RADIO TEST REPORT

Report No.: SHATBL2202018W02

Applicant:
Third Reality, Inc.

Address:
NO.9 Nanxu Road,RunZhou District,Zhenjiang City, Jiangsu, China

Product Name	:	Smart Button
Brand Name	:	THIRD REALITY
Model Name	:	3RSB22BZ
Series Model	:	N/A
Test Standard	:	FCC Part15.247
FCC ID	:	2AOCT-3RSB22BZ

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GENERAL DESCRIPTION

Applicant's Name..... : Third Reality, Inc.

Address..... : NO.9 Nanxu Road,RunZhou District,Zhenjiang City, Jiangsu, China

Manufacture's Name..... : Third Reality, Inc.

Address..... : NO.9 Nanxu Road,RunZhou District,Zhenjiang City, Jiangsu, China

Product Description

Product Name ..... : Smart Button

Brand Name ..... : THIRD REALITY

Model Name..... : 3RSB22BZ

Series Model ..... : N/A

Test Standards..... : FCC Part15.247

Test Procedure ..... : ANSI C63.10-2013

This device described above has been tested by ATBL, the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.
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Date of receipt of test item..... : 21 Feb. 2022

Date (s) of performance of tests ..... : 21 Feb. 2022 ~ 07 March. 2022

Date of Issue ..... : 11 Mar. 2022

Test Result..... : **Pass**

Report Prepared by : Roean Wei

(Roean Wei)

Report Approved by : Ghost Li.

(Ghost Li)

Authorized Signatory : Terry Yang

(Terry Yang)

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Revision History

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	11 Mar. 2022	SHATBL2202018W02	ALL	Initial Issue

1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:
KDB 558074 D01 15.247 Meas Guidance v05r02.

FCC Part 15.247,Subpart C			
Standard Section	Test Item	Judgment	Remark
15.207	Conducted Emission	PASS	--
15.247 (a)(2)	6dB&99% Bandwidth	PASS	--
15.247 (b)(3)	Output Power	PASS	--
15.247(d) & 15.209 & 15.205	Radiated Spurious Emission	PASS	--
15.247(d) & 15.205	Conducted Spurious & Band Edge Emission	PASS	--
15.247 (e)	Power Spectral Density	PASS	--
15.205	Restricted bands of operation	PASS	--
15.203	Antenna Requirement	PASS	--

NOTE:

(1) 'N/A' denotes test is not applicable in this Test Report.

(2) All tests are according to ANSI C63.10-2013.

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	Smart Button
Trade Name	THIRDREALITY
Model Name	3RSB22BZ
Series Model	N/A
Model Difference	N/A
Product Description	The EUT is a Smart Button Operation Frequency: 2405~2480 MHz Modulation Type: OQPSK Radio Technology: ZigBee ZigBee Version: 3.0 Number Of Channel: 16 Antenna Designation: Please refer to the Note 3. Antenna Gain (dBi) 2 dBi
Channel List	Please refer to the Note 2.
Power Rating	20mW
Battery	Rated Voltage:1.5V Capacity:1200mAh
Hardware version number	REV0.2
Software version number	V1.00.03
Connecting I/O Port(s)	Please refer to the Note 1.

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User Manual.

2.

Channel list			
Channel	Frequency (MHz)	Channel	Frequency (MHz)
CH 11	2405	CH 19	2445
CH 12	2410	CH 20	2450
CH 13	2415	CH 21	2455
CH 14	2420	CH 22	2460
CH 15	2425	CH 23	2465
CH 16	2430	CH 24	2470
CH 17	2435	CH 25	2475
CH 18	2440	CH 26	2480

3.

Table for Filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1	THIRDREALITY	3RSB22BZ	PCB	N/A	2 dBi	ZigBee ANT

2.2 DESCRIPTION OF THE TEST MODES

For conducted test items and radiated spurious emissions
Each of these EUT operation mode(s) or test configuration mode(s) mentioned below was evaluated respectively.

Worst Mode	EUT Channel	Test Frequency (MHz)
Mode 1	TX CH11	2405
Mode 2	TX CH18	2440
Mode 3	TX CH26	2480

Note:
(1) The measurements are performed at all Bit Rate of Transmitter, the worst data was reported.

For Conducted Emission

Test Case	
Conducted Emission	Mode 4 : Keeping ZigBee TX

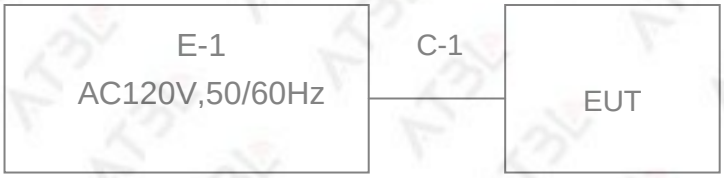
2.3 TEST SOFTWARE AND POWER LEVEL

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level.

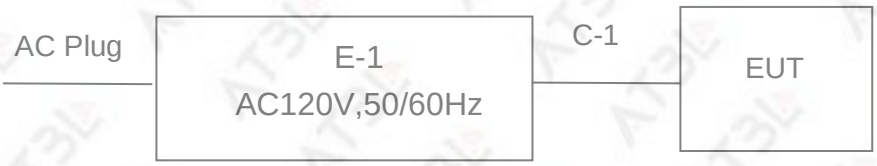
RF Function	Type	Mode Or Modulation type	Ant Gain(dBi)	Power Class	Software For Testing
ZigBee	ZigBee	OQPSK	2	default	EMI_Test_Tool

2.4 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

Radiated Spurious Emission Test



Conduction Emission Test



2.5 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Necessary accessories

Item	Equipment	Mfr/Brand	Model/Type No.	Length	Note
N/A	N/A	N/A	N/A	N/A	N/A

Support units

Item	Equipment	Mfr/Brand	Model	Type No.	Note
E-2	Notebook	Lenovo	DESKTOP-USDEO09	00326-10000-00000-AA636	N/A
C-1	USB Cable	N/A	100cm	N/A	N/A

Note:

(1) The support equipment was authorized by Declaration of Confirmation.

(2) For detachable type I/O cable should be specified the length in cm in『Length』column.

2.6 LABORATORY INFORMATION

Company Name:	Shanghai ATBL Technology Co., Ltd.
Address:	Building 8, No. 160, Basheng Road, Waigaoqiao Free Trade Zone, Pudong New Area, Shanghai
Telephone:	+86(0)21-51298625
The FCC Registration Number (FRN):	0031025281
A2LA Number:	6184.01
CNAS Number:	CNAS L14531

2.7 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement **y** ± **U**, where expended uncertainty **U** is based on a standard uncertainty multiplied by a coverage factor of **k=2**, providing a level of confidence of approximately **95** %.

No.	Item	Uncertainty
1	RF output power, conducted	±0.962dB
2	Conducted spurious emissions	±2.986dB
3	All emissions, radiated 30MHz-1GHz	±2.49dB
4	All emissions, radiated 1GHz-18GHz	±3.50dB
5	Occupied bandwidth	±23.36dB
6	Power spectral density	±0.866dB

2.8 EQUIPMENTS LIST

2.8.1 Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Management number	Calibrated until
Test Receiver	R&S	ESCI	100469	SHATBL-E003	2022.07.13
Spectrum Analyzer	Agilent	N9020A	MY50200811	SHATBL-E017	2022.07.13
Bilog Antenna	SCHWARZBECK	VLUB 9168	01174	SHATBL-E008	2023.09.27
Horn Antenna	SCHWARZBECK	BBHA 9120D	02014	SHATBL-E009	2023.09.27
Pre-Amplifier (0.1M-3GHz)	JPT	JPA-10M1G35	21010100035001	SHATBL-E005	2022.10.07
Pre-Amplifier (1G-18GHz)	JPT	JPA0118-55-303A	1910001800055000	SHATBL-E006	2022.07.13
Temperature & Humidity	DeLi	DeLi	N/A	SHATBL-E016	2022.10.08
Antenna/Turntable Controller	Brilliant	N/A	N/A	SHATBL-E007	N/A
Test SW	FALA	EMC-RI(Ver.4A2)		SHATBL-E046	N/A

2.8.2 Conduction Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Management number	Calibration date
Test Receiver	R&S	ESPI	101679	SHATBL-E012	2022.07.13
LISN	R&S	ENV216	101300	SHATBL-E013	2022.07.13
LISN	R&S	ENV216	100333	SHATBL-E041	2022.03.08
Temperature & Humidity	DeLi	DeLi	N/A	SHATBL-E015	2022.10.07
Test SW	FALA	EZ-EMC(Ver.EMC-CON3A1.1)		SHATBL-E044	N/A

2.8.3 RF Connected Test

Kind of Equipment	Manufacturer	Type No.	Serial No.	equipment number	Calibrated until
Power meter (with pulse power sensor)	Anritsu	ML2496A	1935001	SHATBL-W030	2022.10.26
Pulse power sensor (with power meter)	Anritsu	MA2411B	1911006	SHATBL-W031	2022.10.26
Signal Analyzer	Agilent	N9020A	MY57300196	SHATBL-W004	2022.10.07
Signal Generator	Agilent	N5182B	MY46240556	SHATBL-W005	2022.10.07
Wireless Communications Test Set	R&S	CMW500	101331	SHATBL-W007	2022.10.07
Temperature & Humidity	Deli	deli	N/A	SHATBL-W011	2022.10.07
Attenuator	Agilent	8494B	DC-18G	SHATBL-W009	2022.10.07
Attenuator	Agilent	8496B	DC-18G	SHATBL-W010	2022.10.07
power splitter	MNK	MPD-DC/6-2S	62315 G51	SHATBL-W015	2022.10.07
			62315 G52	SHATBL-W016	2022.10.07
Filter	Chengdu kangmaiwei	ZBSF-C2400-2483.5-T3	N/A	SHATBL-W021	N/A
Constant temperature and humidity box	KSON	THS-B6C-150	6159K	SHATBL-W019	2023.01.17
Test SW	FALA	LZ-RF(Ver.LzRF-03A3.1)		SHATBL-W020	N/A

3. EMC EMISSION TEST

3.1 CONDUCTED EMISSION MEASUREMENT

3.1.1 POWER LINE CONDUCTED EMISSION LIMITS

Operating frequency band. In case the emission fall within the restricted band specified on Part 207(a) limit in the table below has to be followed.

FREQUENCY (MHz)	Conducted Emission limit (dBuV)	
	Quasi-peak	Average
0.15 -0.5	66 - 56 *	56 - 46 *
0.50 -5.0	56.00	46.00
5.0 -30.0	60.00	50.00

Note:

(1) The tighter limit applies at the band edges.

(2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

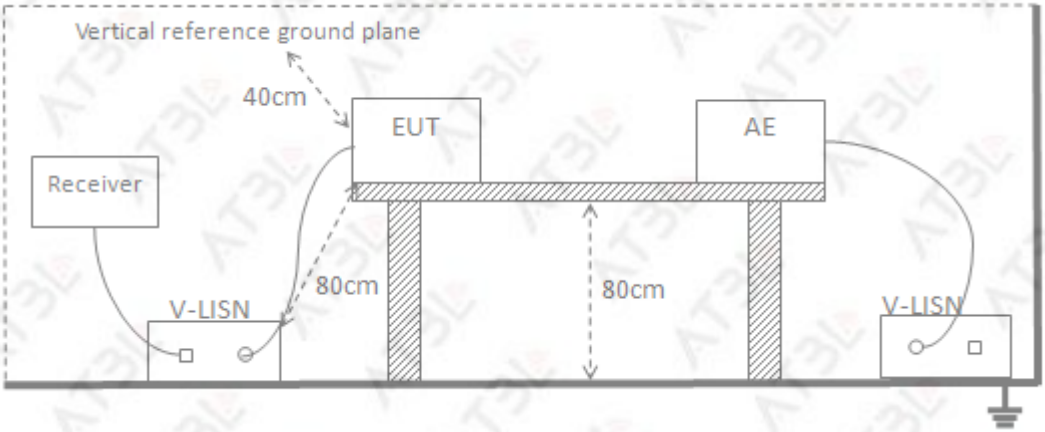
The following table is the setting of the receiver

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

3.2 TEST PROCEDURE

a. The EUT is 0.8 m from the horizontal ground plane and 0.4 m from the vertical ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments are powered from additional LISN(s). The LISN provides 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
d. LISN is at least 80 cm from the nearest part of EUT chassis.
e. For the actual test configuration, please refer to the related Item –EUT Test Photos.

3.3 TEST SETUP



3.4 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

3.5 TEST RESULTS

This EUT does not apply.

4. RADIATED EMISSION MEASUREMENT

4.1 RADIATED EMISSION LIMITS

In any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the Restricted band specified on Part15.205(a)&209(a) limit in the table and according to ANSI C63.10-2013 below has to be followed.

LIMITS OF RADIATED EMISSION MEASUREMENT (Frequency Range 9kHz-1000MHz)

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

FREQUENCY (MHz)	(dBuV/m) (at 3M)	
	PEAK	AVERAGE
Above 1000	74	54

Notes:

(1) The limit for radiated test was performed according to FCC PART 15C.

(2) The tighter limit applies at the band edges.

(3) Emission level (dBuV/m)=20log Emission level (uV/m).

LIMITS OF RESTRICTED FREQUENCY BANDS

FCC:

FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (GHz)
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

For Radiated Emission

Spectrum Parameter	Setting
Attenuation	Auto
Detector	Peak/QP/AV
Start Frequency	9 KHz/150KHz(Peak/QP/AV)
Stop Frequency	150KHz/30MHz(Peak/QP/AV)
RB / VB (emission in restricted band)	200Hz (From 9kHz to 0.15MHz)/ 9KHz (From 0.15MHz to 30MHz); 200Hz (From 9kHz to 0.15MHz)/ 9KHz (From 0.15MHz to 30MHz)

Spectrum Parameter	Setting
Attenuation	Auto
Detector	Peak/QP
Start Frequency	30 MHz(Peak/QP)
Stop Frequency	1000 MHz (Peak/QP)
RB / VB (emission in restricted band)	120 KHz / 300 KHz

Spectrum Parameter	Setting
Attenuation	Auto
Detector	Peak/AV
Start Frequency	1000 MHz(Peak/AV)
Stop Frequency	10th carrier hamonic(Peak/AV)
RB / VB (emission in restricted band)	1 MHz / 3 MHz(Peak) 1 MHz/1/T MHz(AVG)

For Restricted band

Spectrum Parameter	Setting
Detector	Peak/AV
Start/Stop Frequency	Lower Band Edge: 2310 to 2410 MHz Upper Band Edge: 2475 to 2500 MHz
RB / VB	1 MHz / 3 MHz(Peak) 1 MHz/1/T MHz(AVG)

Receiver Parameter	Setting
Start ~ Stop Frequency	9kHz~90kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	90kHz~110kHz / RB 200Hz for QP
Start ~ Stop Frequency	110kHz~490kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	490kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

4.2 TEST PROCEDURE

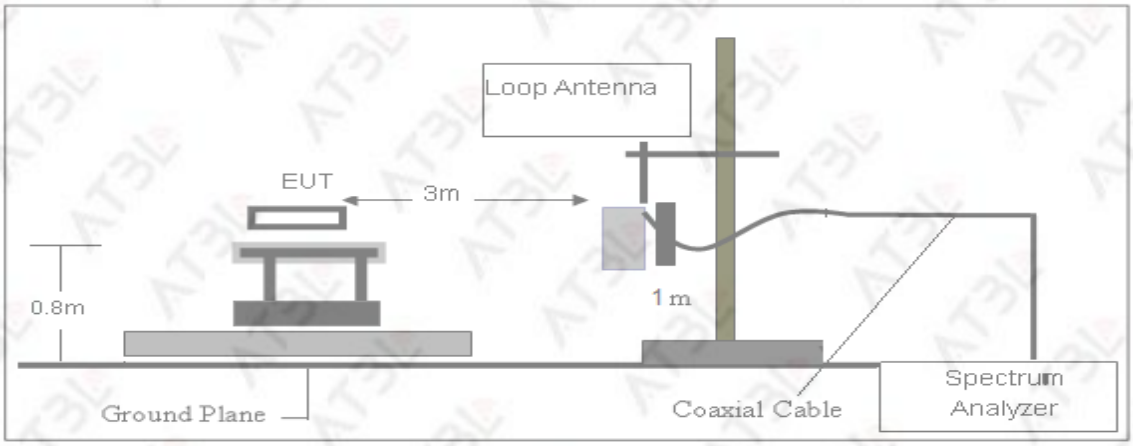
a. The measuring distance of at 3 m shall be used for measurements at frequency 0.009MHz up to 1GHz, and above 1GHz.
b. The EUT was placed on the top of a rotating table 0.8 meters(above 1GHz is 1.5 m) above the ground at a 3 meter anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
c. The height of the equipment shall be 0.8 m(above 1GHz is 1.5 m); the height of the test antenna shall vary between 1 m to 4 m. Horizontal and vertical polarizations of the antenna are set to make the measurement.
d. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
e. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
f. For the actual test configuration, please refer to the related Item –EUT Test Photos.

Note:

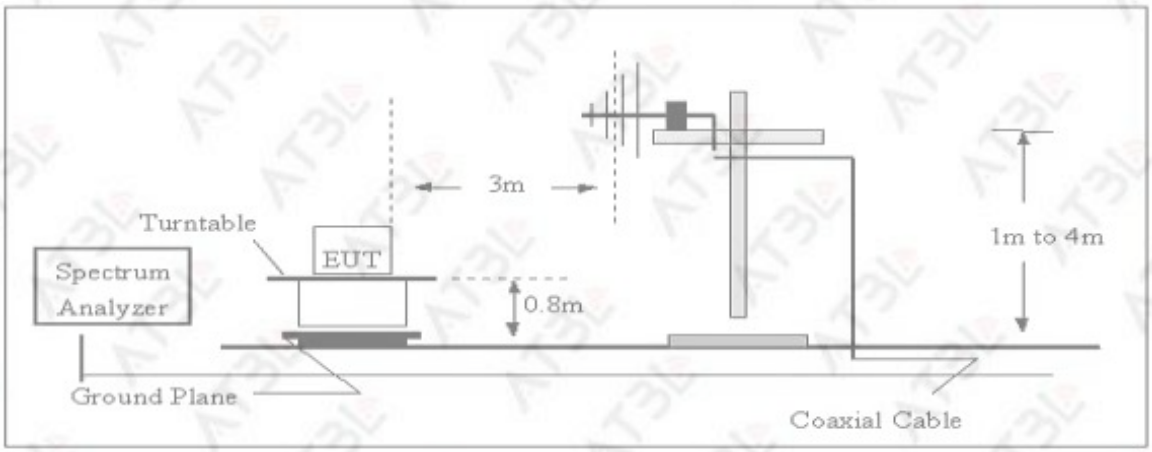
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

4.3 TEST SETUP

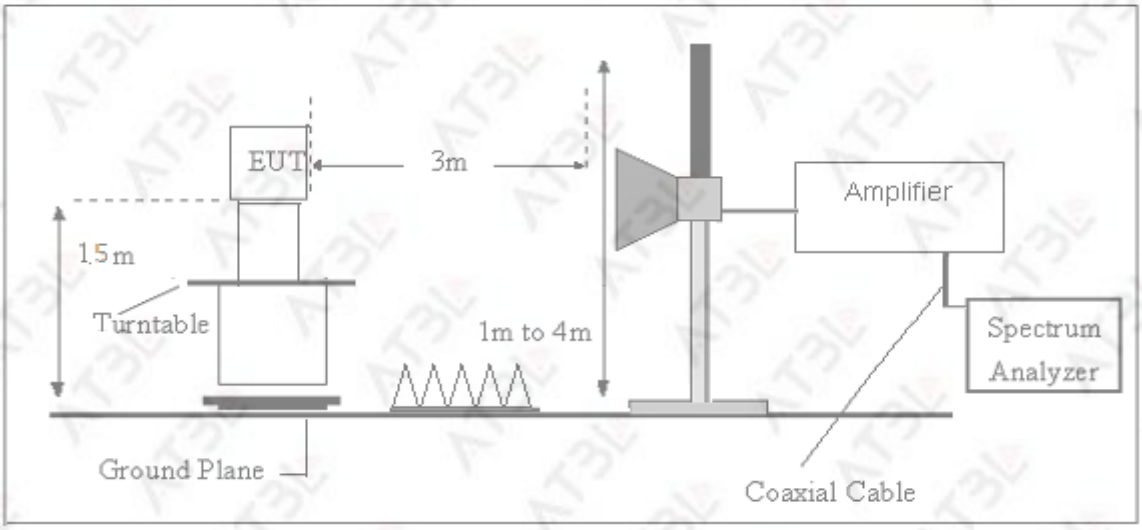
(A) Radiated Emission Test-Up Frequency Below 30MHz



(B) Radiated Emission Test-Up Frequency 30MHz~1GHz



(C) Radiated Emission Test-Up Frequency Above 1GHz



4.4 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

4.5 FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where

FS = Field Strength

CL = Cable Attenuation Factor (Cable Loss)

RA = Reading Amplitude

AG = Amplifier Gain

AF = Antenna Factor

For example

Frequency	FS	RA	AF	CL	AG	Factor
(MHz)	(dBμV/m)	(dBμV/m)	(dB)	(dB)	(dB)	(dB)
300	40	58.1	12.2	1.6	31.9	-18.1

Factor=AF+CL-AG

4.6 TEST RESULTS

Temperature:	23.0℃	Relative Humidtity:	59%RH
Test Voltage:	AC120V	Polarization:	--
Test Mode:	TX Mode1/3		

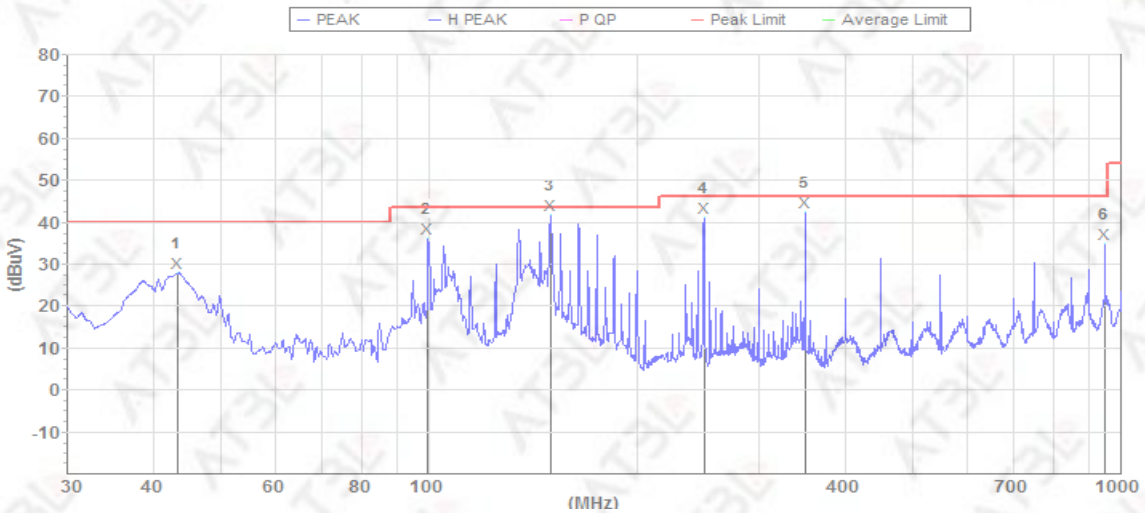
Note:
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
Distance extrapolation factor =40 log (specific distance/test distance)(dB);
Limit line = specific limits(dBuv) + distance extrapolation factor.

(30MHz -1000MHz)

Temperature:	23.3℃	Relative Humidity:	60%RH
Test Voltage:	AC120V	Phase:	Horizontal
Test Mode:	TX Mode 1		

Remark:
1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

Mode 1 Horizontal

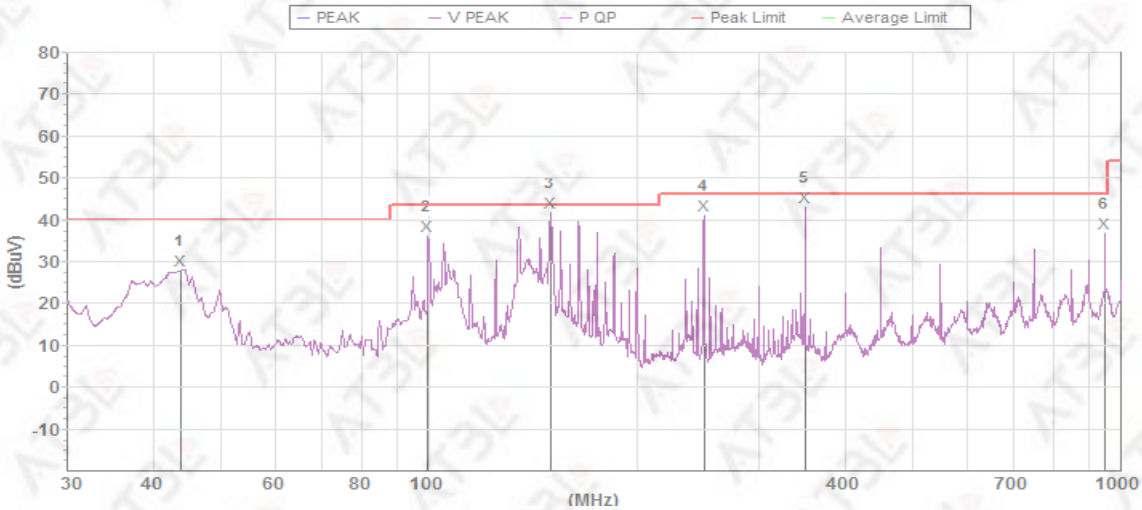


Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
1	43.429513	28.0	40.0	12.0	13.9	32.4	0.8	H
2	99.702770	36.3	43.5	7.2	10.2	32.9	1.4	H
3	150.274066	41.8	43.5	1.7	14.2	32.8	1.3	H
4	249.862716	41.2	46.0	4.8	11.6	32.8	2.6	H
5	349.862839	42.6	46.0	3.4	13.4	32.5	2.7	H
6	948.760988	35.0	46.0	11.0	20.3	31.3	3.8	H

Temperature:	23.0℃	Relative Humidity:	59%RH
Test Voltage:	AC120V	Phase:	Vertical
Test Mode:	TX Mode 1		

Remark:
1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

Mode 1 Vertical



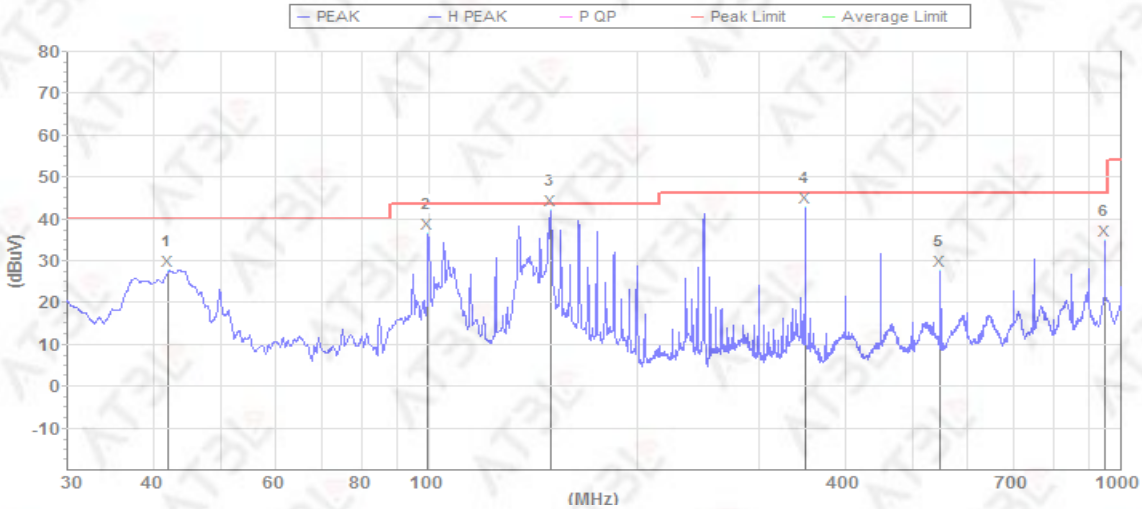
Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
1	43.888789	28.0	40.0	12.0	13.9	32.4	0.8	V
2	99.702770	36.4	43.5	7.1	10.2	32.9	1.4	V
3	150.274066	41.9	43.5	1.6	14.2	32.8	1.3	V
4	249.862716	41.2	46.0	4.8	11.6	32.8	2.6	V
5	349.862839	43.0	46.0	3.0	13.8	32.5	2.7	V
6	948.760988	37.0	46.0	9.0	22.1	31.3	3.8	V

(30MHz -1000MHz)

Temperature:	23.3℃	Relative Humidity:	60%RH
Test Voltage:	AC120V	Phase:	Horizontal
Test Mode:	TX Mode 3		

Remark:
1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

Mode 3 Horizontal

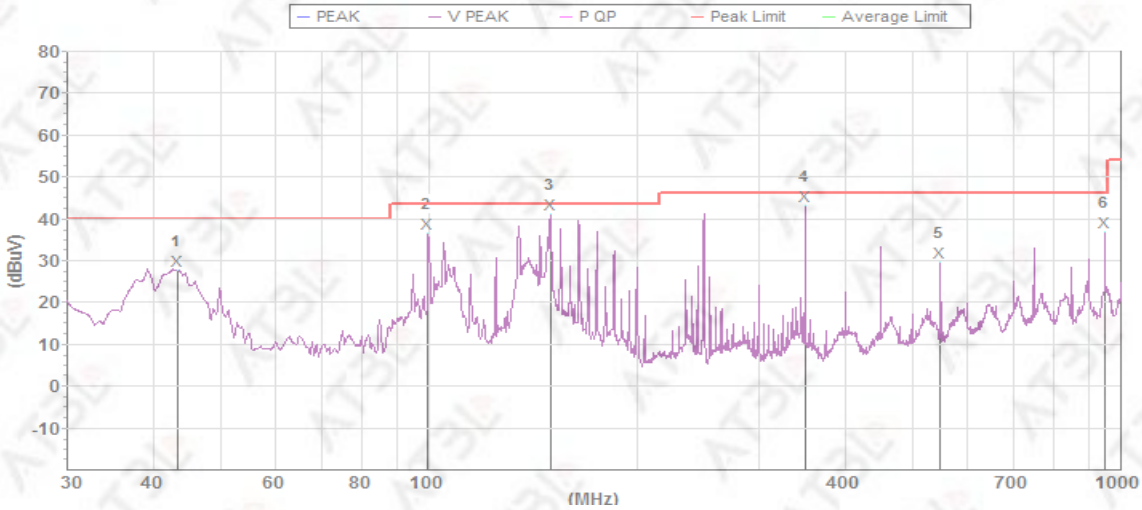


Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
1	42.080322	27.7	40.0	12.3	14.0	32.4	0.8	H
2	99.702770	36.5	43.5	7.0	10.1	32.9	1.4	H
3	149.748044	42.2	43.5	1.3	14.1	32.9	1.3	H
4	349.862839	42.7	46.0	3.3	13.4	32.5	2.7	H
5	549.019455	27.6	46.0	18.4	15.4	32.4	3.1	H
6	948.760988	35.0	46.0	11.0	20.3	31.3	3.7	H

Temperature:	23.3℃	Relative Humidity:	60%RH
Test Voltage:	AC120V	Phase:	Vertical
Test Mode:	TX Mode 3		

Remark:
1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

Mode 3 Vertical



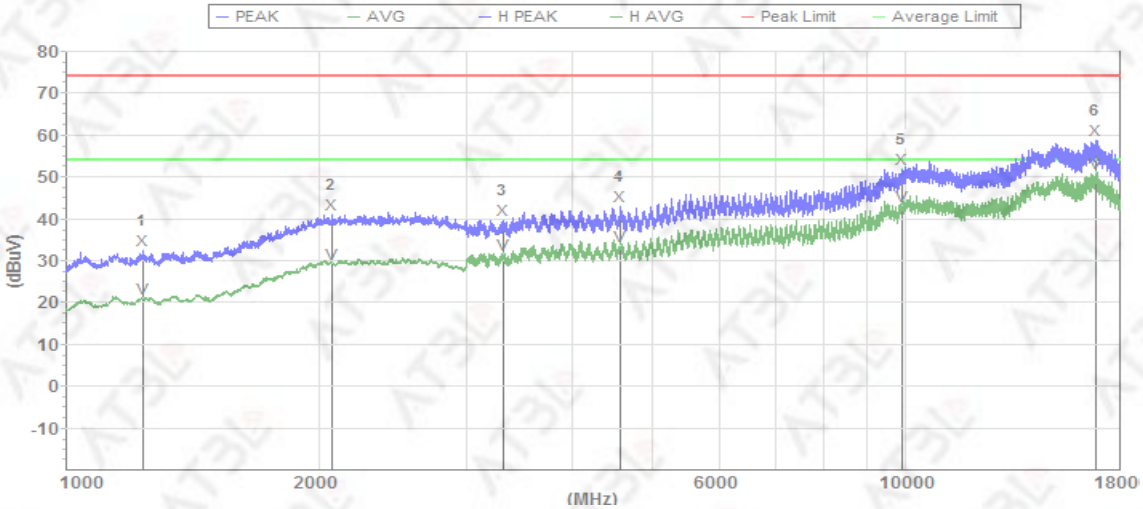
Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
1	43.429513	27.8	40.0	12.2	13.9	32.4	0.8	V
2	99.702770	36.5	43.5	7.0	10.2	32.9	1.4	V
3	149.748044	41.3	43.5	2.2	14.2	32.9	1.3	V
4	349.862839	43.1	46.0	2.9	13.8	32.5	2.7	V
5	549.019455	29.7	46.0	16.3	17.4	32.5	3.1	V
6	948.760988	37.0	46.0	9.0	22.1	31.3	3.8	V

(30MHz -18000MHz)

Temperature:	23.3℃	Relative Humidity:	60%RH
Test Voltage:	AC120V	Phase:	Horizontal
Test Mode:	TX Mode 1		

Remark:
1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

Mode 1 Horizontal

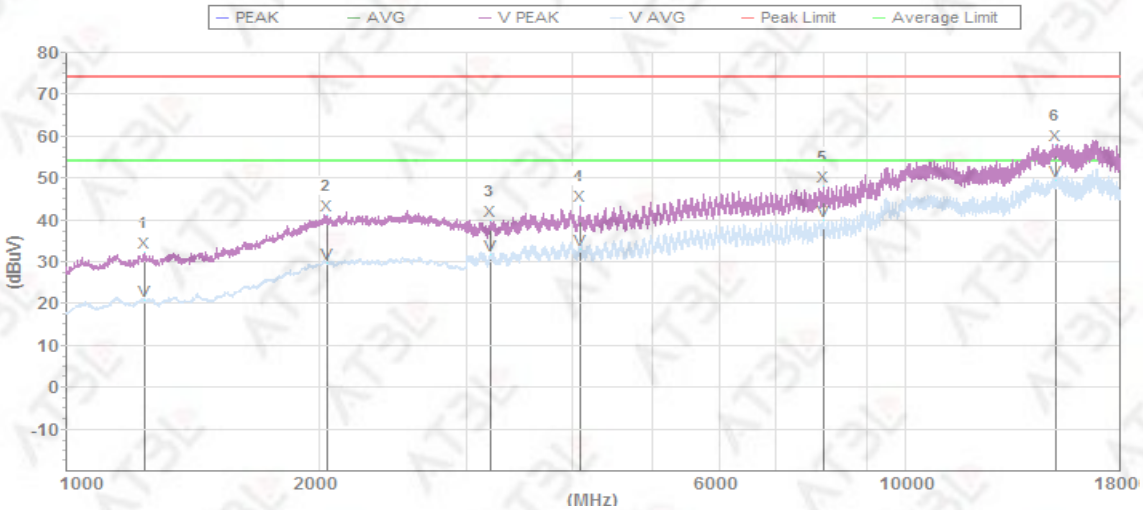


Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
Peak								
1	1235.000000	32.7	74.0	41.3	20.7	57.3	2.3	H
2	2076.000000	41.2	74.0	32.8	22.1	50.1	2.7	H
3	3317.250000	39.9	74.0	34.1	24.1	51.0	3.1	H
4	4569.000000	43.2	74.0	30.8	24.7	50.0	3.6	H
5	9924.000000	51.9	74.0	22.1	27.5	48.5	5.4	H
6	16821.750000	58.8	74.0	15.2	30.9	47.4	6.8	H
Avg								
1	1235.000000	21.2	54.0	32.8	20.7	57.3	2.3	H
2	2076.000000	29.4	54.0	24.6	22.1	50.1	2.7	H
3	3317.250000	31.5	54.0	22.5	24.1	51.0	3.1	H
4	4569.000000	33.6	54.0	20.4	24.7	50.0	3.6	H
5	9924.000000	43.3	54.0	10.7	27.5	48.5	5.4	H
6	16821.750000	51.0	54.0	3.0	30.9	47.4	6.8	H

Temperature:	23.3℃	Relative Humidity:	60%RH
Test Voltage:	AC120V	Phase:	Vertical
Test Mode:	TX Mode 1		

Remark:
1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

Mode 1 Vertical



Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
Peak								
1	1238.000000	32.4	74.0	41.6	20.7	57.3	2.3	V
2	2048.000000	41.3	74.0	32.7	22.2	50.1	2.7	V
3	3205.500000	40.0	74.0	34.0	24.4	51.3	3.0	V
4	4093.500000	43.4	74.0	30.6	24.8	50.1	3.3	V
5	7983.000000	48.0	74.0	26.0	26.9	48.6	4.9	V
6	15078.000000	58.1	74.0	15.9	31.1	46.9	6.3	V
Avg								
1	1238.000000	20.8	54.0	33.2	20.7	57.3	2.3	V
2	2048.000000	29.6	54.0	24.4	22.2	50.1	2.7	V
3	3205.500000	31.7	54.0	22.3	24.4	51.3	3.0	V
4	4093.500000	33.1	54.0	20.9	24.8	50.1	3.3	V
5	7983.000000	39.8	54.0	14.2	26.9	48.6	4.9	V
6	15078.000000	49.4	54.0	4.6	31.1	46.9	6.3	V

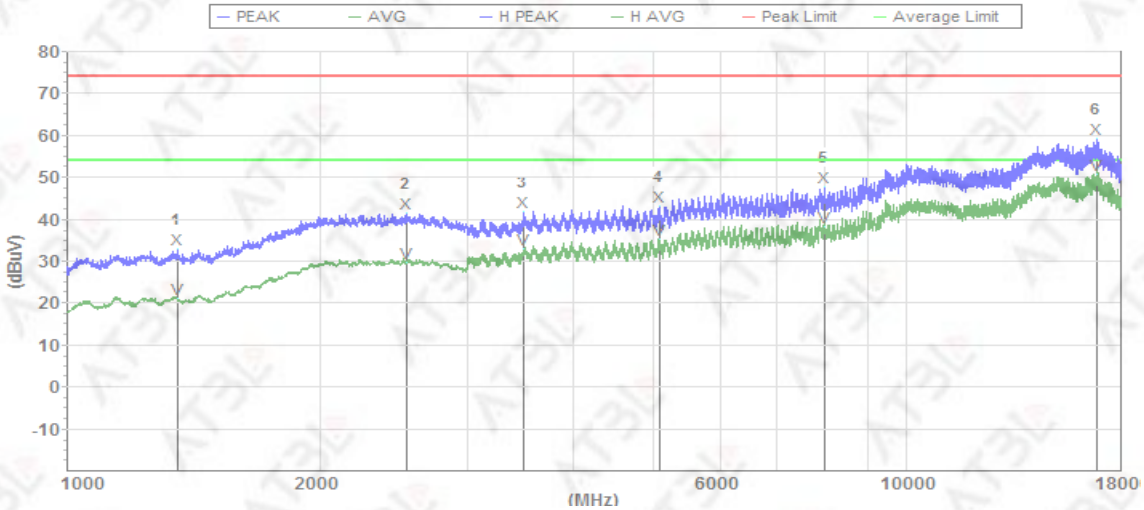
(30MHz -18000MHz)

Temperature:	23.3℃	Relative Humidity:	60%RH
Test Voltage:	AC120V	Phase:	Horizontal

Test Mode:	TX Mode 3

Remark:
1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

Mode 3 Horizontal

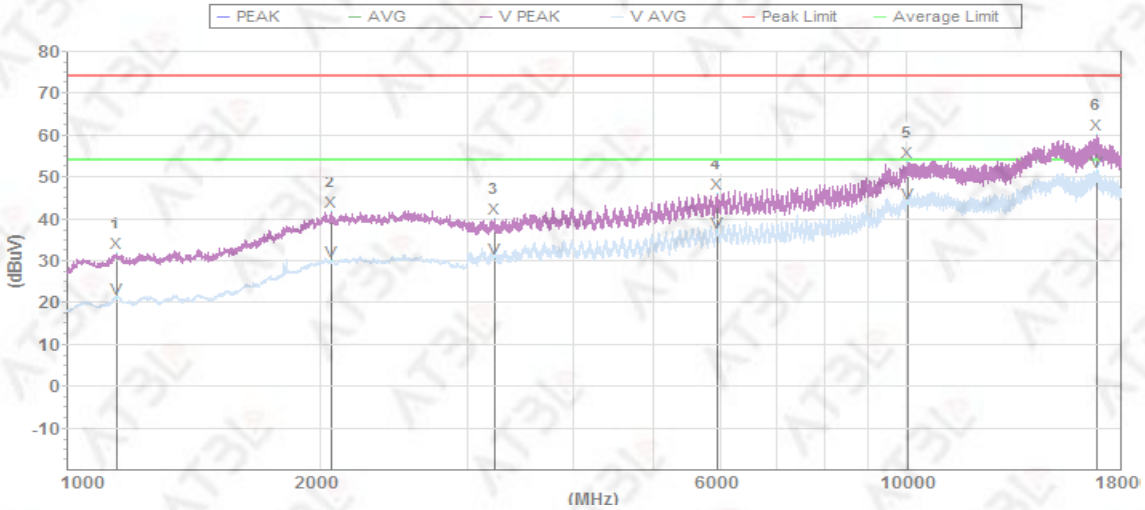


Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
Peak								
1	1353.000000	32.9	74.0	41.1	20.8	57.3	2.3	H
2	2537.000000	41.4	74.0	32.6	23.0	50.3	2.8	H
3	3501.000000	41.9	74.0	32.1	24.2	50.5	3.1	H
4	5072.250000	43.0	74.0	31.0	24.8	49.2	3.7	H
5	7984.500000	47.7	74.0	26.3	26.1	48.6	4.9	H
6	16836.000000	59.4	74.0	14.6	30.9	47.4	6.8	H
Avg								
1	1353.000000	21.2	54.0	32.8	20.8	57.3	2.3	H
2	2537.000000	29.7	54.0	24.3	23.0	50.3	2.8	H
3	3501.000000	32.8	54.0	21.2	24.2	50.5	3.1	H
4	5072.250000	35.1	54.0	18.9	24.8	49.2	3.7	H
5	7984.500000	38.1	54.0	15.9	26.1	48.6	4.9	H
6	16836.000000	50.8	54.0	3.2	30.9	47.4	6.8	H

Temperature:	23.3℃	Relative Humidity:	60%RH
Test Voltage:	AC120V	Phase:	Vertical
Test Mode:	TX Mode 3		

Remark:
1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

Mode 3 Vertical



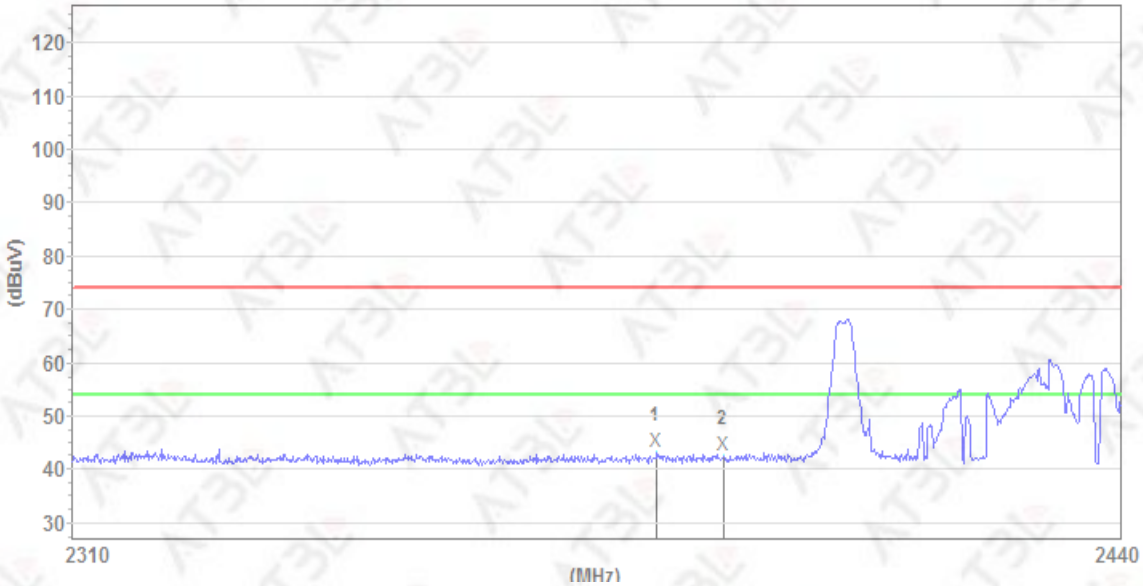
Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
Peak								
1	1144.000000	31.9	74.0	42.1	20.7	57.3	2.2	V
2	2068.000000	41.9	74.0	32.1	22.3	50.1	2.7	V
3	3234.750000	40.1	74.0	33.9	24.4	51.2	3.0	V
4	5940.750000	46.1	74.0	27.9	25.5	48.9	4.1	V
5	10035.750000	53.6	74.0	20.4	28.4	48.5	5.4	V
6	16839.750000	60.2	74.0	13.8	31.4	47.4	6.8	V
Avg								
1	1144.000000	21.1	54.0	32.9	20.7	57.3	2.2	V
2	2068.000000	30.0	54.0	24.0	22.3	50.1	2.7	V
3	3234.750000	30.6	54.0	23.4	24.4	51.2	3.0	V
4	5940.750000	36.8	54.0	17.2	25.5	48.9	4.1	V
5	10035.750000	43.8	54.0	10.2	28.4	48.5	5.4	V
6	16839.750000	51.4	54.0	2.6	31.4	47.4	6.8	V

Note:
1.All TX Mode, the worst case is mode1&3, only show the worst case.
2.Other 18G-25G Emission detected are more than 20dB below the limit.

4.6 TEST RESULTS (Restricted Bands Requirements)

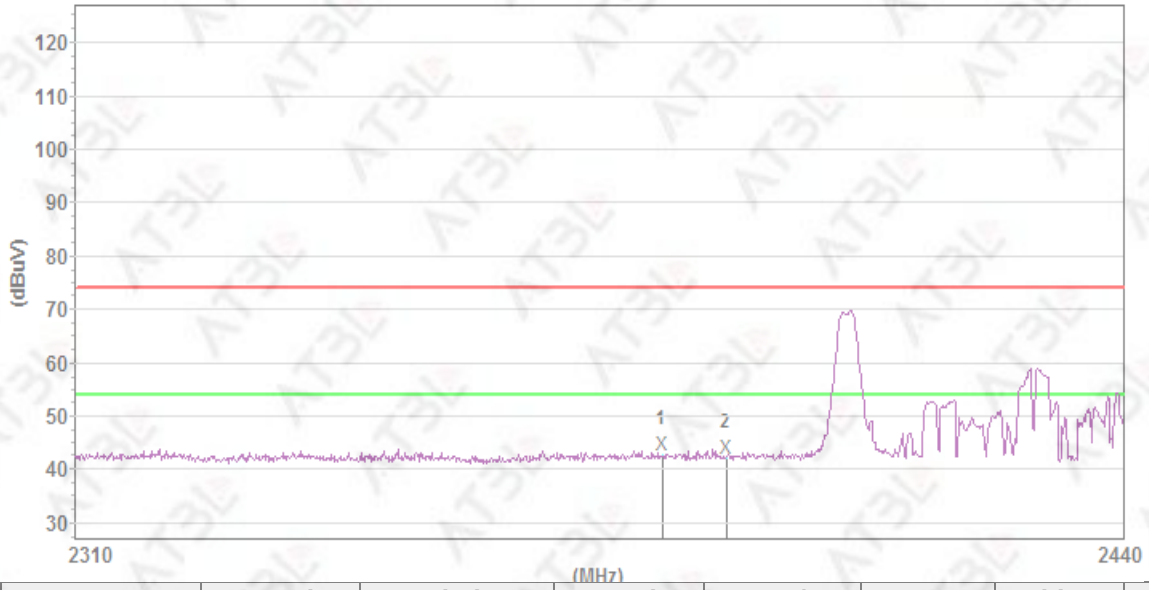
GFSK-Low

Horizontal



Mk.	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.F/G. (dB/m)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
PK								
1	2381.661401	43.3	74.0	30.7	22.7	50.2	2.8	H
2	2390.000000	42.9	74.0	31.1	22.8	50.2	2.8	H

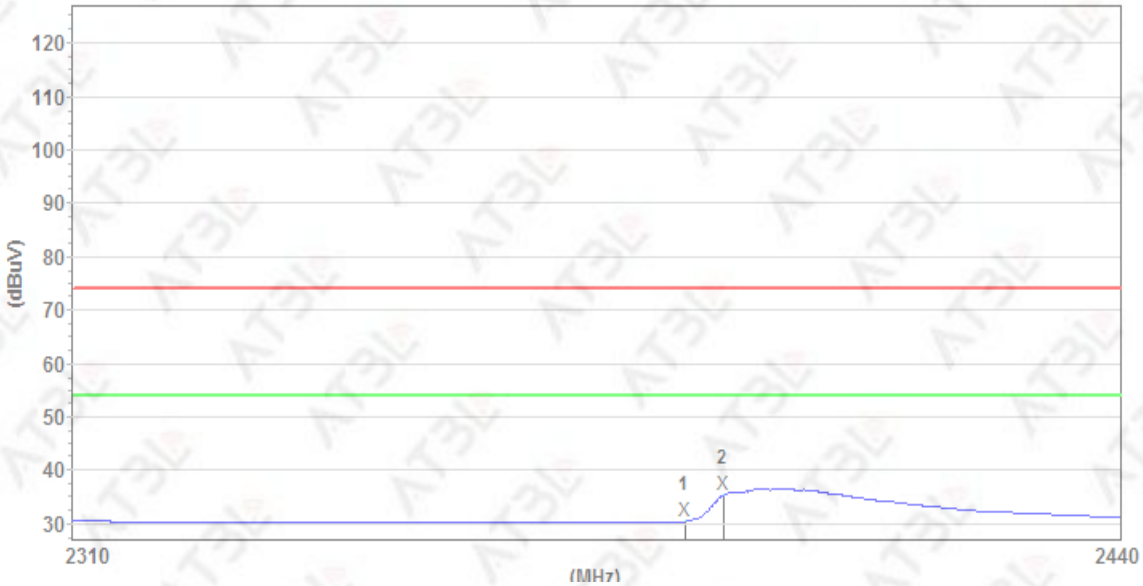
Vertical



Mk.	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.F/G. (dB/m)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
PK								
1	2382.052625	42.9	74.0	31.1	23.1	50.2	2.8	V
2	2390.000000	42.1	74.0	31.9	23.1	50.2	2.8	V

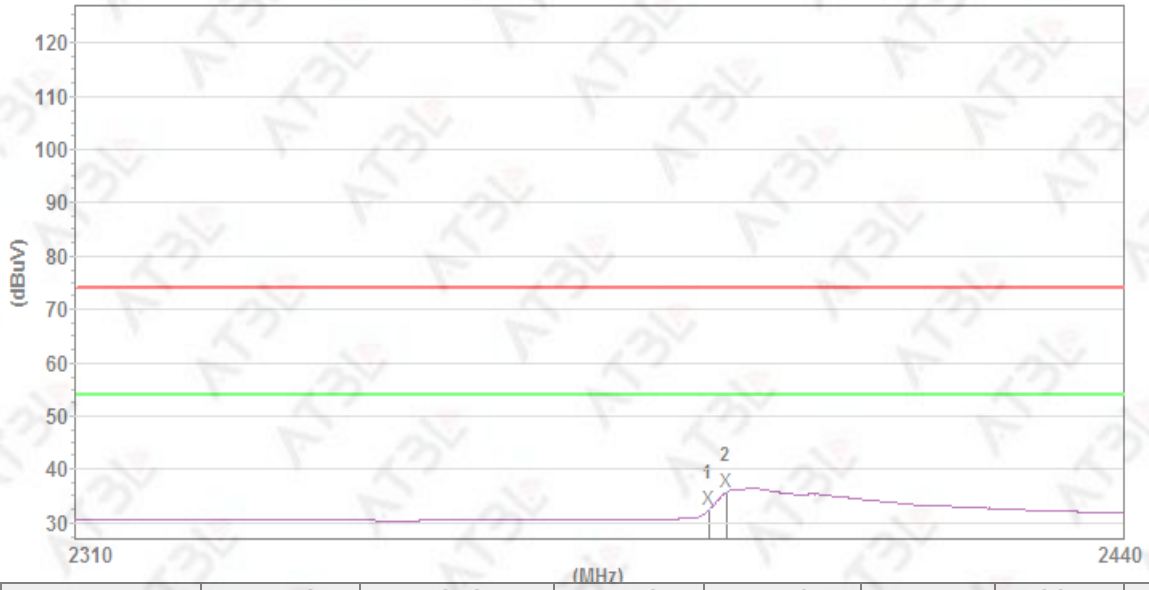
GFSK-Low

Horizontal



Mk.	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.F/G. (dB/m)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
AVG								
1	2385.054142	30.5	54.0	23.5	22.7	50.2	2.8	H
2	2390.000000	35.4	54.0	18.6	22.8	50.2	2.8	H

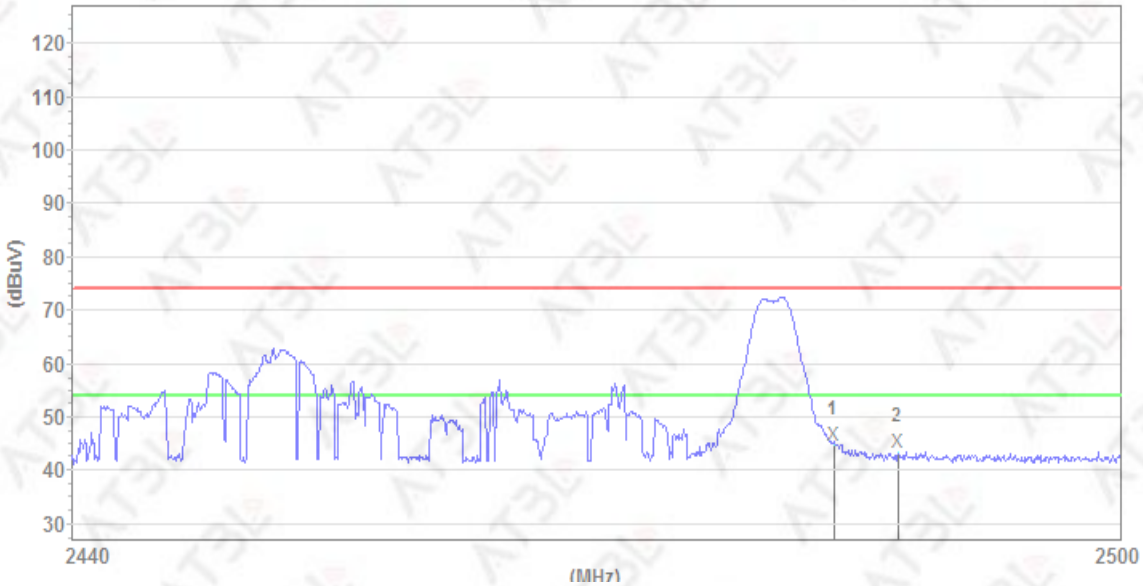
Vertical



Mk.	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.F/G. (dB/m)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
AVG								
1	2387.797961	32.6	54.0	21.4	23.1	50.2	2.8	V
2	2390.000000	35.8	54.0	18.2	23.1	50.2	2.8	V

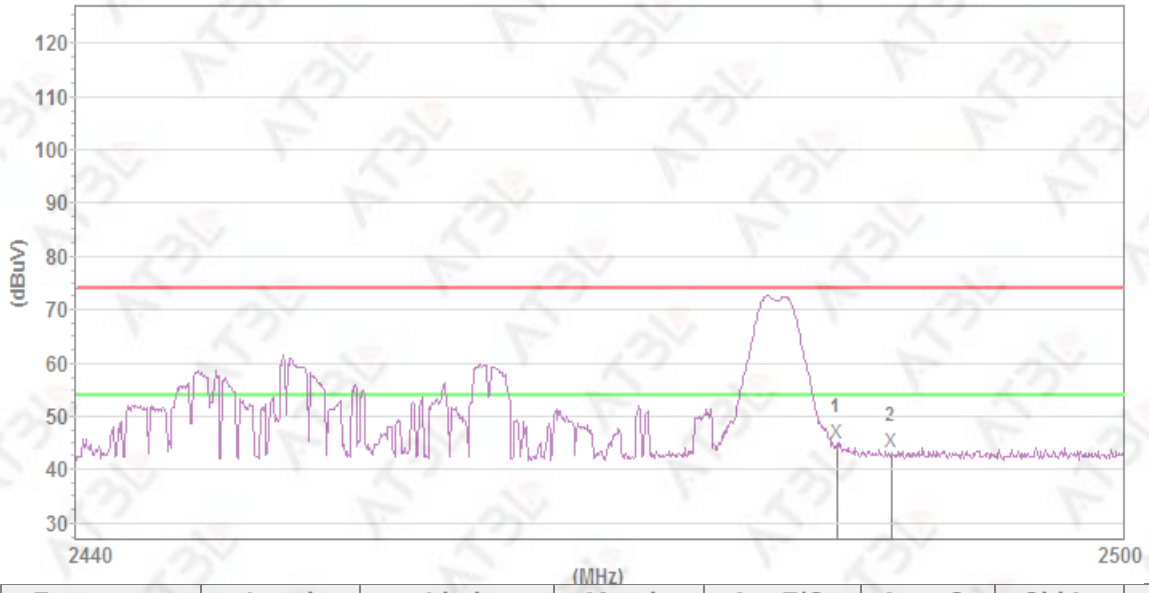
GFSK-High

Horizontal



Mk.	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.F/G. (dB/m)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
PK								
1	2483.500000	44.7	74.0	29.3	22.9	50.2	2.8	H
2	2487.157970	43.3	74.0	30.7	22.9	50.2	2.8	H

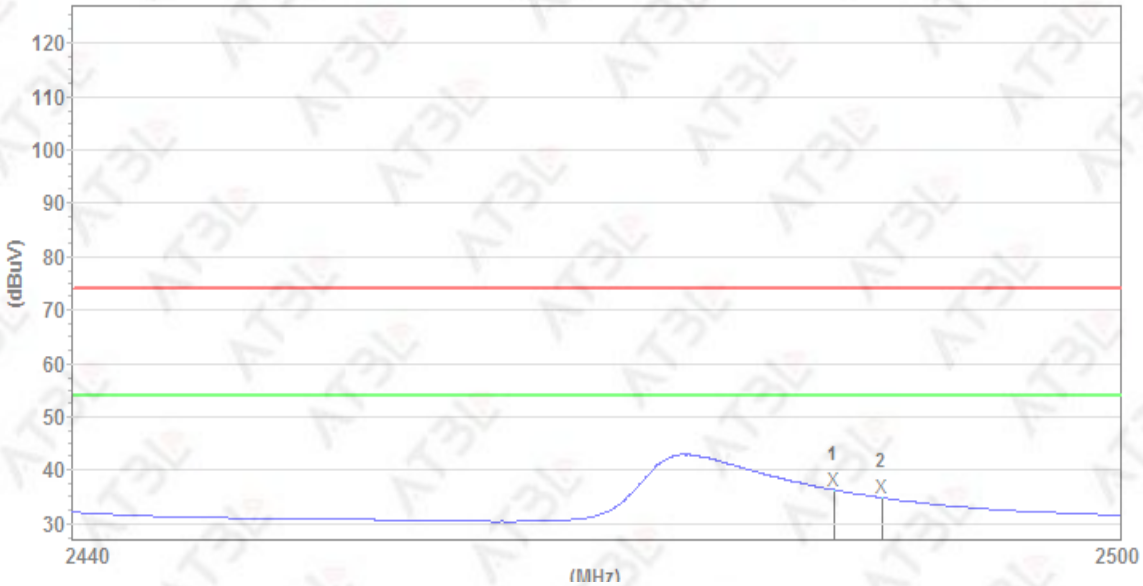
Vertical



Mk.	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.F/G. (dB/m)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
PK								
1	2483.500000	45.0	74.0	29.0	23.3	50.2	2.8	V
2	2486.553846	43.4	74.0	30.6	23.3	50.2	2.8	V

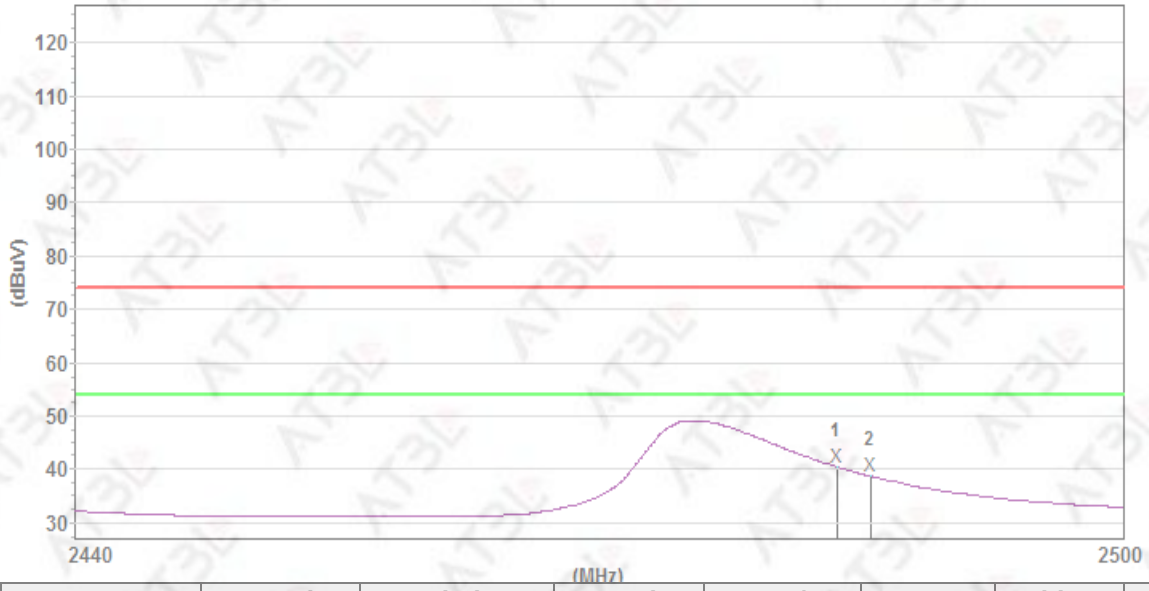
GFSK- High

Horizontal



Mk.	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.F/G. (dB/m)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
AVG								
1	2483.500000	36.3	54.0	17.7	22.9	50.2	2.8	H
2	2486.191442	34.9	54.0	19.1	22.9	50.2	2.8	H

Vertical



Mk.	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.F/G. (dB/m)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
AVG								
1	2483.500000	40.4	54.0	13.6	23.3	50.2	2.8	V
2	2485.406414	38.7	54.0	15.3	23.3	50.2	2.8	V

5. CONDUCTED SPURIOUS & BAND EDGE EMISSION

5.1 LIMIT

According to FCC section 15.247(d), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

5.2 TEST PROCEDURE

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	30 MHz to 10th carrier harmonic
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

For Band edge

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	Lower Band Edge: 2300 – 2407 MHz Upper Band Edge: 2475 – 2500 MHz
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

5.3 TEST SETUP

The EUT which is powered by the Battery, is connected to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50 Ohm; the path loss as the factor is calibrated to correct the reading. Make the measurement with the spectrum analyzer's resolution bandwidth(RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW.

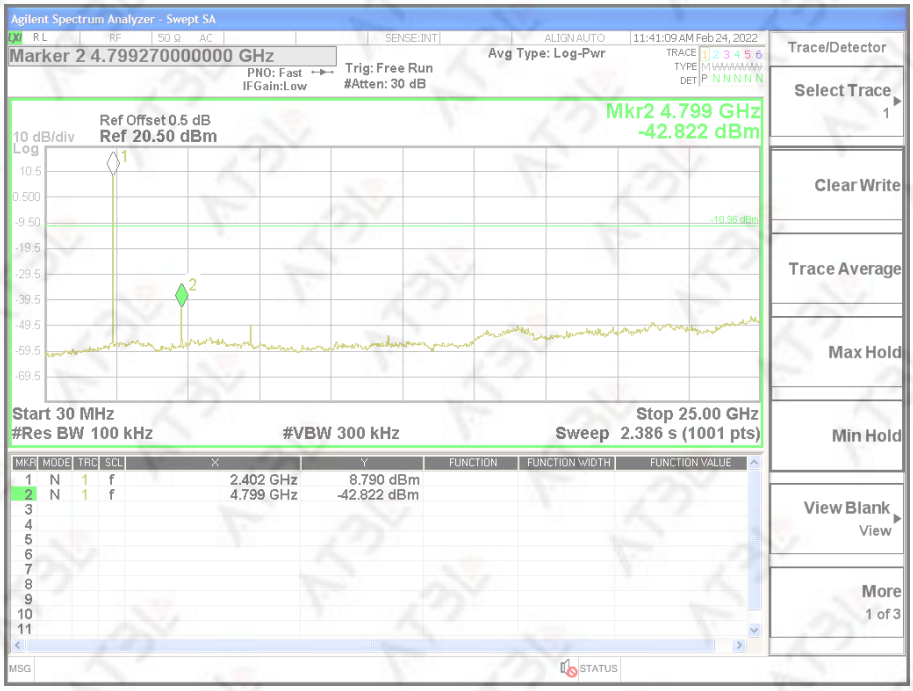
5.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

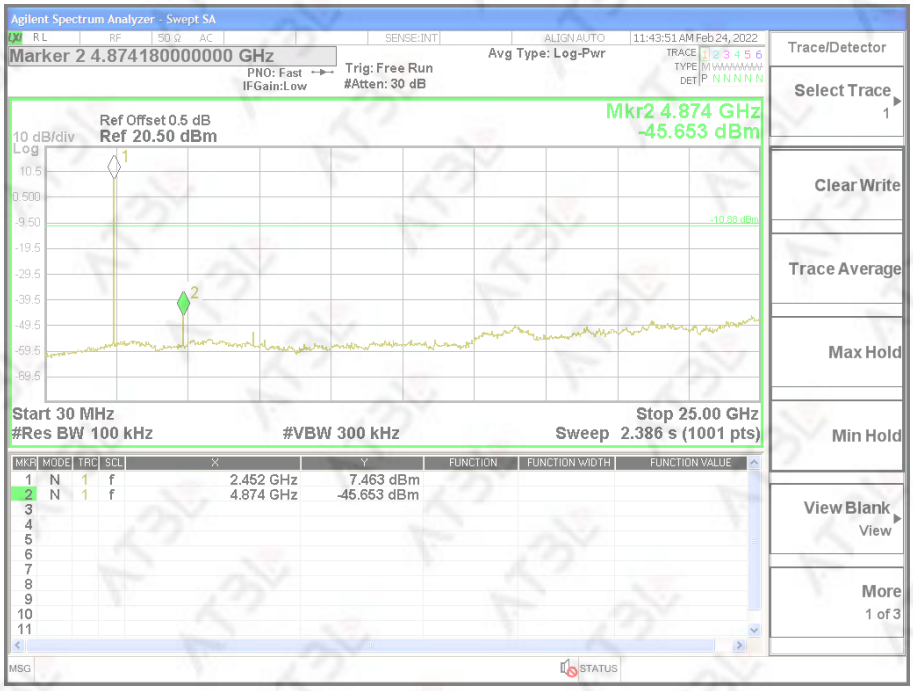
5.5 TEST RESULTS

Temperature:	25 ℃	Relative Humidity:	50%RH
Test Voltage:	AC120V	Test Mode:	TX Mode 1/2/3

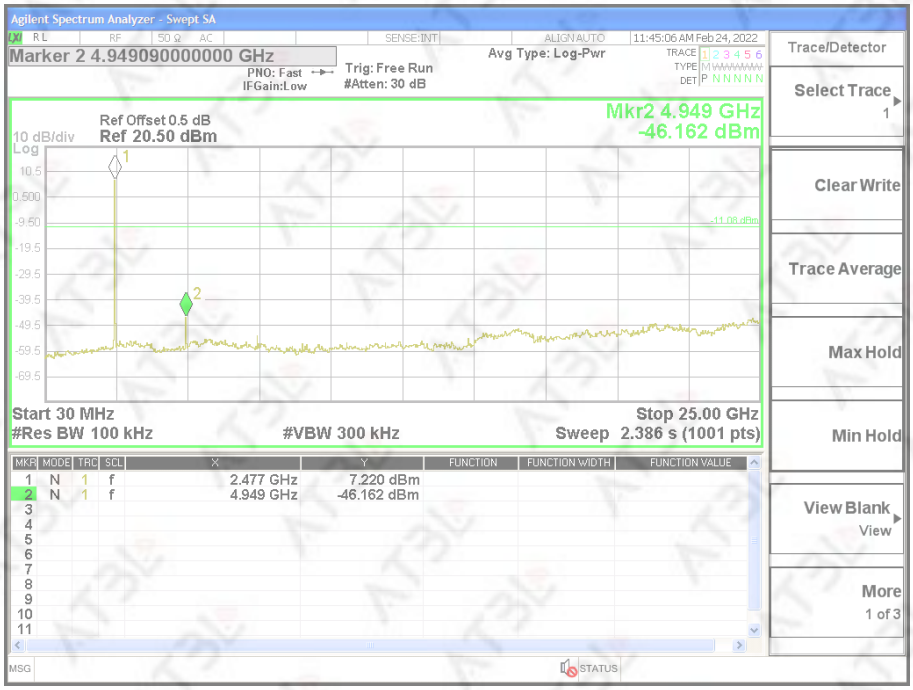
Mode1 CH11



Mode2 CH18

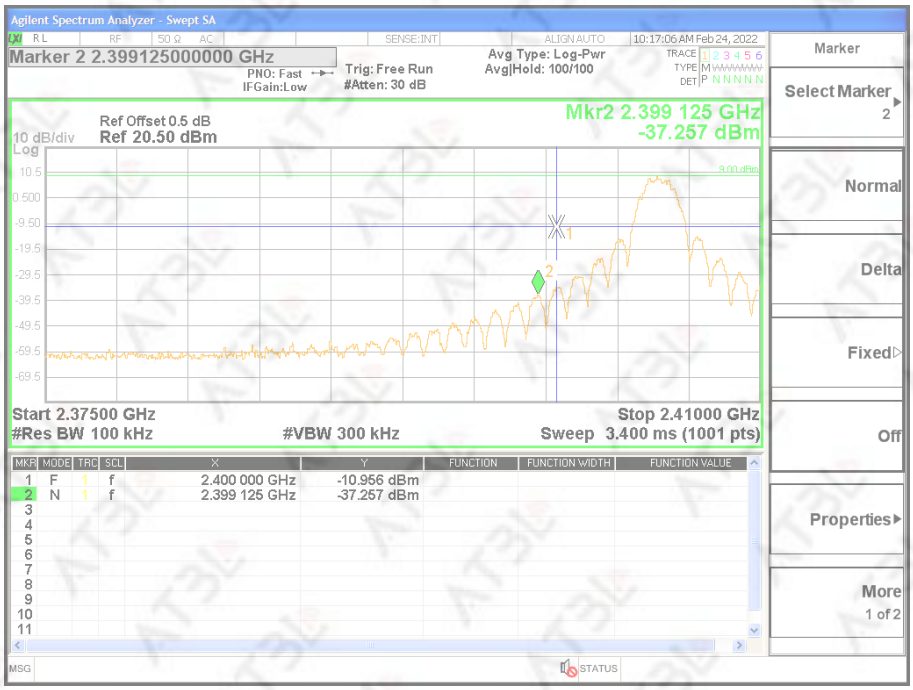


Mode3 CH26


Agilent Spectrum Analyzer - Swept SA
Marker 2 4.949090000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
11:45:06 AM Feb 24, 2022
Ref Offset 0.5 dB
10 dB/div
Ref 20.50 dBm
Mkr2 4.949 GHz
-46.162 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 2.386 s (1001 pts)
1 N 1 f 2.477 GHz 7.220 dBm
2 N 1 f 4.949 GHz -46.162 dBm
Trace/Detector
Select Trace
Clear Write
Trace Average
Max Hold
Min Hold
View Blank
More
1 of 3

For Band edge(it's also the reference level for conducted spurious emission)

Mode1 CH11



Mode3 CH26

6. POWER SPECTRAL DENSITY TEST

6.1 LIMIT

FCC Part 15.247,Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(e)	Power Spectral Density	≤8 dBm (RBW≥3KHz)	2400-2483.5	PASS

6.2 TEST PROCEDURE

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS channel bandwidth.
3. Set the RBW to: 100 kHz ≥ RBW ≥ 3 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

6.3 TEST SETUP

6.4 EUT OPERATION CONDITIONS

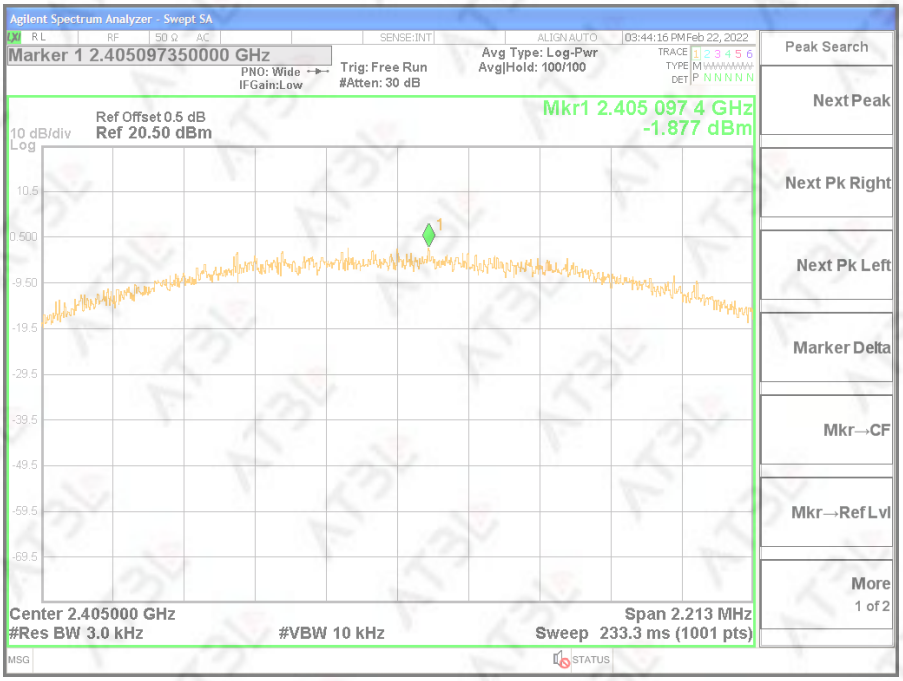
The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

6.5 TEST RESULTS

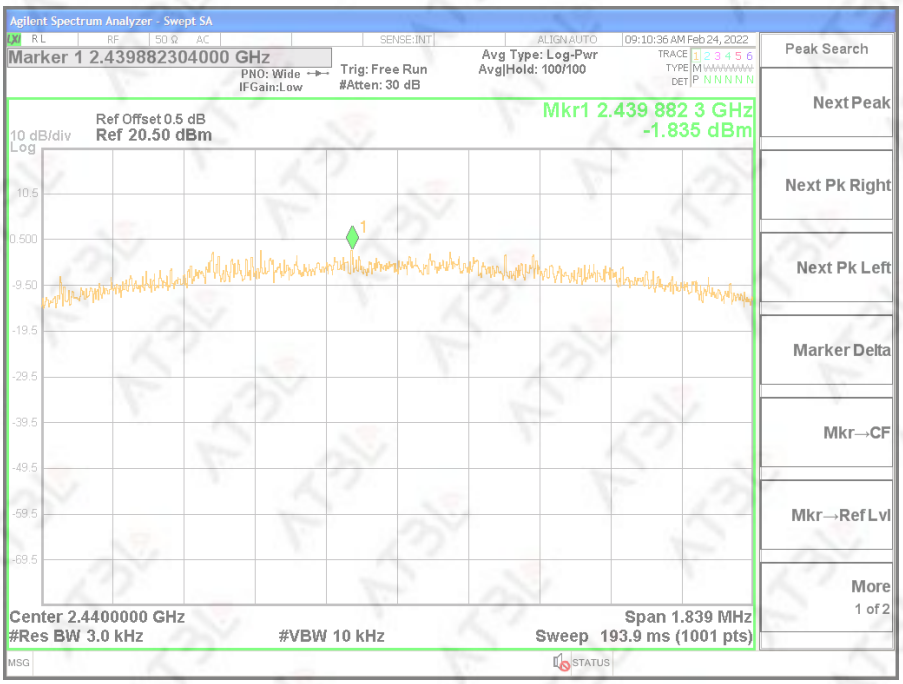
Temperature:	25 ℃	Relative Humidity:	60%RH
Test Voltage:	AC120V	Test Mode:	TX Mode1/2/3

Frequency	Power Density (dBm/3kHz)	Limit (3KHz/dBm)	Result
2405 MHz	-1.877	≤8	PASS
2440 MHz	-1.835	≤8	PASS
2480 MHz	-2.356	≤8	PASS

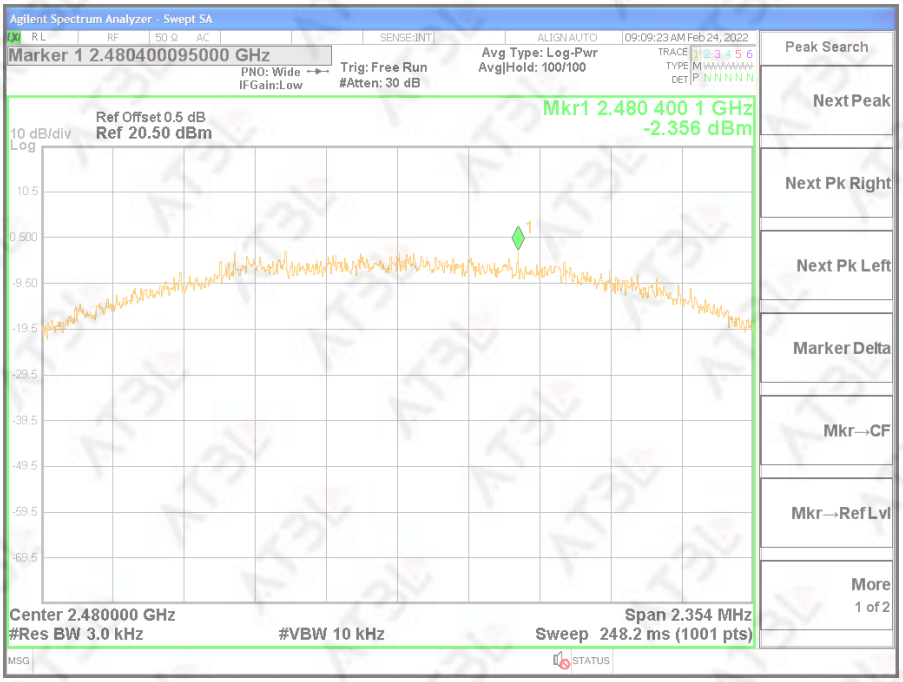
Mode1 CH11



Mode2 CH18



Mode3 CH26



7. BANDWIDTH TEST

7.1 LIMIT

FCC Part 15.247,Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(a)(2)	Bandwidth	>= 500KHz (6dB bandwidth)	2400-2483.5	PASS

7.2 TEST PROCEDURE

Connect the UUT to the spectrum analyser and use the following settings:

Center Frequency	The centre frequency of the channel under test
Detector	Peak
RBW	For 6 dB Bandwidth :100KHz For 99% Bandwidth :1% to 5% of the occupied bandwidth
VBW	For 6dB Bandwidth : ≥3 × RBW For 99% Bandwidth : approximately 3×RBW
Trace	Max hold
Sweep	Auto

Allow the trace to stabilize and measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB and 99% relative to the maximum level measured in the fundamental emission.

7.3 TEST SETUP

7.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

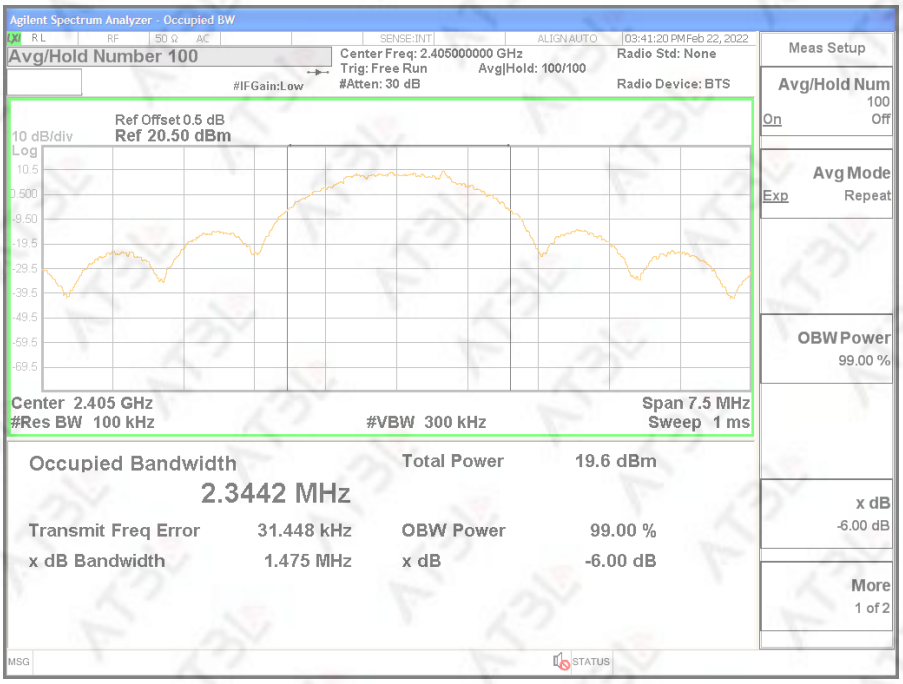
7.5 TEST RESULTS

Temperature:	25 ℃	Relative Humidity:	60%RH
Test Voltage:	AC120V	Test Mode:	TX Mode1/2/3

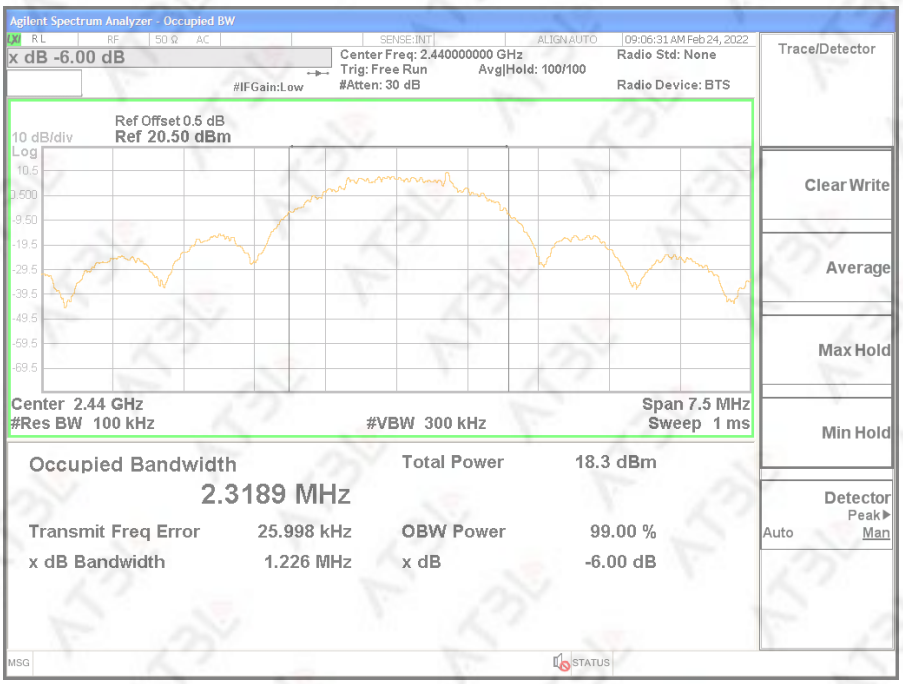
Frequency	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	6dB Bandwidth Limit(KHz)	Result
2405 MHz	1.475	2.344	≥500KHz	PASS
2440 MHz	1.226	2.319	≥500KHz	PASS
2480 MHz	1.569	2.344	≥500KHz	PASS

6dB Bandwidth & 99% Bandwidth

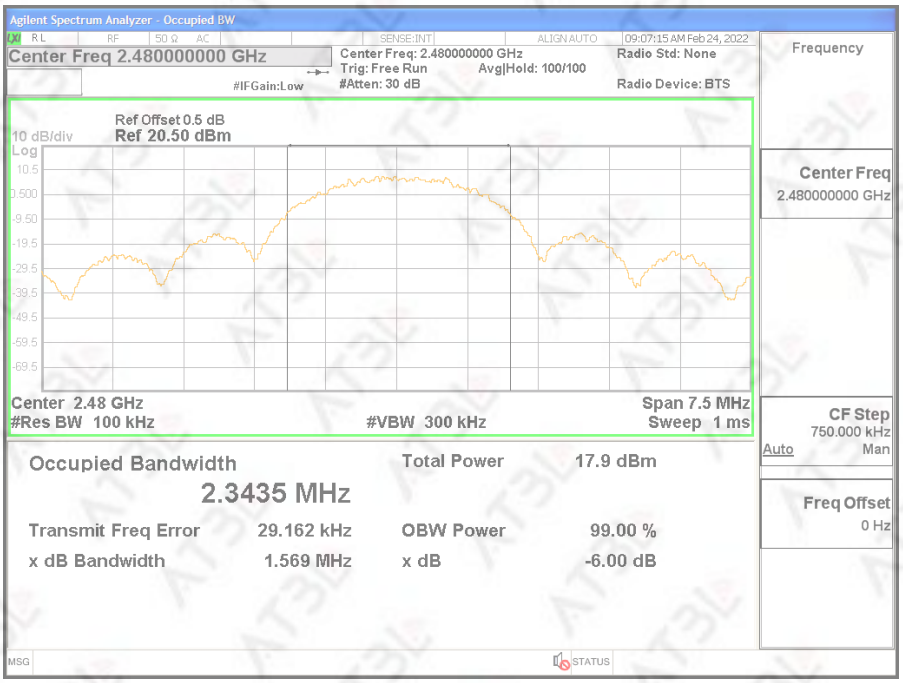
Mode1 CH11



Mode2 CH18



Mode3 CH26



8. PEAK OUTPUT POWER TEST

8.1 LIMIT

FCC Part 15.247,Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(b)(3)	Output Power	1 watt or 30dBm	2400-2483.5	PASS

8.2 TEST PROCEDURE

PKPM1 Peak power meter method:
The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall use a fast-responding diode detector.

8.3 TEST SETUP

8.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

8.5 TEST RESULTS

Temperature:	25 ℃	Relative Humidity:	60%RH
Test Voltage:	AC120V	Test Mode:	TX Mode1/2/3

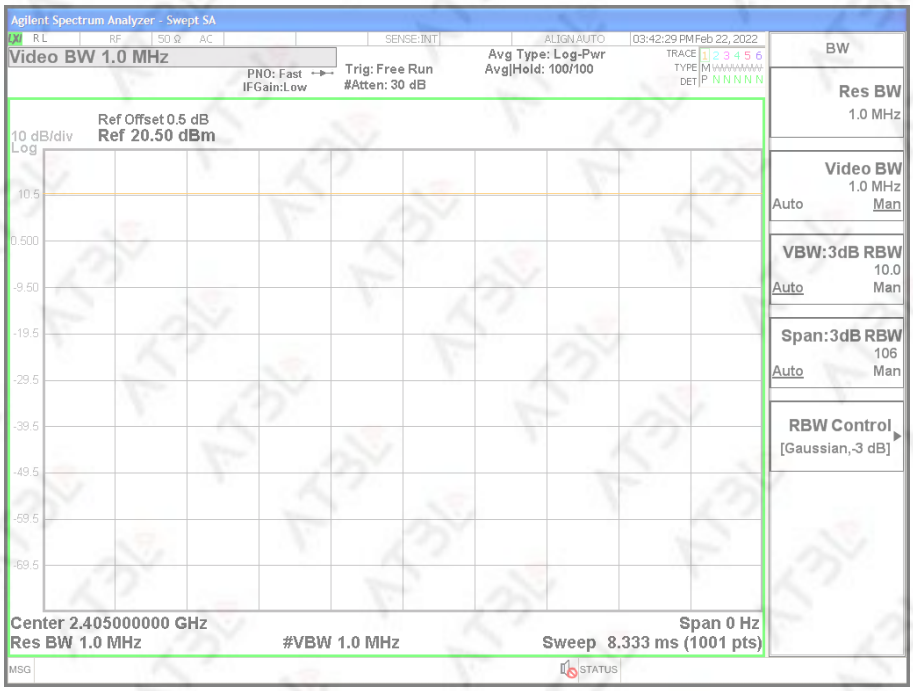
Test Channel	Frequency	Peak Conducted Output Power	Average Conducted Output Power	LIMIT
	(MHz)	(dBm)	(dBm)	dBm
CH11	2405	11.38	11.31	30
CH18	2440	11.10	11.04	30
CH26	2480	10.76	10.69	30

EIRP Power

Test Channe	Frequency	Peak Conducted Output Power	Antenna Gain	EIRP Power	LIMIT
	(MHz)	(dBm)	(dBi)	(dBm)	dBm
CH11	2405	11.38	2	13.38	36
CH18	2440	11.10	2	13.10	36
CH26	2480	10.76	2	12.76	36

Note: Our power sensor test AVG power has no duty cycle display. The power sensor measures AVG power is Burst power. The software has considered the factor of the duty cycle factor, so it is unnecessary to add it again.

Duty cycle



Ton	Tp	Duty cycle(%)	Duty factor(dB)
/	/	100	0

9. ANTENNA REQUIREMENT

9.1 STANDARD REQUIREMENT

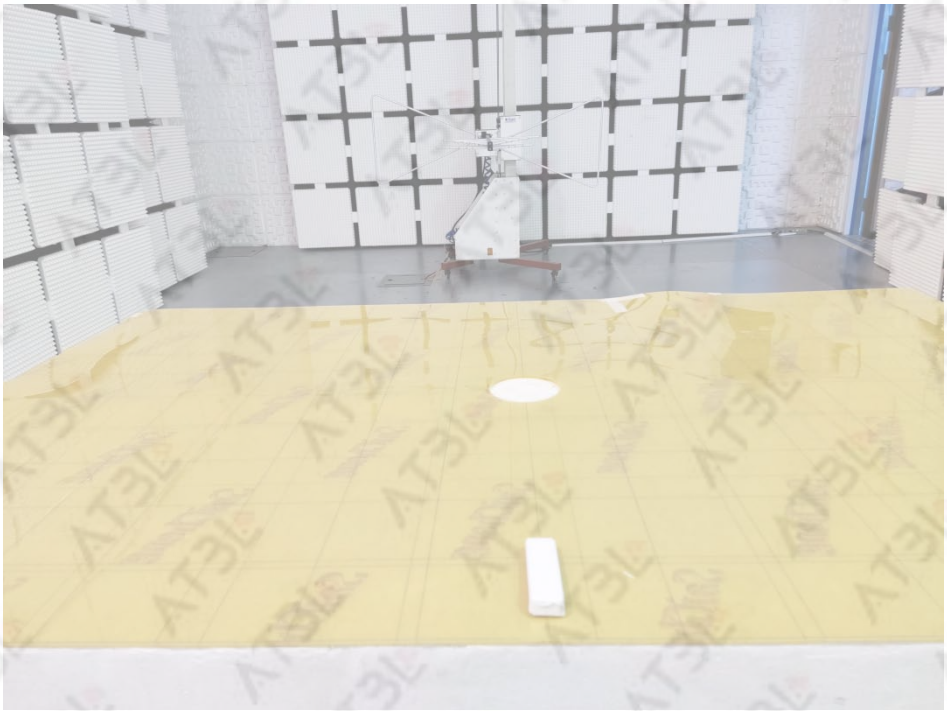
15.203 requirement: For intentional device, according to 15.203: an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

9.2 EUT ANTENNA

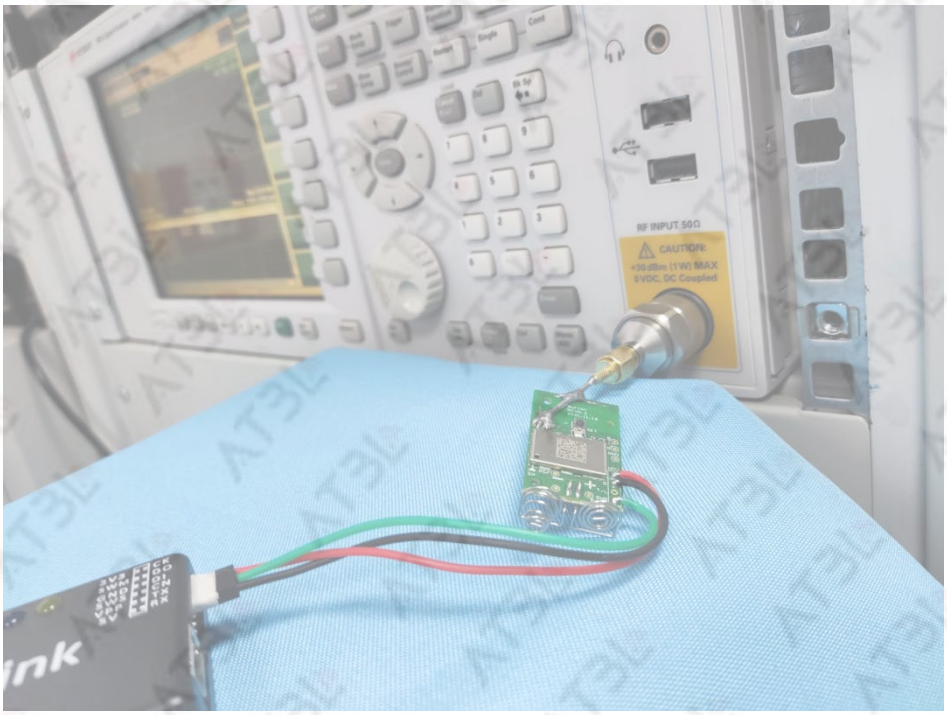
The EUT antenna is PCB Antenna. It comply with the standard requirement.

APPENDIX-PHOTOS OF TEST SETUP

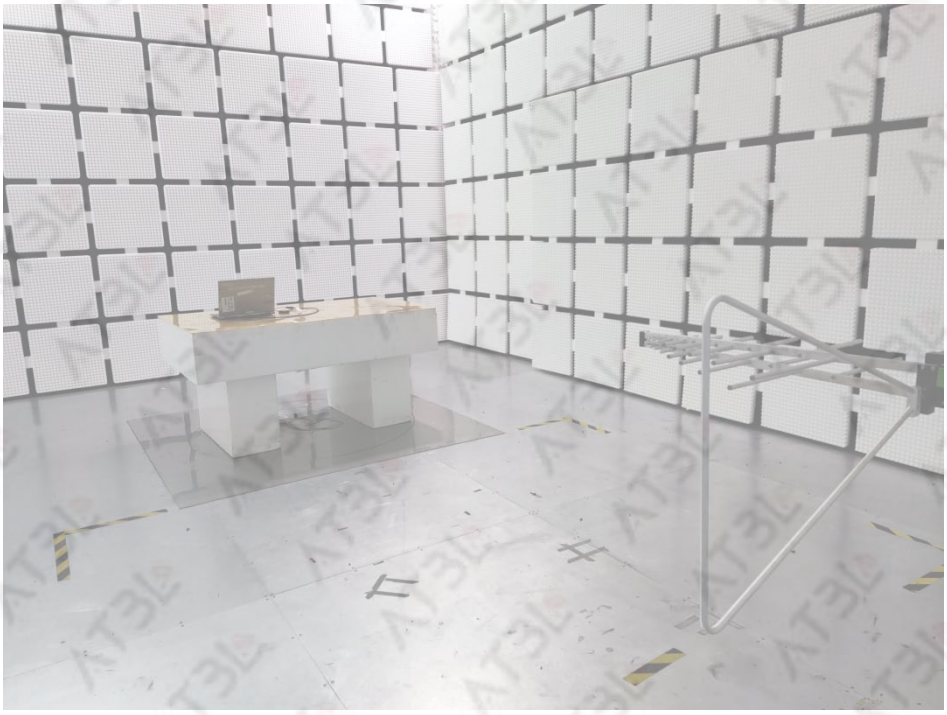
Radiation emission
30MHz-1GHz



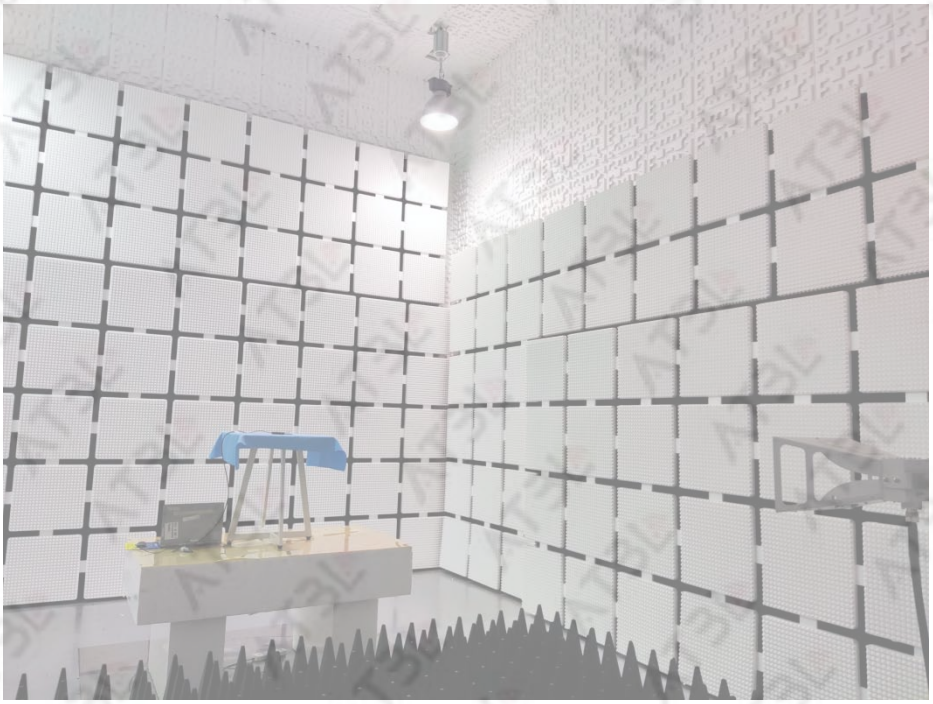
Conducted



RSE 30MHz-1000MHz



RSE 1GHz-18GHz



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