

# FCC TEST REPORT

## FCC ID: 2AGFX-STACK102

Product	:	Microwave Sensor
Model Name	:	STACK102
Brand	:	N/A
Report No.	:	PT800448160510-FC01
<b>Prepared for</b>		
Stack Labs, Inc.		
10054 Pasadena Avenue Cupertino CA 95014		
<b>Prepared by</b>		
DongGuan Precise Testing Service Co.,Ltd.		
Building D, Baoding Technology Park, Guangming Road 2, Guangming Community		
Dongcheng District, Dongguan, Guangdong, China		



**TEST RESULT CERTIFICATION**

Applicant's name : Stack Labs, Inc.  
Address : 10054 Pasadena Avenue Cupertino CA 95014  
Manufacture's name : Ningbo Lexing Inductor Electronic Co., Ltd.  
Address : No.35 Zhuquan Road, Science & Technology Area. Ninghai, Ningbo, China  
Product name : Microwave Sensor  
Model name : STACK102  
Standards : FCC CFR47 Part 15 Section 15.245  
Test procedure : ANSI C63.10:2013  
Test Date : May.06, 2016 ~ May.12, 2016  
Date of Issue : May.13, 2016  
Test Result : Pass

This device described above has been tested by PTS, 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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Testing Engineer

August Qiu

Technical Manager

Hack Ye

Authorized Signatory

Chris Du



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## 2 Test Summary

Test Items	Test Requirement	Result
Conducted Emissions	15.207	PASS
Radiated Spurious Emission	15.245(b) 15.209 15.205(a)	PASS
<b>Field strength of fundamental</b>	15.245(b)	PASS
Band Edge Emission	15.245(b3) 15.205 15.209	PASS
Antenna Requirement	15.203	PASS

Remark:

N/A: Not Applicable



### 3 General Information

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

- Product Name : Microwave Sensor
- Model Name : STACK102
- Model Description : N/A
- Operation Frequency: : 5785-5815MHz
- Antenna installation: : PCB Printed Antenna
- Antenna Gain: : 1.0dBi
- Type of Modulation : Un-modulation
- The lowest oscillator : N/A
- Power supply : DC 5V power by battery
- Remark : The Voltage range is 4.75 ~5.25V, Out of this range, The device cannot work normally

#### 3.2 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

Modulation	Test mode	Low channel	Middle channel	High channel
Un-modulation	continuously Transmitting	5799.93MHz	\	\



## 4 Equipment During Test

### 4.1 Equipments List

Radiated Emissions							
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	Calibration period
1	EMI Test Receiver	Rohde & Schwarz	ESCI	101417	July 15, 2015	July 14, 2016	1 year
2	EMC Analyzer (9k~26.5GHz)	Agilent	E4407B	MY45109572	Aug.04, 2015	Aug.03, 2016	1 year
3	Trilog Broadband Antenna	SCHWARZECK	VULB9160	9160-3355	July 15, 2015	July 14, 2016	1 year
4	Amplifier	EM	EM-30180	060538	July 15, 2015	July 14, 2016	1 year
5	Horn Antenna	SCHWARZECK	BBHA9120D	9120D-1246	July 15, 2015	July 14, 2016	1 year
6	Coaxial Cable(below 1GHz)	LARGE	CALB1	-	July 15, 2015	July 14, 2016	1 year
7	Coaxial Cable(above 1GHz)	LARGE	CALB2	-	July 15, 2015	July 14, 2016	1 year

### 4.2 Measurement Uncertainty

Parameter	Uncertainty
RF output power, conducted	±1.0dB
Power Spectral Density, conducted	±2.2dB
Radio Frequency	± 1 x 10 <sup>-6</sup>
Bandwidth	± 1.5 x 10 <sup>-6</sup>
Time	±2%
Duty Cycle	±2%
Temperature	±1°C
Humidity	±5%
DC and low frequency voltages	±3%
Conducted Emissions (150kHz~30MHz)	±3.64dB
Radiated Emission(30MHz~1GHz)	±5.03dB
Radiated Emission(1GHz~25GHz)	±4.74dB

## 5 Conducted Emission

Test Requirement:	:	FCC CFR 47 Part 15 Section 15.207
Test Method:	:	ANSI C63.10:2013
Frequency Range:	:	150kHz to 30MHz
Class/Severity:	:	Class B
Limit:	:	66-56 dB $\mu$ V between 0.15MHz & 0.5MHz
	:	56 dB $\mu$ V between 0.5MHz & 5MHz
	:	60 dB $\mu$ V between 5MHz & 30MHz
Detector:	:	Peak for pre-scan (9kHz Resolution Bandwidth)

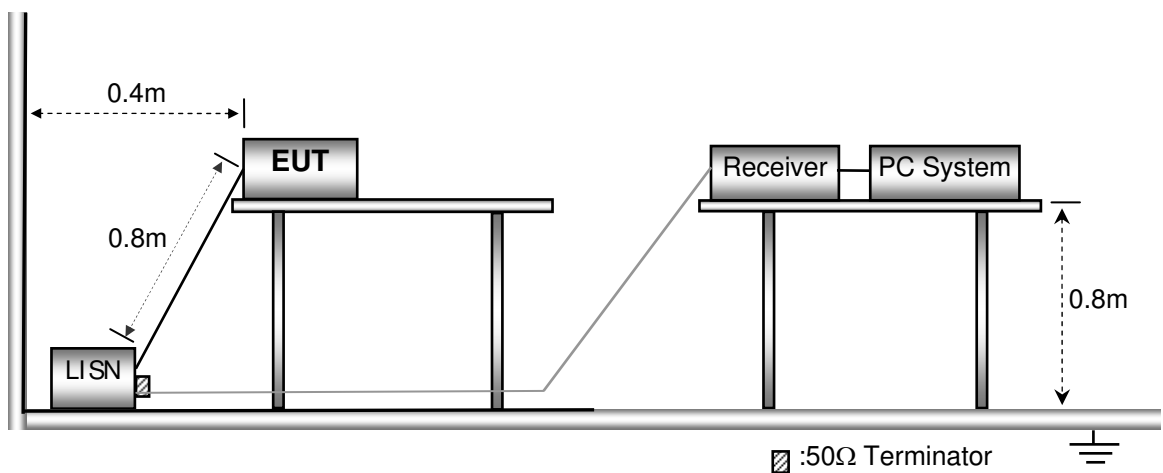
### 5.1 E.U.T. Operation

Operating Environment :

Temperature:	:	25.5 °C
Humidity:	:	51 % RH
Atmospheric Pressure:	:	101.2kPa
EUT Operation :	:	Refer to section 3.3

### 5.2 EUT Setup

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



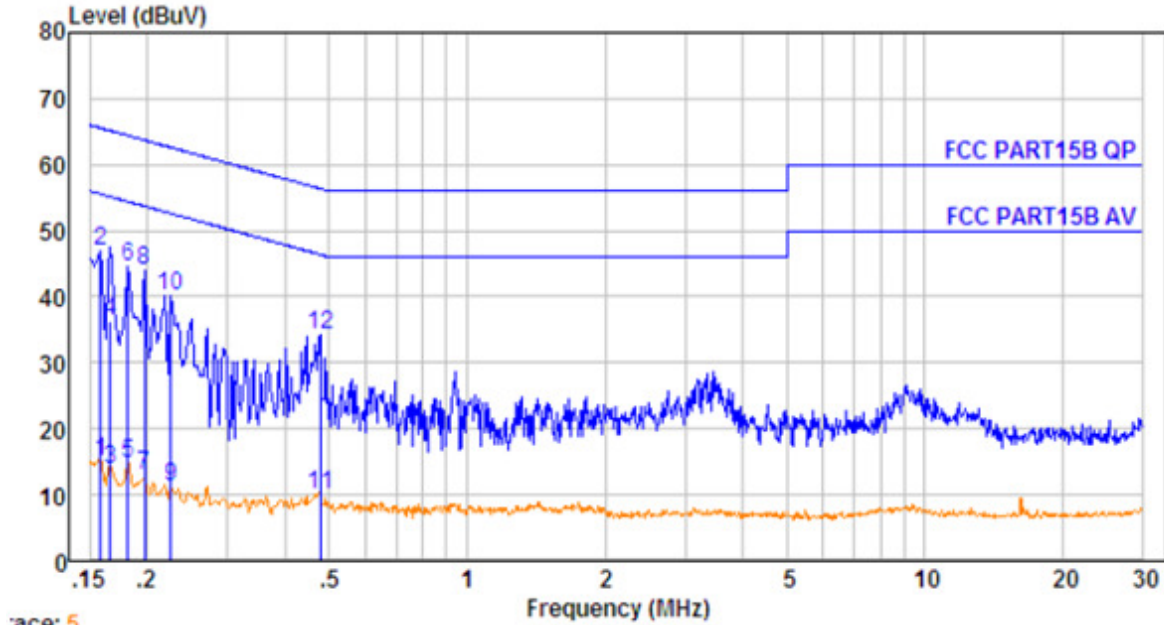
### 5.3 Measurement Description

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.



### 5.4 Test Result

Live line:

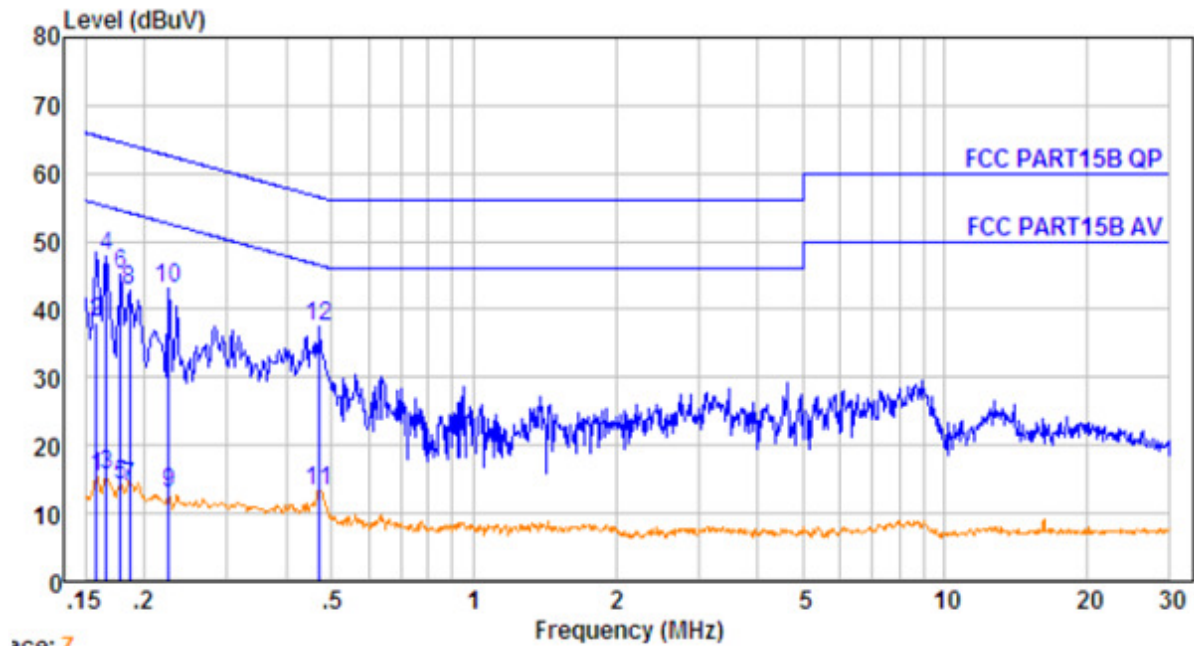


Trace: 5

No.	Freq MHz	Cable Loss dB	AMN Factor dB	Receiver Reading dBUV	Emission Level dBUV	Limit dBUV	Over Limit dB	Remark
1.	0.158	10.60	0.60	3.84	15.04	55.56	-40.52	Average
2.	0.158	10.60	0.60	35.84	47.04	65.56	-18.52	QP
3.	0.166	10.60	0.60	2.70	13.90	55.16	-41.26	Average
4.	0.166	10.60	0.60	25.20	36.40	65.16	-28.76	QP
5.	0.182	10.61	0.60	3.42	14.63	54.42	-39.79	Average
6.	0.182	10.61	0.60	33.42	44.63	64.42	-19.79	QP
7.	0.198	10.61	0.60	1.72	12.93	53.71	-40.78	Average
8.	0.198	10.61	0.60	32.72	43.93	63.71	-19.78	QP
9.	0.226	10.62	0.60	0.06	11.28	52.61	-41.33	Average
10.	0.226	10.62	0.60	29.06	40.28	62.61	-22.33	QP
11.	0.479	10.64	0.60	-1.13	10.11	46.36	-36.25	Average
12.	0.479	10.64	0.60	22.87	34.11	56.36	-22.25	QP



Neutral line:



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No.	Freq MHz	Cable Loss dB	AMN Factor dB	Receiver Reading dBuV	Emission Level dBuV	Limit dBuV	Over Limit dB	Remark
1.	0.158	10.60	0.60	4.20	15.40	55.56	-40.16	Average
2.	0.158	10.60	0.60	26.80	38.00	65.56	-27.56	QP
3.	0.166	10.60	0.60	4.51	15.71	55.16	-39.45	Average
4.	0.166	10.60	0.60	36.51	47.71	65.16	-17.45	QP
5.	0.178	10.61	0.60	2.92	14.13	54.59	-40.46	Average
6.	0.178	10.61	0.60	33.92	45.13	64.59	-19.46	QP
7.	0.186	10.61	0.60	2.71	13.92	54.20	-40.28	Average
8.	0.186	10.61	0.60	31.71	42.92	64.20	-21.28	QP
9.	0.226	10.62	0.60	1.87	13.09	52.61	-39.52	Average
10.	0.226	10.62	0.60	31.87	43.09	62.61	-19.52	QP
11.	0.471	10.64	0.60	2.11	13.35	46.49	-33.14	Average
12.	0.471	10.64	0.60	26.11	37.35	56.49	-19.14	QP



## 6 Radiated Spurious Emissions

Test Requirement: : FCC CFR47 Part 15 Section 15.245 & 15.207 &15.205  
Test Method: : ANSI C63.10:2013  
Test Result: : PASS  
Measurement Distance: : 3m  
Limit: : See the follow table

Fundamental frequency (MHz)	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (millivolts/meter)
902-928	500	1.6
2435-2465	500	1.6
5785-5815	500	1.6
10500-10550	2500	25.0
24075-24175	2500	25.0

### 6.1 EUT Operation

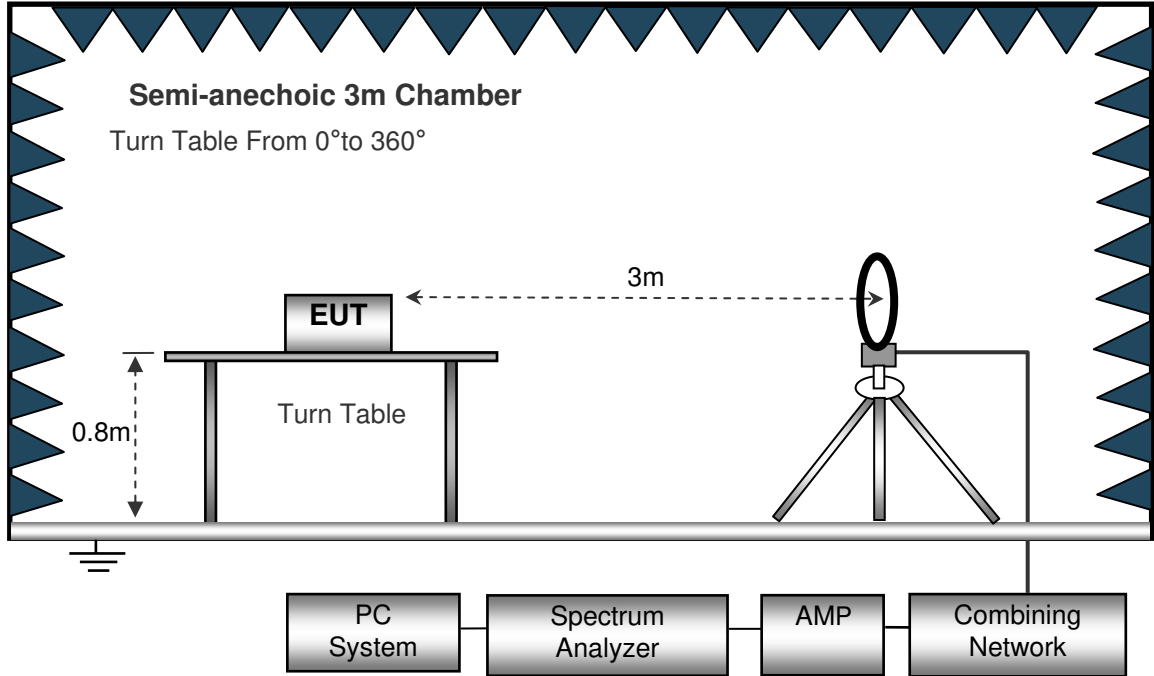
Operating Environment :

Temperature: : 23.5 °C  
Humidity: : 51.1 % RH  
Atmospheric Pressure: : 101.2kPa  
EUT Operation : : Refer to section 3.3

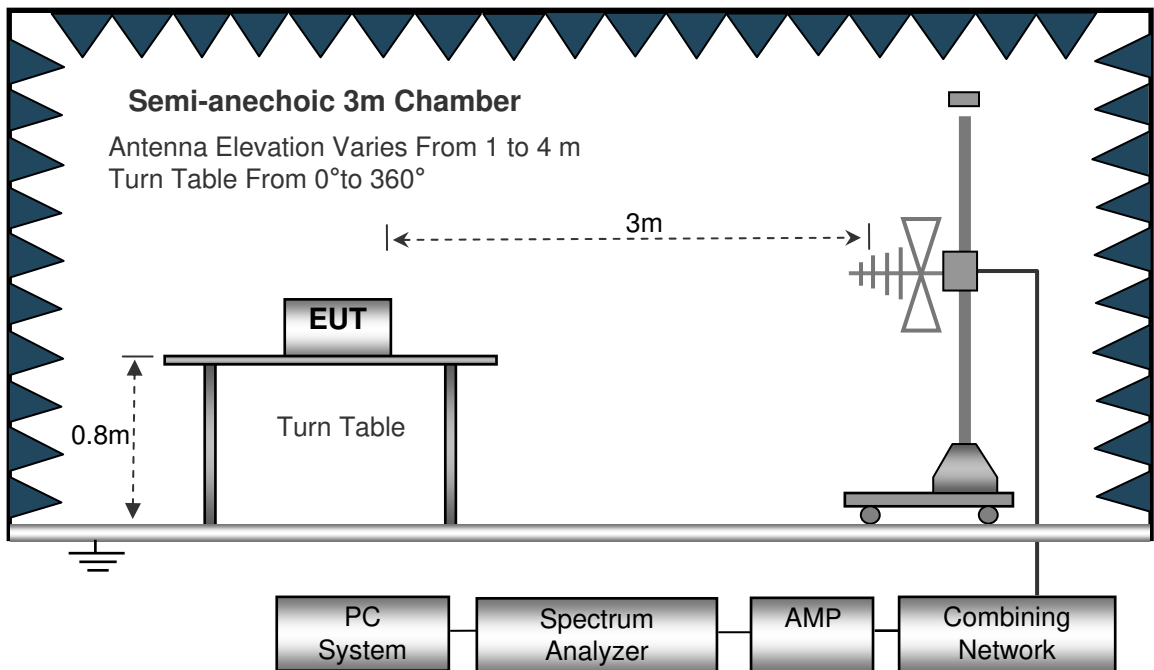
### 6.2 Test Setup

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

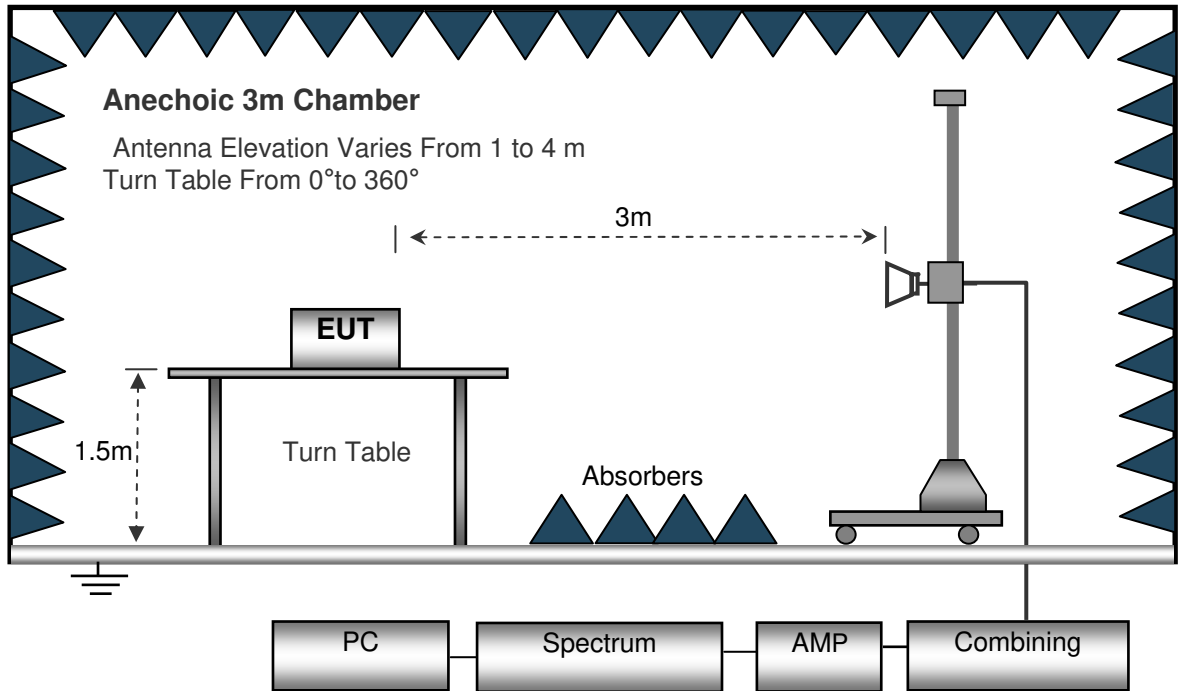
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



### 6.3 Spectrum Analyzer Setup

Below 30MHz

IF Bandwidth	10kHz
Resolution Bandwidth	10kHz
Video Bandwidth	10kHz

30MHz ~ 1GHz

Detector	: PK
Resolution Bandwidth	: 100kHz
Video Bandwidth	: 300kHz
Detector	: QP
Resolution Bandwidth	: 120kHz
Video Bandwidth	: 300kHz

Above 1GHz

Detector	: PK
Resolution Bandwidth	: 1MHz
Video Bandwidth	: 3MHz
Detector	: AV
Resolution Bandwidth	: 1MHz
Video Bandwidth	: 10Hz



## 6.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m or 1.5m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
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.



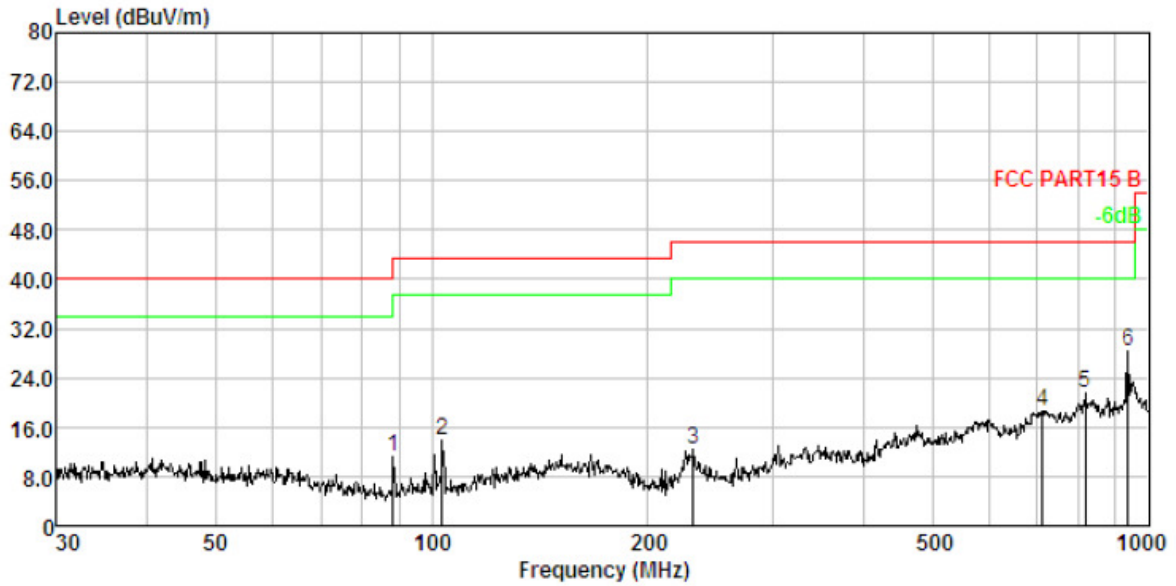
### 6.5 Summary of Test Results

**Test Frequency: Below 30MHz**

The lowest oscillator is 32MHz, the test is not applicable

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

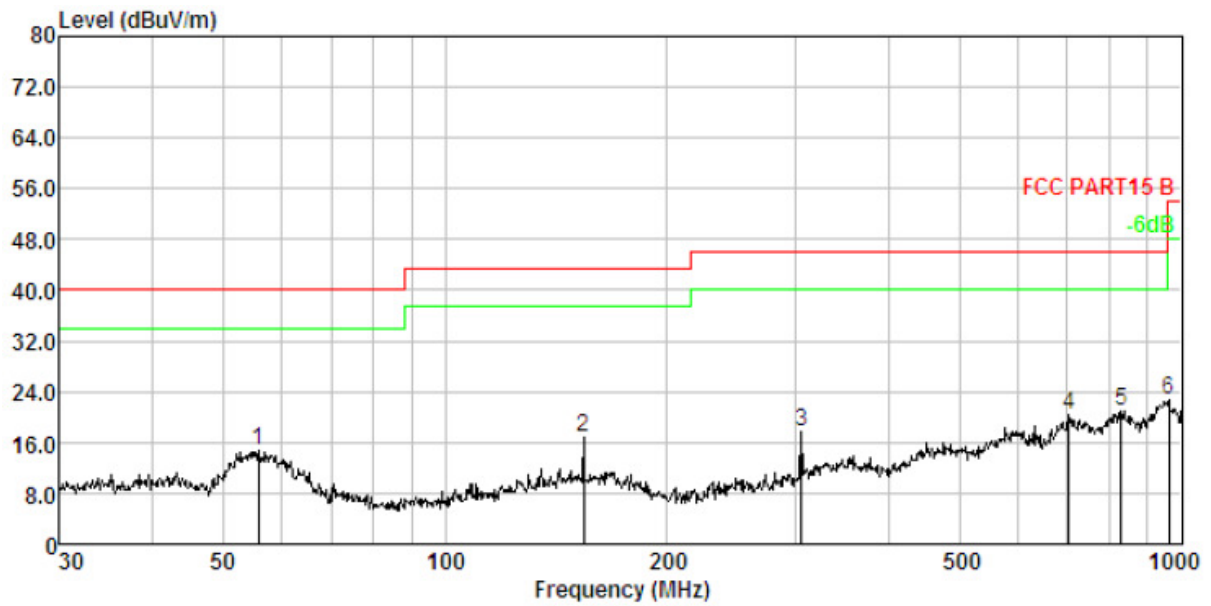
Antenna Polarization: Horizontal



No.	Freq MHz	Cable Loss dB	ANT Factor dB/m	Receiver Reading dBuV	Preamp Factor dB	Emission Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark
1.	88.342	2.03	9.10	30.44	30.35	11.22	43.50	-32.28	QP
2.	103.442	2.18	10.53	31.48	30.40	13.79	43.50	-29.71	QP
3.	231.718	2.91	11.33	28.95	30.68	12.51	46.00	-33.49	QP
4.	711.674	3.92	20.36	25.52	31.07	18.73	46.00	-27.27	QP
5.	815.968	4.05	21.87	26.89	31.12	21.69	46.00	-24.31	QP
6.	935.546	4.17	23.15	32.27	31.17	28.42	46.00	-17.58	QP



Antenna Polarization: Vertical

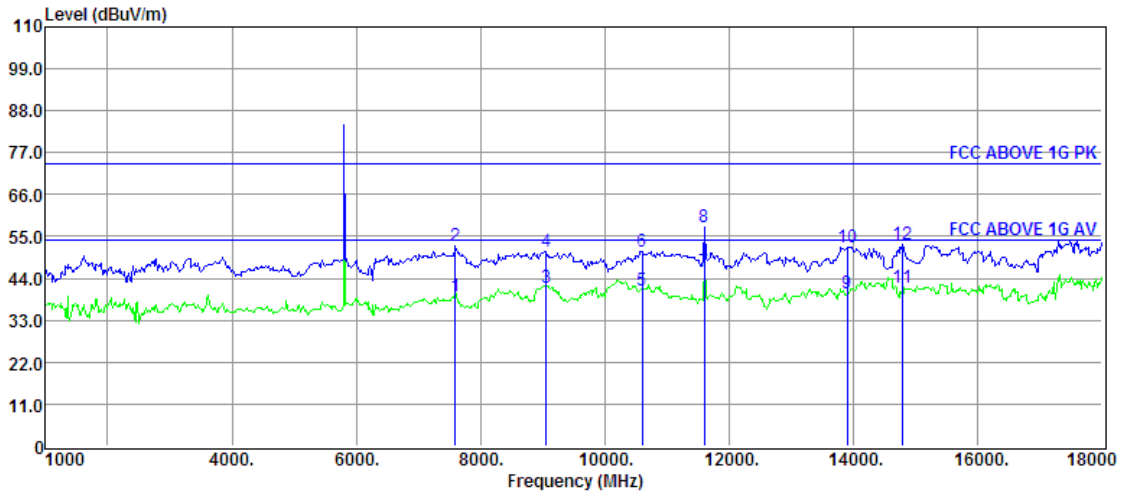


No.	Freq MHz	Cable Loss dB	ANT Factor dB/m	Receiver Reading dBuV	Preamplifier Factor dB	Emission Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark
1.	55.805	1.62	11.95	31.40	30.19	14.78	40.00	-25.22	QP
2.	154.279	2.54	13.89	30.95	30.54	16.84	43.50	-26.66	QP
3.	304.610	3.15	13.30	31.91	30.78	17.58	46.00	-28.42	QP
4.	704.226	3.91	20.22	27.26	31.07	20.32	46.00	-25.68	QP
5.	827.493	4.06	21.94	26.08	31.12	20.96	46.00	-25.04	QP
6.	962.162	4.20	23.43	26.25	31.18	22.70	54.00	-31.30	QP



**Test Frequency: 1GHz ~ 18GHz**

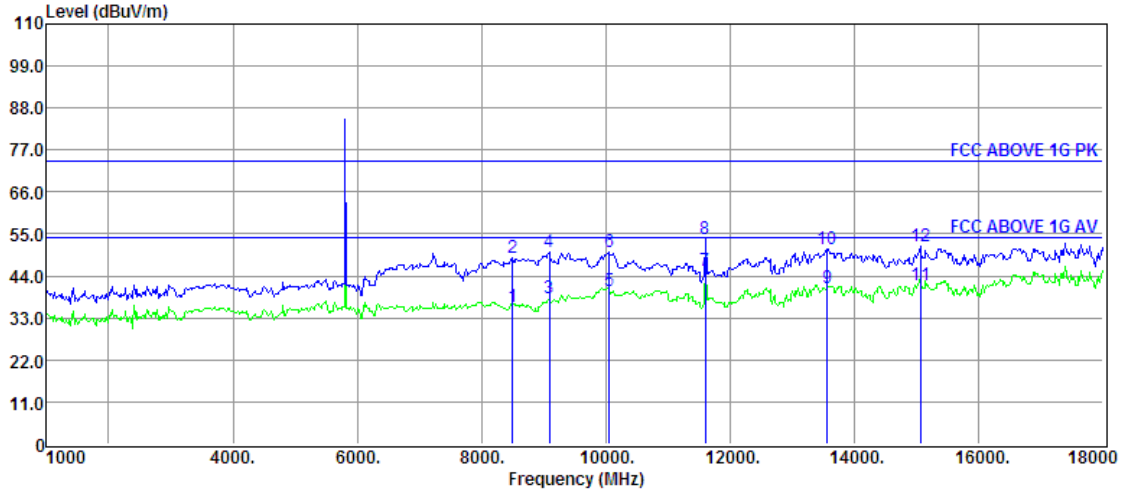
Antenna Polarization: Horizontal



No.	Freq	Cable Loss	Antenna Factor	Receiver Reading	Preamp Factor	Emission Level	Limit	Over Limit	Remark
	MHz	dB	dB/m	dBuV	dB	dBuV/m	dBuV/m	dB	
1.	7596.00	6.51	35.64	25.30	28.00	39.45	54.00	-14.55	Average
2.	7596.00	6.51	35.64	38.56	28.00	52.71	74.00	-21.29	Peak
3.	9058.00	7.50	37.53	24.61	28.00	41.64	54.00	-12.36	Average
4.	9058.00	7.50	37.53	33.98	28.00	51.01	74.00	-22.99	Peak
5.	10605.00	8.38	38.88	21.40	28.00	40.66	54.00	-13.34	Average
6.	10605.00	8.38	38.88	31.92	28.00	51.18	74.00	-22.82	Peak
7.	11600.00	8.89	39.30	25.70	28.00	45.89	54.00	-8.11	Average
8.	11600.00	8.89	39.30	37.18	28.00	57.37	74.00	-16.63	Peak
9.	13903.00	9.90	40.14	17.93	28.00	39.97	54.00	-14.03	Average
10.	13903.00	9.90	40.14	30.10	28.00	52.14	74.00	-21.86	Peak
11.	14787.00	10.25	40.43	18.90	28.00	41.58	54.00	-12.42	Average
12.	14787.00	10.25	40.43	30.14	28.00	52.82	74.00	-21.18	Peak



Antenna Polarization: Vertical



No.	Freq	Cable Loss	Antenna Factor	Receiver Reading	Preamp Factor	Emission Level	Limit	Over Limit	Remark
	MHz	dB	dB/m	dBuV	dB	dBuV/m	dBuV/m	dB	
1.	8497.00	7.14	36.85	20.00	28.00	35.99	54.00	-18.01	Average
2.	8497.00	7.14	36.85	32.67	28.00	48.66	74.00	-25.34	Peak
3.	9092.00	7.52	37.58	21.00	28.00	38.10	54.00	-15.90	Average
4.	9092.00	7.52	37.58	33.14	28.00	50.24	74.00	-23.76	Peak
5.	10061.00	8.09	38.63	21.30	28.00	40.02	54.00	-13.98	Average
6.	10061.00	8.09	38.63	31.73	28.00	50.45	74.00	-23.55	Peak
7.	11600.00	8.89	39.30	24.99	28.00	45.18	54.00	-8.82	Average
8.	11600.00	8.89	39.30	33.39	28.00	53.58	74.00	-20.42	Peak
9.	13563.00	9.76	40.03	19.10	28.00	40.89	54.00	-13.11	Average
10.	13563.00	9.76	40.03	29.38	28.00	51.17	74.00	-22.83	Peak
11.	15059.00	10.35	40.62	18.60	28.00	41.57	54.00	-12.43	Average
12.	15059.00	10.35	40.62	28.79	28.00	51.76	74.00	-22.24	Peak

**Test Frequency: 18G-40GHz**

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



### 7 Field strength of fundamental

Test Requirement: : FCC CFR47 Part 15 Section 15.245  
 Test Method: : ANSI C63.10:2013  
 Test Result: : PASS  
 Measurement Distance: : 3m  
 Limit: : See the follow table

Fundamental frequency (MHz)	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (millivolts/meter)
902-928	500	1.6
2435-2465	500	1.6
5785-5815	500	1.6
10500-10550	2500	25.0
24075-24175	2500	25.0

#### 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

#### 7.2 Spectrum Analyzer Setup

Detector : PK  
 Resolution Bandwidth : 1MHz  
 Video Bandwidth : 3MHz  
 Detector : AV  
 Resolution Bandwidth : 1MHz  
 Video Bandwidth : 10Hz

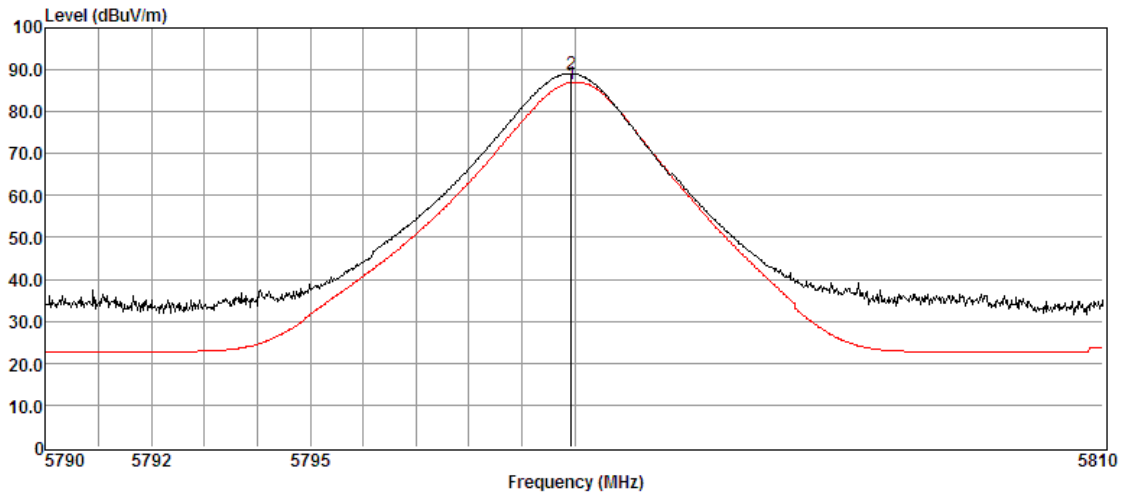


### 7.3 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m or 1.5m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
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.

### 7.4 Summary of Test Results

Antenna Polarization: Vertical



No.	Freq	Cable Loss	Antenna Factor	Receiver Reading	Preamp Factor	Emission Level	Limit	Over Limit	Remark
	MHz	dB	dB/m	dBuV	dB	dBuV/m	dBuV/m	dB	
1.	5799.93	5.00	32.88	76.80	28.00	86.68	94.00	-7.32	Average
2.	5799.93	5.00	32.88	79.29	28.00	89.17	114.00	-24.83	Peak

Remark: The max fundamental level was recorded.



## 8 Band Edge Emission

Test Requirement	:	15.245(b3): Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation..
Test Method	:	ANSI C63.10:2013
Test Limit	:	50 dB below the level of the fundamental or to the general radiated emission limits
Test Mode	:	Refer to section 3.3

### 8.1 Test Procedure

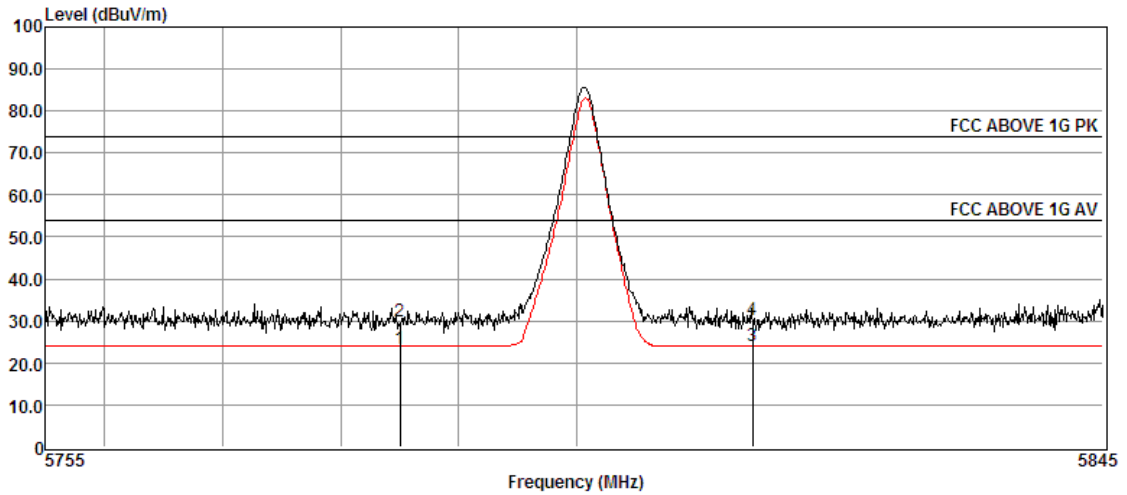
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto

Detector function = peak, Trace = max hold



### 8.2 Summary of Test Results

Antenna Polarization: Vertical



No.	Freq	Cable Loss	Antenna Factor	Receiver Reading	Preamp Factor	Emission Level	Limit	Over Limit	Remark
	MHz	dB	dB/m	dBuV	dB	dBuV/m	dBuV/m	dB	
1.	5785.000	4.99	32.86	13.62	28.00	23.47	54.00	-30.53	Average
2.	5785.000	4.99	32.86	19.90	28.00	29.75	74.00	-44.25	Peak
3.	5815.000	5.02	32.90	13.99	28.00	23.91	54.00	-30.09	Average
4.	5815.000	5.02	32.90	20.30	28.00	30.22	74.00	-43.78	Peak

Remark: The worst case was recorded.



## 9 20dB Bandwidth Measurement

Test Requirement : FCC Part15.215  
 Test Method : ANSI C63.10:2013  
 Test Mode : Refer to section 3.3

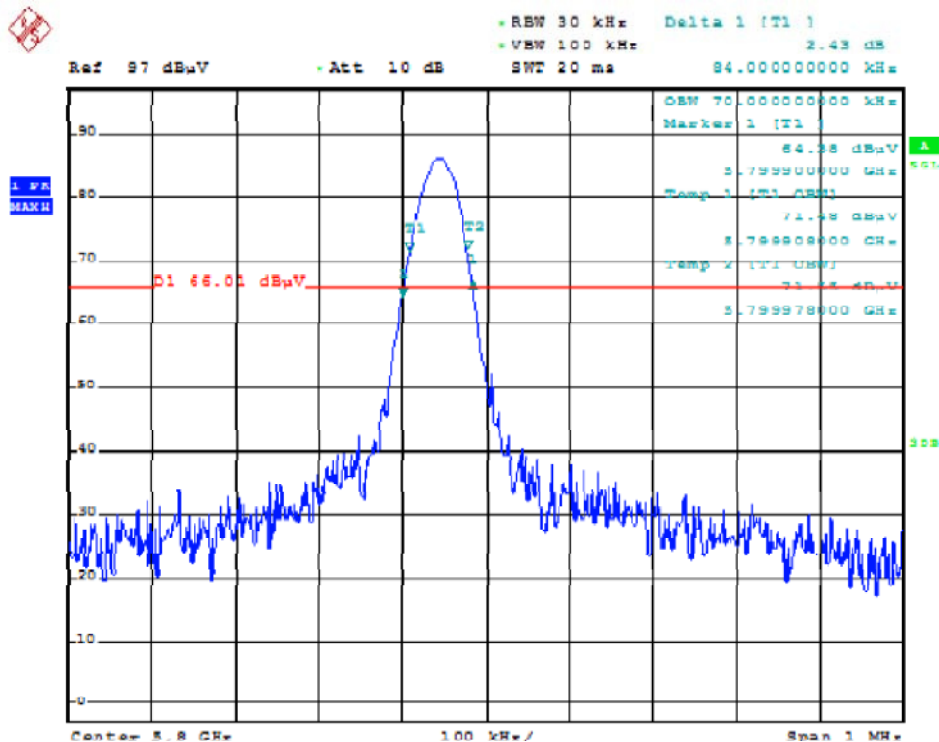
### 9.1 Test Procedure

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: For BLE, RBW = 30 kHz, VBW = 100kHz,

### 9.2 Test Result

Test Frequency (MHz)	Bandwidth (kHz)
5799.4	84.00kHz

Test plots





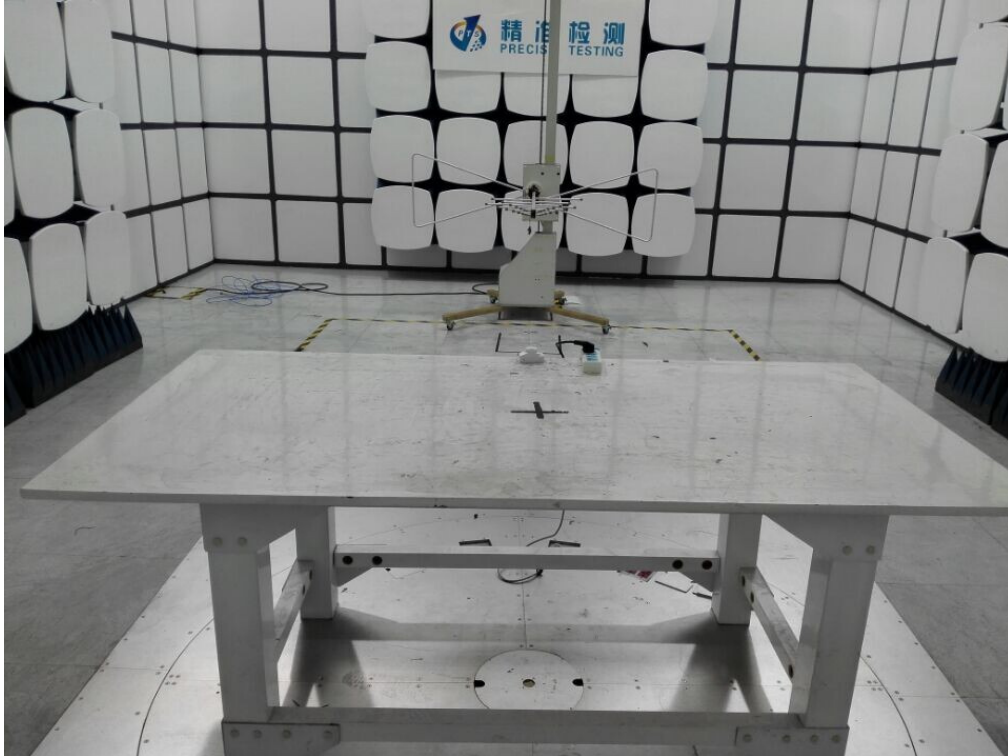
## 10 Antenna Requirement

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

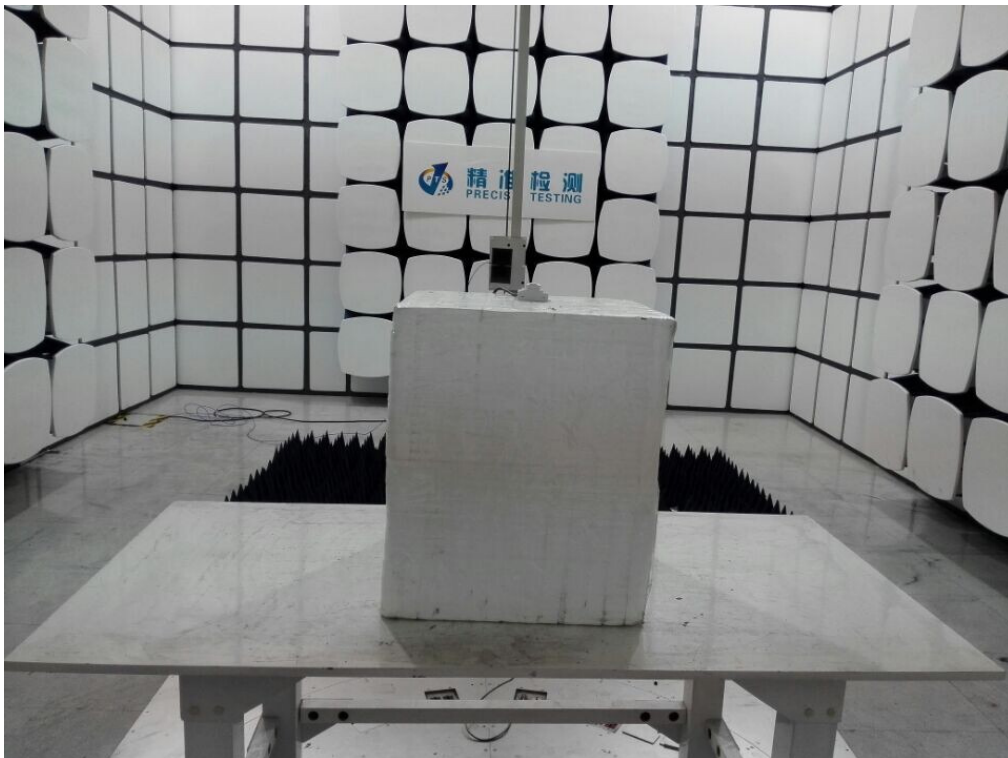


### 11 Test Setup

Radiated Spurious Emissions  
From 30MHz-1000MHz



Above 1GHz



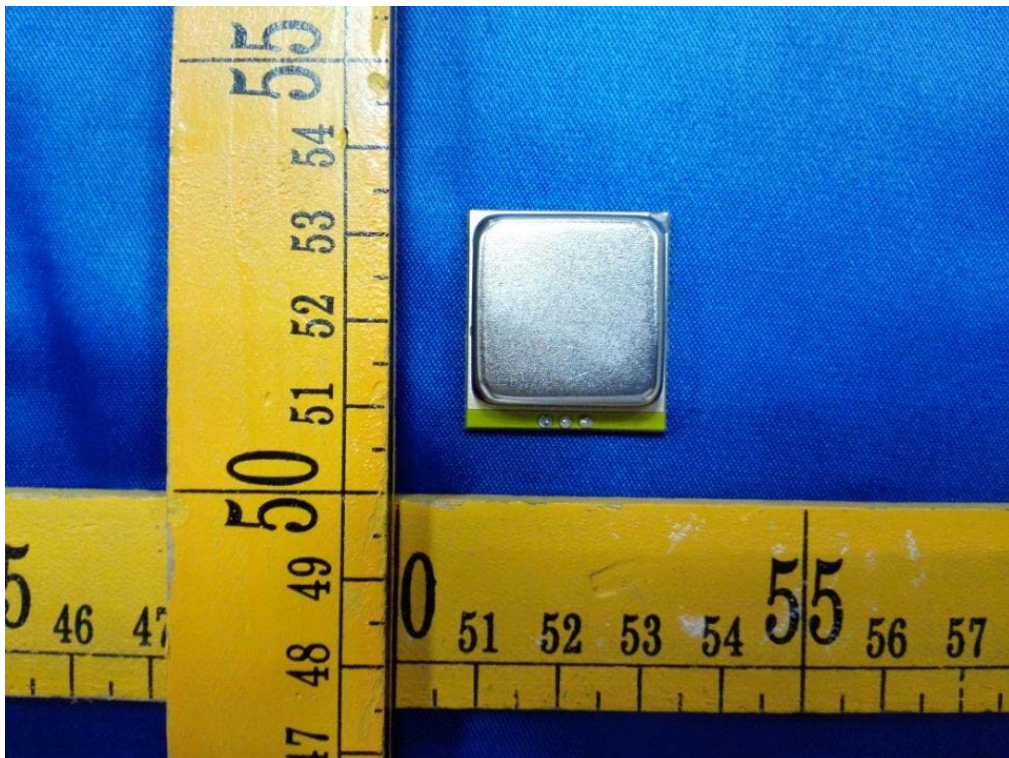
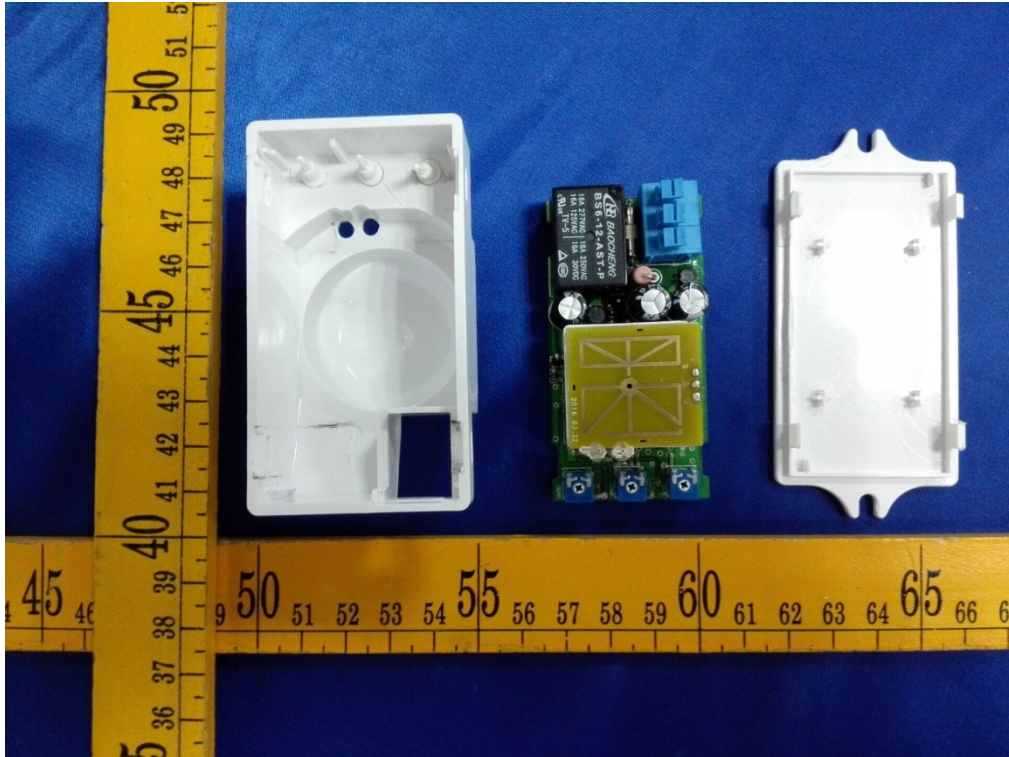
Conducted Emissions

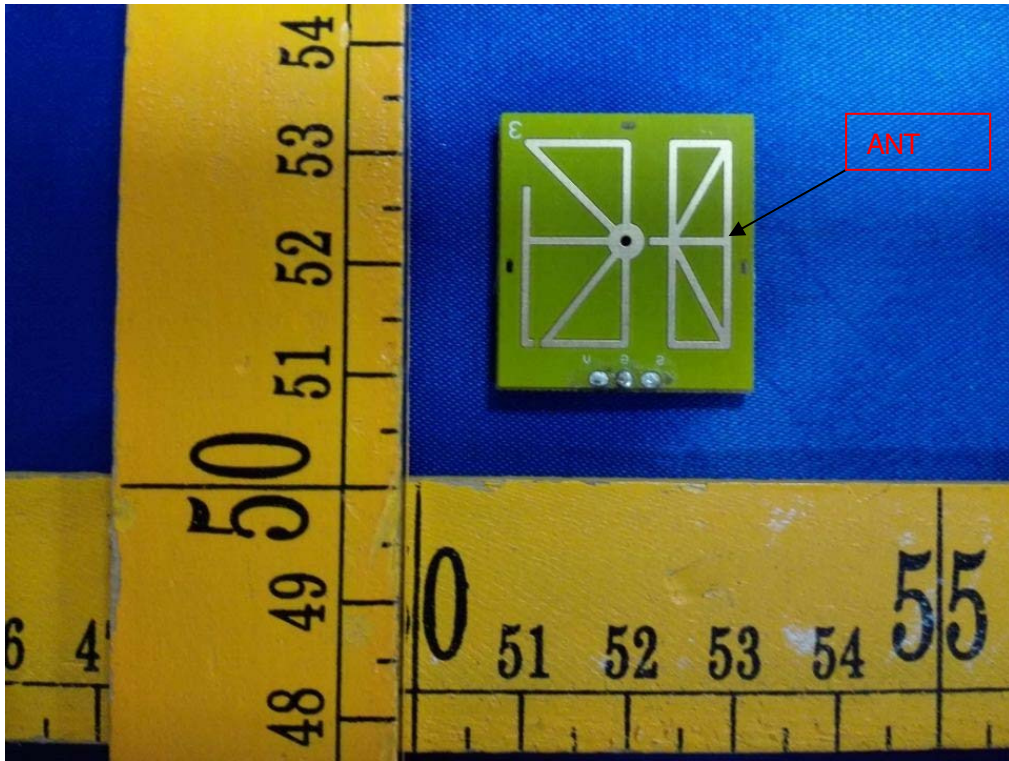




## 12 Module Photos

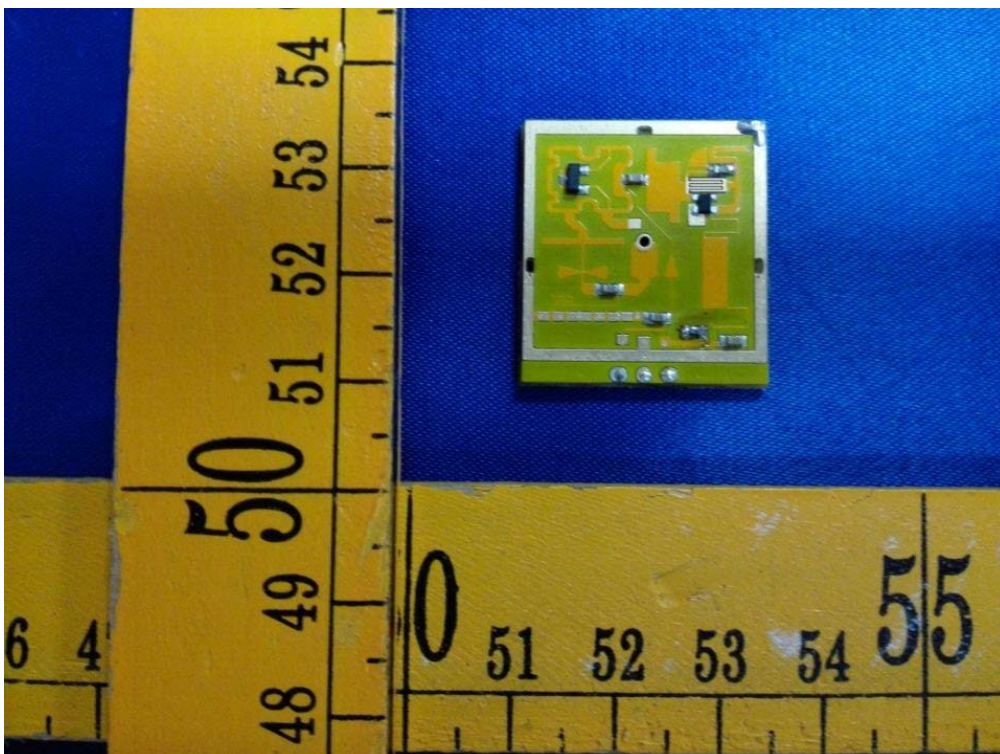
External Photos







Internal Photos



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