

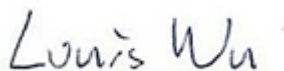


FCC RADIO TEST REPORT

FCC ID : TVE-240702
Equipment : Secured Network Extension Device
Brand Name : FORTINET 
Model Name : FortiExtender 511Gxxxxxxxxxx,
FORTIEXTENDER-511Gxxxxxxxxxx, FEX-511Gxxxxxxxxxx
(where "x" can be used as "A-Z", or "0-9", or "-", or blank
for software changes or marketing purposes only)
Marketing Name : FortiExtender 511G
Applicant : Fortinet, Inc.
909 Kifer Road, Sunnyvale, CA. 94086 USA
Manufacturer : Fortinet, Inc.
909 Kifer Road, Sunnyvale, CA. 94086 USA
Standard : FCC Part 15 Subpart C §15.247

The product was received on Sep. 02, 2024 and testing was performed from Oct. 21, 2024 to Nov. 07, 2024. We, Sporton International Inc. Wensan 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 variant report apply exclusively to the tested model / sample. Without written approval from Sporton International Inc. Wensan Laboratory, the test report shall not be reproduced except in full.



Approved by: Louis Wu

Sporton International Inc. Wensan Laboratory

No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.)



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History of this test report

Report No.	Version	Description	Issue Date
FR490210-01A	01	Initial issue of report	Dec. 09, 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	13.78 dB under the limit at 0.17 MHz
3.6	15.207	AC Conducted Emission	Pass	4.00 dB under the limit at 7320.00 MHz
3.7	15.203	Antenna Requirement	Pass	-

Note: This is a variant report by removing the WiFi chips, RF front-end modules, duplexers, as well as WiFi-related resistors, capacitors, and inductors. All the test cases were performed on original report which can be referred to Sporton Report Number FR490210A. Based on the original report, the test cases were verified.

Conformity Assessment Condition:

- 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.
- 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: Sheng Kuo

Report Producer: Emma Hsiao



1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature		
General Specs WCDMA/LTE/5G NR, Bluetooth-LE and GNSS.		
Antenna Type WWAN: Dipole Antenna Bluetooth-LE: PCB Antenna GPS / Glonass / BDS / Galileo: Dipole Antenna		

Antenna information		
2400 MHz ~ 2483.5 MHz	Peak Gain (dBi)	3.57

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

1.2 Modification of EUT

No modifications made to the EUT during the testing.

1.3 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. CO05-HY (TAF Code: 1190)
Remark	The Conducted Emission test item subcontracted to Sporton International Inc. EMC & Wireless Communications Laboratory

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, 03CH20-HY

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

FCC designation No.: TW1190 and TW3786

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
- ♦ 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	-	-

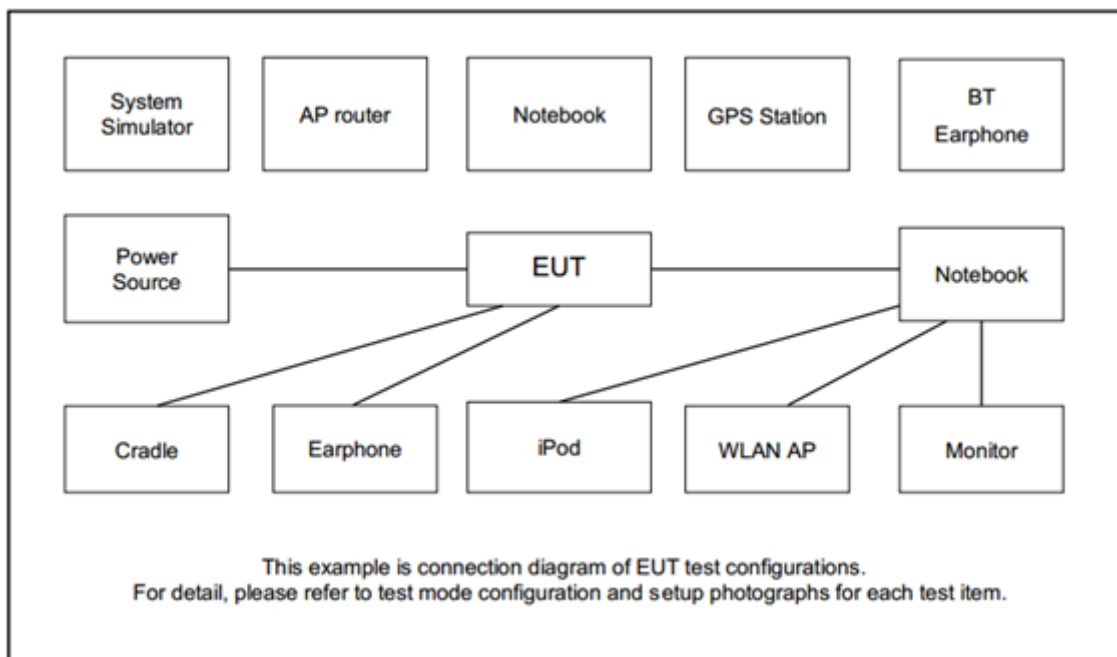
2.2 Test Mode

- 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: conduction emission (150 kHz to 30 MHz), radiation emission (1GHz to the 10th harmonic of the highest fundamental frequency or to 18 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 two config. (Ant. 0° and Ant. 90°), and adjusting the measurement antenna orientation, following C63.10 exploratory test procedures and only the worst case emissions were reported in this report.
- b. AC power line Conducted Emission was tested under maximum output power.

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
Radiated Test Cases	Mode 1: Bluetooth Tx CH39_2480 MHz_1Mbps
	Mode 2: Bluetooth Tx CH19_2440 MHz_2Mbps
AC Conducted Emission	Mode 1: Bluetooth-LE Link + Console with Notebook + Data Link with USB Flash Drive + SFP Port load + PoE Adapter (LAN port 4) + LAN Port 2 & 3 Loop back + LAN Port 1 Link with Notebook + LAN Port 4 Link with Notebook + SIM1 + WAN Port Link with Notebook
Remark: 1. Data Link with USB Flash Drive means data application transferred mode between EUT and USB Flash Drive. 2. 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.	WLAN AP	ASUS	RT-AX88U	MSQ-RTAXHP00	N/A	Unshielded, 1.8m
2.	Notebook	DELL	Latitude 3420	FCC DoC	N/A	AC I/P : Unshielded, 1.2m DC O/P : Shielded, 1.8m
3.	Notebook	DELL	Latitude 5310	FCC DoC	N/A	AC I/P : Unshielded, 1.2m DC O/P : Shielded, 1.8m
4.	PC	MSI	Aegis-B918	FCC DoC	N/A	Unshielded, 1.8m
5.	Mobile Phone	Samsung	GT-N7000	A3LSMA730F	N/A	N/A
6.	USB Flash Drive	Kingston	DTSE9	FCC DoC	N/A	N/A
7.	POE Adapter	Mircosmei	PD-9001GR/AT/AC	FCC DoC	N/A	N/A



2.5 EUT Operation Test Setup

The RF test items, utility “Tera Term Version 4.89” 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.

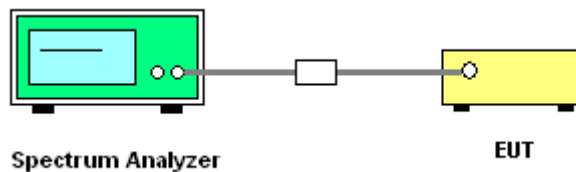
3.1.2 Measuring Instruments

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) $\geq 3 * RBW$.
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.

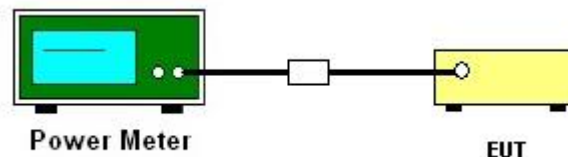
3.2.2 Measuring Instruments

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.

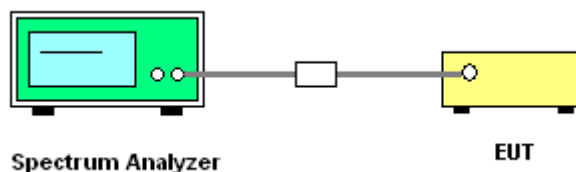
3.3.2 Measuring Instruments

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.

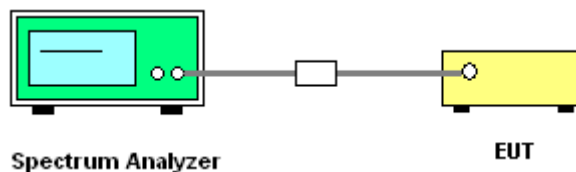
3.4.2 Measuring Instruments

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.

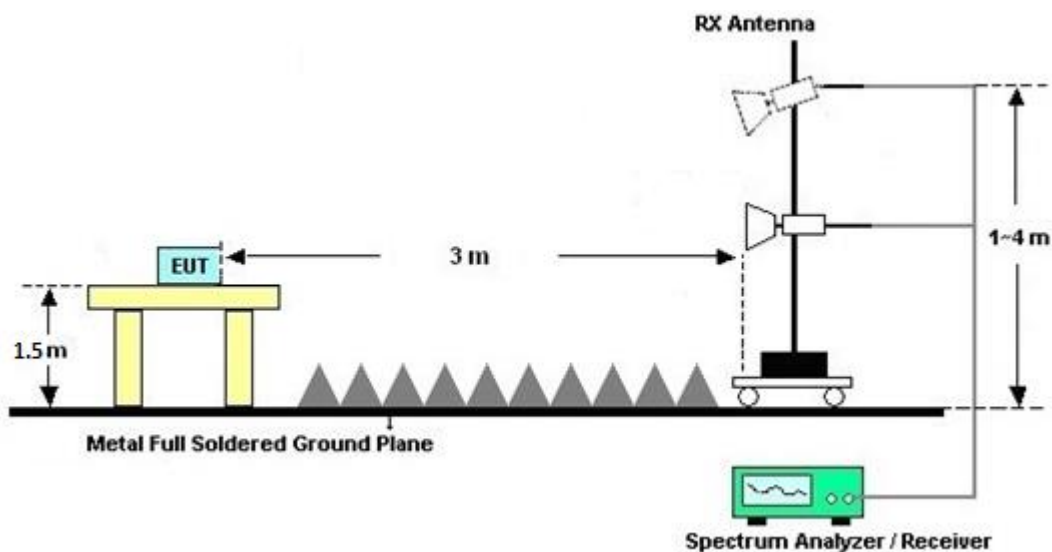


3.5.3 Test Procedures

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 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 - Preamplifier Factor = Level
6. 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 “-”.
7. 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 from 1GHz to 18GHz



3.5.5 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C.

3.5.6 Duty Cycle

Please refer to Appendix D.

3.5.7 Test Result of Radiated Spurious Emission

Please refer to Appendix C.

3.6 AC Conducted Emission Measurement

3.6.1 Limit of AC Conducted Emission

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

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

*Decreases with the logarithm of the frequency.

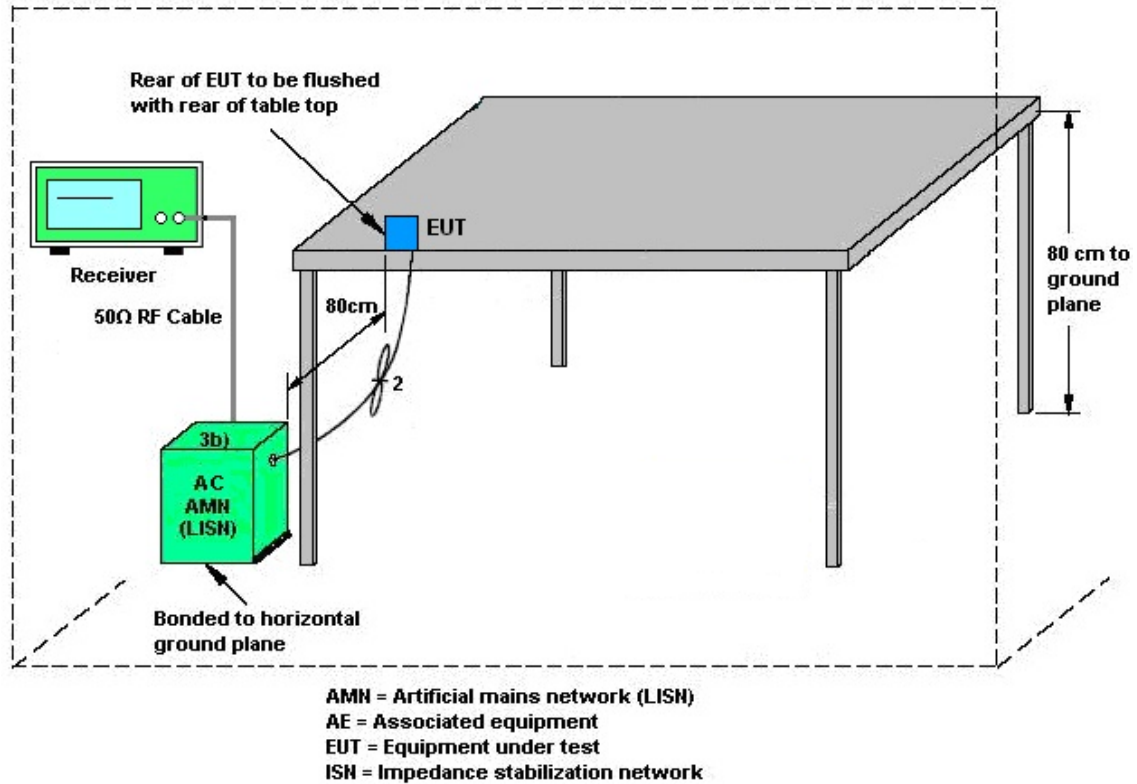
3.6.2 Measuring Instruments

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

3.6.3 Test Procedures

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

3.6.4 Test Setup



3.6.5 Test Result of AC Conducted Emission

Please refer to Appendix B.



3.7 Antenna Requirements

3.7.1 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.

3.7.2 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
EMI Test Receiver	Keysight	N9038B	MY62210111	N/A	Sep. 03, 2024	Oct. 30, 2024~ Nov. 07, 2024	Sep. 02, 2025	Radiation (03CH20-HY)
Controller	ChainTek	3000-1	N/A	Control Turn table & Ant Mast	N/A	Oct. 30, 2024~ Nov. 07, 2024	N/A	Radiation (03CH20-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Oct. 30, 2024~ Nov. 07, 2024	N/A	Radiation (03CH20-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Oct. 30, 2024~ Nov. 07, 2024	N/A	Radiation (03CH20-HY)
Signal Analyzer	Keysight	N9010B	MY60240520	N/A	Dec. 12, 2023	Oct. 30, 2024~ Nov. 07, 2024	Dec. 11, 2024	Radiation (03CH20-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-02038	1GHz~18GHz	Jul. 29, 2024	Oct. 30, 2024~ Oct. 31, 2024	Jul. 28, 2025	Radiation (03CH20-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	02360	1GHz-18GHz	Nov. 01, 2024	Nov. 01, 2024~ Nov. 07, 2024	Oct. 31, 2025	Radiation (03CH20-HY)
Preamplifier	COM-POWER	PAM-103	18020201	1MHz-1000MHz	Jan. 01, 2024	Oct. 30, 2024~ Nov. 07, 2024	Dec. 31, 2024	Radiation (03CH20-HY)
Amplifier	EMCI	EMC118A45SE	980792	N/A	Nov. 13, 2023	Oct. 30, 2024~ Nov. 07, 2024	Nov. 12, 2024	Radiation (03CH20-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	519229/2,804015/ 2,804027/2	N/A	Jan. 17, 2024	Oct. 30, 2024~ Nov. 07, 2024	Jan. 16, 2025	Radiation (03CH20-HY)
Hygrometer	TECEPEL	DTM-303A	TP211382	N/A	Mar. 27, 2024	Oct. 30, 2024~ Nov. 07, 2024	Mar. 26, 2025	Radiation (03CH20-HY)
Software	Audix	N/A	RK-002156	N/A	N/A	Oct. 30, 2024~ Nov. 07, 2024	N/A	Radiation (03CH20-HY)
Hygrometer	TECEPEL	DTM-303A	TP201996	N/A	Nov. 07, 2023	Nov. 01, 2024	Nov. 06, 2024	Conducted (TH05-HY)
Power Sensor	DARE	RPR3006W	17100015SNO35 (NO:109)	10MHz~6GHz	Jan. 15, 2024	Nov. 01, 2024	Jan. 14, 2025	Conducted (TH05-HY)
Signal Analyzer	Rohde & Schwarz	FSV3044	101466	10HZ~44GHZ	Aug. 14, 2024	Nov. 01, 2024	Aug. 13, 2025	Conducted (TH05-HY)
Switch Control Mainframe	Burgeon	ETF-058	EC1300484 (BOX3)	N/A	May 20, 2024	Nov. 01, 2024	May 19, 2025	Conducted (TH05-HY)
Software	Sporton	BTWIFI_Final_ver sion_240513	N/A	Conducted Other Test Item	N/A	Nov. 01, 2024	N/A	Conducted (TH05-HY)
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Oct. 21, 2024	N/A	Conduction (CO05-HY)
EMI Test Receiver	Rohde & Schwarz	ESR3	102388	9kHz~3.6GHz	Dec. 06, 2023	Oct. 21, 2024	Dec. 05, 2024	Conduction (CO05-HY)
Hygrometer	Testo	608-H1	34913912	N/A	Oct. 26, 2023	Oct. 21, 2024	Oct. 25, 2024	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100081	9kHz~30MHz	Nov. 22, 2023	Oct. 21, 2024	Nov. 21, 2024	Conduction (CO05-HY)
Software	Rohde & Schwarz	EMC32	N/A	N/A	N/A	Oct. 21, 2024	N/A	Conduction (CO05-HY)
Pulse Limiter	SCHWARZBECK	VTSD 9561-F N	00691	N/A	Jul. 30, 2024	Oct. 21, 2024	Jul. 29, 2025	Conduction (CO05-HY)
RF Cable	HUBER + SUHNER	RG 214/U	1358175	9kHz~30MHz	Mar. 14, 2024	Oct. 21, 2024	Mar. 13, 2025	Conduction (CO05-HY)



5 Measurement Uncertainty

Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_c(y)$)	3.7 dB
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Uncertainty of Radiated Emission Measurement (1000 MHz ~ 6000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_c(y)$)	5.4 dB
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Uncertainty of Radiated Emission Measurement (6000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_c(y)$)	5.6 dB
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Appendix A. Test Result of Conducted Test Items

Test Engineer:	Hank Hsu	Temperature:	21~25	°C
Test Date:	2024/11/01	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	1.018	0.672	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	7.00	30.00	3.57	10.57	36.00	Pass
BLE	1Mbps	1	19	2440	4.50	30.00	3.57	8.07	36.00	Pass
BLE	1Mbps	1	39	2480	4.80	30.00	3.57	8.37	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	6.03	-9.57	3.57	8.00	Pass

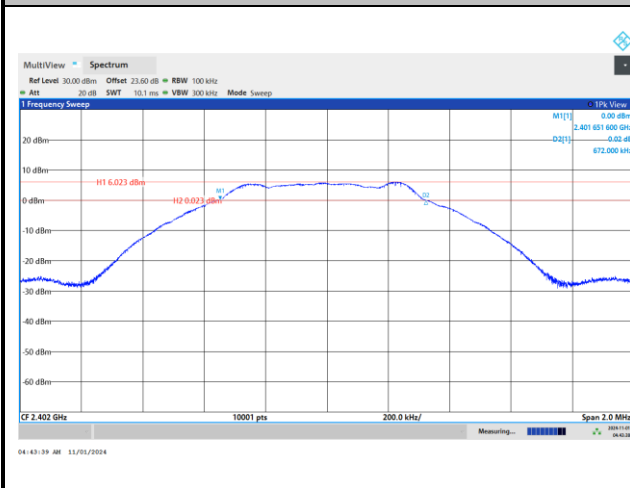
Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 30dBc limit.

TEST RESULTS DATA**Average Power Table**

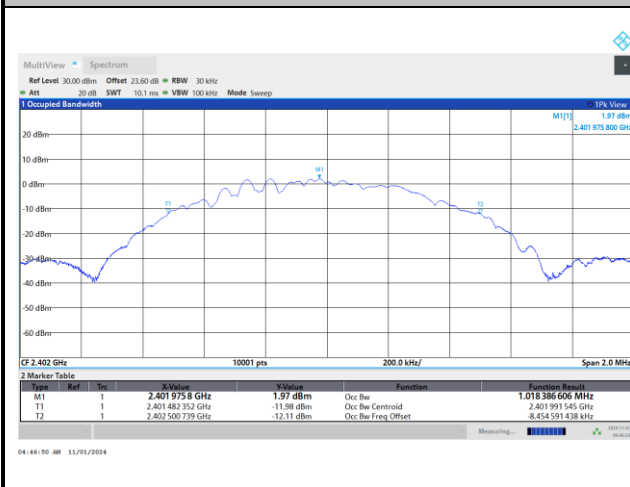
Mod.	Data Rate	N _{TX}	CH.	Freq. (MHz)	Average Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
BLE	2Mbps	1	CH 00	2402 MHz	6.90	30.00	3.57	10.47	36.00	Pass
BLE	2Mbps	1	CH 19	2440 MHz	5.10	30.00	3.57	8.67	36.00	Pass
BLE	2Mbps	1	CH 39	2480 MHz	5.80	30.00	3.57	9.37	36.00	Pass

**6dB Bandwidth**

<1Mbps>

6 dB Bandwidth Plot on Channel 00**99% Occupied Bandwidth**

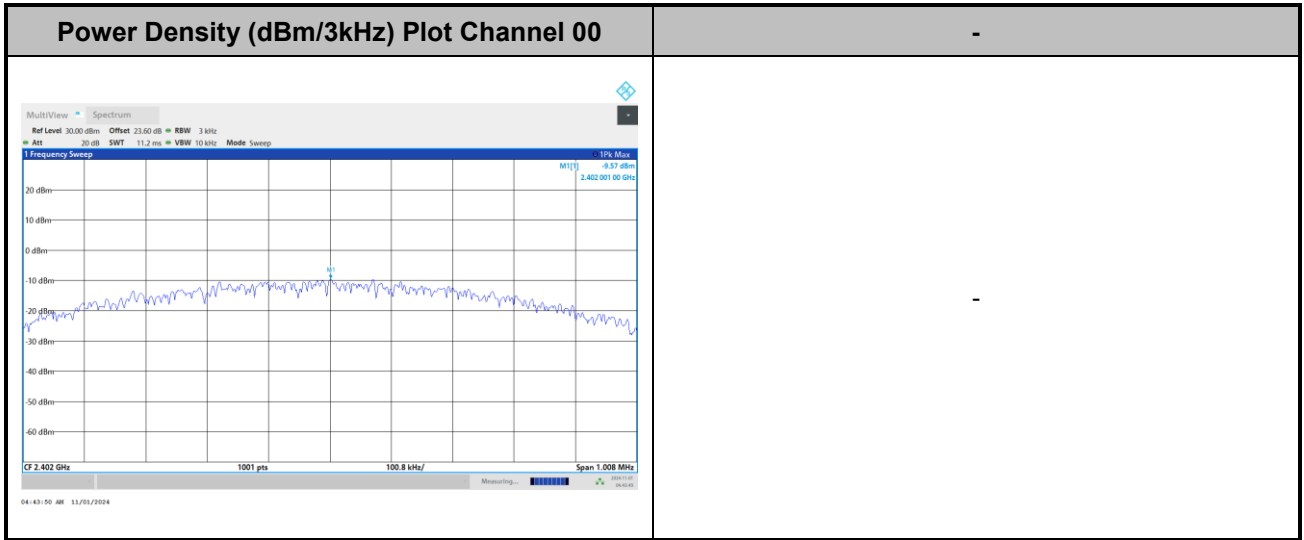
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99% Occupied Bandwidth Plot on Channel 00



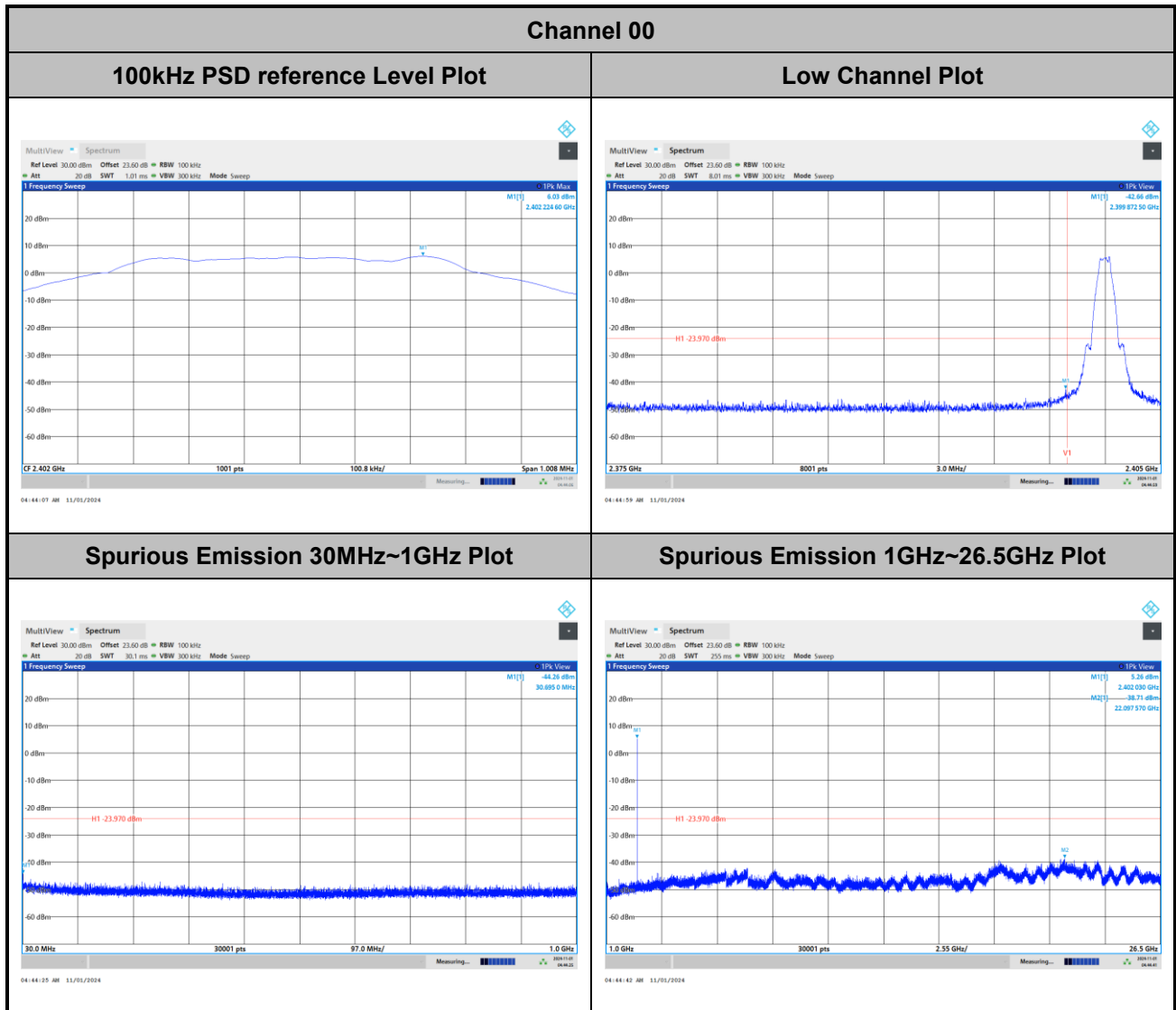
Power Spectral Density (dBm/3kHz)

<1Mbps>



**Band Edge and Conducted Spurious Emission**

<1Mbps>





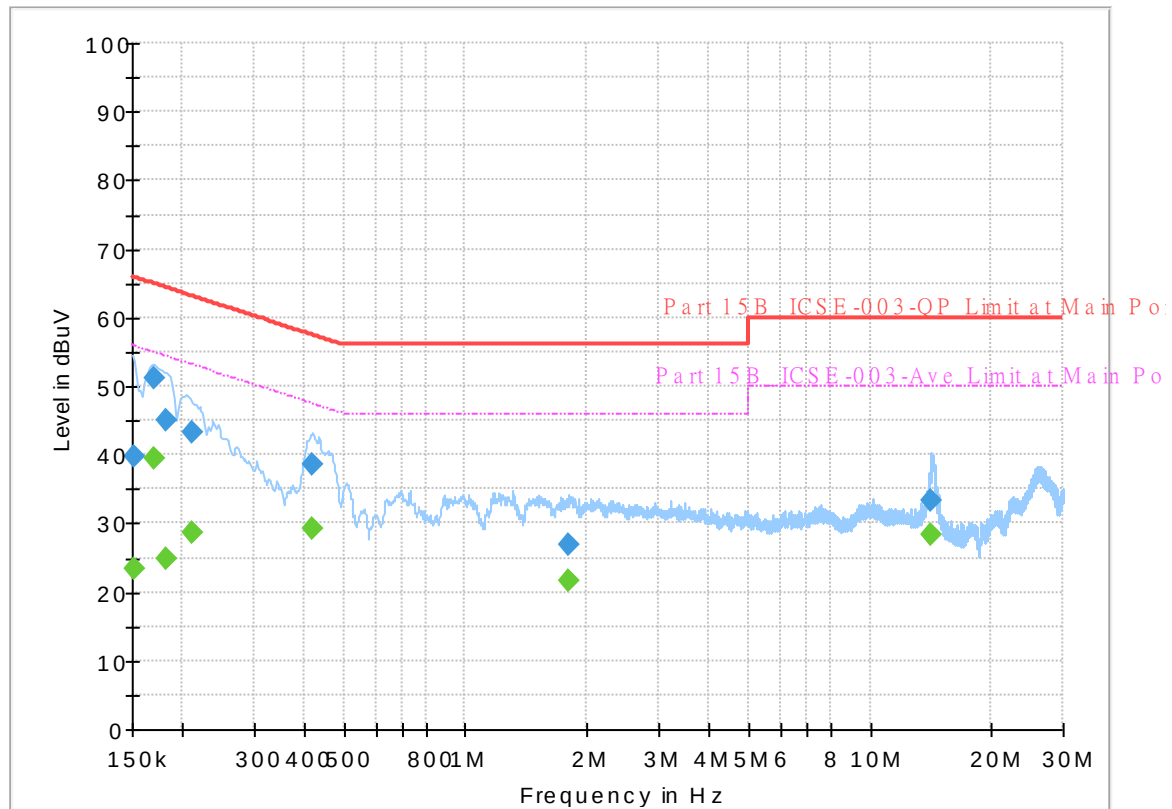
Appendix B. AC Conducted Emission Test Results

Test Engineer :	Calvin Wang	Temperature :	23~26°C
		Relative Humidity :	45~55%

EUT Information

Report NO : 490210-01
 Test Mode : Mode 1
 Test Voltage : 120Vac/60Hz
 Phase : Line

Full Spectrum



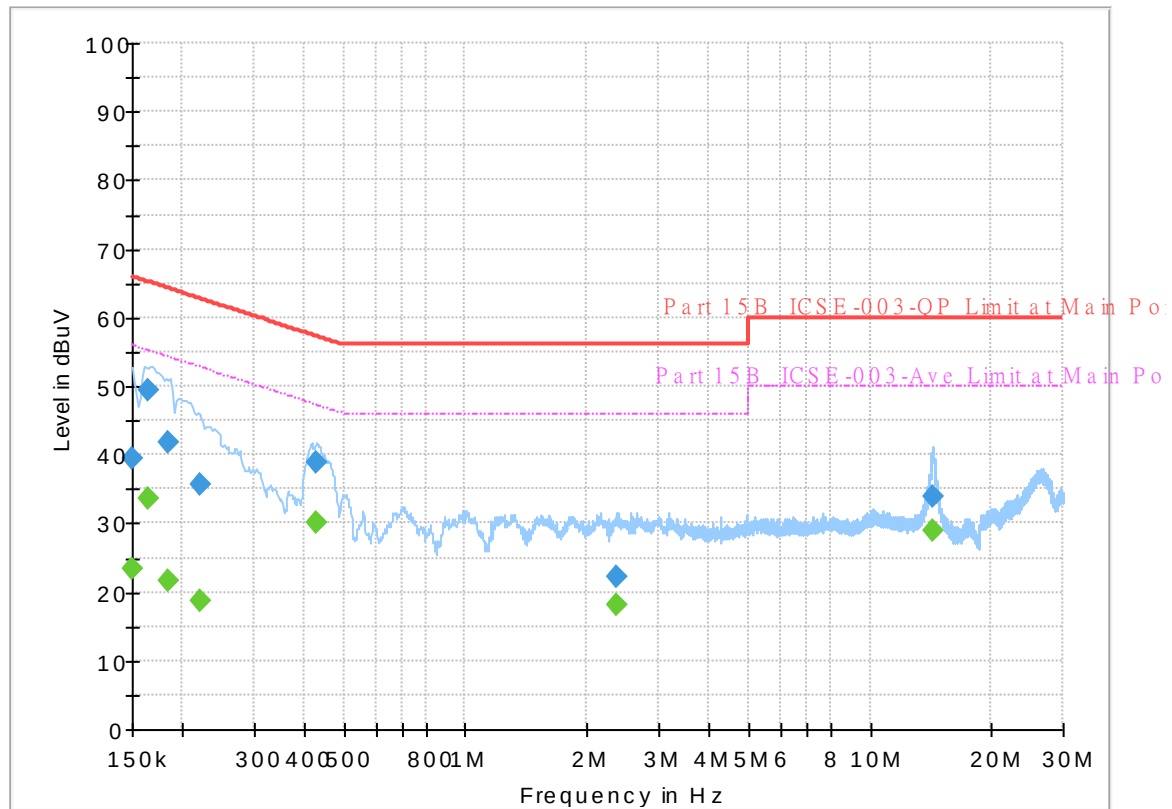
Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.152250	---	23.50	55.88	32.38	L1	OFF	19.8
0.152250	39.72	---	65.88	26.16	L1	OFF	19.8
0.170250	---	39.34	54.95	15.61	L1	OFF	19.8
0.170250	51.17	---	64.95	13.78	L1	OFF	19.8
0.181500	---	24.77	54.42	29.65	L1	OFF	19.8
0.181500	44.96	---	64.42	19.46	L1	OFF	19.8
0.210750	---	28.69	53.18	24.49	L1	OFF	19.8
0.210750	43.40	---	63.18	19.78	L1	OFF	19.8
0.420000	---	29.13	47.45	18.32	L1	OFF	19.8
0.420000	38.49	---	57.45	18.96	L1	OFF	19.8
1.794750	---	21.52	46.00	24.48	L1	OFF	19.8
1.794750	27.04	---	56.00	28.96	L1	OFF	19.8
14.219250	---	28.26	50.00	21.74	L1	OFF	19.9
14.219250	33.34	---	60.00	26.66	L1	OFF	19.9

EUT Information

Report NO : 490210-01
 Test Mode : Mode 1
 Test Voltage : 120Vac/60Hz
 Phase : Neutral

Full Spectrum



Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.150000	---	23.40	56.00	32.60	N	OFF	19.8
0.150000	39.48	---	66.00	26.52	N	OFF	19.8
0.163500	---	33.64	55.28	21.64	N	OFF	19.8
0.163500	49.43	---	65.28	15.85	N	OFF	19.8
0.183750	---	21.53	54.31	32.78	N	OFF	19.8
0.183750	41.93	---	64.31	22.38	N	OFF	19.8
0.219750	---	18.71	52.83	34.12	N	OFF	19.8
0.219750	35.80	---	62.83	27.03	N	OFF	19.8
0.429000	---	29.99	47.27	17.28	N	OFF	19.8
0.429000	38.77	---	57.27	18.50	N	OFF	19.8
2.350500	---	17.99	46.00	28.01	N	OFF	19.8
2.350500	22.25	---	56.00	33.75	N	OFF	19.8
14.255250	---	28.93	50.00	21.07	N	OFF	20.0
14.255250	34.02	---	60.00	25.98	N	OFF	20.0



Appendix C. Radiated Spurious Emission Test Data

Test Engineer :	John Chuang	Temperature :	19.8~23.6℃
		Relative Humidity :	64.8~70.5%

Note symbol

-L	Low channel location
-R	High channel location

C1. Radiated Spurious Emission Test Modes

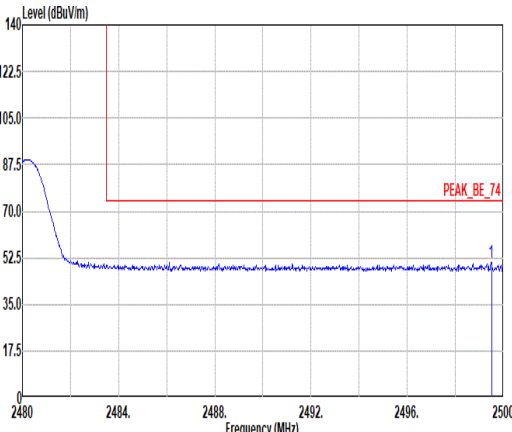
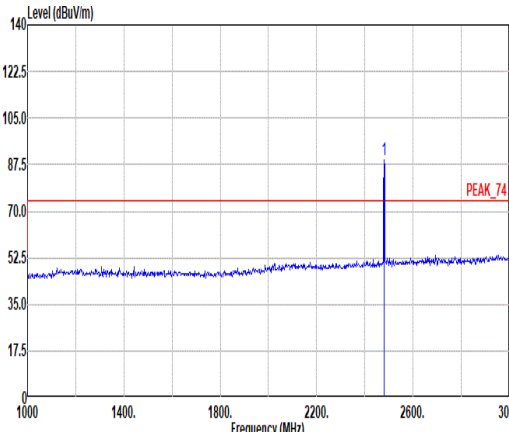
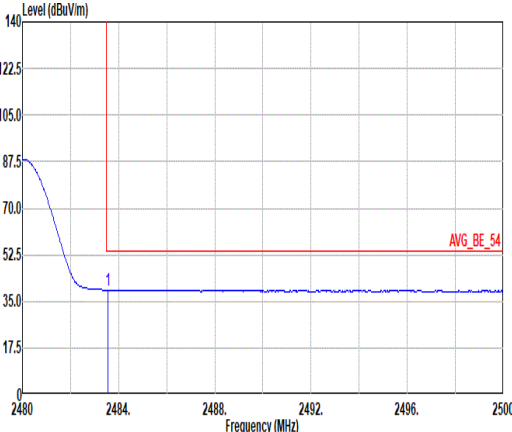
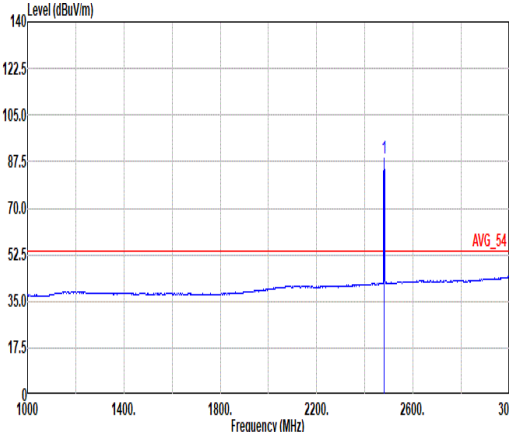
Mode	Band (MHz)	Antenna	Modulation	Channel	Frequency	Data Rate	RU	Remark
Mode 1	2400-2483.5	1	Bluetooth-LE GSKF	39	2480	1Mbps	-	-
Mode 2	2400-2483.5	1	Bluetooth-LE GSKF	19	2440	2Mbps	-	-

C2. Summary of each worse mode

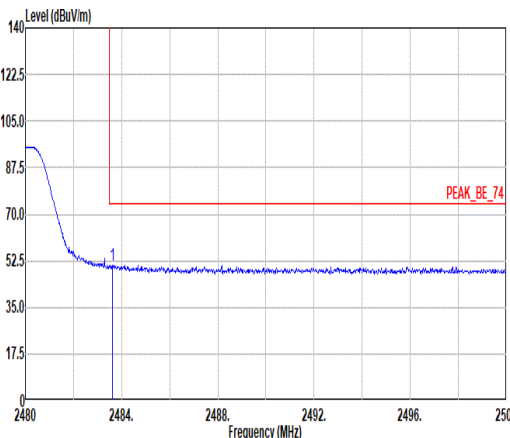
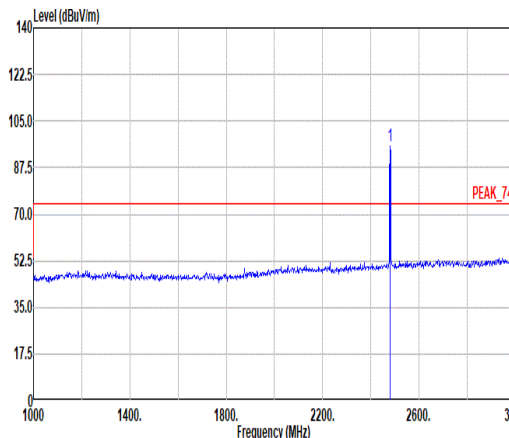
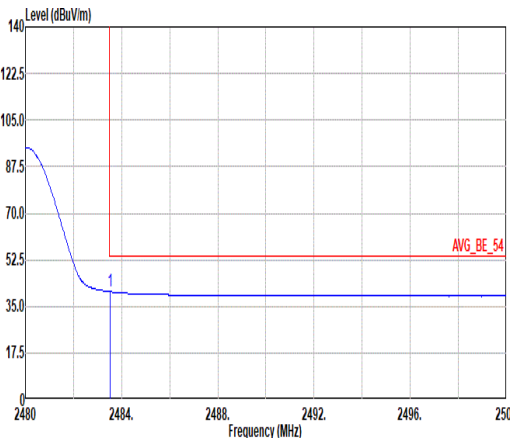
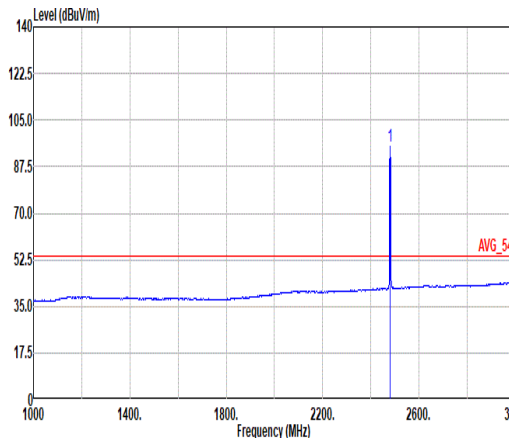
Mode	Modulation	Ch.	Freq. (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol.	Peak Avg.	Result	RU	Remark
1	Bluetooth-LE GSKF	39	2483.52	40.53	54.00	-13.47	V	Avg.	Pass	-	Band Edge
	Bluetooth-LE GSKF	39	-	-	-	-	-	-	-	-	Harmonic
2	Bluetooth-LE GSKF	19	-	-	-	-	-	-	-	-	Band Edge
	Bluetooth-LE GSKF	19	7320.00	50.00	54.00	-4.00	V	Avg.	Pass	-	Harmonic



<1Mbps>

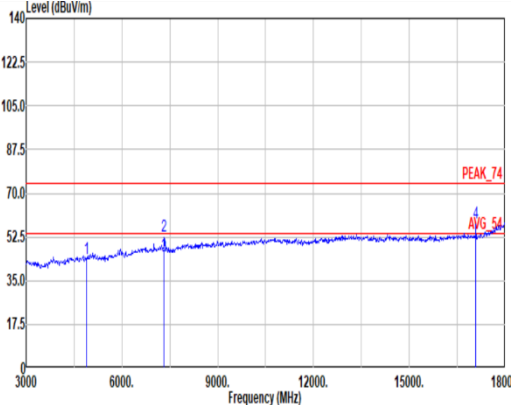
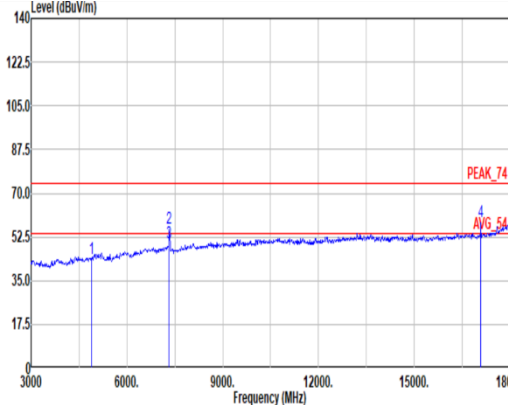
Mode	1																																																																			
	Band Edge																																																																			
	2400-2483.5_Bluetooth-LE GSKF_CH39_2480MHz																																																																			
ANT	1																																																																			
Pol.	Horizontal	Fundamental																																																																		
Peak	 Site : 03CH20-HY Condition: PEAK_BE_74 3m HF_91200_02038_240729 HORIZONTAL : RBW:1000.000kHz VBW:3000.000kHz SMT:Auto <table><tr><th>Freq</th><th>Level</th><th>Limit</th><th>Read</th><th>Ant</th><th>Cable</th><th>Preamp</th><th>Aux</th><th>APos</th><th>TPos</th><th>Remark</th></tr><tr><th>MHz</th><th>dBuV/m</th><th>dBuV/m</th><th>dB</th><th>dBuV</th><th>dB/m</th><th>dB</th><th>dB</th><th>dB</th><th>cm</th><th>deg</th></tr><tr><td>1 2499.50</td><td>50.75</td><td>74.00</td><td>-23.25</td><td>40.66</td><td>27.80</td><td>8.89</td><td>36.28</td><td>9.68</td><td>109</td><td>245 PEAK</td></tr></table>	Freq	Level	Limit	Read	Ant	Cable	Preamp	Aux	APos	TPos	Remark	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB	dB	cm	deg	1 2499.50	50.75	74.00	-23.25	40.66	27.80	8.89	36.28	9.68	109	245 PEAK	 Site : 03CH20-HY Condition: PEAK_74 3m HF_91200_02038_240729 HORIZONTAL : RBW:1000.000kHz VBW:3000.000kHz SMT:Auto <table><tr><th>Freq</th><th>Level</th><th>Limit</th><th>Read</th><th>Ant</th><th>Cable</th><th>Preamp</th><th>Aux</th><th>APos</th><th>TPos</th><th>Remark</th></tr><tr><th>MHz</th><th>dBuV/m</th><th>dBuV/m</th><th>dB</th><th>dBuV</th><th>dB/m</th><th>dB</th><th>dB</th><th>dB</th><th>cm</th><th>deg</th></tr><tr><td>1 2480.00</td><td>89.36</td><td>-----</td><td>-----</td><td>79.39</td><td>27.70</td><td>8.86</td><td>36.27</td><td>9.68</td><td>109</td><td>245 PEAK</td></tr></table>	Freq	Level	Limit	Read	Ant	Cable	Preamp	Aux	APos	TPos	Remark	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB	dB	cm	deg	1 2480.00	89.36	-----	-----	79.39	27.70	8.86	36.27	9.68	109	245 PEAK
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1 2480.00	89.36	-----	-----	79.39	27.70	8.86	36.27	9.68	109	245 PEAK																																																										
Avg.	 Site : 03CH20-HY Condition: AVG_BE_54 3m HF_91200_02038_240729 HORIZONTAL : RBW:1000.000kHz VBW:0.010kHz SMT:Auto <table><tr><th>Freq</th><th>Level</th><th>Limit</th><th>Read</th><th>Ant</th><th>Cable</th><th>Preamp</th><th>Aux</th><th>APos</th><th>TPos</th><th>Remark</th></tr><tr><th>MHz</th><th>dBuV/m</th><th>dBuV/m</th><th>dB</th><th>dBuV</th><th>dB/m</th><th>dB</th><th>dB</th><th>dB</th><th>cm</th><th>deg</th></tr><tr><td>1 2483.54</td><td>39.29</td><td>54.00</td><td>-14.71</td><td>29.28</td><td>27.74</td><td>8.86</td><td>36.27</td><td>9.68</td><td>109</td><td>245 AVERAGE</td></tr></table>	Freq	Level	Limit	Read	Ant	Cable	Preamp	Aux	APos	TPos	Remark	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB	dB	cm	deg	1 2483.54	39.29	54.00	-14.71	29.28	27.74	8.86	36.27	9.68	109	245 AVERAGE	 Site : 03CH20-HY Condition: AVG_54 3m HF_91200_02038_240729 HORIZONTAL : RBW:1000.000kHz VBW:0.010kHz SMT:Auto <table><tr><th>Freq</th><th>Level</th><th>Limit</th><th>Read</th><th>Ant</th><th>Cable</th><th>Preamp</th><th>Aux</th><th>APos</th><th>TPos</th><th>Remark</th></tr><tr><th>MHz</th><th>dBuV/m</th><th>dBuV/m</th><th>dB</th><th>dBuV</th><th>dB/m</th><th>dB</th><th>dB</th><th>dB</th><th>cm</th><th>deg</th></tr><tr><td>1 2480.00</td><td>88.89</td><td>-----</td><td>-----</td><td>78.92</td><td>27.70</td><td>8.86</td><td>36.27</td><td>9.68</td><td>109</td><td>245 AVERAGE</td></tr></table>	Freq	Level	Limit	Read	Ant	Cable	Preamp	Aux	APos	TPos	Remark	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB	dB	cm	deg	1 2480.00	88.89	-----	-----	78.92	27.70	8.86	36.27	9.68	109	245 AVERAGE
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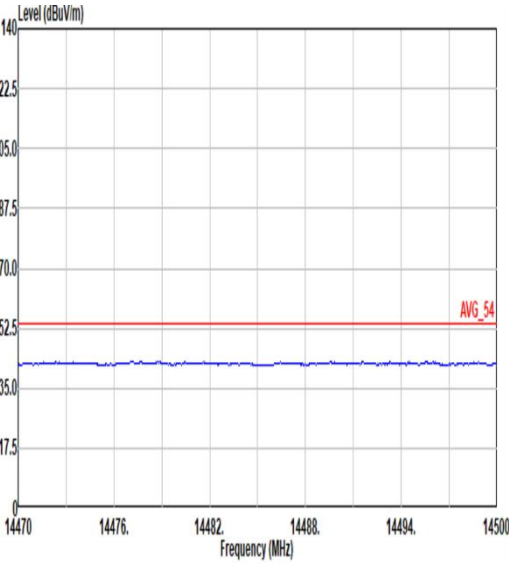
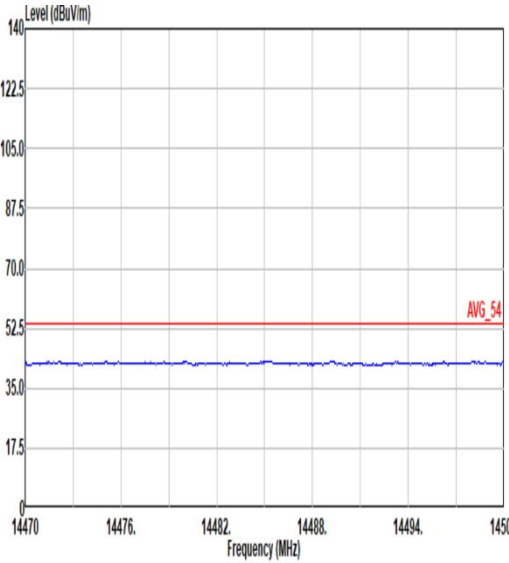
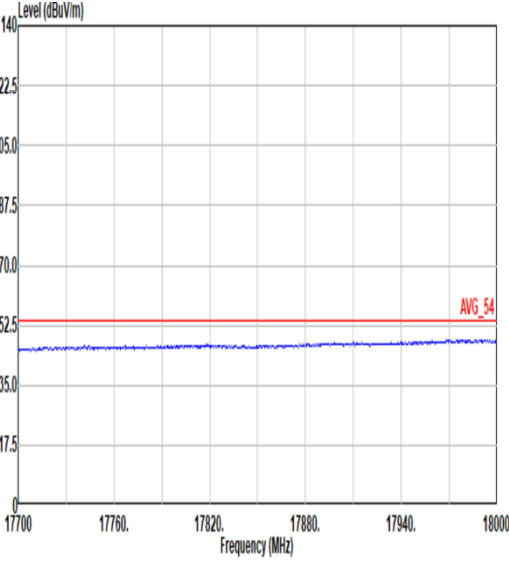
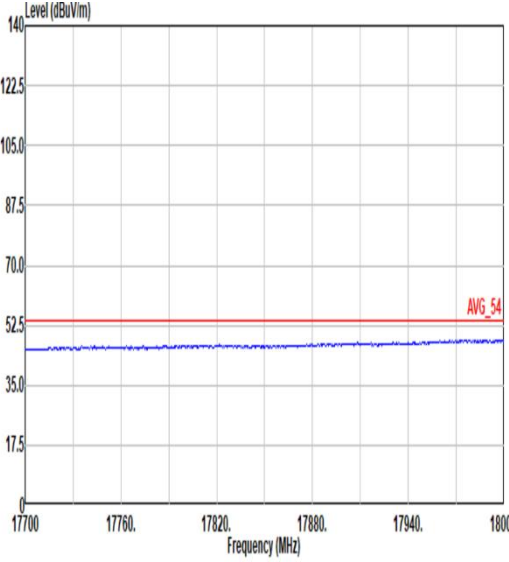
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Avg.	 Site : 03CH20-HY Condition: AVG_BE_54 3m HF_91200_02038_240729 VERTICAL : RBW:1000.000kHz VBW:0.010kHz SWT:Auto <table><thead><tr><th>Limit</th><th>Read</th><th>Ant</th><th>Cable</th><th>Preamp</th><th>Aux</th><th>APos</th><th>TPos</th><th>Remark</th></tr><tr><th>Freq Level Line Margin</th><th>Level Factor</th><th>Loss Factor</th><th>Factor</th><th>Factor</th><th></th><th></th><th></th><th></th></tr><tr><th>MHz dBuV/m dBuV/m dB dB dB dB dB cm deg</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></tr></thead><tbody><tr><td>1 2483.52 40.53 54.00 -13.47</td><td>30.52</td><td>27.74</td><td>8.86</td><td>36.27</td><td>9.68</td><td>106</td><td>172</td><td>AVERAGE</td></tr></tbody></table>	Limit	Read	Ant	Cable	Preamp	Aux	APos	TPos	Remark	Freq Level Line Margin	Level Factor	Loss Factor	Factor	Factor					MHz dBuV/m dBuV/m dB dB dB dB dB cm deg									1 2483.52 40.53 54.00 -13.47	30.52	27.74	8.86	36.27	9.68	106	172	AVERAGE	 Site : 03CH20-HY Condition: AVG_54 3m HF_91200_02038_240729 VERTICAL : RBW:1000.000kHz VBW:0.010kHz SWT:Auto <table><thead><tr><th>Limit</th><th>Read</th><th>Ant</th><th>Cable</th><th>Preamp</th><th>Aux</th><th>APos</th><th>TPos</th><th>Remark</th></tr><tr><th>Freq Level Line Margin</th><th>Level Factor</th><th>Loss Factor</th><th>Factor</th><th>Factor</th><th></th><th></th><th></th><th></th></tr><tr><th>MHz dBuV/m dBuV/m dB dB dB dB dB cm deg</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></tr></thead><tbody><tr><td>1 2480.00 95.13 -----</td><td>85.16</td><td>27.70</td><td>8.86</td><td>36.27</td><td>9.68</td><td>106</td><td>172</td><td>AVERAGE</td></tr></tbody></table>	Limit	Read	Ant	Cable	Preamp	Aux	APos	TPos	Remark	Freq Level Line Margin	Level Factor	Loss Factor	Factor	Factor					MHz dBuV/m dBuV/m dB dB dB dB dB cm deg									1 2480.00 95.13 -----	85.16	27.70	8.86	36.27	9.68	106	172	AVERAGE
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<2Mbps>

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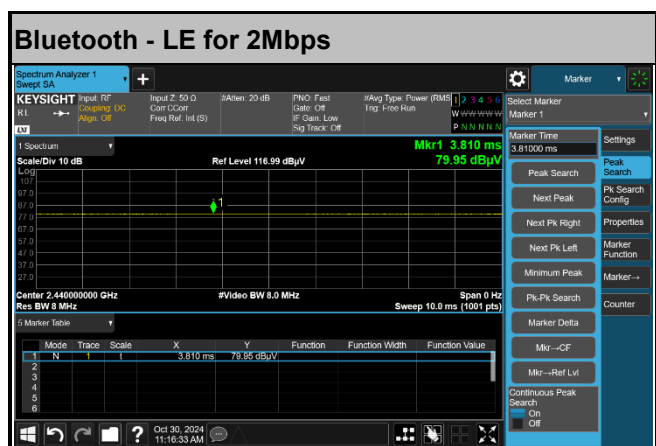


Mode	2	
	Harmonic	
	2400-2483.5_Bluetooth-LE GSKF_CH19_2440MHz	
ANT	1	
Pol.	Horizontal	Vertical
14.47G ~14.5G Avg.	 Site : 03CH20-HY Condition: AVG_54 3m HF_91200_02360_241101 HORIZONTAL	 Site : 03CH20-HY Condition: AVG_54 3m HF_91200_02360_241101 VERTICAL
	 Site : 03CH20-HY Condition: AVG_54 3m HF_91200_02360_241101 HORIZONTAL	 Site : 03CH20-HY Condition: AVG_54 3m HF_91200_02360_241101 VERTICAL



Appendix D. Duty Cycle Plots

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

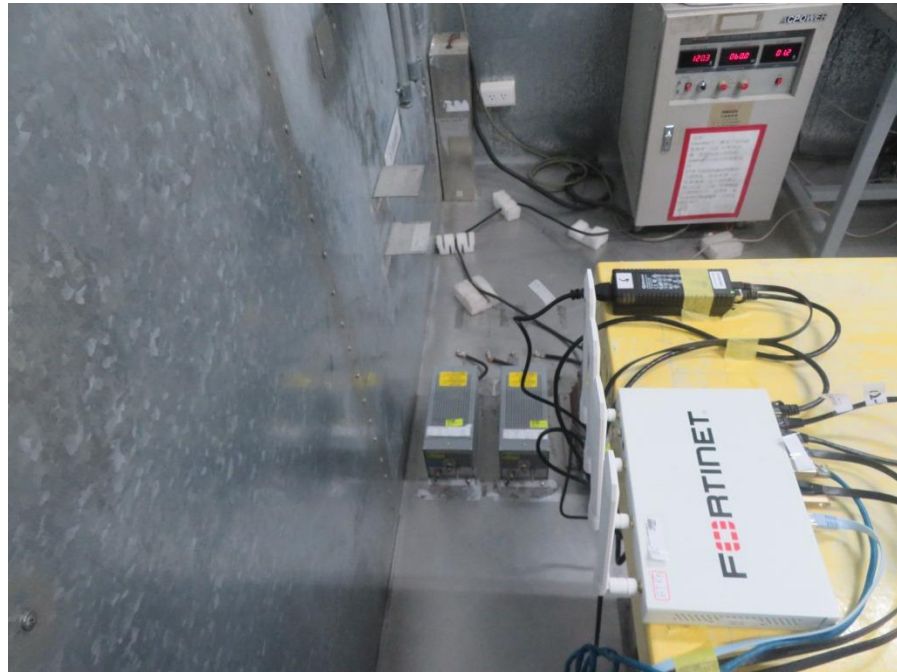


Appendix E. Setup Photographs

<Conducted Emission>

Remote View





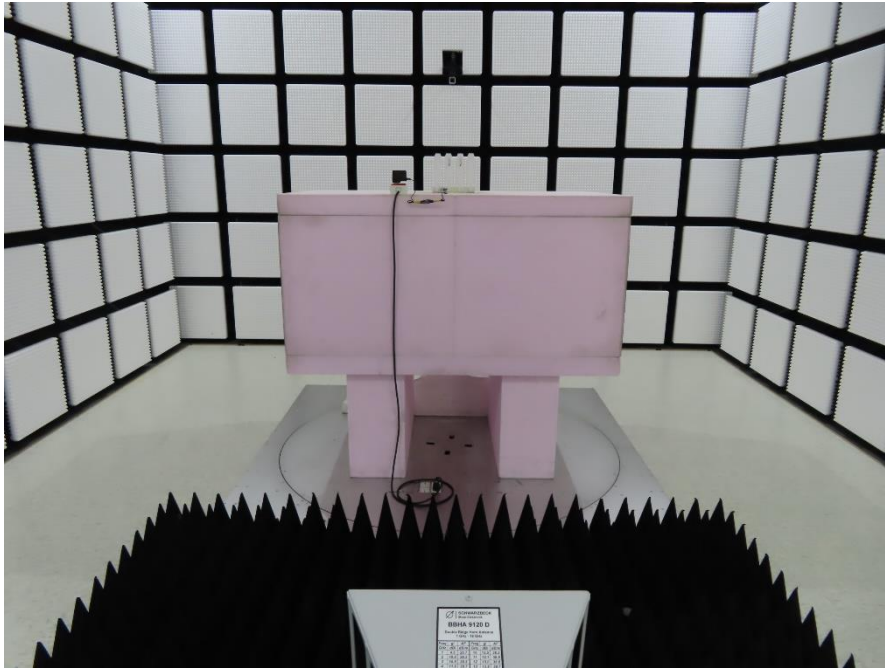
Rear View



<Radiated Emission>

Ant. 90°

HF



————THE END————