FCC Radio Test Report

FCC ID: 2AZ2P-X5M

Original Grant

Report No.	:	TB-FCC180316
Applicant	:	Shenzhen Zijing Optoelectronics Technology Co., Ltd.
Equipment Under Test (EUT)		
EUT Name	:	Projector
Model No.	:	X5M
Series Model No.	:	X5A, X5P, X2A, X2M, X2P, X3A, X3M, X3P
Brand Name	:	Aisy.od, waygoal
Sample ID	:	20210510-22-01#& 20210510-22-04#
Receipt Date	:	2021-05-10
Test Date	:	2021-05-11 to 2021-05-24
Issue Date	:	2021-05-25
Standards	:	FCC Part 15, Subpart C 15.247
Test Method	:	ANSI C63.10: 2013 KDB 558074 D01 15.247 Meas Guidance v05r02
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	:	Rebeca
Engineer Supervisor	:	IVAN SU
Engineer Manager	:	Ray Lai

SHENZHEN TOBY TECHNOLOGY CO., LTD. TOBY

Rebeca

Ivan Su

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.

1/F.,Building 6, Rundongsheng Industrial Zone, Longzhu, Xixiang, Bao'an District, Shenzhen, Guangdong, China
Tel: +86 75526509301 Fax: +86 75526509195

Contents

CONTENTS....2
1. GENERAL INFORMATION ABOUT EUT....5
1.1 Client Information....5
1.2 General Description of EUT (Equipment Under Test)....5
1.3 Block Diagram Showing the Configuration of System Tested....7
1.5 Description of Test Mode....7
1.6 Description of Test Software Setting....8
1.7 Measurement Uncertainty....9
1.8 Test Facility....9
2. TEST SUMMARY....10
3. TEST SOFTWARE....10
4. TEST EQUIPMENT....11
5. CONDUCTED EMISSION TEST....12
5.1 Test Standard and Limit....12
5.2 Test Setup....12
5.3 Test Procedure....12
5.4 Deviation From Test Standard....13
5.5 EUT Operating Mode....13
5.6 Test Data....13
6. RADIATED AND CONDUCTED UNWANTED EMISSIONS....14
6.1 Test Standard and Limit....14
6.2 Test Setup....15
6.3 Test Procedure....16
6.5 EUT Operating Condition....17
6.6 Test Data....17
7. RESTRICTED BANDS REQUIREMENT....18
7.1 Test Standard and Limit....18
7.2 Test Setup....18
7.3 Test Procedure....18
7.4 Deviation From Test Standard....19
7.5 EUT Operating Condition....19
7.6 Test Data....19
8. NUMBER OF HOPPING CHANNEL....20
8.1 Test Standard and Limit....20
8.2 Test Setup....20
8.3 Test Procedure....20
8.4 Deviation From Test Standard....20
8.5 EUT Operating Condition....20
8.6 Test Data....20

9. AVERAGE TIME OF OCCUPANCY 21
9.1 Test Standard and Limit 21
9.2 Test Setup 21
9.3 Test Procedure 21
9.4 EUT Operating Condition 21
9.4 Deviation From Test Standard 22
9.5 EUT Operating Condition 22
9.6 Test Data 22
10. CHANNEL SEPARATION AND BANDWIDTH TEST 23
10.1 Test Standard and Limit 23
10.2 Test Setup 23
10.3 Test Procedure 23
10.4 Deviation From Test Standard 24
10.5 EUT Operating Condition 24
10.6 Test Data 24
11. PEAK OUTPUT POWER TEST 25
11.1 Test Standard and Limit 25
11.2 Test Setup 25
11.3 Test Procedure 25
11.4 Deviation From Test Standard 25
11.5 EUT Operating Condition 25
11.6 Test Data 25
12. ANTENNA REQUIREMENT 26
12.1 Standard Requirement 26
12.2 Deviation From Test Standard 26
12.3 Antenna Connected Construction 26
12.4 Result 26
ATTACHMENT A-- CONDUCTED EMISSION TEST DATA 27
ATTACHMENT B--UNWANTED EMISSIONS DATA 31
ATTACHMENT C-- RESTRICTED BANDS REQUIREMENT AND BAND EDGE TEST DATA 47
ATTACHMENT D-- NUMBER OF HOPPING CHANNEL TEST DATA 59
ATTACHMENT E-- AVERAGE TIME OF OCCUPANCY TEST DATA 60
ATTACHMENT F-- CHANNEL SEPARATION AND BANDWIDTH TEST DATA 64
ATTACHMENT G-- PEAK OUTPUT POWER TEST DATA 72

Revision History

Report No.	Version	Description	Issued Date
TB-FCC180316	Rev.01	Initial issue of report	2021-05-25

1. General Information about EUT

1.1 Client Information

Applicant	:	Shenzhen Zijing Optoelectronics Technology Co., Ltd.
Address	:	4 / F, No.66, Baotian Industrial Park, Xixiang Street, Baoan District, Shenzhen City, China
Manufacturer	:	Shenzhen Zijing Optoelectronics Technology Co., Ltd.
Address	:	4 / F, No.66, Baotian Industrial Park, Xixiang Street, Baoan District, Shenzhen City, China

1.2 General Description of EUT (Equipment Under Test)

EUT Name	:	Projector	
Models No.	:	X5M, X5A, X5P, X2A, X2M, X2P, X3A, X3M, X3P	
Model Difference	:	All these models are identical in the same PCB, layout and electrical circuit, The only difference is model name.	
Product Description	:	Operation Frequency:	Bluetooth V5.0(BT): 2402~2480 MHz
		Number of Channel:	Bluetooth: 79 Channels See Note 2
		Antenna Gain:	-0.58dBi PCB Antenna
		Modulation Type:	GFSK π /4-DQPSK
Power Rating	:	Adapter 1#(PS65B190Y3420S) Input: 100-240V~, 50/60Hz,1.5A MAX Output: DC 19.0V 3.42A 64.98W Adapter 2#(CW1903420) Input: 100-240V~, 50/60Hz,1.2A MAX Output: DC 19.0V 3.42A 64.98W	
Software Version	:	N/A	
Hardware Version	:	N/A	
Remark	:	The antenna gain and adapter provided by the applicant, the verified for the RF conduction test provided by TOBY test lab.	

Note:

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

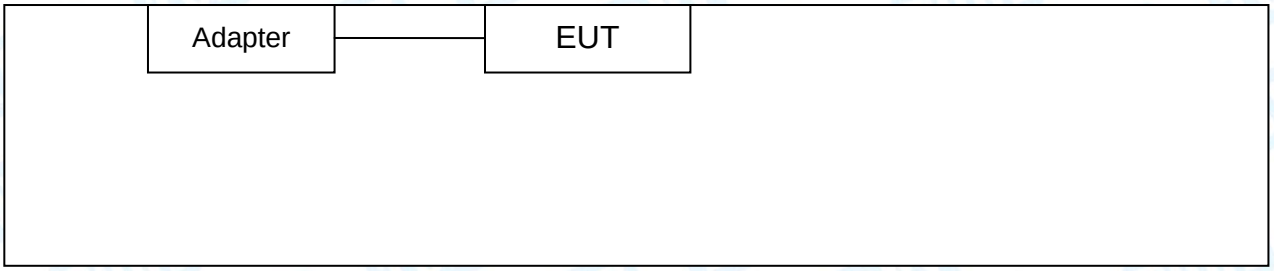
(2) Channel List:

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



1.4 Description of Support Units

Equipment Information				
Name	**Model**	**FCC ID/VOC**	**Manufacturer**	**Used "√"**
---	----	----	----	---
Cable Information				
Number	**Shielded Type**	**Ferrite Core**	**Length**	**Note**
---	----	----	----	---

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 with Adapter 1#
Mode 2	Charging+TX Mode with Adapter 2#
For Radiated Test	
Final Test Mode	**Description**
Mode 3	Charging+TX Mode with Adapter 1#
Mode 4	Charging+TX Mode with Adapter 2#
Mode 5	TX Mode(GFSK) Channel 00/39/78
Mode 6	TX Mode(π /4-DQPSK) Channel 00/39/78
Mode 7	Hopping Mode(GFSK)
Mode 8	Hopping Mode(π /4-DQPSK)

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)

(2) The EUT is considered a Mobile 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	**FCC_assist.exe**		
Frequency	2402 MHz	2441MHz	2480 MHz
GFSK	DEF	DEF	DEF
π /4-DQPSK	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	±3.50 dB ±3.10 dB
Radiated Emission	Level Accuracy: 9kHz to 30 MHz	±4.60 dB
Radiated Emission	Level Accuracy: 30MHz to 1000 MHz	±4.50 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: 2017 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 17025：2017 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.
Designation Number: CN1223.

IC Registration No.: (11950A)

The Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing. The site registration: Site# 11950A. CAB identifier: CN0056

2. Test Summary

FCC Part 15 Subpart C(15.247)				
Standard Section	**Test Item**	**Test Sample(s)**	**Judgment**	**Remark**
15.203	Antenna Requirement	20210510-22-01#	PASS	N/A
15.207	Conducted Emission	20210510-22-04#	PASS	N/A
15.205	Restricted Bands	20210510-22-01#	PASS	N/A
15.247(a)(1)	Hopping Channel Separation	20210510-22-01#	PASS	N/A
15.247(a)(1)	Dwell Time	20210510-22-01#	PASS	N/A
15.247(b)(1)	Peak Output Power	20210510-22-01#	PASS	N/A
15.247(b)(1)	Number of Hopping Frequency	20210510-22-01#	PASS	N/A
15.247(d)	Band Edge	20210510-22-01#	PASS	N/A
15.247(c)&15.209	Radiated Spurious Emission	20210510-22-01# 20210510-22-04#	PASS	N/A
15.247(a)	99% Occupied Bandwidth & 20dB Bandwidth	20210510-22-01#	PASS	N/A
Note: N/A is an abbreviation for Not Applicable.				

3. Test Software

Test Item	Test Software	Manufacturer	Version No.
Conducted Emission	EZ-EMC	EZ	CDI-03A2
Radiation Emission	EZ-EMC	EZ	FA-03A2RE
RF Conducted Measurement	MTS-8310	MWRFtest	V2.0.0.0

4. Test Equipment

Conducted Emission Test					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Last Cal.**	**Cal. Due Date**
EMI Test Receiver	Rohde & Schwarz	ESCI	100321	Jul. 06, 2020	Jul. 05, 2021
RF Switching Unit	Compliance Direction Systems Inc	RSU-A4	34403	Jul. 06, 2020	Jul. 05, 2021
AMN	SCHWARZBECK	NNBL 8226-2	8226-2/164	Jul. 06, 2020	Jul. 05, 2021
LISN	Rohde & Schwarz	ENV216	101131	Jul. 06, 2020	Jul. 05, 2021
Radiation Emission Test					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Last Cal.**	**Cal. Due Date**
Spectrum Analyzer	Agilent	E4407B	MY45106456	Jul. 06, 2020	Jul. 05, 2021
EMI Test Receiver	Rohde & Schwarz	ESPI	100010/007	Jul. 06, 2020	Jul. 05, 2021
Spectrum Analyzer	Rohde & Schwarz	FSV40-N	102197	Jul. 06, 2020	Jul. 05, 2021
Bilog Antenna	ETS-LINDGREN	3142E	00117537	Mar.01, 2020	Feb. 28, 2022
Horn Antenna	ETS-LINDGREN	3117	00143207	Mar.01, 2020	Feb. 28, 2022
Horn Antenna	ETS-LINDGREN	BBHA 9170	BBHA9170582	Mar.01, 2020	Feb. 28, 2022
Loop Antenna	SCHWARZBECK	FMZB 1519 B	1519B-059	Jul. 07, 2020	Jul. 06, 2021
Pre-amplifier	Sonoma	310N	185903	Feb. 25, 2021	Feb. 24, 2022
Pre-amplifier	HP	8449B	3008A00849	Feb. 25, 2021	Feb. 24, 2022
Pre-amplifier	SKET	LNPA_1840G-50	SK201904032	Feb. 25, 2021	Feb. 24, 2022
Cable	HUBER+SUHNER	100	SUCOFLEX	Feb. 25, 2021	Feb. 24, 2022
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. 06, 2020	Jul. 05, 2021
Spectrum Analyzer	Rohde & Schwarz	ESPI	100010/007	Jul. 06, 2020	Jul. 05, 2021
MXA Signal Analyzer	Agilent	N9020A	MY49100060	Sep. 11, 2020	Sep. 10, 2021
Vector Signal Generator	Agilent	N5182A	MY50141294	Sep. 11, 2020	Sep. 10, 2021
Analog Signal Generator	Agilent	N5181A	MY50141953	Sep. 11, 2020	Sep. 10, 2021
RF Power Sensor	DARE!! Instruments	RadiPowerRPR3006W	17I00015SNO26	Sep. 11, 2020	Sep. 10, 2021
	DARE!! Instruments	RadiPowerRPR3006W	17I00015SNO29	Sep. 11, 2020	Sep. 10, 2021
	DARE!! Instruments	RadiPowerRPR3006W	17I00015SNO31	Sep. 11, 2020	Sep. 10, 2021
	DARE!! Instruments	RadiPowerRPR3006W	17I00015SNO33	Sep. 11, 2020	Sep. 10, 2021

5. Conducted Emission Test

5.1 Test Standard and Limit

5.1.1Test Standard

FCC Part 15.207

5.1.2 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

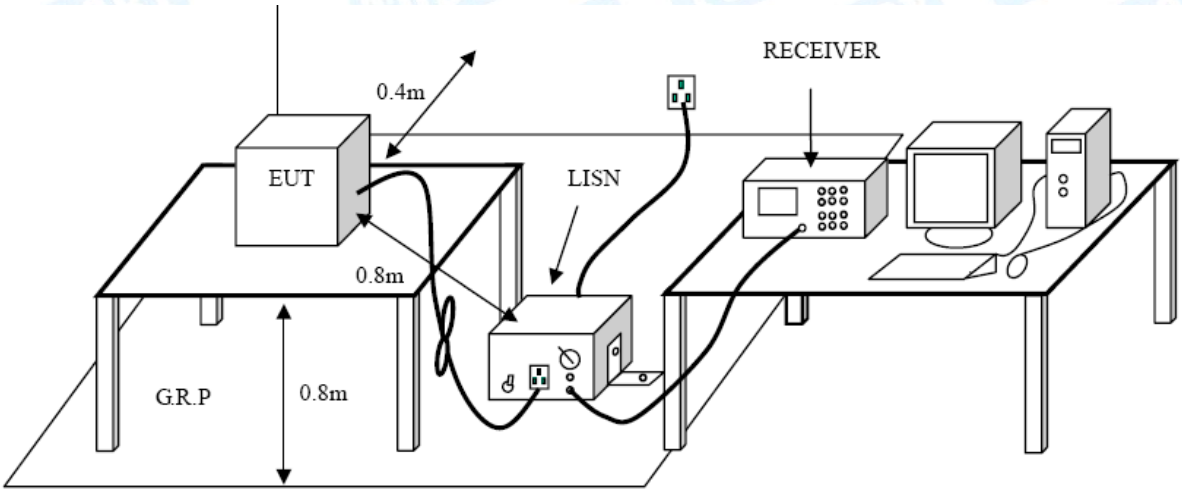
Notes:

(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.

5.2 Test Setup



5.3 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.

5.4 Deviation From Test Standard

No deviation

5.5 EUT Operating Mode

Please refer to the description of test mode.

5.6 Test Data

Please refer to the Attachment A.

6. Radiated and Conducted Unwanted Emissions

6.1 Test Standard and Limit

6.1.1 Test Standard

FCC Part 15.209

6.1.2 Test Limit

Radiated Emission Limits (9kHz~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 (dBuV/m)	Average (dBuV/m)
Above 1000	74	54

Note:

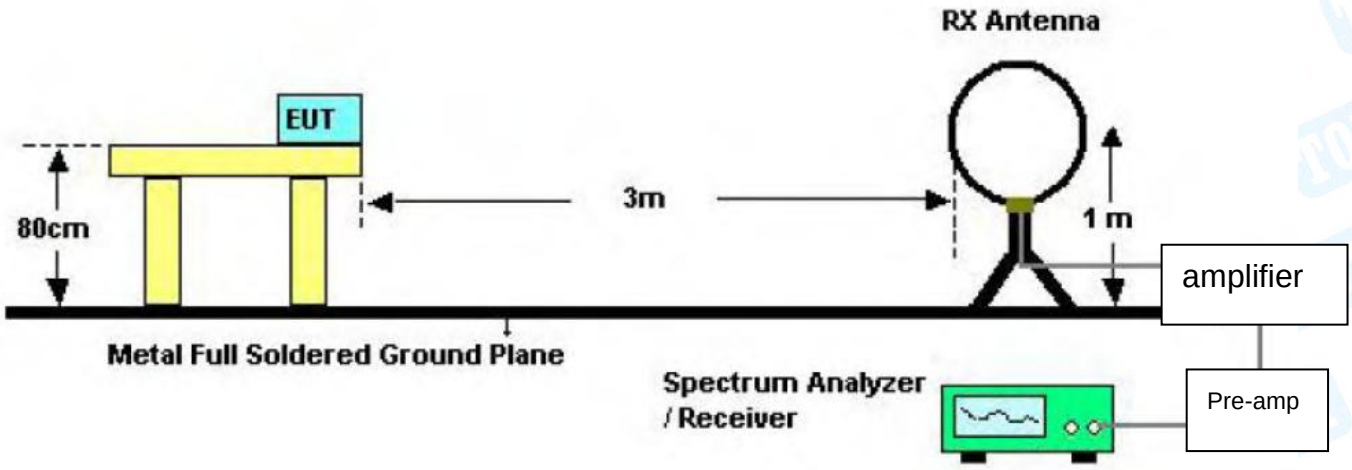
(1) The tighter limit applies at the band edges.

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

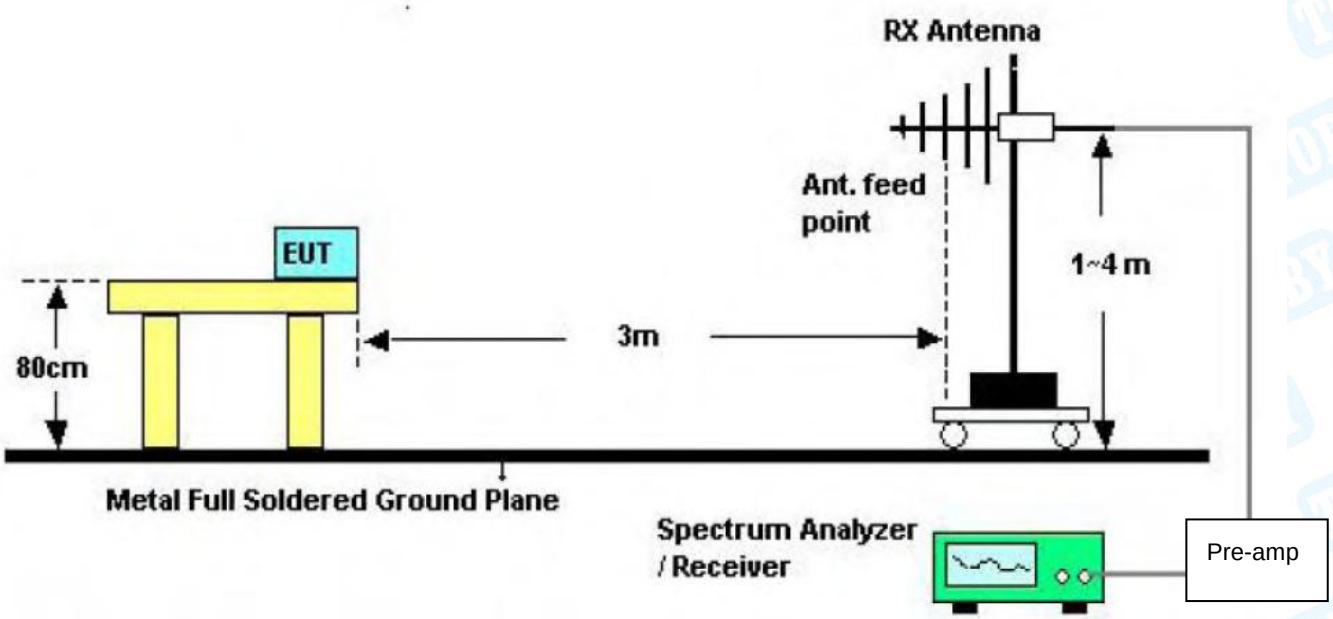
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB.

6.2 Test Setup

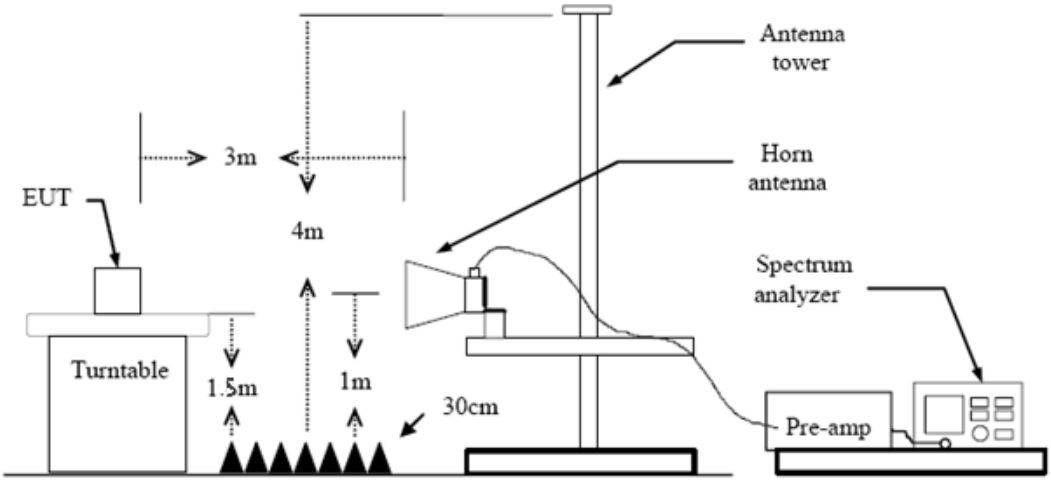
Radiated measurement



Below 30MHz Test Setup

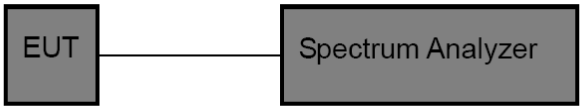


Below 1000MHz Test Setup



Above 1GHz Test Setup

Conducted measurement



6.3 Test Procedure

Radiated measurement

(1) 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.

(2) Measurements at frequency Below 1GHz. The EUT was placed on a rotating 0.8m 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.

Conducted measurement

Testing shall be done on a laboratory bench in a shielded room or in another suitable location. The active antenna port of the unlicensed wireless device shall be connected to the spectrum analyzer after applying appropriate precautions to protect the instrumentation. If a second antenna port is available, then it shall be tested at one operating frequency, with other port(s) appropriately terminated, to verify it has similar output characteristics as the fully tested port. (See also 7.8.8, 11.12.2, and 12.1.2.)

For the actual test configuration, please see the test setup photo.

6.4 Deviation From Test Standard

No deviation

6.5 EUT Operating Condition

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

6.6 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.

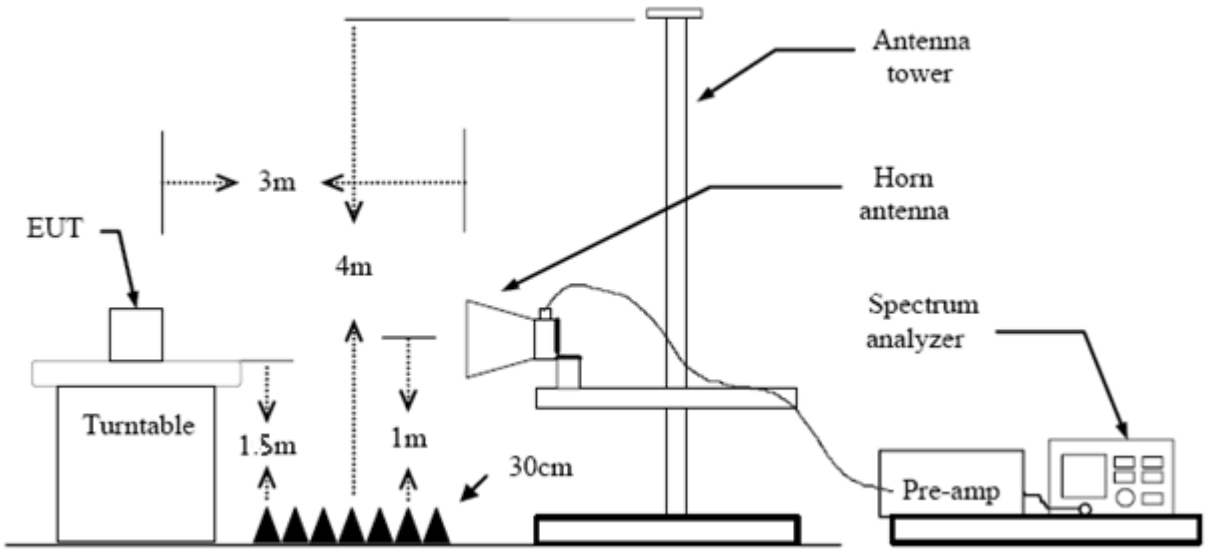
7. Restricted Bands Requirement

7.1 Test Standard and Limit

7.1.1 Test Standard
FCC Part 15.209
FCC Part 15.205
7.1.2 Test Limit

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

7.2 Test Setup



7.3 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.

7.4 Deviation From Test Standard

No deviation

7.5 EUT Operating Condition

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

7.6 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.

8. Number of Hopping Channel

8.1 Test Standard and Limit

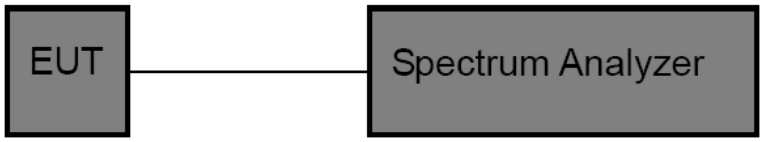
8.1.1 Test Standard

FCC Part 15.247 (a)(1)

8.1.2 Test Limit

Section	Test Item	Limit
15.247	Number of Hopping Channel	>15

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=100 KHz, VBW=100 KHz, Sweep time= Auto.

8.4 Deviation From Test Standard

No deviation

8.5 EUT Operating Condition

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

8.6 Test Data

Please refer to the Attachment D.

9. Average Time of Occupancy

9.1 Test Standard and Limit

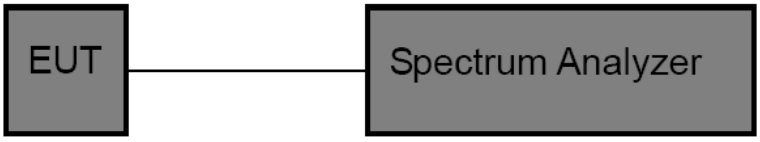
9.1.1 Test Standard

FCC Part 15.247 (a)(1)

9.1.2 Test Limit

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

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: 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 centre 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.

9.4 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.

9.4 Deviation From Test Standard

No deviation

9.5 EUT Operating Condition

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

9.6 Test Data

Please refer to the Attachment E.

10. Channel Separation and Bandwidth Test

10.1 Test Standard and Limit

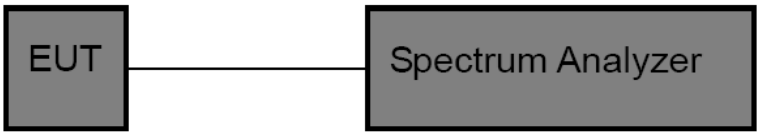
10.1.1 Test Standard

FCC Part 15.247

10.1.2 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

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:
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.

10.4 Deviation From Test Standard

No deviation

10.5 EUT Operating Condition

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

10.6 Test Data

Please refer to the Attachment F.

11. Peak Output Power Test

11.1 Test Standard and Limit

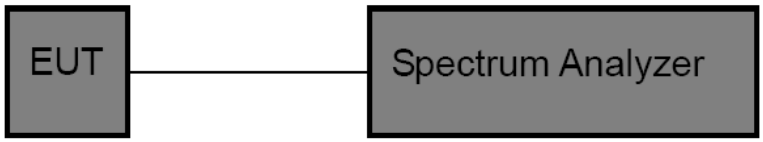
11.1.1 Test Standard

FCC Part 15.247 (b) (1)

11.1.2 Test Limit

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

11.2 Test Setup



11.3 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≥ RBW for bandwidth more than 1MHz.

11.4 Deviation From Test Standard

No deviation

11.5 EUT Operating Condition

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

11.6 Test Data

Please refer to the Attachment G.

12. Antenna Requirement

12.1 Standard Requirement

12.1.1 Standard

FCC Part 15.203

12.1.2 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.

12.2 Deviation From Test Standard

No deviation

12.3 Antenna Connected Construction

The gains of the antenna used for transmitting is -0.58dBi, and the antenna connector is de-signed with permanent attachment and no consideration of replacement. Please see the EUT photo for details.

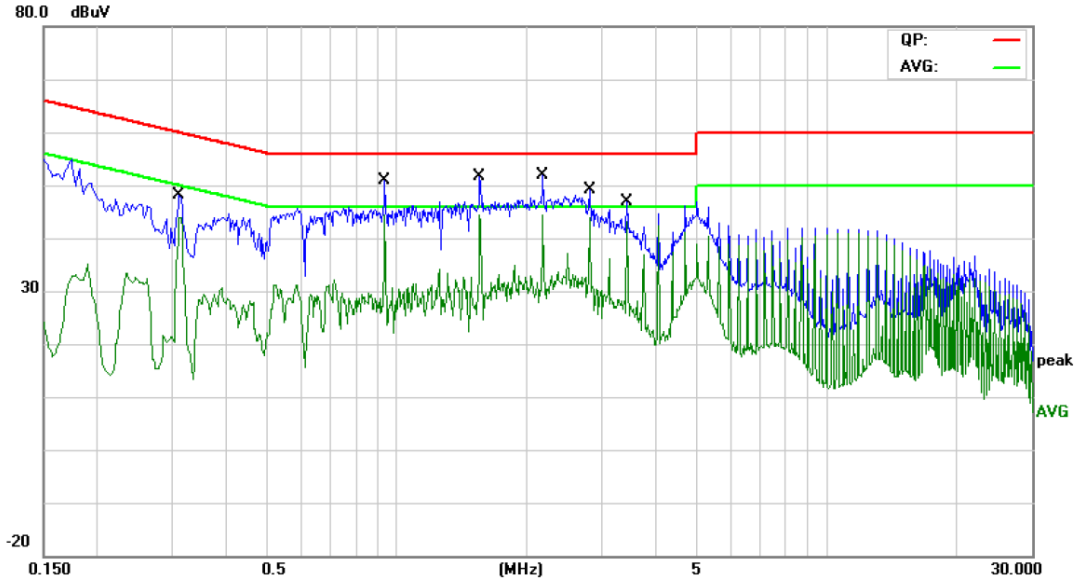
12.4 Result

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

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

Attachment A-- Conducted Emission Test Data

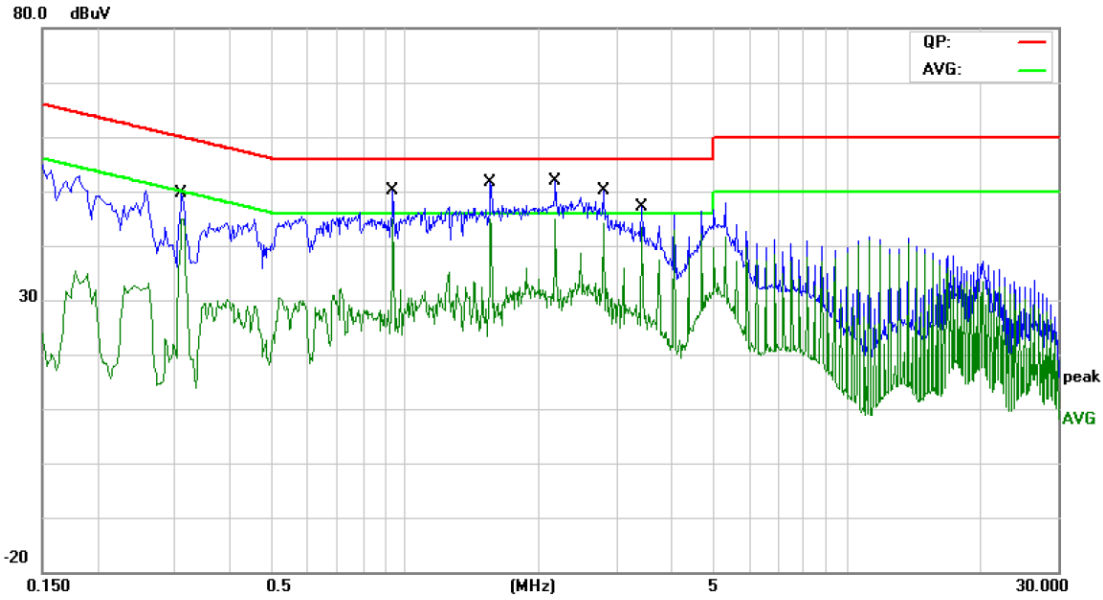
Temperature:	23.5℃	**Relative Humidity:**	48%
Test Voltage:	AC 120V/60 Hz		
Terminal:	Line		
Test Mode:	Mode 1		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.3100	35.05	9.70	44.75	59.97	-15.22	QP
2		0.3100	34.32	9.70	44.02	49.97	-5.95	AVG
3		0.9380	37.29	9.78	47.07	56.00	-8.93	QP
4	*	0.9380	35.18	9.78	44.96	46.00	-1.04	AVG
5		1.5580	38.87	9.74	48.61	56.00	-7.39	QP
6		1.5580	34.89	9.74	44.63	46.00	-1.37	AVG
7		2.1820	39.47	9.74	49.21	56.00	-6.79	QP
8		2.1820	34.63	9.74	44.37	46.00	-1.63	AVG
9		2.8060	37.83	9.86	47.69	56.00	-8.31	QP
10		2.8060	34.40	9.86	44.26	46.00	-1.74	AVG
11		3.4300	35.46	9.90	45.36	56.00	-10.64	QP
12		3.4300	33.28	9.90	43.18	46.00	-2.82	AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. QuasiPeak (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = QuasiPeak (dBμV/m)-Limit QPK(dBμV/m)

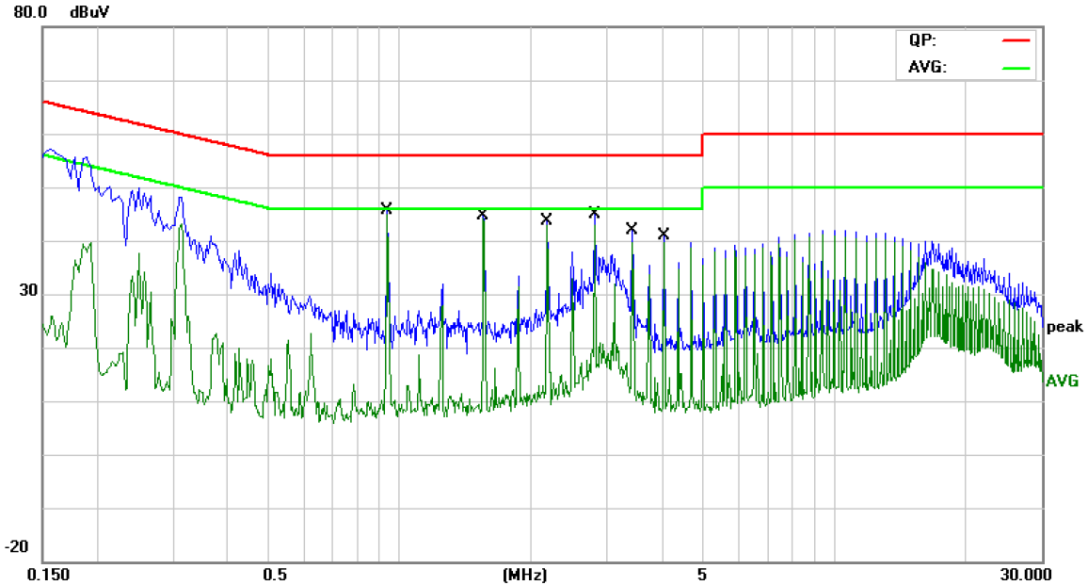
Temperature:	23.5℃	**Relative Humidity:**	48%
Test Voltage:	AC 120V/60 Hz		
Terminal:	Neutral		
Test Mode:	Mode 1		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.3100	35.13	9.70	44.83	59.97	-15.14	QP
2		0.3100	34.42	9.70	44.12	49.97	-5.85	AVG
3		0.9380	37.34	9.78	47.12	56.00	-8.88	QP
4		0.9380	34.08	9.78	43.86	46.00	-2.14	AVG
5		1.5580	38.79	9.74	48.53	56.00	-7.47	QP
6	*	1.5580	34.58	9.74	44.32	46.00	-1.68	AVG
7		2.1820	39.49	9.74	49.23	56.00	-6.77	QP
8		2.1820	34.13	9.74	43.87	46.00	-2.13	AVG
9		2.8060	37.56	9.86	47.42	56.00	-8.58	QP
10		2.8060	34.37	9.86	44.23	46.00	-1.77	AVG
11		3.4300	35.10	9.90	45.00	56.00	-11.00	QP
12		3.4300	33.10	9.90	43.00	46.00	-3.00	AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. QuasiPeak (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = QuasiPeak (dBμV/m)-Limit QPK(dBμV/m)

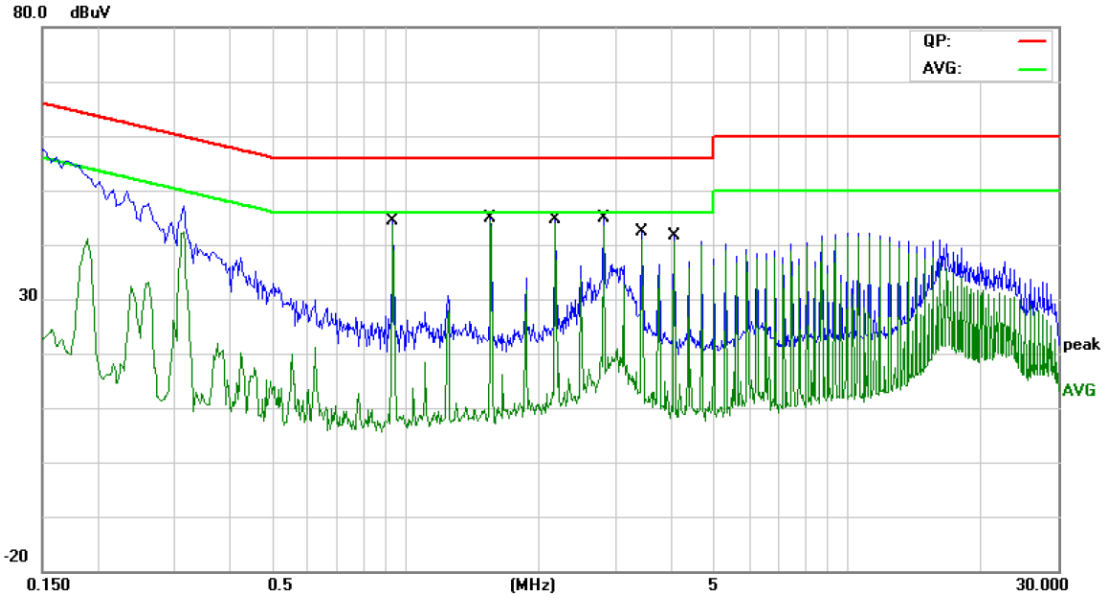
Temperature:	23.5℃	**Relative Humidity:**	48%
Test Voltage:	AC 120V/60 Hz		
Terminal:	Line		
Test Mode:	Mode 2		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.9380	32.85	9.78	42.63	56.00	-13.37	QP
2		0.9380	33.03	9.78	42.81	46.00	-3.19	AVG
3		1.5580	34.22	9.74	43.96	56.00	-12.04	QP
4	*	1.5580	34.40	9.74	44.14	46.00	-1.86	AVG
5		2.1860	31.18	9.74	40.92	56.00	-15.08	QP
6		2.1860	31.06	9.74	40.80	46.00	-5.20	AVG
7		2.8100	30.81	9.86	40.67	56.00	-15.33	QP
8		2.8100	29.99	9.86	39.85	46.00	-6.15	AVG
9		3.4340	27.17	9.90	37.07	56.00	-18.93	QP
10		3.4340	26.06	9.90	35.96	46.00	-10.04	AVG
11		4.0540	30.91	9.90	40.81	56.00	-15.19	QP
12		4.0540	30.55	9.90	40.45	46.00	-5.55	AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. QuasiPeak (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = QuasiPeak (dBμV/m)-Limit QPK(dBμV/m)

Temperature:	23.5℃	**Relative Humidity:**	48%
Test Voltage:	AC 120V/60 Hz		
Terminal:	Neutral		
Test Mode:	Mode 2		
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		0.9340	34.03	9.80	43.83	56.00	-12.17	QP
2		0.9340	34.21	9.80	44.01	46.00	-1.99	AVG
3		1.5580	34.13	9.80	43.93	56.00	-12.07	QP
4	*	1.5580	34.28	9.80	44.08	46.00	-1.92	AVG
5		2.1820	34.00	9.80	43.80	56.00	-12.20	QP
6		2.1820	34.03	9.80	43.83	46.00	-2.17	AVG
7		2.8060	34.19	9.80	43.99	56.00	-12.01	QP
8		2.8060	33.62	9.80	43.42	46.00	-2.58	AVG
9		3.4300	31.84	9.80	41.64	56.00	-14.36	QP
10		3.4300	30.75	9.80	40.55	46.00	-5.45	AVG
11		4.0540	30.96	9.80	40.76	56.00	-15.24	QP
12		4.0540	30.61	9.80	40.41	46.00	-5.59	AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. QuasiPeak (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = QuasiPeak (dBμV/m)-Limit QPK(dBμV/m)

Attachment B--Unwanted Emissions Data

---Radiated Unwanted Emissions

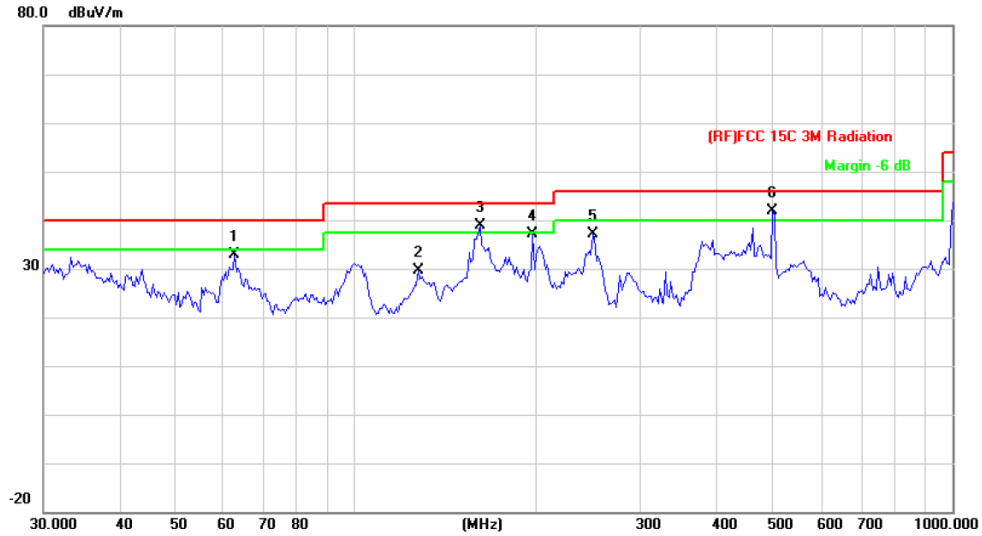
9KHz~30MHz

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:	23.6℃	**Relative Humidity:**	45%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Horizontal		
Test Mode:	Mode 3		
Remark:	Only worse case is reported		

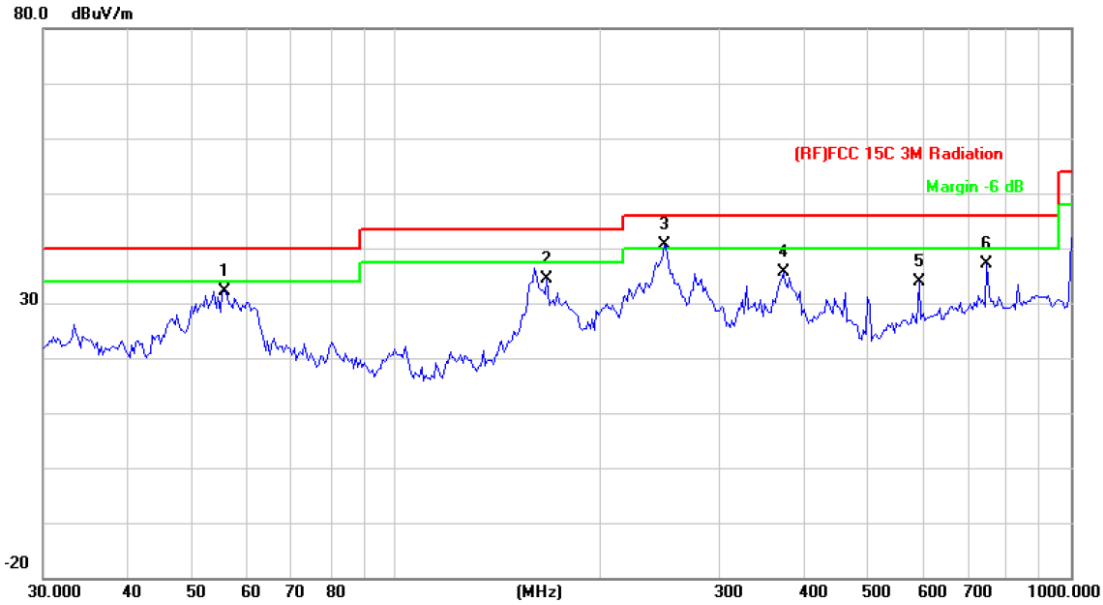


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		62.6507	56.77	-24.00	32.77	40.00	-7.23	peak
2		127.2176	51.80	-22.28	29.52	43.50	-13.98	peak
3	!	161.4740	59.52	-20.76	38.76	43.50	-4.74	peak
4		197.8926	57.08	-19.92	37.16	43.50	-6.34	peak
5		249.4250	54.43	-17.25	37.18	46.00	-8.82	peak
6	*	499.4246	52.33	-10.48	41.85	46.00	-4.15	peak

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

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. QuasiPeak (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = QuasiPeak (dBμV/m)-Limit QPK(dBμV/m)

Temperature:	23.6℃	**Relative Humidity:**	45%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Vertical		
Test Mode:	Mode 3		
Remark:	Only worse case is reported		

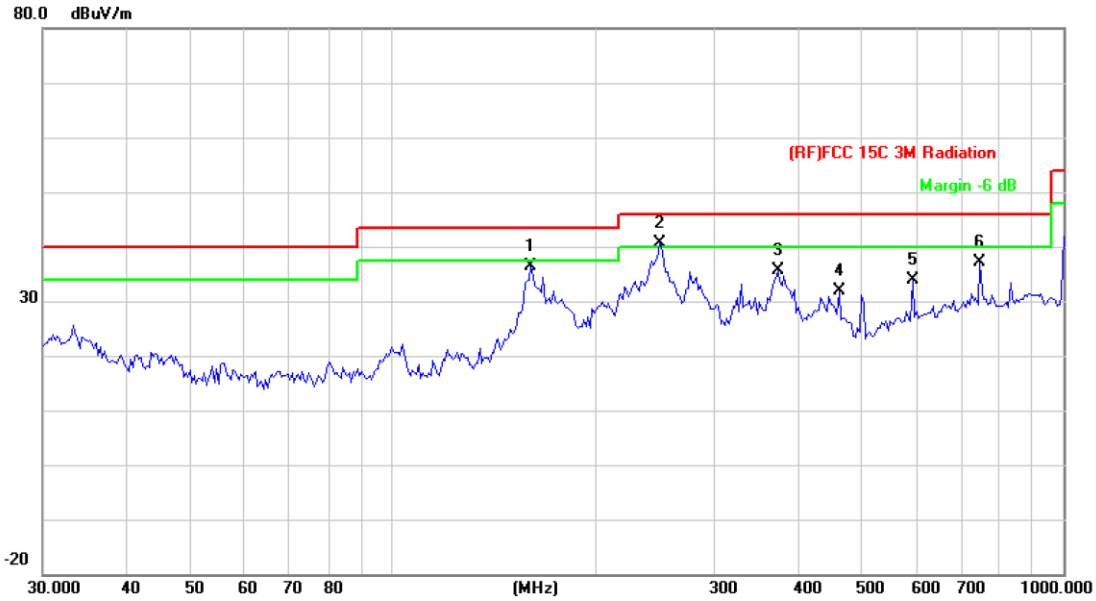


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		55.6094	55.90	-23.70	32.20	40.00	-7.80	peak
2		167.2366	54.85	-20.56	34.29	43.50	-9.21	peak
3	*	249.4250	57.95	-17.25	40.70	46.00	-5.30	peak
4		374.6225	49.23	-13.49	35.74	46.00	-10.26	peak
5		595.1327	42.31	-8.37	33.94	46.00	-12.06	peak
6		750.1082	43.73	-6.60	37.13	46.00	-8.87	peak

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

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. QuasiPeak (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = QuasiPeak (dBμV/m)-Limit QPK(dBμV/m)

Temperature:	23.6℃	**Relative Humidity:**	45%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Horizontal		
Test Mode:	Mode 4		
Remark:	Only worse case is reported		

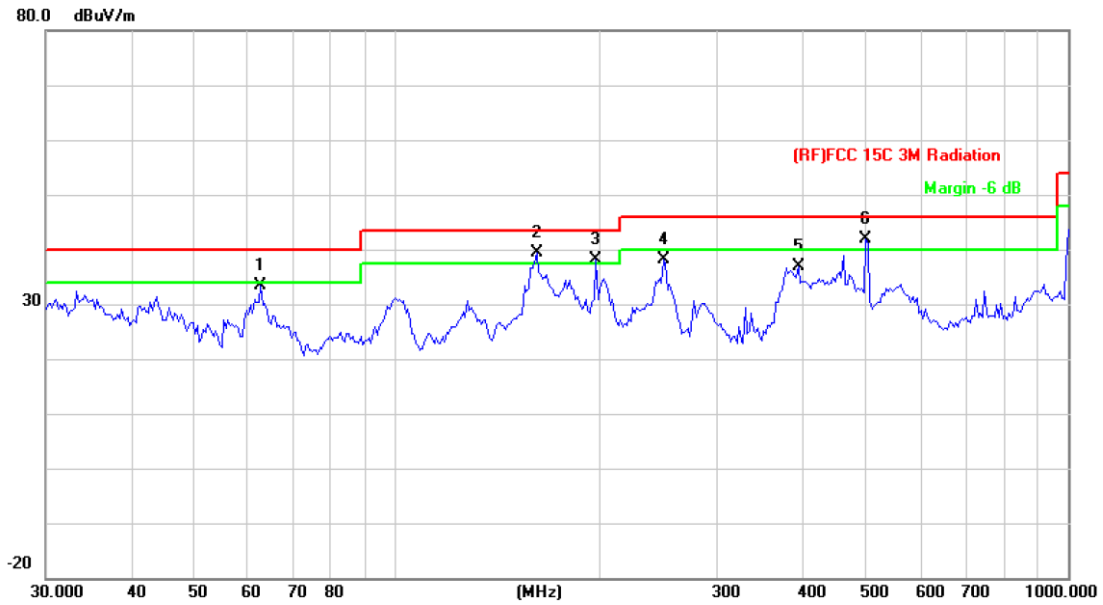


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		160.3456	57.24	-20.79	36.45	43.50	-7.05	peak
2	*	249.4250	57.95	-17.25	40.70	46.00	-5.30	peak
3		374.6225	49.23	-13.49	35.74	46.00	-10.26	peak
4		462.3455	43.37	-11.57	31.80	46.00	-14.20	peak
5		595.1329	42.31	-8.37	33.94	46.00	-12.06	peak
6		750.1083	43.73	-6.60	37.13	46.00	-8.87	peak

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

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. QuasiPeak (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = QuasiPeak (dBμV/m)-Limit QPK(dBμV/m)

Temperature:	23.6℃	**Relative Humidity:**	45%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Vertical		
Test Mode:	Mode 4		
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		62.6507	57.27	-24.00	33.27	40.00	-6.73	peak
2	!	161.4742	60.02	-20.76	39.26	43.50	-4.24	peak
3	!	197.8928	58.08	-19.92	38.16	43.50	-5.34	peak
4		249.4250	55.43	-17.25	38.18	46.00	-7.82	peak
5		396.2415	49.25	-12.48	36.77	46.00	-9.23	peak
6	*	499.4247	52.33	-10.48	41.85	46.00	-4.15	peak

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

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. QuasiPeak (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = QuasiPeak (dBμV/m)-Limit QPK(dBμV/m)

Above 1GHz(Only worse case is reported)

Temperature:	23.6℃	**Relative Humidity:**	46%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2402MHz		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4804.016	37.30	13.01	50.31	54.00	-3.69	AVG
2		4804.742	49.73	13.03	62.76	74.00	-11.24	peak

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated1-26.5GHz,The testing has been conformed to the 10th harmonic of the highest fundamental frequency.
5. No report for the emission which more than 20dB below the prescribed limit.

Temperature:	23.6℃	**Relative Humidity:**	46%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2402MHz		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4804.036	37.33	13.01	50.34	54.00	-3.66	AVG
2		4804.050	48.38	13.01	61.39	74.00	-12.61	peak

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated1-26.5GHz,The testing has been conformed to the 10th harmonic of the highest fundamental frequency.
5. No report for the emission which more than 20dB below the prescribed limit.

Temperature:	23.6℃	**Relative Humidity:**	46%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2441MHz		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4882.030	36.50	13.59	50.09	54.00	-3.91	AVG
2		4882.114	49.80	13.59	63.39	74.00	-10.61	peak

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated1-26.5GHz,The testing has been conformed to the 10th harmonic of the highest fundamental frequency.
5. No report for the emission which more than 20dB below the prescribed limit.

Temperature:	23.6℃	**Relative Humidity:**	46%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2441MHz		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4882.074	49.48	13.59	63.07	74.00	-10.93	peak
2	*	4882.122	36.19	13.59	49.78	54.00	-4.22	AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated1-26.5GHz,The testing has been conformed to the 10th harmonic of the highest fundamental frequency.
5. No report for the emission which more than 20dB below the prescribed limit.

Temperature:	23.6℃	**Relative Humidity:**	46%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2480MHz		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4960.010	50.11	13.01	63.12	74.00	-10.88	peak
2	*	4960.468	34.22	13.03	47.25	54.00	-6.75	AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated1-26.5GHz,The testing has been conformed to the 10th harmonic of the highest fundamental frequency.
5. No report for the emission which more than 20dB below the prescribed limit.

Temperature:	23.6℃	**Relative Humidity:**	46%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2480MHz		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4959.546	49.55	14.15	63.70	74.00	-10.30	peak
2	*	4959.884	35.17	14.15	49.32	54.00	-4.68	AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated1-26.5GHz,The testing has been conformed to the 10th harmonic of the highest fundamental frequency.
5. No report for the emission which more than 20dB below the prescribed limit.

Temperature:	23.6℃	**Relative Humidity:**	46%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Horizontal		
Test Mode:	TXπ /4-DQPSK Mode 2402MHz		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		4803.946	49.08	13.01	62.09	74.00	-11.91	peak
2	*	4804.110	36.35	13.02	49.37	54.00	-4.63	AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated1-26.5GHz,The testing has been conformed to the 10th harmonic of the highest fundamental frequency.
5. No report for the emission which more than 20dB below the prescribed limit.

Temperature:	23.6℃	**Relative Humidity:**	46%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Vertical		
Test Mode:	TXπ /4-DQPSK Mode 2402MHz		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4803.914	35.18	13.01	48.19	54.00	-5.81	AVG
2		4804.376	48.88	13.02	61.90	74.00	-12.10	peak

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated1-26.5GHz,The testing has been conformed to the 10th harmonic of the highest fundamental frequency.
5. No report for the emission which more than 20dB below the prescribed limit.

Temperature:	23.6℃	**Relative Humidity:**	46%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Horizontal		
Test Mode:	TXπ /4-DQPSK Mode 2441MHz		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4881.930	35.59	13.59	49.18	54.00	-4.82	AVG
2		4881.978	45.66	13.59	59.25	74.00	-14.75	peak

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated1-26.5GHz,The testing has been conformed to the 10th harmonic of the highest fundamental frequency.
5. No report for the emission which more than 20dB below the prescribed limit.

Temperature:	23.6℃	**Relative Humidity:**	46%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Vertical		
Test Mode:	TXπ /4-DQPSK Mode 2441MHz		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4881.838	35.44	13.59	49.03	54.00	-4.97	AVG
2		4882.198	48.95	13.59	62.54	74.00	-11.46	peak

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated1-26.5GHz,The testing has been conformed to the 10th harmonic of the highest fundamental frequency.
5. No report for the emission which more than 20dB below the prescribed limit.

Temperature:	23.6℃	**Relative Humidity:**	46%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Horizontal		
Test Mode:	TXπ /4-DQPSK Mode 2480MHz		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4960.112	35.16	14.15	49.31	54.00	-4.69	AVG
2		4960.500	48.32	14.16	62.48	74.00	-11.52	peak

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated1-26.5GHz,The testing has been conformed to the 10th harmonic of the highest fundamental frequency.
5. No report for the emission which more than 20dB below the prescribed limit.

Temperature:	23.6℃	**Relative Humidity:**	46%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Vertical		
Test Mode:	TXπ /4-DQPSK Mode 2480MHz		

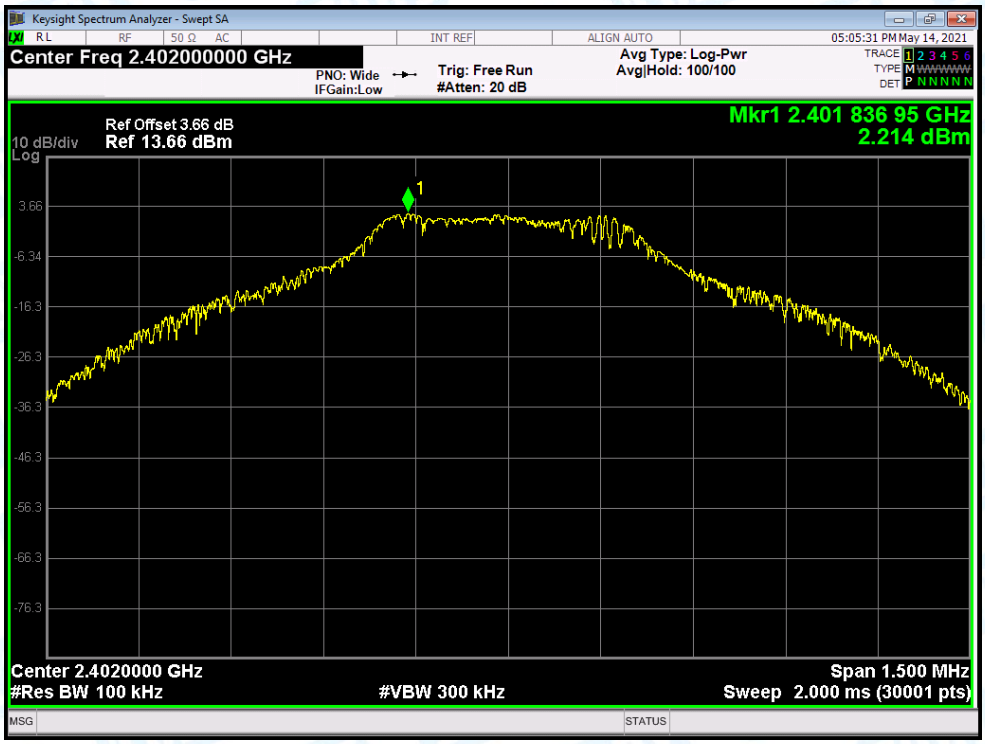
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4959.740	34.93	14.15	49.08	54.00	-4.92	AVG
2		4960.298	48.62	14.15	62.77	74.00	-11.23	peak

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated1-26.5GHz,The testing has been conformed to the 10th harmonic of the highest fundamental frequency.
5. No report for the emission which more than 20dB below the prescribed limit.

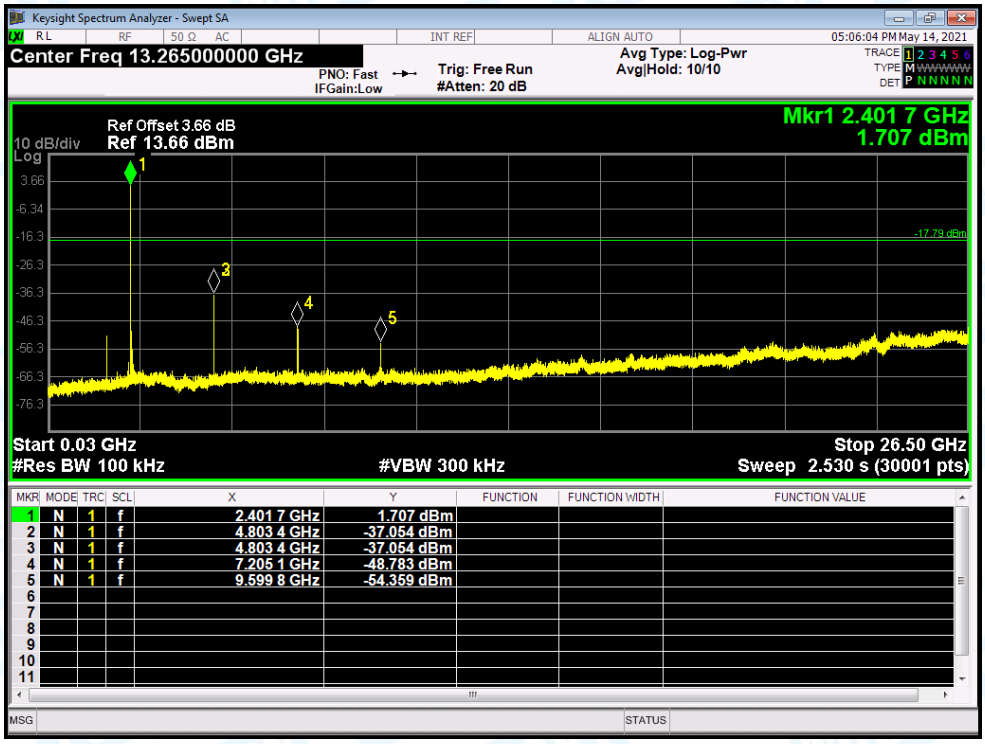
---Conducted Unwanted Emissions

Test Graphs

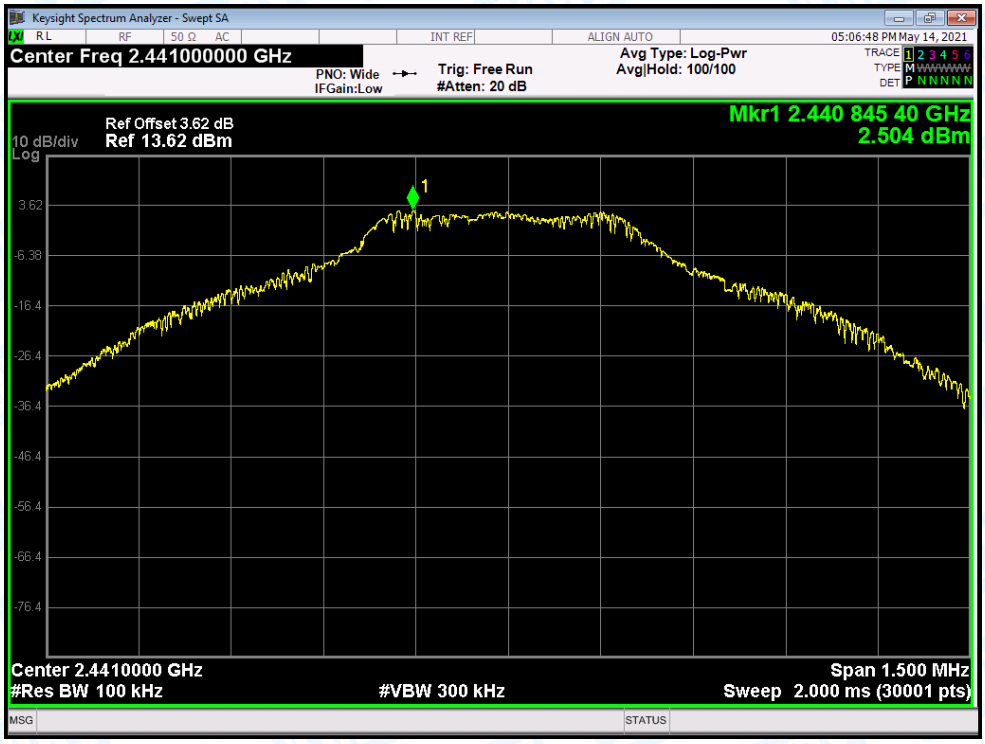
Tx. Spurious NVNT 1-DH1 2402MHz Ant1 Ref



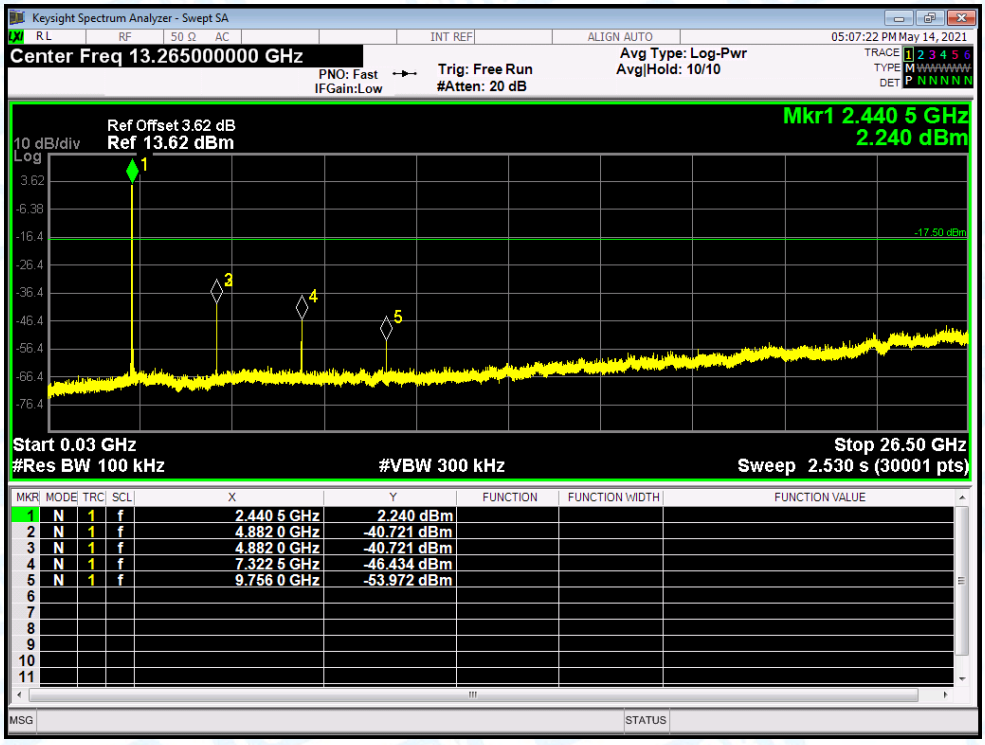
Tx. Spurious NVNT 1-DH1 2402MHz Ant1 Emission



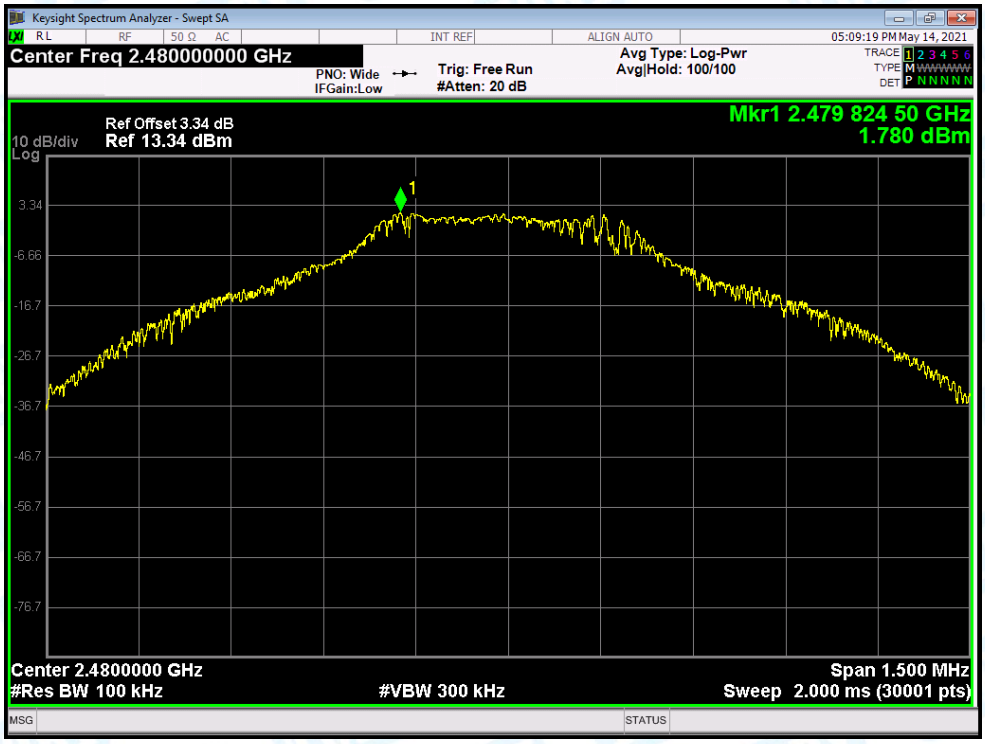
Tx. Spurious NVNT 1-DH1 2441MHz Ant1 Ref



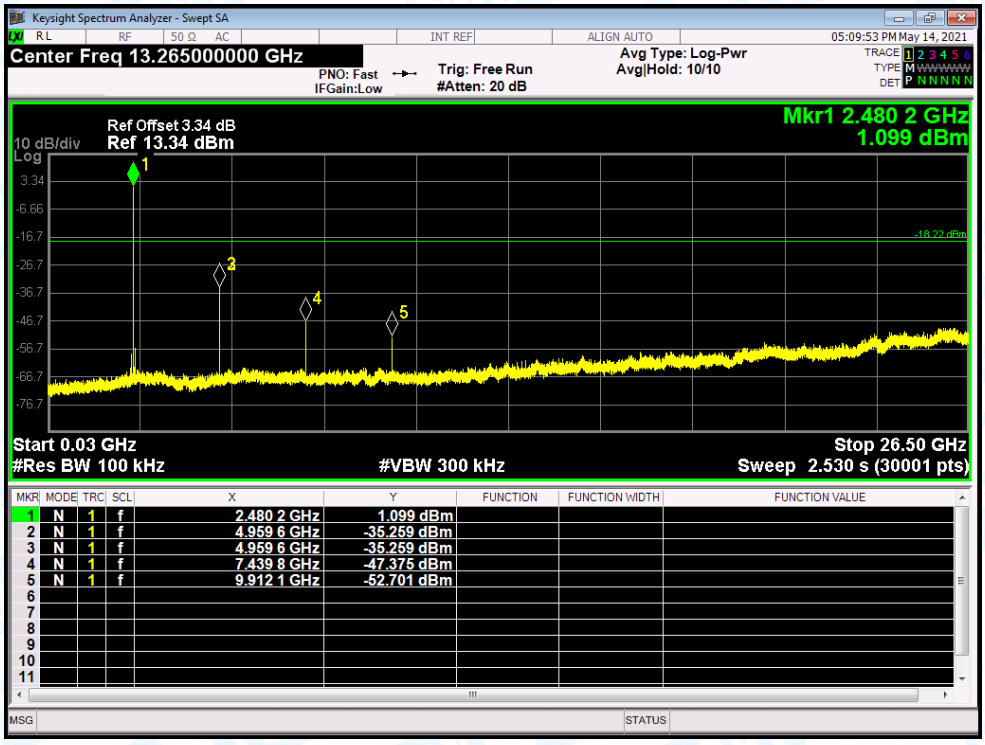
Tx. Spurious NVNT 1-DH1 2441MHz Ant1 Emission



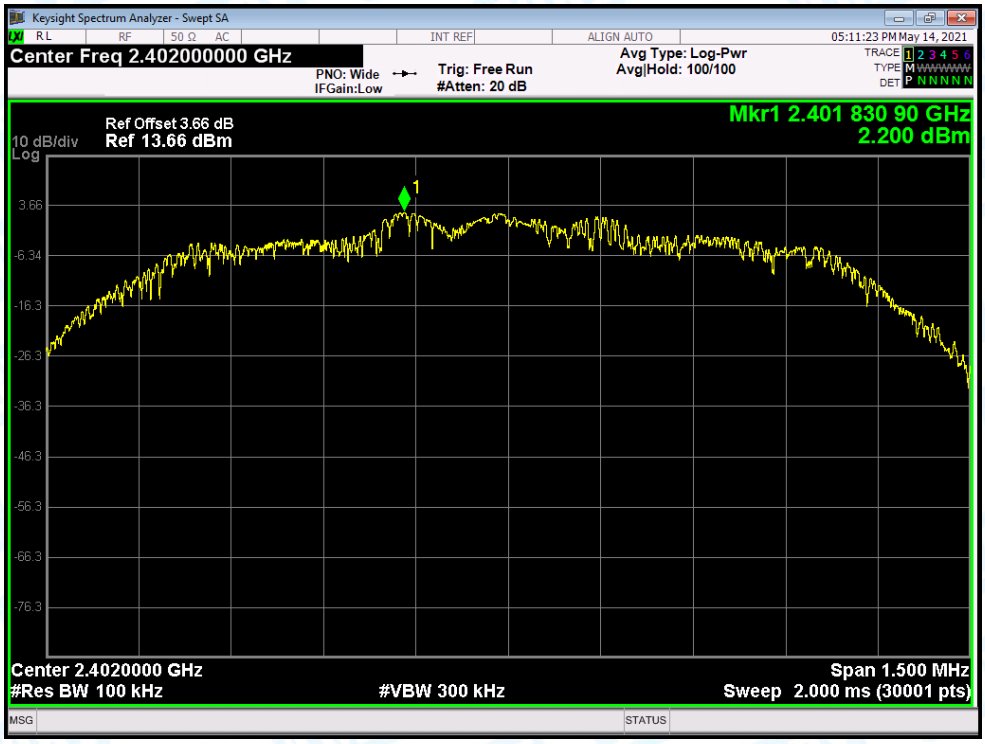
Tx. Spurious NVNT 1-DH1 2480MHz Ant1 Ref



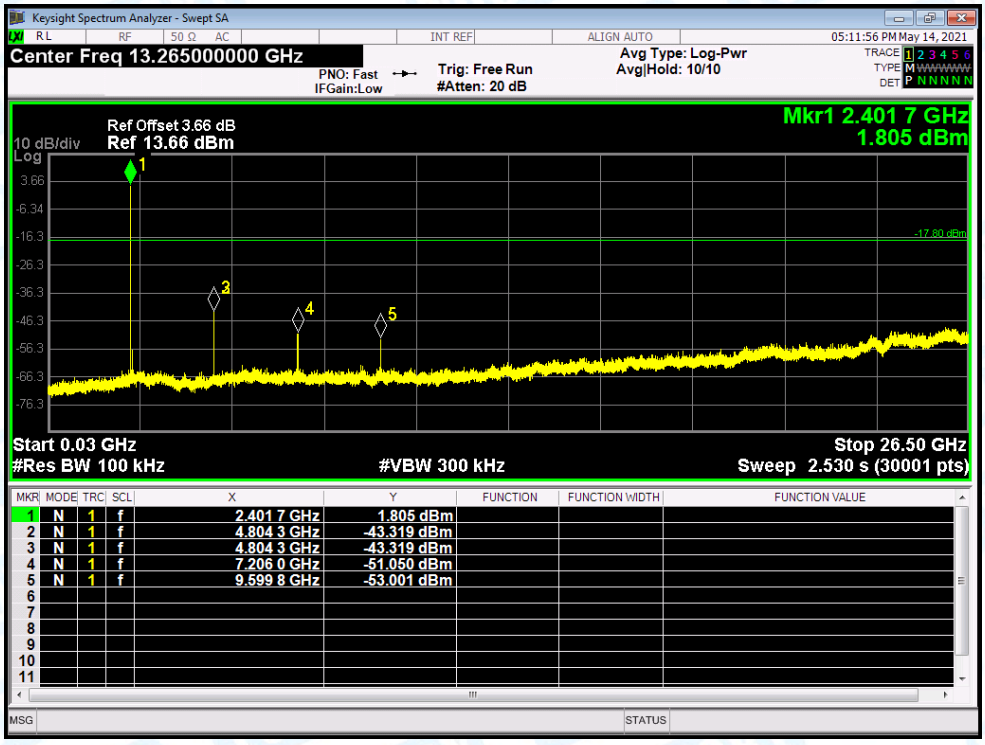
Tx. Spurious NVNT 1-DH1 2480MHz Ant1 Emission



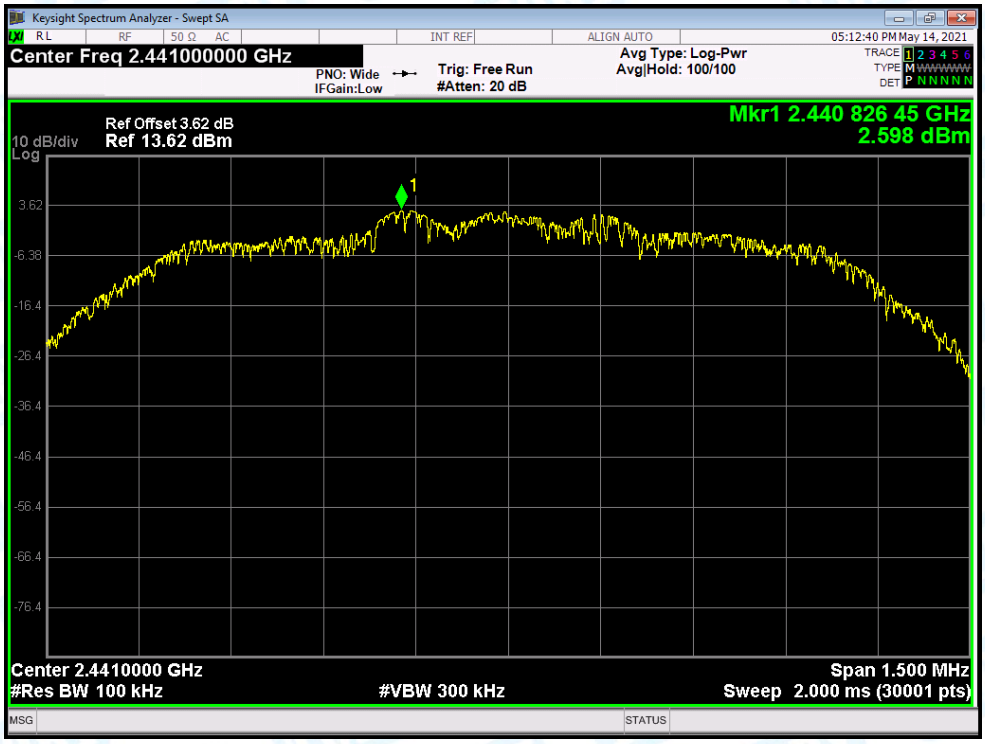
Tx. Spurious NVNT 2-DH1 2402MHz Ant1 Ref



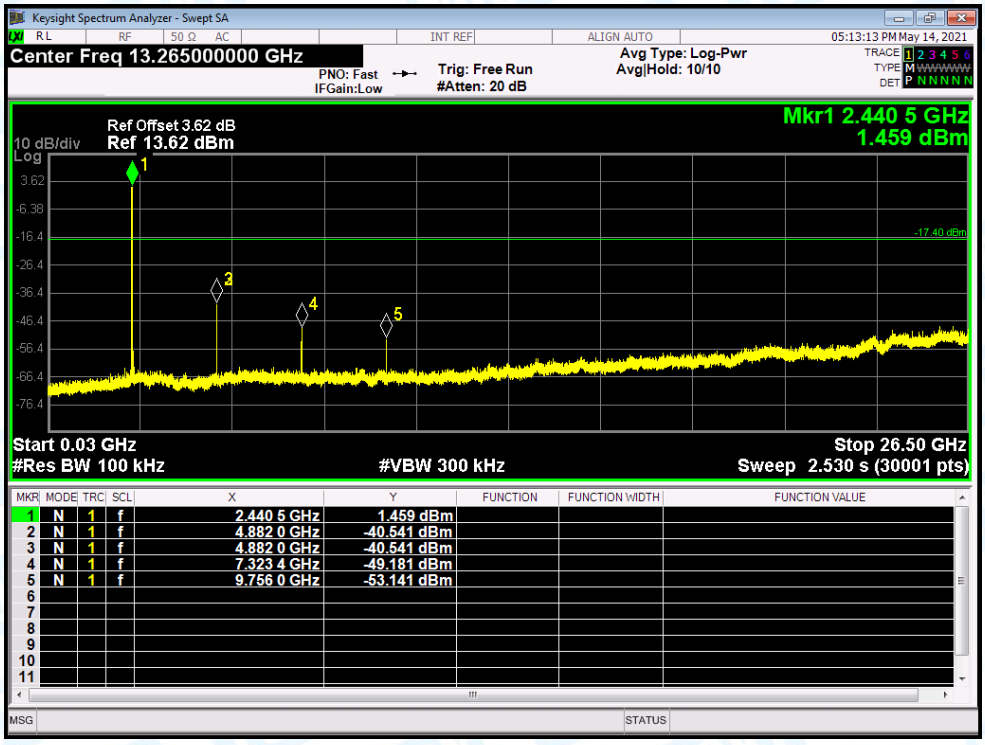
Tx. Spurious NVNT 2-DH1 2402MHz Ant1 Emission



Tx. Spurious NVNT 2-DH1 2441MHz Ant1 Ref

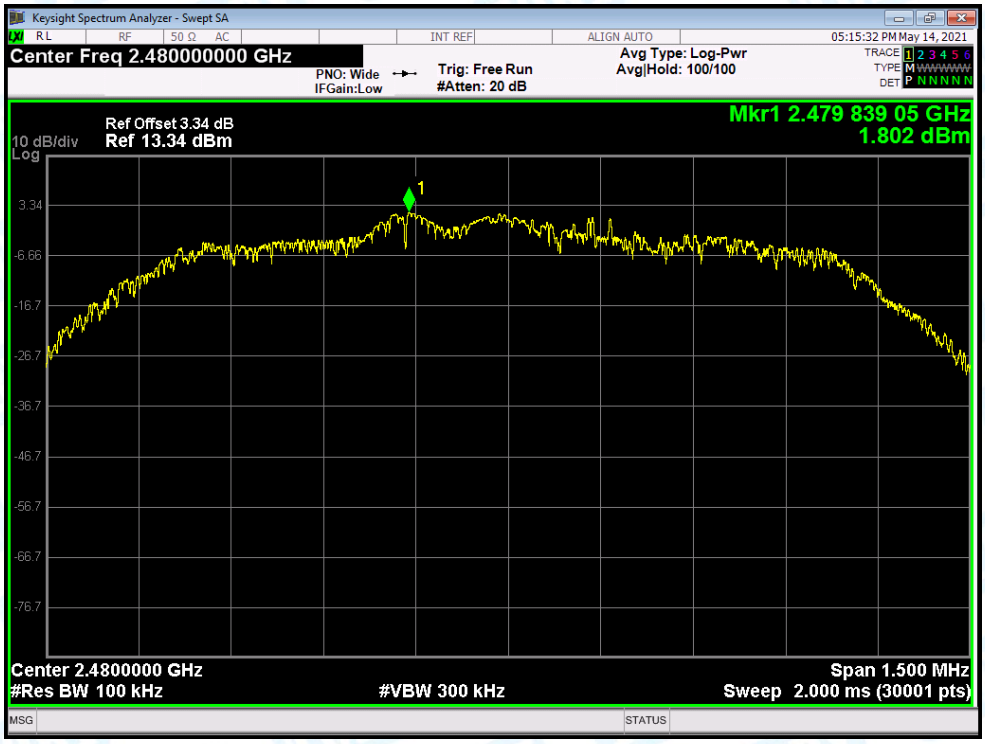


Tx. Spurious NVNT 2-DH1 2441MHz Ant1 Emission

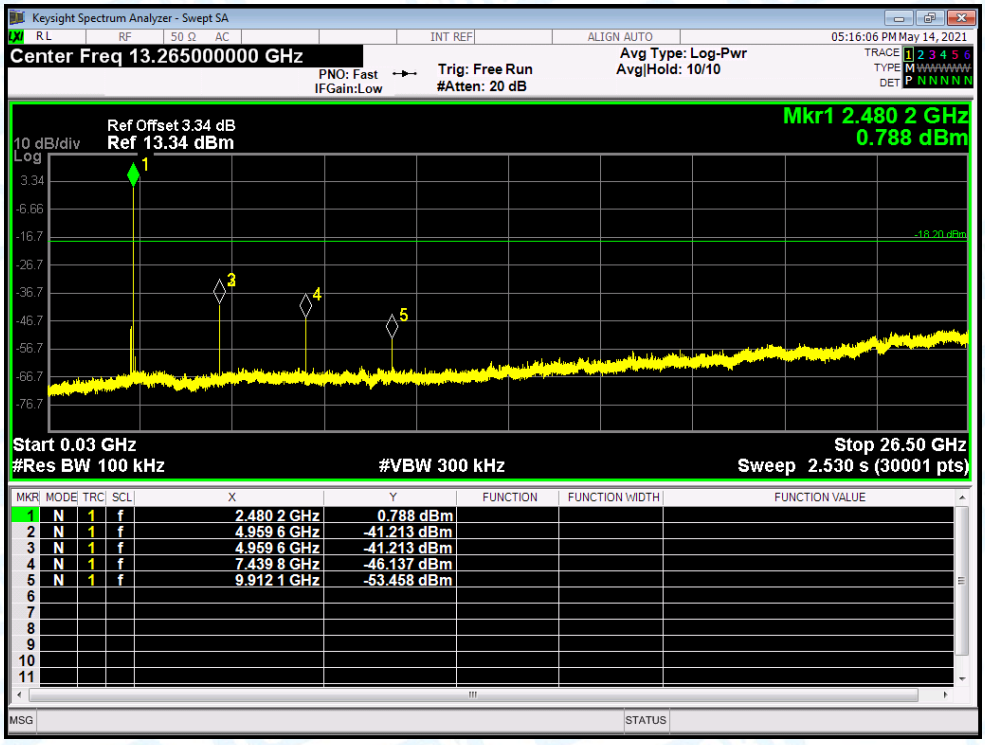


MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.440 5 GHz	1.459 dBm			
2	N	1	f	4.882 0 GHz	-40.541 dBm			
3	N	1	f	4.882 0 GHz	-40.541 dBm			
4	N	1	f	7.323 4 GHz	-49.181 dBm			
5	N	1	f	9.756 0 GHz	-53.141 dBm			
6								
7								
8								
9								
10								
11								

Tx. Spurious NVNT 2-DH1 2480MHz Ant1 Ref



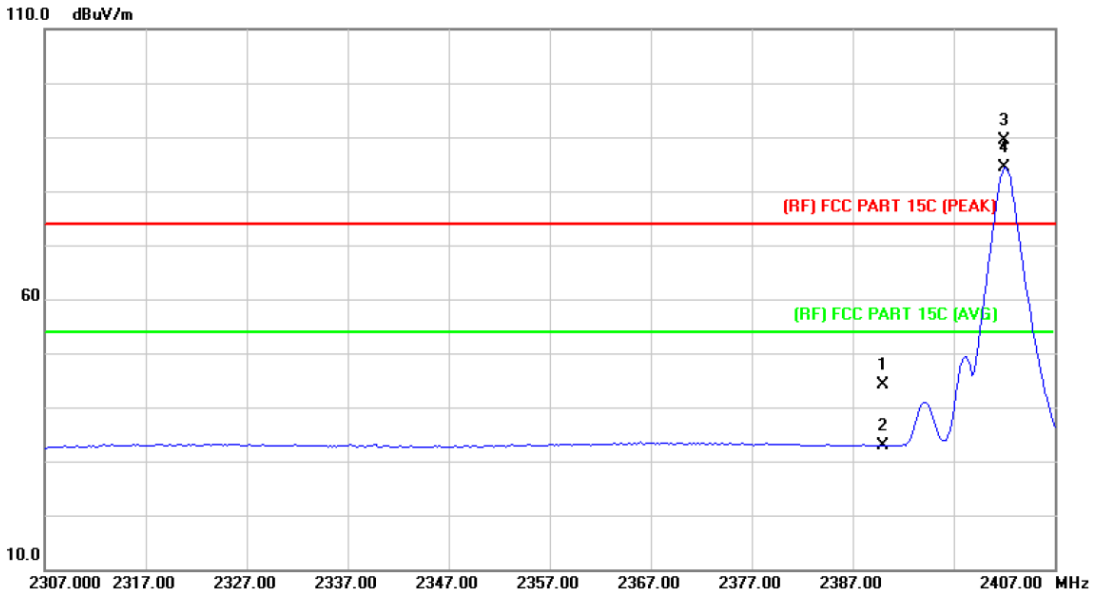
Tx. Spurious NVNT 2-DH1 2480MHz Ant1 Emission



Attachment C-- Restricted Bands Requirement and Band Edge Test Data

(1) Radiation Test

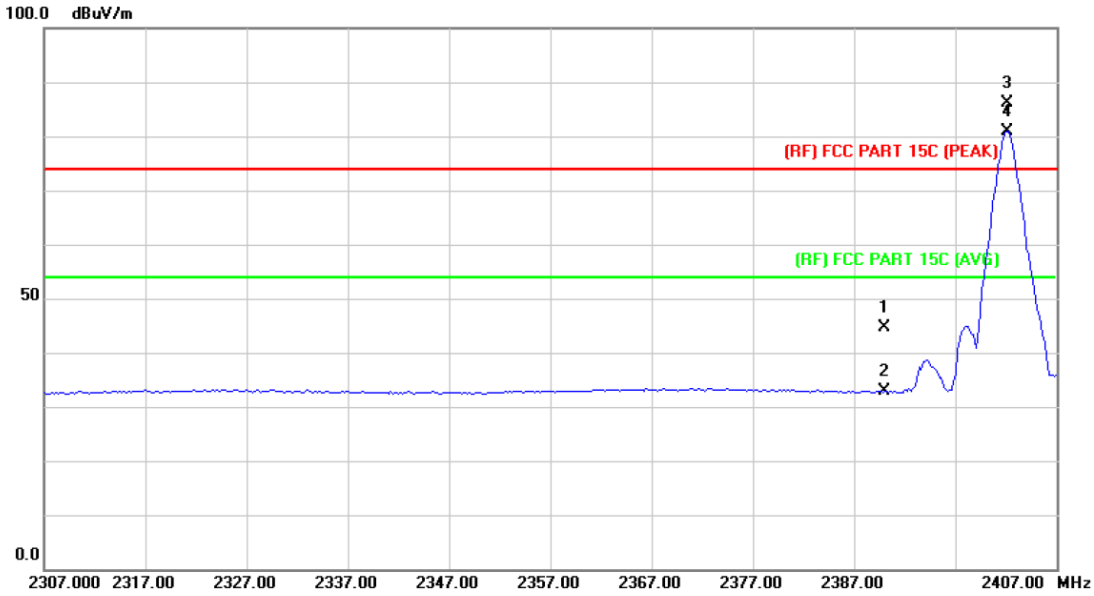
Temperature:	23.6℃	**Relative Humidity:**	46%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2402MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2390.000	42.96	1.28	44.24	74.00	-29.76	peak
2		2390.000	31.48	1.28	32.76	54.00	-21.24	AVG
3	X	2402.000	88.04	1.33	89.37	Fundamental Frequency		peak
4	*	2402.000	82.99	1.33	84.32	Fundamental Frequency		AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)

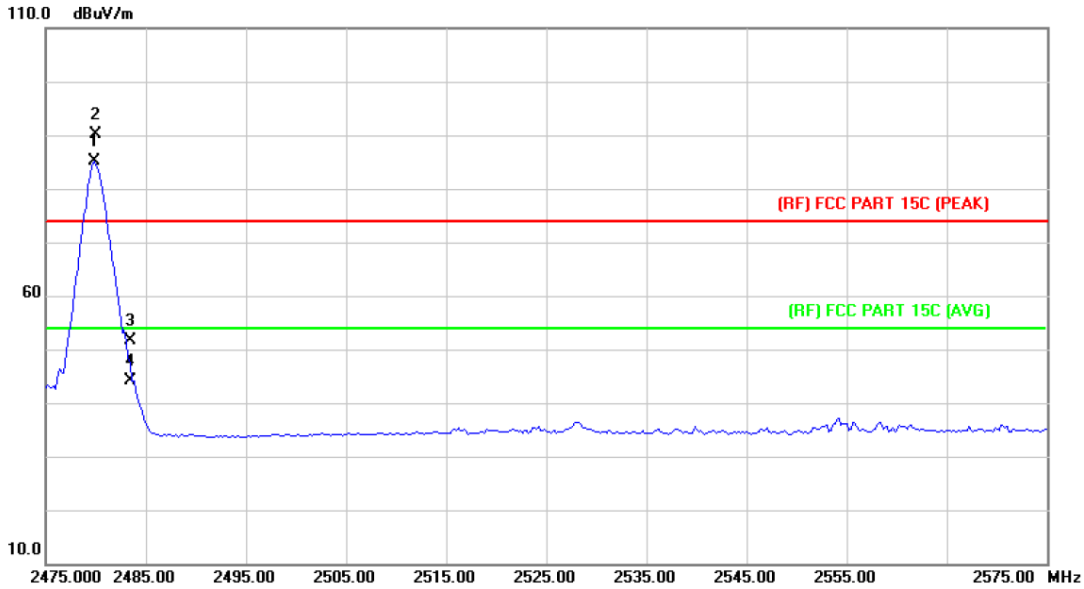
Temperature:	23.6℃	**Relative Humidity:**	46%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2402MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2390.000	43.27	1.28	44.55	74.00	-29.45	peak
2		2390.000	31.53	1.28	32.81	54.00	-21.19	AVG
3	X	2402.200	84.92	1.33	86.25	Fundamental Frequency		peak
4	*	2402.200	79.67	1.33	81.00	Fundamental Frequency		AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBµV/m)= Corr. (dB/m)+ Read Level (dBµV)
3. Margin (dB) = Peak/AVG (dBµV/m)-Limit PK/AVG(dBµV/m)

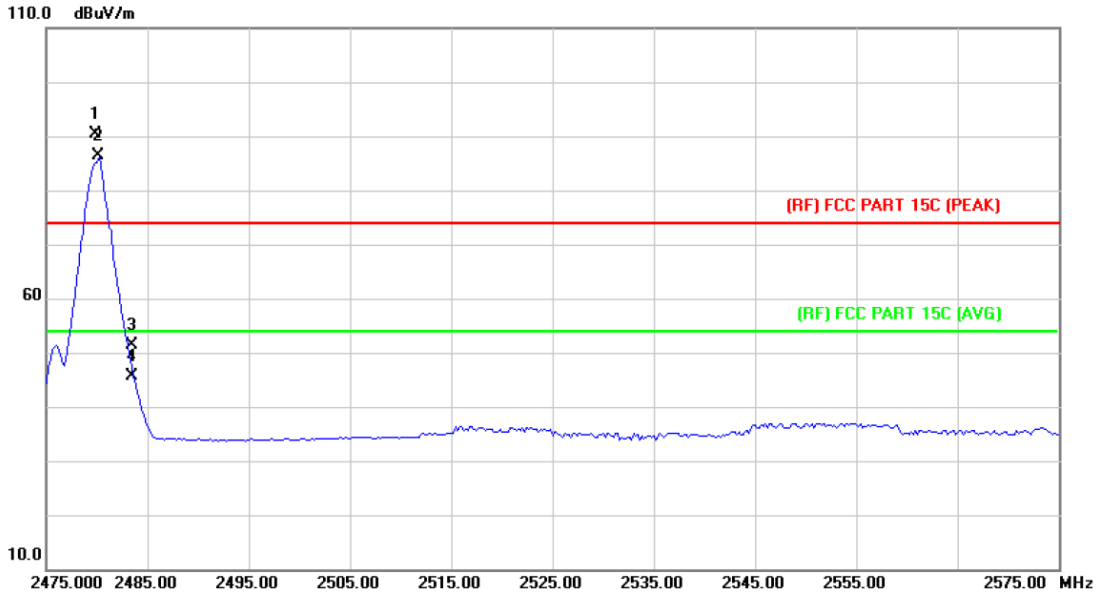
Temperature:	23.6℃	**Relative Humidity:**	46%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2480 MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	2479.800	83.17	1.85	85.02	Fundamental Frequency		AVG
2	X	2480.000	88.30	1.85	90.15	Fundamental Frequency		peak
3		2483.500	49.74	1.88	51.62	74.00	-22.38	peak
4		2483.500	42.27	1.88	44.15	54.00	-9.85	AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)

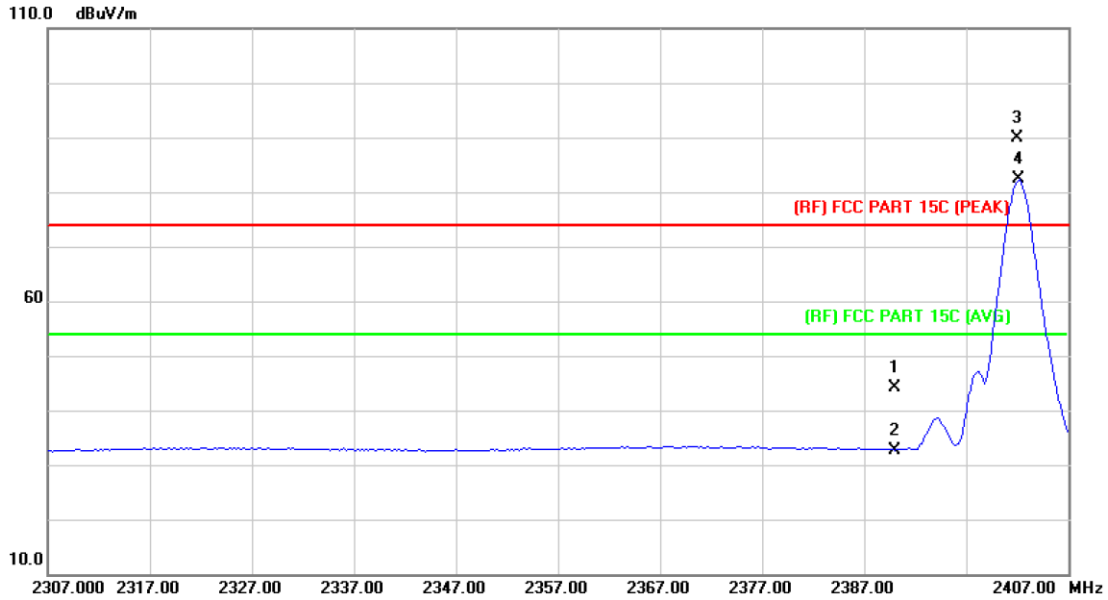
Temperature:	23.6℃	**Relative Humidity:**	46%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2480 MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	X	2479.800	88.46	1.85	90.31	Fundamental Frequency		peak
2	*	2480.200	84.64	1.85	86.49	Fundamental Frequency		AVG
3		2483.500	49.57	1.88	51.45	74.00	-22.55	peak
4		2483.500	43.83	1.88	45.71	54.00	-8.29	AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)

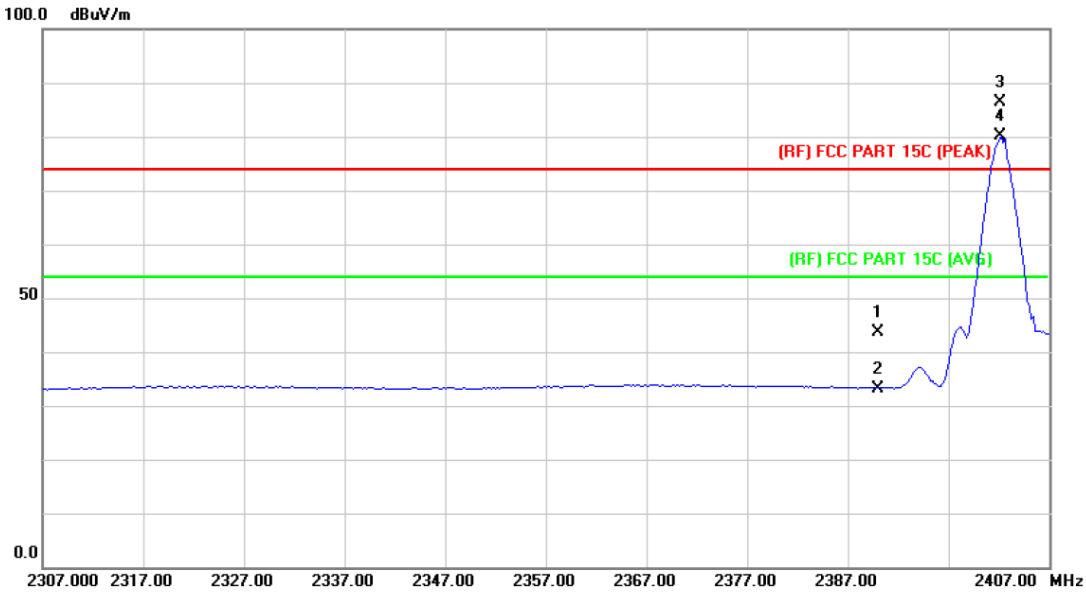
Temperature:	23.6℃	**Relative Humidity:**	46%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Horizontal		
Test Mode:	TXπ /4-DQPSK Mode 2402MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2390.000	42.79	1.28	44.07	74.00	-29.93	peak
2		2390.000	31.41	1.28	32.69	54.00	-21.31	AVG
3	X	2402.000	88.62	1.33	89.95	Fundamental Frequency		peak
4	*	2402.200	80.93	1.33	82.26	Fundamental Frequency		AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)

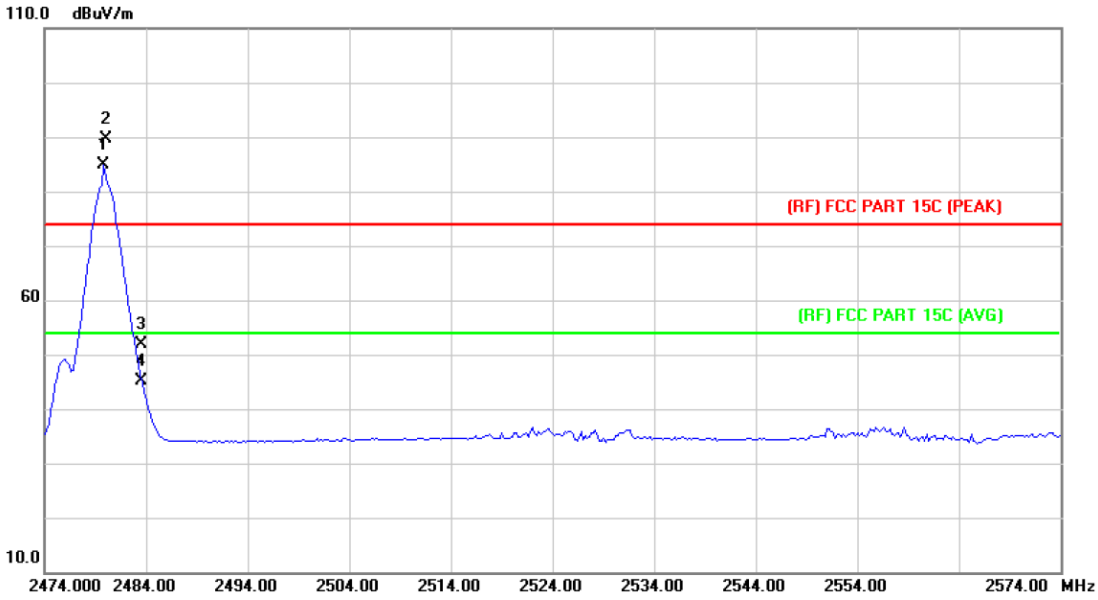
Temperature:	23.6℃	**Relative Humidity:**	46%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Vertical		
Test Mode:	TXπ /4-DQPSK Mode 2402MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2390.000	42.29	1.28	43.57	74.00	-30.43	peak
2		2390.000	31.97	1.28	33.25	54.00	-20.75	AVG
3	X	2402.200	85.15	1.33	86.48	Fundamental Frequency		peak
4	*	2402.200	78.92	1.33	80.25	Fundamental Frequency		AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)

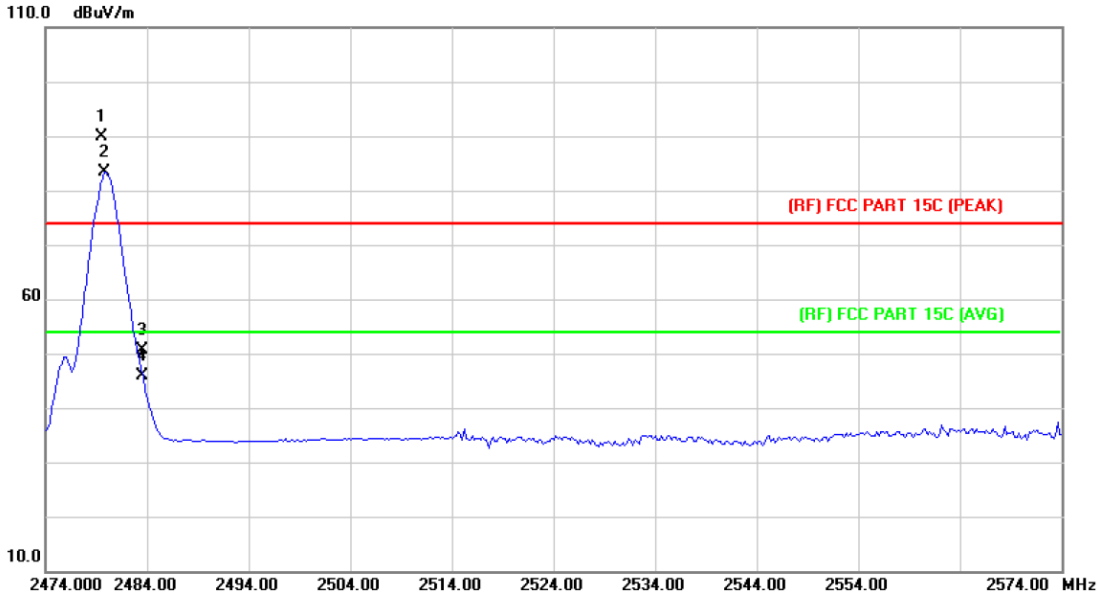
Temperature:	23.6℃	**Relative Humidity:**	46%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Horizontal		
Test Mode:	TXπ /4-DQPSK Mode 2480MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	2479.800	83.04	1.85	84.89	Fundamental Frequency		AVG
2	X	2480.000	87.77	1.85	89.62	Fundamental Frequency		peak
3		2483.500	50.02	1.88	51.90	74.00	-22.10	peak
4		2483.500	43.33	1.88	45.21	54.00	-8.79	AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)

Temperature:	23.6℃	**Relative Humidity:**	46%
Test Voltage:	AC 120V60Hz		
Ant. Pol.	Vertical		
Test Mode:	TXπ /4-DQPSK Mode 2480MHz		
Remark:	Only worse case is reported		

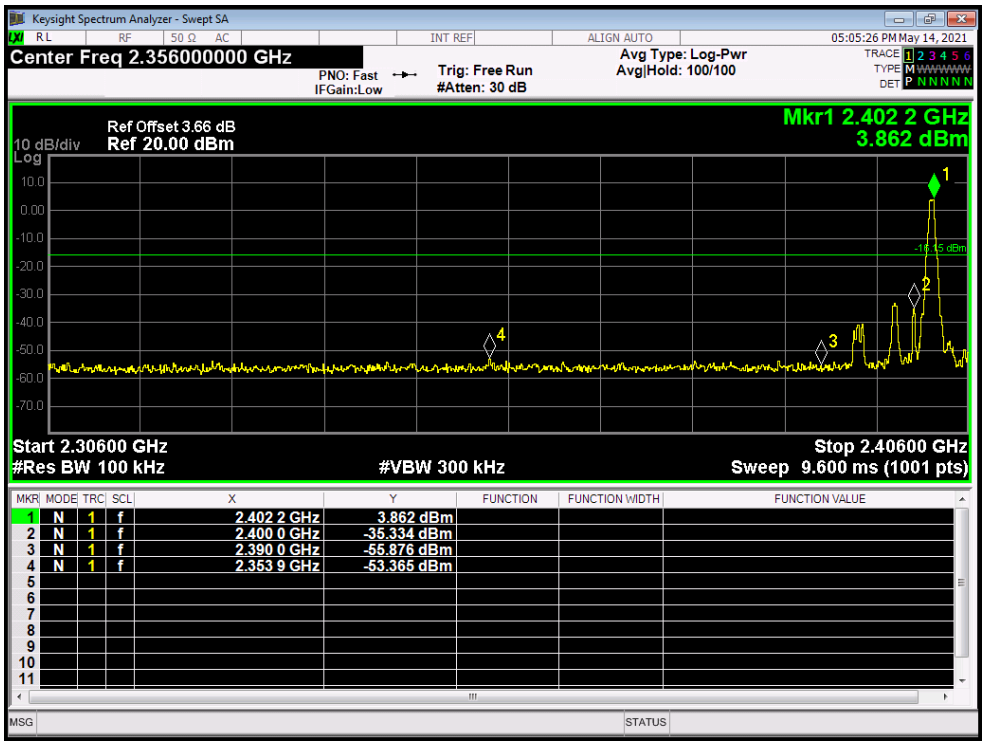


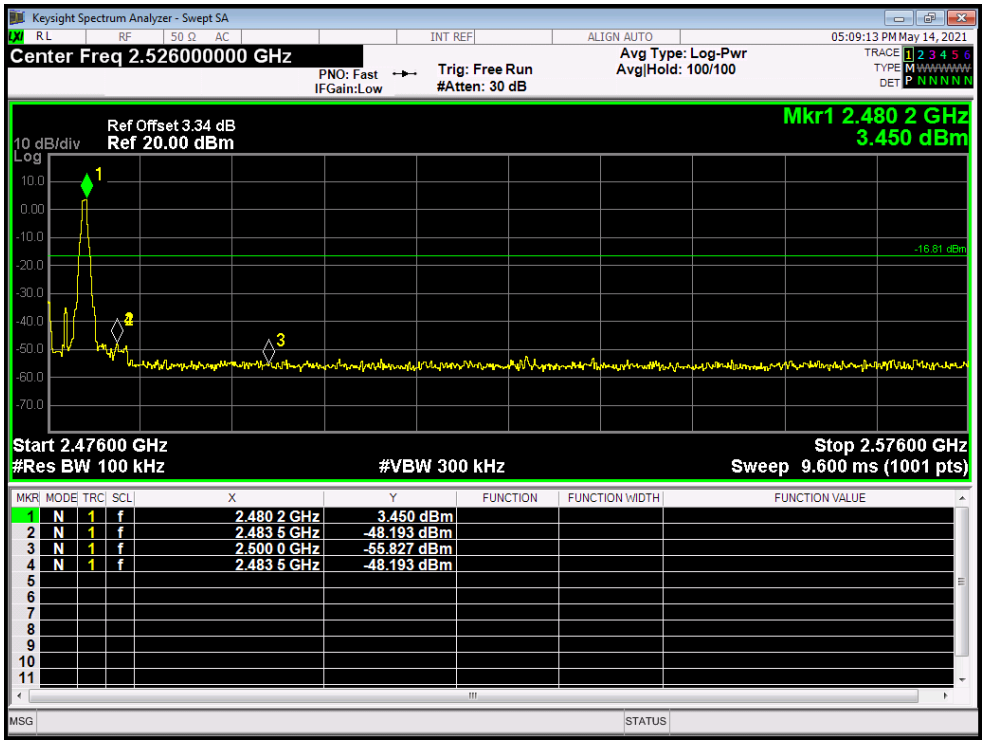
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	X	2479.600	87.93	1.85	89.78	Fundamental Frequency		peak
2	*	2479.800	81.49	1.85	83.34	Fundamental Frequency		AVG
3		2483.500	48.81	1.88	50.69	74.00	-23.31	peak
4		2483.500	43.92	1.88	45.80	54.00	-8.20	AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)

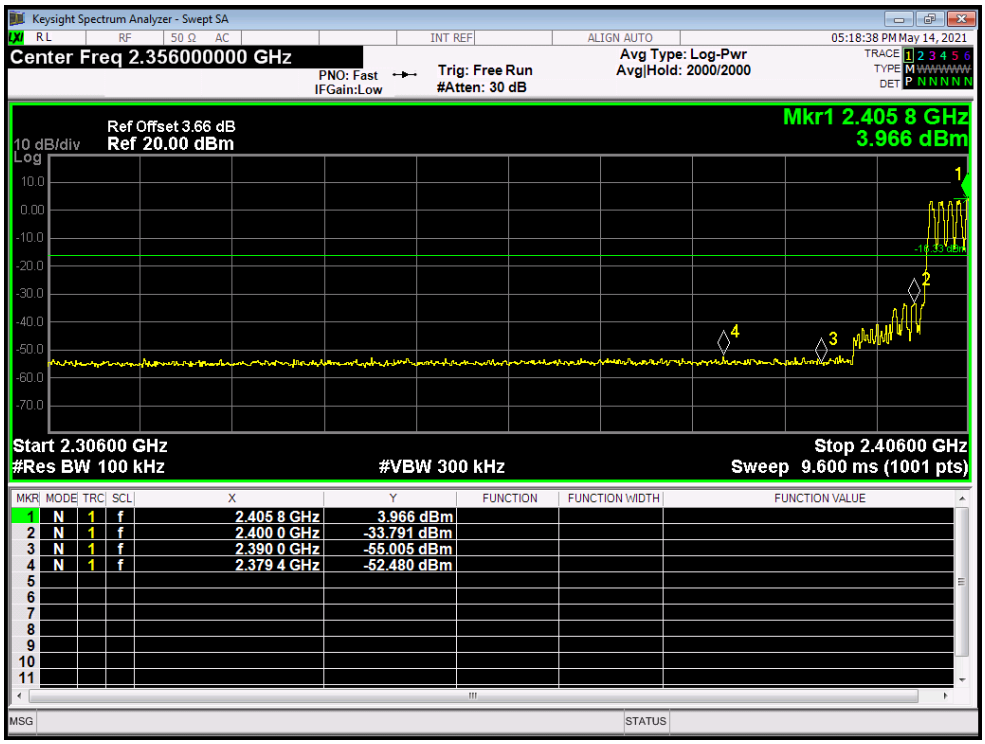
(2) Conducted Test

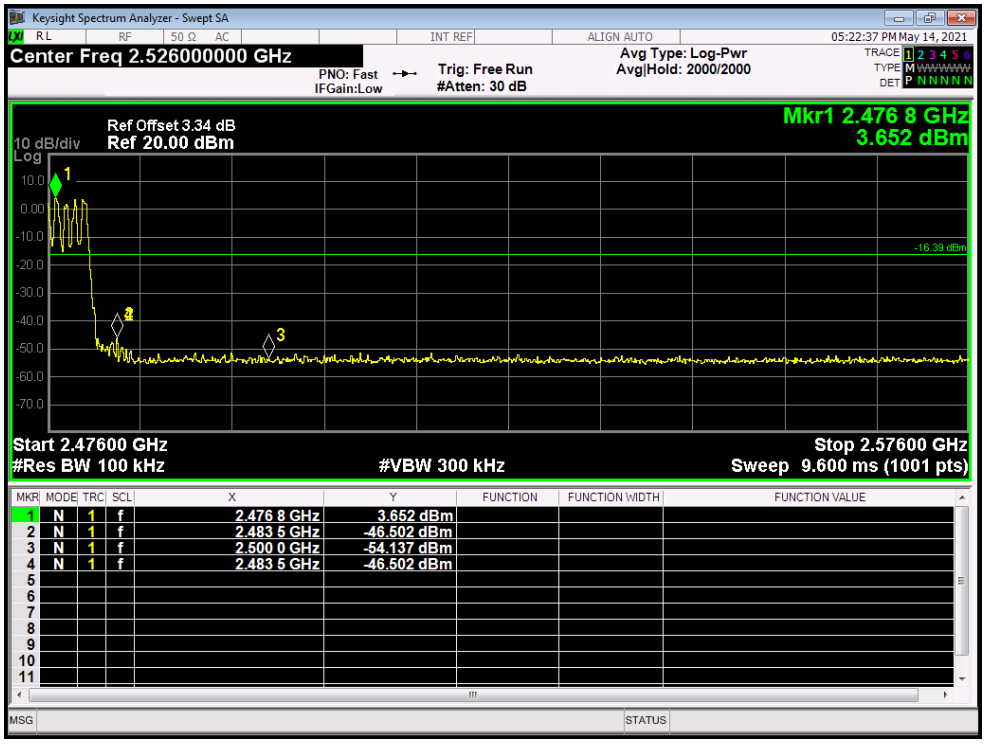
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Test Mode:	TX GFSK Mode 2402MHz/2480 MHz		
Remark:	Only worse case is reported		



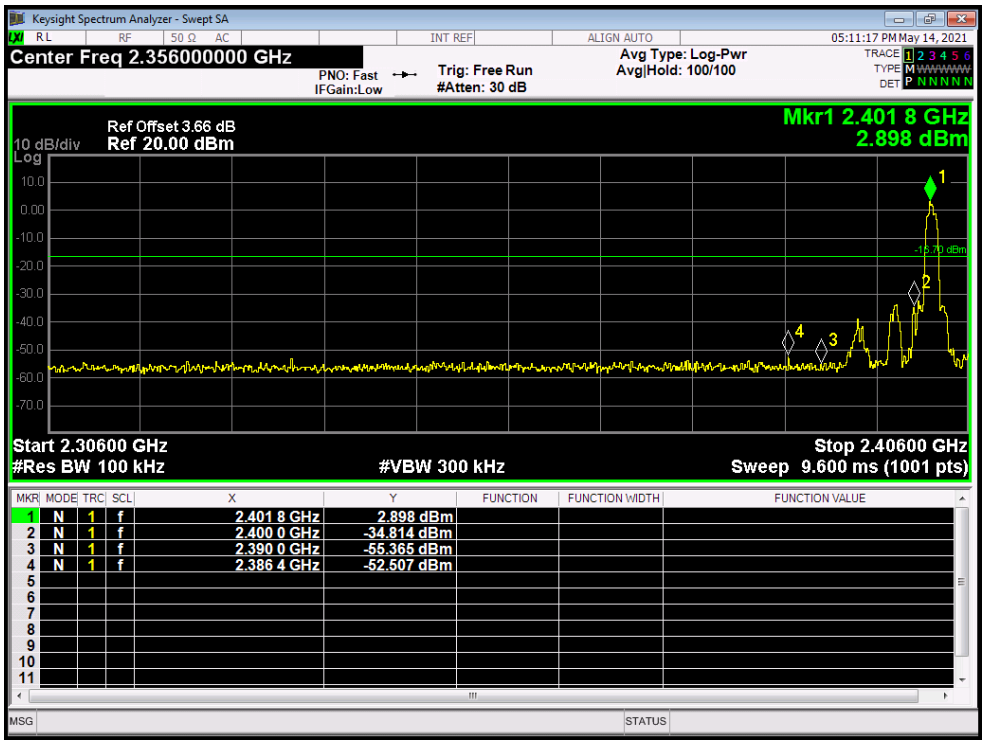


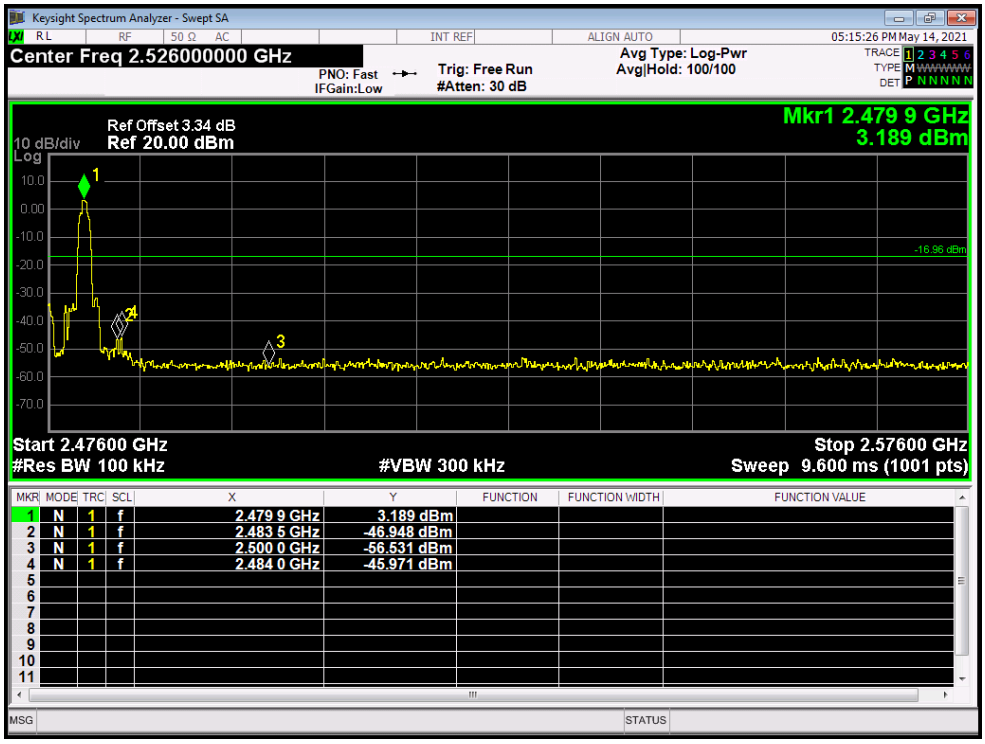
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Test Mode:	GFSK Hopping Mode		
Remark:	Only worse case is reported		



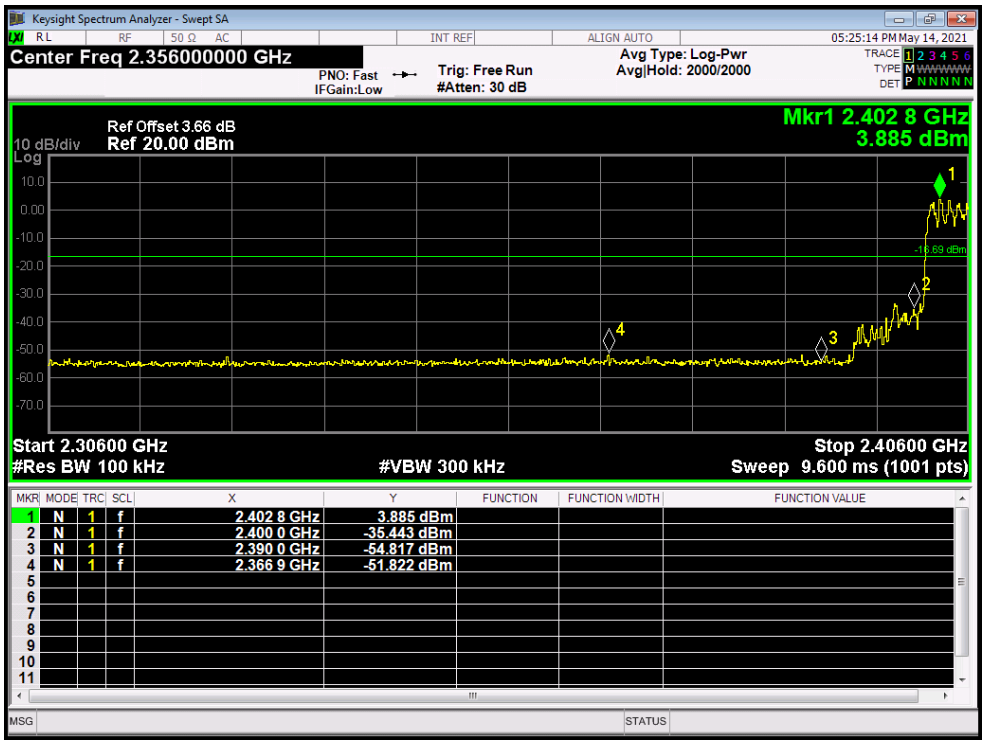


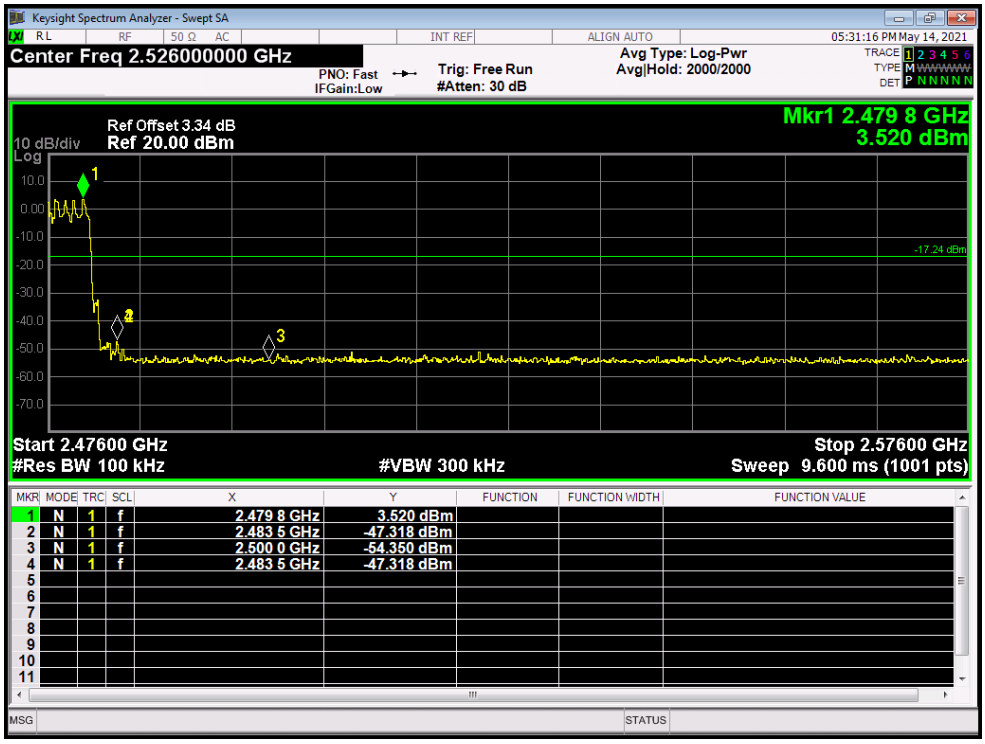
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Test Mode:	TXπ /4-DQPSK Mode 2402MHz/2480 MHz		
Remark:	Only worse case is reported		





Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Test Mode:	π /4-DQPSK Hopping Mode		
Remark:	Only worse case is reported		



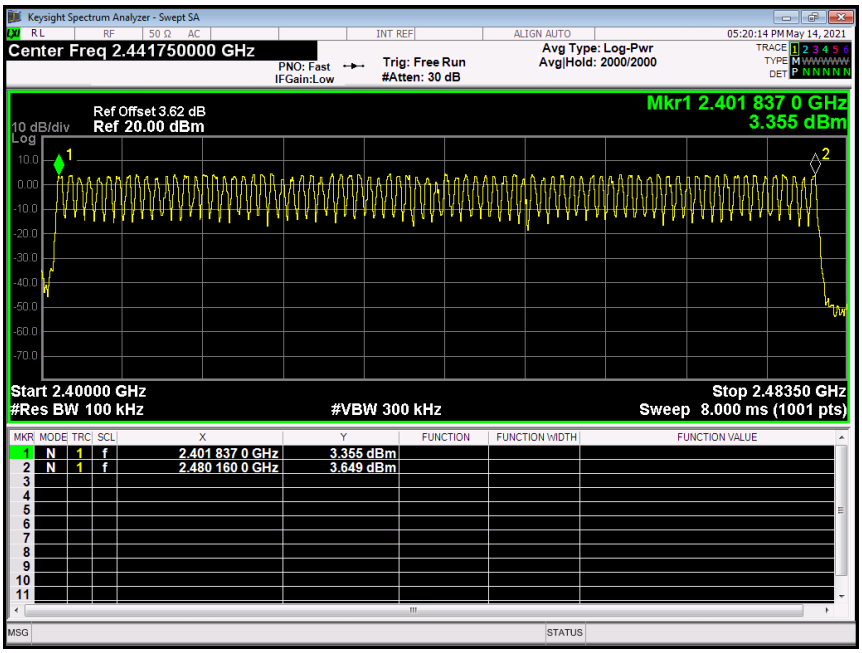


Attachment D-- Number of Hopping Channel Test Data

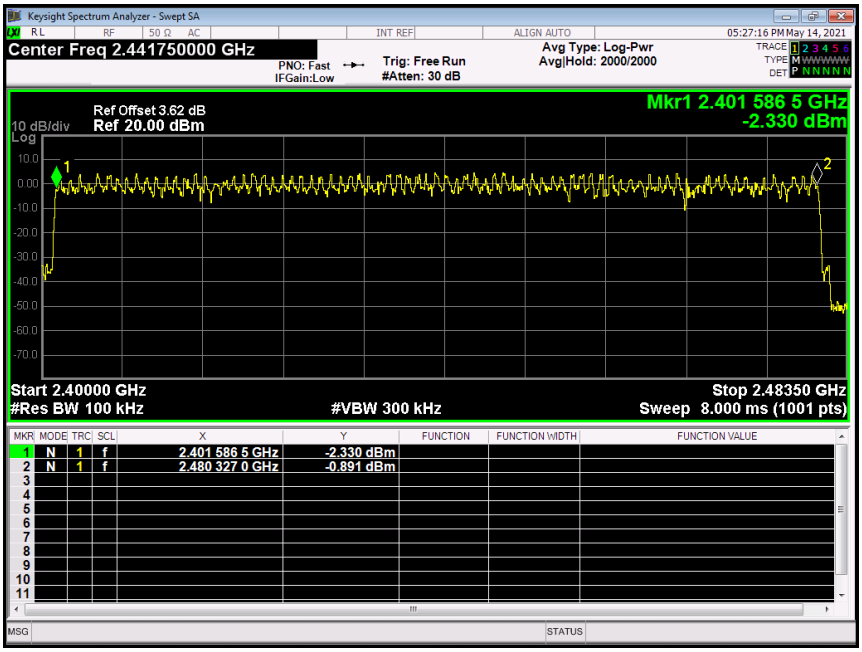
Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Test Mode:	Hopping Mode		

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

GFSK Mode



π /4-DQPSK Mode



Attachment E-- Average Time of Occupancy Test Data

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

Test Mode	Channel (MHz)	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
1DH1	2441	0.377	120.64	31.60	**400**	**PASS**
1DH3	2441	1.633	261.28	31.60	**400**	**PASS**
1DH5	2441	2.88	307.2	31.60	**400**	**PASS**

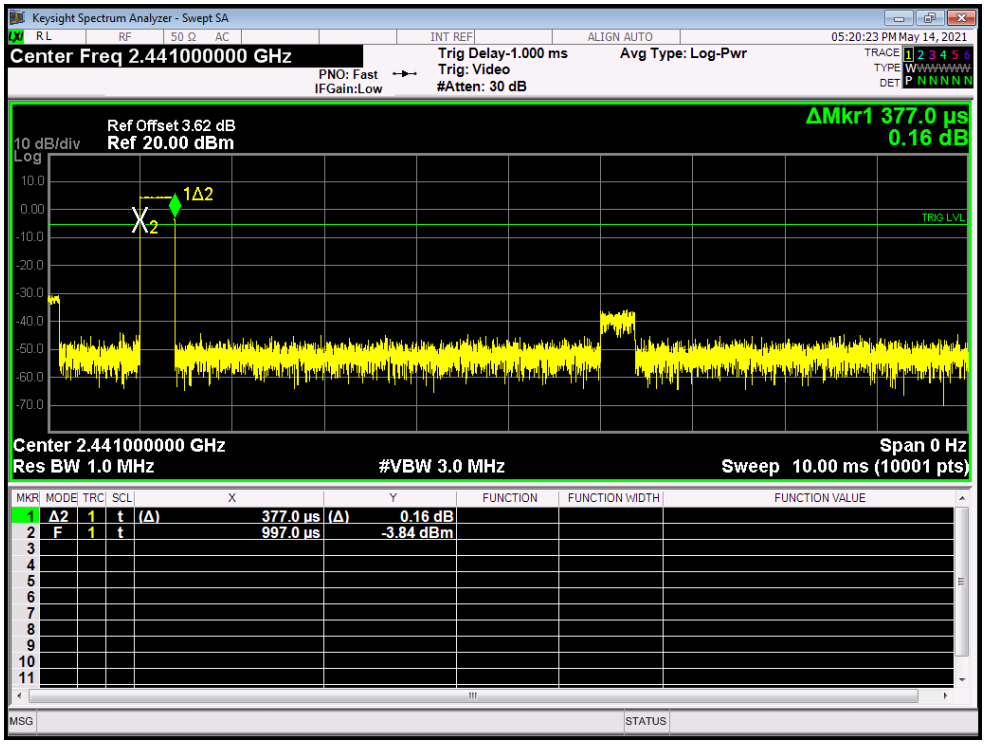
1DH1 Total of Dwell= Pulse Time(1600/2)*31.6/79*

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

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

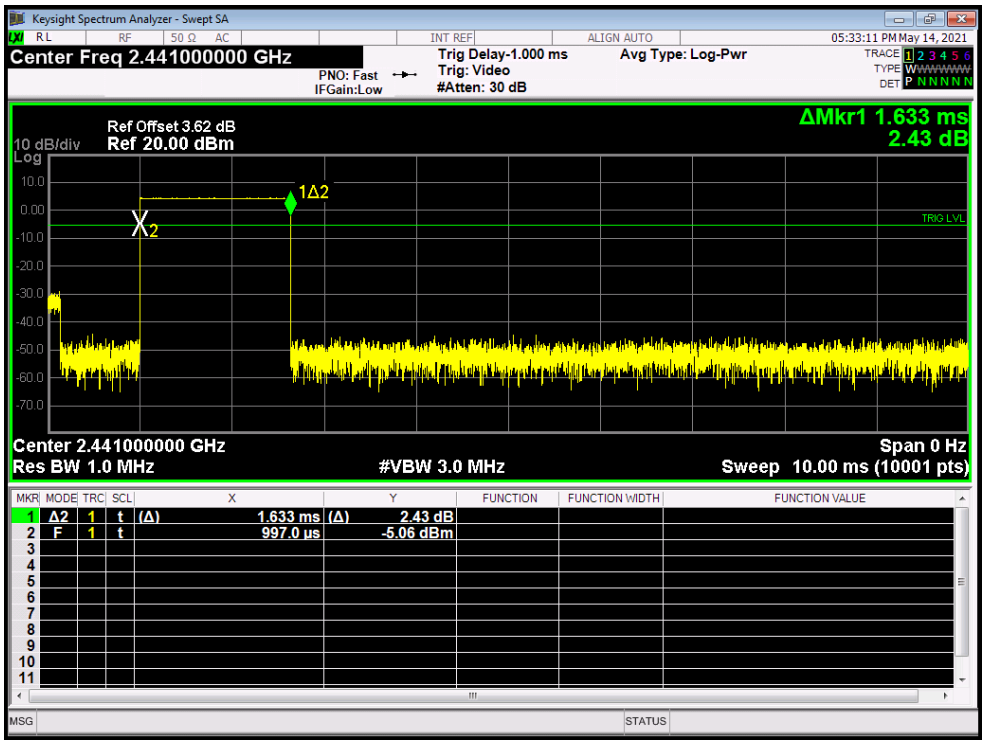
GFSK Hopping Mode 1DH1

2441 MHz



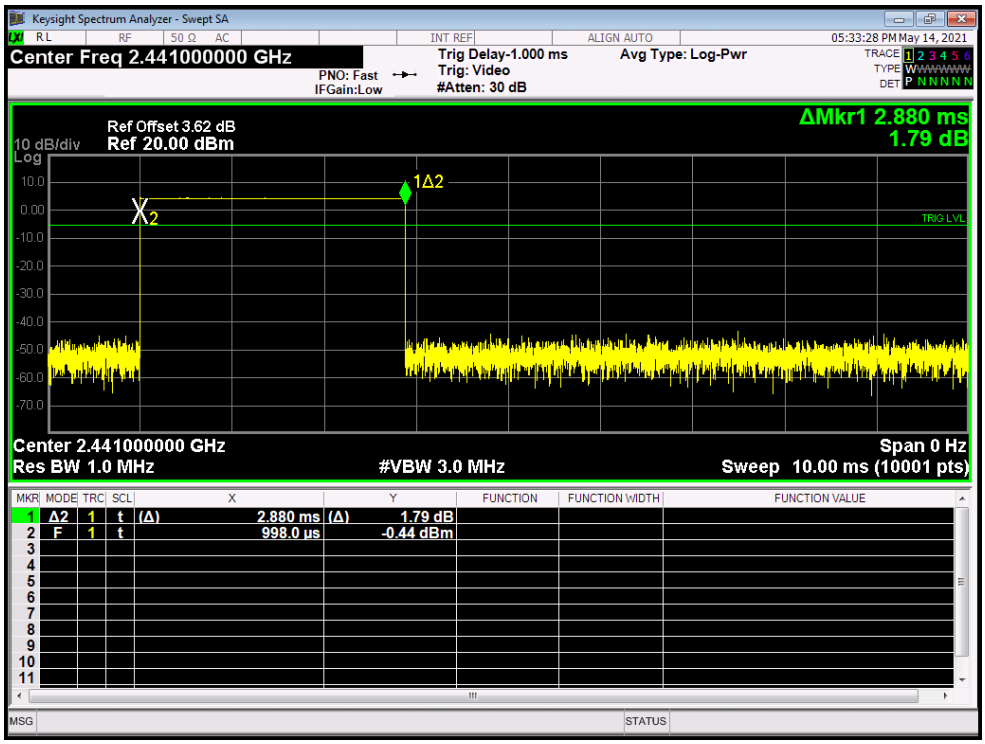
GFSK Hopping Mode 1DH3

2441 MHz



GFSK Hopping Mode 1DH5

2441 MHz



Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	AC 120V/60Hz		
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	0.382	122.24	31.60	**400**	**PASS**
2DH3	2441	1.638	262.08	31.60	**400**	**PASS**
2DH5	2441	2.881	307.307	31.60	**400**	**PASS**

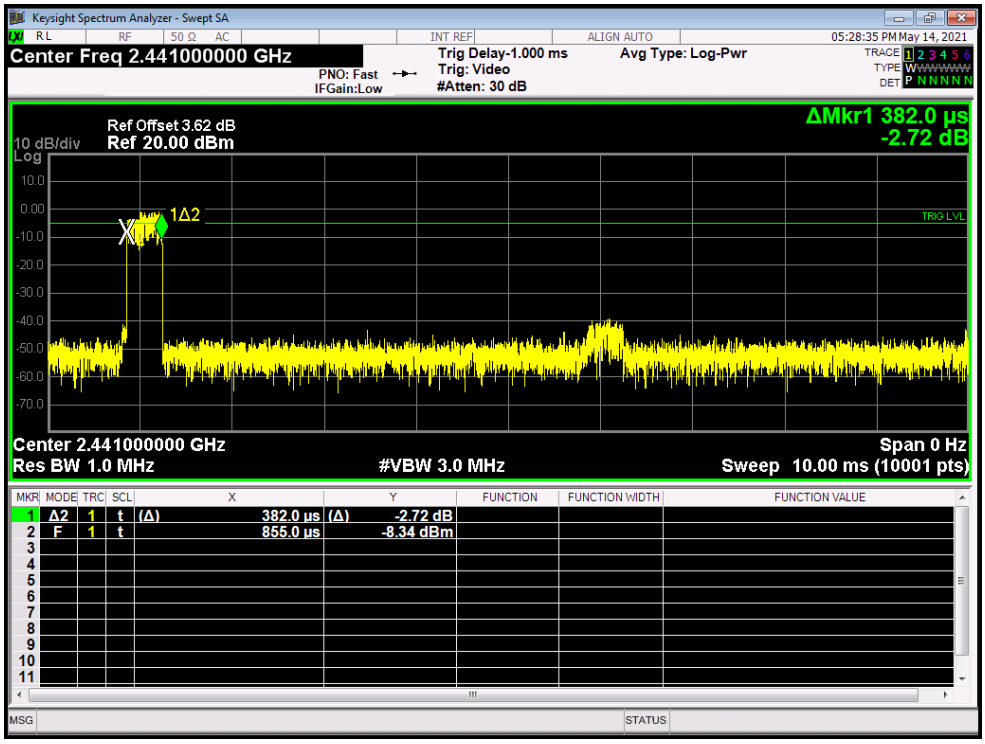
2DH1 Total of Dwell= Pulse Time(1600/2)*31.6/79*

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

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

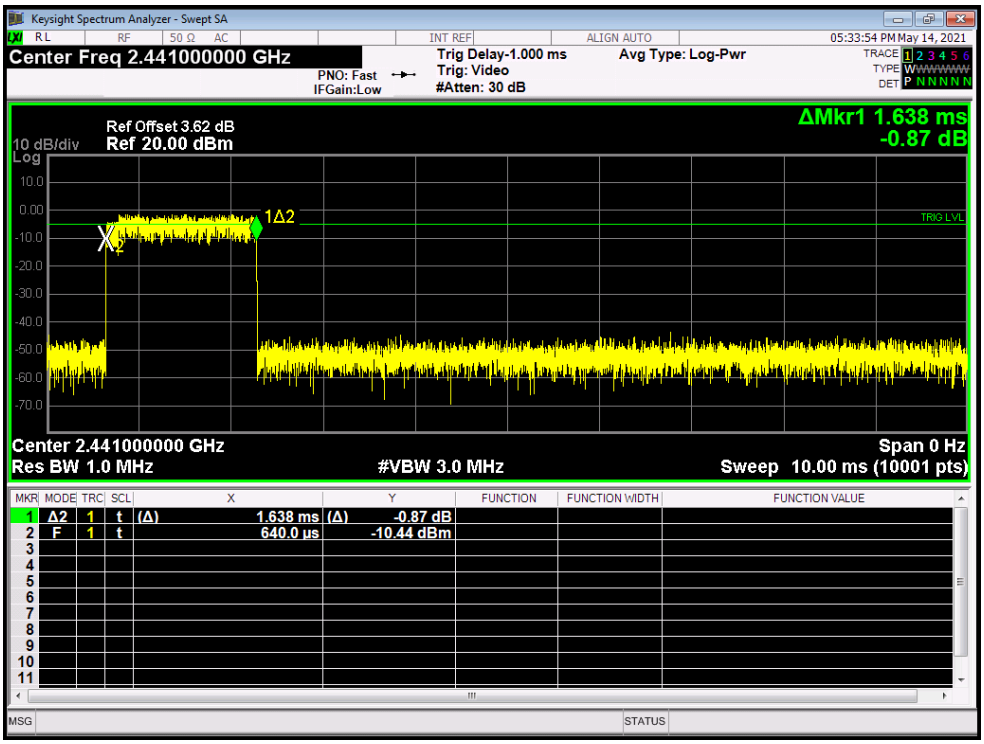
π /4-DQPSK **Hopping Mode 2DH1**

2441 MHz



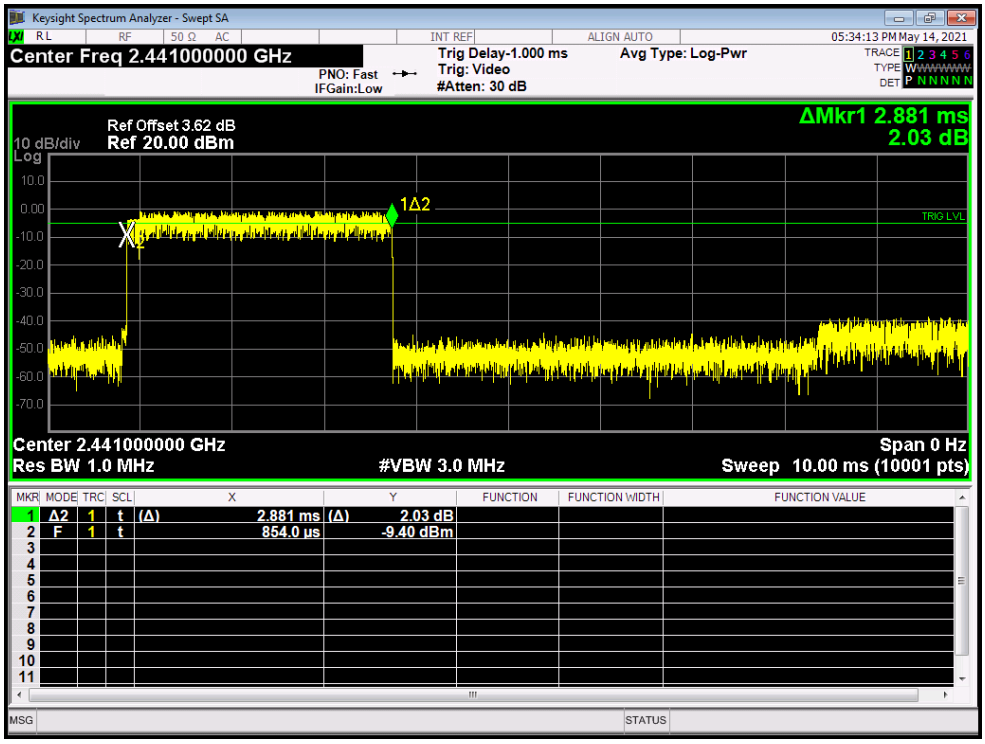
π /4-DQPSK Hopping Mode 2DH3

2441 MHz



π /4-DQPSK Hopping Mode 2DH5

2441 MHz



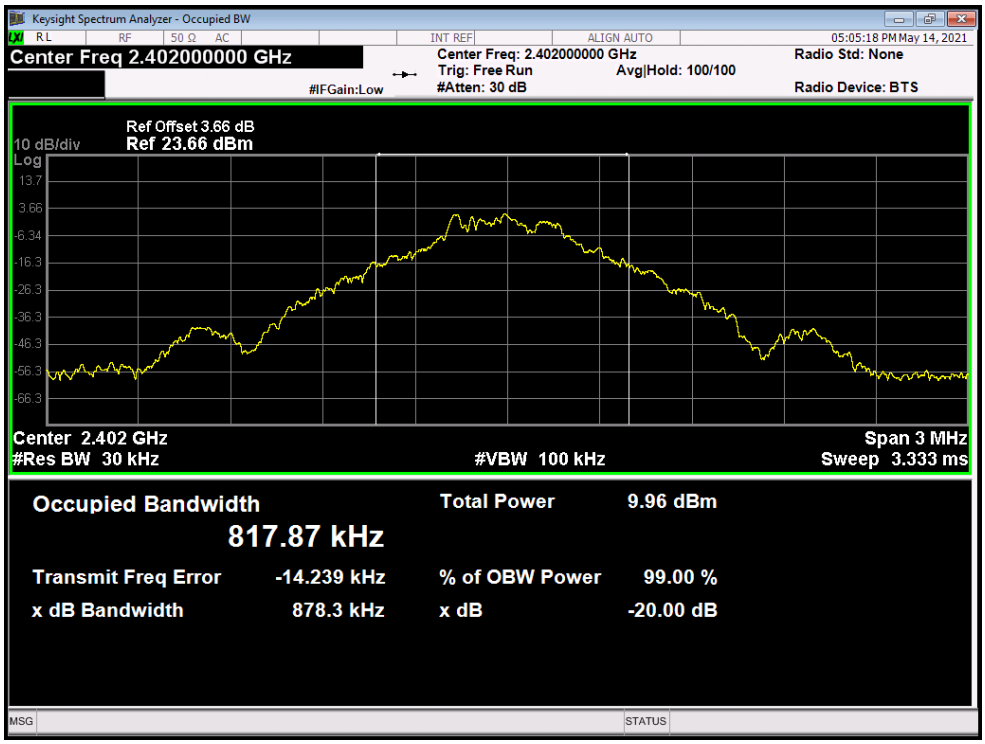
Attachment F-- Channel Separation and Bandwidth Test Data

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)
2402	817.87	878.3	
2441	805.90	880.7	
2480	842.01	878.4	

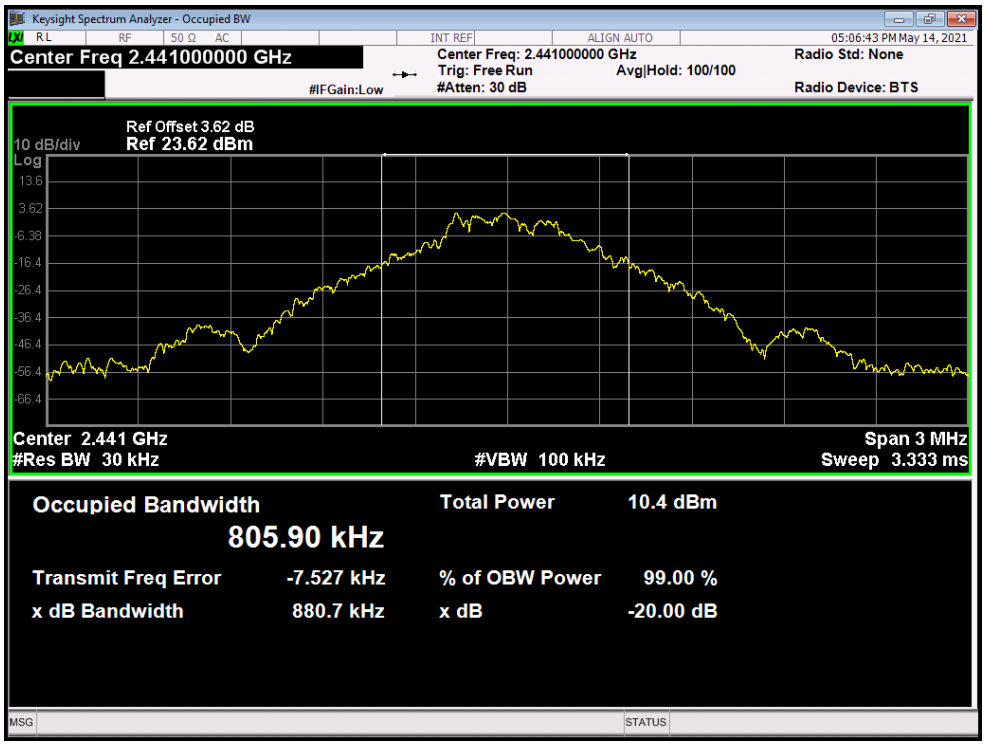
GFSK TX Mode

2402 MHz



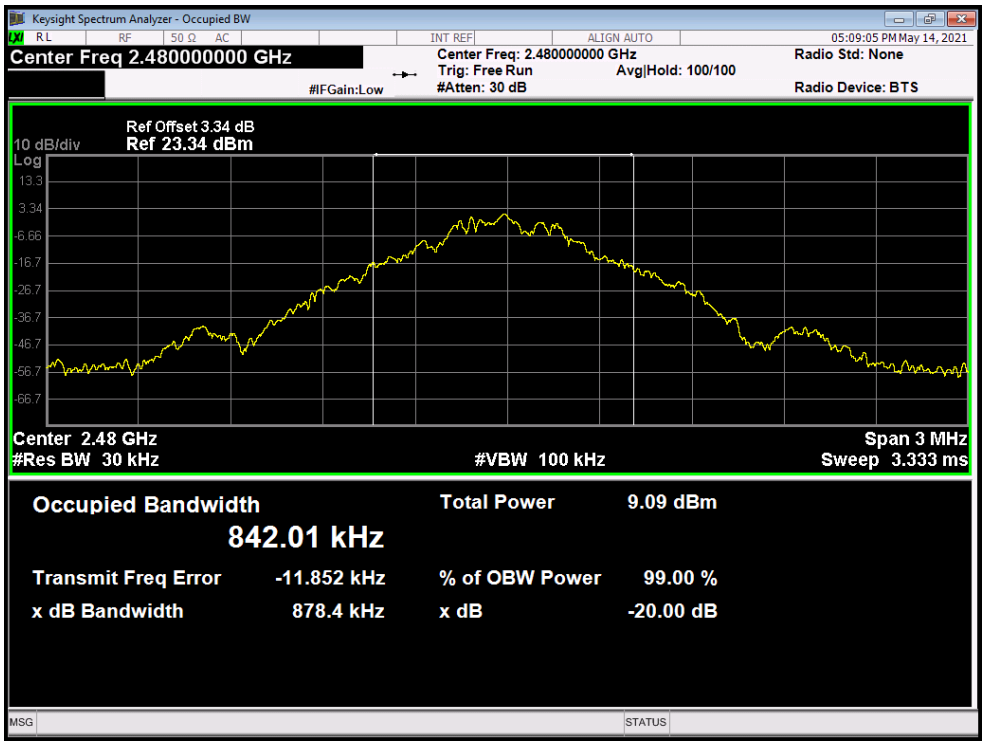
GFSK TX Mode

2441 MHz



GFSK TX Mode

2480 MHz

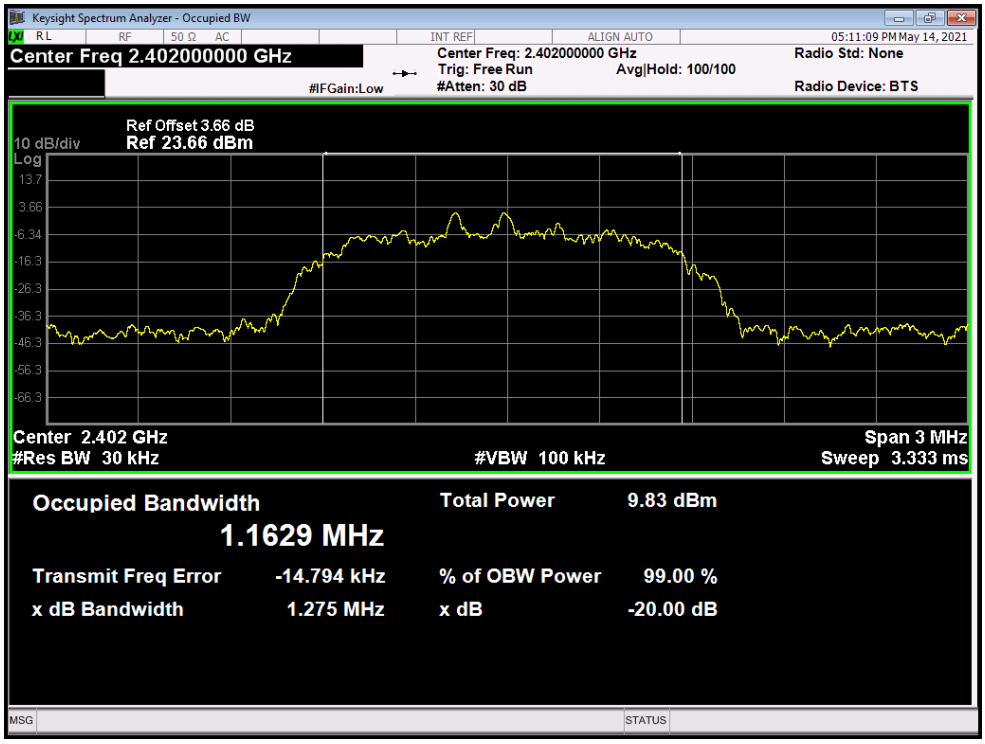


Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	AC 120V/60Hz		
Test Mode:	TX Mode (π /4-DQPSK)		

Channel frequency (MHz)	99% OBW (kHz)	20dB Bandwidth (kHz)	20dB Bandwidth *2/3 (kHz)
2402	1162.9	1275	850.00
2441	1137.1	1240	826.67
2480	1168.6	1274	849.33

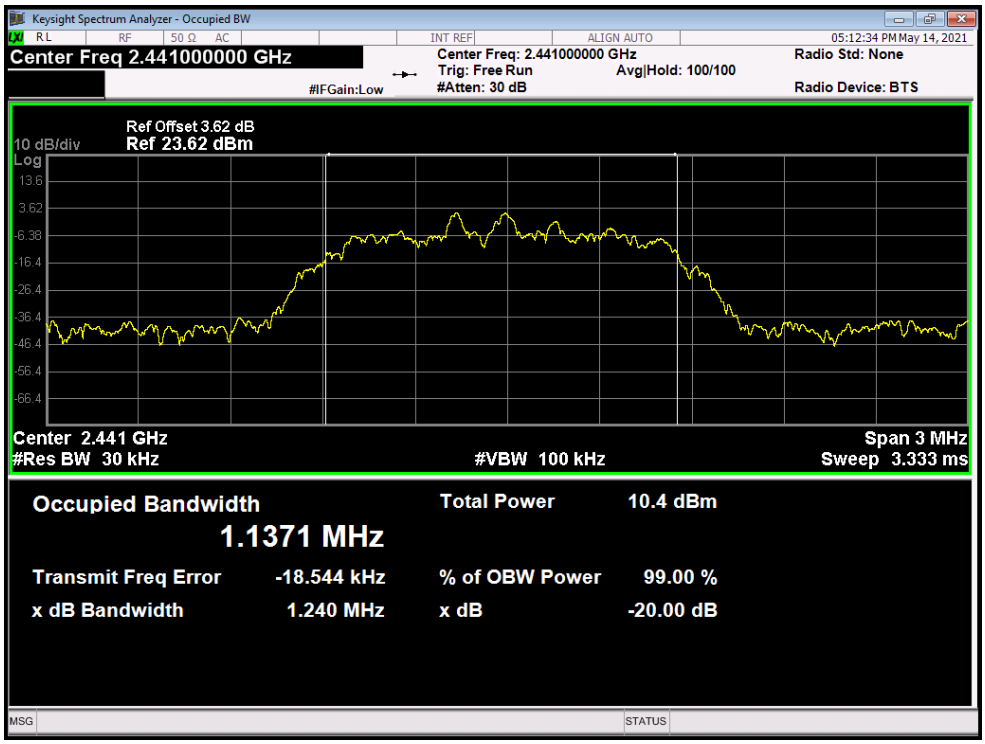
π /4-DQPSK TX Mode

2402 MHz



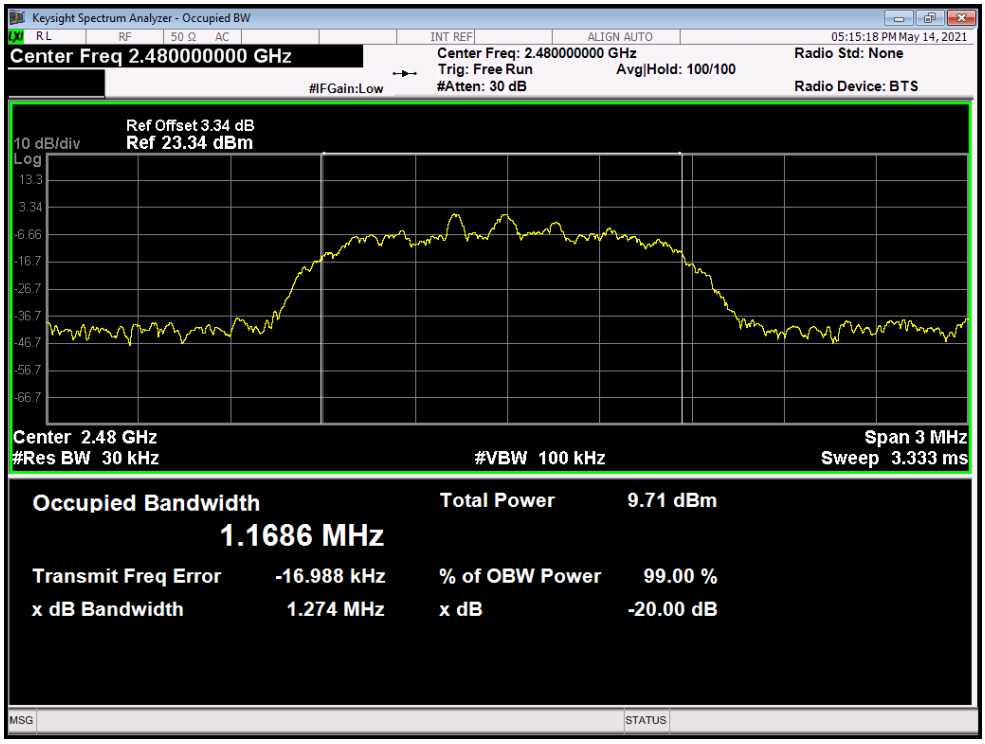
π /4-DQPSK TX Mode

2441 MHz



π /4-DQPSK TX Mode

2480 MHz

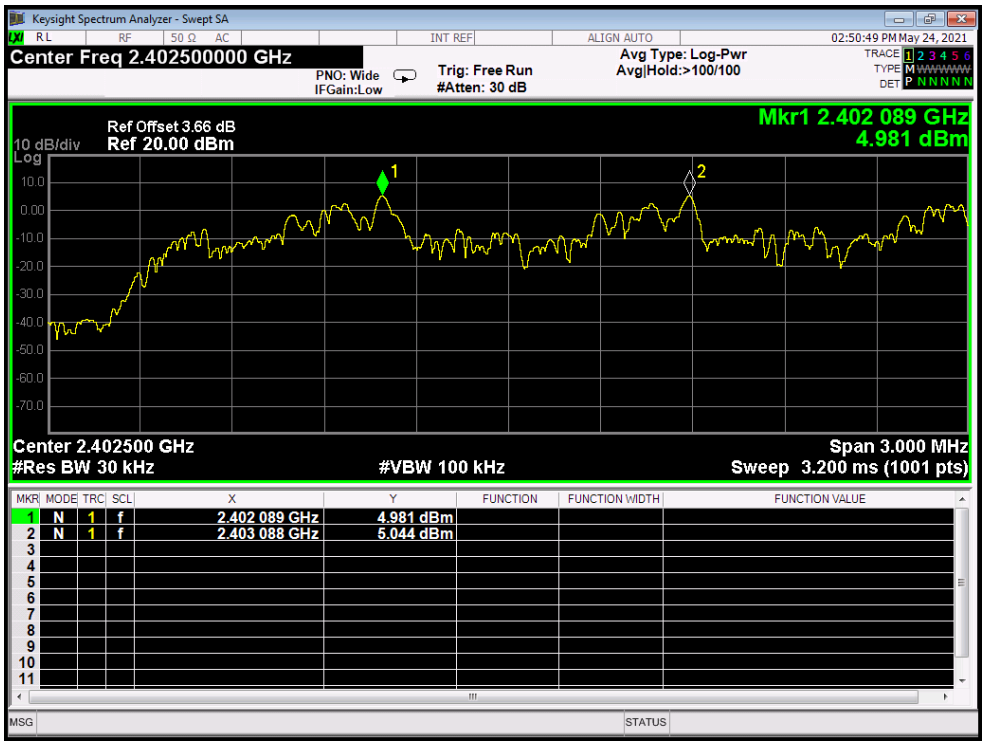


Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	AC 120V/60Hz		
Test Mode:	Hopping Mode (GFSK)		

Channel frequency (MHz)	Separation Read Value (KHz)	Separation Limit (kHz)
2402	999	878.3
2441	1002	880.7
2480	1002	878.4

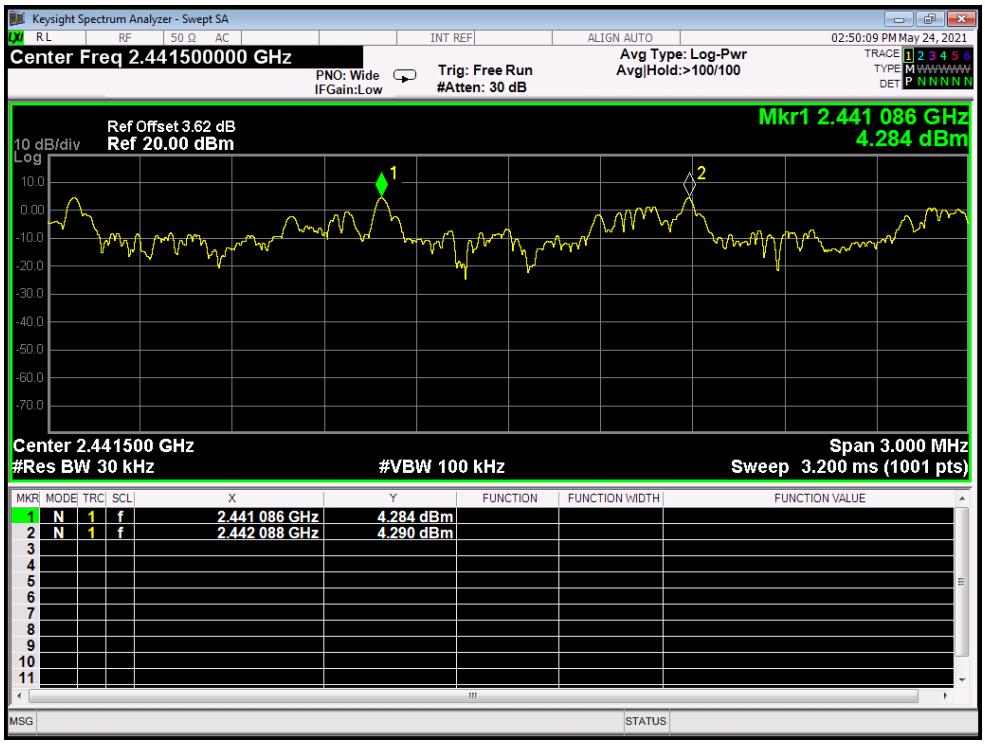
GFSK Hopping Mode

2402 MHz



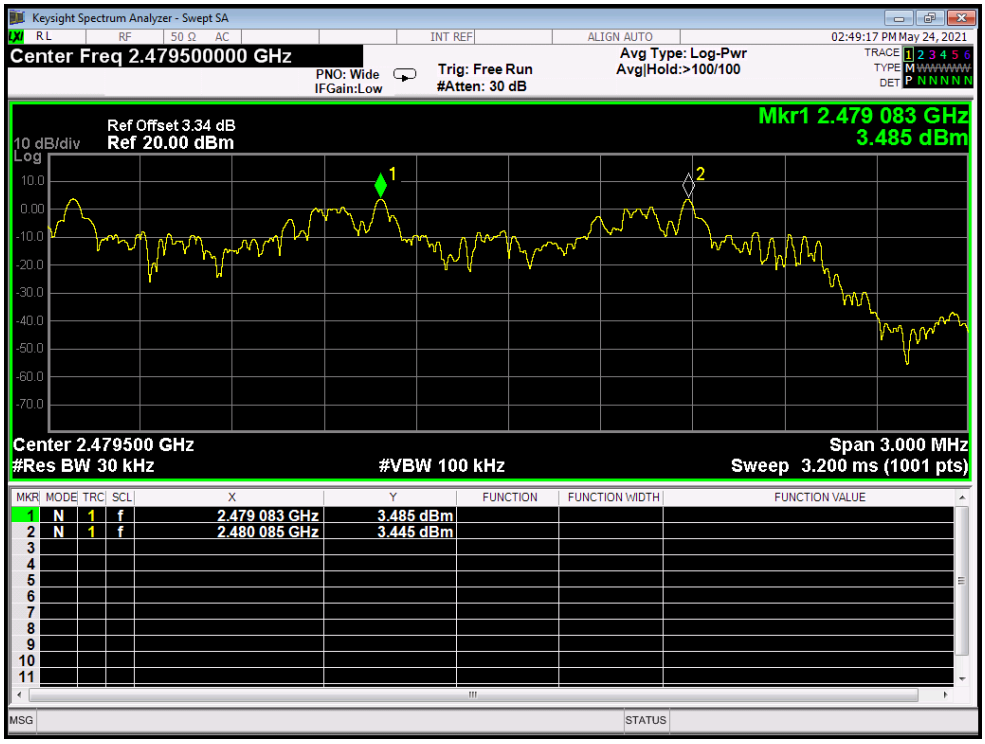
GFSK Hopping Mode

2441 MHz



GFSK Hopping Mode

2480 MHz

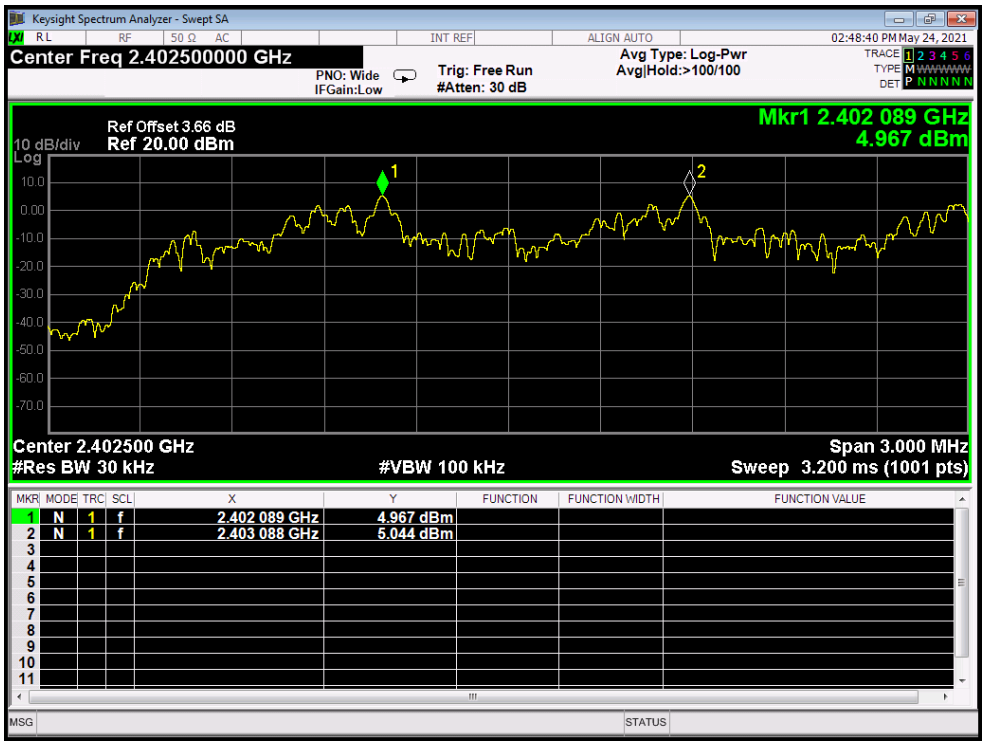


Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	AC 120V/60Hz		
Test Mode:	Hopping Mode (π /4-DQPSK)		

Channel frequency (MHz)	Separation Read Value (KHz)	Separation Limit (kHz)
2402	999	850.00
2441	1002	826.67
2480	999	849.33

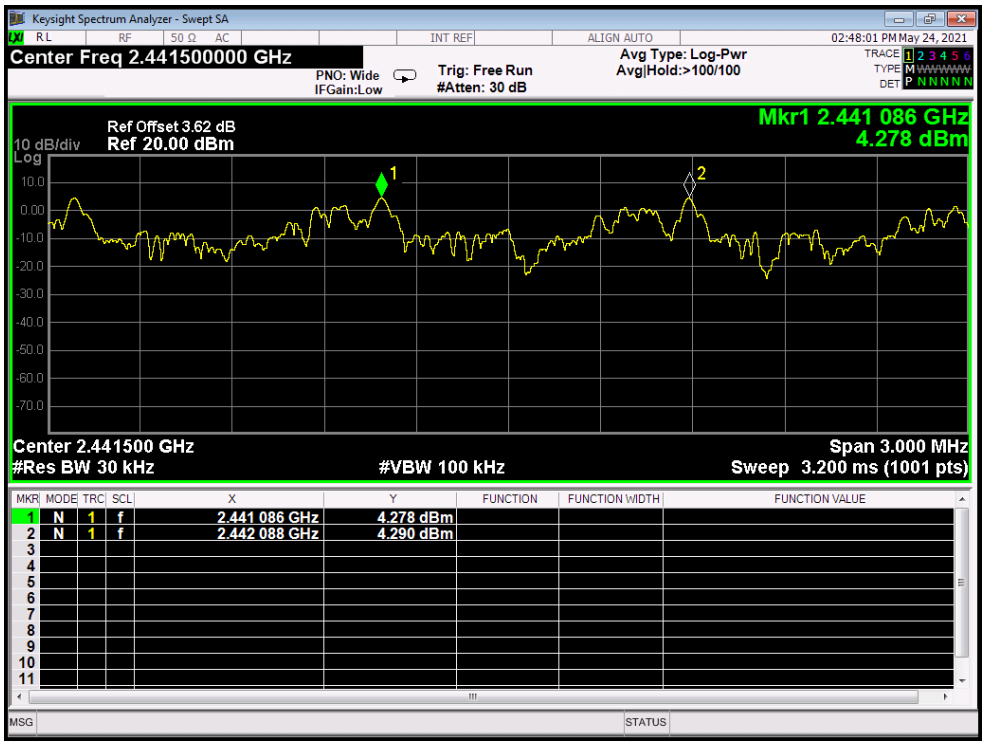
π /4-DQPSK Hopping Mode

2402 MHz



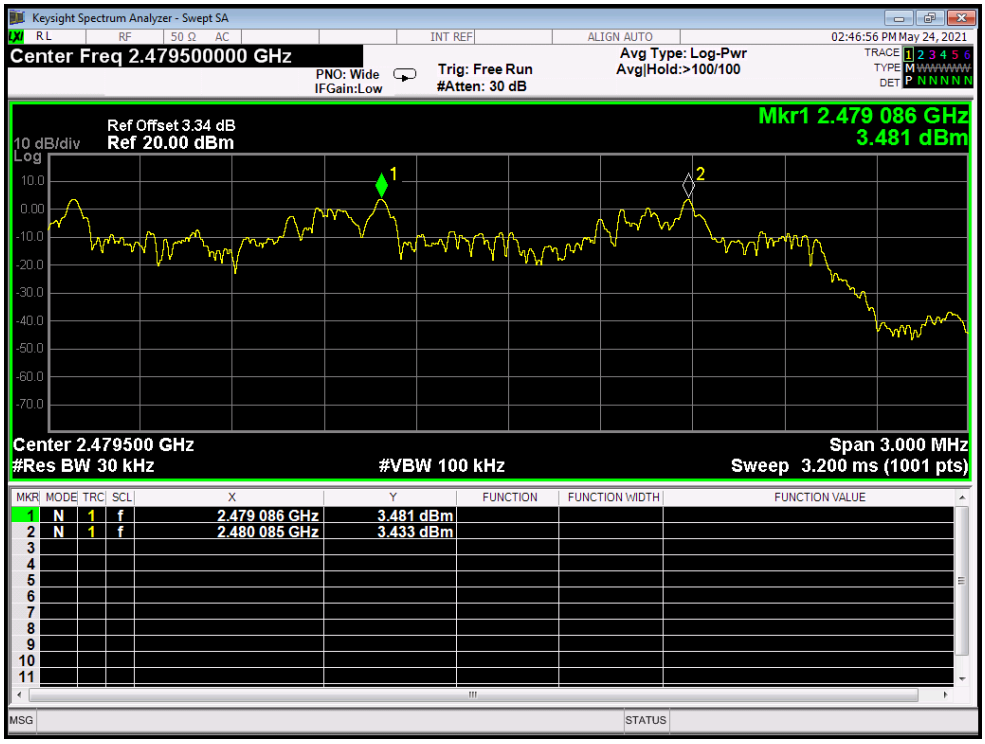
π /4-DQPSK Hopping Mode

2441 MHz



π /4-DQPSK Hopping Mode

2480 MHz



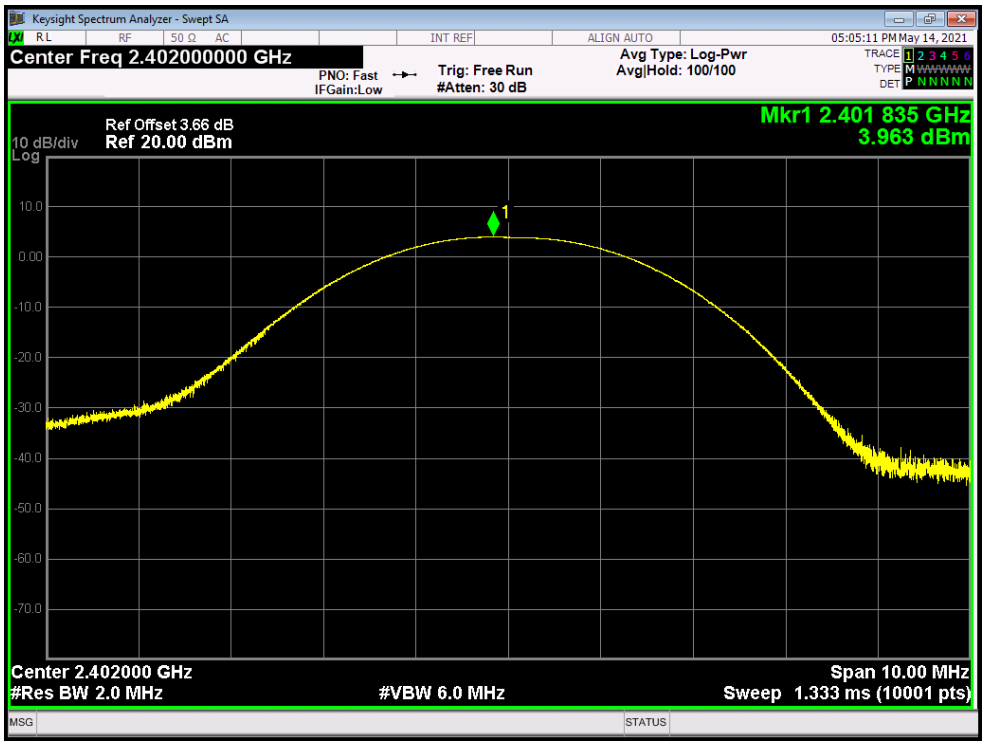
Attachment G-- Peak Output Power Test Data

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

Channel frequency (MHz)	**Test Result (dBm)**	**Limit (dBm)**
2402	3.963	**21**
2441	4.377	
2480	3.652	

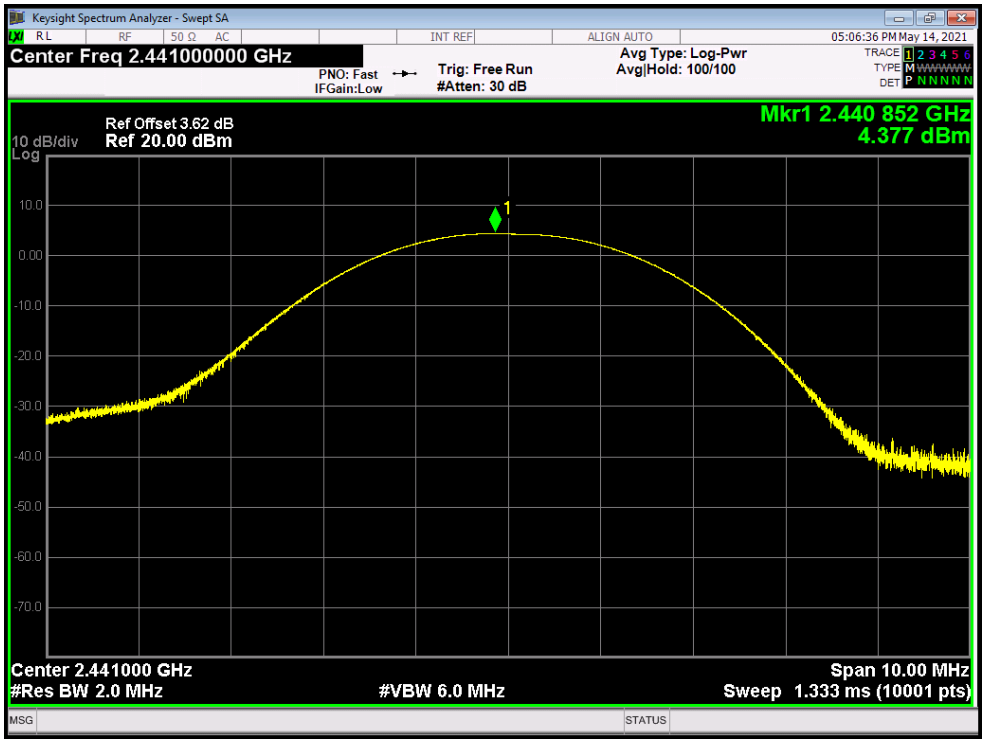
GFSK TX Mode

2402 MHz



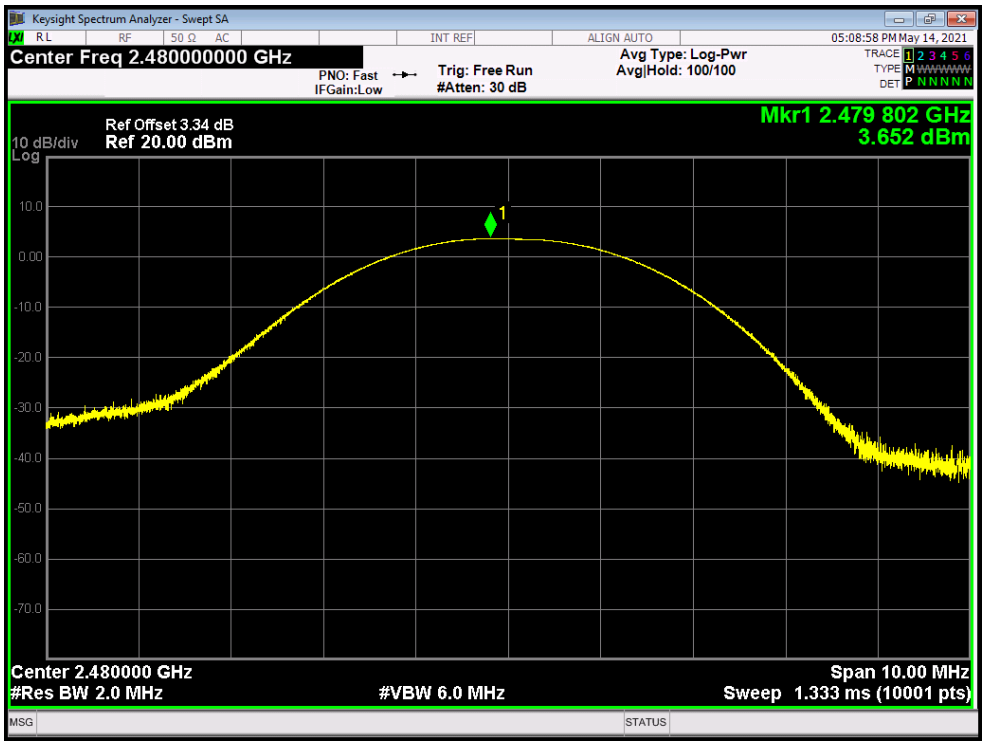
GFSK TX Mode

2441 MHz



GFSK TX Mode

2480 MHz

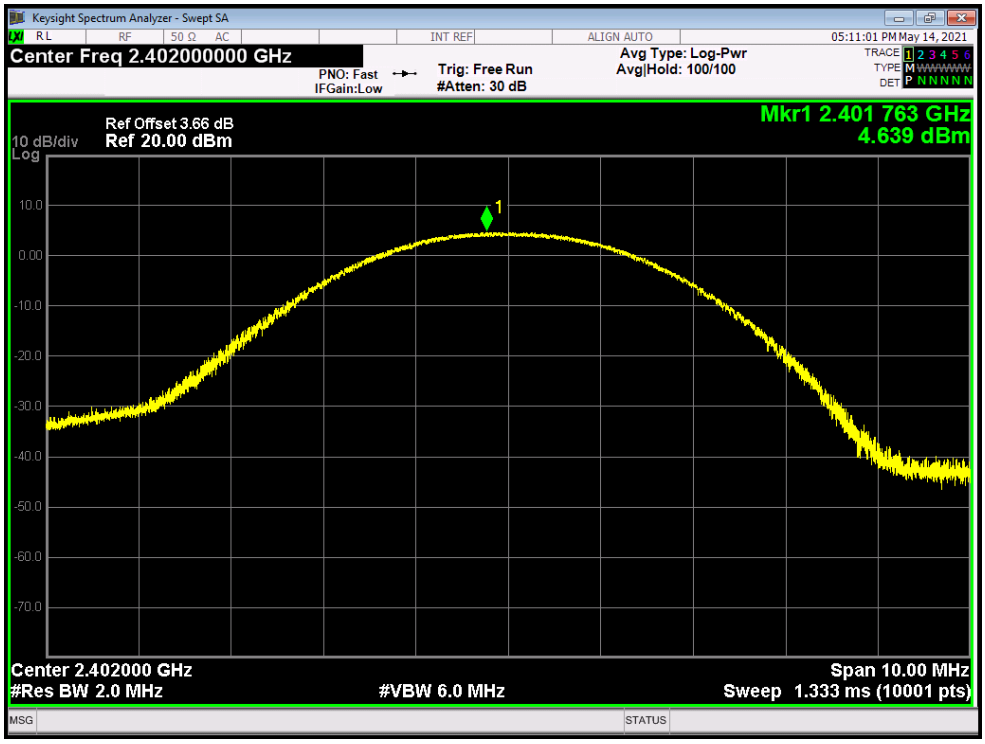


Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	AC 120V/60Hz		
Test Mode:	TX Mode (π /4-DQPSK)		

Channel frequency (MHz)	**Test Result (dBm)**	**Limit (dBm)**
2402	4.639	**21**
2441	5.050	
2480	4.295	

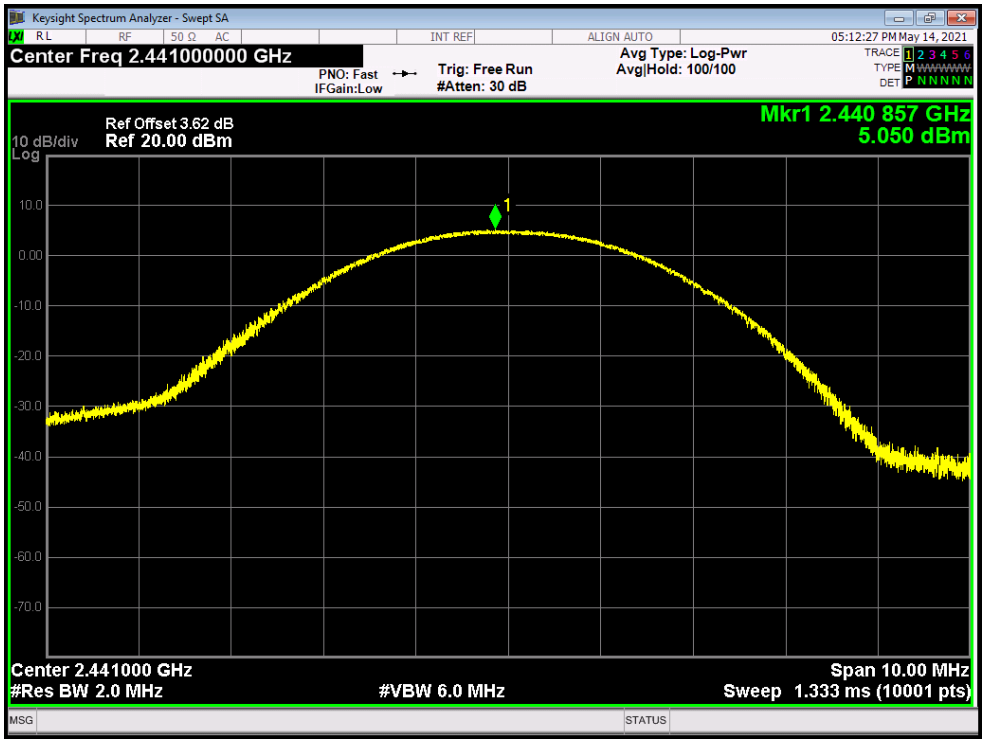
π /4-DQPSK TX Mode

2402 MHz



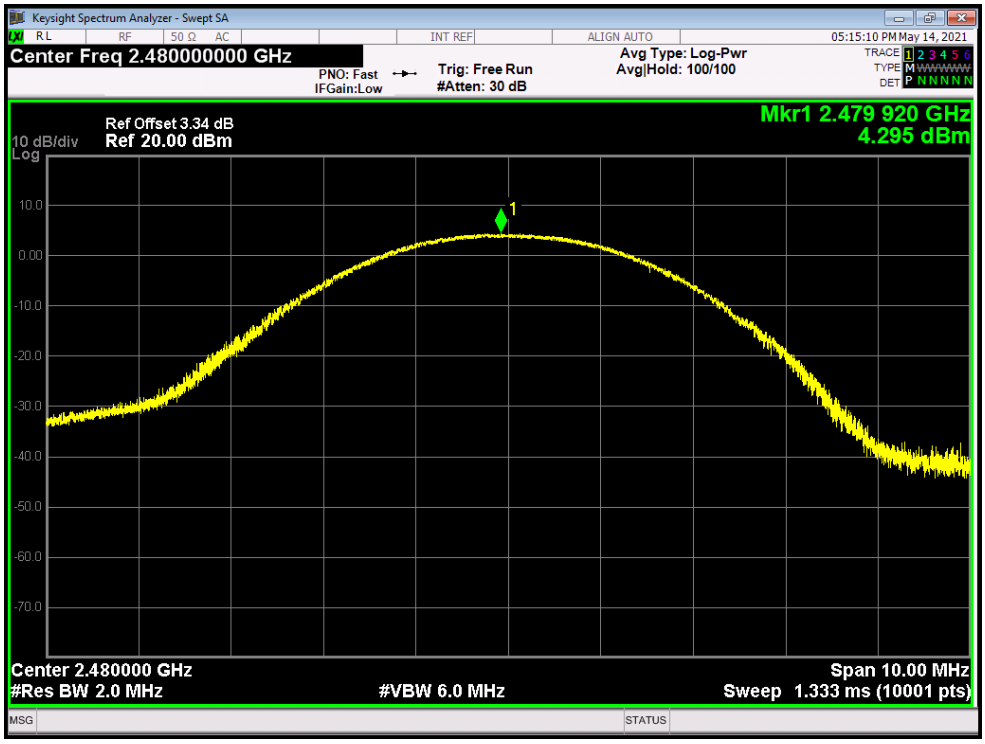
π /4-DQPSK TX Mode

2441 MHz



π /4-DQPSK TX Mode

2480 MHz



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