

TEST REPORT

Reference No...... : WTS17S0579639E
FCC ID : 2AL9J-4687785
Applicant..... : REFCO Manufacturing Ltd.
Address..... : Industriestrasse 11, Hitzkirch CH6285, Switzerland
Manufacturer : ZHONGSHAN CYBERTECH VENTURES INC.
Address..... : 1FL., Building D, The Second industrial Zone, Nam Long Town,
: Zhongshan City, Guangdong, China
Product Name..... : TAP-CLAMP
Model No...... : 4687785
Standards..... : FCC CFR47 Part 15 Section C 15.247:2016
Date of Receipt sample : May 18, 2017
Date of Test : May 20 – Jun, 12, 2017
Date of Issue..... : Jun. 15, 2017
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.

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3 Revision History

Test report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTS17S0579639E	May 18, 2017	May 20 – Jun, 12, 2017	Jun. 15, 2017	original	-	Valid

4 General Information

4.1 General Description of E.U.T.

Product Name:	TAP-CLAMP
Model No.:	4687785
Model Difference:	N/A
Operation Frequency:	2402MHz ~ 2480MHz, separated by 2MHz,40 channels in total
The lowest oscillator:	32.768KHz
Type of modulation:	GFSK(BLE only)

4.2 Details of E.U.T.

Technical Data:	DC 4.5V by 3*1.5V size “AAA” Batteries
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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

Table 2 Tests carried out under FCC part 15.209

Test Item	Test Mode
Radiated Emissions	Transmitting

4.5 Test Facility

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

- **IC – Registration No.: 7760A**

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, July 12, 2012.

- **FCC Test Site– 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

3m Semi-anechoic Chamber for Radiation Emissions						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	Spectrum Analyzer	R&S	FSP	100091	Apr. 29, 2017	Apr. 28, 2018
2	Amplifier	Agilent	8447D	2944A10178	Jan. 12, 2017	Jan. 11, 2018
3	Active Loop Antenna	Beijing Dazhi	ZN30900A	0703	Oct. 17, 2016	Oct. 16, 2017
4	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	Apr. 07, 2017	Apr. 06, 2018
5	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	Sep.12, 2016	Sep.11, 2017
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	Apr. 07, 2017	Apr. 06, 2018
7	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	Apr. 07, 2017	Apr. 06, 2018
8	Coaxial Cable (above 1GHz)	Top	1GHz-18GHz	EW02014-7	Apr. 07, 2017	Apr. 06, 2018
9	Test Receiver	R&S	ESCI	101296	Apr. 06, 2017	Apr. 05, 2018
10	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	Apr. 07, 2017	Apr. 06, 2018
11	Amplifier	ANRITSU	MH648A	M43381	Apr. 07, 2017	Apr. 06, 2018
12	Cable	HUBER+SUHNER	CBL2	525178	Apr. 07, 2017	Apr. 06, 2018
RF Conducted Testing						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	Signal Generater	R&S	SMB100A	105942	Sep.12, 2016	Sep.11, 2017
2.	RF Power Amplifier	BONN Elektronik	BLWA0830-160/100/40D	128740	Sep.12, 2016	Sep.11, 2017
3.	Gestockte Breitband (S tacked) Log.-per.Antenna	SCHWARZBECK	STLP9128D	043	Sep.12, 2016	Sep.11, 2017
4.	Power Meter	R&S	NRP2	102031	Sep.12, 2016	Sep.11, 2017

5.2 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)

5.3 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 Test Summary

Test Items	Test Requirement	Result
Radiated Emissions	15.205(a) 15.209(a) 15.247	C
Conducted Emissions	15.207(a)	N/A
Bandwidth Measurement	15.247(a)(2)	C
Maximum Peak Output Power	15.247(b)(3),(4)	C
Power Spectral Density	15.247(e)	C
Band Edge	15.247(d)	C
Antenna Requirement	15.203	C
SAR Evaluation	1.1307(b)(1)	C
Note: C=Compliance; NC=Not Compliance; NT=Not Tested; N/A=Not Applicable.		

7 Radiated Emissions

Test Requirement: FCC CFR47 Part 15 Section 15.209 & 15.247& 15.205

Test Method: ANSI C63.10:2013,ANSI C63.4:2014

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

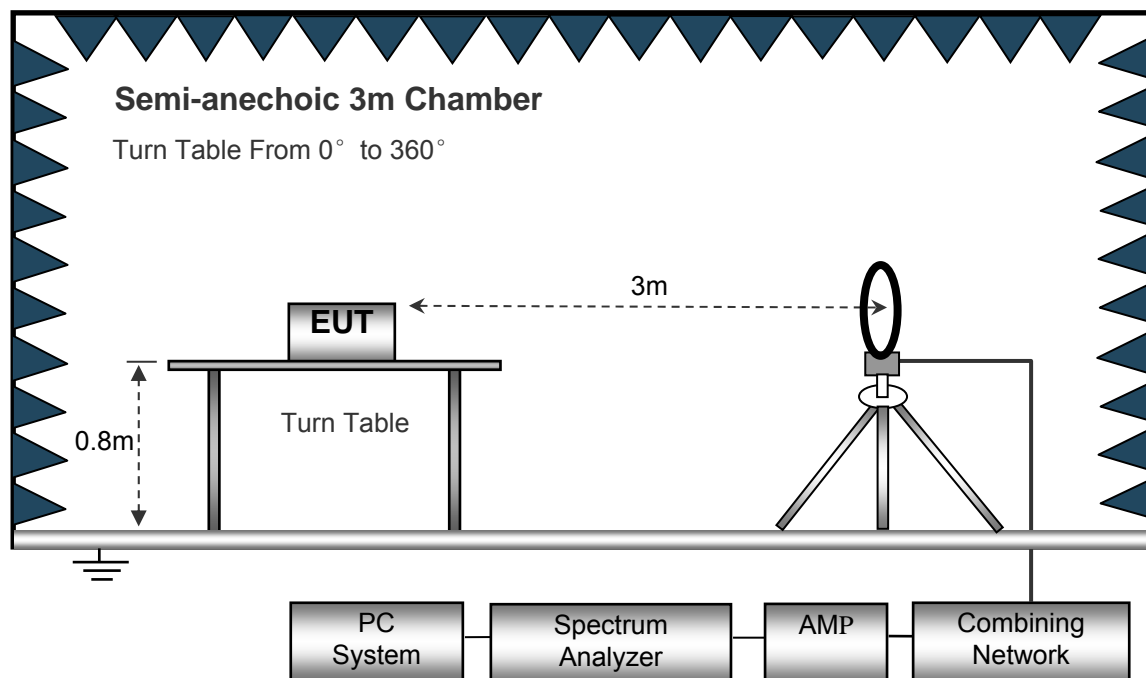
EUT Operation:

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

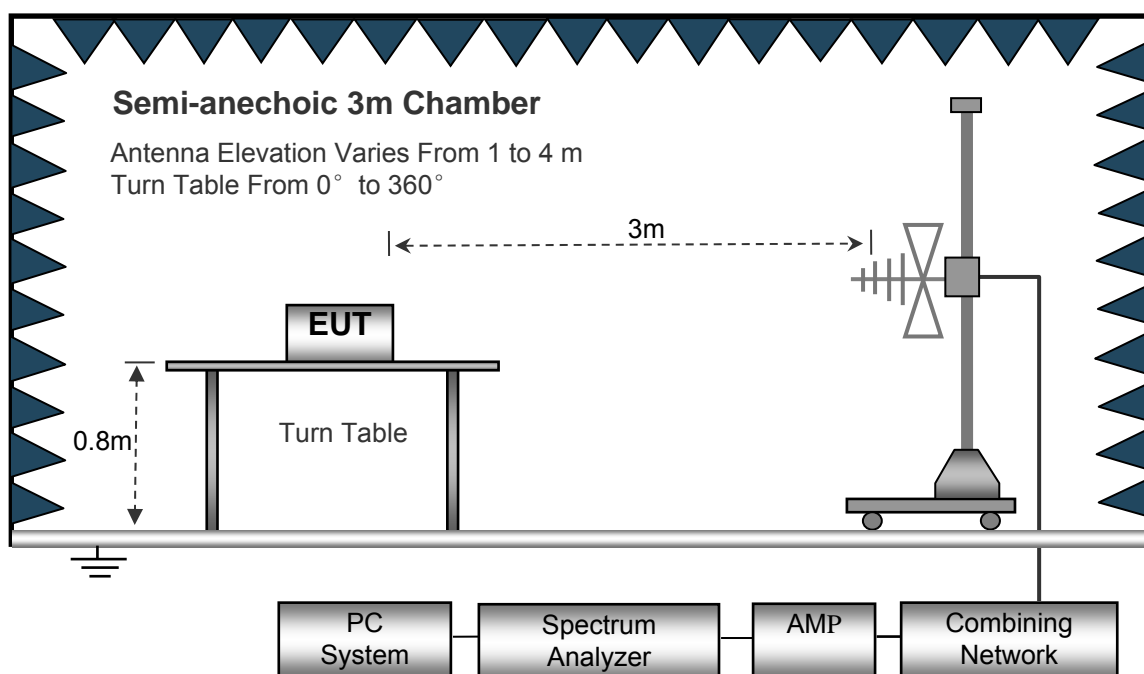
7.2 Test Setup

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

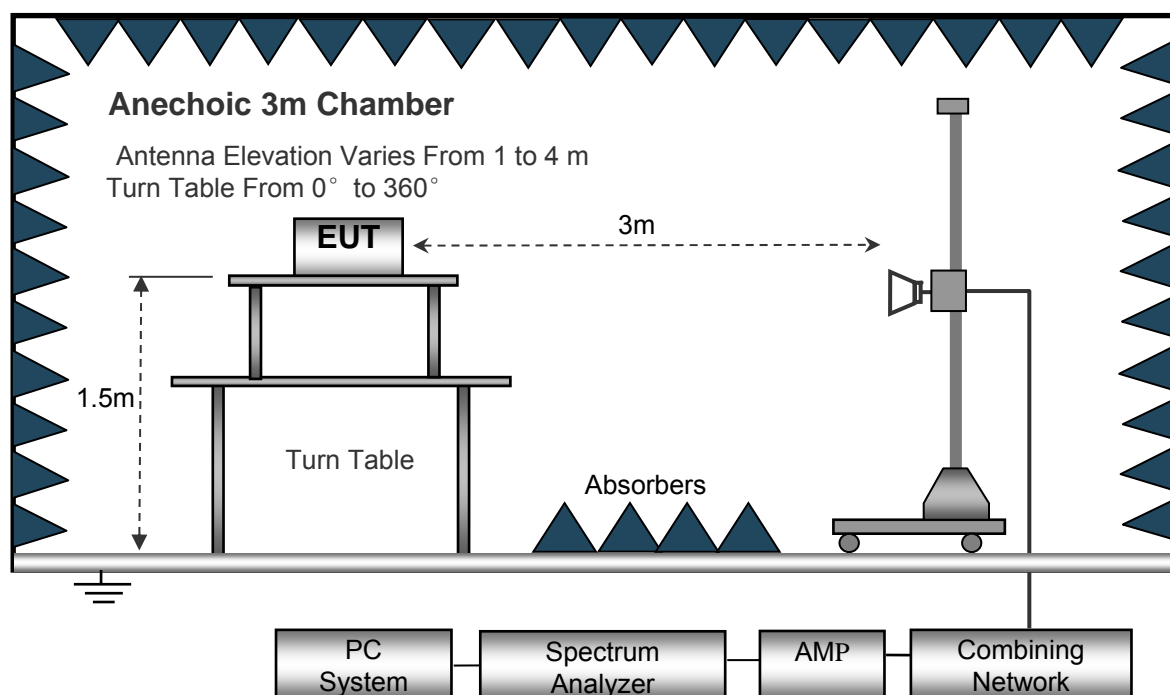
The test setup for emission measurement below 30MHz.



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.
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 performed in X,Y and Z axis positioning(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand),the worst condition was tested putting the eut in X axis,so the worst data were shown as follow.
8. A 2.4GHz high -pass filter is used during radiated emissions above 1GHz measurement.

7.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

The "Margin" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{Limit}$$

7.6 Summary of Test Results

Test Frequency: 9KHz ~ 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)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Low Channel									
252.06	35.28	QP	31	1.3	H	-13.35	21.93	46.00	-24.07
252.06	40.89	QP	329	1.2	V	-13.35	27.54	46.00	-18.46
4804.00	44.56	PK	260	1.6	V	-1.06	43.50	74.00	-30.50
4804.00	42.87	Ave	260	1.6	V	-1.06	41.81	54.00	-12.19
7206.00	41.33	PK	302	1.6	H	1.33	42.66	74.00	-31.34
7206.00	36.78	Ave	302	1.6	H	1.33	38.11	54.00	-15.89
2344.67	45.44	PK	275	1.8	V	-13.19	32.25	74.00	-41.75
2344.67	39.36	Ave	275	1.8	V	-13.19	26.17	54.00	-27.83
2369.93	44.24	PK	122	1.0	H	-13.14	31.10	74.00	-42.90
2369.93	37.57	Ave	122	1.0	H	-13.14	24.43	54.00	-29.57
2483.57	43.31	PK	301	1.0	V	-13.08	30.23	74.00	-43.77
2483.57	36.73	Ave	301	1.0	V	-13.08	23.65	54.00	-30.35

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 Middle Channel									
252.06	37.09	QP	24	1.7	H	-13.35	23.74	46.00	-22.26
252.06	42.45	QP	203	1.0	V	-13.35	29.10	46.00	-16.90
4882.00	46.20	PK	267	1.5	V	-0.62	45.58	74.00	-28.42
4882.00	42.23	Ave	267	1.5	V	-0.62	41.61	54.00	-12.39
7323.00	38.90	PK	272	1.2	H	2.21	41.11	74.00	-32.89
7323.00	34.56	Ave	272	1.2	H	2.21	36.77	54.00	-17.23
2333.97	46.19	PK	96	1.6	V	-13.19	33.00	74.00	-41.00
2333.97	39.02	Ave	96	1.6	V	-13.19	25.83	54.00	-28.17
2360.65	43.67	PK	311	1.8	H	-13.14	30.53	74.00	-43.47
2360.65	37.69	Ave	311	1.8	H	-13.14	24.55	54.00	-29.45
2496.87	44.80	PK	217	1.5	V	-13.08	31.72	74.00	-42.28
2496.87	38.94	Ave	217	1.5	V	-13.08	25.86	54.00	-28.14

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 High Channel									
252.06	38.22	QP	343	1.4	H	-13.35	24.87	46.00	-21.13
252.06	42.56	QP	314	1.9	V	-13.35	29.21	46.00	-16.79
4960.00	43.89	PK	306	1.9	V	-0.24	43.65	74.00	-30.35
4960.00	40.39	Ave	306	1.9	V	-0.24	40.15	54.00	-13.85
7440.00	39.26	PK	208	1.6	H	2.84	42.10	74.00	-31.90
7440.00	36.23	Ave	208	1.6	H	2.84	39.07	54.00	-14.93
2313.02	45.73	PK	201	1.5	V	-13.19	32.54	74.00	-41.46
2313.02	37.91	Ave	201	1.5	V	-13.19	24.72	54.00	-29.28
2382.06	44.38	PK	288	1.7	H	-13.14	31.24	74.00	-42.76
2382.06	36.15	Ave	288	1.7	H	-13.14	23.01	54.00	-30.99
2493.14	44.96	PK	122	1.2	V	-13.08	31.88	74.00	-42.12
2493.14	38.45	Ave	122	1.2	V	-13.08	25.37	54.00	-28.63

Test Frequency: 18GHz~25GHz

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

8 Band Edge Measurement

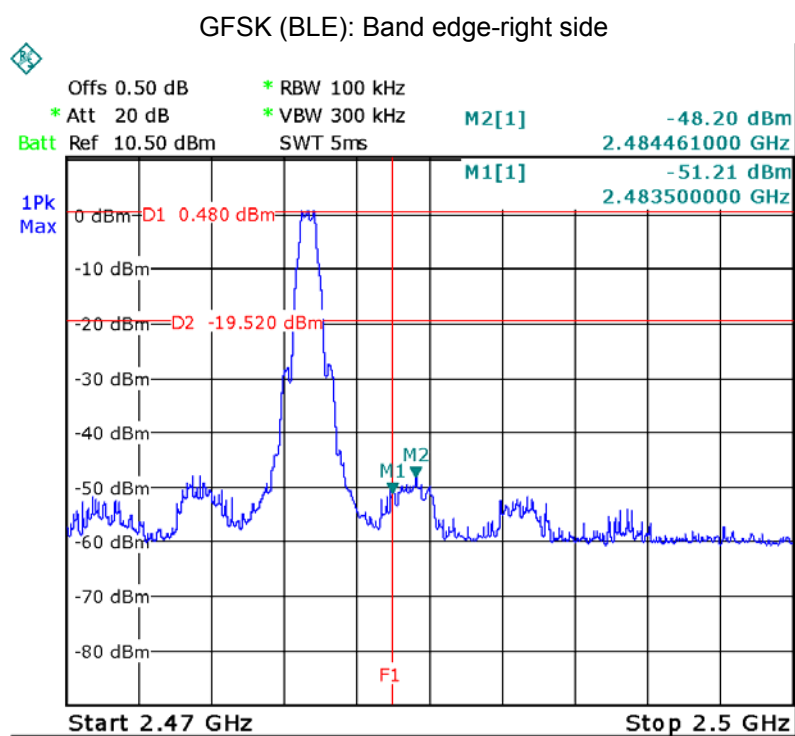
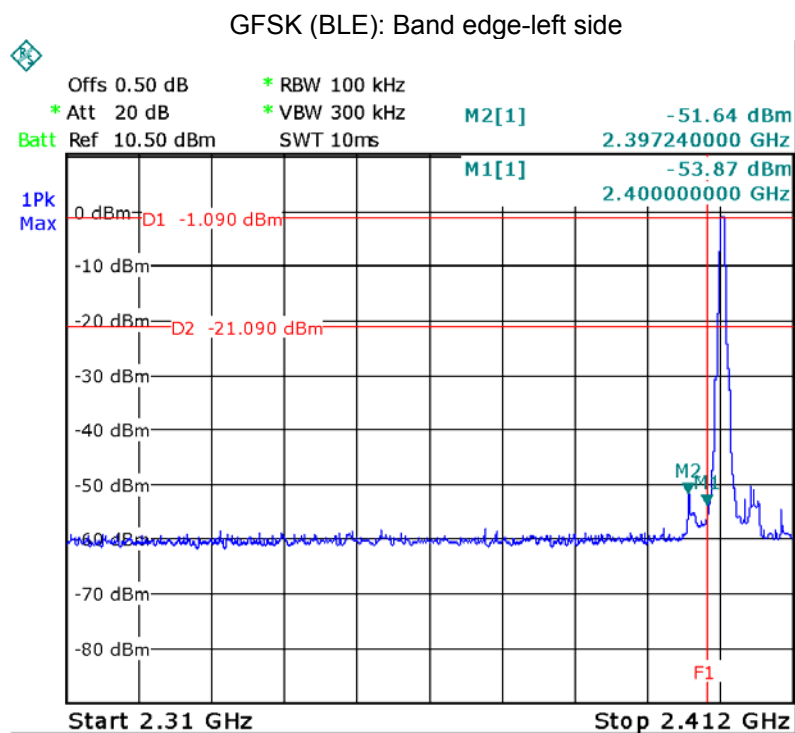
Test Requirement:	Section 15.247(d) In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) and 15.205(c).
Test Method:	558074 D01 DTS Meas Guidance v04, April 5, 2017
Test Limit:	Regulation 15.247 (d), In any 100 kHz 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 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
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



9 Bandwidth Measurement

Test Requirement:

FCC CFR47 Part 15 Section 15.247

Test Method:

558074 D01 DTS Meas Guidance v04, April 5, 2017

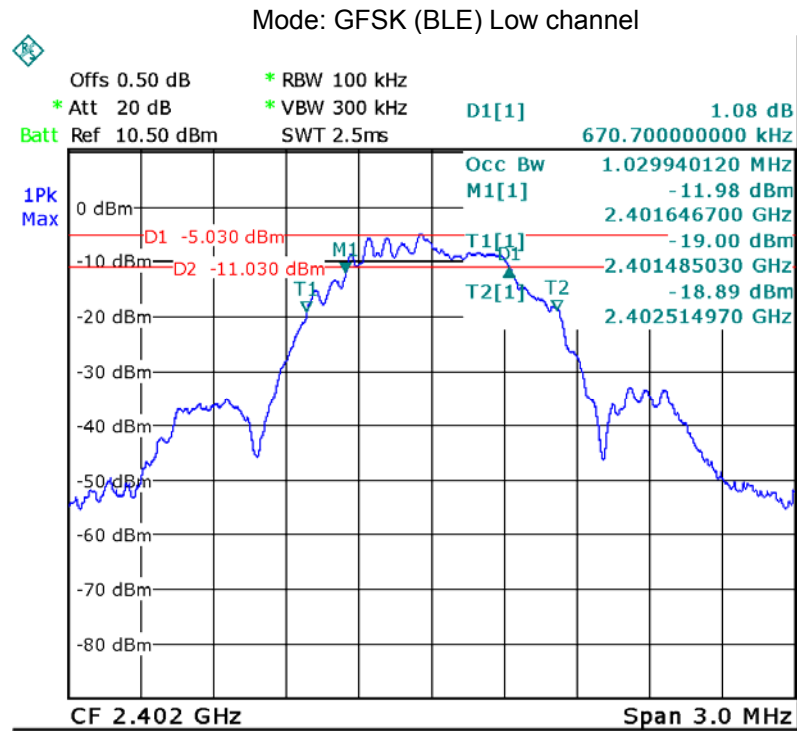
9.1 Test Procedure

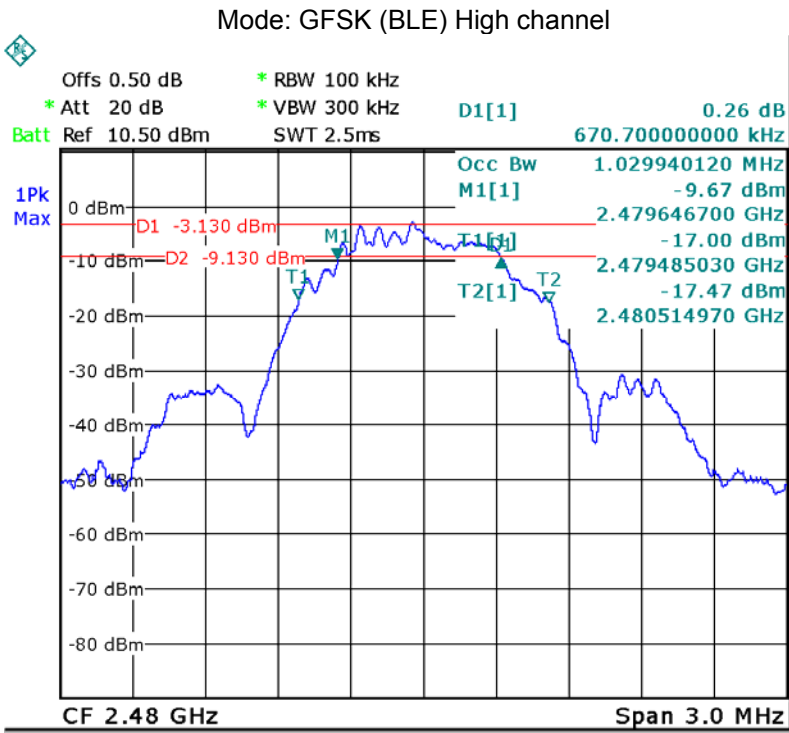
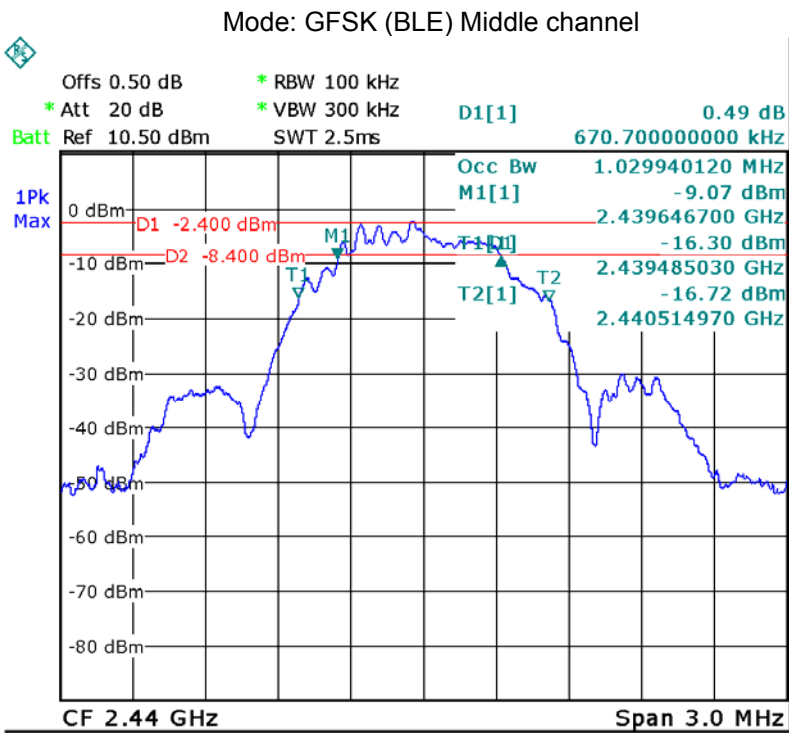
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz

9.2 Test Result

Operation mode	6dB Bandwidth (MHz)	99% Bandwidth(MHz)
Low channel	0.671	1.030
Middle channel	0.671	1.030
High channel	0.671	1.030

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 v04, April 5, 2017

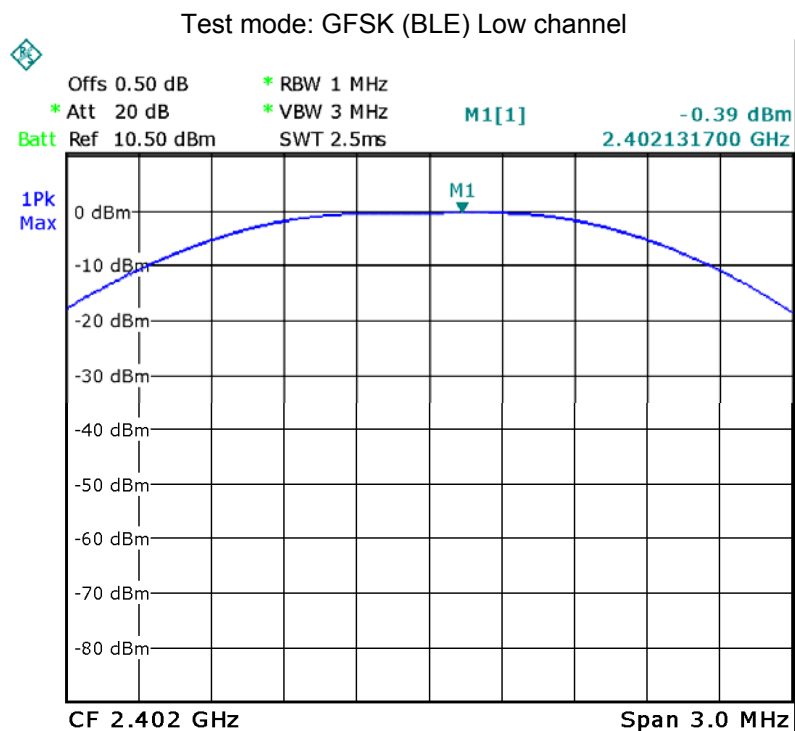
10.1 Test Procedure

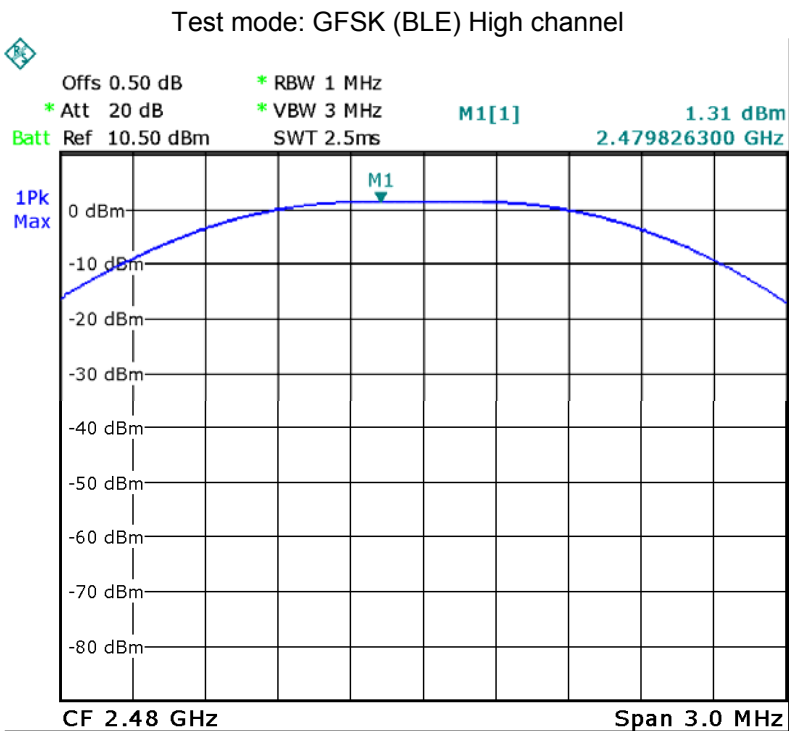
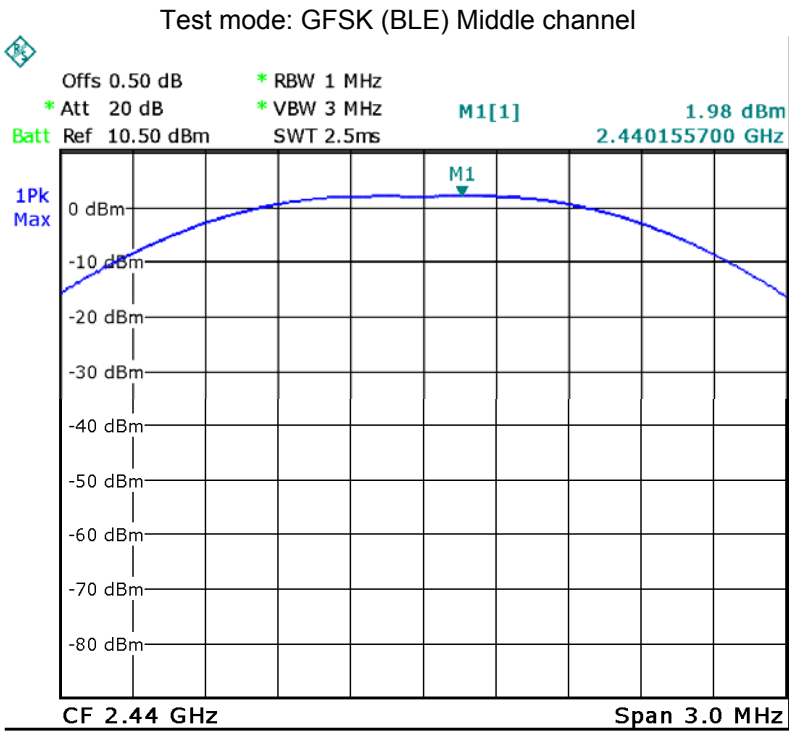
558074 D01 DTS Meas Guidance v04, April 5, 2017

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 = 1MHz. VBW = 3MHz. Sweep = auto; Detector Function = Peak, Set the span to fully encompass the DTS bandwidth.
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)		
Lower channel	Middle channel	Upper channel
-0.39	1.98	1.31
Limit: 1W/30dBm		





11 Power Spectral density

Test Requirement:

FCC CFR47 Part 15 Section 15.247

Test Method:

558074 D01 DTS Meas Guidance v04, April 5, 2017

11.1 Test Procedure

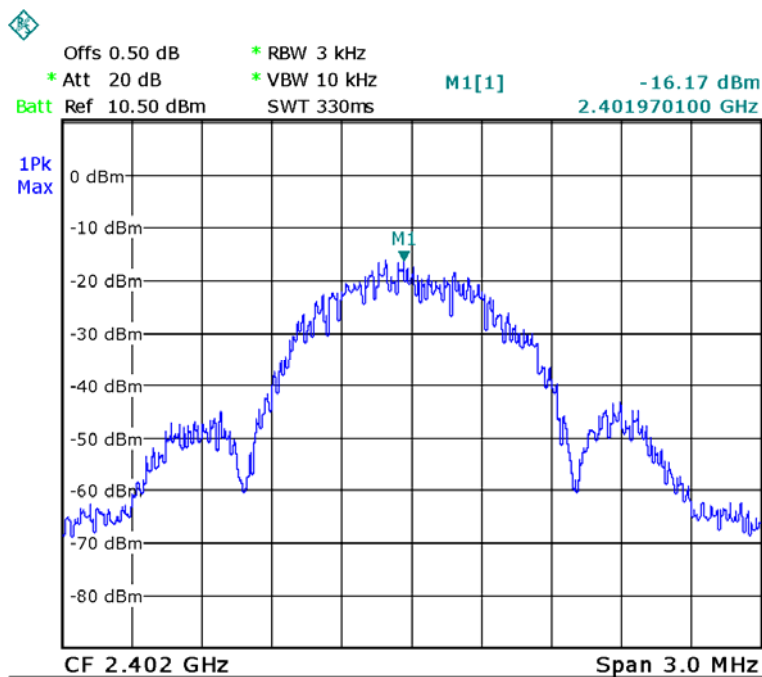
558074 D01 DTS Meas Guidance v04, April 5, 2017

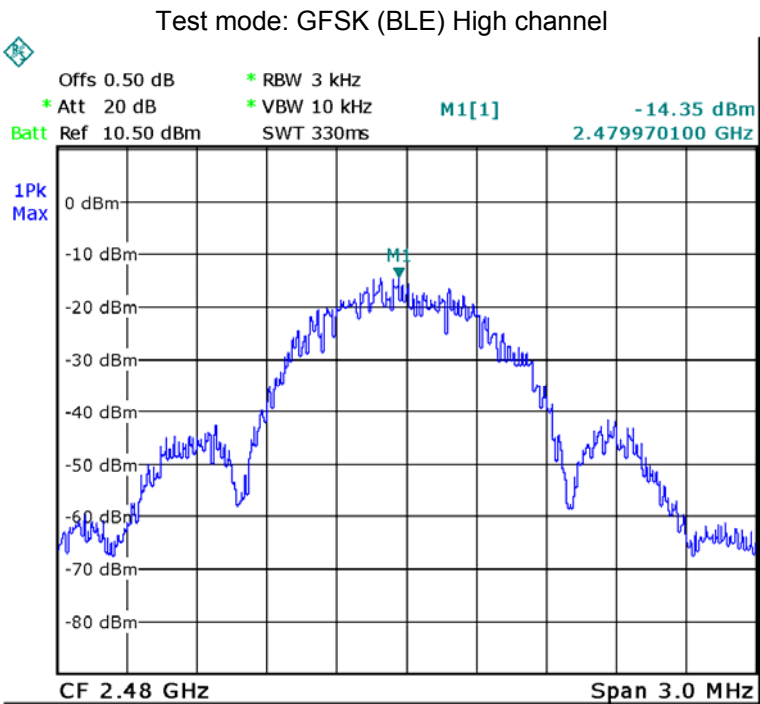
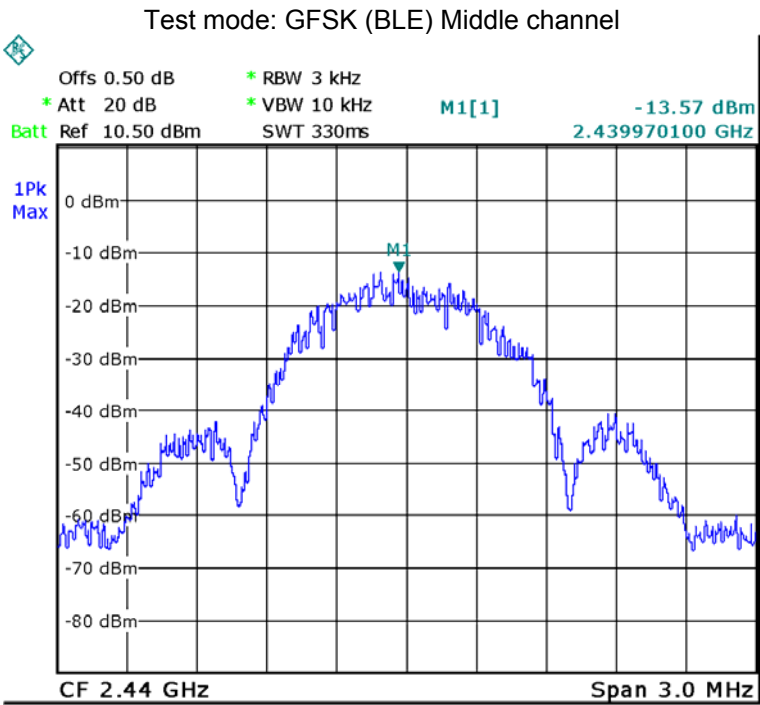
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3kHz. VBW = 10kHz , Span = 1.5 times the DTS channel bandwidth(6 dB bandwidth). Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to 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 (dBm per 3kHz)		
Lower channel	Middle channel	Upper channel
-16.17	-13.57	-14.35
Limit: 8dBm per 3kHz		

Test mode: GFSK (BLE) Lower channel





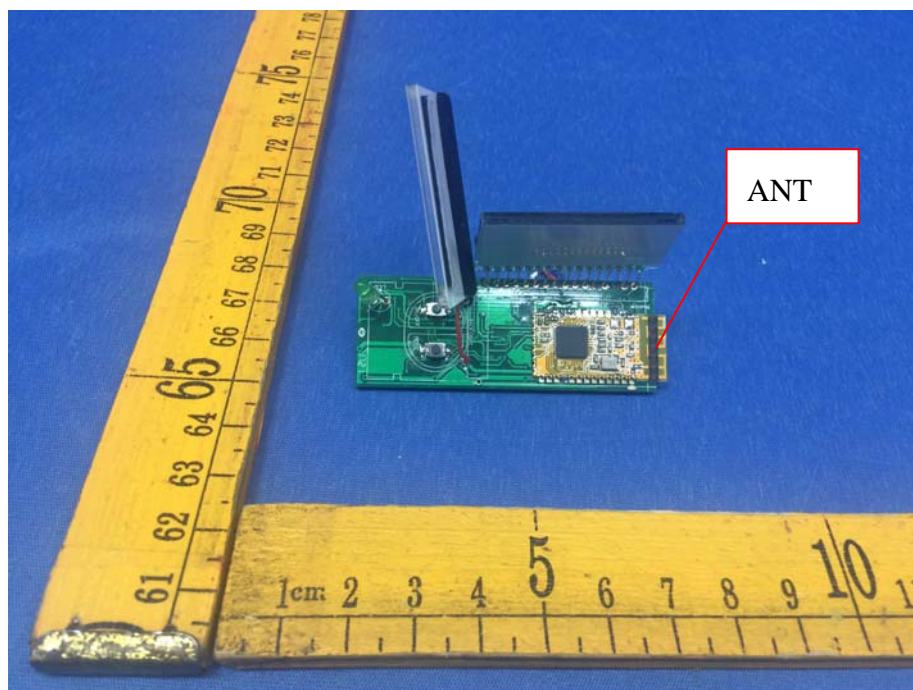
12 Antenna Requirement

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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

For intentional device, according to FCC 47 CFR Section 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.

Result:

The EUT has onePCB Printed Antenna, the gain is 0dBi. meets the requirements of FCC 15.203.



13 SAR Evaluation

Test Requirement: FCC Part 1.1307

Evaluation Method: FCC Part2.1093 & 447498 D01 General RF Exposure Guidance v06

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:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR and ≤ 7.5 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)	Result
1.98	1.578	1.578	5	10	Compliance

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 $\leq 3.0 / [\sqrt{f(\text{GHz})}] * (\text{min. test separation distance, mm}) = 3.0 / (\sqrt{2.480}) * 5 = 9.525 \text{ mW} \approx 10 \text{ mW}$

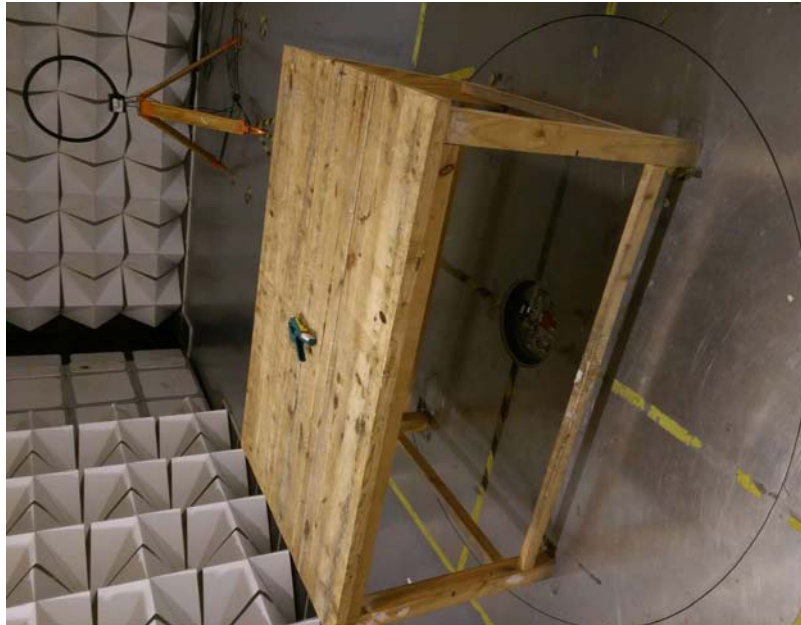
13.3 Result: Compliance

No SAR measurement is required.

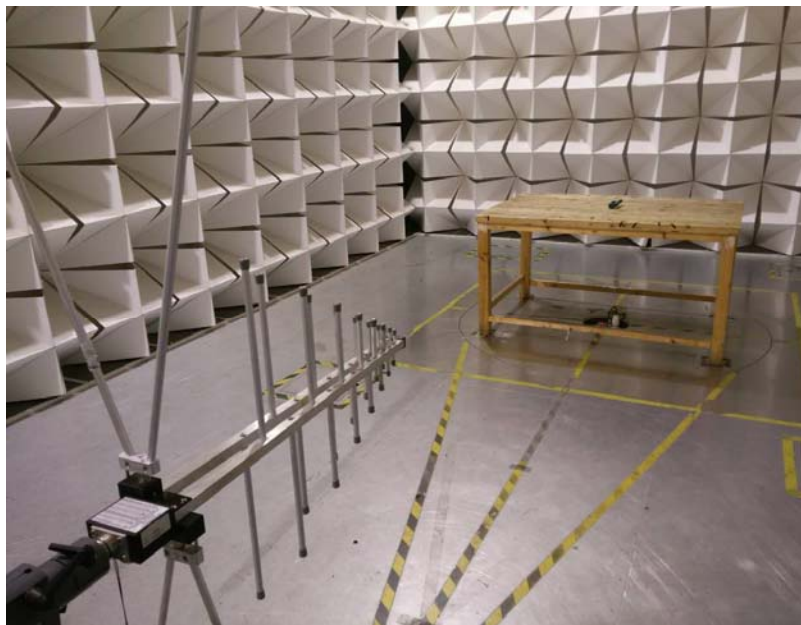
14 Photographs – Model 4687785 Test Setup

14.1 Radiated Emission

Test frequency from 9KHz to 30MHz



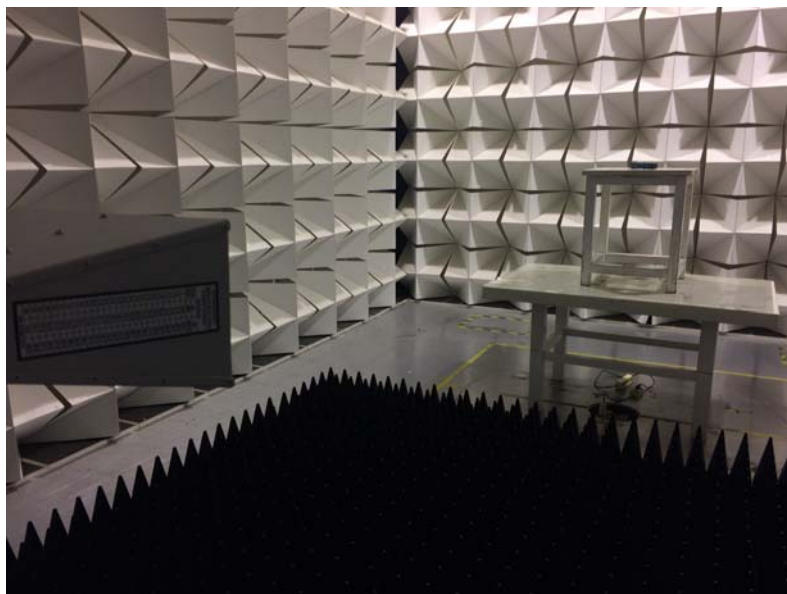
Test frequency from 30MHz to 1GHz





Test frequency from 1GHz to 25GHz





15 Photographs - Constructional Details

15.1 Model 4687785- External Photos

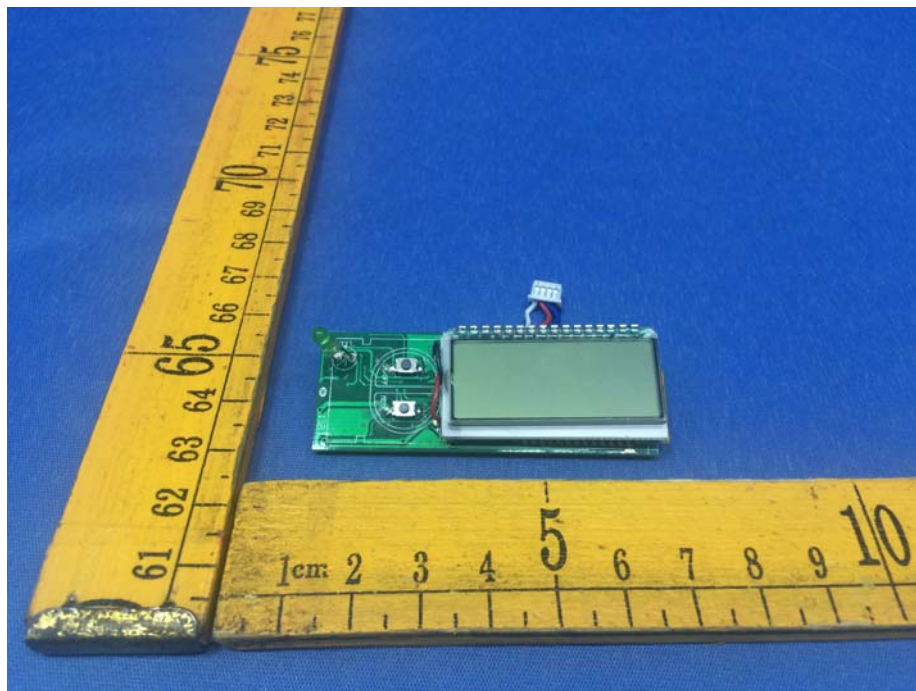


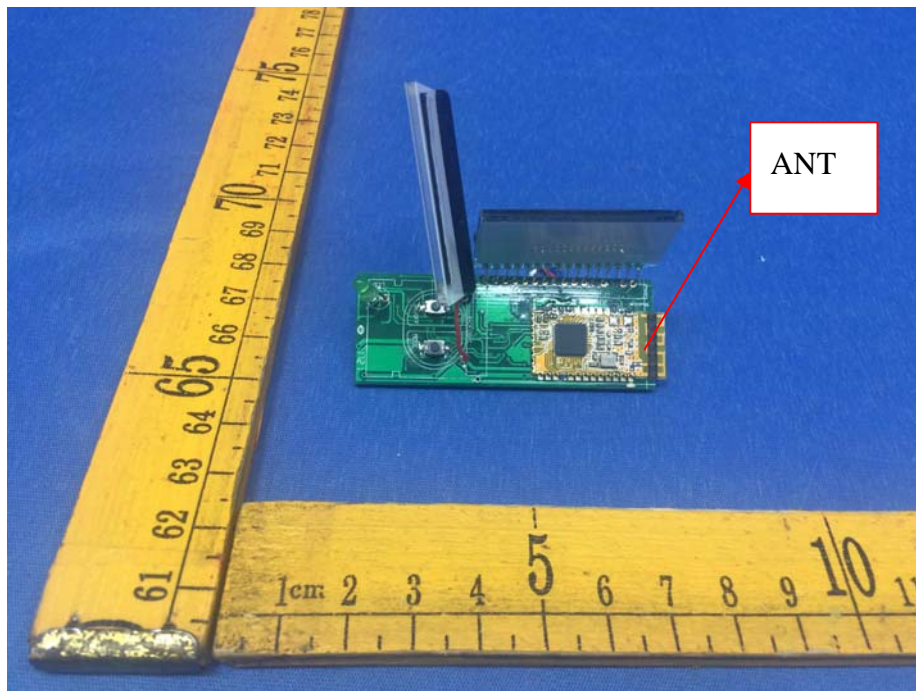
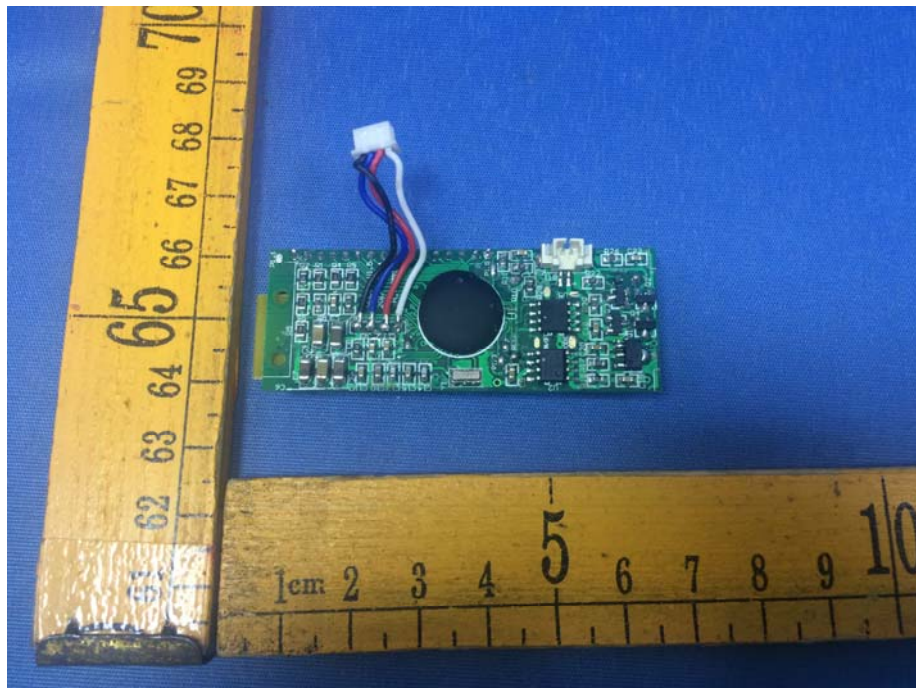


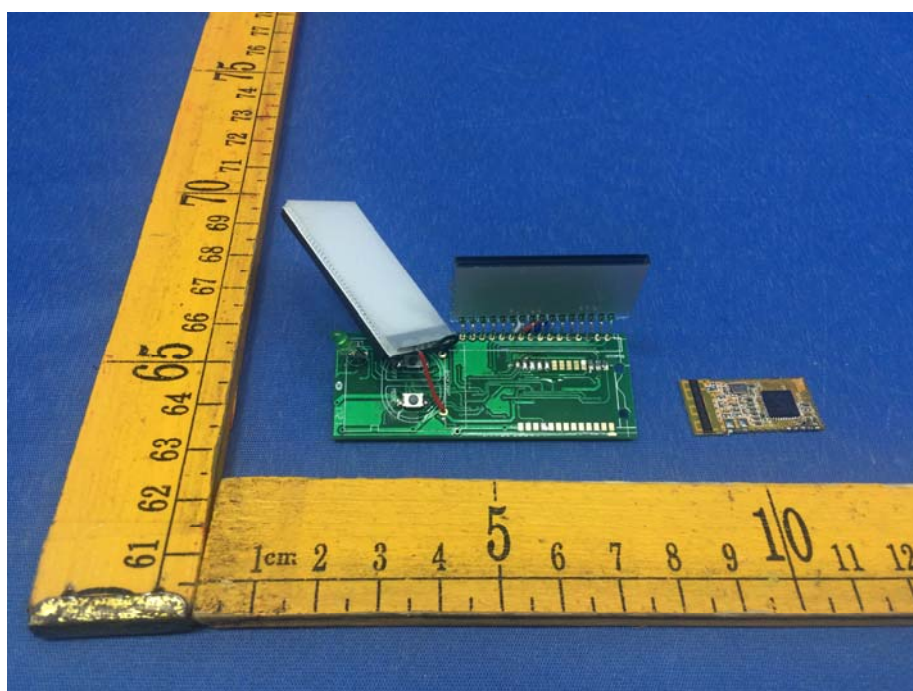
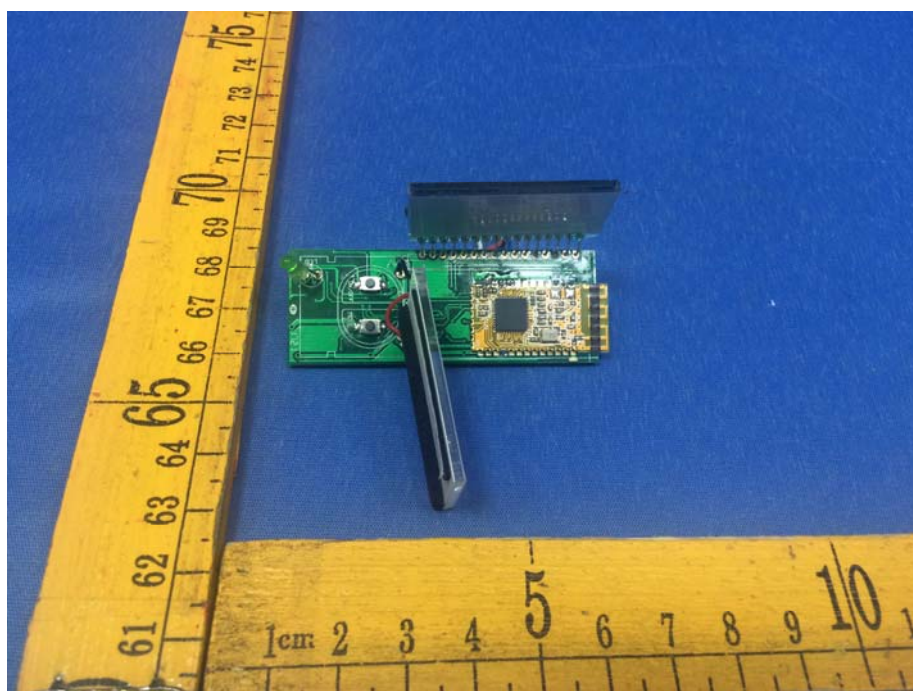


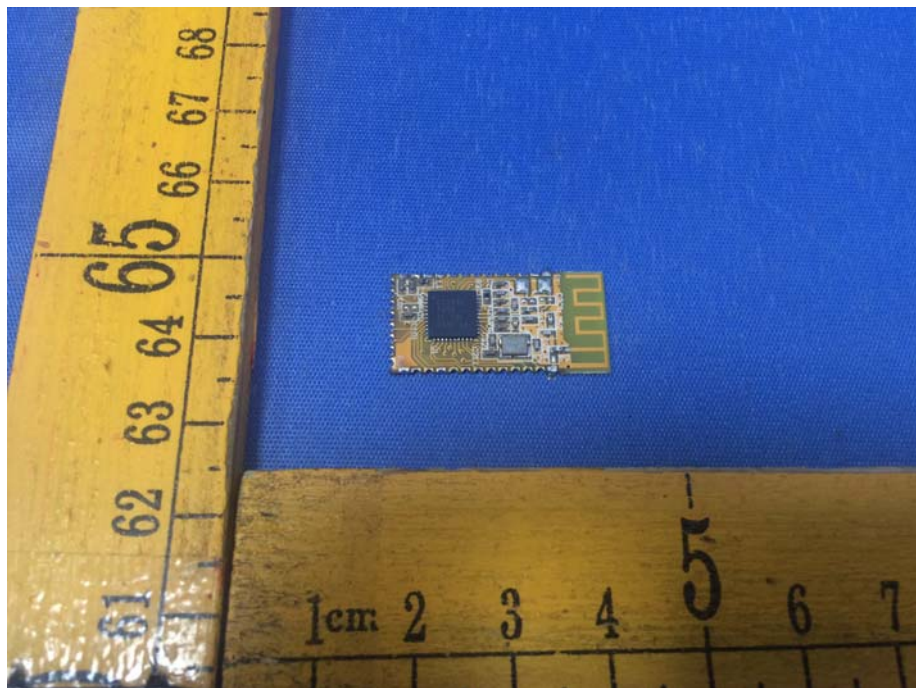
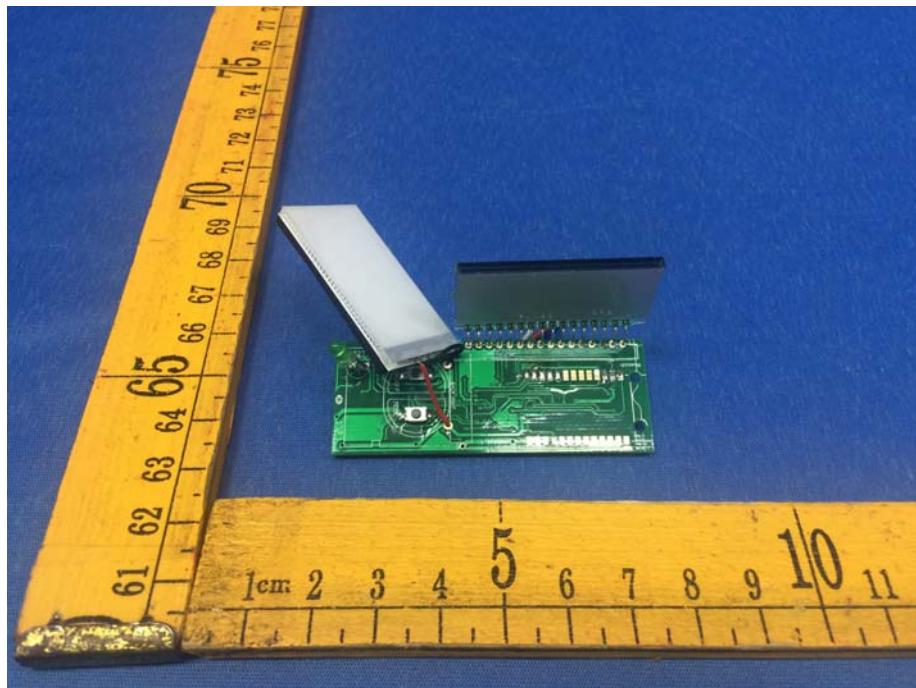


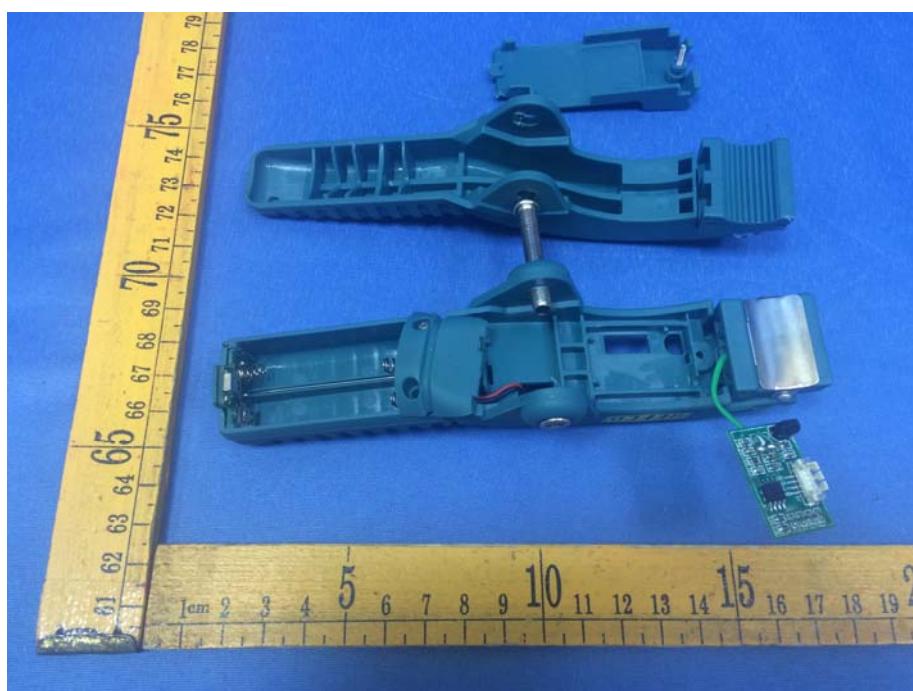
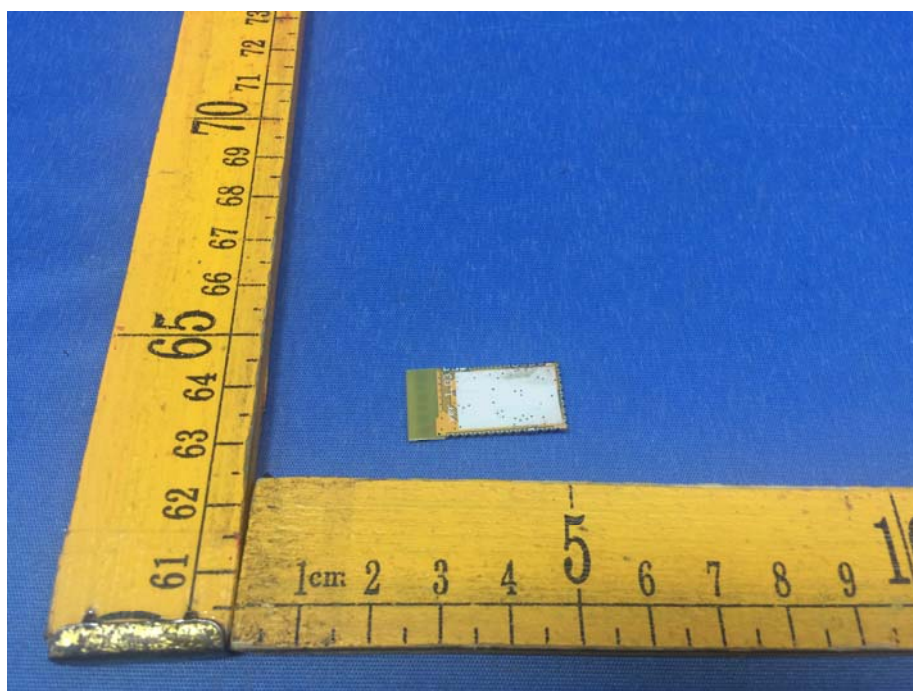
15.2 Model 4687785- Internal Photos

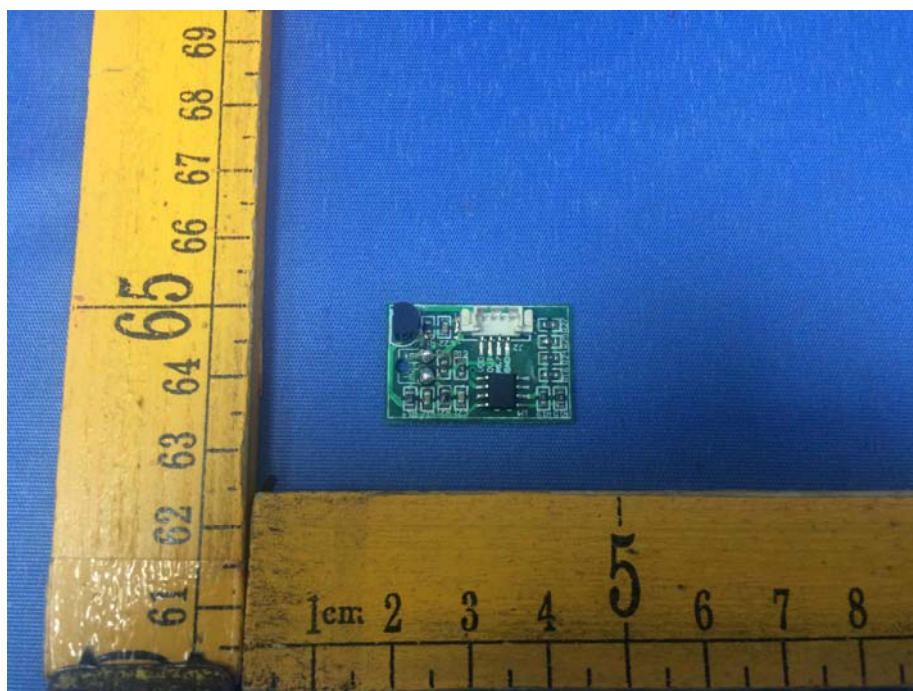
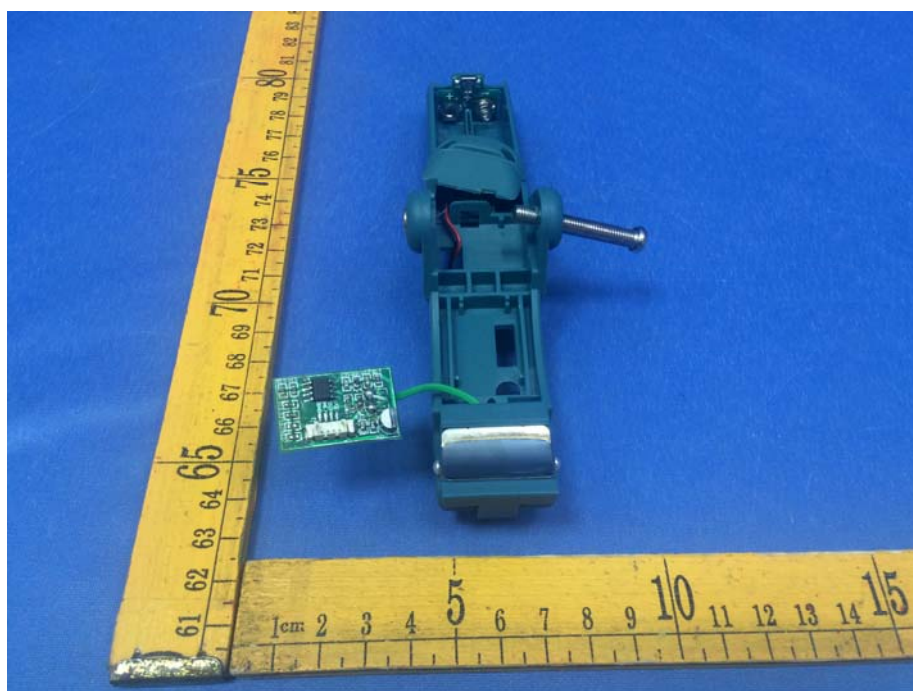


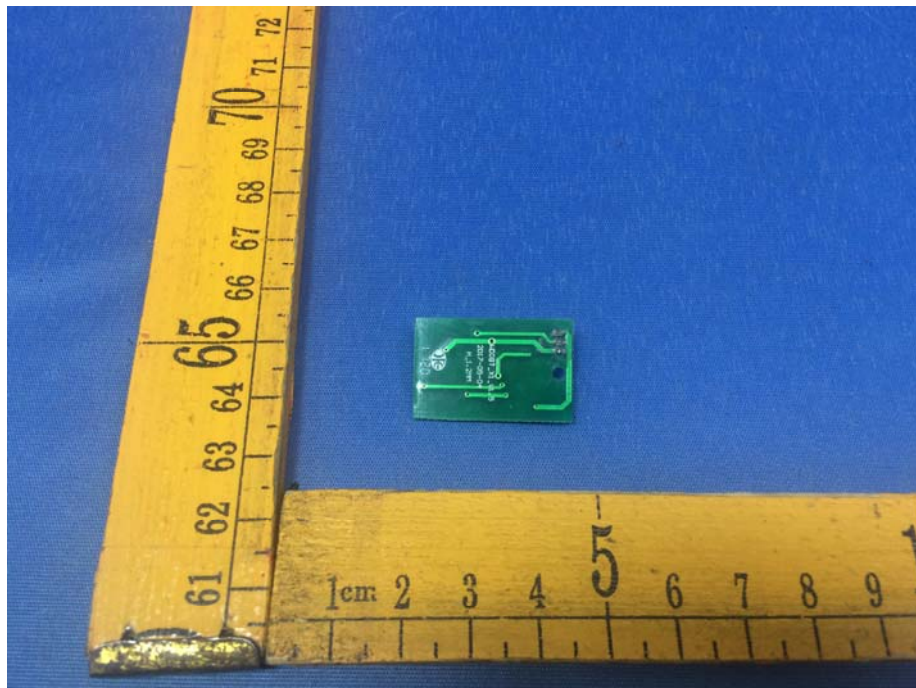












=====End of Report=====