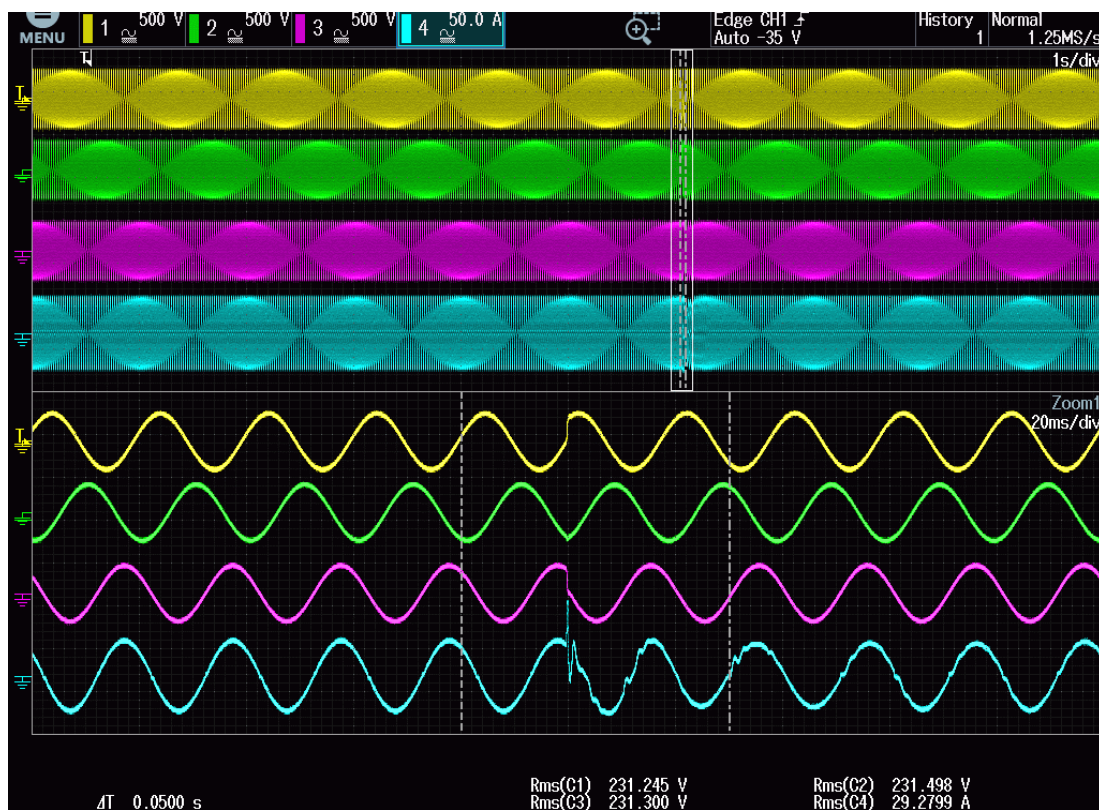


Figure 19 – Negative Step Change (-50 degrees)

### 6.6.5 Loss of Mains Protection, RoCoF Stability test

This test should be carried out in accordance with Annex A.7.1.2.6. Confirmation is required that the **Power Generating Module** does not trip for the duration of the ramp up and ramp down test.

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 deactivated.

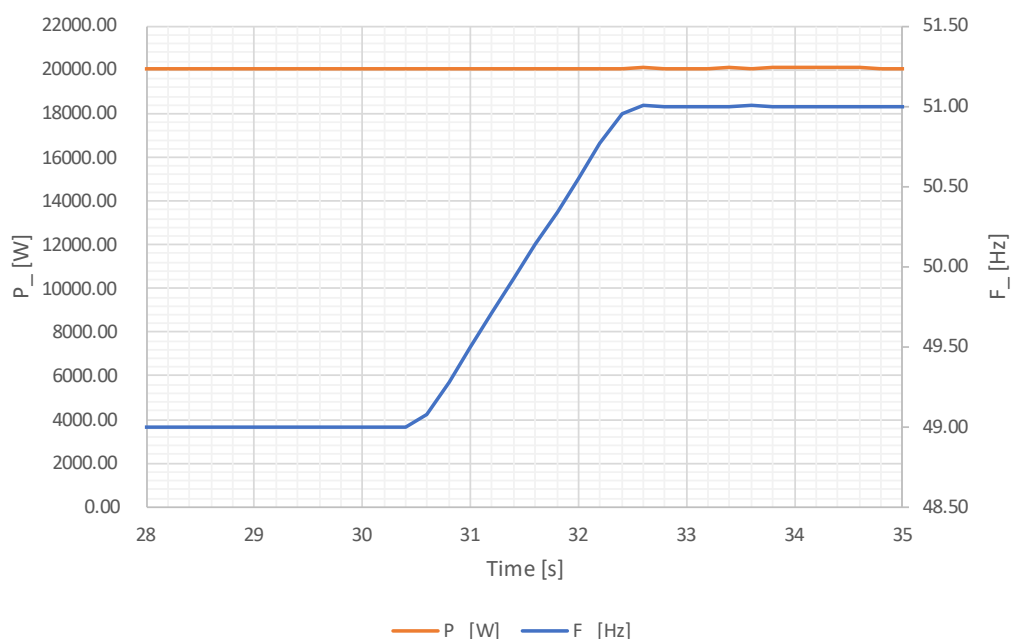


Figure 20 – Positive Frequency Drift (+0.95 Hz/s)

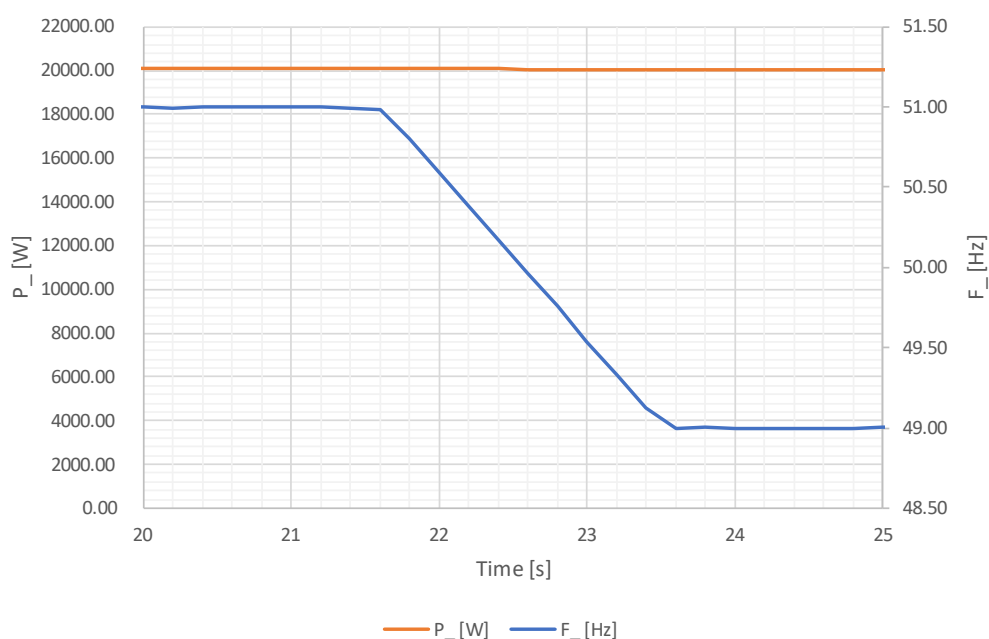


Figure 21 – Negative Frequency Drift (-0.95 Hz/s)

## 6.7 Limited Frequency Sensitive Mode – Overfrequency test

The test should be carried out using the specific threshold frequency of 50.4 Hz and <b>Droop</b> of 10%. This test should be carried out in accordance with Annex A.7.1.3, which also contains the measurement tolerances.				
Active Power response to rising frequency/time plots are attached if frequency injection tests are undertaken in accordance with Annex A.7.2.4.				N *
Alternatively, test results should be noted below:				
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	20020	50.00	20600	---
Step b) 50.45Hz ± 0.05Hz	19814	50.45		---
Step c) 50.70Hz ± 0.10Hz	19030	50.70		12.76% <sup>1)</sup>
Step d) 51.15Hz ± 0.05Hz	17251	51.15		10.11% <sup>2)</sup>
Step e) 50.70Hz ± 0.10Hz	19026	50.70		10.14% <sup>3)</sup>
Step f) 50.45Hz ± 0.05Hz	19807	50.45		12.80% <sup>4)</sup>
Step g) 50.00Hz ± 0.01Hz	20022	50.00		---
	1 <sup>st</sup> Droop (calculated using frequency and power between steps d) & b))			10.92%
	2 <sup>nd</sup> Droop (calculated using frequency and power between steps f) & d))			10.95%
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	10084	50.00	10400	---
Step b) 50.45Hz ± 0.05Hz	9975	50.45		---
Step c) 50.70Hz ± 0.10Hz	9001	50.70		10.28% <sup>1)</sup>
Step d) 51.15Hz ± 0.05Hz	7199	51.15		9.99% <sup>2)</sup>
Step e) 50.70Hz ± 0.10Hz	9001	50.70		9.99% <sup>3)</sup>
Step f) 50.45Hz ± 0.05Hz	9972	50.45		10.30% <sup>4)</sup>
Step g) 50.00Hz ± 0.01Hz	10084	50.00		---
	1 <sup>st</sup> Droop (calculated using frequency and power between steps d) & b))			10.09%
	2 <sup>nd</sup> Droop (calculated using frequency and power between steps f) & d))			10.10%



Note:

- \* Test according to Annex A.7.1.3. Frequency/time plots attached (see Figure 22 & Figure 23)
- 1) Droop calculated using frequency and power between steps c) & b)
- 2) Droop calculated using frequency and power between steps d) & c)
- 3) Droop calculated using frequency and power between steps e) & d)
- 4) Droop calculated using frequency and power between steps f) & e)

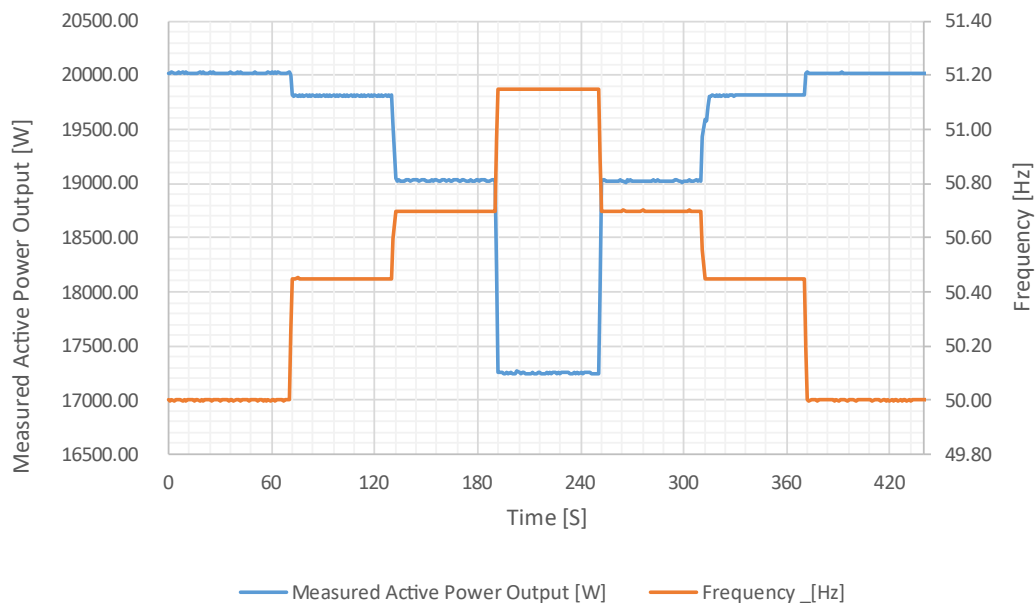


Figure 22 – Test sequence at Registered Capacity >80%

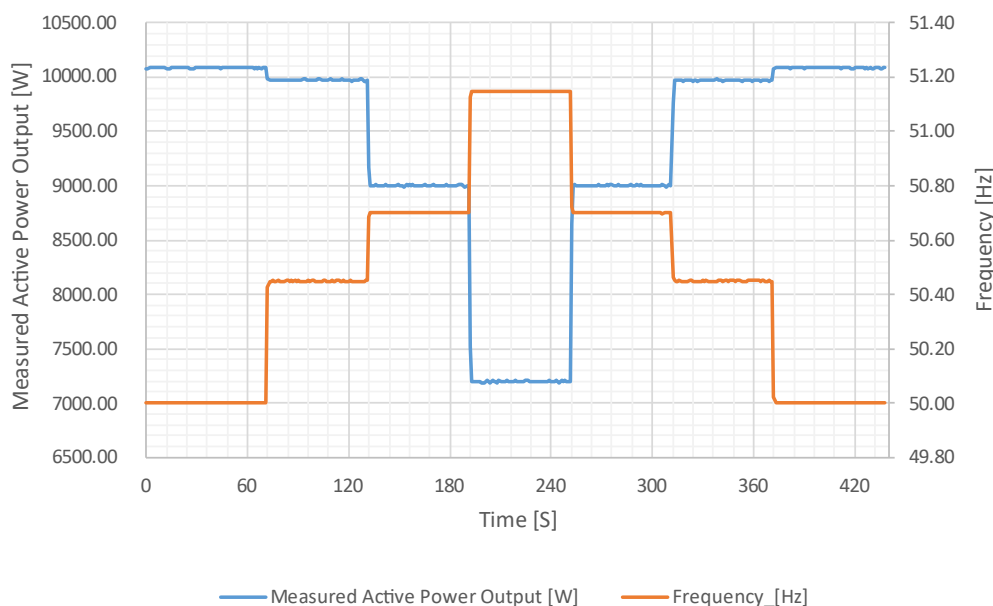


Figure 23 – Test sequence at Registered Capacity 40% - 60%

## 6.8 Protection – Re-connection timer

Test should prove that the reconnection sequence starts after a minimum delay of 20 s for restoration of voltage and frequency to within the stage 1 settings of Table 10.1. Both the time delay setting and the measured delay should be provided in this form; both should be greater than 20 s to pass. Confirmation should be provided that the **Power Generating Module** does not reconnect at the voltage and frequency settings below; a statement of “no reconnection” can be made.

Time delay setting	Measured delay	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of Table 10.1.			
30 s	51 s	At 1.16 pu (266.2 V LV connection)	At 0.78 pu (180.0 V LV connection)	At 47.4 Hz	At 52.1 Hz
Confirmation that the <b>Power Generating Module</b> does not re-connect.		No reconnection occurred	No reconnection occurred	No reconnection occurred	No reconnection occurred

## 6.9 Fault level contribution

These tests shall be carried out in accordance with EREC G99 Annex A.7.1.5. Please complete each entry, even if the contribution to the fault level is zero.

For <b>Inverter</b> output		
Time after fault	Volts	Amps
20ms	L1: 53.3	L1: 26.0
	L2: 54.1	L2: 31.1
	L3: 50.6	L3: 24.2
100ms	L1: 47.8	L1: 1.4
	L2: 47.7	L2: 0.9
	L3: 49.0	L3: 1.3
250ms	L1: 48.2	L1: 1.4
	L2: 48.4	L2: 0.8
	L3: 48.2	L3: 1.4
500ms	L1: 48.7	L1: 1.5
	L2: 48.0	L2: 1.1
	L3: 48.6	L3: 1.5
Time to trip	0.030	In seconds

## 6.10 Self-Monitoring solid state switching

No specified test requirements. Refer to Annex A.7.1.6.

It has been verified that in the event of the solid-state switching device failing to disconnect the **Power Park Module**, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0.5 s.

N/A

Note:

The PGU used electromechanical relay to disconnect from the grid. No solid-state switching device available.

### 6.11 Wiring functional tests

If required by para 15.2.1.	
Confirm that the relevant test schedule is attached (tests to be undertaken at time of commissioning)	NA
Note: Tests carried out in laboratory, specifically designed plugs and sockets used.	

### 6.12 Logic interface (input port)

Confirm that an input port is provided and can be used to shut down the module	Yes
Provide high level description of logic interface, e.g. details in 11.1.3.1 such as AC or DC signal (the additional comments box below can be used)	Yes
Note: For details see "Additional comments." Below.	

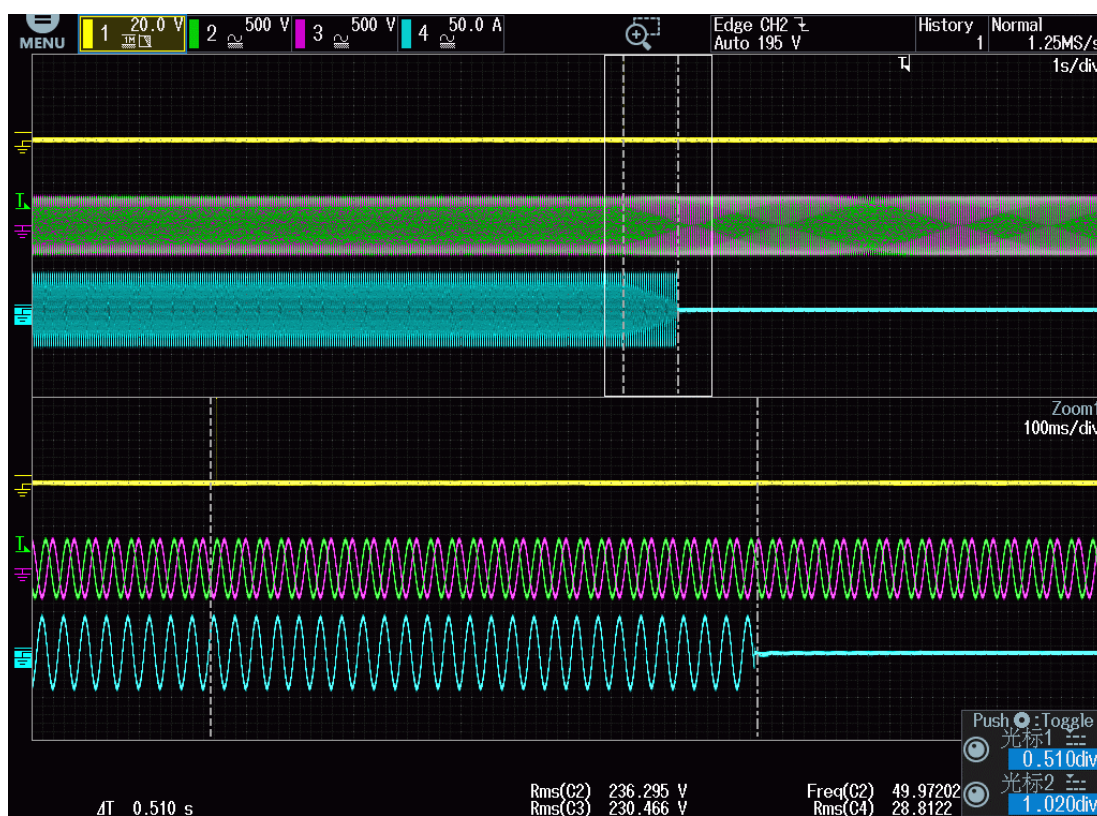


Figure 24 – Test ceasing active power output using logic interface

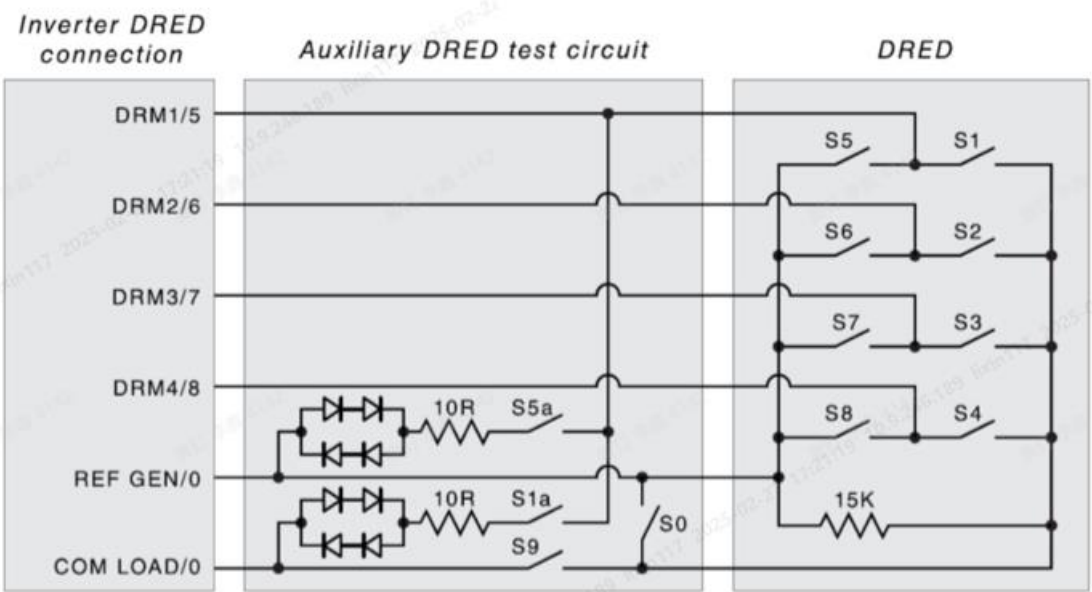
### 6.13 Cyber security

Confirm that the <b>Power Generating Module</b> has been designed to comply with cyber security requirements, as detailed in 9.1.7.	Yes.  Manufacturer's declaration provided. See Annex 2 - <i>Manufacturer's declaration regarding Cyber Security.</i>
---	--

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):

DRM Schematic Diagram of The Circuit



Software Control Logic

By operating the DRM1, DRM2, DRM3, DRM4 switches, making it in a certain state of 0 and 1, the software is controlled to complete the control within 5s, and the specific control logic is as follows; For example, when the switch is in the 0000 state, the inverter outputs 100% of the maximum power.

FYI: If you have any questions, please contact the manufacturer

	8	4	2	1		output
Ordinal number	DRM4	DRM3	DRM2	DRM1	Decimalism	Max output power
1	0	0	0	0	0	100%
2	0	0	0	1	1	0%
3	0	0	1	0	2	30%
4	0	0	1	1	3	0%
5	0	1	0	0	4	60%
6	0	1	0	1	5	0%
7	0	1	1	0	6	30%
8	0	1	1	1	7	0%
9	1	0	0	0	8	100%
10	1	0	0	1	9	100%
11	1	0	1	0	10	100%
12	1	0	1	1	11	100%
13	1	1	0	0	12	100%
14	1	1	0	1	13	100%
15	1	1	1	0	14	100%
16	1	1	1	1	15	100%

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

No.	P <sub>EUT</sub> <sup>a</sup> (% of EUT rating)	Reactive load (% of Q <sub>L</sub> in 6.1d1))	P <sub>AC</sub> <sup>b</sup> (% of nominal)	Q <sub>AC</sub> <sup>c</sup> (% of nominal)	Run on time (ms)	P <sub>EUT</sub> (W)	Actual Q <sub>f</sub>	V <sub>DC</sub> (V)	Remarks <sup>d</sup>
1	100	100	0	0	144	20000	1.000	643	Test A at BL
2	66	66	0	0	227	13210	0.998	485	Test B at BL
3	33	33	0	0	165	6600	1.000	296	Test C at BL
4	100	100	-5	-5	145	20000	1,027	643	Test A at IB
5	100	100	-5	0	164	20000	1,054	643	Test A at IB
6	100	100	-5	+5	147	20000	1,080	643	Test A at IB
7	100	100	0	-5	152	20000	0,976	643	Test A at IB
8	100	100	0	+5	132	20000	1,026	643	Test A at IB
9	100	100	+5	-5	141	20000	0,929	643	Test A at IB
10	100	100	+5	0	153	20000	0,953	643	Test A at IB
11	100	100	+5	+5	140	20000	0,977	643	Test A at IB
12	66	66	0	-5	107	13210	0.972	485	Test B at IB
13	66	66	0	-4	118	13210	0.978	485	Test B at IB
14	66	66	0	-3	132	13210	0.983	485	Test B at IB
15	66	66	0	-2	140	13210	0.988	485	Test B at IB
16	66	66	0	-1	202	13210	0.993	485	Test B at IB
17	66	66	0	1	219	13210	1.003	485	Test B at IB
18	66	66	0	2	143	13210	1.008	485	Test B at IB
19	66	66	0	3	135	13210	1.013	485	Test B at IB
20	66	66	0	4	122	13210	1.017	485	Test B at IB
21	66	66	0	5	113	13210	1.022	485	Test B at IB
22	33	33	0	-5	137	6600	0.975	296	Test C at IB
23	33	33	0	-4	138	6600	0.980	296	Test C at IB
24	33	33	0	-3	143	6600	0.985	296	Test C at IB
25	33	33	0	-2	158	6600	0.990	296	Test C at IB
26	33	33	0	-1	159	6600	0.995	296	Test C at IB
27	33	33	0	1	160	6600	1.005	296	Test C at IB
28	33	33	0	2	151	6600	1.010	296	Test C at IB
29	33	33	0	3	144	6600	1.015	296	Test C at IB
30	33	33	0	4	142	6600	1.020	296	Test C at IB
31	33	33	0	5	137	6600	1.025	296	Test C at IB
Additional tests required if any of the recorded run-on times of tests No. 4 ~ 11 longer than that of test No. 1:									
32	100	100	-10	-10	164	20000	1.160	643	Test A at IB
33	100	100	-10	-5	154	20000	1.141	643	Test A at IB
34	100	100	-10	0	163	20000	1.109	643	Test A at IB
35	100	100	-10	+5	162	20000	1.135	643	Test A at IB
36	100	100	-10	+10	146	20000	1.157	643	Test A at IB
37	100	100	-5	-10	170	20000	1.107	643	Test A at IB

38	100	100	-5	+10	165	20000	1.099	643	Test A at IB
39	100	100	0	-10	157	20000	1.053	643	Test A at IB
40	100	100	0	+10	146	20000	1.045	643	Test A at IB
41	100	100	+5	-10	146	20000	1.004	643	Test A at IB
42	100	100	+5	+10	134	20000	0.993	643	Test A at IB
43	100	100	+10	-10	169	20000	0.958	643	Test A at IB
44	100	100	+10	-5	144	20000	0.937	643	Test A at IB
45	100	100	+10	0	152	20000	0.912	643	Test A at IB
46	100	100	+10	+5	156	20000	0.931	643	Test A at IB
47	100	100	+10	+10	160	20000	0.951	643	Test A at IB

- <sup>a</sup>  $P_{EUT}$ : EUT output power.
- <sup>b</sup>  $P_{AC}$ : Active power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
- <sup>c</sup>  $Q_{AC}$ : Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
- <sup>d</sup> BL: balance condition, IB: imbalance condition.

## Annex 2 - Manufacturer's declaration regarding Cyber Security

**AUXSOL**

Ningbo AUX Solar Technology Co., Ltd.  
No. 17 Fenglin Road, Cichang Town, Jiangbei District, Ningbo City, Zhejiang  
Province, China

Manufacture's declaration in accordance with the requirements of

G99-Amd.10 (2024-03) standard Sec.s 9.1.7 regarding

"Cyber Security"

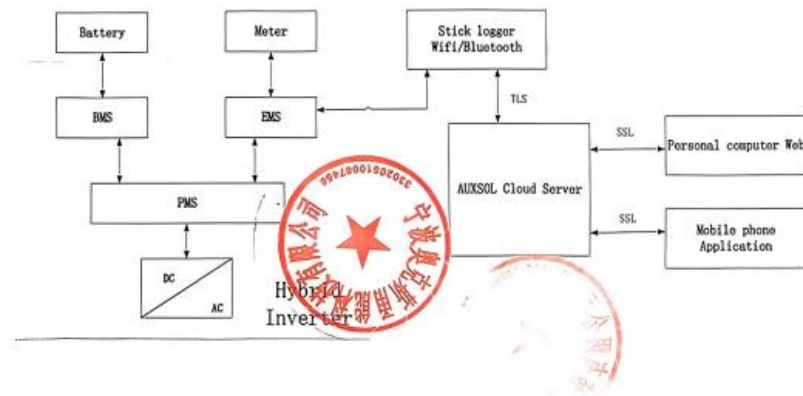
We AUXSOL declare under our sole responsibility that the products referred to below,

Hybrid solar inverter:

ASG-5TL-ZH, ASG-6TL-ZH, ASG-8TL-ZH, ASG-10TL-ZH,  
ASG-12TL-ZH, ASG-15TL-ZH, ASG-20TL-ZH

In the name of the Company declares the following:

1)The Hybrid solar inverter include a system of internal and external logic communications as summarized in the following scheme:





**AUXSOL**

Ningbo AUX Solar Technology Co., Ltd.  
No. 17 Fenglin Road, Cicheng Town, Jiangbei District, Ningbo City, Zhejiang  
Province, China

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

acronym/name	meaning	function	location
EMS	Energy Management System	Send control instructions from the user to PMS and report the current status data of the inverter to the user	Communication
BMS	Battery Management System	Send battery voltage, current, temperature, status, and other data to EMS	Battery
PMS	Power Management System	Receive data from EMS for power control on the DC and AC sides, and return status data on the DC and AC sides to EMS	Inverter
GW	Gate-Way	Transmission of data to cloud server, reception of commands from user	Stick logger
Meter	AC Meter	Electrical parameters measures, such as feed power, current, voltage	Grid port or Load port

2) All communications between internal components of the inverter, and between EMS and meter, take place via appropriate serial lines (RS485) and are not directly connected to any device or system outside the inverter.

3) The communication port between the inverter and the outside is only composed of optional stick logger on the machine; And the communication method between the inverter and the outside world can be selected according to customer requirements, such as Wifi or Bluetooth.

4) The direct receiver/sender of communication with the inverter is AUXSOL Cloud Server. In this case, communication security is ensured by using TLS technology. By integrating software-hardware encrypted computing capabilities, AUXSOL Cloud delivers a secure and reliable platform environment for diverse scenarios.

5) Based on the above concepts, AUXSOL Cloud has launched the Confidentiality solution, providing integrated AI security and privacy protection mechanisms that span the entire lifecycle of large model data and cover end-to-cloud scenarios. In any case, all communication between the AUXSOL Cloud Server and the subject/parties is protected by SSL technology to achieve the goal of improving internet communication security at the root.

Date: 2025/03/07

Signature:



## Annex 3 - CE declaration

LVD

  
Total Quality. Assured.

## Test Verification of Conformity

Verification Number: 240625060GZU-VOC001

On the basis of the tests undertaken, the sample<s> of the below product has been tested by an accredited 3rd party laboratory in accordance to the referenced specification<s>/standard<s> at the time the tests were carried out. This verification is part of the full test report<s> and should be read in conjunction with it <them>.

This document can be used in support of a claim in meeting relevant EU legislation and mandatory Conformity Marking. And in accordance with EU / UK law, the claim is the sole obligation of the Manufacturer/ Importer.

Applicant Name & Address:	Ningbo AUX Solar Technology Co., Ltd. No. 17 Fenglin Road, Cicheng Town, Jiangbei District, Ningbo City, Zhejiang Province, China
Product Description:	Hybrid solar inverter
Ratings & Principle Characteristics:	See APPENDIX: Test Verification of Conformity
Models/Type References:	ASG-5TL-ZH, ASG-6TL-ZH, ASG-8TL-ZH, ASG-10TL-ZH, ASG-12TL-ZH, ASG-15TL-ZH, ASG-20TL-ZH
Brand Names:	<b>AUXSOL</b>
Specification<s>/Standards:	IEC/EN 62109-1: 2010 Safety of power converters for use in photovoltaic power systems – Part 1: General requirements IEC/EN 62109-2: 2011 Safety of power converters for use in photovoltaic power systems – Part 2: Particular requirements for inverters IEC 62477-1:2022 EN 62477-1:2012 + A12:2021 Safety requirements for power electronic converter systems and equipment Part 1: General Low Voltage Directive 2014/35/EU
Verification Issuing Office Name & Address:	Intertek Testing Services Shenzhen Ltd. Guangzhou Branch Room 02, & 101/E201/E301/E401/E501/E601/E701/E801 of Room 01 1-8/F., No. 7-2. Caipin Road, Science City, GETDD, Guangzhou, Guangdong, China
Date of Tests:	04 Jul 2024 – 25 Jul 2024
Test Report Number(s):	240625060GZU-001, 240625060GZU-002, 240625060GZU-003
Additional information in Appendix.	
Signature	
Name: Jason Fu	
Position: Supervisor	
Date: 09 August 2024	

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IntertekPage 1 of 3GFT-OP-11a (09 March 2024)

**APPENDIX: Test Verification of Conformity**

This is an Appendix to Test Verification of Conformity Number: 240625060GZU-VOC001

Ratings & Principle  
Characteristics::

Model	ASG-5TL-ZH		ASG-6TL-ZH	ASG-8TL-ZH
PV Input				
Max. input voltage	1000V			
MPPT voltage range	170-900V			
Max. input current	16A/16A		26A/26A	
Max. short circuit current	20A/20A		32A/32A	
Input Battery				
Battery type	Li-ion			
Battery voltage range	180-800V			
Max.charge/discharge current	30A/30A			
Output AC (Grid side)				
Rated output power	5kW	6kW	8kW	
Max. apparent output power	5.0kVA	6.0kVA	8.0kVA	
Rated grid voltage	3/N/PE, 380V/400V			
Rated grid frequency	50Hz/60Hz			
Max. output current	11.4A	13.6A	18.2A	
Power factor	>0.99 default (0.8 leading...0.8 lagging)			
Input AC (Grid side)				
Rated input power	5kW	6kW	8kW	
Max. input power	10kW	12kW	16kW	
Max. input current	15.2A	18.2A	24.2A	
Rated input voltage	3/N/PE, 380/400V			
Rated input frequency	50/60Hz			
Output AC (Back-up)				
Rated output power	5kW	6kW	8kW	
Max. output current	7.6A	9.1A	12.1A	
Rated output voltage	380V/400V			
Rated frequency	50/60Hz			
Ambient temperature range	-30...+60°C			
Degree of protection	IP66			
Software Version	DSP: A6050; ARM: A3023			



Signature

Name: Jason Fu

Position: Supervisor

Date: 09 August 2024

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**APPENDIX: Test Verification of Conformity**

This is an Appendix to Test Verification of Conformity Number: 240625060GZU-VOC001

Ratings & Principle  
Characteristics::

Model	ASG-10TL- ZH	ASG-12TL- ZH	ASG-15TL- ZH	ASG-20TL- ZH
PV Input				
Max. input voltage	1000V			
MPPT voltage range	170-900V		170-900V	
Max. input current	26A/26A		36A/36A	
Max. short circuit current	32A/32A		45A/45A	
Input Battery				
Battery type	Li-ion			
Battery voltage range	180-800V			
Max. charge/discharge current	30A/30A		2×30A/2×30A	
Output AC (Grid side)				
Rated output power	10kW	12kW	15kW	20kW
Max. apparent output power	10kVA	12kVA	15kVA	20kVA
Rated grid voltage	3/N/PE, 380V/400V			
Rated grid frequency	50Hz/60Hz			
Max. output current	22.7A	27.3A	34.1A	45.5A
Power factor	>0.99 default (0.8 leading...0.8 lagging)			
Input AC (Grid side)				
Rated input power	10kW	12kW	15kW	20kW
Max. input power	20kW	24kW	30kW	40kW
Max. input current	30.3A	36.4A	45.5A	45.5A
Rated input voltage	3/N/PE, 380/400V			
Rated input frequency	50/60Hz			
Output AC (Back-up)				
Rated output power	10kW	12kW	15kW	20kW
Max. output current	15.2A	18.2A	22.7A	30.3A
Rated output voltage	380V/400V			
Rated frequency	50/60Hz			
Ambient temperature range	-30...+60°C			
Degree of protection	IP66			
Software Version	DSP: A6050; ARM: A3023			



Signature

Name: Jason Fu

Position: Supervisor

Date: 09 August 2024

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## EMC

				<p>Shenzhen Nore Testing Center Co., Ltd. South, No.1, Building 10, Maqueling Industrial Zone, Nanshan Shenzhen, Guangdong, 518057, China TEL: +86-755-33525266 Web: www.ntc-c.com</p>	
<h2>CERTIFICATE OF CONFORMITY</h2>					
<p>Electromagnetic Compatibility Directive 2014/30/EU</p>					
<p>Certificate No.: SZNTC2406026EV00</p>					
Applicant	:	Ningbo AUX Solar Technology Co., Ltd.			
Address	:	No. 17 Fenglin Road, Cicheng Town, Jiangbei District, Ningbo City, Zhejiang Province, China			
Manufacturer	:	Ningbo AUX Solar Technology Co., Ltd.			
Address	:	No. 17 Fenglin Road, Cicheng Town, Jiangbei District, Ningbo City, Zhejiang Province, China			
Factory	:	Ningbo AUX Solar Technology Co., Ltd.			
Address	:	No. 17 Fenglin Road, Cicheng Town, Jiangbei District, Ningbo City, Zhejiang Province, China			
E.U.T.	:	Hybrid solar inverter			
Brand Name	:	AUXSOL			
Model No.	:	ASG-20TL-ZH, ASG-15TL-ZH, ASG-12TL-ZH, ASG-10TL-ZH, ASG-8TL-ZH, ASG-6TL-ZH, ASG-5TL-ZH			
Test Report No.	:	SZNTC2406026EV00			
Standard	:	EN IEC 61000-6-1: 2019 EN IEC 61000-6-2: 2019 EN IEC 61000-6-3: 2021 EN IEC 61000-6-4: 2019 EN 61000-3-12: 2011 EN IEC 61000-3-11: 2019			
		 Ran Song July 15, 2024			
<p>The certificate of conformity is based on an evaluation of a sample of the above mentioned product. Technical report and documentation are at the applicant's disposal. This is to certify that the tested sample is in conformity with all provisions of Annex I of Council Directive 2014/30/EU, in its latest amended version, referred to EMC Directive. The certificate does not imply assessment of the production and does not permit the use of Lab's logo.</p>					
<p>Remark: The CE Marking may be used only if all relevant and effective EC Directives are complied with.</p>					

# Annex 4 - Proof of conformity of the integrated protection relay





Note:



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

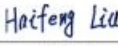
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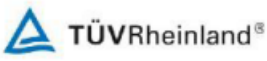
Zertifikat		Certificate		TÜVRheinland	
Zertifikat Nr. Certificate No.	R 50475730	Blatt Sheet	0006		
Ihr Zeichen Client Reference	H.S.J	Unser Zeichen Our Reference	01-LHF-50399690 004	Ausstellungsdatum Date of Issue	20.04.2022 (day/month/yr)
Genehmigungsinhaber License Holder			Fertigungsstätte Manufacturing Plant		
Xiamen Hongfa Electroacoustic Co., Ltd. No. 91-101, Sunban South Rd. Jimei North Ind. District Xiamen 361021 Fujian P.R. China			Refer to latest revision of the annex list of factories		
Prüfzeichen Test Mark		Geprüft nach Tested acc. to			
		EN 61810-1:2015+A1 IEC 61810-1:2015+A1			
Zertifiziertes Produkt (Geräteidentifikation) Certified Product (Product Identification)				Lizenzentgelte - Einheit License Fee - Unit	
Relay (Electromechanical Elementary Relays)					
as page 0001 Change					
Test Requirement : See above					
Additional ratings for					
Type Designation	: HF161F-40W xHTFf x,f = See appendix 1,1 (HF)				
Rated Contact Voltage	: 277VAC				
Rated Contact Current	: 1) 50A 2) Making 20A (100ms) Loading 50A (800ms) Breaking 20A (100ms) 3) Making 50A (900ms) Breaking 20A (100ms)				
Electrical Endurance	: 1) 6000 (85°C) 2) 3) 50000 (85°C)				
Remark: Appendix 1,1 dated on 2022-04-06 replaces Appendix 1,1 dated on 2021-03-10.					
ANLAGE (Appendix): 1,1					
<p>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.</p> <p>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.</p>					
TÜV Rheinland LGA Products GmbH, Tillystraße 2, 90431 Nürnberg http://www.tuv.com/safety E-mail: markcheck@tuv.com Fax: +49 221 806-3935				 Zertifizierungsstelle  Kenny Shi	



										
<b>Certificate No.</b> R50475730 0006 <b>Our Reference</b> 01-LHF-50399690 004 <b>Appendix No.</b> 1.1										
<b>Constructional Data Form (CDF) for Electromechanical Elementary Relays</b>										
Page 1 of 5										
<b>License holder :</b> <b>Xiamen Hongfa Electroacoustic Co., Ltd.</b> (full address) No. 91-101, Sunban South Rd., Jimei North Ind. District, Xiamen, Fujian 361021 P.R. China										
<b>Factory1 :</b> <b>Xiamen Hongfa Electroacoustic Co., Ltd.</b> (full address) No. 91-101, Sunban South Rd., Jimei North Ind. District, Xiamen, Fujian 361021 P.R. China										
<b>Factory2 :</b> <b>Zhangzhou Hongfa Electroacoustic Co., Ltd.</b> (full address) Gangyuan Industrial District, Chenxiang, Changtai, Zhangzhou, Fujian, China										
<b>Type or Model Number :</b> <b>HF161F-40W xHTFf</b> (See nomenclature on the last page) Kind of device: Electromechanical elementary relays										
<b>Specification (contact-circuit)</b>										
Contact material	AgSnO <sub>2</sub>									
Rated contact voltage	220/250/277VAC									
Rated contact current	#Making 20A Loading 40A Breaking 20A	##Ma king 40A Brea king 20A	*40 A	*43 A	#Making 10A Loading 43A Breakin g 10A	##Ma king 43A Breaki ng 10A	50A	#Makin g 20A Loadin g 50A Breakin g 20A	##Ma king 50A Brea king 20A	
cos φ	1									
L/R	--									
Frequency (Hz)	50/60Hz									
Schematics for contact loading <small>*according to Tab 16 of EN 61810-1: 2015</small>	Single-pole: a									
Kind of contacts										
Number of cycles for electrical endurance / Frequency of operation	50000		10000		300 00		6 000		500 00	
	105 °C		85 °C							
	360 Cycles/hour		360 Cycles/hour							
Number of cycles for mechanical endurance / Frequency of operation	500 000 Cycles 10 800 Cycles/hour									
Duty factor	10%									
<b>TÜV Rheinland Group</b>   Date _____ Signature _____					<b>License holder</b>  Sandy Huang      Xiamen Hongfa Electroacoustic Co., Ltd. Name _____ Company Stamp and Signature _____					

			
Certificate No.	R50475730 0006	Our Reference	01-LHF-50399690 004
		Appendix No.	1.1
Constructional Data Form (CDF) for Electromechanical Elementary Relays			
Type of interruption		full-disconnection	
Note:			
*the overload and endurance test are in accordance with clause 2.2 and 2.1 of annex G of IEC 62368-1:2018			
# Making 100ms, Loading 800ms, Breaking 100ms			
## Making 900ms, Breaking 100ms			

TÜV Rheinland Group		License holder	
		Sandy Huang	
Date		Xiamen Hongfa Electroacoustic Co., Ltd.	
Signature		Name	
		Company Stamp and Signature	

			
<b>Certificate No.</b>	R50475730 0006	<b>Our Reference</b>	01-LHF-50399690 004
		<b>Appendix No.</b>	1.1
<b>Constructional Data Form (CDF) for Electromechanical Elementary Relays</b>			Page 5 of 5

**TYPE NOMENCLATURE:**  
**HF161F-40W xHTFf**

x	stands for	Rated Coil Voltage DC Coil (VDC): 6; 9; 12; 24
H	stands for	Contact Configurations H = 1 normally open contact
T	stands for	Contact Material T = AgSnO <sub>2</sub>
F	stands for	Insulation Classification per UL standards F = Class F
f	stands for	Special Code Blank; Coil power(3.8W) (967); Coil power(1.6W)

**Remark:**

**First issue: 04.08.2020**


Certificate is issued based on test report: 50399690 001

**Second issue: 26.02.2021**

Add new model and ratings based on test report: 50399690 002.

**Third issue: 06.04.2022**

Add new ratings based on test report: 50399690 002.

<b>TÜV Rheinland Group</b>		<b>License holder</b>	
		Sandy Huang	
Date		Name	
Signature		Company Stamp and Signature	
		Xiamen Hongfa Electroacoustic Co., Ltd.	



## Annex 5 - ISO 9001 certificate



**Annex 6 - Photo of the unit**

**Enclosure front view**



**Enclosure left view**





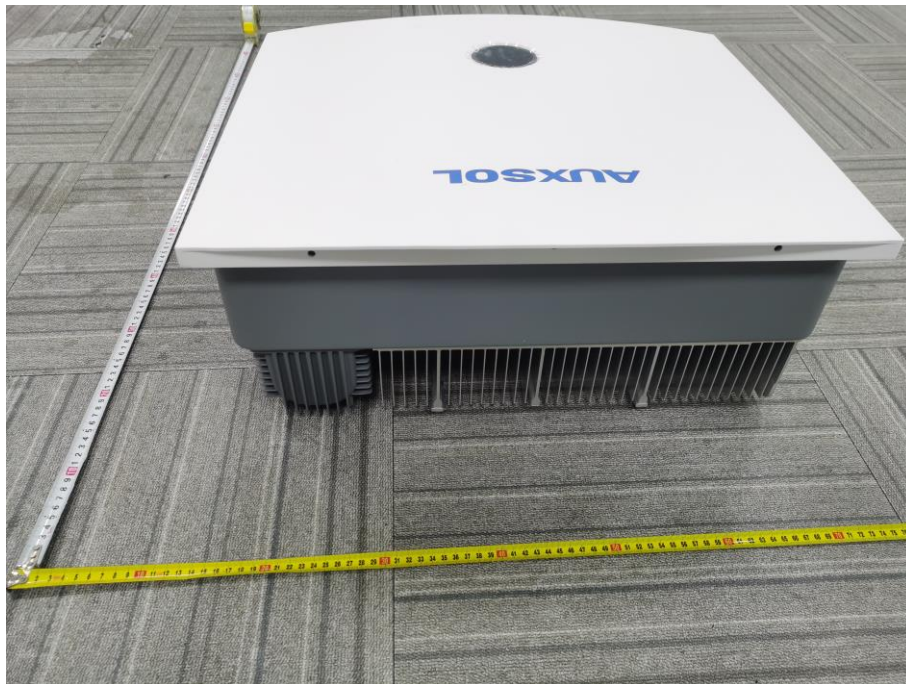
**Enclosure right view**



**Enclosure rear view**



**Enclosure top view**



**Enclosure bottom view**





## Enclosure Internal view



»»»» End of Test Report ««««