

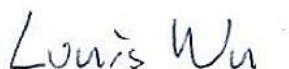


FCC CO-LOCATION RADIO TEST REPORT

FCC ID : 2AFZZ119DG
Equipment : Mobile Phone
Brand Name : XIAOMI
Model Name : 2109119DG
Applicant : Xiaomi Communications Co., Ltd.
#019, 9th Floor, Building 6, 33 Xi'erqi Middle
Road, Haidian District, Beijing, China, 100085
Manufacturer : Xiaomi Communications Co., Ltd.
#019, 9th Floor, Building 6, 33 Xi'erqi Middle
Road, Haidian District, Beijing, China, 100085
Standard : FCC Part 15 Subpart E §15.407

The product was received on Jun. 30, 2021 and testing was started from Jul. 20, 2021 and completed on Jul. 30, 2021. We, Sporton International Inc. Wensan Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. Wensan Laboratory, the test report shall not be reproduced except in full.



Approved by: Louis Wu

Sporton International Inc. Wensan Laboratory

No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.)



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History of this test report

Report No.	Version	Description	Issued Date
FR162425G	01	Initial issue of report	Aug. 02, 2021



Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.407(b)	Unwanted Emissions	Pass	Under limit 3.37 dB at 18000.000 MHz
3.2	15.203 15.407(a)	Antenna Requirement	Pass	-

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Reviewed by: Danny Lee

Report Producer: Vivian Hsu

1 General Description

1.1 Product Feature of Equipment Under Test

GSM/WCDMA/LTE/5G NR, Bluetooth, Wi-Fi 2.4GHz 802.11b/g/n/ax, Wi-Fi 5GHz 802.11a/n/ac/ax, NFC, and GNSS.

Product Specification subjective to this standard	
Sample 1	6G+128GB with Battery 1
Sample 2	8G+128GB with Battery 1
Sample 3	8G+256GB with Battery 1
Sample 4	6G+128GB with Battery 2
Antenna Type	WWAN: PIFA Antenna WLAN <Ant. 7>: PIFA Antenna <Ant. 9>: PIFA Antenna Bluetooth <Ant. 7>: PIFA Antenna <Ant. 9>: PIFA Antenna GPS / Glonass / BDS / Galileo: PIFA Antenna NFC: Coil Antenna

Antenna information		
2400 MHz ~ 2483.5 MHz	Peak Gain (dBi)	Ant. 7: -1.8 Ant. 9: -0.9
5150 MHz ~ 5250 MHz	Peak Gain (dBi)	Ant. 7: -1.53 Ant. 9: -2.66

Remark: The above EUT's information was declared by manufacturer. Please refer to Comments and Explanations in report summary.

1.2 Modification of EUT

No modifications are made to the EUT during all test items.

1.3 Testing Location

Test Site	Sporton International Inc. Wensan Laboratory
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	Sporton Site No. 03CH15-HY

Note: The test site complies with ANSI C63.4 2014 requirement.

FCC designation No.: TW3786

1.4 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ FCC Part 15 Subpart C §15.247
- ♦ FCC Part 15 Subpart E
- ♦ FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02
- ♦ FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
- ♦ FCC KDB 414788 D01 Radiated Test Site v01r01.
- ♦ FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ♦ FCC KDB 971168 D01 Power Meas. License Digital Systems v03r01
- ♦ ANSI C63.10-2013

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. The TAF code is not including all the FCC KDB listed without accreditation.

2 Test Configuration of Equipment Under Test

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated:

2.1 Carrier Frequency and Channel

2400-2483.5 MHz Bluetooth		2400-2483.5 MHz Bluetooth - LE		5150-5250 MHz 802.11ax HE20	
Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
78	2480	39	2480	36	5180

2.2 Test Mode

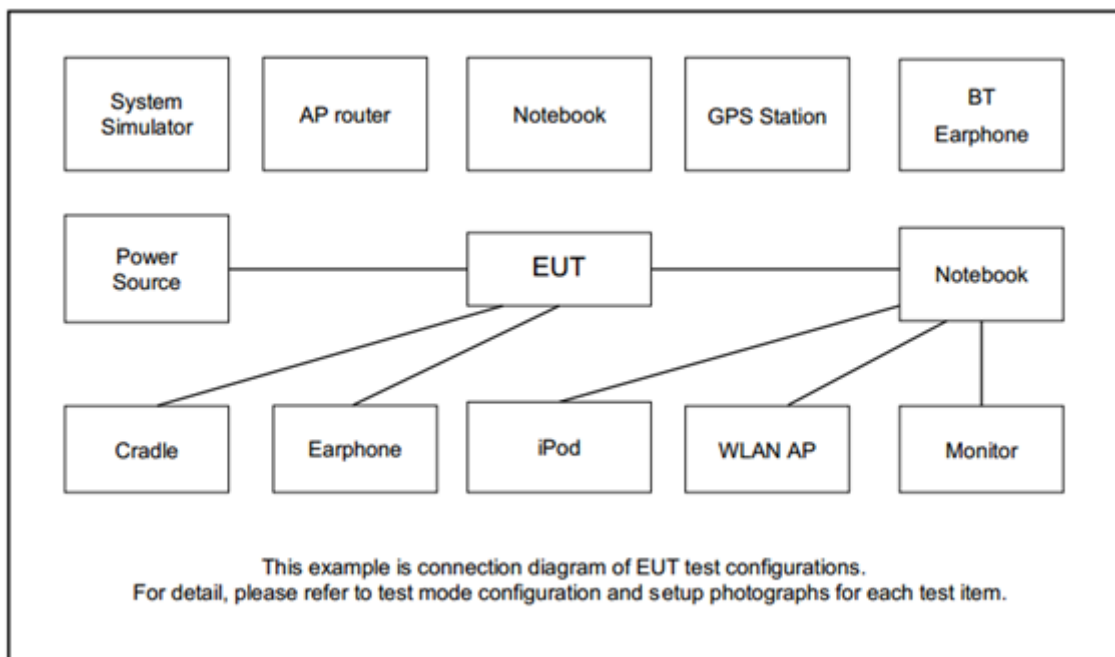
Final test modes are considering the modulation and worse data rates as below table.

<Co-Location>

Modulation	Data Rate
Bluetooth – LE for Ant. 7 + 5GHz 802.11ax HE20 for MIMO Ant. 7+9	2Mbps + MCS0
Bluetooth for Ant. 7 + 5GHz 802.11ax HE20 for MIMO Ant. 7+9	GFSK + MCS0

Remark: For Radiated Test Cases, the tests were performed with USB Cable 2 and Sample 1.

2.3 Connection Diagram of Test System



2.4 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Bluetooth Base Station	R&S	CBT32	N/A	N/A	Unshielded, 1.8 m

2.5 EUT Operation Test Setup

For Bluetooth function, the RF test items, make the EUT (SW: MIUI 12.5 Global 21.6.11) get into the engineering modes to contact with base station to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

For Bluetooth – LE and WLAN function, the RF test items, make the EUT (SW: MIUI 12.5 Global 21.6.11) get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

3 Test Result

3.1 Unwanted Emissions Measurement

This section is to measure unwanted emissions through radiated measurement for band edge spurious emissions and out of band emissions measurement.

3.1.1 Limit of Unwanted Emissions

(1) Unwanted spurious emissions fallen in restricted bands shall comply with the general field strength limits as below table:

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

Note: The following formula is used to convert the EIRP to field strength.

$$E = \frac{1000000\sqrt{30P}}{3} \text{ } \mu\text{V/m, where P is the eirp (Watts)}$$

EIRP (dBm)	Field Strength at 3m (dBμV/m)
- 27	68.3

(2) KDB789033 D02 v02r01 G)2)c)

(i) Sections 15.407(b)(1-3) specifies the unwanted emissions limit for the U-NII-1 and U-NII-2 bands. As specified, emissions above 1000 MHz that are outside of the restricted bands are subject to a peak emission limit of -27 dBm/MHz.

(ii) Section 15.407(b)(4) specifies the unwanted emissions limit for the U-NII-3 band. A band emissions mask is specified in Section 15.407(b)(4)(i). The emission limits are based on the use of a peak detector.

3.1.2 Measuring Instruments

See list of measuring equipment of this test report.



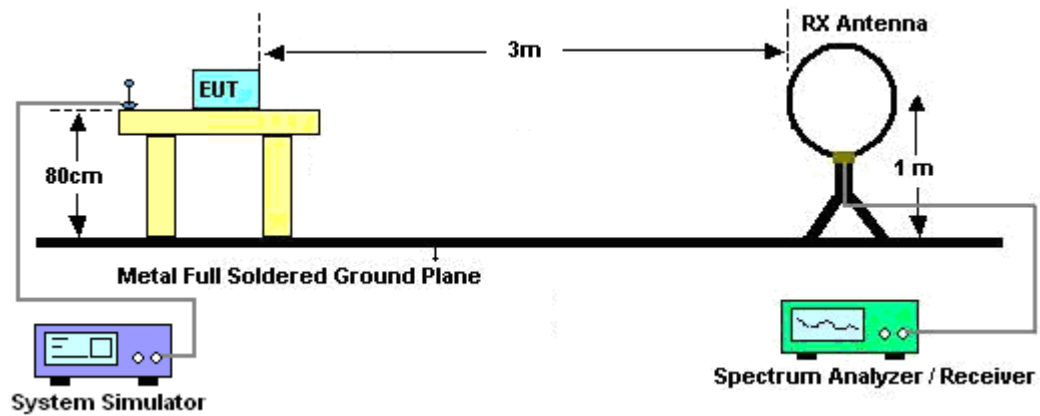
3.1.3 Test Procedures

1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
Section G) Unwanted emissions measurement.
 - (1) Procedure for Unwanted Emissions Measurements Below 1000 MHz
 - RBW = 120 kHz
 - VBW = 300 kHz
 - Detector = Peak
 - Trace mode = max hold
 - (2) Procedure for Peak Unwanted Emissions Measurements Above 1000 MHz
 - RBW = 1 MHz
 - VBW $\geq$ 3 MHz
 - Detector = Peak
 - Sweep time = auto
 - Trace mode = max hold
 - (3) Procedures for Average Unwanted Emissions Measurements Above 1000 MHz
 - RBW = 1 MHz
 - VBW = 10 Hz, when duty cycle is no less than 98 percent.
 - VBW $\geq$ 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.
2. The EUT was 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.
3. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
4. The antenna is a broadband antenna and its height is adjusted between one meter and four meters above ground to find the maximum value of the field strength for both horizontal polarization and vertical polarization of the antenna.
5. For each suspected emission, the EUT was arranged to its worst case and then adjust the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading.
6. For testing below 1 GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1 GHz, the emission level of the EUT in peak mode was 20 dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

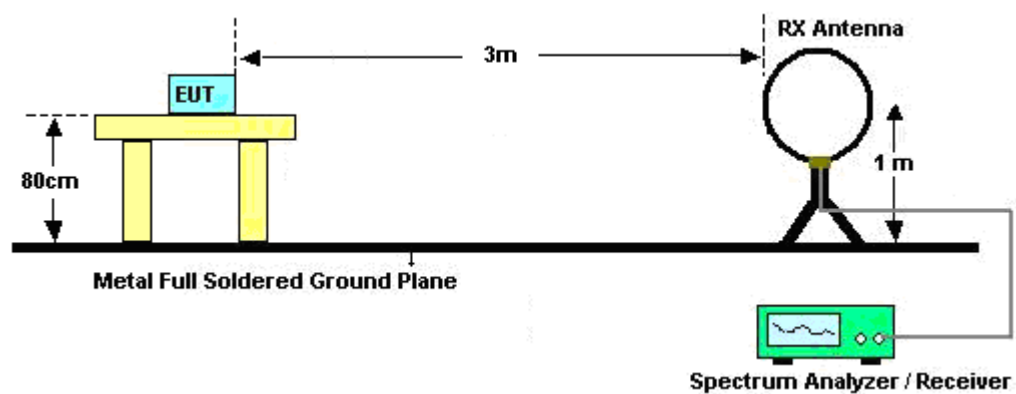
3.1.4 Test Setup

For radiated test below 30MHz

<For Bluetooth Co-location>

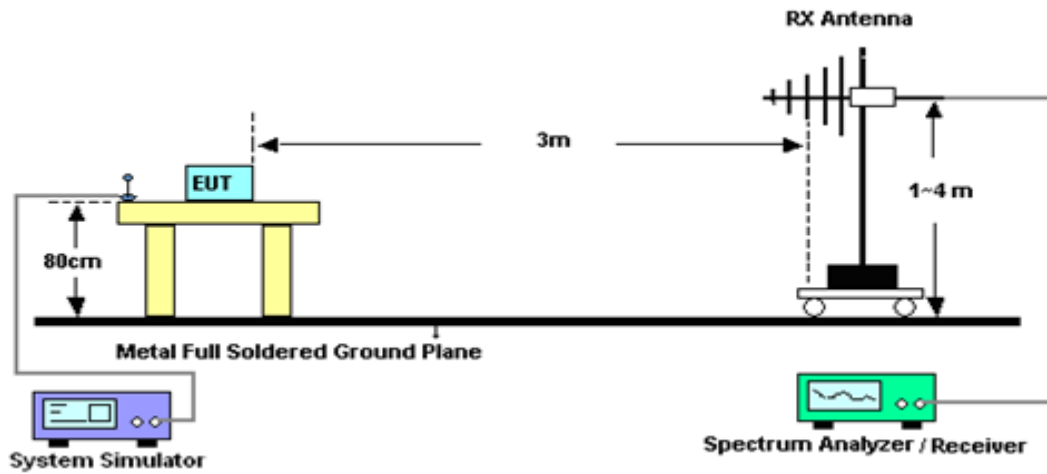


<For Bluetooth – LE Co-location>

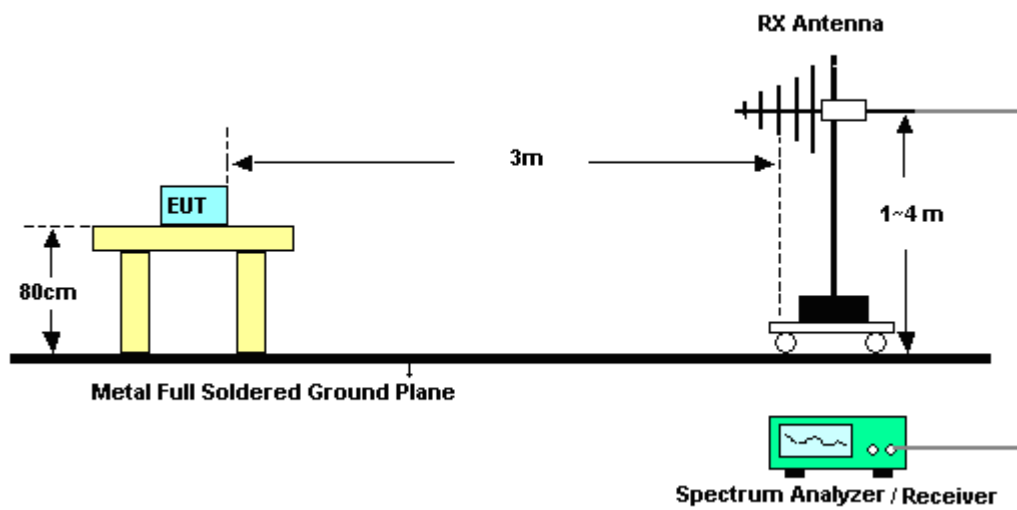


For radiated test from 30MHz to 1GHz

<For Bluetooth Co-location>

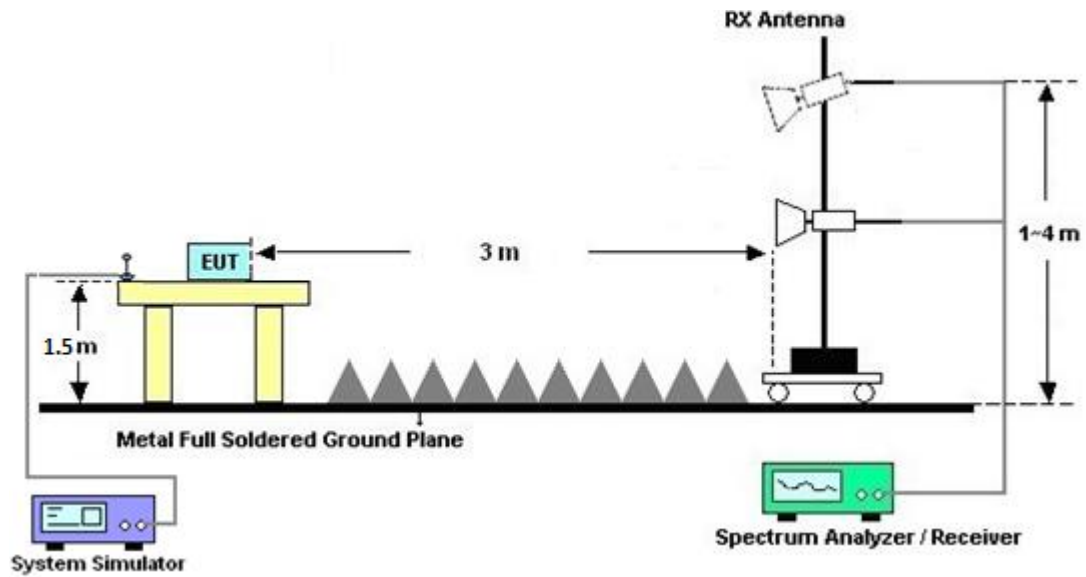


<For Bluetooth – LE Co-location>

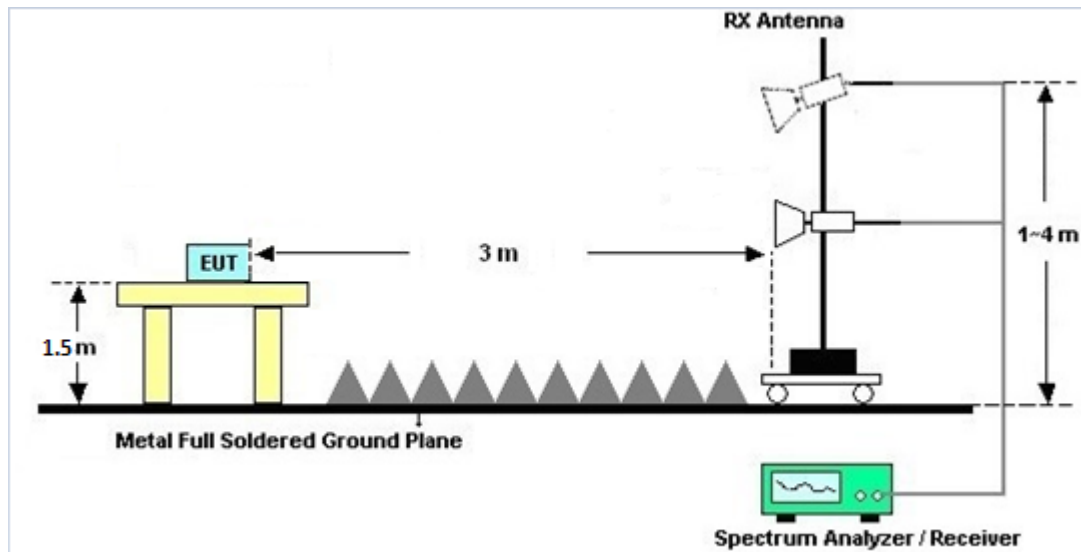


For radiated test from 1GHz to 18GHz

<For Bluetooth Co-location>

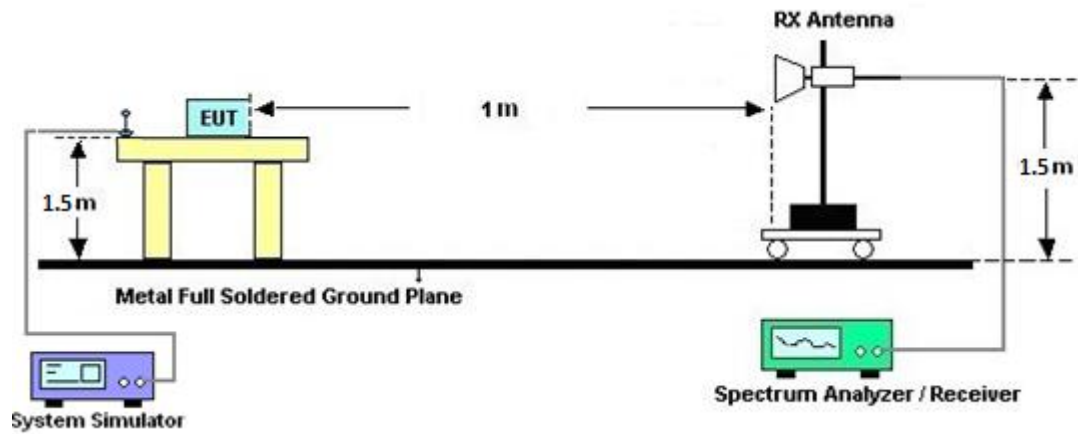


<For Bluetooth – LE Co-location>

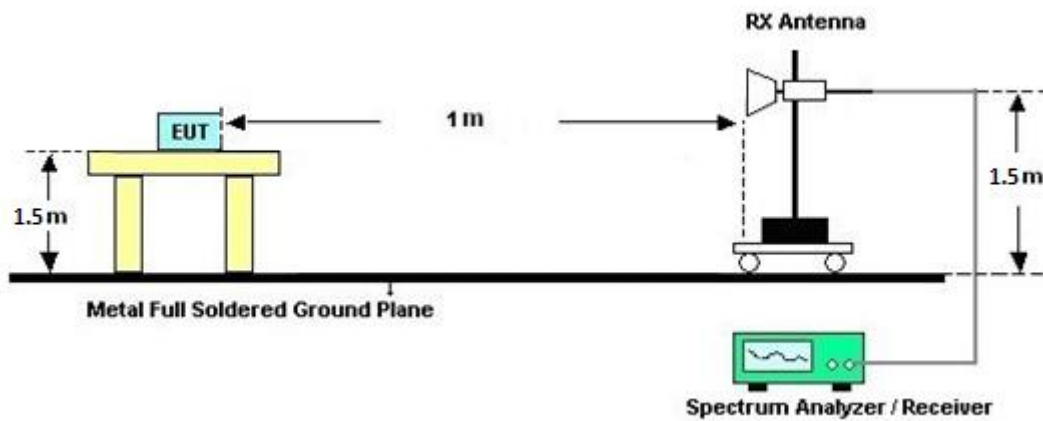


For radiated test above 18GHz

<For Bluetooth Co-location>



<For Bluetooth – LE Co-location>



**3.1.5 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 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 came out very similar.

3.1.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix A and B.

3.1.7 Duty Cycle

Please refer to Appendix C.

3.1.8 Test Result of Radiated Spurious Emissions (30MHz ~ 10th Harmonic)

Please refer to Appendix A and B.



3.2 Antenna Requirements

3.2.1 Standard Applicable

If transmitting antenna directional gain is greater than 6 dBi, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.2.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.2.3 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
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	Jan. 04, 2021	Jul. 20, 2021~ Jul. 30, 2021	Jun. 03, 2022	Radiation (03CH15-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01 N-06	41912 & 05	30MHz~1GHz	Feb. 08, 2021	Jul. 20, 2021~ Jul. 30, 2021	Feb. 07, 2022	Radiation (03CH15-HY)
Horn Antenna	SCHWARZBE CK	BBHA 9120 D	9120D-01620	1GHz~18GHz	Nov. 03, 2020	Jul. 20, 2021~ Jul. 30, 2021	Nov. 02, 2021	Radiation (03CH15-HY)
SHF-EHF Horn Antenna	SCHWARZBE CK	BBHA 9170	BBHA917025 1	18GHz~40GHz	Dec. 02, 2020	Jul. 20, 2021~ Jul. 30, 2021	Dec. 01, 2021	Radiation (03CH15-HY)
Amplifier	SONOMA	310N	363440	9kHz~1GHz	Dec. 28, 2020	Jul. 20, 2021~ Jul. 30, 2021	Dec. 27, 2021	Radiation (03CH15-HY)
Preamplifier	Jet-Power	JPA0118-55-3 03	17100018000 55006	1GHz~18GHz	May 06, 2021	Jul. 20, 2021~ Jul. 30, 2021	May 05, 2022	Radiation (03CH15-HY)
Preamplifier	Keysight	83017A	MY53270195	1GHz~26.5GHz	Aug. 21, 2020	Jul. 20, 2021~ Jul. 30, 2021	Aug. 20, 2021	Radiation (03CH15-HY)
Preamplifier	EMEC	EM18G40G	0600789	18-40GHz	Oct. 27, 2020	Jul. 20, 2021~ Jul. 30, 2021	Oct. 26, 2021	Radiation (03CH15-HY)
EMI Test Receiver	Keysight	N9038A(MXE)	MY54130085	20MHz~8.4GHz	Nov. 02, 2020	Jul. 20, 2021~ Jul. 30, 2021	Nov. 01, 2021	Radiation (03CH15-HY)
Spectrum Analyzer	Agilent	E4446A	MY50180136	3Hz~44GHz	May 07, 2021	Jul. 20, 2021~ Jul. 30, 2021	May 06, 2022	Radiation (03CH15-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Jul. 20, 2021~ Jul. 30, 2021	N/A	Radiation (03CH15-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Jul. 20, 2021~ Jul. 30, 2021	N/A	Radiation (03CH15-HY)
Software	Audix	E3 6.2009-8-24(k 5)	RK-000451	N/A	N/A	Jul. 20, 2021~ Jul. 30, 2021	N/A	Radiation (03CH15-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104, 102E	MY36980/4, MY9838/4PE, 508405/2E	30MHz~18G	Nov. 16, 2020	Jul. 20, 2021~ Jul. 30, 2021	Nov. 15, 2021	Radiation (03CH15-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	505134/2	30MHz-40GHz	Feb. 22, 2021	Jul. 20, 2021~ Jul. 30, 2021	Feb. 21, 2022	Radiation (03CH15-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	800740/2	30MHz-40GHz	Feb. 22, 2021	Jul. 20, 2021~ Jul. 30, 2021	Feb. 21, 2022	Radiation (03CH15-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4PE	9kHz~30MHz	Mar. 11, 2021	Jul. 20, 2021~ Jul. 30, 2021	Mar. 10, 2022	Radiation (03CH15-HY)
Filter	Wainwright	WLJ4-1000-1 530-6000-40S T	SN4	1.53GHz Low Pass Filter	Jul. 02, 2021	Jul. 20, 2021~ Jul. 30, 2021	Jul. 01, 2022	Radiation (03CH15-HY)
Filter	Wainwright	WHKX12-270 0-3000-18000 -60ST	SN4	3GHz High Pass Filter	Sep. 16, 2020	Jul. 20, 2021~ Jul. 30, 2021	Sep. 15, 2021	Radiation (03CH15-HY)
Filter	Wainwright	WHKX8-5872. 5-6750-18000 -40ST	SN6	6.75GHz High Pass Filter	Jun. 30, 2021	Jul. 20, 2021~ Jul. 30, 2021	Jun. 29, 2022	Radiation (03CH15-HY)



5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	4.7 dB
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Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.3 dB
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Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	4.9 dB
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Appendix A. Radiated Spurious Emission

Test Engineer :	Leo Lee Mancy Chou Bigshow Wang	Temperature :	23.2~24.6°C
		Relative Humidity :	42~56%

2.4GHz 2400~2483.5MHz + Band 1 – 5150~5250MHz

BLE_2Mbps_Tx_CH39 Ant. 7 + 802.11ax HE20_Tx_CH36 MIMO Ant 7+9 (Band Edge @ 3m)

	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Chain	Table	Peak	Pol.
BLE+WIFI				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
Simultaneously		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11ax HE20 CH 36 5180MHz		5148.46	62.33	-11.67	74	50.03	31.8	10.51	30.01	100	50	P	H
		5149.76	50.38	-3.62	54	38.08	31.8	10.51	30.01	100	50	A	H
	*	5180	111.26	-	-	99.08	31.62	10.57	30.01	100	50	P	H
	*	5180	101.18	-	-	89	31.62	10.57	30.01	100	50	A	H
		5150.02	58.9	-91.1	150	46.6	31.8	10.51	30.01	342	247	P	V
		5148.98	46.36	-7.64	54	34.06	31.8	10.51	30.01	342	247	A	V
	*	5180	107.41	-	-	95.23	31.62	10.57	30.01	342	247	P	V
	*	5180	97.68	-	-	85.5	31.62	10.57	30.01	342	247	A	V



BLE CH 39 2480MHz	*	2480	100.9	-	-	87.64	27.44	16.7	30.88	102	330	P	H
	*	2480	99.7	-	-	86.44	27.44	16.7	30.88	102	330	A	H
		2492.44	55.3	-18.7	74	42.03	27.42	16.72	30.87	102	330	P	H
		2495.48	47.14	-6.86	54	33.87	27.41	16.73	30.87	102	330	A	H
	*	2480	96.72	-	-	83.46	27.44	16.7	30.88	357	246	P	V
	*	2480	95.39	-	-	82.13	27.44	16.7	30.88	357	246	A	V
		2488.88	55.02	-18.98	74	41.75	27.42	16.72	30.87	357	246	P	V
		2493.6	46.91	-7.09	54	33.64	27.41	16.73	30.87	357	246	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



BLE_2Mbps_Tx_CH39 Ant. 7 + 802.11ax HE20_Tx_CH36 MIMO Ant 7+9 (Harmonic @ 3m)

BLE+WIFI Simultaneously	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)	Chain Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
Co-location		4880	51.7	-22.3	74	39.56	31.04	11.15	30.05	100	20	P	H
		4880	43.76	-10.24	54	31.62	31.04	11.15	30.05	100	20	A	H
		7440	43.1	-30.9	74	52.26	36.3	12.74	58.2	100	0	P	H
		10360	47.74	-20.46	68.2	54.55	39.44	14.55	60.8	100	0	A	H
		15540	46.78	-27.22	74	54.31	37.82	17.01	62.36	100	0	P	H
		18000	60.04	-13.96	74	49.34	49	18.94	57.24	300	138	P	H
		18000	50.34	-3.66	54	39.64	49	18.94	57.24	300	138	P	H
		4880	51.87	-22.13	74	39.73	31.04	11.15	30.05	100	10	P	V
		4880	43.3	-10.7	54	31.16	31.04	11.15	30.05	100	10	A	V
		7440	42.98	-31.02	74	52.14	36.3	12.74	58.2	100	0	P	V
		10360	47.46	-20.74	68.2	54.27	39.44	14.55	60.8	100	0	A	V
		15540	46.65	-27.35	74	54.18	37.82	17.01	62.36	100	0	P	V
		18000	60.68	-13.32	74	49.98	49	18.94	57.24	100	247	P	V
		18000	50.47	-3.53	54	39.77	49	18.94	57.24	100	247	P	V



Emission above 18GHz

BLE_2Mbps_Tx_CH39 Ant. 7 + 802.11ax HE20_Tx_CH36 MIMO Ant 7+9 (SHF@1m)

	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Chain	Table	Peak	Pol.
BLE+WIFI				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
Simultaneously		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
Co-location		22688	39.69	-34.31	74	58.39	38.88	-3.23	54.35	150	0	P	H
		37144	41.93	-26.27	68.2	57.66	43.22	-1.14	57.81	150	0	P	H
													H
													H
													H
													H
													H
													H
		23904	39.76	-34.24	74	57.36	39.05	-2.89	53.76	150	0	P	V
		36836	42.92	-25.28	68.2	59.31	42.9	-1.23	58.06	150	0	P	V
													V
													V
													V
													V
													V
													V
													V
													V
Remark	1. No other spurious found.												
	2. All results are PASS against limit line.												



Emission below 1GHz

BLE_2Mbps_Tx_CH39 Ant. 7 + 802.11ax HE20_Tx_CH36 MIMO Ant 7+9 (LF@3m)

	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Chain	Table	Peak	Pol.
BLE+WIFI				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
Simultaneously		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
Co-location		30	21.28	-18.72	40	28.57	24.59	0.61	32.49	-	-	P	H
		96.93	25.94	-17.56	43.5	41.58	15.55	1.3	32.49	-	-	P	H
		103.72	26.33	-17.17	43.5	41.21	16.28	1.35	32.51	-	-	P	H
		296.75	25.79	-20.21	46	36.89	19.02	2.36	32.48	-	-	P	H
		558.65	25.91	-20.09	46	29.36	25.94	3.22	32.61	-	-	P	H
		958.29	32.74	-13.26	46	28.69	30.97	4.29	31.21	100	0	P	H
		52.31	29.75	-10.25	40	48.07	13.33	0.93	32.58	100	0	P	V
		90.14	21.77	-21.73	43.5	38.4	14.61	1.26	32.5	-	-	P	V
		166.77	20.99	-22.51	43.5	35.71	15.95	1.82	32.49	-	-	P	V
		293.84	21.26	-24.74	46	32.43	18.95	2.36	32.48	-	-	P	V
		767.2	29.01	-16.99	46	29.51	28.11	3.74	32.35	-	-	P	V
		952.47	33.12	-12.88	46	29.33	30.79	4.27	31.27	-	-	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												



2.4GHz 2400~2483.5MHz + Band 1 – 5150~5250MHz

BT_Tx_Ch78 Ant. 7 + 802.11ax HE20_Tx_CH36 MIMO Ant 7+9 (Band Edge @ 3m)

	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Chain	Table	Peak	Pol.
BLE+WIFI				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
Simultaneously		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11ax HE20 CH 36 5180MHz		5148.98	60.65	-13.35	74	48.35	31.8	10	30.01	100	54	P	H
		5150	50.37	-3.63	54	38.07	31.8	10	30.01	100	54	A	H
	*	5180	110	-	-	97.82	31.62	10.03	30.01	100	54	P	H
	*	5180	100.26	-	-	88.08	31.62	10.03	30.01	100	54	A	H
		5149.24	57.55	-16.45	74	45.25	31.8	10	30.01	343	247	P	V
		5150	48.08	-5.92	54	35.78	31.8	10	30.01	343	247	A	V
	*	5180	109.48	-	-	97.3	31.62	10.03	30.01	343	247	P	V
	*	5180	98.6	-	-	86.42	31.62	10.03	30.01	343	247	A	V



BT CH 78 2480MHz	*	2480	106.3	-	-	102.96	27.44	6.78	30.88	373	330	P	H
	*	2480	81.51	-	-	-	-	-	-	-	-	A	H
		2483.52	51.54	-22.46	74	48.2	27.43	6.79	30.88	373	330	P	H
		2480	26.75	-27.25	54	-	-	-	-	-	-	A	H
	*	2480	107.85	-	-	104.51	27.44	6.78	30.88	299	253	P	V
	*	2480	83.06	-	-	-	-	-	-	-	-	A	V
		2483.64	52.9	-21.1	74	49.56	27.43	6.79	30.88	299	253	P	V
		2483.64	28.11	-25.89	54	-	-	-	-	-	-	A	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												


BT_Tx_Ch78 Ant. 7 + 802.11ax HE20_Tx_CH36 MIMO Ant 7+9 (Harmonic @ 3m)

BLE+WIFI Simultaneously	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)	Chain Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
Co-location		4960	50.98	-23.02	74	38.57	31.22	9.79	30.03	100	0	P	H
		4960	26.19	-27.81	54	-	-	-	-	-	-	A	H
		7440	45.05	-28.95	74	54.21	36.3	11.85	58.2	100	0	P	H
		7440	20.26	-33.74	54	-	-	-	-	-	-	A	H
		10360	47.95	-20.25	68.2	54.76	39.44	13.85	60.8	100	0	P	H
		15540	47.42	-26.58	74	54.95	37.82	16.69	62.36	100	0	P	H
		17988.9	60.42	-13.58	74	49.96	48.8	18.23	57.27	300	103	P	H
		17988.9	50.23	-3.77	54	39.77	48.8	18.23	57.27	300	103	A	H
		4960	51.97	-22.03	74	39.56	31.22	9.79	30.03	100	0	P	V
		4960	27.18	-26.82	54	-	-	-	-	-	-	A	V
		7440	45.84	-28.16	74	55	36.3	11.85	58.2	100	0	P	V
		7440	21.05	-32.95	54	-	-	-	-	-	-	A	V
		10360	47.28	-20.92	68.2	54.09	39.44	13.85	60.8	100	0	P	V
		15540	48.1	-25.9	74	55.63	37.82	16.69	62.36	100	0	P	V
		18000	60.57	-13.43	74	49.87	49	18.24	57.24	100	247	P	V
		18000	50.63	-3.37	54	39.93	49	18.24	57.24	100	247	A	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												



Emission above 18GHz

BT_Tx_Ch78 Ant. 7 + 802.11ax HE20_Tx_CH36 MIMO Ant 7+9 (SHF@1m)

	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Chain	Table	Peak	Pol.
BLE+WIFI				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
Simultaneously		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
Co-location		23232	40.1	-28.1	68.2	58.71	38.53	-3.09	54.05	150	0	P	H
		35968	43.36	-24.84	68.2	58.48	44.72	-1.14	58.7	150	0	P	H
													H
													H
													H
													H
													H
													H
		23384	39.35	-28.85	68.2	57.48	38.93	-3.04	54.02	150	0	P	V
		36262	42.45	-25.75	68.2	59.03	43.19	-1.23	58.54	150	0	P	V
													V
													V
													V
													V
													V
													V
Remark	1. No other spurious found.												
	2. All results are PASS against limit line.												



Emission below 1GHz

BT_Tx_Ch78 Ant. 7 + 802.11ax HE20_Tx_CH36 MIMO Ant 7+9 (LF@3m)

	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Chain	Table	Peak	Pol.
BLE+WIFI				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
Simultaneously		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
Co-location		30	21.94	-18.06	40	29.23	24.59	0.6	32.49	-	-	P	H
		99.84	26.24	-17.26	43.5	41.51	15.91	1.29	32.5	-	-	P	H
		181.32	22.21	-21.29	43.5	37.97	14.9	1.74	32.48	-	-	P	H
		299.66	25.7	-20.3	46	36.69	19.13	2.25	32.49	-	-	P	H
		321	25.74	-20.26	46	36.33	19.49	2.33	32.51	-	-	P	H
		956.35	32.14	-13.86	46	28.18	30.91	4.05	31.23	100	0	P	H
		52.31	28.15	-11.85	40	46.47	13.33	0.88	32.58	100	0	P	V
		96.93	22.8	-20.7	43.5	38.44	15.55	1.26	32.49	-	-	P	V
		168.71	19.95	-23.55	43.5	34.92	15.7	1.68	32.49	-	-	P	V
		300.63	22.59	-23.41	46	33.55	19.16	2.25	32.49	-	-	P	V
		835.1	31.07	-14.93	46	30.54	28.55	3.77	31.96	-	-	P	V
		959.26	32.79	-13.21	46	28.7	31	4.06	31.2	-	-	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.
-	The signal is Unintentional Radiators .
P/A	Peak or Average
H/V	Horizontal or Vertical

A calculation example for radiated spurious emission is shown as below:

WIFI Chain.	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Path Loss	Preamp Factor	Chain Pos	Table Pos	Peak Avg.	Pol.
Simultaneously		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
CH 01		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H
2412MHz													

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”.

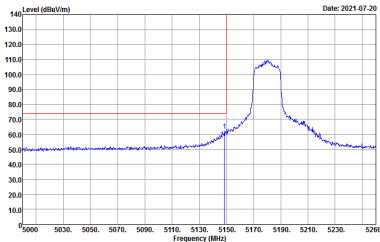
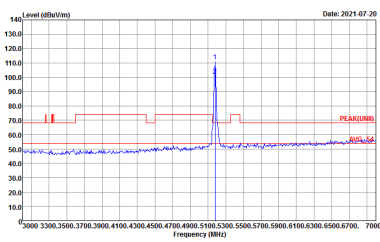
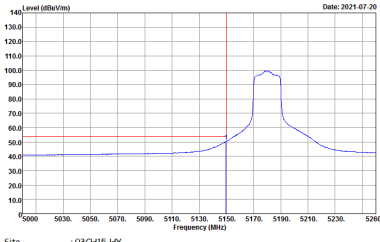


Appendix B. Radiated Spurious Emission

Test Engineer :	Leo Lee Mancy Chou Bigshow Wang	Temperature :	23.2~24.6°C
		Relative Humidity :	42~56%

2.4GHz 2400~2483.5MHz + Band 1 – 5150~5250MHz

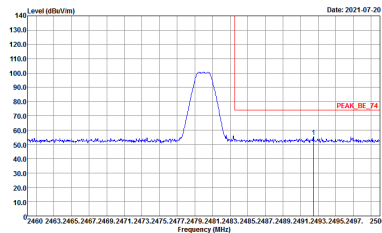
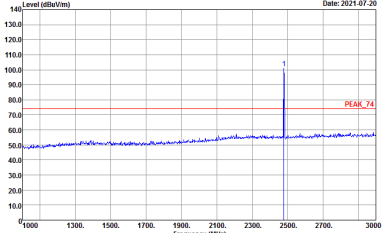
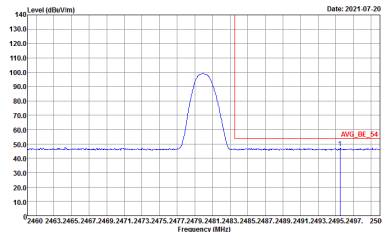
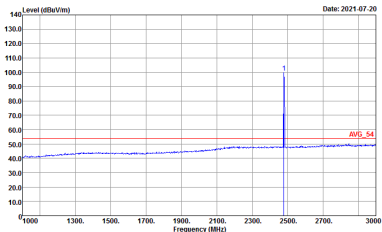
WIFI 802.11ax HE20 (Band Edge @ 3m)

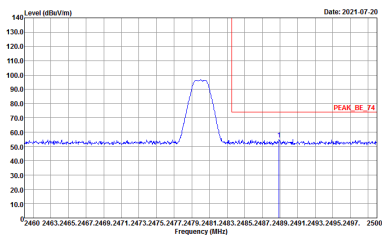
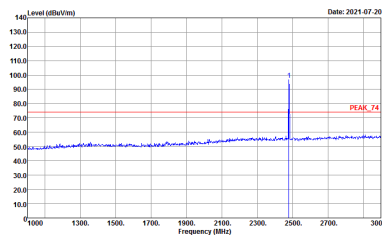
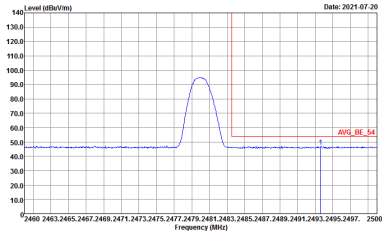
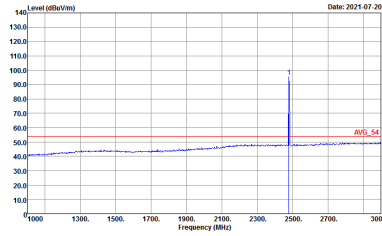
WIFI	Band 1 5150~5250MHz Band Edge @ 3m	
ANT	802.11ax HE20 CH36 5180MHz	
7+9	Horizontal	Fundamental
Peak	 Site : 03CH15-HY Condition : PEAK_9E_74 3m 91200_15_1620 HORIZONTAL RBW:1000.000kHz VBW:3000.000kHz SWT:Auto	 Site : 03CH15-HY Condition : PEAK(UNII) 3m 91200_15_1620 HORIZONTAL RBW:1000.000kHz VBW:3000.000kHz SWT:Auto
Avg.	 Site : 03CH15-HY Condition : AVG_9E_54 3m 91200_15_1620 HORIZONTAL RBW:1000.000kHz VBW:3000.000kHz SWT:Auto	Left blank



WIFI	Band 1 5150~5250MHz Band Edge @ 3m	
ANT	802.11ax HE20 CH36 5180MHz	
7+9	Vertical	Fundamental
Peak	Site : 03CH15-HY Condition : PEAK_BE_74 3m 91200_15_1620 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	Site : 03CH15-HY Condition : PEAK(FUND) 3m 91200_15_1620 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	Site : 03CH15-HY Condition : AVG_BE_54 3m 91200_15_1620 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	Left blank

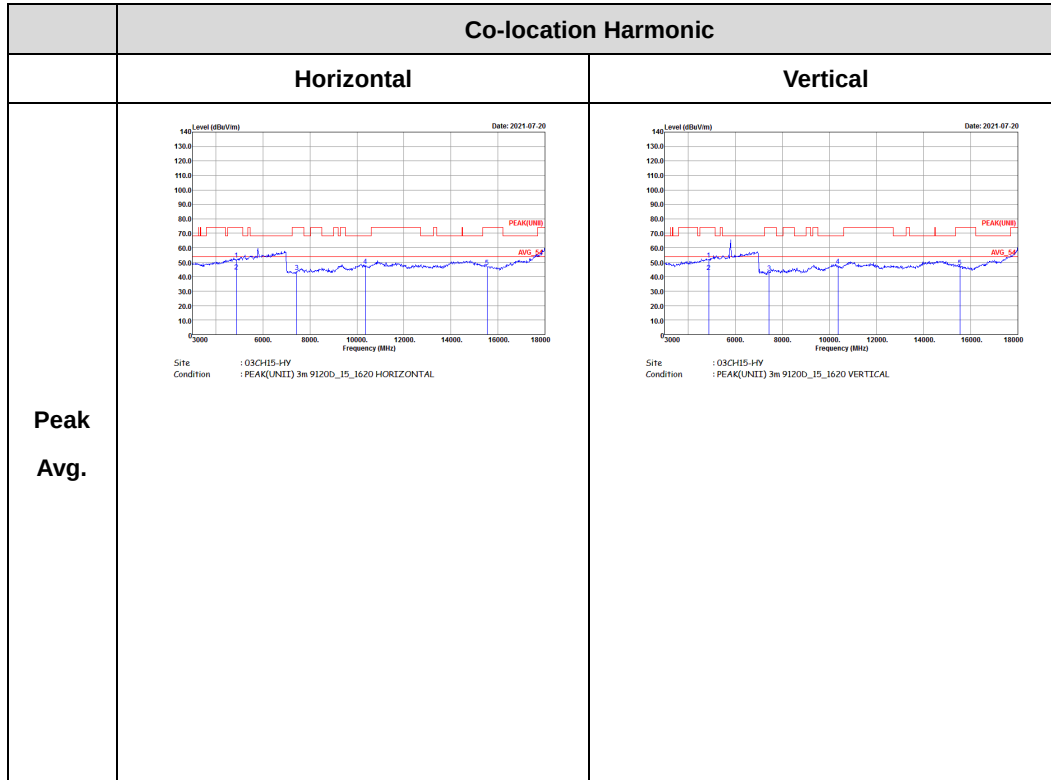
2.4GHz 2400~2483.5MHz
BLE (Band Edge @ 3m)

BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE 2Mbps CH39 2480MHz	
7	Horizontal	Fundamental
Peak	 Site : 03CH15-HY Condition : PEAK_BE_74 3m 91200_15_1620 HORIZONTAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH15-HY Condition : PEAK_74 3m 91200_15_1620 HORIZONTAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
	 Site : 03CH15-HY Condition : AVG_BE_54 3m 91200_15_1620 HORIZONTAL RBW:1000.000KHz VBW:10.000KHz SWT:Auto	 Site : 03CH15-HY Condition : AVG_54 3m 91200_15_1620 HORIZONTAL RBW:1000.000KHz VBW:10.000KHz SWT:Auto
Avg.		

BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE 2Mbps CH39 2480MHz	
7	Vertical	Fundamental
Peak	 Site : 03CH15-HY Condition : PEAK_BE_74 3m 91200_15_1620 VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH15-HY Condition : PEAK_74 3m 91200_15_1620 VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
	 Site : 03CH15-HY Condition : AVG_BE_54 3m 91200_15_1620 VERTICAL RBW:1000.000KHz VBW:10.000KHz SWT:Auto	 Site : 03CH15-HY Condition : AVG_54 3m 91200_15_1620 VERTICAL RBW:1000.000KHz VBW:10.000KHz SWT:Auto
Avg.		



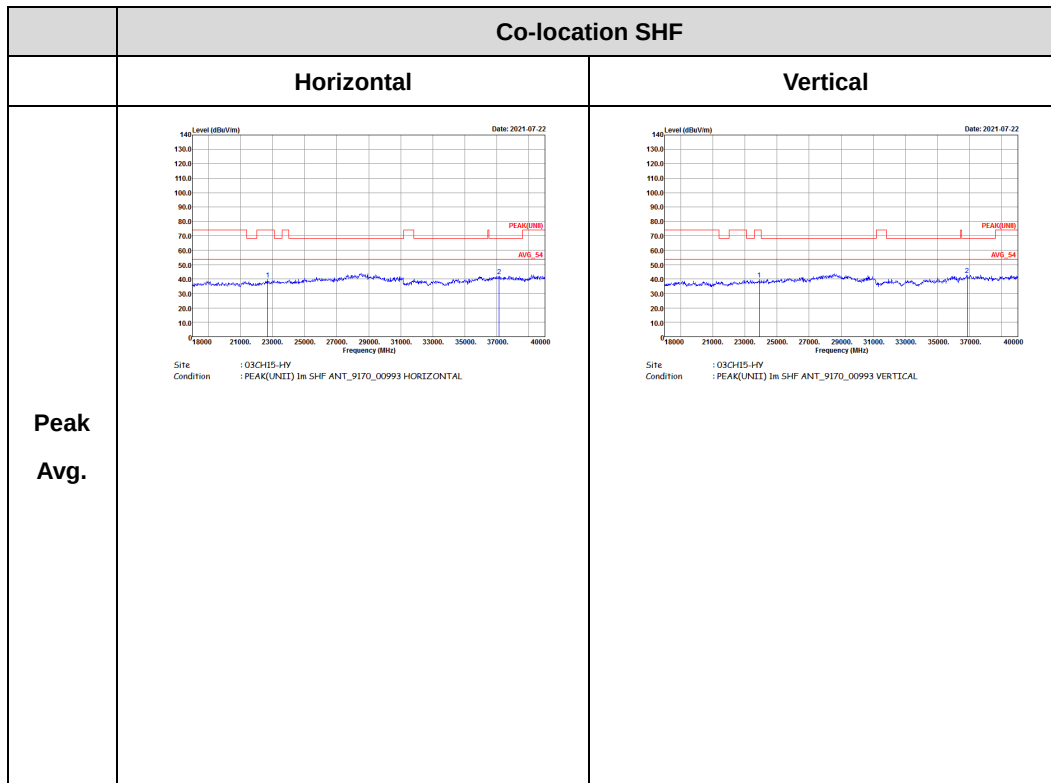
BLE_2Mbps_Tx_CH39 Ant. 7 + 802.11ax HE20_Tx_CH36 MIMO Ant 7+9 (Harmonic @ 3m)





Emission above 18GHz

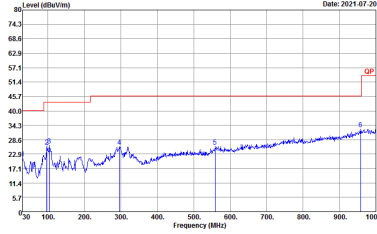
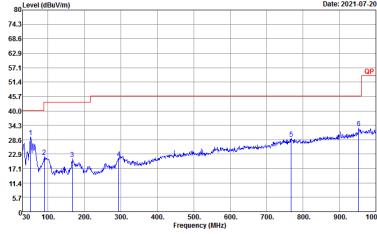
BLE_2Mbps_Tx_CH39 Ant. 7 + 802.11ax HE20_Tx_CH36 MIMO Ant 7+9 (SHF@1m)



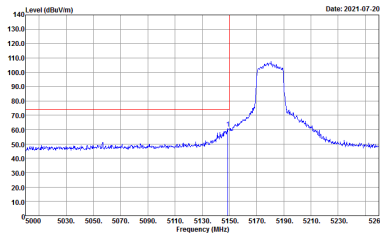
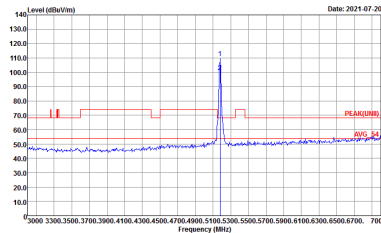
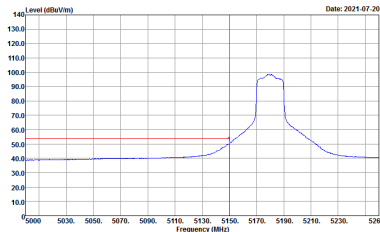


Emission below 1GHz

BLE_2Mbps_Tx_CH39 Ant. 7 + 802.11ax HE20_Tx_CH36 MIMO Ant 7+9 (LF@3m)

	Co-location LF	
	Horizontal	Vertical
QP / Peak	 Site : 03CH15-HY Condition : QP 3m B1LOG_41912_20210208 HORIZONTAL	 Site : 03CH15-HY Condition : QP 3m B1LOG_41912_20210208 VERTICAL

2.4GHz 2400~2483.5MHz + Band 1 – 5150~5250MHz
WIFI 802.11ax HE20 (Band Edge @ 3m)

WIFI	Band 1 5150~5250MHz Band Edge @ 3m	
ANT	802.11ax HE20 CH36 5180MHz	
7+9	Horizontal	Fundamental
Peak	 Site : 03CH15-HY Condition : PEAK_BE_74 3m 91200_15_1620 HORIZONTAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH15-HY Condition : PEAK(FUND) 3m 91200_15_1620 HORIZONTAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site : 03CH15-HY Condition : AVG_BE_54 3m 91200_15_1620 HORIZONTAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	Left blank

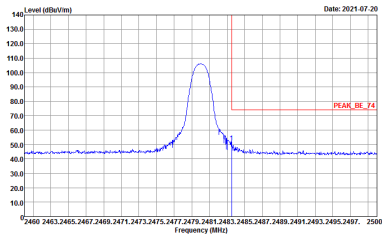
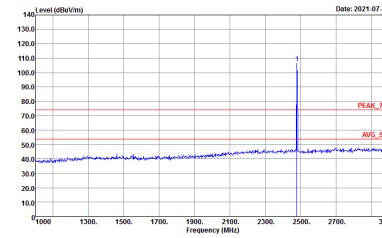


WIFI	Band 1 5150~5250MHz Band Edge @ 3m	
ANT	802.11ax HE20 CH36 5180MHz	
7+9	Vertical	Fundamental
Peak	Site : 03CH15-HY Condition : PEAK_BE_74 3m 91200_15_1620 VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	Site : 03CH15-HY Condition : PEAK(FUND) 3m 91200_15_1620 VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	Site : 03CH15-HY Condition : AVG_BE_54 3m 91200_15_1620 VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	Left blank



2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

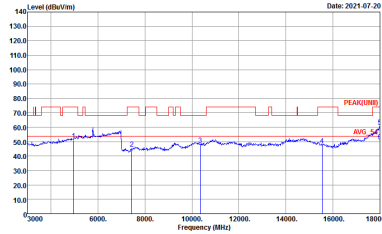
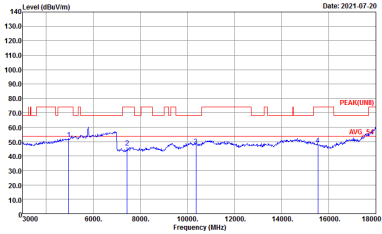
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH78 2480MHz	
7	Horizontal	Fundamental
Peak	 Site : 03CH15-HY Condition : PEAK_BE_74 3m 91200_15_1620 HORIZONTAL RBW:1000.000kHz VBW:3000.000kHz SWT:Auto	 Site : 03CH15-HY Condition : PEAK_74 3m 91200_15_1620 HORIZONTAL RBW:1000.000kHz VBW:3000.000kHz SWT:Auto



BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH78 2480MHz	
7	Vertical	Fundamental
Peak	Site : 03CH15-HY Condition : PEAK_74 3m 91200_15_1620 VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	Site : 03CH15-HY Condition : PEAK_74 3m 91200_15_1620 VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto



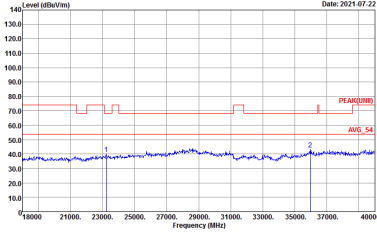
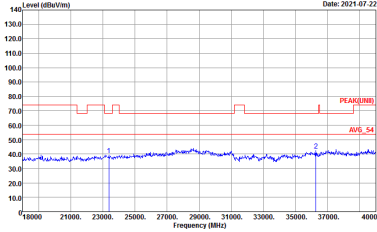
BT_Tx_Ch78 Ant. 7 + 802.11ax HE20_Tx_CH36 MIMO Ant 7+9 (Harmonic @ 3m)

Co-location Harmonic		
	Horizontal	Vertical
Peak Avg.	 Site : 03CH15-11Y Condition : PEAK(UNII) 3m 91200_15_1620 HORIZONTAL	 Site : 03CH15-11Y Condition : PEAK(UNII) 3m 91200_15_1620 VERTICAL

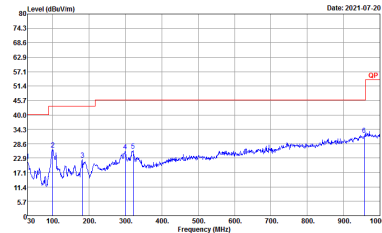
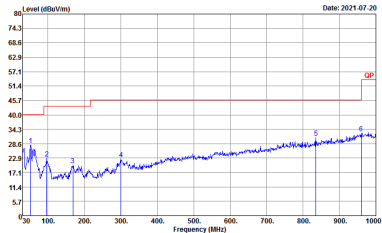


Emission above 18GHz

BT_Tx_Ch78 Ant. 7 + 802.11ax HE20_Tx_CH36 MIMO Ant 7+9 (SHF @ 1m)

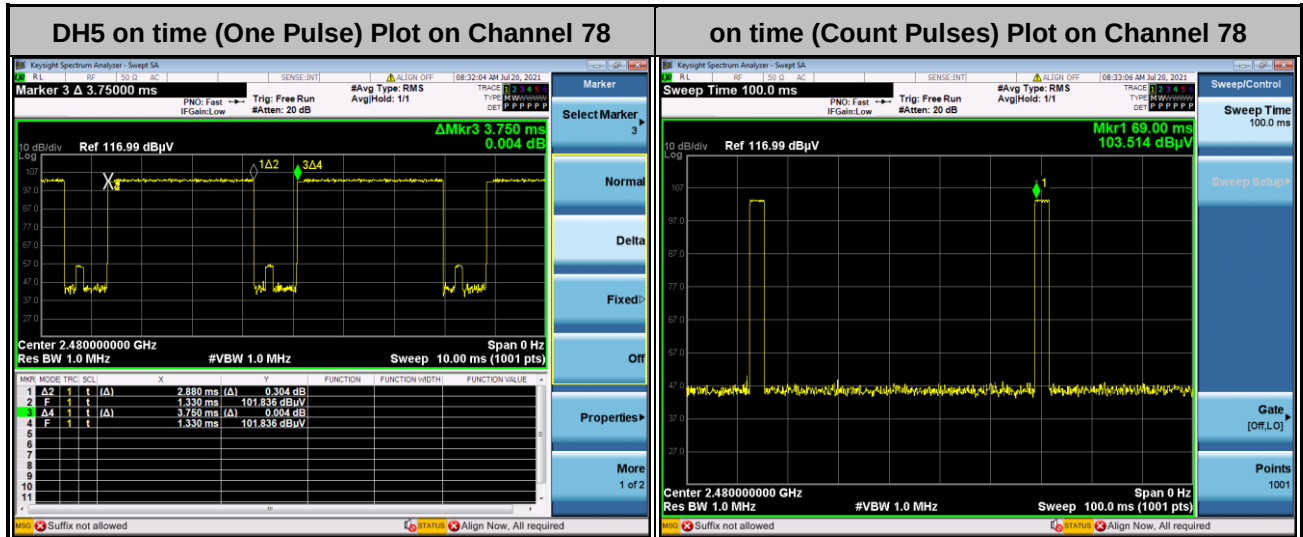
Co-location SHF		
	Horizontal	Vertical
Peak Avg.	 Site : 03CH15-HY Condition : PEAK(UNIT) 1m SHF ANT_9170_00993 HORIZONTAL	 Site : 03CH15-HY Condition : PEAK(UNIT) 1m SHF ANT_9170_00993 VERTICAL

Emission below 1GHz
BT_Tx_Ch78 Ant. 7 + 802.11ax HE20_Tx_CH36 MIMO Ant 7+9 (LF @ 3m)

	Co-location LF	
	Horizontal	Vertical
QP / Peak	 Site : 03CH15-HY Condition : QP 3m B1LOG_41912_20210208 HORIZONTAL	 Site : 03CH15-HY Condition : QP 3m B1LOG_41912_20210208 VERTICAL

Appendix C. Duty Cycle Plots

<Ant. 7>



Note:

1. Worst case Duty cycle = on time/100 milliseconds = $2 * 2.88 / 100 = 5.76 \%$
2. Worst case Duty cycle correction factor = $20 * \log(\text{Duty cycle}) = -24.79 \text{ dB}$
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 period to have DH5 packet completing one hopping sequence is

$$2.88 \text{ ms} \times 20 \text{ channels} = 57.6 \text{ ms}$$

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. $[100 \text{ ms} / 57.6 \text{ ms}] = 2 \text{ hops}$

Thus, the maximum possible ON time:

$$2.88 \text{ ms} \times 2 = 5.76 \text{ ms}$$

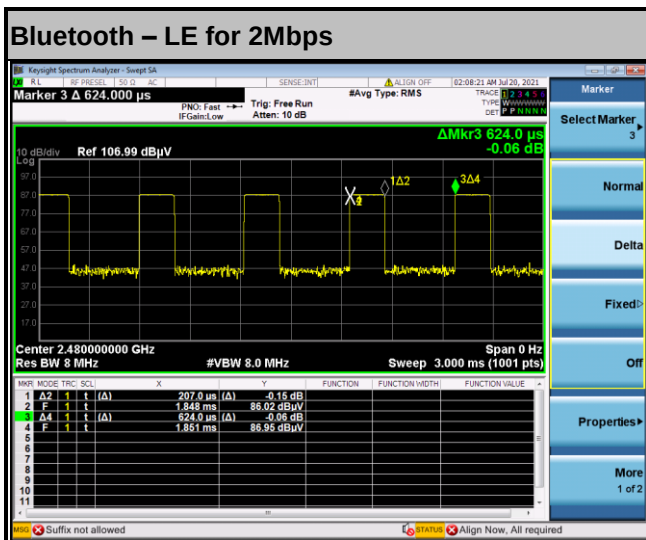
Worst case Duty Cycle Correction factor, which is derived from the maximum possible ON time,

$$20 \times \log(5.76 \text{ ms}/100 \text{ ms}) = -24.79 \text{ dB}$$



Antenna	Band	Duty Cycle (%)	T(us)	1/T(kHz)	VBW Setting
7	Bluetooth - LE for 2Mbps	33.17	207	4.83	10kHz
7+9	5GHz 802.11ax HE20 Full RU	97.49	5440	0.18	300Hz

<Ant. 7>



MIMO <Ant. 7+9>

