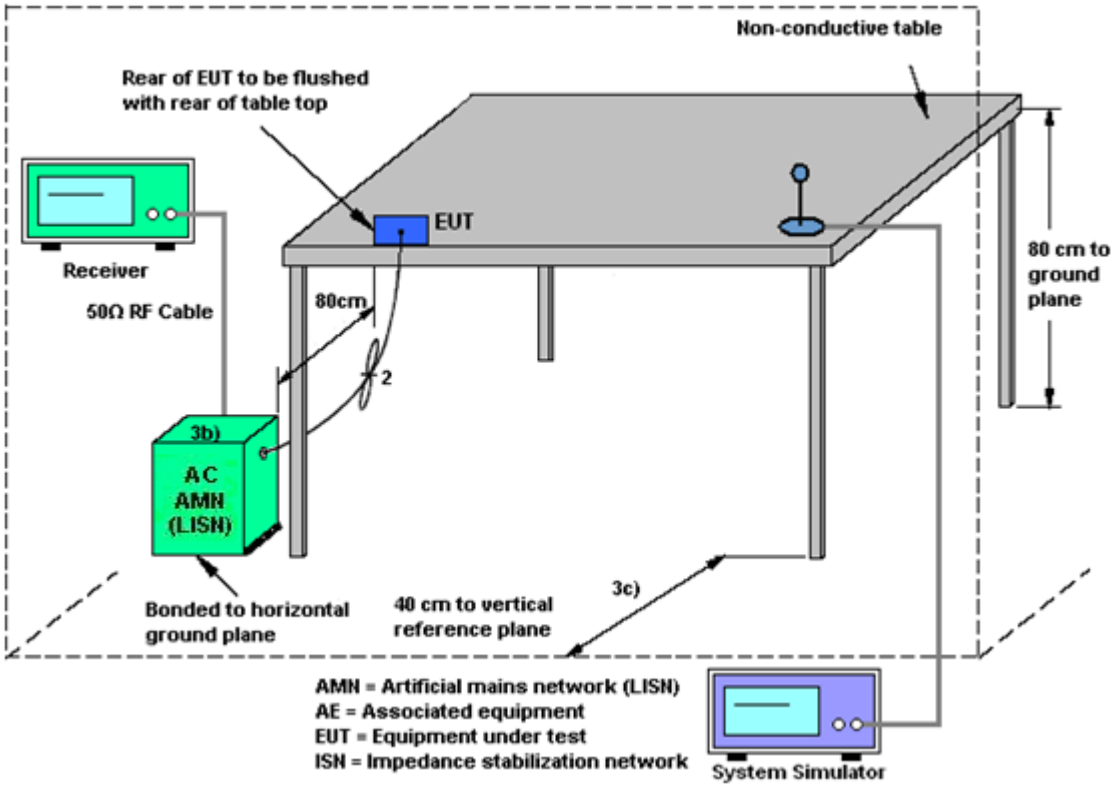
3.9.4 Test Setup



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	101040	10Hz~40GHz	Nov. 02, 2019	Jan. 10, 2020	Nov. 01, 2020	Conducted (TH01-KS)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 08, 2020	Jan. 10, 2020	Jan. 07, 2021	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 08, 2020	Jan. 10, 2020	Jan. 07, 2021	Conducted (TH01-KS)
EMI Test Receiver	Keysight	N9038A	MY57290157	3Hz~8.5GHz;Max 30dBm	Jul. 18, 2019	Mar. 04, 2020	Jul. 17, 2020	Radiation (03CH06-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55150208	10Hz-44GHz	Apr. 16, 2019	Mar. 04, 2020	Apr. 15, 2020	Radiation (03CH06-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Nov. 10, 2019	Mar. 04, 2020	Nov. 09, 2020	Radiation (03CH06-KS)
Bilog Antenna	TeseQ	CBL6111D	49921	30MHz-1GHz	May 30, 2019	Mar. 04, 2020	May 29, 2020	Radiation (03CH06-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	75959	1GHz~18GHz	Apr. 27, 2019	Mar. 04, 2020	Apr. 26, 2020	Radiation (03CH06-KS)
SHF-EHF Horn	Com-power	AH-840	101070	18GHz~40GHz	Jan. 08, 2020	Mar. 04, 2020	Jan. 07, 2021	Radiation (03CH06-KS)
Amplifier	SONOMA	310N	187289	9KHz ~1GHZ	Aug. 06, 2019	Mar. 04, 2020	Aug. 05, 2020	Radiation (03CH06-KS)
Amplifier	MITEQ	TTA1840-35-HG	2014749	18~40GHz	Jun. 05, 2019	Mar. 04, 2020	Jun. 04, 2020	Radiation (03CH06-KS)
high gain Amplifier	MITEQ	AMF-7D-00101800-30-10P	2025788	1Ghz-18Ghz	Aug. 16, 2019	Mar. 04, 2020	Aug. 15, 2020	Radiation (03CH06-KS)
Amplifier	Keysight	83017A	MY53270203	500MHz~26.5GHz	Apr. 15, 2019	Mar. 04, 2020	Apr. 14, 2020	Radiation (03CH06-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Mar. 04, 2020	NCR	Radiation (03CH06-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Mar. 04, 2020	NCR	Radiation (03CH06-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Mar. 04, 2020	NCR	Radiation (03CH06-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	Apr. 16, 2019	Dec. 30, 2019	Apr. 15, 2020	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Oct. 18, 2019	Dec. 30, 2019	Oct. 17, 2020	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060105	9kHz~30MHz	Oct. 28, 2019	Dec. 30, 2019	Oct. 27, 2020	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP000000811	AC 0V~300V, 45Hz~1000Hz	Oct. 18, 2019	Dec. 30, 2019	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))	**2.9dB**

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 : FR9D2102A

Bluetooth

Test Engineer:	Lex Wu	Temperature:	20~26	°C
Test Date:	2020/1/10	Relative Humidity:	40~51	%

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 (kHz)	Hopping Channel Separation Measurement Limit (MHz)	Pass/Fail
DH	1Mbps	1	0	2402	0.973	0.897	1002.890	0.6483	Pass
DH	1Mbps	1	39	2441	0.978	0.900	1154.800	0.6522	Pass
DH	1Mbps	1	78	2480	0.973	0.900	1002.900	0.6483	Pass
2DH	2Mbps	1	0	2402	1.259	1.164	1024.600	0.8393	Pass
2DH	2Mbps	1	39	2441	1.259	1.161	998.600	0.8393	Pass
2DH	2Mbps	1	78	2480	1.259	1.161	1042.000	0.8393	Pass
3DH	3Mbps	1	0	2402	1.233	1.149	1002.900	0.8220	Pass
3DH	3Mbps	1	39	2441	1.233	1.146	994.200	0.8220	Pass
3DH	3Mbps	1	78	2480	1.233	1.143	1011.600	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	2.9029	0.31	0.4	Pass
AFH	20	53.33	2.9029	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	8.44	20.97	Pass
	39	1	**9.55**	20.97	Pass
	78	1	9.47	20.97	Pass

2DH	CH.	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
2DH1	0	1	8.58	20.97	Pass
	39	1	**9.66**	20.97	Pass
	78	1	9.59	20.97	Pass

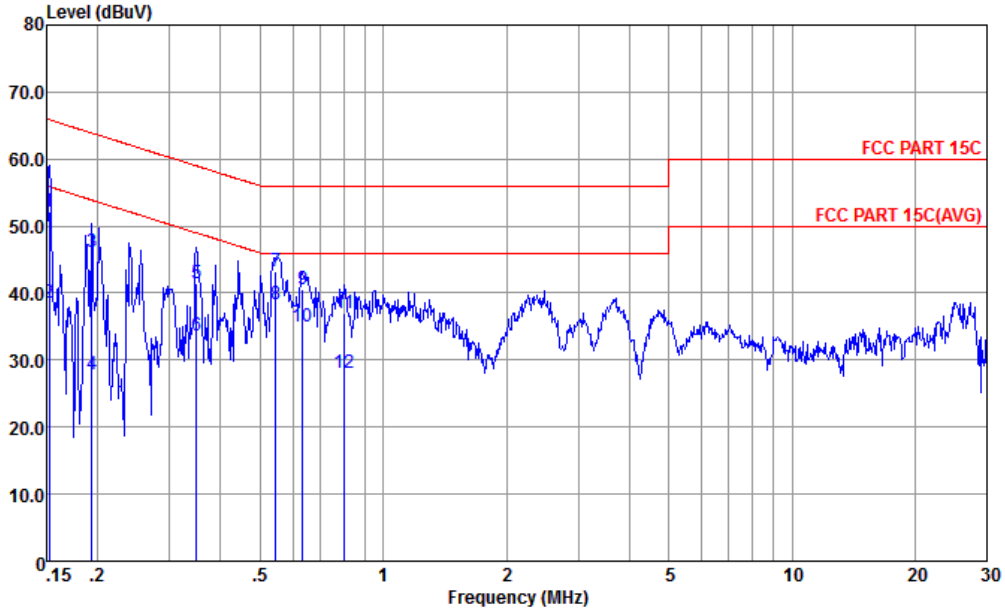
3DH	CH.	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
3DH1	0	1	8.93	20.97	Pass
	39	1	**10.02**	20.97	Pass
	78	1	9.93	20.97	Pass

TEST RESULTS DATA
Number of Hopping Frequency

Number of Hopping (Channel)	Adaptive Frequency Hopping (Channel)	Limits (Channel)	Pass/Fail
79	79	> 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
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		

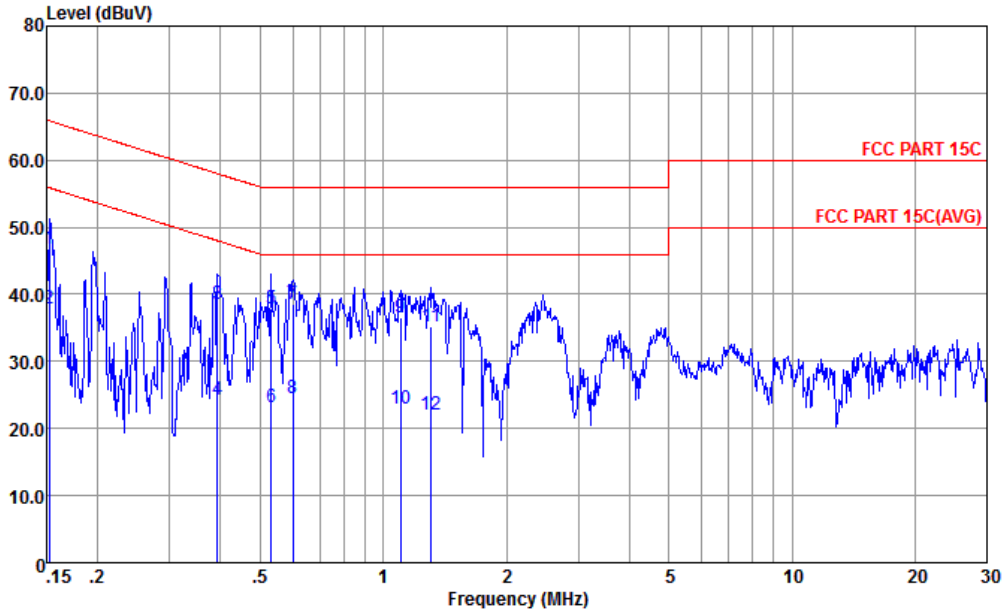


Site : CO01-KS
Condition : FCC PART 15C LISN-L-191028-060105 LINE

mode : Mode 1
: 351636110008238 #5

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.152	52.10	-13.77	65.87	41.60	0.03	10.47	QP
2		0.152	38.60	-17.27	55.87	28.10	0.03	10.47	Average
3		0.193	46.02	-17.87	63.89	35.60	0.04	10.38	QP
4		0.193	27.92	-25.97	53.89	17.50	0.04	10.38	Average
5		0.348	41.44	-17.56	59.00	31.10	0.05	10.29	QP
6		0.348	33.64	-15.36	49.00	23.30	0.05	10.29	Average
7		0.546	43.20	-12.80	56.00	32.90	0.06	10.24	QP
8	*	0.546	38.40	-7.60	46.00	28.10	0.06	10.24	Average
9		0.634	40.50	-15.50	56.00	30.19	0.07	10.24	QP
10		0.634	34.90	-11.10	46.00	24.59	0.07	10.24	Average
11		0.804	36.91	-19.09	56.00	26.60	0.07	10.24	QP
12		0.804	28.11	-17.89	46.00	17.80	0.07	10.24	Average

Test Engineer :	Amos Zhang	**Temperature :**	25.3~26.2℃
		Relative Humidity :	38~40%
Test Voltage :	120Vac / 60Hz	**Phase :**	Neutral
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



Site : CO01-KS
Condition : FCC PART 15C LISN-N-191028-060105 NEUTRAL

mode : Mode 1
: 351636110008238 #5

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.152	46.85	-19.02	65.87	36.30	0.08	10.47	QP
2		0.152	37.85	-18.02	55.87	27.30	0.08	10.47	Average
3		0.393	38.46	-19.53	57.99	28.10	0.09	10.27	QP
4		0.393	24.26	-23.73	47.99	13.90	0.09	10.27	Average
5		0.532	37.94	-18.06	56.00	27.60	0.10	10.24	QP
6		0.532	23.14	-22.86	46.00	12.80	0.10	10.24	Average
7	*	0.601	38.54	-17.46	56.00	28.20	0.10	10.24	QP
8		0.601	24.54	-21.46	46.00	14.20	0.10	10.24	Average
9		1.100	36.65	-19.35	56.00	26.31	0.11	10.23	QP
10		1.100	22.85	-23.15	46.00	12.51	0.11	10.23	Average
11		1.310	35.25	-20.75	56.00	24.90	0.12	10.23	QP
12		1.310	22.15	-23.85	46.00	11.80	0.12	10.23	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	Cable 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		2352.12	55.51	-18.49	74	47.62	32.07	7.25	31.43	100	239	P	H
		2352.12	30.75	-23.25	54	-	-	-	-	-	-	A	H
	*	2402	105.29	-	-	97.4	32	7.3	31.41	100	239	P	H
		2402	80.53	-	-	-	-	-	-	-	-	A	H
		2338.86	55.29	-18.71	74	47.39	32.1	7.23	31.43	343	103	P	V
		2338.86	30.53	-23.47	54	-	-	-	-	-	-	A	V
	*	2402	100.49	-	-	92.6	32	7.3	31.41	343	103	P	V
		2402	75.73	-	-	-	-	-	-	-	-	A	V
BT CH 78 2480MHz		2494.66	56.06	-17.94	74	47.72	32.2	7.52	31.38	100	238	P	H
		2494.66	31.3	-22.7	54	-	-	-	-	-	-	A	H
	*	2480	104.92	-	-	96.56	32.27	7.48	31.39	100	238	P	H
		2480	80.16	-	-	-	-	-	-	-	-	A	H
		2484.52	56.64	-17.36	74	48.28	32.27	7.48	31.39	367	33	P	V
		2484.52	31.88	-22.12	54	-	-	-	-	-	-	A	V
	*	2480	100.71	-	-	92.35	32.27	7.48	31.39	367	33	P	V
		2480	75.95	-	-	-	-	-	-	-	-	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)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BT CH 00 2402MHz		4806	40.96	-33.04	74	57.86	34.2	10.49	61.59	100	360	P	H
		4806	40.47	-33.53	74	57.37	34.2	10.49	61.59	100	360	P	V
BT CH 39 2441MHz		4884	40.72	-33.28	74	57.62	34.13	10.58	61.61	100	360	P	H
		7320	42.35	-31.65	74	54.47	36.6	13.62	62.34	100	360	P	H
		4884	41.45	-32.55	74	58.35	34.13	10.58	61.61	100	360	P	V
		7320	43.13	-30.87	74	55.25	36.6	13.62	62.34	100	360	P	V
BT CH 78 2480MHz		4962	40.36	-33.64	74	57.22	34.1	10.68	61.64	100	360	P	H
		7440	41.21	-32.79	74	53.63	36.4	13.58	62.4	100	360	P	H
		4962	39.38	-34.62	74	56.24	34.1	10.68	61.64	100	360	P	V
		7440	41.96	-32.04	74	54.38	36.4	13.58	62.4	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	Cable	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		51.34	21.15	-18.85	40	39.16	13.76	0.73	32.5	-	-	P	H
		118.27	30.28	-13.22	43.5	43.25	18.08	1.11	32.16	100	0	P	H
		218.18	21.77	-24.23	46	36.76	15.33	1.61	31.93	-	-	P	H
		306.45	18.03	-27.97	46	28.68	19.37	1.85	31.87	-	-	P	H
		504.33	23.27	-22.73	46	28.95	23.54	2.39	31.61	-	-	P	H
		872.93	26.62	-19.38	46	28.71	26.39	3.17	31.65	-	-	P	H
		47.46	23.99	-16.01	40	40.67	15.1	0.67	32.45	100	360	P	V
		115.36	27.24	-16.26	43.5	40.43	17.89	1.09	32.17	-	-	P	V
		196.84	26.92	-16.58	43.5	41.85	15.56	1.52	32.01	-	-	P	V
		257.95	28.53	-17.47	46	39.03	19.57	1.75	31.82	-	-	P	V
		430.61	21.73	-24.27	46	29.03	22.25	2.19	31.74	-	-	P	V
		843.83	26.62	-19.38	46	28.95	26.27	3.1	31.7	-	-	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:

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1+2		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		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. Level(dBμV/m) =

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

2. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable 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) + Cable 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)

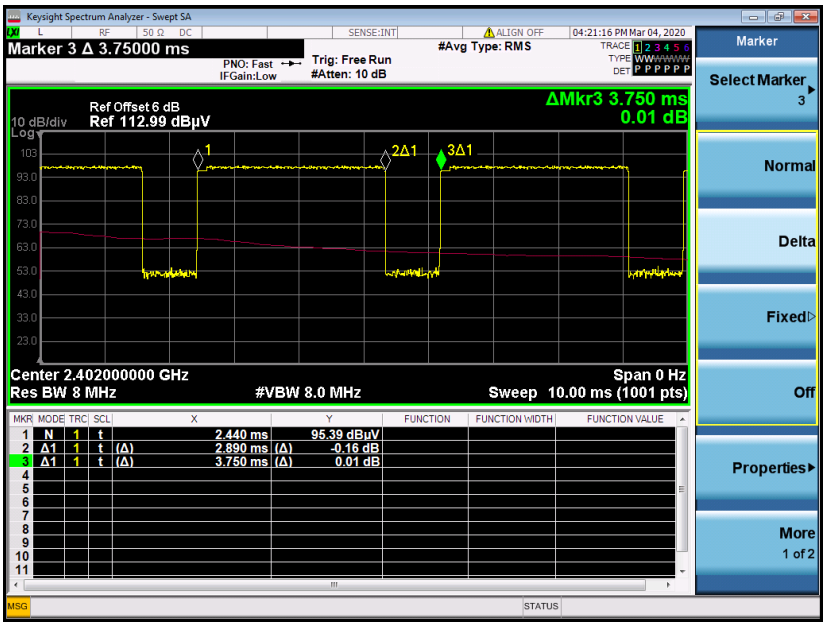
= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

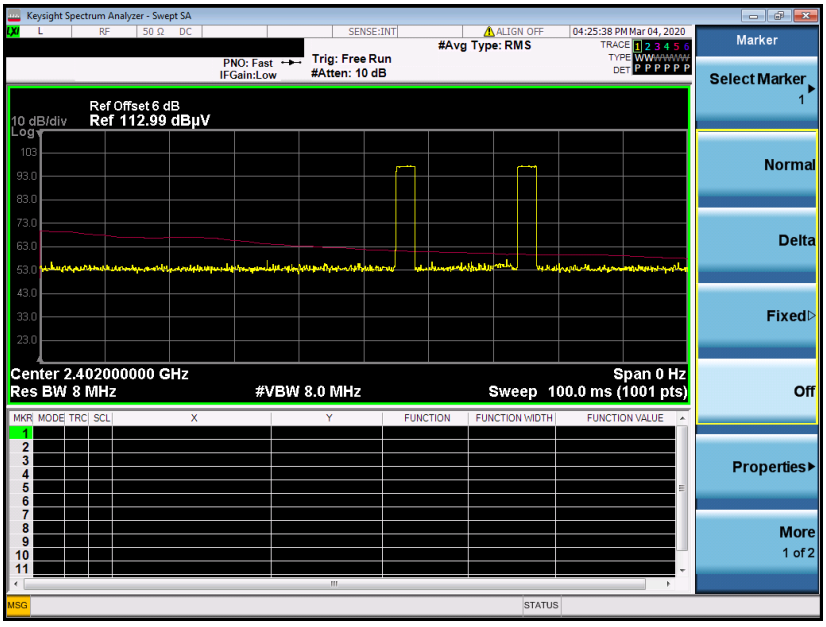
Both peak and average measured complies with the limit line, so test result is "PASS".

Appendix D. Duty Cycle Plots

3DH5 on time (One Pulse) Plot on Channel 00



3DH5 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. 3DH5 has the highest duty cycle worst case and is reported.