

TEST REPORT

Reference No...... : WTS15S1036144E
FCC ID..... : 2AGT3-0001
Applicant..... : NWT Holdings LLC
Address..... : 322 6th Street Suite 4 San Francisco, CA 94103, USA
Manufacturer : DongGuan DongHong XingYe Electronic Technology Co., Ltd
Address..... : 1 Jianxiang Street, Hanxishui, Chashan Town, Dongguan,
Guangdong, China
Product Name..... : Firefly2
Model No..... : 2.0
Standards..... : FCC CFR47 Part 15 Section 15.247:2015
Date of Receipt sample..... : Oct. 28, 2015
Date of Test..... : Oct. 29, 2015 - Jan. 10, 2016
Date of Issue..... : Mar. 03, 2016
Test Result..... : **Pass**

Remarks:

The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

Prepared By:

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Approved by:



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2 Test Summary

Test Items	Test Requirement	Result
Radiated Emissions	15.205(a) 15.209(a)	PASS
Conducted Emissions	15.207(a)	PASS
Bandwidth	15.247(a)(2)	PASS
Maximum Peak Output Power	15.247(b)(3),(4)	PASS
Power Spectral Density	15.247(e)	PASS
Band Edge	15.247(d)	PASS
Antenna Requirement	15.203	PASS
Maximum Permissible Exposure (Exposure of Humans to RF Fields)	1.1307(b)(1)	PASS

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4 General Information

4.1 General Description of E.U.T.

Product Name: : Firefly2

Model No.: : 2.0

Model Difference: :N/A

Operation Frequency: :2402MHz ~ 2480MHz, separated by 2MHz,40 channels in total

The lowest oscillator: :32.768kHz

Antenna Gain: 0 dBi

Type of modulation: :GFSK(BLE only)

4.2 Details of E.U.T.

Technical Data :DC 7.4V 770mAh 5.7Wh by Li-ion battery

4.3 Channel List

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
0	2402	1	2404	2	2406	3	2408
4	2410	5	2412	6	2414	7	2416
8	2418	9	2420	10	2422	11	2424
12	2426	13	2428	14	2430	15	2432
16	2434	17	2436	18	2438	19	2440
20	2442	21	2444	22	2446	23	2448
24	2450	25	2452	26	2454	27	2456
28	2458	29	2460	30	2462	31	2464
32	2466	33	2468	34	2470	35	2472
36	2474	37	2476	38	2478	39	2480

4.4 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.

Table 1 Tests Carried Out Under FCC part 15.247

Test mode	Low channel	Middle channel	High channel
Transmitting	2402MHz	2440MHz	2480MHz

Note: Tests Carried Out with a new battery

4.5 Test Facility

The test facility has a test site registered with the following organizations:

- **IC – Registration No.: 7760A-1**

Waltek Services(Shenzhen) Co., Ltd. Has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files. Registration number 7760A-1, October 15, 2015.

- **FCC Test Site 1#– Registration No.: 880581**

Waltek Services(Shenzhen) Co., Ltd. EMC Laboratory `has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 880581, April 29, 2014.

- **FCC Test Site 2#– Registration No.: 328995**

Waltek Services(Shenzhen) Co., Ltd. EMC Laboratory `has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 328995, December 3, 2014.

5 Equipment Used during Test

5.1 Equipments List

Conducted Emissions Test Site 1#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMI Test Receiver	R&S	ESCI	100947	Sep.15,2015	Sep.14,2016
2.	LISN	R&S	ENV216	101215	Sep.15,2015	Sep.14,2016
3.	Cable	Top	TYPE16(3.5M)	-	Sep.15,2015	Sep.14,2016
Conducted Emissions Test Site 2#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMI Test Receiver	R&S	ESCI	101155	Sep.15,2015	Sep.14,2016
2.	LISN	SCHWARZBECK	NSLK 8128	8128-289	Sep.15,2015	Sep.14,2016
3.	Limiter	York	MTS-IMP-136	261115-001-0024	Sep.15,2015	Sep.14,2016
4.	Cable	LARGE	RF300	-	Sep.15,2015	Sep.14,2016
3m Semi-anechoic Chamber for Radiation Emissions Test site 1#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	EMC Analyzer	Agilent	E7405A	MY45114943	Sep.15,2015	Sep.14,2016
2	Active Loop Antenna	Beijing Dazhi	ZN30900A	-	Sep.15,2015	Sep.14,2016
3	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	Apr.19,2015	Apr.18,2016
4	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	Sep.15,2015	Sep.14,2016
5	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	Apr.19,2015	Apr.18,2016
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	335	Apr.19,2015	Apr.18,2016
7	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	Mar.17,2015	Mar.16,2016
8	Coaxial Cable (above 1GHz)	Top	1GHz-25GHz	EW02014-7	Apr.10,2015	Apr.09,2016
3m Semi-anechoic Chamber for Radiation Emissions Test site 2#						
Item	Equipment	Manufacturer	Model No.	Serial No	Last Calibration Date	Calibration Due Date
1	Test Receiver	R&S	ESCI	101296	Sep.15,2015	Sep.14,2016
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	Sep.15,2015	Sep.14,2016
3	Amplifier	Compliance pirection systems inc	PAP-0203	22024	Sep.15,2015	Sep.14,2016
4	Cable	HUBER+SUHNER	CBL2	525178	Sep.15,2015	Sep.14,2016

RF Conducted Testing						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMC Analyzer (9k~26.5GHz)	Agilent	E7405A	MY45114943	Sep.15,2015	Sep.14,2016
2.	Spectrum Analyzer (9k-6GHz)	R&S	FSL6	100959	Sep.15,2015	Sep.14,2016
3.	Signal Analyzer (9k~26.5GHz)	Agilent	N9010A	MY50520207	Sep.15,2015	Sep.14,2016

5.2 Description of Support Units

Equipment	Manufacturer	Model No.
Adpater	I.T.E POWER SUPPLY	CS18M050200FUSB

5.3 Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-6}$
RF Power	± 1.0 dB
RF Power Density	± 2.2 dB
Radiated Spurious Emissions test	± 5.03 dB (Bilog antenna 30M~1000MHz)
	± 4.74 dB (Horn antenna 1000M~25000MHz)
Conducted Spurious Emissions test	± 3.64 dB (AC mains 150KHz~30MHz)

5.4 Test Equipment Calibration

All the test equipments used are valid and calibrated by CEPREI Certification Body that address is No.110 Dongguan Zhuang RD. Guangzhou, P.R.China.

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
Limit:	66-56 dB μ V between 0.15MHz & 0.5MHz 56 dB μ V between 0.5MHz & 5MHz 60 dB μ V between 5MHz & 30MHz
Detector:	Peak for pre-scan (9kHz Resolution Bandwidth)

6.1 E.U.T. Operation

Operating Environment :

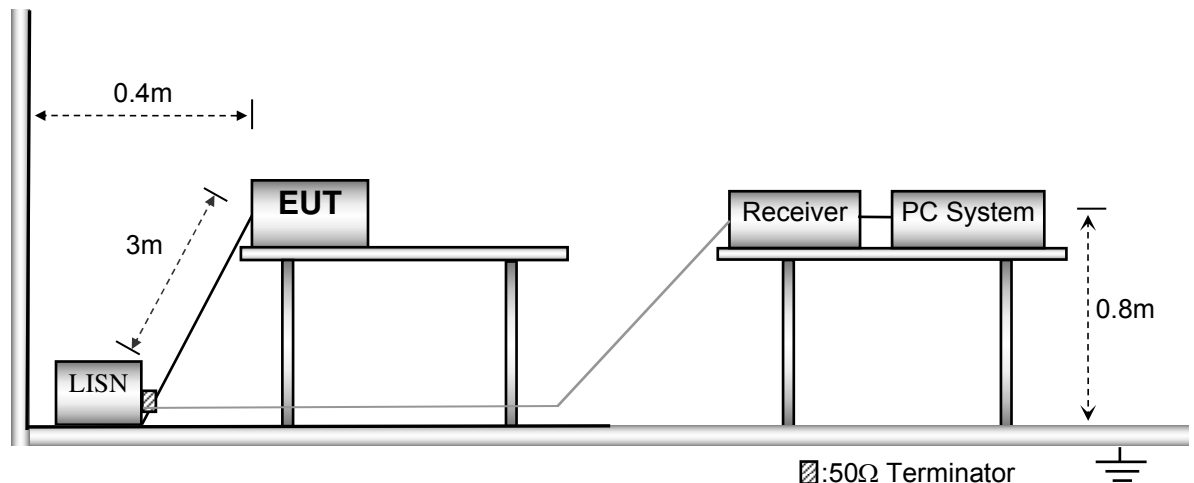
Temperature:	25.5 °C
Humidity:	51 % RH
Atmospheric Pressure:	101.2kPa

EUT Operation :

The test was performed in Transmitting mode, the test data were shown in the report.

6.2 EUT Setup

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

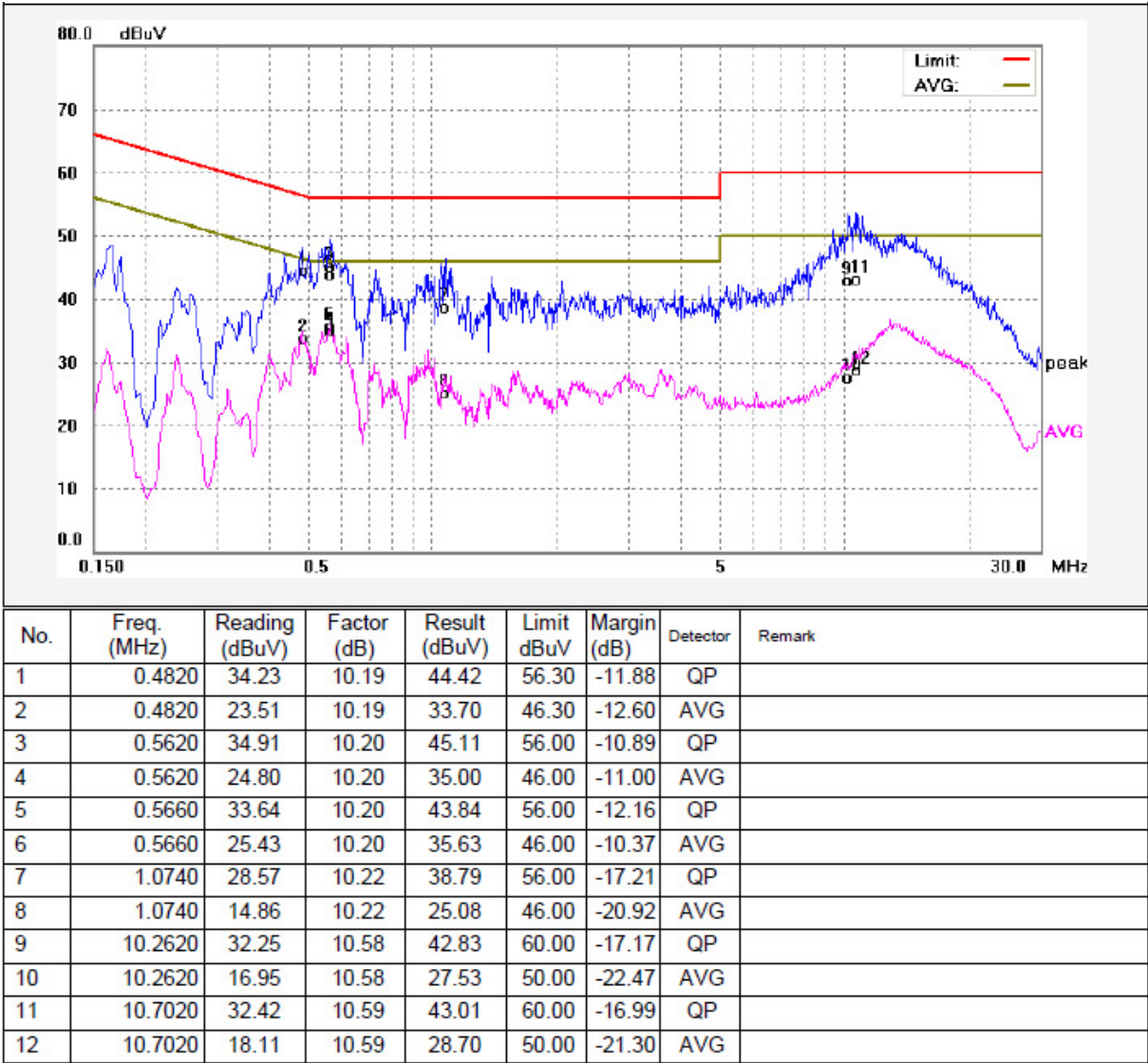


6.3 Measurement Description

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.

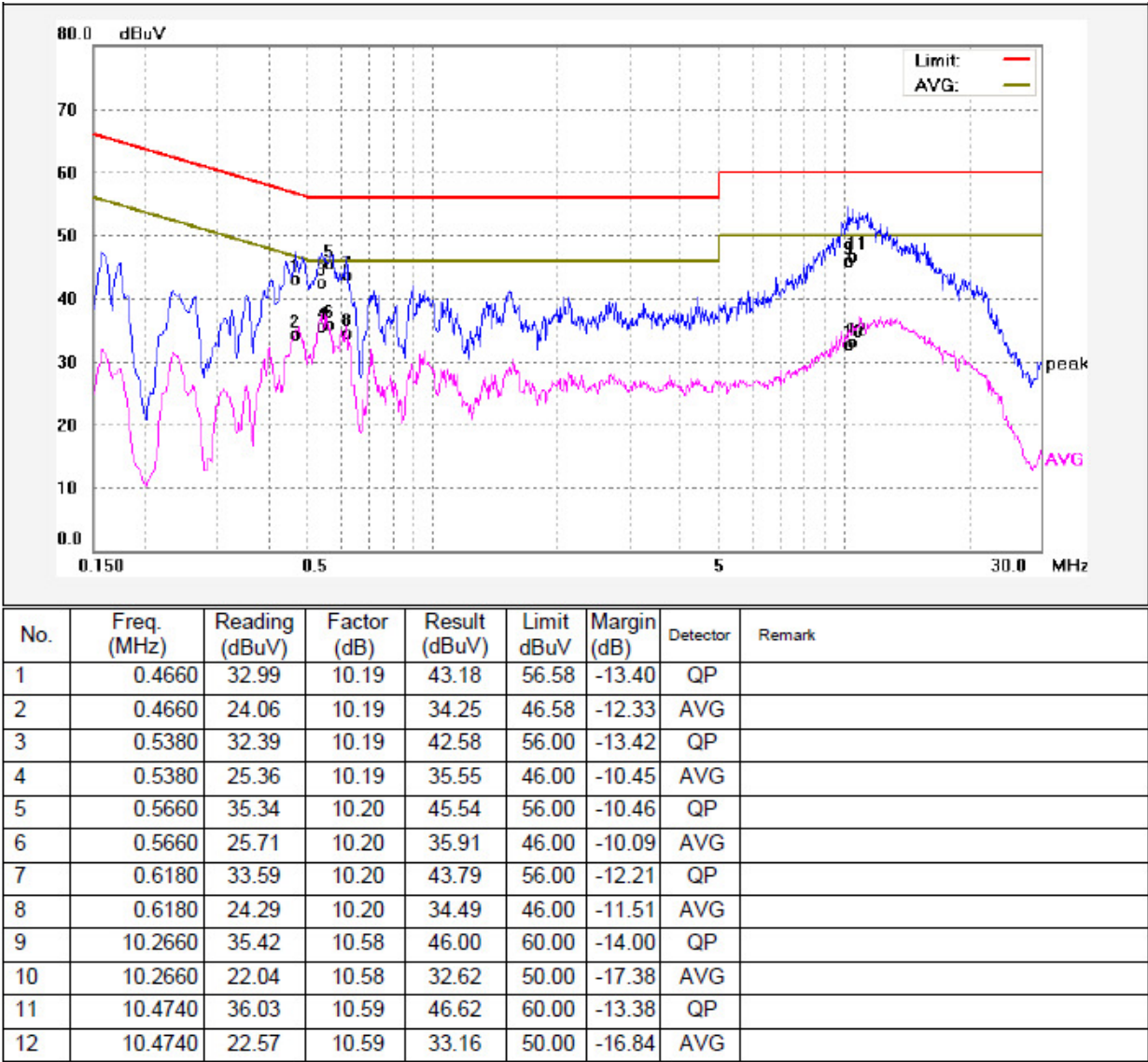
6.4 Conducted Emission Test Result

Live line:



Formulas: Factor=LISN Factor + Cable Loss

Neutral line:



Formulas: Factor=LISN Factor + Cable Loss

7 Radiated Emissions

Test Requirement: FCC CFR47 Part 15 Section 15.209 & 15.247

Test Method: 558074 D01 DTS Meas Guidance v03r04 & ANSI C63.10:2013

Test Result: PASS

Measurement Distance: 3m

Limit:

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	$20\log^{(500)}$

7.1 EUT Operation

Operating Environment:

Temperature: 25.5 °C

Humidity: 51 % RH

Atmospheric Pressure: 1016 mbar

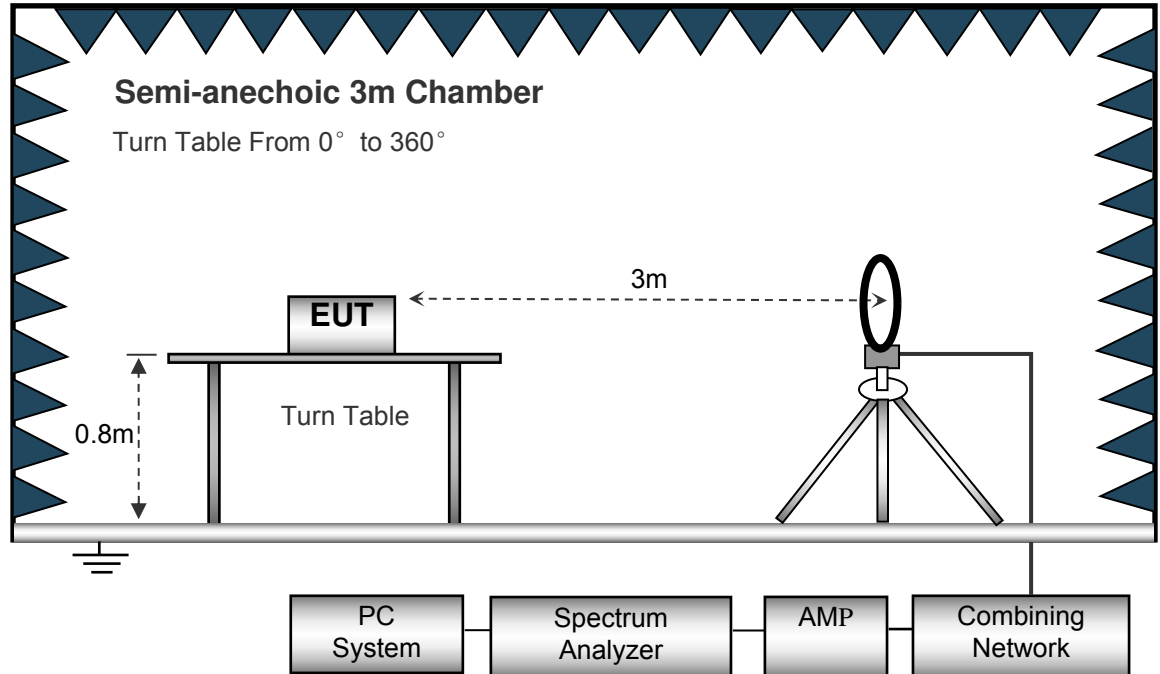
EUT Operation:

The test was performed in transmitting mode, the test data were shown in the report.

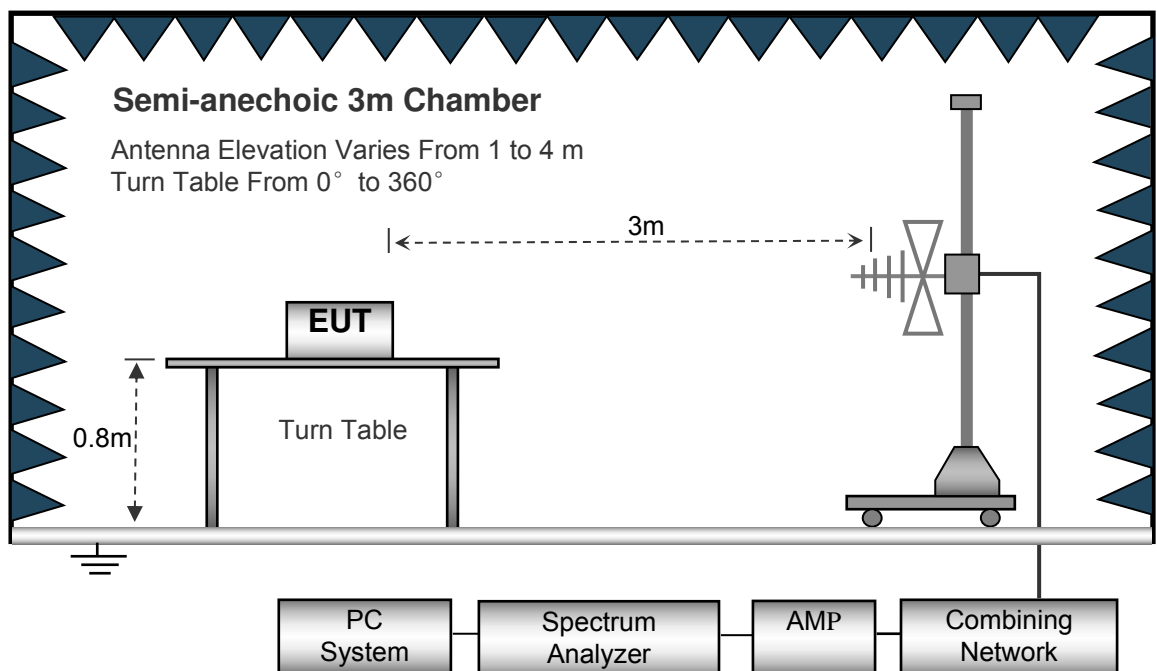
7.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10: 2013.

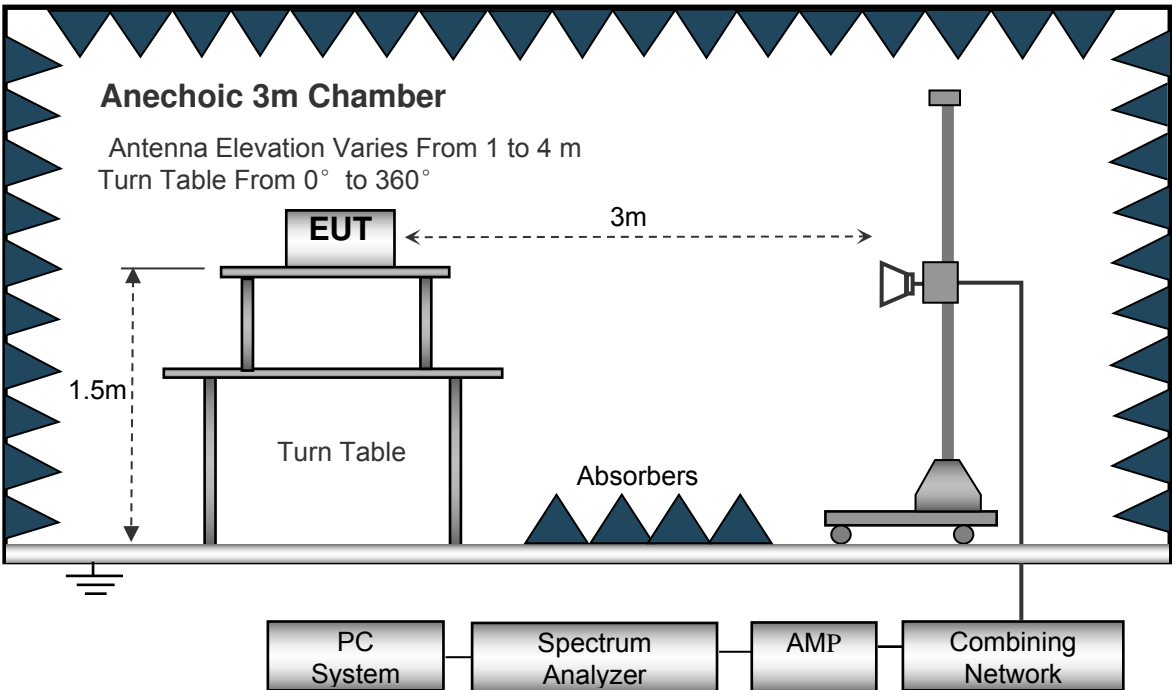
The test setup for emission measurement below 30MHz.



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

Below 30MHz

Sweep Speed..... Auto
IF Bandwidth..... 10kHz
Video Bandwidth..... 10kHz
Resolution Bandwidth..... 10kHz

30MHz ~ 1GHz

Sweep Speed..... Auto
Detector..... PK
Resolution Bandwidth..... 100kHz
Video Bandwidth..... 300kHz

Above 1GHz

Sweep Speed..... Auto
Detector..... PK
Resolution Bandwidth..... 1MHz
Video Bandwidth..... 3MHz
Detector..... Ave.
Resolution Bandwidth..... 1MHz
Video Bandwidth..... 10Hz

7.4 Test Procedure

1. The EUT is placed on a turntable. For below 1GHz, the EUT is 0.8m above ground plane; For above 1GHz, the EUT is 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.

7.5 Summary of Test Results

Test Frequency: 32.768KHz~ 30MHz

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

Test Frequency: 30MHz ~ 18GHz

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dB μ V)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)
GFSK(BLE) Low Channel									
268.32	37.73	QP	107	1.5	H	-13.35	24.38	46.00	-21.62
268.32	41.12	QP	102	1.8	V	-13.35	27.77	46.00	-18.23
4804.00	46.33	PK	303	1.1	V	-1.06	45.27	74.00	-28.73
4804.00	43.27	Ave	303	1.1	V	-1.06	42.21	54.00	-11.79
7206.00	41.39	PK	96	1.3	H	1.33	42.72	74.00	-31.28
7206.00	35.25	Ave	96	1.3	H	1.33	36.58	54.00	-17.42
2333.22	46.06	PK	216	1.8	V	-13.19	32.87	74.00	-41.13
2333.22	39.16	Ave	216	1.8	V	-13.19	25.97	54.00	-28.03
2381.92	42.15	PK	265	1.9	H	-13.14	29.01	74.00	-44.99
2381.92	36.60	Ave	265	1.9	H	-13.14	23.46	54.00	-30.54
2495.93	44.22	PK	206	1.8	V	-13.08	31.14	74.00	-42.86
2495.93	38.93	Ave	206	1.8	V	-13.08	25.85	54.00	-28.15

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK(BLE) Middle Channel									
268.32	38.00	QP	336	1.1	H	-13.35	24.65	46.00	-21.35
268.32	39.73	QP	245	1.1	V	-13.35	26.38	46.00	-19.62
4880.00	45.06	PK	238	1.3	V	-0.62	44.44	74.00	-29.56
4880.00	41.92	Ave	238	1.3	V	-0.62	41.30	54.00	-12.70
7320.00	40.27	PK	257	1.9	H	2.21	42.48	74.00	-31.52
7320.00	34.39	Ave	257	1.9	H	2.21	36.60	54.00	-17.40
2343.50	45.01	PK	140	1.3	V	-13.19	31.82	74.00	-42.18
2343.50	39.21	Ave	140	1.3	V	-13.19	26.02	54.00	-27.98
2366.52	42.86	PK	306	1.6	H	-13.14	29.72	74.00	-44.28
2366.52	37.97	Ave	306	1.6	H	-13.14	24.83	54.00	-29.17
2486.78	42.30	PK	231	1.9	V	-13.08	29.22	74.00	-44.78
2486.78	38.54	Ave	231	1.9	V	-13.08	25.46	54.00	-28.54

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK(BLE) High Channel									
268.32	38.08	QP	19	1.4	H	-13.35	24.73	46.00	-21.27
268.32	39.62	QP	357	1.4	V	-13.35	26.27	46.00	-19.73
4960.00	45.44	PK	188	1.4	V	-0.24	45.20	74.00	-28.80
4960.00	40.77	Ave	188	1.4	V	-0.24	40.53	54.00	-13.47
7440.00	39.49	PK	140	1.4	H	2.84	42.33	74.00	-31.67
7440.00	35.59	Ave	140	1.4	H	2.84	38.43	54.00	-15.57
2324.82	45.61	PK	203	1.9	V	-13.19	32.42	74.00	-41.58
2324.82	39.13	Ave	203	1.9	V	-13.19	25.94	54.00	-28.06
2358.48	44.29	PK	295	1.6	H	-13.14	31.15	74.00	-42.85
2358.48	38.13	Ave	295	1.6	H	-13.14	24.99	54.00	-29.01
2492.10	43.52	PK	83	2.0	V	-13.08	30.44	74.00	-43.56
2492.10	37.67	Ave	83	2.0	V	-13.08	24.59	54.00	-29.41

Test Frequency: 18GHz~25GHz

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

8 Band Edge Measurement

Test Requirement:	Section 15.247(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) and 15.205(c).
Test Method:	558074 D01 DTS Meas Guidance v03r04 January 7, 2016
Test Mode:	Transmitting

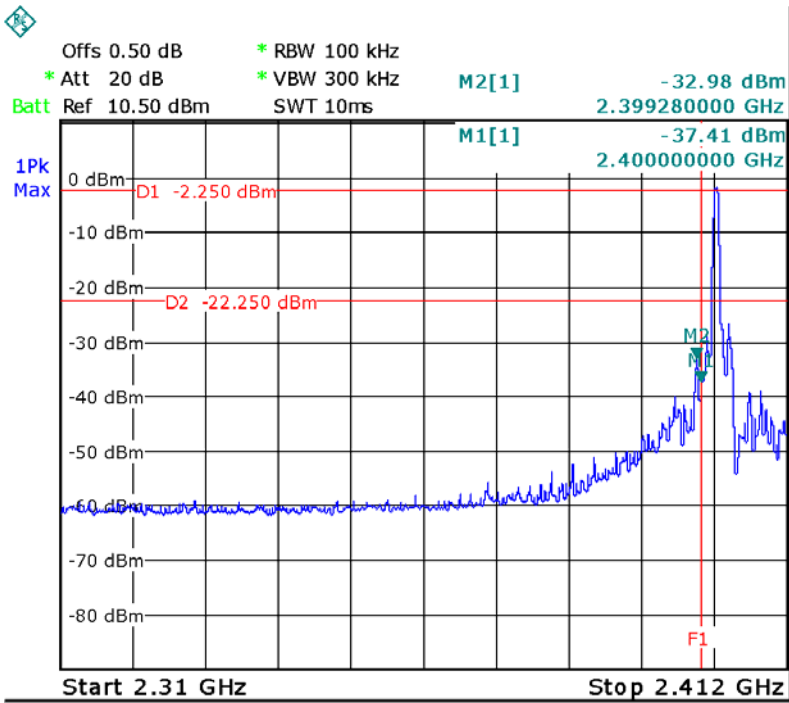
8.1 Test Produce

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto

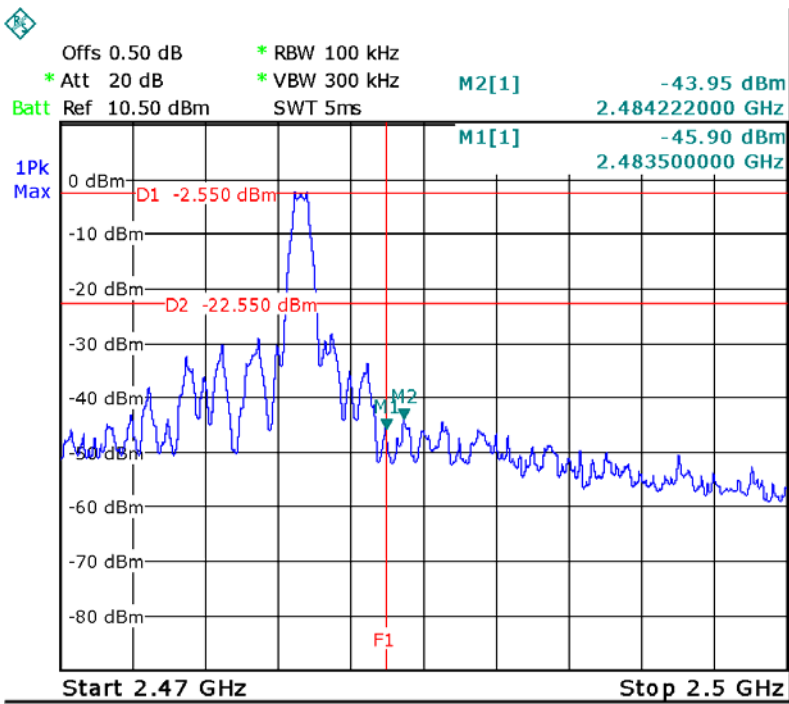
Detector function = peak, Trace = max hold
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

8.2 Test Result

Band edge-left side



Band edge-right side



9 Bandwidth Measurement

Test Requirement:

FCC CFR47 Part 15 Section 15.247

Test Method:

558074 D01 DTS Meas Guidance v03r04 January 7, 2016

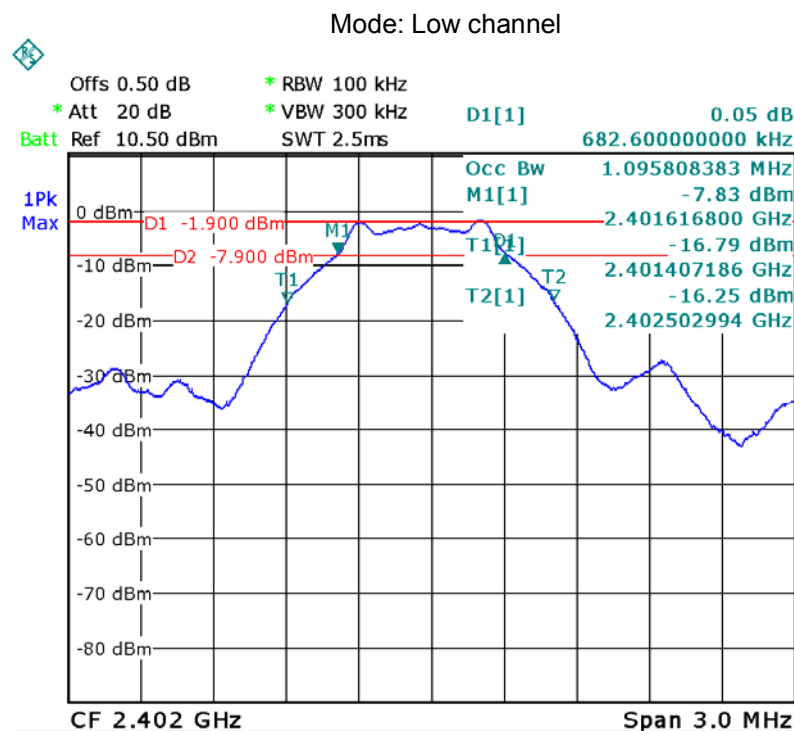
9.1 Test Procedure

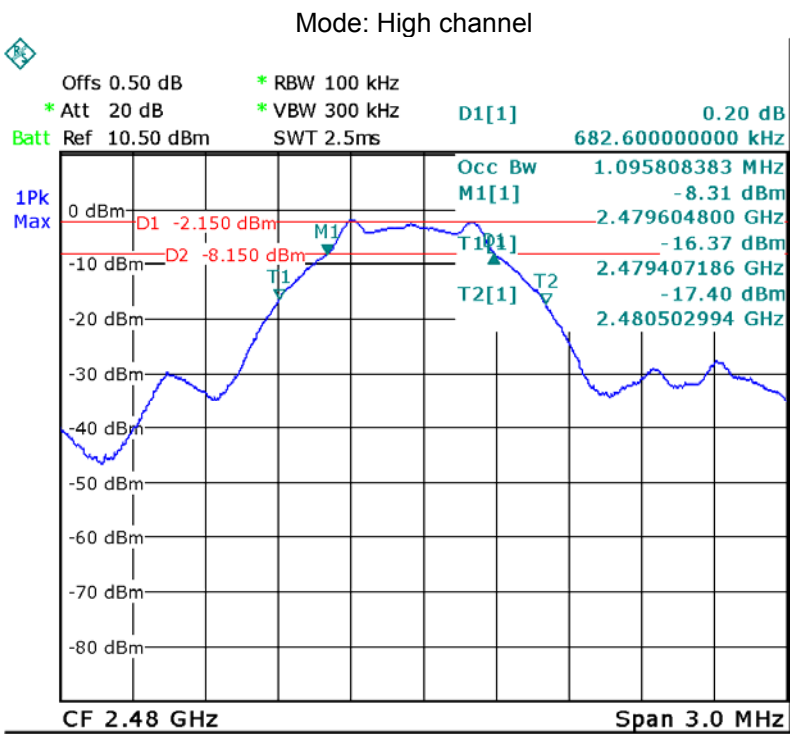
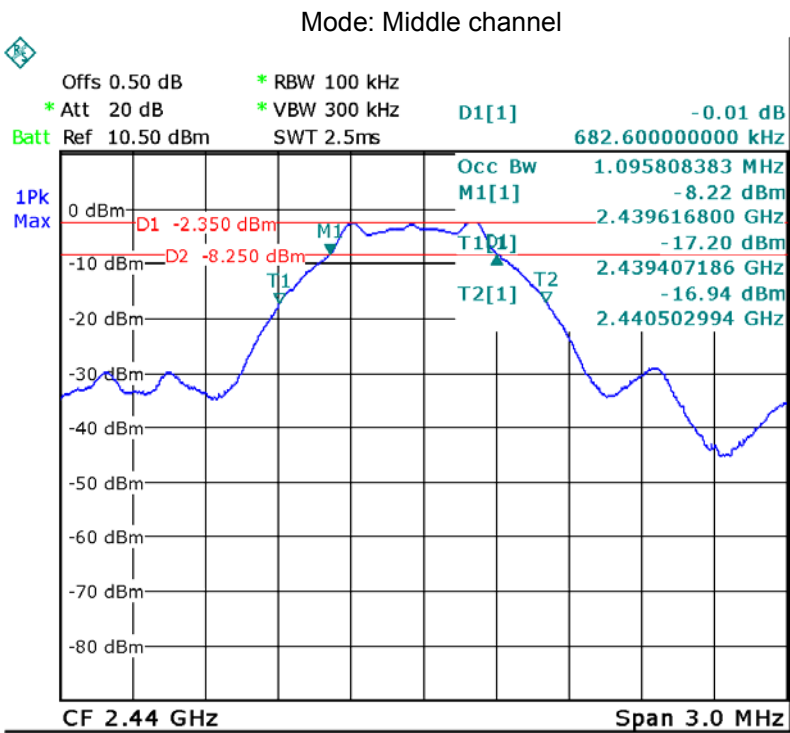
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz

9.2 Test Result:

Operation mode	6dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low channel	0.6826	1.0958
Middle channel	0.6826	1.0958
High channel	0.6826	1.0958

Test result plot as follows:





10 Maximum Peak Output Power

Test Requirement:

FCC CFR47 Part 15 Section 15.247

Test Method:

558074 D01 DTS Meas Guidance v03r04 January 7, 2016

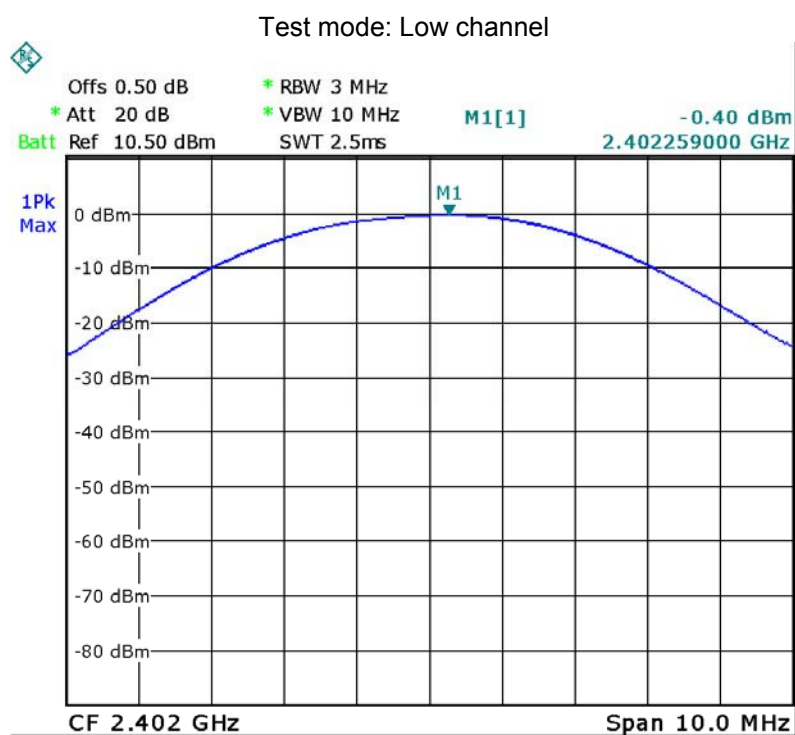
10.1 Test Procedure

558074 D01 DTS Meas Guidance v03r04 January 7, 2016 section 9.1.1

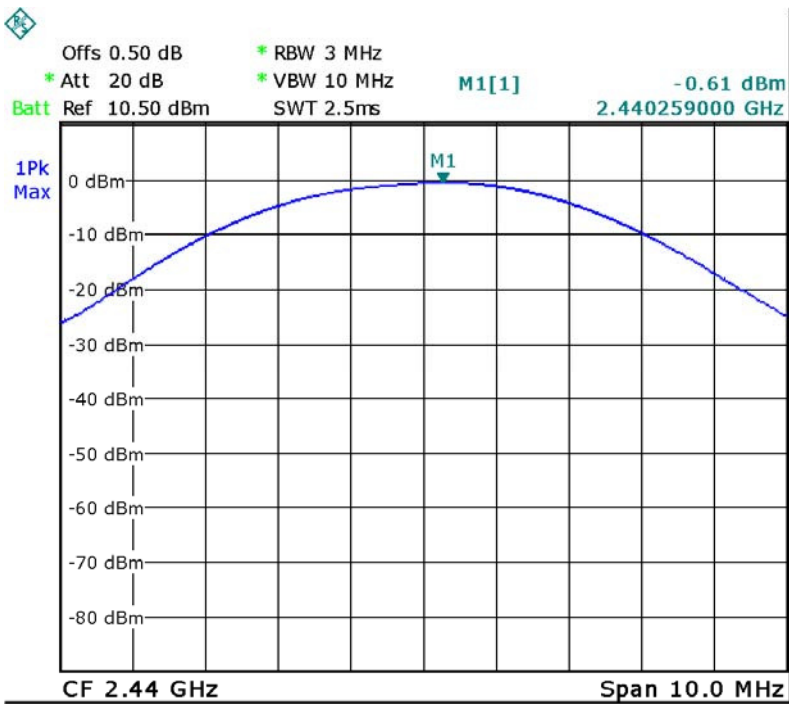
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3MHz. VBW = 10MHz. SPAN=10MHz. Sweep = auto; Detector Function = Peak,
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

10.2 Test Result

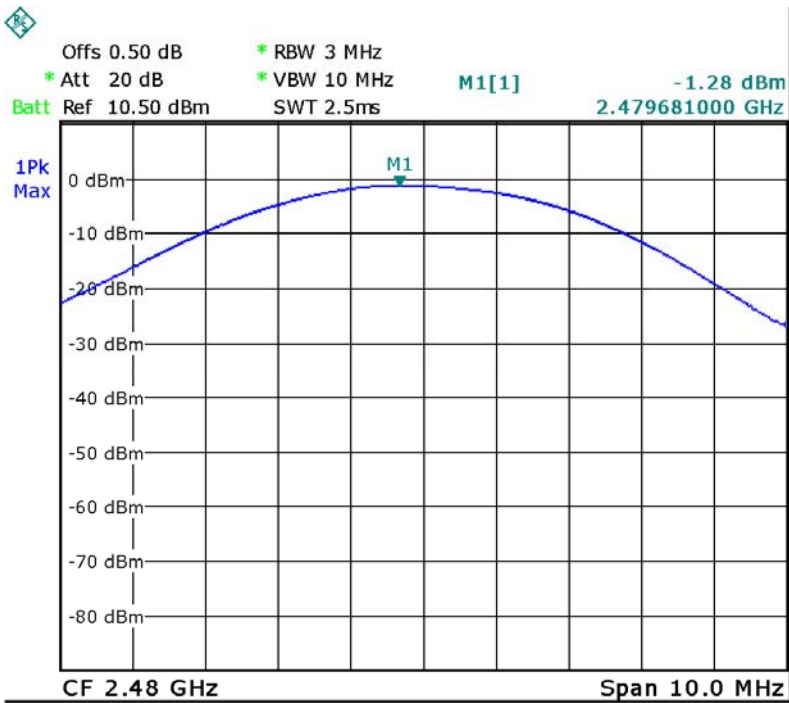
Maximum Peak Output Power (dBm)		
Low channel	Middle channel	High channel
-0.40	-0.61	-1.28
Limit : 1W/30dBm		



Test mode :Middle channel



Test mode: High channel



11 Power Spectral density

Test Requirement:

FCC CFR47 Part 15 Section 15.247

Test Method:

558074 D01 DTS Meas Guidance v03r04 January 7, 2016

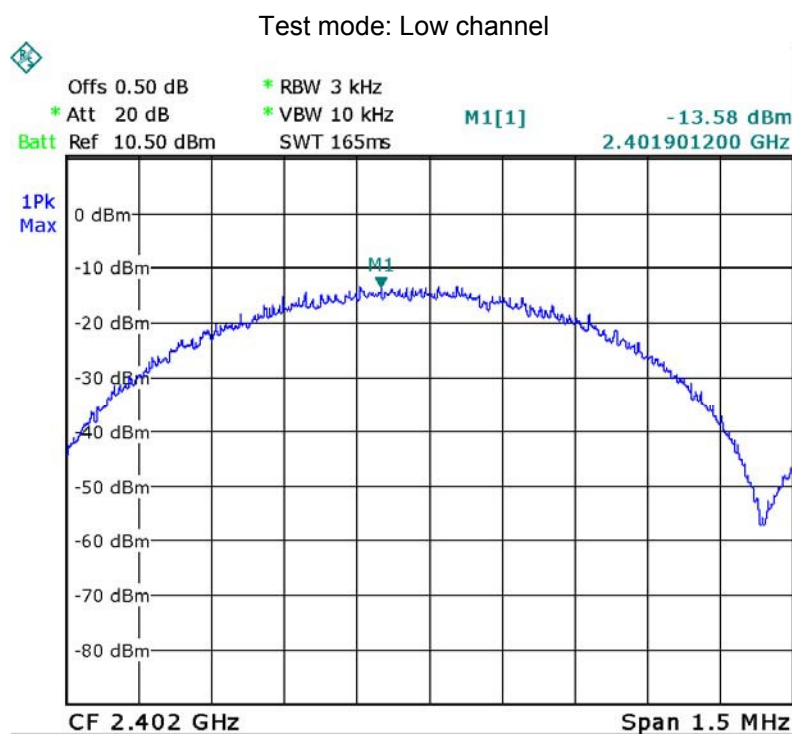
11.1 Test Procedure

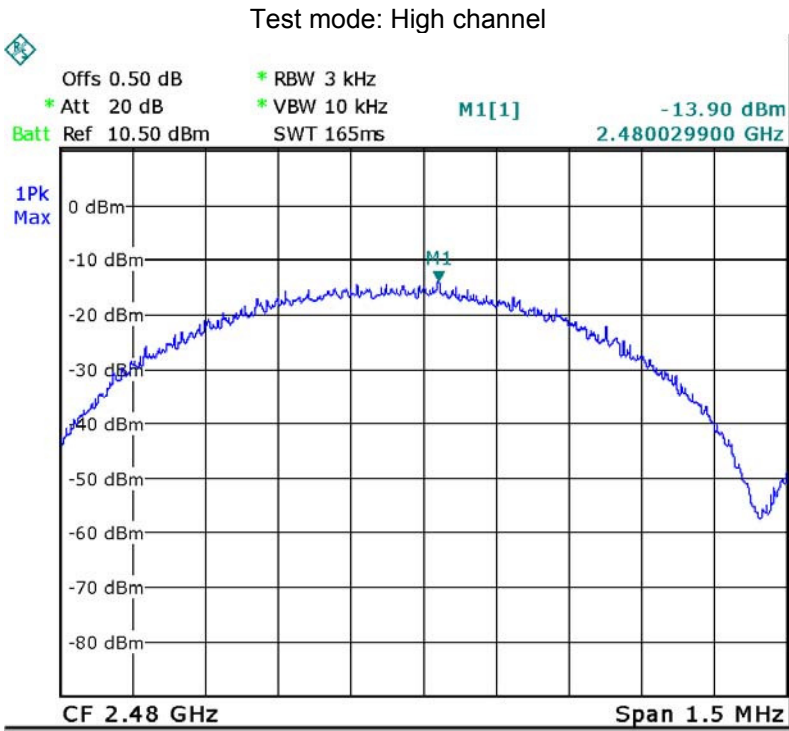
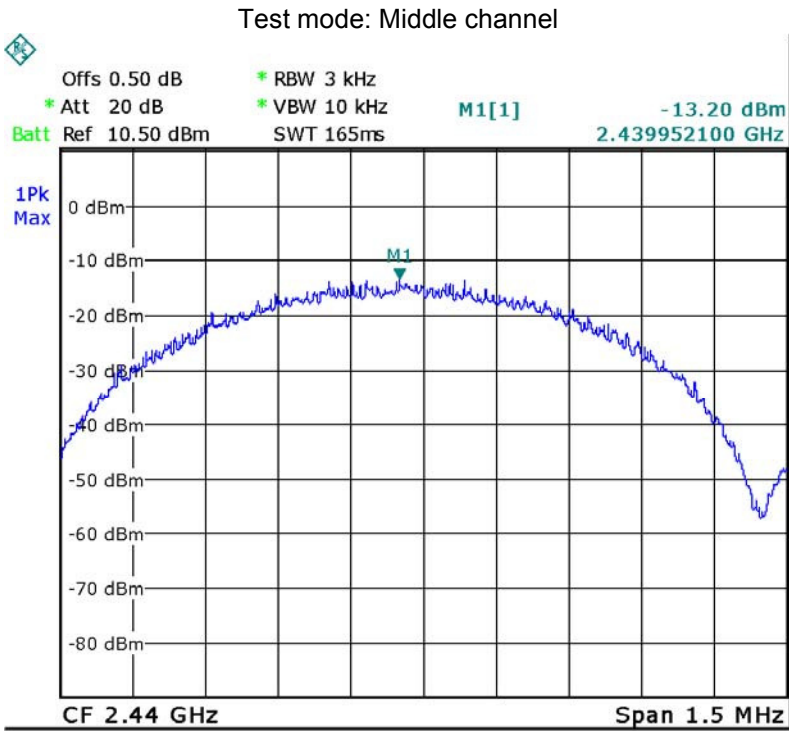
558074 D01 DTS Meas Guidance v03r04 January 7, 2016 section 10.2

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 = 3KHz. VBW = 10KHz , Span = 1.5 times the DTS channel bandwidth(6 dB bandwidth). Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section
Submit this plot.

11.2 Test Result

Power Spectral Density		
Low channel	Middle channel	High channel
-13.58	-13.20	-13.90
Limit : 8dBm per 3kHz		





12 Antenna Requirement

According to the FCC Part 15 Paragraph 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. This product has a Chip Antenna, fulfill the requirement of this section.

13 RF Exposure

Test Requirement: FCC Part 1.1307

Evaluation Method 447498 D01 General RF Exposure Guidance v05r02

13.1 Requirements

1) The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR where}$$

1. $f(\text{GHz})$ is the RF channel transmit frequency in GHz
2. Power and distance are rounded to the nearest mW and mm before calculation
3. The result is rounded to one decimal place for comparison

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

13.2 The procedures / limit

Conducted Peak power(dBm)	Conducted Peak power(mW)	Source-based time-averaged maximum conducted output power(mW)	Minimum test separation distance required for the exposure conditions (mm)	SAR Test Exclusion Thresholds(mW)
-0.40	0.912	0.912	5	10

Remark: Max. duty factor is 100%

Calculation formula: Source-based time-averaged maximum conducted output power(mW) = Conducted peak power(mW) * Duty factor

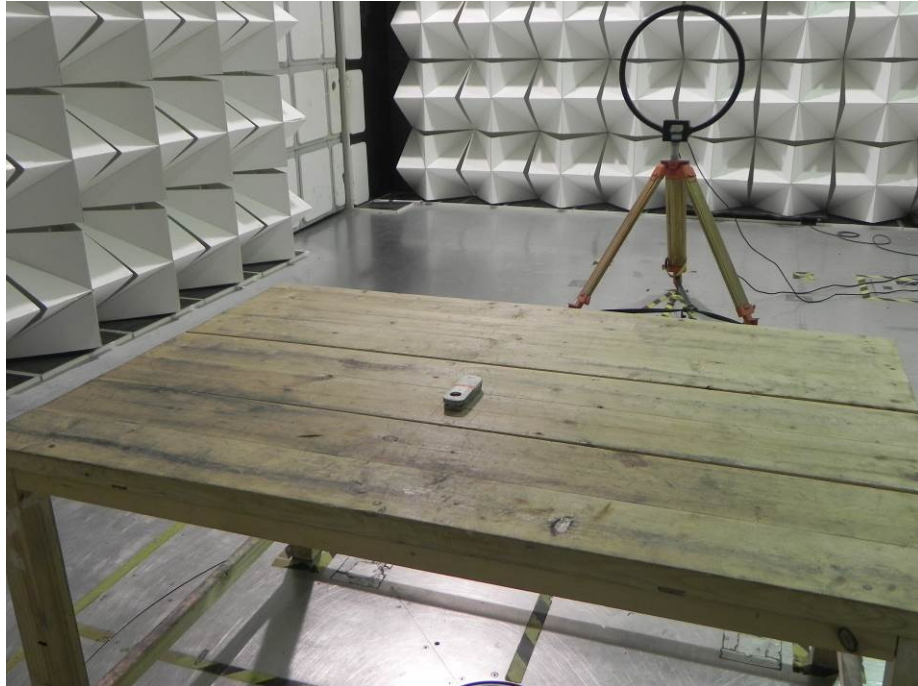
For frequency in 2.402GHz: SAR Test Exclusion Thresholds $\leq 3.0 / [\sqrt{f(\text{GHz})}] * (\text{min. test separation distance, mm}) = 3.0 / (\sqrt{2.402}) * 5 = 9.679 \text{ mW} \approx 10 \text{ mW}$

For frequency in 2.480GHz: SAR Test Exclusion Thresholds $\leq 3.0 / [\sqrt{f(\text{GHz})}] * (\text{min. test separation distance, mm}) = 3.0 / (\sqrt{2.480}) * 5 = 9.525 \text{ mW} \approx 10 \text{ mW}$

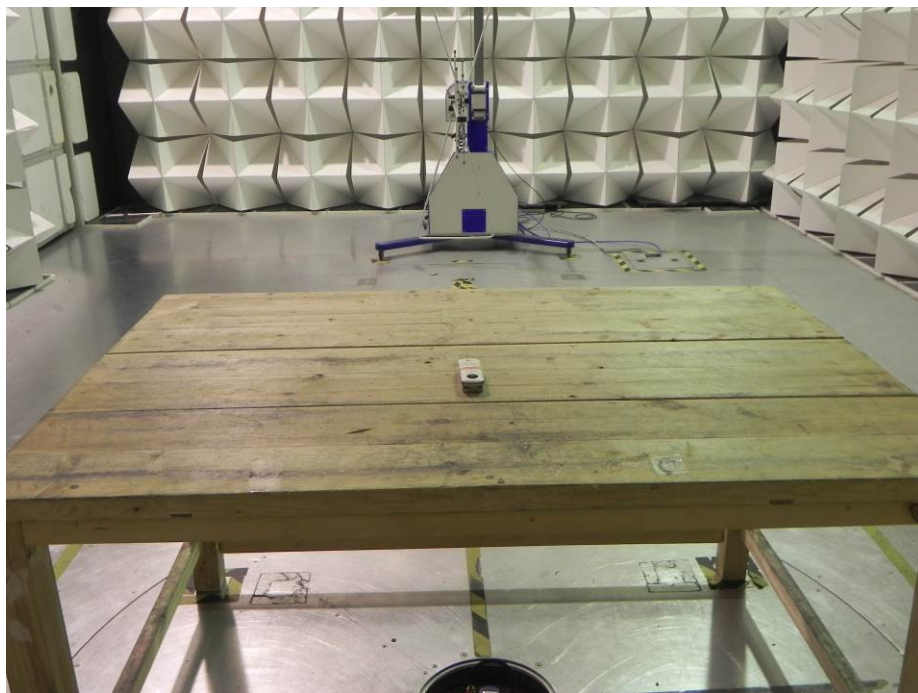
14 Photographs –Model 2.0 Test Setup

14.1 Photograph – Radiated Emission

Test frequency 32.768KHz to 30MHz Test Site 2#



Test frequency from 30MHz to 1GHz Test Site 2#



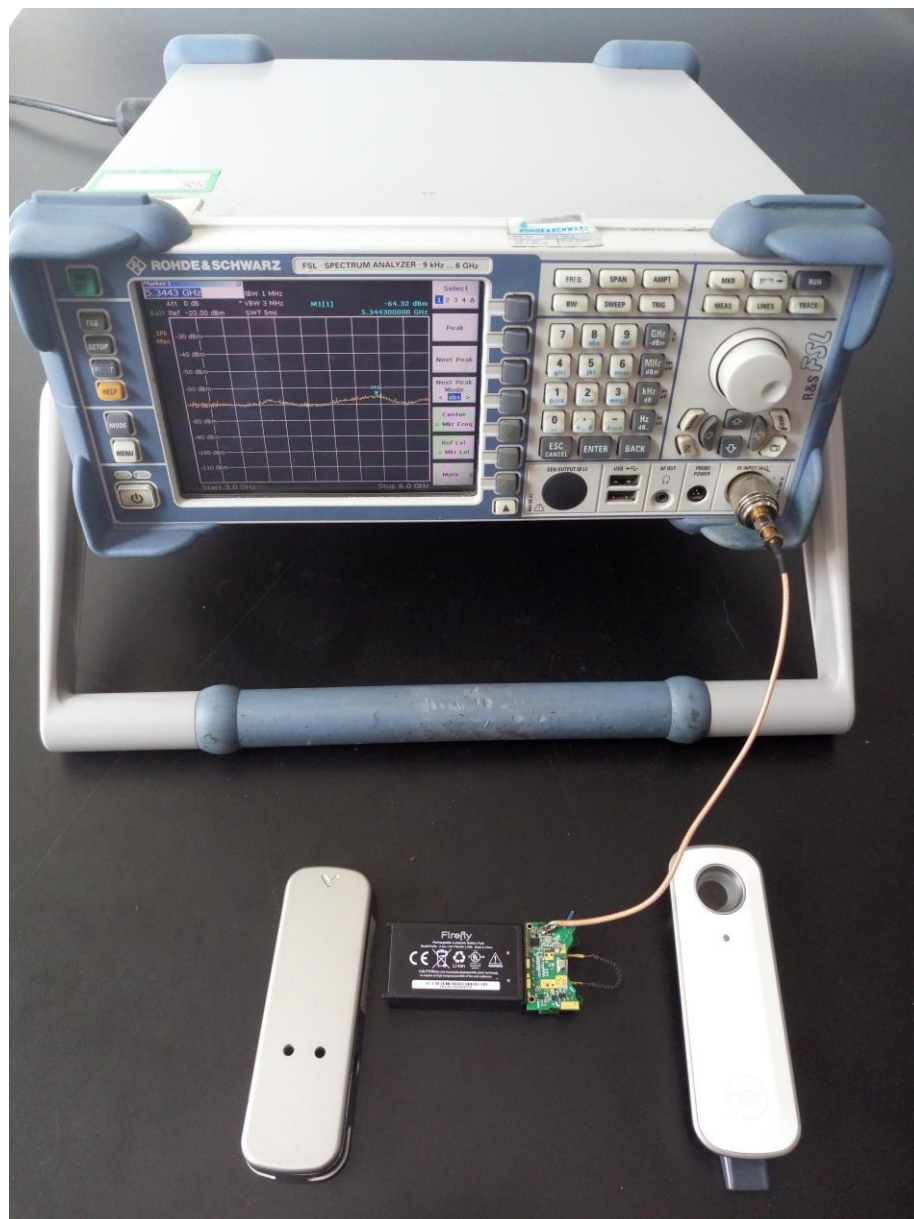
Test frequency above 1GHz Test Site 1#



14.2 Photograph – Conducted Emission Test Setup at Test Site 1#



14.3 Photograph – RF Conducted Test Setup



15 Photographs - Constructional Details

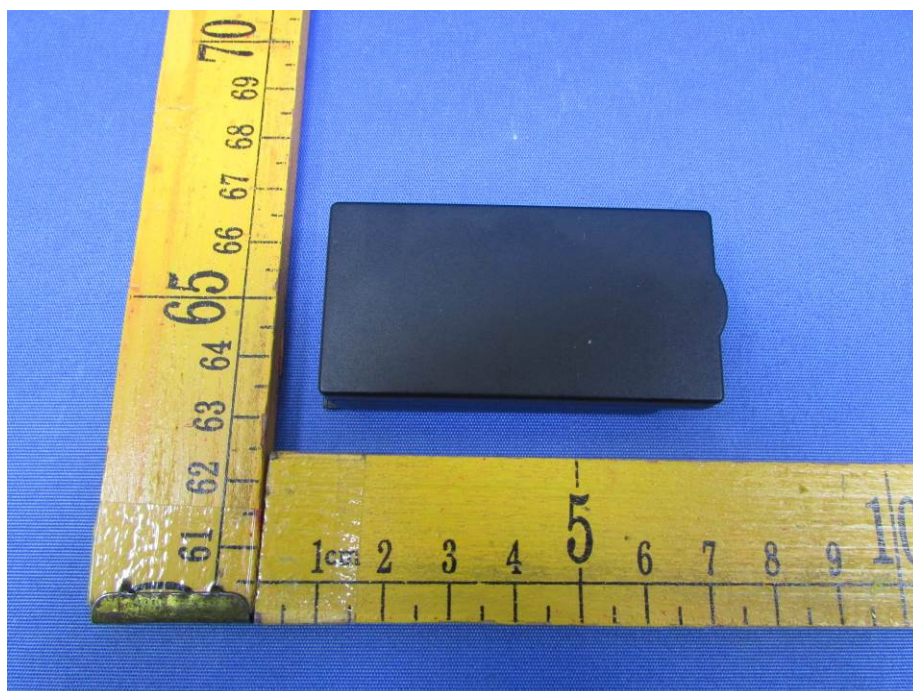
15.1 Model 2.0- External Photos





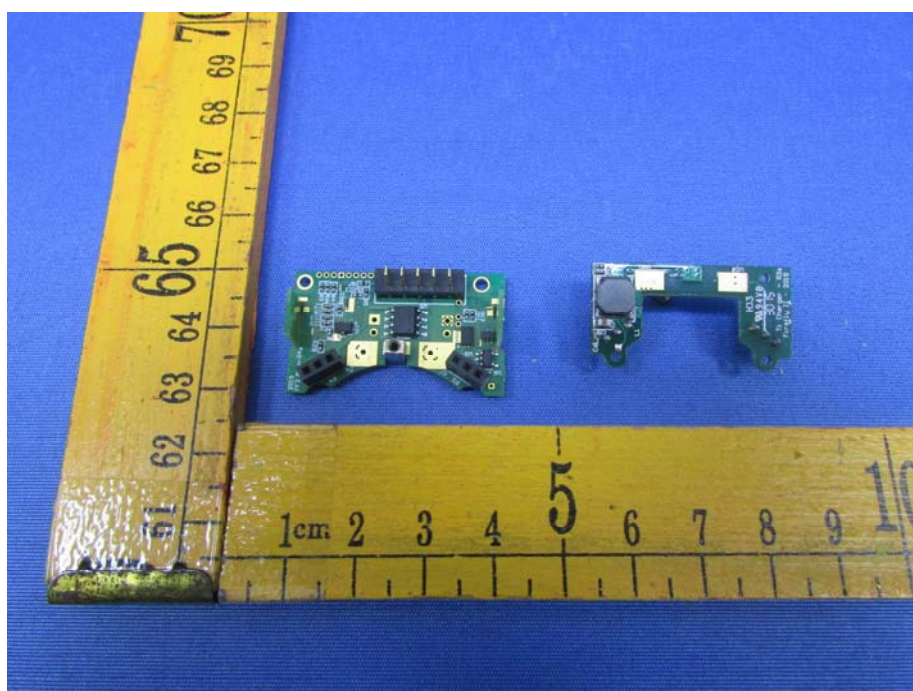
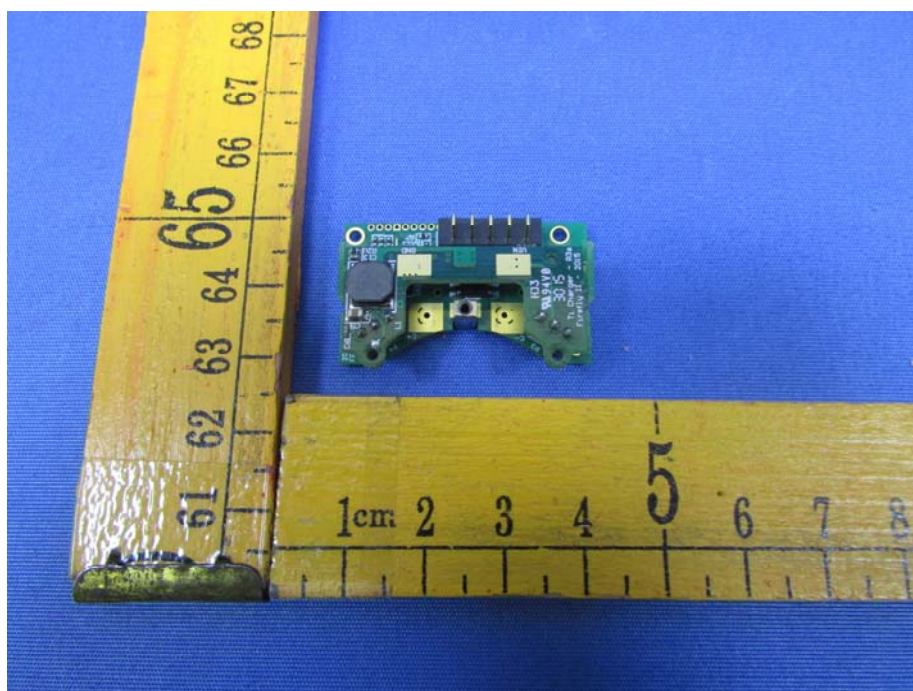


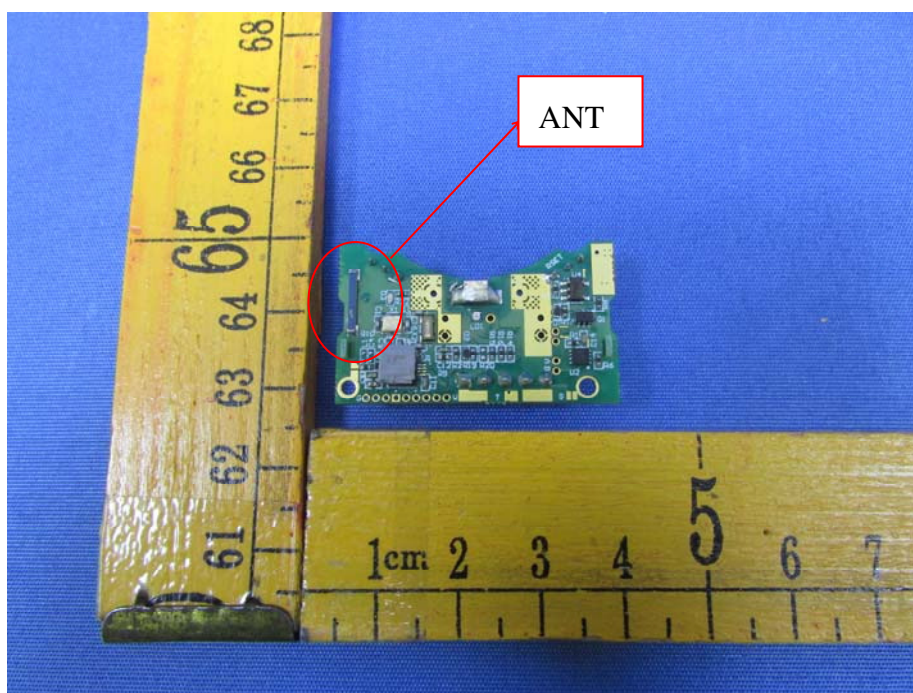
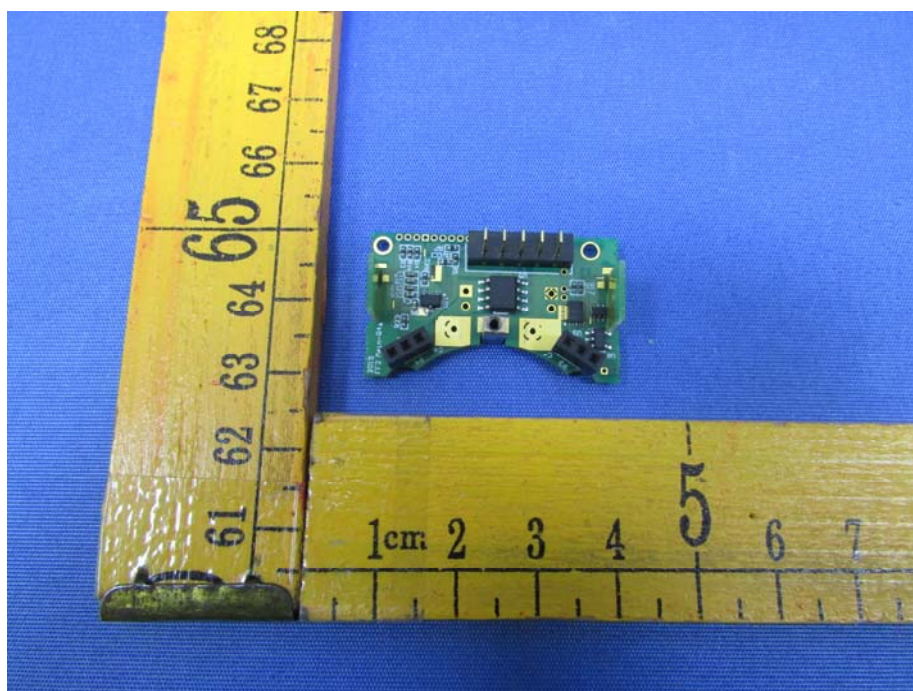


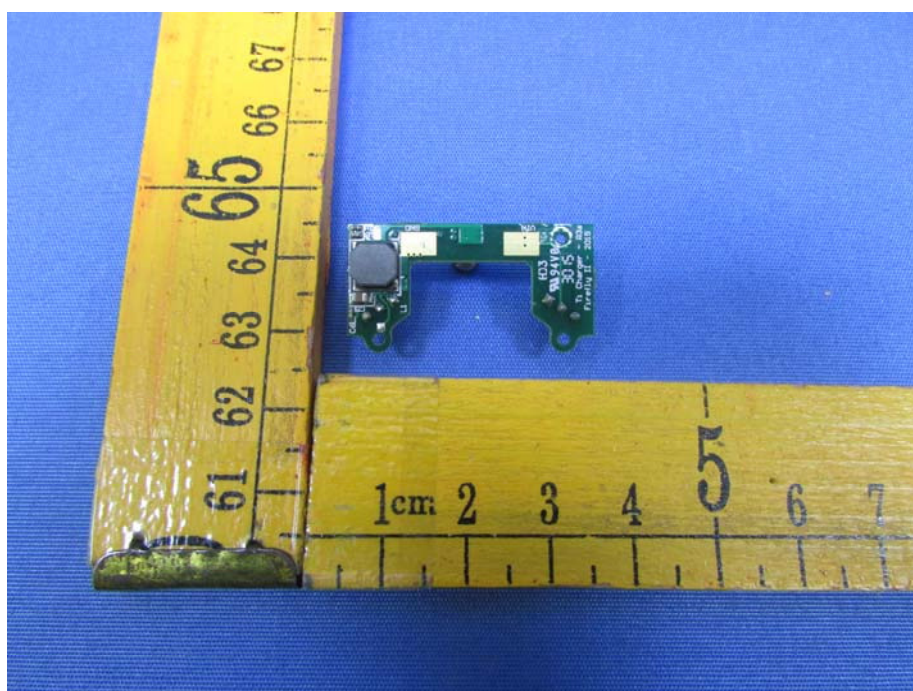
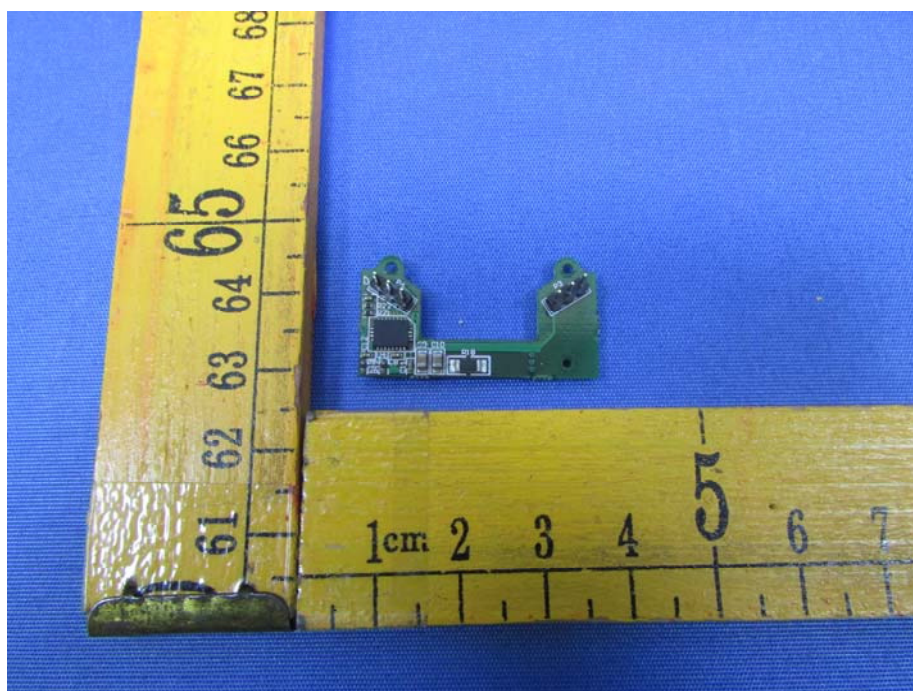


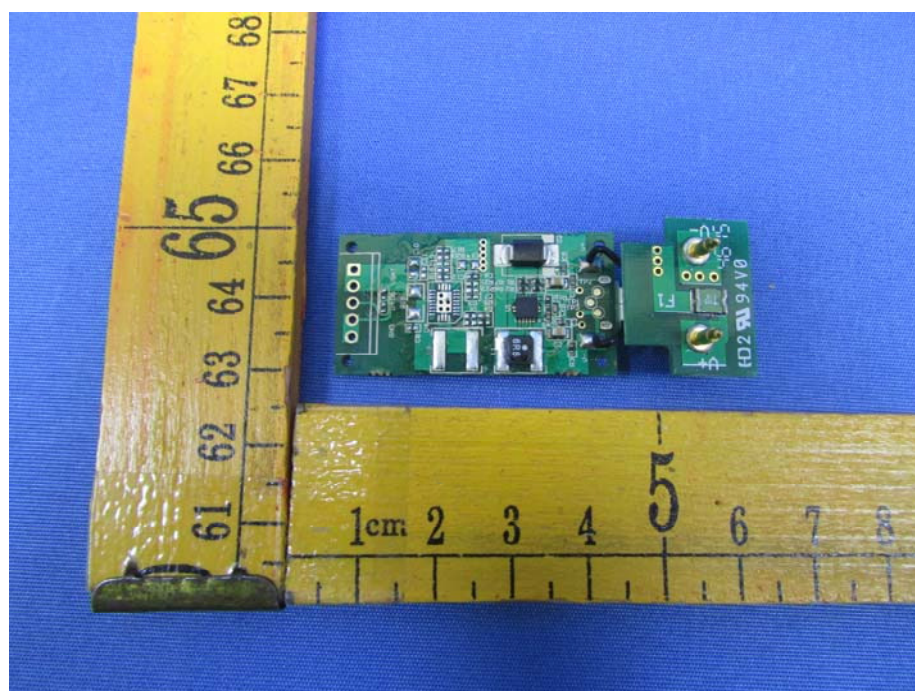
15.2 Model 2.0- Internal Photos

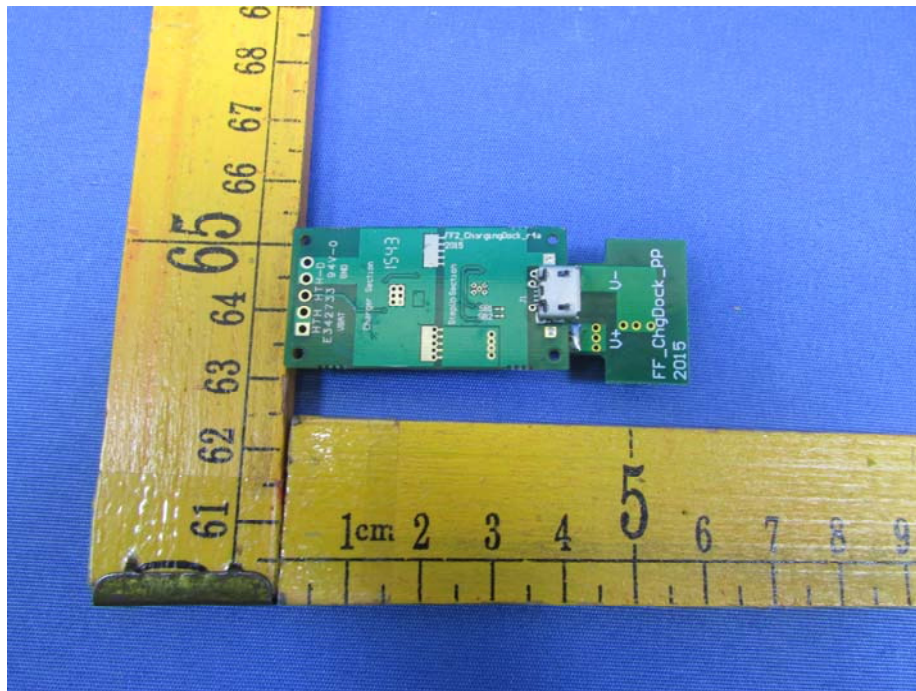












=====End of Report=====