FCC CO-LOCATION RADIO TEST REPORT

FCC ID	:	**APYHRO00309**
Equipment	:	**Smart phone**
Brand Name	:	**SHARP**
Model Name	:	**APYHRO00309**
Applicant	:	**SHARP CORPORATION** **1 Takumi-cho, Sakai-ku, Sakai City Osaka, Japan 590-8522**
Manufacturer	:	**SHARP CORPORATION** **1 Takumi-Cho, Sakai-Ku, Sakai-Shi, Osaka 590-8522, Japan**
Standard	:	**FCC PART 15 SUBPART E §15.407**

The product was received on Jan. 14, 2022 and testing was performed from Feb. 08, 2022 to Feb. 25, 2022. 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 from 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	Issue Date
FR211502F	01	Initial issue of report	Mar. 10, 2022
FR211502F	02	Revise Applicant Address	Mar. 18, 2022

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.407(b)	Unwanted Emissions	Pass	3.54 dB under the limit at 2390.000 MHz
3.2	15.203 15.407(a)	Antenna Requirement	Pass	-

Declaration of Conformity:
1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers. It's means measurement values may risk exceeding the limit of regulation standards, if measurement uncertainty is include in test results. 2. The measurement uncertainty please refer to this report "Uncertainty of Evaluation".
Comments and Explanations:
The product specifications of the EUT presented in the report are declared by the manufacturer who shall take full responsibility for the authenticity.

Reviewed by: Keven Cheng

Report Producer: Ruby Zou

1 General Description

1.1 Product Feature of Equipment Under Test

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

Product Feature	
Antenna Type	WWAN <Ant. 0>: Monopole Antenna <Ant. 1>: PIFA Antenna <Ant. 2>: Monopole Antenna WLAN: Loop Antenna Bluetooth: Loop Antenna GPS / Glonass / BDS / Galileo: PIFA Antenna NFC: Loop Antenna FM: Using earphone as antenna

Antenna information		
2400 MHz ~ 2483.5 MHz	Peak Gain (dBi)	-1.36
5150 MHz ~ 5250 MHz	Peak Gain (dBi)	-0.19

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

1.2 Modification of EUT

No modifications made to the EUT during the testing.

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.**
	03CH16-HY

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

FCC designation No.: TW3786

1.4 Applicable Standards

According to the specifications declared by 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.
- ANSI C63.10-2013

Remark:

1. All the test items were validated and recorded in accordance with the standards without any modification during the testing.
2. The TAF code is not including all the FCC KDB listed without accreditation.
3. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

2 Test Configuration of Equipment Under Test

a. 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). For radiated measurement, 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 as worst plane.

2.1 Carrier Frequency and Channel

2400-2483.5 MHz			
Bluetooth – LE		802.11n	
Channel	Channel	Channel	Freq. (MHz)
39	11	01	2412

5470-5725 MHz 802.11ac VHT80	
Channel	Freq. (MHz)
106	5530

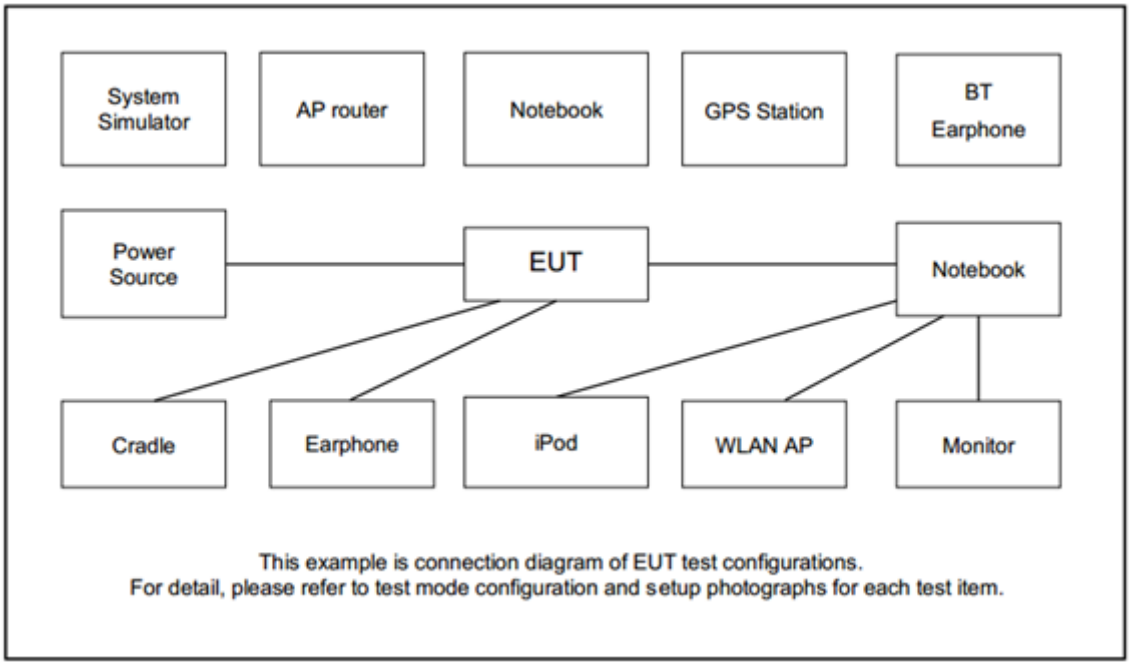
2.2 Test Mode

The final test modes consider the modulation and the worst data rates as shown in the table below.

<Co-Location>

Modulation	Data Rate
Bluetooth – LE + WLAN 5GHz 802.11ac VHT80 for Ant. 4 + LTE Band 7 for Ant. 1	**2 Mbps + MCS0 + QPSK**
WLAN 2.4GHz 802.11n HT20 for Ant. 4 + LTE Band 7 for Ant. 1	**MCS0 + QPSK**

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.	System Simulator	R&S	CMW 500	NA	N/A	Unshielded, 1.8 m
2.	Earphone	Nokia	WH-108	N/A	Unshielded, 1.5m	N/A

2.5 EUT Operation Test Setup

The RF test items, utility “QRCT v3.0.298” 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.

3.1.1 Limit of Unwanted Emissions

(1) Unwanted spurious emissions falls 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.

$$E=\frac{1000000\sqrt{30P}}{3}$$ μV/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

Please refer to the measuring equipment list in 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 ≥ 3 MHz
   - Detector = Peak
   - Sweep time = auto
   - Trace mode = max hold

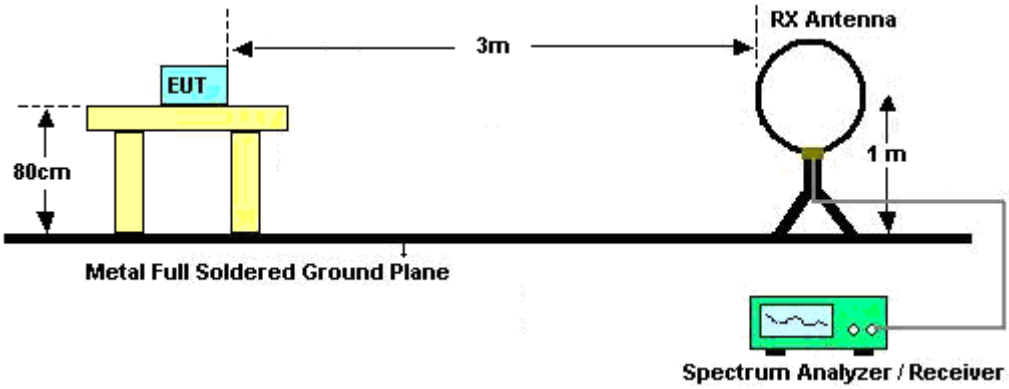
   (3) Procedures for Average Unwanted Emissions Measurements Above 1000 MHz

   - RBW = 1 MHz
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 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.

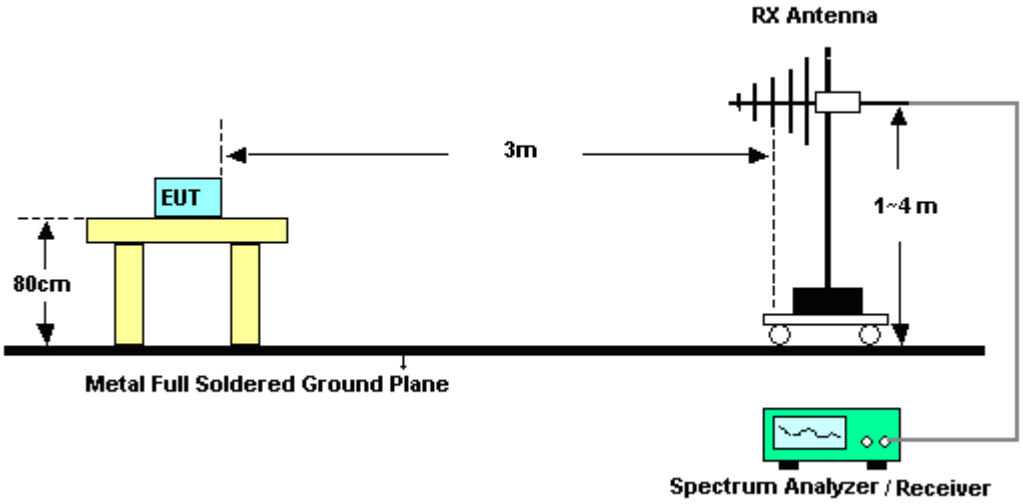
2. The EUT is placed on a turntable with 0.8 meter for frequency below 1 GHz and 1.5 meter for frequency above 1 GHz respectively above ground.
3. The EUT is set 3 meters away from the receiving antenna which is mounted on the top of a variable height antenna tower.
4. The antenna is a broadband antenna 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 is 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 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading. When there is no suspected emission found and the emission level is with at least 6 dB margin against QP limit line, the position is marked as "-".
7. Radiated testing above 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees 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 6 dB margin against average limit line, the position is marked as "-".

3.1.4 Test Setup

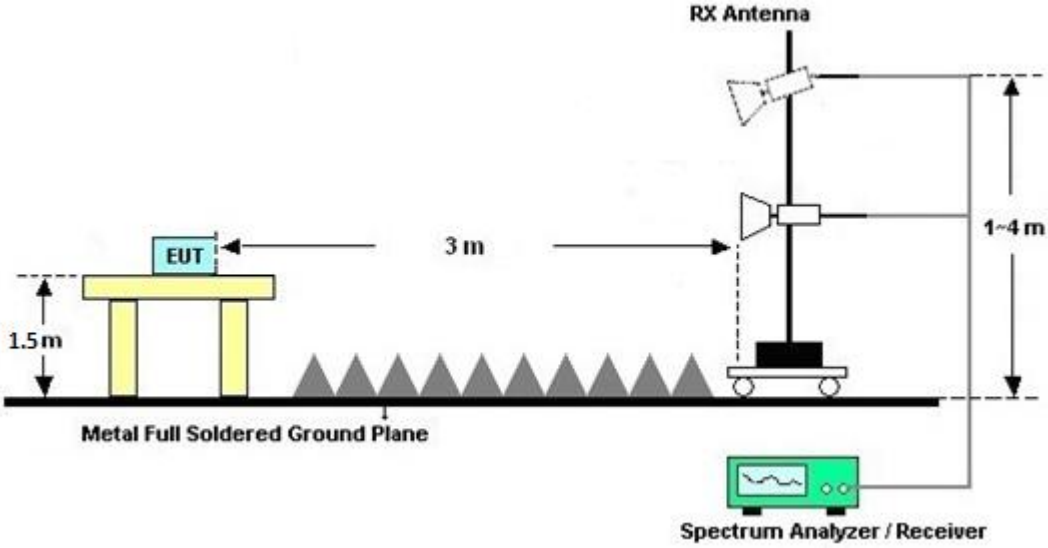
For radiated emissions below 30MHz



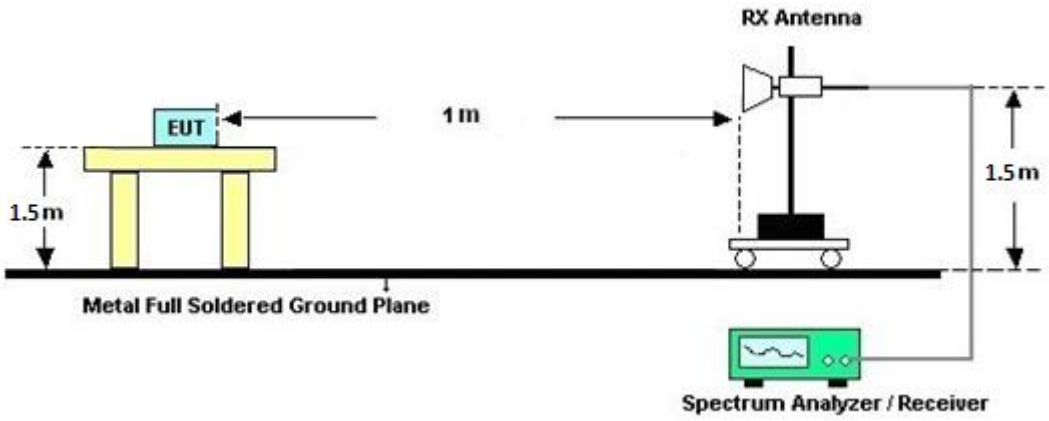
For radiated emissions from 30MHz to 1GHz



For radiated test from 1GHz to 18GHz



For radiated test above 18GHz



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

The low frequency, which starts from 9 kHz to 30 MHz, is pre-scanned and the result which is 20 dB lower than the limit line is 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	100488	9 kHz~30 MHz	Sep. 07, 2021	Feb. 08, 2022~ Feb. 25, 2022	Sep. 06, 2022	Radiation (03CH16-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00802N1D01N-06	47020 & 06	30MHz to 1GHz	Oct. 09, 2021	Feb. 08, 2022~ Feb. 25, 2022	Oct. 08, 2022	Radiation (03CH16-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-02114	1G~18GHz	Aug. 04, 2021	Feb. 08, 2022~ Feb. 25, 2022	Aug. 03, 2022	Radiation (03CH16-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	00993	18GHz ~40GHz	Nov. 30, 2021	Feb. 08, 2022~ Feb. 25, 2022	Nov. 29, 2022	Radiation (03CH16-HY)
Amplifier	SONOMA	310N	371607	9kHz~1G	Jul. 05. 2021	Feb. 08, 2022~ Feb. 25, 2022	Jul. 04. 2022	Radiation (03CH16-HY)
Amplifier	EMCI	EMC051845SE	980729	1-18GHz	Jul. 09, 2021	Feb. 08, 2022~ Feb. 25, 2022	Jul. 08, 2022	Radiation (03CH16-HY)
Preamplifier	EMEC	EM18G40G	060801	18GHz~40GHz	Jun. 22, 2021	Feb. 08, 2022~ Feb. 25, 2022	Jun. 21, 2022	Radiation (03CH16-HY)
Preamplifier	Keysight	83017A	MY53270264	1GHz~26.5GHz	Dec. 09,.2021	Feb. 08, 2022~ Feb. 25, 2022	Dec. 08,.2022	Radiation (03CH16-HY)
EMI Test Receiver	Keysight	N9038A(MXE)	MY57290111	3Hz~26.5GHz	Dec.15,.2021	Feb. 08, 2022~ Feb. 25, 2022	Dec. 14,.2022	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY11680/4PE	NA	Aug. 28, 2021	Feb. 08, 2022~ Feb. 25, 2022	Aug. 27, 2022	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY11688/4PE	NA	Aug. 28, 2021	Feb. 08, 2022~ Feb. 25, 2022	Aug. 27, 2022	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	EC-A5-300-5757	NA	Aug. 28, 2021	Feb. 08, 2022~ Feb. 25, 2022	Aug. 27, 2022	Radiation (03CH16-HY)
Software	Audix	E3 6.2009-8-24	RK-001136	N/A	N/A	Feb. 08, 2022~ Feb. 25, 2022	N/A	Radiation (03CH16-HY)
Controller	ChainTek	3000-1	N/A	Control Turn table & Ant Mast	N/A	Feb. 08, 2022~ Feb. 25, 2022	N/A	Radiation (03CH16-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Feb. 08, 2022~ Feb. 25, 2022	N/A	Radiation (03CH16-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Feb. 08, 2022~ Feb. 25, 2022	N/A	Radiation (03CH16-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))	**5.8 dB**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.2 dB**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.8 dB**

Appendix A. Radiated Spurious Emission

Test Engineer :	Andy Yang, Karl Hou and Wilson Wu	Temperature :	20~25°C
		Relative Humidity :	50~65%

2.4GHz 2400~2483.5MHz + 5GHz Band 3 5470~5725MHz

BLE (2M)_CH39_Tx + 802.11ac VHT80_CH106_Tx + LTE Band 7 CH21350 Link

(Band Edge @ 3m)

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)
BLE CH 39 2480MHz	*	2480	101.02	-	-	84.91	27.78	18.38	30.05	355	349	P	H
	*	2480	99.78	-	-	83.67	27.78	18.38	30.05	355	349	A	H
		2495.88	57.14	-16.86	74	40.89	27.88	18.41	30.04	355	349	P	H
		2494.6	48.88	-5.12	54	32.64	27.87	18.41	30.04	355	349	A	H
													H
													H
	*	2480	99.92	-	-	83.81	27.78	18.38	30.05	360	86	P	V
	*	2480	98.56	-	-	82.45	27.78	18.38	30.05	360	86	A	V
		2493.32	57.89	-16.11	74	41.66	27.86	18.41	30.04	360	86	P	V
		2493.52	49.11	-4.89	54	32.88	27.86	18.41	30.04	360	86	A	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

BLE (2M)_CH39_Tx + 802.11ac VHT80_CH106_Tx + LTE Band 7 CH21350 Link

(Band Edge @ 3m)

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)
802.11ac VHT80 CH 106 5530MHz		5459.92	60.59	-13.41	74	44.45	32.88	12.82	29.56	100	120	P	H
		5466.88	60.75	-7.45	68.2	44.62	32.87	12.82	29.56	100	120	P	H
		5458	50.04	-3.96	54	33.9	32.88	12.82	29.56	100	120	A	H
	*	5530	95.81	-	-	79.74	32.8	12.85	29.58	100	120	P	H
	*	5530	104.42	-	-	88.35	32.8	12.85	29.58	100	120	A	H
		5745.47	54.94	-13.26	68.2	38.02	33.57	12.96	29.61	100	120	P	H
		5455.12	54.83	-19.17	74	38.69	32.89	12.81	29.56	100	22	P	V
		5470	56.29	-11.91	68.2	40.17	32.86	12.82	29.56	100	22	P	V
		5458.96	47.37	-6.63	54	31.23	32.88	12.82	29.56	100	22	A	V
	*	5530	91.78	-	-	75.71	32.8	12.85	29.58	100	22	P	V
	*	5530	84.77	-	-	68.7	32.8	12.85	29.58	100	22	A	V
		5743.895	54.13	-14.07	68.2	37.22	33.56	12.96	29.61	100	22	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

BLE (2M)_CH39_Tx + 802.11ac VHT80_CH106_Tx + LTE Band 7 CH21350 Link

(Harmonic @ 3m)

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)
BLE CH 39 2480MHz + 802.11ac VHT80 CH 106 5530MHz		4960	56.58	-17.42	74	39.64	33.02	13.33	29.41	100	106	P	H
		4960	44.92	-9.08	54	27.98	33.02	13.33	29.41	100	106	A	H
		7440	45.18	-28.82	74	48.18	36.22	16.45	55.67	-	-	P	H
		11060	47.19	-26.81	74	44.58	38.9	19.04	55.33	-	-	P	H
		16590	46.62	-21.58	68.2	39.06	38.32	24.16	54.92	-	-	P	H
													H
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													H
		4960	56.3	-17.7	74	39.36	33.02	14.85	29.41	100	68	P	V
		4960	44.44	-9.56	54	27.5	33.02	14.85	29.41	100	68	A	V
		7440	44.98	-29.02	74	47.98	36.22	17.34	55.67	-	-	P	V
		11060	46.08	-27.92	74	43.47	38.9	19.38	55.33	-	-	P	V
		16590	47.15	-21.05	68.2	39.59	38.32	24.61	54.92	-	-	P	V
													V
													V
													V
													V
													V
													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

WLAN 2.4G 802.11n HT20_CH01 Tx + LTE Band 7 CH20850 Link

(Band Edge @ 3m)

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)
802.11n HT20 CH 01 2412MHz		2389.695	59.87	-14.13	74	44.36	27.36	18.22	30.07	100	106	P	H
		2390	50.46	-3.54	54	34.95	27.36	18.22	30.07	100	106	A	H
	*	2412	107.57	-	-	91.93	27.45	18.26	30.07	100	106	P	H
	*	2412	99.83	-	-	84.19	27.45	18.26	30.07	100	106	A	H
		2389.8	58.04	-15.96	74	42.53	27.36	18.22	30.07	300	68	P	V
		2390	47.87	-6.13	54	32.36	27.36	18.22	30.07	300	68	A	V
	*	2412	104.92	-	-	89.28	27.45	18.26	30.07	300	68	P	V
	*	2412	96.85	-	-	81.21	27.45	18.26	30.07	300	68	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

WLAN 2.4G 802.11n HT20_CH01 Tx + LTE Band 7 CH20850 Link

(Harmonic @ 3m)

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)
802.11n HT20 CH 01 2412MHz		4824	45.18	-28.82	74	55.66	32.45	12.34	55.27	-	-	P	H
												P	H
												P	H
												P	H
												P	H
												A	H
												P	H
												A	H
												P	H
												A	H
		4824	41.75	-32.25	74	52.23	32.45	12.34	55.27	-	-	P	V
												P	V
												P	V
												P	V
												P	V
												A	V
												P	V
												A	V
												P	V
												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 below 1GHz

BLE (2M)_CH39_Tx + 802.11ac VHT80_CH106_Tx + LTE Band 7 CH21350 Link

(LF)

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)
BLE CH 39 2480MHz + 802.11ac VHT80 CH 106 5530MHz		61.04	25.8	-14.2	40	44.76	11.93	1.4	32.29	-	-	P	H
		125.06	26.97	-16.53	43.5	39.72	17.49	2.03	32.27	-	-	P	H
		187.14	24.52	-18.98	43.5	39.49	14.83	2.43	32.23	-	-	P	H
		486.87	25.55	-20.45	46	30.27	23.8	3.85	32.37	-	-	P	H
		793.39	33.03	-12.97	46	32.42	27.99	4.88	32.26	-	-	P	H
		950.53	34.66	-11.34	46	29.86	30.57	5.43	31.2	-	-	P	H
													H
													H
													H
													H
		34.85	31.78	-8.22	40	40.95	22.27	0.87	32.31	-	-	P	V
		97.9	31.34	-12.16	43.5	46.36	15.56	1.72	32.3	-	-	P	V
		184.23	24.37	-19.13	43.5	39.31	14.88	2.41	32.23	-	-	P	V
		617.82	28.03	-17.97	46	30.34	25.88	4.36	32.55	-	-	P	V
		765.26	30.84	-15.16	46	30.28	28.09	4.78	32.31	-	-	P	V
		936.95	34.52	-11.48	46	30.33	30.11	5.37	31.29	-	-	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.												

WLAN 2.4G 802.11n HT20_CH01 Tx + LTE Band 7 CH20850 Link

(LF)

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)
802.11n HT20 CH 01 2412MHz		64.92	24.14	-15.86	40	42.98	12	1.43	32.27	-	-	P	H
		97.9	23.61	-19.89	43.5	38.63	15.56	1.72	32.3	-	-	P	H
		187.14	23.55	-19.95	43.5	38.52	14.83	2.43	32.23	-	-	P	H
		285.11	23.62	-22.38	46	33.82	19.05	3.03	32.28	-	-	P	H
		735.19	29.37	-16.63	46	29.18	27.87	4.67	32.35	-	-	P	H
		944.71	34.72	-11.28	46	30.2	30.36	5.4	31.24	-	-	P	H
													H
													H
													H
													H
		34.85	31.65	-8.35	40	40.82	22.27	0.87	32.31	-	-	P	V
		96.93	30.91	-12.59	43.5	45.96	15.54	1.72	32.31	-	-	P	V
		402.48	22.92	-23.08	46	29.67	22.15	3.49	32.39	-	-	P	V
		650.8	28.25	-17.75	46	30.07	26.24	4.43	32.49	-	-	P	V
		860.32	32.42	-13.58	46	30.15	29.01	5.13	31.87	-	-	P	V
		946.65	34.3	-11.7	46	29.67	30.43	5.42	31.22	-	-	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.

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **over limit** line.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

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

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	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 CH 01 2412MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. 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 :	Andy Yang, Karl Hou and Wilson Wu	**Temperature :**	20~25°C
		Relative Humidity :	50~65%

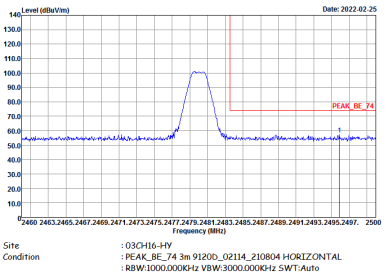
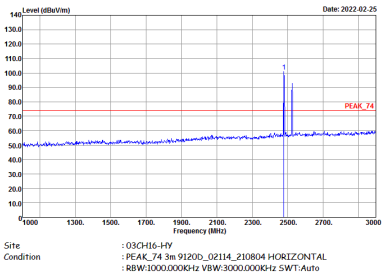
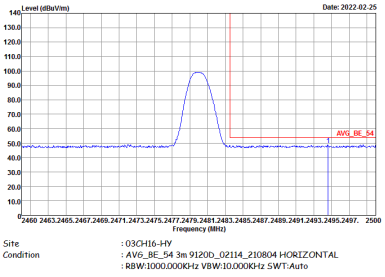
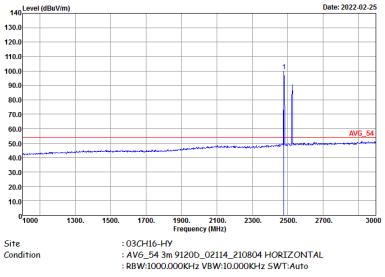
Note symbol

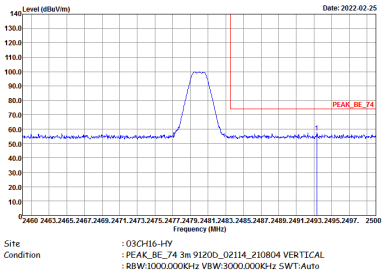
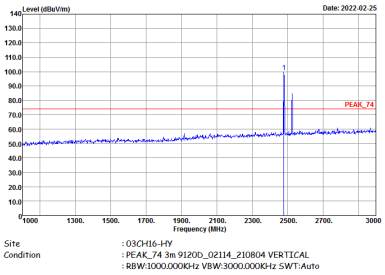
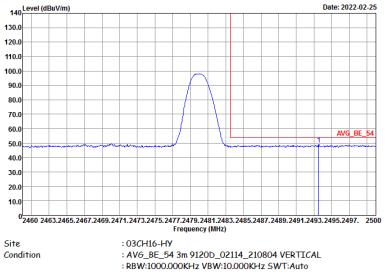
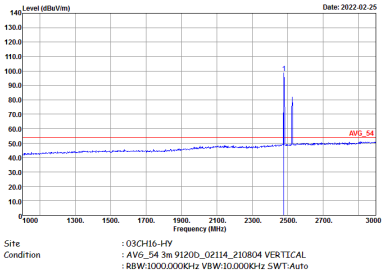
-L	**Low channel location**
-R	**High channel location**

2.4GHz 2400~2483.5MHz + 5GHz Band 3 5470~5725MHz

BLE (2M)_CH39_Tx + 802.11ac VHT80_CH106_Tx + LTE Band 7 CH21350 Link

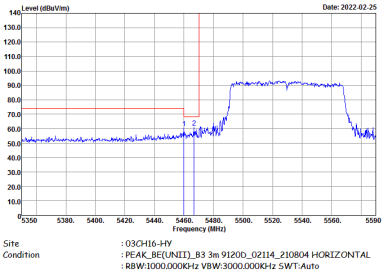
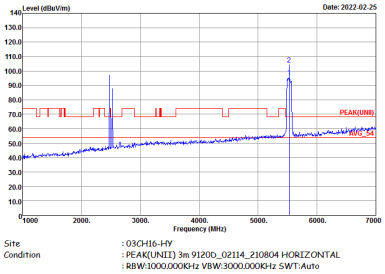
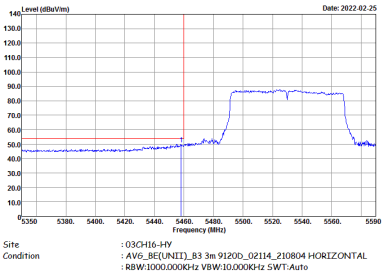
(Band Edge @ 3m)

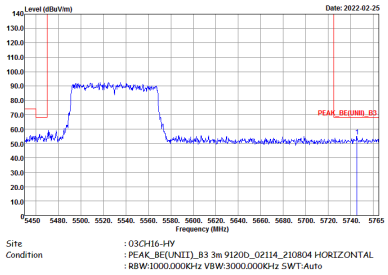
ANT	BLE_CH39 2480MHz	
Simultaneously	Horizontal	Fundamental
Peak		
Avg.		

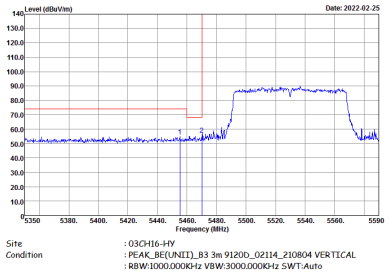
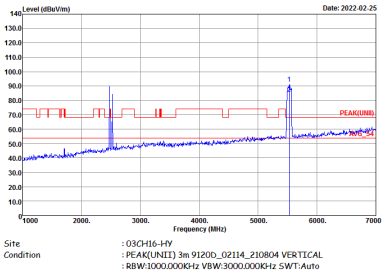
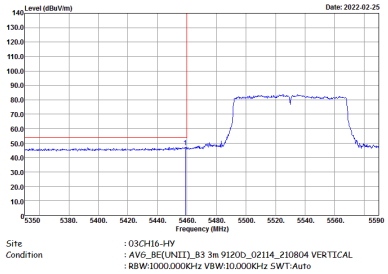
ANT	BLE_CH39 2480MHz	
Simultaneously	Vertical	Fundamental
Peak		
Avg.		

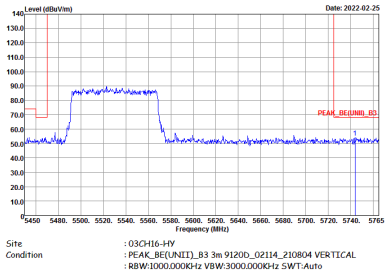
BLE (2M)_CH39_Tx + 802.11ac VHT80_CH106_Tx + LTE Band 7 CH21350 Link

(Band Edge @ 3m)

ANT	802.11ac VHT80 CH106 5530MHz - L	
Simultaneously	Horizontal	Fundamental
Peak		
Avg.		Left blank

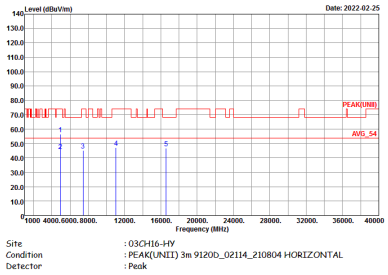
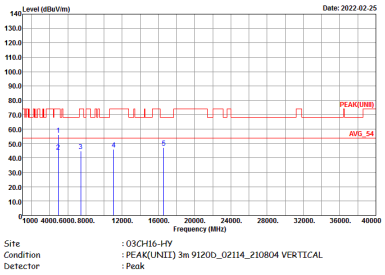
ANT	802.11ac VHT80 CH106 5530MHz - R	
Simultaneously	Horizontal	Fundamental
Peak		Left blank

ANT	802.11ac VHT80 CH106 5530MHz - L	
Simultaneously	Vertical	Fundamental
Peak		
Avg.		Left blank

ANT	802.11ac VHT80 CH106 5530MHz - R	
Simultaneously	Vertical	Fundamental
Peak		Left blank

BLE (2M)_CH39_Tx + 802.11ac VHT80_CH106_Tx + LTE Band 7 CH21350 Link

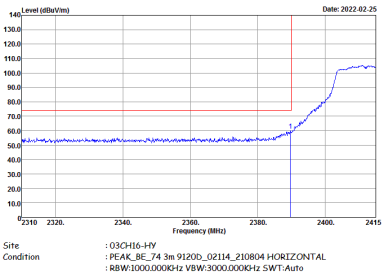
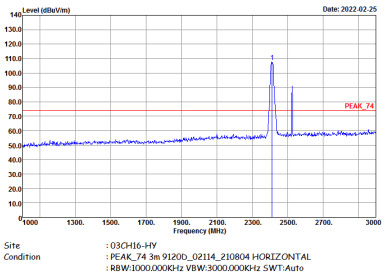
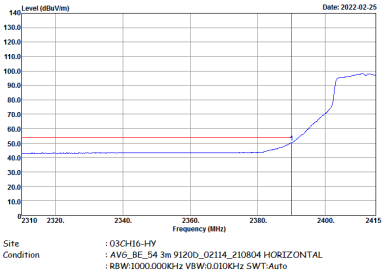
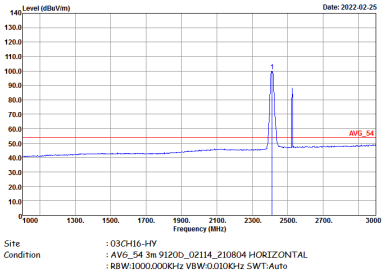
(Harmonic @ 3m)

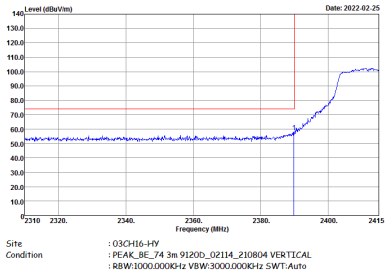
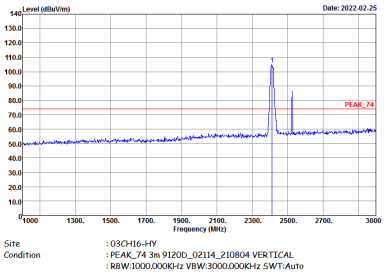
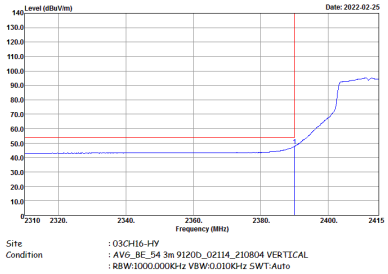
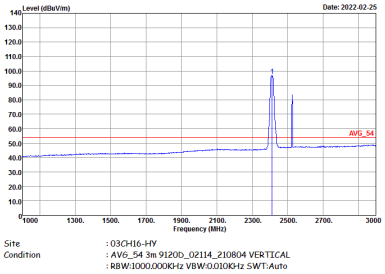
ANT	BLE(2M)_CH39_Tx + 5G 802.11ac VHT80_CH106_Tx + LTE Band 7 CH21350	
Simultaneously	Horizontal	Vertical
Peak Avg.		

2.4GHz 2400~2483.5MHz

WLAN 2.4G 802.11n HT20_CH01 Tx + LTE Band 7 CH20850 Link

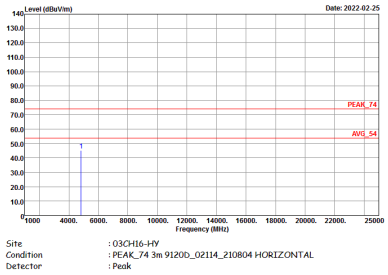
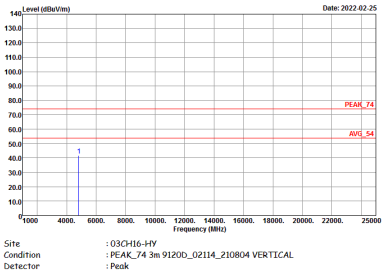
(Band Edge @ 3m)

ANT	802.11n HT20 CH01 2412MHz	
Simultaneously	Horizontal	Fundamental
Peak		
Avg.		

ANT	802.11n HT20 CH01 2412MHz	
Simultaneously	Vertical	Fundamental
Peak		
Avg.		

WLAN 2.4G 802.11n HT20_CH01 Tx + LTE Band 7 CH20850 Link

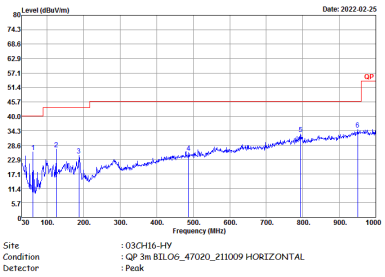
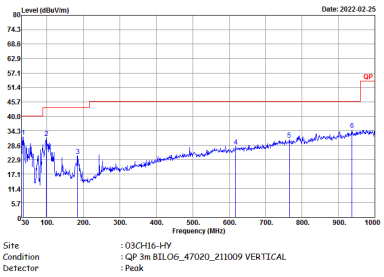
(Harmonic @ 3m)

ANT	WLAN 2.4G 802.11n HT20_CH01_Tx + LTE Band 7 CH20850	
Simultaneously	Horizontal	Vertical
Peak Avg.		

Emission below 1GHz

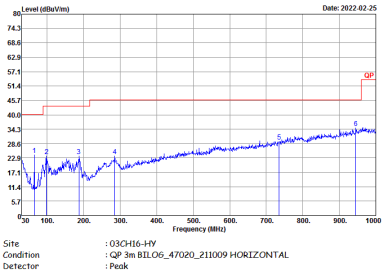
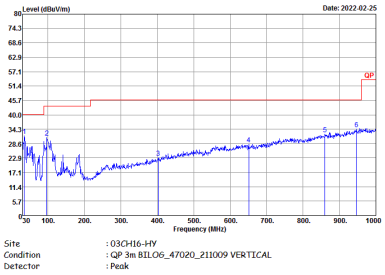
BLE (2M)_CH39_Tx + 802.11ac VHT80_CH106_Tx + LTE Band 7 CH21350 Link

(LF)

ANT	BLE(2M)_CH39_Tx + 5G 802.11ac VHT80_CH106_Tx + LTE Band 7 CH21350	
Simultaneously	Horizontal	Vertical
QP / Peak		

WLAN 2.4G 802.11n HT20_CH01 Tx + LTE Band 7 CH20850 Link

(LF)

ANT	WLAN 2.4G 802.11n HT20_CH01_Tx + LTE Band 7 CH20850	
Simultaneously	Horizontal	Vertical
QP / Peak		

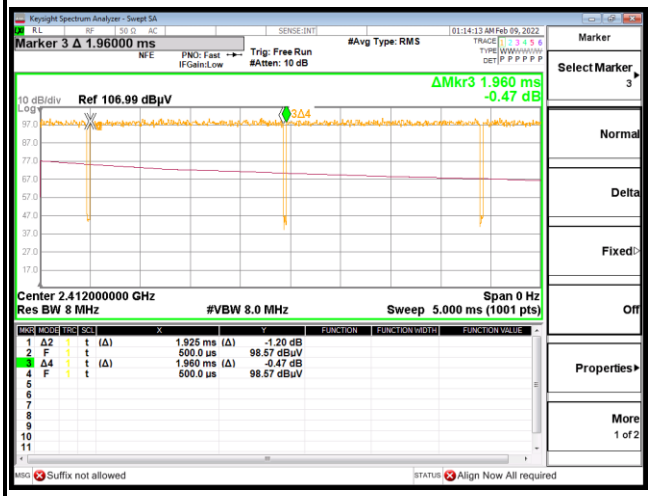
Appendix C. Duty Cycle Plots

Antenna	Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting
4	Bluetooth - LE for 2Mbps	32.91	206	4.85	10kHz
4	2.4GHz 802.11n HT20	98.21	1925	0.52	10Hz
4	5GHz 802.11ac VHT80	92.77	462	2.16	3kHz

Bluetooth - LE for 2Mbps

<Ant. 4>

802.11n HT20



802.11ac VHT80