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.

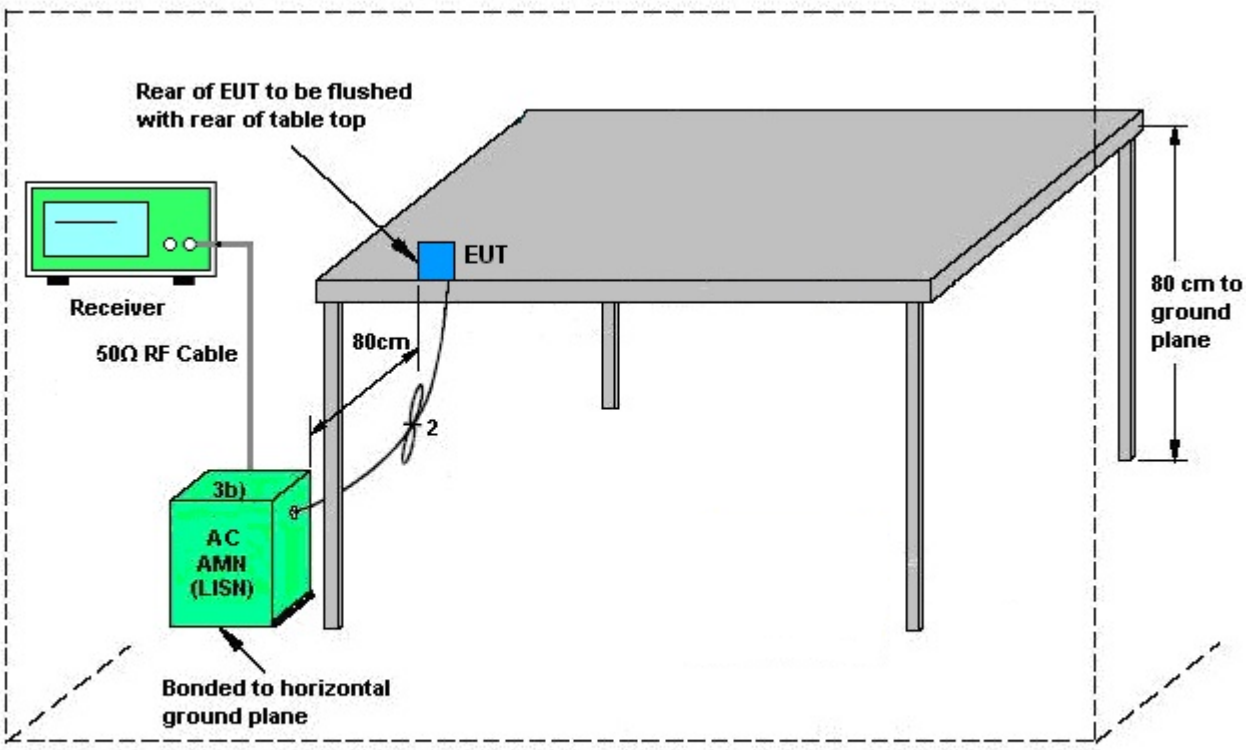
3.9.2 Measuring Instruments

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



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

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
EMI Receiver	R&S	ESR7	101630	9kHz~7GHz;	Mar. 07, 2021	Apr. 02, 2021	Mar. 06, 2022	Conduction (CO01-SZ)
AC LISN	EMCO	3816/2 LISN	00103912	9kHz~30MHz	Dec. 25, 2020	Apr. 02, 2021	Dec. 24, 2021	Conduction (CO01-SZ)
AC LISN (for auxiliary equipment)	EMCO	3816/2SH	00103892	9kHz~30MHz	Oct. 15, 2020	Apr. 02, 2021	Oct. 14, 2021	Conduction (CO01-SZ)
AC Power Source	Chroma	61602	616020000891	100Vac~250Vac	Jul. 21, 2020	Apr. 02, 2021	Jul. 20, 2021	Conduction (CO01-SZ)
Spectrum Analyzer	R&S	FSV40	101078	10Hz~40GHz	Apr. 09, 2020	Apr. 06, 2021	Apr. 08, 2021	Conducted (TH01-SZ)
Pulse Power Senor	Anritsu	MA2411B	1207253	30MHz~40GHz	Dec. 25, 2020	Apr. 06, 2021	Dec. 24, 2021	Conducted (TH01-SZ)
Power Meter	Anritsu	ML2495A	1218010	50MHz Bandwidth	Dec. 25, 2020	Apr. 06, 2021	Dec. 24, 2021	Conducted (TH01-SZ)
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY55150213	10Hz~44GHz	Jul. 21, 2020	May 27, 2021	Jul. 20, 2021	Radiation (03CH02-SZ)
Loop Antenna	R&S	HFH2-Z2	100354	9kHz~30MHz	Jun. 22, 2020	May 27, 2021	Jun. 21, 2021	Radiation (03CH02-SZ)
Bilog Antenna	TeseQ	CBL6112D	35407	30MHz-2GHz	Jul. 15, 2020	May 27, 2021	Jul. 14, 2021	Radiation (03CH02-SZ)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00119436	1GHz~18GHz	Jul. 25, 2020	May 27, 2021	Jul. 24, 2021	Radiation (03CH02-SZ)
SHF-EHF Horn	com-power	AH-840	101071	18Ghz-40GHz	Apr. 23, 2021	May 27, 2021	Apr. 22, 2022	Radiation (03CH02-SZ)
LF Amplifier	Burgeon	BPA-530	102211	0.01~3000Mhz	Oct. 16, 2020	May 27, 2021	Oct. 15, 2021	Radiation (03CH02-SZ)
HF Amplifier	MITEQ	AMF-7D-00101800-30-10P-R	1943528	1GHz~18GHz	Oct. 17, 2020	May 27, 2021	Oct. 15, 2021	Radiation (03CH02-SZ)
HF Amplifier	MITEQ	TTA1840-35-HG	1871923	18GHz~40GHz	Jul. 21, 2020	May 27, 2021	Jul. 20, 2021	Radiation (03CH02-SZ)
HF Amplifier	KEYSIGHT	83017A	MY53270105	0.5GHz~26.5Ghz	Oct. 16, 2020	May 27, 2021	Oct. 15, 2021	Radiation (03CH02-SZ)
AC Power Source	Chroma	61601	616010002470	N/A	NCR	May 27, 2021	NCR	Radiation (03CH02-SZ)
Turn Table	Chaintek	T-200	N/A	0~360 degree	NCR	May 27, 2021	NCR	Radiation (03CH02-SZ)
Antenna Mast	Chaintek	MBS-400	N/A	1 m~4 m	NCR	May 27, 2021	NCR	Radiation (03CH02-SZ)

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))	**2.2dB**

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))	**5.1dB**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.1dB**

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

Appendix A. Conducted Test Results

Appendix A. Test Result of Conducted Test Items

Test Engineer:	Chen Hong	Temperature:	21~25	°C
Test Date:	2021/4/6	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	0.941	0.886	1.003	0.6271	Pass
DH	1Mbps	1	39	2441	0.941	0.886	1.003	0.6271	Pass
DH	1Mbps	1	78	2480	0.938	0.886	0.999	0.6252	Pass
2DH	2Mbps	1	0	2402	1.311	1.181	1.003	0.8741	Pass
2DH	2Mbps	1	39	2441	1.294	1.181	1.003	0.8625	Pass
2DH	2Mbps	1	78	2480	1.294	1.181	1.003	0.8625	Pass
3DH	3Mbps	1	0	2402	1.298	1.181	0.999	0.8654	Pass
3DH	3Mbps	1	39	2441	1.298	1.184	0.999	0.8654	Pass
3DH	3Mbps	1	78	2480	1.298	1.184	0.999	0.8654	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	2.9087	0.31	0.4	Pass
AFH	20	53.33	2.9087	0.16	0.4	Pass

TEST RESULTS DATA
Peak Power Table

DH	CH.	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
DH5	0	1	8.80	20.97	Pass
	39	1	9.00	20.97	Pass
	78	1	**10.10**	20.97	Pass
2DH5	0	1	10.70	20.97	Pass
	39	1	11.00	20.97	Pass
	78	1	**11.80**	20.97	Pass
3DH5	0	1	11.10	20.97	Pass
	39	1	11.30	20.97	Pass
	78	1	**12.20**	20.97	Pass

TEST RESULTS DATA
Average Power Table
(Reporting Only)

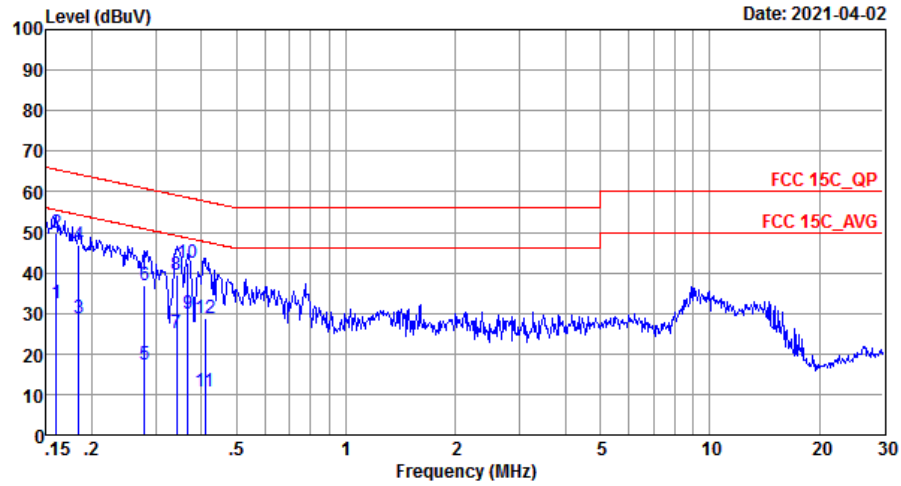
DH	CH.	NTX	Average Power (dBm)	Duty Factor (dB)
DH5	0	1	8.20	1.11
	39	1	8.30	1.11
	78	1	**9.30**	1.11
2DH5	0	1	8.10	1.12
	39	1	8.20	1.12
	78	1	**9.20**	1.12
3DH5	0	1	8.00	1.12
	39	1	8.20	1.12
	78	1	**9.20**	1.12

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

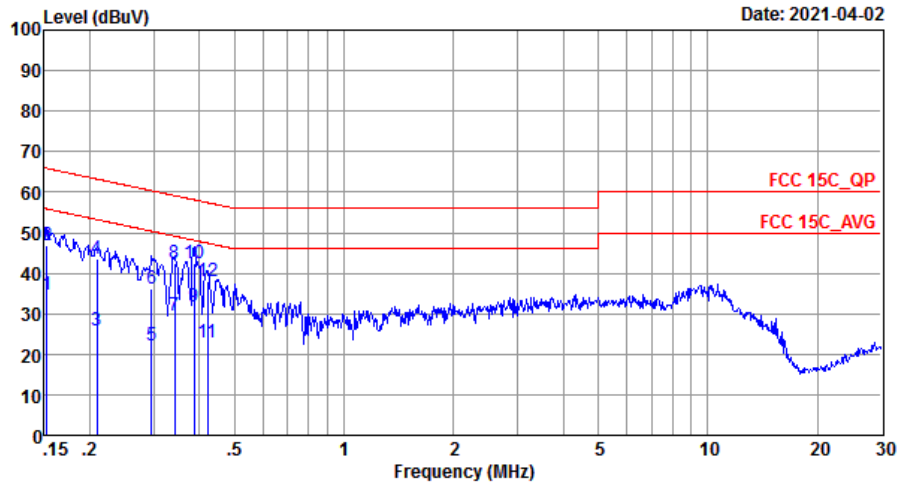
Test Engineer :	Xie YuQiang	**Temperature :**	22~25 ℃
		Relative Humidity :	50~55 %
Test Voltage :	120Vac / 60Hz	**Phase :**	Line
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



Site : CO01-SZ
Condition: FCC 15C QP LISN_20200719_L LINE

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.16	32.44	-23.03	55.47	22.40	0.03	10.01	Average
2	*	0.16	49.64	-15.83	65.47	39.60	0.03	10.01	QP
3		0.18	28.64	-25.64	54.28	18.60	0.03	10.01	Average
4		0.18	47.04	-17.24	64.28	37.00	0.03	10.01	QP
5		0.28	17.44	-33.41	50.85	7.40	0.03	10.01	Average
6		0.28	37.04	-23.81	60.85	27.00	0.03	10.01	QP
7		0.34	25.24	-23.89	49.13	15.20	0.03	10.01	Average
8		0.34	39.54	-19.59	59.13	29.50	0.03	10.01	QP
9		0.37	29.94	-18.62	48.56	19.90	0.03	10.01	Average
10		0.37	42.44	-16.12	58.56	32.40	0.03	10.01	QP
11		0.41	10.64	-37.00	47.64	0.59	0.03	10.02	Average
12		0.41	28.94	-28.70	57.64	18.89	0.03	10.02	QP

Test Engineer :	Xie YuQiang	**Temperature :**	22~25 ℃
		Relative Humidity :	50~55 %
Test Voltage :	120Vac / 60Hz	**Phase :**	Neutral
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



Site : CO01-SZ
Condition: FCC 15C_QP LISN_20200719_N NEUTRAL

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.15	34.64	-21.23	55.87	24.60	0.03	10.01	Average
2		0.15	46.94	-18.93	65.87	36.90	0.03	10.01	QP
3		0.21	25.84	-27.39	53.23	15.80	0.03	10.01	Average
4		0.21	43.54	-19.69	63.23	33.50	0.03	10.01	QP
5		0.30	22.04	-28.33	50.37	12.00	0.03	10.01	Average
6		0.30	36.04	-24.33	60.37	26.00	0.03	10.01	QP
7		0.34	29.54	-19.59	49.13	19.50	0.03	10.01	Average
8		0.34	42.34	-16.79	59.13	32.30	0.03	10.01	QP
9		0.39	31.73	-16.39	48.12	21.70	0.02	10.01	Average
10	*	0.39	42.33	-15.79	58.12	32.30	0.02	10.01	QP
11		0.42	22.94	-24.48	47.42	12.90	0.02	10.02	Average
12		0.42	38.14	-19.28	57.42	28.10	0.02	10.02	QP

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		2389.695	56.52	-17.48	74	52.81	27.82	7.8	31.91	111	0	P	H
		2389.695	31.73	-22.27	54	-	-	-	-	111	0	P	H
		2402	103.66	-	-	99.96	27.79	7.81	31.9	111	0	P	H
	*	2402	78.87	-	-	-	-	-	-	111	0	A	H
		2389.065	62.1	-11.9	74	58.39	27.82	7.8	31.91	139	279	P	V
		2389.065	37.31	-16.69	54	-	-	-	-	139	279	P	V
		2402	106.46	-	-	102.76	27.79	7.81	31.9	139	279	P	V
	*	2402	81.67	-	-	-	-	-	-	139	279	A	V
BT CH 39 2441MHz		2387.84	48.26	-25.74	74	44.55	27.82	7.8	31.91	126	5	P	H
	*	2387.84	23.47	-30.53	54	-	-	-	-	126	5	A	H
		2441	100.63	-	-	96.99	27.64	7.86	31.86	126	5	P	H
		2441	75.84	-	-	-	-	-	-	126	5	A	H
		2488.87	47.08	-26.92	74	43.37	27.6	7.92	31.81	126	5	P	H
		2488.87	22.29	-31.71	54	-	-	-	-	126	5	A	H
		2387.14	52.14	-21.86	74	48.42	27.83	7.8	31.91	143	283	P	V
	*	2387.14	27.35	-26.65	54	-	-	-	-	143	283	A	V
		2441	106.29	-	-	102.66	27.63	7.86	31.86	143	283	P	V
		2441	81.5	-	-	-	-	-	-	143	283	A	V
		2487.05	52.99	-21.01	74	49.29	27.6	7.91	31.81	143	283	P	V
		2487.05	28.2	-25.8	54	-	-	-	-	143	283	A	V

BT CH 78 2480MHz	*	2480	99.89	-	-	96.2	27.6	7.91	31.82	123	3	P	H
		2480	75.1	-	-	-	-	-	-	123	3	V	H
		2483.76	63.32	-10.68	74	59.63	27.6	7.91	31.82	123	3	P	H
		2483.76	38.53	-15.47	54	-	-	-	-	123	3	V	H
	*	2480	107.24	-	-	103.55	27.6	7.91	31.82	122	276	P	V
		2480	82.45	-	-	-	-	-	-	122	276	V	V
		2483.56	70.84	-3.16	74	67.15	27.6	7.91	31.82	122	276	P	V
		2483.56	46.05	-7.95	54	-	-	-	-	122	276	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)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BT CH 00 2402MHz		4804	42.59	-31.41	74	50.46	31.3	10.37	49.54	185	328	P	H
		4804	17.8	-36.2	54	-	-	-	-	185	328	A	H
		4804	41.92	-32.08	74	49.79	31.3	10.37	49.54	151	219	P	V
		4804	17.13	-36.87	54	-	-	-	-	151	219	A	V
BT CH 39 2441MHz		4882	43.37	-30.63	74	51.15	31.3	10.44	49.52	150	258	P	H
		4882	18.58	-35.42	54	-	-	-	-	150	258	P	H
		7323	48.26	-25.74	74	50.5	36.04	12.11	50.39	152	309	P	H
		7323	23.47	-30.53	54	-	-	-	-	152	309	A	H
		4882	43.37	-30.63	74	51.15	31.3	10.44	49.52	165	247	P	V
		4882	18.58	-35.42	54	-	-	-	-	165	247	P	V
		7323	47.29	-26.71	74	49.53	36.04	12.11	50.39	139	177	P	V
		7323	22.5	-31.5	54	-	-	-	-	139	177	A	V
BT CH 78 2480MHz		4960	43.81	-30.19	74	51.31	31.5	10.51	49.51	118	289	P	H
		4960	19.02	-34.98	54	-	-	-	-	118	289	A	H
		7440	47.03	-26.97	74	48.92	36.34	12.23	50.46	158	273	P	H
		7440	22.24	-31.76	54	-	-	-	-	158	273	A	H
		4960	42.35	-31.65	74	49.85	31.5	10.51	49.51	158	321	P	V
		4960	17.56	-36.44	54	-	-	-	-	158	321	A	V
		7440	46.81	-27.19	74	48.7	36.34	12.23	50.46	135	214	P	V
		7440	22.02	-31.98	54	-	-	-	-	135	214	A	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	*	46.49	25.26	-14.74	40	37.91	20.26	2.15	35.06	146	324	P	H
		92.08	23.61	-19.89	43.5	42.43	13.95	2.41	35.18	-	-	P	H
		161.92	26.21	-17.29	43.5	39.4	19.31	2.6	35.1	-	-	P	H
		280.26	30.08	-15.92	46	42.61	19.35	3.06	34.94	-	-	P	H
		394.72	26.13	-19.87	46	35.63	22.01	3.3	34.81	-	-	P	H
		595.51	26.28	-19.72	46	31.22	25.7	3.87	34.51	-	-	P	H
	*	50.37	27.81	-12.19	40	40.39	20.29	2.23	35.1	147	254	P	V
		91.11	28.53	-14.97	43.5	47.39	13.94	2.38	35.18	-	-	P	V
		163.86	28.11	-15.39	43.5	41.3	19.3	2.61	35.1	-	-	P	V
		314.21	28.31	-17.69	46	39.94	20.07	3.2	34.9	-	-	P	V
		394.72	27.4	-18.6	46	36.9	22.01	3.3	34.81	-	-	P	V
		622.67	27.15	-18.85	46	31.69	26.07	3.89	34.5	-	-	P	V

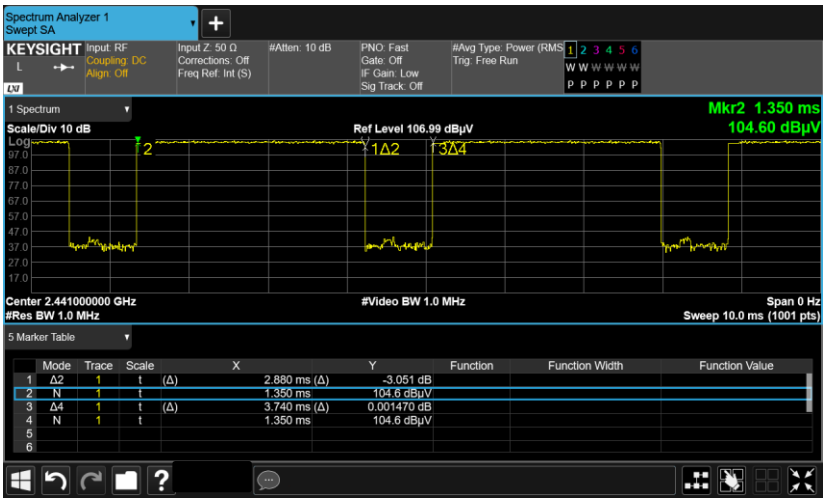
Remark

1. No other spurious found.
2. All results are PASS against limit line.

Appendix D. Duty Cycle Plots

3DH5 on time (One Pulse) Plot on Channel 39

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