TEST REPORT

Report No.....	:	ZHT-231220021E
Product.....	:	Laser Cap
Trademark.....	:	/
Model(s).....	:	Hat-01 Hat-02, Hat-03, Hat-04, Hat-05
Model Difference.....	:	Only the model name is different
Applicant.....	:	Hubei YJT Technology Co.,Ltd.
Address.....	:	Room 1-4, Floor 8, Building 7, Guannan Fuxing Pharmacel Park, No.58, Optics Valley Avenue, East Lake High-tech Development Zone, Wuhan，China (Free Trade Zone,wuhan area)
Manufacturer.....	:	Hubei YJT Technology Co.,Ltd.
Address.....	:	Room 1-4, Floor 8, Building 7, Guannan Fuxing Pharmacel Park, No.58, Optics Valley Avenue, East Lake High-tech Development Zone, Wuhan，China (Free Trade Zone,wuhan area)
Prepared by.....	:	Guangdong Zhonghan Testing Technology Co., Ltd.
Address.....	:	Room 104, Building 1, Yibaolai Industrial Park, Qiaotou Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China
Date of Receipt.....	:	Dec. 20, 2023
Date of Test(s).....	:	Dec. 20, 2023 - Dec. 27, 2023
Date of Issue.....	:	Dec. 27, 2023
Test Standard(s).....	:	EN IEC 55014-1:2021 EN IEC 55014-2:2021 EN IEC 61000-3-2:2019 +A1:2021 EN 61000-3-3:2013 + A1:2019 + A2:2021

In the configuration tested, the EUT complied with the standards specified above.

Tested by:	Reviewed by:	Approved by:
Kimi Lu/ Engineer	Baret Wu/ Director	Leon Lee/ Manager

Note: The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report shall not be reproduced except in full, without prior written approval of ZHT. This document may be altered or revised by ZHT, personnel only, and shall be noted in the revision of the document.

Table of Contents

1. Revision History

Report No.	Issue Date	Description	Approved
ZHT-231220021E	Dec. 27, 2023	Original	Valid

2. Test Summary

Emission			
Requirement - Test	Test Method		Result
Conducted Emission	EN IEC 55014-1:2021		PASS
Discontinuous Disturbance (Clicks)	EN IEC 55014-1:2021		N/A
Disturbance Power Emission	EN IEC 55014-1:2021		N/A
Radiated Electromagnetic Disturbances	EN IEC 55014-1:2021		N/A
Radiated Emission	EN IEC 55014-1:2021		PASS
Immunity			
Requirement - Test	Test Method	Performance criteria	Result
Electrostatic discharges	EN 61000-4-2:2009	B	PASS
Radio-frequency electromagnetic fields	EN 61000-4-3:2020	A	PASS
Fast transients	EN 61000-4-4:2012	B	PASS
Surges	EN 61000-4-5:2014	B	PASS
Injected currents	EN 61000-4-6:2014	A	PASS
Voltage dips and short interruptions	EN 61000-4-11:2020	C & C & C	PASS

Requirement - Test	Test Method	Limit	Result
Harmonic current emissions	EN IEC 61000-3-2:2019 +A1:2021	Class A	N/A
Voltage changes, voltage fluctuations and flicker	EN 61000-3-3:2013 + A1:2019 + A2:2021	Clause 5	PASS

Remark: N/A is abbreviation for Not Applicable.

3. General Information

3.1. Description of EUT

Product:	Laser Cap
Model Name:	Hat-01
Rated Power Supply:	Input: 5 V⎓2 A, Battery*2 3.7 V⎓
Normal Testing Voltage:	AC 230 V/ 50 Hz, 3.7 V⎓
DC Line	/
I/O Ports	Refer to User Manual
Highest Frequency Generated	Below 15 MHz

Power Adapter

Product:	AC/DC ADAPTER
Model Name:	KA12C0502000US
Rated Power Supply:	Input: AC 100 - 240 V, 50 / 60 Hz, 0.35 A Output: 5 V⎓2 A
Normal Testing Voltage:	AC 230 V/ 50 Hz
DC Line	Shorter than 3m

Note:

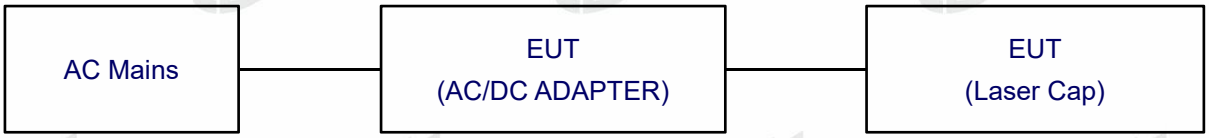
1) Other Accessory Device List and Details

Description	Manufacturer	Model	Note
/	/	/	/
/	/	/	/

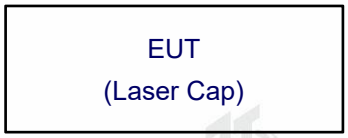
2) The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

3.2. Block diagram of EUT configuration

Mode 1



Mode 2



3.3. Test Mode

Pretest mode	Mode 1: Charging Working mode Mode 2: Working mode		
Final Test mode	Conducted Emission		Mode 1
	Discontinuous Disturbance (Clicks)		N/A
	Disturbance Power Emission		N/A
	Radiated Electromagnetic Disturbances		N/A
	Radiated Emission	Below 1 GHz	Mode 1
		Above 1 GHz	N/A
	Harmonic current emissions		N/A
	Voltage changes, voltage fluctuations and flicker		Mode 1
	Electrostatic discharges		Mode 1
	Radio-frequency electromagnetic fields		Mode 1
	Fast transients		Mode 1
	Surges		Mode 1
	Injected currents		Mode 1
	Voltage dips and short interruptions		Mode 1

* Only the final test mode is shown in the report

3.4. Test Site Environment

Test Item	Required (IEC 60068-1)		Actual
Conducted Emission	Temperature (°C)	15-35	23.6
	Humidity (%RH)	25-75	53.8
	Barometric pressure (mbar)	860-1060	1014
Radiated Emission	Temperature (°C)	15-35	24.0
	Humidity (%RH)	25-75	54
	Barometric pressure (mbar)	860-1060	1014
Voltage Fluctuations & Flicker	Temperature (°C)	--	23.8
	Humidity (%RH)	--	54.5
	Barometric pressure (mbar)	--	1014
Electrostatic discharges	Temperature (°C)	15-35	24.0
	Humidity (%RH)	25-75	52.0
	Barometric pressure (mbar)	860-1060	1014
Radio-frequency electromagnetic fields	Temperature (°C)	15-35	23.8
	Humidity (%RH)	25-75	53.6
	Barometric pressure (mbar)	860-1060	1014
Fast transients	Temperature (°C)	15-35	24.1
	Humidity (%RH)	25-75	53.6
	Barometric pressure (mbar)	860-1060	1014
Surges	Temperature (°C)	15-35	24.1
	Humidity (%RH)	25-75	53.6
	Barometric pressure (mbar)	860-1060	1014
Injected currents	Temperature (°C)	15-35	24.1
	Humidity (%RH)	25-75	53.6
	Barometric pressure (mbar)	860-1060	1014
Voltage dips and short interruptions	Temperature (°C)	15-35	24.1
	Humidity (%RH)	25-75	53.6
	Barometric pressure (mbar)	860-1060	1014

4. Facilities

4.1. Test Facility

Test site 1: Guangdong Zhonghan Testing Technology Co., Ltd.

Room 104, Building 1, Yibaolai Industrial Park, Qiaotou Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

Test site 2: Shenzhen Haiyun Testing Co., Ltd.

No. 2 Danzi North Road, Kengzi Street, Pingshan District, Shenzhen, Guangdong, China

Conducted Emissions Test

Equipment	Manufacturer	Model	Last Cal.	Next Cal.
Receiver	R&S	ESCI	May 12, 2023	May 11, 2024
LISN	R&S	ENV216	May 12, 2023	May 11, 2024
ISN CAT 6	Schwarzbeck	NTFM 8158	May 12, 2023	May 11, 2024
ISN CAT 5	Schwarzbeck	CAT5 8158	May 12, 2023	May 11, 2024
Capacitive Voltage Probe	Schwarzbeck	CVP 9222 C	May 12, 2023	May 11, 2024
Current Transformer Clamp	Schwarzbeck	SW 9605	May 12, 2023	May 11, 2024
CE Shielding Room	EMToni	9m4m3m	Nov. 25, 2021	Nov. 24, 2024

Radiated emissions Test (966 chamber)

Equipment	Manufacturer	Model	Last Cal.	Next Cal.
Receiver	R&S	ESCI	May 12, 2023	May 11, 2024
Amplifier	Schwarzbeck	BBV 9743 B	May 12, 2023	May 11, 2024
Amplifier	Schwarzbeck	BBV 9718 B	May 12, 2023	May 11, 2024
Bilog Antenna	Schwarzbeck	VULB9162	May 17, 2023	May 16, 2024
Horn Antenna	Schwarzbeck	BBHA9120D	May 17, 2023	May 16, 2024
966 Anechoic Chamber	EMToni	9m6m6m	Nov. 25, 2021	Nov. 24, 2024

Harmonic / Flicker Test

Equipment	Manufacturer	Model	Last Cal.	Next Cal.
Power Analyzer	Li	AC2000A	May 12, 2023	May 11, 2024

Electrostatic discharge Test

Equipment	Manufacturer	Model	Last Cal.	Next Cal.
ESD TEST Generator	HTEC	HESD16	May 12, 2023	May 11, 2024

Radio-frequency electromagnetic fields Test(site 2)

Equipment	Manufacturer	Model	Last Cal.	Next Cal.
Signal Generator	R&S	SMB100A	Oct. 15, 2023	Oct. 14, 2024
Signal Generator	R&S	SMR40	Oct. 15, 2023	Oct. 14, 2024
Power Amplifier	A&R	250W1000A	Oct. 15, 2023	Oct. 14, 2024
Power Amplifier	A&R	1150A100B	Oct. 15, 2023	Oct. 14, 2024
Power Amplifier	A&R	60S1G4	Oct. 15, 2023	Oct. 14, 2024
Communication antenna	Schwarzbeck	FPA3-0.8-6.0R/1329	Oct. 15, 2023	Oct. 14, 2024

Fast transients and Surges and Voltage Dips Test

Equipment	Manufacturer	Model	Last Cal.	Next Cal.
Surge Generator	HTEC	HCOMPACT5/HV1P6T	May 12, 2023	May 11, 2024
DIPS Generator	HTEC	HCOMPACT5/HV1P6T	May 12, 2023	May 11, 2024
EFT/B Generator	HTEC	HCOMPACT5/HV1P6T	May 12, 2023	May 11, 2024
EFT/B Clamp	HTEC	H3C	May 12, 2023	May 11, 2024

Injected Currents Susceptibility Test

Equipment	Manufacturer	Model	Last Cal.	Next Cal.
Signal Generator	Schwarzbeck	CDG 7000-25	May 12, 2023	May 11, 2024
Attenuator	Schwarzbeck	6db	May 12, 2023	May 11, 2024
CDN	Schwarzbeck	CDN M2+M3-16A	May 12, 2023	May 11, 2024

4.2. Testing software

Project	Software name	Edition
Conducted Emission	EZ-EMC	EMC-CON 3A1.1+
Radiated Emission	EZ-EMC	FA-03A2 RE+
Injected currents	IEC/EN 61000-4-6	1.4.1
Voltage changes, voltage fluctuations and flicker	Harmonic	121

4.3. Measurement uncertainty

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

Test item	Value (dB)
Conducted Emission (150kHz-30MHz)	2.60
Disturbance Power	4.40
Radiated Emission(30MHz~1GHz)	4.60
Radiated Emission(1GHz~6GHz)	4.30

Decision Rule

☒ Uncertainty is not included

☐ Uncertainty is included

5. Emission

5.1. Conducted Emission

5.1.1. Limit

Disturbance voltage limits for induction cooking appliances

Frequency range	Appliances which are 1000 V rated and without an earth connection		All other appliances	
MHz	dBµV Quasi-peak	dBµV Average	dBµV Quasi-peak	dBµV Average
0,009 to 0,050	122	-	110	-
0,050 to 0,150	Decreasing linearly with logarithm of frequency from	-	Decreasing linearly with logarithm of frequency from	-
	102 to 92		90 to 80	
0,150 to 0,5	Decreasing linearly with logarithm of frequency from			
	72 to 62	60 to 52	66 to 56	56 to 46
0,5 to 5	56	46	56	46
5 to 30	60	50	60	50
The lower limit applies at the transition frequencies.				

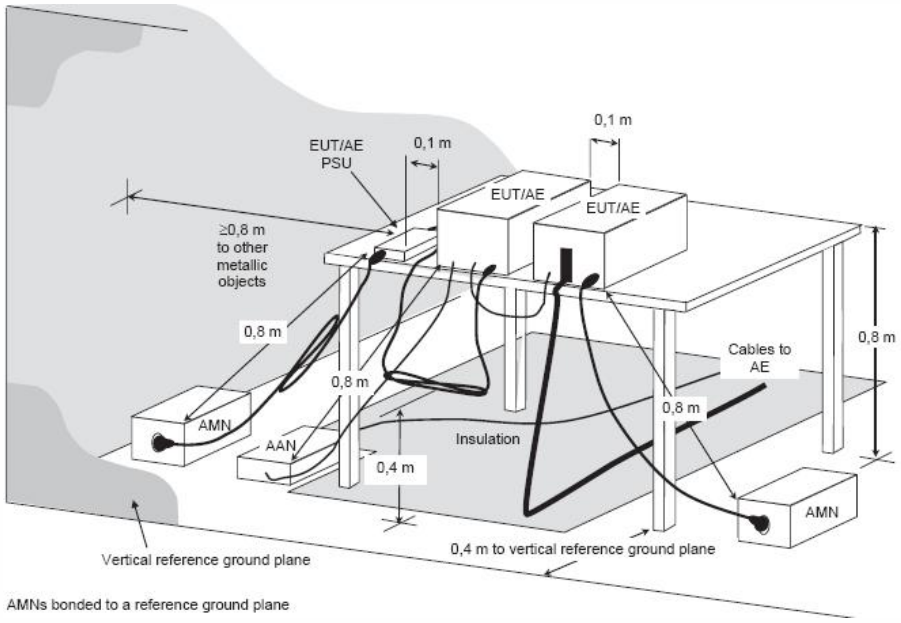
General limits

Frequency range	Mains ports		Associated ports			
	Disturbance voltage		Disturbance voltage		Disturbance current	
MHz	Quasi-peak dBµV	Average dBµV	Quasi-peak dBµV	Average dBµV	Quasi-peak dBµA	Average dBµA
0,15 to 0,50	Decreasing linearly with the logarithm of the frequency from:		80	70	Decreasing linearly with the logarithm of the frequency from:	
	66 to 56	59 to 46			40 to 30	30 to 20
0,50 to 5	56	46	74	64	30	20
5 to 30	60	50	74	64		
The lower limit applies at the transition frequencies. The test report shall state which test method was used and which limits were applied.						

Limits for mains port of tools

Frequency range	P ≤ 700 W		700 W < P ≤ 1 000 W		P > 1 000 W	
MHz	Quasi-peak dBµV	Average dBµV	Quasi-peak dBµV	Average dBµV	Quasi-peak dBµV	Average dBµV
0,15 to 0,35	Decreasing linearly with the logarithm of the frequency from:					
	66 to 59	59 to 49	70 to 63	63 to 53	76 to 69	69 to 59
0,35 to 5	59	49	63	53	69	59
5 to 30	64	54	68	58	74	64
The lower limit applies at the transition frequencies. P = rated power of the motor only.						

5.1.2. Test setup



5.1.3. Test procedure

a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

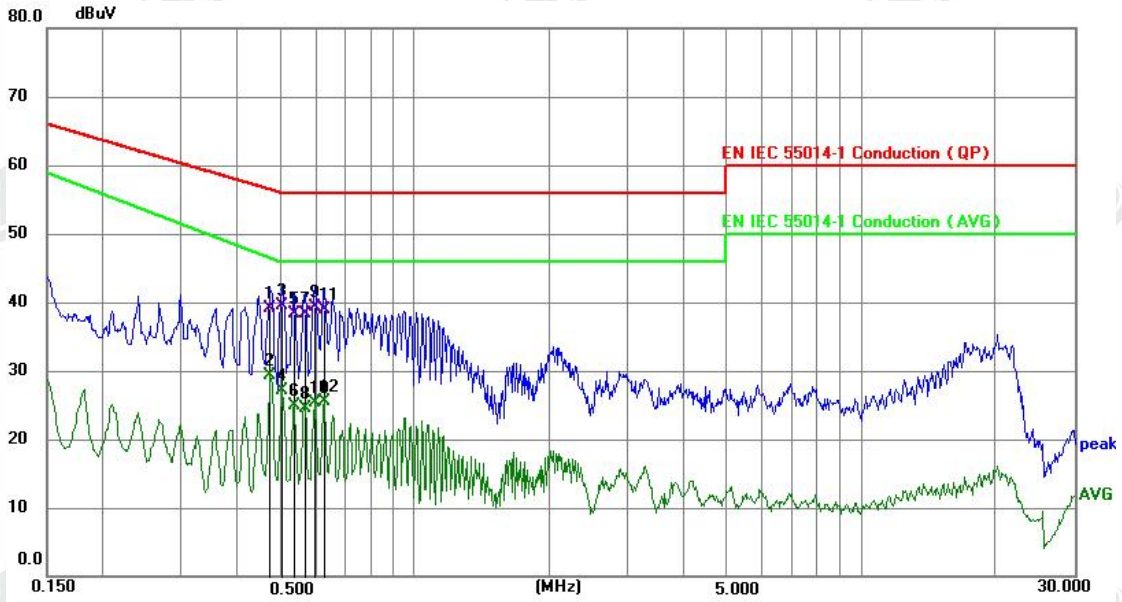
c. The test results of conducted emissions at mains ports are recorded of six worst margins for quasi-peak(mandatory) [and average (if necessary)] values against the limits at frequencies of interest unless the margin is 20 dB or greater.
Note: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

5.1.4. Test results

PASS

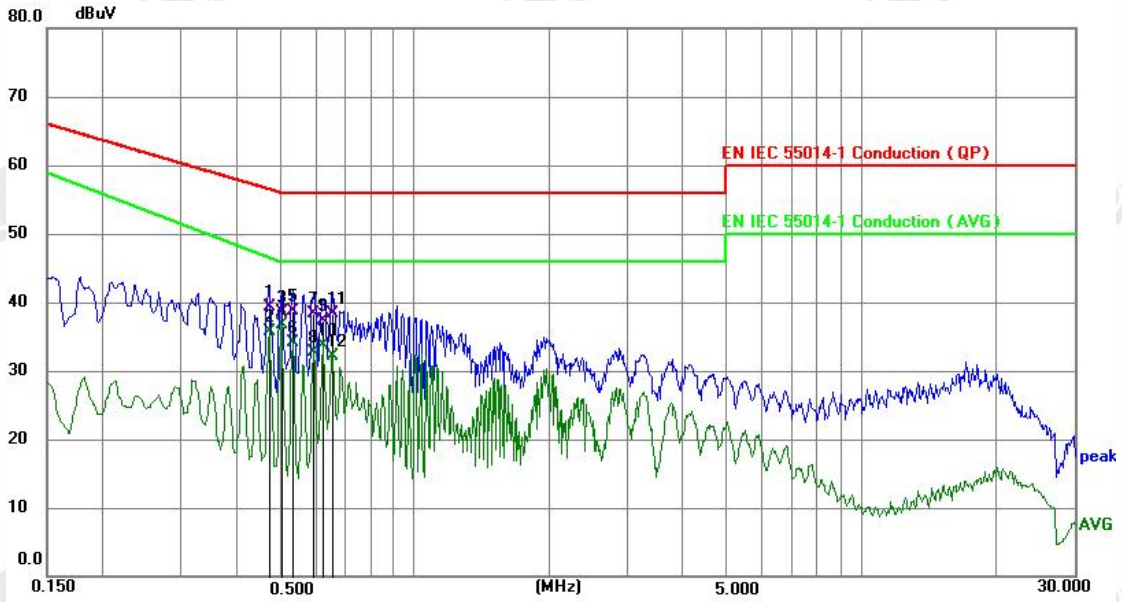
Please refer to pages 14 - 15 for data.

Phase: Live



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.4740	29.11	10.01	39.12	56.44	-17.32	QP	P	
2	0.4740	19.29	10.01	29.30	46.58	-17.28	AVG	P	
3 *	0.5054	29.39	10.02	39.41	56.00	-16.59	QP	P	
4	0.5054	17.02	10.02	27.04	46.00	-18.96	AVG	P	
5	0.5350	28.20	10.02	38.22	56.00	-17.78	QP	P	
6	0.5350	14.91	10.02	24.93	46.00	-21.07	AVG	P	
7	0.5685	28.24	10.03	38.27	56.00	-17.73	QP	P	
8	0.5685	14.51	10.03	24.54	46.00	-21.46	AVG	P	
9	0.5955	29.34	10.03	39.37	56.00	-16.63	QP	P	
10	0.5955	15.36	10.03	25.39	46.00	-20.61	AVG	P	
11	0.6270	28.78	10.03	38.81	56.00	-17.19	QP	P	
12	0.6270	15.38	10.03	25.41	46.00	-20.59	AVG	P	

Phase: Neutral



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.4695	29.23	10.00	39.23	56.52	-17.29	QP	P	
2	0.4695	25.67	10.00	35.67	46.68	-11.01	AVG	P	
3	0.5010	28.49	10.02	38.51	56.00	-17.49	QP	P	
4 *	0.5010	26.72	10.02	36.74	46.00	-9.26	AVG	P	
5	0.5325	28.63	10.02	38.65	56.00	-17.35	QP	P	
6	0.5325	24.04	10.02	34.06	46.00	-11.94	AVG	P	
7	0.5910	28.27	10.03	38.30	56.00	-17.70	QP	P	
8	0.5910	22.69	10.03	32.72	46.00	-13.28	AVG	P	
9	0.6225	27.32	10.03	37.35	56.00	-18.65	QP	P	
10	0.6225	23.64	10.03	33.67	46.00	-12.33	AVG	P	
11	0.6540	28.32	10.03	38.35	56.00	-17.65	QP	P	
12	0.6540	22.13	10.03	32.16	46.00	-13.84	AVG	P	

Note: Level=Reading + Factor

Margin=Level – Limit

5.2. Disturbance Power Emission

5.2.1. Limit

Table A

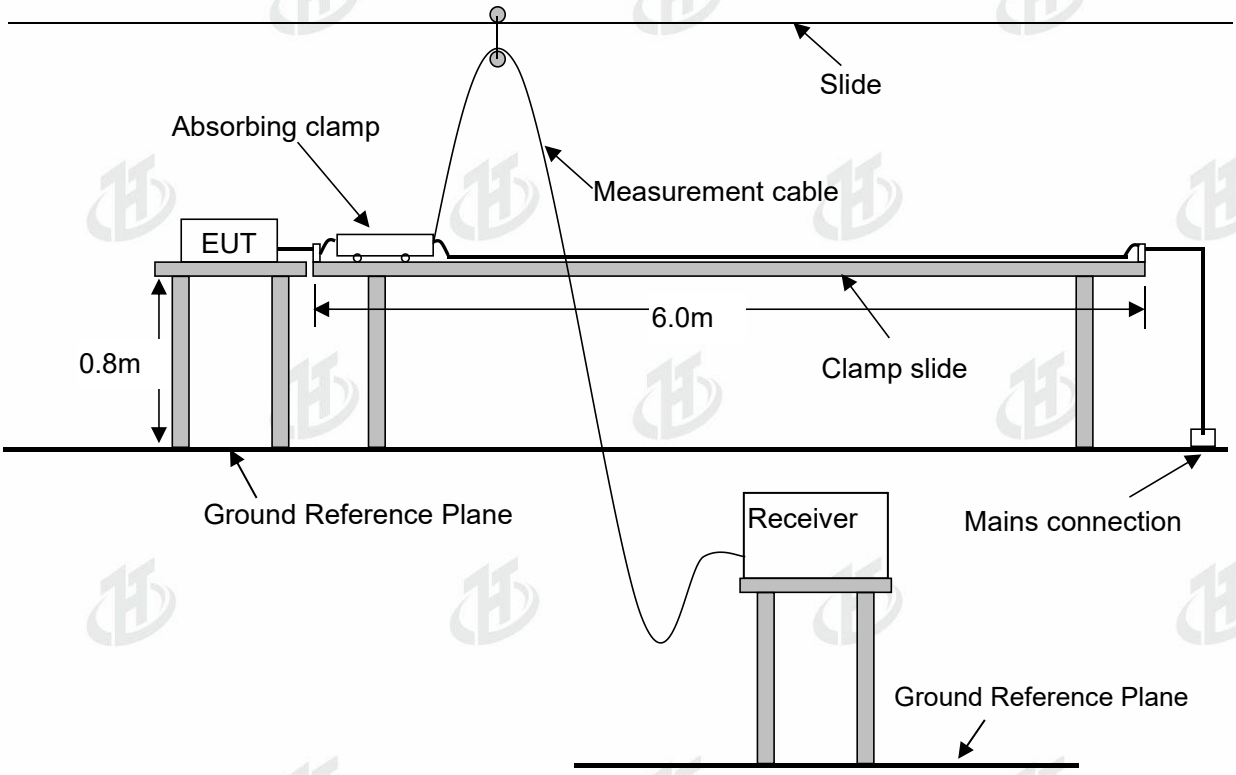
Equipment type	Frequency range	Limits(dB(pW))	
	(MHz)	Quasi-peak	Average
Household and similar appliances	30 to 300	45 to 55	35 to 45

Note: If the limit for the measurement with the average detector is met when using a receiver with a quasi-peak detector, the equipment under test shall be deemed to meet both limits and the measurement using the receiver with an average detector need not be carried out.

Table B Reduction applicable to Table A limits

Equipment type	Frequency range	Limits(dB(pW))	
	(MHz)	Quasi-peak	Average
Household and similar appliances	200 to 300	0 to 10 dB	--

5.2.2. Test setup



5.2.3. Test procedure

The E.U.T. was placed on the 0.8 m high table and away from other metallic surface at least 0.8m. It is connected to the power mains through an extension cord of 6m min. The absorber clamp clamps the cord and moves from the far end to the E.U.T. to measure the disturbing energy emitted from the cord.

5.2.4. Test results

Remark:

According to the standard, the interference power measurement is not required after the radiation measurement.

5.3. Radiated emissions

5.3.1. Limit

Table 2 - Radiated disturbance limits and testing methods – 30 MHz to 1 000 MHz

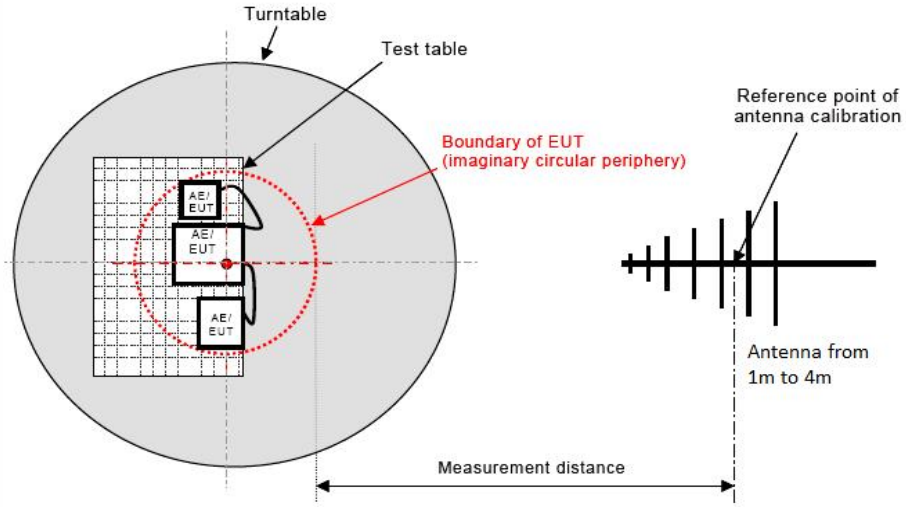
Frequency (MHz)	Quasi-peak limits at 3m dB(μV/m)
30-230	40
230-1000	47

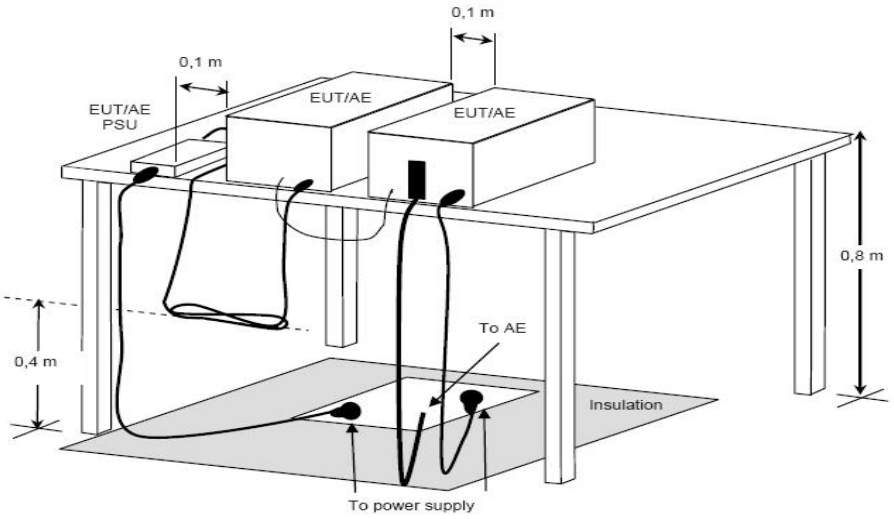
Radiated electric field disturbance limits and test methods - 1 GHz to 6 GHz

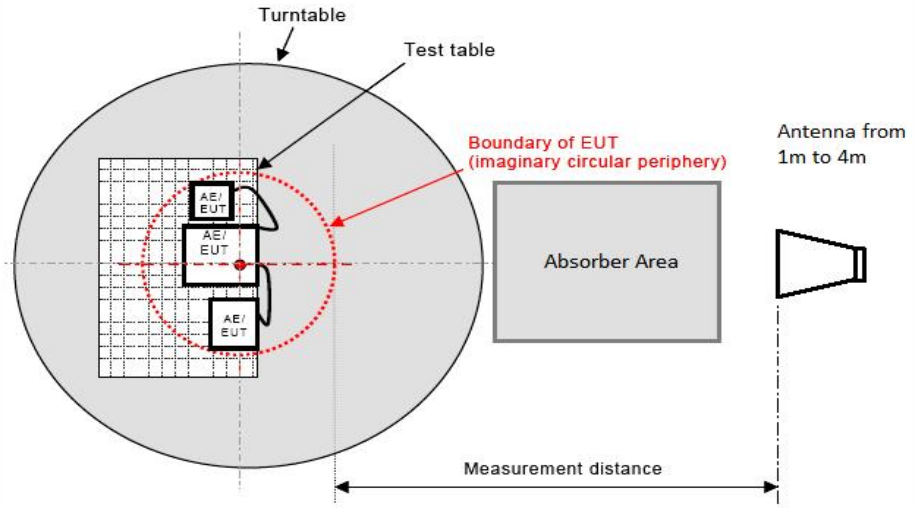
Frequency (MHz)	Quasi-peak limits at 3m dB(μV/m)	
	Peak	Average
1 000 to 3 000	70	50
3 000 to 6 000	74	54

5.3.2. Block diagram of test setup

Measurement distance







5.3.3. Test procedure

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The height of antenna is varied from 1 meter to 4 meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

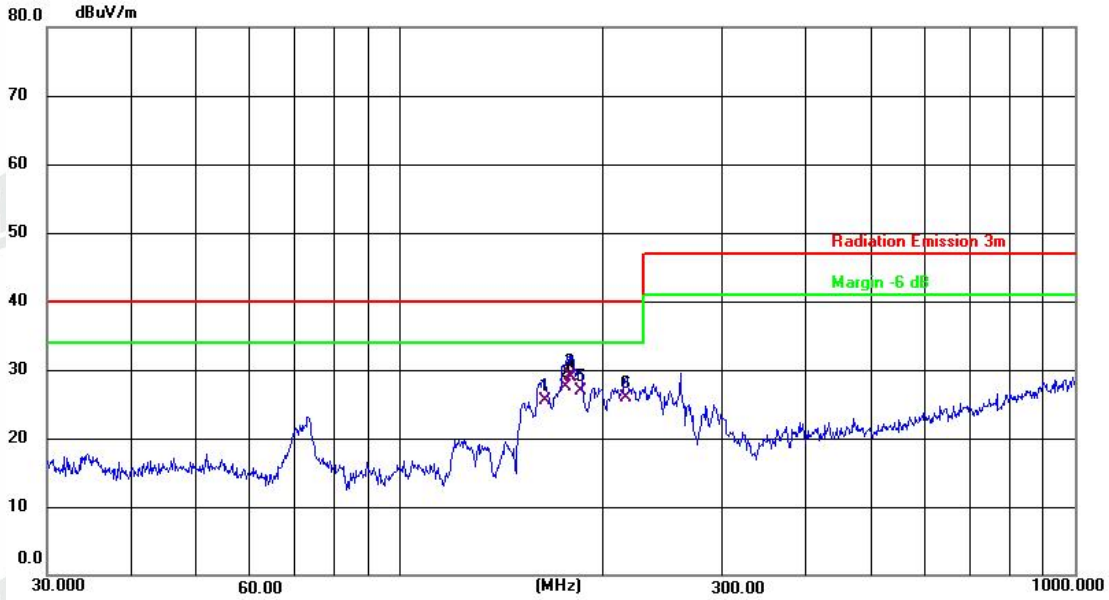
e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1GHz.

5.3.4. Test results

PASS

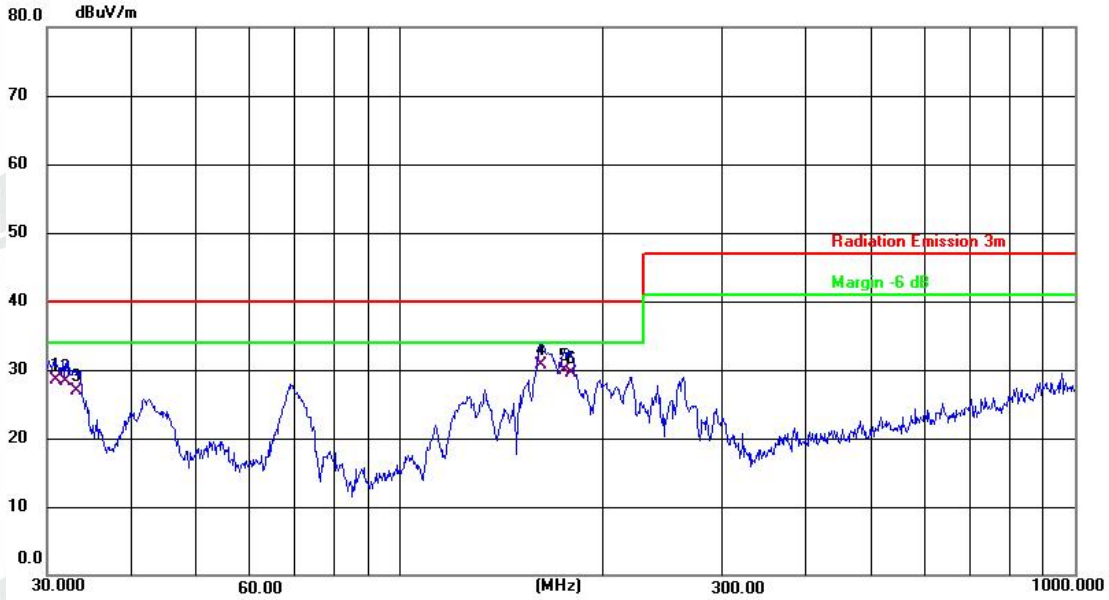
Please refer to pages 20 - 21 for data.

Polarization: Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	163.7550	38.81	-13.24	25.57	40.00	-14.43	QP			P	
2	175.6516	40.16	-12.57	27.59	40.00	-12.41	QP			P	
3 *	178.1327	41.45	-12.44	29.01	40.00	-10.99	QP			P	
4	179.3863	41.21	-12.37	28.84	40.00	-11.16	QP			P	
5	185.1379	38.92	-11.96	26.96	40.00	-13.04	QP			P	
6	216.0240	36.27	-10.31	25.96	40.00	-14.04	QP			P	

Polarization: Vertical



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	30.8535	39.73	-11.30	28.43	40.00	-11.57	QP			P	
2	32.0667	39.45	-11.09	28.36	40.00	-11.64	QP			P	
3	33.2112	37.87	-10.88	26.99	40.00	-13.01	QP			P	
4 *	162.0414	44.10	-13.34	30.76	40.00	-9.24	QP			P	
5	175.0368	42.49	-12.61	29.88	40.00	-10.12	QP			P	
6	179.3863	41.78	-12.37	29.41	40.00	-10.59	QP			P	

Note: Level=Reading + Factor
Margin=Level – Limit

5.4. Harmonic current emissions

5.4.1. Test Procedure

The EUT was placed on the top of a wooden table 0.8 meters above the ground and the EUT is supplied in series with power analyzer from a power source having the same normal voltage and frequency as the rated supply voltage and the equipment under test. And the rated voltage at the supply voltage of EUT of 0.94 times and 1.06 times shall be performed.

A definition of the normal load or of the conditions for adequate heat discharge can usually be found in the EN publication corresponding to the equipment under test.

Equipment may have several separately controlled circuits. Each circuit is considered as a single piece of equipment if it can be operated independently and separately from the other circuits.

5.4.2. Limit

Class A Harmonics Currents

Harmonics Order n	Maximum Permissible harmonic current (A)	Harmonics Order n	Maximum Permissible harmonic current (A)
Odd harmonics		Even harmonics	
3	2.30	2	1.08
5	1.14	4	0.43
7	0.77	6	0.30
9	0.40	8 ≤ n ≤ 40	0.23 * 8/n
11	0.33		
13	0.21		
15 ≤ n ≤ 39	0.15 * 15/n		

Class B Harmonics Currents

For Class B equipment, the harmonic of the input current shall not exceed the maximum permissible values given in table which is the limit of Class A multiplied by a factor of 1.5.

Class C Harmonics Currents

Harmonics Order n	Maximum Permissible harmonic current Expressed as a percentage of the input current at the fundamental frequency (%)
2	2
3	30．λ*
5	10
7	7
9	5
11 ≤ n ≤ 39 (odd harmonics only)	3
* λ is the circuit power factor	

Class D Harmonics Currents

Harmonics Order n	Maximum Permissible harmonic current per watt (mA/W)	Maximum Permissible harmonic current (A)
3	3.4	2.30
5	1.9	1.14
7	1.0	0.77
9	0.5	0.40
11	0.35	0.33
11 ≤ n ≤ 39 (odd harmonics only)	3.85/n	See limit of Class A

5.4.3. Test Result

N/A

This product is not defined as lighting equipment, and has rated power less than 75W, therefore, no limit applies according to EN IEC 61000-3-2

5.5. Voltage changes, voltage fluctuations and flicker

5.5.1. Test Procedure

The EUT is supplied in series with power analyzer from a power source having the same normal voltage and frequency as the rated supply voltage and the equipment under test. And the rated voltage at the supply voltage of EUT of 0.94 times and 1.06 times shall be performed.

The EUT was placed on the top of a wooden table 0.8 meters above the ground and operated to produce the most unfavorable sequence of voltage changes under normal operating conditions.

During the flick measurement, the measure time shall include that part of whole operation cycle in which the EUT produce the most unfavorable sequence of voltage changes. The observation period for short-term flicker indicator is 10 minutes and the observation period for long-term flicker indicator is 2 hours.

5.5.2. Limit

Test Item	Limit
Pst (Short-term flicker indicator.)	1.0
Plt (Long-term flicker indicator.)	0.65
Td(t)(ms) (Maximum time that d(t) exceeds 3.3%)	500
dmax(%) (Maximum relative voltage change.)	4
dc(%) (Relative steady-state voltage change)	3.3

5.5.3. Test Result

PASS

The EUT is unlikely to produce significant voltage fluctuations or flicker by technical analysis and evaluation. So it is deemed to fulfil the requirements without testing.

6. Immunity

Performance criteria

Performance criterion **A**

The equipment shall continue to operate as intended without operator intervention. No degradation of performance or loss function is allowed below a performance level specified by the manufacturer, when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.

Performance criterion **B**

The equipment shall continue to operate as intended after the test. No degradation of performance or loss function is allowed below a performance level specified by the manufacturer, when the equipment is used as intended. During the test, degradation of performance is however allowed. No change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from equipment if used as intended.

Performance criterion **C**

Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by operation of the controls.

6.1. Electrostatic discharge

6.1.1. Test Specification

Test Port	:	Enclosure port
Discharge Impedance	:	330 ohm / 150 pF
Discharge Mode	:	Single Discharge
Discharge Period	:	one second between each discharge

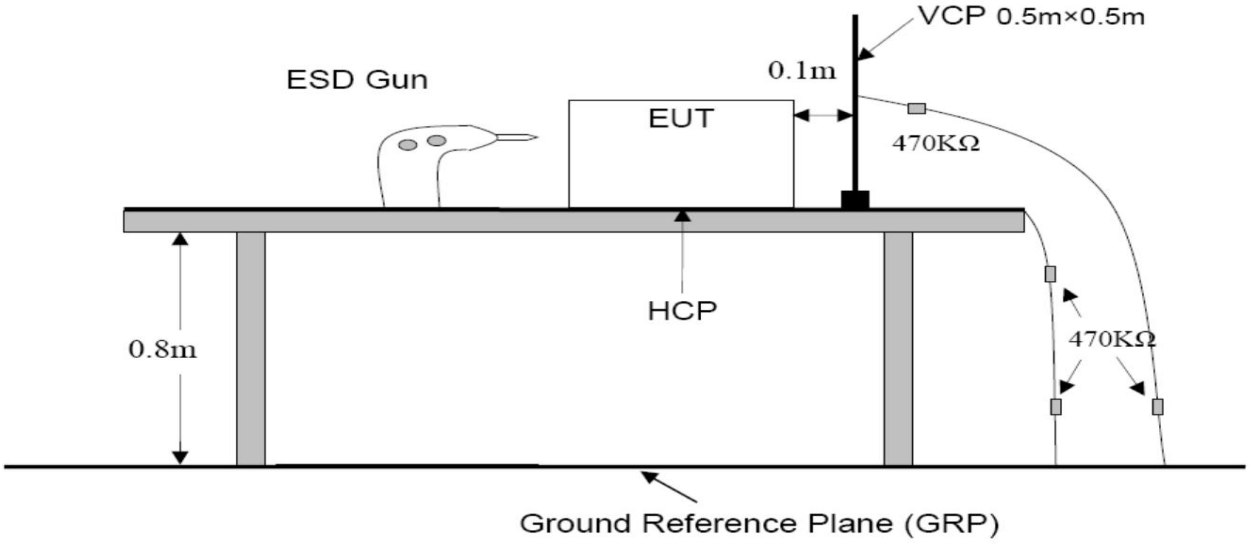
6.1.2. Test Levels and Performance Criterion

Test Standard
EN IEC 55014-2:2021
(EN 61000-4-2:2009)

Level	Test Voltage Contact Discharge (KV)	Test Voltage Air Discharge (KV)
1.	±2	±2
2.	±4	±4
3.	±6	±8
4.	±8	±15
X	Special	Special

Performance criterion: **B**

6.1.3. Test setup



6.1.4. Test Procedure

Air Discharge:

This test is done on a non-conductive surface. The round discharge tip of the discharge electrode shall be approached as fast as possible to touch the E.U.T.. After each discharge, the discharge electrode shall be removed from the E.U.T.. The generator is then re-triggered for a new single discharge and repeated (10 of each polarity) for each pre-selected test point. This procedure shall be repeated until all the air discharge completed.

Contact Discharge:

All the procedure shall be same as Section Air Discharge except that the tip of the discharge electrode shall touch the E.U.T..

Indirect discharge for horizontal coupling plane:

At least 10 single discharges(in the most sensitive polarity) shall be applied at the front edge of each HCP opposite the center point of each unit(if applicable) of the E.U.T. and 0.1m from the front of the E.U.T.. The long axis of the discharge electrode shall be in the plane of the HCP and perpendicular to its front edge during the discharge.

Indirect discharge for vertical coupling plane:

At least 10 single discharge (in the most sensitive polarity) shall be applied to the center of one vertical edge of the coupling plane. The coupling plane, of dimensions 0.5m X 0.5m, is placed parallel to, and positioned at a distance of 0.1m from the E.U.T.. Discharges shall be applied to the coupling plane, with this plane in sufficient different positions that the four faces of the E.U.T. are completely illuminated.

6.1.5. Test Result

PASS

Test Point	Contact (C) Air (A)	Voltage (kV)	Performance Criterion	Result (Performance Criterion)
Indirect Discharge (HCP)	C	± 4	☐A ☒B	A
Indirect Discharge (VCP)	C	± 4	☐A ☒B	A
Conductive Surfaces	C	± 4	☐A ☒B	A
Slots, Apertures, and Insulating Surfaces	A	± 8	☐A ☒B	A

6.2. Radio frequency electromagnetic fields

6.2.1. Test Specification

Test Port	:	Enclosure port
Step Size	:	1%
Modulation	:	1kHz, 80% AM
Dwell Time	:	1 second
Polarization	:	Horizontal & Vertical

6.2.2. Test Levels and Performance Criterion

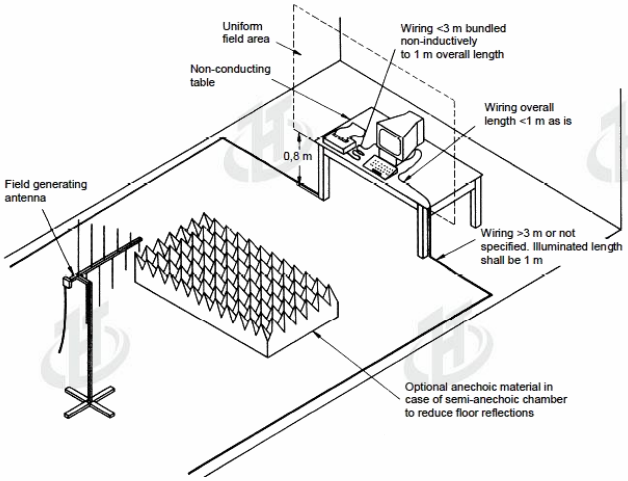
Test Standard
EN IEC 55014-2:2021
(EN 61000-4-3:2020)

Characteristics	Test levels
Frequency range	80 MHz to 1 000 MHz
Test level	3 V/m (unmodulated)
Modulation	1 kHz, 80 % AM, sine wave

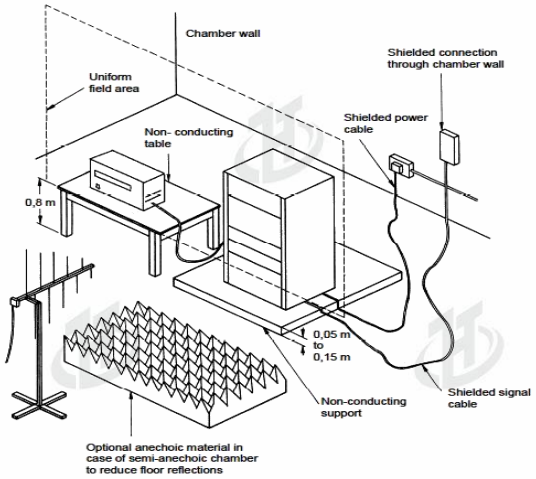
Performance criterion: **A**

6.2.3. Test setup

For table-top equipment



For floor standing equipment



6.2.4. Test Procedure

Measurement was performed in full-anechoic chamber.
Measurement procedure was applied according to EN 61000-4-3 clause 8.
The test method and equipment was specified by EN 61000-4-3.

6.2.5. Test Result

PASS

Frequency (MHz)	Polarization	Test level (V/m)	Modulation	Exposed location	Result (Performance Criterion)
80-1 000	H & V	3	1 kHz, 80% AM, 1 % increment	All sides	A

6.3. Fast transients

6.3.1. Test Specification

Test Port	:	input a.c. power port
Impulse Frequency	:	5 kHz
Impulse Wave-shape	:	5/50 ns
Burst Duration	:	15 ms
Burst Period	:	300 ms
Test Duration	:	2 minutes per polarity

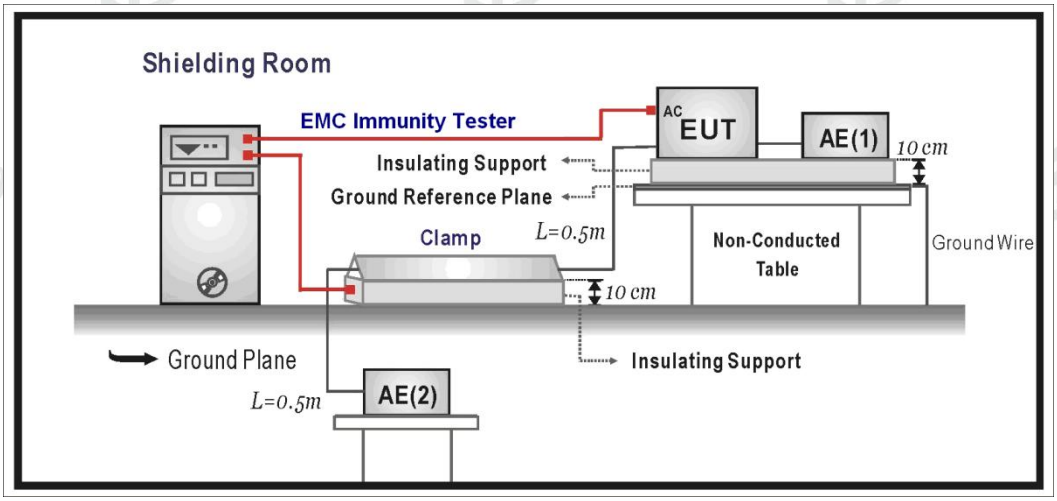
6.3.2. Test Levels and Performance Criterion

Test Standard
EN IEC 55014-2:2021
(EN 61000-4-4:2012)

Open circuit output test voltage and repetition rate of the impulses				
Level	On power port, PE		On I/O (Input/Output) Signal data and control ports	
	Voltage peak KV	Repetition rate KHz	Voltage peak KV	Repetition rate KHz
1.	0.5	5 or 100	0.25	5 or 100
2.	1.0	5 or 100	0.5	5 or 100
3.	2.0	5 or 100	1.0	5 or 100
4.	4.0	5 or 100	2.0	5 or 100
X	Special	Special	Special	Special
Note 1 Use of 5 KHz repetition rates is traditional; however, 100 KHz is closer to reality. Product committees should determine which frequencies are relevant for specific products or product types. Note 2 With some products, there may be no clear distinction, between power ports and I/O ports, in which case it is up to product committees to make this determination for test purposes. Note 3 "X" is an open level. The level has to be specified in the dedicated equipment specification.				

Performance criterion: **B**

6.3.3. Test setup



6.3.4. Test Procedure

The E.U.T. is put on the table which is 0.8 meter high above the ground. This reference ground plane shall project beyond the E.U.T. by at least 0.1m on all sides and the minimum distance between E.U.T. and all other conductive structure, except the ground plane beneath the E.U.T., shall be more than 0.5m.

For input and output AC power ports:

For extra low voltage AC ports and output AC ports, this testing is only applicable to ports interfacing with cables whose total length can exceed 3 m according to the instructions for use.

Signal ports, control ports and wired network ports:

Applicable only to ports interfacing with cables whose total length can exceed 3 m according to the instructions for use.

Ln put and output DC power ports:

Not applicable to input ports intended for connection to a battery or a rechargeable battery which shall be removed or disconnected from the apparatus for recharging. Apparatus with a DC power input port intended for use with an AC - DC power adaptor shall be tested on the AC power input of the Ac - DC power adaptor specified in the instructions for use or，where none is specified，using an AC - DC power adaptor that meets the apparat us specifications.For DC input and output ports intended to be connected permanently, the test is only applicable to cables longer than 3 m.

6.3.5. Test Result

PASS

Test Point	Polarity	Test Level (kV)	Inject Time (Second)	Inject Method	Performance Criterion	Result (Performance Criterion)
L	±	1	60	Direct	☐A ☒B	A
N	±	1	60	Direct	☐A ☒B	A
PE	±	1	60	Direct	☐A ☐B	N/A
L+N	±	1	60	Direct	☐A ☒B	A
L+PE	±	1	60	Direct	☐A ☐B	N/A
N+PE	±	1	60	Direct	☐A ☐B	N/A
L+N+PE	±	1	60	Direct	☐A ☐B	N/A

Note 1: The testing performed is from lowest level up to the highest level as required by standard, but only highest level is shown on the report.

Criterion A: Operate as intended during and after the test

Criterion B: Operate as intended after the test

Criterion C: Loss/Error of function

6.4. Surges

6.4.1. Test Specification

Test Port	:	input a.c. power port
Wave-Shape	:	Open Circuit Voltage - 1.2 / 50 us Short Circuit Current - 8 / 20 us
Pulse Repetition Rate	:	1 pulse / min.
Phase Angle	:	90° / 270°
Test Events	:	5 pulses (positive & negative) for each polarity

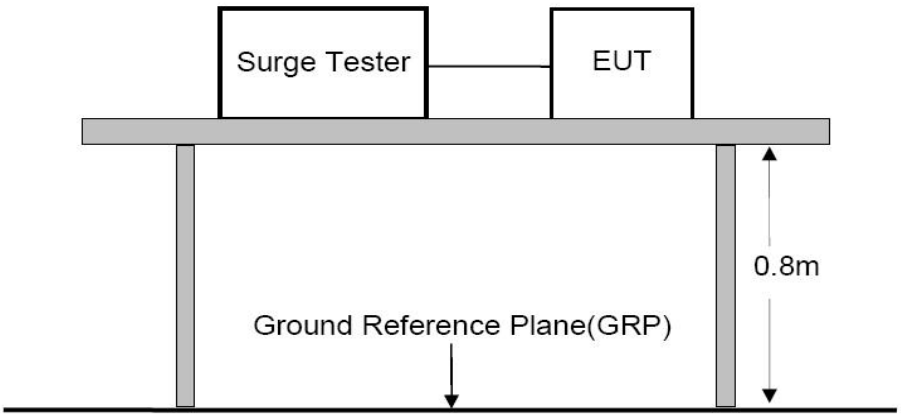
6.4.2. Test Levels and Performance Criterion

Test Standard
EN IEC 55014-2:2021
(EN 61000-4-5:2014)

Severity Level	Open-Circuit Test Voltage KV
1	0.5
2	1.0
3	2.0
4	4.0
*	Special

Performance criterion: **B**

6.4.3. Test setup



6.4.4. Test Procedure

1. Set up the EUT and test generator as shown on Section 12.1.
2. For line to line coupling mode, provide a 1.0KV 1.2/50us voltage surge (at open-circuit condition) and 8/20us current surge to EUT selected points.
3. Five positive pulses Line-to-neutral at 90°phase,Five negative pulses Line-to-neutral at 270°phase. with a maximum 1/min repetition rate are conducted during test.
4. Different phase angles are done individually.
5. Record the EUT operating situation during compliance test and decide the EUT immunity criterion for above each test.

6.4.5. Test Result

PASS

Angle:		Positive pulses at 90° phase, Negative pulses at 270° phase				
Inject Line	Polarity	Voltage (kV)	Time Interval (Second)	Inject Method	Performance Criterion	Result (Performance Criterion)
L-N	±	1	60	Direct	☐A ☒B	A
L-PE	±	2	60	Direct	☐A ☐B	N/A
N-PE	±	2	60	Direct	☐A ☐B	N/A

Note 1: The testing performed is from lowest level up to the highest level as required by standard, but only highest level is shown on the report.

Criterion A: Operate as intended during and after the test

Criterion B: Operate as intended after the test

Criterion C: Loss/Error of function

6.5. Injected currents

6.5.1. Test Specification

Test Port	:	input a.c. power port
Step Size	:	1%
Modulation	:	80% AM (1kHz)
Dwell Time	:	1 second

6.5.2. Test Levels and Performance Criterion

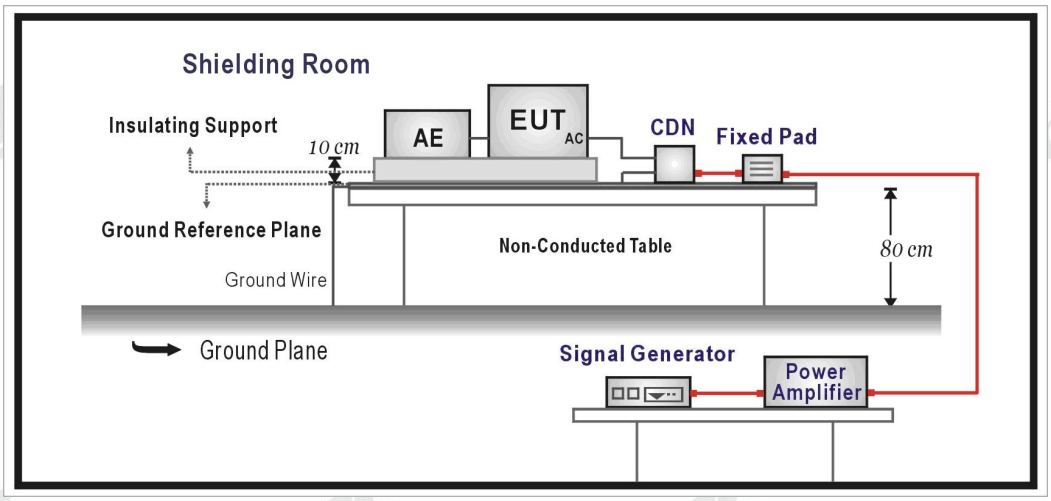
Test Standard
EN IEC 55014-2:2021
(EN 61000-4-6:2014)

Frequency ranges MHz	Test level V	Modulation	Performance criterion
0,15 to 80	3	80% AM (1kHz)	A

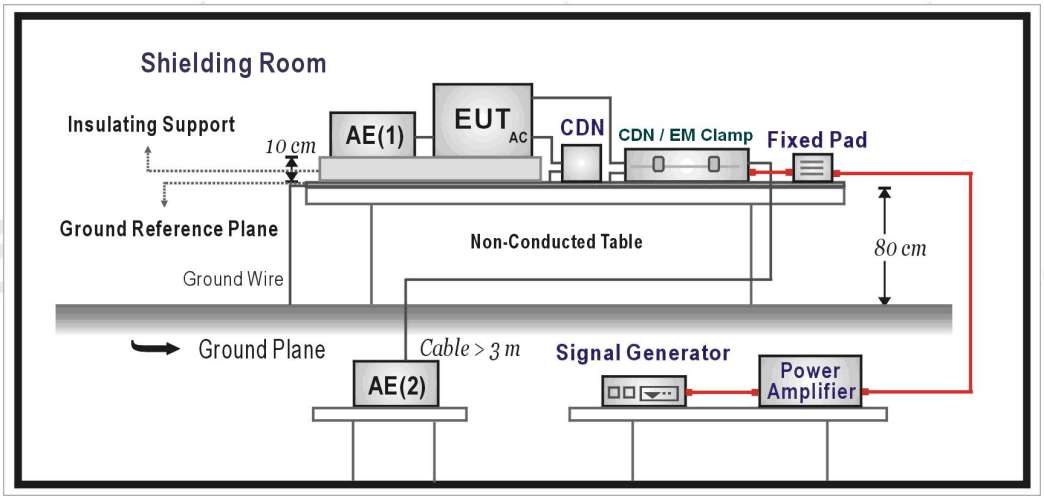
Performance criterion: **A**

6.5.3. Test setup

CDN Method



EM Clamp Method



6.5.4. Test Procedure

1. Set up the EUT, CDN and test generators as shown on Section 5.6.1.
2. Let the EUT work in test mode and measure it.
3. The EUT are placed on an insulating support 0.1m high above a ground reference plane. CDN (coupling and decoupling device) is placed on the ground plane about 0.3m from EUT. Cables between CDN and EUT are as short as possible, and their height above the ground reference plane shall be between 30 and 50 mm (where possible).
4. The disturbance signal described below is injected to EUT through CDN.
5. The EUT operates within its operational mode(s) under intended climatic conditions after power on.
6. The frequency range is swept from 150 KHz to 80 MHz using 3V signal level, and with the disturbance signal 80% amplitude modulated with a 1KHz sine wave.
7. The rate of sweep shall not exceed 1.5*10-3decades/s. Where the frequency is swept incrementally, the step size shall not exceed 1% of the start and thereafter 1% of the preceding frequency value.
8. Recording the EUT operating situation during compliance testing and decide the EUT immunity criterion.

6.5.5. Test Result

PASS

Frequency Band (MHz)	Field Strength (Vrms)	Inject Port	Inject Method	Performance Criterion	Result (Performance Criterion)
0.15 ~ 80	3	AC Mains	CDN	☒A ☐B	A

Note 1: The testing performed is from lowest level up to the highest level as required by standard, but only highest level is shown on the report.

Criterion A: Operate as intended during and after the test

Criterion B: Operate as intended after the test

Criterion C: Loss/Error of function

Note 2: The display quality of a display output was evaluated by using a subjective by direct observation.

6.6. Voltage dips

6.6.1. Test Specification

Test Port	:	input a.c. power port
Phase Angle	:	0°, 180°
Test cycle	:	3 times

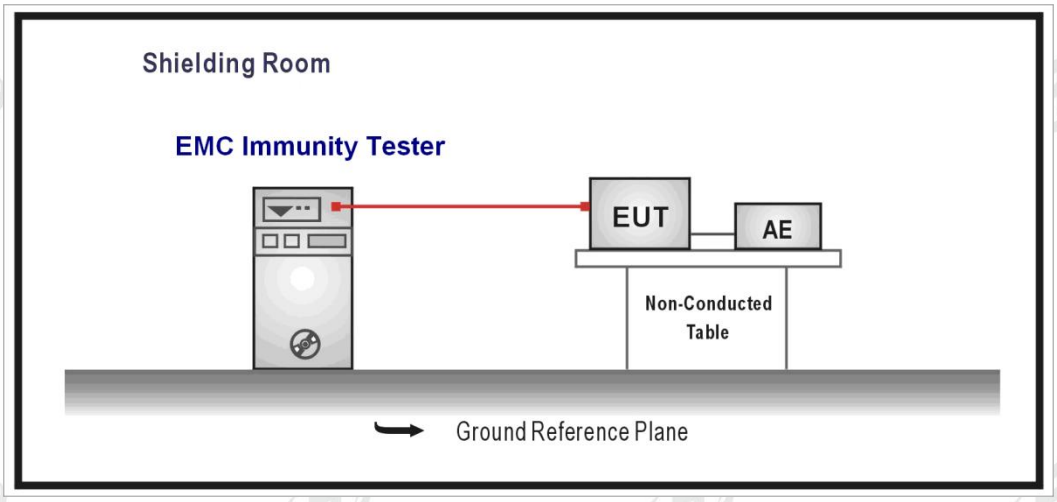
6.6.2. Test Levels and Performance Criterion

Test Standard
EN IEC 55014-2:2021
(EN 61000-4-11:2020)

Test Level %UT	Voltage dip and short interruptions %UT	Duration (in period)
0	100	0.5
40	60	10
70	30	25

Performance criterion: **C, C, C**

6.6.3. Test setup



6.6.4. Test Procedure

The Section of EN 61000-4 defines the immunity test methods and range of preferred test levels for electrical and electronic equipment connected to low-voltage power supply networks for voltage dips. Short interruptions and voltage variations. The standard applies to electrical and electronic equipment having a rated input current not exceeding 16A per phase. It does not apply to electrical and electronic equipment for connection to D.C networks or 400Hz A.C networks. Test for these networks will be covered by future EN standard. A performance criterion is classified as A, B, C, the recommendation is criterion A or B.

The test shall be performed with the EUT connected to the test generator with the shortest power supply cable as specified by EUT manufacturer. If no cable length is specified, it shall be the shortest possible length suitable to the application of the EUT.

The test set-up for the two types of phenomena described in this standard are:

- Voltage dips;

- Voltage variations with gradual transition between the rated voltage and the changed voltage (Option)

Both tests may be implemented with this set-up. Test on the three-phase EUT are accomplished by using three set of equipment mutually synchronized.

The EUT shall be tested for each selected combination of test level and duration with a sequence of three Dip / interruption with intervals of 10 s minimum (between each test event). Each representative mode of operation shall be tested.

6.6.5. Test Result

PASS

Test Voltage (Vac)	Voltage Residual (%)	Test Duration (Periods)	Performance Criterion	Result (Performance Criterion)
230	0	0.5	☐A ☐B ☒C	A
	40	10	☐A ☐B ☒C	B
	70	25	☐A ☐B ☒C	B

Note 1: The testing performed is from lowest level up to the highest level as required by standard, but only highest level is shown on the report.

Criterion A: Operate as intended during and after the test

Criterion B: Operate as intended after the test

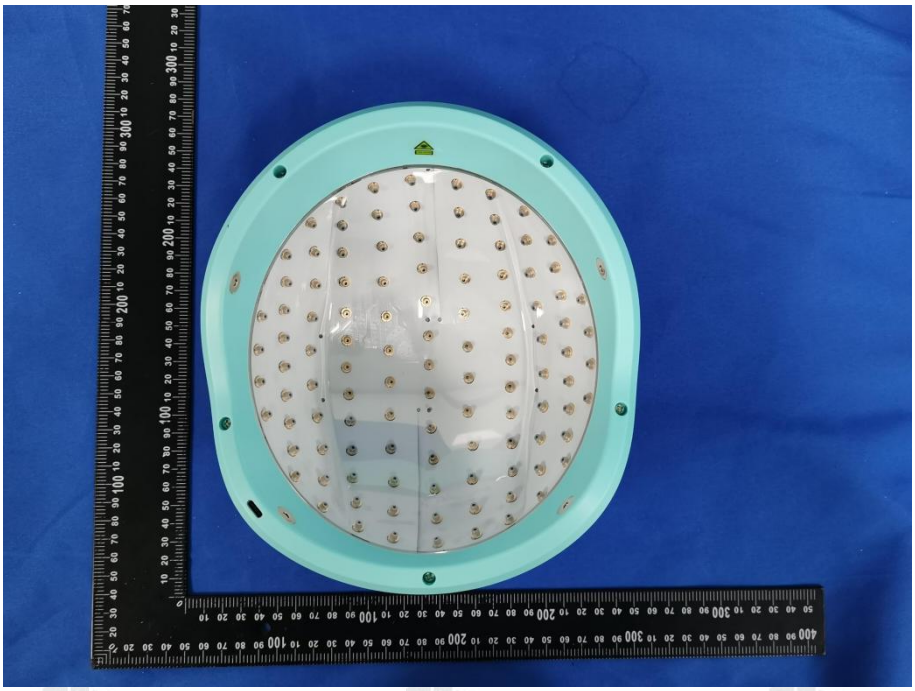
Criterion C: Loss/Error of function

Note2: The power is temporary off and can be reset by the operator.

7. Photographs of EUT

EUT Photo 1

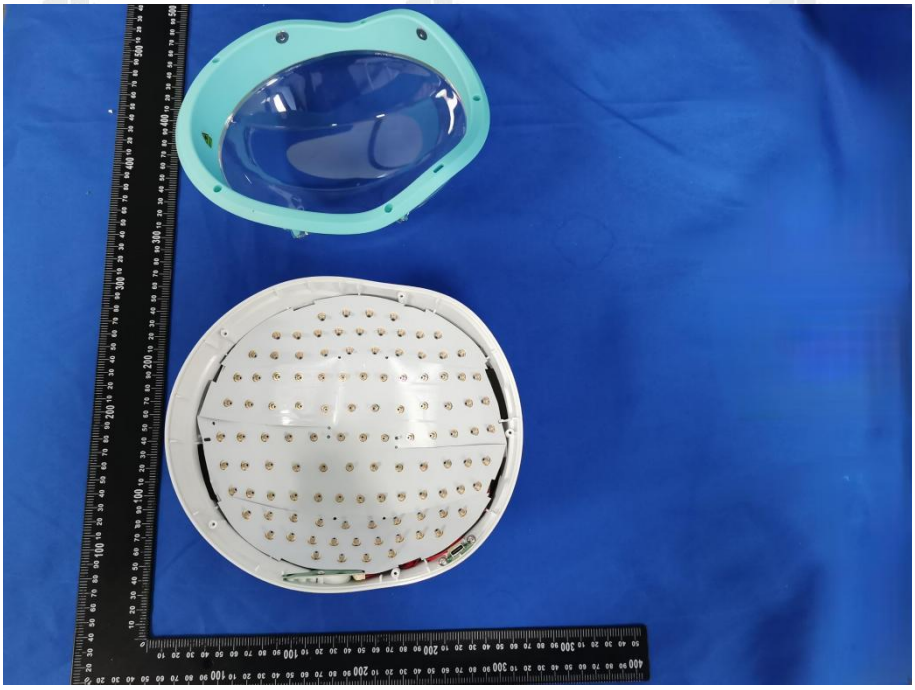
EUT Photo 2



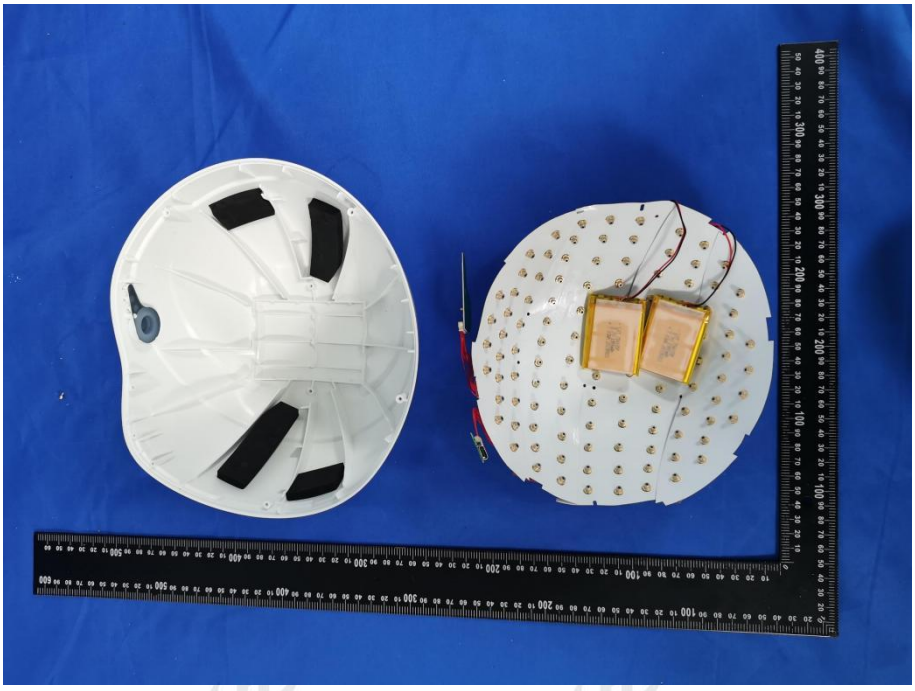
EUT Photo 3

EUT Photo 4

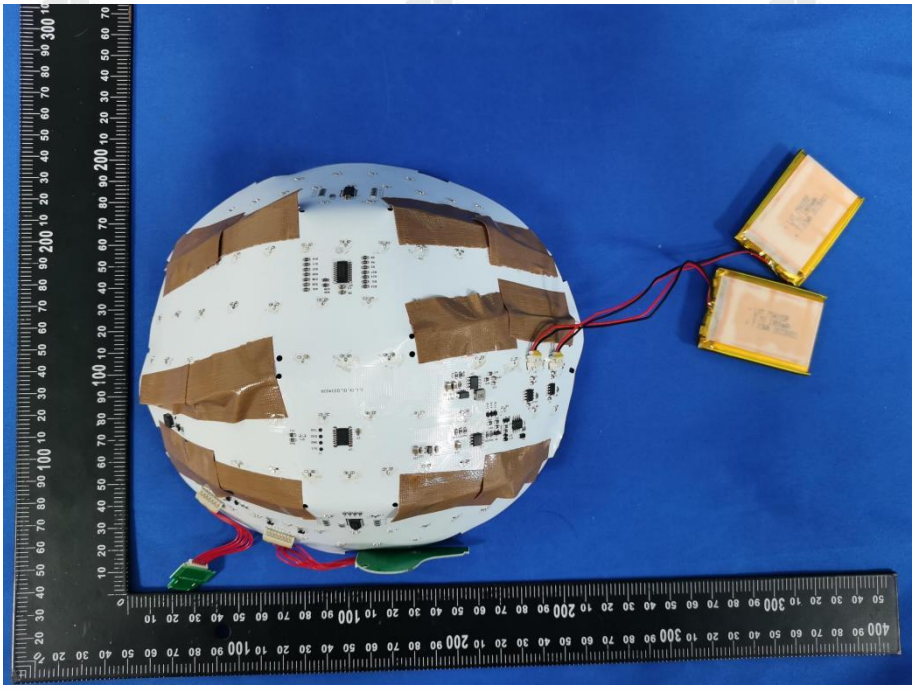
EUT Photo 5



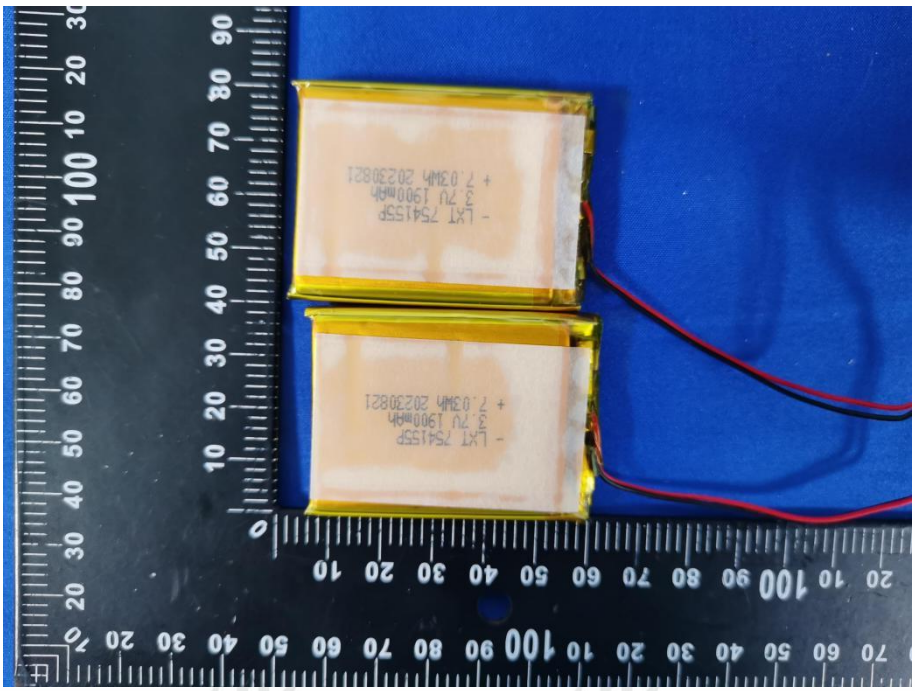
EUT Photo 6



EUT Photo 7

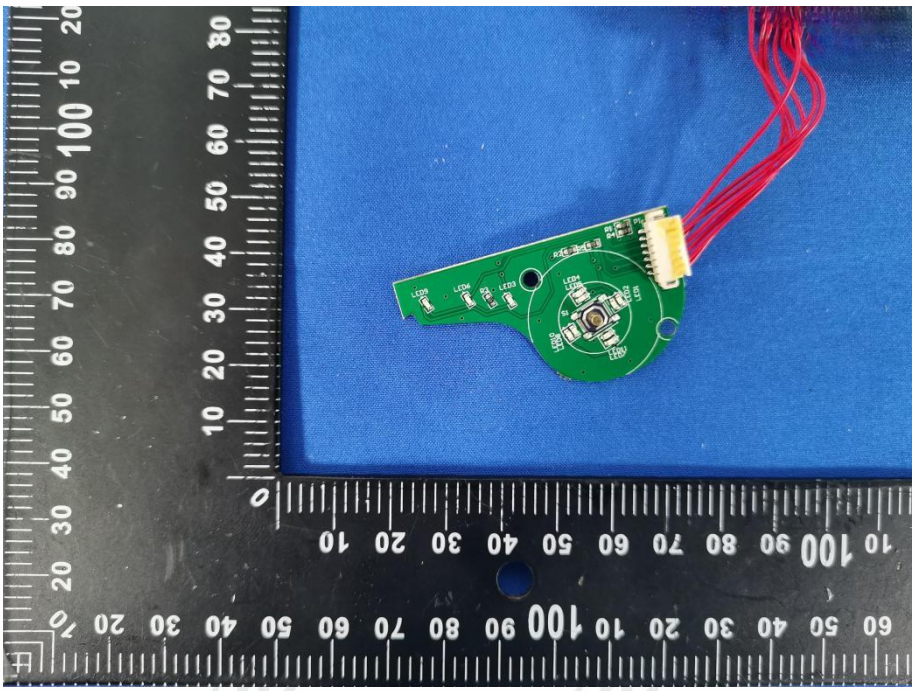


EUT Photo 8

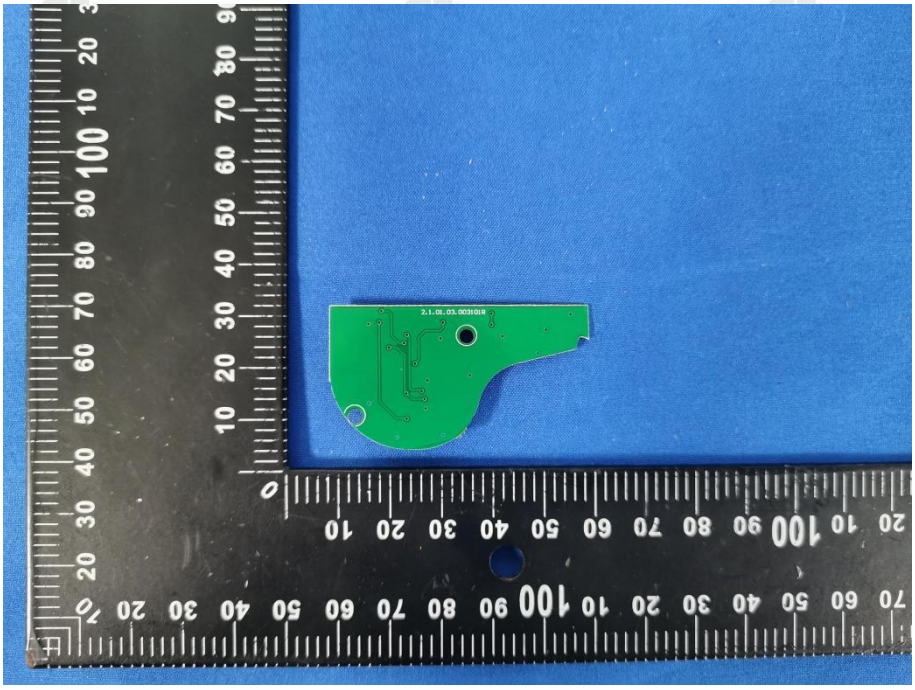


EUT Photo 9

EUT Photo 10



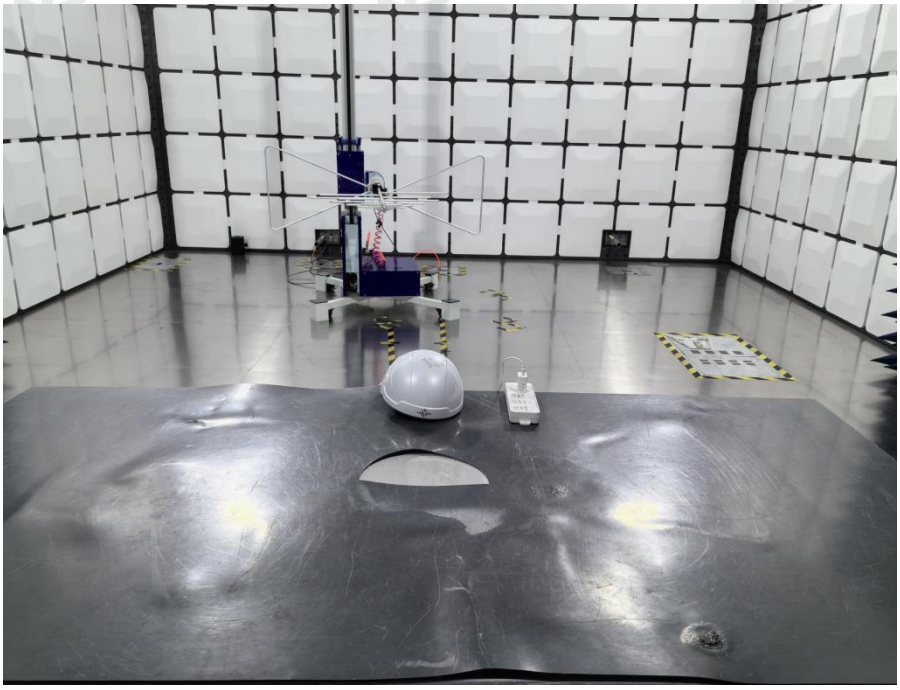
EUT Photo 11



8. Test Setup Photographs

Conducted Emission

Radiated Emission



End of report