FCC Radio Test Report

FCC ID: 2ANZF-TQL-111

Original Grant

Report No.	:	TB-FCC161338
Applicant	:	Shenzhen TQL Technology Co., Ltd
Equipment Under Test (EUT)		
EUT Name	:	T-ONE Smartpen
Model No.	:	TQL-111
Series Model No.	:	TQL-111S , TQL-111W , TQL-111B , TQL-111G , TQL-111RG
Brand Name	:	[illegible]
Receipt Date	:	2018-07-24
Test Date	:	2018-08-07 to 2018-08-17
Issue Date	:	2018-08-20
Standards	:	FCC Part 15: 2017, Subpart C(15.247)
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 Jason Xu
Engineer Supervisor	:	IVAN SU Ivan Su
Engineer Manager	:	Ray Lai Ray Lai

SHENZHEN TOBY TECHNOLOGY CO., LTD. TOBY

This report details the results of the testing carried out on one sample. The result s contained in this test report do not relate to other sample s 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-RF161338 Rev	.01	Initial issue of report	2018-08-20

1. General Information about EUT

1.1 Client Information

Applicant	:	Shenzhen TQL Technology Co., Ltd
Address	:	Room 1202C, Block D, CFG Building, Baoyuan Road, Xixiang, Bao'an District, Shenzhen City, China
Manufacturer	:	Shenzhen TQL Technology Co., Ltd
Address	:	Room 1202C, Block D, CFG Building, Baoyuan Road, Xixiang, Bao'an District, Shenzhen City, China

1.2 General Description of EUT (Equipment Under Test)

EUT Name	:	T-ONE Smartpen	
Models No.	:	TQL-111 , TQL-111S , TQL-111W , TQL-111B , TQL-111G , TQL-111RG	
Model Difference	:	All these models are identical in the same PCB layout and electrical circuit, the only difference is model name, appearance and color for commercial.	
Product Description	:	Operation Frequency:	Bluetooth V4.2: 2402~2480 MHz
		Number of Channel:	Bluetooth: 79 Channels See Note 2
		Max Peak Output Power:	Bluetooth: 1.654 dBm(GFSK)
		Antenna Gain:	2dBi Chip Antenna
		Modulation Type:	GFSK (1 Mbps) π /4-DQPSK (2 Mbps) 8-DPSK (3 Mbps)
Power Rating	:	DC 5.0V 500mAh by USB. DC 3.7V by 260mAh Li-ion battery	
Software Version	:	N/A	
Hardware Version	:	N/A	
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:

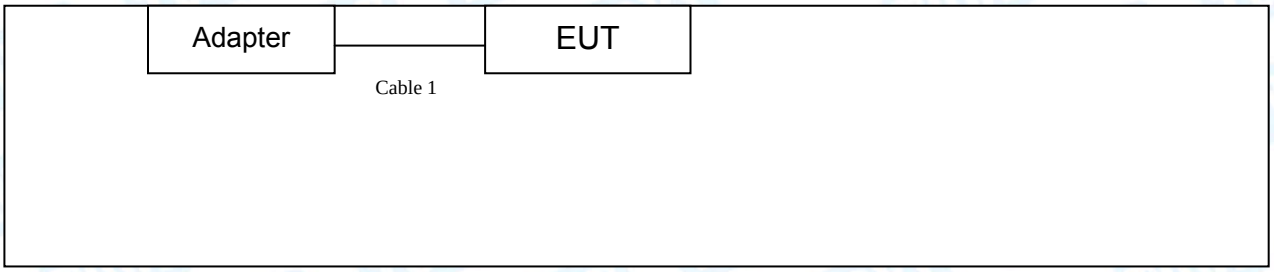
Bluetooth Channel List					
Channel	**Frequency (MHz)**	**Channel**	**Frequency (MHz)**	**Channel**	**Frequency (MHz)**
00	**2402**	27 2429		54 2456	
01 2403		28 2430		55 2457	

02 2404		29 2431		56 2458	
03 2405		30 2432		57 2459	
04 2406		31 2433		58 2460	
05 2407		32 2434		59 2461	
06 2408		33 2435		60 2462	
07 2409		34 2436		61 2463	
08 2410		35 2437		62 2464	
09	2411	36 2438		63 2465	
10 2412		37 2439		64 2466	
11	2413	38 2440		65 2467	
12 2414		**39**	**2441**	66 2468	
13 2415		40 2442		67 2469	
14 2416		41 2443		68 2470	
15 2417		42 2444		69 2471	
16 2418		43 2445		70 2472	
17 2419		44 2446		71 2473	
18 2420		45 2447		72 2474	
19 2421		46 2448		73 2475	
20 2422		47 2449		74 2476	
21 2423		48 2450		75 2477	
22 2424		49 2451		76 2478	
23 2425		50 2452		77 2479	
24 2426	51 2453			**78**	**2480**
25 2427	52 2454				
26 2428	53 2455				

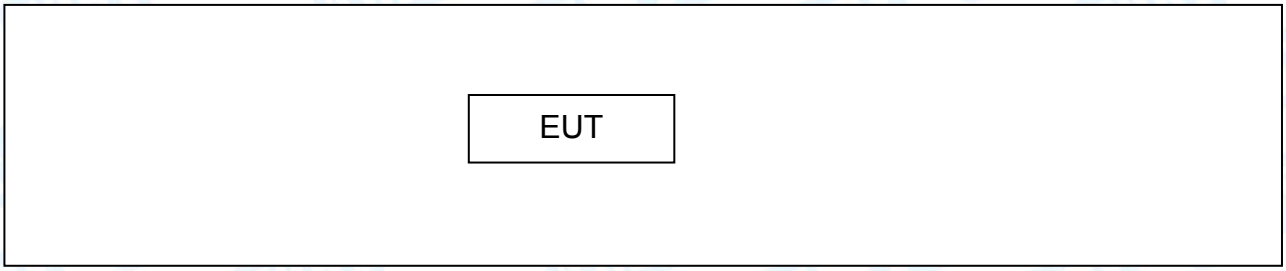
(3) The Antenna information about the equipment is provided by the applicant.

1.3 Block Diagram Showing the Configuration of System Tested

Charging + TX Mode



TX Mode



1.4 Description of Support Units

Equipment Information				
Name	**Model**	**FCC ID/VOC**	**Manufacturer**	**Used "√"**
Adapter BSY02D	050200V	----	BSY	√
Cable Information				
Number	**Shielded Type**	**Ferrite Core**	**Length**	**Note**
Cable 1	YES	NO	1.0M	

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 00/39/78
Mode 3	TX Mode(π/4-DQPSK) Channel 00/39/78
Mode 4	TX Mode(8-DPSK) Channel 00/39/78
Mode 5	Hopping Mode(GFSK)
Mode 6	Hopping Mode(π/4-DQPSK)
Mode 7	Hopping Mode(8-DPSK)

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 Mbps)
TX Mode: π/4-DQPSK (2 Mbps)
TX Mode: 8-DPSK (3Mbps)

(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 dat a of this X-plane was us ed for radiated emission measurement test.

1.6 Description of Test Software Setting

During testing channe l power controlling so ftware provided by the customer was used to control the operating channel as well as the output power le vel. The RF output power selection is for the setting of RF output power expected by t he customer and is going to be fixed on the firmware of the final end product power parameters of Bluetooth mode.

Test Software Version	**BLUETOOL_MI_1.9.2.0.exe**		
Frequency	2402 MHz	2441MHz	2480 MHz
GFSK DEF		DEF	DEF
π/4-DQPSK DEF		DEF	DEF
8-DPSK DEF		DEF	DEF

1.7 Measurement Uncertainty

The reported uncertainty of measurement y ± U, where expended uncertainty U is based on a st andard uncert ainty 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 was performed by the Shenzhe n Toby Technolo gy Co., Ltd., in their facilities located at:1A/F., Bldg.6, Yusheng Industrial Zone, T he Nationa l 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 Competenc e 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 Laborator y Accreditation(A2LA) to ISO/IEC 17025：2005 General Requirements for the Competence of Testing and Calibration Laborat ories for the tec hnical competence in the field of Elec trical Testing. And the A2LA Certificate No.: 4750.01.

IC Registration No.: (11950A-1)
The Labor atory has been regist ered by Certification and Engin eering Bur eau 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 344	03	Jul.18, 2018	Jul. 17, 2019
AMN SCHW	ARZBECK	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 E440	7B	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	Mar.16, 2018	Mar. 15, 2019
Bilog Antenna	ETS-LINDGREN	3142E	00117542	Mar.16, 2018	Mar. 15, 2019
Horn Antenna	ETS-LINDGREN	3117	00143207	Mar.16, 2018	Mar. 15, 2019
Horn Antenna	ETS-LINDGREN	3117	00143209	Mar.16, 2018	Mar. 15, 2019
Loop Antenna	SCHWARZBECK	FMZB 1519 B	1519B-059	Jul. 15, 2018	Jul. 14, 2019
Pre-amplifier Sonom	a	310N	185903	Mar.16, 2018	Mar. 15, 2019
Pre-amplifier HP		8449B	3008A00849	Mar.16, 2018	Mar. 15, 2019
Cable HUBER+SUH	NER	100	SUCOFLEX	Mar.16, 2018	Mar. 15, 2019
Positioning Controller	ETS-LINDGREN 209	0	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	Oct. 26, 2017	Oct. 25, 2018
Vector Signal Generator	Agilent	N5182A	MY50141294	Oct. 26, 2017	Oct. 25, 2018
Analog Signal Generator	Agilent	N5181A	MY50141953	Oct. 26, 2017	Oct. 25, 2018
RF Power Sensor	DARE!! Instruments	RadiPowerRPR3006W	17I00015SNO26	Oct. 26, 2017	Oct. 25, 2018
	DARE!! Instruments	RadiPowerRPR3006W	17I00015SNO29	Oct. 26, 2017	Oct. 25, 2018
	DARE!! Instruments	RadiPowerRPR3006W	17I00015SNO31	Oct. 26, 2017	Oct. 25, 2018
	DARE!! Instruments	RadiPowerRPR3006W	17I00015SNO33	Oct. 26, 2017	Oct. 25, 2018

4. Conducted Emission Test

4.1 Test Standard and Limit

4.1.1T est 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

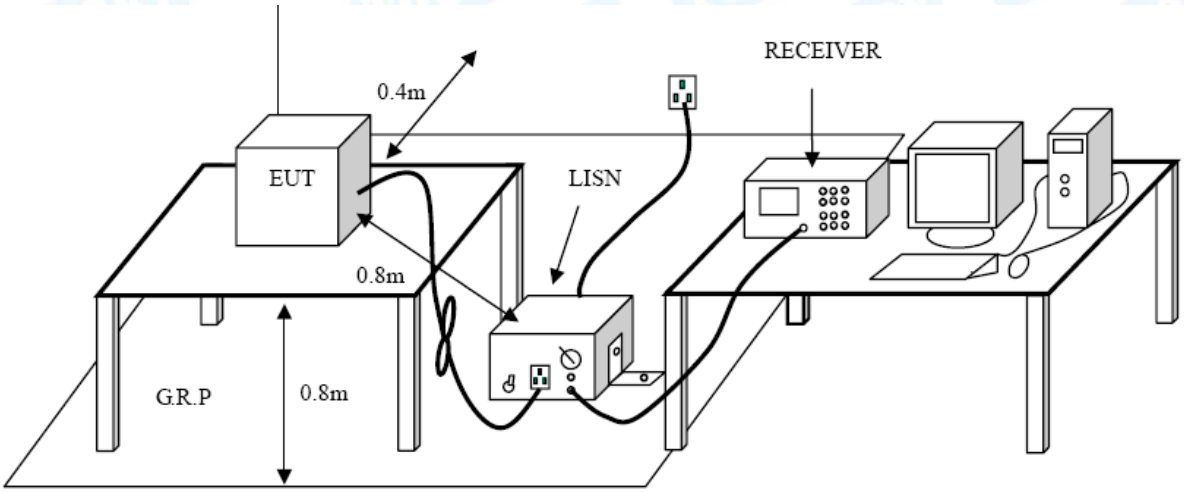
Notes:

(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 logar ithm 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 horizont al ground plane with EUT being connected to the power mains through a line impedanc e stabilization network (LISN). All other support equipment s 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 peripher al 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 bandwid th 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)

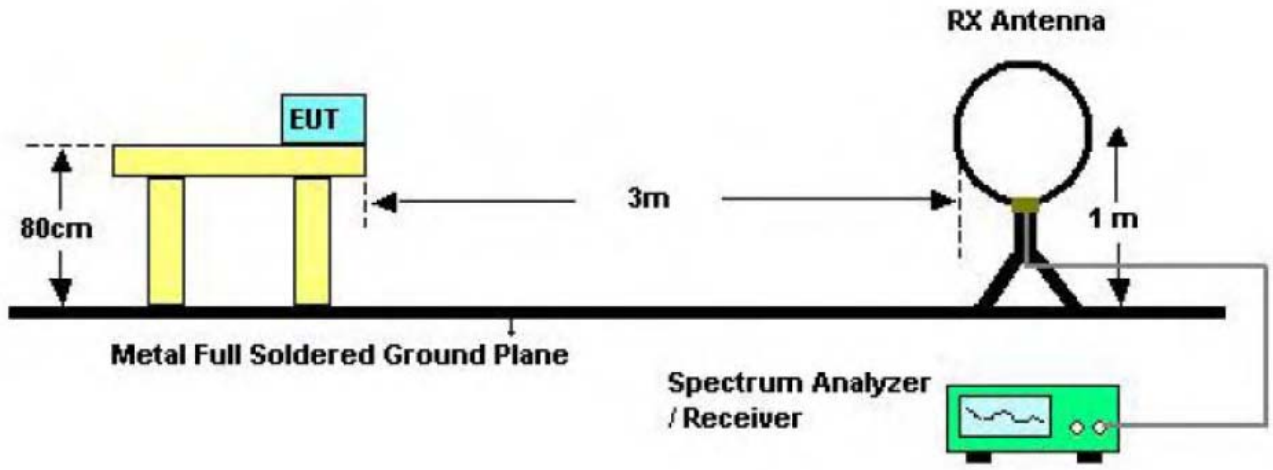
Frequency (MHz	Field Strength (microvolt/meter)	Measurement Distance (meters)
0.009~0.490 2400/F(KHz)		300
0.490~1.705 24000/F(KHz)		30
1.705~30.0 30		30
30~88 100		3
88~216 150		3
216~960 200		3
Above 960	500	3

Radiated Emission Limit (Above 1000MHz)

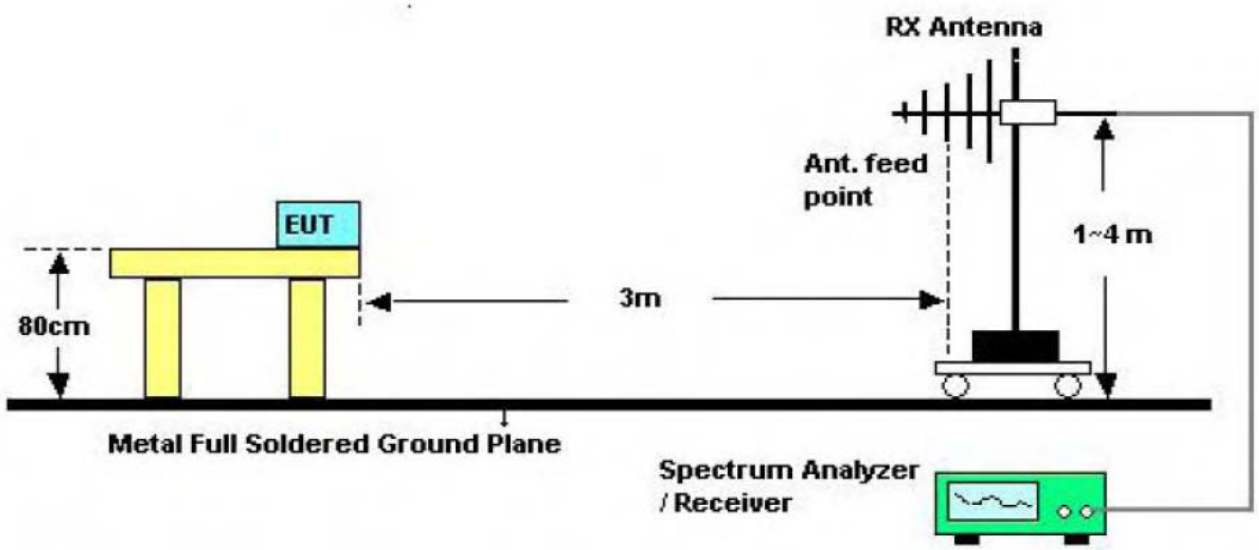
Frequency (MHz)	Class B (dBuV/m)(at 3m)	
	Peak	Average
Above 1000	74	54

Note:
(1) The tighter limit applies at the band edges.
(2) Emission Level (dBuV/m)=20log Emission Level (uV/m)

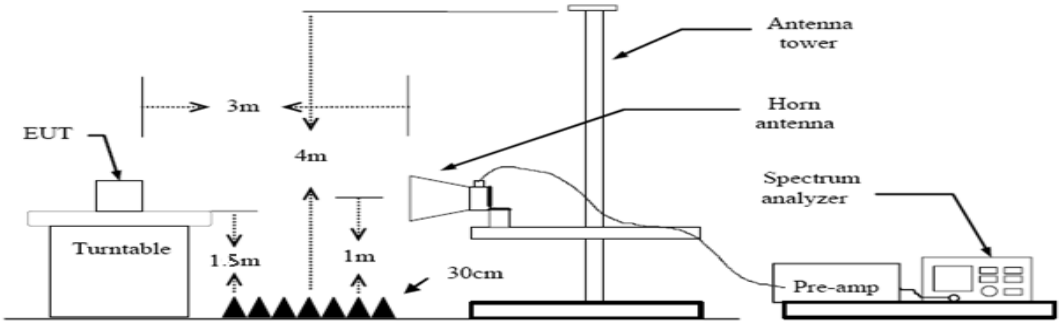
5.2 Test Setup



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 E UT was placed on a rot ating 0.8m high above gr ound, the t able was rotated 360 degrees to determine the position of the highest radiation.

(2) Measurement s at frequency above 1GHz. The EUT was placed on a rot ating 1.5m high above the ground. RF absorbers covered the ground plane with a mi nimum area of 3.0m by 3.0m betw een the EUT and measurement rece iver antenna. The RF absorber shall not exceed 30cm in high above the conducting fl oor. The t able was rot ated 360 degree s to determine the position of the highest radiation.

(3) The Test antenna shall vary between 1m and 4m , Both Horizont al and V ertical antenna are set to make measurement.

(4) The initial step in collect ing conducted emission da ta is a spectrum analyzer peak detector mode pre-scanning the measur ement frequency range. Signi ficant peaks are then marked and then Quasi Peak detector mode re-measured.

(5) If the Peak Mode measured value com pliance wit h and lower than Quasi Peak Mode Limit Bellow 1 GHz, the EUT shall be deemed to m eet QP Limits and then no additional QP Mode measurement performed. But the Peak V alue and a verage value both need to comply with applicable limit above 1 GHz.

(6) T esting frequency range below 1GHz the m easuring instrument use VBW=120 k Hz wit h Quasi-peak detection.

(7) T esting frequency range above 1GHz the m easuring instr ument 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 measur ing instrument use RBW=1 MHz and VBW=3 MHz with Peak Detector for Peak V alues, and use RBW=1 MHz and VBW=10 Hz with Peak Detector for Average Values.

Please refer to the Attachment B.

6. Restricted Bands Requirement

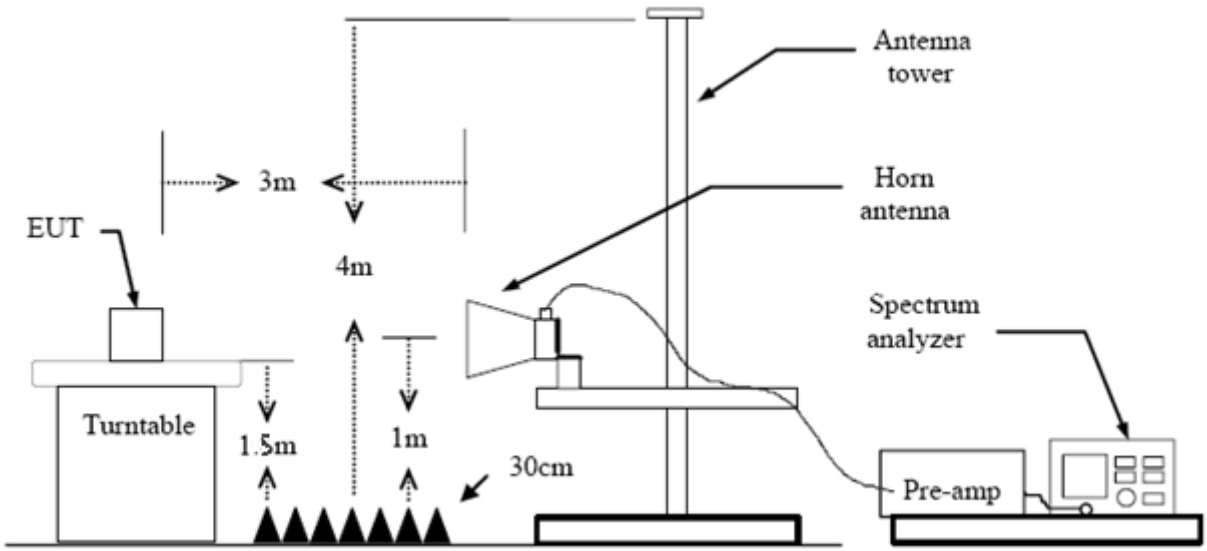
6.1 Test Standard and Limit

6.1.1 Test Standard
FCC Part 15.209
FCC Part 15.205

6.1.2 Test Limit

Restricted Frequency Band (MHz)	Class B (dBuV/m)(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 E UT was placed on a rot ating 0.8m high above ground, the t able was rotated 360 degrees to determine the position of the highest radiation.

(2) Measurement s at frequency above 1GHz. The EUT was placed on a rot ating 1.5m high above the ground. RF absorbers co vered the ground plane with a mi nimum area of 3.0m by 3.0m betw een the EUT and measurement rece iver antenna. The RF absorber shall not exceed 30cm in high above the conducting fl oor. The t able was rot ated 360 degree s 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.

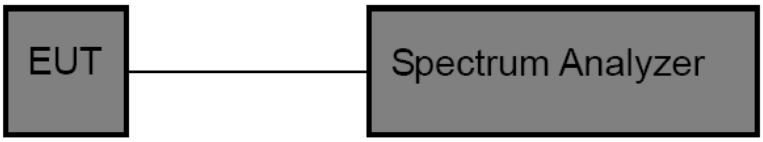
7. Number of Hopping Channel

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 spec trum analyzer and antenna ou tput 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

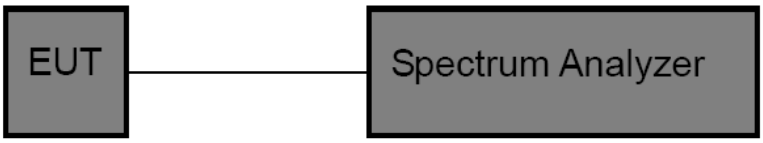
8.1 Test Standard and Limit

8.1.1 Test Standard
FCC Part 15.247 (a)(1)

8.1.2 Test Limit

Section	Test Item	Limit
15.247(a)(1)/ RSS-210 Annex 8(A8.1d)	Average Time of Occupancy	0.4 sec

8.2 Test Setup



8.3 Test Procedure

(1) The EUT was directly connected to the spec trum analyzer and antenna ou tput port as show in the block diagram above.
(2) Spectrum Setting: RBW=1MHz, VBW=1MHz.
(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:
{Total of Dwell} = {Pulse Time} * (1600 / X) / {Number of Hopping Frequency} * {Period}
{Period} = 0.4s * {Number of Hopping Frequency}

Note: X=2 or 4 or 6 (1DH1=2, 1DH3=4, 1DH5=6. 2DH1=2, 2DH3=4, 2DH5=6. 3DH1=2, 3DH3=4, 3DH5=6)

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

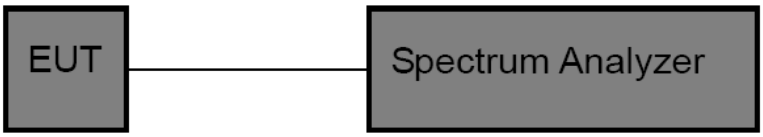
9.1 Test Standard and Limit

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 spec trum analyzer and antenna ou tput 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 am plitude signal observed from the transmitter at the fundament al frequency . Once the referenc e level is est ablished, the equipment is conditioned with typical modulat ing signal to produce the worst –case (i.e the wid est) 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

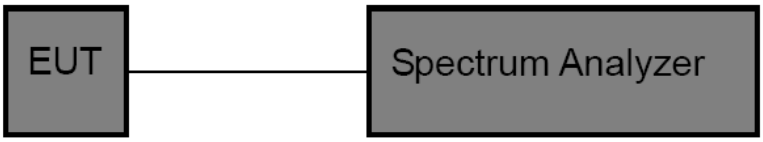
10.1.1 Test Standard

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 spec trum analyzer and antenna ou tput 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

1 1.1.1 Standard
FCC Part 15.203

1 1.1.2 Requirement
An intentional radiator s hall be designed to ensure that no antenna other than that furnished by the responsible p arty sha ll be used with the device. The use of a permanently att ached antenna or of an antenna that uses a unique coupling to the intentional radiator s hall be c onsidered sufficient to comp ly with the provisio ns of this Section. T he manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a st andard 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 att achment and no consideration of replacement. Please see the EUT photo for details.

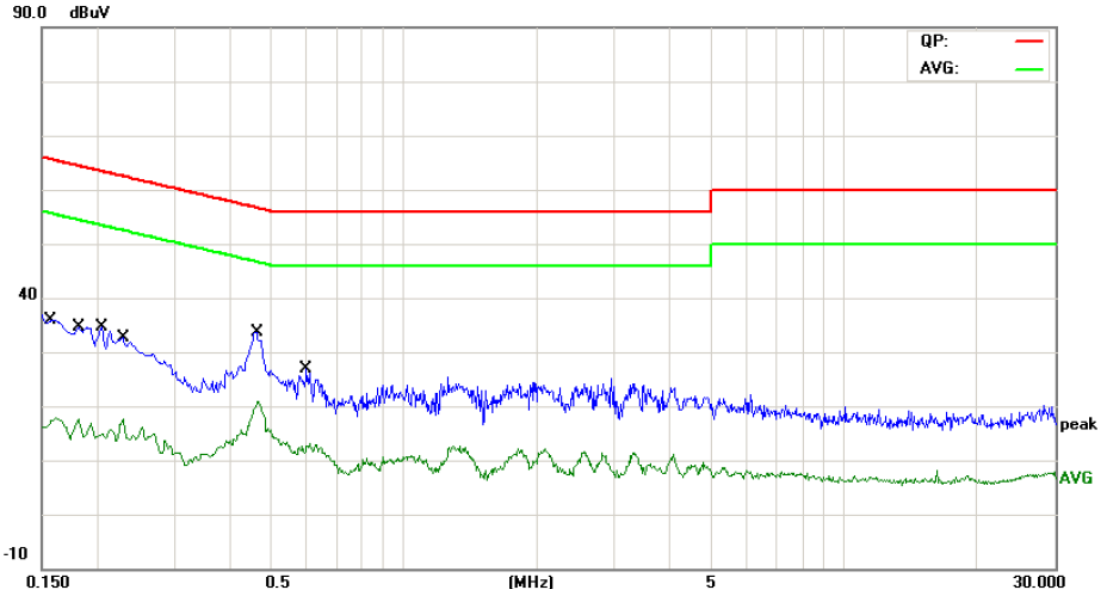
11.3 Result

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

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

Attachment A-- Conducted Emission Test Data

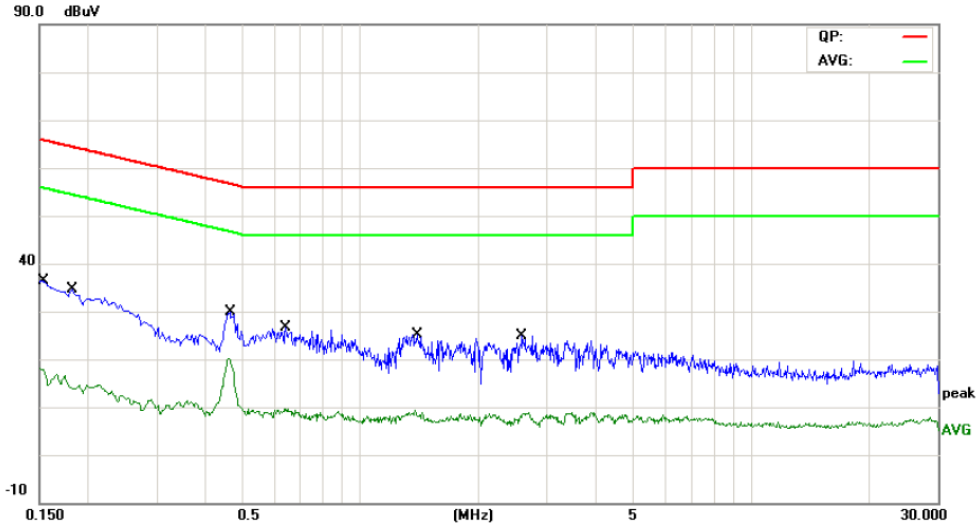
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60 Hz		
Terminal:	Line		
Test Mode:	USB Charging Mode		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.1580	23.02	9.58	32.60	65.56	-32.96	QP
2		0.1580	5.47	9.58	15.05	55.56	-40.51	AVG
3		0.1819	19.72	9.58	29.30	64.39	-35.09	QP
4		0.1819	2.94	9.58	12.52	54.39	-41.87	AVG
5		0.2060	19.38	9.58	28.96	63.36	-34.40	QP
6		0.2060	4.48	9.58	14.06	53.36	-39.30	AVG
7		0.2300	18.69	9.58	28.27	62.45	-34.18	QP
8		0.2300	5.75	9.58	15.33	52.45	-37.12	AVG
9		0.4620	19.92	9.60	29.52	56.66	-27.14	QP
10	*	0.4620	10.24	9.60	19.84	46.66	-26.82	AVG
11		0.5980	8.88	9.60	18.48	56.00	-37.52	QP
12		0.5980	1.47	9.60	11.07	46.00	-34.93	AVG

Emission Level= Read Level+ Correct Factor

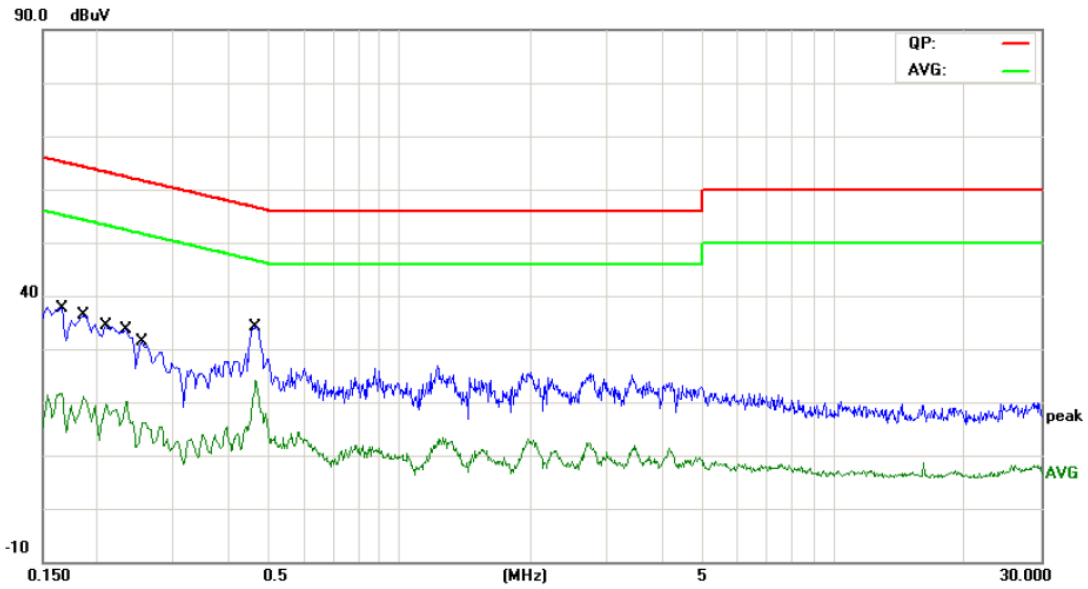
Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	AC 120V/60 Hz		
Terminal:	Neutral		
Test Mode:	USB Charging Mode		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.1539	21.98	9.64	31.62	65.78	-34.16	QP
2		0.1539	3.88	9.64	13.52	55.78	-42.26	AVG
3		0.1819	20.14	9.65	29.79	64.39	-34.60	QP
4		0.1819	2.82	9.65	12.47	54.39	-41.92	AVG
5		0.4620	15.88	9.58	25.46	56.66	-31.20	QP
6	*	0.4620	10.08	9.58	19.66	46.66	-27.00	AVG
7		0.6419	10.86	9.59	20.45	56.00	-35.55	QP
8		0.6419	-1.41	9.59	8.18	46.00	-37.82	AVG
9		1.3900	8.80	9.60	18.40	56.00	-37.60	QP
10		1.3900	-2.17	9.60	7.43	46.00	-38.57	AVG
11		2.5900	6.53	9.64	16.17	56.00	-39.83	QP
12		2.5900	-2.85	9.64	6.79	46.00	-39.21	AVG

Emission Level= Read Level+ Correct Factor

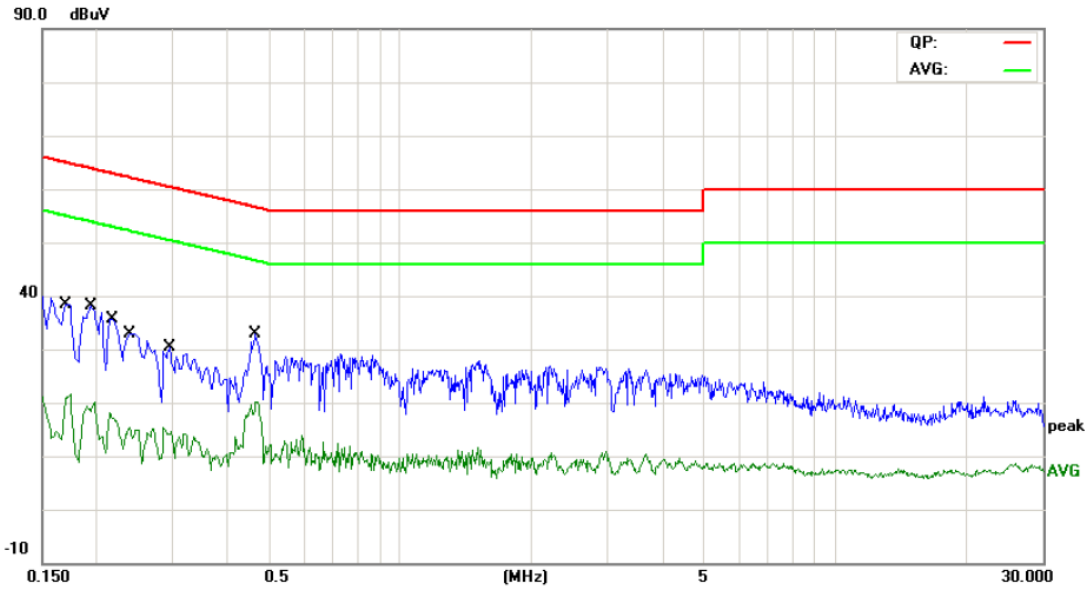
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 240V/60 Hz		
Terminal:	Line		
Test Mode:	USB Charging Mode		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.1660	22.54	9.58	32.12	65.15	-33.03	QP
2		0.1660	4.70	9.58	14.28	55.15	-40.87	AVG
3		0.1860	20.49	9.58	30.07	64.21	-34.14	QP
4		0.1860	2.89	9.58	12.47	54.21	-41.74	AVG
5		0.2100	20.61	9.58	30.19	63.20	-33.01	QP
6		0.2100	5.19	9.58	14.77	53.20	-38.43	AVG
7		0.2340	19.89	9.58	29.47	62.30	-32.83	QP
8		0.2340	6.60	9.58	16.18	52.30	-36.12	AVG
9		0.2540	18.15	9.59	27.74	61.62	-33.88	QP
10		0.2540	5.39	9.59	14.98	51.62	-36.64	AVG
11		0.4660	20.70	9.60	30.30	56.58	-26.28	QP
12	*	0.4660	11.25	9.60	20.85	46.58	-25.73	AVG

Emission Level= Read Level+ Correct Factor

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 240V/60 Hz		
Terminal:	Neutral		
Test Mode:	USB Charging Mode		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.1700	24.63	9.64	34.27	64.96	-30.69	QP
2		0.1700	6.91	9.64	16.55	54.96	-38.41	AVG
3		0.1940	22.68	9.65	32.33	63.86	-31.53	QP
4		0.1940	4.92	9.65	14.57	53.86	-39.29	AVG
5		0.2180	19.89	9.64	29.53	62.89	-33.36	QP
6		0.2180	2.85	9.64	12.49	52.89	-40.40	AVG
7		0.2380	21.37	9.62	30.99	62.16	-31.17	QP
8		0.2380	4.92	9.62	14.54	52.16	-37.62	AVG
9		0.2940	10.15	9.57	19.72	60.41	-40.69	QP
10		0.2940	-2.29	9.57	7.28	50.41	-43.13	AVG
11	*	0.4660	18.96	9.58	28.54	56.58	-28.04	QP
12		0.4660	8.84	9.58	18.42	46.58	-28.16	AVG

Emission Level= Read Level+ Correct Factor

Attachment B-- Radiated Emission Test Data

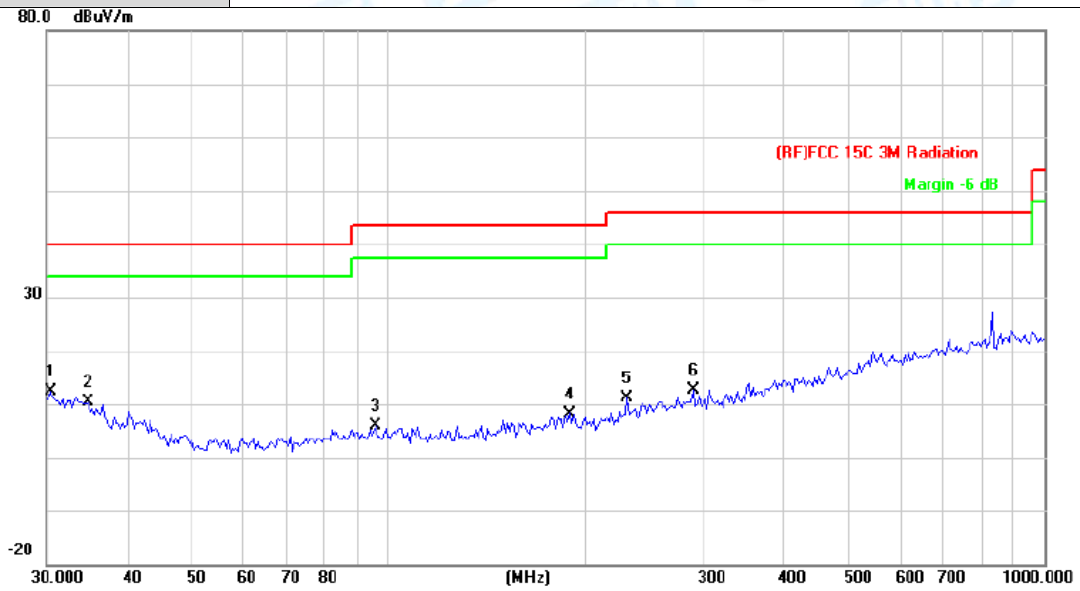
9KHz~30MHz

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:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2402MHz		
Remark:	Only worse case is reported		

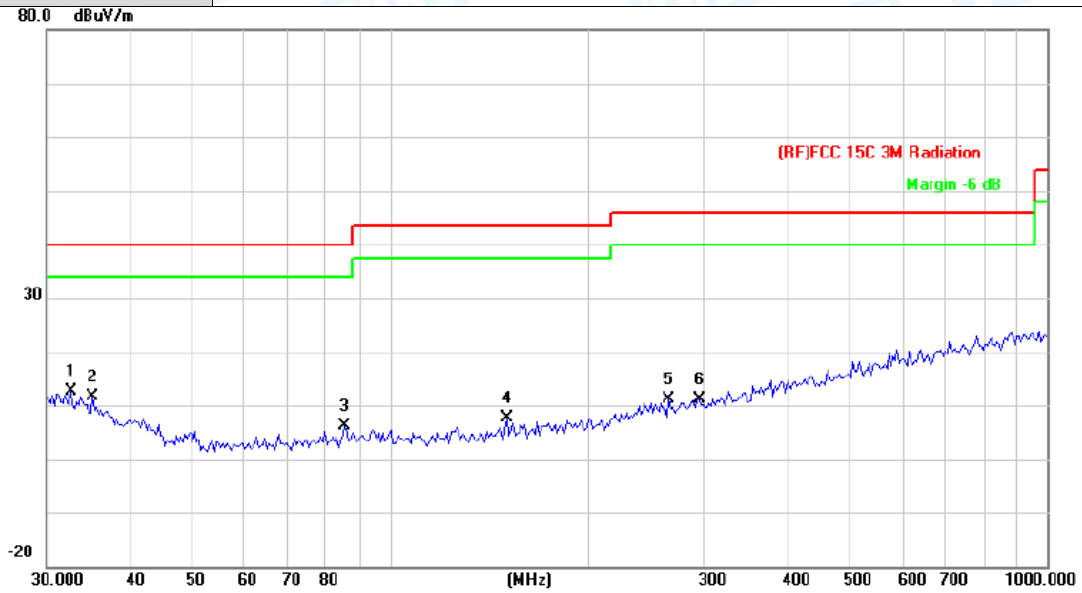


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	30.4238	25.72	-13.32	12.40	40.00	-27.60	peak
2		34.7602	26.94	-16.57	10.37	40.00	-29.63	peak
3		95.4270	27.97	-22.04	5.93	43.50	-37.57	peak
4		188.4125	28.13	-19.88	8.25	43.50	-35.25	peak
5		230.9068	29.28	-18.24	11.04	46.00	-34.96	peak
6		291.0360	29.00	-16.37	12.63	46.00	-33.37	peak

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

Emission Level= Read Level+ Correct Factor

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2402MHz		
Remark:	Only worse case is reported		



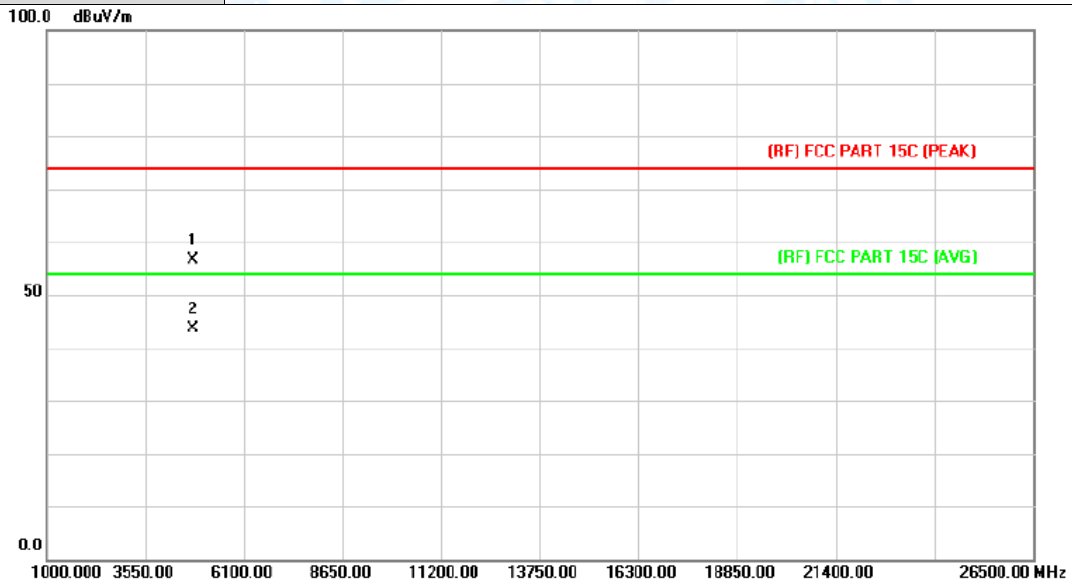
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	32.6340	27.67	-14.98	12.69	40.00	-27.31	peak
2		35.2512	28.48	-16.87	11.61	40.00	-28.39	peak
3		85.2980	28.27	-22.24	6.03	40.00	-33.97	peak
4		150.5378	28.91	-21.39	7.52	43.50	-35.98	peak
5		265.6757	27.91	-16.87	11.04	46.00	-34.96	peak
6		295.1469	27.48	-16.30	11.18	46.00	-34.82	peak

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

Emission Level= Read Level+ Correct Factor

Above 1GHz(Only worse case is reported)

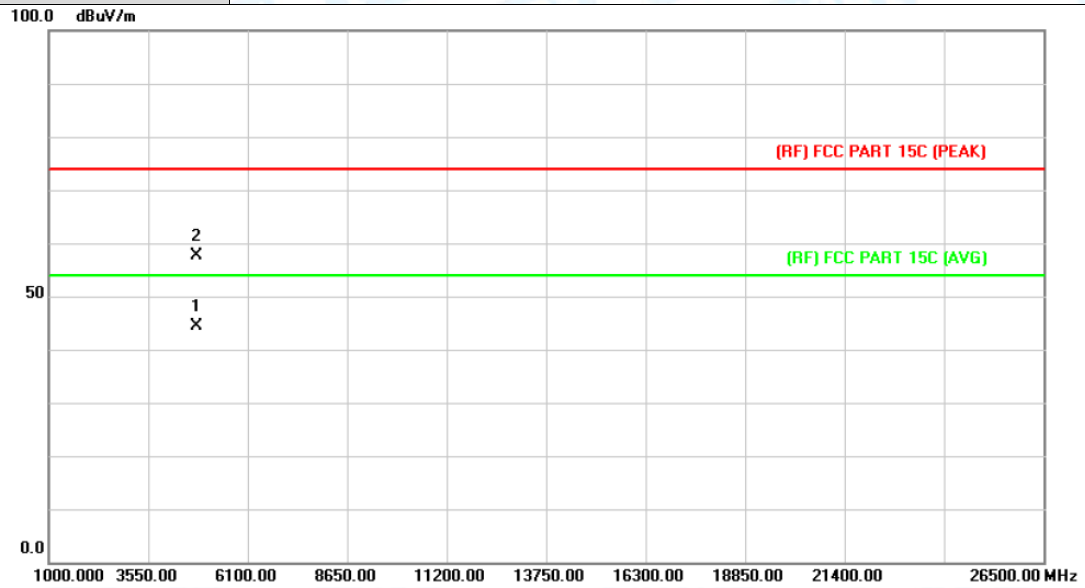
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2402MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4802.500	42.21	14.42	56.63	74.00	-17.37	peak
2		4802.500	29.19	14.42	43.61	54.00	-10.39	AVG

Emission Level= Read Level+ Correct Factor

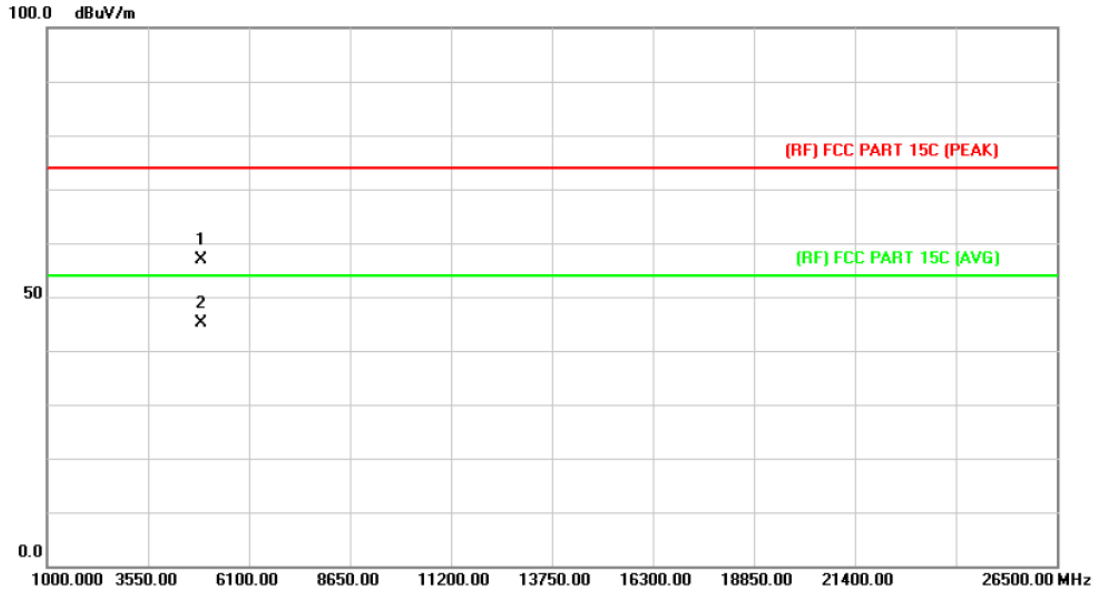
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2402MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4804.426	30.02	14.43	44.45	54.00	-9.55	AVG
2		4804.600	43.29	14.44	57.73	74.00	-16.27	peak

Emission Level= Read Level+ Correct Factor

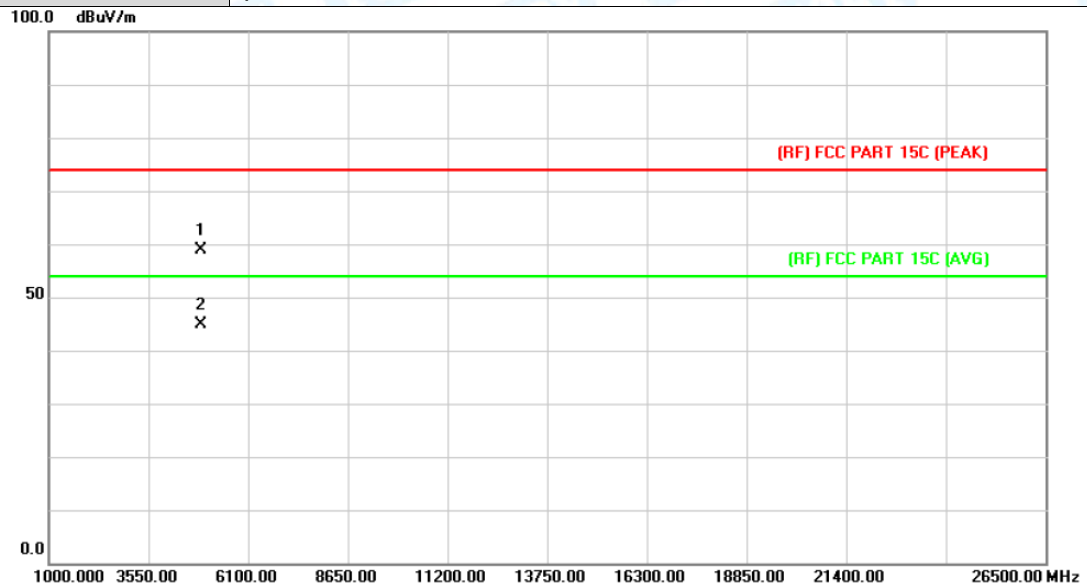
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2441MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4880.500	42.08	14.89	56.97	74.00	-17.03	peak
2	*	4883.314	30.30	14.91	45.21	54.00	-8.79	AVG

Emission Level= Read Level+ Correct Factor

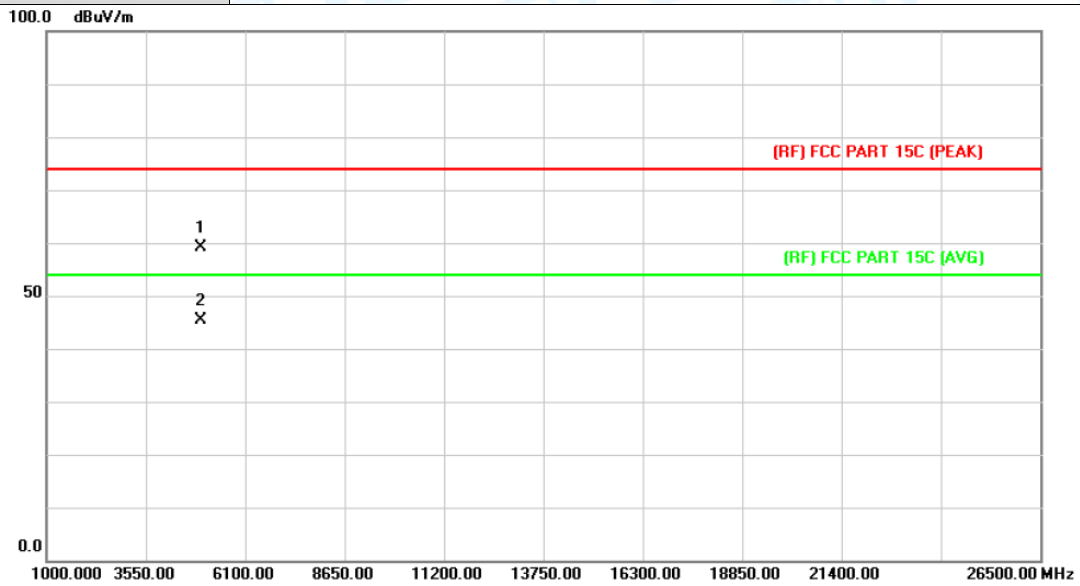
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2441MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4881.928	44.00	14.91	58.91	74.00	-15.09	peak
2	*	4881.928	29.88	14.91	44.79	54.00	-9.21	AVG

Emission Level= Read Level+ Correct Factor

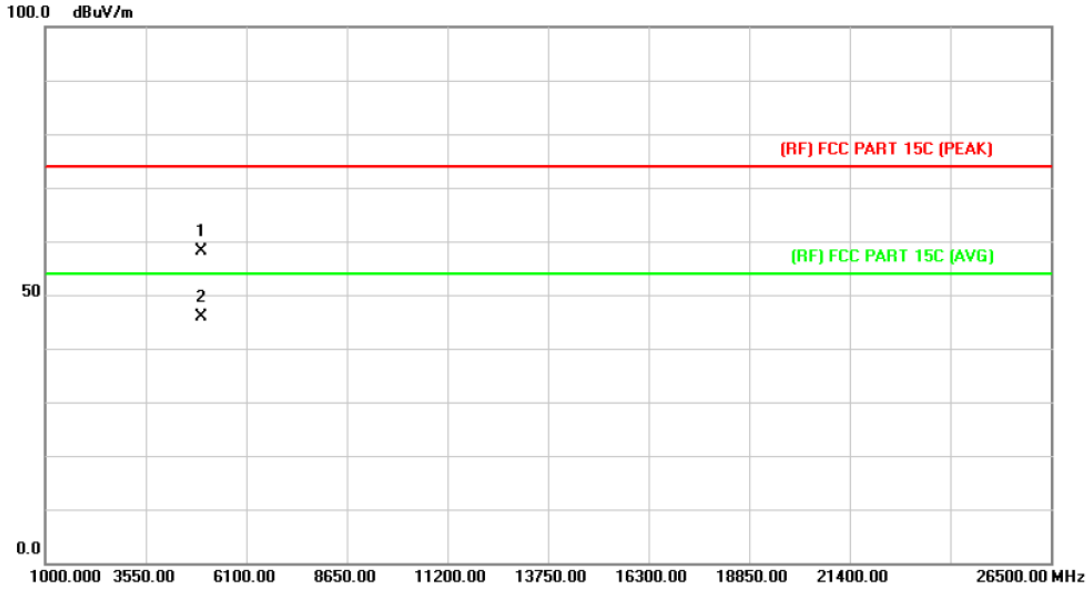
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2480MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4959.316	43.74	15.39	59.13	74.00	-14.87	peak
2	*	4959.316	29.94	15.39	45.33	54.00	-8.67	AVG

Emission Level= Read Level+ Correct Factor

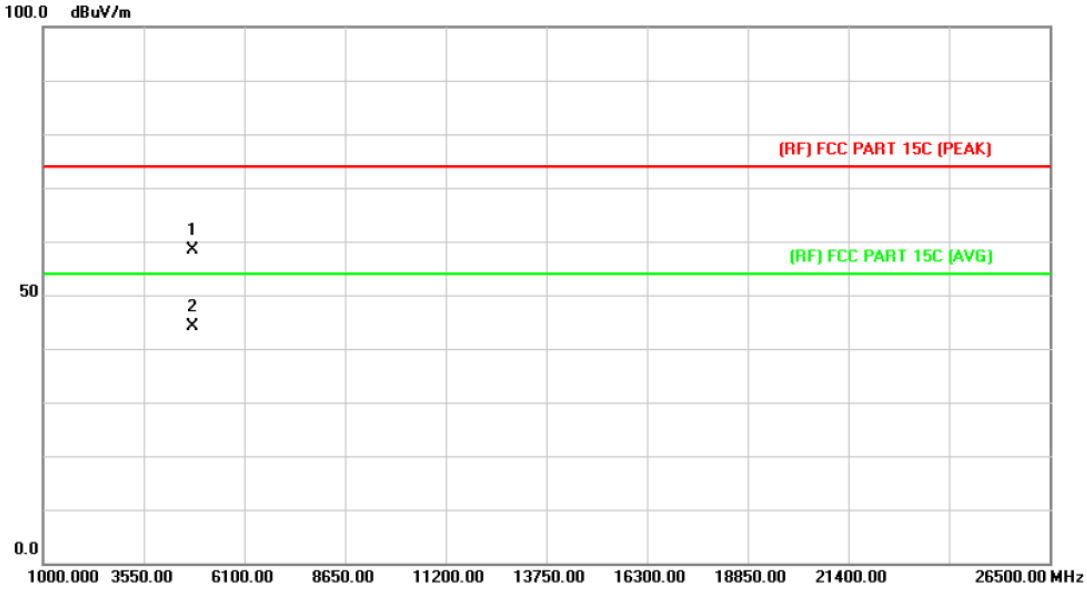
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2480MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4960.090	42.82	15.39	58.21	74.00	-15.79	peak
2	*	4960.090	30.47	15.39	45.86	54.00	-8.14	AVG

Emission Level= Read Level+ Correct Factor

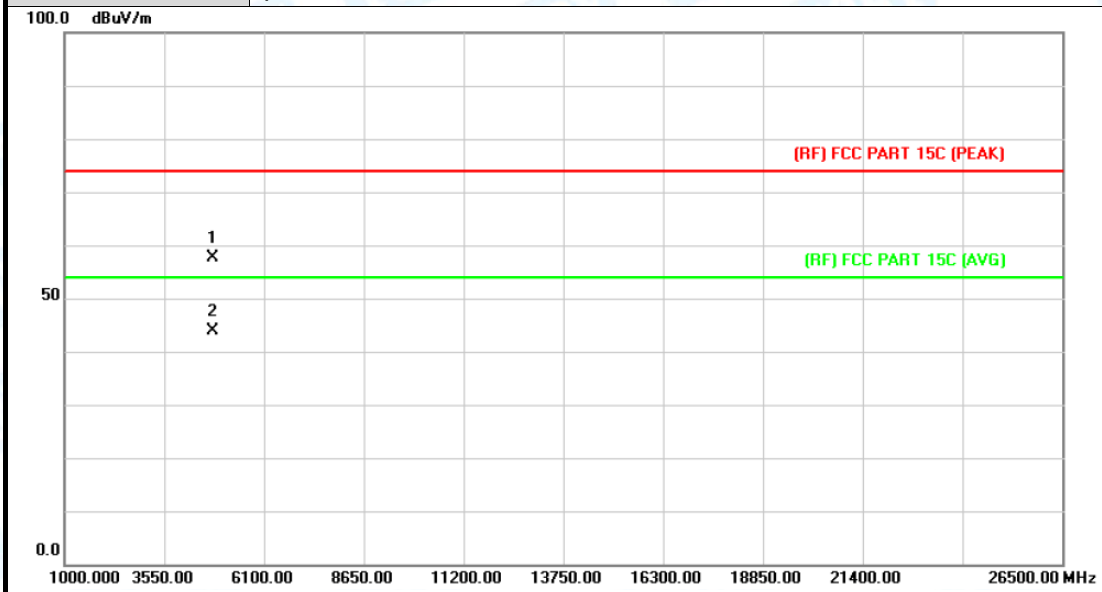
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX π /4-DQPSK Mode 2402MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4804.192	43.84	14.43	58.27	74.00	-15.73	peak
2	*	4805.500	29.75	14.44	44.19	54.00	-9.81	AVG

Emission Level= Read Level+ Correct Factor

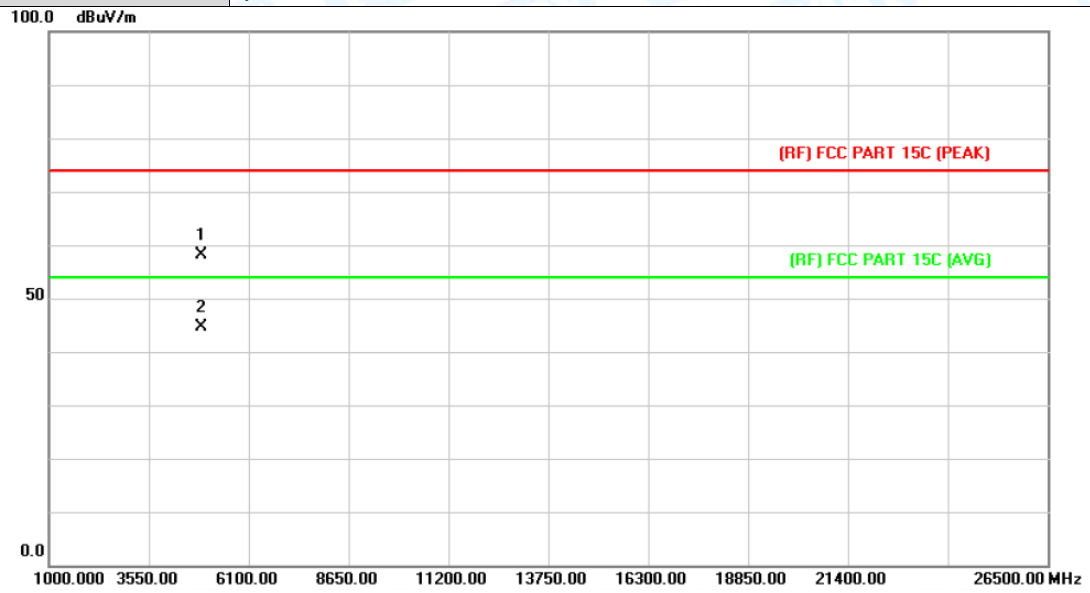
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX π /4-DQPSK Mode 2402MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4804.624	43.31	14.44	57.75	74.00	-16.25	peak
2	*	4804.624	29.46	14.44	43.90	54.00	-10.10	AVG

Emission Level= Read Level+ Correct Factor

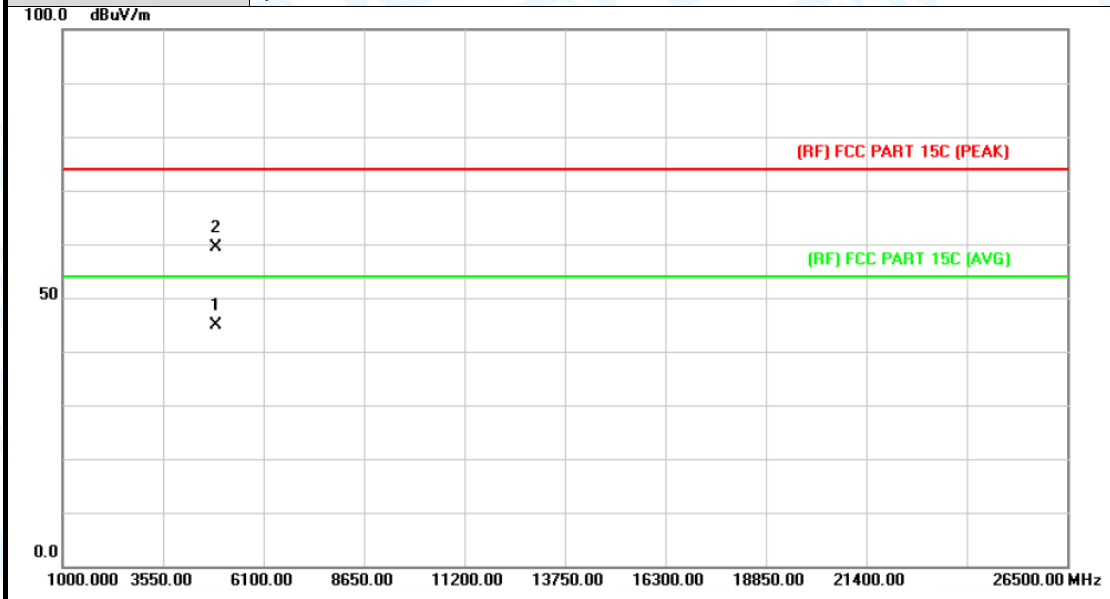
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX π /4-DQPSK Mode 2441MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4881.178	43.31	14.91	58.22	74.00	-15.78	peak
2	*	4881.178	29.74	14.91	44.65	54.00	-9.35	AVG

Emission Level= Read Level+ Correct Factor

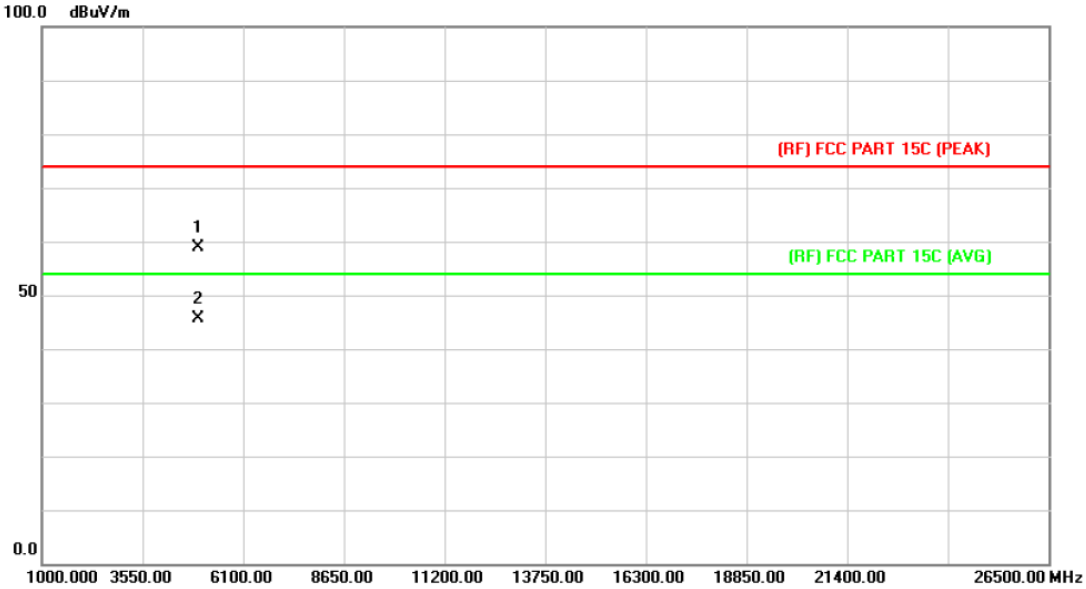
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX π /4-DQPSK Mode 2441MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4880.500	29.99	14.89	44.88	54.00	-9.12	AVG
2		4881.088	44.47	14.91	59.38	74.00	-14.62	peak

Emission Level= Read Level+ Correct Factor

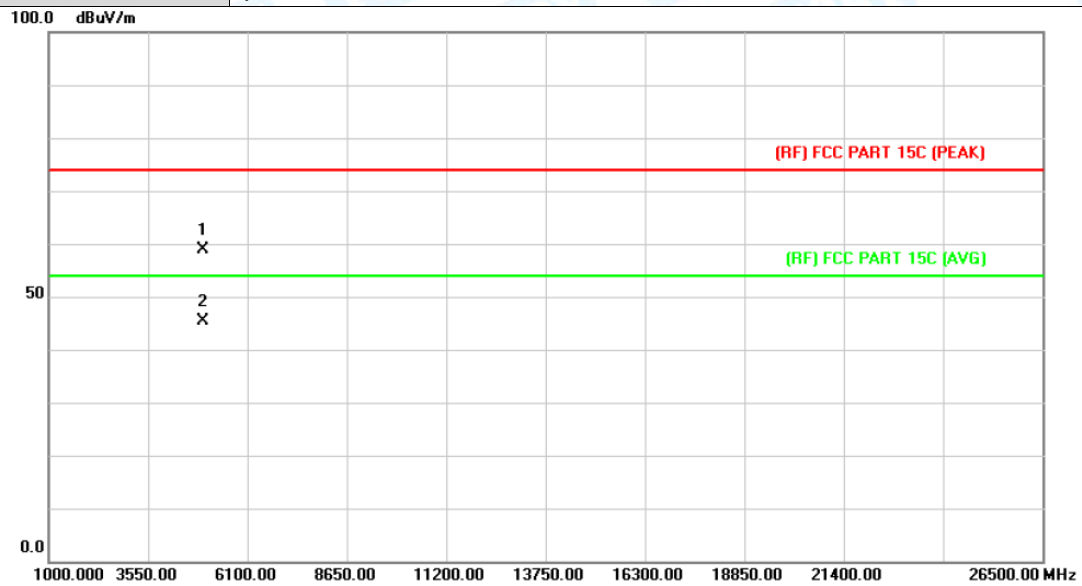
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX π /4-DQPSK Mode 2480MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4959.322	43.59	15.39	58.98	74.00	-15.02	peak
2	*	4961.392	30.35	15.40	45.75	54.00	-8.25	AVG

Emission Level= Read Level+ Correct Factor

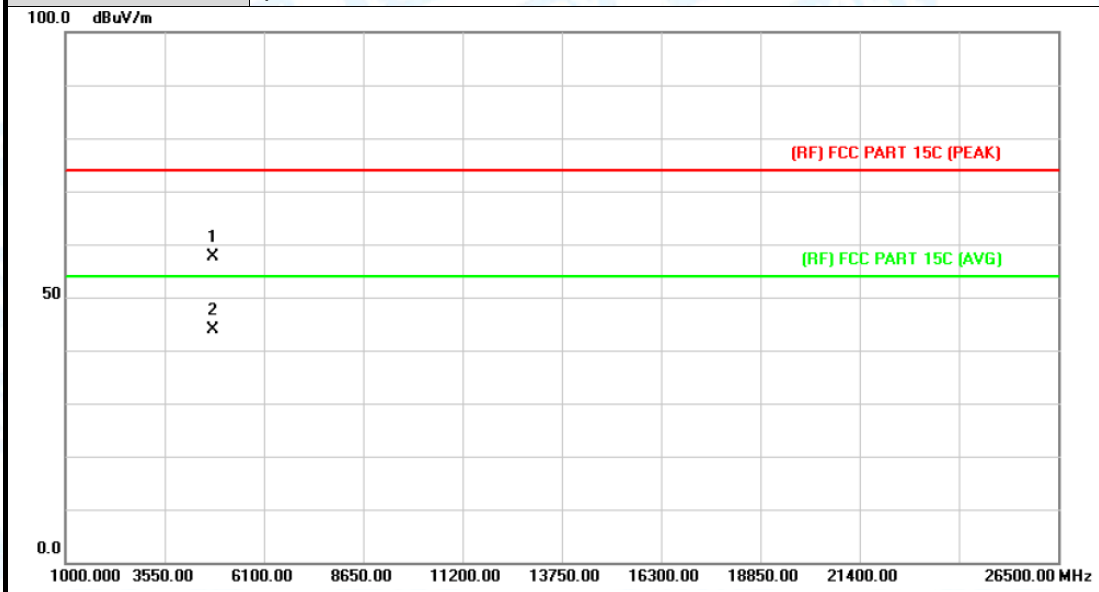
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX π /4-DQPSK Mode 2480MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4960.972	43.45	15.40	58.85	74.00	-15.15	peak
2	*	4960.972	29.99	15.40	45.39	54.00	-8.61	AVG

Emission Level= Read Level+ Correct Factor

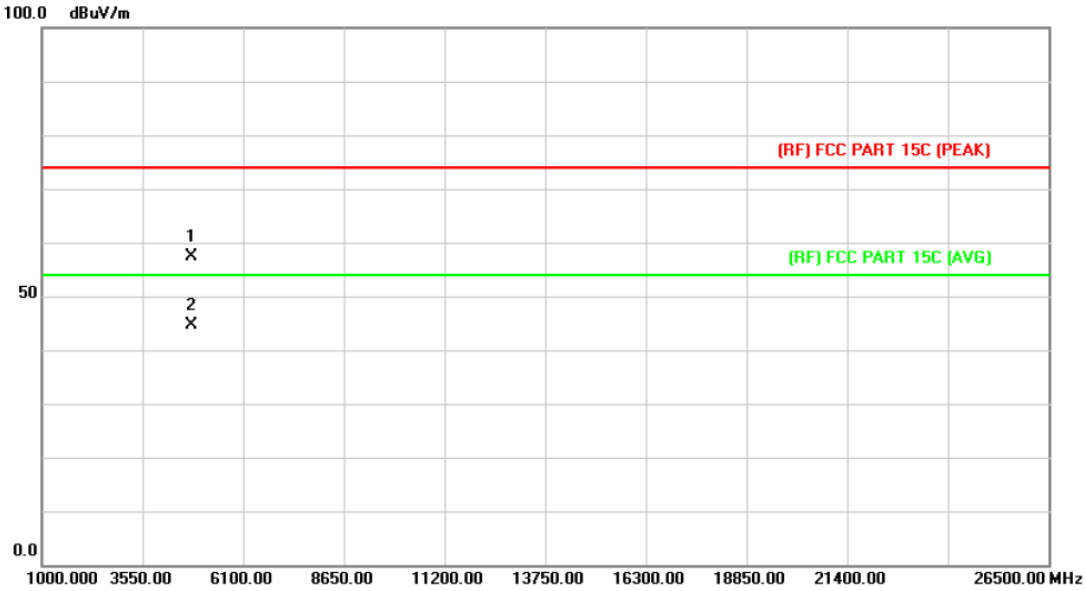
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX 8-DPSK Mode 2402MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4804.606	43.23	14.44	57.67	74.00	-16.33	peak
2	*	4804.606	29.41	14.44	43.85	54.00	-10.15	AVG

Emission Level= Read Level+ Correct Factor

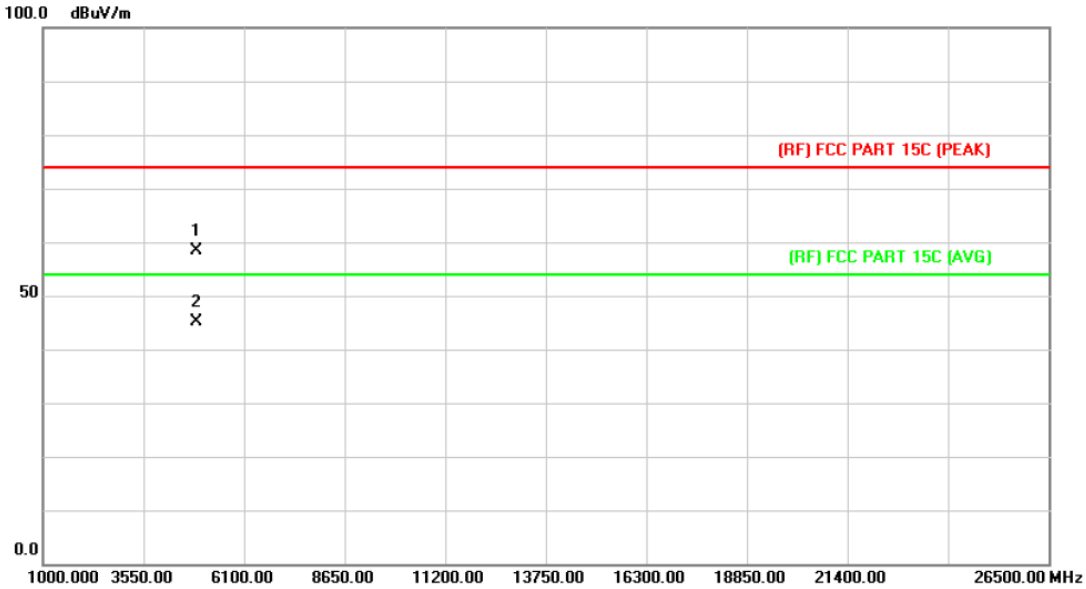
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX 8-DPSK Mode 2402MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4803.460	43.05	14.43	57.48	74.00	-16.52	peak
2	*	4804.264	30.23	14.43	44.66	54.00	-9.34	AVG

Emission Level= Read Level+ Correct Factor

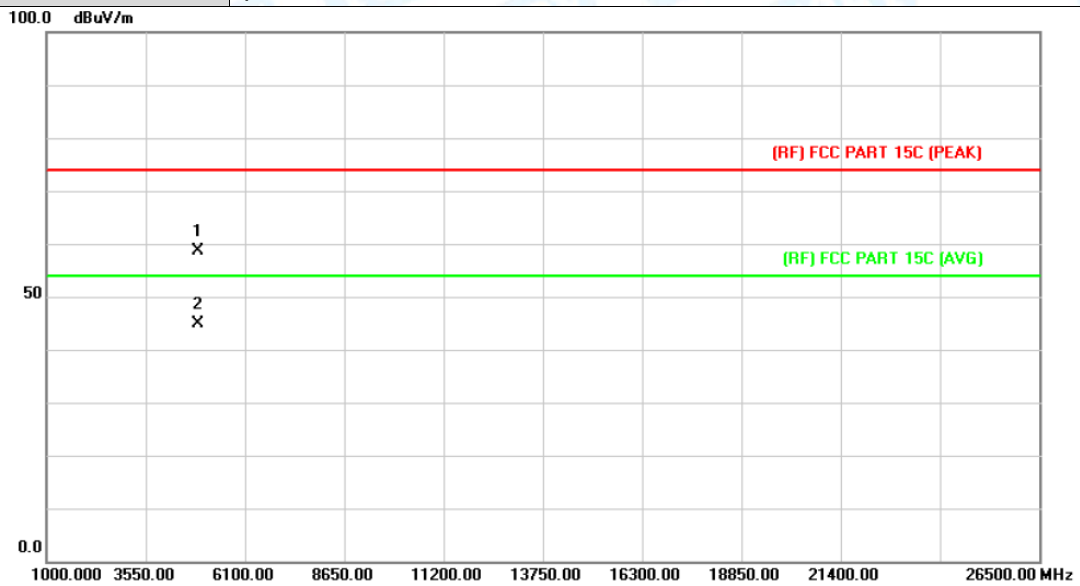
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX 8-DPSK Mode 2441MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4881.130	43.45	14.91	58.36	74.00	-15.64	peak
2	*	4882.186	30.28	14.91	45.19	54.00	-8.81	AVG

Emission Level= Read Level+ Correct Factor

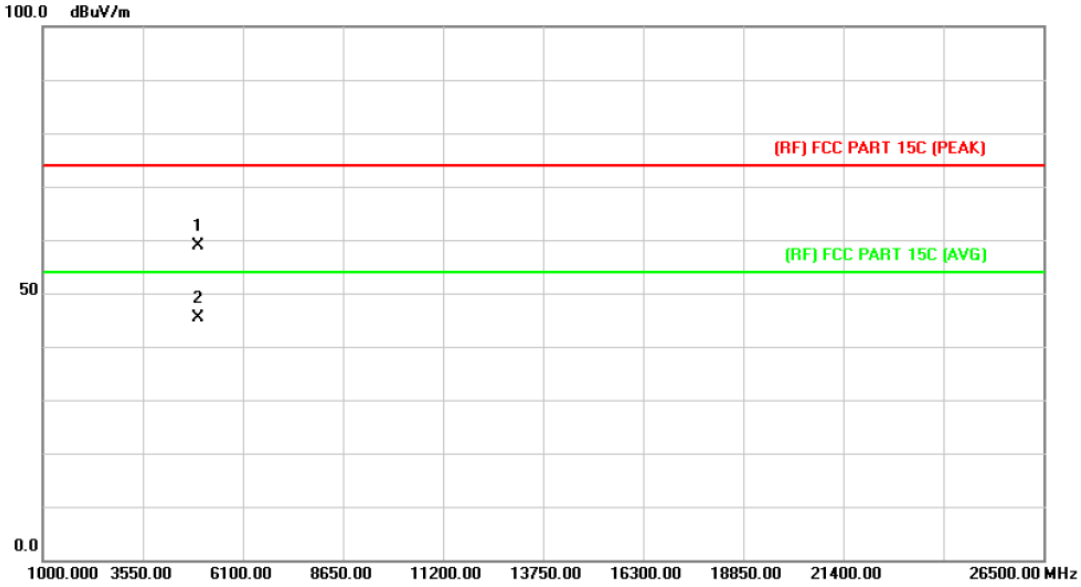
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX 8-DPSK Mode 2441MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4881.172	43.75	14.91	58.66	74.00	-15.34	peak
2	*	4881.172	29.96	14.91	44.87	54.00	-9.13	AVG

Emission Level= Read Level+ Correct Factor

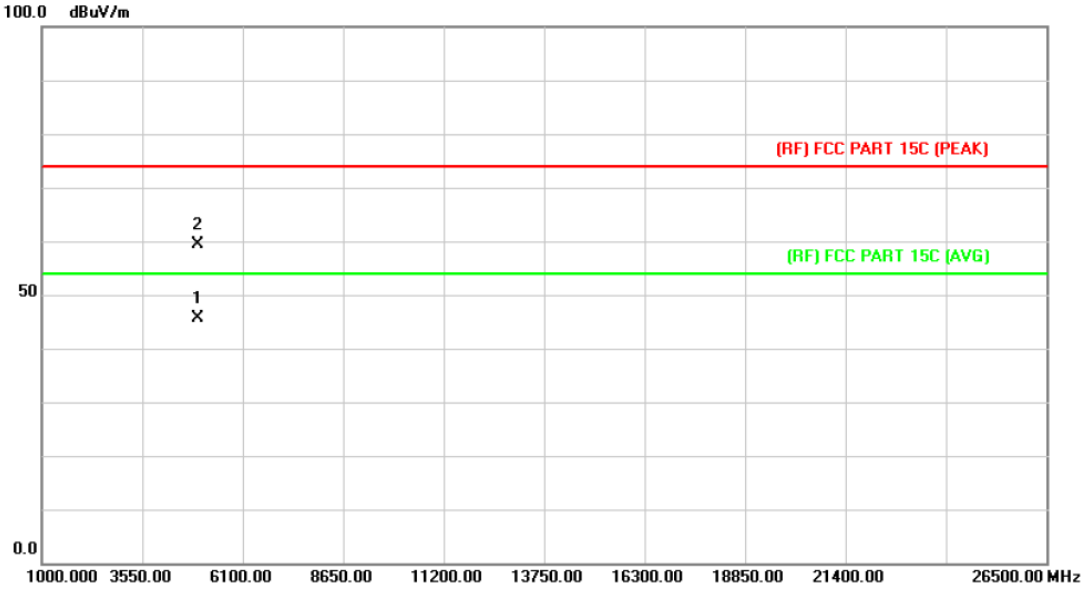
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX 8-DPSK Mode 2480MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4960.456	43.60	15.40	59.00	74.00	-15.00	peak
2	*	4960.456	30.05	15.40	45.45	54.00	-8.55	AVG

Emission Level= Read Level+ Correct Factor

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX 8-DPSK Mode 2480MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



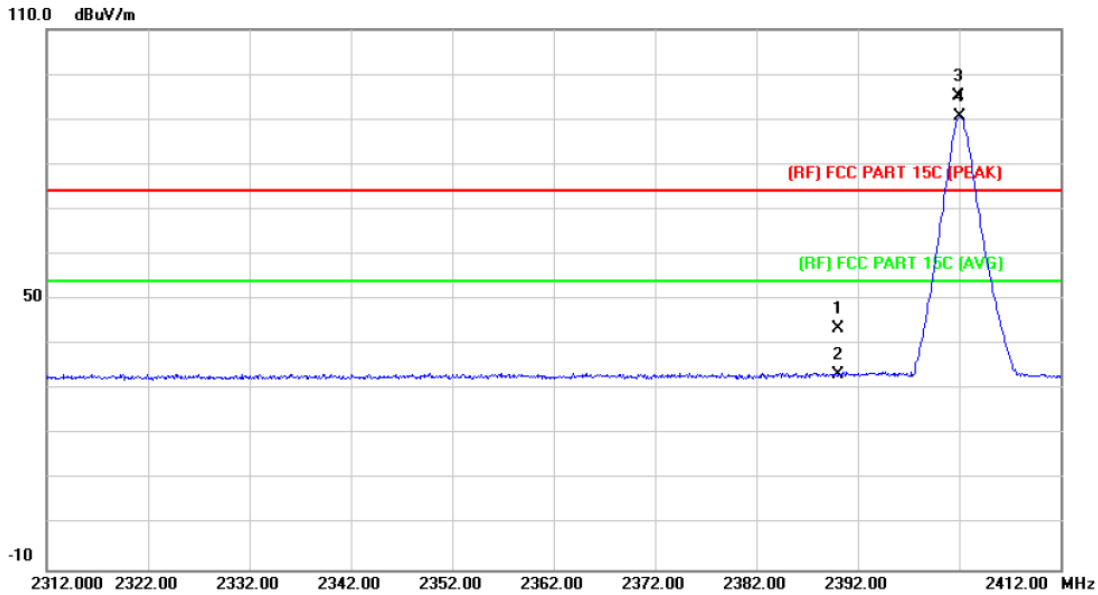
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4958.500	30.12	15.39	45.51	54.00	-8.49	AVG
2		4960.126	44.10	15.39	59.49	74.00	-14.51	peak

Emission Level= Read Level+ Correct Factor

Attachment C-- Restricted Bands Requirement Test Data

(1) Radiation Test

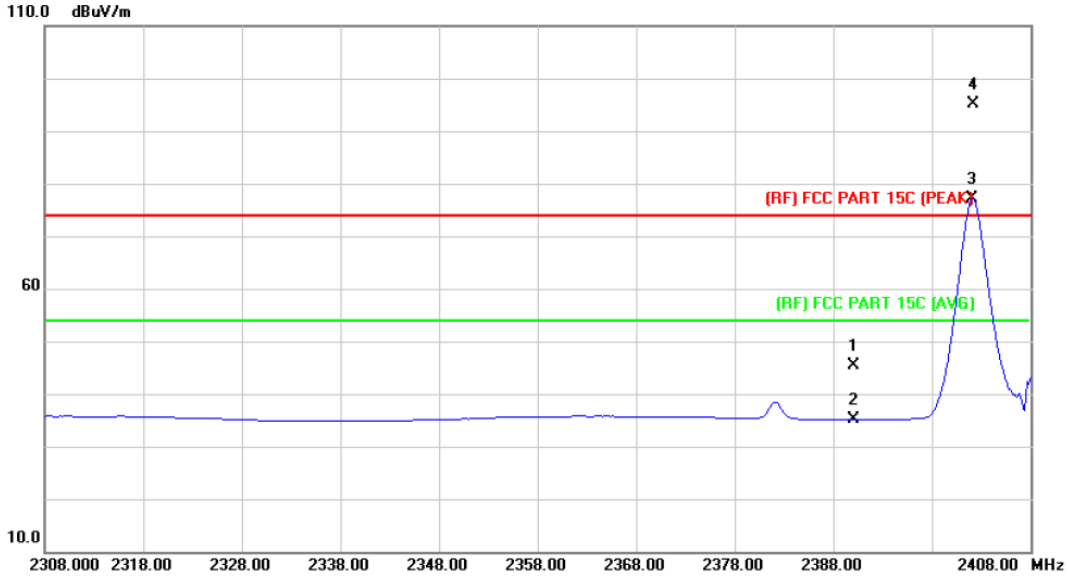
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2402MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2390.000	42.74	0.77	43.51	74.00	-30.49	peak
2		2390.000	32.65	0.77	33.42	54.00	-20.58	AVG
3	X	2401.900	94.44	0.82	95.26	Fundamental Frequency		peak
4	*	2402.000	89.77	0.82	90.59	Fundamental Frequency		AVG

Emission Level= Read Level+ Correct Factor

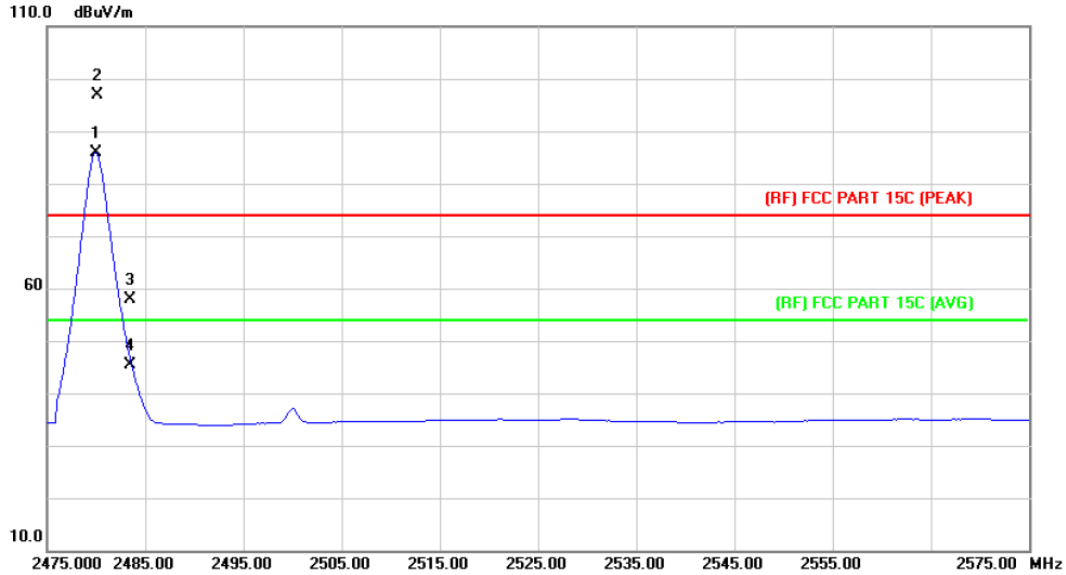
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2402MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2390.000	42.54	2.82	45.36	74.00	-28.64	peak
2		2390.000	32.34	2.82	35.16	54.00	-18.84	AVG
3	*	2402.000	74.36	2.87	77.23	Fundamental Frequency		AVG
4	X	2402.200	92.21	2.87	95.08	Fundamental Frequency		peak

Emission Level= Read Level+ Correct Factor

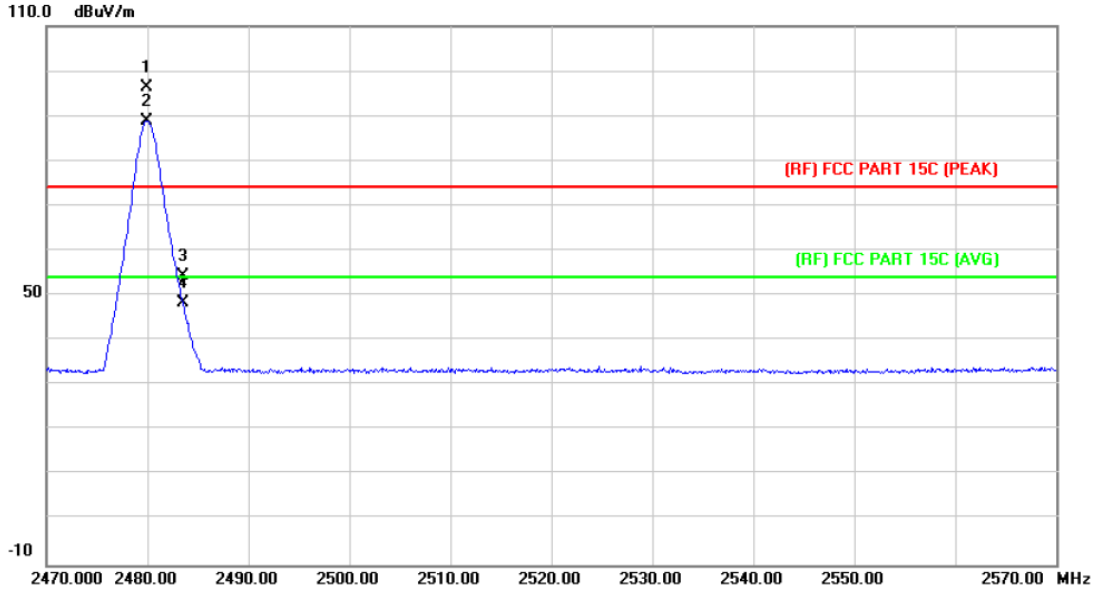
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2480 MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	2480.000	82.59	3.38	85.97	Fundamental Frequency		AVG
2	X	2480.200	93.43	3.38	96.81	Fundamental Frequency		peak
3		2483.500	54.50	3.41	57.91	74.00	-16.09	peak
4		2483.500	41.89	3.41	45.30	54.00	-8.70	AVG

Emission Level= Read Level+ Correct Factor

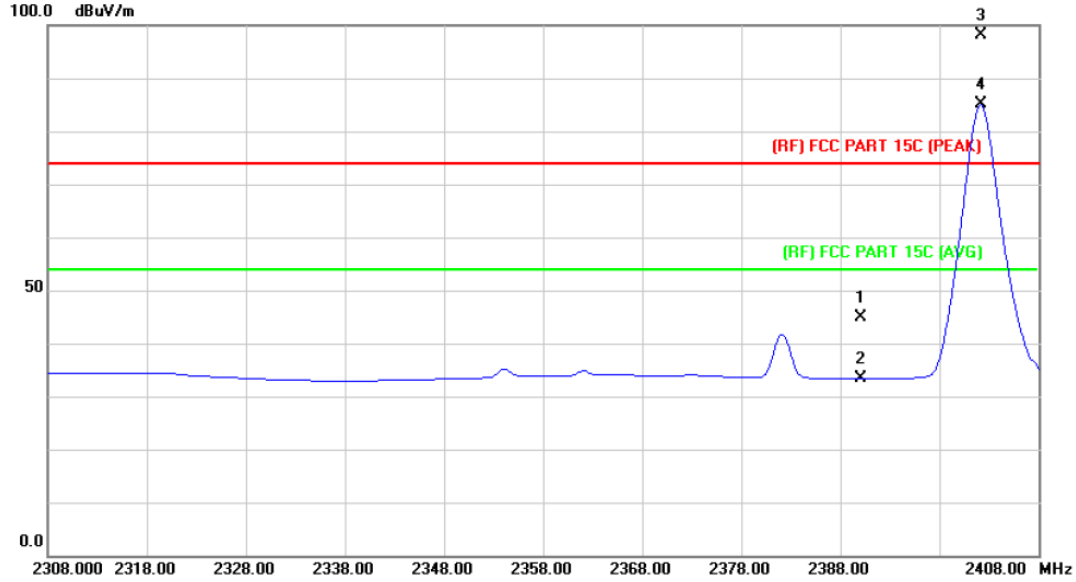
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2480 MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	X	2479.900	95.09	1.15	96.24	Fundamental Frequency		peak
2	*	2479.900	87.70	1.15	88.85	Fundamental Frequency		AVG
3		2483.500	53.09	1.17	54.26	74.00	-19.74	peak
4		2483.500	47.05	1.17	48.22	54.00	-5.78	AVG

Emission Level= Read Level+ Correct Factor

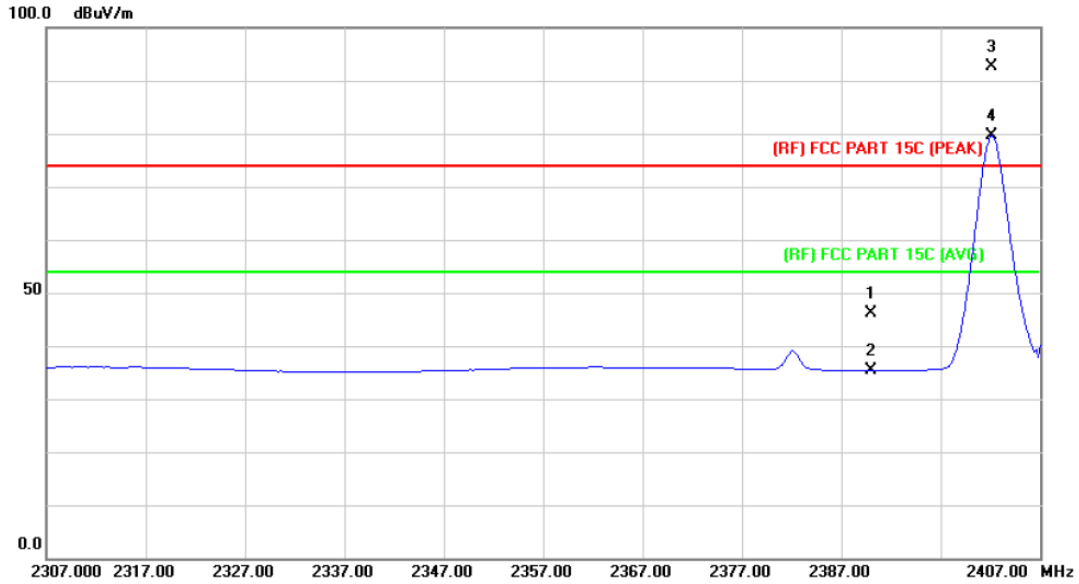
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX π /4-DQPSK Mode 2402MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2390.000	42.05	2.82	44.87	74.00	-29.13	peak
2		2390.000	30.56	2.82	33.38	54.00	-20.62	AVG
3	X	2402.200	95.33	2.87	98.20	Fundamental Frequency		peak
4	*	2402.200	82.23	2.87	85.10	Fundamental Frequency		AVG

Emission Level= Read Level+ Correct Factor

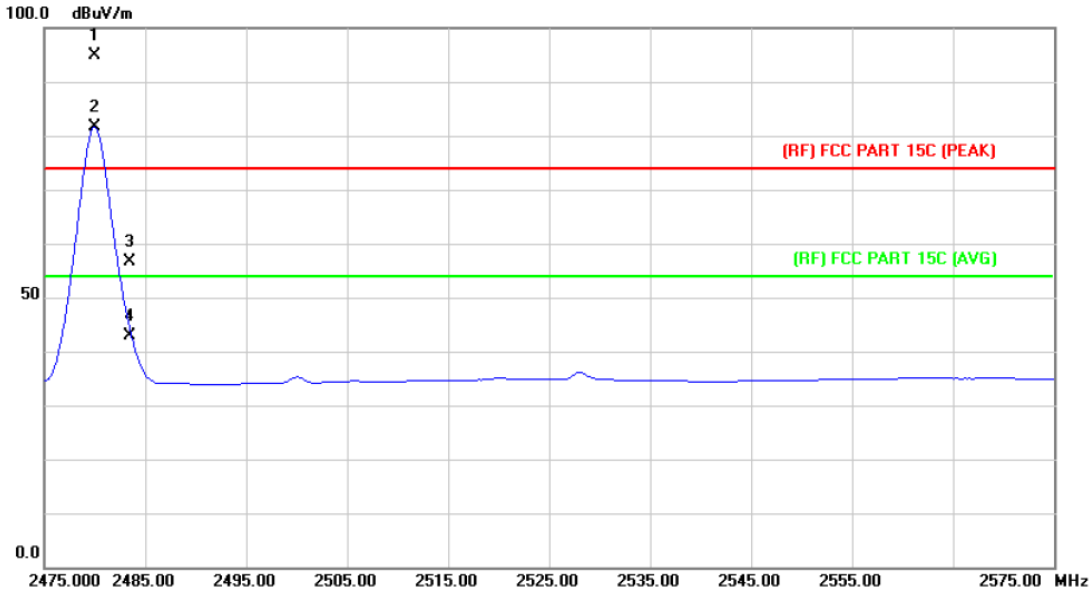
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX π /4-DQPSK Mode 2402MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2390.000	43.21	2.82	46.03	74.00	-27.97	peak
2		2390.000	32.59	2.82	35.41	54.00	-18.59	AVG
3	X	2402.200	89.85	2.87	92.72	Fundamental Frequency		peak
4	*	2402.200	76.70	2.87	79.57	Fundamental Frequency		AVG

Emission Level= Read Level+ Correct Factor

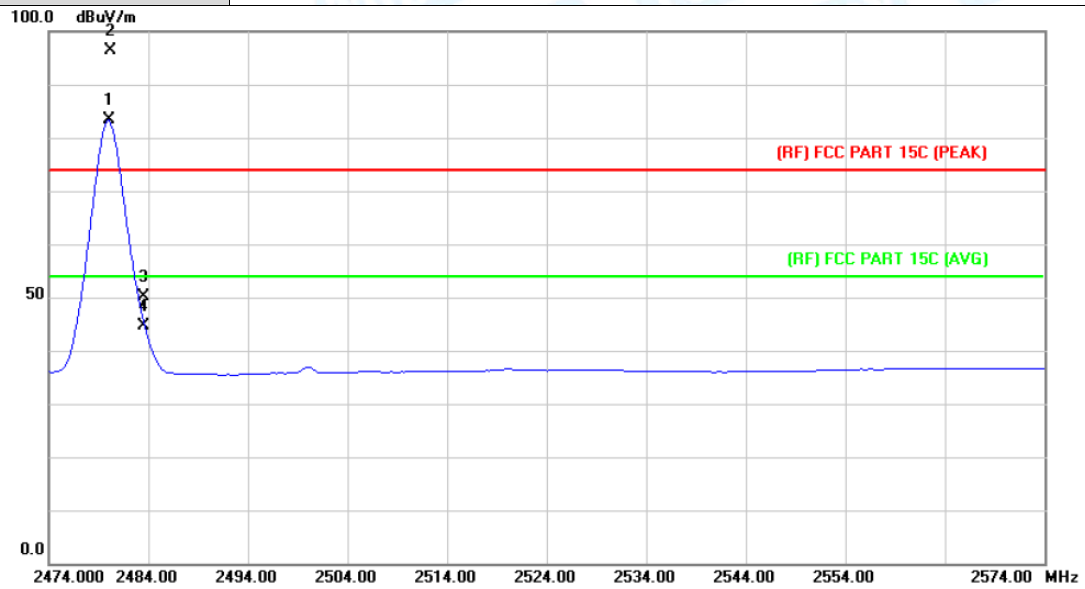
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX π /4-DQPSK Mode 2480MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	X	2480.000	91.39	3.38	94.77	Fundamental Frequency		peak
2	*	2480.000	78.35	3.38	81.73	Fundamental Frequency		AVG
3		2483.500	53.18	3.41	56.59	74.00	-17.41	peak
4		2483.500	39.55	3.41	42.96	54.00	-11.04	AVG

Emission Level= Read Level+ Correct Factor

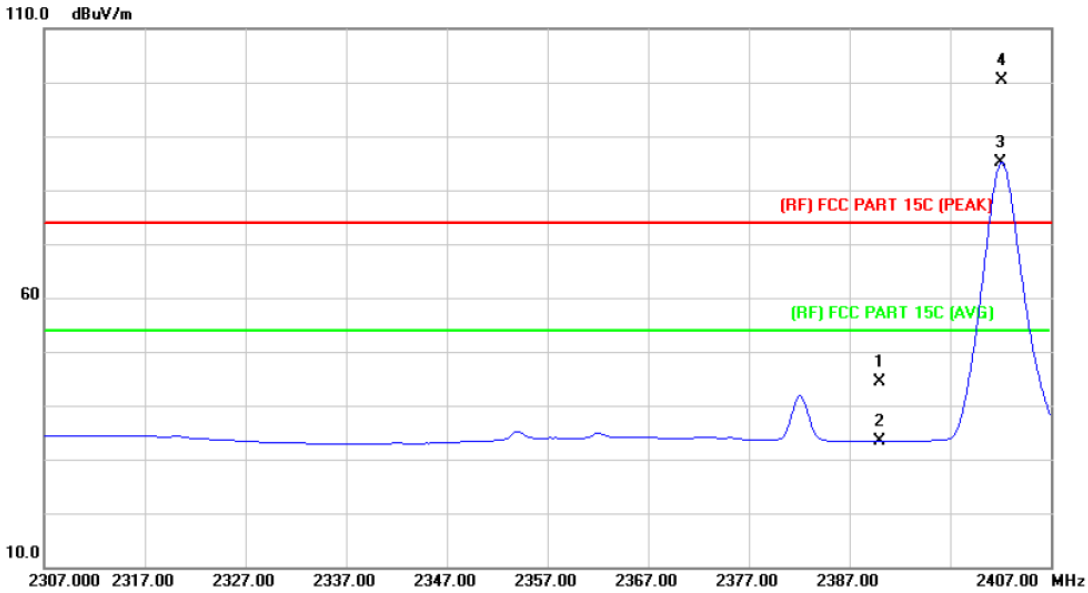
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX π /4-DQPSK Mode 2480MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	2480.000	79.94	3.38	83.32	Fundamental Frequency		AVG
2	X	2480.200	92.96	3.38	96.34	Fundamental Frequency		peak
3		2483.500	46.76	3.41	50.17	74.00	-23.83	peak
4		2483.500	41.30	3.41	44.71	54.00	-9.29	AVG

Emission Level= Read Level+ Correct Factor

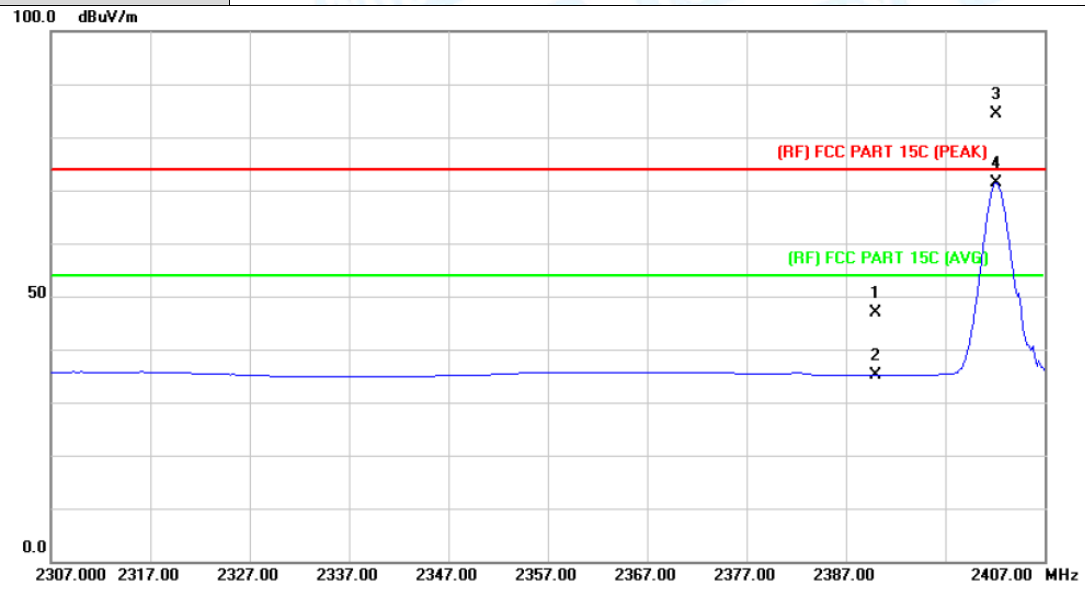
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX 8-DPSK Mode 2402MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2390.000	41.63	2.82	44.45	74.00	-29.55	peak
2		2390.000	30.57	2.82	33.39	54.00	-20.61	AVG
3	*	2402.000	82.19	2.87	85.06	Fundamental Frequency		AVG
4	X	2402.200	97.42	2.87	100.29	Fundamental Frequency		peak

Emission Level= Read Level+ Correct Factor

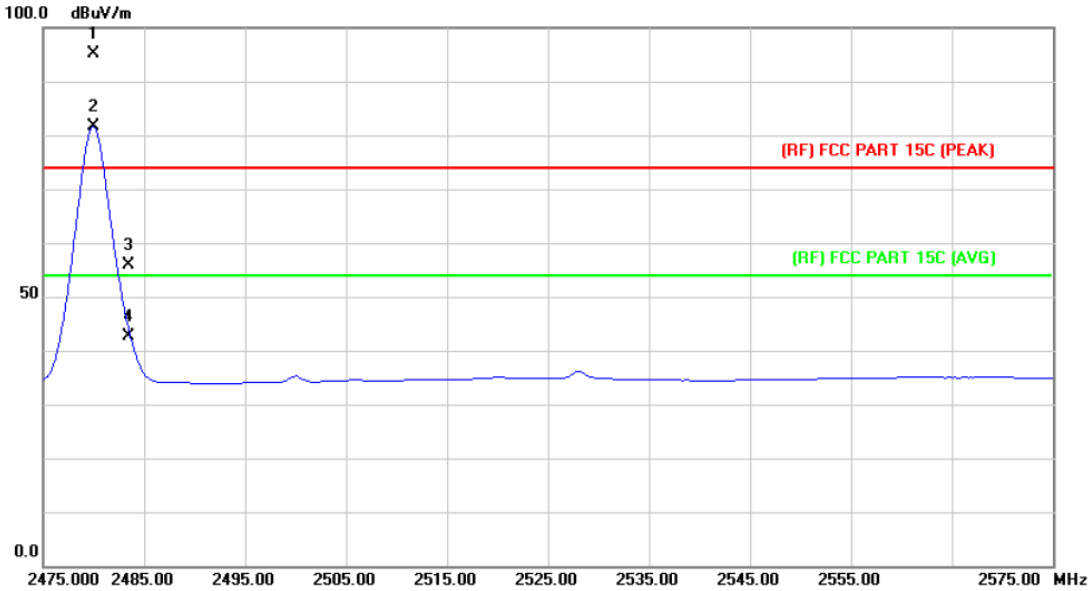
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX 8-DPSK Mode 2402MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2390.000	44.00	2.82	46.82	74.00	-27.18	peak
2		2390.000	32.34	2.82	35.16	54.00	-18.84	AVG
3	X	2402.200	81.59	2.87	84.46	Fundamental Frequency		peak
4	*	2402.200	68.56	2.87	71.43	Fundamental Frequency		AVG

Emission Level= Read Level+ Correct Factor

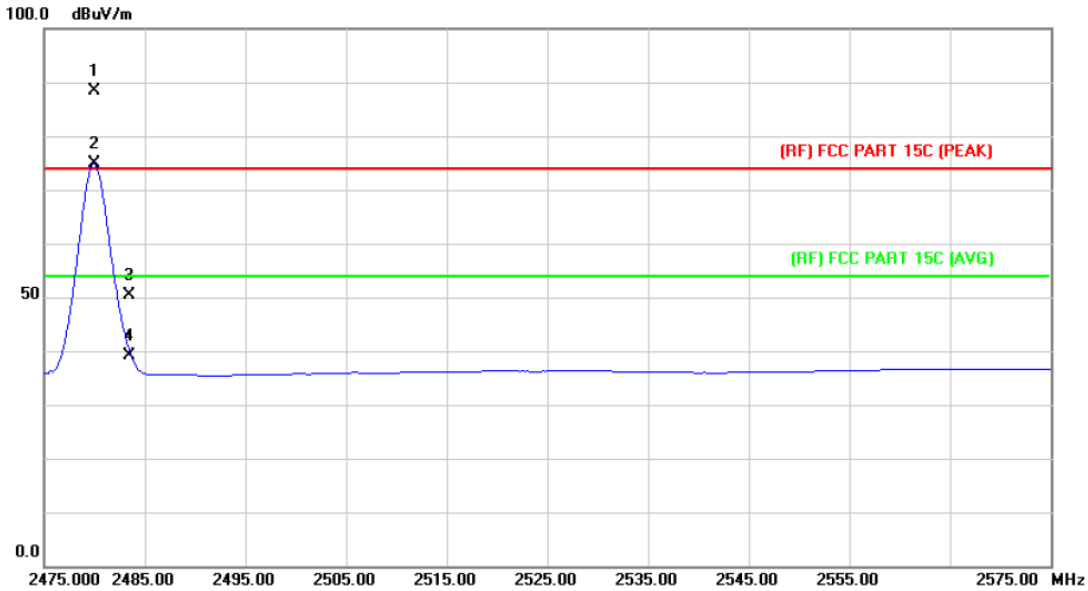
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX 8-DPSK Mode 2480MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	X	2480.000	91.79	3.38	95.17	Fundamental Frequency		peak
2	*	2480.000	78.32	3.38	81.70	Fundamental Frequency		AVG
3		2483.500	52.58	3.41	55.99	74.00	-18.01	peak
4		2483.500	39.33	3.41	42.74	54.00	-11.26	AVG

Emission Level= Read Level+ Correct Factor

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX 8-DPSK Mode 2480MHz		
Remark:	Only worse case is reported		

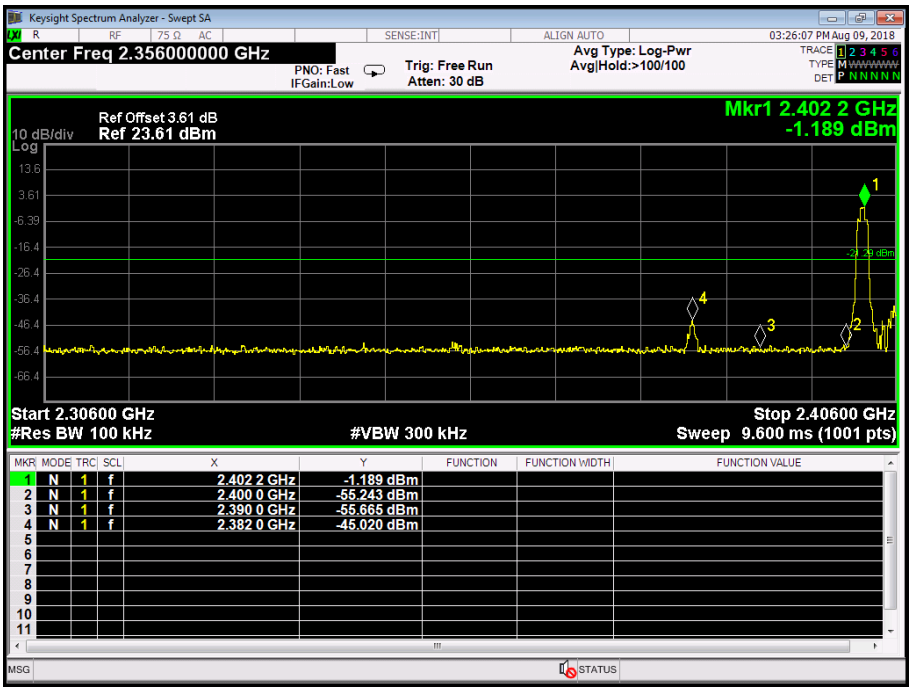


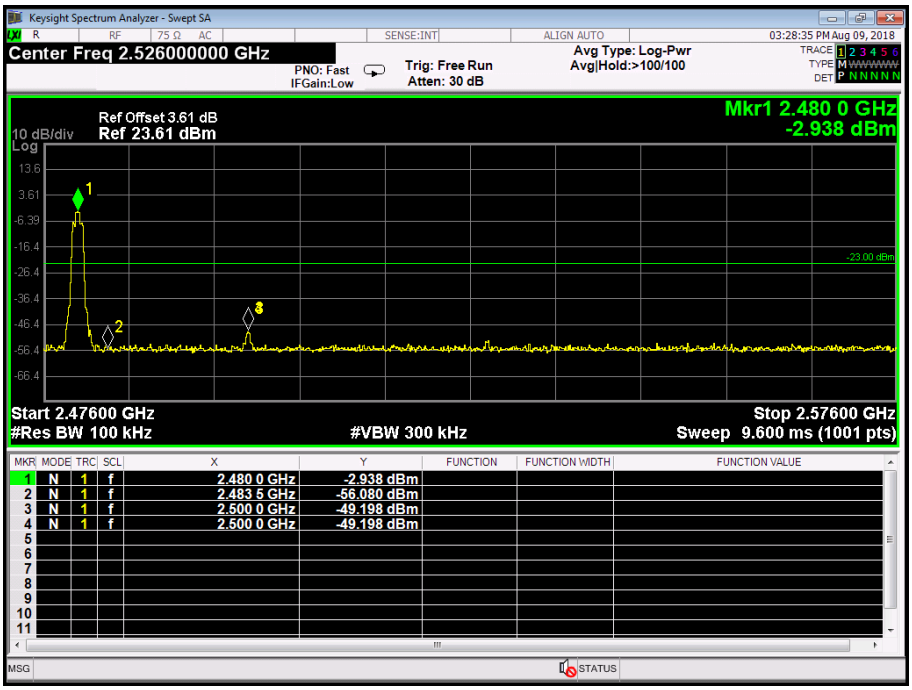
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	X	2480.000	84.96	3.38	88.34	Fundamental Frequency		peak
2	*	2480.000	71.62	3.38	75.00	Fundamental Frequency		AVG
3		2483.500	46.92	3.41	50.33	74.00	-23.67	peak
4		2483.500	35.76	3.41	39.17	54.00	-14.83	AVG

Emission Level= Read Level+ Correct Factor

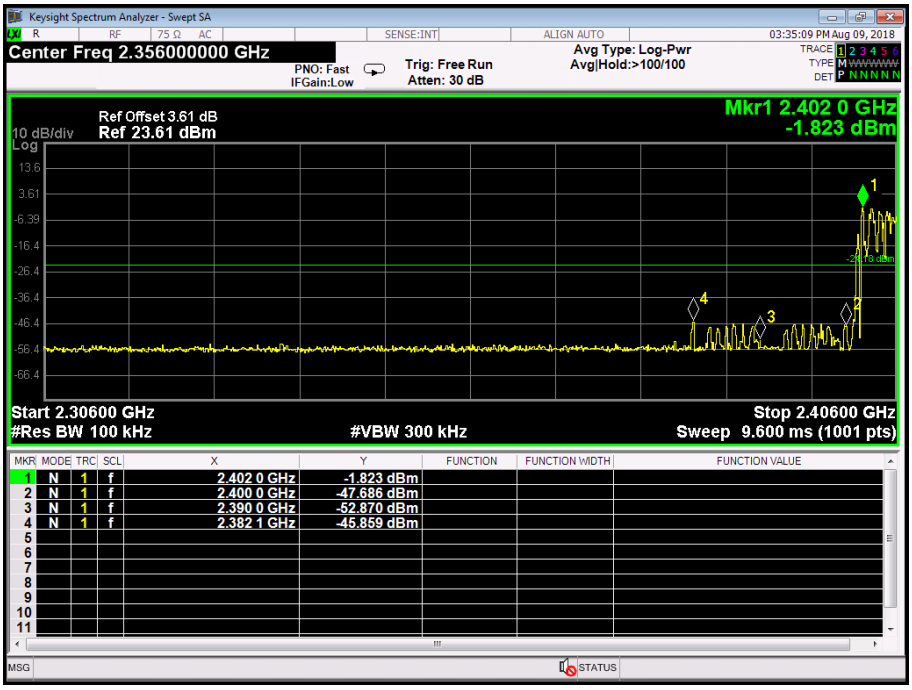
(2) Conducted Test

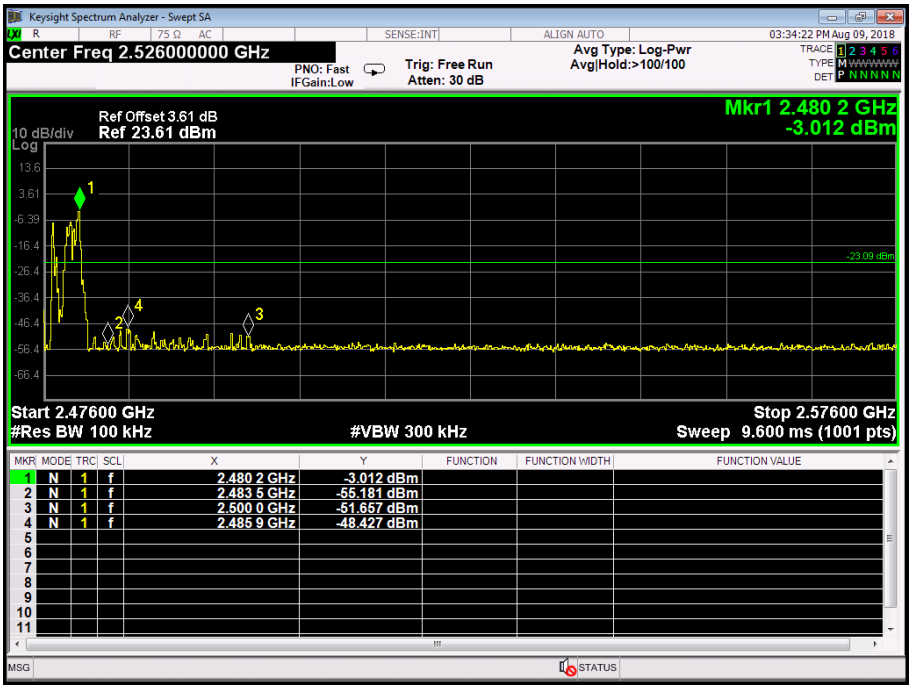
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Test Mode:	TX GFSK Mode 2402MHz/2480 MHz		
Remark:	Only worse case is reported		



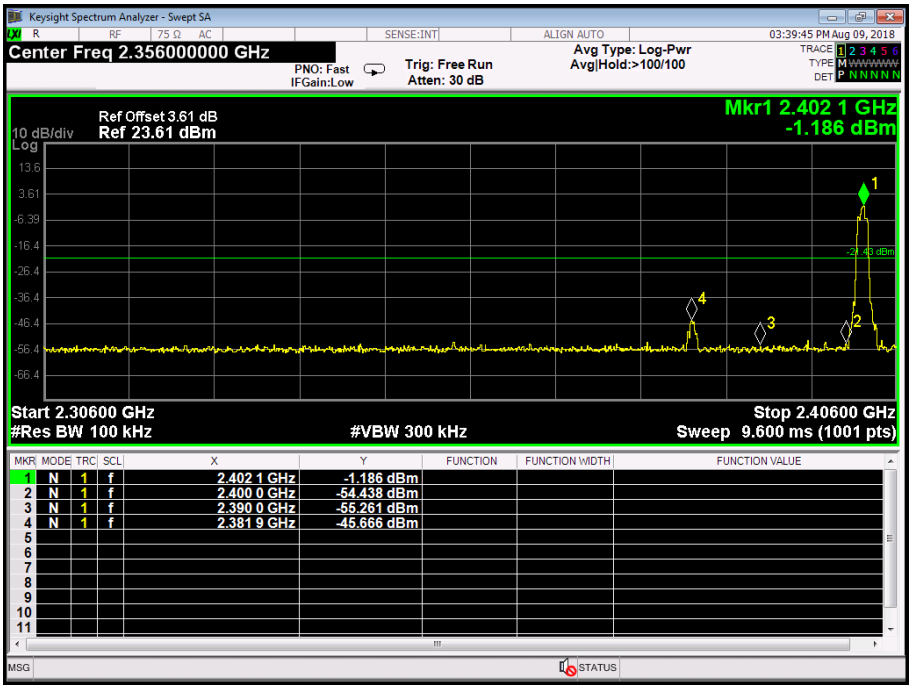


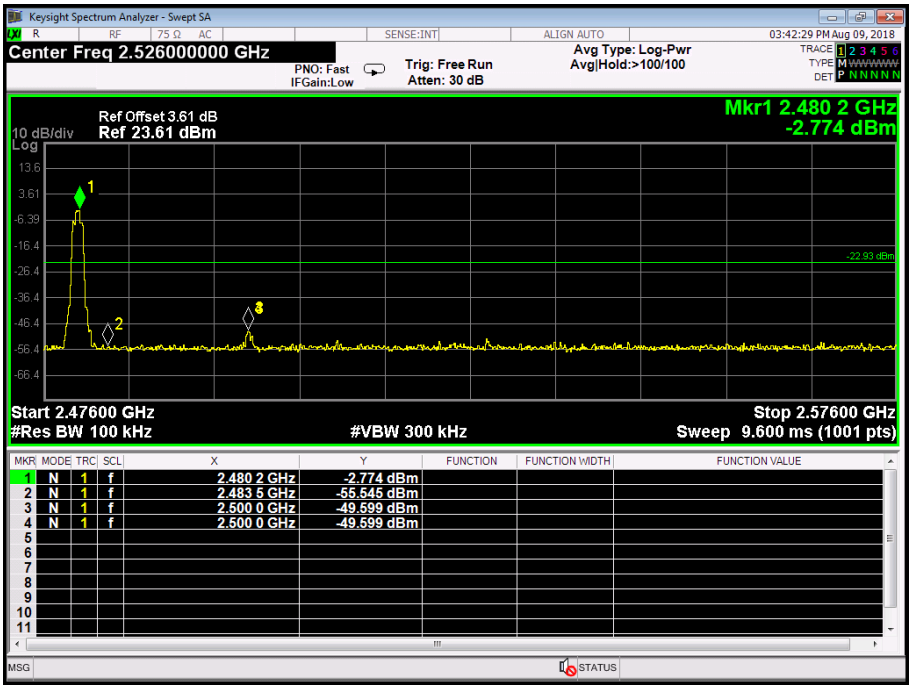
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Test Mode:	GFSK Hopping Mode		
Remark:	Only worse case is reported		



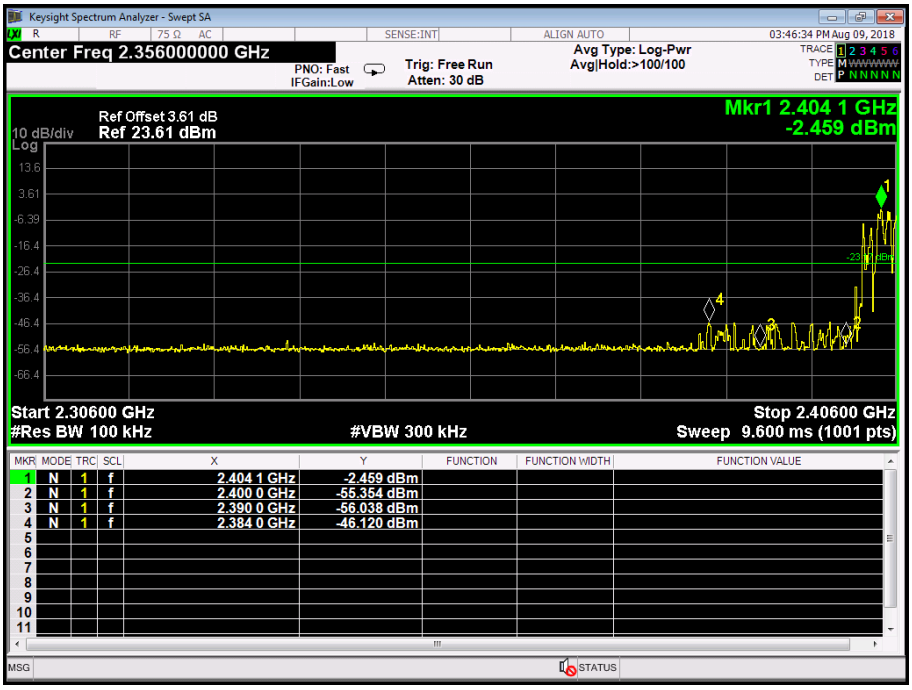


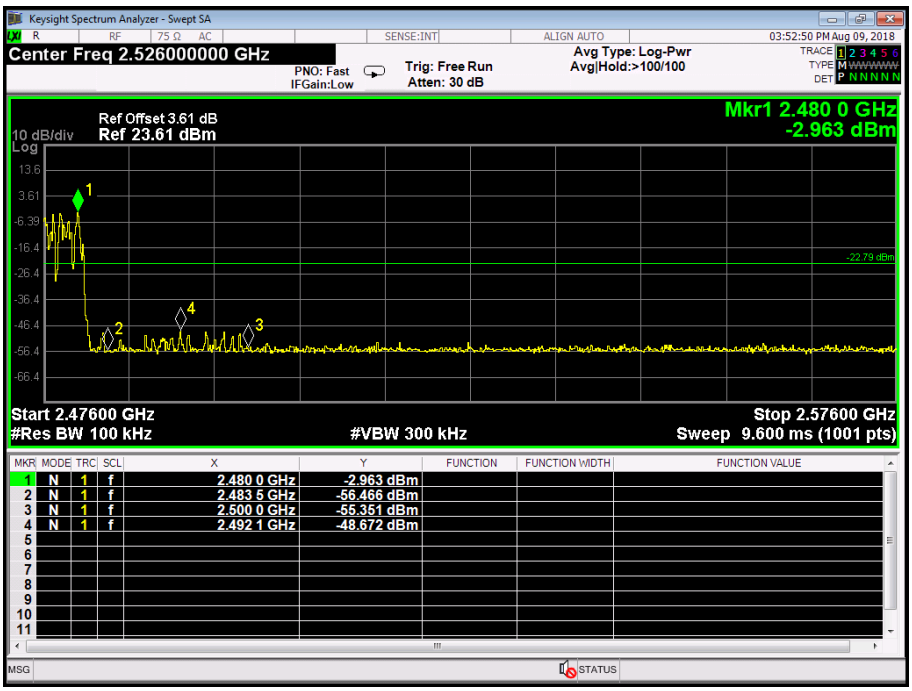
Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	TX π /4-DQPSK Mode 2402MHz/2480 MHz		
Remark:	Only worse case is reported		



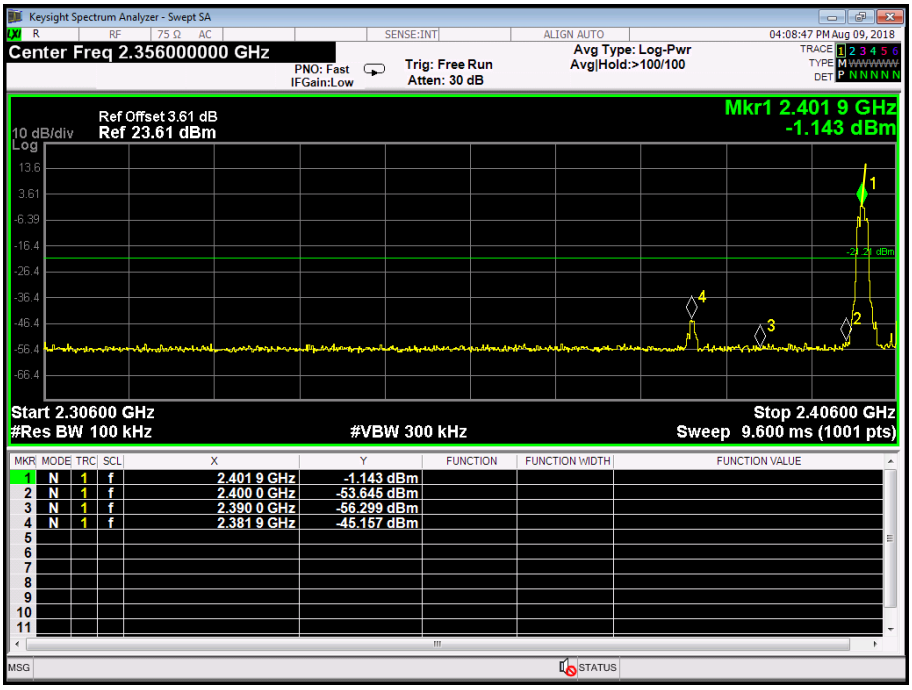


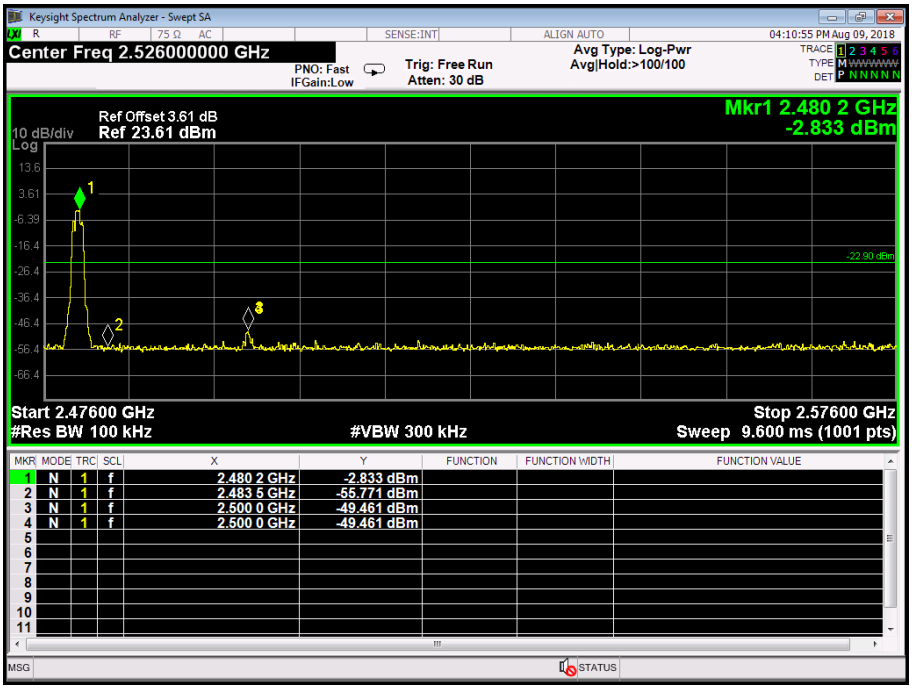
Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	π /4-DQPSK Hopping Mode		
Remark:	Only worse case is reported		



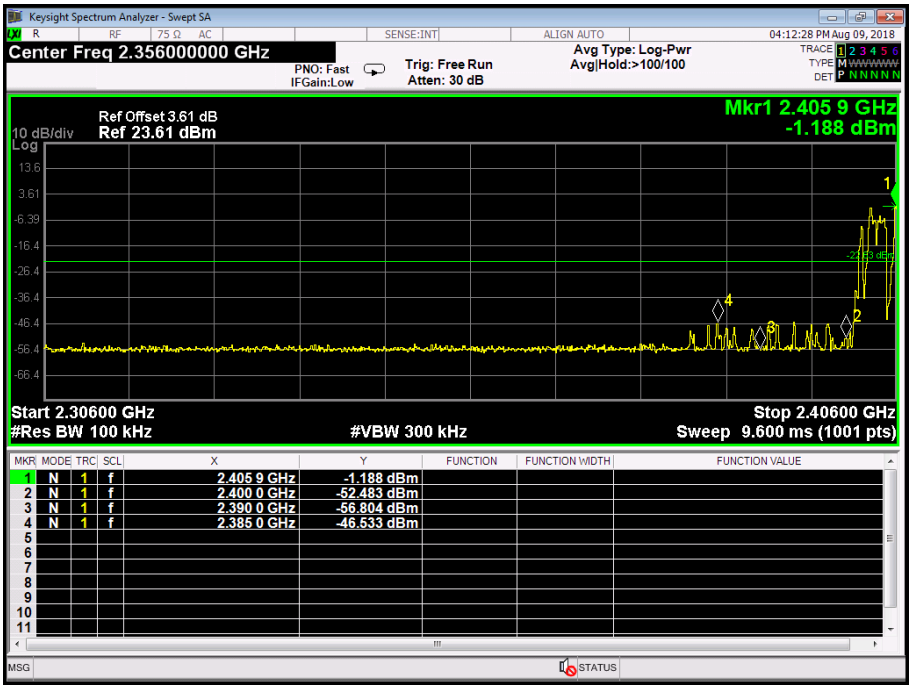


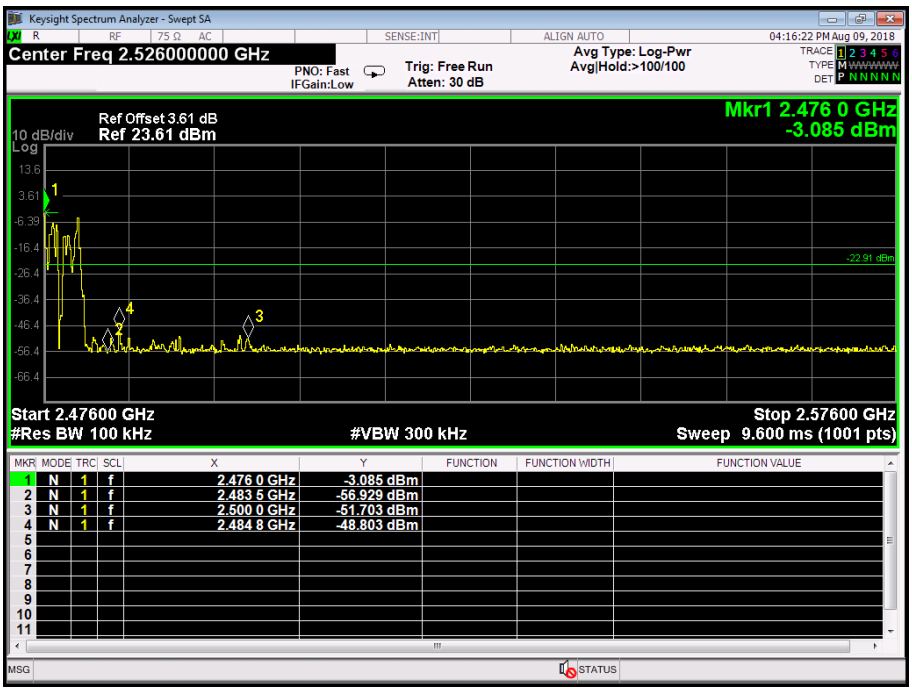
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Test Mode:	TX 8-DPSK Mode 2402MHz/2480 MHz		
Remark:	Only worse case is reported		





Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Test Mode:	8-DPSK Hopping Mode		
Remark:	Only worse case is reported		



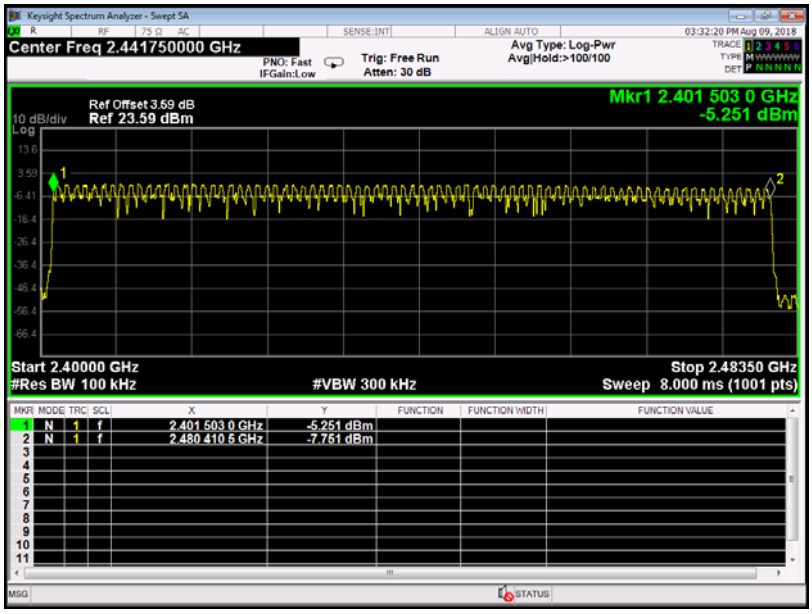


Attachment D-- Number of Hopping Channel Test Data

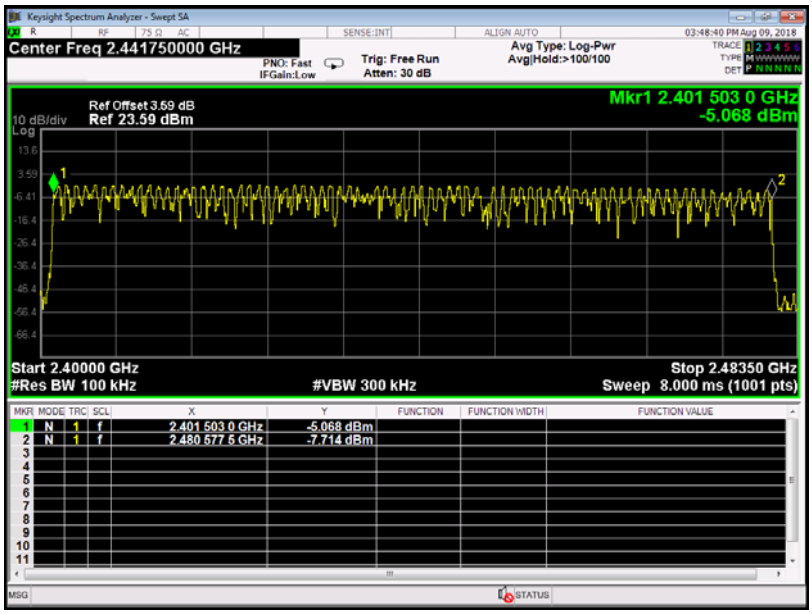
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode		

Frequency Range	Test Mode	Quantity of Hopping Channel	Limit
2402MHz~2480MHz	GFSK	79	**>15**
	π /4-DQPSK	79	
	8-DPSK	79	

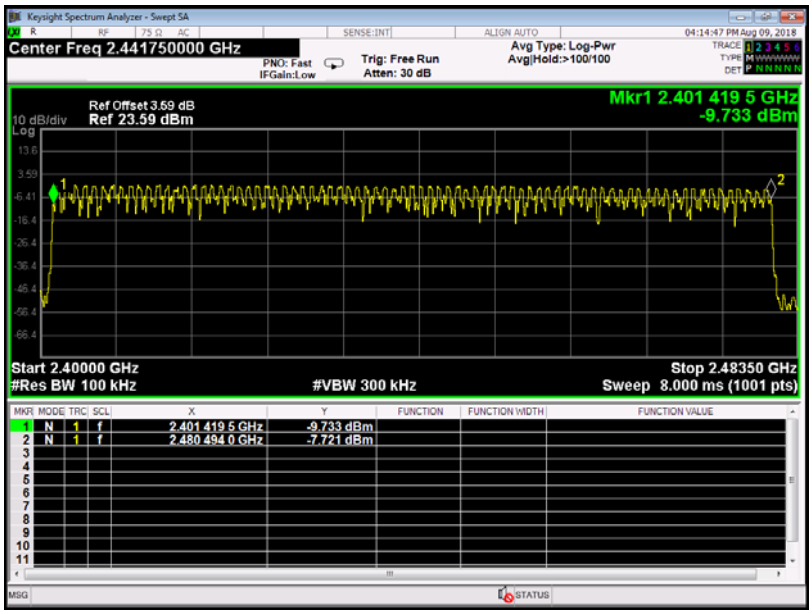
GFSK Mode



π /4-DQPSK Mode



8-DPSK Mode


Keysight Spectrum Analyzer - Swept SA
Center Freq 2.441750000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
04:14:47 PM Aug 09, 2018
Ref Offset 3.59 dB
10 dB/div
Ref 23.59 dBm
Log
Mkr1 2.401 419 5 GHz
-9.733 dBm
Start 2.40000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.48350 GHz
Sweep 8.000 ms (1001 pts)
1 N 1 f 2.401 419 5 GHz -9.733 dBm
2 N 1 f 2.480 494 0 GHz -7.721 dBm

Attachment E-- Average Time of Occupancy Test Data

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode (GFSK)		

Test Mode	Channel (MHz)	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
1DH1	2441	0.388	124.48	31.60	**400**	**PASS**
1DH3	2441	1.640	262.40	31.60	**400**	**PASS**
1DH5	2441	2.891	308.37	31.60	**400**	**PASS**

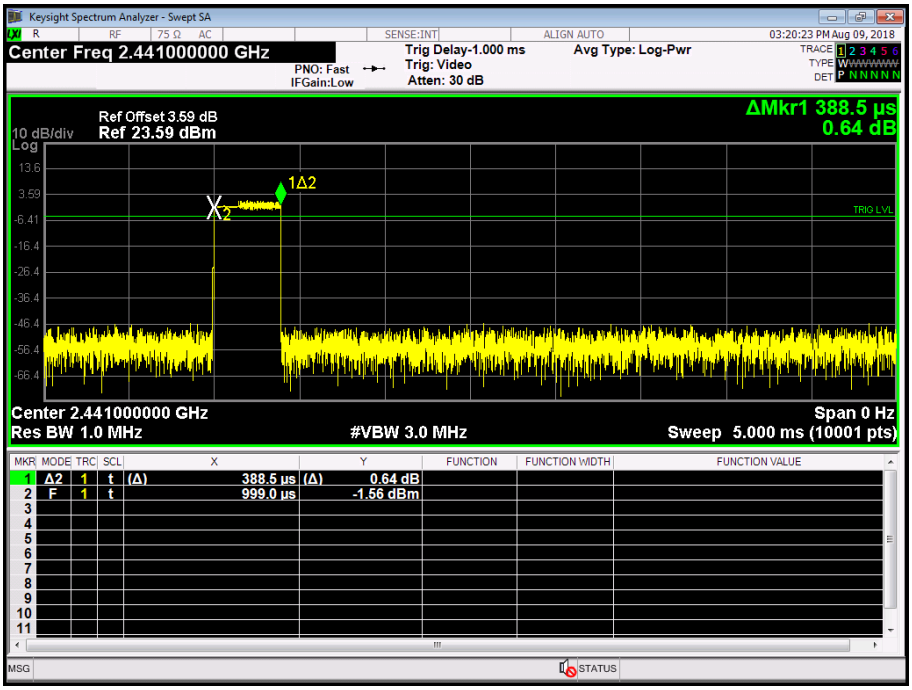
1DH1 Total of Dwell= Pulse Time(1600/2)*31.6/79*

1DH3 Total of Dwell= Pulse Time(1600/4)*31.6/79*

1DH5 Total of Dwell= Pulse Time(1600/6)*31.6/79*

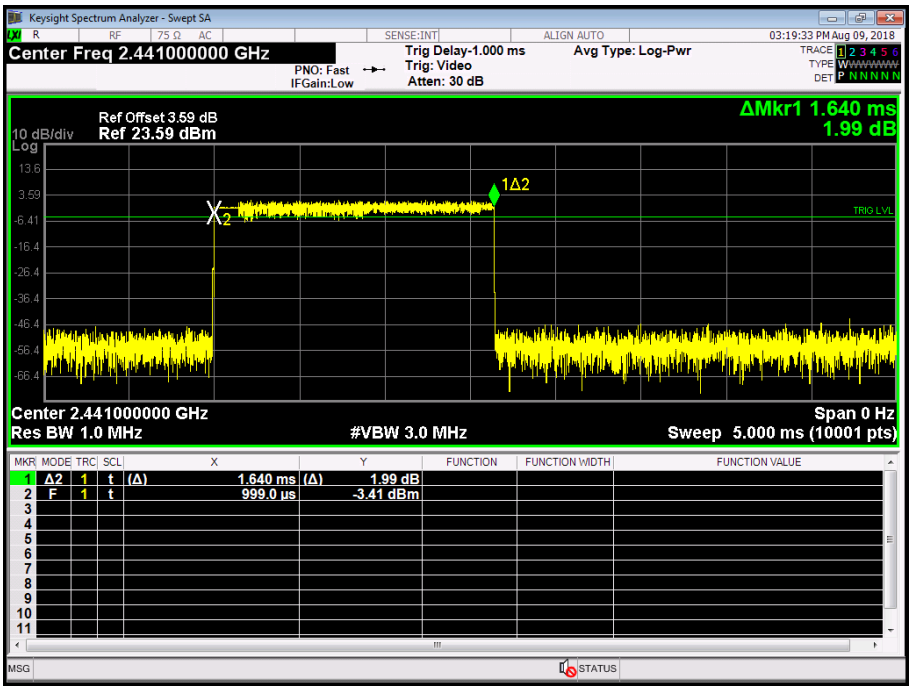
GFSK Hopping Mode 1DH1

2441 MHz



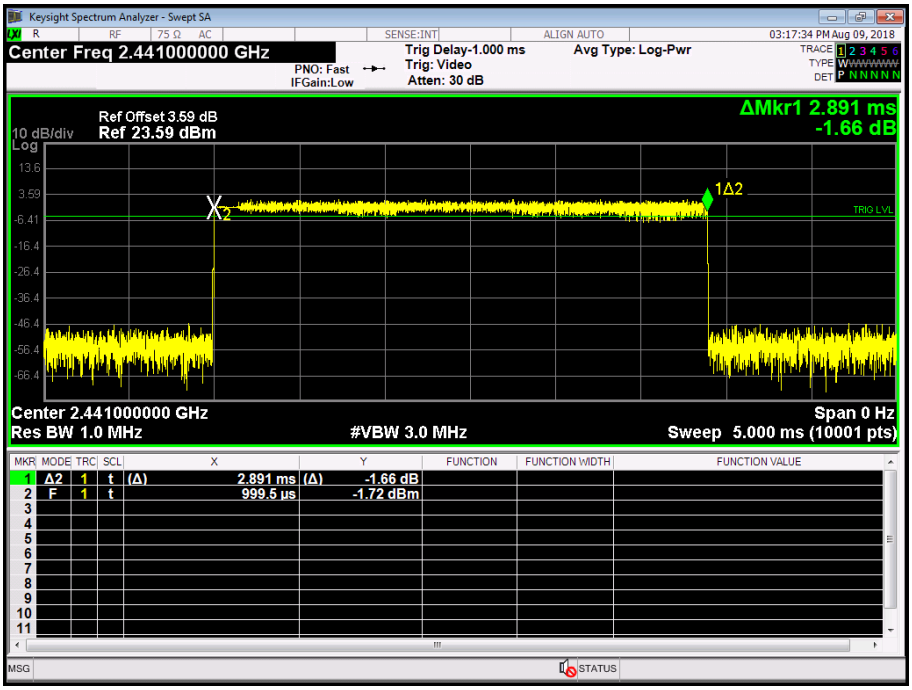
GFSK Hopping Mode 1DH3

2441 MHz



GFSK Hopping Mode 1DH5

2441 MHz



Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode (π /4-DQPSK)		

Test Mode	Channel (MHz)	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
2DH1	2441	0.389	124.48	31.60	**400**	**PASS**
2DH3	2441	1.641	262.56	31.60	**400**	**PASS**
2DH5	2441	2.889	308.16	31.60	**400**	**PASS**

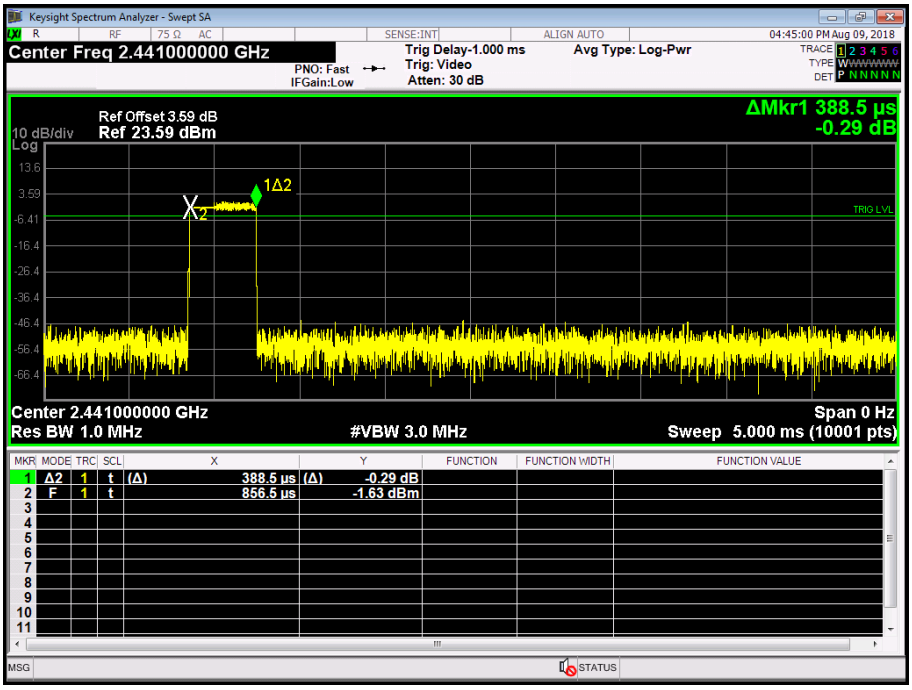
2DH1 Total of Dwell= Pulse Time(1600/2)*31.6/79*

2DH3 Total of Dwell= Pulse Time(1600/4)*31.6/79*

2DH5 Total of Dwell= Pulse Time(1600/6)*31.6/79*

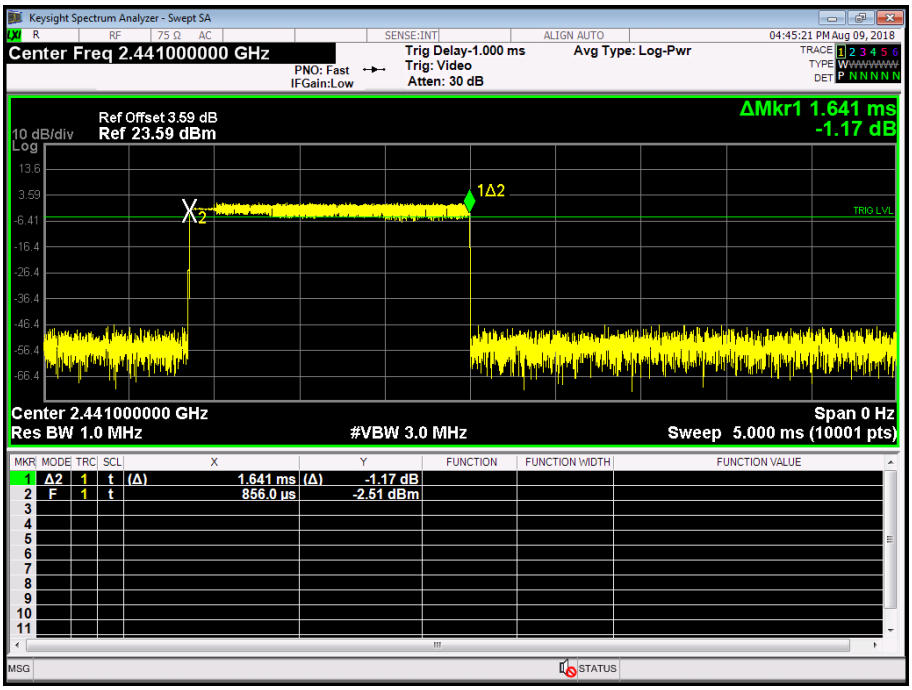
π /4-DQPSK **Hopping Mode 2DH1**

2441 MHz



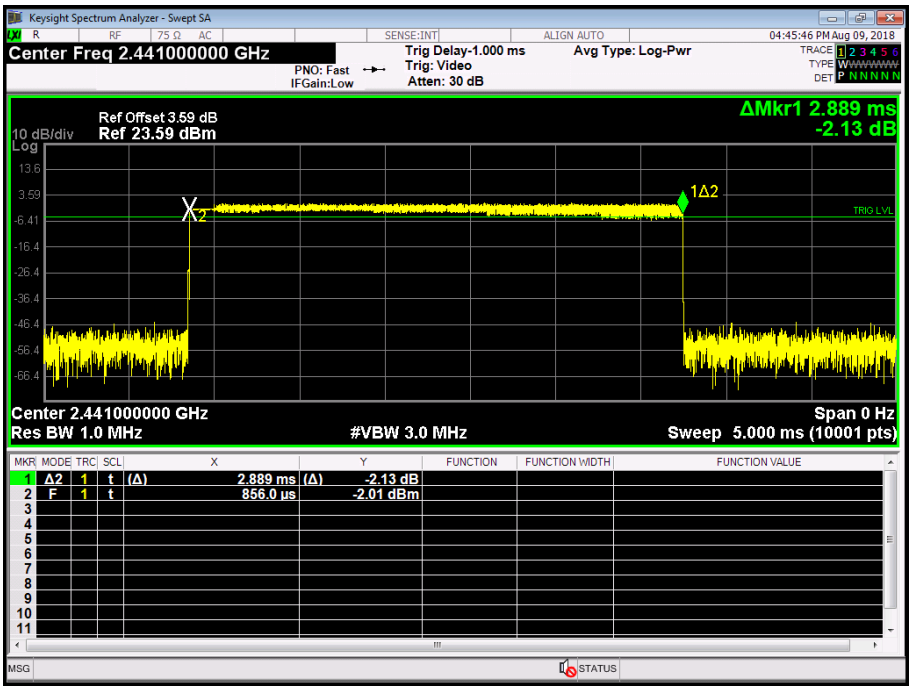
π /4-DQPSK Hopping Mode 2DH3

2441 MHz



π /4-DQPSK Hopping Mode 2DH5

2441 MHz



Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode (8-DPSK)		

Test Mode	Channel (MHz)	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
1DH1	2441	0.389	124.48	31.60	**400**	**PASS**
1DH3	2441	1.640	262.40	31.60	**400**	**PASS**
1DH5	2441	2.891	308.37	31.60	**400**	**PASS**

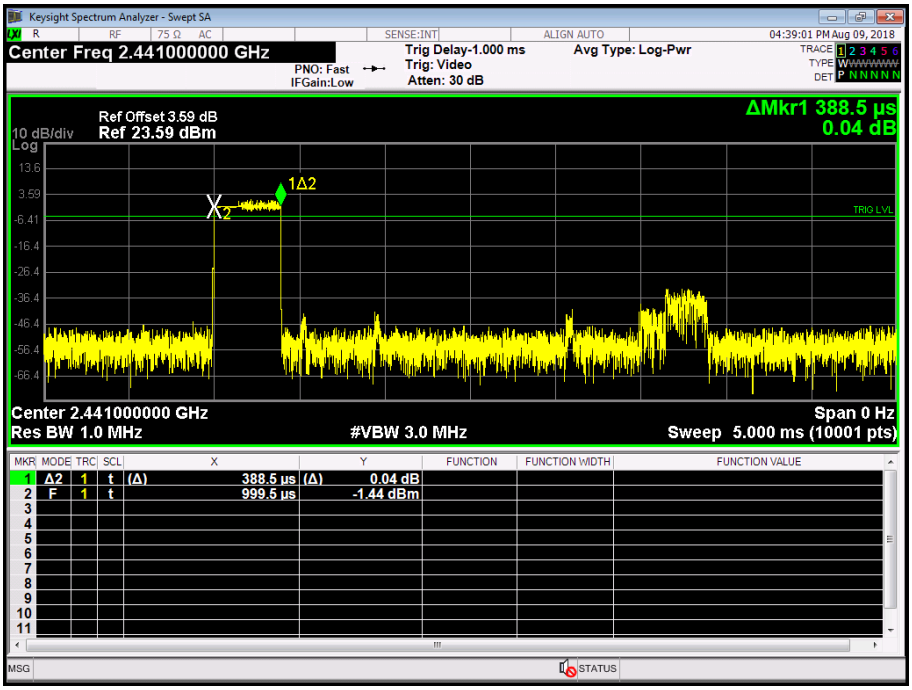
1DH1 Total of Dwell= Pulse Time(1600/2)*31.6/79*

1DH3 Total of Dwell= Pulse Time(1600/4)*31.6/79*

1DH5 Total of Dwell= Pulse Time(1600/6)*31.6/79*

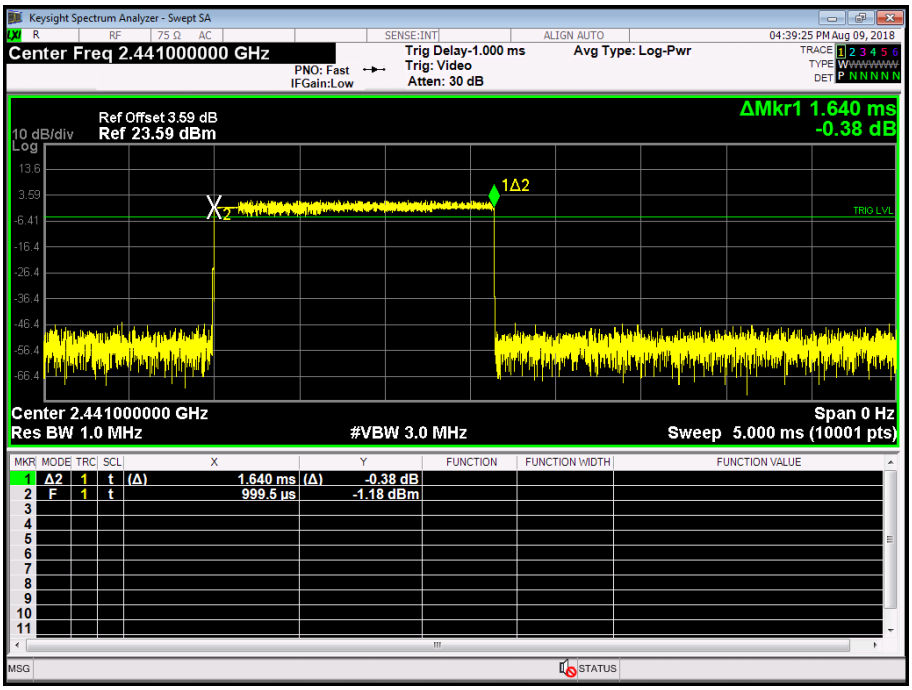
8-DPSK Hopping Mode 3DH1

2441 MHz



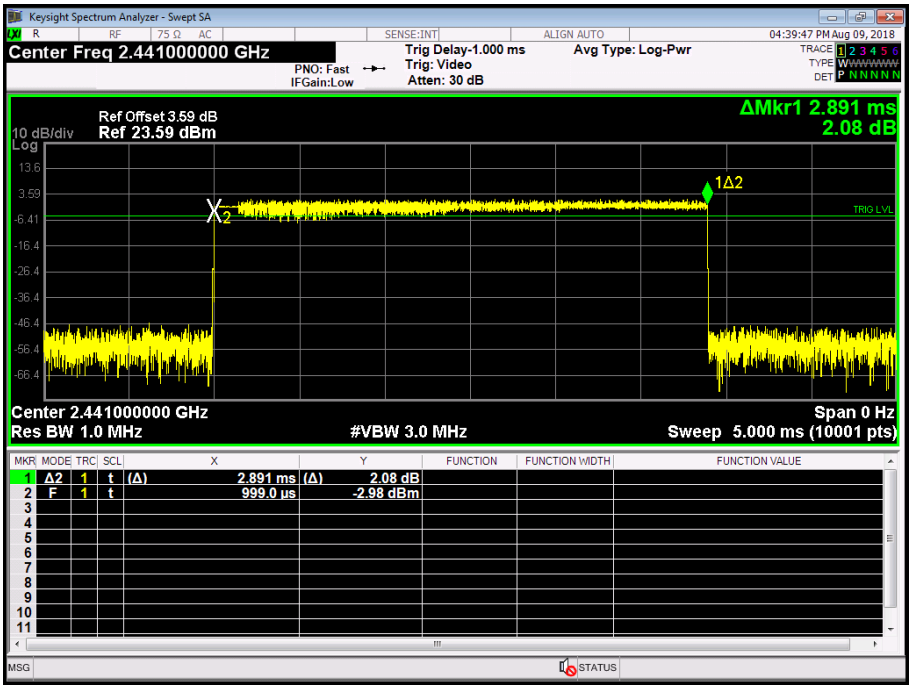
8-DPSK Hopping Mode 3DH3

2441 MHz



8-DPSK Hopping Mode 3DH5

2441 MHz



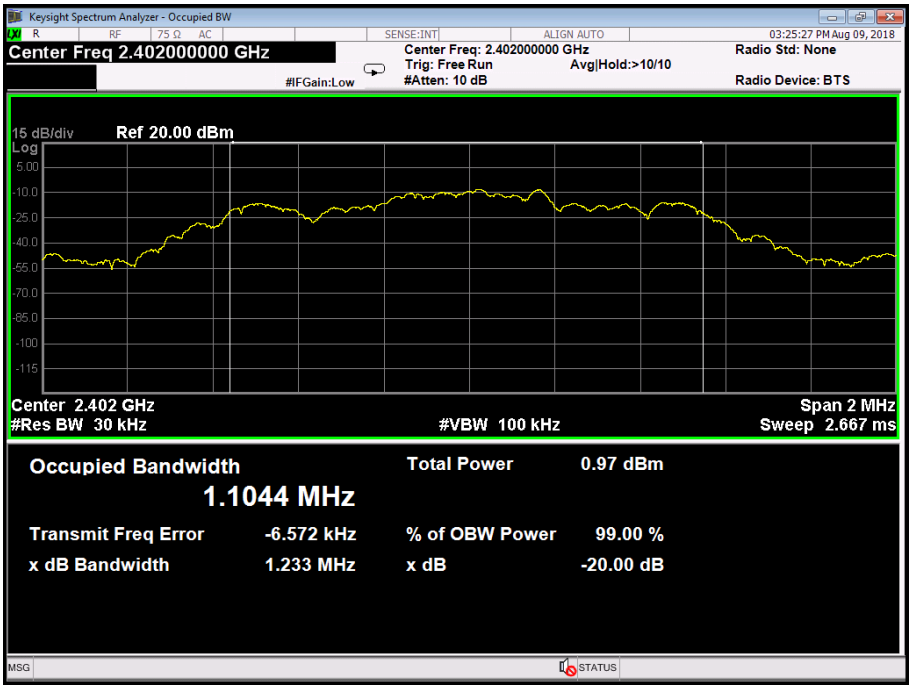
Attachment F-- Channel Separation and Bandwidth Test Data

Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	TX Mode (GFSK)		

Channel frequency (MHz)	99% OBW (kHz)	20dB Bandwidth (kHz)	20dB Bandwidth *2/3 (kHz)
2402	1104.4	1233	
2441	1104.5	1228	
2480	1109.8	1229	

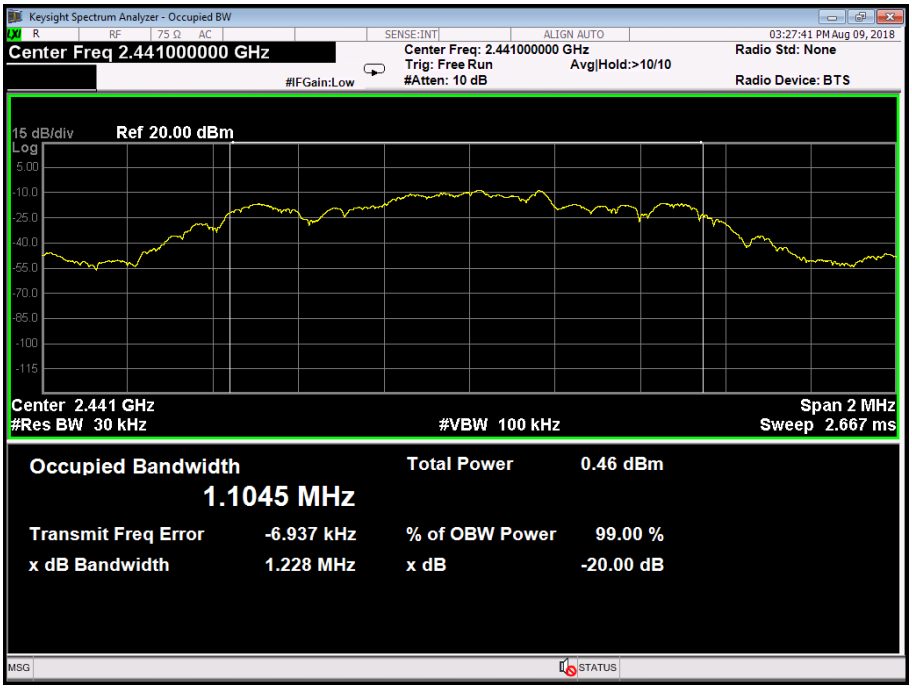
GFSK TX Mode

2402 MHz



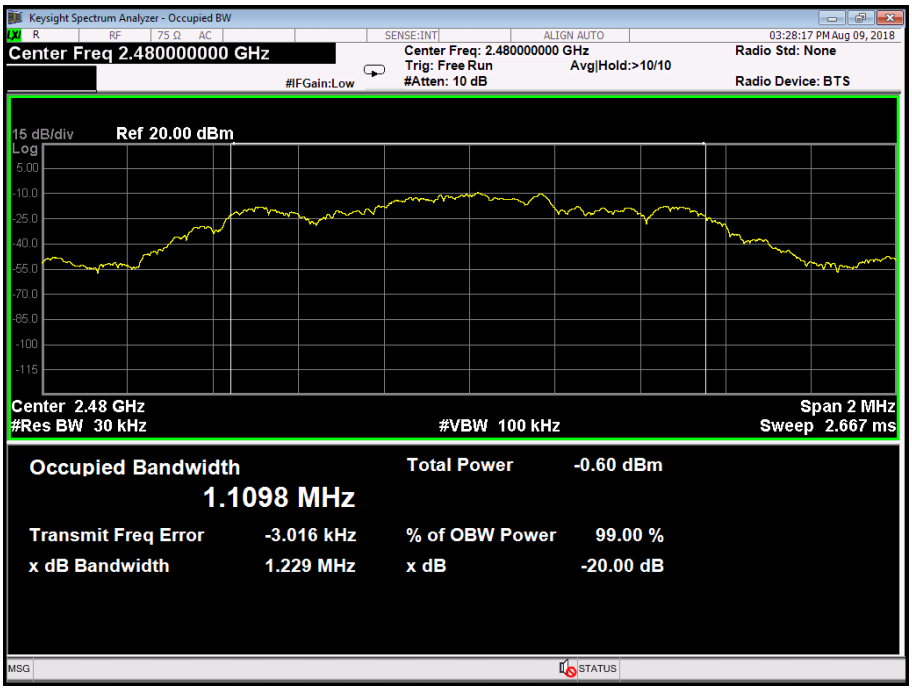
GFSK TX Mode

2441 MHz



GFSK TX Mode

2480 MHz

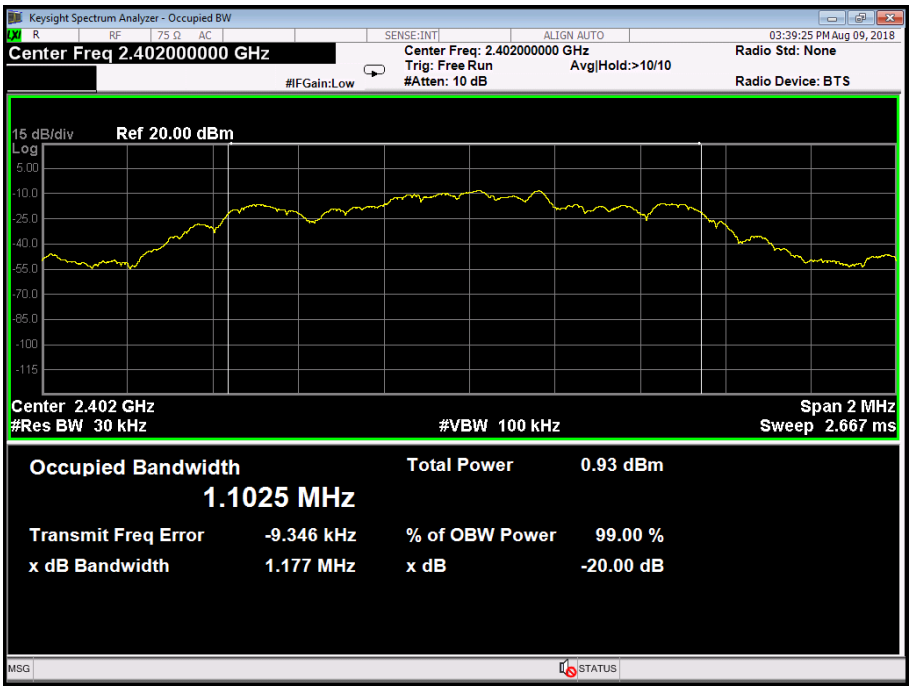


Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	TX Mode (π /4-DQPSK)		

Channel frequency (MHz)	99% OBW (kHz)	20dB Bandwidth (kHz)	20dB Bandwidth *2/3 (kHz)
2402	1102.5	1177	784.67
2441	1104.0	1179	786.00
2480	1108.5	1228	818.67

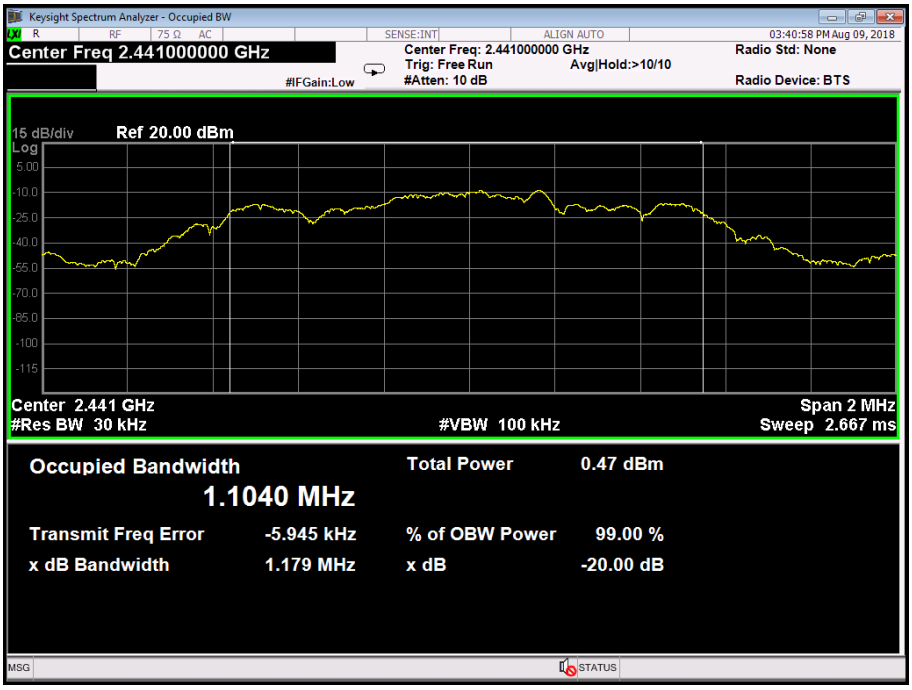
π /4-DQPSK TX Mode

2402 MHz



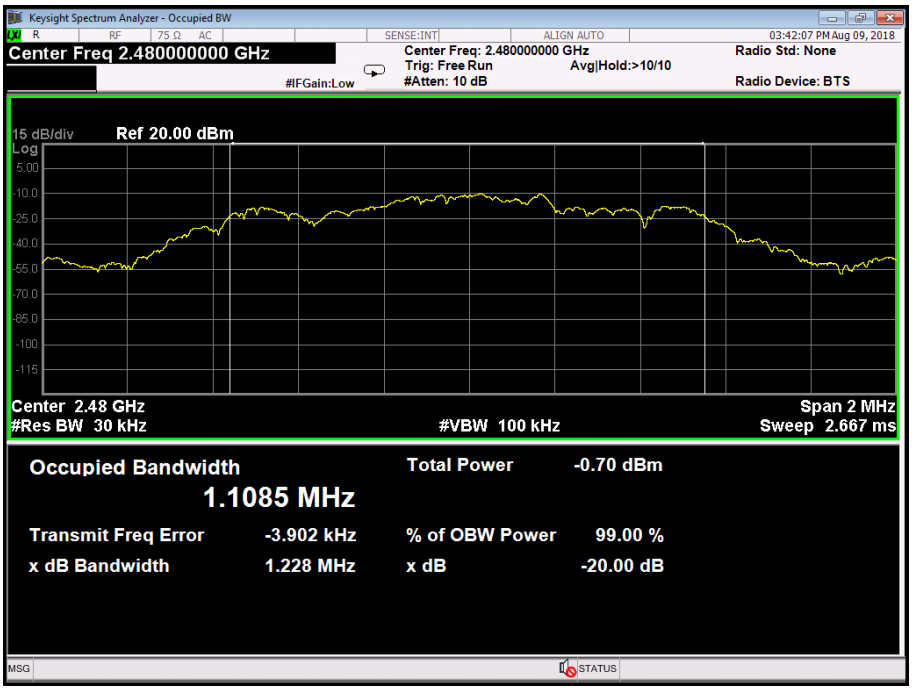
π /4-DQPSK TX Mode

2441 MHz



π /4-DQPSK TX Mode

2480 MHz

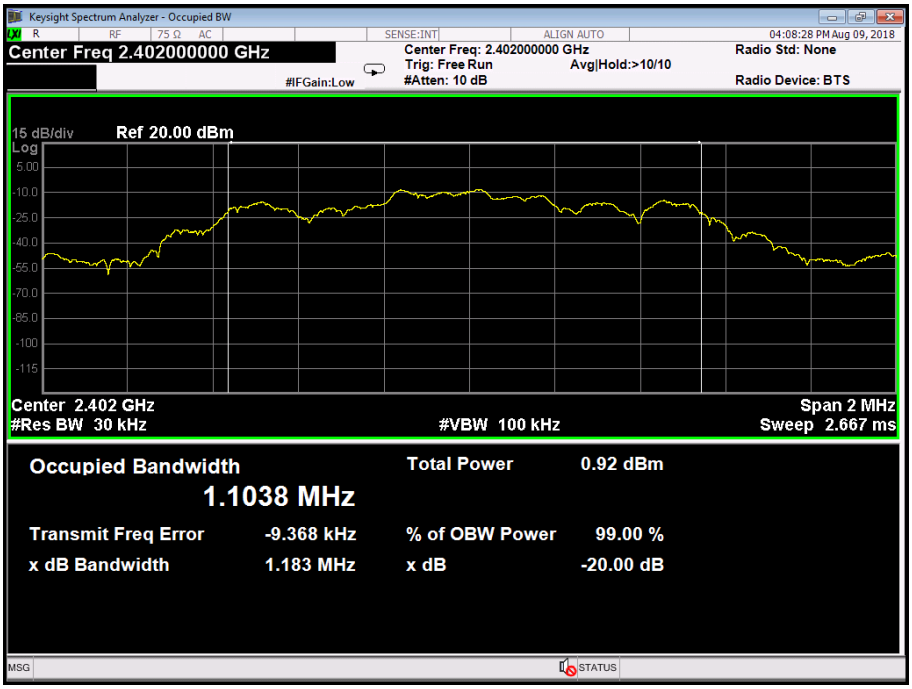


Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	TX Mode (8-DPSK)		

Channel frequency (MHz)	99% OBW (kHz)	20dB Bandwidth (kHz)	20dB Bandwidth *2/3 (kHz)
2402	1.1038	1.183	788.67
2441	1.1079	1.185	790.00
2480	1.1107	1.190	793.33

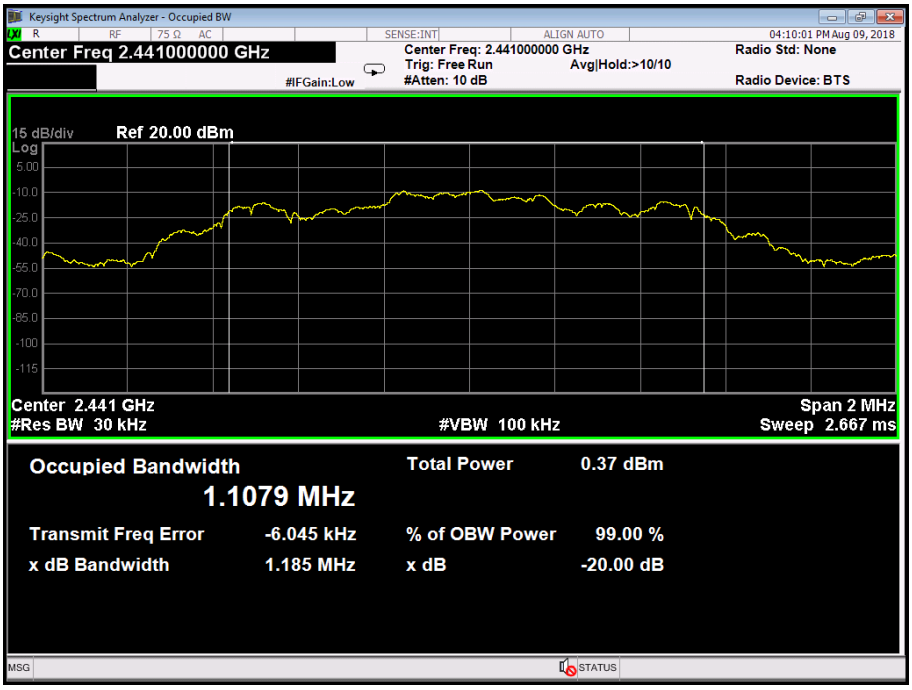
8-DPSK TX Mode

2402 MHz



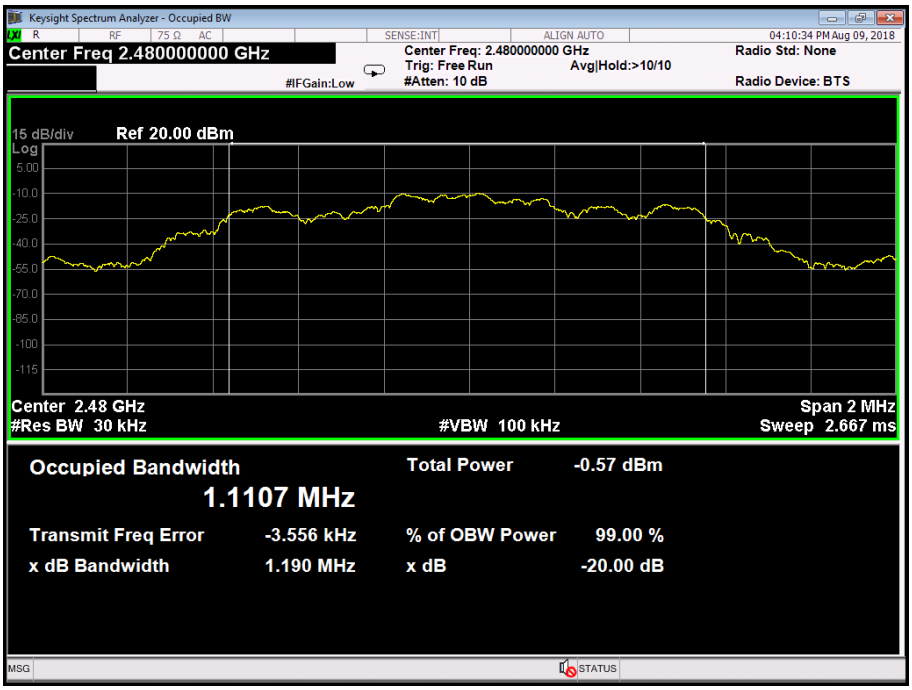
8-DPSK TX Mode

2441 MHz



8-DPSK TX Mode

2480 MHz

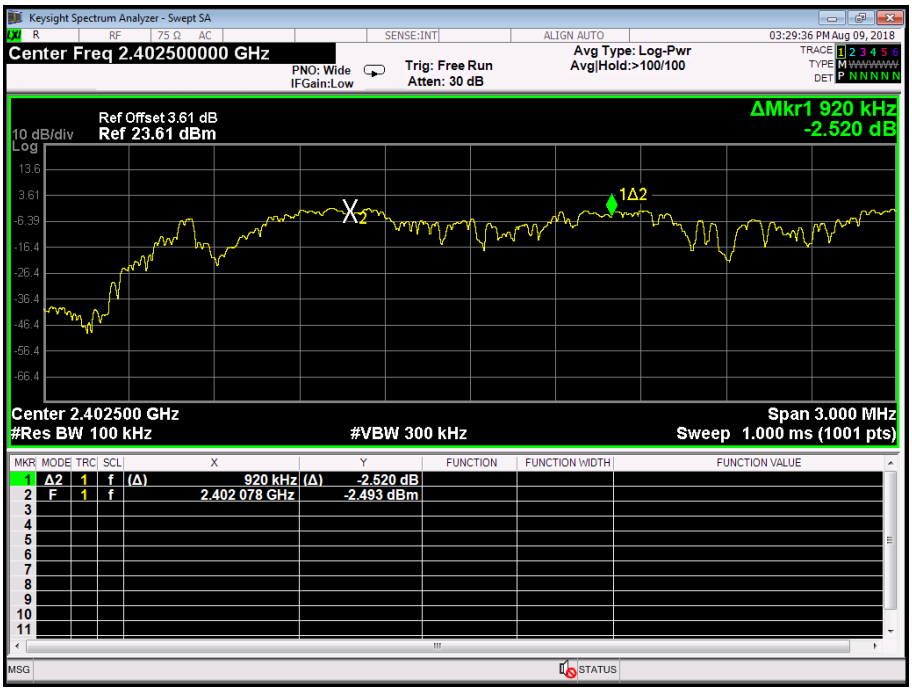


Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode (GFSK)		

Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit (kHz)
2402	920	822.00
2441	990	818.67
2480	870	819.33

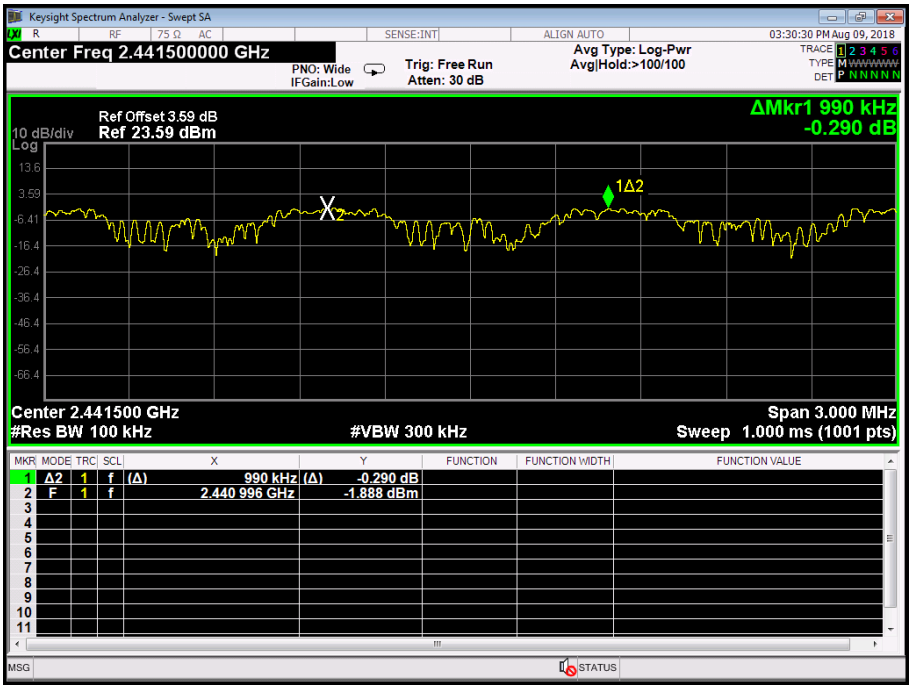
GFSK Hopping Mode

2402 MHz



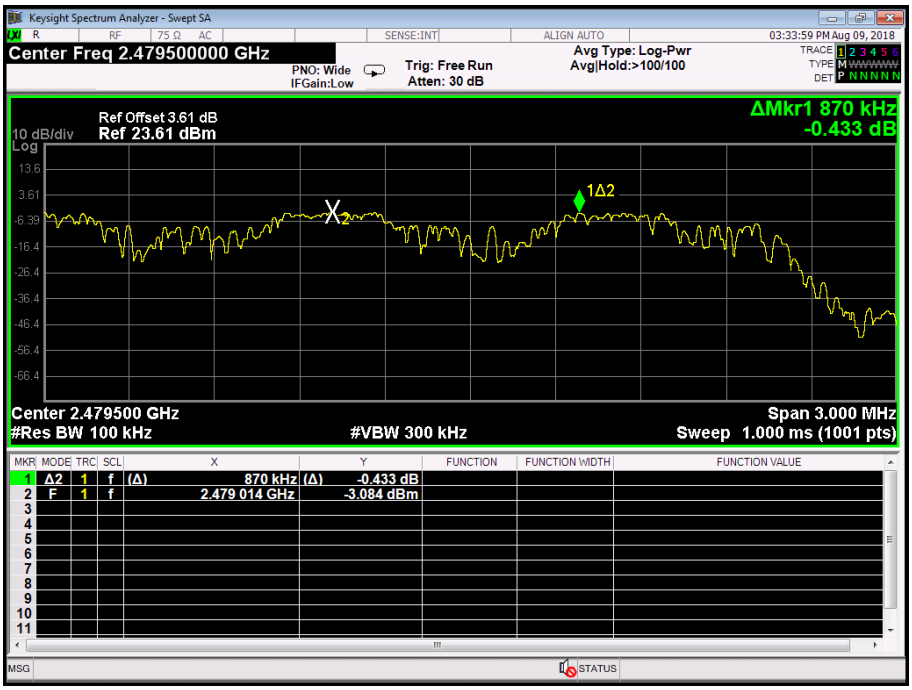
GFSK Hopping Mode

2441 MHz



GFSK Hopping Mode

2480 MHz

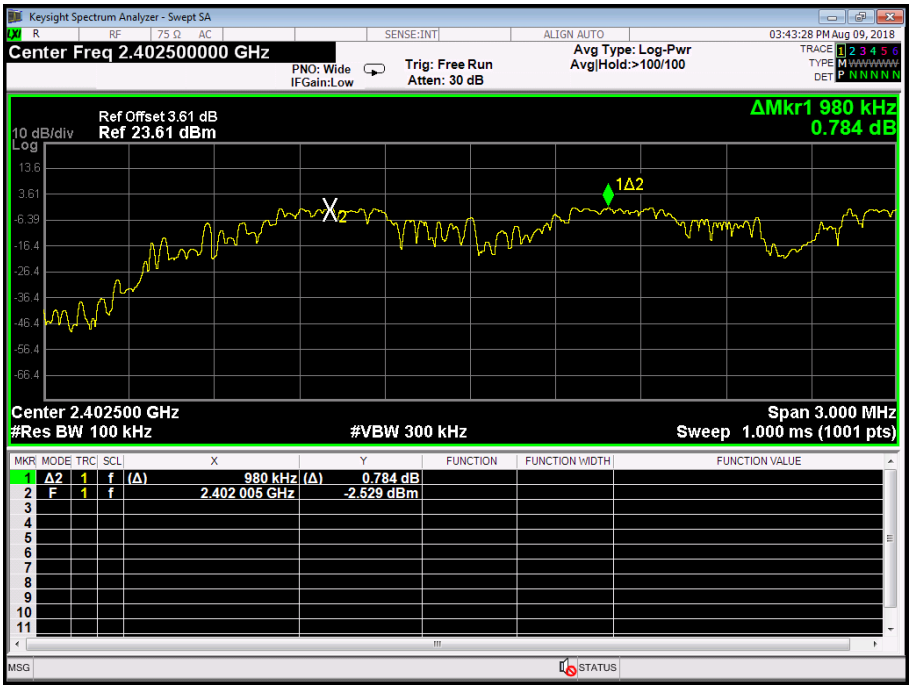


Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode (π /4-DQPSK)		

Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit (kHz)
2402	980	784.67
2441	1130	786.00
2480	990	818.67

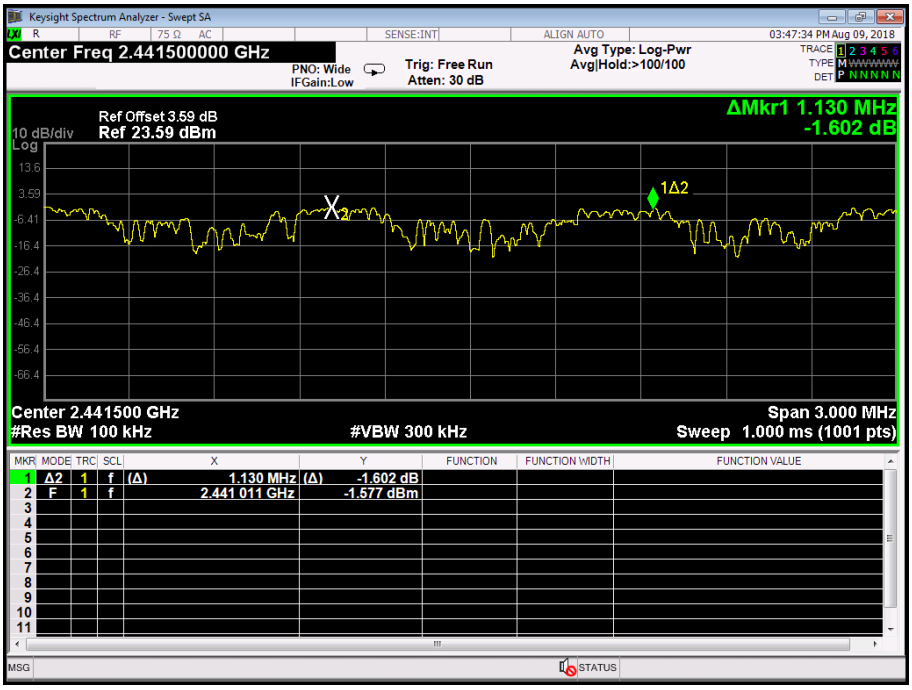
π /4-DQPSK Hopping Mode

2402 MHz



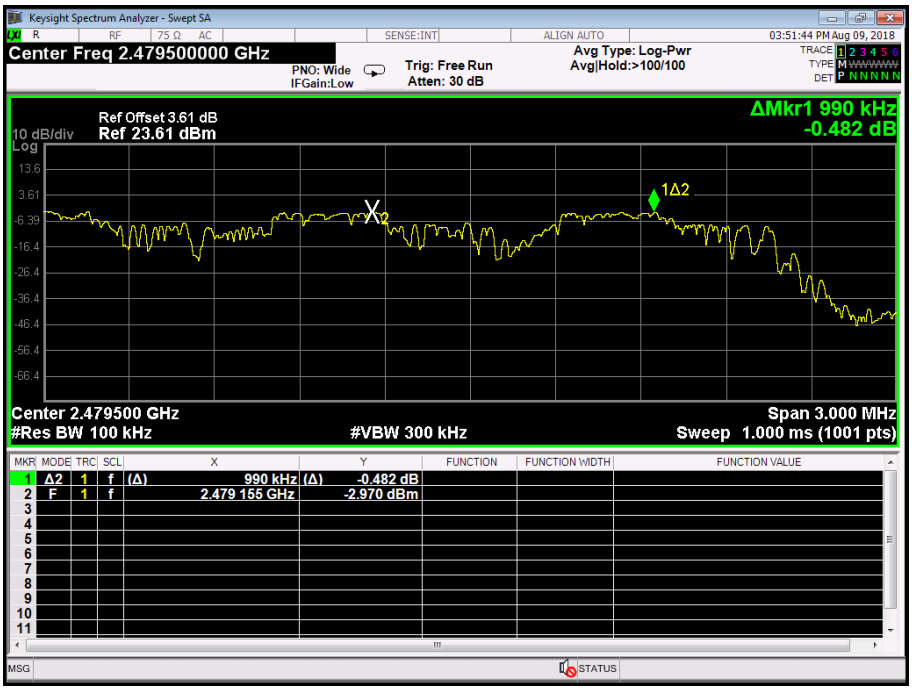
π /4-DQPSK Hopping Mode

2441 MHz



π /4-DQPSK Hopping Mode

2480 MHz

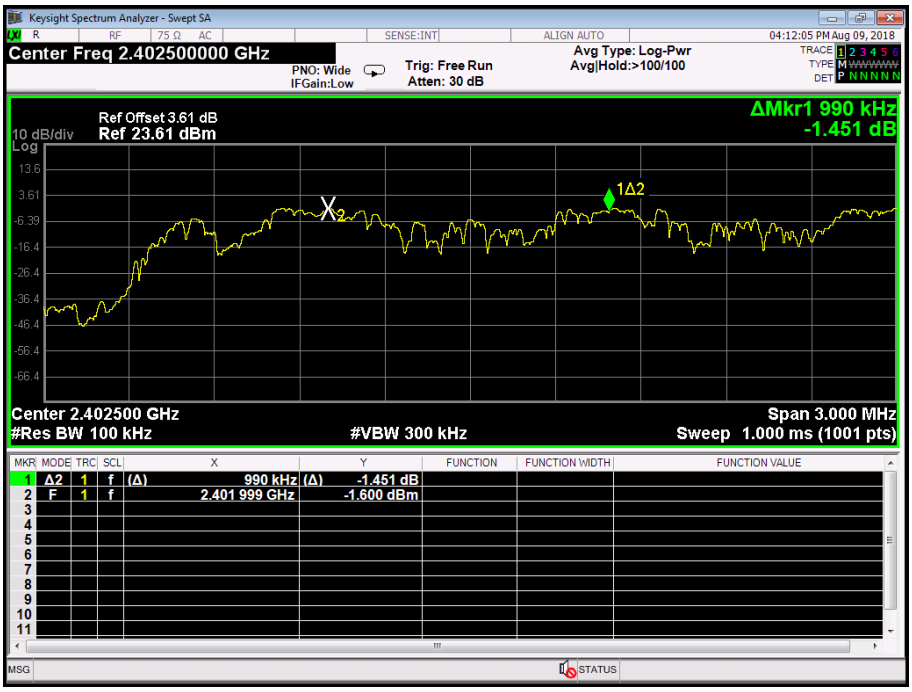


Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode (8-DPSK)		

Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit (kHz)
2402	990	788.67
2441	1010	790.00
2480	1130	793.33

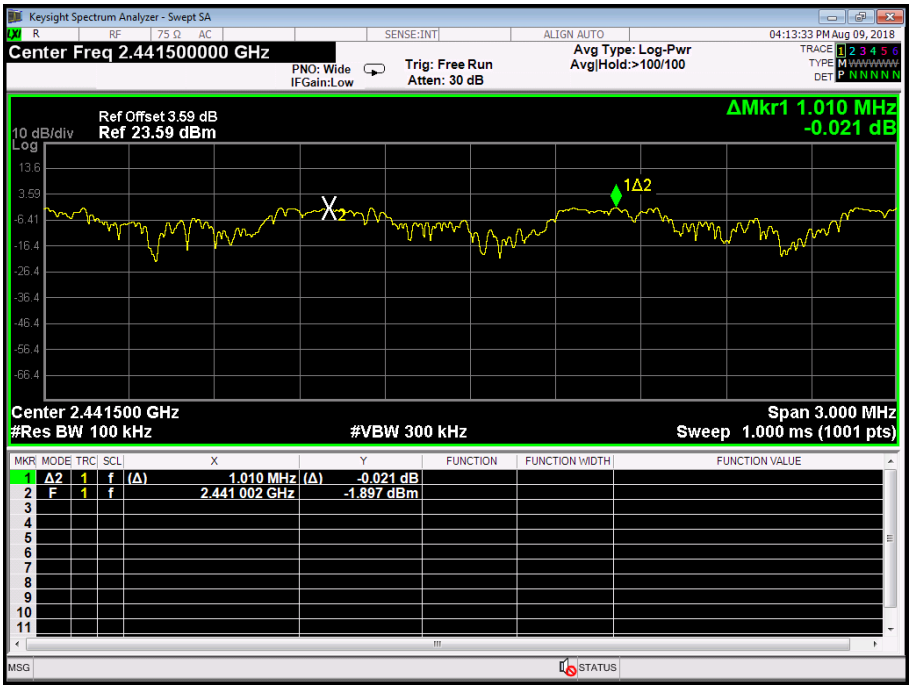
8-DPSK Hopping Mode

2402 MHz



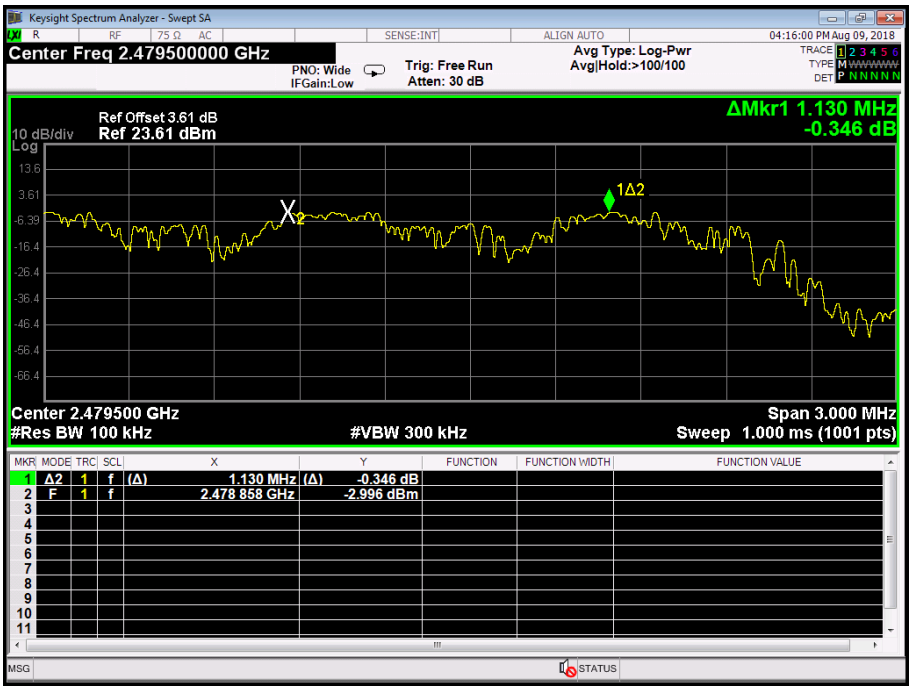
8-DPSK Hopping Mode

2441 MHz



8-DPSK Hopping Mode

2480 MHz



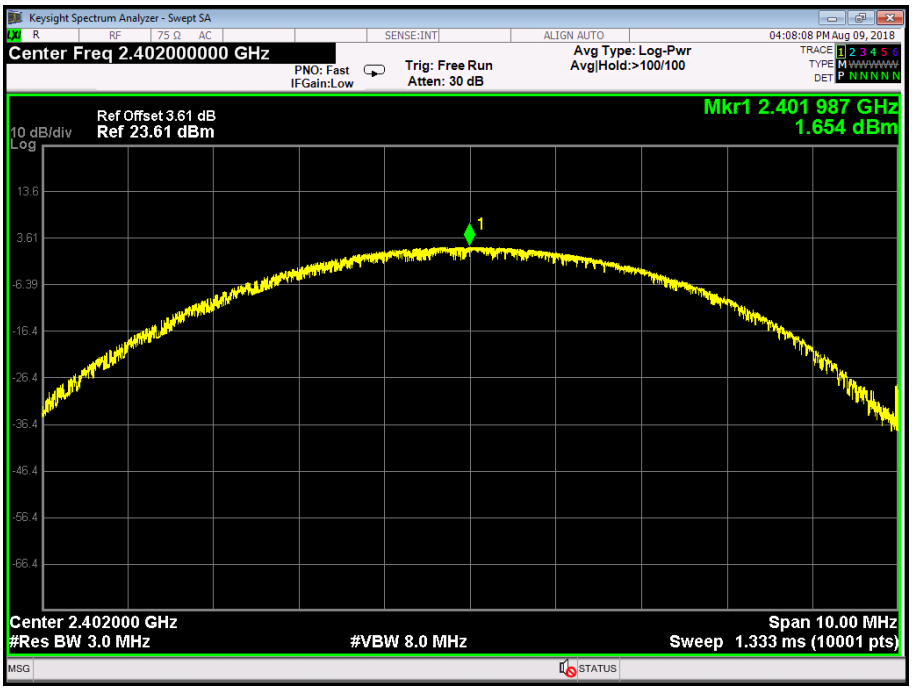
Attachment G-- Peak Output Power Test Data

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Test Mode:	TX Mode (GFSK)		

Channel frequency (MHz)	Test Result (dBm)	Limit (dBm)
2402	1.654	**21**
2441	1.181	
2480	-0.021	

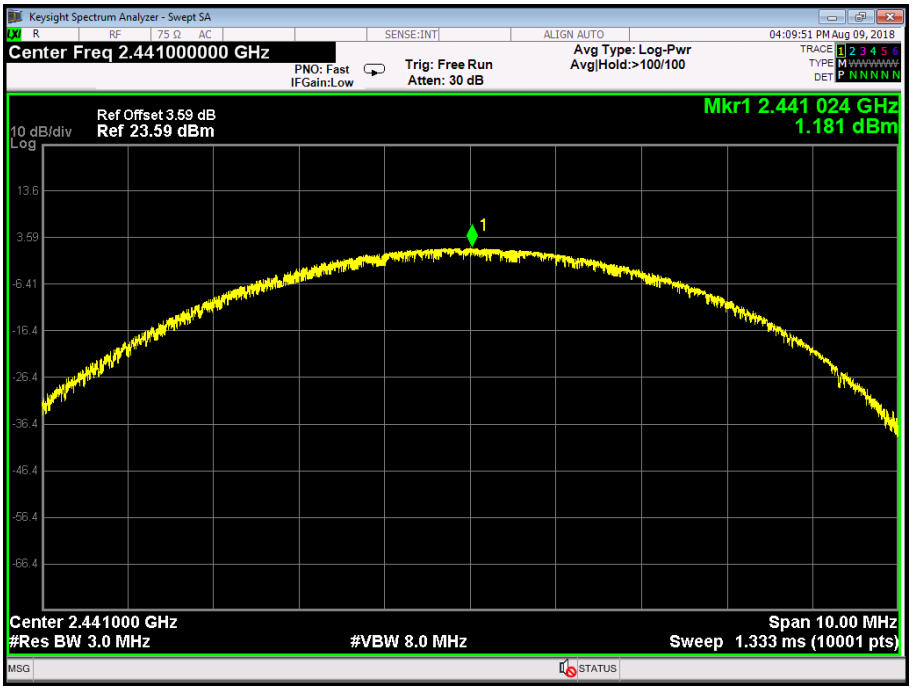
GFSK TX Mode

2402 MHz



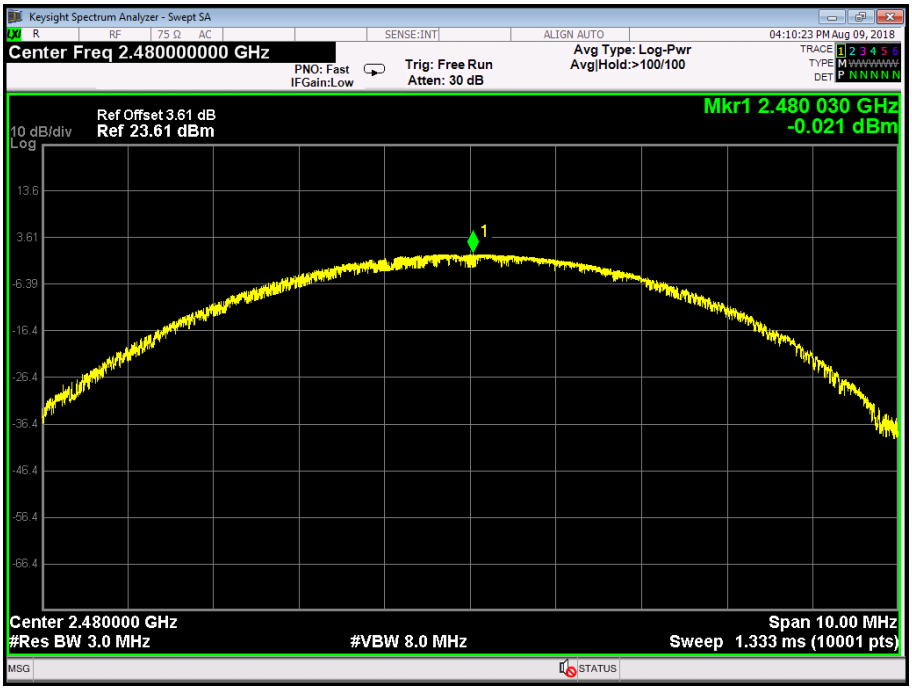
GFSK TX Mode

2441 MHz



GFSK TX Mode

2480 MHz

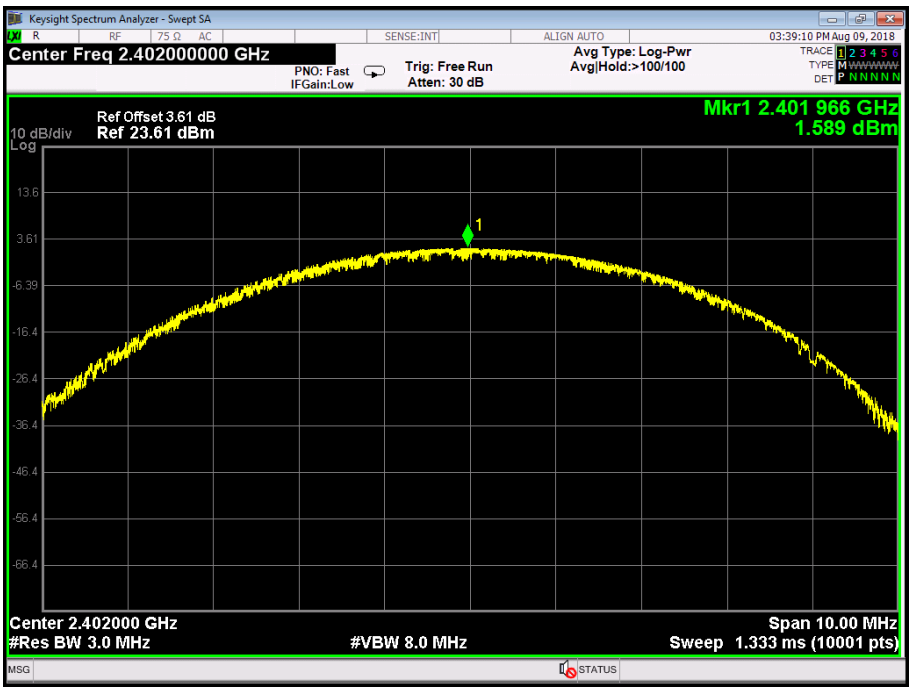


Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	TX Mode (π/4-DQPSK)		

Channel frequency (MHz)	Test Result (dBm)	Limit (dBm)
2402	1.589	21
2441	1.166	
2480	-0.065	

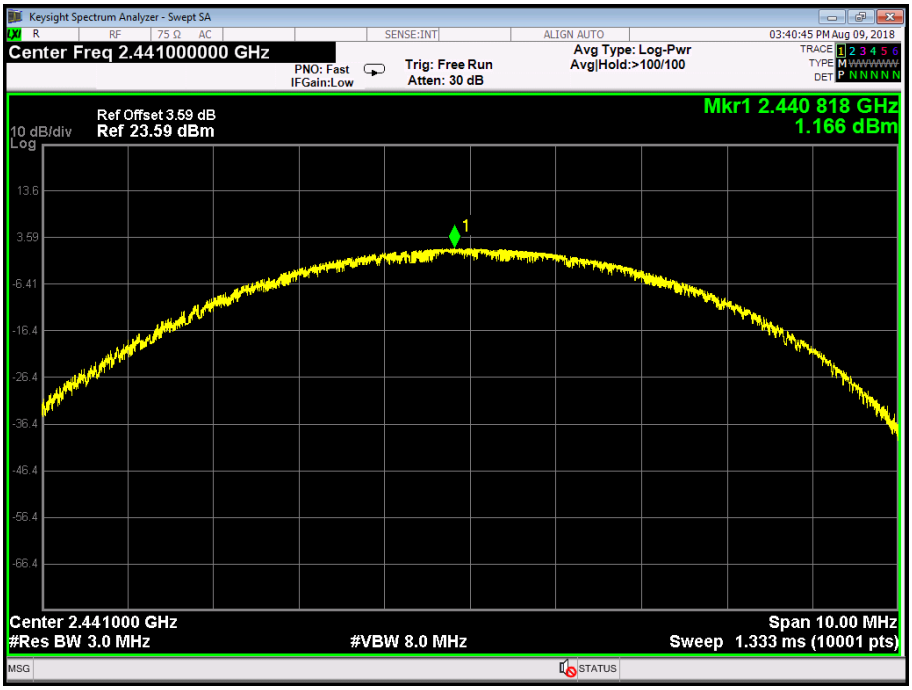
π/4-DQPSK TX Mode

2402 MHz



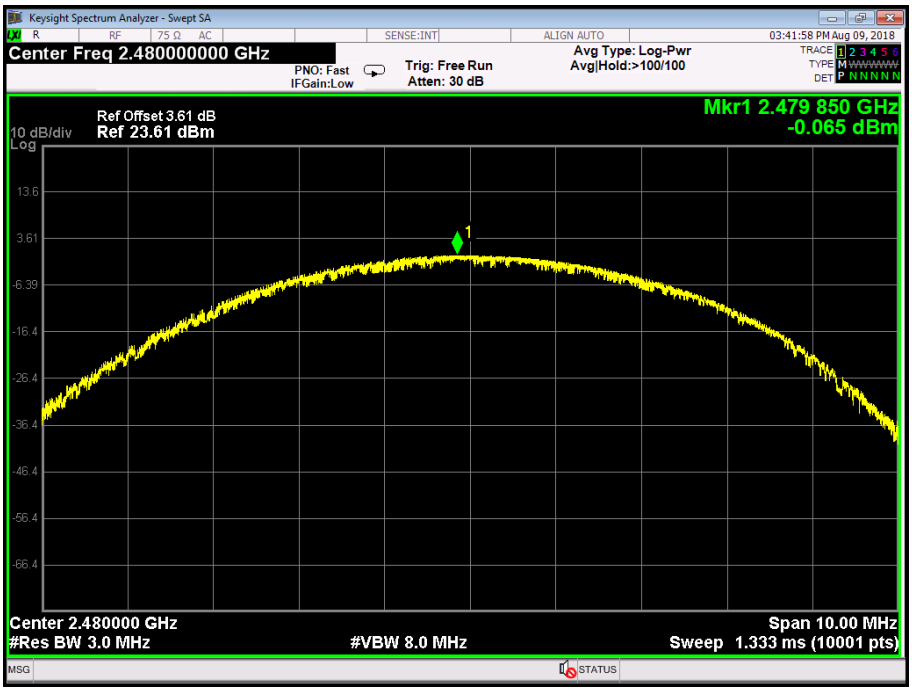
π /4-DQPSK TX Mode

2441 MHz



π /4-DQPSK TX Mode

2480 MHz

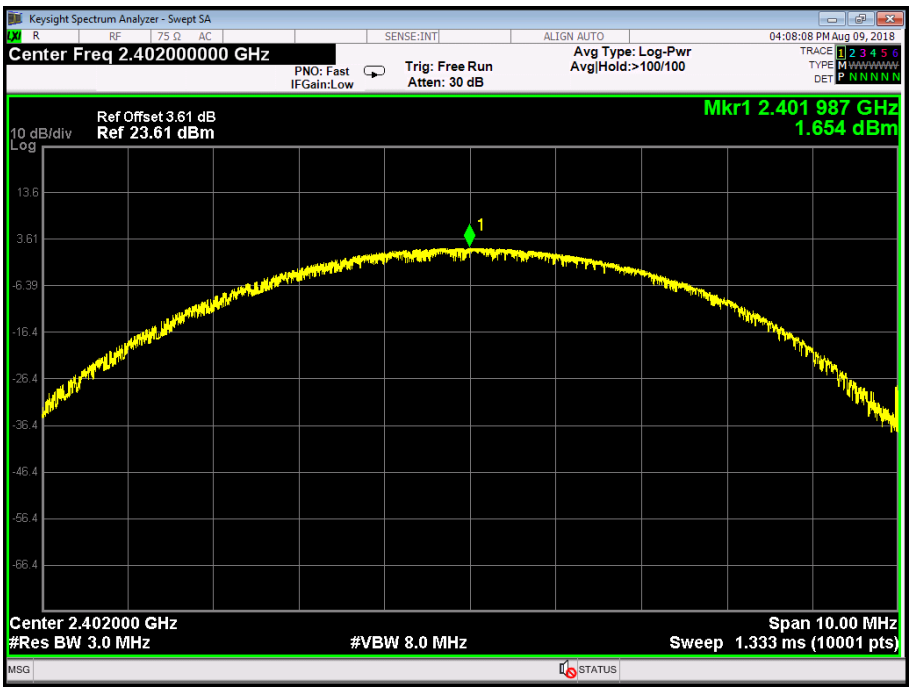


Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	TX Mode (8-DPSK)		

Channel frequency (MHz)	Test Result (dBm)	Limit (dBm)
2402	1.654	21
2441	1.181	
2480	-0.021	

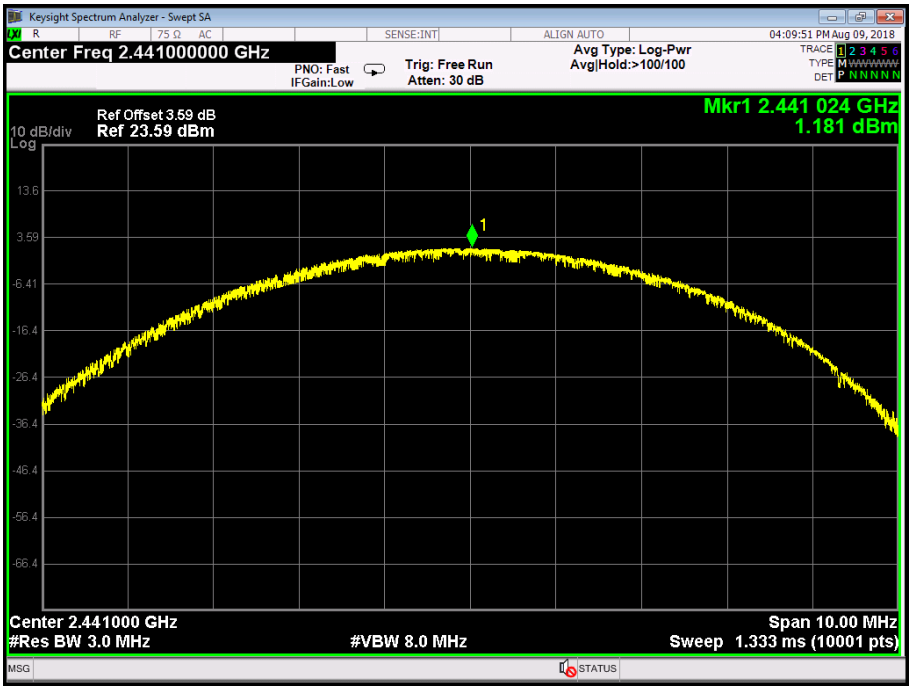
8-DPSK TX Mode

2402 MHz



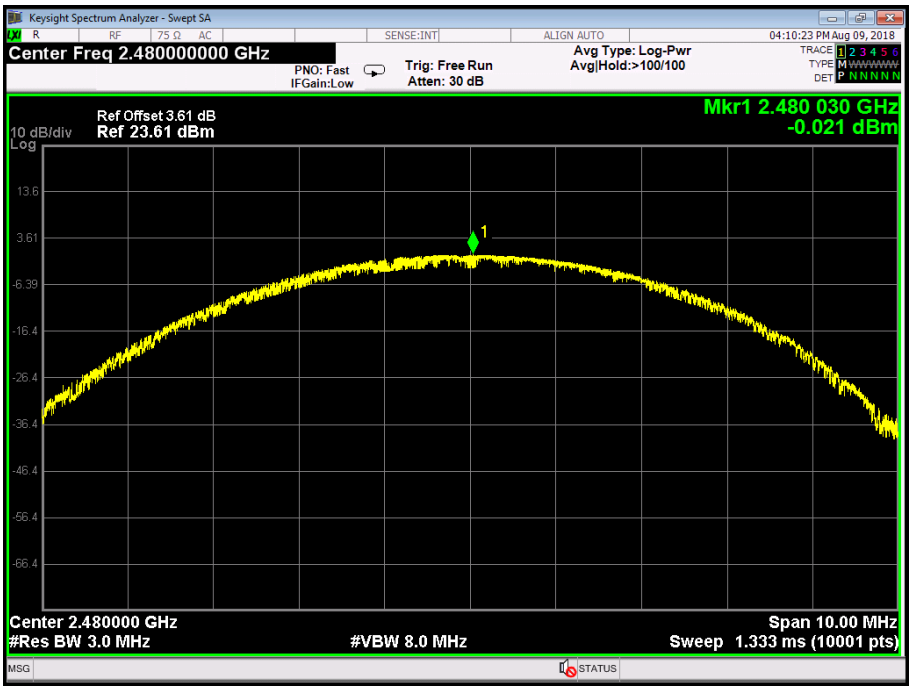
8-DPSK TX Mode

2441 MHz



8-DPSK TX Mode

2480 MHz



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