FCC Test Report

Product Name	Portable computer
Model No.	P102F
FCC ID.	E2K-P102F00401

Applicant	Dell Inc.
Address	One Dell Way, Round Rock, Texas 78682, United States.

Date of Receipt	Mar. 20, 2020
Issued Date	May 28, 2020
Report No.	2030634R-RFUSP23V00-A
Report Version	V1.0

Testing Laboratory
3023

Test Report

Issued Date: May 28, 2020
Report No.: 2030634R-RFUSP23V00-A

Product Name	Portable computer
Applicant	Dell Inc.
Address	One Dell Way, Round Rock, Texas 78682, United States.
Manufacturer	Dell Inc.
Model No.	P102F
FCC ID.	E2K-P102F00401
EUT Rated Voltage	AC 100-240V, 50-60Hz
EUT Test Voltage	AC 120V / 60Hz
Trade Name	DELL
Applicable Standard	FCC CFR Title 47 Part 15 Subpart C ANSI C63.4: 2014, ANSI C63.10: 2013
Test Result	Complied

Documented By : Rita Huang

(Senior Adm. Specialist / Rita Huang)

Tested By : Boris HSU

(Engineer / Boris Hsu)

Approved By :

(Director / Vincent Lin)

TABLE OF CONTENTS

Description		Page
1.	**GENERAL INFORMATION**	**5**
1.1.	EUT Description	5
1.2.	Operational Description	7
1.3.	Tested System Details	8
1.4.	Configuration of Tested System	8
1.5.	EUT Exercise Software	9
1.6.	Test Facility	10
1.7.	List of Test Equipment	11
1.8.	Uncertainty	13
2.	**CONDUCTED EMISSION**	**14**
2.1.	Test Setup	14
2.2.	Limits	14
2.3.	Test Procedure	15
2.4.	Uncertainty	15
2.5.	Test Result of Conducted Emission	16
3.	**PEAK POWER OUTPUT**	**18**
3.1.	Test Setup	18
3.2.	Limit	18
3.3.	Test Procedure	18
3.4.	Uncertainty	18
3.5.	Test Result of Peak Power Output	19
4.	**RADIATED EMISSION**	**20**
4.1.	Test Setup	20
4.2.	Limits	21
4.3.	Test Procedure	22
4.4.	Uncertainty	23
4.5.	Test Result of Radiated Emission	24
5.	**RF ANTENNA CONDUCTED TEST**	**35**
5.1.	Test Setup	35
5.2.	Limits	35
5.3.	Test Procedure	35
5.4.	Uncertainty	35
5.5.	Test Result of RF Antenna Conducted Test	36
6.	**BAND EDGE**	**37**
6.1.	Test Setup	37
6.2.	Limit	38
6.3.	Test Procedure	38
6.4.	Uncertainty	39
6.5.	Test Result of Band Edge	40
7.	**6DB BANDWIDTH**	**42**
7.1.	Test Setup	42

7.2. Limits....42
7.3. Test Procedure....42
7.4. Uncertainty....42
7.5. Test Result of 6dB Bandwidth....43
8. POWER DENSITY....46
8.1. Test Setup....46
8.2. Limits....46
8.3. Test Procedure....46
8.4. Uncertainty....46
8.5. Test Result of Power Density....47
9. DUTY CYCLE....50
9.1. Test Setup....50
9.2. Test Procedure....50
9.3. Uncertainty....50
9.4. Test Result of Duty Cycle....51
10. EMI REDUCTION METHOD DURING COMPLIANCE TESTING....52
Attachment 1: EUT Test Photographs
Attachment 2: EUT Detailed Photographs

1. GENERAL INFORMATION

1.1. EUT Description

Product Name	Portable computer
Trade Name	DELL
Model No.	P102F
FCC ID.	E2K-P102F00401
Frequency Range	2402 – 2480MHz
Channel Number	V5.0: 40CH
Type of Modulation	V5.0: GFSK(1Mbps)
Antenna Type	PIFA Antenna
Channel Control	Auto
Antenna Gain	Refer to the table “Antenna List”
Power Adapter	MFR: Chiconypower, M/N: HA65NS5-00 Input: AC 100-240V~50-60Hz 1.7A Output: 19V⎓3.34A Cable Out: Shielded, 1.7m, with one ferrite core bonded

Antenna List

No.	Manufacturer	Part No. (Vendor)	Antenna Type	Peak Gain
1	SPEED	025.901MP.0001 (Main) 025.901MP.0001 (Aux)	PIFA Antenna	-0.24dBi in 2.4 GHz
2	WNC	025.901MP.0011 (Main) 025.901MP.0011 (Aux)	PIFA Antenna	-0.40dBi in 2.4 GHz

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

Center Frequency of Each Channel: (For V5.0)

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 Portable computer with built-in WLAN and Bluetooth transceiver, this report for Bluetooth.
2. These tests were conducted on a sample for the purpose of demonstrating compliance of Bluetooth V5.0 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 - BLE

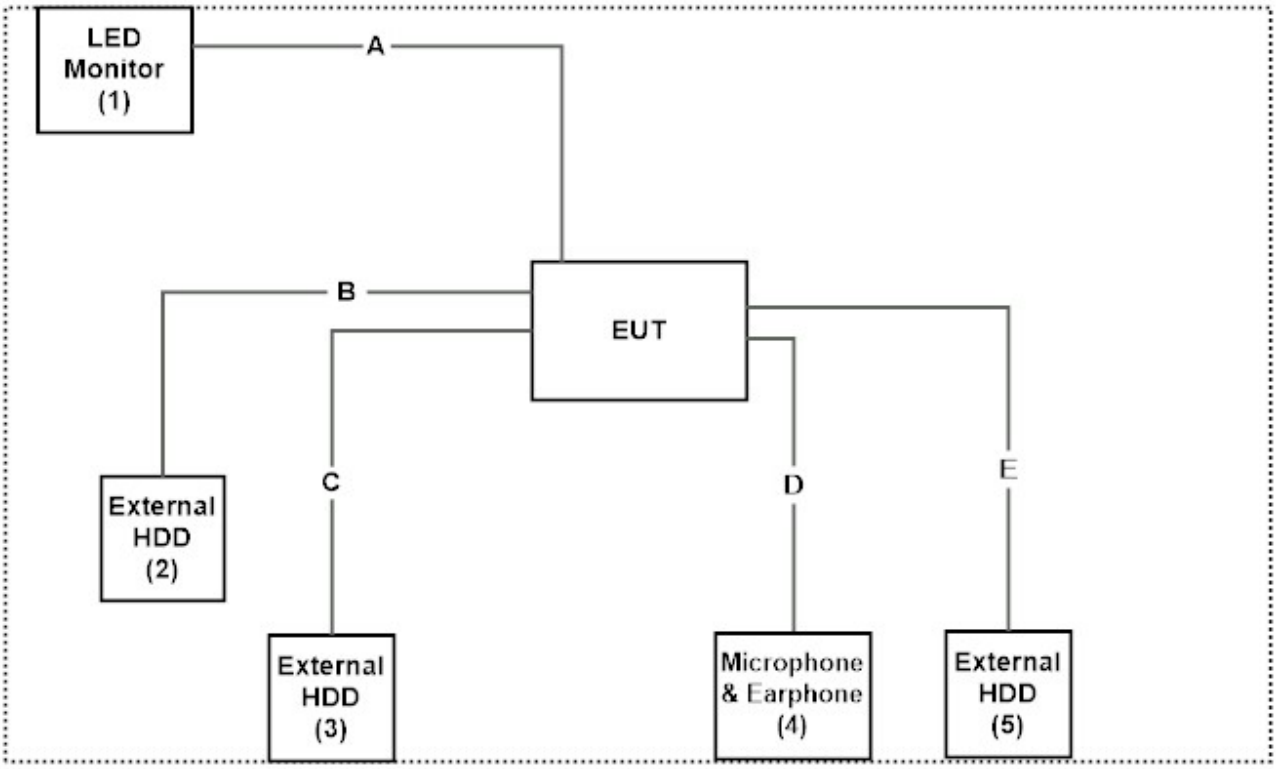
1.3. Tested System Details

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	LED Monitor	ViewSonic	VX2257-mhd	UFY163502150	Non-Shielded, 1.8m
2	External HDD	Transcend	TS1TSJ25H3B	F21786-0125	N/A
3	External HDD	Transcend	TS1TSJ25MC	F30467-0011	N/A
4	Microphone & Earphone	RONEVER	MOE241	N/A	N/A
5	External HDD	Transcend	TS1TSJ25H3B	F21786-0019	N/A

Signal Cable Type		Signal cable Description
A	HDMI Cable	Shielded, 1.8m
B	USB Cable	Shielded, 0.5m
C	USB to Type-C Cable	Shielded, 0.5m
D	Microphone & Earphone Cable	Non-Shielded, 1.2m
E	USB Cable	Shielded, 0.5m

1.4. Configuration of Tested System



1.5. EUT Exercise Software

1. Setup the EUT as shown in Section 1.4.
2. Execute software “DRTU Ver.11.1941.0-10270” on the EUT.
3. Configure the test mode, the test channel, and the data rate.
4. Press “OK” to start the continuous Transmit.
5. Verify that the EUT works properly.

1.6. Test Facility

Ambient conditions in the laboratory:

Performed Item	Items	Required	Actual
Conducted Emission	Temperature (°C)	10~40 ℃	24.9 ℃
	Humidity (%RH)	10~90 %	60 %
Radiated Emission	Temperature (°C)	10~40 ℃	20.5 ℃
	Humidity (%RH)	10~90 %	65.2 %
Conductive	Temperature (°C)	10~40 ℃	21.1 ℃
	Humidity (%RH)	10~90 %	71.7 %

USA : FCC Registration Number: TW3023
Canada : IC Registration Number: 4075A

Site Description: Accredited by TAF
Accredited Number: 3023

Test Laboratory: DEKRA Testing and Certification Co., Ltd
Address: No.5-22, Ruishukeng, Linkou Dist., New Taipei City 24451, Taiwan, R.O.C.
Phone number: 886-2-8601-3788
Fax number: 886-2-8601-3789
Email address: info.tw@dekra.com
Website: http://www.dekra.com.tw

1.7. List of Test Equipment

For Conducted measurements /CB3/SR8

	Equipment	Manufacturer	Model No.	Serial No.	Cali. Date	Due. Date
	Temperature Chamber	WIT GROUP	TH-1S-B	EQ-201-00146	2020/04/06	2021/04/05
X	Spectrum Analyzer	Agilent	N9010A	MY53470892	2019/09/25	2020/09/24
X	Peak Power Analyzer	Keysight	8990B	MY51000410	2019/07/30	2020/07/29
X	Wideband Power Sensor	Keysight	N1923A	MY56080003	2019/07/30	2020/07/29
X	Wideband Power Sensor	Keysight	N1923A	MY56080004	2019/07/30	2020/07/29
X	EMI Test Receiver	R&S	ESCS 30	100369	2019/11/27	2020/11/26
X	LISN	R&S	ENV216	101105	2020/04/27	2021/04/26
X	LISN	R&S	ESH3-Z5	836679/014	2020/04/26	2021/04/25
X	Coaxial Cable	DEKRA	RG 400	LC018-RG	2019/06/20	2020/06/19

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 SystemV9.0.5.

For Radiated measurements /Site3/CB8

	Equipment	Manufacturer	Model No.	Serial No.	Cali. Date	Due. Date
X	Test Receiver	R&S	ESR7	101602	2019/12/16	2020/12/15
X	Signal Analyzer	R&S	FSV40	101869	2019/07/04	2020/07/03
X	Loop Antenna	Teseq	HLA6121	37133	2019/10/15	2021/10/14
X	Bilog Antenna	Schaffner Chase	CBL6112B	2916	2020/01/20	2021/01/19
X	Coaxial Cable	DEKRA	L1907-001C	280280.F141.1000D	2019/07/10	2020/07/09
X	Amplifier	EMCI	EMC001330	980254	2019/08/22	2020/08/21
X	Horn Antenna	ETS-LINDGREN	3117	00228113	2020/05/01	2021/04/30
X	Coaxial Cable	DEKRA	L1907-002C	280280.F141.1000D	2019/07/10	2020/07/09
X	Amplifier	EMCI	EMC05820SE	980362	2019/06/26	2020/06/25
X	Amplifier	EMCI	EMC051845SE	980632	2019/08/08	2020/08/07
	Horn Antenna	Com-Power	AH-1840	101101	2019/10/31	2020/10/30
	Amplifier + Cable	EMCI	EMC184045SE	980369	2020/04/23	2021/04/22
	Bilog Antenna	Schaffner Chase	CBL6112B	2925	2020/02/20	2021/02/19
	Coaxial Cable	DEKRA	L1907-003C	00100A1B3A120M	2019/07/10	2020/07/09
	Amplifier	EMCI	EMC001330	980255	2020/03/17	2021/03/16
X	Filter	MICRO-TRONICS	BRM50702	G270	2019/08/08	2020/08/07
	Filter	MICRO-TRONICS	BRM50716	G196	2019/08/08	2020/08/07

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 Test SystemV1.1.

1.8. Uncertainty

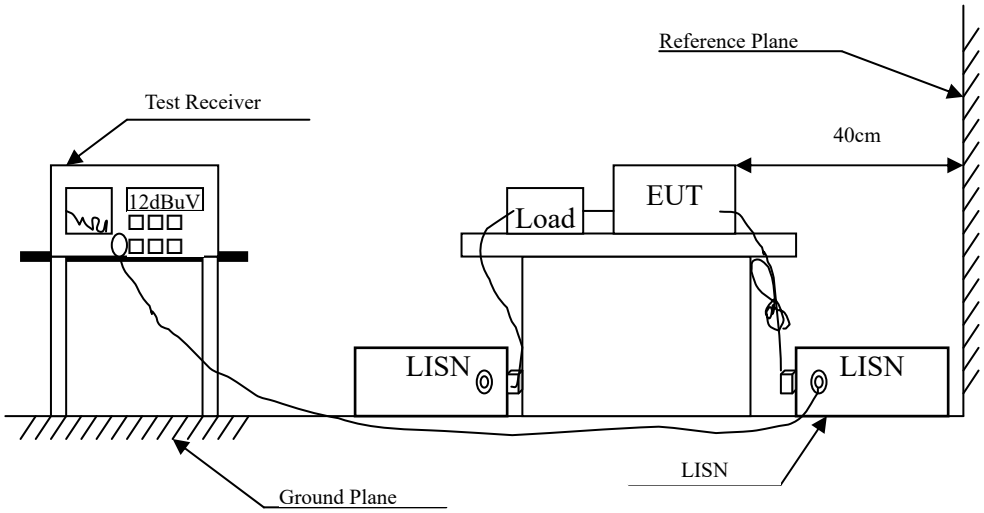
Uncertainties have been calculated according to the DEKRA internal document, and is described in each test chapter of this report.

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.

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.

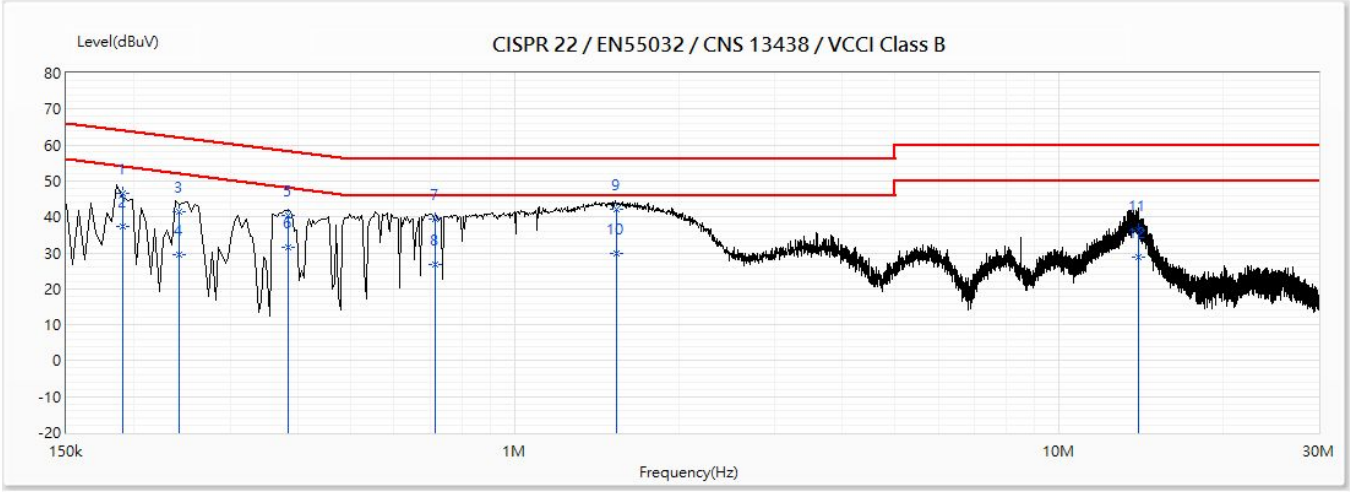
2.4. Uncertainty

±2.26dB

2.5. Test Result of Conducted Emission

Product	:	Portable computer
Test Item	:	Conducted Emission Test
Test date	:	2020/05/28
Test Mode	:	Mode 1: Transmit - BLE (2440MHz)

Line1



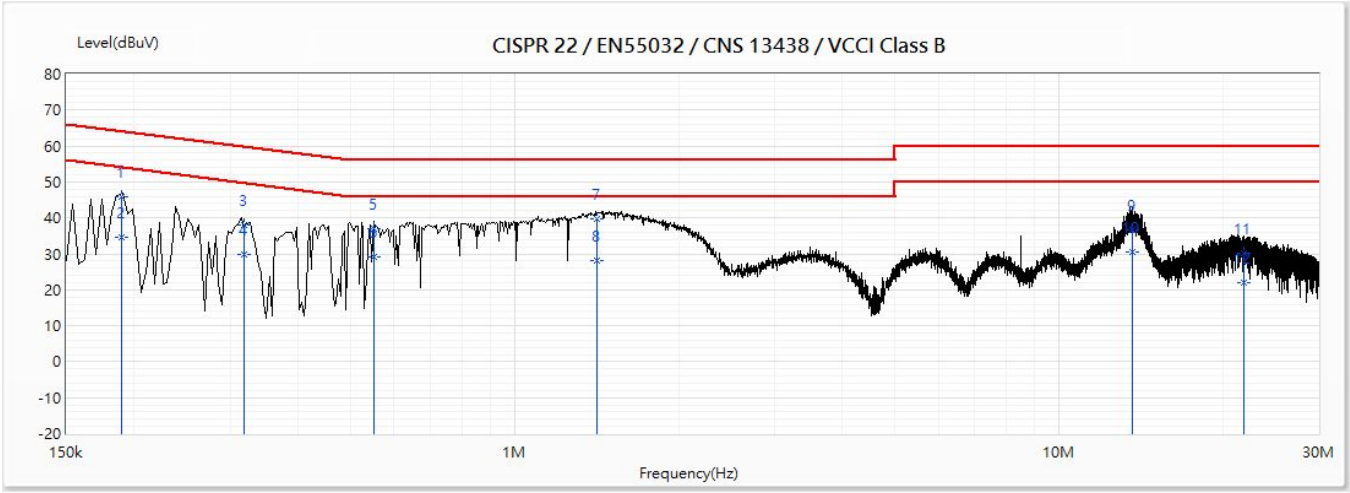
No	Frequency (MHz)	Emission Level (dBuV)	Limit (dBuV)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	0.19	46.70	64.03	-17.33	36.91	9.79	QP
2	0.19	37.32	54.03	-16.71	27.52	9.79	AV
3	0.241	41.46	62.05	-20.59	31.67	9.79	QP
4	0.241	29.47	52.05	-22.58	19.68	9.79	AV
5	0.383	40.25	58.21	-17.96	30.46	9.79	QP
6	0.383	31.39	48.21	-16.82	21.61	9.79	AV
7	0.714	39.34	56.00	-16.66	29.54	9.80	QP
8	0.714	26.76	46.00	-19.24	16.96	9.80	AV
*9	1.535	42.17	56.00	-13.83	32.32	9.85	QP
10	1.535	29.91	46.00	-16.09	20.07	9.85	AV
11	14.006	36.37	60.00	-23.63	26.21	10.16	QP
12	14.006	28.85	50.00	-21.15	18.69	10.16	AV

Remark:

1. "*" means this data is the worst emission level;"!" means this data is over limit.
2. Emission Level=Reading Level + Correct Factor(Correct Factor=LISN Factor+Cable Loss).
3. Margin=Emission Level-Limit

Product	:	Portable computer
Test Item	:	Conducted Emission Test
Test date	:	2020/05/28
Test Mode	:	Mode 1: Transmit - BLE (2440MHz)

N



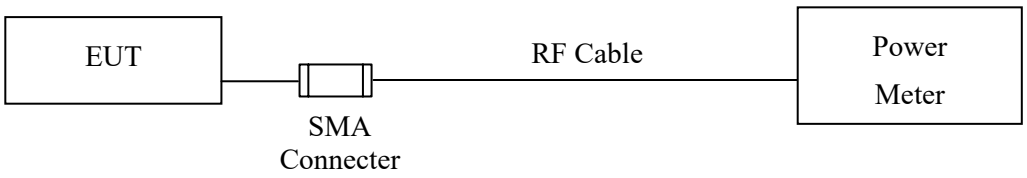
No	Frequency (MHz)	Emission Level (dBuV)	Limit (dBuV)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	0.189	45.75	64.06	-18.31	35.98	9.77	QP
2	0.189	34.55	54.06	-19.51	24.78	9.77	AV
3	0.318	37.90	59.76	-21.85	28.13	9.77	QP
4	0.318	29.96	49.76	-19.80	20.18	9.77	AV
5	0.55	36.90	56.00	-19.10	27.11	9.78	QP
6	0.55	29.22	46.00	-16.78	19.44	9.78	AV
*7	1.417	39.83	56.00	-16.17	30.00	9.83	QP
8	1.417	28.20	46.00	-17.80	18.37	9.83	AV
9	13.617	36.56	60.00	-23.44	26.34	10.22	QP
10	13.617	30.37	50.00	-19.63	20.15	10.22	AV
11	21.894	30.32	60.00	-29.68	19.90	10.41	QP
12	21.894	22.09	50.00	-27.91	11.68	10.41	AV

Remark:

1. "*" means this data is the worst emission level;"!" means this data is over limit.
2. Emission Level=Reading Level + Correct Factor(Correct Factor=LISN Factor+Cable Loss).
3. Margin=Emission Level-Limit

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. Uncertainty

±1.19 dB

3.5. Test Result of Peak Power Output

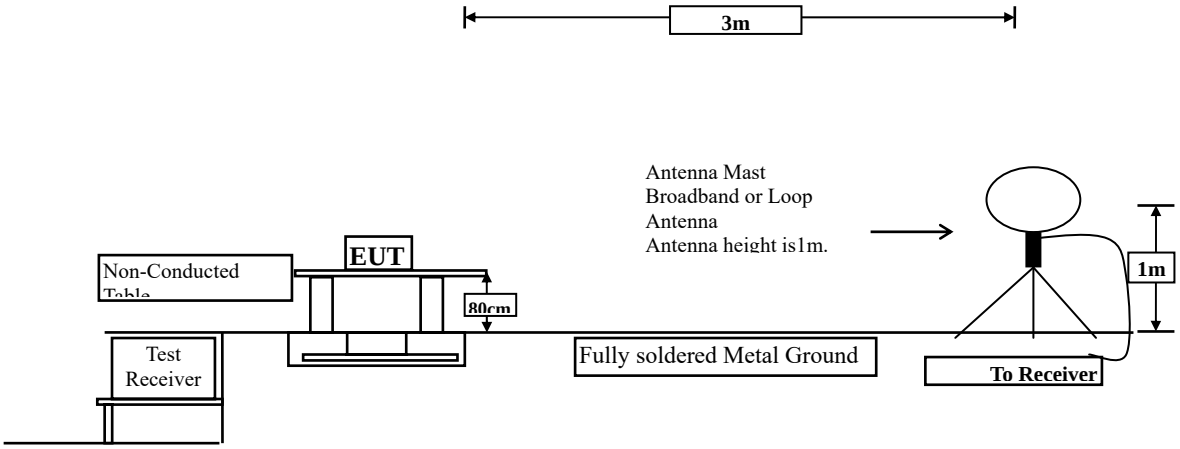
Product : Portable computer
Test Item : Peak Power Output
Test Mode : Mode 1: Transmit - BLE
Test Date : 2020/05/14

Channel No.	Frequency (MHz)	Measurement (dBm)	Required Limit	Result
Channel 00	2402.00	5.98	1 Watt= 30 dBm	Pass
Channel 19	2440.00	5.86	1 Watt= 30 dBm	Pass
Channel 39	2480.00	5.96	1 Watt= 30 dBm	Pass

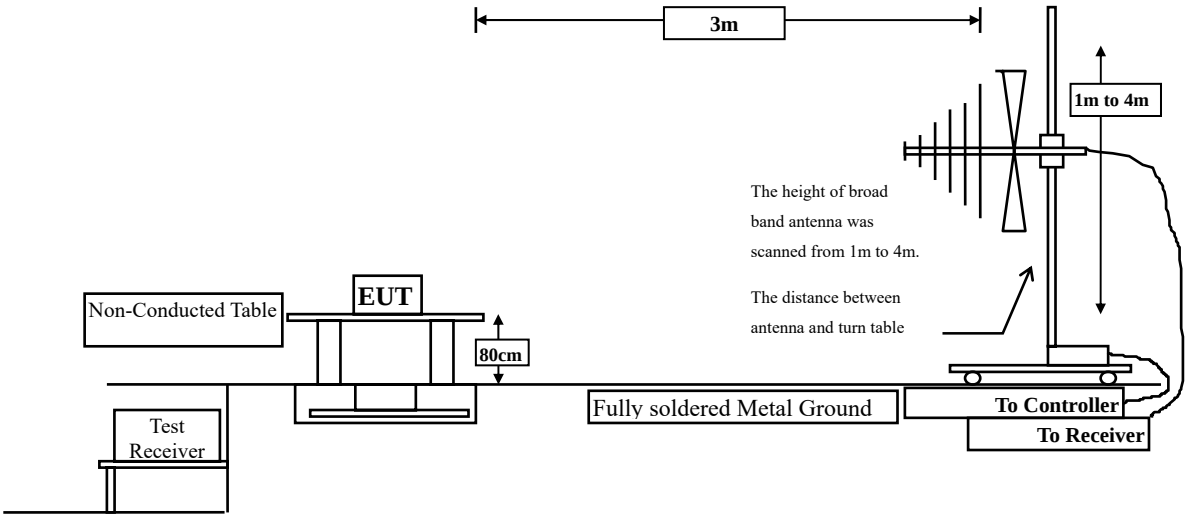
4. Radiated Emission

4.1. Test Setup

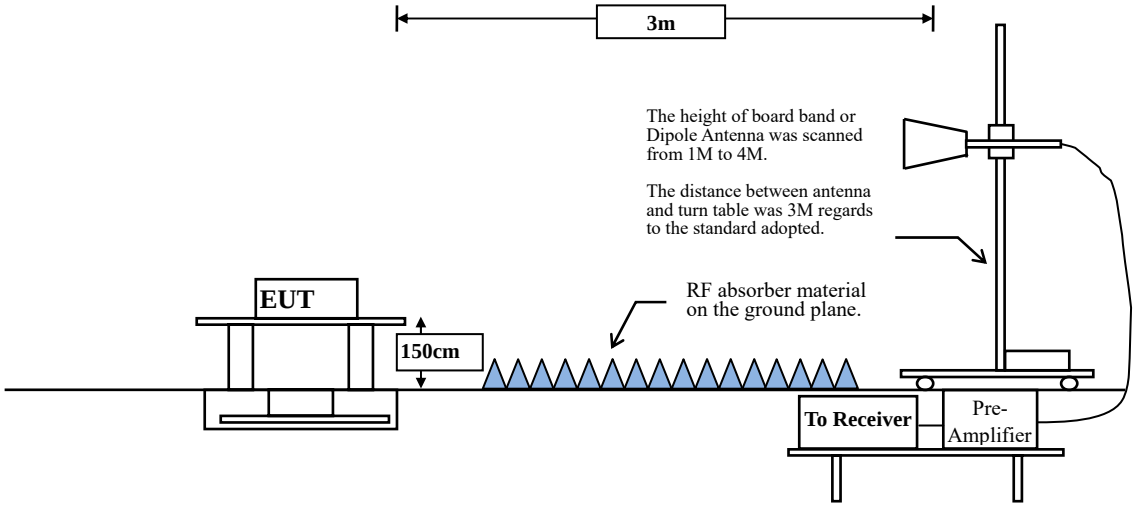
Radiated Emission Under 30MHz



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	85.55	2.1449	466	500

Note: Duty Cycle Refer to Section 9

4.4. Uncertainty

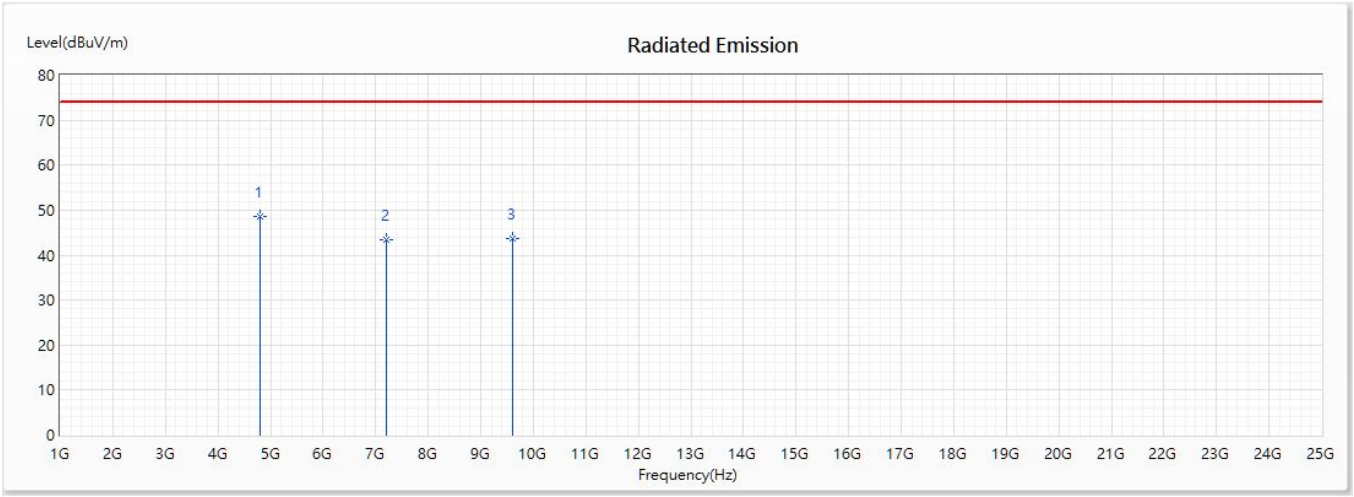
± 4.08 dB above 1GHz

± 4.22 dB below 1GHz

4.5. Test Result of Radiated Emission

Product : Portable computer
Test Item : Harmonic Radiated Emission
Test Mode : Mode 1: Transmit - BLE(2402MHz)
Test Date : 2020/05/14

Horizontal



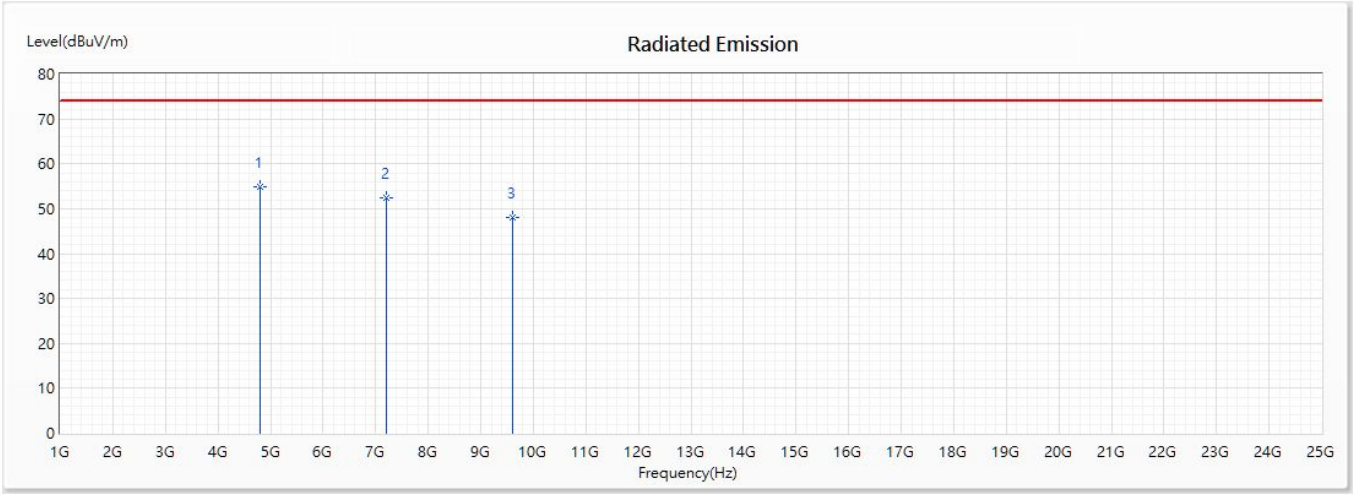
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
* 1	4804	48.66	74.00	-25.34	60.81	-12.15	PK
2	7206	43.41	74.00	-30.59	56.55	-13.14	PK
3	9608	43.57	74.00	-30.43	56.99	-13.42	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Emission 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	:	Portable computer
Test Item	:	Harmonic Radiated Emission
Test Mode	:	Mode 1: Transmit - BLE (2402MHz)
Test Date	:	2020/05/14

Vertical



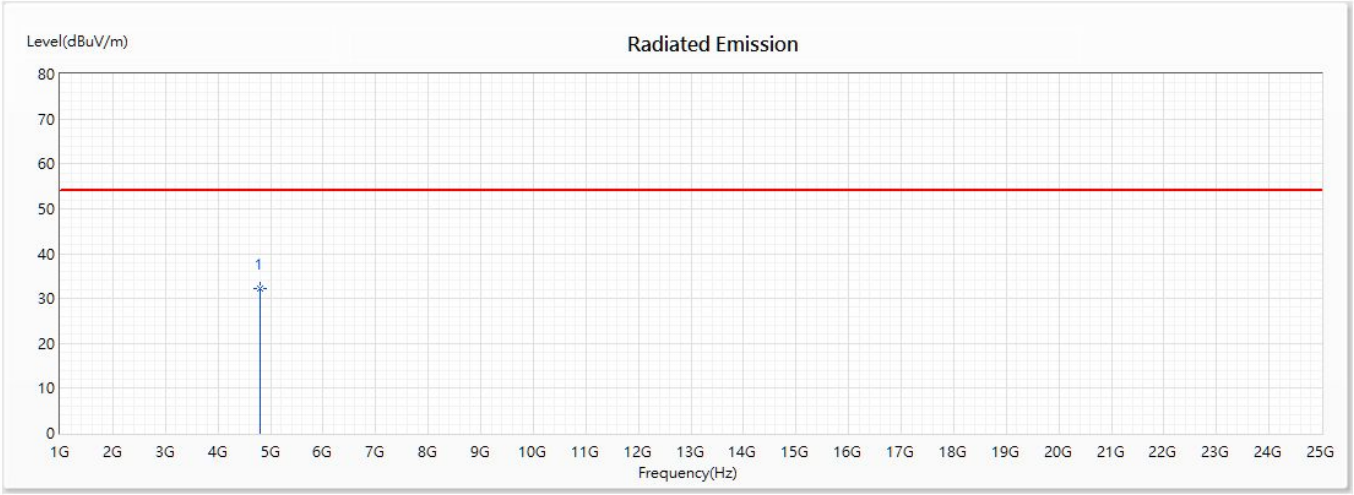
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
* 1	4804	54.95	74.00	-19.05	67.10	-12.15	PK
2	7206	52.41	74.00	-21.59	65.55	-13.14	PK
3	9608	48.08	74.00	-25.92	61.50	-13.42	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Emission 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	:	Portable computer
Test Item	:	Harmonic Radiated Emission
Test Mode	:	Mode 1: Transmit - BLE (2402MHz)
Test Date	:	2020/05/14

Vertical



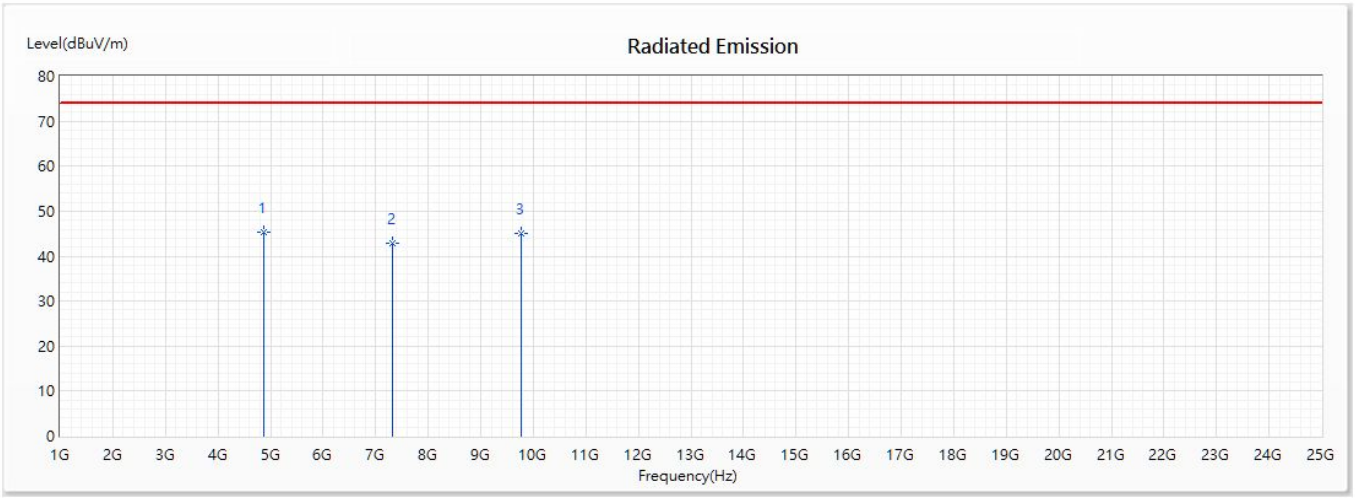
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
* 1	4804	32.31	54.00	-21.69	44.46	-12.15	AV

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Emission 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	:	Portable computer
Test Item	:	Harmonic Radiated Emission
Test Mode	:	Mode 1: Transmit - BLE(2440MHz)
Test Date	:	2020/05/14

Horizontal



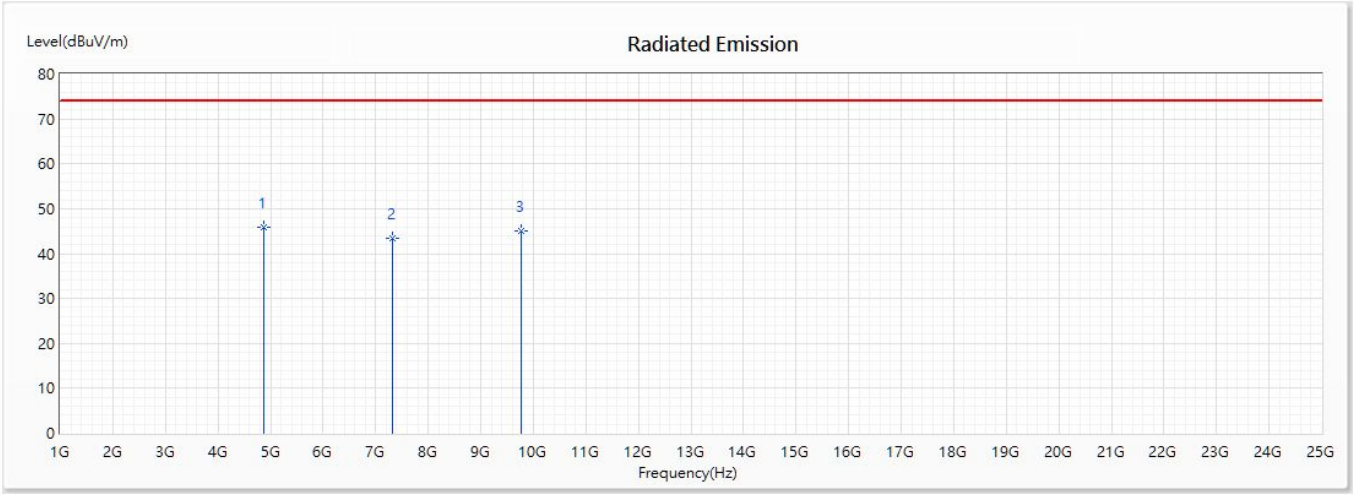
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
* 1	4880	45.36	74.00	-28.64	56.96	-11.60	PK
2	7320	42.97	74.00	-31.03	56.52	-13.55	PK
3	9760	45.02	74.00	-28.98	57.50	-12.48	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Emission 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	:	Portable computer
Test Item	:	Harmonic Radiated Emission
Test Mode	:	Mode 1: Transmit - BLE (2440MHz)
Test Date	:	2020/05/14

Vertical



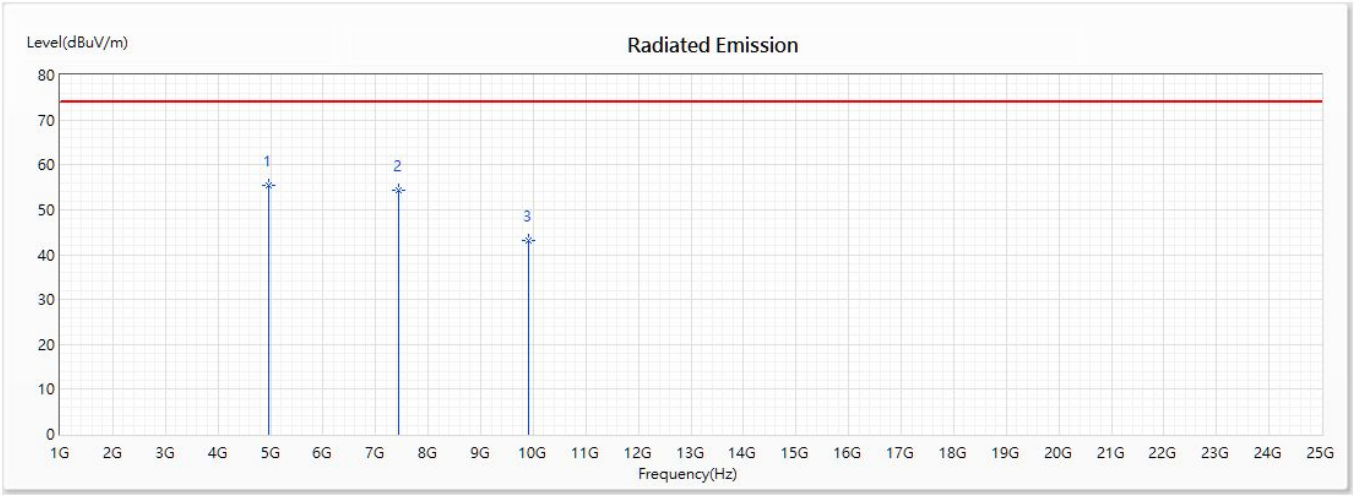
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
* 1	4880	45.81	74.00	-28.19	57.41	-11.60	PK
2	7320	43.31	74.00	-30.69	56.86	-13.55	PK
3	9760	44.93	74.00	-29.07	57.41	-12.48	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Emission 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	:	Portable computer
Test Item	:	Harmonic Radiated Emission
Test Mode	:	Mode 1: Transmit - BLE (2480MHz)
Test Date	:	2020/05/14

Horizontal



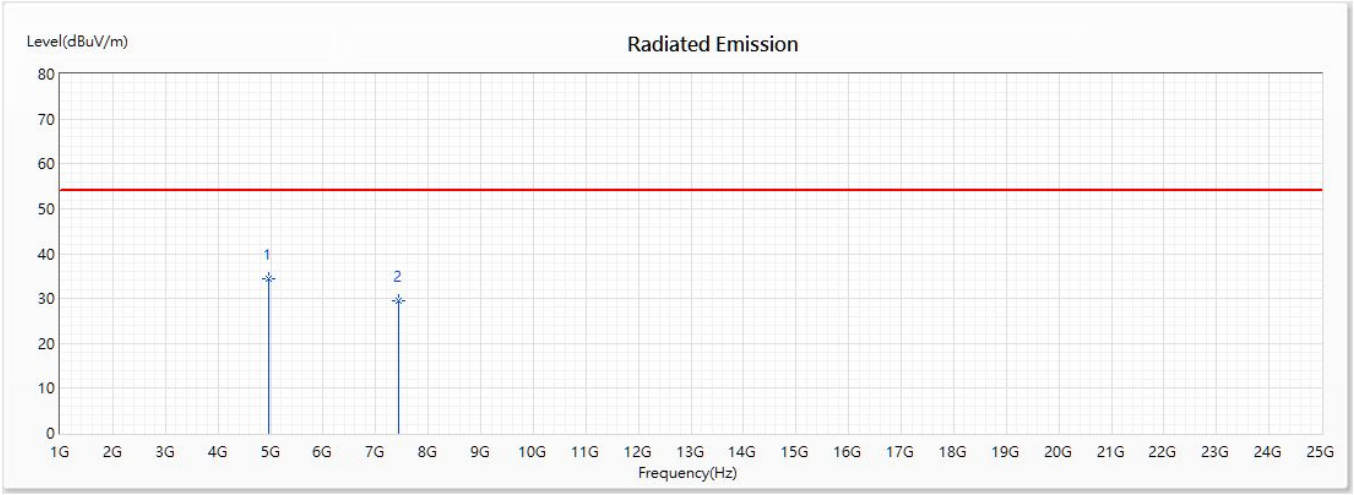
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
* 1	4960	55.41	74.00	-18.59	66.30	-10.89	PK
2	7440	54.23	74.00	-19.77	68.85	-14.62	PK
3	9920	43.01	74.00	-30.99	57.24	-14.23	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Emission 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	:	Portable computer
Test Item	:	Harmonic Radiated Emission
Test Mode	:	Mode 1: Transmit - BLE (2480MHz)
Test Date	:	2020/05/14

Horizontal



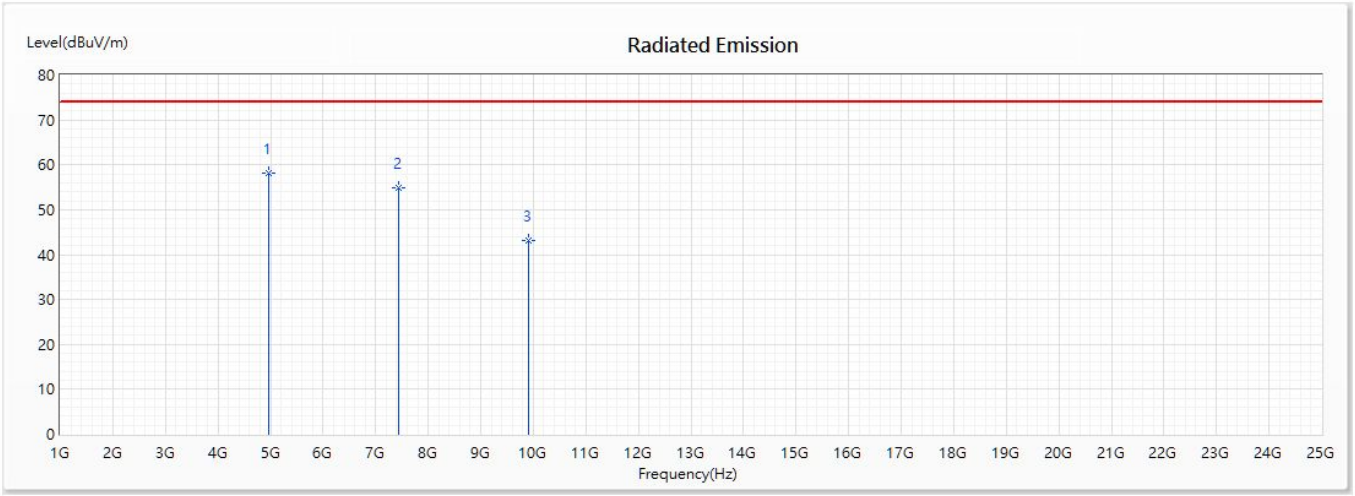
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
* 1	4960	34.38	54.00	-19.62	45.27	-10.89	AV
2	7440	29.53	54.00	-24.47	44.15	-14.62	AV

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Emission 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 : Portable computer
Test Item : Harmonic Radiated Emission
Test Mode : Mode 1: Transmit - BLE (2480MHz)
Test Date : 2020/05/14

Vertical



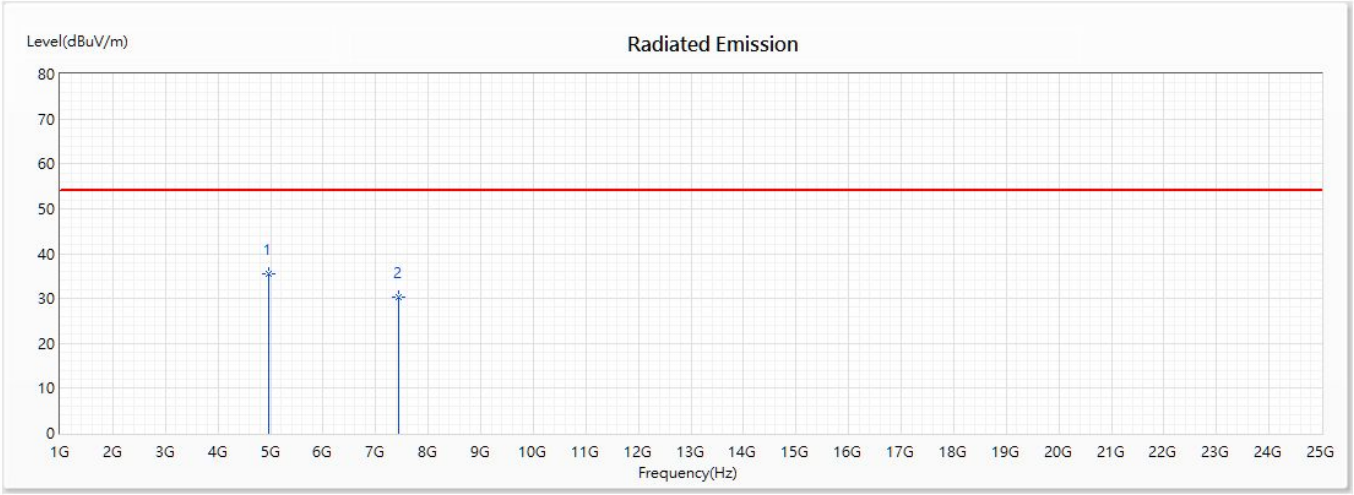
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
* 1	4960	58.18	74.00	-15.82	69.07	-10.89	PK
2	7440	54.88	74.00	-19.12	69.50	-14.62	PK
3	9920	43.18	74.00	-30.82	57.41	-14.23	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Emission 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	:	Portable computer
Test Item	:	Harmonic Radiated Emission
Test Mode	:	Mode 1: Transmit - BLE (2480MHz)
Test Date	:	2020/05/14

Vertical



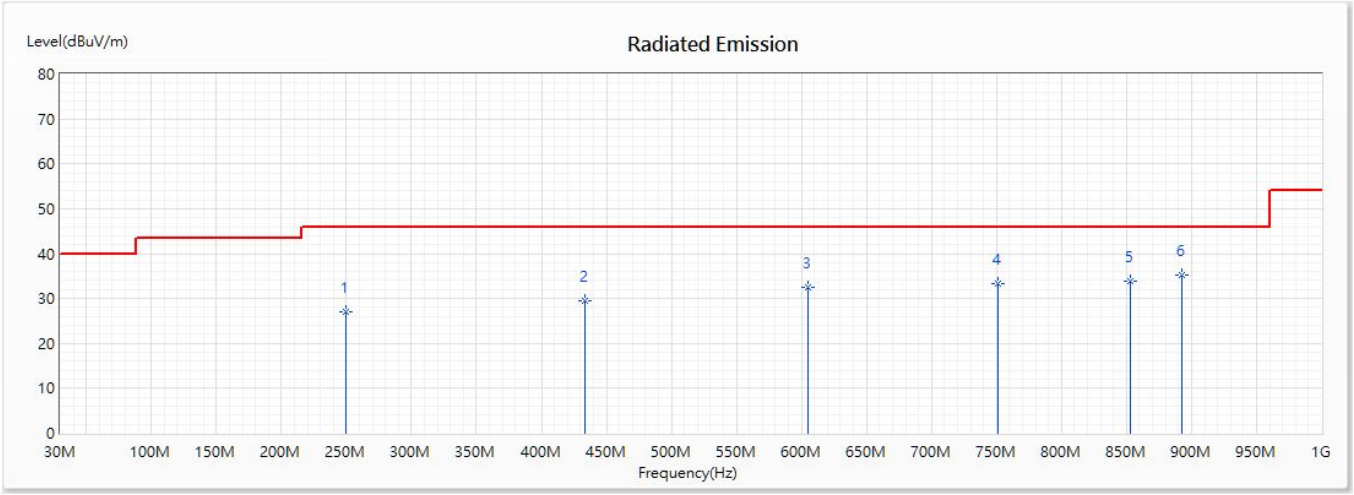
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
* 1	4960	35.46	54.00	-18.54	46.35	-10.89	AV
2	7440	30.41	54.00	-23.59	45.03	-14.62	AV

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Emission 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	:	Portable computer
Test Item	:	General Radiated Emission
Test Mode	:	Mode 1: Transmit - BLE (2440MHz)
Test Date	:	2020/05/14

Horizontal



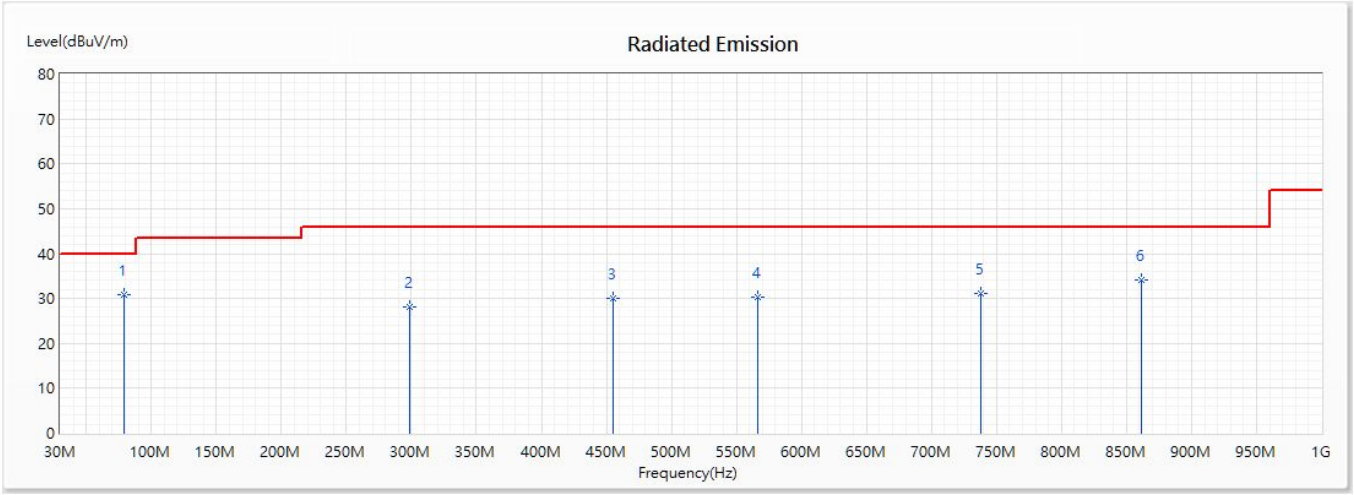
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
1	249.22	27.08	46.00	-18.92	38.53	-11.45	QP
2	433.52	29.62	46.00	-16.38	33.68	-4.06	QP
3	605.21	32.47	46.00	-13.53	33.02	-0.55	QP
4	750.71	33.22	46.00	-12.78	33.76	-0.54	QP
5	852.56	33.76	46.00	-12.24	35.88	-2.12	QP
* 6	892.33	35.30	46.00	-10.70	38.30	-3.00	QP

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Emission 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	:	Portable computer
Test Item	:	General Radiated Emission
Test Mode	:	Mode 1: Transmit - BLE (2440MHz)
Test Date	:	2020/05/14

Vertical



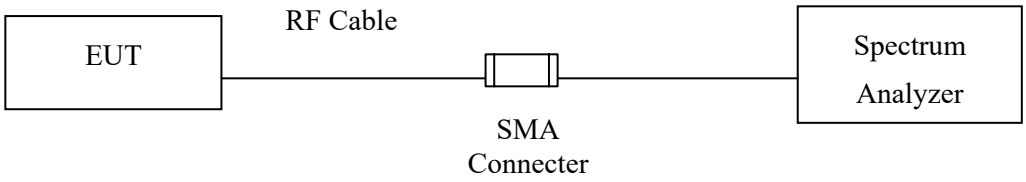
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Detector Type
* 1	79.47	30.79	40.00	-9.21	42.89	-12.10	QP
2	298.69	28.11	46.00	-17.89	36.64	-8.53	QP
3	454.86	30.08	46.00	-15.92	34.04	-3.96	QP
4	566.41	30.30	46.00	-15.70	33.34	-3.04	QP
5	738.1	31.15	46.00	-14.85	30.79	0.36	QP
6	861.29	34.01	46.00	-11.99	36.12	-2.11	QP

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Emission 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. Uncertainty

±1.20dB

5.5. Test Result of RF Antenna Conducted Test

Product : Portable computer
Test Item : RF Antenna Conducted Test
Test Mode : Mode 1: Transmit - BLE
Test Date : 2020/05/14

Figure Channel 00:

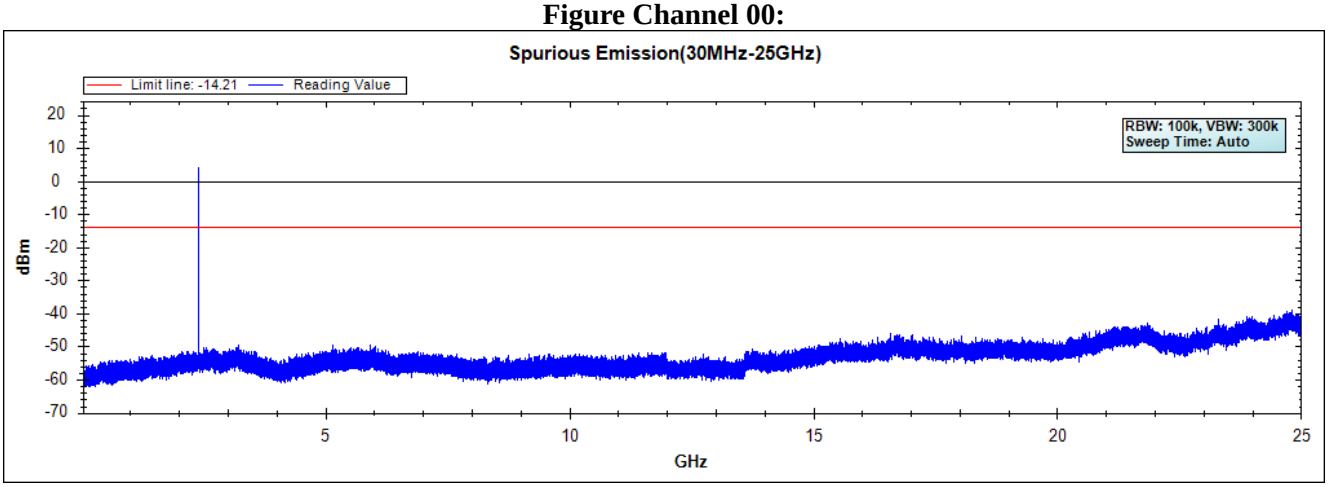


Figure Channel 19:

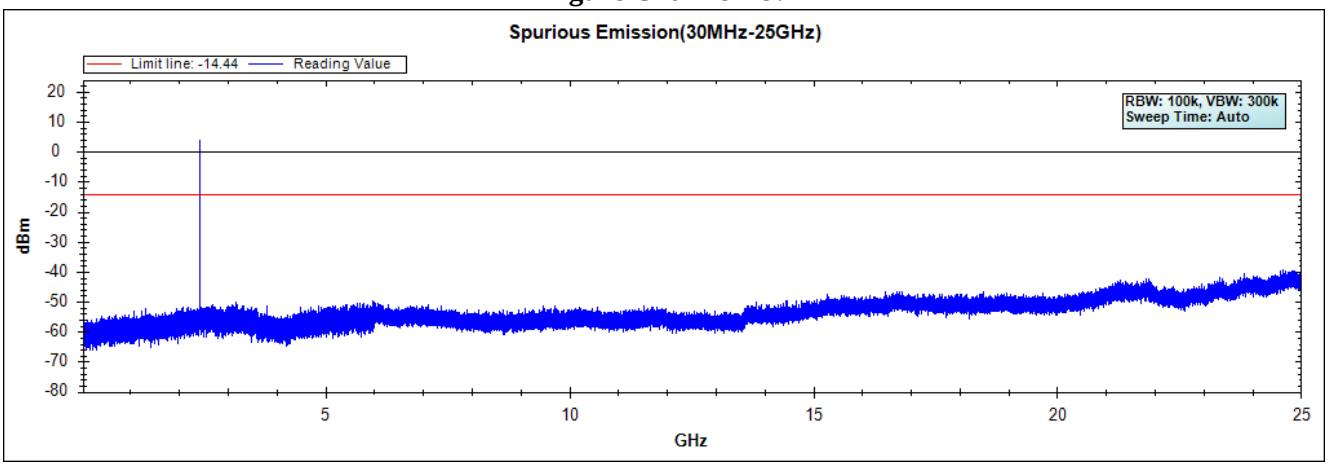
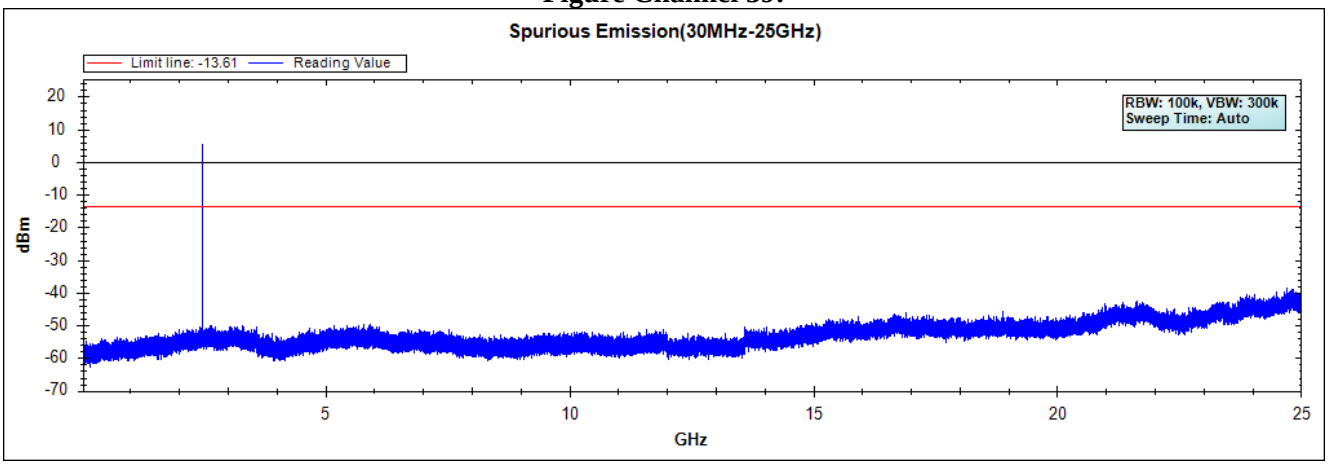


Figure Channel 39:

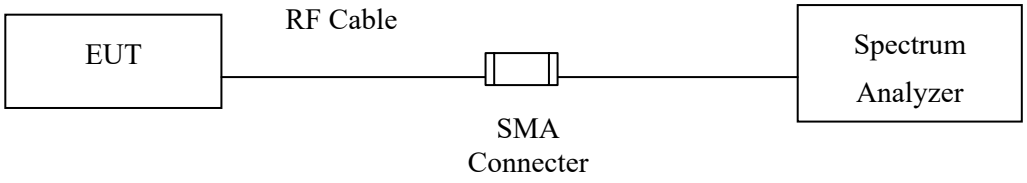


Note: The above test pattern is synthesized by multiple of the frequency range.

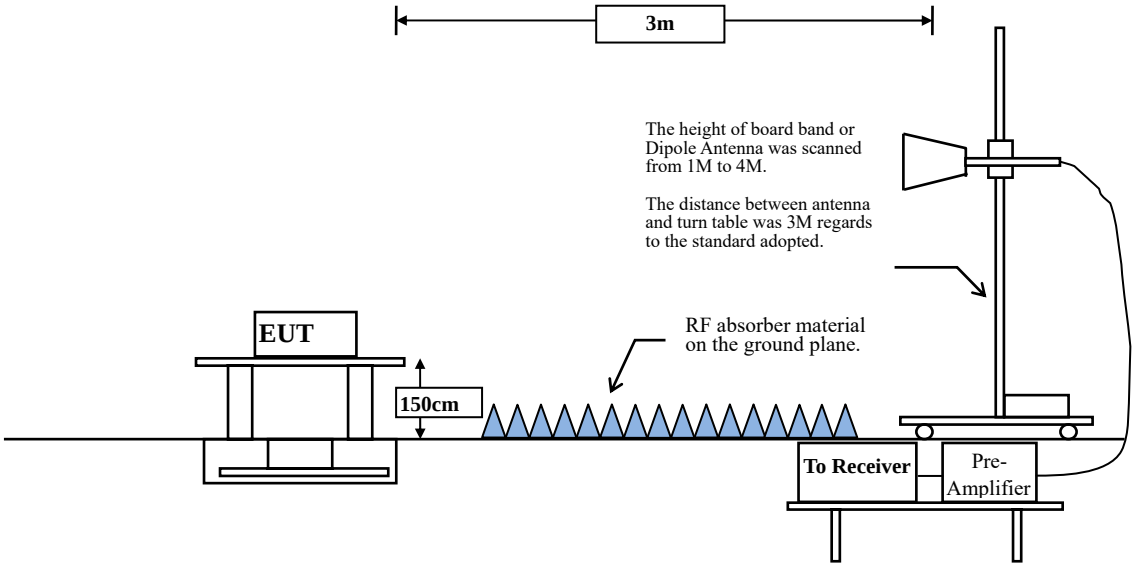
6. Band Edge

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	85.55	2.1449	466	500

Note: Duty Cycle Refer to Section 9

6.4. Uncertainty

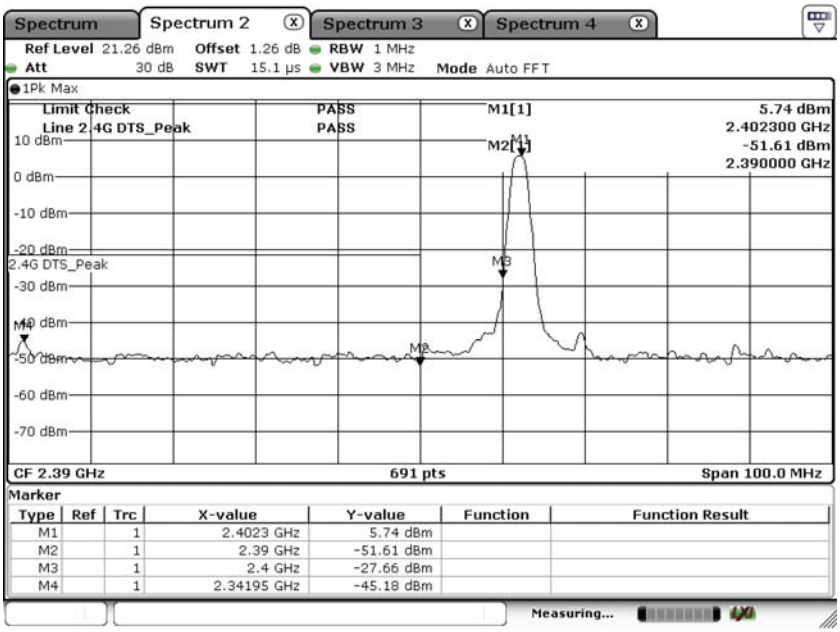
± 4.08 dB above 1GHz

± 4.22 dB below 1GHz

6.5. Test Result of Band Edge

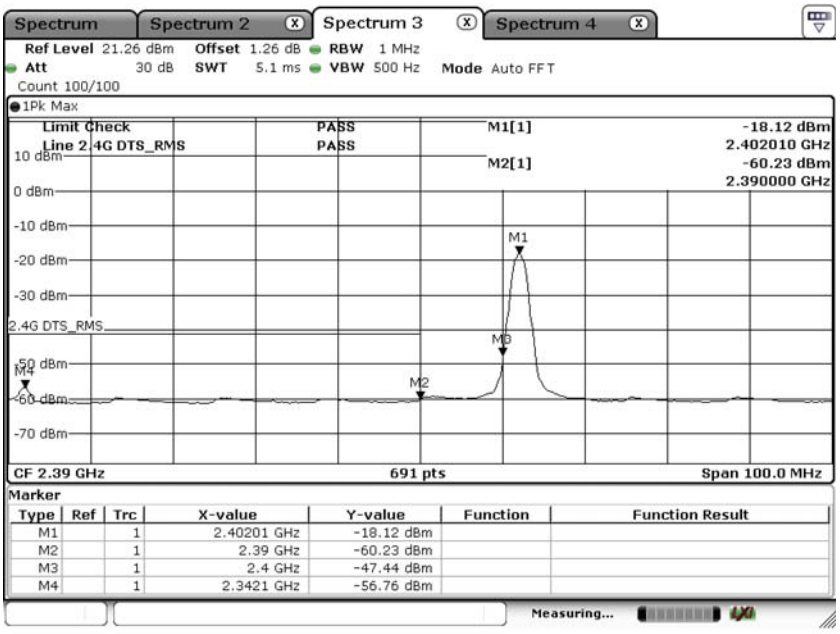
Product : Portable computer
Test Item : Band Edge
Test Mode : Mode 1: Transmit - BLE (2402MHz)
Test Date : 2020/05/13

Peak:



Date: 13.MAY.2020 08:58:50

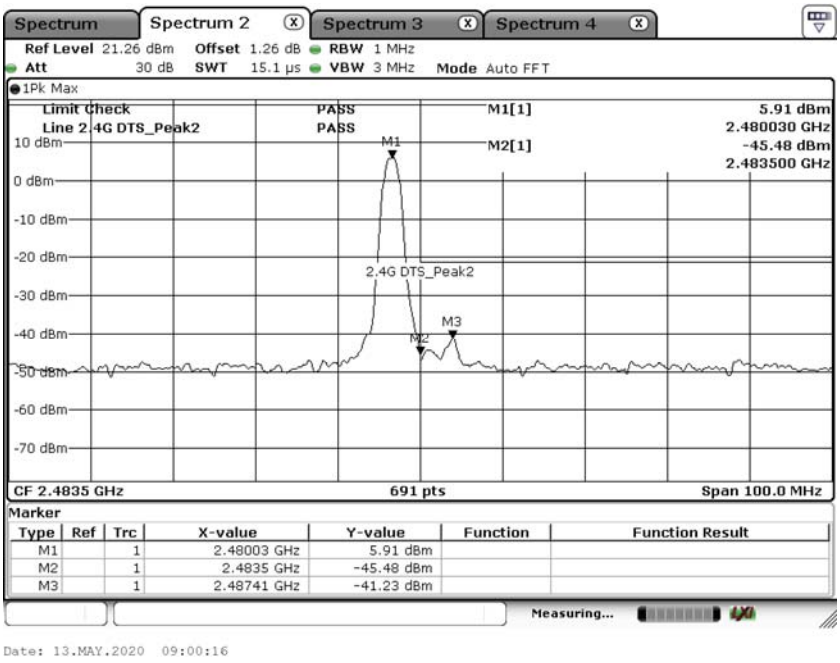
Average:



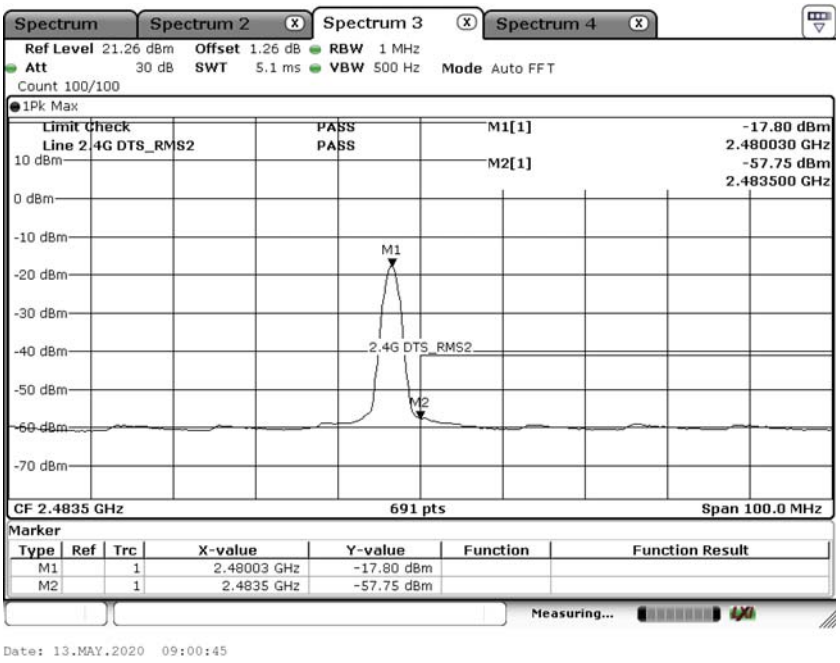
Date: 13.MAY.2020 08:59:31

Product	:	Portable computer
Test Item	:	Band Edge
Test Mode	:	Mode 1: Transmit - BLE (2480MHz)
Test Date	:	2020/05/13

Peak:

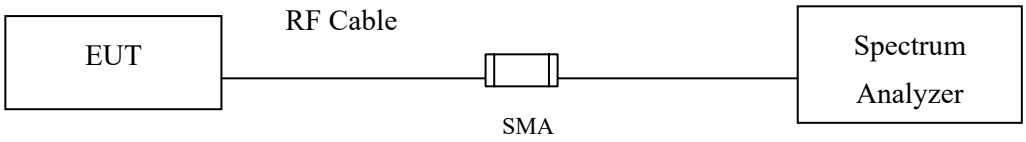


Average:



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. Uncertainty

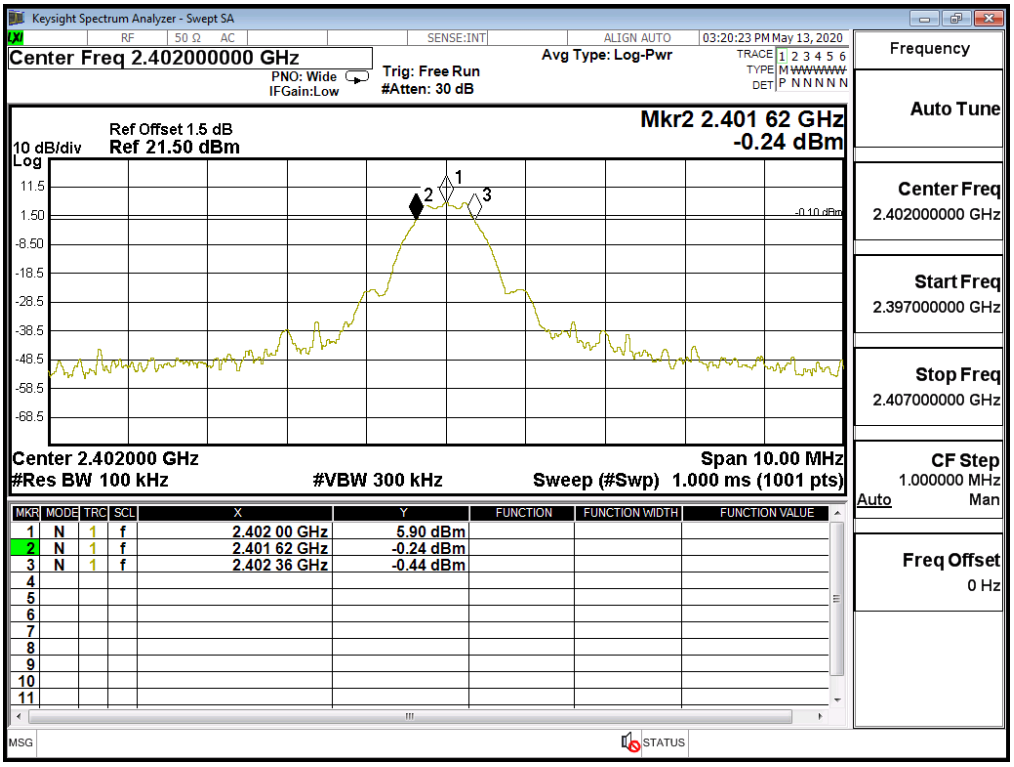
±283Hz

7.5. Test Result of 6dB Bandwidth

Product : Portable computer
Test Item : 6dB Bandwidth Data
Test Mode : Mode 1: Transmit - BLE (2402MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
00	2402	740	>500	Pass

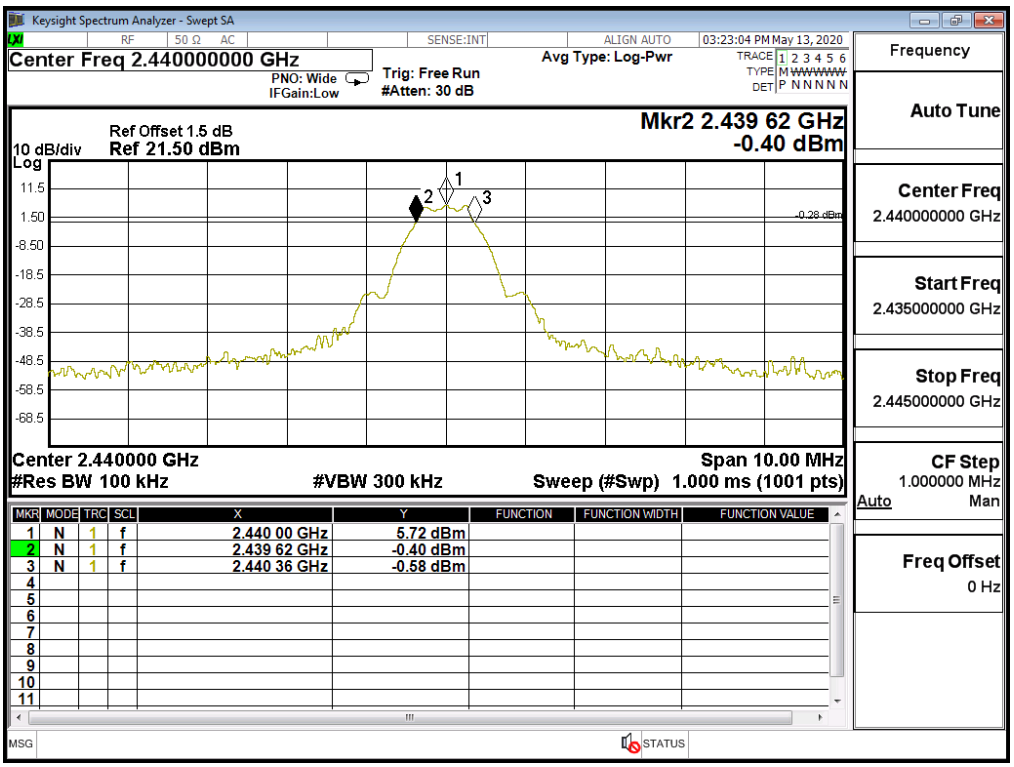
Figure Channel 00:



Product : Portable computer
Test Item : 6dB Bandwidth Data
Test Mode : Mode 1: Transmit - BLE (2440MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
19	2440	740	>500	Pass

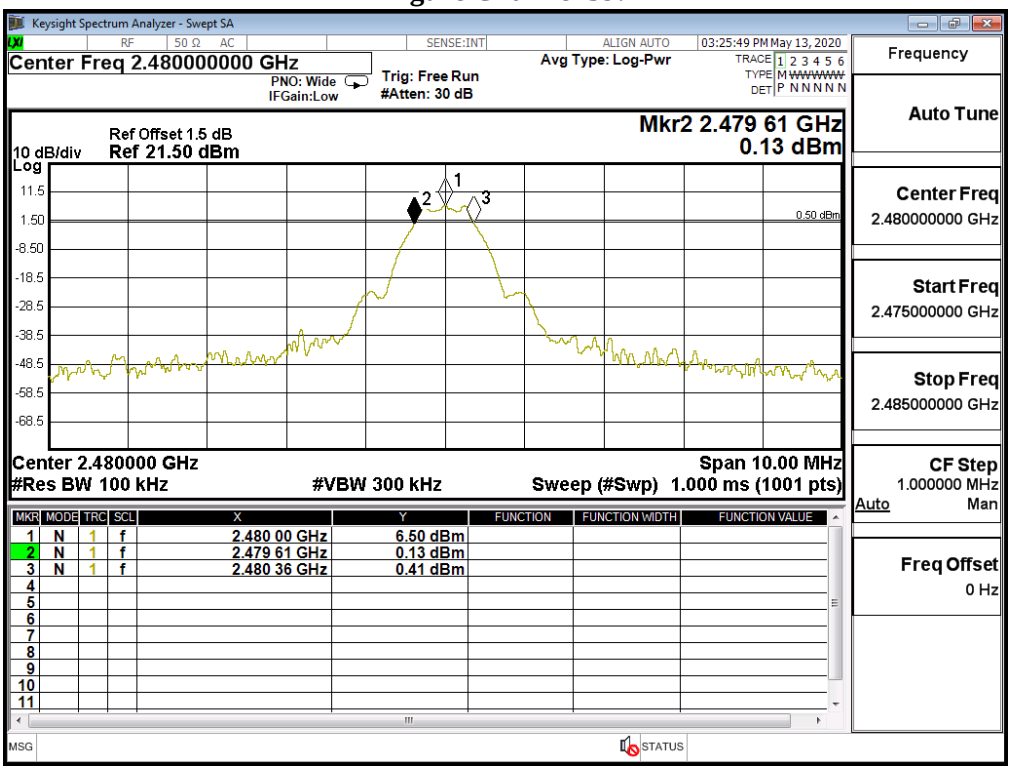
Figure Channel 19:



Product : Portable computer
Test Item : 6dB Bandwidth Data
Test Mode : Mode 1: Transmit - BLE (2480MHz)

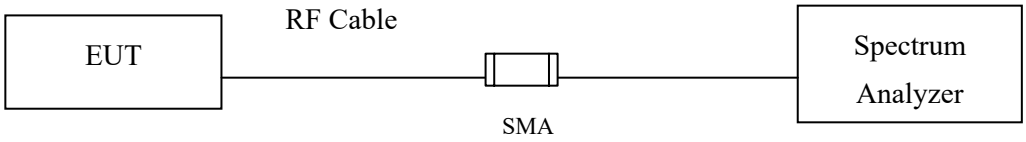
Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
39	2480	750	>500	Pass

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. Uncertainty

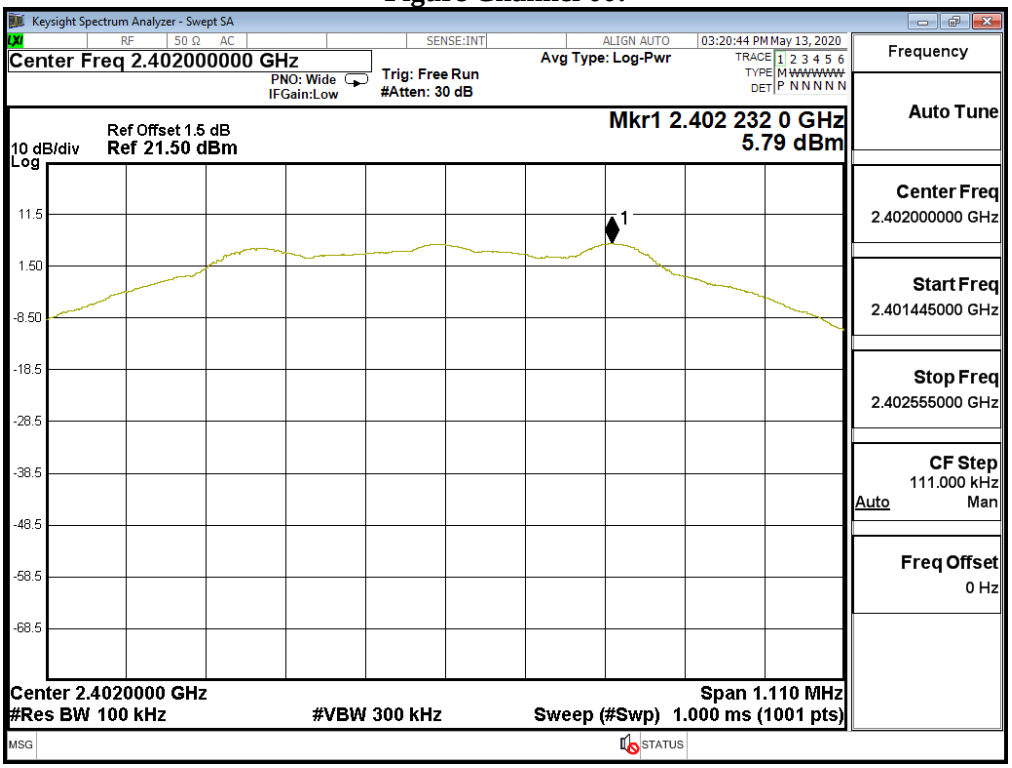
±1.20dB

8.5. Test Result of Power Density

Product : Portable computer
Test Item : Power Density Data
Test Mode : Mode 1: Transmit - BLE (2402MHz)

Channel No.	Frequency (MHz)	Measure Level (dBm)	Limit (dBm)	Result
00	2402	5.79	≦8dBm	Pass

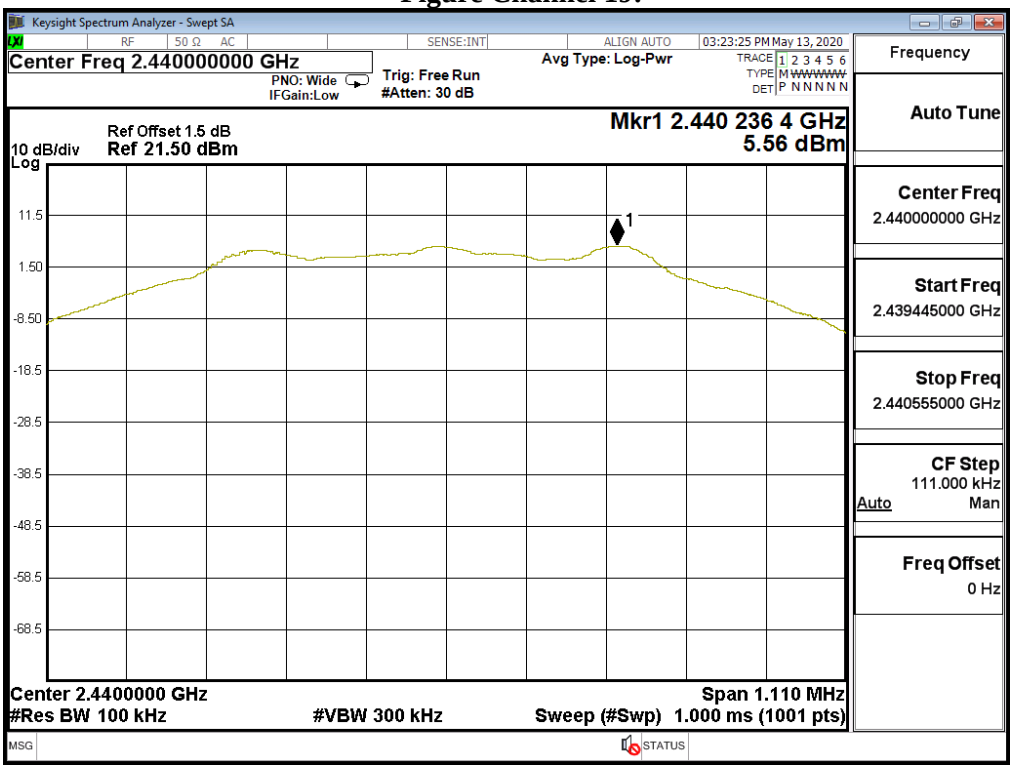
Figure Channel 00:



Product : Portable computer
Test Item : Power Density Data
Test Mode : Mode 1: Transmit - BLE (2440MHz)

Channel No.	Frequency (MHz)	Measurement Level (dBm)	Required Limit (dBm)	Result
19	2440	5.56	≦8dBm	Pass

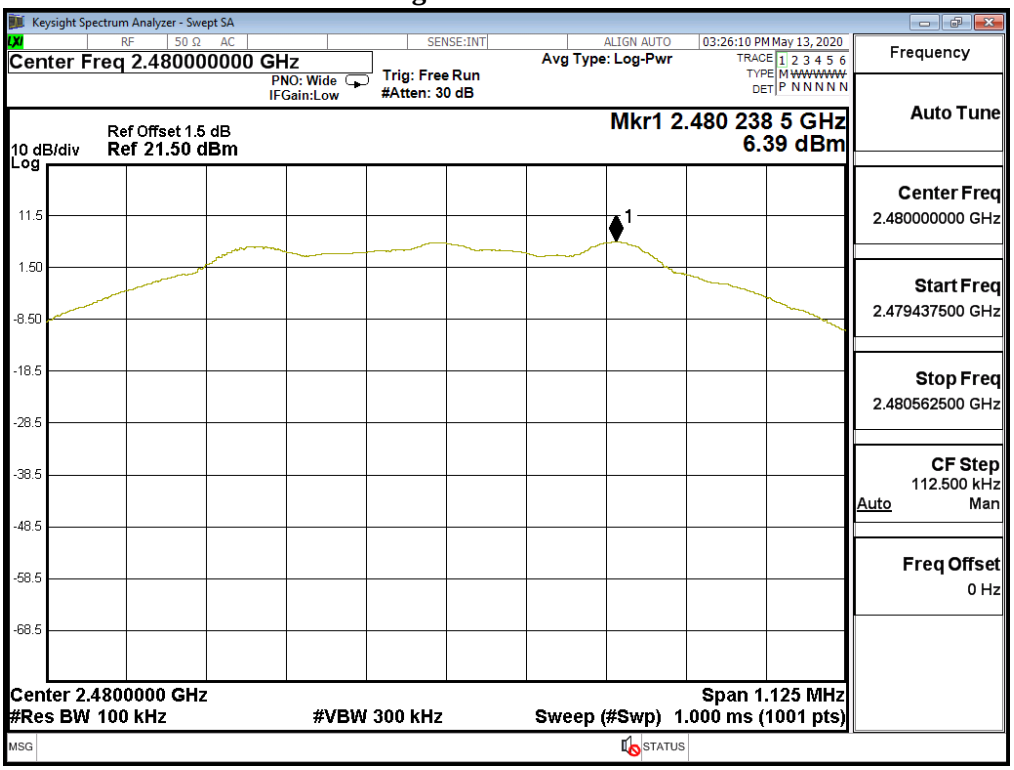
Figure Channel 19:



Product : Portable computer
Test Item : Power Density Data
Test Mode : Mode 1: Transmit - BLE (2480MHz)

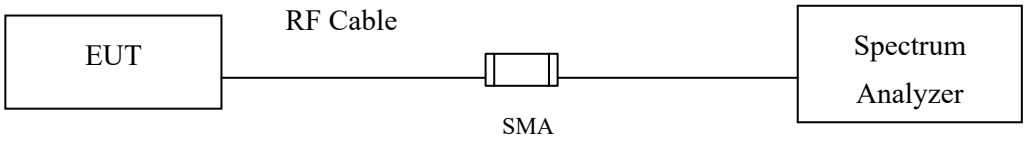
Channel No.	Frequency (MHz)	Measurement Level (dBm)	Required Limit (dBm)	Result
39	2480	6.39	≦8dBm	Pass

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. Uncertainty

± 2.31msec

9.4. Test Result of Duty Cycle

Product : Portable computer
Test Item : Duty Cycle
Test Mode : Mode 1: Transmit - BLE

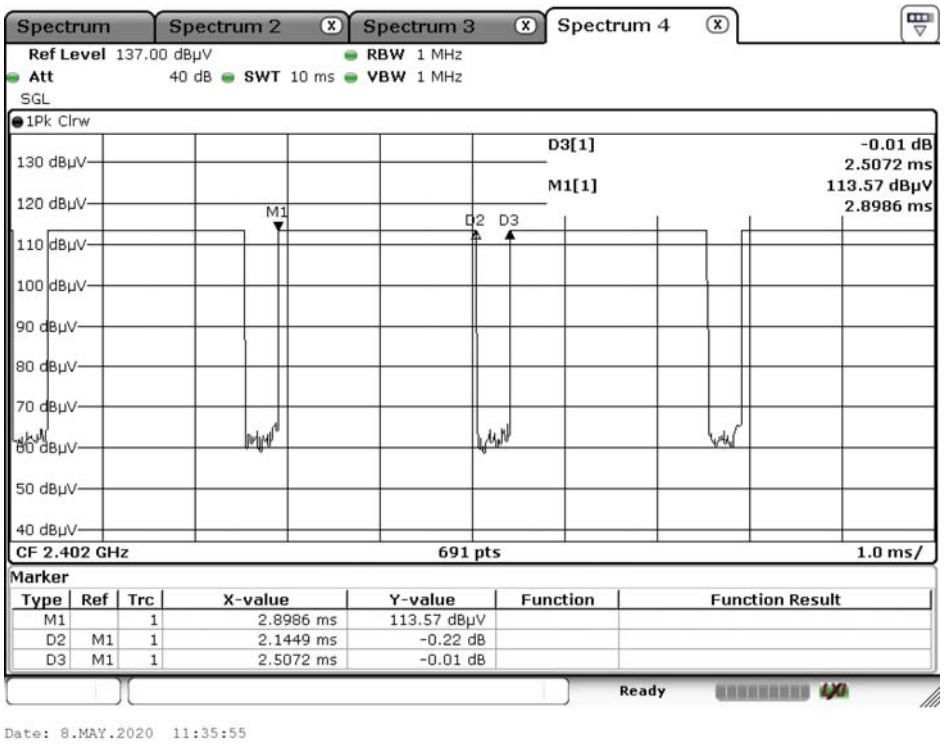
Duty Cycle Formula:

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	2.1449	2.5072	85.55	0.68



10. EMI Reduction Method During Compliance Testing

No modification was made during testing.