EMC Test Report

Applicant: EAST Group Co., Ltd.

Address: No.6 Northern Industry Road, Songshan Lake Sci. & Tech. Industry Park, 523808 DongGuan City, Guangdong Province, PEOPLE'S REPUBLIC OF CHINA

Product: Converter (Hybrid Inverter)

Model: EAHI-6000-SL-S

COMMERCIAL-IN-CONFIDENCE

Report Number: 64.772.23.30907.01

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RESPONSIBLE FOR	NAME	SIGNATURE	DATE
Prepared by	Jayden Li		2023-07-25
Approved by	Samuel Zhang		2023-07-25

Signatures in this approval box have checked this document in li ne with the requirements of TÜV SÜD Product Service control rules.

EXECUTIVE SUMMARY A sample of this product was tested and found to be in compliance with	EN IEC 61000-6-1:2019 EN IEC 61000-6-3:2021

Contents

1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	2023-07-25

1.2 Introduction

The information contained in this report is intended to show verification of the EMC Qualification Approval Testing of the requirements of the standards for the tests listed in Section 1.3.

Applicant	:	EAST Group Co., Ltd.
Address	:	No.6 Northern Industry Road, Songshan Lake Sci. & Tech. Industry Park, 523808 DongGuan City, Guangdong Province PEOPLE'S REPUBLIC OF CHINA
Manufacturer	:	EAST Group Co., Ltd.
Address	:	No.6 Northern Industry Road, Songshan Lake Sci. & Tech. Industry Park, 523808 DongGuan City, Guangdong Province PEOPLE'S REPUBLIC OF CHINA
Model Number(s)	:	EAHI-6000-SL-S
Product Type	:	Converter (Hybrid Inverter)
Trademark	:	/
Date of Receipt of EUT	:	2023-05-01
Start of Test	:	2023-05-04
Finish of Test	:	2023-05-06
Name of Engineer(s)	:	Jayden Li

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with EN IEC 61000-6-1:2019, EN IEC 61000-6-3:2021 is shown below.

Specification	Clause	Test Description	Result	Remark
EN IEC 61000-6-3:2021	11	Emission - Low voltage AC mains port*	Pass	Test Site 1
EN IEC 61000-6-3:2021	11	Emission - DC mains port*	Pass	Test Site 1
EN IEC 61000-6-3:2021	11	Emission – wired network port**	N/A	/
EN IEC 61000-6-3:2021	11	Emission - Enclosure port	Pass	Test Site 1
EN IEC 61000-6-3:2021	11	Harmonic Current	Pass	Test Site 1
EN IEC 61000-6-3:2021	11	Flicker	Pass	Test Site 1
EN IEC 61000-6-1:2019 IEC 61000-4-2:2008	9	Electrostatic discharge immunity test	Pass	Test Site 1
EN IEC 61000-6-1:2019 IEC 61000-4-3:2006+A1:2007+A2:2020	9	Radiated, radio-frequency, electromagnetic field immunity test	Pass	Test Site 1
EN IEC 61000-6-1:2019 IEC 61000-4-6:2013	9	Immunity to conducted disturbances, induced by radio-frequency fields	Pass	Test Site 1
EN IEC 61000-6-1:2019 IEC 61000-4-5:2014	9	Surge immunity test	Pass	Test Site 1
EN IEC 61000-6-1:2019 IEC 61000-4-4:2012	9	Electrical fast transient /burst immunity test	Pass	Test Site 1
EN IEC 61000-6-1:2019 IEC 61000-4-8:2009	9	Immunity - Enclosure port - Power-frequency magnetic field***	Pass	Test Site 2
EN IEC 61000-6-1:2019 IEC 61000-4-11:2004 IEC 61000-4-34:2005+A1:2009	9	Voltage dips, short interruptions and voltage variations immunity tests	Pass	Test Site 1

Remark:

Note *: Tests are only applicable for AC power port connected to public mains.

Note **: Communication ports of RS485 and CAN for EUT are used for local communications (not public network) and have a length <3m. Tests are not applicable to these control ports.

Note ***: This item need only to be applied to equipment containing components susceptible to magnetic fields, such as Hall elements or magnetic field sensors.

Note 1: The highest internal frequency of the EUT is less than 108 MHz, the measurement was made up to 1GHz.

1.4 Test Conditions

1.4.1 Environmental Conditions

The climatic conditions during the tests are within the limits specified by the manufacturer for the operation of the EUT and the test equipment. The climatic conditions during the tests were within the following limits:		
Temperature	**Humidity**	**Atmospheric pressure**
15 °C – 35 °C	30 % - 60 %	860 hPa – 1060 hPa
If explicitly required in the basic standard or applied product standard the climatic values are recorded and documented separately in this test report.		

1.4.2 Performance Criteria

Performance 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 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 reasonable expect from the apparatus if used as intended.

Performance 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. During the test, degradation of performance is allowed, however no change of actual operating state or stored data is allowed to persist after test. 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 reasonable expect from the apparatus if used as intended.

Performance 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.

1.5 Product Information and general remarks

1.5.1 Technical Description

Model	EAHI-6000-SL-S
PV input rating	
Max. input power	8000 W
Rated input voltage	360 V d.c.
Max. input voltage	550 V d.c.
MPPT voltage range	100 V d.c. – 540 V d.c.
MPPT voltage range (full load)	250 V d.c. – 450 V d.c.
Max. input current	15/15 A d.c.
PV short circuit current	20/20 A d.c.
Battery input/output rating	
Battery type	Li-ion
Rated voltage	51.2 V d.c
Battery voltage range	40.8 V d.c. – 57.6 V d.c.
Max. charging power	5000 W
Max. charging current	100 A d.c.
Max. discharging power	6000 W
Max. discharging current	120 A d.c.
Grid rating	
Rated voltage	230 V a.c., L/N/PE
Rated frequency	50/60 Hz
Rated input/output power	6000 W
Max. apparent power	6000 VA
Max. current	26.09 A a.c.
Power factor	0.8 leading – 0.8 lagging
Backup load output rating	
Rated output voltage	230 V a.c., L/N/PE
Rated output frequency	50/60 Hz
Rated output power	6000 W
Max. output apparent power	6000 VA
Max. output current	26.09 A a.c.
General parameter	
Protect class	Class I
Ingress protection rating	IP66
Ambient temperature range	-25 °C to 60 °C (Derating above 45 °C)
Altitude	≤ 4000m

1.5.2 Test Configuration

Configuration	Description
AC Powered	230V AC, 50/60Hz
DC Powered	360V DC

1.5.3 Modes of Operation

Mode	Description
TM1	PV to Grid (Full load)
TM2	PV to Load (Full load)
TM3	PV to Battery charge (Full load)
TM4	Grid to Battery charge (Full load)
TM5	Grid to Load (Full load)
TM6	Battery to Load discharge (Full load)
TM7	PV to Grid (Half load)
TM8	PV to Load (Half load)
TM9	PV to Battery charge (Half load)
TM10	Grid to Battery charge (Half load)
TM11	Grid to Load (Half load)
TM12	Battery to Load discharge (Half load)

1.5.4 General remark

EUT is non-isolated hybrid inverter that convert the DC supplies (battery and PV input) to grid-compliant AC.

1.6 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.7 Test Location

Test Site 1:
EAST Group Co., Ltd.
Address:
No.6 Northern Industry Road, Songshan Lake Sci. & Tech. Industry Park, 523808 DongGuan City, Guangdong Province, PEOPLE'S REPUBLIC OF CHINA

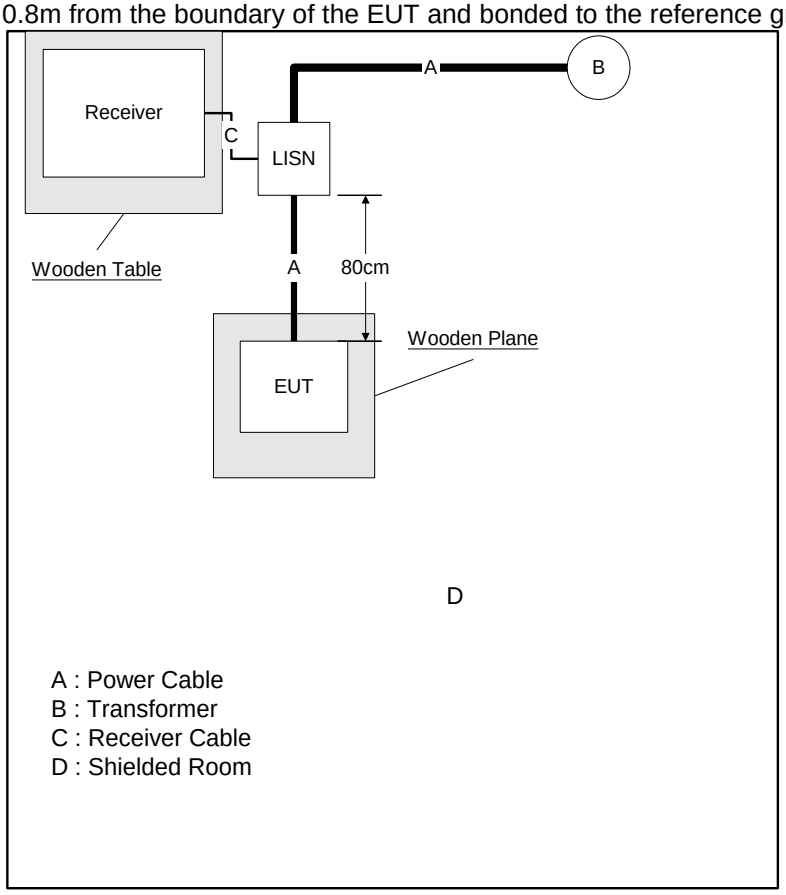
Test Site 2:
TÜV SÜD Certification and Testing (China) Co., Ltd. Guangzhou Branch
Address:
TÜV SÜD Testing Center, D1 Building, No.63, Chuangqi Road, Shilou, Panyu District, Guangzhou, Guangdong, China

2 Test Details

2.1 Conducted Disturbance at Mains Terminals

2.1.1 Test Method

The EUT was placed on a 0.8 m non-conductive table for table-top equipment and on a 0.12 m insulated support for floor standing equipment above a ground reference plane all within a test laboratory.
All power was connected to the EUT through an Artificial Mains Network (AMN). Conducted disturbance voltage measurements on mains lines were made at the output of the AMN. The AMN was placed 0.8m from the boundary of the EUT and bonded to the reference ground plane.



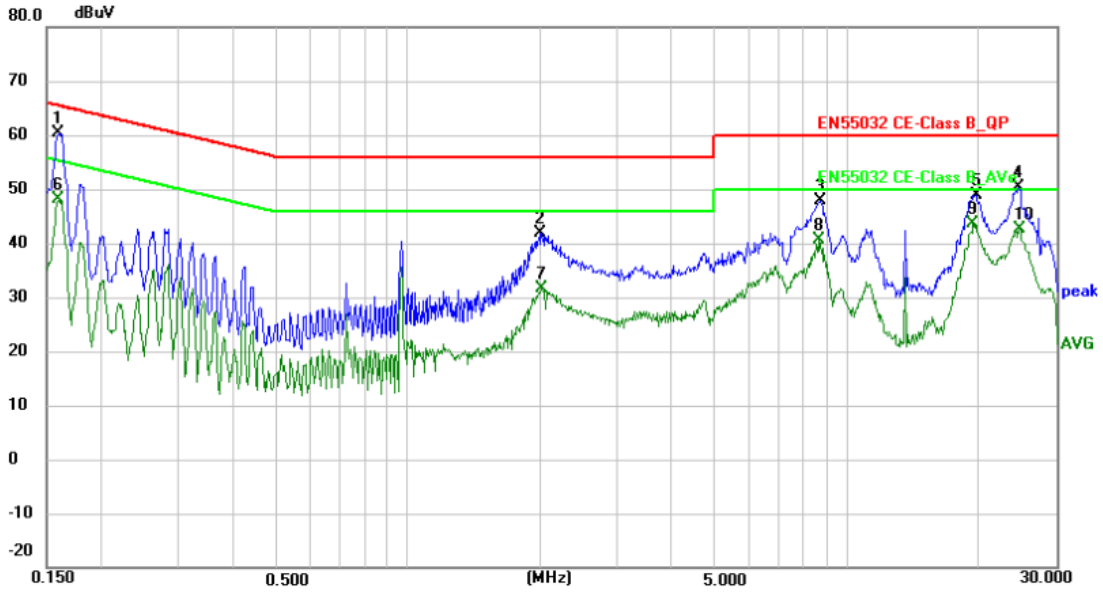
2.1.2 Specification Limits

Requirement for conducted emissions		
Frequency range	AC mains port dB(μV)	
MHz	Quasi-peak	Average
0.15 to 0.5	66-56	56-46
0.5 to 5	56	46
5 to 30	60	50

Requirement for conducted emissions		
Frequency range	DC power port dB(μV)	
MHz	Quasi-peak	Average
0.15 to 0.5	79	66
0.5 to 30	73	60

Remark for test data:
*Level=Reading Level + Correction Factor
**Correction Factor=Cable Loss + LISN Factor
(The Reading Level is recorded by software which is not shown in the sheet)

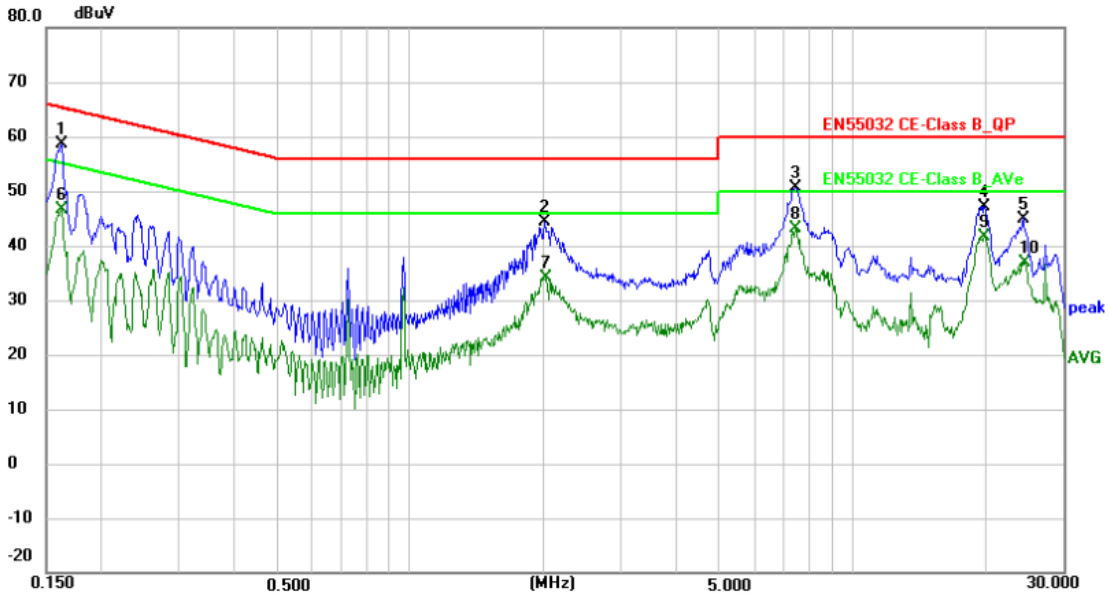
2.1.3 Test Results



Final_Result

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1 *	0.1598	49.88	10.51	60.39	65.47	-5.08	peak	P
2	2.0100	30.77	11.10	41.87	56.00	-14.13	peak	P
3	8.7060	36.29	11.56	47.85	60.00	-12.15	peak	P
4	24.6060	37.65	12.63	50.28	60.00	-9.72	peak	P
5	19.7300	36.69	12.30	48.99	60.00	-11.01	peak	P
6	0.1598	37.50	10.51	48.01	55.47	-7.46	AVG	P
7	2.0140	20.49	11.10	31.59	46.00	-14.41	AVG	P
8	8.6300	29.09	11.55	40.64	50.00	-9.36	AVG	P
9	19.3780	31.39	12.28	43.67	50.00	-6.33	AVG	P
10	24.6660	30.00	12.64	42.64	50.00	-7.36	AVG	P

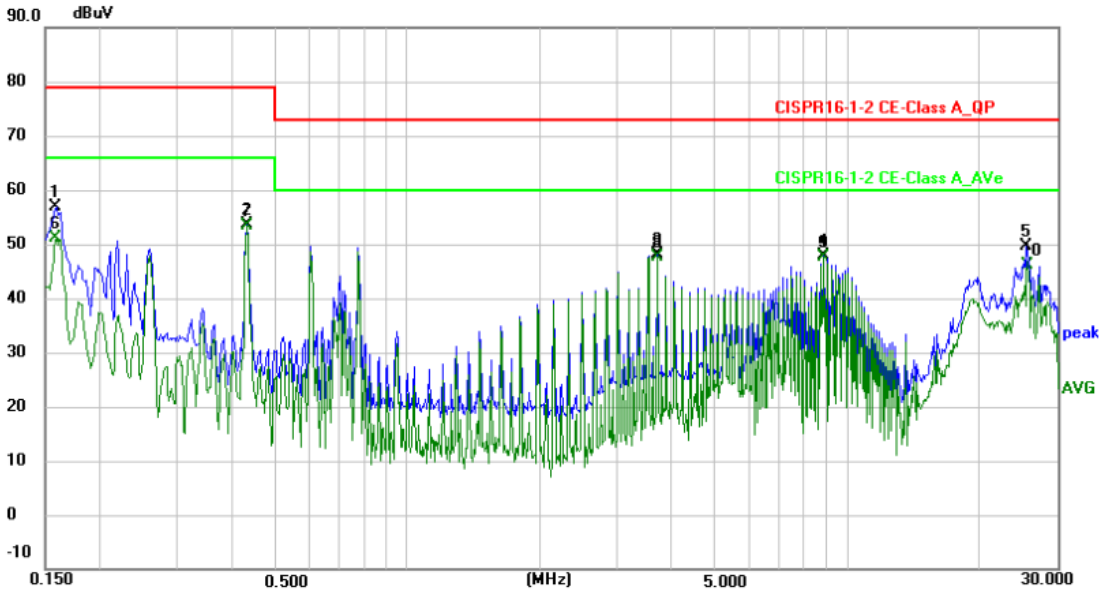
Model : EAHI-6000-SL-S
Test Mode : TM2(the worst case), AC port
Test Voltage : 230V, 50Hz
Remark : L
Test Date : 2023-05-04



Final_Result

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1 *	0.1620	48.01	10.52	58.53	65.36	-6.83	peak	P
2	2.0140	33.35	11.10	44.45	56.00	-11.55	peak	P
3	7.4180	39.22	11.47	50.69	60.00	-9.31	peak	P
4	19.8500	34.89	12.31	47.20	60.00	-12.80	peak	P
5	24.3820	32.38	12.62	45.00	60.00	-15.00	peak	P
6	0.1620	36.18	10.52	46.70	55.36	-8.66	AVG	P
7	2.0300	22.99	11.10	34.09	46.00	-11.91	AVG	P
8	7.4180	31.63	11.47	43.10	50.00	-6.90	AVG	P
9	19.8500	29.39	12.31	41.70	50.00	-8.30	AVG	P
10	24.5860	24.20	12.63	36.83	50.00	-13.17	AVG	P

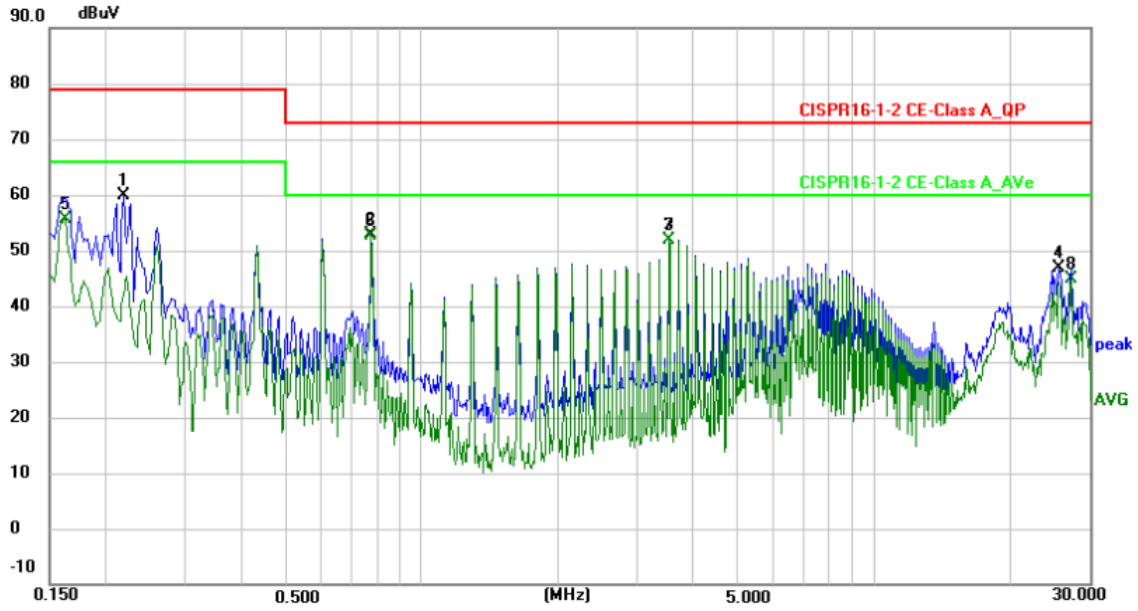
Model	:	EAHI-6000-SL-S
Test Mode	:	TM2(the worst case), AC port
Test Voltage	:	230V, 50Hz
Remark	:	N
Test Date	:	2023-05-04



Final_Result

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	0.1590	46.29	10.51	56.80	79.00	-22.20	peak	P
2	0.4300	42.83	10.90	53.73	79.00	-25.27	peak	P
3	3.7020	36.80	11.22	48.02	73.00	-24.98	peak	P
4	8.8620	36.34	11.57	47.91	73.00	-25.09	peak	P
5	25.4700	36.87	12.69	49.56	73.00	-23.44	peak	P
6	0.1590	40.63	10.51	51.14	66.00	-14.86	AVG	P
7	0.4300	42.51	10.90	53.41	66.00	-12.59	AVG	P
8 *	3.7020	36.49	11.22	47.71	60.00	-12.29	AVG	P
9	8.8620	36.04	11.57	47.61	60.00	-12.39	AVG	P
10	25.6420	33.49	12.70	46.19	60.00	-13.81	AVG	P

Model	:	EAHI-6000-SL-S
Test Mode	:	TM9 (the worst case), DC port
Test Voltage	:	360V
Remark	:	D+
Test Date	:	2023-05-06



Final_Result

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	0.2180	49.36	10.60	59.96	79.00	-19.04	peak	P
2	0.7740	41.78	11.02	52.80	73.00	-20.20	peak	P
3	3.5260	40.67	11.21	51.88	73.00	-21.12	peak	P
4	25.6420	34.10	12.70	46.80	73.00	-26.20	peak	P
5	0.1620	45.18	10.52	55.70	66.00	-10.30	AVG	P
6 *	0.7740	41.55	11.02	52.57	60.00	-7.43	AVG	P
7	3.5260	40.57	11.21	51.78	60.00	-8.22	AVG	P
8	27.3260	32.11	12.82	44.93	60.00	-15.07	AVG	P

Model	:	EAHI-6000-SL-S
Test Mode	:	TM9 (the worst case), DC port
Test Voltage	:	360V
Remark	:	D-
Test Date	:	2023-05-06

2.1.4 Test Setup

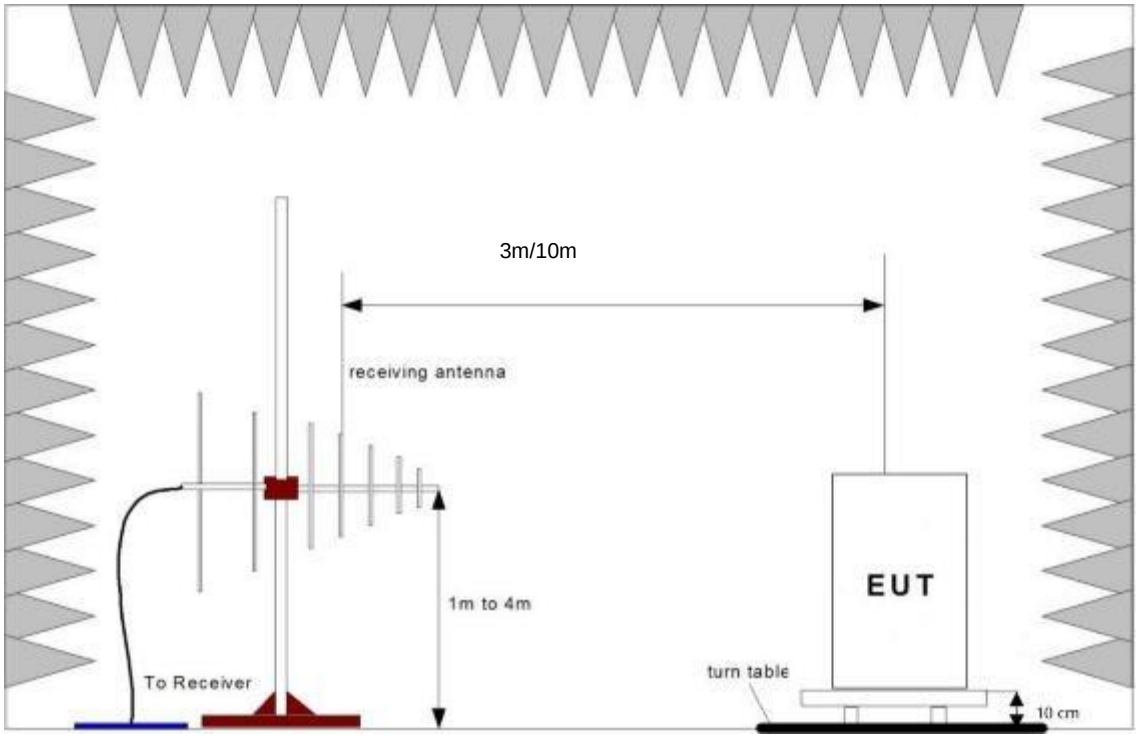
2.1.5 Test Location

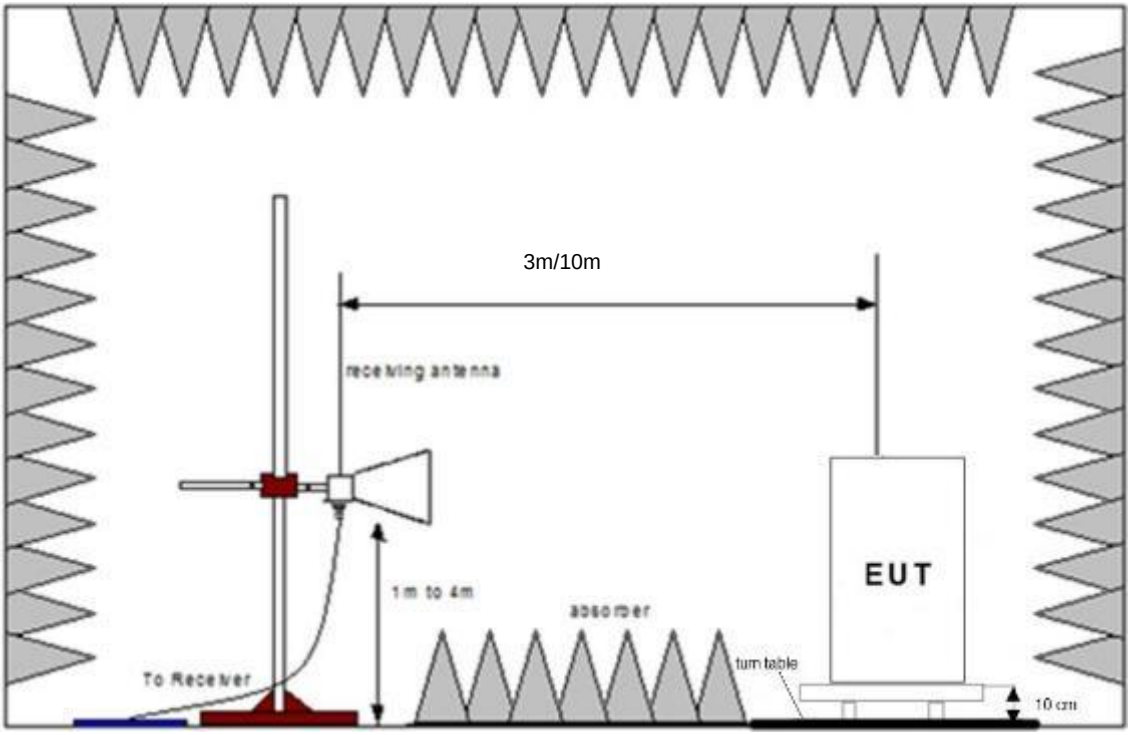
This test was carried out in shielded room.

2.2 Radiated Disturbance (30MHz to 1000MHz)

2.2.1 Test Method

The EUT was set up in a semi-anechoic chamber on a remotely controlled turntable and placed on a non-conductive
< floor 0.1 m above a reference ground plane>
< support 0.1 m above a reference ground plane>
A prescan of the EUT emissions profile was made while varying the antennae-to-EUT azimuth and antenna-to-EUT polarization using a peak detector; measurements were taken at a 10m distance. Using the prescan list of the highest emissions detected, their bearing and associated antenna polarization, the EUT was then formally measured using Quasi-Peak and Average detectors, as appropriate. The readings were maximized by adjusting the antenna height, polarization and turntable azimuth, in accordance with the specification.





2.2.2 Specification Limits

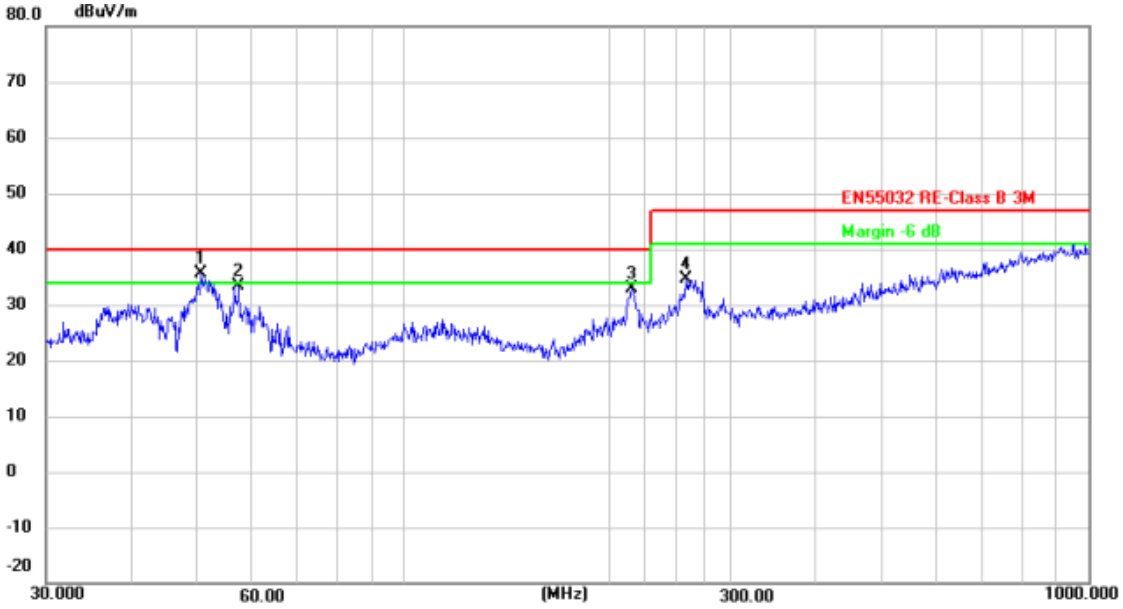
Below 1 GHz

Required Specification Limits (Class B @ 3m)	
Frequency Range (MHz)	Quasi-peak (dBµV/m)
30 to 230	40
230 to 1000	47

Above 1 GHz

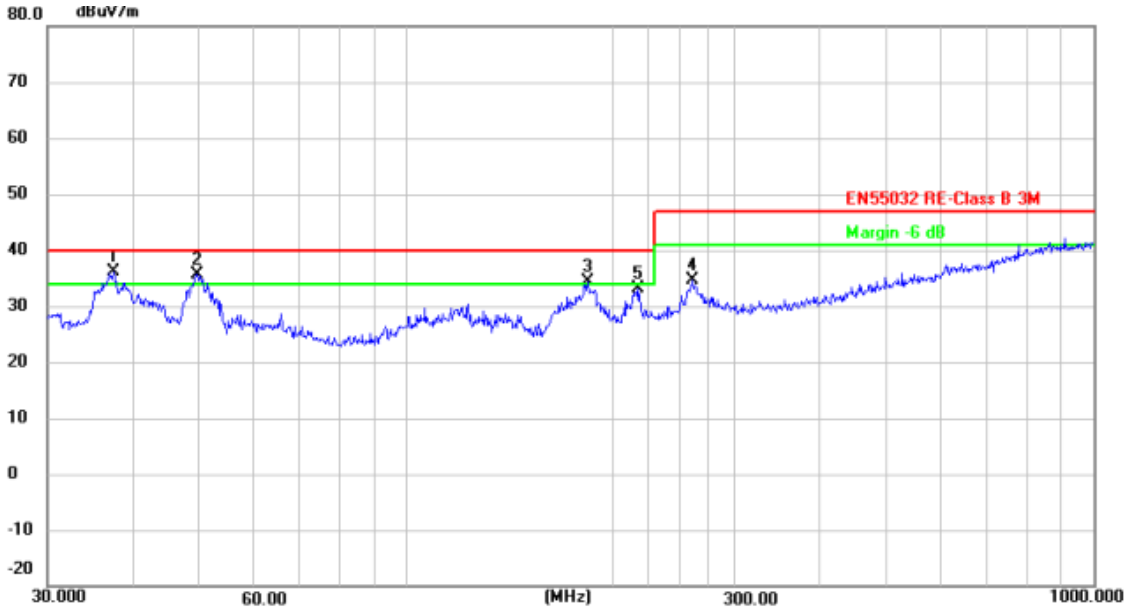
Required Specification Limits (Class B @ 3m)		
Frequency Range (MHz)	Average (dBµV/m)	Peak (dBµV/m)
1000 to 3000	50	70
3000 to 6000	54	74

2.2.3 Test Results



Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
50.5860	21.15	14.52	35.67	40.00	-4.33	peak
57.3922	20.27	13.07	33.34	40.00	-6.66	peak
215.2677	21.39	11.39	32.78	40.00	-7.22	peak
258.3263	22.05	12.62	34.67	47.00	-12.33	peak

Model : EAHI-6000-SL-S
Operating Mode : TM7 (the worst case)
Antenna polarization : Horizontal ☒ Vertical☐
Test Date : 2023-05-06

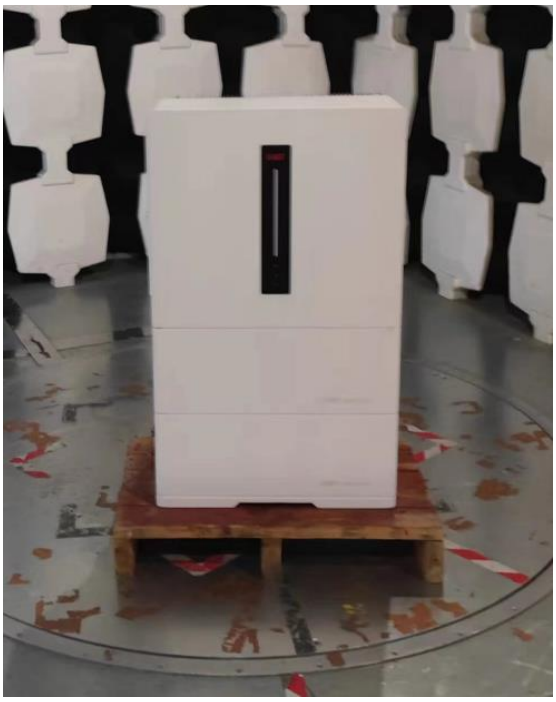


Final_Result

Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
37.4164	23.01	13.06	36.07	40.00	-3.93	peak
49.5328	21.06	14.59	35.65	40.00	-4.35	peak
183.2005	22.82	11.63	34.45	40.00	-5.55	peak
261.0581	19.94	14.78	34.72	47.00	-12.28	peak
217.5442	19.31	13.76	33.07	40.00	-6.93	peak

Model : EAHI-6000-SL-S
Operating Mode : TM7 (the worst case)
Antenna polarization : Horizontal ☐ Vertical☒
Test Date : 2023-05-06

2.2.4 Test Setup



Test Setup (30MHz-1GHz)

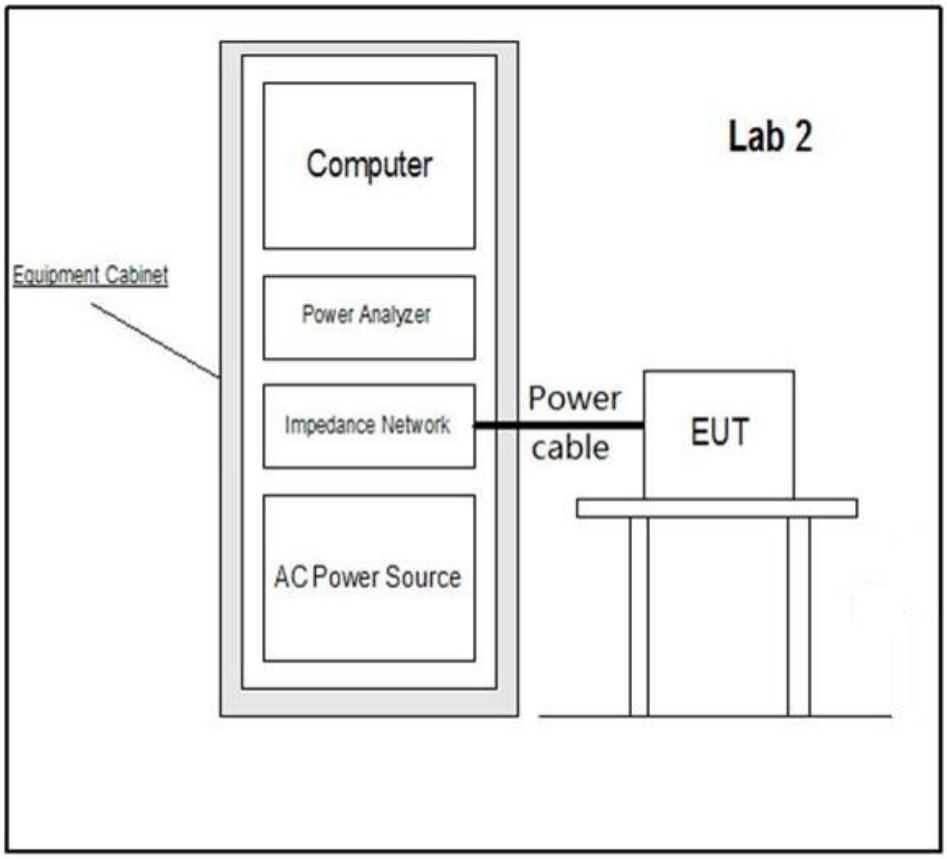
2.2.5 Test Location

This test was carried out in 3m anechoic chamber.

2.3 Harmonic current emission

2.3.1 Test Method

Harmonic current test should be conducted with the user's operation control or automatic programs set to the mode expected to produce the maximum total harmonic current under normal operating conditions.
Specific test conditions for the measurement of harmonic currents associated with some types of equipment are given in test equipment list.



2.3.2 Specification Limits

Limits for class A Equipment	
Harmonic order n	Maximum permissible harmonic current A
Odd harmonics	
3	2.30
5	1.14
7	0.77
9	0.40
11	0.33
13	0.21
15≤ n≤ 39	0.15(15/n)
Even harmonics	
2	1.08
4	0.43
6	0.30
8≤ n ≤40	0.23(8/n)

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 = harmonic current component.

2.3.3 Test Results

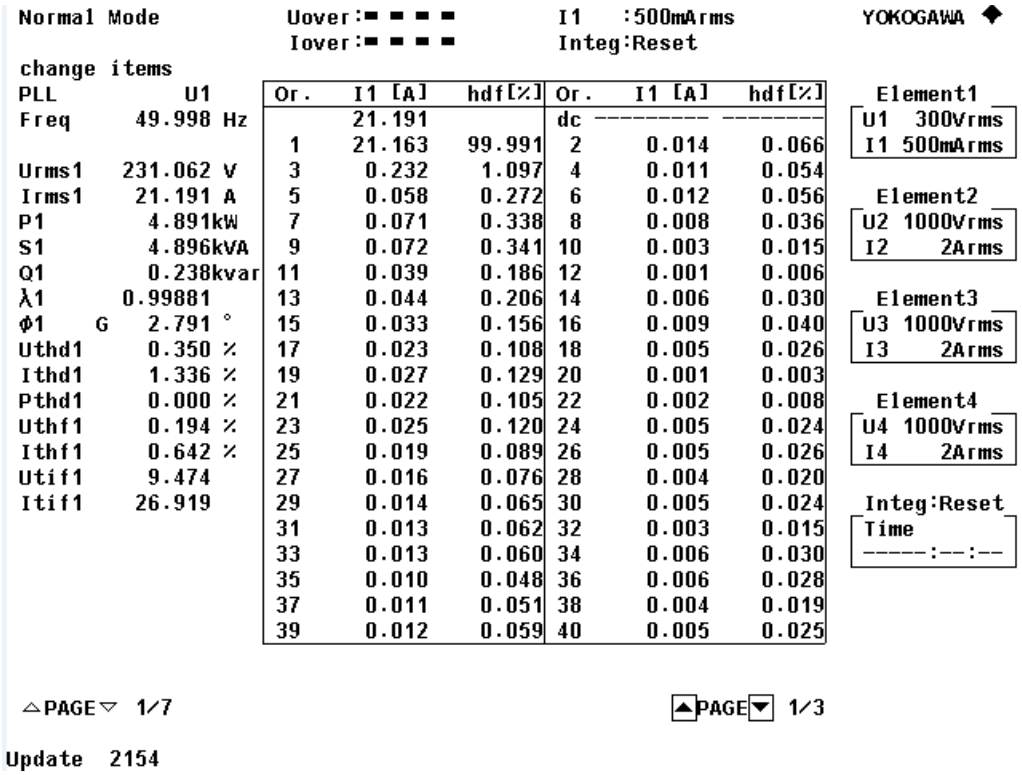
Results for Configuration and Mode: AC power/TM4

Performance assessment of the EUT made during this test: Pass

Detailed results are shown below.

Test date: 2023-05-06

50Hz



Normal Mode Uover:■ ■ ■ I1 :500mArms YOKOGAWA
Iover:■ ■ ■ Integ:Reset

change items

PLL	U1
Freq	49.998 Hz
Urms1	231.062 V
Irms1	21.191 A
P1	4.891kW
S1	4.896kVA
Q1	0.238kvar
λ1	0.99881
ϕ1 G	2.791 °
Uthd1	0.350 %
Ithd1	1.336 %
Pthd1	0.000 %
Uthf1	0.194 %
Ithf1	0.642 %
Utif1	9.474
Itif1	26.919

Or.	I1 [A]	hdf[%]	Or.	I1 [A]	hdf[%]
	21.191		dc	---------	---------
1	21.163	99.991	2	0.014	0.066
3	0.232	1.097	4	0.011	0.054
5	0.058	0.272	6	0.012	0.056
7	0.071	0.338	8	0.008	0.036
9	0.072	0.341	10	0.003	0.015
11	0.039	0.186	12	0.001	0.006
13	0.044	0.206	14	0.006	0.030
15	0.033	0.156	16	0.009	0.040
17	0.023	0.108	18	0.005	0.026
19	0.027	0.129	20	0.001	0.003
21	0.022	0.105	22	0.002	0.008
23	0.025	0.120	24	0.005	0.024
25	0.019	0.089	26	0.005	0.026
27	0.016	0.076	28	0.004	0.020
29	0.014	0.065	30	0.005	0.024
31	0.013	0.062	32	0.003	0.015
33	0.013	0.060	34	0.006	0.030
35	0.010	0.048	36	0.006	0.028
37	0.011	0.051	38	0.004	0.019
39	0.012	0.059	40	0.005	0.025

Element1
U1 300Vrms
I1 500mArms

Element2
U2 1000Vrms
I2 2Arms

Element3
U3 1000Vrms
I3 2Arms

Element4
U4 1000Vrms
I4 2Arms

Integ:Reset
Time
-----:--:--

△PAGE▽ 1/7 ▲PAGE▼ 1/3

Update 2154

2.3.4 Test Setup

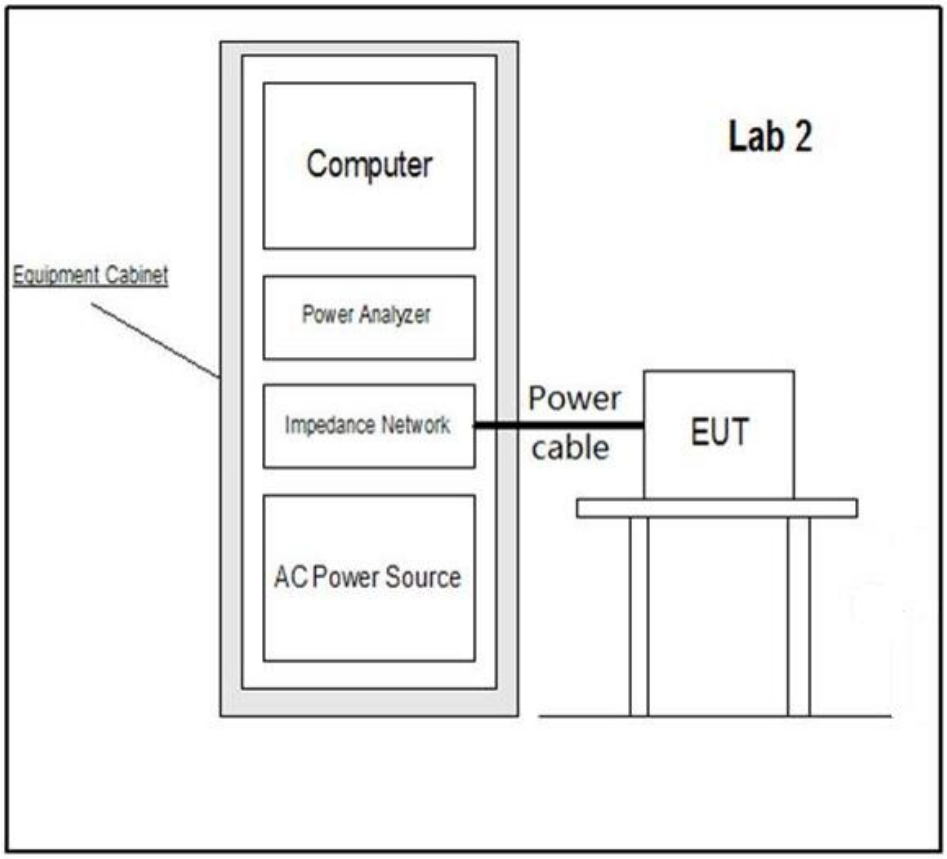
2.3.5 Test Location

This test was carried out in EAST Group Co., Ltd.

2.4 Flicker

2.4.1 Test Method

Flicker test should be conducted with the user's operation controls or automatic programs set to the mode expected to produce the most unfavourable sequence of voltage change, using only those combinations of controls and programmes which are mentioned by the manufacturer in the instruction manual, or are otherwise likely to be used.



2.4.2 Specification Limits

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, *d*c, 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 start, 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 or manual restart, after a power supply interruption

2.4.3 Test Results

Results for Configuration and Mode: AC power/TM4

Performance assessment of the EUT made during this test: Pass

Detailed results are shown below.

Test date: 2023-05-06

Count	12/12	Complete		
Interval	00:00s/10:00s			
Element	1			
Volt Range	300 V/50Hz	Element1	Judgement	Pass
Un (Set)	230.000V	Total	Judgement	Pass
Freq (U1)	50.000Hz	(Element1)		
Dmin	0.20%			

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.000	Pass	0.000	Pass	0.0	Pass	0.071	Pass		
2	0.127	Pass	0.318	Pass	0.0	Pass	0.081	Pass		
3	0.001	Pass	0.308	Pass	0.0	Pass	0.088	Pass		
4	0.191	Pass	0.364	Pass	0.0	Pass	0.108	Pass		
5	0.184	Pass	0.259	Pass	0.0	Pass	0.081	Pass		
6	0.027	Pass	0.263	Pass	0.0	Pass	0.090	Pass		
7	0.000	Pass	0.000	Pass	0.0	Pass	0.074	Pass		
8	0.000	Pass	0.000	Pass	0.0	Pass	0.071	Pass		
9	0.000	Pass	0.000	Pass	0.0	Pass	0.070	Pass		
10	0.000	Pass	0.000	Pass	0.0	Pass	0.070	Pass		
11	0.000	Pass	0.000	Pass	0.0	Pass	0.070	Pass		
12	0.000	Pass	0.000	Pass	0.0	Pass	0.069	Pass		
Result		Pass		Pass		Pass		Pass	0.080	Pass

2.4.4 Test Setup

2.4.5 Test Location

This test was carried out in EAST Group Co., Ltd.

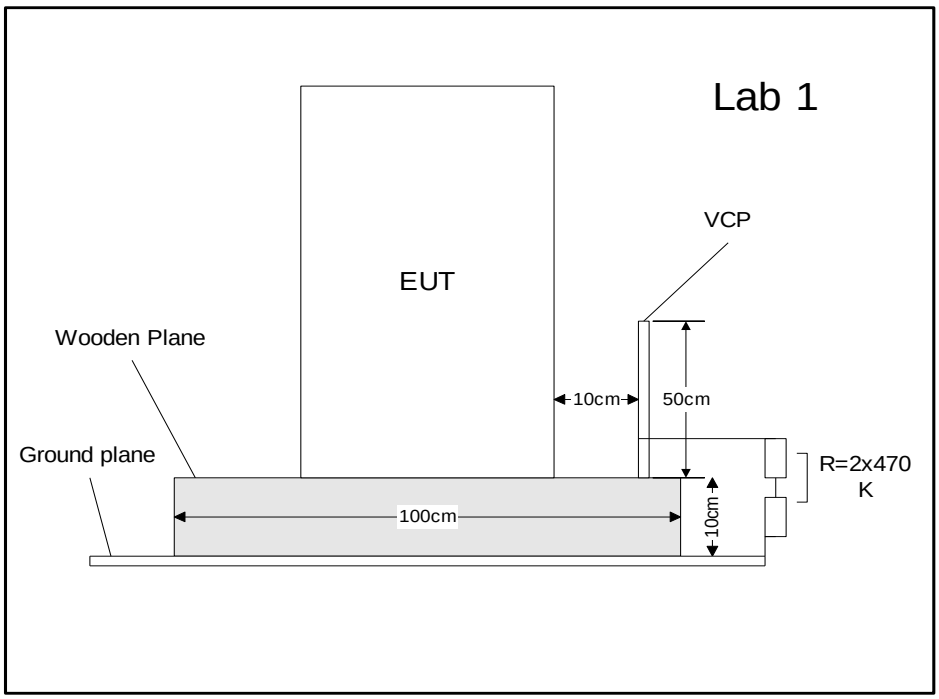
2.5 Electrostatic discharge immunity test

2.5.1 Test Method

The equipment under test including associated cabling was configured on but insulted from, using a 0.5mm isolator, a horizontal coupling plane fitted to the top of a 0.8 m non-conductive floor for Floor-Stand equipment; and on a 0.1 m insulated support for floor standing equipment; above a ground reference plane all within a test laboratory.

Using the air discharge method for non-metallic parts, contact discharge method for metallic parts with both vertical and horizontal couple plane discharge methods for the sides of the equipment under test, the required electrostatic discharge voltage levels in both voltage polarities were applied at the detailed pulse repartition rate.

During this testing any anomalies in the equipment under tests performance was recorded.



Floor-Stand equipment

VCP: Vertical Coupling Plane 0.5 x 0.5 m HCP: Horizontal Coupling Plane 0.95 x 1.6 m

R. Ground: 2 x 2 m R: 470 KΩ

2.5.2 Specification Limits

Required Test Levels				Performance Criteria
Discharge type	Discharge Level (kV)		Number of discharges per location (each polarity)	
	Positive	Negative		
Air – Direct	8	8	see note 1	B
Contact – Direct	4	4	see note 1	B
Contact – Indirect	4	4	see note 1	B
Supplementary information: Note 1. The EUT shall be exposed to at least 200 discharges, 100 each at negative and positive polarity, at a minimum of four test points. For Floor-Stand equipment one of the test points shall be the centre front edge of the horizontal coupling plane, which shall be subjected to at least 50 indirect discharges (25 of each polarity).				

2.5.3 Test Results

Results for Configuration and Mode: TM1, TM2, TM3, TM4, TM5, TM6

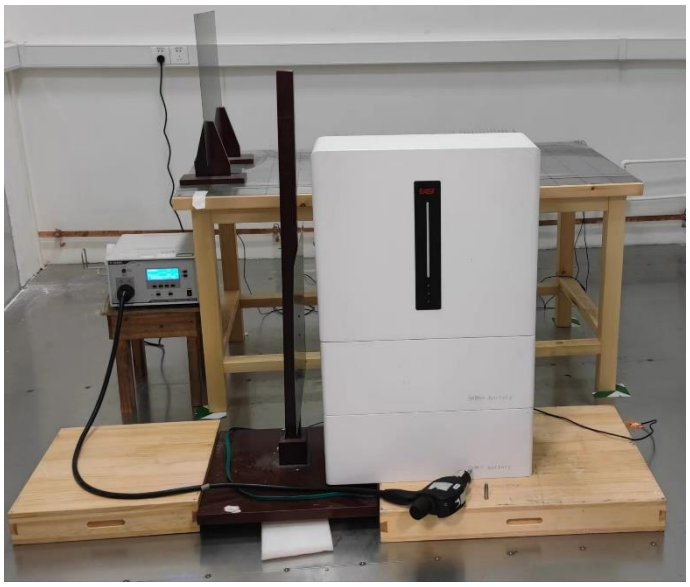
Performance assessment of the EUT made during this test: Pass

Detailed results are shown below.

Test date: 2023-05-06

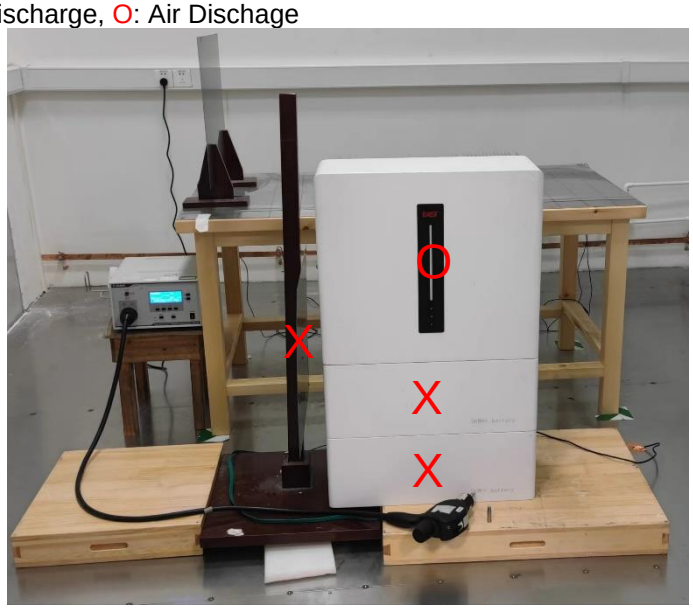
ID	Test Point	Discharge	Results									
			2kV		4kV		6kV		8kV		15kV	
			+	-	+	-	+	-	+	-	+	-
	HCP	Contact	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	VCP	Contact	N/A	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A
	All plastic seams	Air	N/A	N/A	N/A	N/A	N/A	N/A	A	A	N/A	N/A
	All metal seams	Contact	N/A	N/A	A	A	N/A	N/A	N/A	N/A	N/A	N/A
	LAN port	Contact	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A: Not applicable												
Remark: No observable change.												

2.5.4 Test Setup



Test Setup

X: Contact Discharge, O: Air Dischage



Test point

2.5.5 Test Location

This test was carried out in EMS Test Location.

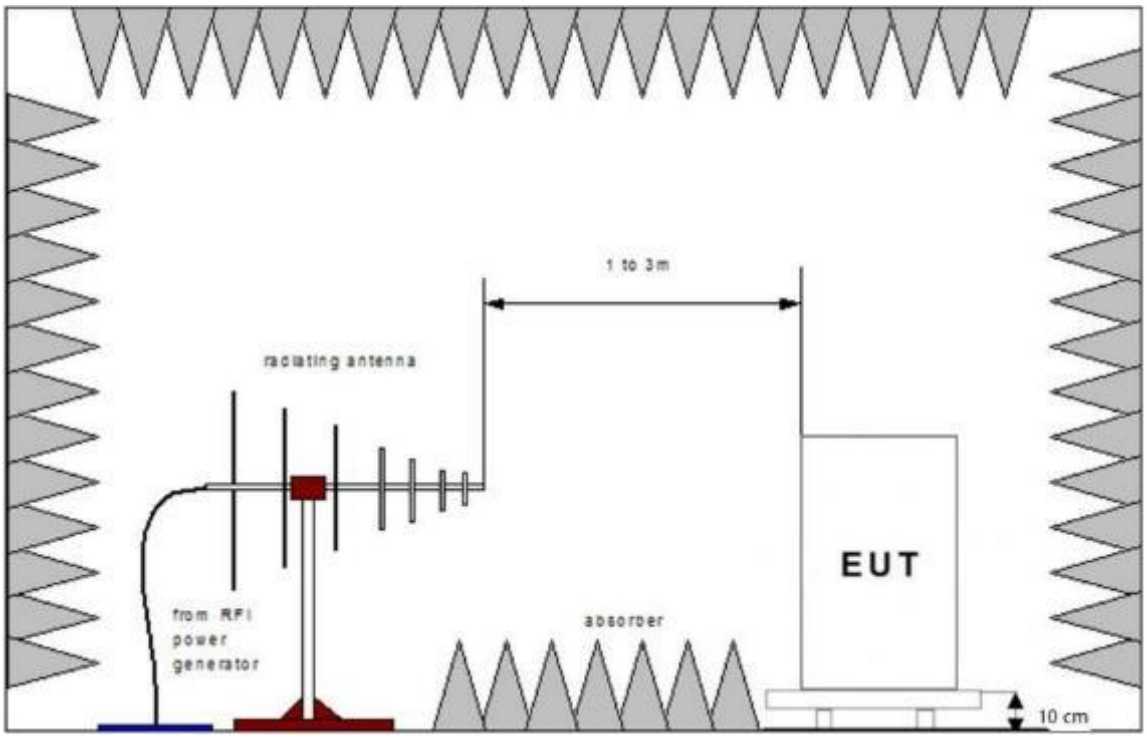
2.6 Enclosure Port - Radio-frequency electromagnetic field Amplitude modulated

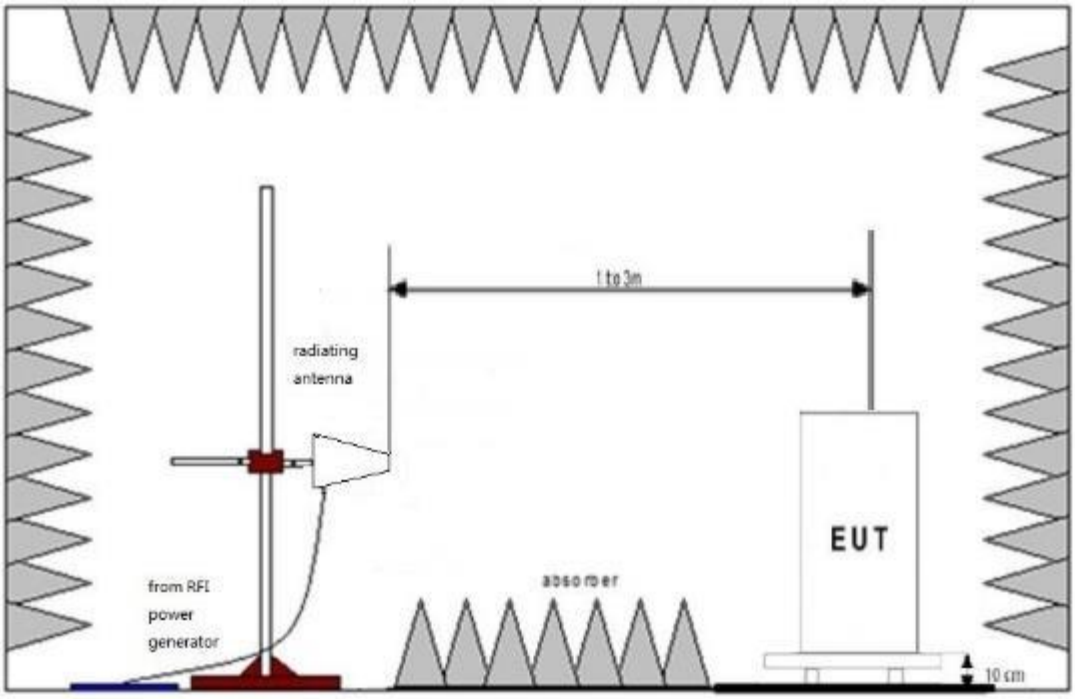
2.6.1 Test Method

The equipment under test including associated cabling was configured, on a 0.1 m non-conductive floor for Floor-Stand equipment and on a 0.1 m insulated support for floor standing equipment; with a pre-calibrated semi anechoic chamber.

All four sides of the equipment under test were subjected to the required RF field strength, modulated as described, swept over the frequency range of test with the antenna positioned in both horizontal and vertical polarizations.

During this testing any anomalies in the equipment under tests performance was recorded.





2.6.2 Specification Limits

Required Test Levels					Performance Criteria
Frequency Range (MHz)	Level (V/m)	Modulation	Step Size (%)	Dwell (s)	
80 to 1000	3	AM (80 %,1 kHz, sine wave)	1	>=1	A
1400 to 6000	3	AM (80 %,1 kHz, sine wave)	1	>=1	A
Supplementary information: Note 1. EUT powered at one of the Nominal input voltages and frequencies					

2.6.3 Test Results

Results for Configuration and Mode: TM1, TM2, TM3, TM4, TM5, TM6

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

Test date: 2023-05-06

Tabulated Results for RF Electromagnetic Field 80 - 1000 MHz					
Side of the equipment under test	Antenna polarization	Test Level	Dwell Time	Measuring distance	Results
All sides	Horizontal	3 V/m	1 s	3 m	A
All sides	Vertical	3 V/m	1 s	3 m	A

Tabulated Results for RF Electromagnetic Field 1400 - 6000 MHz					
Side of the equipment under test	Antenna polarization	Test Level	Dwell Time	Measuring distance	Results
All sides	Horizontal	3 V/m	1 s	3 m	A
All sides	Vertical	3 V/m	1 s	3 m	A

Remark: No observable change.

2.6.4 Test Setup

2.6.5 Test Location

This test was carried out in EMS Test Location.

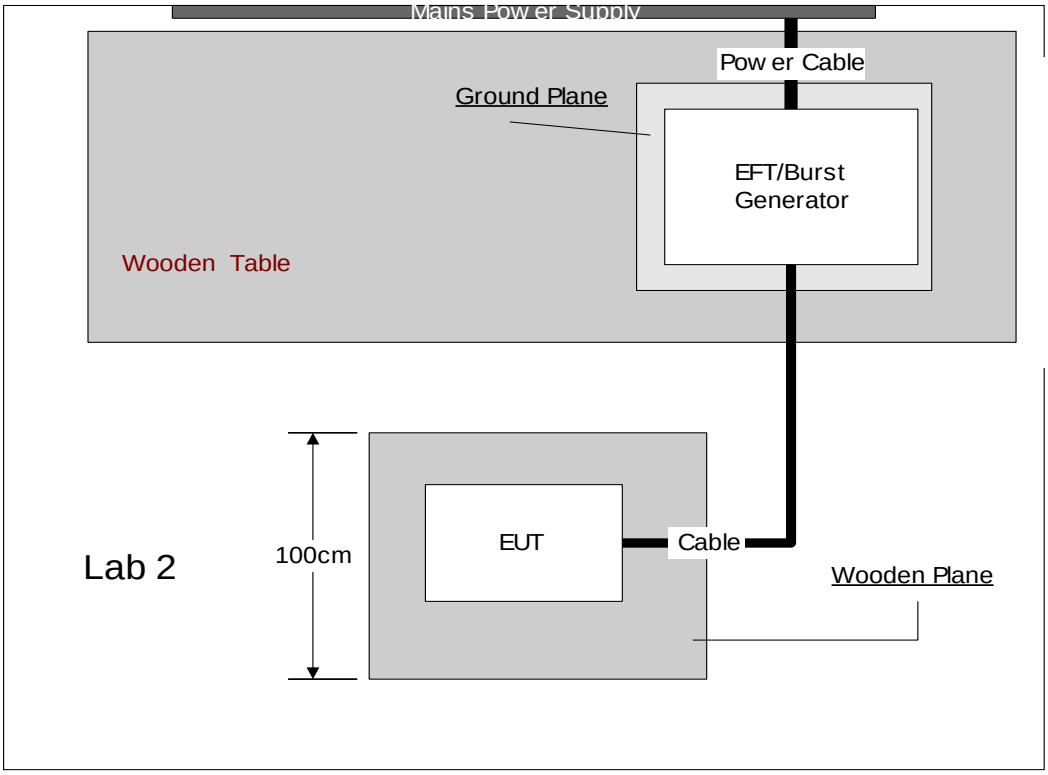
2.7 Electrical fast transient /burst immunity test

2.7.1 Test Method

The equipment under test including associated cabling was configured on but insulated from, using a 0.1 m isolator, a horizontal coupling plane fitted to the top of a 0.8 m non-conductive table for table-top equipment; and on a 0.1 m insulated support for floor standing equipment; above a ground reference plane all within a test laboratory.

Using a CDN for power ports, capacitive coupling clamp for signal and control ports and a 33nF coupling capacitor for earth ports, the required fast transient burst voltage levels in both voltage polarities were applied at the detailed pulse repartition rate and duration of test.

During this testing any anomalies in the equipment under tests performance was recorded.



2.7.2 Specification Limits

Required Test Levels Input and output a.c. power ports					
Line Under Test	Level (kV)	Repetition Rate (kHz)	Test Duration	Coupling Method	Performance Criteria
Input and output a.c. power ports	± 1.0	5 kHz/ 100kHz	2 min per polarity	Direct	B
For extra low voltage a.c. ports and output a.c. ports, this testing is only applicable to ports interfacing with cables whose total length may exceed 3 m according to the manufacturer's functional specification.					

Required Test Levels ports for DC Power Port					
Line Under Test	Level (kV)	Repetition Rate (kHz)	Test Duration	Coupling Method	Performance Criteria
DC Power port	± 0.5	5 kHz/ 100kHz	2 min per polarity	Direct	B
Not applicable to input ports intended for connection to a battery or a rechargeable battery which shall be removed or disconnected from the equipment for recharging. Equipment with a DC power input port intended for use with a dedicated AC–DC power adaptor shall be tested on the AC power input of the AC–DC power adaptor specified by the manufacturer (see the test level of Table 4). Where no adaptor is specified, the test shall be done on the DC power port using the test level of Table 4. Where an adaptor is specified, the test is applicable to DC power input ports only when intended to be connected permanently to cables longer than 3 m. The test may be performed at one or at both repetition frequencies. The use of 5 kHz repetition frequency is traditional; however, 100 kHz is closer to reality.					

Required Test Levels ports for signal and control lines					
Line Under Test	Level (kV)	Repetition Rate (kHz)	Test Duration	Coupling Method	Performance Criteria
Signal and control lines	± 0.5	5 kHz/ 100kHz	2 min per polarity	Direct	B
Applicable only to ports interfacing with cables whose total length can exceed 3m according to the manufacturer’s function specification.					

2.7.3 Test Results

Results for Configuration and Mode: TM1, TM2, TM3, TM4, TM5, TM6

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

Test date: 2023-05-06

Tabulated Results for Fast Transient Burst Immunity					
Line under test	Test Level	Repetition Rate	Test Duration	Coupling Method	Result
AC power ports	± 1.0 kV	5 kHz/ 100kHz	2 min	CDN	A
DC Power port	± 0.5 kV	5 kHz/ 100kHz	2 min	CLAMP	A

Remark: No observable change.

2.7.4 Test Setup

2.7.5 Test Location

This test was carried out in EMS Test Location.

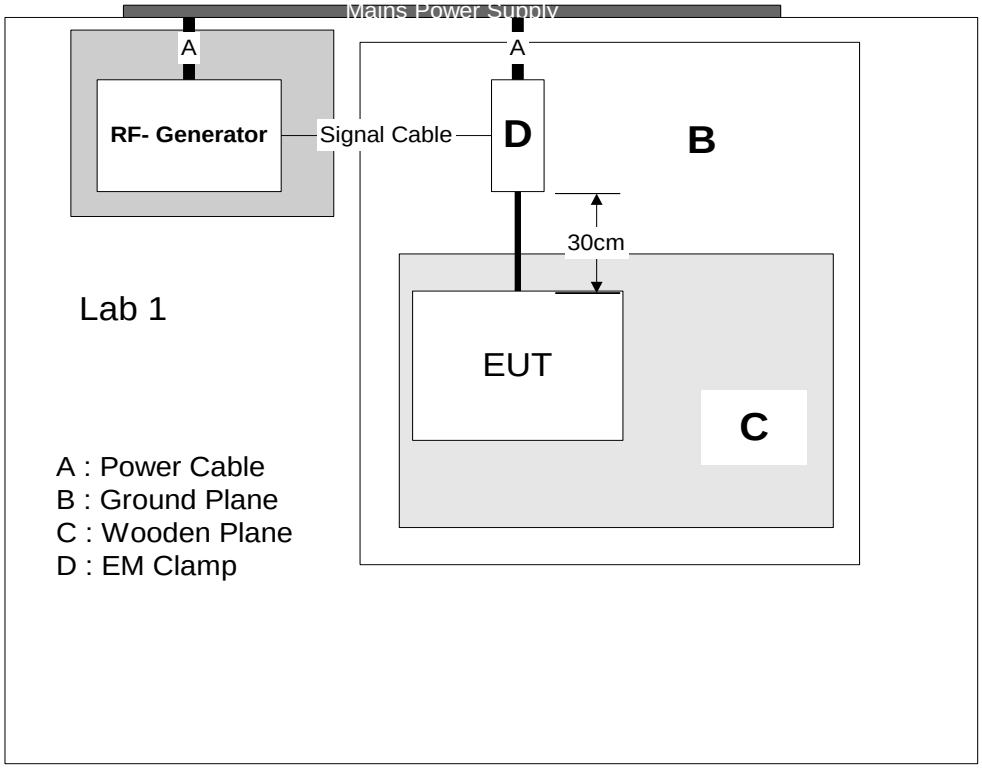
2.8 Immunity to conducted disturbances, induced by radio-frequency fields

2.8.1 Test Method

The equipment under test was configured, on but insulated from, using a 0.1 m isolator, a horizontal coupling plane fitted to the top of a 0.1 m non-conductive table for table-top equipment, above a ground reference plane all within a test laboratory.

All associated cabling was configured, on but insulated from, using a 50 mm isolator, the same horizontal coupling plane as the equipment under test.

Using CDNs, EM Clamps or current clamps as appropriate, the power ports and applicable signal and control ports were subjected to the required, pre calibrated RF injected signal strength, modulated as described, swept over the frequency range of test.
During this testing any anomalies in the equipment under tests performance was recorded.



2.8.2 Specification Limits

Required Test Levels Input and output a.c. power ports						
Line Under Test	Frequency Range (MHz)	Level (V)	Modulation	Step Size (%)	Dwell (s)	Performance Criteria
Input and output a.c. power ports	0.15 to 80	3	AM (80 %,1 kHz, sine wave)	1	3	A
For extra low voltage a.c ports and output a.c. ports, this testing is only applicable to ports interfacing with cables whose total length may exceed 3 m according to the manufacturer's functional specification.						

Required Test Levels Input and output D.C. power ports						
Line Under Test	Frequency Range (MHz)	Level (V)	Modulation	Step Size (%)	Dwell (s)	Performance Criteria
Input and output d.c. power ports	0.15 to 80	3	AM (80 %,1 kHz, sine wave)	1	3	A
For extra low voltage a.c ports and output a.c. ports, this testing is only applicable to ports interfacing with cables whose total length may exceed 3 m according to the manufacturer's functional specification.						

Required Test Levels Ports for signal lines and control lines						
Line Under Test	Frequency Range (MHz)	Level (V)	Modulation	Step Size (%)	Dwell (s)	Performance Criteria
Signal and control port	0.15 to 80	3	AM (80 %,1 kHz, sine wave)	1	3	A
Applicable only to ports interfacing with cables whose total length may exceed 3m according to the manufacturer’s function specification.						

2.8.3 Test Results

Results for Configuration and Mode: TM1, TM2, TM3, TM4, TM5, TM6

Performance assessment of the EUT made during this test: Pass.

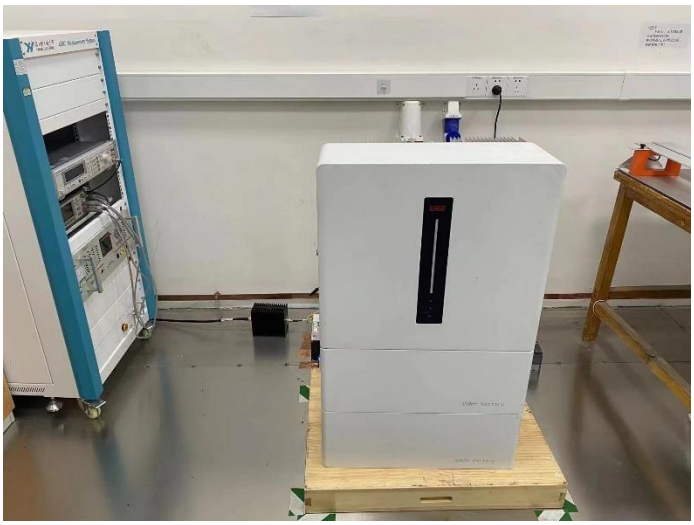
Detailed results are shown below.

Test date: 2023-05-06

Tabulated Results for Injected current						
Line and sensitive frequency under test	Test Level	Step	Dwell Time	Coupling Method	Modulation	Result
AC. power ports	3V	1%	3s	CDN	1kHz, 80%	A
DC. power ports	3V	1%	3s	CLAMP	1kHz, 80%	A

Remark: No observable change.

2.8.4 Test Setup



2.8.5 Test Location

This test was carried out in EMS Test Location.

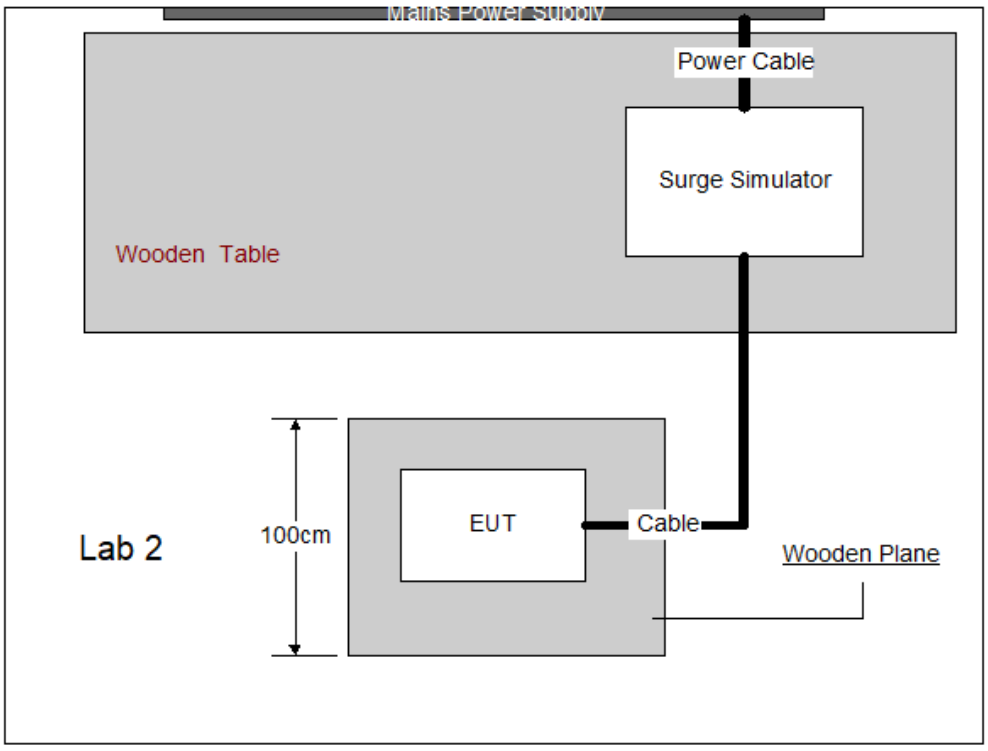
2.9 Surge immunity test

2.9.1 Test Method

The equipment under test including associated cabling was configured, on a 0.8 m non-conductive table for table-top equipment and on a 0.1 m insulated support for floor standing equipment above a ground reference plane all within a test laboratory.

Using CDNs for power ports and appropriate coupling methods for applicable signal and control ports, the required number of surges was applied for each surge voltage level using both positive and negative surge voltage polarities. Surges were applied at the power line frequency phase angles and repartition rates detailed.

During this testing any anomalies in the equipment under tests performance was recorded.



2.9.2 Specification Limits

Required Test Levels Input and output a.c. power ports		
Characteristics	Test Levels	Performance Criteria
Wave-shape data Test levels line to line with 2Ω impedance line to earth with 12Ω impedance	1.2/50 µs ± 1.0 kV ±2.0 kV	B
Note in addition to the specified test level, all lower levels as detailed in IEC 61000-4-5 should also be satisfied.		

Required Test Levels Input and output d.c. power ports		
Characteristics	Test Levels	Performance Criteria
Wave-shape data Test levels line to line with 2Ω impedance line to earth with 12Ω impedance	1.2/50 µs ± 0.5 kV ±1.0 kV	B
Note in addition to the specified test level, all lower levels as detailed in IEC 61000-4-5 should also be satisfied.		

Required Test Levels Signal ports		
Characteristics	Test Levels	Performance Criteria
Wave-shape data Test levels line to earth with 12Ω impedance	1.2/50 µs ± 1.0 kV	B
Note in addition to the specified test level, all lower levels as detailed in IEC 61000-4-5 should also be satisfied.		

2.9.3 Test Results

Results for Configuration and Mode: TM1, TM2, TM3, TM4, TM5, TM6

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

Test date: 2023-05-06

Tabulated Results for Surge Immunity (Power Ports)							
Line Name	Coupling	Level	Polarity	Phase Angle	No of Pulses	Repetition Rate	Result
AC Power Cord	Line to Line	-1.0kV	NEGATIVE	0,90,180 ,270	5	60 sec	A
AC Power Cord	Line to Line	+1.0kV	POSITIVE	0,90,180 ,270	5	60 sec	A
AC Power Cord	Line to Neutral	-1.0kV	NEGATIVE	0,90,180 ,270	5	60 sec	A
AC Power Cord	Line to Neutral	+1.0kV	POSITIVE	0,90,180 ,270	5	60 sec	A
AC Power Cord	Line to Earth	-2.0kV	Negative	0,90,180 ,270	5	60 sec	A
AC Power Cord	Line to Earth	+2.0kV	Positive	0,90,180 ,270	5	60 sec	A
AC Power Cord	Neutral to Earth	-2.0kV	Negative	0,90,180 ,270	5	60 sec	A
AC Power Cord	Neutral to Earth	+2.0kV	Positive	0,90,180 ,270	5	60 sec	A
DC Power Cord	DC+	-0.5kV	Negative	--	5	60 sec	A
DC Power Cord	DC-	+0.5kV	Positive	--	5	60 sec	A

Remark: No observable change.

2.9.4 Test Setup

2.9.5 Test Location

This test was carried out in EMS Test Location.

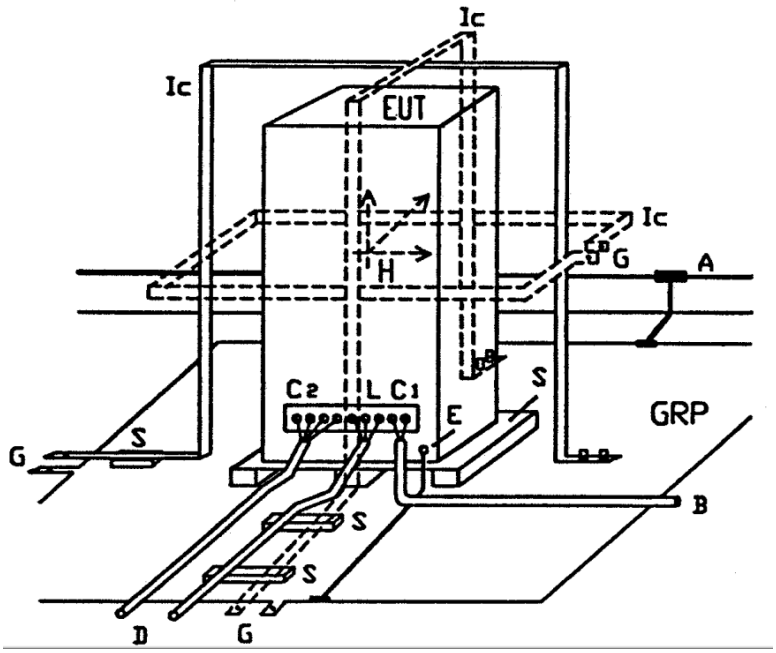
2.10 Enclosure Port - Power-frequency magnetic field

2.10.1 Test Method

The equipment under test including associated cabling was configured on a non-conductive support at the volumetric center of the immunity coils. A pre calibrated input level was then applied to magnetic immunity coils at the detailed frequency and level for the required test period.

The EUT was retested with the magnetic field applied in all 3 orthogonal planes of the EUT.

During this testing any anomalies in the equipment under tests performance was recorded.



2.10.2 Specification Limits

Required Test Levels			Performance Criteria
Application	Level (A/m)	Duration	
Continuous Field	3	dependent on EUT operating cycle	A
Supplementary information: Note 1. EUT powered at one of the Nominal input voltages and frequencies			

2.10.3 Test Results

Results for Configuration and Mode: TM1, TM2, TM3, TM4, TM5, TM6

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

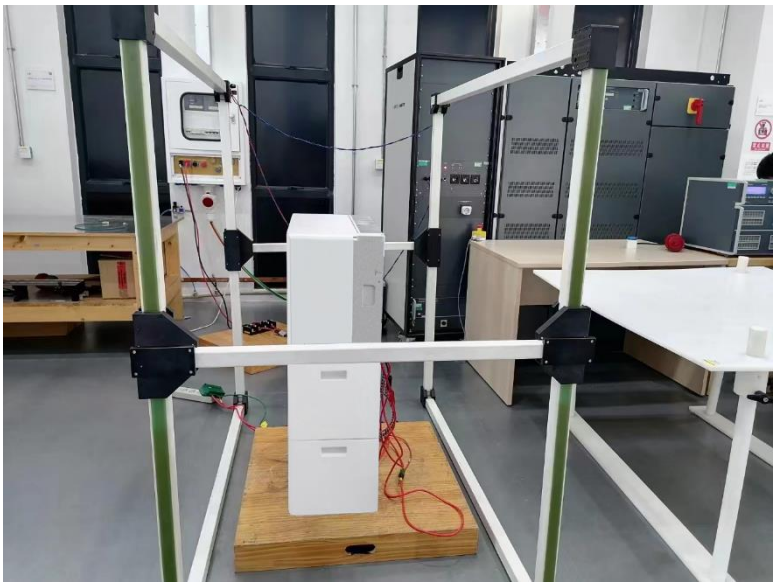
Test date: 2023-05-06

Tabulated Results for Power Frequency Magnetic Immunity					
Orientation	Operating Frequency	Test Frequency	Test Level	Duration	Result
X axis	50 Hz	50 Hz	3 A/m	1 min	A
Y axis	50 Hz	50 Hz	3 A/m	1 min	A
Z axis	50 Hz	50 Hz	3 A/m	1 min	A

Tabulated Results for Power Frequency Magnetic Immunity					
Orientation	Operating Frequency	Test Frequency	Test Level	Duration	Result
X axis	60 Hz	60 Hz	3 A/m	1 min	A
Y axis	60 Hz	60 Hz	3 A/m	1 min	A
Z axis	60 Hz	60 Hz	3 A/m	1 min	A

Remark: No observable change.

2.10.4 Test Setup



2.10.5 Test Location

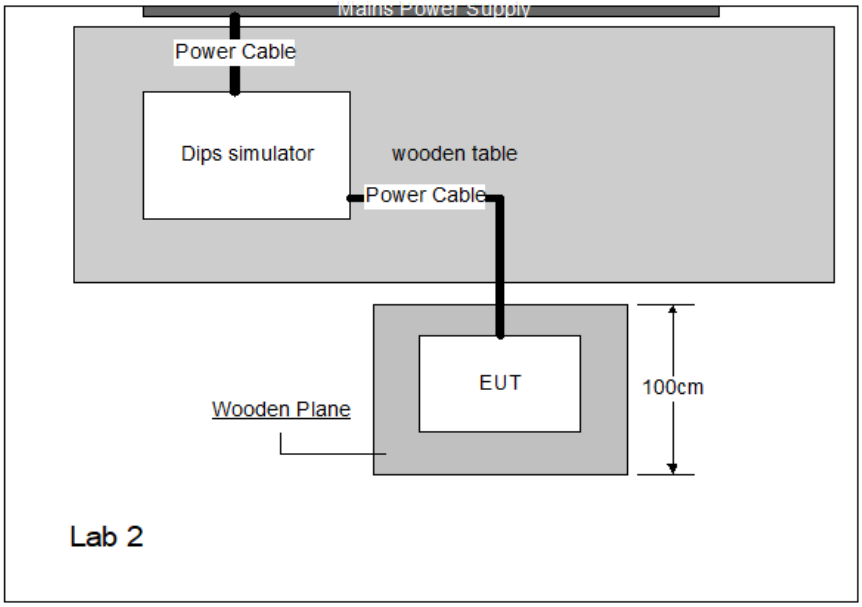
This test was carried out in EMS Test Location.

2.11 Voltage dips, short interruptions and voltage variations immunity tests

2.11.1 Test Method

The equipment under test including associated cabling was configured, on a 0.8 m non-conductive table for table-top equipment and on a 0.1 m insulated support for floor standing equipment above a ground reference plane all within a test laboratory.

Using a programmable power supply the equipment under test was subjected to the detailed supply voltage dips and interruptions. The required supply phase synchronization and test repetition rate, detailed, was controlled by the programmable power supply.
During this testing any anomalies in the equipment under tests performance was recorded.



2.11.2 Specification Limits

Voltage Dips				
Voltage Dips in % UT	Test level in % UT	Duration		Performance Criteria
		50Hz	60Hz	
100	0	0.5 cycle	0.5 cycle	B
100	0	1 cycle	1 cycle	B
30	70	25 cycles	30 cycles	C
100	0	250 cycles	300 cycles	C
UT is the rated voltage of the Equipment Under Test				

2.11.3 Test Results

Results for Configuration and Mode: TM1, TM4, TM5

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

Test date: 2023-05-06

Tabulated Results for Voltage Dip and Short Interruption					
Line under test	Vnom	Operating Frequency	Test Level	Duration	Result
Power line	230 V~	50 Hz	0% of Vnom	0.5cycle	B
Power line	230 V~	50 Hz	0% of Vnom	1cycle	B
Power line	230 V~	50 Hz	70% of Vnom	25 cycles	B
Power line	230 V~	50 Hz	0% of Vnom	250 cycles	B

Tabulated Results for Voltage Dip and Short Interruption					
Line under test	Vnom	Operating Frequency	Test Level	Duration	Result
Power line	230 V~	60 Hz	0% of Vnom	0.5cycle	B
Power line	230 V~	60 Hz	0% of Vnom	1cycle	B
Power line	230 V~	60 Hz	70% of Vnom	30 cycles	B
Power line	230 V~	60 Hz	0% of Vnom	300 cycles	B

Remark: Result B: The EUT stopped during the test and recovered itself after test.

2.11.4 Test Setup

2.11.5 Test Location

This test was carried out in EMS Test Location.

3 Test Equipment Information

3.1 General Test Equipment Used

Test site1:

Conducted Emission Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
Receiver	Rohde & Schwarz	ESCI 7	E-2802	100798	1	2023-11-23
LISN	Rohde & Schwarz	ENV 4200	E-2801	100147	1	2023-11-23

Radiated Emission Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
Receiver	Rohde & Schwarz	ESCI 7	E-2802	100798	1	2023-11-23
Test Antenna	ETS-LINDGREN	3142D	E-2803	00135455	1	2023-06-16
3m Semi-anechoic chamber	TDK	SAC-3	E-2804	1900187-1	3	2023-11-23

Harmonic Test / Flicker Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
3-phase analyzer for Harmonics and Flicker	HENGHE	WT3000	E-2500	91NA23821	1	2023-11-30
Multifunctional threephase voltage source	Chroma	61854	E-3592	618453800095	1	2023-11-30

Electrical Fast Transients Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
Compact Simulator	SHANJI	SKS-0404GB	E-2908	040414002E	1	2023-11-23

Surges Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
Compact Simulator	SHANJI	SKS-0510I	E-2910	100413002E	1	2023-11-23

Conducted Immunity Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
Compact immunity test systemr	SHANJI	SLG-255D	E-2909	05125001E	1	2023-12-06

DC Voltage Dips and Interruptions Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
Multifunctional threephase voltage source	Chroma	61854	E-3592	618453800095	1	2023-11-30

Radiated Immunity Test(CAC-3 area)

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
Signal Generator	Agilent	N5182A	/	MY47420276	1	2023-11-30
Power Amplifier	Wonder	HPA80M1000M500	/	001	1	2023-11-30
Power Amplifier	Wonder	HPA1000M2500M300	/	002	1	2023-11-30
Power Amplifier	Wonder	HPA2500M6000M200	/	003	1	2023-11-30
Microwave Log-Periodic Antenna	Schwarzbeck	STLP9128D	/	121	1	2023-11-30
Microwave Log-Periodic Antenna	Schwarzbeck	STLP9149	/	00597	1	2023-11-30
Average Power Sensor	Agilent	E9323	/	MY44420907	1	2023-11-30
Power Meter	Agilent	E4417A	/	MY45100364	1	2023-11-30

Electrostatic Discharge Test(ESD area)

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
ESD Generator	SHANJI	SKS-0020G	E-2907	020413019E	1	2023-11-30

Test site2:

Variation of power frequency Test(EMS area)

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
Multifunctional threephase voltage source	EMTEST	NetWave 67.3-400	64-2-09-20-011	P2009239095	1	2023-11-23
3-phase Flicker impedance	EMTEST	AIF 503N63.1	64-2-74-20-004	P2009239213	1	2023-11-23

4 Measurement Uncertainty

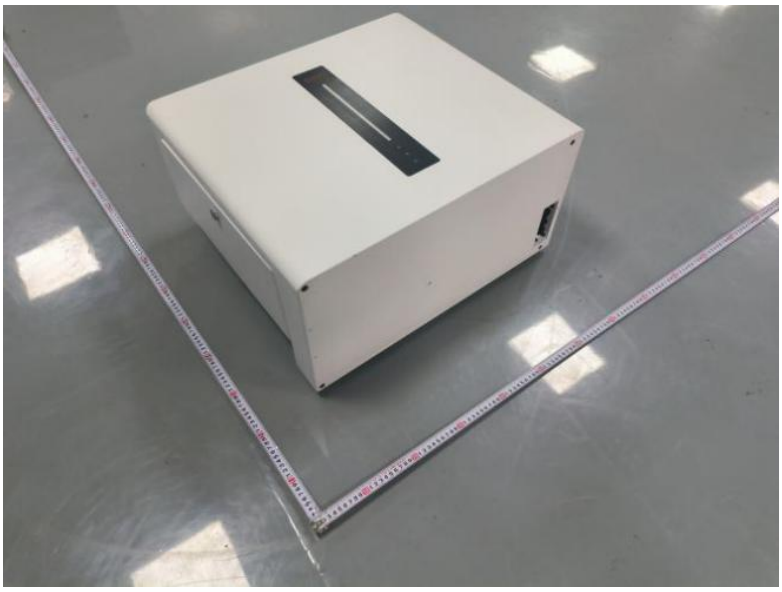
For a 95% confidence level, the measurement uncertainties for defined systems are:

System Measurement Uncertainty	
Test Items	Extended Uncertainty
Uncertainty for Conducted Emission 150kHz-30MHz	2.8dB
Uncertainty for Radiated Emission in 3m chamber 30MHz-1000MHz	Horizontal: 4.5dB; Vertical: 4.5dB
Uncertainty for Harmonic test	0.86%
Uncertainty for Flicker test	0.34%
Uncertainty for RS test	49%, K=2
Uncertainty for CS test	28%(CDN); 45%(EM Clamp) K=2
Uncertainty for ESD test	The immunity measurement system uncertainty is within standard requirement and is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%.
Uncertainty for EFT test	
Uncertainty for Surges test	
Uncertainty for PMF test	
Uncertainty for Voltage Dips, Voltage Variations and Short Interruptions Test	

Remark:
Measurement Uncertainty Decision Rule
Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2007, clause 4.4.3 and 4.5.1.

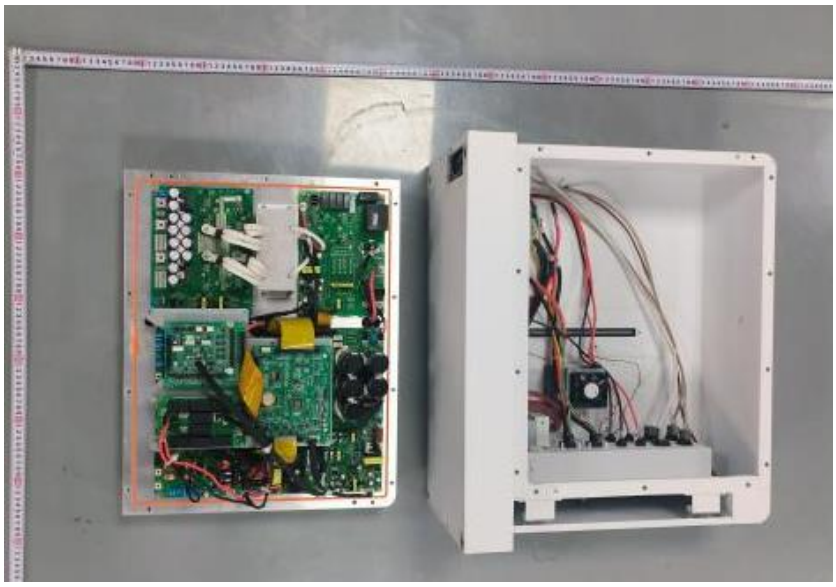
5 Photographs

Details of: General view



Details of: General view

Details of: Internal view



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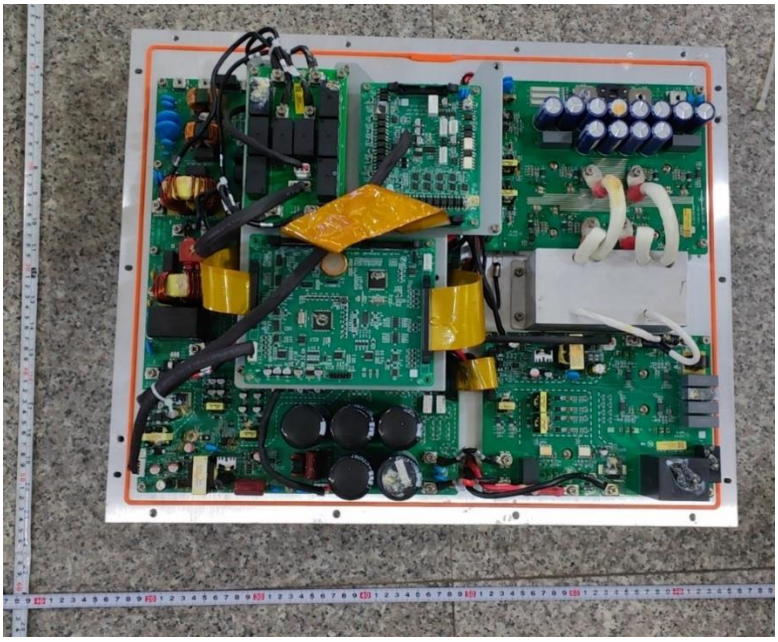

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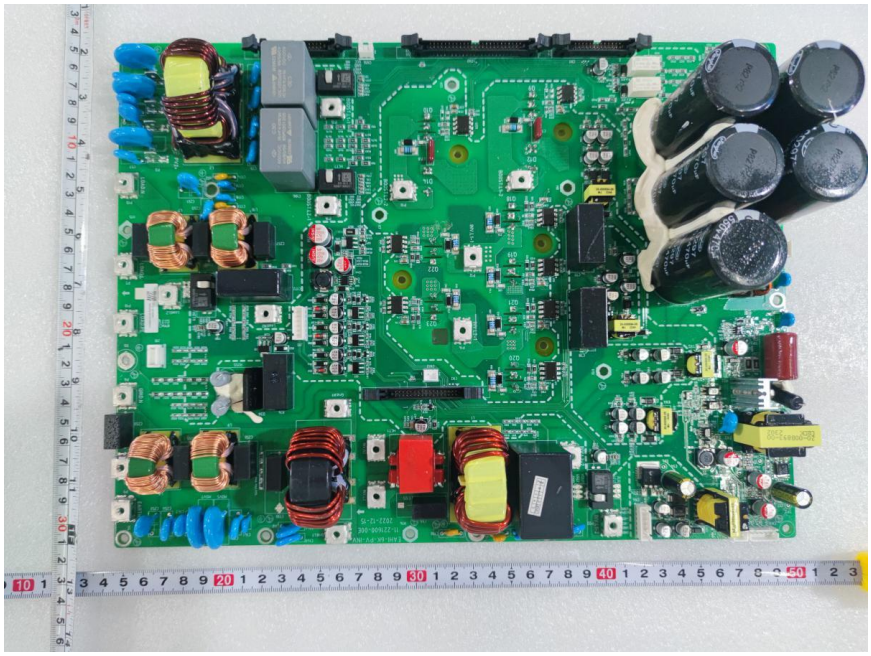

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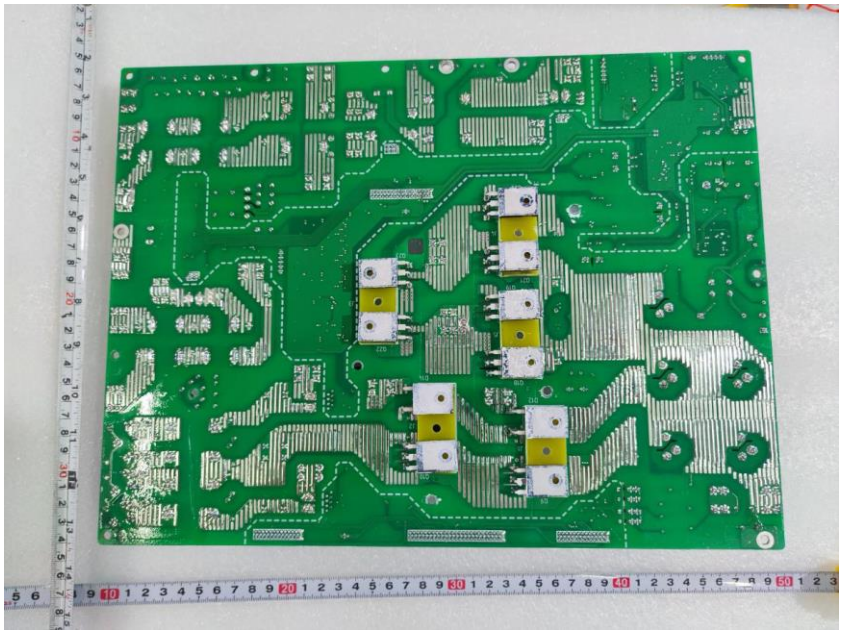

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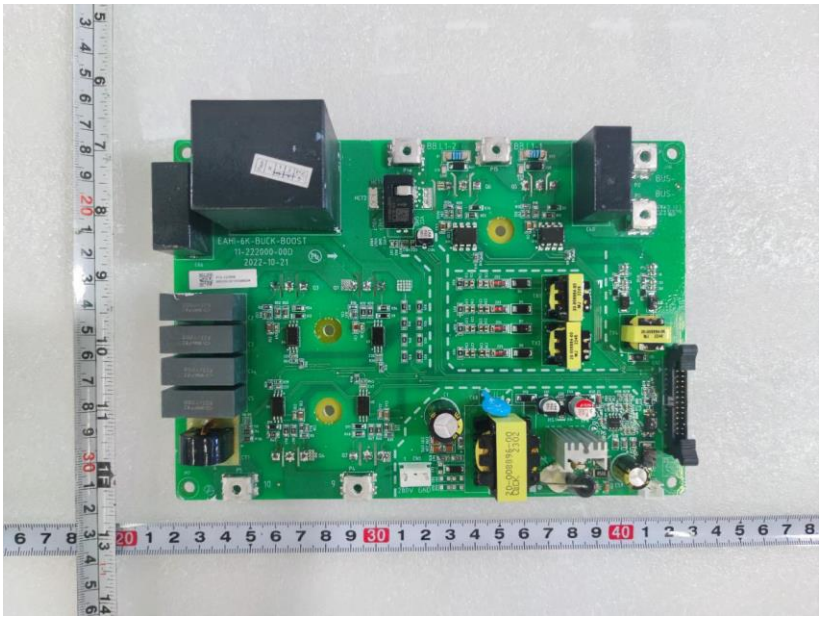
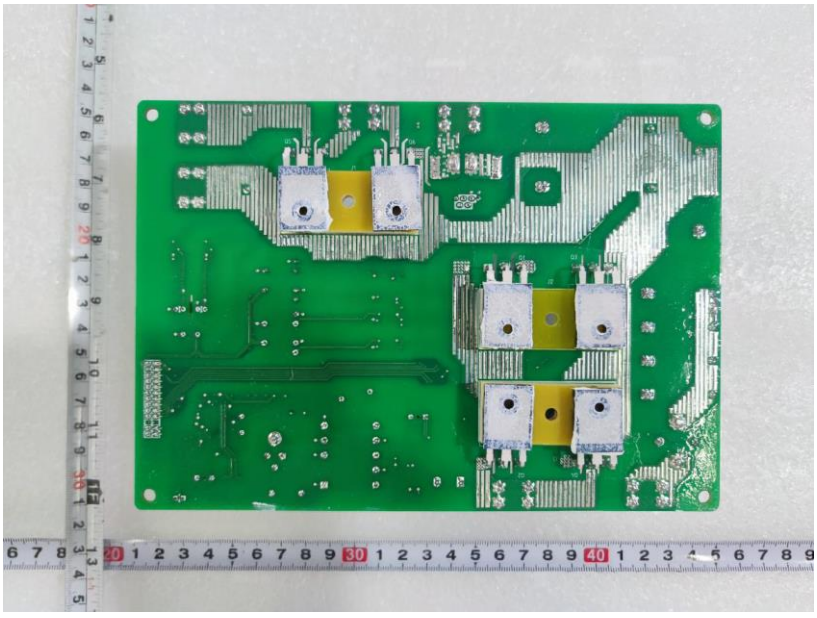
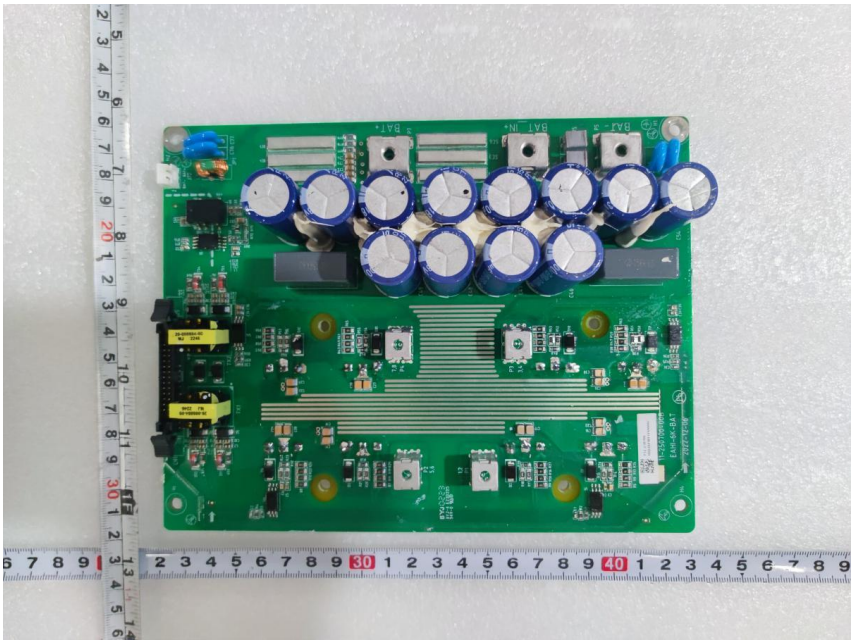


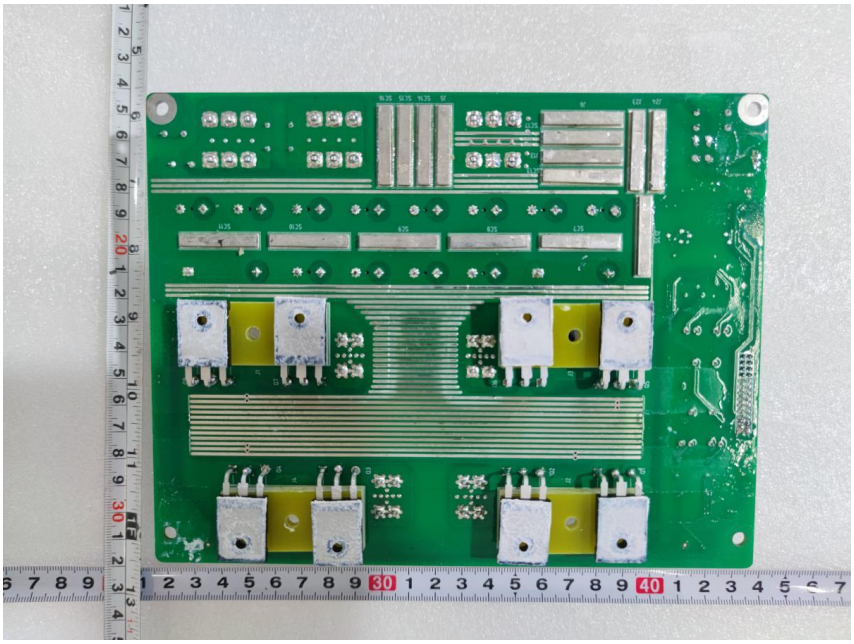
Details of: Inside view



Details of: Inside view



Details of: Inside view



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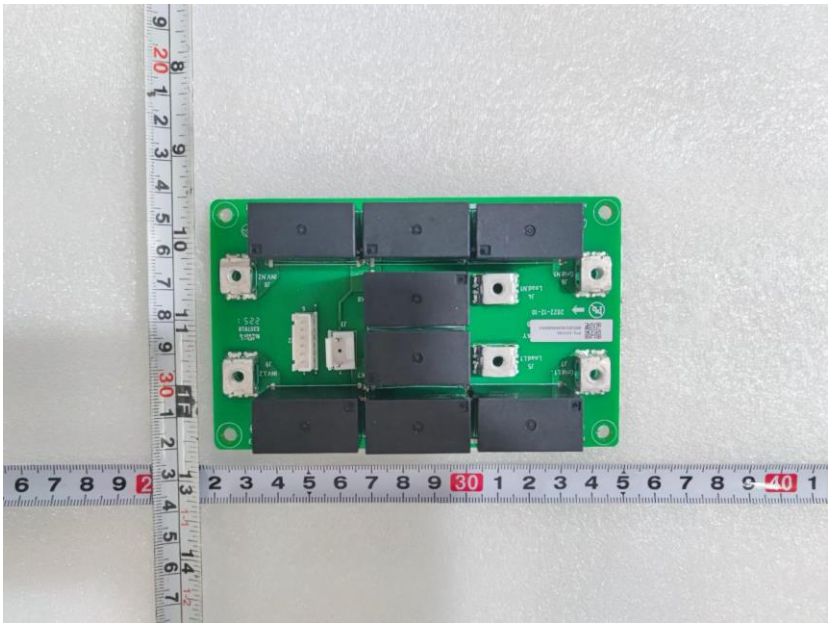

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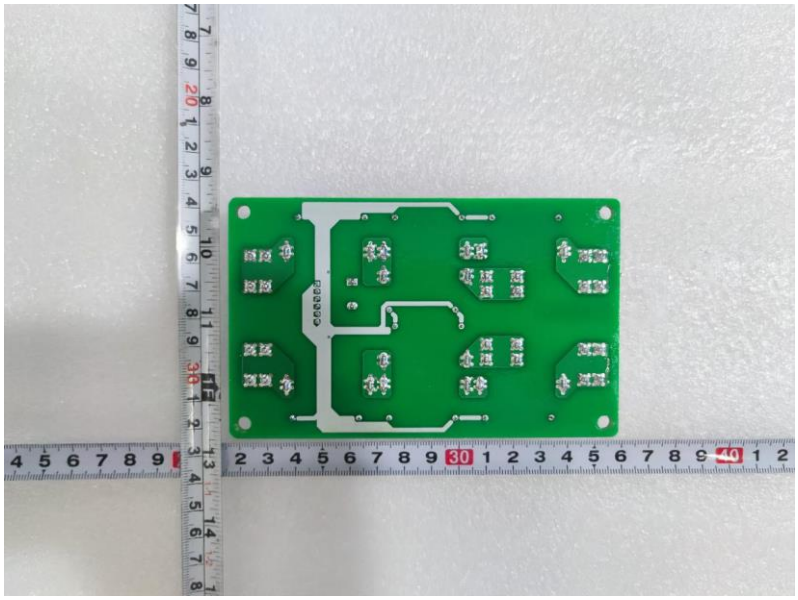
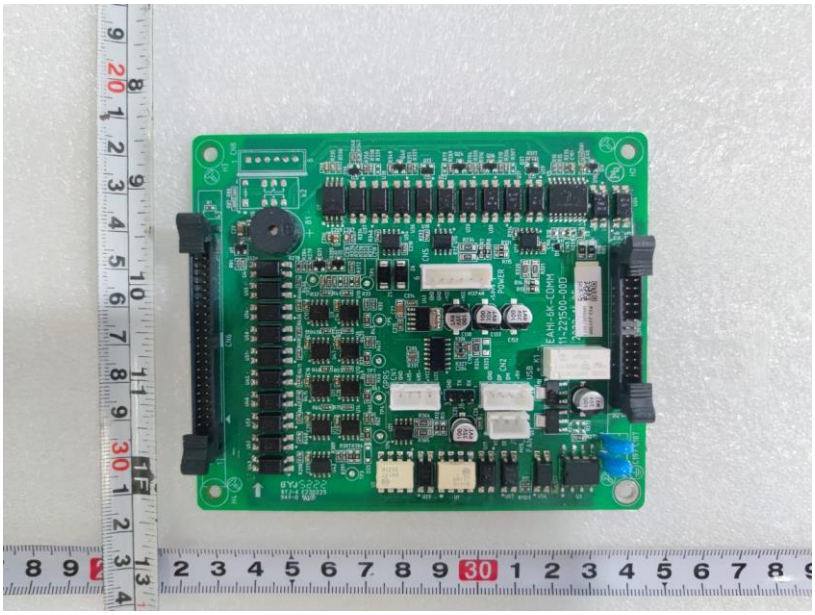
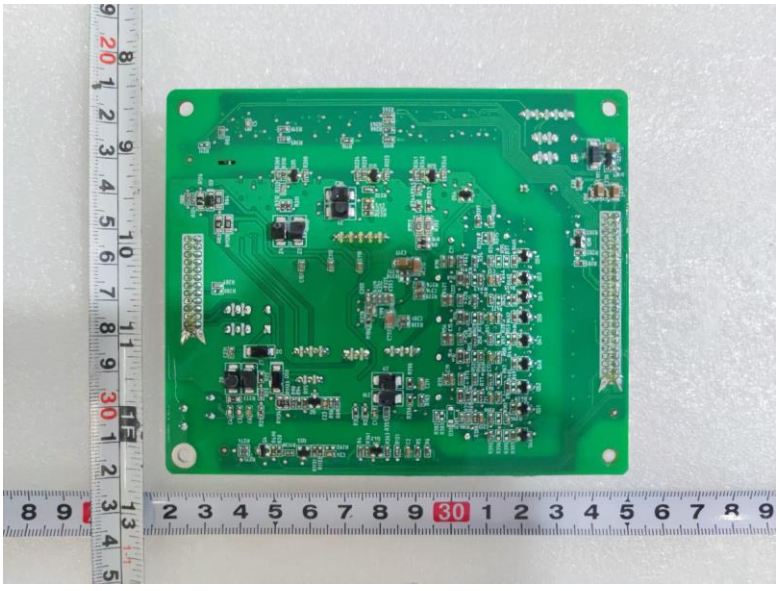


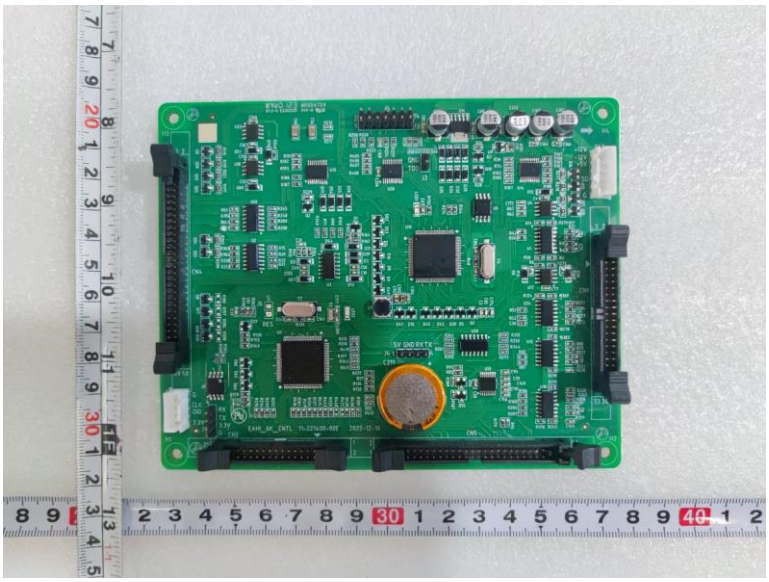
Details of: Inside view



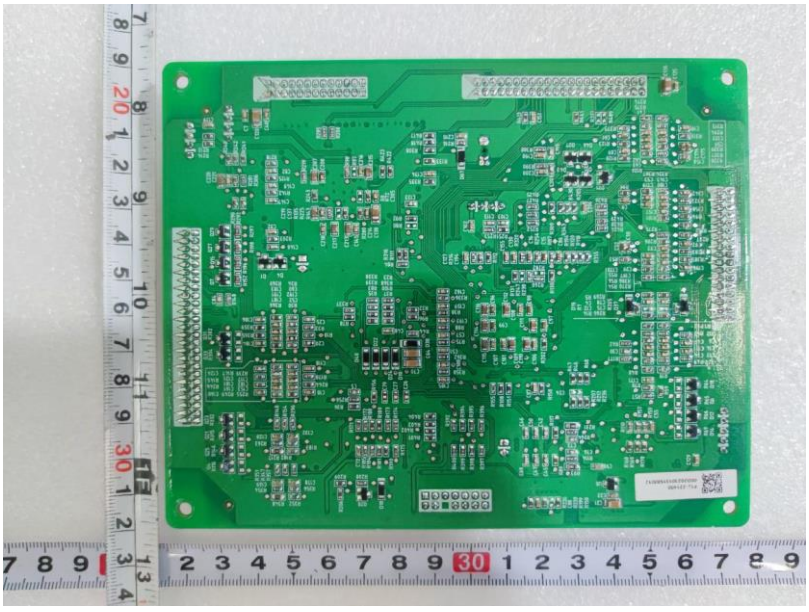
Details of: Inside view



Details of: Inside view



Details of: Inside view



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