

Test Report No.: TWR2204001 001

Page 1 of 1

Applicant: Shenzhen Hopewind Technology Co., Ltd.
A1 Area of Building 6, Jinhaoyuan, No. 1 of Yanshan Avenue, Yanchuan
Community, Songgang Sub-district, Baoan District, Shenzhen,
Guangdong Province, China

Factory: Suzhou Hopewind Electric Co., LTD

Order No.: Q061887 **Date of receipt:** 01st 04.2022

Device under PV Grid-interactive Inverter

Test:

Model No.: hopeSun 100KTL, hopeSun 110KTL, hopeSun 125KTL-M,
hopeSun 136KTL-M

Serial No.: Engineering Sample of hopeSun 136KTL-M

Place of Testing: Dongguan BALUN Testing Technology Co., Ltd.
Room 104, 204, 205, Building 1, No. 6, Industrial South Road,
Songshan Lake District, Dongguan, Guangdong Province, P. R. China
523808

Test Specification: EN IEC 61000-6-2: 2019, EN IEC 61000-6-4: 2019,
EN IEC 61000-3-11:2019, EN 61000-3-12:2011

Technical Administrator:

Evelyn Hu



Reviewer:

George Shih



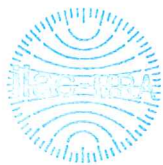
Date: 06th .04.2022 Signature:

Date: 06th .04.2022 Signature

Remark notes:

This report consists of 1 page of cover page and 1 Test Report from Dongguan BALUN Testing Technology Co., Ltd. (Report No. : BL-DG2220385-401)

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TEST REPORT

Applicant: Shenzhen Hopewind Technology Co., Ltd

Address: A1 Area of Building 6, Jinhaoyuan, No.1 of Yanshan Avenue, Yanchuan Community, Songgang Sub-district, Baoan District, Shenzhen, Guangdong Province China

EUT Name: PV Grid-interactive Inverter

Model Name: hopeSun 100KTL, hopeSun 110KTL, hopeSun 125KTL-M, hopeSun 136KTL-M

Brand Name:  **Hopewind**

Test Standard: EN IEC 61000-6-2:2019,
EN IEC 61000-6-4:2019,
EN IEC 61000-3-11:2019,
EN 61000-3-12:2011

Test Date: Feb. 24, 2022 - Mar. 14, 2022

Date of Issue: Mar. 29, 2022

ISSUED BY:

Dongguan BALUN Testing Technology Co., Ltd.

Tested by: Yongqing Chen **Checked by:** Tao Zheng

Yongqing Chen

Tao Zheng



Approved by: Simon Qi

Revision History

Version	Issue Date	Revisions Content
<u>Rev. 01</u>	<u>Mar. 29, 2022</u>	<u>Initial Issue</u>

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1. GENERAL INFORMATION

1.1. Identification of the Testing Laboratory

Company Name	Dongguan BALUN Testing Technology Co., Ltd.
Address	Room 104, 204, 205, Building 1, No. 6, Industrial South Road, Songshan Lake District, Dongguan, Guangdong Province, P. R. China 523808
Phone Number	+86 755 6685 0100

1.2. Identification of the Responsible Testing Location

Test Location	Dongguan BALUN Testing Technology Co., Ltd.
Address	Room 104, 204, 205, Building 1, No. 6, Industrial South Road, Songshan Lake District, Dongguan, Guangdong Province, P. R. China 523808
Description	All measurement facilities used to collect the measurement data are located at Room 104, 204, 205, Building 1, No. 6, Industrial South Road, Songshan Lake District, Dongguan, Guangdong Province, P. R. China 523808

2. PRODUCT INFORMATION

2.1. Applicant Information

Applicant	Shenzhen Hopewind Technology Co., Ltd
Address	A1 Area of Building 6, Jinhaoyuan, No.1 of Yanshan Avenue, Yanchuan Community, Songgang Sub-district, Baoan District, Shenzhen, Guangdong Province China

2.2. Manufacturer Information

Manufacturer	Shenzhen Hopewind Technology Co., Ltd
Address	A1 Area of Building 6, Jinhaoyuan, No.1 of Yanshan Avenue, Yanchuan Community, Songgang Sub-district, Baoan District, Shenzhen, Guangdong Province China

2.3. Factory Information

Factory	Suzhou Hopewind Electric Co., LTD
Address	555 Songjia Road, wusongjiang science and Technology Industrial Park, wuzhong Economic Development Zone, Suzhou, Jiangsu Province, China

2.4. General Description for Equipment under Test (EUT)

EUT Name	PV Grid-interactive Inverter
Mode Name Under Test	hopeSun 136KTL-M
Series Model Name	hopeSun 100KTL, hopeSun 110KTL, hopeSun 125KTL-M, hopeSun 136KTL-M
Description of Model name differentiation	The variants models have the same appearance, topology, PCB board and software. The output power and input power are different which controlled by software.
Hardware Version	PCB: hopeSunC4_PCB_A, hopeSunF7_PCB_A, hopeSunHVB2_PCB_B, hopeSunME_PCB_A, hopeSunP7_PCB_A, hopeSunWP_PCB_A, hopeSunWQ_PCB_A
Software Version	FPGA:108.000.000 Host: 004.013.020 Grid side:106.008.000 Rotor: 59.006.000

Parameters Table:

	Model	hopeSun 100KTL	hopeSun 110KTL	hopeSun 125KTL-M	hopeSun 136KTL-M
Input parameters	Maximum input voltage	1100V			
	Minimum working voltage	200V			
	Working voltage range	200V~1000V			
	MPPT full load working voltage range	550V~850V		600V~850V	
	Rated input voltage	600V		720V	
	Maximum input current per MPPT	65A (13*5)			
	Maximum short circuit current per MPPT	100A (20*5)			
	Maximum input path	20			
	Number of MPPT	4			
Output parameters	Rated output power	100kW	110kW	125kW	136kW
	Maximum output apparent power	110kVA	121kVA	137.5kVA	150kVA
	Maximum active power	110kW	121kW	137.5kW	150kW
	Rated output voltage	3*230/400V 3W+N+PE		3*288V/500V 3W+PE	3*300V/520V 3W+PE
	Output voltage range	300V~480V		375V~600V	
	Rated output frequency	50Hz/60Hz			
	Rated output current	144.4A	158.8A	144.4A	157.0A
	Maximum output current	158.8A	174.6A	158.8A	174.6A
	Power factor	-0.9~+0.9			
Display and communication	Display	LED instructions			
	RS485 communication	Supported			
Conventional parameters	Dimensions (width * height * depth)	880*660*330mm			
	Weight	<89kg			
	Working temperature	-40°C~+60°C			
	Maximum working altitude	4000m			
	Noise index	<70dB			
	Cooling mode	Intelligent air-cooling			
	Protection grade	IP65			
	topological structure	No transformer			
	Input terminal	MC4 plugging terminal			
	Output terminal	Waterproof lock +OT terminal			

2.5. Ancillary Equipment

Note: not applicable.

2.6. Technical Information

Interfaces present on the EUT	AC Ports	From mains to AC power adapter.
	DC Ports	From DC power supply to EUT.
	Telecom Port	No Telecom Ports.
	Signal Ports	RS-485, which cable length is less than 3m.
About the Product		The equipment is PV Grid-interactive Inverter, the above EUT information was declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

Labels:





R2



R2

3. SUMMARY OF TEST RESULTS

3.1. Test Standards

No.	Identity	Document Title
1	EN IEC 61000-6-2:2019	Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity standard for residential, commercial and light-industrial environments
2	EN IEC 61000-6-4:2019	Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential environments
3	EN IEC 61000-3-11:2019	Electromagnetic compatibility (EMC) - Part 3-11: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems - Equipment with rated current ≤ 75 A and subject to conditional connection
4	EN 61000-3-12:2011	Electromagnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase

3.2. Verdict

No.	Base Standard	Description	Test Verdict	Result	Remark
Emission					
1	EN IEC 61000-6-4:2019	Radiated Emission	Below 1 GHz	P	Annex A.1
			Above 1 GHz	N	Note 1
2	EN IEC 61000-6-4:2019	Conducted Emission	AC Ports	P	Annex A.2
			Telecom Ports	N	Note 2
3	EN IEC 61000-3-11:2019	Harmonic Current Emissions	P	Annex A.3	--
4	EN 61000-3-12:2011	Voltage Fluctuations & Flicker	P	Annex A.4	--
Immunity					
5	IEC 61000-4-2:2008	Electrostatic Discharge Immunity	P	Annex A.5	--
6	IEC 61000-4-3:2006 +A1:2007+A2:2010	Radiated RF Electromagnetic Field Immunity	P	Annex A.6	--
7	IEC 61000-4-4:2012	Electrical Fast Transient/Burst Immunity	AC Ports	P	Annex A.7
			DC Ports	P	--
			Signal Ports	N	Note 3
8	IEC 61000-4-5:2014	Surge Immunity	AC Ports	P	Annex A.8
			DC Ports	P	--
			Signal Ports	N	Note 4
9	IEC 61000-4-6:2013	Immunity to Conducted Disturbances Induced by RF Fields	AC Ports	P	Annex A.9
			DC Ports	P	--
			Signal Ports	N	Note 3
10	IEC 61000-4-8:2009	Power-frequency magnetic field	P	Annex A.10	--
11	IEC 61000-4-34:2005 +A1:2009	Voltage Dips and Short Interruptions Immunity	AC Port	P	Annex A.11

Note 1: The highest frequency of the internal sources of the EUT is less than 108 MHz, the measurement shall be made below 1 GHz.

Note 2: Telecommunications/network port is a point of connection for voice, data and signaling transfers intended to interconnect widely dispersed systems via such means as direct connection to multi-user telecommunications networks, local area networks and similar networks. A port generally intended for interconnection of components of an ITE system under test and used in accordance with its functional specifications, is not considered to be a telecommunication port. The EUT does not have telecommunication port according to above definition.

Note 3: Signal/control port is a port at which a conductor or cable intended to carry signals is connected to the equipment. Applicable only to ports interfacing with cables whose total length according to the manufacturer's functional specification may exceed 3 m. The signal ports cable length of EUT is less than 2m.

Note 4: Signal/control port is a port at which a conductor or cable intended to carry signals is connected to the equipment. Applicable only to ports interfacing with cables whose total length according to the manufacturer's functional specification may exceed 30 m. The signal ports cable length of EUT is less than

2m.

This report judges the test conclusions:

——Not applicable for this test product N

——Meet requirements P

——Does not meet the requirements F

3.3. Test Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

Measurement	Value
Conducted emissions (Mains port)	3.34 dB
Radiated emissions (30 MHz-1 GHz)	4.76 dB

4. GENERAL TEST CONFIGURATIONS

4.1. Test Environments

Test items	Voltage	Temperature	Relative Humidity	Ambient Pressure	Test Date	Test Engineer
Radiated Emission	AC 520V 50Hz, MPPT 200~1000V	25.0°C	55%	101.0kPa	Feb. 24, 2022	Yongqing Chen
Conducted Emission		25.0°C	55%	101.6kPa	Feb. 24, 2022	
Harmonic Current Emissions		25.3°C	50%	101.1kPa	Mar. 14, 2022	
Voltage Fluctuations & Flicker		25.0°C	49%	101.5kPa	Mar. 13, 2022	
Electrostatic Discharge Immunity		23.5°C	54%	100.7kPa	Mar. 04, 2022	
Radiated RF Electromagnetic Field Immunity		24.1°C	54%	101.7kPa	Feb. 25, 2022	
Electrical Fast Transient/Burst Immunity		24.5°C	52%	101.4kPa	Feb. 26, 2022	
Surge Immunity		24.6°C	57%	101.4kPa	Mar. 10, 2022	
Immunity to Conducted Disturbances Induced by RF Fields		25.1°C	52%	101.3kPa	Mar. 01, 2022	
Power-frequency magnetic field		24.6°C	57%	101.3kPa	Mar. 03, 2022	
Voltage Dips and Short Interruptions Immunity		24.5°C	52%	101.3kPa	Feb. 26, 2022	

4.2. Test Equipment List

Radiated Emission Test For Frequency Below 1 GHz						
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due	Use
EMI Receiver	Keysight	N9038A	MY55330115	2021.03.02	2022.03.01	✓
Test Antenna-Bi-Log	SCHWARZBECK	VULB 9163	9163-1202	2021.12.01	2024.11.30	✓
Anechoic Chamber	YIHENG ELECTRONIC	12.0m*7.0m*7.5m	19009	2019.03.05	2022.03.04	✓
Description	Manufacturer	Name		Version		
Test Software	BALUN	BL410-E		V19.319		

Conducted Emission						
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due	Use
EMI Receiver	Keysight	N9038A	MY55330115	2021.03.02	2022.03.01	✓
LISN	SCHWARZBECK	NNLK 8129	8129-462	2021.10.27	2022.10.26	✓
AMN	SCHWARZBECK	NNHV8123	271	2021.06.01	2022.05.31	
AMN	SCHWARZBECK	NNHV8123	276	2021.06.01	2022.05.31	
ISN	TESEQ	ISN T800	28602	2021.09.15	2022.09.14	
Anechoic Chamber	YIHENG ELECTRONIC	12.0m*7.0m*7.5m	19009	2019.03.05	2022.03.04	✓
Description	Manufacturer	Name		Version		
Test Software	BALUN	BL410-E		V19.319		

Voltage Fluctuations & Flicker and Harmonic Current Emissions Test						
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due	Use
Power Analyzer	ZHIYUAN	PA6000H	PA6006H-P O600-1456	2021.10.22	2022.10.21	✓
Power Quality Analyzer	FULKE	435II	37143115	2021.02.26	2022.02.25	
Three-phase Flicker Impedance	HTEC	FI-75A	172101	2021.09.16	2022.09.15	✓

Electrostatic Discharge Immunity Test						
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due	Use
ESD Test System	SCHLODER	SESD 30000	607339	2021.03.16	2022.03.15	✓

Radiated RF Electromagnetic Field Immunity Test						
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due	Use
Anechoic Chamber	YIHENG ELECTRONIC	12.0m*7.0m*7.5m	19009	2019.03.05	2022.03.04	√
Signal Generator	ROHDE&SCHWARZ	N5181A	MY50141978	2021.03.18	2022.03.17	√
Power Amplifier	rflight	NTWPA-008 10200E	18093198	2021.03.02	2022.03.01	√
Power Amplifier	rflight	NTWPA-106 0100E	18093195	2021.03.02	2022.03.01	√
Power Meter	Agilent	E4417A	GB41292042	2021.03.02	2022.03.01	√
Feld Strength Meter	Narda	EP601	511WX51129	2021.03.16	2022.03.15	√
Test Antenna-Bi-Log	SCHWARZBECK	VULB 9163	9163-1202	2021.12.01	2024.11.30	√
Test Antenna-Horn	SCHWARZBECK	BBHA 9120D	9120D-1986	2020.01.02	2023.01.01	√
Description	Manufacturer	Name		Version		
Test Software	BALUN	BL410-E		V19.319		

Electrical Fast Transient/Burst Immunity Test						
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due	Use
EFT Test System	HTEC	HEFT 51	1331011	2021.03.02	2022.03.01	√
EFT coupling network	HTEC	ECDN 51	150601	2021.03.02	2022.03.01	√
EFT clamp	TESEQ	CDN 3425	25164	2021.03.02	2022.03.01	

Transients and Surges Test						
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due	Use
SURGE Generator (AC/DC Ports)	HTEC	HCWG 70	151601	2021.03.18	2022.03.17	√
SURGE coupling network (AC/DC Ports)	HTEC	SCDN303P7	151602	2021.03.18	2022.03.17	√
SURGE Generator (Signal ports)	HTEC	HCOMB 70	143806	2021.06.01	2022.05.31	
SURGE coupling network (Signal ports)	HTEC	TCOMB-4	143807	2021.06.01	2022.05.31	

Immunity to Conducted Disturbances Induced by RF Fields						
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due	Use
Conducted Disturbances Test System	Schloder GmbH	CDG 6000	18901932-0101	2021.09.15	2022.09.14	✓
CDN-M2+3	Schloder GmbH	CDN M2+3-32	18901802-0110	2021.09.15	2022.09.14	
CDN-M1	Schloder GmbH	CDN-M1	19902011-0201	2021.03.02	2022.03.01	
CDN-M4	Schloder GmbH	FCC-801-M4-200A-2	190815	2021.09.15	2022.09.14	
CDN-M5	Schloder GmbH	CDN-M5	A2560005	2021.09.15	2022.09.14	✓
EM Clamp	FCC	F-120-8M	190119	2021.12.22	2022.12.21	

Voltage Dips and Short Interruptions Immunity Test						
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due	Use
Voltage Fault Simulating Generator	HTEC	HPFS303P	152301	2021.03.02	2022.03.01	✓
Voltage Fault Coupling Network	HTEC	HV3P30	152302	2021.03.02	2022.03.01	✓

Power Frequency Magnetic Fields Immunity						
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due	Use
Magnetic Field Tester	HEAFELY	HPFMF 1000	183102	2022.02.28	2023.02.27	✓

4.3. Test Enclosure list

Name	Manufacturer	Model	Serial No.	Length	Description
DC Source	WKDY	WLPA-150KW	W20180626011	N/A	N/A
AC Source	WKDY	WPLA-33-1000KVA	N/A	N/A	N/A

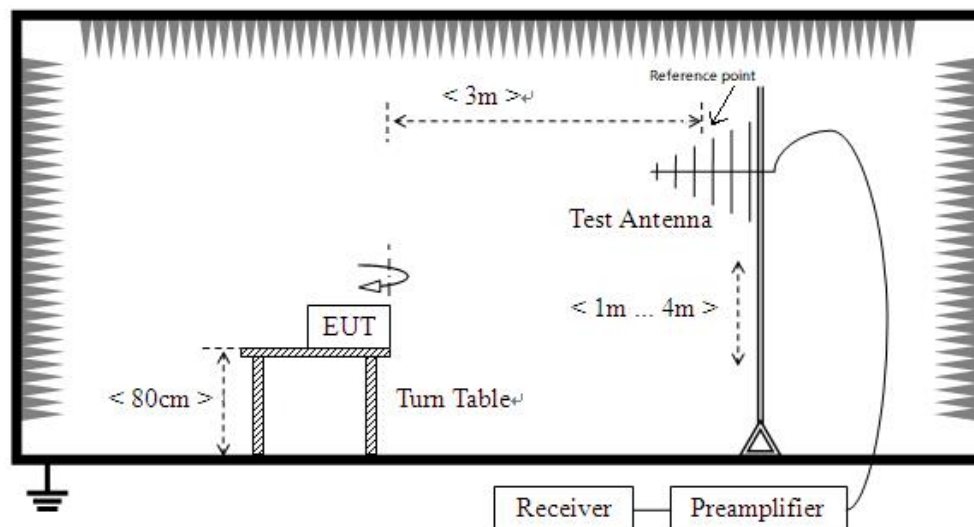
4.4. Test Configurations

Test Configurations (TC) No.	Description
TC01	<u>Grid-connected (100% Load)</u> <u>EUT+DC Source+AC Grid</u>
TC02	<u>Grid-connected (50% Load)</u> <u>EUT+DC Source+AC Grid</u>
TC03	<u>Grid-connected (10% Load)</u> <u>EUT+DC Source+AC Grid</u>
TC04	<u>Standby</u> <u>EUT+DC Source+AC Grid</u>

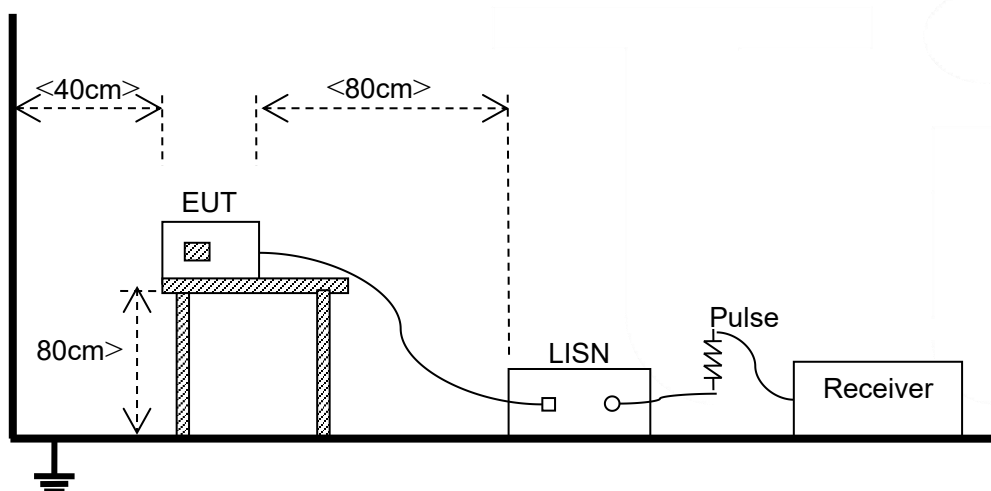
4.5. Description of Test Setup

Test Setup 1

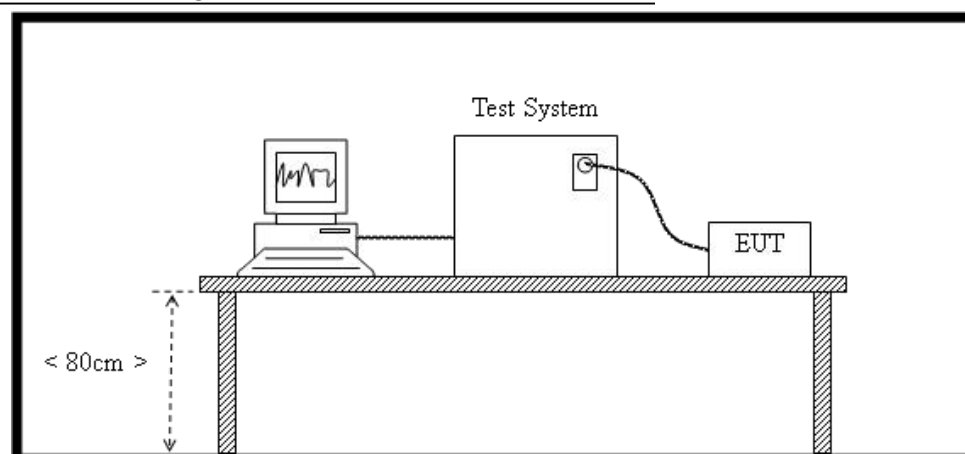
For Radiated Emission Test (30 MHz-1 GHz)



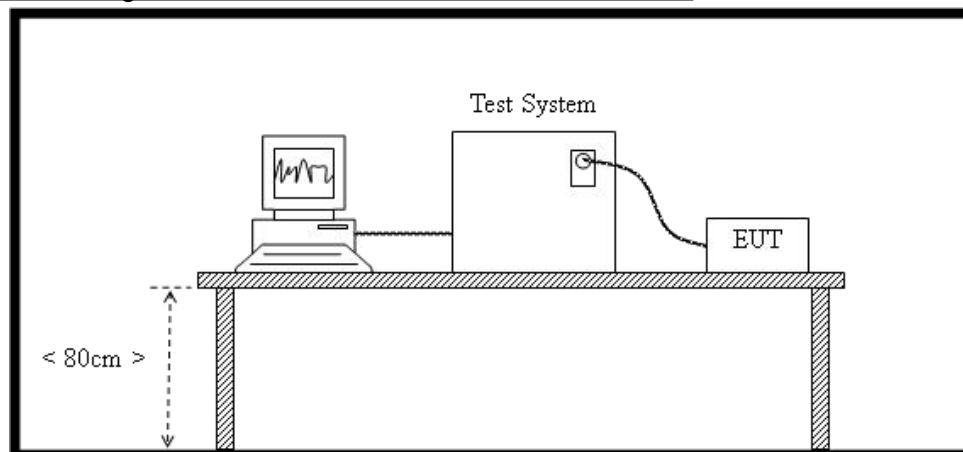
Test Setup 2 For Conducted disturbance voltage at mains terminals Test



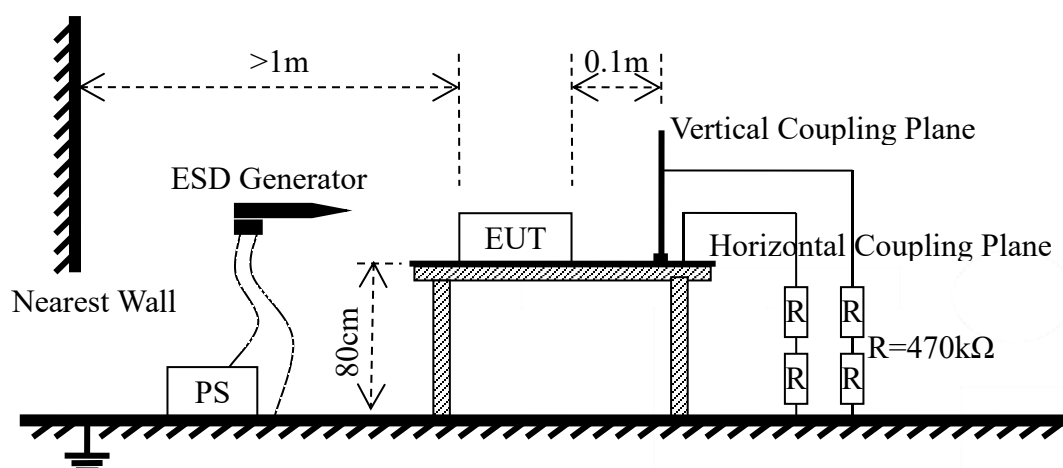
Test Setup 3 For Harmonic Current Emissions Measurement Test



Test Setup 4 For Voltage Fluctuations and Flicker Measurement Test

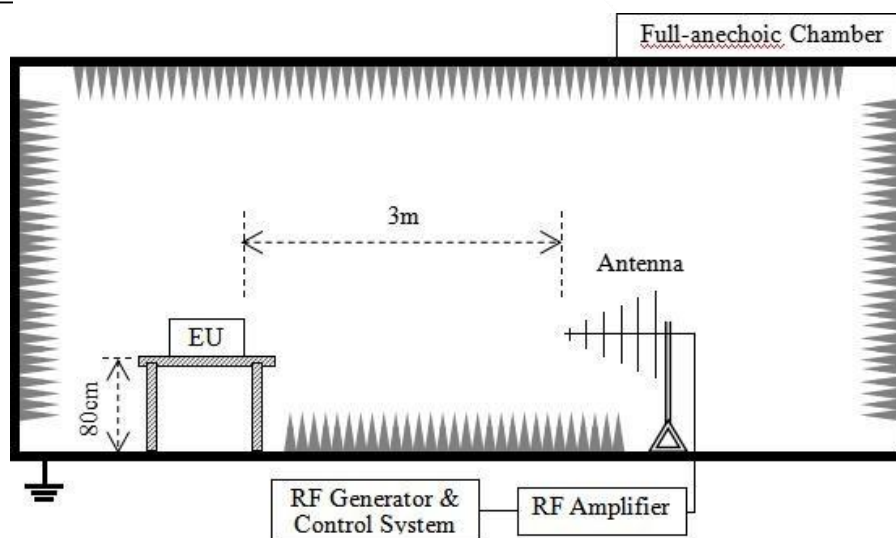


Test Setup 5 For Electrostatic Discharge Immunity Test

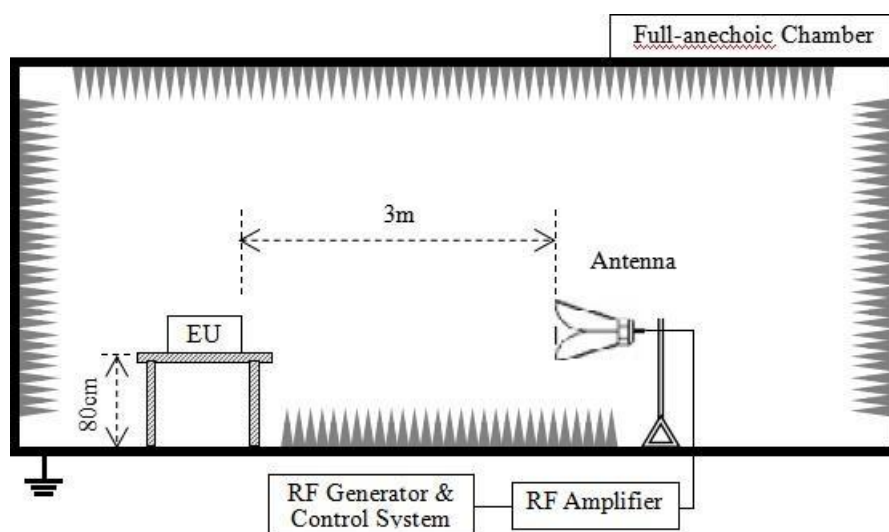


Test Setup 6 For Radiated Immunity Test

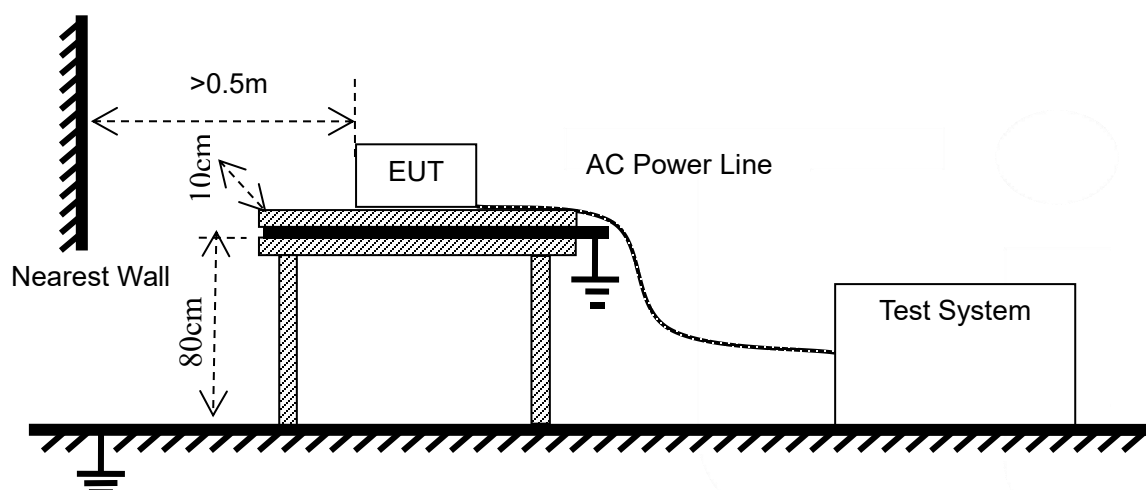
For below 1GHz



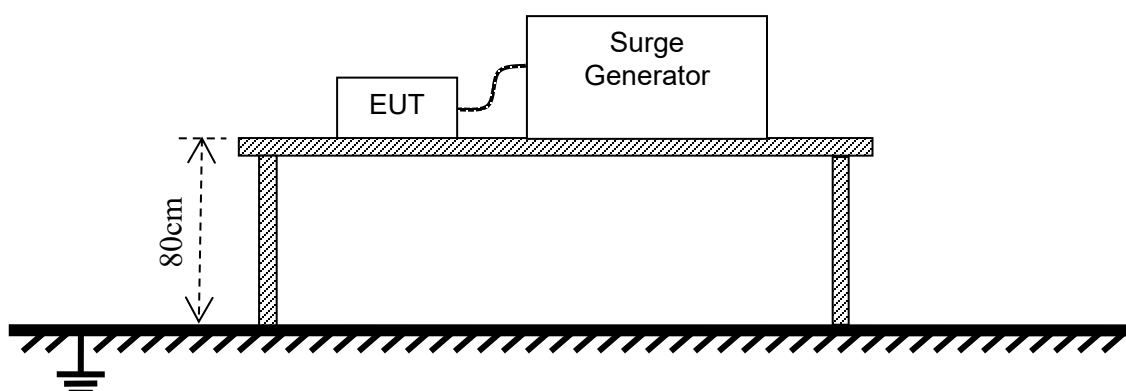
For above 1GHz



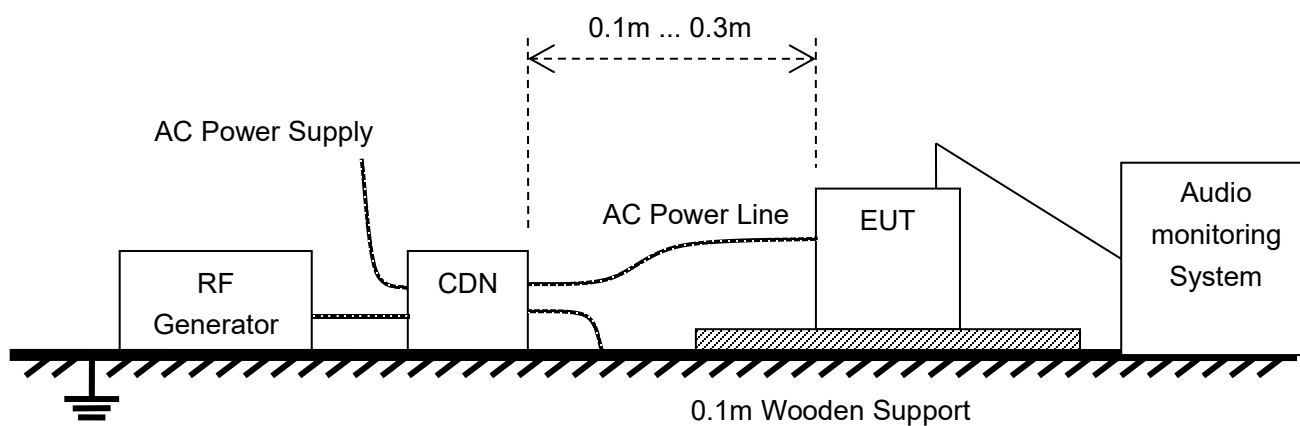
Test Setup 7 For Electrical Fast Transient / Burst Immunity Test



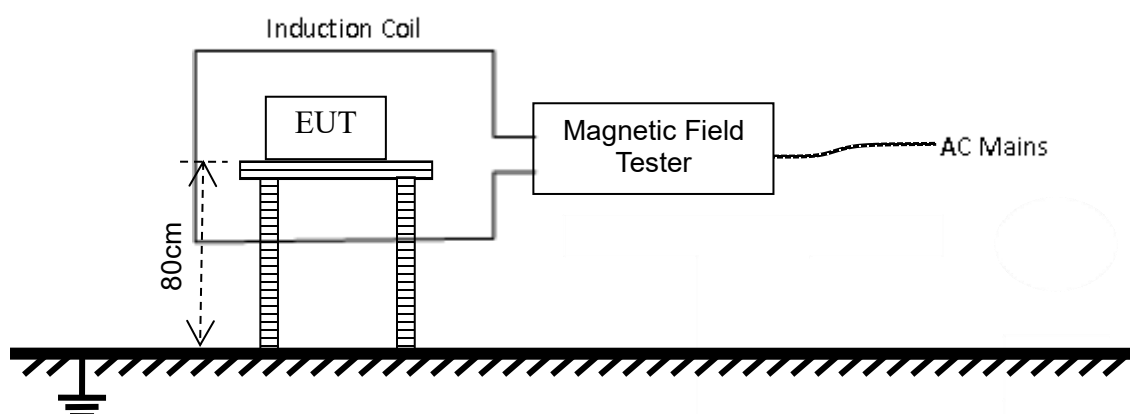
Test Setup 8 For Surge Immunity Test



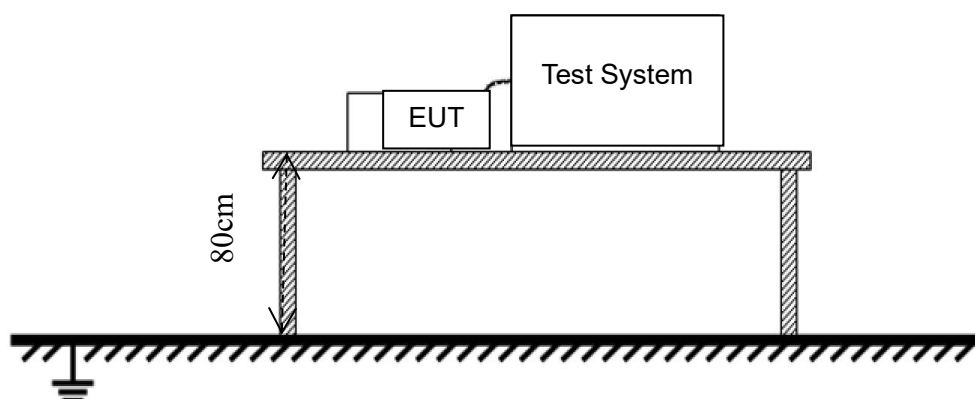
Test Setup 9 For Immunity to Conducted Disturbances Induced By RF Fields Test



Test Setup 10 Power Frequency Magnetic Fields



Test Setup 11 For Voltage Dips and Short Interruptions Immunity Test



4.6. Test Conditions

Test Case	Test Conditions	
Radiated Emission	Test Setup	Test Setup 1
	Test Configuration	TC01, TC02, TC04
Conducted Emission	Test Setup	Test Setup 2
	Test Configuration	TC01, TC02, TC04
Harmonic Current Emissions	Test Setup	Test Setup 3
	Test Configuration	TC02
Voltage Fluctuations and Flicker	Test Setup	Test Setup 4
	Test Configuration	TC02
Electrostatic Discharge Immunity	Test Setup	Test Setup 5
	Test Configuration	TC03
Radiated RF Electromagnetic Field Immunity	Test Setup	Test Setup 6
	Test Configuration	TC03
Electrical Fast Transient/Burst Immunity	Test Setup	Test Setup 7
	Test Configuration	TC03
Surge Immunity	Test Setup	Test Setup 8
	Test Configuration	TC03
Immunity to Conducted Disturbances Induced by RF Fields	Test Setup	Test Setup 9
	Test Configuration	TC03
Power-frequency magnetic field	Test Setup	Test Setup 10
	Test Configuration	TC03
Voltage Dips and Short Interruptions Immunity	Test Setup	Test Setup 11
	Test Configuration	TC03
Note: Based on client request, all normal using modes of the normal function were tested but only the worst test data of the worst mode is reported by this report. The Grid-connected (100% Load) is the worst test mode in this report.		

5. TEST ITEMS

5.1. Emission Tests

5.1.1. Radiated Emission

5.1.1.1. Limit

Frequency range (MHz)	Distance (at 3 m)	Distance (at 10 m)
	Quasi-Peak Limit (dB μ V/m)	Quasi-Peak Limit (dB μ V/m)
30 - 230	50	40
230 - 1000	57	47

Frequency range (MHz)	Distance (at 3 m)	
	Peak Limit (dB μ V/m)	Average Limit (dB μ V/m)
1000-3000	76	56
3000-6000	80	60

NOTE:

- 1) If the highest internal frequency of the EUT is less than 108MHz, the measurement shall only be made up to 1GHz; If the highest internal frequency of the EUT is between 108MHz and 500MHz, the measurement shall only be made up to 2GHz; If the highest internal frequency of the EUT is between 500MHz and 1GHz, the measurement shall only be made up to 5GHz; If the highest internal frequency of the EUT is above 1GHz, the measurement shall be made up to 6GHz; Where the highest internal frequency is not known, tests shall be performed up to 6GHz.
- 2) At transitional frequencies the lower limit applies.

5.1.1.2. Test Procedure

All Radiated Emission tests were performed in the azimuth plane. And test data and plots are recorded in this test report.

An initial pre-scan was performed in the chamber using the EMI Receiver in peak detection mode. Quasi-peak measurements were conducted based on the peak sweep graph. The EUT was measured by Bi-Log antenna with 2 orthogonal polarities.

5.1.2. Conducted Emission

5.1.2.1. Test Limit

AC Port

Frequency range (MHz)	Quasi-peak (dBuV)	Average (dBuV)
0.15 - 0.50	79	66
0.50 - 30	73	60

NOTE:

- 1) The lower limit shall apply at the band edges.

Telecom Port

Frequency range (MHz)	Quasi-peak (dBuV)	Average (dBuV)
0.15 - 0.50	97-87	84-74
0.50 - 30	87	74

NOTE:

- 1) The lower limit shall apply at the band edges.
- 2) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50 MHz.
- 3) The current and voltage disturbance limits are derived for use with an impedance stabilization network (ISN) which presents a common mode (asymmetric mode) impedance of 150 Ω to telecommunication port under test.

Discontinuous disturbances

The click limit L_q is calculated by increasing the relevant quasi-peak limit L for continuous disturbances (as given in AC Port quasi-peak limit) by:

Frequency (MHz)	Click rate N	
	Click limit L_q (dB) $N < 0,2$	Click limit L_q (dB) $0,2 \leq N < 30$
0.15 - 30	AC Port quasi-peak limit + 44	AC Port quasi-peak limit + $20 \lg (30/N)$

5.1.2.2. Test Procedure

The EUT is connected to the power mains through a LISN which provides 50 Ω /50 μ H or 150 Ω of coupling impedance for the measuring instrument. The test frequency range is from 150 kHz to 30 MHz. The maximum conducted interference is searched using Peak (PK), Quasi-peak (QP) and Average (AV) detectors; the emission levels that are more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Telecommunication port was checked to find out the maximum conducted emission.

5.1.3. Harmonic Current Emissions ($\leq 16A$)

5.1.3.1. Limit

For each harmonic order, all 1.5s smoothed r.m.s. harmonic current values, as defined as follows, shall be either:

- Less than or equal to 150% of the applicable limits, or
- Less than or equal to 200% of the applicable limits under the following conditions, which apply all together:

- The EUT belongs to Class A for harmonics;
- The excursion beyond 150% of the applicable limits lasts less than 10% of the test observation period or in total 10min (within the test observation period), whichever is smaller, and
- The average value of the harmonic current, taken over the entire test observation period, is less than 90% of the applicable limits.

Harmonic currents less than 0.6% of the input current measured under the test conditions, or less than 5mA, whichever is greater, are disregarded.

For the 21st and higher odd order harmonics, the average value obtained for each individual odd harmonic over the full observation period, calculated from the 1.5s smoothed r.m.s., may exceed the applicable limits by 50% provided that the following conditions are met:

- The measured partial odd harmonic current does not exceed the partial odd harmonic current which can be calculated from the applicable limits;
- All 1.5s smoothed r.m.s. individual harmonic current values shall be less than or equal to 150% of the applicable limits.

Note: These exemptions (the use of the partial odd harmonic current for the average values and the 200% short term limit for single 1.5s smoothed values) are mutually exclusive and cannot be together.

Limits for Class A equipment				Limits for Class D equipment		
odd harmonic		Even harmonics		Harmonic order (n)	Maximum permissible harmonic current per watt mA/W	Maximum permissible harmonic current A
Harmonic order (n)	Maximum permissible harmonic current A	Harmonic order (n)	Maximum permissible harmonic current A			
3	2.30	2	1.08	3	3.4	2.30
5	1.14	4	0.43	5	1.9	1.14
7	0.77	6	0.30	7	1.0	0.77
9	0.40	8≤n≤40	0.23*(8/n)	9	0.5	0.40
11	0.33			11	0.35	0.33
13	0.21			15≤n≤39 (odd harmonics only)	3.85/n	0.15*(15/n)
15≤n≤39	0.15*(15/n)					
Note: For Class B equipment, the harmonics of the input current shall not exceed the values given in Table “limits for Class A equipment” multiplied by a factor of 1.5.						

For the purpose of harmonic current limitation, equipment is classified as follows:(Note: Class C equipment requirement not include in this standard.)

Class A:

- balanced three-phase equipment;
- household appliances, excluding equipment identified as class D;
- tools, excluding portable tools;
- dimmers for incandescent lamps;
- audio equipment.

Equipment not specified in one of the three other classes shall be considered as class A equipment.

Class B:

- portable tools;
- arc welding equipment which is not professional equipment.

Class C:

- lighting equipment.

Class D:

Equipment having a specified power according to 6.2.2 less than or equal to 600 W, of the following types:

- personal computers and personal computer monitors;
- television receivers.

5.1.3.2. Test Procedure

The EUT is placed on the top of a wooden table 0.8m above the ground and operated to produce the maximum harmonic components under normal operating conditions for each successive harmonic component in turn.

The correspondent test program of test instrument to measure the current harmonics emanated from EUT is chosen. The measure time shall be not less than the necessary for the EUT to be exercised.

5.1.4. Harmonic Current Emissions (>16A)

5.1.4.1. Limit

S_{SC}

value of the three-phase short-circuit power calculated from the nominal interphase system voltage $U_{nominal}$ and the line impedance Z of the system at the PCC:

$$S_{SC} = U_{nominal}^2 / Z$$

where Z is the system impedance at the power frequency

S_{equ}

value calculated from the rated current I_{equ} of the piece of equipment stated by the manufacturer and the rated voltage U_p (single phase) or U_i (interphase) as follows:

$$S_{equ} = U_p I_{equ} \quad \text{for single-phase equipment and the single-phase part of hybrid equipment}$$

$$S_{equ} = U_i I_{equ} \quad \text{for interphase equipment}$$

$$S_{equ} = \sqrt{3} U_i I_{equ} \quad \text{for balanced three-phase equipment and the three-phase part of hybrid equipment}$$

$$S_{equ} = \sqrt{3} U_i I_{equ \max} \quad \text{for unbalanced three-phase equipment}$$

S_{sce}

characteristic value of a piece of equipment defined as follows:

$$R_{sce} = S_{SC} / (3 S_{equ}) \quad \text{for single-phase equipment and the single-phase part of hybrid equipment}$$

$$R_{sce} = S_{SC} / (2 S_{equ}) \quad \text{for interphase equipment}$$

$$R_{sce} = S_{SC} / (S_{equ}) \quad \text{for all three-phase equipment and the three-phase part of hybrid equipment}$$

The limits given apply to 230/400 V, 50 Hz systems. The limits for the other systems will be added in a future edition of this standard.

NOTE 1 In some non-European countries, the proposed methodology cannot be applied because the short-circuit power data is not always available.

The harmonic current limits specified in the tables apply to each of the line currents and not to current in the neutral conductor.

For equipment with multiple rated currents, an assessment is made for each current.

As an example (for the same equipment):

Rated voltage: 230 V single phase, rated current: x A per phase, assessment and test at 230 V.

Rated voltage: 400 V three phase, rated current: y A per phase, assessment and test at 400 V.

The harmonic current limits are specified in Tables 2 to 5

Equipment complying with the harmonic current emission limits corresponding to $R_{sce} = 33$ is suitable for connection at any point of the supply system.

NOTE 2 Values are based on a minimum value of $R_{sce} = 33$. Short-circuit ratios less than 33 are not considered.

NOTE 3 In order to reduce the depth of commutation notches of converters, a short-circuit ratio higher than 33 may be necessary.

For equipment not complying with the harmonic current emission limits corresponding to $R_{sce} = 33$, higher emission values are allowed, under the assumption that the short-circuit ratio R_{sce} is greater than 33. It is

expected that this will apply to the majority of equipment with input current above 16 A per phase. See requirement for product documentation in Clause 6.

Table 2 is applied to equipment other than balanced three-phase equipment and Tables 3, 4 and 5 are applied to balanced three-phase equipment.

Table 3 may be used for any balanced three-phase piece of equipment.

Table 4 may be used with balanced three-phase equipment if any one of these conditions is met.

- a) The 5th and 7th harmonic currents are each less than 5 % of the reference current during the whole test observation period.
- b) The design of the piece of equipment is such that the phase angle of the 5th harmonic current has no preferential value over time and can take any value in the whole interval $[0^\circ, 360^\circ]$
- c) The phase angle of the 5th harmonic current related to the fundamental phase-to-neutral voltage (see 3.16) is in the range of 90° to 150° during the whole test observation period.

Table 5 may be used with balanced three-phase equipment if any one of these conditions is met:

- d) The 5th and 7th harmonic currents are each less than 3 % of the reference current during the whole test observation period.
- e) The design of the piece of equipment is such that the phase angle of the 5th harmonic current has no preferential value over time and can take any value in the whole interval $[0^\circ, 360^\circ]$.
- f) The phase angle of the 5th harmonic current related to the fundamental phase-to-neutral voltage (see 3.16) is in the range of 150° to 210° during the whole test observation period.

Table 3, Table 4 or Table 5 can be applied to hybrid equipment in one of the following circumstances:

- a) hybrid equipment having a maximum 3rd harmonic current of less than 5 % of the reference current, or
- b) there is provision in the construction of hybrid equipment to separate the balanced three- phase and the single-phase or interphase loads for the measurement of supply currents, and when the current is being measured, the part of the equipment being measured draws the same current as under normal operating conditions. In that case, the relevant limits shall be applied separately to the single-phase or interphase part and to the balanced three-phase part. Table 3, Table 4 or Table 5 applies to the current of the balanced three- phase part, even if the rated current of the balanced three-phase part is less than or equal to 16 A per phase. Table 2 applies to the current of the single-phase or interphase part, but if the rated current of the single-phase or interphase part is less than or equal to 16 A, the manufacturer may apply the relevant limits of IEC 61000-3-2 to the single-phase or interphase part instead of the limits stated in Table 2.

For verification purposes, when circumstance b) above applies, the manufacturer shall state in the product documentation the rated current and give in the test report the measured and specified values of the input current as defined in 4.1, for each separate load. The value of R_{sce} for this type of hybrid equipment is determined as follows:

- the minimum R_{sce} value is first determined for each of the two loads, using the reference current of the considered part for the calculation of the harmonic current emissions to be compared to the limit values given in Tables 2 to 5; in case IEC 61000-3-2 is applied to the single-phase or interphase part instead of Table 2 limits, the minimum R_{sce} value for this part is deemed to be equal to 33;
- then, for each of the two parts, the minimum value of S_{sc} is calculated from its minimum R_{sce} value and its rated current (see 3.11 and 3.14);
- finally, the value of R_{sce} for the hybrid equipment is determined from the highest of both minimum values

of S_{sc} and the rated apparent power of the whole hybrid equipment.

Table 2 Current emission limits for equipment other than balanced three-phase equipment

Minimum R_{sce}	Admissible individual harmonic current I_h/I_{ref}^a %						Admissible harmonic parameters %	
	I_3	I_5	I_7	I_9	I_{11}	I_{13}	THC/ I_{ref}	PWHC/ I_{ref}
33	21.6	10.7	7.2	3.8	3.1	2	23	23
66	24	13	8	5	4	3	26	26
120	27	15	10	6	5	4	30	30
250	35	20	13	9	8	6	40	40
≥ 350	41	24	15	12	10	8	47	47

The relative values of even harmonics up to order 12 shall not exceed 16/h %. Even harmonics above order 12 are taken into account in THC and PWHC in the same way as odd order harmonics.

Linear interpolation between successive R_{sce} values is permitted.

a: I_{ref} =reference current; I_h =harmonica current component.

Table 3 Current emission limits for balanced three-phase equipment

Minimum R_{sce}	Admissible individual harmonic current I_h/I_{ref}^a %				Admissible harmonic parameters %	
	I_5	I_7	I_{11}	I_{13}	THC/ I_{ref}	PWHC/ I_{ref}
33	10.7	7.2	3.1	2	13	22
66	14	9	5	3	16	25
120	19	12	7	4	22	28
250	31	20	12	7	37	38
≥ 350	40	25	15	10	48	46

The relative values of even harmonics up to order 12 shall not exceed 16/h %. Even harmonics above order 12 are taken into account in THC and PWHC in the same way as odd order harmonics.

Linear interpolation between successive R_{sce} values is permitted.

a: I_{ref} =reference current; I_h =harmonica current component.

Table 4 Current emission for balanced three-phase equipment under specified conditions(a,b,c)

Minimum R_{sce}	Admissible individual harmonic current I_h/I_{ref}^a %				Admissible harmonic parameters %	
	I_5	I_7	I_{11}	I_{13}	THC/ I_{ref}	PWHC/ I_{ref}
33	10.7	7.2	3.1	2	13	22
≥ 120	40	25	15	10	48	46

The relative values of even harmonics up to order 12 shall not exceed 16/h %. Even harmonics above order 12 are taken into account in THC and PWHC in the same way as odd order harmonics.
Linear interpolation between successive R_{sce} values is permitted.
a: I_{ref} =reference current; I_h =harmonica current component.

Table 5 Current emission for balanced three-phase equipment under specified conditions(d,e,f)

Minimum $R_{sce} = 33$	Admissible individual harmonic current I_h/I_{ref}^a %												Admissible harmonic parameters %	
	I_5	I_7	I_{11}	I_{13}	I_{17}	I_{19}	I_{23}	I_{25}	I_{29}	I_{31}	I_{35}	I_{37}	THC/ I_{ref}	PWHC/ I_{ref}
--														
33	10.7	7.2	3.1	2	2	1.5	1.5	1.5	1	1	1	1	13	22
≥ 250	25	17.3	12.1	10.7	8.4	7.8	6.8	6.5	5.4	5.2	4.9	4.7	35	70

For R_{sce} equal to 33, the relative values of even harmonics up to order 12 shall not exceed 16/h %. The relative values of all harmonics from I_{14} to I_{40} not listed above shall not exceed 1% of I_{ref} .
For $R_{sce} \geq 250$, the relative values of even harmonics up to order 12 shall not exceed 16/h %. The relative values of all harmonics from I_{14} to I_{40} not listed above shall not exceed 3% of I_{ref} .
Linear interpolation between both R_{sce} values is permitted.
a: I_{ref} =reference current; I_h =harmonica current component.

5.1.5. Voltage Fluctuations and Flicker

5.1.5.1. Limit

The following limits apply:

- The value of P_{st} shall not be greater than 1.0;
- The value of P_{lt} shall not be greater than 0.65;
- T_{max} , the accumulated time value of $d(t)$ with a deviation exceeding 3.3% during a single voltage change at the EUT terminals, shall not exceed 500ms;
- The maximum relative steady-state voltage change, dc , shall not exceed 3.3%;
- The maximum relative voltage change d_{max} , shall not exceed:
 - a) 4% without additional conditions;
 - b) 6% for equipment which is:
 - switched manually, or
 - switched automatically more frequently than twice per day, and also has either a delayed restart (the delay being not less than a few tens of seconds), or manual restart, after a power supply interruption.
 - c) 7% for equipment which is:
 - attended whilst in use, or
 - switched on automatically, or is intended to be switched on manually, no more than twice per day, and also has either a delayed restart (the delay being not less than a few tens of seconds) or manual restart, after a power supply interruption.

Note: The cycling frequency is further limited by the P_{st} and P_{lt} limits.

In the case of equipment having several separately controlled circuits with limits b) and c) shall apply only if there is delayed or manual restart after a power supply interruption; for all equipment with automatic switching which is energized immediately on restoration of supply after a power supply interruption, limits a) shall apply; for all equipment with manual switching, limits b) or c) shall apply depending on the rate of switching.

P_{st} and P_{lt} requirement shall not be applied to voltage changes caused by manual switching.

The limits shall not be applied to voltage changes associated with emergency switching or emergency interruptions.

5.1.5.2. Test Procedure

During the Flicker measurement, the measure time shall include that part of whole operation changes. The observation period for short-term flicker indicator is 10 minutes and the observation period for long-term flicker indicator is 2 hours. The test specifications refer the next table.

No.	Specification	Value
1	Test Frequency	50 Hz
2	Test Voltage	230 VAC
3	Waveform	Sine
4	Test Time	10 minutes for P_{st} ; 2 hours for P_{lt}

5.2. Immunity Tests

5.2.1. Test Performance Criteria for Immunity Test

5.2.1.1. General Performance Criteria

Type	Description
Criterion A	The apparatus shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.
Criterion B	The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed. No change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.
Criterion C	Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.

5.2.2. Electrostatic Discharge Immunity

5.2.2.1. Test Specification

Specification	Value
Basic Standard	IEC 61000-4-2:2008
Discharge Impedance	330 Ohm / 150 pF
Discharge Voltage	Air Discharge: 2 kV; 4 kV; 8 kV; Contact Discharge: 2 kV; 4 kV
Polarity	Positive / Negative
Number of Discharge	Minimum 20 times at each test point
Discharge Mode	Single discharge
Discharge Period	1 second minimum

5.2.2.2. Test Procedure

1. Electrostatic discharges are applied only to those points and surfaces of the EUT that are accessible to users during normal operation.
2. The test is performed with at least ten single discharges on the pre-selected points in the most sensitive polarity.
3. The time interval between two successive single discharges is at least 1 second.
4. The ESD generator is held perpendicularly to the surface to which the discharge is applied and the return cable is at least 0.2 meters from the EUT.
5. Contact discharges are applied to the non-insulating coating, with the pointed tip of the generator penetrating the coating and contacting the conducting substrate.
6. Air discharges are applied with the round discharge tip of the discharge electrode approaching the EUT as fast as possible (without causing mechanical damage) to touch the EUT. After each discharge, the ESD generator is removed from the EUT and re-triggered for a new single discharge. The test is repeated until all discharges were completed.
7. At least ten single discharges (in the most sensitive polarity) are applied to the Horizontal Coupling Plane at points on each side of the EUT. The ESD generator is positioned vertically at a distance of 0.1 meters from the EUT with the discharge electrode touching the HCP.
8. At least ten single discharges (in the most sensitive polarity) are applied to the center of one vertical edge of the Vertical Coupling Plane in sufficiently different positions that the four faces of the EUT were completely illuminated. The VCP (dimensions 0.5 m*0.5 m) is placed vertically to and 0.1 meters from the EUT.

5.2.3. Radio Frequency Electromagnetic Field Immunity

5.2.3.1. Test Specification

Specification	Value	
Basic Standard	IEC 61000-4-3:2006+A1:2007+A2:2010	
Frequency Range	80 MHz to 1000 MHz	1.4 GHz to 6.0 GHz
Field Strength	10 V/m (unmodulated, r.m.s)	3 V/m (unmodulated, r.m.s)
Modulation	1 kHz sine wave, 80%, AM modulation	
Frequency Step	1% of fundamental	
Polarity of Antenna	Horizontal and Vertical	
Test Distance	3 m	
Antenna Height	1.5 m	
Dwell Time	3 seconds	

5.2.3.2. Test Procedure

1. The testing is performed in a fully anechoic chamber. The transmit antenna is located at a distance of 3 meters from the EUT.
2. The test signal is 80% amplitude modulated with a 1 kHz sine wave.
3. The frequency range is swept from 80 MHz to 1000 MHz and 1400 MHz to 6000 MHz with the exception of the exclusion band for transmitters, receivers and duplex transceivers. The rate of sweep does not exceed 1.5×10^{-3} decade/s. Where the frequency range is swept incrementally, the step size is 1% of fundamental.
4. The dwell time at each frequency shall be not less than the time necessary for the EUT to be able to respond.
5. The field strength level is 10 V/m for 80 MHz to 1000MHz, 1 V/m for 1400 MHz to 6000 MHz.
6. The test is performed with the EUT exposed to both vertically and horizontally polarized fields on each of the four sides, but only the worst side data is reported in this report.

5.2.4. Electrical Fast Transient / Burst Immunity

5.2.4.1. Test Specification

Specification	Value	
Basic Standard	IEC 61000-4-4:2012	
Test Voltage	AC Power Port: 2 kV.	
	DC Power Port: 1 kV.	
	Signal Port: 1 kV.	
Polarity	Positive / Negative	
Impulse Frequency	5 kHz	100 kHz
Impulse Wave Shape	5/50 ns	
Burst Duration	15 ms	0.75 ms
Burst Period	300 ms	
Test Duration	> 1 min	

NOTE:

- 1) The signal ports tests apply only to ports interfacing with cables whose total length according to the manufacturer's functional specification may exceed 3 m.
- 2) The DC ports test not applicable to input ports intended for connection to a battery or a rechargeable battery which must be removed or disconnected from the apparatus for recharging.
- 3) The EUT with a DC power input port intended for use with an AC-DC power adaptor shall be tested on the AC power input of the AC-DC power adaptor specified by the manufacturer or where none is so specified, using a typical AC-DC power adaptor.
- 4) The test applicable to DC power input ports and signal ports intended to be connected permanently to cables longer than 3 m.

5.2.4.2. Test Procedure

1. The EUT is tested with 2000 V discharges to the AC power input leads, 1000 V for signal port and DC port.
2. Both positive and negative polarity discharges are applied.
3. The length of the "hot wire" from the coaxial output of the EFT generator to the terminals on the EUT should not exceed 1 m.
4. The duration time of each test sequential is 1min.
5. The transient / burst waveform is in accordance with IEC 61000-4-4:2012, 5/50 ns.

5.2.5. Surge Immunity

5.2.5.1. Test Specification

Specification		Value		
Ports class		AC Power Port	DC Power Port	Signal Port
Basic Standard		IEC 61000-4-5:2014		
Waveform		Voltage: 1.2/50 μs; Current: 8/20 μs		
Test Voltage	line to ground	0.5 kV, 1 kV, 2 kV;	0.5 kV, 1 kV	0.5 kV, 1 kV
	line to line	0.5 kV, 1 kV	0.5 kV	/
Polarity		Positive / Negative		
Phase Angle		0°, 90°, 180°, 270°	N/A	
Repetition Rate		60 seconds		
Times		5 times per condition		

NOTE:

- 1) The Signal ports test not applicable to ports interfacing with long distance lines which inside a building is longer than 30 m, or which leaves the building (including a line installed outdoors).
- 2) Signal ports directly connected to AC power network shall be treated as AC power ports.
- 3) The DC ports test not applicable to input ports intended for connection to a battery or a rechargeable battery which must be removed or disconnected from the apparatus for recharging.
- 4) The EUT with a DC power input port intended for use with an AC-DC power adaptor shall be tested on the AC power input of the AC-DC power adaptor specified by the manufacturer or where none is so specified, using a typical AC-DC power adaptor.

5.2.5.2. Test Procedure

The EUT and the auxiliary equipment are placed on a table of 0.8 m heights above a metal ground reference plane. The size of ground plane is greater than 1 m*1 m and project beyond the EUT by at least 0.1 m on all sides. The ground plane is connected to the protective earth. The length of power cord between the coupling device and the EUT is less than 2 meters (provided by the manufacturer).

The EUT is connected to the power mains through a coupling device that directly couples the surge interference signal. The surge noise is applied synchronized to the voltage phase at the zero crossing and the peak value of the AC voltage wave (positive and negative).

The surges are applied line to line and line(s) to earth. When testing line to earth the test voltage is applied successively between each of the lines and earth. Set up to the test level specified increased the test voltage. All lower levels including the selected test level are tested. The polarity of each surge level included positive and negative test pulses.

5.2.6. Immunity to Conducted Disturbances Induced by RF Fields

5.2.6.1. Test Specification

Specification	Value		
Basic Standard	IEC 61000-4-6:2013		
Frequency Range	0.15 MHz – 80 MHz		
Test Voltage	10 V (unmodulated, r.m.s)		
Modulation	1 kHz sine wave, 80% AM		
Frequency Step	1% of fundamental		
Coupled Cable	AC Power Line	DC Power Line	Signal Line
Coupling Device	CDN-M1/2/3/4/5, Capacitive clamp		

NOTE:

- 1) The DC port and Signal port only apply to ports interfacing with cables whose total length according to the manufacturers functional specification may exceed 3 m.
- 2) The test level can also be defined as the equivalent current into a 150 Ω load at signal ports.

5.2.6.2. Test Procedure

The EUT shall be tested within its intended operating and climatic conditions.

The test shall be performed with the test generator connected to each of the coupling and decoupling devices in turn, while the other non-excited RF input ports of the coupling devices are terminated by a 150 Ohm load resistor.

The test signal is 80% amplitude modulated with a 1 kHz sine wave.

The frequency range is swept from 150 kHz to 80 MHz, using the signal level established during the setting process and with a disturbance signal of 80% amplitude. The sweep rate shall not exceed 1.5×10^{-3} decades/s. The step size shall not exceed 1% of the start and thereafter 1% of the preceding frequency value where the frequency is swept incrementally.

The dwell time at each frequency shall not be less than the time necessary for the EUT to be exercised, and able to respond. Sensitive frequencies such as clock frequencies and harmonics or frequencies of dominant interest, shall be analyzed separately.

Attempts should be made to fully exercise the EUT during test, and to fully interrogate all exercise modes selected for susceptibility.

5.2.7. Power Frequency Magnetic Fields Immunity

5.2.7.1. Test Specification

Specification	Value
Basic Standard	IEC 61000-4-8:2009
Field Frequency	50/60 Hz
Test Level	30 A/m
Polarity	Horizontal and Vertical
Test Duration	5 min

NOTE:

- 1) The test shall be carried out at the frequencies appropriate to the power supply frequency. Equipment intended for use in areas supplied only at one of these frequencies need only be tested at that frequency.
- 2) Applicable only to apparatus containing devices susceptible to magnetic fields.

5.2.7.2. Test Procedure

The EUT shall be subjected to the test magnetic field by using the induction coil of standard dimensions (1 m*1 m) and shown in Section 15.1. The induction coil shall then be rotated by 90° in order to expose the EUT to the test field with different orientations.

5.2.8. Voltage Dips and Short Interruptions Immunity

5.2.8.1. Test Specification

AC Ports

Specification	Value
Basic Standard	IEC 61000-4-34:2005+A1:2009
Frequency	50/60Hz
Voltage Dips	100% reduction: 20 ms 60% reduction: 200/240 ms 30% reduction: 500/600 ms
Voltage Interruptions	100% reduction: 5000/6000 ms
Voltage Phase Angle	0°

NOTE:

- 1) Applicable only to AC input ports.

5.2.8.2. Test Procedure

The power cord is used as supplied by the manufacturer. The EUT was connected to the line output of the Voltage Dips and Interruption Generator.

The EUT is tested for a) 100% voltage dip of supplied voltage with duration of 20 ms; b) 60% voltage dip of supplied voltage with duration of 200 or 240 ms; c) 30% voltage dip of supplied voltage and duration 500 or 600 ms. Both of the dip tests are carried out for a sequence of three voltage dips with intervals of 10 seconds.

100% voltage interruption of supplied voltage with duration of 5000 or 6000 ms is followed, which is a sequence of three voltage interruptions with intervals of 10 seconds.

Voltage reductions occur at 0 degrees crossover point of the voltage waveform. The performance of the EUT is checked after the voltage dip or interruption.

ANNEX A TEST RESULTS

A.1 Radiated Emission

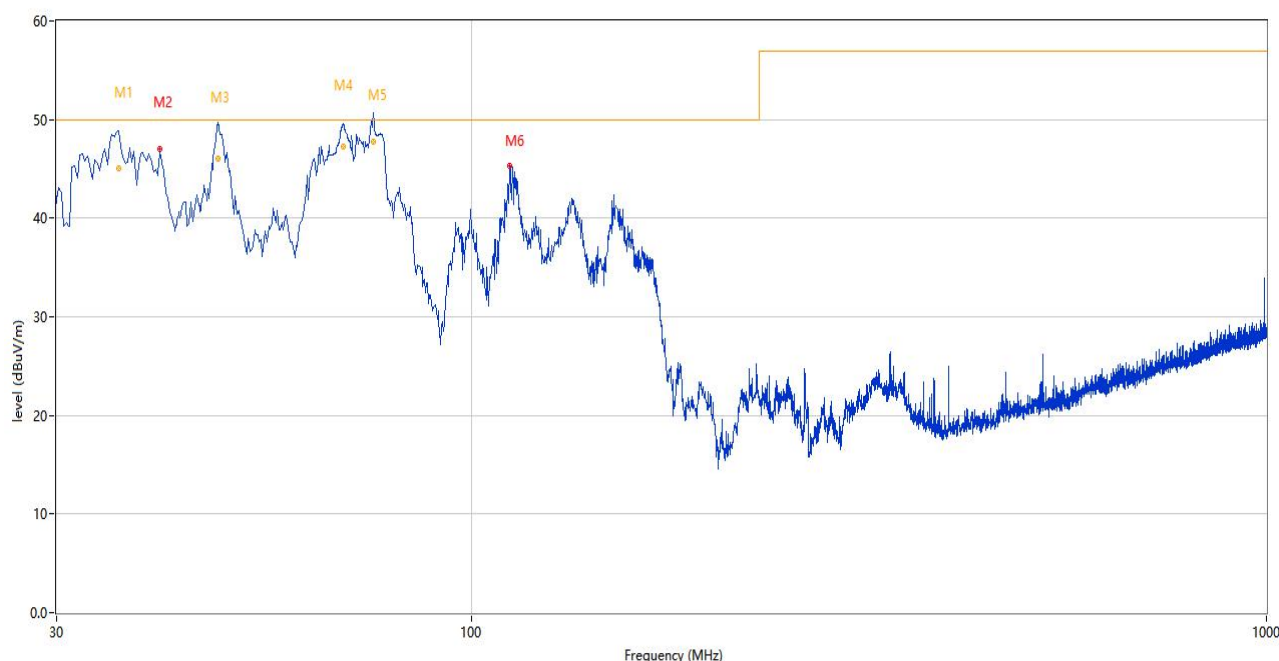
Note 1: The symbol of "--" in the table which means not application.

Note 2: Measurements shall be made with a quasi-peak measuring receiver in the frequency range 30 MHz to 1000 MHz. To reduce the testing time, a peak measuring receiver may be used instead of a quasi-peak measuring receiver. In case of dispute, measurement with a quasi-peak measuring receiver will take precedence.

Test Data and Plots- (Below 1 GHz)

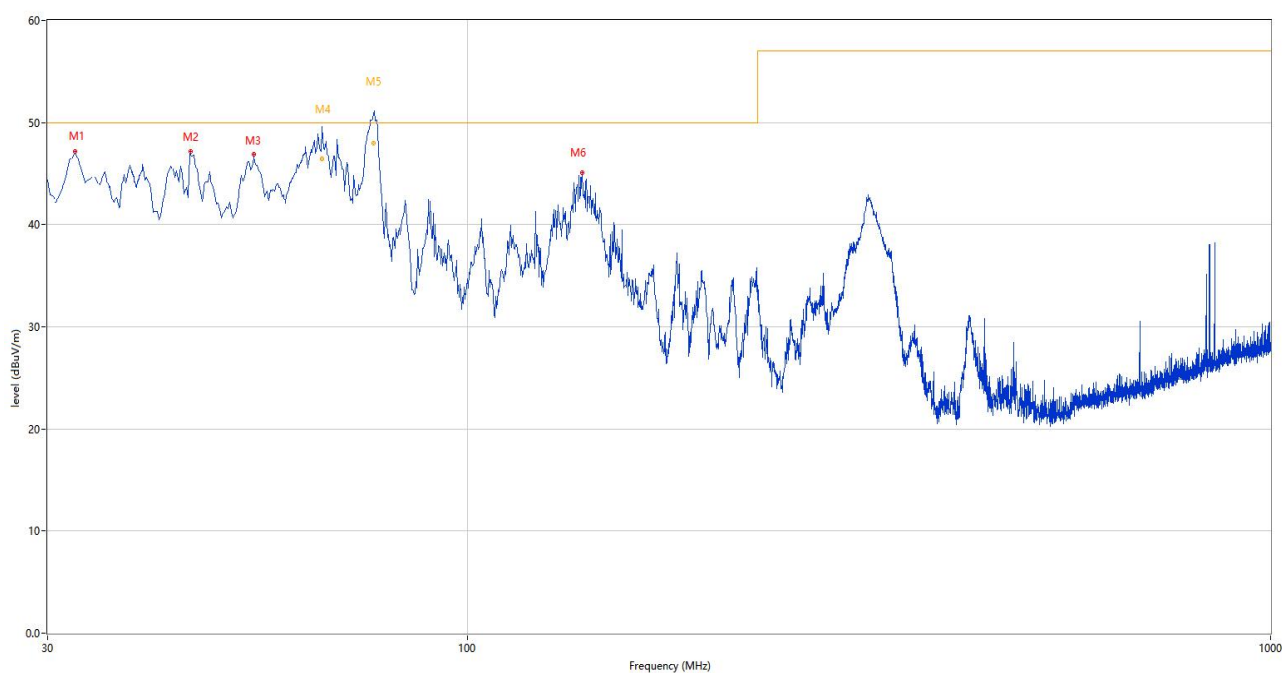
The worst test mode: Grid-connected (100% Load)

A.1.1 Test Antenna Vertical, 30 MHz – 1 GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1*	36.062	45.50	-24.06	50.0	-4.50	QP	246.00	100	Vertical	P
2	40.913	46.75	-22.30	50.0	-3.25	Peak	0.00	100	Vertical	P
3*	47.945	46.56	-21.44	50.0	-3.44	QP	151.00	100	Vertical	P
4*	68.800	47.05	-24.87	50.0	-2.95	QP	123.00	200	Vertical	P
5*	75.105	47.46	-26.99	50.0	-2.54	QP	116.00	200	Vertical	P
6	111.480	45.27	-23.38	50.0	-4.73	Peak	194.00	100	Vertical	P

A.1.2 Test Antenna Horizontal, 30 MHz – 1 GHz



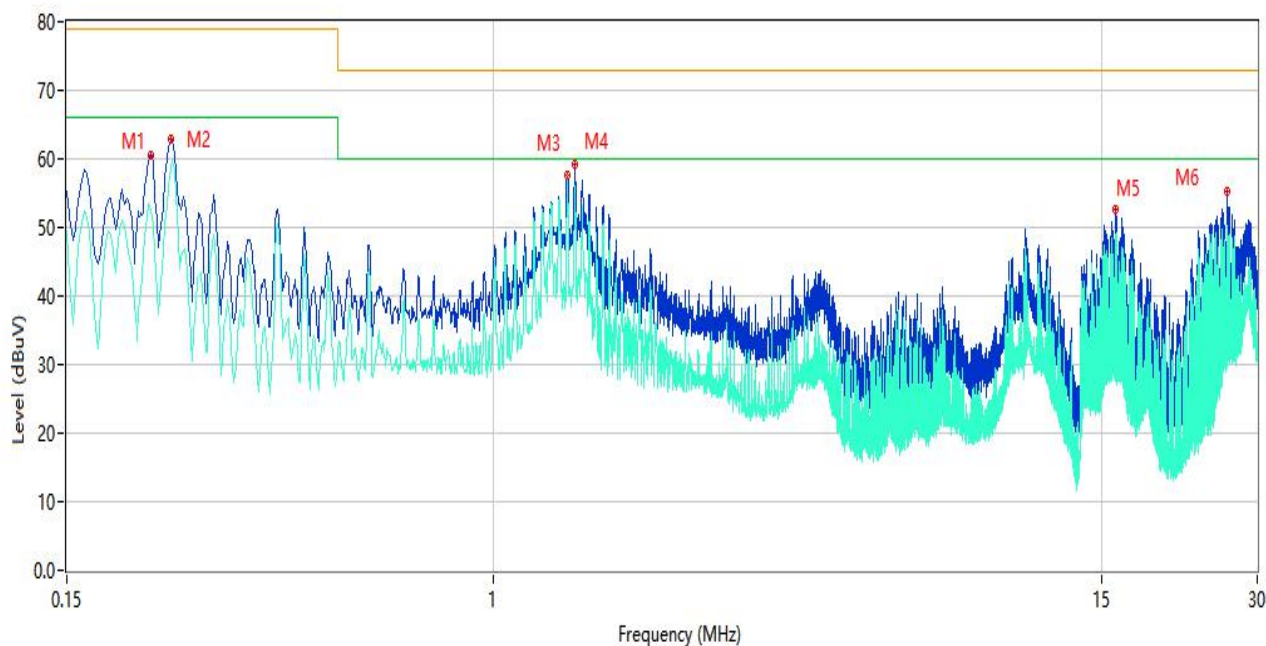
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	32.425	46.94	-25.00	50.0	-3.06	Peak	262.00	100	Horizontal	P
2	45.763	46.79	-21.75	50.0	-3.21	Peak	72.00	100	Horizontal	P
3	54.977	46.57	-21.54	50.0	-3.43	Peak	94.00	100	Horizontal	P
4*	65.890	46.15	-23.72	50.0	-3.85	QP	262.00	100	Horizontal	P
5*	76.560	47.75	-27.19	50.0	-2.25	QP	72.00	100	Horizontal	P
6	138.883	45.05	-26.65	50.0	-4.95	Peak	94.00	100	Horizontal	P

A.2 Conducted Emission

Test Data and Plots-AC Port

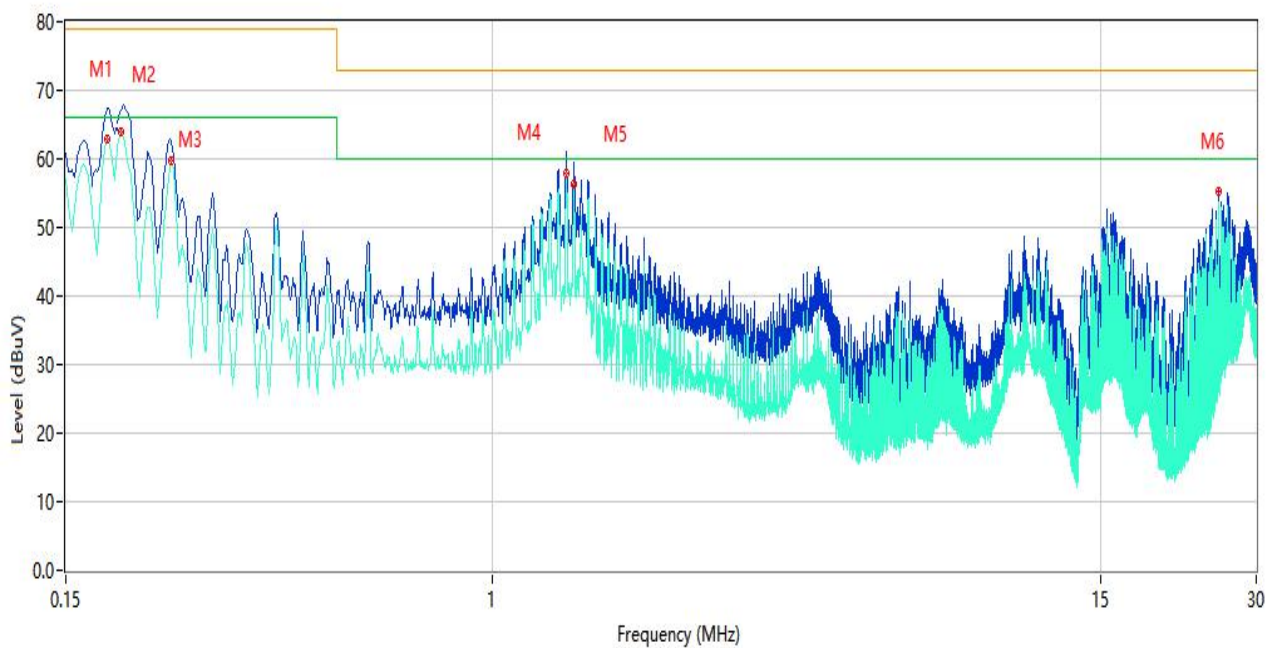
The worst test mode: Grid-connected (100% Load)

A.2.1 L1 Phase



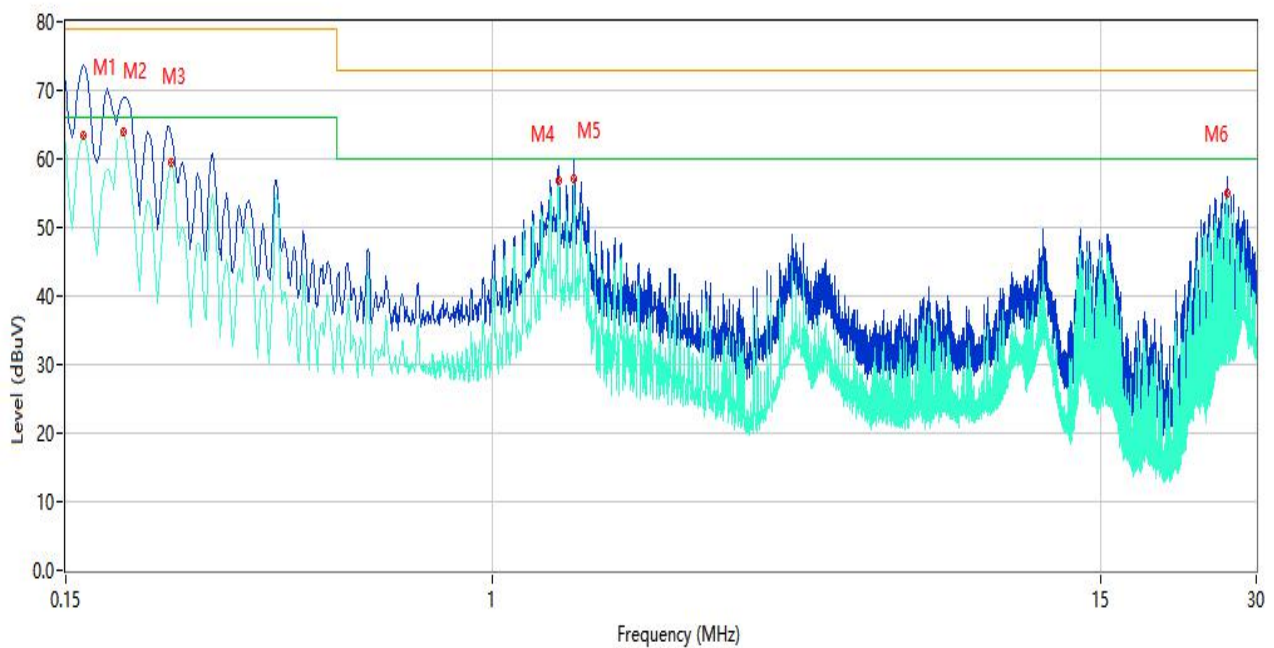
No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Over Limit (dB)	Detector	Line	Verdict
1	0.218	60.51	10.35	79.00	-18.49	Peak	L1	P
1**	0.218	52.68	10.35	66.00	-13.32	AV	L1	P
2	0.238	62.82	10.36	79.00	-16.18	Peak	L1	P
2**	0.238	60.07	10.36	66.00	-5.93	AV	L1	P
3	1.392	59.93	10.23	73.00	-13.07	Peak	L1	P
3**	1.392	57.64	10.23	60.00	-2.36	AV	L1	P
4	1.440	59.20	10.23	73.00	-13.80	Peak	L1	P
4**	1.440	56.07	10.23	60.00	-3.93	AV	L1	P
5	15.976	52.73	10.41	73.00	-20.27	Peak	L1	P
5**	15.976	48.47	10.41	60.00	-11.53	AV	L1	P
6	26.194	55.18	10.27	73.00	-17.82	Peak	L1	P
6**	26.194	50.36	10.27	60.00	-9.64	AV	L1	P

A.2.2 L2 Phase



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Over Limit (dB)	Detector	Line	Verdict
1	0.180	67.33	10.29	79.00	-11.67	Peak	L2	P
1**	0.180	62.96	10.29	66.00	-3.04	AV	L2	P
2	0.192	67.09	10.39	79.00	-11.91	Peak	L2	P
2**	0.192	63.50	10.39	66.00	-2.50	AV	L2	P
3	0.240	62.63	10.35	79.00	-16.37	Peak	L2	P
3**	0.240	59.79	10.35	66.00	-6.21	AV	L2	P
4	1.390	60.95	10.24	73.00	-12.05	Peak	L2	P
4**	1.390	57.75	10.24	60.00	-2.25	AV	L2	P
5	1.436	57.17	10.25	73.00	-15.83	Peak	L2	P
5**	1.436	53.04	10.25	60.00	-6.96	AV	L2	P
6	25.330	55.16	10.23	73.00	-17.84	Peak	L2	P
6**	25.330	51.71	10.23	60.00	-8.29	AV	L2	P

A.2.3 L3 Phase



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Over Limit (dB)	Detector	Line	Verdict
1	0.162	73.81	10.32	79.00	-5.19	Peak	L3	P
1**	0.162	63.41	10.32	66.00	-2.59	AV	L3	P
2	0.194	68.97	10.40	79.00	-10.03	Peak	L3	P
2**	0.194	63.61	10.40	66.00	-2.39	AV	L3	P
3	0.240	63.45	10.35	79.00	-15.55	Peak	L3	P
3**	0.240	59.47	10.35	66.00	-6.53	AV	L3	P
4	1.344	58.90	10.22	73.00	-14.10	Peak	L3	P
4**	1.344	56.80	10.22	60.00	-3.20	AV	L3	P
5	1.440	59.68	10.23	73.00	-13.32	Peak	L3	P
5**	1.440	57.04	10.23	60.00	-2.96	AV	L3	P
6	26.338	56.50	10.28	73.00	-16.50	Peak	L3	P
6**	26.338	54.89	10.28	60.00	-5.11	AV	L3	P

A.3 Harmonic Current Emissions

EUT Category : Balanced three-phase equipment Phase: L1						
Power R _{sce}	33		Frequency		50.01	Hz
Average			Maximum			
Voltage (rms)	300.25	V	Voltage (rms)		300.31	V
Current (rms)	74.31	A	Current (rms)		74.34	A
Power Factor	0.997	-	Power Factor		0.997	-
Active power	22312.50	W	Active power		22321.26	W
THC	1.78	A	THC		1.81	A
Harmonic Number	Limit Current/%	Average/%	%Limit	Max Value/%	%Limit	Verdict
2	8	0.531	6.63%	0.769	6.41%	P
3	-	0.262	-	0.419	-	-
4	4	0.527	13.18%	0.760	12.67%	P
5	10.7	0.980	9.16%	1.074	6.69%	P
6	2.66	0.136	5.12%	0.241	6.05%	P
7	7.2	1.092	15.17%	1.216	11.26%	P
8	2	0.058	2.90%	0.176	5.88%	P
9	-	0.082	-	0.197	-	-
10	1.6	0.049	3.05%	0.146	6.09%	P
11	3.1	0.960	30.98%	1.060	22.79%	P
12	1.33	0.046	3.43%	0.107	5.36%	P
13	2	0.720	35.99%	0.797	26.57%	P
THC/I ₁	13	2.419	18.61%	2.418	12.40%	P
PWHC/I ₁	22	4.655	21.16%	5.144	15.59%	P

EUT Category : Balanced three-phase equipment Phase: L2						
Power R _{sce}	33		Frequency		50.00	Hz
Average			Maximum			
Voltage (rms)	300.03	V	Voltage (rms)		300.07	V
Current (rms)	74.73	A	Current (rms)		74.80	A
Power Factor	0.998	-	Power Factor		0.998	-
Active power	22420.25	W	Active power		22443.17	W
THC	1.80	A	THC		1.82	A
Harmonic Number	Limit Current/%	Average/%	%Limit	Max Value/%	%Limit	Verdict
2	8	0.230	2.87%	0.459	3.83%	P
3	-	0.123	-	0.281	-	-
4	4	0.296	7.41%	0.491	8.18%	P
5	10.7	1.063	9.93%	1.187	7.40%	P
6	2.66	0.159	5.97%	0.350	8.77%	P
7	7.2	1.271	17.65%	1.401	12.97%	P
8	2	0.089	4.46%	0.212	7.07%	P
9	-	0.064	-	0.157	-	-
10	1.6	0.075	4.70%	0.197	8.23%	P
11	3.1	0.860	27.74%	0.961	20.67%	P
12	1.33	0.041	3.08%	0.111	5.58%	P
13	2	0.690	34.48%	0.773	25.78%	P
THC/I ₁	13	2.405	18.50%	2.403	12.32%	P
PWHC/I ₁	22	4.144	18.84%	4.436	13.44%	P

EUT Category : Balanced three-phase equipment Phase: L3						
Power R _{sce}	33		Frequency		50.00	Hz
Average			Maximum			
Voltage (rms)	300.47	V	Voltage (rms)		300.54	V
Current (rms)	74.81	A	Current (rms)		74.90	A
Power Factor	0.997	-	Power Factor		0.997	-
Active power	22477.41	W	Active power		22508.53	W
THC	1.77	A	THC		1.81	A
Harmonic Number	Limit Current/%	Average/%	%Limit	Max Value/%	%Limit	Verdict
2	0.523	6.54%	0.731	6.10%	0.523	P
3	0.227	-	0.357	-	0.227	-
4	0.536	13.40%	0.729	12.15%	0.536	P
5	1.094	10.23%	1.211	7.54%	1.094	P
6	0.181	6.79%	0.327	8.19%	0.181	P
7	1.278	17.75%	1.422	13.17%	1.278	P
8	0.072	3.62%	0.158	5.27%	0.072	P
9	0.118	-	0.240	-	0.118	-
10	0.075	4.70%	0.181	7.53%	0.075	P
11	0.976	31.48%	1.097	23.58%	0.976	P
12	0.042	3.19%	0.108	5.40%	0.042	P
13	0.714	35.71%	0.813	27.09%	0.714	P
THC/I ₁	2.403	18.48%	2.400	12.31%	2.403	P
PWHC/I ₁	4.144	18.84%	4.436	13.44%	4.144	P

A.4 Voltage Fluctuations & Flicker

Voltage(V)	300.03	Frequency(Hz)	49.98
Current (A)	74.31	Coupling Line	L1
Test Parameter	Limit	Measurement Value	Verdict
P_{st}	1.0	0.445	P
P_{lt}	0.65	0.280	P
T_{dt}	0.5	0.0	P
d_{max} (%)	4	0.773	P
d_c (%)	3.3	0.627	P

Voltage(V)	300.04	Frequency(Hz)	49.98
Current (A)	74.73	Coupling Line	L2
Test Parameter	Limit	Measurement Value	Verdict
P_{st}	1.0	0.425	P
P_{lt}	0.65	0.259	P
T_{dt}	0.5	0	P
d_{max} (%)	4	0.804	P
d_c (%)	3.3	0.673	P

Voltage(V)	300.01	Frequency(Hz)	49.98
Current (A)	74.81	Coupling Line	L3
Test Parameter	Limit	Measurement Value	Verdict
P_{st}	1.0	0.451	P
P_{lt}	0.65	0.277	P
T_{dt}	0.5	0	P
d_{max} (%)	4	0.796	P
d_c (%)	3.3	0.963	P

A.5 Electrostatic Discharge Immunity

Test Points	Discharge Level (kV)	Discharge Mode	Number of Discharge	Met Criteria	Required Criteria	Verdict
HCP	±2, ±4	Contact Discharge	100	A	B	P
VCP	±2, ±4	Contact Discharge	100	A	B	P
① Metal screw	±2, ±4	Contact Discharge	1000	A	B	P
② Metal Handle	±2, ±4	Contact Discharge	80	A	B	P
③ Heat sink	±2, ±4	Contact Discharge	80	A	B	P
④ Button	±2, ±4, ±8	Air Discharge	40	A	B	P
⑤ Led light	±2, ±4, ±8	Air Discharge	160	A	B	P

A.6 Radio Frequency Electromagnetic Field Immunity

Antenna Polarity	Frequency (MHz)	Side	Field Strength (V/m)	Met Criteria	Required Criteria	Verdict
Vertical	80 - 1000	Front, Back, Left, Right	10	A	A	P
Horizontal	80 - 1000	Front, Back, Left, Right	10	A	A	P
Vertical	1400 - 6000	Front, Back, Left, Right	3	A	A	P
Horizontal	1400 - 6000	Front, Back, Left, Right	3	A	A	P

A.7 Electrical Fast Transient/Burst Immunity

Test Data (AC Output Port)

Burst Parameters	5/50ns	Pulse Frequency	5kHz	Pulse group action time	15ms		Burst interval	300ms
			100kHz		0.75ms			
Test Port	Coupling Line			Polarity	Test Level (kV)	Met Criteria	Required Criteria	Verdict
AC Output Port	L1+L2+L3+PE			+ / -	0.5, 1, 2	A	B	P

Test Data (PV Input Port)

Burst Parameters	5/50ns	Pulse Frequency	5kHz	Pulse group action time	15ms		Burst interval	300ms
			100kHz		0.75ms			
Test Port	Coupling Line			Polarity	100kHz	Met Criteria	Required Criteria	Verdict
PV Input Port	P+&P-&PE			+ / -	0.5, 1	A	B	P

A.8 Surge Immunity

Test Data (AC Output Port)

Times	5 times for positive and negative		Time interval		60s		
Test Port	Coupling Line	Polarity	Voltage (kV)	Test Waveform	Met Criteria	Required Criteria	Verdict
AC Output Port	L1-L2, L1-L3, L2-L3	+ / -	0.5, 1	1.2/50us	A	B	P
AC Output Port	L1-PE, L2-PE, L3-PE	+ / -	0.5, 1, 2	1.2/50us	A	B	P

Test Data (PV Input Port)

Times	5 times for positive and negative		Time interval		60s		
Test Port	Coupling Line	Polarity	Voltage (kV)	Test Waveform	Met Criteria	Required Criteria	Verdict
PV Input Port	P+ to P-	+ / -	0.5	1.2/50us	A	B	P
PV Input Port	P+ to PE, P- to PE	+ / -	0.5, 1	1.2/50us	B	B	P

A.9 Immunity to Conducted Disturbances Induced by RF Fields

Test Data (AC Output Port)

Test Port	Frequency (MHz)	Test Voltage(V)	Met Criteria	Required Criteria	Verdict
AC Output Port	0.15 - 80	10	A	A	P

Test Data (PV Input Port)

Test Port	Frequency (MHz)	Test Voltage(V)	Met Criteria	Required Criteria	Verdict
PV Input Port	0.15 - 80	10	A	A	P

A.10 Power Frequency Magnetic Fields Immunity

Test direction	Test level(A/m)	Met Criteria	Required Criteria	Verdict
X, Y, Z	30	A	A	P

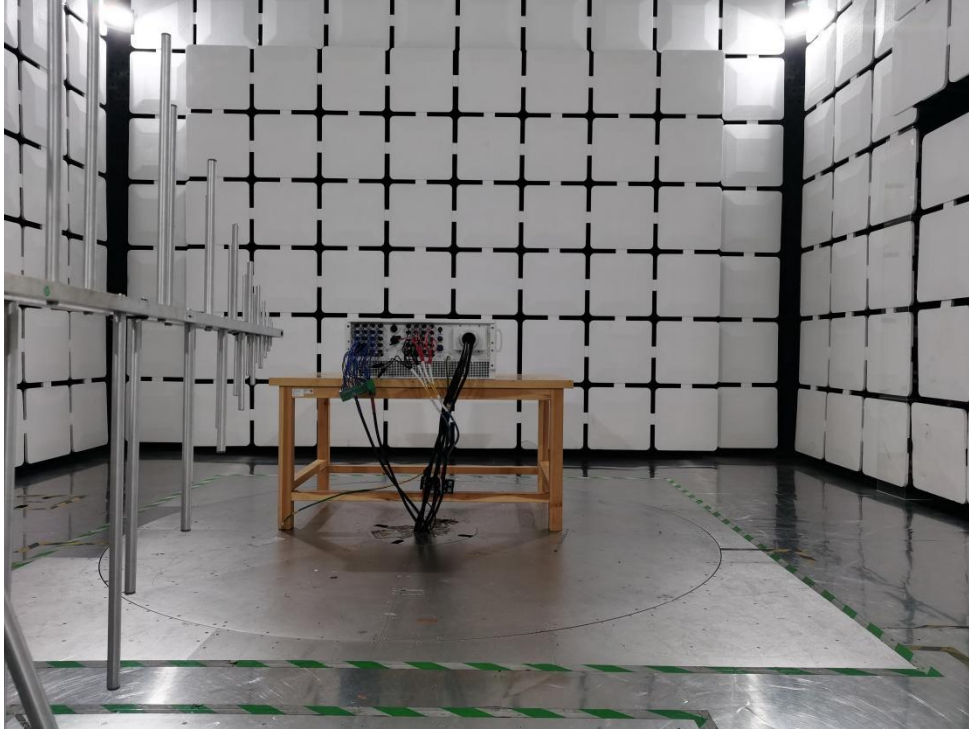
A.11 Voltage Dips and Short Interruptions Immunity

Test Mode	Residual voltage (%)	Duration (ms)	Times	Interval (sec)	Met Criteria	Required Criteria	Verdict
Voltage Dips	0	20	3	10	A	B	P
Voltage Dips	40	200	3	10	B	C	P
Voltage Dips	70	500	3	10	B	C	P
Voltage Interruptions	0	5000	3	10	B	C	P

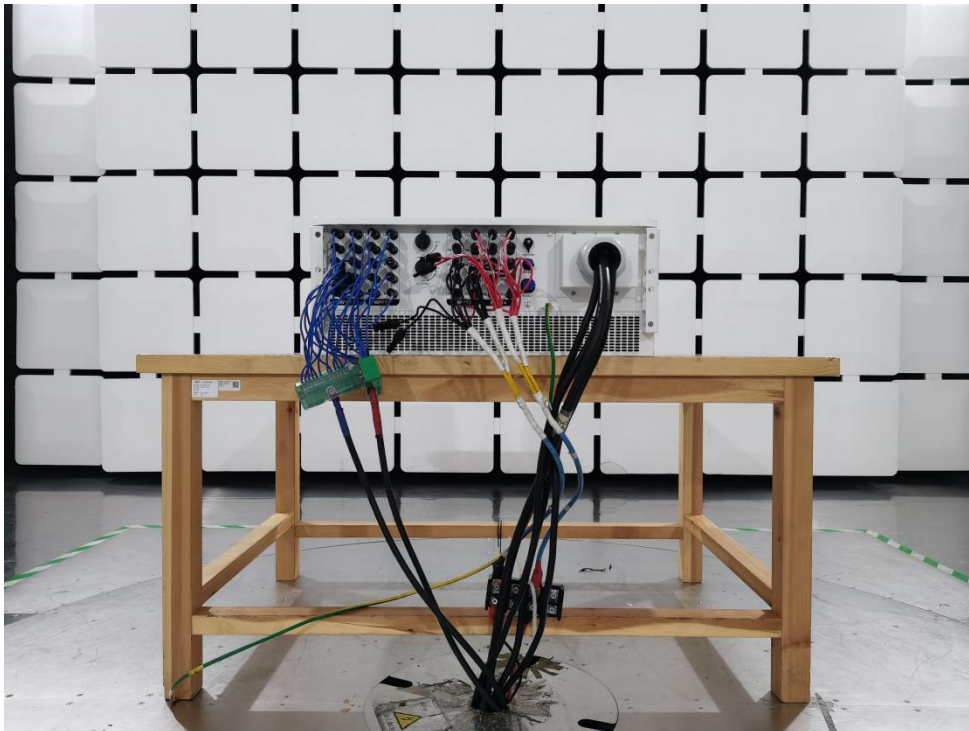
ANNEX B TEST SETUP PHOTOS

B.1 Radiated Emission

30MHz~1000MHz

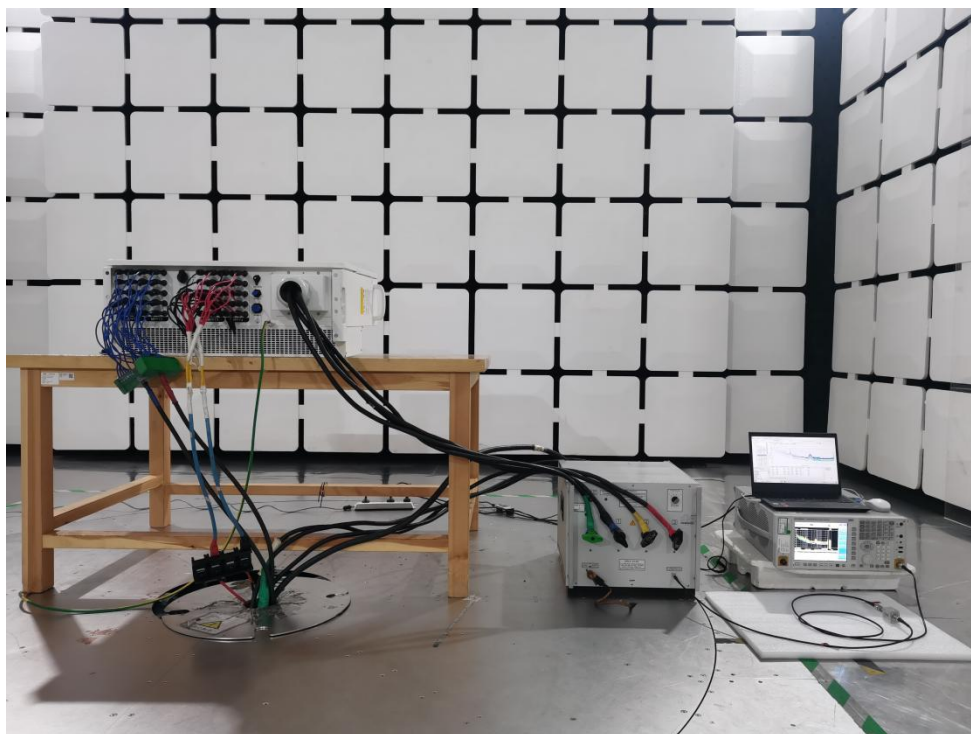


Close-up photo



B.2 Conducted Emission

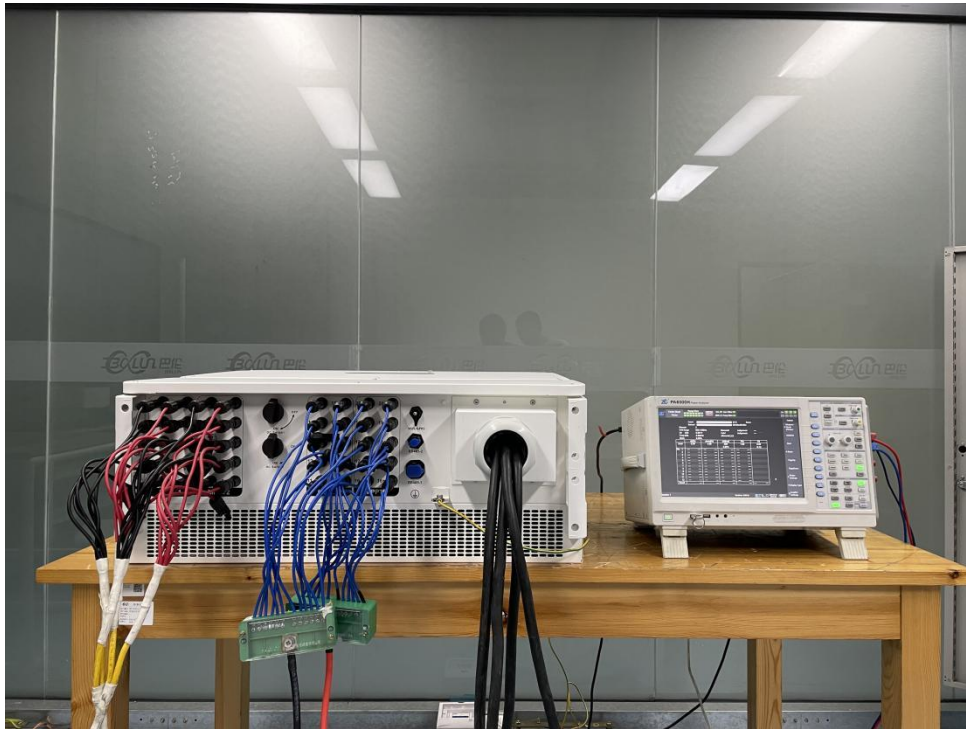
AC Output Port



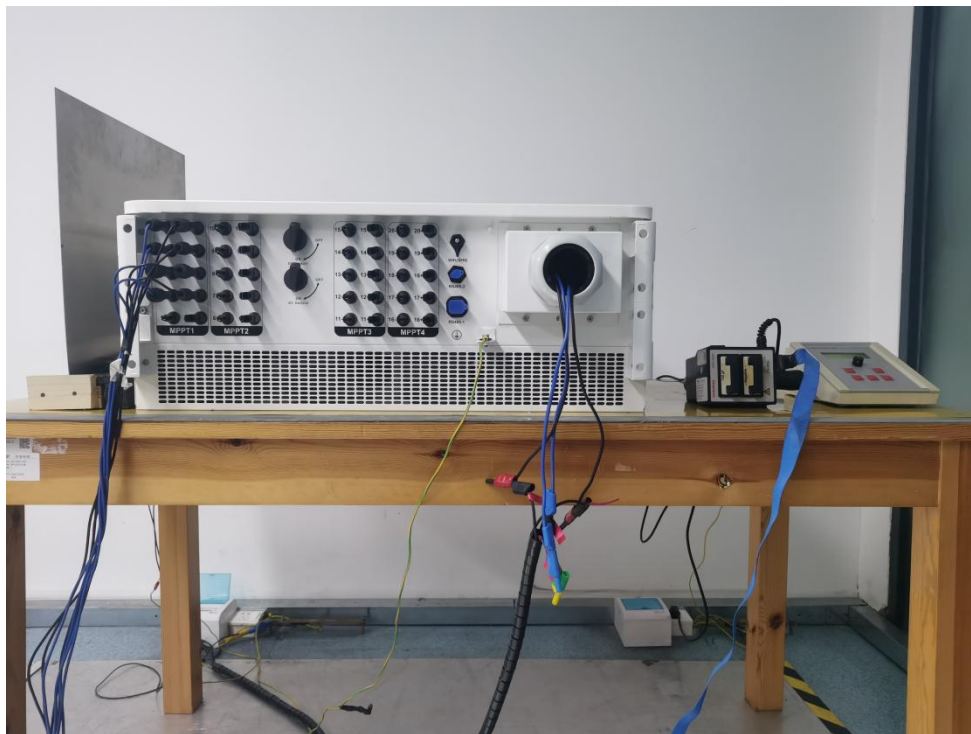
B.3 Harmonic Current Emissions

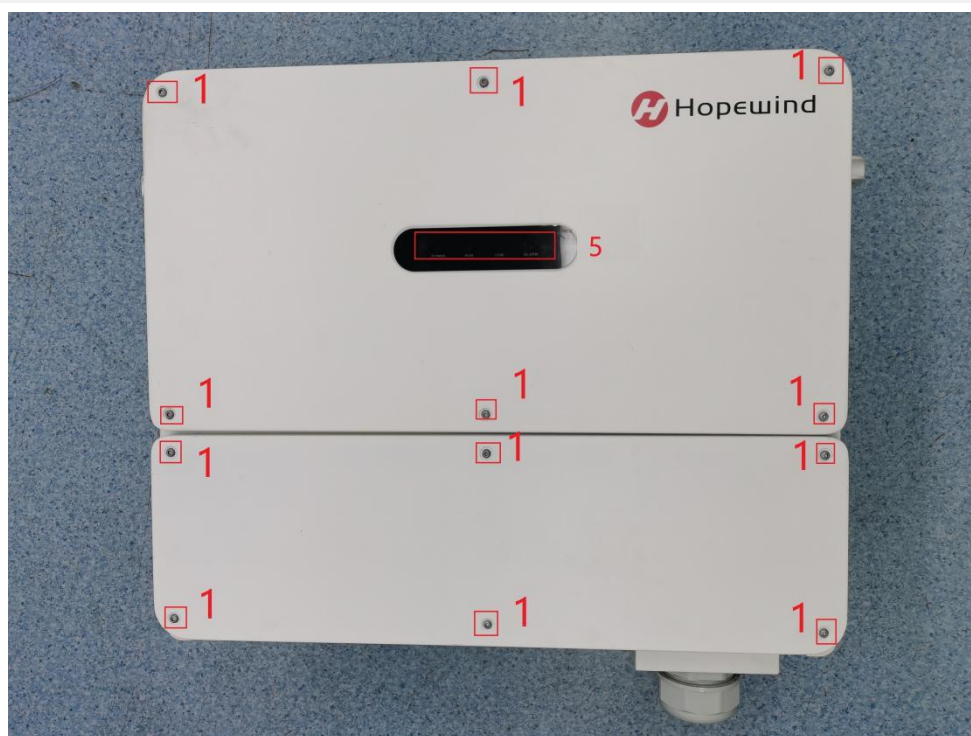


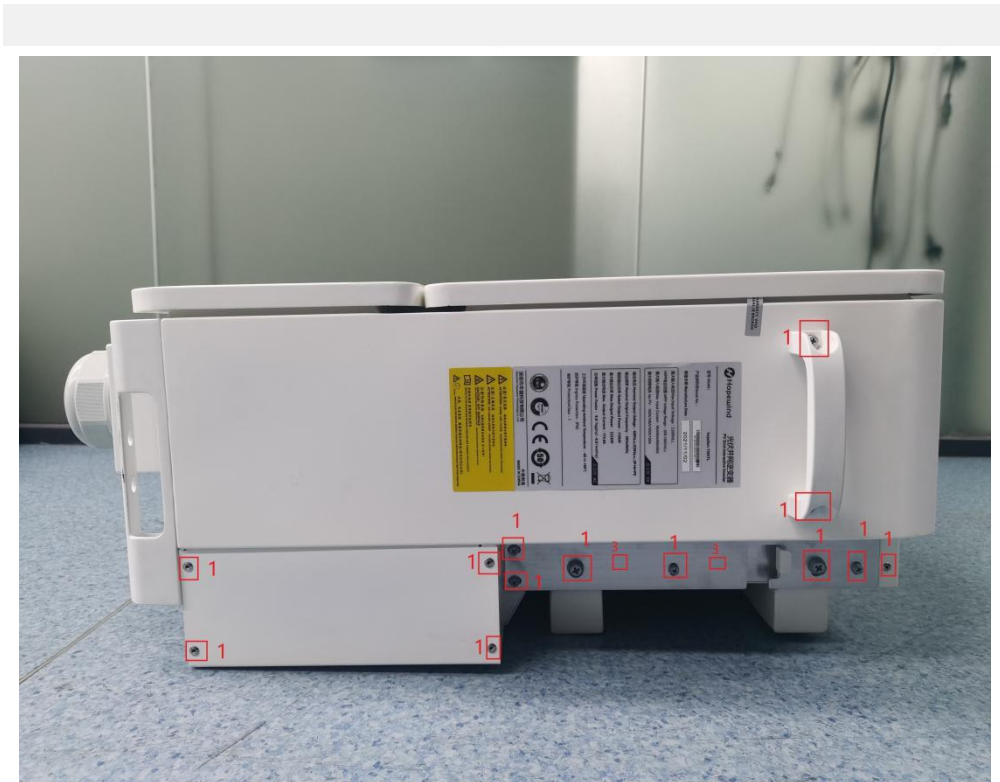
B.4 Voltage Fluctuations & Flicker



B.5 Electrostatic Discharge Immunity

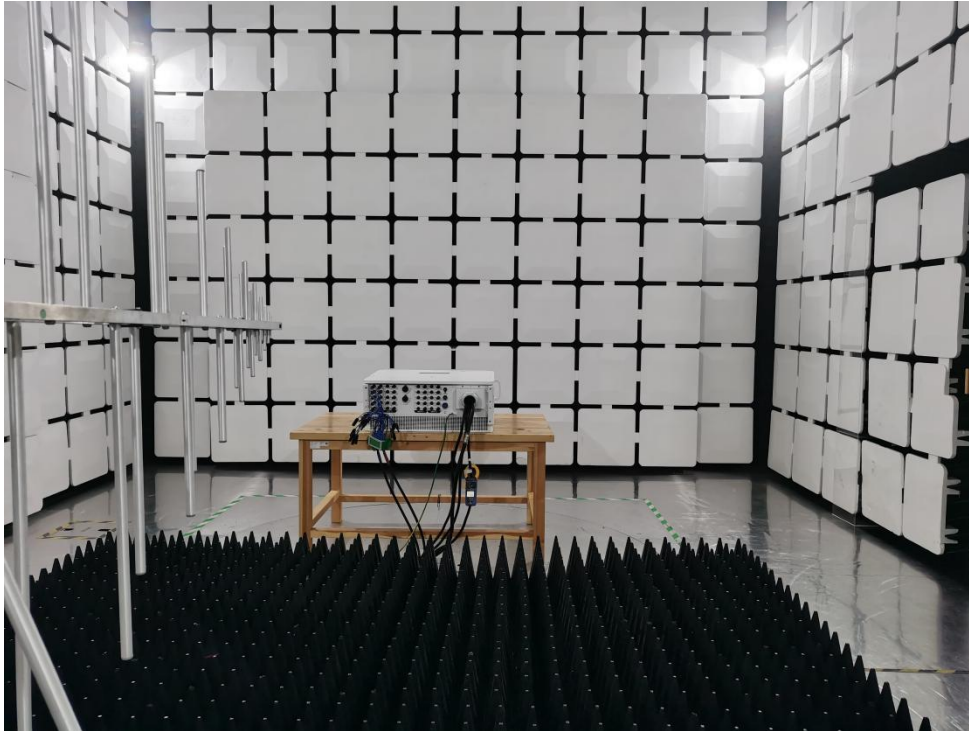




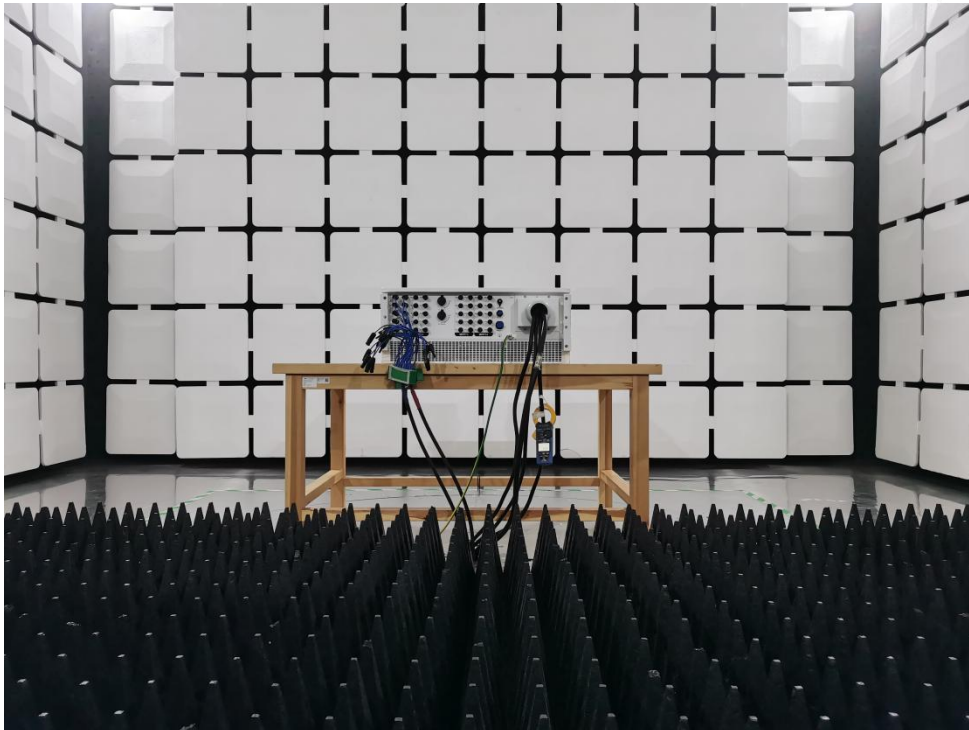


B.6 Radio Frequency Electromagnetic Field Immunity

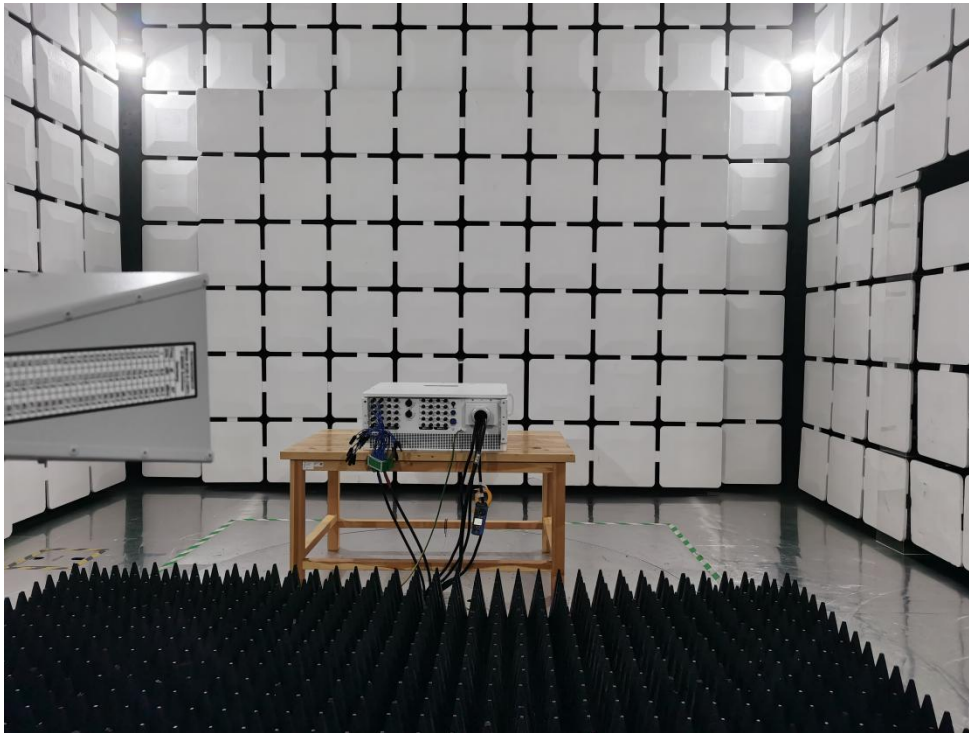
RS_Below 1GHz



Close-up photo

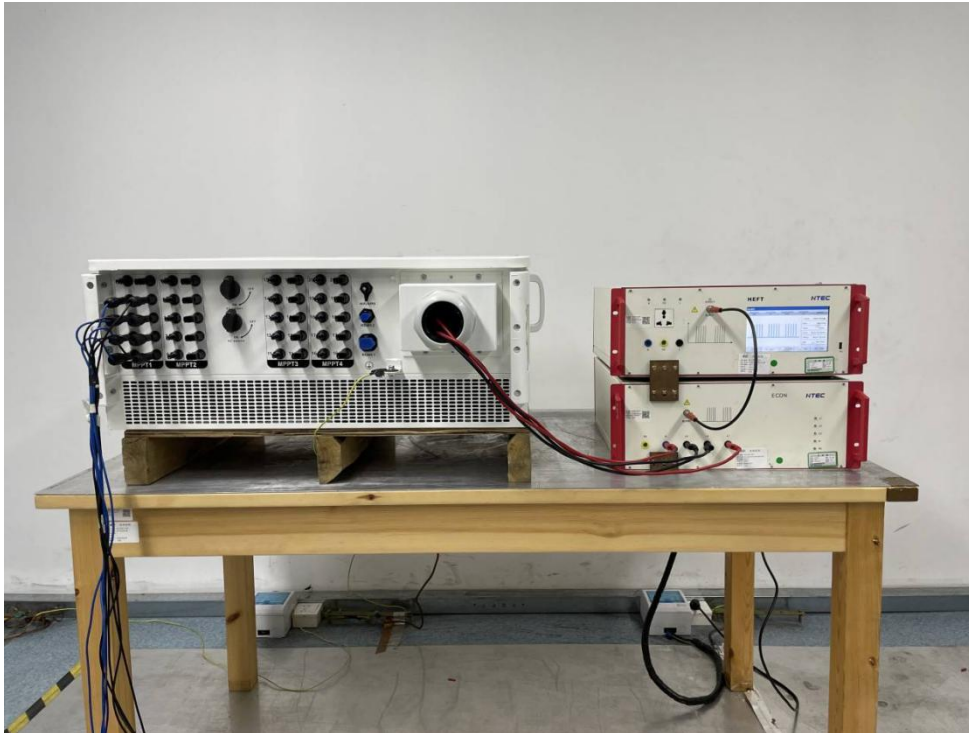


RS_Above 1GHz

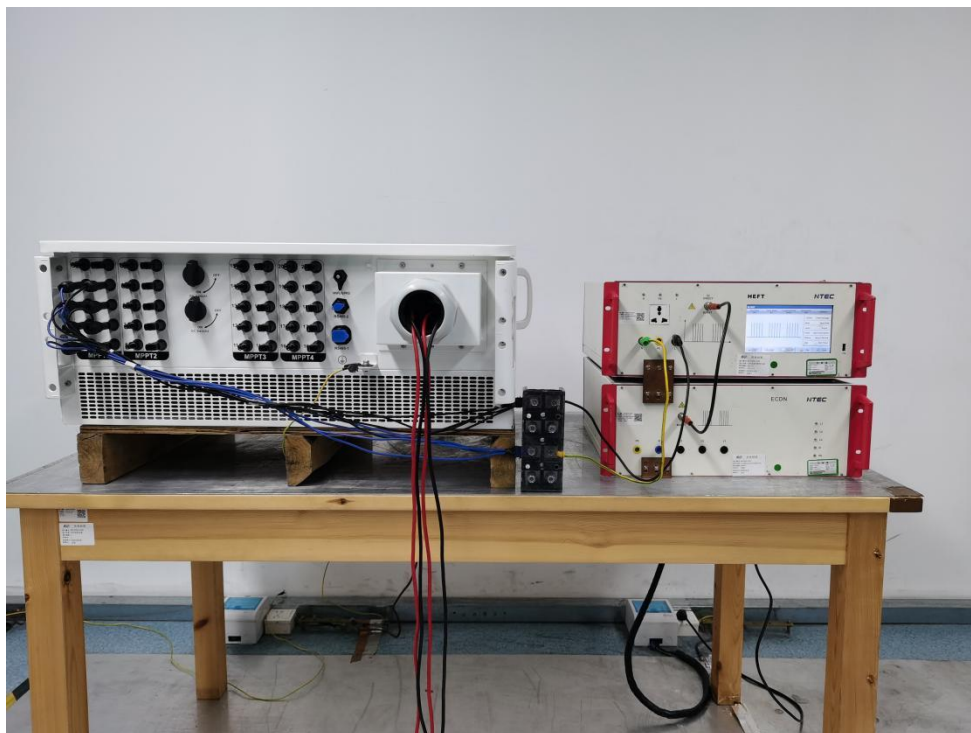


B.7 Electrical Fast Transient/Burst Immunity

AC Output Port



PV Input Port



B.8 Surge Immunity

AC Output Port

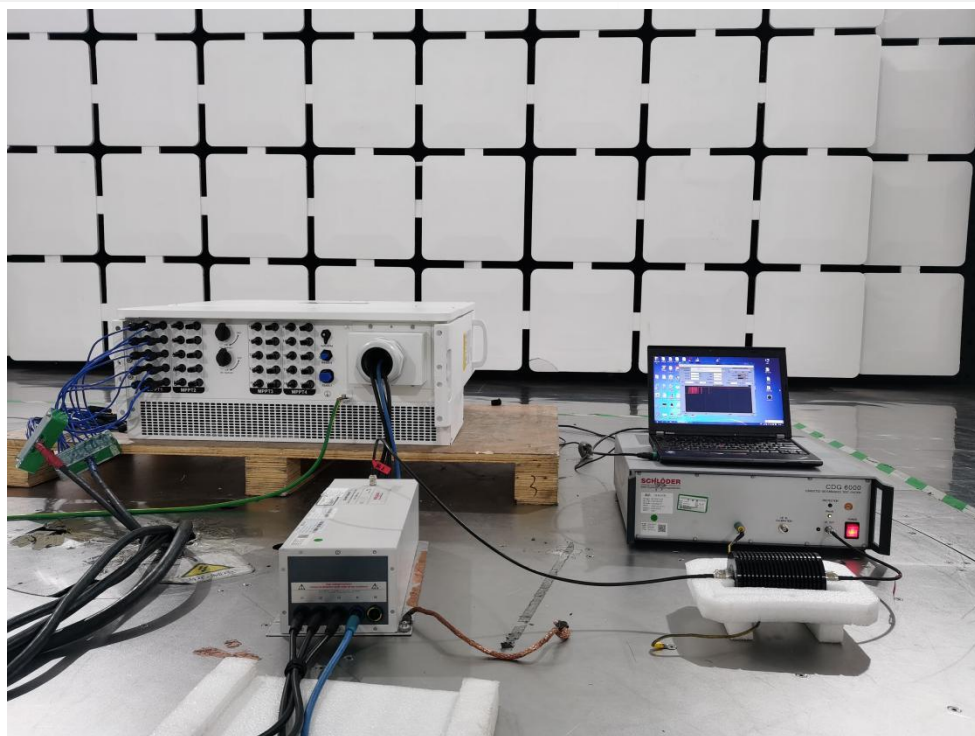


PV Input Port

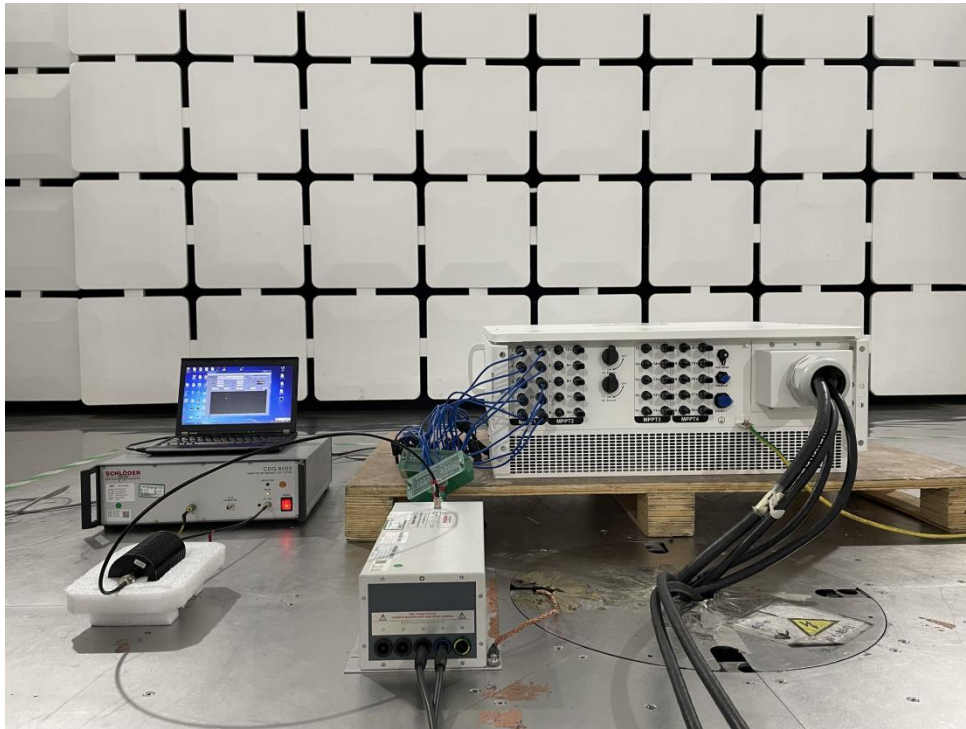


B.9 Immunity to Conducted Disturbances Induced by RF Fields

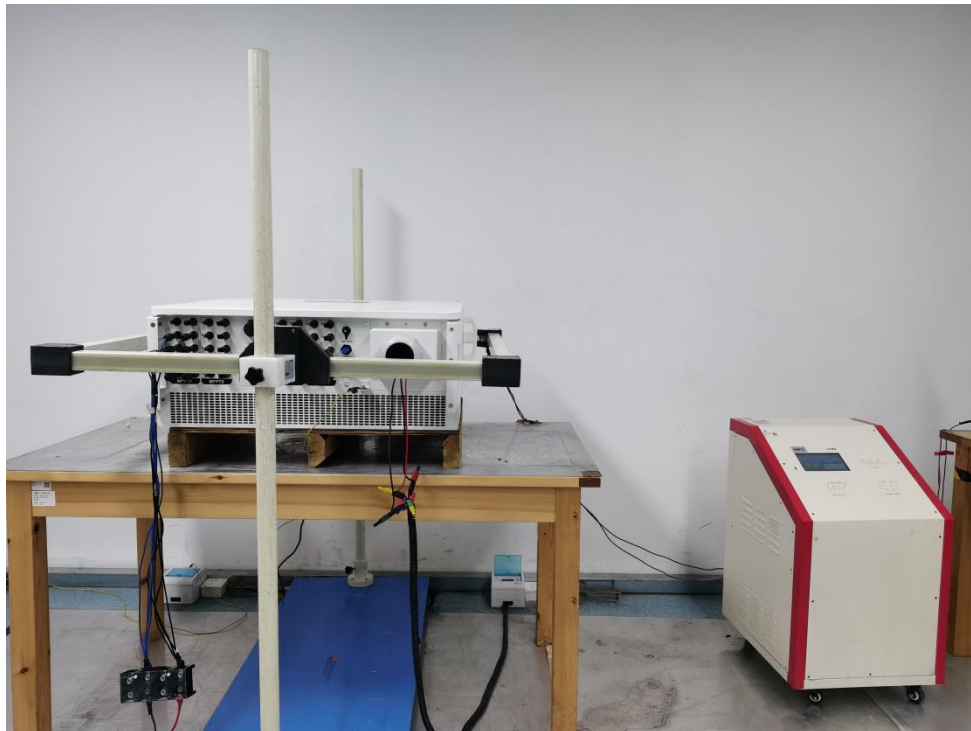
AC Output Port



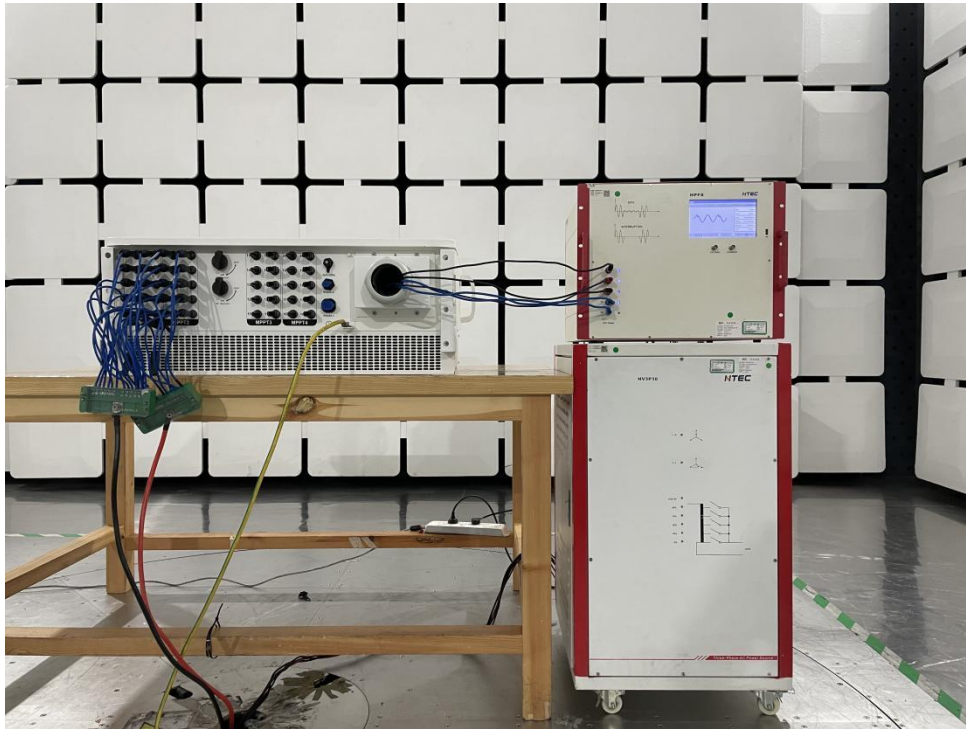
PV Input Port



B.10 Power Frequency Magnetic Fields Immunity



B.11 Voltage Dips and Short Interruptions Immunity

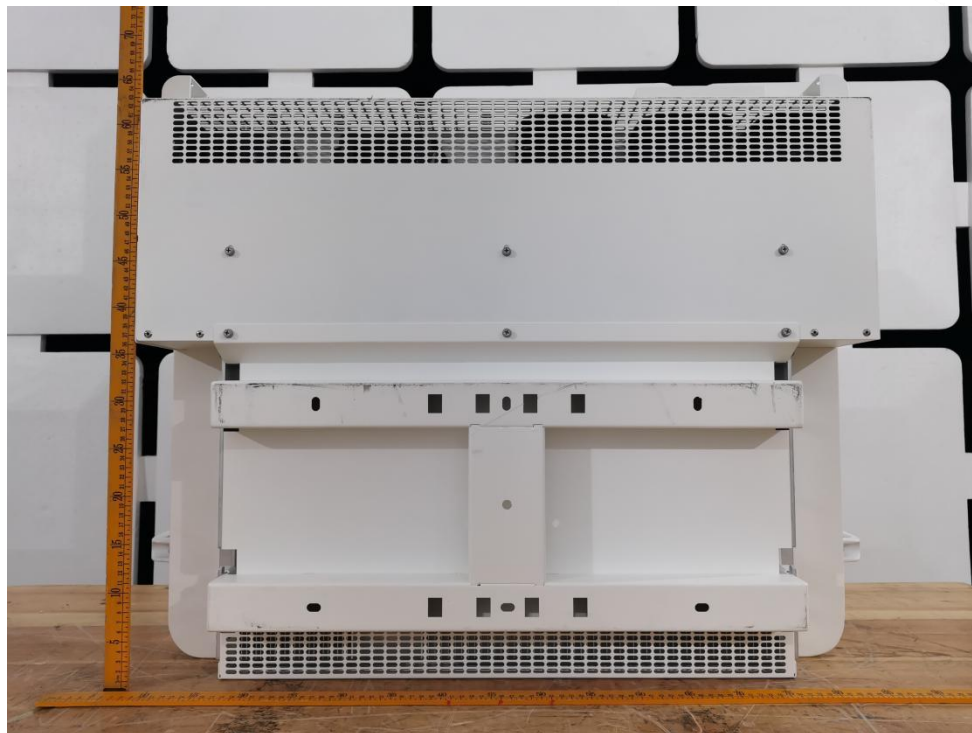


ANNEX C EUT EXTERNAL PHOTOS

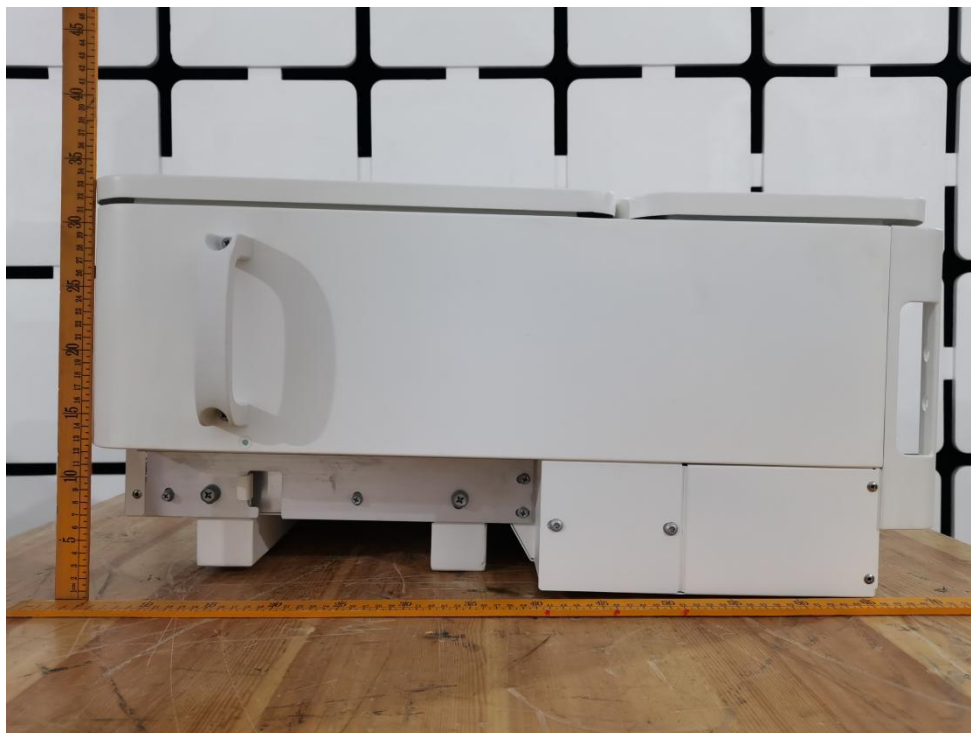
Front



Back



Left



Right



Top



Interface



ANNEX D EUT INTERNAL PHOTOS

Internal



Internal



Internal



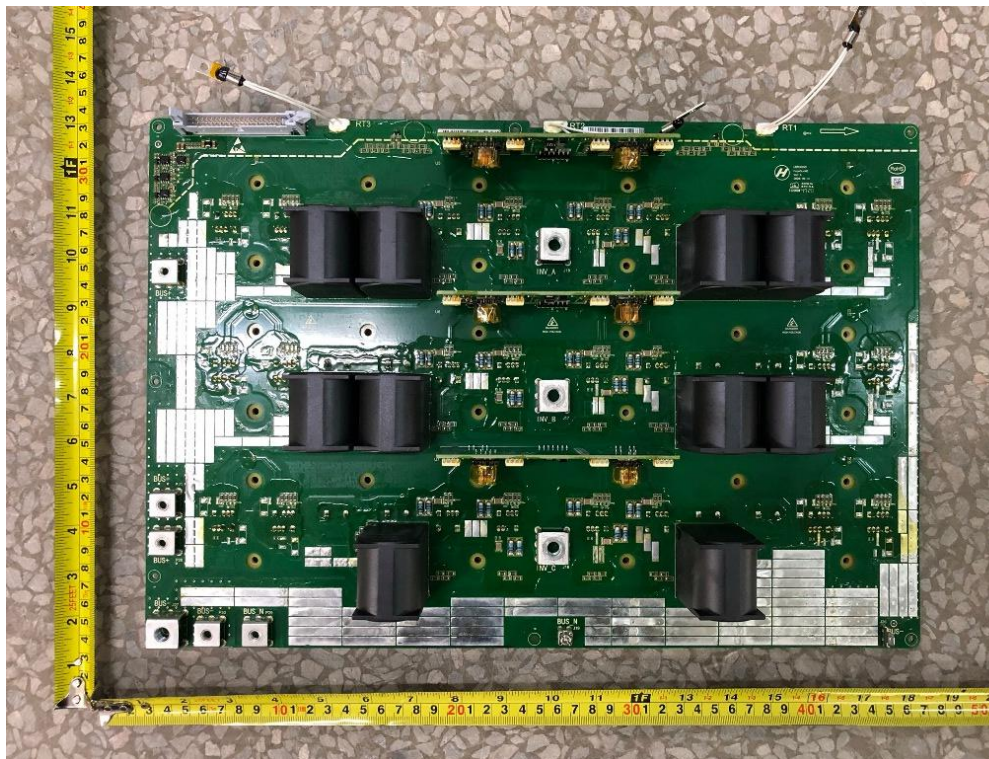
Internal



Internal



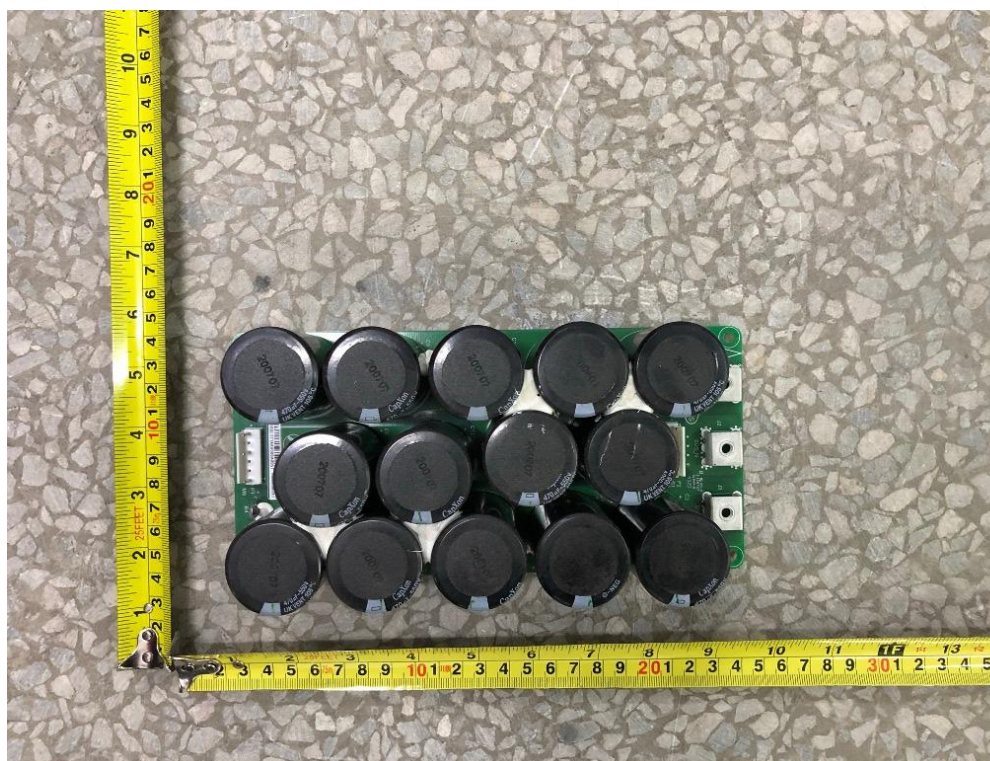
The front view of hopeSunWE board



The back view of hopeSunWE board



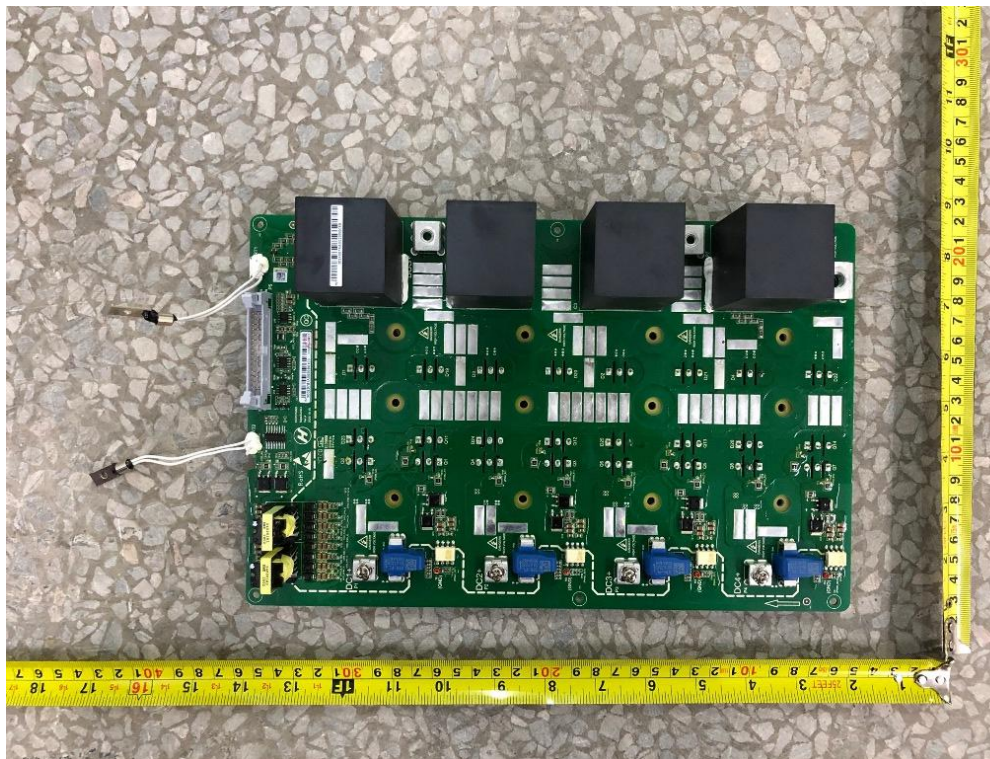
The front view of hopeSunC3 board



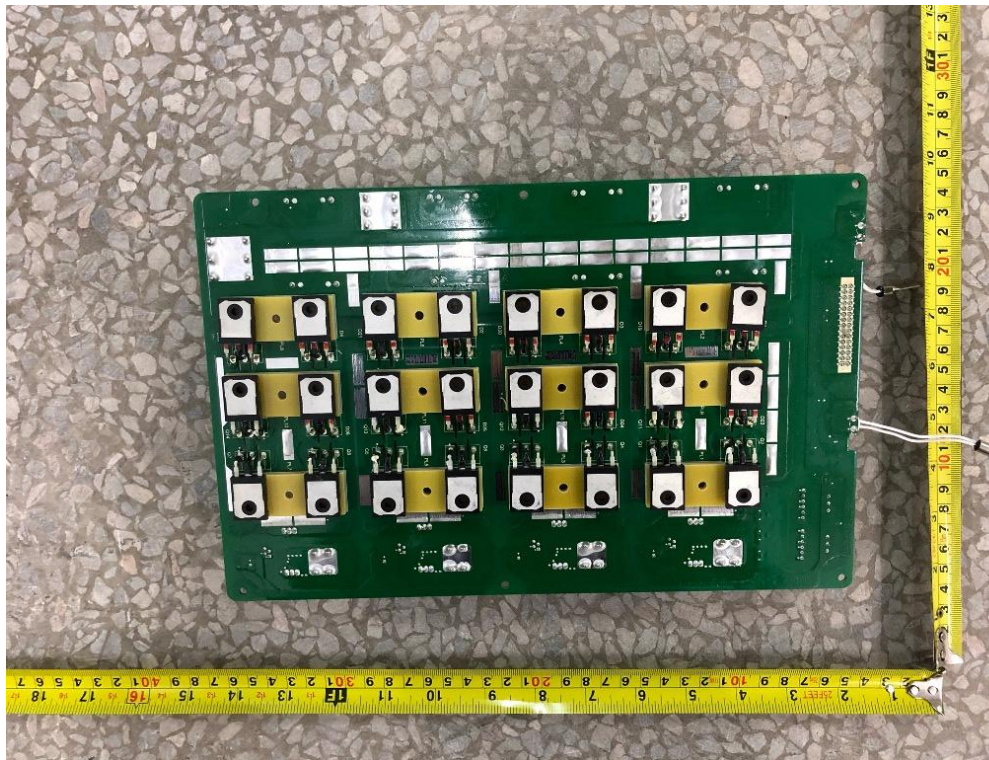
The back view of hopeSunC3 board



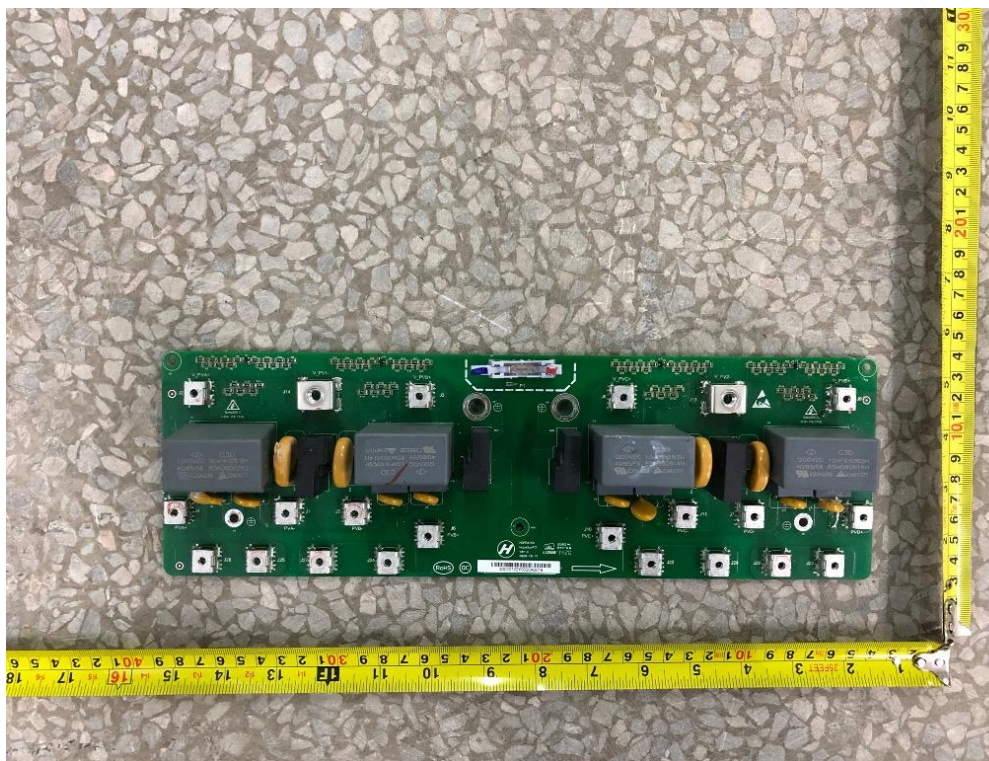
The front view of hopeSunWJ board



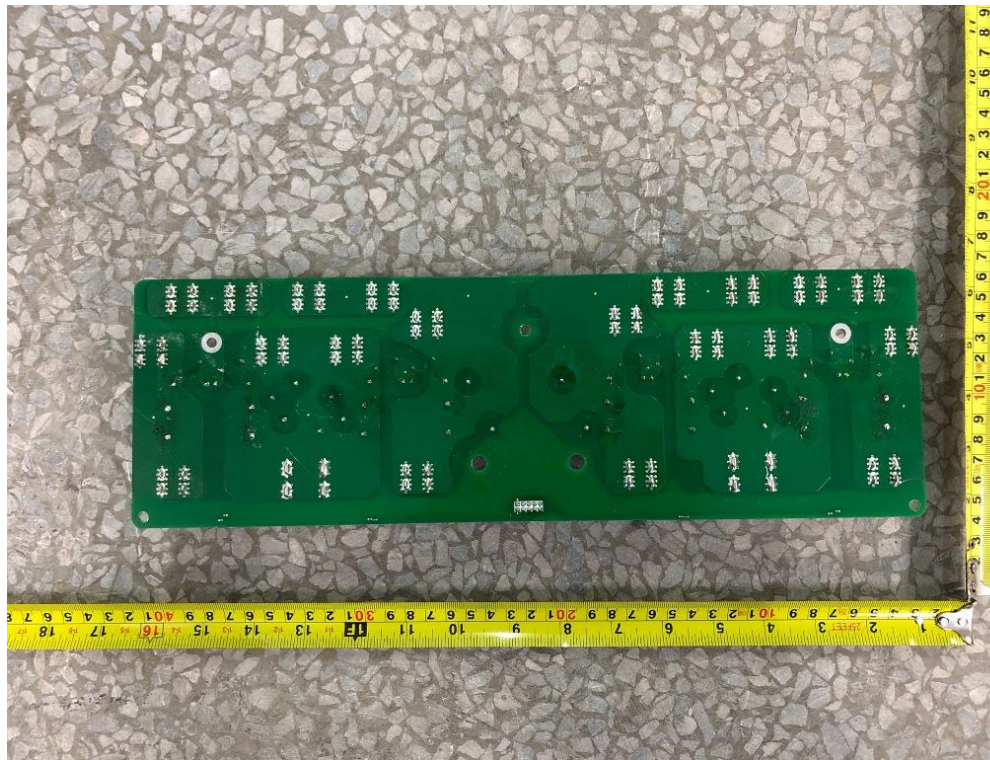
The back view of hopeSunWJ board



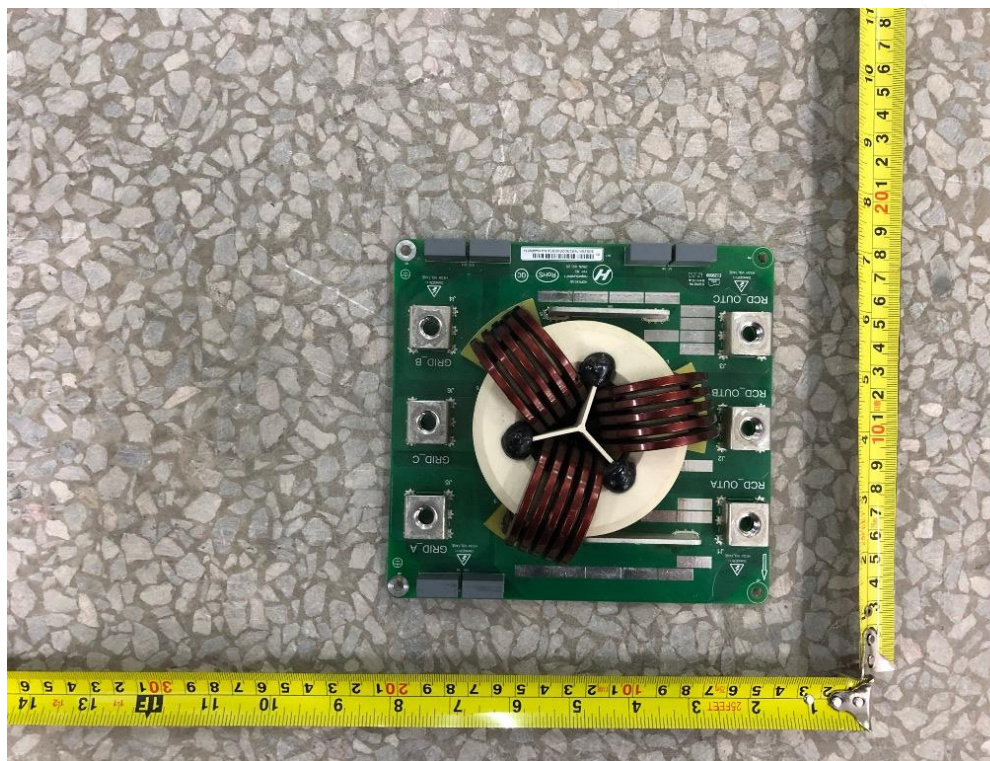
The front view of hopeSunF3 board



The back view of hopeSunF3 board



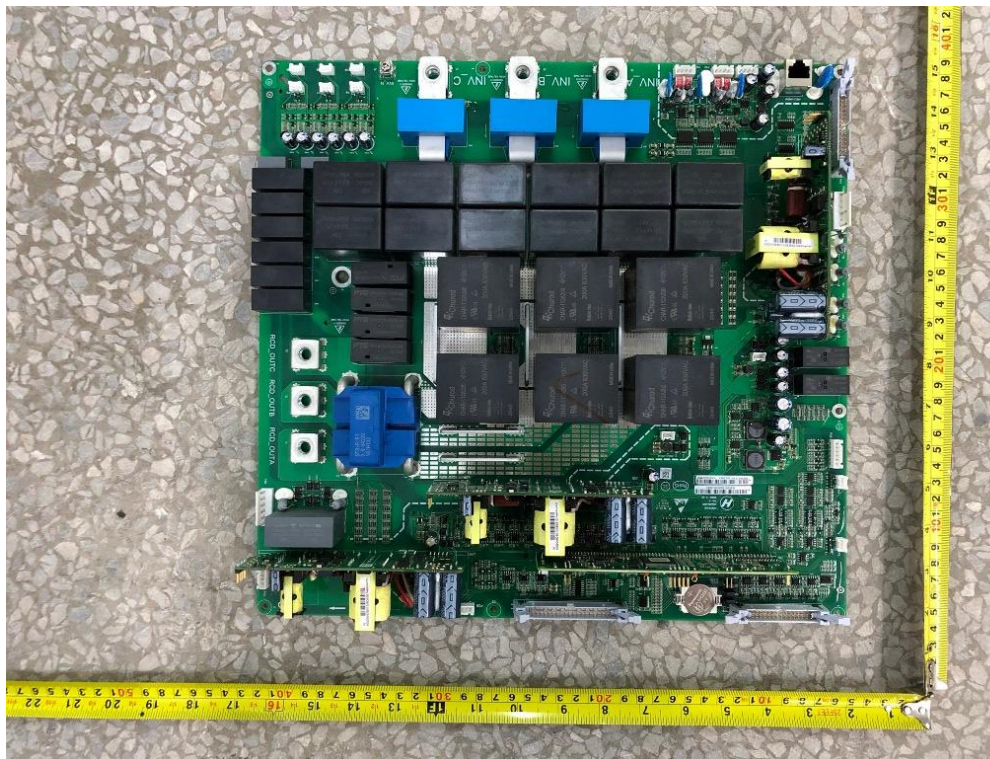
The front view of hopeSunHVF1 board



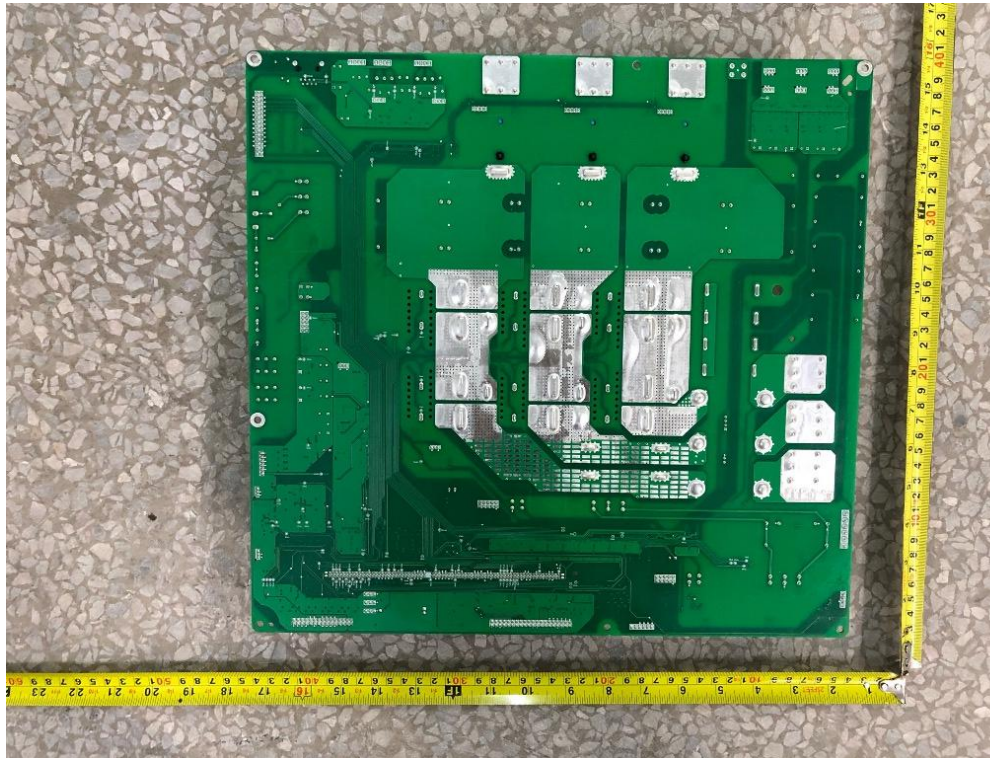
The back view of hopeSunHVF1 board



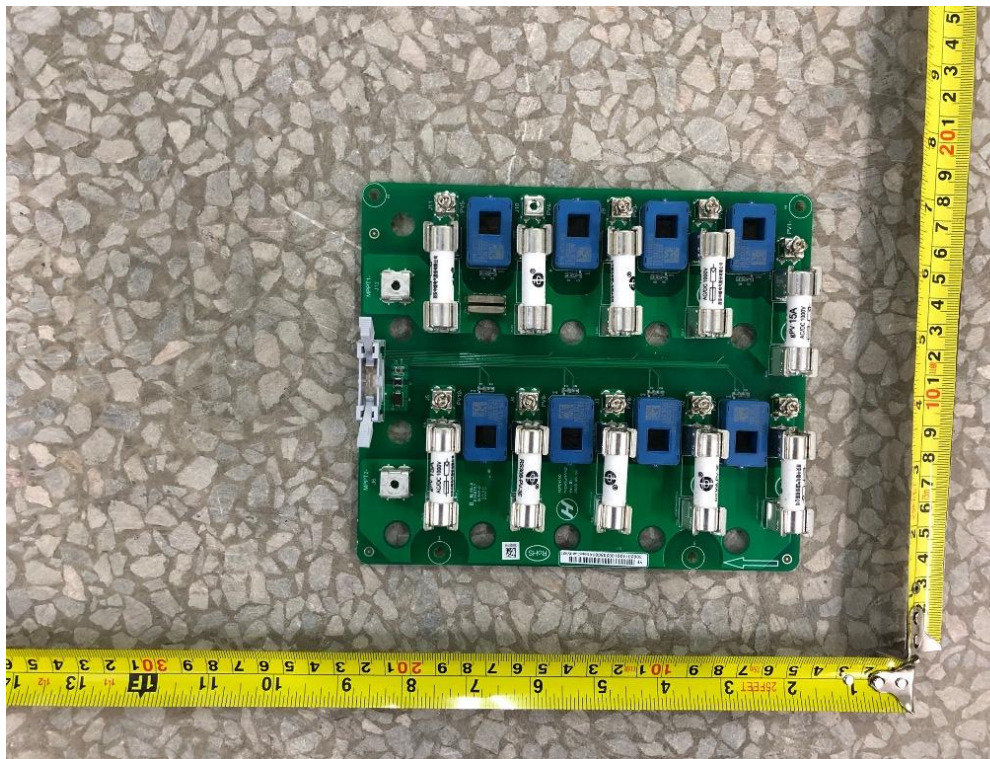
The front view of hopeSunM9 board



The back view of hopeSunM9 board



The front view of hopeSunHVB2 board



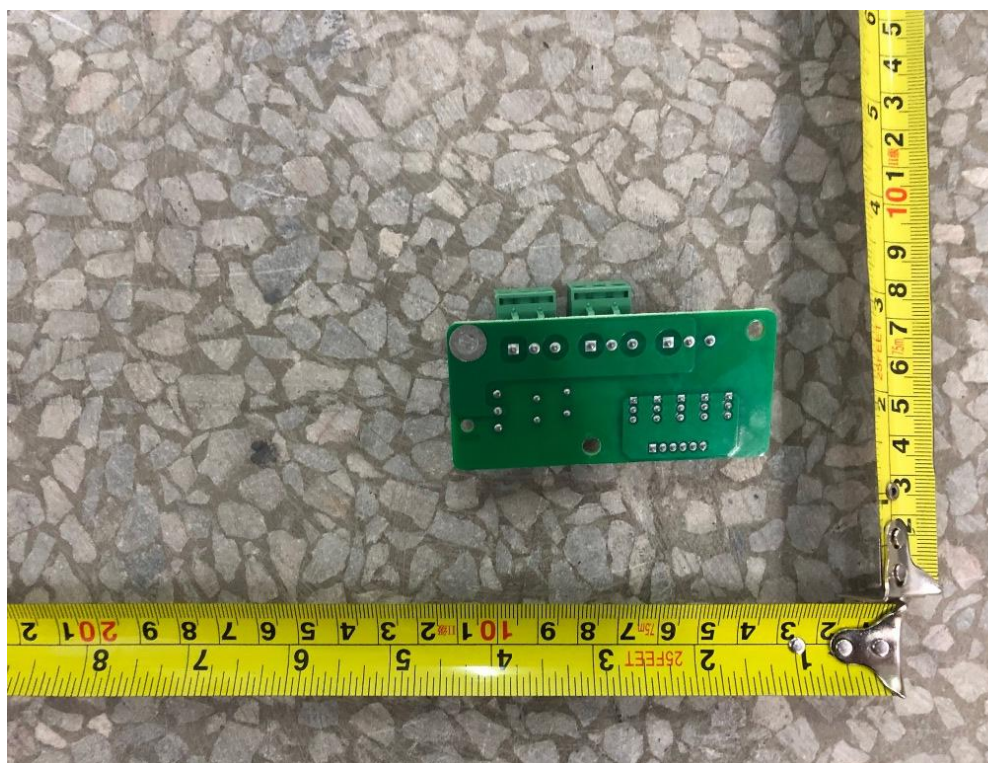
The back view of hopeSunHVVH2 board



The front view of HPS1K0X3 board



The back view of HPS1K0X3 board



Hardware Version & Software Version & Serial Number

hopeinsight 三相组串式逆变器 系统信息 系统配置 参数监控 示波器 数据抓取 数据分析 整机条码: 30100201A002190177

时钟校准 出厂设置 任务触发 系统基本设置 版本信息

开机设置
 时钟校准
 系统基本设置
 批量参数设置
 基本设置
 出厂设置
 参数简化
 固件升级
 升级文件打包
 Flash逻辑配置
 版本信息
 调试功能
 任务触发
 参数曲线

	网侧	机侧	后台	适配器	
软件版本	106.008.000	569.006.000	/	004.013.020	/
CPLD/FPGA版本	108.000.000	000.000.000	/	/	/
平台版本	102.005.003	100.004.119	/	11962	/
后台协议	3-1-600.000.000	3-1-600.000.000	/	600.000.000	/
CAN协议	/-/	2-0-540.000.000	/	/	/
DSP/DSP协议	1-0-540.000.000	1-0-540.000.000	/	/	/
CPLD/FPGA协议	4-0-800.000.000	0-0-560.000.000	/	/	/
产品归属	3.1.3.1.0	3.1.3.1.0	/	/	/

刷新 更多 保存为文件

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--END OF REPORT--