FCC Test Report

Product Name	Bluetooth Module
Model No.	MDBT42Q-VE
FCC ID.	2A2XGMDBT42Q-VE

Applicant	Victron Energy B.V.
Address	De Paal 35 1351 JG Almere Netherlands

Date of Receipt	Dec. 14, 2020
Issued Date	May 07, 2021
Report No.	20C0497R-E3032110109
Report Version	V1.0

Testing Laboratory
3023

The test results relate only to the samples tested.
The test results shown in the test report are traceable to the national/international standard through the calibration report of the equipment and evaluated measurement uncertainty herein.
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The test report shall not be reproduced without the written approval of DEKRA Testing and Certification Co., Ltd.
Measurement uncertainties evaluated for each testing system and associated connections are given here to provide the system information for reference. Compliance determinations do not take into account measurement uncertainties for each testing system, but are based on the results of the compliance measurement.

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Product Name	Bluetooth Module
Applicant	Victron Energy B.V.
Address	De Paal 35 1351 JG Almere Netherlands
Manufacturer	Victron Energy B.V.
Model No.	MDBT42Q-VE
FCC ID.	2A2XGMDBT42Q-VE
EUT Rated Voltage	DC 3V
EUT Test Voltage	DC 3V (By test fixture)
Trade Name	Raytac
Applicable Standard	FCC CFR Title 47 Part 15 Subpart C ANSI C63.4: 2014, ANSI C63.10: 2013
Test Result	Complied

Documented By : Jinn Chen

(Senior Adm. Specialist / Jinn Chen)

Tested By : Bill Lin

(Senior Engineer / Bill Lin)

Approved By :

(Director / Vincent Lin)

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Attachment 1: EUT Test Photographs
Attachment 2: EUT Detailed Photographs

Revision History

Report No.	Version	Description	Issued Date
20C0497R-E3032110109	V1.0	Initial issue of report.	May 07, 2021

1. GENERAL INFORMATION

1.1. EUT Description

Product Name	Bluetooth Module
Trade Name	Raytac
Model No.	MDBT42Q-VE
FCC ID.	2A2XGMDBT42Q-VE
Frequency Range	2402-2480MHz
Channel Number	V4.2: 40CH
Type of Modulation	V4.2: GFSK(1Mbps)
Antenna Type	PCB Antenna
Channel Control	Auto
Antenna Gain	Refer to the table “Antenna List”

Antenna List

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	Raytac	MDBT42Q-VE	PCB Antenna	-5.36597dBi for 2.4 GHz

Note: The antenna of EUT is conforming to FCC 15.203.

Center Frequency of Each Channel: (For V4.2)

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 00:	2402 MHz	Channel 01:	2404 MHz	Channel 02:	2406 MHz	Channel 03:	2408 MHz
Channel 04:	2410 MHz	Channel 05:	2412 MHz	Channel 06:	2414 MHz	Channel 07:	2416 MHz
Channel 08:	2418 MHz	Channel 09:	2420 MHz	Channel 10:	2422 MHz	Channel 11:	2424 MHz
Channel 12:	2426 MHz	Channel 13:	2428 MHz	Channel 14:	2430 MHz	Channel 15:	2432 MHz
Channel 16:	2434 MHz	Channel 17:	2436 MHz	Channel 18:	2438 MHz	Channel 19:	2440 MHz
Channel 20:	2442 MHz	Channel 21:	2444 MHz	Channel 22:	2446 MHz	Channel 23:	2448 MHz
Channel 24:	2450 MHz	Channel 25:	2452 MHz	Channel 26:	2454 MHz	Channel 27:	2456 MHz
Channel 28:	2458 MHz	Channel 29:	2460 MHz	Channel 30:	2462 MHz	Channel 31:	2464 MHz
Channel 32:	2466 MHz	Channel 33:	2468 MHz	Channel 34:	2470 MHz	Channel 35:	2472 MHz
Channel 36:	2474 MHz	Channel 37:	2476 MHz	Channel 38:	2478 MHz	Channel 39:	2480 MHz

Note:

1. The EUT is a Bluetooth Module with built-in Bluetooth V4.2 transceiver.
2. These tests were conducted on a sample for the purpose of demonstrating compliance of Bluetooth V4.2 transmitter with Part 15 Subpart C Paragraph 15.247 for spread spectrum devices.
3. Regarding to the operation frequency, the lowest, middle and highest frequency are selected to perform the test.

Test Mode	Mode 1: Transmit

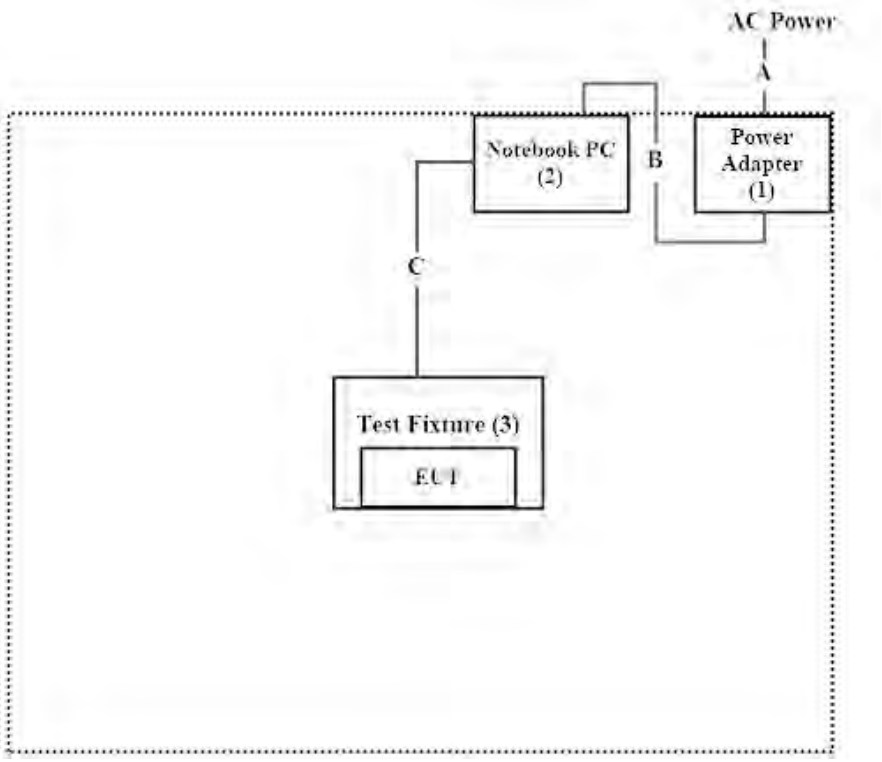
1.2. Tested System Details

The types for all equipment, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product		Manufacturer	Model No.	Serial No.	Power Cord
1	Power Adapter	DELL	LA90M130	N/A	N/A
2	Notebook PC	Dell	Latitude 5501	8JHGL13	Non-shielded, 0.8m
3	Test Fixture	Raytac	01-M404A-A02	N/A	N/A

Signal Cable Type		Signal cable Description
A	Power Cable	Non-shielded, 1.8m
B	Power Cable	Non-shielded, 1.8m
C	USB Cable	Shielded, 1.8m

1.3. Configuration of Tested System



1.4. EUT Exercise Software

(1) Setup the EUT as shown in Section 1.3.

(2) Press the Test Fixture button, switch channel.

(3) Configure the test mode, the test channel, and the data rate.

(4) Verify that the EUT works properly.

1.5. Test Facility

Ambient conditions in the laboratory:

Performed Item	Items	Required	Actual
Conducted Emission	Temperature (°C)	10~40 ℃	24.3 ℃
	Humidity (%RH)	10~90 %	60.2 %
Radiated Emission	Temperature (°C)	10~40 ℃	20.5 ℃
	Humidity (%RH)	10~90 %	60.6 %
Conductive	Temperature (°C)	10~40 ℃	22 ℃
	Humidity (%RH)	10~90 %	55 %

USA : FCC Registration Number: TW0023

Canada : IC Registration Number: 25880

Site Description : Accredited by TAF
Accredited Number: 3023

Test Laboratory : DEKRA Testing and Certification Co., Ltd
Address : No.159, Sec. 2, Wenhua 1st Rd., Linkou Dist.,
New Taipei City 24457, Taiwan, R.O.C.
Phone number : 886-2-2602-7968
Fax number : 866-2-2602-3286
Email address : info.tw@dekra.com
Website : http://www.dekra.com.tw

1.6. List of Test Equipment

For Conduction measurements /ASR1

	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due. Date
X	EMI Test Receiver	R&S	ESR7	101601	2021.01.04	2022.01.03
X	Two-Line V-Network	R&S	ENV216	101306	2021.04.08	2022.04.07
X	Two-Line V-Network	R&S	ENV216	101307	2021.04.17	2022.04.16
X	Coaxial Cable	DEKRA	RG400_BNC	RF001	2020.05.24	2021.05.23

Note:
1. All equipments are calibrated every one year.
2. The test instruments marked with "X" are used to measure the final test results.
3. Test Software version : DEKRA Testing System V2.0

For Conducted measurements /ASR2

	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due. Date
X	Spectrum Analyzer	R&S	FSV30	103466	2020.12.28	2021.12.17
X	Spectrum Analyzer	Keysight	N9030B	MY56320509	2020/08/10	2021/08/09
X	Power Meter	KEYSIGHT	8900B	MY51000539	2020.05.13	2021.05.12
X	Power Sensor	KEYSIGHT	N1923A	MY59240002	2020.05.22	2021.05.21
X	Power Sensor	KEYSIGHT	N1923A	MY59240003	2020.05.22	2021.05.21

Note:
1. All equipments are calibrated every one year.
2. The test instruments marked with "X" are used to measure the final test results.
3. Test Software version : DEKRA Conduction Test System V9.0.5.

For Radiated measurements /ACB1

	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due. Date
X	Loop Antenna	AMETEK	HLA6121	49611	2021.04.14	2022.04.13
X	Bi-Log Antenna	SCHWARZBECK	VULB9168	9168-675	2020.07.20	2021.07.19
X	Horn Antenna	ETS-Lindgren	3117	00201366	2020.09.21	2021.09.20
X	Horn Antenna	Com-Power	AH-840	101088	2020.09.11	2021.09.10
X	Pre-Amplifier	EMCI	EMC001330	980301	2020.06.04	2021.06.03
X	Pre-Amplifier	EMCI	EMC051845SE	980632	2020.08.21	2021.08.20
X	Pre-Amplifier	EMCI	EMC05820SE	980308	2020.09.18	2021.09.17
X	Pre-Amplifier	EMCI	EMC184045SE	980314	2020.06.10	2021.06.09
X	Filter	MICRO TRONICS	BRM50702	G251	2020.09.17	2021.09.16
	Filter	MICRO TRONICS	BRM50716	G188	2020.09.17	2021.09.16
X	EMI Test Receiver	R&S	ESR7	101601	2020.05.21	2021.05.20
X	Spectrum Analyzer	R&S	FSV40	101894	2021.03.10	2022.03.09
X	Coaxial Cable	SUHNER	SUCOFLEX 106	RF002	2020.07.03	2021.07.02
X	Mircoflex Cable	HUBER SUHNER	SUCOFLEX 102	MY3381/2	2020.06.10	2021.06.09

Note:
1. Loop Antenna is calibrated every two years, the other equipments are calibrated every one year.
2. The test instruments marked with "X" are used to measure the final test results.
3. Test Software version : DEKRA Testing System V2.0

1.7. Uncertainty

Uncertainties have been calculated according to the DEKRA internal document, and is described in each test chapter of this report.

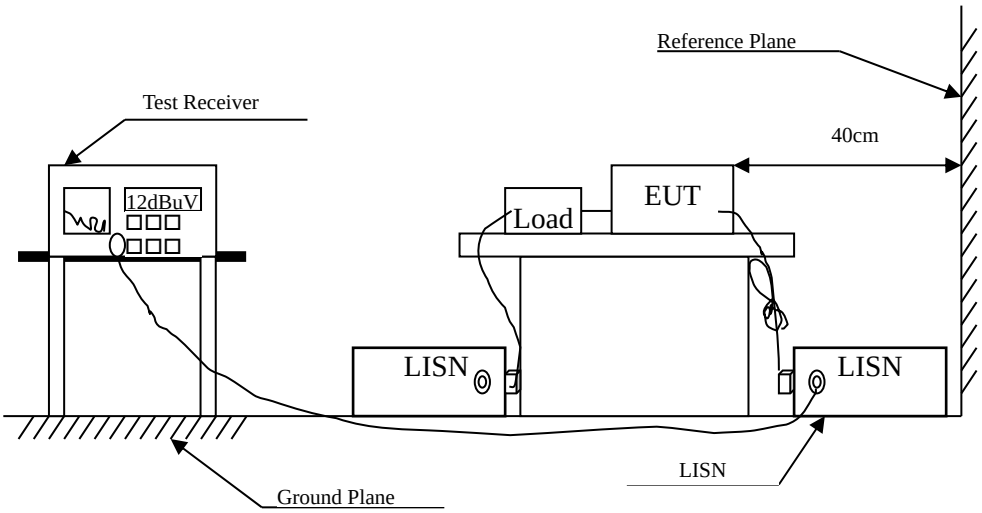
The reported expanded uncertainties are based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Measurement uncertainties evaluated for each testing system and associated connections are given here to provide the system information for reference. Compliance determinations do not take into account measurement uncertainties for each testing system, but are based on the results of the compliance measurement.

Test item	**Uncertainty**	
Conducted Emission	±3.42 dB	
Peak Power Output	±0.91 dB	
Radiated Emission	Under 1GHz ±4.06 dB	Above 1GHz ±3.73 dB
RF Antenna Conducted Test	±2.53 dB	
Band Edge	Under 1GHz ±4.06 dB	Above 1GHz ±3.73 dB
6dB Bandwidth	±682.83 Hz	
Power Density	±2.53 dB	
Duty Cycle	±2.31 ms	

2. Conducted Emission

2.1. Test Setup



2.2. Limits

FCC Part 15 Subpart C Paragraph 15.207 (dBuV) Limit		
Frequency MHz	Limits	
	QP	AV
0.15 - 0.50	66-56	56-46
0.50-5.0	56	46
5.0 - 30	60	50

Remarks: In the above table, the tighter limit applies at the band edges.

2.3. Test Procedure

The EUT and Peripherals are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm /50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs.)

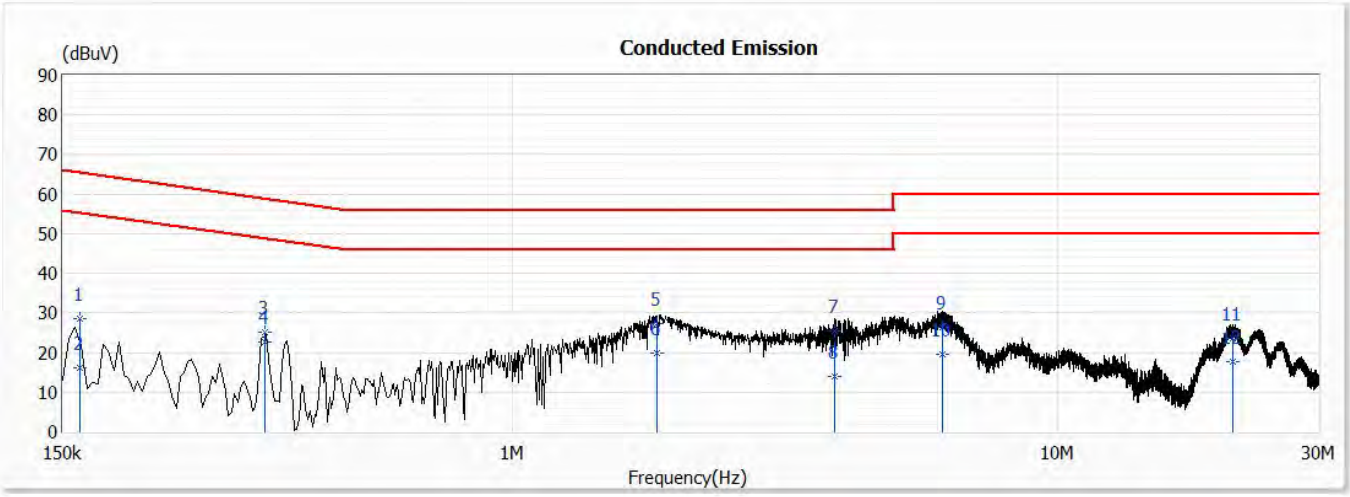
Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all the interface cables must be changed according to ANSI C63.4: 2014 on conducted measurement.

Conducted emissions were invested over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9kHz.

The EUT was setup to ANSI C63.4, 2014; tested to DTS test procedure of FCC KDB-558074 for compliance to FCC 47CFR Subpart C requirements.

2.4. Test Result of Conducted Emission

Product : Bluetooth Module
Test Item : Conducted Emission Test
Power Line : L 1
Test Mode : Mode 1: Transmit (2442MHz)
Test Date : 2021/05/04

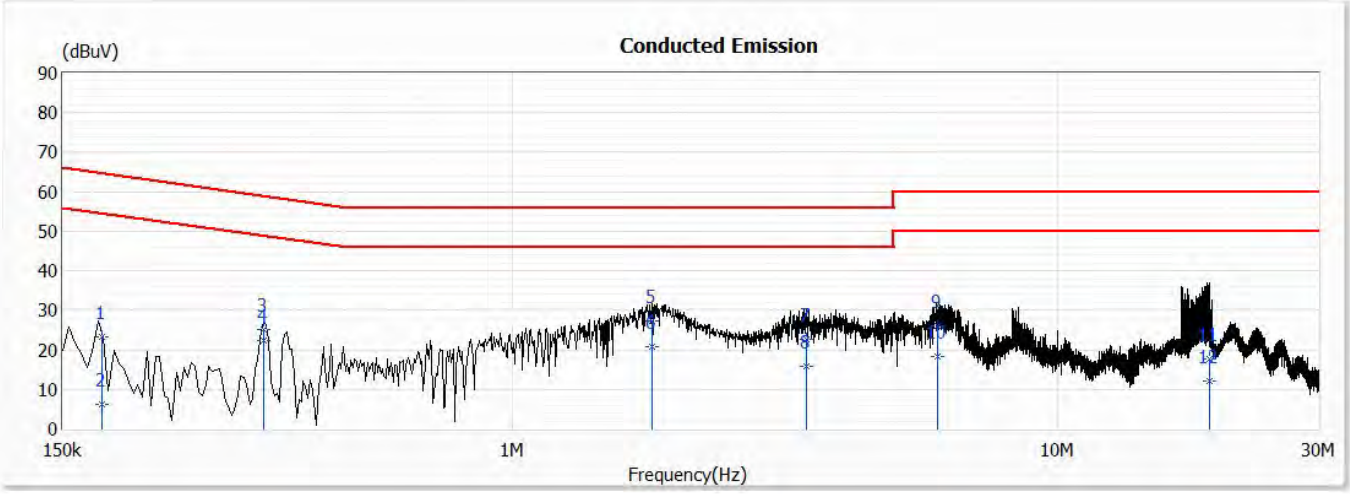


No	Frequency (MHz)	Emission Level (dBuV)	Limit (dBuV)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	0.161	28.57	65.41	-36.83	18.92	9.66	QP
2	0.161	16.18	55.41	-39.23	6.52	9.66	AV
3	0.351	25.16	58.93	-33.77	15.51	9.66	QP
4	0.351	22.69	48.93	-26.24	13.03	9.66	AV
5	1.836	27.39	56.00	-28.61	17.68	9.72	QP
*6	1.836	19.79	46.00	-26.21	10.07	9.72	AV
7	3.894	25.46	56.00	-30.54	15.70	9.77	QP
8	3.894	14.00	46.00	-32.00	4.23	9.77	AV
9	6.140	26.37	60.00	-33.63	16.55	9.82	QP
10	6.140	19.54	50.00	-30.46	9.72	9.82	AV
11	20.900	23.48	60.00	-36.52	13.51	9.97	QP
12	20.900	17.81	50.00	-32.19	7.84	9.97	AV

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. “ * “ means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

Product	:	Bluetooth Module
Test Item	:	Conducted Emission Test
Power Line	:	N
Test Mode	:	Mode 1: Transmit (2442MHz)
Test Date	:	2021/05/04



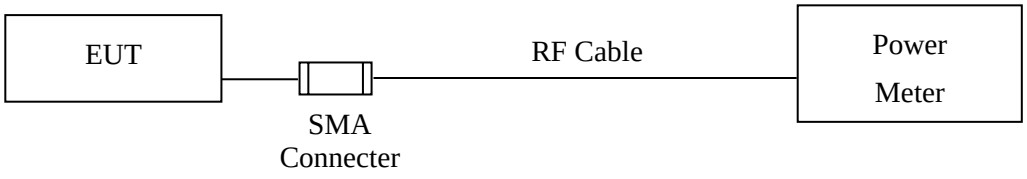
No	Frequency (MHz)	Emission Level (dBuV)	Limit (dBuV)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	0.177	23.29	64.61	-41.32	13.62	9.67	QP
2	0.177	6.09	54.61	-48.52	-3.58	9.67	AV
3	0.351	25.09	58.94	-33.85	15.42	9.67	QP
4	0.351	22.50	48.94	-26.43	12.84	9.67	AV
5	1.805	27.40	56.00	-28.60	17.68	9.72	QP
*6	1.805	20.88	46.00	-25.12	11.16	9.72	AV
7	3.456	22.66	56.00	-33.34	12.90	9.77	QP
8	3.456	15.97	46.00	-30.03	6.20	9.77	AV
9	5.996	26.17	60.00	-33.83	16.34	9.83	QP
10	5.996	18.42	50.00	-31.58	8.59	9.83	AV
11	18.933	17.57	60.00	-42.43	7.54	10.03	QP
12	18.933	12.06	50.00	-37.94	2.02	10.03	AV

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. “ * “ means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

3. Peak Power Output

3.1. Test Setup



3.2. Limit

The maximum peak power shall be less 1Watt.

3.3. Test Procedure

The EUT was tested according to C63.10:2013 for compliance to FCC 47CFR 15.247 requirements. The maximum peak conducted output power using C63.10:2013 Section 11.9.1.3 PKPM1 Peak power meter method.

3.4. Test Result of Peak Power Output

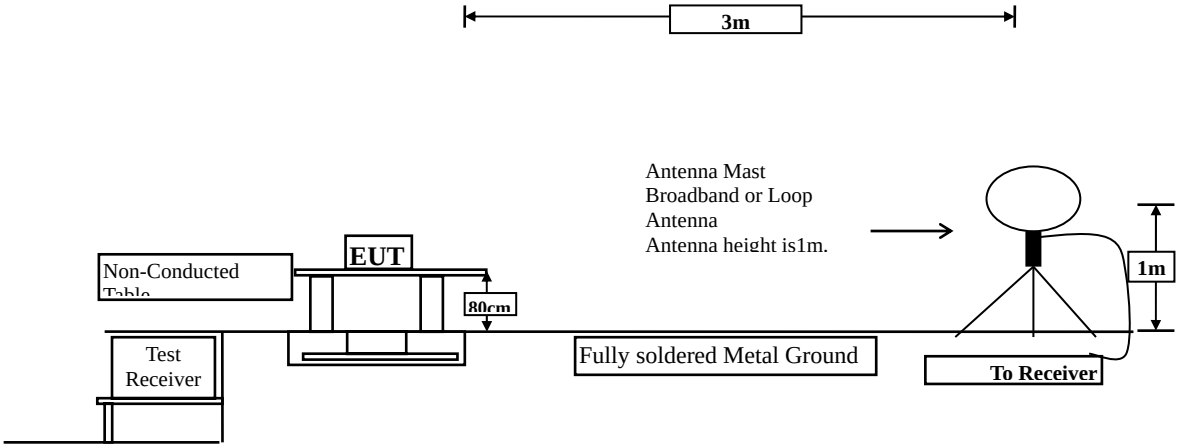
Product : Bluetooth Module
Test Item : Peak Power Output
Test Mode : Mode 1: Transmit
Test Date : 2021/01/15

Channel No.	Frequency (MHz)	Measurement (dBm)	Required Limit	Result
Channel 00	2402	2.40	1 Watt= 30 dBm	Pass
Channel 20	2442	2.32	1 Watt= 30 dBm	Pass
Channel 39	2480	2.33	1 Watt= 30 dBm	Pass

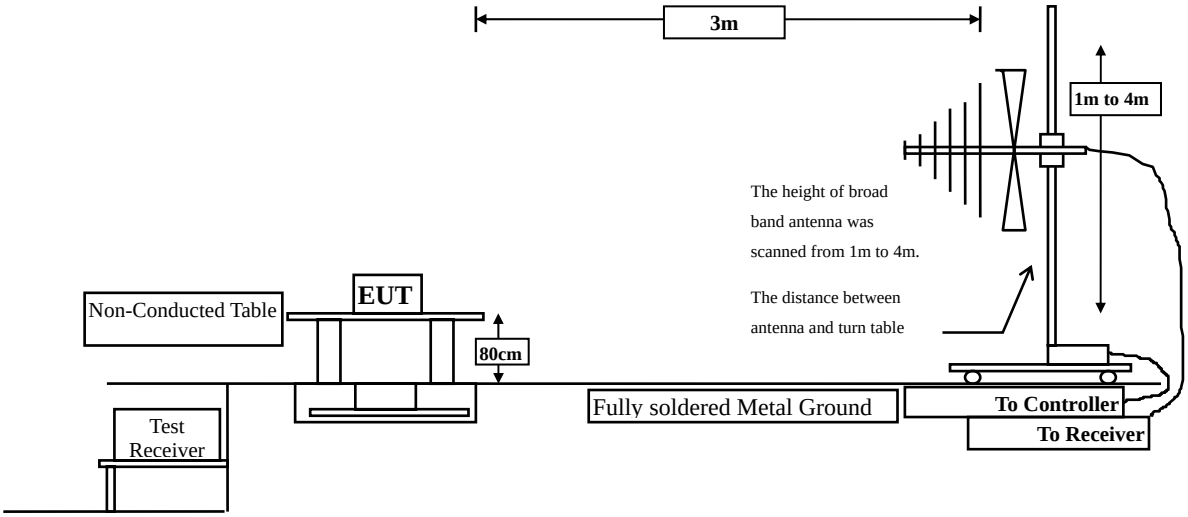
4. Radiated Emission

4.1. Test Setup

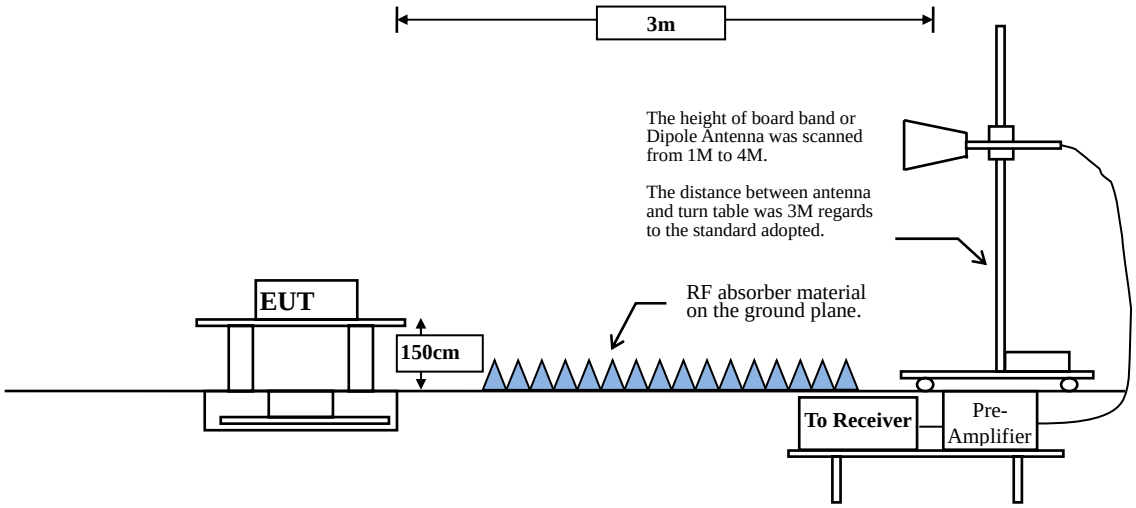
Radiated Emission Under 30MHz



Radiated Emission Below 1GHz



Radiated Emission Above 1GHz



4.2. Limits

➢ **General Radiated Emission Limits**

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

FCC Part 15 Subpart C Paragraph 15.209 Limits		
Frequency MHz	Field strength (microvolts/meter)	Measurement distance (meter)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remarks:
1. RF Voltage (dBuV) = 20 log RF Voltage (uV)
2. In the Above Table, the tighter limit applies at the band edges.
3. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

4.3. Test Procedure

The EUT was setup according to ANSI C63.10: 2013 and tested according to C63.10:2013 Section 11.12.1 for compliance to FCC 47CFR 15.247 requirements.

Measuring the frequency range below 1GHz, the EUT is placed on a turn table which is 0.8 meter above ground,when measuring the frequency range above 1GHz, the EUT is placed on a turn table which is 1.5 meter above ground.

The turn table is rotated 360 degrees to determine the position of the maximum emission level.

The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned between 1 meter and 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10: 2013 on radiated measurement.

The resolution bandwidth below 30MHz setting on the field strength meter is 9kHz and 30MHz~1GHz is 120kHz and above 1GHz is 1MHz.

Radiated emission measurements below 30MHz are made using Loop Antenna and 30MHz~1GHz are made using broadband Bilog antenna and above 1GHz are made using Horn Antennas.

The measurement is divided into the Preliminary Measurement and the Final Measurement.

The suspected frequencies are searched for in Preliminary Measurement with the measurement antenna kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. The antenna is pointed at an angle towards the source of the emission, and the EUT is rotated in both height and polarization to maximize the measured emission. The emission is kept within the illumination area of the 3 dB bandwidth of the antenna.

The measurement frequency range form 9kHz - 10th Harmonic of fundamental was investigated.

RBW and VBW Parameter setting:

According to C63.10 Section 11.12.2.4 Peak measurement procedure.

RBW = as specified in Table 1.

VBW ≥ 3 x RBW.

Table 1 —RBW as a function of frequency

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

According to C63.10 Section 11.12.2.5 Average measurement procedure.

RBW = 1MHz.

VBW = 10Hz, when duty cycle ≥ 98 %

VBW ≥ 1/T, when duty cycle < 98 %

(T refers to the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.)

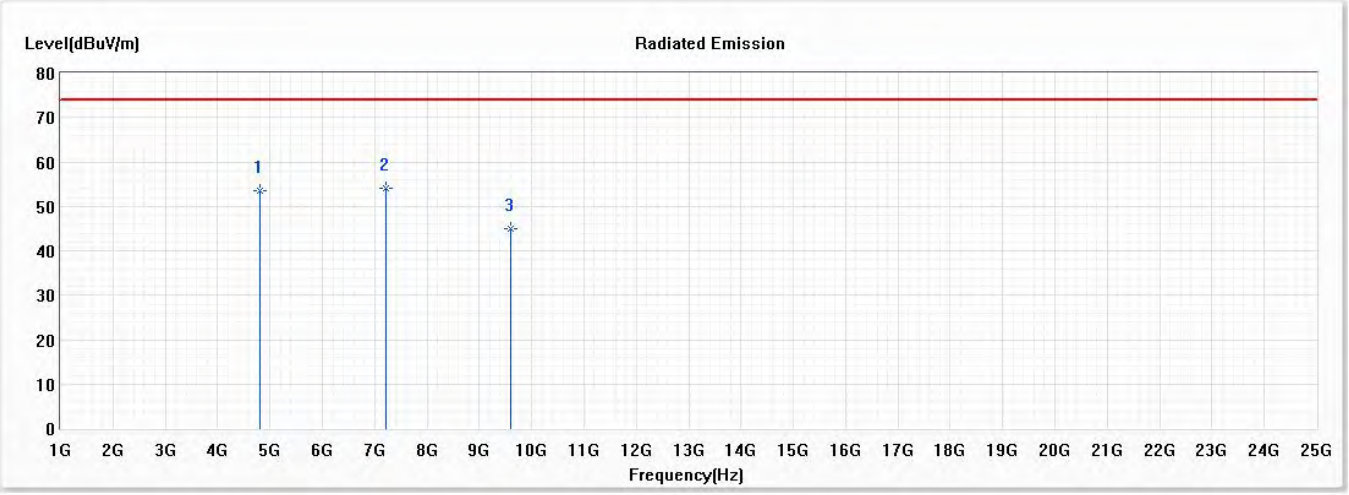
2.4GHz band	Duty Cycle (%)	T (ms)	1/T (Hz)	VBW (Hz)
BLE	8.41	0.1231	8123	10000

Note: Duty Cycle Refer to Section 9.

4.4. Test Result of Radiated Emission

Product : Bluetooth Module
Test Item : Harmonic Radiated Emission
Test Mode : Mode 1: Transmit (2402MHz)
Test Date : 2021/01/18

Horizontal



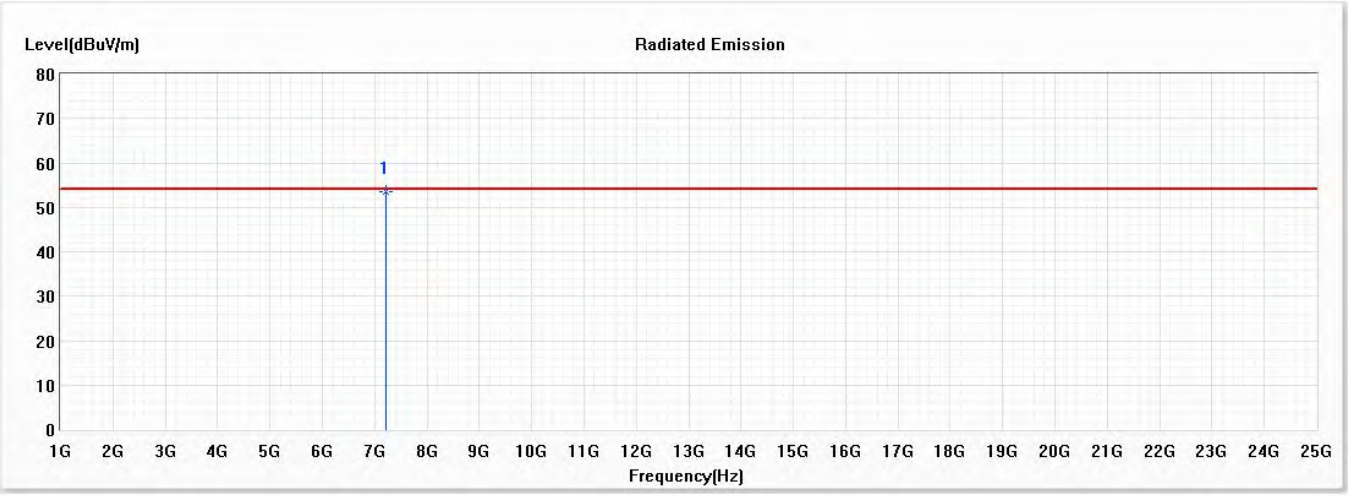
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	4804.000	53.65	74.00	-20.35	66.70	-13.05	PK
* 2	7206.000	54.17	74.00	-19.83	65.86	-11.69	PK
3	9608.000	45.06	74.00	-28.94	56.24	-11.18	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product	:	Bluetooth Module
Test Item	:	Harmonic Radiated Emission
Test Mode	:	Mode 1: Transmit (2402MHz)
Test Date	:	2021/01/18

Horizontal



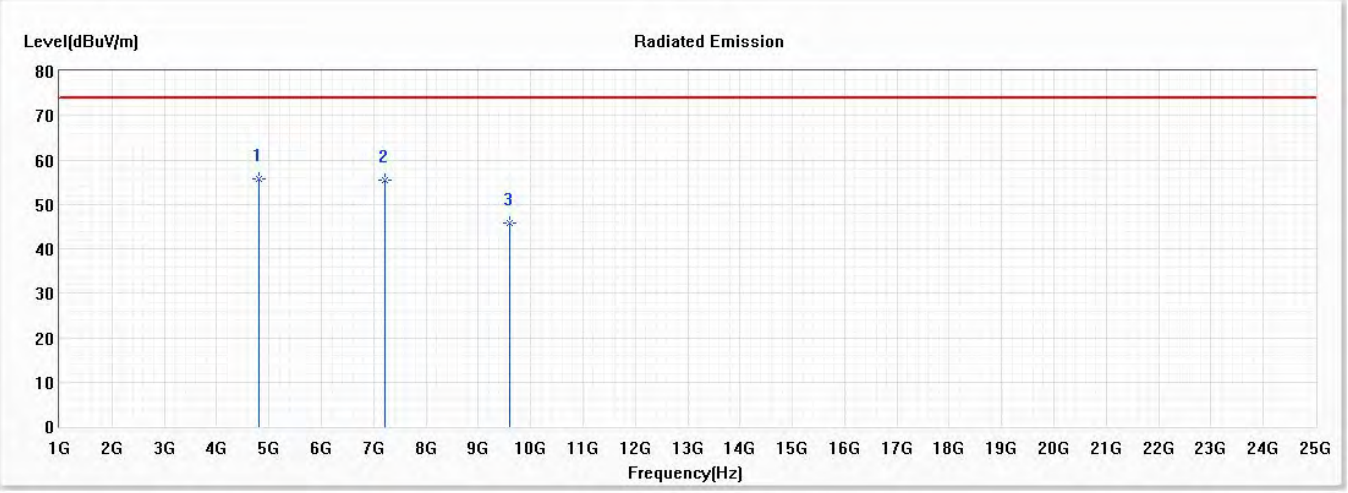
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
* 1	7206.000	53.38	54.00	-0.62	65.07	-11.69	AV

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : Bluetooth Module
Test Item : Harmonic Radiated Emission
Test Mode : Mode 1: Transmit (2402MHz)
Test Date : 2021/01/18

Vertical



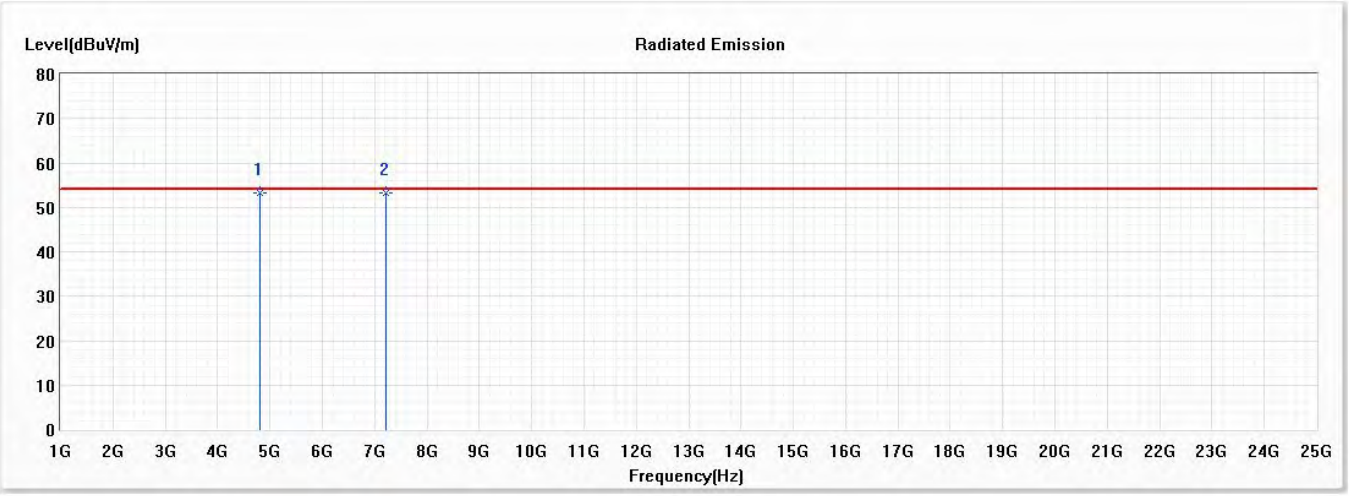
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
* 1	4804.000	55.60	74.00	-18.40	68.65	-13.05	PK
2	7206.000	55.50	74.00	-18.50	67.19	-11.69	PK
3	9608.000	45.89	74.00	-28.11	57.07	-11.18	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product	:	Bluetooth Module
Test Item	:	Harmonic Radiated Emission
Test Mode	:	Mode 1: Transmit (2402MHz)
Test Date	:	2021/01/18

Vertical



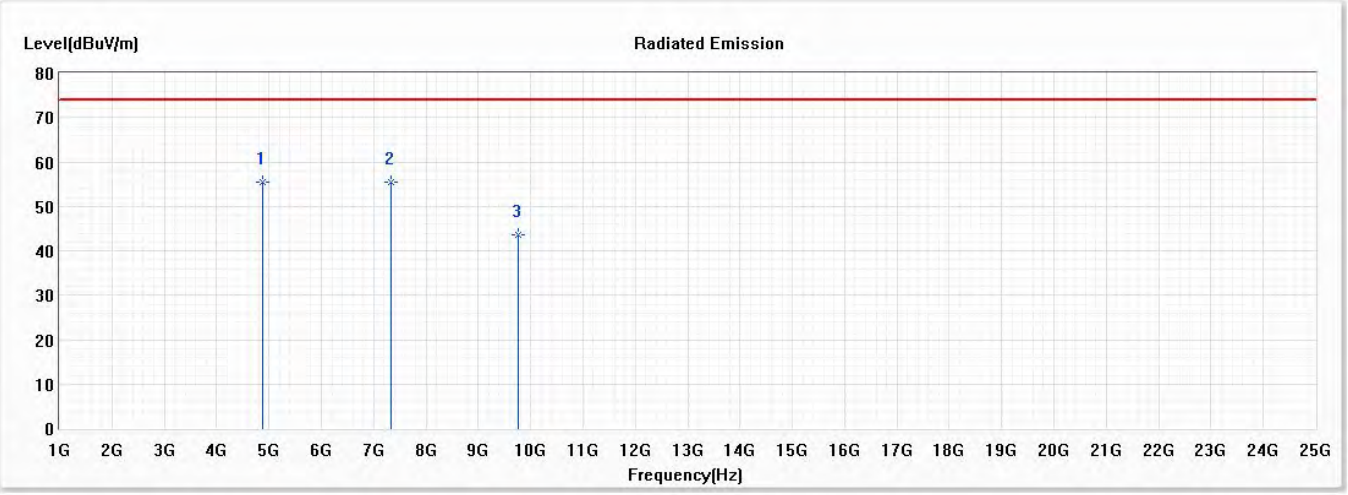
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	4804.000	53.14	54.00	-0.86	66.19	-13.05	AV
* 2	7206.000	53.36	54.00	-0.64	65.05	-11.69	AV

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : Bluetooth Module
Test Item : Harmonic Radiated Emission
Test Mode : Mode 1: Transmit (2442MHz)
Test Date : 2021/01/18

Horizontal



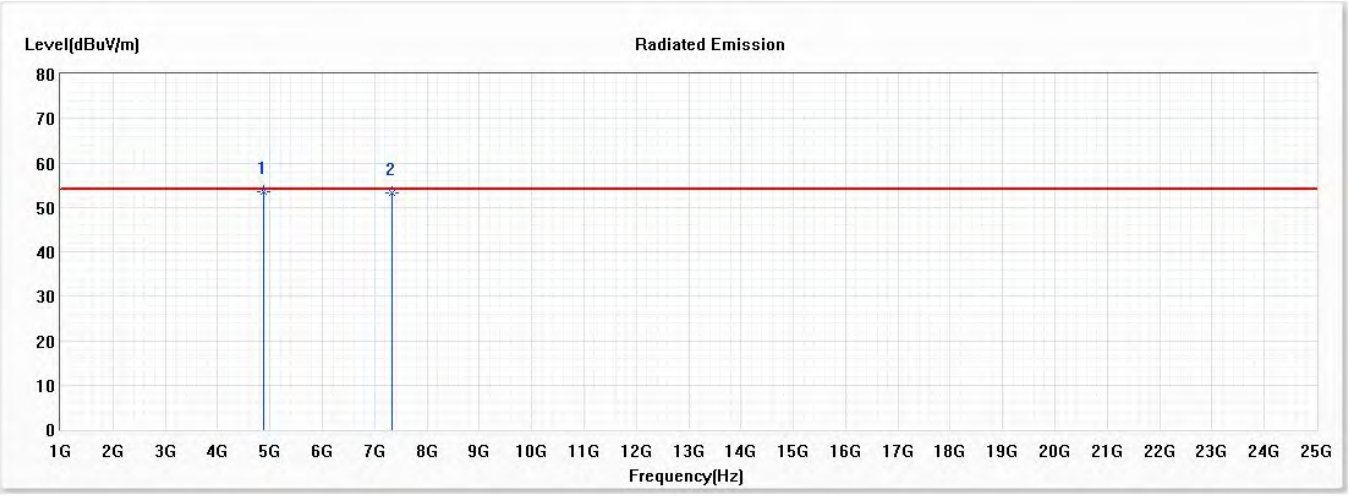
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
* 1	4884.000	55.56	74.00	-18.44	68.58	-13.02	PK
2	7326.000	55.48	74.00	-18.52	67.44	-11.96	PK
3	9768.000	43.69	74.00	-30.31	54.62	-10.93	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : Bluetooth Module
Test Item : Harmonic Radiated Emission
Test Mode : Mode 1: Transmit (2442MHz)
Test Date : 2021/01/18

Horizontal



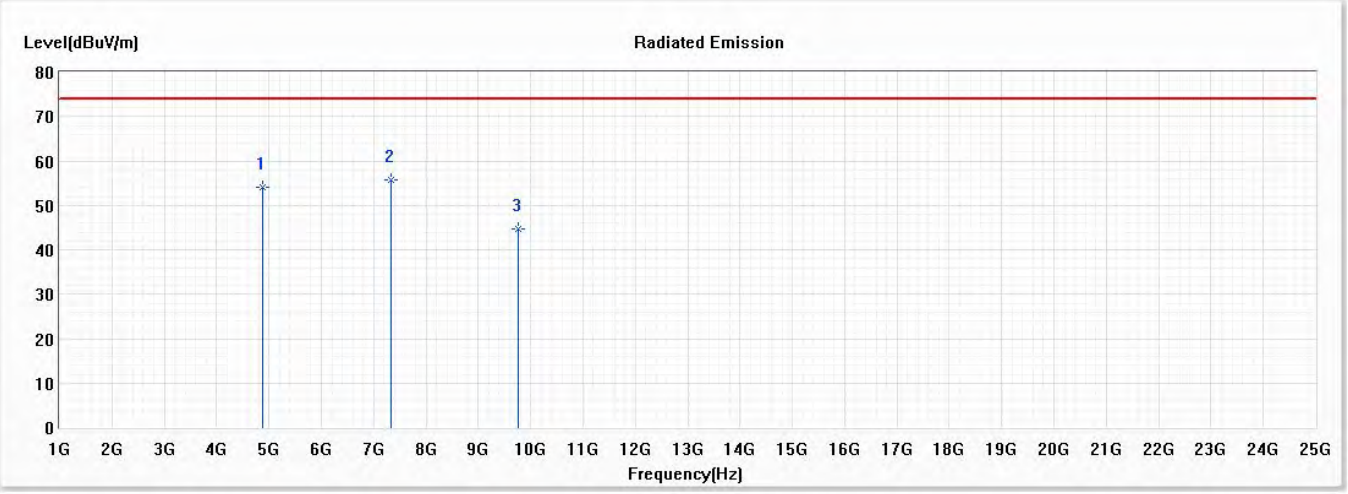
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
* 1	4884.000	53.38	54.00	-0.62	66.40	-13.02	AV
2	7326.000	53.29	54.00	-0.71	65.25	-11.96	AV

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : Bluetooth Module
Test Item : Harmonic Radiated Emission
Test Mode : Mode 1: Transmit (2442MHz)
Test Date : 2021/01/18

Vertical



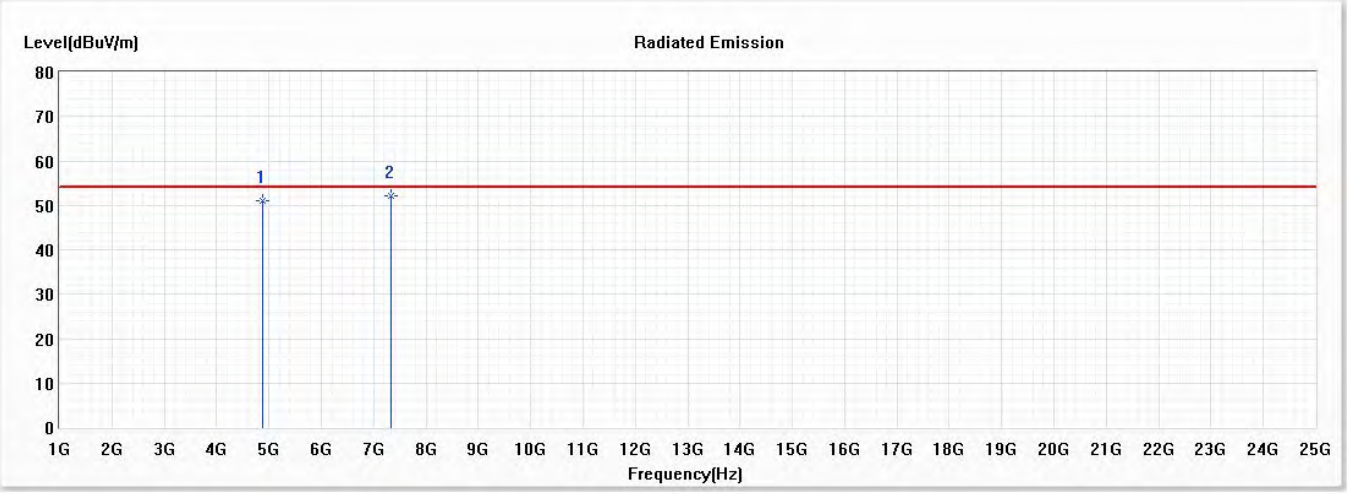
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	4884.000	54.02	74.00	-19.98	67.04	-13.02	PK
* 2	7326.000	55.77	74.00	-18.23	67.73	-11.96	PK
3	9768.000	44.61	74.00	-29.39	55.54	-10.93	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product	:	Bluetooth Module
Test Item	:	Harmonic Radiated Emission
Test Mode	:	Mode 1: Transmit (2442MHz)
Test Date	:	2021/01/18

Vertical



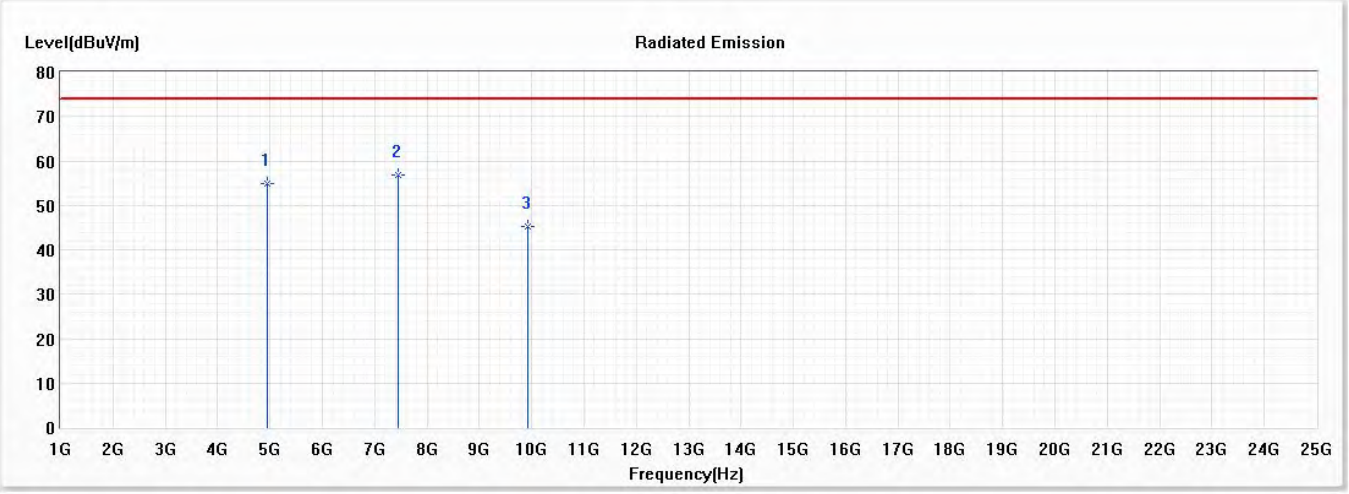
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	4884.000	51.12	54.00	-2.88	64.14	-13.02	AV
* 2	7326.000	52.07	54.00	-1.93	64.03	-11.96	AV

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product	:	Bluetooth Module
Test Item	:	Harmonic Radiated Emission
Test Mode	:	Mode 1: Transmit (2480MHz)
Test Date	:	2021/01/18

Horizontal



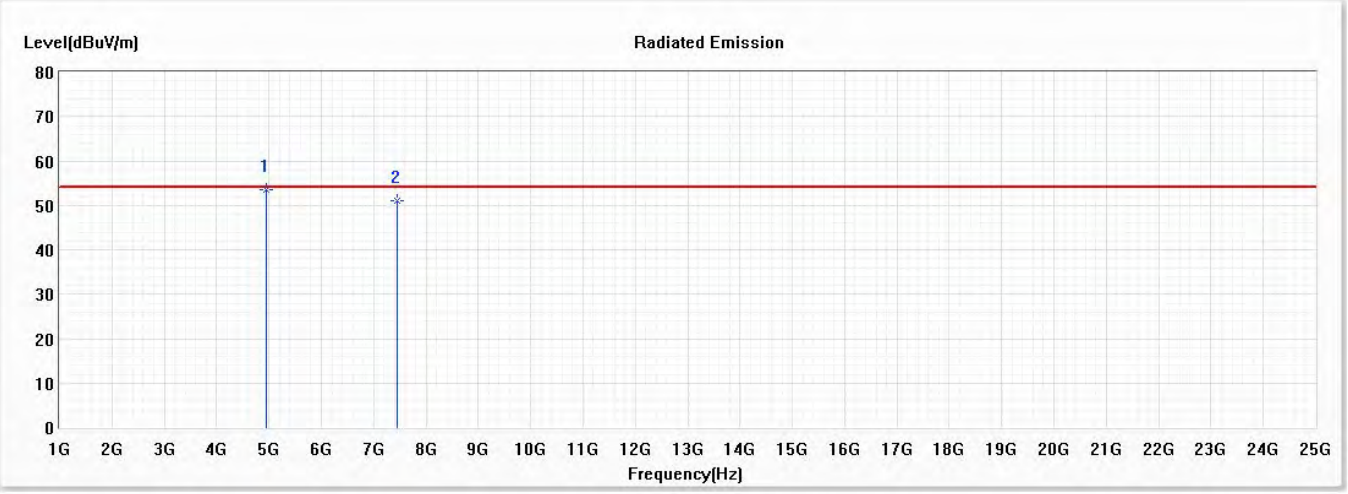
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	4960.000	55.03	74.00	-18.97	67.74	-12.71	PK
* 2	7440.000	56.69	74.00	-17.31	68.77	-12.08	PK
3	9920.000	45.26	74.00	-28.74	56.13	-10.87	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product	:	Bluetooth Module
Test Item	:	Harmonic Radiated Emission
Test Mode	:	Mode 1: Transmit (2480MHz)
Test Date	:	2021/01/18

Horizontal



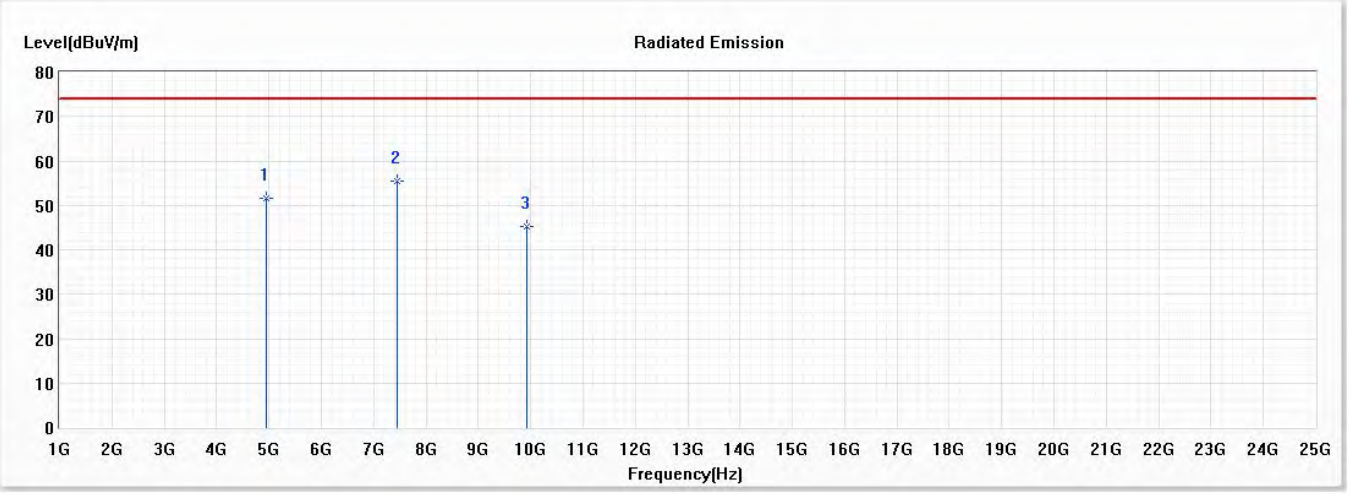
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
* 1	4960.000	53.46	54.00	-0.54	66.17	-12.71	AV
2	7440.000	50.92	54.00	-3.08	63.00	-12.08	AV

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : Bluetooth Module
Test Item : Harmonic Radiated Emission
Test Mode : Mode 1: Transmit (2480MHz)
Test Date : 2021/01/18

Vertical



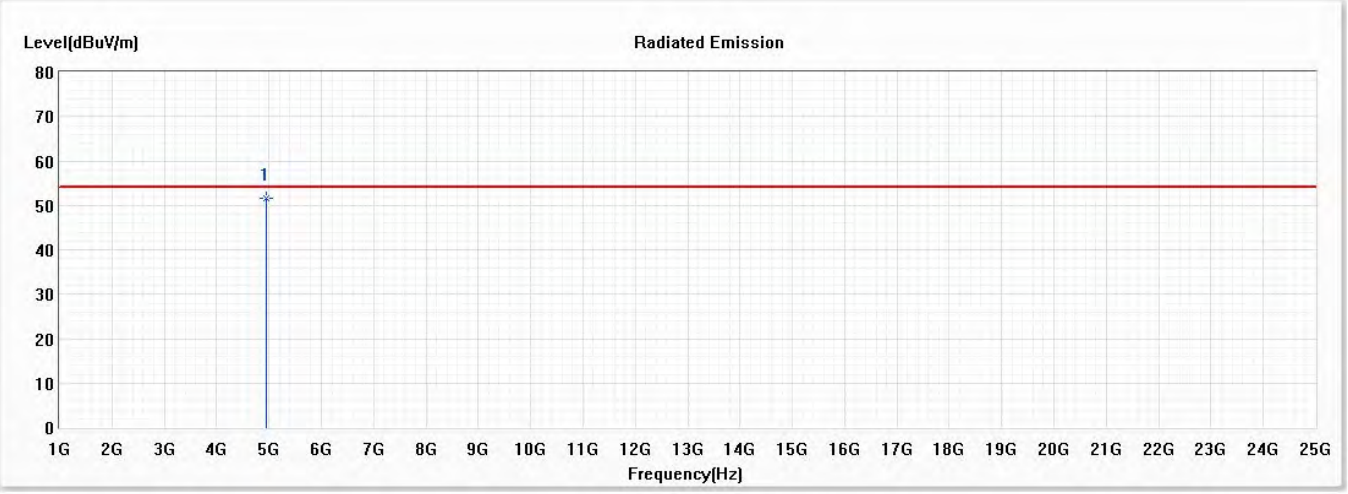
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	4960.000	51.51	74.00	-22.49	64.22	-12.71	PK
* 2	7440.000	55.33	74.00	-18.67	67.41	-12.08	PK
3	9920.000	45.12	74.00	-28.88	55.99	-10.87	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product	:	Bluetooth Module
Test Item	:	Harmonic Radiated Emission
Test Mode	:	Mode 1: Transmit (2480MHz)
Test Date	:	2021/01/18

Vertical



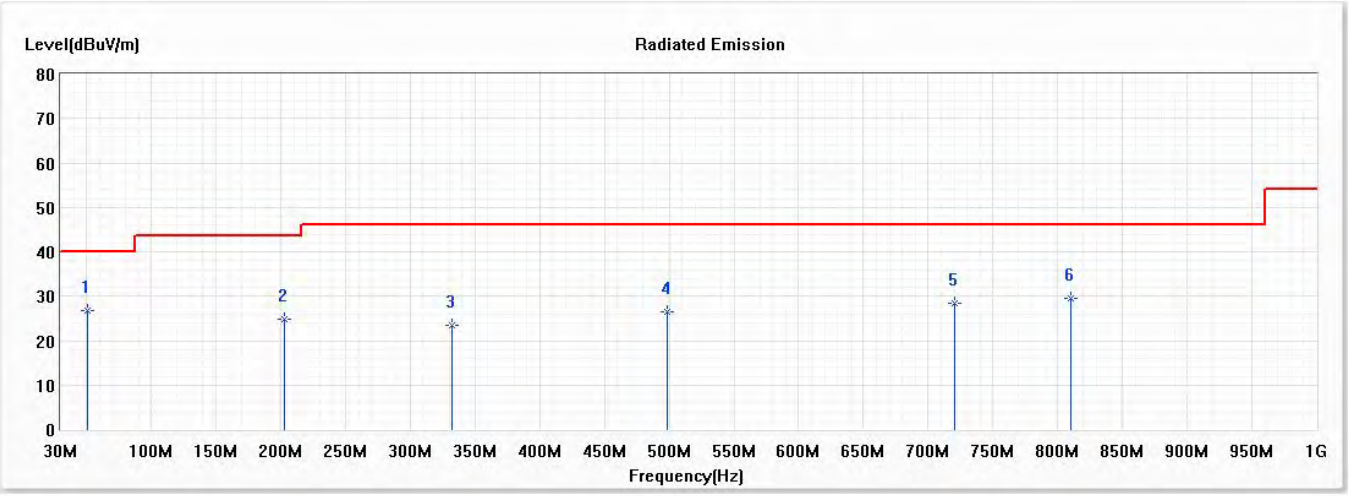
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
* 1	4960.000	51.47	54.00	-2.53	64.18	-12.71	AV

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product	:	Bluetooth Module
Test Item	:	General Radiated Emission
Test Mode	:	Mode 1: Transmit (2442MHz)
Test Date	:	2021/01/19

Horizontal



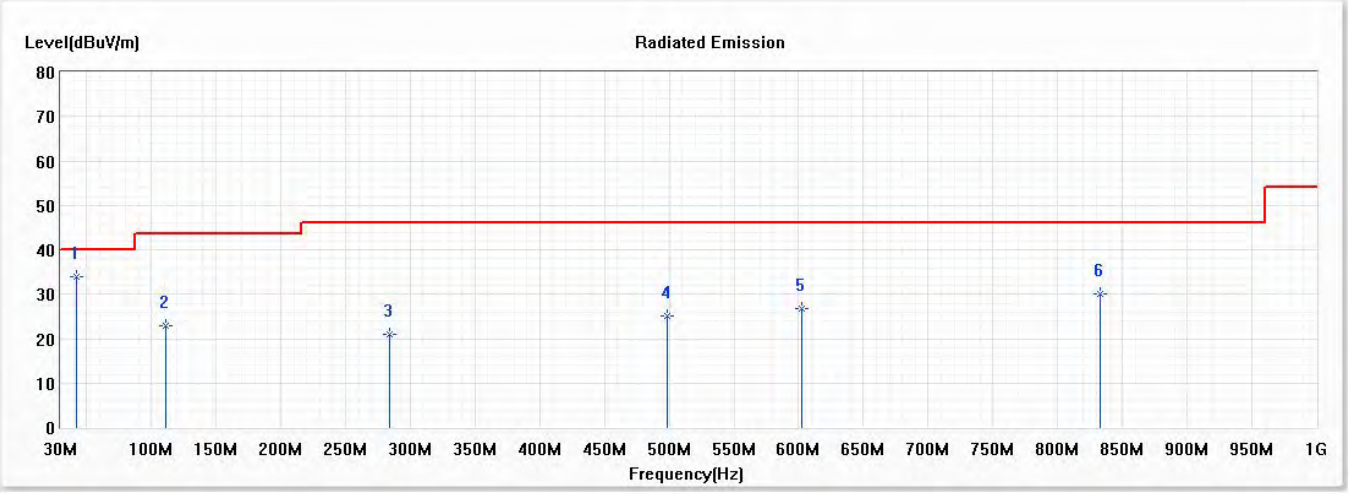
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
* 1	51.087	26.68	40.00	-13.32	37.32	-10.64	QP
2	202.913	24.82	43.50	-18.68	37.91	-13.09	QP
3	332.246	23.46	46.00	-22.54	32.37	-8.91	QP
4	498.130	26.54	46.00	-19.46	31.91	-5.37	QP
5	720.246	28.32	46.00	-17.68	29.99	-1.67	QP
6	810.217	29.63	46.00	-16.37	30.26	-0.63	QP

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The emission levels of other frequencies are very lower than the limit and not show in test report.
5. No emission found between lowest internal used/generated frequency to 30MHz.

Product	:	Bluetooth Module
Test Item	:	General Radiated Emission
Test Mode	:	Mode 1: Transmit (2442MHz)
Test Date	:	2021/01/19

Vertical



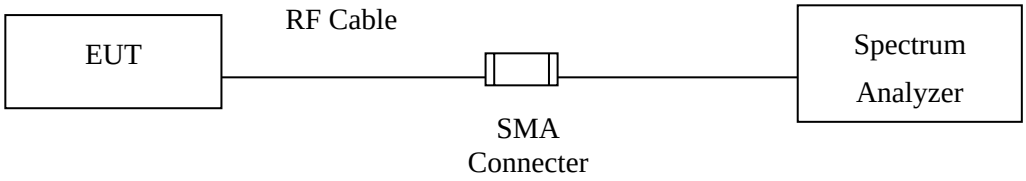
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
* 1	42.652	33.93	40.00	-6.07	44.72	-10.79	QP
2	111.536	22.87	43.50	-20.63	36.87	-14.00	QP
3	284.449	20.87	46.00	-25.13	31.14	-10.27	QP
4	498.130	25.11	46.00	-20.89	30.48	-5.37	QP
5	602.159	26.80	46.00	-19.20	30.06	-3.26	QP
6	832.710	30.11	46.00	-15.89	30.35	-0.24	QP

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The emission levels of other frequencies are very lower than the limit and not show in test report.
5. No emission found between lowest internal used/generated frequency to 30MHz.

5. RF Antenna Conducted Test

5.1. Test Setup



5.2. Limits

According to FCC Section 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 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, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

5.3. Test Procedure

The EUT was tested according to C63.10:2013 Section 11.11 for compliance to FCC 47CFR 15.247 requirements.

Set RBW = 100 kHz, Set VBW> RBW, scan up through 10th harmonic.

5.4. Test Result of RF Antenna Conducted Test

Product	:	Bluetooth Module
Test Item	:	RF Antenna Conducted Test
Test Mode	:	Mode 1: Transmit
Test Date	:	2021/01/15

Figure Channel 00:

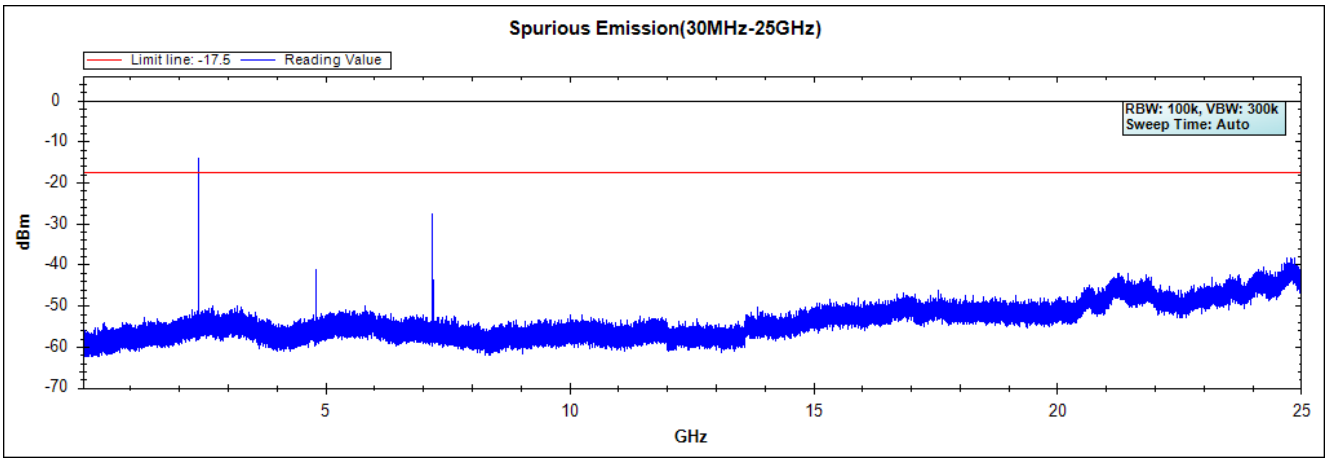


Figure Channel 20:

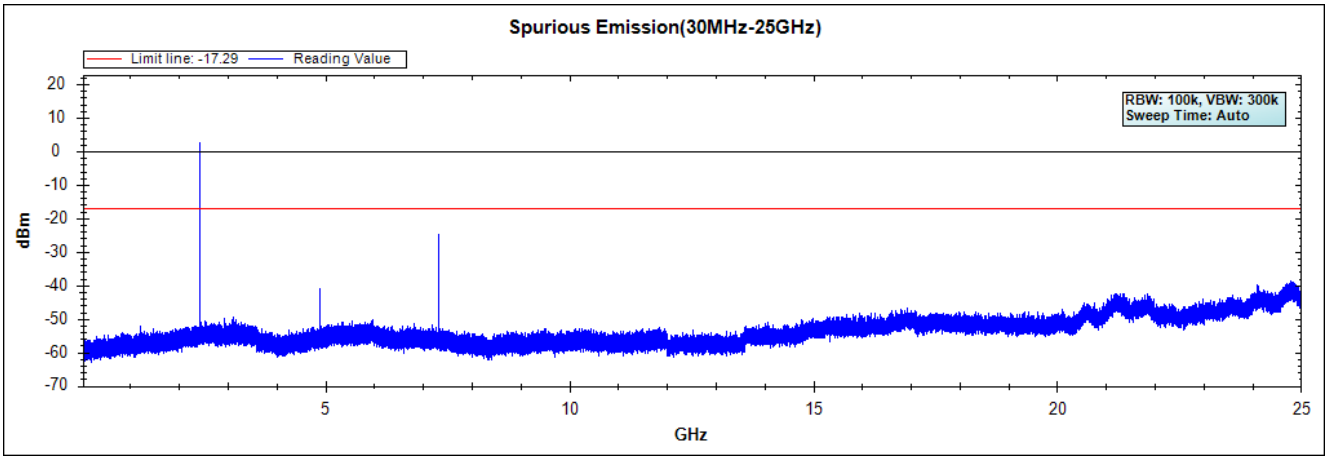
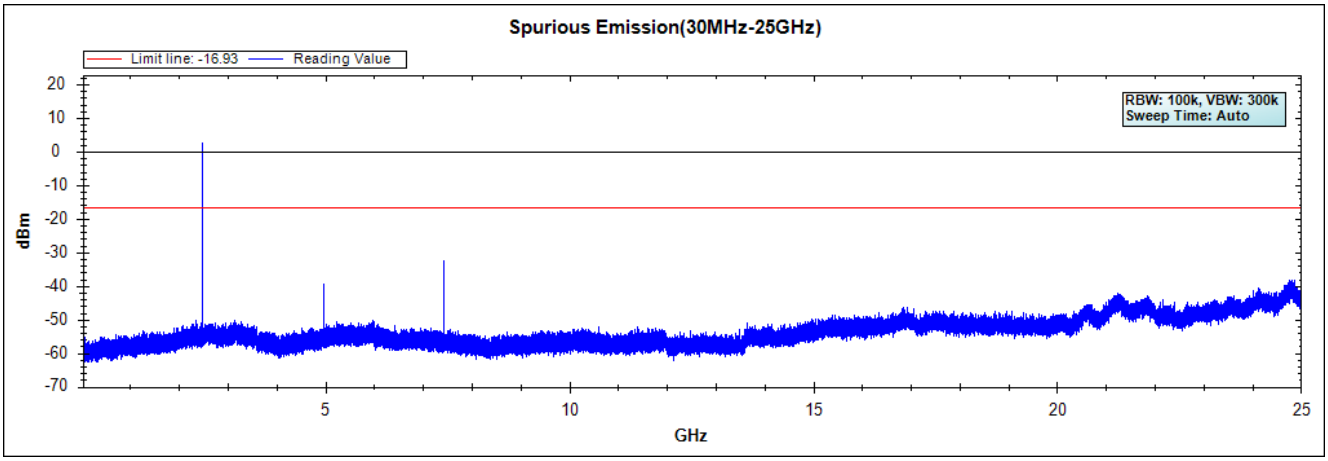


Figure Channel 39:

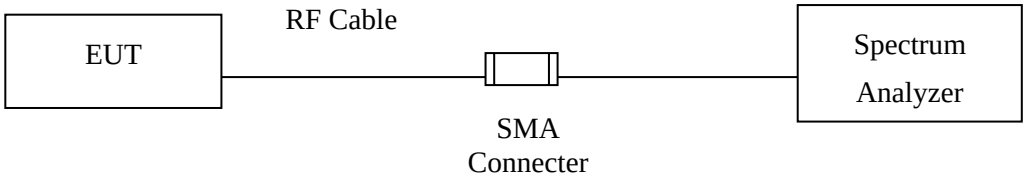


Note: The above test pattern is synthesized by multiple of the frequency range.

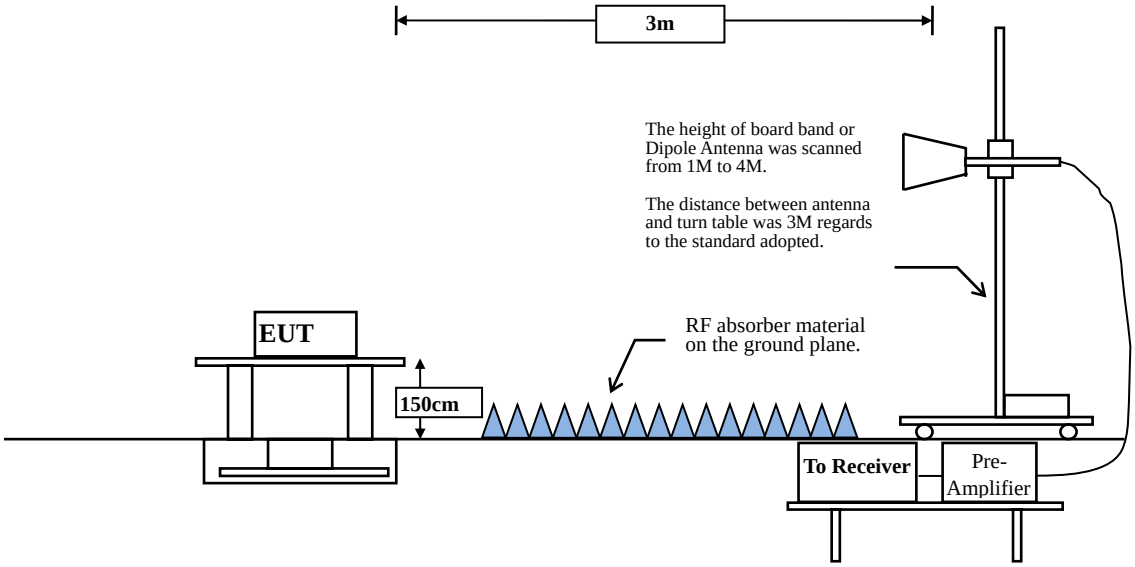
6. Band Edge

6.1. Test Setup

RF Conducted Measurement



RF Radiated Measurement:



6.2. Limit

According to FCC Section 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 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, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

6.3. Test Procedure

The EUT was setup according to ANSI C63.10, 2013 and tested according to C63.10:2013 Section 11.12.1 for compliance to FCC 47CFR 15.247 requirements.

The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.

RBW and VBW Parameter setting:

According to C63.10 Section 11.12.2.4 Peak measurement procedure.

RBW = as specified in Table 1.

VBW ≥ 3 x RBW.

Table 1 —RBW as a function of frequency

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

According to C63.10 Section 11.12.2.5 Average measurement procedure.

RBW = 1MHz.

VBW = 10Hz, when duty cycle ≥ 98 %

VBW ≥ 1/T, when duty cycle < 98 %

(T refers to the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.)

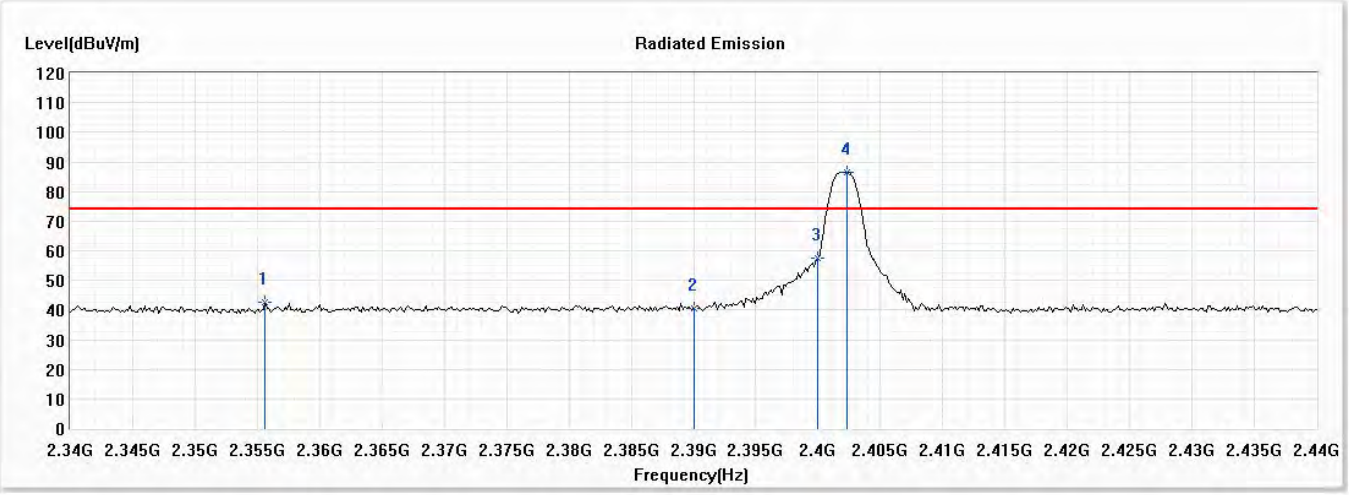
2.4GHz band	Duty Cycle (%)	T (ms)	1/T (Hz)	VBW (Hz)
BLE	8.41	0.1231	8123	10000

Note: Duty Cycle Refer to Section 9.

6.4. Test Result of Band Edge

Product : Bluetooth Module
Test Item : Band Edge
Test Mode : Mode 1: Transmit (2402MHz)
Test Date : 2021/01/18

Horizontal



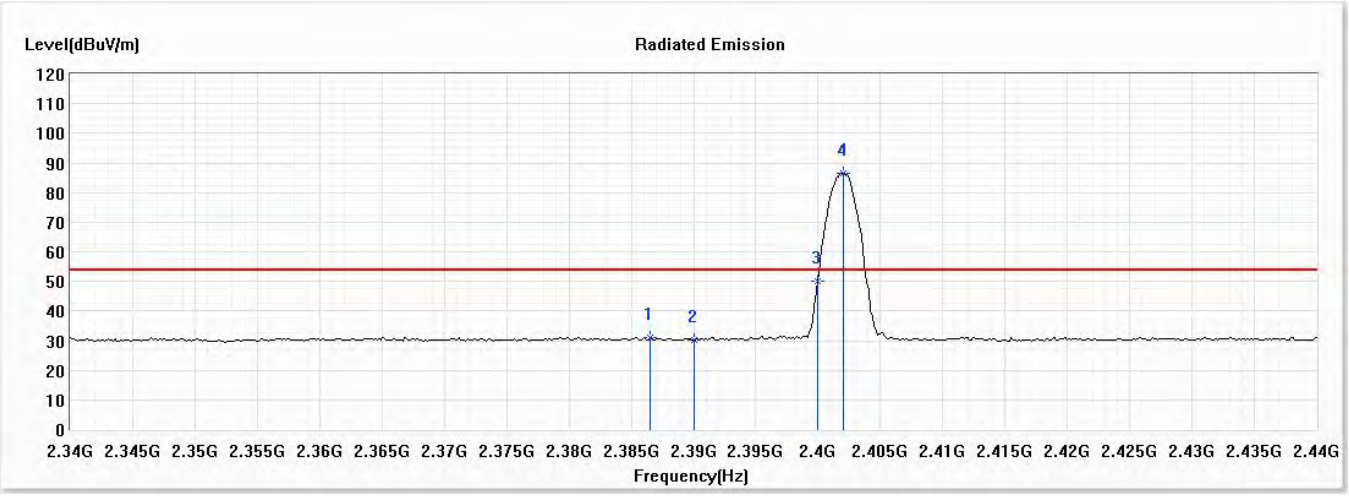
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	2355.652	42.44	74.00	-31.56	30.69	11.75	PK
2	2390.000	40.74	74.00	-33.26	28.82	11.92	PK
3	2400.000	57.54	--	--	45.58	11.96	PK
4	2402.319	86.57	--	--	74.60	11.97	PK

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : Bluetooth Module
Test Item : Band Edge
Test Mode : Mode 1: Transmit (2402MHz)
Test Date : 2021/01/18

Horizontal



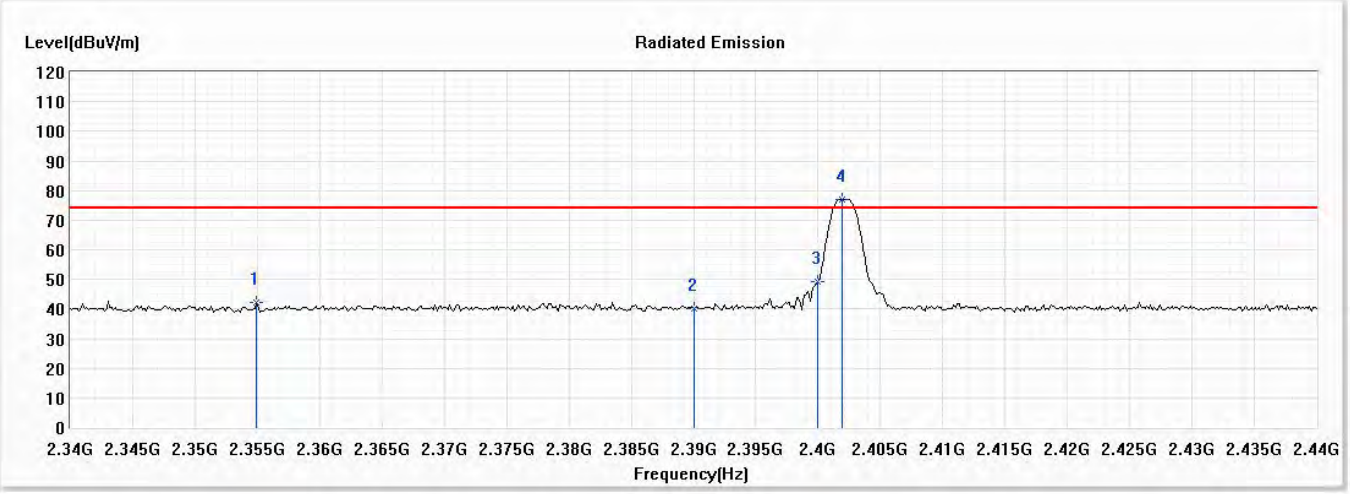
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	2386.522	31.09	54.00	-22.91	19.18	11.91	AV
2	2390.000	30.10	54.00	-23.90	18.18	11.92	AV
3	2400.000	50.26	--	--	38.30	11.96	AV
4	2402.029	86.45	--	--	74.48	11.97	AV

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : Bluetooth Module
Test Item : Band Edge
Test Mode : Mode 1: Transmit (2402MHz)
Test Date : 2021/01/18

Vertical



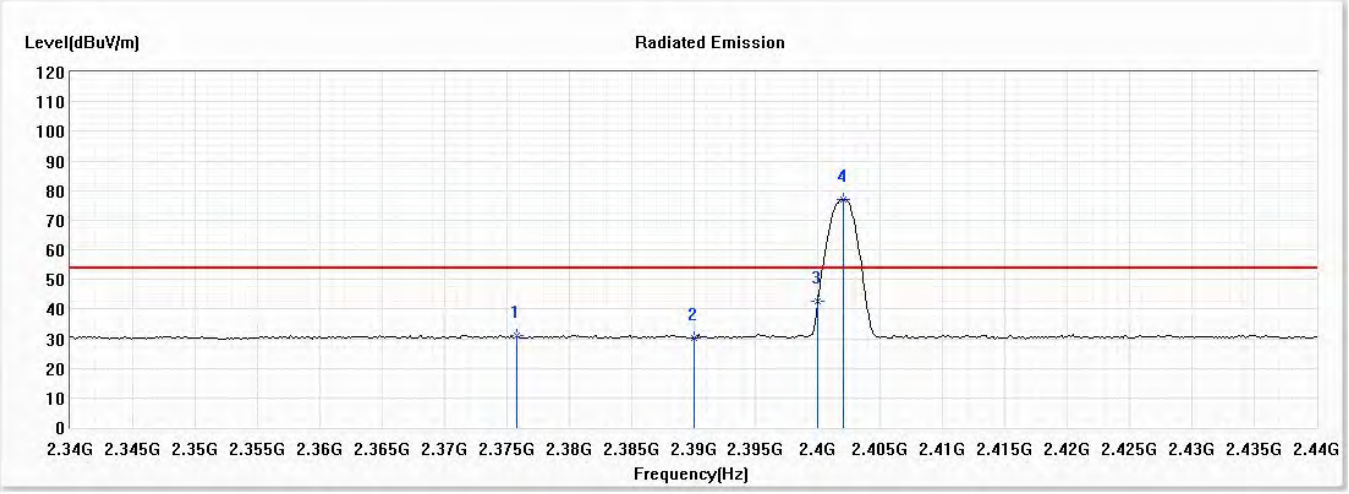
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	2354.928	42.27	74.00	-31.73	30.52	11.75	PK
2	2390.000	40.32	74.00	-33.68	28.40	11.92	PK
3	2400.000	49.37	--	--	37.41	11.96	PK
4	2401.884	77.06	--	--	65.09	11.97	PK

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : Bluetooth Module
Test Item : Band Edge
Test Mode : Mode 1: Transmit (2402MHz)
Test Date : 2021/01/18

Vertical



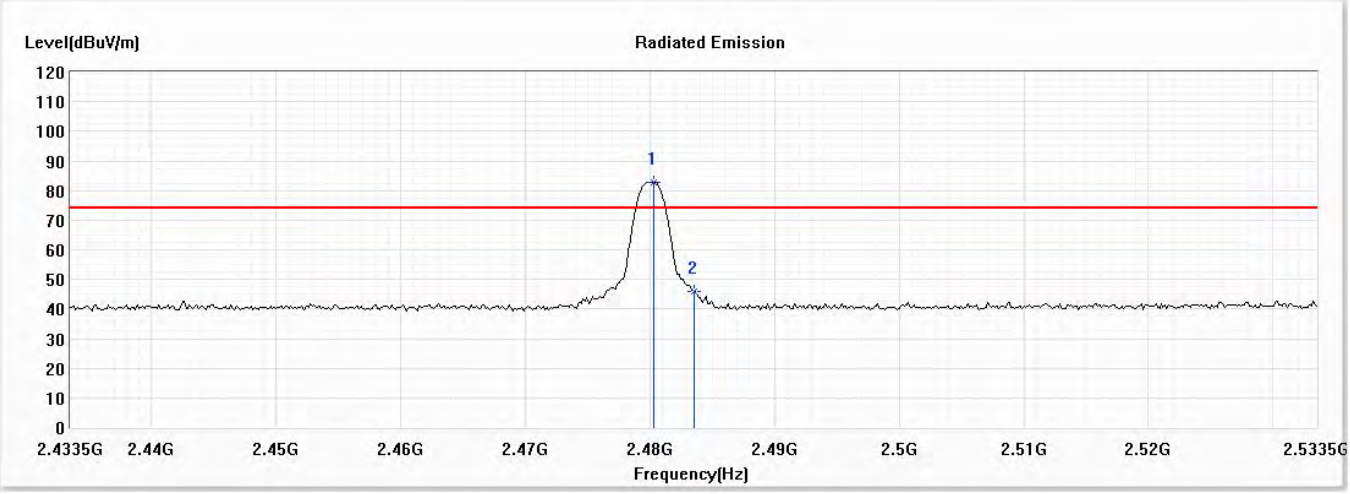
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	2375.797	31.18	54.00	-22.82	19.34	11.84	AV
2	2390.000	30.29	54.00	-23.71	18.37	11.92	AV
3	2400.000	42.47	--	--	30.51	11.96	AV
4	2402.029	76.88	--	--	64.91	11.97	AV

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : Bluetooth Module
Test Item : Band Edge
Test Mode : Mode 1: Transmit (2480MHz)
Test Date : 2021/01/18

Horizontal



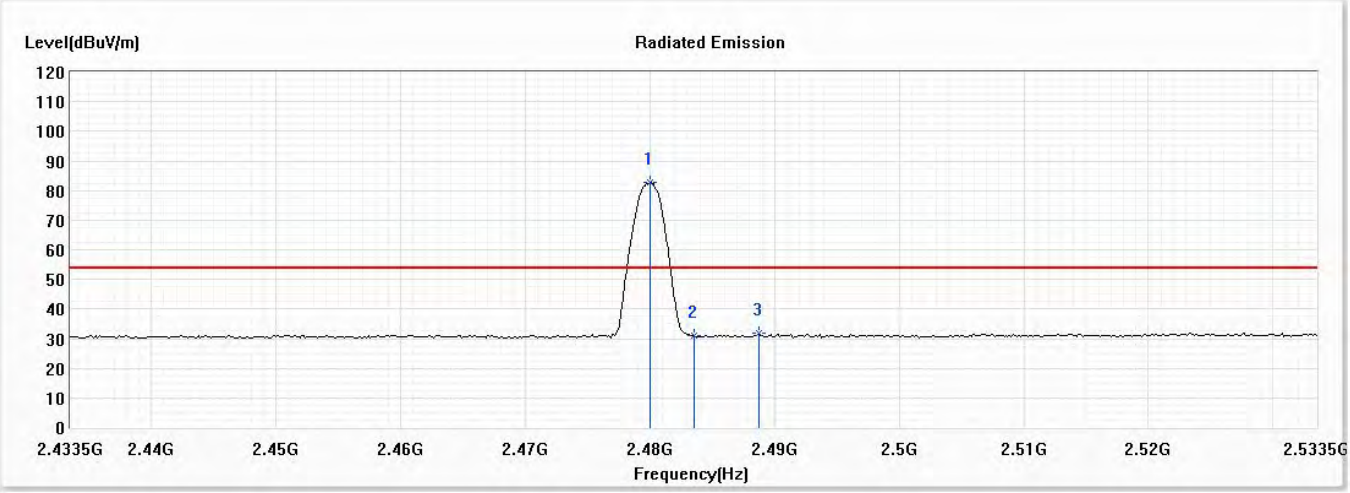
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	2480.312	82.71	--	--	70.48	12.23	PK
2	2483.500	45.89	74.00	-28.11	33.65	12.24	PK

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : Bluetooth Module
Test Item : Band Edge
Test Mode : Mode 1: Transmit (2480MHz)
Test Date : 2021/01/18

Horizontal



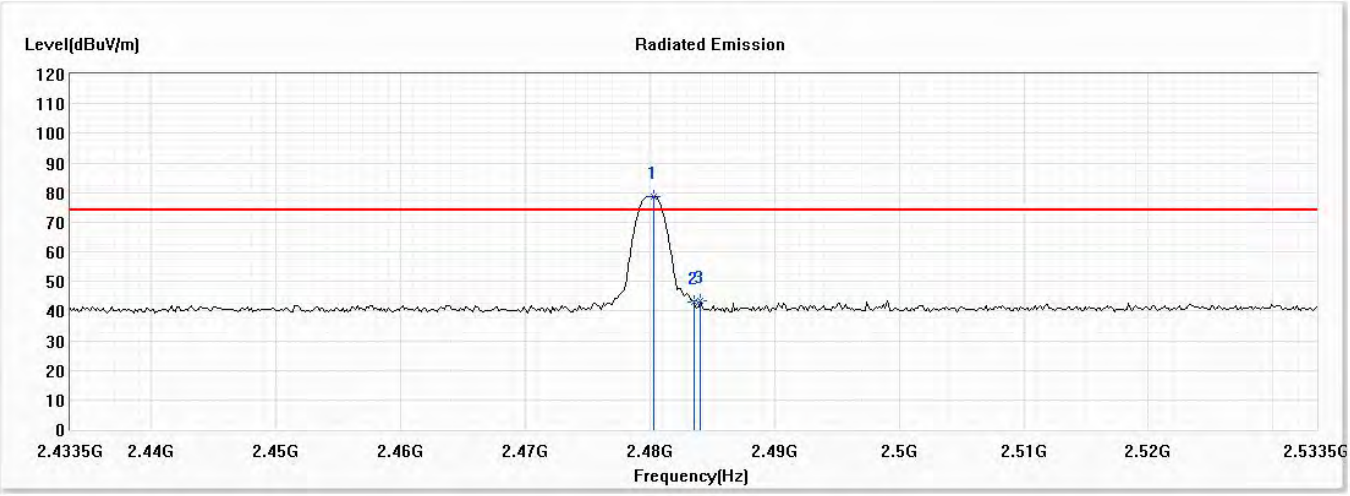
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	2480.022	82.59	--	--	70.36	12.23	AV
2	2483.500	31.13	54.00	-22.87	18.89	12.24	AV
3	2488.717	31.71	54.00	-22.29	19.45	12.26	AV

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : Bluetooth Module
Test Item : Band Edge
Test Mode : Mode 1: Transmit (2480MHz)
Test Date : 2021/01/18

Vertical



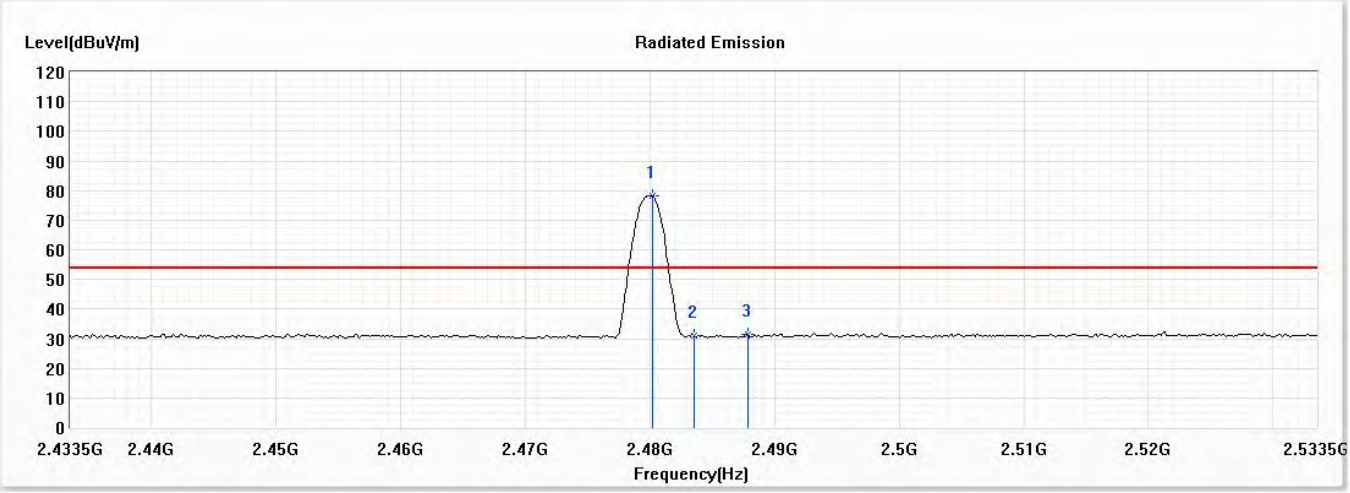
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	2480.312	78.58	--	--	66.35	12.23	PK
2	2483.500	42.86	74.00	-31.14	30.62	12.24	PK
3	2484.080	43.34	74.00	-30.66	31.10	12.24	PK

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : Bluetooth Module
Test Item : Band Edge
Test Mode : Mode 1: Transmit (2480MHz)
Test Date : 2021/01/18

Vertical



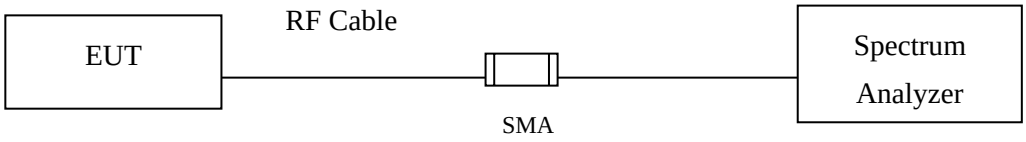
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	2480.167	78.32	--	--	66.09	12.23	AV
2	2483.500	30.99	54.00	-23.01	18.75	12.24	AV
3	2487.848	31.46	54.00	-22.54	19.20	12.26	AV

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

7. 6dB Bandwidth

7.1. Test Setup



7.2. Limits

The minimum bandwidth shall be at least 500 kHz.

7.3. Test Procedure

The EUT was setup according to ANSI C63.4, 2014; tested according to ANSI C63.10 Section 11.8 for compliance to FCC 47CFR 15.247 requirements.

7.4. Test Result of 6dB Bandwidth

Product : Bluetooth Module
Test Item : 6dB Bandwidth Data
Test Mode : Mode 1: Transmit
Test Date : 2021/01/15

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
00	2402	695	>500	Pass
20	2442	720	>500	Pass
39	2480	675	>500	Pass

Figure Channel 00:

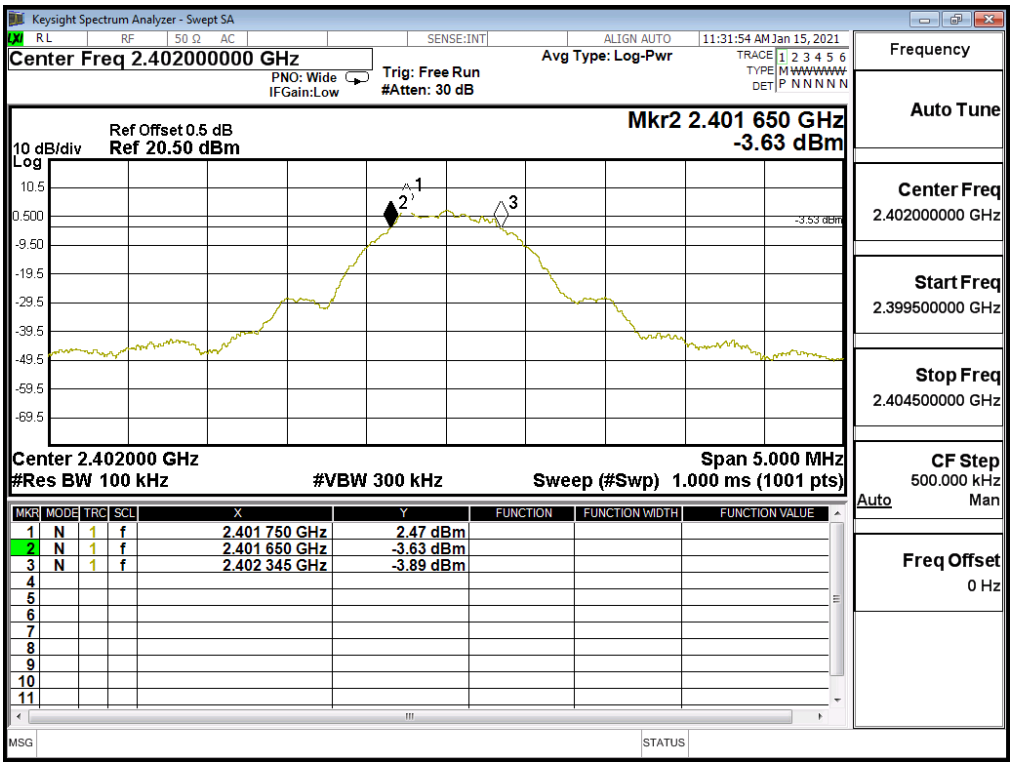


Figure Channel 20:

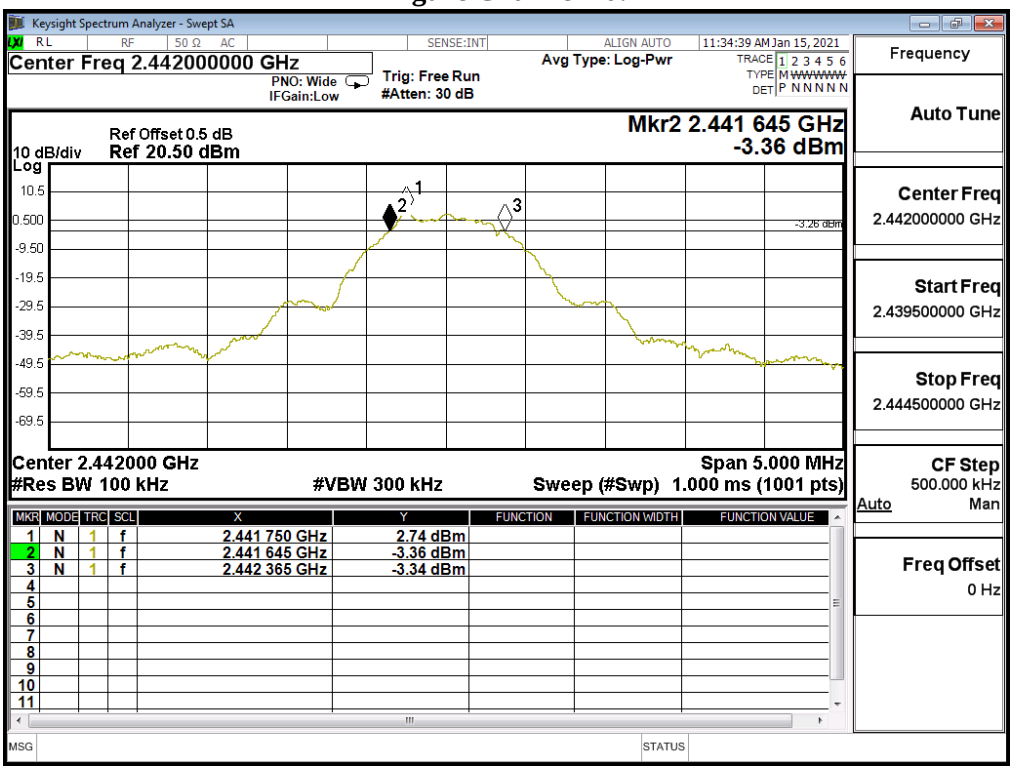
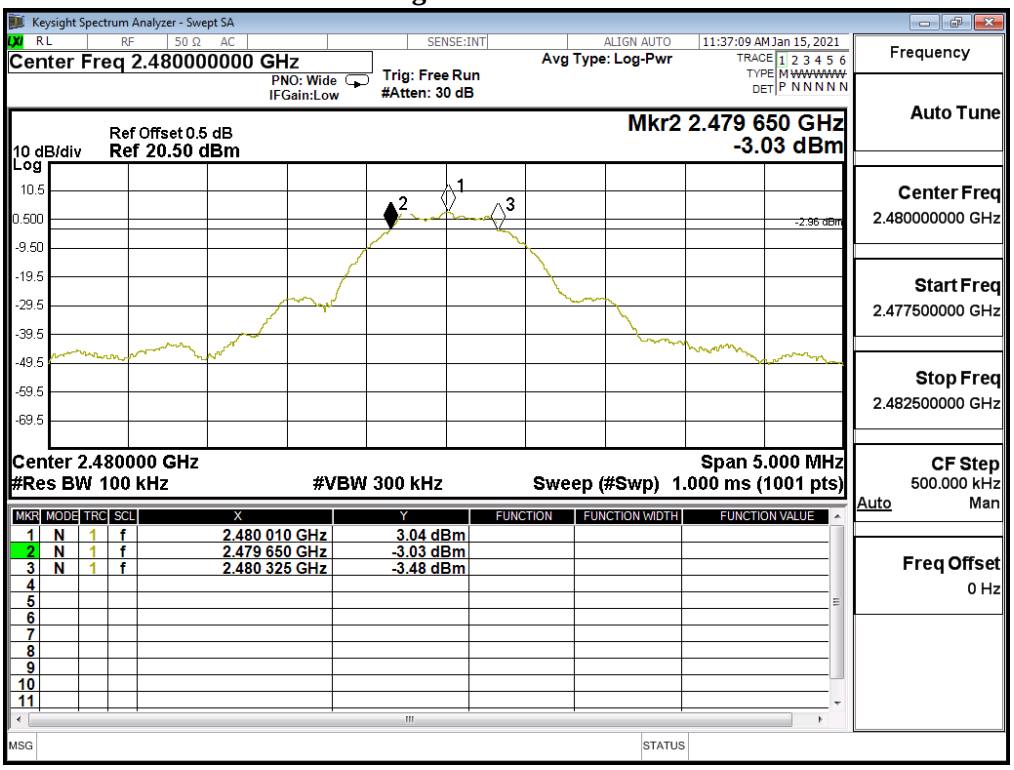
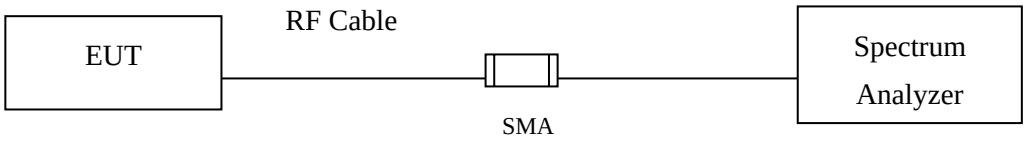


Figure Channel 39:



8. Power Density

8.1. Test Setup



8.2. Limits

The transmitted power density averaged over any 1 second interval shall not be greater +8dBm in any 3kHz bandwidth.

8.3. Test Procedure

The EUT was setup according to ANSI C63.10, 2013; tested according to DTS test procedure of KDB 558074 for compliance to FCC 47CFR 15.247 requirements.

The maximum power spectral density using C63.10 Section 11.10.2 Method PKPSD (peak PSD)

8.4. Test Result of Power Density

Product : Bluetooth Module
Test Item : Power Density Data
Test Mode : Mode 1: Transmit
Test Date : 2021/01/15

Channel No.	Frequency (MHz)	Measure Level (dBm)	Limit (dBm)	Result
00	2402	2.50	≦8dBm	Pass
20	2442	2.71	≦8dBm	Pass
39	2480	3.07	≦8dBm	Pass

Figure Channel 00:

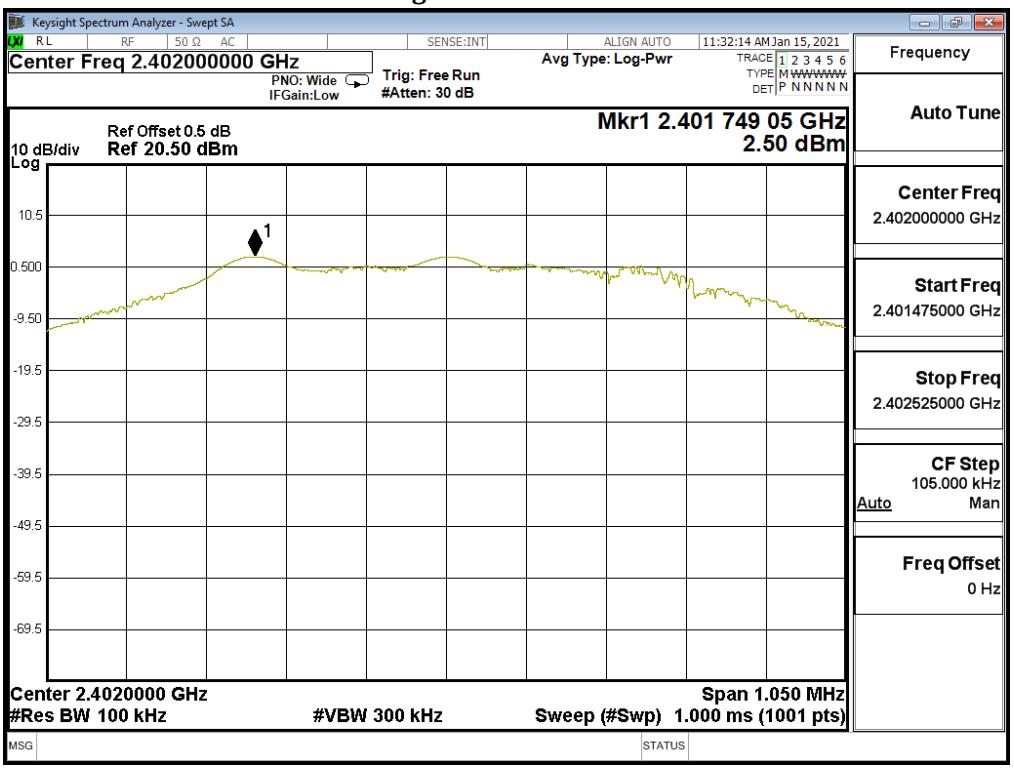


Figure Channel 20:

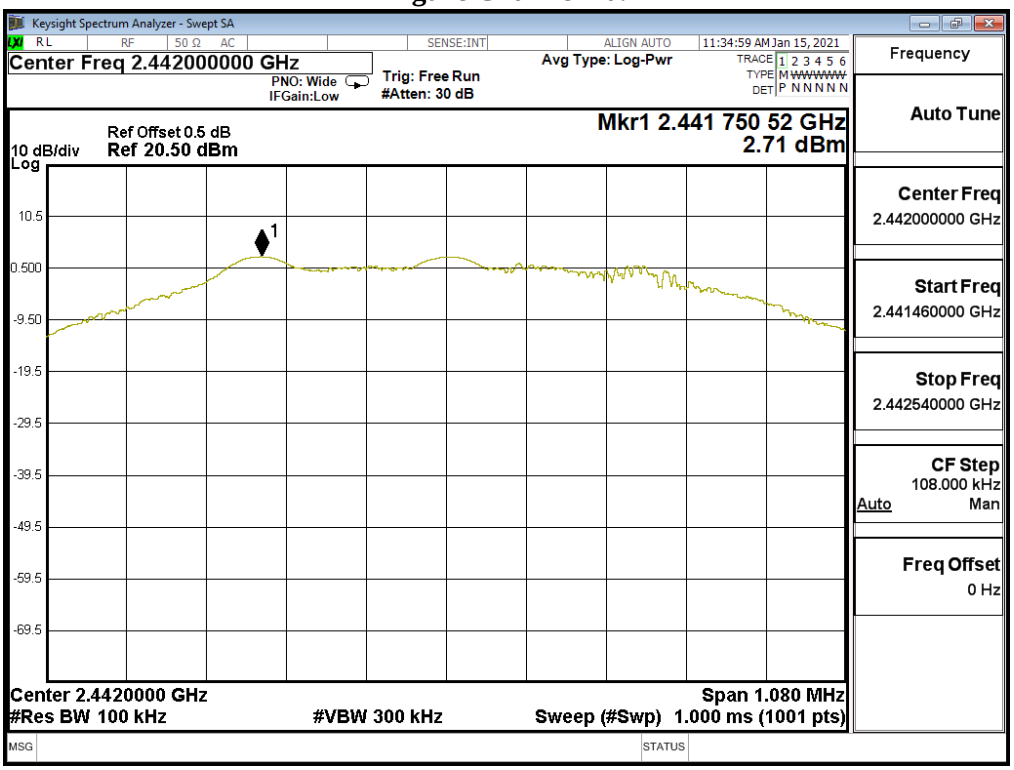
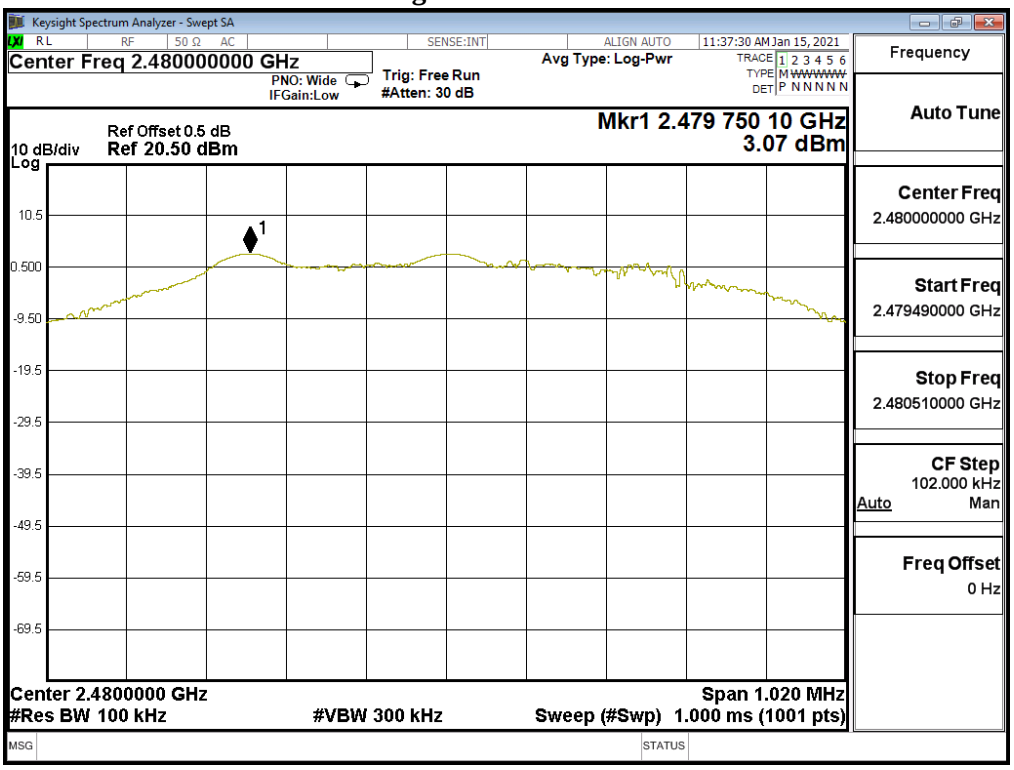
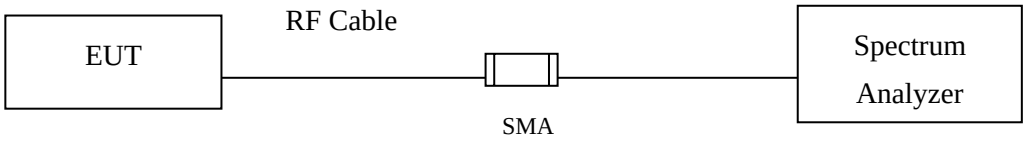


Figure Channel 39:



9. Duty Cycle

9.1. Test Setup



9.2. Test Procedure

The EUT was setup according to ANSI C63.10 2013; tested according to ANSI C63.10 2013 for compliance to FCC 47CFR 15.247 requirements.

9.3. Test Result of Duty Cycle

Product : Bluetooth Module
Test Item : Duty Cycle
Test Mode : Mode 1: Transmit

Duty Cycle Formula:

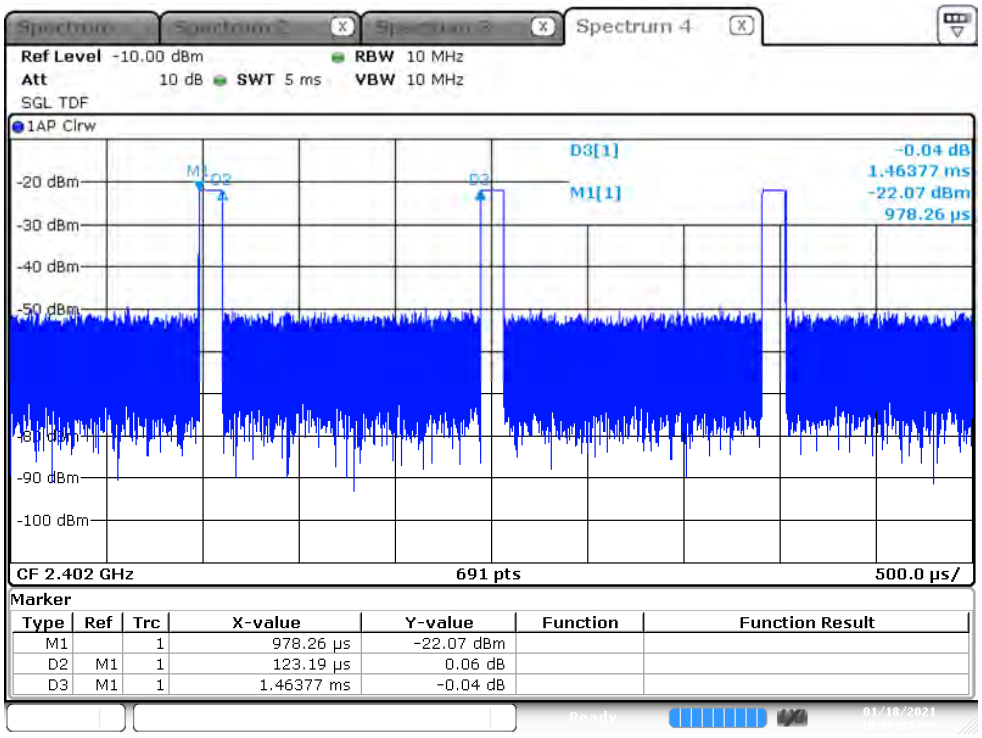
Duty Cycle = Ton / (Ton + Toff)

Duty Factor = 10 Log (1/Duty Cycle)

Results:

2.4GHz band	Ton (ms)	Ton + Toff (ms)	Duty Cycle (%)	Duty Factor (dB)
BLE	0.1231	1.4637	8.41	10.75

BLE



10. EMI Reduction Method During Compliance Testing

No modification was made during testing.