3.9 AC Conducted Emission Measurement

3.9.1 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.

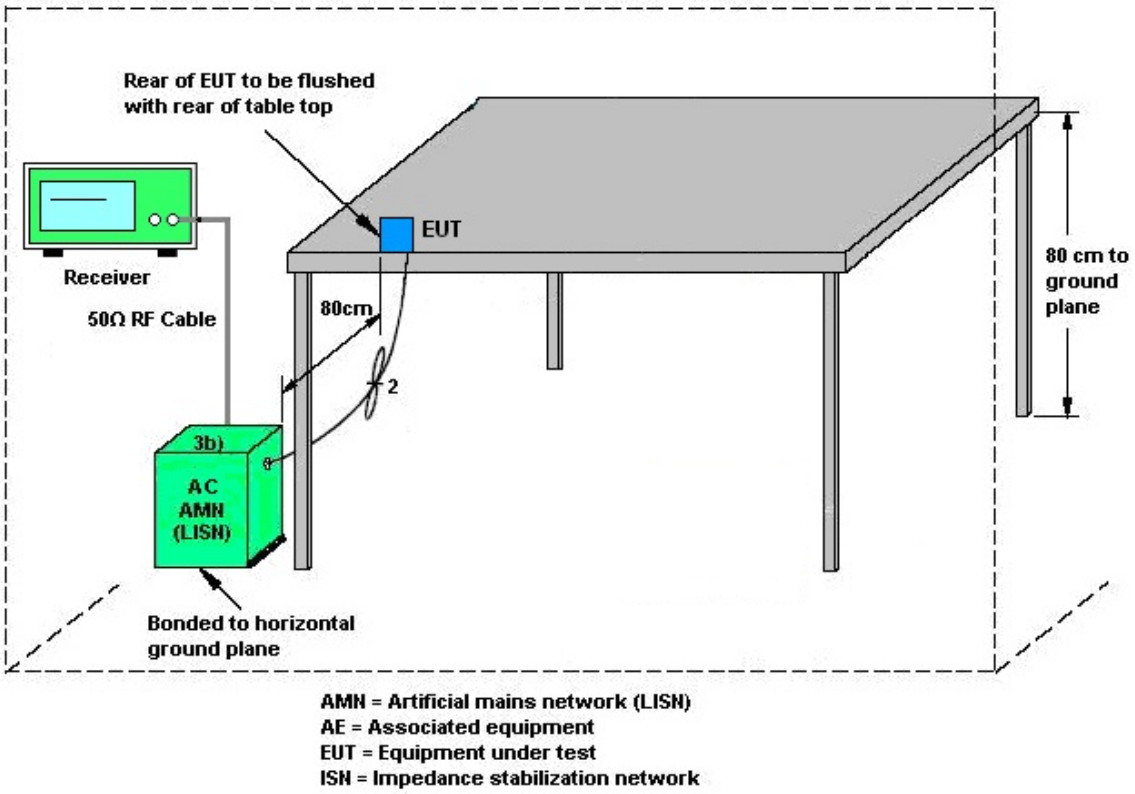
3.9.2 Measuring Instruments

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

3.9.3 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.

3.9.4 Test Setup



3.9.5 Test Result of AC Conducted Emission

Please refer to Appendix B.

3.10 Antenna Requirements

3.10.1 Standard Applicable

The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

3.10.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

4 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Hygrometer	TECPEL	DTM-303A	TP201996	N/A	Nov. 17, 2022	Jan. 09, 2023~ Jan. 19, 2023	Nov. 16, 2023	Conducted (TH05-HY)
Power Meter	Anritsu	ML2495A	1036004	N/A	Aug. 08,2022	Jan. 09, 2023~ Jan. 19, 2023	Aug. 07, 2023	Conducted (TH05-HY)
Power Sensor	Anritsu	MA2411B	1027253	300MHz~40GHz	Aug. 08,2022	Jan. 09, 2023~ Jan. 19, 2023	Aug. 07, 2023	Conducted (TH05-HY)
Power Sensor	DARE	RPR3006W	16I00054SNO 12 (NO:113)	10MHz~6GHz	Dec. 13, 2022	Jan. 09, 2023~ Jan. 19, 2023	Dec. 12, 2023	Conducted (TH05-HY)
Signal Analyzer	Rohde & Schwarz	FSV40	101905	10Hz - 40GHz	Aug. 03, 2022	Jan. 09, 2023~ Jan. 19, 2023	Aug. 02, 2023	Conducted (TH05-HY)
BT Base Station(Measure)	Rohde & Schwarz	CBT	101136	BT 3.0	Oct. 25, 2022	Jan. 09, 2023~ Jan. 19, 2023	Oct. 24, 2023	Conducted (TH05-HY)
AC Power Source	ACPOWER	AFC-11003G	F317040033	N/A	N/A	Feb. 14, 2023	N/A	Conduction (CO07-HY)
Software	Rohde & Schwarz	EMC32 V10.30	N/A	N/A	N/A	Feb. 14, 2023	N/A	Conduction (CO07-HY)
Pulse Limiter	SCHWARZBECK	VTSD 9561-F N	9561-F N00373	9kHz-200MHz	Nov. 01, 2022	Feb. 14, 2023	Oct. 31, 2023	Conduction (CO07-HY)
RF Cable	HUBER + SUHNER	RG 214/U	1358175	9kHz~30MHz	Mar. 16, 2022	Feb. 14, 2023	Mar. 15, 2023	Conduction (CO07-HY)
Two-Line V-Network	TESEQ	NNB 51	45051	N/A	Feb. 16, 2022	Feb. 14, 2023	Feb. 15, 2023	Conduction (CO07-HY)
Four-Line V-Network	TESEQ	NNB 52	36122	N/A	Mar. 04, 2022	Feb. 14, 2023	Mar. 03, 2023	Conduction (CO07-HY)
EMI Test Receiver	Rohde & Schwarz	ESCI7	100724	9kHz~7GHz	Feb. 24, 2022	Feb. 14, 2023	Feb. 23, 2023	Conduction (CO07-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Sep. 20, 2022	Jan. 22, 2023~ Feb. 25, 2023	Sep. 19, 2023	Radiation (03CH16-HY)
Preamplifier	EMEC	EM18G40G	060715	18GHz~40GHz	Dec. 07, 2022	Jan. 22, 2023~ Feb. 25, 2023	Dec. 06, 2023	Radiation (03CH16-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA9170	00993	18GHz-40GHz	Nov. 24, 2022	Jan. 22, 2023~ Feb. 25, 2023	Nov. 23, 2023	Radiation (03CH16-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1522	1GHz~18GHz	Mar. 10, 2022	Jan. 22, 2023~ Feb. 25, 2023	Mar. 09, 2023	Radiation (03CH16-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00802N1D01N-06	47020 & 06	30MHz~1GHz	Oct. 08, 2022	Jan. 22, 2023~ Feb. 25, 2023	Oct. 07, 2023	Radiation (03CH16-HY)
EMI Test Receiver	Keysight	N9038A(MXE)	MY57290111	3Hz~26.5GHz	Dec. 15, 2022	Jan. 22, 2023~ Feb. 25, 2023	Dec. 14, 2023	Radiation (03CH16-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200485	10Hz~44GHz	Mar. 07, 2022	Jan. 22, 2023~ Feb. 25, 2023	Mar. 06, 2023	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	805935/4	N/A	Aug. 09, 2022	Jan. 22, 2023~ Feb. 25, 2023	Aug. 08, 2023	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	802434/4	N/A	Aug. 09, 2022	Jan. 22, 2023~ Feb. 25, 2023	Aug. 08, 2023	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	EC-A5-300-5 757	N/A	Aug. 09, 2022	Jan. 22, 2023~ Feb. 25, 2023	Aug. 08, 2023	Radiation (03CH16-HY)

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Amplifier	SONOMA	310N	371607	9kHz~1GHz	Jul. 04, 2022	Jan. 22, 2023~ Feb. 25, 2023	Jul. 03, 2023	Radiation (03CH16-HY)
Preamplifier	EMEC	EM1G18G	060812	1GHz~18GHz	Dec. 26, 2022	Jan. 22, 2023~ Feb. 25, 2023	Dec. 25, 2023	Radiation (03CH16-HY)
Preamplifier	Keysight	83017A	MY53270264	1GHz~26.5GHz	Dec. 09, 2022	Jan. 22, 2023~ Feb. 25, 2023	Dec. 08, 2023	Radiation (03CH16-HY)
Controller	ChainTek	3000-1	N/A	Control Turn table & Ant Mast	N/A	Jan. 22, 2023~ Feb. 25, 2023	N/A	Radiation (03CH16-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Jan. 22, 2023~ Feb. 25, 2023	N/A	Radiation (03CH16-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Jan. 22, 2023~ Feb. 25, 2023	N/A	Radiation (03CH16-HY)
Software	Audix	E3 6.2009-8-24	RK-001136	N/A	N/A	Jan. 22, 2023~ Feb. 25, 2023	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))	3.46 dB

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	6.50 dB

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	4.60 dB

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	4.50 dB

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.60 dB

Appendix A. Test Result of Conducted Test Items

Test Engineer:	Hank Hsu	Temperature:	21~25	°C
Test Date:	2023/01/09~2023/01/19	Relative Humidity:	51~54	%

TEST RESULTS DATA
20dB and 99% Occupied Bandwidth and Hopping Channel Separation

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	20db BW (MHz)	99% Bandwidth (MHz)	Hopping Channel Separation Measurement (MHz)	Hopping Channel Separation Measurement Limit (MHz)	Pass/Fail
DH	1Mbps	1	0	2402	0.947	0.839	1.003	0.6313	Pass
DH	1Mbps	1	39	2441	0.947	0.851	1.007	0.6313	Pass
DH	1Mbps	1	78	2480	0.944	0.842	1.003	0.6293	Pass
2DH	2Mbps	1	0	2402	1.250	1.164	1.003	0.8333	Pass
2DH	2Mbps	1	39	2441	1.281	1.158	1.303	0.8540	Pass
2DH	2Mbps	1	78	2480	1.272	1.164	1.155	0.8480	Pass
3DH	3Mbps	1	0	2402	1.307	1.178	1.311	0.8713	Pass
3DH	3Mbps	1	39	2441	1.307	1.178	1.003	0.8713	Pass
3DH	3Mbps	1	78	2480	1.272	1.155	1.120	0.8480	Pass

TEST RESULTS DATA
Dwell Time

Mod.	Hopping Channel Number Rate	Hops Over Occupancy Time (hops)	Package Transfer Time (msec)	Dwell Time (sec)	Limits (sec)	Pass/Fail
DH5	79	106.670	2.88	0.31	0.4	Pass
DH5 (AFH)	20	53.330	2.88	0.15	0.4	Pass

TEST RESULTS DATA
Peak Power Table

DH	CH.	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
DH5	0	1	4.08	30.00	Pass
	39	1	4.10	30.00	Pass
	78	1	**4.29**	30.00	Pass
2DH5	0	1	3.44	20.97	Pass
	39	1	3.45	20.97	Pass
	78	1	**3.71**	20.97	Pass
3DH5	0	1	3.59	20.97	Pass
	39	1	3.74	20.97	Pass
	78	1	**3.85**	20.97	Pass

TEST RESULTS DATA
Average Power Table
(Reporting Only)

DH	CH.	NTX	Average Power (dBm)	Duty Factor (dB)
DH1	0	1	3.31	5.18
	39	1	3.52	5.18
	78	1	**3.74**	5.18
2DH1	0	1	1.56	5.17
	39	1	1.67	5.17
	78	1	**1.94**	5.17
3DH1	0	1	1.42	5.15
	39	1	1.64	5.15
	78	1	**1.96**	5.15

TEST RESULTS DATA
Number of Hopping Frequency

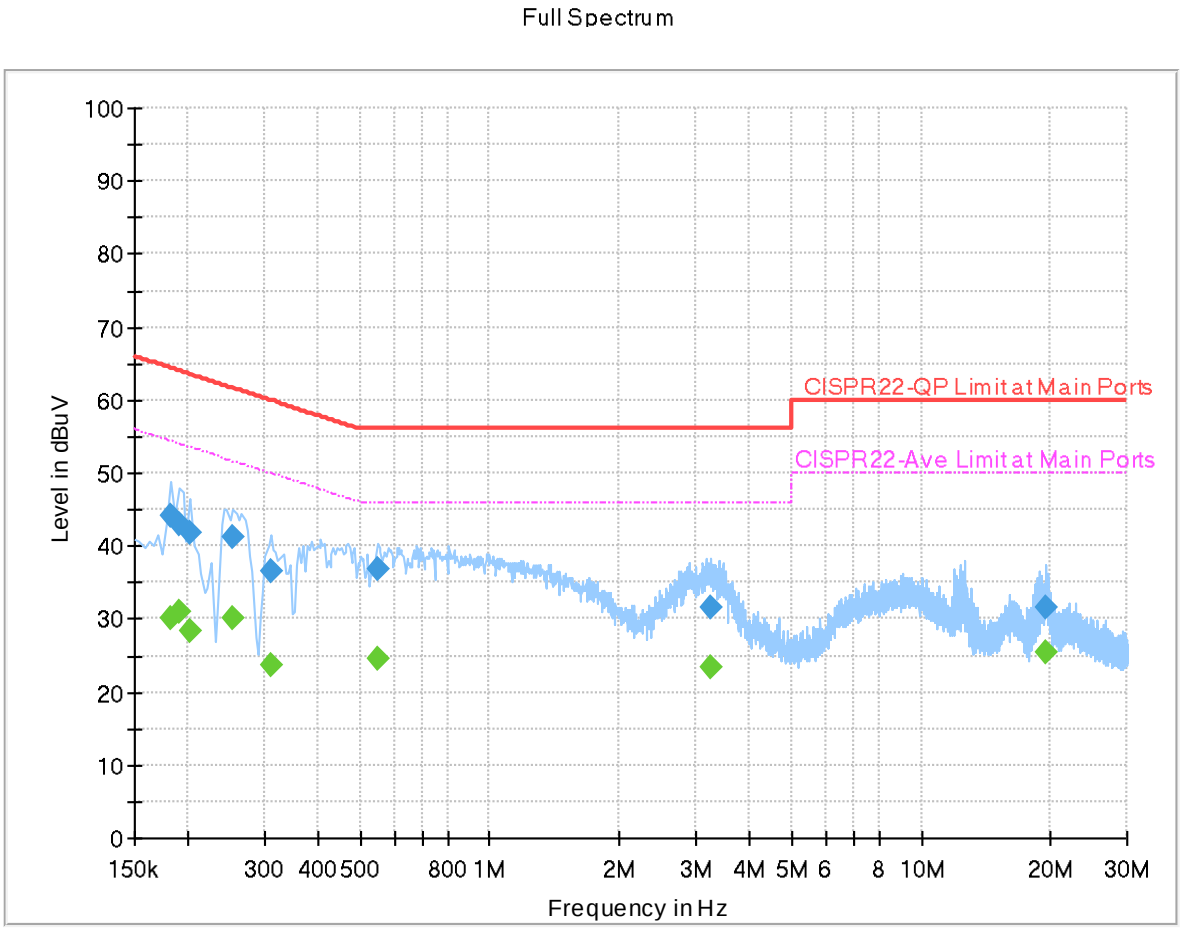
Number of Hopping (Channel)	Adaptive Frequency Hopping (Channel)	Limits (Channel)	Pass/Fail
79	20	> 15	Pass

Appendix B. AC Conducted Emission Test Results

Test Engineer :	Louis Chung	**Temperature :**	20.2~23.4℃
		Relative Humidity :	55.6~71.3%

EUT Information

Report NO :	2D2704
Test Mode :	Mode 1
Test Voltage :	120Vac/60Hz
Phase :	Line

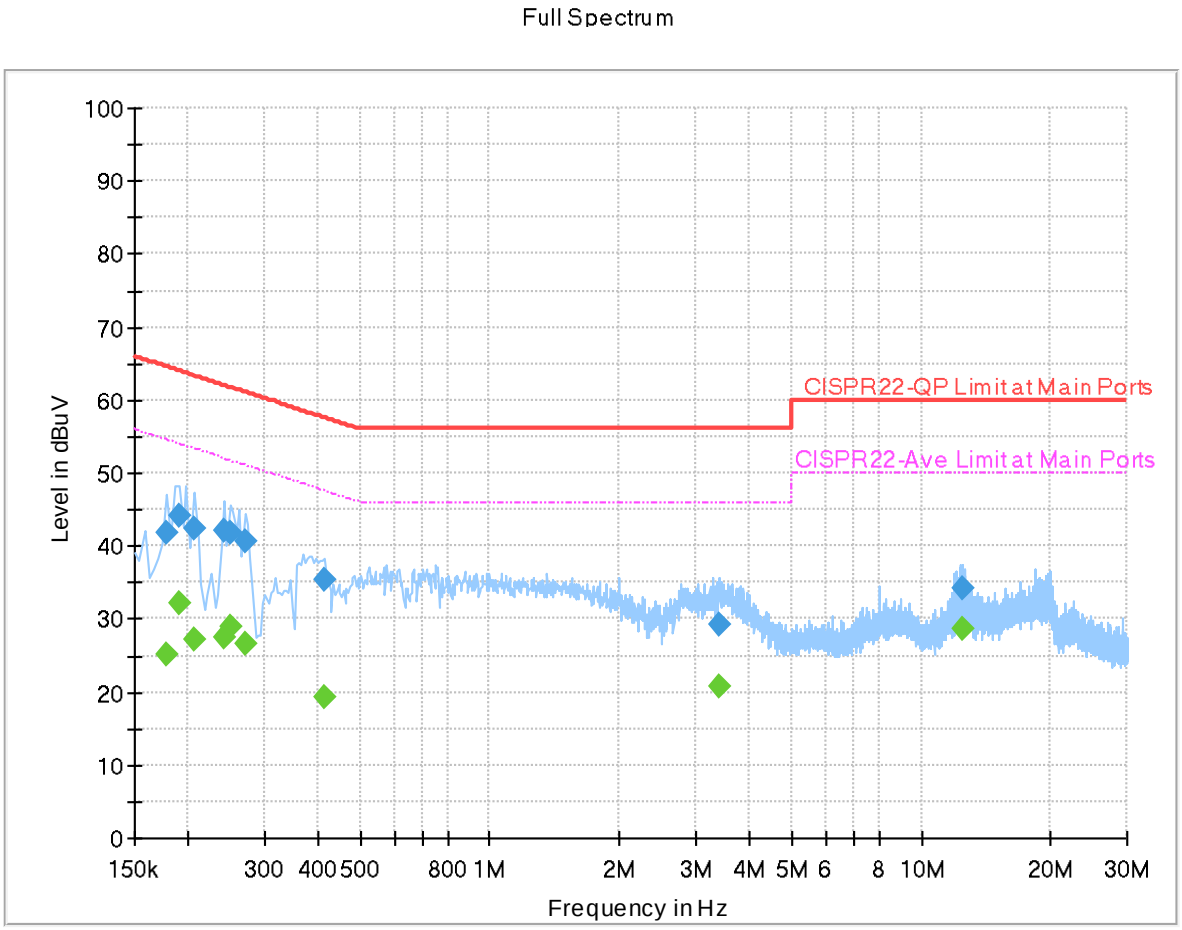


Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.182000	---	30.05	54.39	24.34	L1	OFF	20.0
0.182000	44.15	---	64.39	20.24	L1	OFF	20.0
0.190000	---	30.93	54.04	23.11	L1	OFF	20.0
0.190000	43.06	---	64.04	20.98	L1	OFF	20.0
0.202000	---	28.31	53.53	25.22	L1	OFF	20.0
0.202000	41.71	---	63.53	21.82	L1	OFF	20.0
0.254000	---	30.25	51.63	21.38	L1	OFF	20.0
0.254000	41.34	---	61.63	20.29	L1	OFF	20.0
0.310000	---	23.80	49.97	26.17	L1	OFF	20.0
0.310000	36.47	---	59.97	23.50	L1	OFF	20.0
0.550000	---	24.65	46.00	21.35	L1	OFF	20.0
0.550000	36.70	---	56.00	19.30	L1	OFF	20.0
3.258000	---	23.31	46.00	22.69	L1	OFF	20.0
3.258000	31.47	---	56.00	24.53	L1	OFF	20.0
19.354000	---	25.58	50.00	24.42	L1	OFF	20.2
19.354000	31.53	---	60.00	28.47	L1	OFF	20.2

EUT Information

Report NO :	2D2704
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)
0.178000	41.95	---	64.58	22.63	N	OFF	20.0
0.178000	---	25.17	54.58	29.41	N	OFF	20.0
0.190000	44.19	---	64.04	19.85	N	OFF	20.0
0.190000	---	32.18	54.04	21.86	N	OFF	20.0
0.206000	42.37	---	63.37	21.00	N	OFF	20.0
0.206000	---	27.20	53.37	26.17	N	OFF	20.0
0.242000	42.08	---	62.03	19.95	N	OFF	20.0
0.242000	---	27.48	52.03	24.55	N	OFF	20.0
0.250000	41.85	---	61.76	19.91	N	OFF	20.0
0.250000	---	28.95	51.76	22.81	N	OFF	20.0
0.270000	40.78	---	61.12	20.34	N	OFF	20.0
0.270000	---	26.54	51.12	24.58	N	OFF	20.0
0.414000	35.48	---	57.57	22.09	N	OFF	20.0
0.414000	---	19.22	47.57	28.35	N	OFF	20.0
3.398000	29.17	---	56.00	26.83	N	OFF	20.1
3.398000	---	20.72	46.00	25.28	N	OFF	20.1
12.486000	34.10	---	60.00	25.90	N	OFF	20.2
12.486000	---	28.77	50.00	21.23	N	OFF	20.2

Appendix C. Radiated Spurious Emission

Test Engineer :	Andy Yang, Karl Hou and Gary Guo	Temperature :	18~23°C
		Relative Humidity :	50~65%

<Sample 1 with Battery 1>

2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
		(MHz)	(dBμV/m)	(dB)	Line (dBμV/m)	Level (dBμV)	Factor (dB/m)	Loss (dB)	Factor (dB)	Pos (cm)	Pos (deg)	Avg. (P/A)	(H/V)
BT CH00 2402MHz		2384.865	44.54	-29.46	74	40.24	27.34	7.43	30.47	154	57	P	H
		2384.865	19.75	-34.25	54	-	-	-	-	-	-	A	H
	*	2402	98.3	-	-	93.89	27.41	7.46	30.46	154	57	P	H
	*	2402	73.51	-	-	-	-	-	-	-	-	A	H
													H
													H
		2320.29	44.18	-29.82	74	40.18	27.2	7.29	30.49	111	118	P	V
		2320.29	19.39	-34.61	54	-	-	-	-	-	-	A	V
	*	2402	99.03	-	-	94.62	27.41	7.46	30.46	111	118	P	V
	*	2402	74.24	-	-	-	-	-	-	-	-	A	V
													V
													V
BT CH 39 2441MHz		2387.7	44.34	-29.66	74	40.03	27.35	7.43	30.47	122	57	P	H
		2387.7	19.55	-34.45	54	-	-	-	-	-	-	A	H
	*	2441	100.59	-	-	95.88	27.64	7.52	30.45	122	57	P	H
	*	2441	75.8	-	-	-	-	-	-	-	-	A	H
		2495.8	44.72	-29.28	74	39.67	27.88	7.6	30.43	122	57	P	H
		2495.8	19.93	-34.07	54	-	-	-	-	-	-	A	H
		2345.14	44.4	-29.6	74	40.34	27.2	7.34	30.48	103	117	P	V
		2345.14	19.61	-34.39	54	-	-	-	-	-	-	A	V
	*	2441	101.33	-	-	96.62	27.64	7.52	30.45	103	117	P	V
	*	2441	76.54	-	-	-	-	-	-	-	-	A	V
		2488.38	45.34	-28.66	74	40.33	27.85	7.59	30.43	103	117	P	V
		2488.38	20.55	-33.45	54	-	-	-	-	-	-	A	V

BT CH 78 2480MHz	*	2480	97.58	-	-	92.62	27.82	7.58	30.44	140	69	P	H
	*	2480	72.79	-	-	-	-	-	-	-	-	A	H
		2483.76	46.14	-27.86	74	41.15	27.84	7.59	30.44	140	69	P	H
		2483.76	21.35	-32.65	54	-	-	-	-	-	-	A	H
													H
													H
	*	2480	98.17	-	-	93.21	27.82	7.58	30.44	123	115	P	V
	*	2480	73.38	-	-	-	-	-	-	-	-	A	V
		2498.2	45.46	-28.54	74	40.39	27.89	7.61	30.43	123	115	P	V
		2498.2	20.67	-33.33	54	-	-	-	-	-	-	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

BT (Harmonic @ 3m)

BT	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BT CH 00 2402MHz		4804	39.64	-34.36	74	62.67	32.32	11.3	66.65	-	-	P	H
		4804	14.85	-39.15	54	-	-	-	-	-	-	A	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
		4804	39.09	-34.91	74	62.12	32.32	11.3	66.65	-	-	P	V
		4804	14.3	-39.7	54	-	-	-	-	-	-	A	V
													V
													V
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													V

BT	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BT CH 39 2441MHz		4882	39.75	-34.25	74	62.24	32.73	11.36	66.58	-	-	P	H
		4882	14.96	-39.04	54	-	-	-	-	-	-	A	H
		7323	43.75	-30.25	74	59.54	37.06	13.48	66.33	-	-	P	H
		7323	18.96	-35.04	54	-	-	-	-	-	-	A	H
													H
													H
													H
													H
													H
													H
													H
													H
		4882	39.67	-34.33	74	62.16	32.73	11.36	66.58	-	-	P	V
		4882	14.88	-39.12	54	-	-	-	-	-	-	A	V
		7323	44.38	-29.62	74	60.17	37.06	13.48	66.33	-	-	P	V
		7323	19.59	-34.41	54	-	-	-	-	-	-	A	V
													V
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BT	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BT CH 78 2480MHz		4960	41.27	-32.73	74	63.25	33.12	11.41	66.51	-	-	P	H
		4960	16.48	-37.52	54	-	-	-	-	-	-	A	H
		7440	43.73	-30.27	74	60.16	36.46	13.49	66.38	-	-	P	H
		7440	18.94	-35.06	54	-	-	-	-			A	H
													H
													H
													H
													H
													H
													H
													H
													H
		4960	39.77	-34.23	74	61.75	33.12	11.41	66.51	-	-	P	V
		4960	14.98	-39.02	54	-	-	-	-	-	-	A	V
		7440	43.2	-30.8	74	59.63	36.46	13.49	66.38	-	-	P	V
		7440	18.41	-35.59	54	-	-	-	-			A	V
													V
													V
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													V
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													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 BT (LF)

BT	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
					Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz BT LF		82.65	27.39	-12.61	40	44.59	13.76	1.33	32.29	-	-	P	H
		95.34	29.22	-14.28	43.5	44.75	15.26	1.47	32.26	-	-	P	H
		183.36	27.05	-16.45	43.5	42.36	14.92	2.09	32.32	-	-	P	H
		623.4	27.87	-18.13	46	30.77	25.84	3.88	32.62	-	-	P	H
		793.5	30.52	-15.48	46	31.08	27.5	4.36	32.42	-	-	P	H
		951	32.27	-13.73	46	28.62	30.17	4.81	31.33	-	-	P	H
													H
													H
													H
													H
													H
													H
		44.31	33.63	-6.37	40	48.04	17.1	0.77	32.28	-	-	P	V
		50.79	33.46	-6.54	40	50.92	13.92	0.91	32.29	-	-	P	V
		183.36	29.19	-14.31	43.5	44.5	14.92	2.09	32.32	-	-	P	V
		486.2	24.47	-21.53	46	29.93	23.68	3.39	32.53	-	-	P	V
		694.8	27.97	-18.03	46	30.42	26.05	4.07	32.57	-	-	P	V
		911.8	31.87	-14.13	46	29.91	28.89	4.71	31.64	-	-	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.												

<Sample 1 with Battery 2>

2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
		(MHz)	(dBμV/m)	(dB)	Line (dBμV/m)	Level (dBμV)	Factor (dB/m)	Loss (dB)	Factor (dB)	Pos (cm)	Pos (deg)	Avg. (P/A)	(H/V)
BT CH 78 2480MHz	*	2480	97.99	-	-	93.03	27.82	7.58	30.44	116	56	P	H
	*	2480	73.2	-	-	-	-	-	-	-	-	A	H
		2487.12	45.34	-28.66	74	40.33	27.85	7.59	30.43	116	56	P	H
		2487.12	20.55	-33.45	54	-	-	-	-	-	-	A	H
													H
													H
	*	2480	97.95	-	-	92.99	27.82	7.58	30.44	127	96	P	V
	*	2480	73.16	-	-	-	-	-	-	-	-	A	V
		2487.52	46.54	-27.46	74	41.53	27.85	7.59	30.43	127	96	P	V
		2487.52	21.75	-32.25	54	-	-	-	-	-	-	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

BT (Harmonic @ 3m)

BT	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BT CH 78 2480MHz		4960	40.36	-33.64	74	62.34	33.12	11.41	66.51	-	-	P	H
		4960	15.57	-38.43	54	-	-	-	-	-	-	A	H
		7440	43.75	-30.25	74	60.18	36.46	13.49	66.38	-	-	P	H
		7440	18.96	-35.04	54	-	-	-	-	-	-	A	H
													H
													H
													H
													H
													H
													H
													H
													H
		4960	39.93	-34.07	74	61.91	33.12	11.41	66.51	-	-	P	V
		4960	15.14	-38.86	54	-	-	-	-	-	-	A	V
		7440	43.63	-30.37	74	60.06	36.46	13.49	66.38	-	-	P	V
		7440	18.84	-35.16	54	-	-	-	-	-	-	A	V
													V
													V
													V
													V
													V
													V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line. 3. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only.												

<Sample 1 with Battery 3>

2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
		(MHz)	(dBμV/m)	(dB)	Line (dBμV/m)	Level (dBμV)	Factor (dB/m)	Loss (dB)	Factor (dB)	Pos (cm)	Pos (deg)	Avg. (P/A)	(H/V)
BT CH 78 2480MHz	*	2480	96.91	-	-	91.95	27.82	7.58	30.44	100	30	P	H
	*	2480	72.12	-	-	-	-	-	-	-	-	A	H
		2485.96	45.67	-28.33	74	40.67	27.84	7.59	30.43	100	30	P	H
		2485.96	20.88	-33.12	54	-	-	-	-	-	-	A	H
													H
													H
	*	2480	96.78	-	-	91.82	27.82	7.58	30.44	100	93	P	V
	*	2480	71.99	-	-	-	-	-	-	-	-	A	V
		2485.52	45.38	-28.62	74	40.38	27.84	7.59	30.43	100	93	P	V
		2485.52	20.59	-33.41	54	-	-	-	-	-	-	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

BT (Harmonic @ 3m)

BT	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BT CH 78 2480MHz		4960	40.07	-33.93	74	62.05	33.12	11.41	66.51	-	-	P	H
		4960	15.28	-38.72	54	-	-	-	-	-	-	A	H
		7440	43.23	-30.77	74	59.66	36.46	13.49	66.38	-	-	P	H
		7440	18.44	-35.56	54	-	-	-	-	-	-	A	H
													H
													H
													H
													H
													H
													H
													H
													H
		4960	39.77	-34.23	74	61.75	33.12	11.41	66.51	-	-	P	V
		4960	14.98	-39.02	54	-	-	-	-	-	-	A	V
		7440	43.36	-30.64	74	59.79	36.46	13.49	66.38	-	-	P	V
		7440	18.57	-35.43	54	-	-	-	-	-	-	A	V
													V
													V
													V
													V
													V
													V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line. 3. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only.												

<Sample 2 with Battery 1>

2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
		(MHz)	(dBμV/m)	Limit (dB)	Line (dBμV/m)	Level (dBμV)	Factor (dB/m)	Loss (dB)	Factor (dB)	Pos (cm)	Pos (deg)	Avg. (P/A)	(H/V)
BT CH 78 2480MHz	*	2480	89.45	-	-	84.49	27.82	7.58	30.44	114	66	P	H
	*	2480	64.66	-	-	-	-	-	-	-	-	A	H
		2494.88	45.24	-28.76	74	40.19	27.88	7.6	30.43	114	66	P	H
		2494.88	20.45	-33.55	54	-	-	-	-	-	-	A	H
													H
													H
	*	2480	91.3	-	-	86.34	27.82	7.58	30.44	127	101	P	V
	*	2480	66.51	-	-	-	-	-	-	-	-	A	V
		2487.36	44.96	-29.04	74	39.95	27.85	7.59	30.43	127	101	P	V
		2487.36	20.17	-33.83	54	-	-	-	-	-	-	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

BT (Harmonic @ 3m)

BT	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)
BT CH 78 2480MHz		4960	39.68	-34.32	74	61.66	33.12	11.41	66.51	-	-	P	H
		4960	14.89	-39.11	54	-	-	-	-	-	-	A	H
		7440	43.41	-30.59	74	59.84	36.46	13.49	66.38	-	-	P	H
		7440	18.62	-35.38	54	-	-	-	-	-	-	A	H
													H
													H
													H
													H
													H
													H
													H
													H
		4960	40.67	-33.33	74	62.65	33.12	11.41	66.51	-	-	P	V
		4960	15.88	-38.12	54	-	-	-	-	-	-	A	V
		7440	43.99	-30.01	74	60.42	36.46	13.49	66.38	-	-	P	V
		7440	19.2	-34.8	54	-	-	-	-	-	-	A	V
													V
													V
													V
													V
													V
													V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line. 3. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only.												

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **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:

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

1. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) = Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)
3. Margin(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

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

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

= 55.45 (dBμV/m)

2. Margin(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

Peak measured complies with the limit line, so test result is “PASS”.

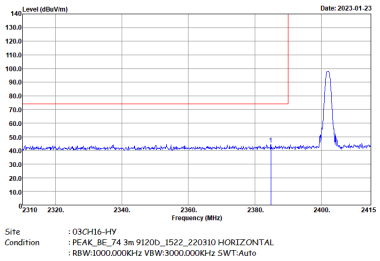
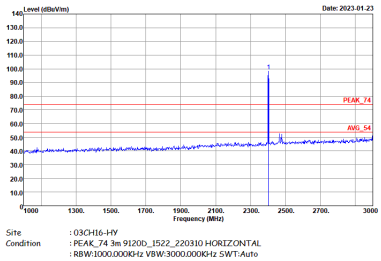
Appendix D. Radiated Spurious Emission Plots

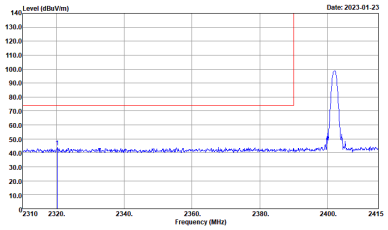
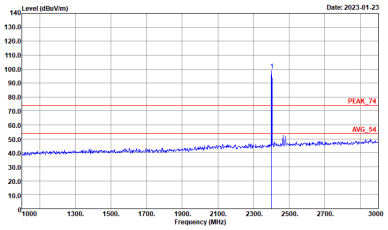
Test Engineer :	Andy Yang, Karl Hou and Gary Guo	Temperature :	18~23°C
		Relative Humidity :	50~65%

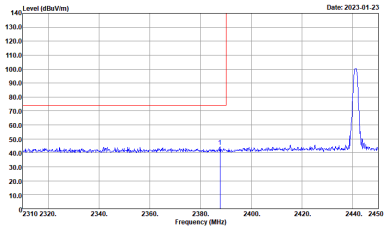
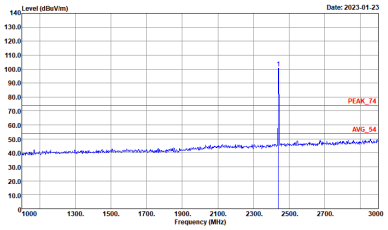
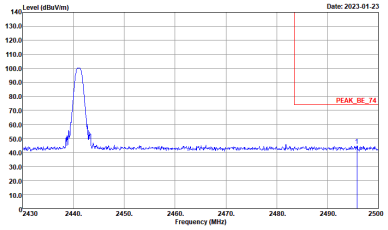
<Sample 1 with Battery 1>

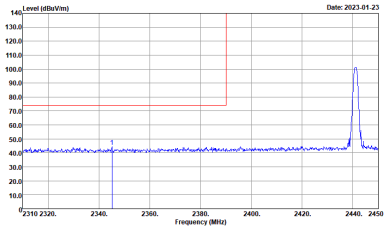
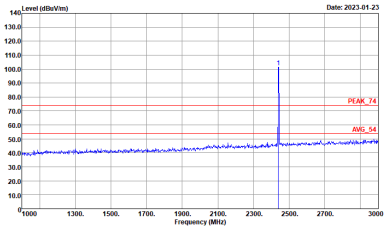
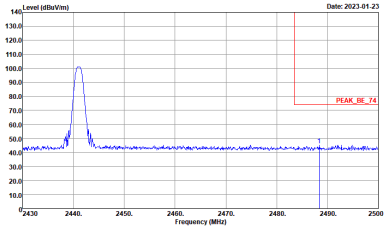
2.4GHz 2400~2483.5MHz

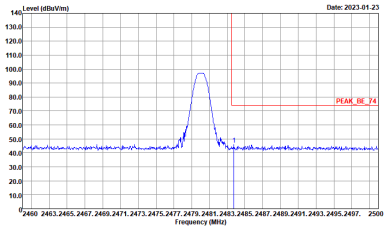
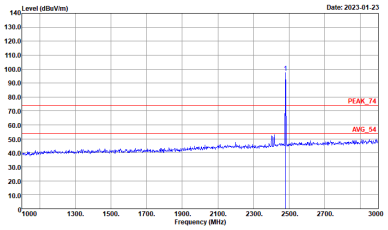
BT (Band Edge @ 3m)

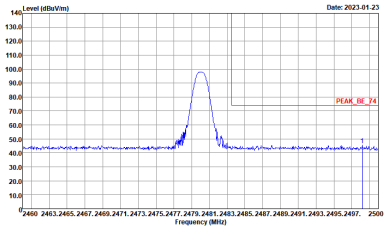
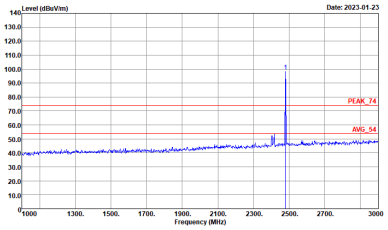
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH00 2402MHz	
	Horizontal	Fundamental
Peak		

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH00 2402MHz	
	Vertical	Fundamental
Peak	 Site : 03CH16-HY Condition : PEAK_8E_74 3m 9120D_1522_220310 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH16-HY Condition : PEAK_74 3m 9120D_1522_220310 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH39 2441MHz	
	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
Peak	 Site : 03CH16-HY Condition : PEAK_BE_74 3m 9120D_1522_220310 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	Left blank

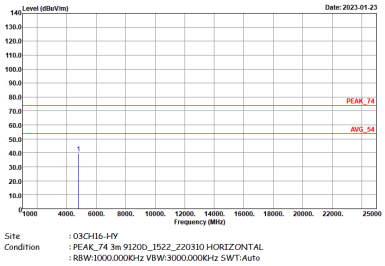
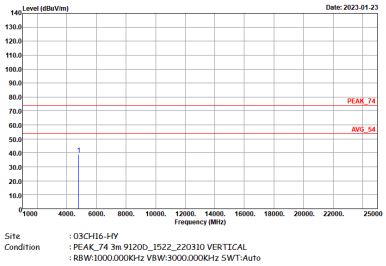
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH39 2441MHz	
	Vertical	Fundamental
Peak		
Peak		Left blank

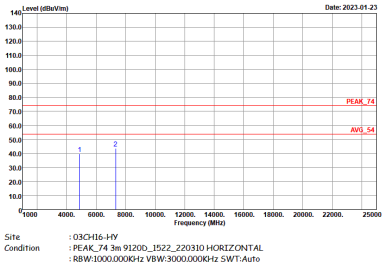
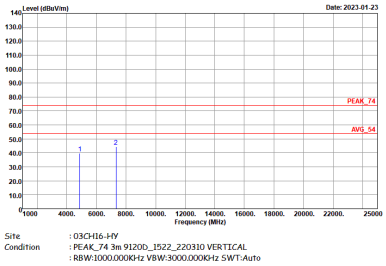
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH78 2480MHz	
	Horizontal	Fundamental
Peak	 Site : 03CH16-HY Condition : PEAK_BE_74 3m 9120D_1522_220310 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH16-HY Condition : PEAK_74 3m 9120D_1522_220310 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto

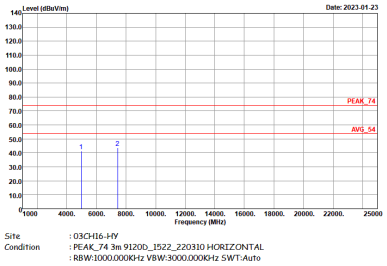
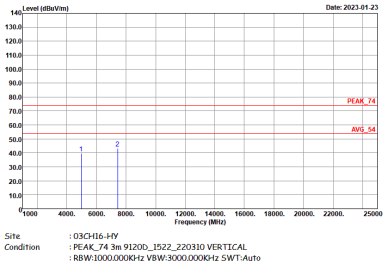
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH78 2480MHz	
	Vertical	Fundamental
Peak	 Site : 03CH16-HY Condition : PEAK_BE_74 3m 9120D_1522_220310 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH16-HY Condition : PEAK_74 3m 9120D_1522_220310 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto

2.4GHz 2400~2483.5MHz

BT (Harmonic @ 3m)

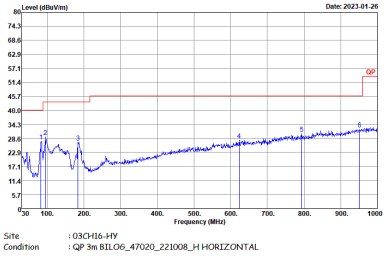
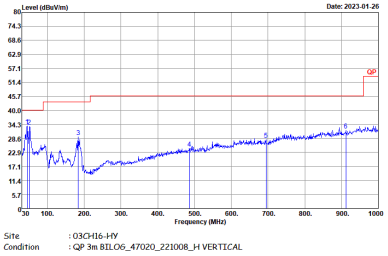
BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BT CH00 2402MHz	
	Horizontal	Vertical
Peak Avg.		

BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BT CH39 2441MHz	
	Horizontal	Vertical
Peak Avg.		

BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BT CH78 2480MHz	
	Horizontal	Vertical
Peak Avg.		

Emission below 1GHz

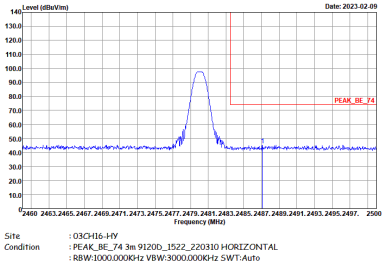
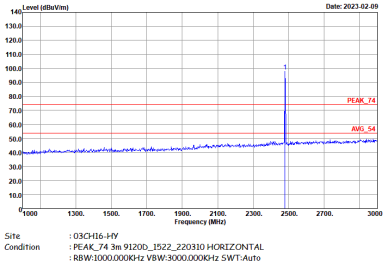
2.4GHz BT (LF)

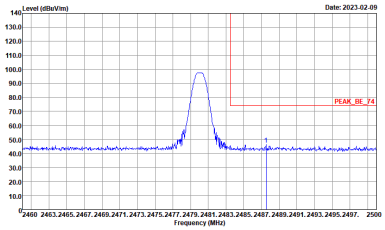
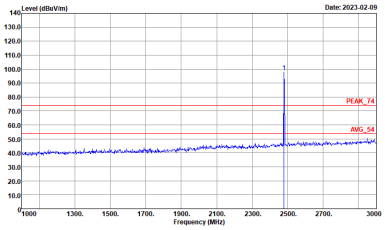
BT	2.4GHz 2400~2483.5MHz	
	BT LF	
	Horizontal	Vertical
QP / Peak		

<Sample 1 with Battery 2>

2.4GHz 2400~2483.5MHz

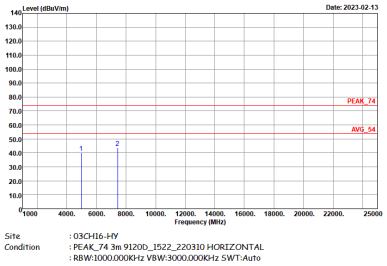
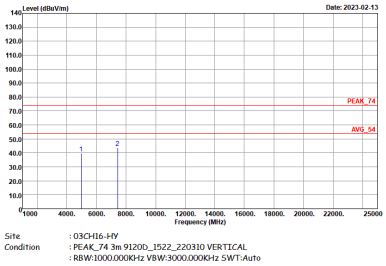
BT (Band Edge @ 3m)

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH78 2480MHz	
	Horizontal	Fundamental
Peak		

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH78 2480MHz	
	Vertical	Fundamental
Peak	 Site : 03CH16-HY Condition : PEAK_BE_74 3m 9120D_1522_220310 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH16-HY Condition : PEAK_74 3m 9120D_1522_220310 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto

2.4GHz 2400~2483.5MHz

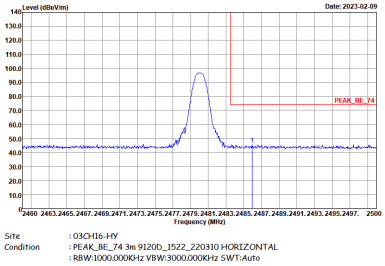
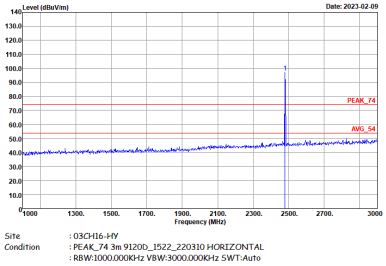
BT (Harmonic @ 3m)

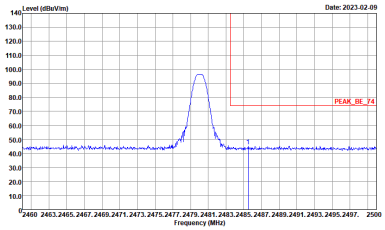
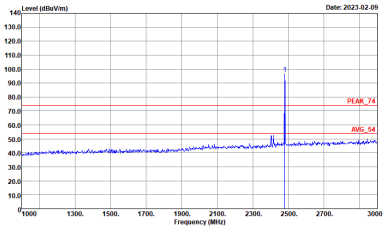
BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BT CH78 2480MHz	
	Horizontal	Vertical
Peak Avg.		

<Sample 1 with Battery 3>

2.4GHz 2400~2483.5MHz

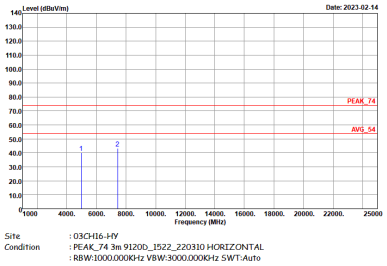
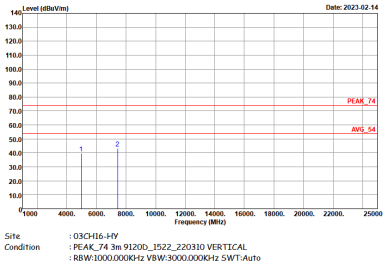
BT (Band Edge @ 3m)

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH78 2480MHz	
	Horizontal	Fundamental
Peak		

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH78 2480MHz	
	Vertical	Fundamental
Peak	 Site : 03CH16-HY Condition : PEAK_BE_74 3m 9120D_1522_220310 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH16-HY Condition : PEAK_74 3m 9120D_1522_220310 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto

2.4GHz 2400~2483.5MHz

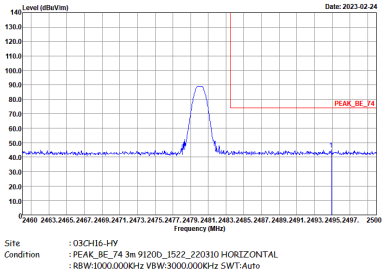
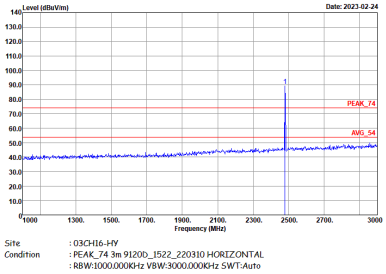
BT (Harmonic @ 3m)

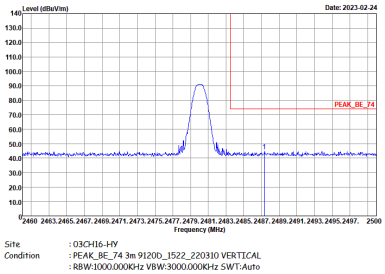
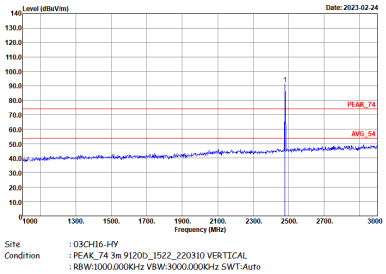
BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BT CH78 2480MHz	
	Horizontal	Vertical
Peak Avg.		

<Sample 2 with Battery 1>

2.4GHz 2400~2483.5MHz

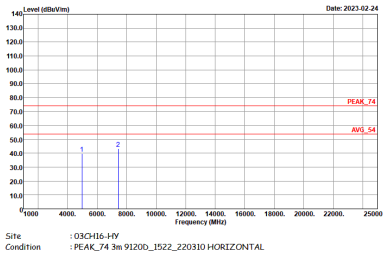
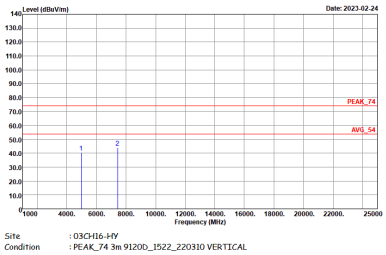
BT (Band Edge @ 3m)

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH78 2480MHz	
	Horizontal	Fundamental
Peak		

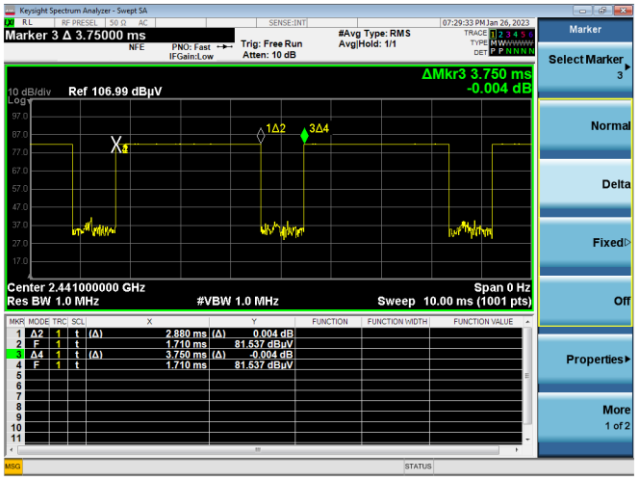
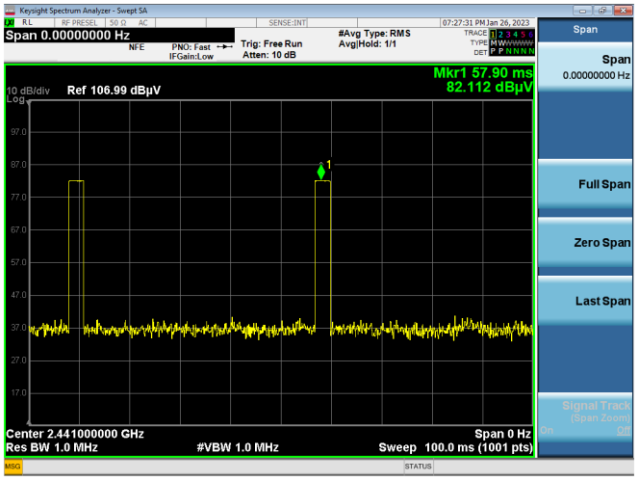
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH78 2480MHz	
	Vertical	Fundamental
Peak		

2.4GHz 2400~2483.5MHz

BT (Harmonic @ 3m)

BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BT CH78 2480MHz	
	Horizontal	Vertical
Peak Avg.		

Appendix E. Duty Cycle Plots

DH5 on time (One Pulse) Plot on Channel 39	on time (Count Pulses) Plot on Channel 39
	

Note:

1. Worst case Duty cycle = on time/100 milliseconds = 2 * 2.88 / 100 = 5.76 %
2. Worst case Duty cycle correction factor = 20*log(Duty cycle) = -24.79 dB
3. DH5 has the highest duty cycle worst case and is reported.

Duty Cycle Correction Factor Consideration for AFH mode:

Bluetooth normal hopping rate is 1600Hz and reduced to 800Hz in AFH mode; due to the reduced number of hopping frequencies, with the same packet configuration the dwell time in each channel frequency within 100msec period is longer in AFH mode than normal mode.

In AFH mode, the minimum hopping frequencies are 20, to get the longest dwell time DH5 packet is observed; the on time period to have DH5 packet completing one hopping sequence is

2.88 ms x 20 channels = 57.6 ms

There cannot be 2 complete hopping sequences within 100ms period, considering the random hopping behavior, maximum 2 hops can be possibly observed within the period. [100 ms / 57.6 ms] = 2 hops

Thus, the maximum possible ON time:

2.88 ms x 2 = 5.76 ms

Worst case Duty Cycle Correction factor, which is derived from the maximum possible ON time,

20 x log(5.76 ms/100 ms) = -24.79 dB