



FCC CO-LOCATION RADIO TEST REPORT

FCC ID : A4RG454V
Equipment : Wireless Device
Model Name : G454V
Applicant : Google LLC
1600 Amphitheatre Parkway,
Mountain View, California, 94043 USA
Standard : FCC Part 15 Subpart E §15.407

The product was received on Oct. 06, 2021 and testing was started from Oct. 13, 2021 and completed on Oct. 27, 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.

Louis Wu

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
FR142340-05F	01	Initial issue of report	Nov. 19, 2021
FR142340-05F	02	1. Revise Summary remark 2. Revise description in section 3.1.1 3. Revise appendix A 4. Add "KDB 558074" information in section 1.5.	Nov. 23, 2021

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.407(b)	Unwanted Emissions	Pass	3.42 dB under the limit at 5150.000 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: Avis Chuang

Report Producer: Cindy Liu

1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	Wireless Device
Model Name	G454V
FCC ID	A4RG454V
EUT supports Radios application	WLAN 11b/g/n HT20 WLAN 11a/n HT20/HT40 WLAN 11ac VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE

Remark: The above EUT's information was declared by manufacturer.

EUT Information List	
S/N	Performed Test Item
1923105GN017YC	Radiated Spurious Emission

1.2 Product Specification of Equipment Under Test

Product Specification subjective to this standard	
Tx/Rx Channel Frequency Range	2412 MHz ~ 2462 MHz 5180 MHz ~ 5240 MHz
Antenna Type / Gain	<Bluetooth> <Ant. 1> : PCB PIFA Antenna with gain 3.03 dBi <Ant. 2> : PCB PIFA Antenna with gain 2.73 dBi <5180 MHz ~ 5240 MHz> <Ant. 1>: PCB PIFA Antenna with gain 5.22 dBi <Ant. 2>: PCB PIFA Antenna with gain 6.33 dBi
Type of Modulation	Bluetooth EDR (3Mbps) : 8-DPSK Bluetooth LE: GFSK 802.11a : OFDM (BPSK / QPSK / 16QAM / 64QAM)

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

1.3 Modification of EUT

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

1.4 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. 03CH13-HY

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

FCC designation No.: TW3786

1.5 Applicable Standards

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

- ♦ 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.
- ♦ 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: radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). The measured emission level of the EUT was maximized by rotating the EUT on a turntable, adjusting the orientation of the EUT and EUT antenna in three orthogonal axis (X: flat, Y: portrait, Z: landscape), and adjusting the measurement antenna orientation, following C63.10 exploratory test procedures and find (X Plane for Bluetooth-LE Ant. 1 + 802.11a Ant. 2, Bluetooth Ant. 2 + 802.11a Ant. 1, Bluetooth-LE Ant. 2 + 802.11a Ant. 1; Z Plane for Bluetooth Ant. 1 + 802.11a Ant. 2) as worst plane.

2.1 Carrier Frequency and Channel

2400-2483.5 MHz Bluetooth EDR 3Mbps		2400-2483.5 MHz Bluetooth – LE for 1Mbps	
Channel	Freq. (MHz)	Channel	Freq. (MHz)
78	2480	39	2480

5150-5250 MHz 802.11a	
Channel	Freq. (MHz)
36	5180

2.2 Test Mode

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

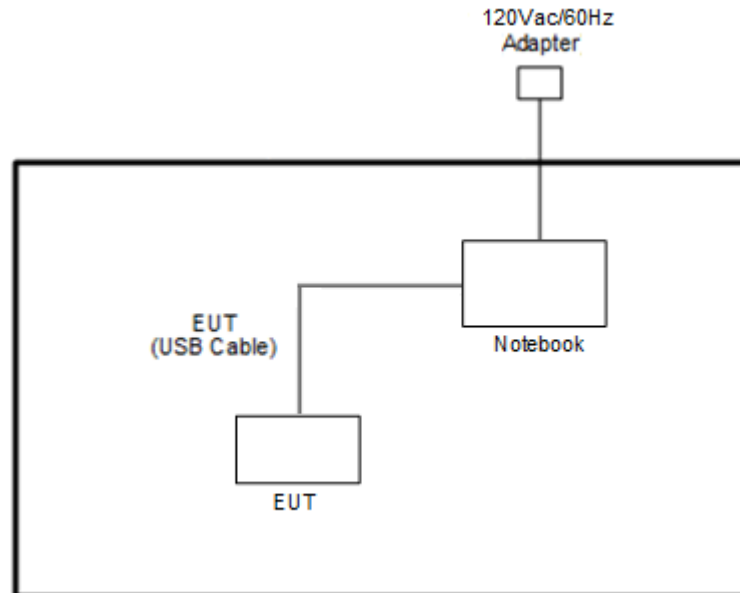
<Co-Location>

Test Mode	Modulation	Data Rate
Mode 1	Bluetooth for Ant. 2 + WLAN 5GHz 802.11a for Ant. 1	3Mbps + 6 Mbps
Mode 2	Bluetooth-LE for Ant. 2 + WLAN 5GHz 802.11a for Ant. 1	1Mbps + 6 Mbps
Mode 3	Bluetooth for Ant. 1 + WLAN 5GHz 802.11a for Ant. 2	3Mbps + 6 Mbps
Mode 4	Bluetooth-LE for Ant. 1 + WLAN 5GHz 802.11a for Ant. 2	1Mbps + 6 Mbps

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

2.3 Connection Diagram of Test System

<Co-Location Tx Mode>



2.4 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Notebook	Acer	A515-54G-51QB	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m

2.5 EUT Operation Test Setup

The RF test items, utility “CMD V10.0.18362.267” was installed in Notebook which was programmed in order to make the EUT 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.

<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.

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

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.

3.1.1 Measuring Instruments

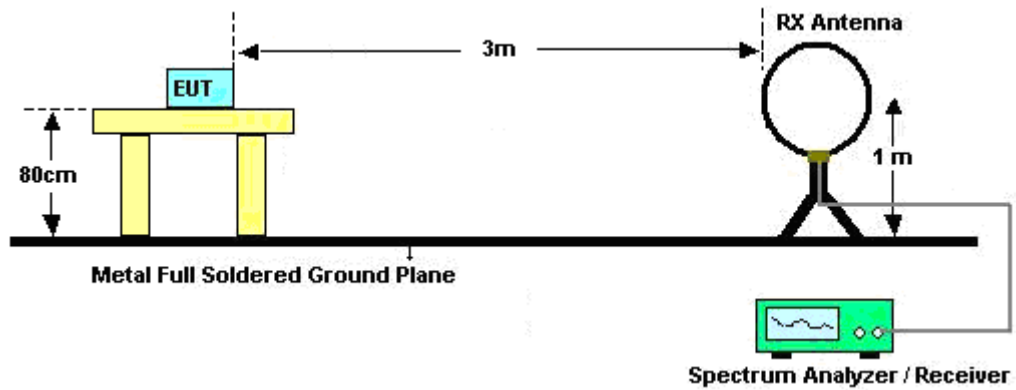
Please refer to the measuring equipment list in this test report.

3.1.2 Test Procedures

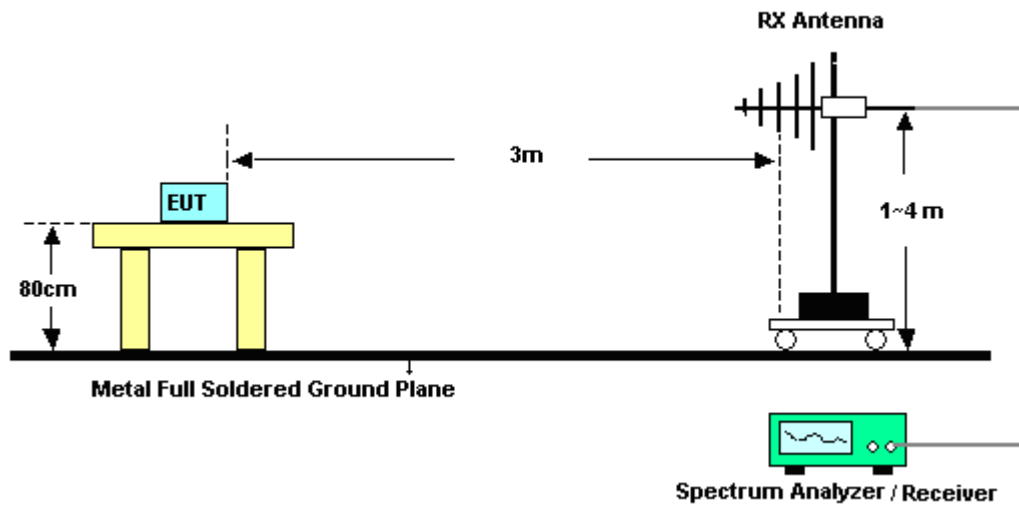
1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
Section G) Unwanted emissions measurement.
 - (1) Procedure for Unwanted Emissions Measurements Below 1000MHz
 - RBW = 120 kHz
 - VBW = 300 kHz
 - Detector = Peak
 - Trace mode = max hold
 - (2) Procedure for Peak 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 1000MHz
 - 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. Radiated testing below 1GHz was performed by adjusting the antenna tower from 1m to 4m and by rotating the turn table from 0degree to 360 degree to find the peak maximum hold reading. When there is no suspected emission found and the emission level is with at least 6dB margin against QP limit line, the position is marked as “-”.
7. Radiated testing above 1GHz was performed by adjusting the antenna tower from 1m to 4m and by rotating the turn table from 0degree to 360 degree to find the peak maximum hold reading for scanning all frequencies. When there is no suspected emission found and the harmonic emission level is with at least 6dB margin against average limit line, the position is marked as “-”.

3.1.3 Test Setup

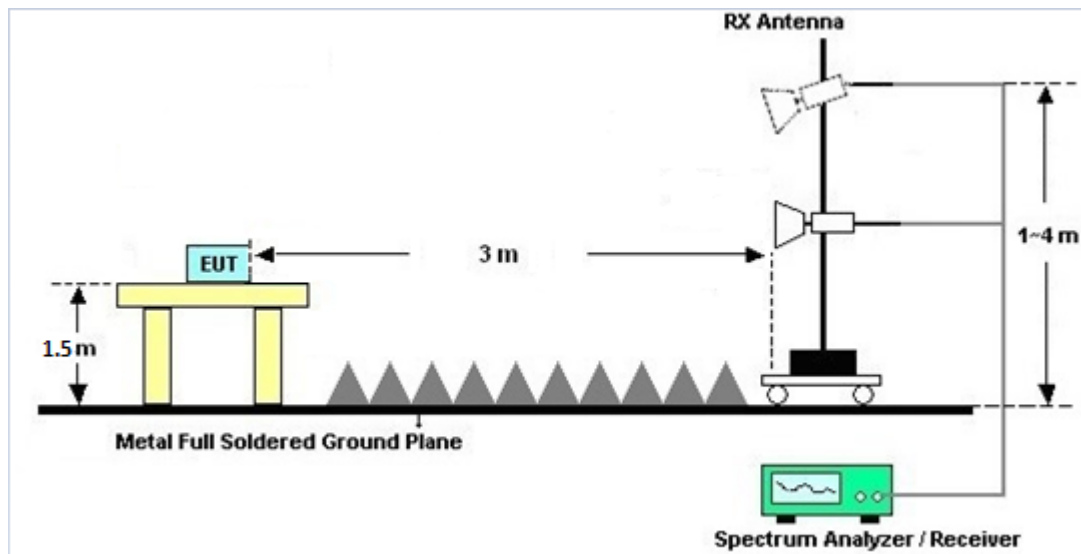
For radiated emissions below 30MHz



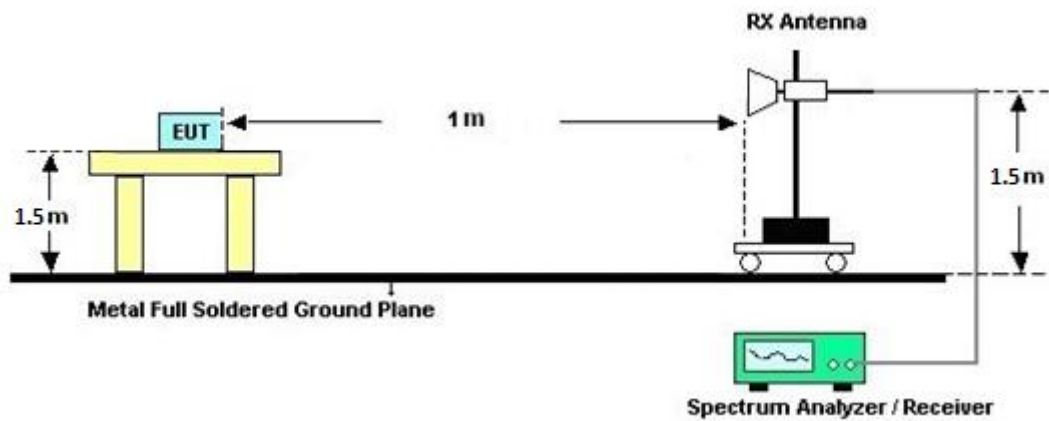
For radiated emissions from 30MHz to 1GHz



For radiated test from 1GHz to 18GHz



For radiated test above 18GHz



**3.1.4 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.

3.1.5 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix A and B.

3.1.6 Duty Cycle

Please refer to Appendix C.

3.1.7 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	Oct. 13, 2021~ Oct. 27, 2021	Jan. 03, 2022	Radiation (03CH13-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01N-06	40103 & 07	30MHz~1GHz	Apr. 28, 2021	Oct. 13, 2021~ Oct. 27, 2021	Apr. 27, 2022	Radiation (03CH13-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1241	1GHz ~ 18GHz	Jul. 13, 2021	Oct. 13, 2021~ Oct. 27, 2021	Jul. 12, 2022	Radiation (03CH13-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	00994	18GHz~ 40GHz	Nov. 19, 2020	Oct. 13, 2021~ Oct. 27, 2021	Nov. 18, 2021	Radiation (03CH13-HY)
Preamplifier	MITEQ	AMF-7D-0010 1800-30-10P	1590074	1GHz~18GHz	May 18, 2021	Oct. 13, 2021~ Oct. 27, 2021	May 17, 2022	Radiation (03CH13-HY)
Preamplifier	Keysight	83017A	MY53270147	1GHz~26.5GHz	Oct. 27, 2020	Oct. 13, 2021~ Oct. 25, 2021	Oct. 26, 2021	Radiation (03CH13-HY)
Preamplifier	Keysight	83017A	MY53270147	1GHz~26.5GHz	Oct. 26, 2021	Oct. 27, 2021	Oct. 25, 2022	Radiation (03CH13-HY)
Amplifier	Sonoma-Instrument	310 N	187282	9KHz~1GHz	Dec. 16, 2020	Oct. 13, 2021~ Oct. 27, 2021	Dec. 15, 2021	Radiation (03CH13-HY)
Signal Generator	Anritsu	MG3694C	163401	0.1Hz~40GHz	Jan. 31, 2021	Oct. 13, 2021~ Oct. 27, 2021	Jan. 30, 2022	Radiation (03CH13-HY)
Spectrum Analyzer	Keysight	N9010A	MY55370526	10Hz~44GHz	Mar. 18, 2021	Oct. 13, 2021~ Oct. 27, 2021	Mar. 17, 2022	Radiation (03CH13-HY)
Controller	EMEC	EM1000	N/A	Control Turn table & Ant Mast	N/A	Oct. 13, 2021~ Oct. 27, 2021	N/A	Radiation (03CH13-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1m~4m	N/A	Oct. 13, 2021~ Oct. 27, 2021	N/A	Radiation (03CH13-HY)
Turn Table	EMEC	TT2000	N/A	0~360 Degree	N/A	Oct. 13, 2021~ Oct. 27, 2021	N/A	Radiation (03CH13-HY)
Software	Audix	E3 6.2009-8-24	RK-000992	N/A	N/A	Oct. 13, 2021~ Oct. 27, 2021	N/A	Radiation (03CH13-HY)
Preamplifier	EMEC	EM18G40G	060715	18GHz ~ 40GHz	Dec. 11, 2020	Oct. 13, 2021~ Oct. 27, 2021	Dec. 10, 2021	Radiation (03CH13-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 126E	0030/126E	30M-18G	Feb. 10, 2021	Oct. 13, 2021~ Oct. 27, 2021	Feb. 09, 2022	Radiation (03CH13-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	804793/4	30M-18G	Feb. 10, 2021	Oct. 13, 2021~ Oct. 27, 2021	Feb. 09, 2022	Radiation (03CH13-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	505134/2	30M~40GHz	Feb. 22, 2021	Oct. 13, 2021~ Oct. 27, 2021	Feb. 21, 2022	Radiation (03CH13-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY4274/2	30MHz~40GHz	Mar. 11, 2021	Oct. 13, 2021~ Oct. 27, 2021	Mar. 10, 2022	Radiation (03CH13-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY24961/4	30M-18G	Feb. 10, 2021	Oct. 13, 2021~ Oct. 27, 2021	Feb. 09, 2022	Radiation (03CH13-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4PE	9kHz~30MHz	Mar. 11, 2021	Oct. 13, 2021~ Oct. 27, 2021	Mar. 10, 2022	Radiation (03CH13-HY)
Hygrometer	TECPEL	DTM-303B	TP200879	N/A	Sep. 30, 2021	Oct. 13, 2021~ Oct. 27, 2021	Sep. 29, 2022	Radiation (03CH13-HY)
Filter	Wainwright	WLK4-1000-15 30-8000-40SS	SN12	1.53GHz Low Pass Filter	Sep. 14, 2021	Oct. 13, 2021~ Oct. 27, 2021	Sep. 13, 2022	Radiation (03CH13-HY)
Filter	Wainwright	WHKX12-2700 -3000-18000-6 0SS	SN2	3GHz High Pass Filter	Jul. 12, 2021	Oct. 13, 2021~ Oct. 27, 2021	Jul. 11, 2022	Radiation (03CH13-HY)
Filter	Wainwright	WHKX8-5872. 5-6750-18000- 40ST	SN5	6.75GHz High Pass Filter	Mar. 11, 2021	Oct. 13, 2021~ Oct. 27, 2021	Mar. 10, 2022	Radiation (03CH13-HY)



5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	6.0 dB
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Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.8 dB
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Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.9 dB
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Appendix A. Radiated Spurious Emission

Test Engineer :	Yuan Lee, Jacky Hong and Wilson Wu	Temperature :	20~25°C
		Relative Humidity :	40~60%

2.4GHz 2400~2483.5MHz

Ant. 2_BT_Tx_Ch78 (Band Edge @ 3m)

WIFI/BT Ant.	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Path Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
Simultaneously		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
ANT2 BT CH78 2480 MHz	*	2480	107.6	-	-	103.5	27.66	4.26	27.82	121	354	P	H
	*	2480	82.81	-	-	-	-	-	-	-	-	A	H
		2484.96	55.95	-18.05	74	51.83	27.67	4.27	27.82	121	354	P	H
		2484.96	31.16	-22.84	54	-	-	-	-	-	-	A	H
													H
													H
	*	2480	102.65	-	-	98.55	27.66	4.26	27.82	302	339	P	V
	*	2480	77.86	-	-	-	-	-	-	-	-	A	V
		2485.56	52.33	-21.67	74	48.21	27.67	4.27	27.82	302	339	P	V
		2485.56	27.54	-26.46	54	-	-	-	-	-	-	A	V
													V
													V
Remark	1. No other spurious found.												
	2. All results are PASS against Peak and Average limit line.												



Band 1 - 5150~5250MHz

Ant. 1_11a_Tx_Ch36 (Band Edge @ 3m)

WIFI/BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
Simultaneously		(MHz)	(dB μ V/m)	(dB)	(dB μ V/m)	(dB μ V)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
ANT1 802.11a CH 36 5180 MHz		5149.24	65.65	-8.35	74	54.58	32.2	6.28	27.41	100	93	P	H
		5150	49.02	-4.98	54	37.95	32.2	6.28	27.41	100	93	A	H
	*	5180	108.61	-	-	97.65	32.08	6.28	27.4	100	93	P	H
	*	5180	100.8	-	-	89.84	32.08	6.28	27.4	100	93	A	H
													H
													H
		5149.5	59.16	-14.84	74	48.09	32.2	6.28	27.41	392	182	P	V
		5150	44.85	-9.15	54	33.78	32.2	6.28	27.41	392	182	A	V
	*	5180	104.23	-	-	93.27	32.08	6.28	27.4	392	182	P	V
	*	5180	96.36	-	-	85.4	32.08	6.28	27.4	392	182	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 + Band 1 - 5150~5250MHz

Ant. 2_BT_Tx_Ch78 + Ant. 1_11a_Tx_Ch36 (Harmonic @ 3m)

WIFI/BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				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)
ANT2 BT CH78 2480 MHz + ANT1 802.11a CH 36 5180 MHz		4960	53.53	-20.47	74	43.13	31.72	6.13	27.45	100	93	P	H
		4960	28.74	-25.26	54	-	-	-	-	-	-	A	H
		7440	44.33	-29.67	74	55.5	37.02	8.98	57.17	200	246	P	H
		7440	19.54	-34.46	54	-	-	-	-	-	-	A	H
		10360	47.27	-20.93	68.2	53.64	39.94	10.15	56.46	-	-	P	H
		15540	45.2	-28.8	74	49.91	39.44	12.03	56.18	-	-	P	H
		17978	55.25	-18.75	74	50.87	47.91	13.19	56.72	113	140	P	H
		17978	45.64	-8.36	54	41.26	47.91	13.19	56.72	113	140	A	H
		4960	51.99	-22.01	74	41.59	31.72	6.13	27.45	392	182	P	V
		4960	27.2	-26.8	54	-	-	-	-	-	-	A	V
		7440	44.32	-29.68	74	55.49	37.02	8.98	57.17	377	312	P	V
		7440	19.53	-34.47	54	-	-	-	-	-	-	A	V
		10360	47.5	-20.7	68.2	53.87	39.94	10.15	56.46	-	-	P	V
		15540	45.24	-28.76	74	49.95	39.44	12.03	56.18	-	-	P	V
		18000	55.78	-18.22	74	50.8	48.5	13.2	56.72	163	134	P	V
		18000	46.18	-7.82	54	41.2	48.5	13.2	56.72	163	134	A	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.												



2.4GHz 2400~2483.5MHz

Ant. 2_BLE_Tx_Ch39 (Band Edge @ 3m)

WIFI/BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				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)
ANT2 BLE CH39 2480 MHz	*	2480	106.95	-	-	92.92	27.66	4.26	27.82	109	263	P	H
	*	2480	105.59	-	-	91.56	27.66	4.26	27.82	109	263	A	H
		2483.76	56.23	-17.77	74	42.18	27.67	4.27	27.82	109	263	P	H
		2487.76	47.15	-6.85	54	33.09	27.68	4.27	27.82	109	263	A	H
													H
													H
	*	2480	102.42	-	-	88.39	27.66	4.26	27.82	301	85	P	V
	*	2480	101.96	-	-	87.93	27.66	4.26	27.82	301	85	A	V
		2484.12	55.67	-18.33	74	41.62	27.67	4.27	27.82	301	85	P	V
		2487.4	46.12	-7.88	54	32.07	27.67	4.27	27.82	301	85	A	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



Band 1 - 5150~5250MHz

Ant. 1_11a_Tx_Ch36 (Band Edge @ 3m)

WIFI/BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				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)
ANT1 802.11a CH 36 5180 MHz		5148.46	69.33	-4.67	74	58.26	32.2	6.28	27.41	103	83	P	H
		5150	50.58	-3.42	54	39.51	32.2	6.28	27.41	103	83	A	H
	*	5180	110.75	-	-	99.79	32.08	6.28	27.4	103	83	P	H
	*	5180	103.02	-	-	92.06	32.08	6.28	27.4	103	83	A	H
													H
													H
		5148.2	62.42	-11.58	74	51.35	32.2	6.28	27.41	393	160	P	V
		5150	45.6	-8.4	54	34.53	32.2	6.28	27.41	393	160	A	V
	*	5180	104.52	-	-	93.56	32.08	6.28	27.4	393	160	P	V
	*	5180	96.85	-	-	85.89	32.08	6.28	27.4	393	160	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 + Band 1 - 5150~5250MHz

Ant. 2_BLE_Tx_Ch39 + Ant. 1_11a_Tx_Ch36 (Harmonic @ 3m)

WIFI/BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				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)
ANT2 BLE CH39 2480 MHz + ANT1 802.11a CH 36 5180 MHz		4960	53.9	-20.1	74	43.5	31.72	6.13	27.45	111	274	P	H
		4960	43.68	-10.32	54	33.28	31.72	6.13	27.45	111	274	A	H
		7440	44.55	-29.45	74	55.72	37.02	8.98	57.17	-	-	P	H
		10360	47.18	-21.02	68.2	53.55	39.94	10.15	56.46	-	-	P	H
		15540	45.53	-28.47	74	50.24	39.44	12.03	56.18	-	-	P	H
		17989	55.76	-18.24	74	51.09	48.2	13.19	56.72	105	232	P	H
		17989	45.9	-8.1	54	41.23	48.2	13.19	56.72	105	232	A	H
		4960	52.68	-21.32	74	42.28	31.72	6.13	27.45	300	77	P	V
		4960	43.44	-10.56	54	33.04	31.72	6.13	27.45	300	77	A	V
		7440	44.05	-29.95	74	55.22	37.02	8.98	57.17	-	-	P	V
		10360	47.53	-20.67	68.2	53.9	39.94	10.15	56.46	-	-	P	V
		15540	46.4	-27.6	74	51.11	39.44	12.03	56.18	-	-	P	V
		18000	55.05	-18.95	74	50.07	48.5	13.2	56.72	139	167	P	V
		18000	46.11	-7.89	54	41.13	48.5	13.2	56.72	139	167	A	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.												



2.4GHz 2400~2483.5MHz

Ant. 1_BT_Tx_Ch78 (Band Edge @ 3m)

WIFI/BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				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)
ANT1 BT CH78 2480 MHz	*	2480	106.51	-	-	102.41	27.66	4.26	27.82	267	354	P	H
	*	2480	81.75	-	-	-	-	-	-	-	-	A	H
		2485.6	55.79	-18.21	74	51.67	27.67	4.27	27.82	267	354	P	H
		2485.6	31.03	-22.97	54	-	-	-	-	-	-	A	H
													H
													H
	*	2480	105.51	-	-	101.41	27.66	4.26	27.82	304	80	P	V
	*	2480	80.75	-	-	-	-	-	-	-	-	A	V
		2483.96	54.1	-19.9	74	49.98	27.67	4.27	27.82	304	80	P	V
		2483.96	29.34	-24.66	54	-	-	-	-	-	-	A	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



Band 1 - 5150~5250MHz

Ant. 2_11a_Tx_Ch36 (Band Edge @ 3m)

WIFI/BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				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)
ANT2 802.11a CH 36 5180 MHz		5148.2	60.7	-13.3	74	49.63	32.2	6.28	27.41	127	4	P	H
		5150	45.67	-8.33	54	34.6	32.2	6.28	27.41	127	4	A	H
	*	5180	104.14	-	-	93.18	32.08	6.28	27.4	127	4	P	H
	*	5180	96.45	-	-	85.49	32.08	6.28	27.4	127	4	A	H
													H
													H
		5148.2	66.19	-7.81	74	55.12	32.2	6.28	27.41	100	89	P	V
		5150	49.28	-4.72	54	38.21	32.2	6.28	27.41	100	89	A	V
	*	5180	108.7	-	-	97.74	32.08	6.28	27.4	100	89	P	V
	*	5180	100.77	-	-	89.81	32.08	6.28	27.4	100	89	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 + Band 1 - 5150~5250MHz

Ant. 1_BT_Tx_Ch78 + Ant. 2_11a_Tx_Ch36 (Harmonic @ 3m)

WIFI/BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				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)
ANT1 BT CH78 2480 MHz + ANT2 802.11a CH 36 5180 MHz		4960	51.53	-22.47	74	41.13	31.72	6.13	27.45	127	4	P	H
		4960	26.77	-27.23	54	-	-	-	-	-	-	A	H
		7440	44.64	-29.36	74	55.81	37.02	8.98	57.17	138	44	P	H
		7440	19.88	-34.12	54	-	-	-	-	-	-	A	H
		10360	47.35	-20.85	68.2	53.72	39.94	10.15	56.46	-	-	P	H
		15540	45.58	-28.42	74	50.29	39.44	12.03	56.18	-	-	P	H
		17956	55.45	-18.55	74	51.7	47.31	13.16	56.72	108	193	P	H
		17956	44.99	-9.01	54	41.24	47.31	13.16	56.72	108	193	A	H
		4960	53.04	-20.96	74	42.64	31.72	6.13	27.45	100	89	P	V
		4960	28.28	-25.72	54	-	-	-	-	-	-	A	V
		7440	44.04	-29.96	74	55.21	37.02	8.98	57.17	112	77	P	V
		7440	19.28	-34.72	54	-	-	-	-	-	-	A	V
		10360	47.73	-20.47	68.2	54.1	39.94	10.15	56.46	-	-	P	V
		15540	45.57	-28.43	74	50.28	39.44	12.03	56.18	-	-	P	V
		18000	55.72	-18.28	74	50.74	48.5	13.2	56.72	141	133	P	V
		18000	46.09	-7.91	54	41.11	48.5	13.2	56.72	141	133	A	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.												



2.4GHz 2400~2483.5MHz

Ant. 1_BLE_Tx_Ch39 (Band Edge @ 3m)

WIFI/BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				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)
ANT1 BLE CH39 2480 MHz	*	2480	105.83	-	-	91.8	27.66	4.26	27.82	116	266	P	H
	*	2480	105.31	-	-	91.28	27.66	4.26	27.82	116	266	A	H
		2483.56	57.68	-16.32	74	43.63	27.67	4.27	27.82	116	266	P	H
		2487.64	47.3	-6.7	54	33.24	27.68	4.27	27.82	116	266	A	H
													H
													H
	*	2480	100.18	-	-	86.15	27.66	4.26	27.82	316	95	P	V
	*	2480	99.65	-	-	85.62	27.66	4.26	27.82	316	95	A	V
		2486	54.85	-19.15	74	40.8	27.67	4.27	27.82	316	95	P	V
		2487.52	47.69	-6.31	54	33.63	27.68	4.27	27.82	316	95	A	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



Band 1 - 5150~5250MHz

Ant. 2_11a_Tx_Ch36 (Band Edge @ 3m)

WIFI/BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				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)
ANT2 802.11a CH 36 5180 MHz		5149.24	66.03	-7.97	74	54.96	32.2	6.28	27.41	100	93	P	H
		5150	49.18	-4.82	54	38.11	32.2	6.28	27.41	100	93	A	H
	*	5180	109	-	-	98.04	32.08	6.28	27.4	100	93	P	H
	*	5180	100.94	-	-	89.98	32.08	6.28	27.4	100	93	A	H
													H
													H
		5148.2	61.87	-12.13	74	50.8	32.2	6.28	27.41	396	160	P	V
		5150	46.22	-7.78	54	35.15	32.2	6.28	27.41	396	160	A	V
	*	5180	104.69	-	-	93.73	32.08	6.28	27.4	393	160	P	V
	*	5180	96.93	-	-	85.97	32.08	6.28	27.4	393	160	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 + Band 1 - 5150~5250MHz

Ant. 1_BLE_Tx_Ch39 + Ant. 2_11a_Tx_Ch36 (Harmonic @ 3m)

WIFI/BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				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)
ANT1 BLE CH39 2480 MHz + ANT2 802.11a CH 36 5180 MHz		4960	54.83	-19.17	74	44.43	31.72	6.13	27.45	122	258	P	H
		4960	43.78	-10.22	54	33.38	31.72	6.13	27.45	122	258	A	H
		7440	44.99	-29.01	74	56.16	37.02	8.98	57.17	-	-	P	H
		10360	47.51	-20.69	68.2	53.88	39.94	10.15	56.46	-	-	P	H
		15540	45.15	-28.85	74	49.86	39.44	12.03	56.18	-	-	P	H
		18000	56.08	-17.92	74	51.1	48.5	13.2	56.72	100	153	P	H
		18000	46.19	-7.81	54	41.21	48.5	13.2	56.72	100	153	A	H
		4960	53.27	-20.73	74	42.87	31.72	6.13	27.45	311	112	P	V
		4960	43.38	-10.62	54	32.98	31.72	6.13	27.45	311	112	A	V
		7440	44.04	-29.96	74	55.21	37.02	8.98	57.17	-	-	P	V
		10360	47.76	-20.44	68.2	54.13	39.94	10.15	56.46	-	-	P	V
		15540	46.03	-27.97	74	50.74	39.44	12.03	56.18	-	-	P	V
		17989	55.54	-18.46	74	50.87	48.2	13.19	56.72	152	225	P	V
		17989	45.78	-8.22	54	41.11	48.2	13.19	56.72	152	225	A	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 above 18GHz

Ant. 2_BLE_Tx_Ch39 + Ant. 1_11a_Tx_Ch36 (SHF @ 1m)

WIFI/BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				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)
ANT2 BLE CH39 2480 MHz + ANT1 802.11a CH 36 5180 MHz		39714	44.72	-29.28	74	58.09	43.64	-0.97	56.04	-	-	P	H
													H
													H
													H
													H
		39604	44.67	-29.33	74	58.15	43.78	-1.08	56.18	-	-	P	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 with sufficient margin against limit line or noise floor only.												



Ant. 1_BT_Tx_Ch78 + Ant. 2_11a_Tx_Ch36 (SHF @ 1m)

WIFI/BT Ant. 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)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
ANT1 BT CH78 2480 MHz + ANT2 802.11a CH 36 5180 MHz		39428	45.05	-28.95	74	58.75	43.84	-1.2	56.34	-	-	P	H
													H
													H
													H
													H
		39692	45.15	-28.85	74	58.55	43.67	-1	56.07	-	-	P	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 with sufficient margin against limit line or noise floor only.												



Emission below 1GHz

Ant. 2_BLE_Tx_Ch39 + Ant. 1_11a_Tx_Ch36 (LF)

WIFI/BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preampl	Ant	Table	Peak	Pol.
Ant.				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)
ANT2 BLE CH39 2480 MHz + ANT1 802.11a CH 36 5180 MHz		34.85	29.99	-10.01	40	39.37	22.11	0.75	32.24	-	-	P	H
		120.21	25.23	-18.27	43.5	38.82	17.5	1.15	32.24	-	-	P	H
		152.22	23.71	-19.79	43.5	37.81	16.93	1.22	32.25	-	-	P	H
		551.86	28.49	-17.51	46	33.65	24.98	2.14	32.28	-	-	P	H
		800.18	30.94	-15.06	46	32.05	27.74	2.47	31.32	-	-	P	H
		958.29	32.08	-13.92	46	29.49	30.73	2.61	30.75	-	-	P	H
		34.85	28.35	-11.65	40	37.73	22.11	0.75	32.24	-	-	P	V
		44.55	29.48	-10.52	40	43.86	17.08	0.81	32.27	-	-	P	V
		159.98	28.64	-14.86	43.5	43.16	16.48	1.25	32.25	-	-	P	V
		504.33	28.03	-17.97	46	34.1	23.85	2.06	31.98	-	-	P	V
		792.42	29.95	-16.05	46	31.06	27.81	2.46	31.38	-	-	P	V
		947.62	32.66	-13.34	46	30.74	30.12	2.6	30.8	-	-	P	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 with sufficient margin against limit line or noise floor only.												



Ant. 1_BT_Tx_Ch78 + Ant. 2_11a_Tx_Ch36 (LF)

WIFI/BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				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)
ANT1 BT CH78 2480 MHz + ANT2 802.11a CH 36 5180 MHz		34.85	29.09	-10.91	40	38.47	22.11	0.75	32.24	-	-	P	H
		45.52	25.43	-14.57	40	40.28	16.62	0.81	32.28	-	-	P	H
		120.21	25.97	-17.53	43.5	39.56	17.5	1.15	32.24	-	-	P	H
		149.31	26.09	-17.41	43.5	39.97	17.17	1.2	32.25	-	-	P	H
		551.86	29.31	-16.69	46	34.47	24.98	2.14	32.28	-	-	P	H
		956.35	33.27	-12.73	46	30.8	30.62	2.61	30.76	-	-	P	H
		35.82	29.31	-10.69	40	39.29	21.5	0.76	32.24	-	-	P	V
		44.55	28.59	-11.41	40	42.97	17.08	0.81	32.27	-	-	P	V
		95.96	25.53	-17.97	43.5	41.32	15.4	1.04	32.23	-	-	P	V
		159.98	27.6	-15.9	43.5	42.12	16.48	1.25	32.25	-	-	P	V
		551.86	28.1	-17.9	46	33.26	24.98	2.14	32.28	-	-	P	V
		957.32	32.24	-13.76	46	29.71	30.67	2.61	30.75	-	-	P	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 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	Peak or Average
H/V	Horizontal or Vertical



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

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	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		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
CH 01													
2412MHz		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”.



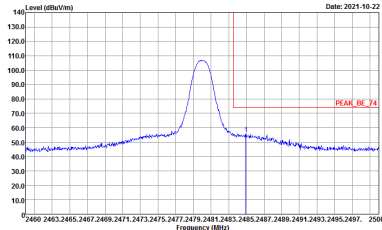
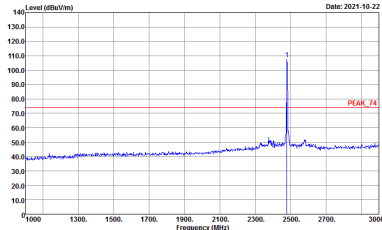
Appendix B. Radiated Spurious Emission Plots

Test Engineer :	Yuan Lee, Jacky Hong and Wilson Wu	Temperature :	20~25°C
		Relative Humidity :	40~60%

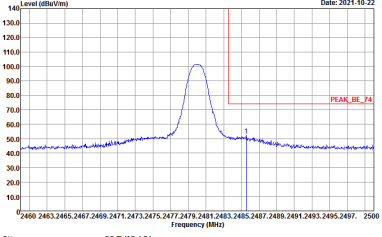
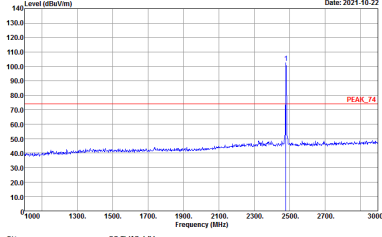
Note symbol

-L	Low channel location
-R	High channel location

2.4GHz 2400~2483.5MHz
Ant. 2_BT_Tx_Ch78 (Band Edge @ 3m)

WIFI/BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
Ant.	BT CH78 2480MHz	
Simultaneously	Horizontal	Fundamental
Peak	 Site : 03CH13-HY Condition : PEAK_BE_74 3m HORN_91200_1241 HORIZONTAL : RBW:3000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH13-HY Condition : PEAK_74 3m HORN_91200_1241 HORIZONTAL : RBW:3000.000KHz VBW:3000.000KHz SWT:Auto

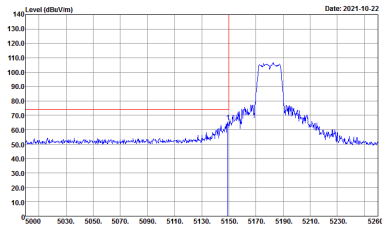
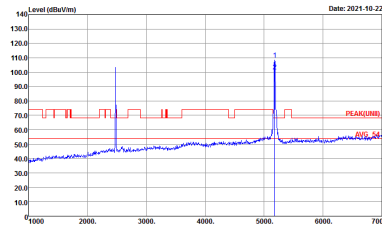
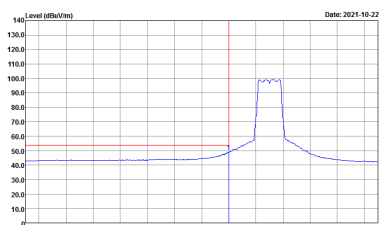


WIFI/BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
Ant.	BT CH78 2480MHz	
Simultaneously	Vertical	Fundamental
Peak	 Site : 03CH13-4V Condition : PEAK_BE_74 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH13-4V Condition : PEAK_74 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto

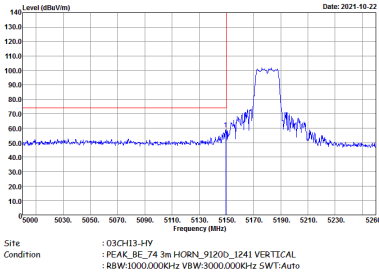
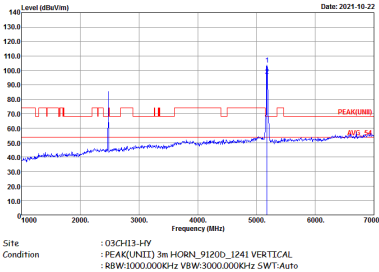
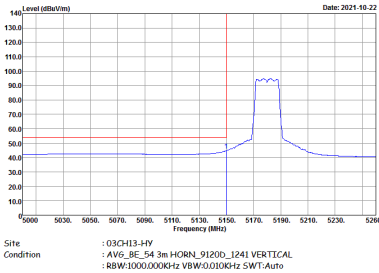


Band 1 - 5150~5250MHz

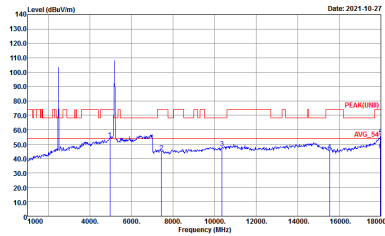
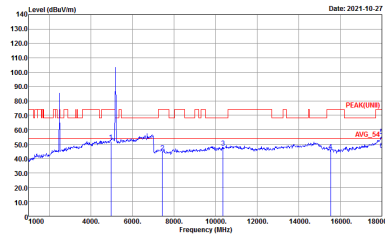
Ant. 1_11a_Tx_Ch36 (Band Edge @ 3m)

WIFI/BT	Band 1 5150~5250MHz Band Edge @ 3m	
Ant.	802.11a CH36 5180MHz	
Simultaneously	Horizontal	Fundamental
Peak	 Site : 03CH13-HY Condition : PEAK_BE_74 3m HORN_91200_1241 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH13-HY Condition : PEAK(UNIT) 3m HORN_91200_1241 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site : 03CH13-HY Condition : AVG_BE_54 3m HORN_91200_1241 HORIZONTAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto	Left blank



WIFI/BT	Band 1 5150~5250MHz Band Edge @ 3m	
Ant.	802.11a CH36 5180MHz	
Simultaneously	Vertical	Fundamental
Peak	 Site : 03CH13-HY Condition : PEAK_BE_74 3m HORN_91200_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH13-HY Condition : PEAK(LINE) 3m HORN_91200_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site : 03CH13-HY Condition : AVG_BE_54 3m HORN_91200_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	Left blank

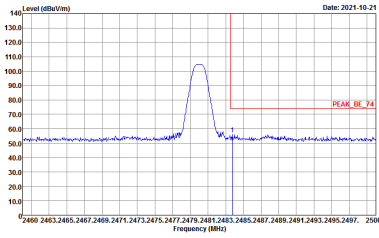
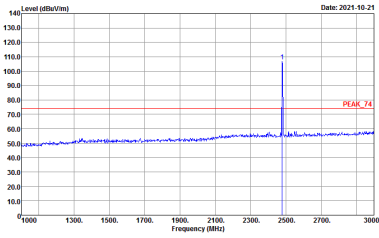
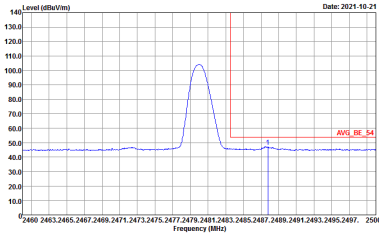
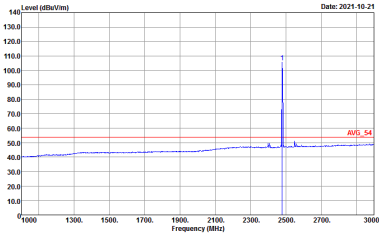
2.4GHz 2400~2483.5MHz + Band 1 - 5150~5250MHz
Ant. 2_BT_Tx_Ch78 + Ant. 1_11a_Tx_Ch36 (Harmonic @ 3m)

WIFI/BT	2.4GHz 2400~2483.5MHz + Band 1 5150~5250MHz Harmonic @ 3m	
Ant.	BT CH78 2480MHz + 802.11a CH36 5180MHz	
Simultaneously	Horizontal	Vertical
Peak Avg.	 Site : 03CH13-HY Condition : PEAK(UNIT) 3m HORN_9120D_1241 HORIZONTAL Detector : Peak	 Site : 03CH13-HY Condition : PEAK(UNIT) 3m HORN_9120D_1241 VERTICAL Detector : Peak

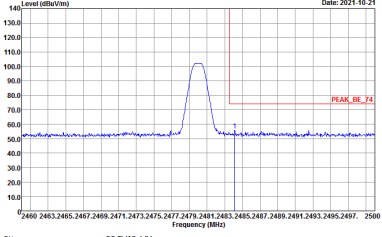
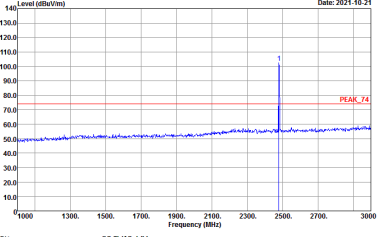
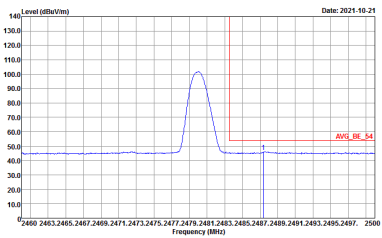
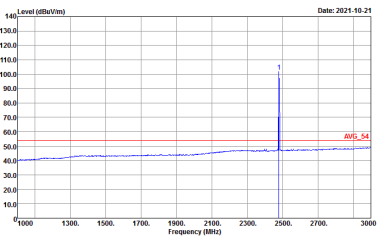


2.4GHz 2400~2483.5MHz

Ant. 2_BLE_Tx_Ch39 (Band Edge @ 3m)

WIFI/BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
Ant.	BLE_CH39 2480MHz	
Simultaneously	Horizontal	Fundamental
Peak	 Site : 03CH13-HY Condition : PEAK_BE_74 3m HORN_91200_1241 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH13-HY Condition : PEAK_74 3m HORN_91200_1241 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site : 03CH13-HY Condition : AVG_BE_54 3m HORN_91200_1241 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH13-HY Condition : AVG_54 3m HORN_91200_1241 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto

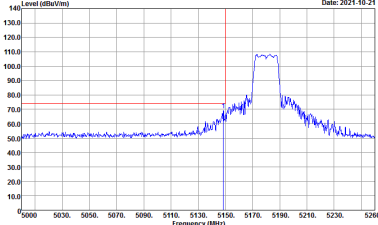
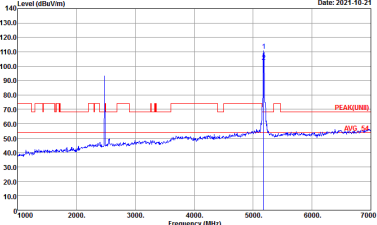
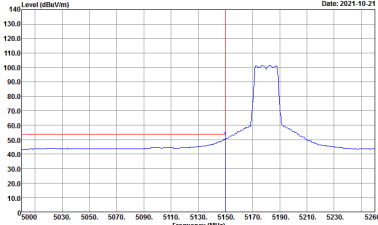


WIFI/BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
Ant.	BLE_CH39 2480MHz	
Simultaneously	Vertical	Fundamental
Peak	 Site : 03CH13-HY Condition : PEAK_BE_74 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH13-HY Condition : PEAK_74 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site : 03CH13-HY Condition : AVG_BE_54 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3.000KHz SWT:Auto	 Site : 03CH13-HY Condition : AVG_54 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3.000KHz SWT:Auto

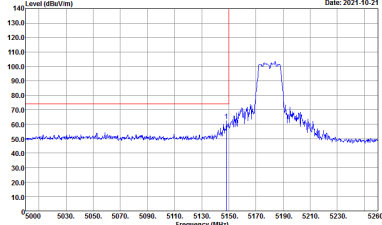
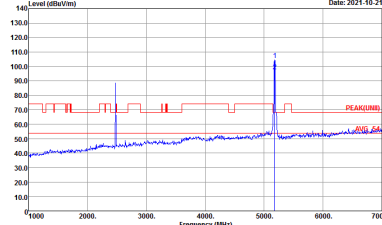
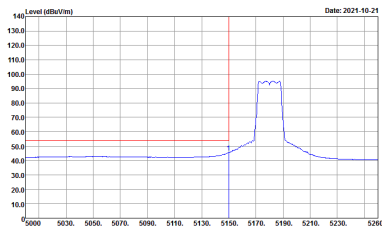


Band 1 - 5150~5250MHz

Ant. 1_11a_Tx_Ch36 (Band Edge @ 3m)

WIFI/BLE	Band 1 5150~5250MHz Band Edge @ 3m	
Ant.	802.11a CH36 5180MHz	
Simultaneously	Horizontal	Fundamental
Peak	 Site : 03CH13-HY Condition : PEAK_BE_74 3m HORN_9120D_1241 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH13-HY Condition : PEAK(UNIT) 3m HORN_9120D_1241 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site : 03CH13-HY Condition : AVG_BE_54 3m HORN_9120D_1241 HORIZONTAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto	Left blank

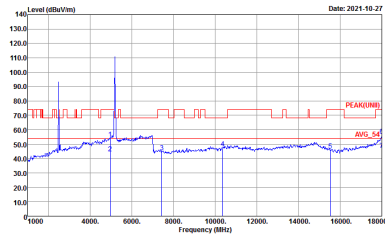
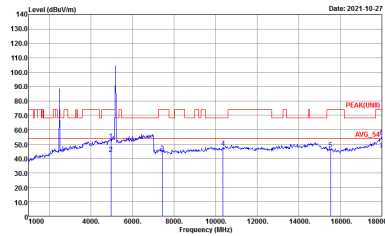


WIFI/BLE	Band 1 5150~5250MHz Band Edge @ 3m	
Ant.	802.11a CH36 5180MHz	
Simultaneously	Vertical	Fundamental
Peak	 Site : 03CH13-HV Condition : PEAK_BE_74 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH13-HV Condition : PEAK(UNIT) 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site : 03CH13-HV Condition : AVG_BE_54 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto	Left blank



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

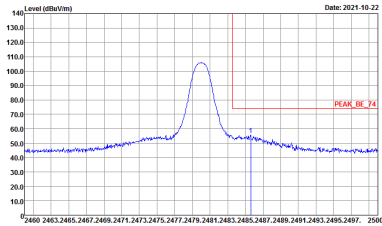
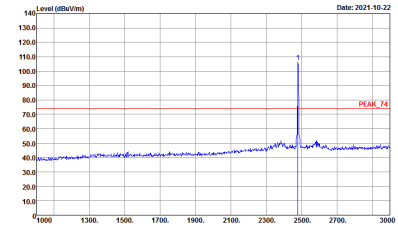
Ant. 2_BLE_Tx_Ch39 + Ant. 1_11a_Tx_Ch36 (Harmonic @ 3m)

WIFI/BLE	2.4GHz 2400~2483.5MHz + Band 1 5150~5250MHz Harmonic @ 3m	
Ant.	BLE_CH39 2480MHz + 802.11a CH36 5180MHz	
Simultaneously	Horizontal	Vertical
Peak Avg.	 Site : 03CH13-HY Condition : PEAK(UNIT) 3m HORN_91200_1241 HORIZONTAL Detector : Peak	 Site : 03CH13-HY Condition : PEAK(UNIT) 3m HORN_91200_1241 VERTICAL Detector : Peak

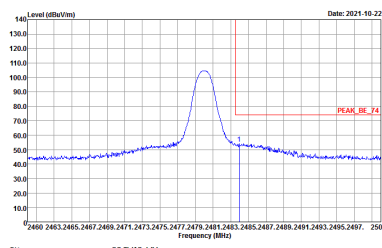
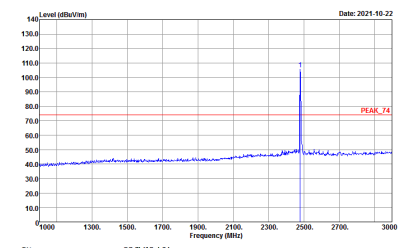


2.4GHz 2400~2483.5MHz

Ant. 1_BT_Tx_Ch78 (Band Edge @ 3m)

WIFI/BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
Ant.	BT CH78 2480MHz	
Simultaneously	Horizontal	Fundamental
Peak	 Site : 03CH13-HY Condition : PEAK_BE_74 3m HORN_91200_1241 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH13-HY Condition : PEAK_74 3m HORN_91200_1241 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto

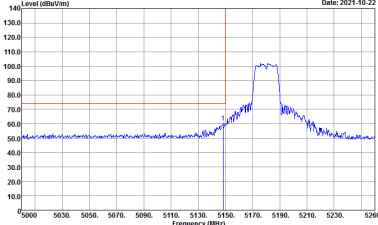
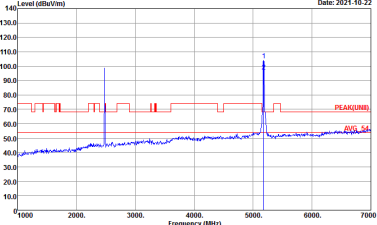
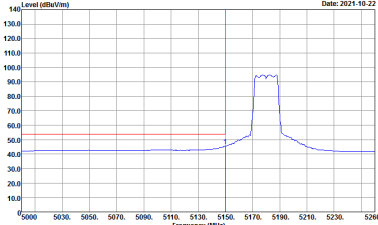


WIFI/BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
Ant.	BT CH78 2480MHz	
Simultaneously	Vertical	Fundamental
Peak	 Site : 03CH13-14V Condition : PEAK_BE_74 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH13-14V Condition : PEAK_74 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto

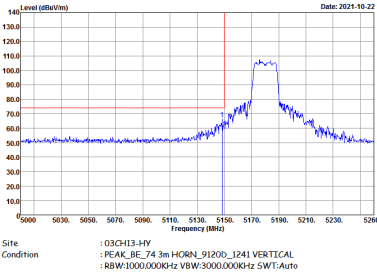
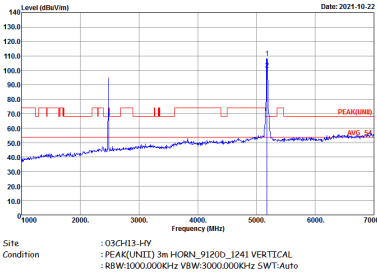
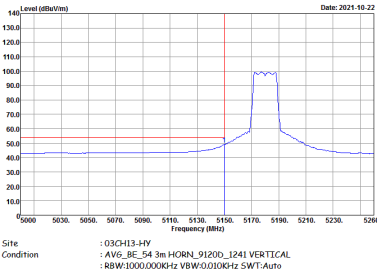


Band 1 - 5150~5250MHz

Ant. 2_11a_Tx_Ch36 (Band Edge @ 3m)

WIFI/BT	Band 1 5150~5250MHz Band Edge @ 3m	
Ant.	802.11a CH36 5180MHz	
Simultaneously	Horizontal	Fundamental
Peak	 Site : 03CH13-HY Condition : PEAK_BE_74 3m HORN_9120D_1241 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH13-HY Condition : PEAK(UNIT) 3m HORN_9120D_1241 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site : 03CH13-HY Condition : AVG_BE_54 3m HORN_9120D_1241 HORIZONTAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto	Left blank

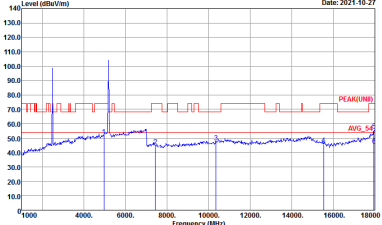
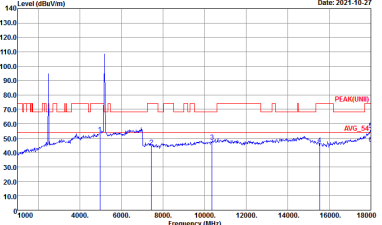


WIFI/BT	Band 1 5150~5250MHz Band Edge @ 3m	
Ant.	802.11a CH36 5180MHz	
Simultaneously	Vertical	Fundamental
Peak	 Site : 03CH13-HY Condition : PEAK_BE_74 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH13-HY Condition : PEAK(FUND) 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site : 03CH13-HY Condition : AVG_BE_54 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	Left blank



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

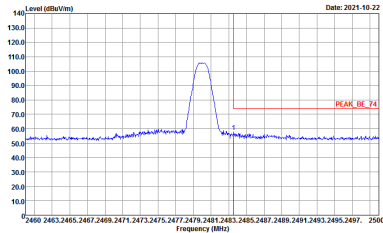
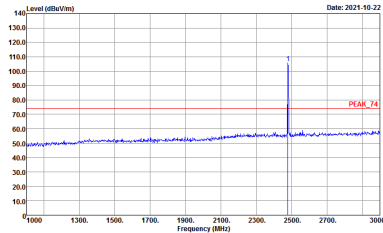
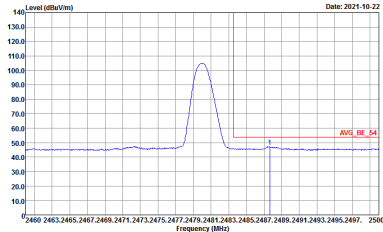
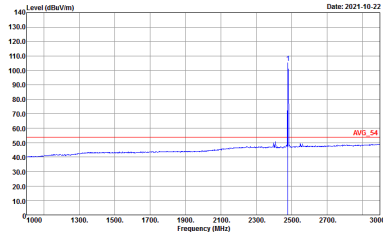
Ant. 1_BT_Tx_Ch78 + Ant. 2_11a_Tx_Ch36 (Harmonic @ 3m)

WIFI/BT	2.4GHz 2400~2483.5MHz + Band 1 5150~5250MHz Harmonic @ 3m	
Ant.	BT CH78 2480MHz + 802.11a CH36 5180MHz	
Simultaneously	Horizontal	Vertical
Peak Avg.	 Site : 03CH13-HY Condition : PEAK(UNIT) 3m HORN_9120D_1241 HORIZONTAL Detector : Peak	 Site : 03CH13-HY Condition : PEAK(UNIT) 3m HORN_9120D_1241 VERTICAL Detector : Peak

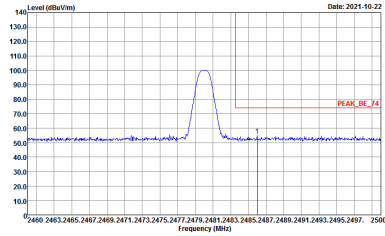
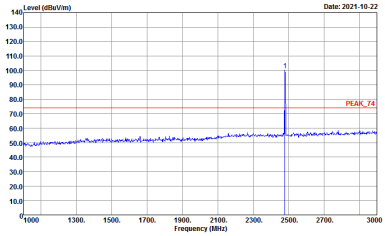
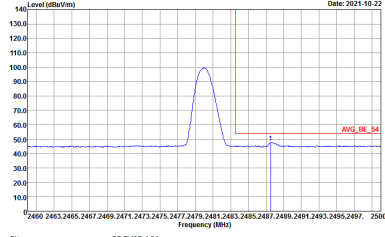
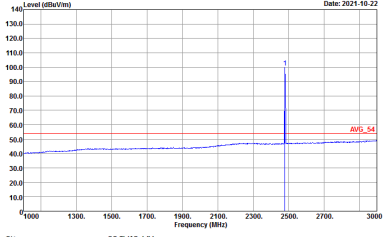


2.4GHz 2400~2483.5MHz

Ant. 1_BLE_Tx_Ch39 (Band Edge @ 3m)

WIFI/BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
Ant.	BLE_CH39 2480MHz	
Simultaneously	Horizontal	Fundamental
Peak	 Site Condition : 03CH13-HY : PEAK_BE_74 3m HORN_91200_1241 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site Condition : 03CH13-HY : PEAK_74 3m HORN_91200_1241 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site Condition : 03CH13-HY : AVG_BE_54 3m HORN_91200_1241 HORIZONTAL : RBW:1000.000KHz VBW:3.000KHz SWT:Auto	 Site Condition : 03CH13-HY : AVG_54 3m HORN_91200_1241 HORIZONTAL : RBW:1000.000KHz VBW:3.000KHz SWT:Auto

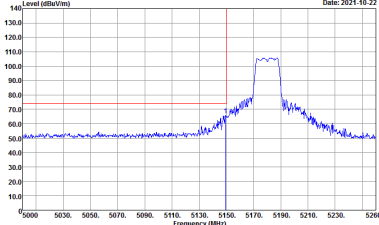
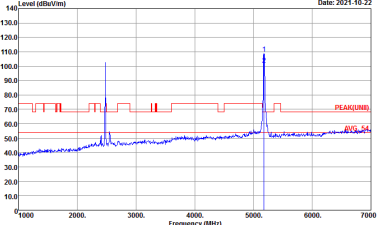
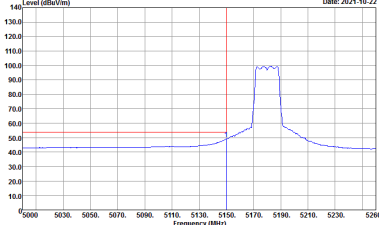


WIFI/BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
Ant.	BLE_CH39 2480MHz	
Simultaneously	Vertical	Fundamental
Peak	 Site : 03CH13-HY Condition : PEAK_BE_74 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH13-HY Condition : PEAK_F4 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site : 03CH13-HY Condition : AVG_BE_54 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3.000KHz SWT:Auto	 Site : 03CH13-HY Condition : AVG_F4 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3.000KHz SWT:Auto

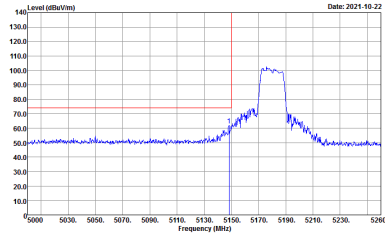
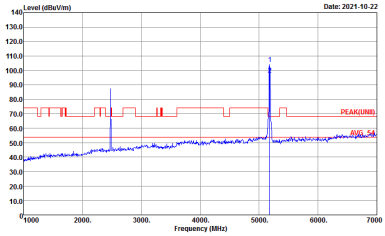
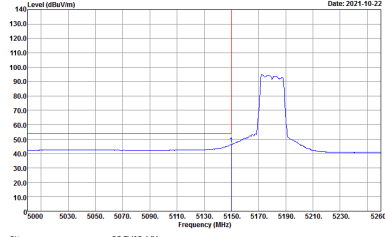


Band 1 - 5150~5250MHz

Ant. 2_11a_Tx_Ch36 (Band Edge @ 3m)

WIFI/BLE	Band 1 5150~5250MHz Band Edge @ 3m	
Ant.	802.11a CH36 5180MHz	
Simultaneously	Horizontal	Fundamental
Peak	 Site : 03CH13-HY Condition : PEAK_BE_74 3m HORN_9120D_1241 HORIZONTAL : RBW:1000.000kHz VBW:3000.000kHz SWT:Auto	 Site : 03CH13-HY Condition : PEAK(UNIT) 3m HORN_9120D_1241 HORIZONTAL : RBW:1000.000kHz VBW:3000.000kHz SWT:Auto
Avg.	 Site : 03CH13-HY Condition : AVG_BE_54 3m HORN_9120D_1241 HORIZONTAL : RBW:1000.000kHz VBW:0.010kHz SWT:Auto	Left blank

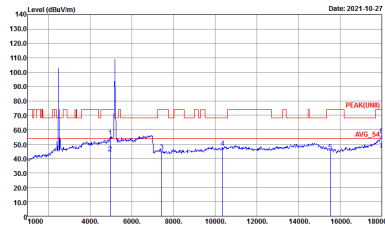
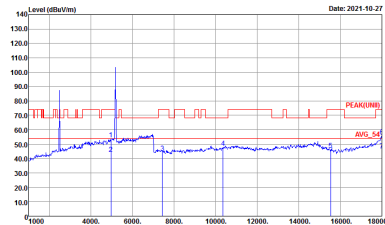


WIFI/BLE	Band 1 5150~5250MHz Band Edge @ 3m	
Ant.	802.11a CH36 5180MHz	
Simultaneously	Vertical	Fundamental
Peak	 Site : 03CH13-HV Condition : PEAK_BE_74 3m HORN_91200_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH13-HV Condition : PEAK(UNIT) 3m HORN_91200_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site : 03CH13-HV Condition : AVG_BE_54 3m HORN_91200_1241 VERTICAL : RBW:1000.000KHz VBW:0.030KHz SWT:Auto	Left blank



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

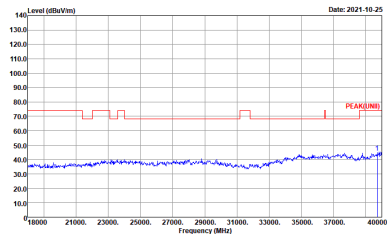
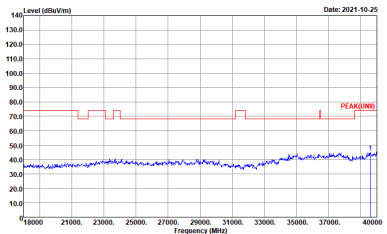
Ant. 1_BLE_Tx_Ch39 + Ant. 2_11a_Tx_Ch36 (Harmonic @ 3m)

WIFI/BLE	2.4GHz 2400~2483.5MHz + Band 1 5150~5250MHz Harmonic @ 3m	
Ant.	BLE_CH39 2480MHz + 802.11a CH36 5180MHz	
Simultaneously	Horizontal	Vertical
Peak Avg.	 Site : 03CH13-HY Condition : PEAK(UNIT) 3m HORN_91200_1241 HORIZONTAL Detector : Peak	 Site : 03CH13-HY Condition : PEAK(UNIT) 3m HORN_91200_1241 VERTICAL Detector : Peak



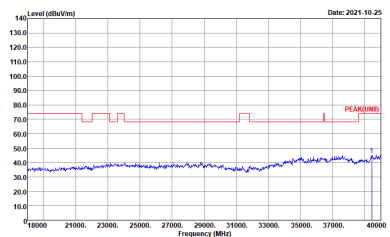
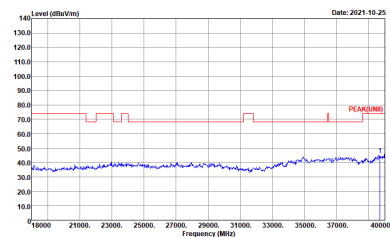
Emission above 18GHz

Ant. 2_BLE_Tx_Ch39 + Ant. 1_11a_Tx_Ch36 (SHF @ 1m)

WIFI/BLE	2.4GHz 2400~2483.5MHz + Band 1 5150~5250MHz	
Ant.	BLE_CH39 2480MHz + 802.11a CH36 5180MHz	
Simultaneously	Horizontal	Vertical
Peak Avg.	 Site : 03CH13-HY Condition : PEAK(UNB) 1m SHF ANT_9170_00994 HORIZONTAL Detector : Peak	 Site : 03CH13-HY Condition : PEAK(UNB) 1m SHF ANT_9170_00994 VERTICAL Detector : Peak



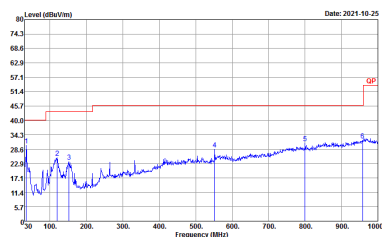
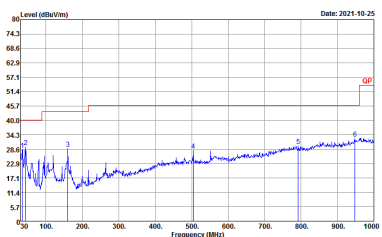
Ant. 1_BT_Tx_Ch78 + Ant. 2_11a_Tx_Ch36 (SHF @ 1m)

WIFI/BT	2.4GHz 2400~2483.5MHz + Band 1 5150~5250MHz	
Ant.	BT Ch78 2480 MHz + 802.11a CH36 5180 MHz	
Simultaneously	Horizontal	Vertical
Peak Avg.	 Site : 03CH13-HY Condition : PEAK(UNIT) 1m SHF ANT_9170_00994 HORIZONTAL Detector : Peak	 Site : 03CH13-HY Condition : PEAK(UNIT) 1m SHF ANT_9170_00994 VERTICAL Detector : Peak



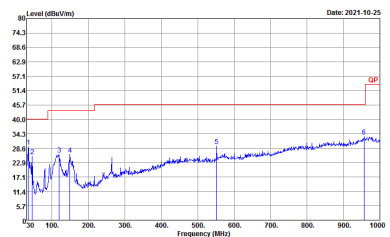
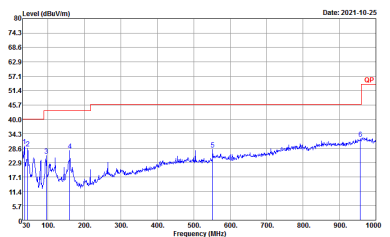
Emission below 1GHz

Ant. 2_BLE_Tx_Ch39 + Ant. 1_11a_Tx_Ch36 (LF)

WIFI/BLE	2.4GHz 2400~2483.5MHz + Band 1 5150~5250MHz	
Ant.	BLE_CH39 2480MHz + 802.11a CH36 5180MHz	
Simultaneously	Horizontal	Vertical
QP / Peak	 Site : 03CH13-HY Condition : QP 3m BIL06_40103 HORIZONTAL Detector : Peak	 Site : 03CH13-HY Condition : QP 3m BIL06_40103 VERTICAL Detector : Peak

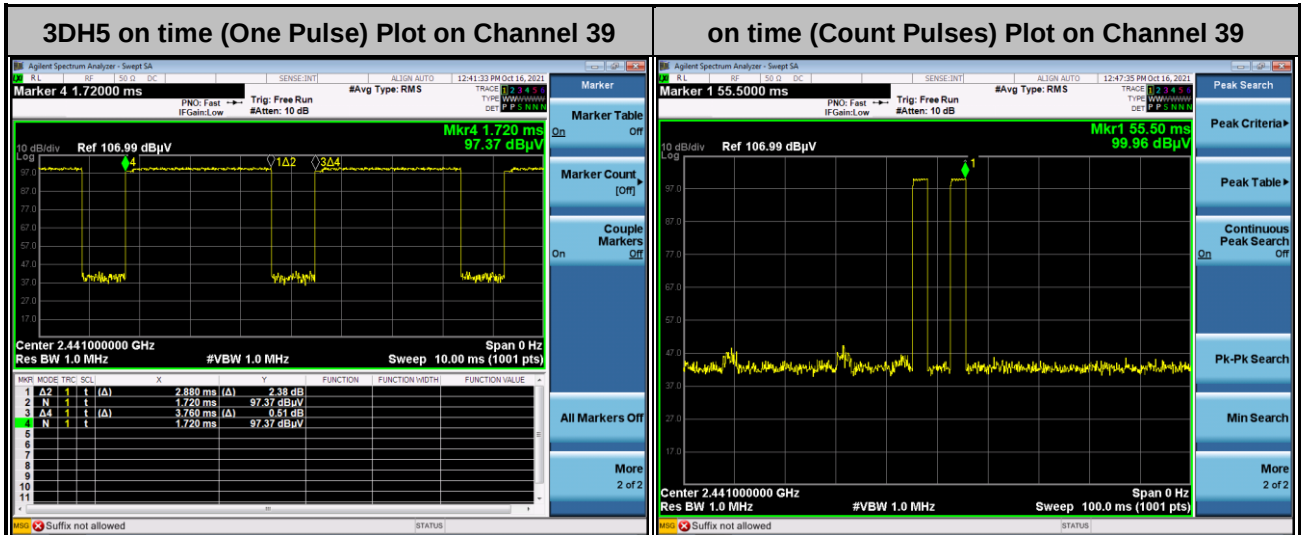


Ant. 1_BT_Tx_Ch78 + Ant. 2_11a_Tx_Ch36 (LF)

WIFI/BT	2.4GHz 2400~2483.5MHz + Band 1 5150~5250MHz	
Ant.	BT Ch78 2480 MHz + 802.11a CH36 5180 MHz	
Simultaneously	Horizontal	Vertical
QP / Peak	 Site : 03CH13-HY Condition : QP 3m B106_40103 HORIZONTAL Detector : Peak	 Site : 03CH13-HY Condition : QP 3m B106_40103 VERTICAL Detector : Peak

Appendix C. Duty Cycle Plots

<Ant. 1>



Note:

1. Worst case Duty cycle = on time/100 milliseconds = $2 \times 2.88 / 100 = 5.76 \%$
2. Worst case Duty cycle correction factor = $20 \times \log(\text{Duty cycle}) = -24.79 \text{ dB}$
3. 3DH5 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

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

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

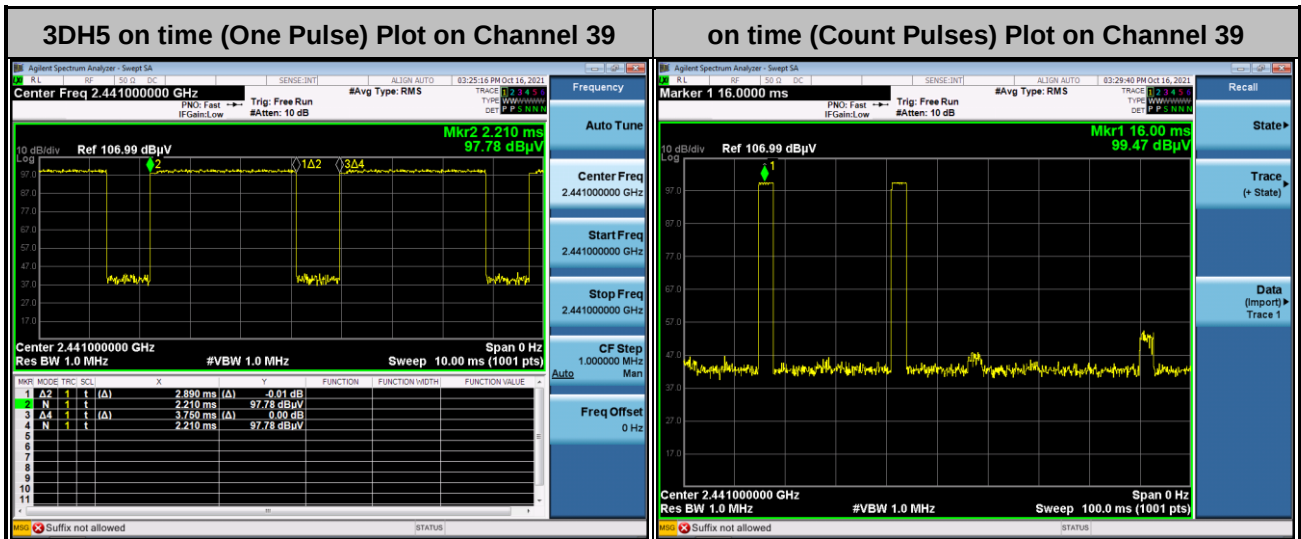
Thus, the maximum possible ON time:

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

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

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

<Ant. 2>



Note:

1. Worst case Duty cycle = on time/100 milliseconds = $2 \times 2.89 / 100 = 5.78 \%$
2. Worst case Duty cycle correction factor = $20 \times \log(\text{Duty cycle}) = -24.76 \text{ dB}$
3. 3DH5 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

$$2.89 \text{ ms} \times 20 \text{ channels} = 57.8 \text{ ms}$$

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. $[100 \text{ ms} / 57.8 \text{ ms}] = 2 \text{ hops}$

Thus, the maximum possible ON time:

$$2.89 \text{ ms} \times 2 = 5.78 \text{ ms}$$

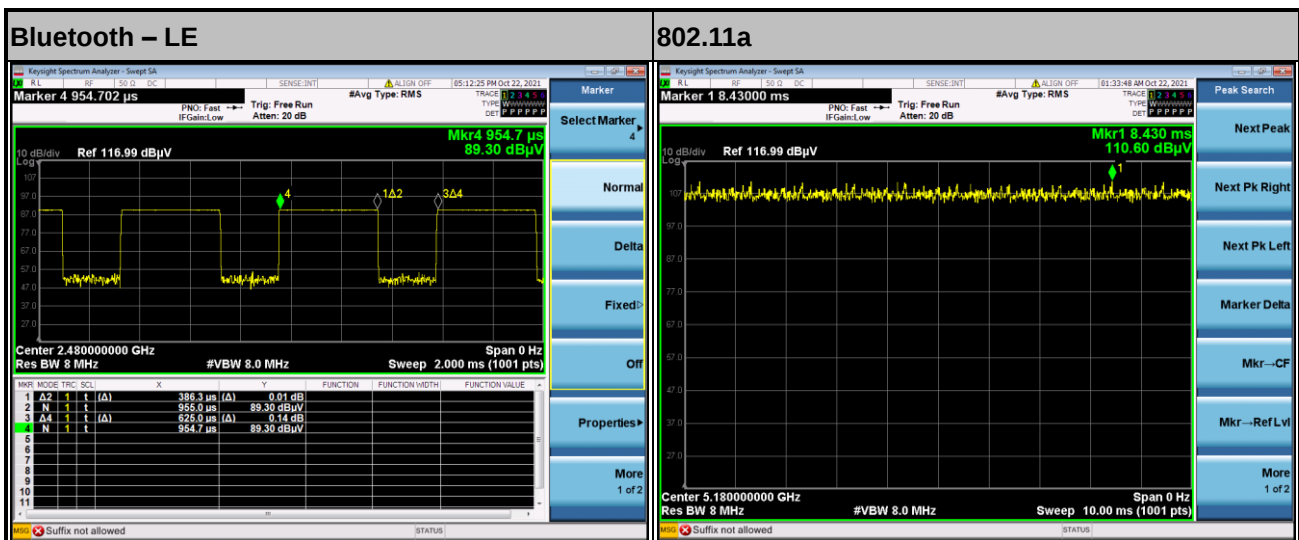
Worst case Duty Cycle Correction factor, which is derived from the maximum possible ON time,

$$20 \times \log(5.78 \text{ ms}/100 \text{ ms}) = -24.76 \text{ dB}$$

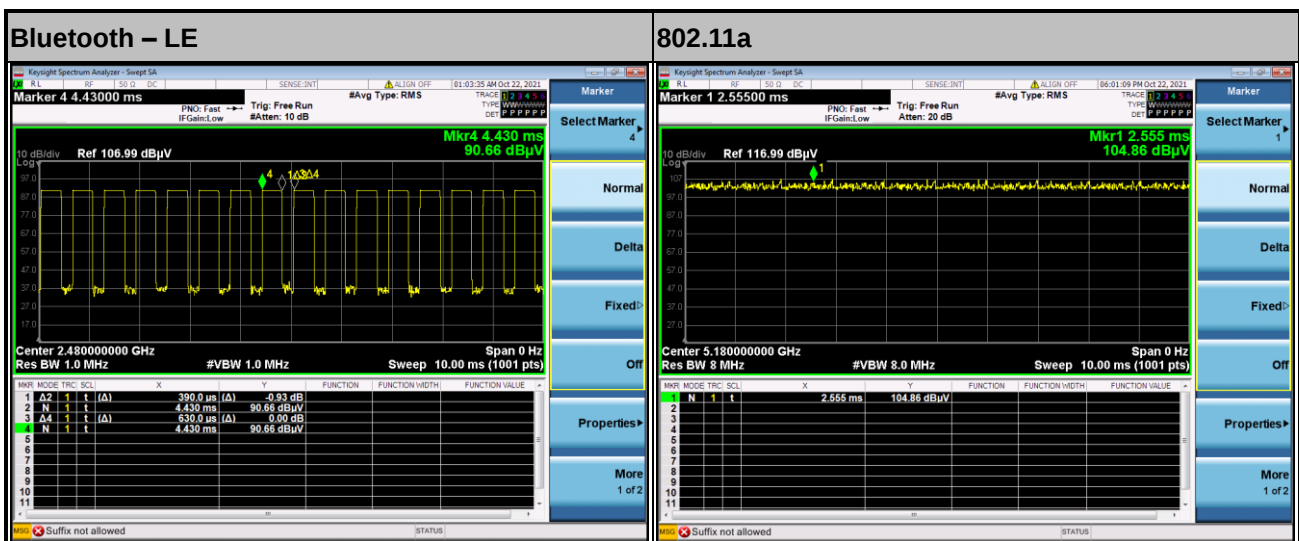


Antenna	Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting
1	Bluetooth – LE	61.76	386	2.59	3Hz
2	Bluetooth – LE	61.90	390	2.56	3Hz
1	5GHz 802.11a	100.00	-	-	10Hz
2	5GHz 802.11a	100.00	-	-	10Hz

<Ant. 1>



<Ant. 2>



—THE END—