Product Service

TEST REPORT

EN 50549-1:2019

TUV SUD Test Report for *Requirements for generating plants to be connected in parallel with distribution networks - Part 1: Connection to a LV distribution network - Generating plants up to and including Type B*

Report No.:	64.290.22.31063.01
Date of issue:	2023-02-28
Project handler:	Lucas Lu
Testing laboratory:	TÜV SÜD Certification and Testing (China) Co., Ltd. Guangzhou Branch
Address:	TÜV SÜD Testing Center, D1 building, No. 63 Chuangqi Road, Shilou Town, Panyu District, Guangzhou, P.R. China
Testing location:	as above
Client:	INVT Solar Technology (ShenZhen) Co., Ltd.
Client number:	093811
Address:	6th Floor, Block A INVT Guangming Technology Building Kejie Fourth Road, Shutianpu Community, Matian Guangming District 518000 Shenzhen PEOPLE'S REPUBLIC OF CHINA
Contact person:	Deng Min Chao
Standard:	This TUV SUD test report form is based on the following requirements: *EN 50549-1:2019/AC:2019*
TRF number and revision*:*	*TRF EN 50549-1:2019/AC:2019 rev.0/2019-04*
TRF originated by:	TUV SUD Product Service, Mr. Billy Qiu
Copyright blank test report:	This test report is based on the content of the standard (see above). The test report considered selected clauses of the a.m. standard(s) and experience gained with product testing. It was prepared by TUV SUD Product Service. TUV SUD Group takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context.
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Scheme:	☐ GS Mark ☐ NRTL Mark ☐ EU-Directive ☐ TUV Mark ☒ Type verification of conformity
Non-standard test method:	☒ No ☐ Yes, see details under Summary of testing
National deviations:	N/A
Number of pages *(Report)*:	59
Number of pages *(Attachments)*:	N/A
Compiled by:	Lucas Lu *(Printed Name and Signature)* Lucas Lu
Approved by:	Kennen Wang *(Printed Name and Signature)* Kennen Wang

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Product Service

Test sample:	Solar Inverter
Type of test object:	Solar Inverter
Trademark:	invt
Model and/or type reference:	iMars XG3KTL-1M,iMars XG3KTL-2M, iMars XG3.68KTL, iMars XG4KTL,iMars XG4.2KTL,iMars XG4.6KTL,iMars XG5KTL,iMars XG6KTL,iMars XG7KTL,iMars XG7KTL1,iMars XG8KTL,iMars XG8KTL1 ,iMars XG10KTL,iMars XG10KTL1
Rating(s):	See page 4-6
Manufacturer:	Same as applicant
Manufacturer number:	Same as applicant
Address:	Same as applicant
Sub-contractors/ tests (clause):	N/A
Name:	N/A
Order description:	☒ Complete test according to TRF
	☐ Partial test according to manufacturer's specifications
	☐ Preliminary test
	☐ Spot check
	☐ Others:
Date of order:	2022-09-16
Date of receipt of test item:	2022-09-17
Date(s) of performance of test:	2022-09-17 to 2023-02-27
Test item particulars:	
Equipment mobility..... :	☐ movable ☐ hand-held ☐ stationary ☒ fixed ☐ transportable ☐ for building-in
Connection to the mains..... :	☐ pluggable equipment ☐ direct plug-in ☒ permanent connection ☐ for building-in
Enviromental category..... :	☒ outdoor ☐ indoor unconditional ☒ indoor conditional
Over voltage category Mains ..... :	☐ OVC I ☒ OVC II ☐ OVC III ☐ OVC IV
Over voltage category PV..... :	☐ OVC I ☒ OVC II ☐ OVC III ☐ OVC IV
Mains supply tolerance (%)..... :	+/- 10%
Tested for power systems..... :	TN system
IT testing, phase-phase voltage (V) ...:	N/A
Class of equipment..... :	☒ Class I ☐ Class II ☐ Class III ☐ Not classified
Mass of equipment (kg) ..... :	13Kg
Pollution degree ..... :	PD 2
IP protection class..... :	IP 66

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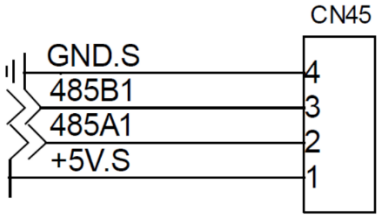
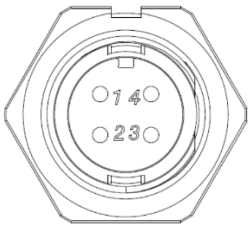
General product information:

1. The unit is non-isolated (transformerless) solar inverter for connection with public low voltage grid. The unit is defined as type A generator according to Regulation (EU) 2016/631 (NC RfG);
2. If certain functions are not permitted by local regulation, the function shall be disabled by hardware or software setting (if applicable) by the manufacturer before putting into the market;
3. Low voltage electrical installations shall comply with national and local regulation. Only qualified electricians are allowed to install and maintain the converter;
4. In order to protect the inverter, user and installer, external DC and AC circuit breaker shall be equipped for all source port (battery, AC grid) at the end-use application.
5. The unit has below reactive power control modes, shall comply with national and local regulation:
    1) Q setpoint mode
    2) Q(U) mode
    3) Cos φ setpoint mode
    4) Cos φ (P)
6. RS 485 communication port is provide for remoted control. The RS 485 port is connected to pin 1 and pin 4 of the terminal;





7. Software version:V1.0
8. LED panel or LCD panel can be optionally chosen by client.

Model differences:

The inverter has 2 kinds of series:KTL,KTL1 series.The KTL series products are the based model. Two series products have same electric circuits topology design,same enclouse structure design,same mian control circuits and firmware.The output power and input power are limited by software.

The differences of different power models:

model	iMars XG3KTL-1M	iMars XG3KTL-2M	iMars XG3.68KTL	iMars XG4KTL	iMars XG4.2KTL
Number of strings of each MPPT tracker	1	1/1	1/1	1/1	1/1
External fan	None	None	None	None	None

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Internal fan	None	None	None	None	None
Bus Capacitor	1000uF×4PCS	1000uF×4PCS	1000uF×4PCS	1000uF×4PCS	1000uF×4PCS
AC Filter Capacitor	4.7uF/310Vac	4.7uF/310Vac	4.7uF/310Vac	4.7uF/310Vac	4.7uF/310Vac
INV inductance	993uH	993uH	993uH	993uH	993uH

model	iMars XG4.6KT	iMars XG5KTL	iMars XG6KTL	iMars XG7KTL	iMars XG7KTL1
Number of strings of each MPPT tracker	1/1	1/1	1/1	1/1	1/2
External fan	None	None	None	None	Yes
Internal fan	None	None	None	None	Yes
Bus Capacitor	1000uF×4PCS	1000uF×6PCS	1000uF×6PCS	1200uF×8PCS	1200uF×8PCS
AC Filter Capacitor	4.7uF/310Vac	4.7uF/310Vac	4.7uF/310Vac	10uF/305Vac	10uF/305Vac
INV inductance	993uH	688uH	688uH	466uH	466uH

model	iMars XG8KTL	iMars XG8KTL1	iMars XG10KTL	iMars XG10KTL1
Number of strings of each MPPT tracker	1/1	1/2	1/1	1/2
External fan	None	Yes	Yes	Yes
Internal fan	Yes	Yes	Yes	Yes
Bus Capacitor	1200uF×8PCS	1200uF×8PCS	1500uF×8PCS	1500uF×8PCS
AC Filter Capacitor	10uF/305Vac	10uF/305Vac	10uF/305Vac	10uF/305Vac
INV inductance	466uH	466uH	466uH	466uH

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Characteristic data *(not shown on the marking plate)*:

Model	iMars XG3KTL-1M	iMars XG3KTL-2M	iMars XG3.68KTL	iMars XG4KTL	iMars XG4.2KTL
PV input terminal parameters					
Maximum input voltage	600 Vd.c.				
MPPT voltage range	80-580 Vd.c.				
MPPT voltage range (full load)	190-480 Vd.c.	120-480 Vd.c.	135-480 Vd.c.	145-480 Vd.c.	150-480 Vd.c.
Number of MPPT circuits	1	2	2	2	2
Maximum number of input string per tracker	1	1/1	1/1	1/1	1/1
Maximum continuous input current	20 Ad.c.	20/20 Ad.c.	20/20 Ad.c.	20/20 Ad.c.	20/20 Ad.c.
Isc PV	26 Ad.c.	26/26 Ad.c.	26/26 Ad.c.	26/26 Ad.c.	26/26 Ad.c.
AC output rating					
Rated output voltage	230 Va.c.				
Rated output frequency	50 Hz				
Maximum continuous output current	15 Aa.c.	15 Aa.c.	16 Aa.c.	20 Aa.c.	21 Aa.c.
Rate output active power	3000 W	3000 W	3680 W	4000 W	4200 W
Maximum output apparent power	3300 VA	3300 VA	3680 VA	4400 VA	4620 VA
Power factor	0.9 inductive … 0.9 capacitive				

Model	iMars XG4.6KTL	iMars XG5KTL	iMars XG6KTL	iMars XG7KTL	iMars XG7KTL1
PV input terminal parameters					
Maximum input voltage	600 Vd.c.				
MPPT voltage range	80-580 Vd.c.				
MPPT voltage range (full load)	160-480 Vd.c.	170-480 Vd.c.	190-480 Vd.c.	230-480 Vd.c.	230V-480 Vd.c.
Number of MPPT circuits	2	2	2	2	2
Maximum number of input string per tracker	1/1	1/1	1/1	1/1	1/2
Maximum continuous input current	20/20 Ad.c.	20/20 Ad.c.	20/20 Ad.c.	20/20 Ad.c.	28/14 Ad.c.
Isc PV	26/26 Ad.c.	26/26 Ad.c.	26/26 Ad.c.	26/26 Ad.c.	36.4/18.2 Ad.c.
AC output rating					
Rated output voltage	230 Va.c.				
Rated output frequency	50 Hz				
Maximum continuous output current	23 Aa.c.	25 Aa.c.	30 Aa.c.	35 Aa.c.	35 Aa.c.

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Rate output active power	4600 W	5000 W	6000 W	7000 W	7000 W
Maximum output apparent power	5000 VA	5500 VA	6600 VA	7700 VA	7700 VA
Power factor	0.9 inductive … 0.9 capacitive				

Model	iMars XG8KTL	iMars XG8KTL1	iMars XG10KTL	iMars XG10KTL1
PV input terminal parameters				
Maximum input voltage	600 Vd.c.			
MPPT voltage range	80-580 Vd.c.			
MPPT voltage range (full load)	250-480 Vd.c.	250-480 Vd.c.	290-480 Vd.c.	290-480 Vd.c.
Number of MPPT circuits	2	2	2	2
Maximum number of input string per tracker	1/1	1/2	1/1	1/2
Maximum continuous input current	20/20 Ad.c.	28/14 Ad.c.	20/20 Ad.c.	28/14 Ad.c.
Isc PV	26/26 Ad.c.	36.4/18.2 Ad.c.	26/26 Ad.c.	36.4/18.2 Ad.c.
AC output rating				
Rated output voltage	230 Va.c.			
Rated output frequency	50 Hz			
Maximum continuous output current	40 Aa.c.	40 Aa.c.	45.5 Aa.c.	45.5 Aa.c.
Rate output active power	8000 W	8000 W	10000 W	10000 W
Maximum output apparent power	8800 VA	8800 VA	10000 VA	10000 VA
Power factor	0.9 inductive … 0.9 capacitive			

Attachments:

N/A

General remarks:

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

*Throughout this report **a point** is used as the decimal separator.*
The test results presented in this report relate only to the object tested.
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Summary of testing:

The test was performed according to EN 50549-1:2019/AC:2019 for assessment of comformity of RfG European Network Code (RfG 2016/631) as generator type A.

Tests performed (name of test and test clause):

Clause	Requirement + Test
4.3	Choice of switchgear
4.4.2	Operating frequency range
4.4.3	Minimal requirement for active power delivery at underfrequencies
4.4.4	Continuous operating voltage range
4.5.2	Rate of change of frequency (ROCOF) immunity
4.6.1	Power response to overfrequency
4.7.2.2	Capabilities
4.7.2.3.2	Setpoint control modes
4.7.2.3.3	Voltage related control modes
4.7.2.3.4	Power related Control mode
4.7.3	Voltage related active power reduction
4.8	Power quality
4.9.3.2	Undervoltage protection
4.9.3.3	Overvoltage protection
4.9.3.4	Overvoltage 10 min mean protection
4.9.3.5	Underfrequency protection
4.9.3.6	Overfrequency protection
4.9.4.2	Active methods tested with a resonant circuit
4.10.2	Automatic reconnection after tripping
4.10.3	Starting to generate electrical power
4.11.1	Ceasing active power
4.11.2	Reduction of active power on set point

Remark: If no special indicates, all the test is applied for model: iMars XG10KTL1.

☐ deviation(s) found

☒ no deviations found

Generator sign convention has been applied for all measurements and results given in this report. This is described in the following figure and table

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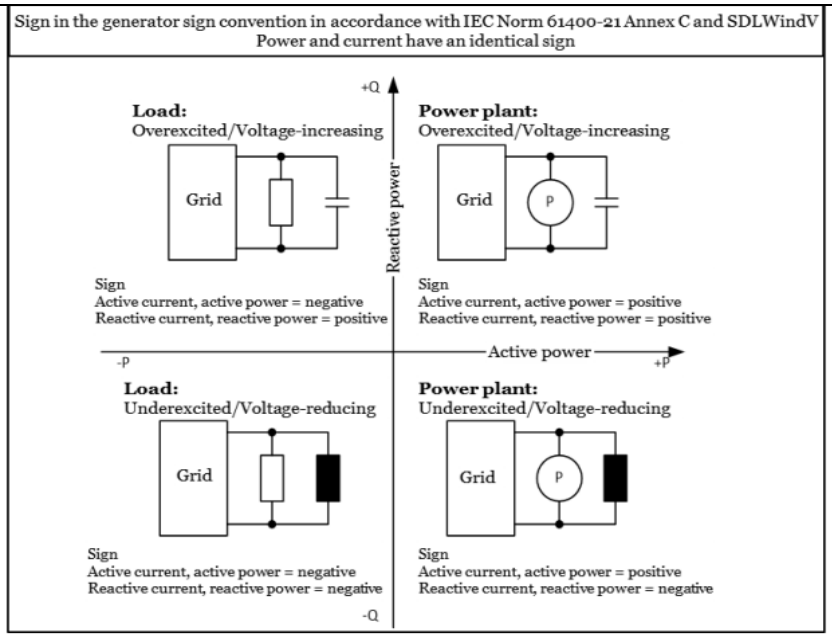

	Inductive (under-excited)	Capacitive(over-excited)
Generator (Discharge mode)	IV. Quadrant P > 0, the equipment supplies active power from the mains (Discharge mode) Q < 0, the equipment draws reactive power from the mains (inductive behaviour)	I. Quadrant P > 0, the equipment supplies active power from the mains (Discharge mode) Q > 0, the equipment supplies reactive power to the mains (capacitive behaviour)
Consumer (Charge mode)	III. Quadrant P < 0, the equipment supplies active power from the mains (Charge mode) Q < 0, the equipment draws reactive power from the mains (inductive behaviour)	II. Quadrant P < 0, the equipment draw active power from the mains (Charge mode) Q > 0, the equipment supplies reactive power to the mains (capacitive behaviour)

Additional information on Non-standard test method(s)

Sub clause: N/A
Page: N/A
Rational: N/A

If additional information is necessary, please provide

N/A

Copy of marking plate:

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invt	Grid-tied Solar Inverter
iMars XG3KTL-1M	
DC Input	
Vmax. PV	600V
MPPT Range	80V-580V
Max. Current	20A
Isc PV	26A
AC Output	
Nominal Voltage	230V
Max. Current	15A
Rated Power	3000W
Max. Output Power	3300VA
Frequency	50Hz/60Hz
Power factor range	0.80un~0.80ov
Environment	
Temperature	-30℃ ~ +60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

Made in China

INVT Solar Technology (Shenzhen) Co.,Ltd.

invt	Grid-tied Solar Inverter
iMars XG3KTL-2M	
DC Input	
Vmax. PV	600V
MPPT Range	80V-580V
Max. Current	20A/20A
Isc PV	26A/26A
AC Output	
Nominal Voltage	230V
Max. Current	15A
Rated Power	3000W
Max. Output Power	3300VA
Frequency	50Hz/60Hz
Power factor range	0.80un~0.80ov
Environment	
Temperature	-30℃ ~ +60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

Made in China

INVT Solar Technology (Shenzhen) Co.,Ltd.

invt	Grid-tied Solar Inverter
iMars XG3.68KTL	
DC Input	
Vmax. PV	600V
MPPT Range	80V-580V
Max. Current	20A/20A
Isc PV	26A/26A
AC Output	
Nominal Voltage	230V
Max. Current	16A
Rated Power	3680W
Max. Output Power	3680VA
Frequency	50Hz/60Hz
Power factor range	0.80un~0.80ov
Environment	
Temperature	-30℃ ~ +60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

Made in China

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invt	Grid-tied Solar Inverter
iMars XG4KTL	
DC Input	
Vmax. PV	600V
MPPT Range	80V-580V
Max. Current	20A/20A
Isc PV	26A/26A
AC Output	
Nominal Voltage	230V
Max. Current	20A
Rated Power	4000W
Max. Output Power	4400VA
Frequency	50Hz/60Hz
Power factor range	0.80un~0.80ov
Environment	
Temperature	-30℃ ~ +60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

Made in China

INVT Solar Technology (Shenzhen) Co.,Ltd.

invt	Grid-tied Solar Inverter
iMars XG4.2KTL	
DC Input	
Vmax. PV	600V
MPPT Range	80V-580V
Max. Current	20A/20A
Isc PV	26A/26A
AC Output	
Nominal Voltage	230V
Max. Current	21A
Rated Power	4200W
Max. Output Power	4620VA
Frequency	50Hz/60Hz
Power factor range	0.80un~0.80ov
Environment	
Temperature	-30℃ ~ +60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

Made in China

INVT Solar Technology (Shenzhen) Co.,Ltd.

invt	Grid-tied Solar Inverter
iMars XG4.6KTL	
DC Input	
Vmax. PV	600V
MPPT Range	80V-580V
Max. Current	20A/20A
Isc PV	26A/26A
AC Output	
Nominal Voltage	230V
Max. Current	23A
Rated Power	4600W
Max. Output Power	5000VA
Frequency	50Hz/60Hz
Power factor range	0.80un~0.80ov
Environment	
Temperature	-30℃ ~ +60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

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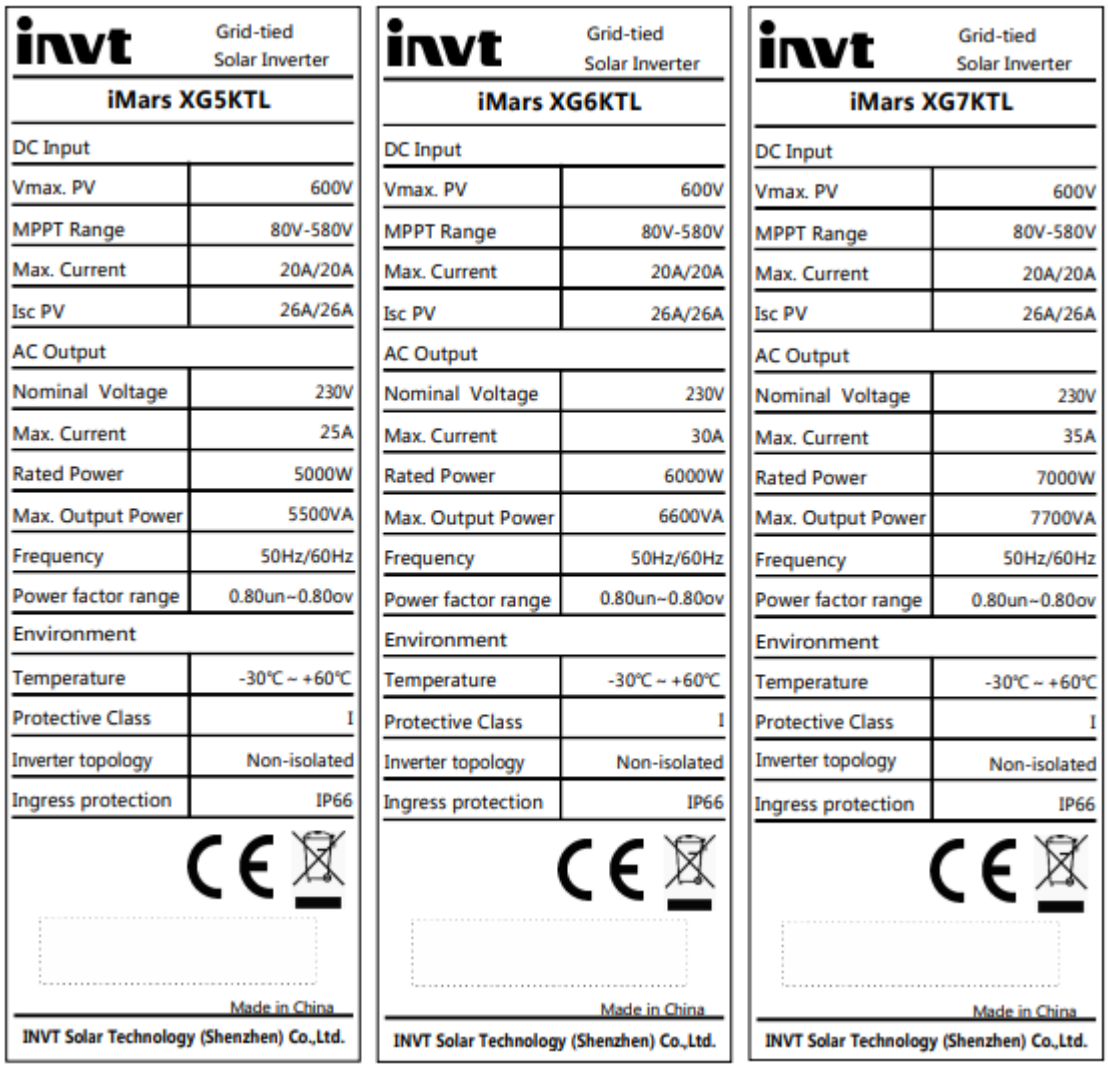

invt Grid-tied Solar Inverter

iMars XG5KTL

DC Input	
Vmax. PV	600V
MPPT Range	80V-580V
Max. Current	20A/20A
Isc PV	26A/26A
AC Output	
Nominal Voltage	230V
Max. Current	25A
Rated Power	5000W
Max. Output Power	5500VA
Frequency	50Hz/60Hz
Power factor range	0.80un~0.80ov
Environment	
Temperature	-30℃ ~ +60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

Made in China

INVT Solar Technology (Shenzhen) Co.,Ltd.

invt Grid-tied Solar Inverter

iMars XG6KTL

DC Input	
Vmax. PV	600V
MPPT Range	80V-580V
Max. Current	20A/20A
Isc PV	26A/26A
AC Output	
Nominal Voltage	230V
Max. Current	30A
Rated Power	6000W
Max. Output Power	6600VA
Frequency	50Hz/60Hz
Power factor range	0.80un~0.80ov
Environment	
Temperature	-30℃ ~ +60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

Made in China

INVT Solar Technology (Shenzhen) Co.,Ltd.

invt Grid-tied Solar Inverter

iMars XG7KTL

DC Input	
Vmax. PV	600V
MPPT Range	80V-580V
Max. Current	20A/20A
Isc PV	26A/26A
AC Output	
Nominal Voltage	230V
Max. Current	35A
Rated Power	7000W
Max. Output Power	7700VA
Frequency	50Hz/60Hz
Power factor range	0.80un~0.80ov
Environment	
Temperature	-30℃ ~ +60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

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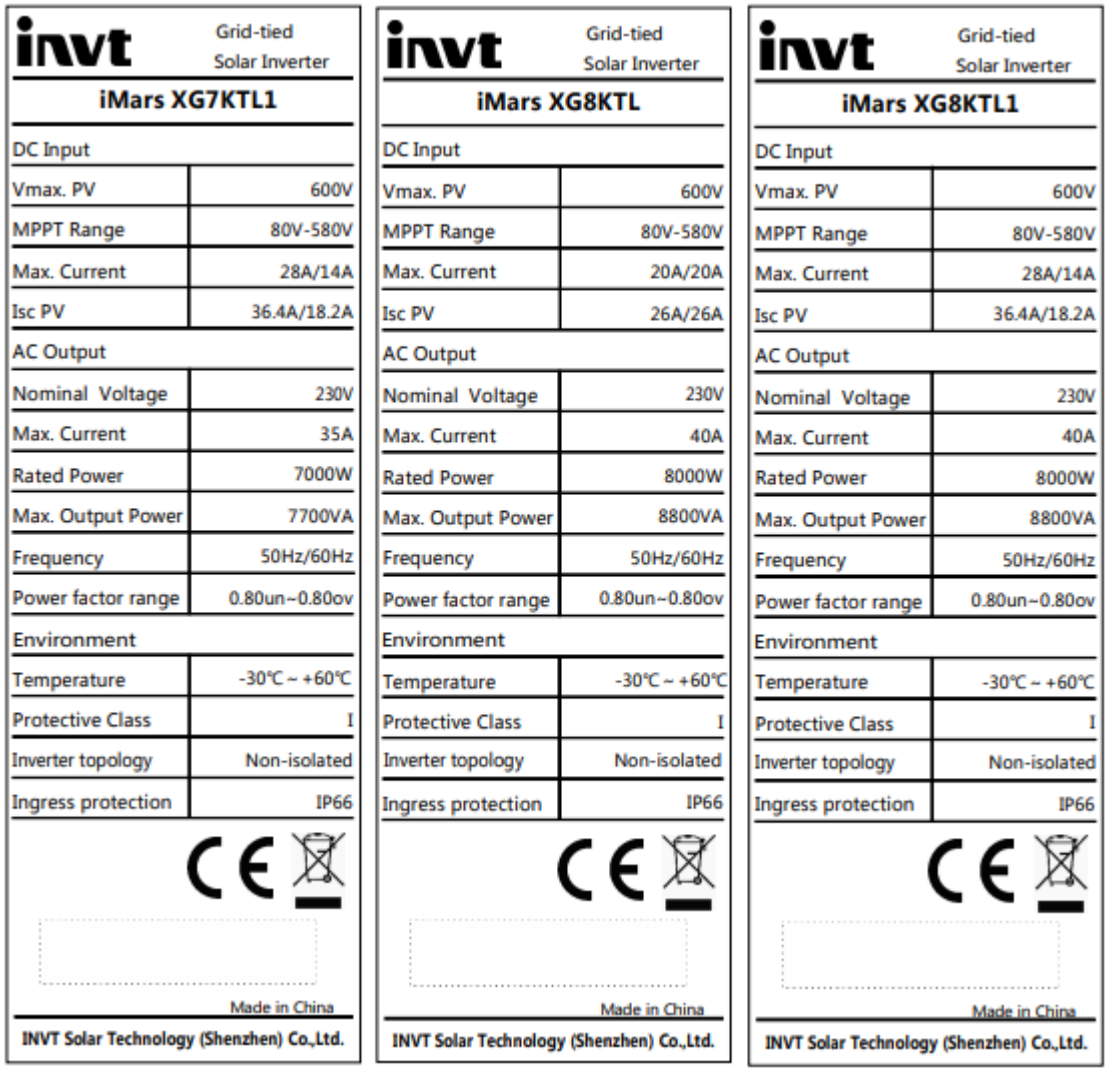

invt	Grid-tied Solar Inverter
iMars XG7KTL1	
DC Input	
Vmax. PV	600V
MPPT Range	80V-580V
Max. Current	28A/14A
Isc PV	36.4A/18.2A
AC Output	
Nominal Voltage	230V
Max. Current	35A
Rated Power	7000W
Max. Output Power	7700VA
Frequency	50Hz/60Hz
Power factor range	0.80un~0.80ov
Environment	
Temperature	-30℃ ~ +60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

Made in China

INVT Solar Technology (Shenzhen) Co.,Ltd.

invt	Grid-tied Solar Inverter
iMars XG8KTL	
DC Input	
Vmax. PV	600V
MPPT Range	80V-580V
Max. Current	20A/20A
Isc PV	26A/26A
AC Output	
Nominal Voltage	230V
Max. Current	40A
Rated Power	8000W
Max. Output Power	8800VA
Frequency	50Hz/60Hz
Power factor range	0.80un~0.80ov
Environment	
Temperature	-30℃ ~ +60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

Made in China

INVT Solar Technology (Shenzhen) Co.,Ltd.

invt	Grid-tied Solar Inverter
iMars XG8KTL1	
DC Input	
Vmax. PV	600V
MPPT Range	80V-580V
Max. Current	28A/14A
Isc PV	36.4A/18.2A
AC Output	
Nominal Voltage	230V
Max. Current	40A
Rated Power	8000W
Max. Output Power	8800VA
Frequency	50Hz/60Hz
Power factor range	0.80un~0.80ov
Environment	
Temperature	-30℃ ~ +60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

Made in China

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invt	Grid-tied Solar Inverter
iMars XG10KTL	
DC Input	
Vmax. PV	600V
MPPT Range	80V-580V
Max. Current	20A/20A
Isc PV	26A/26A
AC Output	
Nominal Voltage	230V
Max. Current	45.5A
Rated Power	10000W
Max. Output Power	10000VA
Frequency	50Hz/60Hz
Power factor range	0.80un~0.80ov
Environment	
Temperature	-30℃ ~ +60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

Made in China

INVT Solar Technology (Shenzhen) Co.,Ltd.

invt	Grid-tied Solar Inverter
iMars XG10KTL1	
DC Input	
Vmax. PV	600V
MPPT Range	80V-580V
Max. Current	28 /14 Ad.c.
Isc PV	36.4/18.2Ad.c
AC Output	
Nominal Voltage	230V
Max. Current	45.5A
Rated Power	10000W
Max. Output Power	10000VA
Frequency	50Hz/60Hz
Power factor range	0.80un~0.80ov
Environment	
Temperature	-30℃ ~ +60℃
Protective Class	I
Inverter topology	Non-isolated
Ingress protection	IP66

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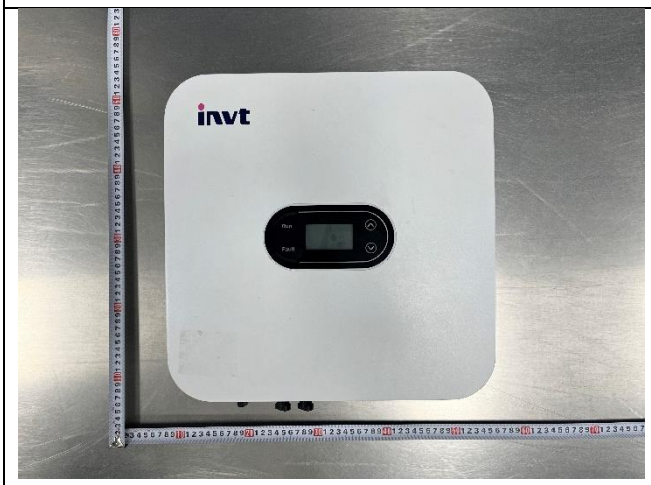
Remark: For application of this standard, the nominal voltage is 230Va.c., nominal frequency is 50Hz, and the power factor range: 0.9 inductive … 0.9 capacitive

Picture of the product:



Overall view (LCD cover board)

Overall view (alternative LED cover board)

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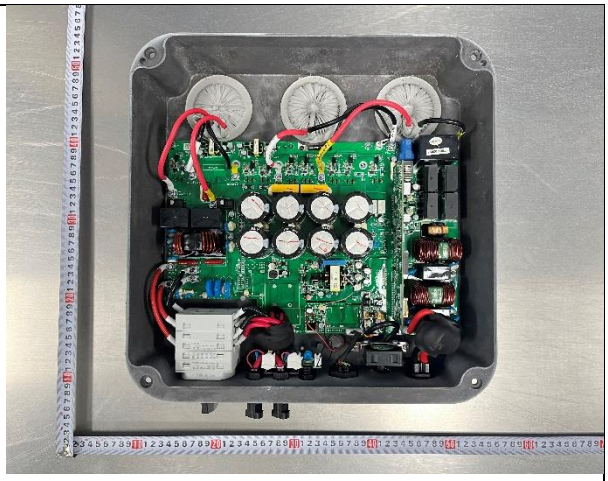
Terminal view



Internal view

Remark:For iMars XG3KTL-1M, the manufacturer will seal one of the MPPT circuits.

Name and address of factory (ies) *(only if certification is provided)*:
Shenzhen INVT Electric Co., Ltd. (Baoan Factory)
4th to 1st floors of Emerson Industrial Park, No. 3, Fengtang Avenue, Tangwei Community, Fuhai Street, Baoan District, Shenzhen

Possible test case verdicts:

test case does not apply to the test object:	N/A (not applicable / not included in the order)
test object does meet the requirement:	P (Pass)
test object does not meet the requirement:	F (Fail)

Possible suffixes to the verdicts:

suffix for detailed information for the client:	C (Comment)
suffix for important information for factory inspection:	M (Manufacturing)

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EN 50549-1:2019/AC:2019			
Clause	Requirement + Test	Result – Remark	Verdict

4	**Requirements on generating plants**		P
4.1	**General**		P
4.2	**Connection scheme**		P
4.3	**Choice of switchgear**		P
4.3.1	General		P
4.3.2	Interface switch		P
4.4	**Normal operating range**		P
4.4.1	General		P
4.4.2	Operating frequency range		P
4.4.3	Minimal requirement for active power delivery at underfrequencies		P
4.4.4	Continuous operating voltage range		P
4.5	**Immunity to disturbances**		P
4.5.1	General		P
4.5.2	Rate of change of frequency (ROCOF) immunity		P
4.5.3	Under-voltage ride through (UVRT)	Not suitable for Type A unit	N/A
4.5.4	Over-voltage ride through (OVRT)	Not suitable for Type A unit	N/A
4.6	**Active response to frequency deviation**		P
4.6.1	Power response to overfrequency		P
4.6.2	Power response to underfrequency		N/A
4.7	**Power response to voltage changes**		P
4.7.1	General		P
4.7.2	Voltage support by reactive power		P
4.7.2.1	General		P
4.7.2.2	Capabilities		P
4.7.2.3	Control modes		P
4.7.2.3.1	General		P
4.7.2.3.2	Setpoint control modes		P
4.7.2.3.3	Voltage related control modes	1.Q(U) control mode, voltage setting is 0.93Un ~ 0.97Un, 0.93Un for Qmax, 1.03Un ~ 1.07Un, 1.07Un for Qmin	P

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EN 50549-1:2019/AC:2019			
Clause	Requirement + Test	Result – Remark	Verdict
		2.The dynamics of control time set is 10 s 3. Lock-in value setting: 20%Pn; Lock-out value setting: 5%Pn.	
4.7.2.3.4	Power related Control mode:		P
4.7.3	Voltage related active power reduction	The overvoltage derating setting and response time setting: 1.10Un and 15s.	P
4.7.4	Short circuit current requirements on generating plants		N/A
4.7.4.1	General		N/A
4.7.4.2	Generating plant with non-synchronous generating technology		N/A
4.7.4.2.1	Voltage support during faults and voltage steps		N/A
4.7.4.2.2	Zero current mode for converter connected generating technology		N/A
4.7.4.2.3	Induction generator based units		N/A
4.7.4.3	Generating plant with synchronous generating technology - Synchronous generator based units		N/A
4.8	EMC and power quality	1.Refer to EMC report, report No.: 64.772.22.30413.01 2. Harmonics, Flicker, DCinjection, Rapid voltage change were tested	P
4.9	**Interface protection**		P
4.9.1	General		P
4.9.2	Void		N/A
4.9.3	Requirements on voltage and frequency protection		P
4.9.3.1	General		P
4.9.3.2	Undervoltage protection [27]		P
4.9.3.3	Overvoltage protection [59]		P
4.9.3.4	Overvoltage 10 min mean protection		P
4.9.3.5	Underfrequency protection [81<]		P
4.9.3.6	Overfrequency protection [81>]		P
4.9.4	Means to detect island situation		P

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Clause	Requirement + Test	Result – Remark	Verdict

4.9.4.1	General		P
4.9.4.2	Active methods tested with a resonant circuit		P
4.9.4.3	Switch to narrow frequency band (see Annex E and Annex F)		N/A
4.9.5	Digital input to the interface protection		N/A
4.10	**Connection and starting to generate electrical power**		P
4.10.1	General		P
4.10.2	Automatic reconnection after tripping		P
4.10.3	Starting to generate electrical power		P
4.10.4	Synchronization		P
4.11	**Active power reduction on set point**		P
4.11.1	Ceasing active power		P
4.11.2	Reduction of active power on set point		P
4.12	**Remote information exchange**		N/A
4.13	**Requirements regarding single fault tolerance of interface protection system and interface switch**		P

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4.3 & 4.13	Choice of switchgear					P
Ambient temperature (°C) ..... :						24.6°C
Component No.	Fault	Supply voltage (V)	Test time	Fuse #	Fuse current (A)	Observation
AC module						
Relay, K1	Each Relay contact short-circuit one at a time before energized PV and AC	480Vd.c. 230Va.c.	10min	--	--	The fault applied before unit operate. After applied the fault, unit does not start and report "11-02".
Relay, K2			10min	--	--	Same as above
Relay, K3			10min	--	--	Same as above
Relay, K4			10min	--	--	Same as above
PV voltage sampling circuit, Resistor, R108	S-C	360Vd.c 230 Va.c.	10 min	--	--	The fault applied during the unit operation. After applied the fault, the machine operated normally, showed “19-6”. No damaged, no hazard. The fault can be recoverable
Grid L phase voltage sampling circuit, Resistor, R157	S-C	360Vd.c 230 Va.c.	10 min	--	--	The fault applied during the unit operation. After applied the fault, the machine protected and get off the network, showed “19-3”. No damaged, no hazard. The fault can be recoverable
Grid N phase voltage sampling circuit, Resistor, R152	S-C	360Vd.c 230 Va.c.	10 min	--	--	The fault applied during the unit operation. After applied the fault, the machine protected and get off the network, showed “19-3”. No damaged, no hazard. The fault can be recoverable

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SN4 pin2 to pin3	S-C	360Vd.c 230 Va.c.	10 min	--	--	The fault applied during the unit operation. After applied the fault, the machine protected and get off the network, showed “19-2”. No damaged, no hazard. The fault can be recoverable
Check that the relays fulfil the basic insulation or simple separation based on the PV circuit working voltage.			Yes L distance:2.3mm N distance: 2.3mm			
Each active phase can be switched. (L and N)			Yes			
Supplementary information: S-C: short circuit						

4.4.2 & 4.4.4	**Operating frequency range & Continuous operating voltage range**	P
Setting (Minimum requirement)		Can operate according to minimum requirement?
Test #1	47.5 Hz at least operate 30 min	Yes
Test #2	51.5 Hz at least operate 30 min	Yes
Setting (Most stringent requirement)		Can operate according to minimum requirement?
Test #1	47.0 Hz at least operate 20 s	Yes
Test #2	47.5 Hz at least operate 90 min	Yes
Test #3	51.5 Hz at least operate 90 min	Yes
Test #4	52.0 Hz at least operate 15 min	Yes

Setting Voltage	85% Un *	110% Un
U_{L1-N} (Va.c.)	196.38	253.01
I_{L1} (Aa.c.)	45.70	39.79
P (W)	8960.22	10046.52
Q (Var)	511.44	582.99
S (VA)	8975.22	10067.31
Supplementary information : *Low voltage cannot reach full power due to maximum current limit		

4.4.3	**Minimal requirement for active power delivery at underfrequencies**			P
Test sequence	Freq (Hz)	Measured active output power $P_{measure}$ (W)	The calculated active output power as per feature curve $P_{minimum}$ (W)	Deviation of P_{shall} (W) less than $P_{measure}$? (Yes/No)
1	50.00	10108.54	100%Pn	Yes

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2	49.50	10061.50	100%Pn	Yes
3	49.00	10059.30	100%Pn	Yes
4	48.50	9973.46	99%Pn	Yes
5	48.00	9966.45	98%Pn	Yes
6	47.50	9866.62	97%Pn	Yes
Supplementary information: N/A				

4.5.2	**Rate of change of frequency (ROCOF) immunity**	P
	Setting	Disconnection during RoCoF
Test #1	47.0Hz to 49.0Hz, enhance 2Hz/s, 100% Un, cosφ=1	No disconnection
Test #2	49.0Hz to 51.0Hz, enhance 2Hz/s, 100% Un, cosφ=1	No disconnection
Test #3	52.0Hz to 50.0Hz, enhance 2Hz/s, 100% Un, cosφ=1	No disconnection
Test #4	50.0Hz to 48.0Hz, enhance 2Hz/s, 100% Un, cosφ=1	No disconnection
Test #5	47.0Hz to 49.0Hz, enhance 2Hz/s, 85% Un, cosφ=1	No disconnection
Test #6	49.0Hz to 51.0Hz, enhance 2Hz/s, 85% Un, cosφ=1	No disconnection
Test #7	52.0Hz to 50.0Hz, enhance 2Hz/s, 85% Un, cosφ=1	No disconnection
Test #8	50.0Hz to 48.0Hz, enhance 2Hz/s, 85% Un, cosφ=1	No disconnection
Test #9	47.0Hz to 49.0Hz, enhance 2Hz/s, 110% Un, cosφ=1	No disconnection
Test #10	49.0Hz to 51.0Hz, enhance 2Hz/s, 110% Un, cosφ=1	No disconnection
Test #11	52.0Hz to 50.0Hz, enhance 2Hz/s, 110% Un, cosφ=1	No disconnection
Test #12	50.0Hz to 48.0Hz, enhance 2Hz/s, 110% Un, cosφ=1	No disconnection
Supplementary information: N/A		

4.6.1	**Power response to overfrequency**	P

a) For Type 2 generation unit (PV or PV+ESS), over-frequency regulation, with active power reduction frequency start point=50.2Hz, gradient s=5%

Stage 1: TYPE 2 inverter DC input power is set to 100% of maximum active output power till the end of the test. The active power value shall not be deviated from the required value calculated from the feature curve for more than 10% P_n.

P_M =9962.85W, 10% P_n= 1000W , intentional delay time: 0.5 s (should ≤2s)

Test sequence	Freq (Hz)	Measured active output power $P_{measure}$ (W)	The calculated active output power as per feature curve $P_{max\text{-}limit}$ (W)	Deviation of $P_{measure}$ and $P_{max\text{-}limit}$ (W)	Deviation within 10% P_n (Yes/No)
1.	50.00	10019.29	--	--	--
2.	50.20	9962.85	--	--	--
3.	50.25	9774.35	9763.59(98%)	10.76	Yes
4.	50.70	7993.36	7970.28(80%)	23.08	Yes

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5.	51.15	6206.77	6176.97(62%)	29.80	Yes
6.	50.70	7991.95	7970.28(80%)	21.67	Yes
7.	50.25	9768.74	9763.59(98%)	5.15	Yes
8.	50.00	10017.83	--	--	--

Stage 2: TYPE 2 inverter DC input power is set to 50% of maximum active output power first. After the TYPE 2 inverter step into frequency range above 50.2Hz, the TYPE 2 inverter available input power is set to 100% of maximum active output. The output active power should not be changed. When the TYPE 2 inverter step back below the frequency 50.2Hz, the output active power should arise with a gradient of 10 % Pn/min.

P_M = 5020.44W, 10% P_n= 1000W, intentional delay time: 0.5 s (should ≤2s)

Test sequence	Freq (Hz)	Measured active output power $P_{measure}$ (W)	The calculated active output power as per feature curve $P_{max-limit}$ (W)	Deviation of $P_{measure}$ and $P_{max-limit}$ (W)	Deviation within 10% P_n (Yes/No)
1.	50.00	5002.92	--	--	--
2.	50.20	5020.44	--	--	--
3.	50.25	4936.45	4920.03(98%)	16.42	Yes
4.	50.70	4041.08	4016.35 (80%)	24.73	Yes
5.	51.15	3140.82	3112.67 (62%)	28.15	Yes
6.	50.70	4040.96	4016.35 (80%)	24.61	Yes
7.	50.25	4932.65	4920.03 (98%)	12.62	Yes
8.	50.00	See below table	--	--	--

Test sequence	Freq (Hz)	Time after step back from 50.2Hz t (min)	Measured active output power $P_{measure}$ (W)	ΔP Arise during next 1 min	Gradient of arising powerΔP/t under 10% P_{Emax} (Yes/No)
9.	50.00	0.0min	4942.30	688.10	Yes
10.	50.00	0.5min	5154.70	644.00	Yes
11.	50.00	1.0min	5630.40	753.80	Yes
12.	50.00	1.5min	5798.70	862.60	Yes
13.	50.00	2.0min	6384.20	746.30	Yes
14.	50.00	2.5min	6661.30	778.60	Yes
15.	50.00	3.0min	7130.50	723.10	Yes
16.	50.00	3.5min	7439.90	773.10	Yes
17.	50.00	4.0min	7853.60	881.80	Yes
18.	50.00	4.5min	8213.00	953.30	Yes
19.	50.00	5.0min	8735.40	657.50	Yes
20.	50.00	5.5min	9166.30	787.60	--
21.	50.00	6.0min	9392.90	574.60	--

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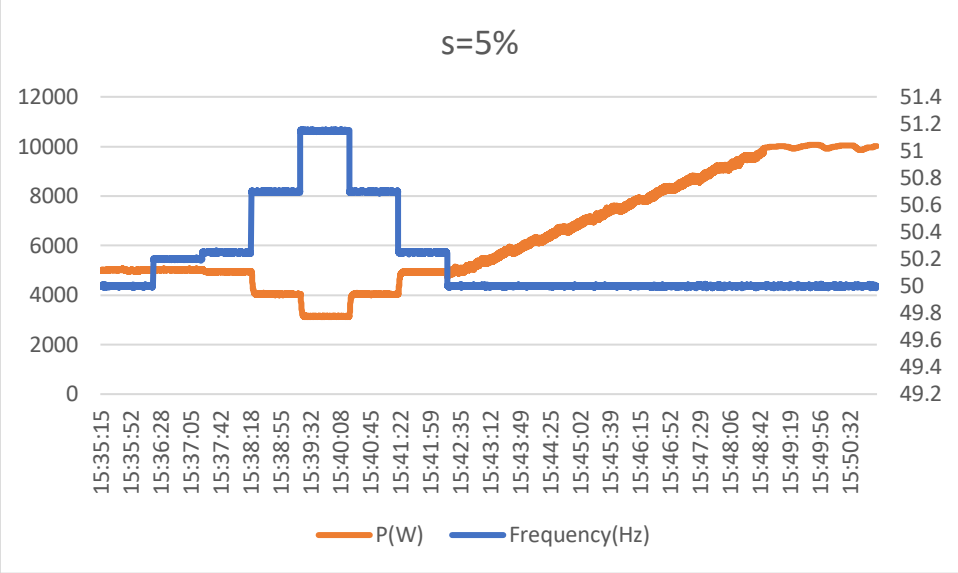
22.	50.00	6.5 min	9953.90	106.10	--
23.	50.00	7.0 min	9967.50	--	--
24.	50.00	7.5min	10060.00	--	--



b) For Type 2 generation unit (PV or PV+ESS), over-frequency regulation, with active power reduction frequency start point=50.2Hz, gradient s=12%

Stage 1: TYPE 2 inverter DC input power is set to 100% of maximum active output power till the end of the test. The active power value shall not be deviated from the required value calculated from the feature curve for more than 10% P_n.

P_M = 9947.47W, 10% P_n= 1000W , intentional delay time: 0.5 s (should ≤2s)

Test sequence	Freq (Hz)	Measured active output power $P_{measure}$ (W)	The calculated active output power as per feature curve $P_{max-limit}$ (W)	Deviation of $P_{measure}$ and $P_{max-limit}$ (W)	Deviation within 10% P_n (Yes/No)
1.	50.00	9990.05	--	--	--
2.	50.20	9947.47	--	--	--
3.	50.25	9774.31	9864.906(99.17%)	-90.60	Yes
4.	50.70	9035.59	9116.856(91.65%)	-81.27	Yes
5.	51.15	8265.01	8372.785(84.17%)	-107.78	Yes
6.	50.70	9037.36	9116.856(91.65%)	-79.50	Yes
7.	50.25	9766.92	9864.906(99.17%)	-97.99	Yes
8.	50.00	9949.74	--	--	--

Stage 2: TYPE 2 inverter DC input power is set to 50% of maximum active output power first. After the TYPE 2 inverter step into frequency range above 50.2Hz, the TYPE 2 inverter available input power is set to 100% of maximum active output. The output active power should not be changed. When the TYPE 2 inverter step back below the frequency 50.2Hz, the output active power should arise with a gradient of 10 % Pn/min.

P_M =4986.99W , 10% P_n=1000W , intentional delay time: 0.5 s (should ≤2s)

Test	Freq (Hz)	Measured active	The calculated active	Deviation of	Deviation within

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sequence		output power $P_{measure}$ (W)	output power as per feature curve $P_{max\text{-}limit}$ (W)	$P_{measure}$ and $P_{max\text{-}limit}$ (W)	10% P_n (Yes/No)
1.	50.00	4985.24	--	--	--
2.	50.20	4986.99	--	--	--
3.	50.25	4829.32	4945.60 (99.17%)	-116.28	Yes
4.	50.70	4483.30	4570.58 (91.65%)	-87.28	Yes
5.	51.15	4112.76	4197.55 (84.17%)	-84.79	Yes
6.	50.70	4483.59	4570.58 (91.65%)	-86.99	Yes
7.	50.25	4828.02	4945.60 (99.17%)	-117.58	Yes
8.	50.00	See below table	--	--	--
Test sequence	Freq (Hz)	Time after step back from 50.2Hz t (min)	Measured active output power $P_{measure}$ (W)	ΔP Arise during next 1 min	Gradient of arising powerΔP/t under 10% P_{Emax} (Yes/No)
9.	50.00	0.0min	4802.80	566.70	Yes
10.	50.00	0.5min	5020.90	864.00	Yes
11.	50.00	1.0min	5369.50	860.60	Yes
12.	50.00	1.5min	5884.90	791.90	Yes
13.	50.00	2.0min	6230.10	784.00	Yes
14.	50.00	2.5min	6676.80	718.30	Yes
15.	50.00	3.0min	7014.10	743.10	Yes
16.	50.00	3.5min	7395.10	757.30	Yes
17.	50.00	4.0min	7757.20	715.90	Yes
18.	50.00	4.5min	8152.40	846.30	Yes
19.	50.00	5.0min	8473.10	735.00	Yes
20.	50.00	5.5min	8998.70	755.50	Yes
21.	50.00	6.0min	9208.10	767.10	Yes
22.	50.00	6.5min	9754.20	305.80	Yes
23.	50.00	7.0min	9975.20	--	Yes

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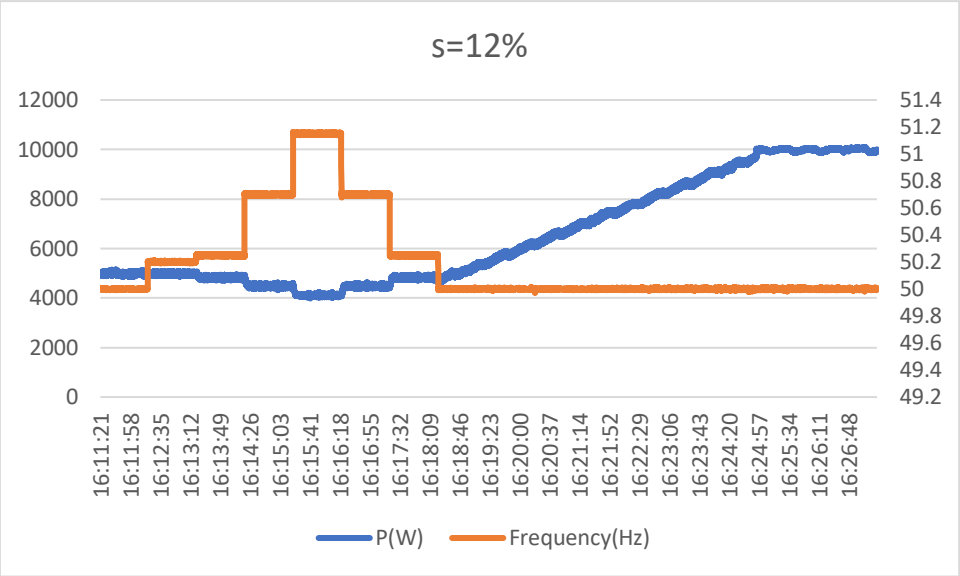

c) For Type 2 generation unit (PV or PV+ESS), over-frequency regulation, with active power reduction frequency start point=50.2Hz, gradient s=2%

Stage 1: TYPE 2 inverter DC input power is set to 100% of maximum active output power till the end of the test. The active power value shall not be deviated from the required value calculated from the feature curve 10% P_n.

P_M = 9942.30W , 10% P_n= 1000W, intentional delay time:__s (should ≤2s)

Test sequence	Freq (Hz)	Measured active output power $P_{measure}$ (W)	The calculated active output power as per feature curve $P_{max\text{-}limit}$ (W)	Deviation of $P_{measure}$ and $P_{max\text{-}limit}$ (W)	Deviation within 10% P_n (Yes/No)
1.	50.00	9953.70	--	--	--
2.	50.20	9942.30	--	--	--
3.	50.25	9418.01	9445.19(95%)	-27.17	Yes
4.	50.70	5024.71	4971.15(50%)	53.56	Yes
5.	51.15	584.85	497.12(5%)	87.74	Yes
6.	50.70	5030.25	4971.15(50%)	59.10	Yes
7.	50.25	9424.57	9445.19(95%)	-20.61	Yes
8.	50.00	10004.41	--	--	--

Stage 2: TYPE 2 inverter DC input power is set to 50% of maximum active output power first. After the TYPE 2 inverter step into frequency range above 50.2Hz, the TYPE 2 inverter available input power is set to 100% of maximum active output. The output active power should not be changed. When the TYPE 2 inverter step back below the frequency 50.2Hz, the output active power should arise with a gradient of 10 % Pn/min.

P_M = 4986.79W , 10% P_n= 1000W, intentional delay time:__s (should ≤2s)

Test sequence	Freq (Hz)	Measured active output power $P_{measure}$ (W)	The calculated active output power as per feature curve $P_{max\text{-}limit}$ (W)	Deviation of $P_{measure}$ and $P_{max\text{-}limit}$ (W)	Deviation within 10% P_n (Yes/No)
1.	50.00	4987.60	--	--	--

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2.	50.20	4986.79	--	--	--
3.	50.25	4700.78	4737.45	-36.67	Yes
4.	50.70	2517.27	2493.40	23.88	Yes
5.	51.15	264.38	249.34	15.04	Yes
6.	50.70	2519.60	2493.40	26.20	Yes
7.	50.25	4697.98	4737.45	-39.47	Yes
8.	50.00	See below table	--	--	--
Test sequence	Freq (Hz)	Time after step back from 50.2Hz t (min)	Measured active output power $P_{measure}$ (W)	ΔP Arise during next 1 min	Gradient of arising powerΔP/t under 10% P_{Emax} (Yes/No)
9.	50.00	0.0min	4806.60	597.30	Yes
10.	50.00	0.5min	4974.90	957.00	Yes
11.	50.00	1.0min	5403.90	784.70	Yes
12.	50.00	1.5min	5931.90	628.90	Yes
13.	50.00	2.0min	6188.60	948.80	Yes
14.	50.00	2.5min	6560.80	833.50	Yes
15.	50.00	3.0min	7137.40	687.60	Yes
16.	50.00	3.5min	7394.30	833.00	Yes
17.	50.00	4.0min	7825.00	742.50	Yes
18.	50.00	4.5min	8227.30	908.10	Yes
19.	50.00	5.0min	8567.50	667.90	Yes
20.	50.00	5.5min	9135.40	755.40	Yes
21.	50.00	6.0min	9235.40	746.50	Yes
22.	50.00	6.5min	9890.80	169.20	Yes
23.	50.00	7.0min	9981.90	--	Yes

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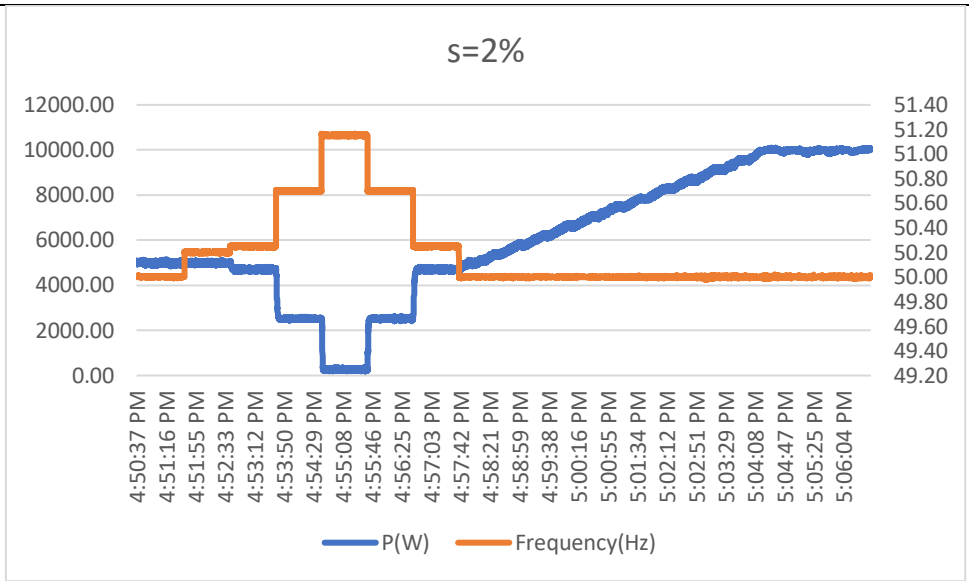

Supplementary information: N/A

4.7.2.2	Capabilities										P
S_{max} (VA)			10077			P_{max}(W)			9982		
Case A: Tested at Nominal voltage 1.00Un											
P/ S_{Emax} (%)	10	20	30	40	50	60	70	80	90	100	Max.
Q set value generation(kVA)	4.84	4.84	4.84	4.84	4.84	4.84	4.84	4.84	4.84	4.84	4.84
Tested cosφ	0.214 ov	0.394 ov	0.509 ov	0.623 ov	0.726 ov	0.776 ov	0.819 ov	0.856 ov	0.874 ov	0.875 ov	0.875 ov
Active power P (W)	1056	2081	2871	3854	5138	5963	6967	8032	8765	8780	8780
Reactive power Q(Var)	4814	4849	4950	4842	4870	4843	4975	4847	4859	4852	4852
Apparent power S (VA)	4929	5277	5636	6188	7080	7682	8504	9382	10023	10032	10032
Deviation within 2% S_{max} (Yes/No)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
P/ S_{Emax} (%)	10	20	30	40	50	60	70	80	90	100	Max.
Q set value generation(kVA)	0	0	0	0	0	0	0	0	0	0	0
Tested cosφ	0.996 ov	0.999 ov	0.999 ov	0.999 ov	0.999 un	0.999 nu	0.999 un	0.999 un	0.999 un	0.999 un	0.999 un
Active power P (W)	971	1977	3016	4008	5001	6041	6954	7935	8987	9981	9981
Reactive power Q(Var)	82	88	99	132	-169	-142	-142	-161	-169	-141	-141
Apparent power S (VA)	974	1979	3018	4011	5004	6043	6956	7936	8989	9982	9982

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Deviation within 2% S_{max} (Yes/No)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
P/ S_{Emax} (%)	10	20	30	40	50	60	70	80	90	100	Max.
Q set value generation(kVA)	-4.84	-4.84	-4.84	-4.84	-4.84	-4.84	-4.84	-4.84	-4.84	-4.84	-4.84
Tested cosφ	0.203 un	0.376 un	0.540 un	0.633 un	0.723 un	0.773 un	0.821 un	0.857 un	0.878 un	0.879 un	0.879 un
Active power P (W)	1008	1960	3094	3991	5040	6014	6999	8040	8844	8849	8849
Reactive power Q(Var)	-4866	-4837	-4822	-4879	-4821	-4829	-4858	-4832	-4830	-4793	-4793
Apparent power S (VA)	4969	5219	5729	6304	6975	7784	8520	9380	10077	10064	10064
Deviation within 2% S_{max} (Yes/No)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Case B Tested at Nominal voltage 1.10Un			
P/ S_{Emax} (%)	Max.	Max.	Max.
Q set value generation(kVA)	4.84	0	-4.84
Tested cosφ	0.876 ov	0.999 ov	0.877 un
Active power P (W)	8755	9924	8836
Reactive power Q(Var)	4799	157	-4832
Apparent power S (VA)	9984	9925	10071
Deviation within 2% S_{max} (Yes/No)	Yes	Yes	Yes

Case C: Tested at Nominal voltage 1.05Un			
P/ S_{Emax} (%)	Max.	Max.	Max.
Q set value generation(kVA)	4.84	0	-4.84
Tested cosφ	0.876 ov	0.999 un	0.876 un
Active power P (W)	8770	9992	8794
Reactive power Q(Var)	4815	-169	-4809
Apparent power S (VA)	10006	9993	10023
Deviation within 2% S_{max} (Yes/No)	Yes	Yes	Yes

Case D: Tested at Nominal voltage 0.95Un

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P/ S_{Emax} (%)	Max.	Max.	Max.
Q set value generation(kVA)	4.84	0	-4.84
Tested cosφ	0.878 ov	0.999 un	0.877 un
Active power P (W)	8808	10021	8760
Reactive power Q(Var)	4790	-159	-4799
Apparent power S (VA)	10026	10023	9988
Deviation within 2% S_{max} (Yes/No)	Yes	Yes	Yes

Case E: Tested at Nominal voltage 0.90Un			
P/ S_{Emax} (%)	Max.	Max.	Max.
Q set value generation(kVA)	4.84	0	-4.84
Tested cosφ	0.859 ov	0.999 un	0.858 un
Active power P (W)	0.859	9450	8065
Reactive power Q(Var)	8172	-170	-4830
Apparent power S (VA)	4869	9452	9400
Deviation within 2% S_{max} (Yes/No)	Yes	Yes	Yes

Case F: Tested at Nominal voltage 0.85Un			
P/ S_{Emax} (%)	Max.	Max.	Max.
Q set value generation(kVA)	4.84	0	-4.84
Tested cosφ	0.842 ov	0.999 un	0.841 un
Active power P (W)	7538	8921	7478
Reactive power Q(Var)	4838	-163	-4810
Apparent power S (VA)	8957	8923	8891
Deviation within 2% S_{max} (Yes/No)	Yes	Yes	Yes

Case A: Tested at Nominal voltage 1.00Un											
P/ S_{Emax} (%)	10	20	30	40	50	60	70	80	90	100	Max.
Cosφ set value generation	0.900 ov	0.900 ov	0.900 ov	0.900 ov	0.900 ov	0.900 ov	0.900 ov	0.900 ov	0.900 ov	0.900 ov	0.900 ov
Tested cosφ	0.901 ov	0.906 ov	0.906 ov	0.902 ov	0.901 ov	0.902 ov	0.900 ov	0.903 ov	0.901 ov	0.902 ov	0.902 ov
Active power P (W)	1001	2306	3037	4031	5084	5979	6954	8012	9055	8995	8995

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Reactive power Q(Var)	481	982	1413	1929	2439	2854	3359	3805	4343	4290	4290
Apparent power S (VA)	1110	2260	3350	4469	5639	6626	7723	8869	10043	9966	9966
Deviation within 2% S_{max} (Yes/No)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
P/ S_{Emax} (%)	10	20	30	40	50	60	70	80	90	100	Max.
Cosφ set value generation	0.900 un	0.900 un	0.900 un	0.900 un	0.900 un	0.900 un	0.900 un	0.900 un	0.900 un	0.900 un	0.900 un
Tested cosφ	0.902 un	0.902 un	0.903 un	0.901 un	0.900 un	0.898 un	0.901 un	0.900 un	0.905 un	0.904 un	0.904 un
Active power P (W)	961	2091	2979	3900	5000	5971	7058	8065	8971	9028	9028
Reactive power Q(Var)	-458	-994	-1415	-1876	-2420	-2923	-3407	-3913	-4208	-4276	-4276
Apparent power S (VA)	1065	2317	3298	4328	5555	6648	7837	8964	9909	9990	9990
Deviation within 2% S_{max} (Yes/No)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
P/ S_{Emax} (%)	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.
Cosφ set value generation	0.800 ov	0.850 ov	0.880 ov	0.90 ov	0.950 ov	1.000	0.950 un	0.900 un	0.880 un	0.850 un	0.800 un
Tested cosφ	--	--	--	0.899 ov	0.950 ov	0.999 un	0.952 un	0.903 un	--	--	--
Active power P (W)	--	--	--	8928	9515	1022	9517	9028	--	--	--
Reactive power Q(Var)	--	--	--	4325	3210	-172	-3049	-4276	--	--	--
Apparent power S (VA)	--	--	--	9921	10014	10023	9994	9990	--	--	--
Deviation within 2% S_{max} (Yes/No)	--	--	--	Yes	Yes	Yes	Yes	Yes	--	--	--

Case B Tested at Nominal voltage 1.10Un

P/ S_{Emax} (%)	Max.	Max.	Max.
Cosφ set value generation	0.900 ov	1.000	0.900 un
Tested cosφ	0.899 ov	0.999 un	0.900 un
Active power P (W)	9096	9964	8931
Reactive power Q(Var)	4413	172	-4325
Apparent power S (VA)	10111	9966	9924

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Deviation within 2% S_{max} (Yes/No)	Yes	Yes	Yes
Case C: Tested at Nominal voltage 1.05Un			
P/ S_{Emax} (%)	Max.	Max.	Max.
Cosφ set value generation	0.900 ov	1.000	0.900 un
Tested cosφ	0.903 ov	0.999 un	0.901 un
Active power P (W)	9102	9996	9096
Reactive power Q(Var)	4319	-143	-4380
Apparent power S (VA)	10075	9997	10096
Deviation within 2% S_{max} (Yes/No)	Yes	Yes	Yes
Case D: Tested at Nominal voltage 0.95Un			
P/ S_{Emax} (%)	Max.	Max.	Max.
Cosφ set value generation	0.900 ov	1.000	0.900 un
Tested cosφ	0.902 ov	0.999 un	0.899 un
Active power P (W)	9016	10002	8979
Reactive power Q(Var)	4310	-156	-4377
Apparent power S (VA)	9993	10003	9989
Deviation within 2% S_{max} (Yes/No)	Yes	Yes	Yes
Case E: Tested at Nominal voltage 0.90Un			
P/ S_{Emax} (%)	Max.	Max.	Max.
Cosφ set value generation	0.900 ov	1.000	0.900 un
Tested cosφ	0.901 ov	0.999 un	0.899 un
Active power P (W)	8484	9479	8477
Reactive power Q(Var)	4096	-154	-4136
Apparent power S (VA)	9421	9480	9432
Deviation within 2% S_{max} (Yes/No)	Yes	Yes	Yes
Case F: Tested at Nominal voltage 0.85Un			
P/ S_{Emax} (%)	Max.	Max.	Max.
Cosφ set value generation	0.900 ov	1.000	0.900 un

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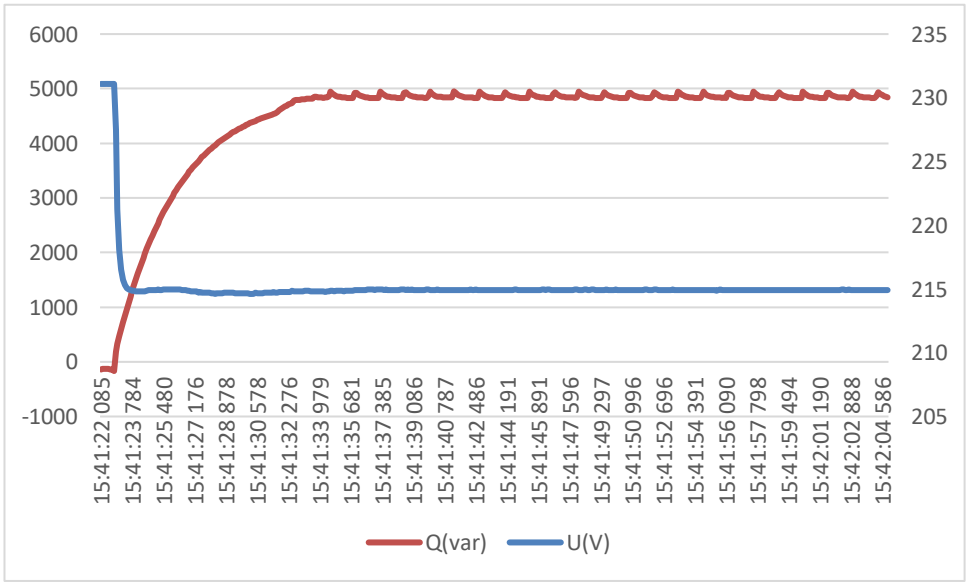
Tested cosφ	0.899 ov	0.999 un	0.899 un
Active power P (W)	8075	8959	8056
Reactive power Q(Var)	3930	-169	-3932
Apparent power S (VA)	8980	8960	8960
Deviation within 2% S_{max} (Yes/No)	Yes	Yes	Yes
Supplementary information: Low voltage cannot reach full power due to maximum current limit.			

4.7.2.3.3	**Voltage related control modes**	P
The dynamics of the Response control time		
Set fixed P=0.5 S_{Emax}, the setting response time is 10 s (the setting should within the range of 3s to 60s), change the voltage by steps: 1) 1.00 Un, stable operation 2) 0.97 - 0.93 Un, 30s (or 240s, should larger than the setting response time 3 times) 3) 1.03 - 1.07 Un, 30s (or 240s, should larger than the setting response time 3 times) 4) 1.00 Un, 30s (or 240s, should larger than the setting response time 3 times)		
Step from 1) to 2)		

Response curve:



Start reactive power Q_S (VA)	-136
Target reactive power Q_T (VA)	4704
Required change of reactive power $\|Q_T-Q_S\|$ (VA)	4840
Step change of reactive power after the setting response time Q_{srt} (VA)	4827
Percentage of step change of reactive power Q_{srt} /$\|Q_T-Q_S\|$ (%)	99%
Step change of reactive power after 3 times the Q_{srt} (VA)	4843
Percentage of step change of reactive power Q_{srt}*3 /$\|Q_T-Q_S\|$ (%)	102%

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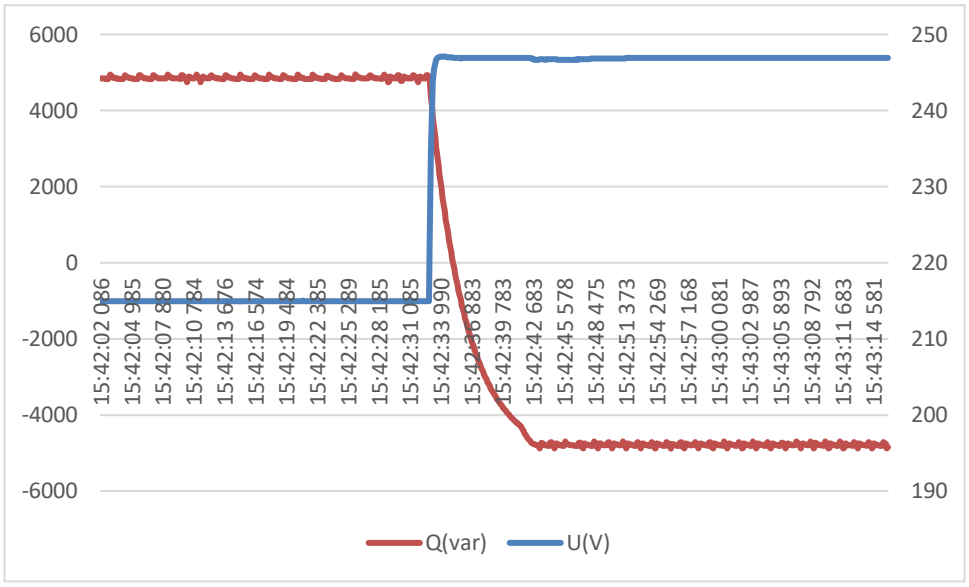
90%< Q_{srt} /$\|Q_T-Q_S\|$<100%	Yes	95%< Q_{srt}*3/$\|Q_T-Q_S\|$<105%	Yes
Step from 2) to 3)			
Response curve: 			

Start reactive power Q_s (VA)	4843
Target reactive power Q_T (VA)	-4837
Required change of reactive power $\|Q_T-Q_S\|$ (VA)	9680
Step change of reactive power after the setting response time Q_{srt} (VA)	9528
Percentage of step change of reactive power Q_{srt} /$\|Q_T-Q_S\|$ (%)	98%
Step change of reactive power after 3 times the Q_{srt} (VA)	9653
Percentage of step change of reactive power Q_{srt}*3 /$\|Q_T-Q_S\|$ (%)	100%

90%< Q_{srt} /$\|Q_T-Q_S\|$<100%	Yes	95%< Q_{srt}*3/$\|Q_T-Q_S\|$<105%	Yes
Step from 3) to 4)			
Response curve:			

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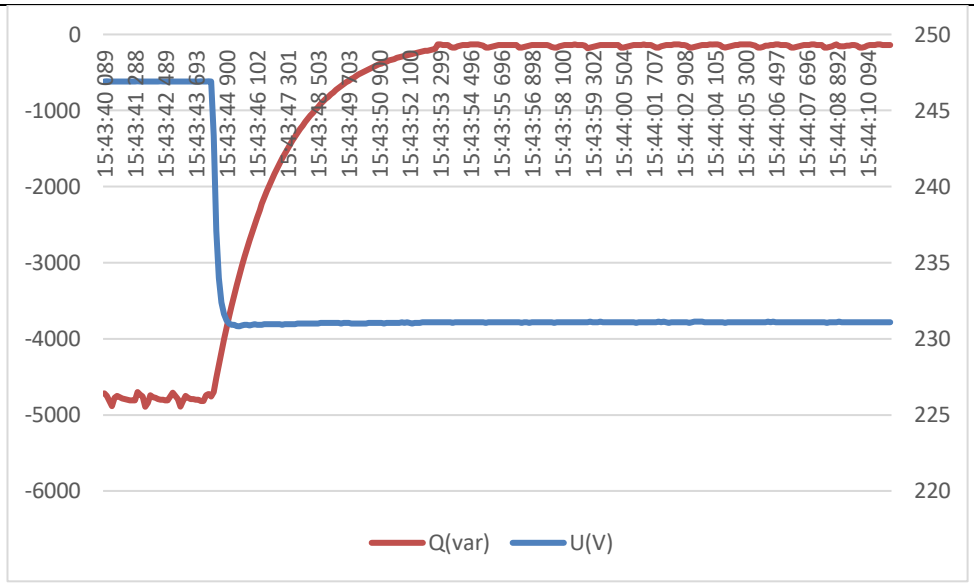

Start reactive power Q_s (VA)	-4818
Target reactive power Q_T (VA)	40
Required change of reactive power $\|Q_T-Q_S\|$ (VA)	4840
Step change of reactive power after the setting response time Q_{srt} (VA)	4676
Percentage of step change of reactive power Q_{srt} /$\|Q_T-Q_S\|$ (%)	97%
Step change of reactive power after 3 times the Q_{srt} (VA)	4679
Percentage of step change of reactive power Q_{srt}*3 /$\|Q_T-Q_S\|$ (%)	97%

90%< Q_{srt} /$\|Q_T-Q_S\|$<100%	Yes	95%< Q_{srt}*3/$\|Q_T-Q_S\|$<105%	Yes

The voltage related control modes control the reactive power output

$-Q_{max}$ and Q_{max} is defined by testing in Cl.4.7.2. Fixed active power setting 0.5 S_{Emax}

Q_{max} at this active power (kVA)	4840	$-Q_{max}$ at this active power (kVA)	-4840

Grid simulator voltage (Un)	Measured Voltage U (V)	Measured active power P (W)	Measured apparent power S (VA)	Measured displacement factor cosφ	Measured reactive power Q(VA)	Required reactive power as to feature curve Q(VA)	Deviation of reactive power(%Sn)
0.91 Un	210.41	8359.35	9644.13	0.8668 ov	4809.28	4840	-0.31%
0.93 Un	215.00	8528.17	9843.49	0.8664 ov	4915.70	4840	0.76%
0.95 Un	219.63	9725.28	10021.68	0.9704 ov	2419.17	2420	-0.01%
0.97 Un	224.27	9908.87	9909.48	0.9999 un	-108.15	0	-1.08%
1.00 Un	231.11	10042.80	10043.27	1.0000	-98.05	0	-0.98%
1.03 Un	237.95	10017.16	10017.70	1.0000	-103.53	0	-1.04%
1.05 Un	242.44	9650.57	9926.24	0.9722 un	-2322.92	-2420	0.97%

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1.07 Un	246.84	8772.50	9976.72	0.8793 un	-4751.61	-4840	0.88%
1.09 Un	251.43	8785.30	9983.23	0.8800 un	-4741.62	-4840	0.98%
1.07 Un	246.84	8776.86	9980.91	0.8794 un	-4752.35	-4840	0.88%
1.05 Un	242.45	9648.96	9929.10	0.9718 un	-2341.76	-2420	0.78%
1.03 Un	237.95	10002.90	10003.42	1.0000	-101.44	0	-1.01%
1.00 Un	231.09	9975.00	9975.46	1.0000	-94.80	0	-0.95%
0.97 Un	224.25	9939.51	9939.85	1.0000	-83.05	0	-0.83%
0.95 Un	219.65	9725.82	10016.09	0.9710 ov	2393.73	2420	-0.26%
0.93 Un	215.03	8576.63	9853.31	0.8704 ov	4850.46	4840	0.10%
0.91 Un	210.40	8318.25	9645.80	0.8624 ov	4883.30	4840	0.43%

Limit the reactive power at low active power

Qmin

Qmin=-4840 Var

P/P_{SMAX} [%] Set-point	Vac [V] set-point	P/P_N [%] Measured	Vac [V] measured	Q [Var] measured	Q [Var] expected	Δ Q (< ± 2 % Sn)
< 20 %	1.03 Vn	1378.17	236.71	93.34	0	0.95%
< 20 %	1.05 Vn	1381.81	241.30	99.24	0	0.98%
<20 % -> 30 %	1.05 Vn	2442.42	241.45	-2348.66	-0.5 Qmin	0.73%
50 %	1.05 Vn	4752.71	241.80	-2387.01	-0.5 Qmin	0.34%
100 %	1.05 Vn	9455.74	242.51	-2442.35	-0.5 Qmin	-0.17%
100 %	1.07 Vn	8342.84	246.90	-4686.88	-Qmin	1.54%
100 % -> 10 %	1.07 Vn	1049.51	246.82	-4669.82	-Qmin	1.72%
10 % -> ≤ 5 %	1.07 Vn	335.58	245.81	133.94	0	1.35%

Qmax

Qmax=4840 Var

P/P_{SMAX} [%] Set-point	Vac [V] set-point	P/P_{SMAX} [%] Measured	Vac [V] measured	Q [Var] measured	Q [Var] expected	Δ Q (< ± 2 % Sn)
< 20 %	0.97 Vn	1086.11	222.88	78.43	0	0.78%
< 20 %	0.95 Vn	1079.08	218.28	73.23	0	0.73%
<20 % -> 30 %	0.95 Vn	2636.17	218.53	2343.08	0.5 Qmax	-0.77%
50 %	0.95 Vn	4963.05	218.88	2340.25	0.5 Qmax	-0.80%
100 %	0.95 Vn	9708.70	219.64	2321.80	0.5 Qmax	-0.99%
100 %	0.93 Vn	8787.27	214.99	4781.28	Qmax	-0.59%

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100 % -> 10 %	0.93 Vn	1024.49	214.05	4796.69	Qmax	-0.35%
10 % -> ≤ 5 %	0.93 Vn	317.38	213.64	176.37	0	1.76%
Supplementary information: Lock-in value setting: 20%Pn, Lock-out value setting: 5%Pn						

4.7.2.3.4	**Power related Control mode:**					P
Maximal active power P_{Emax} with the tested displacement factor (W)						9000
Percentage of output active power P/P_n (%)	Measured active power P (W)	Measured apparent power S (VA)	Measured displacement factor cosφ	Measured reactive power Q(VA)	Displacement factor as to feature curve	Whether the accuracy fulfill according to clause 4.7.2.2? (± 2% Smax)
Set point 1: P=0 P_{Emax}, cosφ=1 Set point 2: P=0.5 P_{Emax}, cosφ=1 Set point 3: P=1 P_{Emax}, cosφ=0.9 or 0.95$_{under\text{-}excited}$						
10%	1042.55	1046.89	0.996 ov	95.15	1.000	Yes
20%	1945.98	1947.57	0.999 ov	78.22	1.000	Yes
30%	2996.99	2998.19	1.000	84.35	1.000	Yes
40%	3989.22	3990.40	1.000	96.52	1.000	Yes
50%	5035.81	5037.26	1.000	45.52	1.000	Yes
60%	5952.62	6074.99	0.980 un	-1212.80	0.980un	Yes
70%	7042.09	7336.24	0.960 un	-2056.31	0.960un	Yes
80%	7964.15	8466.55	0.941 un	-2872.83	0.940un	Yes
90%	9037.63	9816.82	0.921 un	-3832.74	0.920un	Yes
100%	9037.63	9816.82	0.921 un	-3832.74	0.920un	Yes
90%	8999.54	9773.85	0.921 un	-3812.49	0.920un	Yes
80%	8065.14	8573.33	0.941 un	-2907.58	0.940un	Yes
70%	7004.28	7297.03	0.960 un	-2045.84	0.960un	Yes
60%	6027.55	6156.95	0.979 un	-1255.30	0.980un	Yes
50%	5055.95	5057.15	1.000	75.30	1.000	Yes
40%	4024.01	4025.17	1.000	96.13	1.000	Yes
30%	2967.78	2968.99	1.000	84.37	1.000	Yes
20%	1977.47	1979.29	0.999	84.41	1.000	Yes
10%	1030.46	1035.21	0.995	99.10	1.000	Yes
Supplementary information: The software of this function is based on P_n=10kW.Due to P_n=Smax,P_D=9kW, this function can only reach PF=0.920 un.						

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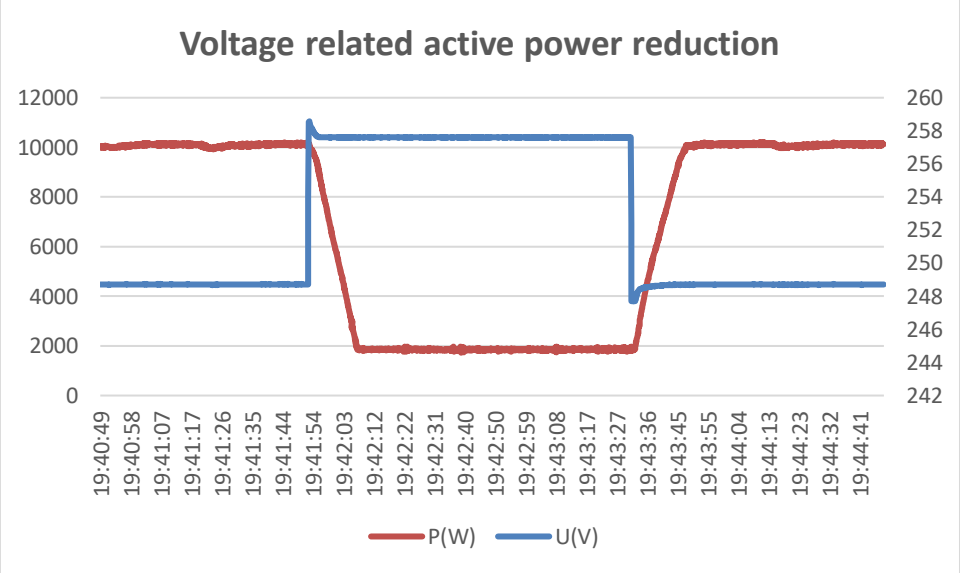
4.7.3	TABLE: Voltage related active power reduction								P
Step	Voltage set-point	Grid voltage [V]			Current [A]			Output active power [W]	Droop during power reduction [%P_n/s]
		L1-N	L2-N	L3-N	L1	L2	L3		
1)	-2% of 110%U_n	248.71	--	--	40.63	--	--	10085.51	-
2)	+2% of 110%U_n	257.60	--	--	7.32	--	--	1854.21	5.42%
3)	-2% of 110%U_n	248.71	--	--	40.67	--	--	10096.62	5.26%



Supplementary information:
Setting:When over 110%Un,active power will reduce to under 20%Pn.

4.8	Power quality - TABLE: Rapid voltage change	P

Test conditions:
Case A: Switch on at any power level of primary energy
Case B: Worst case of switching of generator level
Case C: Switch on at the nominal power
Case D: Switch off at the nominal power (not emergency, but normal operational switch off)

Nominal current of PGU I_n (A)	43.50	The k_{imax} value:	1.01
Test frequency (Hz)	50.00	--	--

Switching action		Ia (A)			U(V)			ki
A	--	L1	L2	L3	L1	L2	L3	--
	#1	7.07	--	--	230.07	--	--	0.16
	#2	6.90	--	--	230.07	--	--	0.16
	#3	7.46	--	--	230.05	--	--	0.17
A-with 0.33%	--	L1	L2	L3	L1	L2	L3	--
	#1	4.04	--	--	230.20	--	--	0.09
	#2	4.87	--	--	230.18	--	--	0.11
	#3	4.04	--	--	230.07	--	--	0.09

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A-with 0.66%	--	L1	L2	L3	L1	L2	L3	--
	#1	3.84	--	--	230.20	--	--	0.09
	#2	2.37	--	--	230.07	--	--	0.05
	#3	2.54	--	--	230.05	--	--	0.06
B	--	L1	L2	L3	L1	L2	L3	--
	#1	16.60	--	--	305.96	--	--	0.38
	#2	16.25	--	--	305.35	--	--	0.37
	#3	19.43	--	--	305.28	--	--	0.45
C	--	L1	L2	L3	L1	L2	L3	--
	#1	6.92	--	--	229.87	--	--	0.16
	#2	7.44	--	--	229.88	--	--	0.17
	#3	6.97	--	--	229.86	--	--	0.16
C-with 0.33% rate	--	L1	L2	L3	L1	L2	L3	--
	#1	5.05	--	--	229.88	--	--	0.12
	#2	3.76	--	--	229.89	--	--	0.09
	#3	4.61	--	--	229.86	--	--	0.11
C-with 0.66%	--	L1	L2	L3	L1	L2	L3	--
	#1	4.96	--	--	229.89	--	--	0.11
	#2	5.21	--	--	229.87	--	--	0.12
	#3	6.23	--	--	229.87	--	--	0.14
D	--	L1	L2	L3	L1	L2	L3	--
	#1	44.12	--	--	230.63	--	--	1.01
	#2	43.60	--	--	230.20	--	--	1.00
	#3	43.27	--	--	227.70	--	--	0.99
Supplementary information: N/A								

4.8	**Power quality - TABLE: Flicker**				P
Simulated network voltage (V)	L1 (P-N)	230.0	Network impedance	L1	--
	L2(P-N)	--		L2	--
	L3(P-N)	--		L3	--
	--	--		N	--
EZE operating current (A)	L1	43.5	EZE operating power (kVA)	L1	--
	L2	--		L2	--
	L3	--		L3	--
Simulated network frequency (Hz)	50.0		Short circuit power Sk (VA)	330000.0	
Plt (Maximum measured Pst)	0.200		EZE nominal power (Pn)	10000.0W	
Maximum flicker coefficient Cφk	0.215		--	--	

Pst	#1	#2	#3	#4	#5	#6
L1	0.215	0.210	0.203	0.199	0.190	0.190
L2	--	--	--	--	--	--
L3	--	--	--	--	--	--
Pst	#7	#8	#9	#10	#11	#12
L1	0.199	0.193	0.188	0.200	0.206	0.205

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L2	--	--	--	--	--	--
L3	--	--	--	--	--	--
Supplementary information: The ratio of Sk,fic/Sn used for the analysis: 33.						

4.8	**Power quality - TABLE: DC injection**								P
It is a design test referring to the test method and evaluation in IEEE 1547.1-2005 standard, item 5.6, which designates to test DC value when the inverter is working at 33%, 66% and 100% of current rating.									
Test level	33%			66%			100%		
Phase	L1	L2	L3	L1	L2	L3	L1	L2	L3
Test results (Amp)	0.04	--	--	0.09	--	--	0.17	--	--
Test results (% of rated output current)	0.09	--	--	0.21	--	--	0.40	--	--
Limit	≤0.5%			≤0.5%			≤0.5%		
Supplementary information: Arithmetic mean value used as test result in test duration of 5min.									

4.8	**Power quality - TABLE: Harmonics and inter-harmonics& Feed-in of direct currents**										P
iMars XG10KTL1											
Phase L-N											
Harmon. Nr.	P/P_{Emax}										Limit
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
1	1.64 %	10.19 %	20.37 %	30.36 %	40.65 %	50.34 %	60.03 %	70.02 %	80.06 %	89.00 %	98.72 %	--
2	1.60 %	0.22 %	0.22 %	0.22 %	0.24 %	0.25 %	0.26 %	0.47 %	0.62 %	0.78 %	0.78 %	8%
3	0.77 %	0.39 %	0.36 %	0.47 %	0.64 %	0.91 %	1.21 %	1.50 %	1.83 %	2.17 %	2.54 %	--
4	0.43 %	0.11 %	0.08 %	0.09 %	0.09 %	0.09 %	0.10 %	0.18 %	0.23 %	0.27 %	0.22 %	4%
5	0.36 %	0.21 %	0.24 %	0.24 %	0.27 %	0.28 %	0.29 %	0.34 %	0.41 %	0.42 %	0.45 %	10.7%
6	0.26 %	0.05 %	0.05 %	0.05 %	0.05 %	0.05 %	0.05 %	0.11 %	0.14 %	0.14 %	0.15 %	2.6%
7	0.22 %	0.10 %	0.15 %	0.18 %	0.19 %	0.22 %	0.25 %	0.26 %	0.32 %	0.34 %	0.30 %	7.2%
8	0.16 %	0.04 %	0.04 %	0.04 %	0.05 %	0.05 %	0.05 %	0.09 %	0.12 %	0.15 %	0.11 %	2%
9	0.15 %	0.07 %	0.10 %	0.12 %	0.13 %	0.16 %	0.17 %	0.20 %	0.24 %	0.27 %	0.29 %	--

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10	0.13 %	0.04 %	0.03 %	0.03 %	0.03 %	0.03 %	0.03 %	0.06 %	0.08 %	0.10 %	0.09 %	1.6%
11	0.12 %	0.05 %	0.07 %	0.08 %	0.10 %	0.10 %	0.11 %	0.14 %	0.14 %	0.15 %	0.17 %	3.1%
12	0.11 %	0.04 %	0.03 %	0.03 %	0.03 %	0.03 %	0.03 %	0.06 %	0.08 %	0.09 %	0.07 %	1.3%
13	0.08 %	0.05 %	0.05 %	0.07 %	0.08 %	0.08 %	0.10 %	0.12 %	0.12 %	0.12 %	0.11 %	2.0%
14	0.08 %	0.03 %	0.02 %	0.03 %	0.03 %	0.02 %	0.02 %	0.05 %	0.06 %	0.07 %	0.06 %	--
15	0.07 %	0.05 %	0.05 %	0.06 %	0.07 %	0.08 %	0.07 %	0.09 %	0.11 %	0.11 %	0.11 %	--
16	0.07 %	0.03 %	0.02 %	0.02 %	0.02 %	0.02 %	0.03 %	0.04 %	0.06 %	0.07 %	0.06 %	--
17	0.06 %	0.04 %	0.04 %	0.06 %	0.07 %	0.08 %	0.08 %	0.09 %	0.11 %	0.11 %	0.10 %	--
18	0.06 %	0.02 %	0.02 %	0.02 %	0.02 %	0.03 %	0.02 %	0.04 %	0.05 %	0.06 %	0.05 %	--
19	0.06 %	0.03 %	0.04 %	0.06 %	0.07 %	0.08 %	0.08 %	0.09 %	0.09 %	0.09 %	0.09 %	--
20	0.05 %	0.02 %	0.02 %	0.02 %	0.02 %	0.02 %	0.03 %	0.04 %	0.05 %	0.06 %	0.05 %	--
21	0.05 %	0.03 %	0.04 %	0.06 %	0.08 %	0.08 %	0.10 %	0.11 %	0.12 %	0.12 %	0.13 %	--
22	0.05 %	0.02 %	0.02 %	0.02 %	0.02 %	0.02 %	0.02 %	0.04 %	0.04 %	0.05 %	0.04 %	--
23	0.05 %	0.03 %	0.05 %	0.06 %	0.08 %	0.09 %	0.10 %	0.12 %	0.13 %	0.14 %	0.15 %	--
24	0.04 %	0.02 %	0.02 %	0.02 %	0.02 %	0.02 %	0.03 %	0.04 %	0.04 %	0.05 %	0.05 %	--
25	0.04 %	0.03 %	0.04 %	0.05 %	0.06 %	0.07 %	0.08 %	0.10 %	0.11 %	0.11 %	0.12 %	--
26	0.04 %	0.02 %	0.02 %	0.02 %	0.02 %	0.02 %	0.03 %	0.03 %	0.05 %	0.05 %	0.04 %	--
27	0.04 %	0.02 %	0.04 %	0.05 %	0.07 %	0.08 %	0.09 %	0.10 %	0.12 %	0.13 %	0.14 %	--
28	0.04 %	0.02 %	0.02 %	0.02 %	0.03 %	0.03 %	0.03 %	0.04 %	0.04 %	0.05 %	0.04 %	--
29	0.04 %	0.02 %	0.03 %	0.04 %	0.05 %	0.07 %	0.08 %	0.09 %	0.10 %	0.11 %	0.11 %	--
30	0.04 %	0.02 %	0.02 %	0.02 %	0.03 %	0.03 %	0.03 %	0.03 %	0.04 %	0.04 %	0.04 %	--
31	0.04 %	0.02 %	0.03 %	0.04 %	0.04 %	0.05 %	0.06 %	0.07 %	0.09 %	0.10 %	0.10 %	--
32	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.04	0.05	0.04	--

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	%	%	%	%	%	%	%	%	%	%	%	
33	0.04 %	0.02 %	0.02 %	0.03 %	0.04 %	0.05 %	0.06 %	0.07 %	0.09 %	0.10 %	0.12 %	--
34	0.04 %	0.02 %	0.02 %	0.02 %	0.02 %	0.02 %	0.02 %	0.03 %	0.03 %	0.04 %	0.04 %	--
35	0.03 %	0.02 %	0.02 %	0.03 %	0.03 %	0.04 %	0.05 %	0.06 %	0.07 %	0.08 %	0.08 %	--
36	0.03 %	0.02 %	0.02 %	0.02 %	0.02 %	0.02 %	0.02 %	0.03 %	0.03 %	0.04 %	0.04 %	--
37	0.03 %	0.02 %	0.02 %	0.02 %	0.03 %	0.03 %	0.04 %	0.05 %	0.06 %	0.07 %	0.08 %	--
38	0.03 %	0.02 %	0.02 %	0.02 %	0.02 %	0.02 %	0.02 %	0.03 %	0.03 %	0.04 %	0.04 %	--
39	0.03 %	0.02 %	0.02 %	0.02 %	0.03 %	0.03 %	0.03 %	0.05 %	0.06 %	0.07 %	0.07 %	--
40	0.03 %	0.02 %	0.02 %	0.02 %	0.02 %	0.02 %	0.02 %	0.03 %	0.03 %	0.04 %	0.04 %	--
THC/I_{ref}	1.93 %	0.54 %	0.55 %	0.66 %	0.82 %	1.07 %	1.35 %	1.70 %	2.08 %	2.46 %	2.78 %	13%
$PWHC/I_{ref}$	0.24 %	0.12 %	0.14 %	0.19 %	0.23 %	0.26 %	0.28 %	0.34 %	0.40 %	0.43 %	0.43 %	22%
Supplementary information: Harmonics of PGU test according to IEC 61000-3-12; This table is applied to devices with rated current of >16A and ≤75A.												

4.8	**Power quality - TABLE: Harmonics and inter-harmonics& Feed-in of direct currents**										P
iMars XG3KTL-1M											
Phase L-N											
Harmon. Nr.	P/P_{Emax}										Limit
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
1	1.240	1.507	2.742	4.091	5.111	6.426	7.761	9.027	10.417	11.657	12.880	-
2	0.166	0.077	0.087	0.095	0.096	0.103	0.105	0.109	0.107	0.105	0.112	1.08
3	0.348	0.409	0.215	0.030	0.041	0.057	0.052	0.059	0.072	0.085	0.097	2.30
4	0.060	0.045	0.030	0.037	0.038	0.039	0.041	0.049	0.047	0.046	0.048	0.43
5	0.105	0.086	0.184	0.067	0.041	0.046	0.050	0.048	0.054	0.060	0.064	1.14
6	0.043	0.028	0.027	0.022	0.022	0.023	0.023	0.030	0.028	0.028	0.028	0.30
7	0.056	0.052	0.036	0.045	0.025	0.034	0.042	0.043	0.047	0.050	0.052	0.77
8	0.029	0.020	0.021	0.018	0.018	0.019	0.021	0.025	0.024	0.023	0.023	0.23
9	0.039	0.028	0.037	0.027	0.015	0.018	0.021	0.021	0.024	0.027	0.031	0.40
10	0.023	0.014	0.017	0.015	0.013	0.013	0.014	0.020	0.018	0.017	0.016	0.18
11	0.022	0.012	0.021	0.015	0.012	0.010	0.017	0.019	0.023	0.025	0.025	0.33

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12	0.019	0.010	0.012	0.013	0.011	0.011	0.014	0.020	0.019	0.017	0.017	0.15
13	0.017	0.010	0.010	0.011	0.008	0.005	0.011	0.013	0.017	0.020	0.022	0.21
14	0.015	0.007	0.010	0.010	0.009	0.009	0.011	0.015	0.015	0.015	0.014	0.13
15	0.014	0.006	0.007	0.012	0.007	0.004	0.009	0.010	0.013	0.015	0.017	0.15
16	0.013	0.006	0.008	0.008	0.008	0.008	0.009	0.015	0.014	0.013	0.013	0.12
17	0.013	0.007	0.012	0.011	0.010	0.007	0.010	0.013	0.016	0.019	0.020	0.13
18	0.012	0.005	0.007	0.007	0.007	0.006	0.008	0.013	0.013	0.012	0.012	0.10
19	0.012	0.007	0.011	0.009	0.009	0.009	0.011	0.013	0.017	0.019	0.022	0.12
20	0.011	0.005	0.005	0.006	0.006	0.006	0.007	0.013	0.012	0.013	0.012	0.09
21	0.010	0.006	0.006	0.008	0.010	0.011	0.014	0.016	0.019	0.021	0.023	0.11
22	0.009	0.004	0.005	0.005	0.005	0.005	0.005	0.010	0.011	0.011	0.010	0.08
23	0.010	0.006	0.005	0.009	0.010	0.013	0.015	0.016	0.019	0.021	0.024	0.10
24	0.009	0.004	0.004	0.005	0.004	0.005	0.005	0.010	0.012	0.012	0.012	0.08
25	0.009	0.005	0.006	0.007	0.008	0.011	0.013	0.014	0.017	0.019	0.021	0.09
26	0.008	0.004	0.004	0.004	0.004	0.004	0.004	0.008	0.009	0.009	0.009	0.07
27	0.008	0.005	0.007	0.007	0.008	0.011	0.012	0.013	0.015	0.017	0.019	0.08
28	0.007	0.004	0.004	0.004	0.004	0.005	0.004	0.008	0.009	0.010	0.010	0.07
29	0.008	0.005	0.005	0.006	0.007	0.008	0.008	0.009	0.011	0.013	0.015	0.08
30	0.007	0.003	0.003	0.004	0.004	0.004	0.004	0.006	0.007	0.007	0.008	0.06
31	0.008	0.005	0.005	0.005	0.006	0.007	0.007	0.006	0.008	0.010	0.012	0.07
32	0.007	0.003	0.003	0.004	0.004	0.004	0.004	0.005	0.006	0.006	0.007	0.06
33	0.007	0.005	0.005	0.005	0.005	0.004	0.004	0.004	0.005	0.007	0.009	0.07
34	0.006	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.005	0.006	0.006	0.05
35	0.007	0.004	0.005	0.004	0.005	0.004	0.004	0.003	0.004	0.005	0.007	0.06
36	0.006	0.003	0.003	0.003	0.003	0.003	0.004	0.005	0.005	0.005	0.006	0.05
37	0.007	0.004	0.004	0.004	0.003	0.004	0.004	0.003	0.003	0.003	0.004	0.06
38	0.006	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.05
39	0.006	0.004	0.003	0.003	0.003	0.004	0.004	0.003	0.003	0.003	0.004	0.06
40	0.005	0.002	0.002	0.003	0.003	0.003	0.003	0.004	0.004	0.005	0.005	0.05
THD	3.20 %	3.33 %	2.36 %	1.11 %	1.01 %	1.12 %	1.18 %	1.28 %	1.35 %	1.42 %	1.53 %	5%
Supplementary information: Harmonics of PGU test according to IEC 61000-3-2; This table is applied to devices with rated current of ≤16A												

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4.9.3.2 & 4.9.3.3	Undervoltage protection & Overvoltage protection		P
Undervoltage threshold stage 1 [27<] setting value	0.85 Un	disconnect time	100ms
Undervoltage threshold stage 2 [27<<] setting value	0.80 Un	disconnect time	100ms
Overvoltage threshold stage 1 [59>] setting value	1.15 Un	disconnect time	100ms
Overvoltage threshold stage 2 [59>>] setting value	1.2 Un	disconnect time	100ms

		1		2		3	
		Value (V)	Time (ms)	Value (V)	Time (ms)	Value (V)	Time (ms)
L-N voltage	U<	194.5	55.6	194.5	67.0	194.5	55.2
	U<<	184.4	74.8	182.1	58.8	182.1	73.0
	U>	264.5	55.4	264.6	59.6	264.6	68.2
	U>>	276.6	70.0	276.6	60.2	276.6	60.0

Supplementary information: N/A

4.9.3.4	Overvoltage 10 min mean protection	P
Test procedure	a) The voltage is maintained at 100% Un for 600s, afterwards the voltage is raise to 112%, the switch off must be within 600s; b) The voltage is maintained at Un for 600s, afterwards the voltage is raised to 108% . The switch off should not be activated; c) The voltage is maintained at 106% Un for 600s, afterwards the voltage is raised to 114%. The switch off should be within 225s-375s.	

Overvoltage threshold setting value	253 Va.c.

L-N					
a		b		c	
Switch off (Yes/No)	Time (s)	Switch off (Yes/ No)	Time (s)	Switch off (Yes/No)	Time (s)
Yes	582.0	NO	--	Yes	300.1

Supplementary information: N/A

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4.9.3.5 & 4.9.3.6	Underfrequency protection & Overfrequency protectionc	P

underfrequency threshold protection [81<] setting value		47.5 Hz		disconnect time		0.1 s	
underfrequency threshold protection [81<<] setting value		47.0 Hz		disconnect time		0.1 s	
Overfrequency threshold protection [81>] setting value		51.5 Hz		disconnect time		0.1 s	
Overfrequency threshold protection [81>>] setting value		52.0 Hz		disconnect time		0.1 s	
		1		2		3	
		Value (Hz)	Time (ms)	Value (Hz)	Time (ms)	Value (Hz)	Time (ms)
Frequecy	F<	47.5	44.7	47.5	42.2	47.5	39.5
	F<<	47.0	36.3	47.0	40.5	47.0	37.1
	F>	51.5	83.0	51.5	35.8	51.5	96.0
	F>>	52.0	62.6	52.0	75.3	52.0	42.8
underfrequency threshold protection [81<] setting value		47.5 Hz		disconnect time		100 s	
underfrequency threshold protection [81<<] setting value		47.0 Hz		disconnect time		5 s	
Overfrequency threshold protection [81>] setting value		51.5 Hz		disconnect time		100 s	
Overfrequency threshold protection [81>>] setting value		52.0 Hz		disconnect time		5 s	
		1		2		3	
		Value (Hz)	Time (s)	Value (Hz)	Time (s)	Value (Hz)	Time (s)
Frequecy	F<	47.5	99.6	47.5	99.6	47.5	99.8
	F<<	47.0	4.2	47.0	4.3	47.0	4.3
	F>	51.5	97.0	51.5	97.0	51.5	96.5
	F>>	52.0	4.8	52.0	4.8	52.0	4.8
Supplementary information: N/A							

4.9.4.2	Active methods tested with a resonant circuit	P

No.	P_{EUT} (% of EUT rating)	Reactive Load (% of Q_L)	P_{AC} (% of nominal)	Q_{AC} (% of nominal)	Run on time (ms)	P_{EUT} (kW)	Actual Q_f	V_{DC} (V)	Remars
1	100	100	0	0	521	10	1.002	460	Test A at BL
2	66	66	0	0	310	6.5	1.016	380	Test B at BL
3	33	33	0	0	218	3.3	1.018	310	Test C at BL
4	100	100	-5	-5	334	10	1.027	460	Test A at IB
5	100	100	-5	0	313	10	1.049	460	Test A at IB

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6	100	100	-5	5	265	10	1.074	460	Test A at IB
7	100	100	0	-5	314	10	0.983	460	Test A at IB
8	100	100	0	5	291	10	1.026	460	Test A at IB
9	100	100	5	-5	303	10	0.942	460	Test A at IB
10	100	100	5	0	328	10	0.971	460	Test A at IB
11	100	100	5	5	401	10	0.992	460	Test B at IB
12	100	100	-10	10					Test A at IB
13	100	100	-5	10					Test A at IB
14	100	100	0	10					Test A at IB
15	100	100	5	10					Test A at IB
16	100	100	10	10					Test A at IB
17	100	100	-10	5					Test A at IB
18	100	100	10	5					Test A at IB
19	100	100	-10	0					Test A at IB
20	100	100	10	0					Test A at IB
21	100	100	-10	-5					Test A at IB
22	100	100	10	-5					Test A at IB
23	100	100	-10	-10					Test A at IB
24	100	100	-5	-10					Test A at IB
25	100	100	0	-10					Test A at IB
26	100	100	5	-10					Test A at IB
27	100	100	10	-10					Test A at IB
28	66	66	0	-5	214	6.5	0.978	380	Test B at IB
29	66	66	0	-4	223	6.5	0.991	380	Test B at IB
30	66	66	0	-3	213	6.5	0.993	380	Test B at IB
31	66	66	0	-2	217	6.5	0.998	380	Test B at IB
32	66	66	0	-1	206	6.5	0.999	380	Test B at IB
33	66	66	0	1	227	6.5	1.009	380	Test B at IB
34	66	66	0	2	202	6.5	1.002	380	Test B at IB
35	66	66	0	3	264	6.5	1.021	380	Test B at IB
36	66	66	0	4	260	6.5	1.027	380	Test B at IB
37	66	66	0	5	232	6.5	1.024	380	Test B at IB
38	33	33	0	-5	140	3.3	0.981	310	Test C at IB

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39	33	33	0	-4	152	3.3	0.987	310	Test C at IB
40	33	33	0	-3	148	3.3	0.991	310	Test C at IB
41	33	33	0	-2	178	3.3	0.993	310	Test C at IB
42	33	33	0	-1	154	3.3	0.993	310	Test C at IB
43	33	33	0	1	204	3.3	1.012	310	Test C at IB
44	33	33	0	2	137	3.3	1.001	310	Test C at IB
45	33	33	0	3	126	3.3	1.019	310	Test C at IB
46	33	33	0	4	208	3.3	1.022	310	Test C at IB
47	33	33	0	5	174	3.3	1.026	310	Test C at IB
Supplementary information: N/A									

4.10.2 & 4.10.3	**Automatic reconnection after tripping & Starting to generate electrical power**	P
Test procedure	Inverter DC input power is set to 100% of maximum active output power till the end of the test. P_M = 10000W, 10% P_{Emax}= 1000W 1) Set the frequency to 49.45Hz, then step to 49.55Hz; 2) Set the frequency to 50.25Hz, then step to 50.15Hz; 3) Set the voltage to 83%Un, then step to 85%Un; 4) Set the voltage to 112%Un, then step to 110%Un;	

Automatic reconnection after tripping

Test 1)
After tripping, set the reconnect frequency to 49.45Hz, then step to 49.55Hz; default observation time setting is 60s

Test sequence	Freq (Hz)	Time stay in step (min.)	Whether reconnect to main and the active power generated? (Yes/No)
1.	49.45	0.5 min	No
2.	49.45	1.0 min	No
3.	49.45	1.5 min	No
4.	49.45	2.0 min	No

Test sequence	Freq (Hz)	Time after reach 49.55 Hz (min.)	Measured charge rate $P_{Measured}$ (W)	Arised charge rate ΔP during next 1 minute (W)	Deviation within 10% P_n (Yes/No)
5.	49.55	0.0 min	--	Reconnection time (s)	73
6.	49.55	0.0 min	0.00	947.47	Yes
7.	49.55	0.5 min	842.73	302.04	Yes
8.	49.55	1.0 min	947.47	620.73	Yes
9.	49.55	1.5 min	1144.77	838.37	Yes
10.	49.55	2.0 min	1568.20	841.77	Yes

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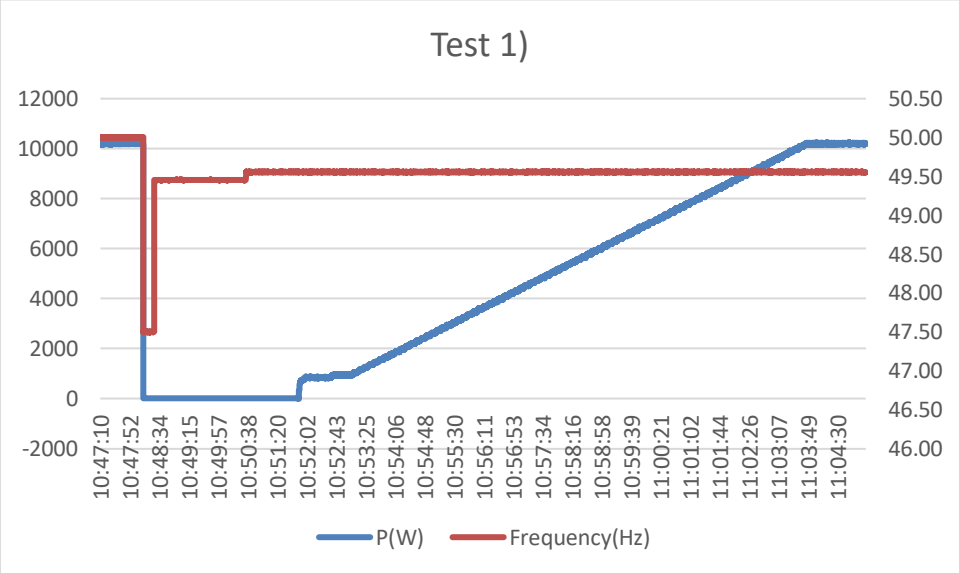
11.	49.55	2.5 min	1983.14	864.59	Yes
12.	49.55	3.0 min	2409.98	879.72	Yes
13.	49.55	3.5 min	2847.72	880.59	Yes
14.	49.55	4.0 min	3289.70	887.26	Yes
15.	49.55	4.5 min	3728.31	882.04	Yes
16.	49.55	5.0 min	4176.95	859.09	Yes
17.	49.55	5.5 min	4610.35	848.57	Yes
18.	49.55	6.0 min	5036.04	849.82	Yes
19.	49.55	6.5 min	5458.92	847.24	Yes
20.	49.55	7.0 min	5885.86	841.26	Yes
21.	49.55	7.5 min	6306.17	853.02	Yes
22.	49.55	8.0 min	6727.12	872.57	Yes
23.	49.55	8.5 min	7159.19	881.61	Yes
24.	49.55	9.0 min	7599.69	887.51	Yes
25.	49.55	9.5 min	8040.80	878.92	Yes
26.	49.55	10.0 min	8487.20	854.63	Yes
27.	49.55	10.5 min	8919.72	848.43	Yes
28.	49.55	11.0 min	9341.83	844.65	Yes
29.	49.55	11.5 min	9768.16	422.86	Yes
30.	49.55	12.0 min	10186.48	3.93	Yes



Test 2)

After tripping, set the reconnect frequency to 50.25Hz, then step to 50.15Hz; default observation time setting is 60s

Test sequence	Freq (Hz)	Time stay in step (min.)	Whether reconnect to main and the active power generated? (Yes/No)

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1.	50.25	0.5 min	No		
2.	50.25	1.0 min	No		
3.	50.25	1.5 min	No		
4.	50.25	2.0 min	No		
Test sequence	Freq (Hz)	Time after reach 50.15 Hz (min.)	Measured charge rate $P_{Measured}$ (W)	Arised charge rate ΔP during next 1 minute (W)	Deviation within 10% P_n (Yes/No)
5.	50.15	0.0 min	--	Reconnection time (s)	76
6.	50.15	0.0 min	0.00	943.12	Yes
7.	50.15	0.5 min	843.13	254.97	Yes
8.	50.15	1.0 min	943.12	605.04	Yes
9.	50.15	1.5 min	1098.10	873.35	Yes
10.	50.15	2.0 min	1548.16	855.84	Yes
11.	50.15	2.5 min	1971.45	859.22	Yes
12.	50.15	3.0 min	2404.00	845.96	Yes
13.	50.15	3.5 min	2830.67	841.50	Yes
14.	50.15	4.0 min	3249.96	848.09	Yes
15.	50.15	4.5 min	3672.18	853.45	Yes
16.	50.15	5.0 min	4098.05	847.41	Yes
17.	50.15	5.5 min	4525.63	885.24	Yes
18.	50.15	6.0 min	4945.45	906.24	Yes
19.	50.15	6.5 min	5410.86	878.92	Yes
20.	50.15	7.0 min	5851.69	857.23	Yes
21.	50.15	7.5 min	6289.78	852.81	Yes
22.	50.15	8.0 min	6708.92	847.77	Yes
23.	50.15	8.5 min	7142.59	834.29	Yes
24.	50.15	9.0 min	7556.69	848.68	Yes
25.	50.15	9.5 min	7976.88	842.50	Yes
26.	50.15	10.0 min	8405.37	861.98	Yes
27.	50.15	10.5 min	8819.38	898.20	Yes
28.	50.15	11.0 min	9267.35	883.45	Yes
29.	50.15	11.5 min	9717.58	472.43	Yes
30.	50.15	12.0 min	10150.80	33.03	Yes

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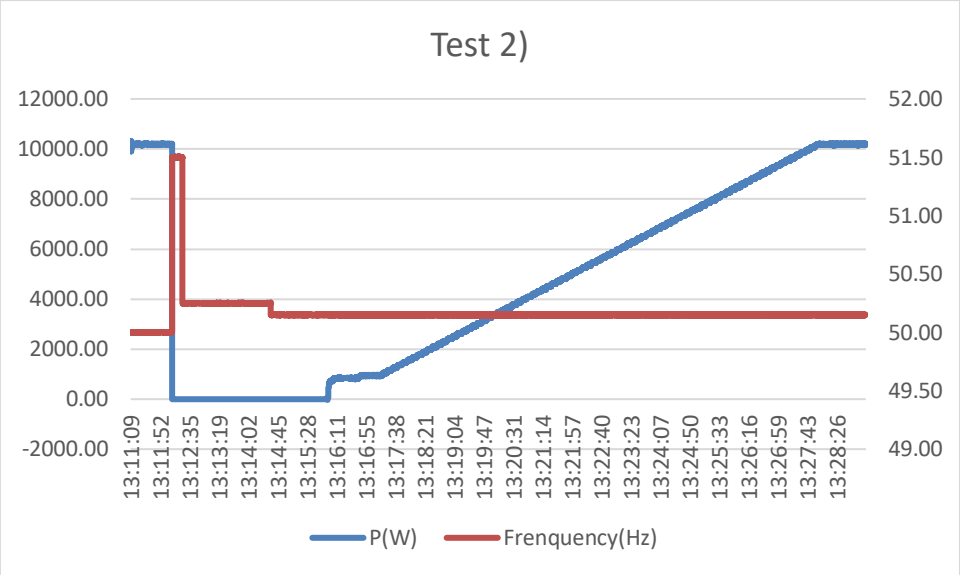

Test 3)

Ater tripping, set the reconnect voltage to 84%Un, then step to 86%Un; default observation time setting is 60s

Test sequence	Vol. (V)	Time stay in step (min.)	Whether reconnect to main and the active power generated? (Yes/No)		
1.	84%Un	0.5 min	No		
2.	84%Un	1.0 min	No		
3.	84%Un	1.5 min	No		
4.	84%Un	2.0 min	No		
Test sequence	Freq (Hz)	Time after reach 86%Un (min.)	Measured charge rate $P_{Measured}$ (W)	Arised charge rate ΔP during next 1 minute (W)	Deviation within 10% P_n (Yes/No)
5.	86%Un	0.0 min	--	Reconnection time (s)	72
6.	86%Un	0.0 min	0.00	962.40	Yes
7.	86%Un	0.5 min	848.99	377.45	Yes
8.	86%Un	1.0 min	962.40	707.16	Yes
9.	86%Un	1.5 min	1226.44	868.18	Yes
10.	86%Un	2.0 min	1669.56	847.71	Yes
11.	86%Un	2.5 min	2094.63	846.47	Yes
12.	86%Un	3.0 min	2517.28	846.84	Yes
13.	86%Un	3.5 min	2941.10	845.93	Yes
14.	86%Un	4.0 min	3364.12	852.99	Yes
15.	86%Un	4.5 min	3787.02	857.10	Yes
16.	86%Un	5.0 min	4217.11	864.84	Yes
17.	86%Un	5.5 min	4644.12	898.74	Yes

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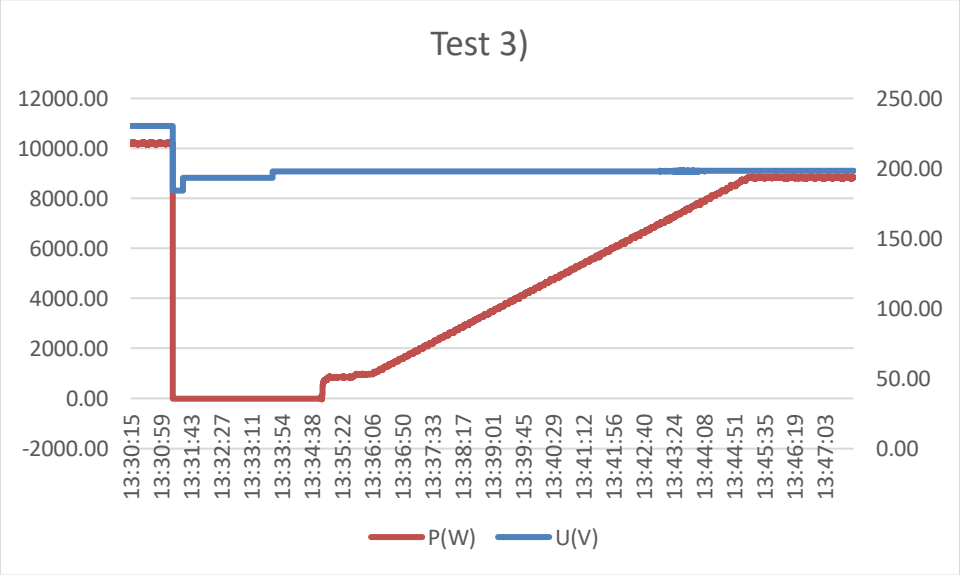
18.	86%Un	6.0 min	5081.95	887.63	Yes
19.	86%Un	6.5 min	5542.87	867.99	Yes
20.	86%Un	7.0 min	5969.58	860.95	Yes
21.	86%Un	7.5 min	6410.85	844.01	Yes
22.	86%Un	8.0 min	6830.53	856.55	Yes
23.	86%Un	8.5 min	7254.86	847.22	Yes
24.	86%Un	9.0 min	7687.08	807.39	Yes
25.	86%Un	9.5 min	8102.08	713.80	Yes
26.	86%Un	10.0 min	8494.47	352.02	Yes
27.	86%Un	10.5 min	8815.89	8.78	Yes
28.	86%Un	11.0 min	8846.49	-17.89	Yes
29.	86%Un	11.5 min	8824.66	18.22	Yes
30.	86%Un	12.0 min	8828.60	4.64	Yes



Test 4)

After tripping, set the reconnect voltage to 111%Un, then step to 109%Un; default observation time setting is 60s

Test sequence	Vol. (V)	Time stay in step (min.)	Whether reconnect to main and the active power generated? (Yes/No)
1.	111%Un	0.5 min	No
2.	111%Un	1.0 min	No
3.	111%Un	1.5 min	No
4.	111%Un	2.0 min	No

Test sequence	Freq (Hz)	Time after reach 109%Un (min.)	Measured charge rate $P_{Measured}$ (W)	Arised charge rate ΔP during next 1 minute (W)	Deviation within 10% P_n (Yes/No)

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5.	109%Un	0.0 min	--	Reconnection time (s)	73
6.	109%Un	0.0 min	0.00	950.33	Yes
7.	109%Un	0.5 min	842.42	323.69	Yes
8.	109%Un	1.0 min	950.33	651.26	Yes
9.	109%Un	1.5 min	1166.11	889.94	Yes
10.	109%Un	2.0 min	1601.59	899.63	Yes
11.	109%Un	2.5 min	2056.06	870.52	Yes
12.	109%Un	3.0 min	2501.22	860.71	Yes
13.	109%Un	3.5 min	2926.57	855.56	Yes
14.	109%Un	4.0 min	3361.93	842.35	Yes
15.	109%Un	4.5 min	3782.13	843.22	Yes
16.	109%Un	5.0 min	4204.28	849.00	Yes
17.	109%Un	5.5 min	4625.35	863.82	Yes
18.	109%Un	6.0 min	5053.28	877.95	Yes
19.	109%Un	6.5 min	5489.18	895.98	Yes
20.	109%Un	7.0 min	5931.23	889.29	Yes
21.	109%Un	7.5 min	6385.16	858.42	Yes
22.	109%Un	8.0 min	6820.52	844.68	Yes
23.	109%Un	8.5 min	7243.58	850.88	Yes
24.	109%Un	9.0 min	7665.20	849.20	Yes
25.	109%Un	9.5 min	8094.46	852.54	Yes
26.	109%Un	10.0 min	8514.40	868.52	Yes
27.	109%Un	10.5 min	8947.01	837.73	Yes
28.	109%Un	11.0 min	9382.92	805.10	Yes
29.	109%Un	11.5 min	9784.74	421.95	Yes
30.	109%Un	12.0 min	10188.02	-9.49	Yes

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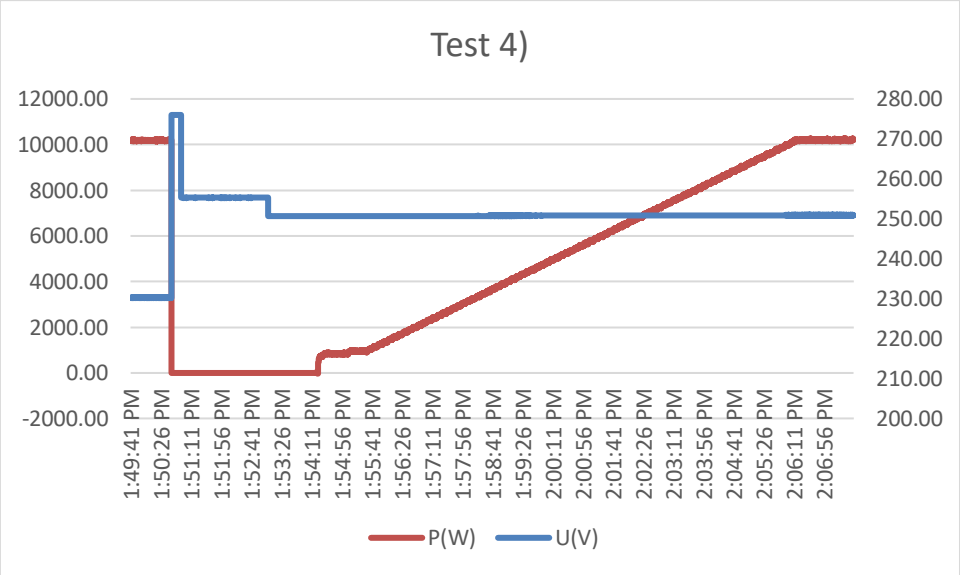

Starting to generate electrical power

Test 1)
Set the start frequency to 49.45Hz, then step to 49.55Hz; default observation time setting is 60s

Test sequence	Freq (Hz)	Time stay in step (min.)	Whether reconnect to main and the active power generated? (Yes/No)
31.	49.45	0.5 min	No
32.	49.45	1.0 min	No
33.	49.45	1.5 min	No
34.	49.45	2.0 min	No

Test sequence	Freq (Hz)	Time after reach 49.55 Hz (min.)	Measured charge rate $P_{Measured}$ (W)	Arised charge rate ΔP during next 1 minute (W)	Deviation within 10% P_n (Yes/No)
35.	49.55	0.0 min	--	Reconnection time (s)	68
36.	49.55	0.0 min	0.00	944.25	Yes
37.	49.55	0.5 min	839.82	413.80	Yes
38.	49.55	1.0 min	944.25	729.95	Yes
39.	49.55	1.5 min	1253.62	840.27	Yes
40.	49.55	2.0 min	1674.20	841.45	Yes
41.	49.55	2.5 min	2093.89	852.55	Yes
42.	49.55	3.0 min	2515.64	874.94	Yes
43.	49.55	3.5 min	2946.43	887.19	Yes
44.	49.55	4.0 min	3390.58	890.22	Yes
45.	49.55	4.5 min	3833.62	881.67	Yes
46.	49.55	5.0 min	4280.81	855.64	Yes

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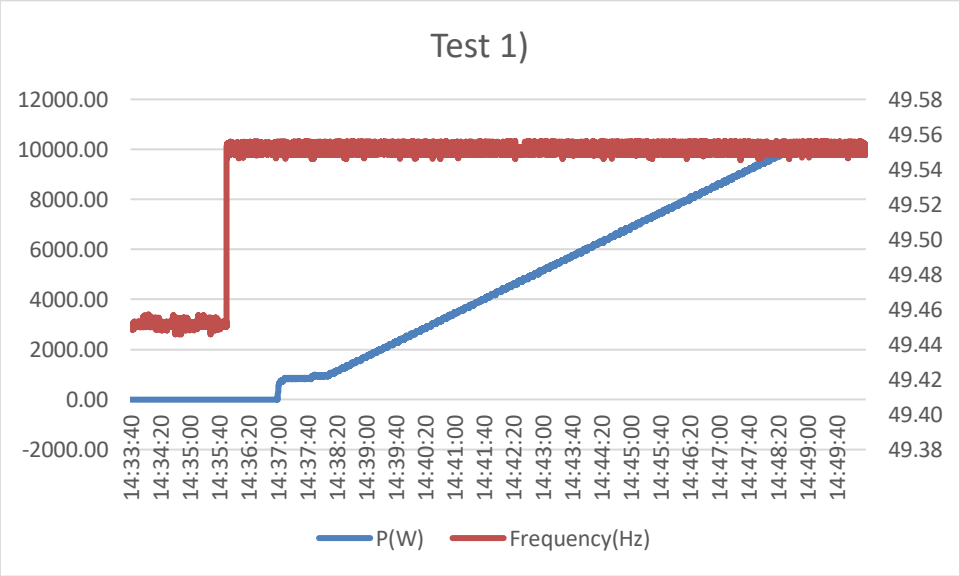
47.	49.55	5.5 min	4715.29	844.81	Yes
48.	49.55	6.0 min	5136.45	844.22	Yes
49.	49.55	6.5 min	5560.10	846.39	Yes
50.	49.55	7.0 min	5980.66	848.98	Yes
51.	49.55	7.5 min	6406.49	856.21	Yes
52.	49.55	8.0 min	6829.65	870.15	Yes
53.	49.55	8.5 min	7262.70	883.87	Yes
54.	49.55	9.0 min	7699.80	887.23	Yes
55.	49.55	9.5 min	8146.57	872.98	Yes
56.	49.55	10.0 min	8587.03	854.15	Yes
57.	49.55	10.5 min	9019.55	844.70	Yes
58.	49.55	11.0 min	9441.18	744.11	Yes
59.	49.55	11.5 min	9864.26	322.56	Yes
60.	49.55	12.0 min	10185.28	3.02	Yes



Test 2)

Set the start frequency to 50.15Hz, then step to 50.05Hz; default observation time setting is 60s

Test sequence	Freq (Hz)	Time stay in step (min.)	Whether reconnect to main and the active power generated? (Yes/No)		
31.	50.15	0.5 min	No		
32.	50.15	1.0 min	No		
33.	50.15	1.5 min	No		
34.	50.15	2.0 min	No		
Test sequence	Freq (Hz)	Time after reach 50.05 Hz (min.)	Measured charge rate $P_{Measured}$ (W)	Arised charge rate ΔP during next 1 minute (W)	Deviation within 10% P_n (Yes/No)

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35.	50.05	0.0 min	--	Reconnection time (s)	71
36.	50.05	0.0 min	0.00	962.80	Yes
37.	50.05	0.5 min	858.4743	408.13	Yes
38.	50.05	1.0 min	962.7969	720.26	Yes
39.	50.05	1.5 min	1266.604	834.75	Yes
40.	50.05	2.0 min	1683.058	831.07	Yes
41.	50.05	2.5 min	2101.352	833.46	Yes
42.	50.05	3.0 min	2514.13	852.34	Yes
43.	50.05	3.5 min	2934.813	867.40	Yes
44.	50.05	4.0 min	3366.471	871.08	Yes
45.	50.05	4.5 min	3802.214	876.28	Yes
46.	50.05	5.0 min	4237.553	867.37	Yes
47.	50.05	5.5 min	4678.499	843.61	Yes
48.	50.05	6.0 min	5104.92	833.55	Yes
49.	50.05	6.5 min	5522.113	833.95	Yes
50.	50.05	7.0 min	5938.472	835.29	Yes
51.	50.05	7.5 min	6356.063	832.31	Yes
52.	50.05	8.0 min	6773.757	843.65	Yes
53.	50.05	8.5 min	7188.373	860.22	Yes
54.	50.05	9.0 min	7617.412	870.62	Yes
55.	50.05	9.5 min	8048.597	872.24	Yes
56.	50.05	10.0 min	8488.032	856.91	Yes
57.	50.05	10.5 min	8920.838	842.49	Yes
58.	50.05	11.0 min	9344.942	734.28	Yes
59.	50.05	11.5 min	9763.331	315.67	Yes
60.	50.05	12.0 min	10079.22	6.82	Yes

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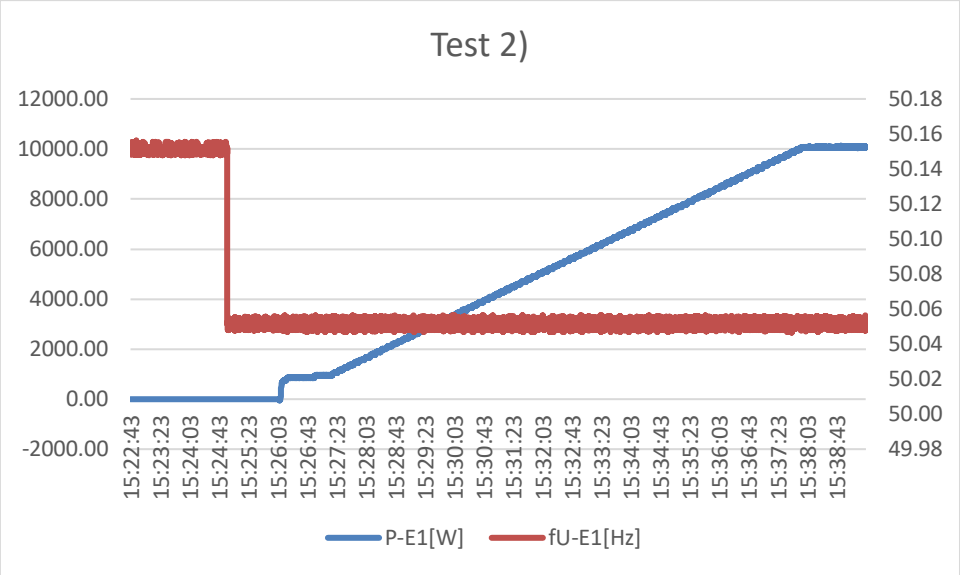

Test 3)
Set the start voltage to 84%Un, then step to 86%Un; default observation time setting is 60s

Test sequence	Vol. (V)	Time stay in step (min.)	Whether reconnect to main and the active power generated? (Yes/No)		
31.	84%Un	0.5 min	No		
32.	84%Un	1.0 min	No		
33.	84%Un	1.5 min	No		
34.	84%Un	2.0 min	No		
Test sequence	Freq (Hz)	Time after reach 86%Un (min.)	Measured charge rate $P_{Measured}$ (W)	Arised charge rate ΔP during next 1 minute (W)	Deviation within 10% P_n (Yes/No)
35.	86%Un	0.0 min	--	Reconnection time (s)	68
36.	86%Un	0.0 min	0.00	960.52	Yes
37.	86%Un	0.5 min	857.0825	410.85	Yes
38.	86%Un	1.0 min	960.5228	735.10	Yes
39.	86%Un	1.5 min	1267.934	855.88	Yes
40.	86%Un	2.0 min	1695.624	874.01	Yes
41.	86%Un	2.5 min	2123.81	884.07	Yes
42.	86%Un	3.0 min	2569.631	868.41	Yes
43.	86%Un	3.5 min	3007.882	848.00	Yes
44.	86%Un	4.0 min	3438.039	838.27	Yes
45.	86%Un	4.5 min	3855.882	838.48	Yes
46.	86%Un	5.0 min	4276.307	825.85	Yes
47.	86%Un	5.5 min	4694.36	826.27	Yes
48.	86%Un	6.0 min	5102.155	857.48	Yes

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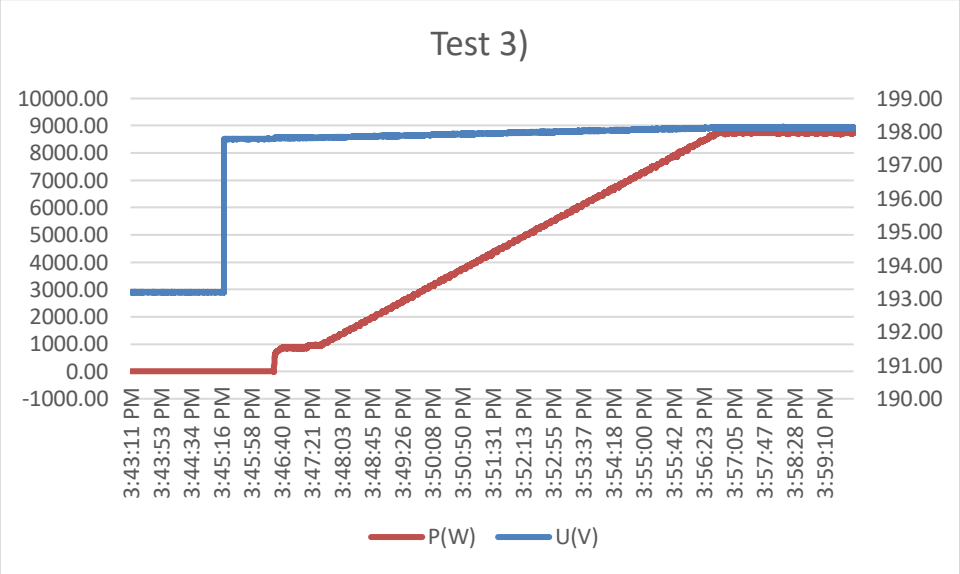
49.	86%Un	6.5 min	5520.631	870.22	Yes
50.	86%Un	7.0 min	5959.633	858.67	Yes
51.	86%Un	7.5 min	6390.848	867.86	Yes
52.	86%Un	8.0 min	6818.3	874.07	Yes
53.	86%Un	8.5 min	7258.71	834.23	Yes
54.	86%Un	9.0 min	7692.37	804.22	Yes
55.	86%Un	9.5 min	8092.936	633.05	Yes
56.	86%Un	10.0 min	8496.59	231.00	Yes
57.	86%Un	10.5 min	8725.991	5.95	Yes
58.	86%Un	11.0 min	8727.592	23.28	Yes
59.	86%Un	11.5 min	8731.942	-6.84	Yes
60.	86%Un	12.0 min	8750.873	-23.09	Yes



Test 4)

Set the start voltage to 111%Un, then step to 109%Un; default observation time setting is 60s

Test sequence	Vol. (V)	Time stay in step (min.)	Whether reconnect to main and the active power generated? (Yes/No)		
31.	111%Un	0.5 min	No		
32.	111%Un	1.0 min	No		
33.	111%Un	1.5 min	No		
34.	111%Un	2.0 min	No		
Test sequence	Freq (Hz)	Time after reach 109%Un (min.)	Measured charge rate $P_{Measured}$ (W)	Arised charge rate ΔP during next 1 minute (W)	Deviation within 10% P_n (Yes/No)
35.	109%Un	0.0 min	--	Reconnection time (s)	68
36.	109%Un	0.0 min	0.00	961.38	Yes

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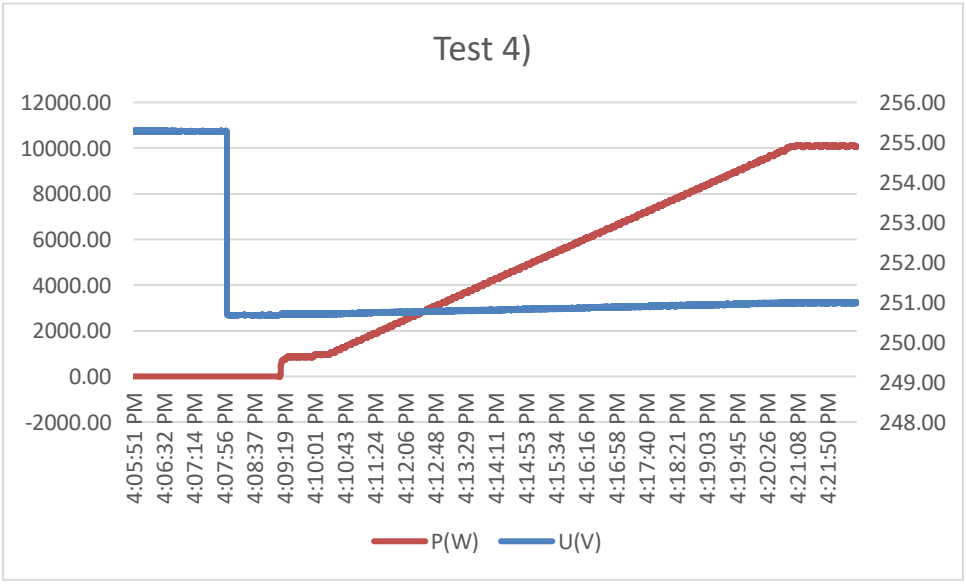
37.	109%Un	0.5 min	852.3143	423.61	Yes
38.	109%Un	1.0 min	961.3803	728.42	Yes
39.	109%Un	1.5 min	1275.928	838.30	Yes
40.	109%Un	2.0 min	1689.801	860.48	Yes
41.	109%Un	2.5 min	2114.229	874.85	Yes
42.	109%Un	3.0 min	2550.28	880.34	Yes
43.	109%Un	3.5 min	2989.08	868.77	Yes
44.	109%Un	4.0 min	3430.621	852.17	Yes
45.	109%Un	4.5 min	3857.852	846.96	Yes
46.	109%Un	5.0 min	4282.79	842.55	Yes
47.	109%Un	5.5 min	4704.807	836.21	Yes
48.	109%Un	6.0 min	5125.345	833.00	Yes
49.	109%Un	6.5 min	5541.017	837.13	Yes
50.	109%Un	7.0 min	5958.345	842.03	Yes
51.	109%Un	7.5 min	6378.142	859.11	Yes
52.	109%Un	8.0 min	6800.377	882.73	Yes
53.	109%Un	8.5 min	7237.254	869.61	Yes
54.	109%Un	9.0 min	7683.11	855.53	Yes
55.	109%Un	9.5 min	8106.863	838.76	Yes
56.	109%Un	10.0 min	8538.639	811.69	Yes
57.	109%Un	10.5 min	8945.621	848.20	Yes
58.	109%Un	11.0 min	9350.329	762.61	Yes
59.	109%Un	11.5 min	9793.818	296.18	Yes
60.	109%Un	12.0 min	10112.94	6.11	Yes



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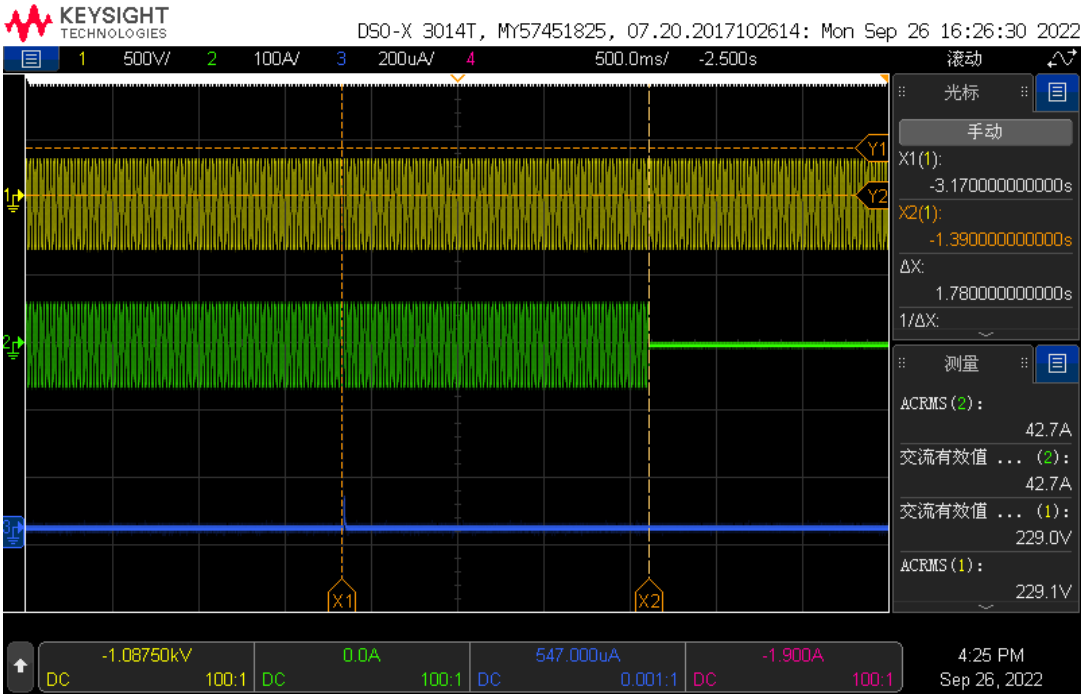
Supplementary information: N/A

4.11.1	Ceasing active power	P
Logic interface provided?	Yes	
Ceasing active power response time(s)	1.78s	
stop the generation of active power time(s)	1.78s	

Ceasing active power log:
(with control signal and power/current curve)



4.11.2	Reduction of active power on set point									P
P/P_{Emax} (%)	100	90	80	70	60	50	40	30	20	10
Setting value	10000	9000	8000	7000	6000	5000	4000	3000	2000	1000
Measured value	10124	9084	8036	7002	6136	5102	4063	3016	2020	1077
Deviation	1.24%	0.84%	0.36%	0.02%	1.36%	1.02%	0.63%	0.16%	0.20%	0.77%

Maximum active power gradient (0.66% Pn inst (or P controllable) per second)	
Sample test from 100% P_n to 5% P_n, settling time [s], (see the graphic below):	144
Sample test from 5% P_n to 100% P_n, settling time [s], (see the graphic below):	144
Sample test from 100% P_n to 5% P_n Gradient [%/s], (see the graphic below):	0.66%
Sample test from 5% P_n to 100% P_n Gradient [%/s], (see the graphic below):	0.66%

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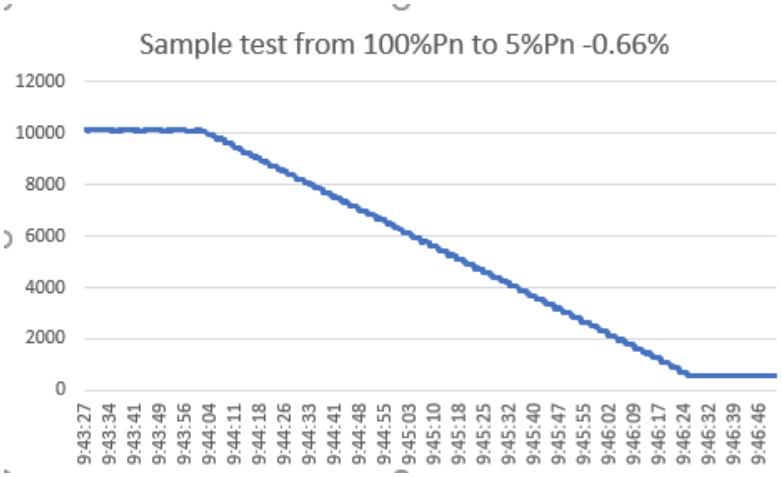
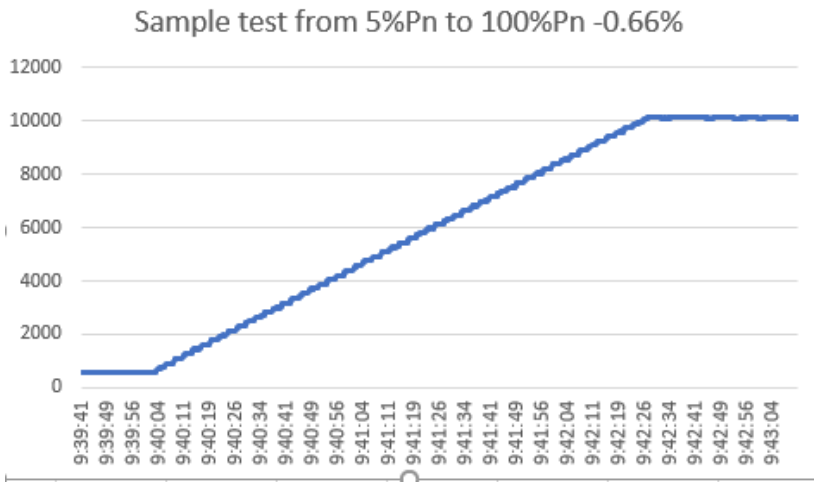
Minimum active power gradient(0.33% Pn inst (or P controllable) per second)	
Sample test from 100% P_n to 5% P_n, settling time [s], (see the graphic below):	288
Sample test from 5% P_n to 100% P_n, settling time [s], (see the graphic below):	288
Sample test from 100% P_n to 5% P_n Gradient [%/s], (see the graphic below):	0.33%
Sample test from 5% P_n to 100% P_n Gradient [%/s], (see the graphic below):	0.33%

Graphic of change setpoint from 100% Pn to 5% Pn curve with 0.66%/s power gradient



Graphic of change setpoint from 5% Pn to 100% Pn curve with 0.66%/s power gradient



Graphic of change setpoint from 100% Pn to 5% Pn curve with 0.33%/s power gradient

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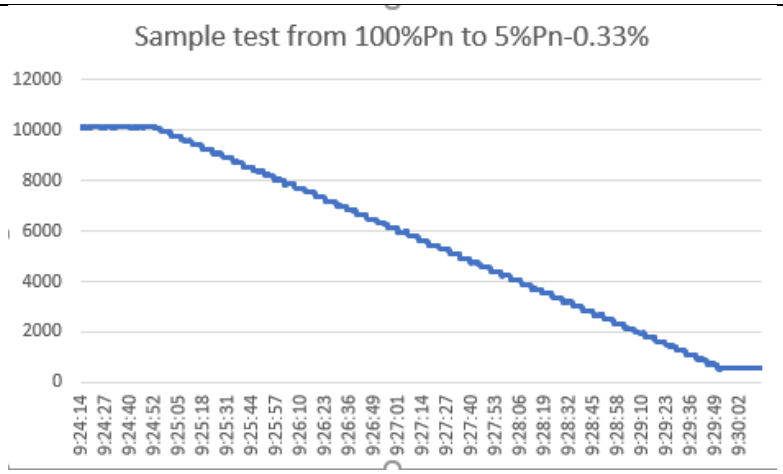
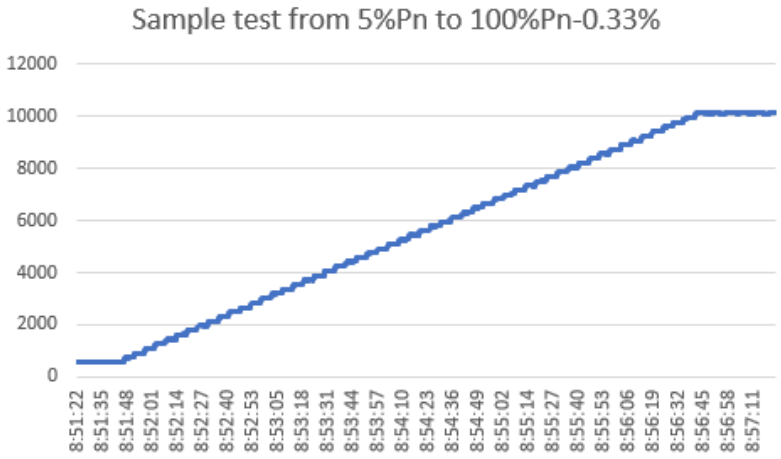


Graphic of change setpoint from 5% Pn to 100% Pn curve with 0.33%/s power gradient



During the active power regulation, the PGU disconnect from the grid or not?	No disconnection	
	Disconnection power level	/
Supplementary information: N/A		

. ……End of test report……..……..

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