FCC RF Test Report

For

Bluetooth Module

Model Number	**:**	**R8002**
FCC ID	**:**	**V3DR8002**
Date of Receipt	**:**	**February 18, 2022**
Date of Report	**:**	**December 12, 2022**

Prepared for

Riotec Co. Ltd.

8F., No.196-2, Sec. 3, Datong Rd., Xizhi Dist., New Taipei City 221, Taiwan

Prepared by

Central Research Technology Co.

11, Lane 41, Fushuen St., Jungshan Chiu, Taipei 104, Taiwan

Testing Laboratory
0905

Verification of Compliance

Equipment under Test	: Bluetooth Module
Model No.	: R8002
FCC ID	: V3DR8002
Applicant	: Riotec Co. Ltd.
Address	: 8F., No.196-2, Sec. 3, Datong Rd., Xizhi Dist., New Taipei City 221, Taiwan
Applicable Standards	: 47 CFR part 15, Subpart C ANSI C63.10:2013
Date of Testing	: April 19~December 12, 2022
Deviation	: The method, configuration and arrangement of the tests are following the requirement of customer and the applicable standards cited above.
Condition of Test Sample	: Mass Production

We, **Central Research Technology Co**., hereby certify that one sample of the designated product was tested in our facility during the period mentioned above. The test records, data evaluation and Equipment Under Test (EUT) configurations shown in the present report are true and accurate representation of the measurements of the sample's RF characteristics under the conditions herein specified.

The test results show that the EUT as described in the present report is in compliance with the requirements set forth in the standards mentioned above and apply to the tested sample identified in the present report only. The test report shall not be reproduced, except in its entirety, without the written approval of Central Research Technology Co.

PREPARED BY : _____ , **DATE :** **December 12, 2022**
(Cathy Chen/ Technical Manager)

APPROVED BY : _____ , **DATE :** **December 12, 2022**
(Sam Chien /General Manager)

Contents

1 General Description

1.1 General Description of EUT

Equipment under Test	:	Bluetooth Module
Model No.	:	R8002
Power in	:	5Vdc
Frequency Range	:	2402 MHz – 2480 MHz
Module Function	:	GFSK, Π/4 DQPSK, 8DPSK
Channel No.	:	79
Antenna Spec	:	Type:PCB Antenna
		Antenna Gain : 2 dBi

Channel List:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461		

Test Mode

Test item	Operation Frequency	
Conducted power test	GFSK, Π/4 DQPSK, 8DPSK	CH 0, CH 39, CH 78
Radiated emission above 1 GHz *	GFSK, 8DPSK	CH 0, CH 39, CH 78
Radiated emission below 1 GHz	8DPSK	CH 0
Line conducted emission	8DPSK	CH 39

Note: According to condcuted test, GFSK/8DPSK were taken as the representative condition for radiated emission and its data are recorded in the present document.

EUT Test step:

1. EUT Connect with PC/NB.
2. Turn on the power.
3. Operation test software: BT98X FCC Tool V1.2
4. Adjust test mode, channel, setting power.
5. Press start testing.
6. EUT run test program and transmit signal.

1.2 Applied standards

(1) Maximum peak conducted output power

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

(2) Outside of band

According to FCC 15.247(d),In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

(3) Frequency Separation

According to FCC 15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW

(4) Hopping number and occupied time

According to FCC 15.247(a)(1)(iii), Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

(5) Radiated emission

For intentional device, according to FCC 15.209, the general requirement of field strength of radiated emissions from intentional radiator at a distance of 3 meters shall not exceed the below table.

Frequency (MHz)	**Measurement Distance (m)**	**Field Strength (uV/m)**	**Field Strength (dBuV/m)**
0.009-0.490	300	2400/F(kHz)	
0.490-1.705	30	24000/F(kHz)	
1.705-30.0	3	30	29.5
30 – 88	3	100	40.0
88 – 216	3	150	43.5
216 – 960	3	200	46.0
above 1610	3	500	54.0

Note1 : At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

Note 2: At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade)

(6) Line Conduction Emission

For intentional device, according to FCC 15.207(a), line conduction emission limit is as below table.

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

* Decreases with the logarithm of the frequency.

(7) Restricted Band

Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (GHz)
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(2)
13.36 - 13.41			

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

[2] Above 38.6

1.3 Test result

Test Item	FCC standard section	Report section	Test result
Maximum peak conducted output power	15.247(b)(1)	2	**PASS**
20 dB Bandwidth	15.247(a)(1)	3	**PASS**
Frequency separation	15.247(a)(1)	4	**PASS**
Hopping number	15.247(a)(1)(iii)	5	**PASS**
Occupied time	15.247(a)(1)(iii)	6	**PASS**
Condutced spurious emission	15.247(d)	7	**PASS**
Radiated spurious emission	15.209	8	**PASS**
Line Conduction Emission	15.207(a)	9	**PASS**
Pseudorandom Frequency Hopping Sequence	15.247(a)(1)	-	**PASS ***

Note: The device is designed according to specifications of SIG，So it has a full support to Medium access protocol and fully compliant with the KDB558074 standard. The device is compliant Pseudorandom hopping, Equal hopping frequency, receiver bandwidth synchronize and have same bandwidth with transmitted signal. And the ability to have adaptive hopping when encountering other signals.

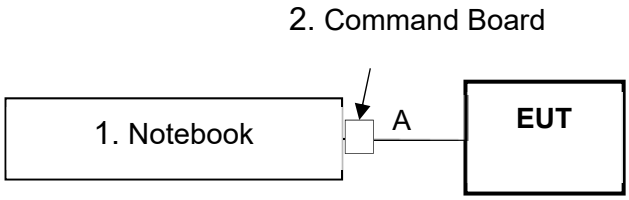
According to ANSI C63.10, determining compliance is based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

1.4 The Support Units

No.	Unit	Model No.	Trade Name	Power Code	Supported by lab.	Note
1.	Notebook	ProBook 6470b	HP		√	
2.	Command Board	USB to TTL	TTL			

No.	Cable	Length	Core	Supported by lab.	Note
A	Testing line	1.0m			

1.5 Layout of Setup



1.6 Test Instruments

Conducted Emission Test

Test Site and Equipment	Manufacturer	Model No. /Serial No.	Last Calibration Date	Calibration Due Date
Spectrum Alayzer	R&S	FSV40/ 101609	2021/10/18 2022/10/18	2022/10/17 2023/10/17
RF cable	JMCA	MWX/ C0150~C0153, C0161~C0163	2021/6/15 2022/6/14	2022/6/14 2023/6/13
Test software	R&S	EMC32/ V11.10.00	NCR	NCR
Test room	N/A	TR13	NCR	NCR

Note:

1. The calibrations are traceable to NML/ROC.
2. NCR:No Calibration Required.

Radiated Emission Test (Below 1GHz)

Test Site and Equipment	Manufacturer	Model No. /Serial No.	Last Calibration Date	Calibration Due Date
EMI Receiver	R&S	ESCS30/ 836858/020	2021/11/3	2022/11/2
Spectrum Alayzer	Agilent	E4407B/ MY45106795	2021/6/23	2022/6/22
Antenna	SCHWARZBECK & Mini-Circuits	VULB 9168 & BW-N5W5+/ VULB 9168-668 & 003	2022/6/1	2023/5/31
Pre-amplifer	Mini-circuit	ZKL-1R5+/ 004	2022/1/5	2022/7/4
RF cable	JYEBAO	0214/ C0080-4 + C0080-1 + C0080-2+RSU(CRC-011/11)+C0080-3	2022/1/5	2022/7/4
Test software	Audix	e3/ V6.20110303a2	NCR	NCR
Semi-anechoic chamber	ETS. LINDGREN	TR11/ 906-A	2022/1/5	2022/7/4

Note:

1. The calibrations are traceable to NML/ROC.
2. NCR : No Calibration Required.
3. The calibration date of the semi-anechoic chamber listed above is the date of NSA measurement.

Radiated Emission Test (Above 1 GHz)

Test Site and Equipment	Manufacturer	Model No. /Serial No.	Last Calibration Date	Calibration Due Date
Antenna	EMCO	3117/ 0082847	2021/11/3	2022/11/2
Antenna	Com-Power	AH-840/ 101098	2021/11/3	2022/11/2
Pre-amplifer	MITEQ	TTA1800-30-HG-N-M/ 1904295	2021/11/3	2022/11/2
Pre-amplifer	MITEQ	TTA1840-35-HG/ 2034375	2021/9/9	2022/9/8
RFcable	Suhner	Sucoflex 106P / C0091	2021/10/4	2022/10/3
RFcable	JMCA	MWX241/B/ C0103~C0104	2021/10/4	2022/10/3
MXA singal analyzer	KeySight	N9020A/ MY54420147	2021/7/5	2022/7/4
Test software	Audix	e3/ V9 20150907c	NCR	NCR
Semi-anechoic chamber	ETS. LINDGREN	TR1/ 17627-B	2022/1/30	2023/1/29

Note:

1. The calibrations are traceable to NML/ROC.
2. NCR : No Calibration Required.
3. The calibration date of the chamber TR1 listed above is the date of site VSWR measurement.

For Power Line Conducted Measurement

Test Site and Equipment	Manufacturer	Model No./ Serial No.	Last Calibration Date	Calibration Due Date
Test Receiver	R&S	ESCI/ 100316/003	2022/4/7	2023/4/6
LISN	R&S	ESH2-Z5/ 880669/039	2022/4/7	2023/4/6
RF Cable	JYBAO	0214/ C0113 + RSU + C0114	2022/2/16	2022/8/15
Test Software	Audix	e3/ V6.20110303a2	NCR	NCR
TR20 shielded room	ETS LINDGREN	T R20/ 17873-2	NCR	NCR

Note:

1. The calibrations are traceable to NML/ROC.
2. NCR : No Calibration Required.

1.7 Test Capability

Test Facility

The test facility used for evaluating the conformance of the EUT with each standard in the present report meets what required in CISPR16 series and ANSI C63.4:2014 amended as per ANSI C63.4a:2017.

Test Room	Type of Test Room	Descriptions
TR1	10m semi-anechoic chamber	For the radiated emission measurement (below 1GHz)
TR1	3m fully-anechoic chamber	For the radiated emission measurement (above 1GHz)
TR11	3m semi-anechoic chamber	For the radiated emission measurement (below 1GHz)
TR13	Test Site	For the RF conducted emission measurement.
TR5	Shielding Room	For the conducted emission measurement.
TR20	Shielding Room	

Test Laboratory Competence Information

Central Research Technology Co. has been accredited / filed / authorized by the agencies listed in the following table.

Certificate	Nation	Agency	Code	Mark
Accreditation Certificate	USA	NVLAP	200575-0	ISO/IEC 17025
	USA	FCC	TW1104, TW0019	ISO/IEC 17025
	R.O.C. (Taiwan)	TAF	0905	ISO/IEC 17025
	R.O.C. (Taiwan)	BSMI	SL2-IN-E-0033, SL2-IS-E-0033, SL2-R1/R2-E-0033, SL2-A1-E-0033, SL2-L1-E-0033	ISO/IEC 17025
	Canada	ISED	TW0905	ISO/IEC 17025
Site Filing Document	Japan	VCCI	R-11527,C-11609,T-11441, G-10010,C-20010, G-10614, T-20009	Test facility list & NSA Data
Authorization Certificate	Germany	TUV	UA 50235497	ISO/IEC 17025

The copy of each certificate can be downloaded from our web site: www.crc-lab.com

1.8 Measurement Uncertainty

The assessed measurement uncertainty with a suitable coverage factor K to ensure 95% confidence level for the normal distribution are shown as below, the values are less than U_{cispr} in table 1 of CISPR 16-4-2.

Test Item	Measurement Uncertainty	
Radiated Emission: (9kHz~30MHz)	Horizontal 3.92dB；Vertical 3.92dB	
Radiated Emission: (30MHz~1000MHz)	Horizontal 4.20dB；Vertical 6.12dB	
Radiated Emission: (1GHz~6GHz)	Horizontal 4.72dB；Vertical 4.62dB	
Radiated Emission: (6GHz~18GHz)	Horizontal 4.66dB；Vertical 4.58dB	
Radiated Emission: (18GHz~40GHz)	Horizontal 4.74dB；Vertical 4.76dB	
Line Conducted Emission	NSLK-8128-RC	2.92 dB
	ENV 4200	2.90 dB
	ESH2-Z5	3.08 dB

2 Maximum peak conducted output power

Result: Pass

2.1 Applied standard

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

2.2 Measurement Procedure

a. The EUT was set up per the test configuration figured in the next section of this chapter to simulate the typical usage per the user's manual.

b. A software provided by client enabled the EUT to transmit data at middle channel frequencies individually.

c. Test procedures follow ANSI C63.10 Section 7.8.5

d. Spectrum alayzer setting: RBW=1 MHz, VBW=3 MHz(for GFSK); RBW=2 MHz, VBW=10 MHz(for Π/4 DQPSK / 8DPSK), Max peak

e. Measure the maximum peak conducted output power and compare with the required limit.

2.3 Test configuration

2.4 Test Data

Test Mode **: Continuous Transmitting** **Tester** **:** Wayne
Ambient Temperature : 24℃ **Relative Humidity :** 62%
Test Date **:** 111/4/19

GFSK

Operating Frequency (MHz)	output power (dBm)	Limit (dBm)	Margin (dB)
2402	0.7	21	20.3
2441	0.0	21	21.0
2480	-0.3	21	21.3

Note:
1. Margin(dB)=Limit- output power

Ⅱ/4 DQPSK

Operating Frequency (MHz)	output power (dBm)	Limit (dBm)	Margin (dB)
2402	-0.6	21	21.6
2441	-1.1	21	22.1
2480	-1.6	21	22.6

Note:
1. Margin(dB)=Limit- output power

8DPSK

Operating Frequency (MHz)	output power (dBm)	Limit (dBm)	Margin (dB)
2402	0.7	21	20.3
2441	-0.1	21	21.1
2480	-0.4	21	21.4

Note:
1. Margin(dB)=Limit- output power

3 20 dB Bandwdith

Result: Pass

3.1 Applied standard

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW

3.2 Measurement Procedure

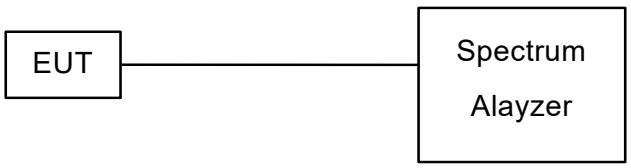
a. The EUT was set up per the test configuration figured in the next section of this chapter to simulate the typical usage per the user's manual.

b. Test procedures follow ANSI C63.10 section 7.8.7

c. Spectrum alayzer setting: RBW=10 kHz, VBW=30 kHz (for GFSK), RBW=20 kHz, VBW=100 kHz (for Π/4 DQPSK/8DPSK)Max peak

d. Measurement the 20 dB Bandwidth and compare with the required limit.

3.3 Test configuration



3.4 Test Data

Test Mode **: Continuous Transmitting** **Tester** **:** Wayne
Ambient Temperature : 24℃ **Relative Humidity :** 62%
Test Date **:** 111/4/19 ~ 111/12/12

GFSK

Operating Frequency (MHz)	20 dB Bandwidth (kHz)
2402	930
2441	930
2480	930

Π/4 DQPSK

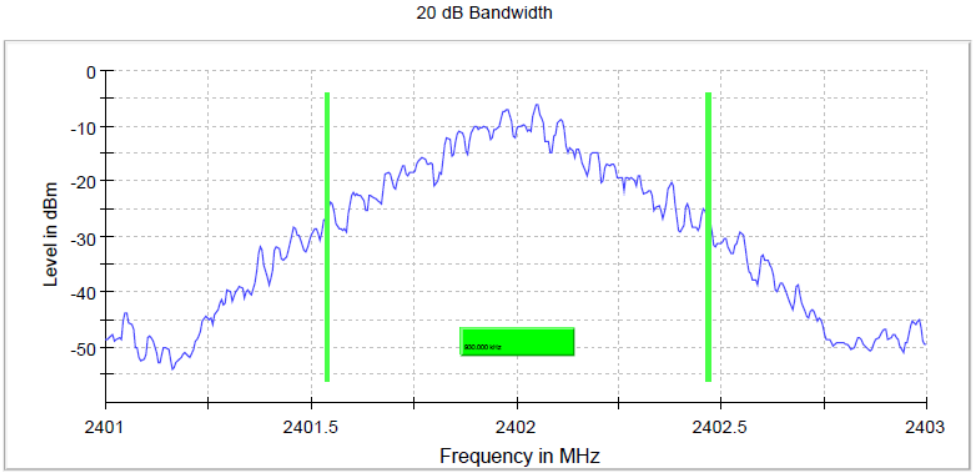
Operating Frequency (MHz)	20 dB Bandwidth (MHz)
2402	1.320
2441	1.320
2480	1.320

8DPSK

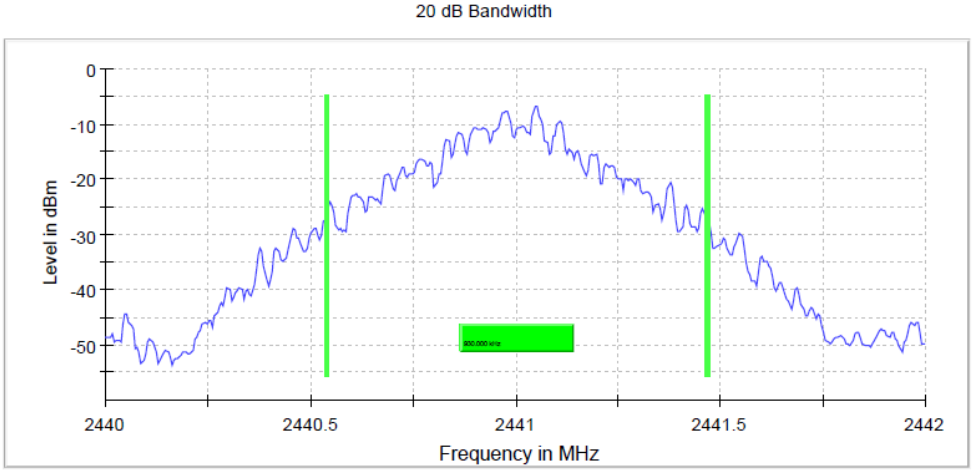
Operating Frequency (MHz)	20 dB Bandwidth (MHz)
2402	1.355
2441	1.360
2480	1.355

GFSK

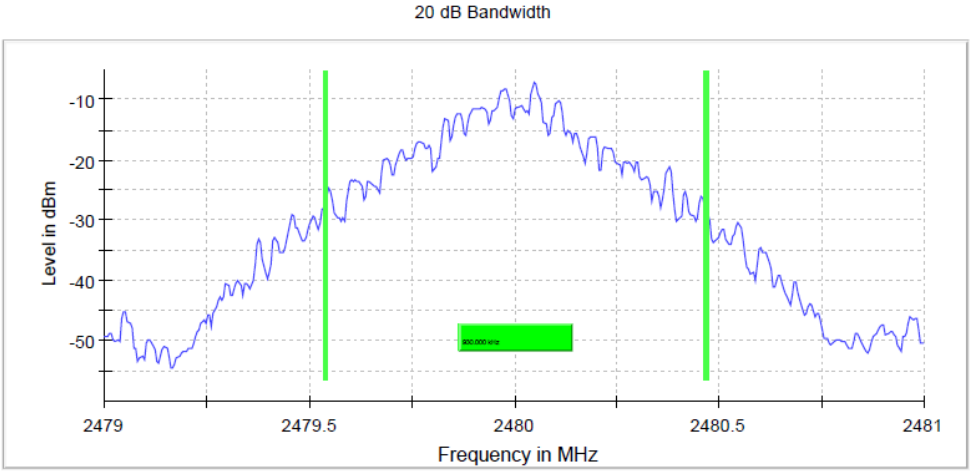
2402MHz



2441MHz

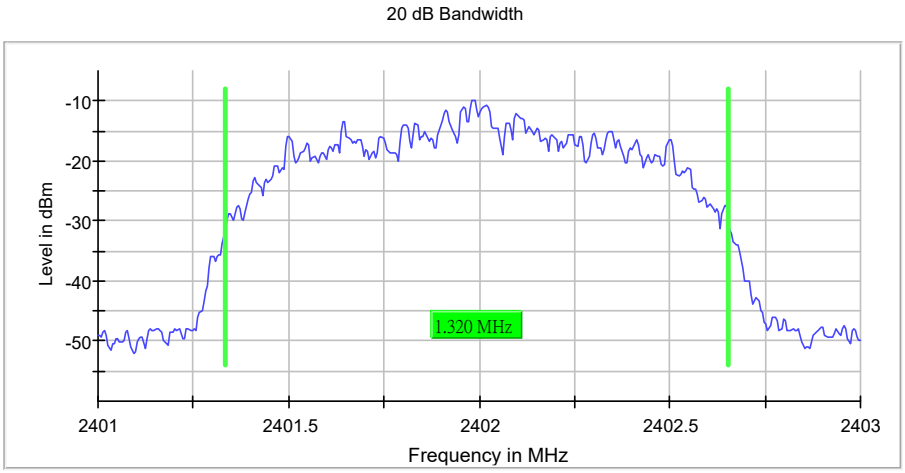


2480MHz

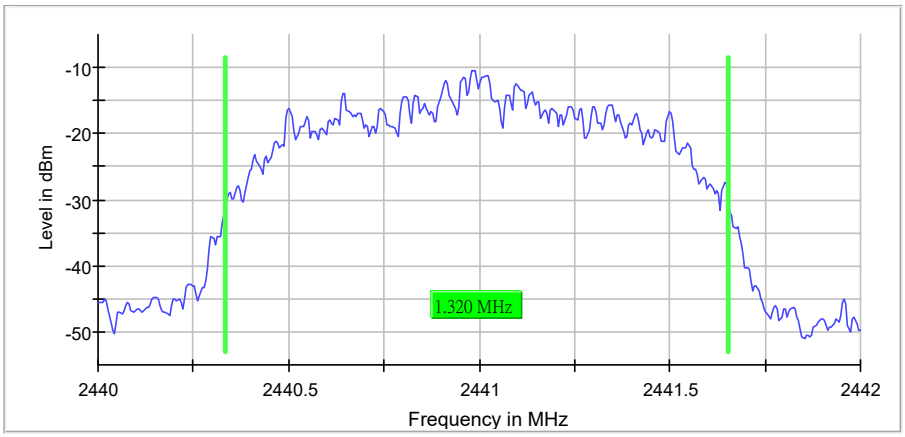


Π/4 DQPSK

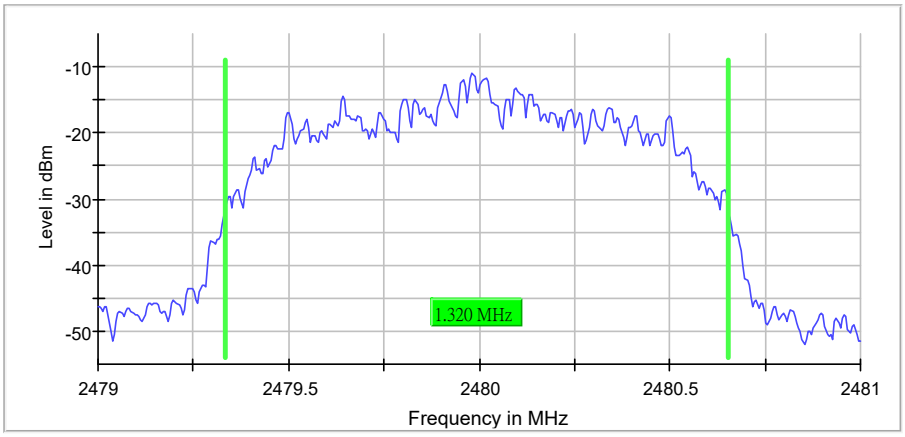
2402MHz



2441MHz

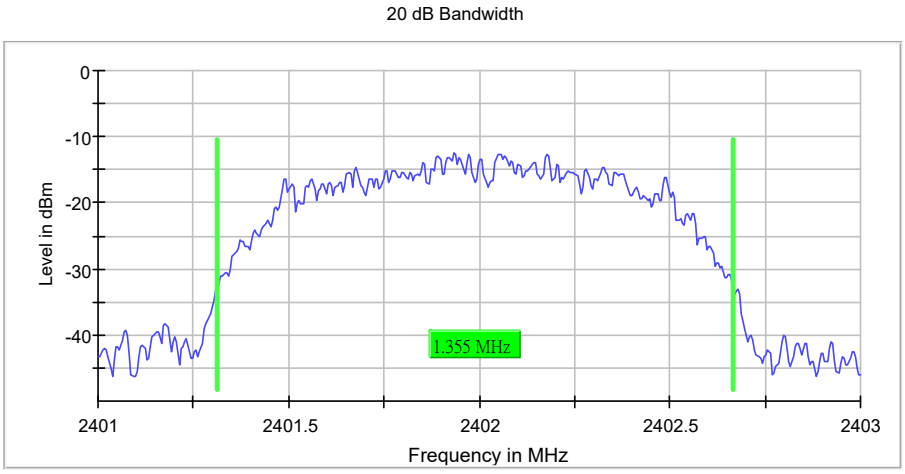


2480MHz

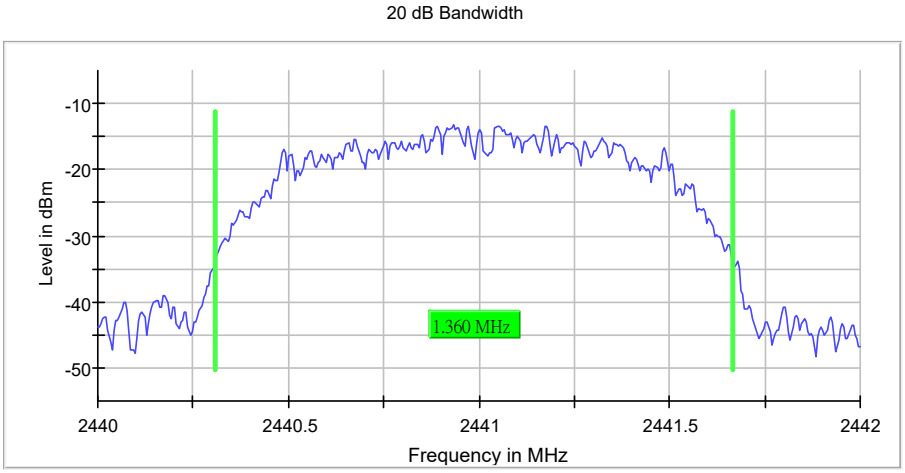


8DPSK

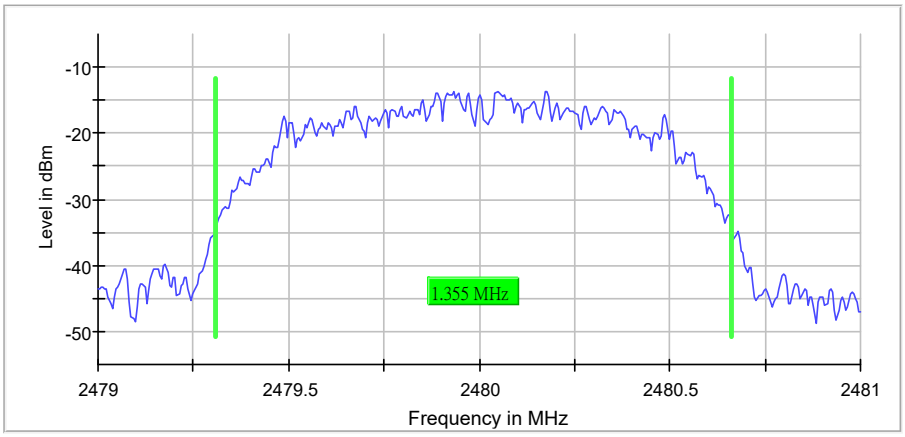
2402MHz



2441MHz



2480MHz



4 Frequency separation

Result: Pass

4.1 Applied standard

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW

4.2 Measurement Procedure

a. The EUT was set up per the test configuration figured in the next section of this chapter to simulate the typical usage per the user's manual.

b. Test procedures follow ANSI C63.10 section 7.8.2

c. Spectrum alayzer setting: RBW=300 kHz, VBW=300 kHz, Max peak

d. Measure the frequency separation and compare with the required limit.

4.3 Test configuration

4.4 Test Data

Test Mode **: Continuous Transmitting** **Tester** **:** Wayne
Ambient Temperature : 24℃ **Relative Humidity :** 62%
Test Date **:** 111/4/19

GFSK

Operating Frequency (MHz)	Frequency Separation (MHz)	Limit (MHz)
2402	0.98	0.81
2441	0.98	0.81
2480	1.01	0.81

Note: 20 dB BW X 2/3 = 0.81 MHz > 25 kHz

Π/4 DQPSK

Operating Frequency (MHz)	Frequency Separation (MHz)	Limit (MHz)
2402	0.98	0.88
2441	0.98	0.88
2480	1.010	0.88

Note: 20 dB BW X 2/3 = 0.88 MHz > 25 kHz

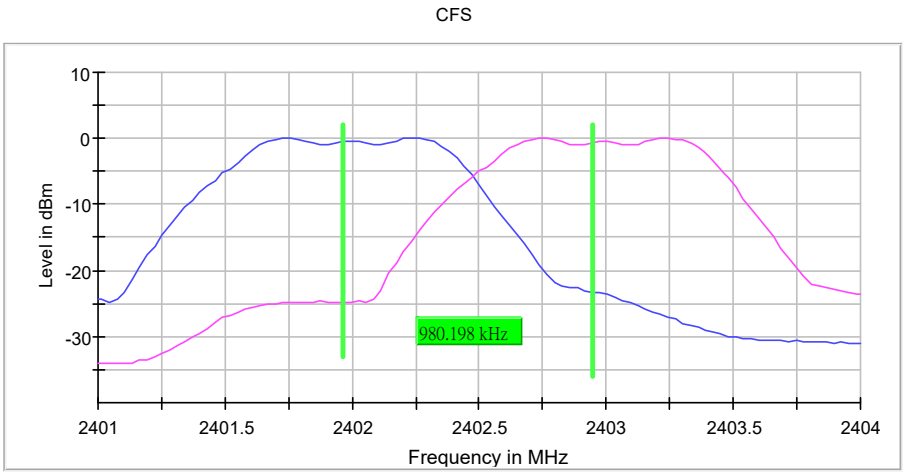
8DPSK

Operating Frequency (MHz)	Frequency Separation (MHz)	Limit (MHz)
2402	0.98	0.91
2441	0.98	0.91
2480	0.98	0.91

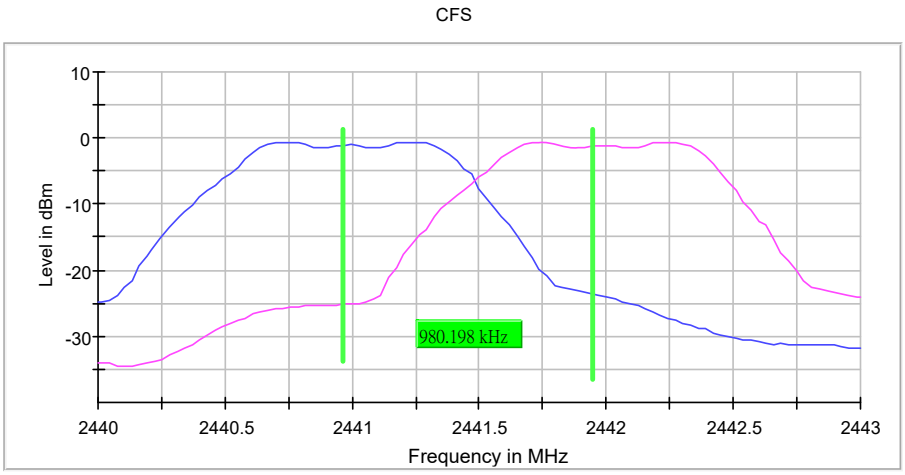
Note: 20 dB BW X 2/3 = 0.91 MHz > 25 kHz

GFSK

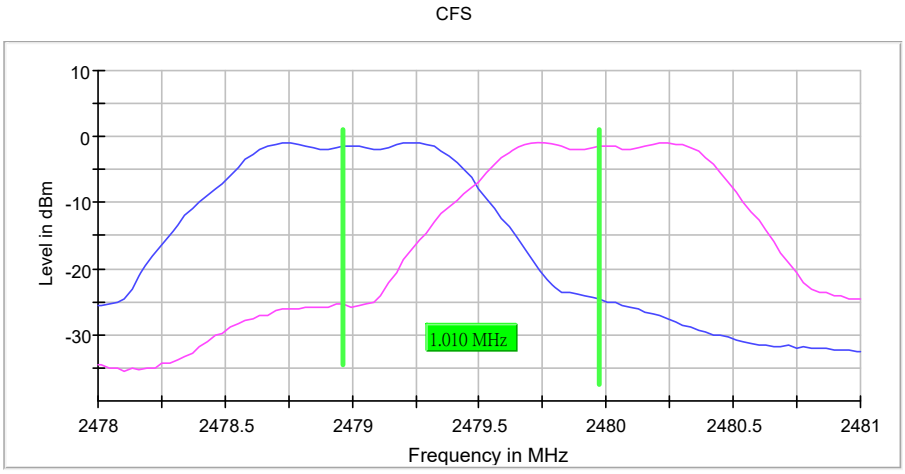
2402MHz



2441MHz

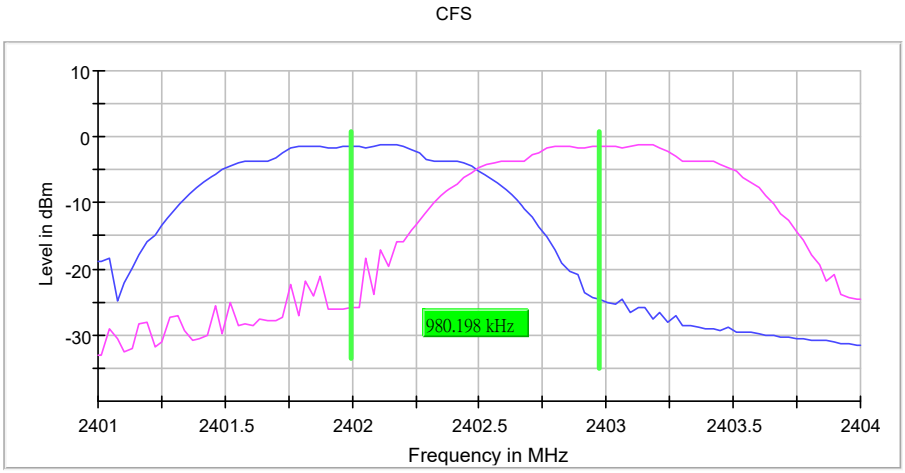


2480MHz

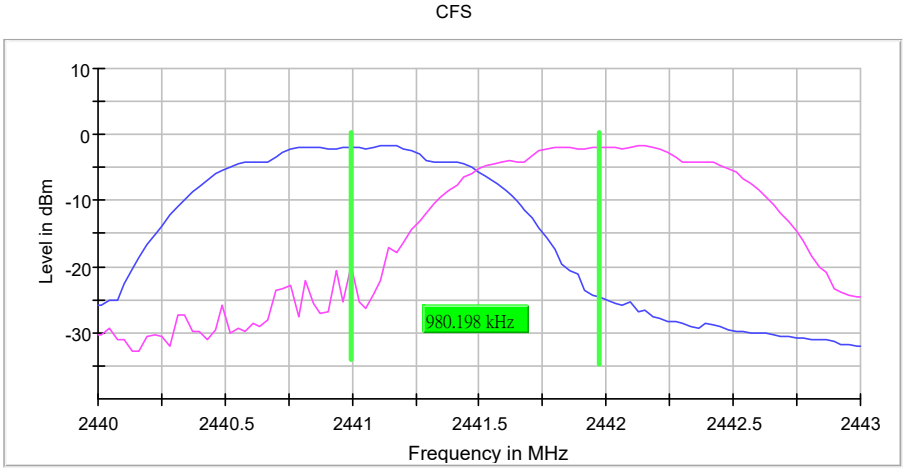


Π/4 DQPSK

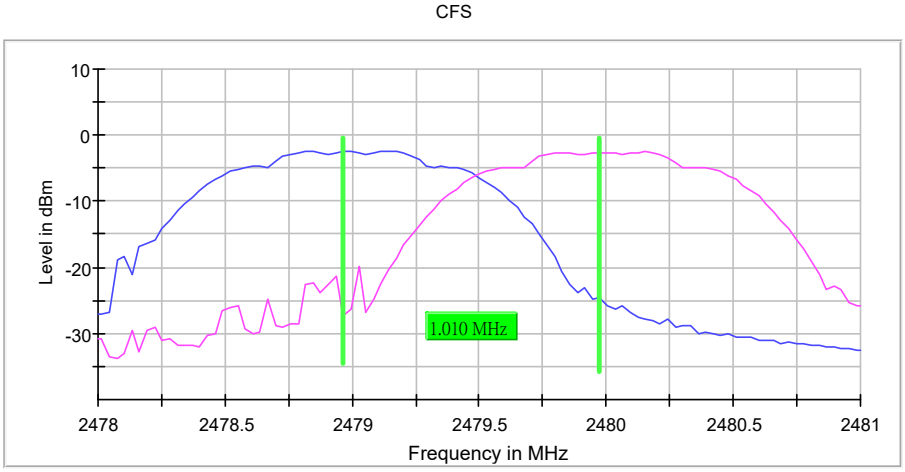
2402MHz



2441MHz

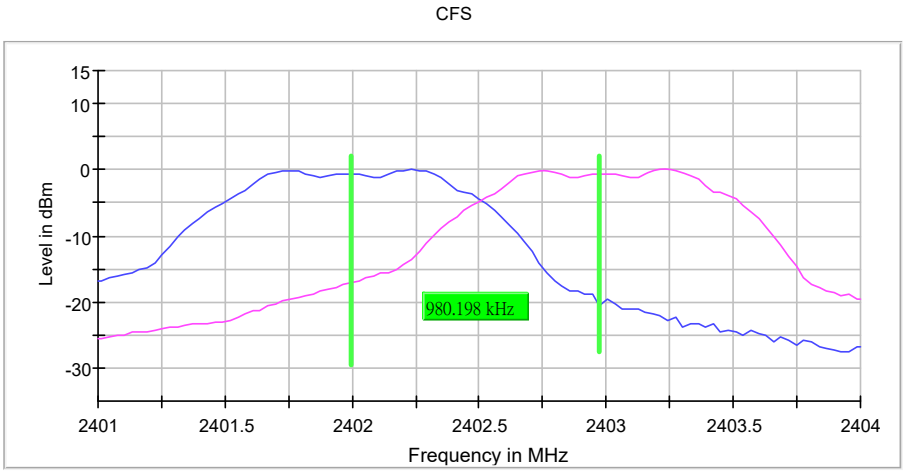


2480MHz

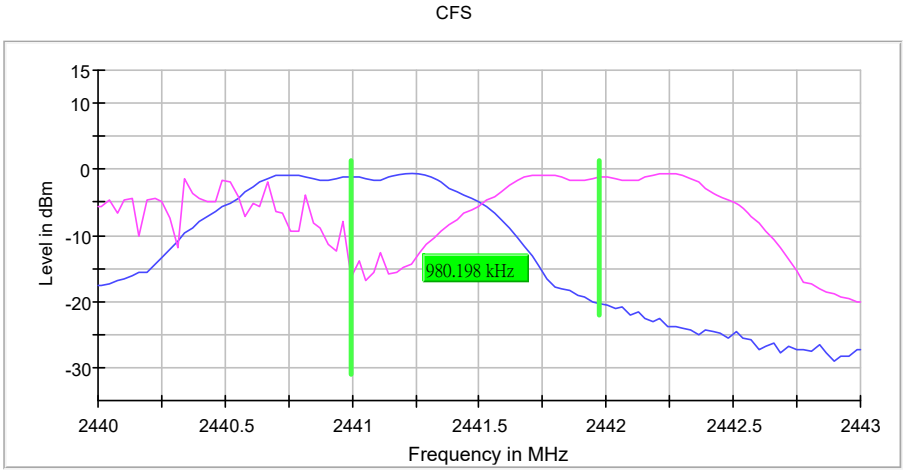


8DPSK

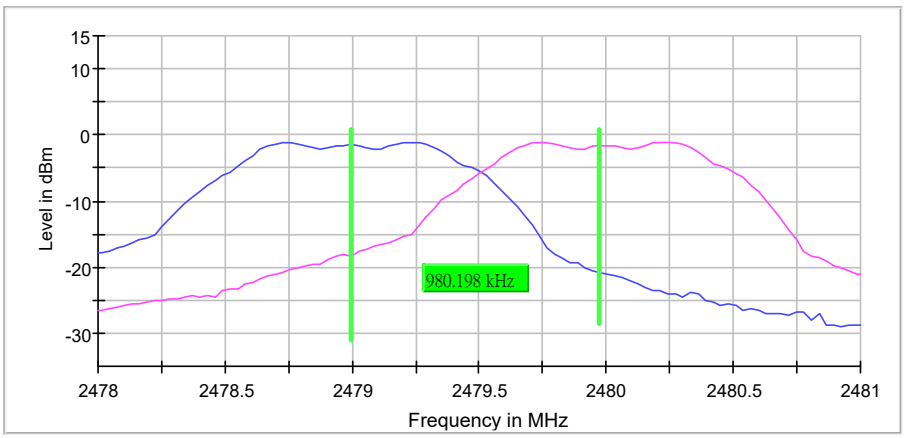
2402MHz



2441MHz



2480MHz



5 Hopping Number

Result: Pass

5.1 Applied standard

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

5.2 Measurement Procedure

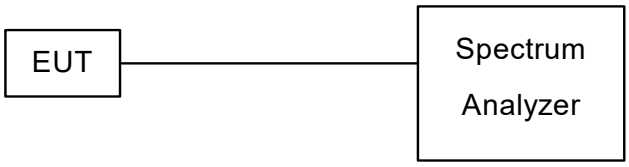
a. The EUT was set up per the test configuration figured in the next section of this chapter to simulate the typical usage per the user's manual.

b. Test procedures follow ANSI C63.10 section 7.8.3.

c. Spectrum alayzer setting: RBW=200 kHz, VBW=200 kHz, Max peak

d. Measure the hopping number and compare with the required limit.

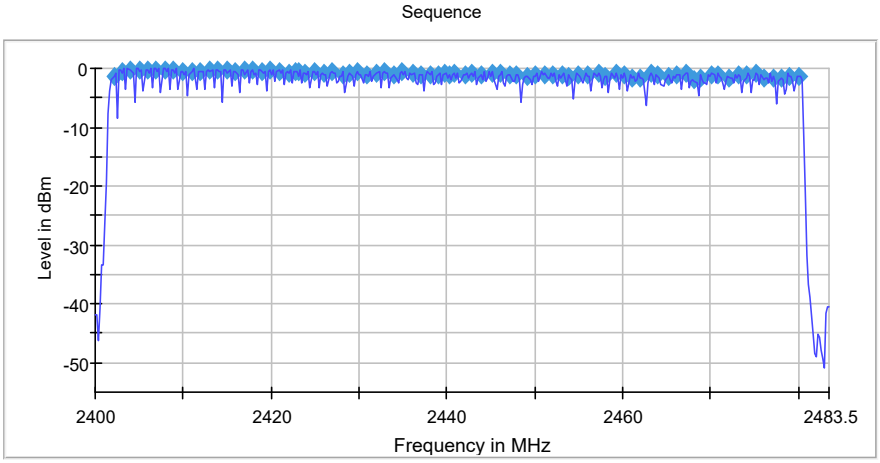
5.3 Test configuration



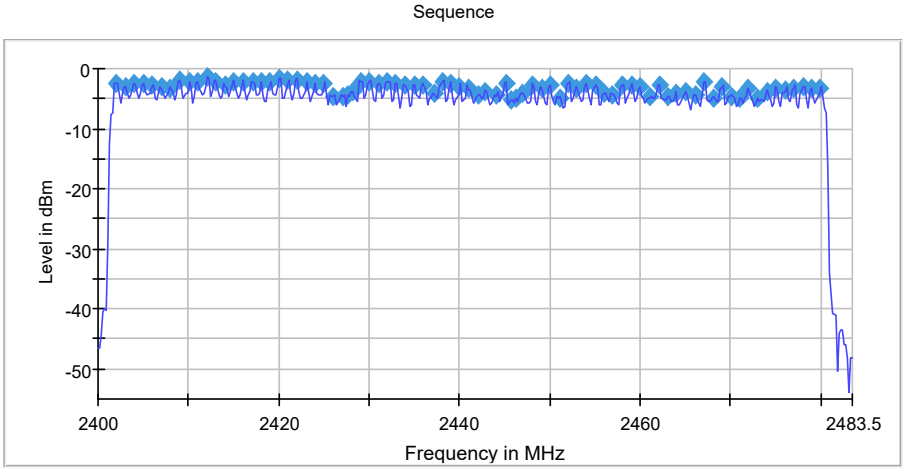
5.4 Test Data

Test Mode : **Hopping** **Tester** : Wayne
Ambient Temperature : 24℃ **Relative Humidity** : 62%
Test Date : 111/4/19

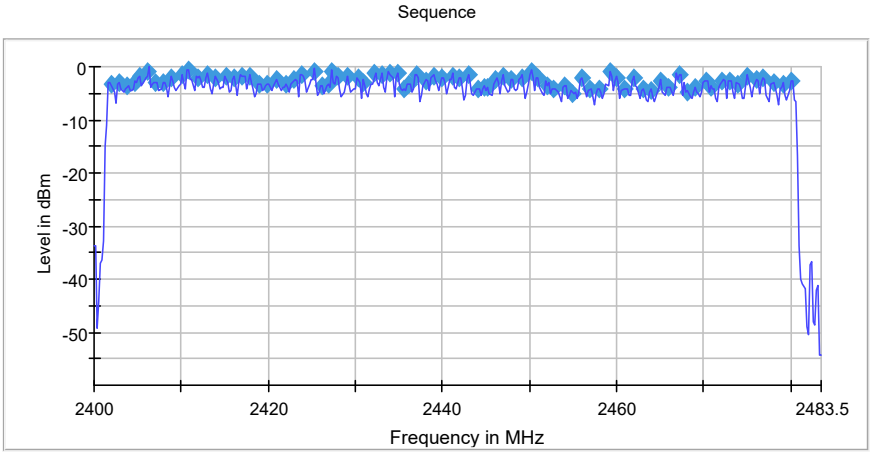
GFSK, Hopping number is 79



Π/4 DQPSK, Hopping number is 79



8DPSK, Hopping number is 79



6 Occupied Time

Result: Pass

6.1 Applied standard

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

6.2 Measurement Procedure

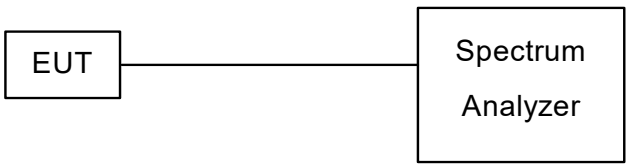
a. The EUT was set up per the test configuration figured in the next section of this chapter to simulate the typical usage per the user's manual.

b. Test procedures follow ANSI C63.10 section 7.8.4.

c. Spectrum alayzer setting: RBW=500 kHz, VBW=1 MHz, Max peak

d. Measure the occupied time and compare with the required limit.

6.3 Test configuration



6.4 Test Data

Test Mode **: Hopping, 2441 MHz** **Tester** **:** Wayne
Ambient Temperature : 24℃ **Relative Humidity :** 62%
Test Date **:** 111/4/19

GFSK				
Mode	**Transmittion duration(T) (ms)**	**Period (s)**	**Dwell Time (ms)**	**Limit (ms)**
DH1	0.4	31.6	128.0	400
DH3	1.6	31.6	255.8	400
DH5	2.8	31.6	299.0	400
Π/4 DQPSK				
Mode	**Transmittion duration(T) (ms)**	**Period (s)**	**Dwell Time (ms)**	**Limit (ms)**
DH1	0.5	31.6	160.1	400
DH3	1.7	31.6	271.8	400
DH5	2.9	31.6	309.7	400
8DPSK				
Mode	**Transmittion duration(T) (ms)**	**Period (s)**	**Dwell Time (ms)**	**Limit (ms)**
DH1	0.6	31.6	192.1	400
DH3	1.7	31.6	271.8	400
DH5	2.8	31.6	299.1	400

Note :
1. DH1 package hop rate: 1600/2/79=10.13 times。
2. DH3 package hop rate :1600/4/79=5.06 times。
3. DH5 package hop rate 1600/6/79=3.38 times。
4. Dwell Time (ms) = T x hop rate x Period

7 Condutced Spurious emission

Result: Pass

7.1 Applied standard

According to FCC 15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph FCC 15.247(b)(3), the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in FCC 15.209(a) are not required.

7.2 Measurement Procedure

a. The EUT was set up per the test configuration figured in the next section of this chapter to simulate the typical usage per the user's manual.

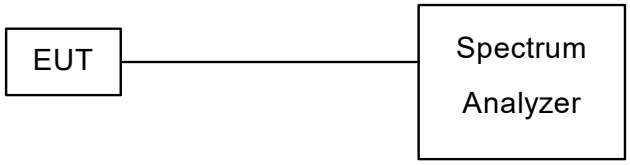
b. The software provided by client enabled the EUT to transmit data at low and high channel frequencies individually.

c. Test procedures follow ANSI C63.10 section 7.8.6 and 7.8.8

d. Spectrum alayzer setting: RBW=100 kHz, VBW=300 MHz, Max peak

e. Measurement the conducted spurious emission and compare with the required limit.

7.3 Test configuration



7.4 Test Data

Bandedge

Test Mode **: Hopping** **Tester** **:** Wayne
Ambient Temperature : 24℃ **Relative Humidity :** 62%
Test Date **:** 111/4/19

GFSK

Testing band	Max emission of in band (dBm)	Frequency of out band max emission (MHz)	Max emission of out band (dBm)	Limit (dBm)	Margin (dB)
Low	-0.6	2399.8	-52.6	-20.6	32.0
High	-0.8	2483.6	-53.4	-20.8	32.6

Note:
1. Limit(dBm) = Max emission of in band - 20
2. Margin (dB) = Limit – Max emission of out band

Π/4 DQPSK

Testing band	Max emission of in band (dBm)	Frequency of out band max emission (MHz)	Max emission of out band (dBm)	Limit (dBm)	Margin (dB)
Low	-1.9	2400.0	-48.3	-21.9	26.4
High	-1.9	2485.2	-55.8	-21.9	33.9

Note:
1. Limit(dBm) = Max emission of in band - 20
2. Margin (dB) = Limit – Max emission of out band

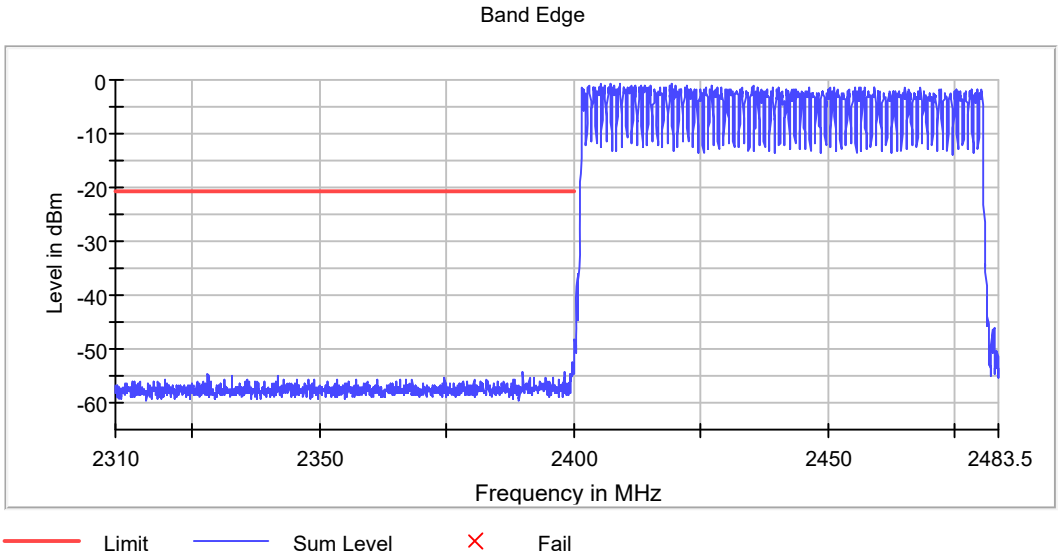
8DPSK

Testing band	Max emission of in band (dBm)	Frequency of out band max emission (MHz)	Max emission of out band (dBm)	Limit (dBm)	Margin (dB)
Low	-0.8	2399.9	-37.7	-20.8	16.9
High	-0.9	2498.8	-55.5	-20.9	34.6

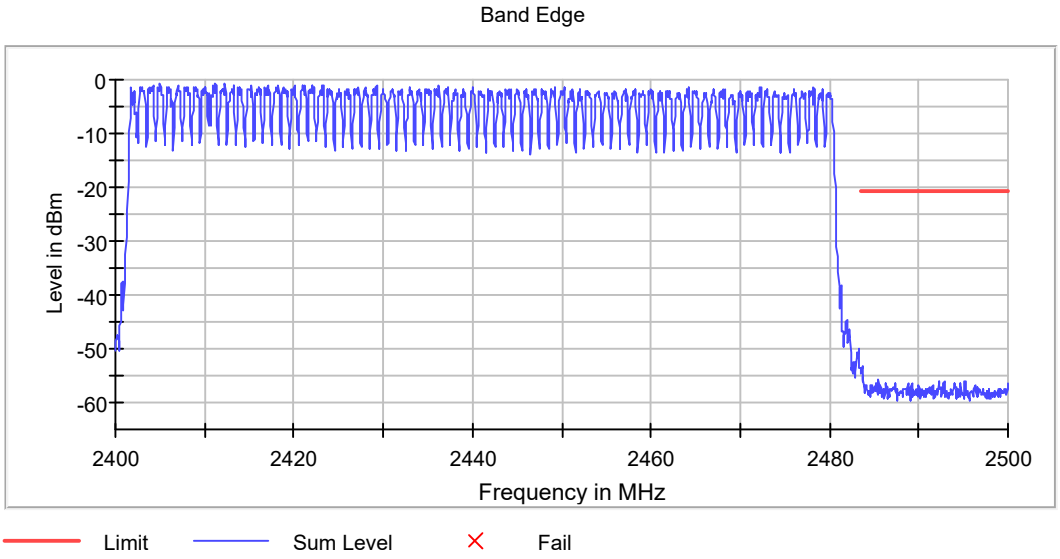
Note:
1. Limit(dBm) = Max emission of in band - 20
2. Margin (dB) = Limit – Max emission of out band

GFSK

2402MHz

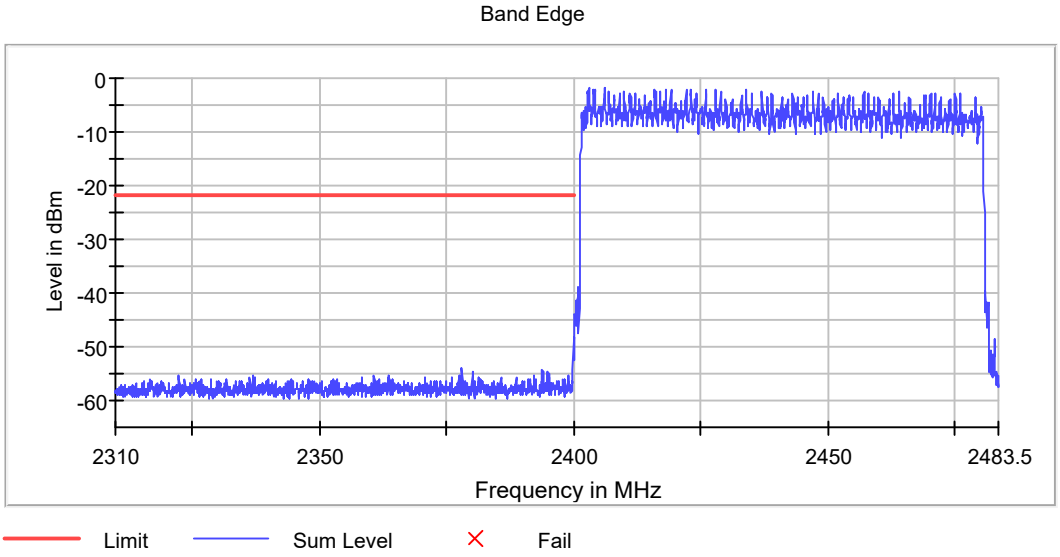


2480MHz

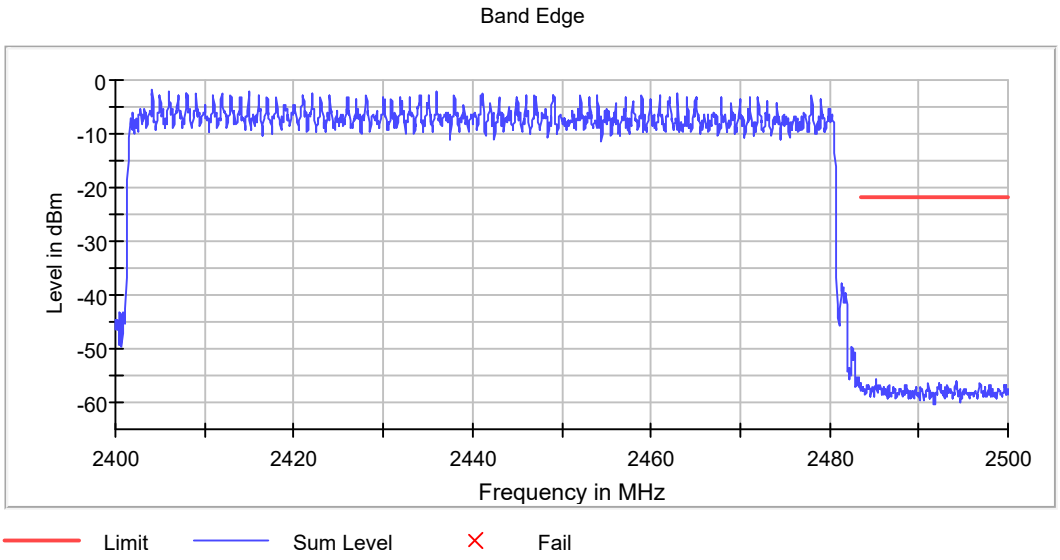


Π/4 DQPSK

2402MHz

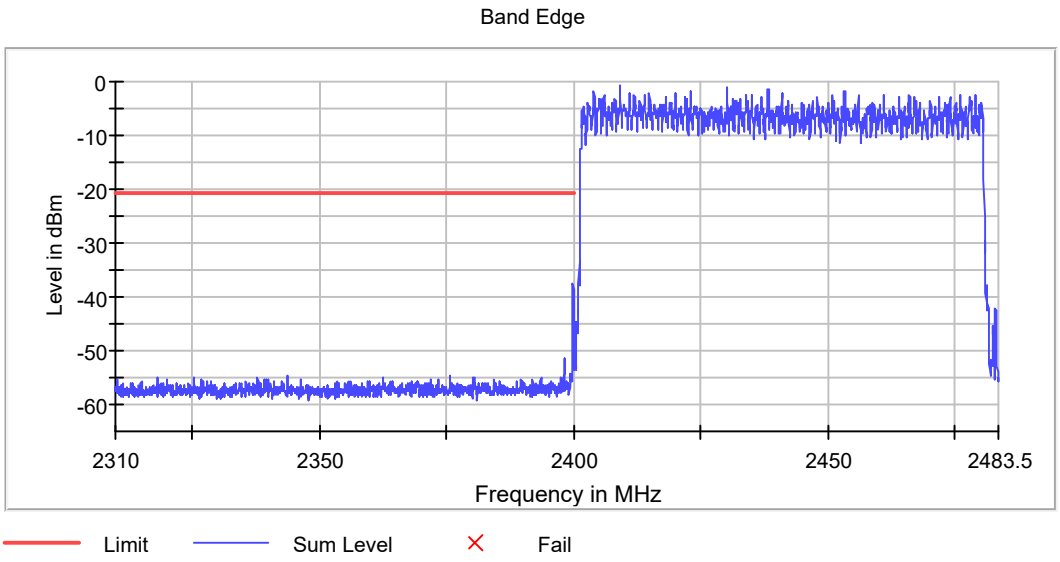


2480MHz

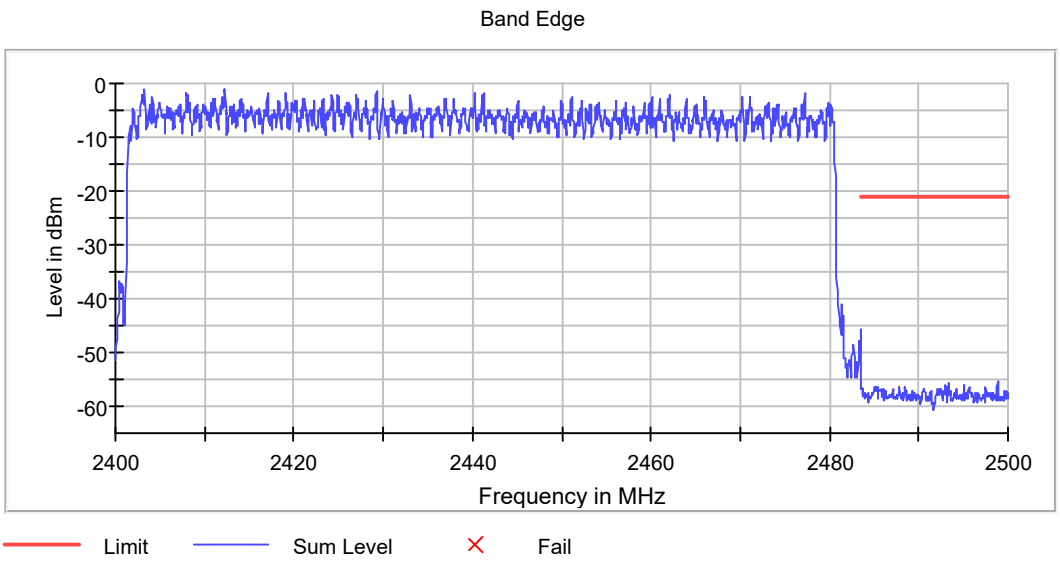


8DPSK

2402MHz



2480MHz



Test Mode **: Continuous Transmitting** **Tester** **:** Wayne
Ambient Temperature : 24℃ **Relative Humidity :** 62%
Test Date **:** 111/4/19

GFSK

Operating Frequency (MHz)	Max emission of in band (dBm)	Frequency of out band max emission (MHz)	Max emission of out band (dBm)	Limit (dBm)	Margin (dB)
2402	-0.8	2399.6	-36.3	-20.8	15.5
2480	-1.7	2483.6	-43.2	-21.7	21.5

Note:
1. Limit(dBm) = Max emission of in band - 20
2. Margin (dB) = Limit – Max emission of out band

Π/4 DQPSK

Operating Frequency (MHz)	Max emission of in band (dBm)	Frequency of out band max emission (MHz)	Max emission of out band (dBm)	Limit (dBm)	Margin (dB)
2402	-1.8	2400.0	-37.6	-21.8	15.8
2480	-3.3	2483.9	-52.4	-23.3	29.1

Note:
1. Limit(dBm) = Max emission of in band - 20
2. Margin (dB) = Limit – Max emission of out band

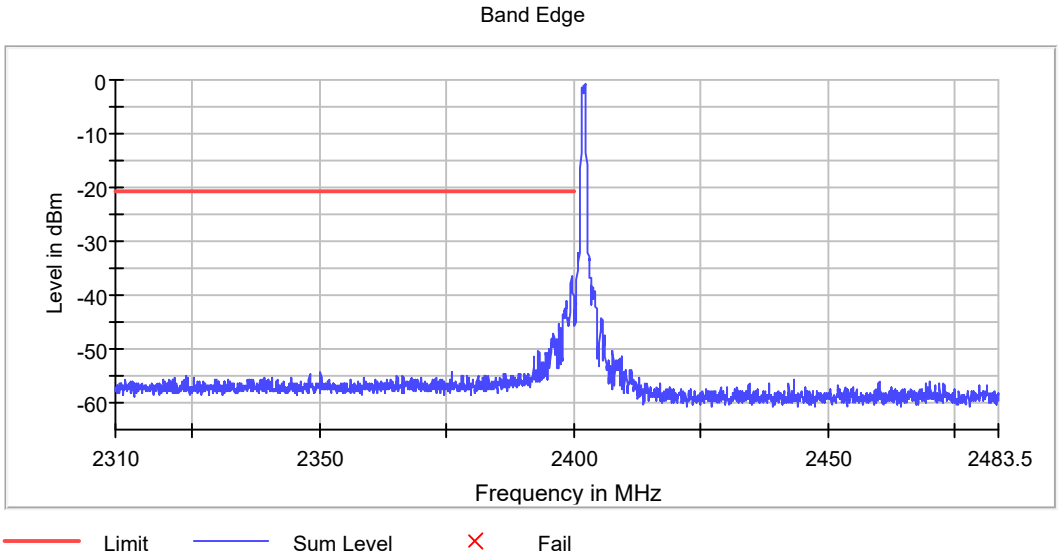
8DPSK

Operating Frequency (MHz)	Max emission of in band (dBm)	Frequency of out band max emission (MHz)	Max emission of out band (dBm)	Limit (dBm)	Margin (dB)
2402	-1.0	2400.0	-33.6	-21.0	12.6
2480	-2.8	2483.6	-43.5	-22.8	20.7

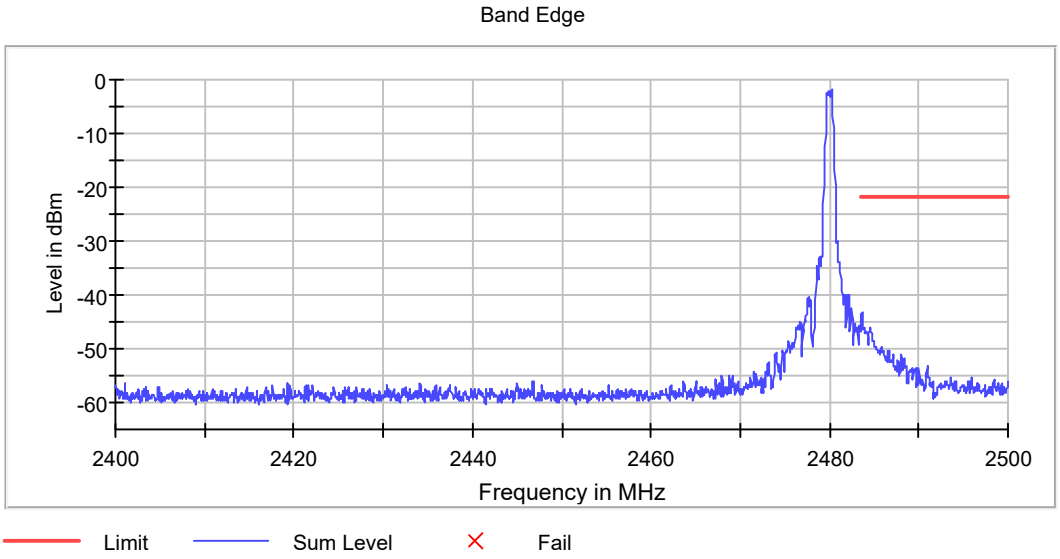
Note:
1. Limit(dBm) = Max emission of in band - 20
2. Margin (dB) = Limit – Max emission of out band

GFSK

2402MHz

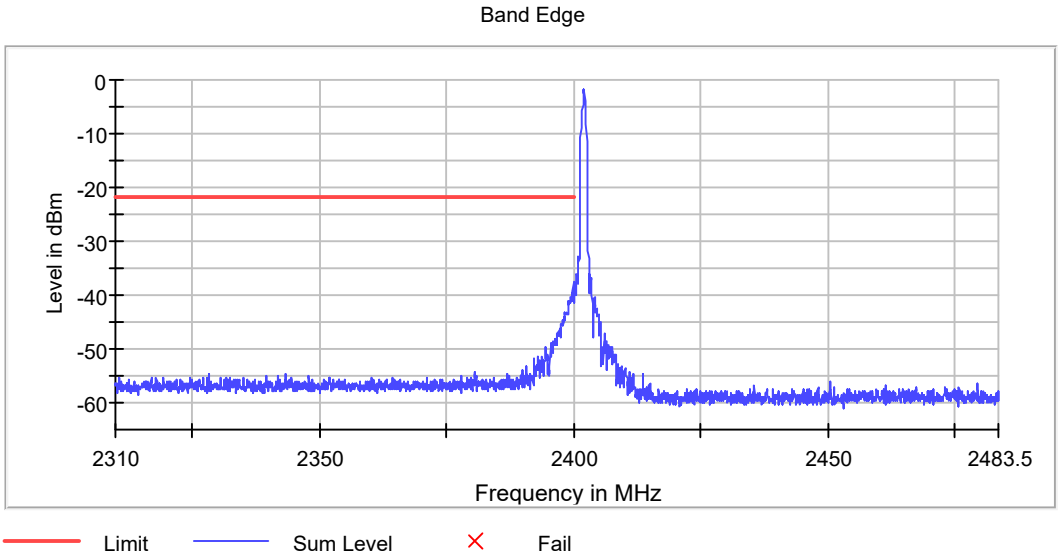


2480MHz

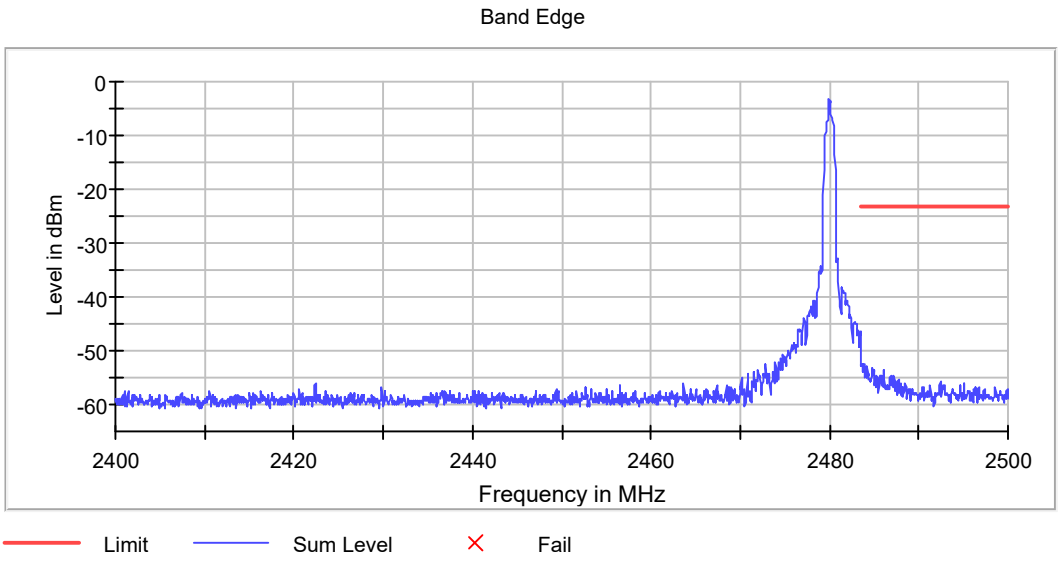


Π/4 DQPSK

2402MHz

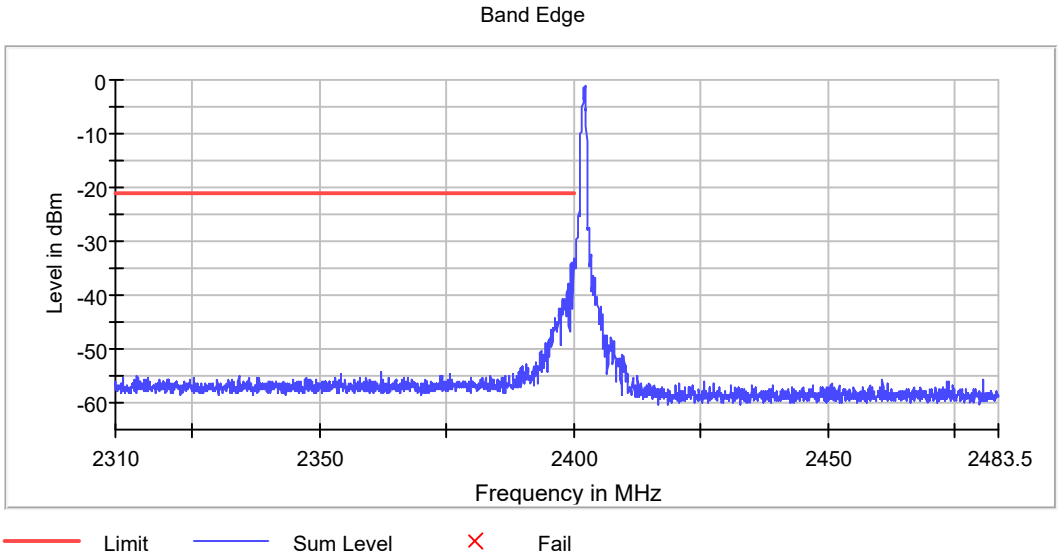


2480MHz

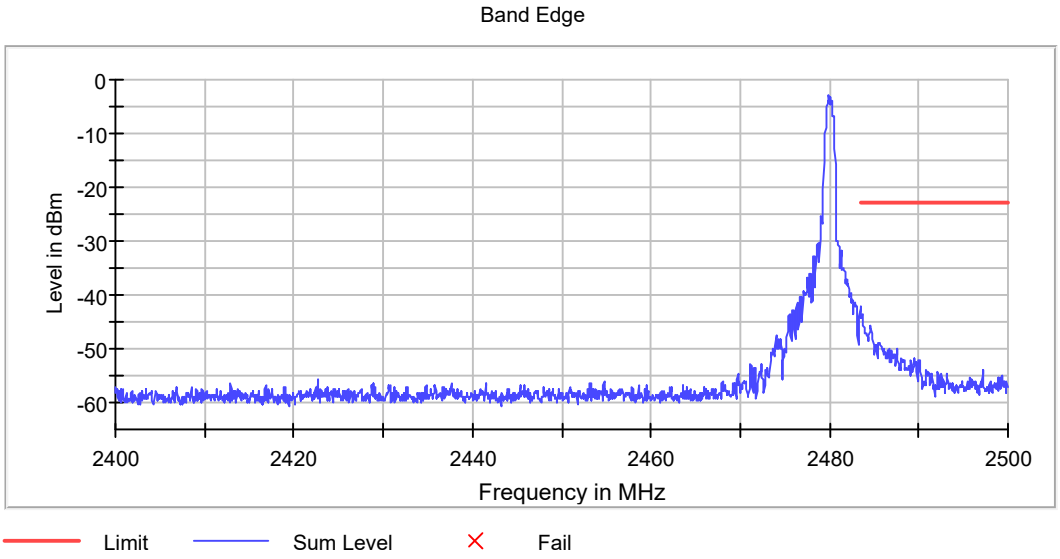


8DPSK

2402MHz



2480MHz

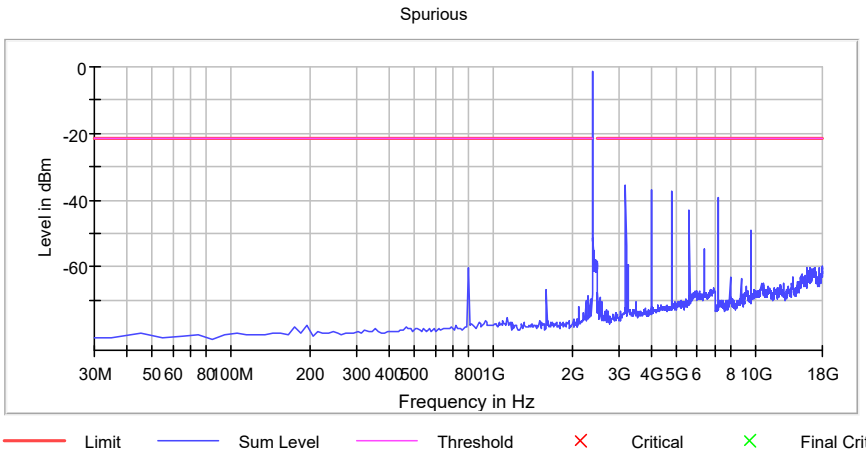


Out of band emission

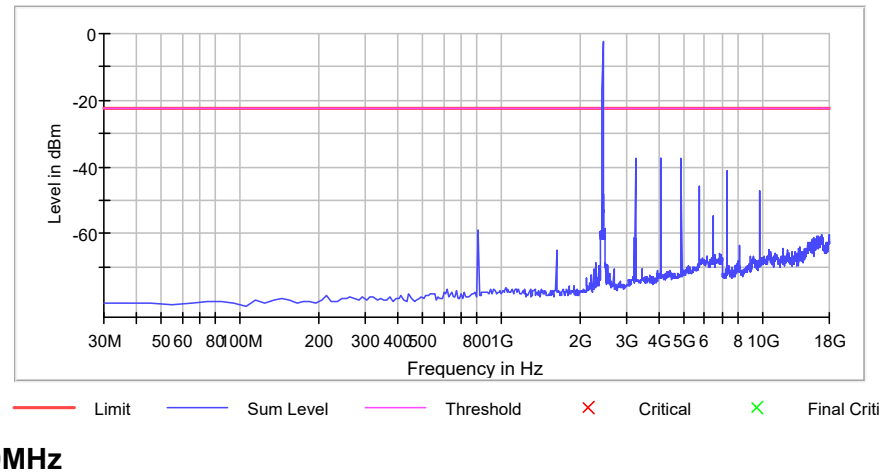
Test Mode : **Continuous Transmitting** **Tester** : Wayne
Ambient Temperature : 24℃ **Relative Humidity** : 62%
Test Date : 111/4/19

GFSK

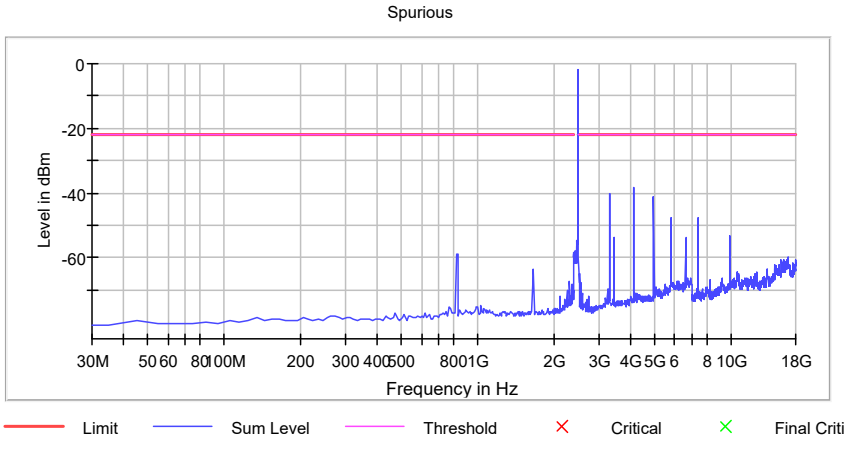
2402MHz



2441MHz



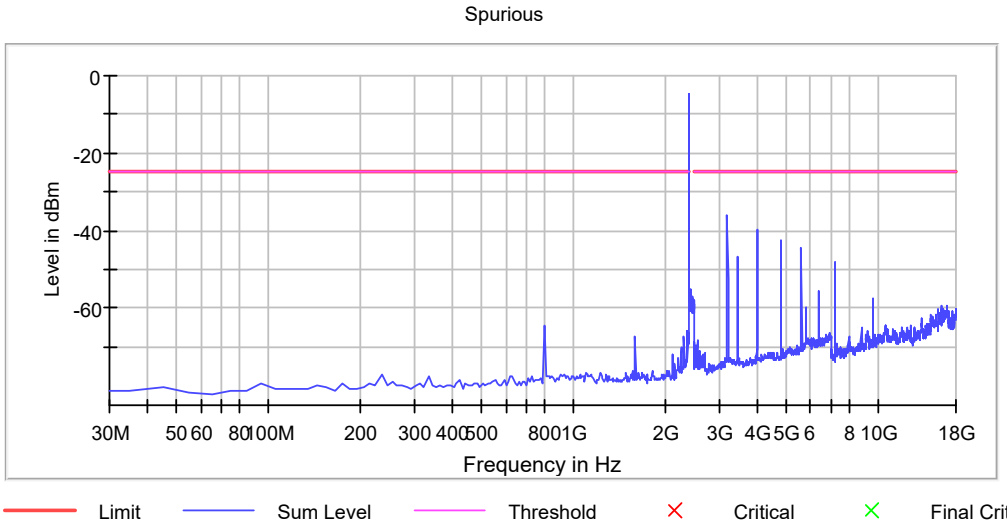
2480MHz



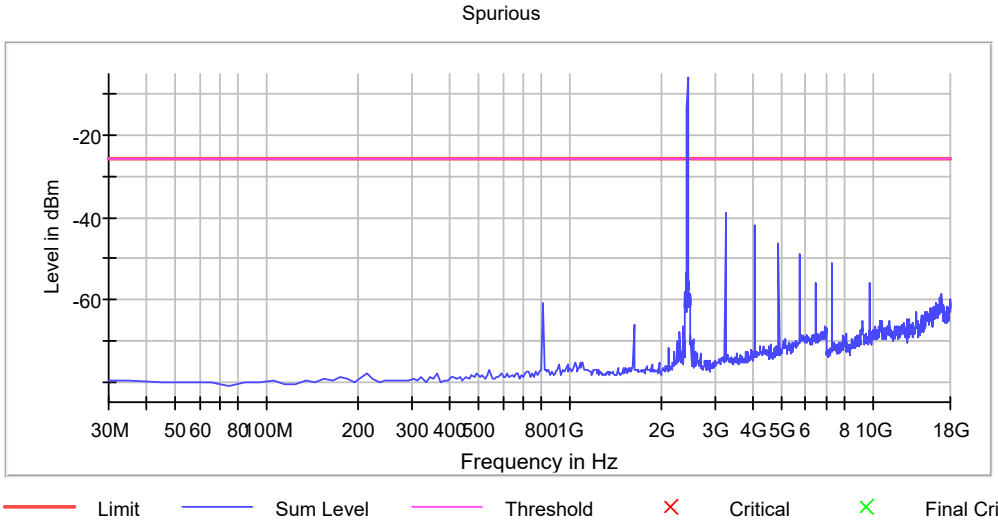
No signal can be detected above 18 GHz, so the graphs are omitted.

Π/4 DQPSK

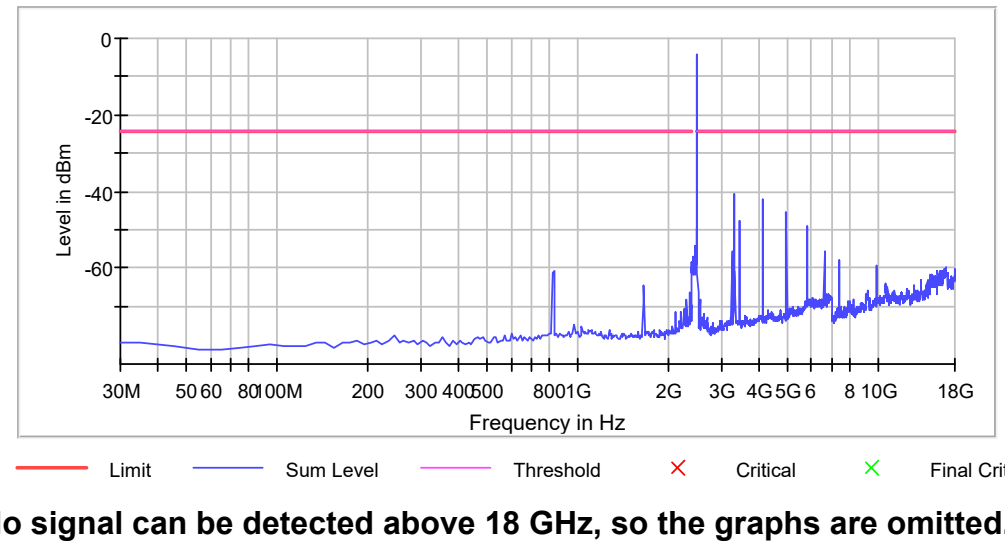
2402MHz



2441MHz



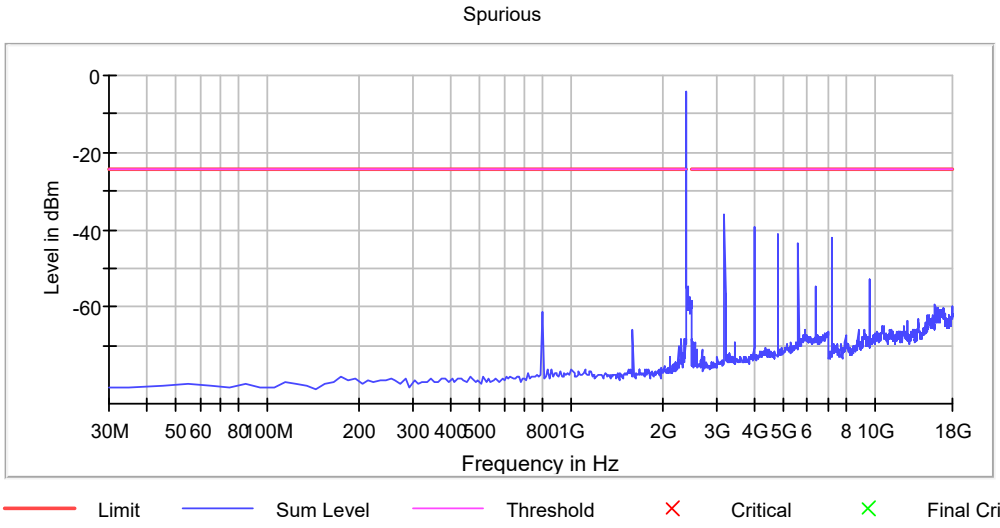
2480MHz



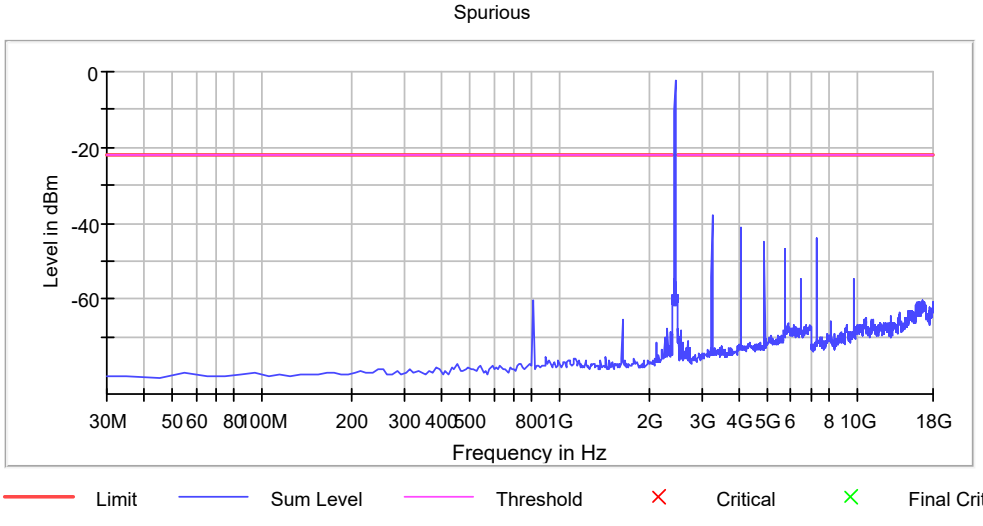
No signal can be detected above 18 GHz, so the graphs are omitted.

8DPSK

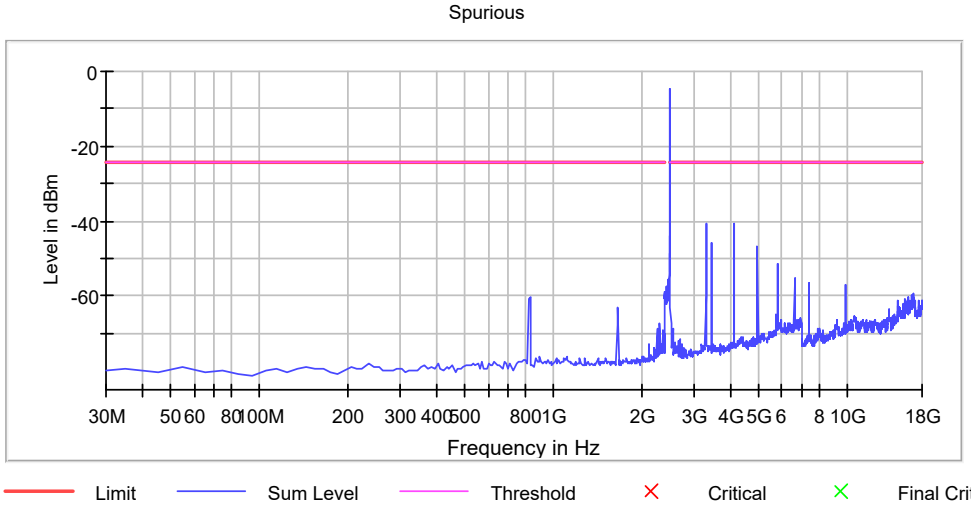
2402MHz



2441MHz



2480MHz



No signal can be detected above 18 GHz, so the graphs are omitted.

8 Radiated Spurious Emission

Result: Pass

8.1 Applied standard

According to FCC 15.247(d), fall in the restricted bands, as defined in FCC 15.205(a), must also comply with the radiated emission limits specified in FCC 15.209(a).

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

8.2 Measurement Procedure

a. The EUT was set up per the test configuration figured in the next section of this chapter to simulate the typical usage per the user's manual.

b. A software provided by client enabled the EUT to transmit and receive data at operating frequency.(if necessary)

c. If the EUT is tabletop equipment, it should be placed on a wooden table with a height of 0.8 meters above the reference ground plane in the semi-anechoic chamber. If the EUT is floor-standing equipment, it should be placed on a non-conducted support with a height of 12 millimeters above the reference ground plane in the semi-anechoic chamber.

d. The EUT is set 3m away from the interference receiving antenna.

e. Rapidly sweep the signal in the test frequency range by using the spectrum through the Maximum-peak detector.

f. Rotate the EUT from 0° to 360° and position the receiving antenna at heights from 1 to 4 meters above the reference ground plane continuously to determine at least six frequencies associated with higher emission levels and record them.

g. Then measure each frequency found from step f. by using the spectrum with rotating the EUT and positioning the receiving antenna height to determine the maximum level.

h. For measurement of frequency below 1000MHz, set the receiver detector to be Quasi-Peak per CISPR 16-1 to find out the maximum level occurred. Receiver Setting is 9 kHz – 150kHz: RBW=200 Hz. 150kHz – 30 MHz: RBW=9 kHz. 30 MHz- 1 GHz: RBW=120 kHz.

i. For measurement of frequency above 1000MHz, set the spectrum detector to be Peak or Average to find out the maximum level occurred, if any. Spectrum Alayzer Setting is Peak:RBW=1 MHz, VBW=3 MHz. Average: RBW=1 MHz, VBW=3 kHz.

j. Record frequency, azimuth angle of the turntable, height, and polarization of the receiving antenna and compare the maximum level with the required limit.

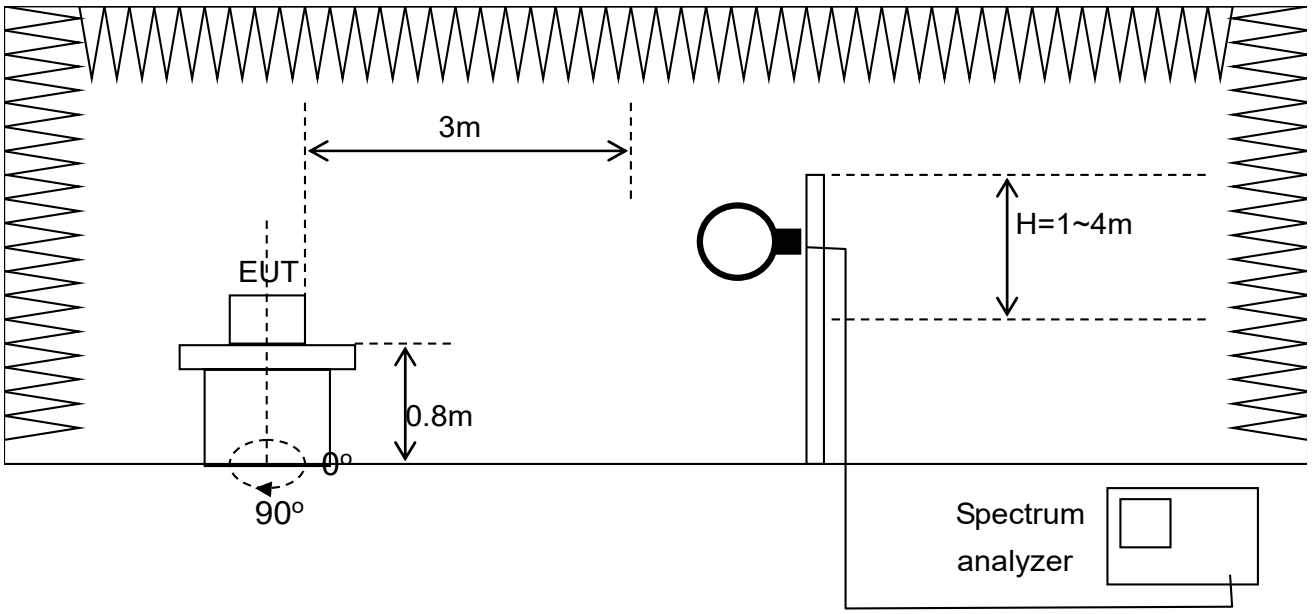
k. Change the receiving antenna to another polarization to measure radiated emission by following step e. to j. again.

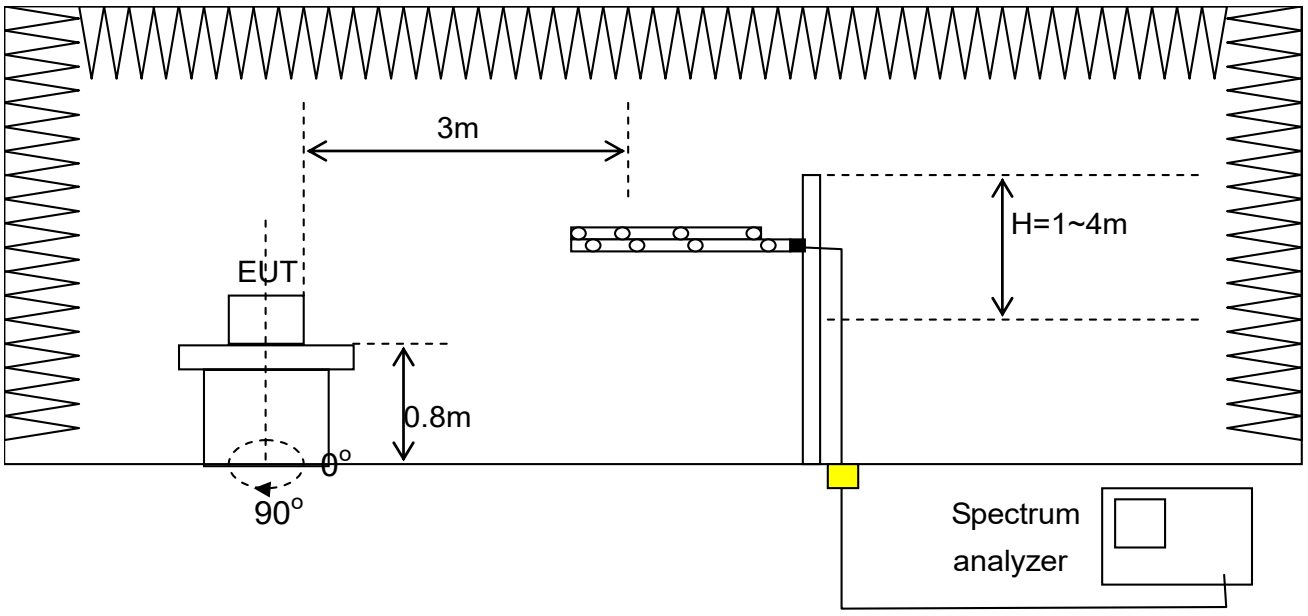
l. If the peak emission level below 1000MHz measured from step f. is 4dB lower than the limit specified, then the emission values presented will be the peak value only. Otherwise, accurate Q.P. value will be measured and presented.

m. If the peak emission level above 1000MHz measured from step f. is 20dB lower than the limit specified, then the emission values presented will be the peak value only. Otherwise, accurate A.V. value will be measured and presented.

8.3 Test configuration

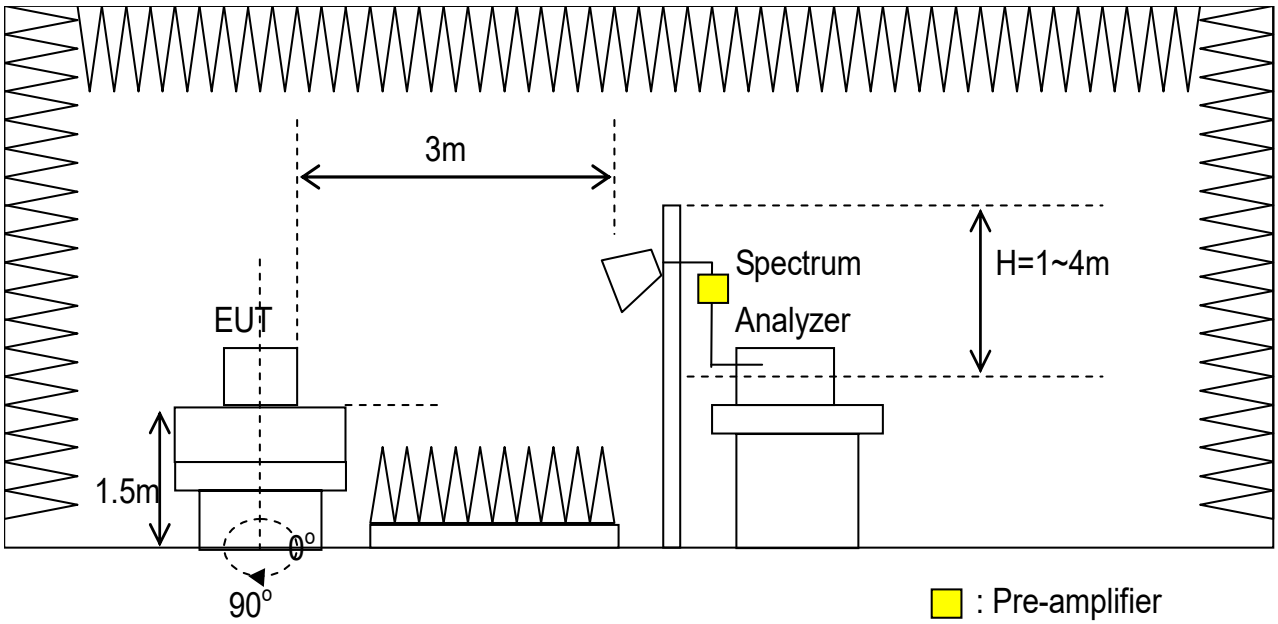
Below 1GHz





: Pre-amplifier

Above 1GHz



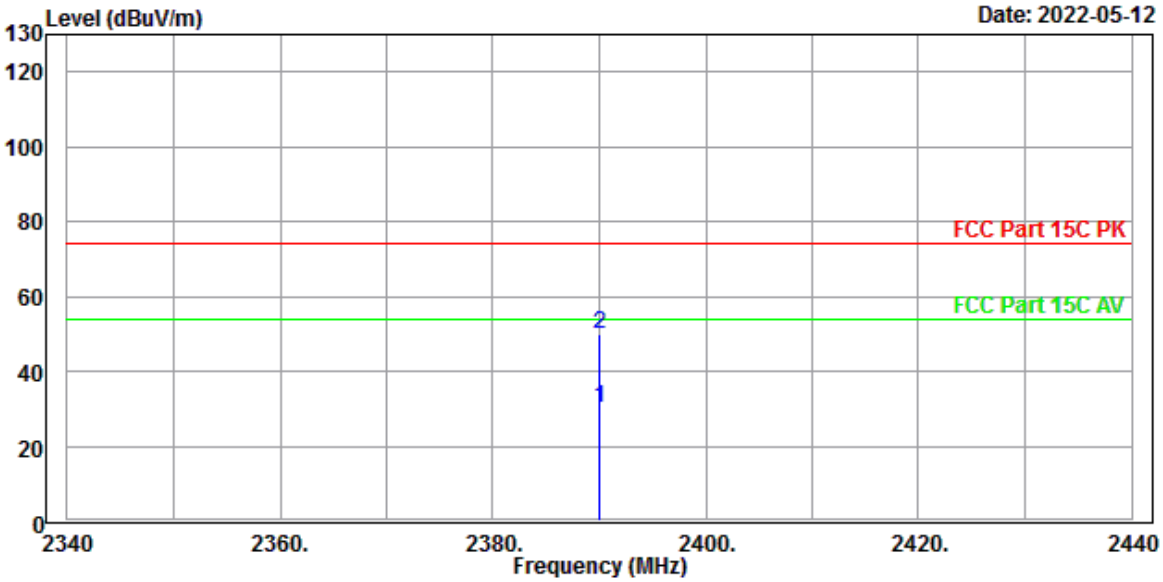
8.4 Test Data

Bandedge

Test Mode : **Continuous Transmitting, BR, 2402 MHz**

Polarization : Horizontal **Tester** : Jeffry

Ambient Temperature : 22℃ **Relative Humidity** : 61%



Condition : FCC Part 15C PK 3m EMCO_3117_82847 HORIZONTAL
POWER :
OPERATOR : JEFFRY T:22 H:61 P:1009

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	2390.000	30.32	46.06	-15.74	54.00	-23.68	391	278	HORIZONTAL	Average
2	2390.000	49.92	65.66	-15.74	74.00	-24.08	391	278	HORIZONTAL	Peak

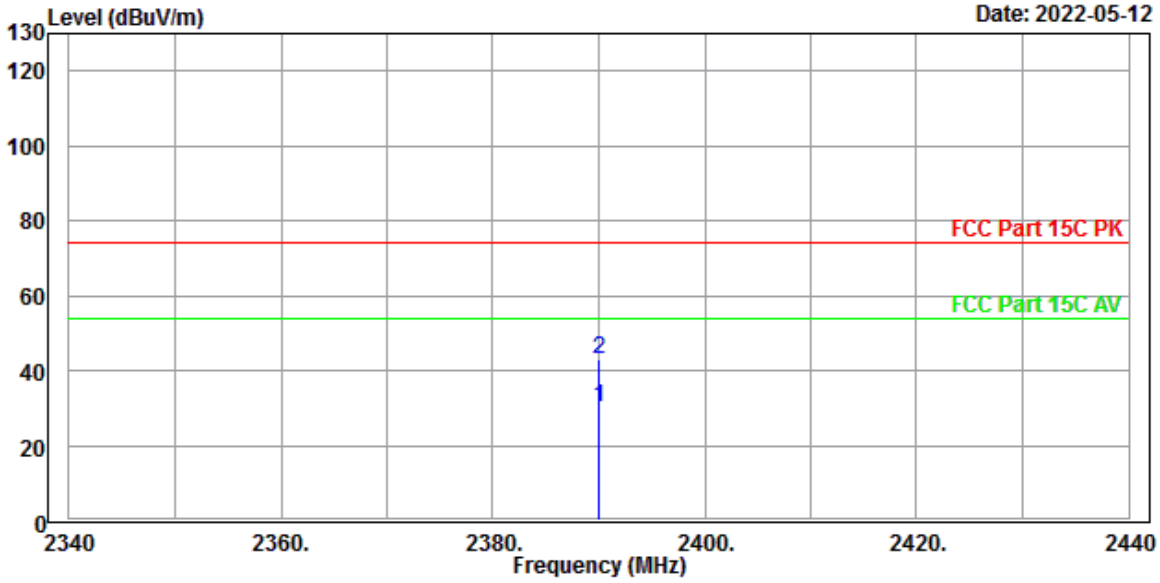
Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line

Test Mode : **Continuous Transmitting, BR, 2402 MHz**

Polarization : Vertical **Tester** : Jeffry

Ambient Temperature : 22℃ **Relative Humidity** : 61%



Condition : FCC Part 15C PK 3m EMCO_3117_82847 VERTICAL
POWER :
OPERATOR : JEFFRY T:22 H:61 P:1009

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	2390.000	29.98	45.72	-15.74	54.00	-24.02	380	55	VERTICAL	Average
2	2390.000	42.81	58.55	-15.74	74.00	-31.19	380	55	VERTICAL	Peak

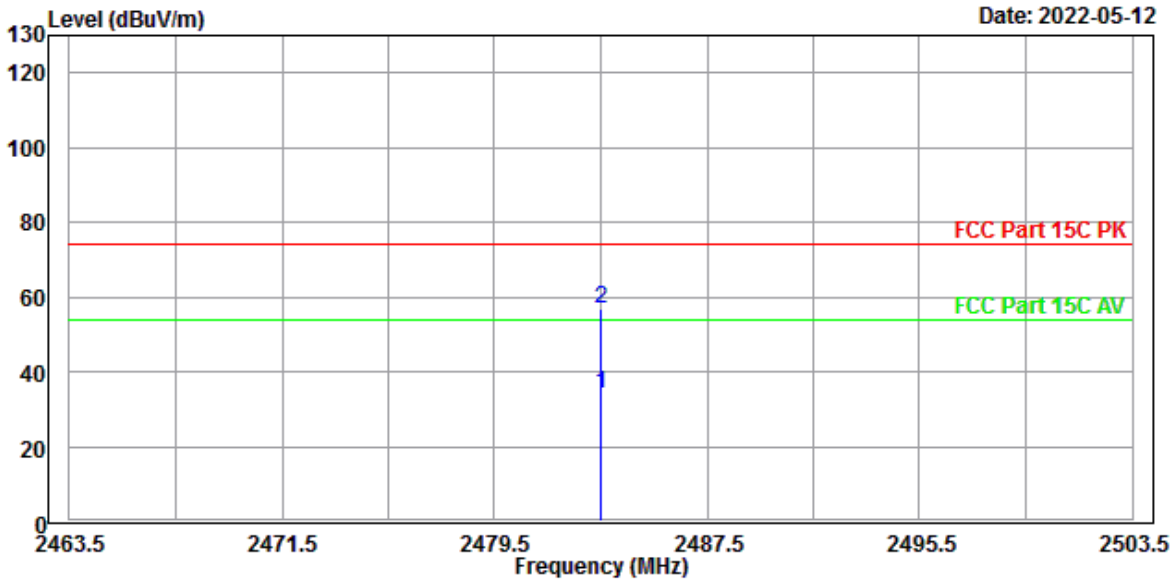
Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line

Test Mode : **Continuous Transmitting, BR, 2480 MHz**

Polarization : Horizontal **Tester** : Jeffry

Ambient Temperature : 22℃ **Relative Humidity** : 61%



Condition : FCC Part 15C PK 3m EMCO_3117_82847 HORIZONTAL
POWER :
OPERATOR : JEFFRY T:22 H:61 P:1009

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	2483.500	33.99	49.63	-15.64	54.00	-20.01	366	270	HORIZONTAL	Average
2	2483.500	56.84	72.48	-15.64	74.00	-17.16	366	270	HORIZONTAL	Peak

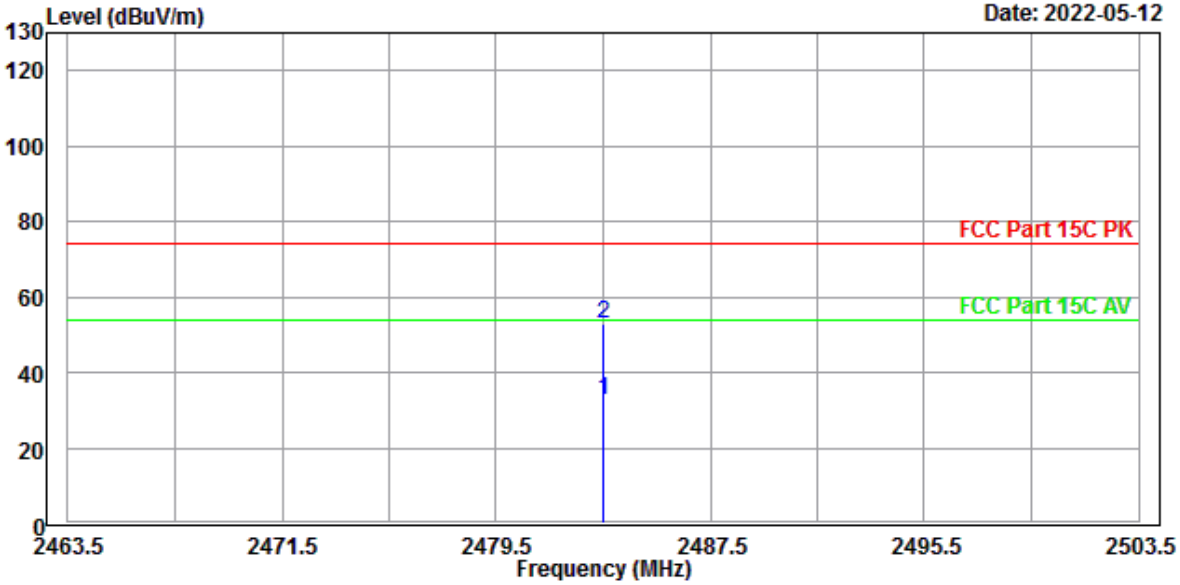
Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line

Test Mode : **Continuous Transmitting, BR, 2480 MHz**

Polarization : Vertical **Tester** : Jeffry

Ambient Temperature : 22℃ **Relative Humidity** : 61%



Condition : FCC Part 15C PK 3m EMCO_3117_82847 VERTICAL
POWER :
OPERATOR : JEFFRY T:22 H:61 P:1009

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	2483.500	32.54	48.18	-15.64	54.00	-21.46	323	54	VERTICAL	Average
2	2483.500	53.13	68.77	-15.64	74.00	-20.87	323	54	VERTICAL	Peak

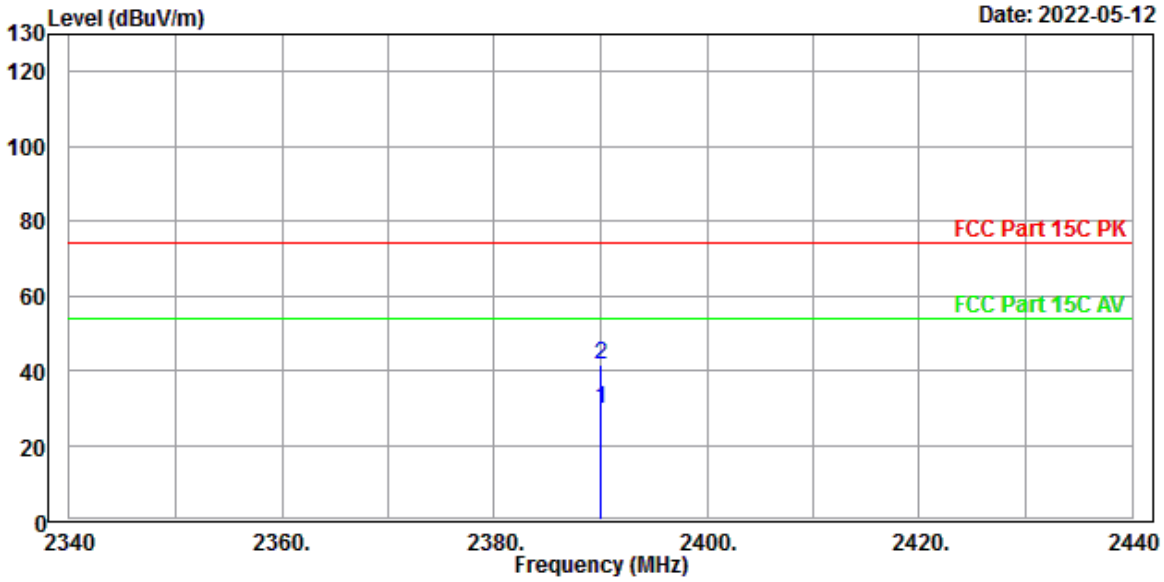
Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line

Test Mode : **Continuous Transmitting, EDR, 2402 MHz**

Polarization : Horizontal **Tester** : Jeffry

Ambient Temperature : 22℃ **Relative Humidity** : 61%



Condition : FCC Part 15C PK 3m EMCO_3117_82847 HORIZONTAL
POWER :
OPERATOR : JEFFRY T:22 H:61 P:1009

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	2390.000	29.77	45.51	-15.74	54.00	-24.23	304	272	HORIZONTAL	Average
2	2390.000	41.61	57.35	-15.74	74.00	-32.39	304	272	HORIZONTAL	Peak

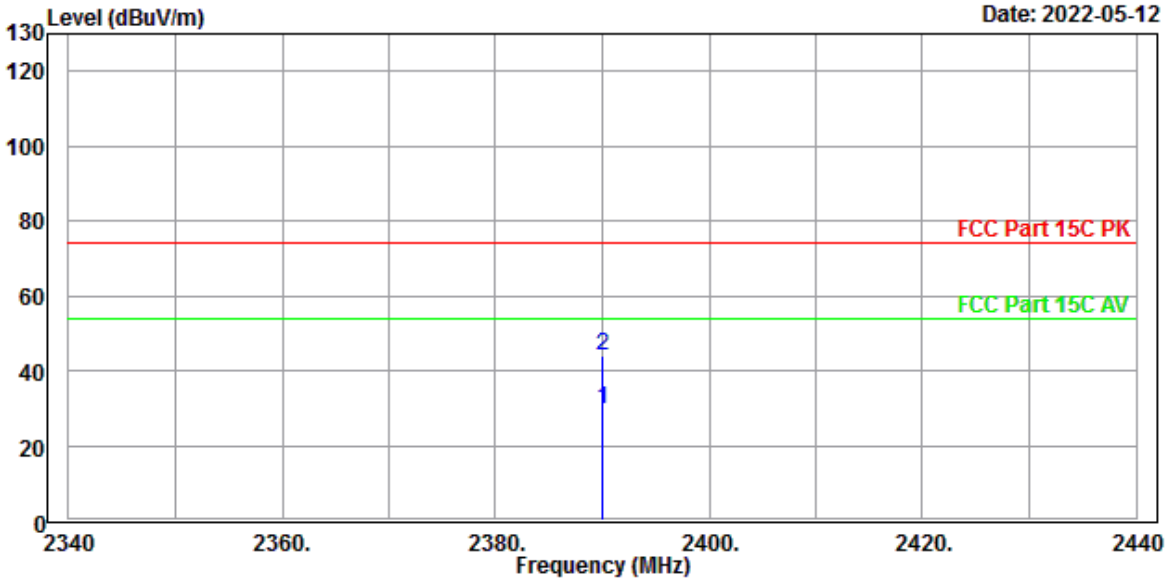
Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line

Test Mode : **Continuous Transmitting, EDR, 2402 MHz**

Polarization : Vertical **Tester** : Jeffry

Ambient Temperature : 22℃ **Relative Humidity** : 61%



Condition : FCC Part 15C PK 3m EMCO_3117_82847 VERTICAL
POWER :
OPERATOR : JEFFRY T:22 H:61 P:1009

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	2390.000	29.77	45.51	-15.74	54.00	-24.23	304	54	VERTICAL	Average
2	2390.000	43.88	59.62	-15.74	74.00	-30.12	304	54	VERTICAL	Peak

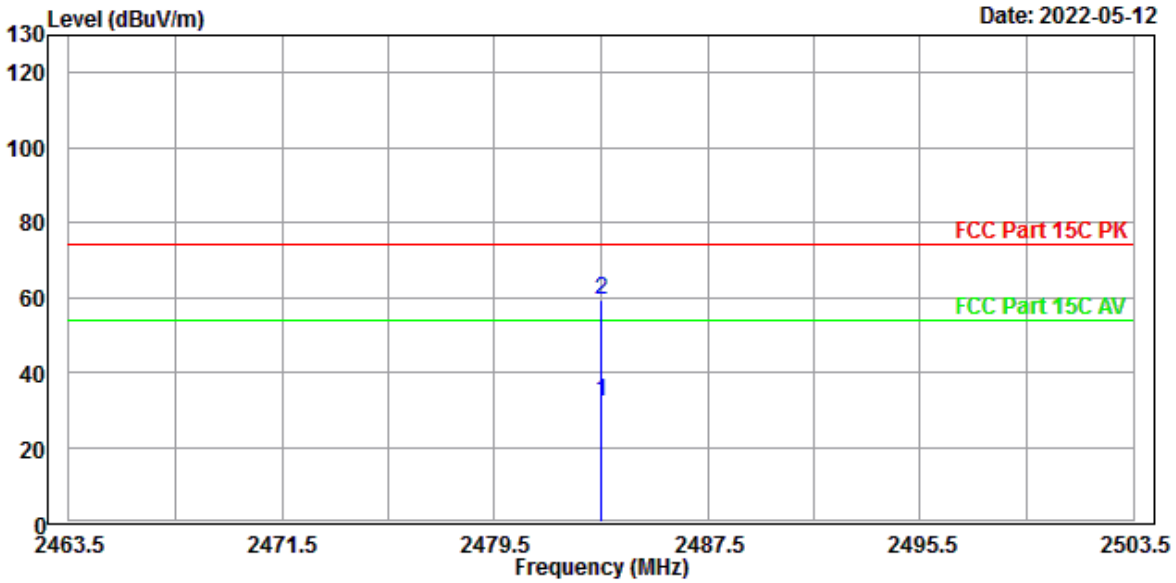
Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line

Test Mode : **Continuous Transmitting, EDR, 2480 MHz**

Polarization : Horizontal **Tester** : Jeffry

Ambient Temperature : 22℃ **Relative Humidity** : 61%



Condition : FCC Part 15C PK 3m EMCO_3117_82847 HORIZONTAL
POWER :
OPERATOR : JEFFRY T:22 H:61 P:1009

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	2483.500	32.11	47.75	-15.64	54.00	-21.89	371	285	HORIZONTAL	Average
2	2483.500	59.23	74.87	-15.64	74.00	-14.77	371	285	HORIZONTAL	Peak

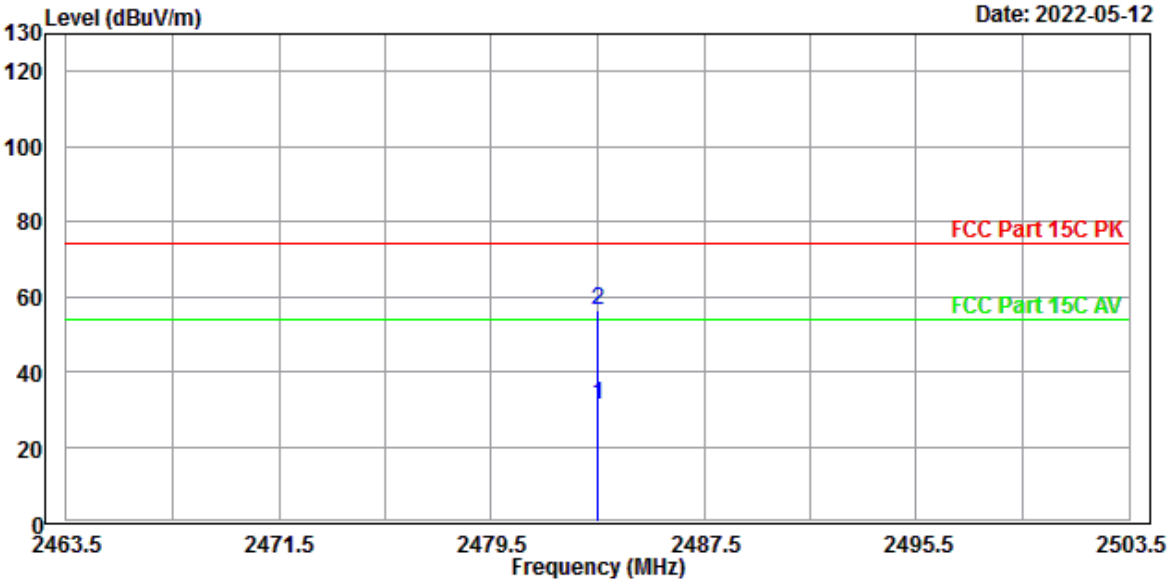
Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line

Test Mode : **Continuous Transmitting, EDR,2480 MHz**

Polarization : Vertical **Tester** : Jeffry

Ambient Temperature : 22℃ **Relative Humidity** : 61%



Condition : FCC Part 15C PK 3m EMCO_3117_82847 VERTICAL
POWER :
OPERATOR : JEFFRY T:22 H:61 P:1009

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	2483.500	31.32	46.96	-15.64	54.00	-22.68	362	43	VERTICAL	Average
2	2483.500	56.12	71.76	-15.64	74.00	-17.88	362	43	VERTICAL	Peak

Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line

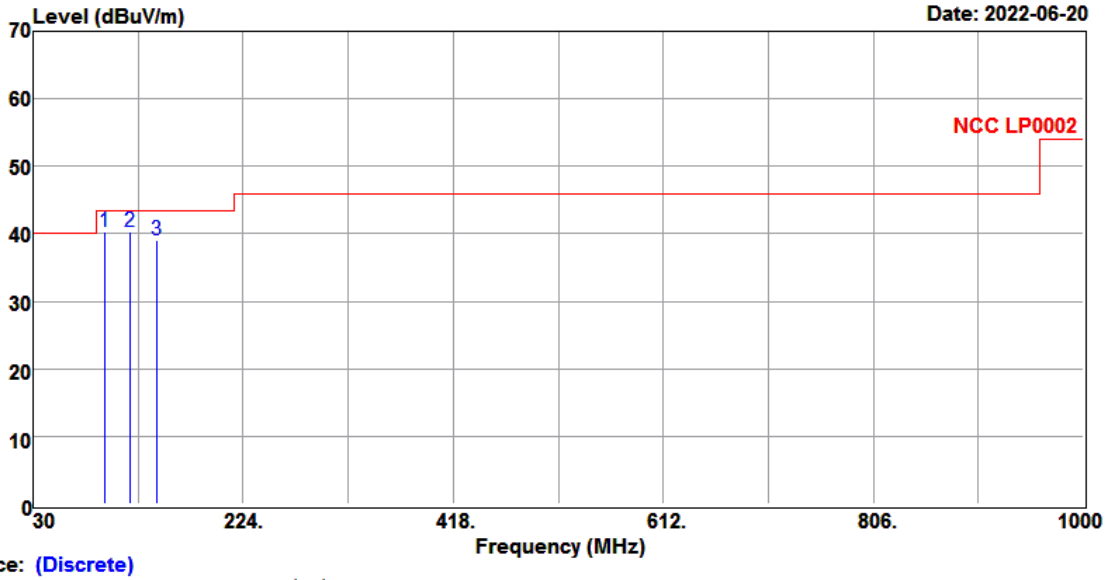
Radiated Emission Measurement below 1000MHz

Test Mode : **Continuous Transmitting, EDR,2402 MHz**

Test Range : 30 MHz ~1 GHz

Polarization : Horizontal **Tester** : Wilson

Ambient Temperature : 23℃ **Relative Humidity** : 52%



Trace: (Discrete)

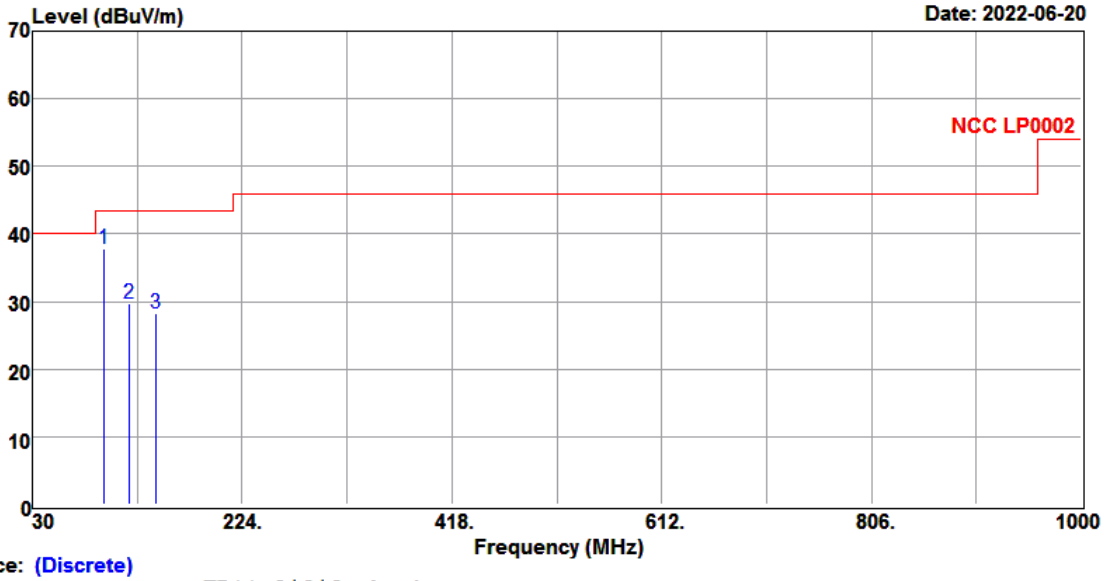
Site : TR11 9*6*6 chamber
Condition : NCC LP0002 3m VULB_9168-668 HORIZONTAL
Power :
Operator : Wilson T23/H52/P1013

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	96.010	40.23	66.00	-25.77	43.50	-3.27	204	38	HORIZONTAL	QP
2	119.990	40.38	63.52	-23.14	43.50	-3.12	231	187	HORIZONTAL	QP
3	144.010	39.05	59.83	-20.78	43.50	-4.45	224	181	HORIZONTAL	QP

Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line
4. QK. is abbreviation of Quasi-Peak
5. The emission levels were too lower against the limit of frequency 9 kHz~ 30 MHz.

Test Mode	**: Continuous Transmitting, EDR,2402 MHz**		
Test Range	: 30 MHz ~1GHz		
Polarization	: Vertical	**Tester**	: Wilson
Ambient Temperature	: 23℃	**Relative Humidity**	: 52%



Trace: (Discrete)

Site : TR11 9*6*6 chamber
Condition : NCC LP0002 3m VULB_9168-668 VERTICAL
Power :
Operator : Wilson T23/H52/P1013

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	96.010	37.80	63.57	-25.77	43.50	-5.70	100	282	VERTICAL	QP
2	119.990	29.78	52.92	-23.14	43.50	-13.72	129	341	VERTICAL	QP
3	144.010	28.29	49.07	-20.78	43.50	-15.21	102	2	VERTICAL	QP

Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line
4. QK. is abbreviation of Quasi-Peak
5. The emission levels were too lower against the limit of frequency 9 kHz~ 30 MHz.

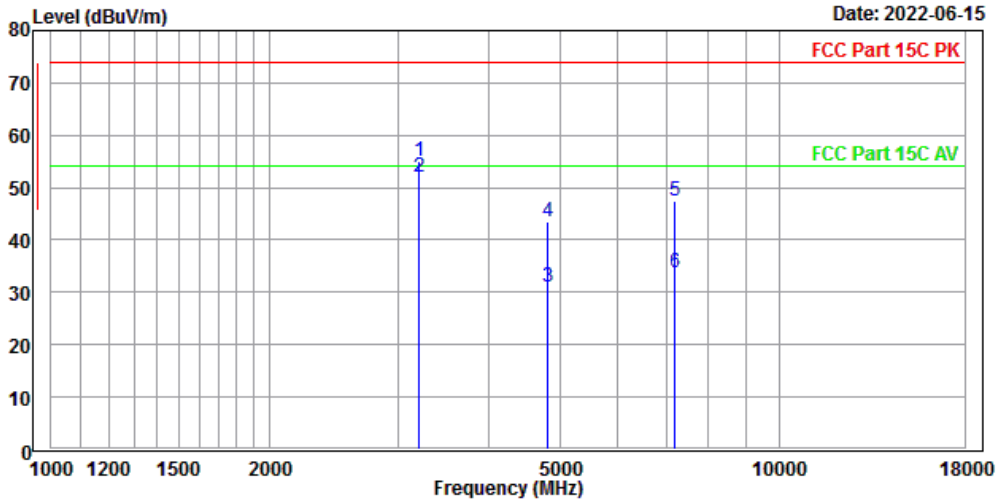
Radiated Emission Measurement above 1000MHz

Test Mode : **Continuous Transmitting, BR, 2402 MHz**

Test Range : 1 GHz ~ 25GHz

Polarization : Horizontal **Tester** : Jack

Ambient Temperature : 22℃ **Relative Humidity** : 61%



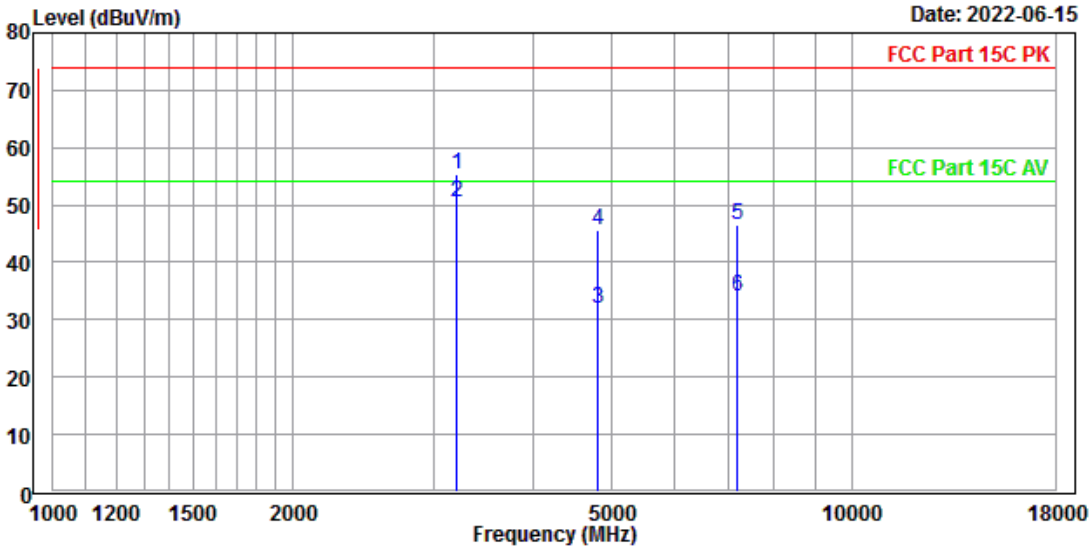
Condition : FCC Part 15C PK 3m EMCO_3117_82847 Horizontal
POWER :
OPERATOR : Jack T:22 H:61 P:1010

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	3202.692	55.21	69.81	-14.60	74.00	-18.79	292	159	Horizontal	Peak
2	3203.135	52.16	66.76	-14.60	54.00	-1.84	296	153	Horizontal	Average
3	4803.625	30.96	44.92	-13.96	54.00	-23.04	232	22	Horizontal	Average
4	4804.058	43.59	57.57	-13.98	74.00	-30.41	228	27	Horizontal	Peak
5	7205.997	47.37	58.40	-11.03	74.00	-26.63	366	283	Horizontal	Peak
6	7206.218	33.70	44.73	-11.03	54.00	-20.30	370	287	Horizontal	Average

Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line
4. No signal can be detected above 18 GHz, so the graphs are omitted.

Test Mode : **Continuous Transmitting, BR, 2402 MHz**
Test Range : 1 GHz ~ 25 GHz
Polarization : Vertical **Tester** : Jack
Ambient Temperature : 22℃ **Relative Humidity** : 61%



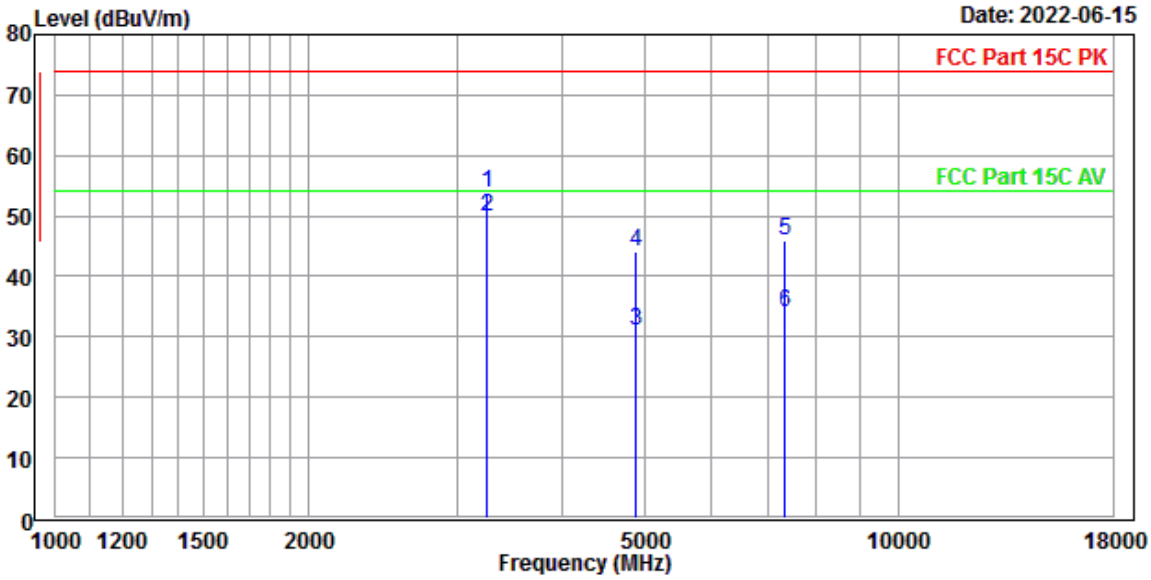
Condition : FCC Part 15C PK 3m EMCO_3117_82847 Vertical
POWER :
OPERATOR : Jack T:22 H:61 P:1010

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	3202.503	55.32	69.92	-14.60	74.00	-18.68	174	351	Vertical	Peak
2	3203.217	50.52	65.12	-14.60	54.00	-3.48	169	355	Vertical	Average
3	4803.827	31.84	45.81	-13.97	54.00	-22.16	223	182	Vertical	Average
4	4804.407	45.66	59.64	-13.98	74.00	-28.34	217	189	Vertical	Peak
5	7205.996	46.39	57.42	-11.03	74.00	-27.61	250	32	Vertical	Peak
6	7206.241	33.97	45.00	-11.03	54.00	-20.03	246	38	Vertical	Average

Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line
4. No signal can be detected above 18 GHz, so the graphs are omitted.

Test Mode : **Continuous Transmitting, BR, 2441 MHz**
Test Range : 1 GHz ~ 25 GHz
Polarization : Horizontal **Tester** : Jack
Ambient Temperature : 22℃ **Relative Humidity** : 61%



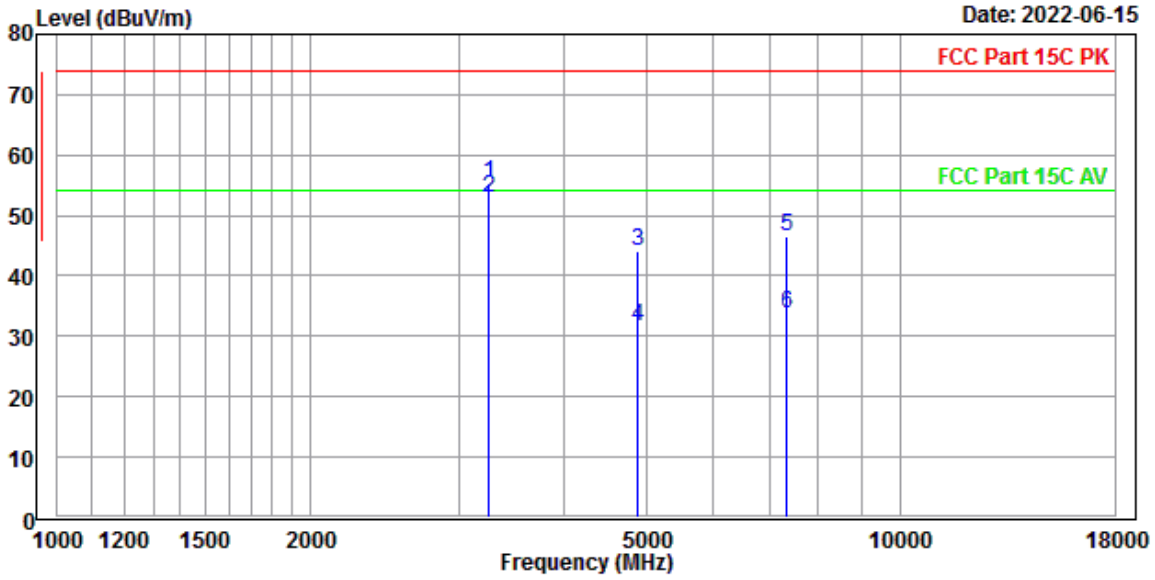
Condition : FCC Part 15C PK 3m EMCO_3117_82847 Horizontal
POWER :
OPERATOR : Jack T:22 H:61 P:1010

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	3254.684	53.70	68.42	-14.72	74.00	-20.30	286	227	Horizontal	Peak
2	3255.194	49.98	64.70	-14.72	54.00	-4.02	282	223	Horizontal	Average
3	4881.832	31.03	45.25	-14.22	54.00	-22.97	345	100	Horizontal	Average
4	4882.487	44.22	58.44	-14.22	74.00	-29.78	341	104	Horizontal	Peak
5	7322.975	45.96	56.90	-10.94	74.00	-28.04	147	139	Horizontal	Peak
6	7323.892	33.98	44.92	-10.94	54.00	-20.02	151	133	Horizontal	Average

Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line
4. No signal can be detected above 18 GHz, so the graphs are omitted.

Test Mode : **Continuous Transmitting, BR, 2441 MHz**
Test Range : 1 GHz ~ 25 GHz
Polarization : Vertical **Tester** : Jack
Ambient Temperature : 22℃ **Relative Humidity** : 61%



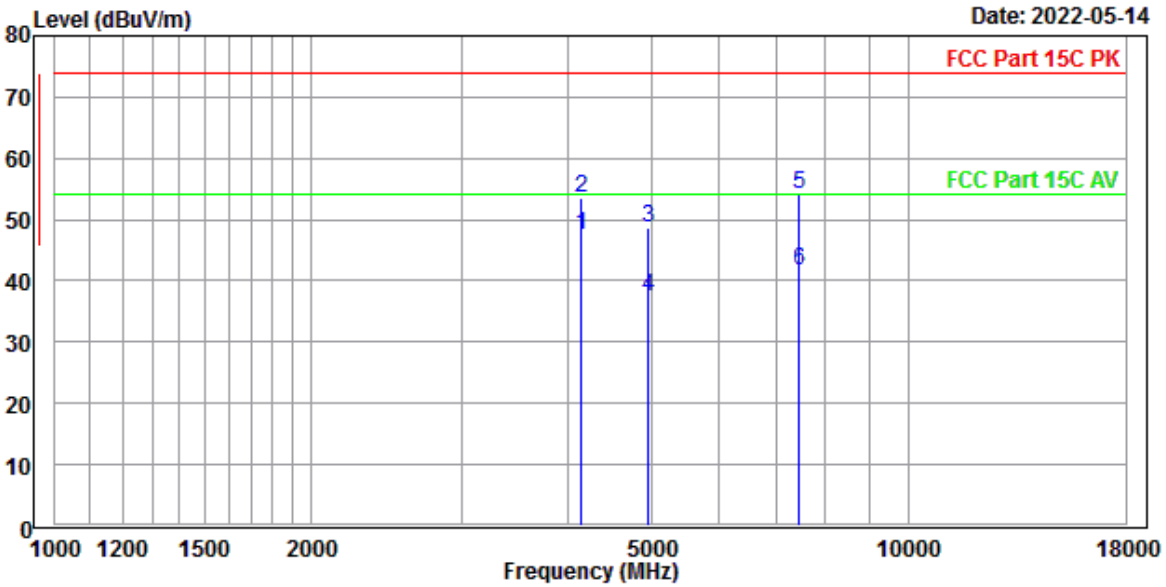
Condition : FCC Part 15C PK 3m EMCO_3117_82847 Vertical
POWER :
OPERATOR : Jack T:22 H:61 P:1010

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	3254.669	55.36	70.08	-14.72	74.00	-18.64	167	359	Vertical	Peak
2	3255.137	52.78	67.50	-14.72	54.00	-1.22	164	350	Vertical	Average
3	4881.526	44.06	58.28	-14.22	74.00	-29.94	189	310	Vertical	Peak
4	4882.339	31.69	45.91	-14.22	54.00	-22.31	184	317	Vertical	Average
5	7322.925	46.63	57.57	-10.94	74.00	-27.37	233	47	Vertical	Peak
6	7323.117	33.76	44.70	-10.94	54.00	-20.24	238	42	Vertical	Average

Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line
4. No signal can be detected above 18 GHz, so the graphs are omitted.

Test Mode : **Continuous Transmitting, BR, 2480 MHz**
Test Range : 1 GHz ~ 25 GHz
Polarization : Horizontal **Tester** : Jack
Ambient Temperature : 21℃ **Relative Humidity** : 65%



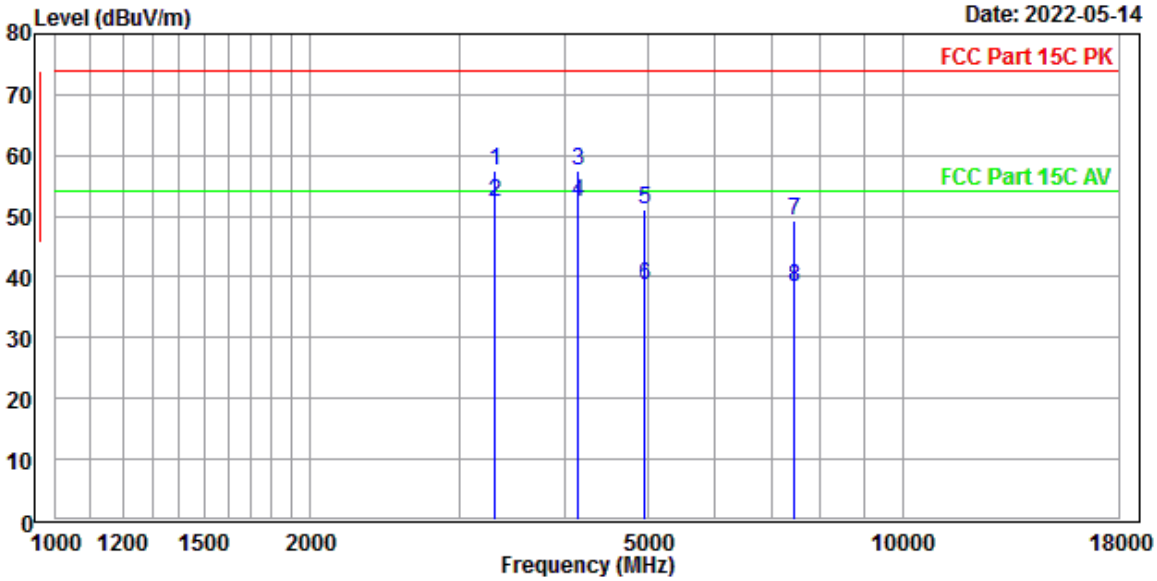
Condition : FCC Part 15C PK 3m EMCO_3117_82847 Horizontal
POWER :
OPERATOR : Jack T:21 H:65 P:1009

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	4132.518	47.51	61.92	-14.41	54.00	-6.49	231	165	Horizontal	Average
2	4133.089	53.57	67.98	-14.41	74.00	-20.43	227	169	Horizontal	Peak
3	4959.526	48.70	62.70	-14.00	74.00	-25.30	262	110	Horizontal	Peak
4	4960.218	37.40	51.40	-14.00	54.00	-16.60	267	114	Horizontal	Average
5	7439.504	54.10	64.76	-10.66	74.00	-19.90	388	347	Horizontal	Peak
6	7440.218	41.70	52.35	-10.65	54.00	-12.30	382	354	Horizontal	Average

Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line
4. No signal can be detected above 18 GHz, so the graphs are omitted.

Test Mode : **Continuous Transmitting, BR, 2480 MHz**
Test Range : 1 GHz ~ 25 GHz
Polarization : Vertical **Tester** : Jack
Ambient Temperature : 21℃ **Relative Humidity** : 65%



Condition : FCC Part 15C PK 3m EMCO_3117_82847 Vertical
POWER :
OPERATOR : Jack T:21 H:65 P:1009

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	3306.599	57.45	72.29	-14.84	74.00	-16.55	164	225	Vertical	Peak
2	3307.248	52.29	67.13	-14.84	54.00	-1.71	158	221	Vertical	Average
3	4133.611	57.40	71.81	-14.41	74.00	-16.60	184	123	Vertical	Peak
4	4134.409	52.30	66.71	-14.41	54.00	-1.70	180	127	Vertical	Average
5	4959.566	51.13	65.13	-14.00	74.00	-22.87	340	252	Vertical	Peak
6	4960.379	38.78	52.78	-14.00	54.00	-15.22	334	256	Vertical	Average
7	7439.599	49.22	59.88	-10.66	74.00	-24.78	291	132	Vertical	Peak
8	7440.147	38.26	48.91	-10.65	54.00	-15.74	295	137	Vertical	Average

Note:

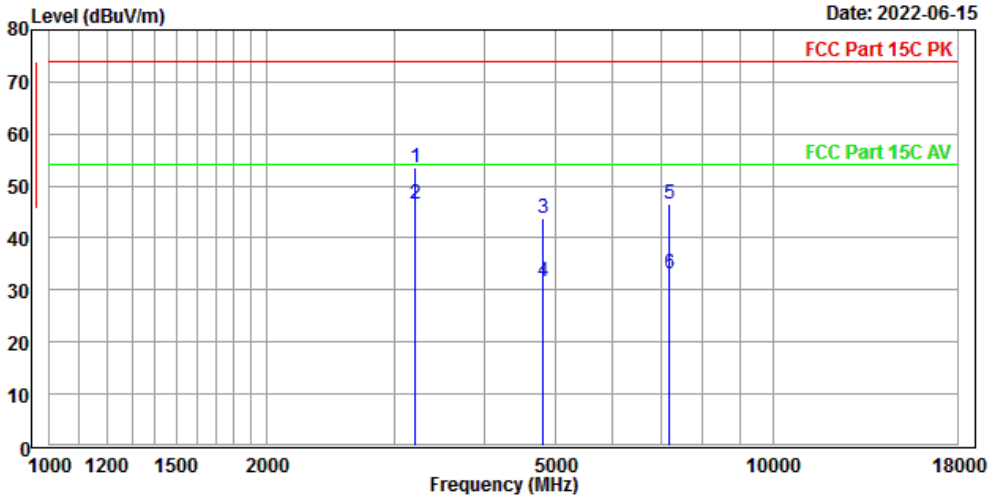
1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line
4. No signal can be detected above 18 GHz, so the graphs are omitted.

Test Mode : **Continuous Transmitting, EDR, 2402 MHz**

Test Range : 1 GHz ~ 25GHz

Polarization : Horizontal **Tester** : Jack

Ambient Temperature : 22℃ **Relative Humidity** : 61%



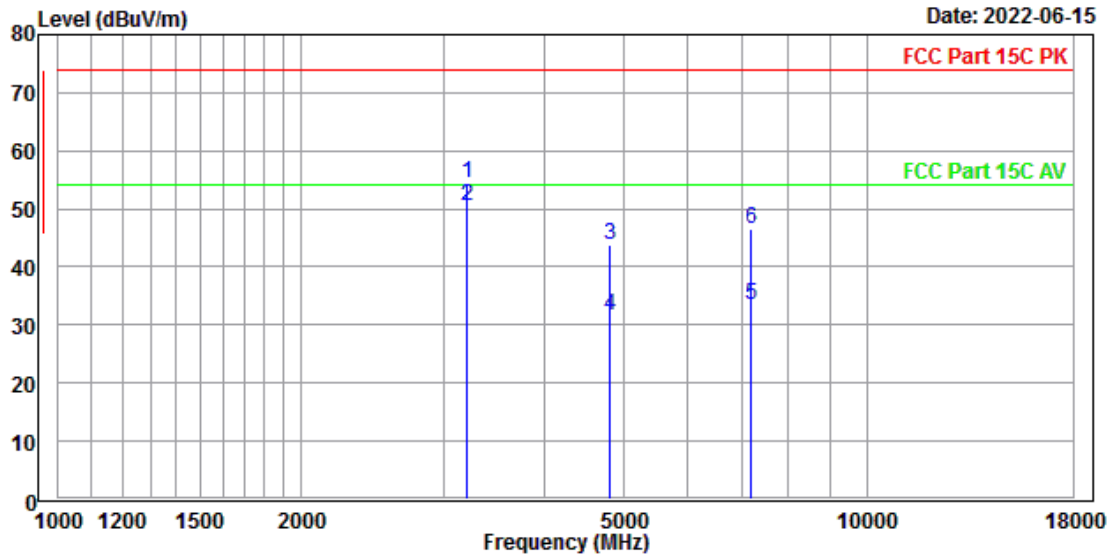
Condition : FCC Part 15C PK 3m EMCO_3117_82847 Horizontal
POWER :
OPERATOR : Jack T:22 H:61 P:1010

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	3202.817	53.67	68.27	-14.60	74.00	-20.33	171	148	Horizontal	Peak
2	3203.388	46.62	61.22	-14.60	54.00	-7.38	175	142	Horizontal	Average
3	4803.838	43.85	57.82	-13.97	74.00	-30.15	248	109	Horizontal	Peak
4	4804.219	31.55	45.53	-13.98	54.00	-22.45	242	103	Horizontal	Average
5	7205.910	46.50	57.53	-11.03	74.00	-27.50	294	291	Horizontal	Peak
6	7206.336	33.27	44.29	-11.02	54.00	-20.73	299	285	Horizontal	Average

Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line
4. No signal can be detected above 18 GHz, so the graphs are omitted.

Test Mode : **Continuous Transmitting, EDR, 2402 MHz**
Test Range : 1 GHz ~ 25 GHz
Polarization : Vertical **Tester** : Jack
Ambient Temperature : 22℃ **Relative Humidity** : 61%



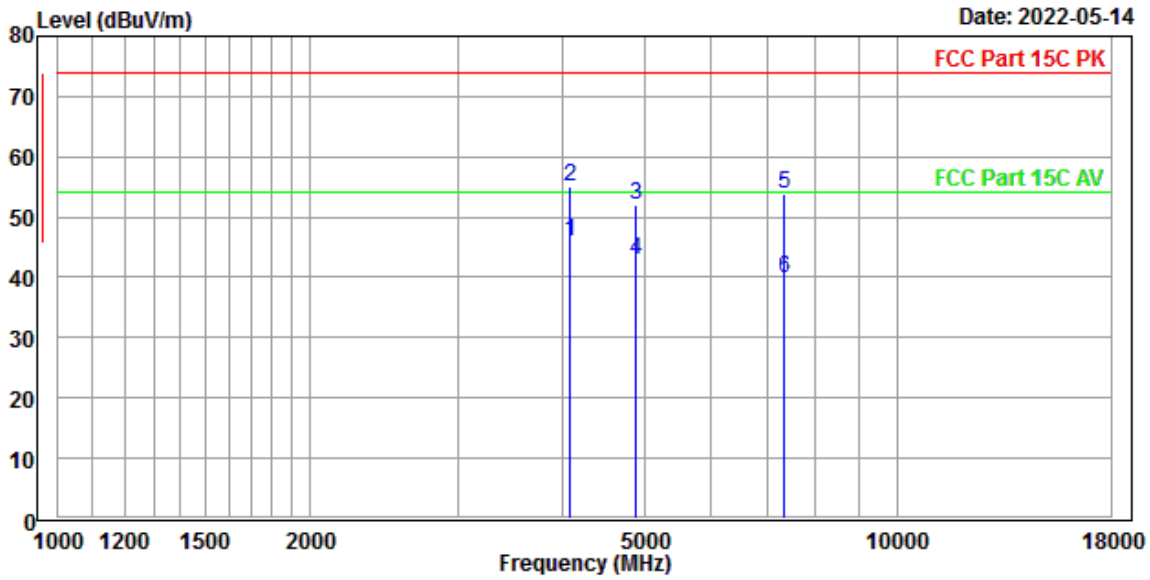
Condition : FCC Part 15C PK 3m EMCO_3117_82847 Vertical
POWER :
OPERATOR : Jack T:22 H:61 P:1010

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	3202.803	54.31	68.91	-14.60	74.00	-19.69	348	109	Vertical	Peak
2	3203.186	50.63	65.23	-14.60	54.00	-3.37	352	114	Vertical	Average
3	4803.585	43.85	57.81	-13.96	74.00	-30.15	180	225	Vertical	Peak
4	4804.219	31.65	45.63	-13.98	54.00	-22.35	177	221	Vertical	Average
5	7205.782	33.49	44.52	-11.03	54.00	-20.51	231	296	Vertical	Average
6	7206.271	46.42	57.44	-11.02	74.00	-27.58	236	292	Vertical	Peak

Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line
4. No signal can be detected above 18 GHz, so the graphs are omitted.

Test Mode : **Continuous Transmitting, EDR, 2441 MHz**
Test Range : 1 GHz ~ 25 GHz
Polarization : Horizontal **Tester** : Jack
Ambient Temperature : 21℃ **Relative Humidity** : 65%



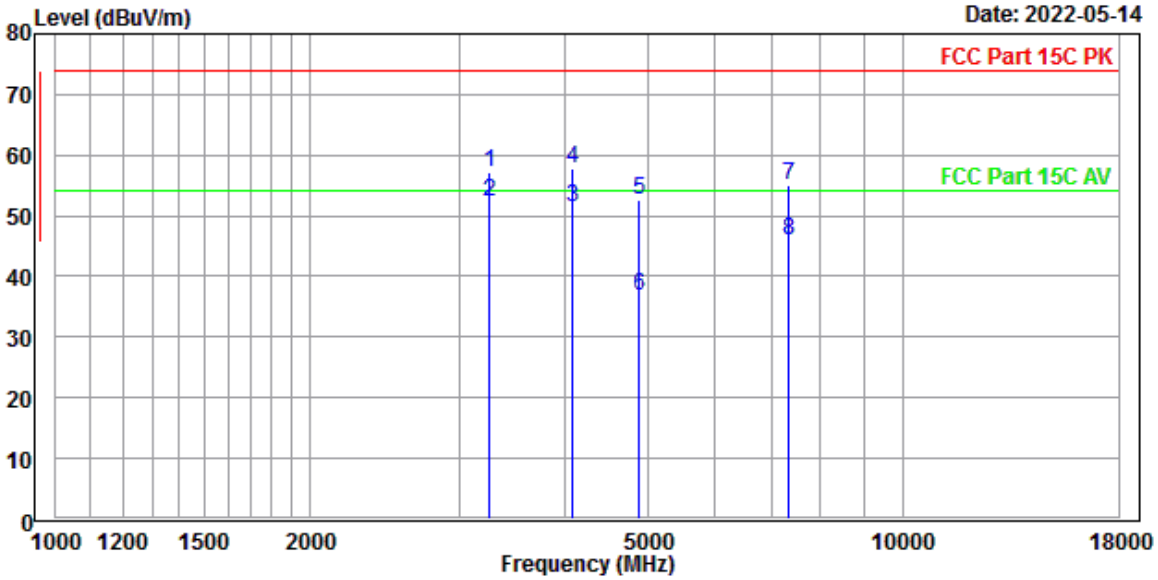
Condition : FCC Part 15C PK 3m EMCO_3117_82847 Horizontal
POWER :
OPERATOR : Jack T:21 H:65 P:1009

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	4067.588	45.90	60.37	-14.47	54.00	-8.10	358	191	Horizontal	Average
2	4068.067	55.02	69.49	-14.47	74.00	-18.98	362	195	Horizontal	Peak
3	4881.708	52.15	66.37	-14.22	74.00	-21.85	169	52	Horizontal	Peak
4	4882.276	42.88	57.10	-14.22	54.00	-11.12	164	57	Horizontal	Average
5	7322.525	53.82	64.76	-10.94	74.00	-20.18	215	137	Horizontal	Peak
6	7323.092	39.99	50.93	-10.94	54.00	-14.01	212	143	Horizontal	Average

Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line
4. No signal can be detected above 18 GHz, so the graphs are omitted.

Test Mode : **Continuous Transmitting, EDR, 2441 MHz**
Test Range : 1 GHz ~ 25 GHz
Polarization : Vertical **Tester** : Jack
Ambient Temperature : 21℃ **Relative Humidity** : 65%



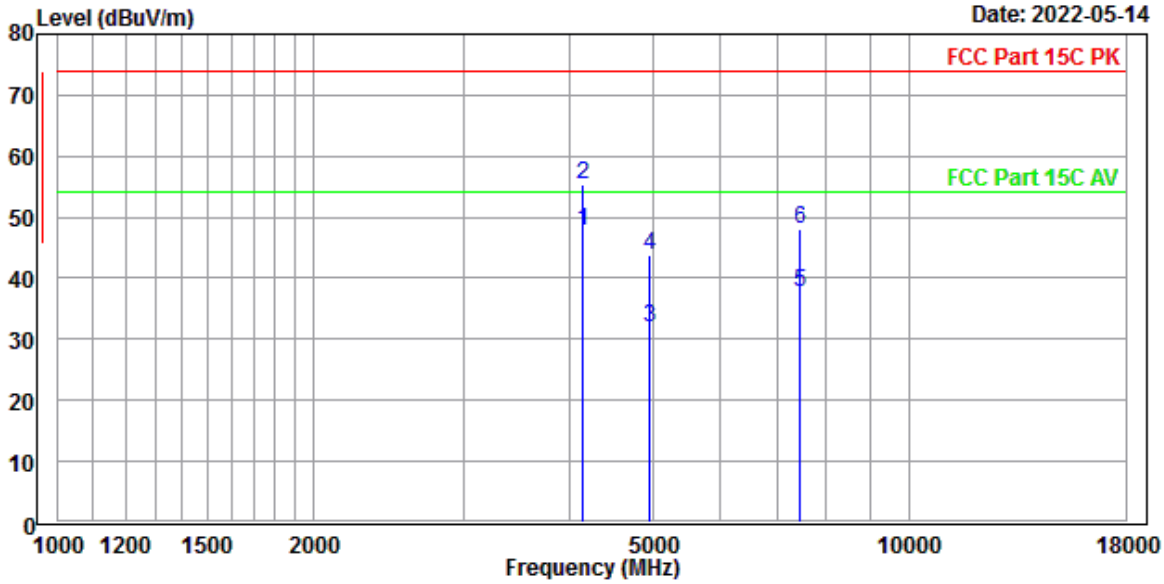
Condition : FCC Part 15C PK 3m EMCO_3117_82847 Vertical
POWER :
OPERATOR : Jack T:21 H:65 P:1009

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	3254.595	57.12	71.84	-14.72	74.00	-16.88	280	262	Vertical	Peak
2	3255.144	52.22	66.94	-14.72	54.00	-1.78	276	265	Vertical	Average
3	4067.827	51.52	65.99	-14.47	54.00	-2.48	160	143	Vertical	Average
4	4068.238	57.91	72.39	-14.48	74.00	-16.09	164	147	Vertical	Peak
5	4881.660	52.65	66.87	-14.22	74.00	-21.35	163	132	Vertical	Peak
6	4882.059	36.85	51.07	-14.22	54.00	-17.15	167	136	Vertical	Average
7	7322.510	55.04	65.98	-10.94	74.00	-18.96	235	290	Vertical	Peak
8	7323.126	45.87	56.81	-10.94	54.00	-8.13	239	294	Vertical	Average

Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line
4. No signal can be detected above 18 GHz, so the graphs are omitted.

Test Mode : **Continuous Transmitting, EDR, 2480 MHz**
Test Range : 1 GHz ~ 25 GHz
Polarization : Horizontal **Tester** : Jack
Ambient Temperature : 21℃ **Relative Humidity** : 65%



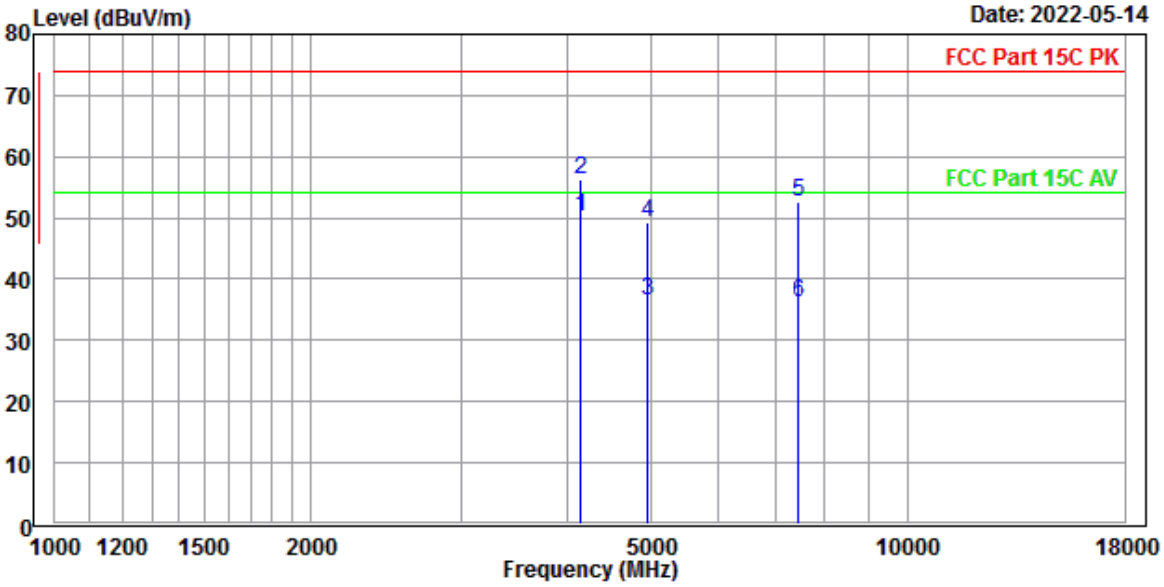
Condition : FCC Part 15C PK 3m EMCO_3117_82847 Horizontal
POWER :
OPERATOR : Jack T:21 H:65 P:1009

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	4132.518	47.71	62.12	-14.41	54.00	-6.29	237	178	Horizontal	Average
2	4133.170	55.27	69.68	-14.41	74.00	-18.73	241	174	Horizontal	Peak
3	4959.765	31.81	45.81	-14.00	54.00	-22.19	284	316	Horizontal	Average
4	4960.345	43.74	57.74	-14.00	74.00	-30.26	280	313	Horizontal	Peak
5	7439.588	37.66	48.32	-10.66	54.00	-16.34	174	136	Horizontal	Average
6	7440.069	48.19	58.84	-10.65	74.00	-25.81	174	132	Horizontal	Peak

Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line
4. No signal can be detected above 18 GHz, so the graphs are omitted.

Test Mode : **Continuous Transmitting, EDR, 2480 MHz**
Test Range : 1 GHz ~ 25 GHz
Polarization : Vertical **Tester** : Jack
Ambient Temperature : 21℃ **Relative Humidity** : 65%



Condition : FCC Part 15C PK 3m EMCO_3117_82847 Vertical
POWER :
OPERATOR : Jack T:21 H:65 P:1009

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	4132.529	50.30	64.71	-14.41	54.00	-3.70	305	132	Vertical	Average
2	4133.055	56.35	70.76	-14.41	74.00	-17.65	309	136	Vertical	Peak
3	4959.618	36.47	50.47	-14.00	54.00	-17.53	283	50	Vertical	Average
4	4960.226	49.13	63.13	-14.00	74.00	-24.87	287	55	Vertical	Peak
5	7439.603	52.51	63.17	-10.66	74.00	-21.49	163	201	Vertical	Peak
6	7440.218	36.34	46.99	-10.65	54.00	-17.66	156	207	Vertical	Average

Note:

1. Level (dBuV/m) = Read level + Factor.
2. Factor (dB/m) = Cable Loss + Antenna Factor – Gain of Preamplifier.
3. Over Limit (dB) = Level – Limit line
4. No signal can be detected above 18 GHz, so the graphs are omitted.

9 Line conducted Emission Measurement

Result: Pass

9.1 Limits for Emission Measurement

According to FCC 15.207(a), line conduction emission limit is as below table.

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

* Decreases with the logarithm of the frequency.

9.2 Measurement Procedure

a. The EUT was set up per the test configuration figured in the next section of this chapter to simulate the typical usage per the user's manual.

b. If the EUT is tabletop equipment, it was placed on a non-conducted table with a height of 0.8 meters above the reference ground plane and 0.4 meters from the conducting wall of the shielded room. Also if the EUT is floor-standing equipment, it was placed on a non-conducted support with a height of 12 millimeters above the reference ground plane.

c. Connect the EUT's power source to the appropriate power mains through the LISN.

d. All the other peripherals are connected to the 2nd LISN, if any.

e. The LISN was placed 0.8 meters from the EUT and at least 0.8 meters from other units and other metal planes.

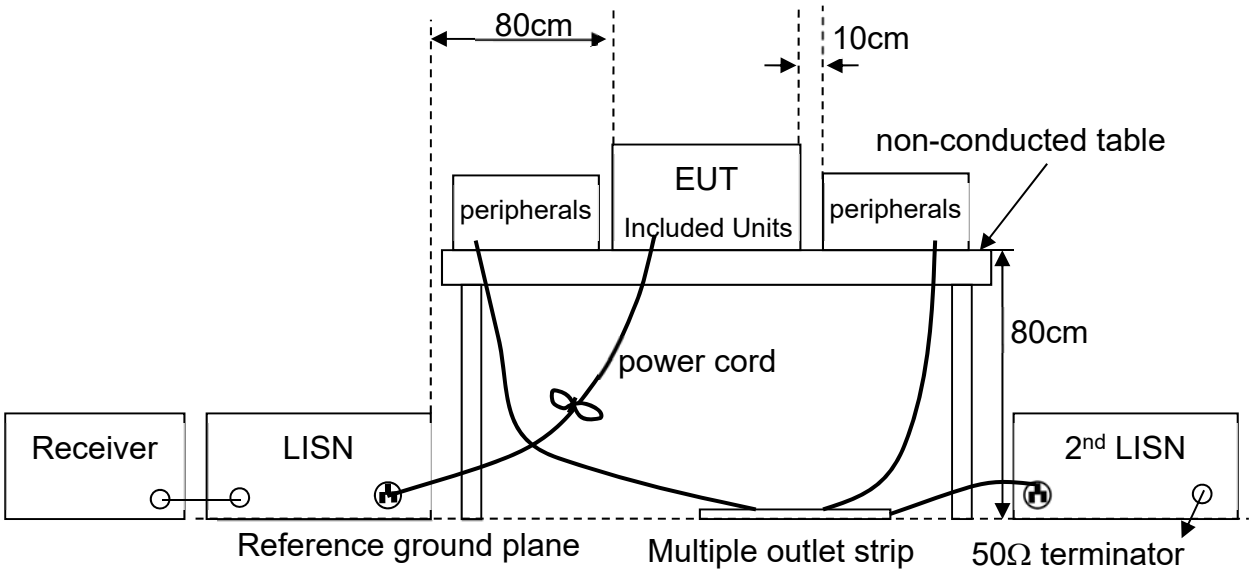
f. Measure the conducted emissions on each power line (Neutral Line and Line 1 – Hot side) of the EUT's power source by using the test receiver connected to the coupling RF output port of LISN.

g. Rapidly scan the signal from 150kHz to 30MHz by using the receiver through the Maximum-Peak detector to determine those frequencies associated with higher emission levels for each measured line. Receiver setting is IF bandwidth=9 kHz.

h. Then measure the maximum level of conducted disturbance for each frequency found from step g. by using the receiver through the Quasi-Peak and Average detectors per CISPR 16-1.

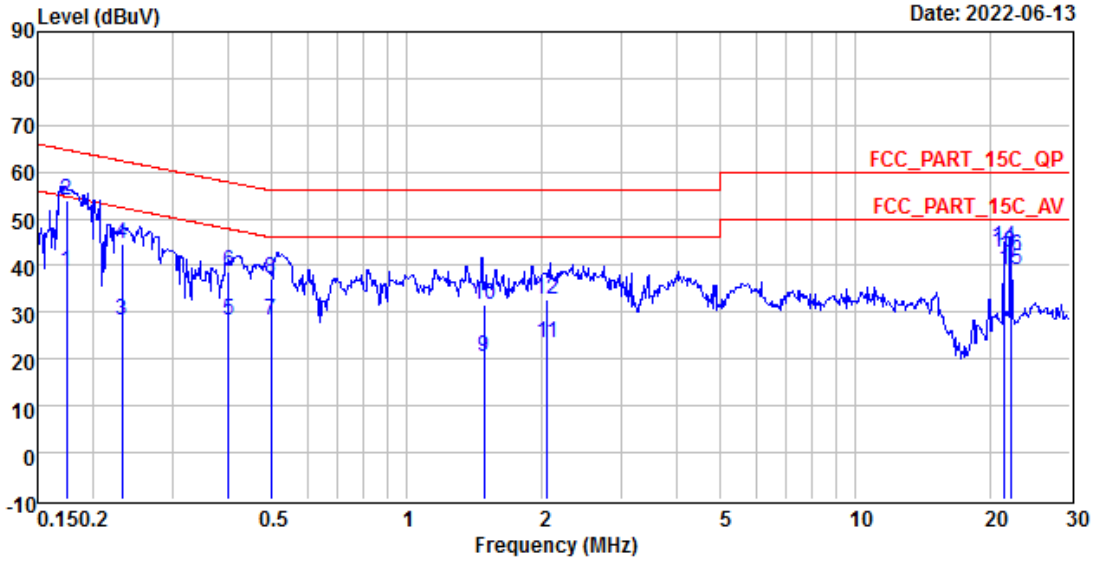
i. Record the level for each frequency and compare with the required limit.

9.3 Test Configurations



9.4 Test Data

Test Mode	**: Continuous Transmitting, EDR, 2441 MHz**		
Phase	: Line	**Tester**	: David Lu
Ambient Temperature	: 26℃	**Relative Humidity**	: 70%



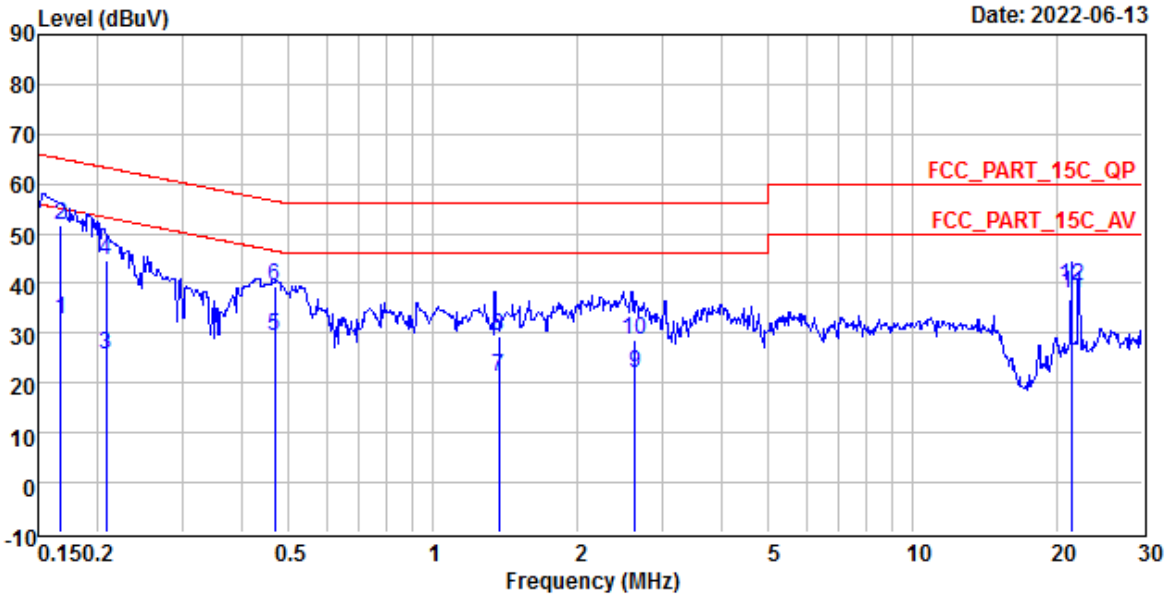
Site : TR20
Condition : FCC_PART_15C_QP ESH2-Z5 LINE
Power : 120V/60Hz
Operator : David Lu T26 H70 P1006

	Freq	Level	Factor	Read Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB		
1	0.174	38.74	10.27	28.47	54.75	-16.01	LINE	Average
2	0.174	54.01	10.27	43.74	64.75	-10.74	LINE	QP
3	0.231	28.42	10.27	18.15	52.40	-23.98	LINE	Average
4	0.231	44.81	10.27	34.54	62.40	-17.59	LINE	QP
5	0.399	28.34	10.30	18.04	47.87	-19.53	LINE	Average
6	0.399	38.75	10.30	28.45	57.87	-19.12	LINE	QP
7	0.496	28.41	10.31	18.10	46.06	-17.65	LINE	Average
8	0.496	37.39	10.31	27.08	56.06	-18.67	LINE	QP
9	1.483	20.61	10.40	10.21	46.00	-25.39	LINE	Average
10	1.483	31.57	10.40	21.17	56.00	-24.43	LINE	QP
11	2.055	23.63	10.43	13.20	46.00	-22.37	LINE	Average
12	2.055	32.84	10.43	22.41	56.00	-23.16	LINE	QP
13	21.443	42.72	11.43	31.29	50.00	-7.28	LINE	Average
14	21.443	43.91	11.43	32.48	60.00	-16.09	LINE	QP
15	22.208	38.95	11.44	27.51	50.00	-11.05	LINE	Average
16	22.208	42.10	11.44	30.66	60.00	-17.90	LINE	QP

Note:

1. Emission Level = reading value + correction factor.
2. Correction factor = cable loss + insertion loss of LISN.
3. Q.P. is abbreviation of quasi-peak.

Test Mode	**: Continuous Transmitting, EDR, 2441 MHz**		
Phase	**:** Neutral	**Tester**	**:** David Lu
Ambient Temperature	**:** 26℃	**Relative Humidity**	**:** 70%



Site : TR20
Condition : FCC_PART_15C_QP ESH2-Z5 NEUTRAL
Power : 120V/60Hz
Operator : David Lu T26 H70 P1006

	Freq	Level	Factor	Read Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB		
1	0.167	32.63	10.29	22.34	55.09	-22.46	NEUTRAL	Average
2	0.167	51.69	10.29	41.40	65.09	-13.40	NEUTRAL	QP
3	0.208	25.53	10.30	15.23	53.30	-27.77	NEUTRAL	Average
4	0.208	44.49	10.30	34.19	63.30	-18.81	NEUTRAL	QP
5	0.467	29.25	10.33	18.92	46.56	-17.31	NEUTRAL	Average
6	0.467	39.27	10.33	28.94	56.56	-17.29	NEUTRAL	QP
7	1.367	21.10	10.41	10.69	46.00	-24.90	NEUTRAL	Average
8	1.367	29.37	10.41	18.96	56.00	-26.63	NEUTRAL	QP
9	2.630	21.98	10.50	11.48	46.00	-24.02	NEUTRAL	Average
10	2.630	28.80	10.50	18.30	56.00	-27.20	NEUTRAL	QP
11	21.447	37.83	11.35	26.48	50.00	-12.17	NEUTRAL	Average
12	21.447	39.53	11.35	28.18	60.00	-20.47	NEUTRAL	QP

Note:

1. Emission Level = reading value + correction factor.
2. Correction factor = cable loss + insertion loss of LISN.
3. Q.P. is abbreviation of quasi-peak.