INVT Solar Technology (Shenzhen) Co., Ltd.

TEST REPORT

SCOPE OF WORK
EMC TESTING– See page 2

REPORT NUMBER
210623193GZU-001

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PAGES
48

DOCUMENT CONTROL NUMBER
EN IEC 61000-6-1, 6-3-a

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Applicant Name & Address	:	INVT Solar Technology (Shenzhen) Co., Ltd. 6 th Floor , Block A, INVT Guangming Technology Building, Kejie Fourth Road, Shutianpu Community, Matian Guangming District, 518000 Shenzhen, PEOPLE'S REPUBLIC OF CHAINA
Manufacturing Site	:	Same as applicant
Intertek Report No:		210623193GZU-001

Test standards

EN IEC 61000-6-3:2021
EN IEC 61000-6-1:2019

Sample Description

Product	:	Grid-tied Solar inverter
Model No.	:	iMars XG25KTR-3M, iMars XG25KTR-3S, iMars XG30KTR, iMars XG30KTR-S, iMars XG33KTR, iMars XG33KTR-S, iMars XG36KTR, iMars XG36KTR-S, iMars XG40KTR, iMars XG40KTR-S
Electrical Rating	:	See page 7 to 8
Serial No.		Not Labeled
Date Received	:	23 June 2021
Date Test Conducted	:	01 September 2021- 03 December 2021

Prepared and Checked By

Guitar Huang

Project Engineer

Approved By:

Sky Zhu

Team Leader

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1. TEST RESULTS SUMMARY

Test Item	Standard	Result
Continuous conducted disturbance voltage	EN IEC 61000-6-3:2021 Reference: EN 55016-2-1:2014	Pass
Discontinuous conducted disturbance voltage	EN IEC 61000-6-3:2021 Reference: EN 55014-1:2017+A11:2020	N/A
Emission at Telecommunications / network Ports	EN IEC 61000-6-3:2021 Reference: EN 55032 :2015+A11 :2020	N/A
Radiated emission (30 MHz–1000 MHz)	EN IEC 61000-6-3:2021 Reference: EN 55016-2-3:2017	Pass
Radiated emission (1 GHz–6 GHz)	EN IEC 61000-6-3:2021 Reference: EN 55016-2-3:2017	N/A
Harmonic of current	EN IEC 61000-6-3:2021 Reference: EN 61000-3-12 :2011	Pass
Flicker	EN IEC 61000-6-3:2021 Reference: EN IEC 61000-3-11 :2019	Pass
ESD immunity	EN IEC 61000-6-1:2019 Reference: EN 61000-4-2:2009	Pass
Radiated EM field immunity	EN IEC 61000-6-1:2019 Reference: EN 61000-4-3:2006 +A1:2008 + A2:2010	Pass
EFT immunity	EN IEC 61000-6-1:2019 Reference: EN 61000-4-4:2012	Pass
Surge immunity	EN IEC 61000-6-1:2019 Reference: EN 61000-4-5:2014	Pass
Inject current immunity	EN IEC 61000-6-1:2019 Reference: EN 61000-4-6:2014	Pass
Power frequency magnetic field immunity	EN IEC 61000-6-1:2019 Reference: EN 61000-4-8:2010	Pass
Voltage dips and interruption immunity	EN IEC 61000-6-1:2019 Reference: EN 61000-4-11:2004	N/A

Remark:
1. The symbol “N/A” in above table means Not Applicable.
2. When determining the test results, measurement uncertainty of tests has been considered.

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2. EMC RESULTS CONCLUSION

RE: EMC Testing Pursuant to EMC Directive 2014/30/EU performed on the Grid-tied Solar inverter, Models: iMars XG25KTR-3M, iMars XG25KTR-3S, iMars XG30KTR, iMars XG30KTR-S, iMars XG33KTR, iMars XG33KTR-S, iMars XG36KTR, iMars XG36KTR-S, iMars XG40KTR, iMars XG40KTR-S

The control system is divided into DC and AC control. DSP on the AC side mainly monitors the voltage, current, frequency and GFCI on the grid side, and participates in the inverter control.
The M0 monitors the voltage, current, and ISO on the PV input side, and participates in the BOOS booster circuit and maximum power MPPT point tracking.
There is an internal communication circuit between the two DSP to coordinate with each other to complete the software function of the whole machine.
The ARM monitoring board does not participate in the control of the whole system. It communicates with the DC-SPS to collect the data of the whole system.
The relays (K1, K2, K3, K4, K5, K6) are designed on redundant structure where K1, K2, K3 are controlled by DC-DSP and K4 K5, K6 are controlled by M0.
The DSP and M0 are used together to control relay open or close, if the single fault on one controller, the other controller can be capable of opening the relay, so that still providing safety means.

Other than special notes, typical model **iMars XG40KTR** used as representative for testing in this report.

The production units are required to conform to the initial sample as received when the units are placed on the market.

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Electrical Rating:

Model	**iMars XG25KTR-3M**	**iMars XG25KTR-3S**
Max.PV voltage	1100V	
MPPT voltage range	200V – 1000V	
Max.input current	26A*3	16A*3
PV Isc	32A*3	20A*3
Nominal output voltage	3/N/PE, 230/400V	
Nominal output Frequency	50/60Hz	
Max.output current	40.1A	
Rated output power	25KW	
Max.apparent power	27.7KVA	
Power factor range	0.8Leading – 0.8 lagging	
Safety level	Class I	
Ingress Protection	IP 66	
Operation Ambient Temperature	-30℃ - +60℃	
Software version	V1.0	
Model	**iMars XG30KTR**	**iMars XG30KTR -S**
Max.PV voltage	1100V	
MPPT voltage range	200V – 1000V	
Max.input current	26A*3	16A*3
PV Isc	32A*3	20A*3
Nominal output voltage	3/N/PE, 230/400V	
Nominal output Frequency	50/60Hz	
Max.output current	48.3A	
Rated output power	30KW	
Max.apparent power	33.3KVA	
Power factor range	0.8Leading – 0.8 lagging	
Safety level	Class I	
Ingress Protection	IP 66	
Operation Ambient Temperature	-30℃ - +60℃	
Software version	V1.0	
Model	**iMars XG33KTR**	**iMars XG33KTR -S**
Max.PV voltage	1100V	
MPPT voltage range	200V – 1000V	
Max.input current	26A*3	16A*3
PV Isc	32A*3	20A*3
Nominal output voltage	3/N/PE, 230/400V	
Nominal output Frequency	50/60Hz	
Max.output current	53A	
Rated output power	33KW	
Max.apparent power	36.6KVA	
Power factor range	0.8Leading – 0.8 lagging	
Safety level	Class I	
Ingress Protection	IP 66	
Operation Ambient Temperature	-30℃ - +60℃	
Software version	V1.0	

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Model	**iMars XG36KTR**	**iMars XG36KTR -S**
Max.PV voltage	1100V	
MPPT voltage range	200V – 1000V	
Max.input current	26A*4	16A*4
PV Isc	32A*4	20A*4
Nominal output voltage	3/N/PE, 230/400V	
Nominal output Frequency	50/60Hz	
Max.output current	57.8A	
Rated output power	36KW	
Max.apparent power	39.6KVA	
Power factor range	0.8Leading – 0.8 lagging	
Safety level	Class I	
Ingress Protection	IP 66	
Operation Ambient Temperature	-30℃ - +60℃	
Software version	V1.0	
Model	**iMars XG40KTR**	**iMars XG40KTR -S**
Max.PV voltage	1100V	
MPPT voltage range	200V – 1000V	
Max.input current	26A*4	16A*4
PV Isc	32A*4	20A*4
Nominal output voltage	3/N/PE, 230/400V	
Nominal output Frequency	50/60Hz	
Max.output current	64.3A	
Rated output power	40KW	
Max.apparent power	44KVA	
Power factor range	0.8Leading – 0.8 lagging	
Safety level	Class I	
Ingress Protection	IP 66	
Operation Ambient Temperature	-30℃ - +60℃	
Software version	V1.0	

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3. LABORATORY MEASUREMENTS

Configuration Information

Support Equipment:	DC power source
Rated Voltage and frequency under test:	See page 6 to 7
Condition of Environment:	Temperature: 22~28°C Relative Humidity:35~60% Atmosphere Pressure:86~106kPa

Notes:

1. The EMI measurements had been made in the operating mode produced the largest emission in the frequency band being investigated consistent with normal applications. An attempt had been made to maximize the emission by varying the configuration of the EUT.

2. The EMS measurements had been made in the frequency bands being investigated, with the EUT in the most susceptible operating mode consistent with normal applications. The configuration of the test sample had been varied to achieve maximum susceptibility.

3. Test Location:
All tests were performed at:
INVT Solar Technology (Shenzhen) Co., Ltd.
6 th Floor , Block A, INVT Guangming Technology Building, Kejie Fourth Road, Shutianpu Community, Matian Guangming District, 518000 Shenzhen, PEOPLE'S REPUBLIC OF CHAINA

Except the Radiated EM field immunity and Power frequency magnetic field immunity tests were subcontracted at:
Shenzhen EMTEK Co.,Ltd.
Bldg. 69, Majialong Industry Zone, Nanshan District, Shenzhen,Guangdong,China.

4.Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Conduction Emission (150 kHz-30 MHz)	3.5dB
2	Radiated Emission (30 MHz-1 GHz)	3.6 dB

The measurement uncertainty describes the overall uncertainty of the given measured value during the operation of the EUT.
Measurement uncertainty is calculated in accordance with CISPR16-4-2:2011
The measurement uncertainty is given with a confidence of 95%, k=2.

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4. EQUIPMENT USED DURING TEST

Equipment from IVT				
Test item	Equipment	Model	No.	Due Date
CS	signal generator	CIT-10	IT-RD-617	2022-07-07
	signal generator	75A250AM1	IT-RD-142	2022-04-05
	EM Clamp	EMCL-20	IT-RD-618	2022-07-07
	attenuator	75W 6dB	IT-RD-619	2022-08-27
	CDN	CDN-M5-32A	IT-RD-642	2022-01-12
EFT	EFT system	EFT 500T	IT-RD-704	2021-11-05
	EFT Clamp	CCC 1000	IT-RD-705	2021-11-05
Surge	Surge signal generator	CWS 800G+SPN 3832T	IT-RD-787	2022-04-05
	Signal line surge generator	SG-728G+SCN-C5	IT-RD-552	2021-09-23
ESD	ESD system	EDS 30V	IT-RD-754	2022-04-08
CE/RE	EMI Receiver	ESPI3	IT-RD-139	2021-12-22
	AMN	NNLK 8121	IT-RD-247	2021-09-23
	Antenna	VULB9168	IT-RD-257	2022-03-11
	shield room	543	IT-RD-455	2024-11-18
	shield room	753	IT-RD-245	2024-11-18
	3m anechoic chamber	966	IT-RD-717	2024-09-21
Harmonics/Flicker	Power analyzer	S7	GF010032	2022/11/24
	AC source	PRE1536	GF010023	2022/11/24
	AC source	Chroma 61511	GF610036	2022/11/24
	DC source	61250H-1800S	GF010159	2022/11/24

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R/S (EMTEK)						
Equ.No.	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
EE-066-2	Power Amplifier	MILMEGA	AS0102-55	1018770	2021/5/15	1 Year
EE-066-4	50ohm Diode Power Sensor	BOONTON	51011EMC	34236	2021/5/15	1 Year
EE-066-6	RF Power Meter. Dual Channel	BOONTON	4232A	10539	2021/5/15	1 Year
EE-067	Log.-Per. Antenna	SCHWARZBECK	VULP 9118E	811	N/A	N/A
EE-218	Signal Generator	Agilent	N5181A	MY50145187	2021/5/15	1 Year
EE-219	50ohm Diode Power Sensor	BOONTON	51011EMC	36164	2021/5/15	1 Year
EE-220	Broad-Band Horn Antenna	SCHWARZBECK	STLP 9149	9149-227	N/A	N/A
EE-221	Field Strength Meter	DARE	RSS1006A	10I00037SNO22	2021/5/15	1 Year
EE-222	Multi-function interface system	DARE	CTR1009B	12I00250SNO72	N/A	N/A
EE-223	Automatic switch group	DARE	RSW1004A	N/A	N/A	N/A
EE-224	Power Amplifier	MILMEGA	AS1860-50	1059346	2021/5/15	1 Year
EE-225	Power Amplifier	MILMEGA	80RF1000-175	1059345	2021/5/15	1 Year
EE-225-1	Directional Coupler	MILMEGA	DC6180AM1	0340463	2021/5/15	1 Year
EE-115	Audio Analyzer	R&S	UPV	101473	2021/5/15	1 Year
EE-615	Audio Test System	AUDIO PRECISION	ATS-1	41100	2021/5/15	1 Year

Power frequency magnetic field (EMTEK)						
Equ.No.	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
EE-006	Magnetic Field Tester	HAEFELY	MAG100	250040.1	2021/5/28	1Year

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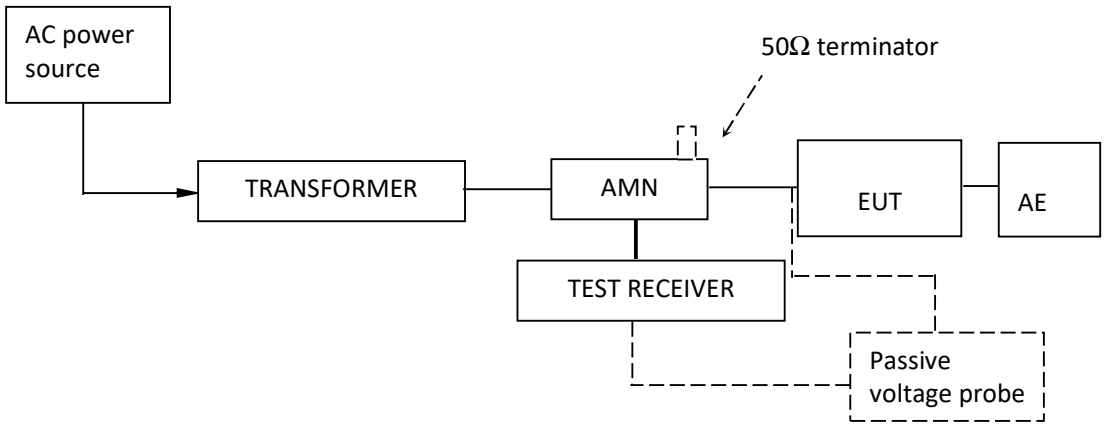
5. EMI TEST

5.1 EN IEC 61000-6-3 Continuous Conducted Disturbance Voltage Test

Test Result: Pass

5.1.1 Block Diagram of Test Setup



5.1.2 Test Setup and Procedure

The EUT was set to achieve the maximum emission level. The mains terminal disturbance voltage was measured with the EUT in a shielded room. The EUT was connected to AC power source through an Artificial Mains Network which provides a 50Ω linear impedance artificial hand is used if appropriate (for handheld apparatus). The load/control terminal disturbance voltage was measured with passive voltage probe if appropriate.

The table-top EUT was placed on a 0.8m high non-metallic table above earthed ground plane (Ground Reference Plane).And for floor standing EUT, was placed on a 0.1m high non-metallic supported on GRP. The EUT keeps a distance of at least 0.4m from a vertical metallic surface. The Artificial Mains Network is situated at a distance of 0.8m from the EUT.

During the test, mains lead of EUT excess 0.8m was folded back and forth parallel to the lead so as to form a horizontal bundle with a length between 0.3m and 0.4m.

The bandwidth of test receiver was set at 9 kHz. The frequency range from 150 kHz to 30 MHz was checked.

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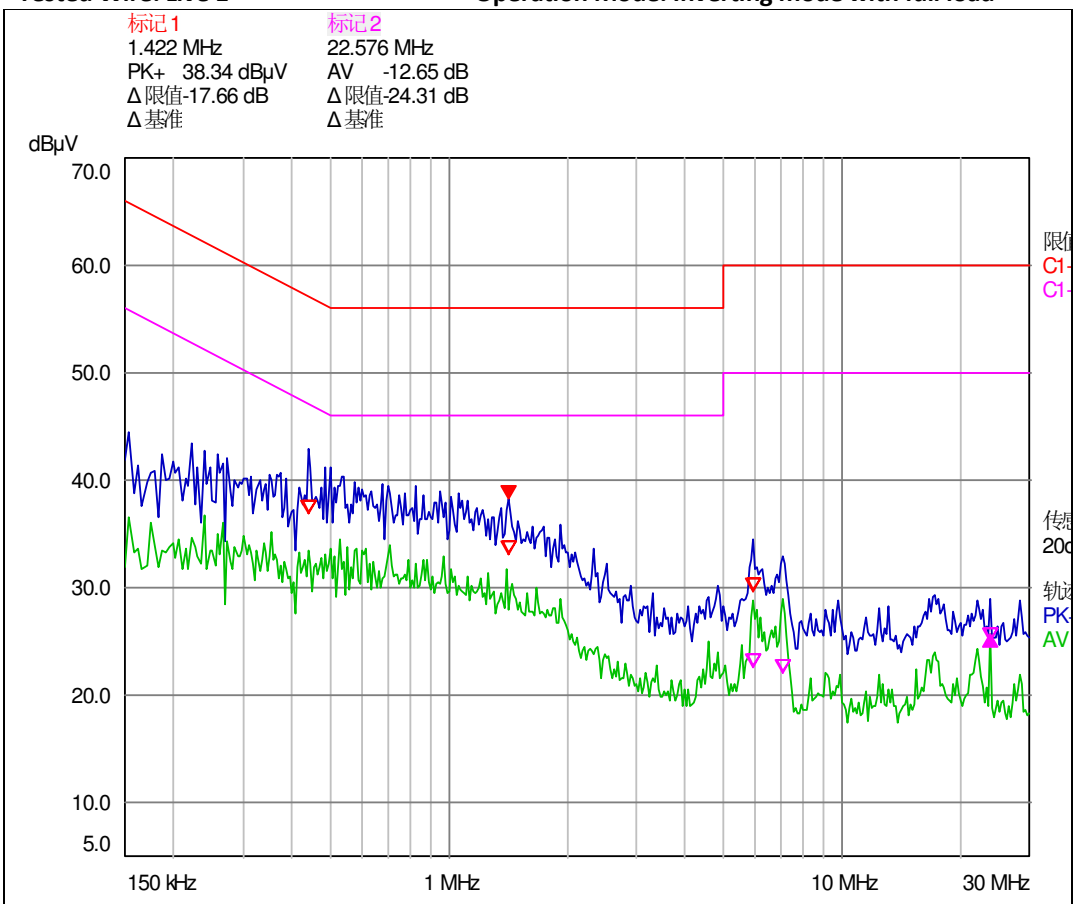
5.1.3 Test Data and curve

At mains terminal:

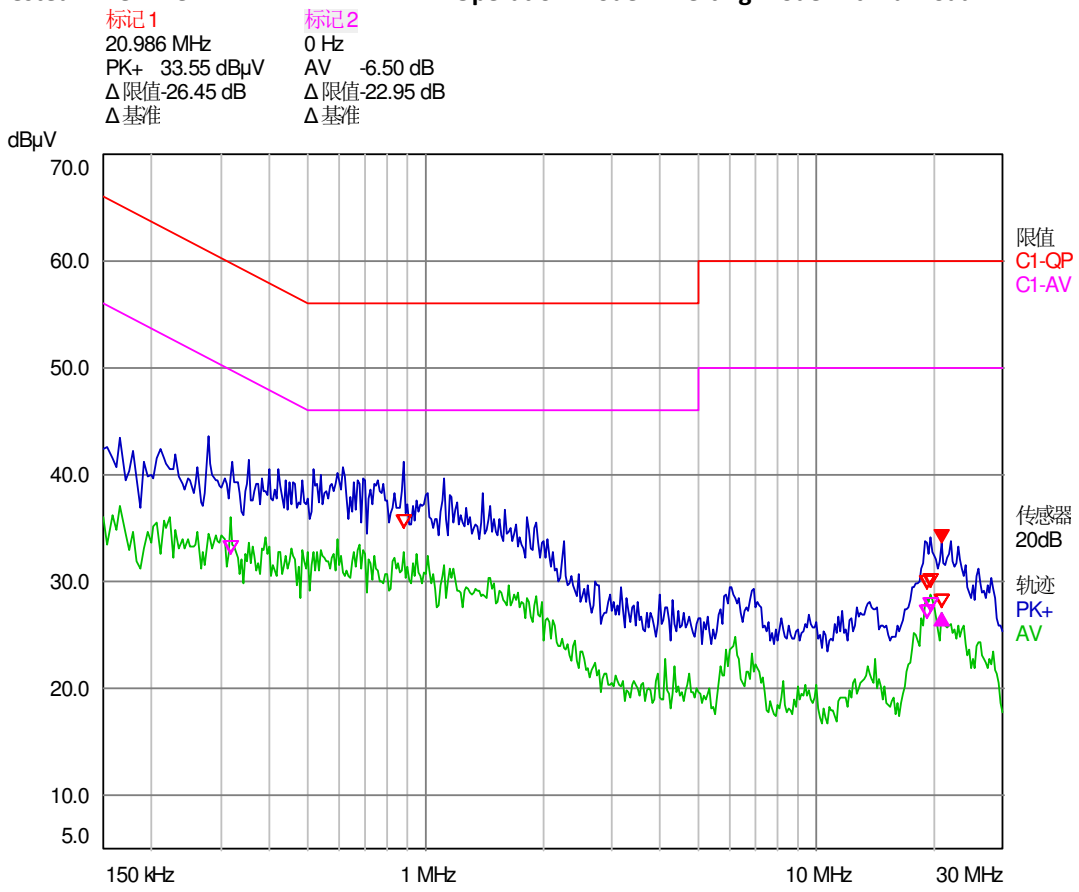
Tested Wire: Live 1 **Operation Mode: Inverting mode with full load**



Track	Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)
1 QP	0.438	36.92	57.10	-20.18
1 QP	1.422	33.16	56.00	-22.84
1 QP	5.962	29.70	60.00	-30.30
2 AV	5.962	22.52	50.00	-27.48
2 AV	7.062	22.03	50.00	-27.97
2 AV	23.998	24.98	50.00	-25.02

TEST REPORT

Tested Wire: Live 2 **Operation Mode: Inverting mode with full load**



Track	Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)
2 AV	0.318	32.55	49.76	-17.21
1 QP	0.878	34.99	56.00	-21.01
2 AV	19.182	26.50	50.00	-23.50
1 QP	19.238	29.34	60.00	-30.66
2 AV	19.682	27.27	50.00	-22.73
1 QP	19.722	29.48	60.00	-30.52
1 QP	20.986	27.54	60.00	-32.46

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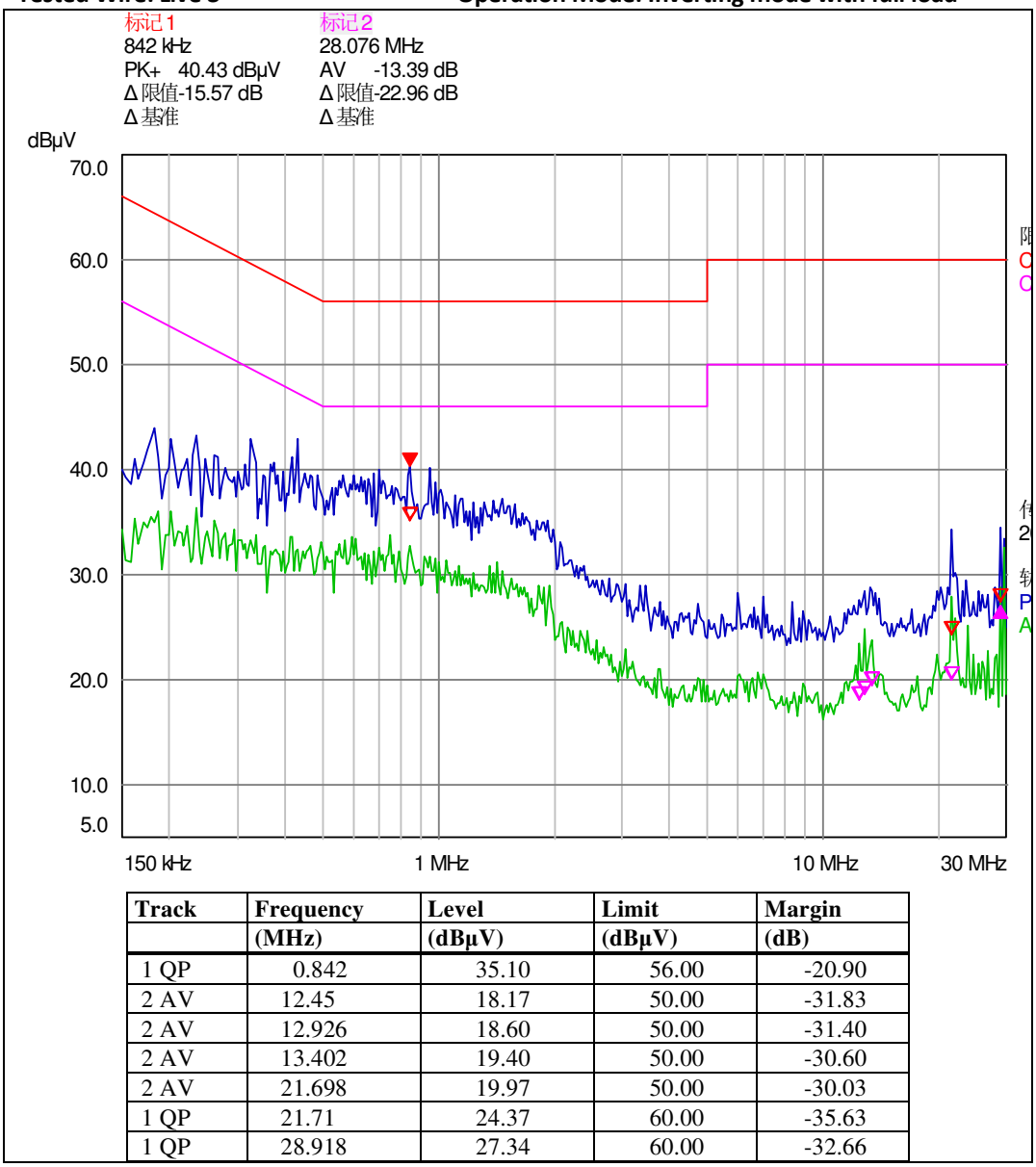
Tested Wire: Live 3 **Operation Mode: Inverting mode with full load**



Track	Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)
1 QP	0.842	35.10	56.00	-20.90
2 AV	12.45	18.17	50.00	-31.83
2 AV	12.926	18.60	50.00	-31.40
2 AV	13.402	19.40	50.00	-30.60
2 AV	21.698	19.97	50.00	-30.03
1 QP	21.71	24.37	60.00	-35.63
1 QP	28.918	27.34	60.00	-32.66

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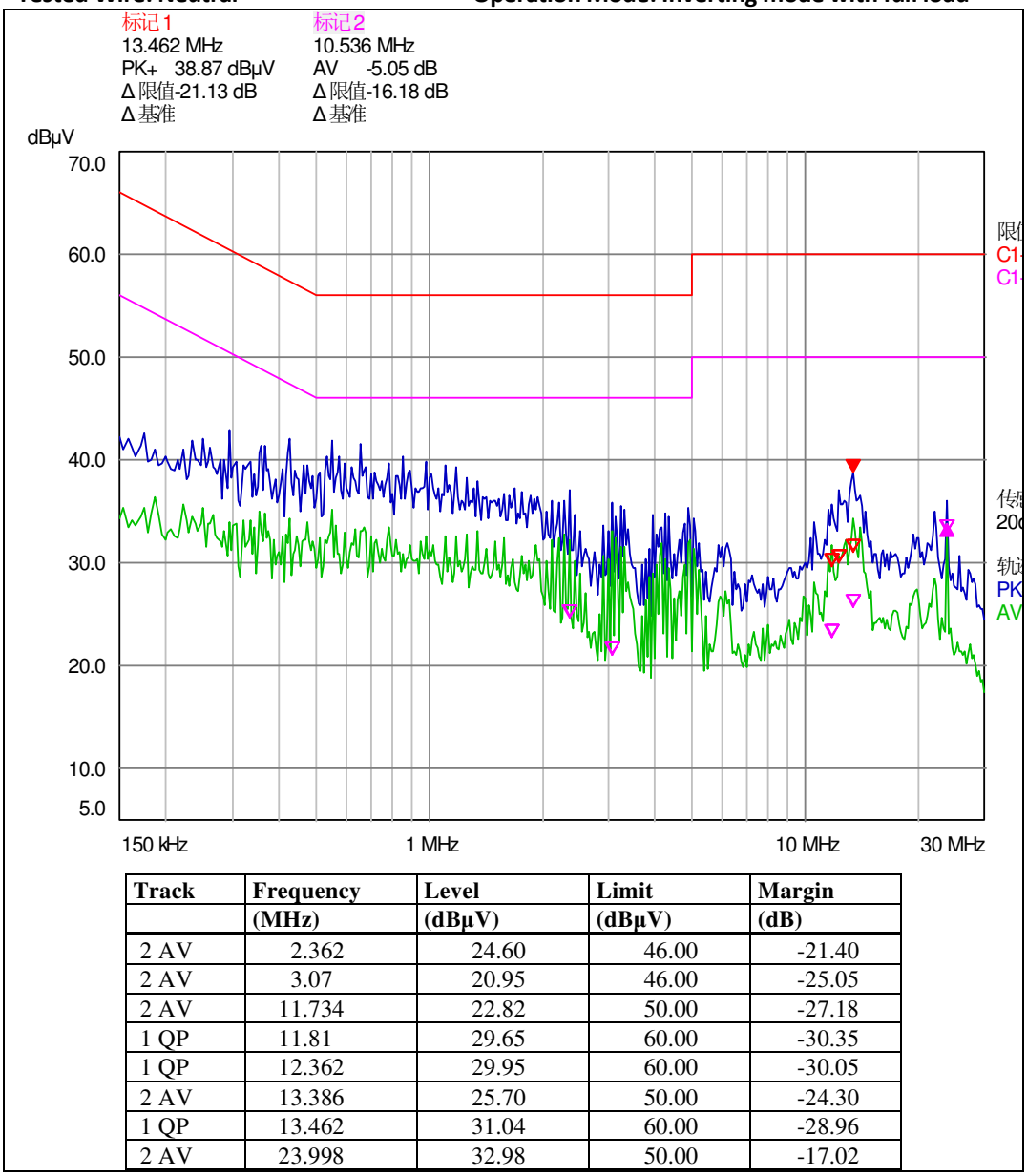
Tested Wire: Neutral **Operation Mode: Inverting mode with full load**



Track	Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)
2 AV	2.362	24.60	46.00	-21.40
2 AV	3.07	20.95	46.00	-25.05
2 AV	11.734	22.82	50.00	-27.18
1 QP	11.81	29.65	60.00	-30.35
1 QP	12.362	29.95	60.00	-30.05
2 AV	13.386	25.70	50.00	-24.30
1 QP	13.462	31.04	60.00	-28.96
2 AV	23.998	32.98	50.00	-17.02

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5.2 EN IEC 61000-6-3 Discontinuous Conducted Disturbance Voltage

Test Result: Not applicable

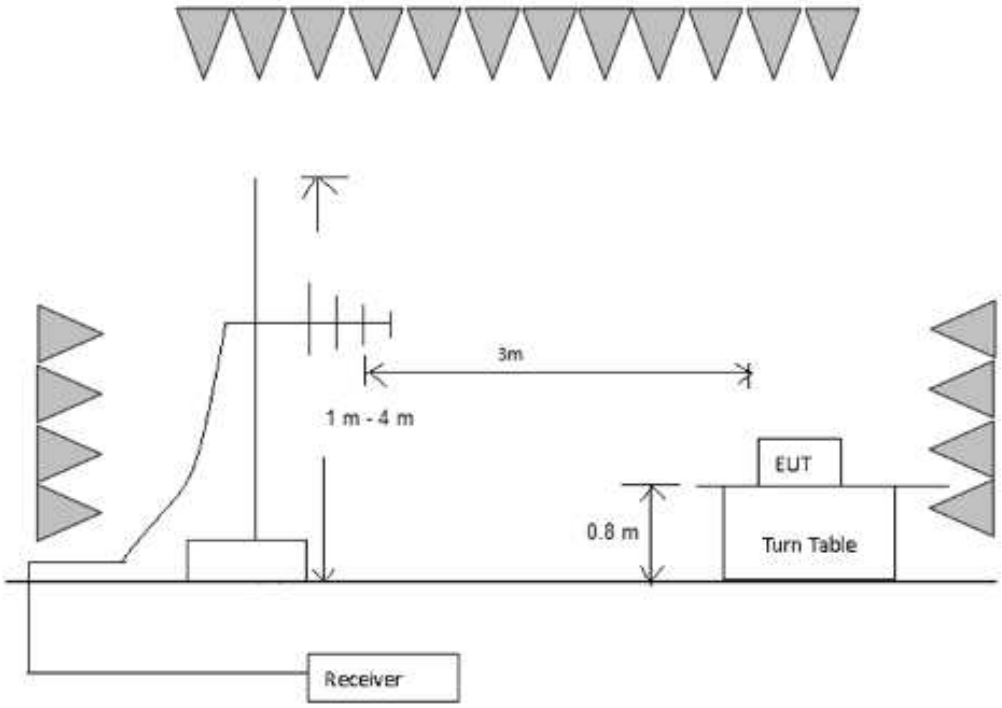
5.3 EN IEC 61000-6-3 Emission at Telecommunications/network Ports

Test Result: Not applicable.
Remark: The test only apply to balanced telecommunication ports intended for connection to unscreened balanced pairs

5.4 EN IEC 61000-6-3 Radiated Emission below 1 GHz

Test Result: Pass

5.4.1 Block Diagram of Test Setup



5.4.2 Test Setup and Procedure

The measurement was applied in a semi-anechoic chamber. The EUT and simulators were placed on a 0.8m high wooden turntable above the horizontal metal ground plane. The turn table rotated 360 degrees to determine the position of the maximum emission level. The EUT was set 3 meters away from the receiving antenna which was mounted on an antenna mask. The antenna moved up and down between from 1meter to 4 meters to find out the maximum emission level.

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Broadband antenna was used as receiving antenna. Both horizontal and vertical polarization of the antenna was set on measurement. In order to find the maximum emission, all of the interface cables were manipulated according to EN55032 requirement during radiated test.
The bandwidth setting on R&S Test Receiver was 120 kHz.
The frequency range from 30MHz to 1000MHz was checked

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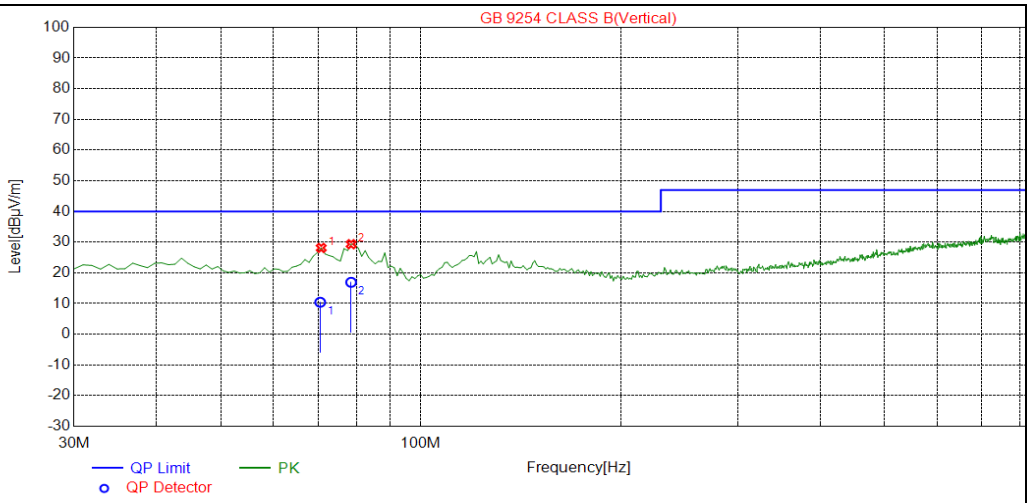
5.4.3 Test Data and Curve

Operation Mode: Inverting mode with full load

Horizontal



Final Data List					
NO.	Freq. [MHz]	QP Value [dBµV/m]	QP Limit [dBµV/m]	QP Margin [dB]	Polarity
1	70.5165	10.43	40.00	29.57	Horizontal
2	78.5167	16.93	40.00	23.07	Horizontal

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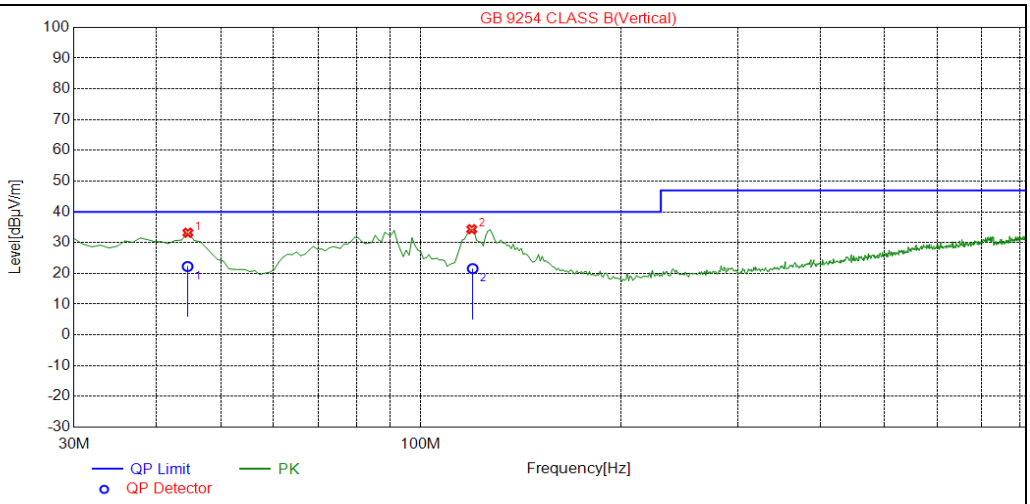
Vertical



Final Data List					
NO.	Freq. [MHz]	QP Value [dBµV/m]	QP Limit [dBµV/m]	QP Margin [dB]	Polarity
1	44.5098	22.25	40.00	17.75	Vertical
2	119.7196	21.56	40.00	18.44	Vertical

5.5 EN IEC 61000-6-3 Radiated Emission above 1 GHz

Test Result: Not Applicable
Remark:
The highest internal source of the EUT is not more than 108 MHz, so the measurement above 1000 MHz is not applicable.

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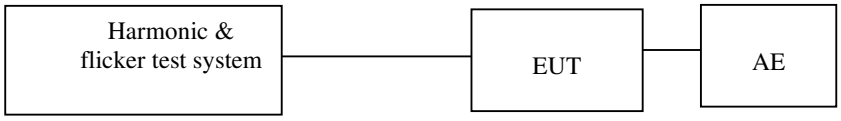
6. Harmonics of current

Test Result: Pass

6.1 Block Diagram of Test Setup



6.2 Test Setup and Procedure

Harmonics of the fundamental current were measured up to 40 order harmonics using a digital power meter with an analogue output and frequency analyser which was integrated in the harmonic & flicker test system. The measurements were carried out under steady conditions.

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6.3 Test Data

Operation Mode: Operation Mode: Inverting mode with full load

	I2%	I3%	I4%	I5%	I6%	I7%	I8%	I9%	I10%	I11%	I12%	I13%	Result
L1	0.44%	0.1759	0.2276	1.1776	0.2052	0.6052	0.1657	0.1081	0.0516	0.2259	0.0695	0.1776	Pass
L2	0.30%	0.1948	0.2483	1.0966	0.0764	0.6672	0.1388	0.119	0.0381	0.2431	0.035	0.1862	Pass
L3	0.30%	0.1612	0.1607	1.3024	0.1718	0.4897	0.0521	0.0402	0.0435	0.256	0.0672	0.1098	Pass

Remark:
Test category: Table:2, Rsce=33
THC/Iref (%): < Limit (%): 23.0 PWHC/Iref (%)<PWHC Limit (%): 23.0

Admissible individual harmonic current Ih/Iref% Limit:
I3< 21.6%, I5<10.7%, I7<7.2%, I9<3.8%, I11<3.1%, I13<2%
The relative values of even harmonics up to order 12 shall not exceed 16/h %.

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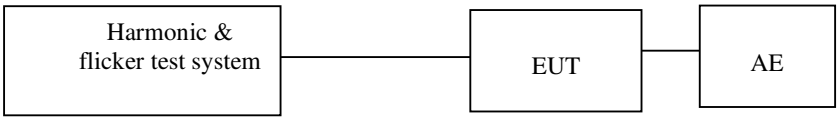
7. Flicker

Test Result: Pass

7.1 Block Diagram of Test Setup



7.2 Test Setup and Procedure

7.2.1 Definition

Flicker:	impression of unsteadiness of visual sensation induced by a lighting stimulus whose luminance or spectral distribution fluctuates with time.
Pst:	Short-term flicker indicator The flicker severity evaluated over a short period (in minutes); Pst=1 is the conventional threshold of irritability
Plt:	long-term flicker indicator; the flicker severity evaluated over a long period (a few hous). Using successive Pst valuse.
dc:	the relative steady-state voltage change
dmax:	the maximum relative voltage change
d(t):	the value during a voltage change

7.2.2 Test condition

The EUT was set to produce the most unfavourable sequence of voltage changes.

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7.3 Test Data

Operation Mode: Inverting mode with full load
Phase A:

	dc[%]	dmax[%]	d(t)[ms,%]	Pst	Plt
Limit	3.30000	4.00000	500.000 3.30000	1.00000	0.65000 N:12
1	0.00000 Pass	827.658 m Pass	0.00000 Pass	303.573 m Pass	
2	2.33543 Pass	2.36205 Pass	0.00000 Pass	305.238 m Pass	
3	2.33575 Pass	2.36348 Pass	0.00000 Pass	302.739 m Pass	
4	2.34470 Pass	2.35787 Pass	0.00000 Pass	312.436 m Pass	
5	2.34981 Pass	2.37565 Pass	0.00000 Pass	302.076 m Pass	
6	2.33041 Pass	2.35037 Pass	0.00000 Pass	313.064 m Pass	
7	2.32882 Pass	2.35014 Pass	0.00000 Pass	268.271 m Pass	
8	2.34557 Pass	2.36096 Pass	0.00000 Pass	238.112 m Pass	
9	2.34836 Pass	2.35418 Pass	0.00000 Pass	235.560 m Pass	
10	2.34269 Pass	2.36840 Pass	0.00000 Pass	259.686 m Pass	
11	2.34007 Pass	2.37147 Pass	0.00000 Pass	286.627 m Pass	
12	2.33653 Pass	2.37509 Pass	0.00000 Pass	297.168 m Pass	
Result	Pass	Pass	Pass	Pass	287.811 m Pass

Phase B:

	dc[%]	dmax[%]	d(t)[ms,%]	Pst	Plt
Limit	3.30000	4.00000	500.000 3.30000	1.00000	0.65000 N:12
1	0.00000 Pass	947.709 m Pass	0.00000 Pass	273.787 m Pass	
2	2.36823 Pass	2.38108 Pass	0.00000 Pass	295.148 m Pass	
3	2.36729 Pass	2.38761 Pass	0.00000 Pass	283.198 m Pass	
4	2.36512 Pass	2.38720 Pass	0.00000 Pass	290.923 m Pass	
5	2.37274 Pass	2.39355 Pass	0.00000 Pass	292.054 m Pass	
6	2.35521 Pass	2.37371 Pass	0.00000 Pass	281.255 m Pass	
7	2.34215 Pass	2.37229 Pass	0.00000 Pass	253.975 m Pass	
8	2.36198 Pass	2.38678 Pass	0.00000 Pass	230.575 m Pass	
9	2.36889 Pass	2.38172 Pass	0.00000 Pass	229.773 m Pass	
10	2.36202 Pass	2.38935 Pass	0.00000 Pass	263.957 m Pass	
11	2.36380 Pass	2.38119 Pass	0.00000 Pass	264.355 m Pass	
12	2.37677 Pass	2.40464 Pass	0.00000 Pass	278.349 m Pass	
Result	Pass	Pass	Pass	Pass	271.416 m Pass

TEST REPORT

Phase C:

	dc[%]	dmax[%]	dt(t)[ms,%]	Pst	Plt
Limit	3.30000	4.00000	500.000 3.30000	1.00000	0.65000 N:12
1	0.00000 Pass	843.918 m Pass	0.00000 Pass	288.512 m Pass	
2	2.37764 Pass	2.39773 Pass	0.00000 Pass	297.746 m Pass	
3	2.39407 Pass	2.40463 Pass	0.00000 Pass	309.487 m Pass	
4	2.37708 Pass	2.40079 Pass	0.00000 Pass	292.649 m Pass	
5	2.38674 Pass	2.40774 Pass	0.00000 Pass	300.501 m Pass	
6	2.38063 Pass	2.39210 Pass	0.00000 Pass	300.796 m Pass	
7	2.36697 Pass	2.38448 Pass	0.00000 Pass	245.712 m Pass	
8	2.38878 Pass	2.40029 Pass	0.00000 Pass	224.406 m Pass	
9	2.38248 Pass	2.40872 Pass	0.00000 Pass	225.947 m Pass	
10	2.38802 Pass	2.40201 Pass	0.00000 Pass	261.174 m Pass	
11	2.37663 Pass	2.39754 Pass	0.00000 Pass	284.508 m Pass	
12	2.38543 Pass	2.40785 Pass	0.00000 Pass	270.974 m Pass	
Result	Pass	Pass	Pass	Pass	278.022 m Pass

TEST REPORT

8. EMS TEST

Performance Criteria:

Criterion A:	The apparatus shall continue to operate as intended during the test. No degradation of performance or loss of function is allowed below a performance level (or permission loss of performance) specified by the manufacturer, when the apparatus is used as intended. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation and from 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 (or permission loss of performance) specified by the manufacturer, when the apparatus is used as intended. During the test, degradation of performance is allowed, however, 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, then either of these may be derived from the product description, and documentation, and from 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, or by any operation specified in the instruction for use.

Operation mode of EMS test:

Test Item	Operation mode
ESD immunity	Inverting mode with light load
Radiated EM field immunity	
EFT immunity	
Surge immunity	
Inject current immunity	
Power frequency magnetic field immunity	
Voltage dips and interruption immunity	

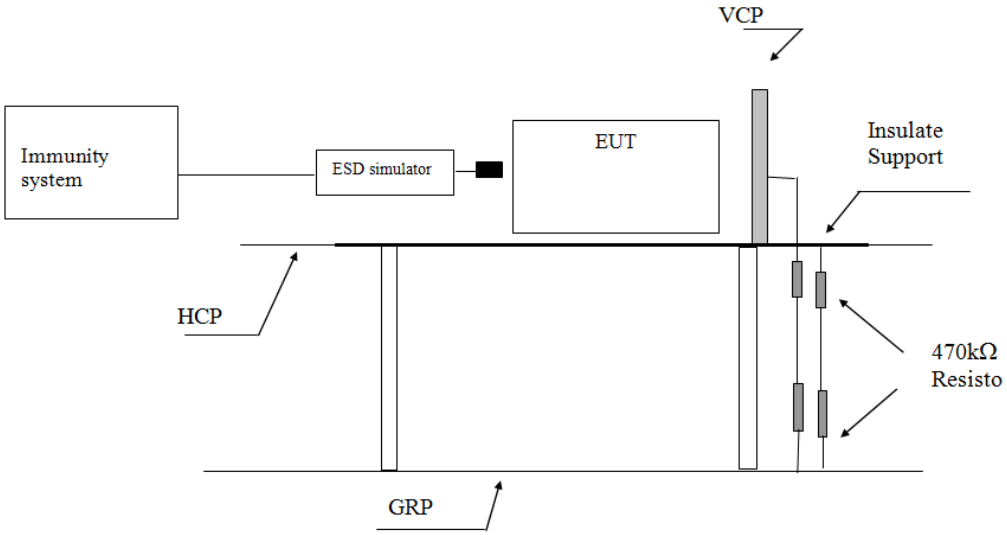
8.1 EN 61000-4-2(Pursuant to EN 61000-6-1) Electrostatic Discharge Immunity

Performance criterion: B

Test Result: Pass

TEST REPORT

8.1.1 Block Diagram of Test Setup



Note: HCP means Horizontal Coupling Plane,

VCP means Vertical Coupling Plane

GRP means Ground Reference Plane

8.1.2 Test Setup and Procedure

The EUT was put on a 0.8m high wooden table 0.1m high for floor standing equipment standing on the ground reference plane (GRP) 3m by 2m in size, made by iron 1.0 mm thick.

A horizontal coupling plane(HCP) 1.6m by 0.8m in size was placed on the table, and the EUT with its cables were isolated from the HCP by an insulating support thick than 0.5mm. The VCP 0.5m by 0.5m in size & HCP were constructed from the same material type & thickness as that of the GRP, and connected to the GRP via a 470kΩ resistor at each end.

The distance between EUT and any of the other metallic surface excepted the GRP, HCP & VCP was greater than 1m.

The EUT was arranged and connected according to its functional requirements.

Direct static electricity discharges were applied only to those points and surface which were accessible to personnel during normal usage.

TEST REPORT

On each preselected points 10 times of each polarity single discharge were applied. The time interval between successive single discharges was at least 1s.

The ESD generator was held perpendicular to the surface to which the discharge was applied. The discharge return cable of the generator was kept at a distance of 0.2m whilst the discharge was being applied. During the contact discharges, the tip of the discharge electrode was touched the EUT before the discharge switch was operated. During the air discharges, the round discharge tip of the discharge electrode was approached as fast as possible to touch the EUT.

Indirect discharge was conducted to objects placed near the EUT, simulated by applying the discharges of the ESD generator to a coupling plane, in the contact discharge mode.

After each discharge, the ESD generator was removed from the EUT, the generator was then retriggered for a new single discharge. For ungrounded product, a grounded carbon fibre brush with bleeder resistors (2×470 kΩ) in the grounding cable was used after each discharge to remove remnant electrostatic voltage.

For air discharge, a minimum of 10 single air discharges were applied to the selected test point for each such area.

8.1.3 Test Result

Direct Application of ESD

Direct Contact Discharge

Applied Voltage (kV)	No. of Discharge for each point	Result	Discharged Points
4	20	Pass	Accessible metal parts of the EUT Conductive substrate with coating which is not declared to be insulating

Direct Air Discharge

Applied Voltage (kV)	No. of Discharge for each point	Result	Discharged Points
2, 4, 8	20	Pass	All accessible points where contact discharge cannot be applied such as Displays, Indicators light, Keyboard, Button, Switch, Knob, Air gap, Slots, Hole and so on

TEST REPORT

Indirect Application of ESD

Horizontal Coupling Plane under the EUT

Applied Voltage (kV)	No. of Discharge for each point	Result	Discharged Point
4	20	Pass	At the front edge of each HCP opposite the centre point of each unit of the EUT

Vertical Coupling Plane beside the EUT

Applied Voltage (kV)	No. of Discharge for each point	Result	Discharged Point
4	20	Pass	The centre of the vertical edge of the coupling plane

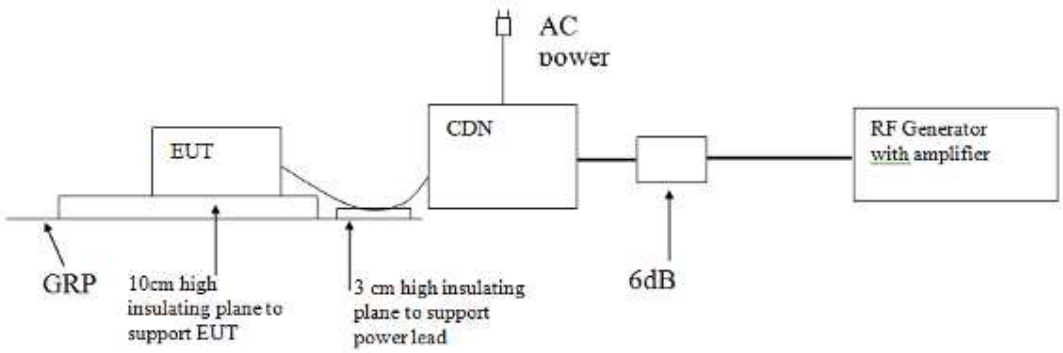
8.2 EN 61000-4-6(Pursuant to EN 61000-6-1) Injected Current (0.15 MHz to 80 MHz)

Tested Port: ☒ AC power ☒DC power ☐Functional earth ☐Signal/Control

Performance criterion: A

Test Result: Pass

8.2.1 Block Diagram of Test Setup



8.2.2 Test Setup and Procedure

The EUT was placed on an insulating support of 0.1m height above a ground reference Plane, arranged and connected to satisfy its functional requirement.
All relevant cables were provided with the appropriate coupling and decoupling devices at a distance between 0.1m and 0.3m from the projected geometry of the EUT on an insulating support of 0.03m height above the ground reference plane.
Test voltage was verified before each testing though power meter combined in the RF generator with AMP.

TEST REPORT

Dwell time was set to 3s and step was set as 1% to keep sufficient response time for EUT.
The frequency from 0.15MHz to 80MHz was checked.
The frequency range is scanned as specified. However, when specified in Annex A of EN 61000-6-1, an additional comprehensive functional test shall be carried out at a limited number of frequencies. The selected frequencies for conducted test are: 0,2; 1; 7,1; 13,56; 21; 27,12 and 40,68 MHz (±1 %).

8.2.3 Test Result

Port	Frequency (MHz)	Level	Result
A.C. Power Lines	0.15 to 80	3V (r.m.s.)	Pass
D.C. Power Lines	0.15 to 80	3V (r.m.s.)	Pass
Signal Lines	0.15 to 80	3V (r.m.s.)	N/A
Control Lines	0.15 to 80	3V (r.m.s.)	N/A
Functional Earth	0.15 to 80	3V (r.m.s.)	N/A

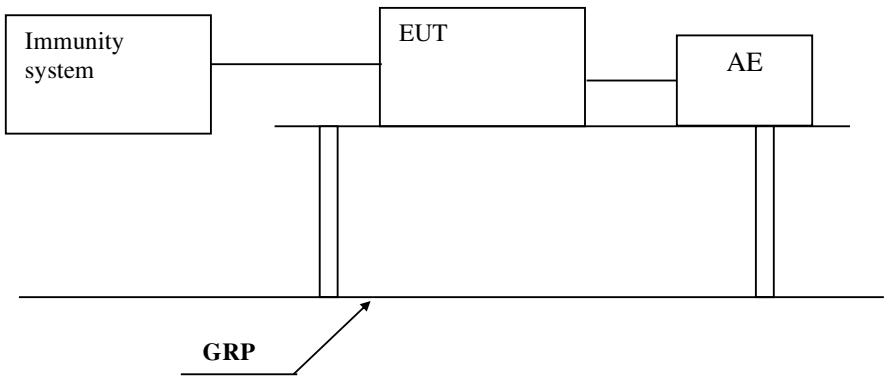
8.3 EN 61000-4-4(Pursuant to EN 61000-6-1) Electrical Fast Transient/Burst

Tested Port: ☒ AC power ☒DC power ☐Functional earth ☐ Signal/Control

Performance criterion: B

Test Result: Pass

8.3.1 Block Diagram of Test Setup



8.3.2 Test Setup and Procedure

The EUT was placed on a 0.1m high wooden table, standing on the ground reference plane 3m by 2m in size, made by steel 1mm thick.

The distance between the EUT and any other of the metallic surface except the GRP was greater than 0.5m.

TEST REPORT

The mains lead excess than 0.5m was folded to avoid a flat coil and situated at a distance of 0.1m above the ground reference plane to insure the distance between the coupling device and the EUT was 0.5m.

The EUT was arranged and connected to satisfy its functional requirement and supplied by the coupling-decoupling network. Repetition Frequency was 5 kHz.

8.3.3 Test Result

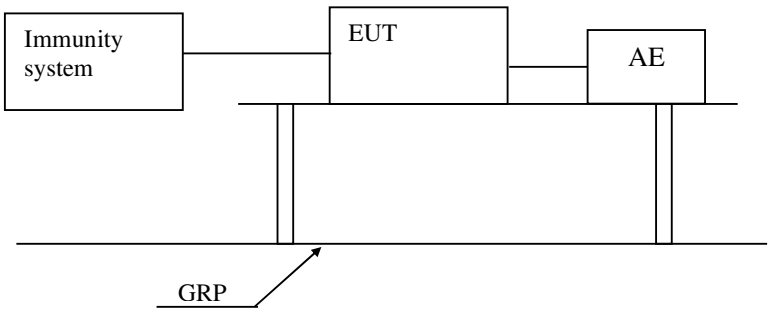
Level	Polarity	A.C. Power supply line and functional earth terminal	D.C. Power Lines, Signal Line & Control Line
0.5 kV	+	N/A	Pass
0.5 kV	-	N/A	Pass
1 kV	+	Pass	N/A
1 kV	-	Pass	N/A

8.4 EN 61000-4-5(Pursuant to EN 61000-6-1) Surge Immunity

Tested Port: ☒ AC power ☐ DC power

Performance criterion: B
Test Result: Pass

8.4.1 Block Diagram of Test Setup



8.4.2 Test Setup and Procedure

The surge was applied to the EUT power supply terminals via the capacitive coupling network.

Decoupling networks were required in order to avoid possible adverse effects on equipment not under test that might be powered by the same lines and to provide sufficient decoupling impedance to the surge wave so that the specified wave might be developed on the lines under test.

The EUT was arranged and connected according to its functional requirements.

TEST REPORT

The EUT was placed on a 0.1m high wooden support above the GRP), supplied by the coupling-decoupling network, and arranged and connected to satisfy its functional requirement. The power cord between the EUT and the coupling/decoupling network was less than 2 meters.

8.4.3 Test Result

Tested Port	Level	Result
AC power	Line to line±0.5kV, ±1kV	Pass
AC power	Line to earth ±0.5kV, ±1kV,±2kV	Pass
DC power	Line to earth ±0.5kV	N/A

8.5 EN 61000-4-11(Pursuant to EN 61000-6-1) Voltage Dips and Interruptions

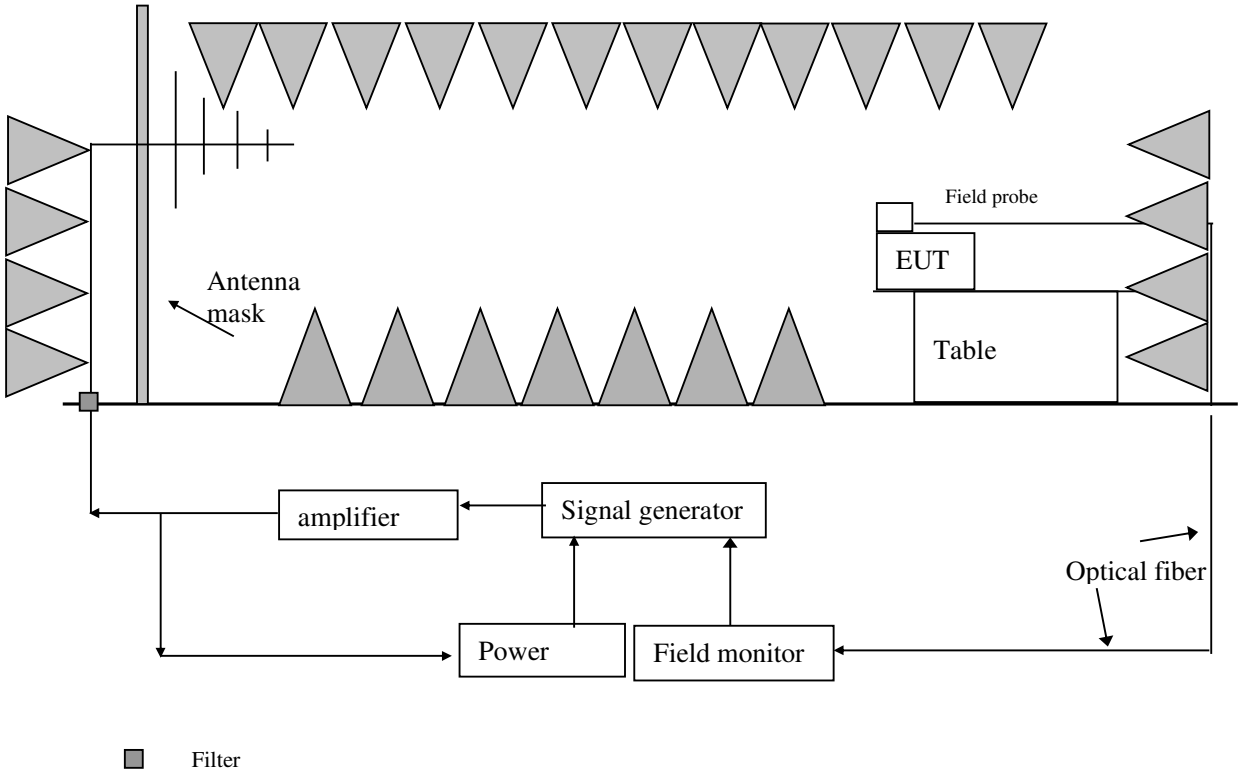
Tested Port: AC power
Test Result: Not Applicable
Remark: the test only applicable to the AC input port.

TEST REPORT

8.6 EN 61000-4-3(Pursuant to EN 61000-6-1) Radiated Electromagnetic Field Immunity

Performance criterion: A
Test Result: Pass

8.6.1 Block Diagram of Test Setup



TEST REPORT

8.6.2 Test Setup and Procedure

The test was conducted in a fully anechoic chamber to maintain a uniform field of sufficient dimensions with respect to the EUT, and also in order to comply with various national and international laws prohibiting interference to radio communications.

The equipment was placed in the test facility on a non-conducting table 0.8m high (for floor standing EUT, is placed on a non-conducting support 0.1m height).

The EUT was placed on the uniform calibrated plane which is 3V/m EM field.

For all ports connected to EUT, manufacturer specified cable type and length was used, for those cables no specification, unshielded cable applied. Wire was left exposed to the electromagnetic field for a distance of 1 m from the EUT.

The EUT was arranged and connected according to its functional requirements

Before testing, the intensity of the established field strength had been checked by placing the field sensor at a calibration grid point, and with the field generating antenna and cables in the same positions as used for the calibration, the forward power needed to give the calibrated field strength was measured. Spot checks was made at a number of calibration grid points over the frequency range 80 to 1000 MHz and 1.4 to 6.0 GHz, both polarizations was checked. After calibration, the EUT was initially placed with one face coincident with the calibration plane.

The frequency range was swept from 80 to 1000MHz and 1.4 to 6.0 GH, with the signal 80% amplitude modulated with a 1 kHz sinewave, pausing to adjust the r.f. signal level.
The dwell time at each frequency was 3s so as that the EUT to be exercised and be able to respond.

The step size was 1% of the fundamental with linear interpolation between calibrated points.
Test was performed with the generating antenna facing each of the four sides of the EUT.

8.6.3 Test Result

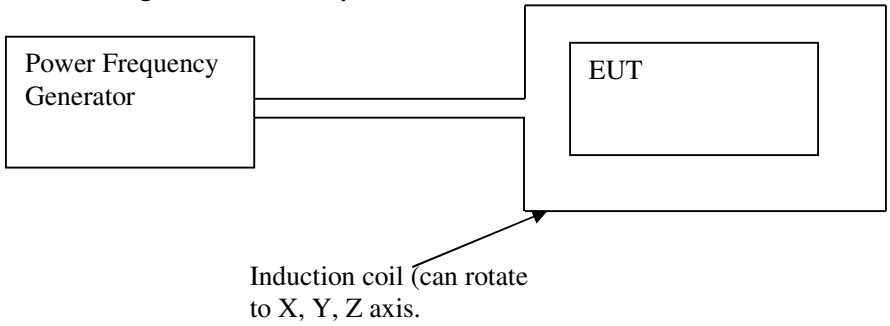
Frequency (MHz)	Exposed Side	Field Strength (V/m)	Result
80 to 1000,1400 to 6000	Front	3 V/m (r.m.s.)	Pass
80 to 1000,1400 to 6000	Left	3 V/m (r.m.s.)	Pass
80 to 1000,1400 to 6000	Rear	3 V/m (r.m.s.)	Pass
80 to 1000,1400 to 6000	Right	3 V/m (r.m.s.)	Pass

TEST REPORT

8.7 EN 61000-4-8(Pursuant to EN 61000-6-1) Power Frequency Magnetic Field Immunity

Tested Port: Enclosure
Performance criterion: A

8.7.1 Block Diagram of Test Setup



8.7.2 Test Setup and Procedure

Put EUT into center of induction coil (with suitable dimensions) in the testing.

For tabletop equipment:
The EUT was placed on a big enough wooden desk with height of 0.8m and operating as intended.
The equipment shall be subjected to the test magnetic field by using the induction coil of standards (1m*1m).
The induction coil shall be rotated by 90^0 in order to expose the EUT to the test field with different orientations.

For Floor-standing equipment:
The EUT was placed on big enough wooden desk with height of 0.1m and operating as intended.

The equipment shall be subjected to the test magnetic field by using induction coils of suitable dimensions; the test shall be repeated by moving and shifting the induction coils, in order to test the whole volume of the EUT for each orthogonal direction. The test shall be repeated with the coil shifted to different position along the side of the EUT, in steps corresponding to 50% of the shortest side of the coil.

The induction coil shall then be rotated by 90^0 in order to expose the EUT to the test field with different orientations and the same procedure followed.

8.7.3 Test Result

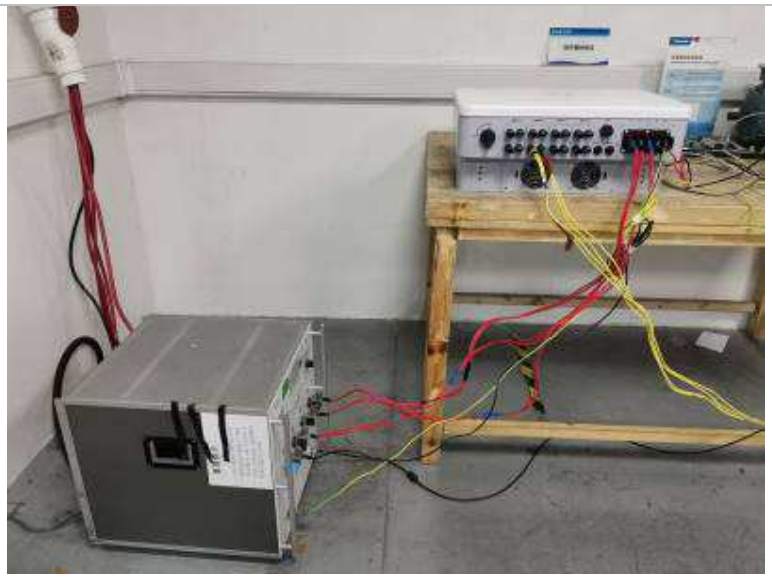
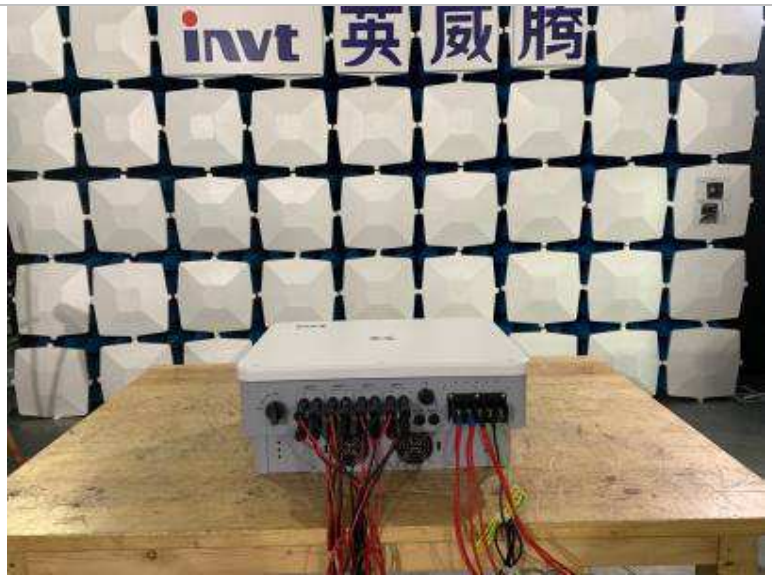
TEST REPORT

Mains frequency: ☒ 50 Hz ☒60 Hz

Orientations of induction coil	Magnetic Field Strength (A/m)	Result
X	3 A/m	Pass
Y	3 A/m	Pass
Z	3 A/m	Pass

TEST REPORT

9. APPENDIX I - PHOTOS OF TEST SETUP

Conducted disturbance voltage at mains ports

Radiated emission (30 MHz–1000 MHz)


TEST REPORT

ESD Immunity


Inject current immunity

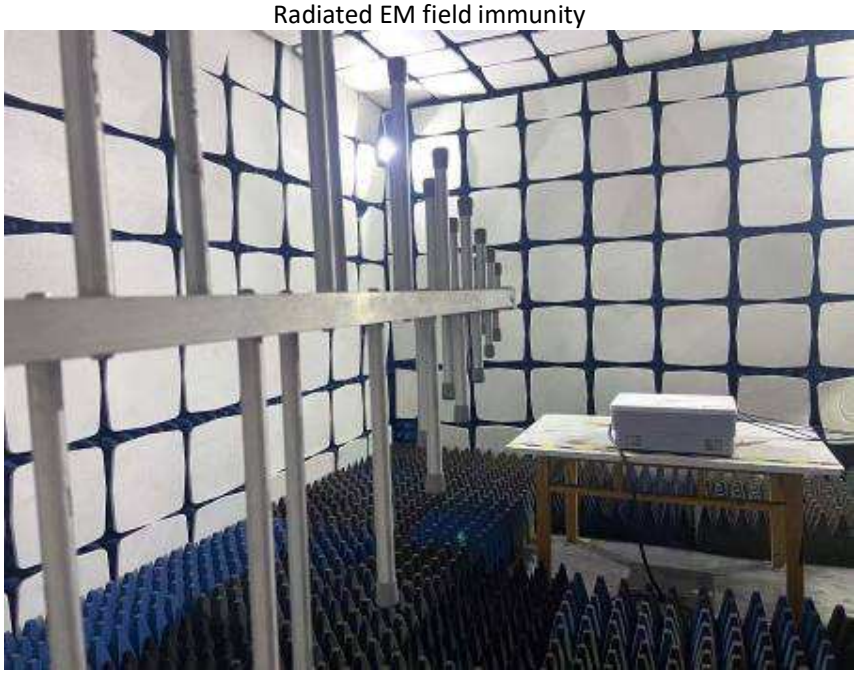

TEST REPORT

Surge Immunity


EFT Immunity


TEST REPORT

Radiated EM field immunity



Power frequency magnetic field immunity

10. APPENDIX II – PHOTOS OF EUT

Appendix 1: Photos

Front view 1

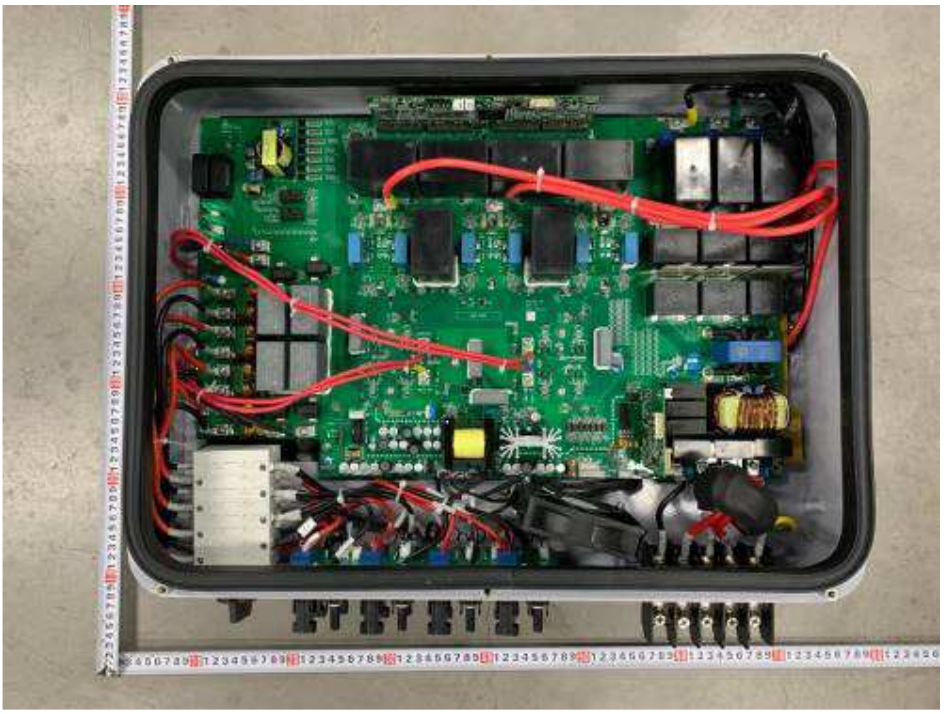
Front view 2

TEST REPORT

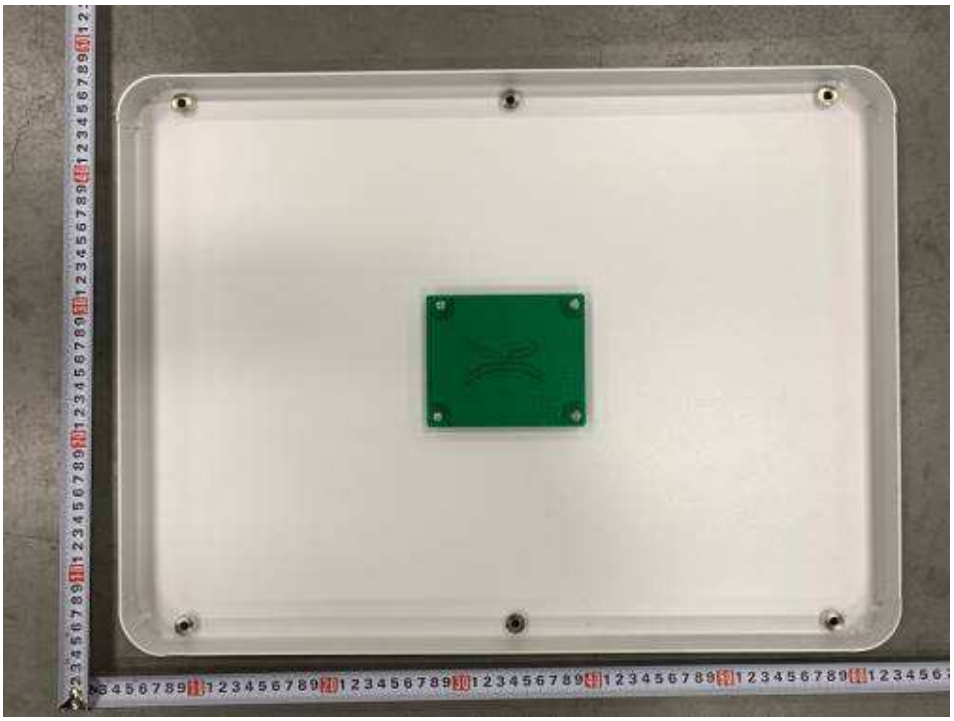
Side view

Connection view

TEST REPORT

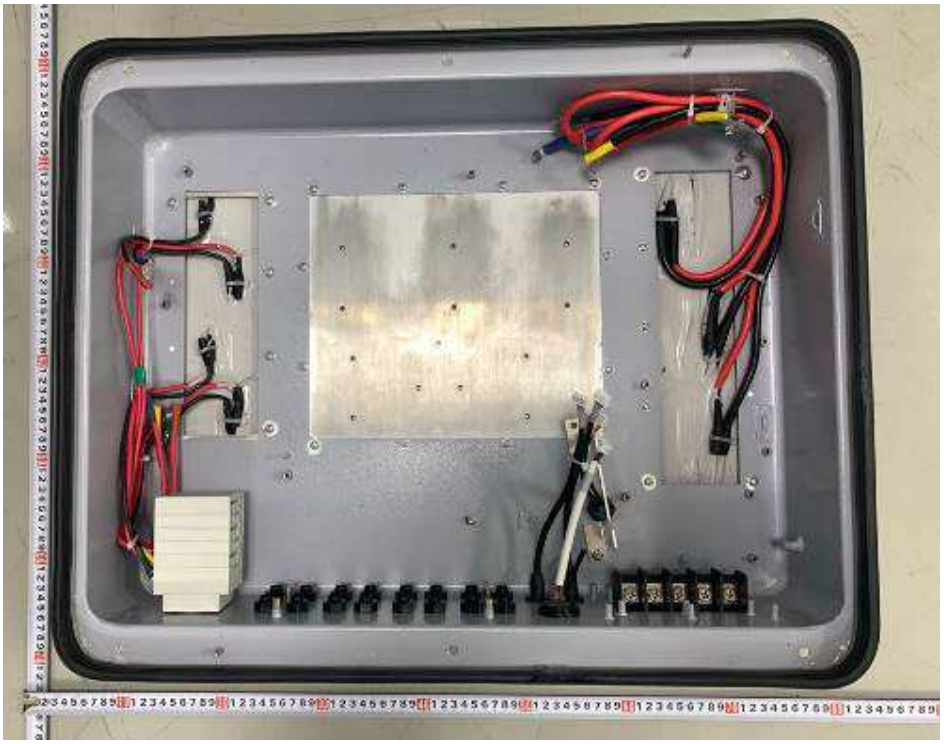


Internal view

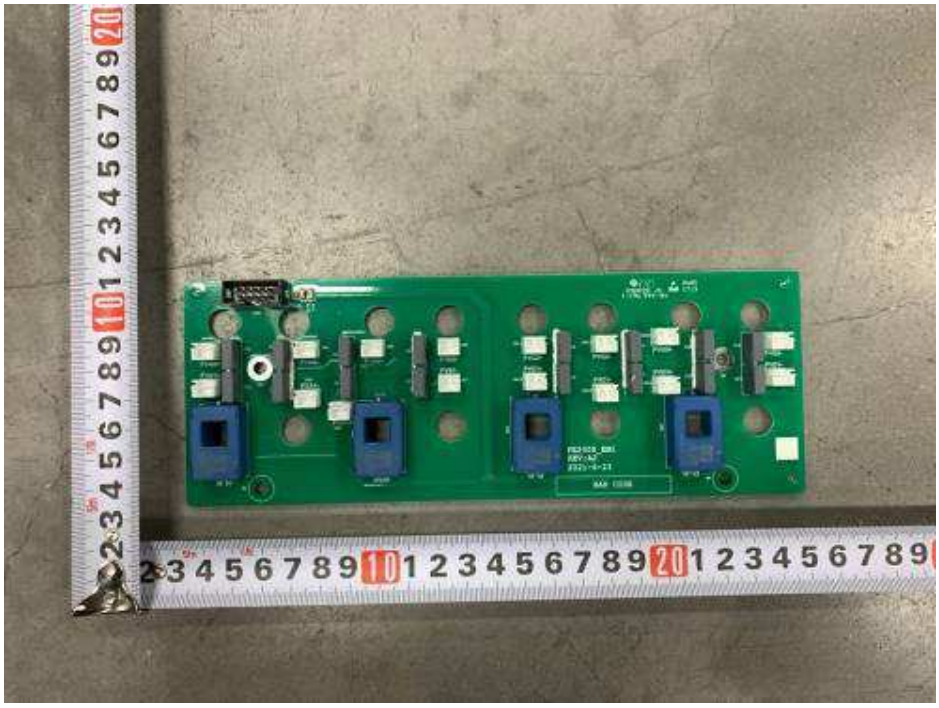


Cover view

TEST REPORT

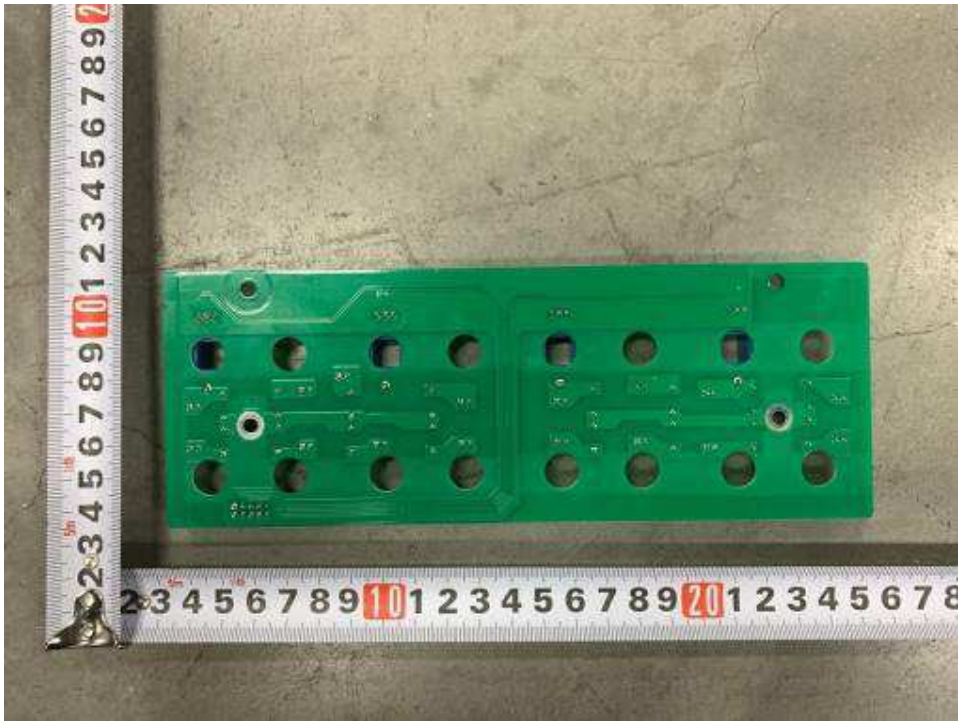


Internal view (remove all PCB)

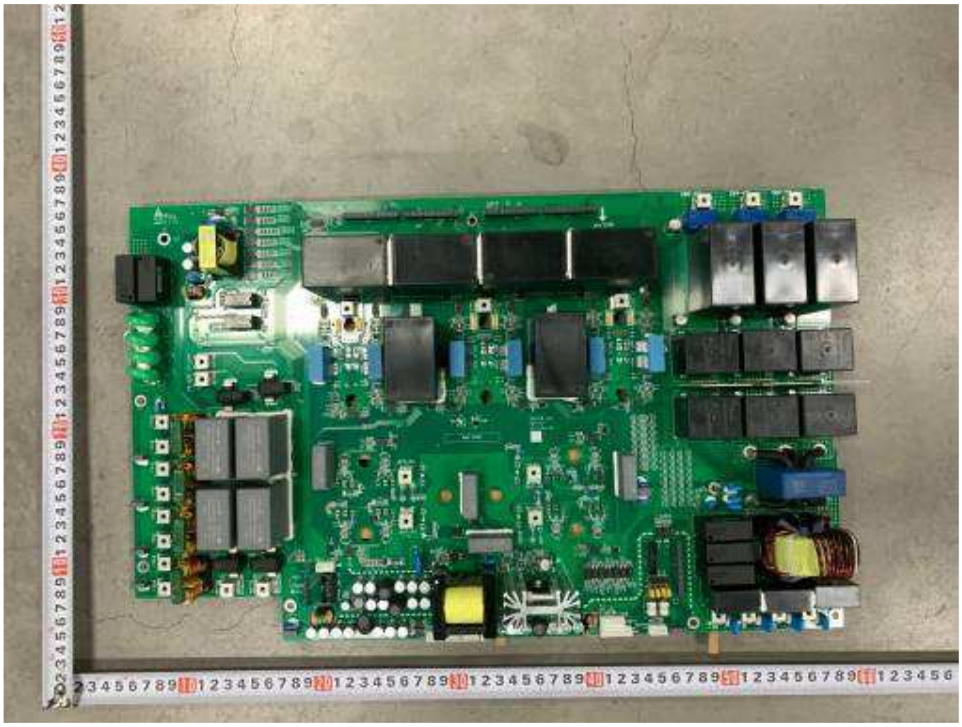


PV input board view

TEST REPORT

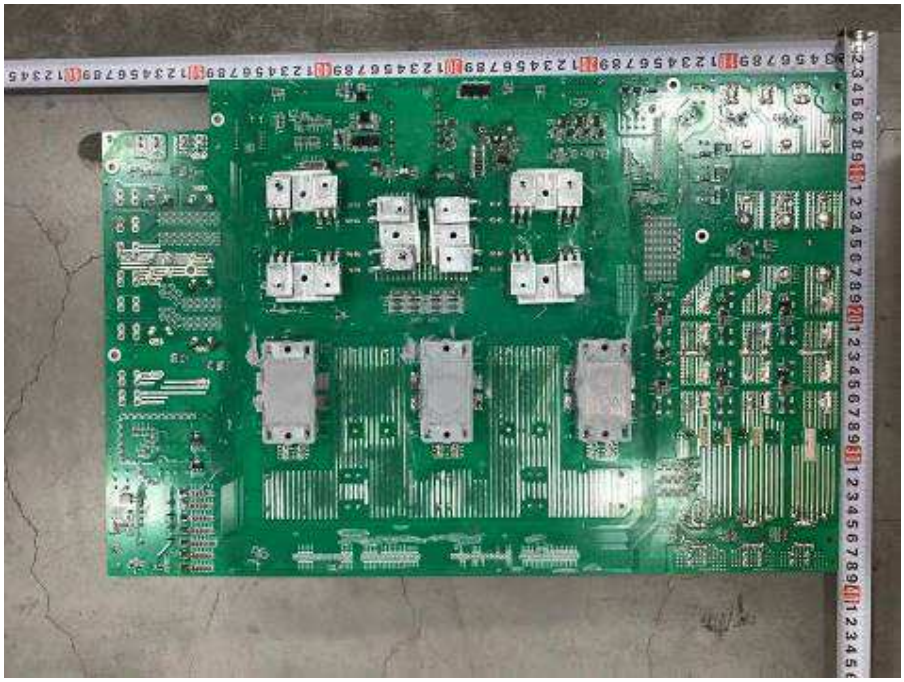


PV input board view view

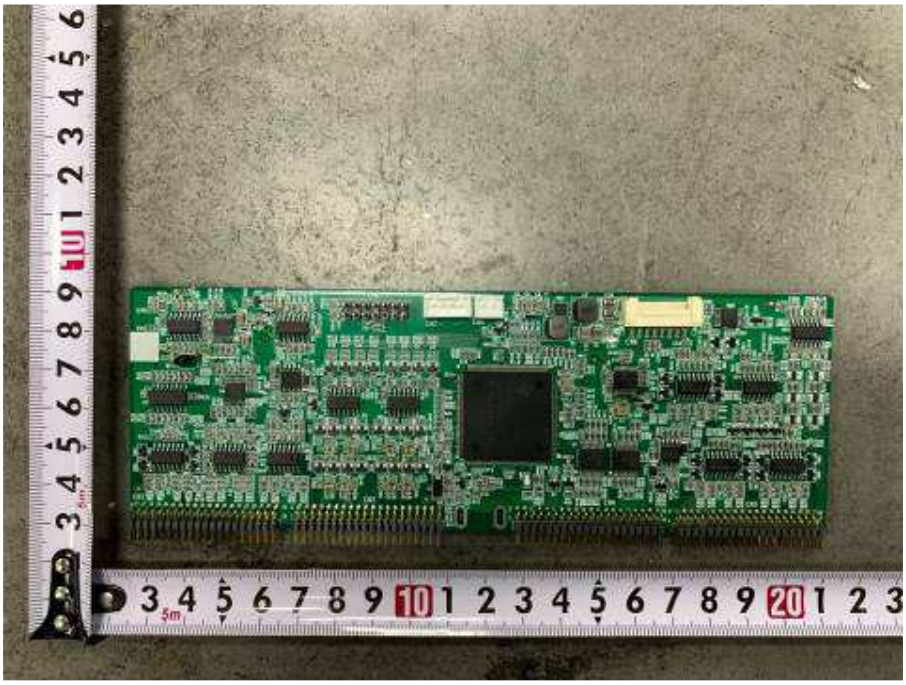


Main board view (Components side)

TEST REPORT

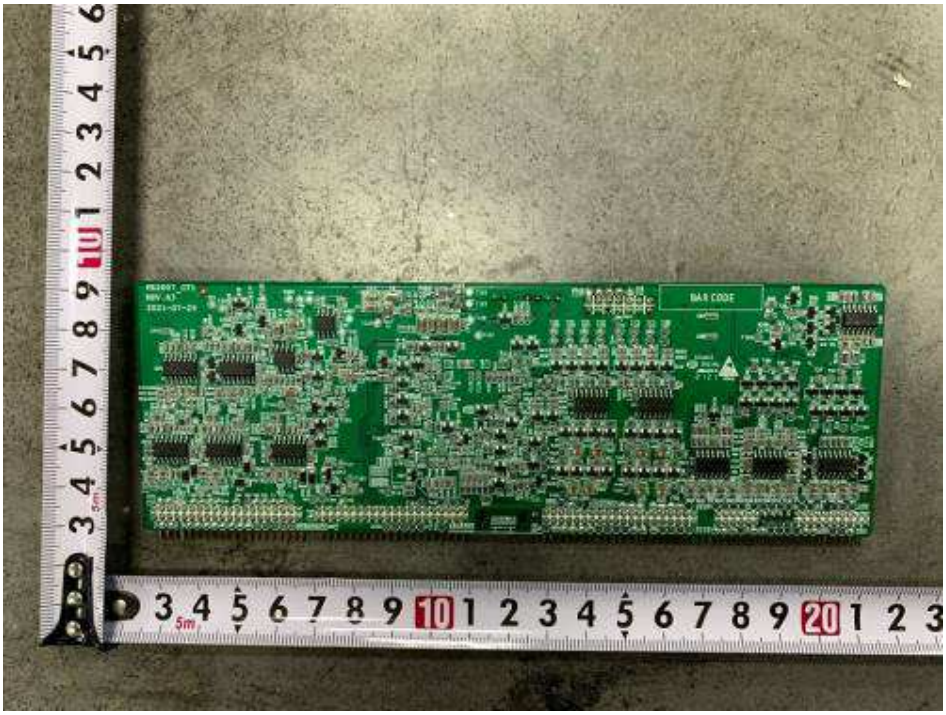


Main board view (Soldered side)

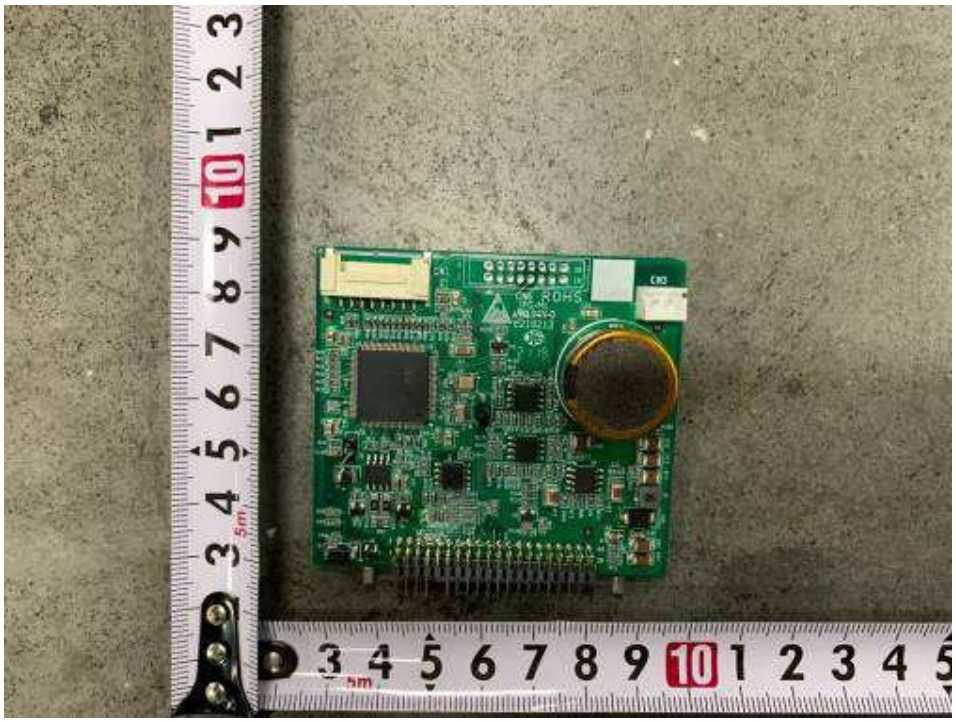


Control board view (Components side)

TEST REPORT



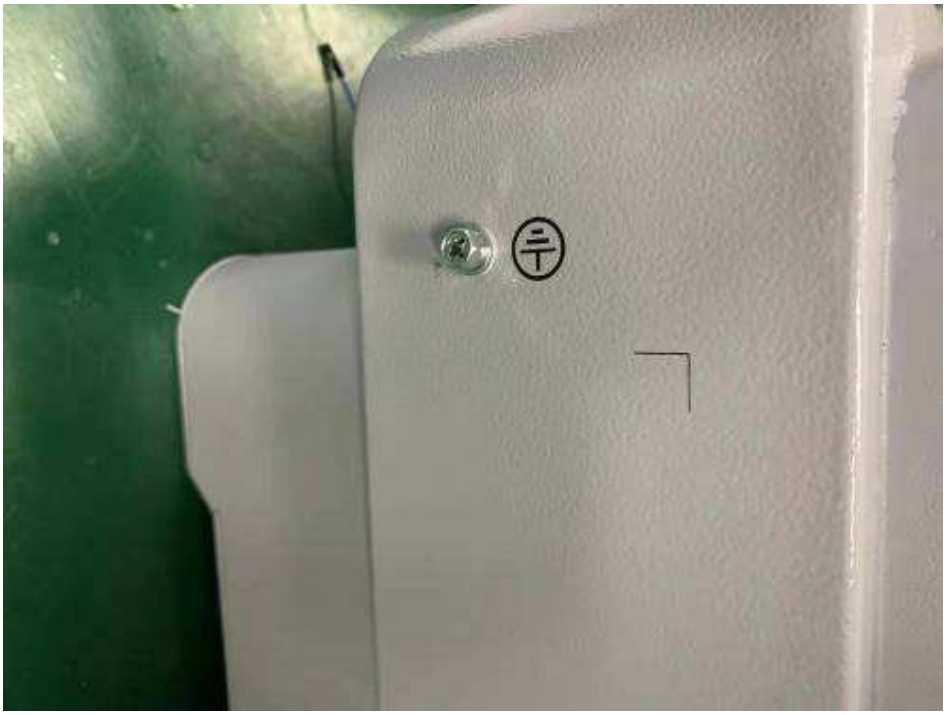
Control board view (Reverse)



ARM board view (Components side)

TEST REPORT

ARM board view (Reverse)



Earthing view

**********End of Report**********