FCC Radio Test Report

FCC ID: 2AF2R-HB30RX

IC ID: 20674-HB30RX

Original Grant

Report No.	:	TB-FCC166059
Applicant	:	Shenzhen Videotimes Technology Co.,Ltd
Equipment Under Test (EUT)		
EUT Name	:	2.4GHz Digital Wireless Video Baby Monitor
Model No.	:	HB31RX
Series Model No.	:	HB30RX
Brand Name	:	HelloBaby
Receipt Date	:	2019-05-08
Test Date	:	2019-05-08 to 2019-06-14
Issue Date	:	2019-06-28
Standards	:	FCC Part 15, Subpart C (15.247:2019)
Test Method	:	ANSI C63.10: 2013
Conclusions	:	**PASS**

In the configuration tested, the EUT complied with the standards specified above,

The EUT technically complies with the FCC requirements

Test/Witness Engineer	:	Jason Xu
Engineer Supervisor	:	Ivan Su
Engineer Manager	:	Ray Lai

This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in the report.

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Revision History

Report No.	Version	Description	Issued Date
TB-FCC166059	Rev.01	Initial issue of report	2019-06-28

1. General Information about EUT

1.1 Client Information

Applicant	:	Shenzhen Videotimes Technology Co.,Ltd
Address	:	Room 601, Building B, Union Financial Building, No 1 Shihua Road, Fubao Street, Futian Free Trade Zone, Shenzhen, Guangdong, China.
Manufacturer	:	Shenzhen Videotimes Technology Co.,Ltd
Address	:	Room 601, Building B, Union Financial Building, No 1 Shihua Road, Fubao Street, Futian Free Trade Zone, Shenzhen, Guangdong, China.

1.2 General Description of EUT (Equipment Under Test)

EUT Name	:	2.4GHz Digital Wireless Video Baby Monitor	
Models No.	:	HB31RX,HB30RX	
Model Difference	:	All these models are identical in the same PCB layout and electrical circuit, Only the appearance design, color and model are different. Does not affect EMC and RF performance.	
Product Description	:	Operation Frequency:	GFSK: 2403.5MHz~2468MHz
		Number of Channel:	GFSK: 44 Channels See Note 2
		Max Peak Output Power:	GFSK: 17.434dBm
		Antenna Gain:	2dBi Monopole antenna
		Modulation Type:	GFSK (1.5 Mbps)
Power Supply	:	DC Voltage Supply from AC/DC Adapter for RX (Monitor) DC Voltage supplied by Li-ion battery for RX (Monitor).	
Power Rating	:	Adapter Model:K05S050100U Input: AC 100-240V~50/60Hz, 0.2A Output: DC 5.0V@1.0A DC 3.7V by 950mAh Li-ion battery.	
Software Version	:	1.0	
Hardware Version	:	1.2	
Connecting I/O Port(S)	:	Please refer to the User's Manual	

Note:

(1) For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

(2) Channel List:

GFSK Channel List					
Channel	**Frequency (MHz)**	**Channel**	**Frequency (MHz)**	**Channel**	**Frequency (MHz)**
00	**2403.5**	21	2435.0	42	2466.5
01	2405.0	22	2436.5	43	2468.0
02	2406.5	23	2438.0		
03	2408.0	**24**	**2439.5**		
04	2409.5	25	2441.0		
05	2411.0	26	2442.5		
06	2412.5	27	2444.0		
07	2414.0	28	2445.5		
08	2415.5	29	2447.0		
09	2417.0	30	2448.5		
10	2418.5	31	2450.0		
11	2420.0	32	2451.5		
12	2421.5	33	2453.0		
13	2423.0	34	2454.5		
14	2424.5	35	2456.0		
15	2426.0	36	2457.5		
16	2427.5	37	2459.0		
17	2429.0	38	2460.5		
18	2430.5	39	2462.0		
19	2432.0	40	2463.5		
20	2433.5	41	2465.0		

(3) The Antenna information about the equipment is provided by the applicant.

1.3 Block Diagram Showing the Configuration of System Tested

Charging & TX Mode

1.4 Description of Support Units

The EUT has been tested as an independent unit.

1.5 Description of Test Mode

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned follow was evaluated respectively.

For Conducted Test	
Final Test Mode	**Description**
Mode 1	Charging+ TX Mode

For Radiated Test	
Final Test Mode	**Description**
Mode 1	TX GFSK Mode
Mode 2	TX Mode(GFSK) Channel 00/24/43

Note:

(1) For all test, we have verified the construction and function in typical operation. And all the test modes were carried out with the EUT in transmitting operation in maximum power with all kinds of data rate. We have pretested all the test modes above.
According to ANSI C63.10 standards, the measurements are performed at the highest, middle, lowest available channels, and the worst case data rate as follows:
TX Mode: GFSK (1.5 Mbps)

(2) The EUT is considered a portable unit; it was pre-tested on the positioned of each 3 axis, X-plane, Y-plane and Z-plane. The worst case was found positioned on X-plane as the normal use. Therefore only the test data of this X-plane was used for radiated emission measurement test.

1.6 Description of Test Software Setting

During testing channel power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters of Bluetooth mode.

Test Software Version	Secure CRT		
Frequency	2403.5 MHz	2439.5 MHz	2468 MHz
GFSK	DEF	DEF	DEF

1.7 Measurement Uncertainty

The reported uncertainty of measurement y ± U，where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2，providing a level of confidence of approximately 95 %.

Test Item	**Parameters**	**Expanded Uncertainty (U_{Lab})**
Conducted Emission	Level Accuracy: 9kHz~150kHz 150kHz to 30MHz	±3.42 dB ±3.42 dB
Radiated Emission	Level Accuracy: 9kHz to 30 MHz	±4.60 dB
Radiated Emission	Level Accuracy: 30MHz to 1000 MHz	±4.40 dB
Radiated Emission	Level Accuracy: Above 1000MHz	±4.20 dB

1.8 Test Facility

The testing report were performed by the Shenzhen Toby Technology Co., Ltd., in their facilities located at 1A/F., Bldg.6, Yusheng Industrial Zone, The National Road No.107 Xixiang Section 467, Xixiang, Bao'an, Shenzhen, Guangdong, China. At the time of testing, the following bodies accredited the Laboratory:

CNAS (L5813)

The Laboratory has been accredited by CNAS to ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories for the competence in the field of testing. And the Registration No.: CNAS L5813.

A2LA Certificate No.: 4750.01

The laboratory has been accredited by American Association for Laboratory Accreditation(A2LA) to ISO/IEC 17025：2005 General Requirements for the Competence of Testing and Calibration Laboratories for the technical competence in the field of Electrical Testing. And the A2LA Certificate No.: 4750.01. FCC Accredited Test Site Number: 854351.

IC Registration No.: (11950A-1)

The Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing. The site registration: Site# 11950A-1.

2. Test Summary

FCC Part 15 Subpart C(15.247)/ RSS 247 Issue 2				
Standard Section		Test Item	Judgment	Remark
FCC	IC			
15.203		Antenna Requirement	PASS	N/A
15.207	RSS-GEN 7.2.2	Conducted Emission	PASS	N/A
15.205	RSS-Gen 7.2.3	Restricted Bands	PASS	N/A
15.247(a)(1)	RSS 247 5.1 (2)	Hopping Channel Separation	PASS	N/A
15.247(a)(1)	RSS 247 5.1 (4)	Dwell Time	PASS	N/A
15.247(b)(1)	RSS 247 5.4 (2)	Peak Output Power	PASS	N/A
15.247(b)(1)	RSS 247 5.1 (4)	Number of Hopping Frequency	PASS	N/A
15.247(d)	RSS 247 5.5	Band Edge	PASS	N/A
15.247(c)& 15.209	RSS 247 5.5	Radiated Spurious Emission	PASS	N/A
15.247(a)	RSS 247 5.1 (1)	99% Occupied Bandwidth & 20dB Bandwidth	PASS	N/A
Note: N/A is an abbreviation for Not Applicable.				

3. Test Equipment

Conducted Emission Test					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Last Cal.**	**Cal. Due Date**
EMI Test Receiver	Rohde & Schwarz	ESCI	100321	Jul. 18, 2018	Jul. 17, 2019
RF Switching Unit	Compliance Direction Systems Inc	RSU-A4	34403	Jul. 18, 2018	Jul. 17, 2019
AMN	SCHWARZBECK	NNBL 8226-2	8226-2/164	Jul. 18, 2018	Jul. 17, 2019
LISN	Rohde & Schwarz	ENV216	101131	Jul. 18, 2018	Jul. 17, 2019
Radiation Emission Test					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Last Cal.**	**Cal. Due Date**
Spectrum Analyzer	Agilent	E4407B	MY45106456	Jul. 18, 2018	Jul. 17, 2019
EMI Test Receiver	Rohde & Schwarz	ESPI	100010/007	Jul. 18, 2018	Jul. 17, 2019
Bilog Antenna	ETS-LINDGREN	3142E	00117537	Jan. 27, 2019	Jan. 26, 2020
Bilog Antenna	ETS-LINDGREN	3142E	00117542	Jan. 27, 2019	Jan. 26, 2020
Horn Antenna	ETS-LINDGREN	3117	00143207	Mar.03, 2019	Mar. 02, 2020
Horn Antenna	ETS-LINDGREN	3117	00143209	Mar.03, 2019	Mar. 02, 2020
Loop Antenna	Laplace instrument	RF300	0701	Mar.04, 2019	Mar. 03, 2020
Pre-amplifier	Sonoma	310N	185903	Mar.03, 2019	Mar. 02, 2020
Pre-amplifier	HP	8449B	3008A00849	Mar.03, 2019	Mar. 02, 2020
Cable	HUBER+SUHNER	100	SUCOFLEX	Mar.03, 2019	Mar. 02, 2020
Positioning Controller	ETS-LINDGREN	2090	N/A	N/A	N/A
Antenna Conducted Emission					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Last Cal.**	**Cal. Due Date**
Spectrum Analyzer	Agilent	E4407B	MY45106456	Jul. 18, 2018	Jul. 17, 2019
Spectrum Analyzer	Rohde & Schwarz	ESCI	100010/007	Jul. 18, 2018	Jul. 17, 2019
MXA Signal Analyzer	Agilent	N9020A	MY49100060	Sep. 15, 2018	Sep. 14, 2019
Vector Signal Generator	Agilent	N5182A	MY50141294	Sep. 15, 2018	Sep. 14, 2019
Analog Signal Generator	Agilent	N5181A	MY50141953	Sep. 15, 2018	Sep. 14, 2019
RF Power Sensor	DARE!! Instruments	RadiPowerRPR3006W	17I00015SNO26	Sep. 15, 2018	Sep. 14, 2019
	DARE!! Instruments	RadiPowerRPR3006W	17I00015SNO29	Sep. 15, 2018	Sep. 14, 2019
	DARE!! Instruments	RadiPowerRPR3006W	17I00015SNO31	Sep. 15, 2018	Sep. 14, 2019
	DARE!! Instruments	RadiPowerRPR3006W	17I00015SNO33	Sep. 15, 2018	Sep. 14, 2019

4. Conducted Emission Test

4.1 Test Standard and Limit

4.1.1Test Standard

FCC Part 15.207

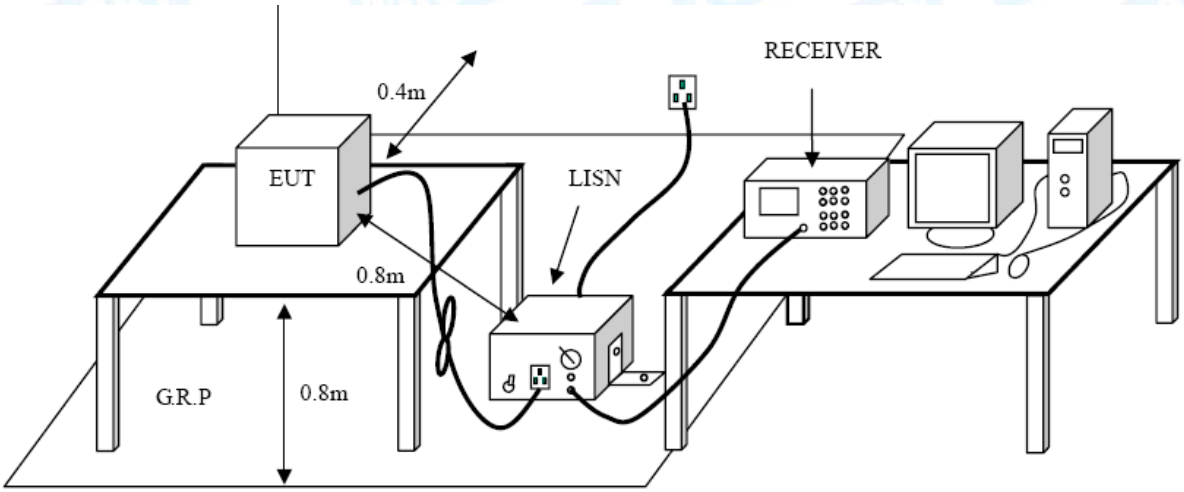
4.1.2 Test Limit

Conducted Emission Test Limit

Frequency	Maximum RF Line Voltage (dBμV)	
	Quasi-peak Level	Average Level
150kHz~500kHz	66 ~ 56 *	56 ~ 46 *
500kHz~5MHz	56	46
5MHz~30MHz	60	50

Notes:
(1) *Decreasing linearly with logarithm of the frequency.
(2) The lower limit shall apply at the transition frequencies.
(3) The limit decrease in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

4.2 Test Setup



4.3 Test Procedure

The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.

Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

LISN at least 80 cm from nearest part of EUT chassis

The bandwidth of EMI test receiver is set at 9kHz, and the test frequency band is from 0.15MHz to 30MHz.

4.4 EUT Operating Mode

Please refer to the description of test mode.

4.5 Test Data

Please refer to the Attachment A.

5. Radiated Emission Test

5.1 Test Standard and Limit

5.1.1 Test Standard

FCC Part 15.209

5.1.2 Test Limit

Radiated Emission Limit (9 kHz~1000MHz)

Frequency (MHz	Field Strength (microvolt/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

Radiated Emission Limit (Above 1000MHz)

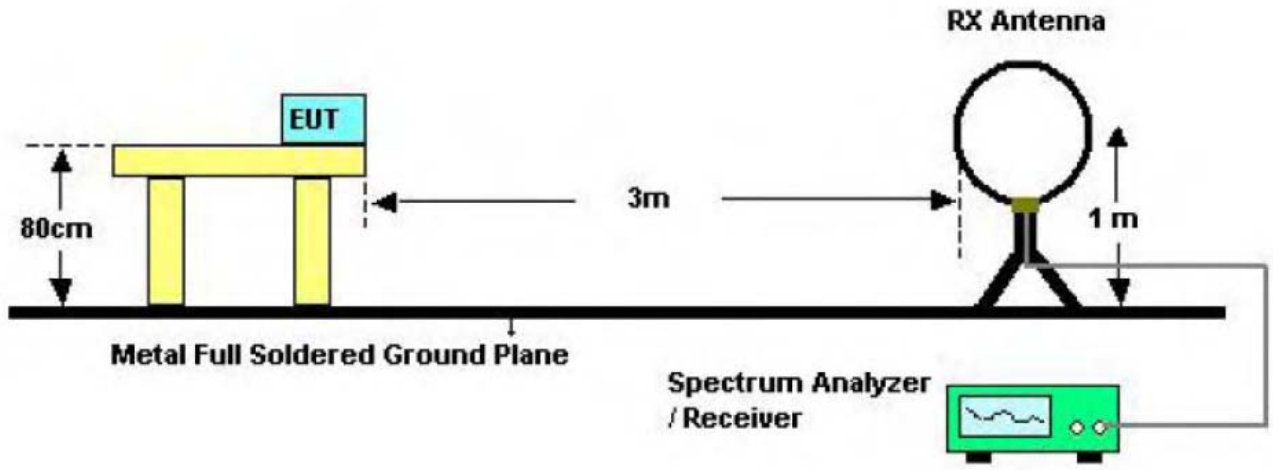
Frequency (MHz)	Distance Meters(at 3m)	
	Peak	Average
Above 1000	74	54

Note:

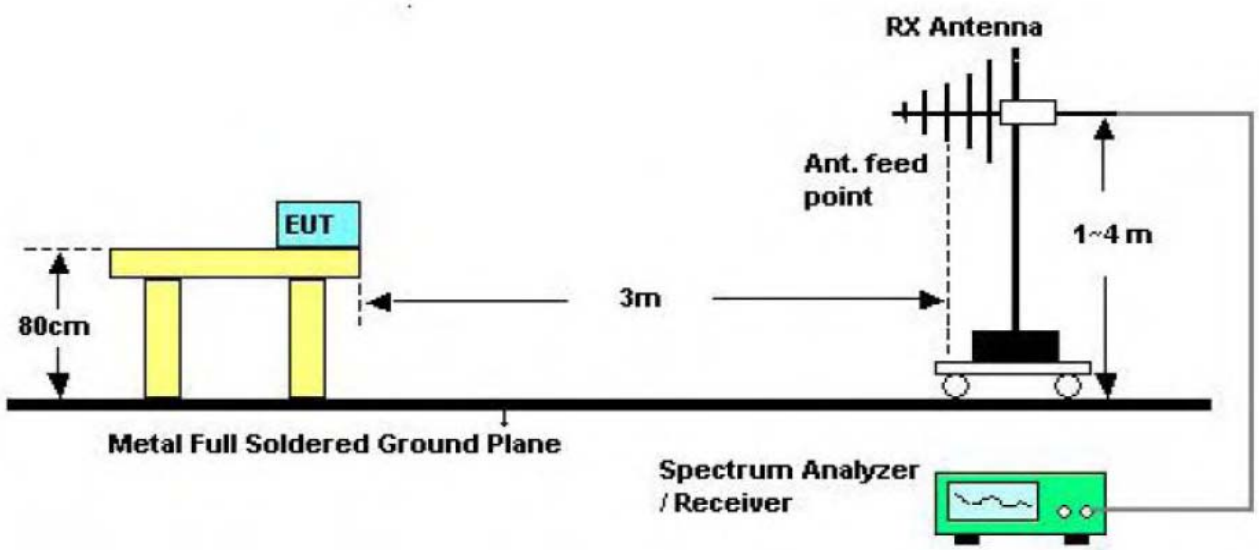
(1) The tighter limit applies at the band edges.

(2) Emission Level (dBuV/m)=20log Emission Level (uV/m)

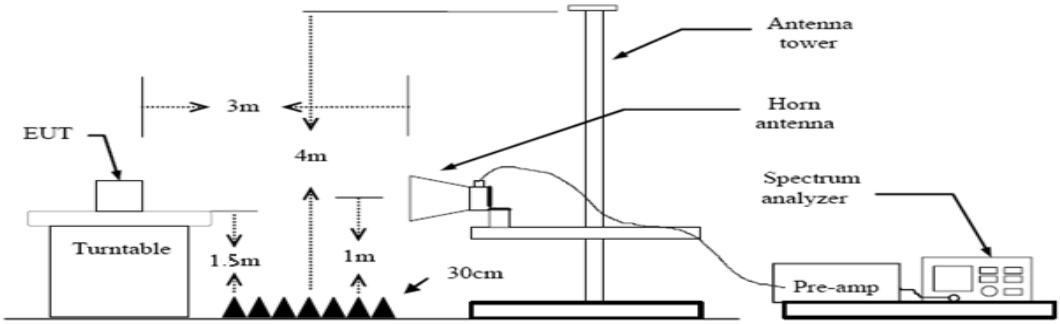
5.2 Test Setup



Below 30MHz Test Setup



Below 1000MHz Test Setup



Above 1GHz Test Setup

5.3 Test Procedure

(1) The measuring distance of 3m shall be used for measurements at frequency up to 1GHz and above 1 GHz. The EUT was placed on a rotating 0.8m high above ground, the table was rotated 360 degrees to determine the position of the highest radiation.

(2) Measurements at frequency above 1GHz. The EUT was placed on a rotating 1.5m high above the ground. RF absorbers covered the ground plane with a minimum area of 3.0m by 3.0m between the EUT and measurement receiver antenna. The RF absorber shall not exceed 30cm in high above the conducting floor. The table was rotated 360 degrees to determine the position of the highest radiation.

(3) The Test antenna shall vary between 1m and 4m, Both Horizontal and Vertical antenna are set to make measurement.

(4) The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.

(5) If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit Bellow 1 GHz, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed. But the Peak Value and average value both need to comply with applicable limit above 1 GHz.

(6) Testing frequency range below 1GHz the measuring instrument use VBW=120 kHz with Quasi-peak detection.

(7) Testing frequency range above 1GHz the measuring instrument use RBW=1 MHz and VBW=3 MHz with Peak Detector for Peak Values, and use RBW=1 MHz and VBW=10 Hz with Peak Detector for Average Values.

(8) For the actual test configuration, please see the test setup photo.

5.4 EUT Operating Condition

The Equipment Under Test was set to Continual Transmitting in maximum power in TX mode.

5.5 Test Data

Remark: During testing above 1GHz the measuring instrument use RBW=1 MHz and VBW=3 MHz with Peak Detector for Peak Values, and use RBW=1 MHz and VBW=10 Hz with Peak Detector for Average Values.

Please refer to the Attachment B.

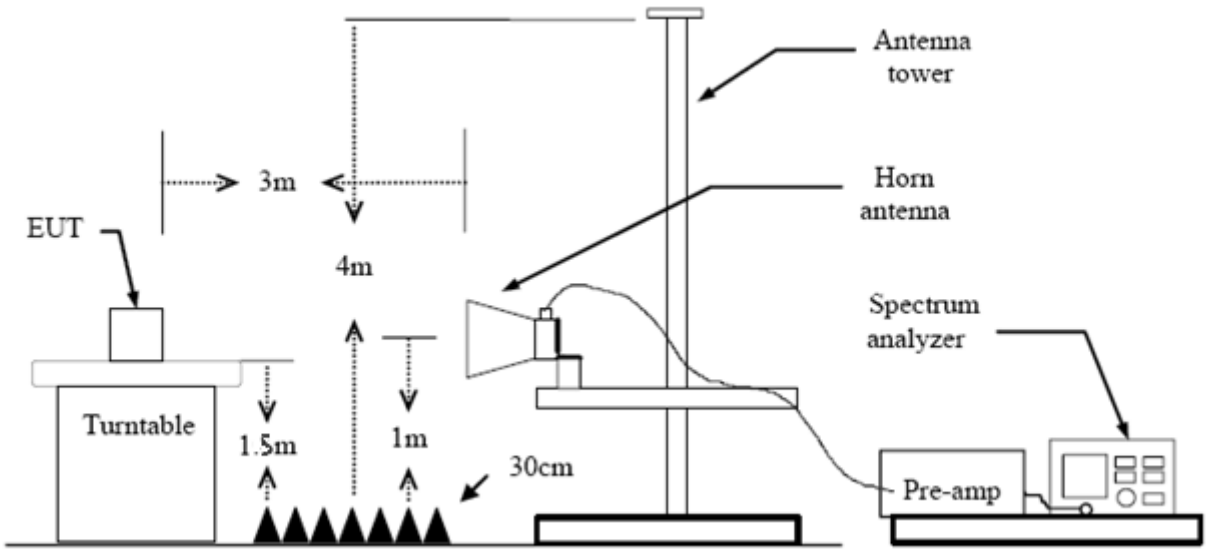
6. Restricted Bands and Band-edge test

6.1 Test Standard and Limit

6.1.1 Test Standard
FCC Part 15.209
FCC Part 15.205
6.1.2 Test Limit

Restricted Frequency Band (MHz)	Distance Meters(at 3m)	
	Peak	Average
2310 ~2390	74	54
2483.5 ~2500	74	54
Note: All restriction bands have been tested, only the worst case is reported.		

6.2 Test Setup



6.3 Test Procedure

(1) The measuring distance of 3m shall be used for measurements at frequency up to 1GHz and above 1 GHz. The EUT was placed on a rotating 0.8m high above ground, the table was rotated 360 degrees to determine the position of the highest radiation.

(2) Measurements at frequency above 1GHz. The EUT was placed on a rotating 1.5m high above the ground. RF absorbers covered the ground plane with a minimum area of 3.0m by 3.0m between the EUT and measurement receiver antenna. The RF absorber shall not exceed 30cm in high above the conducting floor. The table was rotated 360 degrees to determine the position of the highest radiation.

(3) The Test antenna shall vary between 1m and 4m, Both Horizontal and Vertical antenna are set to make measurement.
(4) The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
(5) If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit Bellow 1 GHz, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed. But the Peak Value and average value both need to comply with applicable limit above 1 GHz.
(6) Testing frequency range below 1GHz the measuring instrument use VBW=120 kHz with Quasi-peak detection.
(7) Testing frequency range above 1GHz the measuring instrument use RBW=1 MHz and VBW=3 MHz with Peak Detector for Peak Values, and use RBW=1 MHz and VBW=10 Hz with AVG Detector for Average Values.
(8) For the actual test configuration, please see the test setup photo.

6.4 EUT Operating Condition

The Equipment Under Test was set to Continual Transmitting in maximum power.

6.5 Test Data

Remark: During testing above 1GHz the measuring instrument use RBW=1 MHz and VBW=3 MHz with Peak Detector for Peak Values, and use RBW=1 MHz and VBW=10 Hz with Peak Detector for Average Values.

All restriction bands have been tested, only the worst case is reported.

Please refer to the Attachment C.

7. Number of Hopping Channel

7.1 Test Standard and Limit

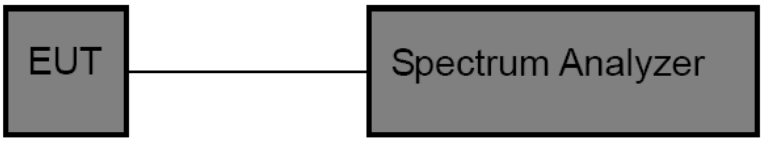
6.1.1 Test Standard

FCC Part 15.247 (a)(1)

6.1.2 Test Limit

Section	Test Item	Limit
15.247	Number of Hopping Channel	>15

7.2 Test Setup



7.3 Test Procedure

(1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.

(2) Spectrum Setting: RBW=100 KHz, VBW=100 KHz, Sweep time= Auto.

7.4 EUT Operating Condition

The EUT was set to the Hopping Mode by the Customer.

7.5 Test Data

Please refer to the Attachment D.

8. Average Time of Occupancy

8.1 Test Standard and Limit

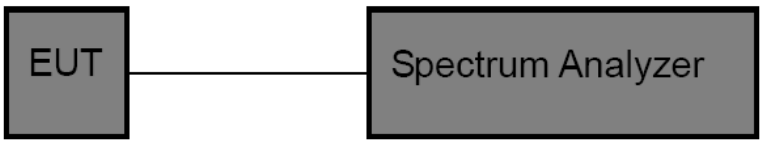
8.1.1 Test Standard

FCC Part 15.247 (a)(1)

8.1.2 Test Limit

Section	Test Item	Limit
15.247(a)(1)	Average Time of Occupancy	0.4 sec

8.2 Test Setup



8.3 Test Procedure

(1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
(2) Spectrum Setting: RBW=100KHz, VBW=300KHz.
(3) Use video trigger with the trigger level set to enable triggering only on full pulses.
(4) Sweep Time is more than once pulse time.
(5) Set the center frequency on any frequency would be measure and set the frequency span to zero.
(6) Measure the maximum time duration of one single pulse.
(7) Set the EUT for packet transmitting.
(8) Measure the maximum time duration of one single pulse.

8.4 EUT Operating Condition

The average time of occupancy on any channel within the Period can be calculated with formulas:
The Dwell Time = Burst Width * Total Hops. The detailed calculations are showed as follows:
The duration for dwell time calculation: 0.4 [s] * hopping number = 0.4 [s] * 20 [ch] = 8.0 [s*ch];
The burst width, which is directly measured, refers to the duration on one channel hop.
The maximum number of hopping channels in 8.0s =3*(8.0/0.24) =100
The lowest, middle and highest channels are selected to perform testing to record the dwell time of each occupation measured in this channel, which is called Pulse Time here.

The EUT was set to the Hopping Mode by the Customer.

8.5 Test Data

Please refer to the Attachment E.

9. Channel Separation and Bandwidth Test

9.1 Test Standard and Limit

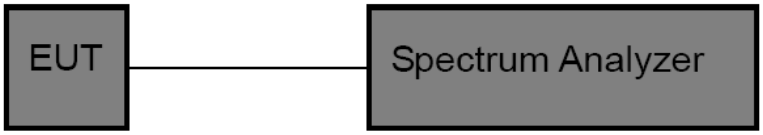
9.1.1 Test Standard

FCC Part 15.247

9.1.2 Test Limit

Test Item	Limit	Frequency Range(MHz)
Bandwidth	<=1 MHz (20dB bandwidth)	2400~2483.5
Channel Separation	>25KHz or >two-thirds of the 20 dB bandwidth Which is greater	2400~2483.5

9.2 Test Setup



9.3 Test Procedure

(1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.

(2) Spectrum Setting:
Channel Separation: RBW=100 kHz, VBW=100 kHz.
Bandwidth: RBW=30 kHz, VBW=100 kHz.

(3) The bandwidth is measured at an amplitude level reduced 20dB from the reference level. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signal to produce the worst –case (i.e the widest) bandwidth.

(4) Measure the channel separation the spectrum analyzer was set to Resolution Bandwidth:30 kHz, and Video Bandwidth:100 kHz. Sweep Time set auto.

9.4 EUT Operating Condition

The EUT was set to the Hopping Mode for Channel Separation Test and continuously transmitting for the Bandwidth Test.

9.5 Test Data

Please refer to the Attachment F.

10. Peak Output Power Test

10.1 Test Standard and Limit

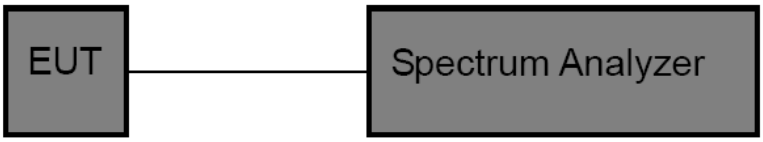
10.1.1 Test Standard

FCC Part 15.247 (b) (1)

10.1.2 Test Limit

Test Item	Limit	Frequency Range(MHz)
Peak Output Power	Hopping Channels>75 Power<1W(30dBm) Other <125 mW(21dBm)	2400~2483.5

10.2 Test Setup



10.3 Test Procedure

(1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.

(2) Spectrum Setting:

Peak Detector: RBW=1 MHz, VBW=3 MHz for bandwidth less than 1MHz.

RBW=3 MHz, VBW=3 MHz for bandwidth more than 1MHz.

10.4 EUT Operating Condition

The EUT was set to continuously transmitting in the max power during the test.

10.5 Test Data

Please refer to the Attachment G.

11. Antenna Requirement

11.1 Standard Requirement

11.1.1 Standard

FCC Part 15.203

11.1.2 Requirement

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

11.2 Antenna Connected Construction

The gains of the antenna used for transmitting is 2dBi, and the antenna connector is de-signed with permanent attachment and no consideration of replacement. Please see the EUT photo for details.

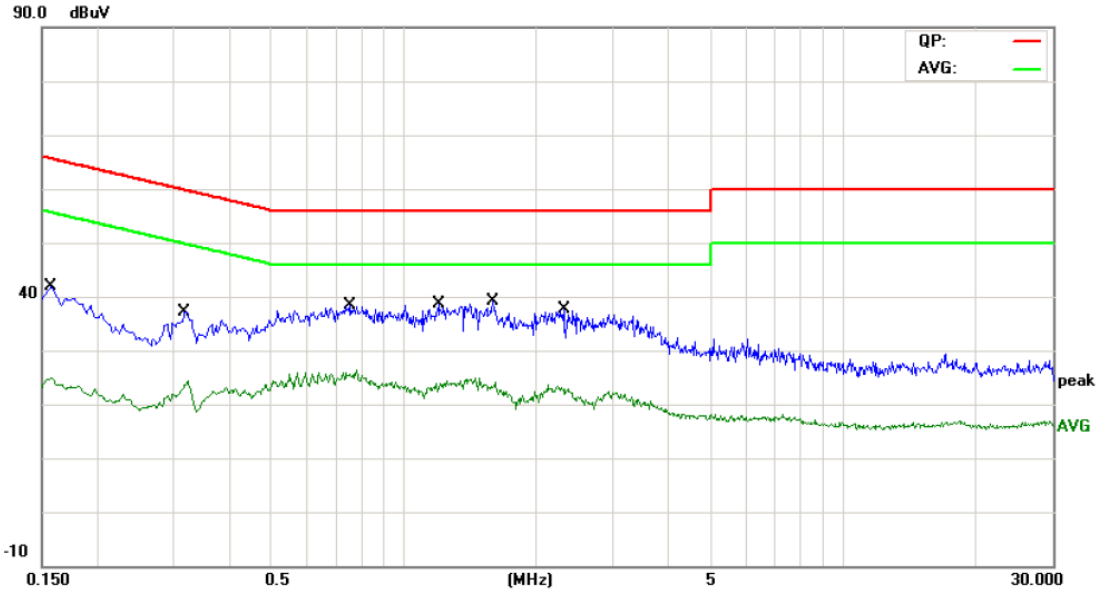
11.3 Result

The EUT antenna is a Monopole Antenna. It complies with the standard requirement.

Antenna Type
☒Permanent attached antenna
☐Unique connector antenna
☐Professional installation antenna

Attachment A-- Conducted Emission Test Data

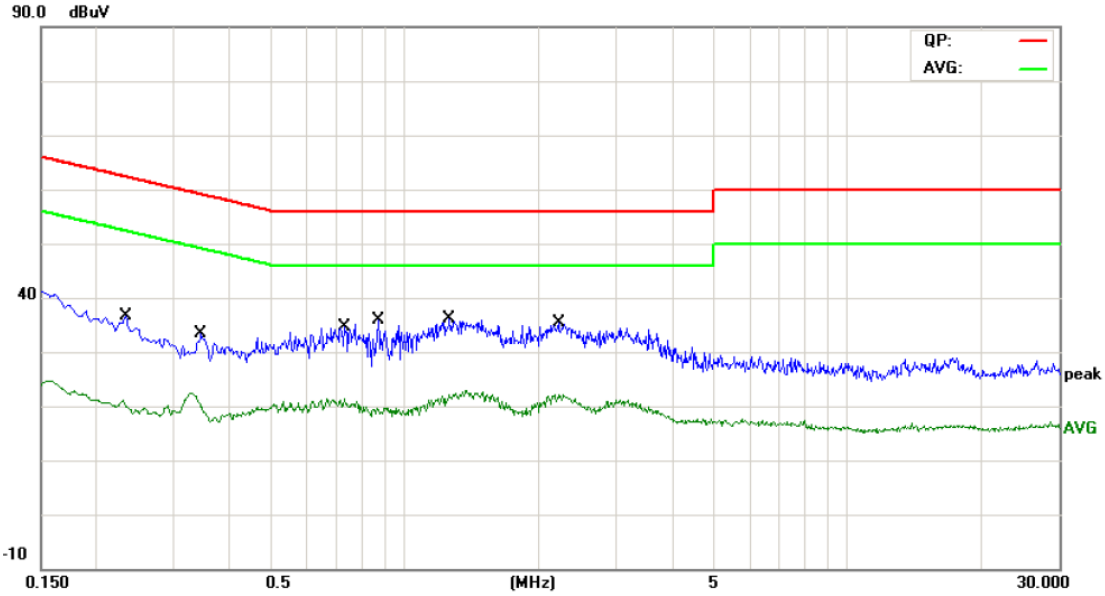
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Terminal:	Line		
Test Mode:	Charging + TX GFSK Mode 2403.5MHz		
Remark:	All channels have been tested and Shows only the worst channels.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.1580	27.63	9.64	37.27	65.56	-28.29	QP
2		0.1580	13.84	9.64	23.48	55.56	-32.08	AVG
3		0.3180	23.04	9.57	32.61	59.76	-27.15	QP
4		0.3180	13.44	9.57	23.01	49.76	-26.75	AVG
5		0.7580	24.05	9.59	33.64	56.00	-22.36	QP
6	*	0.7580	15.40	9.59	24.99	46.00	-21.01	AVG
7		1.2020	22.52	9.59	32.11	56.00	-23.89	QP
8		1.2020	13.38	9.59	22.97	46.00	-23.03	AVG
9		1.5980	22.36	9.60	31.96	56.00	-24.04	QP
10		1.5980	13.41	9.60	23.01	46.00	-22.99	AVG
11		2.3100	21.02	9.63	30.65	56.00	-25.35	QP
12		2.3100	12.69	9.63	22.32	46.00	-23.68	AVG

Emission Level= Read Level+ Correct Factor

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Terminal:	Neutral		
Test Mode:	Charging + TX GFSK Mode 2403.5MHz		
Remark:	All channels have been tested and Shows only the worst channels.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.2340	19.80	9.62	29.42	62.30	-32.88	QP
2		0.2340	9.73	9.62	19.35	52.30	-32.95	AVG
3		0.3460	17.84	9.57	27.41	59.06	-31.65	QP
4		0.3460	9.59	9.57	19.16	49.06	-29.90	AVG
5		0.7300	17.16	9.59	26.75	56.00	-29.25	QP
6		0.7300	10.57	9.59	20.16	46.00	-25.84	AVG
7		0.8700	16.51	9.59	26.10	56.00	-29.90	QP
8		0.8700	9.36	9.59	18.95	46.00	-27.05	AVG
9		1.2579	21.09	9.60	30.69	56.00	-25.31	QP
10		1.2579	11.43	9.60	21.03	46.00	-24.97	AVG
11		2.2180	20.54	9.62	30.16	56.00	-25.84	QP
12	*	2.2180	11.64	9.62	21.26	46.00	-24.74	AVG

Emission Level= Read Level+ Correct Factor

Attachment B-- Radiated Emission Test Data

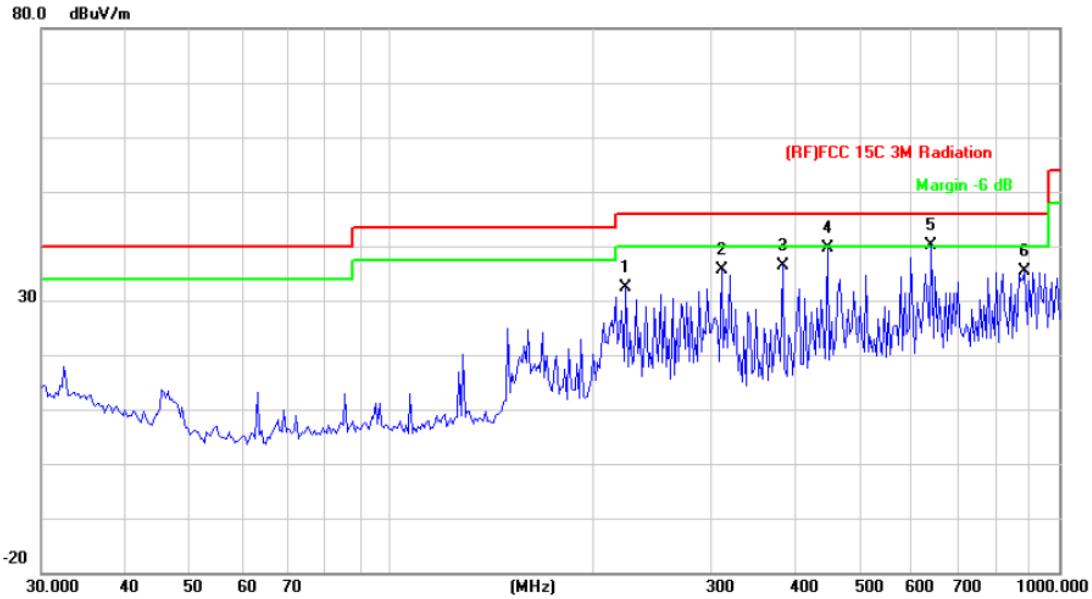
9KHz~30MHz

From 9KHz to 30MHz: Conclusion: PASS

Note: The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

30MHz~1GHz

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2403.5MHz		
Remark:	Only worse case is reported		

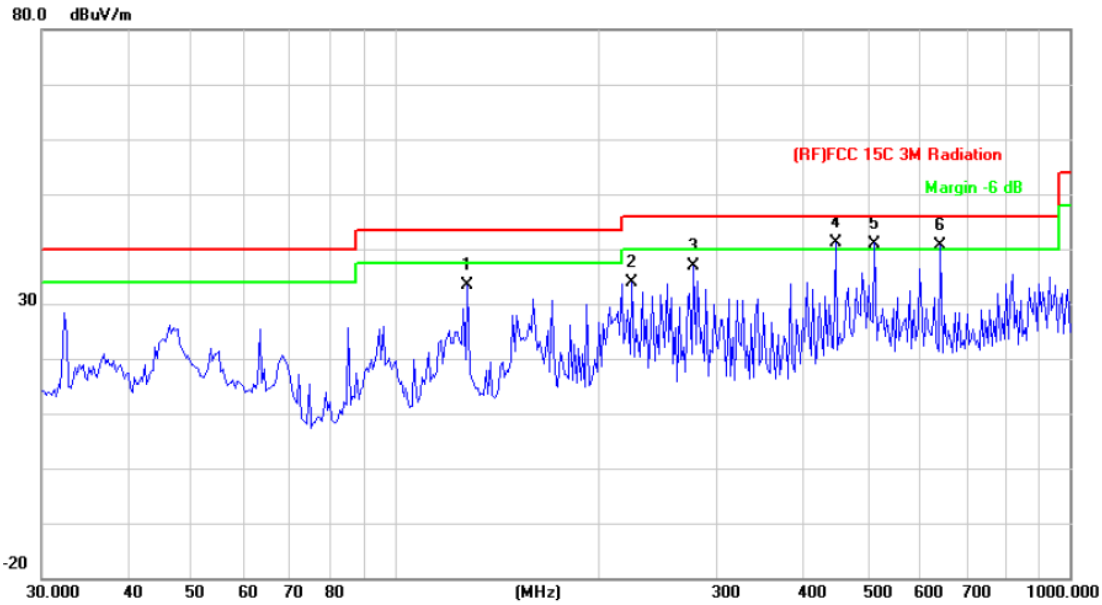


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		224.5193	51.05	-18.60	32.45	46.00	-13.55	QP
2		312.1794	51.47	-15.80	35.67	46.00	-10.33	QP
3		385.2805	49.45	-12.95	36.50	46.00	-9.50	QP
4		449.5558	51.60	-11.99	39.61	46.00	-6.39	QP
5	*	642.8613	48.41	-8.18	40.23	46.00	-5.77	QP
6		887.6099	39.35	-4.08	35.27	46.00	-10.73	QP

*:Maximum data x:Over limit !:over margin

Emission Level= Read Level+ Correct Factor

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2403.5MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		128.1130	55.85	-22.41	33.44	43.50	-10.06	QP
2		224.5193	52.49	-18.60	33.89	46.00	-12.11	QP
3		277.0935	53.48	-16.65	36.83	46.00	-9.17	QP
4	*	449.5558	53.08	-11.99	41.09	46.00	-4.91	QP
5	!	513.6331	51.20	-10.20	41.00	46.00	-5.00	QP
6	!	642.8613	48.75	-8.18	40.57	46.00	-5.43	QP

*:Maximum data x:Over limit !:over margin

Emission Level= Read Level+ Correct Factor

Above 1GHz (Only worse case is reported)

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2403.5MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4808.116	45.62	14.46	60.08	74.00	-13.92	peak
2	*	4808.116	30.01	14.46	44.47	54.00	-9.53	AVG

Emission Level= Read Level+ Correct Factor

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2403.5MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4806.130	49.48	14.44	63.92	74.00	-10.08	peak
2	*	4806.922	32.47	14.44	46.91	54.00	-7.09	AVG

Emission Level= Read Level+ Correct Factor

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2439.5MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4879.290	41.27	14.91	56.18	74.00	-17.82	peak
2	*	4879.290	30.01	14.91	44.92	54.00	-9.08	AVG

Emission Level= Read Level+ Correct Factor

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2439.5MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4879.134	43.20	14.91	58.11	74.00	-15.89	peak
2	*	4879.134	29.71	14.91	44.62	54.00	-9.38	AVG

Emission Level= Read Level+ Correct Factor

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2468MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4936.532	43.66	15.39	59.05	74.00	-14.95	peak
2	*	4936.350	30.11	15.40	45.51	54.00	-8.49	AVG

Emission Level= Read Level+ Correct Factor

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2468MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4936.194	43.45	15.40	58.85	74.00	-15.15	peak
2	*	4936.230	30.05	15.40	45.45	54.00	-8.55	AVG

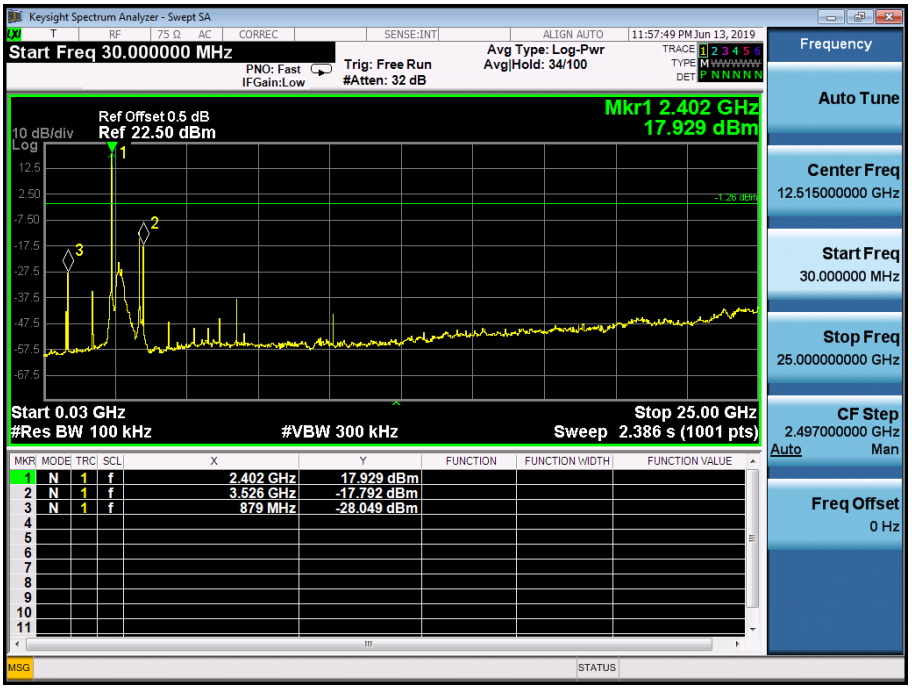
Emission Level= Read Level+ Correct Factor

Conducted Emission Test Data

Temperature:	25 ℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Test Mode:	TX GFSK Mode		
Remark:	This report only shall the worst case mode.		

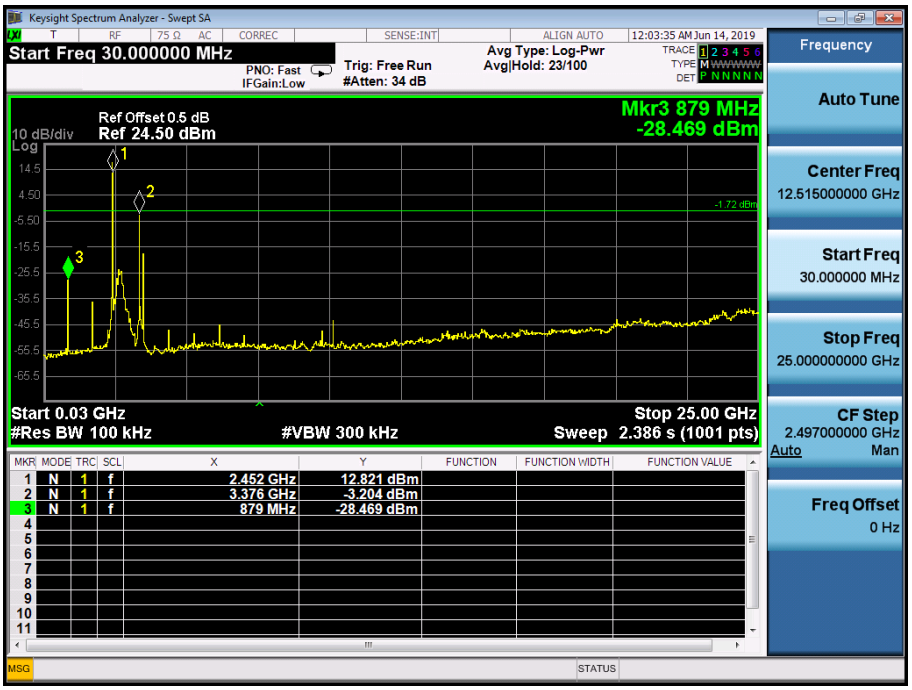
2403.5 MHz

0.03GHz-25GHz



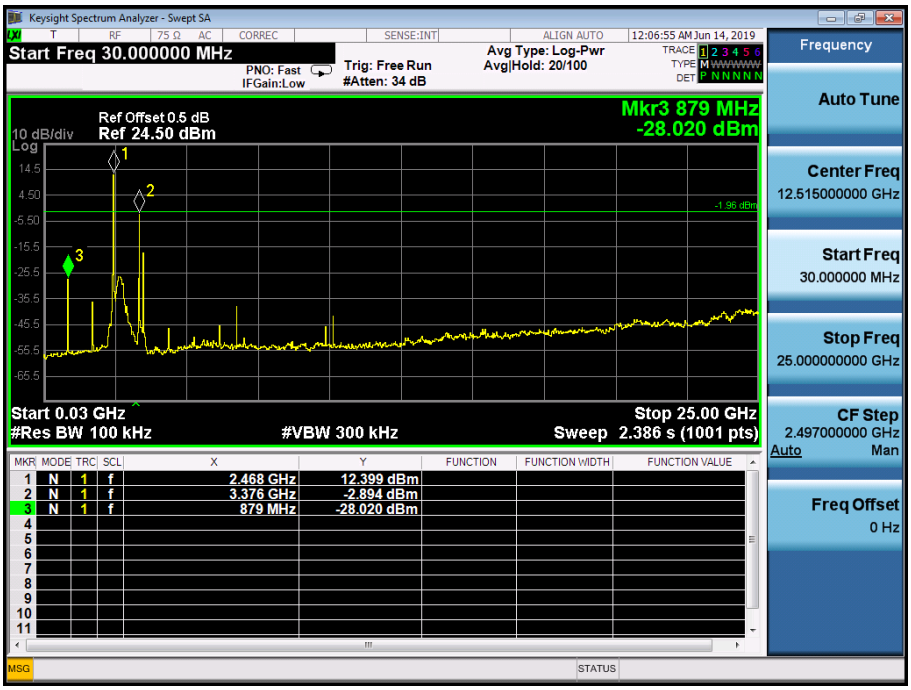
2439.5 MHz

0.03GHz-25GHz



2468 MHz
0.03GHz-25GHz

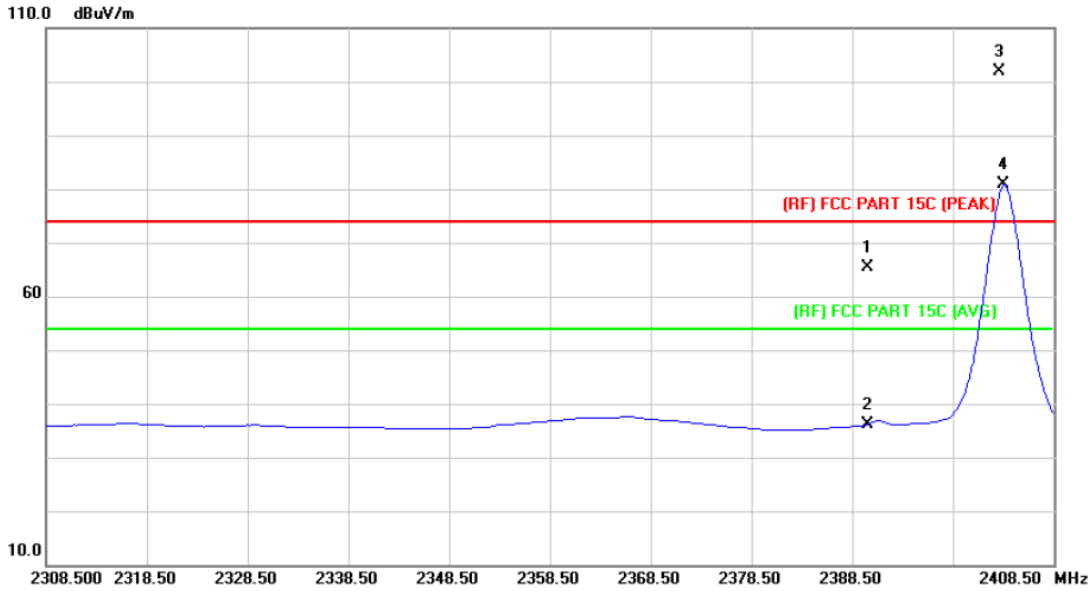
Keysight Spectrum Analyzer - Swept SA
Marker 1 2.468010000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 34 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
12:04:48 AM Jun 14, 2019
Ref Offset 0.5 dB
10 dB/div
Ref 24.50 dBm
Mkr1 2.468 010 GHz
18.044 dBm
Center 2.468000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 5.000 MHz
Sweep 1.000 ms (1001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2


Keysight Spectrum Analyzer - Swept SA
Start Freq 30.000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 34 dB
Avg Type: Log-Pwr
Avg|Hold: 20/100
12:06:55 AM Jun 14, 2019
Ref Offset 0.5 dB
10 dB/div
Ref 24.50 dBm
Mkr3 879 MHz
-28.020 dBm
Start 0.03 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 2.386 s (1001 pts)
1 N 1 f 2.468 GHz 12.399 dBm
2 N 1 f 3.376 GHz -2.894 dBm
3 N 1 f 879 MHz -28.020 dBm
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

Attachment C-- Restricted Bands Requirement Test Data

(1) Radiation Test

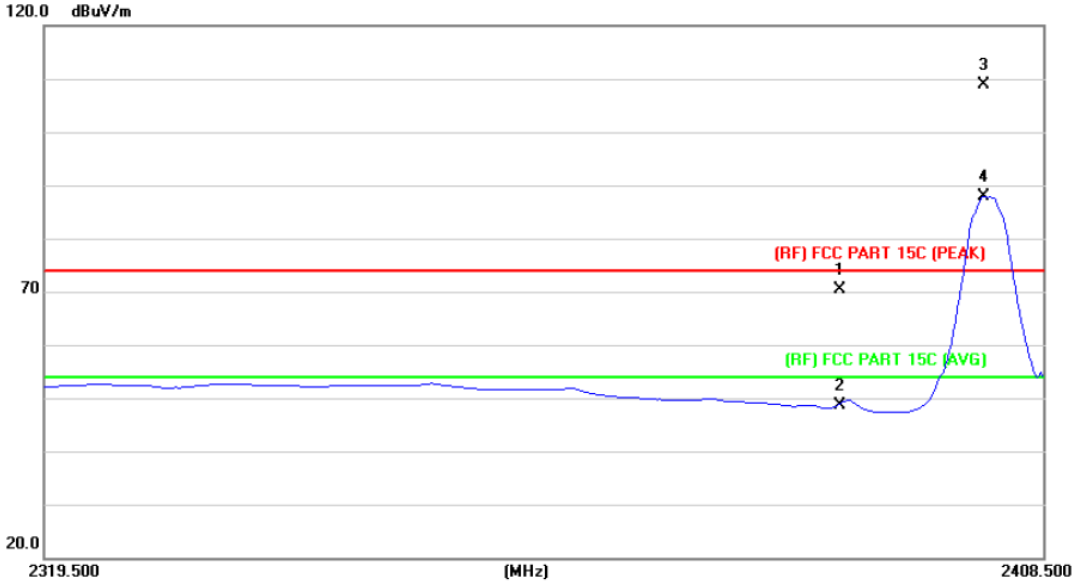
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2403.5MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2390.000	62.46	2.82	65.28	74.00	-8.72	peak
2		2390.000	33.37	2.82	36.19	54.00	-17.81	AVG
3	*	2403.100	98.94	2.88	101.82	Fundamental Frequency		
4	X	2403.500	77.94	2.88	80.82	Fundamental Frequency		

Emission Level= Read Level+ Correct Factor

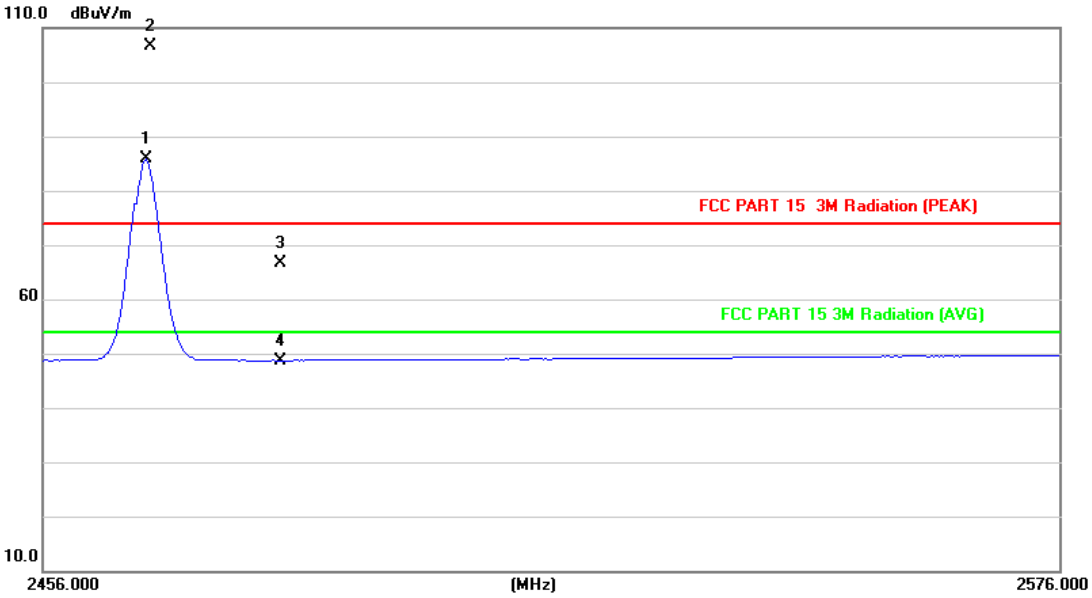
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2403.5MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2390.000	67.53	2.82	70.35	74.00	-3.65	peak
2		2390.000	45.87	2.82	48.69	54.00	-5.31	AVG
3	*	2403.160	105.99	2.88	108.87	Fundamental Frequency		
4	X	2403.160	84.94	2.88	87.82	Fundamental Frequency		

Emission Level= Read Level+ Correct Factor

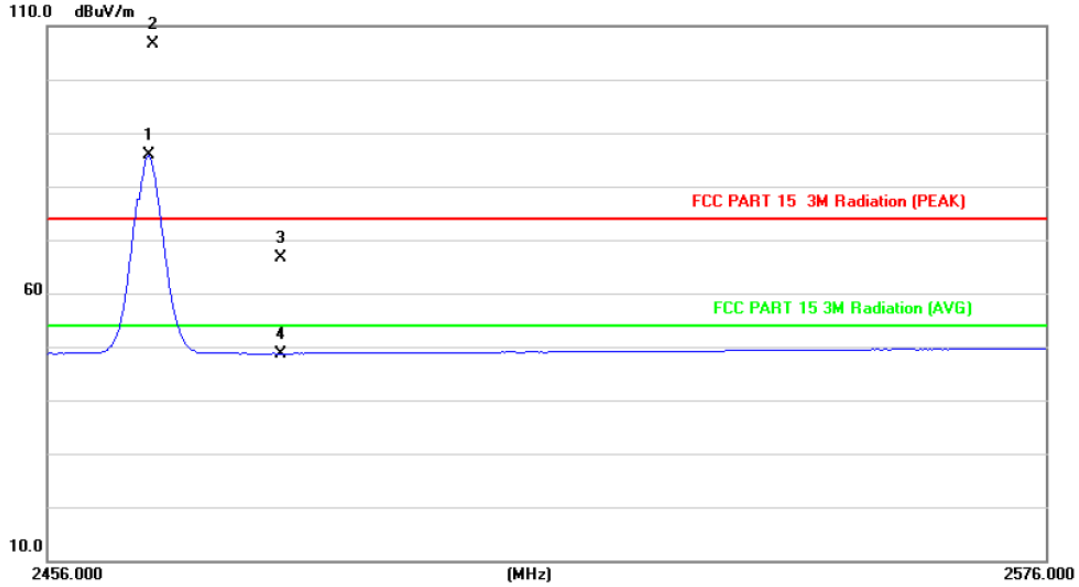
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2468 MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	X	2468.000	92.26	2.00	94.26	Fundamental Frequency		
2	*	2468.480	113.02	2.00	115.02	Fundamental Frequency		
3		2483.500	63.80	2.10	65.90	74.00	-8.10	peak
4		2483.500	46.87	2.10	48.97	54.00	-5.03	AVG

Emission Level= Read Level+ Correct Factor

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2468 MHz		
Remark:	Only worse case is reported		

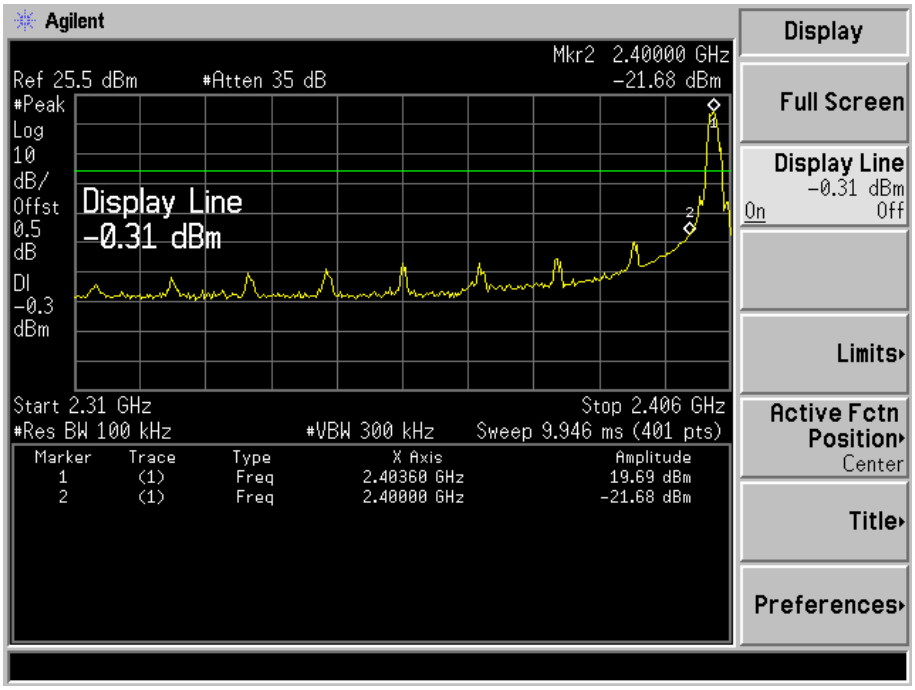


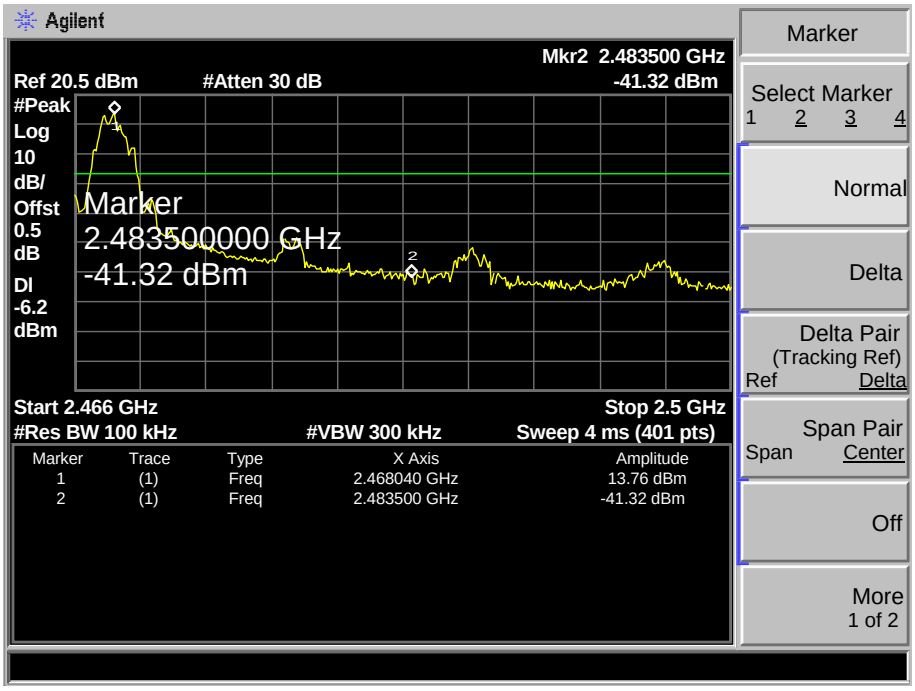
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	X	2468.000	83.81	2.00	85.81	**Fundamental Frequency**		
2	*	2468.480	104.68	2.00	106.68	**Fundamental Frequency**		
3		2483.500	64.41	2.10	66.51	74.00	-7.49	peak
4		2483.500	46.64	2.10	48.74	54.00	-5.26	AVG

Emission Level= Read Level+ Correct Factor

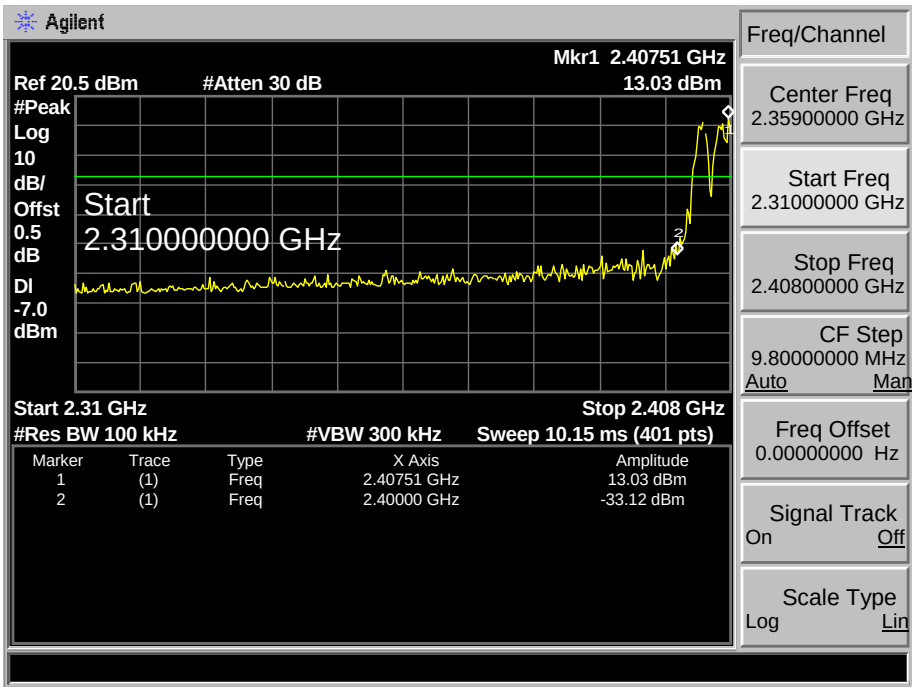
(2) Conducted Band Edge Test

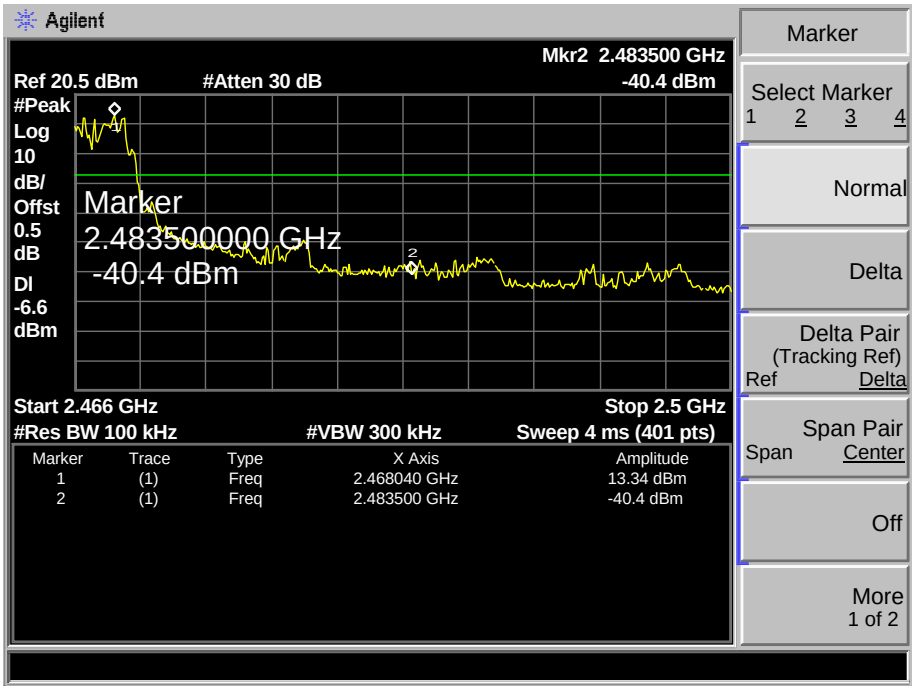
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Test Mode:	TX GFSK Mode 2403.5MHz/2468 MHz		
Remark:	Only worse case is reported		





Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Test Mode:	GFSK Hopping Mode		
Remark:	Only worse case is reported		



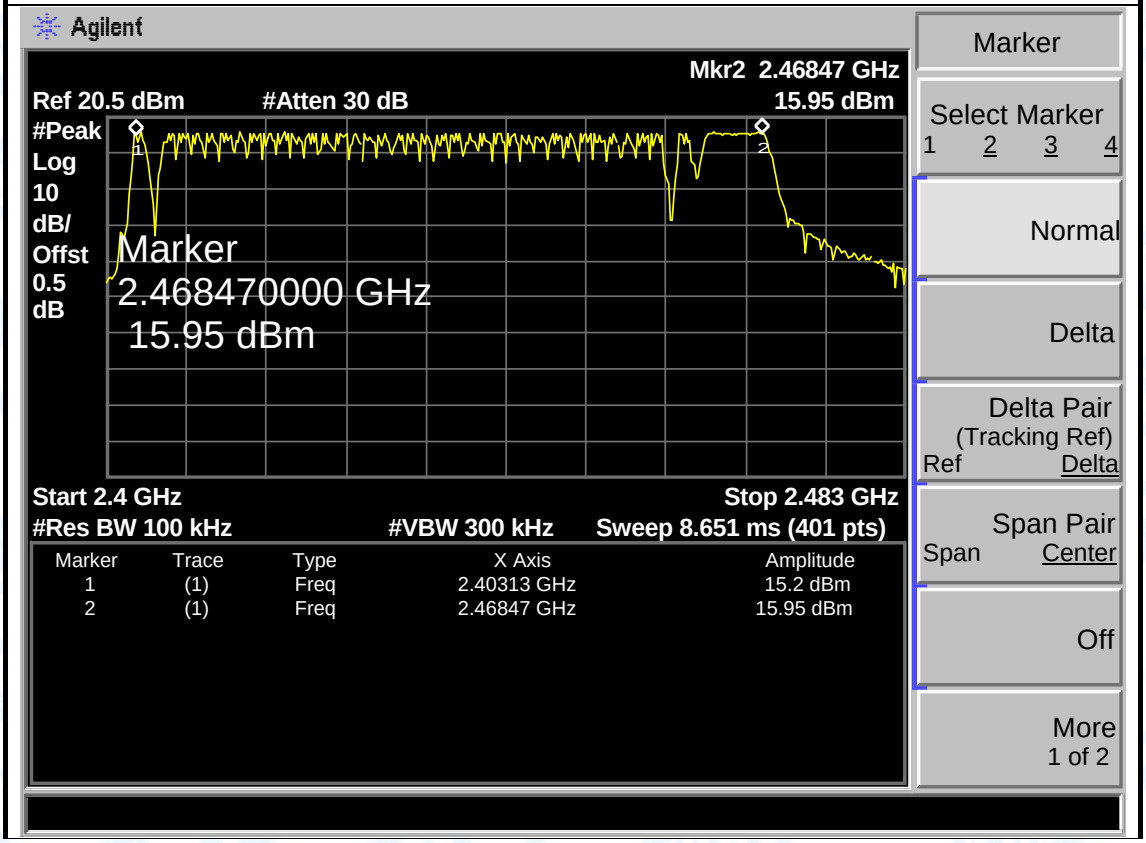


Attachment D-- Number of Hopping Channel Test Data

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Test Mode:	Hopping Mode		
Remark:	The number of total hopping frequencies up to 44 and only 20 channels will hopping at the same time.		

Frequency Range	Test Mode	Quantity of Hopping Channel	Limit
2403.5MHz~2468MHz	GFSK	44	**>15**

GFSK Mode



Attachment E-- Average Time of Occupancy Test Data

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Test Mode:	Hopping Mode (GFSK)		
Remark:	The number of total hopping frequencies up to 44 and only 20 channels will hopping at the same time. We test all mode and worse case recorded in the report.		

Test Mode	Channel (MHz)	Reading Time (ms)	Total hops	Test Result (ms)	Limit (ms)	Result
GFSK	2403.5	3.6948	50.00	184.74	**400**	**PASS**

The Dwell Time = Burst Width * Total Hops. The detailed calculations are showed as follows:

The duration for dwell time calculation: 0.4 [s] * hopping number = 0.4 [s] * 20 [ch] = 8.0 [s*ch];

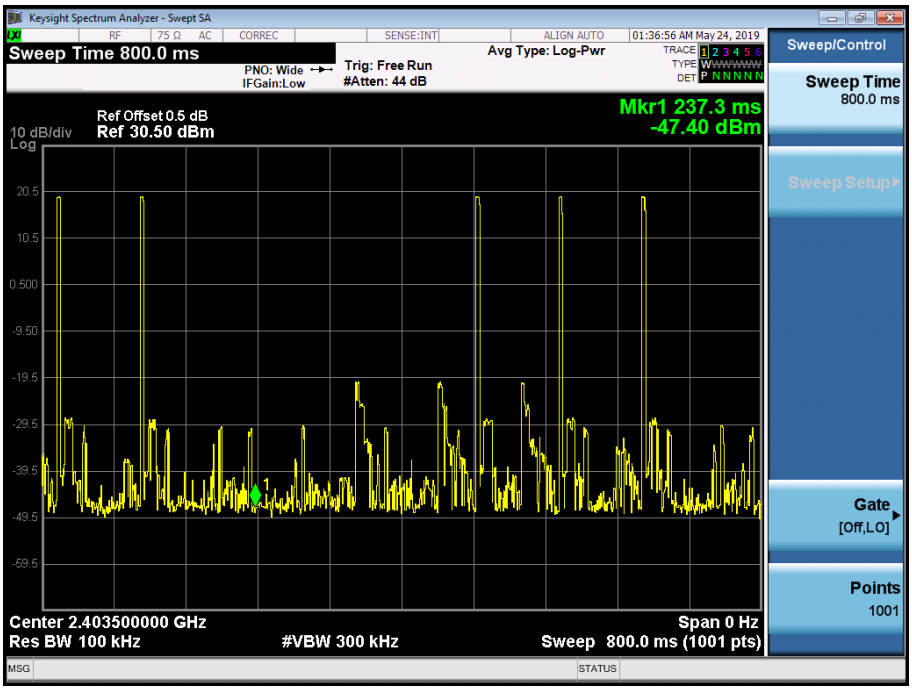
The burst width, which is directly measured, refers to the duration on one channel hop.

The maximum number of hopping channels in 8.0s =5*(8.0/0.800) =50

Reading Time=0.9237ms*4

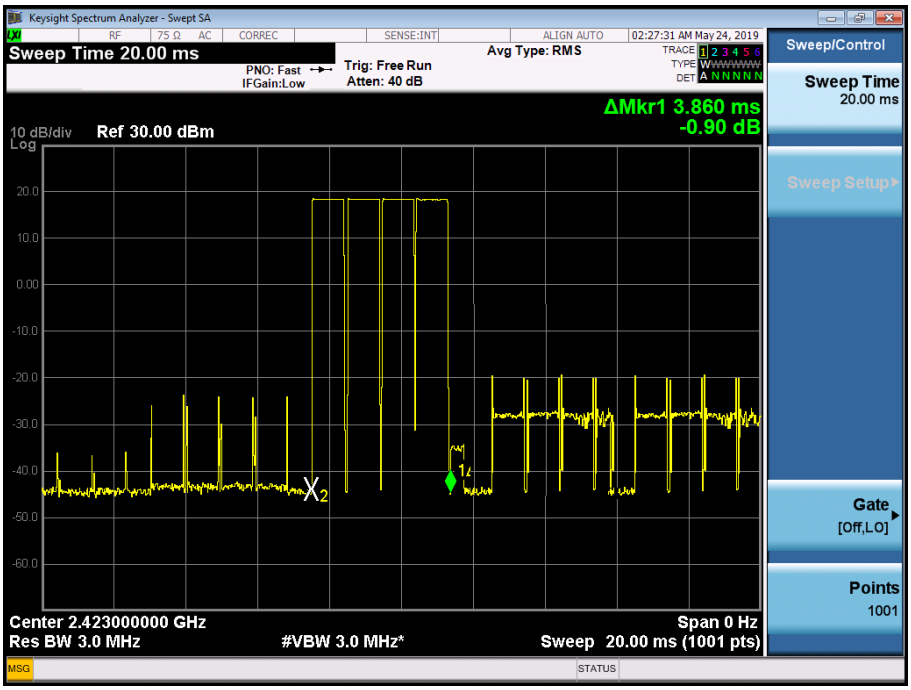
GFSK Hopping Mode

2403.5 MHz



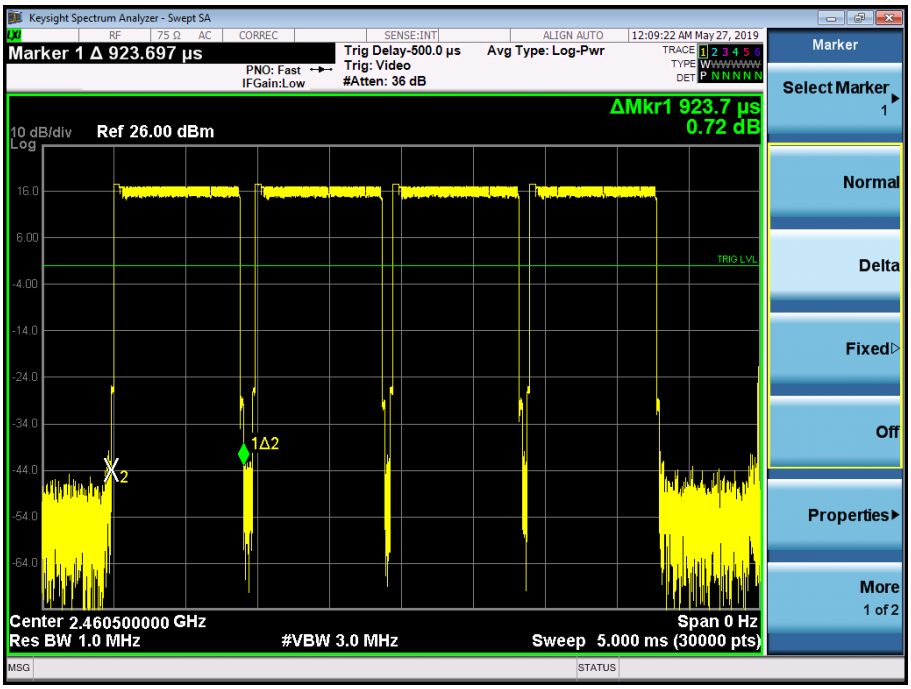
GFSK Hopping Mode

2403.5 MHz



GFSK Hopping Mode

2403.5 MHz



Attachment F-- Channel Separation and Bandwidth Test Data

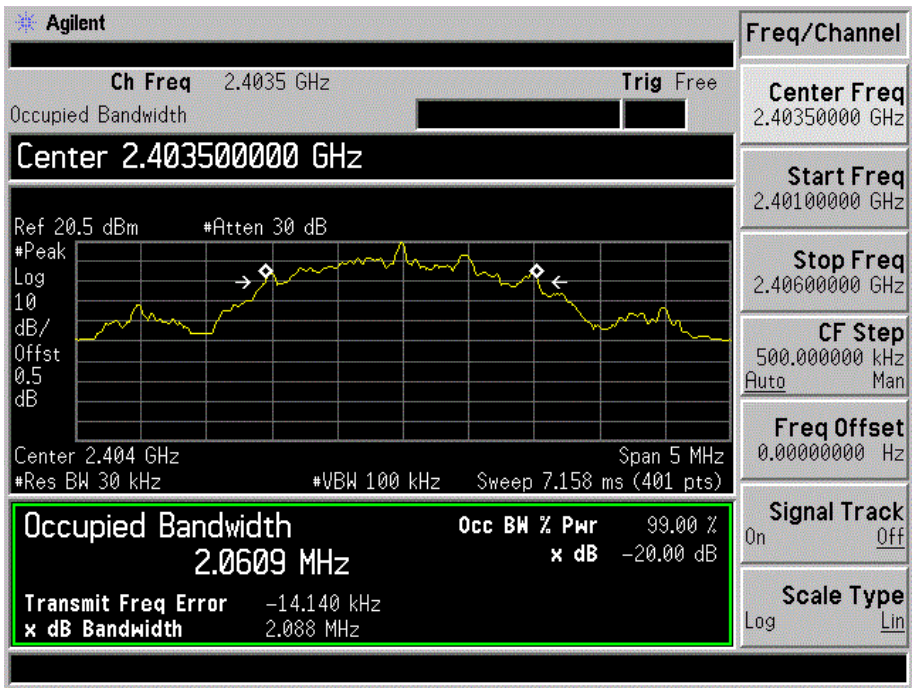
Bandwidth Test Data:

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Test Mode:	TX Mode (GFSK)		

Channel frequency (MHz)	**99% OBW (kHz)**	**20dB Bandwidth (kHz)**	**20dB Bandwidth *2/3 (kHz)**
2403.5	2060.9	2088	
2439.5	2064.7	2102	
2468.0	2066.0	2103	

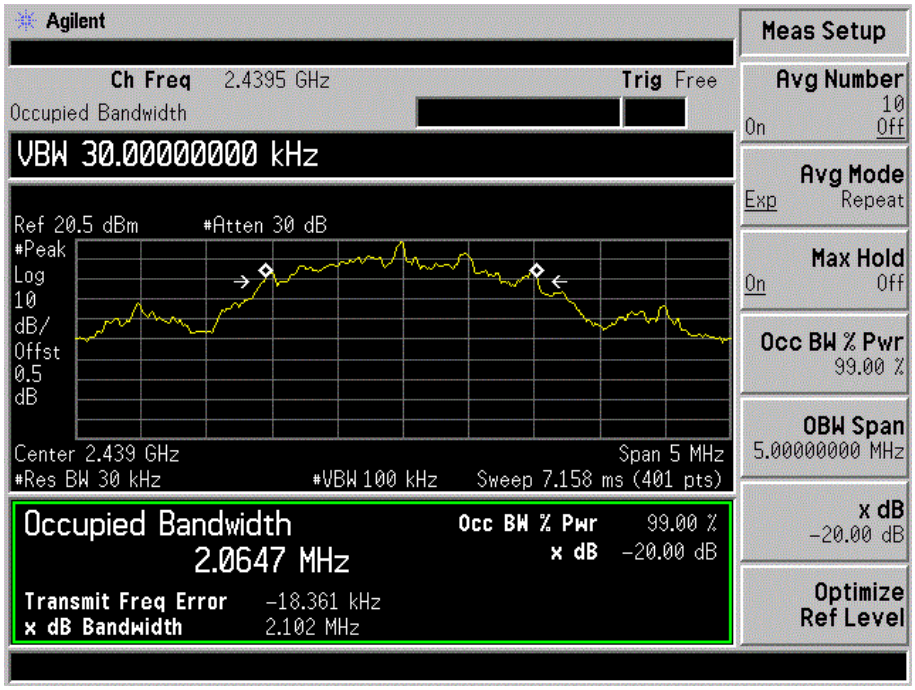
GFSK TX Mode

2403.5 MHz



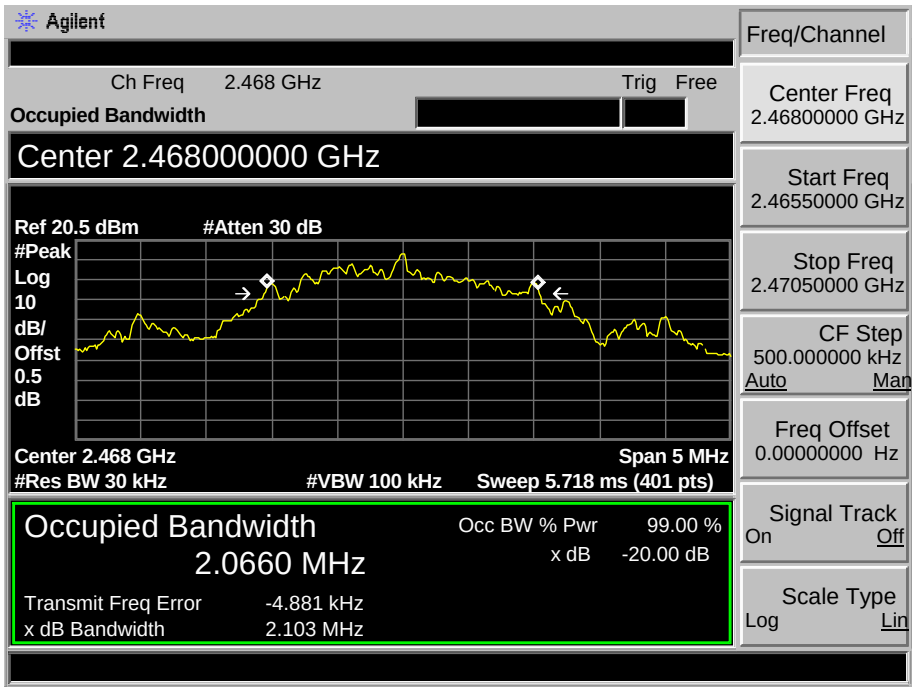
GFSK TX Mode

2439.5 MHz



GFSK TX Mode

2468 MHz



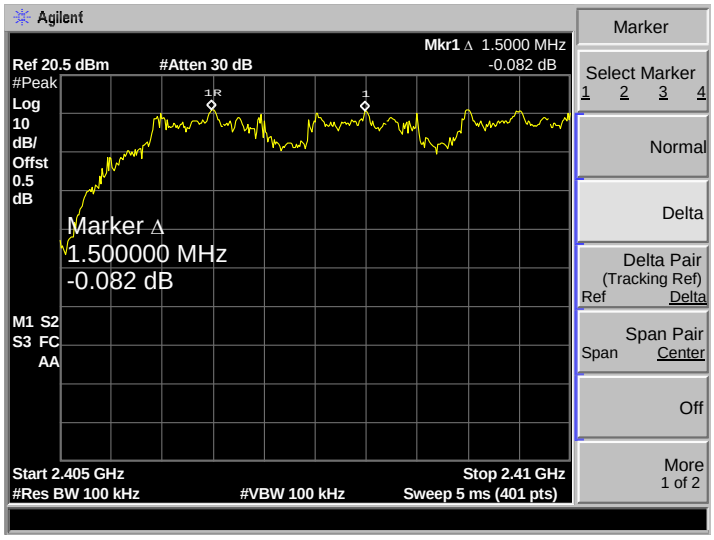
Channel Separation Test data:

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Test Mode:	Hopping Mode (GFSK)		
Remark:	We test all channel and worse case recorded in the report.		

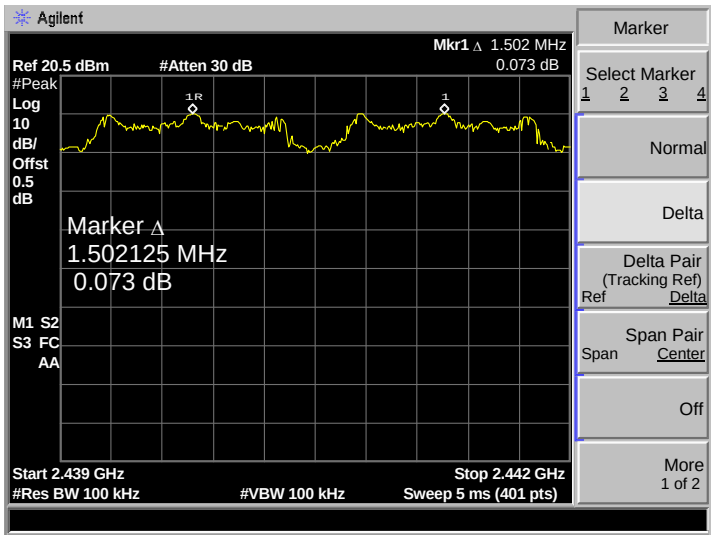
Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit (kHz)
2403.5	1500	1392.00
2439.5	1502	1401.33
2468.0	1500	1402.00

GFSK Hopping Mode

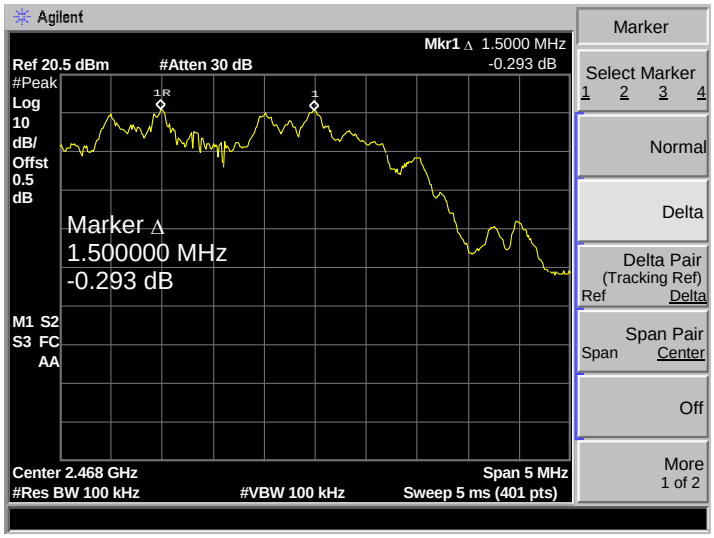
2403.5 MHz



2439.5 MHz



2439.5 MHz


Agilent
Mkr1 Δ 1.5000 MHz
-0.293 dB
Ref 20.5 dBm
#Atten 30 dB
#Peak
Log
10
dB/
Offst
0.5
dB
Marker Δ
1.500000 MHz
-0.293 dB
M1 S2
S3 FC
AA
Center 2.468 GHz
#Res BW 100 kHz
#VBW 100 kHz
Span 5 MHz
Sweep 5 ms (401 pts)
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Delta
Span Pair
Span Center
Off
More
1 of 2

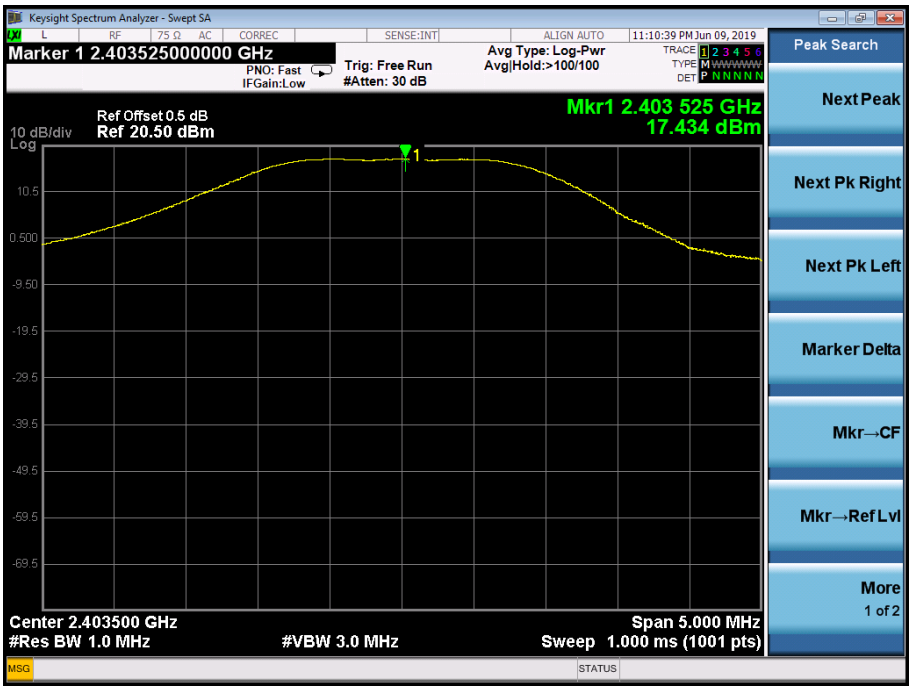
Attachment G-- Peak Output Power Test Data

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Test Mode:	TX Mode (GFSK)		

Channel frequency (MHz)	Test Result (dBm)	Limit (dBm)
2403.5	17.434	**21**
2439.5	17.387	
2468.0	17.125	

GFSK TX Mode

2403.5 MHz

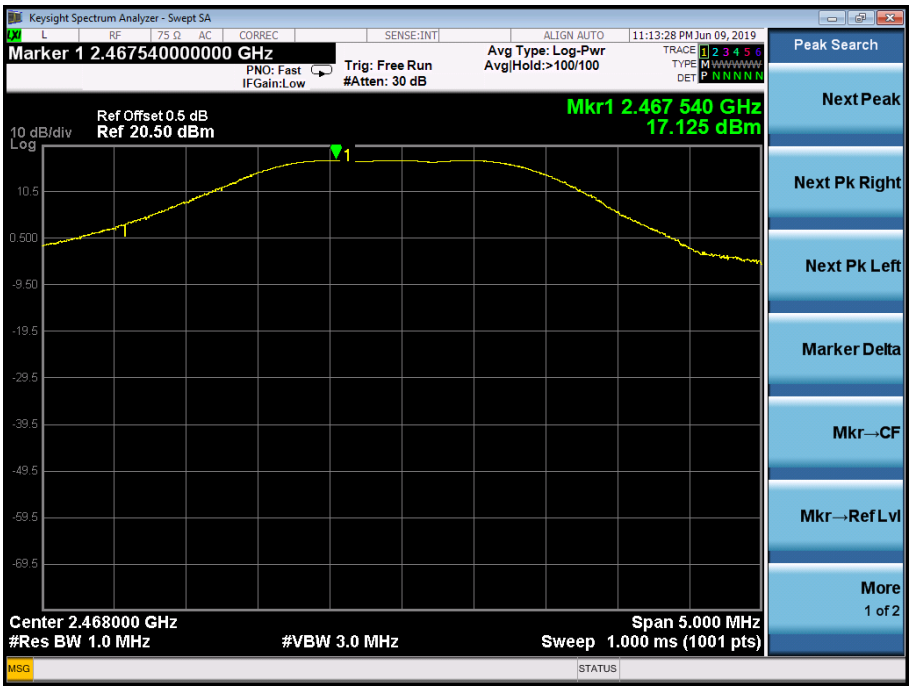


GFSK TX Mode

2439.5 MHz

GFSK TX Mode

2468.0 MHz



-----END OF REPORT-----