

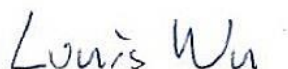


FCC CO-LOCATION RADIO TEST REPORT

FCC ID : UZ7WCMTB
Equipment : Touch Computer
Brand Name : Zebra
Model Name : WCMTB
Applicant : Zebra Technologies Corporation
1 Zebra Plaza, Holtsville, NY 11742
Manufacturer : Zebra Technologies Corporation
1 Zebra Plaza, Holtsville, NY 11742
Standard : FCC Part 15 Subpart E §15.407

The product was received on Feb. 16, 2023 and testing was performed from Mar. 30, 2023 to Mar. 31, 2023. 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.



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.)



Table of Contents

History of this test report.....	3
Summary of Test Result.....	4
1 General Description	5
1.1 Product Feature of Equipment Under Test.....	5
1.2 Product Specification of Equipment Under Test.....	6
1.3 Modification of EUT	6
1.4 Testing Location	6
1.5 Applicable Standards.....	7
2 Test Configuration of Equipment Under Test	8
2.1 Carrier Frequency and Channel	8
2.2 Test Mode.....	8
2.3 Connection Diagram of Test System.....	9
2.4 Support Unit used in test configuration and system	10
2.5 EUT Operation Test Setup	10
3 Test Result	11
3.1 Unwanted Emissions Measurement.....	11
3.2 Antenna Requirements.....	15
4 List of Measuring Equipment.....	16
5 Uncertainty of Evaluation	17
Appendix A. Radiated Spurious Emission	
Appendix B. Radiated Spurious Emission Plots	
Appendix C. Duty Cycle Plots	
Appendix D. Setup Photographs	



History of this test report

Report No.	Version	Description	Issue Date
FR311909G	01	Initial issue of report	Apr. 07, 2023

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.407(b)	Unwanted Emissions	Pass	1.25 dB under the limit at 5469.840 MHz
3.2	15.203 15.407(a)	Antenna Requirement	Pass	-

Conformity Assessment Condition:

1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacture who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
2. Please refer to the section " Uncertainty of Evaluation " for measurement uncertainty.

Disclaimer:

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.

Reviewed by: Keven Cheng

Report Producer: Clio Lo

1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	Touch Computer
Brand Name	Zebra
Model Name	WCMTB
Sample 1	Scanner(SE4710)
Sample 2	Scanner(SE5500)
FCC ID	UZ7WCMTB
EUT supports Radios application	GSM/EGPRS/WCDMA/HSPA/LTE/5G NR/NFC/GNSS WLAN 11a/b/g/n HT20/HT40 WLAN 11ac VHT20/VHT40/VHT80/VHT160 WLAN 11ax HE20/HE40/HE80/HE160 Bluetooth BR/EDR/LE
HW Version	DV
SW Version	13-09-16.00-TG-U00-STD-ATH-04
FW Version	FUSION_QA_4_1.0.0.017_T
MFD	16MAR23
EUT Stage	Identical Prototype

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

Specification of Accessories				
Battery 1 Standard Battery (3800mAh)	Brand Name	Zebra	Model Number	BT-000473

Support Unit used in test configuration and system				
Battery 2 Standard BLE Beacon Battery (3800mAh)	Brand Name	Zebra	Part Number	BT-000473B
Battery 3 Extended Battery (5200mAh)	Brand Name	Zebra	Part Number	BT-000473E
Adapter USB Wall Charger	Brand Name	Zebra	Part Number	PWR-WUA5V12W0US
Earphone 1 3.5mm PTT Headset	Brand Name	Zebra	Part Number	HDST-35MM-PTT1-01
Earphone 2 USB-C Audio Headset	Brand Name	Zebra	Part Number	HDST-USBC-PTT1-01
USB Cable (Type C to Type A)	Brand Name	Zebra	Part Number	CBL-TC5X-USBC2A-01
Type C-Audio Cable (Type C to 3.5mm)	Brand Name	Zebra	Part Number	ADP-USBC-35MM1-01
Trigger Handle	Brand Name	Zebra	Part Number	TRG-TC2L-SNP1-01

1.2 Product Specification of Equipment Under Test

Product Specification is subject to this standard			
Tx/Rx Channel Frequency Range	2402 MHz ~ 2480 MHz 2412 MHz ~ 2462 MHz 5500 MHz ~ 5720 MHz		
Antenna Type / Gain	<Bluetooth – LE> IFA Antenna with gain -1.26 dBi <2412 MHz ~ 2462 MHz> <Ant. 7> : IFA Antenna with gain -1.26 dBi <Ant. 8> : IFA Antenna with gain -1.79 dBi <5500 MHz ~ 5720 MHz> <Ant. 7> : IFA Antenna with gain -0.31 dBi <Ant. 8> : IFA Antenna with gain -0.20 dBi		
Type of Modulation	Bluetooth LE: GFSK 802.11g: OFDM (BPSK/QPSK/16QAM/64QAM) 802.11a: OFDM (BPSK/QPSK/16QAM/64QAM)		
Antenna Function for Transmitter		Ant. 7	Ant. 8
	Bluetooth-LE	✓	-
	802.11g	-	✓
	802.11g/a MIMO	✓	✓

Remark:

1. MIMO Ant. 7+8 is a calculated result from sum of the power MIMO Ant. 7 and MIMO Ant. 8.
2. The EUT's information above is declared by manufacturer. Please refer to Disclaimer 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. 03CH11-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 Part 15 Subpart C §15.247
- ♦ FCC 47 CFR Part 2, 27
- ♦ FCC KDB Publication No. 558074 D01 15.247 Meas Guidance v05r02
- ♦ FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
- ♦ FCC KDB 414788 D01 Radiated Test Site v01r01.
- ♦ FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ♦ 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.
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

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 only the worst case emissions were reported in this report.

2.1 Carrier Frequency and Channel

2400-2483.5 MHz				5500-5720 MHz	
Bluetooth-LE		802.11g		802.11a	
Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
39	2480	1	2412	100	5500

2.2 Test Mode

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

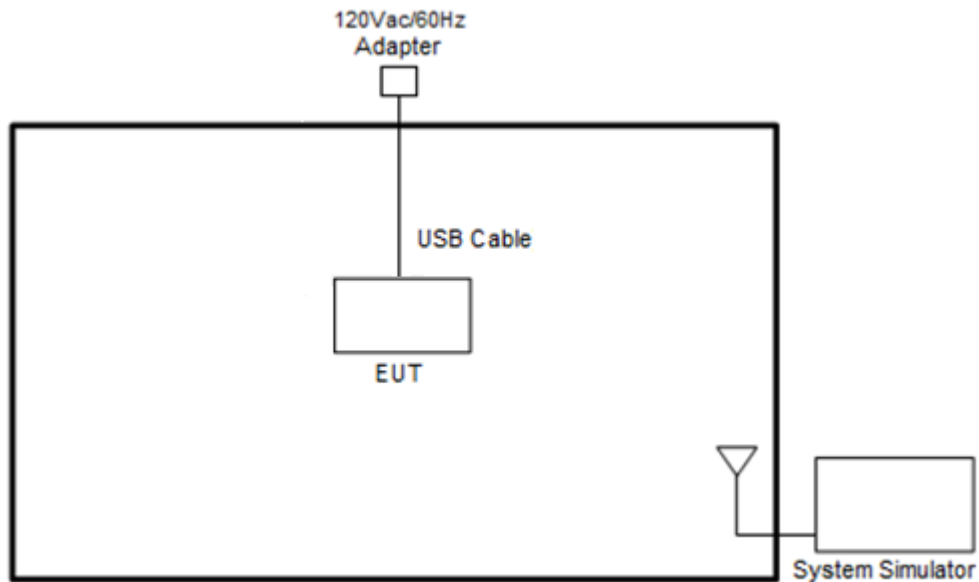
<Co-Location>

Test Mode	Modulation	Data Rate
Mode 1	WLAN 2.4GHz 802.11g for MIMO <Ant. 7+8> + WLAN 5GHz 802.11a for MIMO <Ant. 7+8> + LTE Band 13	6Mbps + MCS0
Mode 2	Bluetooth-LE for Ant. 7 + WLAN 2.4GHz 802.11g for Ant. 8 + WLAN 5GHz 802.11a for MIMO <Ant. 7+8> + LTE Band 13	2Mbps + 6Mbps + MCS0

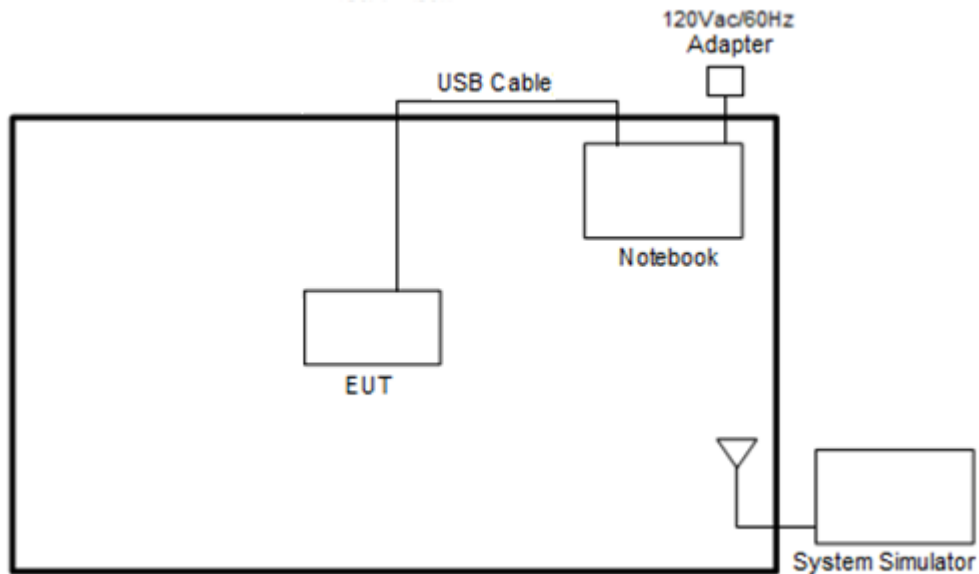
Remark: For Radiated Test Cases, the tests were performed with Battery 1 and Sample 1.

2.3 Connection Diagram of Test System

<Co-Location Tx Mode with Adapter >



<Co-Location Tx Mode with Notebook >





2.4 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Notebook	Dell	Latitude 3400	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
2.	System Simulator	Anritsu	MT8821C	N/A	N/A	Unshielded,1.8m

2.5 EUT Operation Test Setup

The RF test items, utility "QRCT v4.0.210.0" 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 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.

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

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

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

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

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

3.1.2 Measuring Instruments

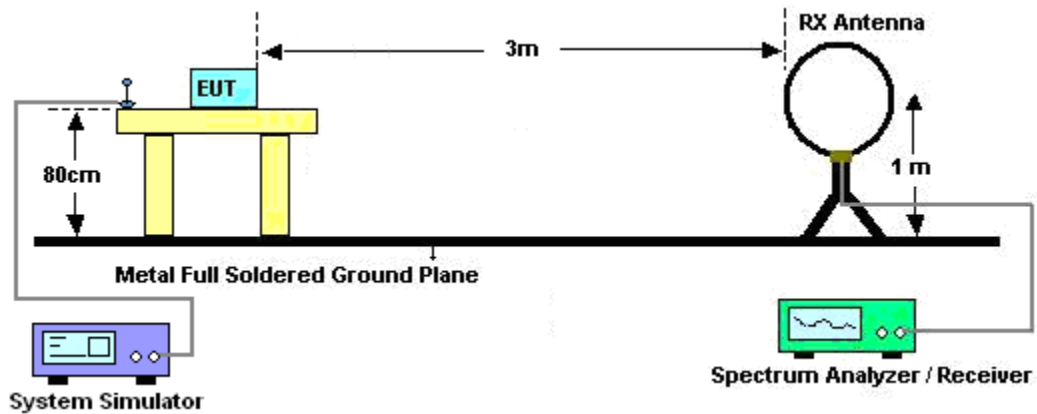
Please refer to the measuring equipment list in this test report.

3.1.3 Test Procedures

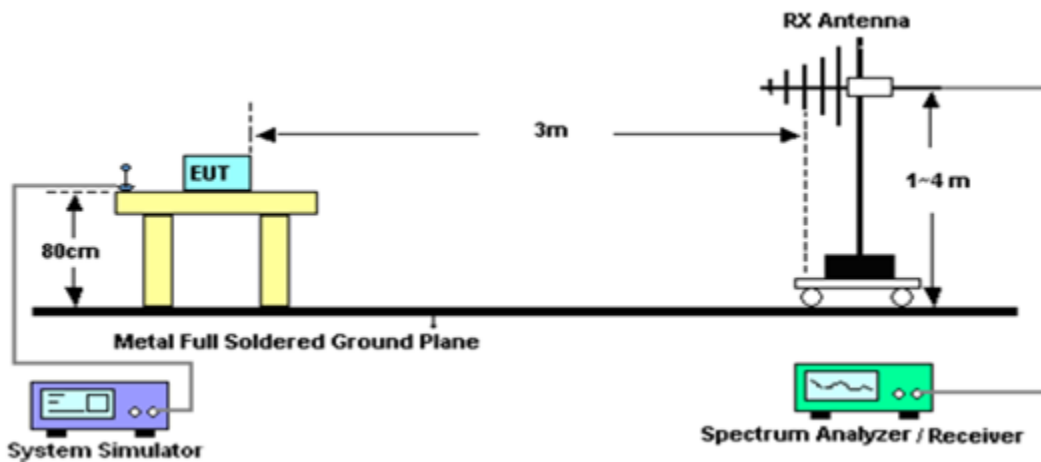
1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
Section G) Unwanted emissions measurement.
 - (1) Procedure for Unwanted Emissions Measurements Below 1000MHz
 - RBW = 120 kHz
 - VBW = 300 kHz
 - Detector = Peak
 - Trace mode = max hold
 - (2) Procedure for Peak 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 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

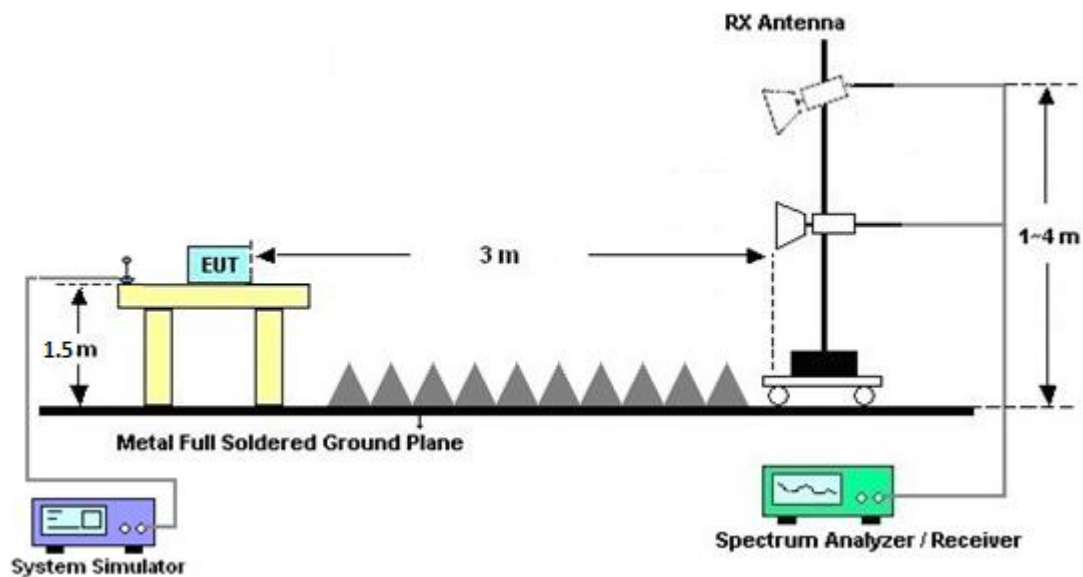
For radiated emissions below 30MHz



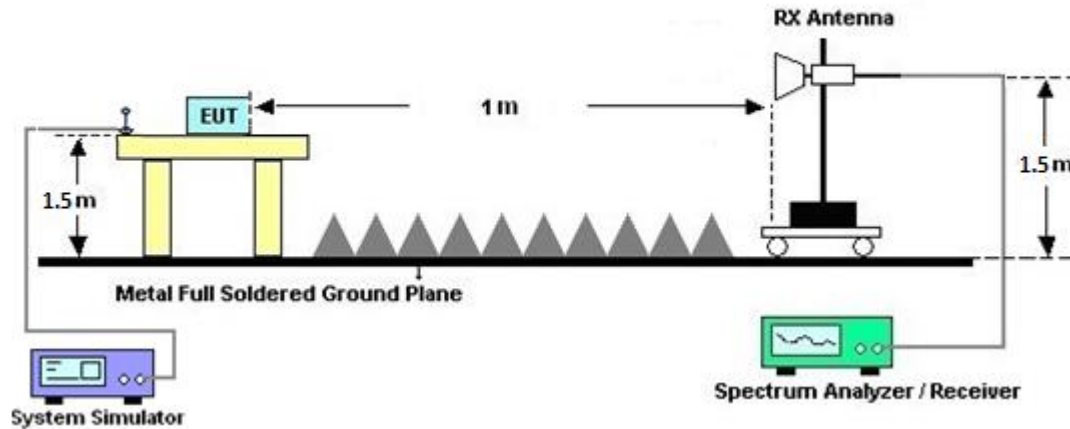
For radiated emissions from 30MHz to 1GHz



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 started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is adequate comparison measurement of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result came out very similar.

3.1.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix A and B.

3.1.7 Duty Cycle

Please refer to Appendix C.

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

Please refer to Appendix A and B.



3.2 Antenna Requirements

3.2.1 Standard Applicable

The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

3.2.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.



4 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1212	1GHz~18GHz	Mar. 23, 2023	Mar. 30, 2023~ Mar. 31, 2023	Mar. 22, 2024	Radiation (03CH11-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA9170	00993	18GHz~40GHz	Nov. 24, 2022	Mar. 30, 2023~ Mar. 31, 2023	Nov. 23, 2023	Radiation (03CH11-HY)
Preamplifier	Keysight	83017A	MY53270080	1GHz~26.5GHz	Nov. 09, 2022	Mar. 30, 2023~ Mar. 31, 2023	Nov. 08, 2023	Radiation (03CH11-HY)
Preamplifier	Jet-Power	JPA0118-55-303	17100018000 55007	1GHz~18GHz	Jun. 15, 2022	Mar. 30, 2023~ Mar. 31, 2023	Jun. 14, 2023	Radiation (03CH11-HY)
Preamplifier	EMEC	EM18G40G	060801	18GHz~40GHz	Jun. 28, 2022	Mar. 30, 2023~ Mar. 31, 2023	Jun. 27, 2023	Radiation (03CH11-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200486	10Hz~44GHz	Oct. 07, 2022	Mar. 30, 2023~ Mar. 31, 2023	Oct. 06, 2023	Radiation (03CH11-HY)
Controller	EMEC	EM 1000	N/A	Control Turn table & Ant Mast	N/A	Mar. 30, 2023~ Mar. 31, 2023	N/A	Radiation (03CH11-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1~4m	N/A	Mar. 30, 2023~ Mar. 31, 2023	N/A	Radiation (03CH11-HY)
Turn Table	EMEC	TT 2000	N/A	0~360 Degree	N/A	Mar. 30, 2023~ Mar. 31, 2023	N/A	Radiation (03CH11-HY)
Software	Audix	E3 6.2009-8-24	RK-001053	N/A	N/A	Mar. 30, 2023~ Mar. 31, 2023	N/A	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	803951/2	9kHz-30MHz	Mar. 07, 2023	Mar. 30, 2023~ Mar. 31, 2023	Mar. 06, 2024	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY15539/4	30MHz-18GHz	Dec. 20, 2022	Mar. 30, 2023~ Mar. 31, 2023	Dec. 19, 2023	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY2859/2	30MHz-40GHz	Mar. 07, 2023	Mar. 30, 2023~ Mar. 31, 2023	Mar. 06, 2024	Radiation (03CH11-HY)
Filter	Wainwright	WLK4-1000-1530- 8000-40SS	SN11	1.53GHz Low Pass Filter	Sep. 12, 2022	Mar. 30, 2023~ Mar. 31, 2023	Sep. 11, 2023	Radiation (03CH11-HY)
Filter	Wainwright	WHKX8-5872.5-6 750-18000-40SS	SN3	6.75GHz High Pass Filter	Sep. 12, 2022	Mar. 30, 2023~ Mar. 31, 2023	Sep. 11, 2023	Radiation (03CH11-HY)
Hygrometer	TECPEL	DTM-303B	TP140325	N/A	Nov. 07, 2022	Mar. 30, 2023~ Mar. 31, 2023	Nov. 06, 2023	Radiation (03CH11-HY)

5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	6.3 dB
--	--------

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 6000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	4.4 dB
--	--------

Uncertainty of Radiated Emission Measurement (6000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	4.8 dB
--	--------

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.3 dB
--	--------



Appendix A. Radiated Spurious Emission

Test Engineer :	Yuan Lee, Bank Lin, Fu Chen and Troye Hsieh	Temperature :	17.9~25.9°C
		Relative Humidity :	35.1~63.6%



2.4GHz 2400~2483.5MHz + Band 3 - 5500~5720MHz

802.11g_Tx_Ch01 + 802.11a_Tx_Ch100 + LTE Band 13 (Band Edge @ 3m)

WIFI	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant					Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
7+8		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11g CH 01 2412MHz		2390	63.91	-10.09	74	53.15	27.46	17.50	34.2	181	13	P	H
		2390	50.96	-3.04	54	40.2	27.46	17.50	34.2	181	13	A	H
	*	2412	113.57	-	-	102.66	27.57	17.53	34.19	181	13	P	H
	*	2412	106.19	-	-	95.28	27.57	17.53	34.19	181	13	A	H
													H
													H
		2390	60.07	-13.93	74	49.31	27.46	17.50	34.2	206	105	P	V
		2390	48.09	-5.91	54	37.33	27.46	17.50	34.2	206	105	A	V
	*	2412	109.11	-	-	98.2	27.57	17.53	34.19	206	105	P	V
	*	2412	101.71	-	-	90.8	27.57	17.53	34.19	206	105	A	V
													V
													V
802.11a CH 100 5500MHz		5459.44	52.23	-21.77	74	41.41	33.02	11.42	33.62	115	342	P	H
		5469.36	64.37	-3.83	68.2	53.52	33.04	11.43	33.62	115	342	P	H
		5459.76	42.87	-11.13	54	32.05	33.02	11.42	33.62	115	342	A	H
	*	5500	111.72	-	-	100.8	33.1	11.44	33.62	115	342	P	H
	*	5500	105.51	-	-	94.59	33.1	11.44	33.62	115	342	A	H
													H
		5459.92	53.1	-20.9	74	42.28	33.02	11.42	33.62	400	20	P	V
		5470	65.18	-3.02	68.2	54.33	33.04	11.43	33.62	400	20	P	V
		5459.76	43.09	-10.91	54	32.27	33.02	11.42	33.62	400	20	A	V
	*	5500	112.04	-	-	101.12	33.1	11.44	33.62	400	20	P	V
	*	5500	105.53	-	-	94.61	33.1	11.44	33.62	400	20	A	V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



Bluetooth-LE + 2.4GHz 2400~2483.5MHz + Band 3 - 5500~5720MHz

802.11g_Tx_Ch01 + Bluetooth-LE_Tx_Ch39 (2M) + 802.11a_Tx_Ch100 +

LTE Band 13 (Band Edge @ 3m)

WIFI	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant					Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
7/8		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11g CH 01 2412MHz		2390	60.52	-13.48	74	49.76	27.46	17.5	34.2	306	42	P	H
		2390	49.03	-4.97	54	38.27	27.46	17.5	34.2	306	42	A	H
	*	2412	107.71	-	-	96.8	27.57	17.53	34.19	306	42	P	H
	*	2412	99.99	-	-	89.08	27.57	17.53	34.19	306	42	A	H
													H
													H
		2389.905	57.47	-16.53	74	46.71	27.46	17.5	34.2	205	132	P	V
		2390	46.25	-7.75	54	35.49	27.46	17.5	34.2	205	132	A	V
	*	2412	105.15	-	-	94.24	27.57	17.53	34.19	205	132	P	V
	*	2412	97.34	-	-	86.43	27.57	17.53	34.19	205	132	A	V
													V
													V
BLE CH 39 2480MHz	*	2480	97.15	-	-	85.85	27.86	17.61	34.17	300	30	P	H
	*	2480	92.97	-	-	81.67	27.86	17.61	34.17	300	30	A	H
		2489.68	53.84	-20.16	74	42.5	27.88	17.62	34.16	300	30	P	H
		2484.16	43.4	-10.6	54	32.09	27.87	17.61	34.17	300	30	A	H
													H
													H
	*	2480	96.47	-	-	85.17	27.86	17.61	34.17	295	90	P	V
	*	2480	92.32	-	-	81.02	27.86	17.61	34.17	295	90	A	V
		2491.32	53.63	-20.37	74	42.29	27.88	17.62	34.16	295	90	P	V
		2485.32	43	-11	54	31.69	27.87	17.61	34.17	295	90	A	V
													V
													V
Remark	1. No other spurious found.												
	2. All results are PASS against Peak and Average limit line.												



WIFI	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant					Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
7+8		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11a CH 100 5500MHz		5458.96	53.65	-20.35	74	42.83	33.02	11.42	33.62	150	322	P	H
		5469.84	66.95	-1.25	68.2	56.1	33.04	11.43	33.62	150	322	P	H
		5460	42.88	-11.12	54	32.06	33.02	11.42	33.62	150	322	A	H
	*	5500	112.87	-	-	101.95	33.1	11.44	33.62	150	322	P	H
	*	5500	106.36	-	-	95.44	33.1	11.44	33.62	150	322	A	H
													H
		5458.8	53.27	-20.73	74	42.45	33.02	11.42	33.62	275	5	P	V
		5469.2	64.21	-3.99	68.2	53.36	33.04	11.43	33.62	275	5	P	V
		5459.92	42.93	-11.07	54	32.11	33.02	11.42	33.62	275	5	A	V
	*	5500	112.21	-	-	101.29	33.1	11.44	33.62	275	5	P	V
	*	5500	105.69	-	-	94.77	33.1	11.44	33.62	275	5	A	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 3 - 5500~5720MHz

802.11g_Tx_Ch01 + 802.11a_Tx_Ch100 + LTE Band 13 (Harmonic @ 3m)

WIFI	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant					Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
7+8		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11g CH 01 2412MHz + 802.11a CH 100 5500MHz		4824	54.06	-19.94	74	43.53	32.54	11.69	33.7	193	70	P	H
		4824	43.85	-10.15	54	33.32	32.54	11.69	33.7	193	70	A	H
		7693	57.08	-16.92	74	63.92	36.39	15.39	58.62	300	294	P	H
		7693	48.74	-5.26	54	55.58	36.39	15.39	58.62	300	294	A	H
		8584	60.79	-7.41	68.2	65.35	37.57	16.07	58.2	252	299	P	H
		11000	47.01	-26.99	74	51.15	38.9	18.12	61.16	-	-	P	H
		16500	47.88	-20.32	68.2	46.62	38.5	22.63	59.87	-	-	P	H
		4824	55.71	-18.29	74	45.18	32.54	11.69	33.7	400	26	P	V
		4824	45.03	-8.97	54	34.5	32.54	11.69	33.7	400	26	A	V
		7693	55.34	-18.66	74	62.18	36.39	15.39	58.62	310	357	P	V
		7693	45.76	-8.24	54	52.6	36.39	15.39	58.62	310	357	A	V
		8584	55.06	-13.14	68.2	59.62	37.57	16.07	58.2	400	228	P	V
		11000	48.81	-25.19	74	52.95	38.9	18.12	61.16	-	-	P	V
		16500	47.67	-20.53	68.2	46.41	38.5	22.63	59.87	-	-	P	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.												



Bluetooth-LE + 2.4GHz 2400~2483.5MHz + Band 3 - 5500~5720MHz

802.11g_Tx_Ch01 + Bluetooth-LE_Tx_Ch39 (2M) + 802.11a_Tx_Ch100 + LTE Band 13 (Harmonic @ 3m)

WIFI	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant					Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
7/8/7+8		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11g CH 01 2412MHz + BLE(2M) CH39 2480MHz + 802.11a CH 100 5500MHz		4824	56.38	-17.62	74	45.85	32.54	11.69	33.7	171	66	P	H
		4824	44.85	-9.15	54	34.32	32.54	11.69	33.7	171	66	A	H
		4960	55.74	-18.26	74	45.2	33.06	11.14	33.66	100	73	P	H
		4960	45.6	-8.4	54	35.06	33.06	11.14	33.66	100	73	A	H
		7440	44.63	-29.37	74	52.07	36.42	14.85	58.71	-	-	P	H
		7700	56.7	-17.3	74	63.5	36.4	15.41	58.61	300	291	P	H
		7700	48.6	-5.4	54	55.4	36.4	15.41	58.61	300	291	A	H
		11000	47.97	-26.03	74	52.11	38.9	18.12	61.16	-	-	P	H
		16500	47.17	-21.03	68.2	45.91	38.5	22.63	59.87	-	-	P	H
		4824	57.83	-16.17	74	47.3	32.54	11.69	33.7	380	29	P	V
		4824	46.23	-7.77	54	35.7	32.54	11.69	33.7	380	29	A	V
		4960	55.47	-18.53	74	44.93	33.06	11.14	33.66	100	22	P	V
		4960	45.55	-8.45	54	35.01	33.06	11.14	33.66	100	22	A	V
		7440	45.19	-28.81	74	52.63	36.42	14.85	58.71	-	-	P	V
		7700	54.99	-19.01	74	61.79	36.4	15.41	58.61	199	319	P	V
		7700	46.56	-7.44	54	53.36	36.4	15.41	58.61	199	319	A	V
		11000	47.54	-26.46	74	51.68	38.9	18.12	61.16	-	-	P	V
		16500	47.24	-20.96	68.2	45.98	38.5	22.63	59.87	-	-	P	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

802.11g_Tx_Ch01 + Bluetooth-LE_Tx_Ch39 (2M) + 802.11a_Tx_Ch100 + LTE Band 13 (LF @ 3m)

[illegible]



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 Margin 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	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.					Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
7+8		(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. Margin(dB) = Level(dBμV/m) – LimitLine(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. Margin(dB)
= Level(dBμV/m) – LimitLine(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. Margin(dB)
= Level(dBμV/m) – LimitLine(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”.



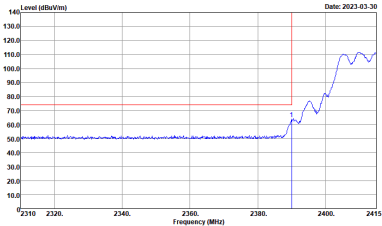
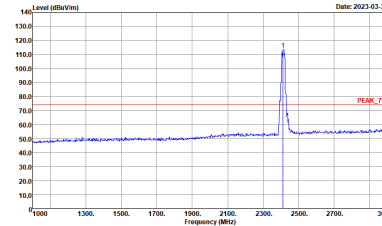
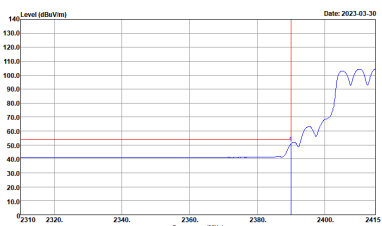
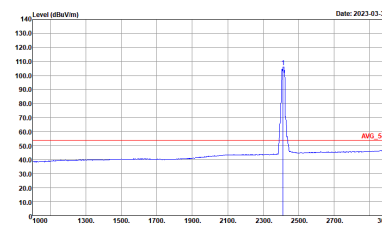
Appendix B. Radiated Spurious Emission Plots

Test Engineer :	Yuan Lee, Bank Lin, Fu Chen and Troye Hsieh	Temperature :	17.9~25.9°C
		Relative Humidity :	35.1~63.6%

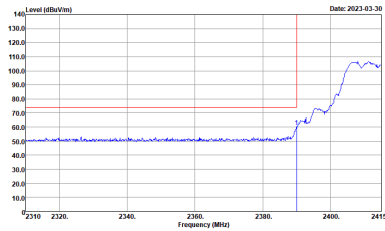
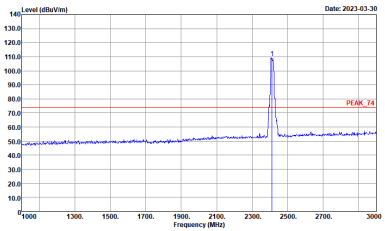
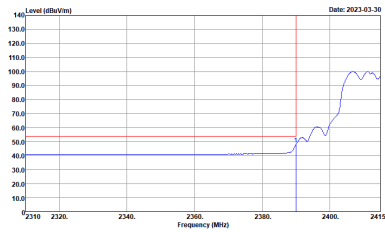
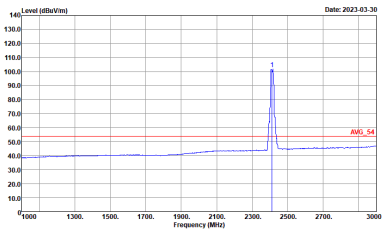


2.4GHz 2400~2483.5MHz + Band 3 - 5500~5720MHz

802.11g_Tx_Ch01 + 802.11a_Tx_Ch100 + LTE Band 13 (Band Edge @ 3m)

WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11g CH01 2412MHz	
7+8	Horizontal	Fundamental
Peak	 Site : 03CH11-HY Condition : PEAK_BE_74 3m 91200_01620_220824 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH11-HY Condition : PEAK_74 3m 91200_01620_220824 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site : 03CH11-HY Condition : AVG_BE_54 3m 91200_01620_220824 HORIZONTAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto	 Site : 03CH11-HY Condition : AVG_54 3m 91200_01620_220824 HORIZONTAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto



WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11g CH01 2412MHz	
7+8	Vertical	Fundamental
Peak	 Site : 03CH11-HY Condition : PEAK_BE_74 3m 91200_01620_220824 VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH11-HY Condition : PEAK_74 3m 91200_01620_220824 VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
	 Site : 03CH11-HY Condition : AVG_BE_54 3m 91200_01620_220824 VERTICAL RBW:1000.000KHz VBW:0.010KHz SWT:Auto	 Site : 03CH11-HY Condition : AVG_54 3m 91200_01620_220824 VERTICAL RBW:1000.000KHz VBW:0.010KHz SWT:Auto



WIFI	Band 3 5470~5725MHz Band Edge @ 3m	
ANT	802.11a CH100 5500MHz	
7+8	Horizontal	Fundamental
Peak	Site : 03CH11-HY Condition : PEAK_8E(UNIT)_B3 3m 91200_01620_220824 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	Site : 03CH11-HY Condition : PEAK(UNIT) 3m 91200_01620_220824 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
	Site : 03CH11-HY Condition : AVG_8E(UNIT)_B3 3m 91200_01620_220824 HORIZONTAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto	Site : 03CH11-HY Condition : AVG_54 3m 91200_01620_220824 HORIZONTAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto



WIFI	Band 3 5470~5725MHz Band Edge @ 3m	
ANT	802.11a CH100 5500MHz	
7+8	Vertical	Fundamental
Peak	Site : 03CH11-HY Condition : PEAK_BE(UNIT1)_B3 3m 91200_01620_220824 VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	Site : 03CH11-HY Condition : PEAK(UNIT1) 3m 91200_01620_220824 VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
	Site : 03CH11-HY Condition : AVG_BE(UNIT1)_B3 3m 91200_01620_220824 VERTICAL RBW:1000.000KHz VBW:0.010KHz SWT:Auto	Site : 03CH11-HY Condition : AVG_54 3m 91200_01620_220824 VERTICAL RBW:1000.000KHz VBW:0.010KHz SWT:Auto

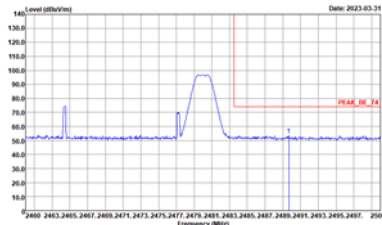
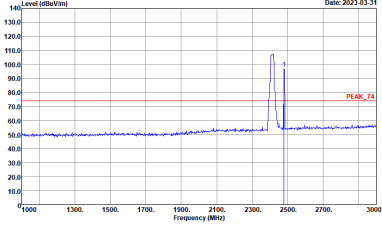
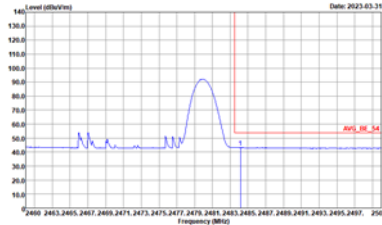
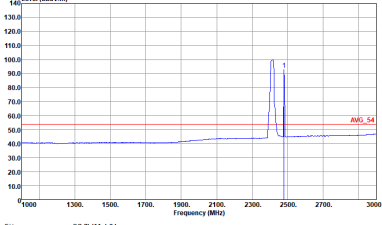
**Bluetooth-LE + 2.4GHz 2400~2483.5MHz + Band 3 - 5500~5720MHz****802.11g_Tx_Ch01 + Bluetooth-LE_Tx_Ch39 (2M) + 802.11a_Tx_Ch100 +****LTE Band 13 (Band Edge @ 3m)**

WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11g CH01 2412MHz	
8	Horizontal	Fundamental
Peak	Site : 03CH11-HY Condition : PEAK_BE_74 3m 91200_01620_220824 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	Site : 03CH11-HY Condition : PEAK_74 3m 91200_01620_220824 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	Site : 03CH11-HY Condition : AVG_BE_54 3m 91200_01620_220824 HORIZONTAL : RBW:1000.000KHz VBW:0.001KHz SWT:Auto	Site : 03CH11-HY Condition : AVG_54 3m 91200_01620_220824 HORIZONTAL : RBW:1000.000KHz VBW:0.001KHz SWT:Auto

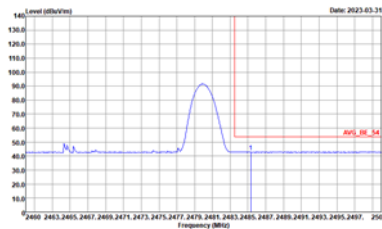
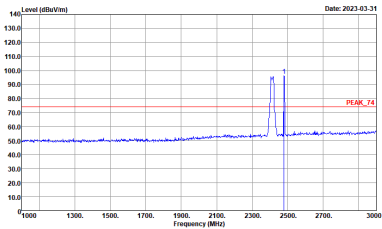
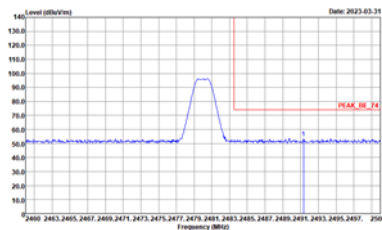
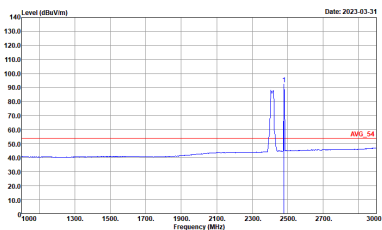


WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11g CH01 2412MHz	
8	Vertical	Fundamental
Peak	Site Condition : 03CH11-HY : PEAK_BE_74 3m 91200_01620_220824 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	Site Condition : 03CH11-HY : PEAK_74 3m 91200_01620_220824 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
	Site Condition : 03CH11-HY : AVG_BE_54 3m 91200_01620_220824 VERTICAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto	Site Condition : 03CH11-HY : AVG_54 3m 91200_01620_220824 VERTICAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto

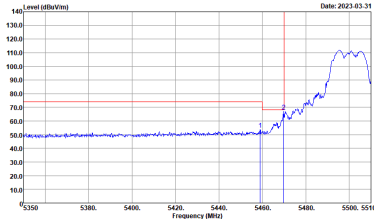
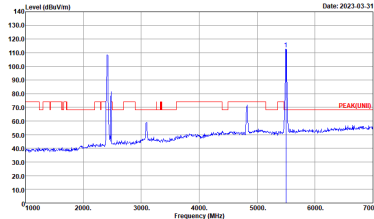
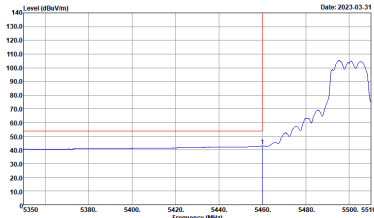
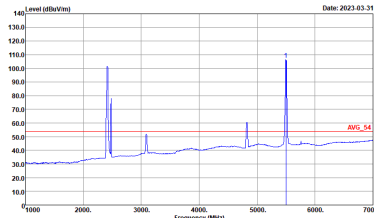


BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH39 2480MHz	
7	Horizontal	Fundamental
Peak	 Site : 03CH11-HY Condition : PEAK_74 3m 91200_01620_220824 HORIZONTAL RBW:1000.0000Hz VBW:3000.0000Hz SWT:Auto	 Site : 03CH11-HY Condition : PEAK_74 3m 91200_01620_220824 HORIZONTAL RBW:1000.0000Hz VBW:3000.0000Hz SWT:Auto
Avg.	 Site : 03CH11-HY Condition : AVG_54 3m 91200_01620_220824 HORIZONTAL RBW:1000.0000Hz VBW:0.5100Hz SWT:Auto	 Site : 03CH11-HY Condition : AVG_54 3m 91200_01620_220824 HORIZONTAL RBW:1000.0000Hz VBW:0.5100Hz SWT:Auto

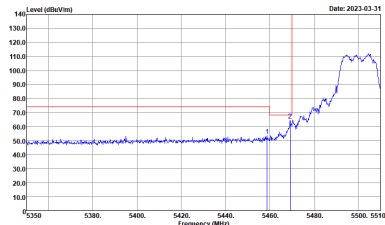
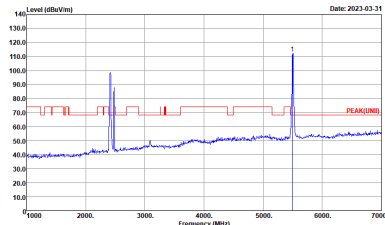
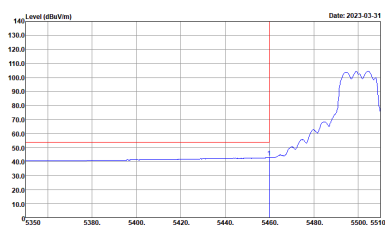
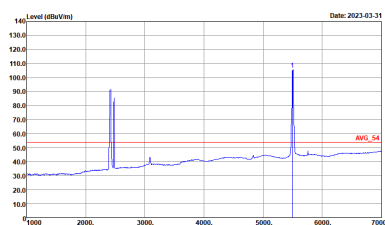


BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH39 2480MHz	
7	Vertical	Fundamental
Peak	 Site : 03CH11-HY Condition : AVS_BE_54 3m 91200_01620_220824 VERTICAL RBW:1000.0000kHz VBW:0.5100kHz SWT:Auto	 Site : 03CH11-HY Condition : PEAK_74 3m 91200_01620_220824 VERTICAL RBW:1000.0000kHz VBW:3000.0000kHz SWT:Auto
Avg.	 Site : 03CH11-HY Condition : PEAK_BE_74 3m 91200_01620_220824 VERTICAL RBW:1000.0000kHz VBW:3000.0000kHz SWT:Auto	 Site : 03CH11-HY Condition : AVG_54 3m 91200_01620_220824 VERTICAL RBW:1000.0000kHz VBW:0.5100kHz SWT:Auto



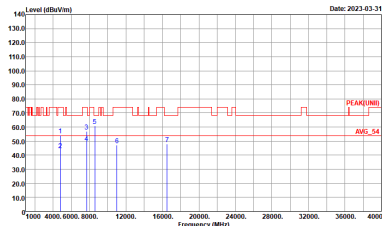
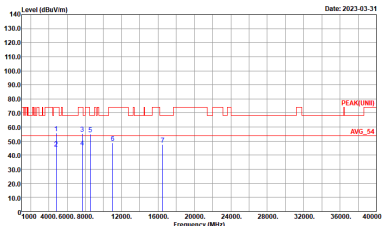
WIFI	Band 3 5470~5725MHz Band Edge @ 3m	
ANT	802.11a CH100 5500MHz	
7+8	Horizontal	Fundamental
Peak	 Site : 03CH11-HY Condition : PEAK_8E(UNIT)_B3 3m 91200_01620_220824 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH11-HY Condition : PEAK(UNIT) 3m 91200_01620_220824 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
	 Site : 03CH11-HY Condition : AVG_8E(UNIT)_B3 3m 91200_01620_220824 HORIZONTAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto	 Site : 03CH11-HY Condition : AVG_54 3m 91200_01620_220824 HORIZONTAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto



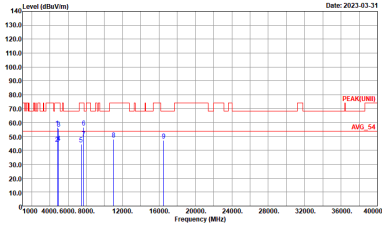
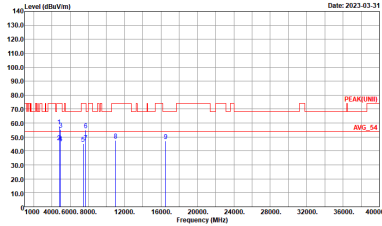
WIFI	Band 3 5470~5725MHz Band Edge @ 3m	
ANT	802.11a CH100 5500MHz	
7+8	Vertical	Fundamental
Peak	 Site : 03CH11-HY Condition : PEAK_BE(UNIT1)_B3 3m 91200_01620_220824 VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH11-HY Condition : PEAK(UNIT1) 3m 91200_01620_220824 VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
	 Site : 03CH11-HY Condition : AVG_BE(UNIT1)_B3 3m 91200_01620_220824 VERTICAL RBW:1000.000KHz VBW:0.010KHz SWT:Auto	 Site : 03CH11-HY Condition : AVG_54 3m 91200_01620_220824 VERTICAL RBW:1000.000KHz VBW:0.010KHz SWT:Auto



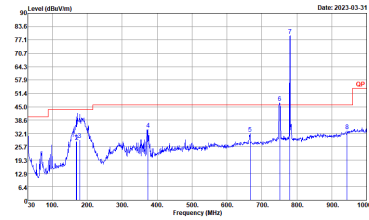
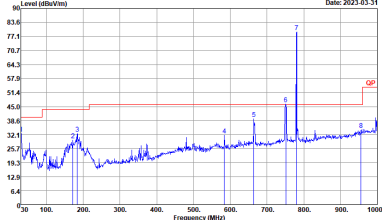
2.4GHz 2400~2483.5MHz + Band 3 - 5500~5720MHz
802.11g_Tx_Ch01 + 802.11a_Tx_Ch100 + LTE Band 13 (Harmonic @ 3m)

WIFI	Harmonic @ 3m	
Ant	802.11g CH01 2412MHz + 802.11a CH100 5500MHz+ LTE B13 CH23230	
7+8	Horizontal	Vertical
Peak Avg.	 Site : 03CH11-HY Condition : PEAK(UNIT) 3m 91200_01620_220824 HORIZONTAL ..	 Site : 03CH11-HY Condition : PEAK(UNIT) 3m 91200_01620_220824 VERTICAL ..

**Bluetooth-LE + 2.4GHz 2400~2483.5MHz + Band 3 - 5500~5720MHz****802.11g_Tx_Ch01 + Bluetooth-LE_Tx_Ch39 (2M) + 802.11a_Tx_Ch100 + LTE Band 13 (Harmonic @ 3m)**

WIFI	WLAN 2.4G+BLE+WLAN 5G+WWAN	
Ant	802.11g CH01 2412MHz +BLE CH39 2480MHz + 802.11a CH100 5500MHz+ LTE B13 CH23230	
7/8/7+8	Horizontal	Vertical
Peak Avg.	 Site : 03CH11-HY Condition : PEAK(UNIT) 3m 91200_01620_220824 HORIZONTAL .	 Site : 03CH11-HY Condition : PEAK(UNIT) 3m 91200_01620_220824 VERTICAL .

Emission below 1GHz
802.11g_Tx_Ch01 + Bluetooth-LE_Tx_Ch39 (2M) + 802.11a_Tx_Ch100 + LTE Band 13 (LF @ 3m)

WIFI	WLAN 2.4G+BLE+WLAN 5G+WWAN	
Ant	802.11g CH01 2412MHz +BLE CH39 2480MHz + 802.11a CH100 5500MHz+ LTE B13 CH23230	
7/8/7+8	Horizontal	Vertical
QP / Peak	 Site : 03CH11-HY Condition : QP 3m 2_BILO6_35414_221008 HORIZONTAL Date: 2023-03-31	 Site : 03CH11-HY Condition : QP 3m 2_BILO6_35414_221008 VERTICAL Date: 2023-03-31

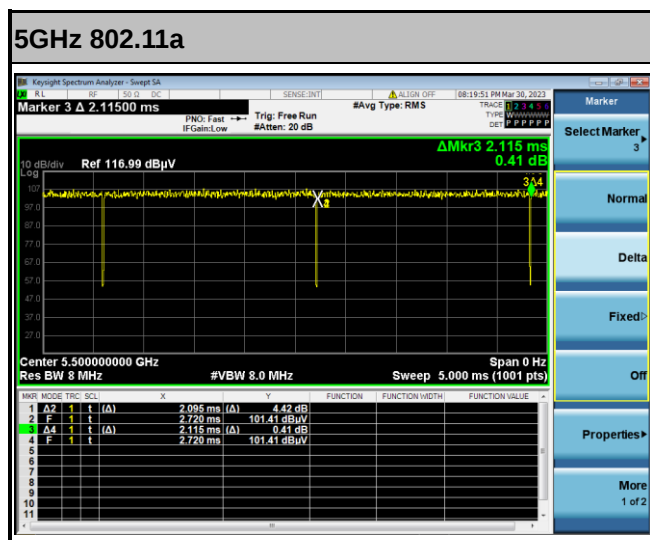
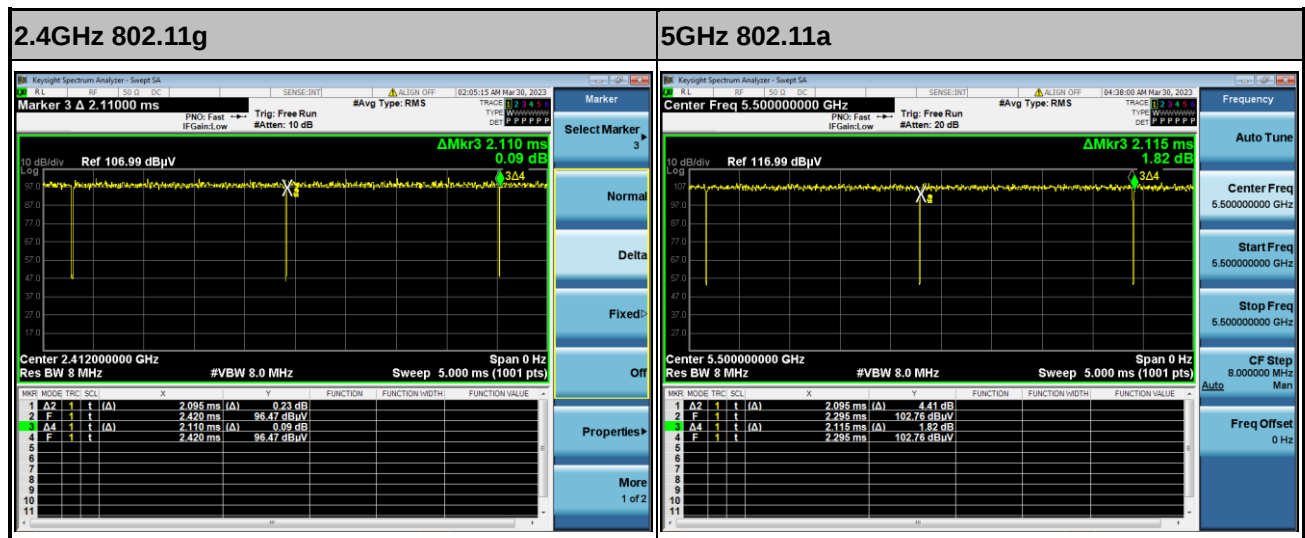
Remark : The #6,#7 are mobile station signal which can be ignored<Tx/Rx Signal>



Appendix C. Duty Cycle Plots

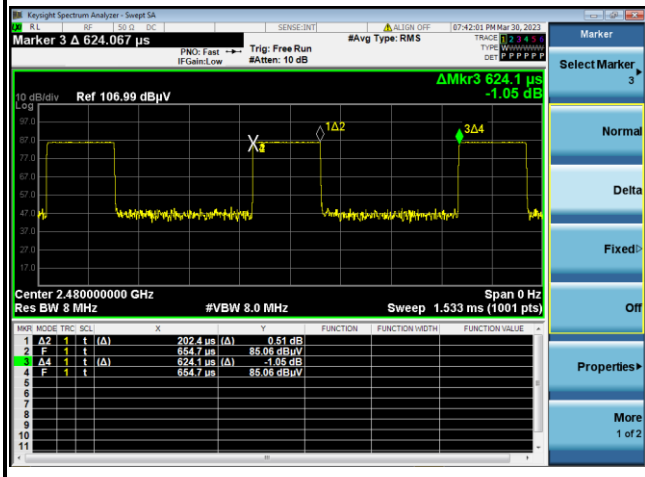
Antenna	Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting
7+8	802.11g	99.29	-	-	10Hz
7+8	802.11a	99.05	-	-	10Hz
7	Bluetooth - LE for 2Mbps	32.44	202.4	4.94	5.1kHz
8	802.11g	99.29	-	-	10Hz
7+8	802.11a	99.05	-	-	10Hz

MIMO < Ant. 7+8>



< Ant. 7>

Bluetooth - LE for 2Mbps



< Ant. 8>

802.11g

