FCC RADIO TEST REPORT

FCC ID	:	**T4522084**
Equipment	:	**TCU 2.2**
Brand Name	:	**LID Technologies**
Model Name	:	**22084**
Applicant	:	**LID Technologies S.A.S.** **3 rue GIOTTO Parc Technologique du canal, Ramonville-Saint-Agne, France 31520**
Manufacturer	:	**LID Technologies S.A.S.** **3 rue GIOTTO Parc Technologique du canal, Ramonville-Saint-Agne, France 31520**
Factory	:	**SVI Public Company Limited** **141-142 Moo 5 Bangkadi Industrial Park, Tiwanon Road Bangkadi, Muang, Pathumthani 12000 Thailand**
Standard	:	**FCC Part 15 Subpart C §15.247**

The product was received on Mar. 05, 2024 and testing was performed from Apr. 01, 2024 to Apr. 25, 2024. We, Sporton International Inc. EMC & Wireless Communications Laboratory, 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 Inc. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Louis Wu

Approved by: Louis Wu

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History of this test report

Report No.	Version	Description	Issue Date
FR430602A	01	Initial issue of report	Sep. 16, 2024

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	Pass	-
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	1.39 dB under the limit at 7320.00 MHz
-	15.207	AC Conducted Emission	Not Required	-
3.6	15.203	Antenna Requirement	Pass	-

Note: The power source method of the EUT is to use Car Battery (DC power source), and there is no other AC power port, after assessing, AC Conduction Emission test is not required.

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. The measurement uncertainty please refer to each test result in the section “Measurement Uncertainty”.
Disclaimer:
The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.

Reviewed by: Yun Huang

Report Producer: Mila Chen

1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	TCU 2.2
FCC ID	T4522084
Brand Name	LID Technologies
Model Name	22084
EUT supports Radios application	GSM/LTE, Bluetooth-LE, RFID, SRD and GNSS.
EUT Stage	Production Unit

Remark: The above EUT's information was declared by manufacturer.

1.2 Product Specification of Equipment Under Test

Product Specification is subject to this standard	
Tx / Rx Frequency	2400 MHz ~ 2483.5 MHz
Antenna Type	Ceramic SMD Chip Antenna
Antenna Gain	4.0 dBi
Type of Modulation	Bluetooth-LE: GFSK

Remark: The above EUT's information was declared by manufacturer. Please refer to Disclaimer in report summary.

1.3 Modification of EUT

No modifications made to the EUT during the testing.

1.4 Testing Location

Test Site	Sporton International Inc. EMC & Wireless Communications Laboratory
Test Site Location	No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978
Test Site No.	**Sporton Site No.**
	03CH07-HY

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

Test Site	Sporton International Inc. Wensan Laboratory
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	**Sporton Site No.**
	TH05-HY (TAF Code: 3786)
Remark	The Conducted test item subcontracted to Sporton International Inc. Wensan Laboratory

FCC designation No.: TW1190 and TW3786

1.5 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. The TAF code is not including all the FCC KDB listed without accreditation.
3. 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	-	-

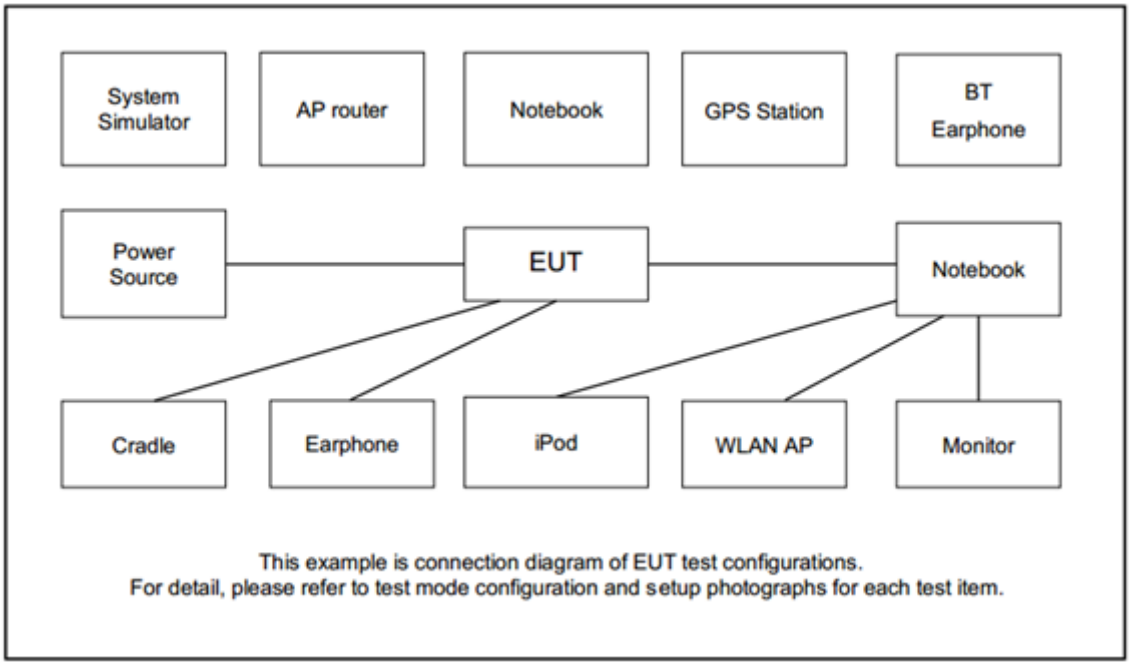
2.2 Test Mode

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
	Mode 4: Bluetooth Tx CH00_2402 MHz_2Mbps
	Mode 5: Bluetooth Tx CH19_2440 MHz_2Mbps
	Mode 6: Bluetooth Tx CH39_2480 MHz_2Mbps
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
	Mode 4: Bluetooth Tx CH00_2402 MHz_2Mbps
	Mode 5: Bluetooth Tx CH19_2440 MHz_2Mbps
	Mode 6: Bluetooth Tx CH39_2480 MHz_2Mbps
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.	USB to RS232	UGREEN	N/A	N/A	N/A	N/A
2.	DC Power Supply	GW Instek	GPE2323	N/A	N/A	N/A

2.5 EUT Operation Test Setup

The RF test items, utility “Terminal v1.9b” 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.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).

= 4.2 + 10 = 14.2 (dB)

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.

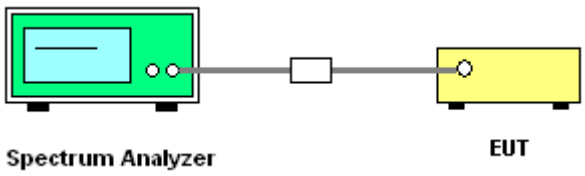
3.1.2 Measuring Instruments

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) ≥ 3 * 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.

3.1.6 Test Result of 99% Occupied Bandwidth

Please refer to Appendix A.

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.

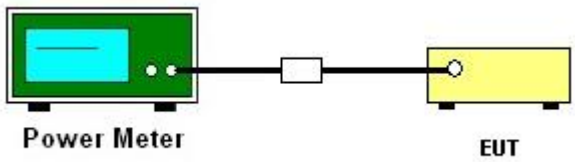
3.2.2 Measuring Instruments

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.

3.4 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

Please refer to Appendix A.

3.4.6 Test Result of Conducted Spurious Emission Plots

Please refer to Appendix A.

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 transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required 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

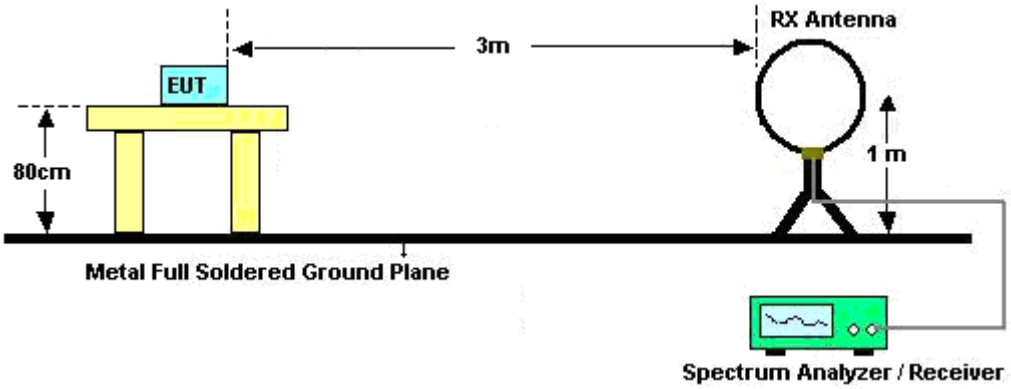
Please refer to the measuring equipment list in this test report.

3.5.3 Test Procedures

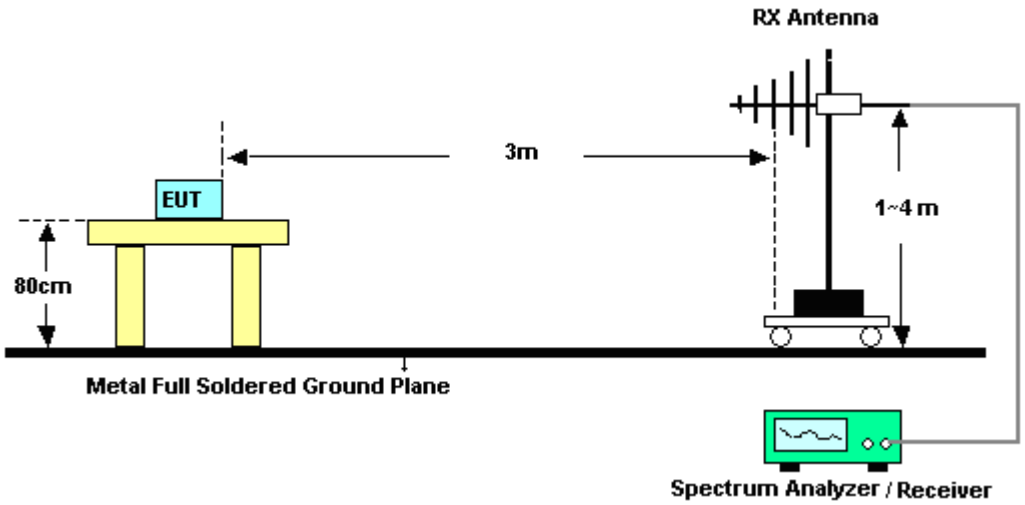
1. The testing follows the ANSI C63.10 Section 11.12.1 Radiated emission measurements.
2. The EUT is arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the 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 ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW = 3 MHz for f ≥ 1 GHz for peak measurement.
   For average measurement:
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 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

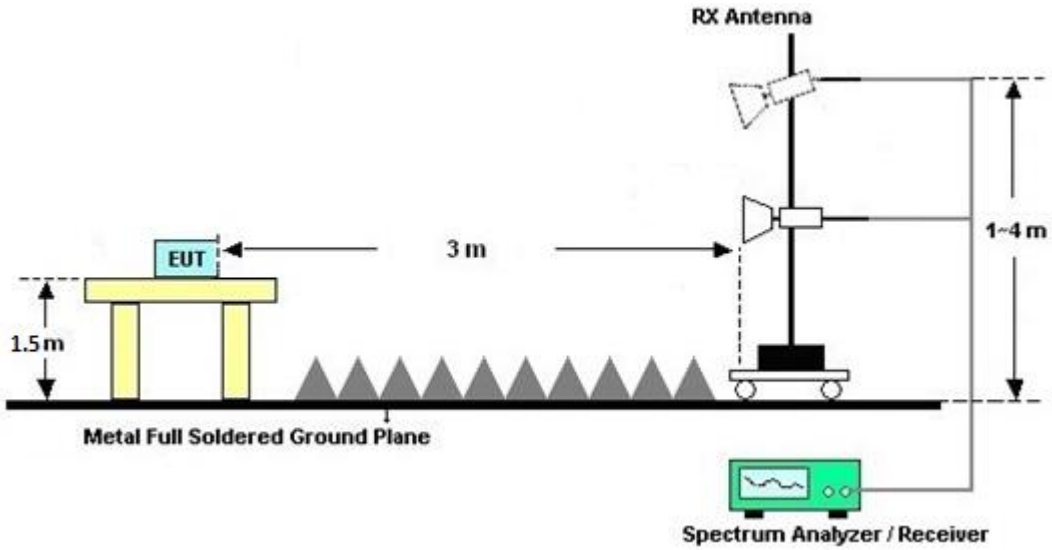
For radiated test below 30MHz



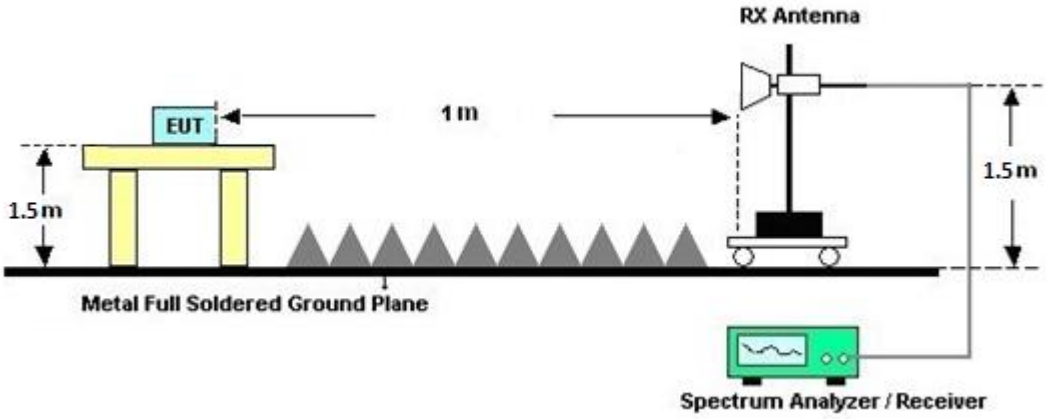
For radiated test from 30MHz to 1GHz



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

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 replaced 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 §§ 15.211, 15.213, 15.217, 15.219, 15.221, or § 15.236. 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 § 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.

3.6.2 Antenna Anti-Replacement Construction

Antenna permanently attached.

4 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Hygrometer	TECPEL	DTM-303A	TP201996	N/A	Nov. 07, 2023	Apr. 01, 2024~ Apr. 03, 2024	Nov. 06, 2024	Conducted (TH05-HY)
Power Meter	Anritsu	ML2495A	1036004	N/A	Jul. 27, 2023	Apr. 01, 2024~ Apr. 03, 2024	Jul. 26, 2024	Conducted (TH05-HY)
Power Sensor	Anritsu	MA2411B	1027253	300MHz~40GHz	Jul. 27, 2023	Apr. 01, 2024~ Apr. 03, 2024	Jul. 26, 2024	Conducted (TH05-HY)
Signal Analyzer	Rohde & Schwarz	FSV40	101566	10Hz~40GHz	Aug. 23, 2023	Apr. 01, 2024~ Apr. 03, 2024	Aug. 22, 2024	Conducted (TH05-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01N -06	35419 & 03	30MHz~1GHz	Apr. 23, 2023	Apr. 02, 2024~ Apr. 21, 2024	Apr. 22, 2024	Radiation (03CH07-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01N -06	35419 & 03	30MHz~1GHz	Apr. 22, 2024	Apr. 22, 2024~ Apr. 25, 2024	Apr. 21, 2025	Radiation (03CH07-HY)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00075962	1GHz ~ 18GHz	Nov. 27, 2023	Apr. 02, 2024~ Apr. 25, 2024	Nov. 26, 2024	Radiation (03CH07-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	Feb. 23, 2024	Apr. 02, 2024~ Apr. 25, 2024	Feb. 22, 2025	Radiation (03CH07-HY)
Preamplifier	MITEQ	AMF-7D-0010 1800-30-10P	1590075	1GHz~18GHz	Apr. 20, 2023	Apr. 02, 2024~ Apr. 18, 2024	Apr. 19, 2024	Radiation (03CH07-HY)
Preamplifier	MITEQ	AMF-7D-0010 1800-30-10P	1590075	1GHz~18GHz	Apr. 19, 2024	Apr. 19, 2024~ Apr. 25, 2024	Apr. 18, 2025	Radiation (03CH07-HY)
Preamplifier	COM-POWER	PA-103A	161241	10MHz~1GHz	Oct. 02, 2023	Apr. 02, 2024~ Apr. 25, 2024	Oct. 01, 2024	Radiation (03CH07-HY)
Preamplifier	Agilent	8449B	3008A02362	1GHz~26.5GHz	Mar. 23, 2024	Apr. 02, 2024~ Apr. 25, 2024	Mar. 22, 2025	Radiation (03CH07-HY)
Preamplifier	EMEC	EM18G40G	0600789	18-40GHz	Jul. 25, 2023	Apr. 02, 2024~ Apr. 25, 2024	Jul. 24, 2024	Radiation (03CH07-HY)
Spectrum Analyzer	Agilent	N9030A	MY52350276	3Hz~44GHz	Mar. 26, 2024	Apr. 02, 2024~ Apr. 25, 2024	Mar. 25, 2025	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY28655/4 MY24971/4 MY15682/4	30MHz to 18GHz	Feb. 21, 2024	Apr. 02, 2024~ Apr. 25, 2024	Feb. 20, 2025	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY28655/4 MY24971/4	9kHz to 30MHz	Feb. 21, 2024	Apr. 02, 2024~ Apr. 25, 2024	Feb. 20, 2025	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 126	532078/126E	30MHz~18GHz	Sep. 15, 2023	Apr. 02, 2024~ Apr. 25, 2024	Sep. 14, 2024	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY2858/2	18GHz~40GHz	Feb. 21, 2024	Apr. 02, 2024~ Apr. 25, 2024	Feb. 20, 2025	Radiation (03CH07-HY)
Controller	EMEC	EM1000	N/A	Control Ant Mast	N/A	Apr. 02, 2024~ Apr. 25, 2024	N/A	Radiation (03CH07-HY)
Controller	MF	MF-7802	N/A	Control Turn table	N/A	Apr. 02, 2024~ Apr. 25, 2024	N/A	Radiation (03CH07-HY)
Antenna Mast	EMEC	AM-BS-4500E	N/A	Boresight mast 1M~4M	N/A	Apr. 02, 2024~ Apr. 25, 2024	N/A	Radiation (03CH07-HY)
Turn Table	ChainTek	Chaintek 3000	N/A	0~360 Degree	N/A	Apr. 02, 2024~ Apr. 25, 2024	N/A	Radiation (03CH07-HY)
Software	Audix	E3	N/A	N/A	N/A	Apr. 02, 2024~ Apr. 25, 2024	N/A	Radiation (03CH07-HY)
USB Data Logger	TECPEL	TR-32	HE17XB2495	N/A	Mar. 01, 2024	Apr. 02, 2024~ Apr. 25, 2024	Feb. 28, 2025	Radiation (03CH07-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170251	18GHz~40GHz	Nov. 24, 2023	Apr. 02, 2024~ Apr. 25, 2024	Nov. 23, 2024	Radiation (03CH07-HY)

5 Measurement Uncertainty

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**6.3 dB**

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 6000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.6 dB**

Uncertainty of Radiated Emission Measurement (6000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.3 dB**

Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.3 dB**

Appendix A. Test Result of Conducted Test Items

Test Engineer:	Shiming Liu	Temperature:	21~25	°C
Test Date:	2024/4/1~2024/4/3	Relative Humidity:	51~54	%

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	1.005	0.666	0.50	Pass
BLE	1Mbps	1	19	2440	1.013	0.671	0.50	Pass
BLE	1Mbps	1	39	2480	1.011	0.668	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	3.79	30.00	4.00	7.79	36.00	Pass
BLE	1Mbps	1	19	2440	3.97	30.00	4.00	7.97	36.00	Pass
BLE	1Mbps	1	39	2480	3.45	30.00	4.00	7.45	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	3.09	-11.67	4.00	8.00	Pass
BLE	1Mbps	1	19	2440	3.08	-11.79	4.00	8.00	Pass
BLE	1Mbps	1	39	2480	2.75	-11.79	4.00	8.00	Pass

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

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	2Mbps	1	0	2402	2.026	1.135	0.50	Pass
BLE	2Mbps	1	19	2440	2.034	1.131	0.50	Pass
BLE	2Mbps	1	39	2480	2.034	1.132	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	2Mbps	1	0	2402	3.81	30.00	4.00	7.81	36.00	Pass
BLE	2Mbps	1	19	2440	4.01	30.00	4.00	8.01	36.00	Pass
BLE	2Mbps	1	39	2480	3.47	30.00	4.00	7.47	36.00	Pass

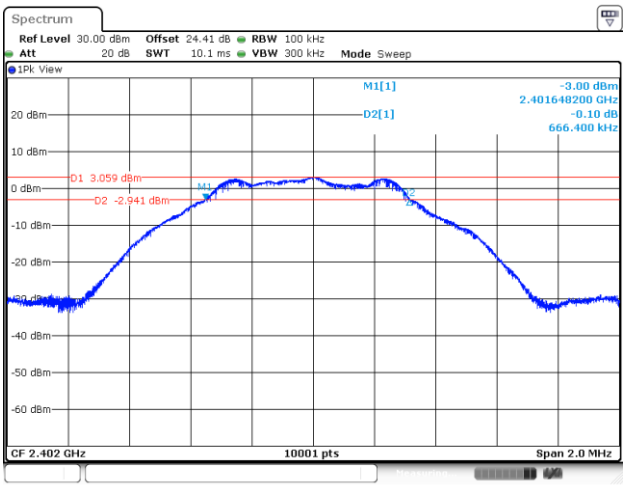
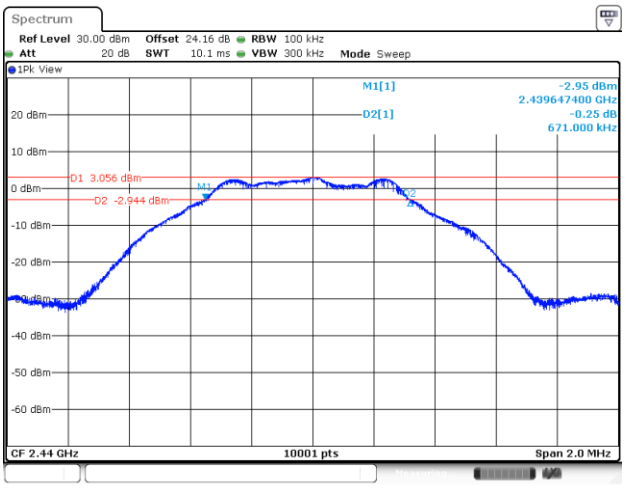
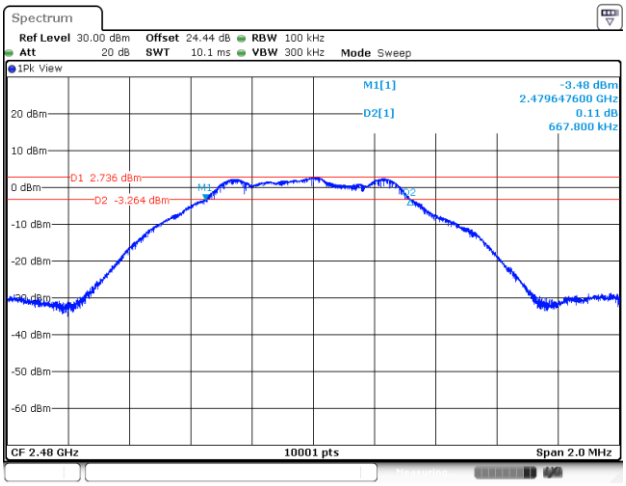
TEST RESULTS DATA
Peak Power Density

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	2Mbps	1	0	2402	2.95	-15.05	4.00	8.00	Pass
BLE	2Mbps	1	19	2440	3.01	-15.24	4.00	8.00	Pass
BLE	2Mbps	1	39	2480	2.68	-15.45	4.00	8.00	Pass

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

6dB Bandwidth

<1Mbps>

6 dB Bandwidth Plot on Channel 00	6 dB Bandwidth Plot on Channel 19
	
6 dB Bandwidth Plot on Channel 39	
	

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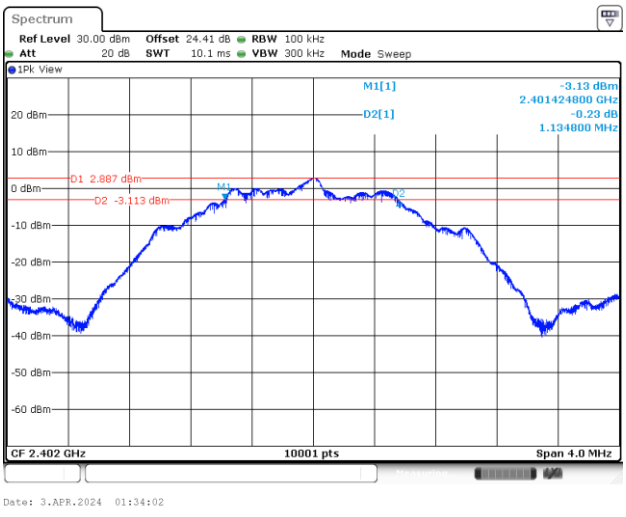
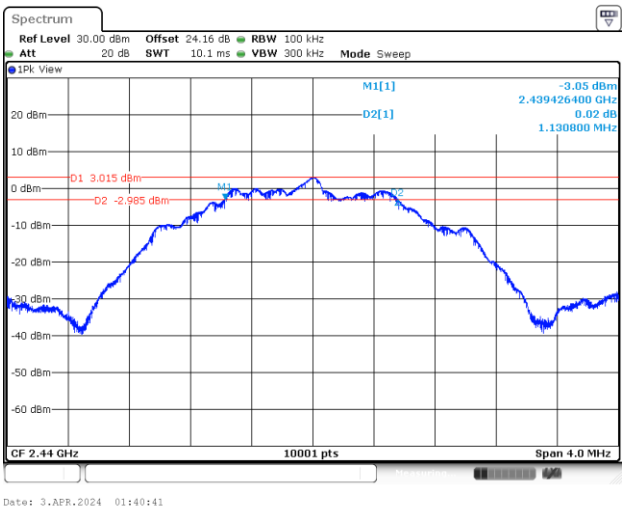
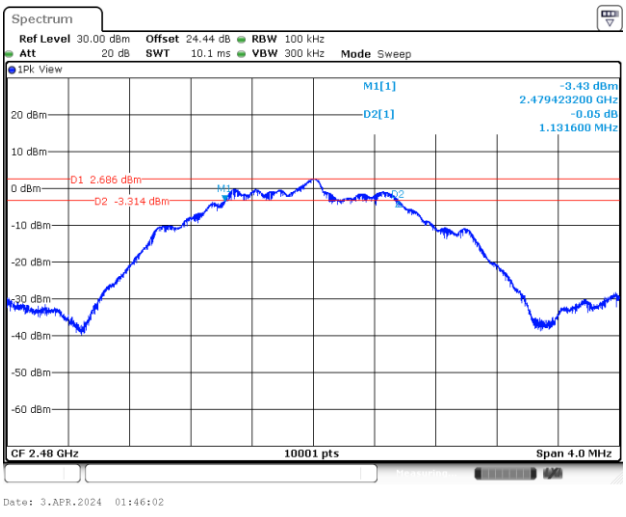
6 dB Bandwidth Plot on Channel 00	6 dB Bandwidth Plot on Channel 19
	
6 dB Bandwidth Plot on Channel 39	
	

99% Occupied Bandwidth

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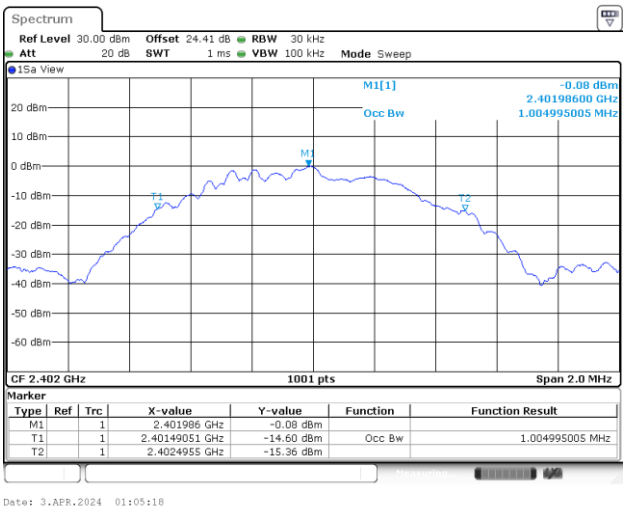
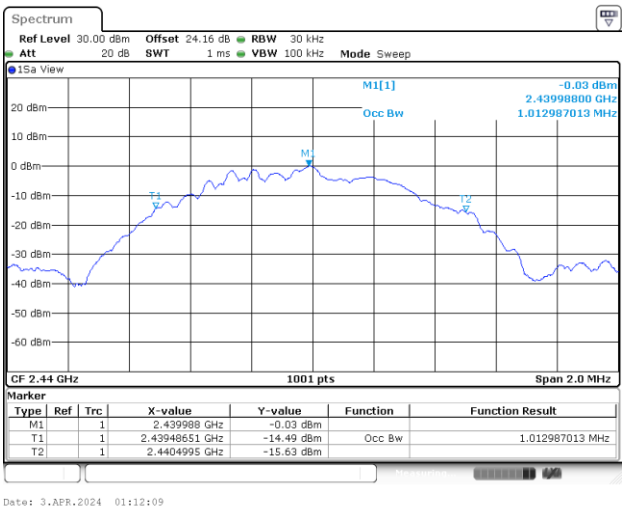
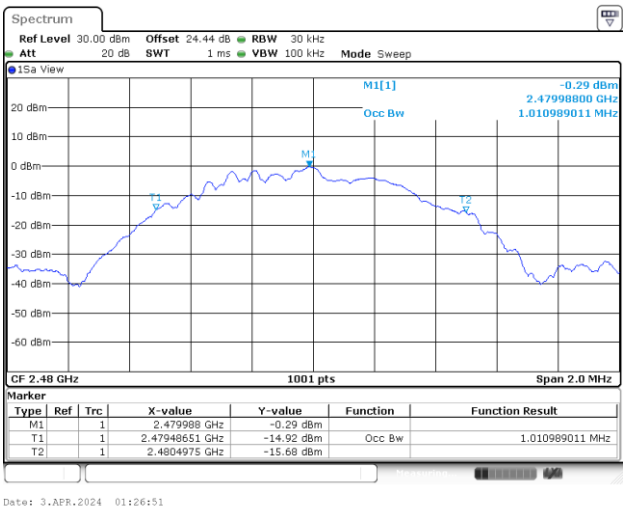
99% Occupied Bandwidth Plot on Channel 00	99% Occupied Bandwidth Plot on Channel 19
	
99% Occupied Bandwidth Plot on Channel 39	
	

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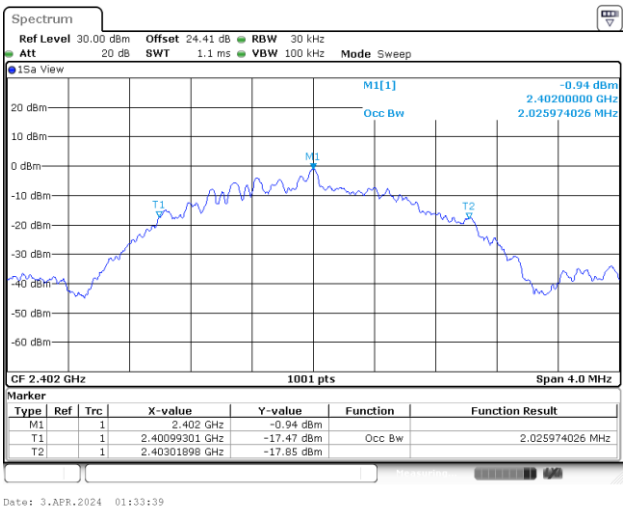
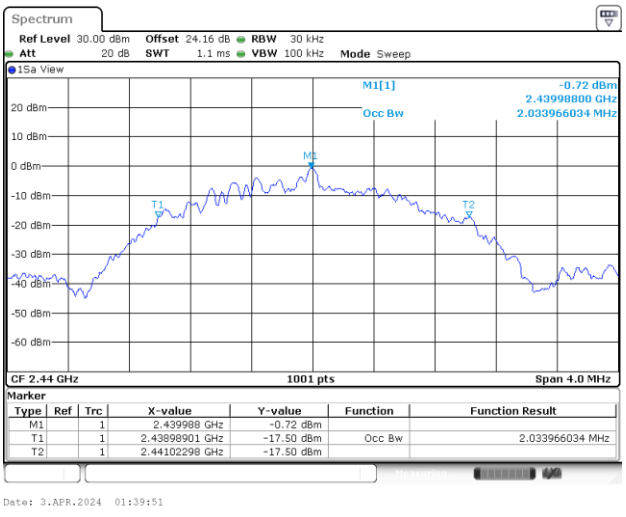
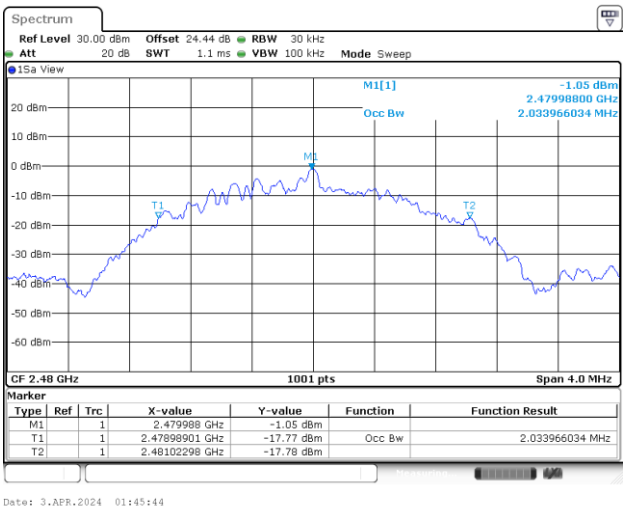
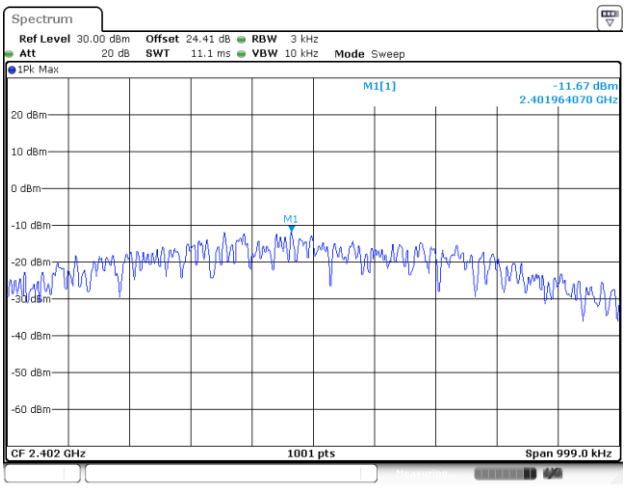
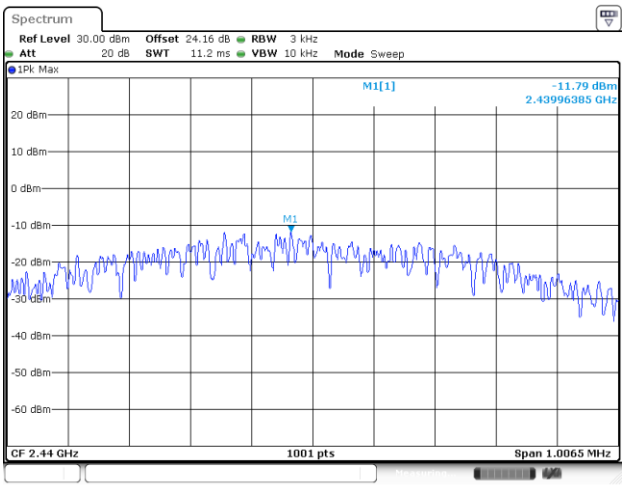
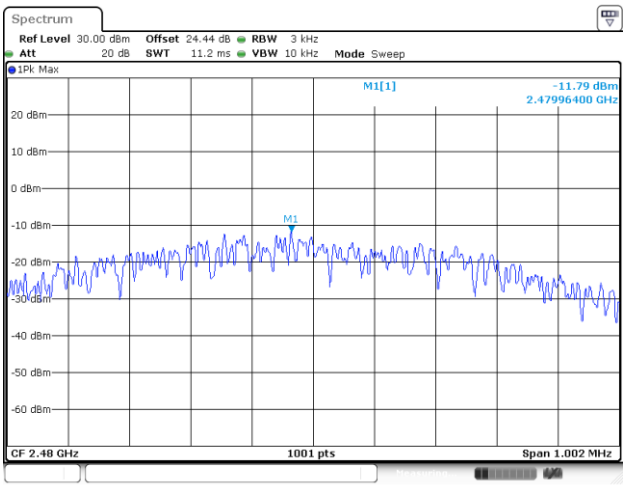
99% Occupied Bandwidth Plot on Channel 00	99% Occupied Bandwidth Plot on Channel 19
	
99% Occupied Bandwidth Plot on Channel 39	
	

Power Spectral Density (dBm/3kHz)

<1Mbps>

Power Density (dBm/3kHz) Plot Channel 00	Power Density (dBm/3kHz) Plot Channel 19
	
Power Density (dBm/3kHz) Plot Channel 39	
	

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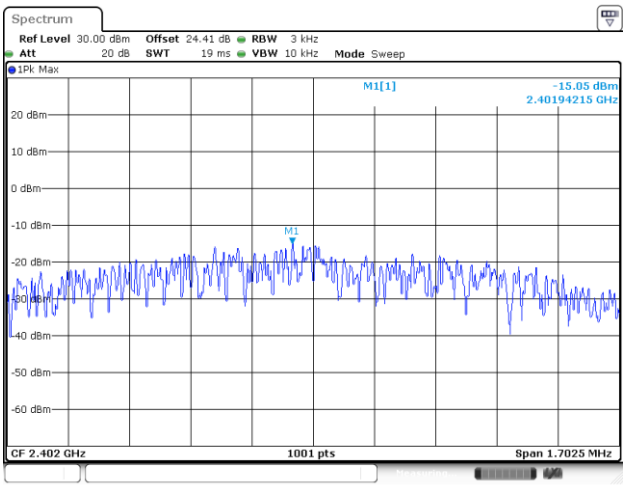
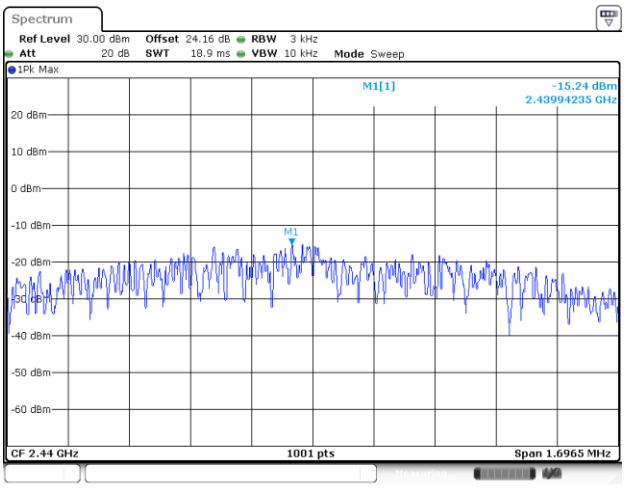
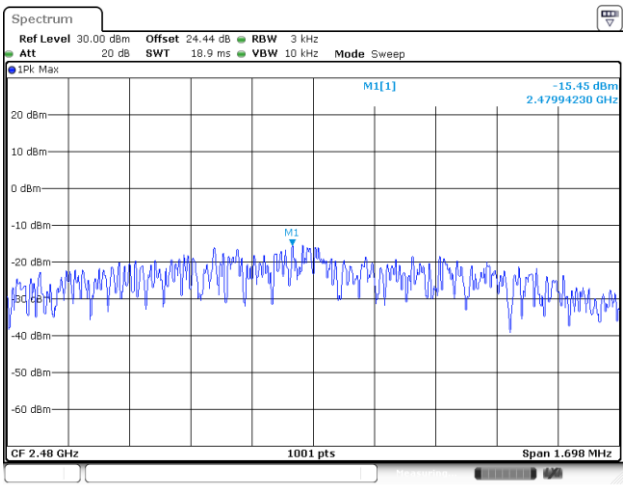
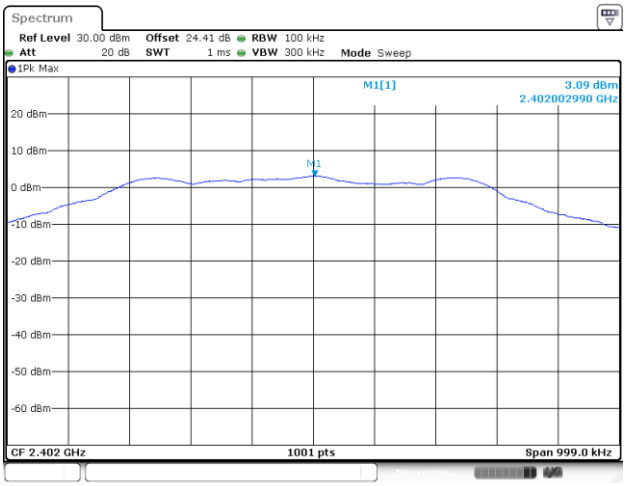
Power Density (dBm/3kHz) Plot Channel 00	Power Density (dBm/3kHz) Plot Channel 19
	
Power Density (dBm/3kHz) Plot Channel 39	
	

Band Edge and Conducted Spurious Emission

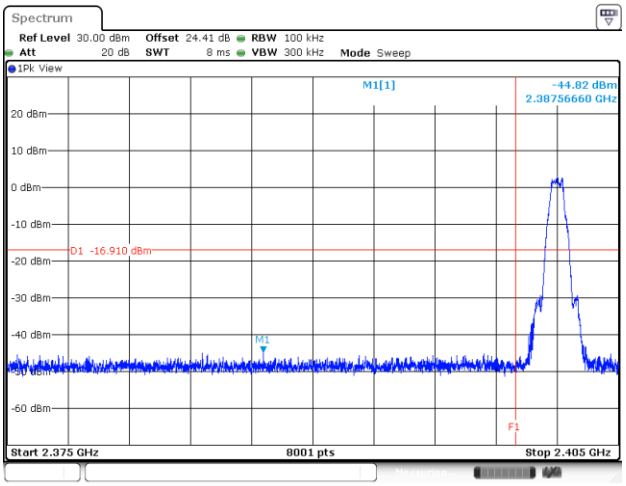
<1Mbps>

Channel 00

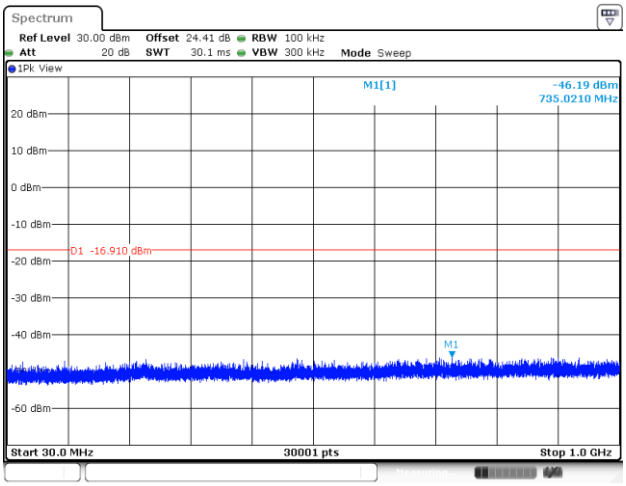
100kHz PSD reference Level Plot



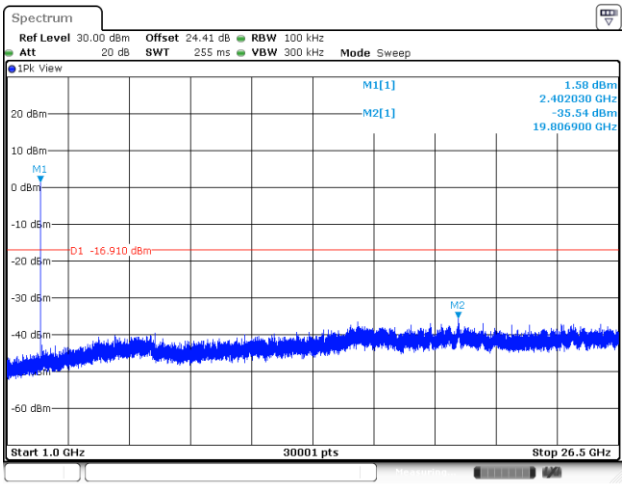
Low Channel Plot

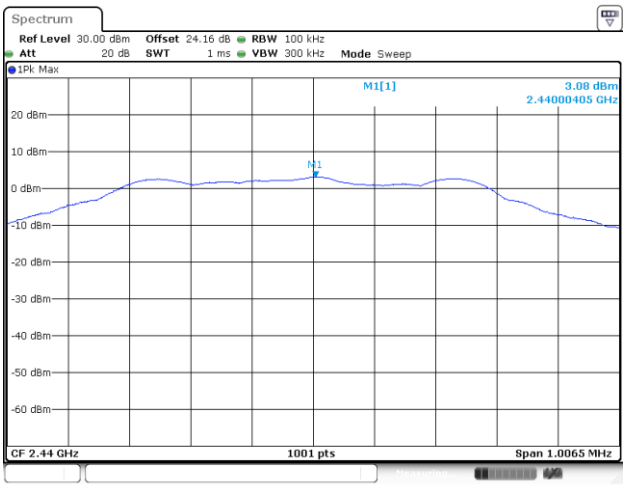
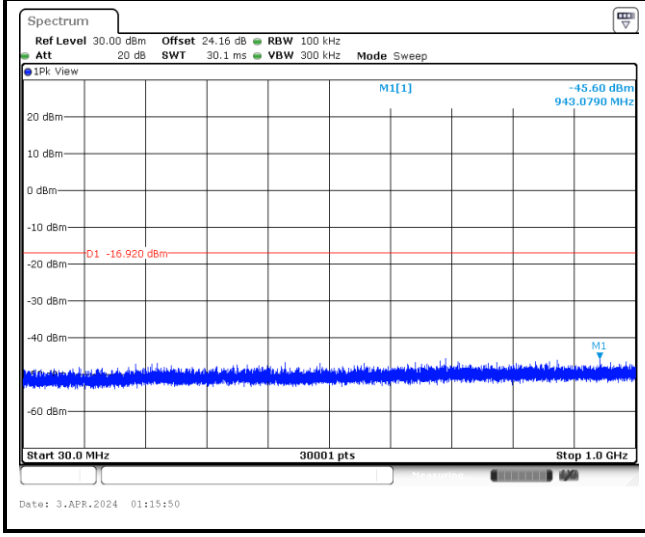
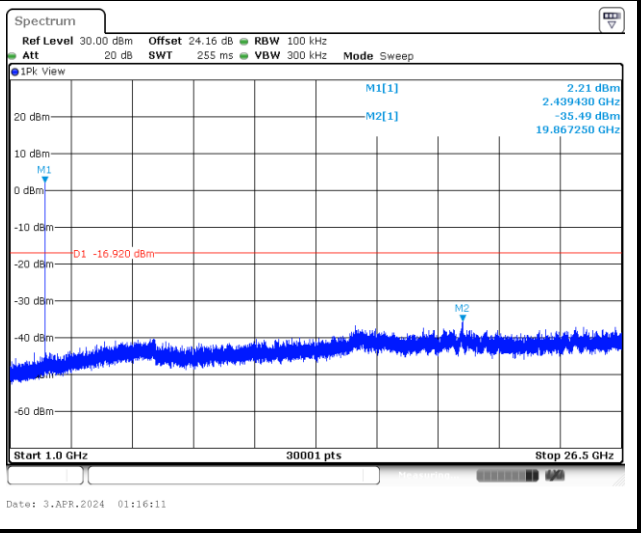


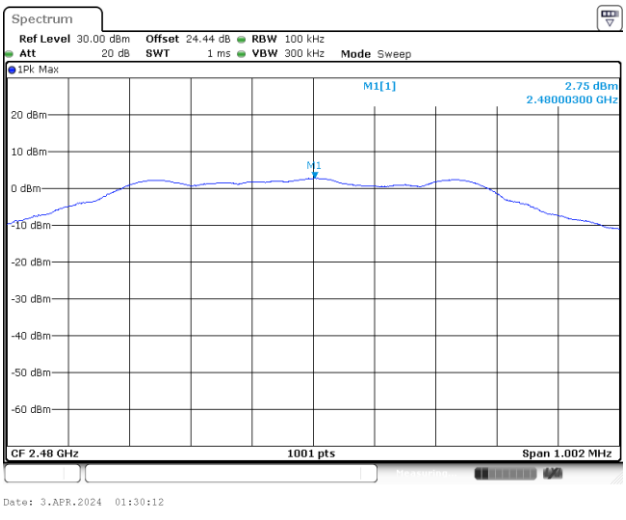
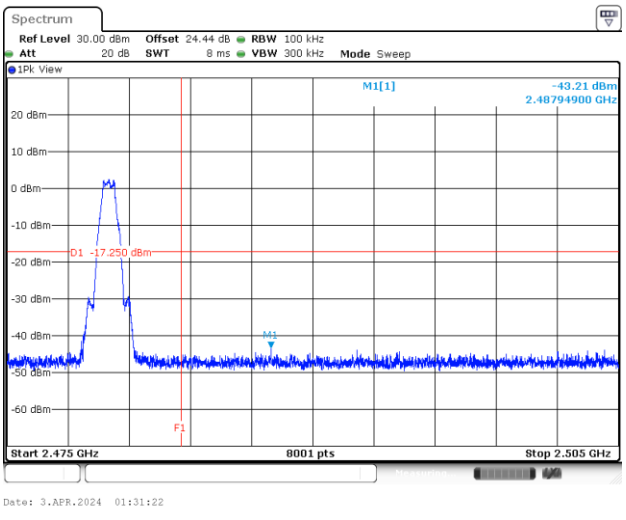
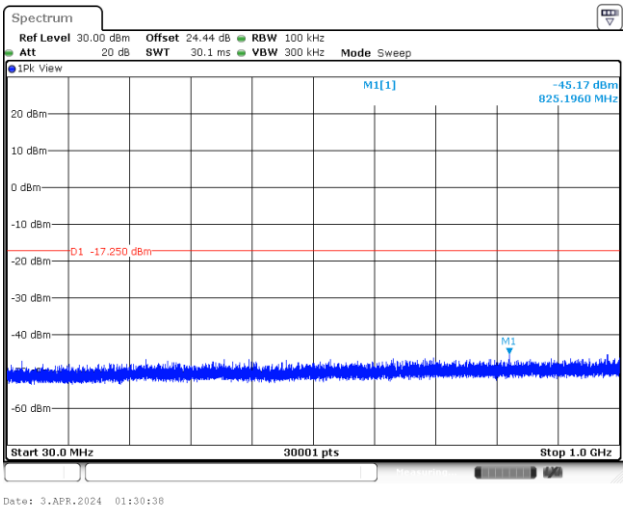
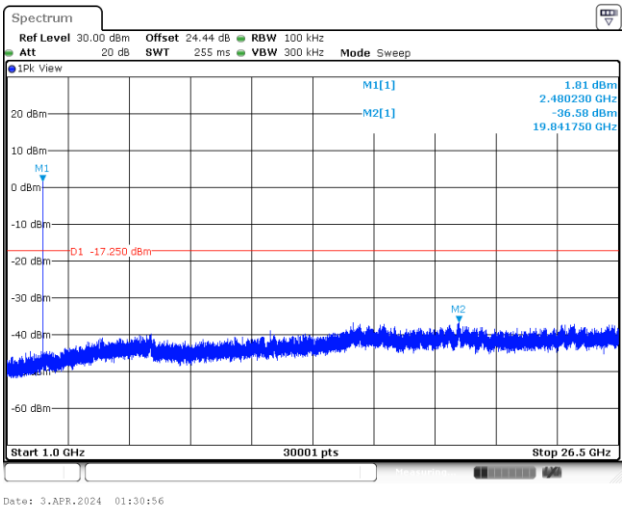
Spurious Emission 30MHz~1GHz Plot



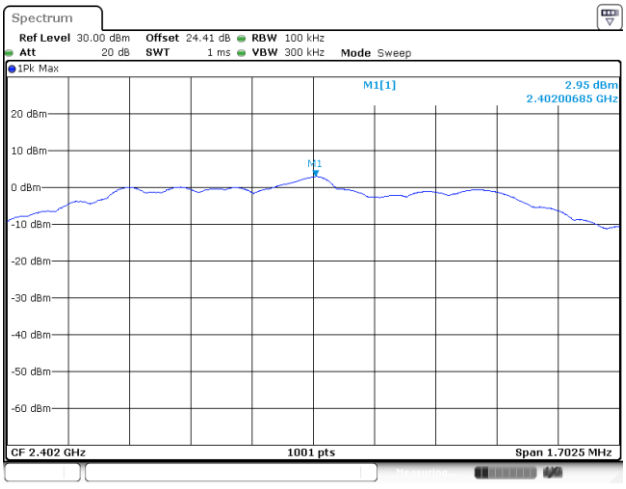
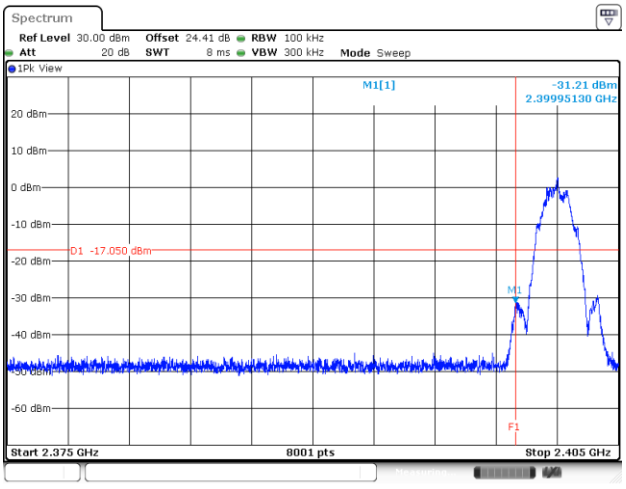
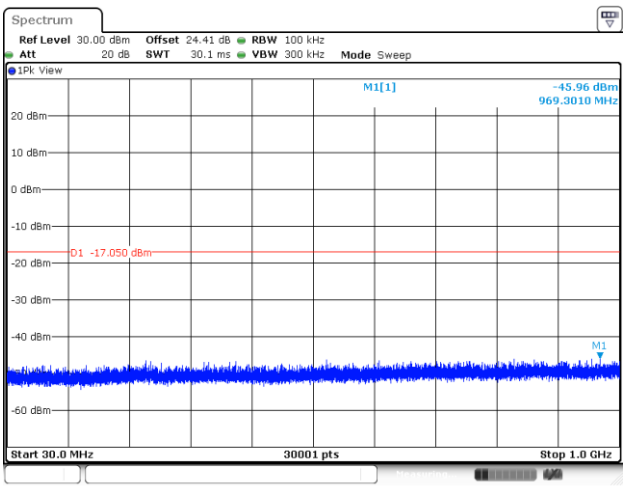
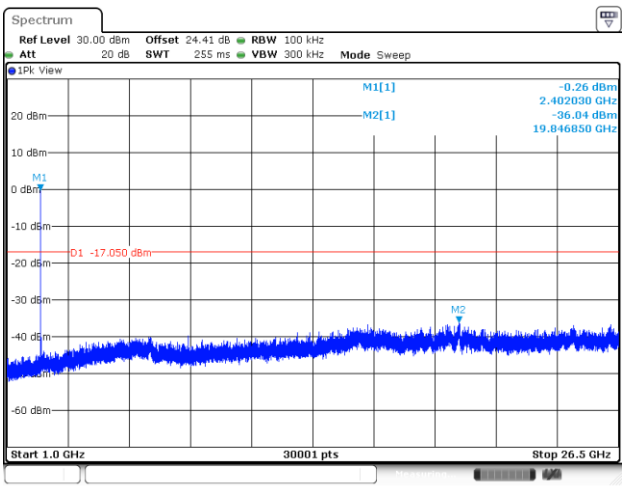
Spurious Emission 1GHz~26.5GHz Plot

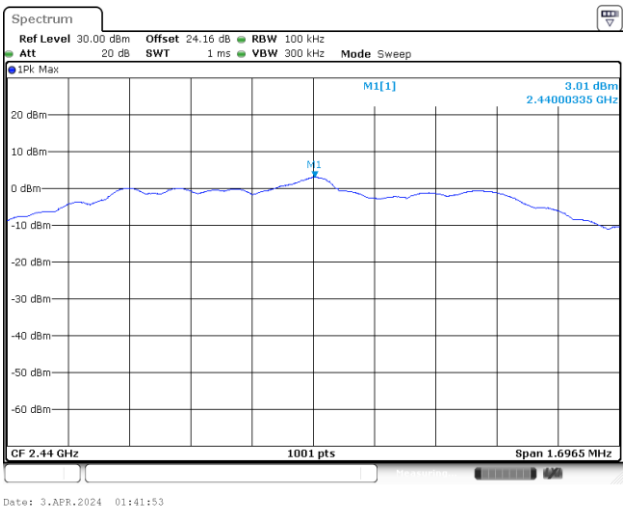
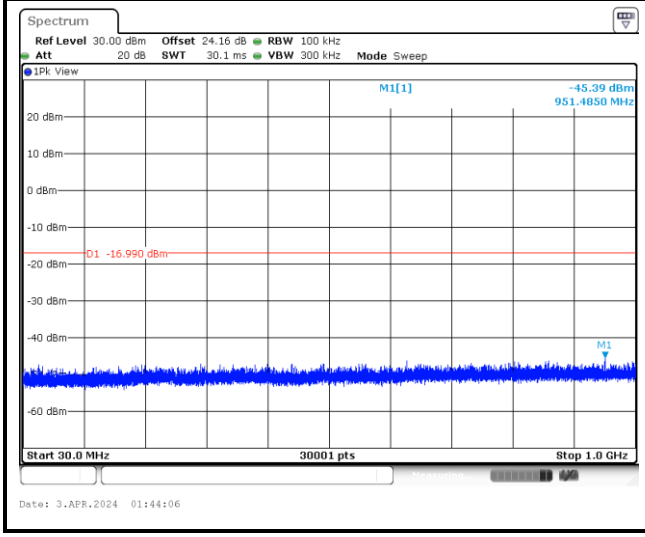
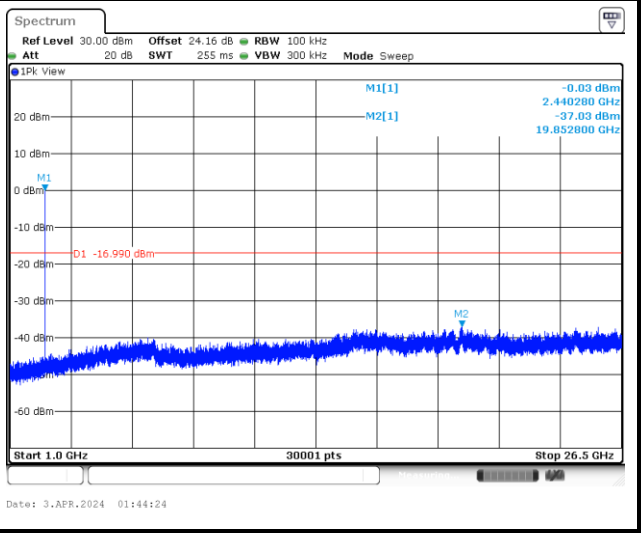


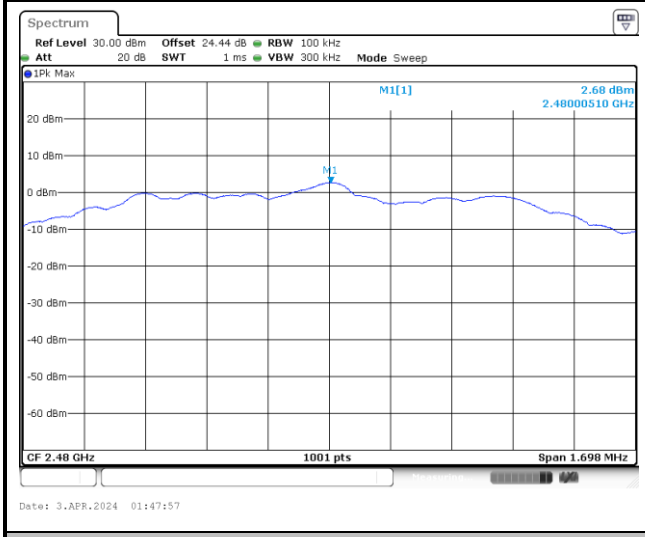
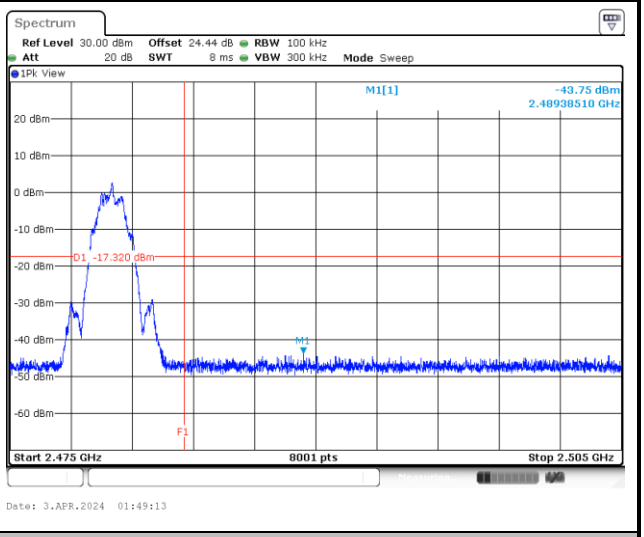
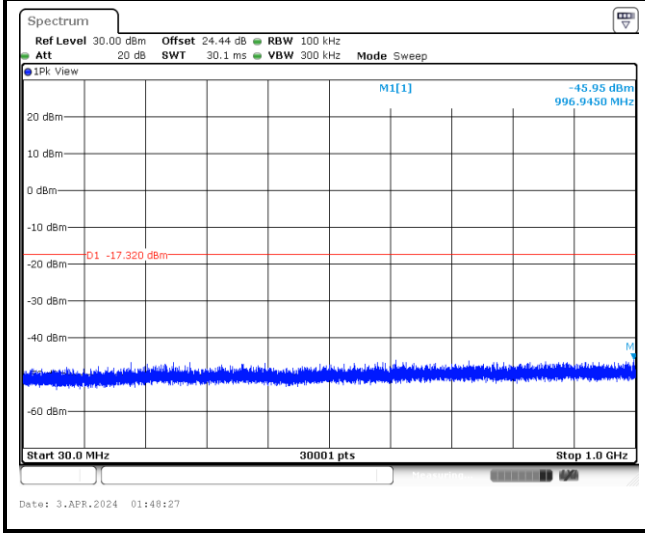
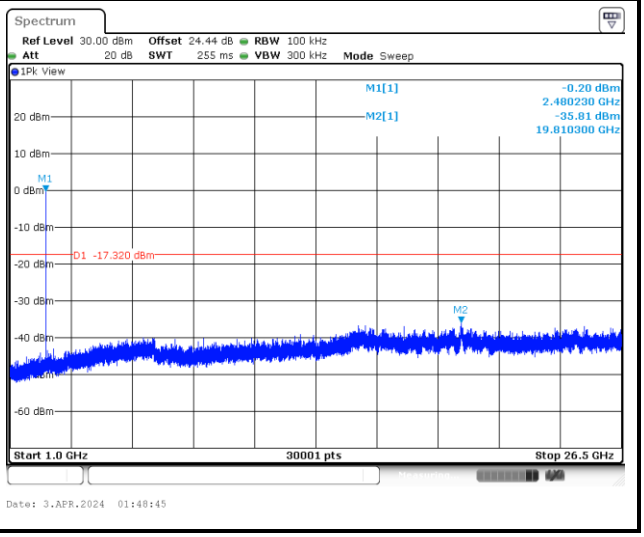
Channel 19	
100kHz PSD reference Level Plot	**Mid Channel Plot**
	
Spurious Emission 30MHz~1GHz Plot	**Spurious Emission 1GHz~26.5GHz Plot**
	

Channel 39	
100kHz PSD reference Level Plot	**High Channel Plot**
	
Spurious Emission 30MHz~1GHz Plot	**Spurious Emission 1GHz~26.5GHz Plot**
	

<2Mbps>

Channel 00	
100kHz PSD reference Level Plot	**Low Channel Plot**
	
Spurious Emission 30MHz~1GHz Plot	**Spurious Emission 1GHz~26.5GHz Plot**
	

Channel 19	
100kHz PSD reference Level Plot	**Mid Channel Plot**
	
Spurious Emission 30MHz~1GHz Plot	**Spurious Emission 1GHz~26.5GHz Plot**
	

Channel 39	
100kHz PSD reference Level Plot	**High Channel Plot**
	
Spurious Emission 30MHz~1GHz Plot	**Spurious Emission 1GHz~26.5GHz Plot**
	

Appendix B. Radiated Spurious Emission

Test Engineer :	Stan Hsieh, Ken Wu, and Jesse Wang	Temperature :	20.7~24.5°C
		Relative Humidity :	57.3~69.4%

<1Mbps>

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)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 00 2402MHz		2390	53.86	-20.14	74	37.83	32	18.35	34.32	263	317	P	H
		2333.94	45.11	-8.89	54	29.09	32.1	18.26	34.34	263	317	A	H
	*	2402	96.38	-	-	80.32	32	18.37	34.31	263	317	P	H
	*	2402	95.84	-	-	79.78	32	18.37	34.31	263	317	A	H
													H
		2327.22	54.12	-19.88	74	38.12	32.1	18.25	34.35	332	277	P	V
		2343.915	45.03	-8.97	54	29	32.1	18.27	34.34	332	277	A	V
	*	2402	95.29	-	-	79.23	32	18.37	34.31	332	277	P	V
	*	2402	94.14	-	-	78.08	32	18.37	34.31	332	277	A	V
													V
BLE CH 19 2440MHz		2376.22	54.2	-19.8	74	38.29	31.9	18.33	34.32	199	320	P	H
		2383.78	45.23	-8.77	54	29.27	31.94	18.34	34.32	199	320	A	H
	*	2440	95.96	-	-	79.9	31.9	18.46	34.3	199	320	P	H
	*	2440	95.52	-	-	79.46	31.9	18.46	34.3	199	320	A	H
		2499.37	54.15	-19.85	74	37.55	32.29	18.58	34.27	199	320	P	H
		2497.48	45.41	-8.59	54	28.83	32.27	18.58	34.27	199	320	A	H
		2328.9	53.91	-20.09	74	37.91	32.1	18.25	34.35	359	280	P	V
		2341.64	44.9	-9.1	54	28.87	32.1	18.27	34.34	359	280	A	V
	*	2440	94.55	-	-	78.49	31.9	18.46	34.3	359	280	P	V
	*	2440	93.96	-	-	77.9	31.9	18.46	34.3	359	280	A	V
		2490.06	54.3	-19.7	74	37.81	32.2	18.56	34.27	359	280	P	V
		2497.41	45.64	-8.36	54	29.06	32.27	18.58	34.27	359	280	A	V

BLE CH 39 2480MHz	*	2480	95.67	-	-	79.31	32.1	18.54	34.28	246	324	P	H
	*	2480	93.98	-	-	77.62	32.1	18.54	34.28	246	324	A	H
		2499.48	54.53	-19.47	74	37.93	32.29	18.58	34.27	246	324	P	H
		2484.08	45.62	-8.38	54	29.22	32.14	18.54	34.28	246	324	A	H
													H
													H
	*	2480	93.69	-	-	77.33	32.1	18.54	34.28	311	272	P	V
	*	2480	93.13	-	-	76.77	32.1	18.54	34.28	311	272	A	V
		2494.24	54.89	-19.11	74	38.35	32.24	18.57	34.27	311	272	P	V
		2494.64	45.65	-8.35	54	29.1	32.25	18.57	34.27	311	272	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 (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	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	48.7	-25.3	74	60.62	34.2	13.07	59.19	212	135	P	H
		4804	44.97	-9.03	54	56.89	34.2	13.07	59.19	212	135	A	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
		4804	41.64	-32.36	74	53.56	34.2	13.07	59.19	-	-	P	V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V

BLE	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
		4880	48.21	-25.79	74	59.9	34.26	13.07	59.02	218	128	P	H
		4880	44.36	-9.64	54	56.05	34.26	13.07	59.02	218	128	A	H
		7320	56.05	-17.95	74	62.7	35.8	15.29	57.74	136	215	P	H
		7320	52.61	-1.39	54	59.26	35.8	15.29	57.74	136	215	A	H
													H
													H
													H
													H
													H
													H
													H
BLE CH 19 2440MHz		4880	44.81	-29.19	74	56.5	34.26	13.07	59.02	400	277	P	V
		4880	38.11	-15.89	54	49.8	34.26	13.07	59.02	400	277	A	V
		7320	50.94	-23.06	74	57.59	35.8	15.29	57.74	162	225	P	V
		7320	46.24	-7.76	54	52.89	35.8	15.29	57.74	162	225	A	V
													V
													V
													V
													V
													V
													V
													V
													V

BLE	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	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	47.58	-26.42	74	58.95	34.4	13.07	58.84	185	142	P	H
		4960	42.96	-11.04	54	54.33	34.4	13.07	58.84	185	142	A	H
		7440	53.38	-20.62	74	60.2	35.62	15.45	57.89	139	223	P	H
		7440	49.28	-4.72	54	56.1	35.62	15.45	57.89	139	223	A	H
													H
													H
													H
													H
													H
													H
													H
		4960	43.83	-30.17	74	55.2	34.4	13.07	58.84	173	165	P	V
		4960	36.73	-17.27	54	48.1	34.4	13.07	58.84	173	165	A	V
		7440	48.6	-25.4	74	55.42	35.62	15.45	57.89	180	224	P	V
		7440	43.28	-10.72	54	50.1	35.62	15.45	57.89	180	224	A	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.

Emission above 18GHz

2.4GHz BLE (SHF)

BT	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
					Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz BLE SHF		24874	37.72	-36.28	74	47.7	39.15	8.37	57.5	-	-	P	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
		24874	37.9	-36.1	74	47.88	39.15	8.37	57.5	-	-	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 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	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz BLE LF		30.27	23	-17	40	27.44	24.39	1.11	29.94	-	-	P	H
		152.04	21.96	-21.54	43.5	32.39	16.93	2.48	29.84	-	-	P	H
		265.71	21.53	-24.47	46	28.61	19.64	3.1	29.82	-	-	P	H
		794.9	31.07	-14.93	46	27.27	27.85	5.25	29.3	-	-	P	H
		855.8	32.8	-13.2	46	27.55	28.89	5.49	29.13	-	-	P	H
		931.4	34.4	-11.6	46	28.14	29.27	5.73	28.74	-	-	P	H
													H
													H
													H
													H
													H
													H
		30	32.85	-7.15	40	37.17	24.51	1.11	29.94	-	-	P	V
		91.02	19.69	-23.81	43.5	32.89	14.72	1.99	29.91	-	-	P	V
		152.04	20.43	-23.07	43.5	30.86	16.93	2.48	29.84	-	-	P	V
		741.7	31.51	-14.49	46	28.42	27.53	5.06	29.5	-	-	P	V
		894.3	34.94	-11.06	46	29.58	28.59	5.65	28.88	-	-	P	V
		965.7	34.66	-19.34	54	26.57	30.79	5.83	28.53	-	-	P	V
													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 emission is noise floor only.

<2Mbps>

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)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 00 2402MHz		2385.285	54.69	-19.31	74	38.72	31.95	18.34	34.32	263	317	P	H
		2379.09	45.76	-8.24	54	29.85	31.9	18.33	34.32	263	317	A	H
	*	2402	96.36	-	-	80.3	32	18.37	34.31	263	317	P	H
	*	2402	95.09	-	-	79.03	32	18.37	34.31	263	317	A	H
													H
													H
		2363.97	54.11	-19.89	74	38.17	31.96	18.31	34.33	332	277	P	V
		2341.92	45.57	-8.43	54	29.54	32.1	18.27	34.34	332	277	A	V
	*	2402	95.33	-	-	79.27	32	18.37	34.31	332	277	P	V
	*	2402	93.84	-	-	77.78	32	18.37	34.31	332	277	A	V
													V
													V
BLE CH 19 2440MHz		2330.72	53.92	-20.08	74	37.91	32.1	18.25	34.34	199	320	P	H
		2359.42	45.52	-8.48	54	29.54	32.01	18.3	34.33	199	320	A	H
	*	2440	96.06	-	-	80	31.9	18.46	34.3	199	320	P	H
	*	2440	94.62	-	-	78.56	31.9	18.46	34.3	199	320	A	H
		2490.97	53.95	-20.05	74	37.45	32.21	18.56	34.27	199	320	P	H
		2498.53	46.21	-7.79	54	29.61	32.29	18.58	34.27	199	320	A	H
		2360.26	53.55	-20.45	74	37.58	32	18.3	34.33	359	280	P	V
		2370.2	45.74	-8.26	54	29.85	31.9	18.32	34.33	359	280	A	V
	*	2440	94.45	-	-	78.39	31.9	18.46	34.3	359	280	P	V
	*	2440	93.22	-	-	77.16	31.9	18.46	34.3	359	280	A	V
		2485.93	55.59	-18.41	74	39.16	32.16	18.55	34.28	359	280	P	V
		2495.52	46.09	-7.91	54	29.53	32.26	18.57	34.27	359	280	A	V

BLE CH 39 2480MHz	*	2480	95.72	-	-	79.36	32.1	18.54	34.28	246	324	P	H
	*	2480	94.26	-	-	77.9	32.1	18.54	34.28	246	324	A	H
		2484.56	55.47	-18.53	74	39.06	32.15	18.54	34.28	246	324	P	H
		2493.04	46.13	-7.87	54	29.6	32.23	18.57	34.27	246	324	A	H
													H
													H
	*	2480	93.69	-	-	77.33	32.1	18.54	34.28	311	272	P	V
	*	2480	92.42	-	-	76.06	32.1	18.54	34.28	311	272	A	V
		2484.48	54.37	-19.63	74	37.97	32.14	18.54	34.28	311	272	P	V
		2484.08	45.98	-8.02	54	29.58	32.14	18.54	34.28	311	272	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 (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	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	48.04	-25.96	74	59.96	34.2	13.07	59.19	212	135	P	H
		4804	43.13	-10.87	54	55.05	34.2	13.07	59.19	212	135	A	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
		4804	41.57	-32.43	74	53.49	34.2	13.07	59.19	-	-	P	V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V

BLE	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
		4880	47.87	-26.13	74	59.56	34.26	13.07	59.02	218	128	P	H
		4880	42.51	-11.49	54	54.2	34.26	13.07	59.02	218	128	A	H
		7320	55.91	-18.09	74	62.56	35.8	15.29	57.74	136	215	P	H
		7320	51.59	-2.41	54	58.24	35.8	15.29	57.74	136	215	A	H
													H
													H
													H
													H
													H
													H
													H
BLE CH 19 2440MHz		4880	42.5	-31.5	74	54.19	34.26	13.07	59.02	-	-	P	V
		7320	50.72	-23.28	74	57.37	35.8	15.29	57.74	162	225	P	V
		7320	45.39	-8.61	54	52.04	35.8	15.29	57.74	162	225	A	V
													V
													V
													V
													V
													V
													V
													V
													V
													V

BLE	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
		4960	47.29	-26.71	74	58.66	34.4	13.07	58.84	185	144	P	H
		4960	42.33	-11.67	54	53.7	34.4	13.07	58.84	185	144	A	H
		7440	53.9	-20.1	74	60.72	35.62	15.45	57.89	100	230	P	H
		7440	48.82	-5.18	54	55.64	35.62	15.45	57.89	100	230	A	H
													H
													H
													H
													H
													H
													H
													H
BLE CH 39 2480MHz		4960	42.43	-31.57	74	53.8	34.4	13.07	58.84	100	197	P	V
		4960	36.23	-17.77	54	47.6	34.4	13.07	58.84	100	197	A	V
		7440	48.83	-25.17	74	55.65	35.62	15.45	57.89	188	233	P	V
		7440	42.66	-11.34	54	49.48	35.62	15.45	57.89	188	233	A	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.

Emission above 18GHz

2.4GHz BLE (SHF)

BT	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
					Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz BLE SHF		21045	37.42	-36.58	74	53.52	37.92	6.04	60.06	-	-	P	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
		21339	37.94	-36.06	74	53.75	37.81	6.21	59.83	-	-	P	V
													V
													V
													V
													V
													V
													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 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	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz BLE LF		30	22.42	-17.58	40	26.74	24.51	1.11	29.94	-	-	P	H
		152.04	20.39	-23.11	43.5	30.82	16.93	2.48	29.84	-	-	P	H
		258.96	22.42	-23.58	46	29.78	19.4	3.06	29.82	-	-	P	H
		698.3	28.11	-17.89	46	26.66	26.16	4.89	29.6	-	-	P	H
		879.6	32.46	-13.54	46	27.26	28.59	5.58	28.97	-	-	P	H
		956.6	34.41	-11.59	46	26.61	30.63	5.79	28.62	-	-	P	H
													H
													H
													H
													H
													H
													H
		30	32.32	-7.68	40	36.64	24.51	1.11	29.94	-	-	P	V
		152.04	20.39	-23.11	43.5	30.82	16.93	2.48	29.84	-	-	P	V
		253.56	22.25	-23.75	46	30.36	18.68	3.03	29.82	-	-	P	V
		709.5	32.37	-13.63	46	30.73	26.28	4.94	29.58	-	-	P	V
		885.9	32.99	-13.01	46	27.66	28.64	5.62	28.93	-	-	P	V
		957.3	34.21	-11.79	46	26.39	30.64	5.79	28.61	-	-	P	V
													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 emission is 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	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

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)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(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(dBμV/m) =

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

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

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

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

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

= 55.45 (dBμV/m)

2. Margin (dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

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

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

= 43.54 (dBμV/m)

2. Margin (dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/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 :	Stan Hsieh, Ken Wu, and Jesse Wang	**Temperature :**	20.7~24.5°C
		Relative Humidity :	57.3~69.4%

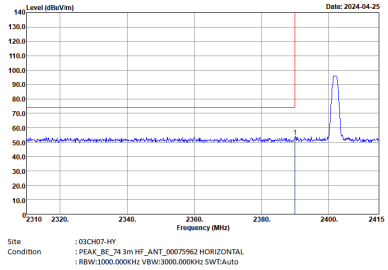
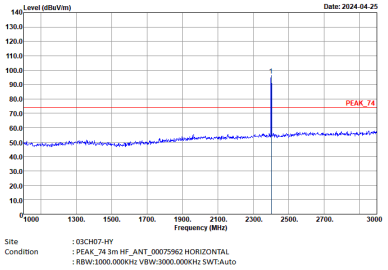
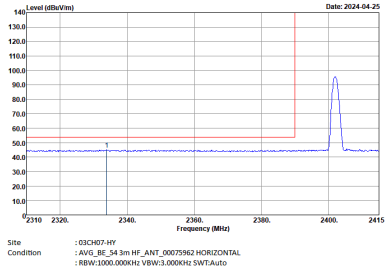
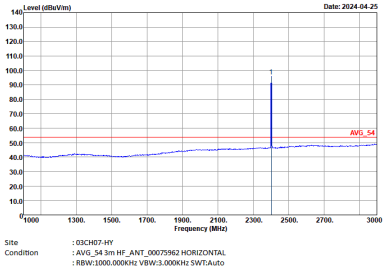
Note symbol

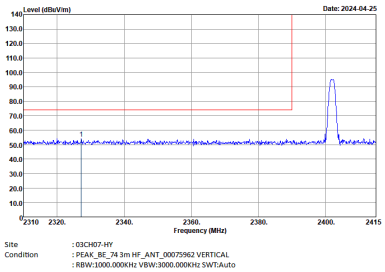
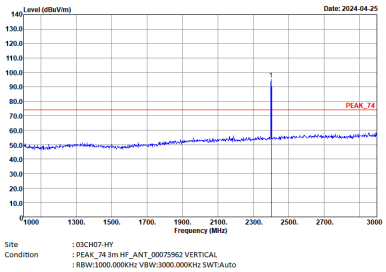
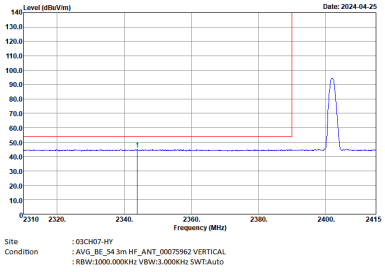
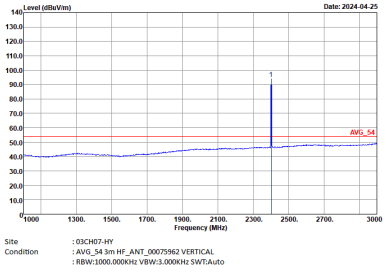
-L	**Low channel location**
-R	**High channel location**

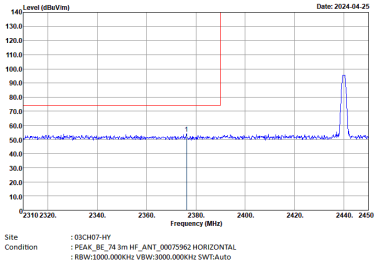
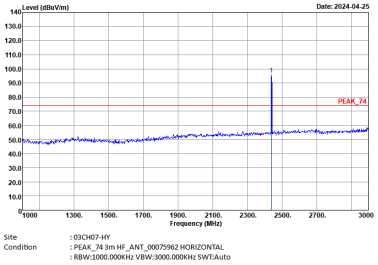
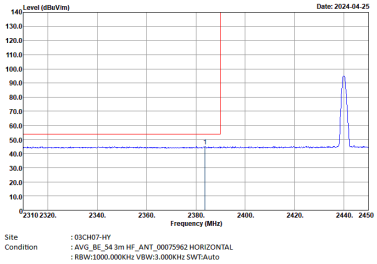
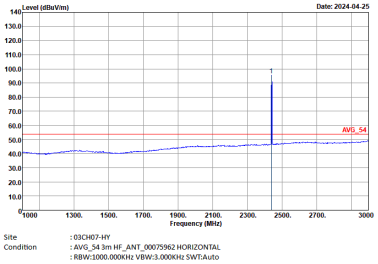
<1Mbps>

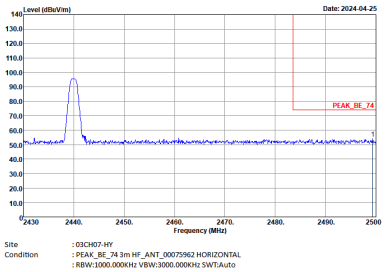
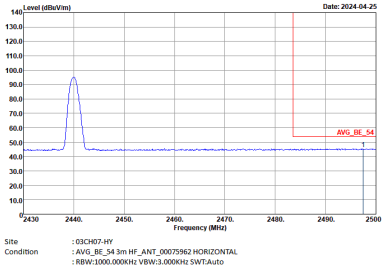
2.4GHz 2400~2483.5MHz

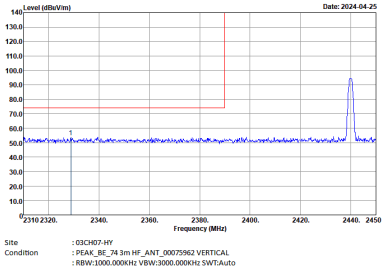
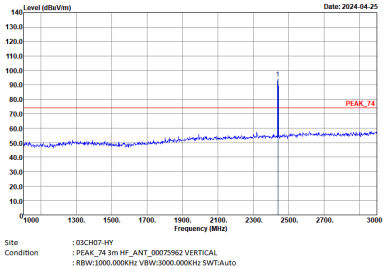
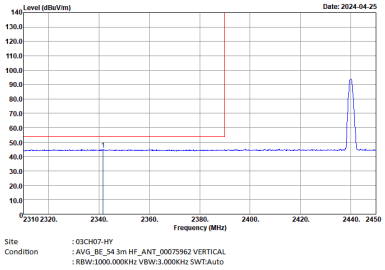
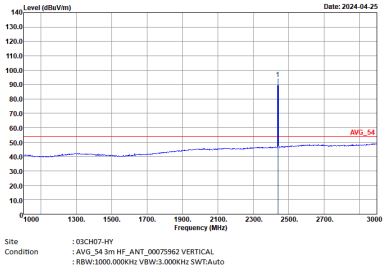
BLE (Band Edge @ 3m)

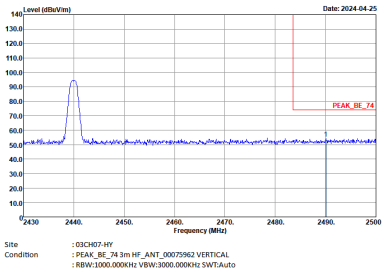
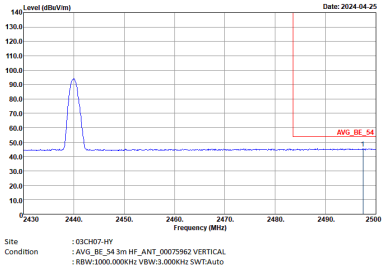
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH00 2402MHz	
	Horizontal	Fundamental
Peak		
Avg.		

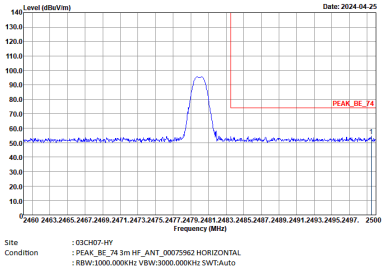
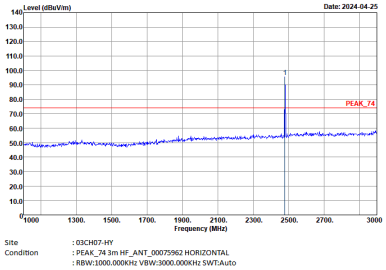
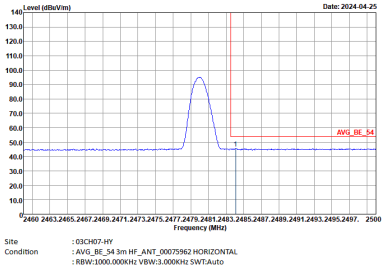
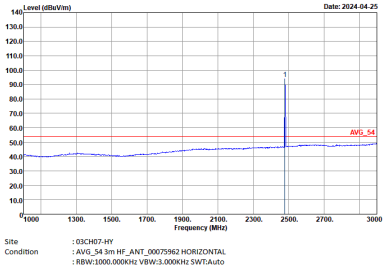
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH00 2402MHz	
	Vertical	Fundamental
Peak		
Avg.		

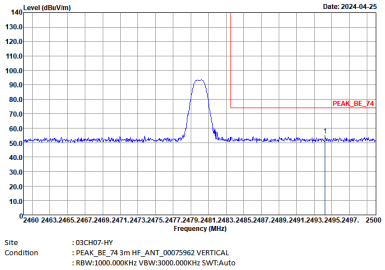
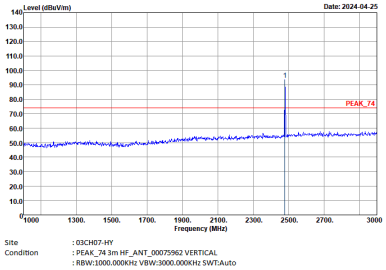
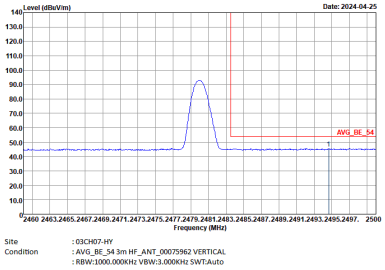
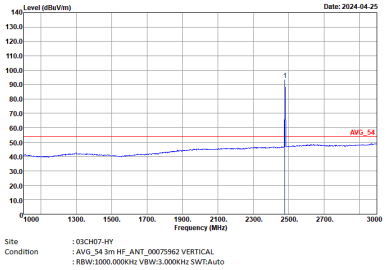
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH19 2440MHz - L	
	Horizontal	Fundamental
Peak		
Avg.		

BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH19 2440MHz - R	
	Horizontal	Fundamental
Peak		Left blank
Avg.		Left blank

BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH19 2440MHz - L	
	Vertical	Fundamental
Peak		
Avg.		

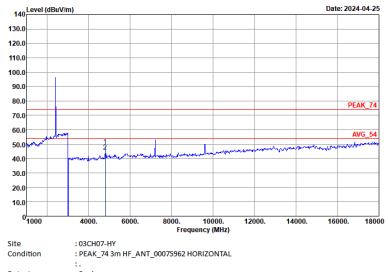
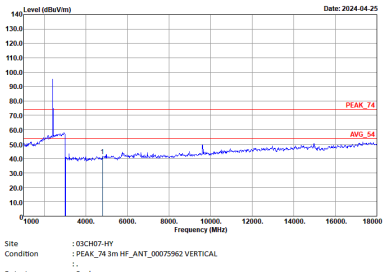
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH19 2440MHz - R	
	Vertical	Fundamental
Peak		Left blank
Avg.		Left blank

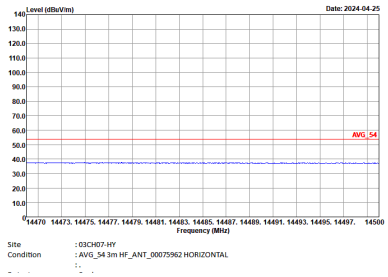
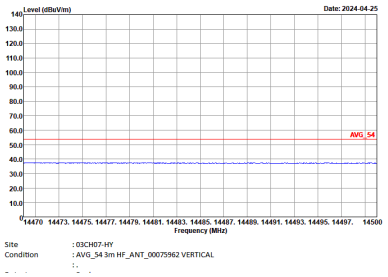
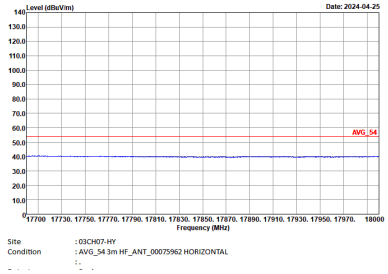
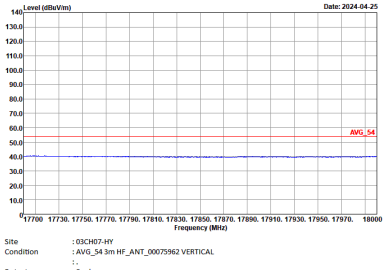
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH39 2480MHz	
	Horizontal	Fundamental
Peak		
Avg.		

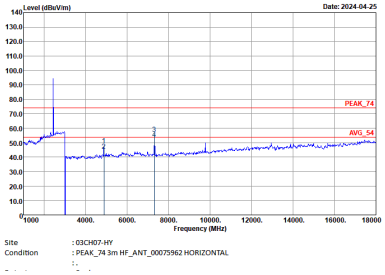
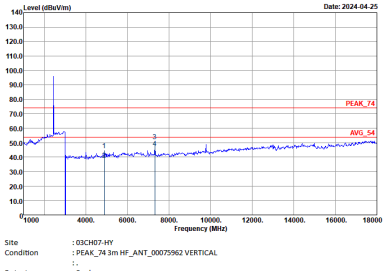
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH39 2480MHz	
	Vertical	Fundamental
Peak		
Avg.		

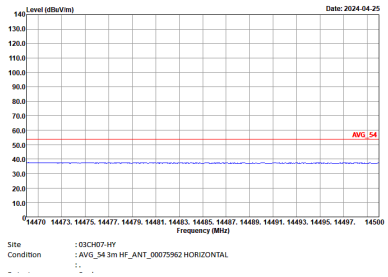
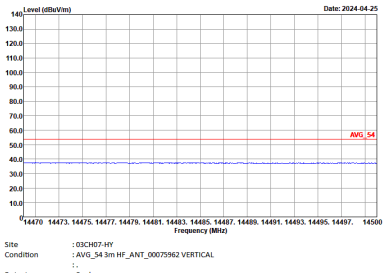
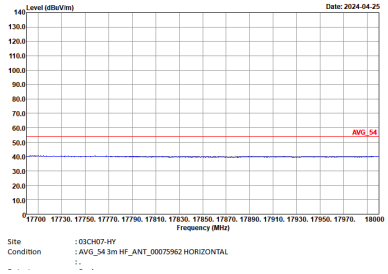
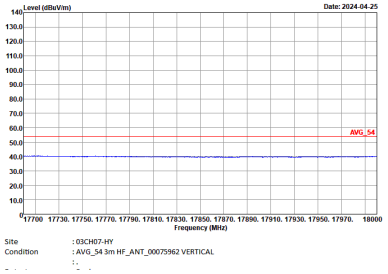
2.4GHz 2400~2483.5MHz

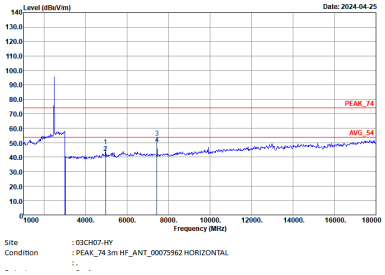
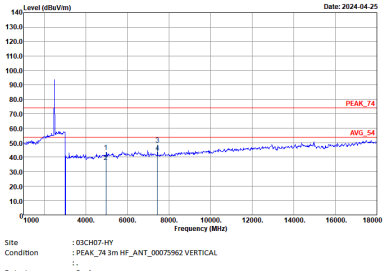
BLE (Harmonic @ 3m)

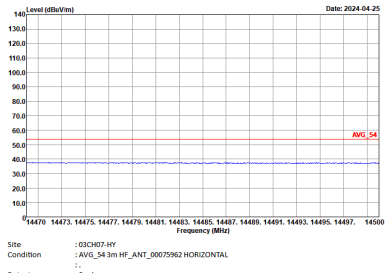
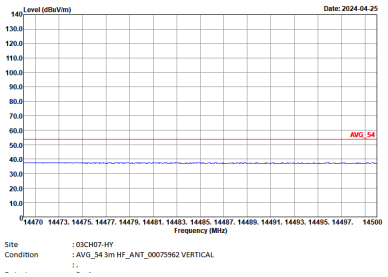
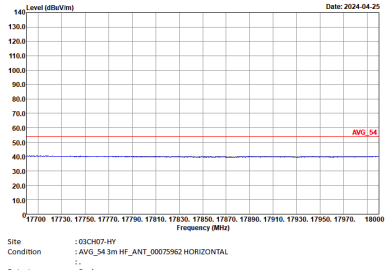
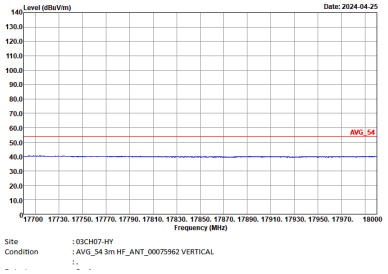
BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BLE CH00 2402MHz	
	Horizontal	Vertical
Peak Avg.		

BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BLE CH00 2402MHz	
	Horizontal	Vertical
14.47G ~14.5G Avg.		
17.7G ~18G Avg.		

BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BLE CH19 2440MHz	
	Horizontal	Vertical
Peak Avg.		

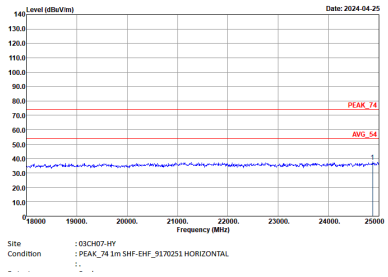
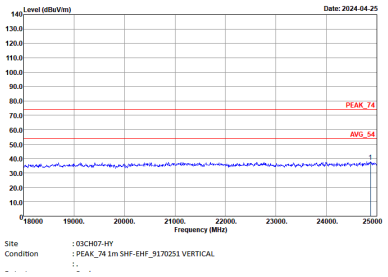
BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BLE CH19 2440MHz	
	Horizontal	Vertical
14.47G ~14.5G Avg.		
17.7G ~18G Avg.		

BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BLE CH39 2480MHz	
	Horizontal	Vertical
Peak		

BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BLE CH39 2480MHz	
	Horizontal	Vertical
14.47G ~14.5G Avg.		
17.7G ~18G Avg.		

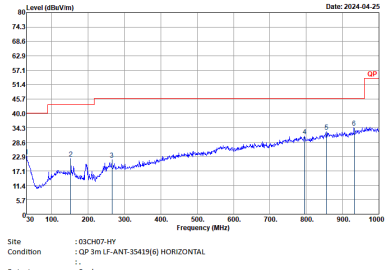
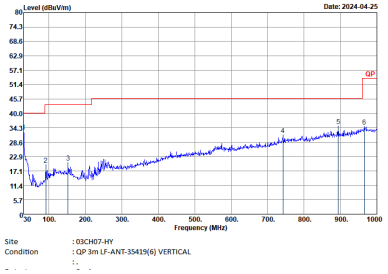
Emission above 18GHz

2.4GHz BLE (SHF @ 1m)

BLE	2.4GHz 2400~2483.5MHz	
ANT	BLE SHF	
	Horizontal	Vertical
Peak Avg.		

Emission below 1GHz

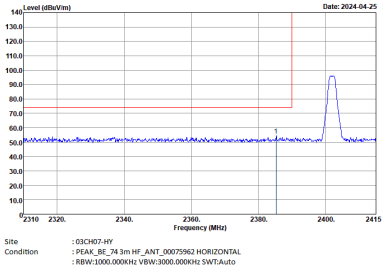
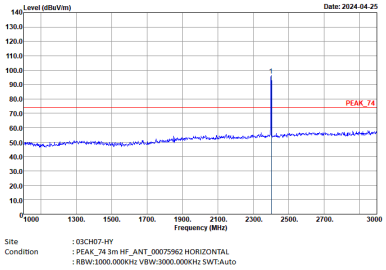
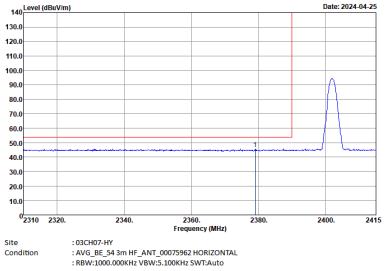
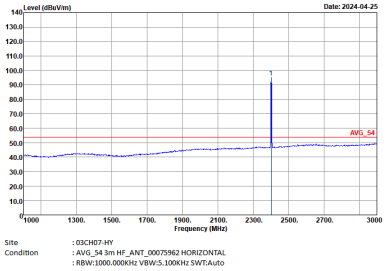
2.4GHz BLE (LF)

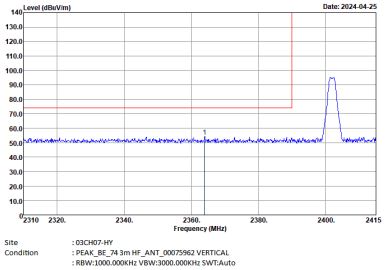
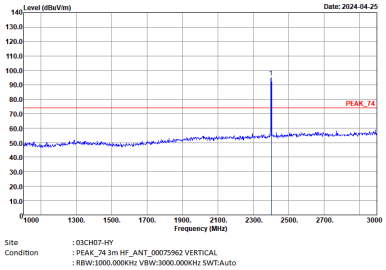
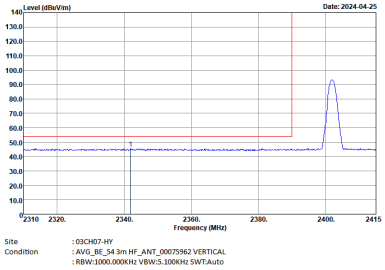
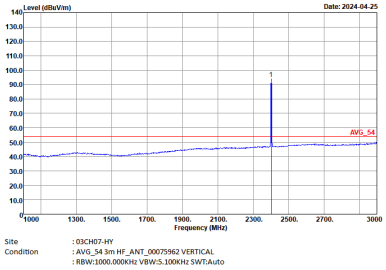
BLE	2.4GHz 2400~2483.5MHz	
ANT	BLE LF	
	Horizontal	Vertical
QP / Peak		

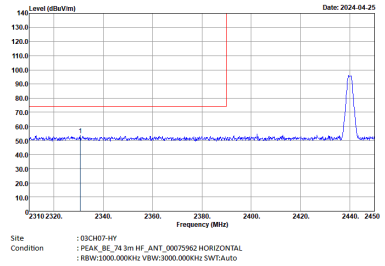
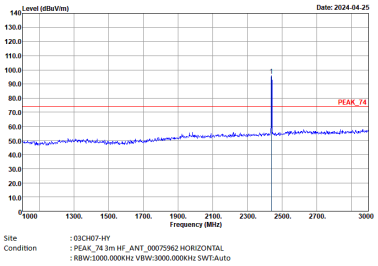
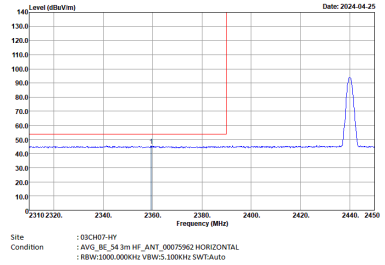
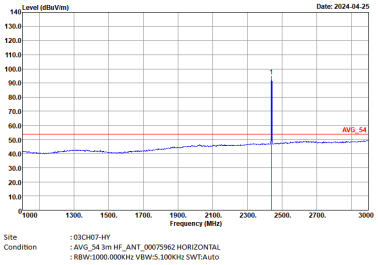
<2Mbps>

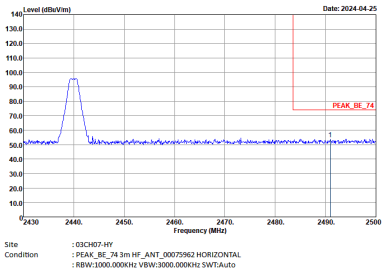
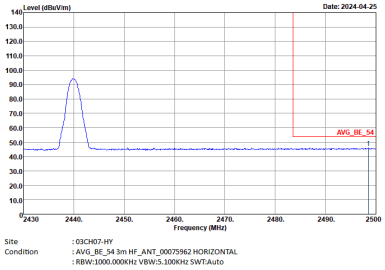
2.4GHz 2400~2483.5MHz

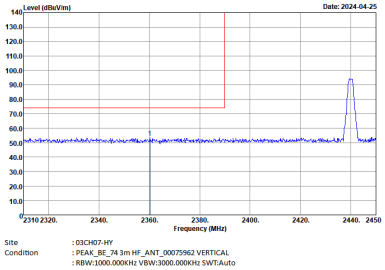
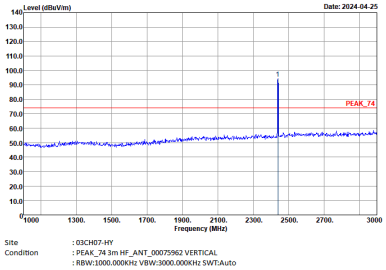
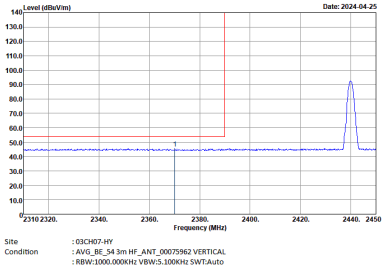
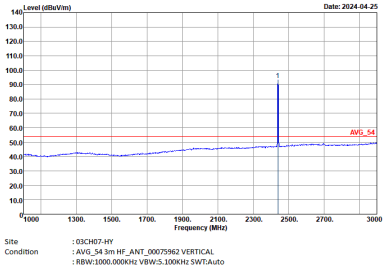
BLE (Band Edge @ 3m)

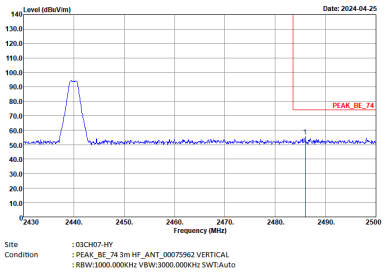
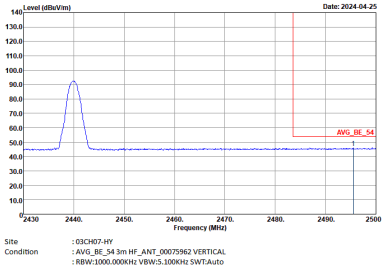
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH00 2402MHz	
	Horizontal	Fundamental
Peak		
Avg.		

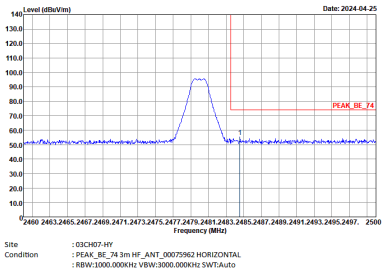
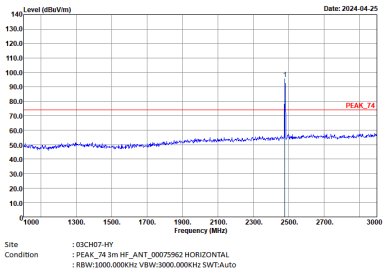
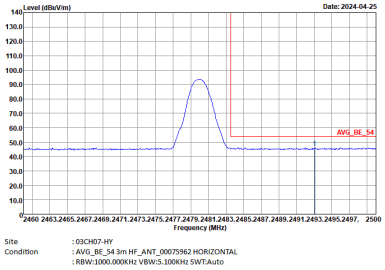
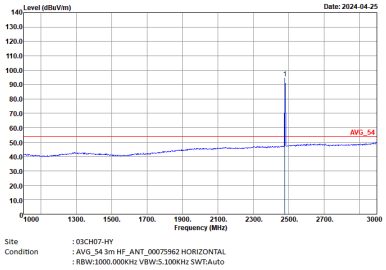
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH00 2402MHz	
	Vertical	Fundamental
Peak		
Avg.		

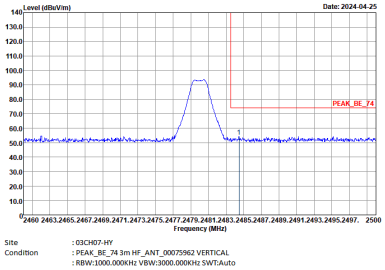
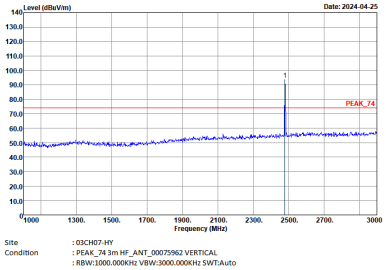
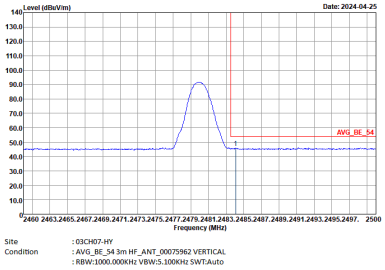
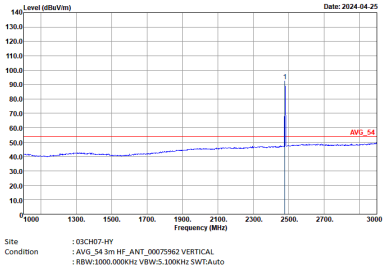
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH19 2440MHz - L	
	Horizontal	Fundamental
Peak		
Avg.		

BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH19 2440MHz - R	
	Horizontal	Fundamental
Peak		Left blank
Avg.		Left blank

BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH19 2440MHz - L	
	Vertical	Fundamental
Peak		
Avg.		

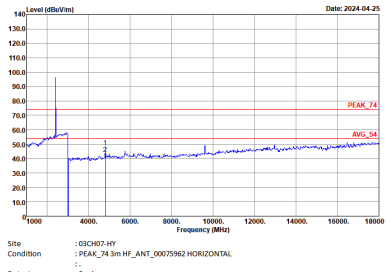
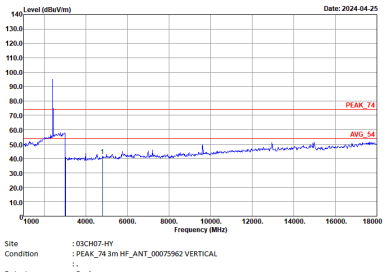
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH19 2440MHz - R	
	Vertical	Fundamental
Peak		Left blank
Avg.		Left blank

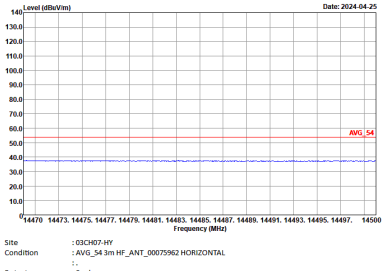
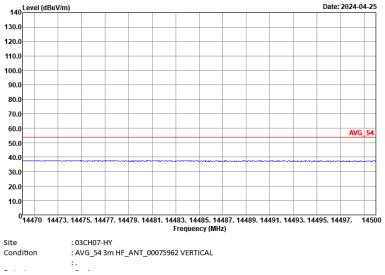
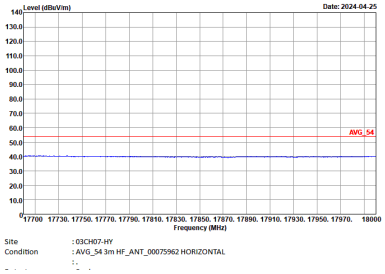
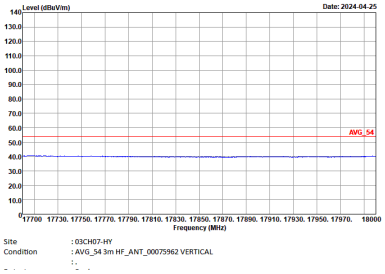
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH39 2480MHz	
	Horizontal	Fundamental
Peak		
Avg.		

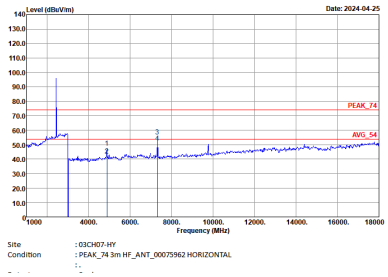
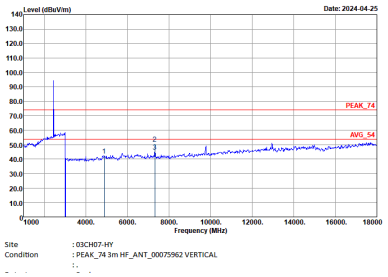
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH39 2480MHz	
	Vertical	Fundamental
Peak		
Avg.		

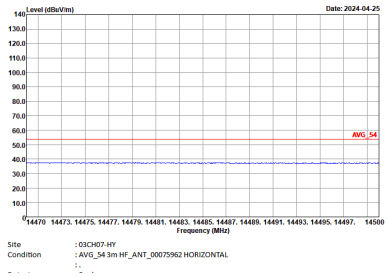
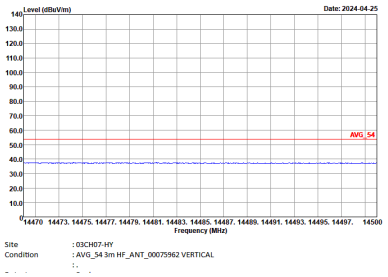
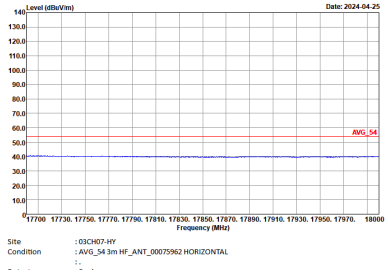
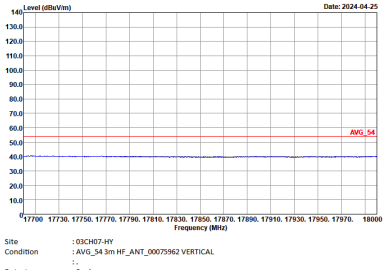
2.4GHz 2400~2483.5MHz

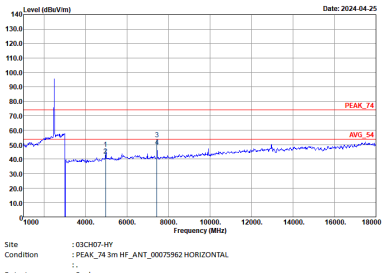
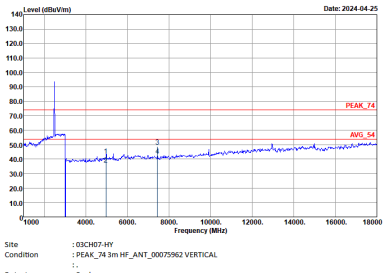
BLE (Harmonic @ 3m)

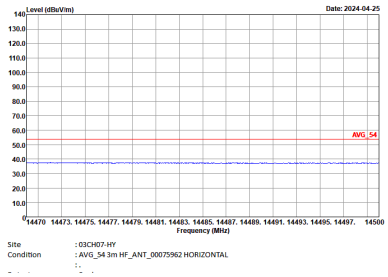
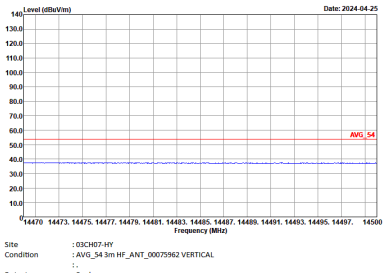
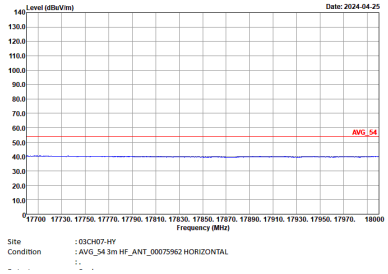
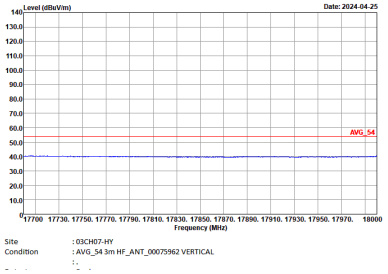
BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BLE CH00 2402MHz	
	Horizontal	Vertical
Peak Avg.		

BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BLE CH00 2402MHz	
	Horizontal	Vertical
14.47G ~14.5G Avg.		
17.7G ~18G Avg.		

BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BLE CH19 2440MHz	
	Horizontal	Vertical
Peak Avg.		

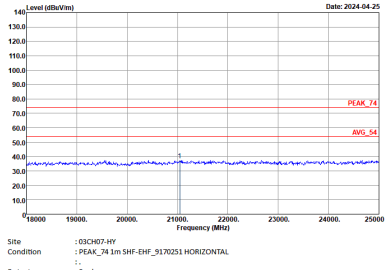
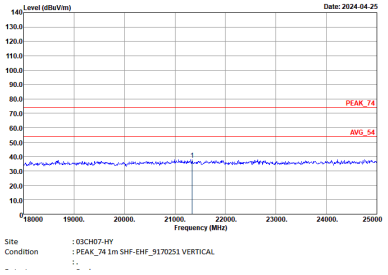
BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BLE CH19 2440MHz	
	Horizontal	Vertical
14.47G ~14.5G Avg.		
17.7G ~18G Avg.		

BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BLE CH39 2480MHz	
	Horizontal	Vertical
Peak		

BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BLE CH39 2480MHz	
	Horizontal	Vertical
14.47G ~14.5G Avg.		
17.7G ~18G Avg.		

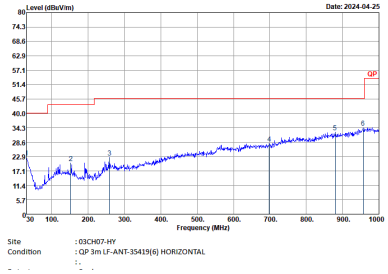
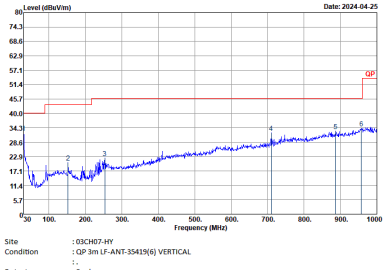
Emission above 18GHz

2.4GHz BLE (SHF @ 1m)

BLE	2.4GHz 2400~2483.5MHz	
ANT	BLE SHF	
	Horizontal	Vertical
Peak Avg.		

Emission below 1GHz

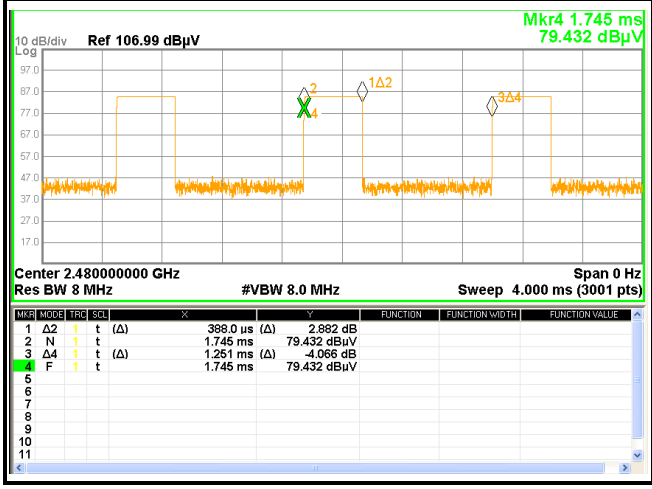
2.4GHz BLE (LF)

BLE	2.4GHz 2400~2483.5MHz	
ANT	BLE LF	
	Horizontal	Vertical
QP / Peak		

Appendix D. Duty Cycle Plots

Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting
Bluetooth - LE for 1Mbps	31.02	388	2.58	3kHz
Bluetooth - LE for 2Mbps	33.07	206	4.85	5.1kHz

Bluetooth - LE for 1Mbps



Bluetooth - LE for 2Mbps