



FCC RADIO TEST REPORT

FCC ID : 2AZIR52840BG95NN
Equipment : BeWhere Asset Tracker
Brand Name : BeWhere
Model Name : B4-MIOT-MR BSP
 B4-MIOT-MR BTP
 B4-MIOT-MR BTW
Applicant : BeWhere Inc
 3264 Lakeshore Blvd West Etobicoke, Ontario
 M8V 1M4
Manufacturer : BeWhere Inc
 3264 Lakeshore Blvd West Etobicoke, Ontario
 M8V 1M4
Standard : FCC Part 15 Subpart C §15.247

The product was received on Nov. 08, 2022 and testing was performed from Nov. 09, 2022 to Jan. 27, 2023. We, Sporton International (USA) Inc., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval from Sporton International (USA) Inc., the test report shall not be reproduced except in full.

Approved by: Lance Tang

Sportun International (USA) Inc.
1175 Montague Expressway, Milpitas, CA 95035



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History of this test report



Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.247(a)(2)	6dB Bandwidth	Pass	-
3.1	2.1049	99% Occupied Bandwidth	Reporting only	-
3.2	15.247(b)(3) 15.247(b)(4)	Output Power	Pass	-
3.3	15.247(e)	Power Spectral Density	Pass	-
3.4	15.247(d)	Conducted Band Edges and Spurious Emission	Pass	-
3.5	15.247(d)	Radiated Band Edges and Spurious Emission	Pass	5.63 dB under the limit at 7320.000 MHz
-	15.207	AC Conducted Emission	Not Required	See Note
3.6	15.203	Antenna Requirement	Pass	-

Note: The EUT is powered by batteries which is deemed DC power source, it does not operate from the AC power lines or contain provisions for operation while connected to the AC power lines, according to 47 CFR §15.207(c), the conducted emission limits are not applicable to the device hence the test is not performed.

Conformity Assessment Condition:

1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
2. Please refer to the section " Uncertainty of Evaluation " for measurement uncertainty.

Comments and Explanations:

The product specifications of the EUT presented in the report are declared by the manufacturer who shall take full responsibility for the authenticity.



1 General Description

1.1 Product Feature of Equipment Under Test

LTE, Bluetooth-LE, and GNSS.

Product Feature	
Sample 1	B4-BeSol +
Sample 2	B4-BeTen +
Sample 3	B4-Bewired
Antenna Type	WWAN: Omni-directional Antenna Bluetooth-LE: SMD Chip Antenna GPS/Glonass/BDS/Galileo/Compass/SBAS: Miniature Loop Antenna
Antenna information	
2400 MHz ~ 2483.5 MHz	Peak Gain (dBi) 1

Remark:

1. The EUT's information above is declared by manufacturer. Please refer to Comments and Explanations in report summary.
2. The manufacturer declares that device model numbers B4-MIOT-MR BSP, B4-MIOT-MR BTP and B4-MIOT-MR BTW are electrically equivalent in PCB Version, BLE Chipset, Cellular Modem and Antennas. The models listed in this test report share the identical circuit design and topology, electrical components and physical layout. The only differences in between are charging method and components, battery capacity and enclosure dimensions. For more details please refer to the Declaration of Product Equivalence Letter issued by the manufacturer.

1.2 Modification of EUT

No modifications made to the EUT during the testing.



1.3 Testing Location

Test Site	Sportun International (USA) Inc.
Test Site Location	1175 Montague Expressway, Milpitas, CA 95035 TEL : 408 9043300
Test Site No.	Sportun Site No. TH01-CA, 03CH02-CA

Note: The test site complies with ANSI C63.4 2014 requirement.

FCC Designation No.: US1250

1.4 Applicable Standards

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

- ♦ FCC Part 15 Subpart C §15.247
- ♦ FCC KDB Publication No. 558074 D01 15.247 Meas Guidance v05r02
- ♦ FCC KDB 414788 D01 Radiated Test Site v01r01
- ♦ ANSI C63.10-2013

Remark:

1. All the test items were validated and recorded in accordance with the standards without any modification during the testing.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.



2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	0	2402	21	2444
	1	2404	22	2446
	2	2406	23	2448
	3	2408	24	2450
	4	2410	25	2452
	5	2412	26	2454
	6	2414	27	2456
	7	2416	28	2458
	8	2418	29	2460
	9	2420	30	2462
	10	2422	31	2464
	11	2424	32	2466
	12	2426	33	2468
	13	2428	34	2470
	14	2430	35	2472
	15	2432	36	2474
	16	2434	37	2476
	17	2436	38	2478
	18	2438	39	2480
	19	2440	-	-
	20	2442	-	-



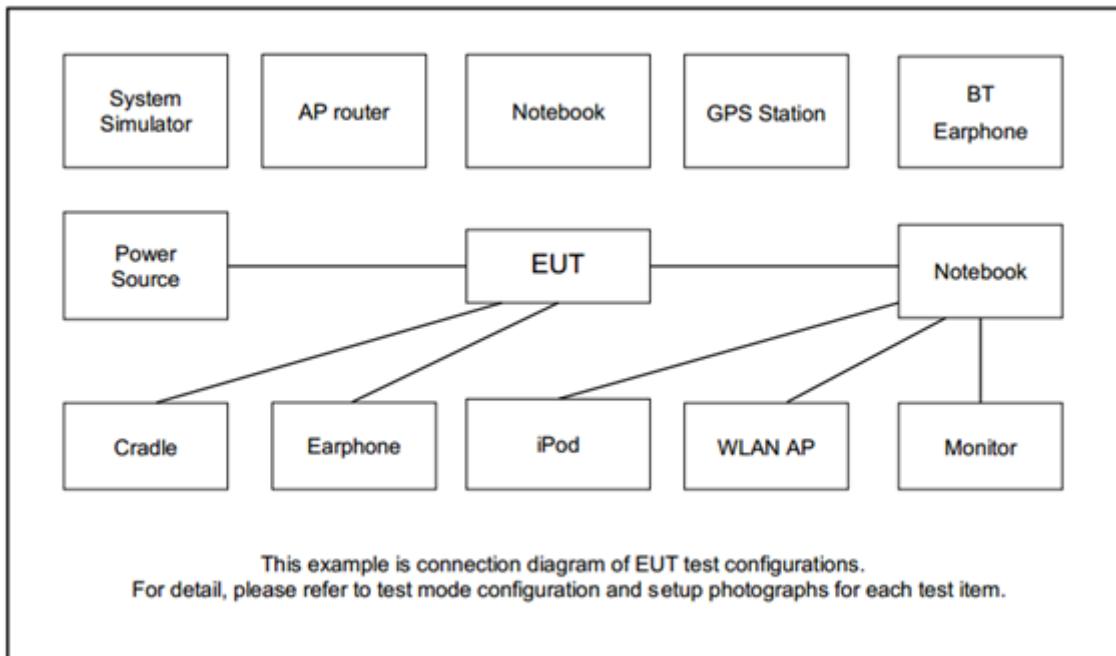
2.2 Test Mode

- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, the measured emission level of the EUT was maximized by rotating the EUT on a turntable, adjusting the orientation of the EUT and EUT antenna in three orthogonal axis (X: flat, Y: portrait, Z: landscape), and adjusting the measurement antenna orientation, following C63.10 exploratory test procedures and only the worst case emissions were reported in this report.

The following summary table is showing all test modes to demonstrate in compliance with the standard.

Summary table of Test Cases	
Test Item	Data Rate / Modulation
Conducted Test Cases	Bluetooth – LE / GFSK
	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps
Radiated Test Cases	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps
Remark: For radiation spurious emission, the modulation and the data rate picked for testing are determined by the Max. RF conducted power.	

2.3 Connection Diagram of Test System



2.4 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Notebook	Lenovo	SL11H55466	TP00116F	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m

2.5 EUT Operation Test Setup

The RF test items, utility “Putty V0.2.203” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.



2.6 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 4.2 dB and 10 dB attenuator.

$$\begin{aligned} \text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)} \\ &= 4.2 + 10 = 14.2 \text{ (dB)} \end{aligned}$$

3 Test Result

3.1 6dB and 99% Bandwidth Measurement

3.1.1 Limit of 6dB and 99% Bandwidth

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

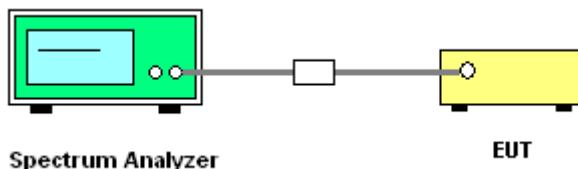
3.1.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.1.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 6.9.3 (OBW) and 11.8.1 (6dB BW).
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to 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 6dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1-5% of the emission bandwidth and set the Video bandwidth (VBW) $\geq 3 * \text{RBW}$.
6. Measure and record the results in the test report.

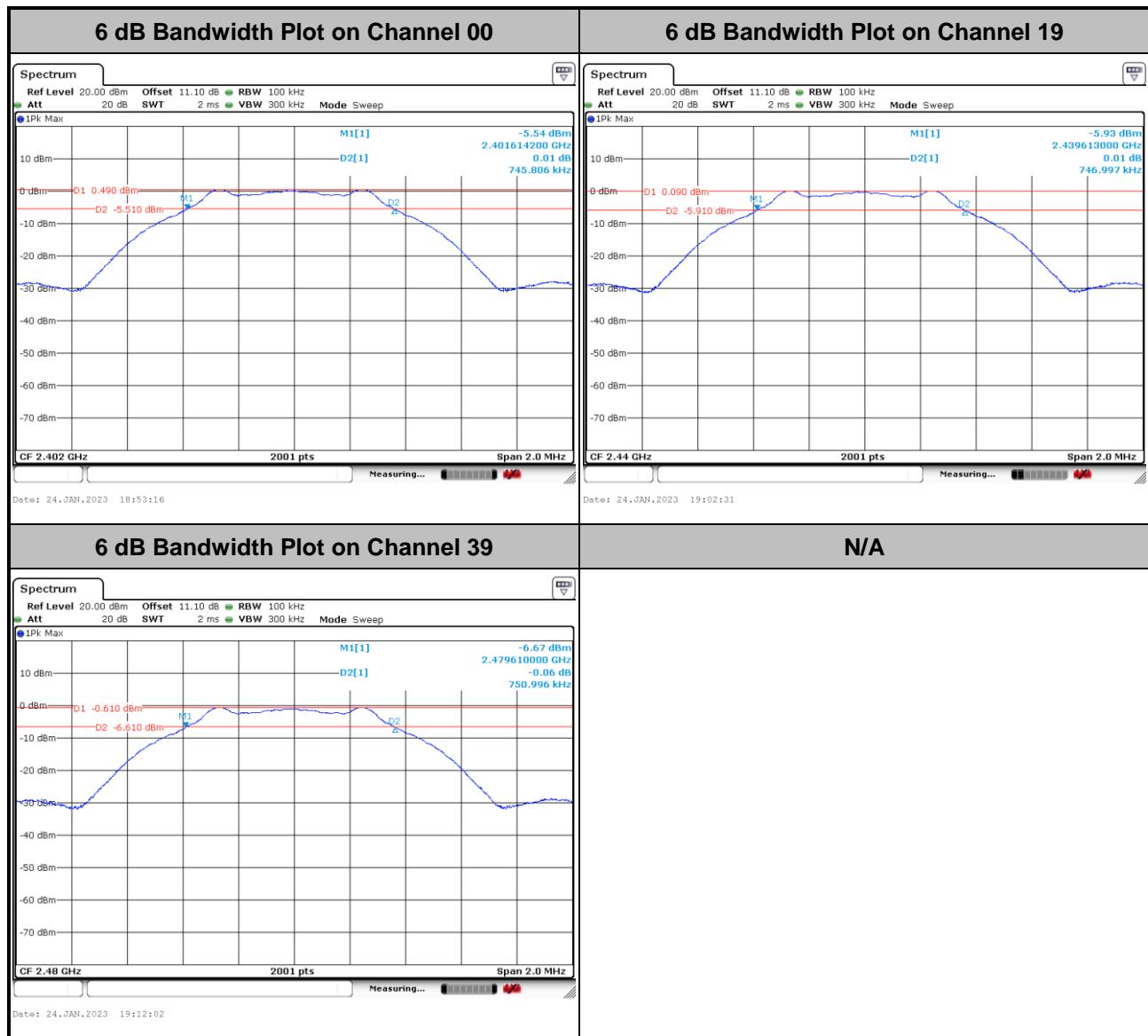
3.1.4 Test Setup



3.1.5 Test Result of 6dB Bandwidth

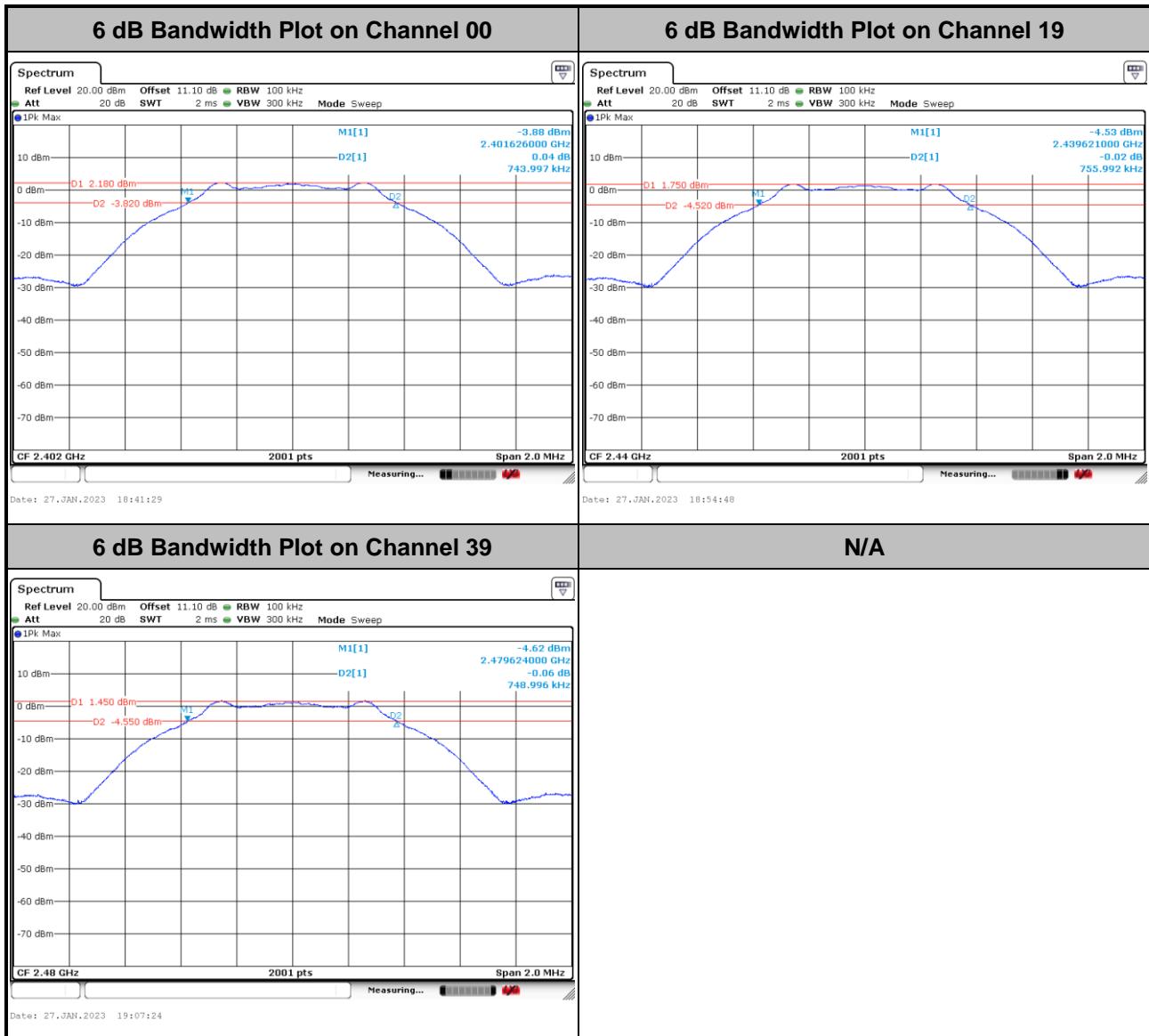
Please refer to Appendix A.

<Sample 1>



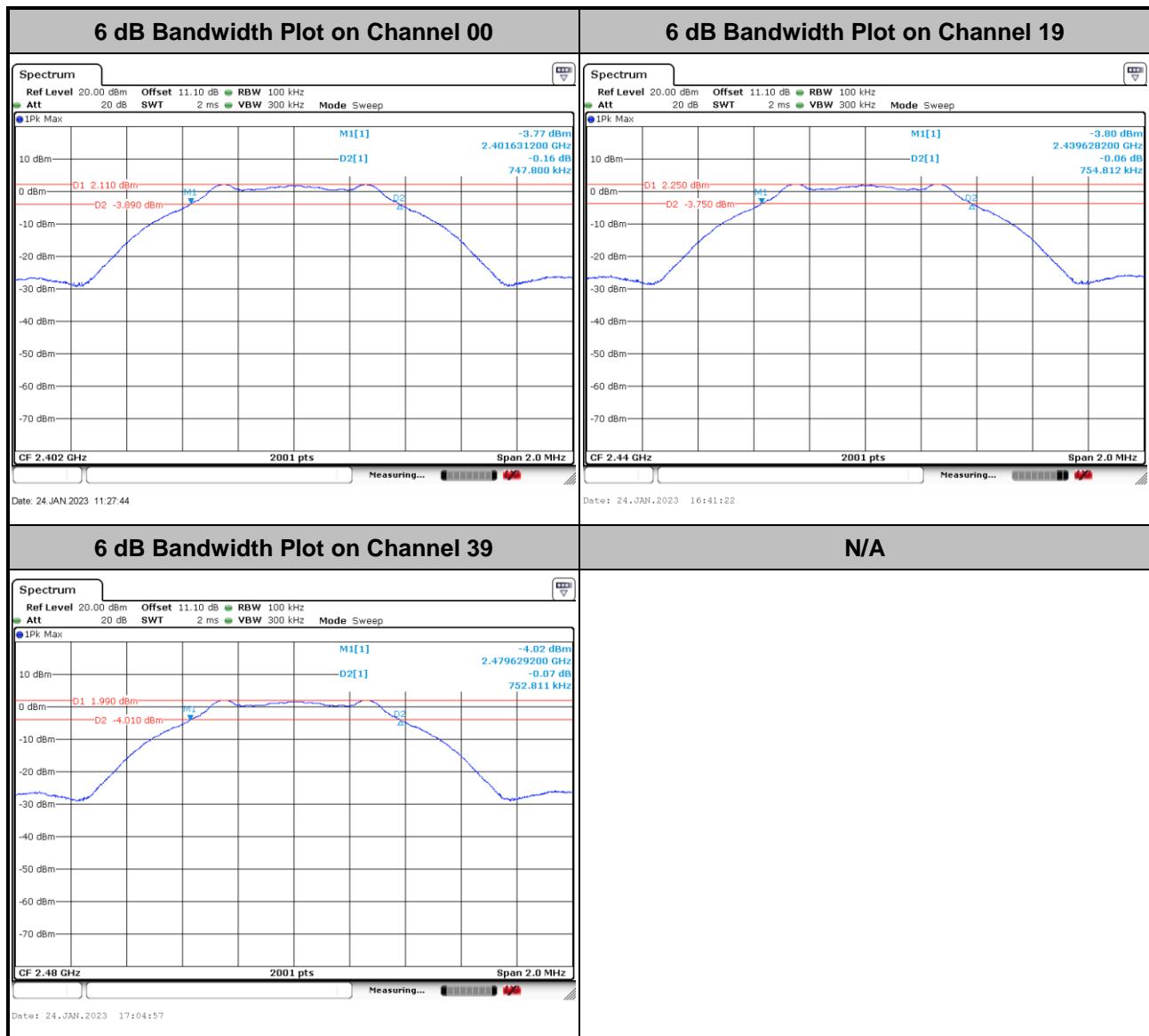


<Sample 2>





<Sample 3>

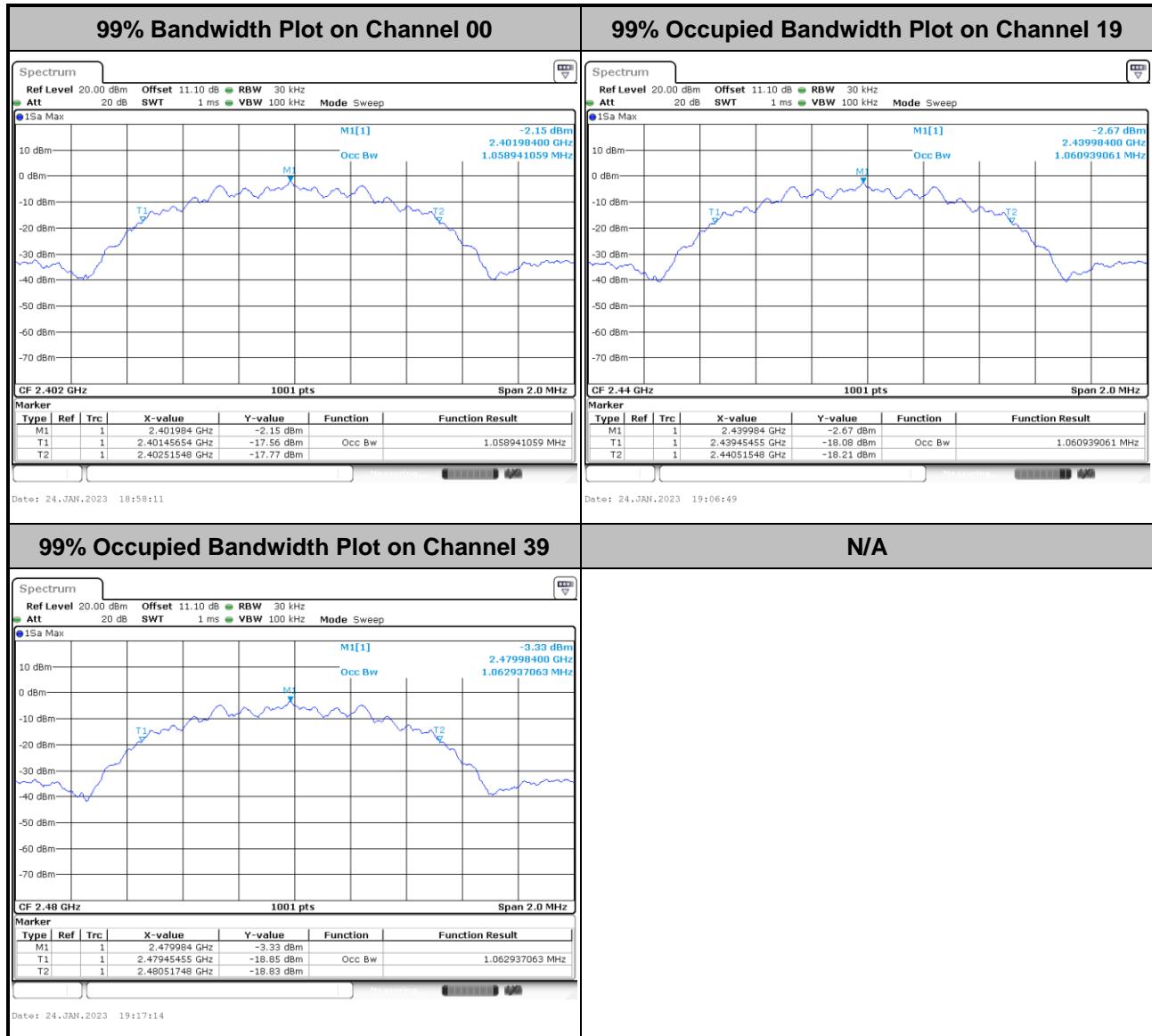




3.1.6 Test Result of 99% Occupied Bandwidth

Please refer to Appendix A.

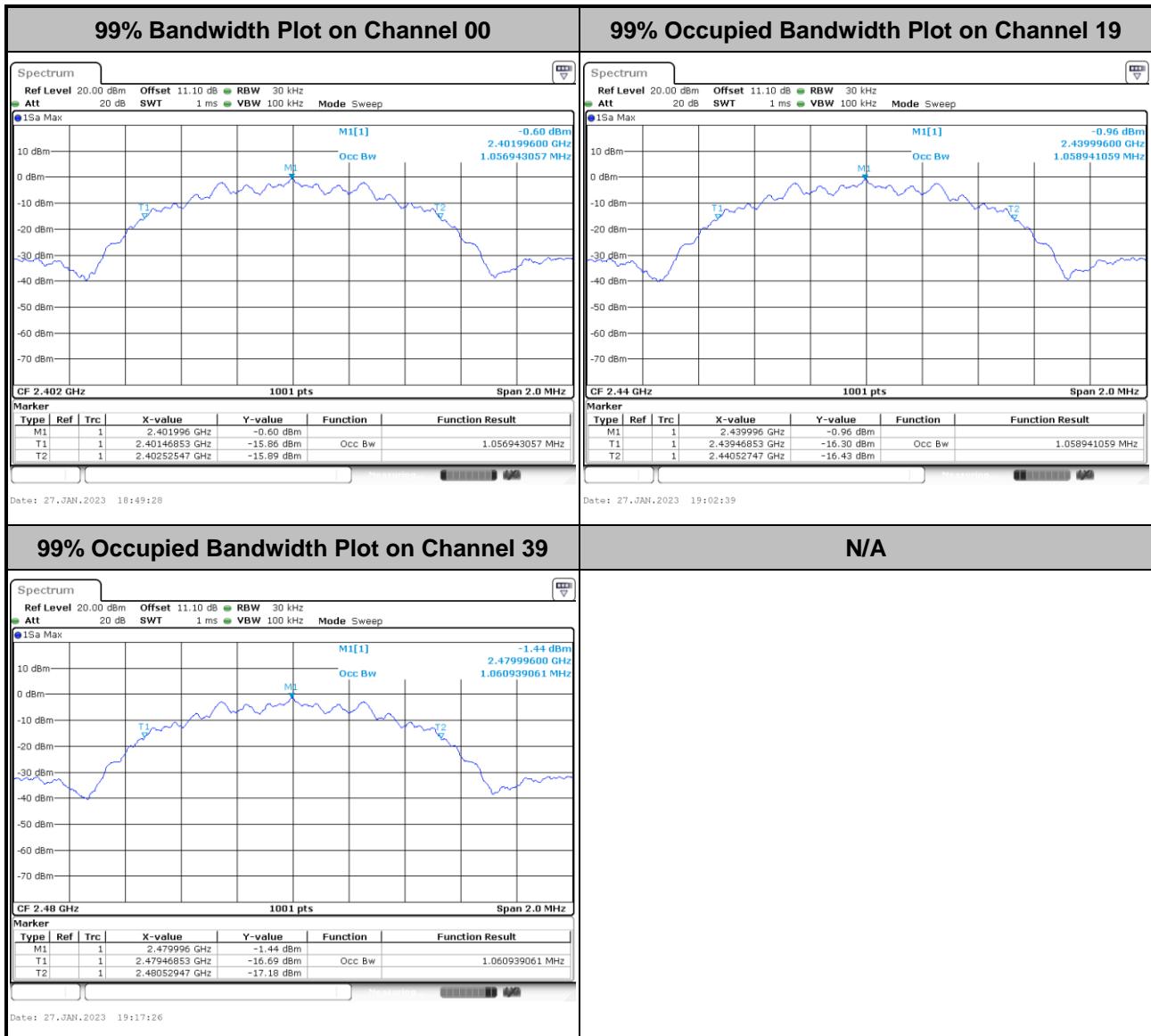
<Sample 1>



Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.



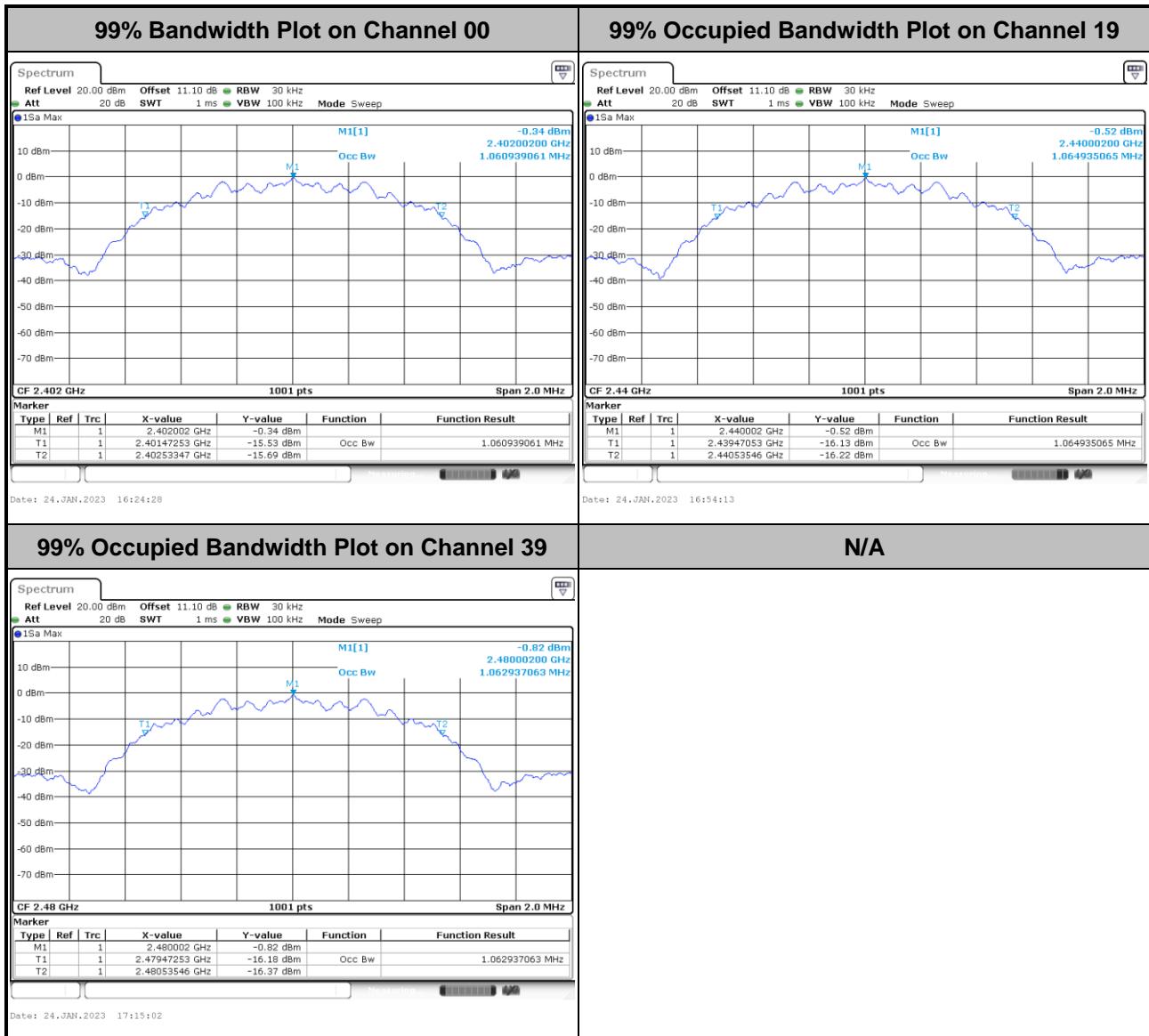
<Sample 2>



Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.



<Sample 3>



Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

3.2 Output Power Measurement

3.2.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5 MHz, the limit for output power is 30 dBm. If transmitting antenna of directional gain greater than 6 dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

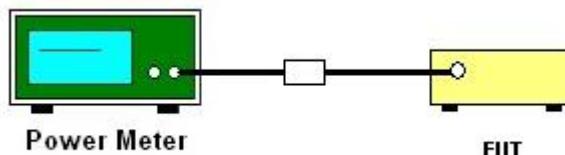
3.2.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.2.3 Test Procedures

1. For Average Power, the testing follows ANSI C63.10 Section 11.9.2.3.2 Method AVGPM-G
2. The RF output of EUT is connected to the power meter by RF cable and attenuator.
3. The path loss is compensated to the results for each measurement.
4. Set the maximum power setting and enable the EUT to transmit continuously.
5. Measure the conducted output power and record the results in the test report.

3.2.4 Test Setup



3.2.5 Test Result of Average Output Power

Please refer to Appendix A.

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

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

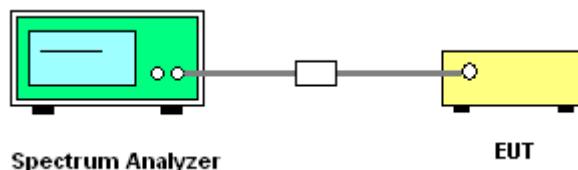
3.3.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.3.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 11.10.2 Method PKPSD.
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. 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. (6 dB BW)
5. 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.
6. Measure and record the results in the test report.
7. The Measured power density (dBm)/ 100 kHz is a reference level and is used as 20 dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

3.3.4 Test Setup



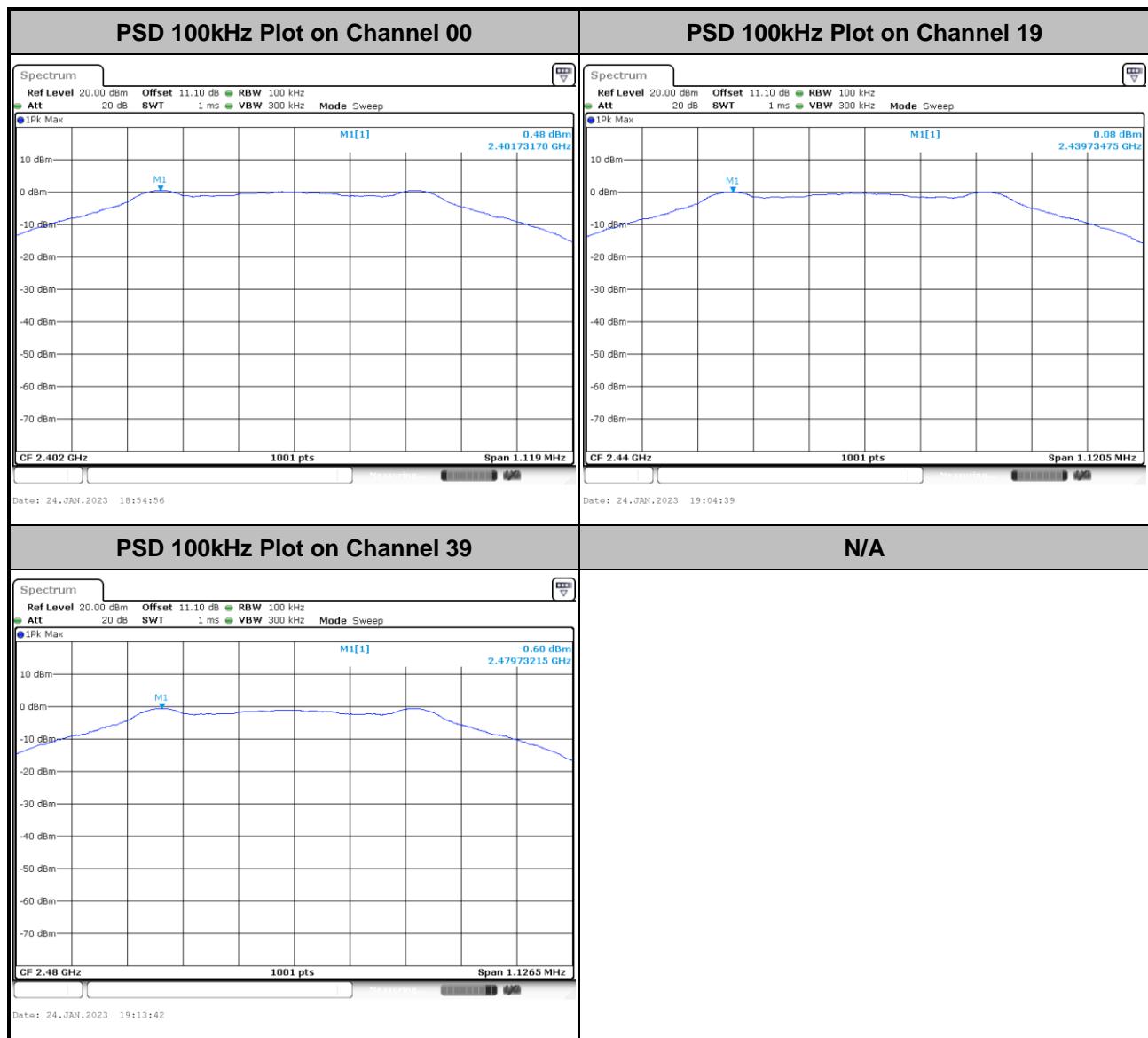
3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.



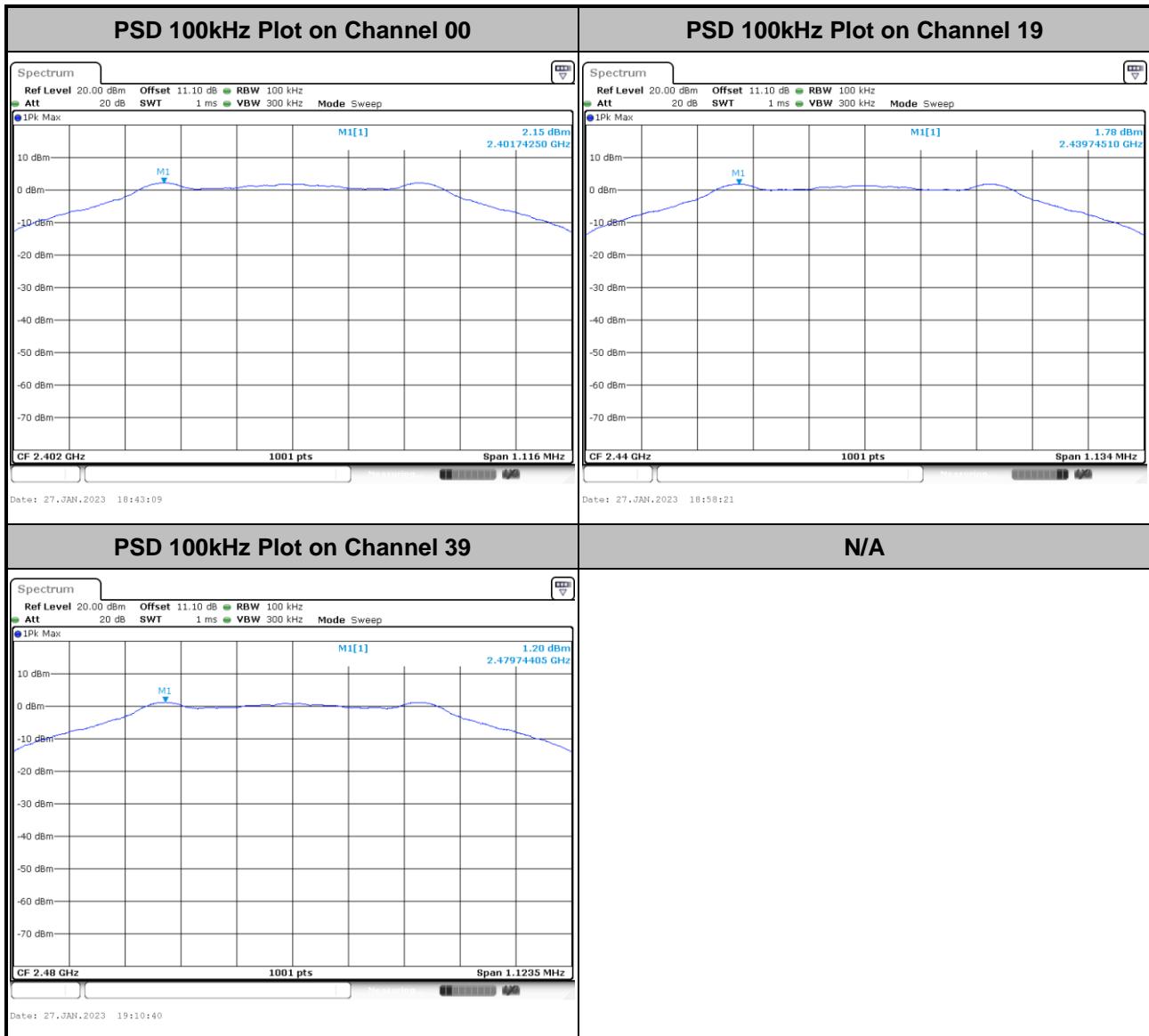
3.3.6 Test Result of Power Spectral Density Plots (100kHz)

<Sample 1>



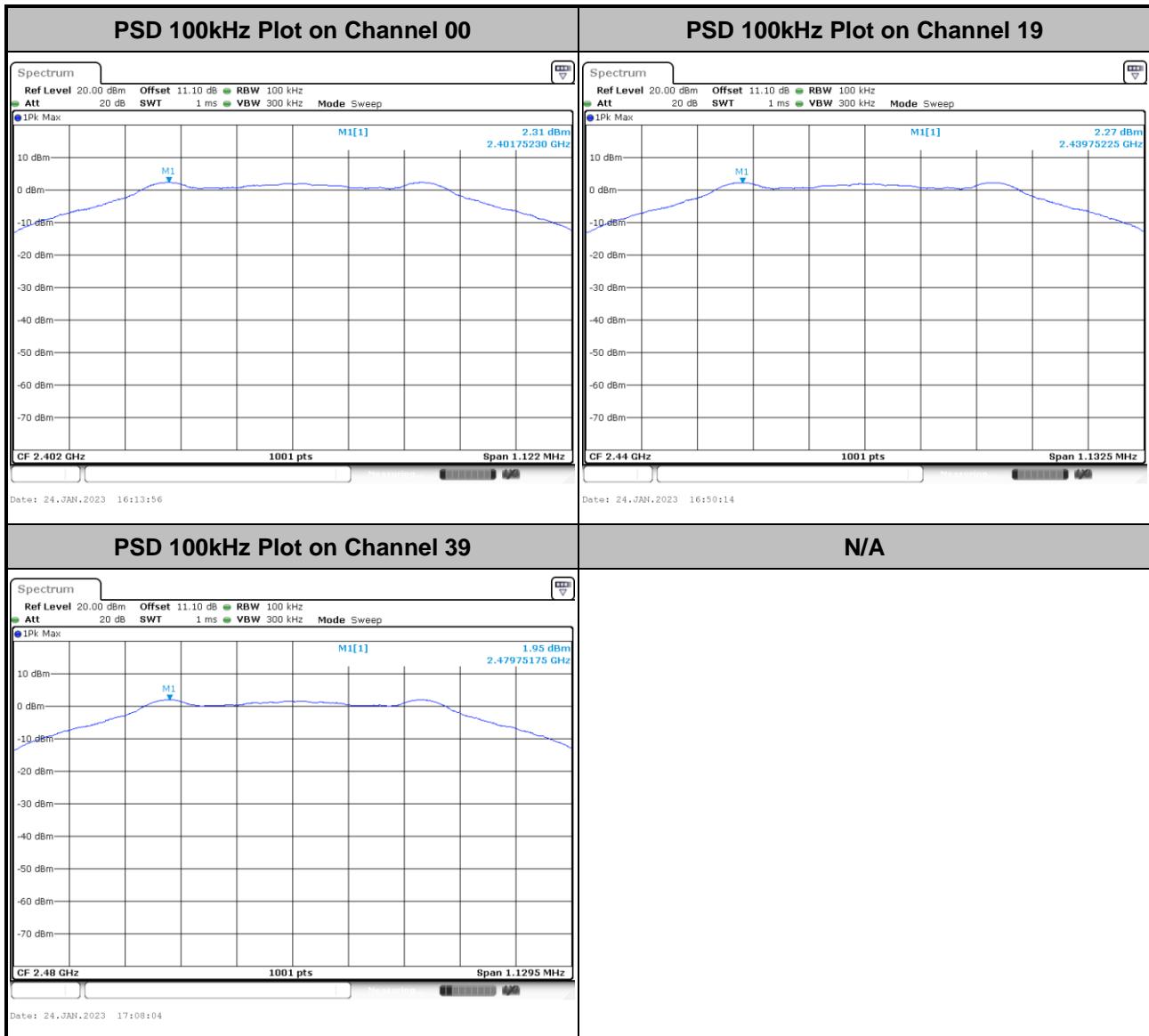


<Sample 2>





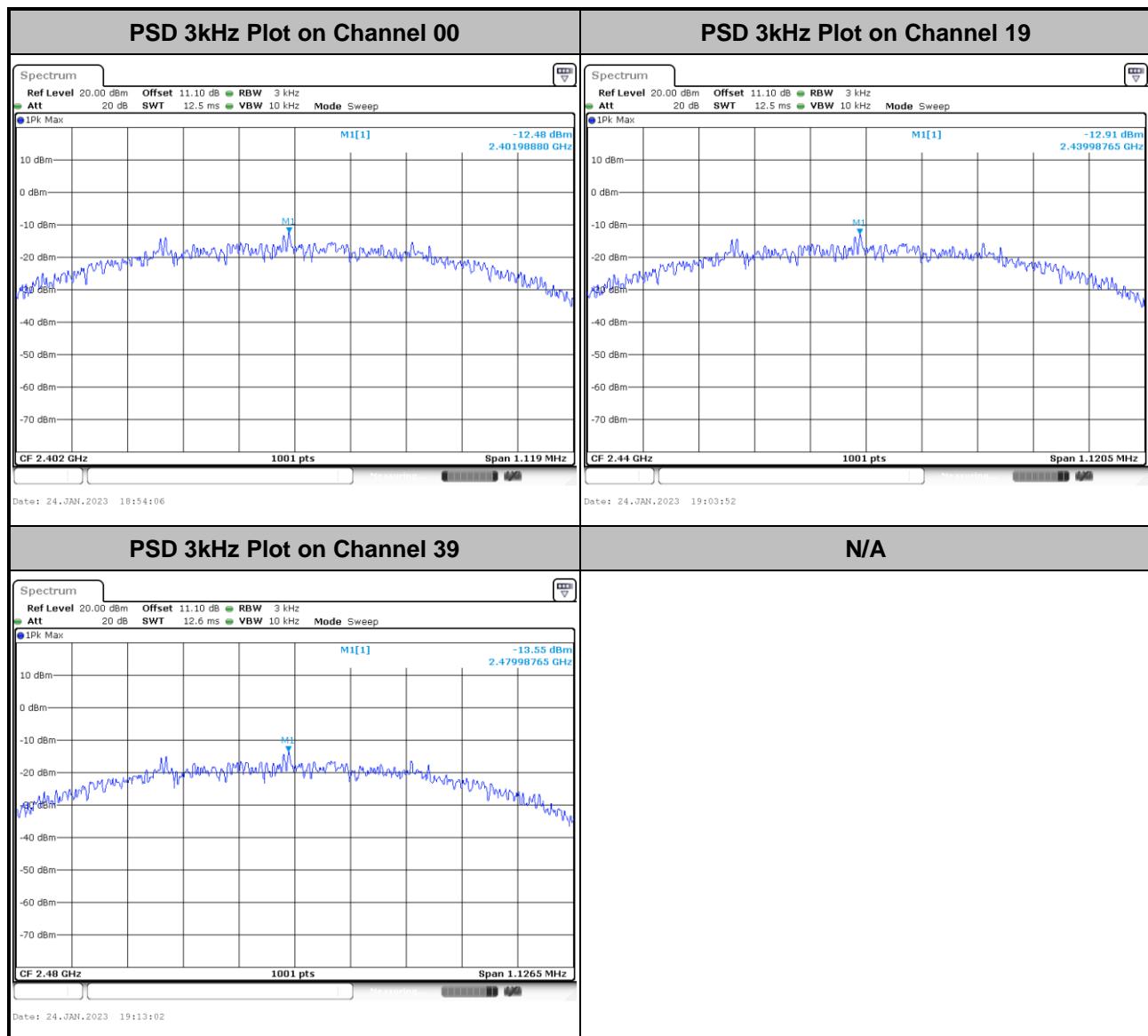
<Sample 3>





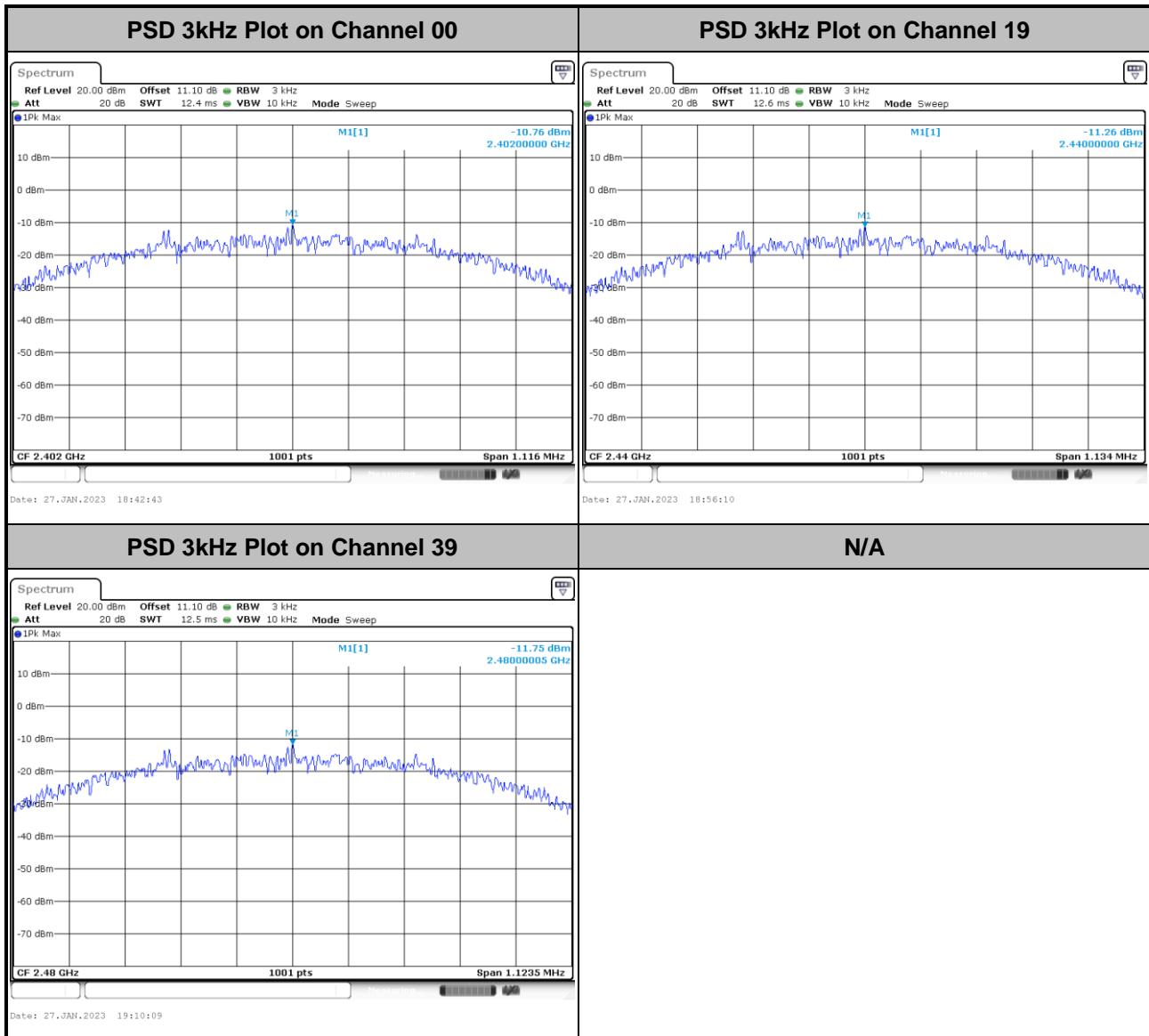
3.3.7 Test Result of Power Spectral Density Plots (3kHz)

<Sample 1>



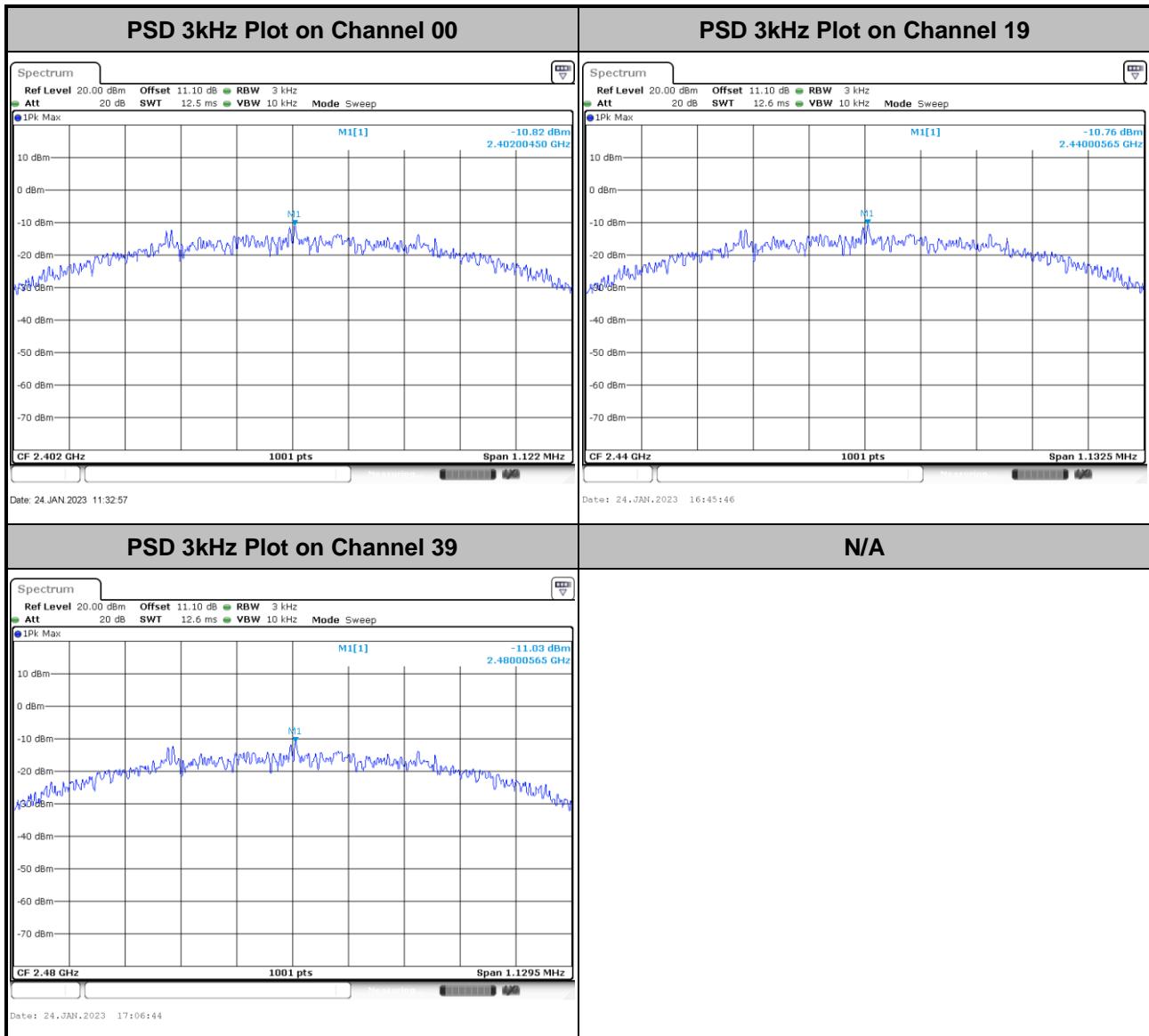


<Sample 2>





<Sample 3>



3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission

All harmonics/spurious must be at least 30 dB down from the highest emission level within the authorized band.

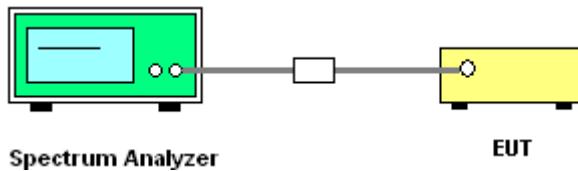
3.4.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.4.3 Test Procedure

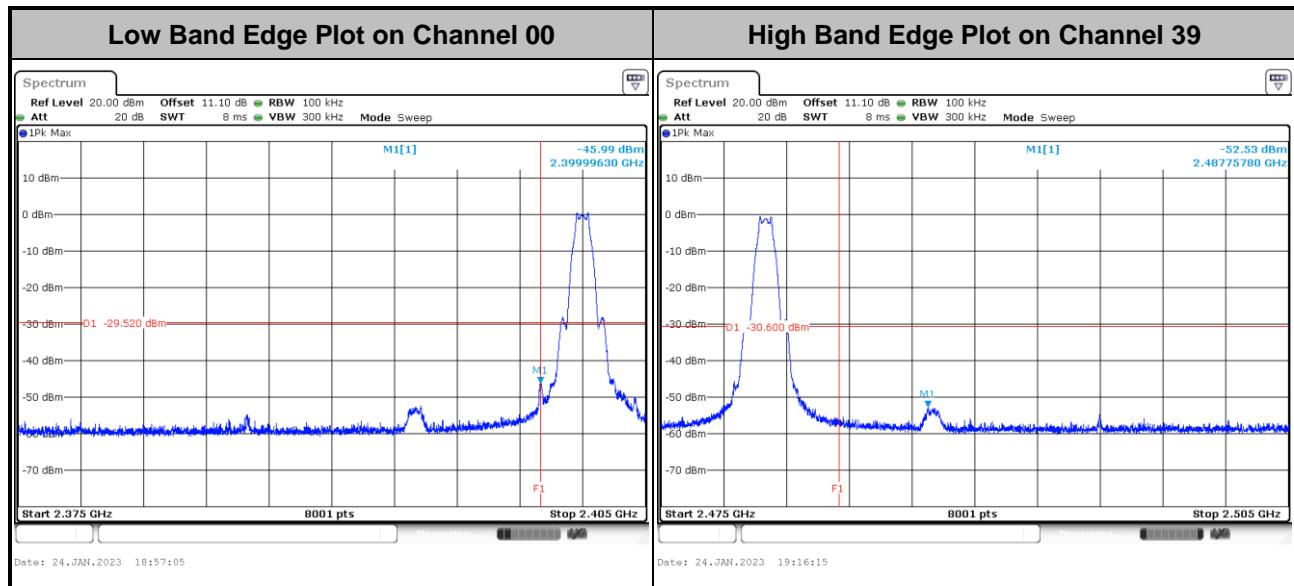
1. The testing follows the ANSI C63.10 Section 11.11.3 Emission level measurement.
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. 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.
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.4.4 Test Setup

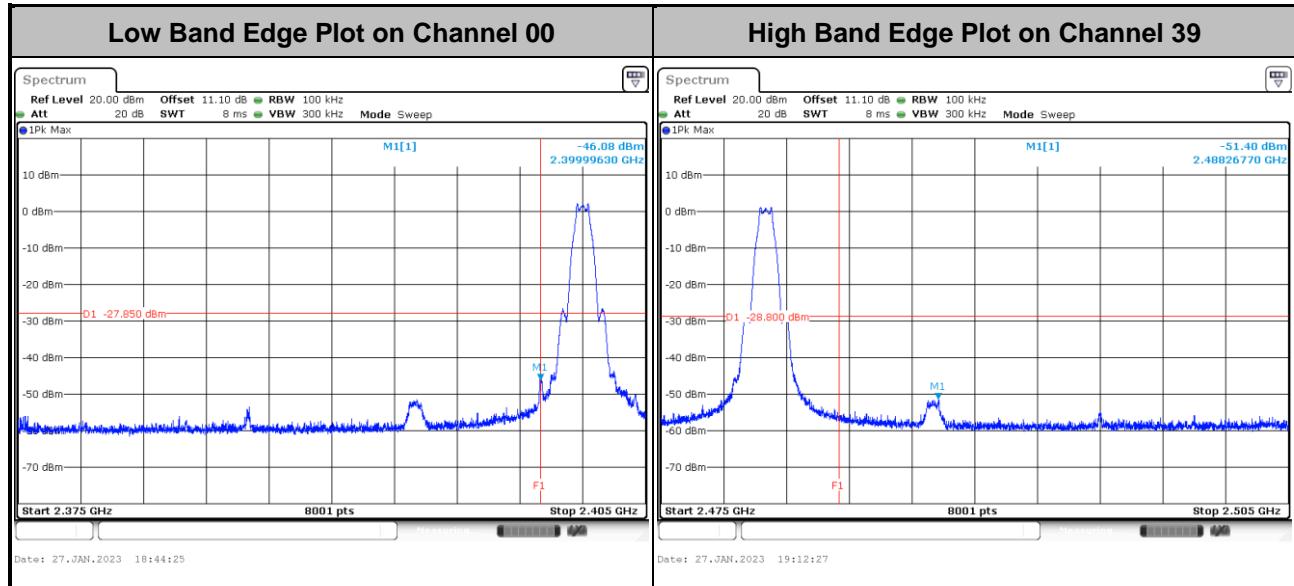


3.4.5 Test Result of Conducted Band Edges Plots

<Sample 1>

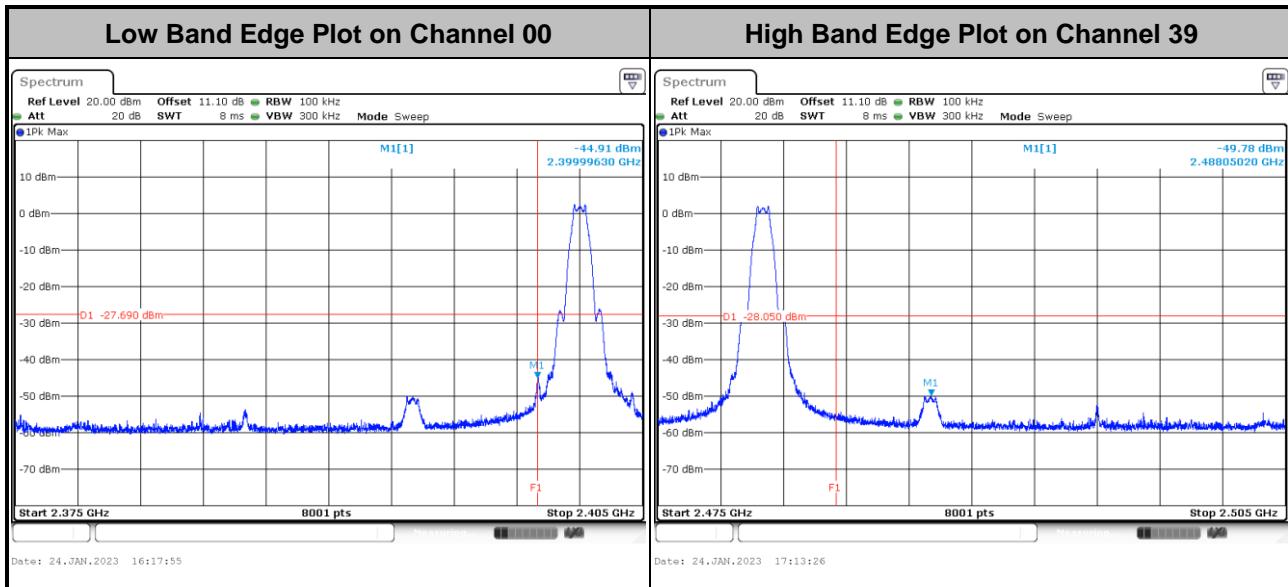


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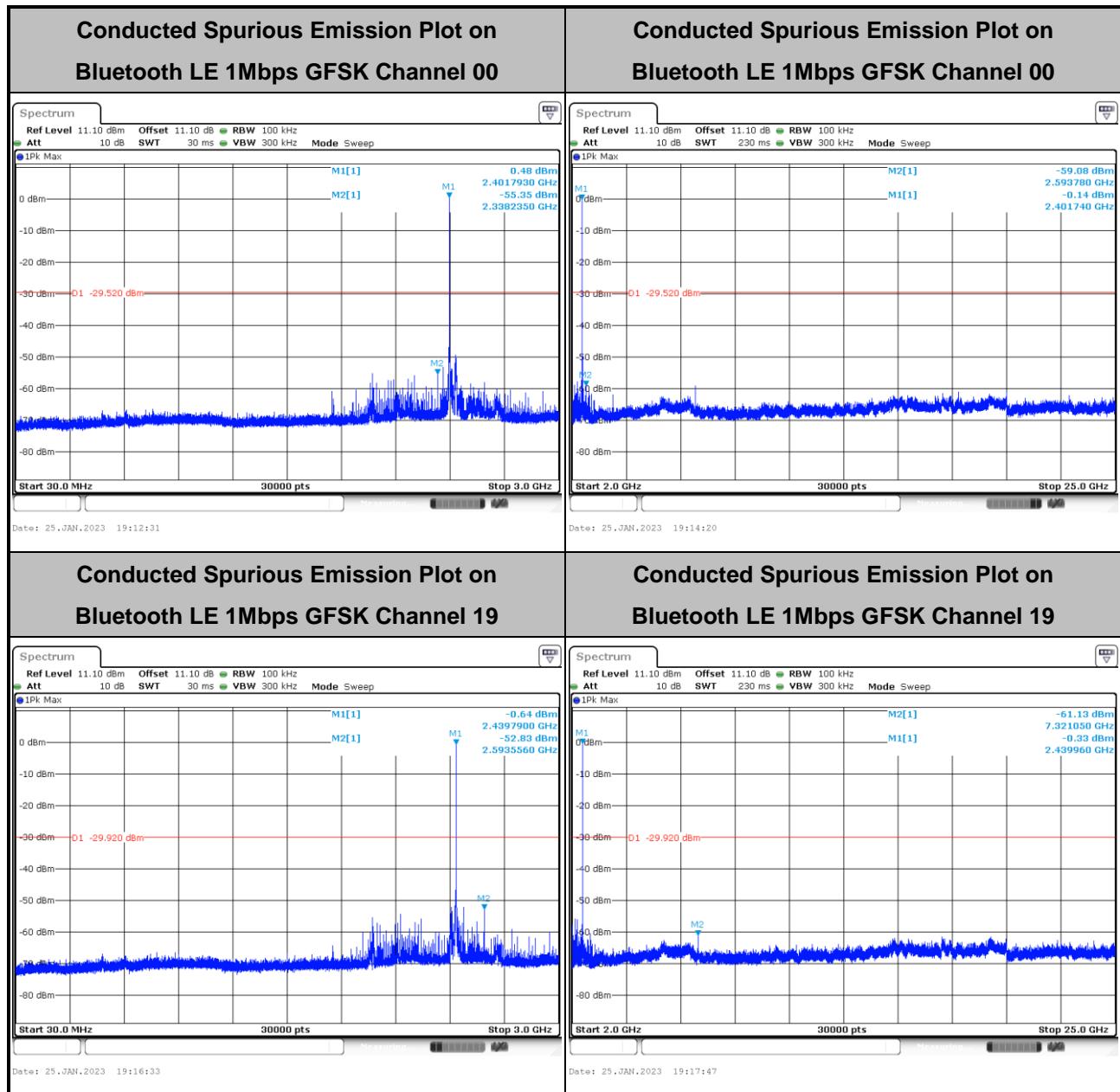


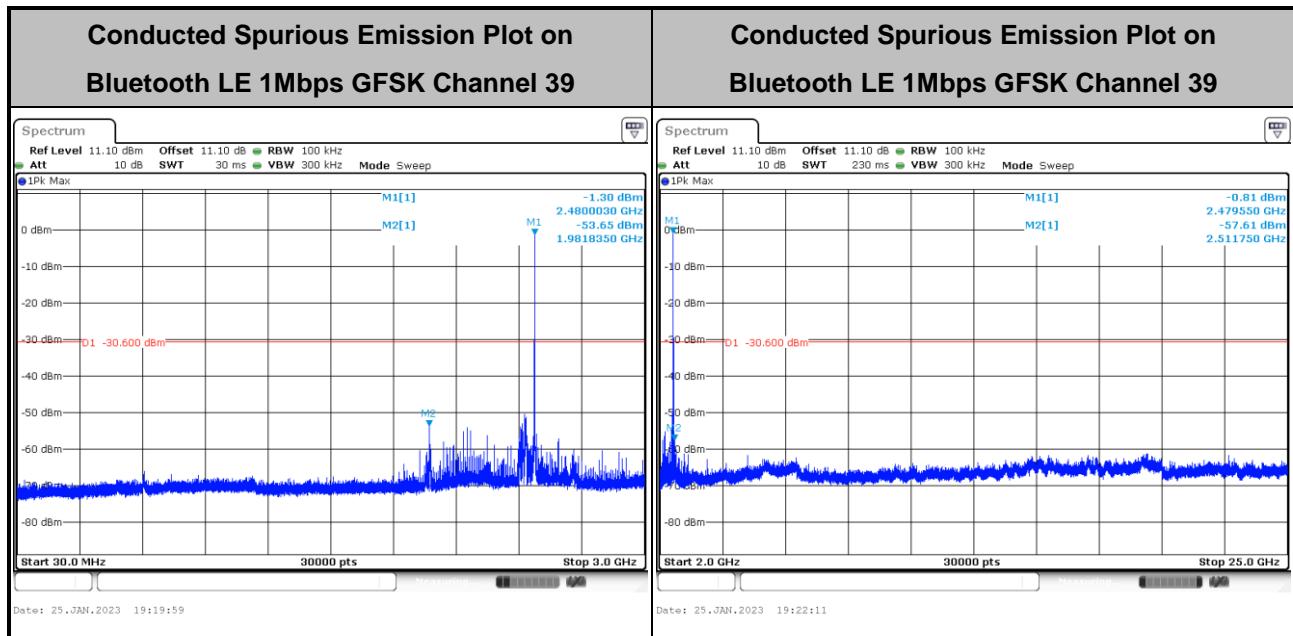
<Sample 3>



3.4.6 Test Result of Conducted Spurious Emission Plots

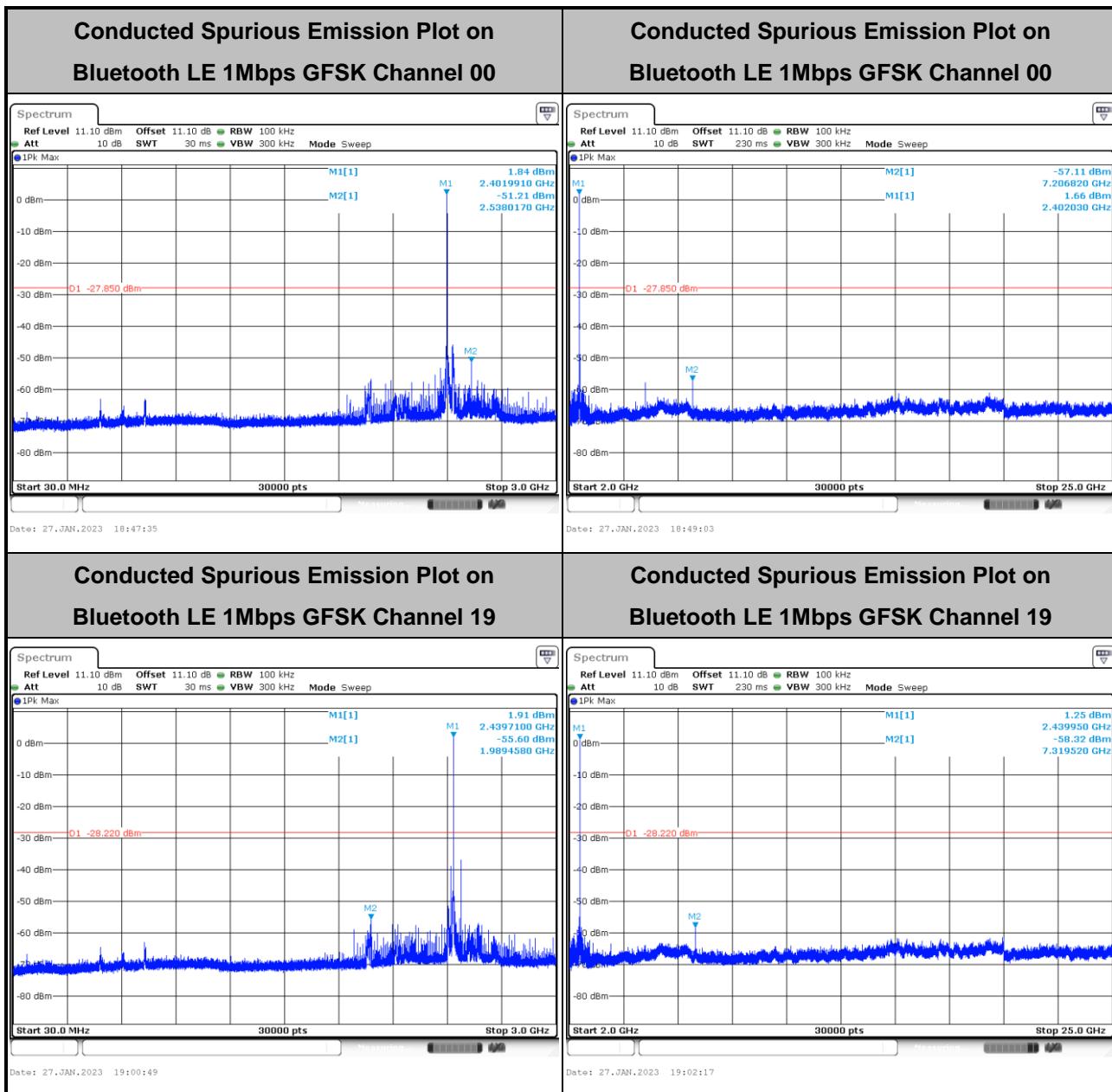
<Sample 1>

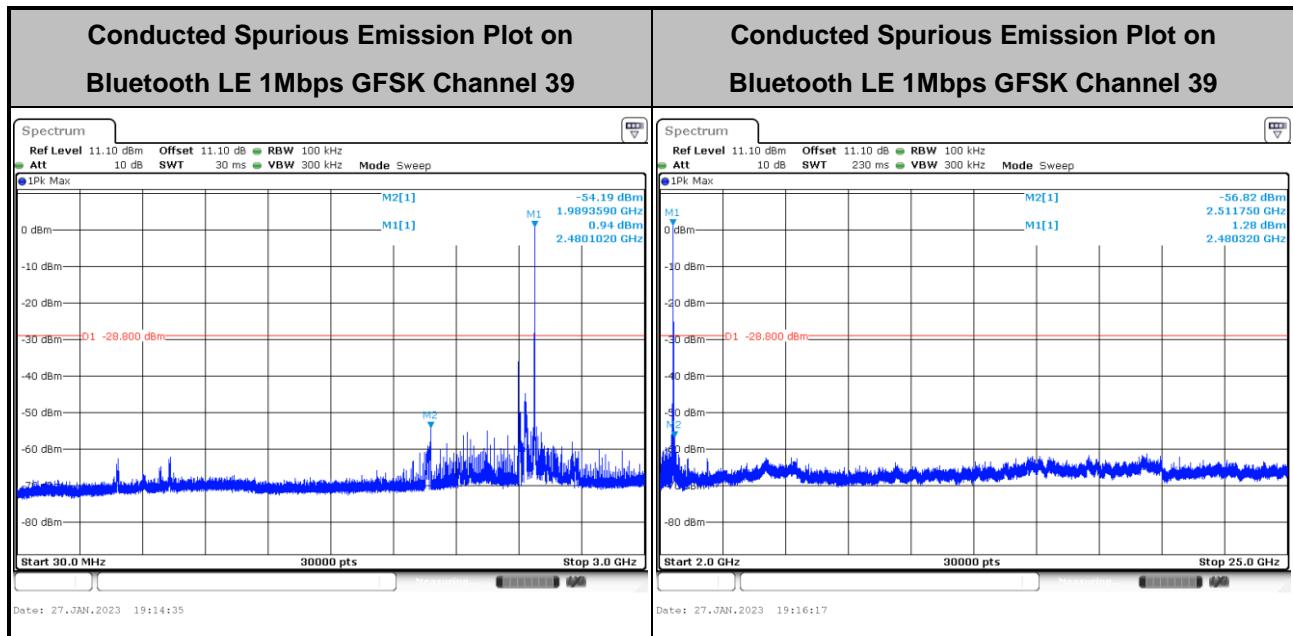






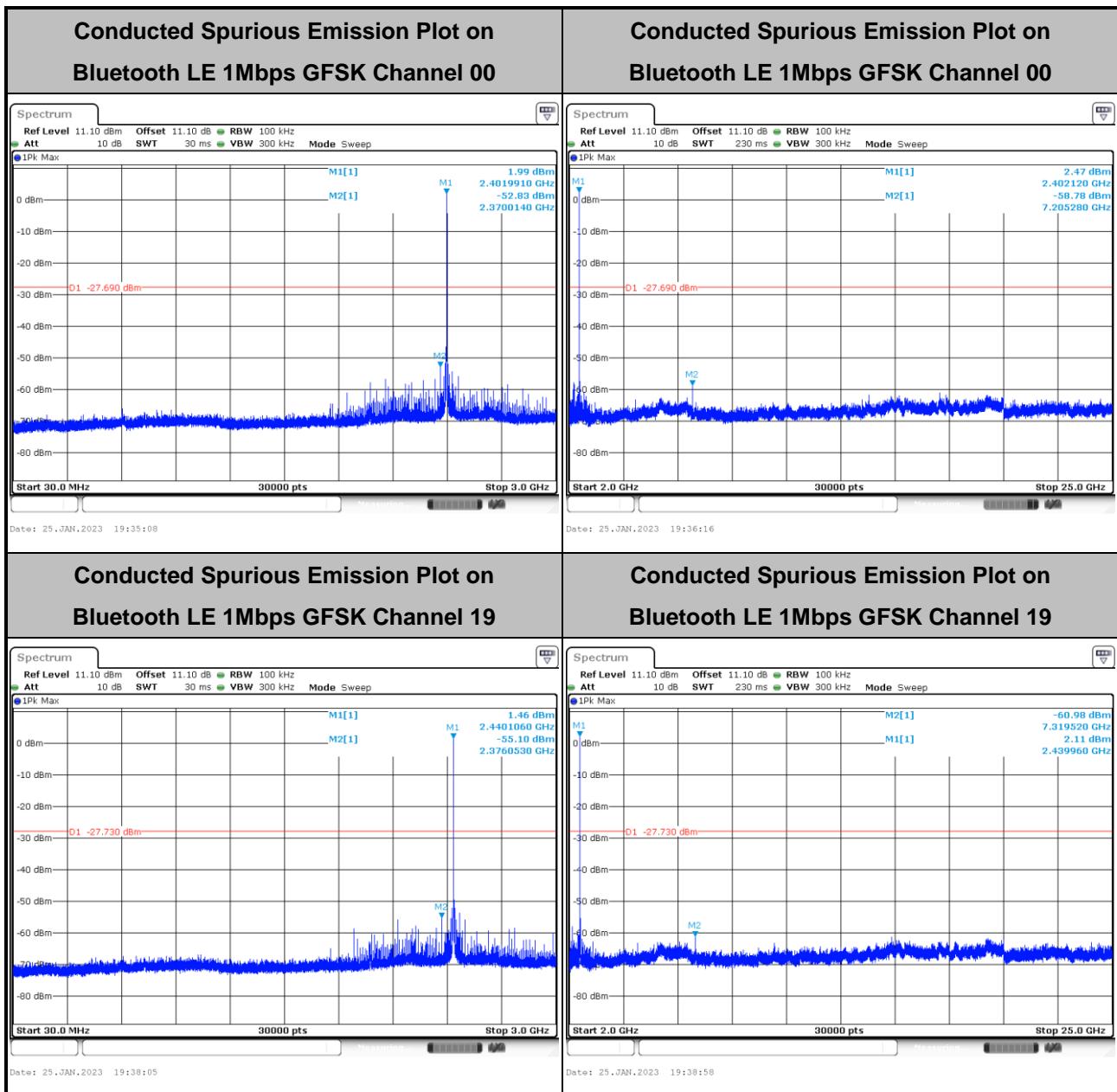
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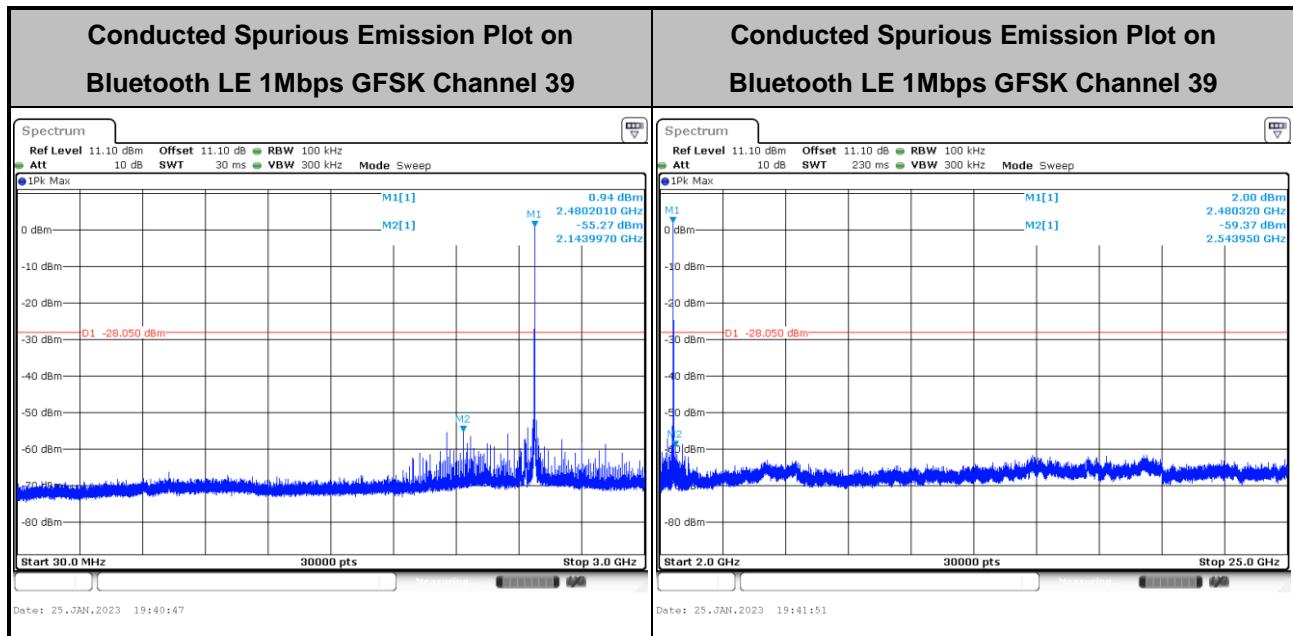






<Sample 3>







3.5 Radiated Band Edges and Spurious Emission Measurement

3.5.1 Limit of Radiated Band Edges and Spurious Emission

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. If the output power of this device is measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the 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

3.5.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.



3.5.3 Test Procedures

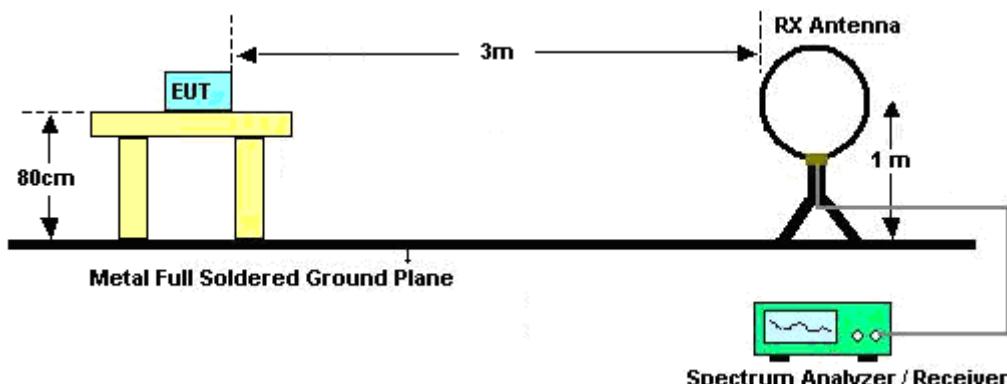
1. The testing follows the ANSI C63.10 Section 11.12.1 Radiated emission measurements.
2. The EUT is arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT is placed on a turntable with 0.8 meter for frequency below 1 GHz and 1.5 meter for frequency above 1 GHz respectively above ground.
4. The EUT is set 3 meters away from the receiving antenna, which is mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. Radiated testing below 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading. When there is no suspected emission found and the emission level is with at least 6 dB margin against QP limit line, the position is marked as “-”.
7. Radiated testing above 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading for scanning all frequencies. When there is no suspected emission found and the harmonic emission level is with at least 6 dB margin against average limit line, the position is marked as “-”.
8. 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; VBW \geq RBW; Sweep = auto; Detector function = peak; Trace = max hold;
 - (3) Set RBW = 1 MHz, VBW = 3 MHz for $f \geq 1$ GHz for peak measurement.

For average measurement:

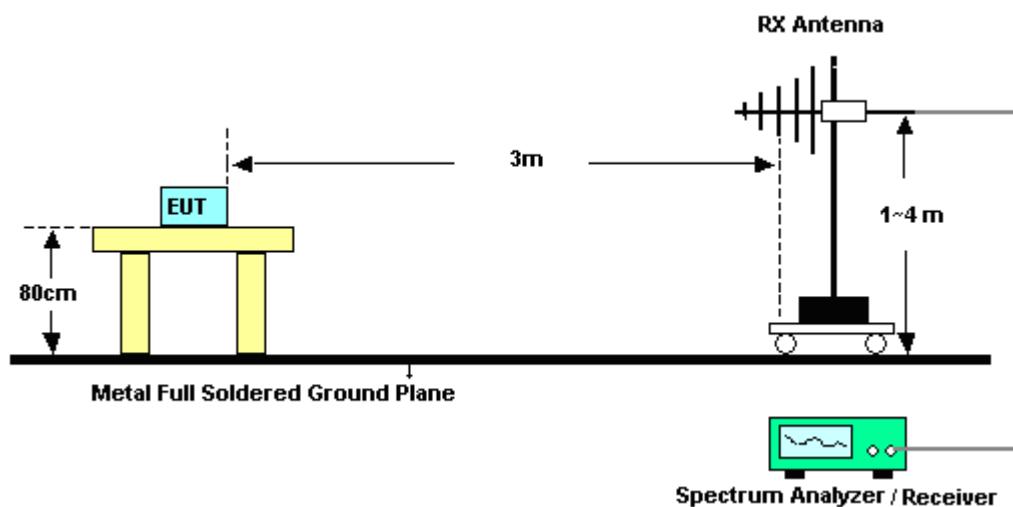
 - VBW = 10 Hz, when duty cycle is no less than 98 percent.
 - VBW $\geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.5.4 Test Setup

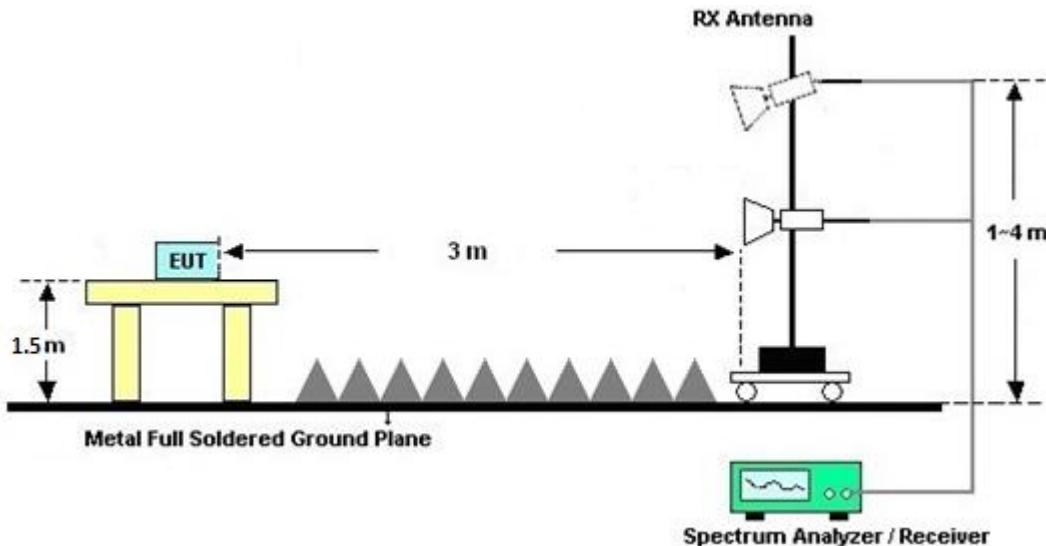
For radiated test below 30MHz



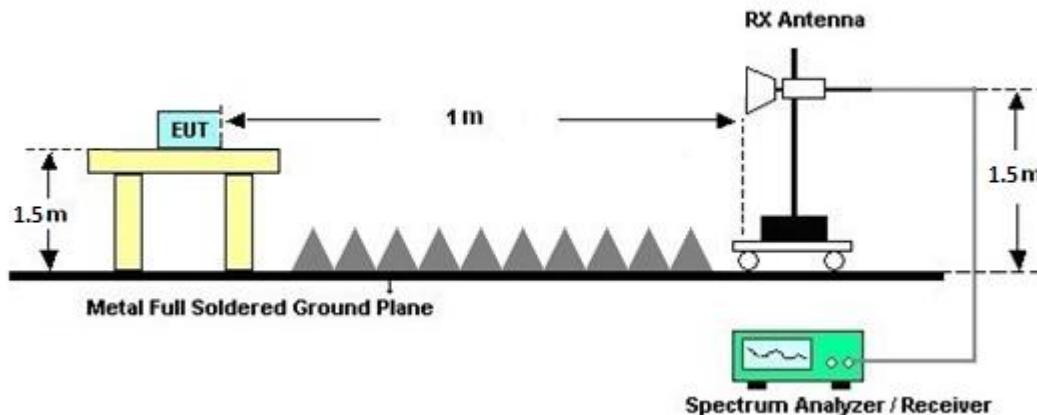
For radiated test from 30MHz to 1GHz



For radiated test from 1GHz to 18GHz



For radiated test above 18GHz



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

The low frequency, which starts from 9 kHz to 30 MHz, is pre-scanned and the result which is 20 dB lower than the limit line is not reported.

There is adequate comparison measurement of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result comes out very similar.

3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B and C.

3.5.7 Duty Cycle

Please refer to Appendix D.

3.5.8 Test Result of Radiated Spurious Emission (30 MHz ~ 10th Harmonic)

Please refer to Appendix B and C.



3.6 Antenna Requirements

3.6.1 Standard Applicable

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 rule.

3.6.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.



4 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100840	9kHz~30MHz	Jul. 05, 2022	Nov. 09, 2022~Jan. 25, 2023	Jul. 04, 2023	Radiation (03CH02-CA)
Bilog Antenna	TESEQ	6111D	50392	30MHz~1GHz	Jul. 11, 2022	Nov. 09, 2022~Jan. 25, 2023	Jul. 10, 2023	Radiation (03CH02-CA)
Horn Antenna	SCHWARZBECK	BBHA 9120D	02113	1GHz~18GHz	Jun. 22, 2022	Nov. 09, 2022~Jan. 25, 2023	Jun. 21, 2023	Radiation (03CH02-CA)
Horn Antenna	SCHWARZBECK	BBHA 9170D	00842	18GHz~40GHz	Aug. 16, 2022	Nov. 09, 2022~Jan. 25, 2023	Aug. 15, 2023	Radiation (03CH02-CA)
Amplifier	SONOMA	310N	372240	N/A	May 10, 2022	Nov. 09, 2022~Jan. 25, 2023	May 09, 2023	Radiation (03CH02-CA)
Preamplifier	Keysight	83017A	MY53270323	1GHz~26.5GHz	May 11, 2022	Nov. 09, 2022~Jan. 25, 2023	May 10, 2023	Radiation (03CH02-CA)
Preamplifier	E-instrument	ERA-100M-18G-56-01-A70	EC1900251	1GHz~18GHz	May 10, 2022	Nov. 09, 2022~Jan. 25, 2023	May 09, 2023	Radiation (03CH02-CA)
Preamplifier	EMEC	EMC18G40G	060726	18GHz~40GHz	Feb. 10, 2022	Nov. 09, 2022~Jan. 25, 2023	Feb. 09, 2023	Radiation (03CH02-CA)
RF Cable	HUBER+SUHNER	SUCOFLEX 102	8024032/2, 802406/2, 802875/2	N/A	Jun. 22, 2022	Nov. 09, 2022~Jan. 25, 2023	Jun. 21, 2023	Radiation (03CH02-CA)
Filter	Wainwright	WHKX12-2700-3000-18000-60ST	SN10	3GHz High Pass Filter	Jul. 22, 2022	Nov. 09, 2022~Jan. 25, 2023	Jul. 21, 2023	Radiation (03CH02-CA)
Filter	Wainwright	WLK12-1200-1272-11000-40SS	SN1	1.2GHz Low Pass Filter	Jul. 22, 2022	Nov. 09, 2022~Jan. 25, 2023	Jul. 21, 2023	Radiation (03CH02-CA)
Hygrometer	TESEO	608-H1	45142602	N/A	Sep. 12, 2022	Nov. 09, 2022~Jan. 25, 2023	Sep. 11, 2023	Radiation (03CH02-CA)
Controller	ChainTek	EM-1000	060876	NA	N/A	Nov. 09, 2022~Jan. 25, 2023	N/A	Radiation (03CH02-CA)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Nov. 09, 2022~Jan. 25, 2023	N/A	Radiation (03CH02-CA)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Nov. 09, 2022~Jan. 25, 2023	N/A	Radiation (03CH02-CA)
Software	Audix	E3	N/A	N/A	N/A	Nov. 09, 2022~Jan. 25, 2023	N/A	Radiation (03CH02-CA)
Hygrometer	Testo	608-H1	45141354	N/A	Jul. 27, 2022	Jan. 23, 2023~Jan. 27, 2023	Jul. 26, 2023	Conducted (TH01-CA)
Power Sensor	DARE!!	RPR3006W	RPR6W-1901024	10MHz-6GHz	May 10, 2022	Jan. 23, 2023~Jan. 27, 2023	May 09, 2023	Conducted (TH01-CA)
Spectrum Analyzer	Rohde & Schwarz	FSV40	101545	10Hz-40GHz	May 31, 2022	Jan. 23, 2023~Jan. 27, 2023	May 30, 2023	Conducted (TH01-CA)



5 Uncertainty of Evaluation

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_{C(y)}$)	4.5 dB
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Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_{C(y)}$)	4.9 dB
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Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_{C(y)}$)	5.2 dB
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Appendix A. Test Result of Conducted Test Items

Test Engineer:	Venkata Kondepudi				Temperature:	19.4~21.3		°C
Test Date:	2023/01/23-2023/01/27				Relative Humidity:	28.4~31.5		%

<Sample 1>

<u>TEST RESULTS DATA</u> <u>6dB and 99% Occupied Bandwidth</u>								
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
BLE	1Mbps	1	0	2402	1.059	0.746	0.50	Pass
BLE	1Mbps	1	19	2440	1.061	0.747	0.50	Pass
BLE	1Mbps	1	39	2480	1.063	0.751	0.50	Pass

<u>TEST RESULTS DATA</u> <u>Average Power Table</u>										
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
BLE	1Mbps	1	0	2402	1.35	30.00	1.00	2.35	36.00	Pass
BLE	1Mbps	1	19	2440	0.77	30.00	1.00	1.77	36.00	Pass
BLE	1Mbps	1	39	2480	0.02	30.00	1.00	1.02	36.00	Pass

<u>TEST RESULTS DATA</u> <u>Peak Power Density</u>									
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak PSD (dBm /100kHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail
BLE	1Mbps	1	0	2402	0.48	-12.48	1.00	8.00	Pass
BLE	1Mbps	1	19	2440	0.08	-12.91	1.00	8.00	Pass
BLE	1Mbps	1	39	2480	-0.60	-13.55	1.00	8.00	Pass

Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 30dBc limit.

<Sample 2>

TEST RESULTS DATA
6dB and 99% Occupied Bandwidth

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
BLE	1Mbps	1	0	2402	1.057	0.744	0.50	Pass
BLE	1Mbps	1	19	2440	1.059	0.756	0.50	Pass
BLE	1Mbps	1	39	2480	1.061	0.749	0.50	Pass

TEST RESULTS DATA
Average Power Table

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
BLE	1Mbps	1	0	2402	2.64	30.00	1.00	3.64	36.00	Pass
BLE	1Mbps	1	19	2440	2.29	30.00	1.00	3.29	36.00	Pass
BLE	1Mbps	1	39	2480	2.07	30.00	1.00	3.07	36.00	Pass

TEST RESULTS DATA
Peak Power Density

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak PSD (dBm /100kHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail
BLE	1Mbps	1	0	2402	2.15	-10.76	1.00	8.00	Pass
BLE	1Mbps	1	19	2440	1.78	-11.26	1.00	8.00	Pass
BLE	1Mbps	1	39	2480	1.20	-11.75	1.00	8.00	Pass

Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 30dBc limit.

<Sample 3>

TEST RESULTS DATA
6dB and 99% Occupied Bandwidth

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
BLE	1Mbps	1	0	2402	1.061	0.748	0.50	Pass
BLE	1Mbps	1	19	2440	1.065	0.755	0.50	Pass
BLE	1Mbps	1	39	2480	1.063	0.753	0.50	Pass

TEST RESULTS DATA
Average Power Table

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
BLE	1Mbps	1	0	2402	3.25	30.00	1.00	4.25	36.00	Pass
BLE	1Mbps	1	19	2440	3.13	30.00	1.00	4.13	36.00	Pass
BLE	1Mbps	1	39	2480	2.89	30.00	1.00	3.89	36.00	Pass

TEST RESULTS DATA
Peak Power Density

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak PSD (dBm /100kHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail
BLE	1Mbps	1	0	2402	2.31	-10.82	1.00	8.00	Pass
BLE	1Mbps	1	19	2440	2.27	-10.76	1.00	8.00	Pass
BLE	1Mbps	1	39	2480	1.95	-11.03	1.00	8.00	Pass

Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 30dBc limit.



Appendix B. Radiated Spurious Emission

Test Engineer :	Daniel Lee	Temperature :		19~23°C	
		Relative Humidity :		43~49%	

<Sample 1>

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	Note	Frequency	Level	Margin	Limit Line	Read Level	Antenna Factor	Path Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dB μ V/m)	(dB)	(dB μ V/m)	(dB μ V)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 00 2402MHz		2376.255	54.34	-19.66	74	41.23	27.23	17.4	31.52	103	243	P	H
		2389.065	43.29	-10.71	54	30.08	27.29	17.42	31.5	103	243	A	H
	*	2402	94.07	-	-	80.74	27.38	17.44	31.49	103	243	P	H
	*	2402	93.75	-	-	80.42	27.38	17.44	31.49	103	243	A	H
													H
													H
		2362.605	54.35	-19.65	74	41.33	27.17	17.38	31.53	103	65	P	V
		2389.485	43.29	-10.71	54	30.08	27.29	17.42	31.5	103	65	A	V
	*	2402	93.7	-	-	80.37	27.38	17.44	31.49	103	65	P	V
	*	2402	93.38	-	-	80.05	27.38	17.44	31.49	103	65	A	V
BLE CH 19 2440MHz													V
		2388.08	54.51	-19.49	74	41.31	27.28	17.42	31.5	100	244	P	H
		2390	43.3	-10.7	54	30.09	27.29	17.42	31.5	100	244	A	H
	*	2440	94.84	-	-	81.35	27.46	17.5	31.47	100	244	P	H
	*	2440	94.51	-	-	81.02	27.46	17.5	31.47	100	244	A	H
		2492.08	54.87	-19.13	74	40.98	27.75	17.6	31.46	100	244	P	H
		2499.92	44.09	-9.91	54	30.11	27.82	17.61	31.45	100	244	A	H
		2382.16	54.54	-19.46	74	41.39	27.26	17.41	31.52	106	63	P	V
		2389.2	43.31	-10.69	54	30.1	27.29	17.42	31.5	106	63	A	V
	*	2440	93.32	-	-	79.83	27.46	17.5	31.47	106	63	P	V
	*	2440	93	-	-	79.51	27.46	17.5	31.47	106	63	A	V
		2485.76	54.6	-19.4	74	40.76	27.71	17.59	31.46	106	63	P	V
		2500	44.05	-9.95	54	30.07	27.82	17.61	31.45	106	63	A	V



BLE CH 39 2480MHz	*	2480	96.09	-	-	82.29	27.68	17.58	31.46	100	58	P	H
	*	2480	95.75	-	-	81.95	27.68	17.58	31.46	100	58	P	H
		2489.84	55.08	-18.92	74	41.22	27.73	17.59	31.46	100	58	P	H
		2488.08	44.98	-9.02	54	31.13	27.72	17.59	31.46	100	58	A	H
													H
													H
	*	2480	92.89	-	-	79.09	27.68	17.58	31.46	344	70	P	V
	*	2480	92.52	-	-	78.72	27.68	17.58	31.46	344	70	A	V
		2488	55.61	-18.39	74	41.76	27.72	17.59	31.46	344	70	P	V
		2488	44.69	-9.31	54	30.84	27.72	17.59	31.46	344	70	A	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)





BLE	Note	Frequency (MHz)	Level (dB μ V/m)	Margin (dB)	Limit Line (dB μ V/m)	Read Level (dB μ V)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE CH 39 2480MHz		4960	41.83	-32.17	74	65.23	33.08	11.58	68.06	-	-	P	H
		7440	45.36	-28.64	74	62.06	36.33	14.2	67.23	-	-	P	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
BLE CH 39 2480MHz		4960	43.11	-30.89	74	66.51	33.08	11.58	68.06	-	-	P	V
		7440	47.54	-26.46	74	64.24	36.33	14.2	67.23	-	-	P	V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V
Remark	1.	No other spurious found.											
	2.	All results are PASS against Peak and Average limit line.											
	3.	The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only.											



Emission above 18GHz

2.4GHz BLE (SHF)



Emission below 1GHz

2.4GHz BLE (LF)



<Sample 2>

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	Note	Frequency	Level	Margin	Limit Line	Read Level	Antenna Factor	Path Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dB μ V/m)	(dB)	(dB μ V/m)	(dB μ V)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 00 2402MHz		2352.105	54.75	-19.25	74	41.26	27.12	17.89	31.52	100	243	P	H
		2389.905	43.56	-10.44	54	29.81	27.29	17.96	31.5	100	243	A	H
	*	2402	92.66	-	-	78.79	27.38	17.98	31.49	100	243	P	H
	*	2402	92.28	-	-	78.41	27.38	17.98	31.49	100	243	A	H
													H
													H
		2351.475	55.21	-18.79	74	41.72	27.12	17.89	31.52	375	297	P	V
		2387.7	43.59	-10.41	54	29.85	27.28	17.96	31.5	375	297	A	V
	*	2402	88.93	-	-	75.06	27.38	17.98	31.49	375	297	P	V
	*	2402	88.56	-	-	74.69	27.38	17.98	31.49	375	297	A	V
													V
													V
BLE CH 19 2440MHz		2360.4	54.36	-19.64	74	40.82	27.16	17.91	31.53	284	49	P	H
		2390	43.58	-10.42	54	29.83	27.29	17.96	31.5	284	49	A	H
	*	2440	92	-	-	77.96	27.46	18.05	31.47	284	49	P	H
	*	2440	91.57	-	-	77.53	27.46	18.05	31.47	284	49	A	H
		2485.44	55.56	-18.44	74	41.17	27.71	18.14	31.46	284	49	P	H
		2498.64	44.34	-9.66	54	29.82	27.81	18.16	31.45	284	49	A	H
		2356.72	54.6	-19.4	74	41.1	27.14	17.89	31.53	400	121	P	V
		2389.36	43.58	-10.42	54	29.83	27.29	17.96	31.5	400	121	A	V
	*	2440	87.78	-	-	73.74	27.46	18.05	31.47	400	121	P	V
	*	2440	87.3	-	-	73.26	27.46	18.05	31.47	400	121	A	V
		2485.04	55.26	-18.74	74	40.88	27.71	18.13	31.46	400	121	P	V
		2498.32	44.34	-9.66	54	29.83	27.8	18.16	31.45	400	121	A	V



BLE CH 39 2480MHz	*	2480	81.3	-	-	66.95	27.68	18.13	31.46	385	175	P	H
	*	2480	80.63	-	-	66.28	27.68	18.13	31.46	385	175	A	H
	2485.04	55.03	-18.97	74	40.65	27.71	18.13	31.46	385	175	P	H	
	2499.88	44.36	-9.64	54	29.83	27.82	18.16	31.45	385	175	A	H	
													H
													H
	*	2480	92.32	-	-	77.97	27.68	18.13	31.46	215	167	P	V
	*	2480	91.95	-	-	77.6	27.68	18.13	31.46	215	167	A	V
	2496.48	55.61	-18.39	74	41.12	27.79	18.15	31.45	215	167	P	V	
	2488.12	44.57	-9.43	54	30.17	27.72	18.14	31.46	215	167	A	V	
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)

BLE	Note	Frequency (MHz)	Level (dB μ V/m)	Margin (dB)	Limit Line (dB μ V/m)	Read Level (dB μ V)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE CH 00 2402MHz		4804	49.58	-24.42	74	72.99	32.43	12.04	67.88	317	196	P	H
		4804	45.03	-8.97	54	68.44	32.43	12.04	67.88	317	196	A	H
		7206	52.33	-10.33	62.66	66.5	37	14.78	65.95	-	-	P	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H



BLE	Note	Frequency (MHz)	Level (dB μ V/m)	Margin (dB)	Limit Line (dB μ V/m)	Read Level (dB μ V)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE CH 19 2440MHz		4880	47.85	-26.15	74	70.8	32.73	12.24	67.92	-	-	P	H
		7320	52.39	-21.61	74	67.74	36.82	14.9	67.07	400	232	P	H
		7320	46.84	-7.16	54	62.19	36.82	14.9	67.07	400	232	A	H
													H
													H
													H
													H
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													V



BLE	Note	Frequency (MHz)	Level (dB μ V/m)	Margin (dB)	Limit Line (dB μ V/m)	Read Level (dB μ V)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE CH 39 2480MHz		4960	46.1	-27.9	74	68.62	33.08	12.46	68.06	-	-	P	H
		7440	53.44	-20.56	74	69.36	36.33	14.98	67.23	400	234	P	H
		7440	47.15	-6.85	54	63.07	36.33	14.98	67.23	400	234	A	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
BLE CH 39 2480MHz		4960	47.91	-26.09	74	70.43	33.08	12.46	68.06	-	-	P	V
		7440	53.21	-20.79	74	69.13	36.33	14.98	67.23	247	158	P	V
		7440	48.29	-5.71	54	64.21	36.33	14.98	67.23	247	158	A	V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line. 3. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only.												



Emission above 18GHz

2.4GHz BLE (SHF)



Emission below 1GHz

2.4GHz BLE (LF)

BLE	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
												Line	Level
												Factor	Loss
2.4GHz BLE LF		560.59	26.21	-19.79	46	28.68	26.02	4.12	32.61	-	-	P	H
		659.53	27.56	-18.44	46	29.25	26.41	4.48	32.58	-	-	P	H
		741.98	29.3	-16.7	46	28.86	28	4.87	32.43	-	-	P	H
		800.18	31.11	-14.89	46	30.21	28.19	4.93	32.22	-	-	P	H
		874.87	31.25	-14.75	46	28.93	28.9	5.21	31.79	-	-	P	H
		939.86	32.42	-13.58	46	27.85	30.49	5.38	31.3	-	-	P	H
													H
													H
													H
													H
													H
													H
													H
													V
		30	22.4	-17.6	40	28.77	25.1	0.96	32.43	-	-	P	V
		558.65	26.28	-19.72	46	28.86	25.92	4.11	32.61	-	-	P	V
		655.65	27.45	-18.55	46	29.09	26.49	4.46	32.59	-	-	P	V
		771.08	29.79	-16.21	46	29.02	28.2	4.91	32.34	-	-	P	V
		884.57	32.76	-13.24	46	30.25	29	5.24	31.73	-	-	P	V
		933.07	33.16	-12.84	46	29.07	30.08	5.37	31.36	-	-	P	V
													V
													V
													V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against limit line. 3. The emission position marked as “-” means no suspected emission found and emission level has at least 6dB margin against limit or noise floor only.												



<Sample 3>

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	Note	Frequency	Level	Margin	Limit Line	Read Level	Antenna Factor	Path Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dB μ V/m)	(dB)	(dB μ V/m)	(dB μ V)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 00 2402MHz		2329.53	54.82	-19.18	74	41.38	27.12	17.85	31.53	100	193	P	H
		2389.38	43.53	-10.47	54	29.78	27.29	17.96	31.5	100	193	A	H
	*	2402	93.07	-	-	79.2	27.38	17.98	31.49	100	193	P	H
	*	2402	92.68	-	-	78.81	27.38	17.98	31.49	100	193	A	H
													H
													H
		2359.56	54.73	-19.27	74	41.19	27.16	17.91	31.53	111	303	P	V
		2389.065	43.54	-10.46	54	29.79	27.29	17.96	31.5	111	303	A	V
	*	2402	92.25	-	-	78.38	27.38	17.98	31.49	111	303	P	V
	*	2402	91.8	-	-	77.93	27.38	17.98	31.49	111	303	A	V
BLE CH 19 2440MHz													V
		2384.08	54.4	-19.6	74	40.69	27.27	17.95	31.51	100	195	P	H
		2389.04	43.52	-10.48	54	29.77	27.29	17.96	31.5	100	195	A	H
	*	2440	93.82	-	-	79.78	27.46	18.05	31.47	100	195	P	H
	*	2440	93.52	-	-	79.48	27.46	18.05	31.47	100	195	A	H
		2486.32	55.68	-18.32	74	41.29	27.71	18.14	31.46	100	195	P	H
		2500	44.31	-9.69	54	29.78	27.82	18.16	31.45	100	195	A	H
		2322.96	54.55	-19.45	74	41.14	27.1	17.84	31.53	100	301	P	V
		2388.24	43.52	-10.48	54	29.78	27.28	17.96	31.5	100	301	A	V
	*	2440	91.86	-	-	77.82	27.46	18.05	31.47	100	301	P	V
	*	2440	91.5	-	-	77.46	27.46	18.05	31.47	100	301	A	V
		2498.32	56.37	-17.63	74	41.86	27.8	18.16	31.45	100	301	P	V
		2499.92	44.29	-9.71	54	29.76	27.82	18.16	31.45	100	301	A	V



BLE CH 39 2480MHz	*	2480	92.86	-	-	78.51	27.68	18.13	31.46	100	198	P	H
	*	2480	92.42	-	-	78.07	27.68	18.13	31.46	100	198	A	H
		2485.48	55.36	-18.64	74	40.97	27.71	18.14	31.46	100	198	P	H
		2488.04	44.92	-9.08	54	30.52	27.72	18.14	31.46	100	198	A	H
													H
													H
	*	2480	93.29	-	-	78.94	27.68	18.13	31.46	100	295	P	V
	*	2480	92.83	-	-	78.48	27.68	18.13	31.46	100	295	A	V
		2485.04	55.26	-18.74	74	40.88	27.71	18.13	31.46	100	295	P	V
		2487.96	45.02	-8.98	54	30.62	27.72	18.14	31.46	100	295	A	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)





BLE	Note	Frequency (MHz)	Level (dB μ V/m)	Margin (dB)	Limit Line (dB μ V/m)	Read Level (dB μ V)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE CH 39 2480MHz		4960	43.61	-30.39	74	66.13	33.08	12.46	68.06	-	-	P	H
		7440	47.81	-26.19	74	63.73	36.33	14.98	67.23	-	-	P	H
													H
													H
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													H
													H
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													H
													H
		4960	43.68	-30.32	74	66.2	33.08	12.46	68.06	-	-	P	V
		7440	51.85	-22.15	74	67.77	36.33	14.98	67.23	100	250	P	V
Remark		7440	46.11	-7.89	54	62.03	36.33	14.98	67.23	100	250	A	V
													V
													V
													V
													V
													V
													V
													V
													V
													V
1. No other spurious found. 2. All results are PASS against Peak and Average limit line. 3. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only.													



Emission above 18GHz

2.4GHz BLE (SHF)

BLE	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.									
												Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.			
												(MHz)	(dB μ V/m)	(dB)	(dB μ V/m)	(dB μ V)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)
2.4GHz BLE SHF		23691	39.21	-34.79	74	37.96	38.51	15.09	52.35	-	-	P	H									
		24699	39.21	-34.79	74	37.36	38.81	15.68	52.64	-	-	P	H									
																						H
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	Remark	1. No other spurious found. 2. All results are PASS against limit line. 3. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only.																				



Emission below 1GHz

2.4GHz BLE (LF)

BLE	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.		
												Line	Level	Factor	
												(dB/m)	(dB)	(dB)	Pos
2.4GHz BLE LF		30	22.36	-17.64	40	28.73	25.1	0.96	32.43	-	-			P	H
		502.39	24.3	-21.7	46	29.03	23.95	3.91	32.59	-	-			P	H
		580.96	26.84	-19.16	46	29.28	26	4.18	32.62	-	-			P	H
		741.01	29.61	-16.39	46	29.18	28	4.86	32.43	-	-			P	H
		859.35	31.83	-14.17	46	29.46	29.1	5.16	31.89	-	-			P	H
		935.98	33.2	-12.8	46	28.9	30.26	5.37	31.33	-	-			P	H
															H
															H
															H
															H
															H
															H
															H
															H
															H
															V
		30	22.06	-17.94	40	28.43	25.1	0.96	32.43	-	-			P	V
		575.14	26.65	-19.35	46	29.01	26.1	4.16	32.62	-	-			P	V
		662.44	27.25	-18.75	46	28.98	26.35	4.5	32.58	-	-			P	V
		799.21	30.03	-15.97	46	29.09	28.23	4.93	32.22	-	-			P	V
		881.66	32.72	-13.28	46	30.24	29	5.23	31.75	-	-			P	V
		948.59	34.7	-11.3	46	29.33	31.19	5.41	31.23	-	-			P	V
															V
															V
															V
															V
															V
	Remark	1. No other spurious found. 2. All results are PASS against limit line. 3. The emission position marked as “-” means no suspected emission found and emission level has at least 6dB margin against limit or noise floor only.													



Note symbol

*	Fundamental Frequency which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is Margin line.
P/A	Peak or Average
H/V	Horizontal or Vertical



A calculation example for radiated spurious emission is shown as below:

BLE	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
					Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dB μ V/m)	(dB)	(dB μ V/m)	(dB μ V)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 00 2402MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)

2. Level(dB μ V/m) =

Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dB μ V) - Preamp Factor(dB)

3. Margin(dB) = Level(dB μ V/m) – Limit Line(dB μ V/m)

For Peak Limit @ 2390MHz:

1. Level(dB μ V/m)

= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dB μ V) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 54.51(dB μ V) – 35.86 (dB)

= 55.45 (dB μ V/m)

2. Margin(dB)

= Level(dB μ V/m) – Limit Line(dB μ V/m)

= 55.45(dB μ V/m) – 74(dB μ V/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dB μ V/m)

= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dB μ V) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 42.6(dB μ V) – 35.86 (dB)

= 43.54 (dB μ V/m)

2. Margin(dB)

= Level(dB μ V/m) – Limit Line(dB μ V/m)

= 43.54(dB μ V/m) – 54(dB μ V/m)

= -10.46(dB)

Both peak and average measured complies with the limit line, so test result is “PASS”.



Appendix C. Radiated Spurious Emission Plots

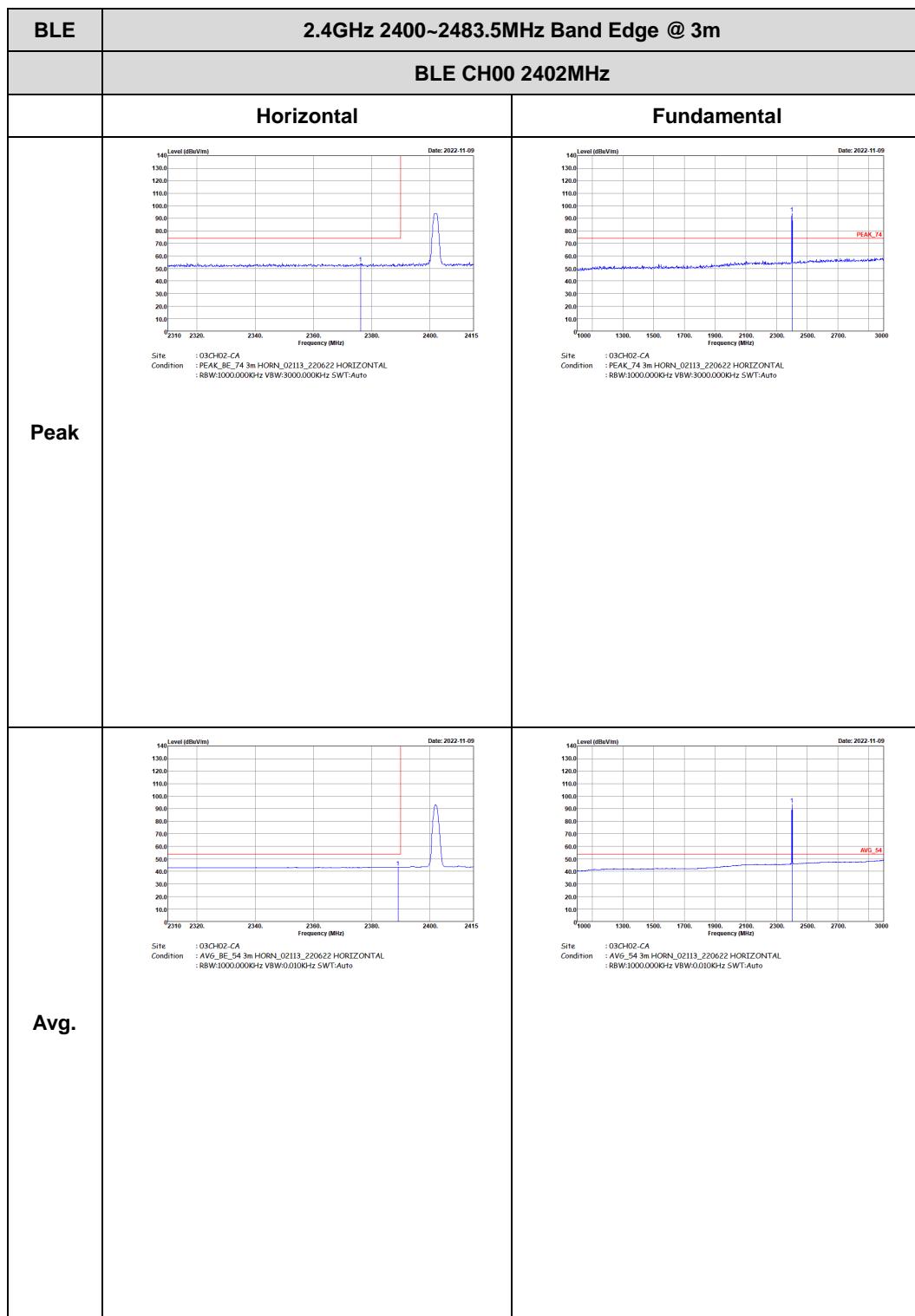
Test Engineer :	Daniel Lee	Temperature :	19~23°C
		Relative Humidity :	43~49%

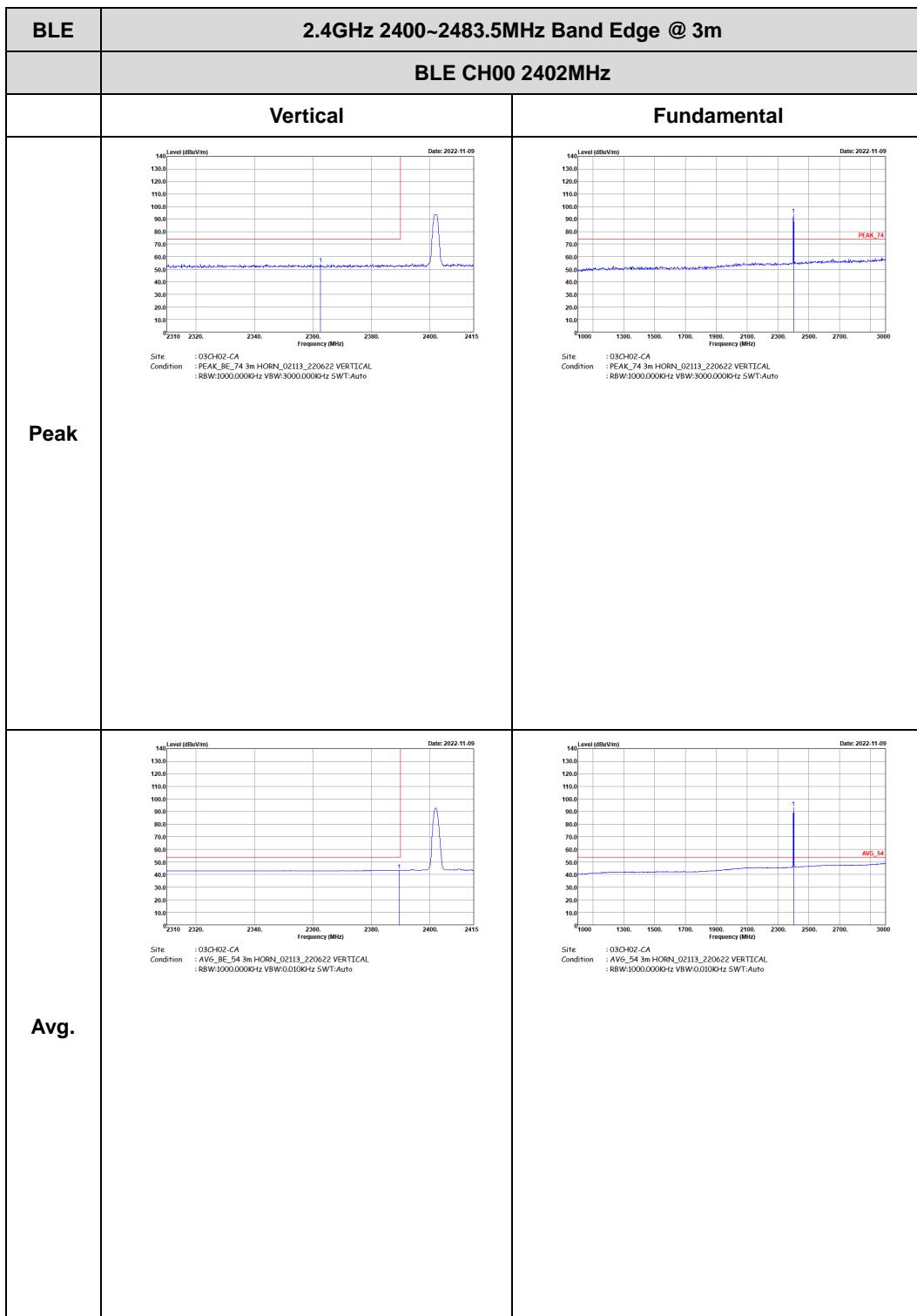
Note symbol

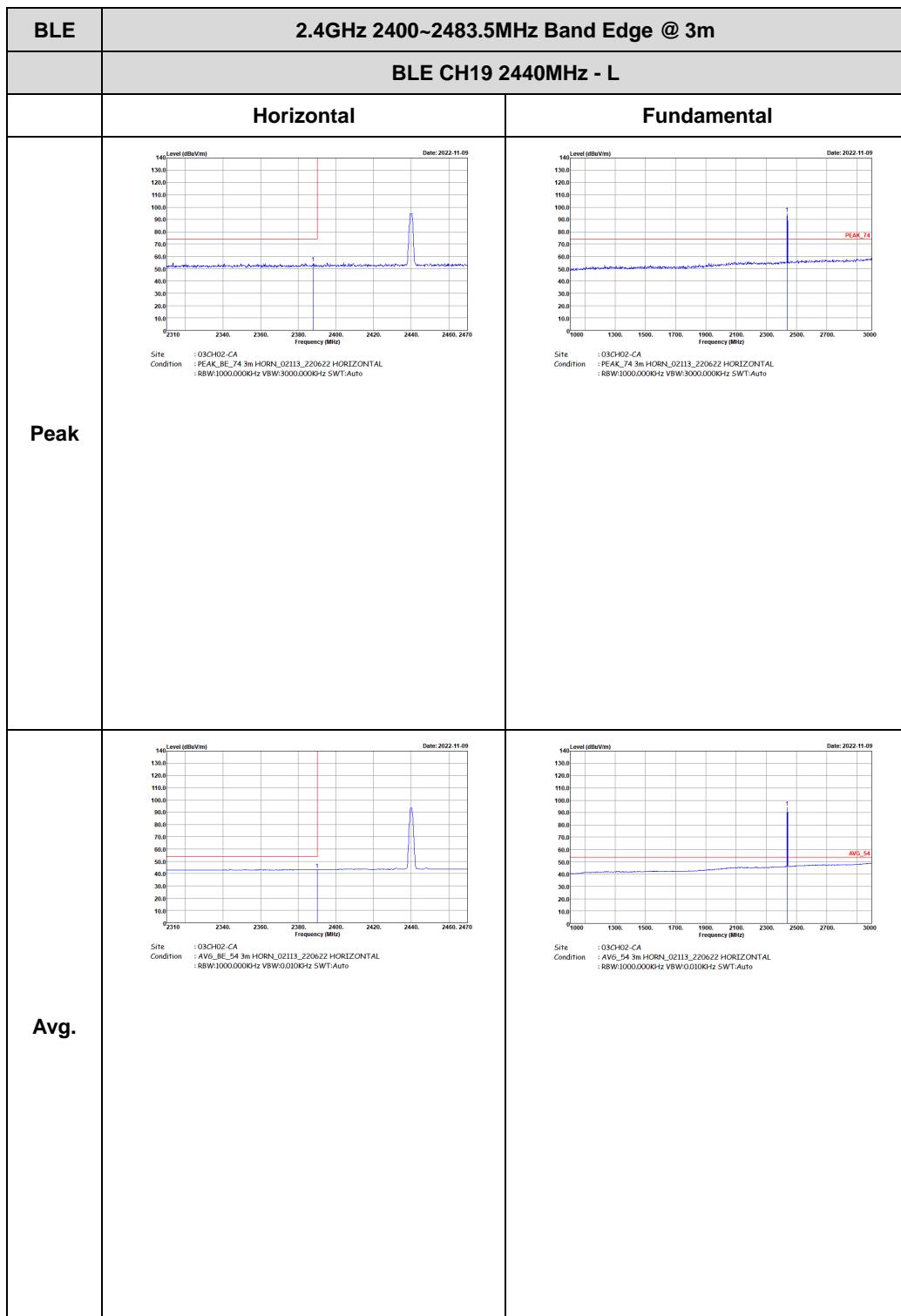
-L	Low channel location
-R	High channel location



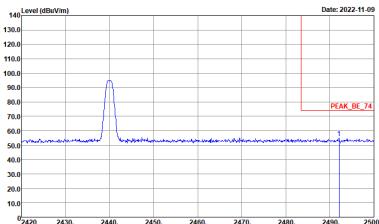
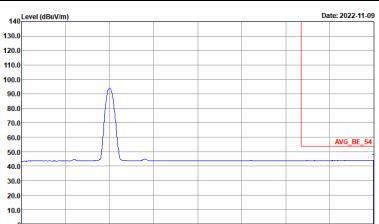
<Sample 1>

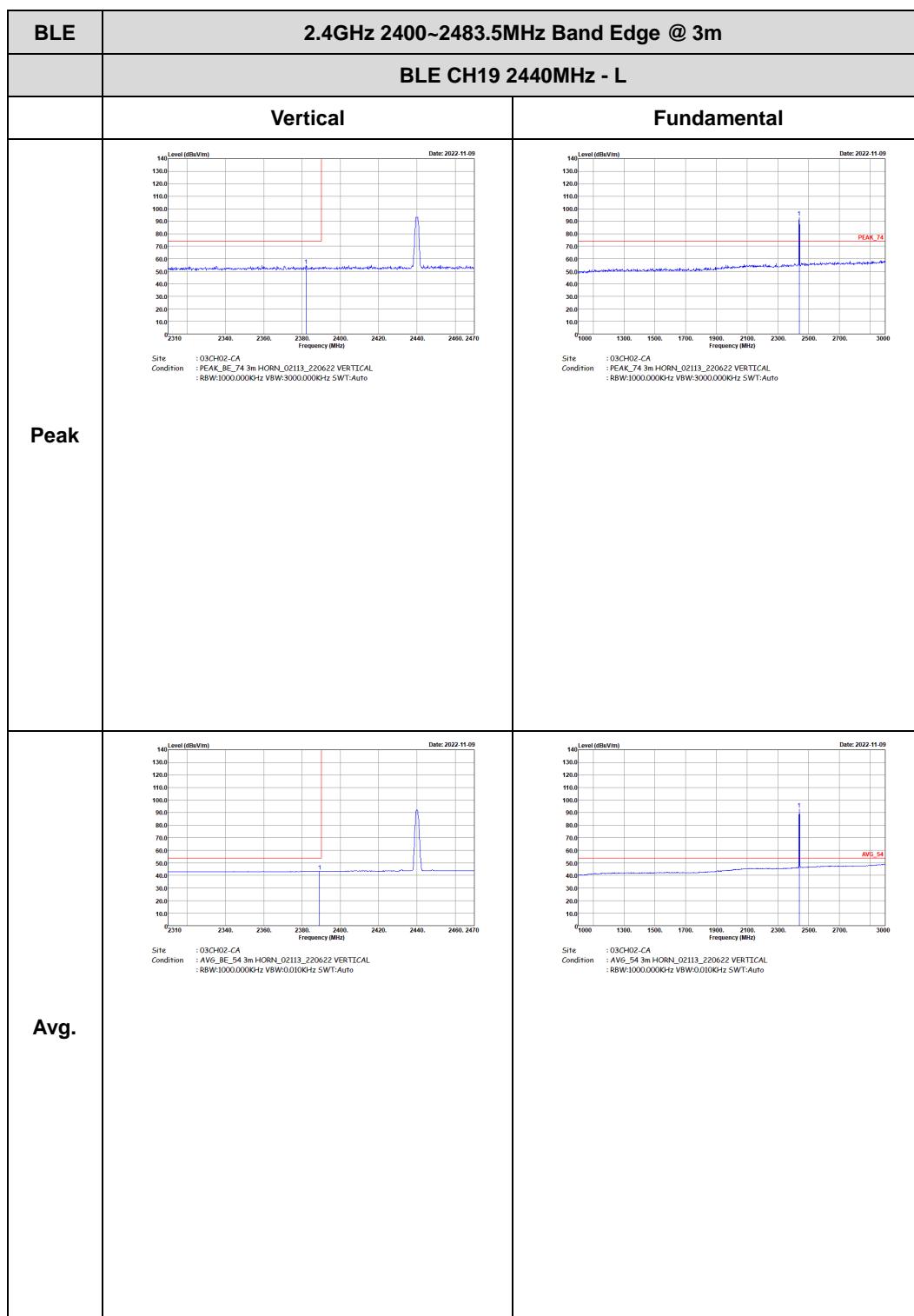
2.4GHz 2400~2483.5MHz**BLE (Band Edge @ 3m)**



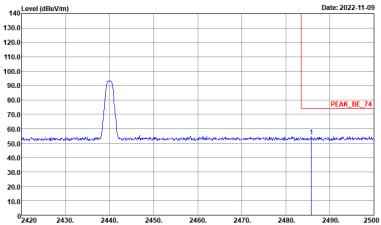
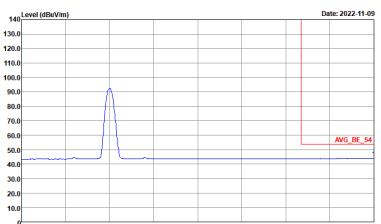


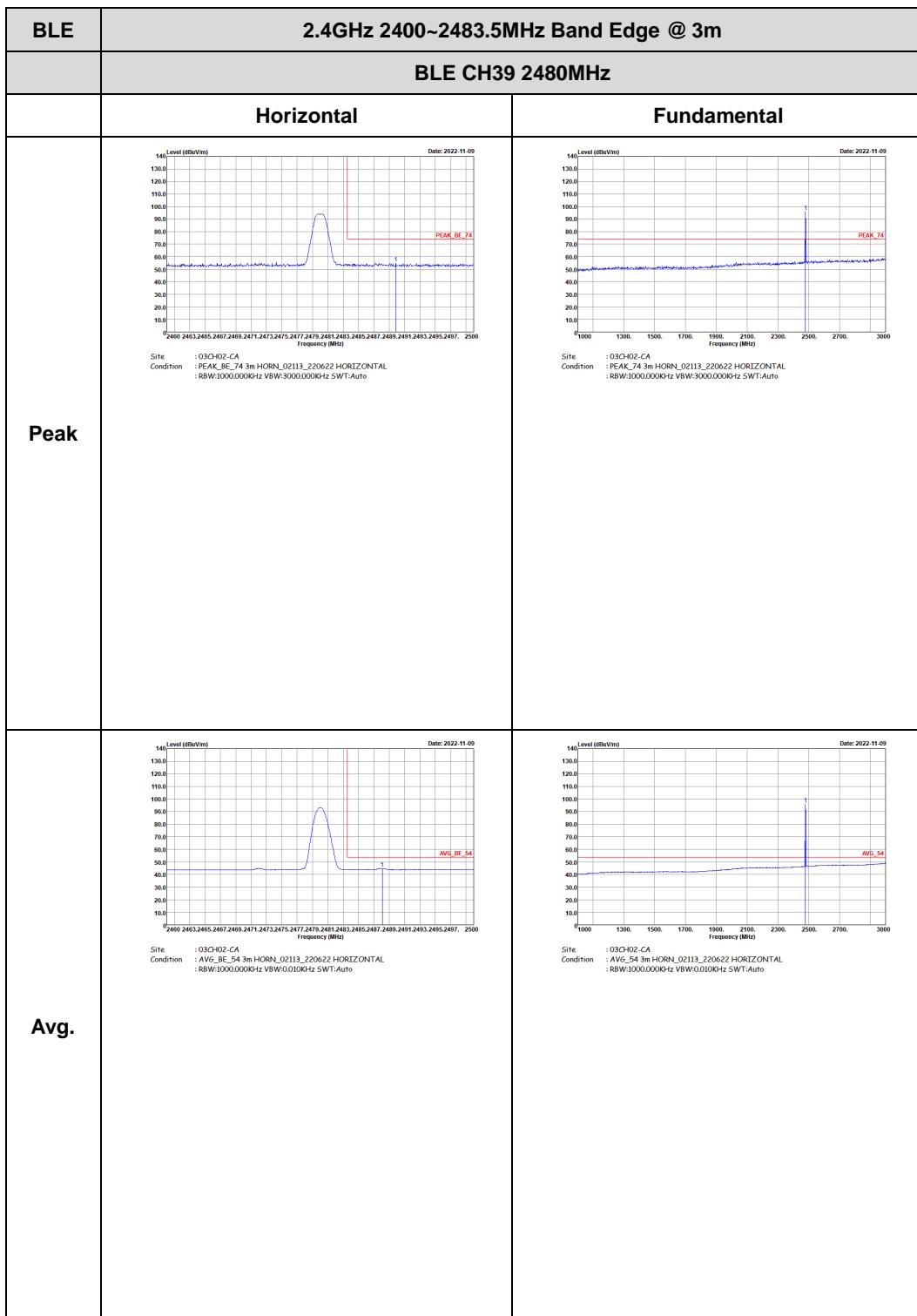


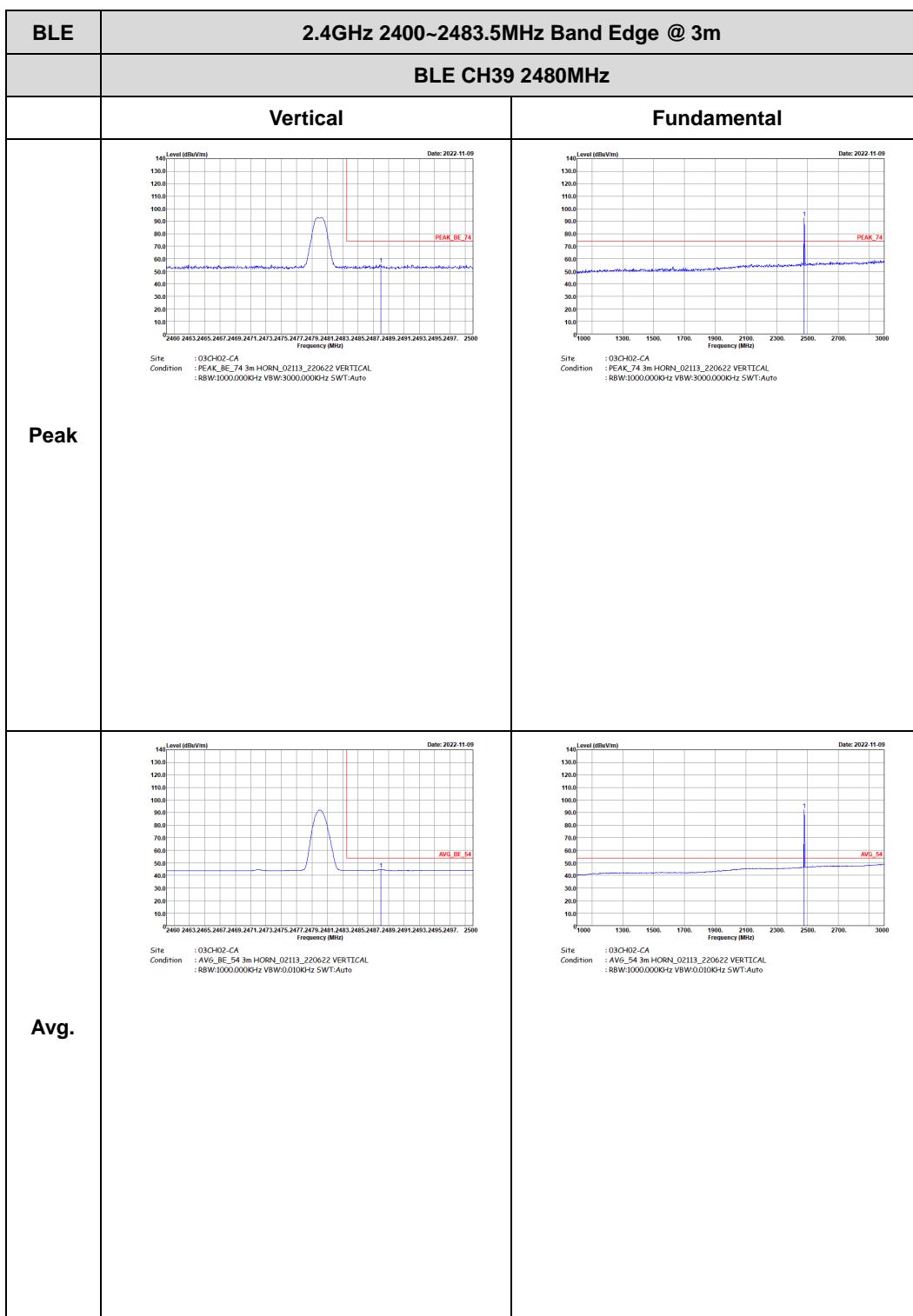
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BLE CH19 2440MHz - R		
Horizontal		Fundamental
Peak	 <p>Site : 03CH02-CA Condition : PEAK_BE_74 3m HORN_02113_220622 HORIZONTAL : R8W:1000.0000Hz VBW:3000.0000Hz SWT:Auto</p>	Left blank
Avg.	 <p>Site : 03CH02-CA Condition : AVG_BE_54 3m HORN_02113_220622 HORIZONTAL : R8W:1000.0000Hz VBW:0.0100Hz SWT:Auto</p>	Left blank





BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BLE CH19 2440MHz - R		
Vertical		Fundamental
Peak	 <p>Site : 03CH02-CA Condition : PEAK_BE_74 3m HORN_02113_220622 VERTICAL : R8W:1000.0000kHz VBW:3000.0000Hz SWT:Auto</p>	Left blank
Avg.	 <p>Site : 03CH02-CA Condition : AVG_BE_54 3m HORN_02113_220622 VERTICAL : R8W:1000.0000kHz VBW:0.0100Hz SWT:Auto</p>	Left blank

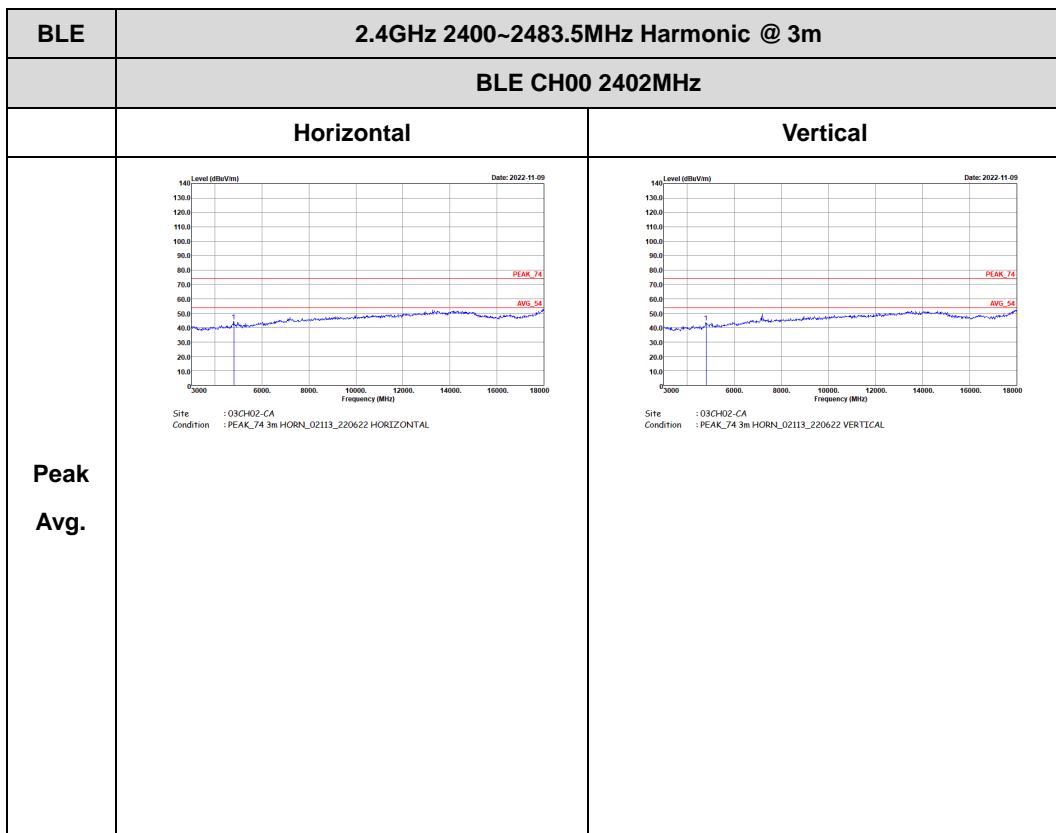


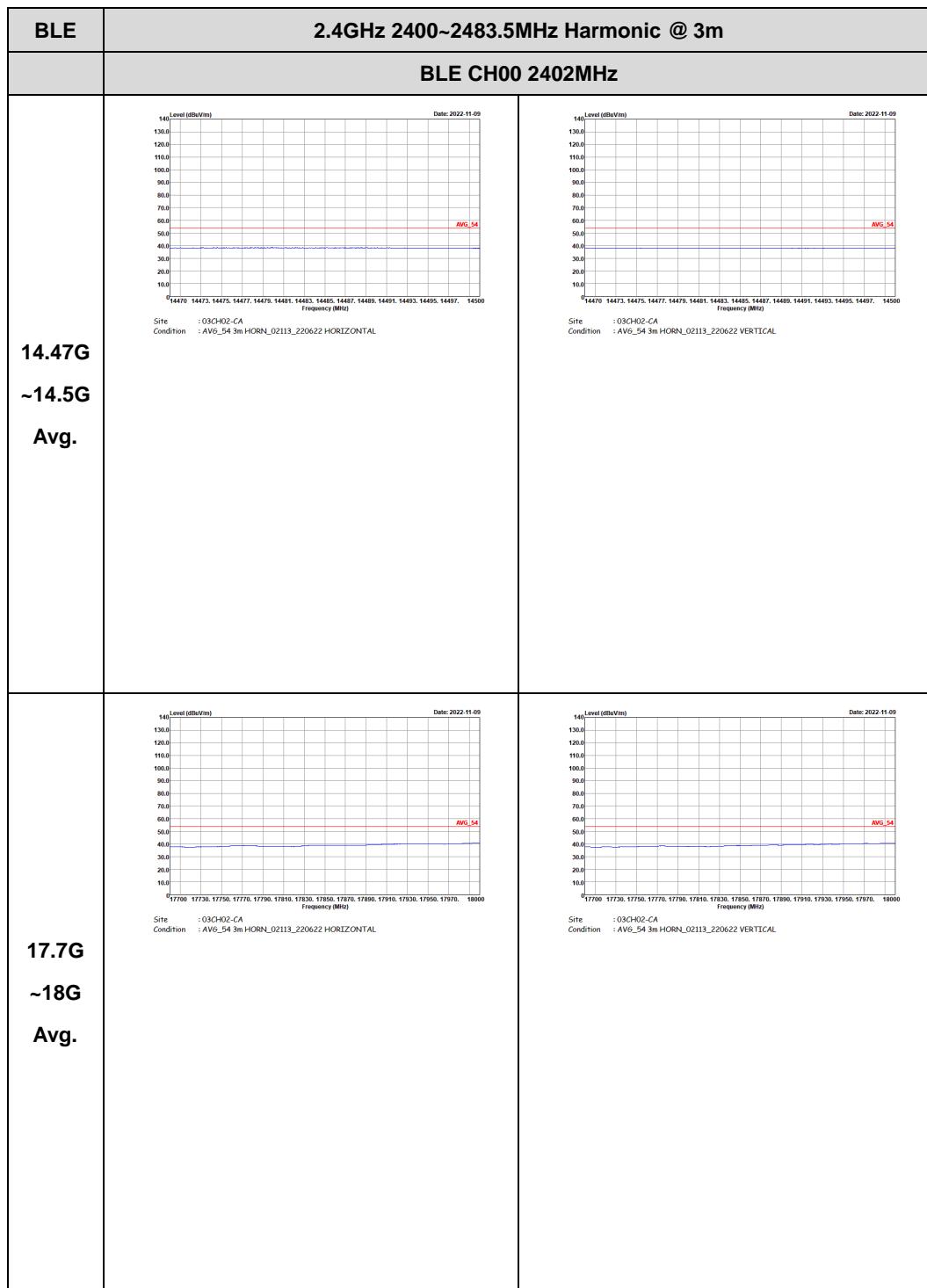


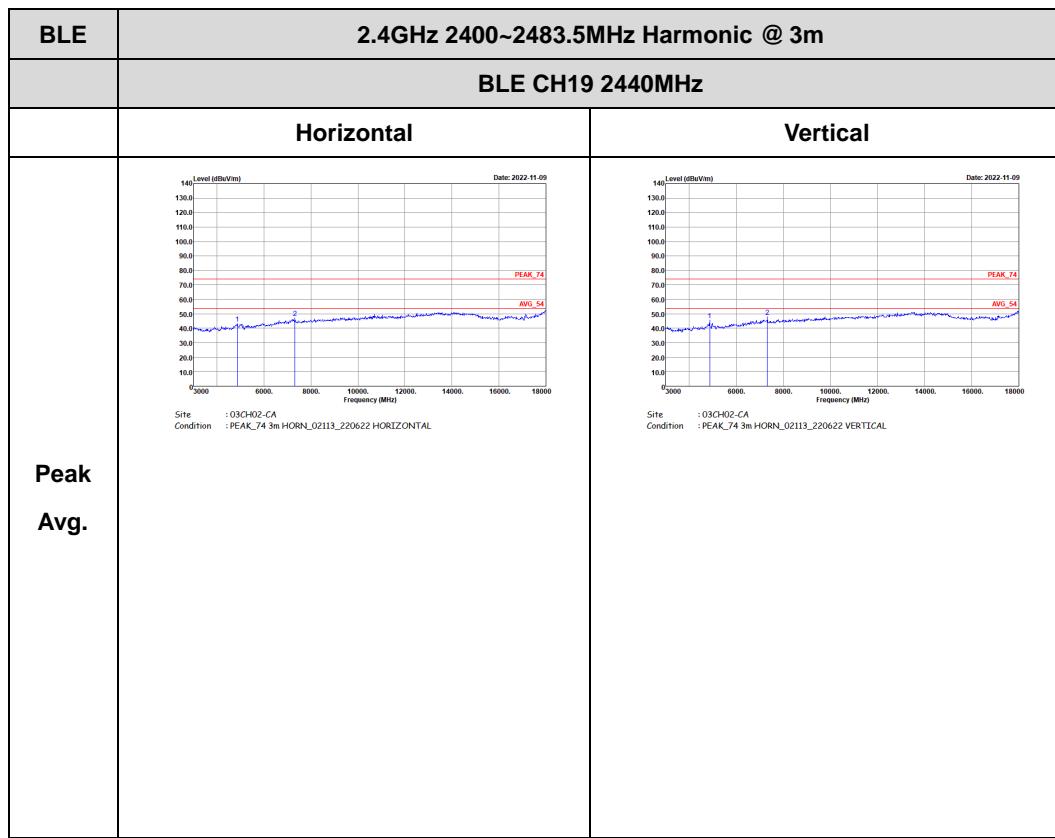


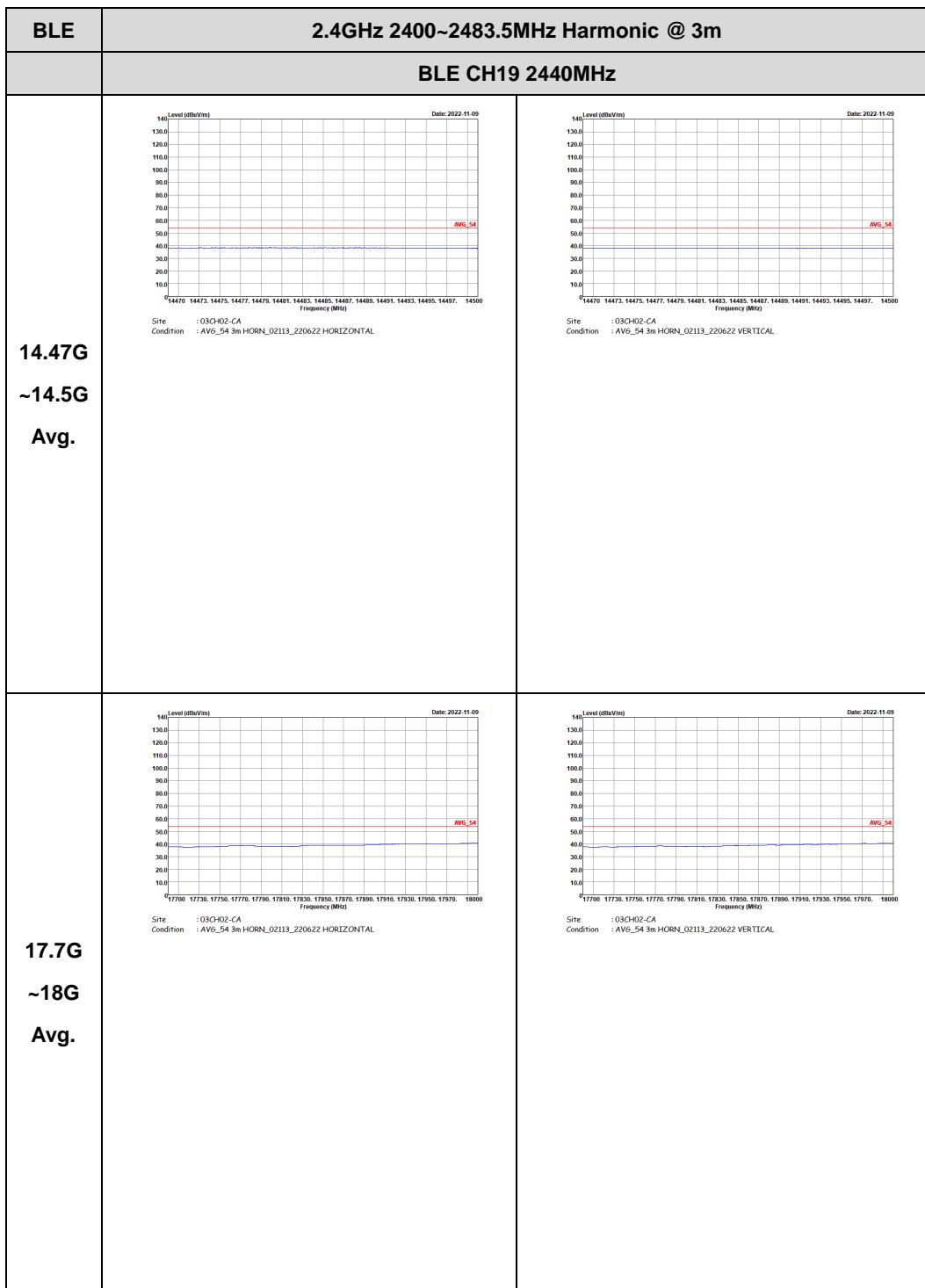
2.4GHz 2400~2483.5MHz

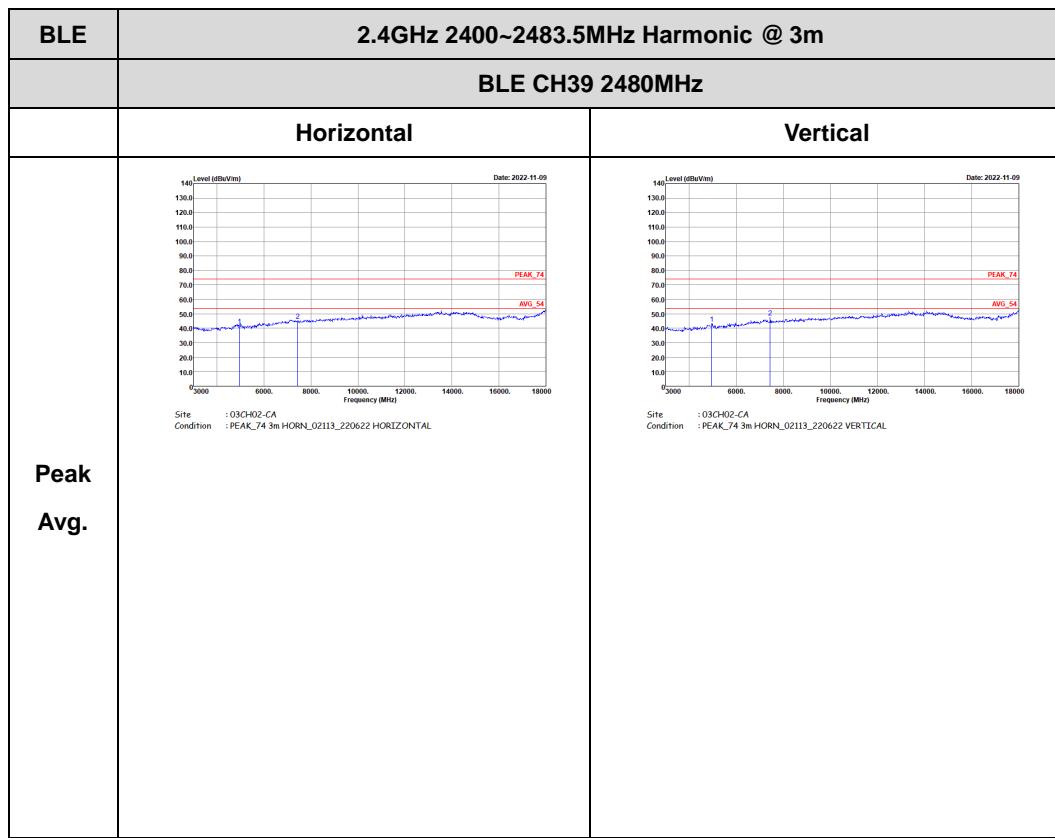
BLE (Harmonic @ 3m)

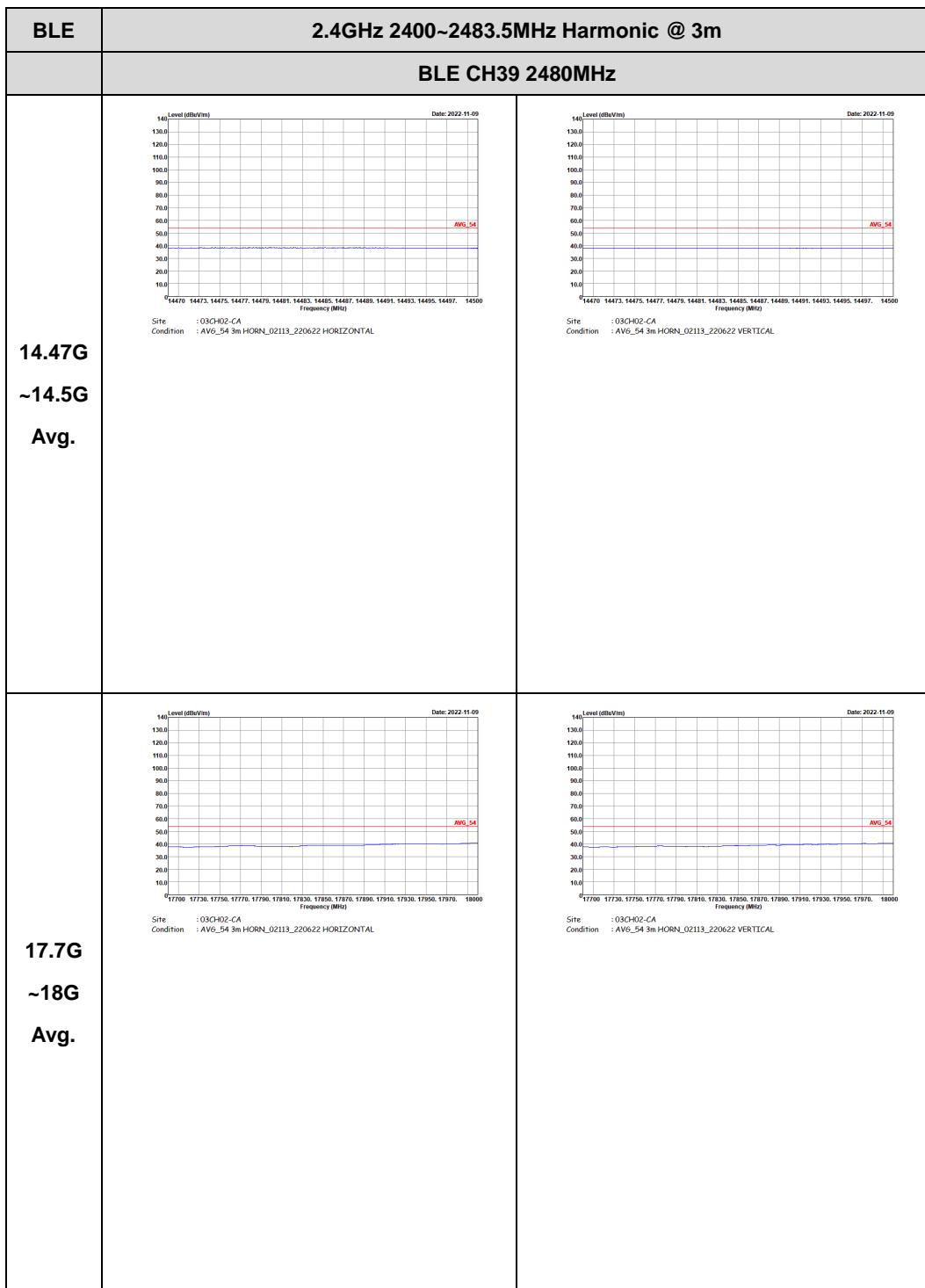








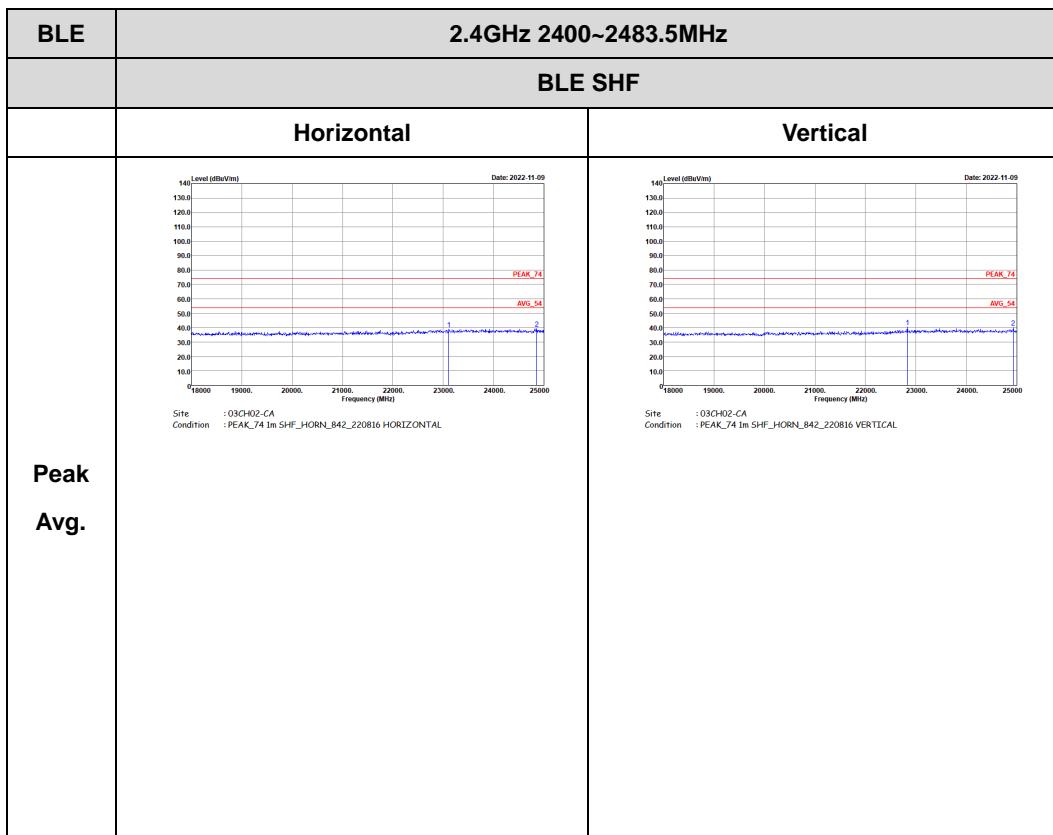






Emission above 18GHz

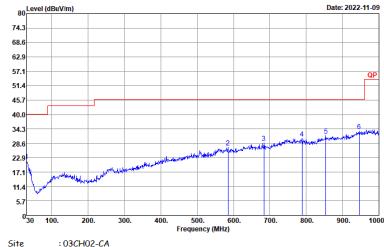
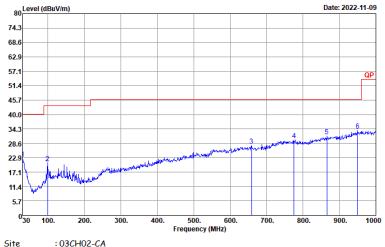
2.4GHz BLE (SHF @ 1m)





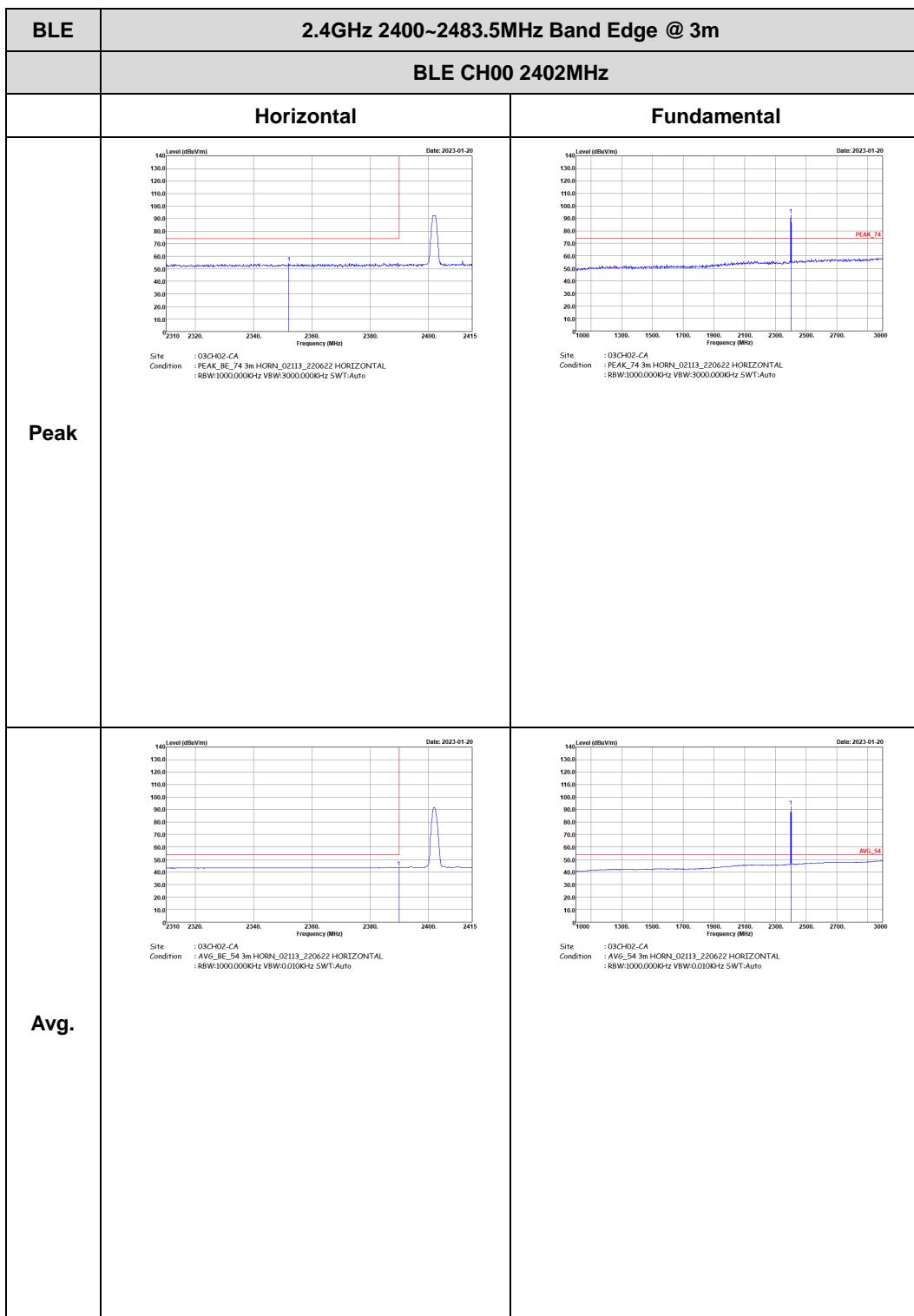
Emission below 1GHz

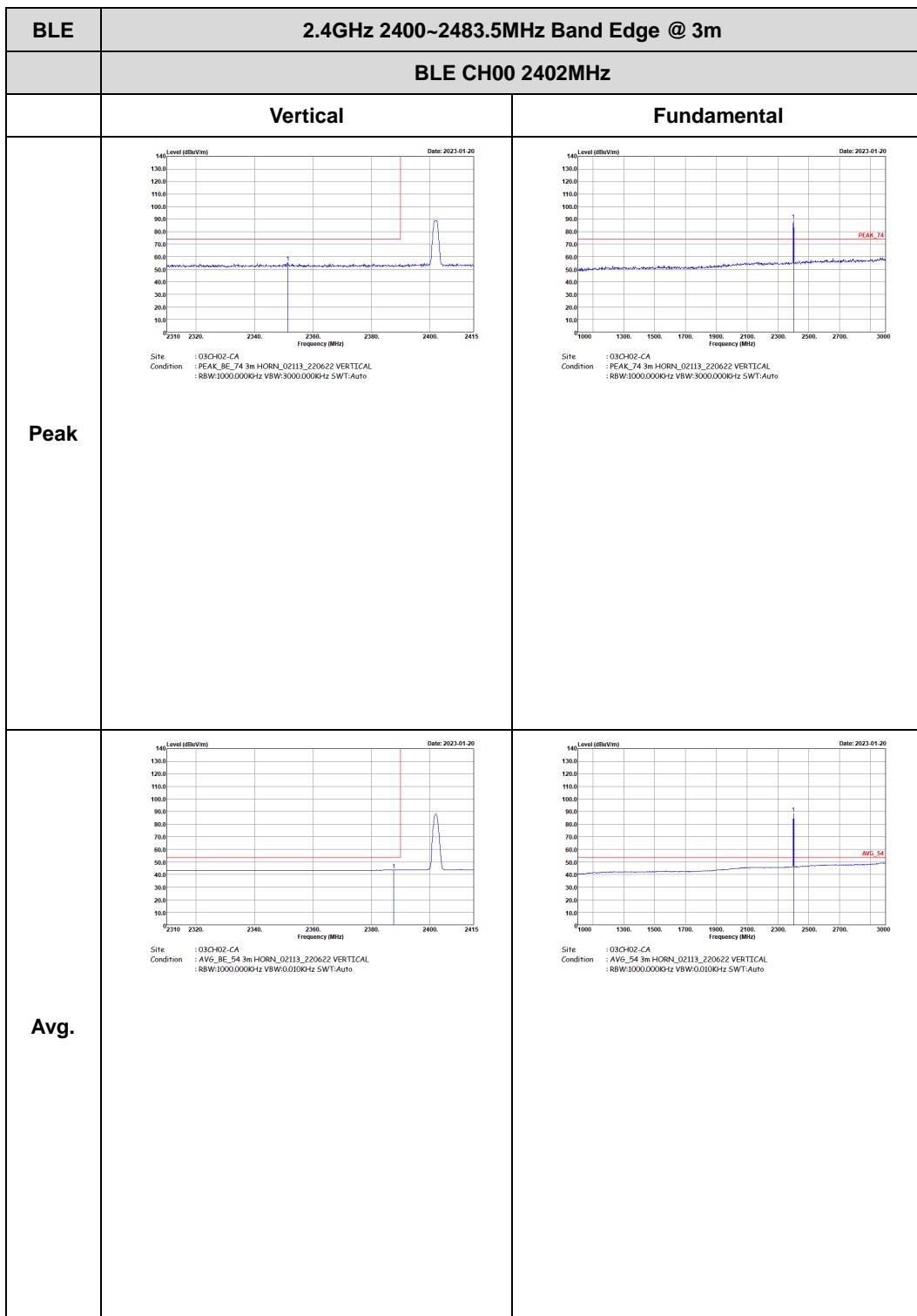
2.4GHz BLE (LF)

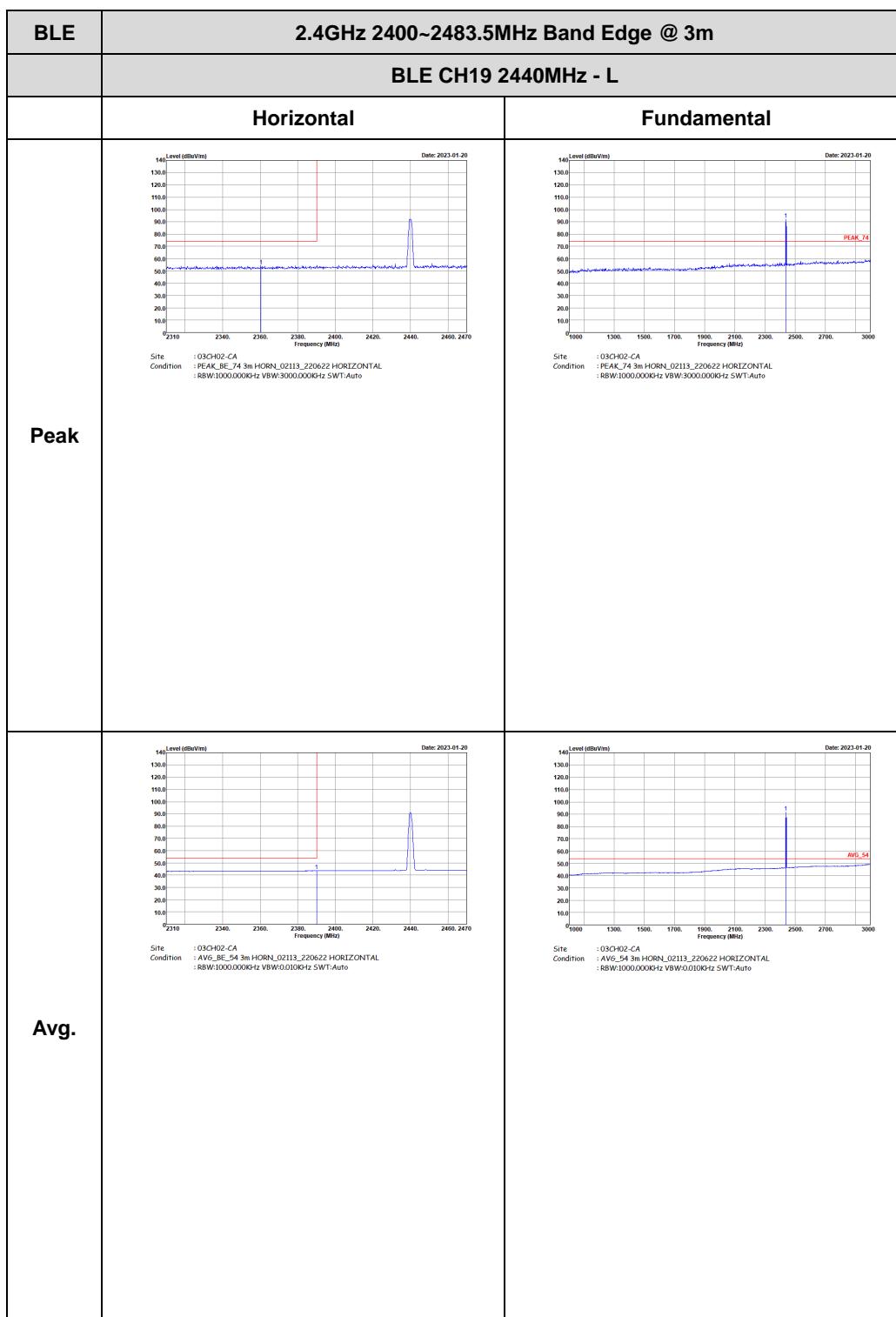
BLE	2.4GHz 2400~2483.5MHz	
	BLE LF	
	Horizontal	Vertical
QP / Peak	 <p>Site : 03CH02-CA Condition : QP 3m B1L06_50392_220711 HORIZONTAL</p> <p>Date: 2022-11-09</p>	 <p>Site : 03CH02-CA Condition : QP 3m B1L06_50392_220711 VERTICAL</p> <p>Date: 2022-11-09</p>



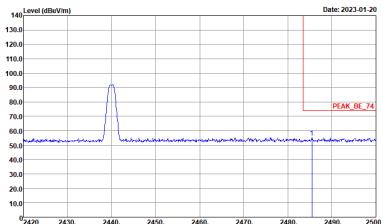
<Sample 2>

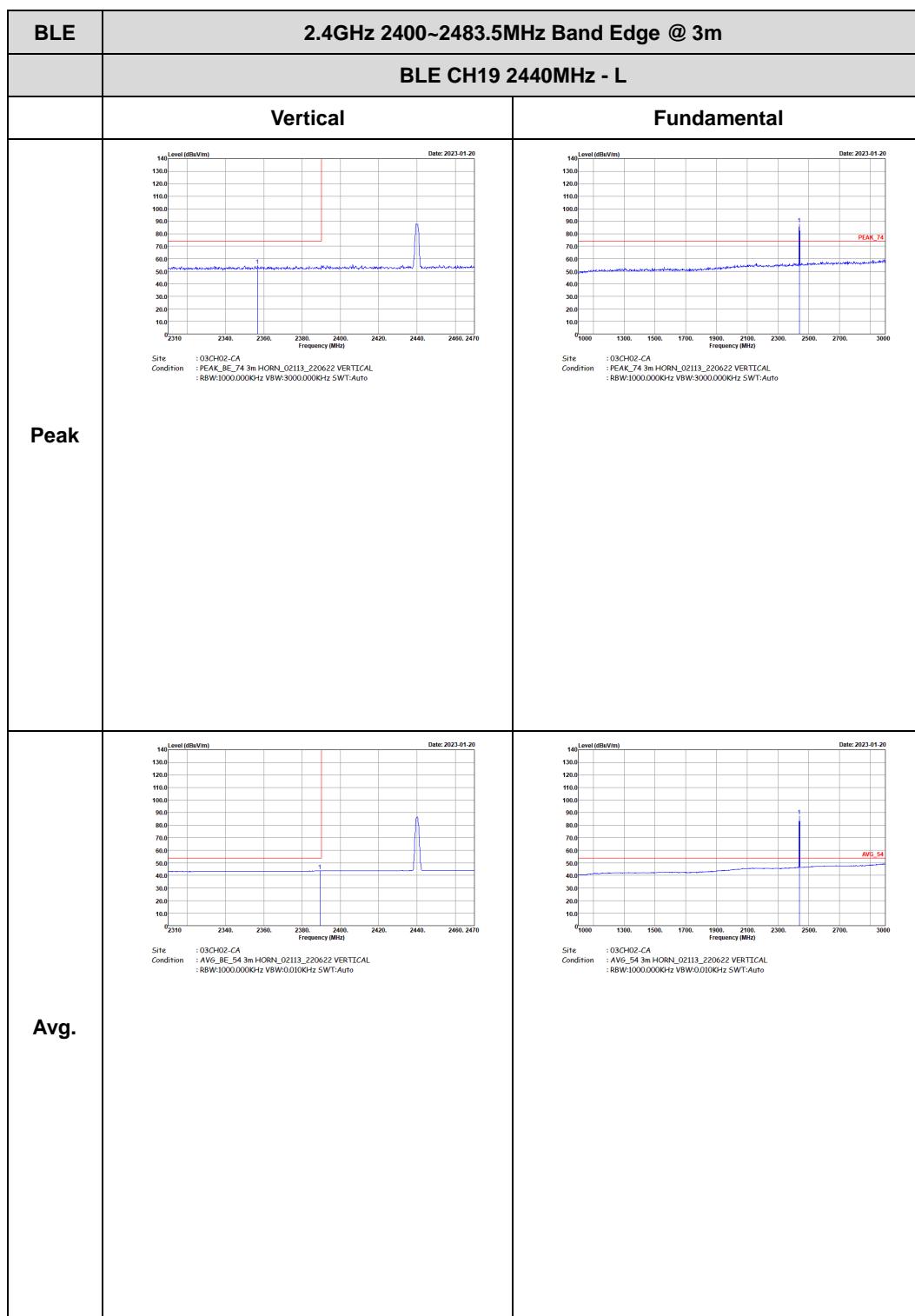
2.4GHz 2400~2483.5MHz**BLE (Band Edge @ 3m)**



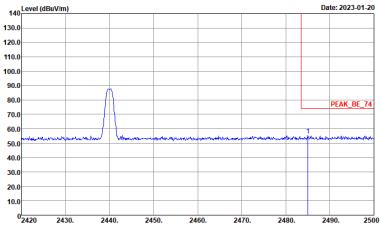
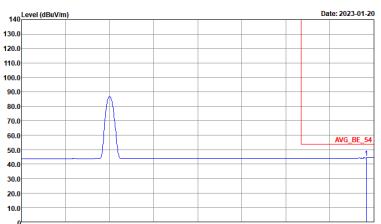


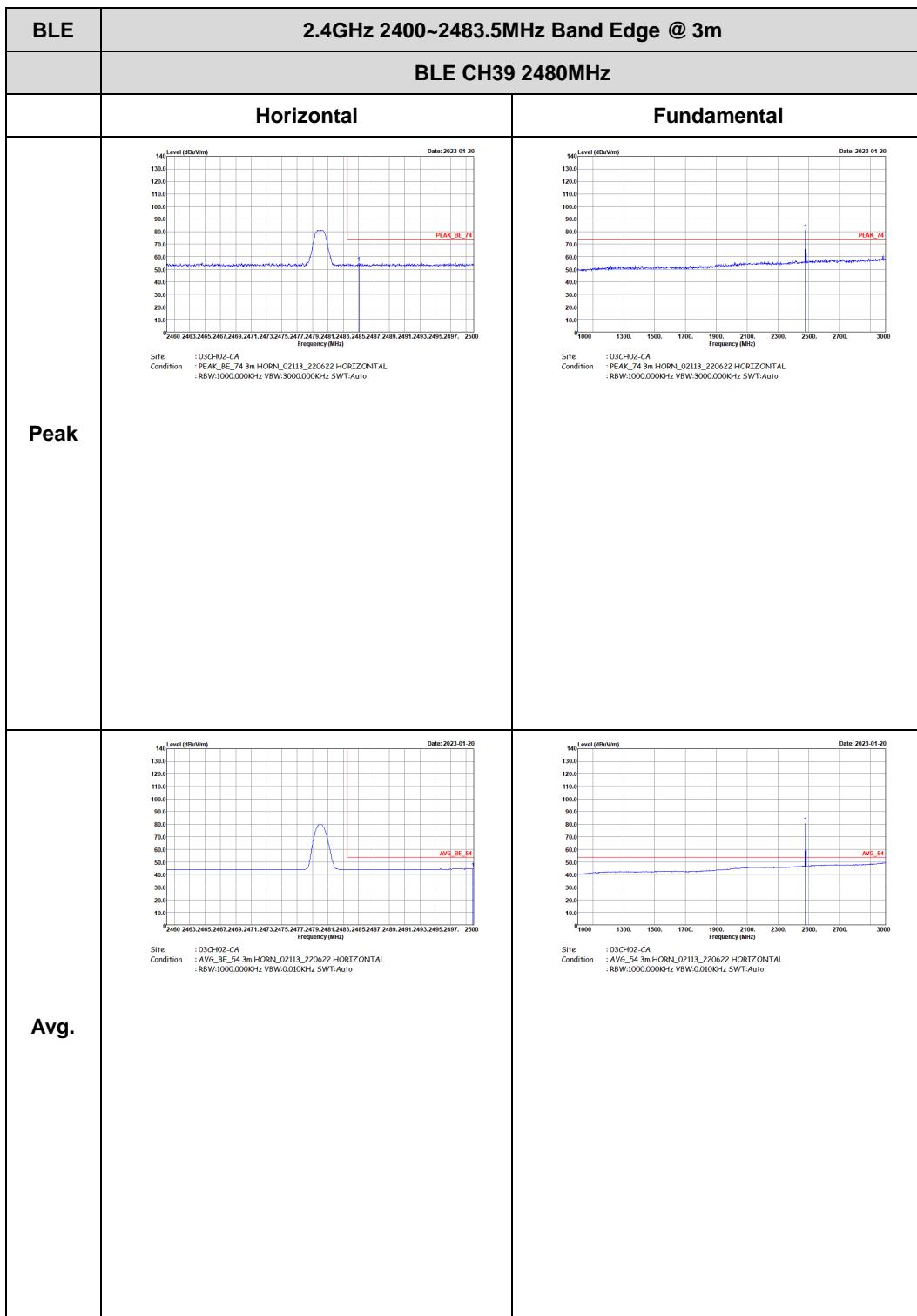


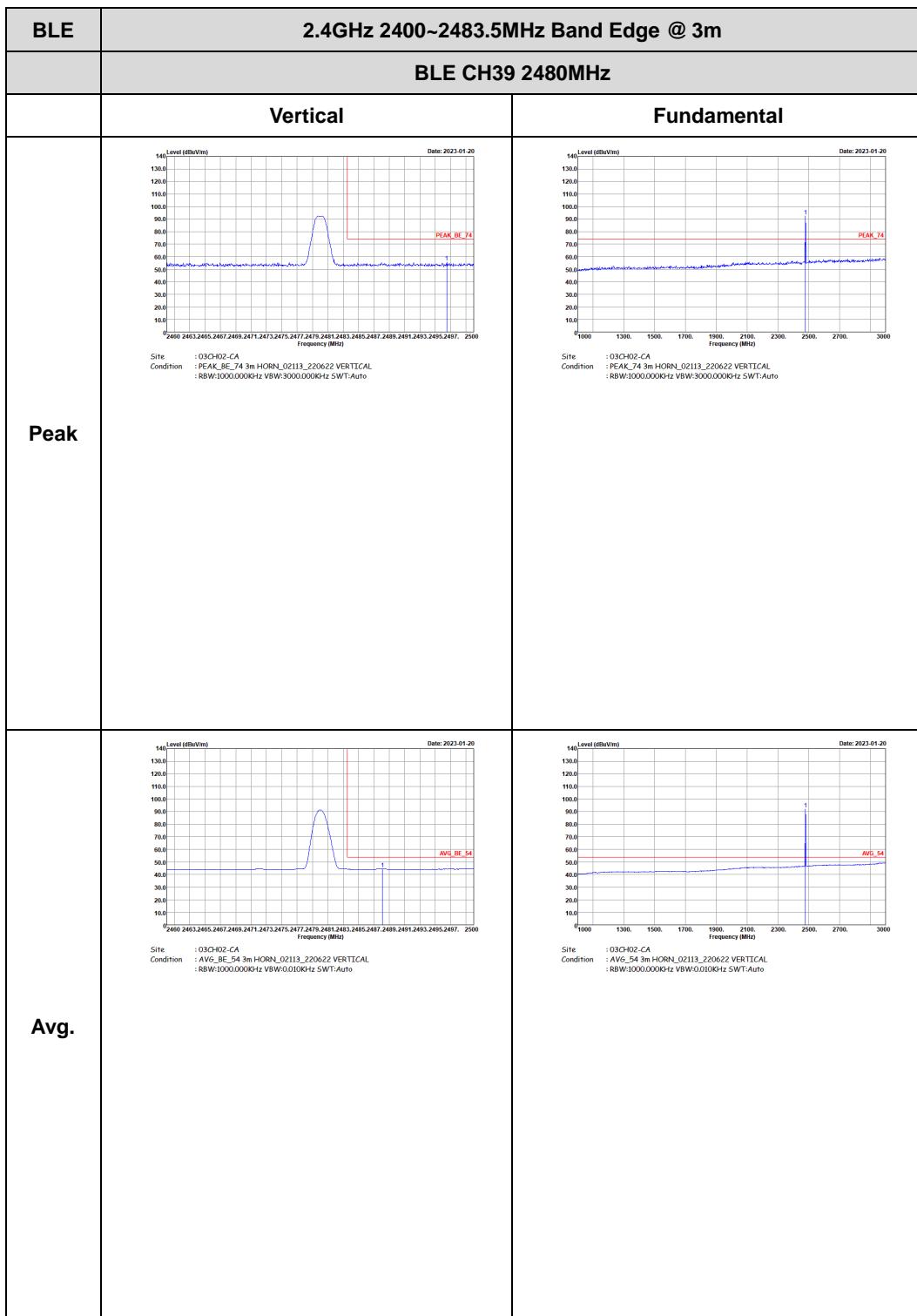
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BLE CH19 2440MHz - R		
Horizontal		Fundamental
Peak	 <p>Site : 03CH02-CA Condition : PEAK_BE_74 3m HORN_02113_220622 HORIZONTAL : R8W:1000.0000kHz VBW:3000.0000Hz SWT:Auto</p>	Left blank
Avg.	 <p>Site : 03CH02-CA Condition : AVG_BE_54 3m HORN_02113_220622 HORIZONTAL : R8W:1000.0000kHz VBW:0.0100Hz SWT:Auto</p>	Left blank





BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BLE CH19 2440MHz - R		
Vertical		Fundamental
Peak	 <p>Site : 03CH02-CA Condition : PEAK_BE_74 3m HORN_02113_220622 VERTICAL : R8W:1000.0000kHz VBW:3000.0000Hz SWT:Auto</p>	Left blank
Avg.	 <p>Site : 03CH02-CA Condition : AVG_BE_54 3m HORN_02113_220622 VERTICAL : R8W:1000.0000kHz VBW:0.0100Hz SWT:Auto</p>	Left blank

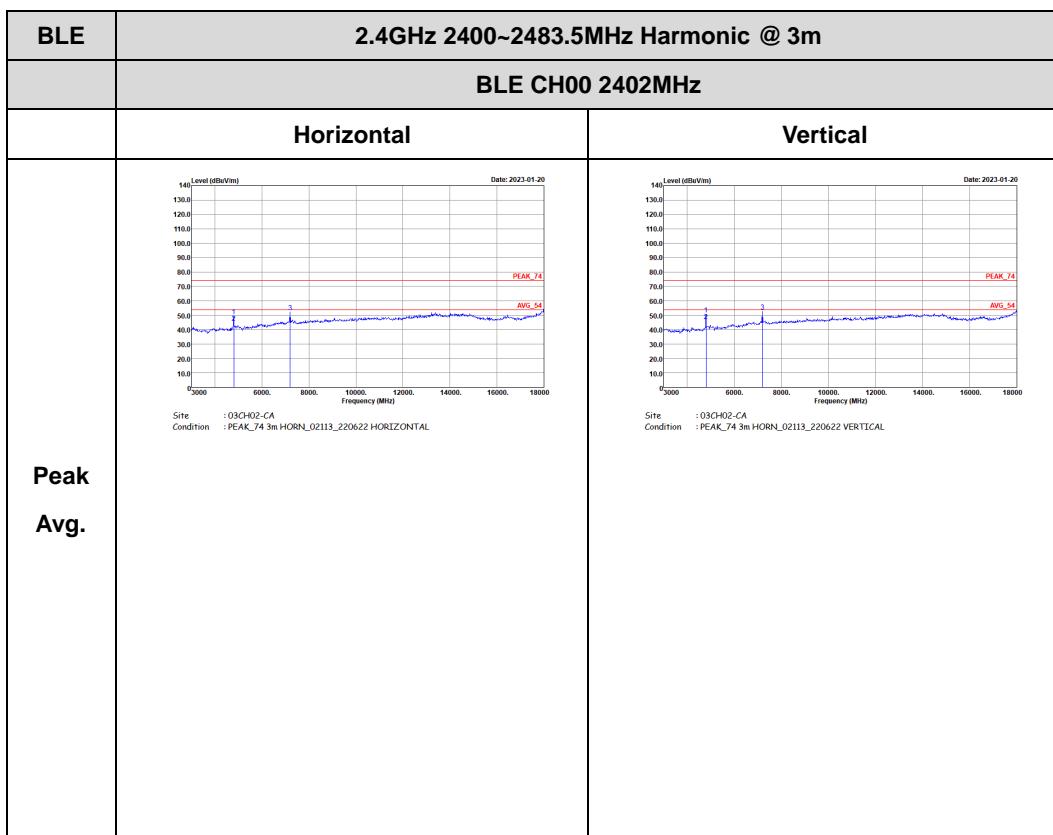


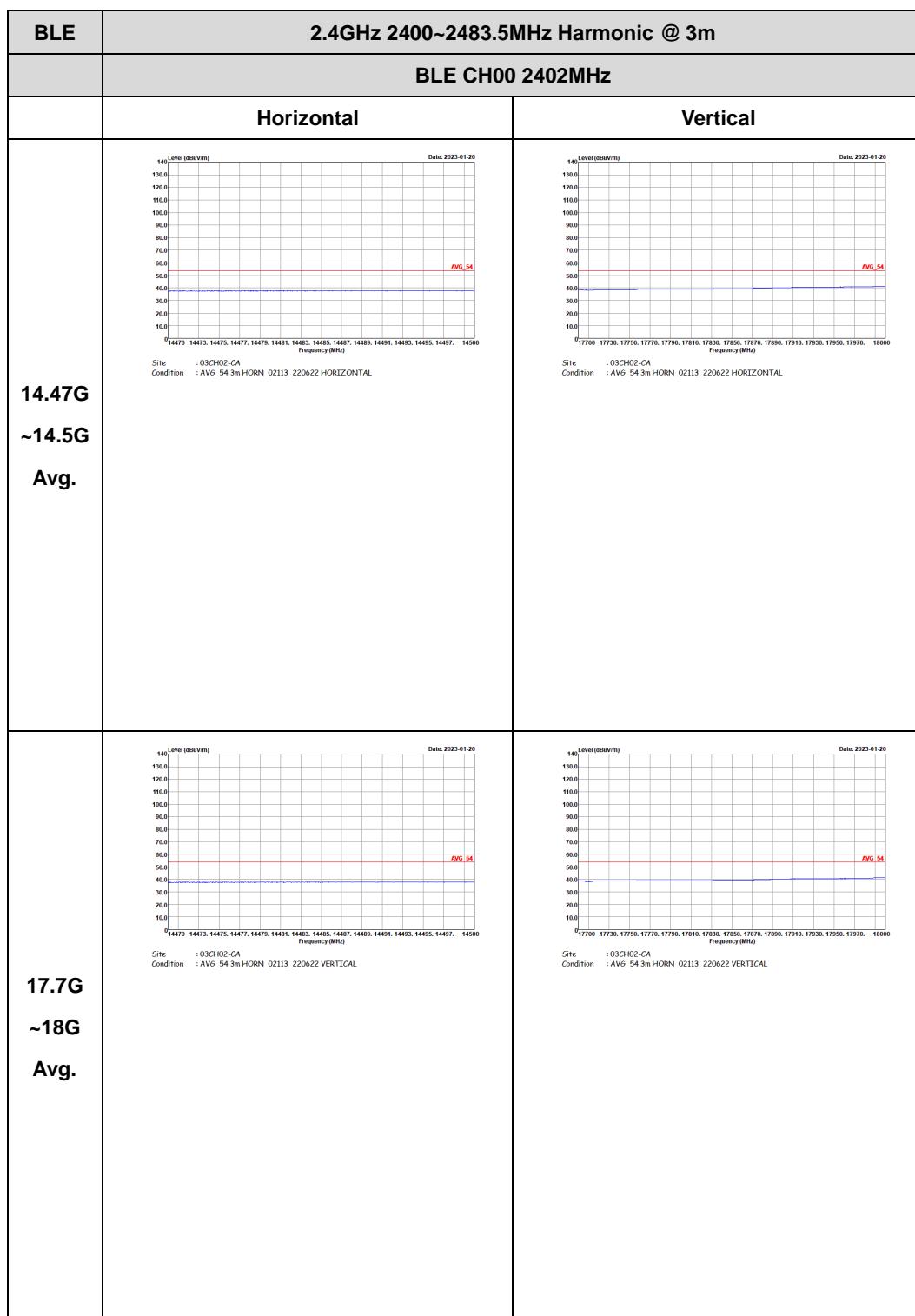


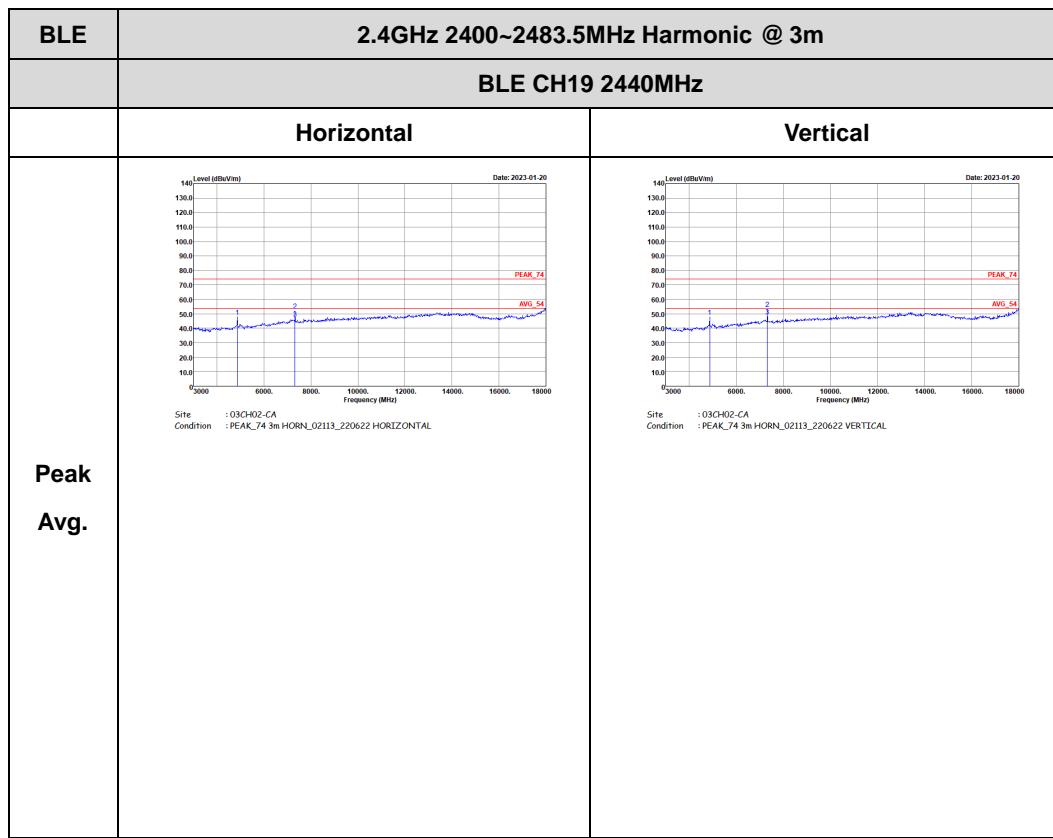


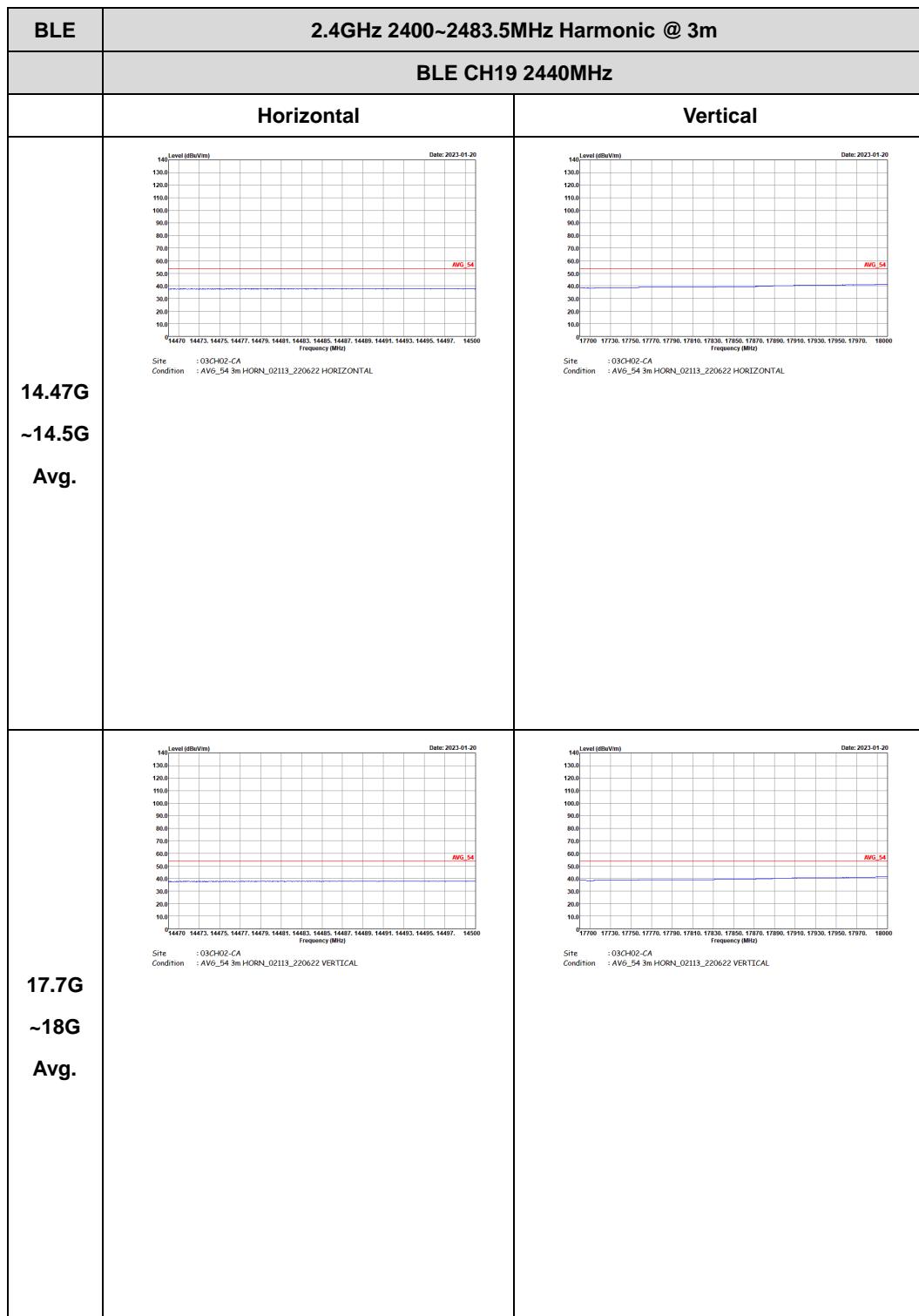
2.4GHz 2400~2483.5MHz

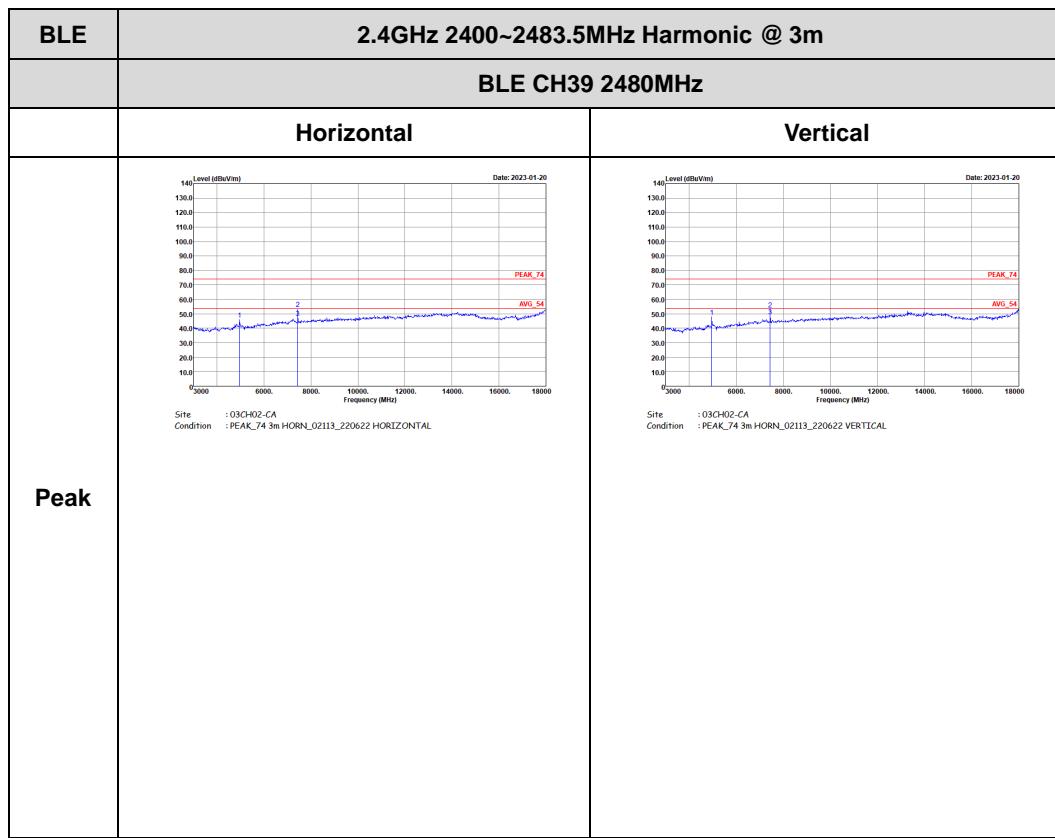
BLE (Harmonic @ 3m)

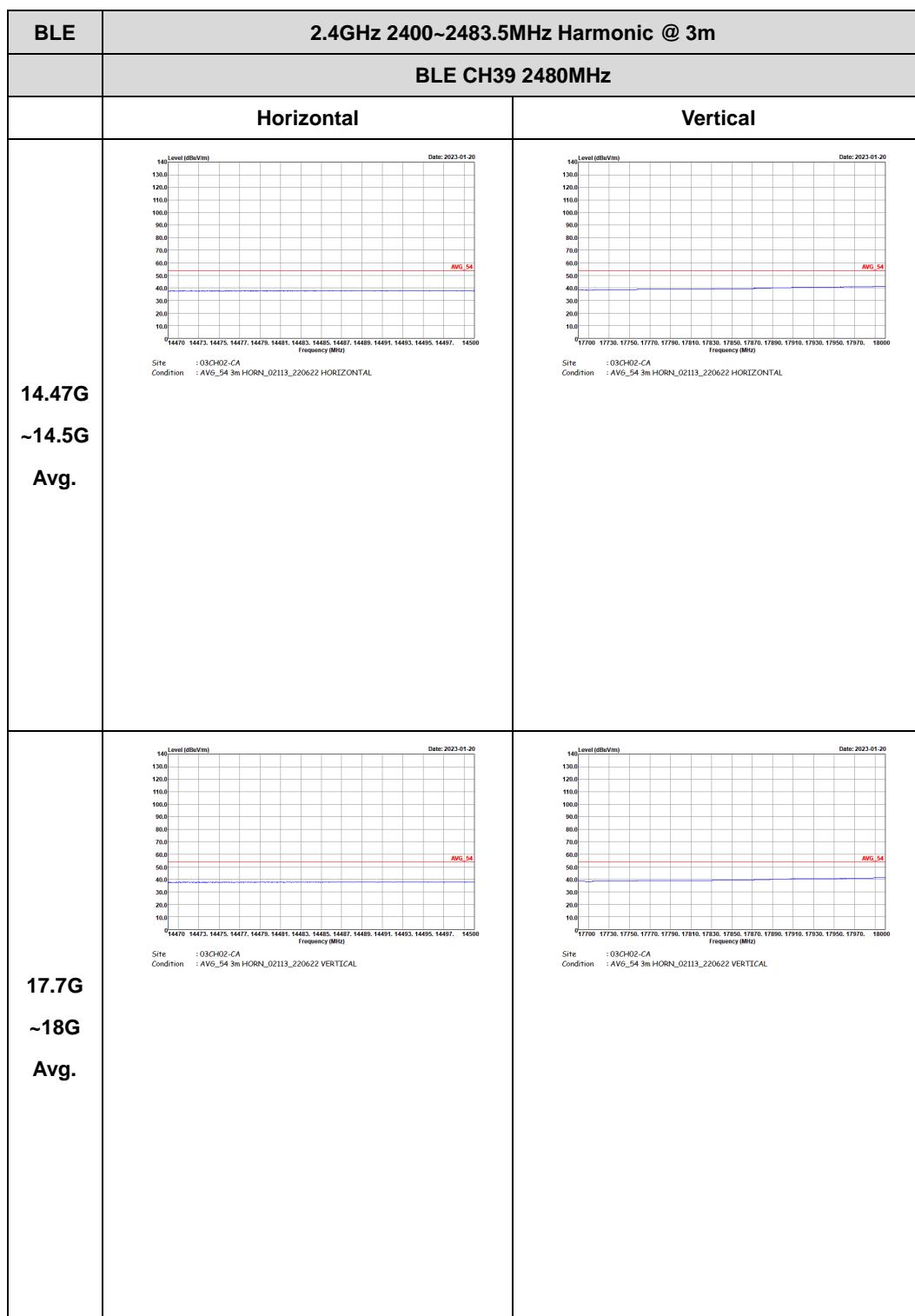








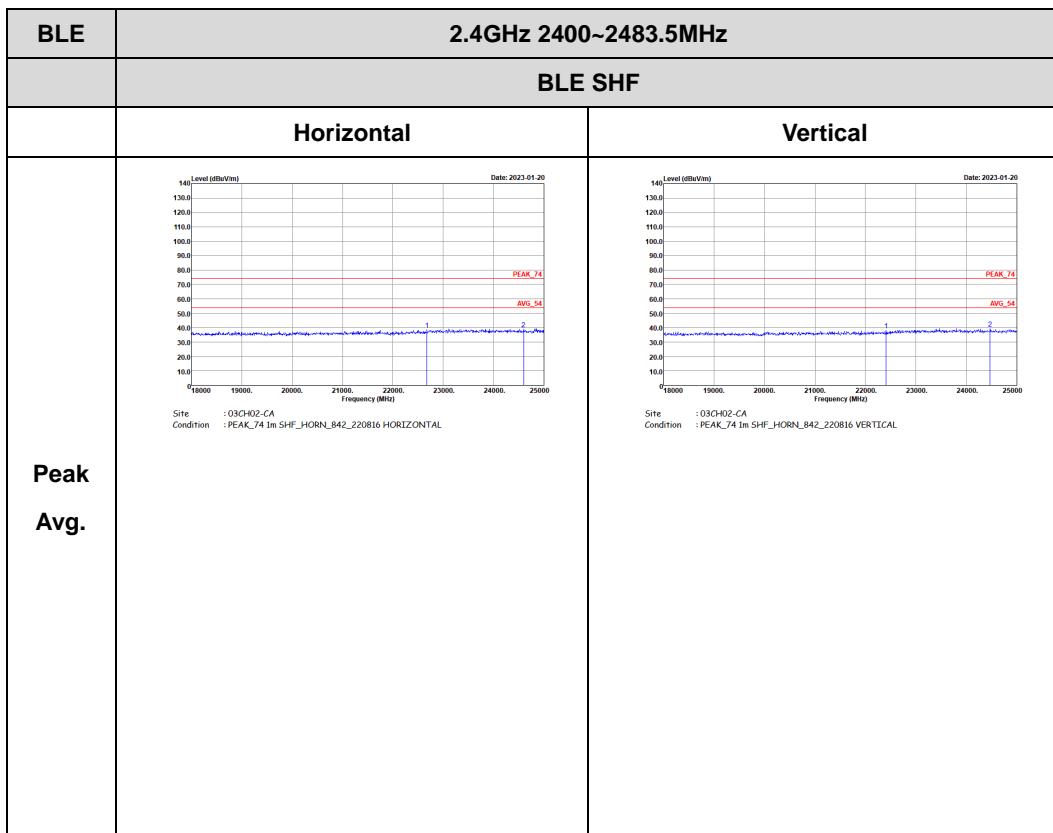






Emission above 18GHz

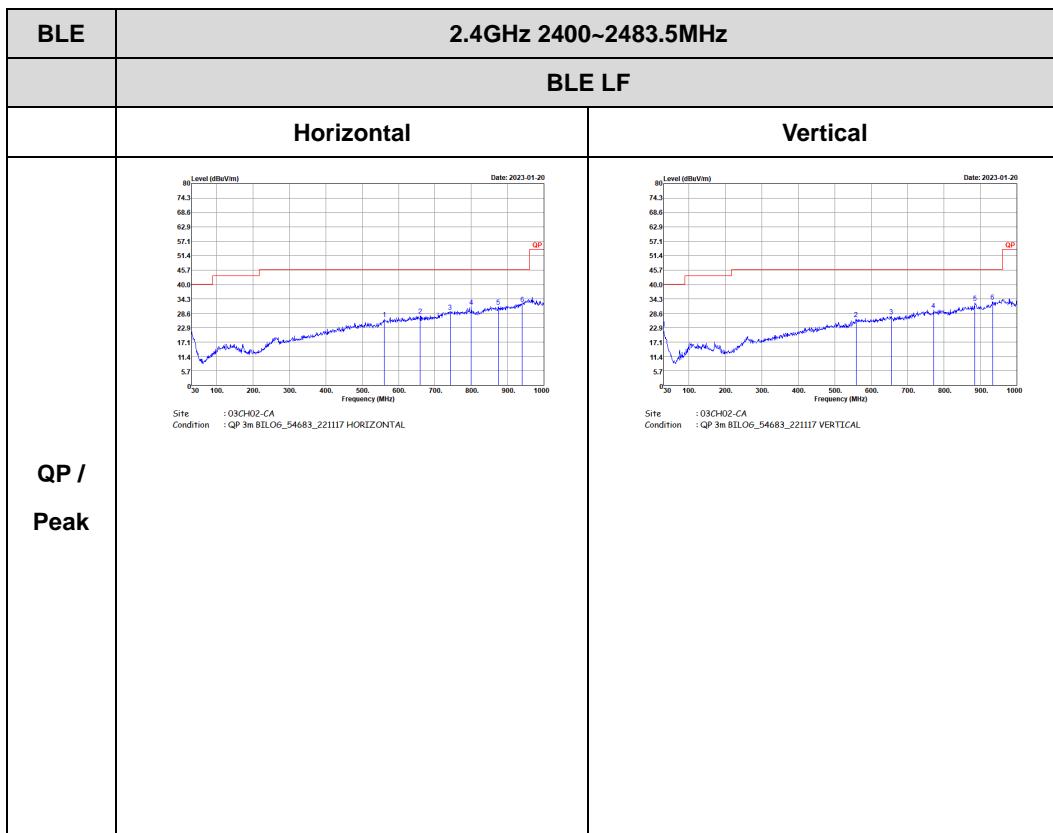
2.4GHz BLE (SHF @ 1m)





Emission below 1GHz

2.4GHz BLE (LF)

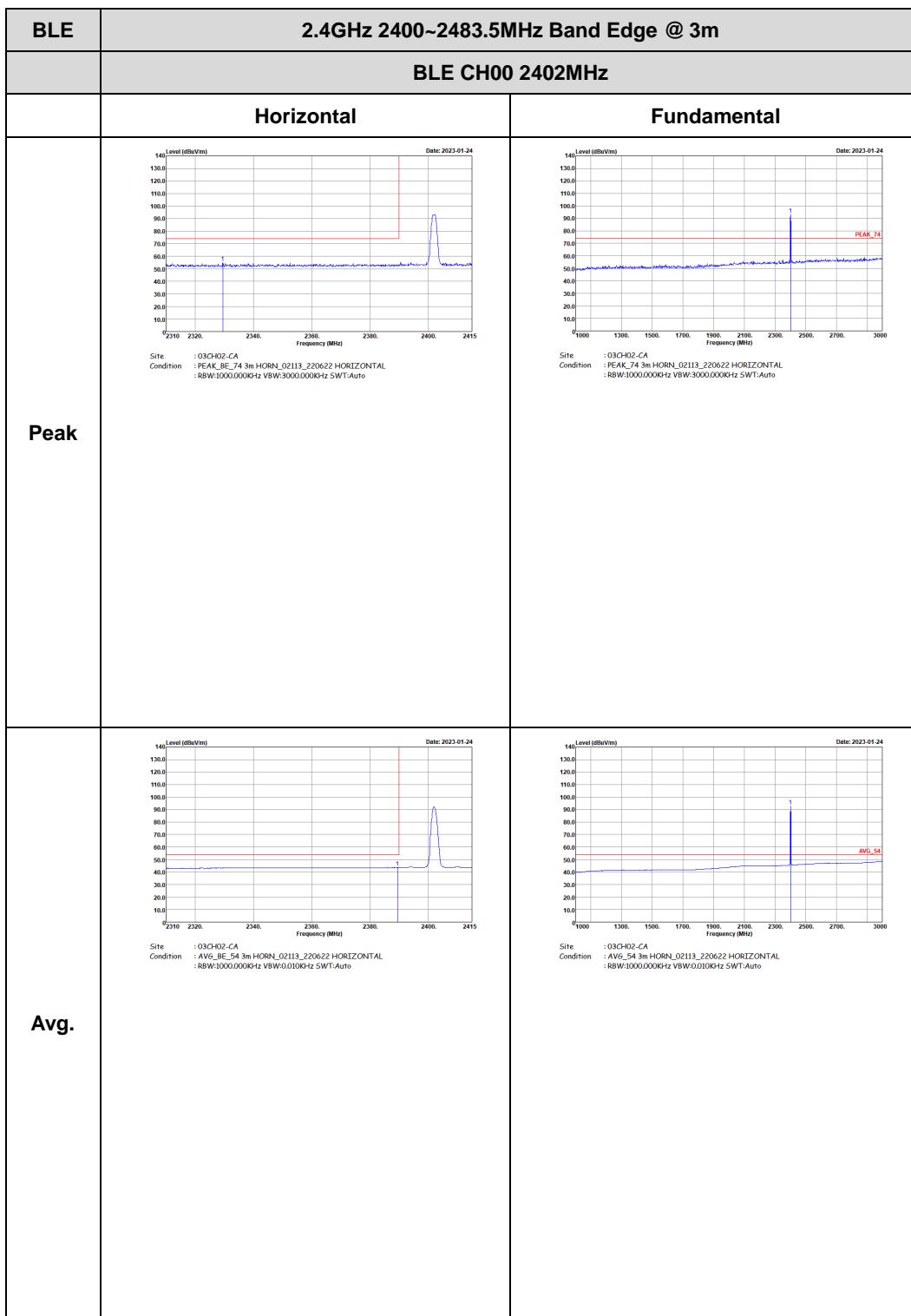


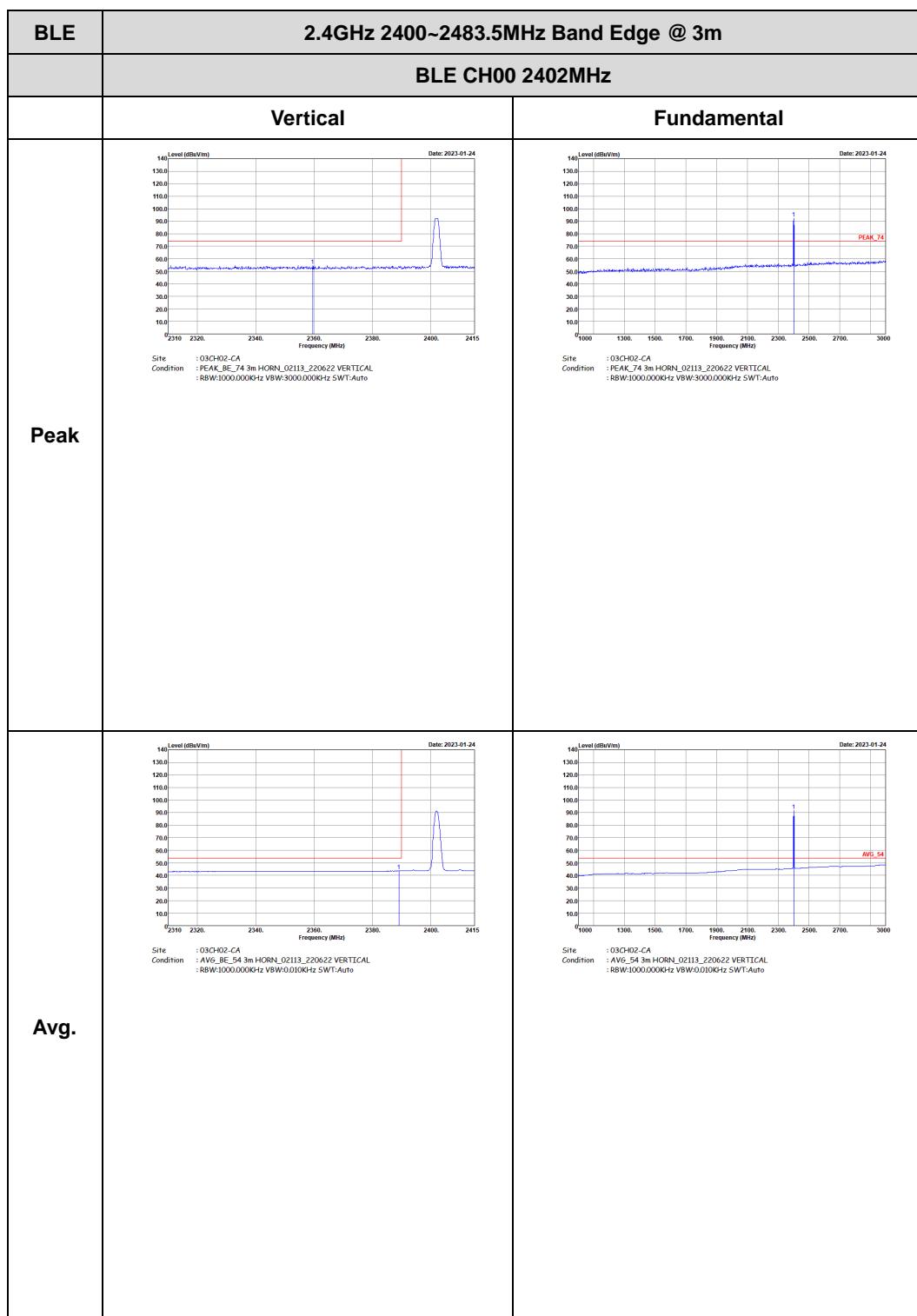


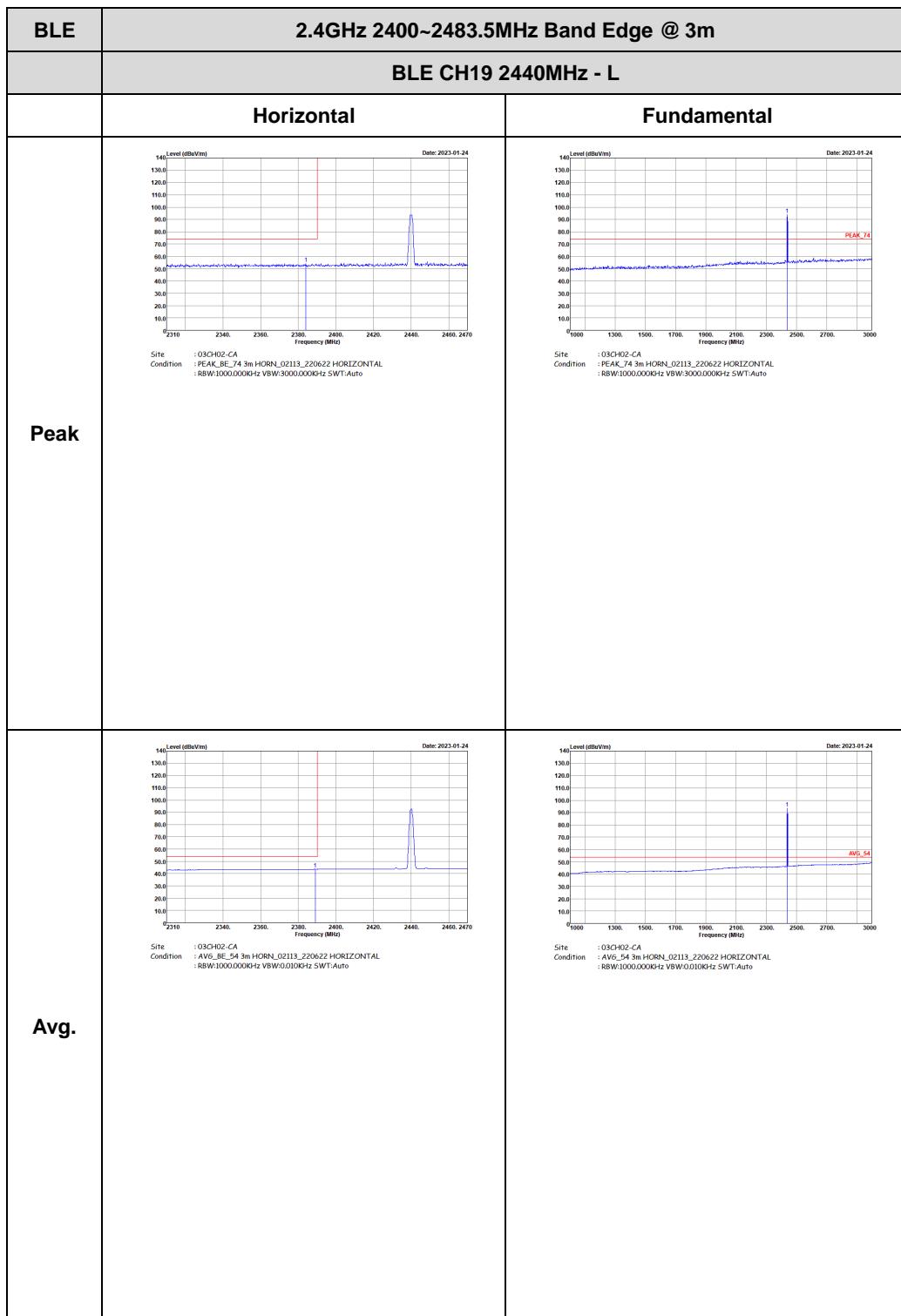
<Sample 3>

2.4GHz 2400~2483.5MHz

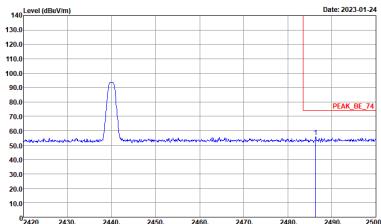
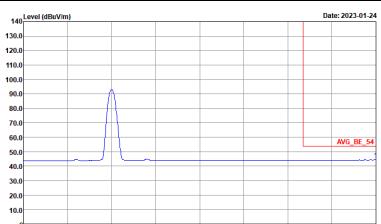
BLE (Band Edge @ 3m)

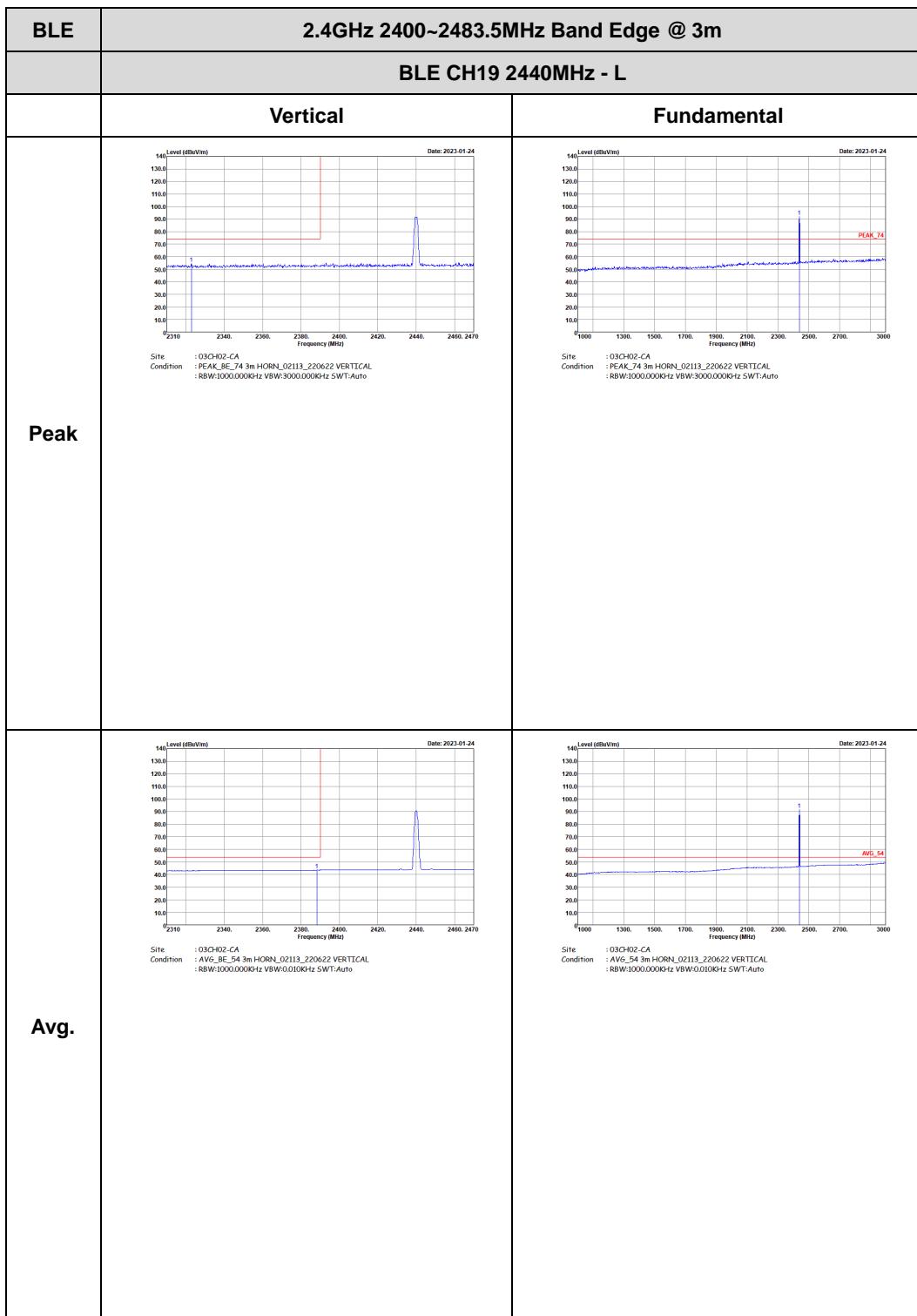




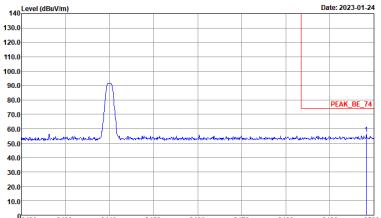
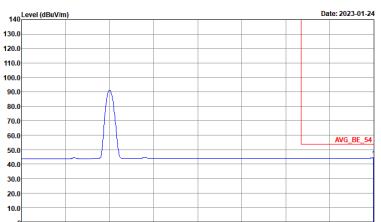


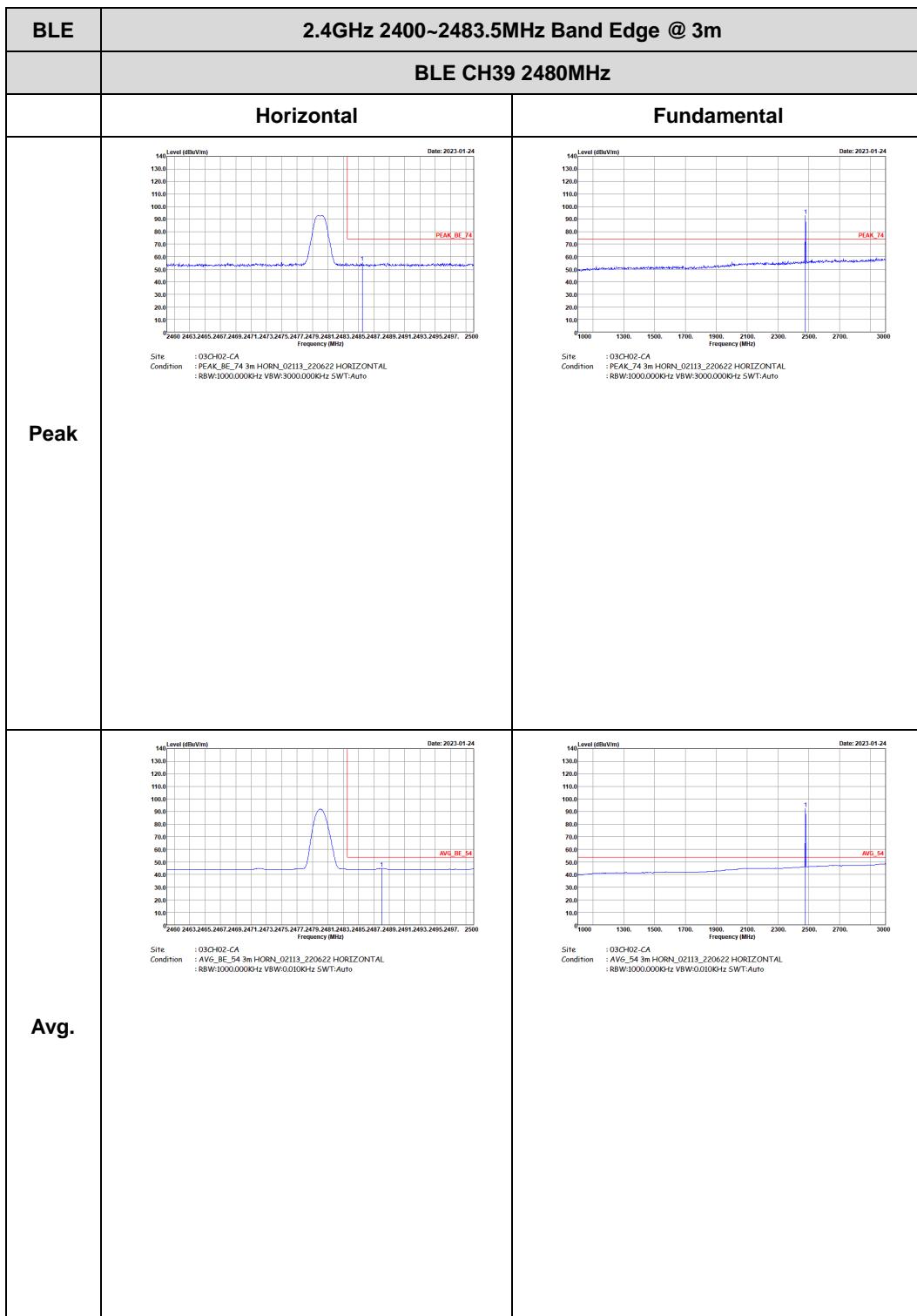


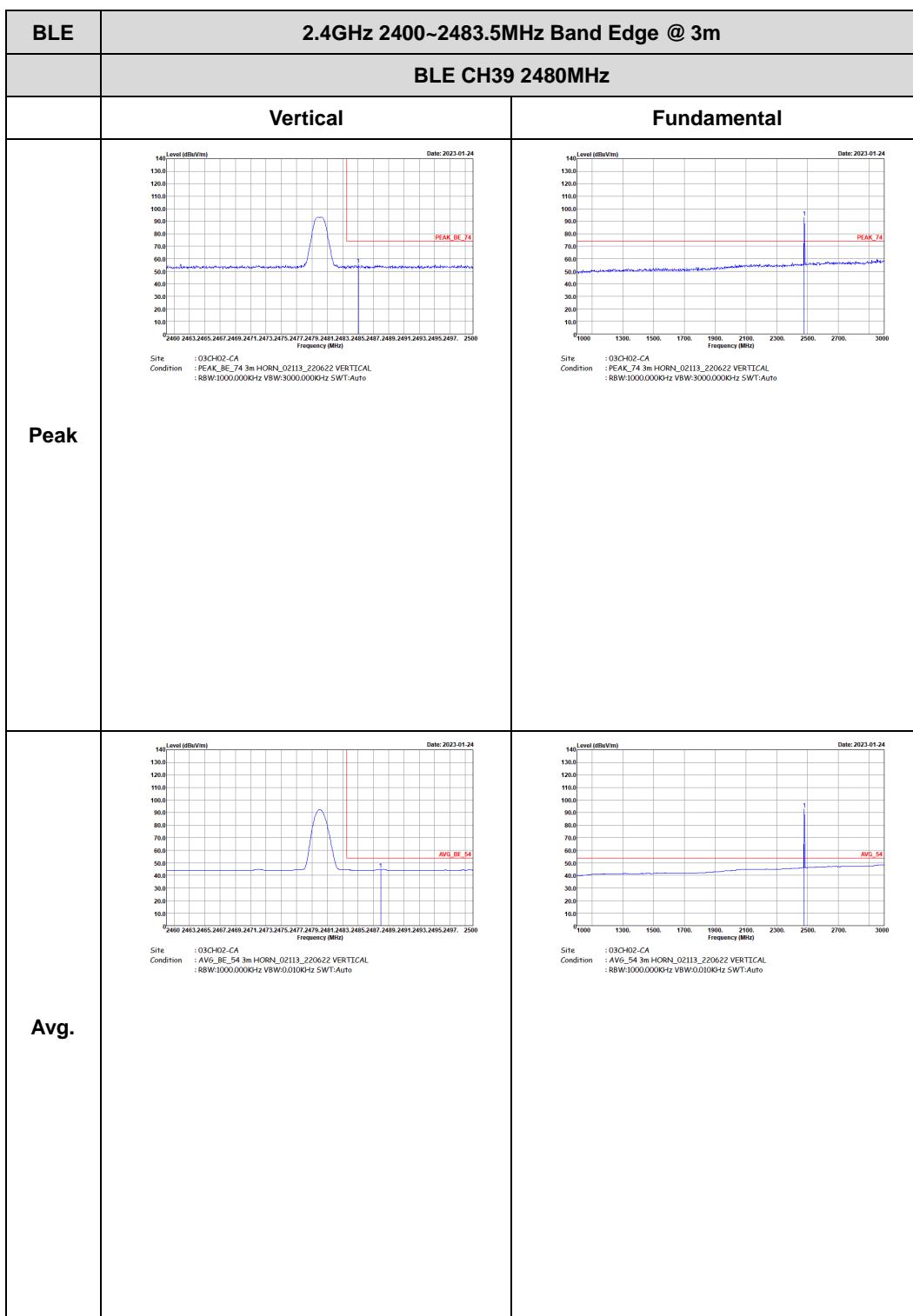
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BLE CH19 2440MHz - R		
Horizontal		Fundamental
Peak	 <p>Site : 03CH02-CA Condition : PEAK_BE_74 3m HORN_02113_220622 HORIZONTAL : R8W:1000.0000Hz VBW:3000.0000Hz SWT:Auto</p>	Left blank
Avg.	 <p>Site : 03CH02-CA Condition : AVG_BE_54 3m HORN_02113_220622 HORIZONTAL : R8W:1000.0000Hz VBW:0.0100Hz SWT:Auto</p>	Left blank





BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BLE CH19 2440MHz - R		
Vertical		Fundamental
Peak	 <p>Site : 03CH02-CA Condition : PEAK_BE_74 3m HORN_02113_220622 VERTICAL : R8W:1000.000kHz VBW:3000.000Hz SWT:Auto</p>	Left blank
Avg.	 <p>Site : 03CH02-CA Condition : AVG_BE_54 3m HORN_02113_220622 VERTICAL : R8W:1000.000kHz VBW:0.010kHz SWT:Auto</p>	Left blank

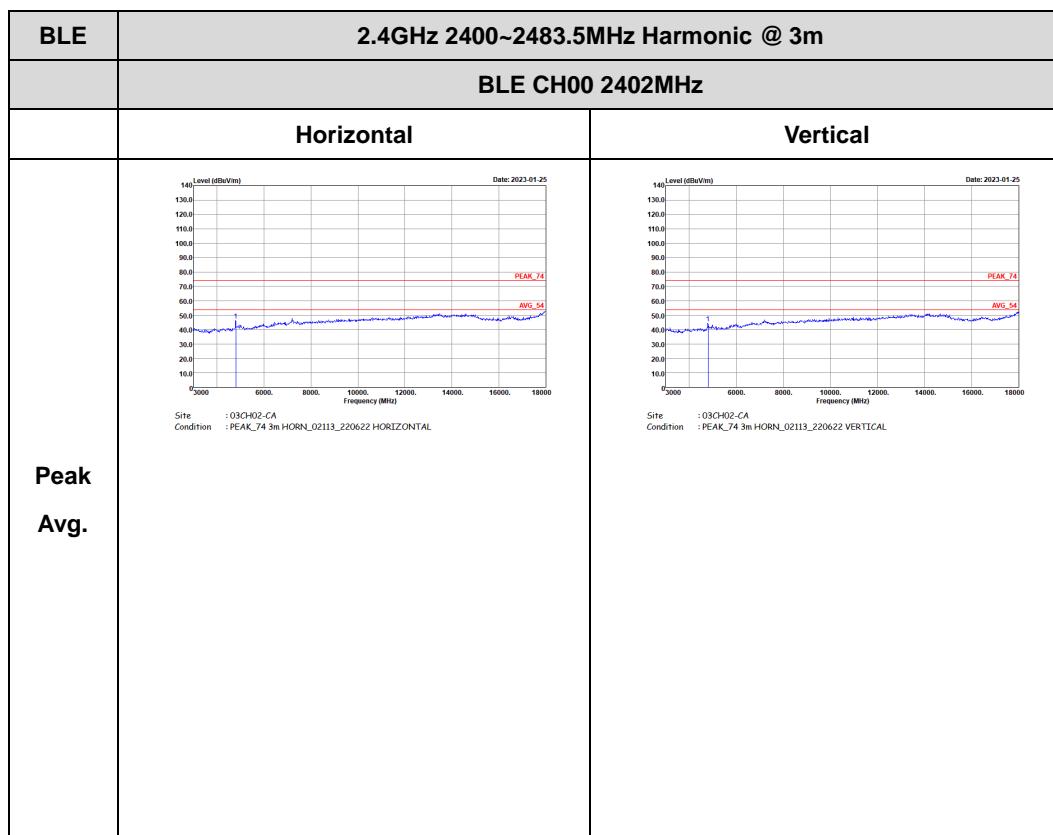




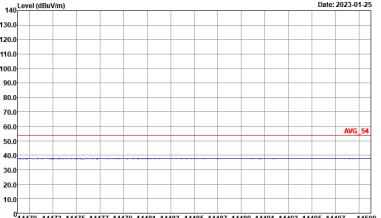
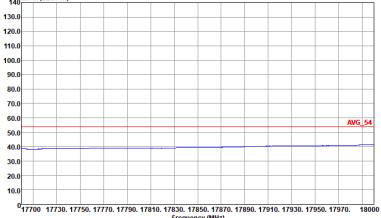
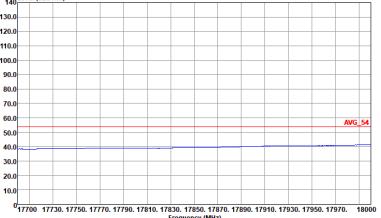


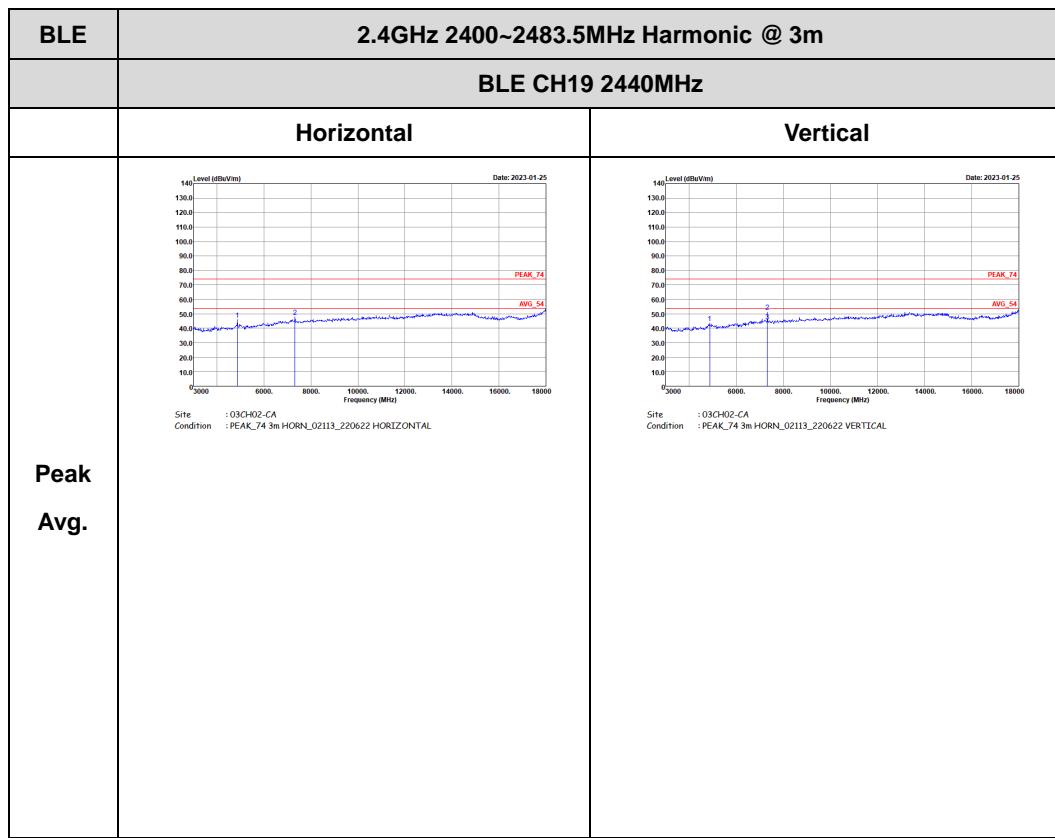
2.4GHz 2400~2483.5MHz

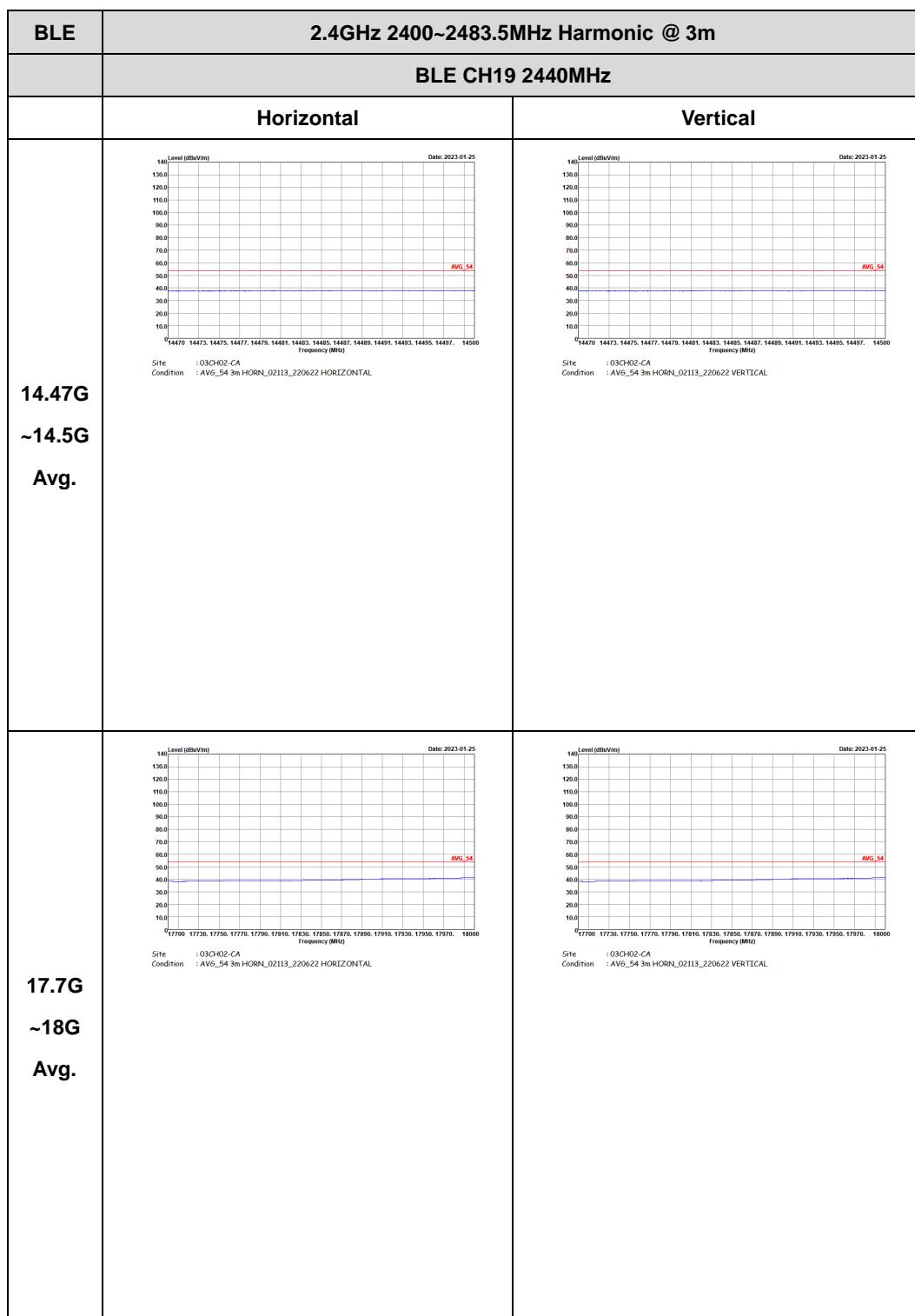
BLE (Harmonic @ 3m)

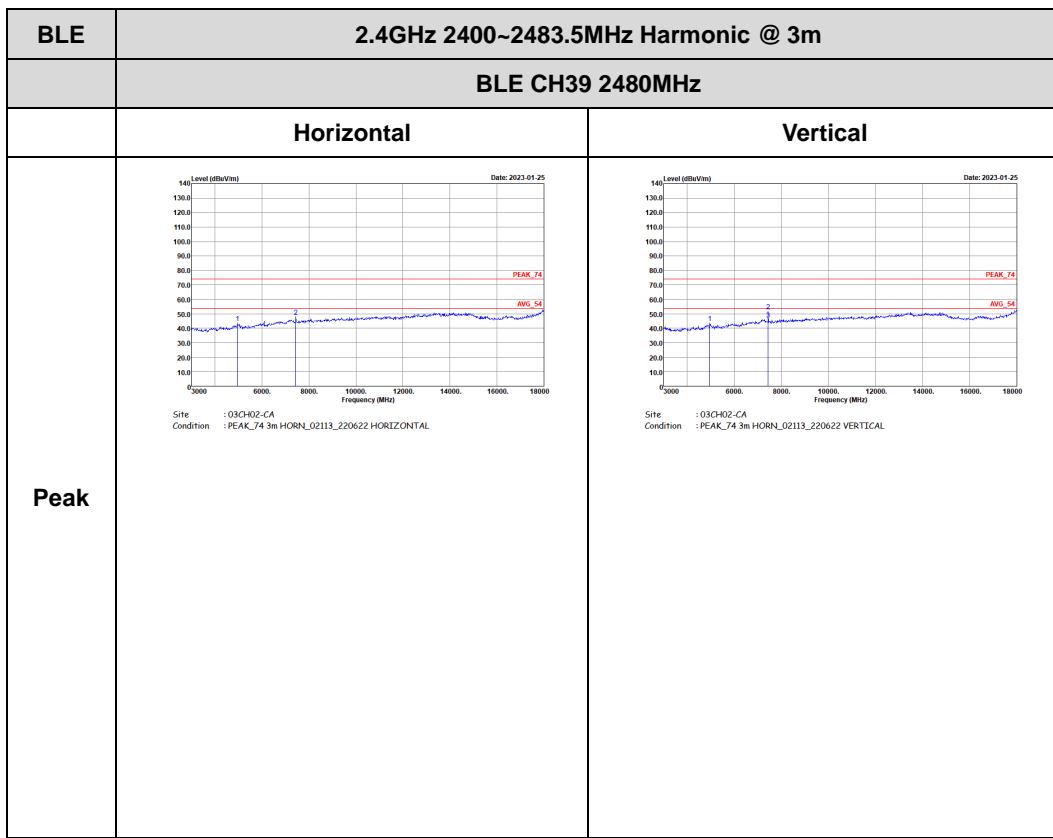


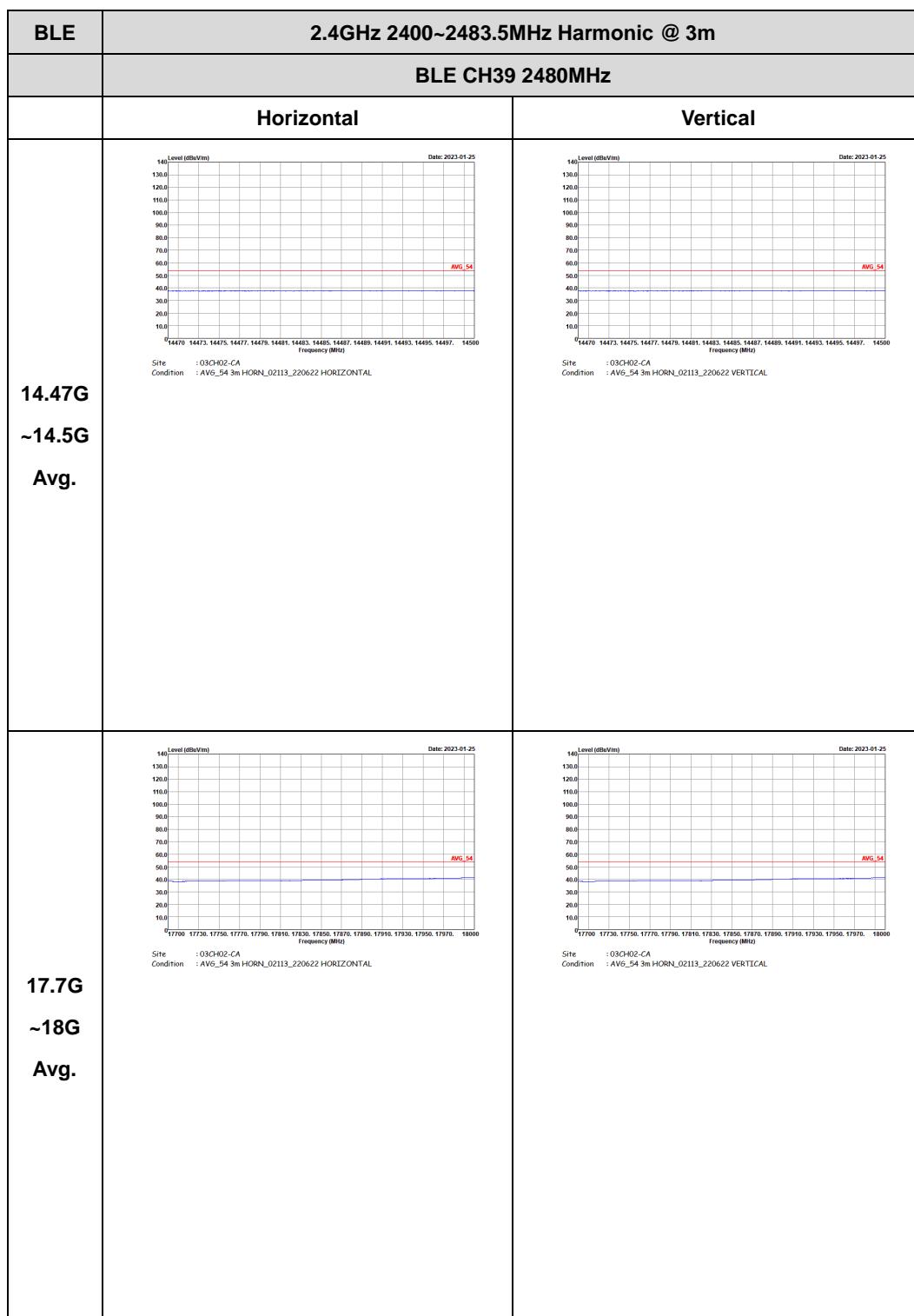


BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BLE CH00 2402MHz	
	Horizontal	Vertical
14.47G ~14.5G Avg.	 Site : 03CH02-CA Condition : AVG_54 3m HORN_02113_220622 HORIZONTAL	 Site : 03CH02-CA Condition : AVG_54 3m HORN_02113_220622 VERTICAL
17.7G ~18G Avg.	 Site : 03CH02-CA Condition : AVG_54 3m HORN_02113_220622 HORIZONTAL	 Site : 03CH02-CA Condition : AVG_54 3m HORN_02113_220622 VERTICAL





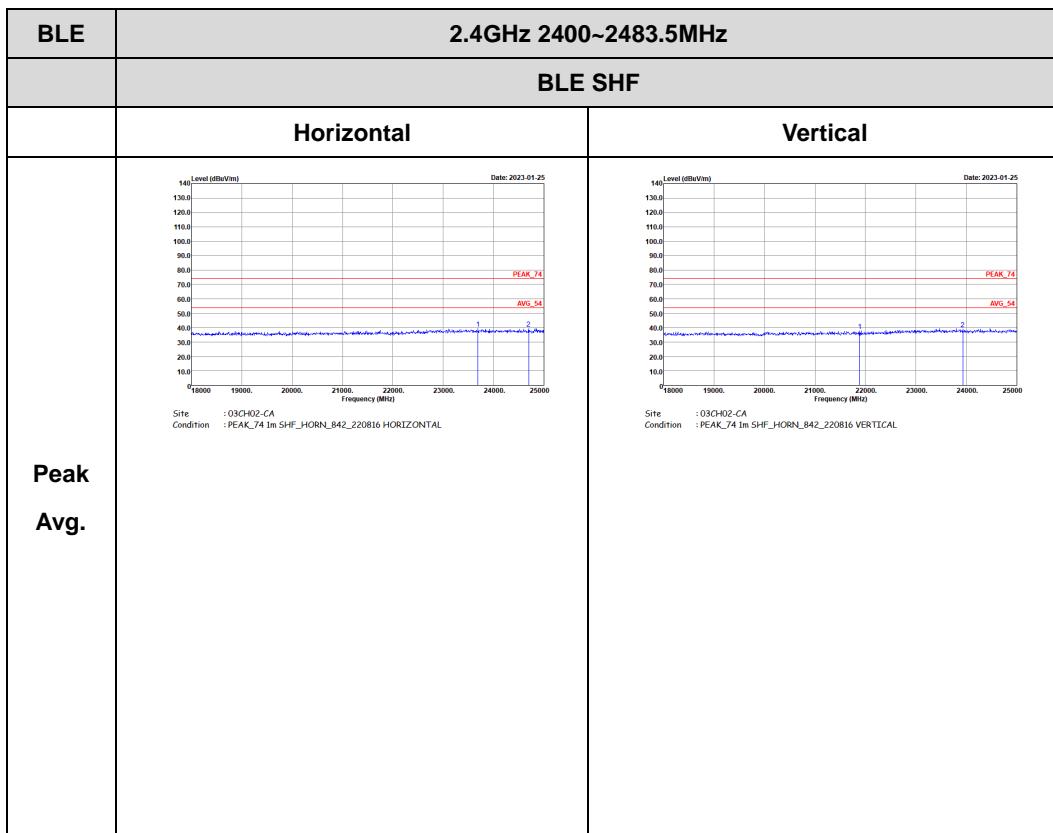






Emission above 18GHz

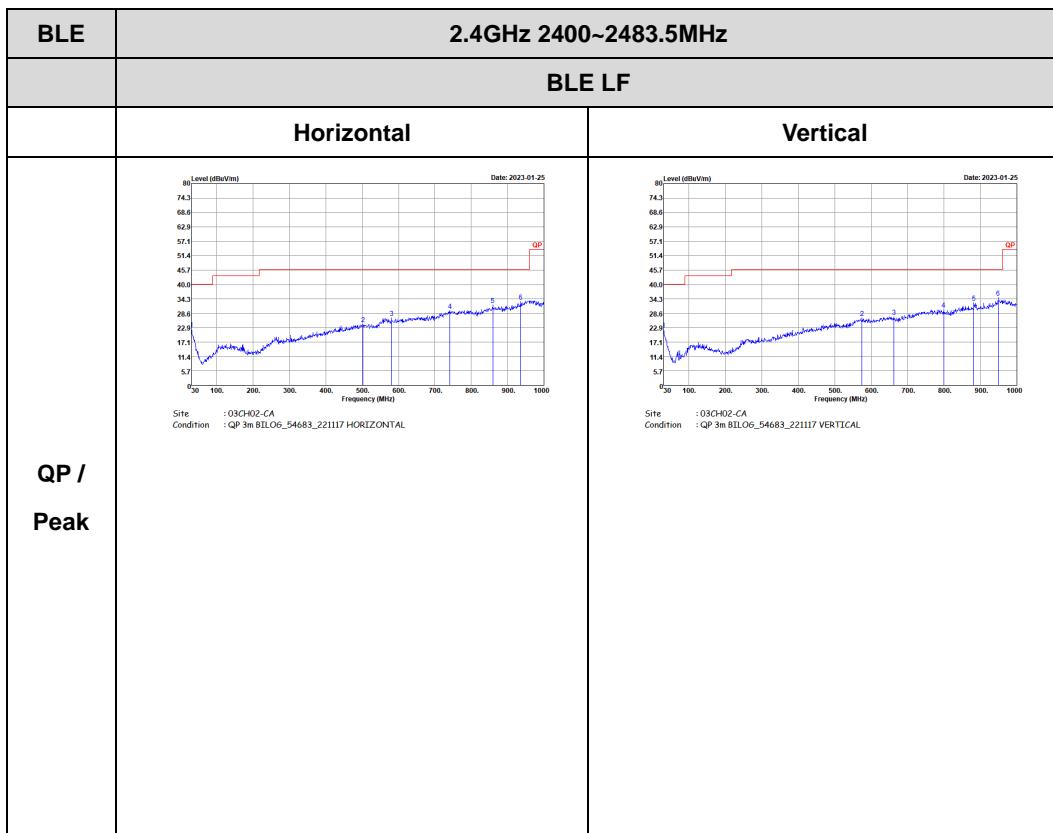
2.4GHz BLE (SHF @ 1m)





Emission below 1GHz

2.4GHz BLE (LF)

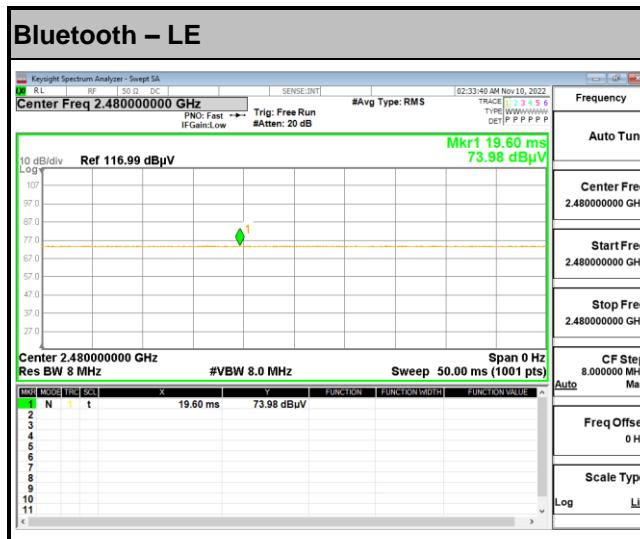




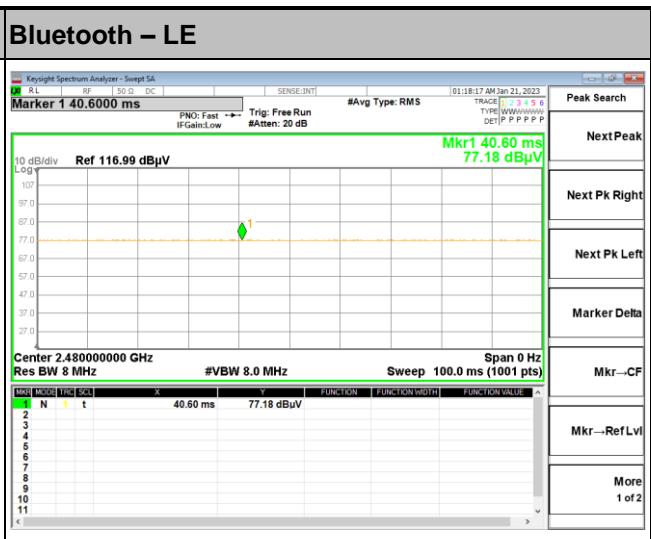
Appendix D. Duty Cycle Plots

Sample	Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting
1	Bluetooth -LE	100.00	-	-	10Hz
2	Bluetooth -LE	100.00	-	-	10Hz
3	Bluetooth -LE	100.00	-	-	10Hz

<Sample 1>



<Sample 2>



<Sample 3>

