

# FCC RADIO TEST REPORT

**FCC ID** : IHDT56XN3  
**Equipment** : Mobile Cellular Phone  
**Brand Name** : Motorola  
**Model Name** : XT1965-3  
**Applicant** : Motorola Mobility LLC  
222 W,Merchandise Mart Plaza, Chicago IL  
60654 USA  
**Manufacturer** : Motorola Mobility LLC  
222 W,Merchandise Mart Plaza, Chicago IL  
60654 USA  
**Standard** : FCC Part 15 Subpart C §15.247

The product was received on Sep. 04, 2018 and testing was started from Sep. 20, 2018 and completed on Sep. 27, 2018. We, SPORTON INTERNATIONAL INC., 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 report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.

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.



Reviewed by: Joseph Lin

**SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory**

No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)



## Table of Contents

<b>History of this test report.....</b>	<b>3</b>
<b>Summary of Test Result.....</b>	<b>4</b>
<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.....	7
1.3 Modification of EUT .....	7
1.4 Testing Location .....	8
1.5 Applicable Standards.....	8
<b>2 Test Configuration of Equipment Under Test.....</b>	<b>9</b>
2.1 Carrier Frequency Channel .....	9
2.2 Test Mode.....	10
2.3 Connection Diagram of Test System.....	11
2.4 Support Unit used in test configuration and system .....	11
2.5 EUT Operation Test Setup .....	11
<b>3 Test Result.....</b>	<b>12</b>
3.1 Output Power Measurement.....	12
3.2 Radiated Band Edges and Spurious Emission Measurement .....	13
3.3 Antenna Requirements.....	17
<b>4 List of Measuring Equipment .....</b>	<b>18</b>
<b>5 Uncertainty of Evaluation .....</b>	<b>20</b>
<b>Appendix A. Conducted Test Results</b>	
<b>Appendix B. Radiated Spurious Emission</b>	
<b>Appendix C. Radiated Spurious Emission Plots</b>	
<b>Appendix D. Duty Cycle Plots</b>	



## History of this test report

Report No.	Version	Description	Issued Date
FR890437-01A	01	Initial issue of report	Oct. 22, 2018

## Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
-	15.247(a)(1)	Number of Channels	Not Required	-
-	15.247(a)(1)	Hopping Channel Separation	Not Required	-
-	15.247(a)(1)	Dwell Time of Each Channel	Not Required	-
-	15.247(a)(1)	20dB Bandwidth	Not Required	-
-	2.1049	99% Occupied Bandwidth	Reporting only	-
3.1	15.247(b)(1)	Peak Output Power	Pass	-
-	15.247(d)	Conducted Band Edges	Not Required	-
-	15.247(d)	Conducted Spurious Emission	Not Required	-
3.2	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	Pass	Under limit 5.98 dB at 40.800 MHz
-	15.207	AC Conducted Emission	Not Required	-
3.3	15.203 & 15.247(b)	Antenna Requirement	Pass	-

**Remark:**

- Not required means after assessing, test items are not necessary to carry out.
- This is a variant report. All the test cases were performed on original report which can be referred to Sporton Report Number FR890437A.

**Reviewed by: Wii Chang**
**Report Producer: Natasha Hsieh**



# 1 General Description

## 1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	Mobile Cellular Phone
Brand Name	Motorola
Model Name	XT1965-3
Sample 1	Dual SIM
Sample 2	Single SIM
FCC ID	IHDT56XN3
IMEI Code	<b>Conducted :</b> IMEI 1: 355575090010432 IMEI 2: 355575090010440 <b>Radiation :</b> IMEI 1: 355575090013295 IMEI 2: 355575090013303
EUT supports Radios application	GSM/EGPRS/WCDMA/HSPA/LTE/GNSS/NFC/FM WLAN 11b/g/n/ac HT20/VHT20 WLAN 11a/n HT20/HT40 WLAN 11ac VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE
HW Version	DVT1B
EUT Stage	Identical Prototype

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



Accessory List		
AC Adapter 1	Brand Name :	Motorola
	Model Name :	SC-31
	Manufacturer :	Salom
AC Adapter 1	Brand Name :	Motorola
	Model Name :	SC-32
	Manufacturer :	Salom
AC Adapter 1	Brand Name :	Motorola
	Model Name :	SC-33
	Manufacturer :	Salom
AC Adapter 1	Brand Name :	Motorola
	Model Name :	SC-35
	Manufacturer :	Salom
AC Adapter 2	Brand Name :	Motorola
	Model Name :	SC-31
	Manufacturer :	Acbel
AC Adapter 2	Brand Name :	Motorola
	Model Name :	SC-32
	Manufacturer :	Acbel
AC Adapter 2	Brand Name :	Motorola
	Model Name :	SC-33
	Manufacturer :	Acbel
AC Adapter 2	Brand Name :	Motorola
	Model Name :	SC-35
	Manufacturer :	Acbel
Battery	Brand Name :	Motorola
	Model Name :	JG40
	Manufacturer :	Amperex
Earphone	Brand Name :	Motorola
	Model Name :	SH38C37773
	Manufacturer :	Lyand
USB Cable 1	Brand Name :	Cabletech
	Model Name :	SC18C37157
USB Cable 2	Brand Name :	Luxshare
	Model Name :	SC18C37156
USB Cable 3	Brand Name :	Saibao
	Model Name :	SC18C37155

## 1.2 Product Specification of Equipment Under Test

Standards-related Product Specification	
<b>Tx/Rx Frequency Range</b>	2402 MHz ~ 2480 MHz
<b>Number of Channels</b>	79
<b>Carrier Frequency of Each Channel</b>	2402+n*1 MHz; n=0~78
<b>Maximum Output Power to Antenna</b>	Bluetooth BR(1Mbps) : 12.11 dBm (0.0163 W) Bluetooth EDR (2Mbps) : 11.59 dBm (0.0144 W) Bluetooth EDR (3Mbps) : 11.87 dBm (0.0154 W)
<b>Antenna Type / Gain</b>	Internal Loop Antenna with gain -2.04 dBi
<b>Type of Modulation</b>	Bluetooth BR (1Mbps) : GFSK Bluetooth EDR (2Mbps) : $\pi/4$ -DQPSK Bluetooth EDR (3Mbps) : 8-DPSK

## 1.3 Modification of EUT

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

## 1.4 Testing Location

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code : 1190) and the FCC designation No. TW1190 and TW0007 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC Test.

Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978
Test Site No.	<b>Sporton Site No.</b> TH05-HY

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

Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	<b>Sporton Site No.</b> 03CH11-HY

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

## 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 v05
- ♦ 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. 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)	Channel	Freq. (MHz)
2400-2483.5 MHz	0	2402	27	2429	54	2456
	1	2403	28	2430	55	2457
	2	2404	29	2431	56	2458
	3	2405	30	2432	57	2459
	4	2406	31	2433	58	2460
	5	2407	32	2434	59	2461
	6	2408	33	2435	60	2462
	7	2409	34	2436	61	2463
	8	2410	35	2437	62	2464
	9	2411	36	2438	63	2465
	10	2412	37	2439	64	2466
	11	2413	38	2440	65	2467
	12	2414	39	2441	66	2468
	13	2415	40	2442	67	2469
	14	2416	41	2443	68	2470
	15	2417	42	2444	69	2471
	16	2418	43	2445	70	2472
	17	2419	44	2446	71	2473
	18	2420	45	2447	72	2474
	19	2421	46	2448	73	2475
	20	2422	47	2449	74	2476
	21	2423	48	2450	75	2477
	22	2424	49	2451	76	2478
	23	2425	50	2452	77	2479
	24	2426	51	2453	78	2480
	25	2427	52	2454	-	-
	26	2428	53	2455	-	-

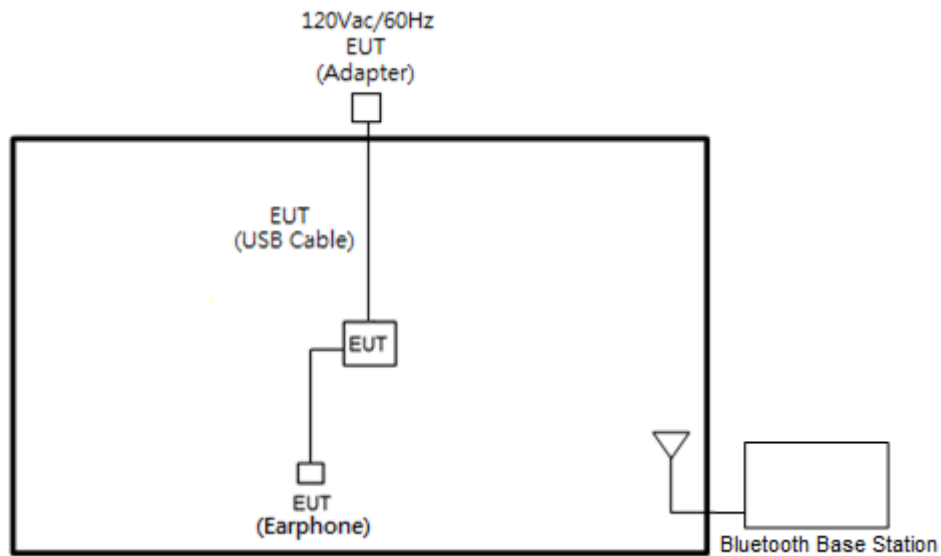
## 2.2 Test Mode

- 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 (Z plane) were recorded in this report, and the worst mode of radiated spurious emissions is Bluetooth 1Mbps mode, and 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 BR 1Mbps GFSK	Bluetooth EDR 2Mbps $\pi$ /4-DQPSK	Bluetooth EDR 3Mbps 8-DPSK
Conducted Test Cases	Mode 1: CH00_2402 MHz	Mode 4: CH00_2402 MHz	Mode 7: CH00_2402 MHz
	Mode 2: CH39_2441 MHz	Mode 5: CH39_2441 MHz	Mode 8: CH39_2441 MHz
	Mode 3: CH78_2480 MHz	Mode 6: CH78_2480 MHz	Mode 9: CH78_2480 MHz
Radiated Test Cases	Bluetooth BR 1Mbps GFSK		
	Mode 1: CH78_2480 MHz		
Remark:			
1. For radiated test cases, the worst mode data rate 1Mbps was reported only since the highest RF output power in the preliminary tests. The conducted spurious emissions and conducted band edge measurement for other data rates were not worse than 1Mbps, and no other significantly frequencies found in conducted spurious emission.			
2. For Radiated Test Cases, the tests were performed with Adapter 1, USB Cable 1 Type C and Sample 1			

## 2.3 Connection Diagram of Test System



## 2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Bluetooth Base Station	R&S	CBT32	N/A	N/A	Unshielded, 1.8 m

## 2.5 EUT Operation Test Setup

The RF test items, utility "CMD" was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to contact with base station 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

The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band 0.125 watts. The power limit for 1Mbps, 2Mbps, 3Mbps and AFH modes are 0.125 watts.

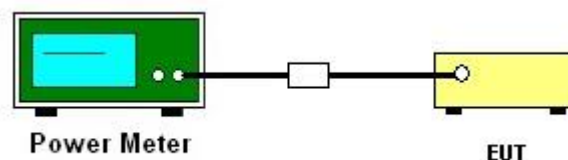
##### 3.1.2 Measuring Instruments

See list of measuring equipment of this test report.

##### 3.1.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.5.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power with cable loss and record the results in the test report.
5. Measure and record the results in the test report.

##### 3.1.4 Test Setup



##### 3.1.5 Test Result of Peak Output Power

Please refer to Appendix A.

##### 3.1.6 Test Result of Average Output Power (Reporting Only)

Please refer to Appendix A.



## **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. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

<b>Frequency (MHz)</b>	<b>Field Strength (microvolts/meter)</b>	<b>Measurement Distance (meters)</b>
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.

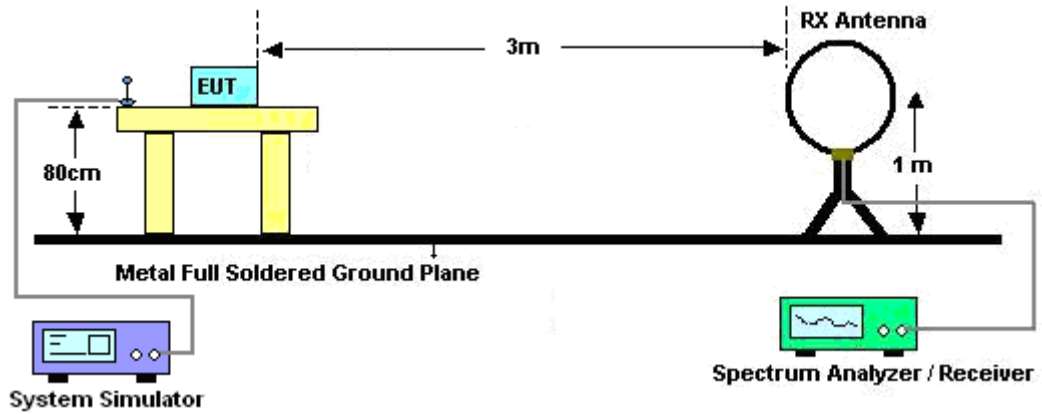
### 3.2.3 Test Procedures

1. The 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.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. For each suspected emission, 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 to comply with the guidelines.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. 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, RBW=1MHz for  $f > 1$ GHz ; VBW  $\geq$  RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
  - (3) For average measurement: use duty cycle correction factor method per 15.35(c).  
Duty cycle = On time/100 milliseconds  
$$\text{On time} = N_1 * L_1 + N_2 * L_2 + \dots + N_{n-1} * L_{n-1} + N_n * L_n$$
  
Where  $N_1$  is number of type 1 pulses,  $L_1$  is length of type 1 pulses, etc.  
Average Emission Level = Peak Emission Level +  $20 * \log(\text{Duty cycle})$
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
7. 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.
8. 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.

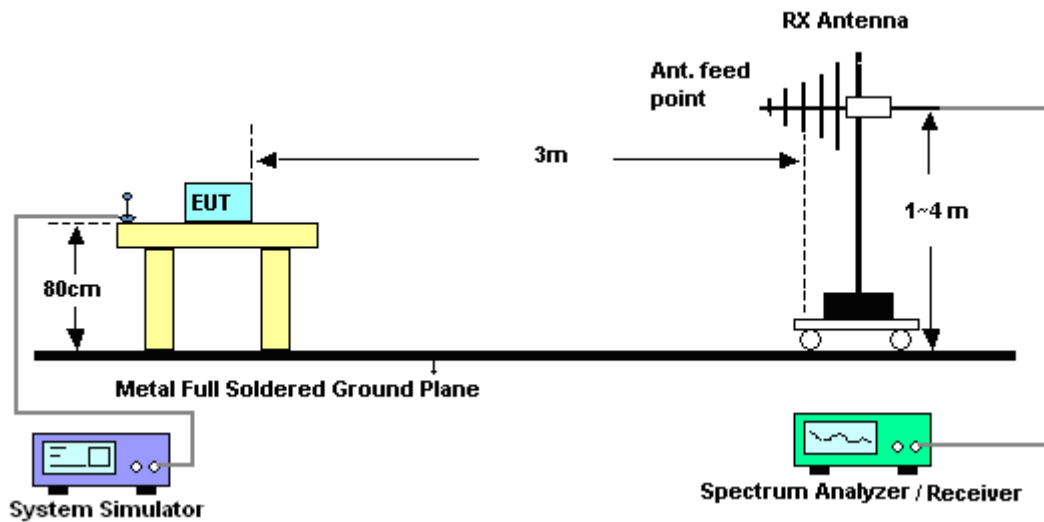
Note: The average levels were calculated from the peak level corrected with duty cycle correction factor (-24.79dB) derived from  $20 \log(\text{dwell time}/100\text{ms})$ . This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

### 3.2.4 Test Setup

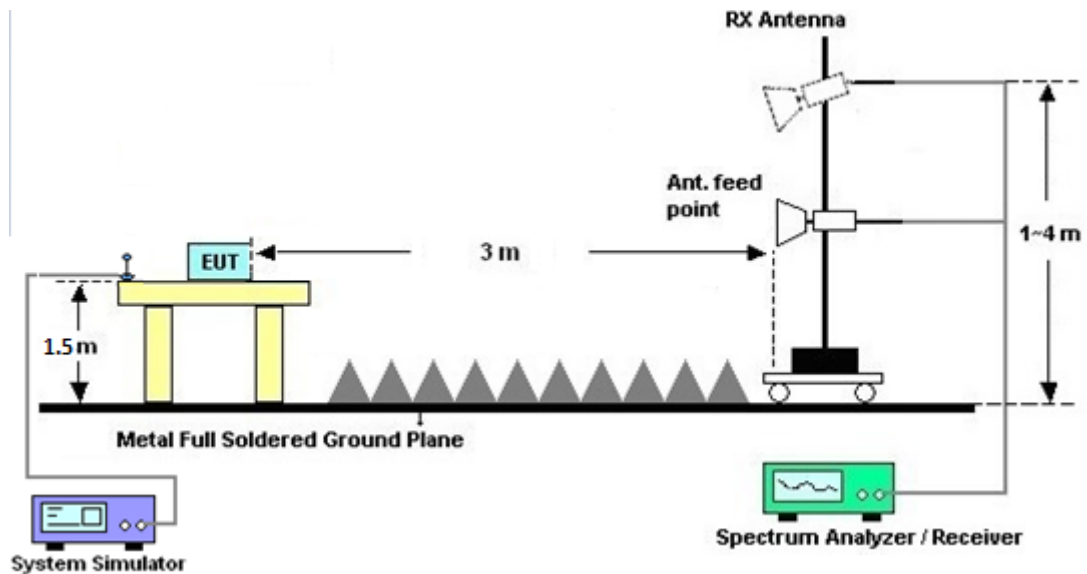
For radiated emissions below 30MHz



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 B and C.

### 3.2.7 Duty Cycle

Please refer to Appendix D.

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

Please refer to Appendix B and C.





### **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	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Hygrometer	Testo	DTM-303A	TP157075	N/A	Mar. 06, 2018	Sep. 20, 2018	Mar. 05, 2019	Conducted (TH05-HY)
Power Meter	Agilent	E4416A	GB41292344	N/A	Dec. 20, 2017	Sep. 20, 2018	Dec. 19, 2018	Conducted (TH05-HY)
Power Sensor	Agilent	E9327A	US40441548	50MHz~18GHz	Dec. 20, 2017	Sep. 20, 2018	Dec. 19, 2018	Conducted (TH05-HY)
Spectrum Analyzer	Rohde & Schwarz	FSP40	100057	9kHz-40GHz	Nov. 21, 2017	Sep. 20, 2018	Nov. 20, 2018	Conducted (TH05-HY)
Switch Box & RF Cable	Burgeon	ETF-058	EC1300484	N/A	Mar. 01, 2018	Sep. 20, 2018	Feb. 28, 2019	Conducted (TH05-HY)
Amplifier	MITEQ	TTA1840-35-HG	1871923	18GHz~40GHz, VSWR : 2.5:1 max	Jul. 16, 2018	Sep. 25, 2018~Sep. 27, 2018	Jul. 15, 2019	Radiation (03CH11-HY)
Amplifier	SONOMA	310N	187312	9kHz~1GHz	Jan. 16, 2018	Sep. 25, 2018~Sep. 27, 2018	Jan. 15, 2019	Radiation (03CH11-HY)
Bilog Antenna	TESEQ	CBL 6111D&N-6-06	35414&AT-N 0602	30MHz~1GHz	Oct. 14, 2017	Sep. 25, 2018~Sep. 27, 2018	Oct. 13, 2018	Radiation (03CH11-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1326	1GHz ~ 18GHz	Oct. 16, 2017	Sep. 25, 2018~Sep. 27, 2018	Oct. 15, 2018	Radiation (03CH11-HY)
Hygrometer	TECPEL	DTN-303B	TP140325	N/A	Oct. 12, 2017	Sep. 25, 2018~Sep. 27, 2018	Oct. 11, 2018	Radiation (03CH11-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Nov. 23, 2017	Sep. 25, 2018~Sep. 27, 2018	Nov. 22, 2018	Radiation (03CH11-HY)
Preamplifier	Keysight	83017A	MY53270080	1GHz~26.5GHz	Jan. 16, 2018	Sep. 25, 2018~Sep. 27, 2018	Jan. 15, 2020	Radiation (03CH11-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200486	10Hz ~ 44GHz	Oct. 19, 2017	Sep. 25, 2018~Sep. 27, 2018	Oct. 18, 2018	Radiation (03CH11-HY)
Controller	EMEC	EM 1000	N/A	Control Turn table & Ant Mast	N/A	Sep. 25, 2018~Sep. 27, 2018	N/A	Radiation (03CH11-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1~4m	N/A	Sep. 25, 2018~Sep. 27, 2018	N/A	Radiation (03CH11-HY)
Turn Table	EMEC	TT 2000	N/A	0~360 Degree	N/A	Sep. 25, 2018~Sep. 27, 2018	N/A	Radiation (03CH11-HY)
Preamplifier	Jet-Power	JPA0118-55-303K	1710001800054002	1GHz~18GHz	Apr. 17, 2018	Sep. 25, 2018~Sep. 27, 2018	Apr. 16, 2019	Radiation (03CH11-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170584	18GHz- 40GHz	Nov. 27, 2017	Sep. 25, 2018~Sep. 27, 2018	Nov. 26, 2018	Radiation (03CH11-HY)



Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Software	Audix	E3 6.2009-8-24	RK-001042	N/A	N/A	Sep. 25, 2018~ Sep. 27, 2018	N/A	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4P E	9kHz-30MHz	Mar. 14, 2018	Sep. 25, 2018~ Sep. 27, 2018	Mar. 13, 2019	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY2859/2	30MHz-40GHz	Mar. 14, 2018	Sep. 25, 2018~ Sep. 27, 2018	Mar. 13, 2019	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4P E	30M-18G	Mar. 14, 2018	Sep. 25, 2018~ Sep. 27, 2018	Mar. 13, 2019	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY4274/2	30MHz-40GHz	Mar. 14, 2018	Sep. 25, 2018~ Sep. 27, 2018	Mar. 13, 2019	Radiation (03CH11-HY)
Filter	Wainwright	WLK4-1000- 1530-8000-4 0SS	SN11	1G Low Pass	Sep. 17, 2018	Sep. 25, 2018~ Sep. 27, 2018	Sep. 16, 2019	Radiation (03CH11-HY)
Filter	Wainwright	WHKX12-27 00-3000-180 00-60SS	SN3	2.7G High Pass	Sep. 17, 2018	Sep. 25, 2018~ Sep. 27, 2018	Sep. 16, 2019	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% ( $U = 2Uc(y)$ )	5.20
--	------

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

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	5.50
--	------

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

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	5.20
--	------

**Appendix A. Test Result of Conducted Test Items**

Test Engineer:	EasonHuang	Temperature:	21~25	°C
Test Date:	2018/9/20	Relative Humidity:	51~54	%

**TEST RESULTS DATA****Peak Power Table**

DH	CH.	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
DH1	0	1	<b>12.11</b>	20.97	Pass
	39	1	11.63	20.97	Pass
	78	1	11.64	20.97	Pass
2DH1	0	1	<b>11.59</b>	20.97	Pass
	39	1	10.89	20.97	Pass
	78	1	11.06	20.97	Pass
3DH1	0	1	<b>11.87</b>	20.97	Pass
	39	1	11.26	20.97	Pass
	78	1	11.37	20.97	Pass

**TEST RESULTS DATA****Average Power Table*****(Reporting Only)***

DH	CH.	NTX	Average Power (dBm)	Duty Factor (dB)
DH1	0	1	<b>11.99</b>	5.16
	39	1	11.46	5.16
	78	1	11.50	5.16
2DH1	0	1	<b>9.46</b>	5.12
	39	1	8.54	5.12
	78	1	8.95	5.12
3DH1	0	1	<b>9.55</b>	5.21
	39	1	8.63	5.21
	78	1	9.07	5.21



## Appendix B. Radiated Spurious Emission

Test Engineer :	Chuan Zhu	Temperature :	21~26°C
		Relative Humidity :	51~56%

## 2.4GHz 2400~2483.5MHz

## BT (Band Edge @ 3m)

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )
BT CH 78 2480MHz	*	2480	101.46			101.03	27.36	6.65	33.58	354	74	P	H
	*	2480	76.67			-	-	-	-	-	-	A	H
		2483.64	51	-23	74	50.56	27.36	6.66	33.58	354	74	P	H
		2483.64	26.21	-27.79	54	-	-	-	-	-	-	A	H
													H
													H
	*	2480	106.13			105.7	27.36	6.65	33.58	138	328	P	V
	*	2480	81.34			-	-	-	-	-	-	A	V
		2483.52	54.42	-19.58	74	53.98	27.36	6.66	33.58	138	328	P	V
		2483.52	29.63	-24.37	54	-	-	-	-	-	-	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****BT (Harmonic @ 3m)**

BT	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>BT CH 78 2480MHz</b>		4960	46.04	-27.96	74	60.76	31.54	9.81	56.51	100	0	P	H
		4960	21.25	-32.75	54	-	-	-	-	-	-	A	H
		7440	43.67	-30.33	74	50.67	36.59	12.09	56.06	100	0	P	H
		7440	18.88	-35.12	54	-	-	-	-	-	-	A	H
		4960	45.7	-28.3	74	60.42	31.54	9.81	56.51	100	0	P	V
		4960	20.91	-33.09	54	-	-	-	-	-	-	A	V
		7440	43.64	-30.36	74	50.64	36.59	12.09	56.06	100	0	P	V
		7440	18.85	-35.15	54	-	-	-	-	-	-	A	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 BT (LF)

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.	
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.		
		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	(dBμV)	( dB/m )	( dB )	( dB )	( cm )	( deg )	(P/A)	(H/V)	
2.4GHz  BT  LF		31.08	26.22	-13.78	40	34.24	23.7	0.75	32.49	-	-	P	H	
		68.07	25.14	-14.86	40	44.61	11.88	1.14	32.49	-	-	P	H	
		182.55	26.32	-17.18	43.5	42.18	14.69	1.86	32.41	-	-	P	H	
		482	31.44	-14.56	46	37.51	23.47	2.83	32.37	-	-	P	H	
		853.7	30.54	-15.46	46	29.65	28.87	3.92	31.9	-	-	P	H	
		948.2	33.36	-12.64	46	29.94	30.51	4.13	31.22	100	0	P	H	
													H	
													H	
													H	
													H	
													H	
													H	
													H	
		40.8	34.02	-5.98	40	46.95	18.68	0.88	32.49	100	0	P	V	
		50.79	30.84	-9.16	40	48.3	14.07	0.96	32.49	-	-	P	V	
		74.28	32.08	-7.92	40	50.94	12.44	1.19	32.49	-	-	P	V	
		482	30.28	-15.72	46	36.35	23.47	2.83	32.37	-	-	P	V	
		721.4	29.31	-16.69	46	31.23	26.94	3.55	32.41	-	-	P	V	
		958.7	33.26	-12.74	46	29.2	31.02	4.16	31.12	-	-	P	V	
														V
														V
														V
														V
														V
													V	
Remark	1. No other spurious found. 2. All results are PASS against 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>P</b> eak or <b>A</b> verage
H/V	<b>H</b> orizontal or <b>V</b> ertical

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

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

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

**For Peak Limit @ 2390MHz:**

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

**For Average Limit @ 2390MHz:**

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

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



## Appendix C. Radiated Spurious Emission Plots

Test Engineer :	Chuan Zhu	Temperature :	21~26°C
		Relative Humidity :	51~56%

### Note symbol

-L	Low channel location
-R	High channel location



2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH78 2480MHz	
	Horizontal	Fundamental
Peak	<div><p>Site : 03CH11-HY Condition : PEAK_BE_74 3m HORN 91200-4F HORIZONTAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 890437-01</p></div>	<div><p>Site : 03CH11-HY Condition : PEAK_74 3m HORN 91200-4F HORIZONTAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 890437-01</p></div>

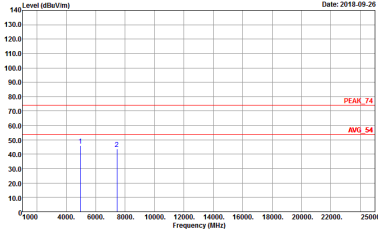
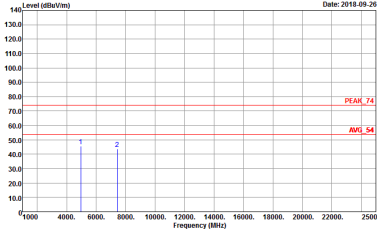


BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH78 2480MHz	
	Vertical	Fundamental
Peak	<div><p>Level (dBuV/m)</p><p>Date: 2018-09-25</p><p>2460 2463.2465 2467 2469 2471 2473 2475 2477 2479 2481 2483 2485 2487 2489 2491 2493 2495 2497 2500</p><p>Frequency (MHz)</p><p>Site : 03CH11-14Y Condition : PEAK_BE_74 3m HORN 91200-HF VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 890437-01</p></div>	<div><p>Level (dBuV/m)</p><p>Date: 2018-09-25</p><p>1000 1300 1600 1900 2100 2300 2500 2700 2900 3000</p><p>Frequency (MHz)</p><p>Site : 03CH11-14Y Condition : PEAK_74 3m HORN 91200-HF VERTICAL RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 890437-01</p></div>



2.4GHz 2400~2483.5MHz

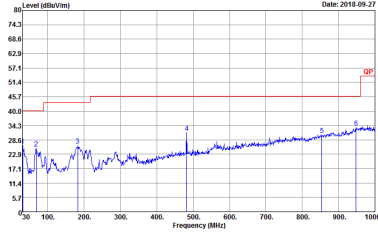
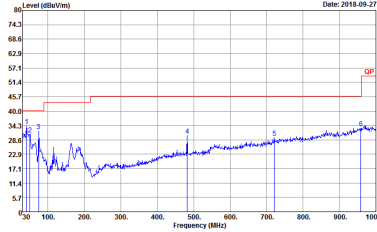
BT (Harmonic @ 3m)

BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BT CH78 2480MHz	
	Horizontal	Vertical
Peak Avg.	<div><p>Site : 03CH11-HY Condition : PEAK_74 3m HORN 91200-HF HORIZONTAL Detector : Peak Project : 890437-01</p></div>	<div><p>Site : 03CH11-HY Condition : PEAK_74 3m HORN 91200-HF VERTICAL Detector : Peak Project : 890437-01</p></div>

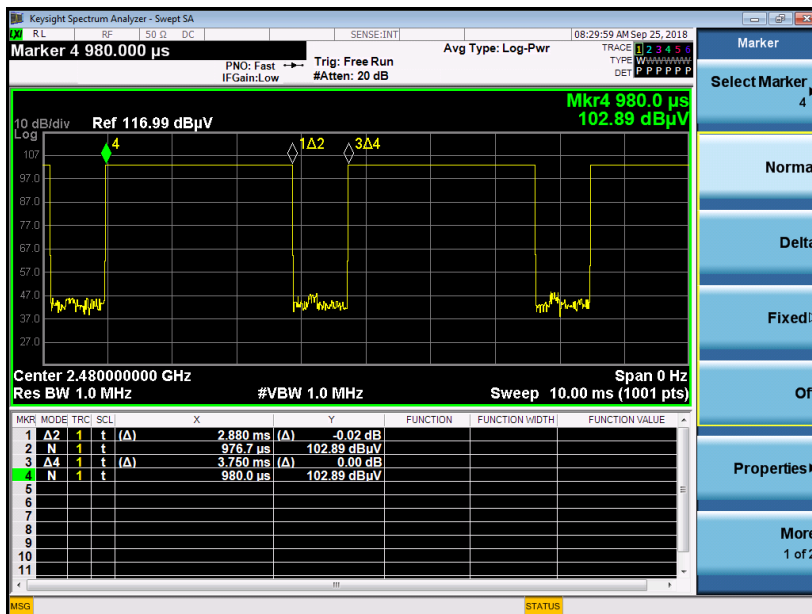
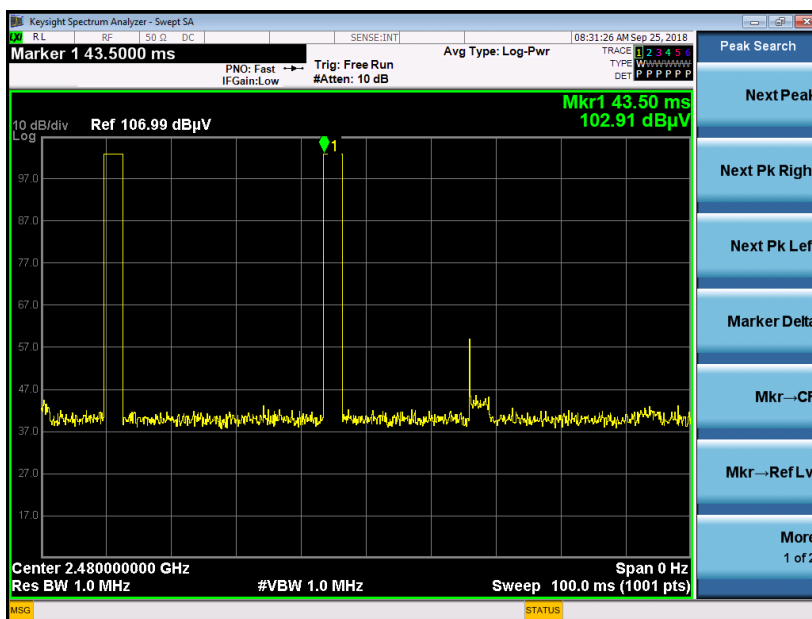


Emission below 1GHz

2.4GHz BT (LF)

BT	2.4GHz 2400~2483.5MHz	
	BT LF	
	Horizontal	Vertical
QP / Peak	 <p>Site : 03CH11-HY Condition : QP 3m BT-LOG 6111D-LF_ETC HORIZONTAL Detector : Peak Project : 890437-01</p>	 <p>Site : 03CH11-HY Condition : QP 3m BT-LOG 6111D-LF_ETC VERTICAL Detector : Peak Project : 890437-01</p>

## Appendix D. Duty Cycle Plots

**DH5 on time (One Pulse) Plot on Channel 39**

**on time (Count Pulses) Plot on Channel 39**

**Note:**

1. Worst case Duty cycle = on time/100 milliseconds =  $2 * 2.88 / 100 = 5.766 \%$
2. Worst case Duty cycle correction factor =  $20 * \log(\text{Duty cycle}) = -24.79 \text{ dB}$
3. **DH5** has the highest duty cycle worst case and is reported.



**Duty Cycle Correction Factor Consideration for AFH mode:**

Bluetooth normal hopping rate is 1600Hz and reduced to 800Hz in AFH mode; due to the reduced number of hopping frequencies, with the same packet configuration the dwell time in each channel frequency within 100msec period is longer in AFH mode than normal mode.

In AFH mode, the minimum hopping frequencies are 20, to get the longest dwell time DH5 packet is observed; the period to have DH5 packet completing one hopping sequence is

$$2.88 \text{ ms} \times 20 \text{ channels} = 57.6 \text{ ms}$$

There cannot be 2 complete hopping sequences within 100ms period, considering the random hopping behavior, maximum 2 hops can be possibly observed within the period.  $[100\text{ms} / 57.6\text{ms}] = 2 \text{ hops}$

Thus, the maximum possible ON time:

$$2.88 \text{ ms} \times 2 = 5.76 \text{ ms}$$

Worst case Duty Cycle Correction factor, which is derived from the maximum possible ON time,

$$20 \times \log(5.76 \text{ ms}/100\text{ms}) = -24.79 \text{ dB}$$

—————THE END—————