FCC RF Test Report

For

Shenzhen Hangshi Technology Co.,Ltd.

Test Standards:	Part 15C Subpart C §15.247
Product Description:	Bluetooth Keyboard
Tested Model:	HB216
Additional Model No.:	N/A
Brand Name:	N/A
FCC ID:	2AKHJHB216
Classification	Digital Spread Spectrum (DSS)
Report No.:	EC1901003F01
Tested Date:	2019-01-07 to 2019-01-11
Issued Date:	2019-01-11
Prepared By:	Tiny Yang/ Engineer
Approved By:	Bacon Wu / RF Manager

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Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	2019.01.11	Valid	Original Report

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Summary of Test Result

FCC Rule	IC Rule	Description	Limit	Result	Remark
15.247(a)(1)	RSS-247 5.1(1)	20dB Bandwidth	NA	Pass	-
-	RSS-Gen 6.6	99% Bandwidth	-	Pass	-
15.247(a)(1)	RSS-247 5.1(2)	Hopping Channel Separation	≥ 2/3 of 20dB BW	Pass	-
15.247(a)(1)	RSS-247 5.1(4)	Number of Channels	≥ 15Chs	Pass	-
15.247(a)(1)	RSS-247 5.1(4)	Average Time of Occupancy	≤ 0.4sec in 31.6sec period	Pass	-
15.247(b)(1)	RSS-247 5.4(2)	Peak Output Power	≤ 125 mW	Pass	-
15.247(d)	RSS-247 5.5	Conducted Band Edges	≤ 20dBc	Pass	-
15.247(d)	RSS-247 5.5	Conducted Spurious Emission	≤ 20dBc	Pass	-
15.247(d)	RSS-247 5.5	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit -2.25 dB at 9608 MHz
15.207	RSS-Gen 8.8	AC Conducted Emission	15.207(a)	Pass	Under limit -13.98 dB at 0.516 MHz
15.203 & 15.247(b)	N/A	Antenna Requirement	N/A	Pass	-

1 Test Laboratory

1.1 Test facility

CNAS (accreditation number: L11138)

Hunan Ecloud Testing Technology Co., Ltd. has obtained the accreditation of China National Accreditation Service for Conformity Assessment (CNAS).

FCC (Designation number: CN1244 , Test Firm Registration Number: 793308)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

ISED(CAB identifier: CN0012)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the Wireless Device Testing Laboratories list of innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements.

A2LA (Certificate Code : 4895.01)

Hunan Ecloud Testing Technology Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

2 General Description

2.1 Applicant

Shenzhen Hangshi Technology Co.,Ltd.
Hangshi Technology Park,Democracy West Industry Area,Shajing Town,Bao'an District,Shenzhen,China.

2.2 Manufacturer

Shenzhen Hangshi Technology Co.,Ltd.
Hangshi Technology Park,Democracy West Industry Area,Shajing Town,Bao'an District,Shenzhen,China.

2.3 General Description Of EUT

Product	Bluetooth Keyboard
Model No.	HB216
Additional No.	N/A
Difference Description	N/A
FCC ID	2AKHJHB216
IC ID	N/A
Power Supply	5Vdc (adapter or host equipment) 3.7Vdc (Li-ion)
Modulation Technology	FHSS
Modulation Type	GFSK
Operating Frequency	2402MHz~2480MHz
Number Of Channel	79
Max. Output Power	Bluetooth BR(1Mbps) : -5.152 dBm (0.3054 mW)
Antenna Type	FPC Antenna with 1.87dBi gain
I/O Ports	Refer to user's manual

NOTE:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.

2. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.

2.4 Modification of EUT

No modifications are made to the EUT during all test items.

2.5 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247
- ANSI C63.10-2013
- KDB 558074 D01 15.247 Meas Guidance v05

3 Test Configuration of Equipment Under Test

3.1 Descriptions of Test Mode

The transmitter has a maximum peak conducted output power as follows:

Channel	Frequency	Mode	Bluetooth RF Output Power
Ch00	2402MHz	GFSK	-5.152
Ch39	2441MHz	GFSK	-6.449
Ch78	2480MHz	GFSK	-7.883

Remark:

1. All the test data for each data rate were verified, but only the worst case was reported.
2. The data rate was set in 1Mbps for all the test items due to the highest RF output power.

a. Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

b. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z it was determined that Z orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Z orientation.

3.2 Test Mode

3.2.1 Antenna Port Conducted Measurement

Summary table of Test Cases	
Test Item	Data Rate / Modulation
	Bluetooth BR 1Mbps GFSK
Conducted Test Cases	Mode 1: CH00_2402 MHz Mode 2: CH39_2441 MHz Mode 3: CH78_2480 MHz

3.2.2 Radiated Emission Test (Below 1GHz)

	Bluetooth BR 1Mbps GFSK
Radiated Test Cases	Mode 1: CH00_2402 MHz Mode 2: CH39_2441 MHz Mode 3: CH78_2480 MHz

Note : 1. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type.

2. All above modes were tested, but only the worst case test mode 2 was reported.

3.2.3 Radiated Emission Test (Above 1GHz)

	Bluetooth BR 1Mbps GFSK
Radiated Test Cases	Mode 1: CH00_2402 MHz Mode 2: CH39_2441 MHz Mode 3: CH78_2480 MHz

Note : 1. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type.

2. Following channel(s) was (were) selected for the final test as listed above

3.2.4 Power Line Conducted Emission Test:

AC Conducted Emission	Mode 1 : Bluetooth Link + USB Cable (Charging from Adapter)

3.3 Support Equipment

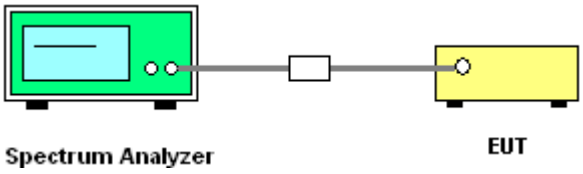
Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Adapter	HTC	TC E250	N/A	N/A	N/A
2.	Micro-USB Cable	HTC	N/A	N/A	N/A	unshielded 1.2m
3.	Notebook	Lenovo	E470C	FCC DoC	N/A	shielded cable DC O/P 1.8 m unshielded AC I/P cable1.2 m

3.4 Test Setup

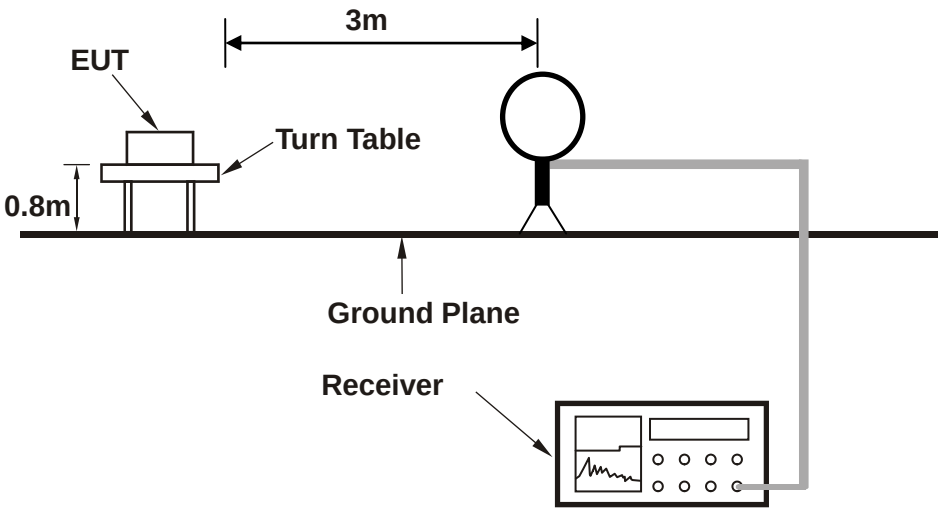
The EUT is continuously communicating to the Bluetooth tester during the tests.

EUT was set in the Hidden menu mode to enable BT communications.

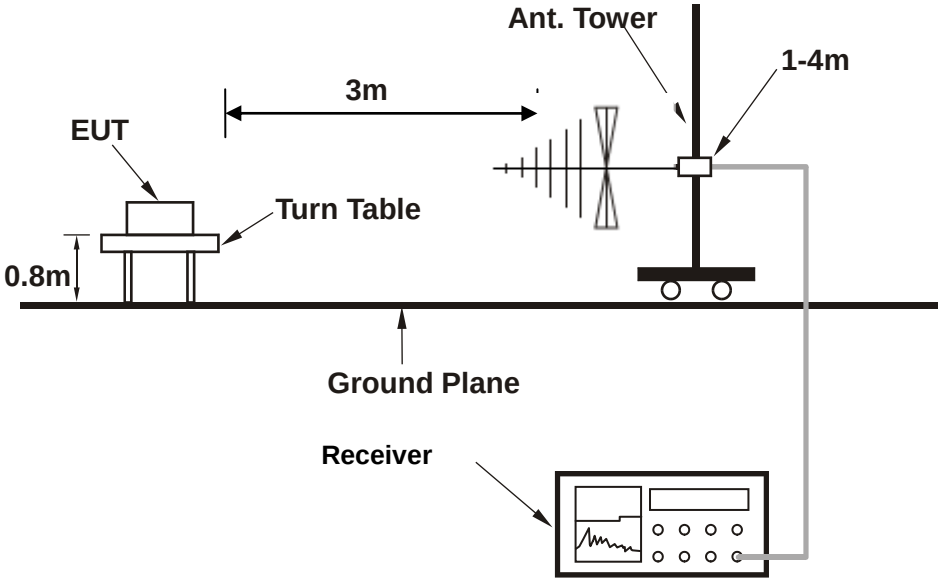
Setup diagram for Conducted Test



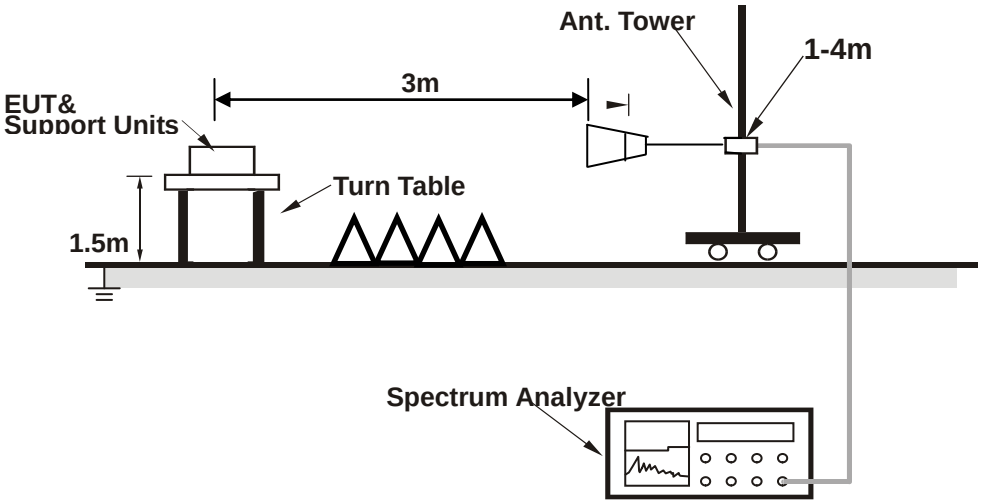
Setup diagram for Raidation(9KHz~30MHz) Test



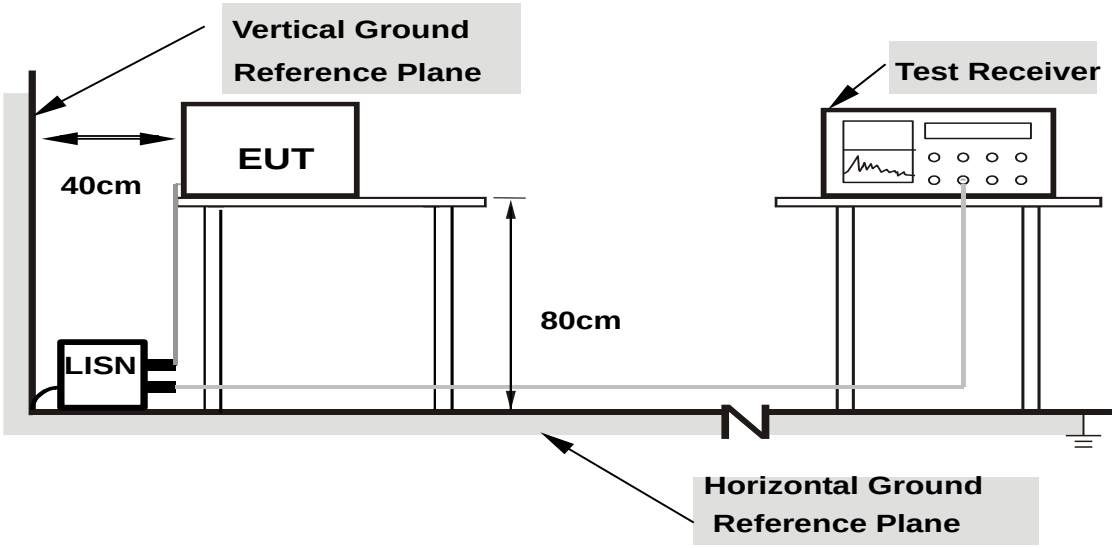
Setup diagram for Raidation(Below 1G) Test



Setup diagram for Raidation(Above1G) Test



Setup diagram for AC Conducted Emission Test



Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

3.5 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 5 dB and 10dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).

= 5 + 10 = 15 (dB)

4 Test Result

4.1 20dB and 99% Bandwidth Measurement

4.1.1 Limit of 20dB and 99% Bandwidth

None; for reporting purposes only.

4.1.2 Test Procedures

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument.
3. Use the following spectrum analyzer settings for 20dB Bandwidth measurement.

   Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel;

   RBW = 1% to 5% of the 20 dB bandwidth; VBW = approximately 3 times RBW; Sweep = auto;

   Detector function = peak; Trace = max hold.
4. Use the following spectrum analyzer settings for 99 % Bandwidth measurement.

   Span = approximately 1.5 to 5 times the 99% bandwidth, centered on a hopping channel;

   RBW = 1% to 5% of the 99% bandwidth; VBW = approximately 3 times RBW; Sweep = auto;

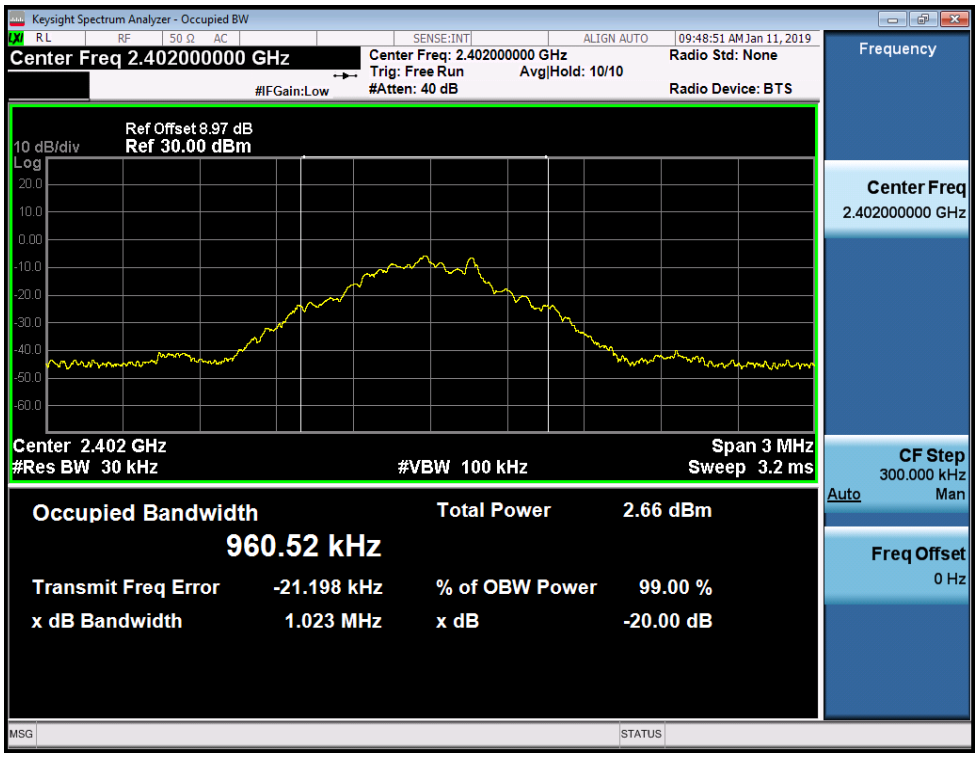
   Detector function = peak; Trace = max hold.

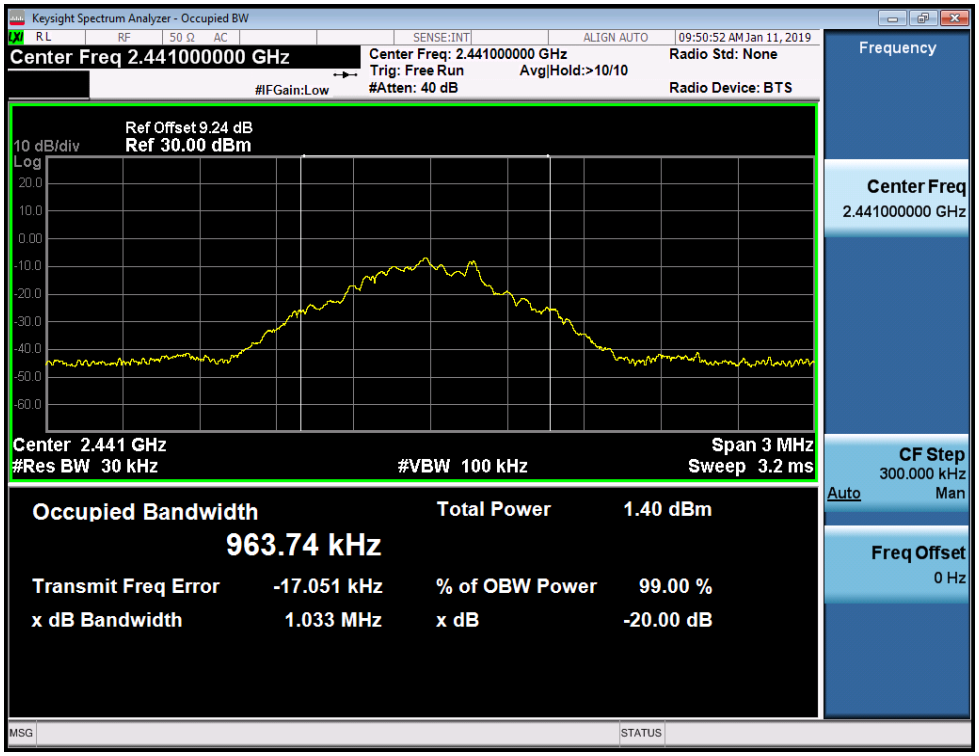
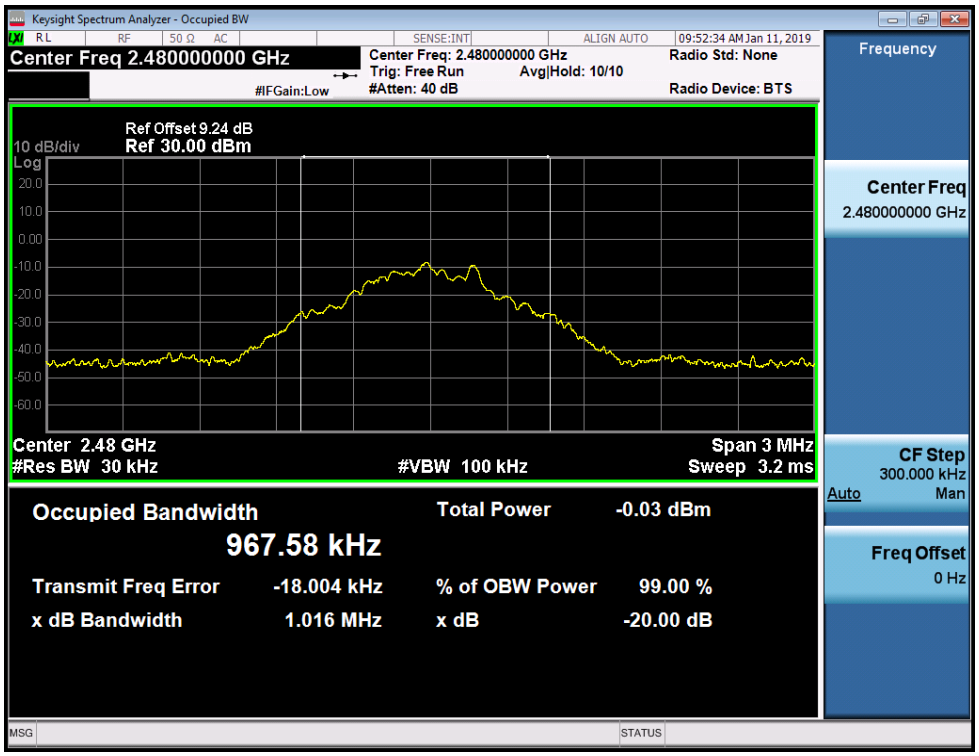
4.1.3 Test Result of 20dB Bandwidth and 99% Bandwidth

Test Mode :	Transmitting	Temperature :	24~26℃
Test Engineer :	Damon Zhang	Relative Humidity :	50~53%

Data Rate	Modulation	Channel	20dB Bandwidth [MHz]	99% OBW [MHz]	Verdict
1Mbps	GFSK	LCH	1.023	0.96052	PASS
1Mbps	GFSK	MCH	1.033	0.96374	PASS
1Mbps	GFSK	HCH	1.016	0.96758	PASS

20dB and 99% Plot

Graphs	
GFSK/LCH	

GFSK/MCH	
GFSK/HCH	

4.2 Hopping Channel Separation Measurement

4.2.1 Limit of Hopping Channel Separation

FCC §15.247 (a) (1)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping 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.

4.2.2 Test Procedures

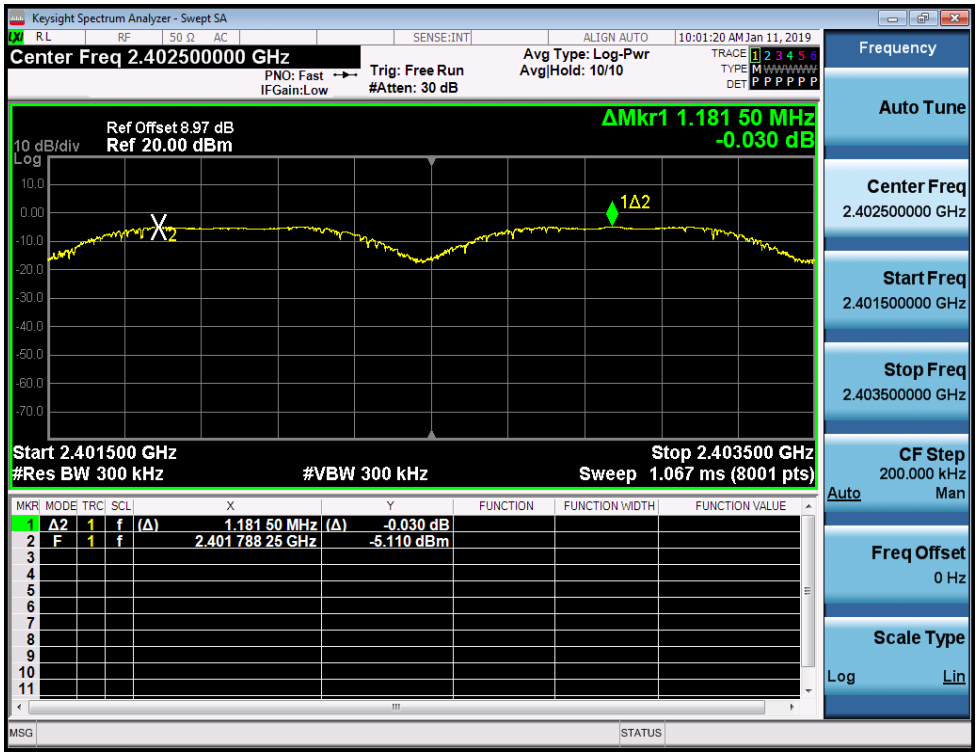
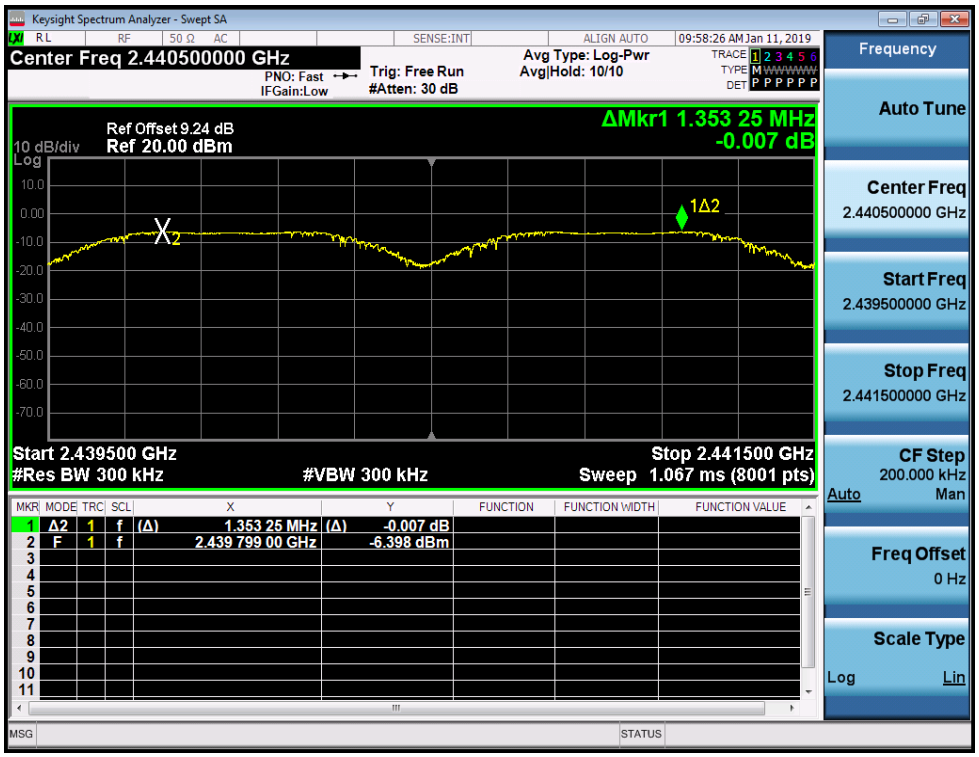
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument.
3. The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

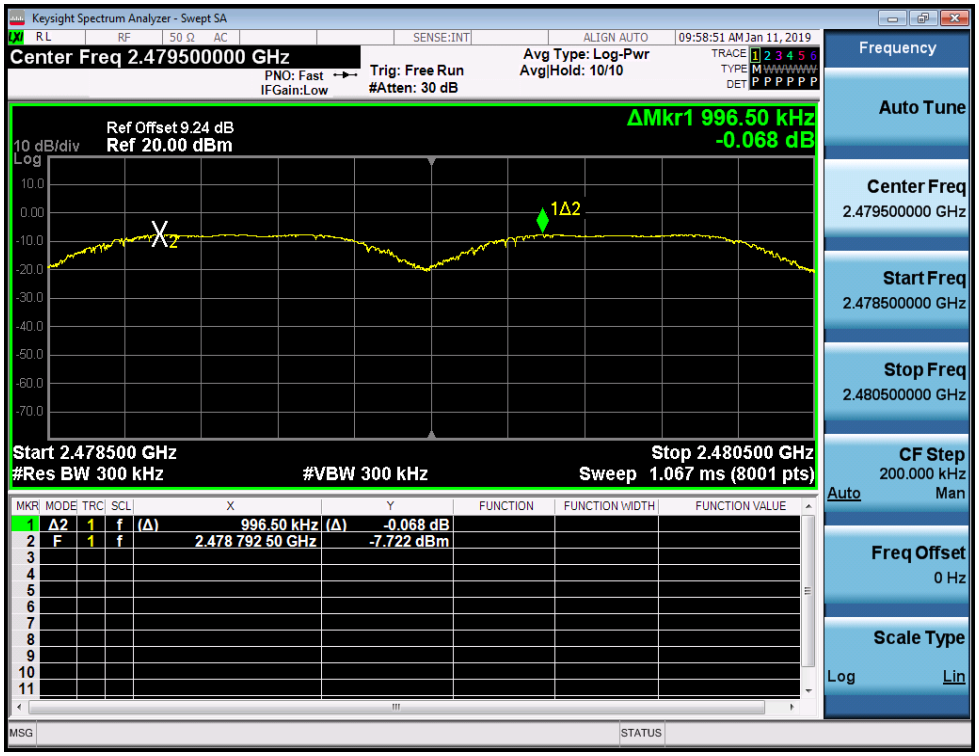
4.2.3 Test Result of Hopping Channel Separation

Test Mode :	Transmitting	**Temperature :**	24~26℃
Test Engineer :	Damon Zhang	**Relative Humidity :**	50~53%

Data Rate	**Modulation**	**Channel**	**Carrier Frequency Separation [MHz]**	**Verdict**
1Mbps	GFSK	LCH	1.182	PASS
1Mbps	GFSK	MCH	1.353	PASS
1Mbps	GFSK	HCH	0.997	PASS

Hopping Frequency Separation Plot

Graphs	
GFSK/LCH	
GFSK/MCH	

GFSK/HCH	

Keysight Spectrum Analyzer - Swept SA
Center Freq 2.479500000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold: 10/10
09:58:51 AM Jan 11, 2019
Ref Offset 9.24 dB
10 dB/div
Log
Ref 20.00 dBm
ΔMkr1 996.50 kHz
-0.068 dB
1Δ2
Start 2.478500 GHz
#Res BW 300 kHz
#VBW 300 kHz
Stop 2.480500 GHz
Sweep 1.067 ms (8001 pts)
1 Δ2 1 f (Δ) 996.50 kHz (Δ) -0.068 dB
2 F 1 f 2.478 792 50 GHz -7.722 dBm
Frequency
Auto Tune
Center Freq
2.479500000 GHz
Start Freq
2.478500000 GHz
Stop Freq
2.480500000 GHz
CF Step
200.000 kHz
Auto
Man
Freq Offset
0 Hz
Scale Type
Log
Lin
MSG
STATUS

4.3 Number of Channel Measurement

4.3.1 Limits of Number of Hopping Frequency

FCC§15.247(a)(1)(iii)

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

4.3.2 Test Procedure

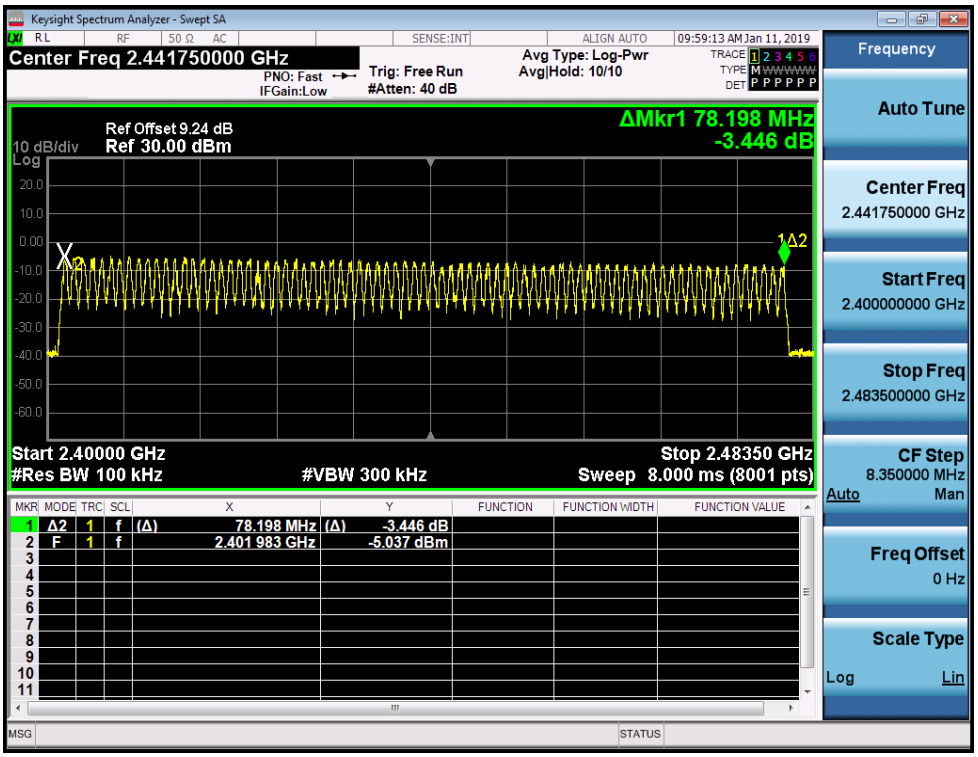
4. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
5. Turn on the EUT and connect it to measurement instrument.
6. The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple continuous sweeps. The RBW is set to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.. The analyzer is set to Max Hold.

4.3.3 Test Result of Number of Hopping Frequency

Test Mode :	Transmitting	**Temperature :**	24~26℃
Test Engineer :	Damon Zhang	**Relative Humidity :**	50~53%

Data Rate	**Modulation**	**Channel.**	**Number of Hopping Channel**	**Verdict**
1Mbps	GFSK	Hop	79	PASS

Number of Hopping Channels

Graphs	
GFSK/Hop	

4.4 Average Time of Occupancy Measurement

4.4.1 Limit of Average Time of Occupancy

FCC §15.247 (a) (1) (iii)

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.

4.4.2 Test Procedures

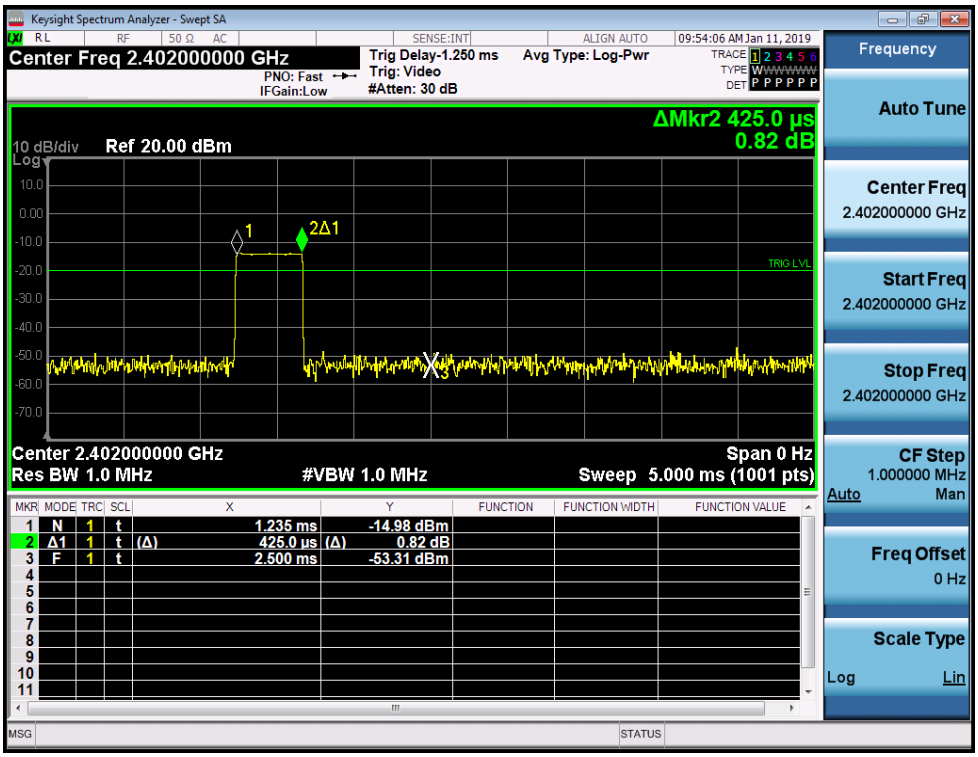
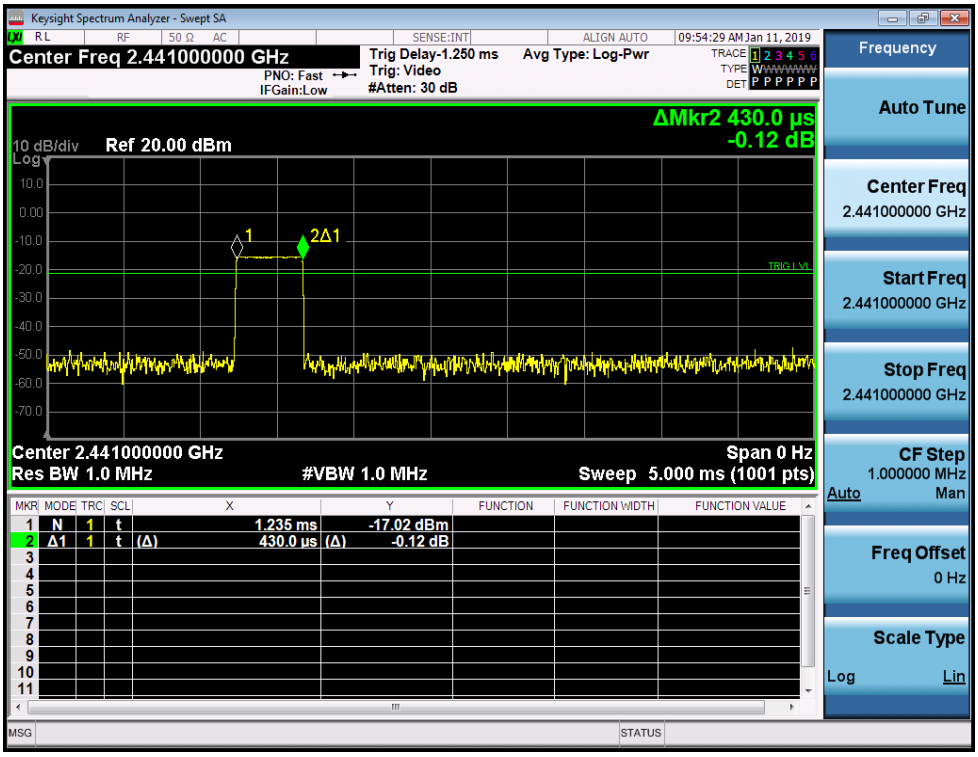
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument.
3. The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.
4. The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to 10 * (# of pulses in 3.16 s) * pulse width.

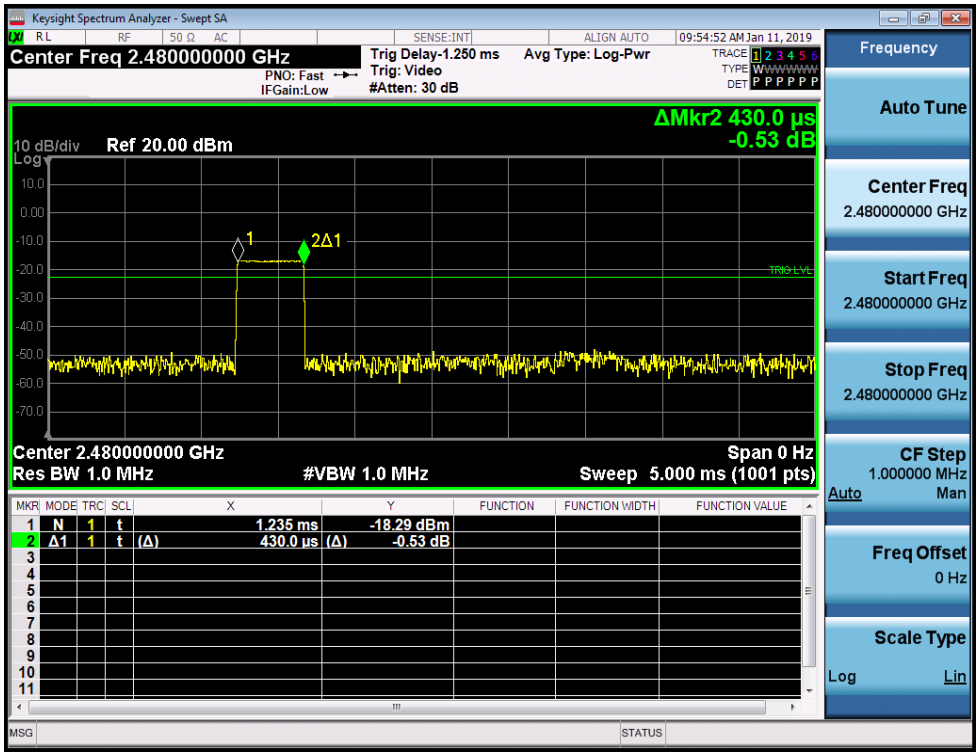
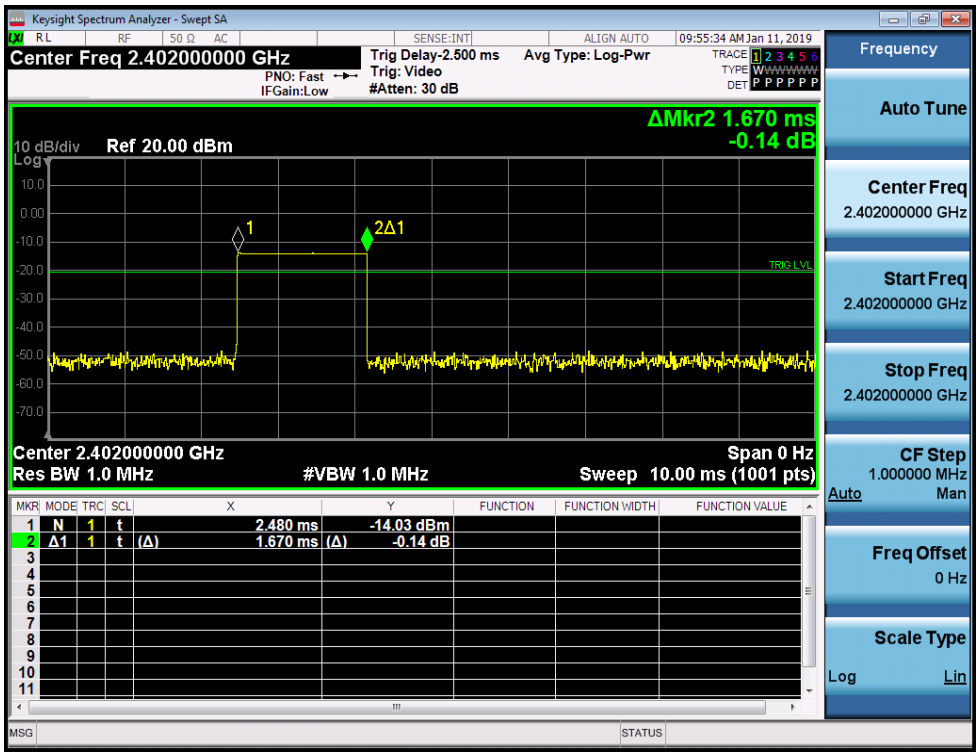
4.4.3 Test Result of Dwell Time

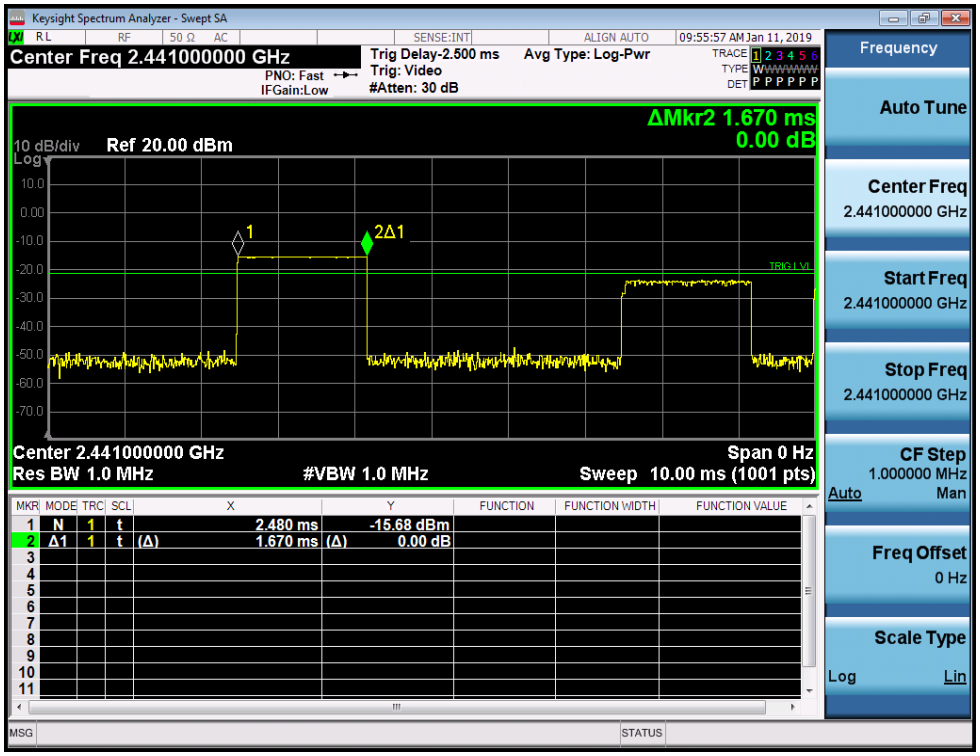
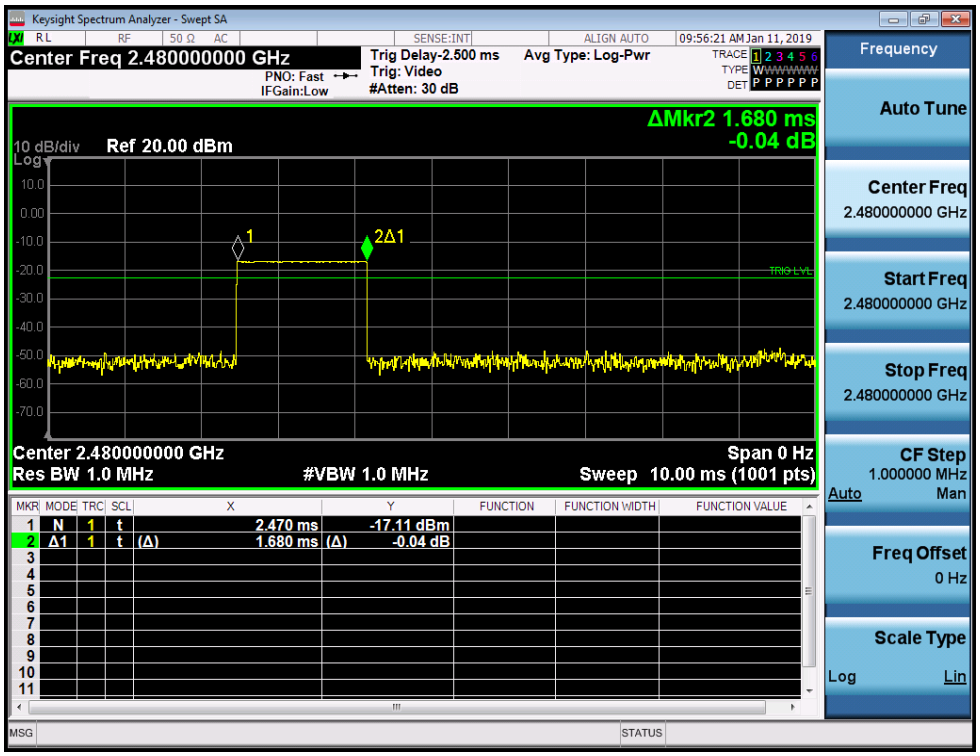
Test Mode :	Transmitting	Temperature :	24~26℃
Test Engineer :	Damon Zhang	Relative Humidity :	50~53%

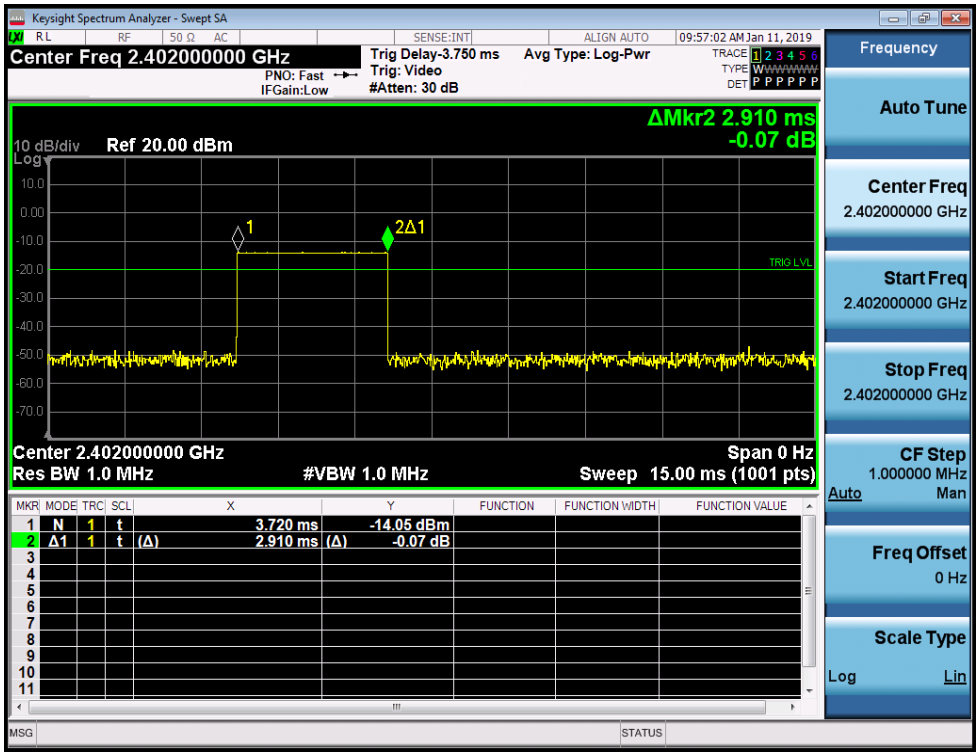
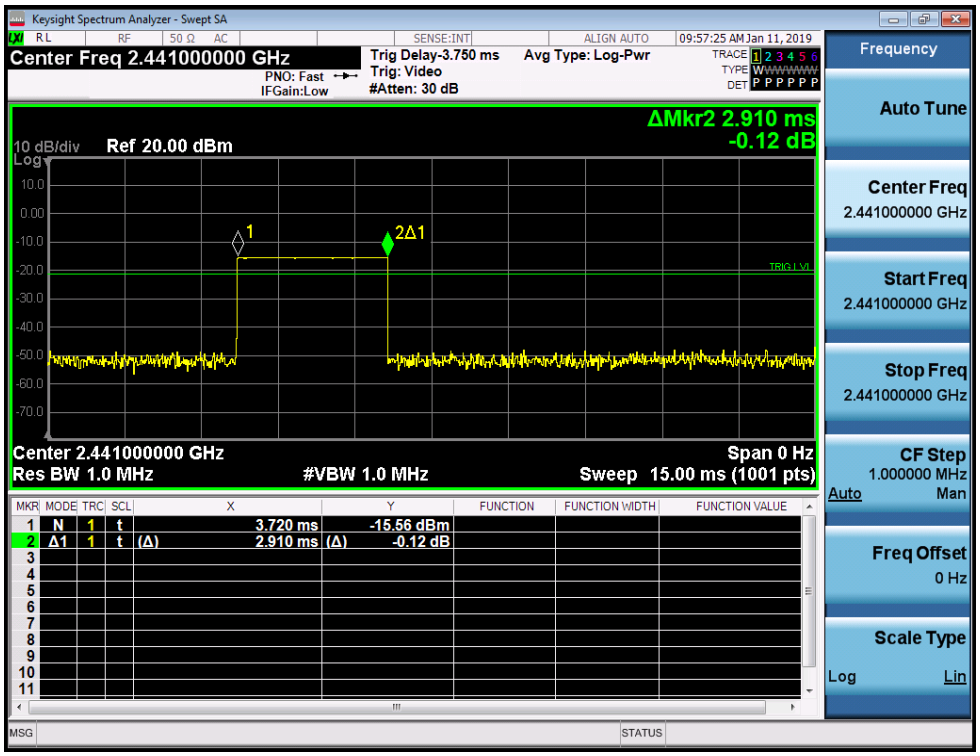
Data Rate	Modulation	Packet	Channel	Burst Width [ms/hop/ch]	Total Hops[hop*ch]	Dwell Time[s]	Verdict
1Mbps	GFSK	DH1	LCH	0.43	320	0.138	PASS
1Mbps	GFSK	DH1	MCH	0.43	320	0.138	PASS
1Mbps	GFSK	DH1	HCH	0.43	320	0.138	PASS
1Mbps	GFSK	DH3	LCH	1.67	160	0.267	PASS
1Mbps	GFSK	DH3	MCH	1.67	160	0.267	PASS
1Mbps	GFSK	DH3	HCH	1.68	160	0.269	PASS
1Mbps	GFSK	DH5	LCH	2.91	106.7	0.31	PASS
1Mbps	GFSK	DH5	MCH	2.91	106.7	0.31	PASS
1Mbps	GFSK	DH5	HCH	2.91	106.7	0.31	PASS

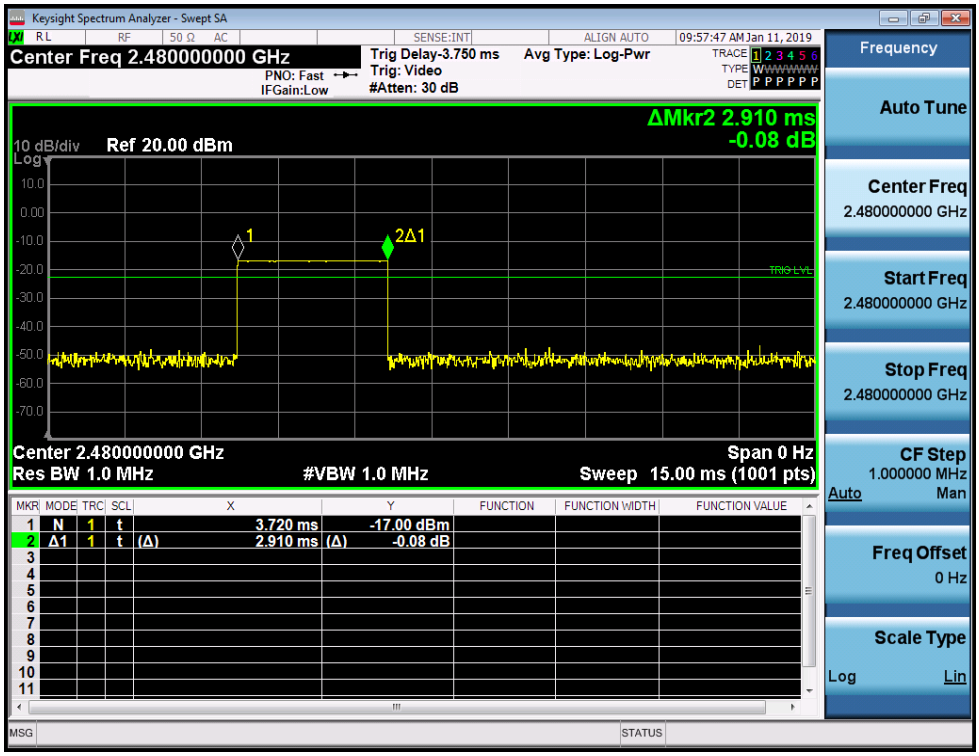
The Average Time of Occupancy Plot

Graphs	
GFSK_DH1/LCH	
GFSK_DH1/MCH	

GFSK_DH1/HCH	
GFSK_DH3/LCH	

GFSK_DH3/MCH	
GFSK_DH3/HCH	

GFSK_DH5/LCH	
GFSK_DH5/MCH	

GFSK_DH5/HCH	

Keysight Spectrum Analyzer - Swept SA
Center Freq 2.480000000 GHz
PNO: Fast
IFGain:Low
Trig Delay-3.750 ms
Trig: Video
#Atten: 30 dB
Avg Type: Log-Pwr
09:57:47 AM Jan 11, 2019
ΔMkr2 2.910 ms
-0.08 dB
10 dB/div
Log
Ref 20.00 dBm
Center 2.480000000 GHz
Res BW 1.0 MHz
#VBW 1.0 MHz
Span 0 Hz
Sweep 15.00 ms (1001 pts)
1 N 1 t 3.720 ms -17.00 dBm
2 Δ1 1 t (Δ) 2.910 ms (Δ) -0.08 dB
Frequency
Auto Tune
Center Freq
2.480000000 GHz
Start Freq
2.480000000 GHz
Stop Freq
2.480000000 GHz
CF Step
1.000000 MHz
Auto
Man
Freq Offset
0 Hz
Scale Type
Log
Lin
MSG
STATUS

4.5 Peak Output Power Measurement

4.5.1 Limit of Peak Output Power

Section 15.247 (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band 0.125 watts.

4.5.2 Test Procedures

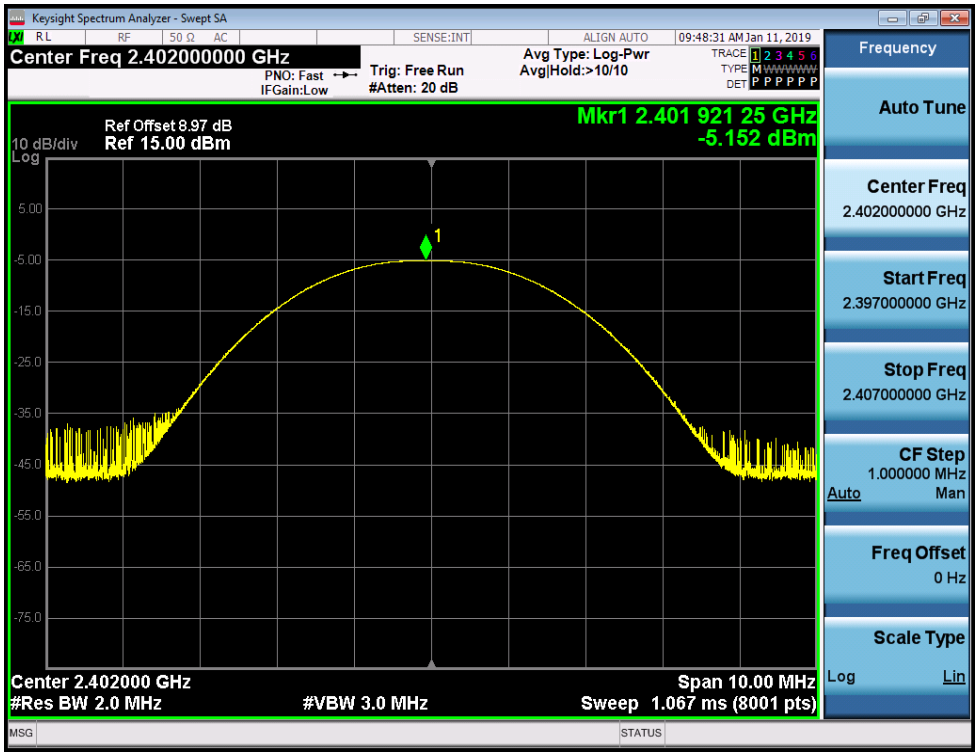
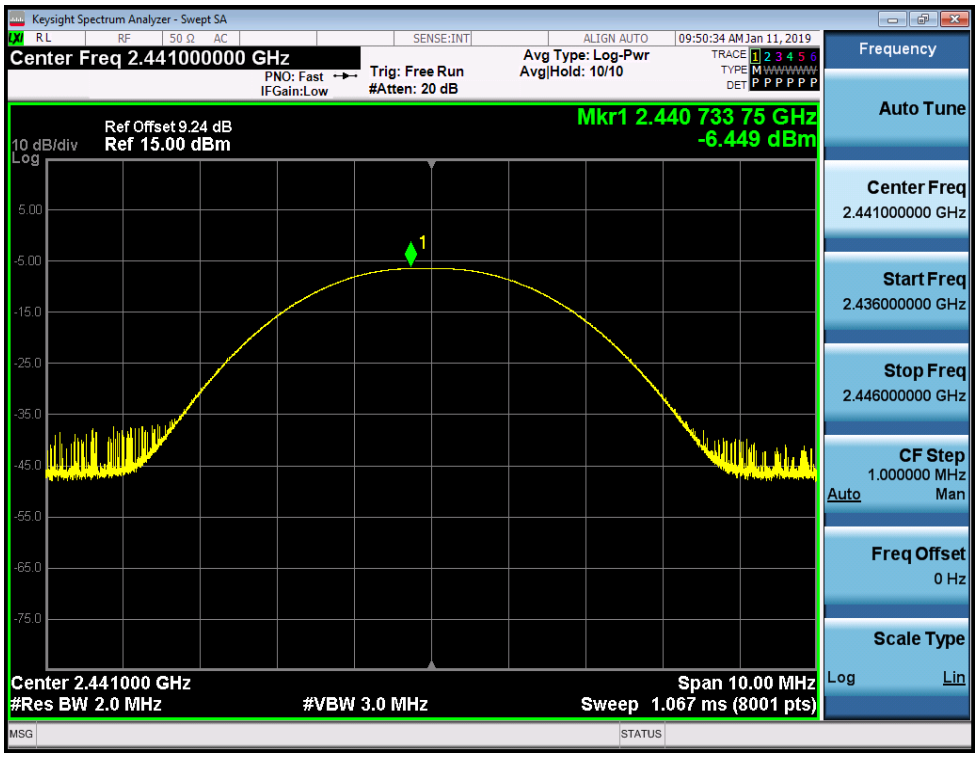
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument.
3. The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

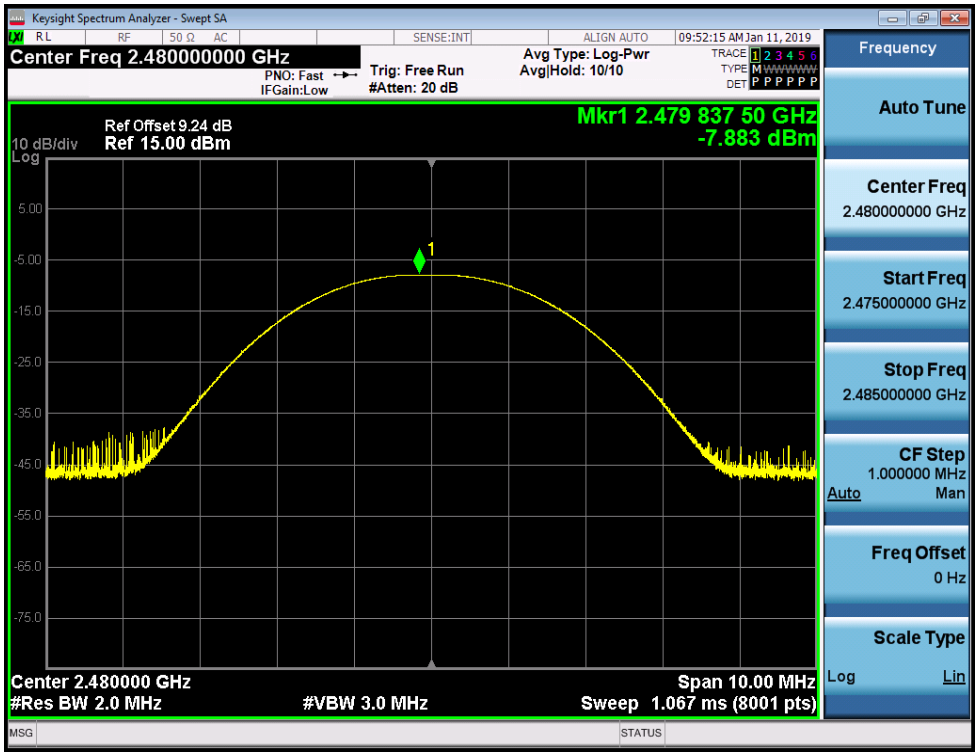
4.5.3 Test Result of Peak Output Power

Test Mode :	Transmitting	**Temperature :**	24~26℃
Test Engineer :	Damon Zhang	**Relative Humidity :**	50~53%

Data Rate	**Modulation**	**Channel**	**Maximum Peak Output Power [dBm]**	**Limit[dBm]**	**Verdict**
1Mbps	GFSK	LCH	-5.152	21	PASS
1Mbps	GFSK	MCH	-6.449	21	PASS
1Mbps	GFSK	HCH	-7.883	21	PASS

Peak Output Power Polt

Graphs	
GFSK/LCH	
GFSK/MCH	

GFSK/HCH	

Keysight Spectrum Analyzer - Swept SA
Center Freq 2.480000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold: 10/10
09:52:15 AM Jan 11, 2019
Ref Offset 9.24 dB
10 dB/div
Log
Ref 15.00 dBm
Mkr1 2.479 837 50 GHz
-7.883 dBm
Center 2.480000 GHz
#Res BW 2.0 MHz
#VBW 3.0 MHz
Span 10.00 MHz
Sweep 1.067 ms (8001 pts)
Frequency
Auto Tune
Center Freq
2.480000000 GHz
Start Freq
2.475000000 GHz
Stop Freq
2.485000000 GHz
CF Step
1.000000 MHz
Auto
Man
Freq Offset
0 Hz
Scale Type
Log
Lin
MSG
STATUS

4.6 Conducted Band Edges Measurement

4.6.1 Limit of Band Edges

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

4.6.2 Test Procedures

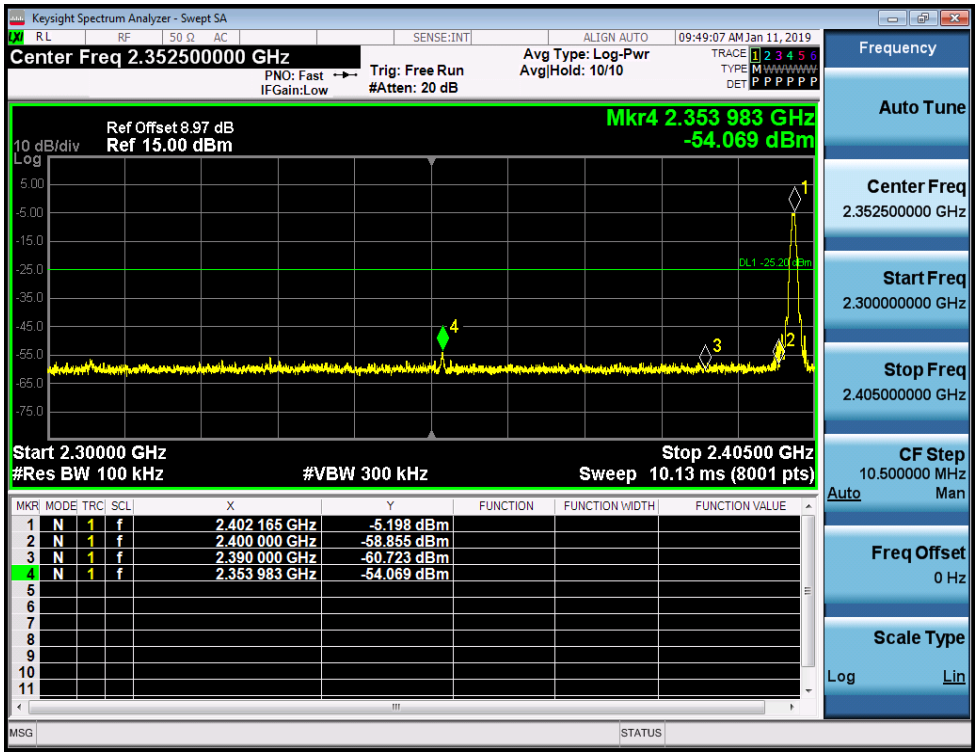
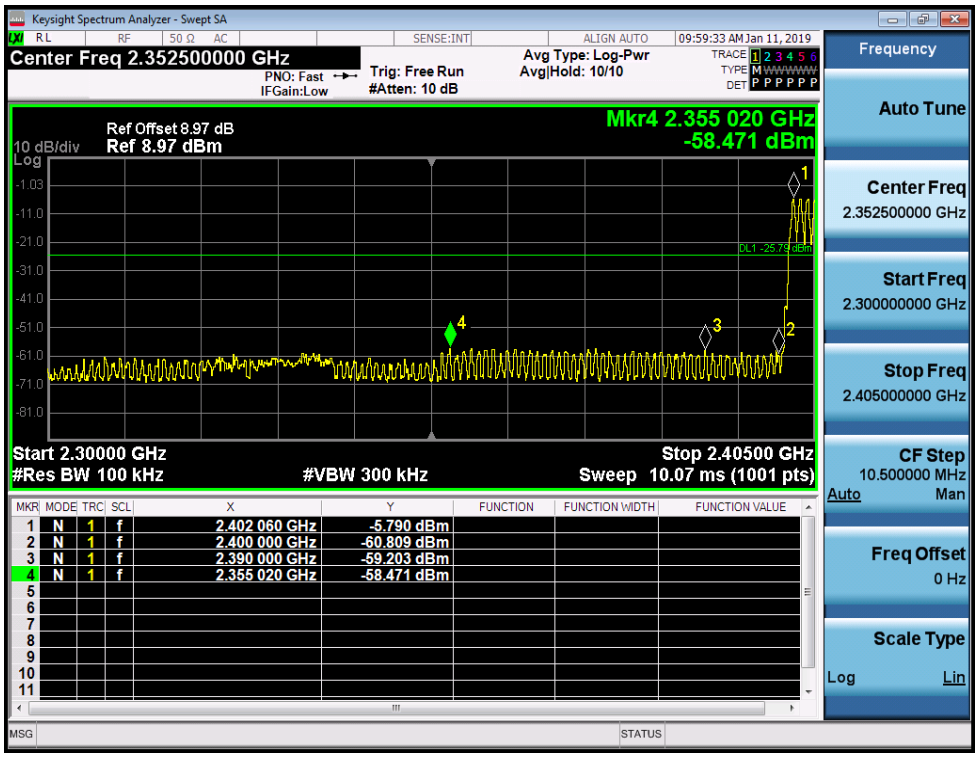
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument.
3. Set RBW = 100kHz, VBW = 300kHz. Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used.
4. Enable hopping function of the EUT and then repeat step 1~3.

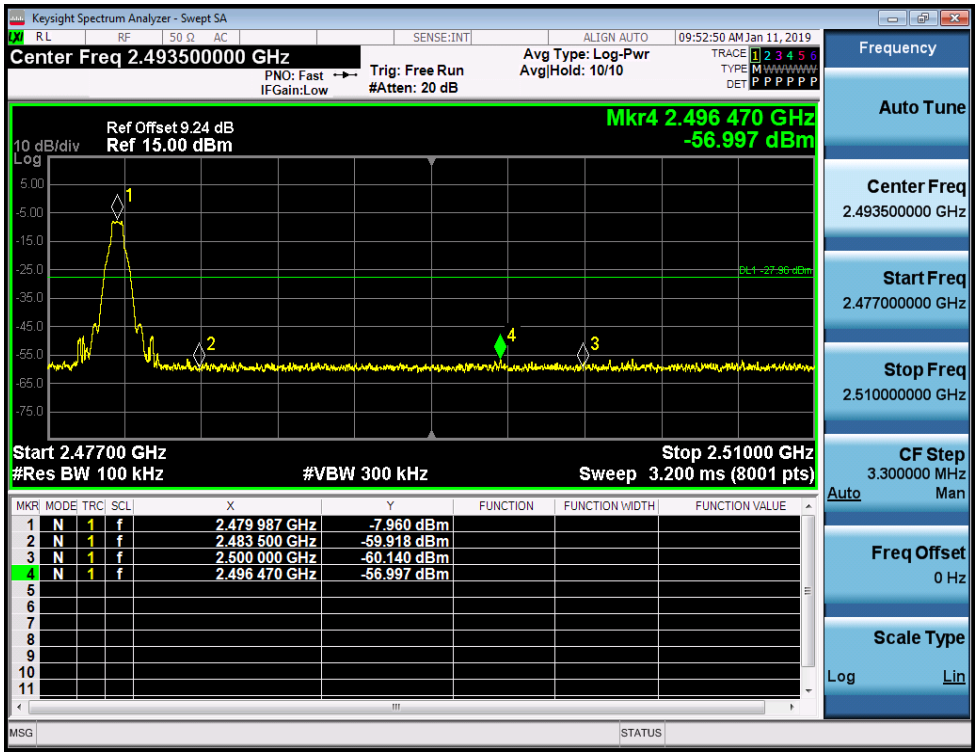
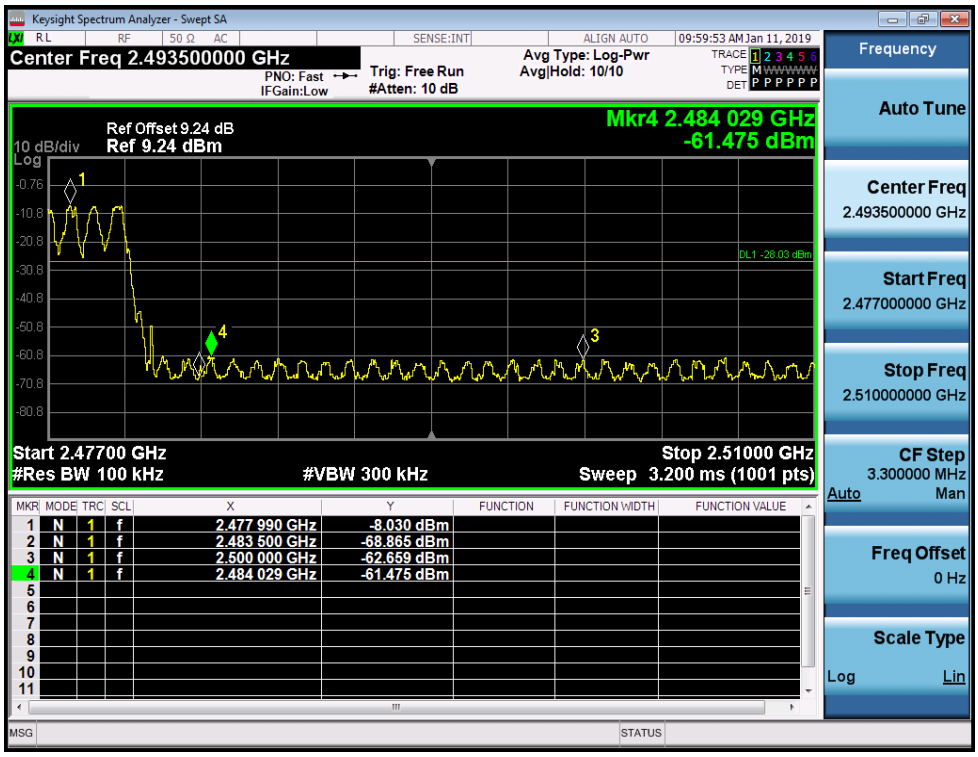
4.6.3 Test Result of Conducted Band Edges

Test Mode :	Transmitting	Temperature :	24~26℃
Test Engineer :	Damon Zhang	Relative Humidity :	50~53%

Data Rate	Modulation	Channel	Carrier Frequency [MHz]	Carrier Power [dBm]	Frequency Hopping	Max Spurious Level [dBm]	Limit [dBm]	Verdict
1Mbps	GFSK	LCH	2402	-5.198	Off	-54.069	-25.2	PASS
				-5.790	On	-58.471	-25.79	PASS
1Mbps	GFSK	HCH	2480	-7.960	Off	-56.997	-27.96	PASS
				-8.030	On	-61.475	-28.03	PASS

Conducted Band Edge Polt

Graphs	
GFSK/LCH/No Hop	
GFSK/LCH/Hop	

GFSK/HCH/No Hop	
GFSK/HCH/Hop	

4.7 Conducted Spurious Emission Measurement

4.7.1 Limit of Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

4.7.2 Test Procedure

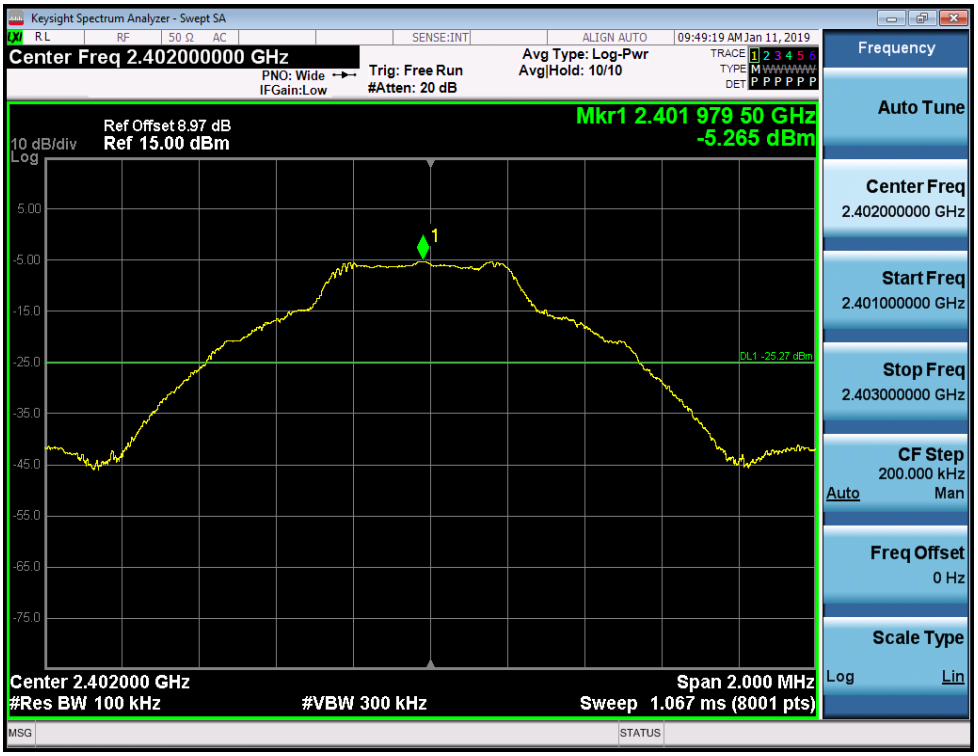
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW = 300kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
5. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

4.7.3 Test Result of Conducted Spurious Emission

Test Mode :	Transmitting	**Temperature :**	24~26℃
Test Engineer :	Damon Zhang	**Relative Humidity :**	50~53%

Data Rate	Modulation	Channel	Pref [dBm]	Puw[dBm]	Verdict
1Mbps	GFSK	LCH	-5.265	<Limit	PASS
1Mbps	GFSK	MCH	-6.569	<Limit	PASS
1Mbps	GFSK	HCH	-8.011	<Limit	PASS

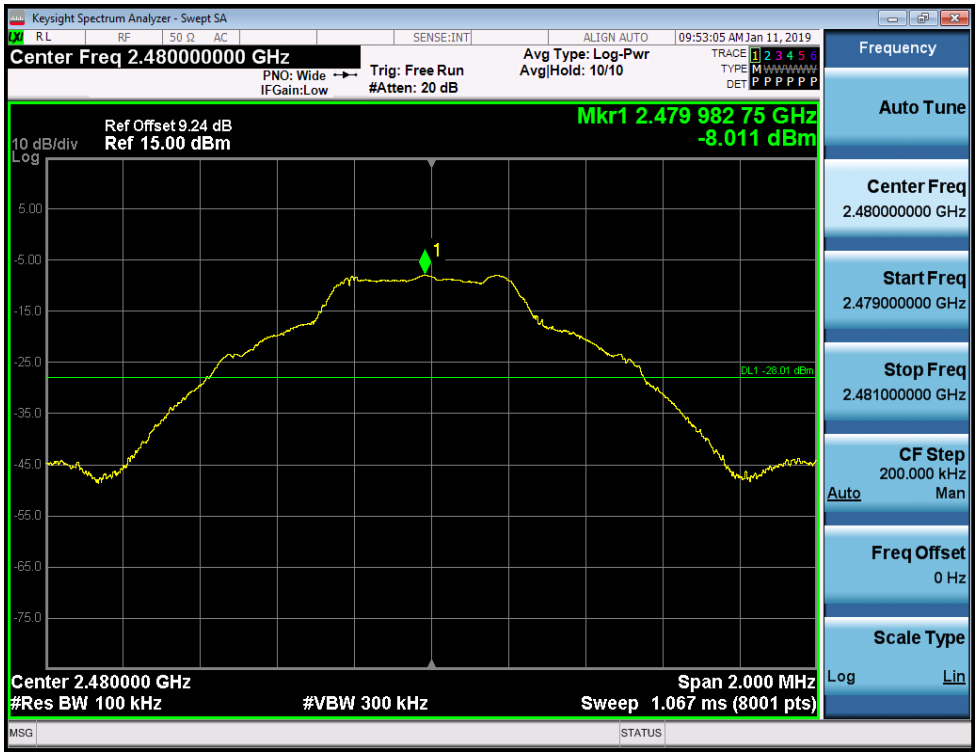
Conducted Spurious Emission Polt

GFSK_LCH_Graphs	
Pref	
Puw	

GFSK_MCH_Graphs

Pref	
Puw	

GFSK_HCH_Graphs

Pref	 Keysight Spectrum Analyzer - Swept SA Center Freq 2.480000000 GHz PNO: Wide IFGain:Low Trig: Free Run #Atten: 20 dB Avg Type: Log-Pwr Avg|Hold: 10/10 09:53:05 AM Jan 11, 2019 Ref Offset 9.24 dB 10 dB/div Ref 15.00 dBm Log Mkr1 2.479 982 75 GHz -8.011 dBm DL1 -28.01 dBm Center 2.480000 GHz #Res BW 100 kHz #VBW 300 kHz Span 2.000 MHz Sweep 1.067 ms (8001 pts) Frequency Auto Tune Center Freq 2.480000000 GHz Start Freq 2.479000000 GHz Stop Freq 2.481000000 GHz CF Step 200.000 kHz Auto Man Freq Offset 0 Hz Scale Type Log Lin MSG STATUS
Puw	 Keysight Spectrum Analyzer - Swept SA Center Freq 12.515000000 GHz PNO: Fast IFGain:Low Trig: Free Run #Atten: 20 dB Avg Type: Log-Pwr Avg|Hold: 1/10 09:53:16 AM Jan 11, 2019 Ref Offset 9.24 dB 10 dB/div Ref 19.24 dBm Log Mkr2 24.772 GHz -39.412 dBm DL1 -28.01 dBm Start 30 MHz #Res BW 100 kHz #VBW 300 kHz Stop 25.00 GHz Sweep 2.387 s (8001 pts) Frequency Auto Tune Center Freq 12.515000000 GHz Start Freq 30.000000 MHz Stop Freq 25.000000000 GHz CF Step 2.497000000 GHz Auto Man Freq Offset 0 Hz Scale Type Log Lin MSG STATUS

4.8 Radiated Band Edges and Spurious Emission Measurement

4.8.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

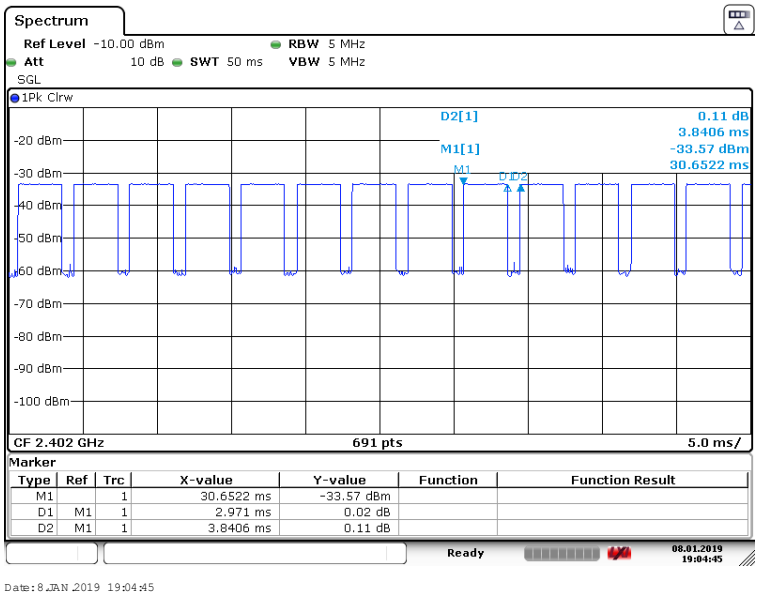
Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

Note: The frequency range from 9KHz to 10th harmonic (25GHz) are checked, and no any emissions were found from 18GHz to 25GHz, So the radiated emissions from 18GHz to 25GHz were not record.

4.8.2 Test Procedures

1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The measurement distance is 3 meter.
3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
   (3) For average measurement:
   VBW = 10 Hz, when duty cycle is no less than 98 percent.
   VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
1Mbps	77	2.971	0.34	1KHz



6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

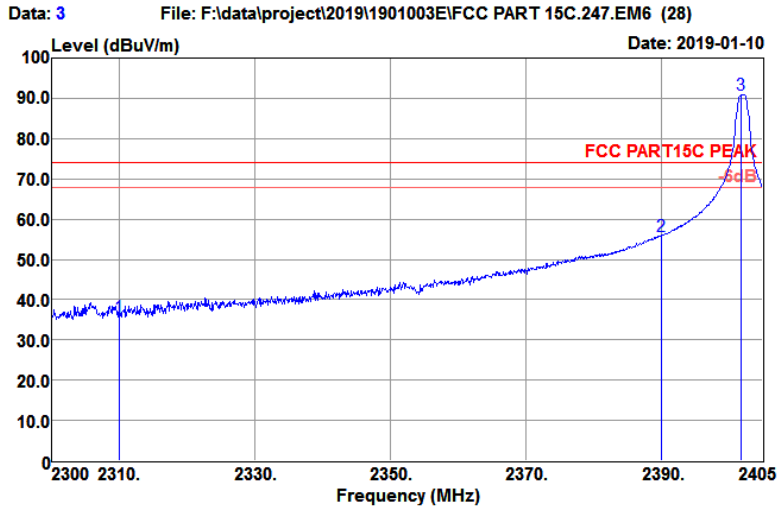
4.8.3 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

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

4.8.4 Test Result of Radiated Spurious at Band Edges

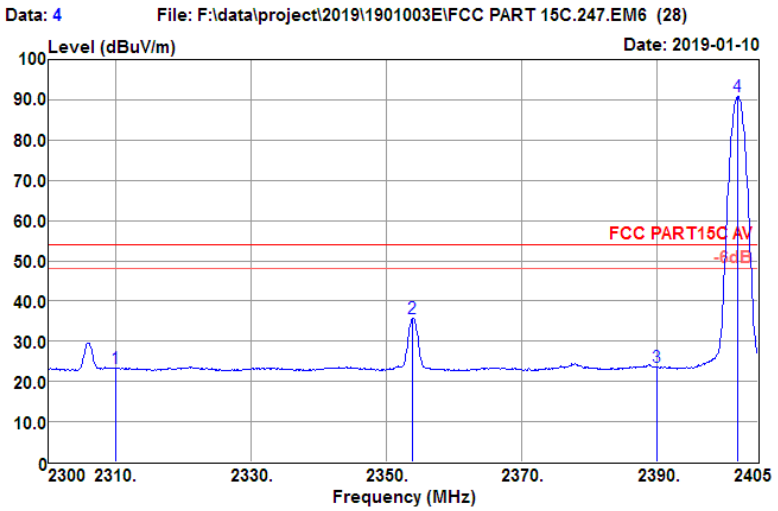
Low Channel Horizontal:

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: HORIZONTAL
Model No.	: HB216		
Test Mode	: 2402MHz TX mode		



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark	A/Pos	T/Pos
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB		cm	deg
2310.000	41.17	26.91	3.56	35.87	35.77	74.00	-38.23	Peak	**	**
2390.000	61.21	27.11	3.64	36.08	55.88	74.00	-18.12	Peak	**	**
2401.850	96.30	27.14	3.65	36.11	90.98	74.00	16.98	Peak	**	**

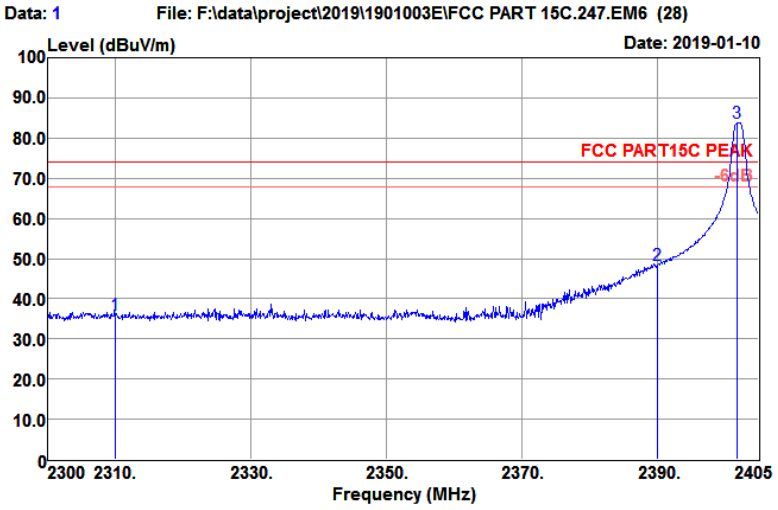
Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
Model No.	: HB216	Pol/Phase	: HORIZONTAL
EUT	: Bluetooth keyboard		
Test Mode	: 2402MHz TX mode		



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark	A/Pos	T/Pos
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB		cm	deg
2310.000	28.83	26.91	3.56	35.87	23.43	54.00	-30.57	Average	150	246
2353.970	41.01	27.02	3.60	35.98	35.65	54.00	-18.35	Average	150	246
2390.000	28.87	27.11	3.64	36.08	23.54	54.00	-30.46	Average	150	246
2402.060	96.10	27.15	3.65	36.11	90.79	54.00	36.79	Average	150	246

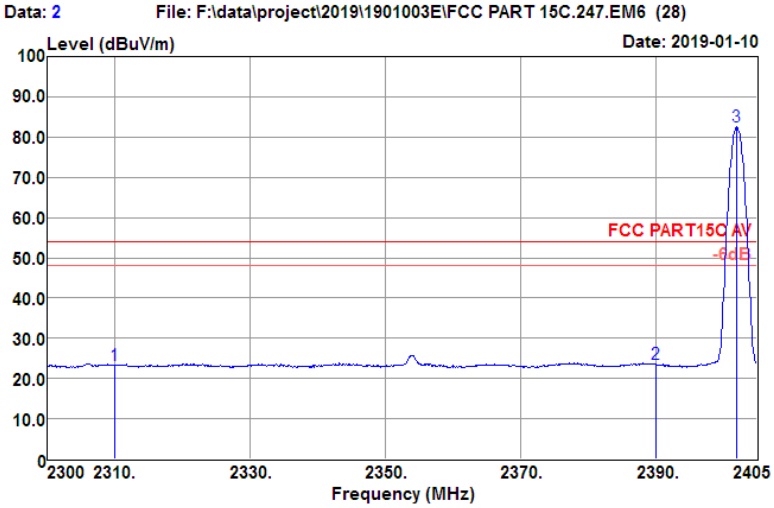
Low Channel Vertical:

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: VERTICAL
Model No.	: HB216		
Test Mode	: 2402MHz TX mode		



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark	A/Pos cm	T/Pos deg
2310.000	41.47	26.91	3.56	35.87	36.07	74.00	-37.93	Peak	**	**
2390.000	53.68	27.11	3.64	36.08	48.35	74.00	-25.65	Peak	**	**
2401.850	89.10	27.14	3.65	36.11	83.78	74.00	9.78	Peak	**	**

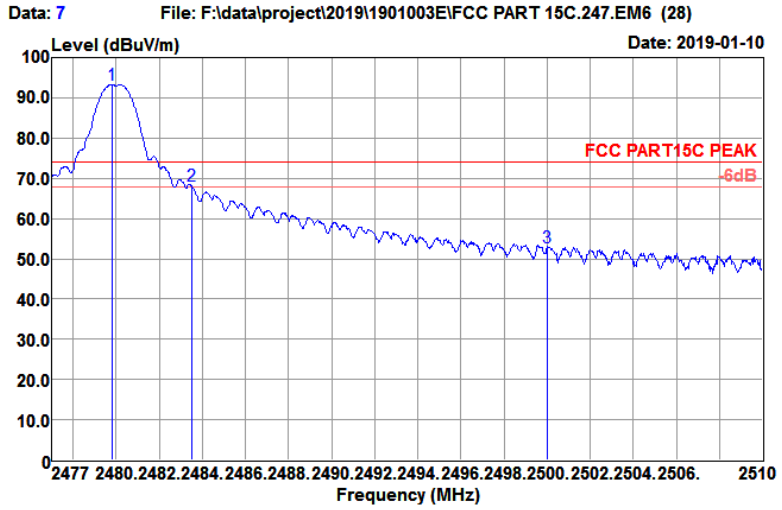
Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
Model No.	: HB216	Pol/Phase	: VERTICAL
EUT	: Bluetooth keyboard		
Test Mode	: 2402MHz TX mode		



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark	A/Pos	T/Pos
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB		cm	deg
2310.000	28.75	26.91	3.56	35.87	23.35	54.00	-30.65	Average	213	15
2390.000	28.88	27.11	3.64	36.08	23.55	54.00	-30.45	Average	213	15
2402.060	87.78	27.15	3.65	36.11	82.47	54.00	28.47	Average	213	15

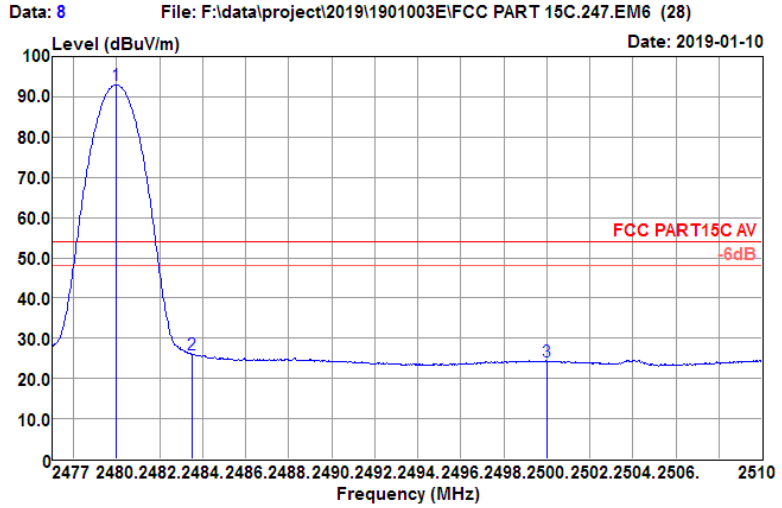
High Channel Horizontal:

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: HORIZONTAL
Model No.	: HB216		
Test Mode	: 2480MHz TX mode		



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark	A/Pos	T/Pos
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB		cm	deg
2479.805	98.56	27.35	3.68	36.32	93.27	74.00	19.27	Peak	**	**
2483.500	73.39	27.36	3.68	36.33	68.10	74.00	-5.90	Peak	**	**
2500.000	58.14	27.40	3.68	36.37	52.85	74.00	-21.15	Peak	**	**

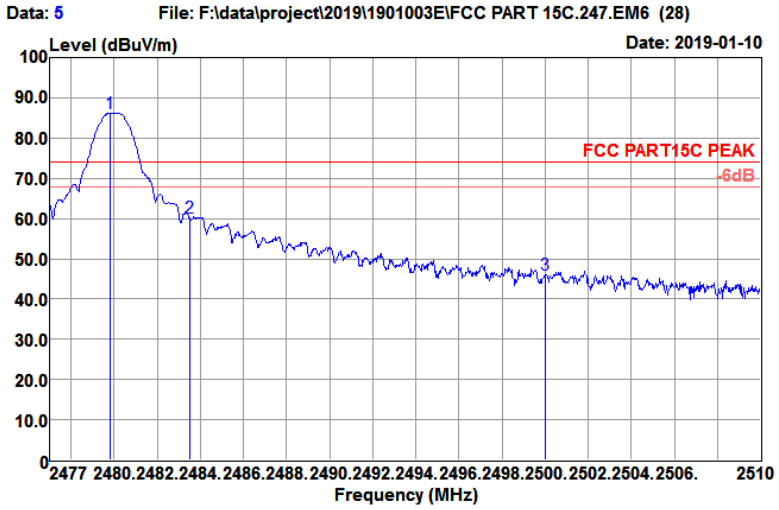
Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
Model No.	: HB216	Pol/Phase	: HORIZONTAL
EUT	: Bluetooth keyboard		
Test Mode	: 2480MHz TX mode		



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark	A/Pos	T/Pos
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB		cm	deg
2480.003	98.29	27.35	3.68	36.32	93.00	54.00	39.00	Average	152	246
2483.500	31.31	27.36	3.68	36.33	26.02	54.00	-27.98	Average	152	246
2500.000	29.58	27.40	3.68	36.37	24.29	54.00	-29.71	Average	152	246

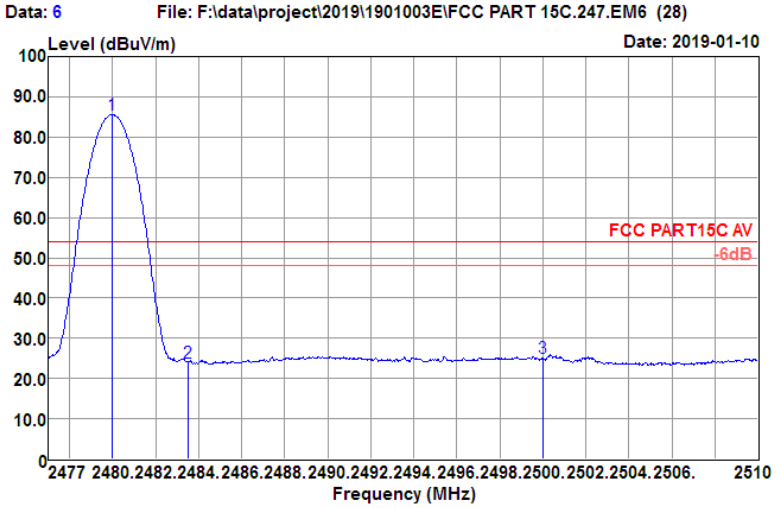
High Channel Vertical:

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: VERTICAL
Model No.	: HB216		
Test Mode	: 2480MHz TX mode		



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark	A/Pos	T/Pos
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB		cm	deg
2479.805	91.44	27.35	3.68	36.32	86.15	74.00	12.15	Peak	**	**
2483.500	65.41	27.36	3.68	36.33	60.12	74.00	-13.88	Peak	**	**
2500.000	51.41	27.40	3.68	36.37	46.12	74.00	-27.88	Peak	**	**

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
Model No.	: HB216	Pol/Phase	: VERTICAL
EUT	: Bluetooth keyboard		
Test Mode	: 2480MHz TX mode		

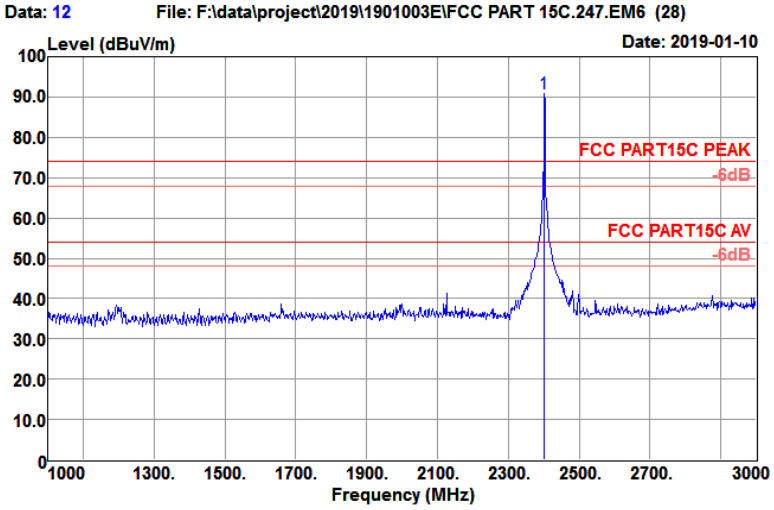


Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark	A/Pos	T/Pos
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB		cm	deg
2479.970	90.81	27.35	3.68	36.32	85.52	54.00	31.52	Average	210	15
2483.500	29.34	27.36	3.68	36.33	24.05	54.00	-29.95	Average	210	15
2500.000	30.26	27.40	3.68	36.37	24.97	54.00	-29.03	Average	210	15

4.8.5 Test Result of Radiated Spurious Emission (1GHz ~ 10th Harmonic)

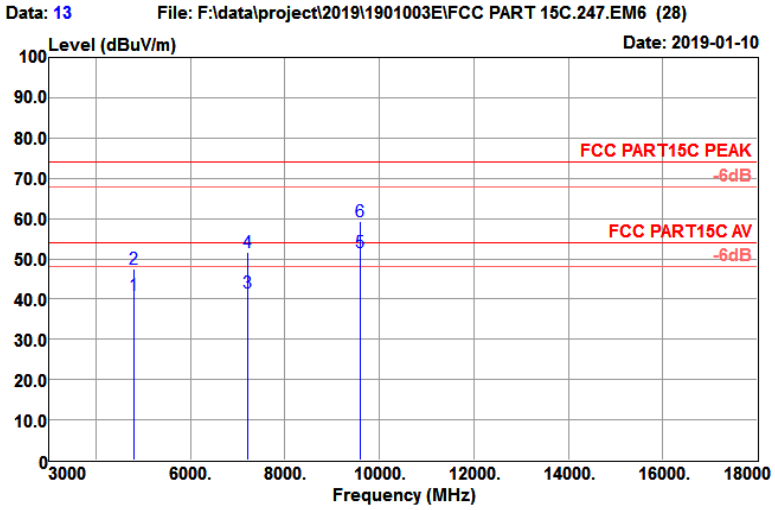
Low Channel Horizontal:

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: HORIZONTAL
Model No.	: HB216		
Test Mode	: 2402MHz TX mode		



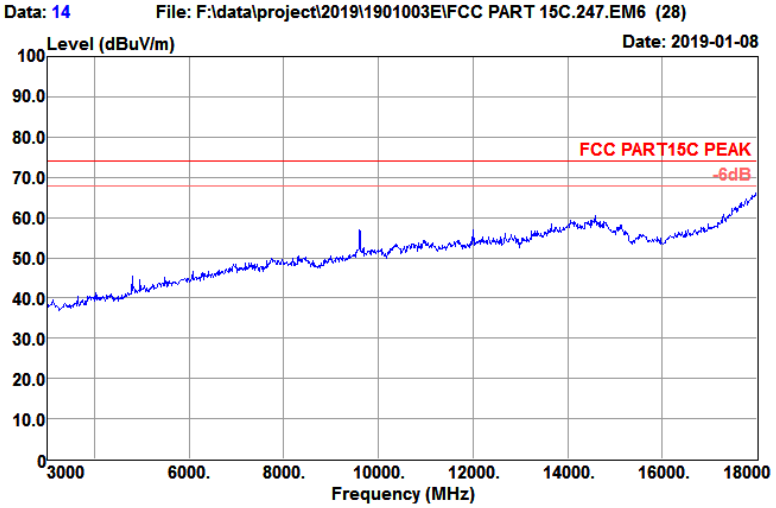
Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark	A/Pos	T/Pos
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB		cm	deg
2402.000	96.29	27.15	3.65	36.11	90.98	74.00	16.98	Peak	**	**

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: HORIZONTAL
Model No.	: HB216		
Test Mode	: 2402MHz TX mode		



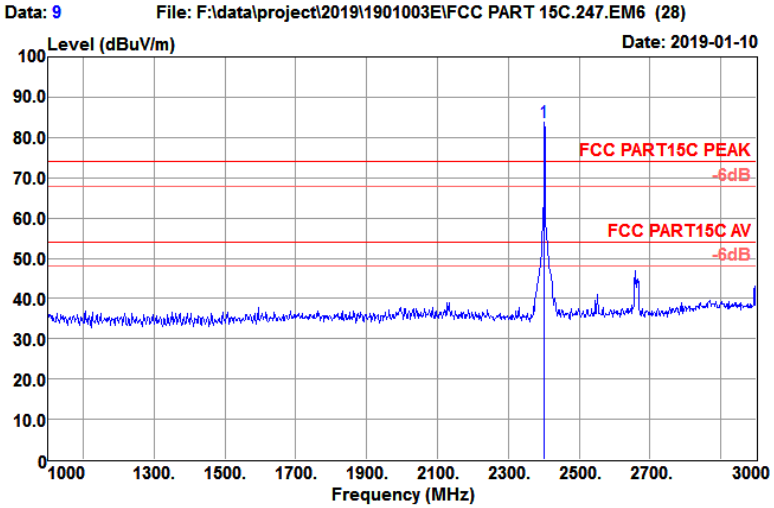
Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark	A/Pos	T/Pos
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB		cm	deg
4804.000	40.70	31.23	5.45	36.27	41.11	54.00	-12.89	Average	210	322
4804.000	47.18	31.23	5.45	36.27	47.59	74.00	-26.41	Peak	210	320
7206.000	33.09	35.87	6.94	34.25	41.65	54.00	-12.35	Average	150	191
7206.000	43.01	35.87	6.94	34.25	51.57	74.00	-22.43	Peak	150	191
9608.000	40.32	37.79	7.77	34.13	51.75	54.00	-2.25	Average	150	246
9608.000	47.87	37.79	7.77	34.13	59.30	74.00	-14.70	Peak	150	246

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: HORIZONTAL
Model No.	: HB216		
Test Mode	: 2402MHz TX mode		



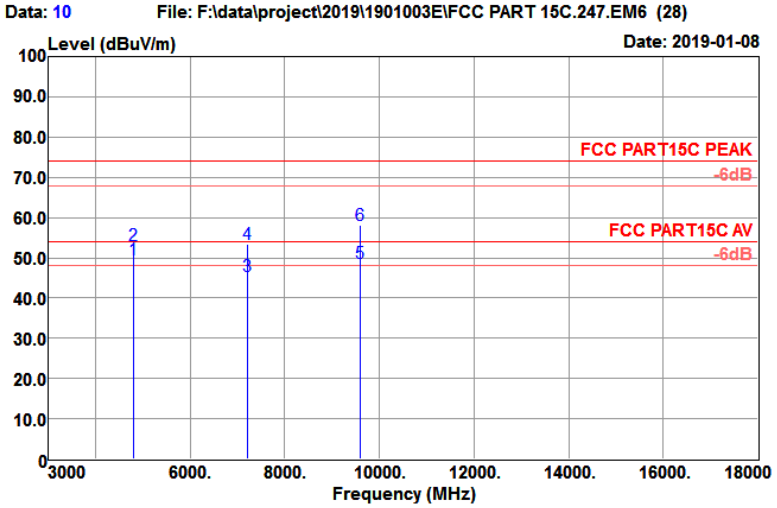
Low Channel Vertical:

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: VERTICAL
Model No.	: HB216		
Test Mode	: 2402MHz TX mode		



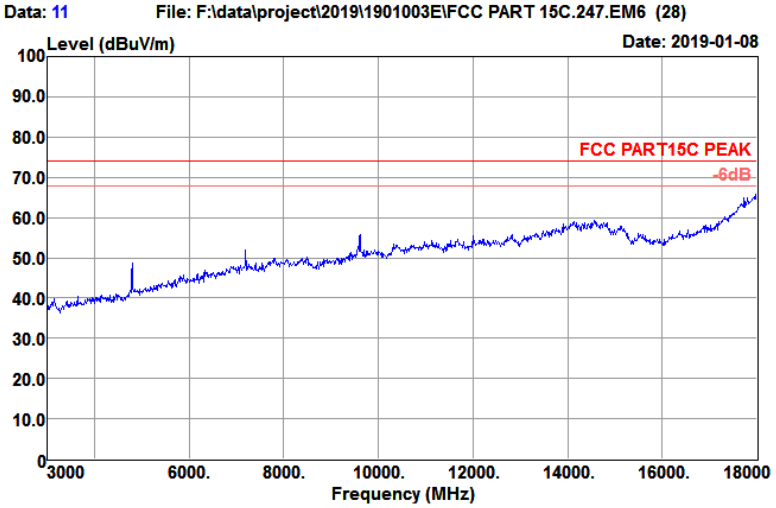
Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark	A/Pos	T/Pos
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB		cm	deg
2402.000	89.10	27.15	3.65	36.11	83.79	74.00	9.79	Peak	**	**

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: VERTICAL
Model No.	: HB216		
Test Mode	: 2402MHz TX mode		



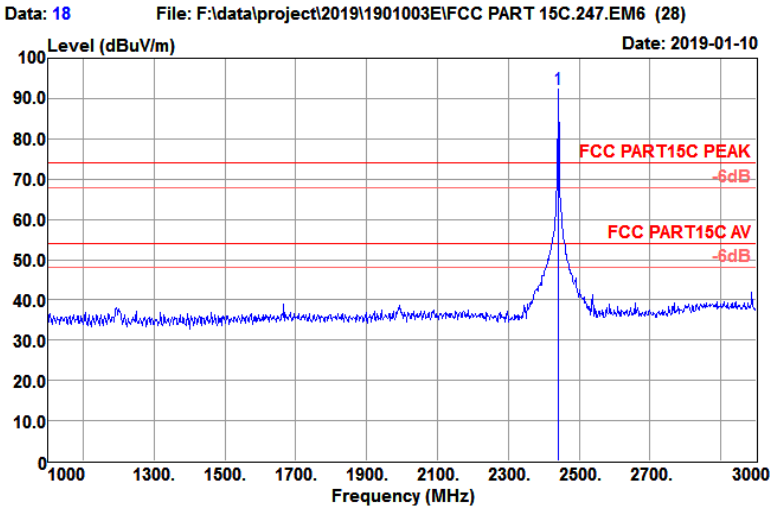
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark	A/Pos cm	T/Pos deg
4804.000	49.24	31.23	5.45	36.27	49.65	54.00	-4.35	Average	298	15
4804.000	52.63	31.23	5.45	36.27	53.04	74.00	-20.96	Peak	298	18
7206.000	37.03	35.87	6.94	34.25	45.59	54.00	-8.41	Average	213	0
7206.000	44.95	35.87	6.94	34.25	53.51	74.00	-20.49	Peak	213	15
9608.000	37.13	37.79	7.77	34.13	48.56	54.00	-5.44	Average	213	8
9608.000	46.78	37.79	7.77	34.13	58.21	74.00	-15.79	Peak	213	10

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: VERTICAL
Model No.	: HB216		
Test Mode	: 2402MHz TX mode		



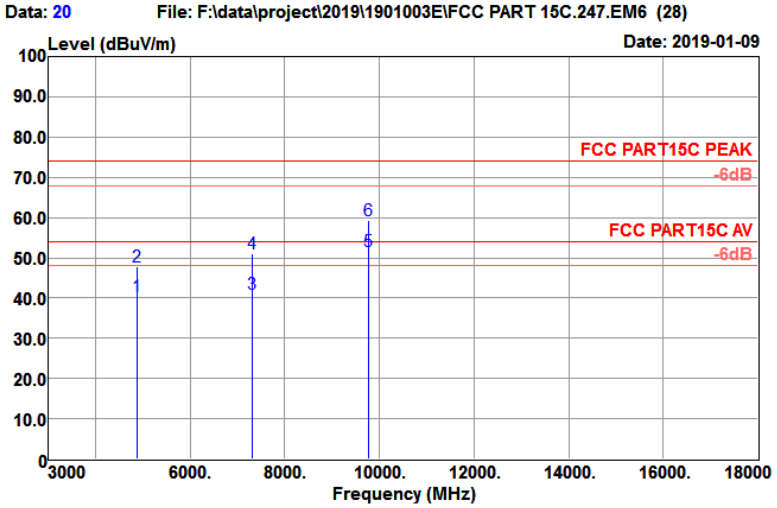
Middle Channel Horizontal:

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: HORIZONTAL
Model No.	: HB216		
Test Mode	: 2441MHz TX mode		



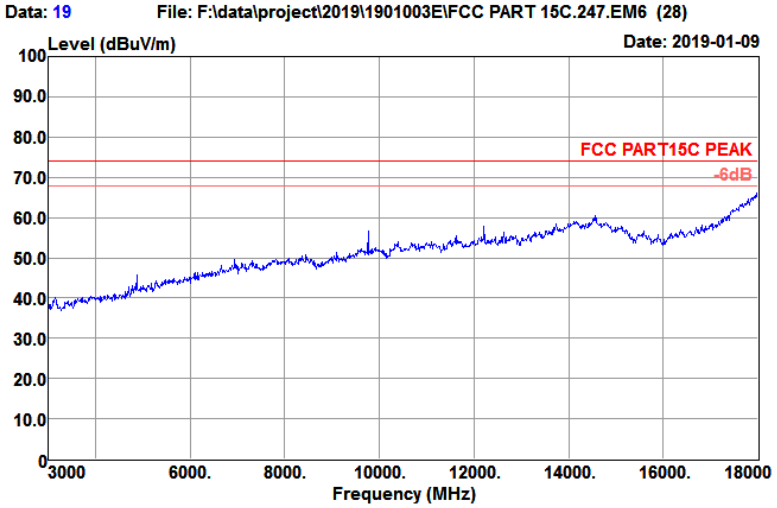
Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark	A/Pos	T/Pos
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB		cm	deg
2442.000	97.76	27.25	3.66	36.22	92.45	74.00	18.45	Peak	**	**

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: HORIZONTAL
Model No.	: HB216		
Test Mode	: 2441MHz TX mode		



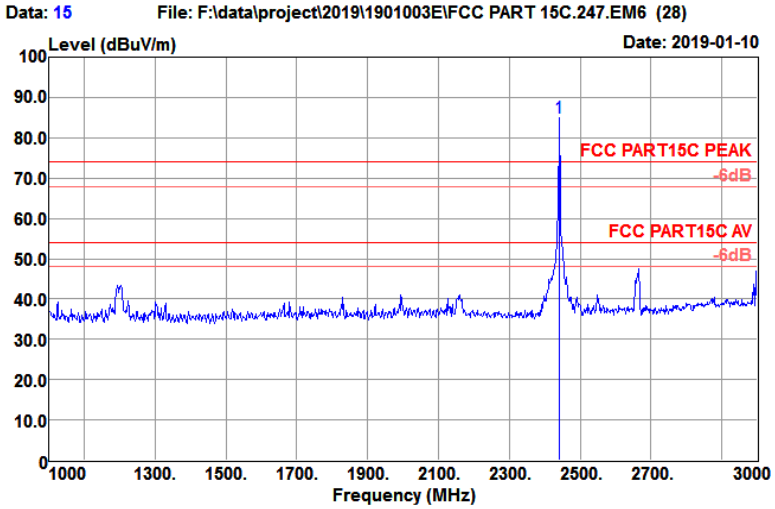
Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark	A/Pos	T/Pos
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB		cm	deg
4882.000	39.88	31.42	5.40	36.24	40.46	54.00	-13.54	Average	150	233
4882.000	47.17	31.42	5.40	36.24	47.75	74.00	-26.25	Peak	150	239
7323.000	32.01	36.14	7.28	34.36	41.07	54.00	-12.93	Average	150	234
7323.000	41.99	36.14	7.28	34.36	51.05	74.00	-22.95	Peak	150	249
9764.000	39.80	38.08	7.98	34.20	51.66	54.00	-2.34	Average	150	240
9764.000	47.37	38.08	7.98	34.20	59.23	74.00	-14.77	Peak	150	246

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: HORIZONTAL
Model No.	: HB216		
Test Mode	: 2441MHz TX mode		



Middle Channel Vertical:

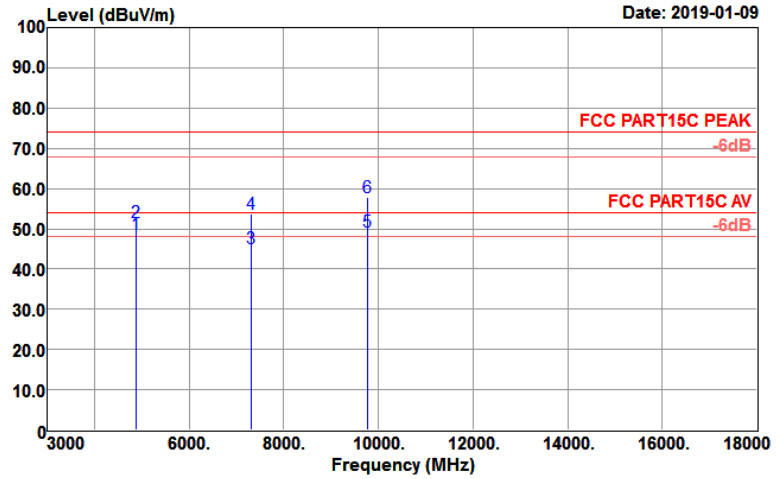
Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: VERTICAL
Model No.	: HB216		
Test Mode	: 2441MHz TX mode		



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark	A/Pos	T/Pos
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB		cm	deg
2442.000	90.18	27.25	3.66	36.22	84.87	74.00	10.87	Peak	**	**

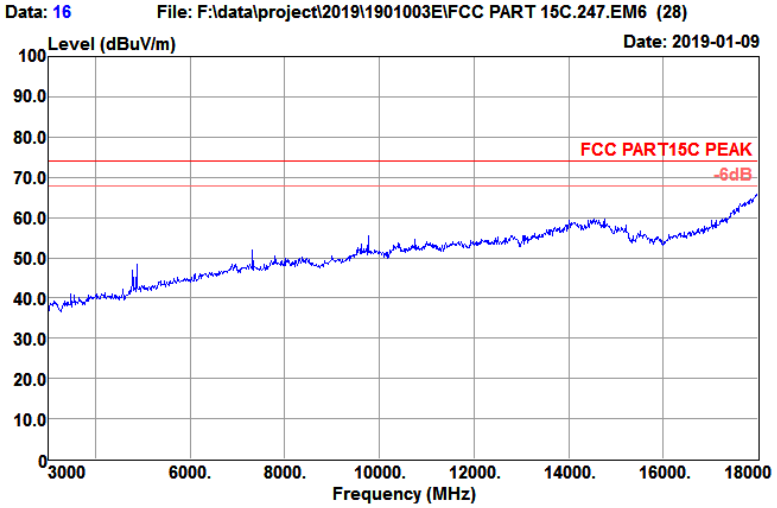
Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: VERTICAL
Model No.	: HB216		
Test Mode	: 2441MHz TX mode		

Data: 17 File: F:\data\project\2019\1901003E\FCC PART 15C.247.EM6 (28)



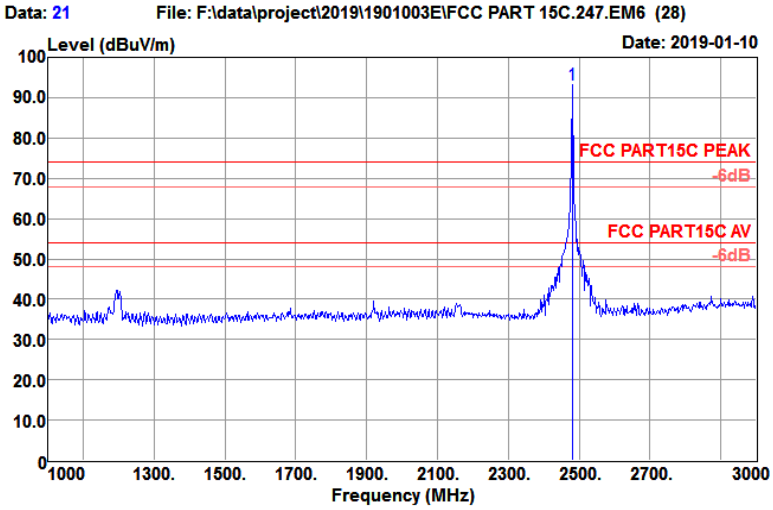
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark	A/Pos cm	T/Pos deg
4882.000	48.03	31.42	5.40	36.24	48.61	54.00	-5.39	Average	314	23
4882.000	51.18	31.42	5.40	36.24	51.76	74.00	-22.24	Peak	314	23
7323.000	36.13	36.14	7.28	34.36	45.19	54.00	-8.81	Average	220	29
7323.000	44.70	36.14	7.28	34.36	53.76	74.00	-20.24	Peak	220	23
9764.000	37.30	38.08	7.98	34.20	49.16	54.00	-4.84	Average	198	0
9764.000	45.96	38.08	7.98	34.20	57.82	74.00	-16.18	Peak	198	2

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: VERTICAL
Model No.	: HB216		
Test Mode	: 2441MHz TX mode		



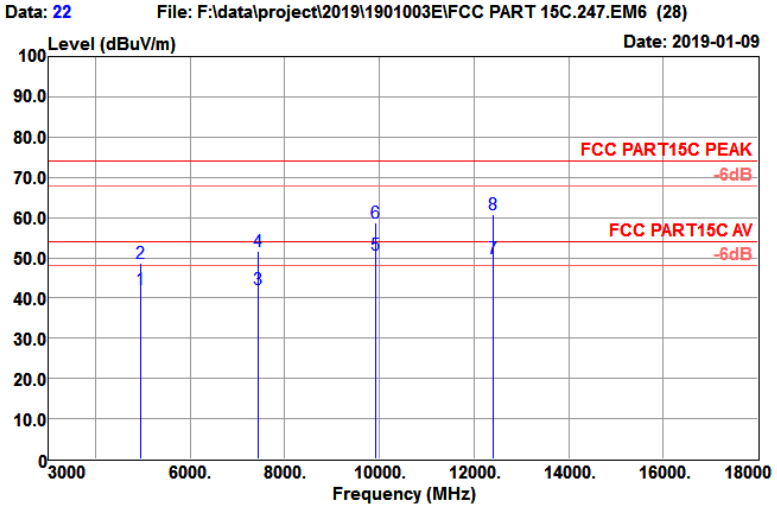
High Channel Horizontal:

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: HORIZONTAL
Model No.	: HB216		
Test Mode	: 2480MHz TX mode		



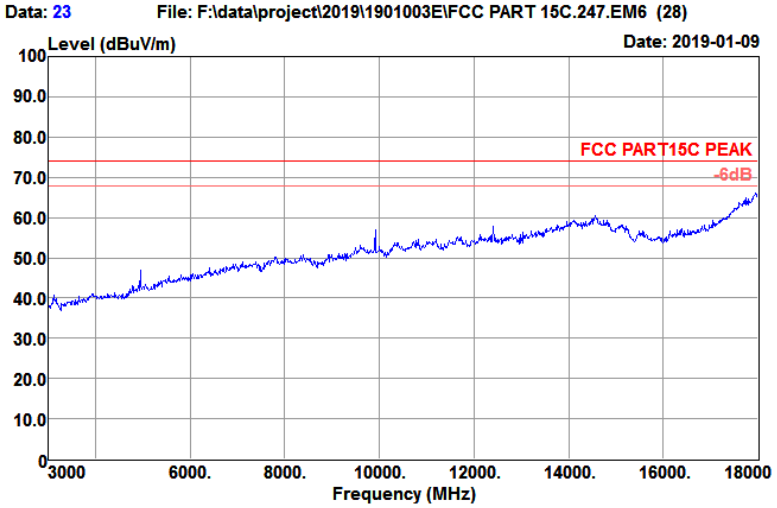
Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark	A/Pos	T/Pos
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB		cm	deg
2480.000	98.54	27.35	3.68	36.32	93.25	74.00	19.25	Peak	**	**

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: HORIZONTAL
Model No.	: HB216		
Test Mode	: 2480MHz TX mode		



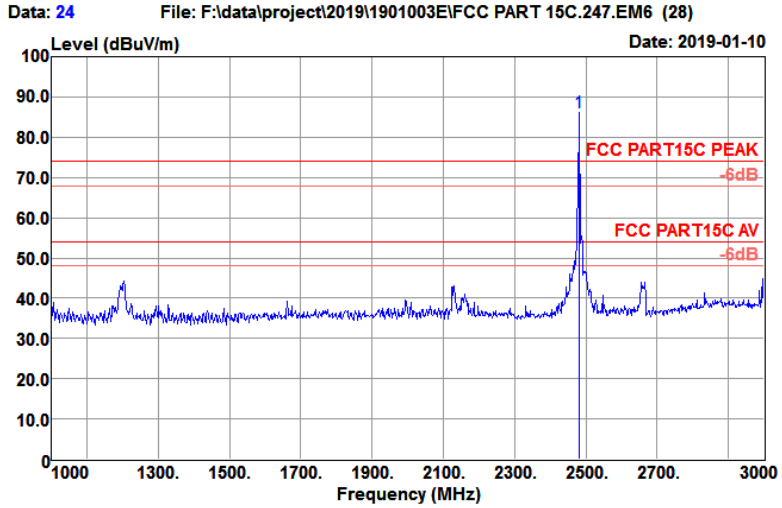
Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark	A/Pos	T/Pos
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB		cm	deg
4960.000	41.46	31.60	5.36	36.21	42.21	54.00	-11.79	Average	150	196
4960.000	47.91	31.60	5.36	36.21	48.66	74.00	-25.34	Peak	150	193
7440.000	32.96	36.41	7.44	34.47	42.34	54.00	-11.66	Average	150	182
7440.000	42.37	36.41	7.44	34.47	51.75	74.00	-22.25	Peak	150	197
9920.000	38.56	38.36	8.05	34.26	50.71	54.00	-3.29	Average	150	240
9920.000	46.50	38.36	8.05	34.26	58.65	74.00	-15.35	Peak	150	248
12400.000	33.96	39.46	9.00	32.51	49.91	54.00	-4.09	Average	150	148
12400.000	44.69	39.46	9.00	32.51	60.64	74.00	-13.36	Peak	150	153

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: HORIZONTAL
Model No.	: HB216		
Test Mode	: 2480MHz TX mode		



High Channel Vertical:

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: VERTICAL
Model No.	: HB216		
Test Mode	: 2480MHz TX mode		



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark	A/Pos	T/Pos
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB		cm	deg
2480.000	91.41	27.35	3.68	36.32	86.12	74.00	12.12	Peak	**	**

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: VERTICAL
Model No.	: HB216		
Test Mode	: 2480MHz TX mode		

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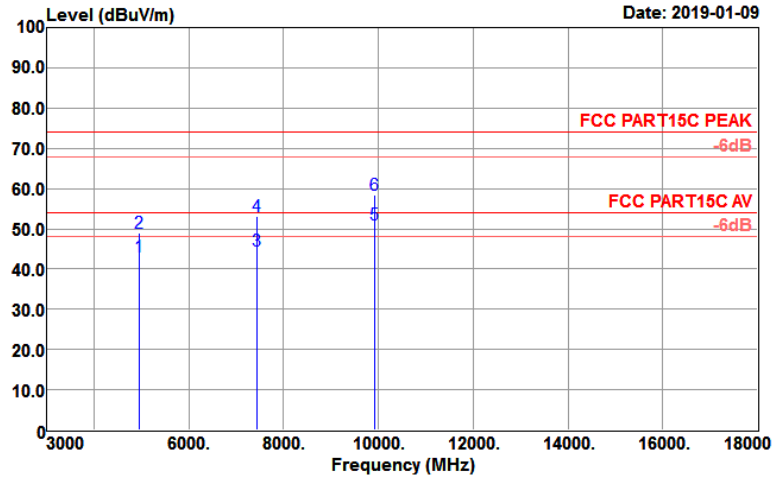
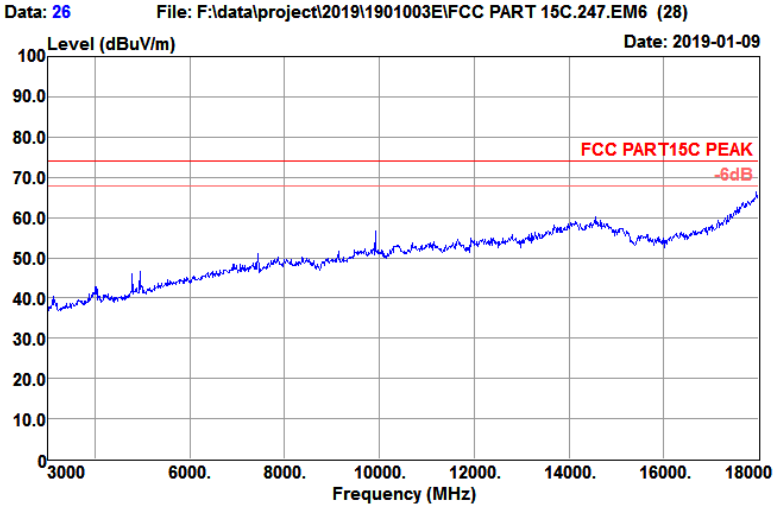


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark	A/Pos cm	T/Pos deg
4960.000	42.26	31.60	5.36	36.21	43.01	54.00	-10.99	Average	220	20
4960.000	48.16	31.60	5.36	36.21	48.91	74.00	-25.09	Peak	220	18
7440.000	35.15	36.41	7.44	34.47	44.53	54.00	-9.47	Average	150	9
7440.000	43.65	36.41	7.44	34.47	53.03	74.00	-20.97	Peak	150	0
9920.000	38.87	38.36	8.05	34.26	51.02	54.00	-2.98	Average	221	360
9920.000	46.32	38.36	8.05	34.26	58.47	74.00	-15.53	Peak	221	360

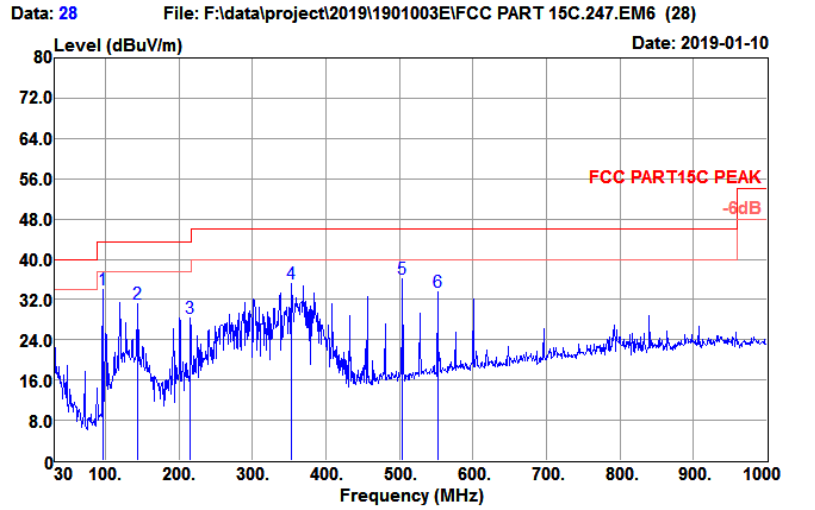
Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: VERTICAL
Model No.	: HB216		
Test Mode	: 2480MHz TX mode		



4.8.6 Test Result of Radiated Spurious Emission (30MHz ~ 1GHz)

Horizontal:

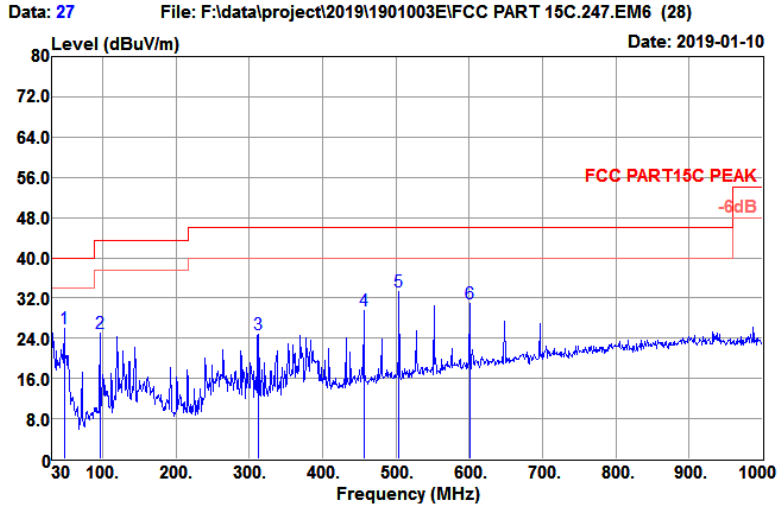
Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: HORIZONTAL
Model No.	: HB216		
Test Mode	: TX Mode		



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark	A/Pos cm	T/Pos deg
95.960	54.56	9.92	1.91	32.45	33.94	43.50	-9.56	Peak	**	**
143.490	47.46	13.74	2.36	32.50	31.06	43.50	-12.44	Peak	**	**
215.270	47.67	10.36	2.91	32.54	28.40	43.50	-15.10	Peak	**	**
352.040	49.95	13.89	3.84	32.49	35.19	46.00	-10.81	Peak	**	**
504.330	47.49	16.58	4.51	32.56	36.02	46.00	-9.98	Peak	**	**
551.860	43.93	17.49	4.73	32.63	33.52	46.00	-12.48	Peak	**	**

Vertical:

Test Site	: 3m Chamber	Temp/Humi	: 17℃/56%
Tested by	: Damon	Power rating	: DC 3.7V
EUT	: Bluetooth keyboard	Pol/Phase	: VERTICAL
Model No.	: HB216		
Test Mode	: TX Mode		



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark	A/Pos	T/Pos
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB		cm	deg
47.460	43.54	13.65	1.31	32.58	25.92	40.00	-14.08	Peak	**	**
95.960	45.60	9.92	1.91	32.45	24.98	43.50	-18.52	Peak	**	**
312.270	40.58	13.13	3.52	32.51	24.72	46.00	-21.28	Peak	**	**
455.830	42.03	15.75	4.34	32.52	29.60	46.00	-16.40	Peak	**	**
504.330	44.84	16.58	4.51	32.56	33.37	46.00	-12.63	Peak	**	**
600.360	40.24	18.40	5.02	32.69	30.97	46.00	-15.03	Peak	**	**

4.9 AC Conducted Emission Measurement

4.9.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

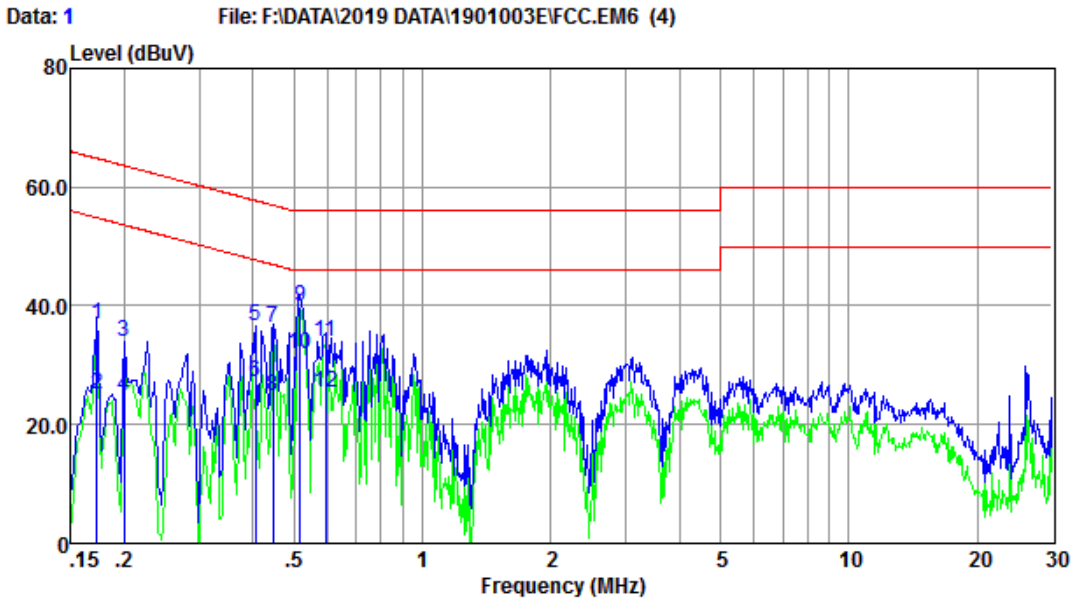
*Decreases with the logarithm of the frequency.

4.9.2 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

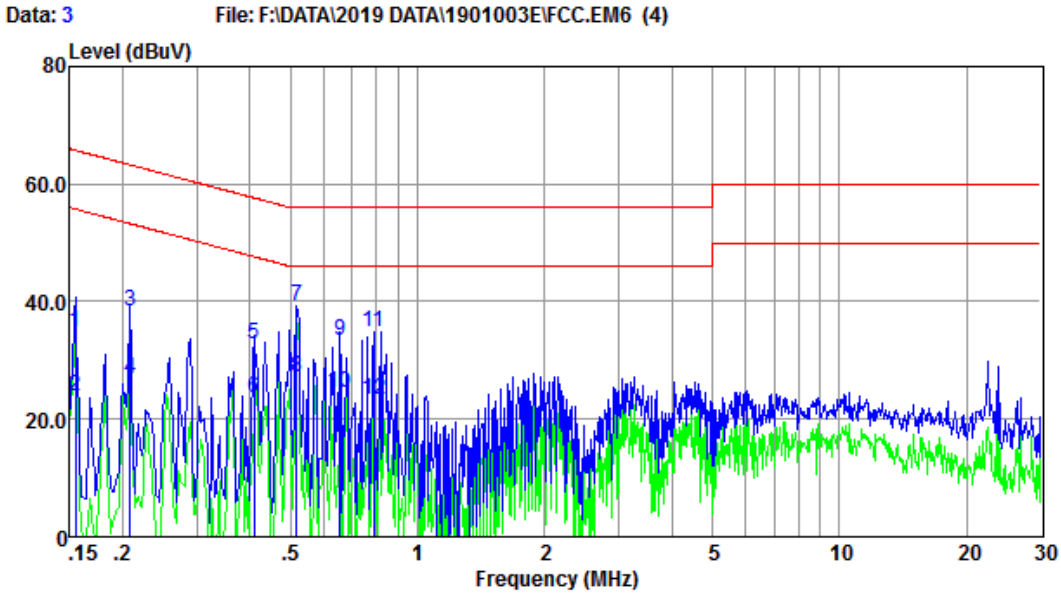
4.9.3 Test Result of AC Conducted Emission

Test Mode :	Mode 1	**Temperature :**	21~23℃
Test Engineer :	Damon Zhang	**Relative Humidity :**	41~43%
Test Voltage :	120Vac / 60Hz	**Phase :**	Line
Function Type :	Bluetooth Link + USB Cable (Charging from Adapter)		



Freq	Reading level	LISN/ISN factor	Cable loss	level	Limit level	Over limit	Remark
MHz	dBuV	dB	dB	dBuV	dBuV	dB	
0.172	27.26	9.55	0.04	36.85	64.86	-28.01	QP
0.172	15.59	9.55	0.04	25.18	54.86	-29.68	Average
0.200	24.52	9.56	0.01	34.09	63.62	-29.53	QP
0.200	15.24	9.56	0.01	24.81	53.62	-28.81	Average
0.406	27.08	9.58	0.02	36.68	57.73	-21.05	QP
0.406	17.45	9.58	0.02	27.05	47.73	-20.68	Average
0.447	26.76	9.58	0.02	36.36	56.93	-20.57	QP
0.447	15.18	9.58	0.02	24.78	46.93	-22.15	Average
0.516	30.19	9.58	0.02	39.79	56.00	-16.21	QP
0.516	22.42	9.58	0.02	32.02	46.00	-13.98	Average
0.592	24.31	9.59	0.03	33.93	56.00	-22.07	QP
0.592	15.85	9.59	0.03	25.47	46.00	-20.53	Average

Test Mode :	Mode 1	Temperature :	21~23℃
Test Engineer :	Damon Zhang	Relative Humidity :	41~43%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	Bluetooth Link + USB Cable (Charging from Adapter)		



Freq	Reading level	LISN/ISN factor	Cable loss	level	Limit level	Over limit	Remark
MHz	dBuV	dB	dB	dBuV	dBuV	dB	
0.155	25.21	9.54	0.06	34.81	65.74	-30.93	QP
0.155	14.31	9.54	0.06	23.91	55.74	-31.83	Average
0.208	28.77	9.57	0.01	38.35	63.27	-24.92	QP
0.208	17.29	9.57	0.01	26.87	53.27	-26.40	Average
0.410	23.19	9.62	0.02	32.83	57.64	-24.81	QP
0.410	13.85	9.62	0.02	23.49	47.64	-24.15	Average
0.516	29.52	9.63	0.02	39.17	56.00	-16.83	QP
0.516	17.65	9.63	0.02	27.30	46.00	-18.70	Average
0.654	23.59	9.64	0.03	33.26	56.00	-22.74	QP
0.654	14.89	9.64	0.03	24.56	46.00	-21.44	Average
0.788	25.13	9.64	0.03	34.80	56.00	-21.20	QP
0.788	13.70	9.64	0.03	23.37	46.00	-22.63	Average

4.10 Antenna Requirements

4.10.1 Standard Applicable

According to antenna requirement of §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. 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 re-placed 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 Sections 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 Section 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..

And according to §15.247(4)(1), system operating in the 2400-2483.5MHz bands that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

4.10.2 Antenna Connected Construction

An embedded-in antenna design is used.

4.10.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

5 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
Spectrum Analyzer	Keysight	N9010A	MY56070788	2018-03-02	2019-03-01	Conducted
Power Sensor	Keysight	U2021XA	MY56510025	2018-03-02	2019-03-01	Conducted
Power Sensor	Keysight	U2021XA	MY57030005	2018-03-02	2019-03-01	Conducted
Power Sensor	Keysight	U2021XA	MY56510018	2018-03-02	2019-03-01	Conducted
Power Sensor	Keysight	U2021XA	MY56480002	2018-03-02	2019-03-01	Conducted
Thermal Chamber	Sanmtest	SMC-408-CD	2435	2018-07-05	2019-07-04	Conducted
Base Station	R&S	CMW 270	101231	2018-03-17	2019-03-16	Conducted
Signal Generator (Interferer)	Keysight	N5182B	MY56200384	2018-04-10	2019-04-09	Conducted
Signal Generator (Blocker)	Keysight	N5171B	MY56200661	2018-03-15	2019-03-14	Conducted

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV 40	101433	2018-03-14	2019-03-13	Radiation
Amplifier	Sonoma	310	363917	2018-03-06	2019-03-05	Radiation
Amplifier	Schwarzbeck	BBV 9718	327	2018-03-14	2019-03-13	Radiation
Amplifier	Narda	TTA1840-35-HG	2034380	2018-07-18	2019-07-17	Radiation
Broadband Antenna	Schwarzbeck	VULB 9168	9168-757	2017-03-03	2020-03-02	Radiation
Horn Antenna	Schwarzbeck	BBHA 9120 D	1677	2017-03-03	2020-03-02	Radiation
Horn Antenna	COM-POWER	AH-1840	101117	2018-06-20	2021-06-19	Radiation
Test Software	Auidx	E3	6.111221a	N/A	N/A	Radiation
Filter	Micro-Tronics	BRM 50702	G266	N/A	N/A	Radiation

N/A: No Calibration Required

6 Uncertainty of Evaluation

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

MEASUREMENT	FREQUENCY	UNCERTAINTY
Conducted emissions	9kHz~30MHz	2.64dB
Radiated emission	30MHz ~ 1GMHz	5.05dB
	1GHz ~ 18GHz	5.06 dB
	18GHz ~ 40GHz	3.65dB

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