



# FCC CO-LOCATION RADIO TEST REPORT

FCC ID : UZ7TC520L  
Equipment : Touch Computer  
Brand Name : Zebra  
Model Name : TC520L  
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 Mar. 22, 2021 and testing was started from Apr. 02, 2021 and completed on May 14, 2021. We, Sporton International Inc. Wensan Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

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

Approved by: Louis Wu

**Sporton International Inc. Wensan Laboratory**

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



## Table of Contents

History of this test report.....	3
Summary of Test Result.....	4
<b>1 General Description .....</b>	<b>5</b>
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
<b>2 Test Configuration of Equipment Under Test .....</b>	<b>8</b>
2.1 Carrier Frequency and Channel .....	8
2.2 Test Mode.....	8
2.3 Connection Diagram of Test System.....	9
2.4 EUT Operation Test Setup .....	9
<b>3 Test Result .....</b>	<b>10</b>
3.1 Unwanted Emissions Measurement.....	10
3.2 Antenna Requirements.....	14
<b>4 List of Measuring Equipment.....</b>	<b>15</b>
<b>5 Uncertainty of Evaluation .....</b>	<b>16</b>
<b>Appendix A. Radiated Spurious Emission</b>	
<b>Appendix B. Radiated Spurious Emission Plots</b>	
<b>Appendix C. Duty Cycle Plots</b>	
<b>Appendix D. Setup Photographs</b>	



### History of this test report

Report No.	Version	Description	Issued Date
FR122002G	01	Initial issue of report	May 26, 2021



### Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.407(b)	Unwanted Emissions	Pass	Under limit 2.73 dB at 5350.240 MHz
3.2	15.203 15.407(a)	Antenna Requirement	Pass	-

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

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

**Reviewed by: Wei Chen**  
**Report Producer: Ruby Zou**



# 1 General Description

## 1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	Touch Computer
Brand Name	Zebra
Model Name	TC520L
FCC ID	UZ7TC520L
EUT supports Radios application	NFC WLAN 11b/g/n HT20 WLAN 11a/n HT20/HT40 WLAN 11ac VHT20/VHT40/VHT80 WLAN 11ax HE20/HE40/HE80 Bluetooth BR/EDR/LE
HW Version	DV
SW Version	11-09-22.00-RG-U00-PRD-HEL-04
FW Version	FUSION_SA_2_1.1.0.012_R
MFD	07APR21
EUT Stage	Identical Prototype

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

Specification of Accessories				
Adapter	Brand Name	Zebra	Part Number	PWR-WUA5V12W0US
Battery 1	Brand Name	Zebra	Part Number	BT-000314-01
Battery 2	Brand Name	Zebra	Part Number	BT-000314-50
Rugged Charge/USB cable	Brand Name	Zebra	Part Number	CBL-TC51-USB1-01
Headset Jumper 1	Brand Name	Zebra	Part Number	CBL-TC51-HDST25-01
Headset Jumper 2	Brand Name	Zebra	Part Number	CBL-TC51-HDST35-01
2.5mm Earphone	Brand Name	Zebra	Part Number	HDST-25MM-PTVP-01
3.5mm Earphone	Brand Name	Zebra	Part Number	HDST-35MM-PTVP-01
Exoskeleton	Brand Name	Zebra	Part Number	SG-TC51-EX01-01
Trigger Handle	Brand Name	Zebra	Part Number	TRG-TC51-SNP1-01
Soft Holster	Brand Name	Zebra	Part Number	SG-TC51-HLSTR1-01
Hand strap	Brand Name	Zebra	Part Number	SG-TC51-BHDSTP1-03
USB-C Adaptor	Brand Name	Zebra	Part Number	ADPTR-TC56-USBC-01
USB Type C cable	Brand Name	Zebra	Part Number	N/A



## 1.2 Product Specification of Equipment Under Test

Product Specification subjective to this standard	
<b>Tx/Rx Frequency Range</b>	2402 MHz ~ 2480 MHz 5260 MHz ~ 5320 MHz
<b>Antenna Type / Gain</b>	<b>Bluetooth</b> PIFA Antenna with gain 2.10 dBi <b>WLAN</b> <5260 MHz ~ 5320 MHz> <b>Ant. 1</b> : PIFA Antenna with gain 3.70 dBi <b>Ant. 2</b> : PIFA Antenna with gain -0.10 dBi
<b>Type of Modulation</b>	Bluetooth LE : GFSK 802.11ax : OFDM (BPSK/QPSK/16QAM/64QAM/256QAM/1024QAM)

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

## 1.3 Modification of EUT

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

## 1.4 Testing Location

<b>Test Site</b>	Sporton International Inc. Wensan Laboratory
<b>Test Site Location</b>	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
<b>Test Site No.</b>	<b>Sporton Site No.</b> 03CH13-HY

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

FCC designation No.: TW3786



## **1.5 Applicable Standards**

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

- ♦ FCC Part 15 Subpart C §15.247
- ♦ FCC Part 15 Subpart E
- ♦ FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02
- ♦ FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
- ♦ FCC KDB 414788 D01 Radiated Test Site v01r01.
- ♦ FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ♦ 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, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (X plane) were recorded in this report.

### 2.1 Carrier Frequency and Channel

2400-2483.5 MHz		5260 MHz-5320 MHz	
Bluetooth-LE		802.11ax HE20	
Channel	Freq. (MHz)	Channel	Freq. (MHz)
19	2440	64	5320

### 2.2 Test Mode

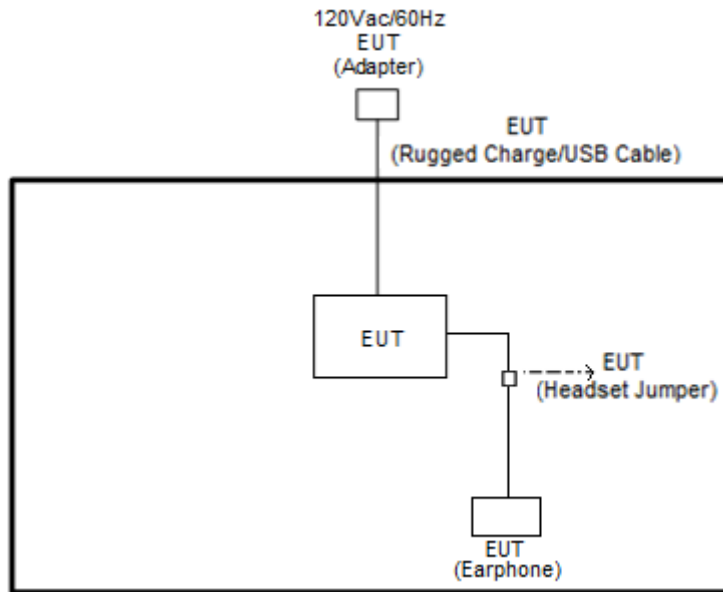
<Co-Location>

Modulation	Data Rate
Bluetooth-LE + 5GHz 802.11ax HE20 for MIMO Ant. 1+2	GFSK + MCS 0

**Remark:** For Radiated Test Cases, the tests were performed with Battery 1, Headset Jumper 2 and 3.5mm Earphone.



### 2.3 Connection Diagram of Test System



### 2.4 EUT Operation Test Setup

The RF test items, utility “QRCT4 V4.0 - 00175” 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.

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

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

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

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

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

##### 3.1.2 Measuring Instruments

See list of measuring equipment of this test report.

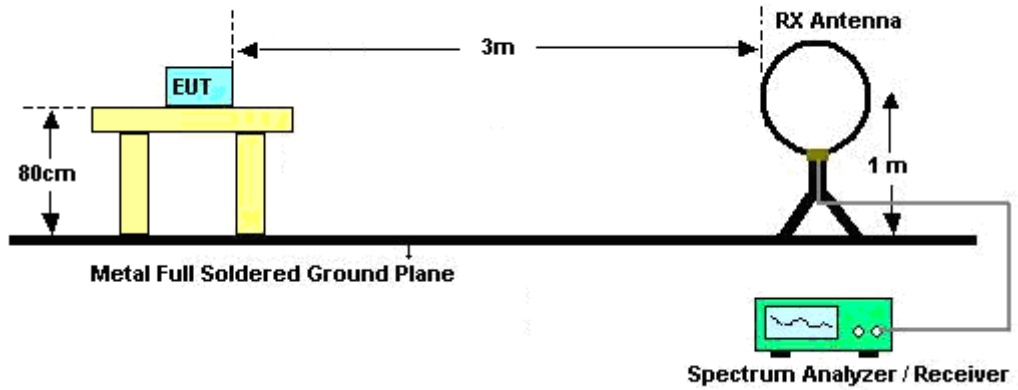


### 3.1.3 Test Procedures

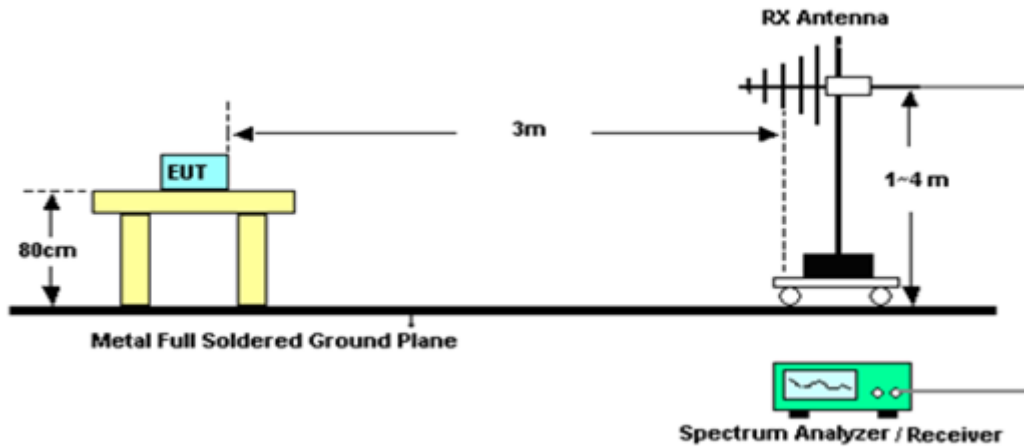
1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01. Section G) Unwanted emissions measurement.
  - (1) Procedure for Unwanted Emissions Measurements Below 1000 MHz
    - RBW = 120 kHz
    - VBW = 300 kHz
    - Detector = Peak
    - Trace mode = max hold
  - (2) Procedure for Peak Unwanted Emissions Measurements Above 1000 MHz
    - RBW = 1 MHz
    - VBW  $\geq$  3 MHz
    - Detector = Peak
    - Sweep time = auto
    - Trace mode = max hold
  - (3) Procedures for Average Unwanted Emissions Measurements Above 1000 MHz
    - RBW = 1 MHz
    - VBW = 10 Hz, when duty cycle is no less than 98 percent.
    - VBW  $\geq$  1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.
2. The EUT was placed on a turntable with 0.8 meter for frequency below 1 GHz and 1.5 meter for frequency above 1 GHz respectively above ground.
3. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
4. The antenna is a broadband antenna and its height is adjusted between one meter and four meters above ground to find the maximum value of the field strength for both horizontal polarization and vertical polarization of the antenna.
5. For each suspected emission, the EUT was arranged to its worst case and then adjust the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading.
6. For testing below 1 GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1 GHz, the emission level of the EUT in peak mode was 20 dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

### 3.1.4 Test Setup

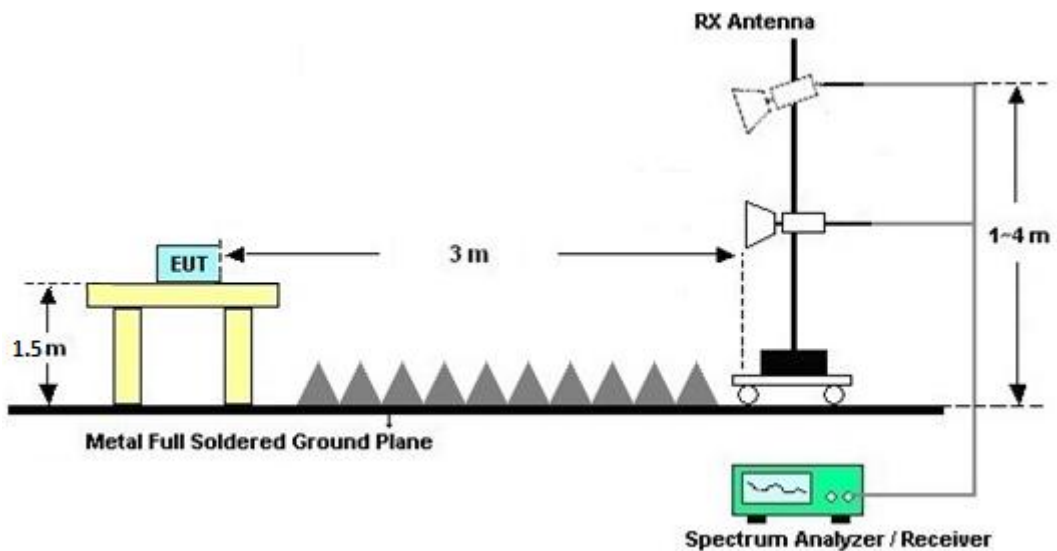
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz





### **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 a comparison data 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**

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	Jul. 14, 2020	Apr. 02, 2021~ May 14, 2021	Jul. 13, 2021	Radiation (03CH13-HY)
Amplifier	Sonoma-Instrument	310 N	187282	9KHz~1GHz	Dec. 16, 2020	Apr. 02, 2021~ May 14, 2021	Dec. 15, 2021	Radiation (03CH13-HY)
Bilog Antenna	TESEQ	CBL 6111D&00800 N1D01N-06	40103&07	30MHz to 1GHz	Apr. 29, 2020	Apr. 02, 2021~ Apr. 27, 2021	Apr. 28, 2021	Radiation (03CH13-HY)
Bilog Antenna	TESEQ	CBL 6111D&00800 N1D01N-06	40103&07	30MHz to 1GHz	Apr. 28, 2021	Apr. 28, 2021 ~ May 14, 2021	Apr. 27, 2022	Radiation (03CH13-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-124 1	1GHz ~ 18GHz	Jul. 15, 2020	Apr. 02, 2021~ May 14, 2021	Jul. 14, 2021	Radiation (03CH13-HY)
Preamplifier	MITEQ	AMF-7D-0010 1800-30-10P	1590074	1GHz~18GHz	May 19, 2020	Apr. 02, 2021~ May 14, 2021	May 18, 2021	Radiation (03CH13-HY)
Preamplifier	Keysight	83017A	MY532701 47	1GHz~26.5GHz	Oct. 28, 2020	Apr. 02, 2021~ May 14, 2021	Oct. 27, 2021	Radiation (03CH13-HY)
Signal Generator	Anritsu	MG3694C	163401	0.1Hz~40GHz	Jan. 31, 2021	Apr. 02, 2021~ May 14, 2021	Jan. 30, 2022	Radiation (03CH13-HY)
Spectrum Analyzer	Keysight	N9010A	MY553705 26	10Hz~44GHz	Mar. 18, 2021	Apr. 02, 2021~ May 14, 2021	Mar. 17, 2022	Radiation (03CH13-HY)
Controller	EMEC	EM1000	N/A	Control Turn table & Ant Mast	N/A	Apr. 02, 2021~ May 14, 2021	N/A	Radiation (03CH13-HY)
Antenna Mast	EMEC	AM-BS-4500- B	N/A	1m~4m	N/A	Apr. 02, 2021~ May 14, 2021	N/A	Radiation (03CH13-HY)
Turn Table	EMEC	TT2000	N/A	0~360 Degree	N/A	Apr. 02, 2021~ May 14, 2021	N/A	Radiation (03CH13-HY)
Software	Audix	E3 6.2009-8-24	RK-00099 2	N/A	N/A	Apr. 02, 2021~ May 14, 2021	N/A	Radiation (03CH13-HY)
Preamplifier	EMEC	EM18G40G	060715	18GHz ~ 40GHz	Dec. 11, 2020	Apr. 02, 2021~ May 14, 2021	Dec. 10, 2021	Radiation (03CH13-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 126E	0030/126E	30M-18G	Feb. 10, 2021	Apr. 02, 2021~ May 14, 2021	Feb. 09, 2022	Radiation (03CH13-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	804793/4	30M-18G	Feb. 10, 2021	Apr. 02, 2021~ May 14, 2021	Feb. 09, 2022	Radiation (03CH13-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	505134/2	30M~40GHz	Feb. 22, 2021	Apr. 02, 2021~ May 14, 2021	Feb. 21, 2022	Radiation (03CH13-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY4274/2	30MHz~40GHz	Mar. 11, 2021	Apr. 02, 2021~ May 14, 2021	Mar. 10, 2022	Radiation (03CH13-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY24961/ 4	30M-18G	Feb. 10, 2021	Apr. 02, 2021~ May 14, 2021	Feb. 09, 2022	Radiation (03CH13-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4 PE	9kHz~30MHz	Mar. 11, 2021	Apr. 02, 2021~ May 14, 2021	Mar. 10, 2022	Radiation (03CH13-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170 584	18GHz- 40GHz	Dec. 11, 2020	Apr. 02, 2021~ May 14, 2021	Dec. 10, 2021	Radiation (03CH13-HY)
Hygrometer	TECPEL	DTM-303B	TP200879	N/A	Oct. 22, 2020	Apr. 02, 2021~ May 14, 2021	Oct. 21, 2021	Radiation (03CH13-HY)
Filter	Wainwright	WHKX8-5872. 5-6750-18000 -40ST	SN5	6.75GHz High Pass Filter	Mar. 11, 2021	Apr. 02, 2021~ May 14, 2021	Mar. 10, 2022	Radiation (03CH13-HY)



## 5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	4.8
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### Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	5.1
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### Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	4.6
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### Appendix A. Radiated Spurious Emission

Test Engineer :	Daniel Lee, Jacky Hong and Wilson Wu	Temperature :	20~25°C
		Relative Humidity :	50~60%

BLE (1M)\_CH19 + WLAN 802.11ax HE20\_Tx\_CH64 for MIMO Ant. 1+2

2.4GHz 2400~2483.5MHz

BLE (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 19 2440MHz		2352.56	54.27	-19.73	74	40.35	27.69	14.08	27.85	119	138	P	H
		2347.24	48.25	-5.75	54	34.31	27.71	14.08	27.85	119	138	A	H
	*	2440	100.83	-	-	86.98	27.52	14.16	27.83	119	138	P	H
	*	2440	100.11	-	-	86.26	27.52	14.16	27.83	119	138	A	H
		2486.21	53.96	-20.04	74	40.08	27.5	14.2	27.82	119	138	P	H
		2497.55	49.27	-4.73	54	35.38	27.5	14.21	27.82	119	138	A	H
		2359	53.78	-20.22	74	39.86	27.68	14.09	27.85	389	11	P	V
		2343.18	48.47	-5.53	54	34.54	27.71	14.07	27.85	389	11	A	V
	*	2440	96.7	-	-	82.85	27.52	14.16	27.83	389	11	P	V
	*	2440	96.47	-	-	82.62	27.52	14.16	27.83	389	11	A	V
		2487.75	53.86	-20.14	74	39.98	27.5	14.2	27.82	389	11	P	V
		2484.25	48.39	-5.61	54	34.51	27.5	14.2	27.82	389	11	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



Band 2 - 5250~5350MHz

WIFI 802.11ax HE20 (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)
802.11ax HE20 CH 64 5320MHz	*	5320	116.63	-	-	106.35	31.3	6.35	27.37	252	70	P	H
	*	5320	105.49	-	-	95.21	31.3	6.35	27.37	252	70	A	H
		5353.28	60.07	-13.93	74	49.75	31.31	6.37	27.36	252	70	P	H
		5350.24	51.27	-2.73	54	40.96	31.3	6.37	27.36	252	70	A	H
	*	5320	113.11	-	-	102.83	31.3	6.35	27.37	100	106	P	V
	*	5320	103.96	-	-	93.68	31.3	6.35	27.37	100	106	A	V
		5351.36	58.17	-15.83	74	47.85	31.31	6.37	27.36	100	106	P	V
		5350.08	51.16	-2.84	54	40.85	31.3	6.37	27.36	100	106	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



**BLE (1M)\_CH19 + WLAN 802.11ax HE20\_Tx\_CH64 for MIMO Ant. 1+2 (Harmonic @ 3m)**

Ant.	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.	
Simultaneously		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )	
<b>BLE CH 19 2440MHz + 802.11ax HE20 CH 64 5320MHz</b>		4880	49.04	-24.96	74	39.38	31.2	5.92	27.46	100	0	P	H	
		7320	43.95	-30.05	74	55.19	36.76	9.1	57.1	100	0	P	H	
		10640	51.7	-22.3	74	57.55	40.2	10.29	56.34	100	14	P	H	
		10640	41.5	-12.5	54	47.35	40.2	10.29	56.34	100	14	A	H	
		15960	49.81	-24.19	74	55.57	37.8	12.07	55.63	100	0	P	H	
			4880	49.39	-24.61	74	39.73	31.2	5.92	27.46	100	0	P	V
			7320	44.78	-29.22	74	56.02	36.76	9.1	57.1	100	0	P	V
			10640	57.18	-16.82	74	63.03	40.2	10.29	56.34	100	27	P	V
			10640	45.22	-8.78	54	51.07	40.2	10.29	56.34	100	27	A	V
			15960	47.47	-26.53	74	53.23	37.8	12.07	55.63	100	0	P	V
<b>Remark</b>	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.													



**Note symbol**

*	<b>Fundamental Frequency</b> which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is <b>over limit</b> line.
P/A	<b>Peak</b> or <b>Average</b>
H/V	<b>Horizontal</b> or <b>Vertical</b>



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

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1+2		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )
802.11b		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
CH 01													
2412MHz		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) =  
Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)
3. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

**For Peak Limit @ 2390MHz:**

1. Level(dBμV/m)  
= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)  
= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)  
= 55.45 (dBμV/m)
2. Over Limit(dB)  
= Level(dBμV/m) – Limit Line(dBμV/m)  
= 55.45(dBμV/m) – 74(dBμV/m)  
= -18.55(dB)

**For Average Limit @ 2390MHz:**

1. Level(dBμV/m)  
= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)  
= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)  
= 43.54 (dBμV/m)
2. Over Limit(dB)  
= Level(dBμV/m) – Limit Line(dBμV/m)  
= 43.54(dBμV/m) – 54(dBμV/m)  
= -10.46(dB)

**Both peak and average measured complies with the limit line, so test result is “PASS”.**



## Appendix B. Radiated Spurious Emission Plots

Test Engineer :	Daniel Lee, Jacky Hong and Wilson Wu	Temperature :	20~25°C
		Relative Humidity :	50~60%

### Note symbol

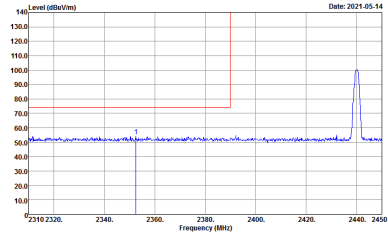
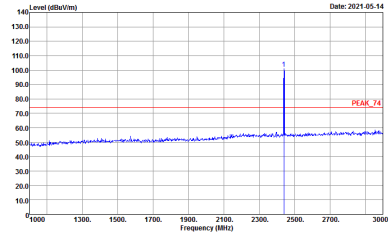
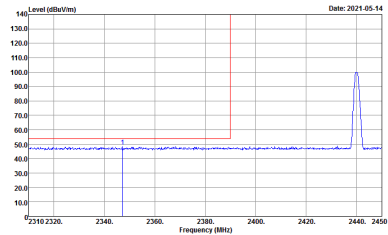
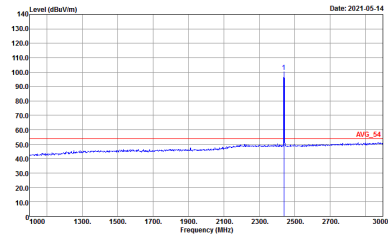
-L	Low channel location
-R	High channel location



BLE (1M)\_CH19 + WLAN 802.11ax HE20\_Tx\_CH64 for MIMO Ant. 1+2

2400~2483.5MHz

BLE (Band Edge @ 3m)

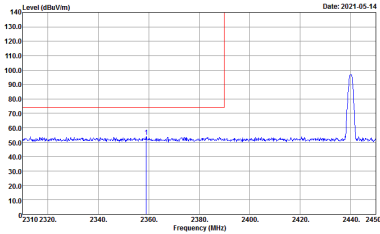
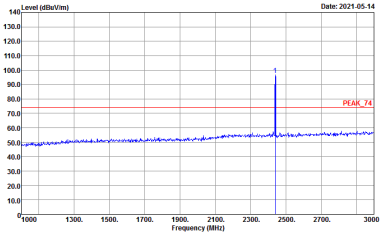
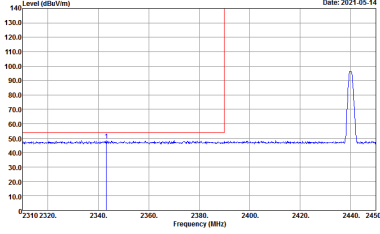
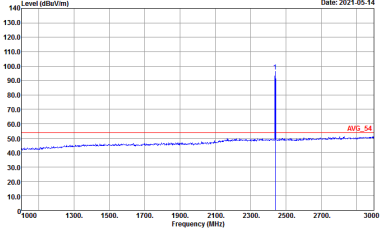
Ant.	BLE (1M)_CH19 + WLAN 802.11ax HE20_Tx_CH64	
Simultaneously	Horizontal	Fundamental
Peak	 <p>Site : 03CH13-HY Condition : PEAK_BE_74 3m HORN_9120D_1241 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>	 <p>Site : 03CH13-HY Condition : PEAK_74 3m HORN_9120D_1241 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>
Avg.	 <p>Site : 03CH13-HY Condition : AVG_BE_54 3m HORN_9120D_1241 HORIZONTAL : RBW:1000.000KHz VBW:30.000KHz SWT:Auto</p>	 <p>Site : 03CH13-HY Condition : AVG_54 3m HORN_9120D_1241 HORIZONTAL : RBW:1000.000KHz VBW:30.000KHz SWT:Auto</p>



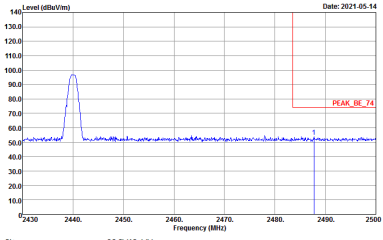
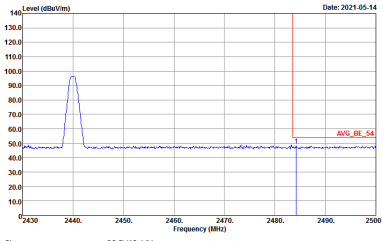
Ant.	BLE (1M)_CH19 + WLAN 802.11ax HE20_Tx_CH64	
Simultaneously	Horizontal	Fundamental
<p style="text-align: center;"><b>Peak</b></p>		<p style="text-align: center;">Left blank</p>
<p style="text-align: center;"><b>Avg.</b></p>		<p style="text-align: center;">Left blank</p>





Ant.	BLE (1M)_CH19 + WLAN 802.11ax HE20_Tx_CH64	
Simultaneously	Vertical	Fundamental
<p style="text-align: center;"><b>Peak</b></p>	 <p>Date: 2021-05-14</p> <p>Site Condition : 03CH13-HY : PEAK_BE_74 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>	 <p>Date: 2021-05-14</p> <p>Site Condition : 03CH13-HY : PEAK_74 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>
<p style="text-align: center;"><b>Avg.</b></p>	 <p>Date: 2021-05-14</p> <p>Site Condition : 03CH13-HY : AV6_BE_54 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:30.000KHz SWT:Auto</p>	 <p>Date: 2021-05-14</p> <p>Site Condition : 03CH13-HY : AV6_54 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:30.000KHz SWT:Auto</p>

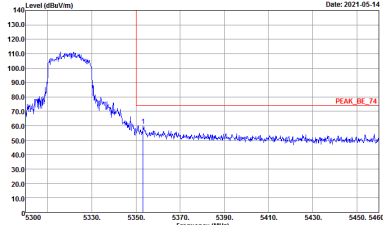
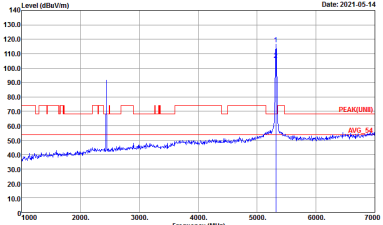
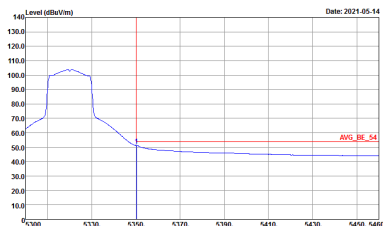


Ant.	BLE (1M)_CH19 + WLAN 802.11ax HE20_Tx_CH64	
Simultaneously	Vertical	Fundamental
Peak	 <p data-bbox="486 660 869 694">Date: 2021-05-14 Site : 03CH13-HY Condition : PEAK_BE_74 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>	Left blank
Avg.	 <p data-bbox="486 1339 869 1373">Date: 2021-05-14 Site : 03CH13-HY Condition : AVG_BE_54 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:30.000KHz SWT:Auto</p>	Left blank

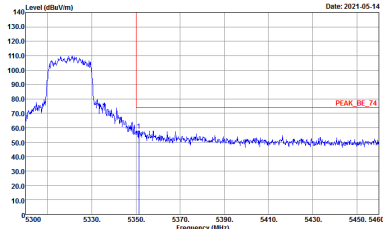
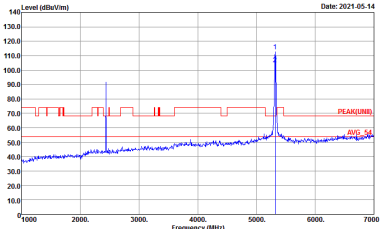
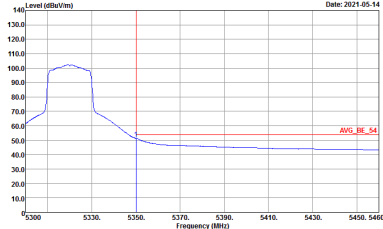


Band 2 5250~5350MHz

WLAN 802.11ax HE20 (Band Edge @ 3m)


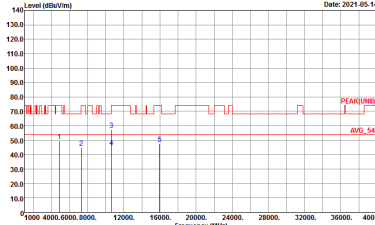
Ant.	BLE (1M)_CH19 + WLAN 802.11ax HE20_Tx_CH64 - L	
Simultaneously	Horizontal	Fundamental
<p style="text-align: center;"><b>Peak</b></p>	 <p style="font-size: small;">Date: 2021-05-14</p> <p style="font-size: x-small;">Site Condition : 03CH13-HY : PEAK_BE_74 3m HORN_9120D_1241 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>	 <p style="font-size: small;">Date: 2021-05-14</p> <p style="font-size: x-small;">Site Condition : 03CH13-HY : PEAK(UMBL) 3m HORN_9120D_1241 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>
<p style="text-align: center;"><b>Avg.</b></p>	 <p style="font-size: small;">Date: 2021-05-14</p> <p style="font-size: x-small;">Site Condition : 03CH13-HY : AVG_BE_54 3m HORN_9120D_1241 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>	<p style="text-align: center;"><b>Left blank</b></p>



Ant.	BLE (1M)_CH19 + WLAN 802.11ax HE20_Tx_CH64 - L	
Simultaneously	Vertical	Fundamental
<p style="text-align: center;"><b>Peak</b></p>	 <p>Date: 2021-05-14</p> <p>Level (dBµV/m)</p> <p>Frequency (MHz)</p> <p>PEAK_BE_74</p> <p>Site : 03CH13-HY Condition : PEAK_BE_74 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>	 <p>Date: 2021-05-14</p> <p>Level (dBµV/m)</p> <p>Frequency (MHz)</p> <p>PEAK(UM)</p> <p>AVG_54</p> <p>Site : 03CH13-HY Condition : PEAK(UM) 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>
<p style="text-align: center;"><b>Avg.</b></p>	 <p>Date: 2021-05-14</p> <p>Level (dBµV/m)</p> <p>Frequency (MHz)</p> <p>AVG_BE_54</p> <p>Site : 03CH13-HY Condition : AVG_BE_54 3m HORN_9120D_1241 VERTICAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto</p>	<p style="text-align: center;"><b>Left blank</b></p>



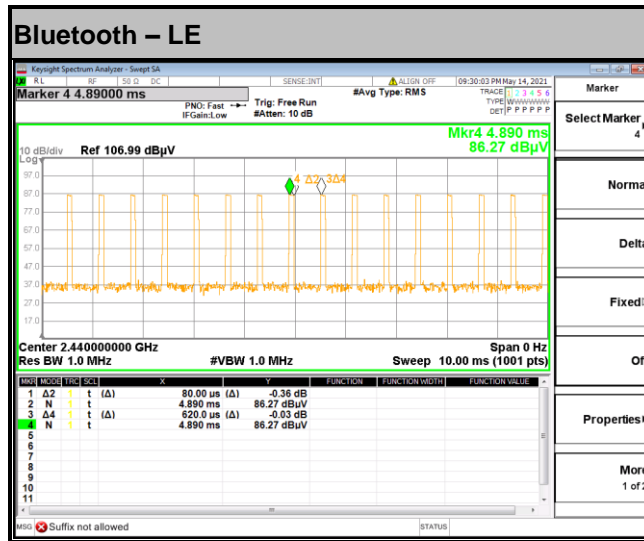
BLE (1M)\_CH19 + WLAN 802.11ax HE20\_Tx\_CH64 for MIMO Ant. 1+2 (Harmonic @ 3m)

Ant.	BLE (1M)_CH19 + WLAN 802.11ax HE20_Tx_CH64	
Simultaneously	Horizontal	Vertical
<p><b>Peak</b></p> <p><b>Avg.</b></p>	 <p>Site : 03CH13-HY            Condition : PEAK(LINE) 3m HORN_9120D_1241 HORIZONTAL            Detector : Peak</p>	 <p>Site : 03CH13-VY            Condition : PEAK(LINE) 3m HORN_9120D_1241 VERTICAL            Detector : Peak</p>



### Appendix C. Duty Cycle Plots

Antenna	Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting	Duty Factor(dB)
-	Bluetooth –LE for 1Mbps	12.90	80.00	12.50	30kHz	8.89
1+2	5GHz 802.11ax HE20	100	-	-	10Hz	0.00



### MIMO <Ant. 1+2>

