

# FCC TEST REPORT

## FCC ID: 2AT7B-T18PLUS

Product Name	:	Mini Air Mouse Remote Keyboard
Model Name	:	T18PLUS,T2, T18, T1, T1+, T5, T8, T9, T10, T11, T12, T15 , T16, T16+,T19, T20, MX3
Brand Name	:	N/A
Report No.	:	PTC19061102201E-FC01
<b>Prepared for</b>		
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<b>Prepared by</b>		
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## 1 TEST RESULT CERTIFICATION

Applicant's name : Shenzhen TYX Technology Co., Ltd.

Address : 2F, Building 11, TianFuAn Industria Area, Lezhujiao, Xixiang, Baoan, Shenzhen, 518102 China

Manufacture's name : Shenzhen TYX Technology Co., Ltd.

Address : 2F, Building 11, TianFuAn Industria Area, Lezhujiao, Xixiang, Baoan, Shenzhen, 518102 China

Product name : Mini Air Mouse Remote Keyboard

Model name : T18PLUS, T2, T18, T1, T1+, T5, T8, T9, T10, T11, T12, T15, T16, T16+, T19, T20, MX3

Brand Name : N/A

Standards : FCC CFR47 Part 15 Section 15.249

Test procedure : ANSI C63.10:2013

Test Date : July 09, 2019 to July 28, 2019

Date of Issue : July 29, 2019

Test Result : Pass

This device described above has been tested by PTC, and 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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## 2 Test Summary

Test Items	Test Requirement	Result
AC Power Conducted Emission	15.207	PASS
20dB Bandwidth	15.215(c)	PASS
Band edge	15.249 15.205	PASS
Field Strength of Fundamental Emissions	15.249(a)	PASS
Radiated Spurious Emissions	15.205(a) 15.249(a) (d)	PASS
Antenna Requirement	15.203	PASS

Remark:

N/A: Not Applicable



PRECISE TESTING

Report No.: PTC19061102201E-FC01

### **3 TEST FACILITY**

Dongguan Precise Testing & Certification Corp., Ltd.

Address: Building D, Baoding Technology Park, Guangming Road2, Dongcheng District, Dongguan,  
Guangdong, China

FCC Registration Number: 790290

A2LA Certificate No.: 4408.01

IC Registration Number: 12191A-1



## 4 General Information

### 4.1 General Description of E.U.T.

Product Name	: Mini Air Mouse Remote Keyboard
Model Name	: T18PLUS, T2, T18, T1, T1+, T5, T8, T9, T10, T11, T12, T15, T16, T16+, T19, T20, MX3
Operating frequency	: 2.402-2.480GHZ
Numbers of Channel	: 16
Channel Space	: 1MHz
Antenna Type:	: PCB Print Antenna
Antenna Gain:	: 0dBi
Type of Modulation	: GFSK
Power supply	: DC3.7V Battery



## 4.2 Test Mode

For Radiated: The EUT's antenna was pre-tested under the following modes:

Test Mode	Description
Mode A	X-Y axis
Mode B	Y-Z axis
Mode C	X-Z axis

From the above modes, the worst case was found in Mode A, Therefore only the test data of the mode was recorded in this report.

Channel List					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
01	2402	07	2436	13	2463
02	2407	08	2440	14	2466
03	2414	09	2441	15	2473
04	2419	10	2445	16	2480
05	2422	11	2453	----	----
06	2426	12	2459	----	----

Channel List:

The 3 channels of lower, middle and higher were chosen for test.

Channel	Frequency(MHz)
1	2402
2	2440
16	2480





## 5 Equipment During Test

### 5.1 Equipments List

RF Conducted Test

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
MXG Signal Analyzer	Agilent	N9020A	MY56070279	10Hz-30GHz	Sep.19, 2019
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	Sep.19, 2019
Antenna Connector	Florida RF Labs	N/A	RF01#	N/A	Sep.19, 2019

Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

Radiated Emissions

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
EMI Test Receiver	Rohde&Schwarz	ESCI	101417	9KHz-3GHz	Sep.19, 2019
Loop Antenna	Schwarzbeck	FMZB 1519	012	9 KHz -30MHz	Sep.19, 2019
Bilog Antenna	SCHWARZBECK	VULB9160	9160-3355	25MHz-2GHz	Sep.19, 2019
Preamplifier (low frequency)	SCHWARZBECK	BBV 9475	9745-0013	1MHz-1GHz	Sep.19, 2019
Cable	Schwarzbeck	PLF-100	549489	9KHz-3GHz	Sep.19, 2019
Spectrum Analyzer	Agilent	E4407B	MY45109572	9KHz-40GHz	Sep.19, 2019
Horn Antenna	SCHWARZBECK	9120D	9120D-1246	1GHz-18GHz	Sep.19, 2019
Power Amplifier	LUNAR EM	LNA1G18-40	J10100000081	1GHz-26.5GHz	Sep.19, 2019
Horn Antenna	SCHWARZBECK	BBHA 9170	9170-181	14GHz-40GHz	Sep.25, 2019
Amplifier	SCHWARZBECK	BBV 9721	9721-205	18GHz-40GHz	Sep.19, 2019
Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	Sep.19, 2019
RF Cable	R&S	R204	R21X	1GHz-40GHz	Sep.19, 2019



## Conducted Emissions

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
EMI Test Receiver	Rohde&Schwarz	ESCI	101417	9KHz-3GHz	Sep.19, 2019
Artificial Mains Network	Rohde&Schwarz	L2-16B	000WX31025	9KHz-300MHz	Sep.19, 2019
Artificial Mains Network	Rohde&Schwarz	ENV216	101342	9KHz-300MHz	Sep.19, 2019



## 5.2 Measurement Uncertainty

Parameter	Uncertainty
RF output power, conducted	$\pm 1.0\text{dB}$
Power Spectral Density, conducted	$\pm 2.2\text{dB}$
Radio Frequency	$\pm 1 \times 10^{-6}$
Bandwidth	$\pm 1.5 \times 10^{-6}$
Time	$\pm 2\%$
Duty Cycle	$\pm 2\%$
Temperature	$\pm 1^{\circ}\text{C}$
Humidity	$\pm 5\%$
DC and low frequency voltages	$\pm 3\%$
Conducted Emissions (150kHz~30MHz)	$\pm 3.64\text{dB}$
Radiated Emission(30MHz~1GHz)	$\pm 5.03\text{dB}$
Radiated Emission(1GHz~25GHz)	$\pm 4.74\text{dB}$
Remark: The coverage Factor (k=2), and measurement Uncertainty for a level of Confidence of 95%	



### 5.3 Description of Support Units

Equipment	Model No.	Series No.
Adapter	NSA12UH-050200 Input: AC 100-240V, 50/60Hz, 0.5A Output: DC 5V, 2A	N/A



## 6 Conducted Emission

Test Requirement: : FCC CFR 47 Part 15 Section 15.207  
Test Method: : ANSI C63.10:2013  
Test Result: : PASS  
Frequency Range: : 150kHz to 30MHz  
Class/Severity: : Class B  
Detector: : Peak for pre-scan (9kHz Resolution Bandwidth)

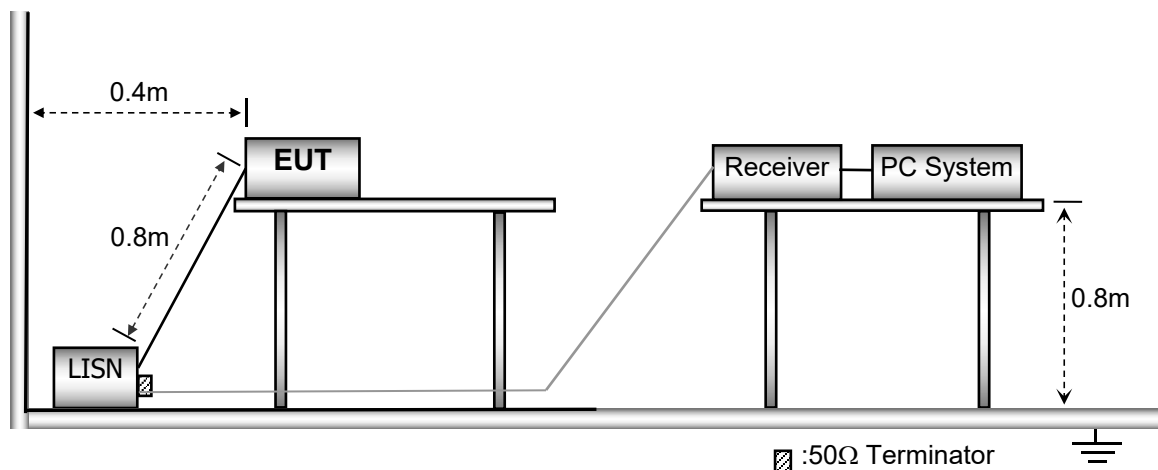
### 6.1 E.U.T. Operation

Operating Environment :

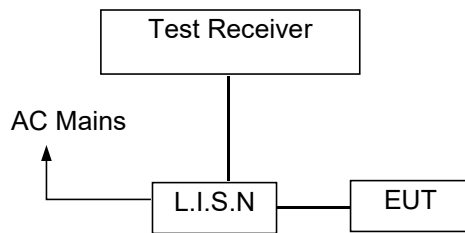
Temperature: : 25.5 °C  
Humidity: : 51 % RH  
Atmospheric Pressure: : 101.2kPa  
EUT Operation : : Refer to section 3.3  
Test Voltage : : AC 120V/60Hz

### 6.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10: 2013



### 6.3 Test SET-UP (Block Diagram of Configuration)



### 6.4 Measurement Procedure:

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured was complete.

### 6.5 Conducted Emission Limit

#### Conducted Emission

Frequency(MHz)	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

#### Note:

1. The lower limit shall apply at the transition frequencies
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

### 6.6 Measurement Description

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

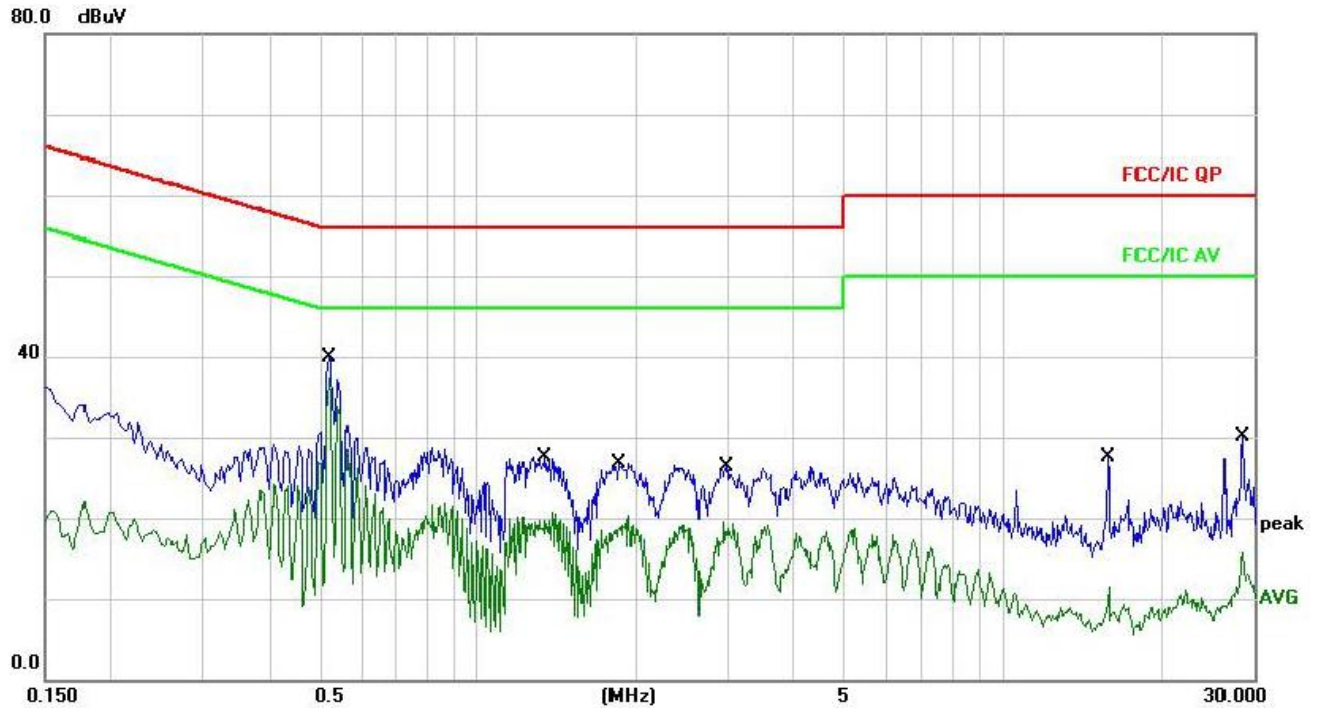
### 6.7 Conducted Emission Test Result

Pass

Please find the following pages.



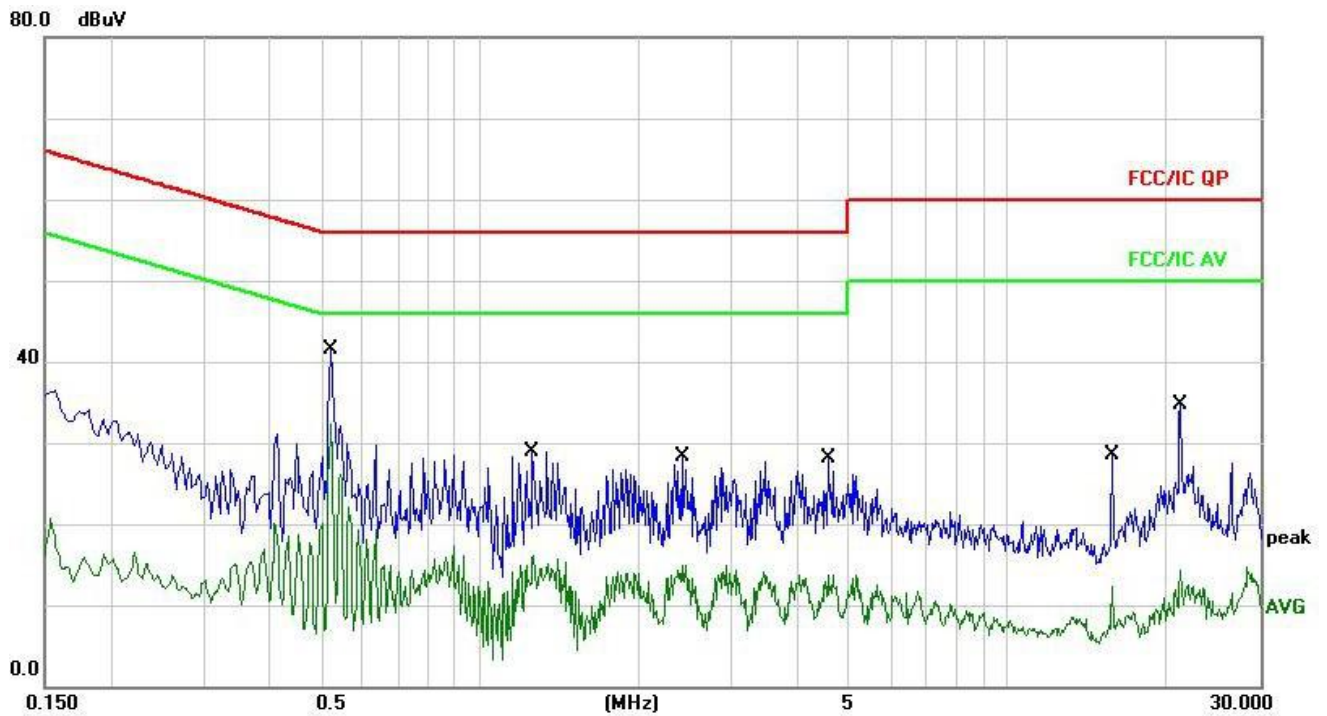
Line -120V/60Hz:



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.5220	30.14	9.68	39.82	56.00	-16.18	QP	
2	*	0.5220	27.52	9.68	37.20	46.00	-8.80	AVG	
3		1.3420	17.78	9.70	27.48	56.00	-28.52	QP	
4		1.3420	11.01	9.70	20.71	46.00	-25.29	AVG	
5		1.8500	16.95	9.71	26.66	56.00	-29.34	QP	
6		1.8500	10.66	9.71	20.37	46.00	-25.63	AVG	
7		2.9340	16.64	9.72	26.36	56.00	-29.64	QP	
8		2.9340	9.71	9.72	19.43	46.00	-26.57	AVG	
9		15.8660	17.70	9.87	27.57	60.00	-32.43	QP	
10		15.8660	1.61	9.87	11.48	50.00	-38.52	AVG	
11		28.5340	20.29	9.86	30.15	60.00	-29.85	QP	
12		28.5340	5.94	9.86	15.80	50.00	-34.20	AVG	



Neutral -120V/60Hz:



No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over		
		MHz	Level	Factor	ment			Detector	Comment
1		0.5220	31.74	9.68	41.42	56.00	-14.58	QP	
2	*	0.5220	22.65	9.68	32.33	46.00	-13.67	AVG	
3		1.2620	19.26	9.70	28.96	56.00	-27.04	QP	
4		1.2620	6.40	9.70	16.10	46.00	-29.90	AVG	
5		2.4100	18.52	9.72	28.24	56.00	-27.76	QP	
6		2.4100	5.24	9.72	14.96	46.00	-31.04	AVG	
7		4.5580	18.43	9.73	28.16	56.00	-27.84	QP	
8		4.5580	4.05	9.73	13.78	46.00	-32.22	AVG	
9		15.7420	18.65	9.87	28.52	60.00	-31.48	QP	
10		15.7420	2.35	9.87	12.22	50.00	-37.78	AVG	
11		21.1820	24.83	9.84	34.67	60.00	-25.33	QP	
12		21.1820	4.38	9.84	14.22	50.00	-35.78	AVG	





## 7 Field Strength of Fundamental Emission and Radiated Spurious Emissions

Test Requirement: : FCC CFR47 Part 15 Section 15.209 & 15.249  
 Test Method: : ANSI C63.10:2013  
 Test Result: : PASS  
 Measurement Distance: : 3m  
 Limit: : See the follow table

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	$2400/F(\text{kHz})$	300	$10000 * 2400/F(\text{kHz})$	$20\log^{(2400/F(\text{kHz}))} + 80$
0.490 ~ 1.705	$24000/F(\text{kHz})$	30	$100 * 24000/F(\text{kHz})$	$20\log^{(24000/F(\text{kHz}))} + 40$
1.705 ~ 30	30	30	$100 * 30$	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

Note: 1. Emission level in dBuV/m =  $20 \log (\text{uV/m})$

2. Measurement was performed at an antenna to the closed point of EUT distance of meters.

The field strength of emission from intentional radiators operated within these frequency bands shall comply with the following:

Frequency(MHz)	Filed Strength of Fundamental(at 3m)		Filed Strength of Harmonics(at 3m)	
	PEAK	AVERAGE	PEAK	AVERAGE
902-928	114	94	74.0	54.0
2400-2483.5	114	94	74.0	54.0
5725-5875	114	94	74.0	54.0
24000-24250	128	108	88.0	68.0



## 7.1 EUT Operation

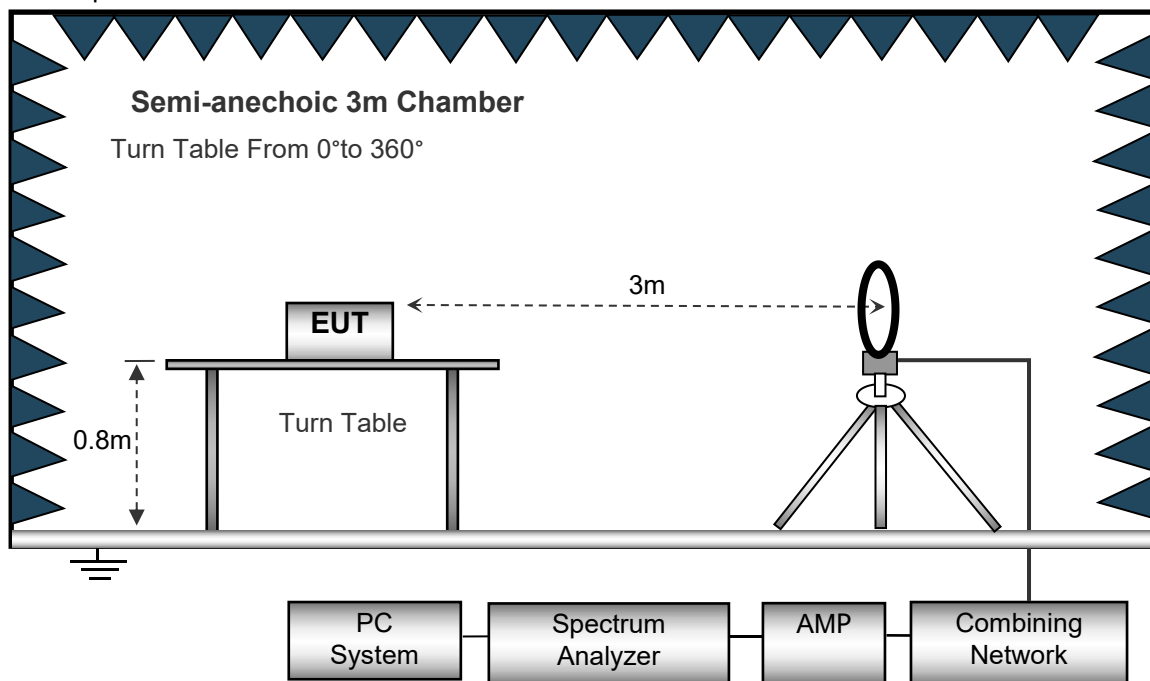
Operating Environment :

Temperature:	: 23.5 °C
Humidity:	: 51.1 % RH
Atmospheric Pressure:	: 101.2kPa
EUT Operation :	: Refer to section 3.3
Test Voltage	: DC 3.7V

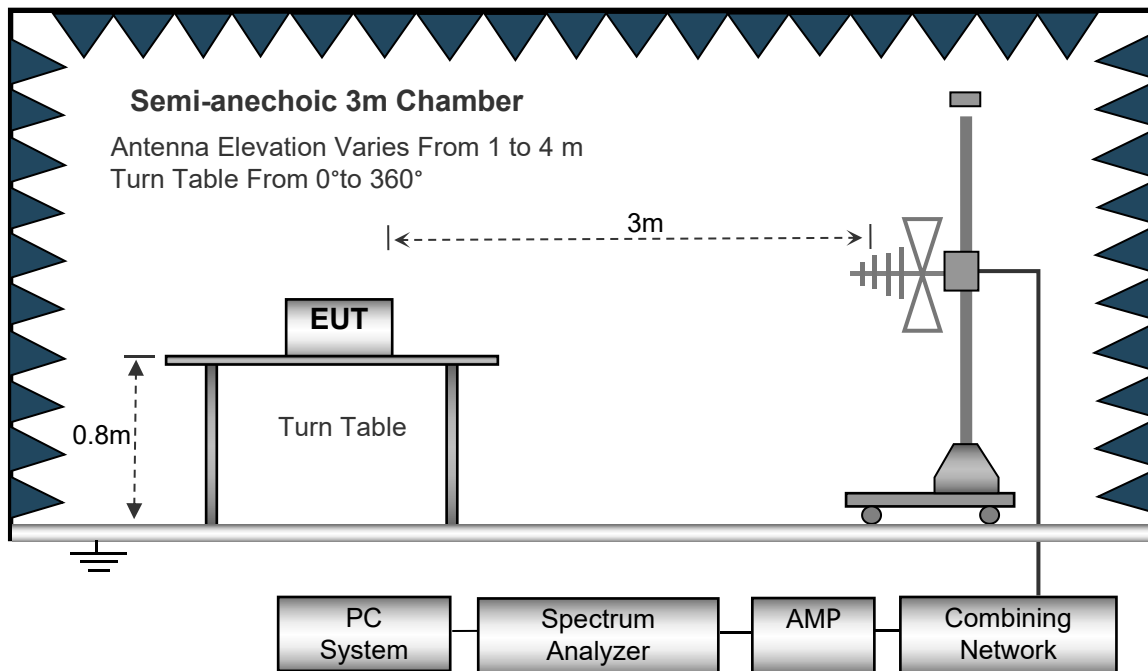
## 7.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site

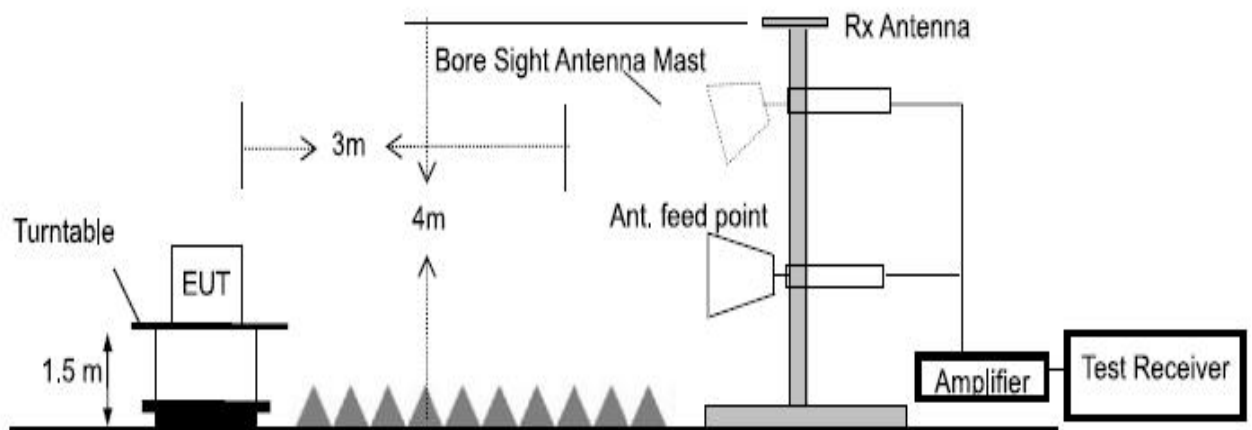
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz.





### 7.3 Spectrum Analyzer Setup

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (emission in restricted band)	1 MHz / 1 MHz for Peak, 1 MHz / 10Hz for Average

Receiver Parameter	Setting
Attenuation	Auto
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



## 7.4 Test Procedure

1. The testing follows the guidelines in Spurious Radiated Emissions of ANSI C63.10-2013.
2. Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 1.5m above ground plane.
3. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (From 1m to 4m) and turntable (from 0 degree to 360 degree) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Final measurement (Above 1GHz): The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1MHz. The measurement will be performed in horizontal and vertical polarization of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 degree to 360 degree in order to have the antenna inside the cone of radiation.
7. Test Procedure of measurement (For Above 1GHz):
  - 1) Monitor the frequency range at horizontal polarization and move the antenna over all sides of the EUT(if necessary move the EUT to another orthogonal axis).
  - 2) Change the antenna polarization and repeat 1) with vertical polarization.
  - 3) Make a hardcopy of the spectrum.
  - 4) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
  - 5) Change the analyser mode to Clear/ Write and found the cone of emission.
  - 6) Rotate and move the EUT, so that the measuring distance can be enlarged to 3m and the antenna will be still inside the cone of emission.
  - 7) Measure the level of the detected frequency with the correct resolution bandwidth, with the antenna polarization and azimuth and the peak and average detector, which causes the maximum emission.
  - 8) Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beamwidth.
7. The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.



## **7.5 Summary of Test Results**

### **Test Frequency: Below 30MHz**

The measurements were more than 20 dB below the limit and not reported.

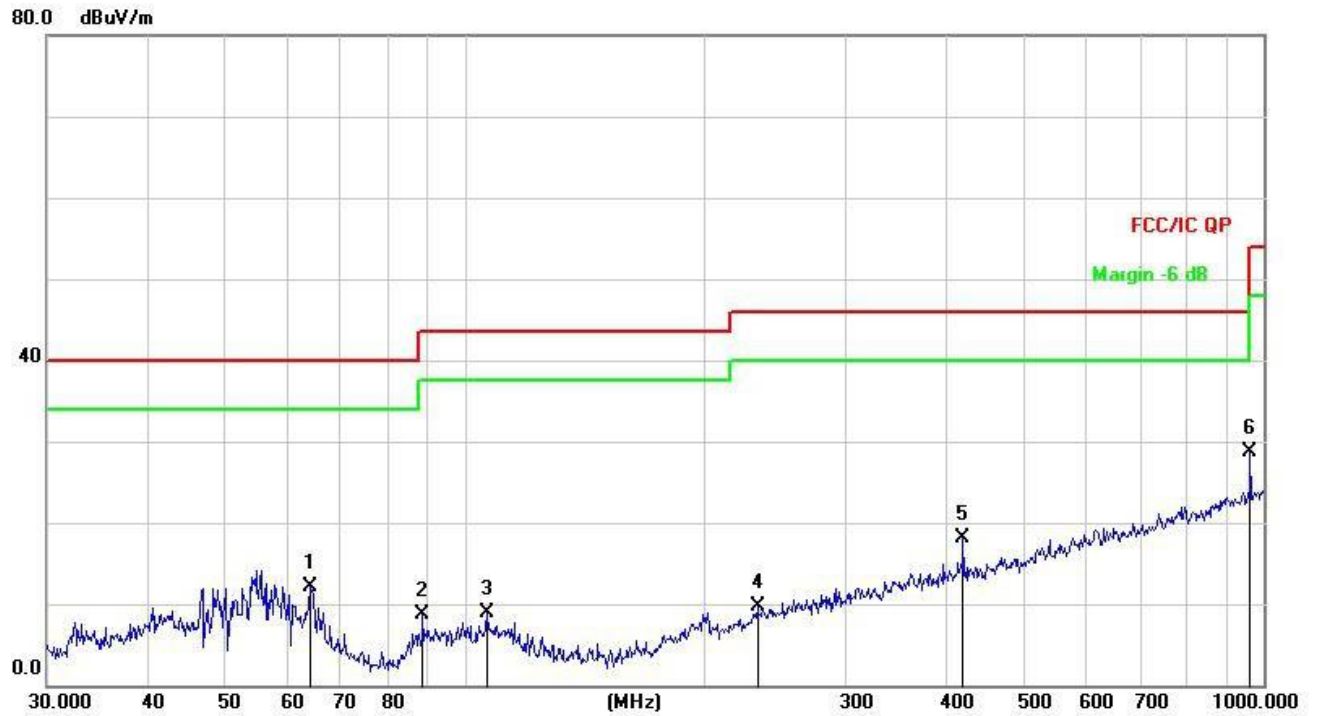
The low frequency, which started from 9KHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

### **Test Frequency: 30MHz ~ 1GHz**

Remark: only the worst data were reported(CH01: 2402MHZ).



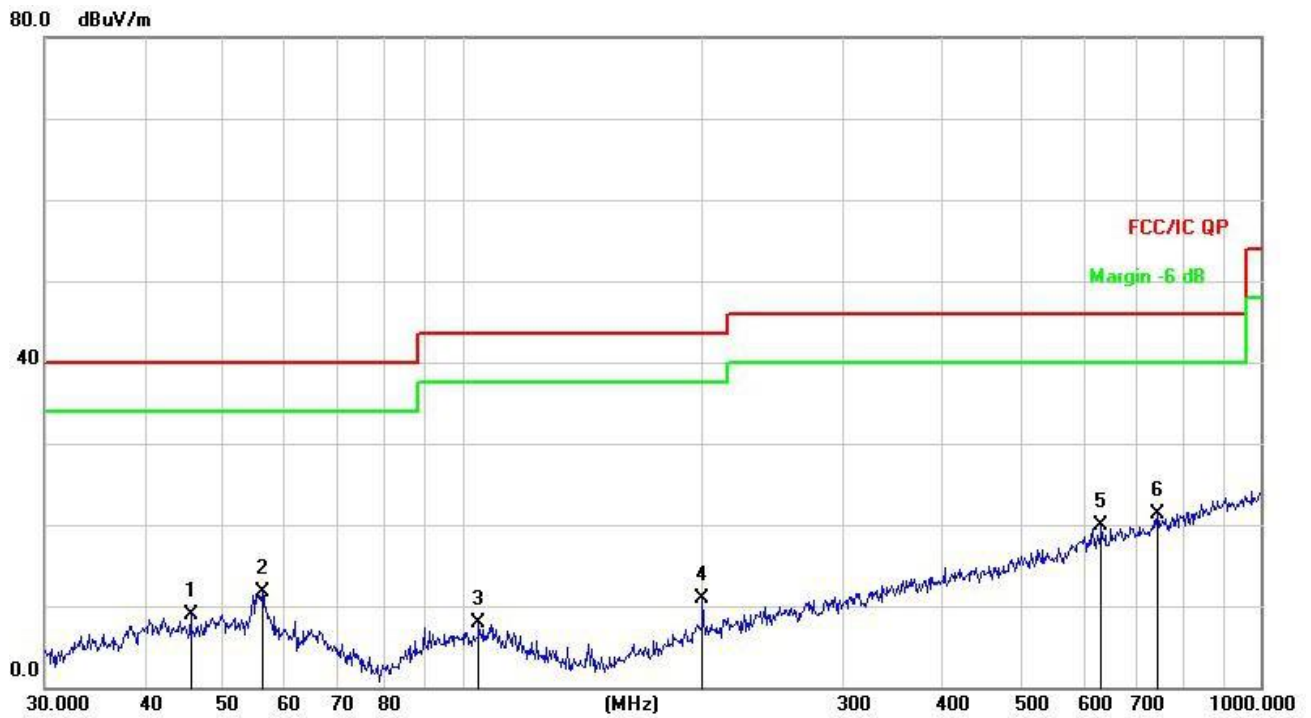
Test plot for Horizontal: 2402MHz



No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Antenna	Table	
		MHz	Level	Factor	ment			Height	Degree	
			dBuV	dB	dBuV/m	dB/m	dB	Detector	cm	degree
1		64.2074	28.85	-16.66	12.19	40.00	-27.81	QP		
2		88.6524	27.35	-18.57	8.78	43.50	-34.72	QP		
3		106.7587	25.08	-16.27	8.81	43.50	-34.69	QP		
4		232.5318	24.22	-14.45	9.77	46.00	-36.23	QP		
5		420.5803	26.87	-8.83	18.04	46.00	-27.96	QP		
6	*	962.1623	27.28	1.43	28.71	54.00	-25.29	QP		



Test plot for Vertical: 2402MHz



No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Antenna	Table
		MHz	Level	Factor	ment			Height	Degree
			dBuV	dB	dBuV/m	dB/m	dB	cm	degree
1		45.6948	23.64	-14.77	8.87	40.00	-31.13	QP	
2		56.1974	27.12	-15.43	11.69	40.00	-28.31	QP	
3		104.9033	24.11	-16.17	7.94	43.50	-35.56	QP	
4		199.9856	26.50	-15.63	10.87	43.50	-32.63	QP	
5		631.6884	23.98	-4.12	19.86	46.00	-26.14	QP	
6	*	742.2587	23.27	-1.96	21.31	46.00	-24.69	QP	





**Above 1000MHz-10<sup>th</sup> Harmonics:**

	Freq.	Receiver Reading	Detector	Polar	Corrected Factor	Emission Level	Limit	Margin	Result
	(MHz)	(dBμV)	(PK/QP/Ave)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
<b>Lower Channel 2402MHz</b>	2402	86.25	PK	H	13.85	100.10	114	-13.90	Pass
	2402	67.96	Ave	H	13.85	81.81	94	-12.19	Pass
	4804	47.32	PK	H	19.33	66.65	74	-7.35	Pass
	4804	24.27	Ave	H	19.33	43.60	54	-10.40	Pass
	2402	85.37	PK	V	13.85	99.22	114	-14.78	Pass
	2402	67.42	Ave	V	13.85	81.27	94	-12.73	Pass
	4804	46.66	PK	V	19.33	65.99	74	-8.01	Pass
	4804	25.51	Ave	V	19.33	44.84	54	-9.16	Pass
	2440	85.28	PK	H	13.94	99.22	114	-14.78	Pass
	2440	67.13	Ave	H	13.94	81.07	94	-12.93	Pass
<b>Middle Channel 2440MHz</b>	4880	45.74	PK	H	19.43	65.17	74	-8.83	Pass
	4880	27.55	Ave	H	19.43	46.98	54	-7.02	Pass
	2440	86.02	PK	V	13.94	99.96	114	-14.04	Pass
	2440	68.35	Ave	V	13.94	82.29	94	-11.71	Pass
	4880	46.06	PK	V	19.43	65.49	74	-8.51	Pass
	4880	26.34	Ave	V	19.43	45.77	54	-8.23	Pass



<b>Upper Channel 2480MHz</b>	2480	85.73	PK	H	14.02	99.75	114	-14.25	Pass
	2480	67.37	Ave	H	14.02	81.39	94	-12.61	Pass
	4960	43.23	PK	H	19.51	62.74	74	-11.26	Pass
	4960	25.76	Ave	H	19.51	45.27	54	-8.73	Pass
	2480	84.89	PK	V	14.02	98.91	114	-15.09	Pass
	2480	68.33	Ave	V	14.02	82.35	94	-11.65	Pass
	4960	42.52	PK	V	19.51	62.03	74	-11.97	Pass
	4960	25.26	Ave	V	19.51	44.77	54	-9.23	Pass

## 8 BAND EDGE EMISSION

### 8.1 TEST PROCEDURE

The EUT was placed on a styrofoam table which is 1.5m above ground plane.

The measurement procedure at the band edges was simplified by performing the measurement in just one plot. Both, the in-band-emission and the unwanted emission were encompassed by the span. After trace stabilization, the maximum peak was determined by a peak detector and the value was marked by an appropriate limit line. The second limit line, which is 20dB below the first, marks the limit for the emissions in the unrestricted band. A maximum-peak-detector marks the highest emission in the unrestricted band next to the band edge.

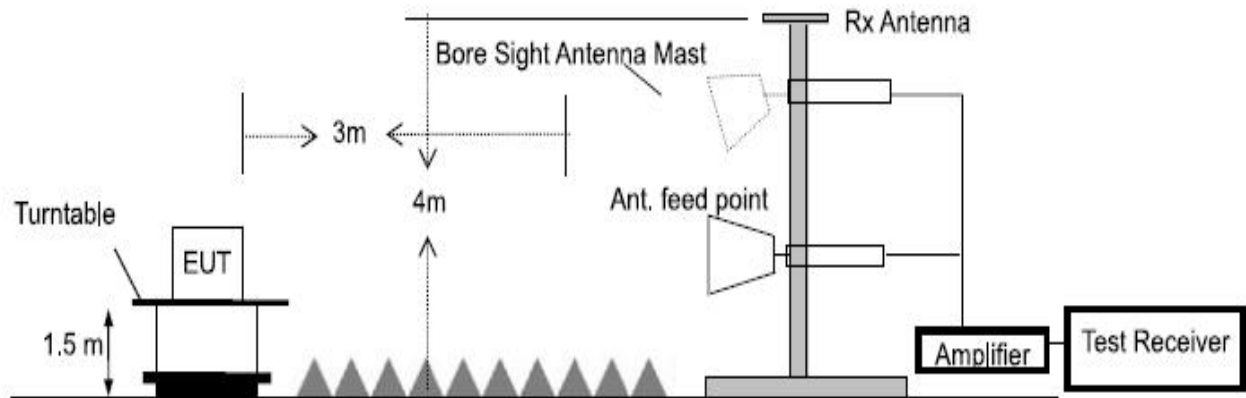
The measurements were performed at the lower end of the 2.4GHz band.

Use the following spectrum analyzer settings:

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 3MHz:

EMI Test Receiver	Setting
Attenuation	Auto
RBW	1MHz
VBW	3MHz
Detector	Peak
Trace	Max hold

### 8.2 TEST SETUP



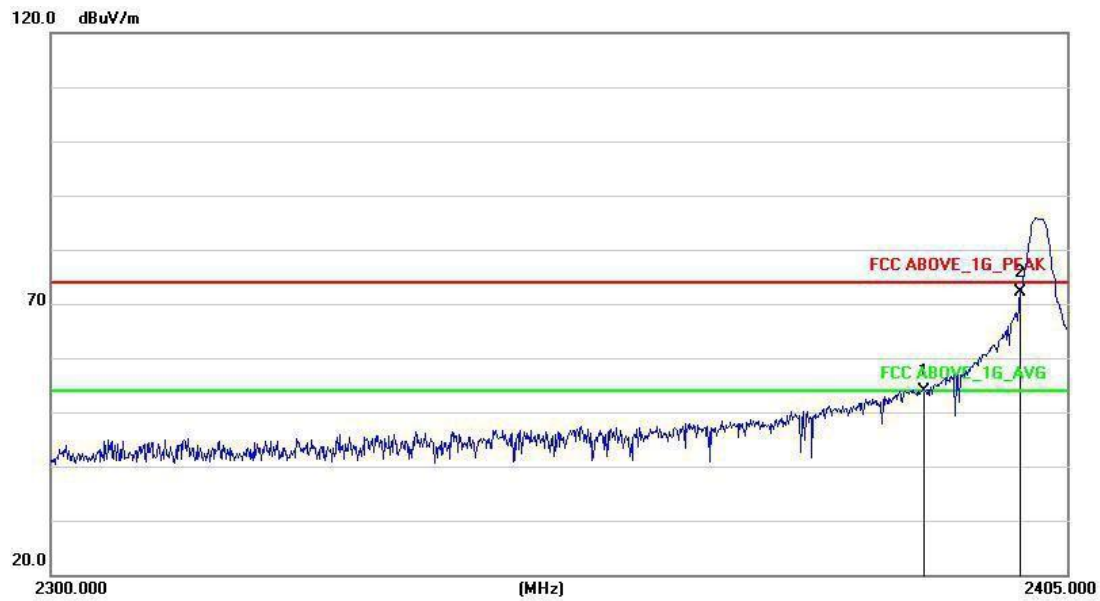


### 8.3 TEST RESULTS

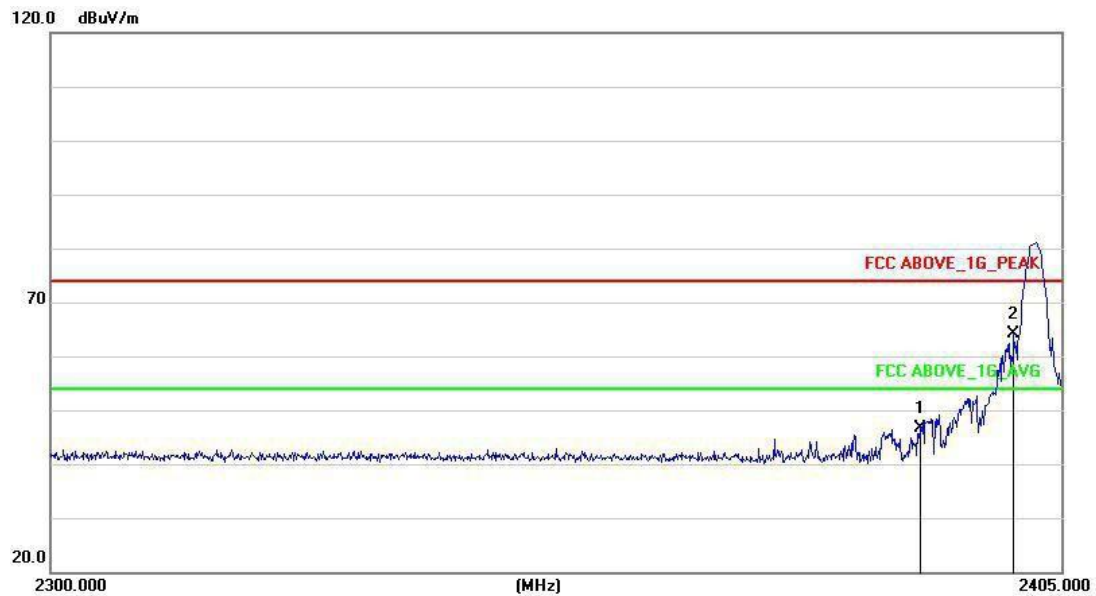
	Frequency (MHz)	Antenna polarization (H/V)	Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission (dBuV/m)	Emission (dBuV/m)	Band edge Limit (dBuV/m)		Result
						PK	AV	PK	AV	
GFSK	<2400	H	2390.00	58.51	-4.71	53.80	38.78	74.00	54.00	Pass
	<2400	V	2390.00	51.22	-4.71	46.51	31.53	74.00	54.00	Pass
	<2400	H	2400.00	76.80	-4.77	72.03	57.02	74.00	54.00	Pass
	<2400	V	2400.00	68.89	-4.77	64.12	49.15	74.00	54.00	Pass
	>2483.5	H	2483.50	64.30	-5.08	59.22	44.19	74.00	54.00	Pass
	>2483.5	V	2483.50	61.02	-5.08	55.94	40.98	74.00	54.00	Pass
	>2483.5	H	2485.50	60.03	-5.08	54.95	39.97	74.00	54.00	Pass
	>2483.5	V	2485.50	57.01	-5.08	51.93	36.91	74.00	54.00	Pass



### 2402MHz Horizontal

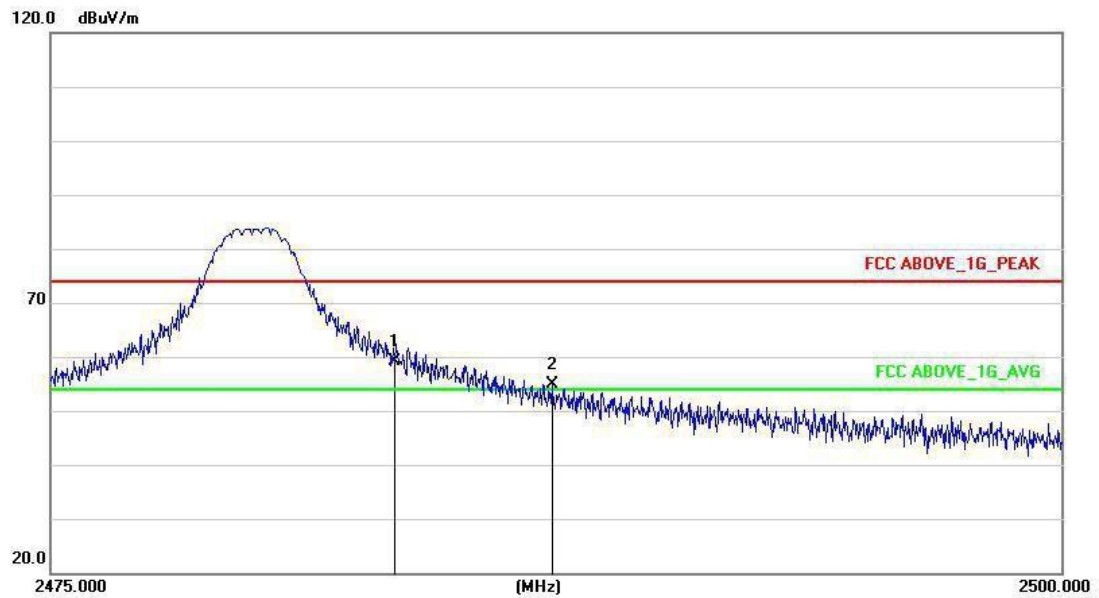


### 2402MHz Vertical

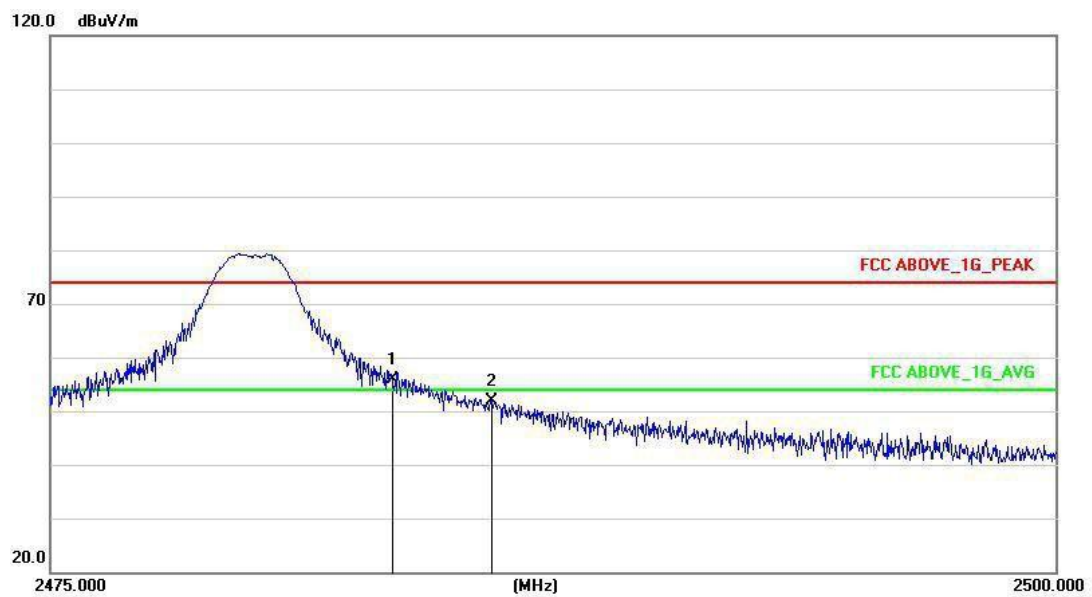




2480MHz Horizontal



2480MHz Vertical





## 9 20 dB Bandwidth Measurement

Test Requirement : FCC Part 15C Section 15.215(c)/Part 2 J Section 2.1049  
Test Method : ANSI C63.10:2013  
Test Mode : Refer to section 3.3

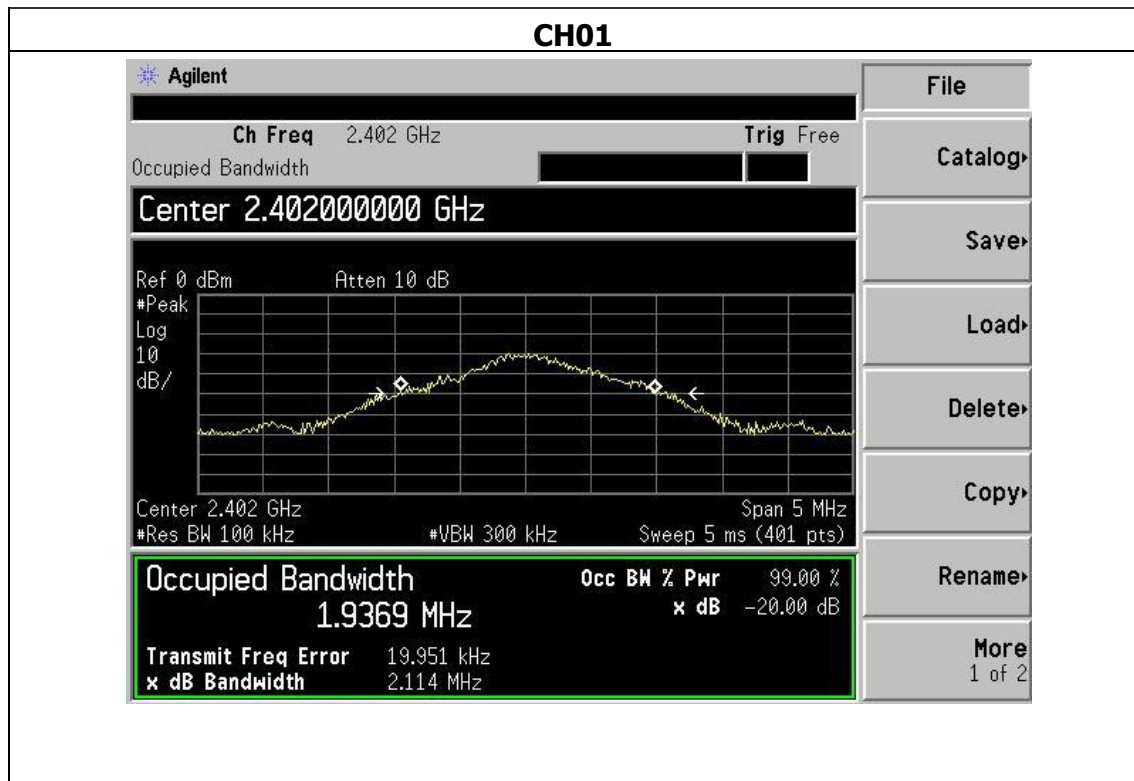
### 9.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 30kHz, VBW = 100kHz

### 9.2 Test Result

Test Mode: CH00 / CH08 / CH16 (GFSK Mode)

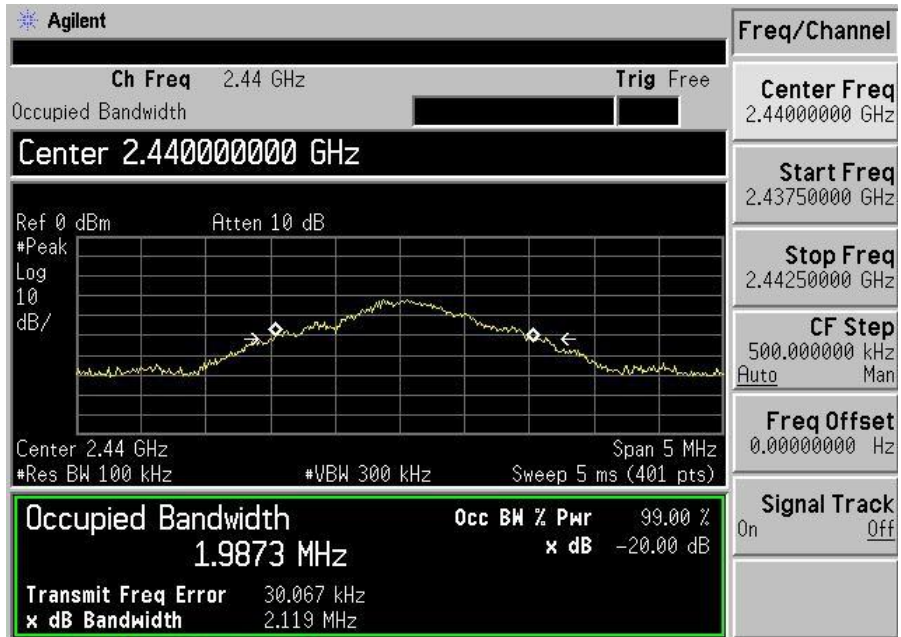
Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
01	2402	2114
08	2440	2119
16	2480	2250



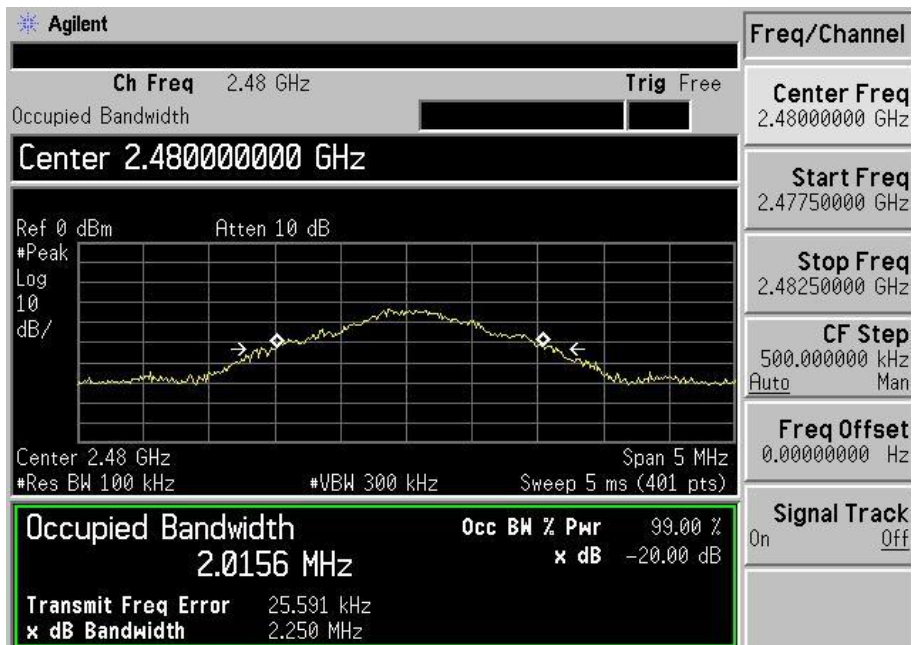




## CH08



## CH16





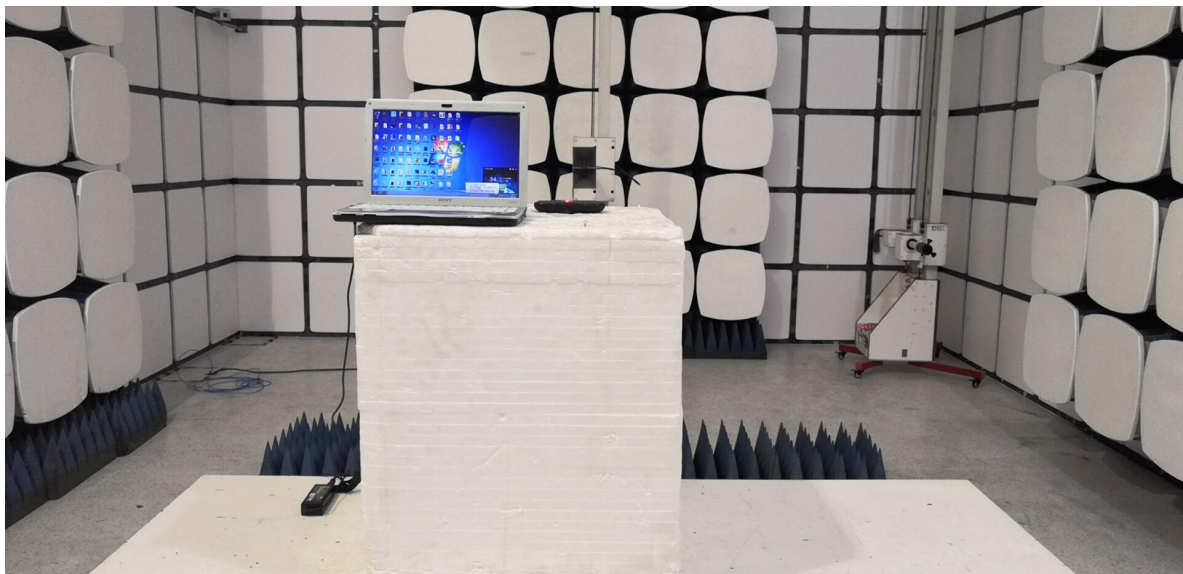
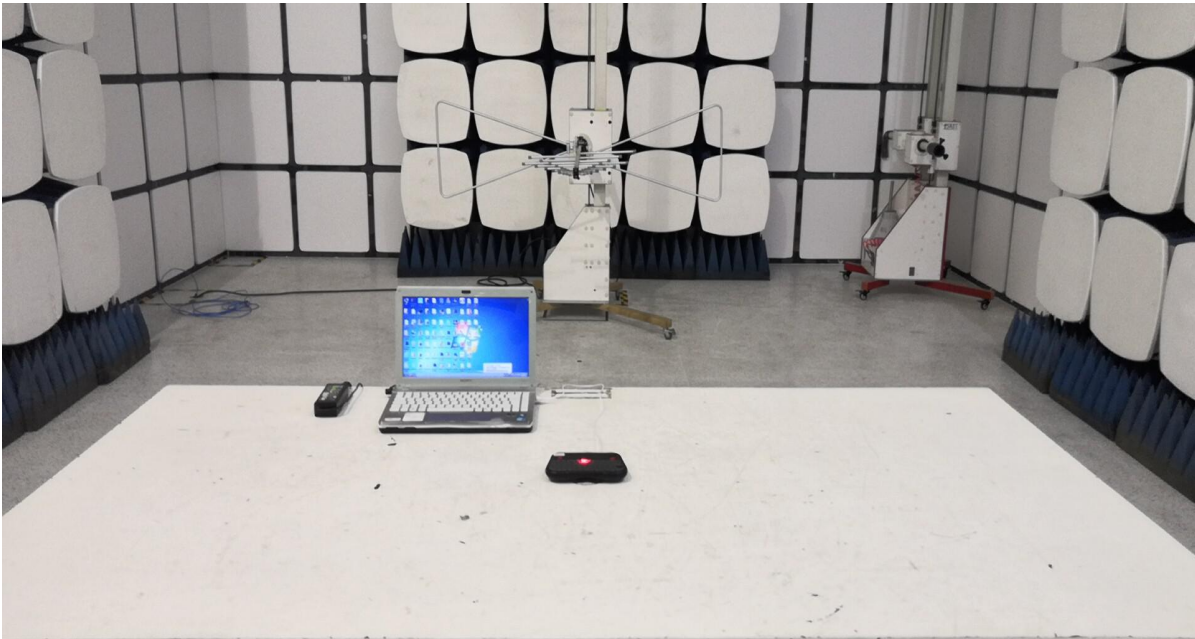
## 10 Antenna Requirement

According to the FCC part15.203, a transmitter can only be sold or operated with antennas with which it was approved. This product has an internal PCB Antenna, it meet the requirement of this section.



## 11 TEST PHOTOS



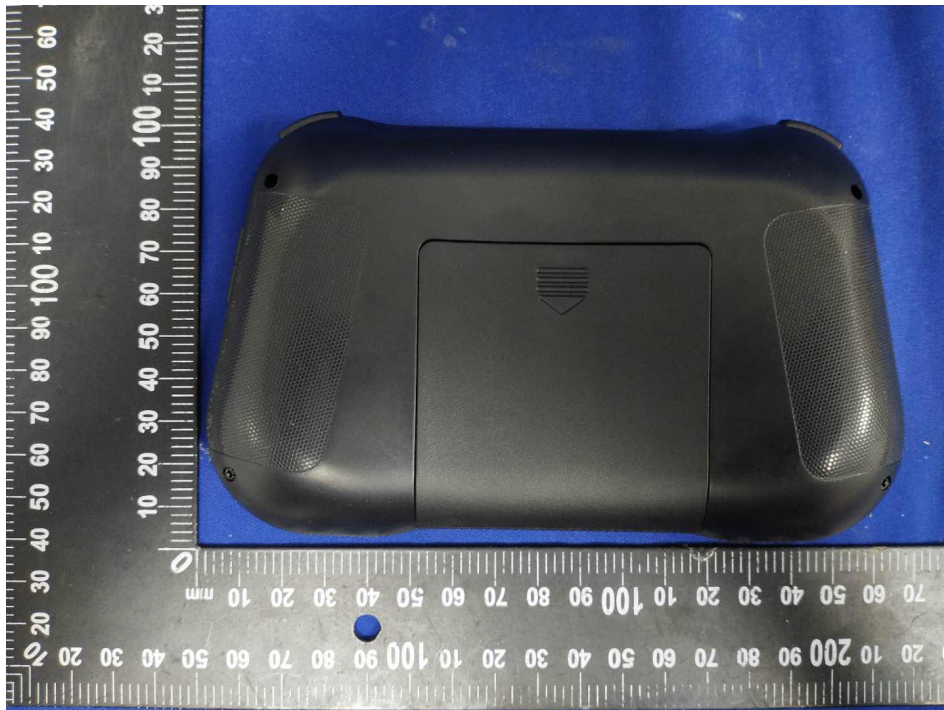






## 12 EUT PHOTOS











\*\*\*\*\*THE END REPORT\*\*\*\*\*