



# FCC RADIO TEST REPORT

**FCC ID** : UZ7MC27BK  
**Equipment** : Mobile computer  
**Brand Name** : Zebra  
**Model Name** : MC27BK  
**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 C §15.247

The product was received on Jul. 30, 2020 and testing was started from Jul. 30, 2020 and completed on Sep. 28, 2020. We, SPORTON INTERNATIONAL INC., EMC & Wireless Communications 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 variant report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

*Louis Wu*

Approved by: Louis Wu

**SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory**  
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)



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### History of this test report

Report No.	Version	Description	Issued Date
FR052913-02B	01	Initial issue of report	Oct. 28, 2020



### Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
-	15.247(a)(2)	6dB Bandwidth	Not Required	-
-	2.1049	99% Occupied Bandwidth	Not Required	-
3.1	15.247(b)(3)	Output Power	Pass	-
-	15.247(e)	Power Spectral Density	Not Required	-
-	15.247(d)	Conducted Band Edges and Spurious Emission	Not Required	-
3.2	15.247(d)	Radiated Band Edges and Spurious Emission	Pass	Under limit 8.13 dB at 2496.240 MHz
-	15.207	AC Conducted Emission	Not Required	-
3.3	15.203 & 15.247(b)	Antenna Requirement	Pass	-

**Note:**

1. Not required means after assessing, test items are not necessary to carry out.
2. This is a variant report which can be referred Product Equality Declaration. All the test cases were performed on original report which can be referred to Sporton Report Number FR052917-01B as appendix E. Based on the original report, the test cases were verified.

<b>Declaration of Conformity:</b>
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
<b>Comments and Explanations:</b>
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: Wii Chang

Report Producer: Vivian Hsu



# 1 General Description

## 1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	Mobile computer
Brand Name	Zebra
Model Name	MC27BK
FCC ID	UZ7MC27BK
EUT supports Radios application	GSM/EGPRS/WCDMA/HSPA/LTE/NFC/GNSS WLAN 11a/b/g/n HT20/HT40 WLAN 11ac VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE
HW Version	EV
SW Version	10-11-31.00-QG-U00-PRD-HEL-04
OS Version	Android 10
MFD	02JUN20
EUT Stage	Engineering sample

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

Specification of Accessories				
AC Adapter	Brand Name	Zebra	Part Number	PWR-WUA5V12W0US
Battery	Brand Name	Zebra	Part Number	BT-000418-10
USB Cable (TypeA plug to TypeC plug)	Brand Name	Zebra	Part Number	CBL-TC2X-USBC-01
Trigger Handle	Brand Name	Zebra	Part Number	TRG-MC2X-SNP1-01
Holster	Brand Name	Zebra	Part Number	SG-MC2X-HLSTR-01
Holster	Brand Name	Zebra	Part Number	SG-MC3021212-01R

## 1.2 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	2402 MHz ~ 2480 MHz
Number of Channels	40
Carrier Frequency of Each Channel	40 Channel(37 hopping + 3 advertising channel)
Maximum Output Power to Antenna	Bluetooth LE (1Mbps) : 7.50 dBm (0.0056 W) Bluetooth LE (2Mbps) : 7.50 dBm (0.0056 W)
Antenna Type / Gain	PIFA Antenna type with gain 2.31 dBi
Type of Modulation	Bluetooth LE : GFSK

## 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. EMC & Wireless Communications Laboratory	
<b>Test Site Location</b>	No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978	
<b>Test Site No.</b>	<b>Sporton Site No.</b>	
	TH05-HY	03CH07-HY

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

FCC designation No.: TW1190

### 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 KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02
- ♦ FCC KDB 414788 D01 Radiated Test Site v01r01
- ♦ ANSI C63.10-2013

**Remark:**

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. The TAF code is not including all the FCC KDB listed without accreditation.
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

### 2.1 Carrier Frequency Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	0	2402	21	2444
	1	2404	22	2446
	2	2406	23	2448
	3	2408	24	2450
	4	2410	25	2452
	5	2412	26	2454
	6	2414	27	2456
	7	2416	28	2458
	8	2418	29	2460
	9	2420	30	2462
	10	2422	31	2464
	11	2424	32	2466
	12	2426	33	2468
	13	2428	34	2470
	14	2430	35	2472
	15	2432	36	2474
	16	2434	37	2476
	17	2436	38	2478
	18	2438	39	2480
	19	2440	-	-
20	2442	-	-	



## 2.2 Test Mode

- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (X plane) were recorded in this report.

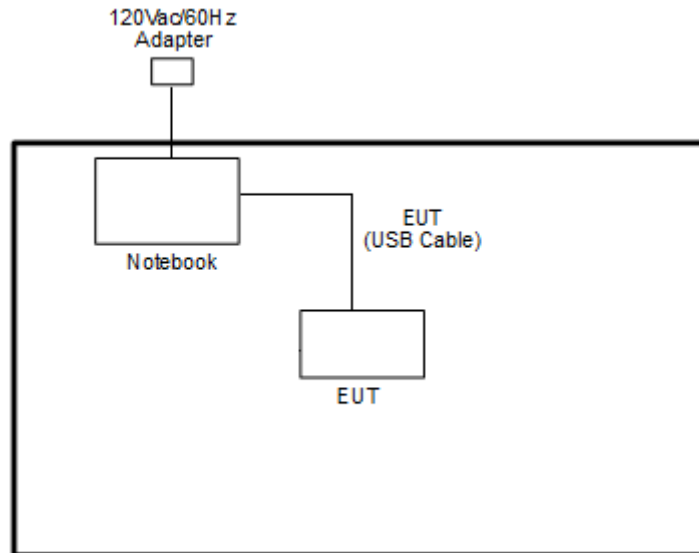
The following summary table is showing all test modes to demonstrate in compliance with the standard.

Summary table of Test Cases	
Test Item	Data Rate / Modulation
	Bluetooth – LE / GFSK
<b>Conducted Test Cases</b>	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps
	Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps
	Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps
	Mode 4: Bluetooth Tx CH00_2402 MHz_2Mbps
	Mode 5: Bluetooth Tx CH19_2440 MHz_2Mbps
	Mode 6: Bluetooth Tx CH39_2480 MHz_2Mbps
<b>Radiated Test Cases</b>	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps
	Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps
	Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps
	Mode 4: Bluetooth Tx CH00_2402 MHz_2Mbps
	Mode 5: Bluetooth Tx CH19_2440 MHz_2Mbps
	Mode 6: Bluetooth Tx CH39_2480 MHz_2Mbps



## 2.3 Connection Diagram of Test System

<Bluetooth - LE Tx Mode>



## 2.4 EUT Operation Test Setup

The RF test items, utility “QRCT V\_4.0.00156.0” 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 Output Power Measurement

##### 3.1.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for output power is 30dBm. If transmitting antenna of directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

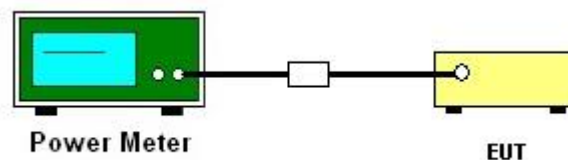
##### 3.1.2 Measuring Instruments

See list of measuring equipment of this test report.

##### 3.1.3 Test Procedures

1. For Average Power, the testing follows ANSI C63.10 Section 11.9.2.3.2 Method AVGP-M-G
2. The RF output of EUT was connected to the power meter by RF cable and attenuator.
3. The path loss was compensated to the results for each measurement.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. Measure the conducted output power and record the results in the test report.

##### 3.1.4 Test Setup





3.1.5 Test Result of Average Output Power

Test Engineer :	Tommy Lee	Temperature :	21~25°C
		Relative Humidity :	51~54%

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power (dBm)
BLE	1Mbps	1	0	2402	6.70
BLE	1Mbps	1	19	2440	7.10
BLE	1Mbps	1	39	2480	7.50
BLE	2Mbps	1	0	2402	6.60
BLE	2Mbps	1	19	2440	7.10
BLE	2Mbps	1	39	2480	7.50



## 3.2 Radiated Band Edges and Spurious Emission Measurement

### 3.2.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

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

### 3.2.2 Measuring Instruments

See list of measuring equipment of this test report.

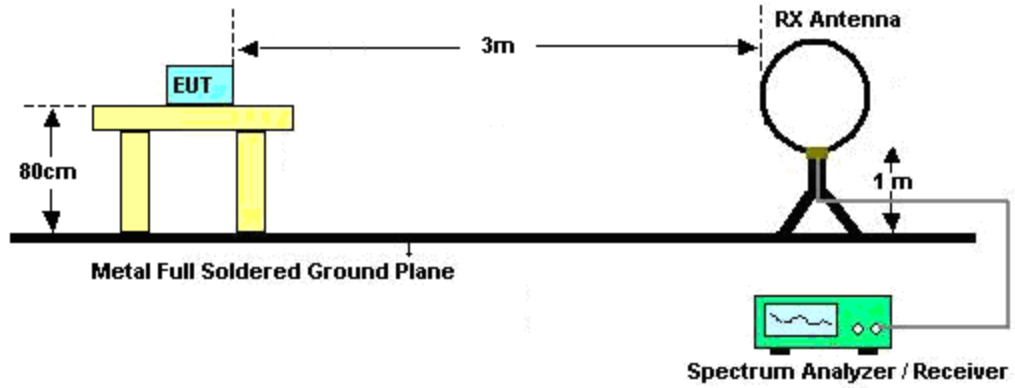


### 3.2.3 Test Procedures

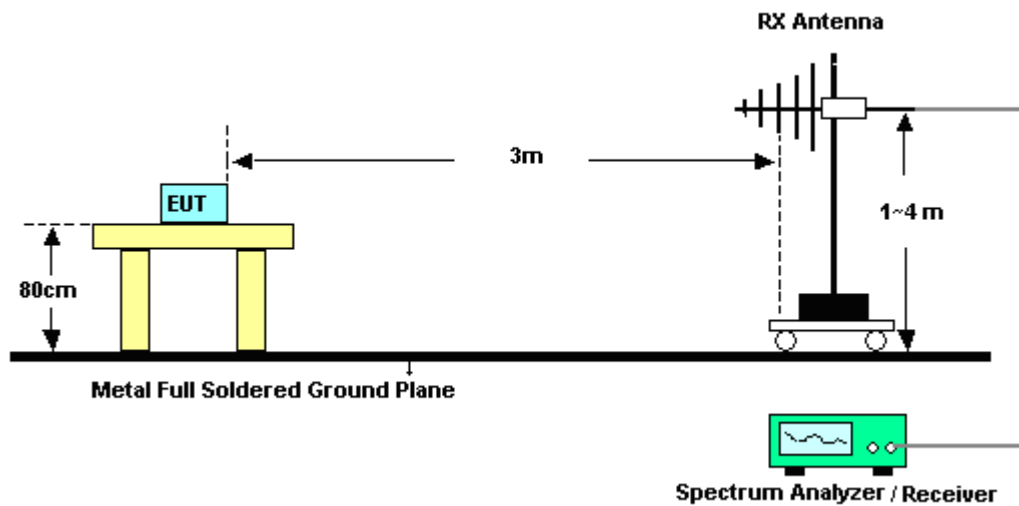
1. The testing follows the ANSI C63.10 Section 11.12.1 Radiated emission measurements.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For testing below 1GHz, 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 1GHz, the emission level of the EUT in peak mode was 20dB 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.
8. Use the following spectrum analyzer settings:
  - (1) Span shall wide enough to fully capture the emission being measured;
  - (2) Set RBW=100 kHz for  $f < 1$  GHz;  $VBW \geq RBW$ ; Sweep = auto; Detector function = peak; Trace = max hold;
  - (3) Set RBW = 1 MHz, VBW= 3MHz for  $f \geq 1$  GHz for peak measurement.  
For average measurement:
    - $VBW = 10$  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.

### 3.2.4 Test Setup

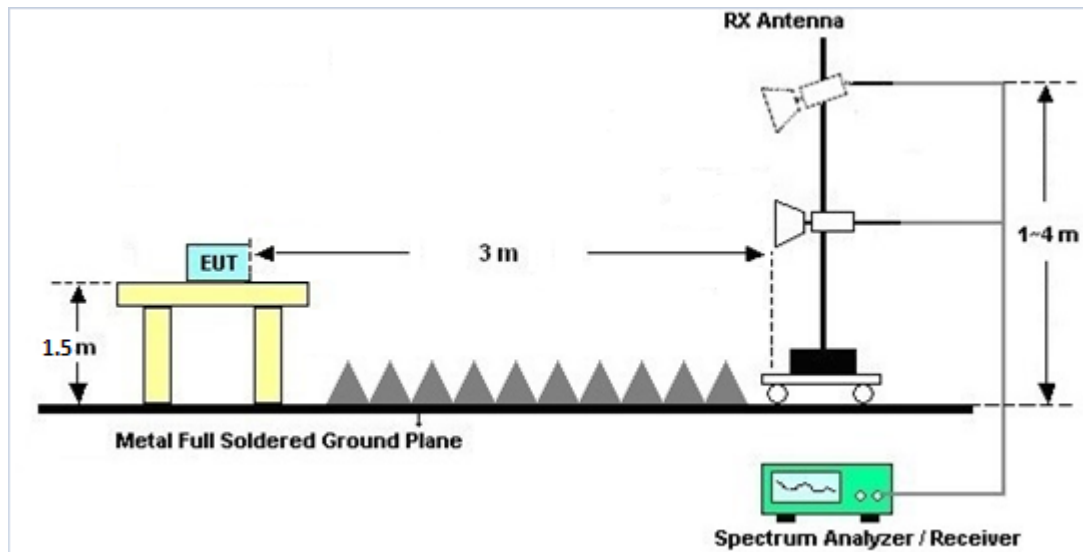
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



### 3.2.5 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.

### 3.2.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix A and B.

### 3.2.7 Duty Cycle

Please refer to Appendix C.

### 3.2.8 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic)

Please refer to Appendix A and B..



### **3.3 Antenna Requirements**

#### **3.3.1 Standard Applicable**

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. 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.

#### **3.3.2 Antenna Anti-Replacement Construction**

An embedded-in antenna design is used.

#### **3.3.3 Antenna Gain**

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.





## 4 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	Dec. 26, 2019	Sep. 22, 2020~ Sep. 28, 2020	Dec. 25, 2020	Radiation (03CH07-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D0 1N-06	35419 & 03	30MHz~1GHz	Apr. 29, 2020	Sep. 22, 2020~ Sep. 28, 2020	Apr. 28, 2021	Radiation (03CH07-HY)
Double Ridge Horn Antenna	ESCO	3117	00075962	1GHz ~ 18GHz	Dec. 06, 2019	Sep. 22, 2020~ Sep. 28, 2020	Dec. 05, 2020	Radiation (03CH07-HY)
SHF-EHF Horn Antenna	SCHWARZBE CK	BBHA 9170	BBHA917058 4	18GHz~40GHz	Dec. 10, 2019	Sep. 22, 2020~ Sep. 28, 2020	Dec. 09, 2020	Radiation (03CH07-HY)
EMI Test Receiver	Agilent	N9038A(MX E)	MY53290053	20Hz~26.5GHz	May 21, 2020	Sep. 22, 2020~ Sep. 28, 2020	May 20, 2021	Radiation (03CH07-HY)
Spectrum Analyzer	Agilent	N9030A	MY52350276	3Hz~44GHz	Jun. 09, 2020	Sep. 22, 2020~ Sep. 28, 2020	Jun. 08, 2021	Radiation (03CH07-HY)
Preamplifier	COM-POWER	PA-103A	161241	10MHz~1GHz	May 19, 2020	Sep. 22, 2020~ Sep. 28, 2020	May 18, 2021	Radiation (03CH07-HY)
Preamplifier	MITEQ	AMF-7D-001 01800-30-10 P	1590075	1GHz~18GHz	Apr. 23, 2020	Sep. 22, 2020~ Sep. 28, 2020	Apr. 22, 2021	Radiation (03CH07-HY)
Preamplifier	Agilent	8449B	3008A02362	1GHz~26.5GHz	Nov. 01, 2019	Sep. 22, 2020~ Sep. 28, 2020	Oct. 31, 2020	Radiation (03CH07-HY)
Preamplifier	EMEC	EM18G40G	060715	18GHz~40GHz	Dec. 13, 2019	Sep. 22, 2020~ Sep. 28, 2020	Dec. 12, 2020	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY2858/2,80 1606/2	18GHz~40GHz	Feb. 25, 2020	Sep. 22, 2020~ Sep. 28, 2020	Feb. 24, 2021	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY24971/4, MY28655/4	9kHz~30MHz	Feb. 25, 2020	Sep. 22, 2020~ Sep. 28, 2020	Feb. 24, 2021	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY28655/4, MY24971/4, MY15682/4	30MHz~1GHz	Feb. 25, 2020	Sep. 22, 2020~ Sep. 28, 2020	Feb. 24, 2021	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY28655/4, MY24971/4, MY15682/4	1GHz~18GHz	Feb. 25, 2020	Sep. 22, 2020~ Sep. 28, 2020	Feb. 24, 2021	Radiation (03CH07-HY)
Antenna Mast	Max-Full	MFA520BS	N/A	1m~4m	N/A	Sep. 22, 2020~ Sep. 28, 2020	N/A	Radiation (03CH07-HY)
Turn Table	ChainTek	Chaintek 3000	N/A	0~360 Degree	N/A	Sep. 22, 2020~ Sep. 28, 2020	N/A	Radiation (03CH07-HY)
USB Data Logger	TECPEL	TR-32	HE17XB2495	N/A	N/A	Sep. 22, 2020~ Sep. 28, 2020	N/A	Radiation (03CH07-HY)
Software	Audix	E3 6.2009-8-24	N/A	N/A	N/A	Sep. 22, 2020~ Sep. 28, 2020	N/A	Radiation (03CH07-HY)
Hygrometer	Testo	608-H1	34893241	N/A	Mar. 02, 2020	Jul. 30, 2020~ Sep. 02, 2020	Mar. 01, 2021	Conducted (TH05-HY)
Power Sensor	DARE	RPR3006W	16100054SN O10	10MHz~6GHz	Dec. 23, 2019	Jul. 30, 2020~ Sep. 02, 2020	Dec. 22, 2020	Conducted (TH05-HY)
Signal Analyzer	Rohde & Schwarz	FSV40	101397	10Hz~40GHz	Nov. 15, 2019	Jul. 30, 2020~ Sep. 02, 2020	Nov. 14, 2020	Conducted (TH05-HY)
Switch Box & RF Cable	EM Electronics	EMSW18SE	SW200302	N/A	Mar. 17, 2020	Jul. 30, 2020~ Sep. 02, 2020	Mar. 16, 2021	Conducted (TH05-HY)



## 5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	4.7
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### Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	5.3
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### Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	5.0
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### Appendix A. Radiated Spurious Emission

Test Engineer :	Jesse Wang, Stan Hsieh and Ken Wu	Temperature :	22~23°C
		Relative Humidity :	51~58%

#### 2.4GHz 2400~2483.5MHz

#### BLE (Band Edge @ 3m)

BLE	Note	Frequency ( MHz )	Level ( dBµV/m )	Over Limit ( dB )	Limit Line ( dBµV/m )	Read Level ( dBµV )	Antenna Factor ( dB/m )	Path Loss ( dB )	Preamp Factor ( dB )	Ant Pos ( cm )	Table Pos ( deg )	Peak Avg. ( P/A )	Pol. ( H/V )	
BLE CH 39 2480MHz	*	2480	103.85	-	-	88.95	32.07	18.12	35.29	265	78	P	H	
	*	2480	102.55	-	-	87.65	32.07	18.12	35.29	265	78	A	H	
		2483.52	55.85	-18.15	74	40.95	32.07	18.12	35.29	265	78	P	H	
		2496.24	45.87	-8.13	54	30.93	32.1	18.14	35.3	265	78	A	H	
													H	
														H
	*	2480	100.02	-	-	85.12	32.07	18.12	35.29	107	0	P	V	
	*	2480	98.73	-	-	83.83	32.07	18.12	35.29	107	0	A	V	
		2496.28	53.95	-20.05	74	39.01	32.1	18.14	35.3	107	0	P	V	
		2488.8	45.65	-8.35	54	30.71	32.1	18.13	35.29	107	0	A	V	
													V	
													V	
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.													



**2.4GHz 2400~2483.5MHz  
BLE (Harmonic @ 3m)**

BLE	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 )
<b>BLE CH 39 2480MHz</b>		4960	39.88	-34.12	74	52.02	34.23	12.18	58.55	100	0	P	H
		7440	40.77	-33.23	74	48.18	35.5	14.68	57.59	100	0	P	H
													H
													H
		4960	40.74	-33.26	74	52.88	34.23	12.18	58.55	100	0	P	V
		7440	41.3	-32.7	74	48.71	35.5	14.68	57.59	100	0	P	V
													V
													V
<b>Remark</b>	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



Emission below 1GHz

2.4GHz BLE (LF)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.	
		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )	
2.4GHz BLE LF		30.27	22.6	-17.4	40	27.36	24.32	0.93	30.01	-	-	P	H	
		128.28	28.76	-14.74	43.5	39.27	17.55	1.9	29.96	-	-	P	H	
		264.09	27.18	-18.82	46	34.69	19.66	2.74	29.91	-	-	P	H	
		916	31.87	-14.13	46	26.68	28.93	5.16	28.9	-	-	P	H	
		925.1	32.6	-13.4	46	27.17	29.09	5.19	28.85	-	-	P	H	
		951	32.96	-13.04	46	26.13	30.26	5.26	28.69	100	0	P	H	
													H	
													H	
													H	
													H	
													H	
													H	
			30	31.81	-8.19	40	36.57	24.32	0.93	30.01	100	0	P	V
			59.43	22.22	-17.78	40	38.98	11.94	1.29	29.99	-	-	P	V
			141.24	21.75	-21.75	43.5	32.35	17.36	1.99	29.95	-	-	P	V
			923	32.52	-13.48	46	27.1	29.1	5.18	28.86	-	-	P	V
			941.9	32.97	-13.03	46	26.71	29.77	5.24	28.75	-	-	P	V
			957.3	34.25	-11.75	46	27.16	30.47	5.28	28.66	-	-	P	V
														V
														V
													V	
													V	
													V	
													V	
Remark	<ol style="list-style-type: none"> <li>No other spurious found.</li> <li>All results are PASS against limit line.</li> </ol>													



**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:

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
		( MHz )	( dBμV/m )	( dB )	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
					( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )
BLE		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
CH 00		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H
2402MHz													

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 :	Jesse Wang, Stan Hsieh and Ken Wu	Temperature :	22~23°C
		Relative Humidity :	51~58%

### Note symbol

-L	Low channel location
-R	High channel location



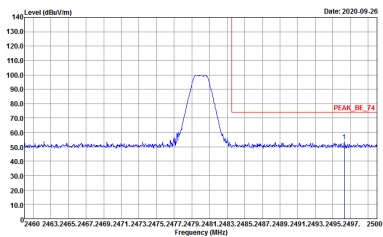
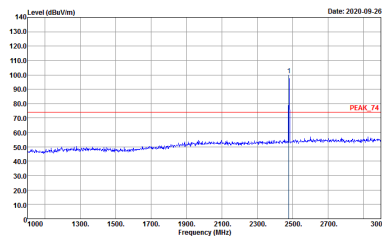
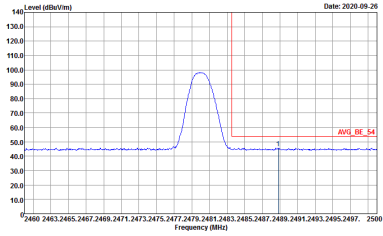
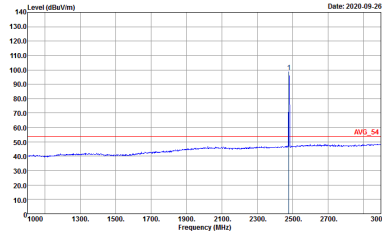


2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BLE CH39 2480MHz		
Horizontal		Fundamental
Peak	<p>Site : 03CH07-HY            Condition : PEAK_BE_74 3m HF_ANT_00075962 HORIZONTAL            : RBW:1000.000kHz VBW:3000.000kHz SWT:Auto            Detector : Peak            Project : 052913-02            Mode : 9</p>	<p>Site : 03CH07-HY            Condition : PEAK_74 3m HF_ANT_00075962 HORIZONTAL            : RBW:1000.000kHz VBW:3000.000kHz SWT:Auto            Detector : Peak            Project : 052913-02            Mode : 9</p>
Avg.	<p>Site : 03CH07-HY            Condition : AVG_BE_S4 3m HF_ANT_00075962 HORIZONTAL            : RBW:1000.000kHz VBW:30.000kHz SWT:Auto            Detector : Peak            Project : 052913-02            Mode : 9</p>	<p>Site : 03CH07-HY            Condition : AVG_S4 3m HF_ANT_00075962 HORIZONTAL            : RBW:1000.000kHz VBW:30.000kHz SWT:Auto            Detector : Peak            Project : 052913-02            Mode : 9</p>



BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BLE CH39 2480MHz		
Vertical		Fundamental
<b>Peak</b>	 <p>Date: 2020-09-26</p> <p>Level (dBm/Vm)</p> <p>Frequency (MHz)</p> <p>PEAK_BE_74</p> <p>Site : 03CH07-HY            Condition : PEAK_BE_74 3m HF_ANT_00075962 VERTICAL            RBW:1000.000kHz VBW:3000.000kHz SWT:Auto            Detector : Peak            Project : 052913-02            Mode : 9</p>	 <p>Date: 2020-09-26</p> <p>Level (dBm/Vm)</p> <p>Frequency (MHz)</p> <p>PEAK_74</p> <p>Site : 03CH07-HY            Condition : PEAK_74 3m HF_ANT_00075962 VERTICAL            RBW:1000.000kHz VBW:3000.000kHz SWT:Auto            Detector : Peak            Project : 052913-02            Mode : 9</p>
<b>Avg.</b>	 <p>Date: 2020-09-26</p> <p>Level (dBm/Vm)</p> <p>Frequency (MHz)</p> <p>AVG_BE_54</p> <p>Site : 03CH07-HY            Condition : AVG_BE_54 3m HF_ANT_00075962 VERTICAL            RBW:1000.000kHz VBW:30.000kHz SWT:Auto            Detector : Peak            Project : 052913-02            Mode : 9</p>	 <p>Date: 2020-09-26</p> <p>Level (dBm/Vm)</p> <p>Frequency (MHz)</p> <p>AVG_54</p> <p>Site : 03CH07-HY            Condition : AVG_54 3m HF_ANT_00075962 VERTICAL            RBW:1000.000kHz VBW:30.000kHz SWT:Auto            Detector : Peak            Project : 052913-02            Mode : 9</p>



2.4GHz 2400~2483.5MHz

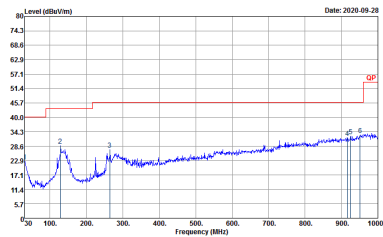
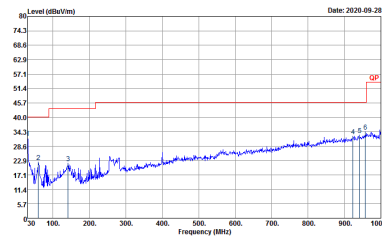
BLE (Harmonic @ 3m)

BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BLE CH39 2480MHz	
	Horizontal	Vertical
Peak	<p>Site : 03CH07-4Y            Condition : PEAK_24.3m HF_ANT_00075962 HORIZONTAL            Detector : Peak            Project : 052913-02            Mode : 19</p>	<p>Site : 03CH07-4Y            Condition : PEAK_24.3m HF_ANT_00075962 VERTICAL            Detector : Peak            Project : 052913-02            Mode : 19</p>



Emission below 1GHz

2.4GHz BLE (LF)

BLE	2.4GHz 2400~2483.5MHz	
	BLE LF	
	Horizontal	Vertical
<p>QP / Peak</p>	 <p>Site : 03C1027-01Y            Condition : QP 3m LF-ANT-35419(6) HORIZONTAL            Detector : Peak            Project : 052913-02            Mode : 23</p>	 <p>Site : 03C1027-01Y            Condition : QP 3m LF-ANT-35419(6) VERTICAL            Detector : Peak            Project : 052913-02            Mode : 23</p>



## Appendix C. Duty Cycle Plots

Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting	Duty Factor(dB)
Bluetooth –LE for 1Mbps	62.30	390	2.56	3kHz	2.06
Bluetooth –LE for 2Mbps	32.59	204	4.90	10kHz	4.87

