

FCC Test Report

Report No.: AGC00945180101FE02

FCC ID : 2AOZRTRANSMITTER
APPLICATION PURPOSE : Original Equipment
PRODUCT DESIGNATION : Remote Control
BRAND NAME : Sphera
MODEL NAME : Transmitter 2500
CLIENT : ATHENA OPTICS
DATE OF ISSUE : Feb. 05, 2018
STANDARD(S)
TEST PROCEDURE(S) : FCC Part 15.249
REPORT VERSION : V1.0



Attestation of Global Compliance (Shenzhen) Co., Ltd

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Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Feb. 05, 2018	Valid	Initial Release



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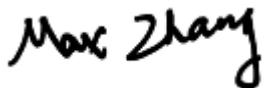
1. VERIFICATION OF CONFORMITY

Applicant	ATHENA OPTICS LP
Address	43 Duke Street, Edinburgh, EH6 8HH, United Kingdom
Manufacturer	OOO PP SPHERA
Address	25, DALNITSKAYA STR, ODESSA 65005, UKRAINE
Product Designation	Remote Control
Brand Name	Sphera
Test Model	Transmitter 2500
Date of test	Feb. 02, 2018 to Feb. 05, 2018
Deviation	None
Condition of Test Sample	Normal
Test Result	Pass
Report Template	AGCRT-US-BR/RF

We hereby certify that:

The above equipment was tested by Attestation of Global Compliance (Shenzhen) Co., Ltd. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 (2013) and the energy emitted by the sample EUT tested as described in this report is in compliance with radiated emission limits of FCC Rules Part 15.249.

Tested By



Max Zhang(Zhang Yi)

Feb. 05, 2018

Reviewed By



Bart Xie(Xie Xiaobin)

Feb. 05, 2018

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2. GENERAL INFORMATION

2.1. PRODUCT DESCRIPTION

A major technical description of EUT is described as following

Operation Frequency	2.433GHz
Maximum field strength	91.54dBuV/m(Peak)@3m 87.42dBuV/m(Average)@3m
Modulation	GFSK
Antenna Gain	0dBi
Antenna Designation	PCB Antenna (Met 15.203 Antenna requirement)
Hardware Version	V1.0
Software Version	V1.0
Power Supply	DC3V by button battery

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3. MEASUREMENT UNCERTAINTY

The uncertainty is calculated using the methods suggested in the "Guide to the Expression of Uncertainty in measurement" (GUM) published by CISPR and ANSI.

- Uncertainty of Conducted Emission, $U_c = \pm 3.2 \text{ dB}$
- Uncertainty of Radiated Emission below 1GHz, $U_c = \pm 3.9 \text{ dB}$
- Uncertainty of Radiated Emission above 1GHz, $U_c = \pm 4.8 \text{ dB}$



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4. DESCRIPTION OF TEST MODES

NO.	TEST MODE DESCRIPTION
1	Transmitting mode

Note:

1. All the test modes can be supply by battery, only the result of the worst case was recorded in the report, if no other cases.
2. For Radiated Emission, 3axis were chosen for testing for each applicable mode.

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5. SYSTEM TEST CONFIGURATION

5.1. CONFIGURATION OF EUT SYSTEM

Radiated Emission Configure :



5.2. EQUIPMENT USED IN EUT SYSTEM

Item	Equipment	Model No.	ID or Specification	Remark
1	Remote Control	Transmitter 2500	2AOZRTRANSMITTER	EUT

5.3. SUMMARY OF TEST RESULTS

FCC RULES	DESCRIPTION OF TEST	RESULT
§15.249&15.209	Radiated Emission	Compliant
§15.249	Band Edges	Compliant
§15.215	20dB bandwidth	Compliant

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6. TEST FACILITY

Test Site	Attestation of Global Compliance (Shenzhen) Co., Ltd
Location	1-2F., Bldg.2, No.1-4, Chaxi Sanwei Technical Industrial Park, Gushu, Xixiang, Bao'an District B112-B113, Bldg.12, Baoan Bldg Materials Center, No.1 of Xixiang Inner Ring Road, Baoan District, Shenzhen 518012
NVLAP LAB CODE	600153-0
Designation Number	CN5028
Description	Attestation of Global Compliance(Shenzhen) Co., Ltd is accredited by National Voluntary Laboratory Accreditation program, NVLAP Code 600153-0

TEST EQUIPMENT OF RADIATED EMISSION TEST

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Due
TEST RECEIVER	R&S	ESCI	10096	Jun.20, 2017	Jun.19, 2018
EXA Signal Analyzer	Agilent	N9010A	MY53470504	Dec.08, 2017	Dec.07, 2018
Horn antenna	SCHWARZBECK	BBHA 9170	#768	Sep.20, 2017	Sep.19, 2018
preamplifier	ChengYi	EMC184045SE	980508	Sep.15, 2017	Sep.14, 2018
Loop Antenna	A.H.Systems, Inc	SAS-562B	--	Mar. 01, 2016	Feb. 28, 2018
Double-Ridged Waveguide Horn	ETS LINDGREN	3117	00034609	May.18, 2017	May.17, 2019
Broadband Preamplifier	SCHWARZBECK	BBV 9718	9718-205	Jun.20, 2017	Jun.19, 2018
ANTENNA	SCHWARZBECK	VULB9168	D69250	Sep.28, 2017	Sep.27, 2018

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7. RADIATED EMISSION

7.1 TEST LIMIT

Standard FCC15.249

Fundamental Frequency	Field Strength of Fundamental (millivolts/meter)	Field Strength of Harmonics (microvolts/meter)
900-928MHz	50	500
2400-2483.5MHz	50	500
5725-5875MHz	50	500
24.0-24.25GHz	250	2500

Standard FCC 15.209

Frequency (MHz)	Distance Meters	Field Strengths Limit	
		μ V/m	dB(μ V)/m
0.009 ~ 0.490	300	2400/F(kHz)	---
0.490 ~ 1.705	30	24000/F(kHz)	---
1.705 ~ 30	30	30	---
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
960 ~ 1000	3	500	54.0
Above 1000	3	Other: 74.0 dB(μ V)/m (Peak) 54.0 dB(μ V)/m (Average)	

Remark: (1) Emission level $dB_{\mu}V = 20 \log$ Emission level $\mu V/m$
 (2) The smaller limit shall apply at the cross point between two frequency bands.
 (3) Distance is the distance in meters between the measuring instrument, antenna and the closest point of any part of the device or system.

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7.2. MEASUREMENT PROCEDURE

1. The EUT was placed on the top of the turntable 0.8 or 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use minimum resolution bandwidth of 1 MHz. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum values.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High - Low scan is not required in this case.

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The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Start ~Stop Frequency	9KHz~150KHz/RB 200Hz for QP
Start ~Stop Frequency	150KHz~30MHz/RB 9KHz for QP
Start ~Stop Frequency	30MHz~1000MHz/RB 120KHz for QP
Start ~Stop Frequency	1GHz~26.5GHz RBW 1.5MHz/ VBW 5MHz for Peak, RBW 1.5MHz/10Hz for Average

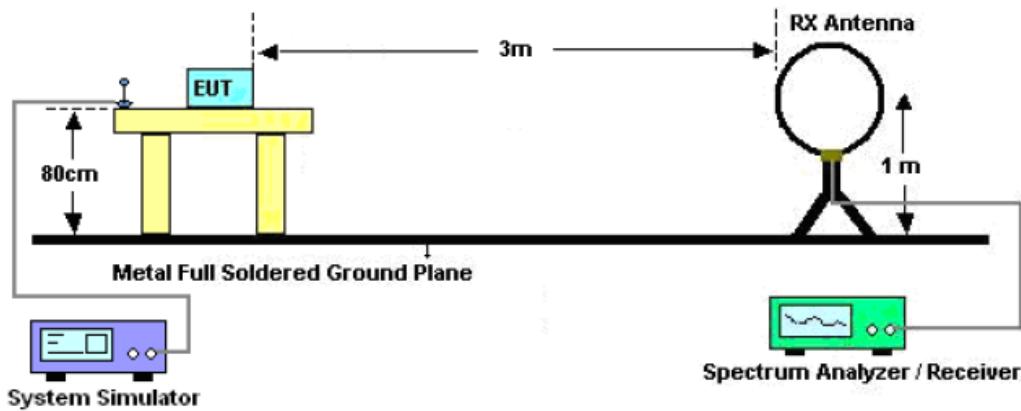
Receiver Parameter	Setting
Start ~Stop Frequency	9KHz~150KHz/RB 200Hz for QP
Start ~Stop Frequency	150KHz~30MHz/RB 9KHz for QP
Start ~Stop Frequency	30MHz~1000MHz/RB 120KHz for QP

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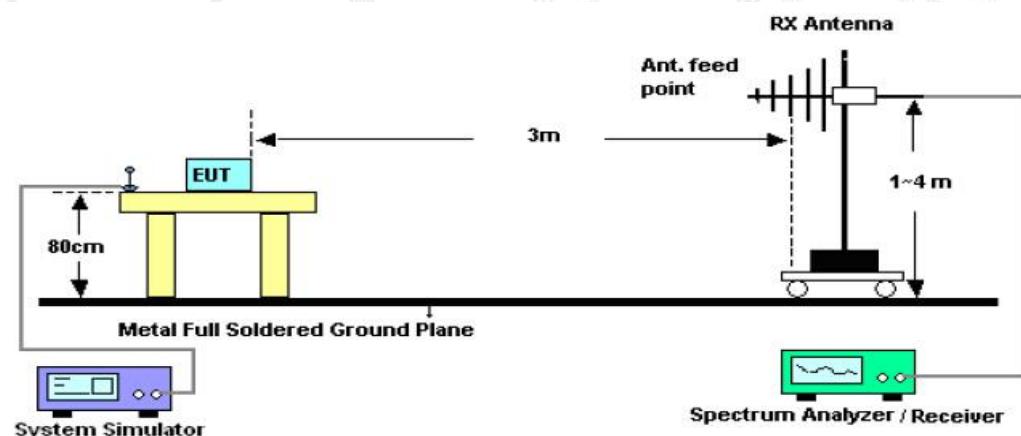


7.3. TEST SETUP

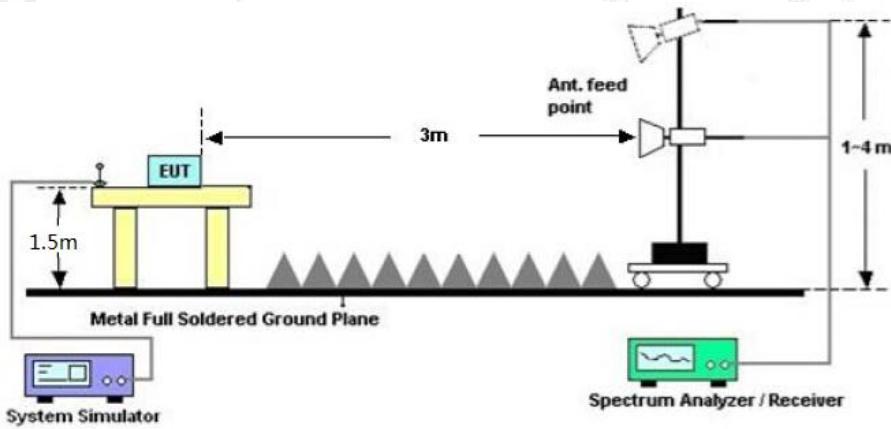
Radiated Emission Test-Setup Frequency Below 30MHz



RADIATED EMISSION TEST SETUP 30MHz-1000MHz



RADIATED EMISSION TEST SETUP ABOVE 1000MHz



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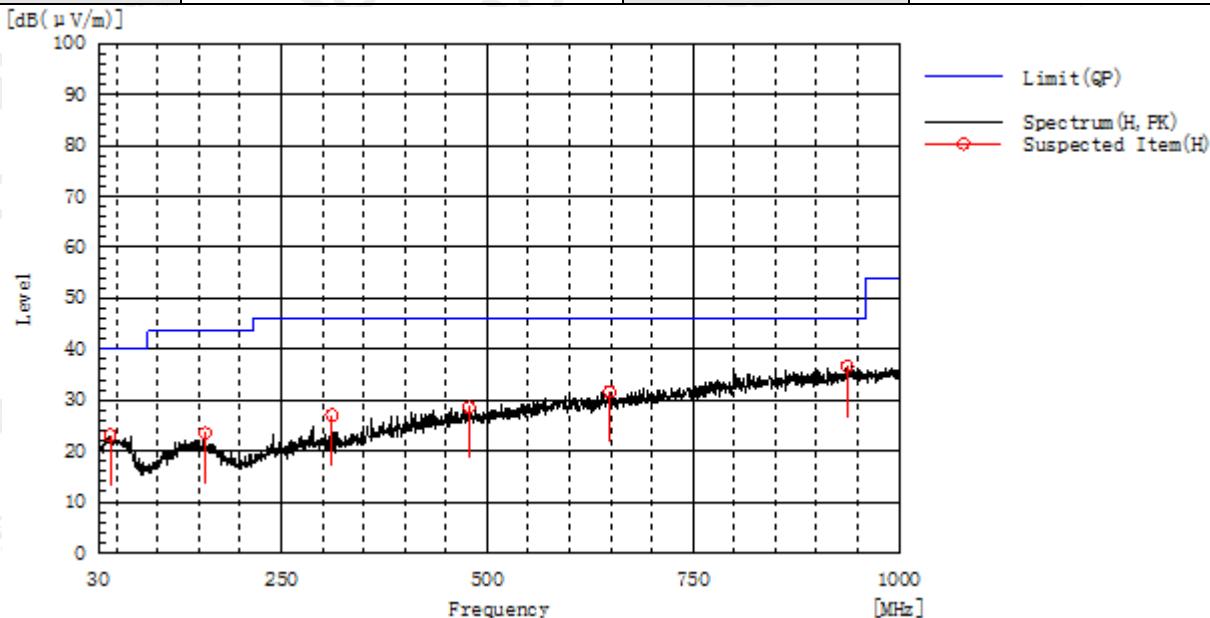
7.4. TEST RESULT

RADIATED EMISSION BELOW 30MHZ

No emission found between lowest internal used/generated frequencies to 30MHz.

RADIATED EMISSION 30MHz- 1GHZ

EUT :	Remote Control	Model Name. :	Transmitter 2500
Temperature :	20 °C	Relative Humidity :	48%
Pressure :	1010 hPa	Test Voltage :	DC3V
Test Mode :	Mode 1	Polarization :	Horizontal



Frequency MHz	Polarization	Reading dB(uV)	Factor dB (1/m)	Level dB(uV/m) PK	Limit dB(uV/m) QP	Margin dB	Pass/Fail	Height cm	Angle deg
42.610	H	5.7	17.4	23.1	40.0	16.9	Pass	100.0	16.8
158.040	H	6.9	16.6	23.5	43.5	20.0	Pass	100.0	52.6
311.785	H	9.5	17.6	27.1	46.0	18.9	Pass	200.0	107.9
936.950	H	6.1	30.5	36.6	46.0	9.4	Pass	200.0	326.1
648.860	H	6.0	25.6	31.6	46.0	14.4	Pass	100.0	267.7
478.140	H	6.1	22.5	28.6	46.0	17.4	Pass	200.0	107.9

RESULT: PASS

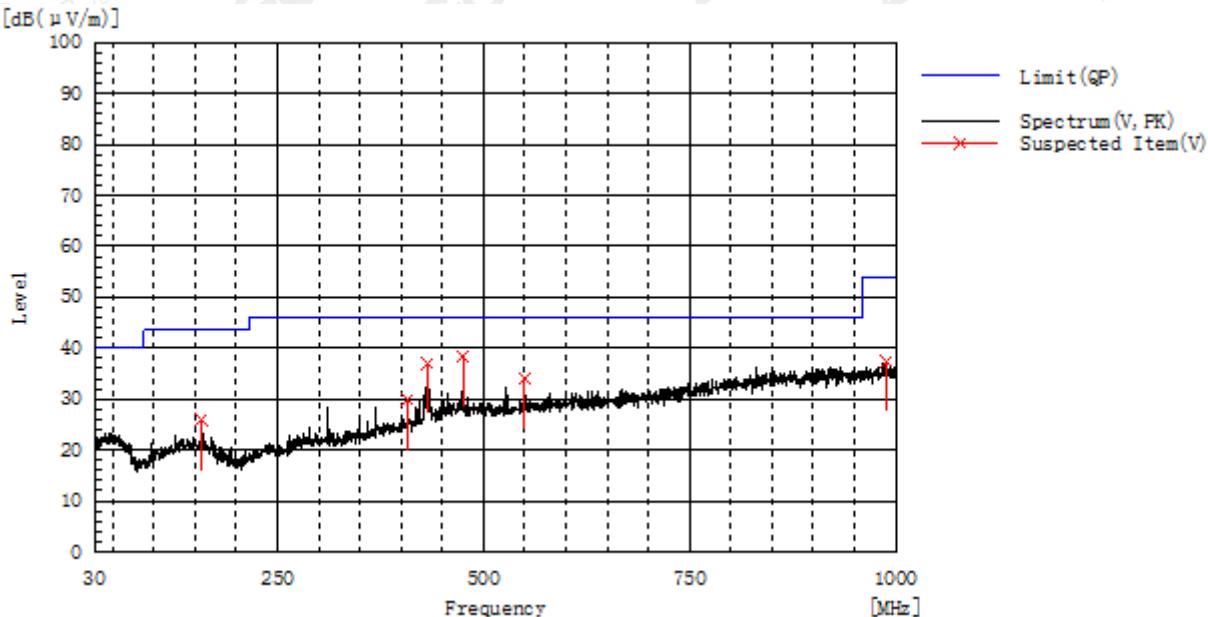
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EUT :	Remote Control	Model Name. :	Transmitter 2500
Temperature :	20 °C	Relative Humidity :	48%
Pressure :	1010 hPa	Test Voltage :	DC3V
Test Mode :	Mode 1	Polarization :	Vertical



Frequency MHz	Polarization	Reading dB(uV)	Factor dB (1/m)	Level dB(uV/m) PK	Limit dB(uV/m) QP	Margin dB	Pass/Fail	Height cm	Angle deg
158.040	V	9.3	16.6	25.9	43.5	17.6	Pass	200.0	336.2
407.815	V	8.8	21.1	29.9	46.0	16.1	Pass	150.0	213.3
432.065	V	15.4	21.7	37.1	46.0	8.9	Pass	150.0	213.3
475.230	V	15.9	22.5	38.4	46.0	7.6	Pass	200.0	47.6
549.920	V	10.3	23.9	34.2	46.0	11.8	Pass	200.0	47.6
988.360	V	6.4	31.0	37.4	54.0	16.6	Pass	100.0	34.2

RESULT: PASS

Note:

Factor=Antenna Factor + Cable loss, Margin=Result-Limit.

The "Factor" value can be calculated automatically by software of measurement system.

The mode 1 is the worst case, and only the data of the worst case recorded in this test report.

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RADIATED EMISSION ABOVE 1GHZ

EUT :	Remote Control	Model Name. :	Transmitter 2500
Temperature :	20 °C	Relative Humidity :	48%
Pressure :	1010 hPa	Test Voltage :	DC3V
Test Modulation :	GFSK	Polarization :	Horizontal

Frequency	Reading Level	Factor	Emission Level	Limit	Margin	Value type
(MHz)	(dB μ V)	(dB/m)	(dB μ V/m)	(dB μ V/m)	(dB)	
2433.00	88.12	3.42	91.54	114.00	22.46	Peak
2433.00	84.00	3.42	87.42	94.00	6.58	Average
4866.00	36.36	7.18	43.54	74.00	30.46	Peak
4866.00	32.20	7.18	39.38	54.00	14.62	Average
7299.00	30.39	9.86	40.25	74.00	33.75	Peak
7299.00	26.32	9.86	36.18	54.00	17.82	Average

EUT :	Remote Control	Model Name. :	Transmitter 2500
Temperature :	20 °C	Relative Humidity :	48%
Pressure :	1010 hPa	Test Voltage :	DC3V
Test Modulation :	GFSK	Polarization :	Vertical

Frequency	Reading Level	Factor	Emission Level	Limit	Margin	Value type
(MHz)	(dB μ V)	(dB/m)	(dB μ V/m)	(dB μ V/m)	(dB)	
2433.00	86.92	3.42	90.34	114.00	23.66	Peak
2433.00	82.77	3.42	86.19	94.00	7.81	Average
4866.00	35.56	7.18	42.74	74.00	31.26	Peak
4866.00	31.40	7.18	38.58	54.00	15.42	Average
7299.00	31.36	9.86	41.22	74.00	32.78	Peak
7299.00	27.21	9.86	37.07	54.00	16.93	Average

Note:

Other emissions from 1G to 25 GHz are considered as ambient noise. No recording in the test report.

Factor = Antenna Factor + Cable loss - Amplifier gain, Margin= Limit-Emission level.

The "Factor" value can be calculated automatically by software of measurement system.

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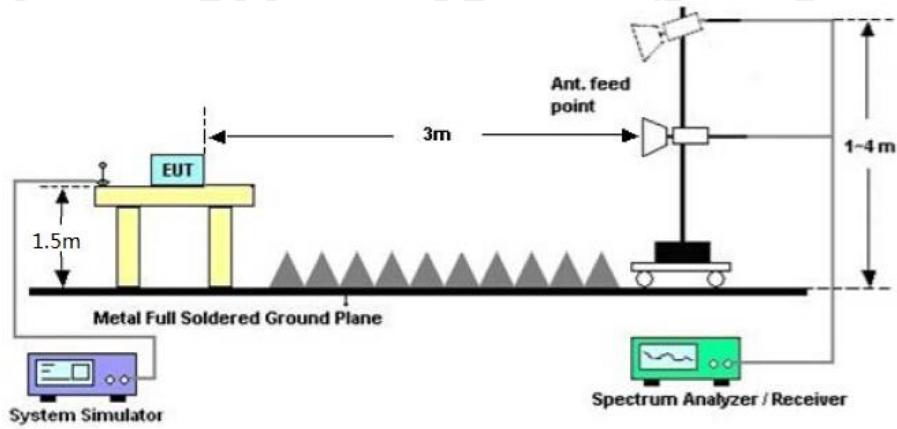
8. BAND EDGE EMISSION

8.1. MEASUREMENT PROCEDURE

1. The EUT operates at transmitting mode. The operate channel is tested to verify the largest transmission and spurious emissions power at the continuous transmission mode.
2. Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission: (a) PEAK: RBW=1MHz VBW=3MHz / Sweep=AUTO
(b) AVERAGE: RBW=1MHz ; VBW=1/on time(1KHz) / Sweep=AUTO
3. Other procedures refer to clause 7.2.

8.2 TEST SETUP

RADIATED EMISSION TEST SETUP



8.3 RADIATED TEST RESULT

Note:

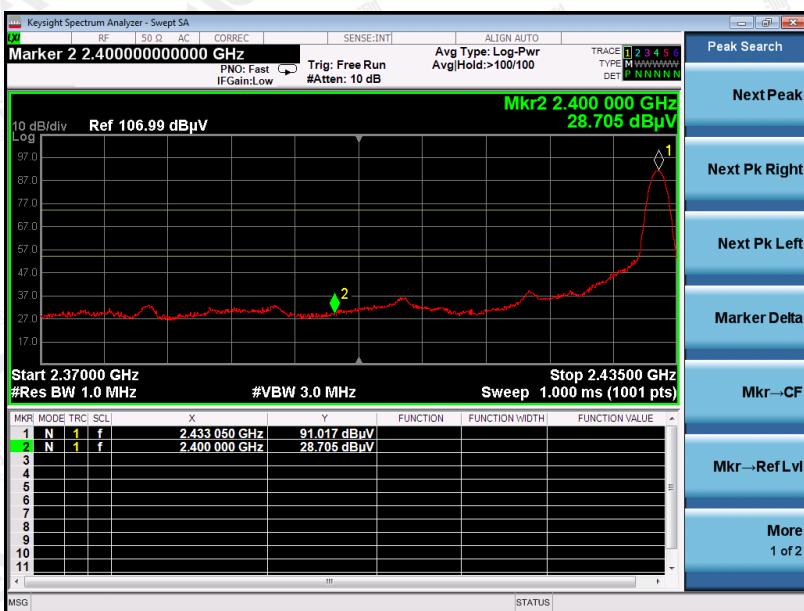
1. Factor=Antenna Factor + Cable loss - Amplifier gain. Field Strength=Factor + Reading level
2. The factor had been edited in the "Input Correction" of the Spectrum Analyzer. So the Amplitude of test plots is equal to Reading level plus the Factor in dB. Use the A dB(μ V) to represent the Amplitude. Use the F dB(μ V/m) to represent the Field Strength. So A=F.

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EUT :	Remote Control	Model Name. :	Transmitter 2500
Temperature :	20 °C	Relative Humidity :	48%
Pressure :	1010 hPa	Test Voltage :	DC3V
Test Mode :	Mode 1	Polarization :	Horizontal

PK Value



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EUT :	Remote Control	Model Name. :	Transmitter 2500
Temperature :	20 °C	Relative Humidity :	48%
Pressure :	1010 hPa	Test Voltage :	DC3V
Test Mode :	Mode 1	Polarization :	Vertical

PK Value



Note: The level of peak emission is less than the average limit, so the level of average emission need not to be tested.

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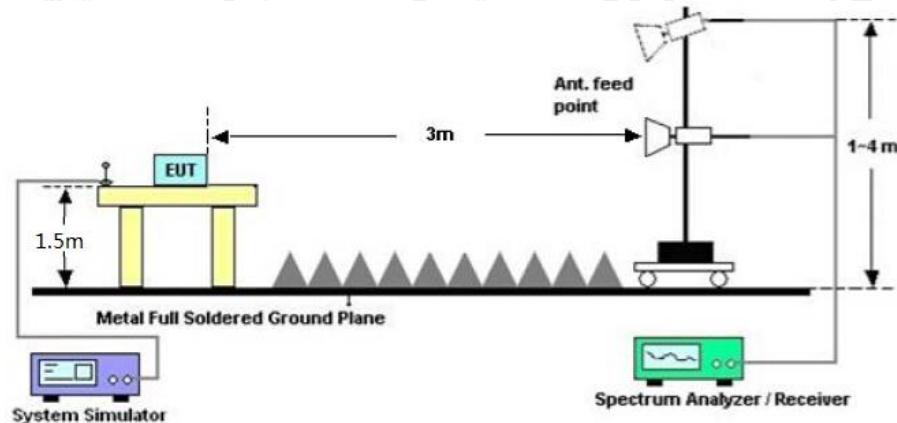


9. 20DB BANDWIDTH

9.1. MEASUREMENT PROCEDURE

- 1 Set the EUT Work on the top, the middle and the bottom operation frequency individually.
2. Set SPA Centre Frequency = Operation Frequency, RBW= 3 KHz, VBW \geqslant 3 \times RBW.
3. Set SPA Trace 1 Max hold, then View.

9.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)



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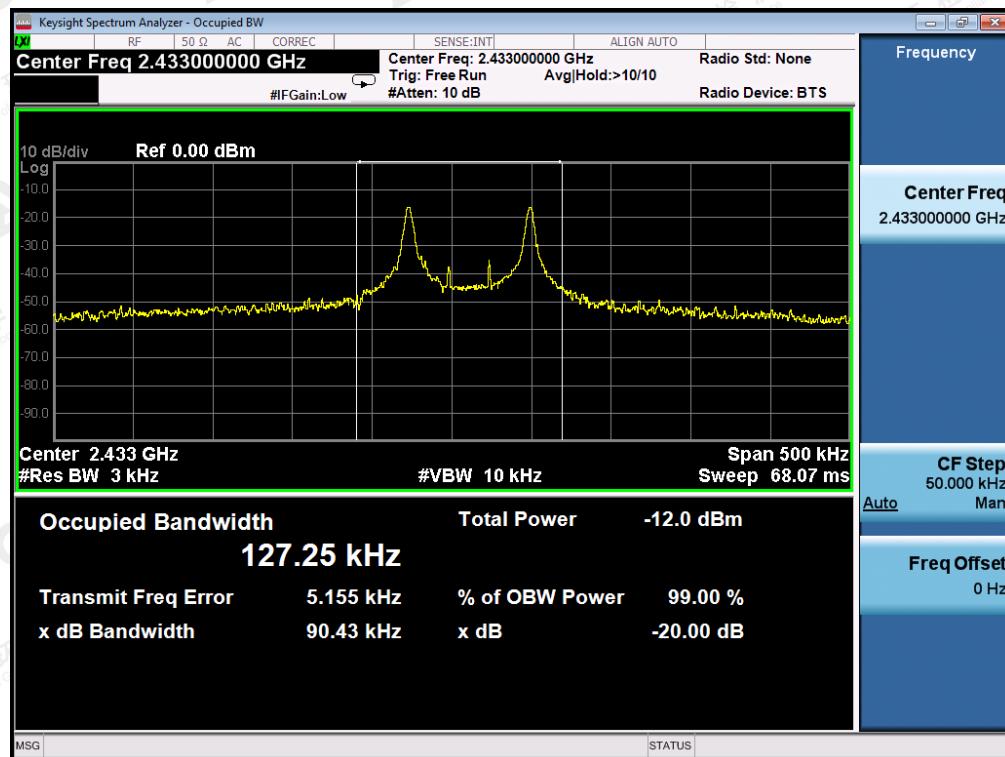


9.3. MEASUREMENT RESULTS

TEST ITEM	20DB BANDWIDTH
TEST MODULATION	GFSK

Test Data (kHz)	Criteria
Operate Channel 90.43	PASS

TEST PLOT OF BANDWIDTH

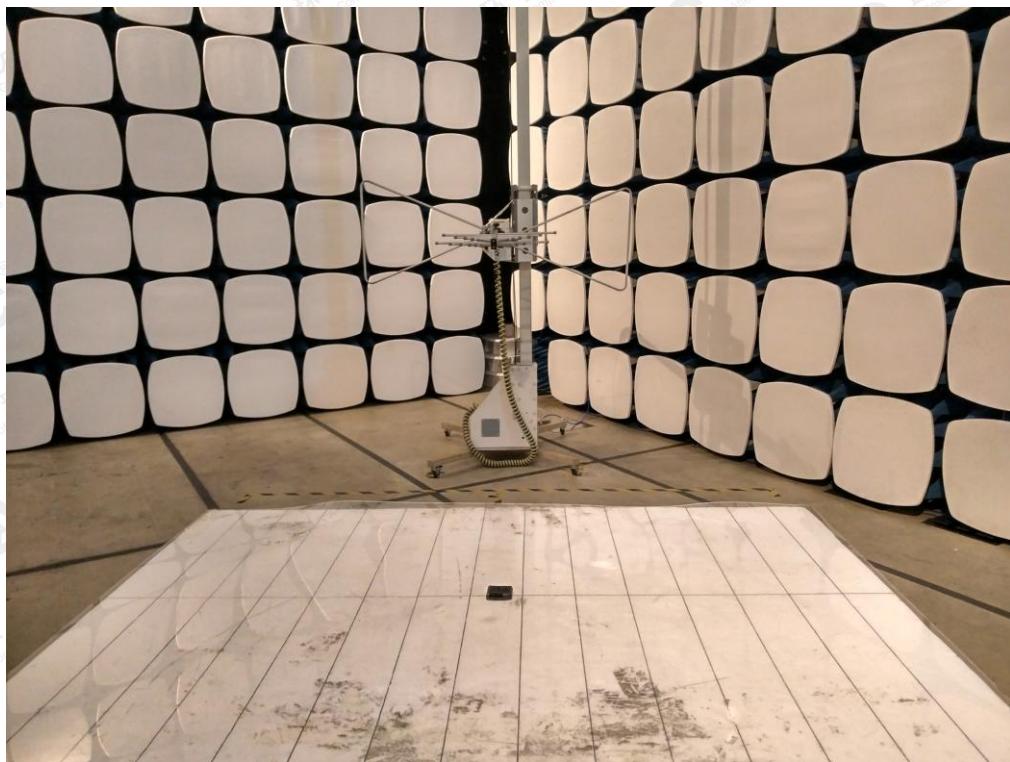


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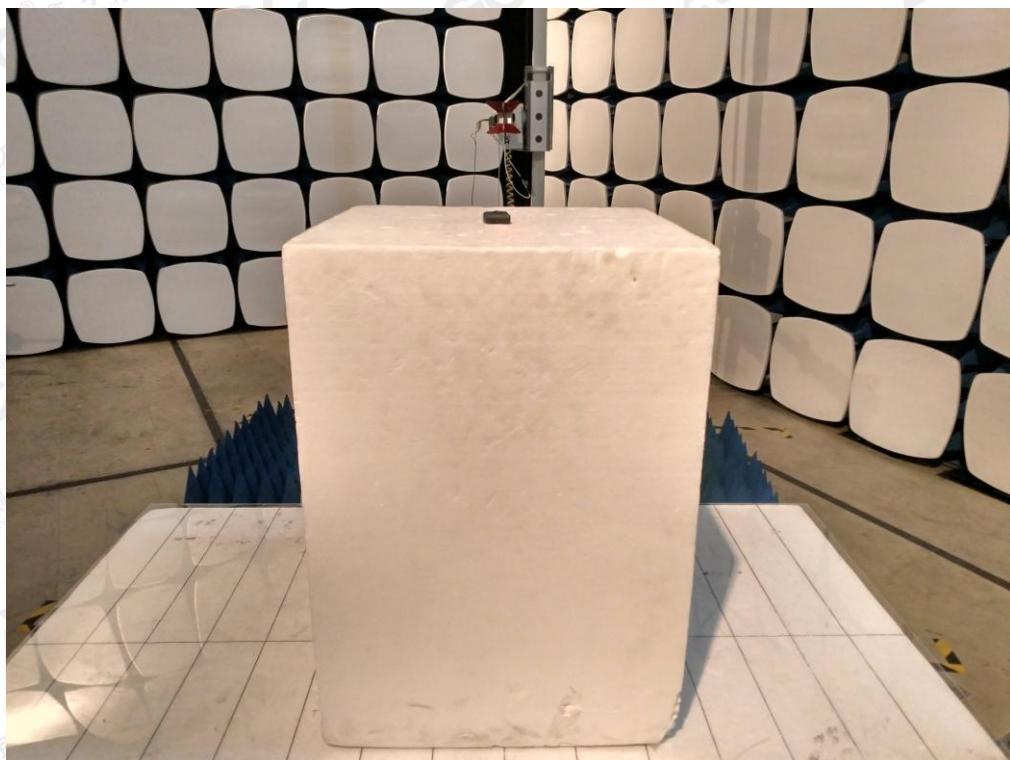


APPENDIX A: PHOTOGRAPHS OF TEST SETUP

FCC RADIATED EMISSION TEST SETUP BELOW 1GHZ



FCC RADIATED EMISSION TEST SETUP ABOVE 1GHZ



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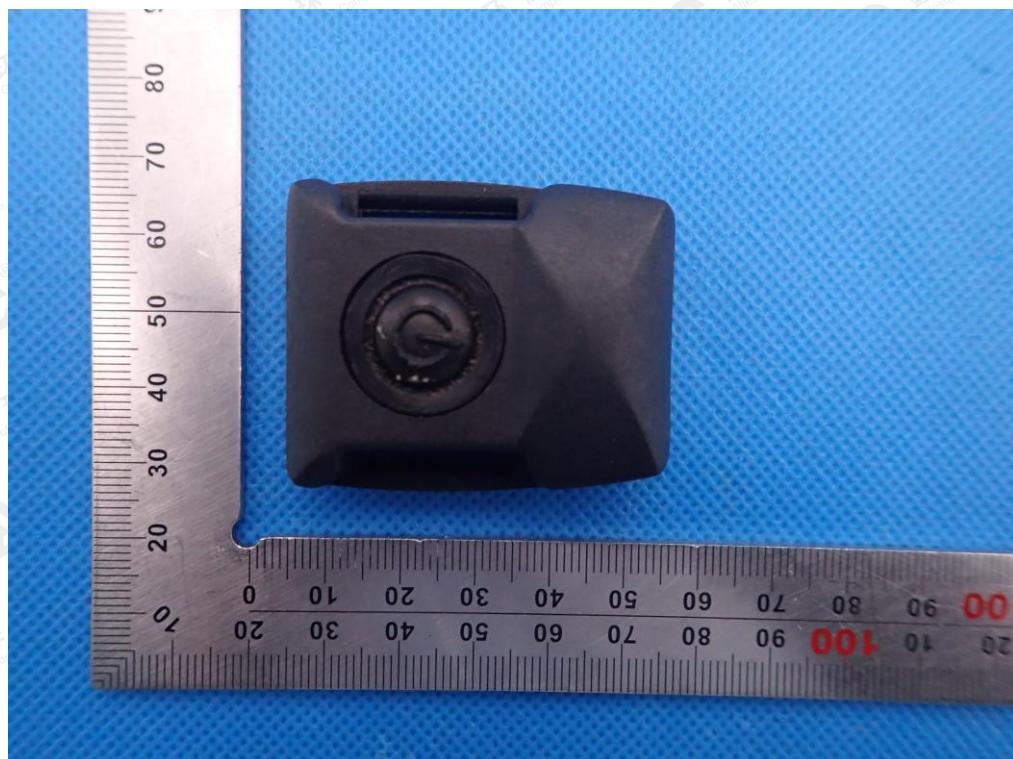


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APPENDIX B: PHOTOGRAPHS OF EUT

TOP VIEW OF EUT



BOTTOM VIEW OF EUT



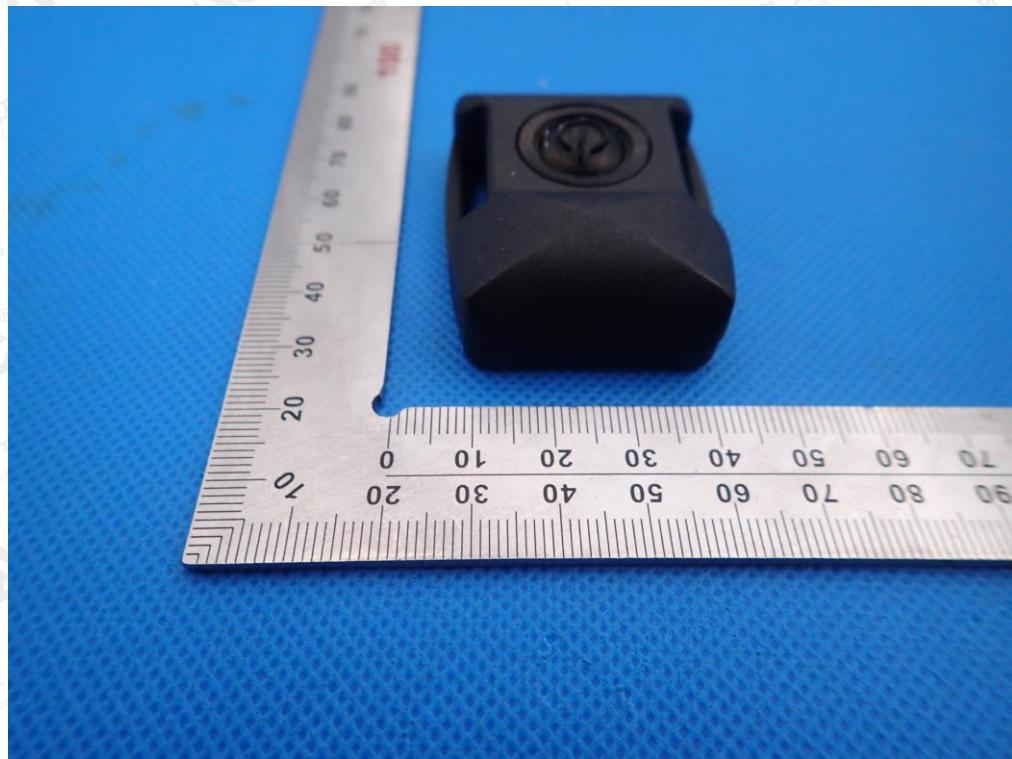
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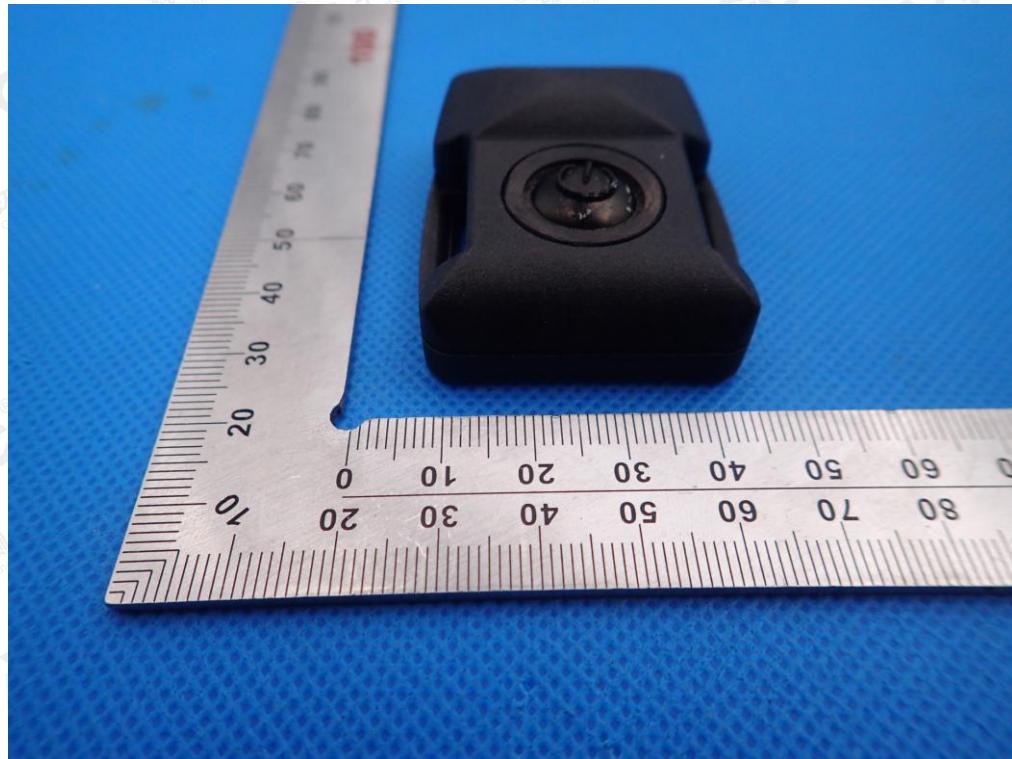
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FRONT VIEW OF EUT



BACK VIEW OF EUT



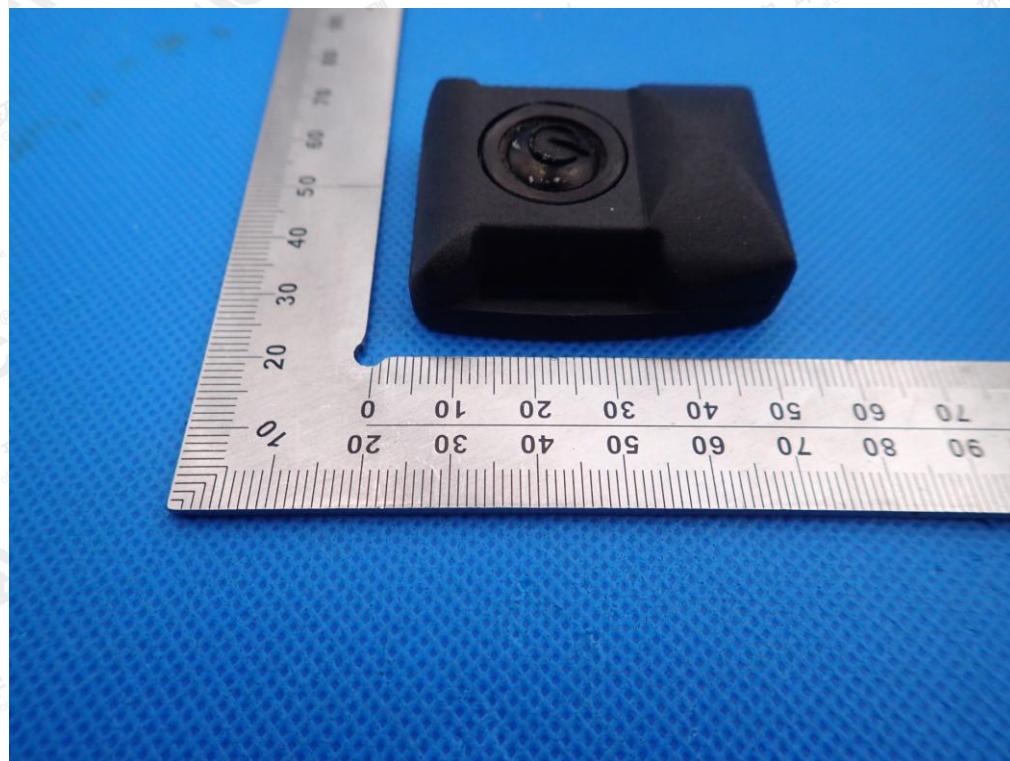
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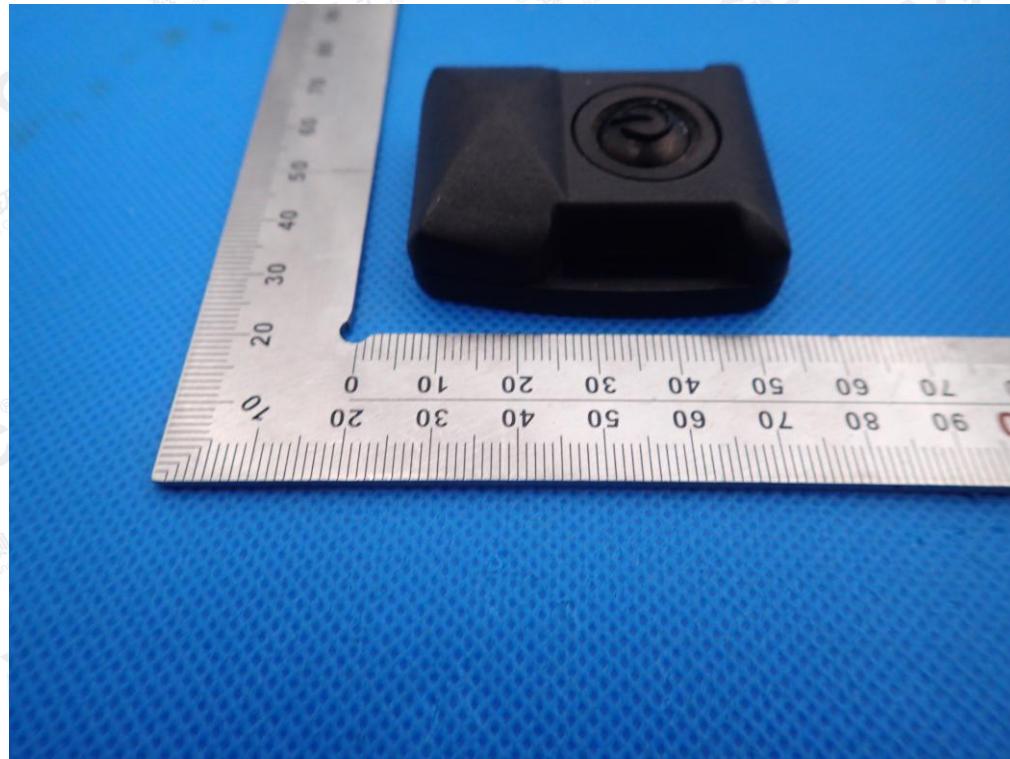
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LEFT VIEW OF EUT



RIGHT VIEW OF EUT



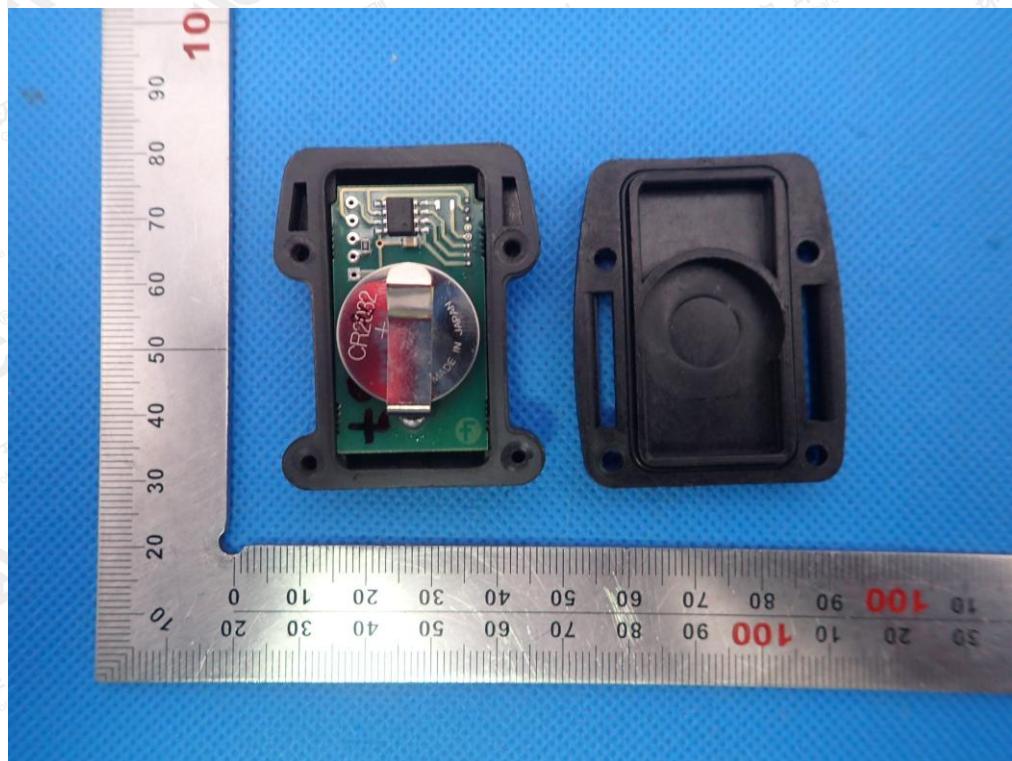
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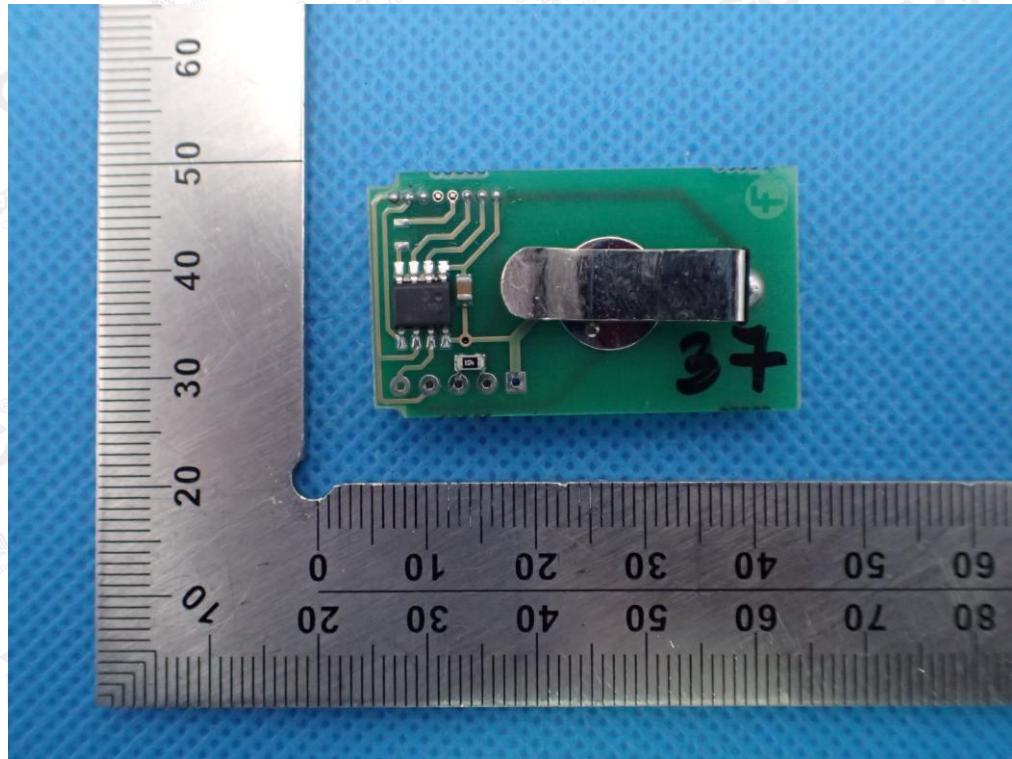
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OPEN VIEW OF EUT



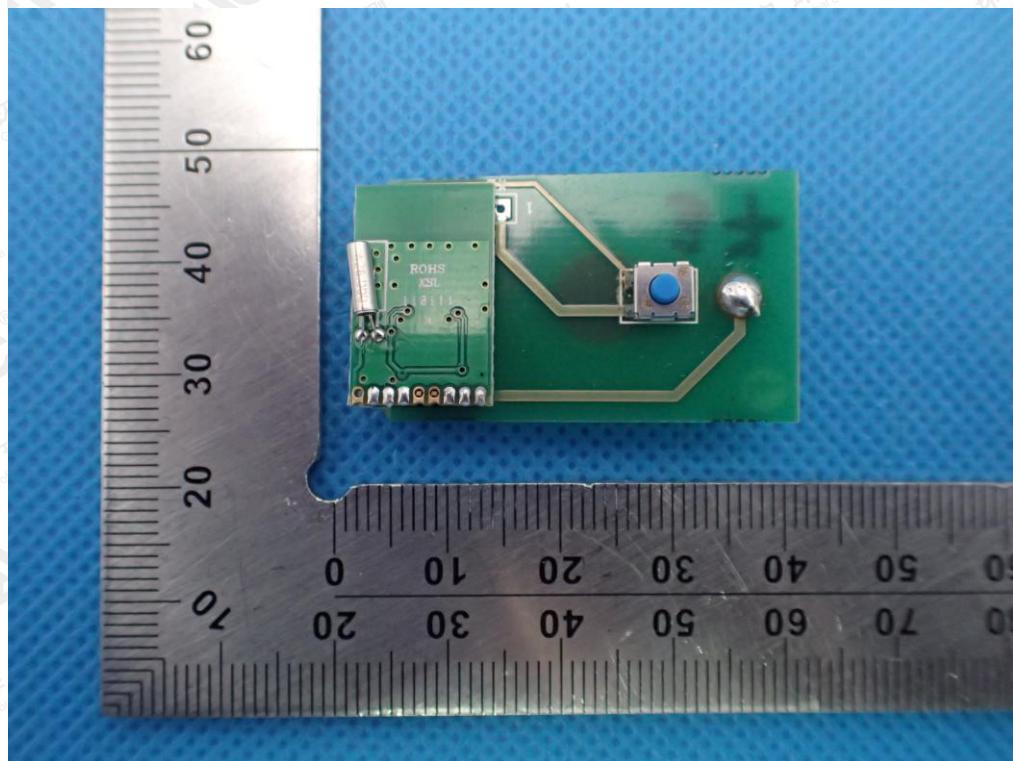
INTERNAL VIEW OF EUT-1



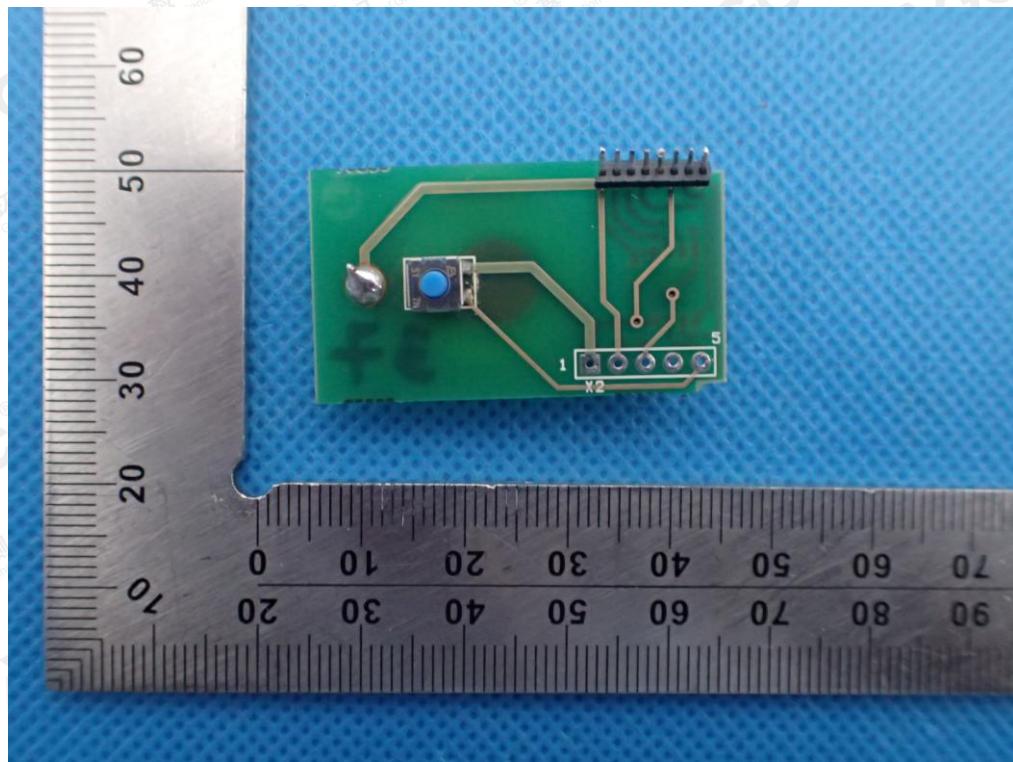
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INTERNAL VIEW OF EUT-2



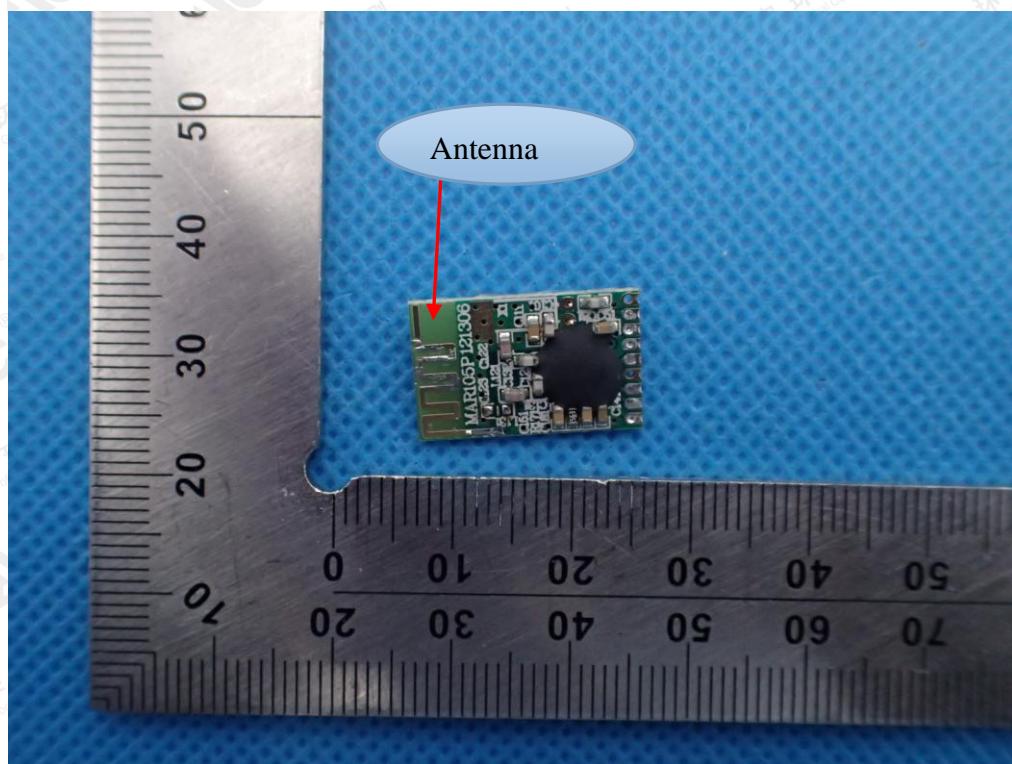
INTERNAL VIEW OF EUT-3



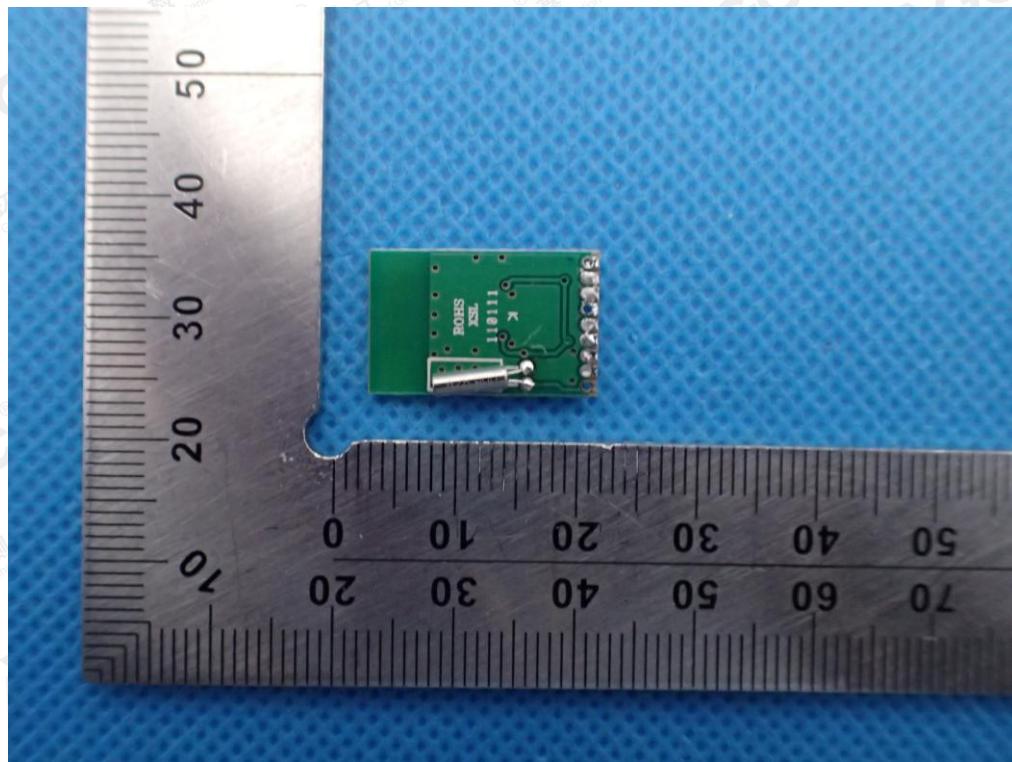
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INTERNAL VIEW OF EUT-4



INTERNAL VIEW OF EUT-5



----END OF REPORT----

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