



FCC CO-LOCATION RADIO TEST REPORT

FCC ID : UZ7TC58AE
Equipment : Touch Computer
Brand Name : Zebra
Model Name : TC58AE
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. 06, 2024 and testing was performed from Apr. 15, 2024 to Apr. 15, 2024. 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
FR411111G	01	Initial issue of report	May 03, 2024



Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.407(b)	Unwanted Emissions	Pass	1.02 dB under the limit at 2483.52 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/manufacturee who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
2. The measurement uncertainty please refer to each test result in the section "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: Wei Chen**Report Producer: Michelle Chen**

1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	Touch Computer
Brand Name	Zebra
Model Name	TC58AE
FCC ID	UZ7TC58AE
Sample 1	SE55 + 8GB 128G (Samsung/SK Hynix)
Sample 2	SE4720 + 6GB 64G (SK Hynix/WD)
Sample 3	SE4770 + 6GB 64G (SK Hynix/WD)
EUT supports Radios application	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	DV1-2
SW Version	nemesis_A13_userdebug_GMS_RelKey_2023-12-12-0451_main_SE
FW Version	FUSION_QA_6_1.1.0.004_T
MFD	06DEC23
EUT Stage	Identical Prototype

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

Specification of Accessories				
Adapter	Brand Name	Zebra	Part Number	PWR-WUA5V12W0US
Battery 1 (1x)	Brand Name	Zebra	Part Number	BT-000442-0020
Battery 2 (1.5x)	Brand Name	Zebra	Part Number	BT-000442-0820
Battery 3 (BLE battery)	Brand Name	Zebra	Part Number	BT-000442-002B
Battery 4 (Wireless Battery)	Brand Name	Zebra	Part Number	BT-000442-002A
Battery 5 (1x)	Brand Name	Zebra	Part Number	BT-000442-1020
USB TYPE A to TYPE C cable	Brand Name	Zebra	Part Number	CBL-TC5X-USBC2A-01
USB TYPE C to 3.5mm audio connector	Brand Name	Zebra	Part Number	ADP-USBC-35MM1-01
3.5mm Earphone	Brand Name	Zebra	Part Number	HDST-35MM-PTT1-01
Rugged Headset	Brand Name	Zebra	Part Number	HS2100-OTH
USB TYPE C Earphone	Brand Name	Zebra	Part Number	HPST-USBC-PTT1-01
Trigger Handle	Brand Name	Zebra	Part Number	TRG-NGTC5-ELEC-01
Soft Holster	Brand Name	Zebra	Part Number	SG-NGTC5TC7-HLSTR-01
TC53/TC58 RUGGED BOOT	Brand Name	Zebra	Part Number	SG-NGTC5EXO1-01
3.5mm to 3.5mm audio connector	Brand Name	Zebra	Part Number	CBL-HS2100-3MS1-01

1.2 Product Specification of Equipment Under Test

Product Specification is subject to this standard									
Tx/Rx Channel Frequency Range		2412 MHz ~ 2462 MHz 5180 MHz ~ 5240 MHz							
Antenna Type / Gain		<2412 MHz ~ 2462 MHz> <Ant. 6>: PIFA Antenna with gain 2.32 dBi <Ant. 7>: PIFA Antenna with gain 0.14 dBi <5180 MHz ~ 5240MHz> <Ant. 6>: PIFA Antenna with gain 3.51 dBi <Ant. 7>: PIFA Antenna with gain 1.77 dBi							
Type of Modulation		802.11g : OFDM (BPSK / QPSK / 16QAM / 64QAM) 802.11ax: OFDMA (BPSK / QPSK / 16QAM / 64QAM / 256QAM / 1024QAM)							
Antenna Function for Transmitter		<table><tr><td></td><td>Ant. 6</td><td>Ant. 7</td></tr><tr><td>802.11g/ax MIMO</td><td>V</td><td>V</td></tr></table>			Ant. 6	Ant. 7	802.11g/ax MIMO	V	V
	Ant. 6	Ant. 7							
802.11g/ax MIMO	V	V							

Remark:

1. MIMO Ant. 6+7 is a calculated result from sum of the power MIMO Ant. 6 and MIMO Ant. 7.
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. 03CH20-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 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 Accessory (Adapter or Earphone), 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		5150-5250 MHz	
802.11g		802.11ax HE40	
Channel	Freq. (MHz)	Channel	Freq. (MHz)
11	2462	38	5190

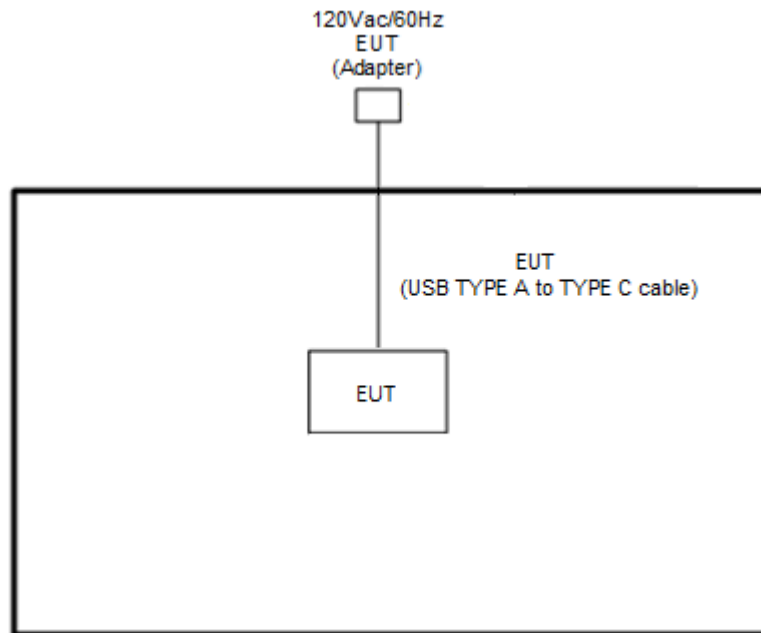
2.2 Test Mode

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. 6+7> + WLAN 5GHz 802.11ax HE40 for MIMO <Ant. 6+7>	6Mbps + MCS0

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.	Notebook	Dell	Latitude 5310	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 "QRCT Version 4.0.211.0" 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

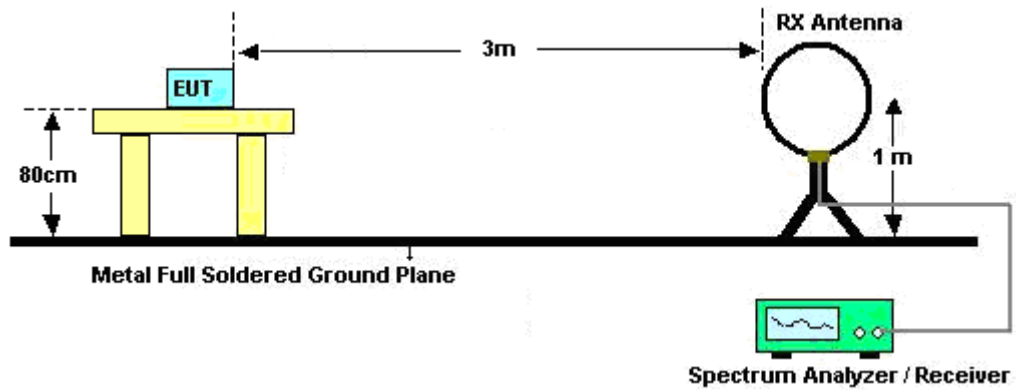
Please refer to the measuring equipment list in this test report.

3.1.3 Test Procedures

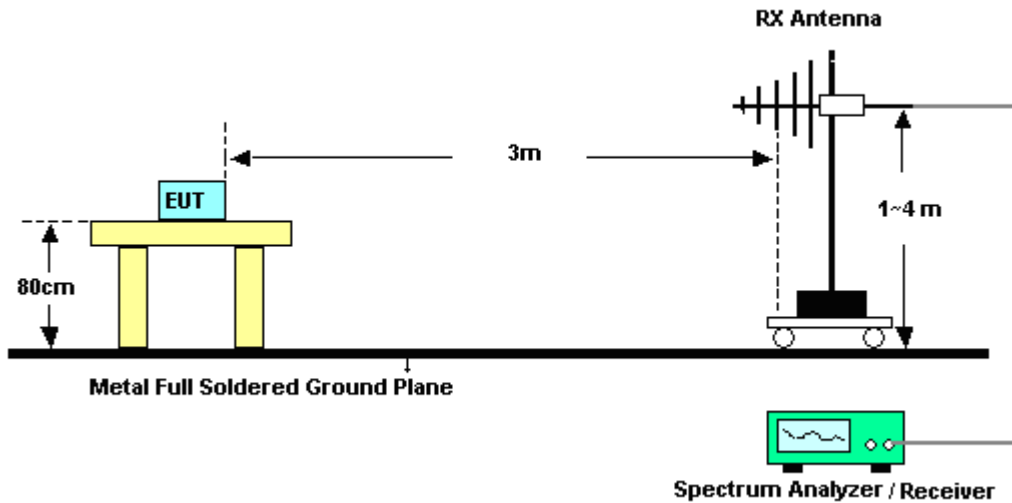
1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01. Section G) Unwanted emissions measurement.
 - (1) Procedure for Unwanted Emissions Measurements Below 1000MHz
 - RBW = 120 kHz
 - VBW = 300 kHz
 - Detector = Peak
 - Trace mode = max hold
 - (2) Procedure for Peak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

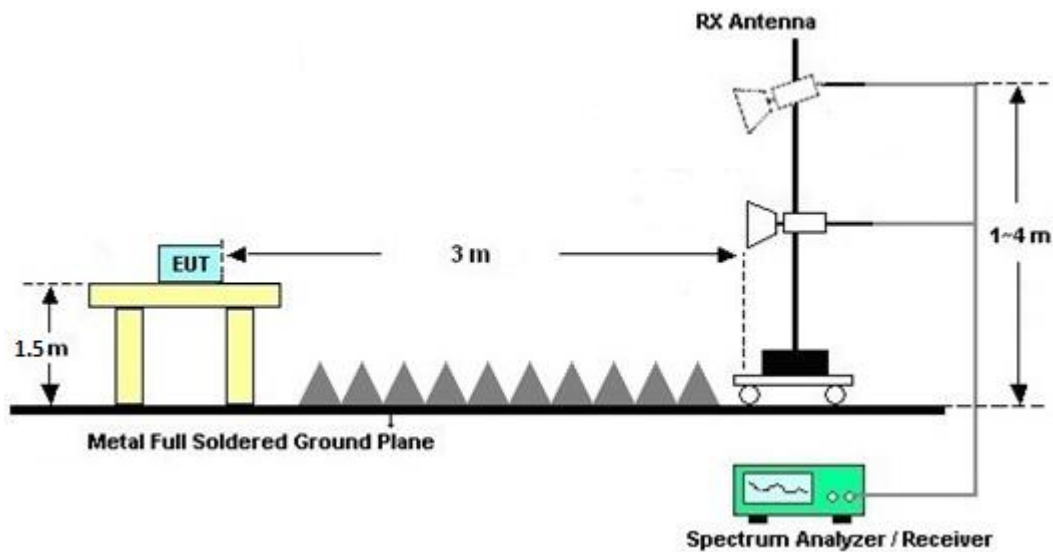
For radiated emissions below 30MHz



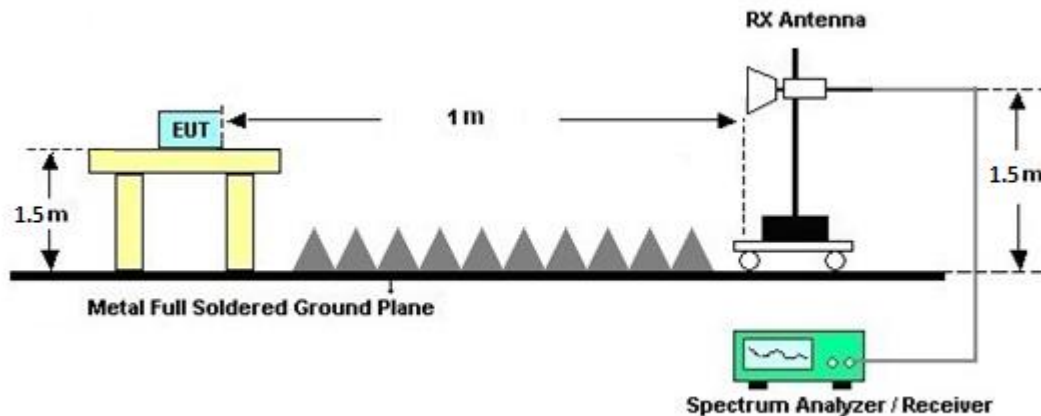
For radiated emissions from 30MHz to 1GHz



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
EMI Test Receiver	Keysight	N9038A(MXE)	MY54130085	N/A	Oct. 06, 2023	Apr. 15, 2024	Oct. 05, 2024	Radiation (03CH20-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Sep. 12, 2023	Apr. 15, 2024	Sep. 11, 2024	Radiation (03CH20-HY)
Preamplifier	EMEC	EM18G40G	060801	18GHz~40GHz	Jun. 27, 2023	Apr. 15, 2024	Jun. 26, 2024	Radiation (03CH20-HY)
Controller	ChainTek	3000-1	N/A	Control Turn table & Ant Mast	N/A	Apr. 15, 2024	N/A	Radiation (03CH20-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Apr. 15, 2024	N/A	Radiation (03CH20-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Apr. 15, 2024	N/A	Radiation (03CH20-HY)
Signal Analyzer	Keysight	N9010B	MY60240520	N/A	Dec. 12, 2023	Apr. 15, 2024	Dec. 11, 2024	Radiation (03CH20-HY)
Bilog Antenna	TESEQ	CBL 6111D&00802N1 D01N-06	55606 & 08	30MHz~1GHz	Oct. 20, 2023	Apr. 15, 2024	Oct. 19, 2024	Radiation (03CH20-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	02360	1GHz-18GHz	Oct. 30, 2023	Apr. 15, 2024	Oct. 29, 2024	Radiation (03CH20-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	1224	18GHz-40GHz	Jul. 10, 2023	Apr. 15, 2024	Jul. 09, 2024	Radiation (03CH20-HY)
Preamplifier	COM-POWER	PAM-103	18020201	1MHz-1000MHz	Jan. 01, 2024	Apr. 15, 2024	Dec. 31, 2024	Radiation (03CH20-HY)
Amplifier	EMCI	EMC118A45SE	980792	N/A	Nov. 13, 2023	Apr. 15, 2024	Nov. 12, 2024	Radiation (03CH20-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	519229/2,80401 5/2,804027/2	N/A	Jan. 17, 2024	Apr. 15, 2024	Jan. 16, 2025	Radiation (03CH20-HY)
Hygrometer	TECPEL	DTM-303A	TP211382	N/A	Mar. 27, 2024	Apr. 15, 2024	Mar. 26, 2025	Radiation (03CH20-HY)
Software	Audix	N/A	RK-002156	N/A	N/A	Apr. 15, 2024	N/A	Radiation (03CH20-HY)

5 Measurement Uncertainty

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	6.4 dB
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Uncertainty of Radiated Emission Measurement (1000 MHz ~ 6000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	4.5 dB
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Uncertainty of Radiated Emission Measurement (6000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	4.6 dB
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Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.4 dB
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Appendix A. Radiated Spurious Emission

Test Engineer :	John Chuang and David Dai	Temperature :	19.5~23.5°C
		Relative Humidity :	64.9~70.7%

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

802.11g _Tx_CH11 (Band edge @ 3m)

WIFI Ant	Note	Frequency	Level	Margin	Limit Line	Read Level	Antenna Factor	Path Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
6+7		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11g CH 11 2462MHz	*	2462	112.5	-	-	102.06	27.55	19.16	36.27	100	66	P	H
	*	2462	104.99	-	-	94.55	27.55	19.16	36.27	100	66	A	H
		2483.56	64.59	-9.41	74	54.03	27.63	19.2	36.27	100	66	P	H
		2483.52	52.98	-1.02	54	42.42	27.63	19.2	36.27	100	66	A	H
													H
													H
													H
													H
													H
													H
													H
	*	2462	110.21	-	-	99.77	27.55	19.16	36.27	250	304	P	V
	*	2462	103.16	-	-	92.72	27.55	19.16	36.27	250	304	A	V
		2483.88	64.56	-9.44	74	53.98	27.64	19.21	36.27	250	304	P	V
		2483.52	52.2	-1.8	54	41.64	27.63	19.2	36.27	250	304	A	V
													V
													V
													V
													V
													V
												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

802.11ax HE40_Tx_CH38 (Band edge @ 3m)

WIFI Ant.	Note	Frequency	Level	Margin	Limit Line	Read Level	Antenna Factor	Path Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
6+7		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11ax HE40 CH 38 5190MHz		5146.12	60.58	-13.42	74	52.08	32.91	13.37	37.78	100	302	P	H
		5150	49.3	-4.7	54	40.81	32.9	13.37	37.78	100	302	A	H
	*	5190	111.17	-	-	102.57	32.98	13.43	37.81	100	302	P	H
	*	5190	103.22	-	-	94.62	32.98	13.43	37.81	100	302	A	H
		5359.76	48.62	-25.38	74	40.16	32.74	13.65	37.93	100	302	P	H
		5354.72	38.91	-15.09	54	30.48	32.72	13.64	37.93	100	302	A	H
													H
													H
													H
													H
													H
													H
		5148.2	61.45	-12.55	74	52.96	32.9	13.37	37.78	100	289	P	V
		5150	49.81	-4.19	54	41.32	32.9	13.37	37.78	100	289	A	V
	*	5190	112.35	-	-	103.75	32.98	13.43	37.81	100	289	P	V
	*	5190	105.02	-	-	96.42	32.98	13.43	37.81	100	289	A	V
		5390.28	48.84	-25.16	74	40.24	32.86	13.69	37.95	100	289	P	V
		5350	38.98	-15.02	54	30.56	32.7	13.64	37.92	100	289	A	V
													V
													V
													V
													V
													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

802.11g_Tx_CH11 + 802.11ax HE40_Tx_CH38 (Harmonic @ 3m)

WIFI Ant.	Note	Frequency	Level	Margin	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)
802.11g_Tx_CH11 + 802.11ax HE40_Tx_CH38		4924	47.94	-26.06	74	39.58	32.74	13.22	37.6	100	302	P	H
		4924	39.68	-14.32	54	31.32	32.74	13.22	37.6	100	302	A	H
		7386	58.71	-15.29	74	43.89	36.68	16.81	38.67	218	253	P	H
		7386	46.23	-7.77	54	31.41	36.68	16.81	38.67	218	253	A	H
		10380	50.44	-17.76	68.2	34.17	38.74	18.96	41.43	-	-	P	H
		15570	51.99	-22.01	74	35.23	38.16	23.31	44.71	400	236	P	H
		15570	41.94	-12.06	54	25.18	38.16	23.31	44.71	400	236	A	H
													H
													H
													H
													H
													H
		4924	47.04	-26.96	74	38.68	32.74	13.22	37.6	100	289	P	V
		4924	39.63	-14.37	54	31.27	32.74	13.22	37.6	100	289	A	V
		7386	60.79	-13.21	74	45.97	36.68	16.81	38.67	110	343	P	V
		7386	47.55	-6.45	54	32.73	36.68	16.81	38.67	110	343	A	V
		10380	50.88	-17.32	68.2	34.61	38.74	18.96	41.43	-	-	P	V
		15570	52.02	-21.98	74	35.26	38.16	23.31	44.71	300	1	P	V
		15570	41.99	-12.01	54	25.23	38.16	23.31	44.71	300	1	A	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.												

Emission below 1GHz

802.11g_Tx_CH11 + 802.11ax HE40_Tx_CH38 (LF @ 3m)

[illegible]

Emission above 18GHz

802.11g_Tx_CH11 + 802.11ax HE40_Tx_CH38 (SHF @ 3m)

Ant. Simultaneously	Note	Frequency (MHz)	Level (dBμV/m)	Margin (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)
802.11g_Tx_CH11 + 802.11ax HE40_Tx_CH38 SHF		39440	55.77	-18.23	74	39.24	45.78	27.29	56.54	-	-	P	H
		39440	45.66	-8.34	54	29.13	45.78	27.29	56.54	-	-	A	H
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802.11g_Tx_CH11 + 802.11ax HE40_Tx_CH38 SHF		39468	54.85	-19.15	74	38.45	45.62	27.3	56.52	-	-	P	V
		39468	45.44	-8.56	54	29.04	45.62	27.3	56.52	-	-	A	V
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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.	
6+7		(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 :	John Chuang and David Dai	Temperature :	19.5~23.5°C
		Relative Humidity :	64.9~70.7%

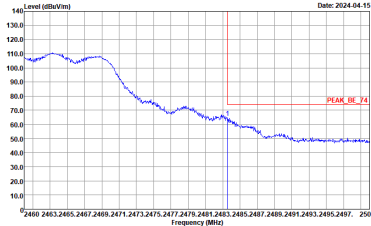
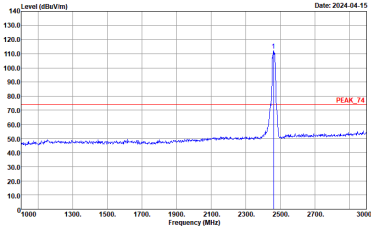
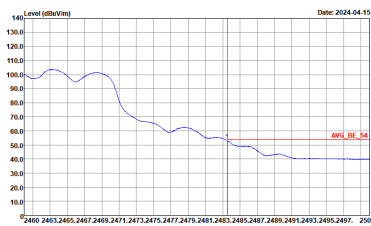
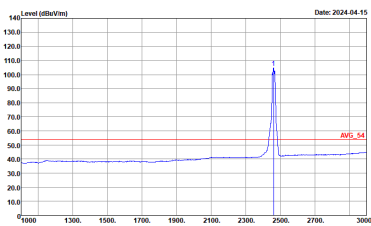
Note symbol

-L	Low channel location
-R	High channel location

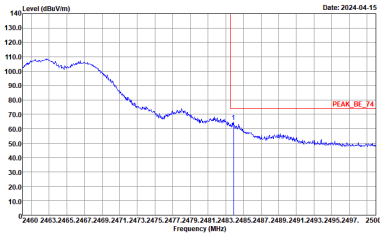
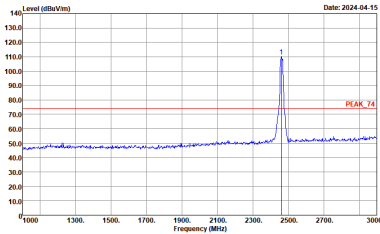
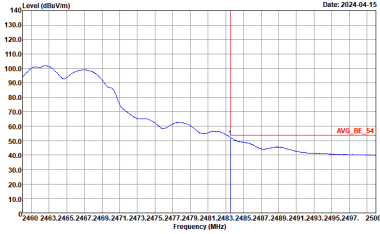
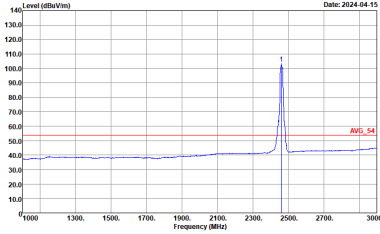


2.4GHz 2400~2483.5MHz +Band 1 - 5150~5250MHz

802.11g _Tx_CH11 (Band Edge @ 3m)

WLAN	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11g _Tx_CH11 2462MHz - L	
6+7	Horizontal	Fundamental
Peak	 Site : 03CH20-HY Condition : PEAK_BE_74 3m 91200_02360_231030 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH20-HY Condition : PEAK_74 3m 91200_02360_231030 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site : 03CH20-HY Condition : AVG_BE_54 3m 91200_02360_231030 HORIZONTAL : RBW:1000.000KHz VBW:0.620KHz SWT:Auto	 Site : 03CH20-HY Condition : AVG_54 3m 91200_02360_231030 HORIZONTAL : RBW:1000.000KHz VBW:0.620KHz SWT:Auto



WLAN	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11g_Tx_CH11 2462MHz - L	
6+7	Vertical	Fundamental
Peak	 Site : 03CH20-HY Condition : PEAK_BE_74 3m 91200_02360_231030 VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH20-HY Condition : PEAK_74 3m 91200_02360_231030 VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
	 Site : 03CH20-HY Condition : AVG_BE_54 3m 91200_02360_231030 VERTICAL RBW:1000.000KHz VBW:0.620KHz SWT:Auto	 Site : 03CH20-HY Condition : AVG_54 3m 91200_02360_231030 VERTICAL RBW:1000.000KHz VBW:0.620KHz SWT:Auto
Avg.		

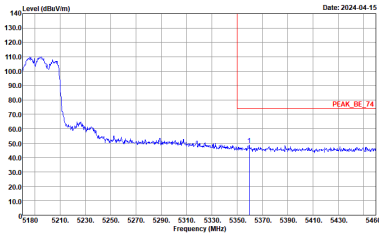
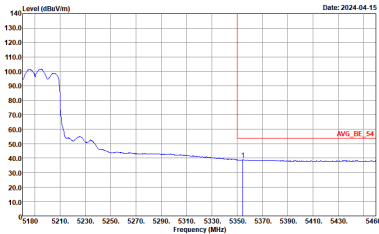


2.4GHz 2400~2483.5MHz + Band 1 - 5150~5250MHz

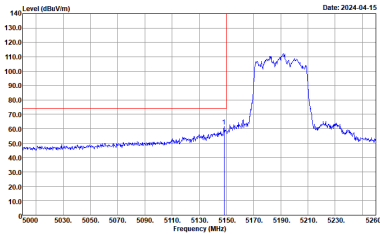
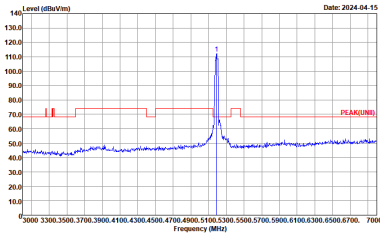
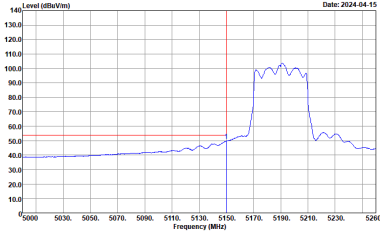
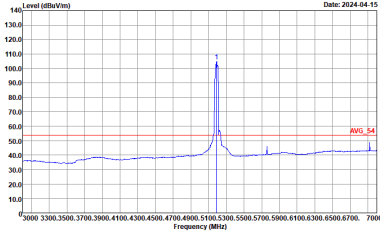
802.11ax HE40_Tx_CH38 (Band edge @ 3m)

WIFI	Band 1 5150~5250MHz Band Edge @ 3m	
ANT	802.11ax HE40_Tx_CH38 5190MHz	
6+7	Horizontal	Fundamental
Peak	Site : 03CH20-HY Condition : PEAK_BE_74 3m 91200_02360_231030 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	Site : 03CH20-HY Condition : PEAK(FUND) 3m 91200_02360_231030 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	Site : 03CH20-HY Condition : AVG_BE_54 3m 91200_02360_231030 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	Site : 03CH20-HY Condition : AVG_54 3m 91200_02360_231030 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto

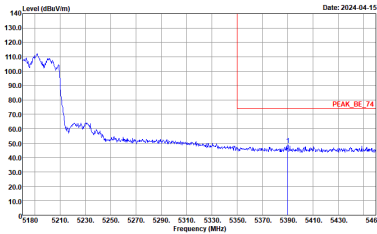
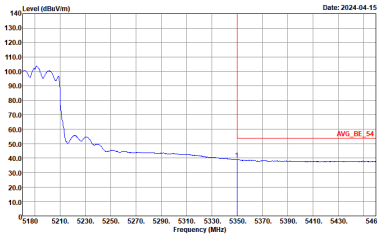


WIFI	Band 1 5150~5250MHz Band Edge @ 3m	
ANT	802.11ax HE40_Tx_CH38 Full CH38 5190MHz - R	
6+7	Horizontal	Fundamental
Peak	 Site : 03CH20-HY Condition : PEAK_BE_74 3m 91200_02360_231030 HORIZONTAL RBW:1000.000kHz VBW:3000.000kHz SWT:Auto	Left blank
Avg.	 Site : 03CH20-HY Condition : AVG_BE_54 3m 91200_02360_231030 HORIZONTAL RBW:1000.000kHz VBW:0.470kHz SWT:Auto	Left blank



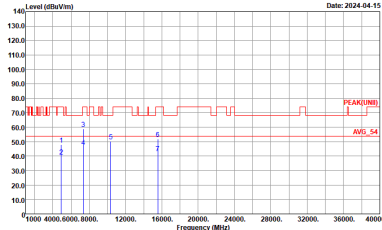
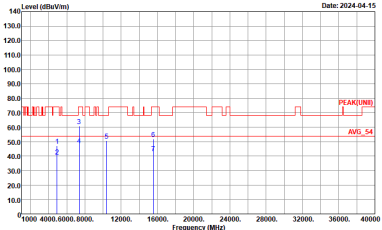
WIFI	Band 1 5150~5250MHz Band Edge @ 3m	
ANT	802.11ax HE40_Tx_CH38 5190MHz	
6+7	Vertical	Fundamental
Peak	 Site : 03CH20-HY Condition : PEAK_BE_74 3m 91200_02360_231030 VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH20-HY Condition : PEAK(LINE) 3m 91200_02360_231030 VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site : 03CH20-HY Condition : AVG_BE_54 3m 91200_02360_231030 VERTICAL RBW:1000.000KHz VBW:0.470KHz SWT:Auto	 Site : 03CH20-HY Condition : AVG_54 3m 91200_02360_231030 VERTICAL RBW:1000.000KHz VBW:0.470KHz SWT:Auto



WIFI	Band 1 5150~5250MHz Band Edge @ 3m	
ANT	802.11ax HE40 Full CH38 5190MHz - R	
6+7	Vertical	Fundamental
Peak	 Site : 03CH20-HY Condition : PEAK_BE_74 3m 91200_02360_231030 VERTICAL RBW:1000.000kHz VBW:3000.000kHz SWT:Auto	Left blank
Avg.	 Site : 03CH20-HY Condition : AVG_BE_54 3m 91200_02360_231030 VERTICAL RBW:1000.000kHz VBW:0.470kHz SWT:Auto	Left blank



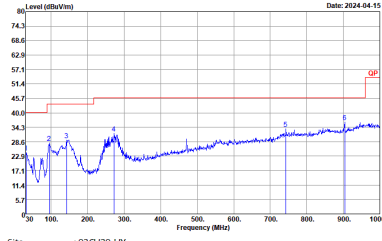
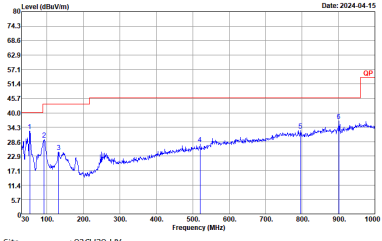
2.4GHz 2400~2483.5MHz + Band 1 - 5150~5250MHz
802.11g_Tx_CH11 + 802.11ax HE40_Tx_CH38 (Harmonic @ 3m)

WIFI	2.4GHz 2400~2483.5MHz +Band 1 5150~5250MHz Harmonic @ 3m	
ANT	802.11g_Tx_CH11 + 802.11ax HE40_Tx_CH38	
Simultaneously	Horizontal	Vertical
Peak Avg.	 Site : 03CH20-HY Condition : PEAK(UNIT) 3m 91200_02360_231030 HORIZONTAL :	 Site : 03CH20-HY Condition : PEAK(UNIT) 3m 91200_02360_231030 VERTICAL :



Emission below 1GHz

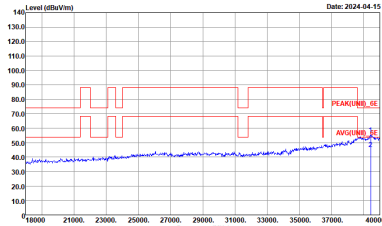
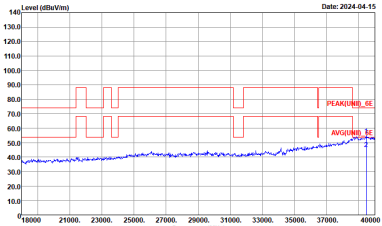
802.11g_Tx_CH11 + 802.11ax HE40_Tx_CH38 (LF @ 3m)

	2.4GHz 2400~2483.5MHz +Band 1 5150~5250MHz LF @ 3m	
ANT	802.11g_Tx_CH11 + 802.11ax HE40_Tx_CH38	
Simultaneously	Horizontal	Vertical
QP / Peak	 Site : 03CH20-HY Condition : QP 3m LF_55606_231020_200 HORIZONTAL :	 Site : 03CH20-HY Condition : QP 3m LF_55606_231020_200 VERTICAL :



Emission above 18GHz

802.11g_Tx_CH11 + 802.11ax HE40_Tx_CH38 (SHF @ 3m)

WIFI	2.4GHz 2400~2483.5MHz +Band 1 5150~5250MHz	
ANT	802.11g_Tx_CH11 + 802.11ax HE40_Tx_CH38	
Simultaneously	Horizontal	Vertical
Peak Avg.	 Site : 03CH20-HY Condition : PEAK(UNIT)_6E 1m SHF_1224_230710 HORIZONTAL :	 Site : 03CH20-HY Condition : PEAK(UNIT)_6E 1m SHF_1224_230710 VERTICAL :



Appendix C. Duty Cycle Plots

Antenna	Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting
6+7	802.11g	85.43	1718	0.58	620Hz
6+7	5GHz 802.11ax HE40 Full RU	86.05	2220	0.45	1kHz

MIMO <Ant. 6+7>

