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# FCC RF Test Report

# For

# Shenzhen Hangshi Technology Co.,Ltd

Test Standards:	Part 15C Subpart C §15.247					
Product Description:	Bluetooth Mouse					
Tested Model:	MB156					
Additional Model No.:	<u>N/A</u>					
Brand Name:	<u>N/A</u>					
FCC ID:	2AKHJ-MB156					
Classification Digital Spread Spectrum (DSS)						
Report No.:	EC1907001RF01					
Tested Date:	2019-07-01 to 2019-07-11					
Issued Date:	<u>2019-07-11</u>					
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Note: The test results in this report apply exclusively to the tested model / sample. Without written approval of Hunan Ecloud Testing Technology Co., Ltd., the test report shall not be reproduced except in full.



# **Report Revise Record**

Report Version	Revise Time	Revise Time Issued Date		Notes	
V1.0	/	2019.07.11	Valid	Original Report	



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**APPENDIX C. EUT INTERNAL PHOTOGRAPHS** 



# **Summary of Test Result**

FCC Rule	IC Rule	Description	Limit	Result	Remark
15.247(a)(1)	RSS-247 5.1(1)	20dB Bandwidth	NA	Pass	-
-	RSS-Gen 6.6	99% Bandwidth	-	Pass	-
15.247(a)(1)	RSS-247 5.1(2)	Hopping Channel Separation	≥ 2/3 of 20dB BW	Pass	-
15.247(a)(1)	RSS-247 5.1(4)	Number of Channels	≥ 15Chs	Pass	-
15.247(a)(1)	RSS-247 5.1(4)	Average Time of Occupancy	≤ 0.4sec in 31.6sec period	Pass	-
15.247(b)(1)	RSS-247 5.4(2)	Peak Output Power	≤ 125 mW	Pass	-
15.247(d)	RSS-247 5.5	Conducted Band Edges	≤ 20dBc	Pass	-
15.247(d)	RSS-247 5.5	Conducted Spurious Emission	≤ 20dBc	Pass	-
15.247(d)	RSS-247 5.5	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 1.89 dB at 4882 MHz
15.207	RSS-Gen 8.8	AC Conducted Emission	15.207(a)	Not required	
15.203 & 15.247(b)	N/A	Antenna Requirement	N/A	Pass	-



# 1 Test Laboratory

# 1.1 Test facility

# CNAS (accreditation number: L11138)

Hunan Ecloud Testing Technology Co., Ltd. has obtained the accreditation of China National Accreditation

Service for Conformity Assessment (CNAS).

# FCC (Designation number: CN1244, Test Firm Registration Number:

## 793308)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the US Federal Communications Commission

list of test facilities recognized to perform electromagnetic emissions measurements.

# ISED(CAB identifier: CN0012, ISED#:24347)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the Wireless Device Testing Laboratories list of

innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements.

# A2LA (Certificate Code : 4895.01 )

Hunan Ecloud Testing Technology Co., Ltd. has been listed by American Association for Laboratory

Accreditation to perform electromagnetic emission measurement.



# 2 General Description

## 2.1 Applicant

#### Shenzhen Hangshi Technology Co.,Ltd

Hangshi Technology Park, Democracy West Industry Area, Shajing Town, Bao'an District, Shenzhen, China.

## 2.2 Manufacturer

#### Shenzhen Hangshi Technology Co.,Ltd

Hangshi Technology Park, Democracy West Industry Area, Shajing Town, Bao'an District, Shenzhen, China.

## 2.3 General Description Of EUT

Product	Bluetooth Mouse
Model No.	MB156
Additional No.	N/A
FCC ID	2AKHJ-MB156
Power Supply	3.0Vdc (AAA*2 batteries)
Modulation Technology	FHSS
Modulation Type	GFSK
Operating Frequency	2402MHz~2480MHz
Number Of Channel	79
Max. Output Power	Bluetooth BR(1Mbps) : -2.11 dBm (0.000615 W)
Antenna Type	PCB Antenna with 1.8dBi gain
HW Version	BTS20730 V4.3
SW Version	BTS20730-03
I/O Ports	Refer to user's manual
Cable Supplied	Refer to user's manual

#### NOTE:

- 1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
- 2. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.





2.4 Modification of EUT

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

# 2.5 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
- ANSI C63.10-2013
- KDB 558074 D01 15.247 Meas Guidance v05r02

#### Remark:

1. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.



# 3 Test Configuration of Equipment Under Test

## 3.1 Descriptions of Test Mode

The transmitter has a maximum peak conducted output power as follows:

Channel	Frequency	Mode	Bluetooth RF Output Power
Ch00	2402MHz	GFSK	-2.11
Ch39	2441MHz	GFSK	-2.13
Ch78	2480MHz	GFSK	-2.25

Remark:

1. All the test data for each data rate were verified, but only the worst case was reported.

2. The data rate was set in 1Mbps for all the test items due to the highest RF output power.



## 3.2 Test Mode

Summary table of Test Cases						
Toot Kom	Data Rate / Modulation					
Test Item	Bluetooth BR 1Mbps GFSK					
Conducted	Mode 1: CH00_2402 MHz					
	Mode 2: CH39_2441 MHz					
Test Cases	Mode 3: CH78_2480 MHz					

## 3.2.1 Antenna Port Conducted Measurement

### 3.2.2 Radiated Emission Test (Below 1GHz)

	Bluetooth BR 1Mbps GFSK					
Radiated	Mode 1: CH00_2402 MHz					
Test Cases	Mode 2: CH39_2441 MHz					
	Mode 3: CH78_2480 MHz					

Note : 1. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type. X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

2. Following channel(s) was (were) selected for the final test as listed above

#### 3.2.3 Radiated Emission Test (Above 1GHz)

	Bluetooth BR 1Mbps GFSK				
Radiated	Mode 1: CH00_2402 MHz				
Test Cases	Mode 2: CH39_2441 MHz				
	Mode 3: CH78_2480 MHz				

Note : 1. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z it was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

2. Following channel(s) was (were) selected for the final test as listed above

3. For frequency above 18GHz, the measured value is much lower than the limit, therefore, it is not reflected in the report.

#### 3.2.4 Power Line Conducted Emission Test:

AC Conducted Emission

Mode 1 : Bluetooth Link



# 3.3 Support Equipment

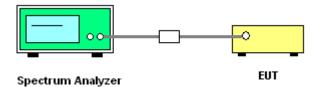
Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Notebook	Lenovo	E470C	FCC DoC	N/A	shielded cable DC O/P 1.8 m unshielded AC I/P cable1.2 m

## 3.4 Test Setup

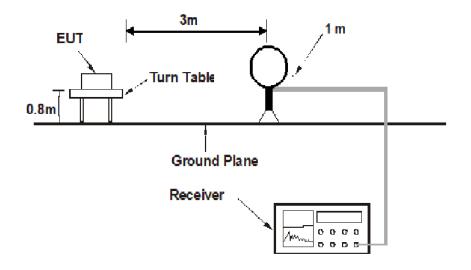
The EUT is continuously communicating to the Bluetooth tester during the tests.

EUT was set in the Hidden menu mode to enable BT communications.

#### Setup diagram for Conducted Test

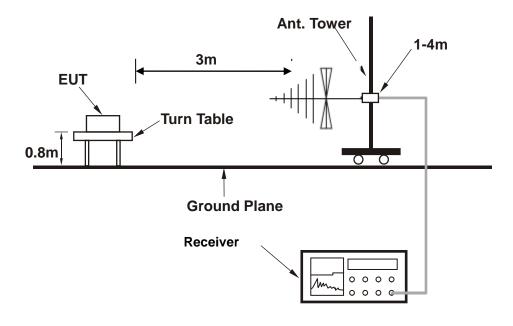


Setup diagram for Raidation(9KHz~30MHz) Test

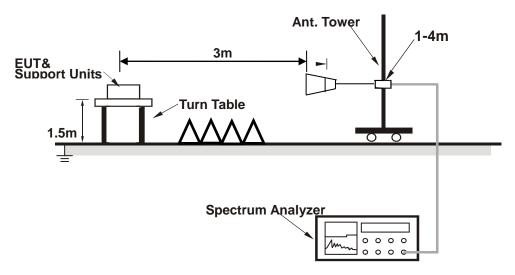




Setup diagram for Raidation(Below 1G) Test

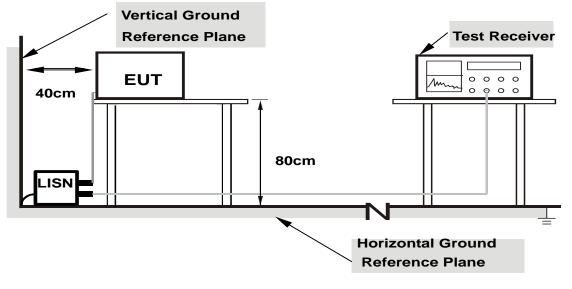


Setup diagram for Raidation(Above1G) Test





Setup diagram for AC Conducted Emission Test



Note: 1.Support units were connected to second LISN.2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

## **3.5 Measurement Results Explanation Example**

#### For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 5 dB and 10dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).

= 5 + 10 = 15 (dB)



# 4 Test Result

## 4.1 20dB and 99% Bandwidth Measurement

#### 4.1.1 Limit of 20dB and 99% Bandwidth

None; for reporting purposes only.

#### 4.1.2 Test Procedures

- 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Turn on the EUT and connect it to measurement instrument.
- 3. Use the following spectrum analyzer settings for 20dB Bandwidth measurement.

Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel;

RBW = 1% to 5% of the 20 dB bandwidth; VBW = approximately 3 times RBW; Sweep = auto; Detector function = peak; Trace = max hold.

4. Use the following spectrum analyzer settings for 99 % Bandwidth measurement.

Span = approximately 1.5 to 5 times the 99% bandwidth, centered on a hopping channel;

RBW = 1% to 5% of the 99% bandwidth; VBW = approximately 3 times RBW; Sweep = auto; Detector function = peak; Trace = max hold.



#### 4.1.3 Test Result of 20dB Bandwidth

Test Mode :		Transmitting	Temperature : 24~26°C	
Test Engine	er :	Damon Zhang	Relative Humidity : 50~53%	
Data Rate	Modulatio	on Channel	20dB Bandwidth [MHz]	Verdict
1Mbps	GFSK	LCH	1.034	PASS
1Mbps	GFSK	MCH	1.034	PASS
1Mbps	GFSK	НСН	1.030	PASS

#### 20dB Plot





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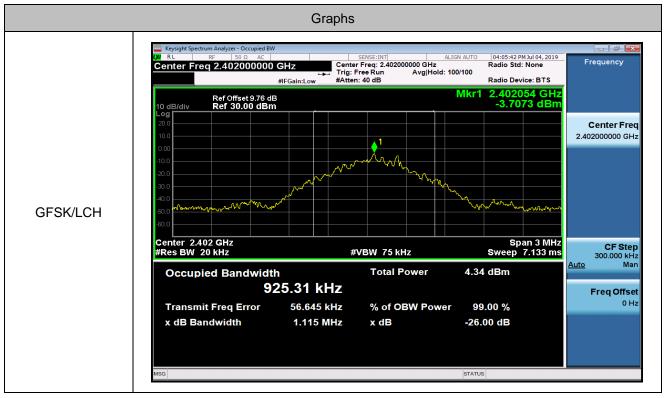




## 4.1.4 Test Result of 99% Bandwidth

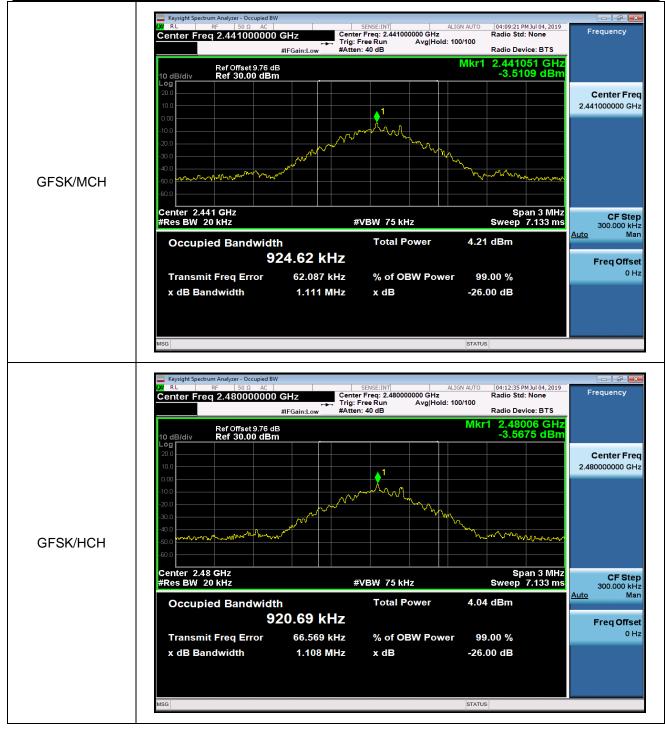
Test Mode :		Transmitting		Temperature :	<b>24~26</b> ℃			
Test Engine	er:	Damon Zha	ng		Relative Humidity	: 50~53%		
Data Rate	Modulatio	on Chanr	nel		99% OBW [N	IHz]		Verdict
1Mbps	GFSK	LCH	I		0.92531			PASS
1Mbps	GFSK	MCF	ł	0.92462				PASS
1Mbps	GFSK	HCF	1		0.92069			PASS

#### 99% Plot





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# 4.2 Hopping Channel Separation Measurement

#### 4.2.1 Limit of Hopping Channel Separation

FCC §15.247 (a) (1)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping channel, whichever is greater.

Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

#### 4.2.2 Test Procedures

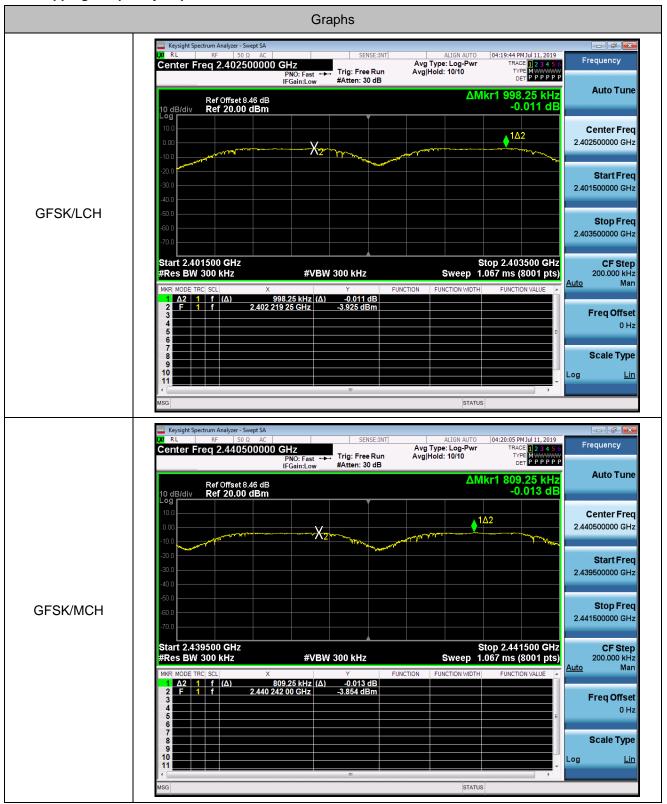
- 1.Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Turn on the EUT and connect it to measurement instrument.
- 3. The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

#### 4.2.3 Test Result of Hopping Channel Separation

Test Mode :		Transmitting		Temperature :	<b>24~26</b> ℃		
Test Enginee	r:	Damon Zhang		Relative Humidity :	50~53%		
Data Rate	Modulatio	n Channel	Carrier	Frequency Separatio	on [MHz]	Verdict	
1Mbps	GFSK	LCH		0.998		PASS	
1Mbps	GFSK	MCH	0.809		PASS		
1Mbps	GFSK	НСН		1.184		PASS	



#### **Hopping Frequency Separation Plot**





	🧱 Keysight Spectrum Analyzer - Swept SA	
	Image: Non-State State         SENSE:INT         ALIGN AUTO         04:20:29 PM3ul 11, 2019           Center Freq 2.479500000 GHz         Trig: Free Run         Avg Type: Log-Pwr         TRACE 12 34 5 6           PNO: Fast →→         Trig: Free Run         AvgHold: 10/10         Type PP PP           If Gain: Low         #Atten: 30 dB         Det         PP PP PP	requency
	Ref Offset 8.46 dB         ΔMkr1 1.184 00 MHz           10 dB/div         Ref 20.00 dBm	Auto Tune
		Center Freq 79500000 GHz
	-20.0 -30.0 -40.0	Start Fred 78500000 GHz
GFSK/HCH	-50.0	Stop Fred 30500000 GHz
	Start 2.478500 GHz         Stop 2.480500 GHz           #Res BW 300 kHz         #VBW 300 kHz         Sweep 1.067 ms (8001 pts)           MKR MODE TRC SCL         X         Y         FUNCTION WIDTH         FUNCTION VALUE	CF Step 200.000 kHz Man
	1         Δ2         1         f         (Δ)         1.184 00 MHz         (Δ)         0.030 dB           2         F         1         f         2.478 868 50 GHz         -4.058 dBm         -4.058 dBm	Freq Offset 0 Hz
	6 7 8 9 9 10 11	Scale Type Lir



## 4.3 Number of Channel Measurement

#### 4.3.1 Limits of Number of Hopping Frequency

#### FCC§15.247(a)(1)(iii)

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

### 4.3.2 Test Procedure

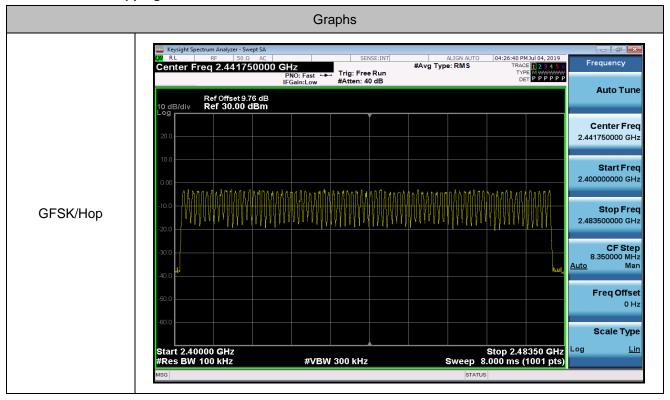
- 4. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 5. Turn on the EUT and connect it to measurement instrument.
- 6. The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple continuous sweeps. The RBW is set to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.. The analyzer is set to Max Hold.

#### 4.3.3 Test Result of Number of Hopping Frequency

Test Mode :		Trans	smitting		Temperature :	<b>24~26</b> ℃	
Test Engineer :	:	Damo	on Zhang		Relative Humidity :	50~53%	
Data Rate	Modulati	ion	Channel.	Nur	nber of Hopping Cha	nnel	Verdict
1Mbps	GFSK		Нор		79		PASS



#### **Number of Hopping Channels**





## 4.4 Average Time of Occupancy Measurement

#### 4.4.1 Limit of Average Time of Occupancy

#### FCC §15.247 (a) (1) (iii)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

#### 4.4.2 Test Procedures

- 1.Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2.Turn on the EUT and connect it to measurement instrument.
- 3. The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

4. The average time of occupancy in the specified 31.6 second period (79 channels \* 0.4 s) is equal to 10 \* (# of pulses in 3.16 s) \* pulse width.

5.The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s

DH1 time slot=0.44(ms)\*(1600/ (2\*79))\*31.6=137.60ms DH3 time slot=1.69(ms)\*(1600/ (4\*79))\*31.6=270.40ms

DH5 time slot=2.94ms)\*(1600/ (6\*79))\*31.6=313.60ms

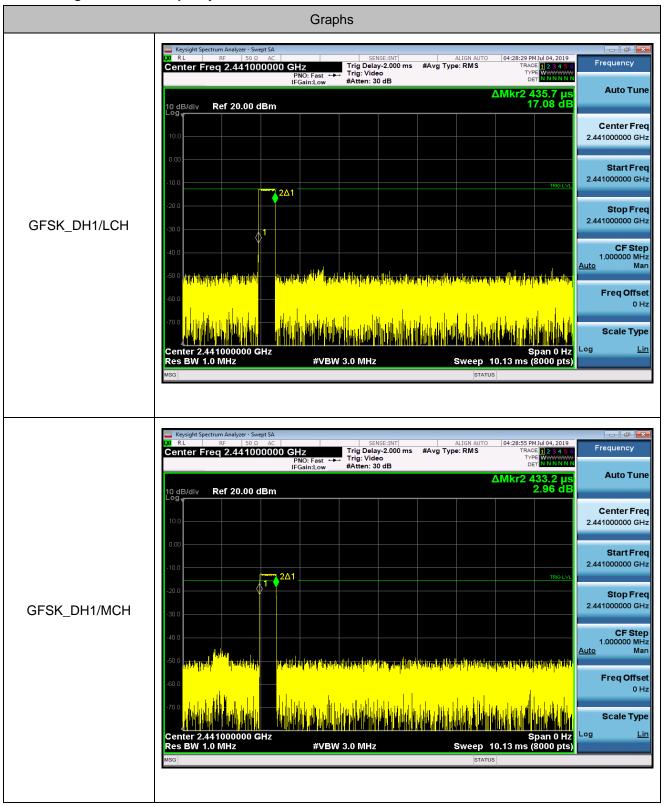


## 4.4.3 Test Result of Dwell Time

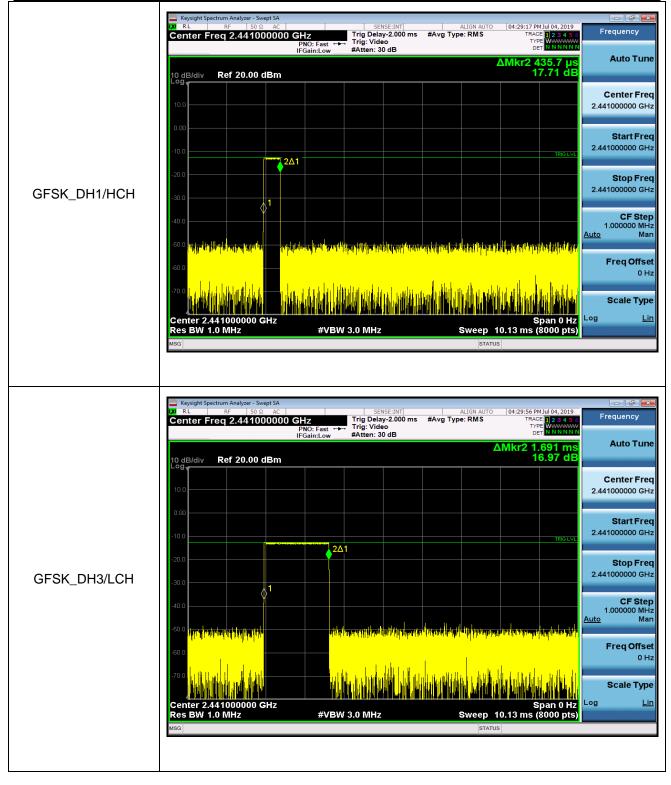
Test Mo	de :	Transr	nitting		Temperature :	24	<b>~26</b> ℃		
Test Eng	Engineer :		n Zhang		Relative Humidity :	<b>/</b> : 50~53%			
Data	Modulation	Packet	Channel	Burg	st Width [ms/hop/ch]		Dwell	Verdict	
Rate	wouldton	Tacket	Channel	Dura			Time[s]	Verdict	
1Mbp	GFSK	DH1	LCH		0.44		0.1408	PASS	
S	GI SK		LOIT		0.44		0.1400	FAGG	
1Mbp	GFSK	DH1	МСН		0.43		0.1408	PASS	
S		5111			0.10		011100		
1Mbp	GFSK	DH1	нсн		0.44		0.1408	PASS	
S	or or c	BIII			0.11		011100		
1Mbp	GFSK	DH3	LCH		1.69		0.2704	PASS	
S	OI OIX	Brio	2011			0.2701	17,00		
1Mbp	GFSK	DH3	МСН		1.69		0.2704	PASS	
S		Brio					0.2101		
1Mbp	GFSK	DH3	нсн		1.69		0.2704	PASS	
S		Brio					0.2101		
1Mbp	GFSK	DH5	LCH		2.94		0.3136	PASS	
S		DIB	LOIT		2.54		0.0100	1700	
1Mbp	GFSK	DH5	МСН		2.94		0.3136	PASS	
S		010			2.07		0.0100	1700	
1Mbp	GFSK	DH5	НСН		2.94		0.3136	PASS	
S		010			2.07		0.0100	1700	



#### The Average Time of Occupancy Plot

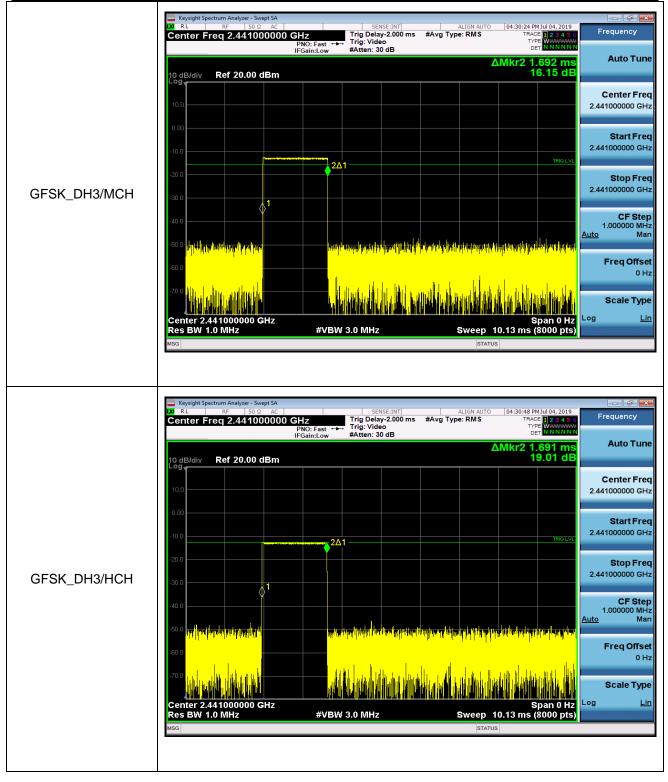




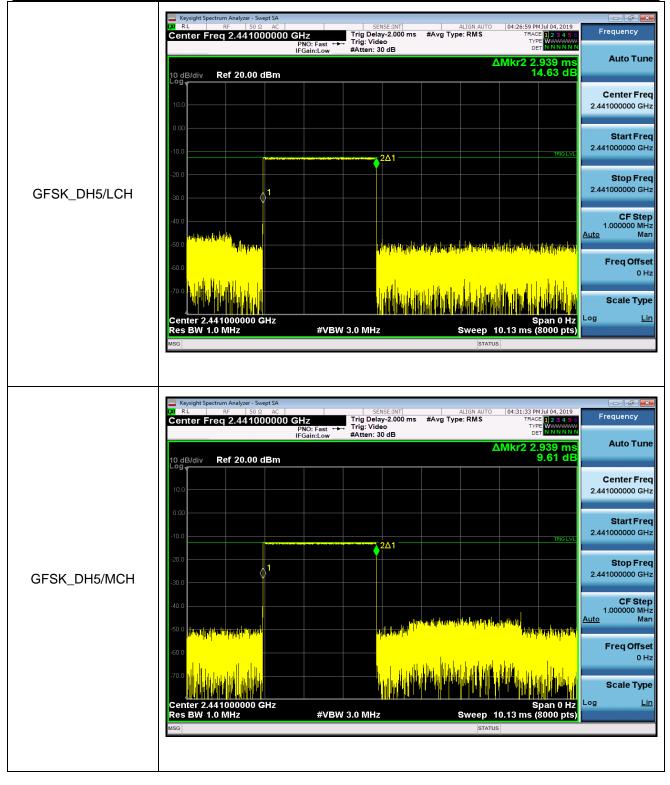




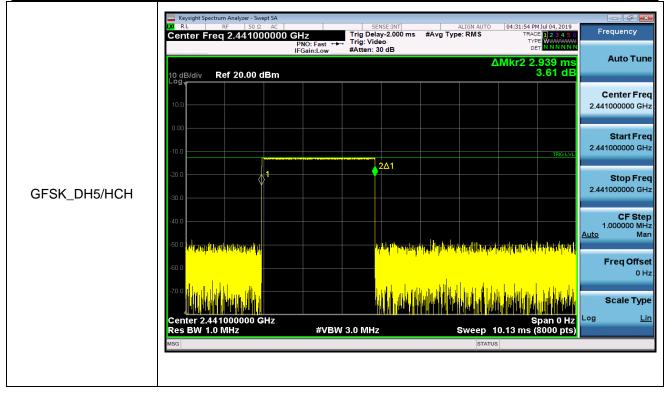
Report No.: EC1907001RF01













## 4.5 Peak Output Power Measurement

#### 4.5.1 Limit of Peak Output Power

Section 15.247 (b) 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.

#### 4.5.2 Test Procedures

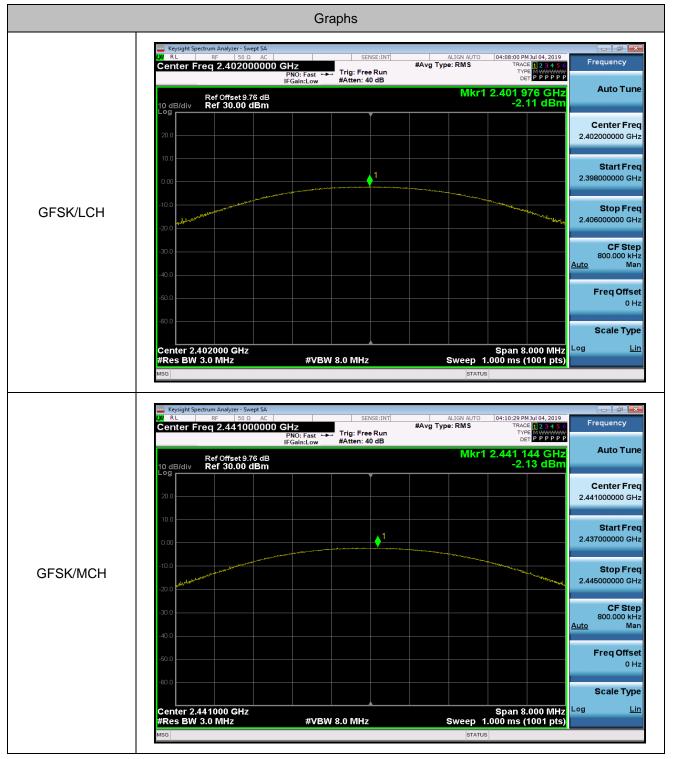
- 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Turn on the EUT and connect it to measurement instrument.
- 3. The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

4.5.3	Test Result of Peak Output Power
-------	----------------------------------

Test Mode :		Transmitting	Те	emperature :	24~2	<b>24~26</b> ℃		
Test Engineer :		Damon Zhang	Re	elative Humidity :	50~:			
Data	Modulation	Channal	Maximum Peak Output		ıt	Limit[dDm]	Mandiat	
Rate	Modulation			Power [dBm]		Limit[dBm]	Verdict	
1Mbps	GFSK	LCH	-2.11			21	PASS	
1Mbps	GFSK	MCH	-2.13			21	PASS	
1Mbps	GFSK	НСН		-2.25		21	PASS	



#### Peak Output Power Polt





	Center Freq 2.4800000	AC SENSE:INT DOO CHZ PNO: Fast IFGain:Low #Atten: 40 dB	ALIGN AUTO	14:14:52 PMJul 04, 2019 TRACE 1 2 3 4 5 6 TYPE M WWWWW DET P P P P P P	Frequency
	Ref Offset 9.76 o 10 dB/div Ref 30.00 dB	dB m	Mkr1 2.	480 056 GHz -2.25 dBm	Auto Tu
	20.0			2	Center Fi 2.480000000 0
	0.00	1		2	<b>Start Fr</b> 2.476000000 G
GFSK/HCH	-10.0 -20.0			Connection and the second states of the second stat	<b>Stop Fr</b> 2.484000000 G
	-30.0			Aut	CF St 800.000 H to M
	-50.0				Freq Off 0
	-60.0				Scale Ty
	Center 2.480000 GHz #Res BW 3.0 MHz	#VBW 8.0 MHz	Sweep 1.00	Span 8.000 MHz 10 ms (1001 pts)	g .



# 4.6 Conducted Band Edges Measurement

#### 4.6.1 Limit of Band Edges

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

#### 4.6.2 Test Procedures

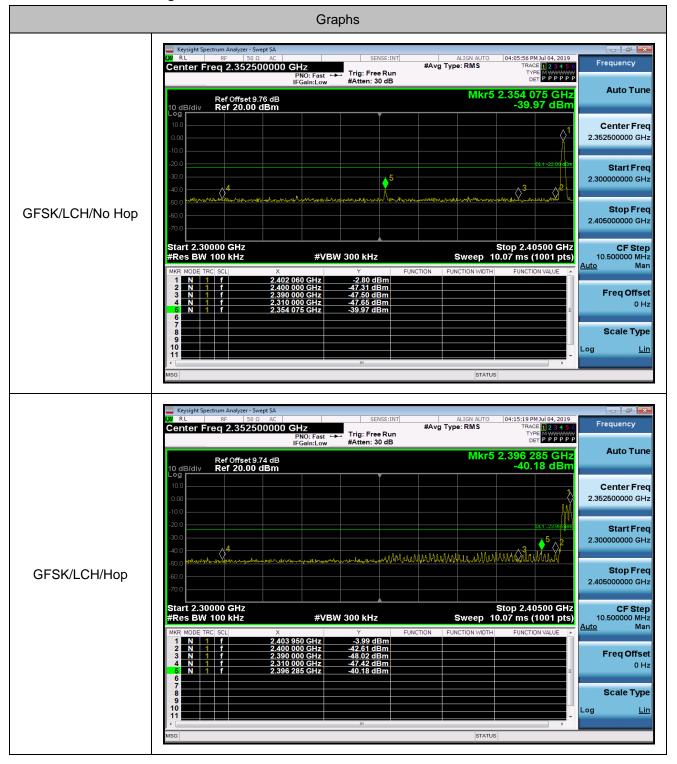
- 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Turn on the EUT and connect it to measurement instrument.
- 3.Set RBW = 100kHz, VBW = 300kHz. Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used.
- 4. Enable hopping function of the EUT and then repeat step 1~3.

# 4.6.3 Test Result of Conducted Band Edges

Test M	Test Mode : Transmitting			Temperature :	mperature : 24~26℃				
Test Engineer :         Damon Zhang         Relative Humidity :		50~53	3%						
Data Rate	Modulation	Channel	Carrier Frequency [MHz]	Carrier Power [dBm]	Frequency Hopping	Ma Spuri Lev [dB	ous el	Limit [dBm]	Verdict
1Mb	GFSK	LCH	2402	-2.80	Off	-39.	97	-22.8	PASS
ps	GFSK	Lon	2402	-3.99	On	-40.	18	-23.99	PASS
1Mb	GFSK	НСН	2480	-3.04	Off	-40.	65	-23.04	PASS
ps	GFSK		2400	-2.98	On	-40.	96	-22.98	PASS



#### **Conducted Band Edge Polt**





	Keysight Spectrum Analyzer - Swept SA         SENSE:INT         ALIGN AUTO         04:12:49 PM Jul 04, 2019           W         RL<         RF         50 Ω         AC         SENSE:INT         ALIGN AUTO         04:12:49 PM Jul 04, 2019           Center Freq 2.510000000 GHz         PN0: Fast →→         Trig: Free Run         Trig: Free Run         Trig: P P P P P           PN0: Fast →→         If Gain:Low         #Atten: 30 dB         Der P P P P	Frequency Auto Tune
	Ref Offset 9.76 dB         -40.65 dBm           10 dB/div         Ref 20.00 dBm         -40.65 dBm           10.0         0.00         -10         -00           -10.0         -00         -00         -00           -20.0         -00         -00         -00	Center Freq 2.51000000 GHz
GFSK/HCH/No Hop	-30.0 -40.0 -50.0 -50.0 -60.0	Start Freq 2.47000000 GHz Stop Freq 2.55000000 GHz
	MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE	CF Step 8.000000 MHz <u>Auto</u> Man
	2 N 1 f 2.483 50 GHz 47.24 dBm 3 N 1 f 2.500 00 GHz 48.33 dBm 4 N 1 f 2.502 08 GHz 48.33 dBm 5 1 f 2.528 08 GHz 40.65 dBm 6 6 7 8	Freq Offset 0 Hz Scale Type
	9 10 11 *	Log <u>Lin</u>
	Keysight Spectrum Analyzer - Swept SA         SENSE:INT         ALIGN AUTO         04:18:26 PM Jul 04, 2019           V// RL         RF         50 Ω         AC         SENSE:INT         ALIGN AUTO         04:18:26 PM Jul 04, 2019           Center Freq 2.510000000 GHz         Trig: Free Run IFGaint.tow         Trig: Free Run #Atten: 30 dB         Trig: P P P P P	Frequency
	Ref Offset 9.76 dB         Mkr4 2.494 08 GHz           10 dB/div         Ref 20.00 dBm           Log         -40.96 dBm           10.00         1           -0.00         1	Auto Tune Center Freq 2.51000000 GHz
GFSK/HCH/Hop	-20.0 12111111111111111111111111111111111	Start Freq 2.47000000 GHz Stop Freq 2.55000000 GHz
	Start 2.47000 GHz         Stop 2.55000 GHz           #Res BW 100 kHz         #VBW 300 kHz         Sweep 7.667 ms (1001 pts)	CF Step 8.000000 MHz Auto Man
	2         N         1         f         2.483.69 GHz         -48.66 dBm           3         N         1         f         2.500 00 GHz         -43.07 dBm           4         N         1         f         2.494 08 GHz         -43.07 dBm           5         5         -         -         -         -           6         -         -         -         -         -           7         -         -         -         -         -         -	Freq Offset 0 Hz Scale Type
	8 9 10 11 11 MSG STATUS	Log <u>Lin</u>



## 4.7 Conducted Spurious Emission Measurement

### 4.7.1 Limit of Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

### 4.7.2 Test Procedure

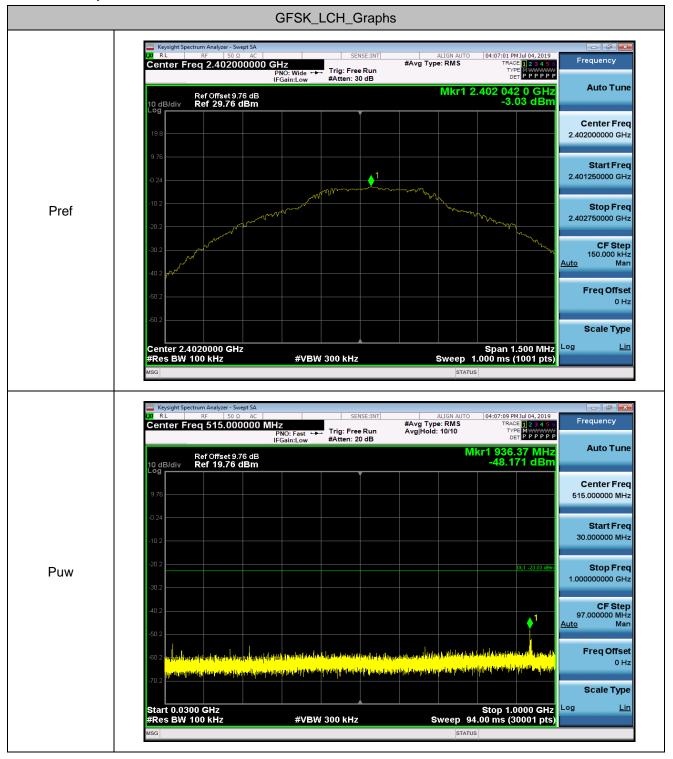
- 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Turn on the EUT and connect it to measurement instrument.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4.Set RBW = 100 kHz, VBW = 300kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
- 5. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

Test Mode :	Transm	itting	Temperature :	<b>24~26</b> ℃	
Test Engineer	: Damon	Zhang	Relative Humidity :	50~53%	
Data Rate	Modulatio	n Channel	Pref [dBm]	Puw[dBm]	Verdict
1Mbps	GFSK	LCH	-3.03	<limit< td=""><td>PASS</td></limit<>	PASS
1Mbps	GFSK	MCH	-2.95	<limit< td=""><td>PASS</td></limit<>	PASS
1Mbps	GFSK	НСН	-3.74	<limit< td=""><td>PASS</td></limit<>	PASS

### 4.7.3 Test Result of Conducted Spurious Emission

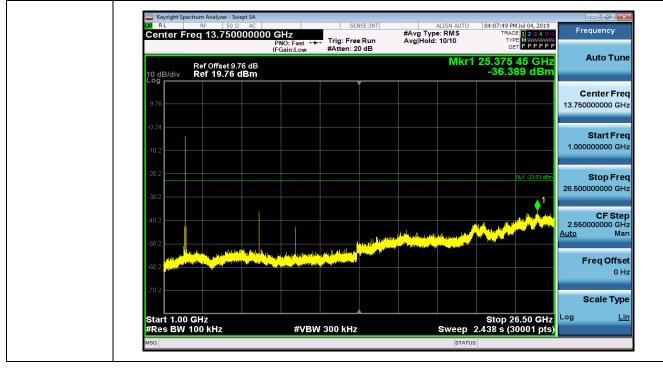


#### **Conducted Spurious Emission Polt**



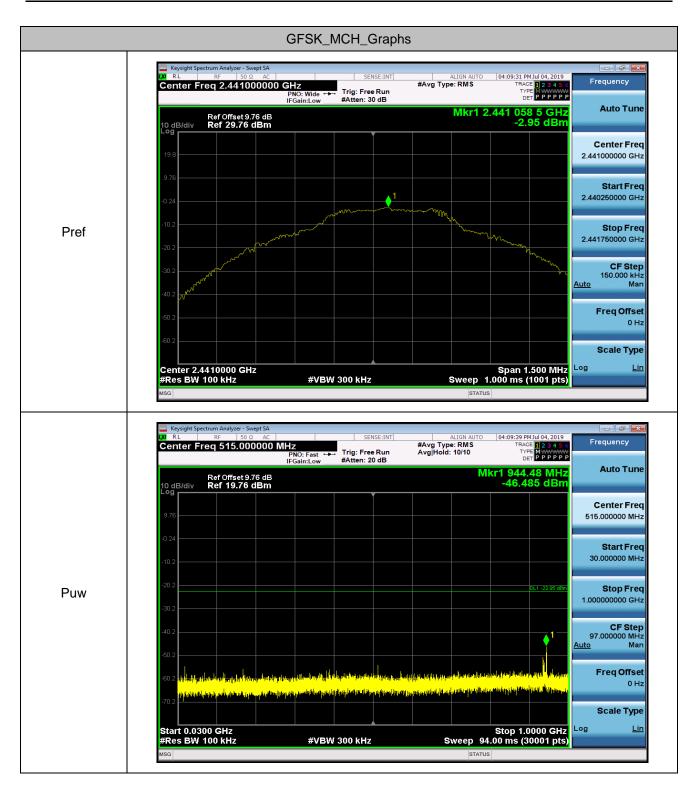


### Report No.: EC1907001RF01









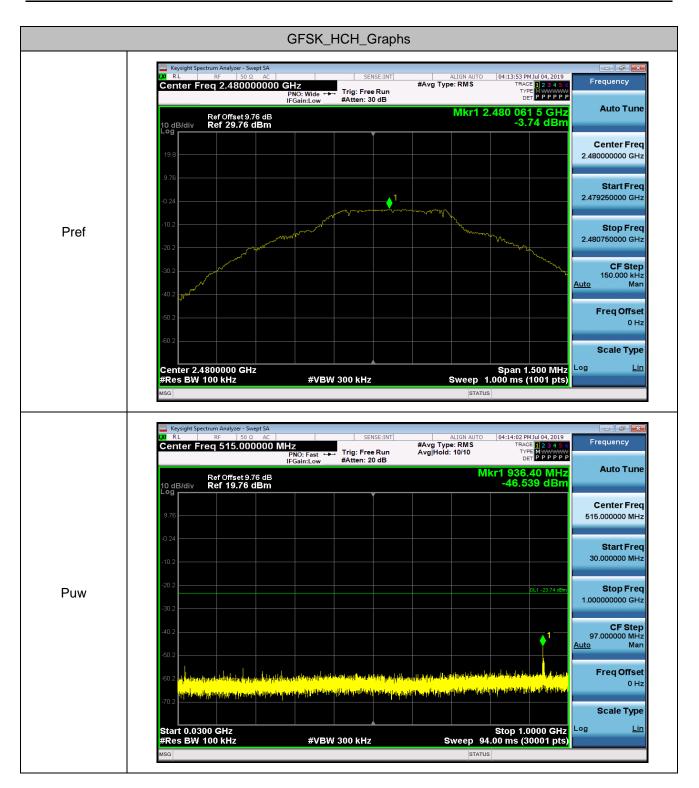


### Report No.: EC1907001RF01



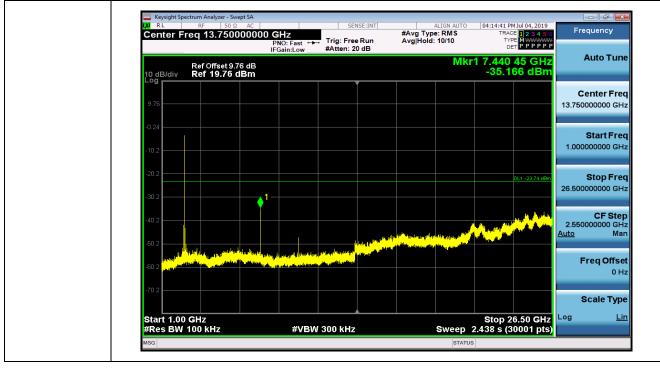








### Report No.: EC1907001RF01





## 4.8 Radiated Band Edges and Spurious Emission Measurement

### 4.8.1 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 FCC section 15.209 limits as below.

Frequency	Field Strength	Measurement Distance
(MHz)	(microvolts/meter)	(meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

Note: The frequency range from 9KHz to 10th harmonic (25GHz) are checked, and no any emissions were found from 18GHz to 25GHz, So the radiated emissions from 18GHz to 25GHz were not record.



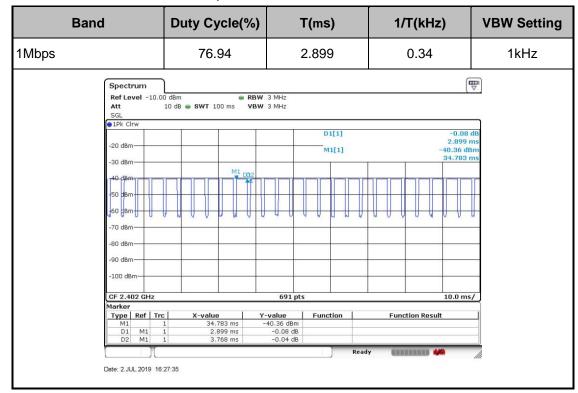


### 4.8.2 Test Procedures

- 6. 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.
- 7. The measurement distance is 3 meter.
- 8. 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.
- 9. Set to the maximum power setting and enable the EUT transmit continuously.
- 10. Use the following spectrum analyzer settings:
  - (1) Span shall wide enough to fully capture the emission being measured;
  - Set RBW=120 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW RBW; Sweep = auto;
     Detector function = peak; Trace = max hold for peak
  - (3) 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.



11. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level



### 4.8.3 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 per 15.31(o) was not reported.

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

st Mode :	Bluetooth (1	Vbps) CH00	(2402MHz)	Tempe	erature :	2	<b>3~25</b> ℃
st Engineer :	Damon Zhar	g		Relativ	ve Humid	<b>ity</b> : 6	0~62%
equencey Range	2.3GHz~2.4(	)5GHz		Polaria	zation :	ŀ	lorizontal
Data: 14							
100 Level (c	lBuV/m)					Date:	2019-07-03
90.0							
80.0					FC		15C PEAK
70.0							-6dB
60.0							(
50.0							[]
40.0						2	
30.0	manyle charter that a stare	Understand the second states	manufacture of the second	Murrature	and the state of t	10 martine 10 miles	Handler 1
20.0							
10.0							
10.0							
<sup>0</sup> 2300 23	10.	2330.	2350. requency (MH		70.	2390	. 2405
	leading Ant	enna Cabl		12)	Limit	0ver	
Erea R				lovol		limi	
1	evel fac BuV dB/				dBuV/m	dB	
MHz d 2310.000	.evel fac HBuV dB/	m dB 91 3.56	dB d 35.87 3	BuV/m 38.02		dB  -35.9	 8 Peak 7 Peak



est Mode :	Bluetoo	th (1Mbps	) CH00 (	(2402MHz)	Tempe	rature :	23~	<b>∙25</b> ℃
est Engineer :	Damon	Zhang			Relativ	ve Humidi	<b>ty</b> : 60~	·62%
requencey Ran	<b>ge</b> 2.3GHz	~2.405GH	lz		Polariz	ation :	Hor	izontal
Data: 15								
100	(dBuV/m)						Date: 2	019-07-03
90.0								
80.0								
70.0								3
60.0							FCC PAR	T15CAV
50.0								-6dB
40.0								
30.0	1						2	
20.0	$\frown$	$\sim$	$\sim$	$\sim$	$\sim$	$\sim$		
10.0								
0 <mark>2300</mark>	2310.	2330.		2350.		570.	2390.	2405
-	D 11			requency (N	IHZ)	<b>.</b>	0	
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB		level dBuV/m		Over limit dB	Remark
2310.000 2390.000 2402.165	29.88 29.51 73.62	26.91 27.11 27.15	3.56 3.64 3.65	35.87 36.08 36.11	24. 48 24. 18 68. 31	54.00 54.00 54.00	-29.52 -29.82 14.31	



Bluetor	oth (1Mbps)	) CH00 (2	402MHz)	Tempera	ture :	<b>23~25</b> ℃	
: Damor	1 Zhang			Relative	Humidity :	60~62%	
i <b>nge</b> 2.3GH	z~2.405GH	z		Polarizat	ion :	Vertical	
						Dete: 00	40.07.02
(dBuV/m)						Date: 20	19-07-03
					FCC	PART15	C PEAK
							-6dB
							$-\mathbb{A}$
1						2	
	And the second s		ala an	and monthead			
2310.	2330.	Fn	2350. equency (I		70.	2390.	2405
		Cable	Preamp	level	level	Over limit dB	Remark
40.78	27.11	3.56 3.64 3.65	35.87 36.08 36.11	35.45	74.00	-38.83 -38.55 -9.82	Peak Peak Peak
	Damor         Inge       2.3GHz         (dBuV/m)	Damon Zhang inge 2.3GHz~2.405GH (dBuV/m) (dBuV/m) 2.3GHz~2.405GH (dBuV/m) 2.3GHz~2.405GH (dBuV/m) 2.3GHz~2.405GH (dBuV/m) 2.3GHz~2.405GH 2.3GHz~2.505GH 2.3GHz~2.5	Damon Zhang inge 2.3GHz~2.405GHz (dBuV/m) (dBuV/m) 2.3GHz~2.405GHz (dBuV/m) 2.3GHz~2.405GHz (dBuV/m) 2.3GHz~2.405GHz (dBuV/m) 2.3GHz~2.405GHz (dBuV/m) 2.3GHz~2.405GHz (dBuV/m) 2.3GHz~2.405GHz (dBuV/m) 2.3GHz~2.405GHz (dBuV/m) 2.3GHz~2.405GHz (dBuV/m) 2.3GHz~2.405GHz (dBuV/m) 2.3GHz~2.405GHz (dBuV/m) 2.3GHz~2.405GHz (dBuV/m) 2.3GHz~2.405GHz 2.3GHz~2.405GHz (dBuV/m) 2.3GHz~2.405GHz 2.3GHz~2.505GHz 2	Inge       2.3GHz~2.405GHz         (dBuV/m)	Damon Zhang         Relative           Inge         2.3GHz~2.405GHz         Polarizat           I(dBuV/m)	Damon Zhang       Relative Humidity :         Inge       2.3GHz~2.405GHz       Polarization :         I(dBuV/m)       FCC         IdBuV/m)       FCC         IdBuV/m)       FCC         IdBuV/m)       FCC         IdBuV/m)       FCC         IdBuV/m)       FCC         IdBuV/m)       FCC         IdBuV       IdBuV         IdBuV       IdBuV       IdBuV         IdBuV       IdBuV       IdBuV       IdBuV/m         IdBuV       IdBuV       IdBuV/m       IdBuV/m         IdBuV       IdBuV       IdBuV/m       IdBuV/m         IdBuV       IdBuV       IdBuV/m       IdBuV/m         IdBuV       IdBuV       IdBuV/m       IdBuV/m	Damon Zhang         Relative Humidity :         60~62%           Inge         2.3GHz~2.405GHz         Polarization :         Vertical           (dBuV/m)         Date: 20         Date: 20           (dBuV/m)         Date: 20           2310.         2330.         2350.         2370.         2390.           Frequency (MHz)         Limit         Over         Imit           40.57         26.91         3.56         35.87         35.17         74.00         -38.83           40.57         26.91         3.56         35.87         35.17         74.00         -38.83



est Mode :	Bluetoo	th (1Mbps	) CH00 (2	2402MHz)	Temper	ature :	23~2	5℃
est Engineer :	Damon	Zhang			Relative	e Humidit	<b>y</b> : 60~6	2%
requencey Ran	ge 2.3GHz	~2.405GH	z		Polariza	ation :	Vertic	al
Data: 12								
100 Leve	l (dBuV/m)						Date: 20	19-07-03
90.0								
80.0								
70.0								3
60.0							FCC PAR	A
50.0								-6dB
40.0								
30.0	-						2	
20.0								~~ ' '
10.0								
0 <mark>0</mark> 0	2310.	2330.	Er	2350. equency (N		70.	2390.	2405
Freq	Reading	Antenna			1112)	Limit	0ver	
MHz	level dBuV	factor dB/m	loss dB		level dBuV/m		limit dB	Remark
2310.000 2390.000	28.04 28.47	26.91 27.11	3.56 3.64	35.87 36.08	22.64 23.14		-31.36 -30.86	Average Average
	20.47 68.98	27.11	3.65	36.11	63.67	54.00 54.00	-30.80	Average



est Mode :	Bluetooth (1Mbp	s) CH78 (2480MHz)	Temper	ature :	<b>23~25</b> ℃
est Engineer :	Damon Zhang		Relative	Humidity :	60~62%
requencey Range	e 2.477GHz~2.510	)GHz	Polariza	tion :	Horizontal
Data: 30 100 Level (d	BuV/m)			E	Date: 2019-07-03
90.0					
80.0				FCC P	ART15C PEAK
70.0	×				-6dB
60.0					
50.0					
40.0	Lundenser	mare and marked and and and and and and and and and an	mundan	adanities a conservation and	the ground and an and the second s
30.0					
20.0					
10.0					
<sup>0</sup> 2477 248	0.2482.2484.2486.2	2488.2490.2492.2494. Frequency (N	2496.2498 //Hz)	2500.2502.250	04.2506. 251
10	eading Antenna evel factor BuV dB/m	a Cable Preamp	level	level 1	Over limit Remarl dB
2479.838 2483.501 2500.000	74.81 27.35 40.09 27.36 42.91 27.40	3. 68 36. 32 3. 68 36. 33 3. 68 36. 33 3. 68 36. 37	69.52 34.80 37.62	74.00 74.00 74.00	-4.48 Peak 39.20 Peak 36.38 Peak



Test Mode :		Bluetoo	th (1Mbps	) CH78	(2480MHz	) Temp	erature :	2	<b>23~25</b> ℃
Fest Engine	er :	Damon	Zhang			Relati	ve Humid	ity: 6	60~62%
Frequencey	Range	2.477G	Hz~2.510	GHz		Polari	ization :	ŀ	Horizontal
Data: 3 100 90.0 80.0 70.0 60.0 50.0	31 .evel (di	BuV/m)							2019-07-04
30.0 20.0 10.0 20.0	2477 248	0.2482.24		188.2490.	2492.2494.	2496.2498	3	.2504.28	506. 2510
Free MH2	le	eading evel BuV	Antenna factor dB/m	Cable		level	Limit level dBuV/m	Over limi dB	
2480. ( 2483. § 2500. (	500 2	70. 29 27. 12 30. 08	27.35 27.36 27.40	3. 68 3. 68 3. 68	36. 32 36. 33 36. 37	65.00 21.83 24.79	54.00 54.00 54.00	11.0 -32.1 -29.2	00 Average 17 Average 21 Average



	Blue	tooth (1N	Mbps) C⊢	178 (248	30MHz)	Temp	eratu	re :	23~	<b>∙25</b> ℃	
st Engineer :	Dam	ion Zhan	g			Relat	ive H	umidity	<b>y</b> : 60~	·62%	
equencey Ra	<b>nge</b> 2.47	7GHz~2	.510GHz			Polar	izatio	n :	Ver	tical	
Data: 27	l (dBuV/m	)							Date:	2019-	-07-04
100		,									
90.0											
80.0								FC		15C F	EAK
70.0											-6dB
60.0	<u>∕</u> †∖+										
50.0	<u> </u>										
40.0	+	-2			1 1 11		2				
30.0		Manufrid of the State of the St	hantshnangustawan	14-412/8-5-84/8-6-1 <sup>48</sup>		****	And a second	disady.Madrid	ytultane sooluk dar	ere and	A. marine
20.0											
10.0											
0 2477	2480.2482	.2484.24	86.2488.2	490.249 Frequ	2.2494.: Jency (N	2496.249	98.250	0.2502	.2504.25	06.	2510
Freq MHz	Readin; level dBuV	g Ante fact dB/m	or lo		Preamp factor dB	leve dBuV/n	l le	mit vel SuV/m	Over limi dB		emark



fest Mode :	Bluetooth (1Mbp	s) CH78 (2480MHz)	Temperature	:	<b>23~25</b> ℃
Test Engineer :	Damon Zhang		Relative Hum	idity :	60~62%
Frequencey Range	2.477GHz~2.510	)GHz	Polarization :		Vertical
Data: 28 100 <mark>Level (d</mark> E	BuV/m)	,		Date:	2019-07-04
90.0					
80.0					
70.0					
60.0				FCC PA	RT15C AV
50.0					-6dB
40.0					
30.0	2		3		
20.0					
10.0					
02477 2480	0.2482.2484.2486.2	488.2490.2492.2494.24 Frequency (Mi	96.2498.2500.2502	2.2504.25	506. 2510
le		Cable Preamp loss factor	Limit level level BuV/m dBuV/m	limi	t Remark
2483.500 2	7.34         27.35           9.43         27.36           8.53         27.40	3.68         36.32         6           3.68         36.33         2           3.68         36.33         2           3.68         36.37         2	4.14 54.00	-29.8	5 Average 6 Average 6 Average

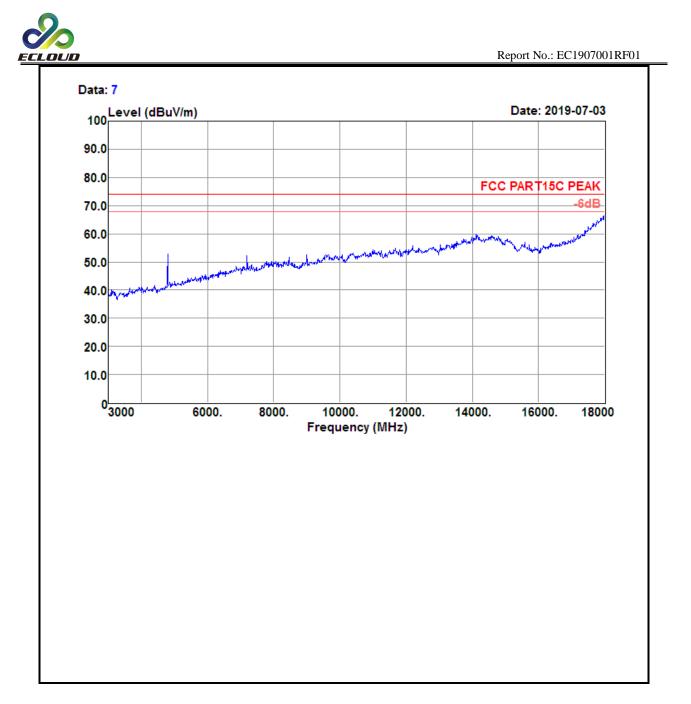


# 4.8.5 Test Result of Radiated Spurious Emission (1GHz ~ 10<sup>th</sup> Harmonic)

	Blueto	oth (1Mbps	s) CH00 (	(2402MHz)	Temper	rature :		23~25	5°C
st Engineer :	Damor	n Zhang			Relativ	e Humio	dity :	60~62	2%
equencey Ran	<b>ge</b> 1GHz-	-3GHz			Polariza	ation :		Horizo	ontal
Data: 16									
100	dBuV/m)						D	ate: 20	)19-07-03
90.0									
80.0									
70.0						1	FCC P	AR 115	C PEAK -6dB
60.0							FC		T15C AV
50.0							FU		-6dB
40.0 30.0	handinan kandada	www.www.	handri ad in sui di an di a	hwananananananan	MMANAMANA	wawalupWMMM	aladahanada	awayahahaha	valinterinterint
20.0									
	1300.	1500.		1900. 210		0. 250	DO. 2	2700.	3000
10.0 0 1000 Freq F	1300. Reading level dBuV	Antenna factor	Fr Cable loss	<b>equency(N</b> Preamp factor		Limit level	0	2700.	3000 Remark



st Mode :		Bluetoo	th (1Mbp	os) CH00 (	2402MHz)	Tempe	rature :	2	23~2	5℃
st Enginee	r:	Damon	Zhang			Relativ	e Humidi	t <b>y</b> :	60~6	2%
equencey l	Range	3GHz~1	8GHz			Polariz	ation :	ł	Horiz	ontal
Data:	8									
100	evel (	dBuV/m)	1					Date	e: 201	19-07-03
90.0										
80.0							50		T150	PEAK
70.0										-6dB
<mark>60.0</mark>		2	4		6			FCC		15C AV
50.0		1	3		Ĭ					-6dB
40.0					5					
30.0										
20.0										
10.0										
03	3000	60	00.	8000.	10000.	12000.	14000.	16	6000.	18000
F	T				requency (	-	T. S. S. S.	0		
Fre MH:	1	Reading Level BuV	Anten facto dB/m			level dBuV/m	Limit level dBuV/m	Ove lin dE	nit	Remark
4804. ( 4804. ( 7206. ( 7206. ( 9608. (	000 000 000 000	51.09 54.50 38.99 48.02 30.07 42.15	31. 23 31. 23 35. 87 35. 87 37. 79 37. 79	$5.45 \\ 6.94 \\ 6.94$	36. 27 36. 27 34. 25 34. 25 34. 13 34. 13	51.5054.9147.5556.5841.5053.58	$\begin{array}{c} 54.\ 00\\74.\ 00\\54.\ 00\\74.\ 00\\54.\ 00\\74.\ 00\end{array}$	-19. -6. -17. -12.	09 45 42 50	Peak Average



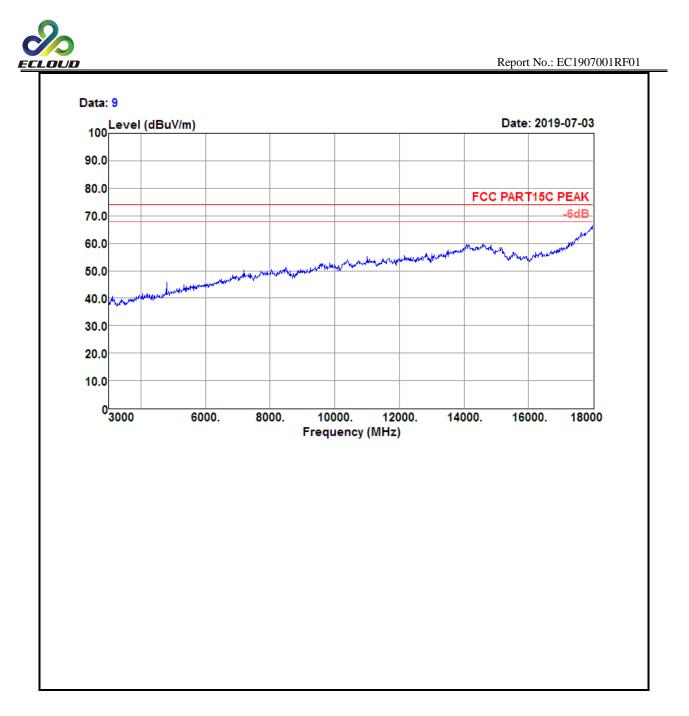
Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.



70.0	y : 60~62% Vertical Date: 2019-07-03
Data: 13	
100       Level (dBuV/m)         90.0	Date: 2019-07-03
100     100       90.0       80.0       80.0       70.0       60.0       50.0       40.0       10.0	Date: 2019-07-03
80.0	
70.0	
70.0	
50.0	C PART15C PEAK
40.0 40.0	FCC PART15¢ AV
30.0 20.0 10.0	-6dB
30.0 20.0 10.0	
10.0	New York Constraints (Constraints (Constrain
0	
<sup>0</sup> 1000 1300. 1500. 1700. 1900. 2100. 2300. 2500 Frequency (MHz)	. 2700. 300
Freq Reading Antenna Cable Preamp Limit level factor loss factor level level MHz dBuV dB/m dB dB dBuV/m dBuV/m	
2402.000 68.64 27.15 3.65 36.11 63.33 74.00	-10.67 Peak



st Mode :	Blueto	ooth (1Mbp	s) CH00	(2402MHz)	Tempe	erature :	2	23~2	5℃
st Engineer	: Damo	n Zhang			Relativ	ve Humidi	t <b>y</b> :6	62~62	2%
equencey Ra	ange 3GHz	~18GHz			Polariz	zation :	١	/ertic	al
Data: 10									
100 Leve	(dBuV/m)						Date	e: 201	19-07-03
90.0									
80.0						50		T450	PEAK
70.0									-6dB
60.0		4		6			FCC	Арт	15C AV
50.0	2	3							-6dB
40.0				5					
30.0									
20.0									
10.0									
0 <mark>3000</mark>	60	00. 8	000. Fr	10000. equency (N	12000. IHz)	14000.	16	000.	18000
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Ove lim dB	it	Remark
4804.000 4804.000 7206.000 7206.000 9608.000 9608.000	43. 80 48. 13 39. 24 47. 84 29. 12 42. 98	31. 23 31. 23 35. 87 35. 87 37. 79 37. 79	$5.45 \\ 5.45 \\ 6.94 \\ 6.94 \\ 7.77 \\ 7.77 \\ 7.77 \\ \end{array}$	36. 27 36. 27 34. 25 34. 25 34. 13 34. 13 34. 13	44. 21 48. 54 47. 80 56. 40 40. 55 54. 41	54.0074.0054.0074.0054.0074.0074.00		46 20 60 45	Average Peak Average Peak Average Peak



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

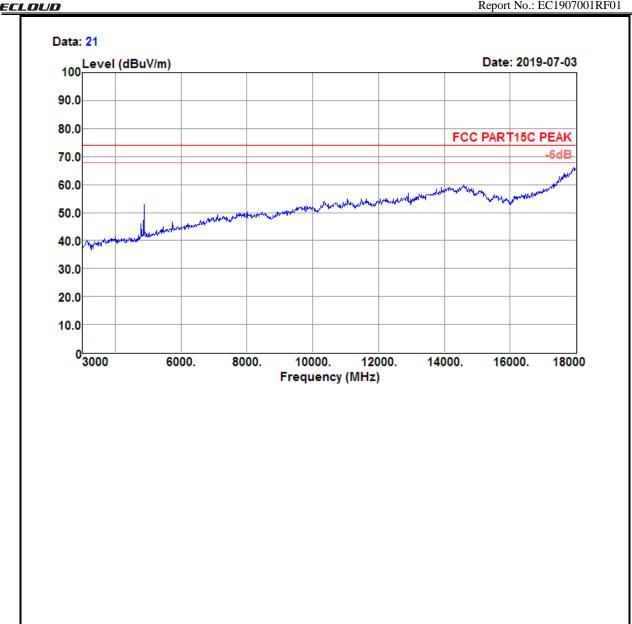


est Mode	:	Bluetoo	oth (1Mbp	s) CH39 (	2441MHz	) Temp	eratu	ire :		23~2	<b>5℃</b>
est Engine	er:	Damor	n Zhang			Relat	ive H	umid	ity :	60~6	2%
requence	y Range	1GHz~	·3GHz			Polar	izatio	on :		Horiz	ontal
Data:	17										
100	Level (d	BuV/m)							Da	te: 20	19-07-03
90.0											
80.0								F		RT15	C PEAK
70.0								1			-6dB
60.0									500	DAD.	T15C AV
50.0									FUU		-6dB
	ni/wikipawani	heter heter heter het	dan <mark>dan kana</mark> dar	han the second second	analaya ya a a a a a a a a a a a a a a a a	wyaliliwaliwawi	synthe-414	hter water w	Million	nestenble	<sup>U</sup> kwadaukudhu
30.0											
20.0											
10.0											
0											
-	1000	1300.	1500.		1900. 21 equency (		300.	2500	). 2	700.	3000
Fre	a R	eading	Antenna		Preamp	-	Li	imit	0,	ver	
	1	evel	factor	loss	factor	level	l le	evel	1:	imit	Remark
MH	z a.	BuV	dB/m	dB	dB	dBuV/r	n ar	5UV/m		ΉB 	
2441.		71.31			36.21	66.01					



st Mode :	Blu	uetoot	h (1Mb	ps) (	CH39 (	244	1MHz	) <b>T</b>	empe	ratur	e:		23~2	25℃
st Engineer :	Da	amon 2	Zhang					R	elativ	ve Hu	midi	ty :	60~6	62%
equencey Rar	nge 30	GHz∼1	8GHz					Р	olariz	ation	1:		Hori	zontal
Data: 22														
100 Lev	el (dBu	ıV/m)										Date	e: 20′	19-07-03
90.0														
80.0	_										FC		T150	PEAK
70.0														-6dB
60.0		2		4		6						FCC I	PART	15C AV
50.0														-6dB
40.0			:	8		5								
30.0	_					_								
20.0														
10.0						_								
0300	0	60	00.	800	0.	100	00.	12	000.	14(	000.	16	5000.	18000
						-	ency (		)					
Freq MHz	Rea lev dBu	el	Anten facto dB/m		Cable loss dB			· 1	evel uV/m	Lim: levo dBu	el	Ove lin dE	nit	Remark
4882.000 4882.000 7323.000 7323.000 9764.000 9764.000	) 54 ) 31 ) 44 ) 29	. 53 . 30 . 79 . 95 . 52 . 58	31. 42 31. 42 36. 14 36. 14 38. 08 38. 08		5. 40 5. 40 7. 28 7. 28 7. 98 7. 98	36 34 34 34	24 24 36 36 20 20	54. 40. 54. 41.	. 11 . 88 . 85 . 01 . 38 . 44	54. 74. 54. 74. 74. 54. 74. 74.	00 00 00 00	-19. -13. -19. -12.	12 15 99 62	Average Peak





Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.



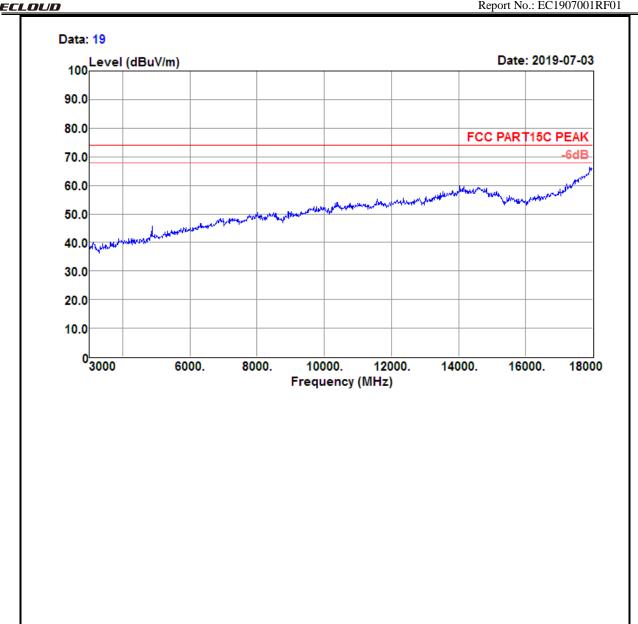
Damon	Zhang			Temper			23~25	C
1	Zhang			Relative	e Humid	lity :	60~62	%
1GHz~	3GHz			Polariza	ation :		Vertica	al
3uV/m)						C	)ate: 20	19-07-03
						FCC P	ART15	C PEAK
					1			-6dB
						FC	C PAR	T15C AV
								-6dB
desweepelandese	andalana na	antarinalitania	hilosoon an	Annoneurope	www.weekuwa	weetwoodersta	Arrighter	hann ann an thailte ann an thailte ann an thailte ann an thail ann an thail ann an thail ann an thail ann an t
1300.	1500. 1				0. 25	00.	2700.	3000
evel	factor	loss	factor	level	level	. 1		Remark
9.44	27.25	3.66	36.21	64.14	74.00	) -	-9.86	Peak
	1300. Pading evel BuV	1300. 1500. 1 Pading Antenna evel factor BuV dB/m	1300. 1500. 1700. 1 Fr eading Antenna Cable evel factor loss BuV dB/m dB	1300. 1500. 1700. 1900. 210 Frequency (N Pading Antenna Cable Preamp evel factor loss factor BuV dB/m dB dB	Image: State of the second	1300.     1500.     1700.     1900.     2100.     2300.     250       Frequency (MHz)       eading     Antenna     Cable     Preamp     Limit       eading     Antenna     Cable     Preamp     Limit       BuV     dB/m     dB     dB     dBuV/m     dBuV/m	Image: Second	Image: Sector





est Mode :		Bluetoo	oth (1Mbp	os) CH39	(2441	MHz)	Temp	eratur	e :	2	23~2	5℃
est Engine	er :	Damon	Zhang				Relati	ve Hu	midit	<b>y</b> : 0	60~6	2%
requencey	Range	e 3GHz~	18GHz				Polari	zatior	<b>)</b> :	١	Verti	cal
Data:	20											
100 <sup>L</sup>	.evel (d	lBuV/m)								Date	e: 201	19-07-03
90.0												
80.0												
70.0									FCC	PAR	T15C	-6dB
60.0					6							450 414
50.0		2	4							·CC F		15C AV -6dB
40.0			3		5							
30.0												
20.0												
10.0												
03	000	60	00. 8	B000.	1000	0.	12000.	14	000.	16	000.	18000
						ncy (M	Hz)					
Free MH:	1	leading evel BuV	Antenna factor dB/m		fa	ctor	level dBuV/m		el	Ove lim dB	it	Remark
4882.0 4882.0 7323.0 7323.0 9764.0 9764.0	000 000 000 000	44. 40 49. 41 32. 23 45. 17 30. 48 43. 44	31. 42 31. 42 36. 14 36. 14 38. 08 38. 08	7.28 7.28	36. 36. 34. 34. 34. 34. 34.	24 36 36 20	44. 98 49. 99 41. 29 54. 23 42. 34 55. 30	74. 54. 74. 54.	00 00 00	-24. -12. -19. -11.	01 71 77 66	Averag Peak





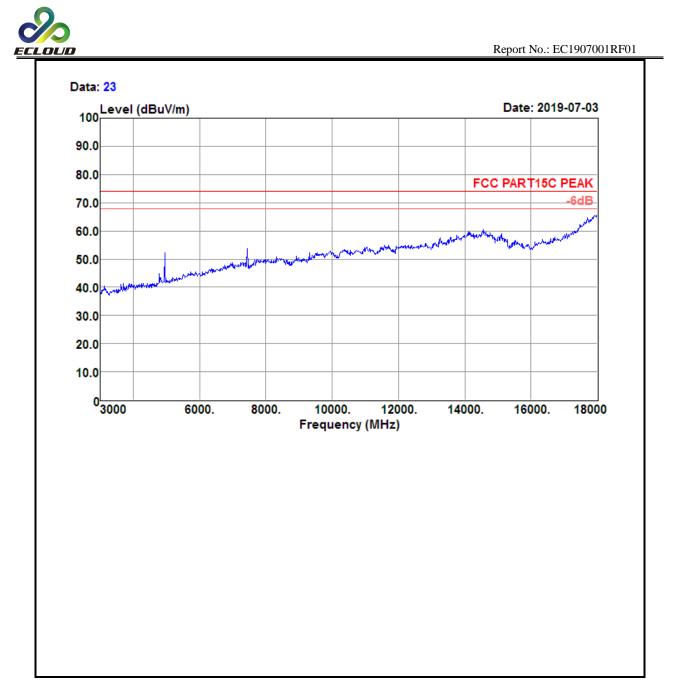
Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.



est Mode :	Bluetoo	th (1Mbps)	) CH78 (2	2480MHz)	Tempera	ature :	2	23~25	°C
est Engineer :	Damon	Zhang			Relative	Humid	ity: 6	60~62	?%
requencey Ran	ge 1GHz~3	3GHz			Polariza	tion :	ŀ	Horizo	ontal
Data: 32									
100 Level	(dBuV/m)						Da	te: 20	19-07-04
100									
90.0									
80.0						F		RT15	C PEAK
70.0									-6dB
60.0							FOO	DAD	T15¢ AV
50.0							PUC	PAR	-6dB
40.0						, III			and the state
40.0	nandatan ang ang ang ang ang ang ang ang ang a	halanan maratan maratan markan mar	nlihinnya ku	www.www.www.	nahohaliyanyyy	hypertermine	kaumilian	WWWWW	nyaWaylayha
30.0	nanan ana ang ang ang ang ang ang ang an	hite and the second	ng n	wananananan Manananan	naponananan	hypelenen	kuumiinni	ntayatan Mayatan	wyWybybybybybybybybybybybybybybybybybyby
30.0 20.0	n an	hytenne and a state and a s	ng ting the second s	wadanshi damadi	nahonahonahonah	hwaveened	kuumhaa	ntwywWiM	wallophethehi
30.0	nyantapinanyirahiyi	hypener verdet also also hypener verdet also also hypener verdet also also also also also also also also			notri noti in anna anna anna anna anna anna anna	k <sub>epate</sub> tani na	kuumhaa	nwww	neween and a second
30.0 20.0	1300.		1700. 1	1900. 210	00. 230			700.	10000000000000000000000000000000000000
30.0 20.0 10.0 0 1000	1300.	1500.	1700. 1 Fr	1900. 210 equency (N	00. 230 ЛНz)	0. 250	00. 21	700.	
30.0 20.0 10.0			1700. 1 Fr Cable	1900. 210 equency (N Preamp	00. 230 ЛНz)	0. 250 Limit level	00. 21		



est Mode :	Bluetoot	n (1Mbps)	CH78 (2	480MHz)	Temper	ature :	2	23~2	5℃
est Engineer :	Damon Z	Zhang			Relativ	e Humidit	: <b>y:</b> 6	62~62	2%
requencey Range	3GHz~18	BGHz			Polariza	ation :	F	loriz	ontal
Data: 24									
100 Level (	(dBuV/m)						Date	e: 20′	19-07-03
90.0									
80.0						EC		T150	PEAK
70.0									-6dB
60.0	2	4		6			FCC		15C AV
50.0		3					1001		-6dB
40.0				5					
30.0									
20.0									
10.0									
0 <mark></mark>	60	00. 80	000.	10000.	12000.	14000.	16	000.	18000
				equency (N					
-	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Ove lin dE	nit	Remark
$\begin{array}{r}$	49. 85 58. 71 36. 40 45. 08 28. 18 43. 14	31. 60 31. 60 36. 41 36. 41 38. 36 38. 36	5.36 5.36 7.44 7.44 8.05 8.05	36. 21 36. 21 34. 47 34. 47 34. 26 34. 26 34. 26	$50.60 \\ 59.46 \\ 45.78 \\ 54.46 \\ 40.33 \\ 55.29$	$\begin{array}{c} 54.\ 00\\ 74.\ 00\\ 54.\ 00\\ 74.\ 00\\ 54.\ 00\\ 74.\ 00\\ 74.\ 00\\ \end{array}$	-3. -14. -8. -19. -13. -18.	54 22 54 67	Average Peak Average Peak Average Peak



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

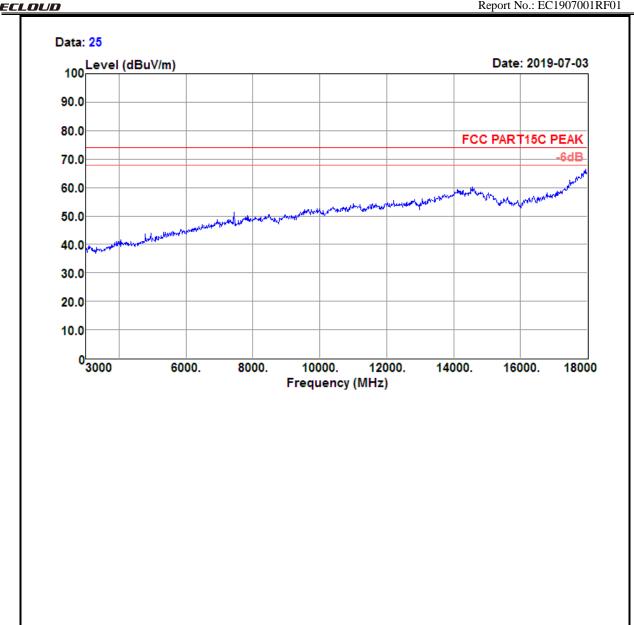


est Mode :	Bluetoc	th (1Mbps	s) CH78 (2	2480MHz)	Tempe	rature :		23~2	2 <b>5</b> ℃
est Engineer :	Damon	Zhang			Relativ	e Humi	dity :	60~6	2%
requencey Rang	e 1GHz~	3GHz			Polariz	ation :		Verti	cal
Data: 29									
100 Level (	dBuV/m)						Da	ite: 20	19-07-03
90.0									
80.0								D T 1 5	C PEAK
70.0									-6dB
60.0						1	FCC		T15¢ AV
50.0									-6dB
40.0 W//////// 30.0	untanan dara	neteedaat <sup>ja</sup> tiittiiseesta	epoclyske alexander of	ngdyngsslandingdyngodd	hinninanan	hand	-ajdelanerade-add	entherenally	nevallation (
20.0									
10.0									
0 <mark></mark> 1000	1300.	1500.		1900. 210 equency (M		0. 250	00. 2	700.	3000
	Reading level dBuV	Antenna factor dB/m		Preamp factor			1:	ver imit dB	Remark
2480.000	67.35	27.35	3.68	36.32	62.06	74.00	-1	1.94	Peak



st Mode :		Bluetoo	th (1Mbp	s) CH78 (	2480MHz)	Tempe	erature :		23~2	<b>25</b> ℃
st Engine	er:	Damon	Zhang			Relativ	/e Humidi	ity :	60~6	62%
equencey	Range	<b>a</b> 3GHz~′	18GHz			Polariz	zation :		Verti	ical
Data:		dBuV/m)						Date	e: 20 <sup>,</sup>	19-07-03
	Ì									
90.0										
80.0							FC	C PAR	T150	PEAK
70.0										-6dB
60.0			4		6			FCC F	PART	15C AV
50.0		21	•							-6dB
40.0					5					
30.0										
20.0										
10.0										
0	3000	60	00. 8	B000.	10000.	12000.	14000.	16	6000.	18000
					equency (M					
Fre MH	1	Reading level dBuV	Antenna factor dB/m		Preamp factor dB	level dBuV/m	Limit level dBuV/m	Ove lin dE	nit	Remark
4960. 4960. 7440. 7440. 9920. 9920.	000 000 000 000 000	42. 26 47. 52 42. 19 48. 17 28. 75 42. 41	36. 41 36. 41 38. 36	$7.44 \\ 7.44$	36.21 34.47 34.47 34.26	43.01 48.27 51.57 57.55 40.90 54.56	74.00	-25. -2. -16. -13.	73 43 45 10	Average Peak Average Peak Average Peak





Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.



## 4.8.6 Test Result of Radiated Spurious Emission (30MHz ~ 1GHz)

est Mode :	Bluetooth (1	Mbps) CH	00 (2402N	ЛНz)	Tempera	ature :	23~2	5℃
est Engineer :	Damon Zhai	ng			Relative	Humidity	v: 60~62	2%
requencey Range	30MHz~1GH	łz			Polariza	tion :	Horiz	ontal
Data: <mark>5</mark> 80 Level (dE	3uV/m)						Date: 20	019-07-02
72.0								
64.0 56.0						FCC	PART15	C PEAK
48.0								-6dB
40.0	12	3	4	5				
32.0 24.0 16.0					Withdrah	with a particular south	whenter	6
	I INTER THEY	ar i						
8.0 0 30 100.	200.	300. 40	00. 50			700. 80	00. 90	0. 1000
	200.	300. 40	00. 50 Frequer			700. 80	00. 90	0. 1000
0 <mark>30 100.</mark> Freq Re le	ading Ant	enna Ca tor lo	<b>Freque</b> ble Press fac	<b>ncy (MH</b> eamp etor	Hz)	700. 80 Limit level dBuV/m	00. 90 Over limit dB	0. 1000 Remark



est Mode :	Bluetoo	th (1Mbps)	CH00 (2	2402MHz)	Temper	ature :	23~2	5℃
est Engineer :	Damon	Zhang			Relative	e Humidity	<b>y</b> : 60~62	2%
requencey Rang	<b>je</b> 30MHz~	~1GHz			Polariza	ation :	Vertic	al
Data: 6								
80 Level (	dBuV/m)						Date: 20	019-07-02
72.0								
64.0								
56.0						FC	C PART15	
48.0								-6dB
40.0			2					
40.0	1		î	~				6
32.0		. 1		3	4		5	
				3	4	haladhala	5 Aurola Habbart	6
32.0 24.0 16.0 8.0		h.M	And July July Mark	3 	4 	talast Atueta	5 Hund Hulled	
32.0 24.0 16.0	0. 200.	300.	400.	3 500.	4 600.	700. 8	5 	He water
32.0 24.0 16.0 8.0 0 30 100 Freq		300. Antenna factor dB/m	400. Fr	equency(N Preamp		700. 8 Limit level dBuV/m	0ver	He water





## 4.9 AC Conducted Emission Measurement

### 4.9.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of omission (MHz)	Conducted limit (dBµV)		
Frequency of emission (MHz)	Quasi-peak	Average	
0.15-0.5	66 to 56*	56 to 46*	
0.5-5	56	46	
5-30	60	50	

\*Decreases with the logarithm of the frequency.

### 4.9.2 Test Procedures

- 12. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
- 13. Connect EUT to the power mains through a line impedance stabilization network (LISN).
- 14. All the support units are connecting to the other LISN.
- 15. The LISN provides 50 ohm coupling impedance for the measuring instrument.
- 16. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
- 17. Both sides of AC line were checked for maximum conducted interference.
- 18. The frequency range from 150 kHz to 30 MHz was searched.
- Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.



## 4.9.3 Test Result of AC Conducted Emission

Not required



## 4.10 Antenna Requirements

### 4.10.1 Standard Applicable

According to antenna requirement of §15.203.

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. 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 provisions of this Section. The manufacturer may design the unit so that a broken antenna can be re-placed by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded..

And according to §15.247(4)(1), system operating in the 2400-2483.5MHz bands that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

### 4.10.2 Antenna Connected Construction

An embedded-in antenna design is used.

### 4.10.3 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.



# 5 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
Spectrum Analyzer	Keysight	N9010A	MY56070788	2019-01-23	2020-01-22	Conducted
Power Sensor	Keysight	U2021XA	MY56510025	2019-01-23	2020-01-22	Conducted
Power Sensor	Keysight	U2021XA	MY57030005	2019-01-23	2020-01-22	Conducted
Power Sensor	Keysight	U2021XA	MY56510018	2019-01-23	2020-01-22	Conducted
Power Sensor	Keysight	U2021XA	MY56480002	2019-01-23	2020-01-22	Conducted
Thermal Chamber	Sanmtest	SMC-408-CD	2435	2019-05-09	2020-05-08	Conducted
Base Station	R&S	CMW 270	101231	2019-01-23	2020-01-22	Conducted
Signal Generator (Interferer)	Keysight	N5182B	MY56200384	2019-04-19	2020-04-18	Conducted
Signal Generator (Blocker)	Keysight	N5171B	MY56200661	2019-01-23	2020-01-22	Conducted

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV 40	101433	2019-02-18	2020-02-17	Radiation
Amplifier	Sonoma	310	363917	2019-01-22	2020-01-21	Radiation
Amplifier	Schwarzbeck	BBV 9718	327	2019-01-22	2020-01-21	Radiation
Amplifier	Narda	TTA1840-35-HG	2034380	2018-07-18	2019-07-17	Radiation
Loop Antenna	Schwarzbeck	FMZB 1519B	1519B-051	2017/3/3	2020/3/2	Radiation
Broadband Antenna	Schwarzbeck	VULB 9168	9168-757	2017-03-03	2020-03-02	Radiation
Horn Antenna	Schwarzbeck	BBHA 9120 D	1677	2017-03-03	2020-03-02	Radiation
Horn Antenna	COM-POWER	AH-1840	101117	2019-05-15	2020-05-14	Radiation
Test Software	Audix	E3	6.111221a	N/A	N/A	Radiation
Filter	Micro-Tronics	BRM 50702	G266	N/A	N/A	Radiation
EMI Receiver	R&S	ESR 3	102143	2019-01-23	2020-01-22	Conduction
LISN	R&S	ENV216	102125	2019-01-22	2020-01-21	Conduction

N/A: No Calibration Required

Building A1, Changsha E Center, No. 18 Xiangtai Avenue,

Tel.:+86-731-89634887 Fax.: +86-731-89634887



## 6 Uncertainty of Evaluation

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

MEASUREMENT	FREQUENCY	UNCERTAINTY
Conducted emissions	9kHz~30MHz	2.64dB
Radiated emission	30MHz ~ 1GMHz	5.05dB
	1GHz ~ 18GHz	5.06 dB
	18GHz ~ 40GHz	3.65dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

-----End of the report------End of the report------