

FCC RF Test Report

For

Bluetooth Module

Model Number : R8002

FCC ID : V3DR8002

Date of Receipt : February 18, 2022

Date of Report : August 19, 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.

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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~June 20, 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 : Cathy Chen, **DATE** : August 19, 2022
(Cathy Chen/ Technical Manager)
APPROVED BY : Sam Chien, **DATE** : August 19, 2022
(Sam Chien /General Manager)

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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

Modular Function : GFSK

Channel No. : 40

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	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

Test Mode

Test item	Mode	Operation Frequency
Conducted power test/ Radiated emission above 1 GHz	BLE 1M	CH 0 , CH 19, CH 39
Radiated emission below 1 GHz	BLE 1M	CH 0
Power line conducted emission	BLE 1M	CH 19

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) 6 dB Bandwidth

According to FCC 15.247(a)(2), the minimum 6 dB bandwidth shall be at least 500 kHz.

(2) Maximun Peak Output Power

According to FCC 15.247(b)(3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

According to FCC 15.247(b) (4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(3) Conducted emission measurements

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) is not required. Radiated emissions which 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).

(4) Power Spectral Density

According to FCC 15.247(e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

(5) Radiated emission measurements

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) Conduction Emission Requirement

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
6 dB bandwidth	FCC 15.247(a)(2)	2	PASS
Maximun Peak Output Power	FCC 15.247(b)(3)	3	PASS
Power Spectral Density	FCC 15.247(e)	4	PASS
Conducted spurious emission	FCC 15.247(d)	5	PASS
Radiated emission measurements	FCC 15.209	6	PASS
Power line conducted	FCC 15.207(a)	7	PASS

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

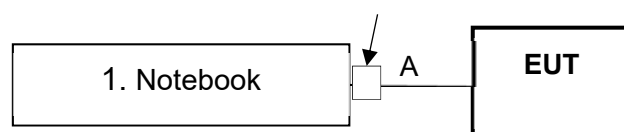
1.4 The Support Units

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

2. Command Board



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	2022/10/17
RF cable	JMCA	MWX/ C0150~C0153, C0161~C0163	2021/6/15	2022/6/14
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-amplifier	MITEQ	TTA1800-30-HG- N-M/ 1904295	2021/11/3	2022/11/2
Pre-amplifier	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 signal 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	
Occupied bandwidth	1.2%	
Conducted emission	0.9 dB	
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 6dB Bandwidth

Result: Pass

2.1 Applied standard

According to According to FCC 15.247(a)(2), the minimum 6 dB bandwidth shall be at least 500 kHz.

2.2 Measurement Procedure

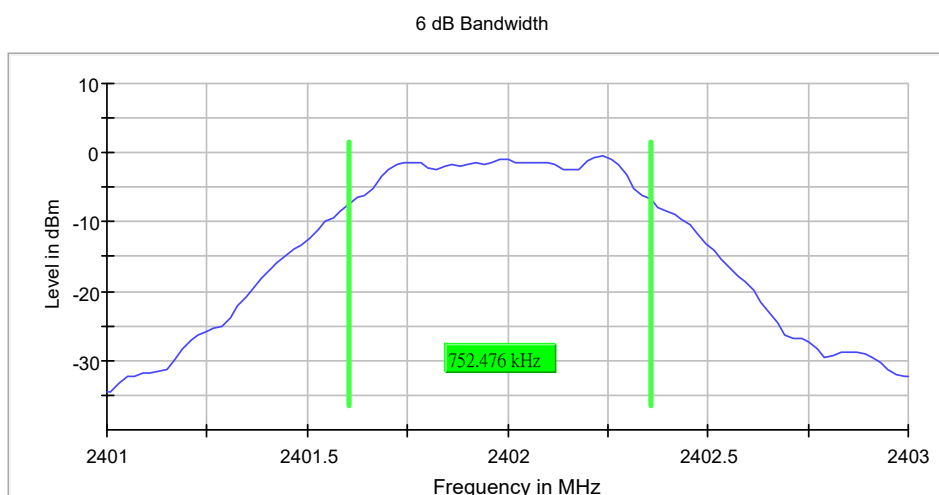
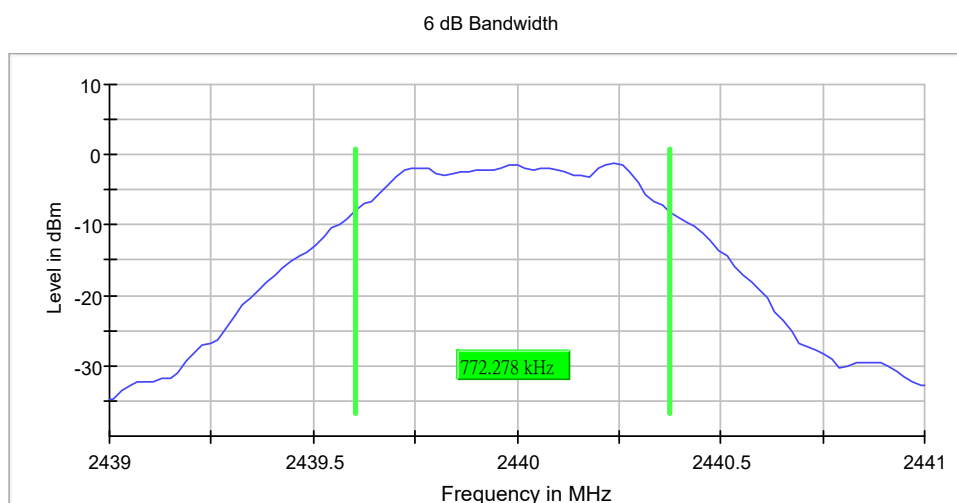
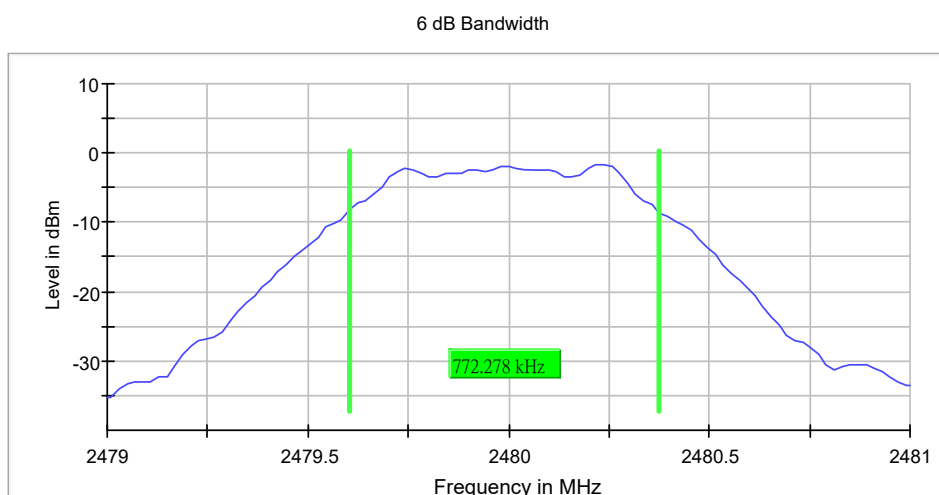
- a. The EUT was set up per the test configuration figured in the next section of this chapter to simulate the typical usage per the user's manual.
- b. A software provided by client enabled the EUT to transmit data at middle channel frequencies individually.
- c. Test procedures follow ANSI C63.10 Section 11.8.1.
- d. Spectrum Alayzer Setting: RBW=100 kHz, VBW=300 kHz, Max peak.
- e. Measure the 6dB bandwidth and compare with the required limit.

2.3 Test configuration



2.4 Test Data**Test Mode : Continuous transmitter****Tester : Wayne****Ambient Temperature : 24°C****Relative Humidity : 62%****Test Date : 111/4/19**

Operating Frequency (MHz)	6 dB Bandwidth (MHz)	Limit (kHz)
2402	0.752	> 500
2440	0.772	> 500
2480	0.772	> 500

2402MHz**2440MHz****2480MHz**

3 Maximum Peak Output Power

Result: Pass

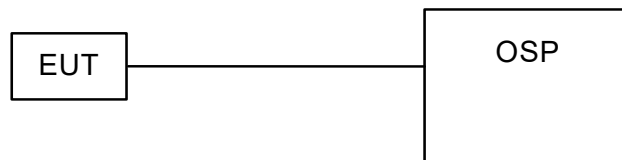
3.1 Applied standard

According to FCC 15.247(b)(3), for systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

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 11.9.2.3.2
- c. Measurement the Maximum Peak Output Power and compare with the required limit.

3.3 Test configuration



3.4 Test Data

Test Mode : Continuous transmitter

Tester : Wayne

Ambient Temperature : 24°C

Relative Humidity : 62%

Test Date : 111/4/19

Operating Frequency (MHz)	RMS output power (dBm)	Limit (dBm)	Margin (dB)
2402	0.7	30	29.3
2440	0.1	30	29.9
2480	-0.3	30	30.3

Note:

1. $\text{Margin(dB)} = \text{Limit} - \text{output power}$

4 Power Spectral Density

Result: Pass

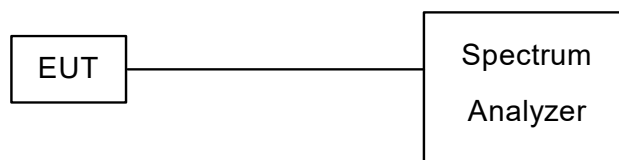
4.1 Applied standard

According to FCC 15.247(e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

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 11.10.5.
- c. Spectrum Alayzer Setting: RBW=10 kHz, VBW=100 kHz, Max peak., if fail, RBW=3 kHz, VBW=10 kHz.
- d. Measure the power spectrtal density and compare with the required limit.

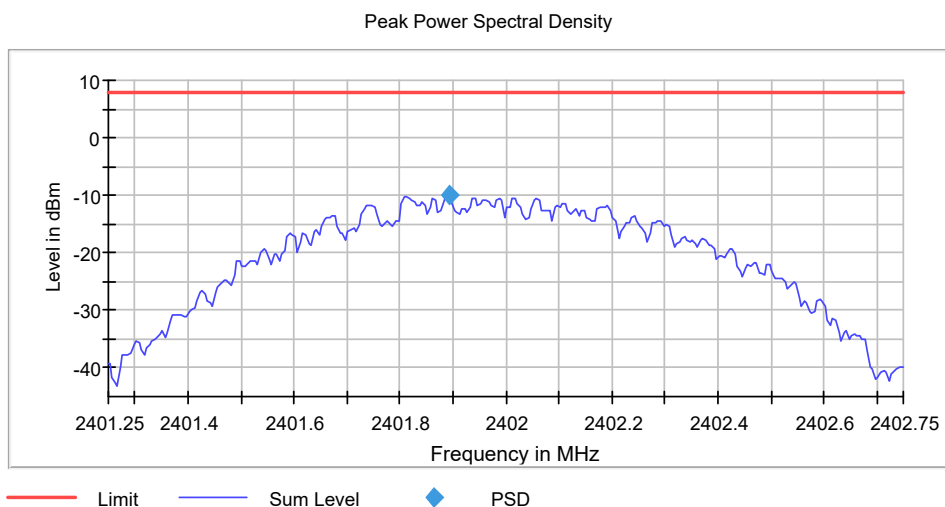
4.3 Test configuration



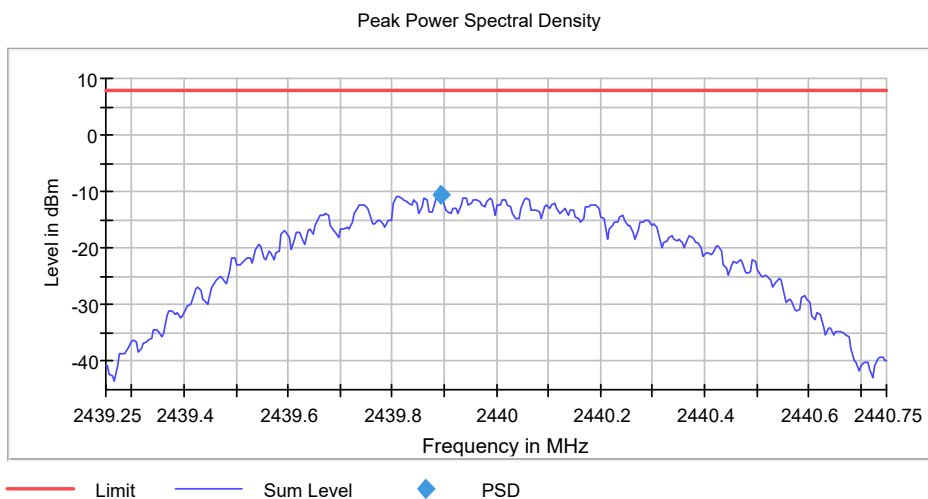
4.4 Test Data**Test Mode : Continuous transmitter****Tester : Wayne****Ambient Temperature : 24°C****Relative Humidity : 62%****Test Date : 111/4/19**

Operating Frequency (MHz)	Power spectral Density (dBm/10kHz)	Limit (dBm/3kHz)	Margin (dB)
2402	-9.9	8	17.9
2440	-10.4	8	18.4
2480	-10.8	8	18.8

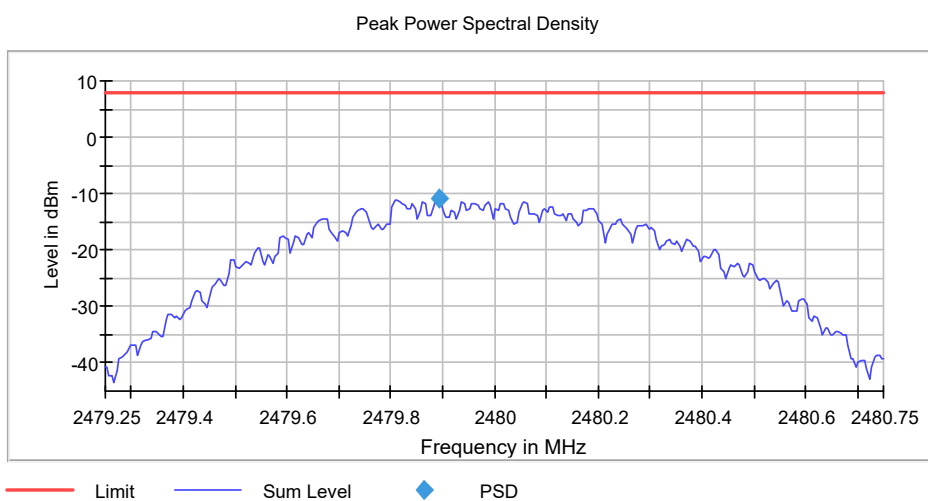
2402MHz



2440MHz



2480MHz



5 Conducted Spurious emission

Result: Pass

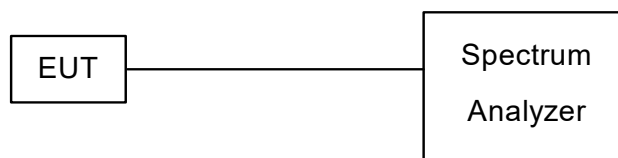
5.1 Applied standard

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.

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. 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 11.11.
- d. Spectrum Alayzer Setting: RBW=100 kHz, VBW=300 kHz, Max peak
- e. Measurement the conducted spurious emission and compare with the required limit.

5.3 Test configuration



5.4 Test Data

Bandedge

Test Mode : Continuous transmitter

Tester : Wayne

Ambient Temperature : 24°C

Relative Humidity : 62%

Test Date : 111/4/19

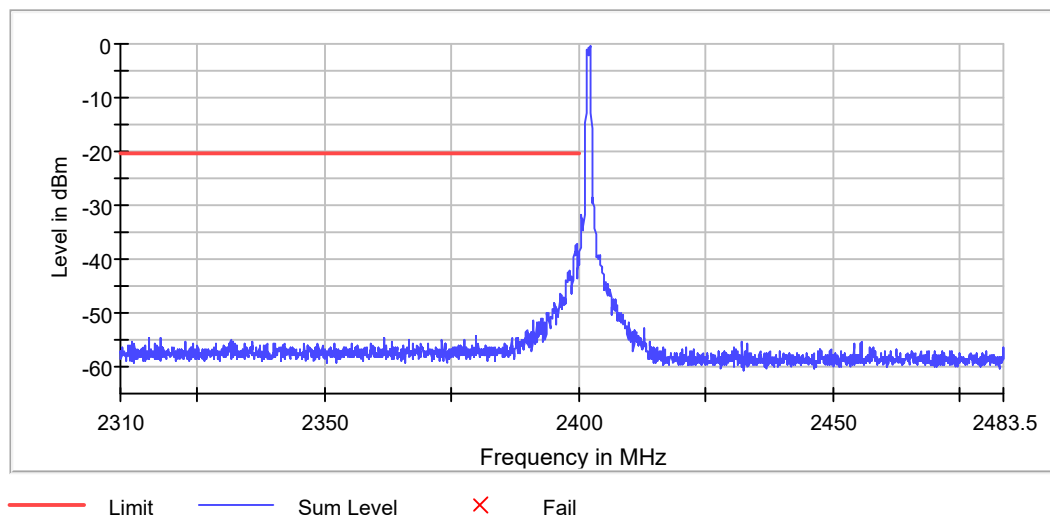
Operating Frequency (MHz)	Max emission of in band (dBm)	Frequency of out band max emission (MHz)	Max emission of out band (dBm)	Limit (dBm)	Margin (dB)
2412	-0.4	2399.6	-37.3	-20.4	16.9
2462	-1.6	2483.9	-47.6	-21.6	26.0

Note:

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

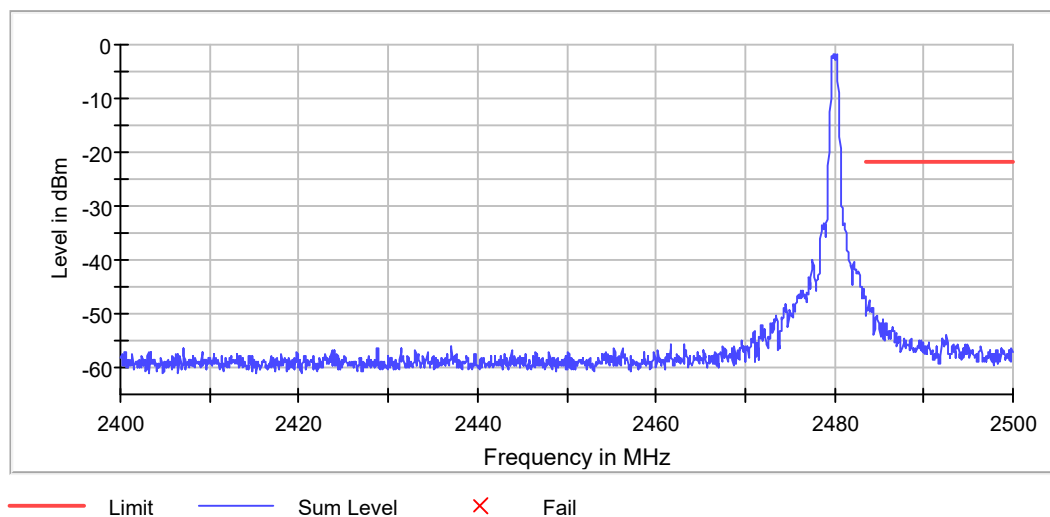
2402MHz

Band Edge



2480MHz

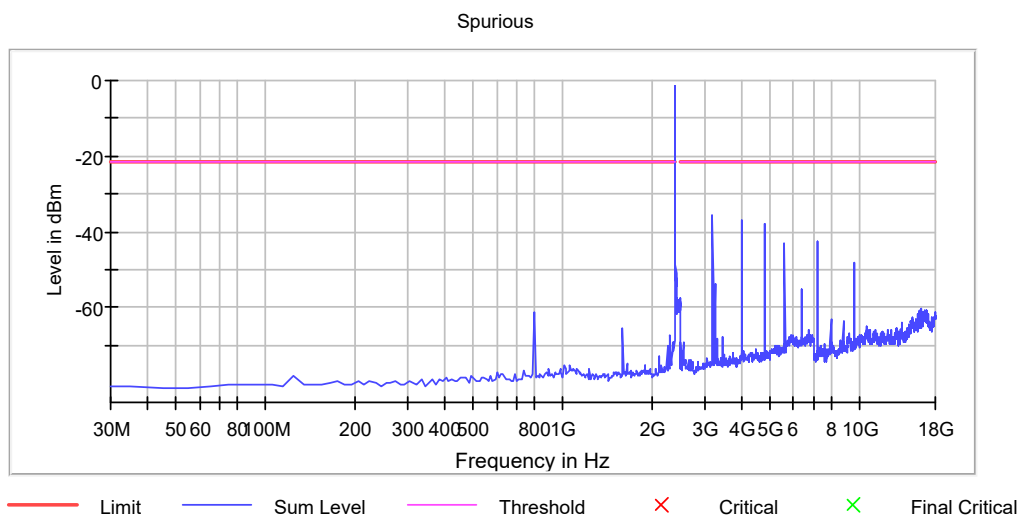
Band Edge



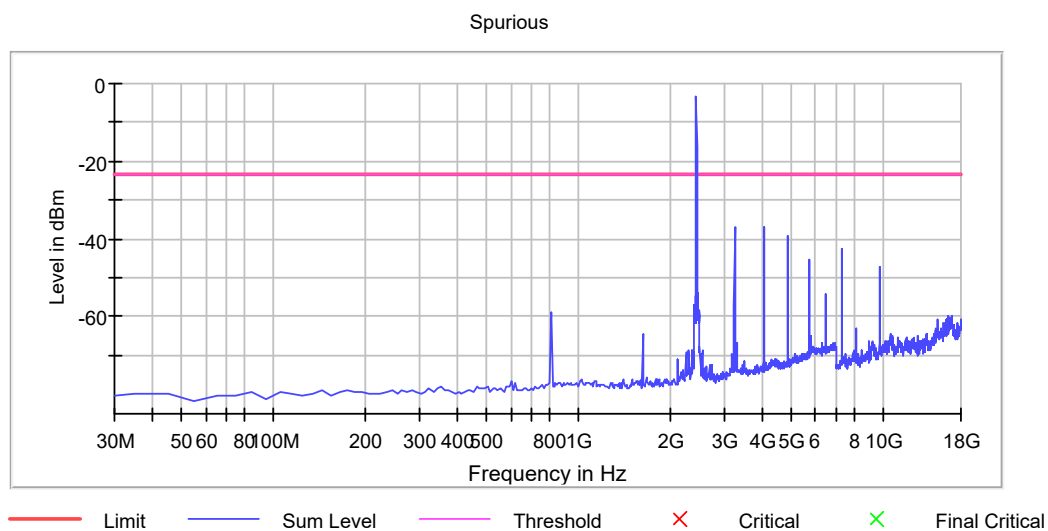
Out of band emission**Test Mode : Continuous transmitter****Tester : Wayne****Ambient Temperature : 24°C****Relative Humidity : 62%****Test Date : 111/4/19**

No signal can be detected from 18GHz to 25GHz, so the graphs are omitted above 18GHz

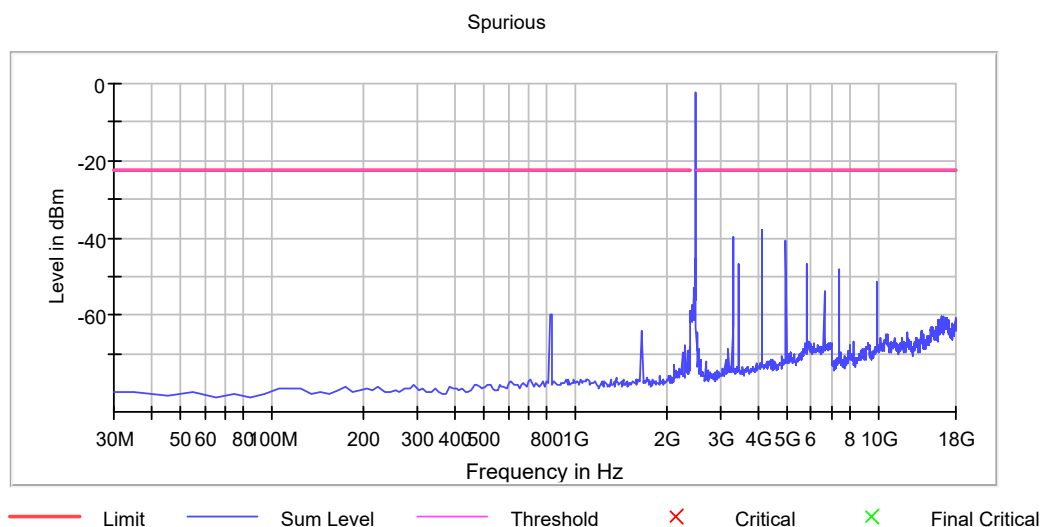
2402MHz



2440MHz



2480MHz



6 Radiated Spurious Emission

Result: Pass

6.1 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.

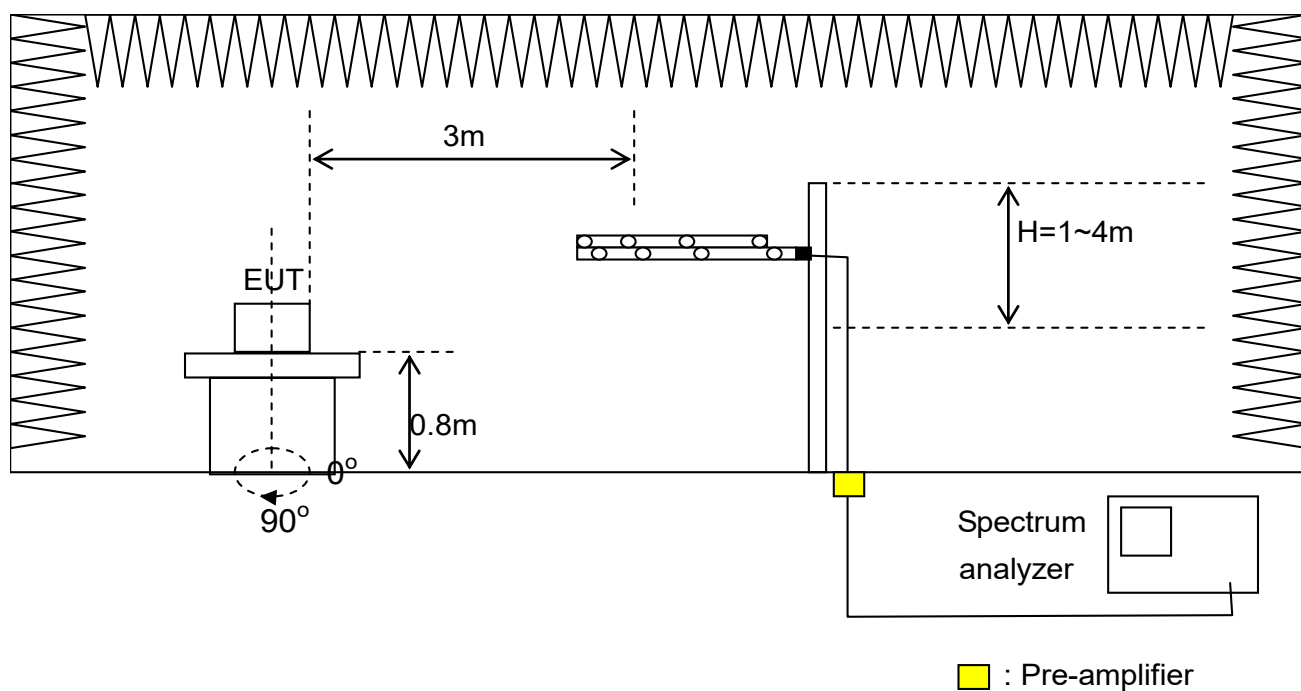
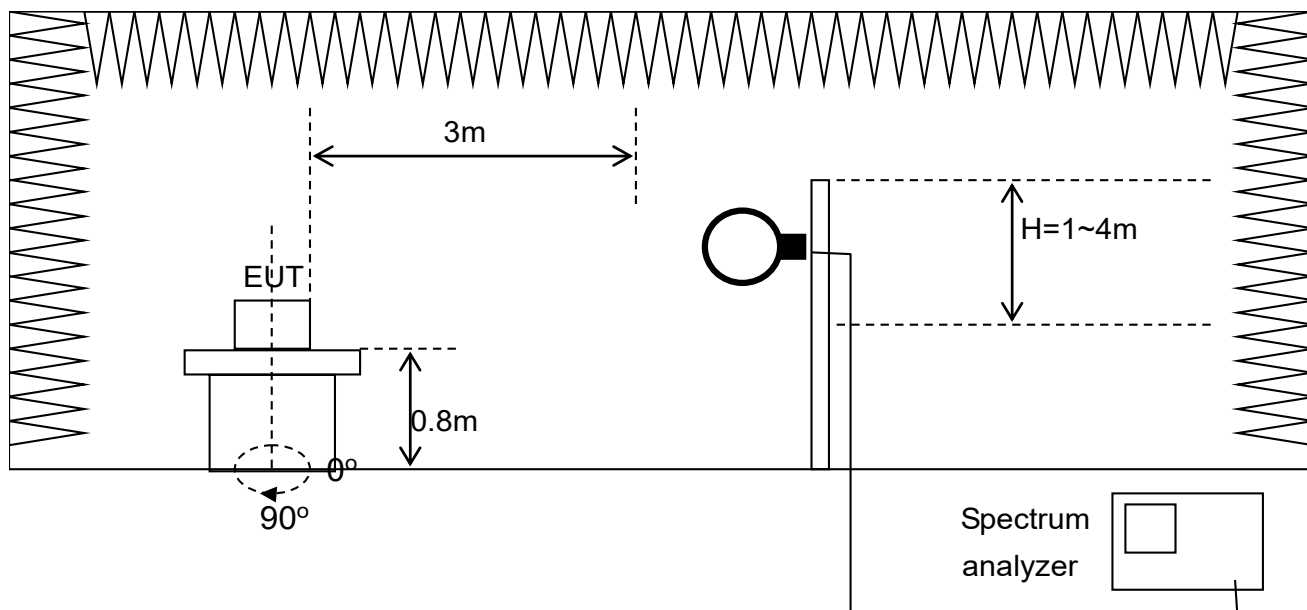
6.2 Measurement Procedure

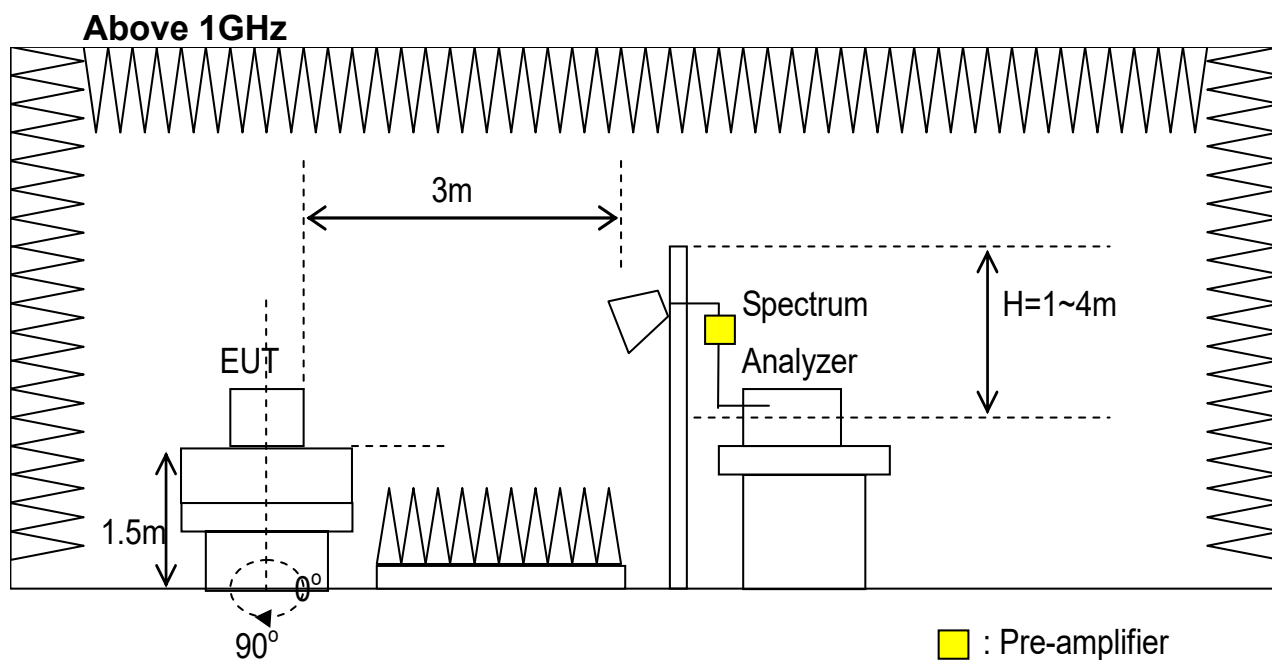
- a. The EUT was set up per the test configuration figured in the next section of this chapter to simulate the typical usage per the user's manual.
- b. A software provided by client enabled the EUT to transmit and receive data at operating frequency.(if necessary)
- c. If the EUT is tabletop equipment, 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 Analyzer 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.

n.

6.3 Test configuration

Below 1GHz





6.4 Test Data

Bandedge

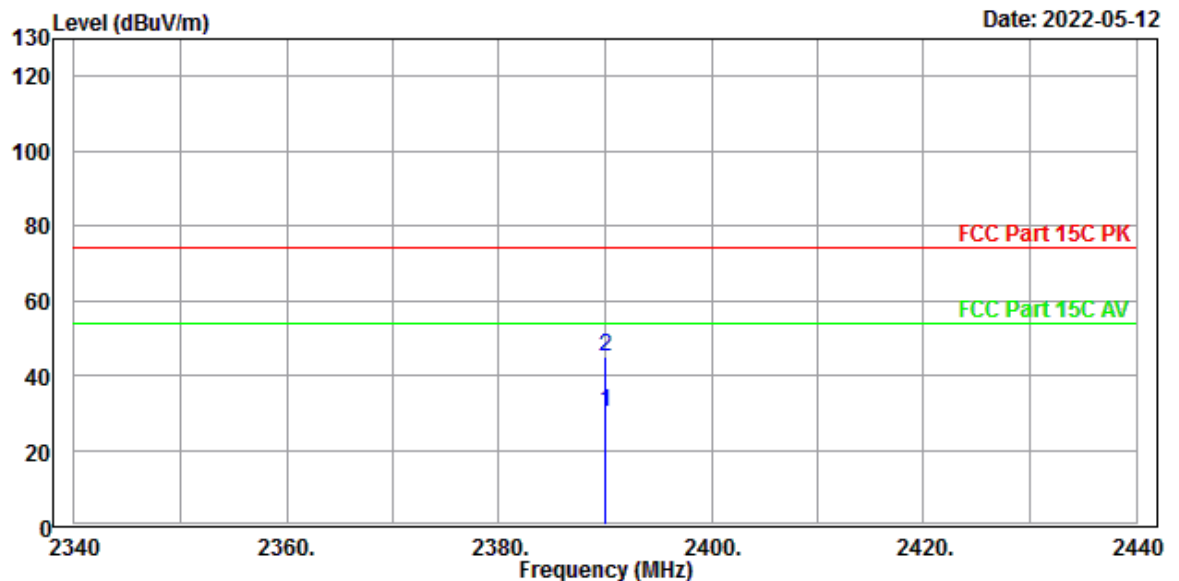
Test Mode : Continuous Transmitting, 2402 MHz

Polarization : Horizontal

Tester : Jeffry

Ambient Temperature : 22°C

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	30.06	45.80	-15.74	54.00	-23.94	387	279	HORIZONTAL	Average
2	2390.000	45.06	60.80	-15.74	74.00	-28.94	387	279	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

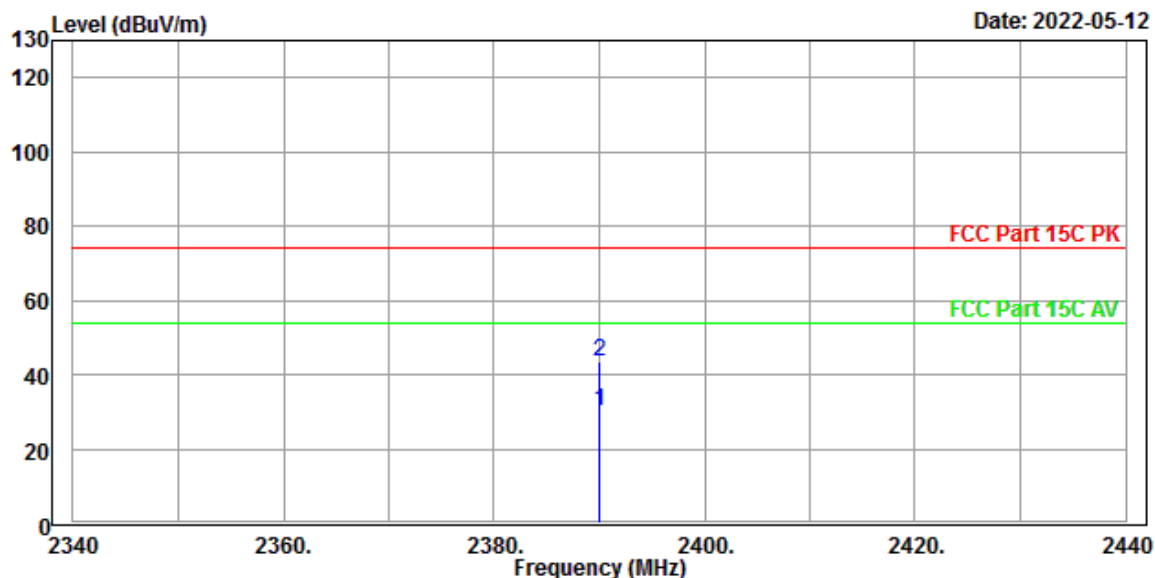
Test Mode : Continuous Transmitting, 2402 MHz

Polarization : Vertical

Tester : Jeffry

Ambient Temperature : 22°C

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	30.00	45.74	-15.74	54.00	-24.00	379	55	VERTICAL	Average
2	2390.000	43.46	59.20	-15.74	74.00	-30.54	379	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

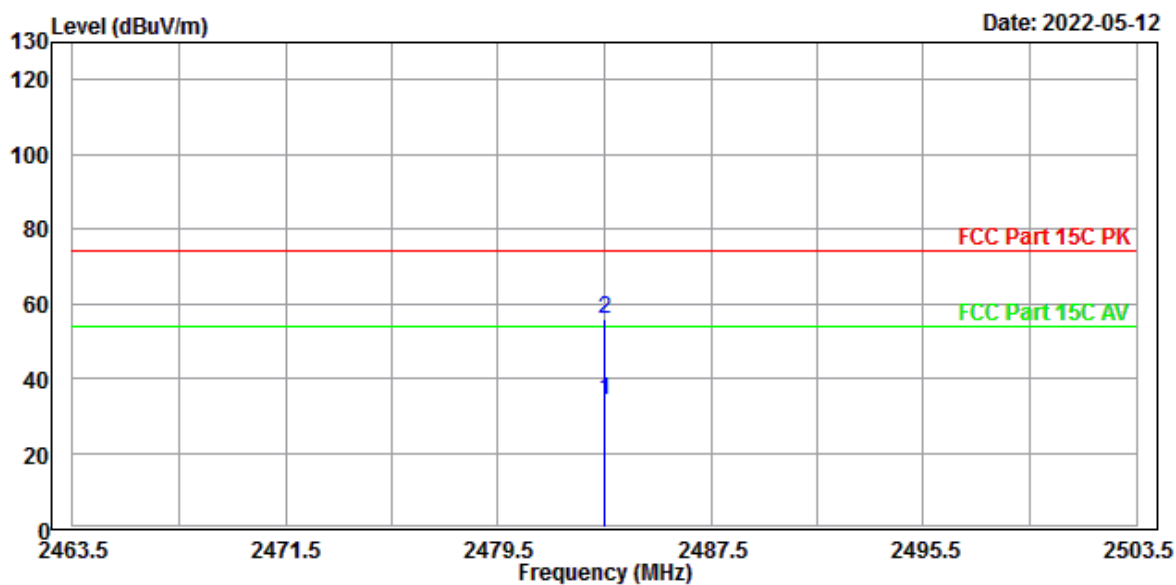
Test Mode : Continuous Transmitting, 2480 MHz

Polarization : Horizontal

Tester : Jeffry

Ambient Temperature : 22°C

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	33.86	49.50	-15.64	54.00	-20.14	375	113	HORIZONTAL	Average
2	2483.500	56.05	71.69	-15.64	74.00	-17.95	375	113	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

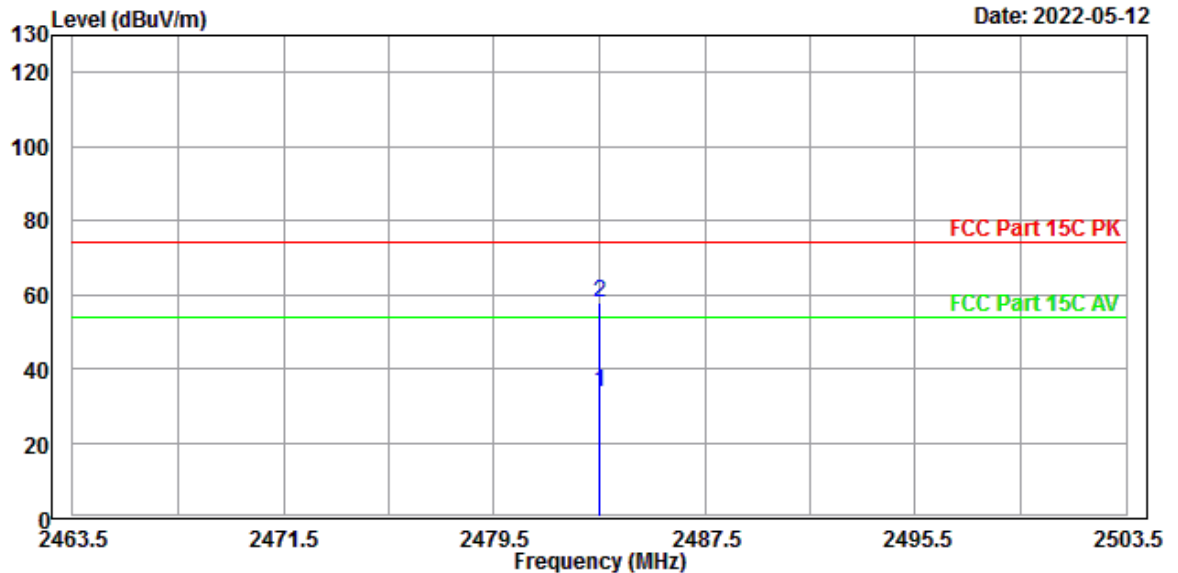
Test Mode : Continuous Transmitting, 2480 MHz

Polarization : Vertical

Tester : Jeffry

Ambient Temperature : 22°C

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	33.61	49.25	-15.64	54.00	-20.39	380	215	VERTICAL	Average
2	2483.500	57.67	73.31	-15.64	74.00	-16.33	380	215	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, 2402 MHz

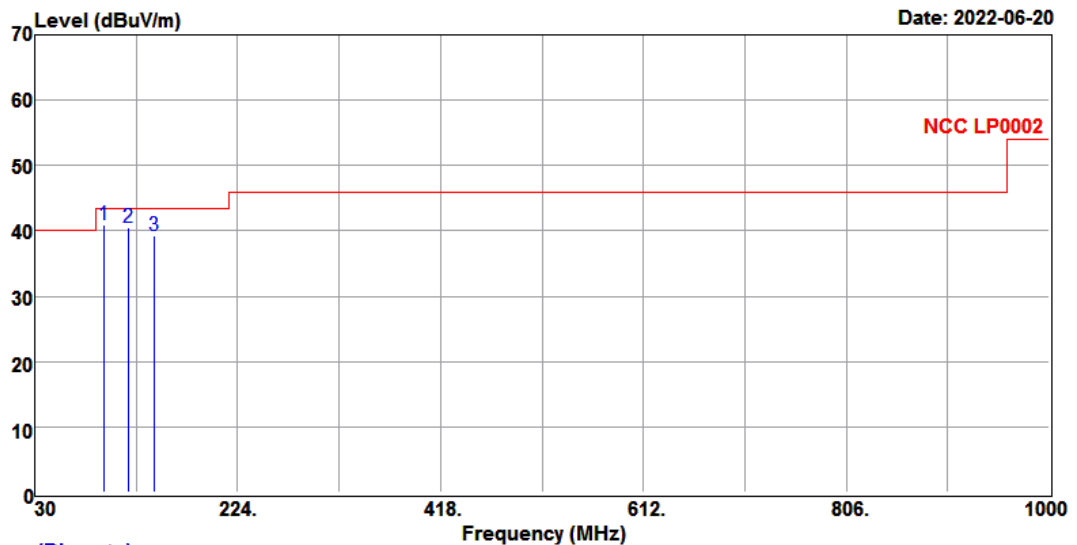
Test Range : 30 MHz ~1 GHz

Polarization : Horizontal

Tester : Wilson

Ambient Temperature : 23°C

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	Limit	Over	A/Pos	T/Pos		
	MHz	dBuV/m	Level	Factor	Line	Limit		Pol/Phase	Remark
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg	
1	96.005	40.84	66.61	-25.77	43.50	-2.66	302	318	HORIZONTAL QP
2	119.990	40.47	63.61	-23.14	43.50	-3.03	300	166	HORIZONTAL QP
3	144.010	39.25	60.03	-20.78	43.50	-4.25	274	216	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, 2402 MHz

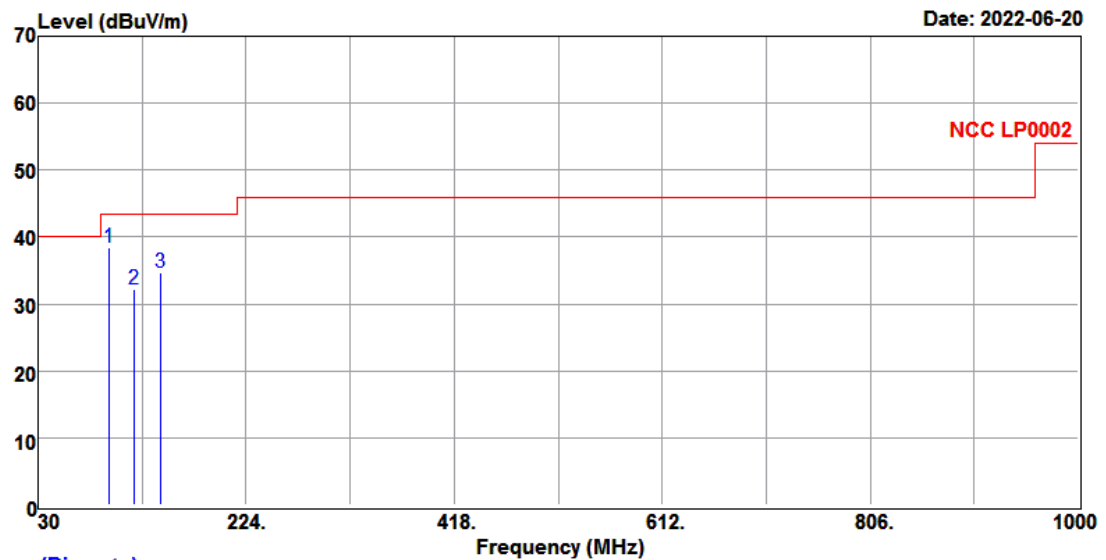
Test Range : 30 MHz ~1 GHz

Polarization : Vertical

Tester : Wilson

Ambient Temperature : 23°C

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	Limit	Over	A/Pos	T/Pos	Pol/Phase	Remark
	MHz	dBuV/m	Level	Line	Limit				
			Factor						
			dB/m	dBuV/m	dB	cm	deg		
1	96.005	38.38	64.15	-25.77	43.50	-5.12	100	87 VERTICAL	QP
2	119.990	32.30	55.44	-23.14	43.50	-11.20	106	70 VERTICAL	QP
3	144.010	34.65	55.43	-20.78	43.50	-8.85	103	275 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, 2402 MHz

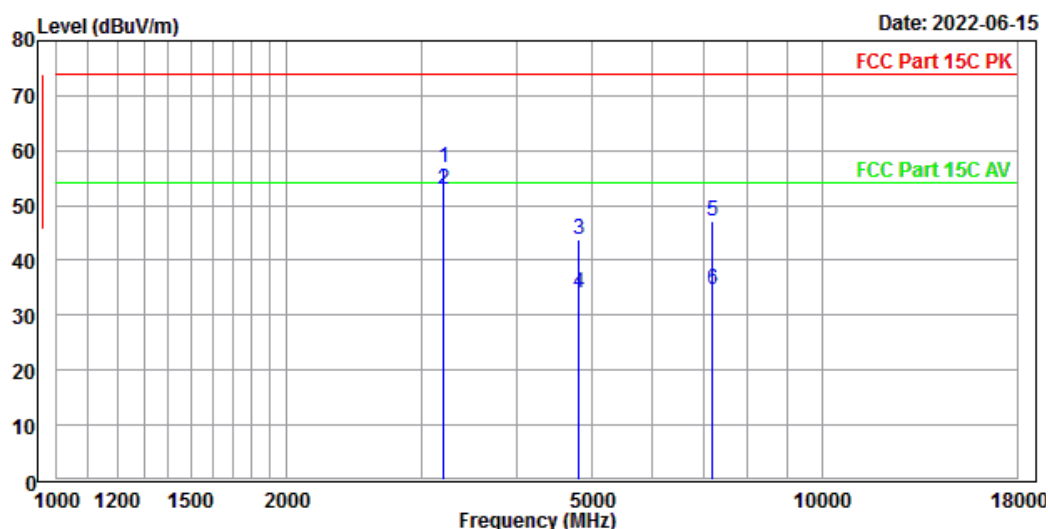
Test Range : 1 GHz ~ 25 GHz

Polarization : Horizontal

Tester : Jack

Ambient Temperature : 22°C

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	Limit	Over	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	Level	Factor	Line	Limit			
			dBuV	dB/m	dBuV/m	dB	cm	deg	
1	3202.695	56.73	71.33	-14.60	74.00	-17.27	194	131	Horizontal Peak
2	3203.267	52.84	67.44	-14.60	54.00	-1.16	190	137	Horizontal Average
3	4803.741	43.74	57.70	-13.96	74.00	-30.26	241	55	Horizontal Peak
4	4804.127	33.92	47.90	-13.98	54.00	-20.08	237	51	Horizontal Average
5	7205.578	47.10	58.13	-11.03	74.00	-26.90	288	343	Horizontal Peak
6	7206.218	34.57	45.60	-11.03	54.00	-19.43	282	339	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, 2402 MHz

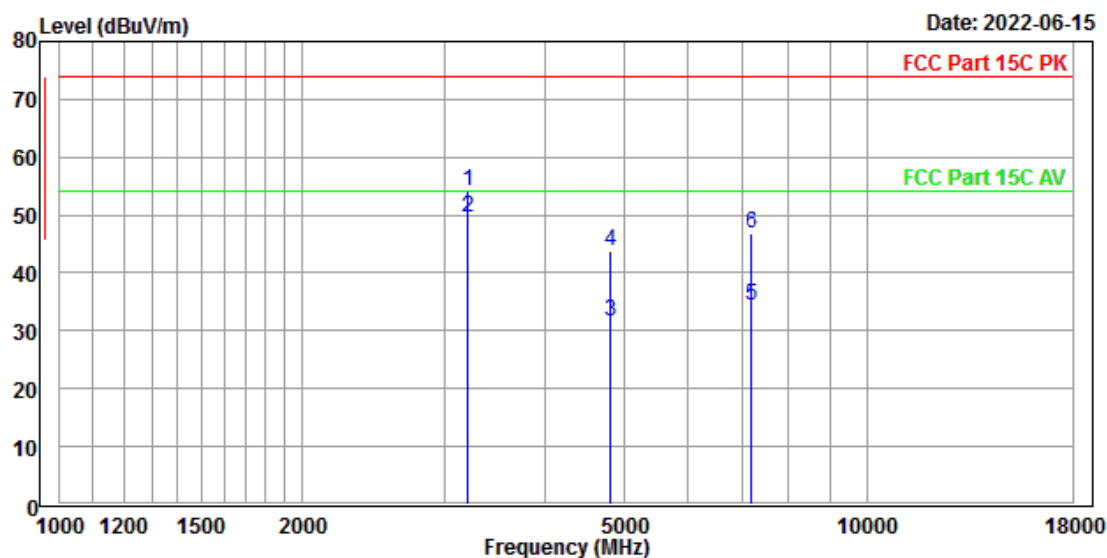
Test Range : 1 GHz ~ 25 GHz

Polarization : Vertical

Tester : Jack

Ambient Temperature : 22°C

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	Limit	Over	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	Level	Factor	Line	Limit			
			dBuV	dB/m	dBuV/m	dB	cm	deg	
1	3202.818	54.23	68.83	-14.60	74.00	-19.77	387	10	VERTICAL Peak
2	3203.418	49.45	64.05	-14.60	54.00	-4.55	393	2	VERTICAL Average
3	4803.822	31.73	45.70	-13.97	54.00	-22.27	355	189	VERTICAL Average
4	4804.248	43.75	57.73	-13.98	74.00	-30.25	351	182	VERTICAL Peak
5	7205.794	34.49	45.52	-11.03	54.00	-19.51	257	118	VERTICAL Average
6	7206.304	46.91	57.93	-11.02	74.00	-27.09	262	123	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, 2440 MHz

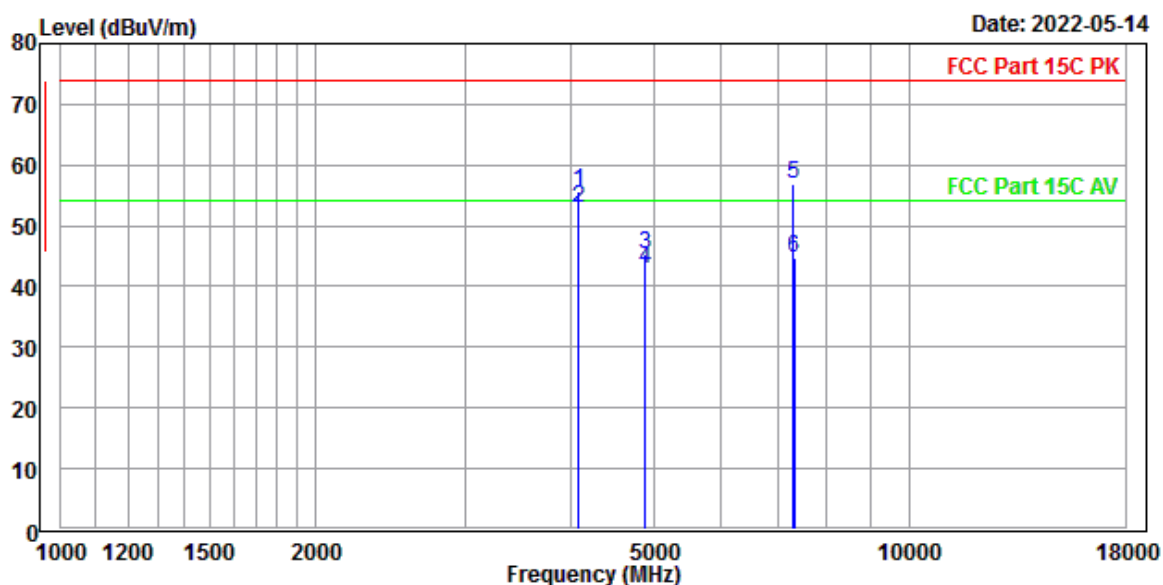
Test Range : 1 GHz ~ 25 GHz

Polarization : Horizontal

Tester : Jack

Ambient Temperature : 21°C

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	Limit	Over	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	Level	Factor	Line	Limit			
			dBuV	dB/m	dBuV/m	dB	cm	deg	
1	4066.910	55.68	70.16	-14.48	74.00	-18.32	317	185	Horizontal Peak
2	4067.517	52.85	67.32	-14.47	54.00	-1.15	312	181	Horizontal Average
3	4879.564	45.27	59.49	-14.22	74.00	-28.73	365	322	Horizontal Peak
4	4880.159	42.77	56.99	-14.22	54.00	-11.23	361	326	Horizontal Average
5	7319.641	56.98	67.91	-10.93	74.00	-17.02	248	72	Horizontal Peak
6	7320.428	44.75	55.68	-10.93	54.00	-9.25	244	67	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, 2440 MHz

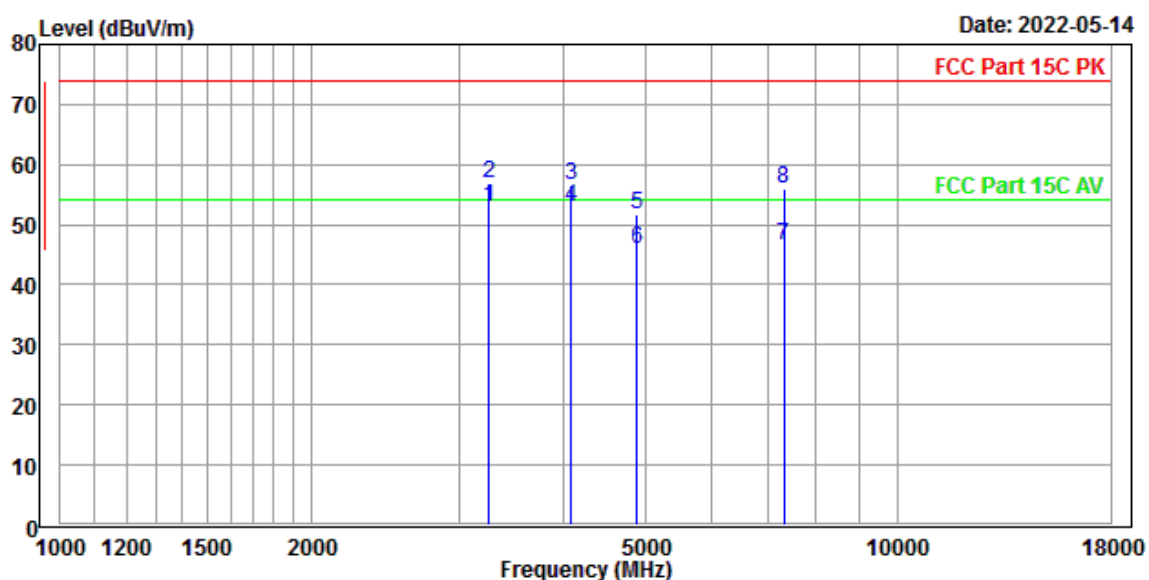
Test Range : 1 GHz ~ 25 GHz

Polarization : Vertical

Tester : Jack

Ambient Temperature : 21°C

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	Limit	Over	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	Level	Factor	Line	Limit			
			dBuV	dB/m	dBuV/m	dB	cm	deg	
1	3252.971	52.95	67.67	-14.72	54.00	-1.05	173	168 Vertical	Average
2	3253.298	56.97	71.69	-14.72	74.00	-17.03	177	160 Vertical	Peak
3	4066.809	56.59	71.07	-14.48	74.00	-17.41	188	206 Vertical	Peak
4	4067.129	52.78	67.26	-14.48	54.00	-1.22	194	202 Vertical	Average
5	4879.680	51.56	65.78	-14.22	74.00	-22.44	365	308 Vertical	Peak
6	4880.257	45.91	60.13	-14.22	54.00	-8.09	361	304 Vertical	Average
7	7319.877	46.69	57.62	-10.93	54.00	-7.31	294	213 Vertical	Average
8	7320.483	55.97	66.90	-10.93	74.00	-18.03	290	208 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, 2480 MHz

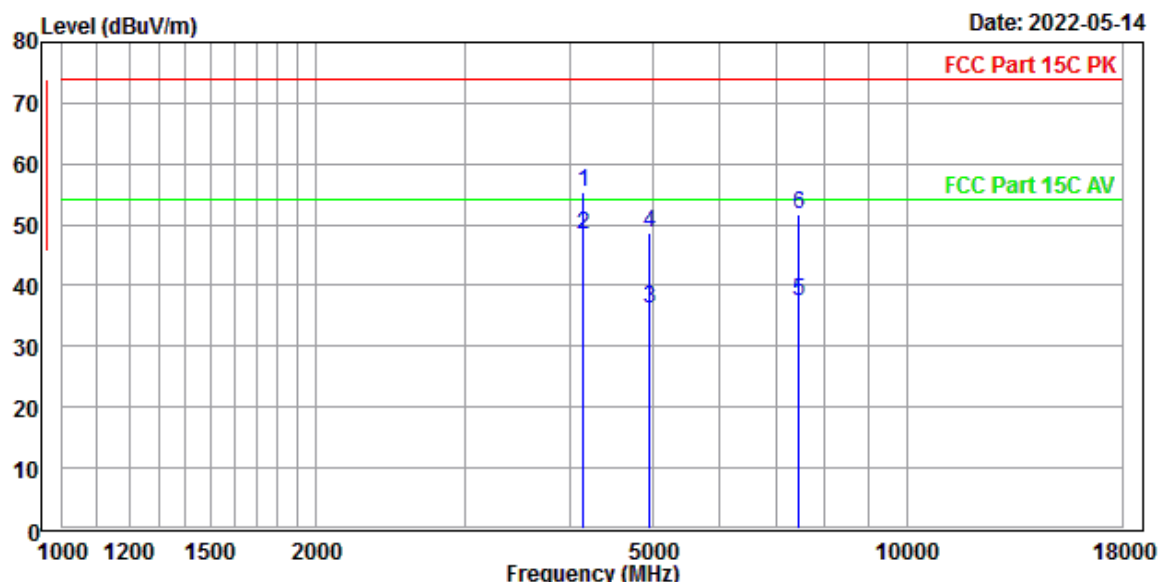
Test Range : 1 GHz ~ 25 GHz

Polarization : Horizontal

Tester : Jack

Ambient Temperature : 21°C

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	Limit	Over	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	Level	Factor	Line	Limit			
			dBuV	dB/m	dBuV/m	dB	cm	deg	
1	4133.577	55.45	69.86	-14.41	74.00	-18.55	238	135	Horizontal Peak
2	4134.297	48.46	62.87	-14.41	54.00	-5.54	234	131	Horizontal Average
3	4959.528	36.33	50.33	-14.00	54.00	-17.67	168	359	Horizontal Average
4	4960.297	48.55	62.55	-14.00	74.00	-25.45	162	355	Horizontal Peak
5	7439.872	37.38	48.03	-10.65	54.00	-16.62	281	32	Horizontal Average
6	7440.491	51.77	62.42	-10.65	74.00	-22.23	277	35	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, 2480 MHz

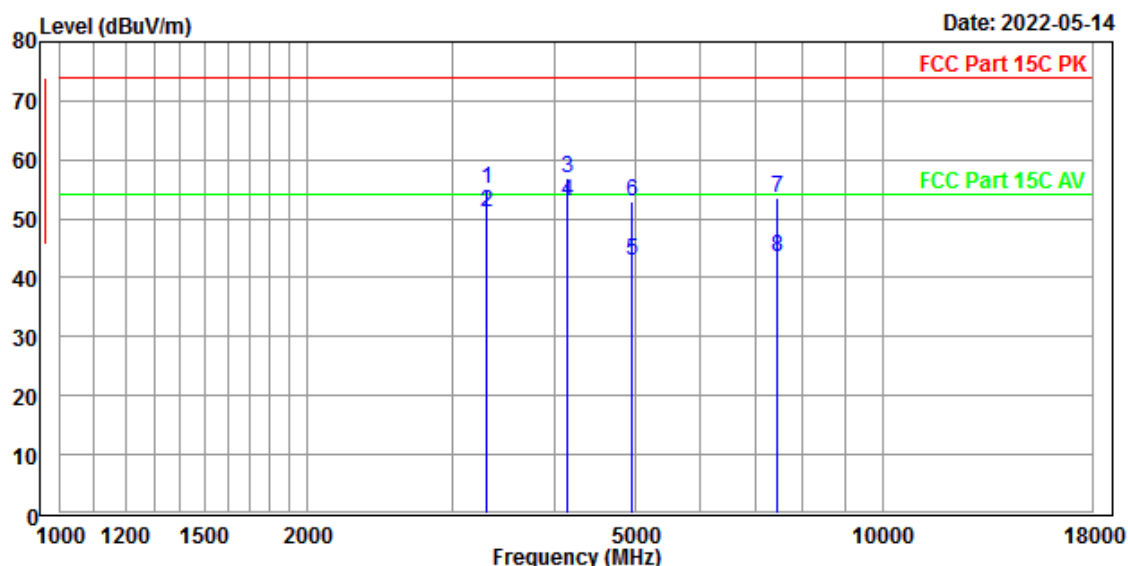
Test Range : 1 GHz ~ 25 GHz

Polarization : Vertical

Tester : Jack

Ambient Temperature : 21°C

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	Limit	Over	APos	TPos	Pol/Phase	Remark
	MHz	dBuV/m	Level	Factor	Line	Limit			
			dBuV	dB/m	dBuV/m	dB	cm	deg	
1	3306.586	55.03	69.87	-14.84	74.00	-18.97	352	237	Vertical Peak
2	3307.179	51.00	65.84	-14.84	54.00	-3.00	346	232	Vertical Average
3	4133.531	56.80	71.21	-14.41	74.00	-17.20	182	51	Vertical Peak
4	4134.110	52.88	67.29	-14.41	54.00	-1.12	186	54	Vertical Average
5	4959.897	42.80	56.80	-14.00	54.00	-11.20	204	172	Vertical Average
6	4960.493	52.78	66.78	-14.00	74.00	-21.22	208	176	Vertical Peak
7	7439.527	53.39	64.05	-10.66	74.00	-20.61	255	281	Vertical Peak
8	7440.258	43.44	54.09	-10.65	54.00	-10.56	250	286	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.

7 Line Conducted Emission Measurement

Result: Pass

7.1 Limits for Emission Measurement

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

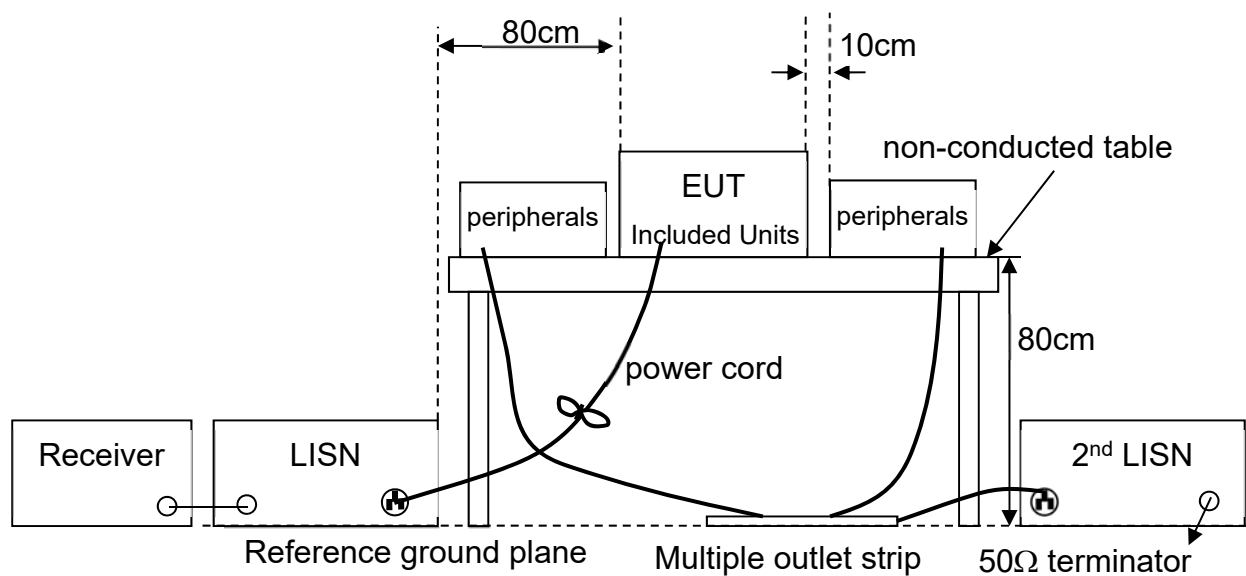
Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 - 5	56	46
5 - 30	60	50

* Decreases with the logarithm of the frequency.

7.2 Test Procedures

- 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.

7.3 Test Configurations



7.4 Test Data

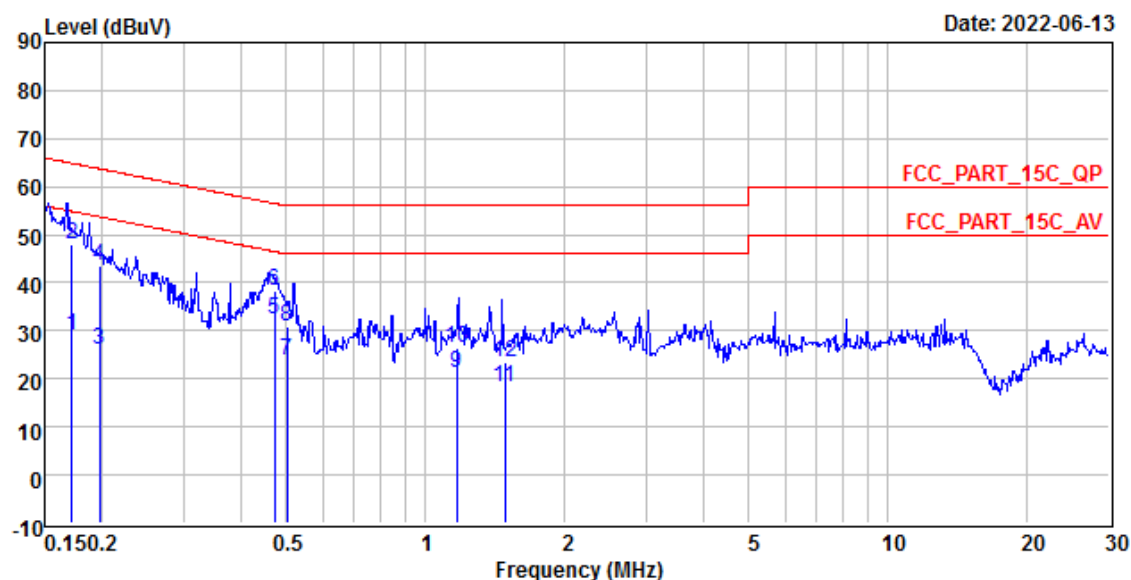
Test Mode : Continuous Transmitting, 2440 MHz

Phase : Line

Tester : David Lu

Ambient Temperature : 26°C

Relative Humidity : 70%



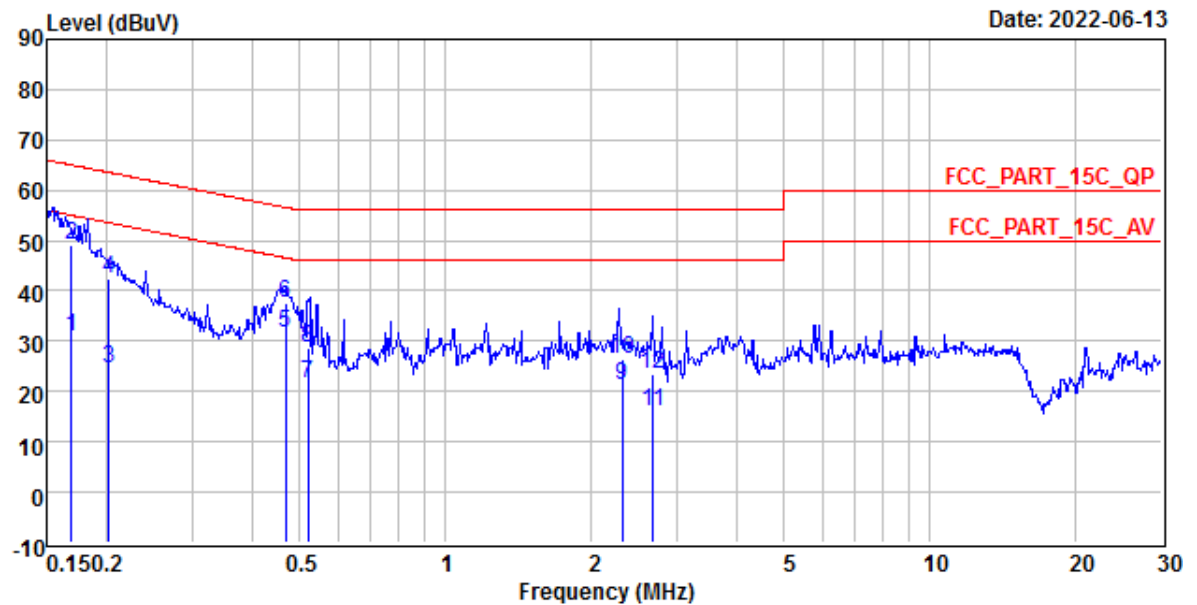
Site : TR20
 Condition : FCC_PART_15C_QP ESH2-Z5 LINE
 Power : 120V/60Hz
 Operator : David Lu T26 H70 P1006

	Freq	Level	Factor	Read	Limit	Over		
	MHz	dBuV	dB	dBuV	dBuV	dB	Pol/Phase	Remark
1	0.172	29.20	10.27	18.93	54.88	-25.68	LINE	Average
2	0.172	48.09	10.27	37.82	64.88	-16.79	LINE	QP
3	0.197	25.89	10.27	15.62	53.73	-27.84	LINE	Average
4	0.197	43.70	10.27	33.43	63.73	-20.03	LINE	QP
5	0.471	32.51	10.31	22.20	46.49	-13.98	LINE	Average
6	0.471	38.28	10.31	27.97	56.49	-18.21	LINE	QP
7	0.501	23.76	10.32	13.44	46.00	-22.24	LINE	Average
8	0.501	30.91	10.32	20.59	56.00	-25.09	LINE	QP
9	1.164	21.25	10.38	10.87	46.00	-24.75	LINE	Average
10	1.164	26.43	10.38	16.05	56.00	-29.57	LINE	QP
11	1.486	18.40	10.40	8.00	46.00	-27.60	LINE	Average
12	1.486	23.58	10.40	13.18	56.00	-32.42	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, 2440 MHz
Phase : Line **Tester** : David Lu
Ambient Temperature : 26°C **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	Limit	Over	Pol/Phase	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB		
1	0.168	30.77	10.29	20.48	55.04	-24.27	NEUTRAL	Average
2	0.168	49.12	10.29	38.83	65.04	-15.92	NEUTRAL	QP
3	0.202	24.60	10.30	14.30	53.53	-28.93	NEUTRAL	Average
4	0.202	42.49	10.30	32.19	63.53	-21.04	NEUTRAL	QP
5	0.466	31.69	10.33	21.36	46.58	-14.89	NEUTRAL	Average
6	0.466	37.61	10.33	27.28	56.58	-18.97	NEUTRAL	QP
7	0.520	21.60	10.34	11.26	46.00	-24.40	NEUTRAL	Average
8	0.520	28.53	10.34	18.19	56.00	-27.47	NEUTRAL	QP
9	2.318	21.28	10.47	10.81	46.00	-24.72	NEUTRAL	Average
10	2.318	26.50	10.47	16.03	56.00	-29.50	NEUTRAL	QP
11	2.675	15.99	10.50	5.49	46.00	-30.01	NEUTRAL	Average
12	2.675	23.30	10.50	12.80	56.00	-32.70	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.