



FCC RADIO TEST REPORT

FCC ID	:	TVE-240703
Equipment	:	Secured Network Extension Device
Brand Name	:	
Model Name	:	FortiExtender 511G-WiFixxxxxxxx, FORTIEXTENDER-511G-WiFixxxxxxxx, FEX-511G-WiFixxxxxxxxx (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-WiFi
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 Sep. 11, 2024 to Oct. 30, 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 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.

Louis Wu

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.)

Page Number: 1 of 24Issue Date: Nov. 28, 2024Report Version: 01



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History of this test report

Report No.	Version	Description	Issue Date
FR490210A	01	Initial issue of report	Nov. 28, 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	1.12 dB under the limit at 7320.00 MHz
3.6	15.207	AC Conducted Emission	Pass	14.41 dB under the limit at 0.40 MHz
3.7	15.203	Antenna Requirement	Pass	-

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.

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: 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, Wi-Fi 2.4GHz 802.11b/g/n/VHT/ax, Wi-Fi 5GHz 802.11a/n/ac/ax and GNSS.			
Antenna Type			
WWAN: Dipole Antenna			
WLAN			
<ant. 1="">: Dipole Antenna</ant.>			
<ant. 2="">: Dipole Antenna</ant.>			
Bluetooth-LE: PCB Antenna			
GPS / Glonass / BDS / Galileo: Dipole Antenna			
Antenna information			

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

3.57

Peak Gain (dBi)

1.2 Modification of EUT

2400 MHz ~ 2483.5 MHz

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.		
Test Sile No.	CO05-HY (TAF Code: 1190)		
Remark The Conducted Emission test item subcontracted to Sporton Internations. 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			
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
- 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)
	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
2400-2483.5 MHz	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

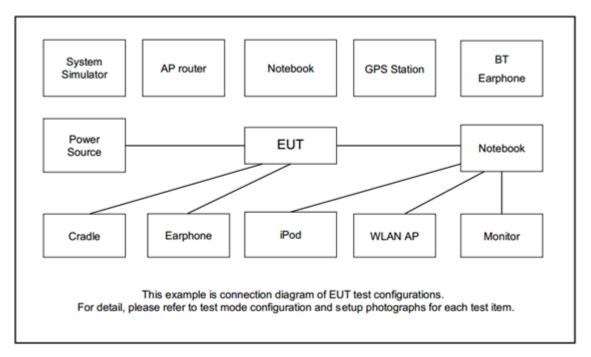
- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental 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 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.



Summary table of Test Cases				
Test Item	Data Rate / Modulation			
	Bluetooth – LE / GFSK			
	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps			
Conducted	Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps			
Test Cases	Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps			
1631 04363	Mode 4: Bluetooth Tx CH00_2402 MHz_2Mbps			
	Mode 5: Bluetooth Tx CH19_2440 MHz_2Mbps			
	Mode 6: Bluetooth Tx CH39_2480 MHz_2Mbps			
	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps			
	Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps			
Radiated	Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps			
Test Cases	Mode 4: Bluetooth Tx CH00_2402 MHz_2Mbps			
	Mode 5: Bluetooth Tx CH19_2440 MHz_2Mbps			
	Mode 6: Bluetooth Tx CH39_2480 MHz_2Mbps			
	Mode 1: Bluetooth-LE Link + WLAN (2.4GHz) Link + Console Cable with			
	Notebook + Data Link with USB Flash Drive + SFP Port load + Adapter +			
	LAN Port 2 & 3 Loop back + LAN Port 1 Link with Notebook + LAN Port 4			
AC Conducted	Link with Notebook + WAN Port Link with Notebook			
Emission	Mode 2: Bluetooth-LE Link + WLAN (2.4GHz) Link + Console Cable with			
Linission	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. The worst ca	ase of Conducted Emission is mode 2; only the test data of it was reported.			
	ith USB Flash Drive means data application transferred mode between EUT and			
USB Flash [
	n spurious emission, the modulation and the data rate picked for testing are by the Max. RF conducted power.			



2.3 Connection Diagram of Test System



2.4 Support Unit used in test configuration and system

ltem	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.	PC	MSI	Aegis-B918	FCC DoC	N/A	Unshielded, 1.8m
4.	Mobile Phone	Samsung	GT-N7000	A3LSMA730F	N/A	N/A
5.	USB Flash Drive	Kingston	DTSE9	FCC DoC	N/A	N/A
6.	POE Adapter	MICROSEMI	PD-9001GR/AT/AC	FCC DoC	N/A	N/A
7.	Adapter	APD	WA-36W12R	N/A	N/A	Unshielded, 1.8m



2.5 EUT Operation Test Setup

The RF test items, utility "Tera Term 4.105" 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.

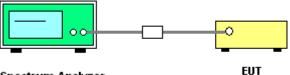
3.1.2 Measuring Instruments

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.
- 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) \ge 3 * RBW.
- 6. Measure and record the results in the test report.

3.1.4 Test Setup



Spectrum Analyzer

3.1.5 Test Result of 6dB Bandwidth

Please refer to Appendix A.

3.1.6 Test Result of 99% Occupied Bandwidth



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.

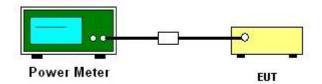
3.2.2 Measuring Instruments

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



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.

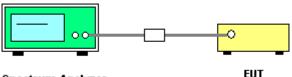
3.3.2 Measuring Instruments

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.
- 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



Spectrum Analyzer

3.3.5 Test Result of Power Spectral Density

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.

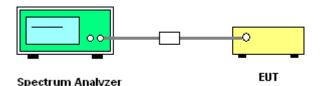
3.4.2 Measuring Instruments

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

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	Field Strength	Measurement Distance
(MHz)	(microvolts/meter)	(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.

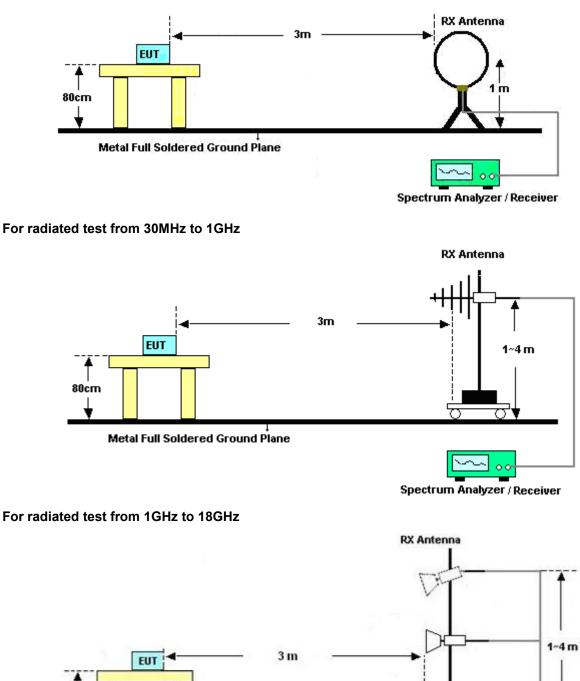
3.5.3 Test Procedures

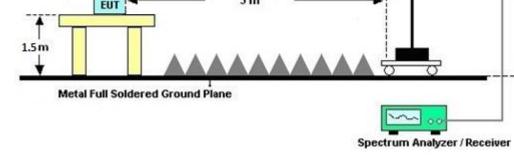
- 1. The testing follows the ANSI C63.10 Section 11.12.1 Radiated emission measurements.
- 2. The EUT is arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for 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 \geq 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

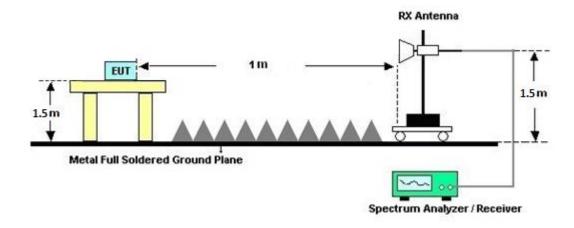
For radiated test below 30MHz







For radiated test 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 C.

3.5.7 Duty Cycle

Please refer to Appendix D.

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



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 (dBµV)
Frequency of emission (MHZ)	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

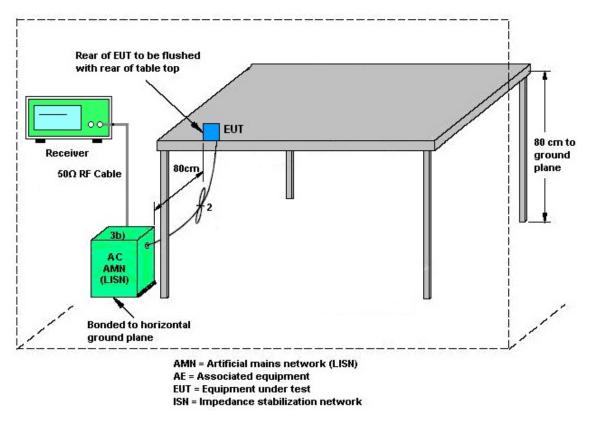
Please refer to the measuring equipment list in this test report.

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.
- 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



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	Sep. 20, 2024~ Oct. 30, 2024	Sep. 02, 2025	Radiation (03CH20-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Aug. 29, 2024	Sep. 20, 2024~ Oct. 30, 2024	Aug. 28, 2025	
Preamplifier	EMEC	EM18G40G	060801	18GHz~40GHz	May 27, 2024	Sep. 20, 2024~ Oct. 30, 2024	May 26, 2025	Radiation (03CH20-HY)
Controller	ChainTek	3000-1	N/A	Control Turn table & Ant Mast	N/A	Sep. 20, 2024~ Oct. 30, 2024	N/A	Radiation (03CH20-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Sep. 20, 2024~ Oct. 30, 2024	N/A	Radiation (03CH20-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Sep. 20, 2024~ Oct. 30, 2024	N/A	Radiation (03CH20-HY)
Signal Analyzer	Keysight	N9010B	MY60240520	N/A	Dec. 12, 2023	Sep. 20, 2024~ Oct. 30, 2024	Dec. 11, 2024	Radiation (03CH20-HY)
Bilog Antenna	TESEQ	CBL 6111D&00802N1 D01N-06	55606 & 08	30MHz~1GHz	Oct. 20, 2023	Sep. 20, 2024~ Oct. 09, 2024	Oct. 19, 2024	Radiation (03CH20-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01N-06	41912 & 05	30MHz~1GHz	Feb. 04, 2024	Oct. 10, 2024~ Oct. 30, 2024	Feb. 03, 2025	Radiation (03CH20-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	02360	1GHz-18GHz	Oct. 30, 2023	Sep. 20, 2024~ Oct. 09, 2024	Oct. 29, 2024	Radiation (03CH20-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-02038	1GHz~18GHz	Jul. 29, 2024	Oct. 10, 2024~ Oct. 30, 2024	Jul. 28, 2025	Radiation (03CH20-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	1224	18GHz-40GHz	Jun. 24, 2024	Sep. 20, 2024~ Oct. 30, 2024	Jun. 23, 2025	Radiation
Preamplifier	COM-POWER	PAM-103	18020201	1MHz-1000MHz	Jan. 01, 2024	Sep. 20, 2024~ Oct. 30, 2024	Dec. 31, 2024	Radiation (03CH20-HY)
Amplifier	EMCI	EMC118A45SE	980792	N/A	Nov. 13, 2023	Sep. 20, 2024~ Oct. 30, 2024	Nov. 12, 2024	Radiation (03CH20-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	519229/2,8040 15/2,804027/2	N/A	Jan. 17, 2024	Sep. 20, 2024~ Oct. 30, 2024	Jan. 16, 2025	Radiation (03CH20-HY)
Hygrometer	TECPEL	DTM-303A	TP211382	N/A	Mar. 27, 2024	Sep. 20, 2024~ Oct. 30, 2024	Mar. 26, 2025	Radiation (03CH20-HY)
Software	Audix	N/A	RK-002156	N/A	N/A	Sep. 20, 2024~ Oct. 30, 2024	N/A	Radiation (03CH20-HY)
Hygrometer	TECPEL	DTM-303A	TP201996	N/A	Nov. 07, 2023	Sep. 11, 2024~ Oct. 24, 2024	Nov. 06, 2024	Conducted (TH05-HY)
Power Sensor	DARE	RPR3006W	17I00015SNO 35 (NO:109)	10MHz~6GHz	Jan. 15, 2024	Sep. 11, 2024~ Oct. 24, 2024	Jan. 14, 2025	Conducted (TH05-HY)
Signal Analyzer	Rohde & Schwarz	FSV40	101566	10Hz~40GHz	Aug. 23, 2024	Sep. 11, 2024~ Oct. 24, 2024	Aug. 22, 2025	Conducted (TH05-HY)
Switch Control Mainframe	Burgeon	ETF-058	EC1300484 (BOX3)	N/A	May 20, 2024	Sep. 11, 2024~ Oct. 24, 2024	May 19, 2025	Conducted (TH05-HY)
Software	Sporton	BTWIFI_Final_ver sion 240513	N/A	Conducted Other Test Item	N/A	Sep. 11, 2024~ Oct. 24, 2024	N/A	Conducted (TH05-HY)
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Oct. 17, 2024~ Oct. 21, 2024	N/A	Conduction (CO05-HY)
EMI Test Receiver	Rohde & Schwarz	ESR3	102388	9kHz~3.6GHz	Dec. 06, 2023	Oct. 17, 2024~ Oct. 21, 2024	Dec. 05, 2024	Conduction (CO05-HY)
Hygrometer	Testo	608-H1	34913912	N/A	Oct. 26, 2023	Oct. 17, 2024~ Oct. 21, 2024	Oct. 25, 2024	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100081	9kHz~30MHz	Nov. 22, 2023	Oct. 17, 2024~ Oct. 21, 2024	Nov. 21, 2024	Conduction (CO05-HY)
Software	Rohde & Schwarz	EMC32	N/A	N/A	N/A	Oct. 17, 2024~ Oct. 21, 2024	N/A	Conduction (CO05-HY)
Pulse Limiter	SCHWARZBECK	VTSD 9561-F N	00691	N/A	Jul. 30, 2024	Oct. 17, 2024~ Oct. 21, 2024	Jul. 29, 2025	Conduction (CO05-HY)
RF Cable	HUBER + SUHNER	RG 214/U	1358175	9kHz~30MHz	Mar. 14, 2024	Oct. 17, 2024~ Oct. 21, 2024	Mar. 13, 2025	Conduction (CO05-HY)

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: 01



5 Measurement Uncertainty

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

Measuring Uncertainty for a Level of Confidence	3.7 dB
of 95% (U = 2Uc(y))	5.7 UB

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

Measuring Uncertainty for a Level of Confidence	6.7 dB
of 95% (U = 2Uc(y))	0.7 UB

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

Measuring Uncertainty for a Level of Confidence	5.4 dB
of 95% (U = 2Uc(y))	5.4 UB

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

Measuring Uncertainty for a Level of Confidence	5.6 dB
of 95% (U = 2Uc(y))	5.8 dB

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

Measuring Uncertainty for a Level of Confidence	5.7 dB
of 95% (U = 2Uc(y))	5.7 UB

Report Number : FR490210A

Appendix A. Test Result of Conducted Test Items

Test Engineer:	Kevin Xiao	Temperature:	21~25	°C
Test Date:	2024/09/11~2024/10/24	Relative Humidity:	51~54	%

	TEST RESULTS DATA 6dB and 99% Occupied Band								
N	vlod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
I	BLE	1Mbps	1	0	2402	1.020	0.673	0.50	Pass
I	BLE	1Mbps	1	19	2440	1.021	0.669	0.50	Pass
I	BLE	1Mbps	1	39	2480	1.022	0.666	0.50	Pass

						<u>RESULTS</u> ge Power				
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	7.20	30.00	3.57	10.77	36.00	Pass
BLE	1Mbps	1	19	2440	4.80	30.00	3.57	8.37	36.00	Pass
BLE	1Mbps	1	39	2480	5.00	30.00	3.57	8.57	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	6.56	-8.85	3.57	8.00	Pass
BLE	1Mbps	1	19	2440	3.82	-11.57	3.57	8.00	Pass
BLE	1Mbps	1	39	2480	4.07	-11.27	3.57	8.00	Pass

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

Report Number : FR490210A

<u>TEST RESULTS DATA</u> 6dB and 99% Occupied Bandwi								
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	2.044	1.376	0.50	Pass
BLE	2Mbps	1	19	2440	2.045	1.376	0.50	Pass
BLE	2Mbps	1	39	2480	2.048	1.372	0.50	Pass

TEST RESULTS DATA

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	7.20	30.00	3.57	10.77	36.00	Pass
BLE	2Mbps	1	19	2440	5.30	30.00	3.57	8.87	36.00	Pass
BLE	2Mbps	1	39	2480	6.10	30.00	3.57	9.67	36.00	Pass

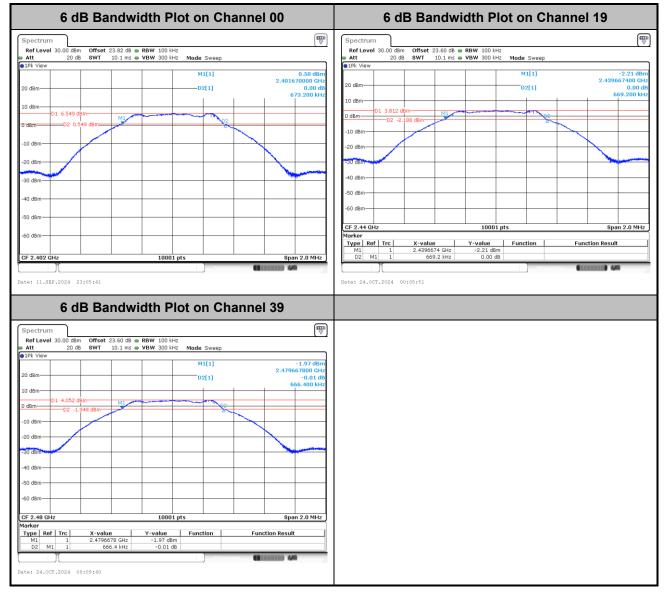
							ESULTS I Power Dei		
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak PSD (dBm /100kHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail
BLE	2Mbps	1	0	2402	4.42	-14.95	3.57	8.00	Pass
BLE	2Mbps	1	19	2440	2.16	-17.21	3.57	8.00	Pass
BLE	2Mbps	1	39	2480	2.99	-16.36	3.57	8.00	Pass

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



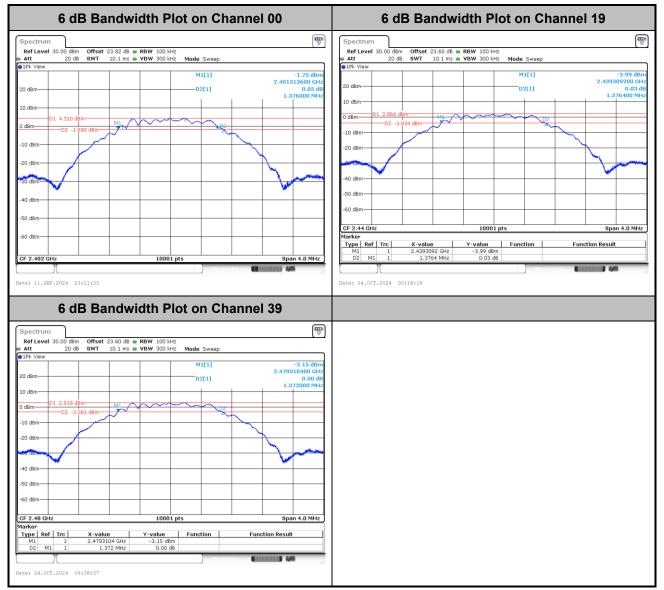
6dB Bandwidth

<1Mbps>





<2Mbps>

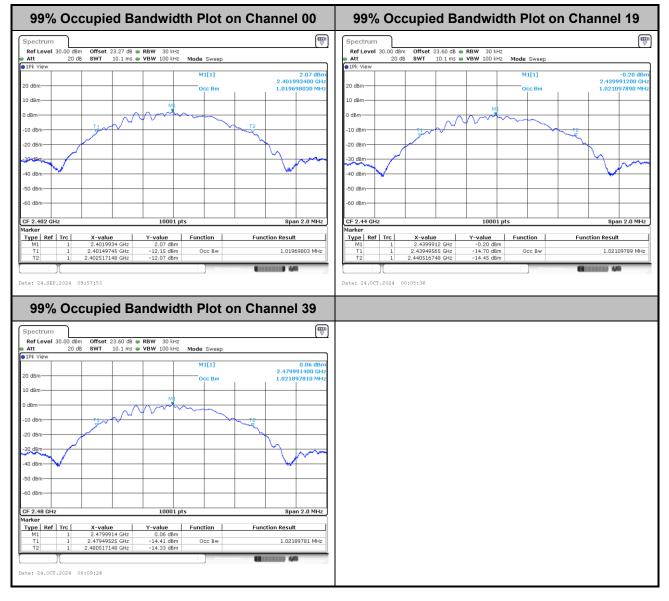






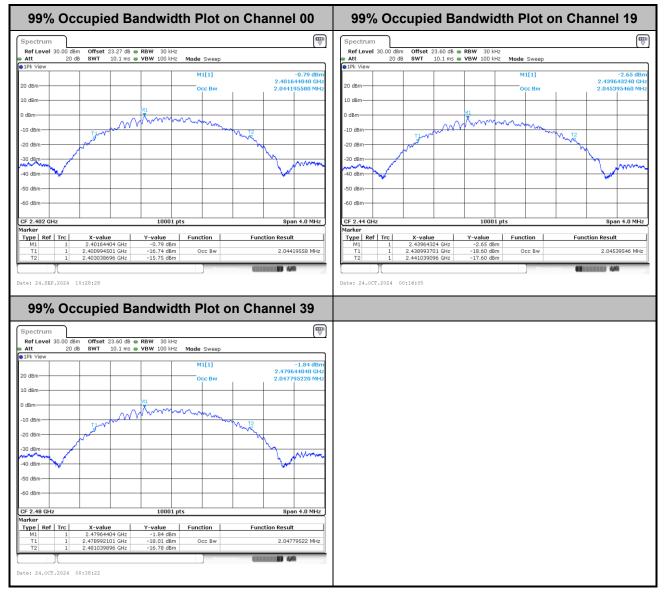
99% Occupied Bandwidth

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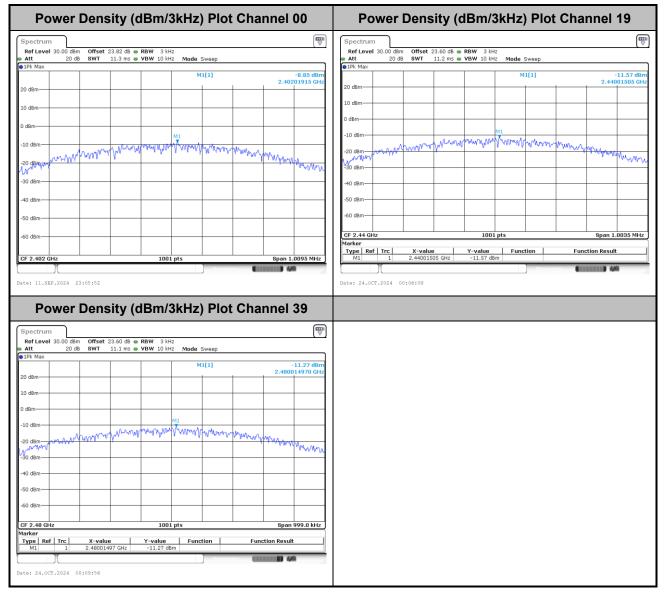
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Power Spectral Density (dBm/3kHz)

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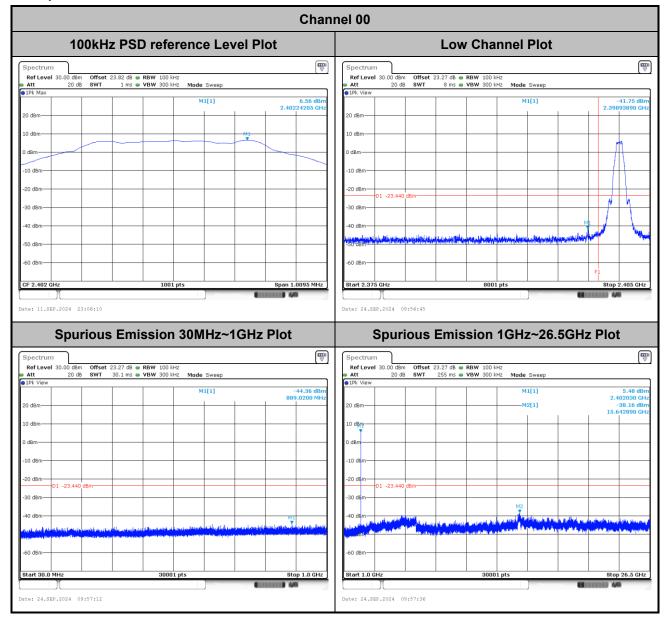
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Spectrum Spectrum Rof Lavel 30.00 dBm Offset 23.82 dB RBW 3 kHz Att 20 dB SWT 23 ms VBW 10 kHz Mode Sweep 0 IPk Max M1[1] -14.95 dBm 20 dB SWT 23 ms VBW 10 kHz 0 dBm 0 dBm <th>M1[1] -17.21 dBm 2.44007010 GHz M1</th>	M1[1] -17.21 dBm 2.44007010 GHz M1
Ref Level 30.00 dBm Offset 23.82 db BBW 3 Hz Att 20 dB SWT 23 ms VBW 10 Hz Mode Swep In the second secon	Mode Sweep M1[1] -17.21 dBm 2.44007010 GHz M1 M2 M3 M3 M4 M4
	M1[1] -17.21 dBm 2.44007010 GHz M1
20 dem 2.40207630 GHz 10 dem 10 dem 0 dem 10 dem 0 dem 10 dem -10 dem 10 dem -20 dem 10 dem -10 dem 10 dem -20 dem 10 dem -10 dem 10 dem -20 dem 10 dem -20 dem 10 dem -10 dem 10 dem -20 dem <th>2.44007010 GHz</th>	2.44007010 GHz
10 dBm 10 dBm 10 dBm 10 dBm 10 dBm 10 dBm 0 dBm 10 dBm 10 dBm 10 dBm 10 dBm 10 dBm 10 dBm 10 dBm 10 dBm 20 dBm 10 dBm 10 dBm 10 dBm 30 dBm 10 dBm 10 dBm 10 dBm 40 dBm 10 dBm 10 dBm 10 dBm 50 dBm 10 dBm 10 dBm 10 dBm 60 dBm 10 dBm 10 dBm 10 dBm 40 dBm 10 dBm 10 dBm 10 dBm 10 dBm 10 dBm 10 dBm	pts Span 2.064 MHz
0 dBm	pts Span 2.064 MHz
-10 dBm	pts Span 2.064 MHz
-20 dbm -20 dbm -20 dbm -30 dbm -40 dbm -50 dbm -60 dbm -60 dbm -60 dbm -50	pts Span 2.064 MHz
-20 dBm -30 dBm -40 dBm -50 dBm -60 dBm -60 dBm -50 dBm -50 dBm -50 dBm -50 dBm -60 dBm -50	Function Function Result
30 dsm	Function Function Result
-40 dBm	Function Function Result
-50 dBm	Function Function Result
-60 dBm	Function Function Result
Marker Type Ref Trc X-value Y-value	Function Function Result
CF 2.402 GHz 1001 pts Span 2.064 MHz Type Ref Trc X-value Y-value M1 1 2.4400701 GHz -17.21 dBm	Function Function Result
Power Density (dBm/3kHz) Plot Channel 39	
RefLevel 30.00 dBm Offset 23.60 dB RBW 3 kHz Att 20 dB SWT 22.9 ms VBW 10 kHz	
20 d8m 2.48007400 GHz	
10 dBm	
0 dBm	
-10 dBm	
-20 d8m	
30 dBm	
-40 dBm-	
-50 dBm	
-60 dBm	
CF 2.48 GHz 1001 pts Span 2.058 MHz Marker	
Type Ref Trc X-value Y-value Function Function Result M1 1 2.480074 GHz -16.36 dBm	
Meanwine Carlos A	
ate: 24.0CT.2024 00:39:02	

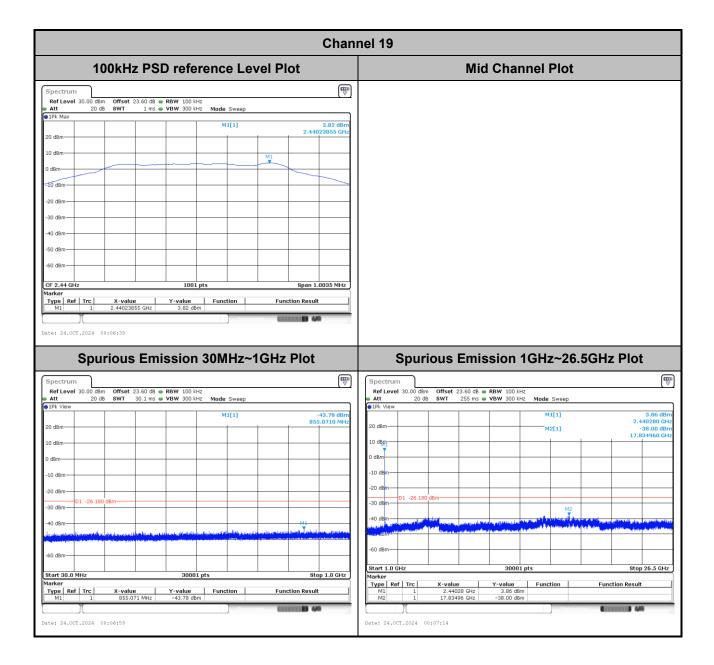


Band Edge and Conducted Spurious Emission

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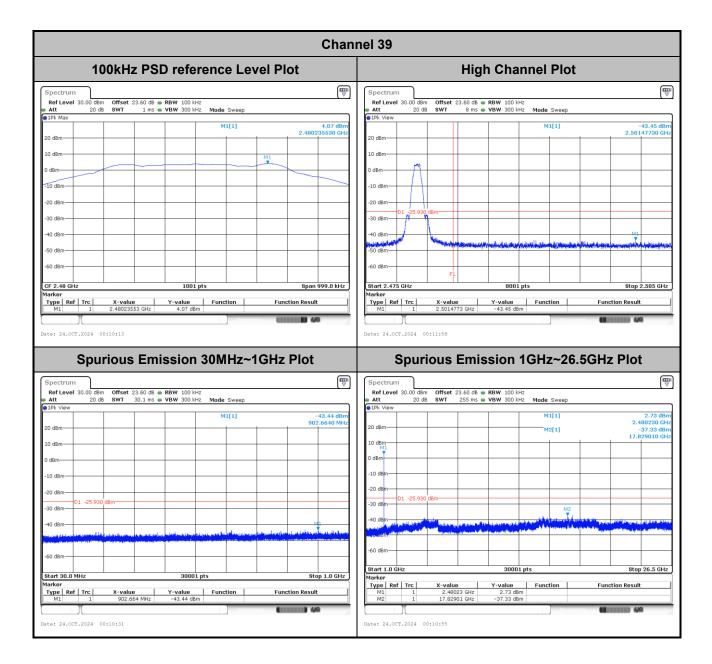






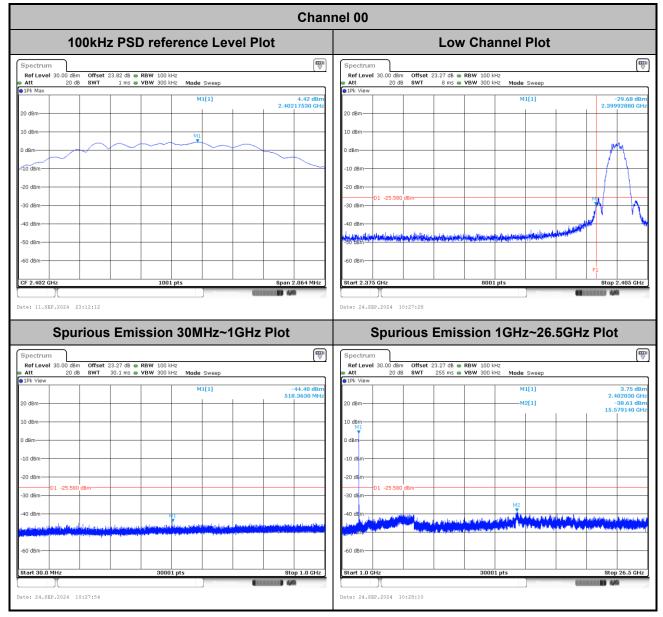




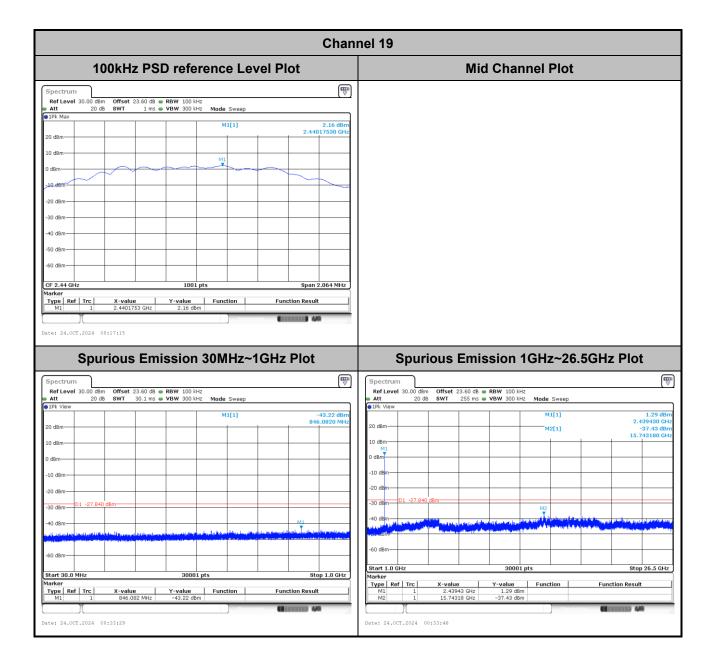




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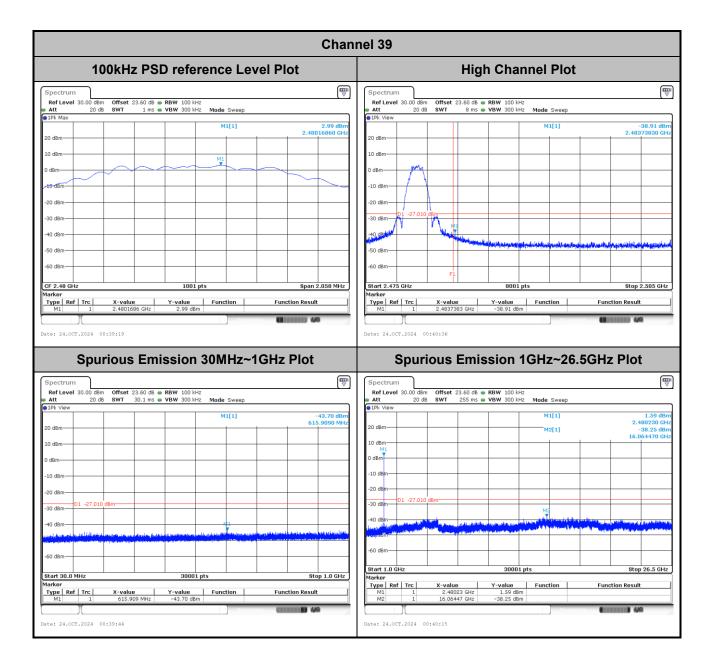












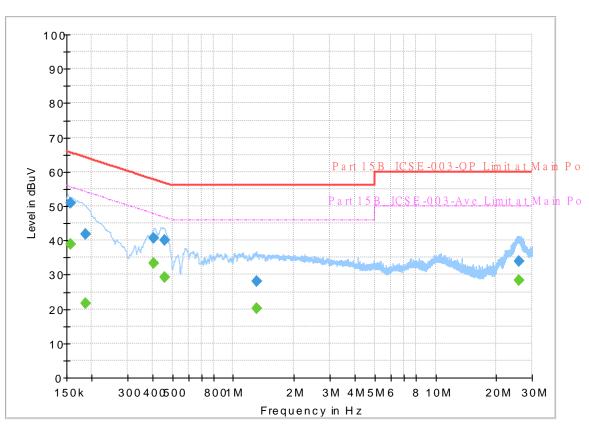


Appendix B. AC Conducted Emission Test Results

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

EUT Information

Report NO : Test Mode : Test Voltage : Phase : 490210 Mode 2 120Vac/60Hz Line



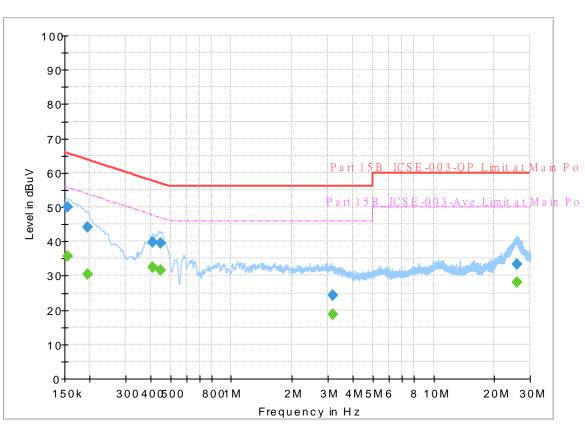
FullSpectrum

Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.156750		38.94	55.63	16.69	L1	OFF	19.8
0.156750	50.87		65.63	14.76	L1	OFF	19.8
0.186000		21.74	54.21	32.47	L1	OFF	19.8
0.186000	41.85		64.21	22.36	L1	OFF	19.8
0.402000		33.40	47.81	14.41	L1	OFF	19.8
0.402000	40.59		57.81	17.22	L1	OFF	19.8
0.456000		29.25	46.77	17.52	L1	OFF	19.8
0.456000	40.07		56.77	16.70	L1	OFF	19.8
1.299750		20.10	46.00	25.90	L1	OFF	19.8
1.299750	28.01		56.00	27.99	L1	OFF	19.8
25.939500		28.32	50.00	21.68	L1	OFF	20.0
25.939500	33.84		60.00	26.16	L1	OFF	20.0

EUT Information

Report NO : Test Mode : Test Voltage : Phase : 490210 Mode 2 120Vac/60Hz Neutral



FullSpectrum

Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.154500		35.75	55.75	20.00	Ν	OFF	19.8
0.154500	50.12		65.75	15.63	Ν	OFF	19.8
0.195000		30.51	53.82	23.31	Ν	OFF	19.8
0.195000	44.14		63.82	19.68	Ν	OFF	19.8
0.408750		32.51	47.67	15.16	Ν	OFF	19.8
0.408750	39.91		57.67	17.76	Ν	OFF	19.8
0.449250		31.70	46.89	15.19	Ν	OFF	19.8
0.449250	39.59		56.89	17.30	Ν	OFF	19.8
3.162750		18.71	46.00	27.29	Ν	OFF	19.8
3.162750	24.24		56.00	31.76	Ν	OFF	19.8
26.007000		27.97	50.00	22.03	Ν	OFF	20.2
26.007000	33.24		60.00	26.76	Ν	OFF	20.2



Appendix C. Radiated Spurious Emission Test Data

Test Engineer :	John Chuang, David Dai and Sam Chou	Temperature :	19.8~23.6°C	
	John Chuang, David Dai and Sam Chou	Relative Humidity :	64.8~70.5%	
	Note symbol			
	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 GSFK	00	2402	1Mbps	-	-
Mode 2	2400-2483.5	1	Bluetooth-LE GSFK	19	2440	1Mbps	-	-
Mode 3	2400-2483.5	1	Bluetooth-LE GSFK	39	2480	1Mbps	-	-
Mode 4	2400-2483.5	1	Bluetooth-LE GSFK	00	2402	2Mbps	-	-
Mode 5	2400-2483.5	1	Bluetooth-LE GSFK	19	2440	2Mbps	-	-
Mode 6	2400-2483.5	1	Bluetooth-LE GSFK	39	2480	2Mbps	-	-
Mode 7	2400-2483.5	1	Bluetooth-LE GSFK	19	2440	2Mbps	-	LF
Mode 8	2400-2483.5	1	Bluetooth-LE GSFK	19	2440	2Mbps	-	SHF

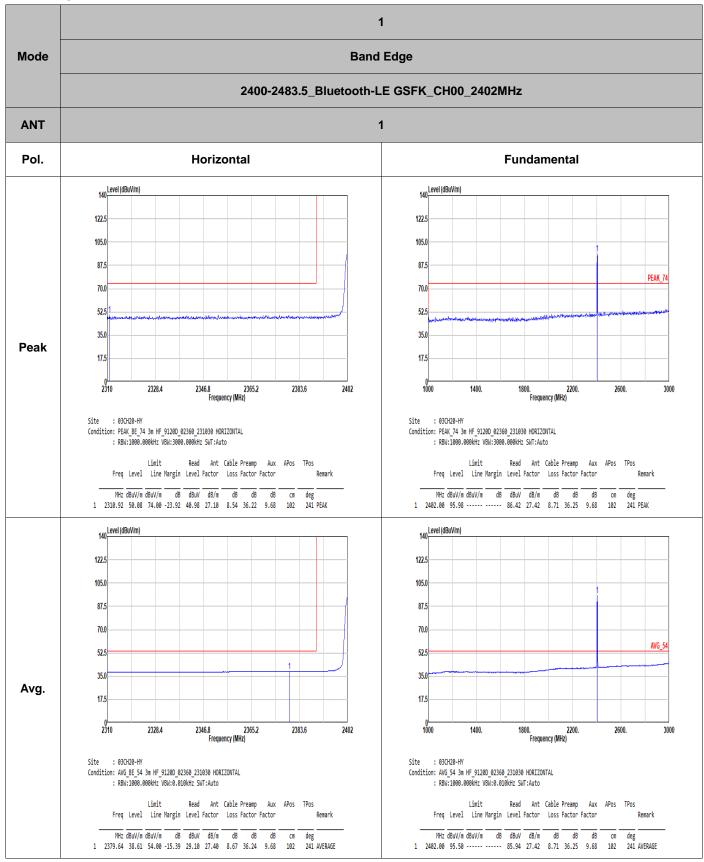


C2. Summary of each worse mode

N4 - 1 -			Freq.	Level	Limit	Margin	Del	Peak	Desself	БЦ	Demail
Mode	Modulation	Ch.	(MHz)	(dBuV/m)	(dBuV/m)	(dB)	Pol.	Avg.	Result RU	RU	Remark
1	Bluetooth-LE GSFK	00	2377.80	38.64	54.00	-15.36	V	Avg.	Pass	-	Band Edge
	Bluetooth-LE GSFK	00	4804.00	44.91	74.00	-29.09	Н	Peak	Pass	-	Harmonic
2	Bluetooth-LE GSFK	19	2492.62	38.81	54.00	-15.19	V	Avg.	Pass	-	Band Edge
	Bluetooth-LE GSFK	19	7320.00	52.43	54.00	-1.57	V	Avg.	Pass	-	Harmonic
3	Bluetooth-LE GSFK	39	2483.52	42.81	54.00	-11.19	V	Avg.	Pass	-	Band Edge
3	Bluetooth-LE GSFK	39	7440.00	52.48	54.00	-1.52	V	Avg.	Pass	-	Harmonic
4	Bluetooth-LE GSFK	00	2389.58	38.51	54.00	-15.49	Н	Avg.	Pass	-	Band Edge
4	Bluetooth-LE GSFK	00	4804.00	43.95	74.00	-30.05	V	Peak	Pass	-	Harmonic
5	Bluetooth-LE GSFK	19	2490.70	38.86	54.00	-15.14	V	Avg.	Pass	-	Band Edge
5	Bluetooth-LE GSFK	19	7320.00	52.88	54.00	-1.12	V	Avg.	Pass	-	Harmonic
6	Bluetooth-LE GSFK	39	2483.52	52.75	54.00	-1.25	V	Avg.	Pass	-	Band Edge
6	Bluetooth-LE GSFK	39	7440.00	52.87	54.00	-1.13	V	Avg.	Pass	-	Harmonic
7	LF	19	708.03	38.23	46.00	-7.77	V	Peak	Pass	-	LF
8	SHF	19	25888.00	43.62	74.00	-30.38	V	Peak	Pass	-	SHF



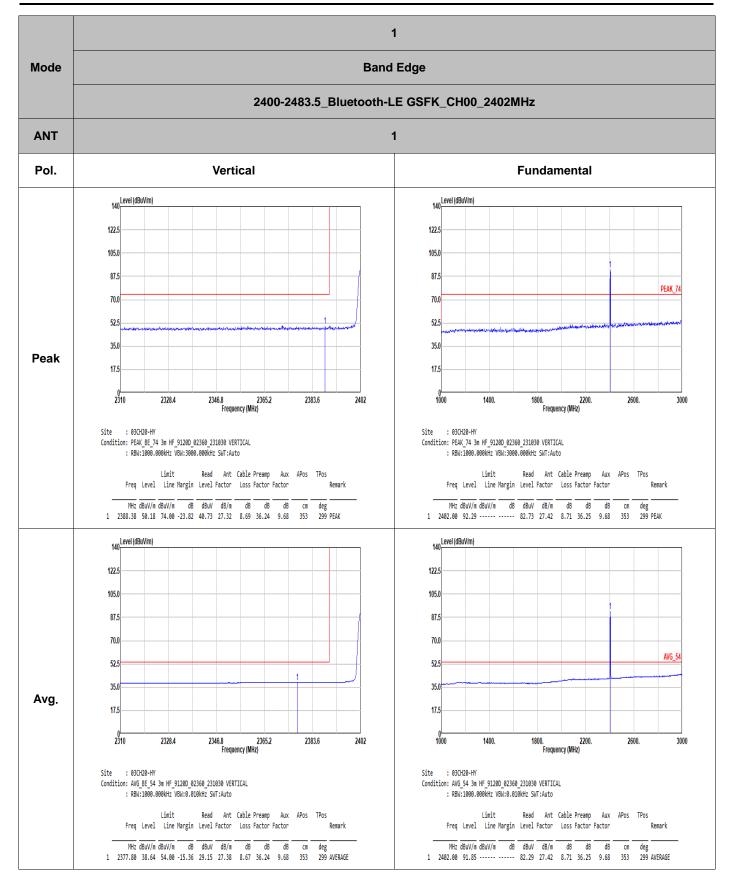
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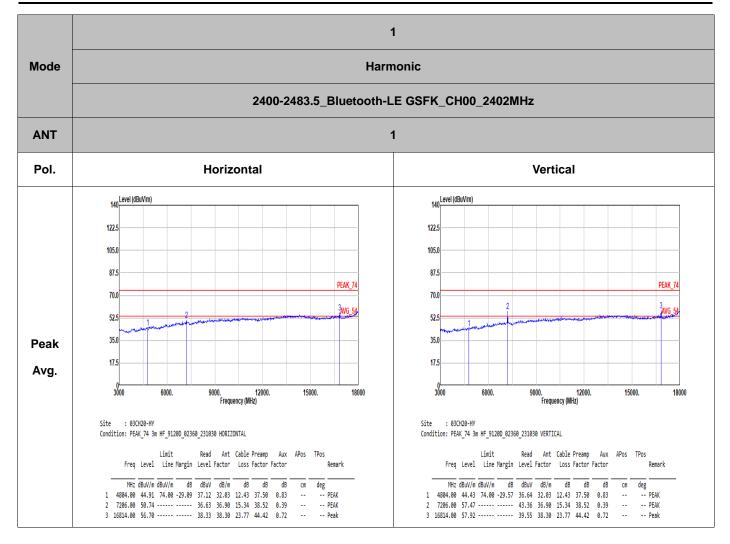
TEL: 886-3-327-0868

FAX: 886-3-327-0855

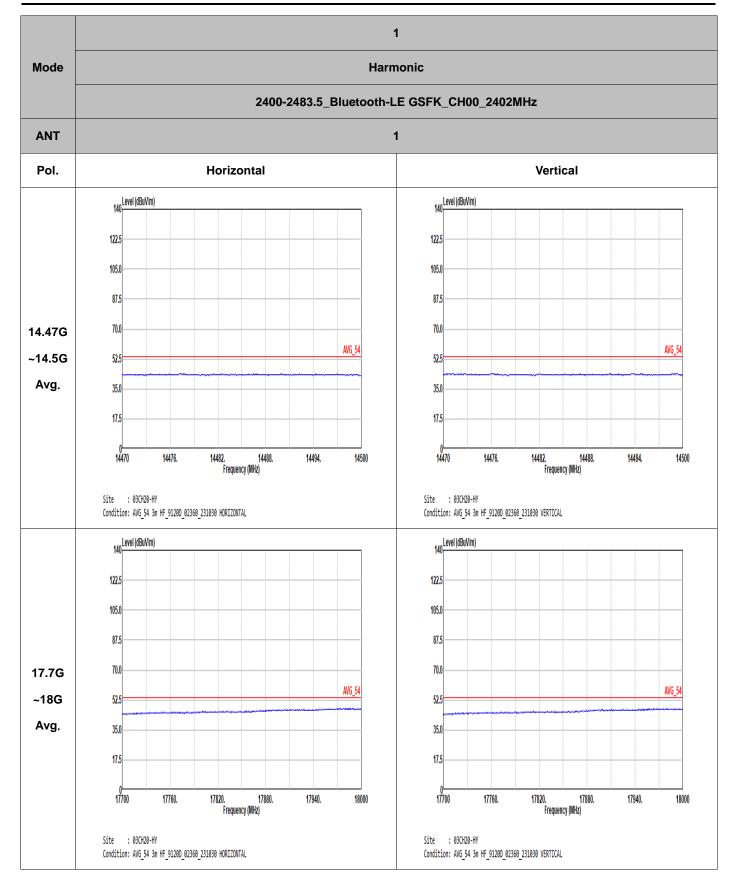




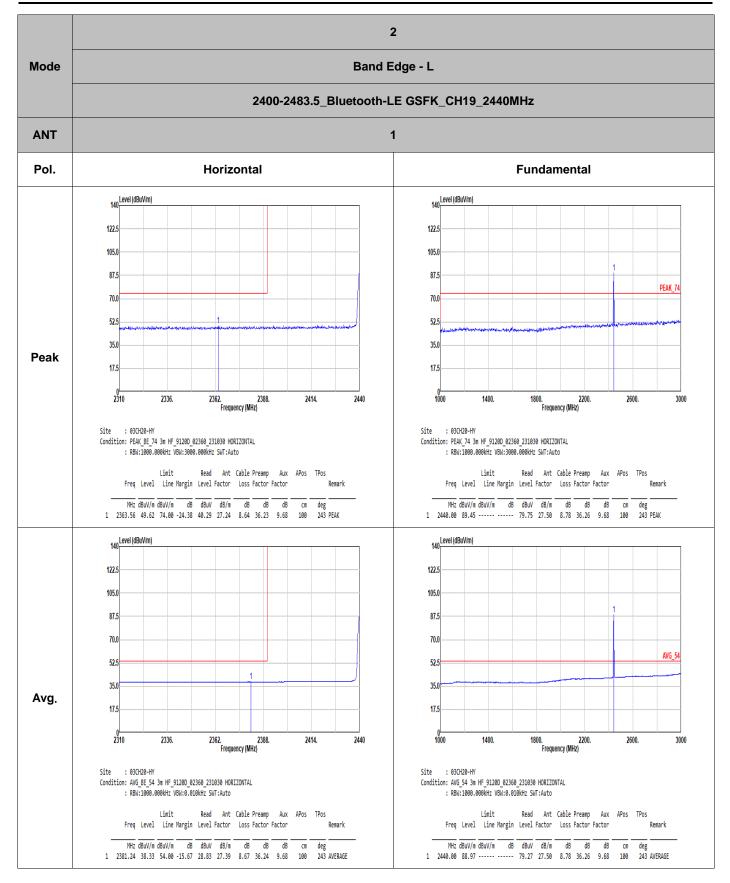




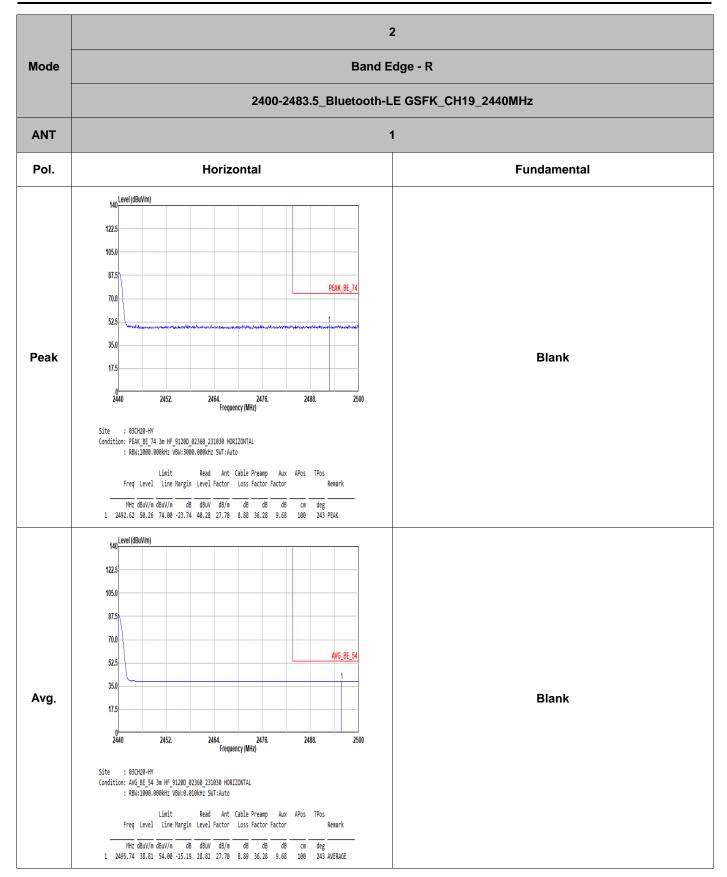




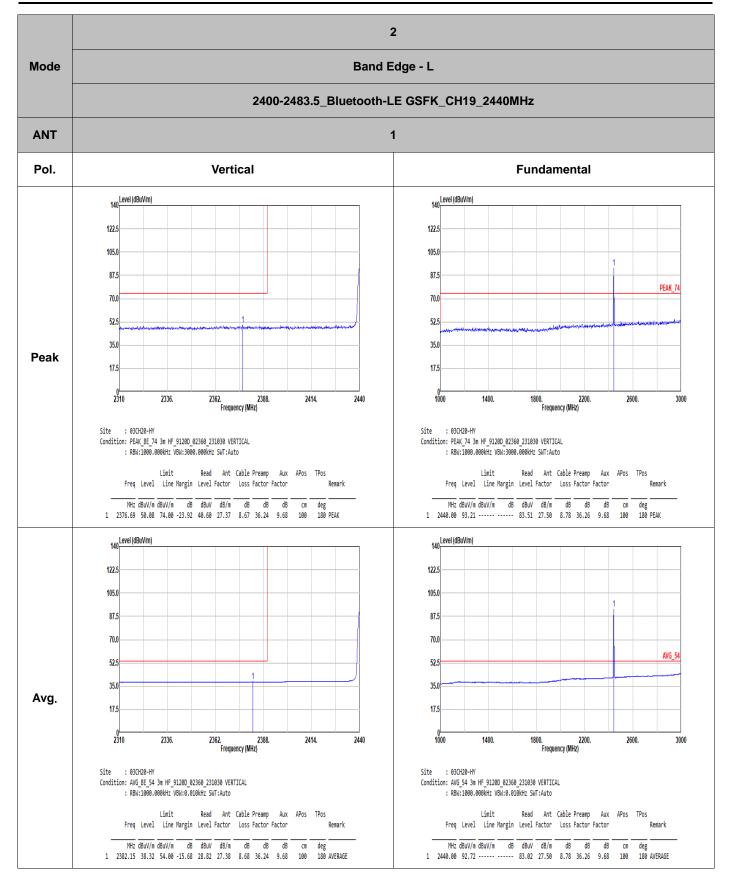




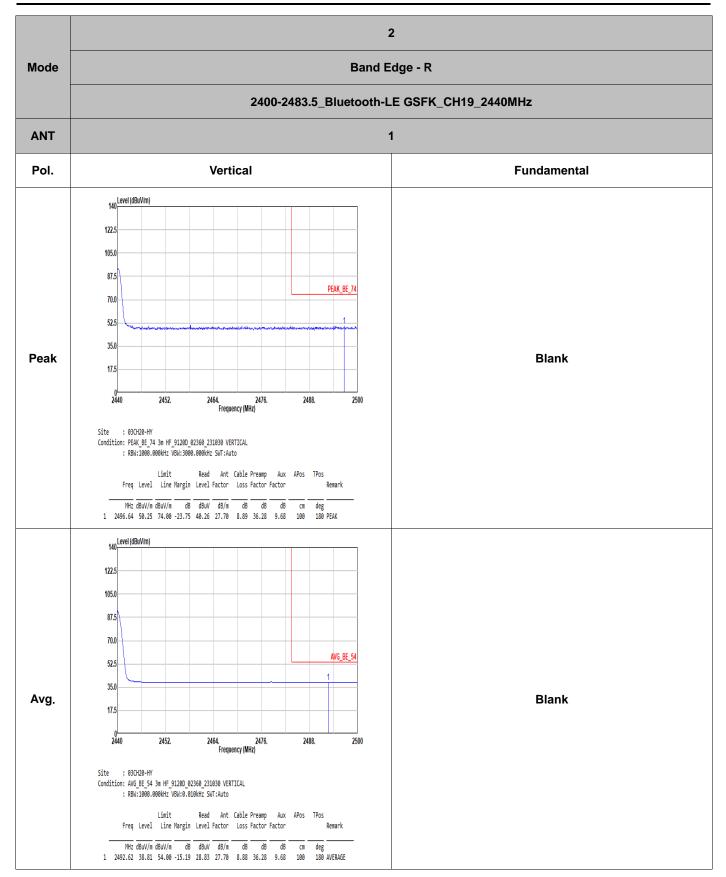




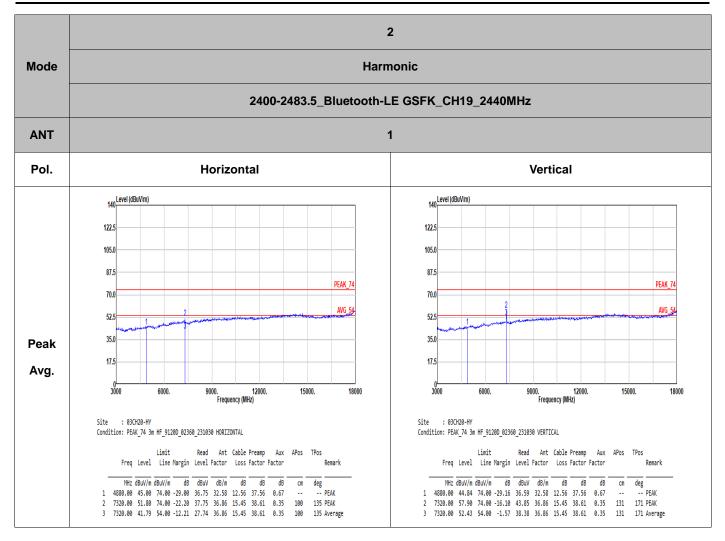




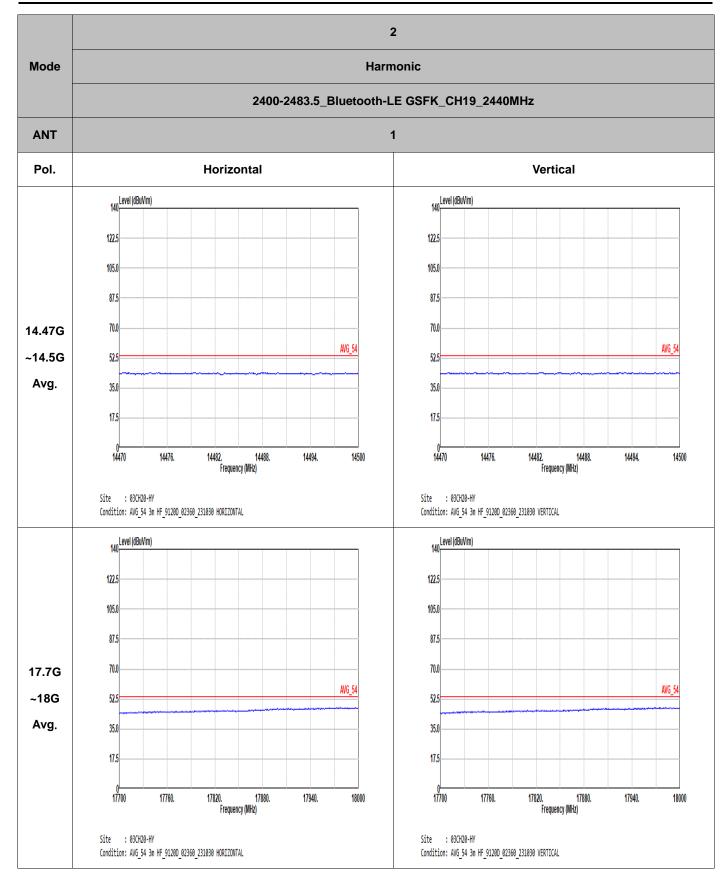




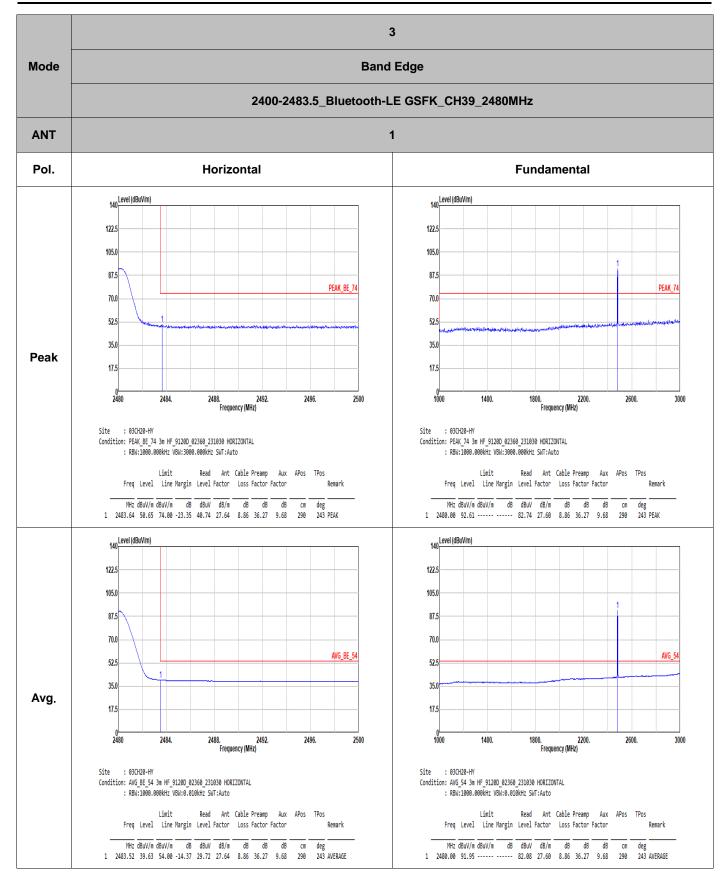




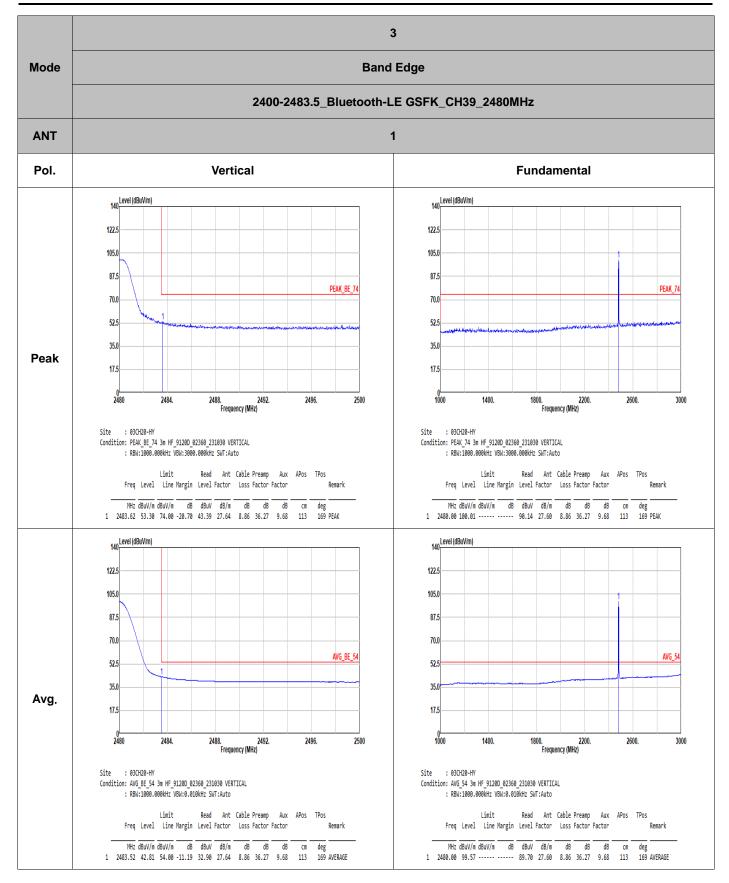




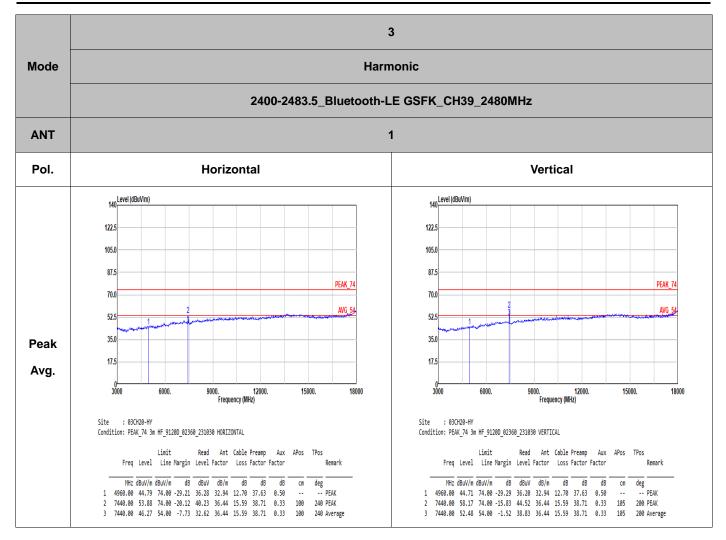




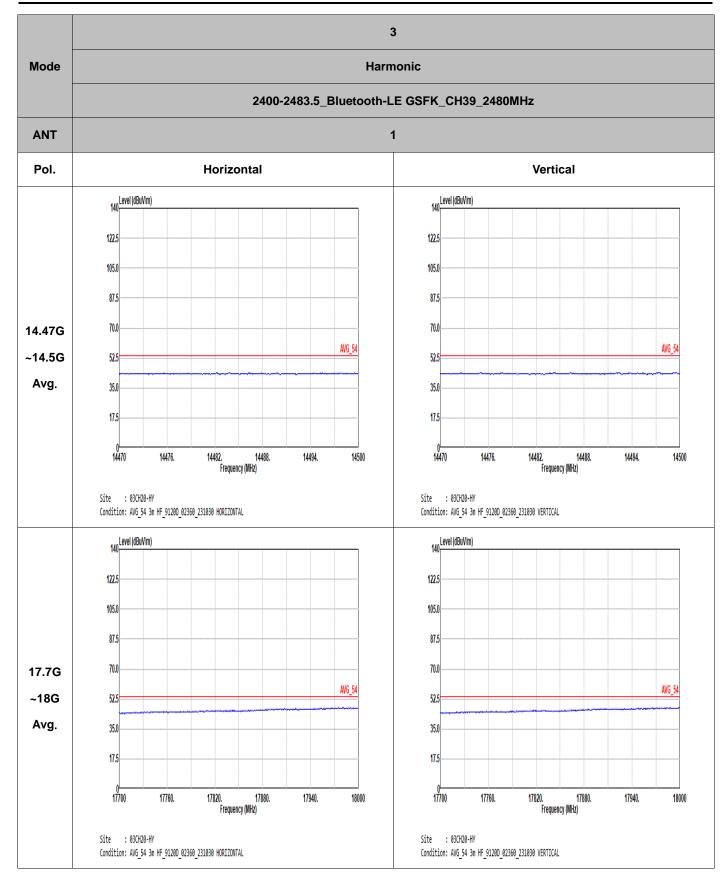






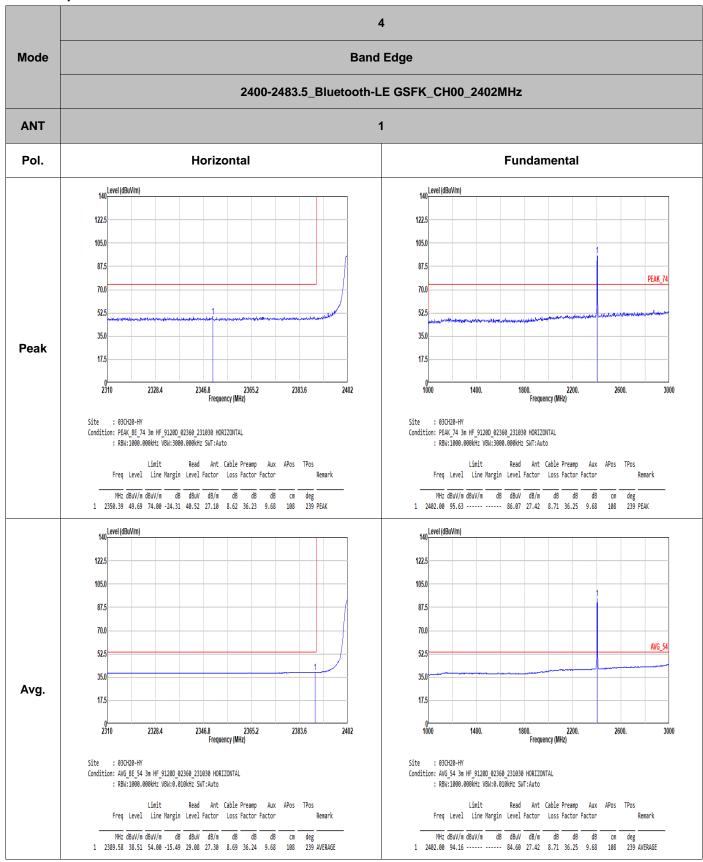






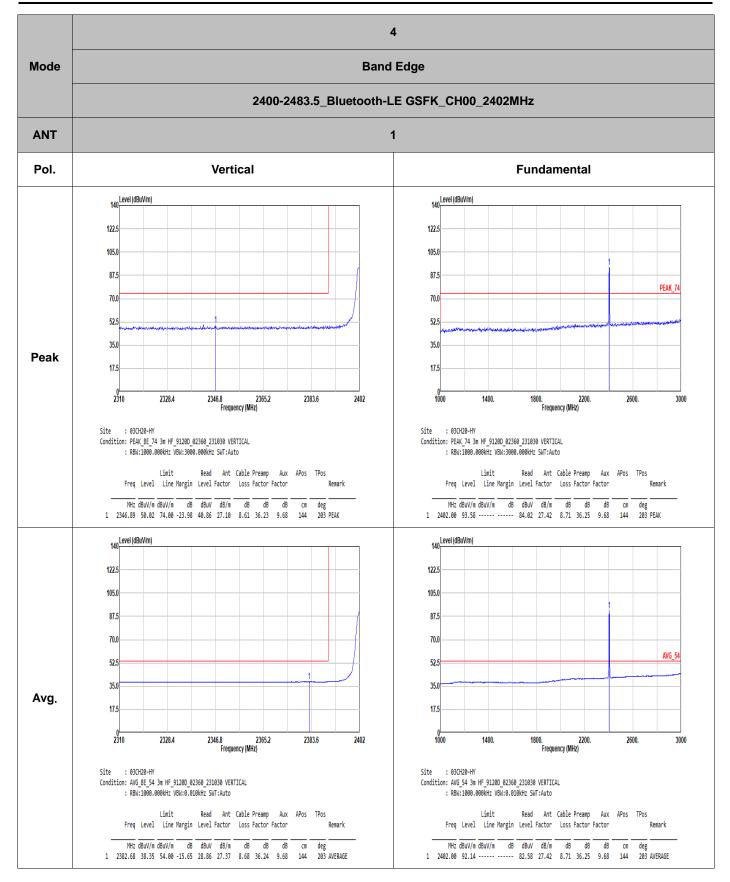


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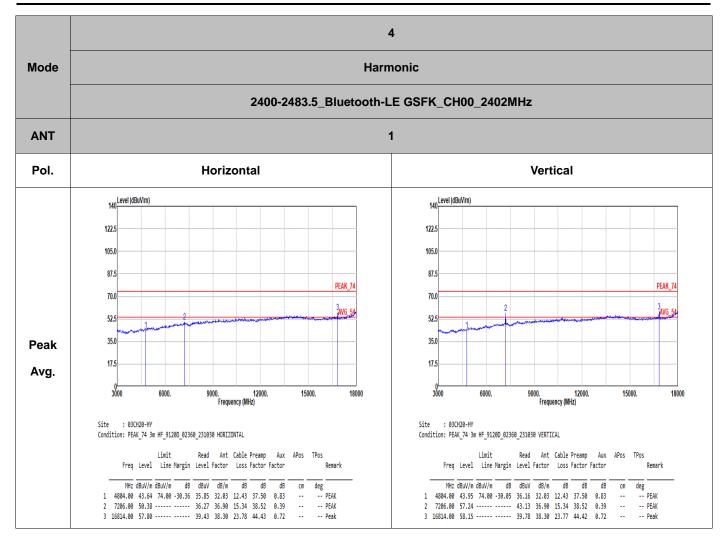


TEL: 886-3-327-0868

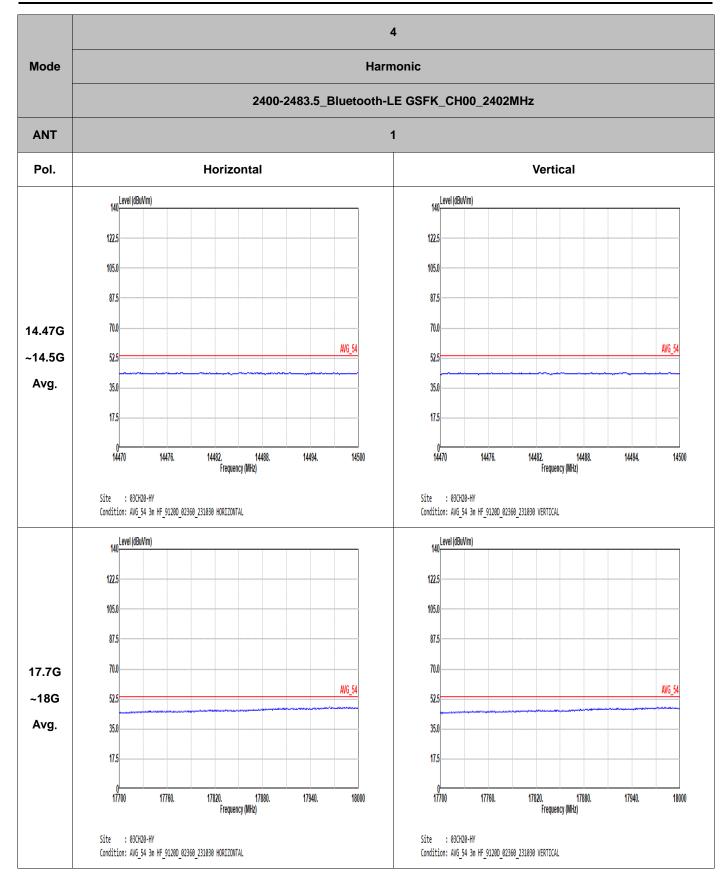




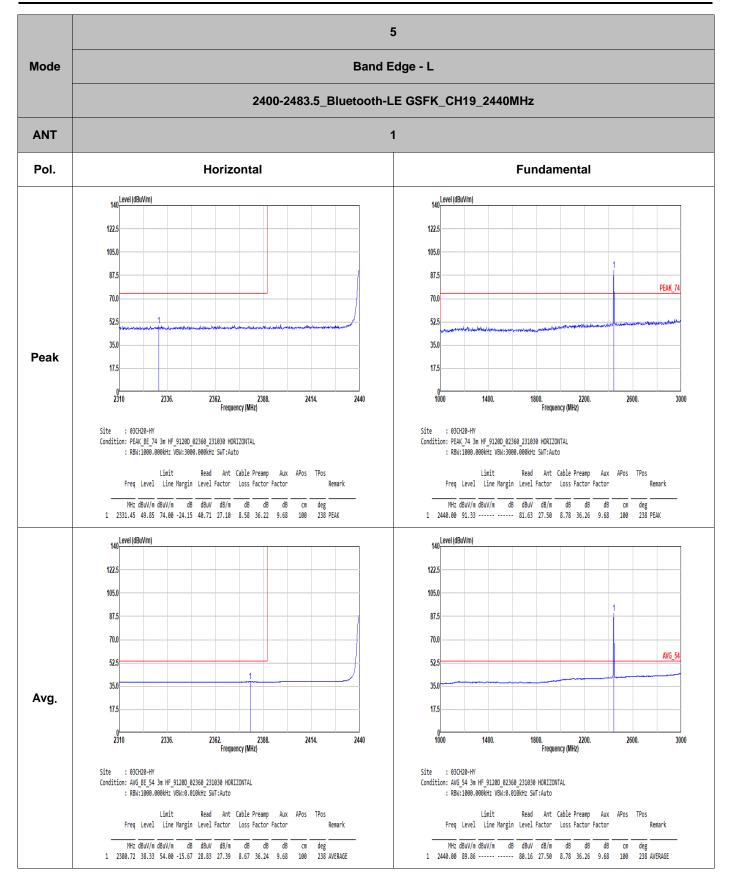




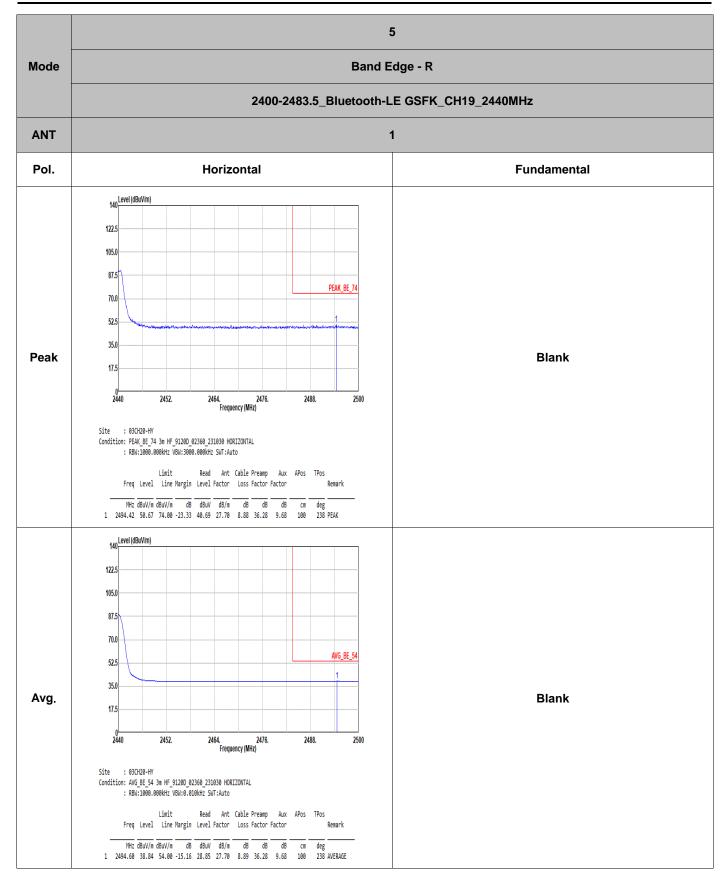




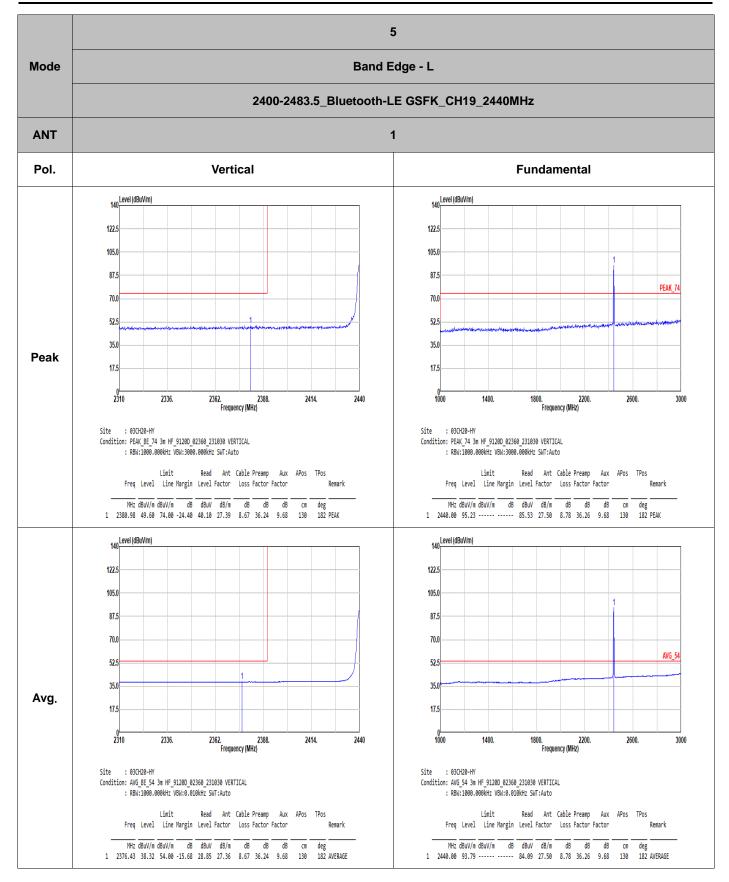




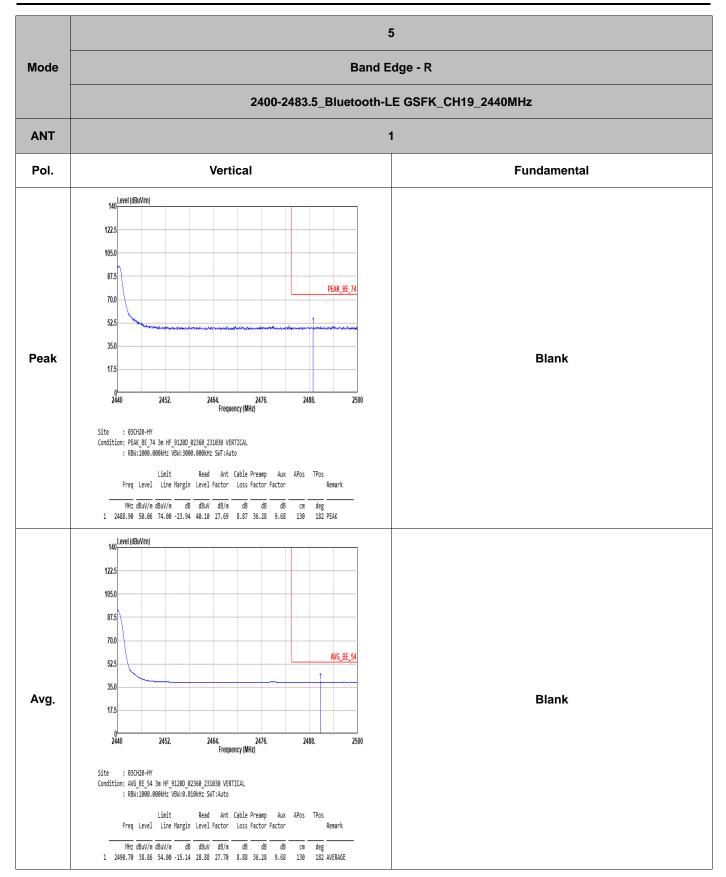




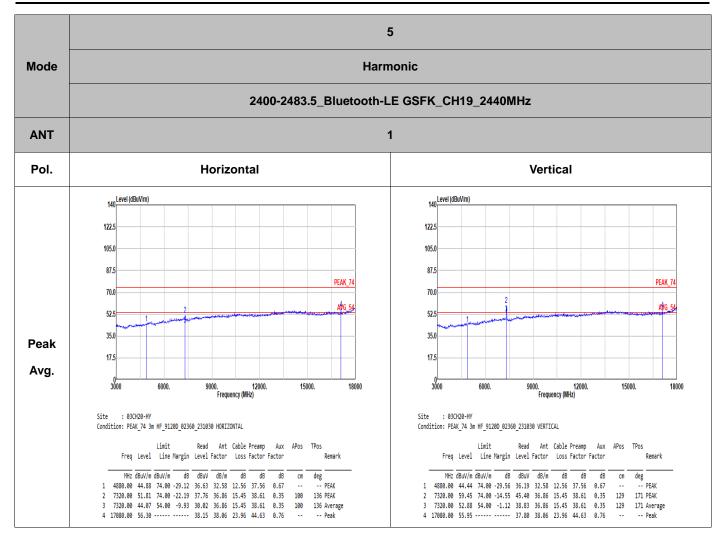




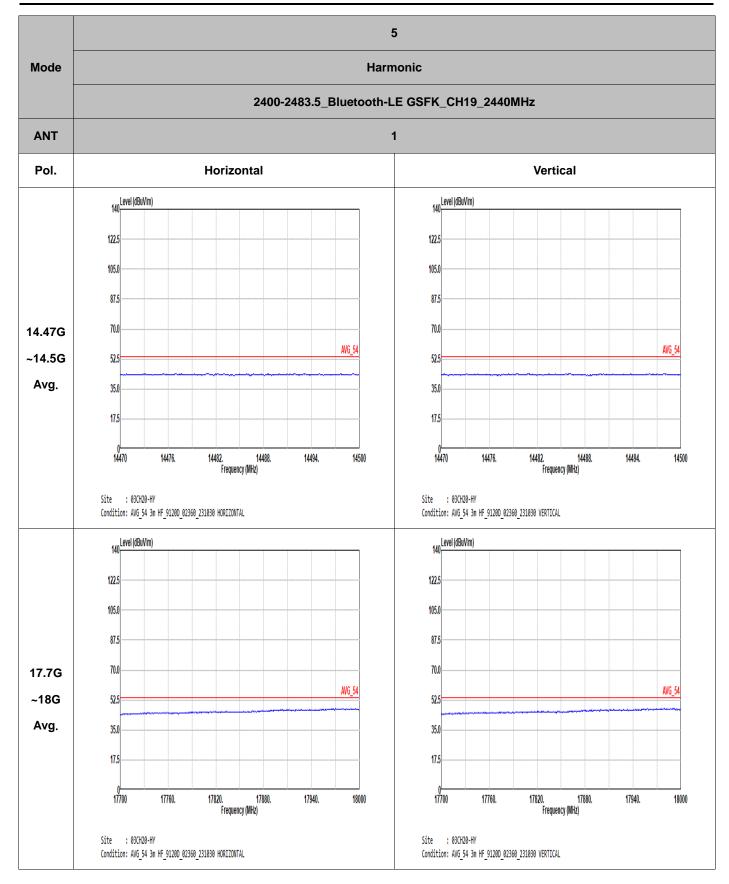




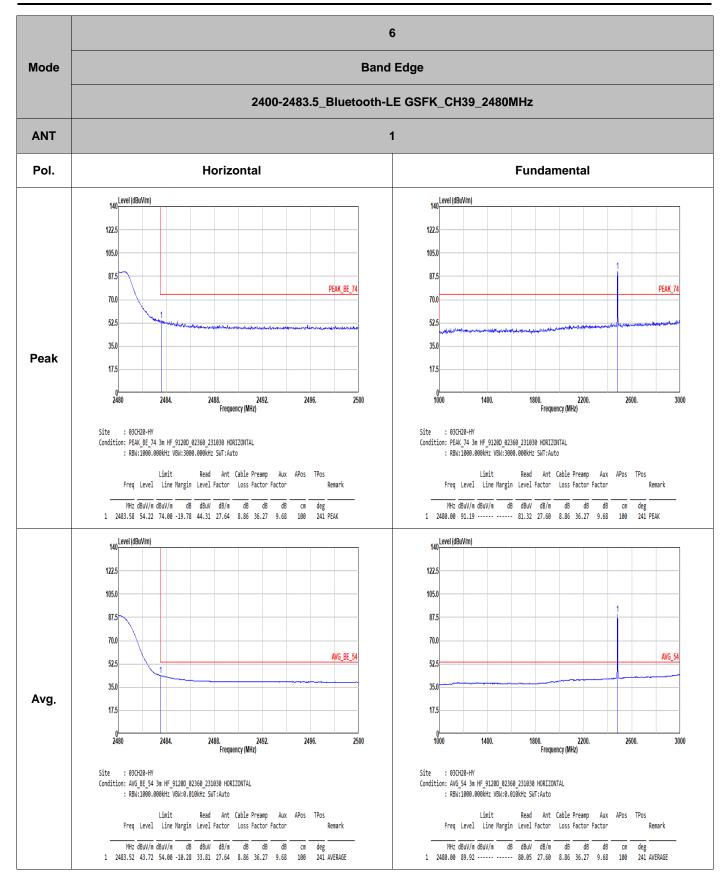




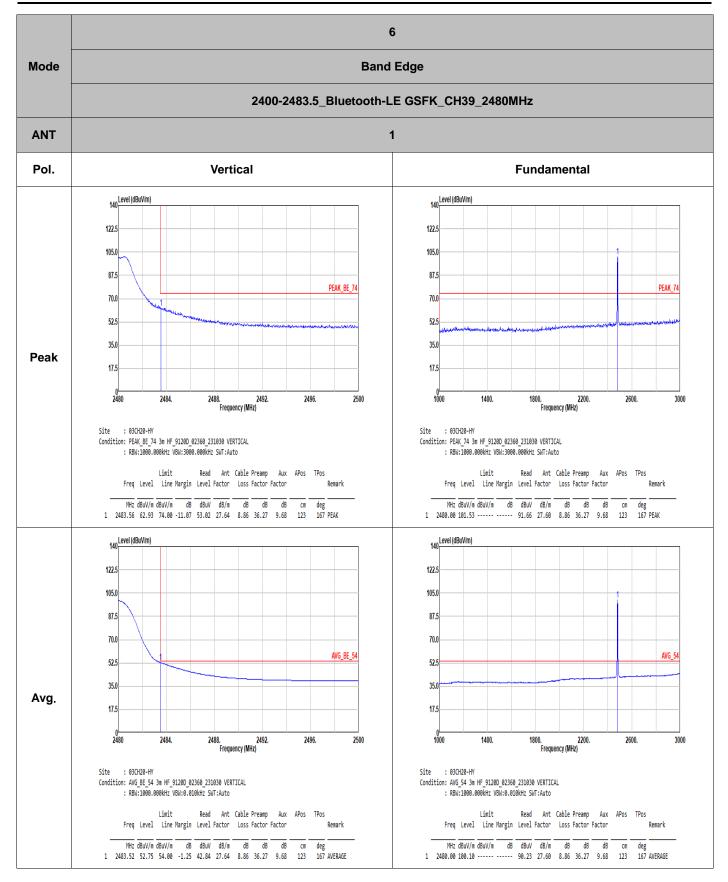




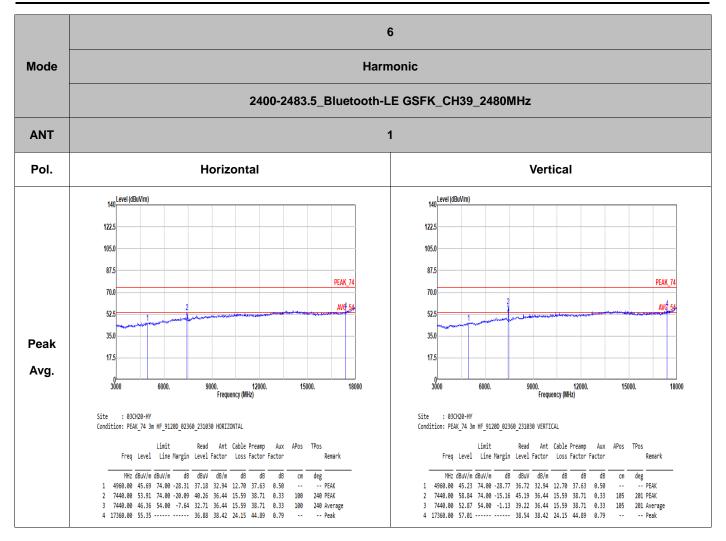




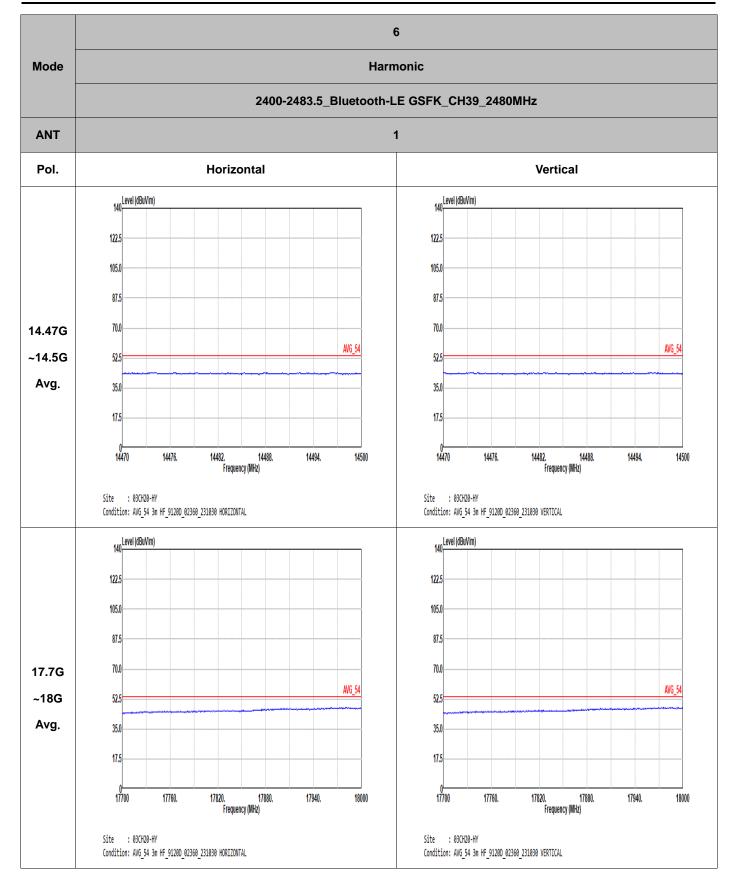




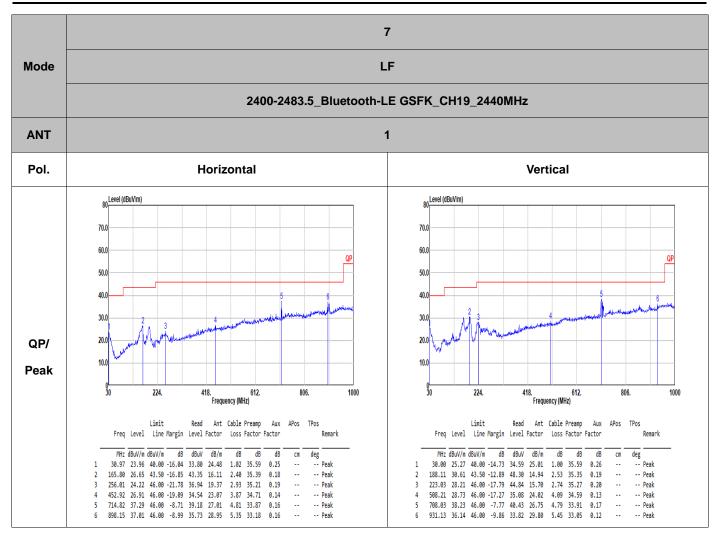




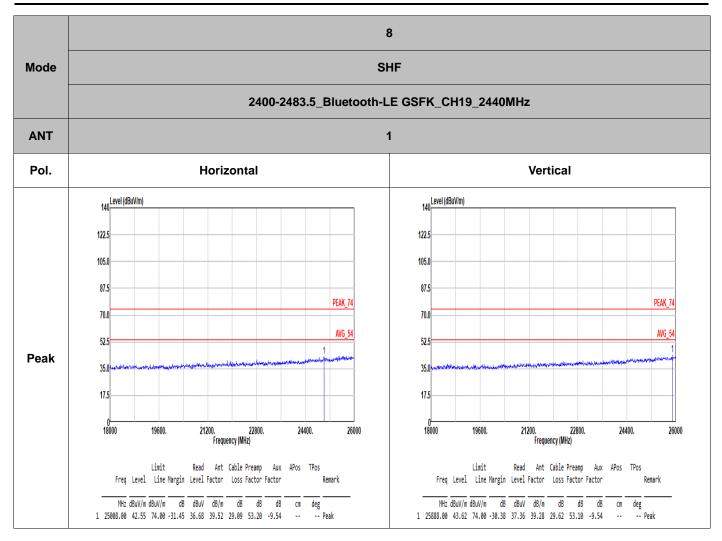
















Appendix D. Duty Cycle Plots

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

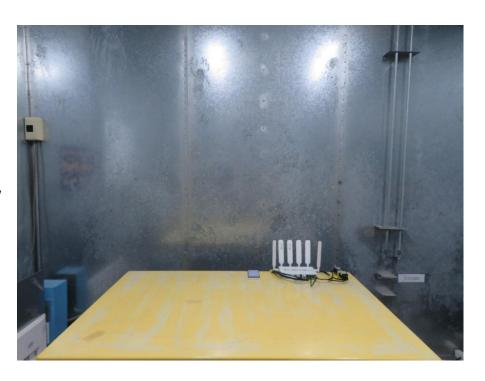
Bluetooth - LE for 1Mbps		Bluetooth - LE for 2Mbps		
Spectrum Analyzer 1	Select Marker	KEYSIGHT Input RF Input Z. 50 0 #Atten: 20 dB PNO. Fast #Avg Type: Power (RMS) 2 3 4 5 6 S Coupling: D6 CorrCorr Gate: Off Ing: Free Run	Marker elect Marker darker 1	*
No. Page 0F Flog Ref. Int (S) IF Gan. Low V 1 Sockum V N Int N N N Int N 1 Sockum V N Int N N N Int N 1 Sockum V Ref. Level 116.99 dBuV 72.22 dBuV	Marker Time 1.60000 ms Peak	N N N N N N N N N N N N N N N N N N N	Marker Time 3.79000 ms	Settings
	Peak Search Search Pk Search	arch log	Peak Search	Search Pk Search
	Next Peak Config Next Pk Right Propert			Config Properties
57.0	Next Pk Left Marker Functio			Marker Function
27.0 Center 2.450000000 GHz #Video BW 8.0 MHz System 10.0 ms (1001 ub Res BW 8 MHz System 10.0 ms (1001 ub		Center 2.480000000 GHz #Video BW 8.0 MHz Span 0 Hz	Pk-Pk Search	Marker→ Counter
Res BW 8 MHz Sweep 10.0 ms (1001 pts 5 Marker Table Y	Marker Delta	Res BW 8 MHz Sweep 10.0 ms (1001 pts) 6 Marker Table *	Marker Delta	Counter
Mode Trace Scale X Y Function Function Width Function Value 1 N 1 t 1.600 ms 79.22 dBuV Image: Compare the second	Mkr→CF	Mode Trace Scale X Y Function Function Width Function Value 1 N 1 1 3.790 ms 79.49 dBµV 2	Mkr→CF	
	Mkr→Ref Lvi Continuous Peak Search On		Mkr→Ref Lvi Continuous Peak Search On	
	Off		Off	



Appendix E. Setup Photographs

<Conducted Emission>

Mode 2



Remote View

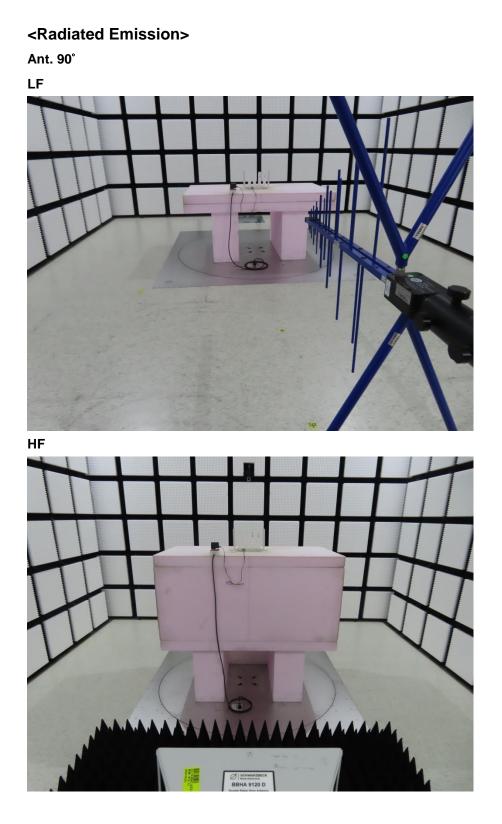




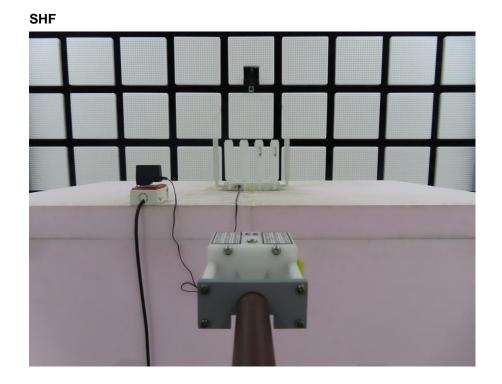


Rear View









------THE END------