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TEST REPORT

FCC PART 15 SUBPART C 15.247 & RSS 247

Report Reference No. .....: **CTL1606242416-WF**

Compiled by: (position+printed name+signature)	Jacky Chen (File administrators)	Jackychen
Tested by: (position+printed name+signature)	Allen Wang (Test Engineer)	Allen Wang
Approved by: (position+printed name+signature)	Tracy Qi (Manager)	Tracy Qi

Product Name.....:	Bluetooth speaker
Model/Type reference .....:	4001B
List Model(s).....:	4002B, 4003B, 4004B
Trade Mark.....:	N/A
FCC ID .....:	**2AGR44001B**
Applicant's name .....:	**The Gem Group, Inc.**
Address of applicant .....:	9 International Way, Lawrence, MA 01843, USA
Test Firm .....:	**Shenzhen CTL Testing Technology Co., Ltd.**
Address of Test Firm .....:	Floor 1-A, Baisha Technology Park, No.3011, Shahexi Road, Nanshan District, Shenzhen, China 518055
Test specification.....:	
Standard.....:	**47 CFR FCC Part 15 Subpart C 15.247** **RSS 247 Issue 1, May 2015**
TRF Originator .....:	Shenzhen CTL Testing Technology Co., Ltd.
Master TRF .....:	Dated 2011-01
Date of Receipt.....:	Jun. 24, 2016
Date of Test Date.....:	Jun. 25, 2016 –Jul. 05, 2016
Data of Issue.....:	Jul. 07, 2016
Result.....:	Pass

TEST REPORT

Test Report No. :	CTL1606242416-WF	Jul. 07, 2016 Date of issue

Equipment under Test	:	Bluetooth speaker
Model /Type	:	4001B
Listed Models	:	4002B, 4003B, 4004B
Applicant	:	**The Gem Group, Inc.**
Address	:	9 International Way, Lawrence, MA 01843, USA
Manufacturer	:	**Shenzhen Trendwoo Tech. Co.,Ltd**
Address	:	12th Floor, Block B, Building 6, BaoNeng Tech Park, No.1 Qingxiang Road, Longhua District, Shenzhen, China

Test result	Pass *

* In the configuration tested, the EUT complied with the standards specified page 5.

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

** Modified History **

Revisions	Description	Issued Data	Report No.	Remark
Version 1.0	Initial Test Report Release	2016-07-07	CTL1606242416-WF	Tracy Qi

Table of Contents Page

1. SUMMARY

1.1. TEST STANDARDS

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

RSS-247-Issue 1: Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices.

RSS-Gen Issue 4: General Requirements for Compliance of Radio Apparatus

ANSI C63.10:2013 : American National Standard for Testing Unlicensed Wireless Devices

ANSI C63.4: 2014: –American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40GHz

1.2. Test Description

FCC PART 15.247 & RSS 247		
FCC Part 15.207 RSS-Gen 8.8	AC Power Conducted Emission	PASS
FCC Part 15.247(a)(1)(i) RSS 247 5.1 (1) RSS-Gen 4.6	20dB Bandwidth&99% Bandwidth	PASS
FCC Part 15.247(d) RSS 247 5.5	Spurious RF Conducted Emission	PASS
FCC Part 15.247(b) RSS 247 5.4 (2)	Maximum Peak Output Power	PASS
FCC Part 15.247(b) RSS 247 5.1 (1)	Pseudorandom Frequency Hopping Sequence	PASS
FCC Part 15.247(a)(1)(iii) RSS 247 5.1 (4)	Number of hopping frequency& Time of Occupancy	PASS
FCC Part 15.247(a)(1) RSS 247 5.1 (2)	Frequency Separation	PASS
FCC Part 15.205/15.209 RSS-Gen 8.9	Radiated Emissions	PASS
FCC Part 15.247(d) RSS-Gen 8.10	Band Edge Compliance of RF Emission	PASS

1.3. Test Facility

1.3.1 Address of the test laboratory

Shenzhen CTL Testing Technology Co., Ltd.
Floor 1-A, Baisha Technology Park, No. 3011, Shahexi Road, Nanshan, Shenzhen 518055 China

There is one 3m semi-anechoic chamber and two line conducted labs for final test. The Test Sites meet the requirements in documents ANSI C63.4 and CISPR 22/EN 55022 requirements.

1.3.2 Laboratory accreditation

The test facility is recognized, certified, or accredited by the following organizations:

IC Registration No.: 9618B

The 3m alternate test site of Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration No.: 9618B on November 13, 2013.

FCC-Registration No.: 970318

Shenzhen CTL Testing Technology 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 970318, December 19, 2013.

1.4. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Shenzhen CTL Testing Technology Co., Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for CTL laboratory is reported:

Test	Measurement Uncertainty	Notes
Transmitter power conducted	±0.57 dB	(1)
Transmitter power Radiated	±2.20 dB	(1)
Conducted spurious emission 9KHz-40 GHz	±2.20 dB	(1)
Occupied Bandwidth	±0.01ppm	(1)
Radiated Emission 30~1000MHz	±4.10dB	(1)
Radiated Emission Above 1GHz	±4.32dB	(1)
Conducted Disturbance0.15~30MHz	±3.20dB	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

2. GENERAL INFORMATION

2.1. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Normal Temperature:	25°C
Relative Humidity:	55 %
Air Pressure:	101 kPa

2.2. General Description of EUT

Product Name:	Bluetooth speaker
Model/Type reference:	4001B
Power supply:	DC 3.7V form 180mAh battery
Bluetooth	
Version:	Supported BT3.0
Modulation:	GFSK, π/4DQPSK, 8DPSK
Operation frequency:	2402MHz~2480MHz
Channel number:	79
Channel separation:	1MHz
Antenna type:	PCB Antenna
Antenna gain:	0 dBi

Note: For more details, refer to the user's manual of the EUT.

2.3. Description of Test Modes and Test Frequency

The Applicant provides communication tools software to control the EUT for staying in continuous transmitting and receiving mode for testing.

There are 79 channels provided to the EUT and Channel 00/39/78 was selected for testing.

Operation Frequency：

Channel	Frequency (MHz)
00	2402
01	2403
⋮	⋮
38	2440
39	2441
40	2442
⋮	⋮
77	2479
78	2480

Note: The line display in grey were the channel selected for testing

Preliminary tests were performed in each mode and packet length of BT, and found worst case as bellow, finally test were conducted at those mode and recorded in this report.

Test Items	Worst case
Conducted Emissions	DH5 Middle channel
Radiated Emissions and Band Edge	DH5
Maximum Conducted Output Power	DH5/2DH5/3DH5
20dB Bandwidth&99% Bandwidth	DH5/2DH5/3DH5
Frequency Separation	DH5/2DH5/3DH5 Middle channel
Number of hopping frequency	DH5/2DH5/3DH5
Time of Occupancy (Dwell Time)	DH1/DH3/DH5 Middle channel 2DH1/2DH3/2DH5 Middle channel 3DH1/3DH3/3DH5 Middle channel
Out-of-band Emissions	DH5/2DH5/3DH5

2.4. Equipments Used during the Test

Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	3560.6550.12	2016/06/02	2017/06/01
LISN	R&S	ESH2-Z5	860014/010	2016/06/02	2017/06/01
Bilog Antenna	Sunol Sciences Corp.	JB1	A061713	2016/06/02	2017/06/01
EMI Test Receiver	R&S	ESCI	103710	2016/06/02	2017/06/01
Spectrum Analyzer	Agilent	E4407B	MY41440676	2016/05/21	2017/05/20
Spectrum Analyzer	Agilent	N9020	US46220290	2016/01/17	2017/01/16
Power Meter	Anritsu	ML2487B	110553	2016/06/02	2017/06/01
Power Sensor	Anritsu	MA2411B	100345	2016/05/21	2017/05/20
Controller	EM Electronics	Controller EM 1000	N/A	2016/05/21	2017/05/20
Horn Antenna	Sunol Sciences Corp.	DRH-118	A062013	2016/05/19	2017/05/18
Active Loop Antenna	SCHWARZBECK	FMZB1519	1519-037	2016/05/19	2017/05/18
Amplifier	Agilent	8349B	3008A02306	2016/05/19	2017/05/18
Amplifier	Agilent	8447D	2944A10176	2016/05/19	2017/05/18
Temperature/Humidity Meter	Gangxing	CTH-608	02	2016/05/20	2017/05/19
High-Pass Filter	K&L	9SH10-2700/X12750-O/O	N/A	2016/05/20	2017/05/19
High-Pass Filter	K&L	41H10-1375/U12750-O/O	N/A	2016/05/20	2017/05/19
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-10M	10m	2016/06/02	2017/06/01
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	2016/06/02	2017/06/01

Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	2016/06/02	2017/06/01
RF Cable	Megalon	RF-A303	N/A	2016/06/02	2017/06/01

The calibration interval was one year

2.5. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: 2AGR44001B filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.6. Modifications

No modifications were implemented to meet testing criteria.

3. TEST CONDITIONS AND RESULTS

3.1. Conducted Emissions Test

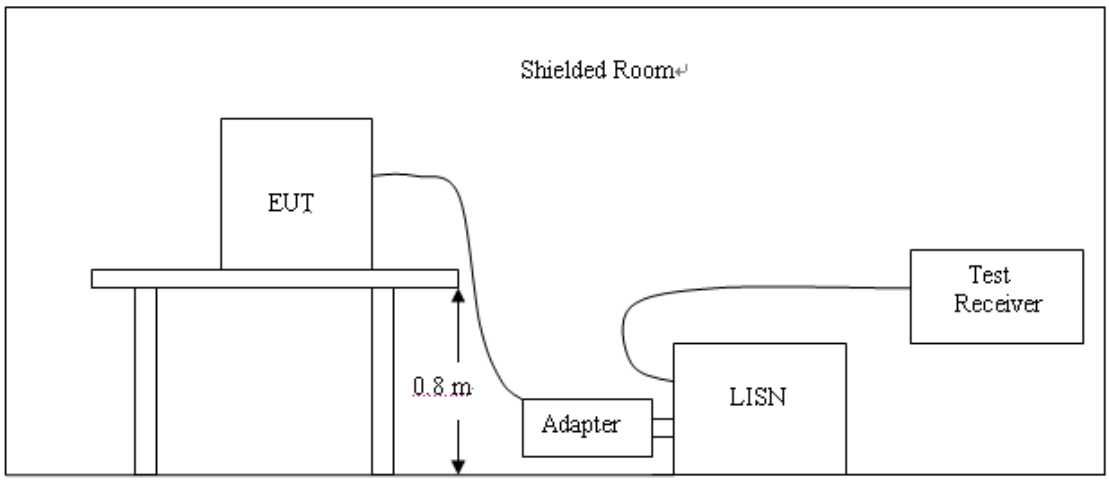
LIMIT

According to FCC CFR Title 47 Part 15 Subpart C Section 15.207 and RSS Gen 8.8, AC Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus as below:

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

TEST CONFIGURATION



TEST PROCEDURE

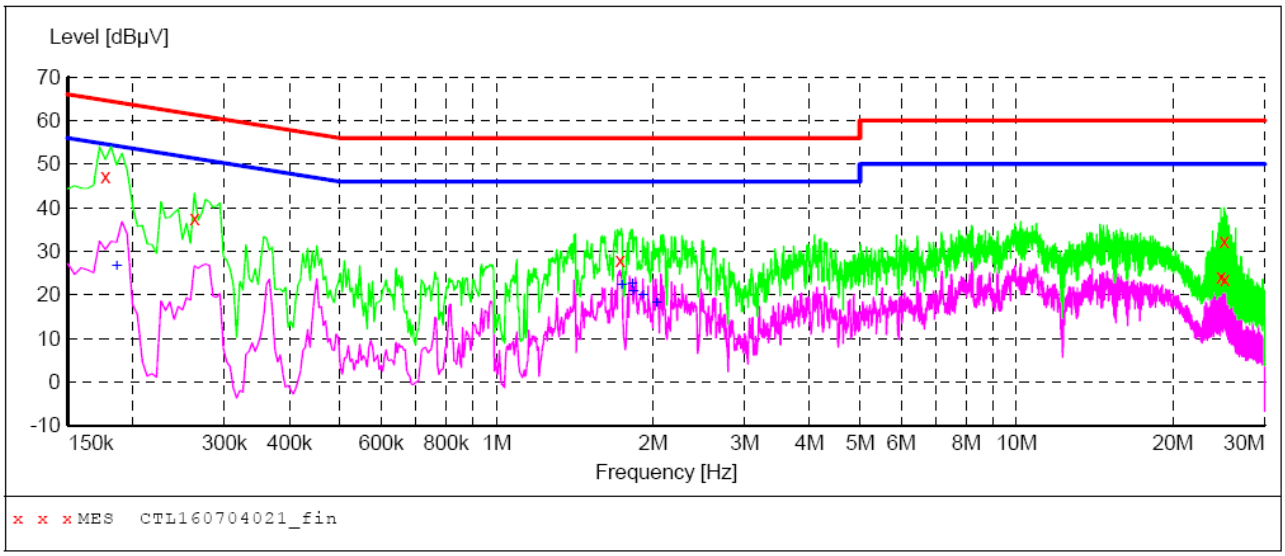
1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10:2013.
2. Support equipment, if needed, was placed as per ANSI C63.10:2013
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10:2013.
4. The adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5. All support equipments received AC power from a second LISN, if any.
6. The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.

TEST RESULTS

Remark: All modes of GFSK, Pi/4 DQPSK, and 8DPSK were test at Low, Middle, and High channel; only the worst result of 8DPSK High Channel was reported as below:

Line:	L

SCAN TABLE: "Voltage (9K-30M)FIN"
Short Description: 150K-30M Voltage



MEASUREMENT RESULT: "CTL160704021_fin"

7/5/2016 11:11AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.177001	47.20	10.2	65	17.4	QP	L1	GND
0.262501	37.60	10.2	61	23.8	QP	L1	GND
1.729501	28.00	10.3	56	28.0	QP	L1	GND
24.724501	24.30	11.1	60	35.7	QP	L1	GND
25.089001	32.40	11.1	60	27.6	QP	L1	GND
25.152001	23.60	11.1	60	36.4	QP	L1	GND

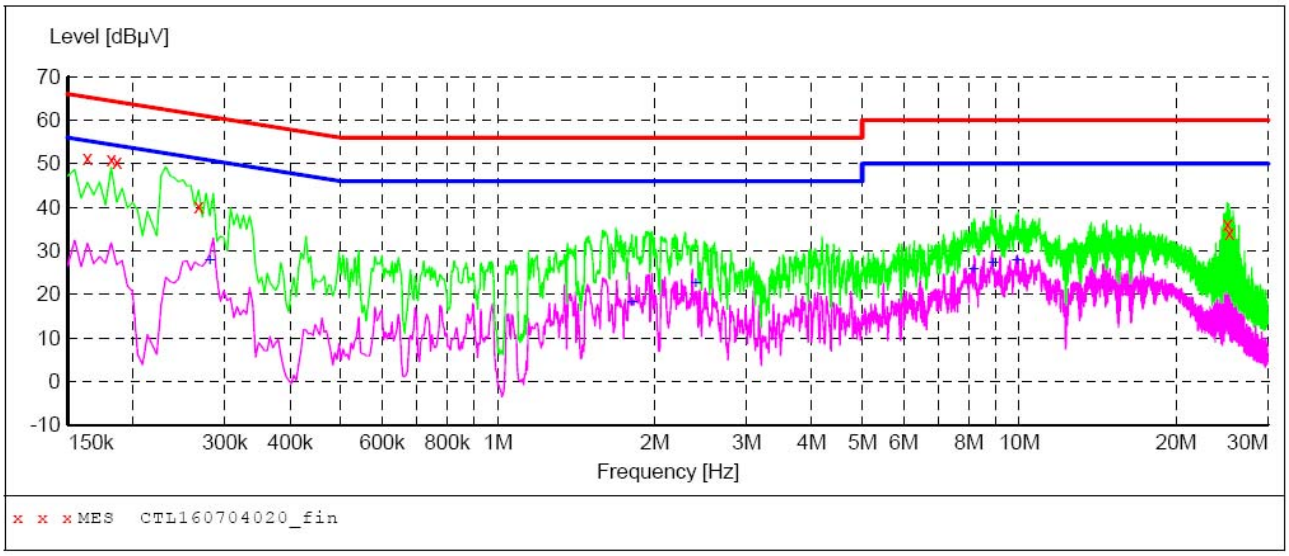
MEASUREMENT RESULT: "CTL160704021_fin2"

7/5/2016 11:11AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.186001	26.60	10.2	54	27.6	AV	L1	GND
1.743001	22.10	10.3	46	23.9	AV	L1	GND
1.824001	22.40	10.3	46	23.6	AV	L1	GND
1.833001	20.70	10.3	46	25.3	AV	L1	GND
1.914001	19.80	10.3	46	26.2	AV	L1	GND
2.035501	18.00	10.4	46	28.0	AV	L1	GND

Line:	N

SCAN TABLE: "Voltage (9K-30M)FIN"
Short Description: 150K-30M Voltage



MEASUREMENT RESULT: "CTL160704020_fin"

7/5/2016 11:07AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.163501	51.30	10.2	65	14.0	QP	N	GND
0.181501	51.10	10.2	64	13.3	QP	N	GND
0.186001	50.40	10.2	64	13.8	QP	N	GND
0.267001	40.30	10.2	61	20.9	QP	N	GND
25.089001	36.10	11.1	60	23.9	QP	N	GND
25.264501	34.00	11.1	60	26.0	QP	N	GND

MEASUREMENT RESULT: "CTL160704020_fin2"

7/5/2016 11:07AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.280501	27.70	10.2	51	23.1	AV	N	GND
1.810501	17.90	10.3	46	28.1	AV	N	GND
2.395501	22.40	10.4	46	23.6	AV	N	GND
8.178001	25.60	10.5	50	24.4	AV	N	GND
8.920501	27.20	10.6	50	22.8	AV	N	GND
9.897001	27.50	10.6	50	22.5	AV	N	GND

Note:
1. Margin = Limit – level
2. Peripheral device during the Testing

No.	Product	Manufacturer	Model	Certification
1	Notebook	Dell	H57	DOC
2	Adapter	Dell	PA-1650-05D	DOC
3	USB line	--	--	--

3.2. Radiated Emissions and Band Edge

Limit

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission out of authorized band shall not exceed the following table at a 3 meters measurement distance.

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)

Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in table below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission

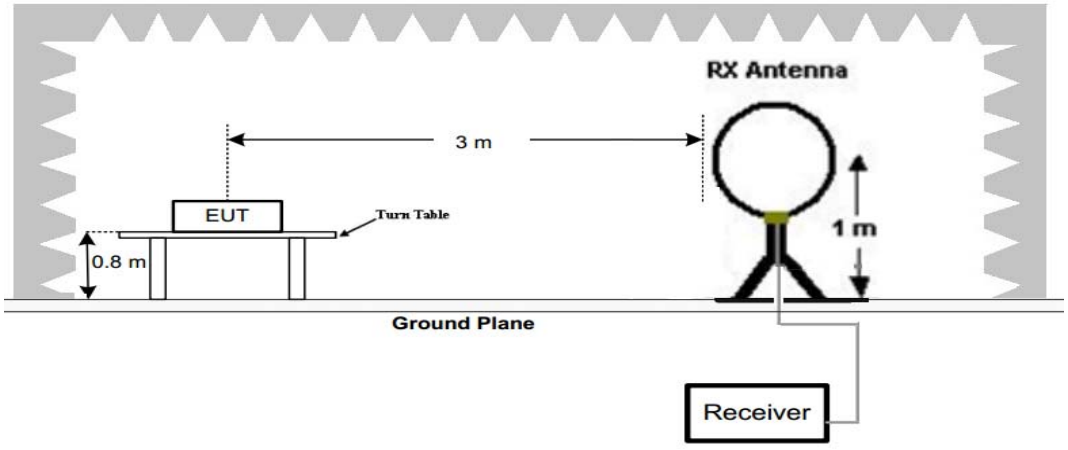
Unwanted emissions that fall into restricted bands shall comply with the limits specified in RSS-Gen; and Unwanted emissions that do not fall within the restricted frequency bands shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

Radiated emission limits

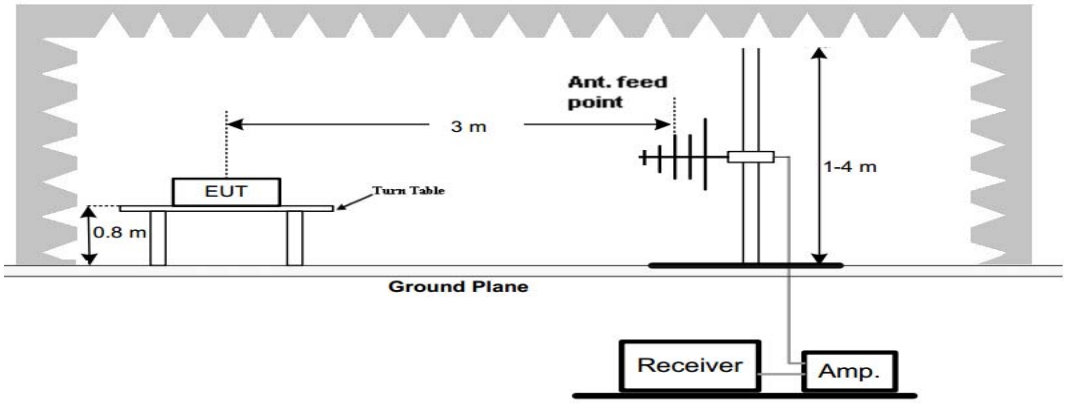
Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

TEST CONFIGURATION

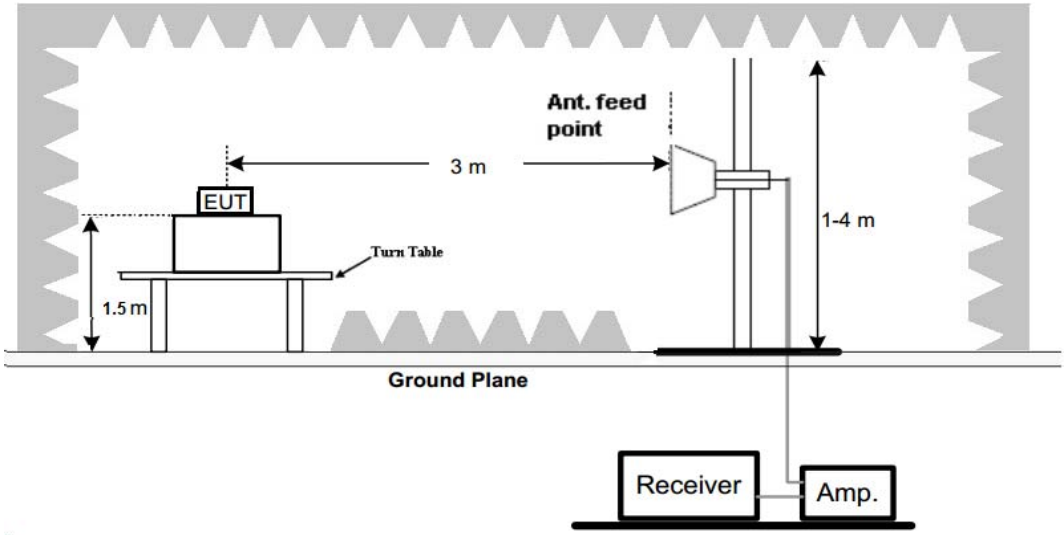
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency below 1000MHz



(C) Radiated Emission Test Set-Up, Frequency above 1000MHz



Test Procedure

1. The EUT was placed on turn table which is 0.8m above ground plane for below 1GHz test, and on a low permittivity and low loss tangent turn table which is 1.5m above ground plane for above 1GHz test.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0℃ to 360℃ to acquire the highest emissions from EUT
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.

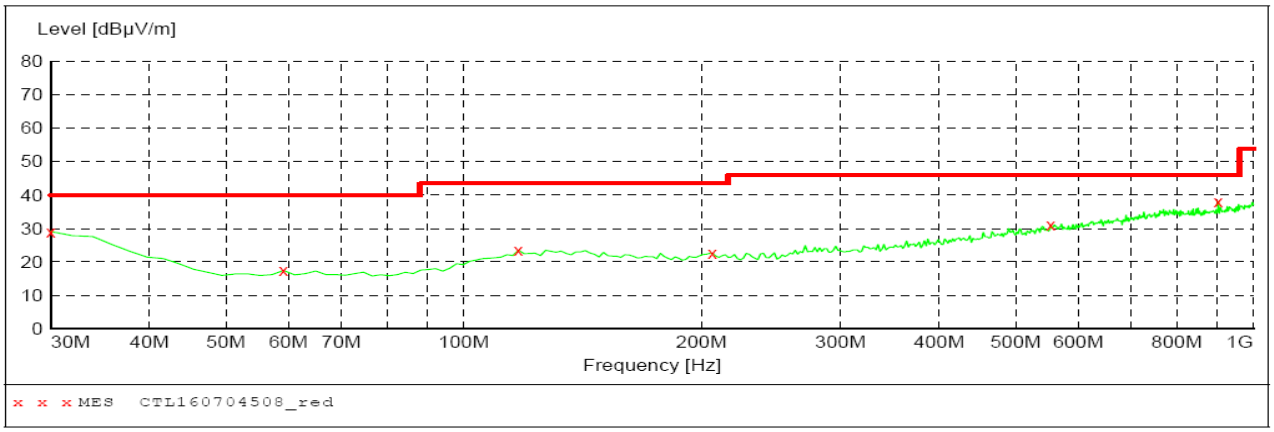
TEST RESULTS

Remark:
1. Radiated Emission measured at GFSK, π/4 DQPSK and 8DPSK mode from 9 KHz to 10th harmonic of fundamental and recorded worst case at GFSK DH5 mode.
2. There is no emission found except system noise floor in 9 KHz to 30MHz and not recorded in this report.
3. For below 1GHz testing recorded worst at GFSK DH5 low channel.

For 30MHz-1GHz

Test mode:	DH5	Polarization:	Horizontal

```
SWEEP TABLE: "test (30M-1G)"
  Short Description:            Field Strength
  Start       Stop        Detector  Meas.      IF         Transducer
  Frequency   Frequency             Time       Bandw.
  30.0 MHz    1.0 GHz     MaxPeak   300.0 ms   120 kHz    JB1
```



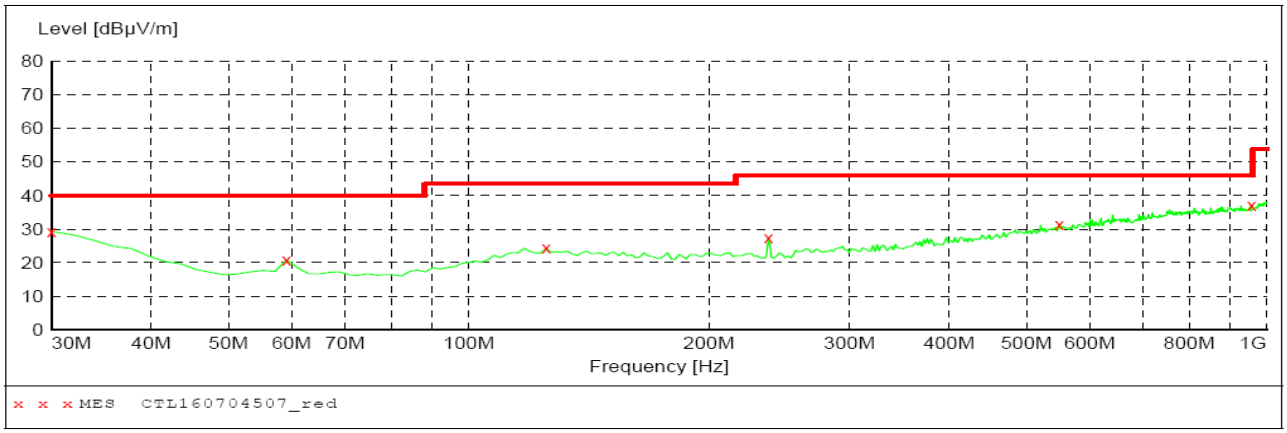

```
MEASUREMENT RESULT: "CTL160704508_red"

7/4/2016  9:54AM
   Frequency     Level   Transd   Limit   Margin  Det.  Height  Azimuth  Polarization
         MHz    dBµV/m       dB  dBµV/m       dB              cm      deg

  30.000000     29.10     20.8     40.0     10.9  ---    100.0   114.00  HORIZONTAL
  59.100000     17.40      8.0     40.0     22.6  ---    200.0   125.00  HORIZONTAL
 117.300000     23.50     14.7     43.5     20.0  ---    200.0    89.00  HORIZONTAL
 206.540000     22.60     14.1     43.5     20.9  ---    300.0   136.00  HORIZONTAL
 553.800000     31.00     21.0     46.0     15.0  ---    100.0   114.00  HORIZONTAL
 903.000000     38.10     26.0     46.0      7.9  ---    100.0   150.00  HORIZONTAL
```

Test mode:	DH5	Polarization:	Vertical

```
SWEEP TABLE: "test (30M-1G)"
  Short Description:            Field Strength
  Start       Stop        Detector  Meas.      IF         Transducer
  Frequency   Frequency             Time       Bandw.
  30.0 MHz    1.0 GHz     MaxPeak   300.0 ms   120 kHz    JB1
```




```
MEASUREMENT RESULT: "CTL160704507_red"

7/4/2016  9:53AM
   Frequency     Level   Transd   Limit   Margin  Det.  Height  Azimuth  Polarization
         MHz    dBµV/m       dB  dBµV/m       dB              cm      deg

  30.000000     29.30     20.8     40.0     10.7  ---    100.0   225.00  VERTICAL
  59.100000     20.80      8.0     40.0     19.2  ---    100.0   135.00  VERTICAL
 125.060000     24.30     14.6     43.5     19.2  ---    300.0    98.00  VERTICAL
 237.580000     27.50     13.7     46.0     18.5  ---    200.0   137.00  VERTICAL
 549.920000     31.50     21.0     46.0     14.5  ---    100.0   288.00  VERTICAL
 957.320000     37.00     26.6     46.0      9.0  ---    100.0   150.00  VERTICAL
```

Note:

1. Margin = Limit – level

For 1GHz to 25GHz

GFSK (DH5) Mode (above 1GHz)

Frequency(MHz):				2402		Polarity:			HORIZONTAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
1	2402.00	93.56	PK	--	--	60.16	28.78	4.61	0.00	33.40
1	2402.00	84.41	AV	--	--	51.01	28.78	4.61	0.00	33.40
2	2390.00	38.74	PK	74	35.26	5.42	28.72	4.60	0.00	33.32
2	2390.00	--	AV	54	--	--	--	--	--	--
3	2400.00	46.69	PK	74	27.31	13.30	28.78	4.61	0.00	33.39
3	2400.00	--	AV	54	--	--	--	--	--	--
4	4804.00	55.65	PK	74	18.35	51.14	33.49	6.91	35.89	4.51
4	4804.00	46.41	AV	54	7.59	41.90	33.49	6.91	35.89	4.51
5	5023.75	42.23	PK	74	31.77	35.36	34.06	7.04	34.24	6.87
5	5023.75	--	AV	54	--	--	--	--	--	--
6	7206.00	43.74	PK	74	30.26	32.63	36.95	9.18	35.03	11.11
6	7206.00	--	AV	54	--	--	--	--	--	--

Frequency(MHz):				2402		Polarity:			VERTICAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
1	2402.00	94.55	PK	--	--	61.15	28.78	4.61	0.00	33.40
1	2402.00	83.36	AV	--	--	49.96	28.78	4.61	0.00	33.40
2	2390.00	37.74	PK	74	36.26	4.42	28.72	4.60	0.00	33.32
2	2390.00	--	AV	54	--	--	--	--	--	--
3	2400.00	42.98	PK	74	31.02	9.59	28.78	4.61	0.00	33.39
3	2400.00	--	AV	54	--	--	--	--	--	--
4	4804.00	57.21	PK	74	16.79	52.70	33.49	6.91	35.89	4.51
4	4804.00	48.78	AV	54	5.22	44.27	33.49	6.91	35.89	4.51
5	5154.50	43.58	PK	74	30.42	36.30	34.44	7.12	34.29	7.28
5	5154.50	--	AV	54	--	--	--	--	--	--
6	7206.00	46.44	PK	74	27.56	35.33	36.95	9.18	35.03	11.11
6	7206.00	--	AV	54	--	--	--	--	--	--

REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.
6. RBW1MHz VBW3MHz Peak detector is for PK value; RBW 1MHz VBW10Hz Peak detector is for AV value.

Frequency(MHz):		2441				Polarity:			HORIZONTAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
1	2441.00	93.58	PK	--	--	60.07	28.85	4.66	0.00	33.51
1	2441.00	84.15	AV	--	--	50.64	28.85	4.66	0.00	33.51
2	4015.25	39.87	PK	74	34.13	35.19	33.07	6.40	34.79	4.68
2	4015.25	--	AV	54	--	--	--	--	--	--
3	4882.00	56.44	PK	74	17.56	50.18	33.60	6.95	34.30	6.26
3	4882.00	48.84	AV	54	5.16	42.58	33.60	6.95	34.30	6.26
4	5255.75	42.41	PK	74	31.59	34.73	34.60	7.17	34.08	7.68
4	5255.75	--	AV	54	--	--	--	--	--	--
5	7323.00	45.36	PK	74	28.64	33.66	37.46	9.23	35.00	11.70
5	7323.00	--	AV	54	--	--	--	--	--	--

Frequency(MHz):		2441				Polarity:			VERTICAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
1	2441.00	93.78	PK	--	--	60.27	28.85	4.66	0.00	33.51
1	2441.00	83.63	AV	--	--	50.12	28.85	4.66	0.00	33.51
2	3956.75	42.45	PK	74	31.55	37.74	33.19	6.35	34.83	4.71
2	3956.75	--	AV	54	--	--	--	--	--	--
3	4882.00	56.58	PK	74	17.42	50.22	33.60	6.95	34.19	6.36
3	4882.00	47.21	AV	54	6.79	40.85	33.60	6.95	34.19	6.36
4	5352.50	40.34	PK	74	33.66	32.45	34.69	7.23	34.03	7.89
4	5352.50	--	AV	54	--	--	--	--	--	--
5	7323.00	43.61	PK	74	30.39	31.91	37.46	9.23	35.00	11.70
5	7323.00	--	AV	54	--	--	--	--	--	--

REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.
6. RBW1MHz VBW3MHz Peak detector is for PK value; RBW 1MHz VBW10Hz Peak detector is for AV value.

Frequency(MHz):				2480		Polarity:			HORIZONTAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
1	2480.00	93.69	PK	--	--	60.07	28.92	4.70	0.00	33.62
1	2480.00	84.25	AV	--	--	50.63	28.92	4.70	0.00	33.62
2	2483.50	45.54	PK	74	28.46	11.91	28.93	4.70	0.00	33.63
2	2483.50	--	AV	54	--	--	--	--	--	--
3	2500.00	39.65	PK	74	34.35	5.97	28.96	4.72	0.00	33.68
3	2500.00	--	AV	54	--	--	--	--	--	--
4	4960.00	56.74	PK	74	17.26	51.82	33.84	7.00	35.92	4.92
4	4960.00	47.88	AV	54	6.12	42.96	33.84	7.00	35.92	4.92
5	5411.50	41.20	PK	74	32.8	33.57	34.74	7.27	34.38	7.63
5	5411.50	--	AV	54	--	--	--	--	--	--
6	7440.00	42.44	PK	74	31.56	30.49	37.64	9.28	34.97	11.95
6	7440.00	--	AV	54	--	--	--	--	--	--

Frequency(MHz):				2480		Polarity:			VERTICAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
1	2480.00	94.15	PK	--	--	60.53	28.92	4.70	0.00	33.62
1	2480.00	84.85	AV	--	--	51.23	28.92	4.70	0.00	33.62
2	2483.50	45.69	PK	74	28.31	12.06	28.93	4.70	0.00	33.63
2	2483.50	--	AV	54	--	--	--	--	--	--
3	2500.00	38.41	PK	74	35.59	4.73	28.96	4.72	0.00	33.68
3	2500.00	--	AV	54	--	--	--	--	--	--
4	4960.00	56.45	PK	74	17.55	51.53	33.84	7.00	35.92	4.92
4	4960.00	47.52	AV	54	6.48	42.60	33.84	7.00	35.92	4.92
5	5225.50	41.22	PK	74	32.78	33.81	34.57	7.16	34.31	7.41
5	5225.50	--	AV	54	--	--	--	--	--	--
6	7440.00	42.58	PK	74	31.42	30.63	37.64	9.28	34.97	11.95
6	7440.00	--	AV	54	--	--	--	--	--	--

REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.
6. RBW1MHz VBW3MHz Peak detector is for PK value; RBW 1MHz VBW10Hz Peak detector is for AV value.

3.3. Maximum Peak Conducted Output Power

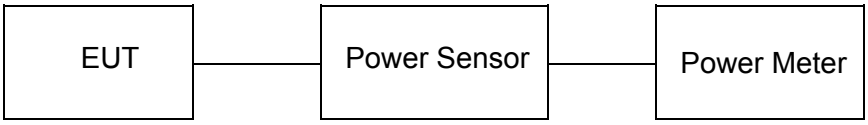
Limit

The Maximum Peak Output Power Measurement is 30dBm.

Test Procedure

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power sensor.

Test Configuration



Test Results

Type	Channel	Output power (dBm)	Limit (dBm)	Result
GFSK	00	3.22	30.00	Pass
	39	3.45		
	78	3.15		
π/4DQPSK	00	2.32	30.00	Pass
	39	2.64		
	78	2.58		
8DPSK	00	2.33	30.00	Pass
	39	2.38		
	78	2.24		

Note: 1.The test results including the cable lose.

3.4. 20dB and 99% Bandwidth

Limit

For frequency hopping systems operating in the 2400MHz-2483.5MHz no limit for 20dB bandwidth.

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 30 KHz RBW and 100 KHz VBW.

The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth:

RBW=1% to 5% of the OBW
VBW=approximately 3 X RBW
Detector=Peak
Trace Mode: Max Hold

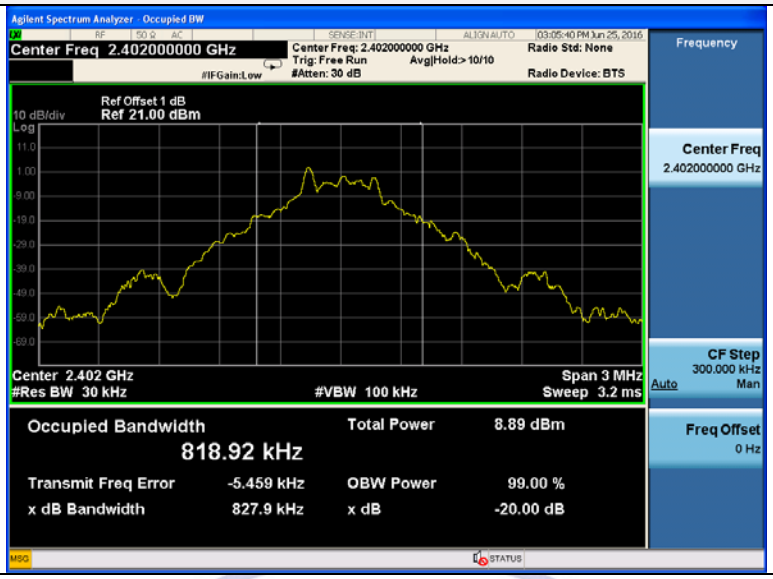
Use the 99% power bandwidth function of the instrument to measure the Occupied Bandwidth and recoded.

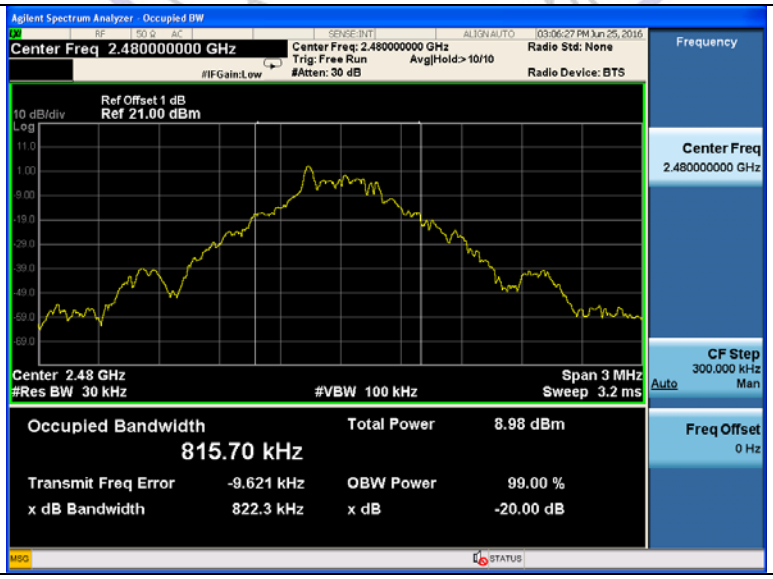
Test Configuration

Test Results

Modulation	Channel	20dB bandwidth (MHz)	99% OBW(MHz)	Result
GFSK	CH00	0.828	0.819	Pass
	CH39	0.830	0.813	
	CH78	0.822	0.816	
π/4DQPSK	CH00	1.117	1.066	
	CH39	1.116	1.054	
	CH78	1.113	1.067	
8DPSK	CH00	1.113	1.035	
	CH39	1.091	1.048	
	CH78	1.117	1.059	

Test plot as follows:

GFSK Modulation

CH00

CH39

CH78

π/4DQPSK Modulation

CH00

CH39

CH78

8DPSK Modulation

CH00

CH39

CH78

3.5. Frequency Separation

LIMIT

Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.

TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with100 KHz RBW and 300 KHz VBW.

TEST CONFIGURATION

TEST RESULTS

Modulation	Channel	Channel Separation (MHz)	Limit(MHz)	Result
GFSK	CH39	1.002	25KHz or 2/3*20dB bandwidth	Pass
	CH40			
π/4DQPSK	CH39	1.000	25KHz or 2/3*20dB bandwidth	Pass
	CH40			
8DPSK	CH39	1.004	25KHz or 2/3*20dB bandwidth	Pass
	CH40			

Note: We have tested all mode at high, middle and low channel, and recorded worst case at middle

Test plot as follows:

Frequency Separation

GFSK

π/4DQPSK

8DPSK

3.6. Number of hopping frequency

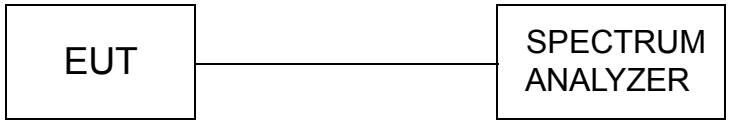
Limit

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. Set spectrum analyzer start 2400MHz to 2483.5MHz.

Test Configuration

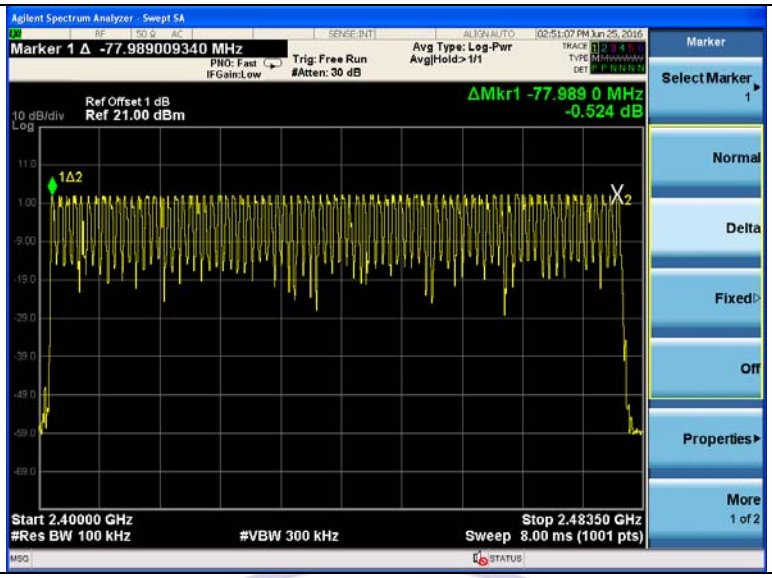


Test Results

Modulation	Number of Hopping Channel	Limit	Result
GFSK	79	≥15	Pass
π/4DQPSK	79		
8DPSK	79		

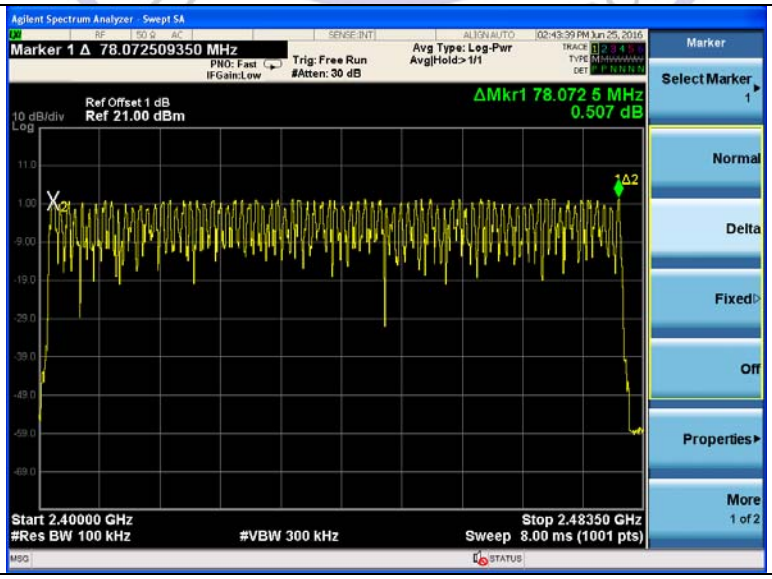
Test plot as follows:

GFSK Modulation



π/4DQPSK Modulation

8DPSK Modulation



3.7. Time of Occupancy (Dwell Time)

Limit

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. Set center frequency of spectrum analyzer=operating frequency with 1MHz RBW and 1MHz VBW, Span 0Hz.

Test Configuration

Test Results

Modulation	Packet	Pulse time (ms)	Dwell time (second)	Limit (second)	Result
GFSK	DH1	0.370	0.118	0.40	Pass
	DH3	1.620	0.259		
	DH5	2.880	0.307		
π/4DQPSK	2-DH1	0.378	0.121	0.40	Pass
	2-DH3	1.620	0.259		
	2-DH5	2.880	0.307		
8DPSK	3-DH1	0.378	0.121	0.40	Pass
	3-DH3	1.627	0.260		
	3-DH5	2.870	0.306		

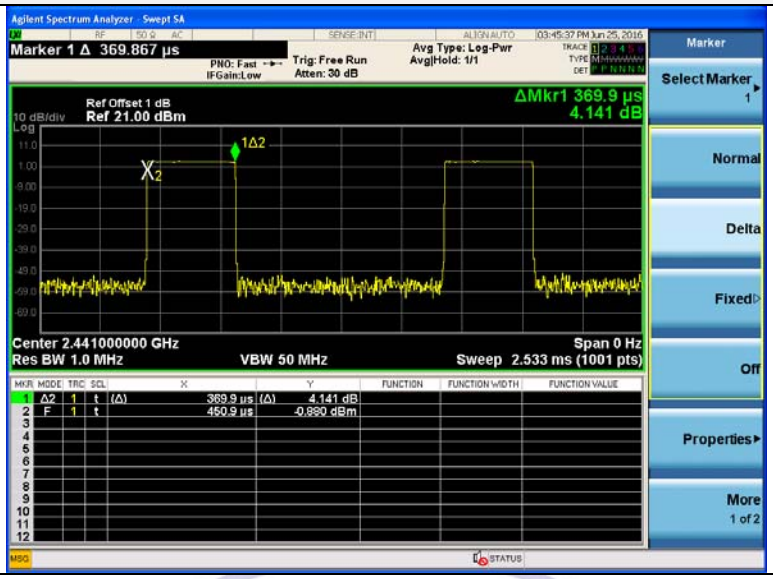
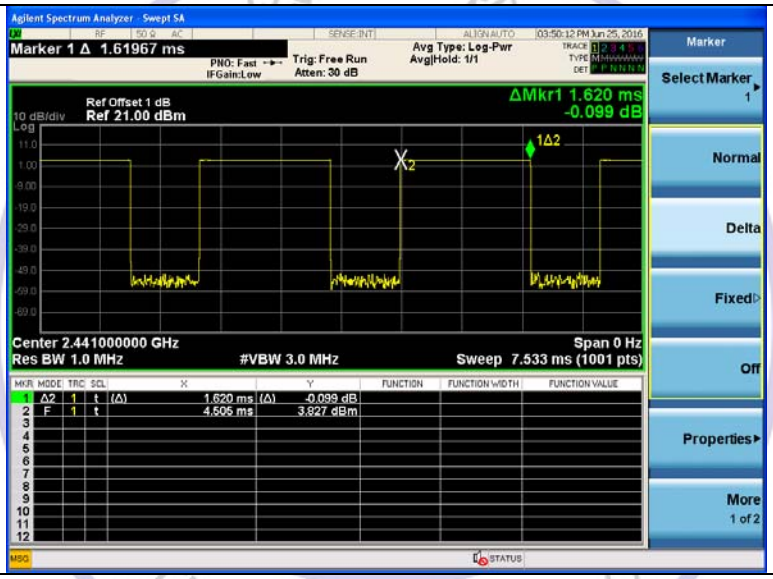
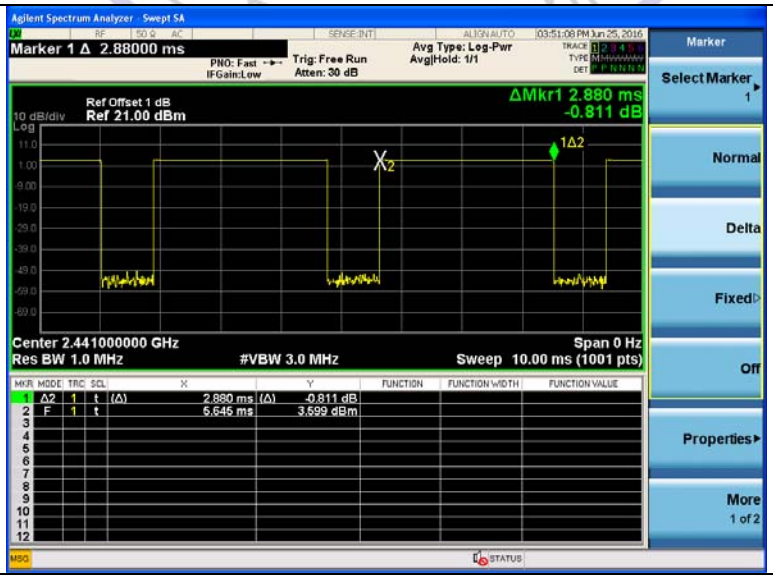
Note:

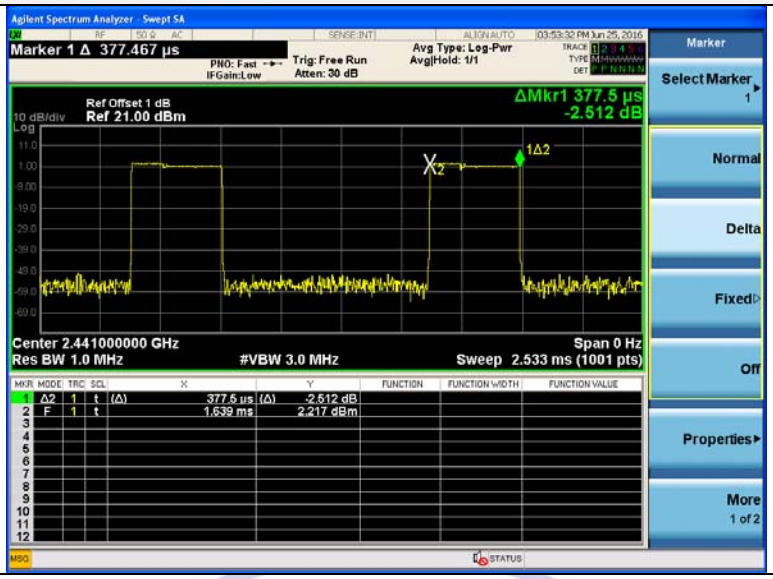
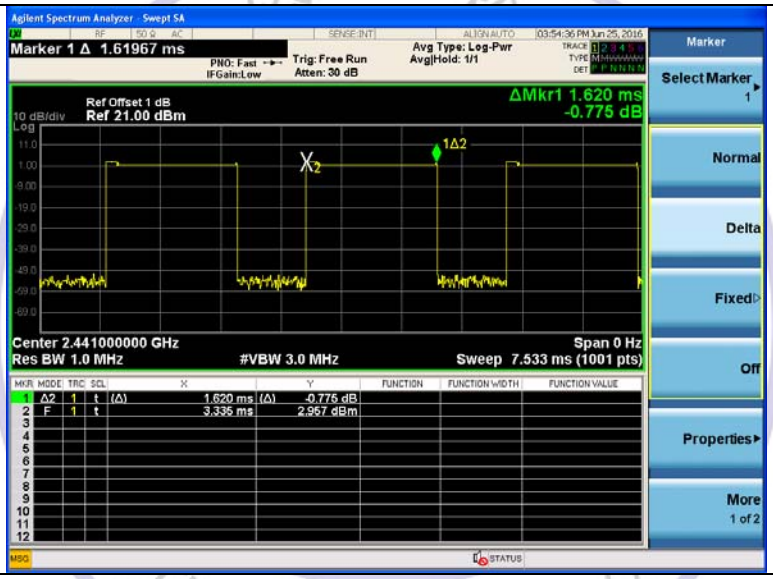
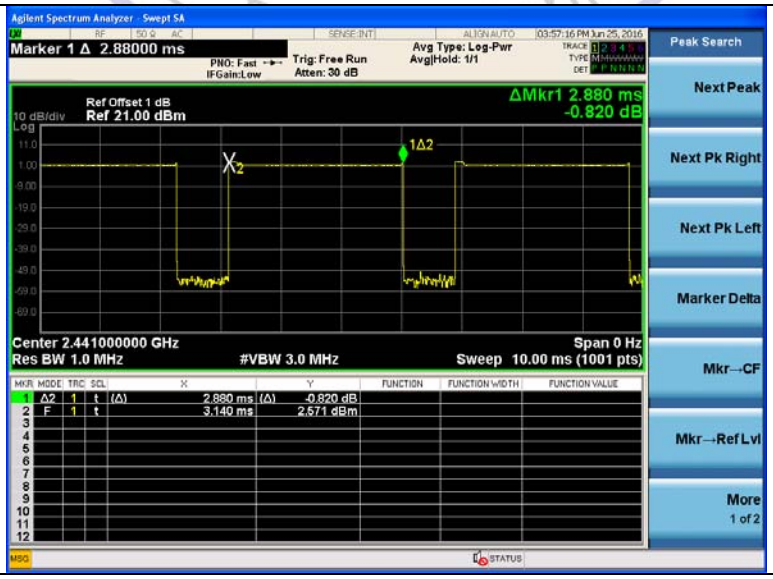
1. We have tested all mode at high,middle and low channel,and recoreded worst case at middle channel.
2. Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second for DH1, 2-DH1, 3-DH1

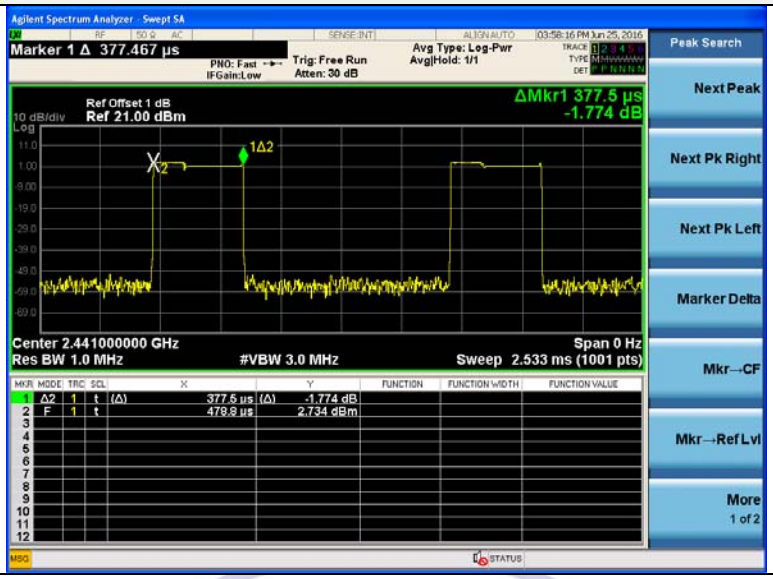
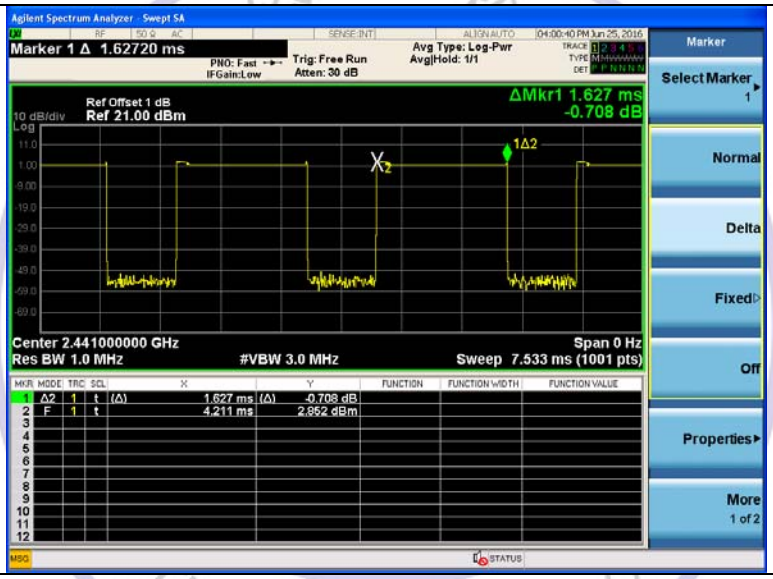
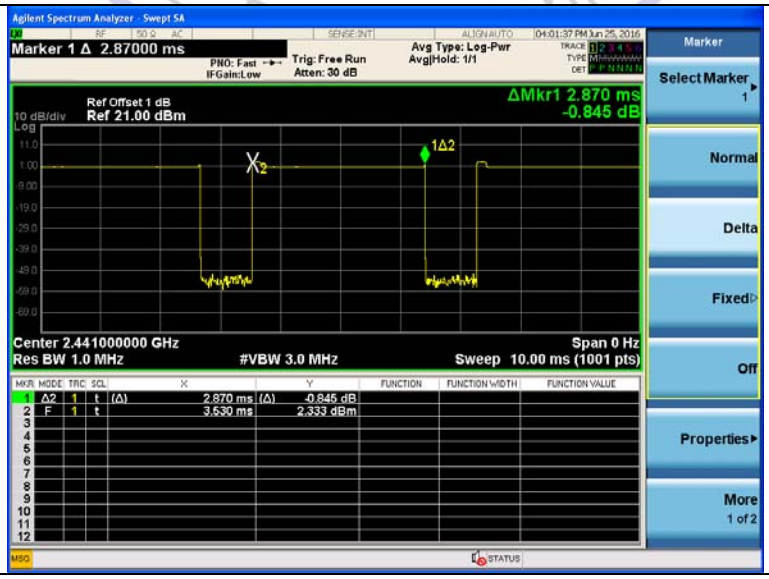
   Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second for DH3, 2-DH3, 3-DH3

   Dwell time=Pulse time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second for DH5, 2-DH5, 3-DH5

Test plot as follows:

GFSK Modulation

DH1

DH3

DH5

π/4DQPSK Modulation

2-DH1

2-DH3

2-DH5

8DPSK Modulation

3-DH1

3-DH3

3-DH5

3.8. Out-of-band Emissions

Limit

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 con-ducted or a radiated measurement, pro-vided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter com-plies 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 any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Test Procedure

Connect the transmitter output to spectrum analyzer using a low loss RF cable, and set the spectrum analyzer to RBW=100 kHz, VBW= 300 kHz, peak detector , and max hold. Measurements utilizing these setting are made of the in-band reference level, bandedge and out-of-band emissions.

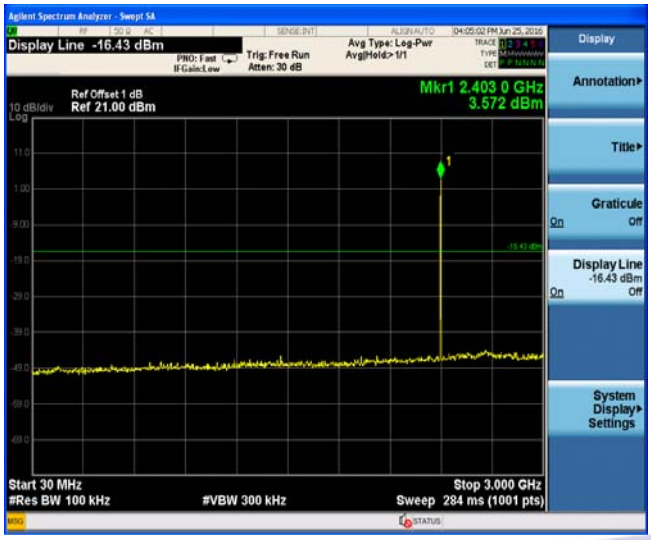
Test Configuration

Test Results

Remark: The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandage measurement data.
We measured all conditions (DH1, DH3, DH5) and recorded worst case at DH5 and 3DH5

Test plot as follows:

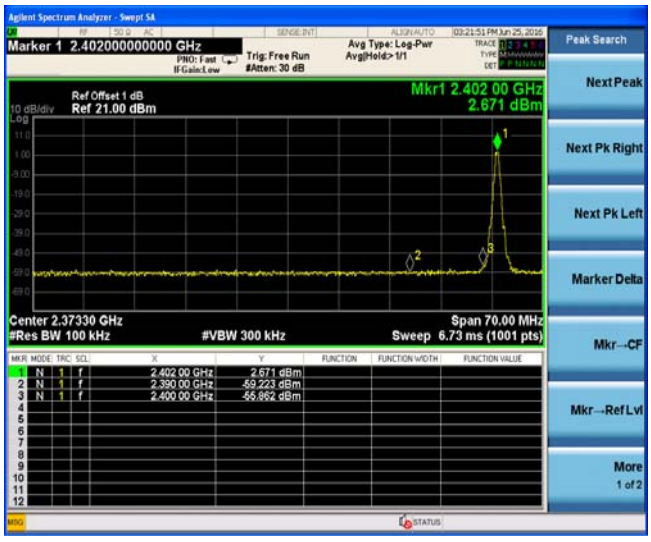
GFSK



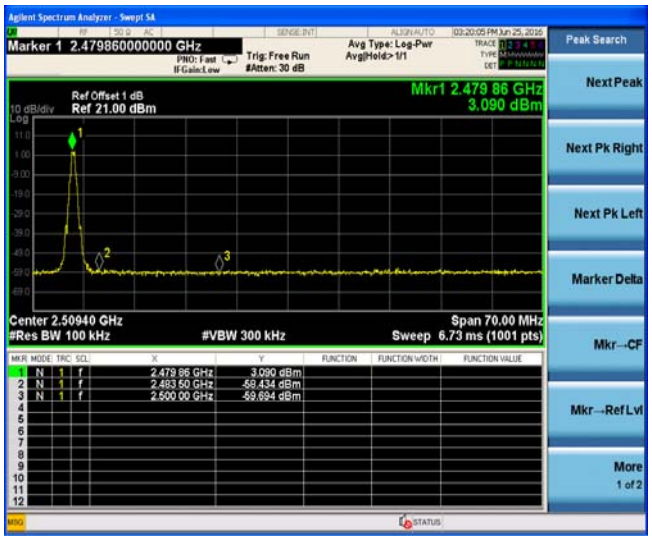
CH00

CH39

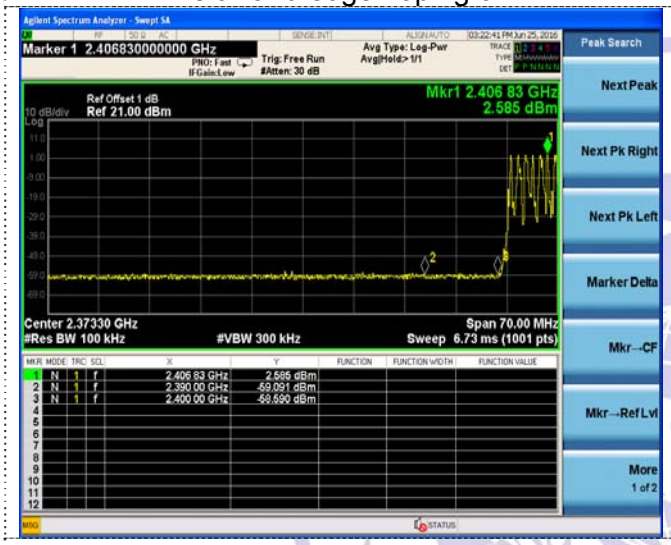
CH78



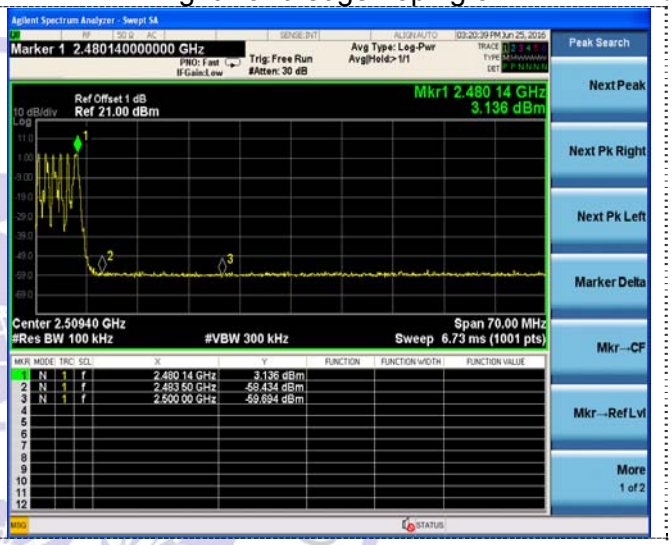
Left Band edge hoping off



Right Band edge hoping off

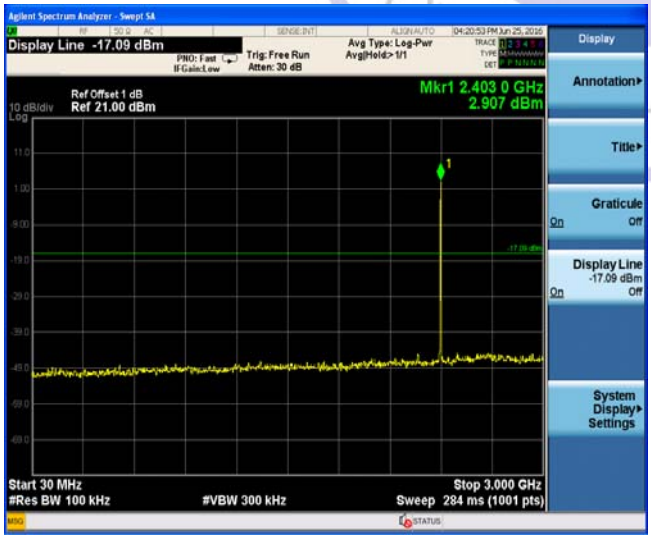


Left Band edge hoping on



Right Band edge hoping on

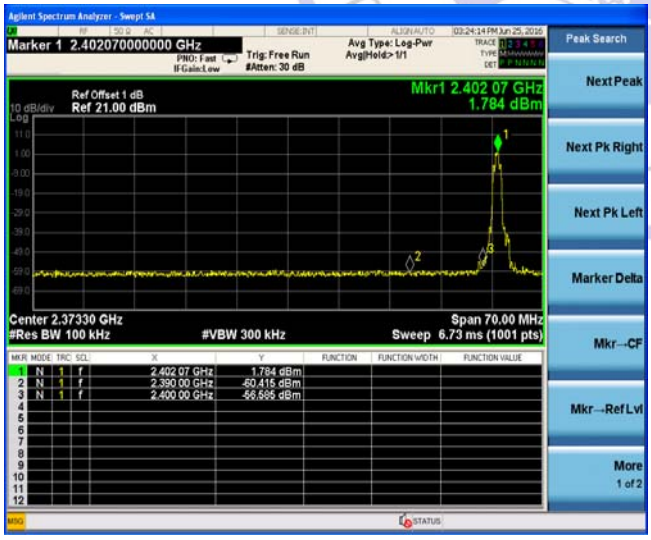
π /4DQPSK



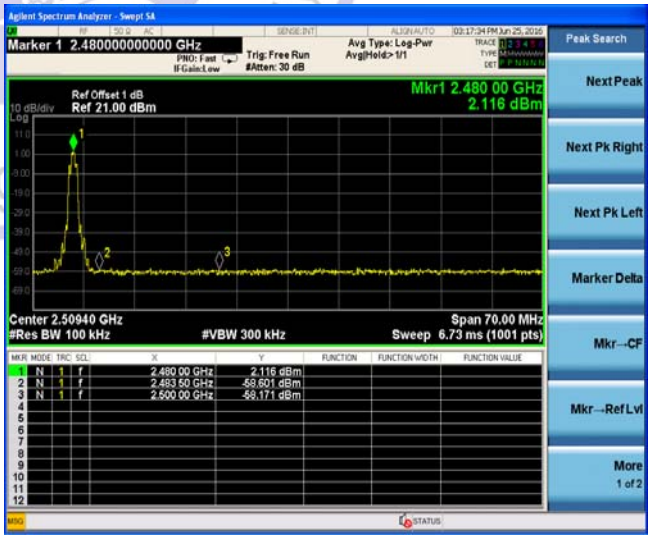
CH00

CH39

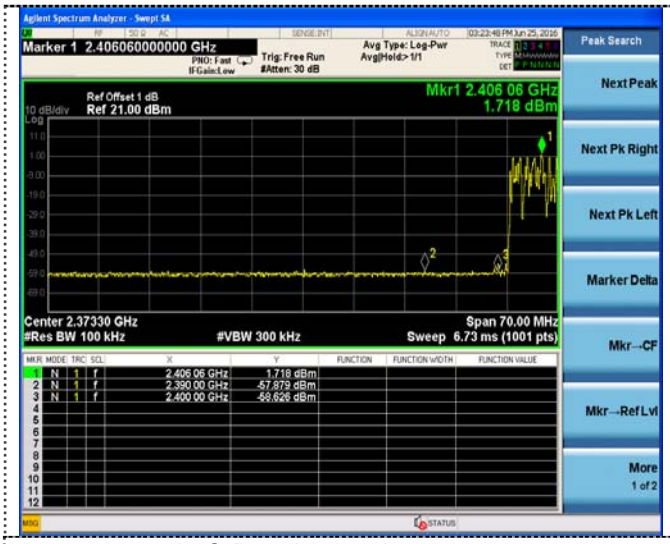
CH78



Left Band edge hoping off



Right Band edge hoping off



Left Band edge hoping on

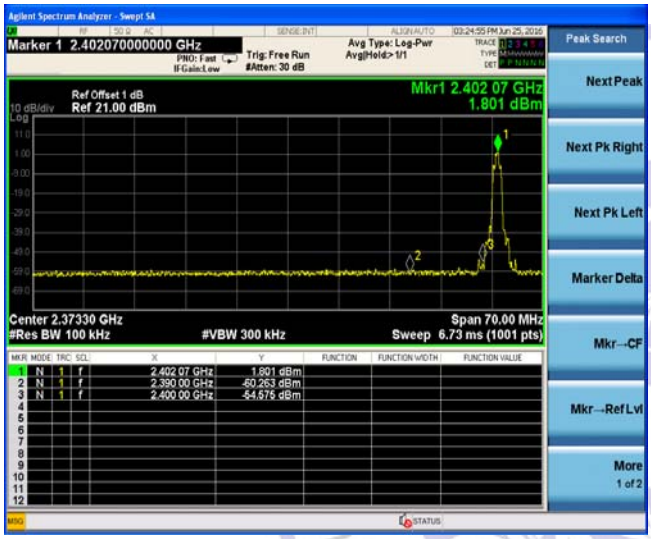
Right Band edge hoping on

8DPSK

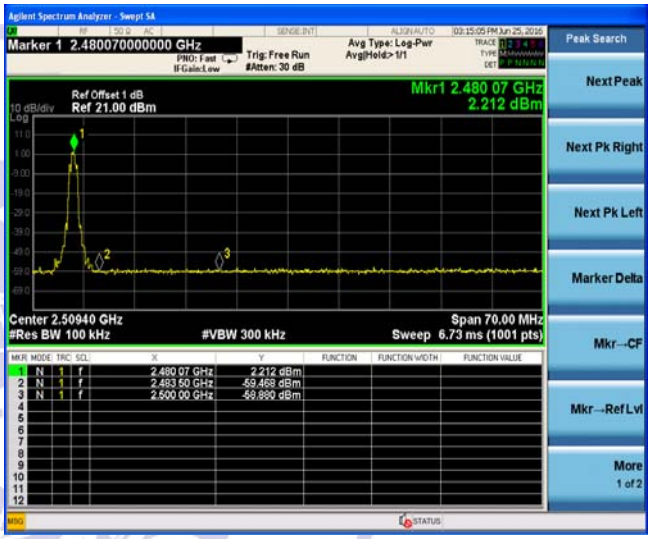
CH00

CH39

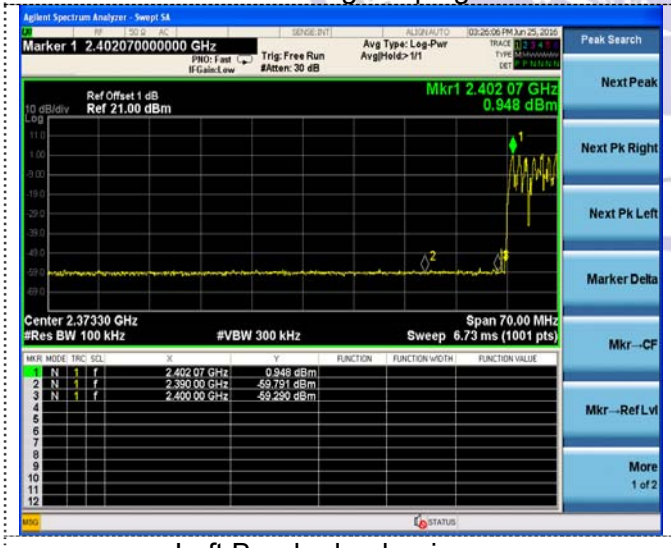
CH78



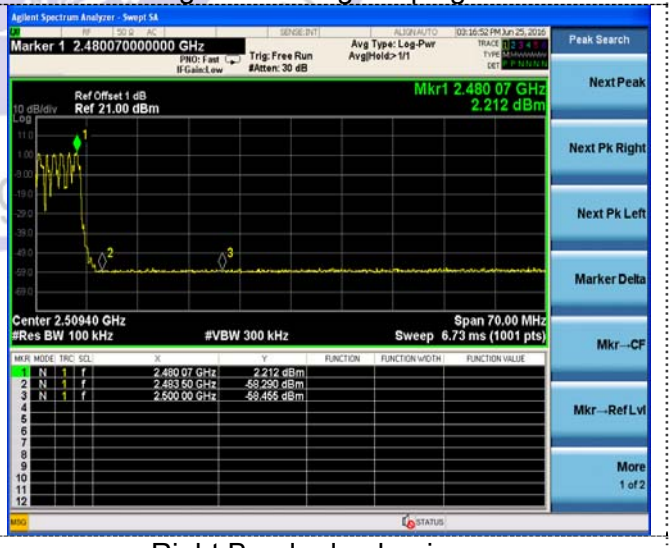
Left Band edge hoping off



Right Band edge hoping off



Left Band edge hoping on



Right Band edge hoping on

3.9. Pseudorandom Frequency Hopping Sequence

TEST APPLICABLE

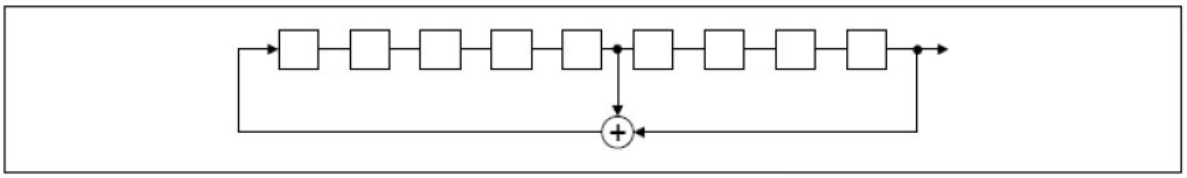
For 47 CFR Part 15C section 15.247 (a) (1) & RSS 247 requirement:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hop-ping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hop-ping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

EUT Pseudorandom Frequency Hopping Sequence Requirement

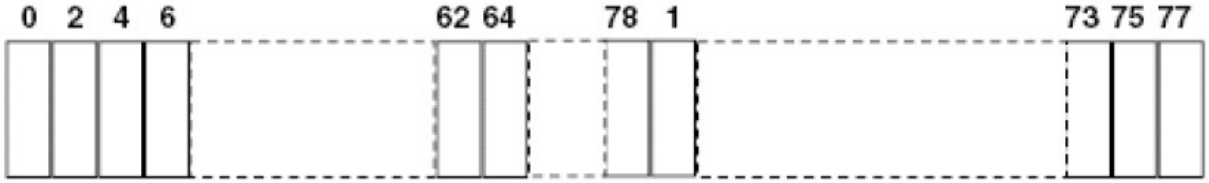
The pseudorandom frequency hopping sequence may be generated in a nice-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones, for example: the shift register is initialized with nine ones.

- Number of shift register stages:9
- Length of pseudo-random sequence:29-1=511 bits
- Longest sequence of zeros:8(non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

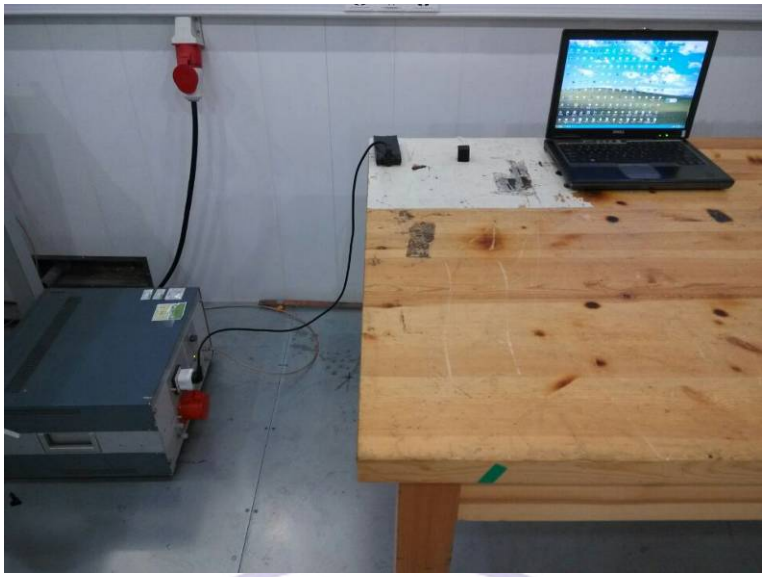
An example of pseudorandom frequency hopping sequence as follows:

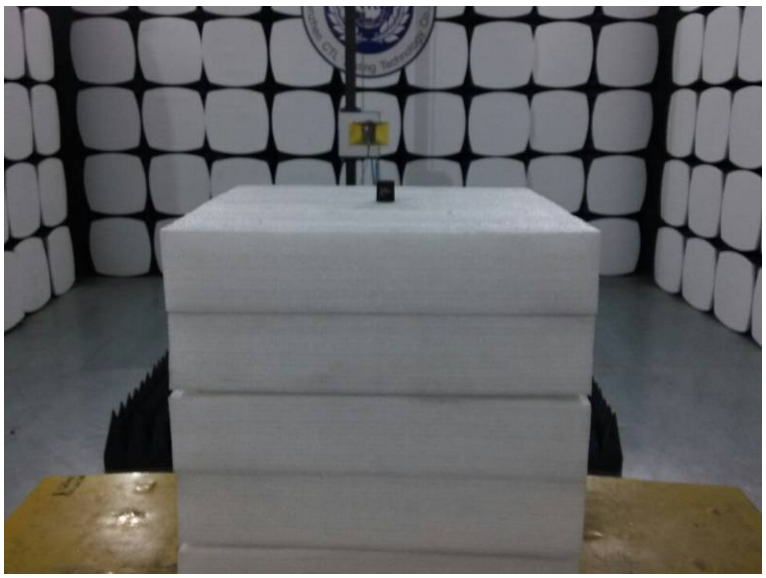


Each frequency used equally one the average by each transmitter.

The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitter and shift frequencies in synchronization with the transmitted signals.

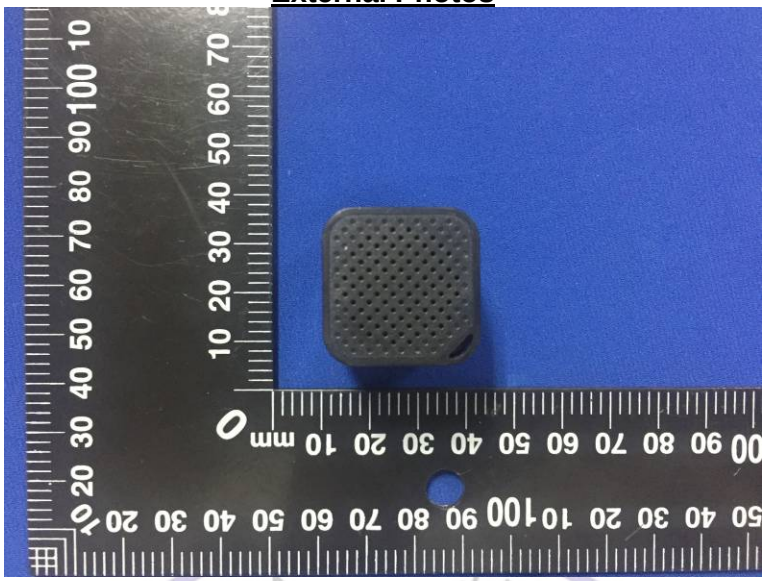
4. Test Setup Photos of the EUT

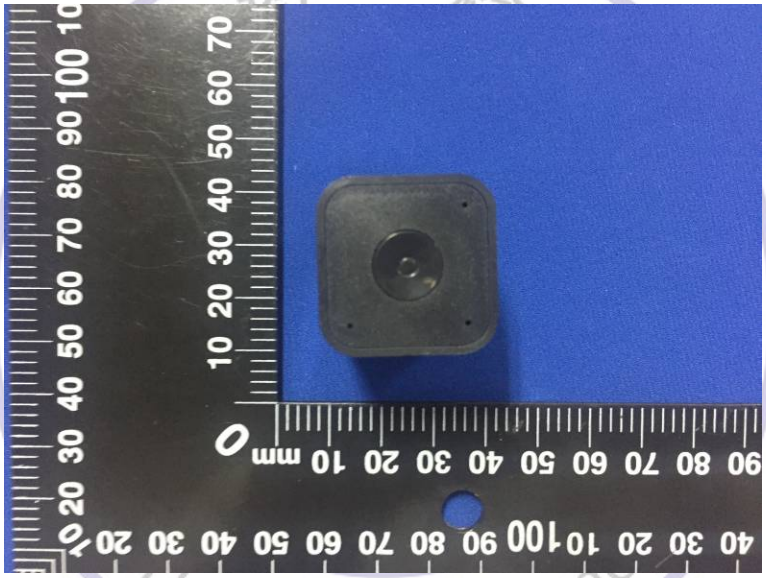


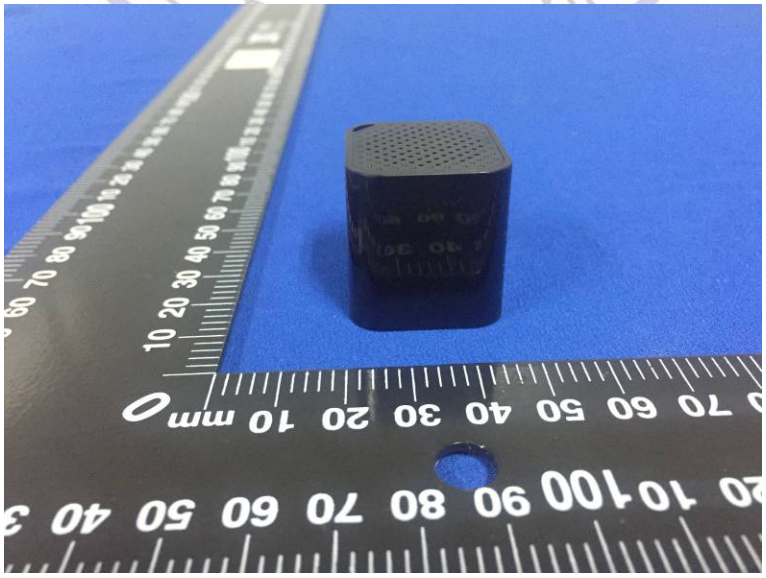


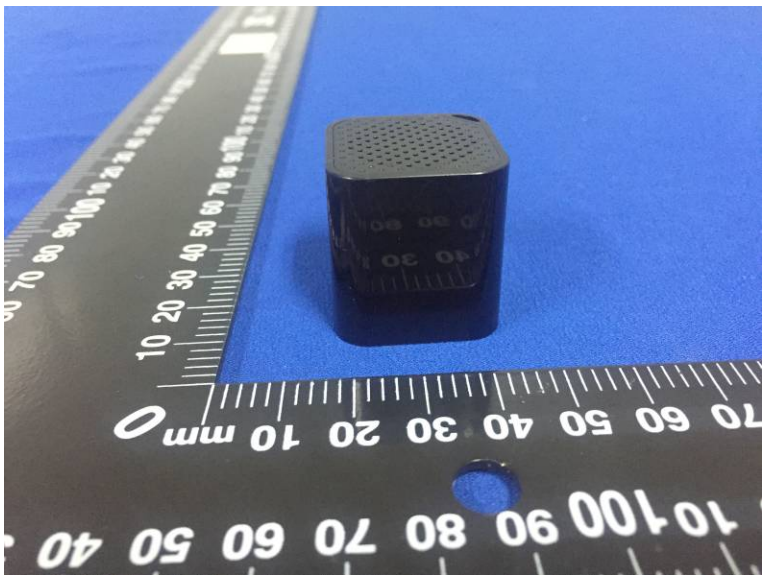
5. External and Internal Photos of the EUT

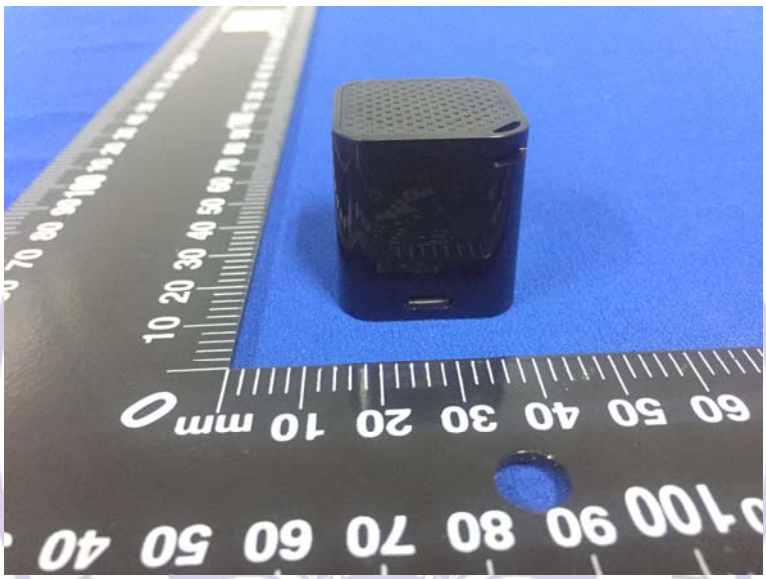
External Photos

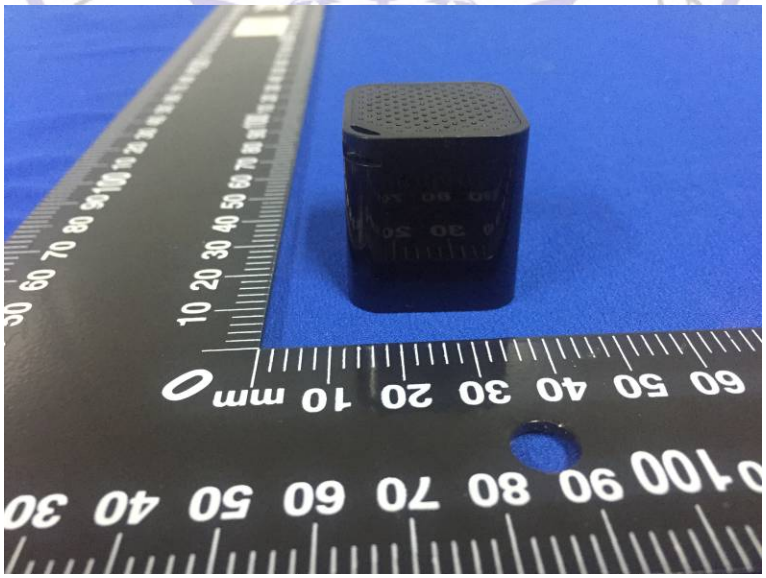




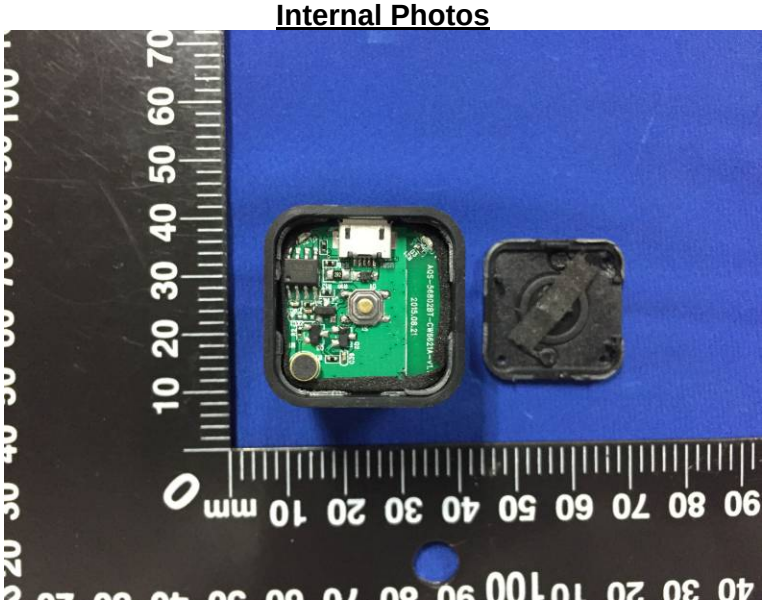


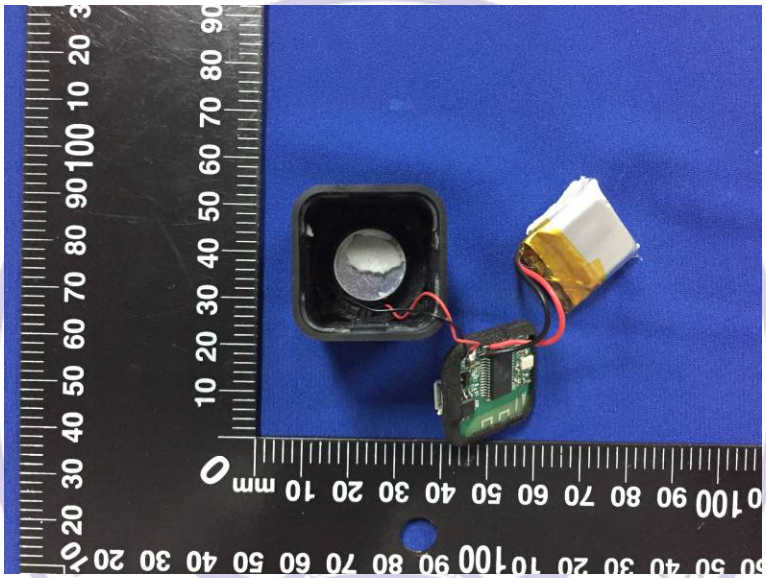


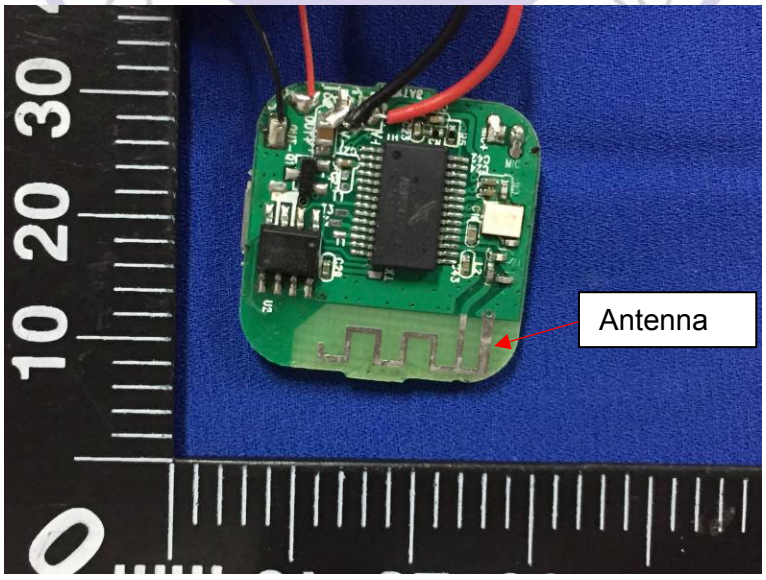


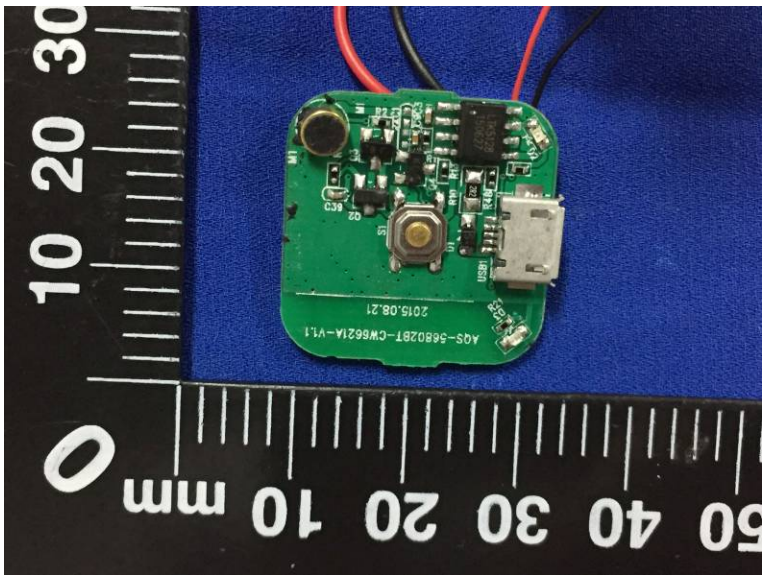


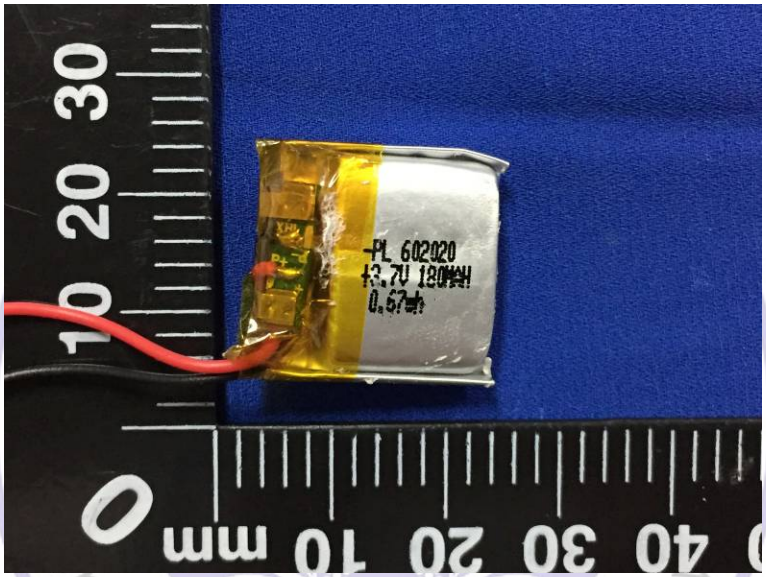
Internal Photos











********** End of Report **********