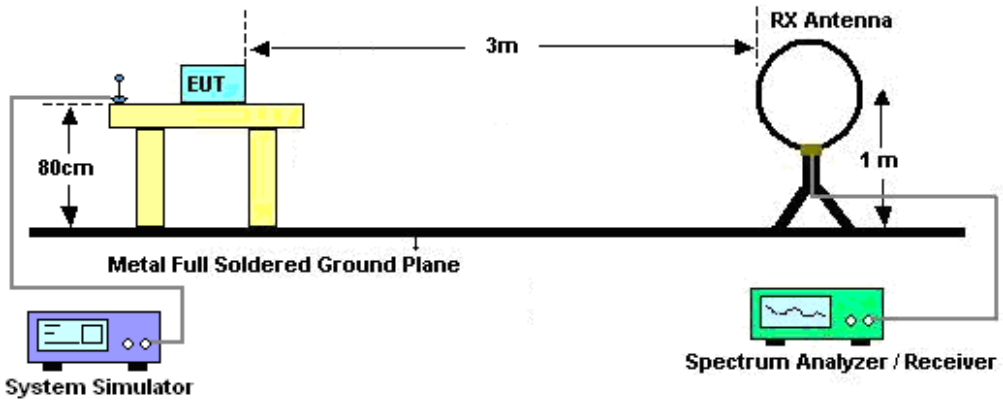
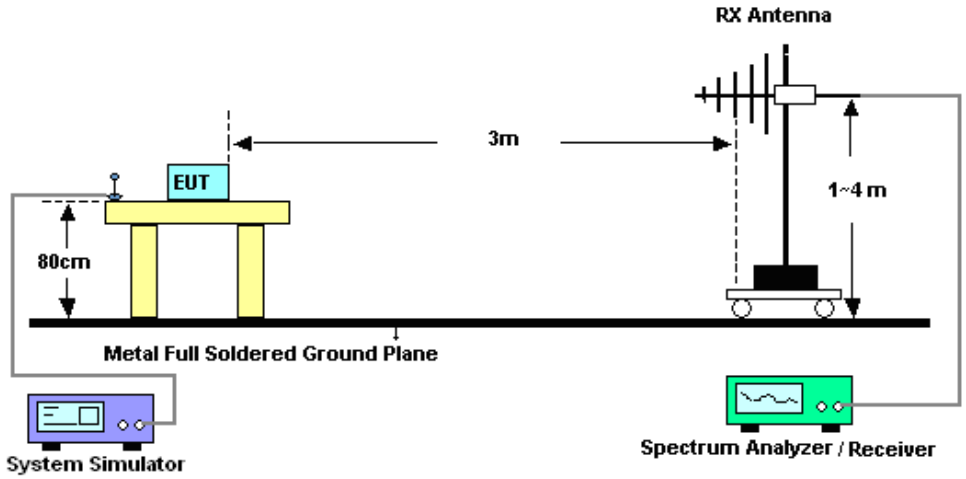
3.8.4 Test Setup

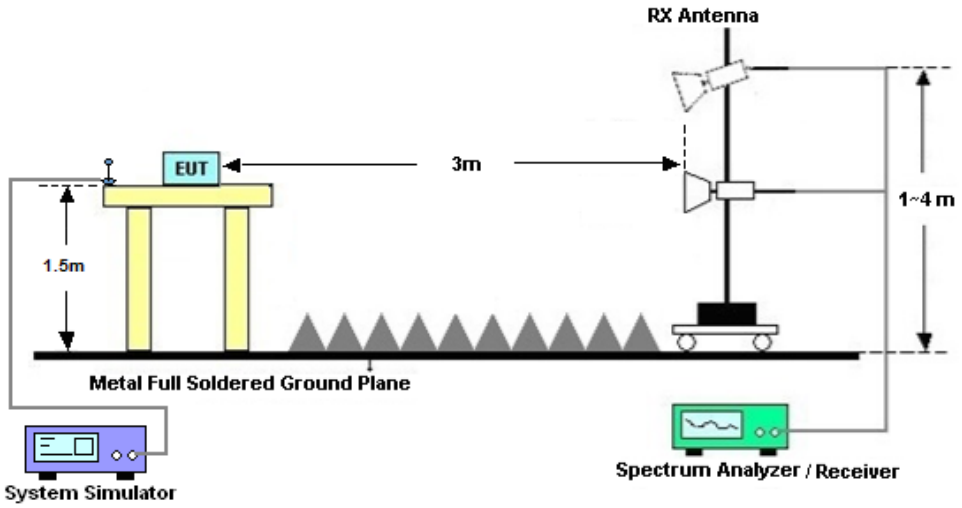
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.8.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

3.8.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C.

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

Please refer to Appendix C.

3.8.8 Duty cycle correction factor for average measurement

Please refer to Appendix D.

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.

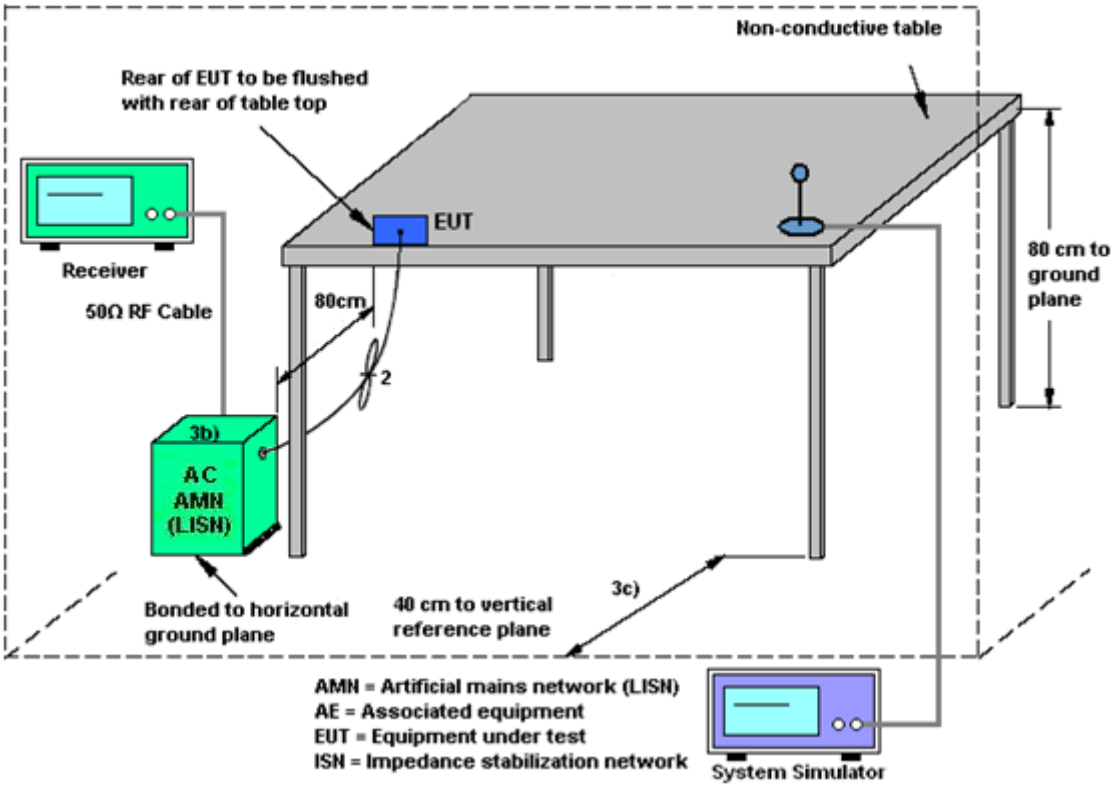
3.9.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.9.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was 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 should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) 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

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. 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.

3.10.3 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	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101078	10Hz~40GHz	Apr. 17, 2020	Aug. 20, 2020~ Aug. 25, 2020	Apr. 16, 2021	Conducted (TH01-SZ)
Pulse Power Senor	Anritsu	MA2411B	1207253	30MHz~40GHz	Dec. 26, 2019	Aug. 20, 2020~ Aug. 25, 2020	Dec. 25, 2020	Conducted (TH01-SZ)
Power Meter	Anritsu	ML2495A	1218010	50MHz Bandwidth	Dec. 26, 2019	Aug. 20, 2020~ Aug. 25, 2020	Dec. 25, 2020	Conducted (TH01-SZ)
EMI Test Receiver	Keysight	N9038A	MY56400004	3Hz~8.5GHz;Max 30dBm	Oct. 18, 2019	Aug. 31, 2020	Oct. 17, 2020	Radiation (03CH06-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55150208	10Hz-44GHz	Apr. 14, 2020	Aug. 31, 2020	Apr. 13, 2021	Radiation (03CH06-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Nov. 10, 2019	Aug. 31, 2020	Nov. 09, 2020	Radiation (03CH06-KS)
Bilog Antenna	TeseQ	CBL6111D	49921	30MHz-1GHz	May 29, 2020	Aug. 31, 2020	May 28, 2021	Radiation (03CH06-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00218652	1GHz~18GHz	Apr. 27, 2020	Aug. 31, 2020	Apr. 26, 2021	Radiation (03CH06-KS)
SHF-EHF Horn	Com-power	AH-840	101115	18GHz~40GHz	Nov. 10, 2019	Aug. 31, 2020	Nov. 09, 2020	Radiation (03CH06-KS)
Amplifier	SONOMA	310N	187289	9KHz ~1GHZ	Apr. 14, 2020	Aug. 31, 2020	Apr. 13, 2021	Radiation (03CH06-KS)
Amplifier	MITEQ	EM18G40GGA	060728	18~40GHz	Jan. 08, 2020	Aug. 31, 2020	Jan. 07, 2021	Radiation (03CH06-KS)
high gain Amplifier	MITEQ	AMF-7D-00101800-30-10P	2025788	1Ghz-18Ghz	Jan. 02, 2020	Aug. 31, 2020	Jan. 01, 2021	Radiation (03CH06-KS)
Amplifier	Keysight	83017A	MY53270203	500MHz~26.5GHz	Apr. 15, 2020	Aug. 31, 2020	Apr. 14, 2021	Radiation (03CH06-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Aug. 31, 2020	NCR	Radiation (03CH06-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Aug. 31, 2020	NCR	Radiation (03CH06-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Aug. 31, 2020	NCR	Radiation (03CH06-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	Apr. 14, 2020	Aug. 21, 2020	Apr. 13, 2021	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Oct. 18, 2019	Aug. 21, 2020	Oct. 17, 2020	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060105	9kHz~30MHz	Oct. 28, 2019	Aug. 21, 2020	Oct. 27, 2020	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP000000811	AC 0V~300V, 45Hz~1000Hz	Oct. 18, 2019	Aug. 21, 2020	Oct. 17, 2020	Conduction (CO01-KS)

NCR: No Calibration Required

5 Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**2.94dB**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.0dB**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.0dB**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.0dB**

Appendix A. Conducted Test Results

Report Number : FR081310A

Test Engineer:	Chen Hong	Temperature:	21~25	°C
Test Date:	2020/8/20~2020/8/25	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	0.918	0.842	1.003	0.6117	Pass
DH	1Mbps	1	39	2441	0.918	0.845	1.003	0.6117	Pass
DH	1Mbps	1	78	2480	0.894	0.845	1.003	0.5963	Pass
2DH	2Mbps	1	0	2402	1.259	1.166	1.003	0.8393	Pass
2DH	2Mbps	1	39	2441	1.259	1.161	1.003	0.8393	Pass
2DH	2Mbps	1	78	2480	1.281	1.166	1.003	0.8539	Pass
3DH	3Mbps	1	0	2402	1.233	1.149	0.999	0.8220	Pass
3DH	3Mbps	1	39	2441	1.233	1.146	0.999	0.8220	Pass
3DH	3Mbps	1	78	2480	1.233	1.152	1.007	0.8220	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
Nomal	79	106.67	2.90	0.31	0.4	Pass
AFH	20	53.33	2.90	0.15	0.4	Pass

TEST RESULTS DATA
Peak Power Table

DH	CH.	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
DH1	0	1	**9.10**	20.97	Pass
	39	1	8.60	20.97	Pass
	78	1	8.10	20.97	Pass
2DH1	0	1	**8.80**	20.97	Pass
	39	1	7.90	20.97	Pass
	78	1	7.80	20.97	Pass
3DH1	0	1	**9.00**	20.97	Pass
	39	1	8.20	20.97	Pass
	78	1	8.00	20.97	Pass

TEST RESULTS DATA
Average Power Table
(Reporting Only)

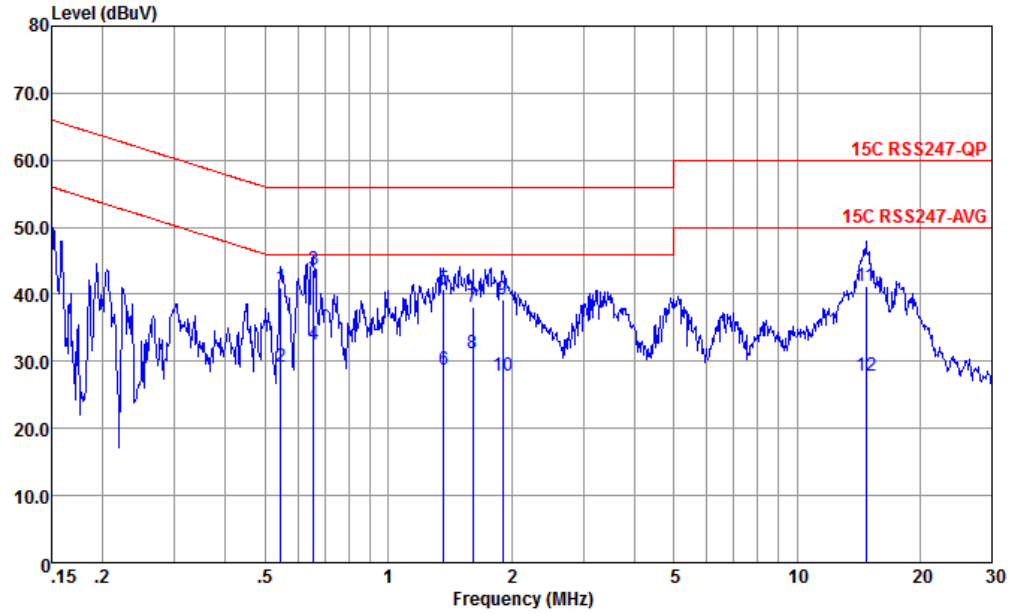
DH	CH.	NTX	Average Power (dBm)	Duty Factor (dB)
DH1	0	1	**8.70**	5.19
	39	1	8.10	5.19
	78	1	7.60	5.19
2DH1	0	1	**6.70**	5.12
	39	1	5.70	5.12
	78	1	5.70	5.12
3DH1	0	1	**6.70**	5.09
	39	1	5.70	5.09
	78	1	5.70	5.09

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

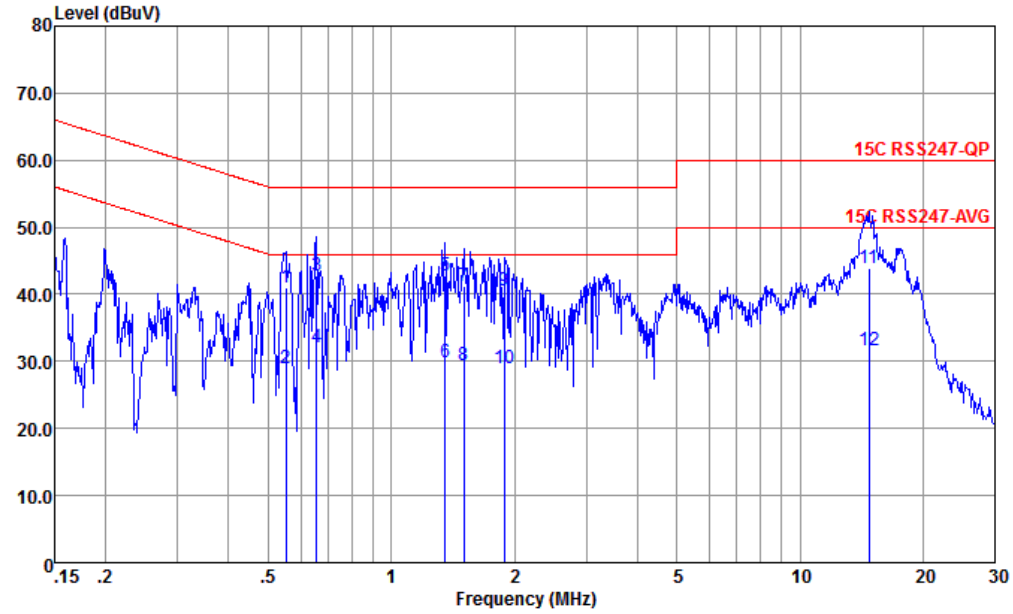
Test Engineer :	Amos Zhang	**Temperature :**	25.3~26.2℃
		Relative Humidity :	38~40%
Test Voltage :	120Vac / 60Hz	**Phase :**	Line



Site : CO01-KS
Condition : 15C RSS247-QP LISN-L-191028-CN02 LINE

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.546	40.97	-15.03	56.00	30.59	0.14	10.24	QP
2		0.546	29.27	-16.73	46.00	18.89	0.14	10.24	Average
3	*	0.658	43.59	-12.41	56.00	33.20	0.15	10.24	QP
4		0.658	32.49	-13.51	46.00	22.10	0.15	10.24	Average
5		1.367	40.71	-15.29	56.00	30.20	0.28	10.23	QP
6		1.367	28.71	-17.29	46.00	18.20	0.28	10.23	Average
7		1.610	38.05	-17.95	56.00	27.49	0.33	10.23	QP
8		1.610	31.15	-14.85	46.00	20.59	0.33	10.23	Average
9		1.908	39.21	-16.79	56.00	28.60	0.38	10.23	QP
10		1.908	27.81	-18.19	46.00	17.20	0.38	10.23	Average
11		14.750	41.12	-18.88	60.00	29.21	1.52	10.39	QP
12		14.750	27.82	-22.18	50.00	15.91	1.52	10.39	Average

Test Engineer :	Amos Zhang	Temperature :	25.3~26.2℃
		Relative Humidity :	38~40%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral



Site : CO01-KS
Condition : 15C RSS247-QP LISN-N-191028-CN02 NEUTRAL

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.552	40.97	-15.03	56.00	30.49	0.24	10.24	QP
2		0.552	29.07	-16.93	46.00	18.59	0.24	10.24	Average
3		0.658	42.69	-13.31	56.00	32.20	0.25	10.24	QP
4		0.658	31.99	-14.01	46.00	21.50	0.25	10.24	Average
5	*	1.352	42.82	-13.18	56.00	32.20	0.39	10.23	QP
6		1.352	29.92	-16.08	46.00	19.30	0.39	10.23	Average
7		1.503	41.16	-14.84	56.00	30.50	0.43	10.23	QP
8		1.503	29.46	-16.54	46.00	18.80	0.43	10.23	Average
9		1.888	40.63	-15.37	56.00	29.90	0.50	10.23	QP
10		1.888	28.93	-17.07	46.00	18.20	0.50	10.23	Average
11		14.750	43.89	-16.11	60.00	31.60	1.90	10.39	QP
12		14.750	31.59	-18.41	50.00	19.30	1.90	10.39	Average

Note:

1. Level(dBμV) = Read Level(dBμV) + LISN Factor(dB) + Cable Loss(dB)
2. Over Limit(dB) = Level(dBμV) – Limit Line(dBμV)

Appendix C. Radiated Spurious Emission

2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	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)
BT CH00 2402MHz		2383.19	54.24	-19.76	74	48.42	32.1	7.71	33.99	100	309	P	H
		2383.19	29.48	-24.52	54	-	-	-	-	-	-	A	H
	*	2402	101.61	-	-	95.65	32.2	7.74	33.98	100	309	P	H
	*	2402	76.85	-	-	-	-	-	-	-	-	A	H
		2362.91	53.5	-20.5	74	47.83	32	7.68	34.01	343	51	P	V
		2362.91	28.74	-25.26	54	-	-	-	-	-	-	A	V
	*	2402	100.44	-	-	94.48	32.2	7.74	33.98	343	51	P	V
	*	2402	75.68	-	-	-	-	-	-	-	-	A	V
BT CH 78 2480MHz		2483.68	55.56	-18.44	74	49.62	31.99	7.89	33.94	181	311	P	H
		2483.68	30.8	-23.2	54	-	-	-	-	-	-	A	H
	*	2480	102.43	-	-	96.49	31.99	7.89	33.94	181	311	P	H
	*	2480	77.67	-	-	-	-	-	-	-	-	A	H
		2483.56	54.45	-19.55	74	48.51	31.99	7.89	33.94	368	50	P	V
		2483.56	29.69	-24.31	54	-	-	-	-	-	-	A	V
	*	2480	99.77	-	-	93.83	31.99	7.89	33.94	368	50	P	V
	*	2480	75.01	-	-	-	-	-	-	-	-	A	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 00 2402MHz		4806	41.24	-32.76	74	57.73	35.16	10.93	62.58	100	360	P	H
		4806	40.17	-33.83	74	56.66	35.16	10.93	62.58	100	360	P	V
BT CH 39 2441MHz		4884	41.81	-32.19	74	57.8	35.17	11.04	62.2	100	360	P	H
		7320	43.5	-30.5	74	55.29	36.87	13.48	62.14	100	360	P	H
		4884	42.27	-31.73	74	58.26	35.17	11.04	62.2	100	360	P	V
		7320	43.38	-30.62	74	55.17	36.87	13.48	62.14	100	360	P	V
BT CH 78 2480MHz		4962	40.83	-33.17	74	56.53	35.19	11.14	62.03	100	360	P	H
		7440	42.27	-31.73	74	53.9	36.89	13.59	62.11	100	360	P	H
		4962	41.57	-32.43	74	57.27	35.19	11.14	62.03	100	360	P	V
		7440	41.52	-32.48	74	53.15	36.89	13.59	62.11	100	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

2.4GHz BT (LF)

BT	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 BT LF		30	18.63	-21.37	40	31.02	25.5	1.11	39	-	-	P	H
		108.57	23.05	-20.45	43.5	42.14	18	1.69	38.78	-	-	P	H
		171.62	25.42	-18.08	43.5	44.84	16.98	2.08	38.48	100	0	P	H
		205.57	21.86	-21.64	43.5	41.19	16.66	2.26	38.25	-	-	P	H
		353.98	22.16	-23.84	46	35.34	21.5	2.92	37.6	-	-	P	H
		967.99	29.54	-24.46	54	28.55	28.08	4.74	31.83	-	-	P	H
		30	23.98	-16.02	40	36.37	25.5	1.11	39	-	-	P	V
		51.34	23.87	-16.13	40	46.39	14.84	1.24	38.6	-	-	P	V
		74.62	24.54	-15.46	40	48.36	13.56	1.42	38.8	100	0	P	V
		108.57	21.99	-21.51	43.5	41.08	18	1.69	38.78	-	-	P	V
		203.63	18.9	-24.6	43.5	38.34	16.54	2.25	38.23	-	-	P	V
		943.74	29.42	-16.58	46	28.86	27.84	4.7	31.98	-	-	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

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	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)
BT 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)

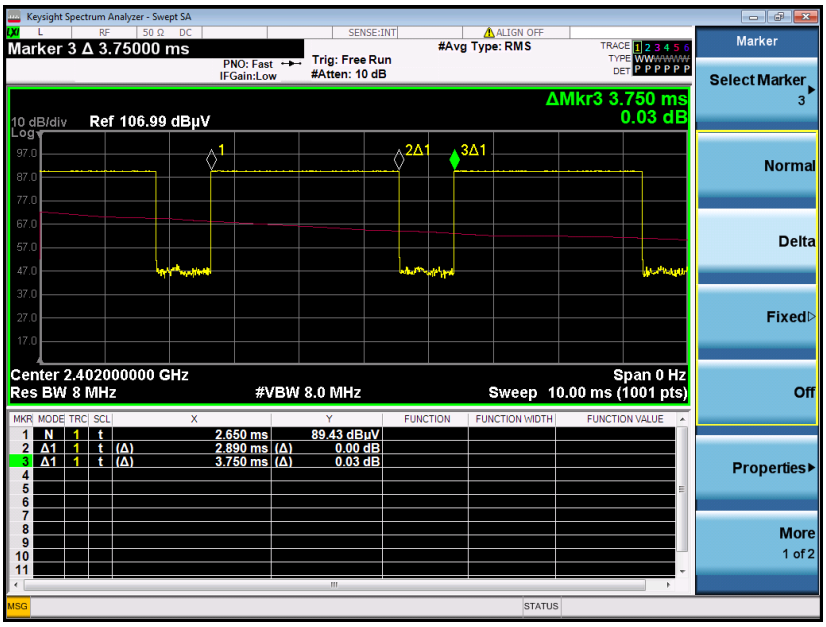
= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

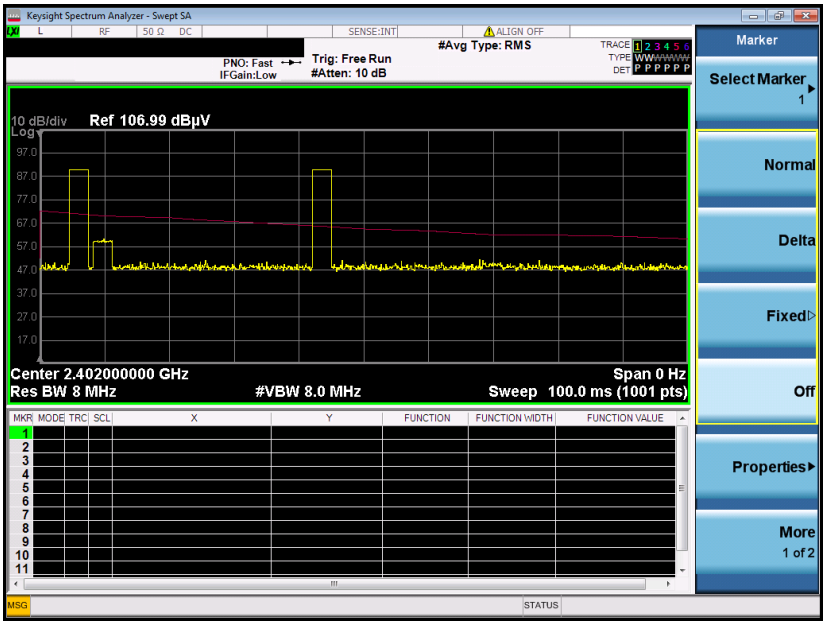
Both peak and average measured complies with the limit line, so test result is “PASS”.

Appendix D. Duty Cycle Plots

DH5 on time (One Pulse) Plot on Channel 00



DH5 on time (Count Pulses) Plot on Channel 00



Note:

1. Worst case Duty cycle = on time/100 milliseconds = 2 * 2.89 / 100 = 5.78 %
2. Worst case Duty cycle correction factor = 20*log(Duty cycle) = -24.76 dB
3. DH5 has the highest duty cycle worst case and is reported.