
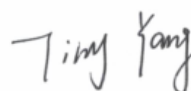


RF Test Report

For

Intwine Connect, LLC

Test Standards:	<u>Part 15C Subpart C §15.247</u> <u>IC RSS-247 Issue 2</u>
Product Name:	<u>Edge Computer</u>
Tested Model:	<u>ICG-200-NA</u>
Brand Name:	<u>Intwine</u>
FCC ID:	<u>2AZINICG200NA</u>
IC:	<u>27619-ICG200NA</u>
Classification	<u>(DTS) Digital Transmission System</u>
Report No.:	<u>EC2105008RF02</u>
Tested Date:	<u>2021-05-31 to 2021-07-08</u>
Issued Date:	<u>2021-07-08</u>
Prepared By:	 Jerry Wang / Engineer
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Note: The test results in this report apply exclusively to the tested model / sample. Without written approval of Hunan Ecloud Testing Technology Co., Ltd., the test report shall not be reproduced except in full.

Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	2021.07.08	Valid	Original Report

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Summary of Test RESULT

FCC Rule	IC Rule	Description	Limit	Result	Remark
15.247(a)(2)	RSS-247 5.2(a)	6dB Bandwidth	$\geq 0.5\text{MHz}$	Pass	-
-	RSS-Gen 6.7	99% Bandwidth	-	Pass	-
15.247(b)(3)	RSS-247 5.4(d)	Peak Output Power	$\leq 30\text{dBm}$	Pass	-
15.247(e)	RSS-247 5.2(b)	Power Spectral Density	$\leq 8\text{dBm}/3\text{kHz}$	Pass	-
15.247(d)	RSS-247 5.5	Conducted Band Edges and Spurious Emission	$\leq 20\text{dBc}$	Pass	-
15.247(d)	RSS-247 5.5	Radiated Band Edges and Spurious Emission	15.209(a) & 15.247(d) RSS-247 5.5 & RSS-Gen Table 5 , Table 6	Pass	Under limit 2.48 dB at 213.330 MHz
15.207	RSS-GEN 8.8	AC Conducted Emission	15.207(a) RSS-GEN 8.8 Table 4	Pass	Under limit 22.98 dB at 18.622 MHz
15.203 & 15.247(b)	RSS-GEN 6.8	Antenna Requirement	15.203 & 15.247(b) RSS-GEN 6.8	Pass	-

1. Test Laboratory

1.1 Test facility

CNAS (accreditation number:L11138)

Hunan Ecloud Testing Technology Co., Ltd. has obtained the accreditation of China National Accreditation Service for Conformity Assessment (CNAS).

FCC (Designation number:CN1244 , Test Firm Registration

Number:793308)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

ISED(CAB identifier: CN0012, ISED# :24347)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the Wireless Device Testing Laboratories list of innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements.

A2LA (Certificate Number:4895.01)

Hunan Ecloud Testing Technology Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

2. General Description

2.1 Applicant

Intwine Connect, LLC

8401 Chagrin Road, Suite 10A, Chagrin Falls, OH 44023

2.2 Manufacturer

Intwine Connect, LLC

8401 Chagrin Road, Suite 10A, Chagrin Falls, OH 44023

2.3 General Description Of EUT

Product	Edge Computer
Model No.	ICG-200-NA
Brand Name	Intwine
Additional No.	N/A
Difference Description	N/A
FCC ID	2AZINICG200NA
IC	27619-ICG200NA
Power Supply	DC 12V of EUT
Modulation Technology	BLE
Modulation Type	GFSK
Operating Frequency	2402MHz~2480MHz
Number Of Channel	40
Max. Output Power	3.88 dBm (0.0024 W)
Max. e.i.r.p.	6.88 dBm (0.0049W)
Antenna Type	Suction cup Antenna with 3dBi gain
HW Version	V10
SW Version	V1.4
I/O Ports	Refer to user's manual

NOTE:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
2. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.

3. Antenna listed as below

Cable No.	Description	Connector	Length	Supplied by
1	WIFI /BT Antenna	RP-SMA-J	2.5m	Applicant
2	3/4G Antenna	SMA-J	2.0m	Applicant
3	3/4G Antenna	SMA-J	2.0m	Applicant

4. The EUT was powered by the following adapters:

MODEL:	KT241120200M2
INPUT:	100-240V~50/60Hz 0.8A
OUTPUT:	12V DC 2A
DC LINE:	2.5 m

2.4 Modification of EUT

No modifications are made to the EUT during all test items.

2.5 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ FCC Part 15 Subpart C §15.247
- ♦ ANSI C63.10-2013
- ♦ KDB 558074 D01 15.247 Meas Guidance v05r02
- ♦ IC RSS-247 Issue 2
- ♦ IC RSS-Gen Issue 5

Remark:

1. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B&ICES-003, recorded in a separate test report.

3. Test Configuration of Equipment Under Test

3.1 Descriptions of Test Mode

The transmitter has a maximum peak conducted output power as follows:

Channel	Frequency	Mode	Bluetooth RF Output Power
Ch00	2402MHz	GFSK	3.74
Ch19	2440MHz	GFSK	3.88
Ch39	2480MHz	GFSK	3.07

- a. Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

3.2 Test Mode

3.2.1 Antenna Port Conducted Measurement

Summary table of Test Cases	
Test Item	Data Rate / Modulation
	Bluetooth 4.0 – LE GFSK
Conducted Test Cases	Mode 1: CH00_2402 MHz
	Mode 2: CH19_2440 MHz
	Mode 3: CH39_2480 MHz

3.2.2 Radiated Emission Test (Below 1GHz)

Radiated Test Cases	Bluetooth 4.0 – LE GFSK
	Mode 1: CH00_2402 MHz

- Note : 1. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type. Z orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Z orientation.
2. Following channel(s) was (were) selected for the final test as listed above

3.2.3 Radiated Emission Test (Above 1GHz)

Radiated Test Cases	Bluetooth 4.0 – LE GFSK
	Mode 1: CH00_2402 MHz Mode 2: CH19_2440 MHz

Mode 3: CH39_2480 MHz

- Note : 1. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z it was determined that Z orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Z orientation.
2. Following channel(s) was (were) selected for the final test as listed above
3. For frequency above 18GHz, the measured value is much lower than the limit, therefore, it is not reflected in the report.

3.2.4 Power Line Conducted Emission Test:

AC Conducted Emission	Mode 1 : BT Linking + RJ45 ping + HDMI + USB Playing + Adapter
--------------------------------------	--

3.3 Support Equipment

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	WLAN AP	NETGARE	R7800	PY315100319	N/A	unshielded AC I/P cable1.2 m
2.	Notebook	Lenovo	E470C	FCC SDOC	N/A	shielded cable DC O/P 1.8 m unshielded AC I/P cable1.2 m
3.	Computer Monitor	PHILIPS	243E9Q	SDOC	UK0A1947000361	N/A
4.	Keyboard	Lenovo	EKB-536A	SDOC	801J9679	NA
5.	Mouse	Logitech	U0026	SDOC	810-002149	NA

3.4 Test Setup

The EUT is continuously communicating to the Bluetooth tester during the tests.

EUT was set in the Hidden menu mode to enable BT communications.

The following picture is a screenshot of the test software

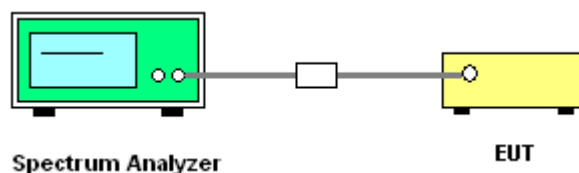
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C:\Windows\system32\cmd.exe - adb shell
root@linaro-alip:/# /userdata/bt_test.sh
bcm_patchram_plus1: no process found
proc_resetsend hci_download_minidriverproc_resetDone setting line discipline
hci0:  Type: Primary  Bus: UART
      BD Address: D4:12:43:C4:93:DD  ACL MTU: 1021:7  SCO MTU: 64:1
      UP RUNNING
      RX bytes:841 acl:0 sco:0 events:57 errors:0
      TX bytes:4006 acl:0 sco:0 commands:57 errors:0

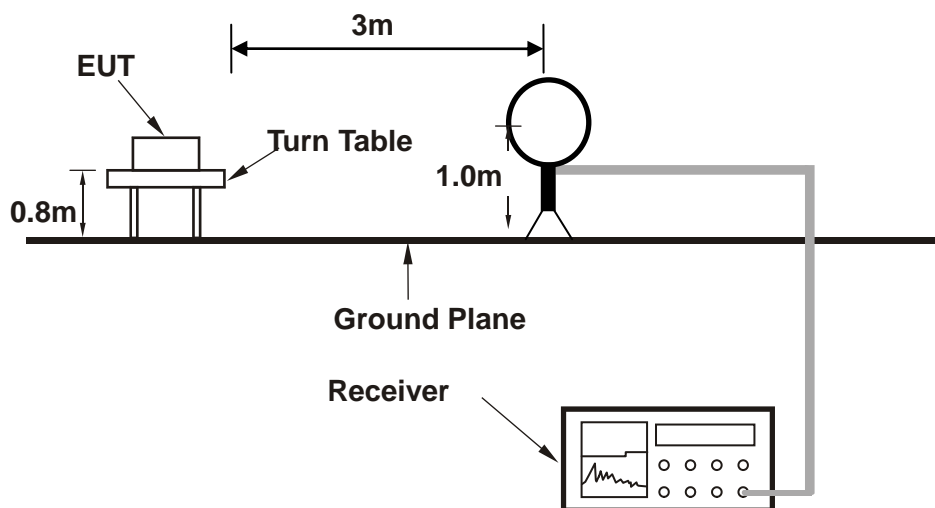
< HCI Command: ogf 0x03, ocf 0x0003, plen 0
> HCI Event: 0x0e plen 4
01 03 0C 00
< HCI Command: ogf 0x03, ocf 0x001a, plen 1
03
> HCI Event: 0x0e plen 4
01 1A 0C 00
< HCI Command: ogf 0x03, ocf 0x0005, plen 3
02 00 02
> HCI Event: 0x0e plen 4
01 05 0C 00
< HCI Command: ogf 0x06, ocf 0x0003, plen 0
> HCI Event: 0x0e plen 4
01 03 18 00
root@linaro-alip:/#

```

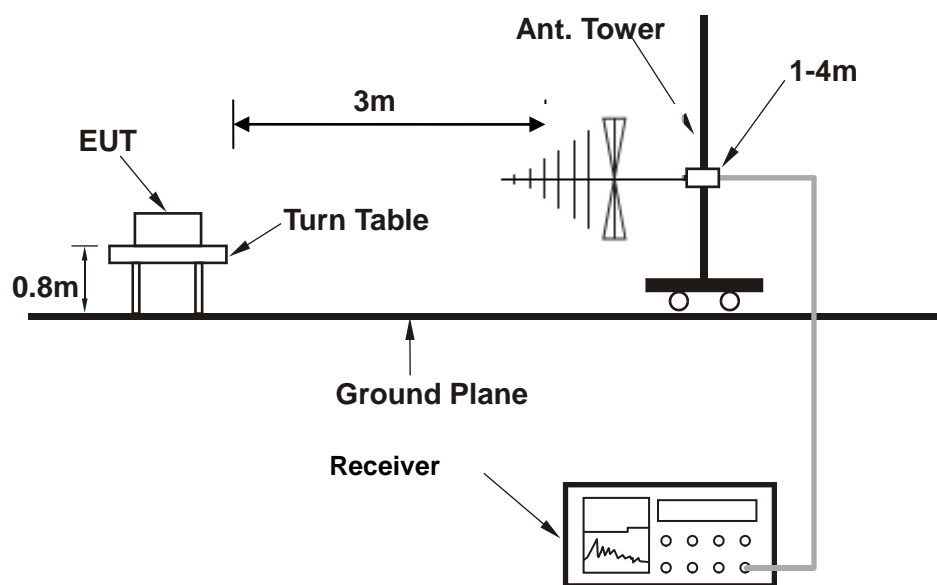
Setup diagram for Conducted Test



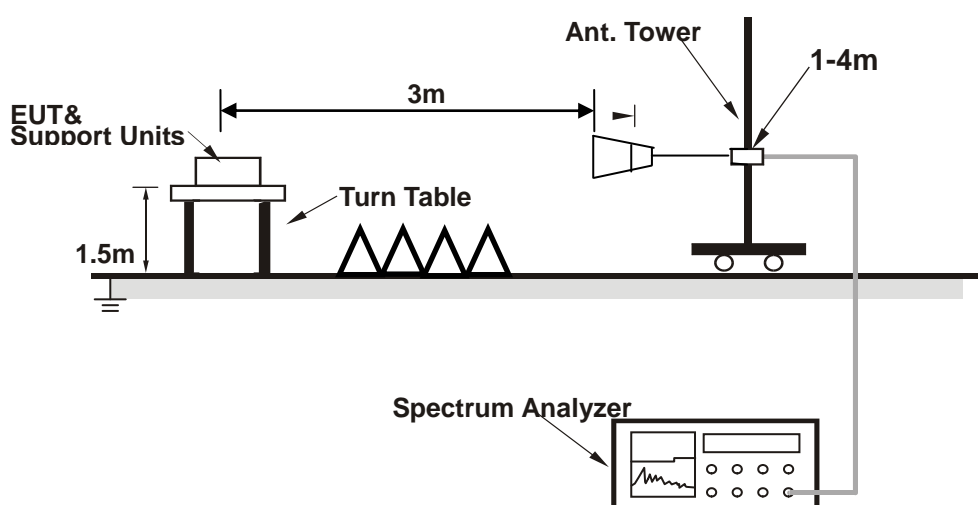
Setup diagram for Radiation(9KHz~30MHz) Test



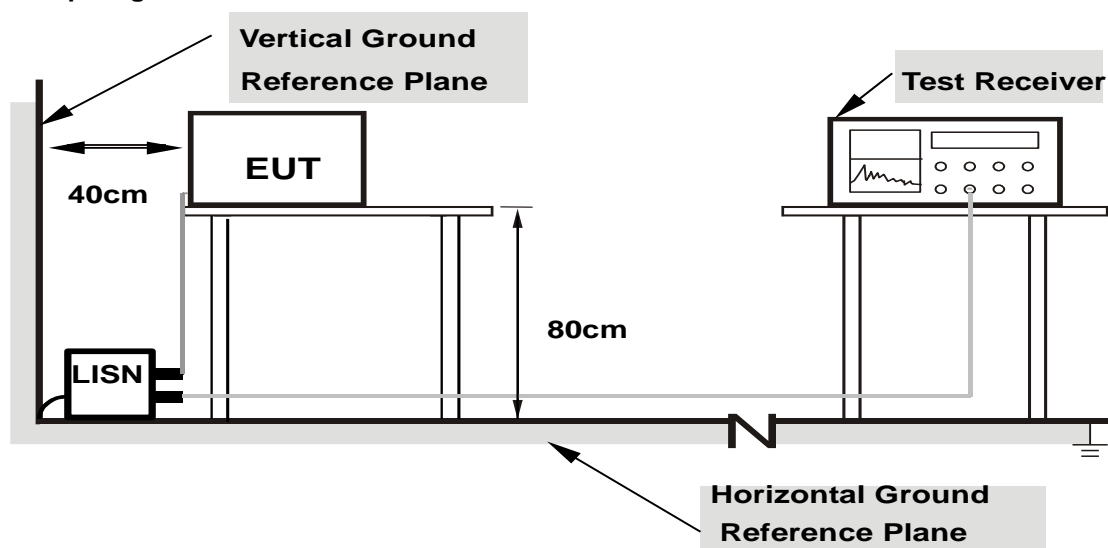
Setup diagram for Radiation(Below 1G) Test



Setup diagram for Radiation (Above1G) Test



Setup diagram for AC Conducted Emission Test



Note: 1.Support units were connected to second LISN.

2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

3.5 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 5 dB and 10dB attenuator.

$$\begin{aligned} \text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)}. \\ &= 5 + 10 = 15 \text{ (dB)} \end{aligned}$$

For all radiated test items:

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

Over Limit (dB μ V/m) = Level(dB μ V/m) - Limit Level (dB μ V/m)

4. Test Result

4.1 6dB and 99% Bandwidth Measurement

4.1.1 Limit of 6dB and 99% Bandwidth

FCC §15.247 (a) (2)

IC RSS-247 5.2(a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

4.1.2 Test Procedures

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument.
3. Set to the maximum power setting and enable the EUT transmit continuously
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 30kHz and set the Video bandwidth (VBW) = 100kHz.

4.1.3 Test Result of 6dB Bandwidth

Refer to Appendix A of this test report.

4.1.4 Test Result of 99% Bandwidth

Refer to Appendix B of this test report.

4.2 Peak Output Power Measurement

4.2.1 Limit of Peak Output Power

FCC §15.247 (b)(3)

For systems using digital modulation in the 2400-2483.5 MHz bands: 30dBm.

IC RSS-247 A5.4(d)

For DTSs employing digital modulation techniques operating in the bands 902-928MHz and 2400-2483.5MHz, the maximum peak conducted output power shall not exceed 1 W.

The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e)

4.2.2 Test Procedures

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to spectrum analyzer.
3. Set to the maximum power setting and enable the EUT transmit continuously
4. Set the $RBW \geq DTS \text{ Bandwidth}$, $VBW \geq 3 * RBW$, $Span \geq 1.5 * DTS \text{ Bandwidth}$, $Detector = Peak$, $Sweep \text{ time} = auto \text{ couple}$, $Trace \text{ mode} = max \text{ holde}$.
5. Allow trace to fully stabilize, Use peak marker function to determine the peak amplitude level.
6. Measure the conducted output power

4.2.3 Test Result of Peak Output Power

Refer to Appendix C of this test report.

4.3 Power Spectral Density Measurement

4.3.1 Limits of Power Spectral Density

FCC§15.247(e)

IC RSS-247 5.2(b)

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

4.3.2 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument.
3. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
4. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
5. Measure and record the results in the test report.
6. The Measured power density (dBm)/ 100kHz is a reference level and used as 20dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

4.3.3 Test Result of Power Spectral Density

Refer to Appendix D of this test report.

4.4 Conducted Band Edges and Spurious Emission Measurement

4.4.1 Limit of Conducted Band Edges and Spurious Emission

FCC §15.247 (d)

IC RSS-247 5.5

Maximum conducted (average) output power was used to determine compliance, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 20 dBc).

4.4.2 Test Procedures

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument.
3. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. 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 per 15.247(d).
4. Measure and record the results in the test report.
5. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

4.4.3 Test Result of Conducted Band Edges

Refer to Appendix E of this test report.

4.4.4 Test Result of Conducted Spurious Emission

Refer to Appendix F of this test report.

4.5 Radiated Band Edges and Spurious Emission Measurement

4.5.1 Limit of Radiated Band Edges and Spurious Emission

FCC §15.247 (d)

IC RSS-247 5.5

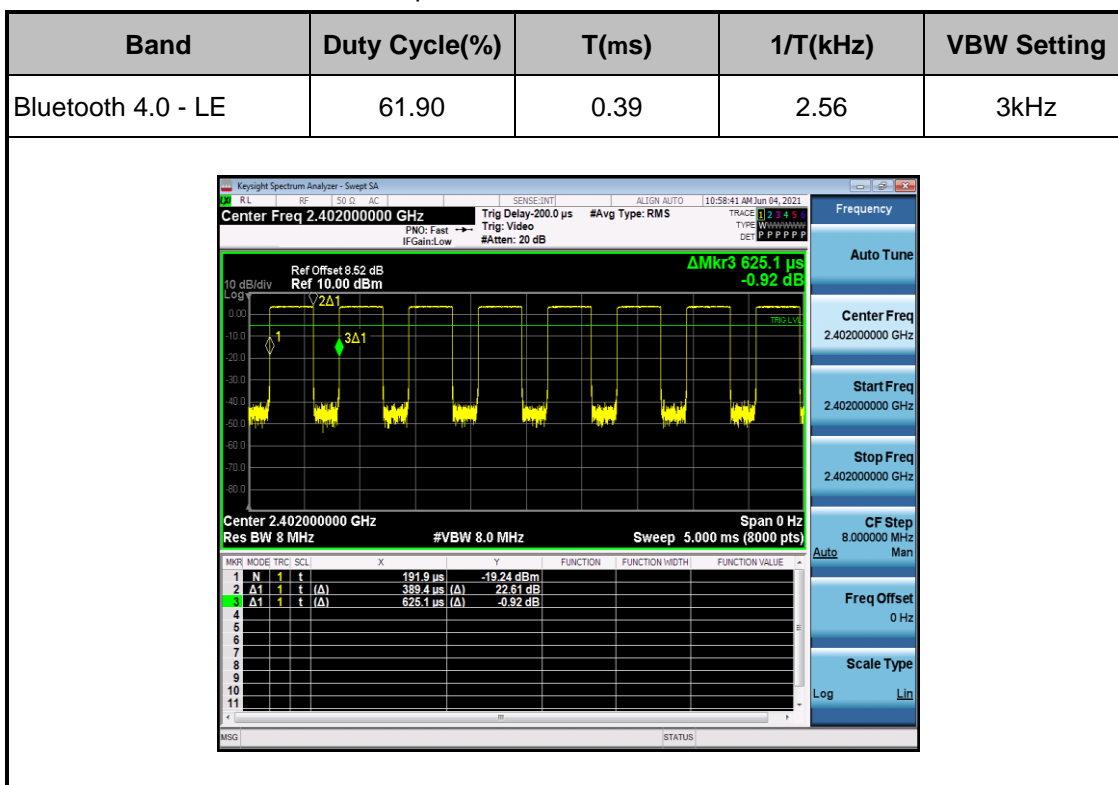
In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

4.5.2 Test Procedures

1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The measurement distance is 3 meter.
3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. Use the following spectrum analyzer settings:
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Set RBW=100 kHz for $f < 1$ GHz, RBW=1MHz for $f > 1$ GHz ; VBW RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
 - (3) For average measurement:
 VBW = 10 Hz, when duty cycle is no less than 98 percent.
 VBW $\geq 1/T$, when duty cycle is less than 98 percent where T is 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.



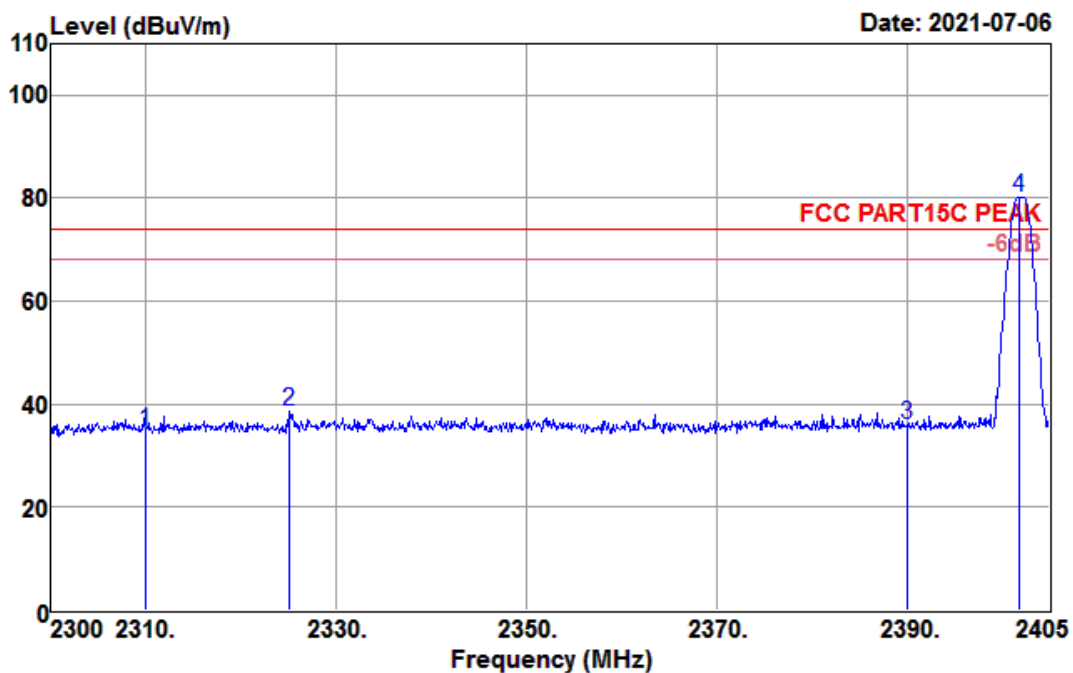
4.5.3 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

4.5.4 Test Result of Radiated Spurious at Band Edges

Test Mode :	BLE CH00 (2402 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	2.3GHz~2.405GHz	Polarization :	Horizontal

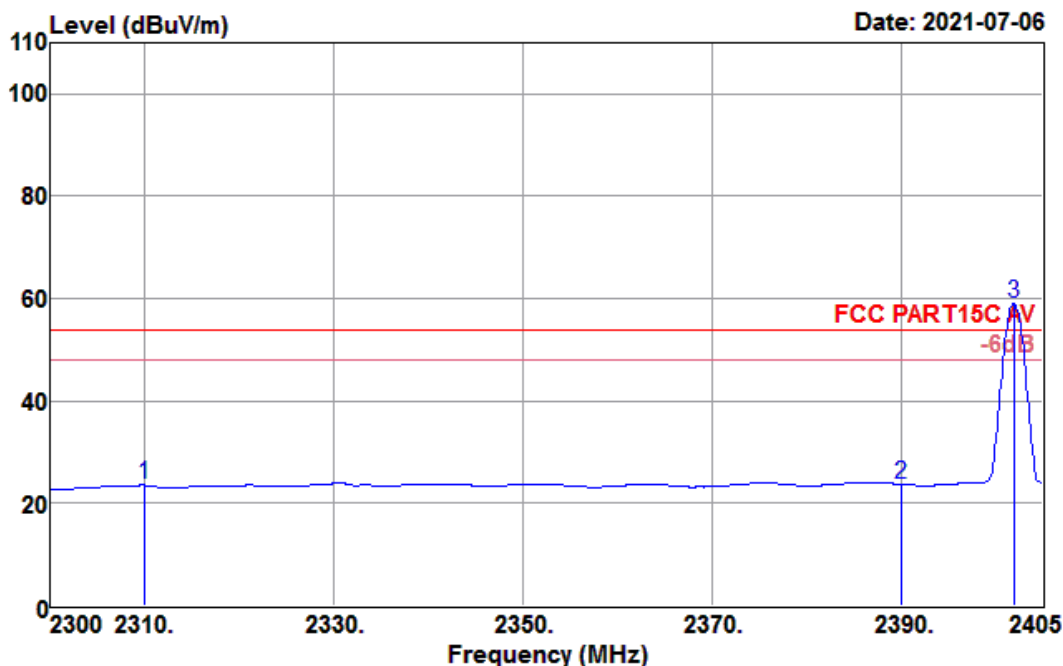
Data: 88



Freq MHz	Reading level dBUV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBUV/m	Limit level dBUV/m	Over limit dB	Remark
2310.000	39.03	27.38	4.08	35.68	34.81	74.00	-39.19	Peak
2325.095	42.78	27.42	4.10	35.71	38.59	74.00	-35.41	Peak
2390.000	40.17	27.56	4.16	35.88	36.01	74.00	-37.99	Peak
2401.745	84.44	27.58	4.17	35.90	80.29	74.00	6.29	Peak

Test Mode :	BLE CH00 (2402 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	2.3GHz~2.405GHz	Polarization :	Horizontal

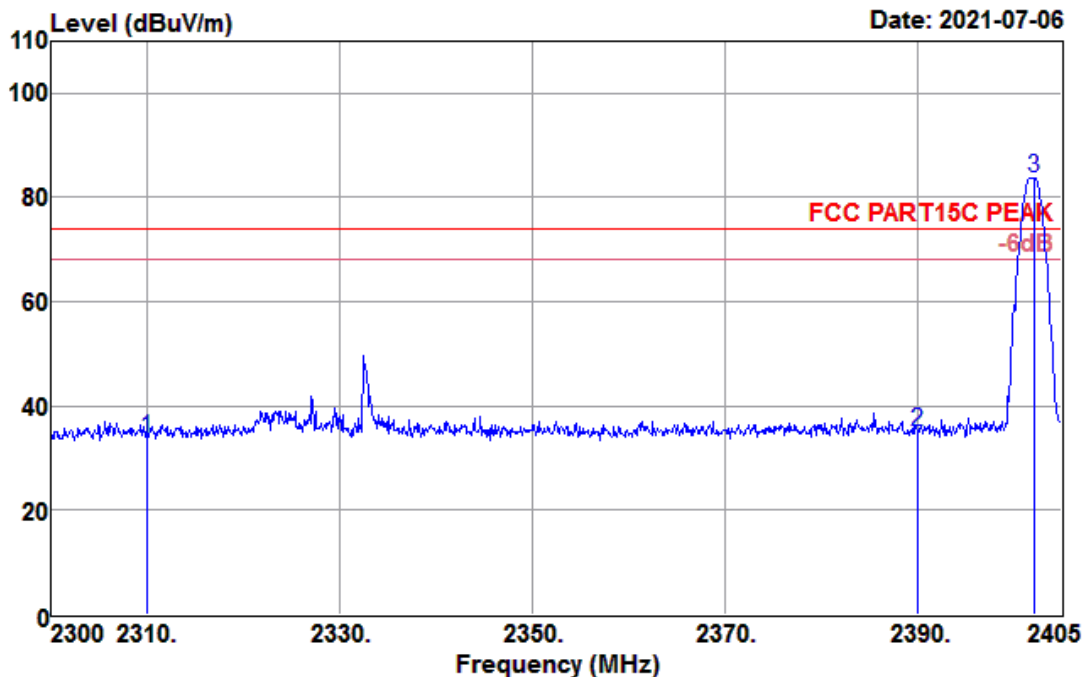
Data: 89



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2310.000	27.81	27.38	4.08	35.68	23.59	54.00	-30.41	Average
2390.000	27.86	27.56	4.16	35.88	23.70	54.00	-30.30	Average
2401.955	63.31	27.58	4.17	35.90	59.16	54.00	5.16	Average

Test Mode :	BLE CH00 (2402 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	2.3GHz~2.405GHz	Polarization :	Vertical

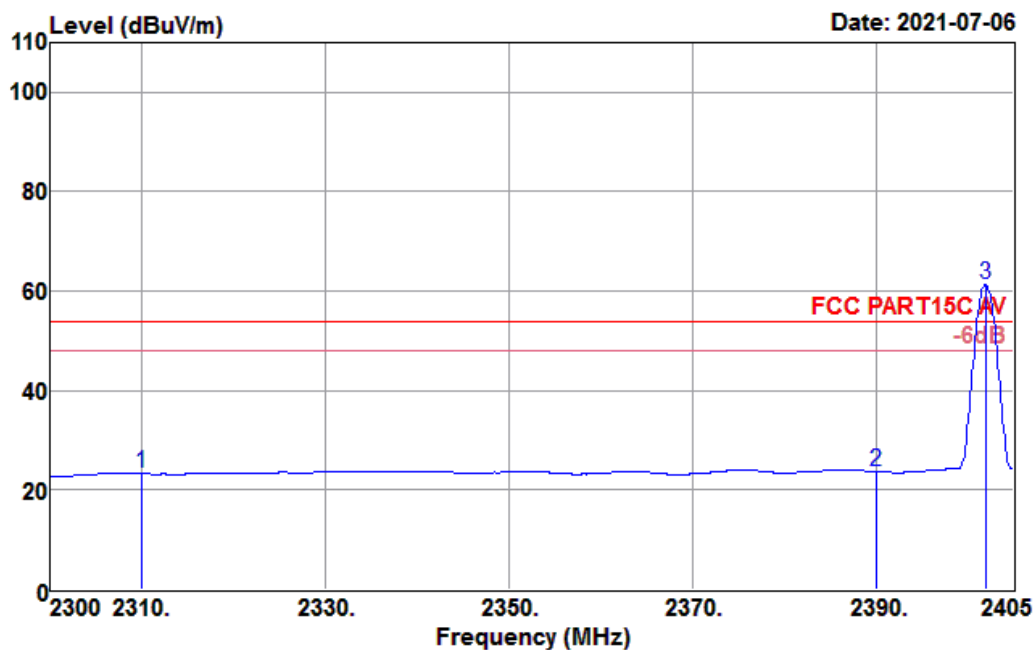
Data: 91



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2310.000	38.10	27.38	4.08	35.68	33.88	74.00	-40.12	Peak
2390.000	39.30	27.56	4.16	35.88	35.14	74.00	-38.86	Peak
2402.165	87.87	27.58	4.17	35.91	83.71	74.00	9.71	Peak

Test Mode :	BLE CH00 (2402 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	2.3GHz~2.405GHz	Polarization :	Vertical

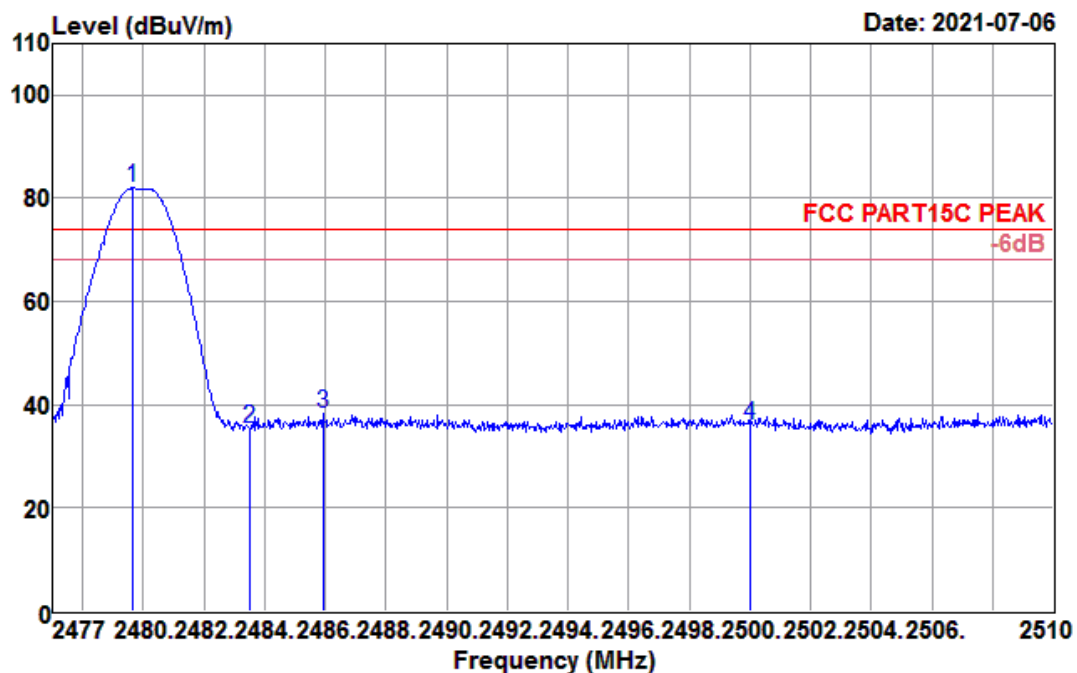
Data: 92



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2310.000	27.50	27.38	4.08	35.68	23.28	54.00	-30.72	Average
2390.000	27.92	27.56	4.16	35.88	23.76	54.00	-30.24	Average
2401.955	65.57	27.58	4.17	35.90	61.42	54.00	7.42	Average

Test Mode :	BLE CH39 (2480 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	2.477GHz~2.51GHz	Polarization :	Horizontal

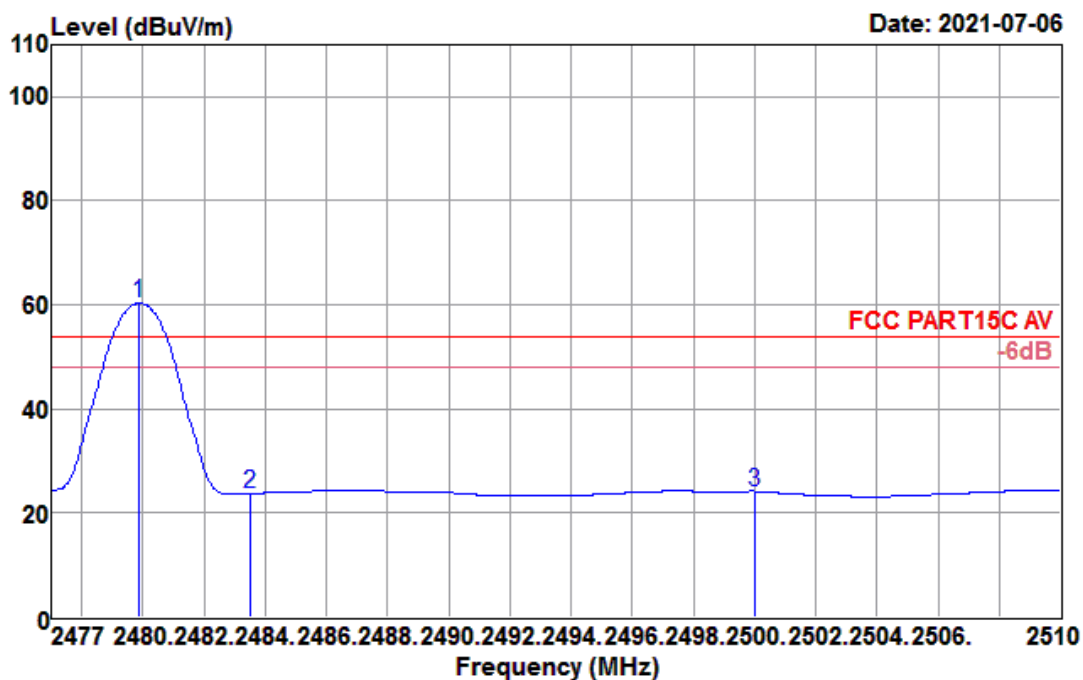
Data: 102



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamplifier factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2479.673	86.16	27.76	4.19	36.10	82.01	74.00	8.01	Peak
2483.501	39.52	27.76	4.19	36.11	35.36	74.00	-38.64	Peak
2485.910	42.37	27.77	4.19	36.11	38.22	74.00	-35.78	Peak
2500.000	40.15	27.80	4.19	36.15	35.99	74.00	-38.01	Peak

Test Mode :	BLE CH39 (2480 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	2.477GHz~2.51GHz	Polarization :	Horizontal

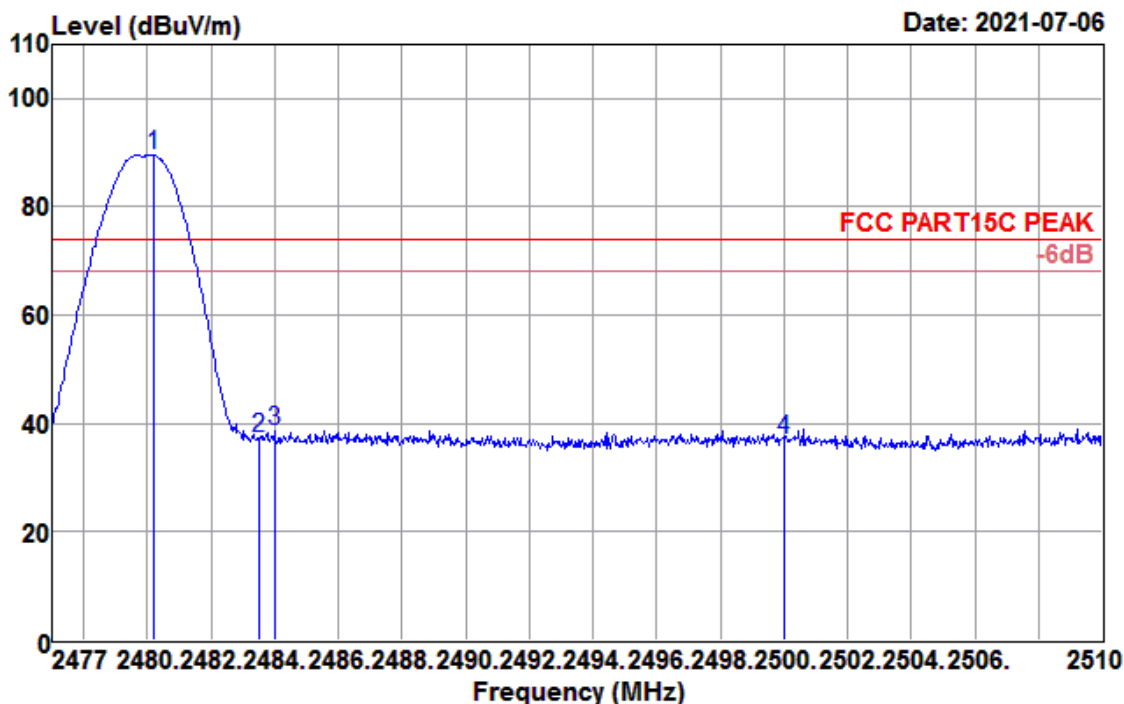
Data: 103



Freq MHz	Reading level dBUV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBUV/m	Limit level dBUV/m	Over limit dB	Remark
2479.871	64.52	27.76	4.19	36.10	60.37	54.00	6.37	Average
2483.500	27.91	27.76	4.19	36.11	23.75	54.00	-30.25	Average
2500.000	28.35	27.80	4.19	36.15	24.19	54.00	-29.81	Average

Test Mode :	BLE CH39 (2480 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	2.477GHz~2.51GHz	Polarization :	Vertical

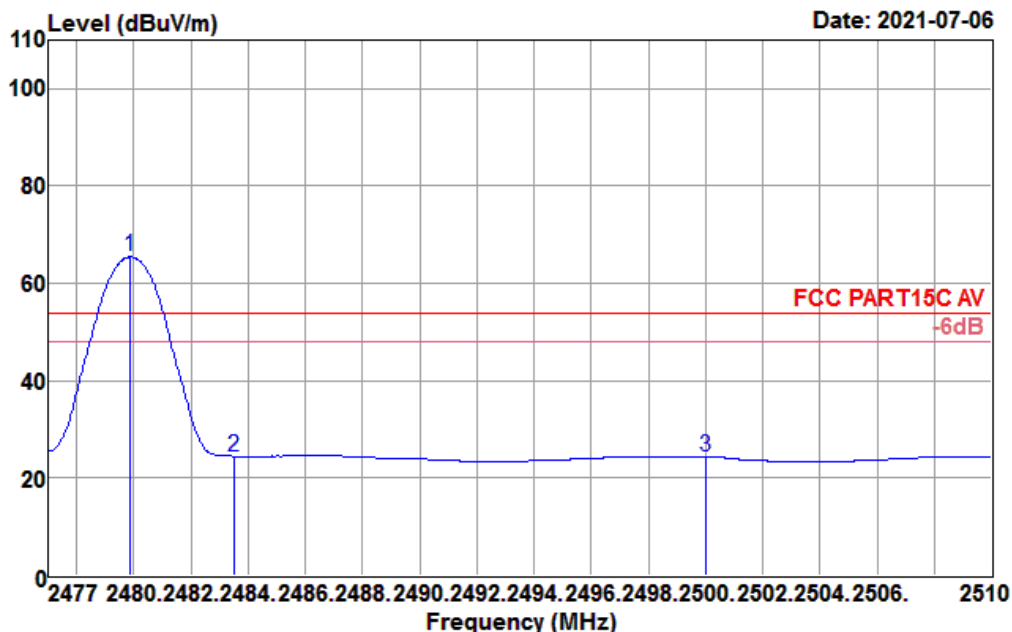
Data: 105



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2480.201	93.73	27.76	4.19	36.10	89.58	74.00	15.58	Peak
2483.501	41.41	27.76	4.19	36.11	37.25	74.00	-36.75	Peak
2483.996	42.86	27.76	4.19	36.11	38.70	74.00	-35.30	Peak
2500.000	41.27	27.80	4.19	36.15	37.11	74.00	-36.89	Peak

Test Mode :	BLE CH39 (2480 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	2.477GHz~2.51GHz	Polarization :	Vertical

Data: 106

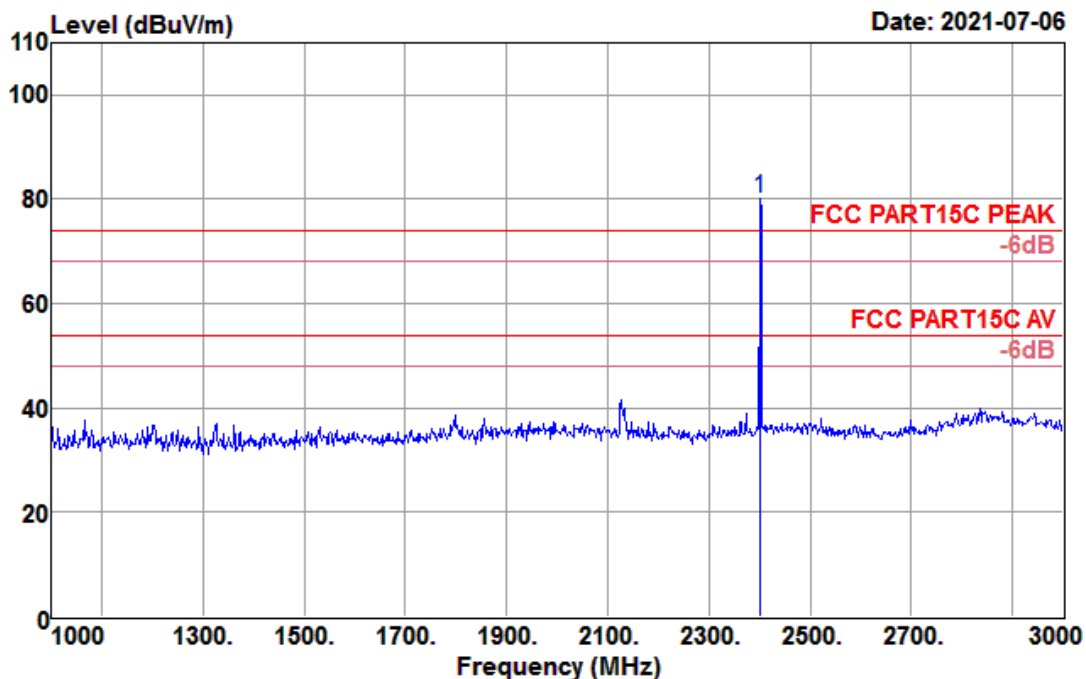


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2479.871	69.58	27.76	4.19	36.10	65.43	54.00	11.43	Average
2483.500	28.65	27.76	4.19	36.11	24.49	54.00	-29.51	Average
2500.000	28.57	27.80	4.19	36.15	24.41	54.00	-29.59	Average

4.5.5 Test Result of Radiated Spurious Emission (1GHz ~ 10th Harmonic)

Test Mode :	BLE CH00 (2402 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	1GHz~3GHz	Polarization :	Horizontal

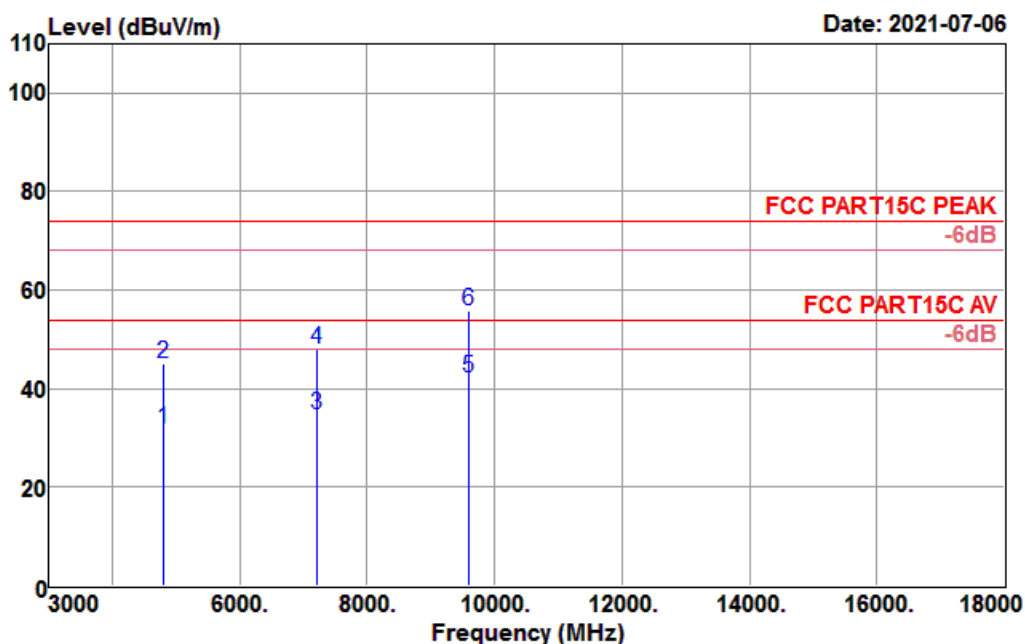
Data: 90



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2402.000	84.28	27.58	4.17	35.91	80.12	74.00	6.12	Peak

Test Mode :	BLE CH00 (2402 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	3GHz~18GHz	Polarization :	Horizontal

Data: 95

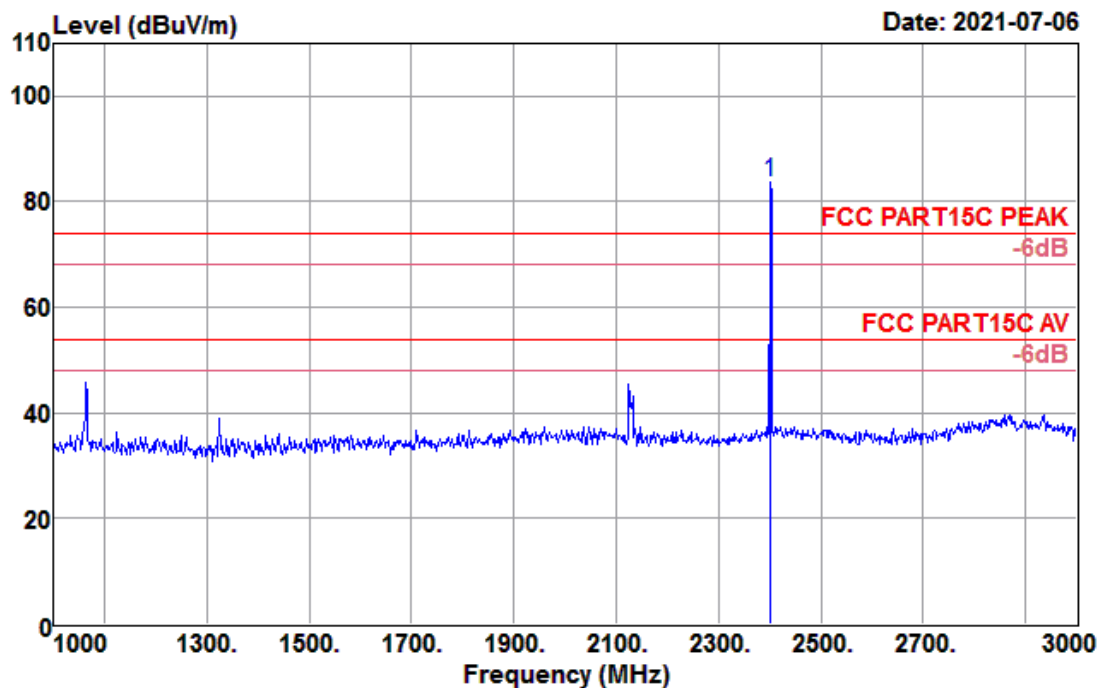


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4804.000	28.52	30.93	6.44	34.12	31.77	54.00	-22.23	Average
4804.000	41.96	30.93	6.44	34.12	45.21	74.00	-28.79	Peak
7206.000	25.14	35.39	8.61	34.39	34.75	54.00	-19.25	Average
7206.000	38.44	35.39	8.61	34.39	48.05	74.00	-25.95	Peak
9608.000	26.13	38.39	11.69	34.14	42.07	54.00	-11.93	Average
9608.000	39.82	38.39	11.69	34.14	55.76	74.00	-18.24	Peak

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

Test Mode :	BLE CH00 (2402 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	1GHz~3GHz	Polarization :	Vertical

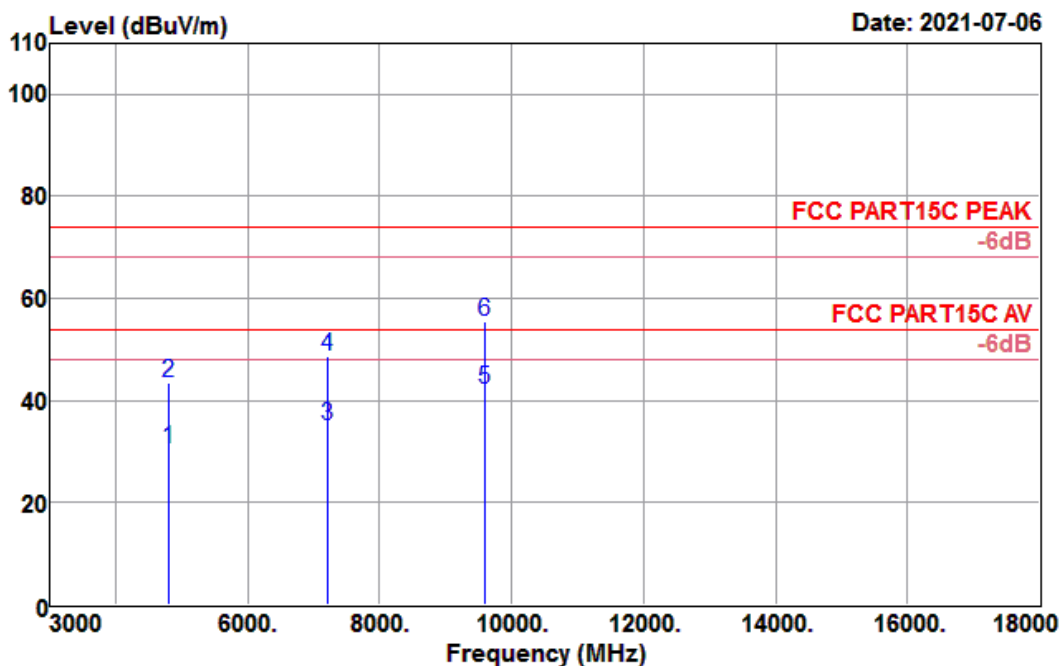
Data: 93



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2402.000	87.87	27.58	4.17	35.91	83.71	74.00	9.71	Peak

Test Mode :	BLE CH00 (2402 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	3GHz~18GHz	Polarization :	Vertical

Data: 94

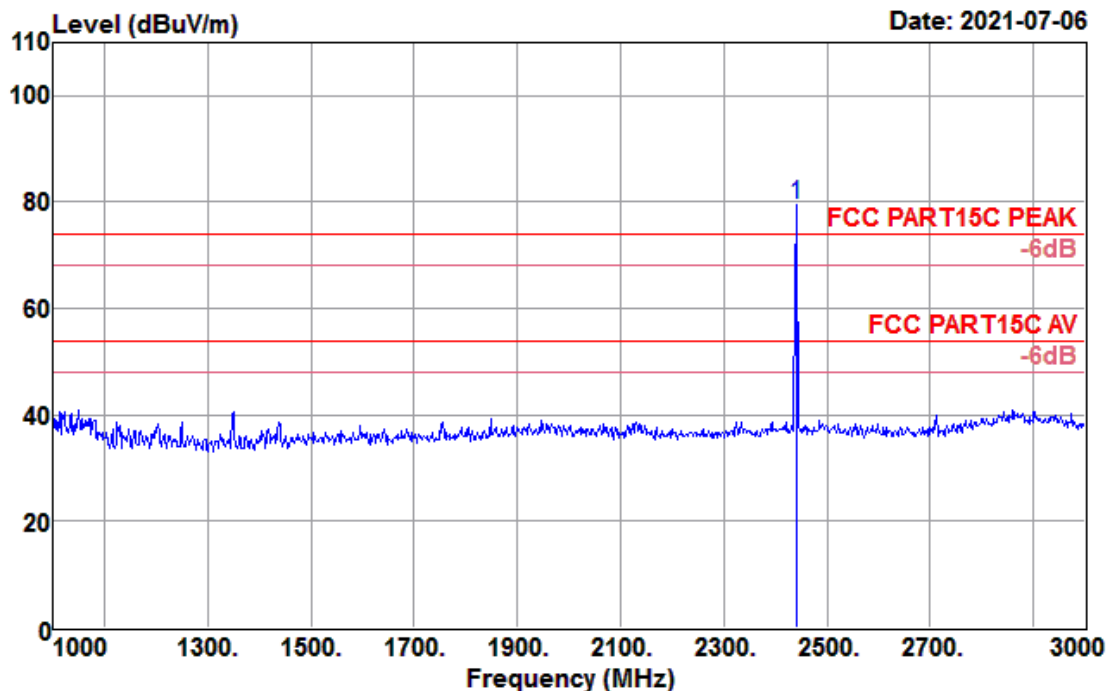


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4804.000	27.18	30.93	6.44	34.12	30.43	54.00	-23.57	Average
4804.000	40.29	30.93	6.44	34.12	43.54	74.00	-30.46	Peak
7206.000	25.30	35.39	8.61	34.39	34.91	54.00	-19.09	Average
7206.000	39.12	35.39	8.61	34.39	48.73	74.00	-25.27	Peak
9608.000	26.34	38.39	11.69	34.14	42.28	54.00	-11.72	Average
9608.000	39.46	38.39	11.69	34.14	55.40	74.00	-18.60	Peak

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

Test Mode :	BLE CH19 (2440 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	1GHz~3GHz	Polarization :	Horizontal

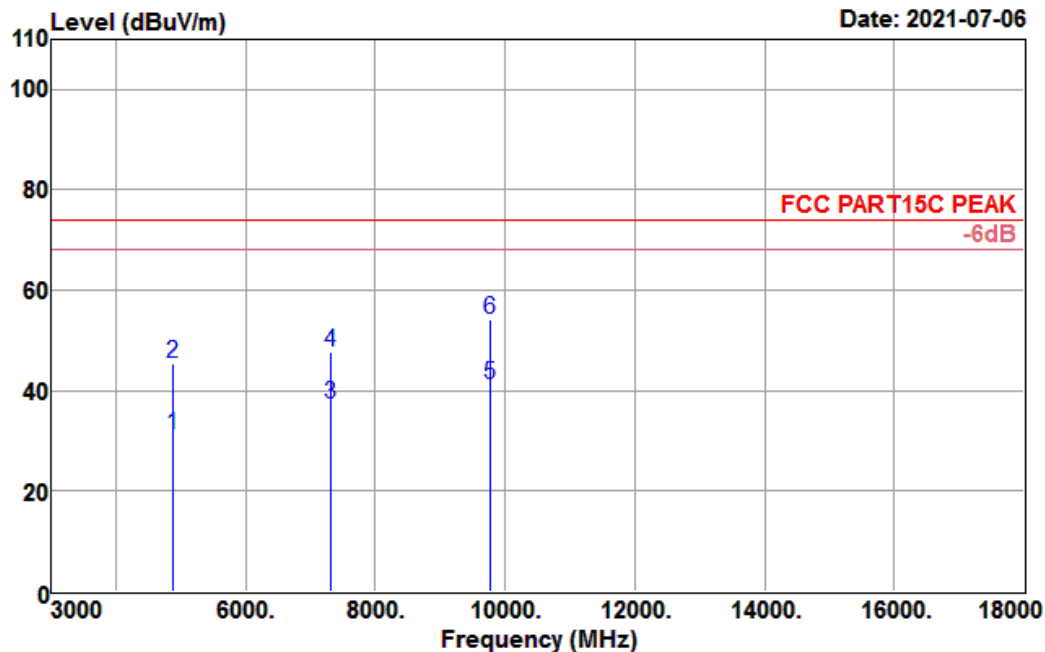
Data: 99



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2440.000	83.69	27.67	4.18	36.00	79.54	74.00	5.54	Peak

Test Mode :	BLE CH19 (2440 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	3GHz~18GHz	Polarization :	Horizontal

Data: 96

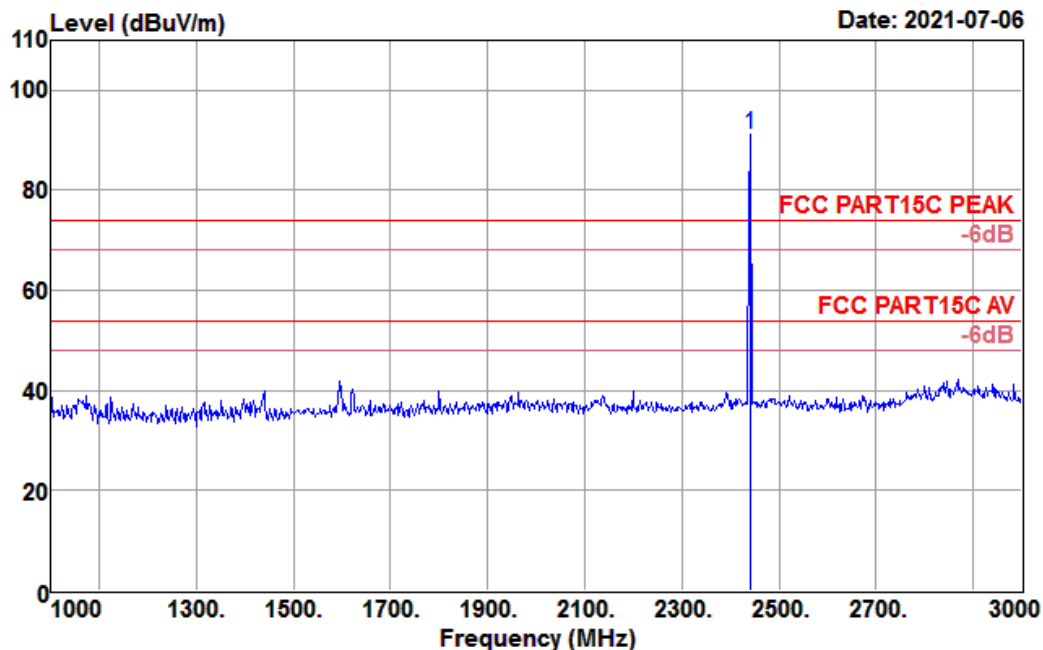


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4880.000	27.06	31.03	7.01	34.03	31.07	74.00	-42.93	Average
4880.000	41.33	31.03	7.01	34.03	45.34	74.00	-28.66	Peak
7320.000	27.06	35.67	8.97	34.49	37.21	74.00	-36.79	Average
7320.000	37.59	35.67	8.97	34.49	47.74	74.00	-26.26	Peak
9760.000	25.78	38.51	11.16	34.20	41.25	74.00	-32.75	Average
9760.000	38.85	38.51	11.16	34.20	54.32	74.00	-19.68	Peak

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

Test Mode :	BLE CH19 (2440 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	1GHz~3GHz	Polarization :	Vertical

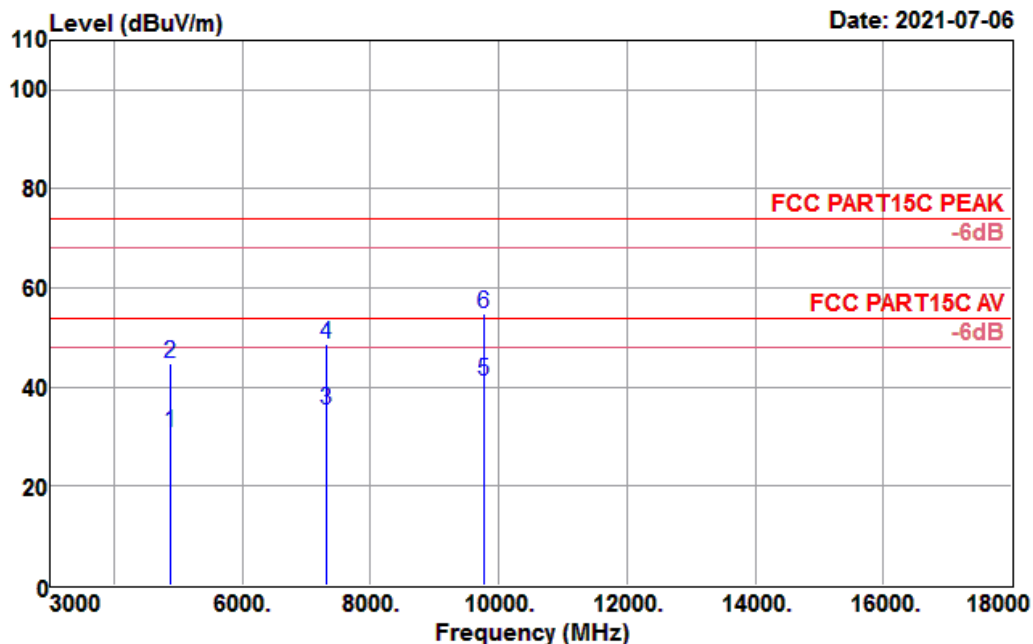
Data: 98



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2440.000	95.49	27.67	4.18	36.00	91.34	74.00	17.34	Peak

Test Mode :	BLE CH19 (2440 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	3GHz~18GHz	Polarization :	Vertical

Data: 97

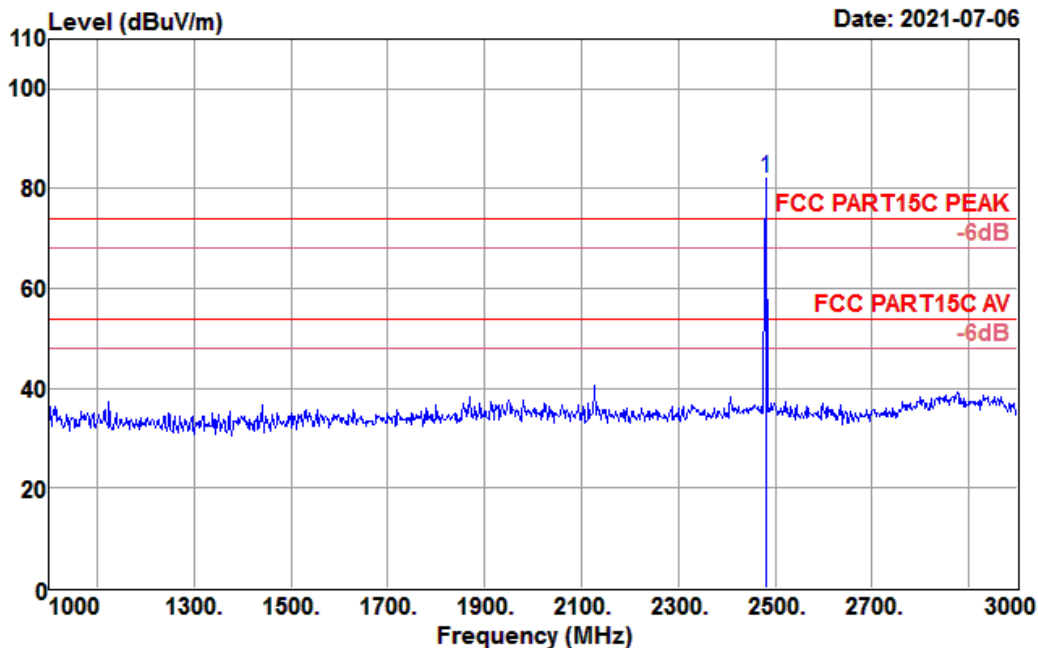


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4880.000	26.97	31.03	7.01	34.03	30.98	54.00	-23.02	Average
4880.000	40.78	31.03	7.01	34.03	44.79	74.00	-29.21	Peak
7320.000	25.38	35.67	8.97	34.49	35.53	54.00	-18.47	Average
7320.000	38.69	35.67	8.97	34.49	48.84	74.00	-25.16	Peak
9760.000	25.82	38.51	11.16	34.20	41.29	54.00	-12.71	Average
9760.000	39.39	38.51	11.16	34.20	54.86	74.00	-19.14	Peak

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

Test Mode :	BLE CH39 (2480 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	1GHz~3GHz	Polarization :	Horizontal

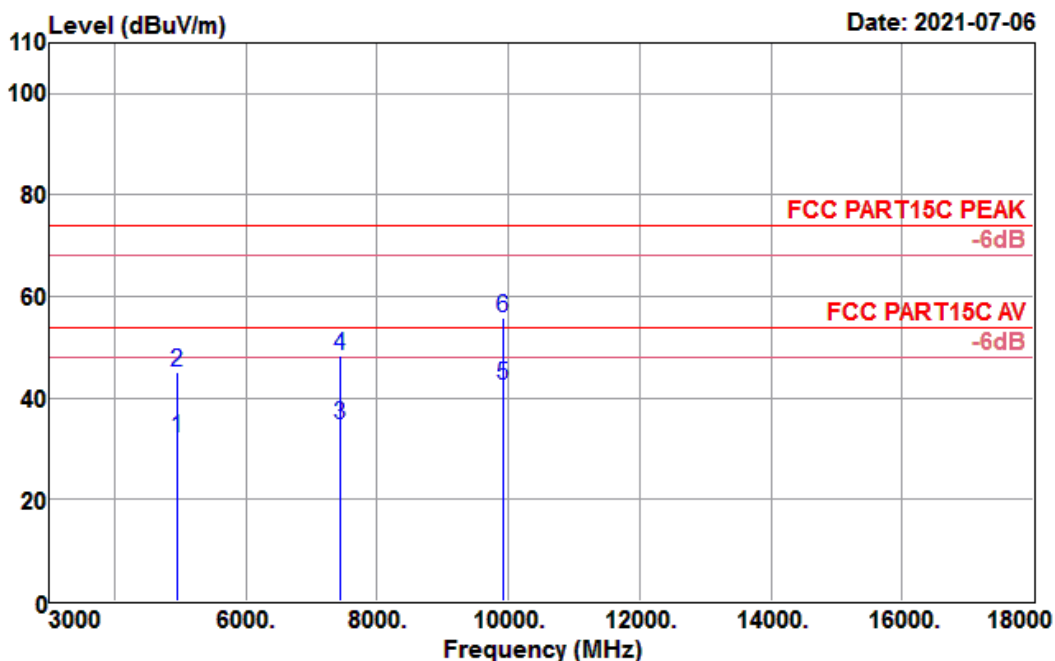
Data: 104



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2480.000	86.17	27.76	4.19	36.10	82.02	74.00	8.02	Peak

Test Mode :	BLE CH39 (2480 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	3GHz~18GHz	Polarization :	Horizontal

Data: 101

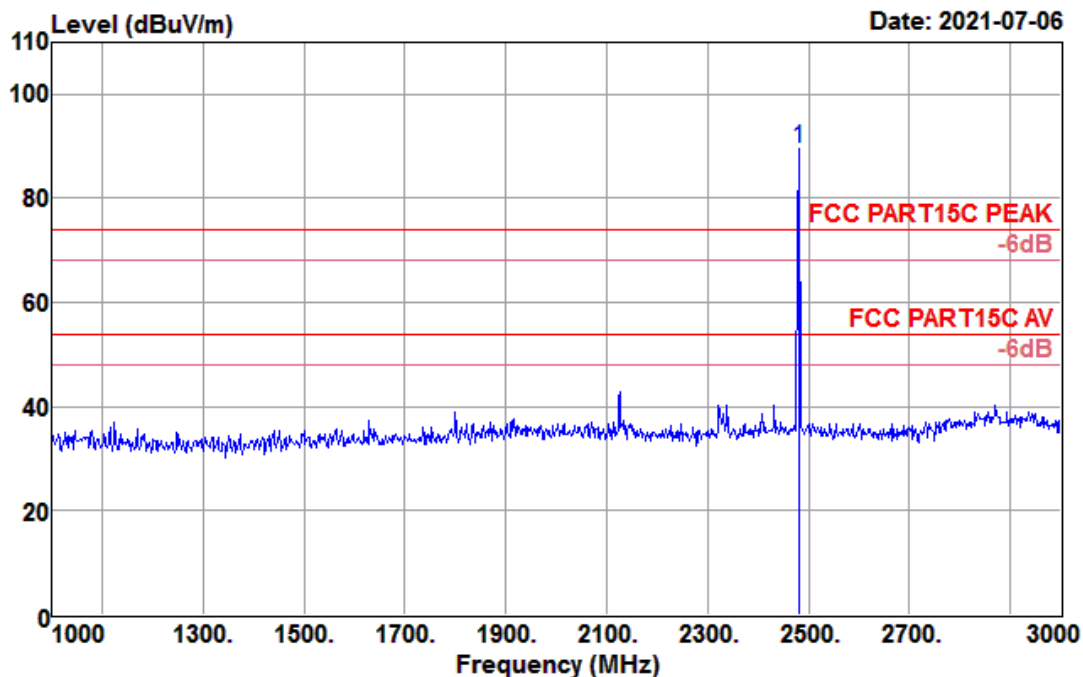


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamplifier factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4960.000	27.25	31.14	7.62	33.94	32.07	54.00	-21.93	Average
4960.000	40.18	31.14	7.62	33.94	45.00	74.00	-29.00	Peak
7440.000	24.38	35.96	9.03	34.60	34.77	54.00	-19.23	Average
7440.000	37.89	35.96	9.03	34.60	48.28	74.00	-25.72	Peak
9920.000	26.09	38.64	12.18	34.27	42.64	54.00	-11.36	Average
9920.000	39.34	38.64	12.18	34.27	55.89	74.00	-18.11	Peak

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

Test Mode :	BLE CH39 (2480 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	1GHz~3GHz	Polarization :	Vertical

Data: 107



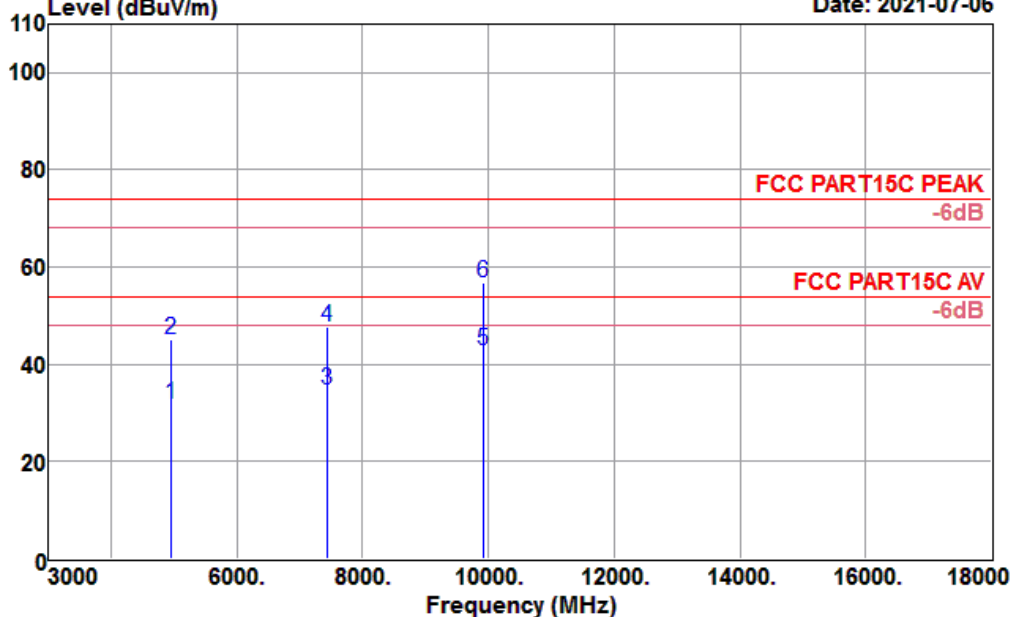
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2480.000	93.65	27.76	4.19	36.10	89.50	74.00	15.50	Peak

Test Mode :	BLE CH39 (2480 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	3GHz~18GHz	Polarization :	Vertical

Data: 100

Level (dBuV/m)

Date: 2021-07-06



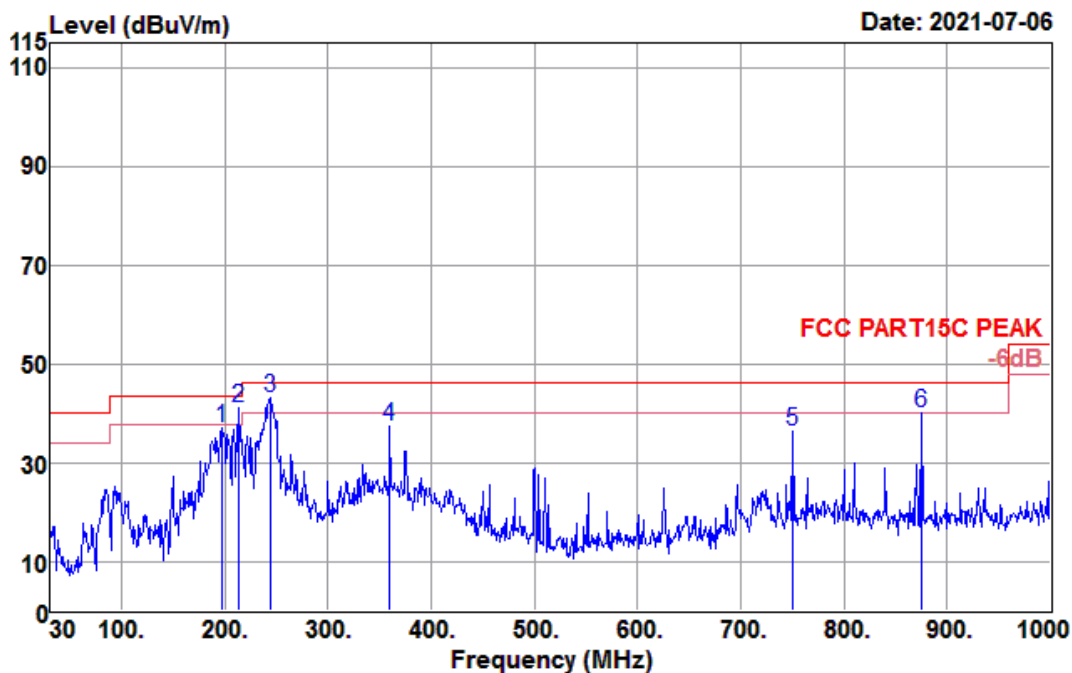
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4960.000	27.09	31.14	7.62	33.94	31.91	54.00	-22.09	Average
4960.000	40.39	31.14	7.62	33.94	45.21	74.00	-28.79	Peak
7440.000	24.35	35.96	9.03	34.60	34.74	54.00	-19.26	Average
7440.000	37.47	35.96	9.03	34.60	47.86	74.00	-26.14	Peak
9920.000	26.14	38.64	12.18	34.27	42.69	54.00	-11.31	Average
9920.000	40.17	38.64	12.18	34.27	56.72	74.00	-17.28	Peak

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

4.5.6 Test Result of Radiated Spurious Emission (30MHz ~ 1GHz)

Test Mode :	BLE CH00 (2402 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	30MHz~1GHz	Polarization :	Horizontal

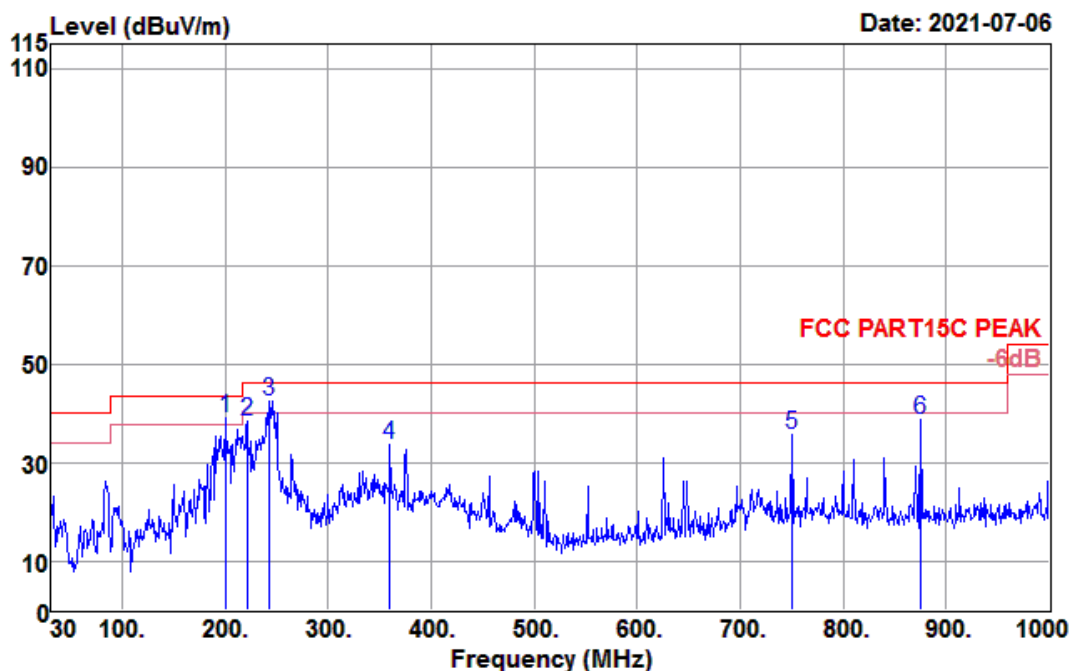
Data: 57



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
196.840	56.75	10.34	2.41	32.60	36.90	43.50	-6.60	QP
213.330	61.18	9.90	2.54	32.60	41.02	43.50	-2.48	QP
243.400	61.13	11.72	2.74	32.60	42.99	46.00	-3.01	QP
359.800	52.58	14.24	3.34	32.66	37.50	46.00	-8.50	QP
750.710	42.91	20.79	5.01	32.55	36.16	46.00	-9.84	QP
875.840	45.08	21.48	5.57	31.93	40.20	46.00	-5.80	QP

Test Mode :	BLE CH00 (2402 MHz)	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequency Range	30MHz~1GHz	Polarization :	Vertical

Data: 56



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
199.750	59.14	10.06	2.43	32.60	39.03	43.50	-4.47	QP
221.090	58.47	10.03	2.59	32.60	38.49	46.00	-7.51	QP
242.430	60.61	11.74	2.74	32.60	42.49	46.00	-3.51	QP
359.800	48.61	14.24	3.34	32.66	33.53	46.00	-12.47	QP
750.710	42.55	20.79	5.01	32.55	35.80	46.00	-10.20	QP
875.840	43.54	21.48	5.57	31.93	38.66	46.00	-7.34	QP

4.6 AC Conducted Emission Measurement

4.6.1 Limit of AC Conducted Emission

FCC §15.207

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

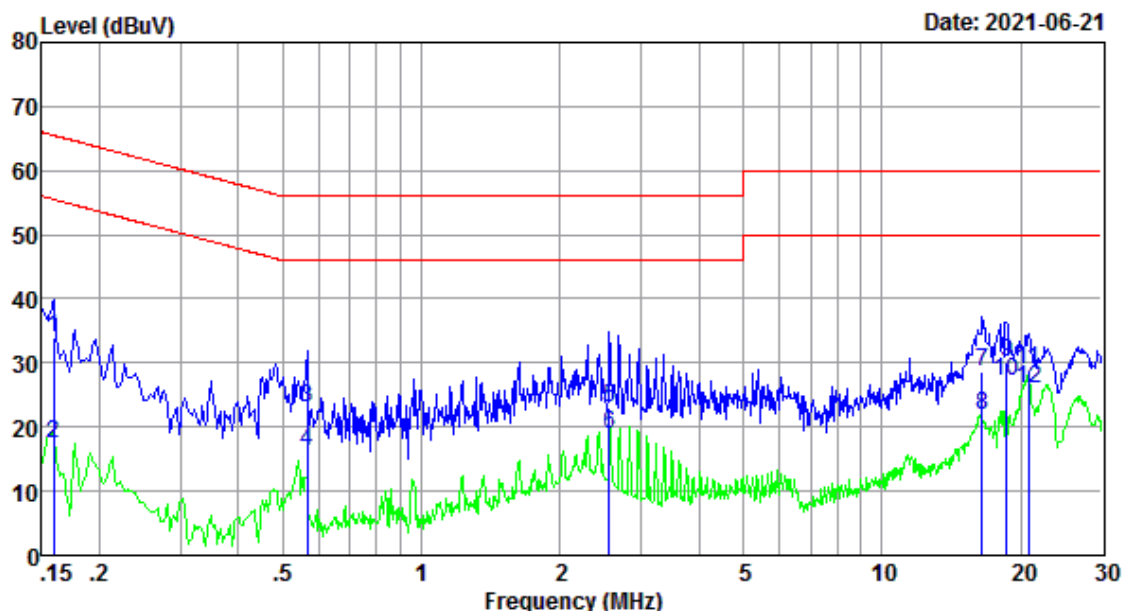
*Decreases with the logarithm of the frequency.

4.6.2 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

4.6.3 Test Result of AC Conducted Emission

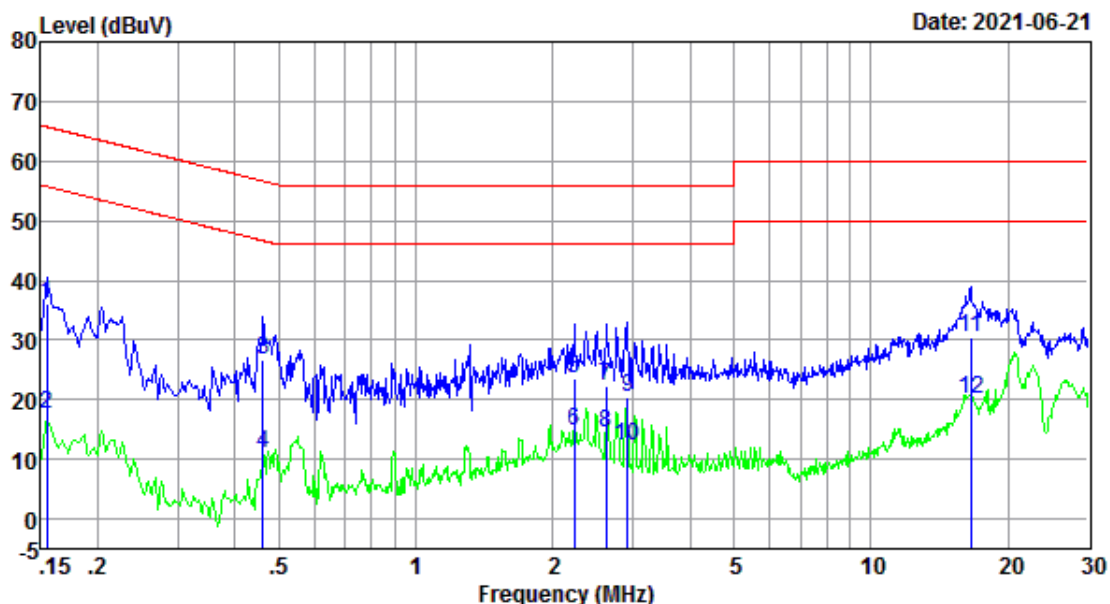
Test Mode :	Mode 1	Temperature :	24°C
Test Engineer :	Jack Liu	Relative Humidity :	58%
Test Voltage :	120Vac / 60Hz	Phase :	Line
Function Type :	BT Linking + RJ45 ping + HDMI + USB Playing + Adapter		



Freq MHz	Reading level dBuV	LISN/ISN factor dB	Cable loss dB	Result level dBuV	Limit level dBuV	Over limit dB	Remark
0.159	24.50	9.55	0.01	34.06	65.52	-31.46	QP
0.159	7.90	9.55	0.01	17.46	55.52	-38.06	Average
0.564	13.40	9.58	0.01	22.99	56.00	-33.01	QP
0.564	6.50	9.58	0.01	16.09	46.00	-29.91	Average
2.554	13.30	9.60	0.04	22.94	56.00	-33.06	QP
2.554	9.30	9.60	0.04	18.94	46.00	-27.06	Average
16.486	18.50	10.05	0.11	28.66	60.00	-31.34	QP
16.486	11.70	10.05	0.11	21.86	50.00	-28.14	Average
18.622	19.90	10.20	0.12	30.22	60.00	-29.78	QP
18.622	16.70	10.20	0.12	27.02	50.00	-22.98	Average
20.814	18.50	10.28	0.12	28.90	60.00	-31.10	QP
20.814	15.60	10.28	0.12	26.00	50.00	-24.00	Average

Result Level= Reading Level + LISN Factor + Cable Loss

Test Mode :	Mode 1	Temperature :	24°C
Test Engineer :	Jack Liu	Relative Humidity :	58%
Test Voltage :	120Vac / 60Hz	Phase :	NEUTRAL
Function Type :	BT Linking + RJ45 ping + HDMI + USB Playing + Adapter		



Freq MHz	Reading level dBuV	LISN/ISN factor dB	Cable loss dB	Result level dBuV	Limit level dBuV	Over limit dB	Remark
0.155	26.40	9.54	0.01	35.95	65.74	-29.79	QP
0.155	8.10	9.54	0.01	17.65	55.74	-38.09	Average
0.461	17.20	9.57	0.01	26.78	56.67	-29.89	QP
0.461	1.30	9.57	0.01	10.88	46.67	-35.79	Average
2.225	13.91	9.59	0.03	23.53	56.00	-32.47	QP
2.225	5.01	9.59	0.03	14.63	46.00	-31.37	Average
2.622	12.60	9.60	0.04	22.24	56.00	-33.76	QP
2.622	4.70	9.60	0.04	14.34	46.00	-31.66	Average
2.915	10.70	9.61	0.04	20.35	56.00	-35.65	QP
2.915	2.50	9.61	0.04	12.15	46.00	-33.85	Average
16.573	20.09	10.12	0.11	30.32	60.00	-29.68	QP
16.573	9.79	10.12	0.11	20.02	50.00	-29.98	Average

Result Level= Reading Level + LISN Factor + Cable Loss

4.7 Antenna Requirements

4.7.1 Standard Applicable

According to antenna requirement of §15.203.

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be re-placed by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded..

And according to §15.247(4)(1), system operating in the 2400-2483.5MHz bands that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

4.7.2 Antenna Connected Construction

An Suction cup Antenna design is used.

4.7.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

5. List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
Spectrum Analyzer	Keysight	N9010A	MY56070788	2021-01-05	2022-01-04	Conducted
Power Sensor	Keysight	U2021XA	MY56510025	2021-01-05	2022-01-04	Conducted
Power Sensor	Keysight	U2021XA	MY57030005	2021-01-05	2022-01-04	Conducted
Power Sensor	Keysight	U2021XA	MY56510018	2021-01-05	2022-01-04	Conducted
Power Sensor	Keysight	U2021XA	MY56480002	2021-01-05	2022-01-04	Conducted
Thermal Chamber	Howkin	UHL-34	19111801	2021-04-21	2022-04-20	Conducted
Base Station	R&S	CMW 270	101231	2021-01-05	2022-01-04	Conducted
Signal Generator (Interferer)	Keysight	N5182B	MY56200384	2021-01-05	2022-01-04	Conducted
Signal Generator (Blocker)	Keysight	N5171B	MY56200661	2021-01-05	2022-01-04	Conducted

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV 40	101433	2021-01-05	2022-01-04	Radiation
Amplifier	Sonoma	310	363917	2021-01-06	2022-01-05	Radiation
Amplifier	Schwarzbeck	BBV 9718	327	2021-01-06	2022-01-05	Radiation
Amplifier	Narda	TTA1840-35-HG	2034380	2020-11-28	2021-11-27	Radiation
Loop Antenna	Schwarzbeck	FMZB 1519B	1519B-051	2020-02-14	2023-02-13	Radiation
Broadband Antenna	Schwarzbeck	VULB 9168	9168-757	2020-09-27	2023-09-26	Radiation
Horn Antenna	Schwarzbeck	BBHA 9120 D	1677	2020-02-14	2023-02-13	Radiation
Horn Antenna	COM-POWER	AH-1840	101117	2021-06-05	2024-06-04	Radiation
Test Software	Audix	E3	6.111221a	N/A	N/A	Radiation
Filter	Micro-Tronics	BRM 50702	G266	N/A	N/A	Radiation

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
LISN	R&S	ENV216	102125	2021-01-05	2022-01-04	Conducted
LISN	R&S	ENV432	101327	2021-01-06	2022-01-05	Conducted
EMI Test Receiver	R&S	ESR3	102143	2021-01-06	2022-01-05	Conducted
EMI Test Software	Audix	E3	N/A	N/A	N/A	Conducted

N/A: No Calibration Required

6. Uncertainty of Evaluation

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

MEASUREMENT	FREQUENCY	UNCERTAINTY
Conducted emissions	9kHz~30MHz	2.42dB
Radiated emission	30MHz ~ 1GMHz	2.50dB
	1GHz ~ 18GHz	3.51dB
	18GHz ~ 40GHz	3.96dB

MEASUREMENT	UNCERTAINTY
Occupied Channel Bandwidth	$\pm 196.4\text{Hz}$
RF output power, conducted	$\pm 2.31\text{dB}$
Power density, conducted	$\pm 2.31\text{dB}$

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

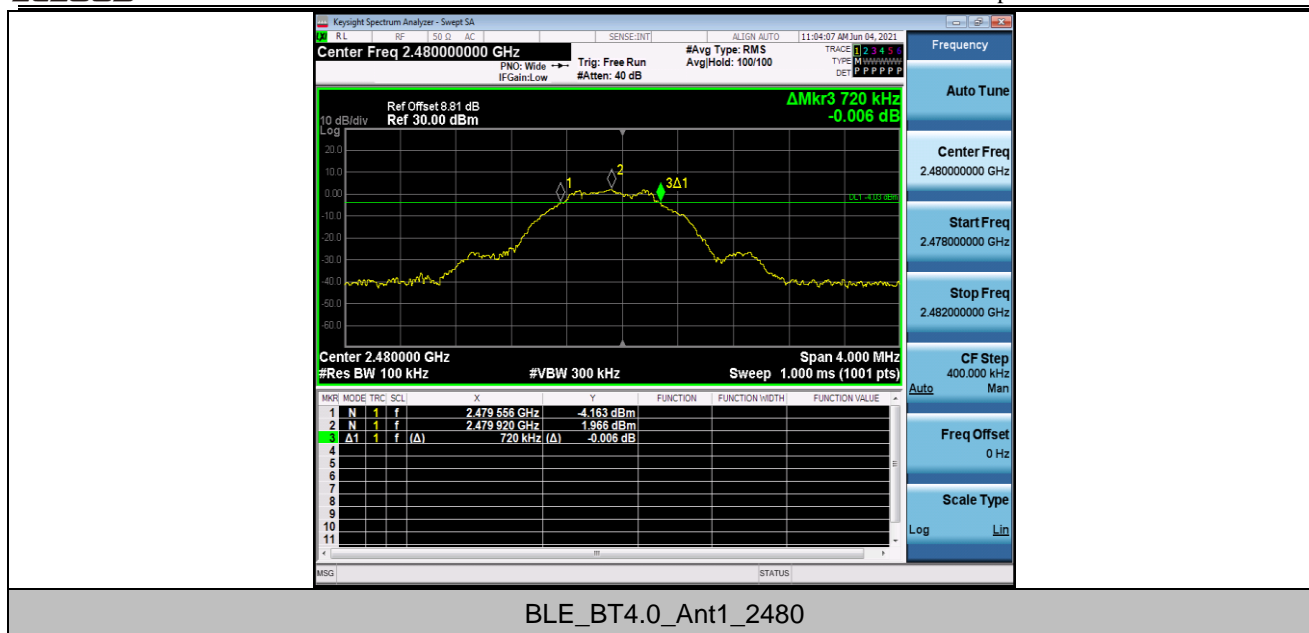
Appendix A: DTS Bandwidth

Test Result

TestMode	Antenna	Channel	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE_BT4.0	Ant1	2402	0.684	2401.588	2402.272	0.5	PASS
		2440	0.704	2439.560	2440.264	0.5	PASS
		2480	0.720	2479.556	2480.276	0.5	PASS

Test Graphs





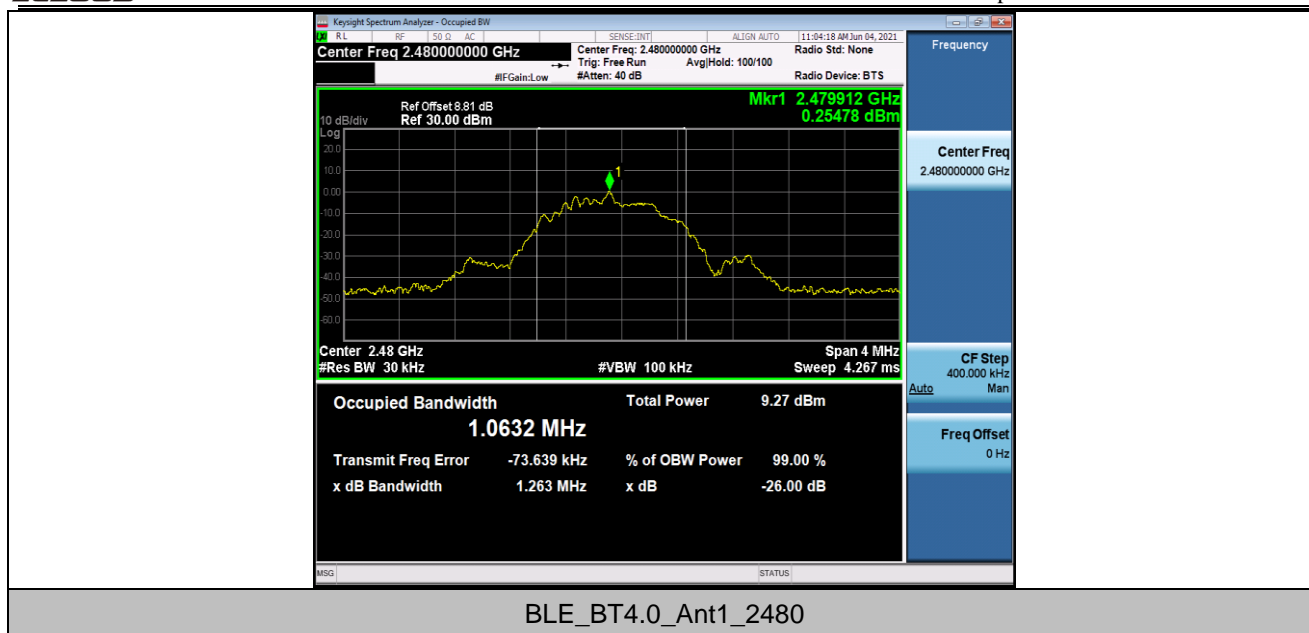
Appendix B: Occupied Channel Bandwidth

Test Result

TestMode	Antenna	Channel	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE_BT4.0	Ant1	2402	1.0638	2401.410	2402.474	---	PASS
		2440	1.0674	2439.399	2440.467	---	PASS
		2480	1.0632	2479.395	2480.458	---	PASS

Test Graphs



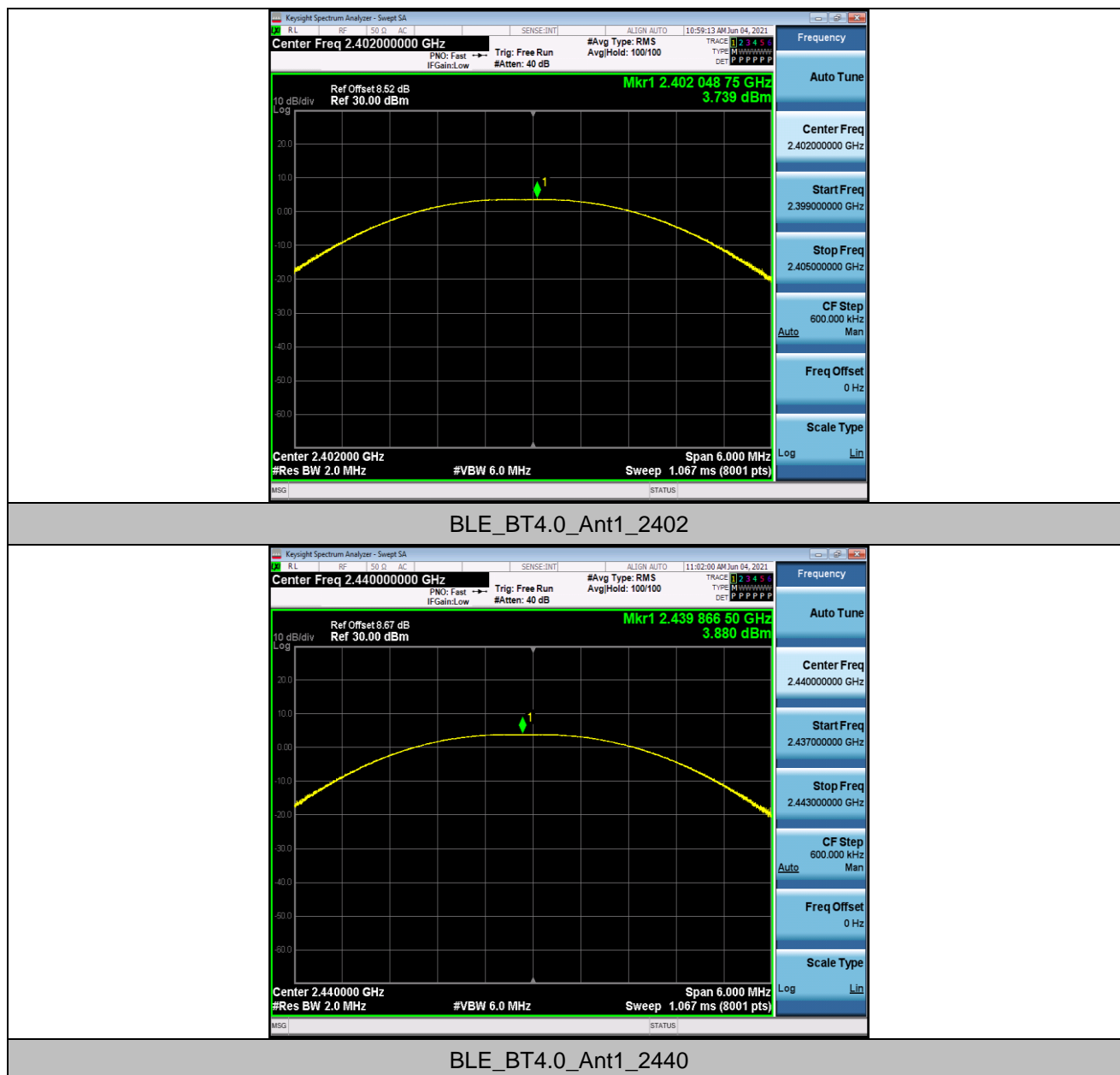


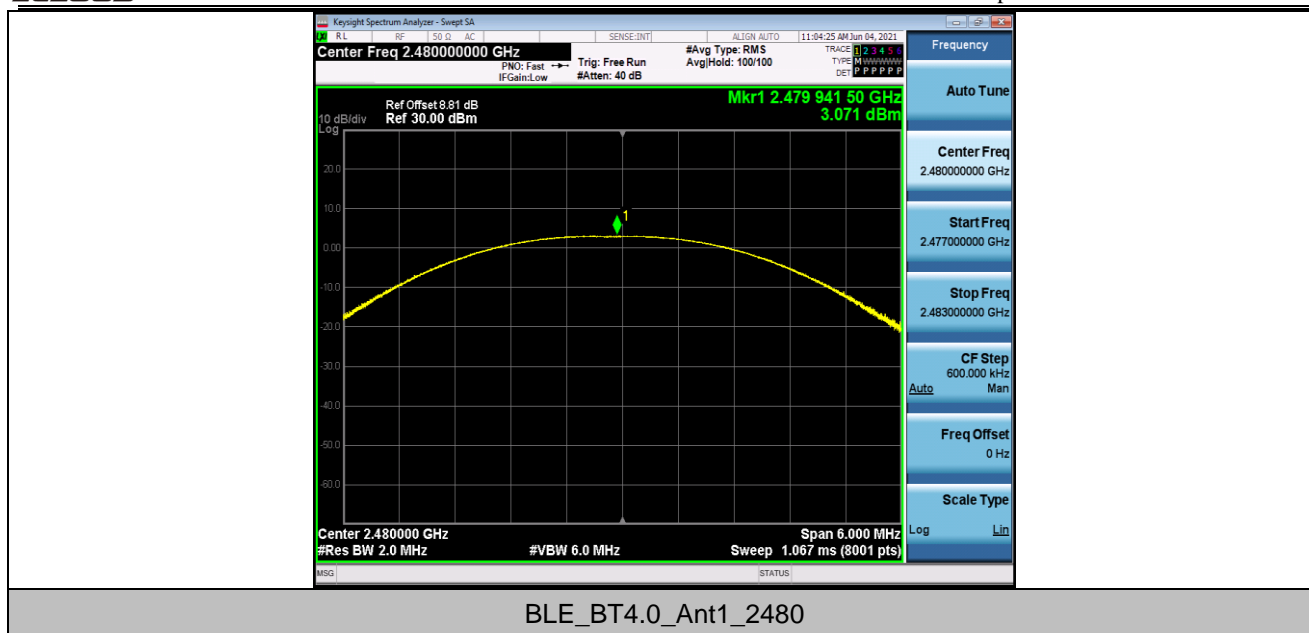
Appendix C: Maximum conducted output power

Test Result

TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
BLE_BT4.0	Ant1	2402	3.74	<=30	PASS
		2440	3.88	<=30	PASS
		2480	3.07	<=30	PASS

Test Graphs



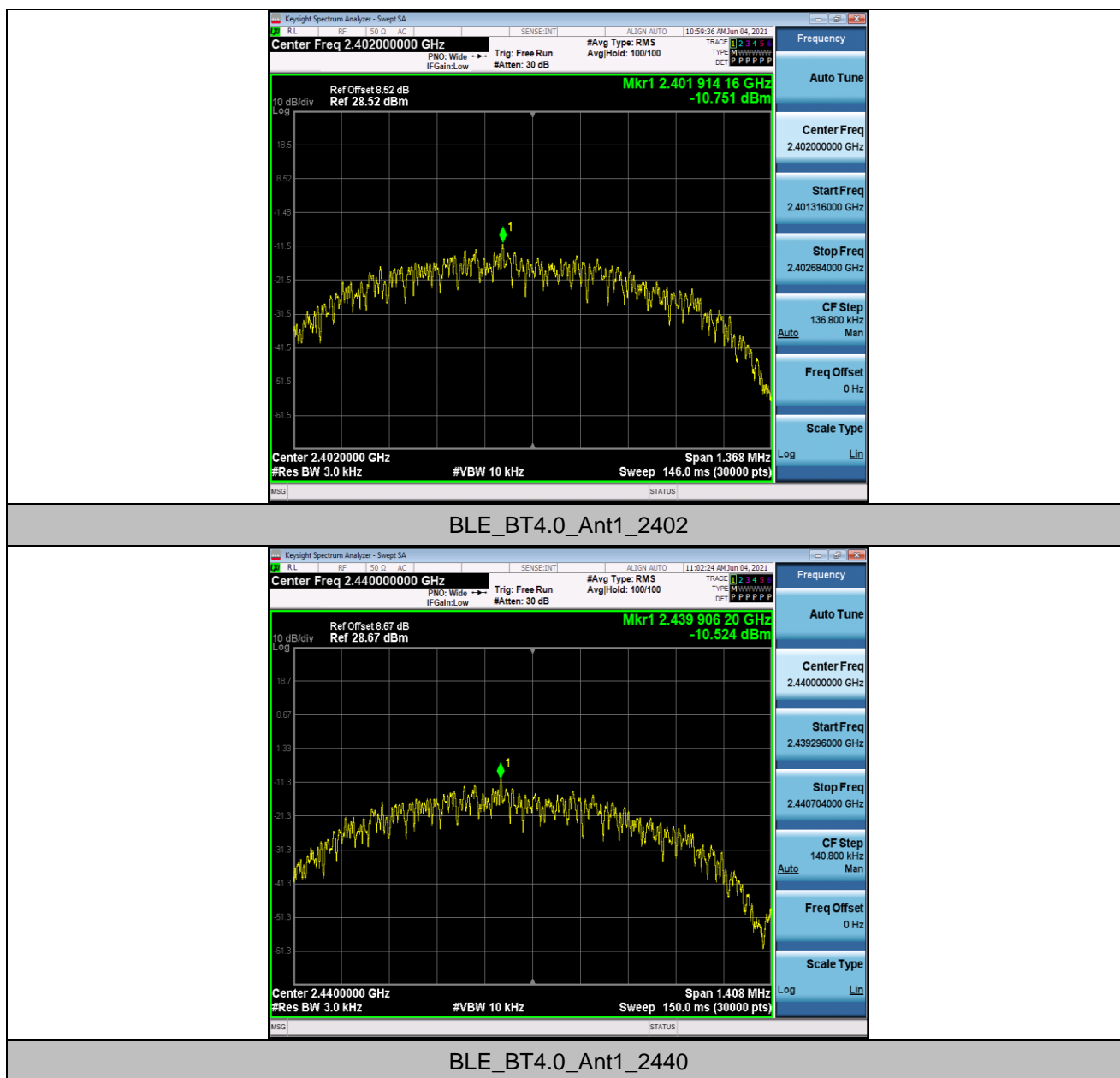


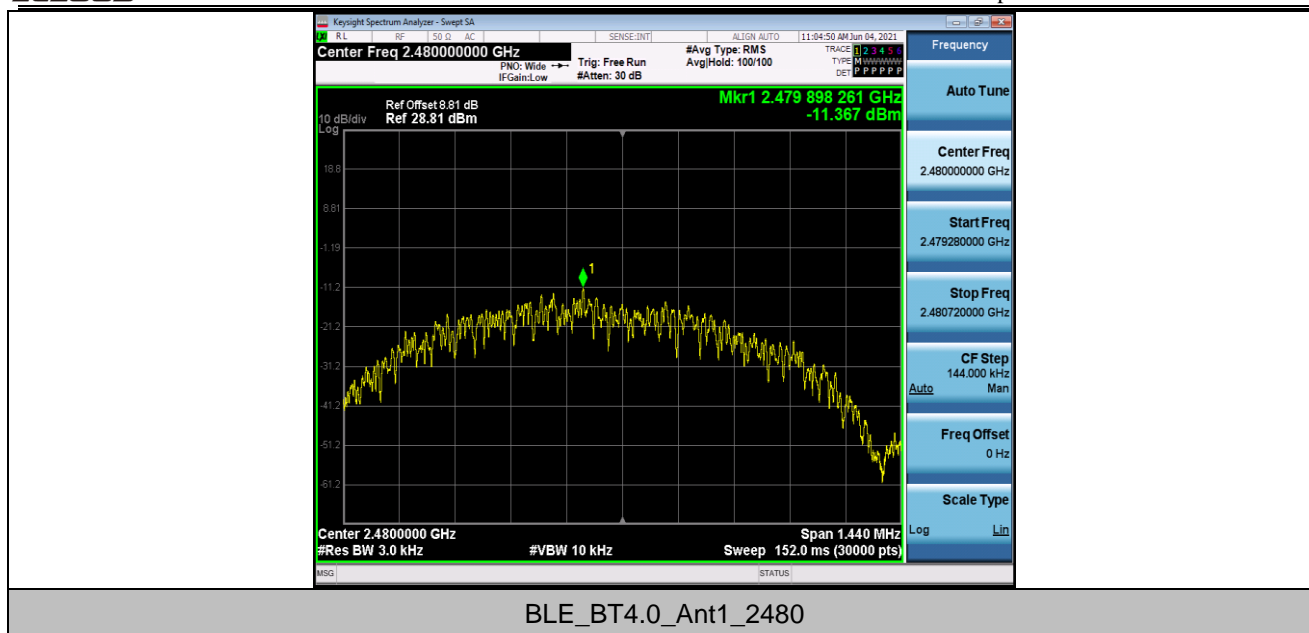
Appendix D: Maximum power spectral density

Test Result

TestMode	Antenna	Channel	Result[dBm/3-100kHz]	Limit[dBm/3kHz]	Verdict
BLE_BT4.0	Ant1	2402	-10.75	≤ 8	PASS
		2440	-10.52	≤ 8	PASS
		2480	-11.37	≤ 8	PASS

Test Graphs



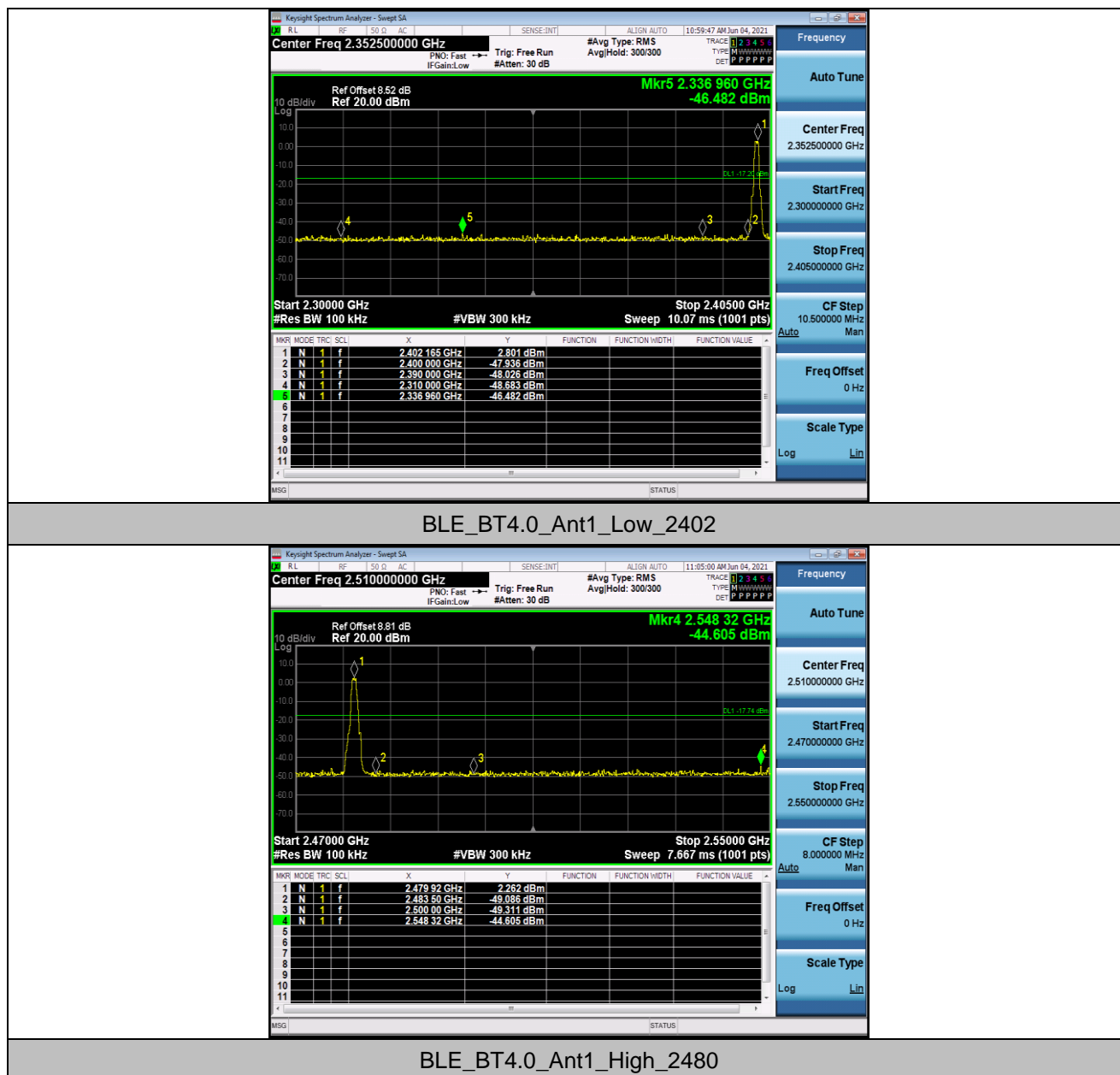


Appendix E: Band edge measurements

Test Result

TestMode	Antenna	ChName	Channel	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_BT4.0	Ant1	Low	2402	2.80	-46.48	<=-17.2	PASS
		High	2480	2.26	-44.61	<=-17.74	PASS

Test Graphs

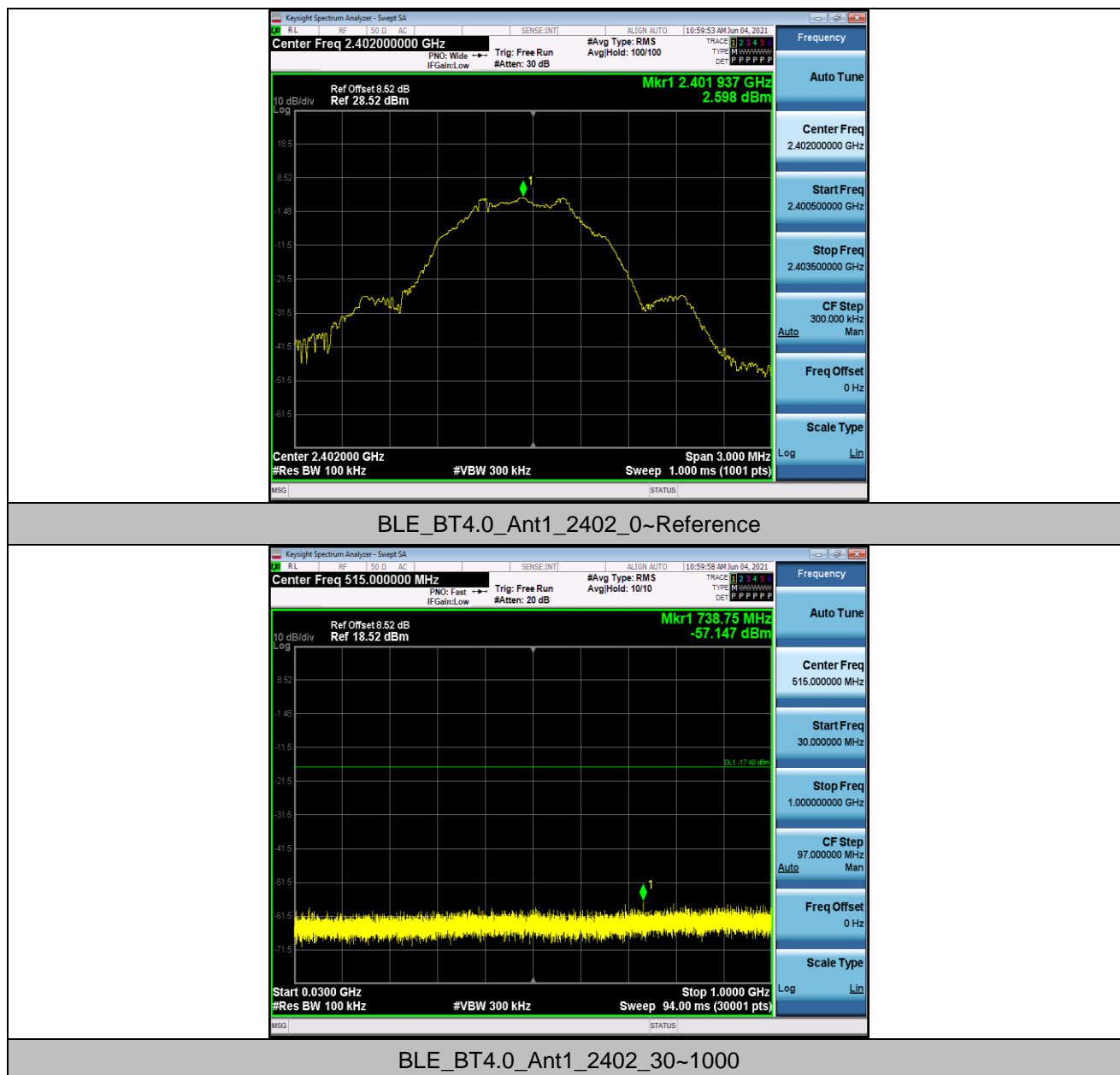


Appendix F: Conducted Spurious Emission

Test Result

TestMode	Antenna	Channel	FreqRange [MHz]	RefLevel [dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_BT4.0	Ant1	2402	Reference	2.60	2.60	---	PASS
			30~1000	2.60	-57.15	<=-17.4	PASS
			1000~26500	2.60	-37.89	<=-17.4	PASS
		2440	Reference	2.77	2.77	---	PASS
			30~1000	2.77	-56.86	<=-17.23	PASS
			1000~26500	2.77	-37.71	<=-17.23	PASS
		2480	Reference	2.08	2.08	---	PASS
			30~1000	2.08	-56.82	<=-17.92	PASS
			1000~26500	2.08	-37.8	<=-17.92	PASS

Test Graphs

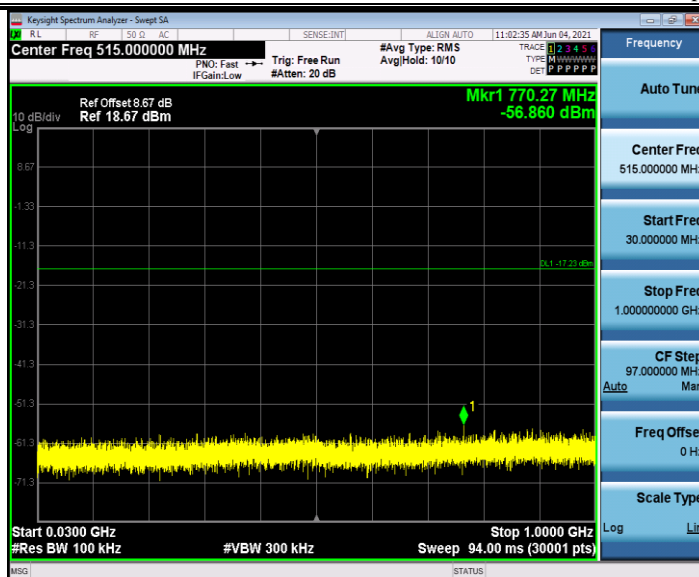




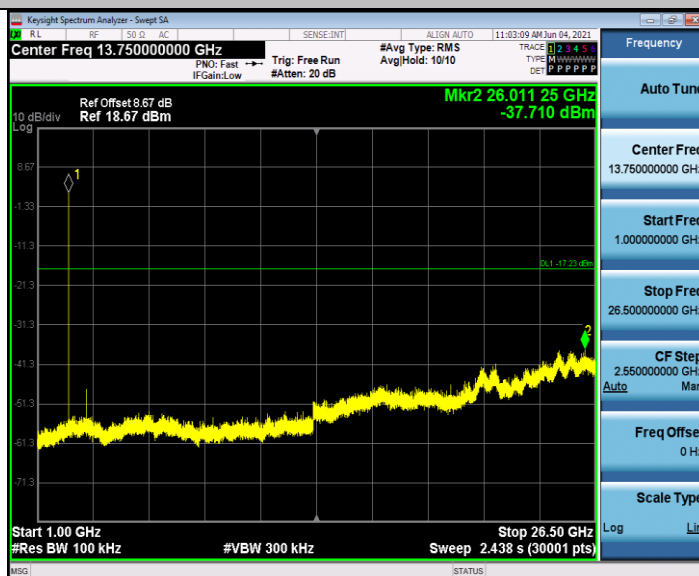
BLE_BT4.0_Ant1_2402_1000~26500



BLE_BT4.0_Ant1_2440_0~Reference



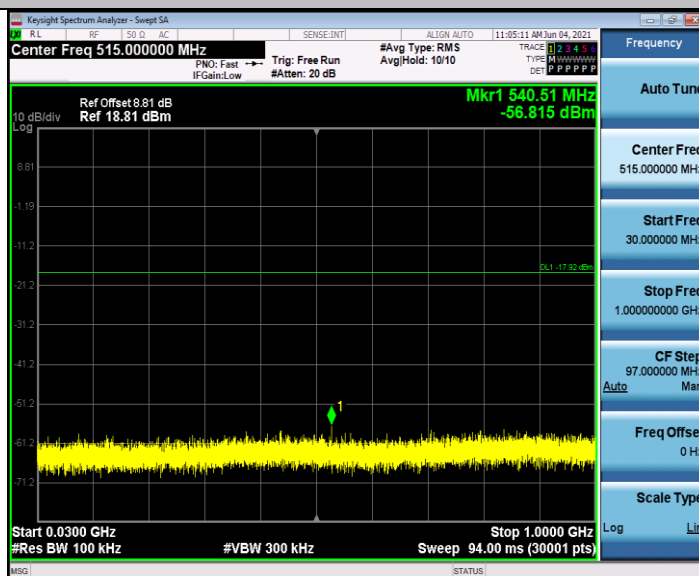
BLE_BT4.0_Ant1_2440_30~1000



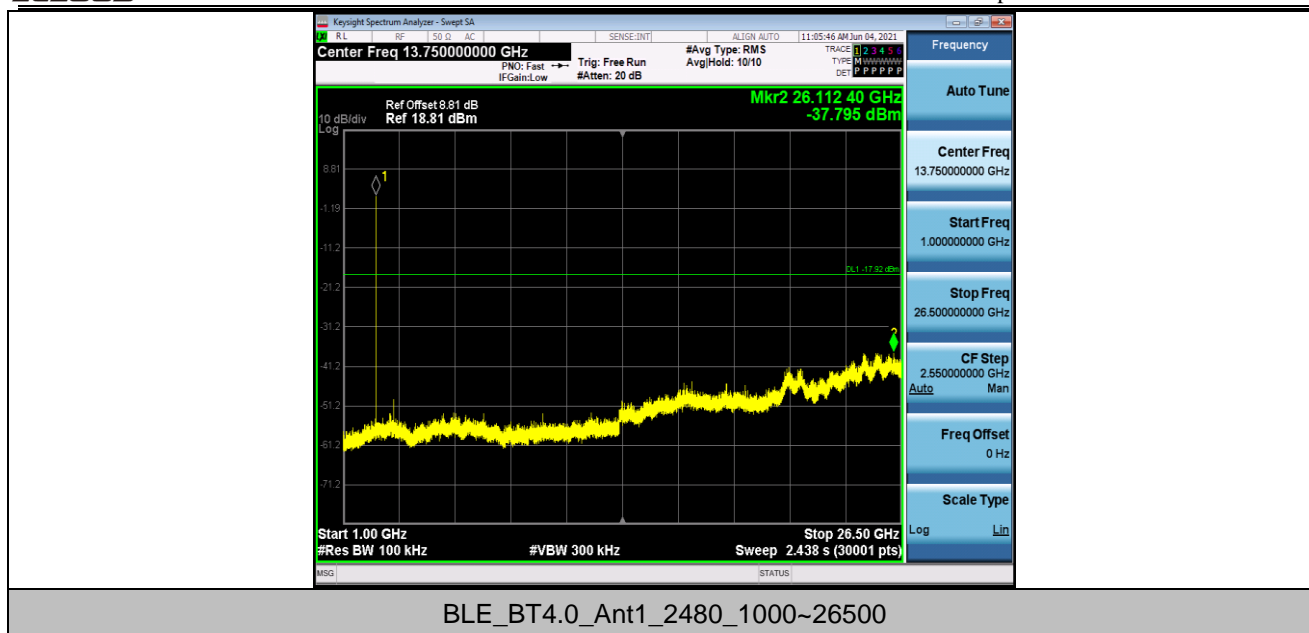
BLE_BT4.0_Ant1_2440_1000~26500



BLE_BT4.0_Ant1_2480_0~Reference



BLE_BT4.0_Ant1_2480_30~1000



Appendix G: Setup Photographs

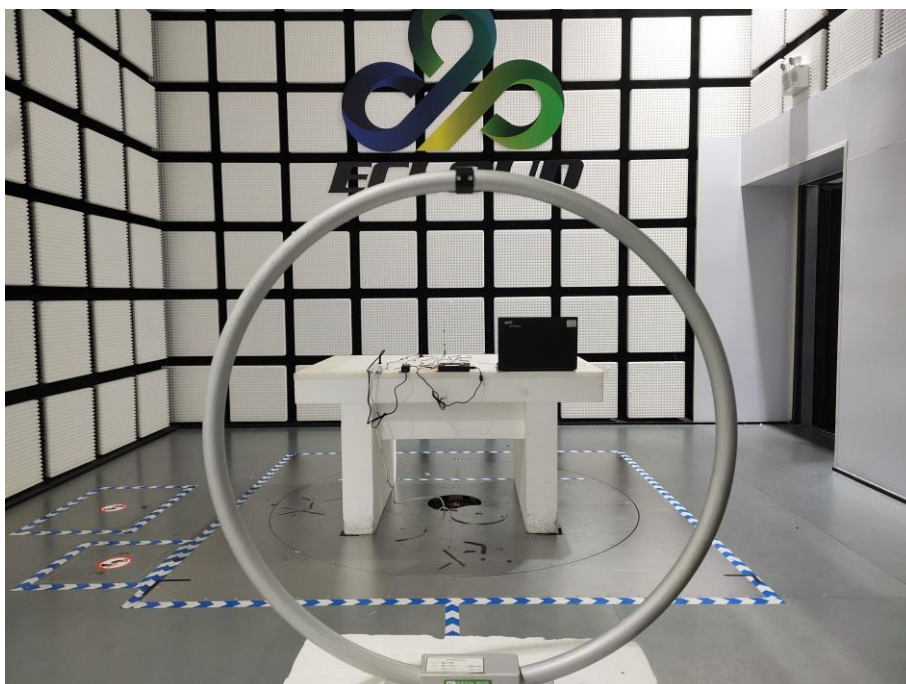


Fig. 1 Radiated emission setup photo(Below 30MHz)

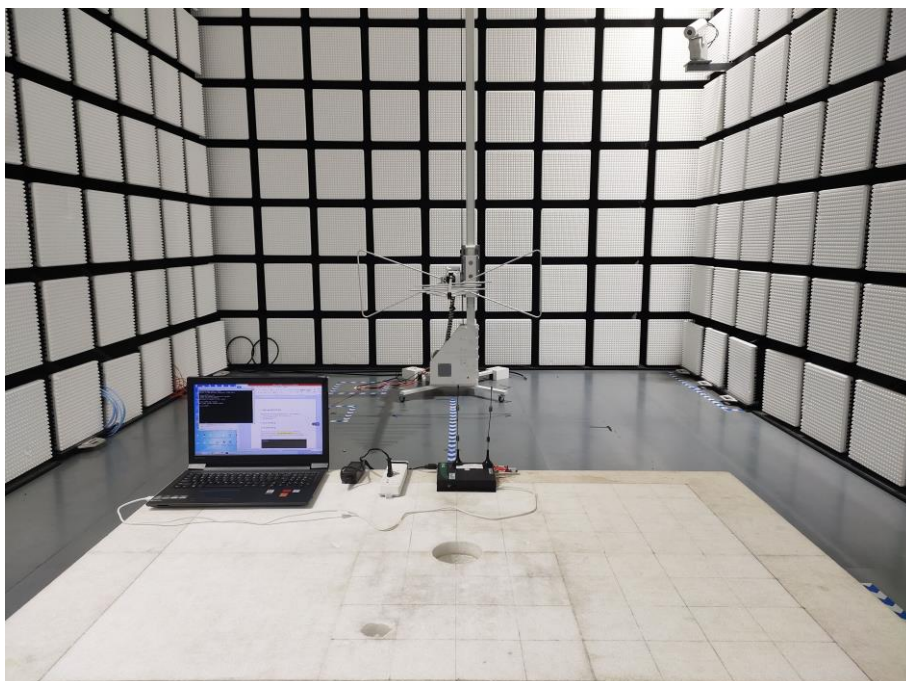


Fig. 2 Radiated emission setup photo(30MHz-1GHz)

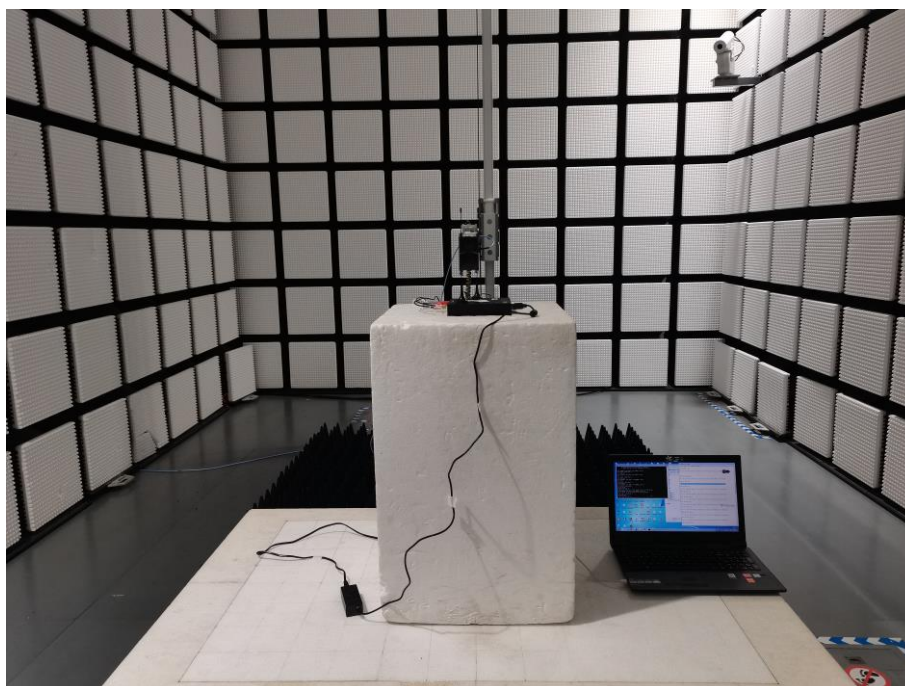


Fig. 3 Radiated emission setup photo(Above 1GHz)



Fig. 4 Power line conducted emission setup photo

-----End of the report-----