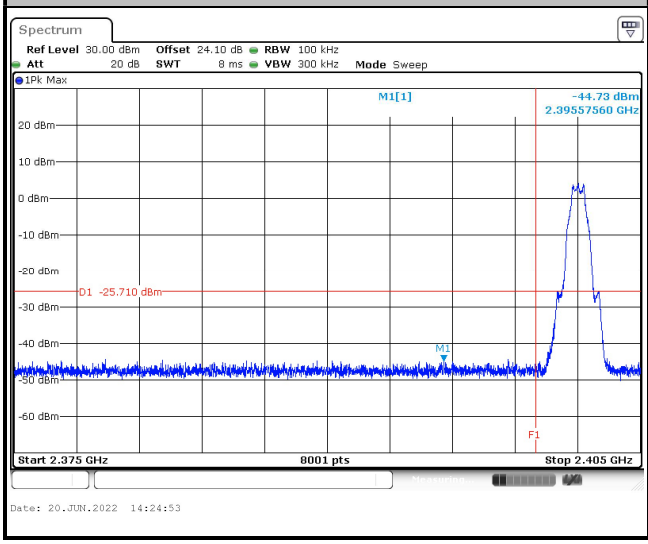
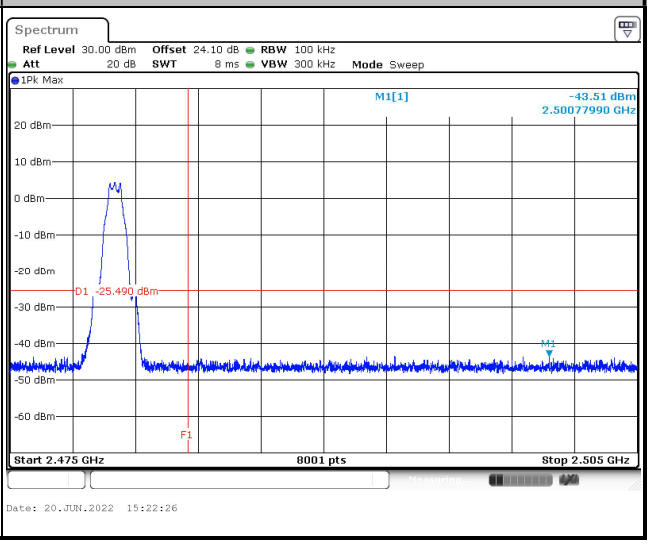
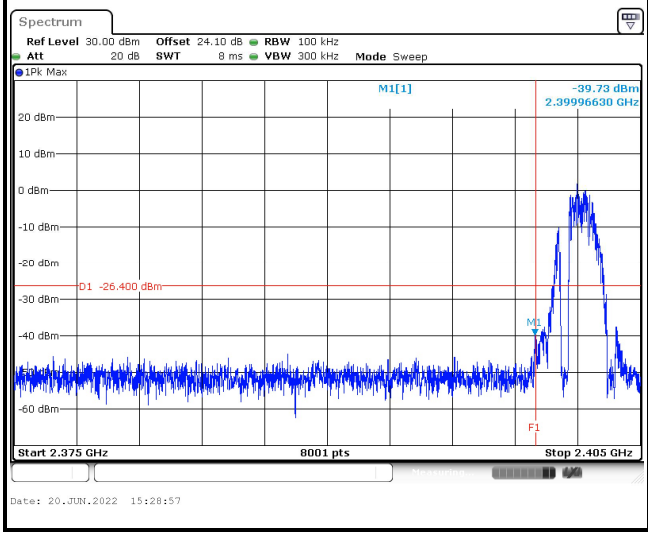
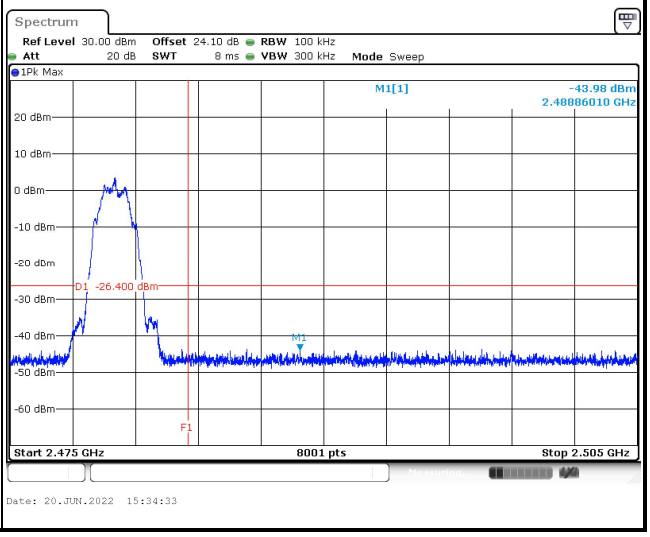
3.4.5 Test Result of Conducted Band Edges Plots

Test Engineer :	Eason Huang	Temperature :	21~25℃
		Relative Humidity :	51~54%

<1Mbps>

Low Band Edge Plot on Channel 00	High Band Edge Plot on Channel 39
	

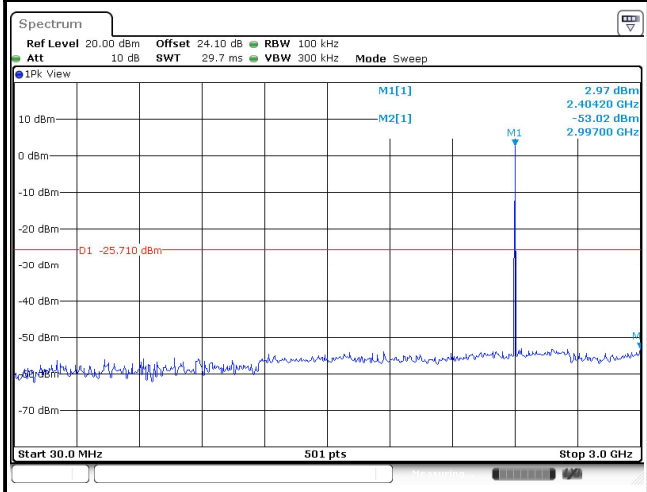
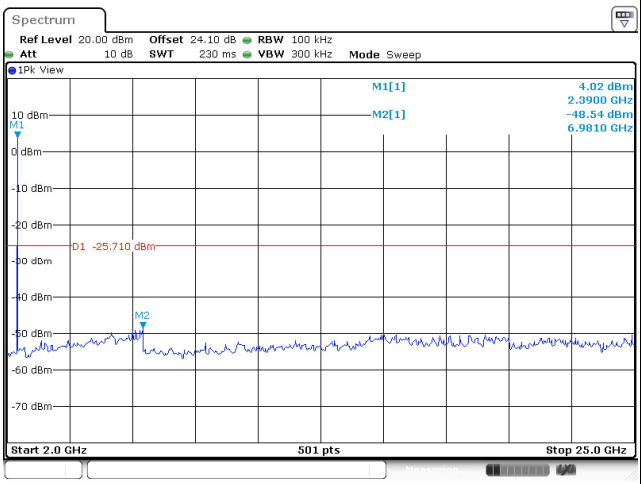
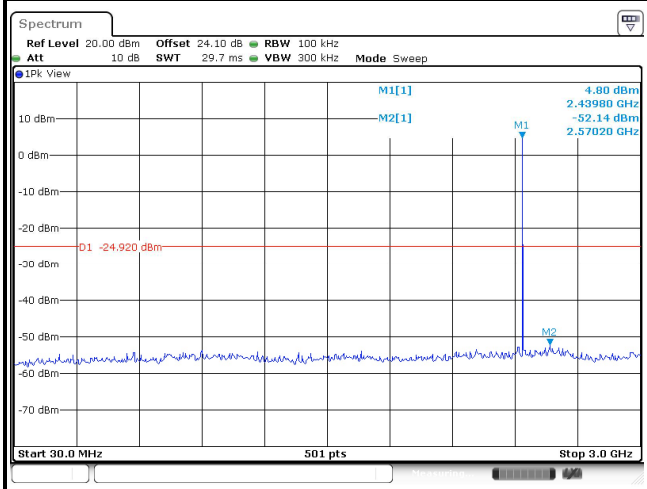
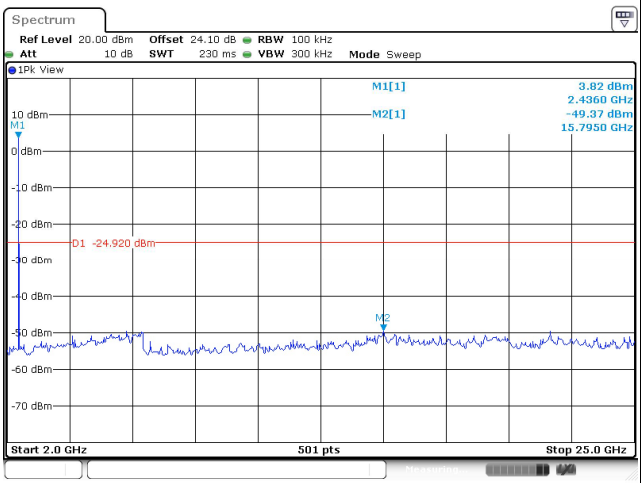
<2Mbps>

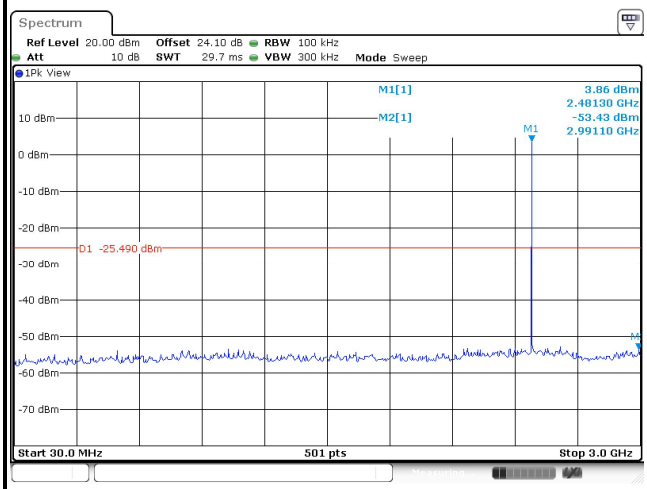
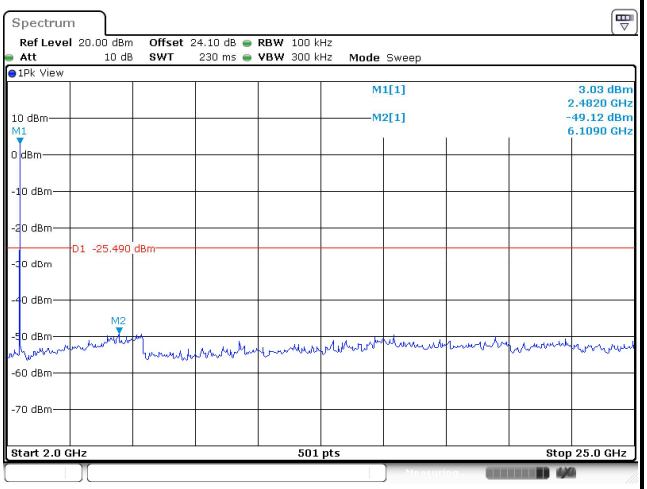
Low Band Edge Plot on Channel 00	High Band Edge Plot on Channel 39
	

3.4.6 Test Result of Conducted Spurious Emission Plots

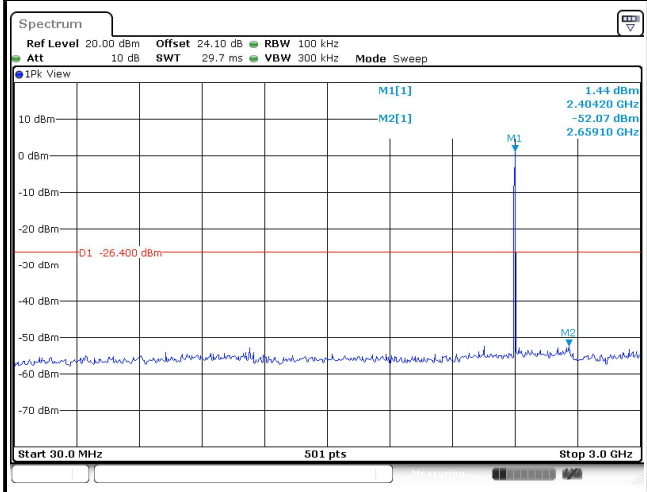
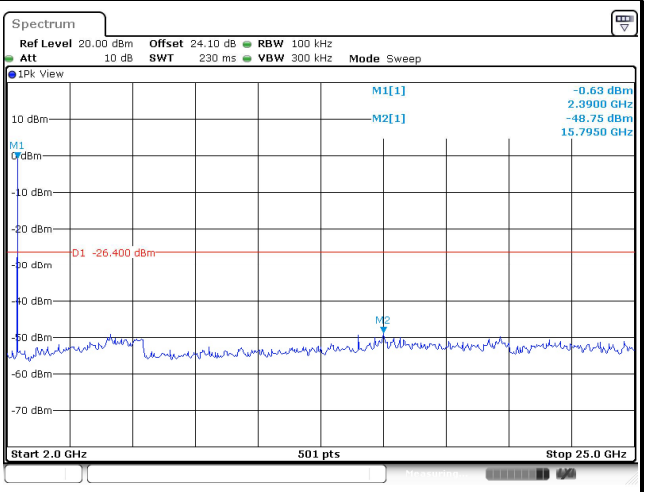
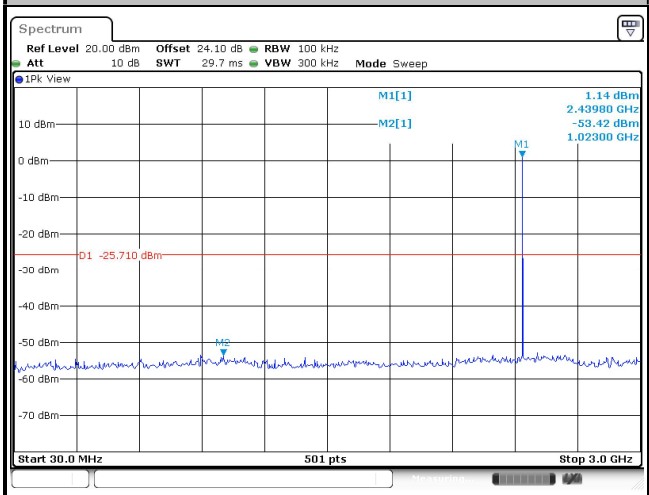
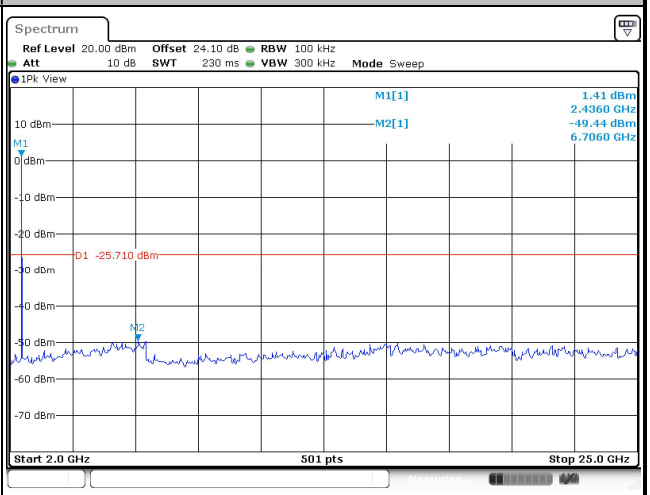
Test Engineer :	Eason Huang	Temperature :	21~25℃
		Relative Humidity :	51~54%

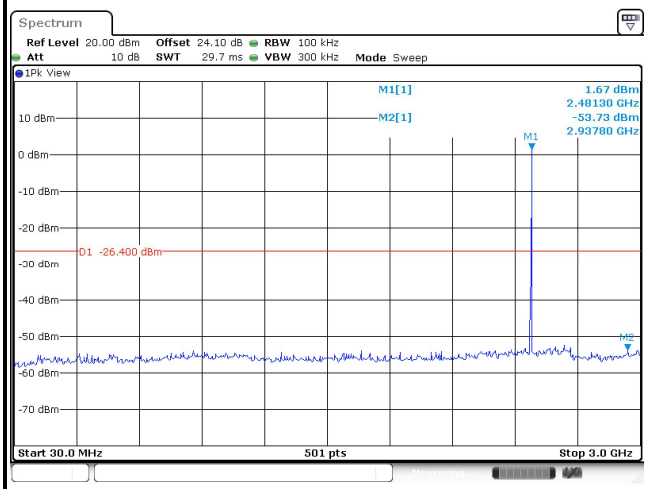
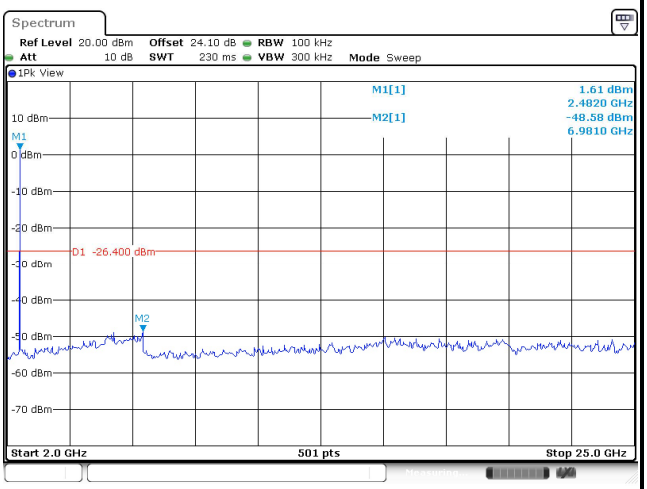
<1Mbps>

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 00	Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 00
	
Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 19	Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 19
	

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 39	Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 39
	

<2Mbps>

Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 00	Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 00
	
Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 19	Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 19
	

Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 39	Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 39
	

3.5 Radiated Band Edges and Spurious Emission Measurement

3.5.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device is measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

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

3.5.2 Measuring Instruments

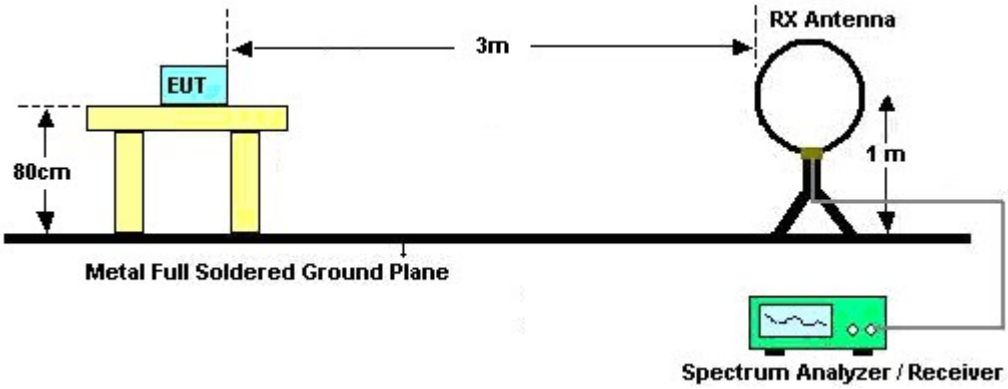
Please refer to the measuring equipment list in this test report.

3.5.3 Test Procedures

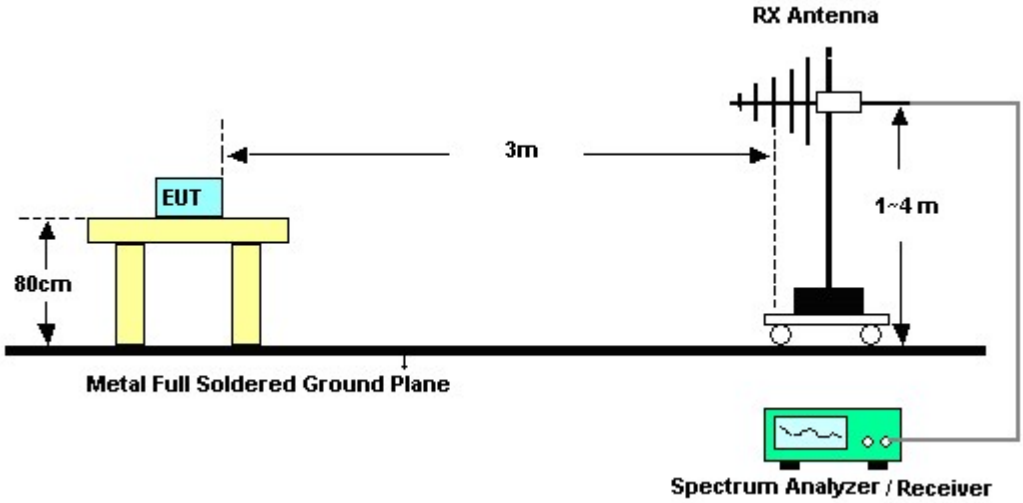
1. The testing follows the ANSI C63.10 Section 11.12.1 Radiated emission measurements.
2. The EUT is arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT is placed on a turntable with 0.8 meter for frequency below 1 GHz and 1.5 meter for frequency above 1 GHz respectively above ground.
4. The EUT is set 3 meters away from the receiving antenna, which is mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. Radiated testing below 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading. When there is no suspected emission found and the emission level is with at least 6 dB margin against QP limit line, the position is marked as "-".
7. Radiated testing above 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading for scanning all frequencies. When there is no suspected emission found and the harmonic emission level is with at least 6 dB margin against average limit line, the position is marked as "-".
8. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW = 100 kHz for f < 1 GHz; VBW ≥ 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

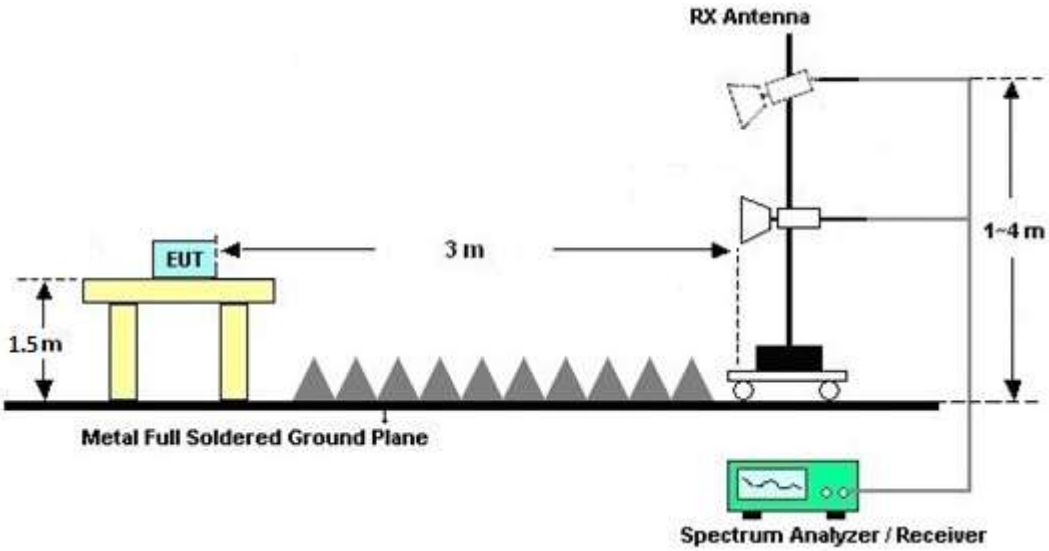
For radiated test below 30MHz



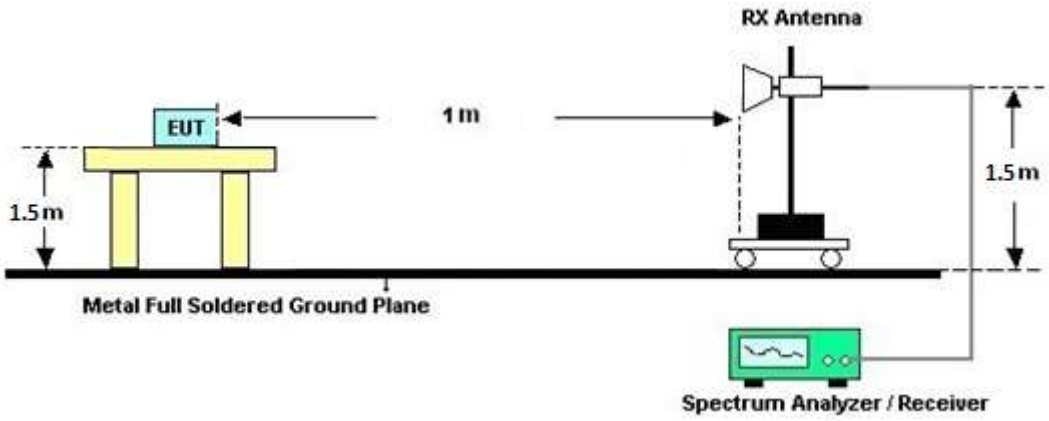
For radiated test from 30MHz to 1GHz



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 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)	
	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.

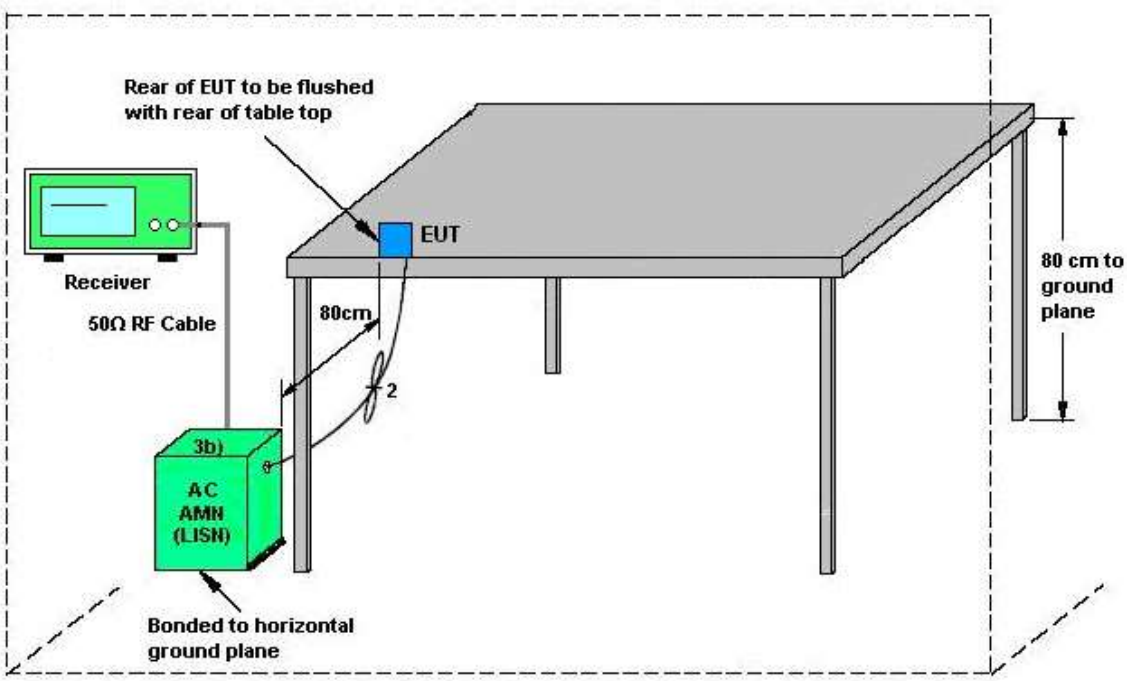
3.6.2 Measuring Instruments

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



AMN = Artificial mains network (LISN)
AE = Associated equipment
EUT = Equipment under test
ISN = Impedance stabilization network

3.6.5 Test Result of AC Conducted Emission

Please refer to Appendix A.

3.7 Antenna Requirements

3.7.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

3.7.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.7.3 Antenna Gain

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

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. 16, 2021	Jun. 14, 2022~ Jun. 20, 2022	Nov. 15, 2022	Conducted (TH05-HY)
Power Sensor	DARE	RPR3006W	16I00054SNO 12 (NO:113)	10MHz~6GHz	Dec. 16, 2021	Jun. 14, 2022~ Jun. 20, 2022	Dec. 15, 2022	Conducted (TH05-HY)
Signal Analyzer	Rohde & Schwarz	FSV40	101566	10Hz~40GHz	Aug. 30, 2021	Jun. 14, 2022~ Jun. 20, 2022	Aug. 29, 2022	Conducted (TH05-HY)
Switch Control Mainframe	E-IUSTRUME NT	ETF-1405-0	EC1900067 (BOX7)	N/A	Aug. 12, 2021	Jun. 14, 2022~ Jun. 20, 2022	Aug. 11, 2022	Conducted (TH05-HY)
AC Power Source	ACPOWER	AFC-11003G	F317040033	N/A	N/A	Jul. 04, 2022	N/A	Conduction (CO07-HY)
Software	Rohde & Schwarz	EMC32 V10.30	N/A	N/A	N/A	Jul. 04, 2022	N/A	Conduction (CO07-HY)
Pulse Limiter	SCHWARZBE CK	VTSD 9561-F N	9561-F N00373	9kHz-200MHz	Oct. 29, 2021	Jul. 04, 2022	Oct. 28, 2022	Conduction (CO07-HY)
RF Cable	HUBER + SUHNER	RG 214/U	1358175	9kHz~30MHz	Mar. 16, 2022	Jul. 04, 2022	Mar. 15, 2023	Conduction (CO07-HY)
Two-Line V-Network	TESEQ	NNB 51	45051	N/A	Feb. 16, 2022	Jul. 04, 2022	Feb. 15, 2023	Conduction (CO07-HY)
EMI Test Receiver	Rohde & Schwarz	ESCI7	100724	9kHz~7GHz	Feb. 24, 2022	Jul. 04, 2022	Feb. 23, 2023	Conduction (CO07-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	May 13, 2022	Jun. 23, 2022~ Jun. 30, 2022	May 12, 2023	Radiation (03CH16-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00802N1D01N -06	47020 & 06	30MHz to 1GHz	Oct. 09, 2021	Jun. 23, 2022~ Jun. 30, 2022	Oct. 08, 2022	Radiation (03CH16-HY)
Horn Antenna	SCHWARZBE CK	BBHA 9120 D	9120D-1522	1G~18GHz	Mar. 10, 2022	Jun. 23, 2022~ Jun. 30, 2022	Mar. 09, 2023	Radiation (03CH16-HY)
SHF-EHF Horn Antenna	SCHWARZBE CK	BBHA 9170	00993	18GHz ~40GHz	Nov. 30, 2021	Jun. 23, 2022~ Jun. 30, 2022	Nov. 29, 2022	Radiation (03CH16-HY)
Amplifier	SONOMA	310N	371607	9kHz~1G	Jul. 05, 2021	Jun. 23, 2022~ Jun. 30, 2022	Jul. 04, 2022	Radiation (03CH16-HY)
Preamplifier	EMEC	EM18G40G	060812	18GHz~40GHz	Dec. 27, 2021	Jun. 23, 2022~ Jun. 30, 2022	Dec. 26, 2022	Radiation (03CH16-HY)
Preamplifier	Keysight	83017A	MY53270264	1GHz~26.5GHz	Dec. 09, 2021	Jun. 23, 2022~ Jun. 30, 2022	Dec. 08, 2022	Radiation (03CH16-HY)
EMI Test Receiver	Keysight	N9038A(MXE)	MY57290111	3Hz~26.5GHz	Dec.15, 2021	Jun. 23, 2022~ Jun. 30, 2022	Dec. 14, 2022	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY11680/4P E	NA	Aug. 28, 2021	Jun. 23, 2022~ Jun. 30, 2022	Aug. 27, 2022	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY11688/4P E	NA	Aug. 28, 2021	Jun. 23, 2022~ Jun. 30, 2022	Aug. 27, 2022	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	EC-A5-300-5 757	NA	Aug. 28, 2021	Jun. 23, 2022~ Jun. 30, 2022	Aug. 27, 2022	Radiation (03CH16-HY)
Software	Audix	E3 6.2009-8-24	RK-001136	N/A	N/A	Jun. 23, 2022~ Jun. 30, 2022	N/A	Radiation (03CH16-HY)
Controller	ChainTek	3000-1	N/A	Control Turn table & Ant Mast	N/A	Jun. 23, 2022~ Jun. 30, 2022	N/A	Radiation (03CH16-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Jun. 23, 2022~ Jun. 30, 2022	N/A	Radiation (03CH16-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Jun. 23, 2022~ Jun. 30, 2022	N/A	Radiation (03CH16-HY)

5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	2.3 dB

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

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

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.2 dB

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

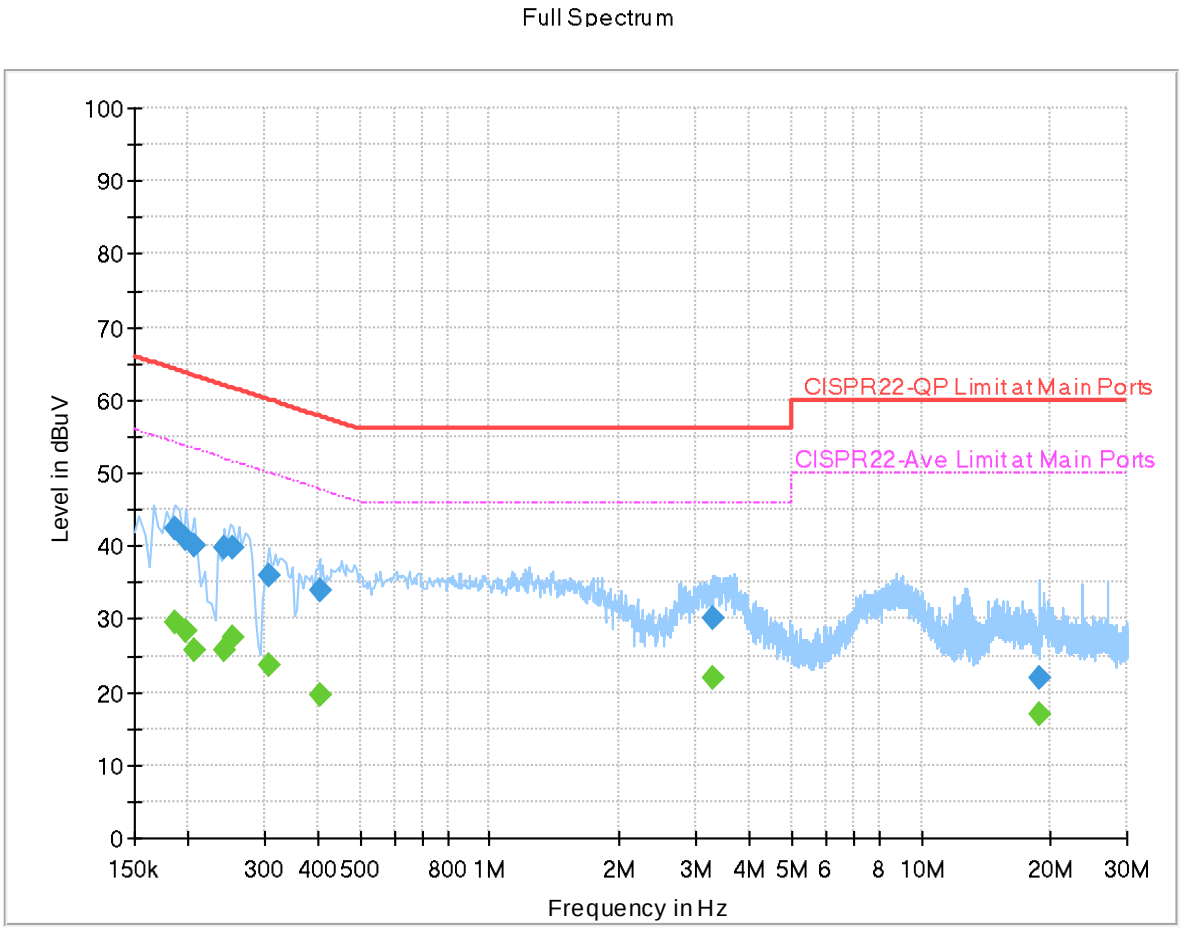
Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.8 dB

Appendix A. AC Conducted Emission Test Results

Test Engineer :	Louis Chung	**Temperature :**	22.2~26.3℃
		Relative Humidity :	48.2~58.7%

EUT Information

Report NO :	1N2541
Test Mode :	Mode 1
Test Voltage :	120Vac/60Hz
Phase :	Line

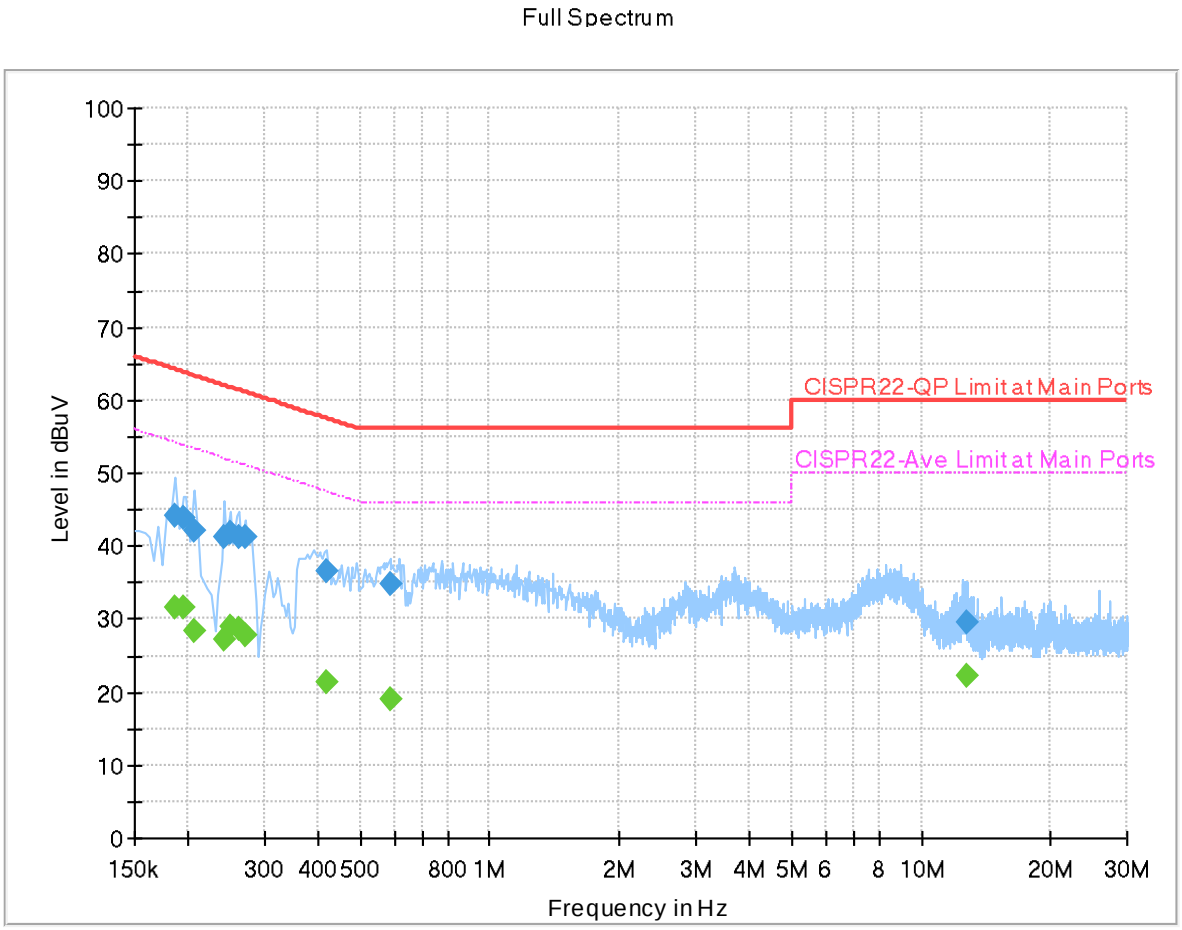


Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.186000	---	29.64	54.21	24.57	L1	OFF	20.0
0.186000	42.41	---	64.21	21.80	L1	OFF	20.0
0.198000	---	28.30	53.69	25.39	L1	OFF	20.0
0.198000	40.97	---	63.69	22.72	L1	OFF	20.0
0.206000	---	25.66	53.37	27.71	L1	OFF	20.0
0.206000	40.05	---	63.37	23.32	L1	OFF	20.0
0.242000	---	25.77	52.03	26.26	L1	OFF	20.0
0.242000	39.86	---	62.03	22.17	L1	OFF	20.0
0.254000	---	27.63	51.63	24.00	L1	OFF	20.0
0.254000	39.74	---	61.63	21.89	L1	OFF	20.0
0.306000	---	23.55	50.08	26.53	L1	OFF	20.0
0.306000	35.86	---	60.08	24.22	L1	OFF	20.0
0.402000	---	19.63	47.81	28.18	L1	OFF	20.0
0.402000	34.05	---	57.81	23.76	L1	OFF	20.0
3.286000	---	22.03	46.00	23.97	L1	OFF	20.0
3.286000	30.11	---	56.00	25.89	L1	OFF	20.0
18.826000	---	16.91	50.00	33.09	L1	OFF	20.2
18.826000	21.87	---	60.00	38.13	L1	OFF	20.2

EUT Information

Report NO :	1N2541
Test Mode :	Mode 1
Test Voltage :	120Vac/60Hz
Phase :	Neutral



Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.186000	---	31.60	54.21	22.61	N	OFF	20.0
0.186000	44.26	---	64.21	19.95	N	OFF	20.0
0.194000	---	31.48	53.86	22.38	N	OFF	20.0
0.194000	43.72	---	63.86	20.14	N	OFF	20.0
0.206000	---	28.41	53.37	24.96	N	OFF	20.0
0.206000	42.09	---	63.37	21.28	N	OFF	20.0
0.242000	---	27.33	52.03	24.70	N	OFF	20.0
0.242000	41.16	---	62.03	20.87	N	OFF	20.0
0.250000	---	29.05	51.76	22.71	N	OFF	20.0
0.250000	41.70	---	61.76	20.06	N	OFF	20.0
0.262000	---	28.68	51.37	22.69	N	OFF	20.0
0.262000	41.32	---	61.37	20.05	N	OFF	20.0
0.270000	---	27.78	51.12	23.34	N	OFF	20.0
0.270000	41.15	---	61.12	19.97	N	OFF	20.0
0.418000	---	21.28	47.49	26.21	N	OFF	20.0
0.418000	36.69	---	57.49	20.80	N	OFF	20.0
0.586000	---	19.15	46.00	26.85	N	OFF	20.0
0.586000	34.77	---	56.00	21.23	N	OFF	20.0
12.718000	---	22.17	50.00	27.83	N	OFF	20.2

12.718000	**29.44**	**---**	**60.00**	**30.56**	**N**	**OFF**	**20.2**

Appendix B. Radiated Spurious Emission

Test Engineer :	Andy Yang, Karl Hou and Steven Wu	**Temperature :**	20~25°C
		Relative Humidity :	50~60%

<1Mbps>

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	Note	Frequency	Level	Over Limit	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		2350.635	55.86	-18.14	74	40.6	27.2	18.14	30.08	145	156	P	H
		2341.185	45.99	-8.01	54	30.76	27.2	18.12	30.09	145	156	A	H
	*	2402	100.08	-	-	84.5	27.41	18.24	30.07	145	156	P	H
	*	2402	99.14	-	-	83.56	27.41	18.24	30.07	145	156	A	H
													H
													H
		2384.13	56	-18	74	40.52	27.34	18.21	30.07	383	199	P	V
		2383.395	45.87	-8.13	54	30.4	27.33	18.21	30.07	383	199	A	V
	*	2402	99.06	-	-	83.48	27.41	18.24	30.07	383	199	P	V
	*	2402	98.23	-	-	82.65	27.41	18.24	30.07	383	199	A	V
													V
													V
BLE CH 19 2440MHz		2378.04	55.67	-18.33	74	40.24	27.31	18.2	30.08	100	156	P	H
		2380.84	46.14	-7.86	54	30.7	27.32	18.2	30.08	100	156	A	H
	*	2440	98.43	-	-	82.54	27.64	18.31	30.06	100	156	P	H
	*	2440	97.23	-	-	81.34	27.64	18.31	30.06	100	156	A	H
		2494.05	57	-17	74	40.75	27.88	18.41	30.04	100	156	P	H
		2492.93	46.91	-7.09	54	30.67	27.87	18.41	30.04	100	156	A	H
		2325.68	56.27	-17.73	74	41.07	27.2	18.09	30.09	368	196	P	V
		2383.5	45.9	-8.1	54	30.43	27.33	18.21	30.07	368	196	A	V
	*	2440	97.09	-	-	81.2	27.64	18.31	30.06	368	196	P	V
	*	2440	95.81	-	-	79.92	27.64	18.31	30.06	368	196	A	V
		2488.8	56.71	-17.29	74	40.49	27.86	18.4	30.04	368	196	P	V
		2488.17	46.94	-7.06	54	30.73	27.85	18.4	30.04	368	196	A	V

BLE CH 39 2480MHz	*	2480	100.18	-	-	84.03	27.82	18.38	30.05	103	150	P	H
	*	2480	99.36	-	-	83.21	27.82	18.38	30.05	103	150	A	H
		2487.48	58.05	-15.95	74	41.84	27.85	18.4	30.04	103	150	P	H
		2484.04	46.97	-7.03	54	30.78	27.84	18.39	30.04	103	150	A	H
													H
													H
	*	2480	98.71	-	-	82.56	27.82	18.38	30.05	400	197	P	V
	*	2480	97.71	-	-	81.56	27.82	18.38	30.05	400	197	A	V
		2486.72	57.22	-16.78	74	41.01	27.85	18.4	30.04	400	197	P	V
		2493.48	46.99	-7.01	54	30.75	27.87	18.41	30.04	400	197	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)	Over Limit (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	39.92	-34.08	74	61.42	32.32	12.35	66.17	-	-	P	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
		4804	40.19	-33.81	74	61.69	32.32	12.35	66.17	-	-	P	V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V

BLE	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (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 19 2440MHz		4880	40.35	-33.65	74	61.43	32.72	12.32	66.12	-	-	P	H
		7320	45.47	-28.53	74	58.23	37.08	15.88	65.72	-	-	P	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
		4880	40.75	-33.25	74	61.83	32.72	12.32	66.12	-	-	P	V
		7320	45.19	-28.81	74	57.95	37.08	15.88	65.72	-	-	P	V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V

BLE	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (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	40.29	-33.71	74	60.95	33.12	12.28	66.06	-	-	P	H
		7440	44.72	-29.28	74	57.85	36.46	16.2	65.79	-	-	P	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
		4960	40.58	-33.42	74	61.24	33.12	12.28	66.06	-	-	P	V
		7440	45.14	-28.86	74	58.27	36.46	16.2	65.79	-	-	P	V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line. 3. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only.												

<2Mbps>

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	Note	Frequency	Level	Over Limit	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		2380.98	55.78	-18.22	74	40.34	27.32	18.2	30.08	144	153	P	H
		2383.92	47.97	-6.03	54	32.49	27.34	18.21	30.07	144	153	A	H
	*	2402	100.05	-	-	84.47	27.41	18.24	30.07	144	153	P	H
	*	2402	98.31	-	-	82.73	27.41	18.24	30.07	144	153	A	H
													H
													H
		2386.44	55.71	-18.29	74	40.22	27.35	18.21	30.07	380	199	P	V
		2376.045	47.9	-6.1	54	32.49	27.3	18.19	30.08	380	199	A	V
	*	2402	99.38	-	-	83.8	27.41	18.24	30.07	380	199	P	V
	*	2402	97.35	-	-	81.77	27.41	18.24	30.07	380	199	A	V
													V
													V
BLE CH 19 2440MHz		2375.38	56.71	-17.29	74	41.3	27.3	18.19	30.08	103	154	P	H
		2379.72	48.37	-5.63	54	32.93	27.32	18.2	30.08	103	154	A	H
	*	2440	98.58	-	-	82.69	27.64	18.31	30.06	103	154	P	H
	*	2440	97.01	-	-	81.12	27.64	18.31	30.06	103	154	A	H
		2492.79	57.09	-16.91	74	40.85	27.87	18.41	30.04	103	154	P	H
		2493.91	49.04	-4.96	54	32.79	27.88	18.41	30.04	103	154	A	H
		2384.62	56.06	-17.94	74	40.58	27.34	18.21	30.07	372	194	P	V
		2384.62	48.04	-5.96	54	32.56	27.34	18.21	30.07	372	194	A	V
	*	2440	97.18	-	-	81.29	27.64	18.31	30.06	372	194	P	V
	*	2440	95.51	-	-	79.62	27.64	18.31	30.06	372	194	A	V
		2490.9	57.81	-16.19	74	41.59	27.86	18.4	30.04	372	194	P	V
		2488.17	48.74	-5.26	54	32.53	27.85	18.4	30.04	372	194	A	V

BLE CH 39 2480MHz	*	2480	100.79	-	-	84.64	27.82	18.38	30.05	132	152	P	H
	*	2480	99.28	-	-	83.13	27.82	18.38	30.05	132	152	A	H
		2484.04	57.57	-16.43	74	41.38	27.84	18.39	30.04	132	152	P	H
		2487.92	49.18	-4.82	54	32.97	27.85	18.4	30.04	132	152	A	H
													H
													H
	*	2480	99.12	-	-	82.97	27.82	18.38	30.05	400	192	P	V
	*	2480	97.72	-	-	81.57	27.82	18.38	30.05	400	192	A	V
		2484.36	56.72	-17.28	74	40.53	27.84	18.39	30.04	400	192	P	V
		2495.56	48.66	-5.34	54	32.41	27.88	18.41	30.04	400	192	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)	Over Limit (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	39.85	-34.15	74	61.35	32.32	12.35	66.17	-	-	P	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
		4804	40.21	-33.79	74	61.71	32.32	12.35	66.17	-	-	P	V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V

BLE	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (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 19 2440MHz		4880	40.4	-33.6	74	61.48	32.72	12.32	66.12	-	-	P	H
		7320	45.47	-28.53	74	58.23	37.08	15.88	65.72	-	-	P	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
		4880	40.29	-33.71	74	61.37	32.72	12.32	66.12	-	-	P	V
		7320	45.23	-28.77	74	57.99	37.08	15.88	65.72	-	-	P	V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V

BLE	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (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		4965	39.92	-34.08	74	60.57	33.13	12.28	66.06	-	-	P	H
		7440	44.23	-29.77	74	57.36	36.46	16.2	65.79	-	-	P	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
		4965	39.58	-34.42	74	60.23	33.13	12.28	66.06	-	-	P	V
		7440	44.96	-29.04	74	58.09	36.46	16.2	65.79	-	-	P	V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line. 3. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only.												

Emission below 1GHz

2.4GHz BLE (LF)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
				Limit	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		55.22	26.59	-13.41	40	44.92	12.63	1.32	32.28	-	-	P	H
		90.14	26.1	-17.4	43.5	42.12	14.6	1.68	32.3	-	-	P	H
		126.03	25.04	-18.46	43.5	37.86	17.48	1.97	32.27	-	-	P	H
		436.43	24.2	-21.8	46	29.88	23.09	3.65	32.42	-	-	P	H
		577.08	28.85	-17.15	46	31.37	25.78	4.2	32.5	-	-	P	H
		953.44	34.22	-11.78	46	29.34	30.64	5.41	31.17	-	-	P	H
													H
													H
													H
													H
													H
													H
		37.76	33.14	-6.86	40	43.64	20.79	1.01	32.3	-	-	P	V
		51.34	33.71	-6.29	40	51.06	13.67	1.27	32.29	-	-	P	V
		184.23	26.42	-17.08	43.5	41.35	14.88	2.42	32.23	-	-	P	V
		579.99	27.68	-18.32	46	30.26	25.72	4.21	32.51	-	-	P	V
		752.65	30.65	-15.35	46	30.14	28.1	4.75	32.34	-	-	P	V
		958.29	34.27	-11.73	46	29.15	30.83	5.42	31.13	-	-	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 **over limit** 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	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
				Limit	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. Over Limit(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. Over Limit(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. Over Limit(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 :	Andy Yang, Karl Hou and Steven Wu	**Temperature :**	20~25°C
		Relative Humidity :	50~60%

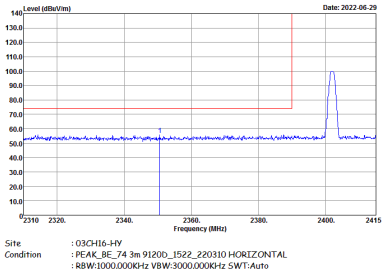
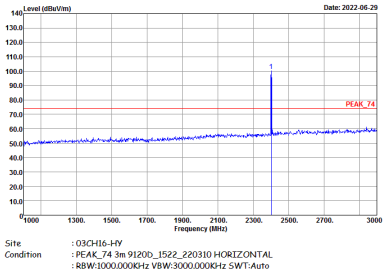
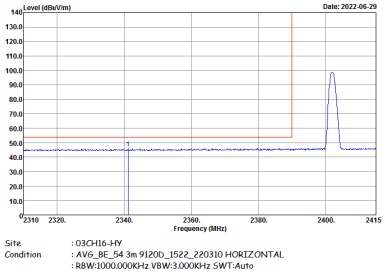
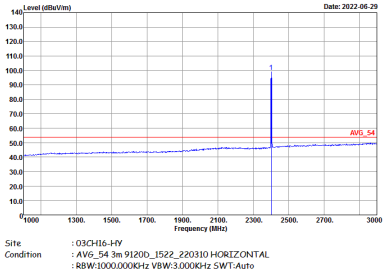
Note symbol

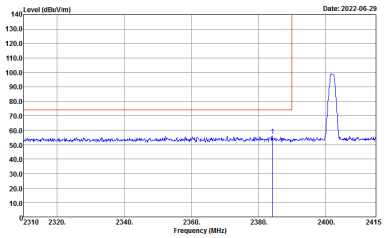
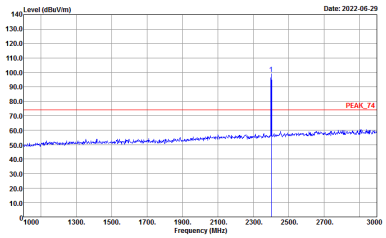
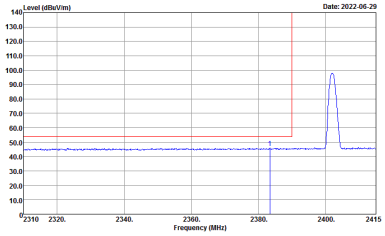
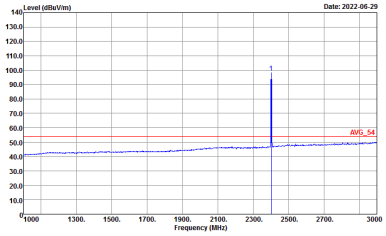
-L	**Low channel location**
-R	**High channel location**

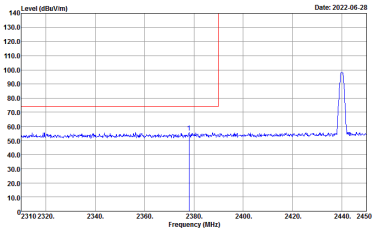
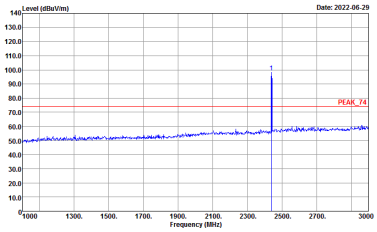
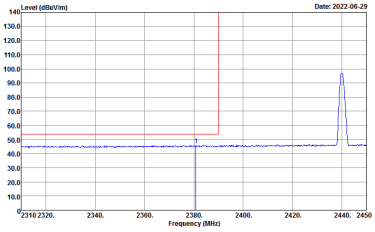
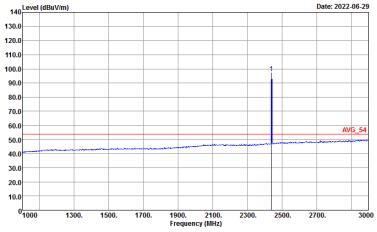
<1Mbps>

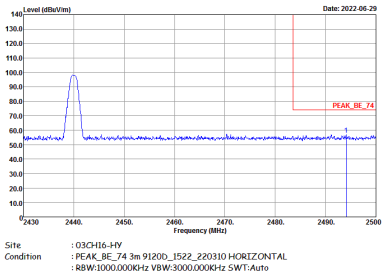
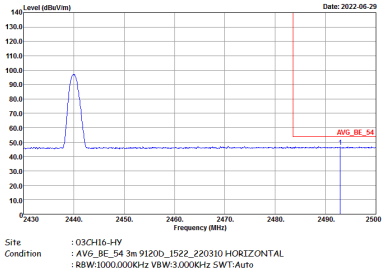
2.4GHz 2400~2483.5MHz

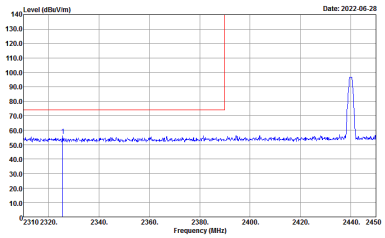
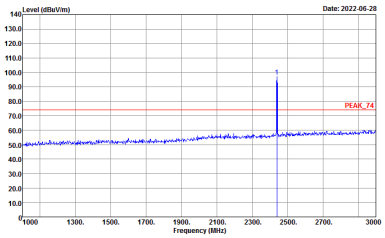
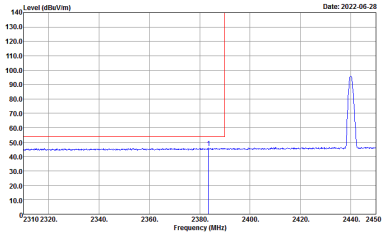
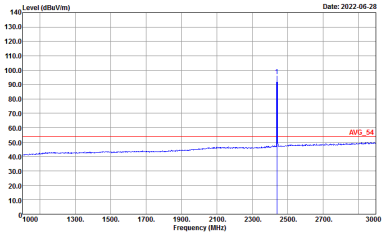
BLE (Band Edge @ 3m)

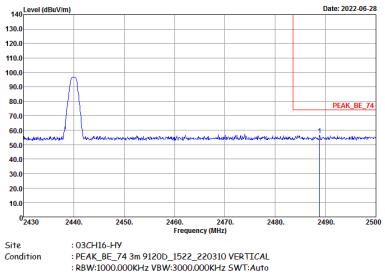
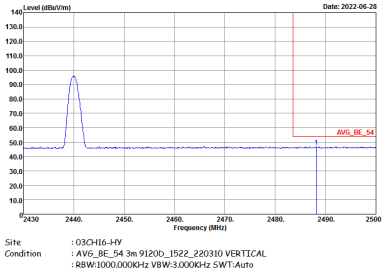
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH00 2402MHz	
	Horizontal	Fundamental
Peak		
Avg.		

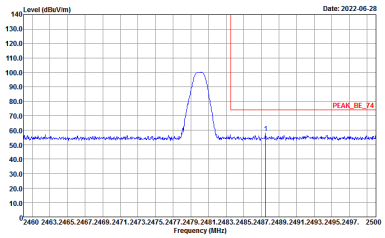
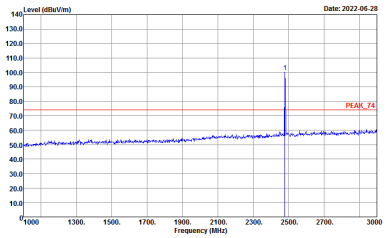
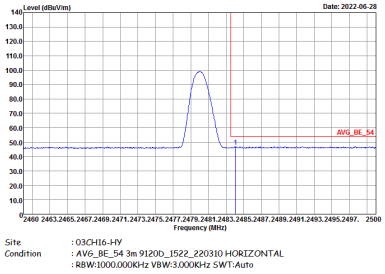
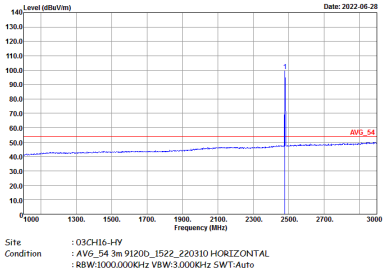
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH00 2402MHz	
	Vertical	Fundamental
Peak		
Avg		

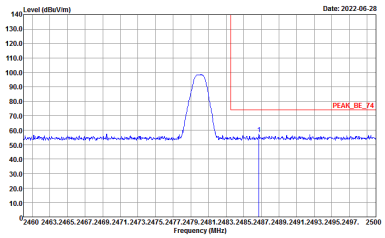
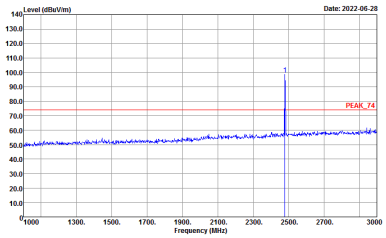
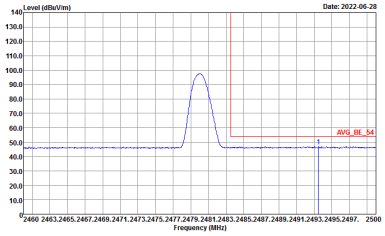
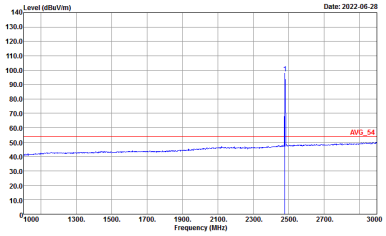
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH19 2440MHz - L	
	Horizontal	Fundamental
Peak	 Site : 03CH16-HY Condition : PEAK_BE_74 3m 9120D_1522_220310 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH16-HY Condition : PEAK_74 3m 9120D_1522_220310 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site : 03CH16-HY Condition : AVG_BE_54 3m 9120D_1522_220310 HORIZONTAL : RBW:1000.000KHz VBW:3.000KHz SWT:Auto	 Site : 03CH16-HY Condition : AVG_54 3m 9120D_1522_220310 HORIZONTAL : RBW:1000.000KHz VBW:3.000KHz SWT:Auto

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

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

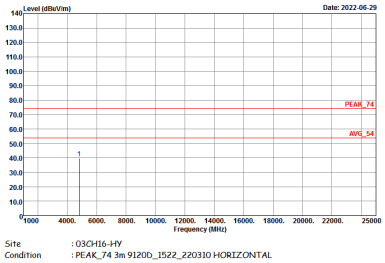
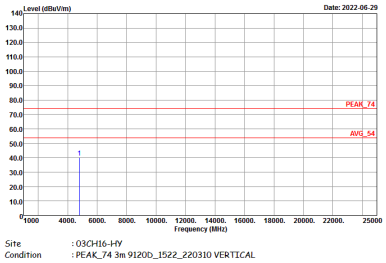
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH19 2440MHz - R	
	Vertical	Fundamental
Peak		Left blank
Avg.		Left blank

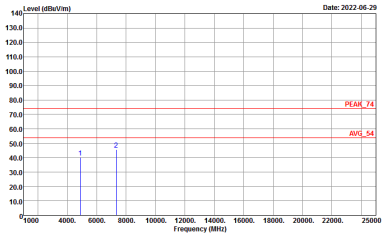
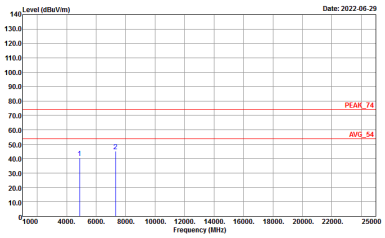
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH39 2480MHz	
	Horizontal	Fundamental
Peak		
Avg.		

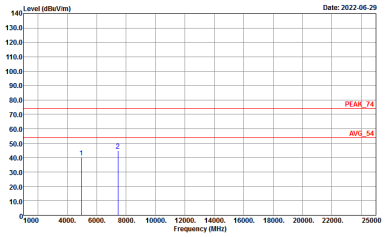
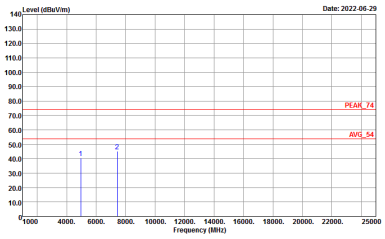
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH39 2480MHz	
	Vertical	Fundamental
Peak		
Avg.		

2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)

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

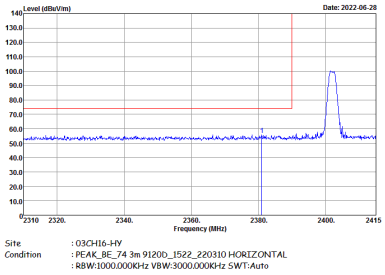
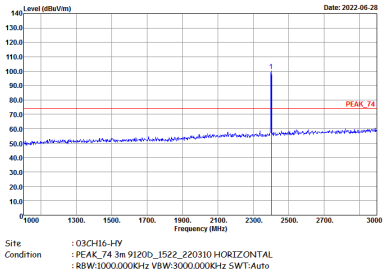
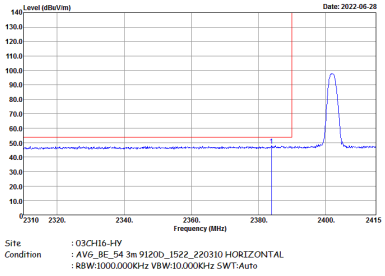
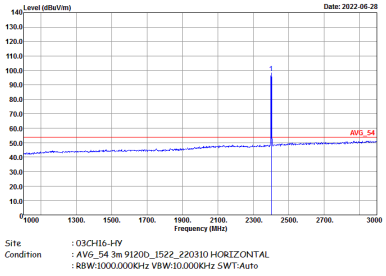
BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BLE CH19 2440MHz	
	Horizontal	Vertical
Peak Avg.		

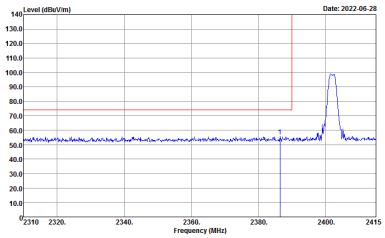
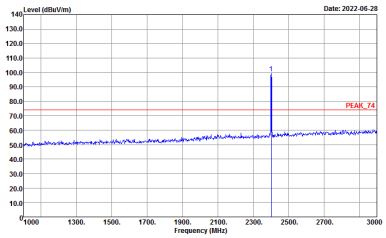
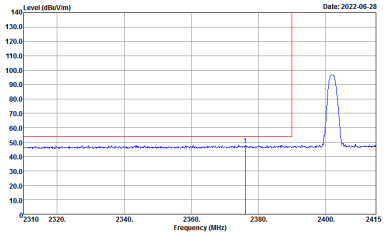
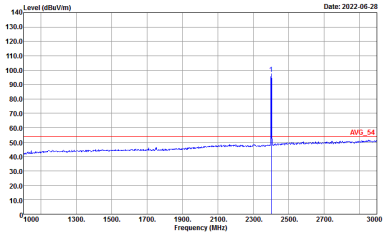
BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BLE CH39 2480MHz	
	Horizontal	Vertical
Peak Avg.		

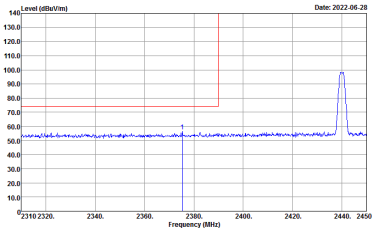
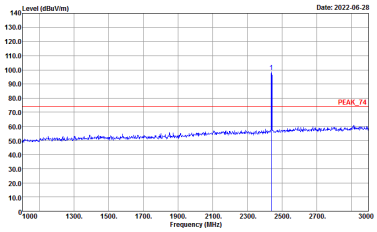
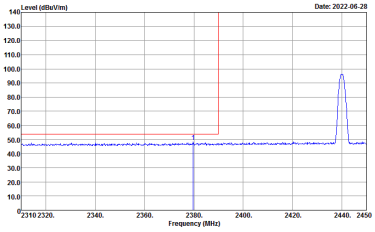
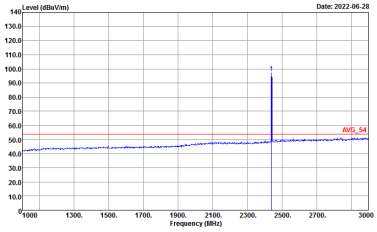
<2Mbps>

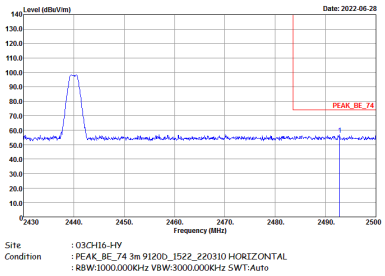
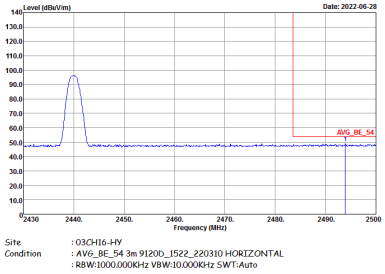
2.4GHz 2400~2483.5MHz

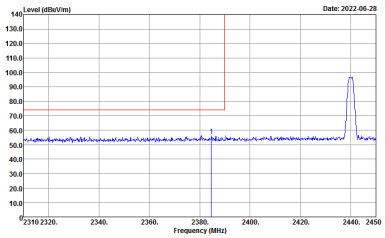
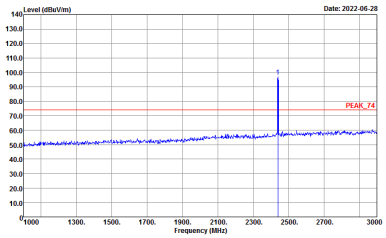
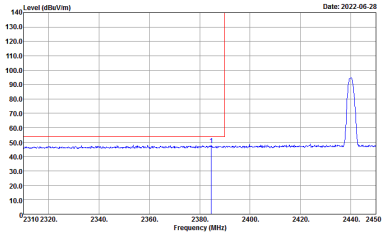
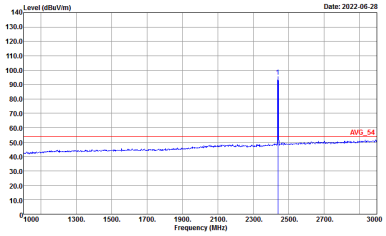
BLE (Band Edge @ 3m)

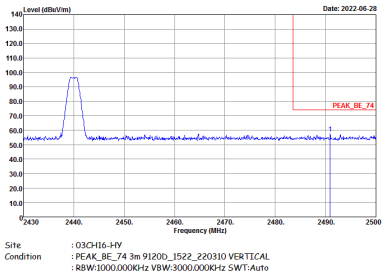
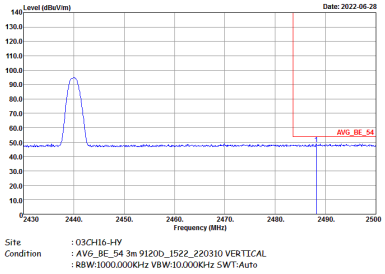
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH00 2402MHz	
	Horizontal	Fundamental
Peak		
Avg.		

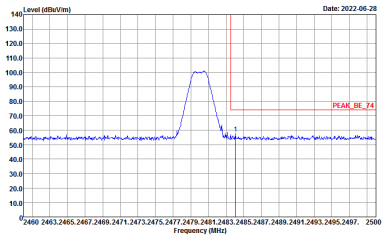
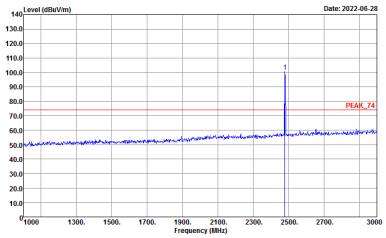
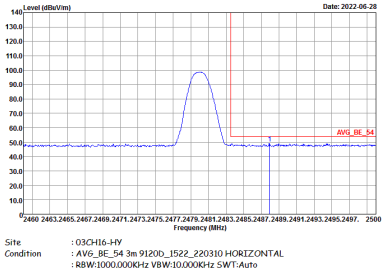
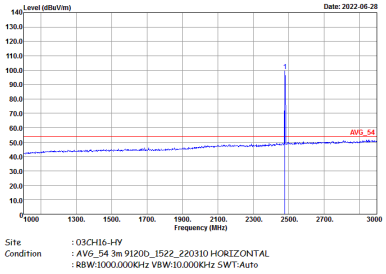
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH00 2402MHz	
	Vertical	Fundamental
Peak		
Avg		

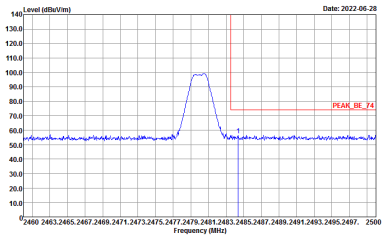
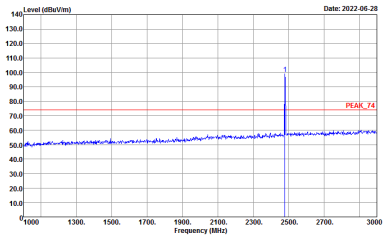
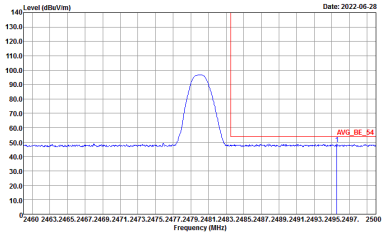
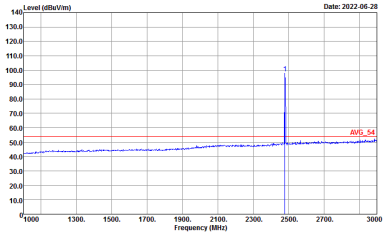
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH19 2440MHz - L	
	Horizontal	Fundamental
Peak		
Avg.		

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

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

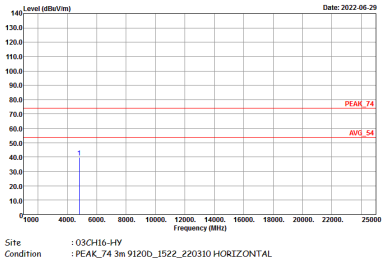
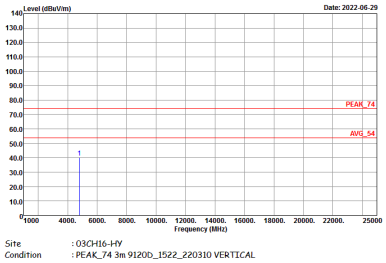
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH19 2440MHz - R	
	Vertical	Fundamental
Peak		Left blank
Avg.		Left blank

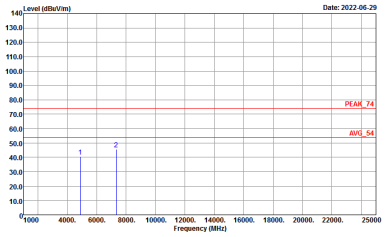
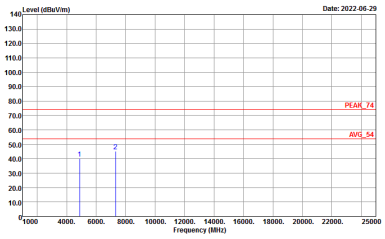
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH39 2480MHz	
	Horizontal	Fundamental
Peak		
Avg.		

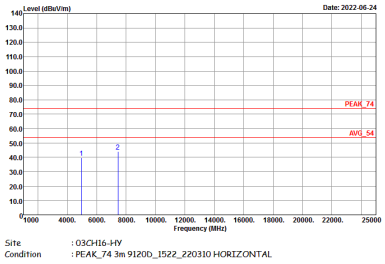
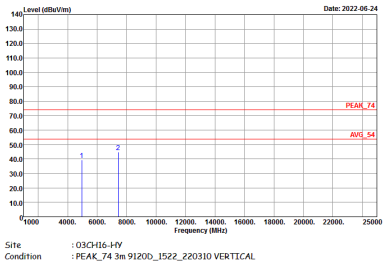
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH39 2480MHz	
	Vertical	Fundamental
Peak		
Avg.		

2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)

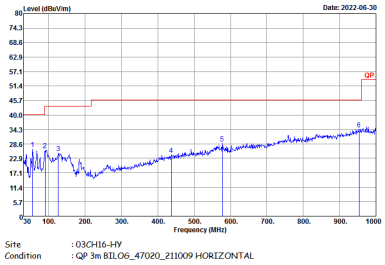
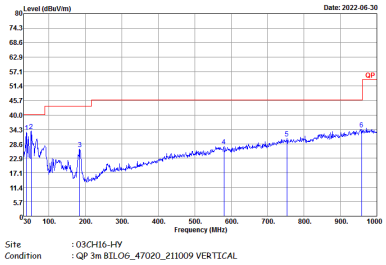
BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BLE CH00 2402MHz	
	Horizontal	Vertical
Peak Avg.		

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

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

Emission below 1GHz

2.4GHz BLE (LF)

BLE	2.4GHz 2400~2483.5MHz	
	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	60.58	378	2.65	3kHz
Bluetooth –LE for 2Mbps	30.99	194	5.15	10kHz

Bluetooth –LE for 1Mbps

Bluetooth –LE for 2Mbps