



# JAPAN Radio Test Report

## Bluetooth

**APPLICANT** : PAX Computer Technology (Shenzhen) Co., Ltd.

**PRODUNCT NAME** : Wireless Base

**BRAND NAME** : PAX

**MODEL NAME** : L920-BE

**MARKETING NAME** : L920-BE

**TYPE EMISSIONS** : 78M1F1D(BR);  
78M4G1D(EDR);  
19M6F1D(BR\_AFH);  
1M06F1D(4.0 LE);

**DECLARATION** : 0.130 mW/MHz (BR/EDR);

**OUTPUT POWER** : 0.520 mW/MHz (BR\_AFH);  
7.600 mW (4.0 LE);

**STANDARD** : Article 49 - 20 and the relevant articles of the  
Ordinance Regulating Radio Equipment

**TEST PROCEDURE** : MIC Notice No.88 Appendix No.43



The product sample received on Jul. 30, 2018 and completely tested on Sep. 12, 2018. We, Sporton International Inc. (ShenZhen), would like to declare that the tested sample has been evaluated in accordance with the procedures given in MIC Notice No.88 Appendix No.43 and shown to be compliant with the applicable technical standards. Article 2 Paragraph 1 Item 19 of the Certificate Ordinance of the Radio Law indicates the classification of the specified radio equipment.

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

*Eric Shih*

Prepared by: Eric Shih / Manager

*Jones Tsai*

Approved by: Jones Tsai / Manager

**Sporton International Inc. (ShenZhen)**

**1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan District, Shenzhen City,  
Guangdong Province, China**



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## REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
JR873011	Rev. 01	Initial issue of report	Sep. 18, 2018

**SUMMARY OF TEST RESULT**

Report Section	Description	Result
3.1	Frequency Tolerance	Pass
3.2	Occupied Bandwidth and Spread-spectrum Bandwidth / Spread Factor	Pass
3.3	Unwanted Emission Intensity	Pass
3.4	RF Output Power / Tolerance	Pass
3.5	Limitation of Collateral Emission of Receiver	Pass
3.6	Transmission Antenna Gain (EIRP Antenna Power)	NA
3.7	Transmission Radiation Angle Width (3dB Beam width)	NA
3.8	Radio Interference Prevention Capability	Pass
3.9	Hopping Frequency Dwell Time	Pass
3.10	Construction Protection Confirmation	Pass



## **1 General Description**

### **1.1 Applicant**

**PAX Computer Technology (Shenzhen) Co., Ltd.**

Room 401-402, No.3 Bldg, Software Park, Nanshan District, Shenzhen City, Guangdong Province,  
P.R.China

### **1.2 Manufacturer**

**PAX Computer Technology (Shenzhen) Co., Ltd.**

Room 401-402, No.3 Bldg, Software Park, Nanshan District, Shenzhen City, Guangdong Province,  
P.R.China






### 1.3 Feature of Equipment Under Test

Product Feature & Specification		
Product Name	Wireless Base	
Brand Name	PAX	
Model Name	L920-BE	
Marketing Name	L920-BE	
Support Category / Frequency Range	Article 2-1-19 / 2400MHz ~ 2483.5MHz	
Type of Modulation	<input type="checkbox"/> Direct Spreading (DS) <input type="checkbox"/> Orthogonal frequency-division multiplexing (OFDM) <input checked="" type="checkbox"/> Frequency Hopping (FH) <input checked="" type="checkbox"/> Other :GFSK	
Number of Channels	BR/EDR Mode	79
	AFH Mode	20
	Other : BT 4.0	40
Channel Spacing	BR/EDR/AFH Mode	1MHz
	Other : BT 4.0	2MHz
Declaration RF Output Power	0.130 mW/MHz (BR/EDR mode); 0.520 mW/MHz (BR_AFH mode) 7.600 mW (4.0 LE mode)	
Antenna Power (E.I.R.P)	-8.06 dBm/MHz(BR/EDR mode); -2.04 dBm/MHz (BR_AFH mode) 9.61 dBm (4.0 LE mode)	
Modulation	<input checked="" type="checkbox"/> GFSK <input checked="" type="checkbox"/> $\pi/4$ -DQPSK <input checked="" type="checkbox"/> 8-DPSK <input type="checkbox"/> Other : FSK	
Power Source <sup>NOTE</sup>	<input type="checkbox"/> Commercial power	AC 100~240 V
	<input checked="" type="checkbox"/> External Power Source	DC 5 V
	<input type="checkbox"/> Lithium battery	DC 3.7V
	<input type="checkbox"/> UM battery	DC 1.5V

**NOTE:** When EUT be operated at  $\pm 10\%$  from the normal supply voltage, the supply voltage of RF part was varied within  $\pm 1\%$ . All test cases were done under the normal supply voltage.



Power Supply voltage 5.00 Vdc (Nominal)	Power Supply voltage 5.50 Vdc (+10%)	Power Supply voltage 4.50 Vdc (-10%)
3.30	3.30	3.30
Measurement point		
		

Antenna Information			
Brand Name :	N/A	Model Name :	N/A
Antenna Type :	PCB	Antenna Gain :	0.80 dBi

**Remark:** The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.





## 1.4 Modification of EUT

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

## 1.5 Testing Site

<b>Test Lab.</b>	Sporton International Inc. (ShenZhen) Mobile Communications Laboratory
<b>Test Site Location</b>	1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan District, Shenzhen City, Guangdong Province, China TEL: 86-755-8637-9589 FAX: 86-755-8637-9595
<b>Test Site No.</b>	<b>Sporton Site No.:</b> TH01-SZ

Test Items	Uncertainty	Remark
Occupied Channel Bandwidth	$\pm 0.49 \%$	Confidence 95%
RF output power, conducted	$\pm 0.61 \text{ dB}$	Confidence 95%
Frequency Tolerance	$\pm 10 \text{ Hz}$	Confidence 95%
Power density, conducted	$\pm 0.60 \text{ dB}$	Confidence 95%
Temperature	$\pm 0.8 \text{ }^{\circ}\text{C}$	Confidence 95%
Humidity	$\pm 3 \%$	Confidence 95%
Time	$\pm 0.33 \%$	Confidence 95%

## 1.6 Applied Standards

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

- Article 49-20 and the relevant articles of the Ordinance Regulating Radio Equipment

**Remark:**

- All test items were verified and recorded according to the standards and without any deviation during the test.
- The measurement was implemented in accordance with MIC Notice No. 88 Appendix No. 43.

## 1.7 Ancillary Equipment List

None.



## 2 Test Configuration of Equipment Under Test

### 2.1 Carrier Frequency Channel

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

### 2.2 EUT Operation Test Setup

The equipment under test (EUT) was linked with Bluetooth simulator or operated by commands in order to make the EUT into the engineering modes for transmitting, receiving signals continuously, and hopping mode.



### 3 Test Result

#### 3.1 Frequency Tolerance Measurement

##### 3.1.1 Limit

Item	Limits
Frequency Tolerance	$\leq \pm 50\text{ppm}$

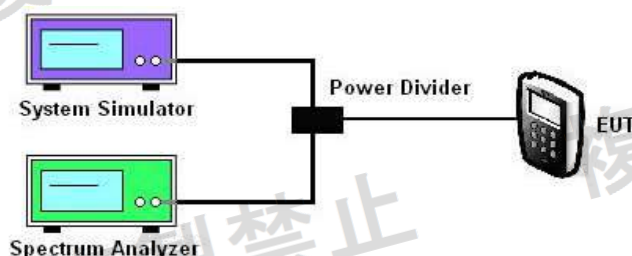
##### 3.1.2 Measuring Instruments

See list of measuring instruments of this test report.

##### 3.1.3 Test Procedure

1. Frequency accuracy of instrument shall be less than 10% of limits tolerance (5ppm).
2. Three testing methods
  - a. Measure frequency tolerance by the system simulator.
  - b. CW Tone method
    - i. Setting of SA is following as: RBW: 1kHz / VBW: 30kHz.
    - ii. Maker Max. Level to get measuring frequency f.
  - c. 10dB down method
    - i. Setting of SA is following as: RBW:30kHz / VBW: 30kHz / Trace: MaxHold
    - ii. Display line Level = Max. level - 10dB to place two markers, highest(fH) and lowest(fL) frequency
    - iii. Determine measuring frequency  $f = (fH + fL) / 2$
3. The frequency tolerance test case is directly measured using the frequency accuracy function of Bluetooth tester or spectrum analyzer. Then the frequency error formula is  $(f - f_c) / f_c \times 10^6 \text{ ppm}$  and the limit is less than  $\pm 50\text{ppm}$ .

##### 3.1.4 Test Setup



##### 3.1.5 Test Result of Frequency Tolerance

Please refer to Appendix B.



## 3.2 Occupied Bandwidth and Spread-spectrum Bandwidth / Spread Factor Measurement

### 3.2.1 Limit

Item	Limits
Occupied Band Width	$\leq 83.5\text{MHz}$ (FH)
	$\leq 26\text{MHz}$ (OFDM, DS and Others)
Spreading Bandwidth	$\geq 500\text{ kHz}$ (FH, DS)

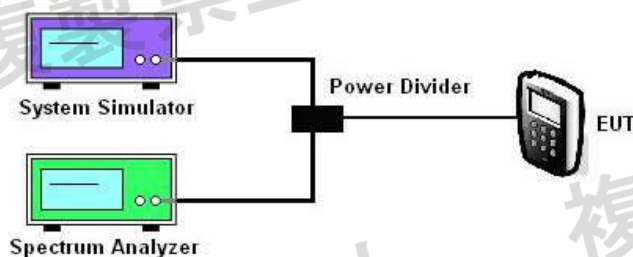
### 3.2.2 Measuring Instruments

See list of measuring instruments of this test report.

### 3.2.3 Test Procedures

1. Setting of SA is following as: RBW  $\leq 3\%$  of bandwidth / VBW = RBW / Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold.
2. EUT have transmitted each modulation signal and fixed channelize (For DSSS or OFDM Device) or continuous maximum power of hopping mode (For FHSS Device). SA set to 99% of occupied bandwidth to measure occupied bandwidth. The limit is less than 26MHz (For DSSS or OFDM Device) or 83.5MHz (For FHSS Device).
3. SA set to 90% of occupied bandwidth to measure Spread Spectrum Bandwidth and must greater than 500kHz.
4. Spread Spectrum Factor = Spread Spectrum Bandwidth / modulation rate of EUT.
5. Spread Spectrum Factor limit is greater than 5.

### 3.2.4 Test Setup



### 3.2.5 Test Result of Occupied Bandwidth and Spread-spectrum Bandwidth / Spread Factor Measurement

Please refer to Appendix B.





### 3.3 Unwanted Emission Intensity Measurement

#### 3.3.1 Limit

Item	Limits
Tx Spurious Emission	$\leq 2.5 \mu\text{W}/\text{MHz}$ ( $2387\text{MHz} > f$ ; $2496.5\text{MHz} < f$ )
	$\leq 25 \mu\text{W}/\text{MHz}$
	( $2387\text{MHz} \leq f < 2400\text{MHz}$ ) and ( $2483.5\text{MHz} < f \leq 2496.5\text{MHz}$ )

#### 3.3.2 Measuring Instruments

See list of measuring instruments of this test report.

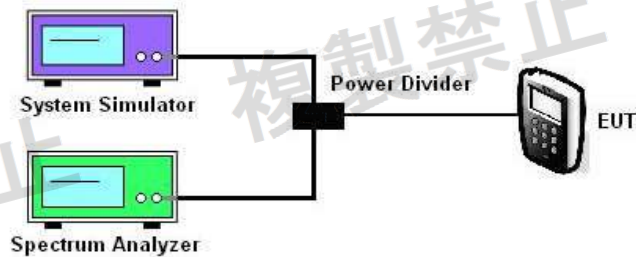
#### 3.3.3 Test Procedures

1. EUT have transmitted the maximum power and fixed channelize.
2. Setting of SA is following as: RBW:1MHz / VBW:1MHz above 1GHz, Sweep time: Auto / Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold.
3. Setting of SA is following as: RBW:100KHz / VBW:100KHz under 1GHz, Sweep time: Auto / Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold.
4. Setting of SA is following as 30MHz and stop frequency 2387MHz Then to mark peak reading value + cable loss shall be less than 2.5 $\mu$ W.
5. SA adjusted to start frequency 2387MHz and stop frequency 2400MHz. Then to mark peak reading value + cable loss shall be less than 25 $\mu$ W.
6. SA adjusted to start frequency 2483.5MHz and stop frequency 2496.5MHz Then to mark peak reading value + cable loss shall be less than 25 $\mu$ W.
7. SA adjusted to start frequency 2496.5MHz and stop frequency 12500MHz Then to mark peak reading value + cable loss shall be less than 2.5 $\mu$ W.
8. If the Result\_Value is over the requirement, take total sum of 1MHz band centered at the spur frequency like ACLP measurement as Result\_Value.





### 3.3.4 Test Setup



### 3.3.5 Test Result of Unwanted Emission Intensity

Please refer to Appendix B.



### 3.4 RF Output Power / Tolerance

#### 3.4.1 Limit

Item	Limits
Antenna Power Density	$\leq 3\text{mW/MHz}$ (FH form 2400~2483.5MHz)
	$\leq 10\text{mW/MHz}$ (OFDM,DS from 2400~2483.5MHz)
	$\leq 10\text{mW}$ (Other from 2400~2483.5MHz)
Antenna Power Error	+20%, -80% (Base on manufacturer declare antenna power density)

#### 3.4.2 Measuring Instruments

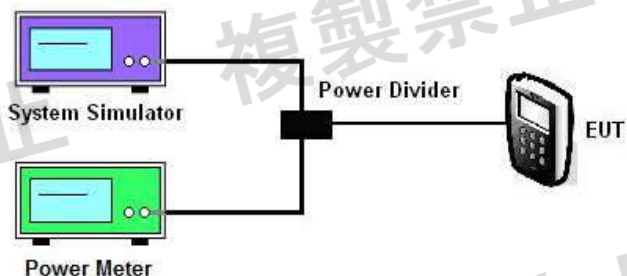
See list of measuring instruments of this test report.

#### 3.4.3 Test Procedures

1. EUT have transmitted continuous maximum power on hopping mode (For FHSS Device).
2. Frequency hopping system or combined systems of direct spread and frequency hopping:
  - i. Connect the high frequency power meter to the output of the attenuator and measure the total power (without bandwidth limitation)
  - ii. Divide the total power by the spread bandwidth to find the "average" power per MHz.  
The average power per MHz is equal to the power meter value dBm + cable loss dB +  $10 \log_{10} (1/\text{Duty Cycle})$  dB +  $10 \log_{10} (1/\text{Spread Bandwidth})$  dB.
  - iii. Confirm that frequency distribution of the hopping frequencies is homogeneous according to the supporting data.  
If frequency distribution of the frequencies is not homogeneous, consider other measurement or correction methods based on the supporting data.
  - iv. Set the antenna power as follows:
    - Continuous waves: value in ii.
3. Antenna RF Output Power Tolerance is definition that actual measure antenna power tolerance between + 20% to - 80% power range that manufacturer declare the conducted power density.



#### 3.4.4 Test Setup



#### 3.4.5 Test Result of RF Output Power / Tolerance

Please refer to Appendix B.



### 3.5 Limitation of Collateral Emission of Receiver Measurement

#### 3.5.1 Limit

Item	Limits
Rx Spurious Emission	$\leq 4\text{nW/MHz}$ ( $f < 1\text{GHz}$ )
	$\leq 20\text{nW/MHz}$ ( $1\text{GHz} \leq f$ )

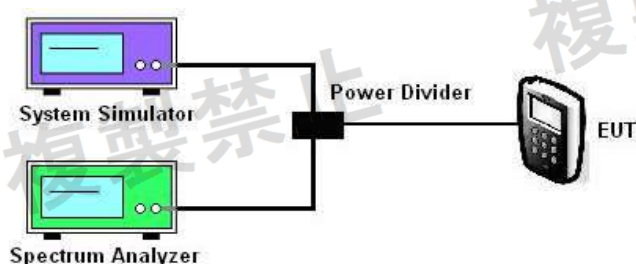
#### 3.5.2 Measuring Instruments

See list of measuring instruments of this test report.

#### 3.5.3 Test Procedures

1. EUT have the continuous reception mode and fixed only one channelize.
2. SA set RBW: 100KHz and VBW: 100KHz. Then adjust to start frequency 30MHz and stop frequency 1GHz. Search to mark peak reading value + cable loss shall be less than 4nW.
3. SA set RBW: 1MHz and VBW: 1MHz. Then adjust to start frequency 1000MHz and stop frequency 12.5GHz. Search to mark peak reading value + cable loss shall be less than 20nW.
4. If power level of lower emissions are more than 1/10 of limit (.0.4nW for  $f < 1\text{GHz}$ , 2nW for  $f \geq 1\text{GHz}$ ), all those are to be indicated in the 2nd and 3rd lines. If others are 1/10 or less more of the limit, no necessary to be indicated.

#### 3.5.4 Test Setup



#### 3.5.5 Test Result of Limitation of Collateral Emission of Receiver

Please refer to Appendix B.



### 3.6 Transmission Antenna Gain (EIRP Antenna Power) Measurement

#### 3.6.1 Limit

Item	Limits
EIRP Power Density	$\leq 6.91\text{dBm/MHz}$ (FH form 2400~2483.5MHz)
	$\leq 12.14\text{dBm/MHz}$ (OFDM,DS from 2400~2483.5MHz)
	$\leq 12.14\text{dBm}$ (Other from 2400~2483.5MHz)
Remark: This test item will not be applied to EIRP power of EUT is lower than 12.14dBm/MHz.	

#### 3.6.2 Measuring Instruments

See list of measuring instruments of this test report.

#### 3.6.3 Test Procedures

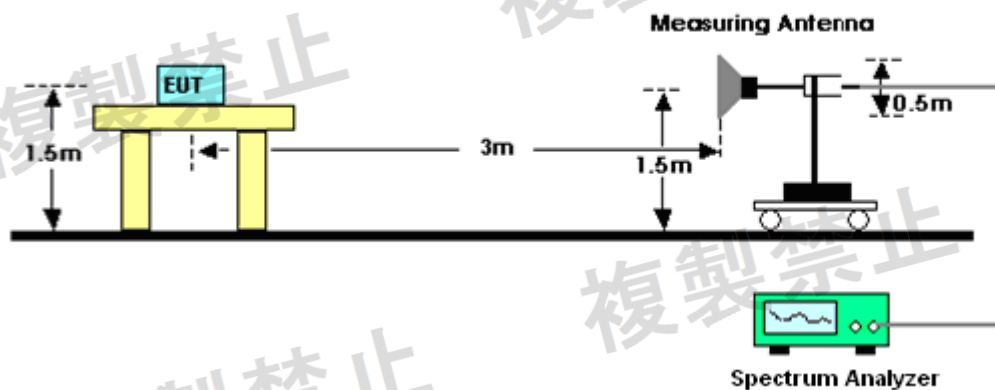
1. Set EUT ad measuring antenna at the same height and roughly facing each other.
2. Move the measuring antenna height up and down within  $\pm 50\text{cm}$  of EUT height and swing it to find the maximum output of the measuring antenna. The output level at the spectrum analyzer is read as "E".
3. Remove the EUT from the turn table and put the replacing antenna facing to measuring antenna at same height. Set the standard signal generator (SSG) at same frequency and transmit on then receive the signal.
4. Swing the replacing antenna give a maximum receiving level.
5. Move the measuring antenna height up and down within  $\pm 50\text{cm}$  of replacing antenna height and swing it to find the maximum receiving level.
6. Set SSG output power at  $P_t$  to give the equivalent output level of "E" or calculate  $P_t$  with SSG output which gives the nearest of "E" and difference ( $\pm 1\text{dB}$ ). Record the  $P_t$ .
7. Calculate EIRP by the formula below  $\text{EIRP} = G_t - L + P_t$ .  
Gt: gain of replacing antenna (dBi)  
L: feeder loss between SSG and replacing antenna  
Pt: Output power of the SSG
8. If the antenna for the EUT has circular polarization, sum of V-field and H-field will be result if measuring antenna is linear polarization.



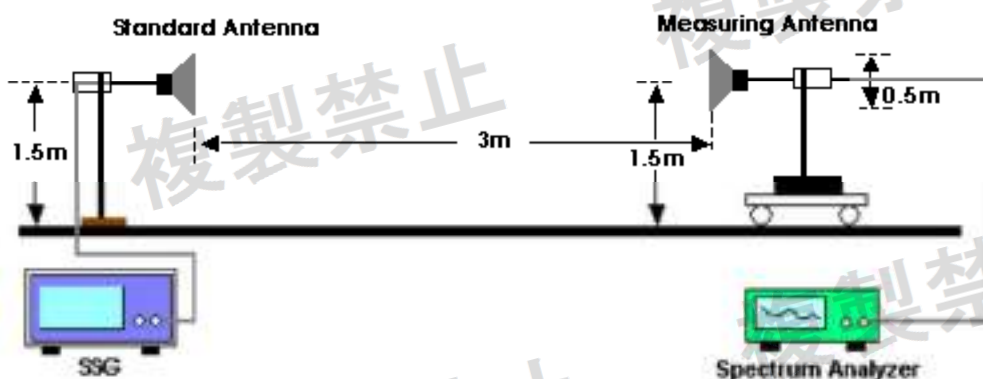


### 3.6.4 Test Setup

<For EUT radiation measurement>



<For standard antenna measurement>



### 3.6.5 Test Result of Transmission Antenna Gain (EIRP Antenna Power)

Please refer to Appendix B. For the antenna gain, please refer to antenna test report.

Remark: This test item will not be applied to EIRP power of EUT is lower than 12.14dBm/MHz.



### 3.7 Transmission Radiation Angle Width (3dB Beamwidth) Measurement

#### 3.7.1 Limit

Item	Limits
3dB antenna beamwidth	360/A (If $A < 1$ ; then $A = 1$ ) $A = \{\text{EIRP Power [mW]} / 16.36 \text{ for DS, OFDM}\}$ or $A = \{\text{EIRP Power [mW]} / 4.9 \text{ for FH}\}$
Remark: This test item will not be applied to EIRP power of EUT is lower than 12.14dBm/MHz.	

#### 3.7.2 Measuring Instruments

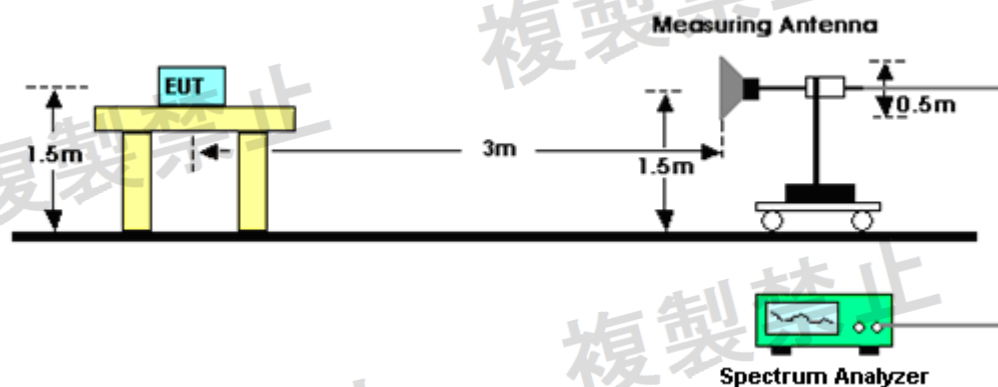
See list of measuring instruments of this test report.

#### 3.7.3 Test Procedures

1. Set EUT and measuring antenna at the same height and roughly facing each other.
2. Set spectrum analyzer with condition in section 3.7.2 and tune reference level to observe receiving signal position.
3. Rotate directions of the EUT horizontally and vertically to find the maximum receiving power.
4. Move the measuring antenna height up and down within  $\pm 50\text{cm}$  of EUT height and swing it to find the maximum output of measuring antenna. The output level at the spectrum analyzer is read as "E".
5. Calculate permitted radiation angle in horizontal and vertical using EIRP measured in another test method.
6. Calculate 3dB antenna beam width by the formula below  $360/A$  (If  $A < 1$ ; then  $A = 1$ ).  
 $A = \{\text{EIRP Power [mW]} / 16.36 \text{ for DS, OFDM}\}$  or  
 $A = \{\text{EIRP Power [mW]} / 4.9 \text{ for FH}\}$



### 3.7.4 Test Setup



### 3.7.5 Test Result of Transmission Radiation Angle Width (3dB Beamwidth)

Please refer to Appendix B.

For the antenna gain, please refer to antenna test report.

Remark: This test item will not be applied to EIRP power of EUT is lower than 12.14dBm/MHz.



### 3.8 Radio Interference Prevention Capability Measurement

#### 3.8.1 Limit

Item	Limits
Identification code	$\geq 48$ bits

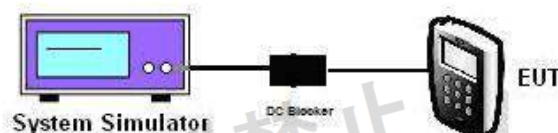
#### 3.8.2 Measuring Instruments

See list of measuring instruments of this test report.

#### 3.8.3 Test Procedures

1. In the case that the EUT has the function of automatically transmitting the identification code: a. Transmit the predetermined identification codes form EUT. b. Check the transmitted identification codes with the demodulator.
2. In the case of receiving the identification code: a. Transmit the predetermined identification codes form the counterpart. b . Check if communication is normal. c. Transmit the signals other than predetermined ID codes form the counterpart. d. check if the EUT stops the transmission, or if it displays that identification codes are different from the predetermined ones.

#### 3.8.4 Test Setup



#### 3.8.5 Test Result of Radio Interference Prevention Capability

Please refer to Appendix B.



### 3.9 Hopping Frequency Dwell Time Measurement

#### 3.9.1 Limit

Item	Limits
Hopping Freq. Dwell Time	$\leq 0.4$ seconds

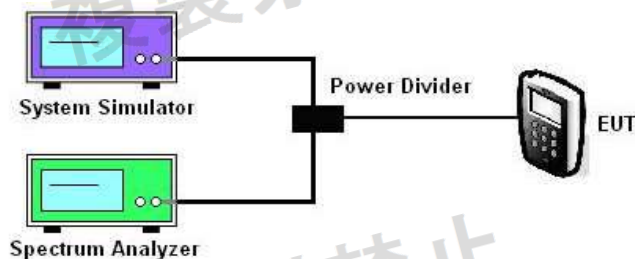
#### 3.9.2 Measuring Instruments

See list of measuring instruments of this test report.

#### 3.9.3 Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyzer.
2. Set RBW of spectrum analyzer to 1MHz and VBW to 1MHz.
3. Use a video trigger with the trigger level set to enable triggering only on full pulses.
4. Sweep Time is more than once pulse time.
5. Set the center frequency on any frequency would be measured and set the frequency span to zero span.
6. Measure the maximum time duration of one single pulse.
7. Set the EUT in continuous transmitting for each supported maximum packet format.
8. Measure the maximum time duration of one single pulse.
9. Use the marker-delta function to calculate the dwell time.
10. Dwell Time = Total Number of channels x 0.4(s) x Average Hopping Channel x package transfer time
11. Average Hopping Channel = Total Number of hopping / sweep time

#### 3.9.4 Test Setup



#### 3.9.5 Test Result of Hopping Frequency Dwell Time

Please refer to Appendix B.





### 3.10 Construction Protection Confirmation Method

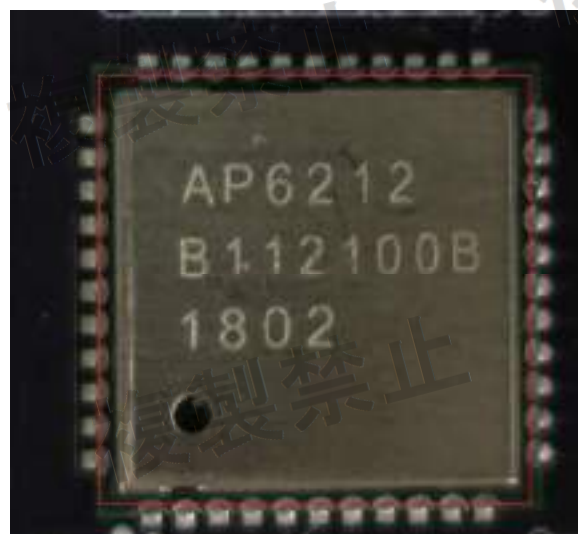
#### 3.10.1 Limit

The high-frequency section and modulation section of the radio equipment except for the antenna system shall not be capable of being opened easily.

#### 3.10.2 Confirmation Method

<input type="checkbox"/>	Sealed with special screws.
<input type="checkbox"/>	Plastic chassis is being welded using ultrasonic waves.
<input type="checkbox"/>	Chassis is glued using a special adhesive.
<input type="checkbox"/>	Metal covers are spot-fused.
<input type="checkbox"/>	Cover is specially interlocked.
<input checked="" type="checkbox"/>	RF and Modulation components are covered with shielding case and this shielding case is soldered.
<input type="checkbox"/>	Shield case is welded at RF and modulation parts, and ID-ROM is welded using the BGA Method.
<input type="checkbox"/>	Shield case is welded at RF and modulation parts, and ID-ROM is glued at its lead with a special adhesive.
<input type="checkbox"/>	Shield case is welded at RF and modulation parts, and ID-ROM is glued with a non-transparent laminating agent.
<input type="checkbox"/>	Other :

#### 3.10.3 The Photos of Construction Protection





## 4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Periods of Test	Due Date	Calibration Body	Calibration Method
Signal Analyzer	R&S	FSV40	101078	10Hz~40GHz	Apr. 19, 2018	Jul. 30, 2018~ Sep. 12, 2018	Apr. 18, 2019	LISAI	C
Power Meter	Anritsu	ML2495A	1542004	50MHz Bandwidth	Dec. 26, 2017	Jul. 30, 2018~ Sep. 12, 2018	Dec. 25, 2018	LISAI	C
Power Sensor	Anritsu	MA2411B	1339473	300MHZ~40GHz (-20~+20dBm)	Dec. 26, 2017	Jul. 30, 2018~ Sep. 12, 2018	Dec. 25, 2018	LISAI	C
BLUETOOTH TESTER	R&S	CBT	100963	Max input Power +27dBm	Dec. 26, 2017	Jul. 30, 2018~ Sep. 12, 2018	Dec. 25, 2018	LISAI	C
DC Power Supply	TTI	PL330P	253498	Max 32V,3A	Oct. 18, 2017	Jul. 30, 2018~ Sep. 12, 2018	Oct. 17, 2018	LISAI	C
Multi-meter	ALLOSUN	EM666	4743078	0~500V	Dec. 28, 2017	Jul. 30, 2018~ Sep. 12, 2018	Dec. 27, 2018	LISAI	C

Note: Above test equipment was used and kept valid calibration period during test.

### Calibration Method :

a) : Calibration conducted by the National Institute of Information and Communications Technology~  
NICT~ or a designated calibration agency under Article 102-18 paragraph

(1) TELEC Engineering Center, Intertek Japan K.K., Keysight Technologies, Inc~.

b) : Correction conducted pursuant to the provisions of Article 135 or Article 144 of the Measurement  
Law (Law No. 51 of 1992)~Japan Calibration Service Syste~

c) : Calibration conducted in foreign countries, which shall be equivalent to the calibration conducted by  
the NICT or a designated calibration agency under Article 102-18 paragraph

(1)~ TELEC Engineering Center, Intertek Japan K.K., Keysight Technologies, Inc~.

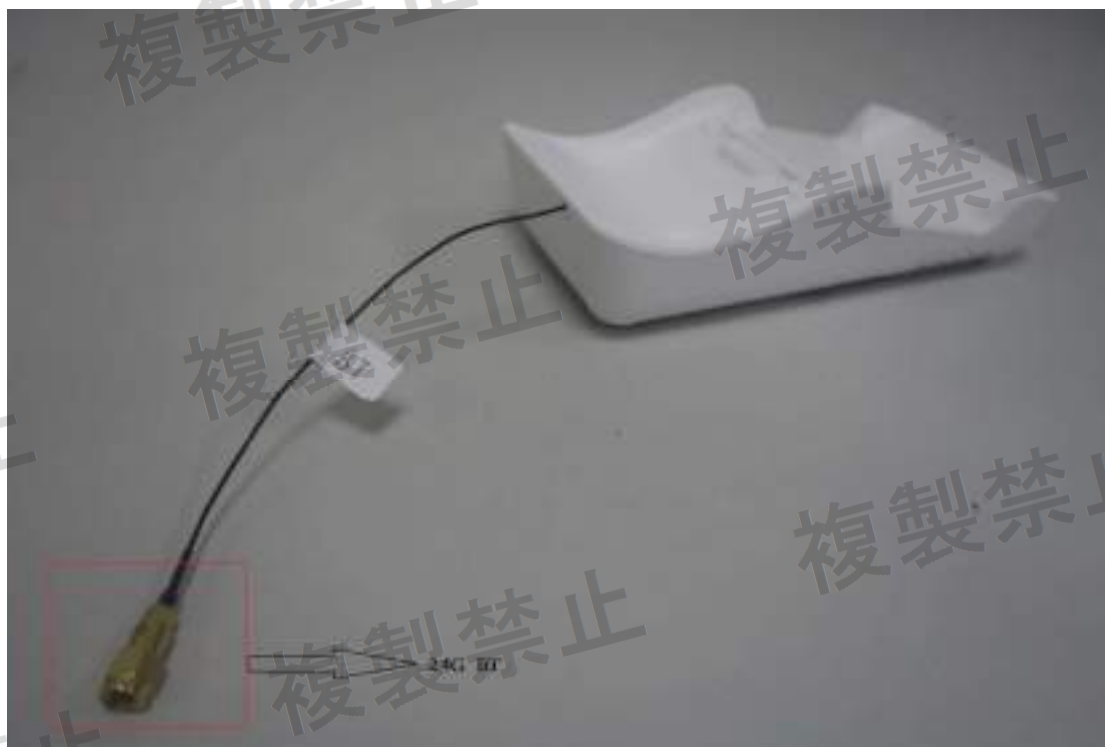


## Appendix A. Setup Photographs

Front View



Near View





## **Appendix B. Test Results**

Please refer to the following pages for test results.

# **1. TEST RESULTS DATA** **BLUETOOTH - BR**

Environment of Test Room	Temperature	23~26 °C
	Humidity	49~56 %
Test Engineer	Sam Zheng	

Modulatoin Type :	GFSK
Type Emissions :	78M1F1D

Declaration Output Power	0.130	mW/MHz
Declaration Output Power	-8.86	dBm/MHz
Antenna Power (E.I.R.P.)	-8.06	dBm/MHz
Input Power Voltage	5.000	Vdc

Path Loss		5.00	dB
Burst	ON TIME	0.383	msec
	OFF TIME	0.870	msec
	Ratio	30.56	%
Packet Type (Mode)		DH1	mode

## **Antenna Information:**

Antenna Model	Antenna Type	Gain(dBi)
Refer to antenna report	PCB	0.80

## **1.1. Test Results (Normal Voltage)**

Measurement Frequency	MHz	2402	2441	2480	Limit	Result			Note
Channel Number	Ch.	0	39	78		0	39	78	
Reading Frequency	MHz	2401.977	2440.974	2479.974		-----	-----	-----	
Frequency Tolerance	ppm	-9.638	-10.672	-10.504	±50	PASS	PASS	PASS	

Occupied Bandwidth	MHz	78.15	83.5	PASS	
Spread Bandwidth	MHz	70.33	0.5	PASS	
RF Output Power	mW/MHz	0.126	-----	-----	-----
RF Output Power Tolerance	%	-2.97	-80~+20	PASS	
Output Power (With burst ratio)	dBm	9.48	-----	-----	-----

Unwanted Emission Intensity	Under 2387MHz	μW/MHz	0.00337	0.00358	0.00341	2.5	PASS	PASS	PASS	
		MHz	879.296	954.075	837.590		-----	-----	-----	
	2387MHz - 2400MHz	μW/MHz	0.56105	0.00210	0.00271	25	PASS	PASS	PASS	
		MHz	2399.960	2389.290	2389.360		-----	-----	-----	
	2483.5MHz - 2496.5MHz	μW/MHz	0.00237	0.00265	0.03767	25	PASS	PASS	PASS	
		MHz	2492.770	2493.320	2483.590		-----	-----	-----	
Limitation of Collateral Emission of Receiver	2496.5MHz - 12.5GHz	μW/MHz	0.03767	0.03499	0.03899	2.5	PASS	PASS	PASS	
		MHz	4803.580	4882.600	7440.240		-----	-----	-----	
	Under 1GHz	nW	0.014	0.013	0.019	4	PASS	PASS	PASS	
		MHz	37.614	37.420	37.323		-----	-----	-----	
	1 - 12.5GHz	nW	0.036	0.037	0.040	20	PASS	PASS	PASS	
		MHz	6933.030	2458.940	6835.280		-----	-----	-----	

Spread Factor	-----	70.33	5	PASS	
Dwell Time	mSec	320.26	400	PASS	DH5
Radio Interference Prevention Capability	-----	good		PASS	

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## 2. TEST RESULTS DATA

### BLUETOOTH - EDR

Environment of Test Room	Temperature	23~26 °C
	Humidity	49~56 %
Test Engineer	Sam Zheng	

Modulatoion Type :	$\pi/4$ -DQPSK
Type Emissions :	78M4G1D

Declaration Output Power	0.130	mW/MHz
Declaration Output Power	-8.86	dBm/MHz
Antenna Power (E.I.R.P.)	-8.06	dBm/MHz
Input Power Voltage	5.000	Vdc

Path Loss		5.00	dB
Burst	ON TIME	0.388	msec
	OFF TIME	0.864	msec
	Ratio	31.02	%
Packet Type (Mode)		2-DH1	mode

#### Antenna Information:

Antenna Model	Antenna Type	Gain(dBi)
Refer to antenna report	PCB	0.80

#### 2.1. Test Results (Normal Voltage)

Measurement Frequency	MHz	2402	2441	2480	Limit	Result			Note
Channel Number	Ch.	0	39	78		0	39	78	
Reading Frequency	MHz	2401.994	2440.991	2479.988		-----	-----	-----	
Frequency Tolerance	ppm	-2.415	-3.564	-4.677	±50	PASS	PASS	PASS	

Occupied Bandwidth	MHz	78.44	83.5	PASS	
Spread Bandwidth	MHz	69.18	0.5	PASS	
RF Output Power	mW/MHz	0.058	-----	-----	-----
RF Output Power Tolerance	%	-55.63	-80~+20	PASS	
Output Power (With burst ratio)	dBm	6.01	-----	-----	-----

Unwanted Emission Intensity	Under 2387MHz	$\mu$ W/MHz	0.00409	0.00406	0.00419	2.5	PASS	PASS	PASS	
		MHz	428.776	198.424	913.630		-----	-----	-----	
	2387MHz - 2400MHz	$\mu$ W/MHz	1.54525	0.00224	0.00258	25	PASS	PASS	PASS	
		MHz	2400.000	2388.590	2393.430		-----	-----	-----	
	2483.5MHz - 2496.5MHz	$\mu$ W/MHz	0.00223	0.00290	0.01982	25	PASS	PASS	PASS	
		MHz	2495.670	2492.770	2483.540		-----	-----	-----	
	2496.5MHz - 12.5GHz	$\mu$ W/MHz	0.01079	0.01094	0.01462	2.5	PASS	PASS	PASS	
		MHz	4803.580	4882.600	7440.240		-----	-----	-----	
Limitation of Collateral Emission of Receiver	Under 1GHz	nW	0.015	0.016	0.020	4	PASS	PASS	PASS	
		MHz	37.614	37.323	37.614		-----	-----	-----	
	1 -12.5GHz	nW	0.046	0.040	0.034	20	PASS	PASS	PASS	
		MHz	6841.990	2458.940	6858.280		-----	-----	-----	

Spread Factor	-----	69.18	5	PASS	
Dwell Time	mSec	317.84	400	PASS	2DH5
Radio Interference Prevention Capability	-----	good		PASS	

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### 3. TEST RESULTS DATA

#### BLUETOOTH - AFH BR

Environment of Test Room	Temperature	23~26 °C
	Humidity	49~56 %
Test Engineer	Sam Zheng	

Modulatoion Type :	GFSK
Type Emissions :	19M6F1D

Declaration Output Power	0.520	mW/MHz
Declaration Output Power	-2.84	dBm/MHz
Antenna Power (E.I.R.P)	-2.04	dBm/MHz
Input Power Voltage	5.000	Vdc

Burst	Path Loss	5.00	dB
	ON TIME	0.383	msec
	OFF TIME	0.870	msec
	Ratio	30.56	%
Packet Type (Mode)		DH1	mode

#### Antenna Information:

Antenna Model	Antenna Type	Gain(dBi)
Refer to antenna report	PCB	0.80

#### 3.1. Test Results (Normal Voltage)

Measurement Frequency	MHz	2402	2411	2421	Limit	Result			Note
Channel Number	Ch.	0	9	19		0	9	19	
Reading Frequency	MHz	2401.974	2410.974	2420.974		-----	-----	-----	
Frequency Tolerance	ppm	-10.845	-10.805	-10.760	±50	PASS	PASS	PASS	

Occupied Bandwidth	MHz	19.61	83.5	PASS	
Spread Bandwidth	MHz	18.09	0.5	PASS	
RF Output Power	mW/MHz	0.490	-----	-----	-----
RF Output Power Tolerance	%	-5.69	-80~+20	PASS	
Output Power (With burst ratio)	dBm	9.48	-----	-----	-----

Unwanted Emission Intensity	Under 2387MHz	μW/MHz	0.00381	0.00422	0.00452	2.5	PASS	PASS	PASS	
		MHz	995.005	612.475	972.794		-----	-----	-----	
	2387-2400MHz	μW/MHz	2.10378	0.00259	0.00290	25	PASS	PASS	PASS	
		MHz	2399.940	2398.350	2397.160		-----	-----	-----	
	2483.5-2496.5MHz	μW/MHz	0.00264	0.00286	0.00219	25	PASS	PASS	PASS	
		MHz	2493.950	2489.200	2490.970		-----	-----	-----	
	2496.5MHz - 12.5GHz	μW/MHz	0.03311	0.01393	0.01222	2.5	PASS	PASS	PASS	
		MHz	4804.580	4822.580	7263.190		-----	-----	-----	
Limitation of Collateral Emission of Receiver	Under 1GHz	nW	0.014	0.013	0.015	4	PASS	PASS	PASS	
		MHz	37.808	38.390	38.0987		-----	-----	-----	
	1 -12.5GHz	nW	0.033	0.033	0.037	20	PASS	PASS	PASS	
		MHz	6858.280	6855.410	6850.620		-----	-----	-----	

Spread Factor	-----	18.09	5	PASS	
Dwell Time	mSec	66.91	400	PASS	DH5
Radio Interference Prevention Capability	-----	good		PASS	

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#### 4. TEST RESULTS DATA

##### BLUETOOTH - LE

Environment of Test Room	Temperature	23~26 °C
	Humidity	49~56 %
Test Engineer	Sam Zheng	

Modulatoin Type :	GFSK
Type Emissions :	1M06F1D

Declaration Output Power	7.600	mW
Declaration Output Power	8.81	dBm
Antenna Power (E.I.R.P.)	9.61	dBm
Input Power Voltage	5.000	Vdc

Burst	Path Loss	5.00	dB
	ON TIME	0.388	msec
	OFF TIME	0.238	msec
Packet Type (Mode)	Ratio	62.04	%
	Low Energy	mode	

#### Antenna Information:

Antenna Model	Antenna Type	Gain(dBi)
Refer to antenna report	PCB	0.80

#### 4.1. Test Results (Normal Voltage)

Measurement Frequency	MHz	2402	2440	2480	Limit	Result			Note
Channel Number	Ch.	0	19	39		0	19	39	
Reading Frequency	MHz	2401.965	2439.980	2479.980		-----	-----	-----	
Frequency Tolerance	ppm	-14.446	-8.299	-8.165	$-50 \leq x \leq +50$	PASS	PASS	PASS	

Occupied Bandwidth	MHz	1.05	1.06	1.05	26	PASS			
Spreading Bandwidth	MHz	N/A			0.5	N/A			
RF Output Power	mW	4.169	6.427	7.568		-----			
RF Output Power Tolerance	%	-45.15	-15.44	-0.42	$-80 \leq x \leq +20$	PASS			
Output Power (With burst ratio)	dBm	6.20	8.08	8.79		-----			

Unwanted Emission Intensity	Under 2387MHz	$\mu\text{W}/\text{MHz}$	0.00377	0.00381	0.00365	2.5	PASS	PASS	PASS	
		MHz	966.393	908.975	892.680		-----	-----	-----	
	2387MHz - 2400MHz	$\mu\text{W}/\text{MHz}$	1.71396	0.00224	0.00240	25	PASS	PASS	PASS	
		MHz	2399.890	2398.020	2394.600		-----	-----	-----	
	2483.5MHz - 2496.5MHz	$\mu\text{W}/\text{MHz}$	0.00232	0.00249	0.01862	25	PASS	PASS	PASS	
		MHz	2495.630	2492.300	2484.240		-----	-----	-----	
Limitation of Collateral Emission of Receiver	2496.5MHz - 12.5GHz	$\mu\text{W}/\text{MHz}$	0.02118	0.02716	0.02716	2.5	PASS	PASS	PASS	
		MHz	4804.580	4880.600	7439.240		-----	-----	-----	
	Under 1GHz	nW	0.016	0.017	0.012	4	PASS	PASS	PASS	
		MHz	37.420	37.517	37.517		-----	-----	-----	
Limitation of Collateral Emission of Receiver	1 - 12.5GHz	nW	0.038	0.035	0.033	20	PASS	PASS	PASS	
		MHz	2456.070	2456.070	6459.650		-----	-----	-----	

Spread Factor	-----	N/A			5	N/A			
Dwell Time	mSec	N/A			400	N/A			
Radio Interference Prevention Capability	-----	good				PASS			

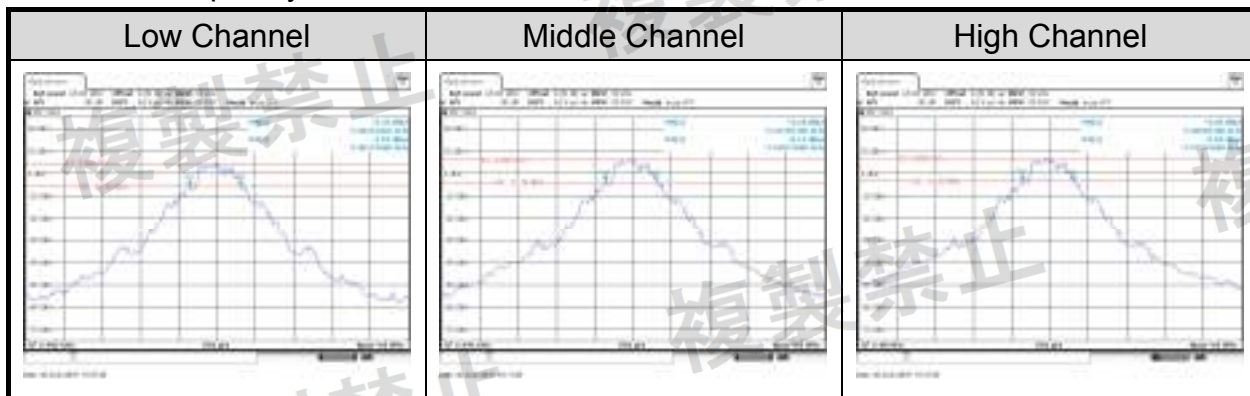
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## Appendix C. Test Plots

### C.1. BR (Basic Rate)

#### C.1.1. Frequency Tolerance



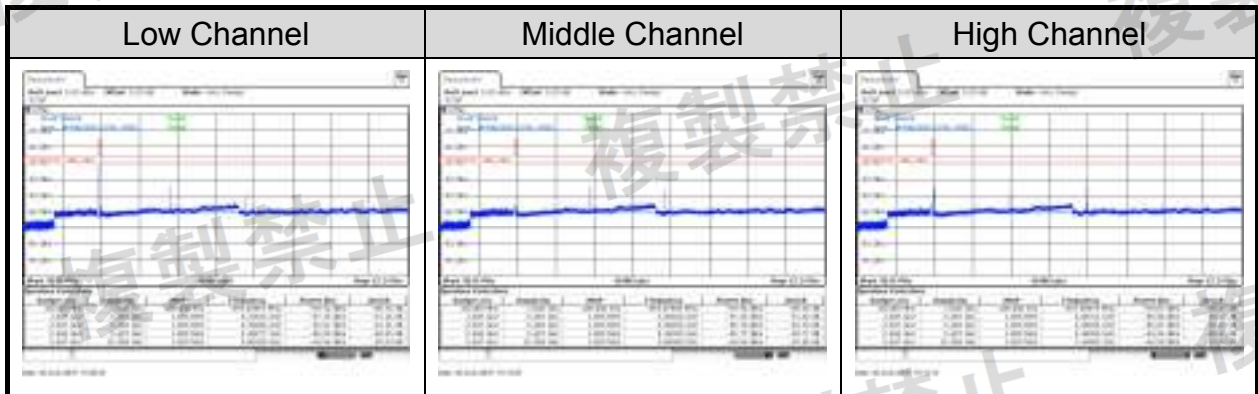
#### C.1.2. Occupied Bandwidth and Spread-spectrum Bandwidth



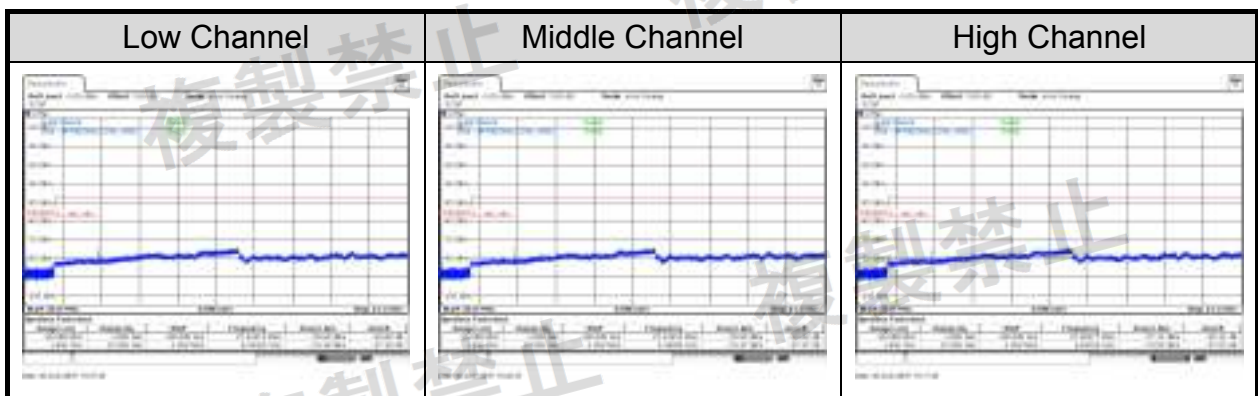




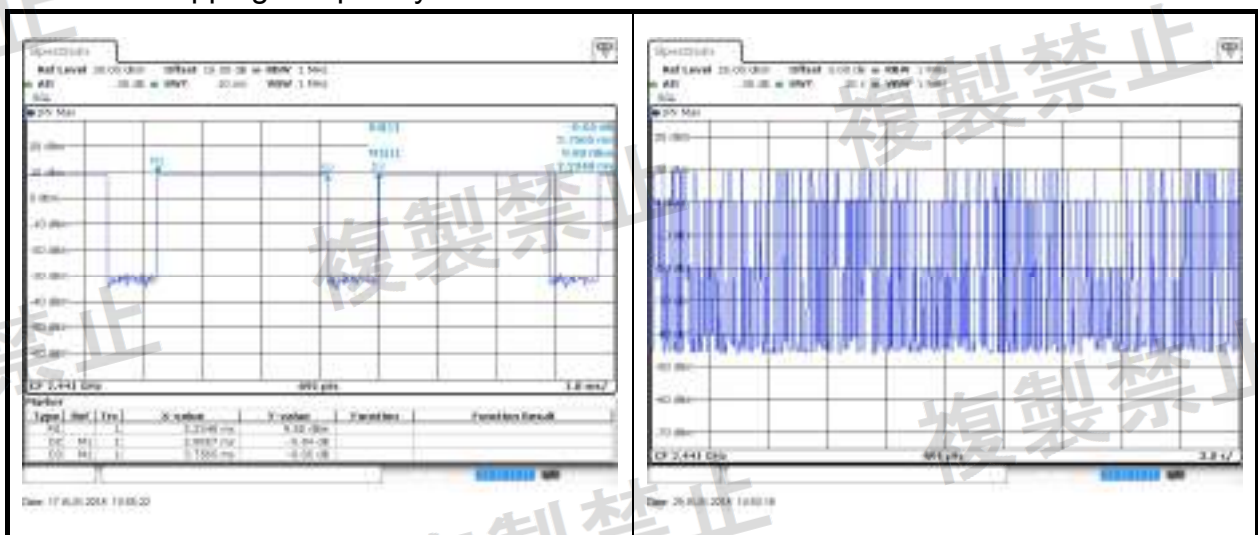
C.1.3. Unwanted Emission Intensity



C.1.4. Limitation of Collateral Emission of Receiver



C.1.5. Hopping Frequency Dwell Time

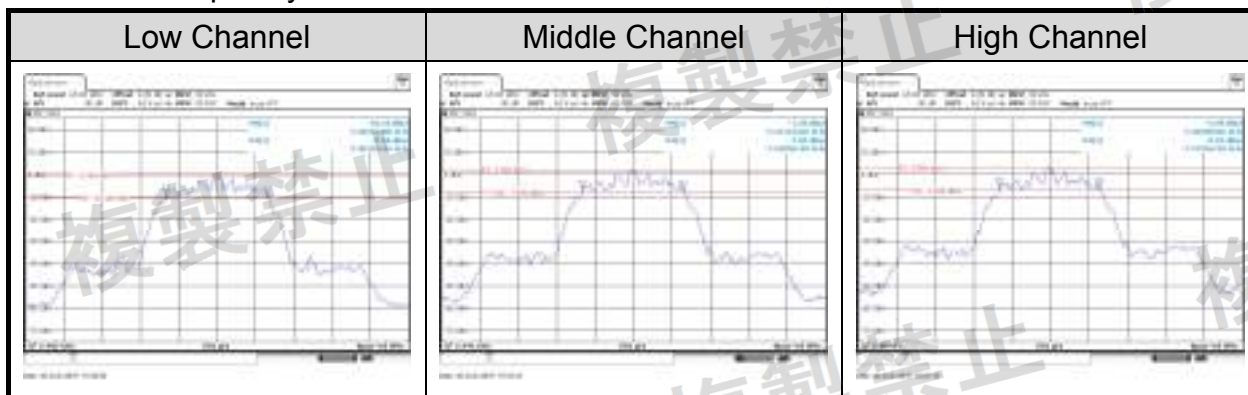




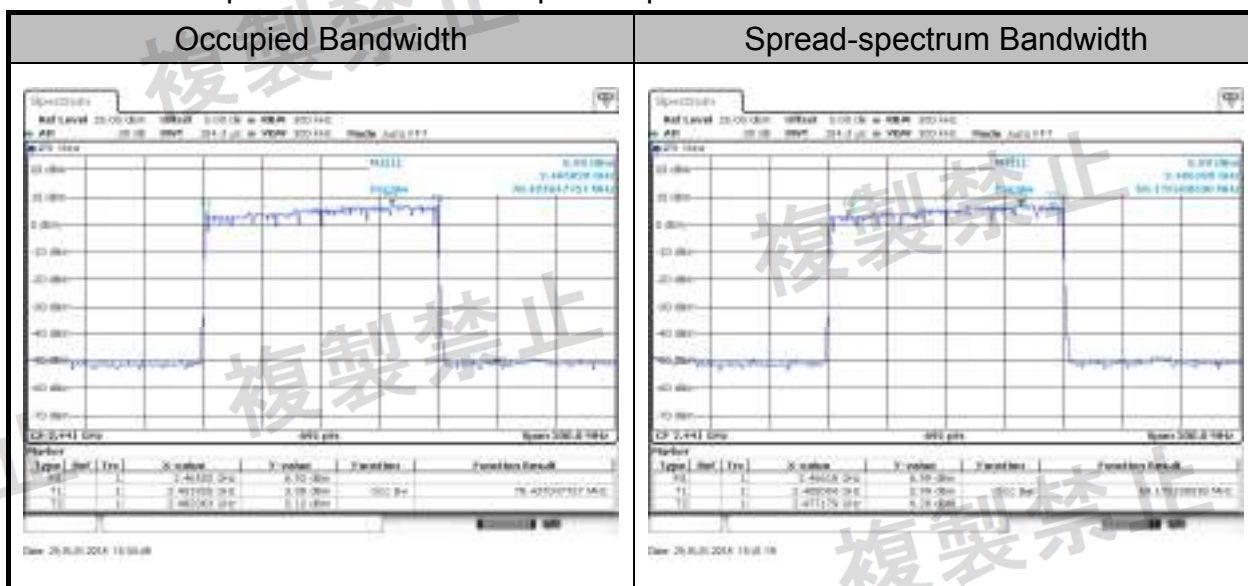


## C.2. EDR (Enhanced Data Rate)

## C.2.1. Frequency Tolerance

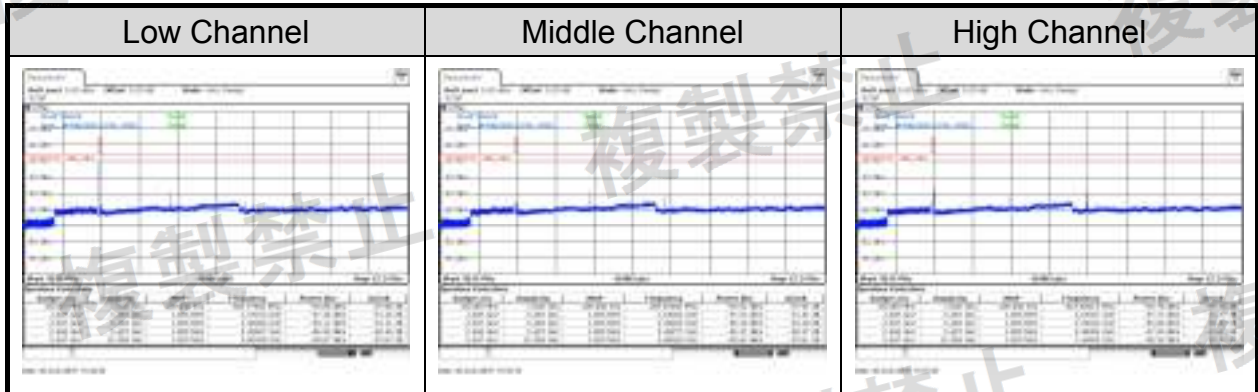


## C.2.2. Occupied Bandwidth and Spread-spectrum Bandwidth

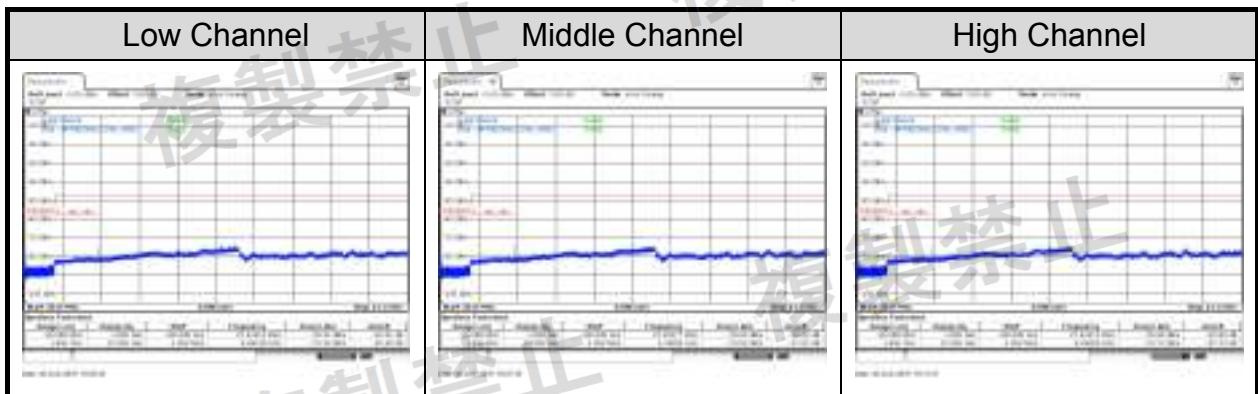




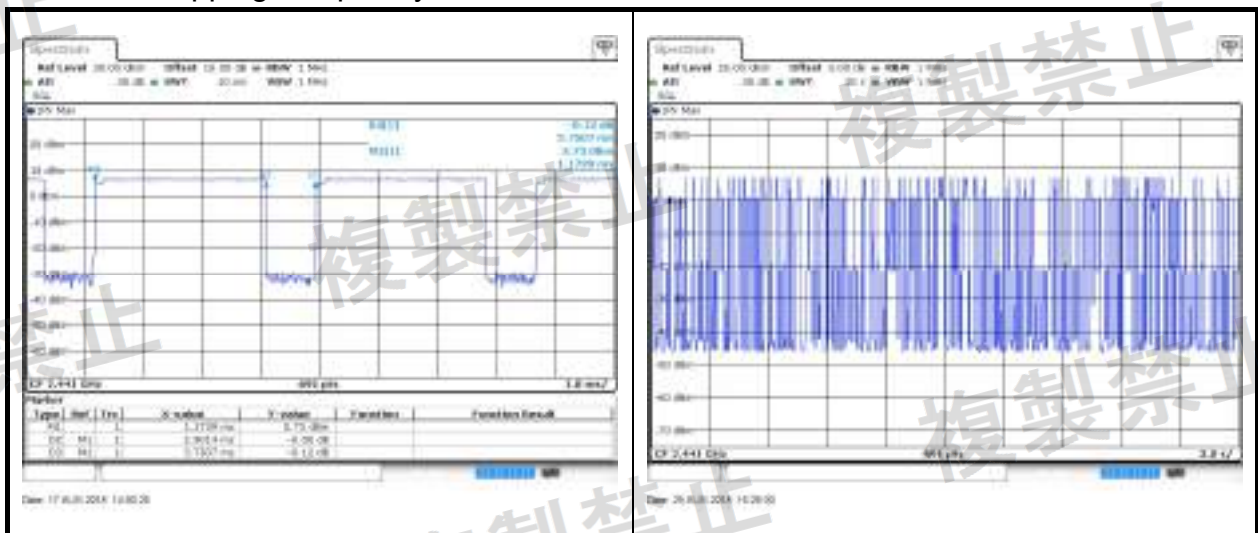
C.2.3. Unwanted Emission Intensity



C.2.4. Limitation of Collateral Emission of Receiver



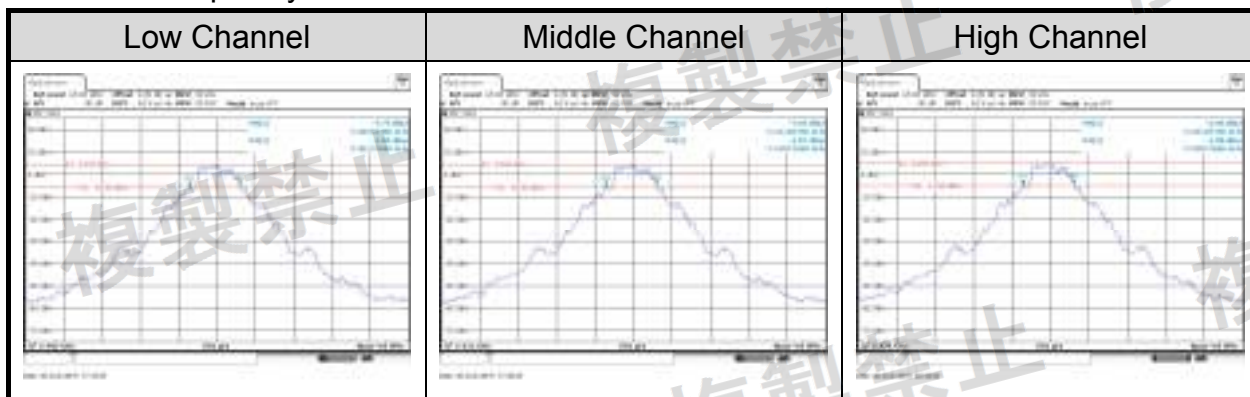
C.2.5. Hopping Frequency Dwell Time





## C.3. BR\_AFH (Adaptive Frequency Hopping)

## C.3.1. Frequency Tolerance



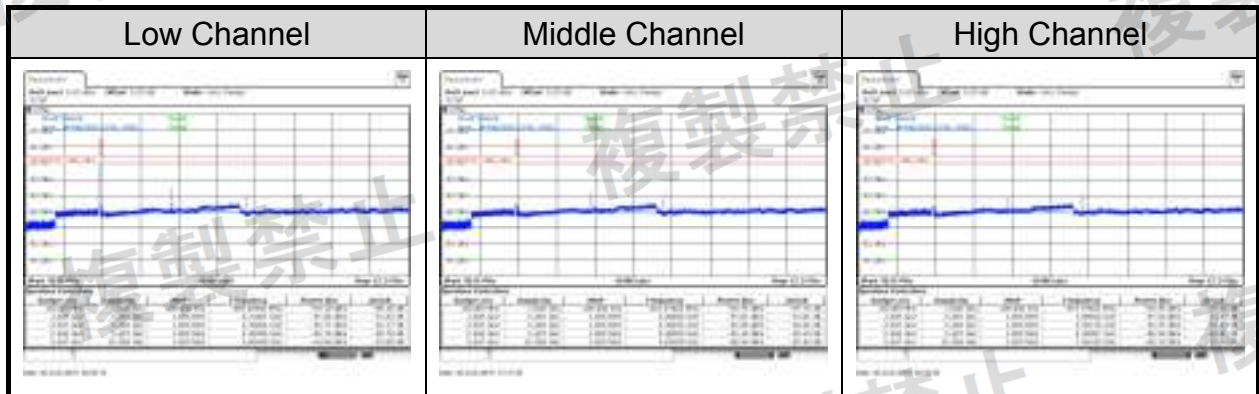
## C.3.2. Occupied Bandwidth and Spread-spectrum Bandwidth



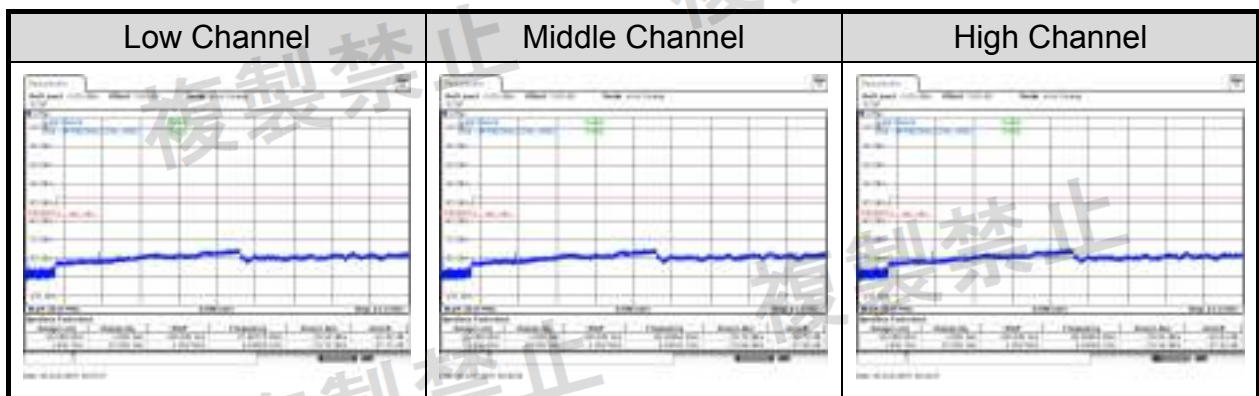




## C.3.3. Unwanted Emission Intensity



## C.3.4. Limitation of Collateral Emission of Receiver



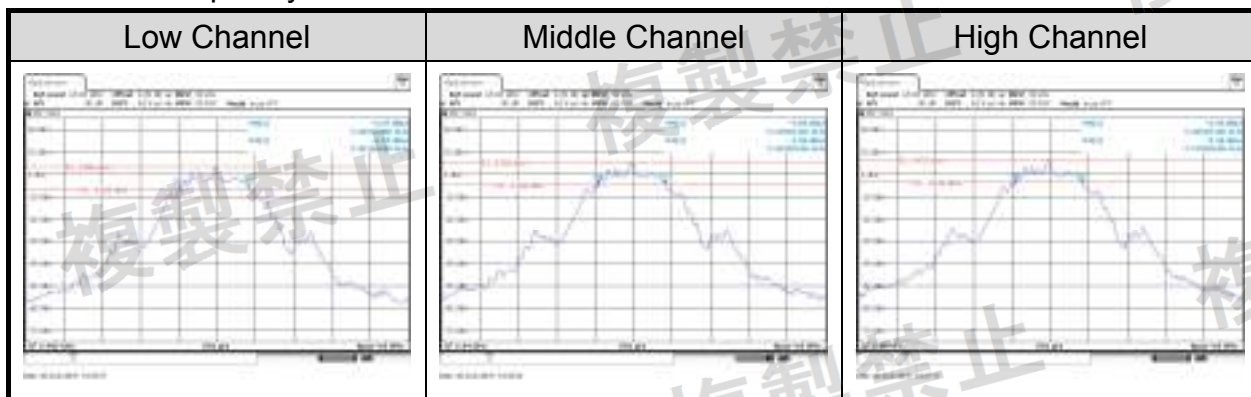
## C.3.5. Hopping Frequency Dwell Time



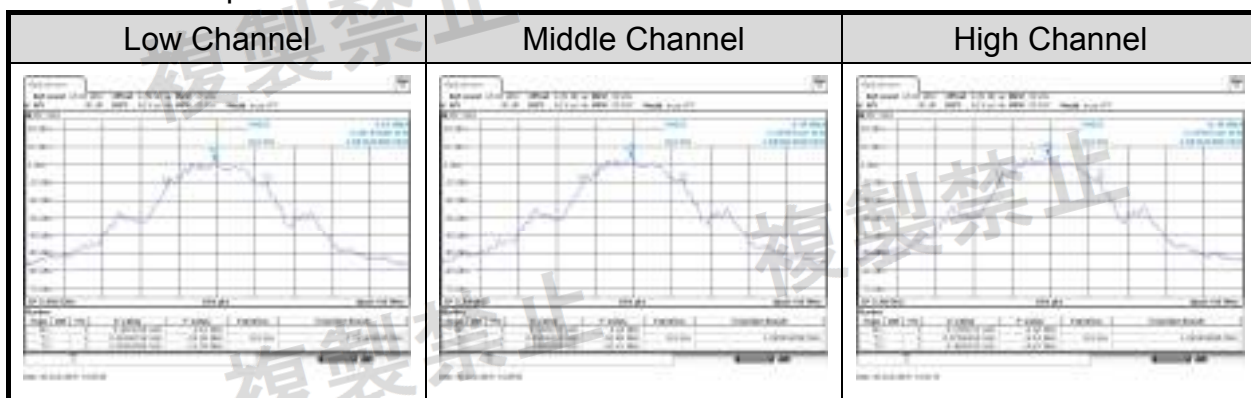


C.4. LE (Low Energy /4.0)

C.4.1. Frequency Tolerance



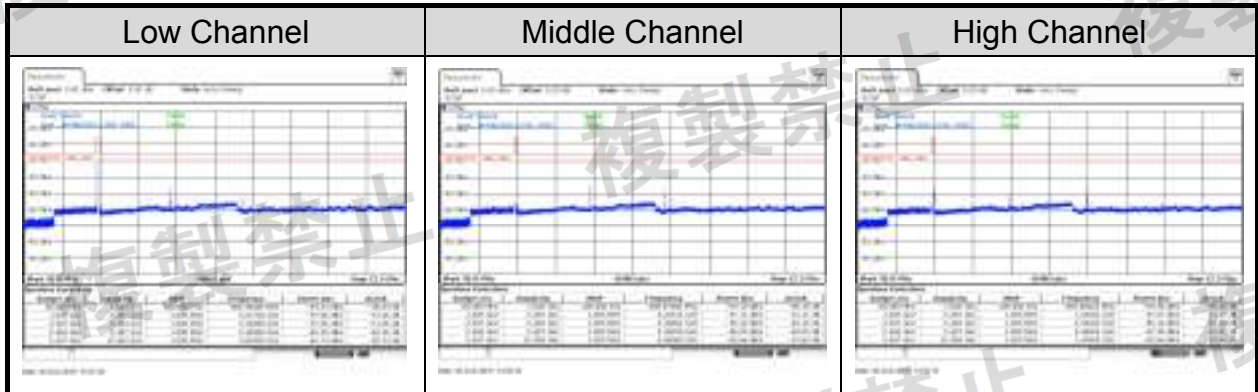
C.4.2. Occupied Bandwidth







C.4.3. Unwanted Emission Intensity



C.4.4. Limitation of Collateral Emission of Receiver

