

**FCC/IC - TEST REPORT**Report Number : **708882003259-00**Date of Issue: August 31, 2020Model : TCWBRCU1Product Type : WIFI and Bluetooth moduleApplicant : Hangzhou Tuya Information Technology Co.,LtdAddress : Room701,Building3,More Center,No.87 GuDun  
Road, Hangzhou, Zhejiang ChinaProduction Facility : Newtronics Hangzhou Co.,LtdAddress : No.15,Jiu zhou Road,Jiang Gan Science&Technology  
Economic Park HangzhouTest Result : ☒ **Positive** ☐ **Negative**Total pages including  
Appendices : 36

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch is a subcontractor to TÜV SÜD Product Service GmbH according to the principles outlined in ISO 17025.

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch reports apply only to the specific samples tested under stated test conditions. Construction of the actual test samples has been documented. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. The manufacturer/importer is responsible to the Competent Authorities in Europe for any modifications made to the production units which result in non-compliance to the relevant regulations. TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch shall have no liability for any deductions, inferences or generalizations drawn by the client or others from TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch issued reports.

This report is the confidential property of the client. As a mutual protection to our clients, the public and ourselves, extracts from the test report shall not be reproduced except in full without our written approval.

## 1 Table of Contents

1	Table of Contents .....	2
2	Details about the Test Laboratory .....	3
3	Description of the Equipment under Test.....	4
4	Summary of Test Standards .....	5
5	Summary of Test Results .....	6
6	General Remarks .....	7
7	Test Setups .....	8
8	Systems test configuration .....	11
9	Technical Requirement.....	12
9.1	Conducted Emission.....	12
9.2	Conducted peak output power .....	15
9.3	6dB bandwidth and 99% Occupied Bandwidth .....	17
9.4	Power spectral density.....	20
9.5	Spurious RF conducted emissions .....	22
9.6	Band edge .....	26
9.7	Spurious radiated emissions for transmitter.....	28
10	Test Equipment List.....	33
11	System Measurement Uncertainty .....	34
12	Photographs of Test Set-ups.....	35
13	Photographs of EUT .....	36



## 2 Details about the Test Laboratory

### Details about the Test Laboratory

#### Test Site 1

Company name: TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch  
No.16 Lane, 1951 Du Hui Road,  
Shanghai 201108,  
P.R. China

FCC Registration No.: 820234

IC Registration No.: 25988

Telephone: +86 21 6141 0123

Fax: +86 21 6140 8600

### 3 Description of the Equipment under Test

#### Description of the Equipment Under Test

Product:	WIFI and Bluetooth module
Model no.:	TCWBRCU1
FCC ID:	2ANDL-TCWBRCU1
IC:	23243-TCWBRCU1
Options and accessories:	NA
Rating:	DC 5V
RF Transmission Frequency:	For 802.11b/g/n-HT20: 2412~2462 MHz For 802.15.1:2402~2480 MHz
No. of Operated Channel:	2.4GHz WIFI: 11 for 802.11b/802.11g/802.11(H20) 2.4GHz BLE: 40
Modulation:	For 2.4GHz WIFI: Direct Sequence Spread Spectrum (DSSS) for 802.11b Orthogonal Frequency Division Multiplexing (OFDM) for 802.11g/n For 2.4GHz BLE: GFSK
Antenna Type:	PCB antenna
Antenna Gain:	2.5 dBi
Description of the EUT:	The Equipment Under Test (EUT) is a low-power embedded Wi-Fi and Bluetooth module (4.2). We tested it and listed the worst data in this report.

The sample's mentioned in this report is supplied by client. The laboratory therefore assumes no responsibility for accuracy of information on the brand name, model number, origin of manufacture, consignment, antenna gain or any information supplied.

## 4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2014 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators
RSS-Gen Issue 5 Amendment 1 March 2019	General Requirements for Compliance of Radio Apparatus
RSS-247 Issue 2 February 2017	Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSS) and License-Exempt Local Area Network (LE-LAN) Devices

All the test methods were according to KDB 558074 D01 15.247 Meas Guidance v05r02 and ANSI C63.10 (2013).

## 5 Summary of Test Results

Technical Requirements						
FCC Part 15 Subpart C						
Test Condition		Pages	Test Site	Test Result		
				Pass	Fail	N/A
§15.207 & RSS-GEN 8.8	Conducted emission AC power port	12-14	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247 (b) (3) & RSS-247 5.4(d)	Conducted peak output power	15-16	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(a)(1) & RSS-247 5.1(b)	20dB bandwidth	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247(a)(1) & RSS-247 5.1(b)	Carrier frequency separation	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247(a)(1)(iii) & RSS-247 5.1(d)	Number of hopping frequencies	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247(a)(1)(iii) & RSS-247 5.1(d)	Dwell Time	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247(a)(2) & RSS-247 5.2(a) & RSSGEN 6.7	6dB bandwidth and 99% Occupied Bandwidth	17-19	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(e) & RSS-247 5.2(b)	Power spectral density	20-21	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(d) & RSS-247 5.5	Spurious RF conducted emissions	22-25	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(d) & RSS-247 5.5	Band edge	26-27	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(d) & §15.209 & RSS-247 5.5 & RSS-Gen 6.13	Spurious radiated emissions for transmitter	28-32	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.203 & RSS-Gen 6.8	Antenna requirement	See note 1		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Remark 1: N/A – Not Applicable.

Note 1: The EUT uses a PCB antenna, which gain is 2.5dBi. In accordance to §15.203 and RSS-Gen 6.8, It is considered sufficiently to comply with the provisions of this section.

## 6 General Remarks

### Remarks

This submittal(s) (test report) is intended for FCC ID: 2ANDL-TCWBRCU1, IC: 23243-TCWBRCU1 complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C Rules and RSS-247, RSS-GEN.

This report is only for the 2.4GHz BLE test report, for the 2.4GHz WiFi test report please refer to 708882003258-00.

### SUMMARY:

All tests according to the regulations cited on page 5 were

■ - Performed

□ - **Not** Performed

The Equipment under Test

■ - **Fulfills** the general approval requirements.

□ - **Does not** fulfill the general approval requirements.

Sample Received Date: July 9, 2020

Testing Start Date: July 14, 2020

Testing End Date: July 21, 2020

- TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch

Reviewed by:

Prepared by:

Tested by:



Hui TONG  
EMC Section Manager



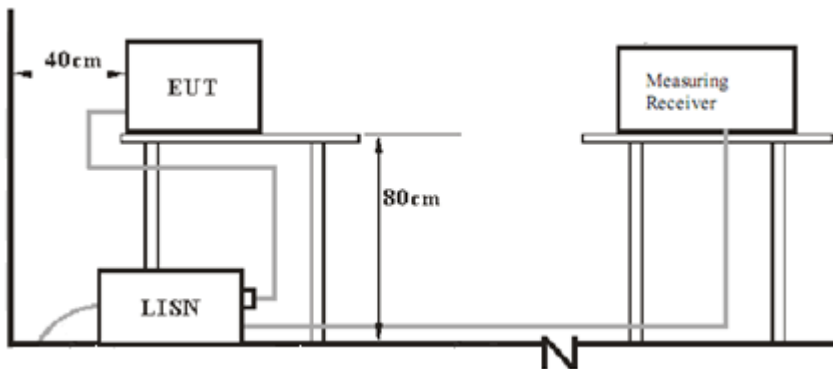
Jiaxi XU  
EMC Project Engineer



Wenqiang LU  
EMC Test Engineer

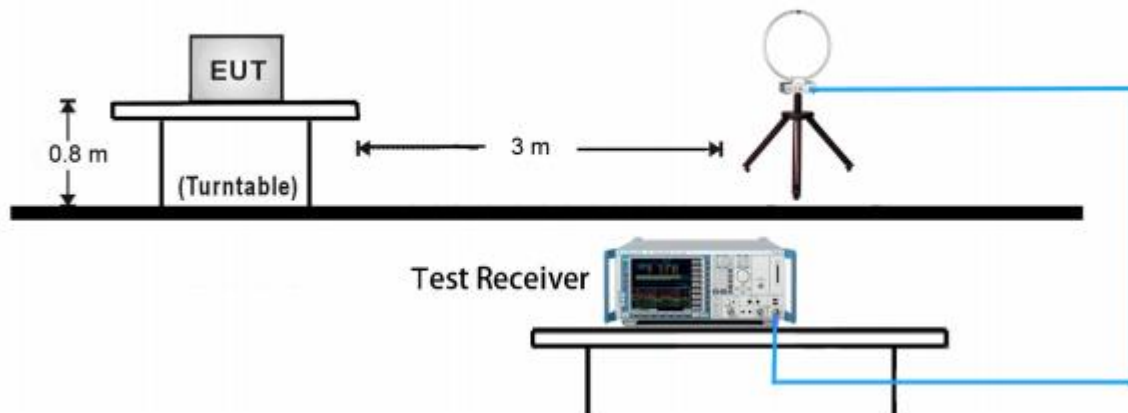
## 7 Test Setups

### 7.1 AC Power Line Conducted Emission test setups



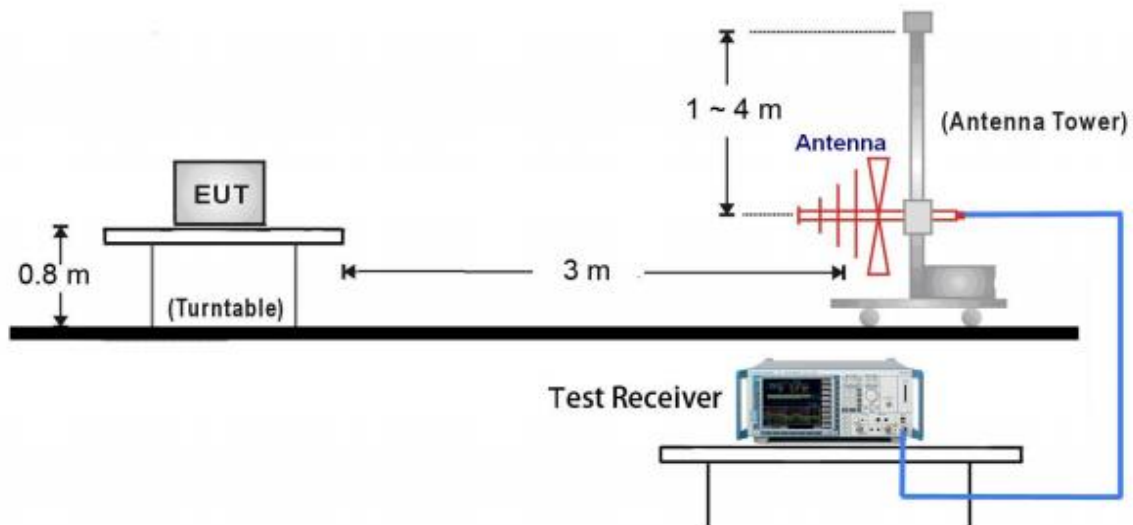
### 7.2 Radiated test setups

#### 9kHz ~ 30MHz Test Setup:

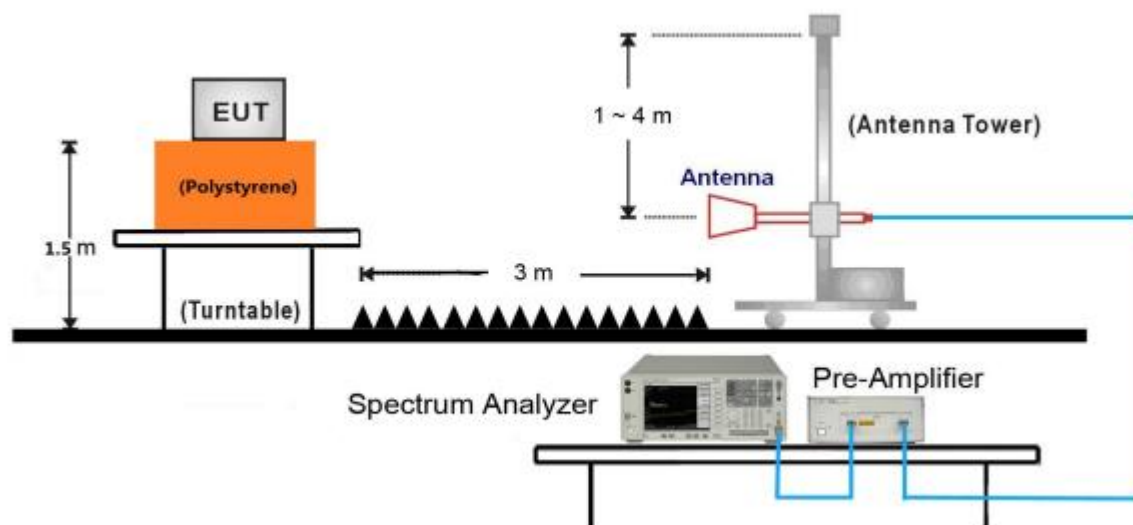




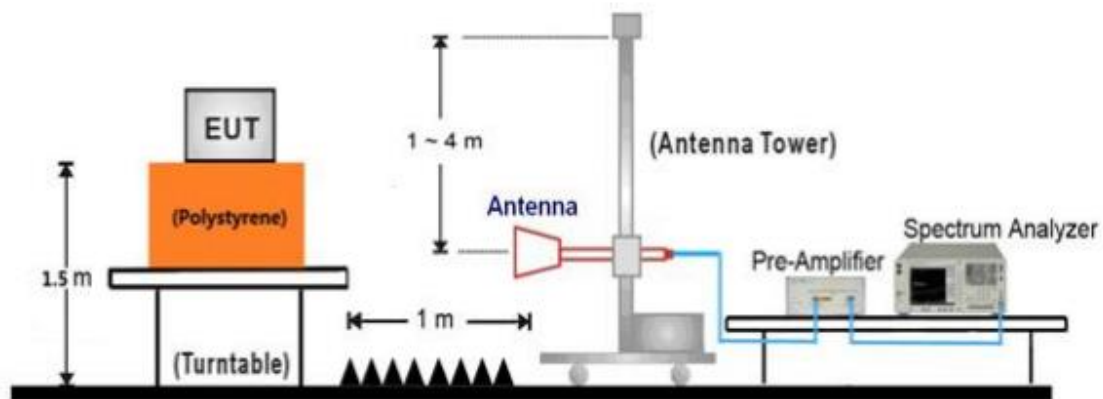
### 30MHz ~ 1GHz Test Setup:



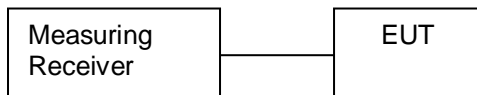
### 1GHz ~ 18GHz Test Setup:



### 18GHz ~ 25GHz Test Setup:



### 7.3 Conducted RF test setups



## 8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.(SHIELD)	S/N(LENGTH)
Notebook	Lenove	X240	Notebook

Test software: AmebaD\_mptool\_2V1 for Wi-Fi  
Bluetooth RF Test Tool (REALTEK) for BLE

The system was configured to channel 0, 19, and 39 for the test.

Non-hopping mode: The system was configured to operate at a signal channel transmitting. The test software allows the configuration and operation at the worst-case duty and the highest transmit power.

## 9 Technical Requirement

### 9.1 Conducted Emission

#### Test Method

1. The EUT was placed on a table, which is 0.8m above ground plane
2. The power line of the EUT is connected to the AC mains through an Artificial Mains Network (A.M.N.).
3. Maximum procedure was performed to ensure EUT compliance
4. A EMI test receiver is used to test the emissions from both sides of AC line

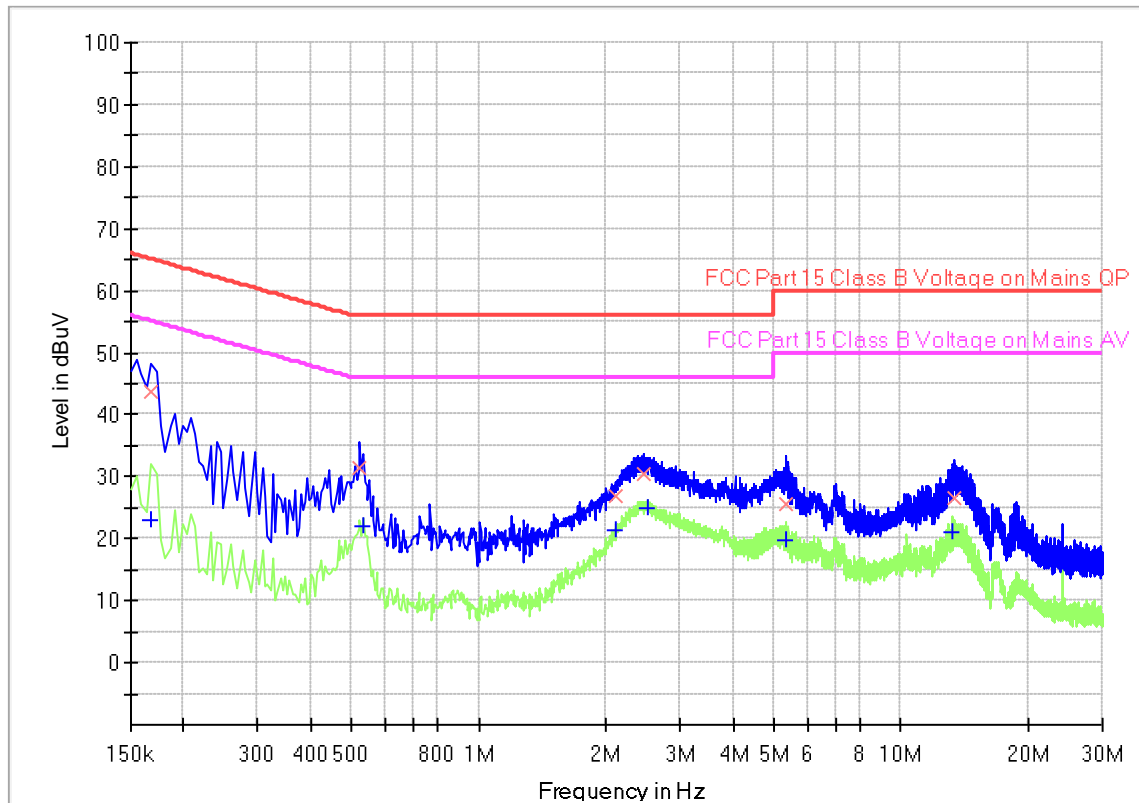
#### Limit

According to §15.207 & RSS-GEN 8.8, conducted emissions limit as below:

Frequency MHz	QP Limit dB $\mu$ V	AV Limit dB $\mu$ V
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

Decreasing linearly with logarithm of the frequency

Product Type : WIFI and Bluetooth Module  
 M/N : TCWBRCU1  
 Operating Condition : Mode 1: Tx\_2402MHz (worst case)  
 Test Specification : L-line  
 Comment : AC 120V/60Hz (powered by notebook)

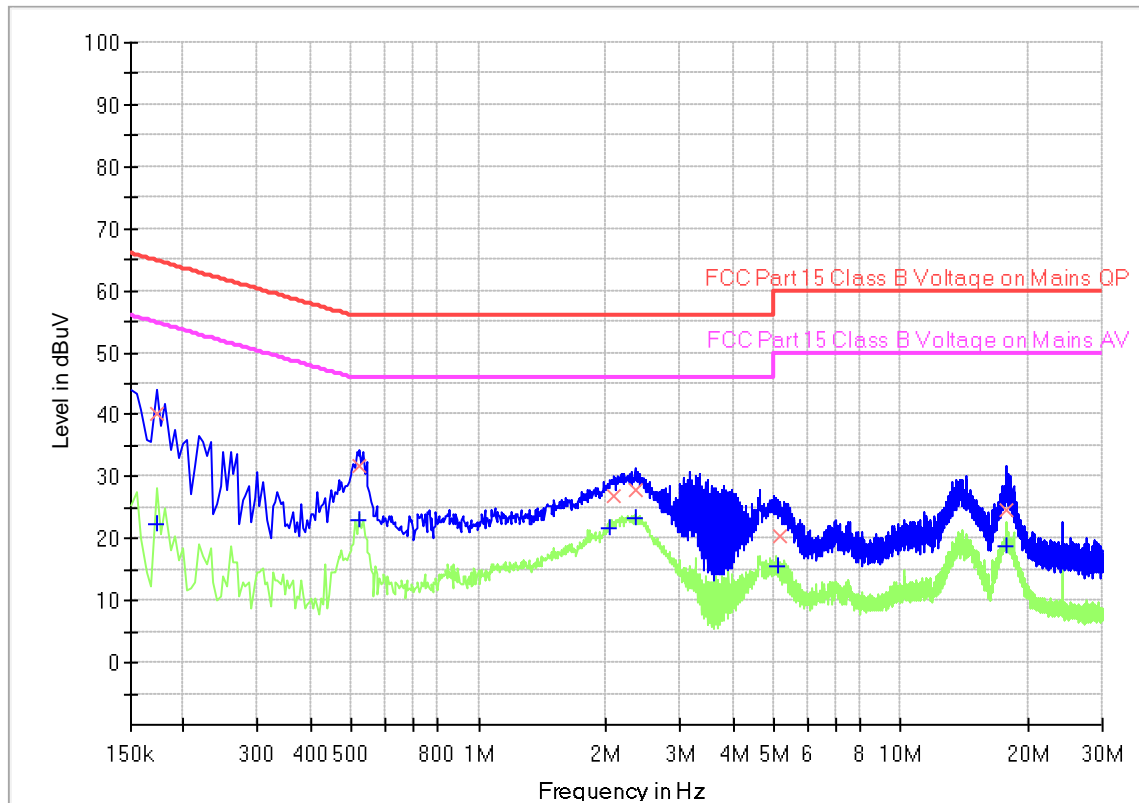


## Final Result

Frequency (MHz)	Quasi Peak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.168000	---	22.87	55.06	32.19	1000.0	9.000	L1	19.4
0.168000	43.62	---	65.06	21.44	1000.0	9.000	L1	19.4
0.523500	31.42	---	56.00	24.58	1000.0	9.000	L1	19.4
0.532500	---	22.06	46.00	23.94	1000.0	9.000	L1	19.4
2.121000	---	21.45	46.00	24.55	1000.0	9.000	L1	19.5
2.121000	26.85	---	56.00	29.15	1000.0	9.000	L1	19.5
2.454000	30.45	---	56.00	25.55	1000.0	9.000	L1	19.5
2.512500	---	25.07	46.00	20.93	1000.0	9.000	L1	19.5
5.338500	25.49	---	60.00	34.51	1000.0	9.000	L1	19.6
5.361000	---	19.70	50.00	30.30	1000.0	9.000	L1	19.6
13.290000	---	21.20	50.00	28.80	1000.0	9.000	L1	19.7
13.375500	26.72	---	60.00	33.28	1000.0	9.000	L1	19.7

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)  
 Factor (dB) = Cable Loss (dB) + LISN Factor (dB) + 10dB Attenuator

Product Type : WiFi and Bluetooth Module  
 M/N : TCWBRCU1  
 Operating Condition : Mode 1: Tx\_2402MHz (worst case)  
 Test Specification : N-line  
 Comment : AC 120V/60Hz (powered by notebook)



## Final Result

Frequency (MHz)	Quasi Peak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.172500	---	22.30	54.84	32.54	1000.0	9.000	N	19.6
0.172500	39.99	---	64.84	24.85	1000.0	9.000	N	19.6
0.519000	---	23.15	46.00	22.85	1000.0	9.000	N	19.5
0.523500	31.86	---	56.00	24.14	1000.0	9.000	N	19.5
2.031000	---	21.81	46.00	24.19	1000.0	9.000	N	19.6
2.094000	26.85	---	56.00	29.15	1000.0	9.000	N	19.6
2.341500	27.76	---	56.00	28.24	1000.0	9.000	N	19.6
2.341500	---	23.30	46.00	22.70	1000.0	9.000	N	19.6
5.131500	---	15.68	50.00	34.32	1000.0	9.000	N	19.7
5.190000	20.52	---	60.00	39.48	1000.0	9.000	N	19.7
17.776500	---	18.95	50.00	31.05	1000.0	9.000	N	19.8
17.794500	24.63	---	60.00	35.37	1000.0	9.000	N	19.8

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)  
 Factor (dB) = Cable Loss (dB) + LISN Factor (dB) + 10dB Attenuator

## 9.2 Conducted peak output power

### Test Method

1. Use the following spectrum analyzer settings:  
RBW > the 6 dB bandwidth of the emission being measured, VBW $\geq$ 3RBW, Span $\geq$ 3RBW  
Sweep = auto, Detector function = peak, Trace = max hold.
2. Add a correction factor to the display.
3. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.

### Limits

According to §15.247 (b) (3) & RSS-247 5.4(d), conducted peak output power limit as below:

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	$\leq 1$	$\leq 30$

Frequency Range MHz	Limit (EIRP) W	Limit dBm
2400-2483.5	$\leq 4$	$\leq 36$

Test result as below table

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	7.42	Pass
Middle channel 2440MHz	7.00	Pass
High channel 2480MHz	6.90	Pass

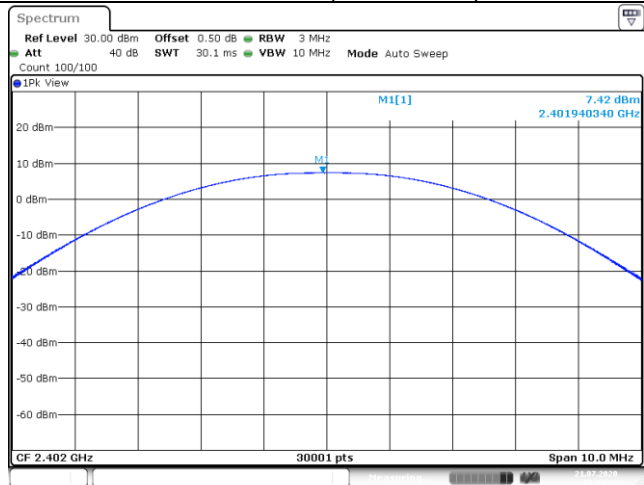
Frequency MHz	EIRP dBm	Result
Low channel 2402MHz	9.92	Pass
Middle channel 2440MHz	9.50	Pass
High channel 2480MHz	9.40	Pass



China

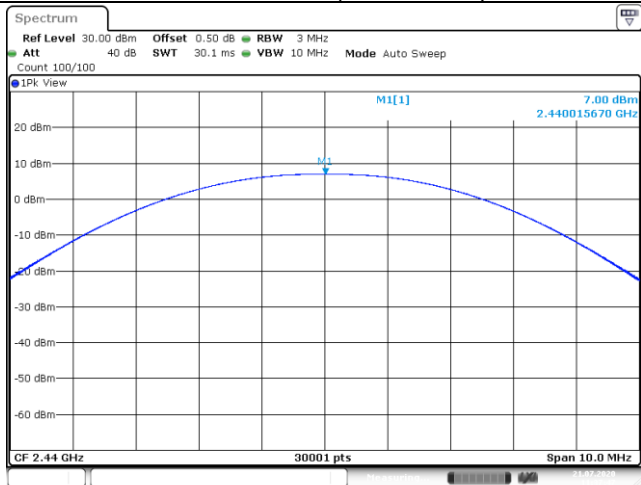
Peak output power

Channel 0 (2402MHz)



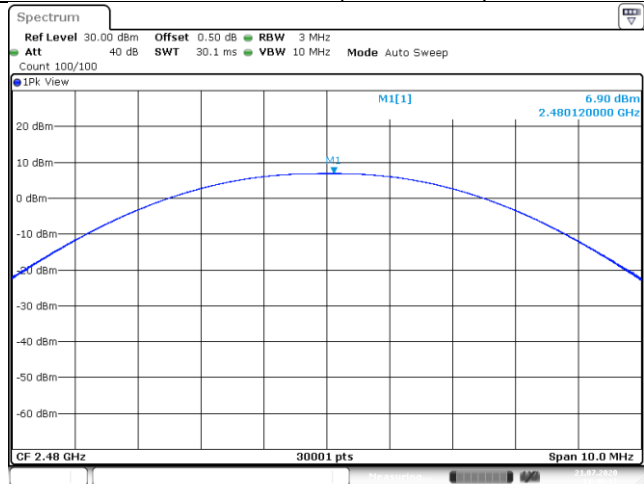
Date: 21 JUL 2020 11:34:47

Channel 19 (2440MHz)



Date: 21 JUL 2020 11:37:47

Channel 39 (2480MHz)



Date: 21 JUL 2020 11:40:11



### 9.3 6dB bandwidth and 99% Occupied Bandwidth

#### Test Method

1. Use the following spectrum analyzer settings:  
RBW=100K, VBW $\geq$ 3RBW, Sweep = auto, Detector function = peak, Trace = max hold
2. Use the automatic bandwidth measurement capability of an instrument, may be employed using the X dB bandwidth mode with X set to 6 dB, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be  $\geq$  6 dB.
3. Allow the trace to stabilize, record the X dB Bandwidth value.

#### Test Method for 99 % Bandwidth

1. Use the following spectrum analyzer settings:  
RBW=1% to 5% of the actual occupied, VBW $\geq$ 3RBW, Sweep = auto, Detector function = peak, Trace = max hold
2. Use the automatic bandwidth measurement capability of an instrument, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be  $\geq$  6 dB.
3. Allow the trace to stabilize, record the X dB Bandwidth value.

#### Limit

Limit [kHz]

$\geq 500$

#### Test result

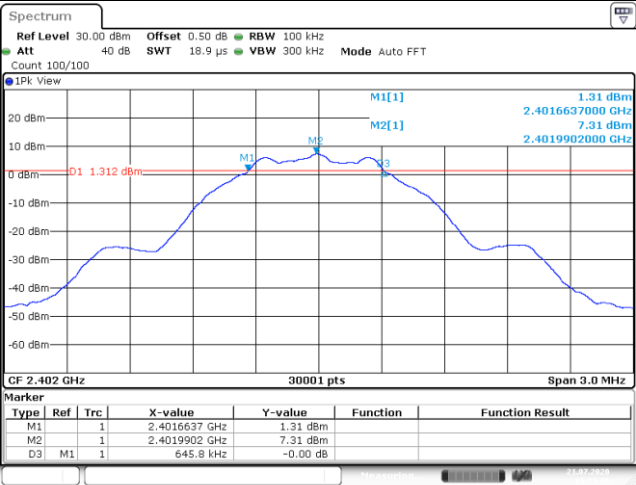
Frequency MHz	6dB bandwidth kHz	99% occupied bandwidth MHz	Result
Top channel 2402MHz	646	1.021	Pass
Middle channel 2440MHz	649	1.028	Pass
Bottom channel 2480MHz	657	1.029	Pass



China

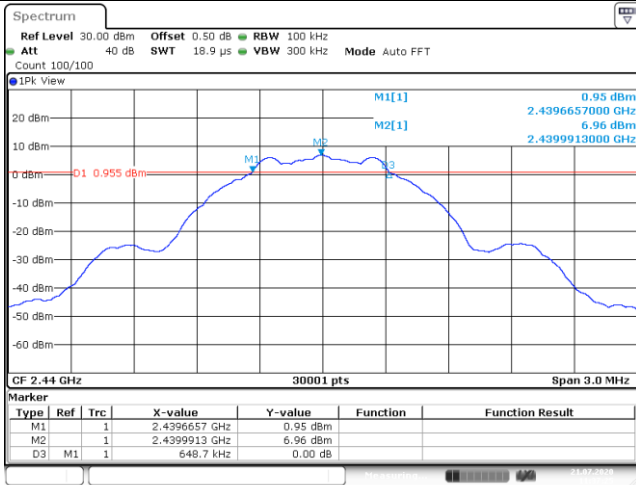
6dB Bandwidth

Channel 0 (2402MHz)



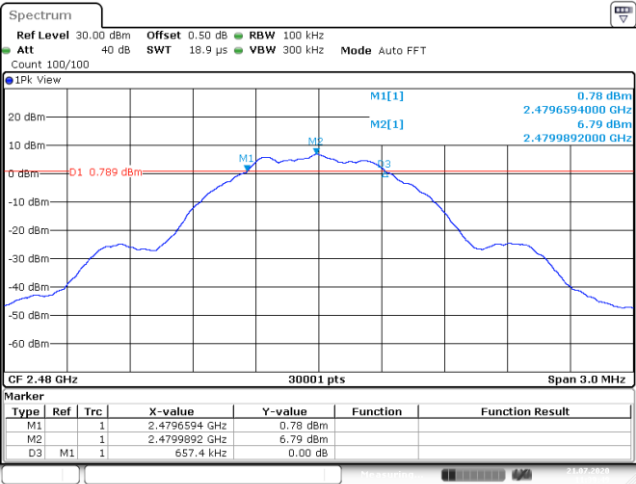
Date: 21 JUL 2020 11:34:26

Channel 19 (2440MHz)



Date: 21 JUL 2020 11:37:26

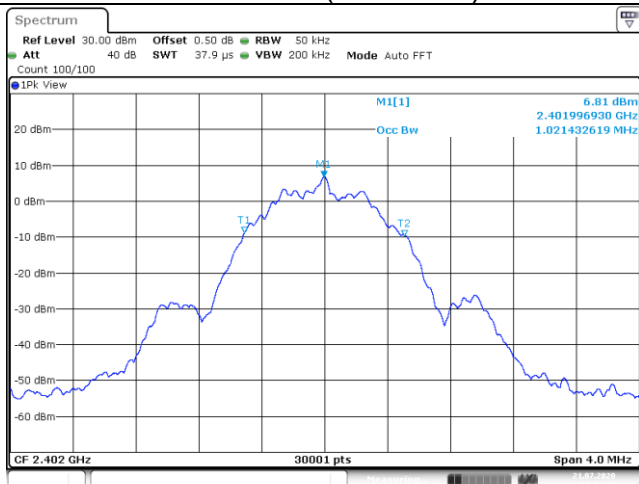
Channel 39 (2480MHz)



Date: 21 JUL 2020 11:39:50

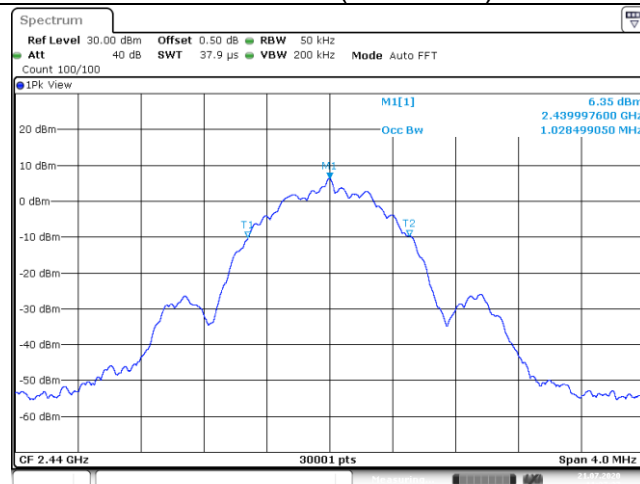
## 99% Bandwidth

## Channel 0 (2402MHz)



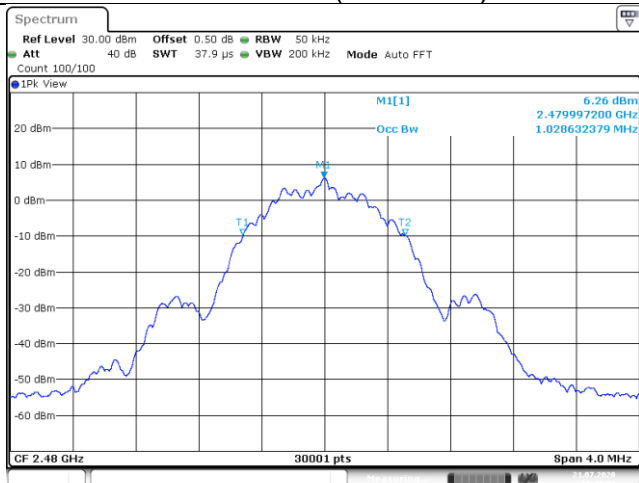
Date: 21 JUL 2020 11:34:37

## Channel 19 (2440MHz)



Date: 21 JUL 2020 11:37:37

## Channel 39 (2480MHz)



Date: 21 JUL 2020 11:40:01

## 9.4 Power spectral density

### Test Method

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance:

1. Set analyzer center frequency to DTS channel center frequency.  
RBW=3kHz, VBW $\geq$ 3RBW, Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
2. Allow trace to fully stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
3. Repeat above procedures until other frequencies measured were completed.

### Limit

Limit [dBm/3kHz]

$\leq 8$

### Test result

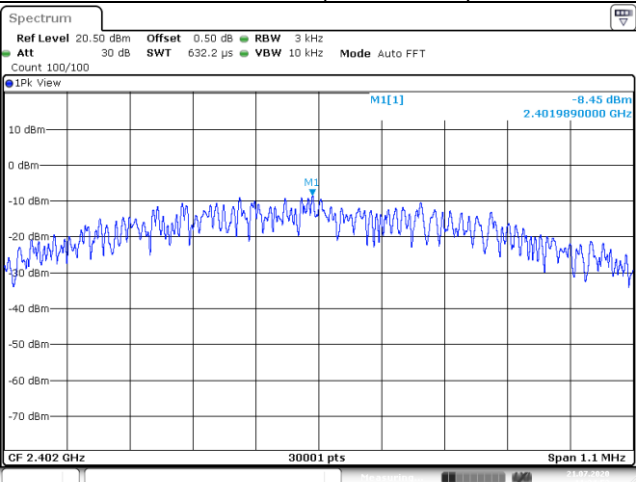
Frequency MHz	1 Mbit/s Power spectral density dBm/3kHz	Result
Top channel 2402MHz	-8.45	Pass
Middle channel 2440MHz	-7.28	Pass
Bottom channel 2480MHz	-8.51	Pass



China

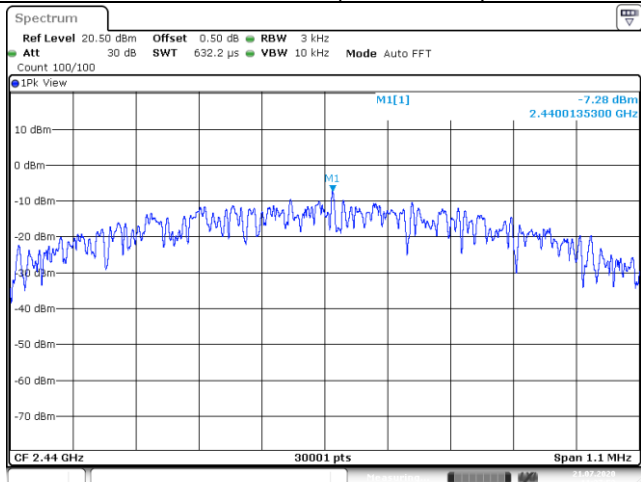
PK PSD

Channel 0 (2402MHz)



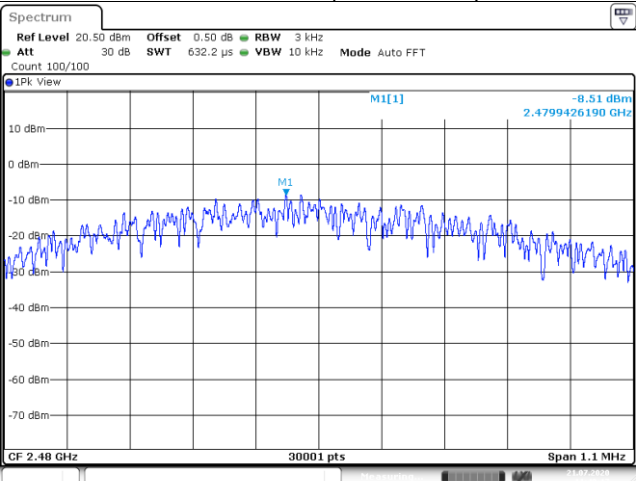
Date: 21 JUL 2020 11:34:54

Channel 19 (2440MHz)



Date: 21 JUL 2020 11:37:53

Channel 39 (2480MHz)



Date: 21 JUL 2020 11:40:17

## 9.5 Spurious RF conducted emissions

### Test Method

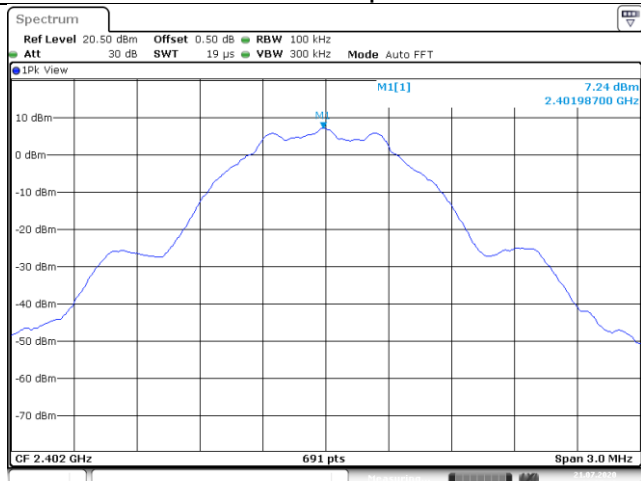
1. Establish a reference level by using the following procedure:
  - a. Set RBW=100 kHz. VBW $\geq$ 3RBW. Detector =peak, Sweep time = auto couple, Trace mode = max hold.
  - b. Allow trace to fully stabilize, use the peak marker function to determine the maximum PSD level.
2. Use the maximum PSD level to establish the reference level.
  - a. Set the center frequency and span to encompass frequency range to be measured.
  - b. Use the peak marker function to determine the maximum amplitude level. Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements, report the three highest emissions relative to the limit.
3. Repeat above procedures until other frequencies measured were completed.

### Limit

Frequency Range MHz	Limit (dBc)
30-25000	-20

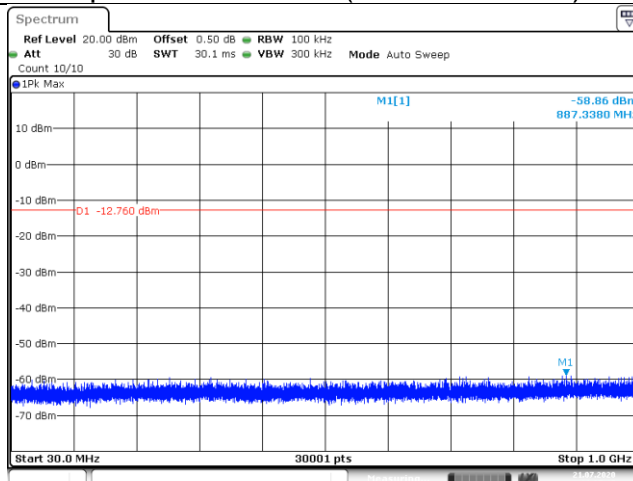
## Out-of-Band Emission Channel 0 (2402MHz)

### Reference point



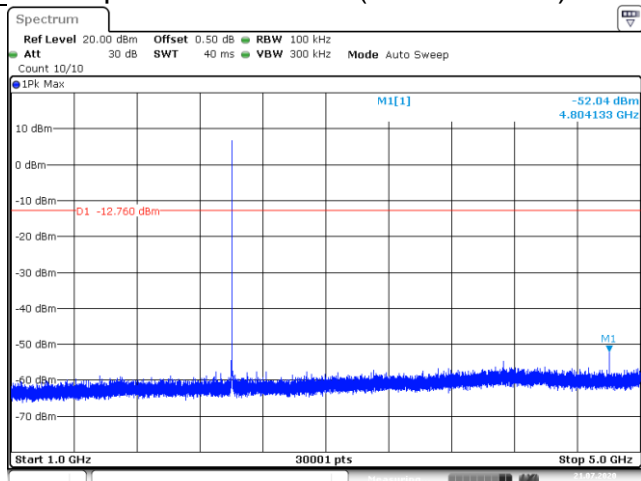
Date: 21 JUL 2020 11:35:10

### Spurious Emission (30MHz – 1GHz)



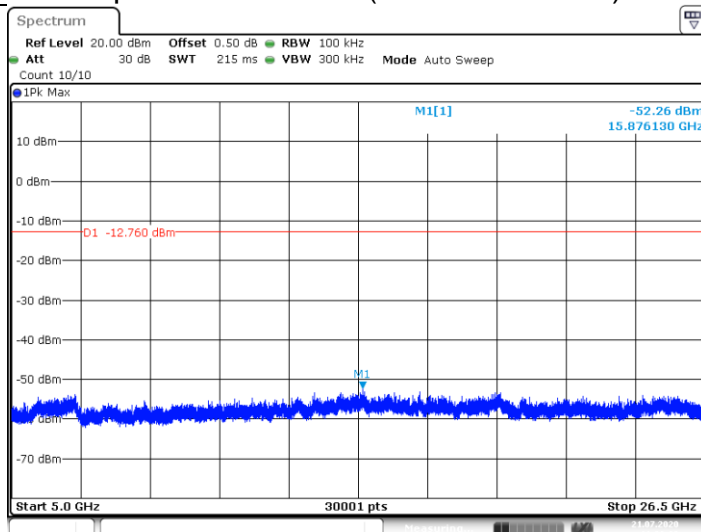
Date: 21 JUL 2020 11:35:15

### Spurious Emission (1GHz –5GHz)



Date: 21 JUL 2020 11:35:28

### Spurious Emission (5GHz –26.5GHz)

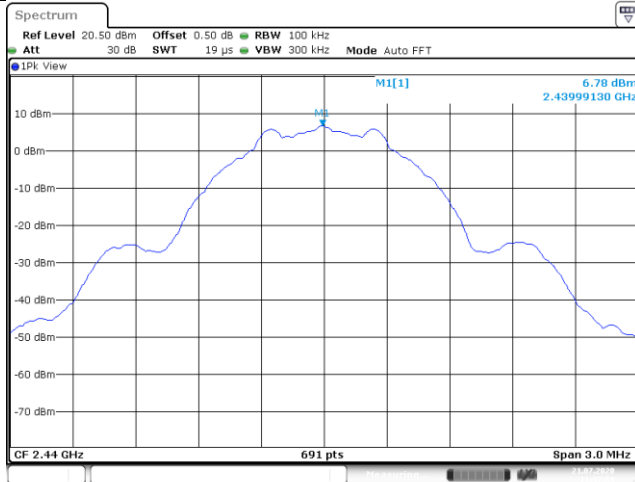


Date: 21 JUL 2020 11:36:00

Note: The emission which exceed the limit is the fundamental.

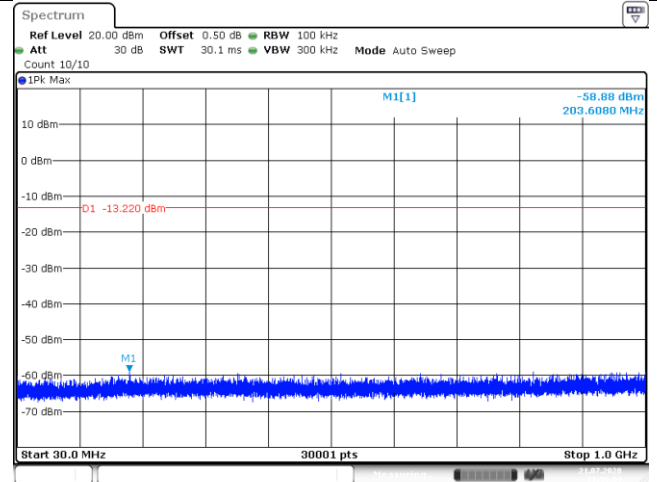
## Out-of-Band Emission Channel 19 (2440MHz)

### Reference point



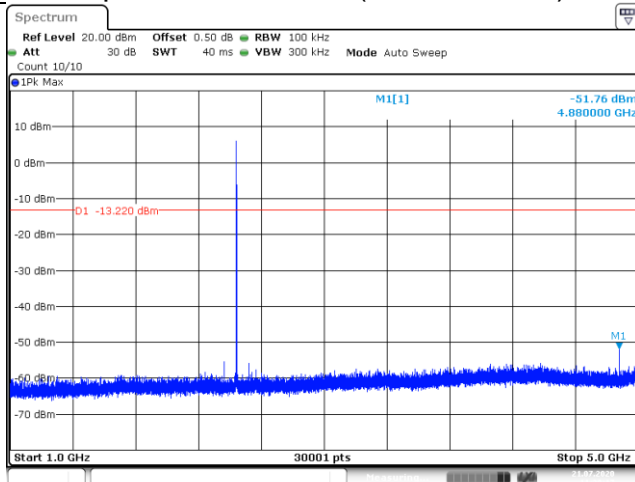
Date: 21 JUL 2020 11:37:59

### Spurious Emission (30MHz – 1GHz)



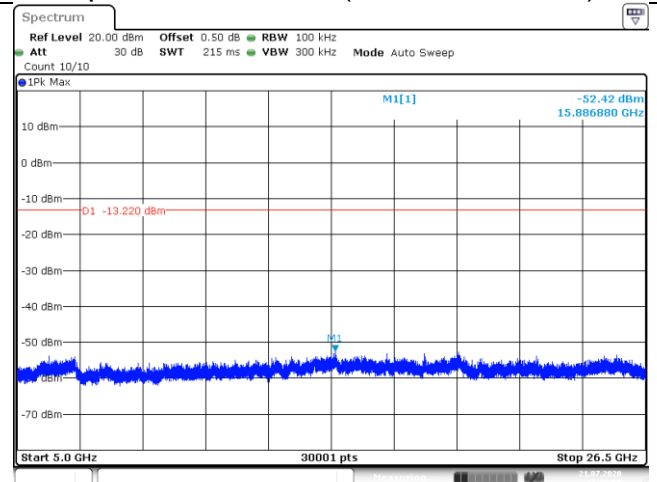
Date: 21 JUL 2020 11:38:04

### Spurious Emission (1GHz – 5GHz)



Date: 21 JUL 2020 11:38:17

### Spurious Emission (5GHz – 26.5GHz)



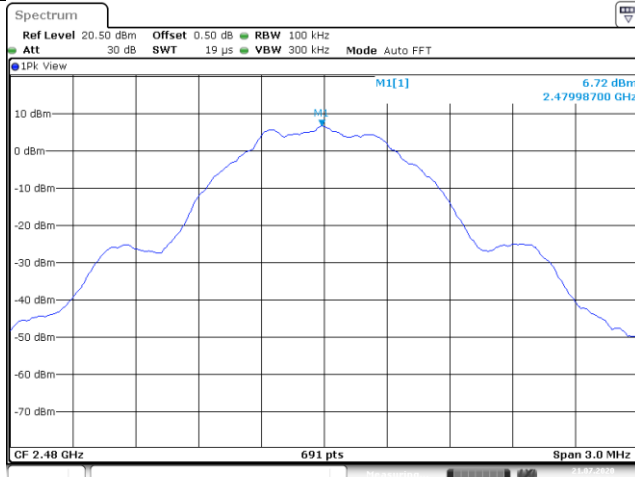
Date: 21 JUL 2020 11:38:49

Note: The emission which exceed the limit is the fundamental.



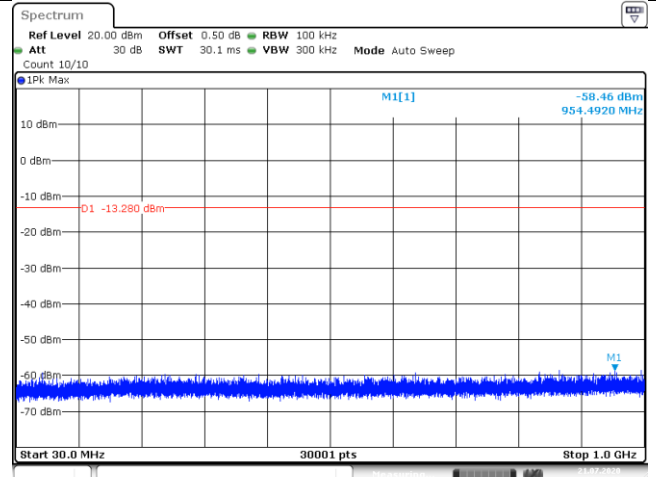
## Out-of-Band Emission Channel 39 (2480MHz)

### Reference point



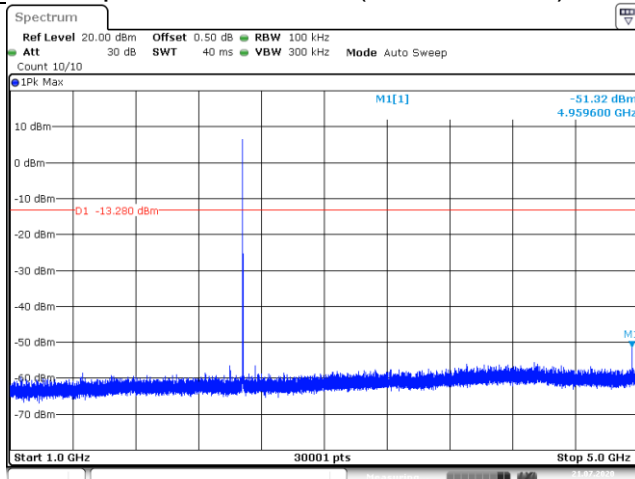
Date: 21 JUL 2020 11:40:33

### Spurious Emission (30MHz – 1GHz)



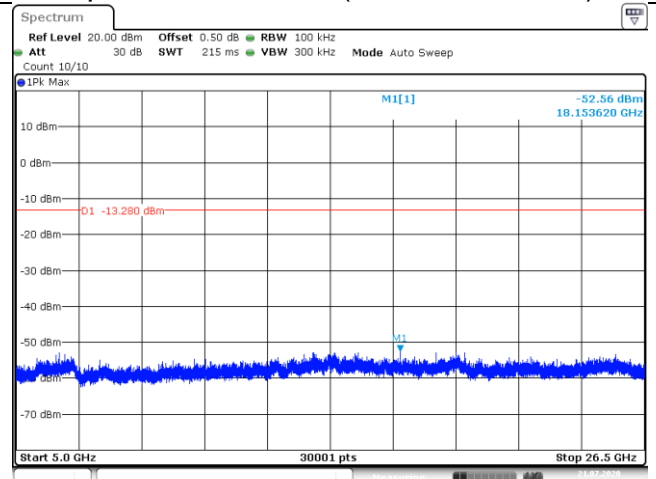
Date: 21 JUL 2020 11:40:39

### Spurious Emission (1GHz – 5GHz)



Date: 21 JUL 2020 11:40:52

### Spurious Emission (5GHz – 26.5GHz)



Date: 21 JUL 2020 11:41:24

Note: The emission which exceed the limit is the fundamental.

## 9.6 Band edge

### Test Method

- 1 Use the following spectrum analyzer settings:  
Span = wide enough to capture the peak level of the in-band emission and all spurious  
RBW = 100 kHz, VBW  $\geq$  RBW, Sweep = auto, Detector function = peak, Trace = max hold.
- 2 Allow the trace to stabilize, use the peak and delta measurement to record the result.
- 3 The level displayed must comply with the limit specified in this Section.

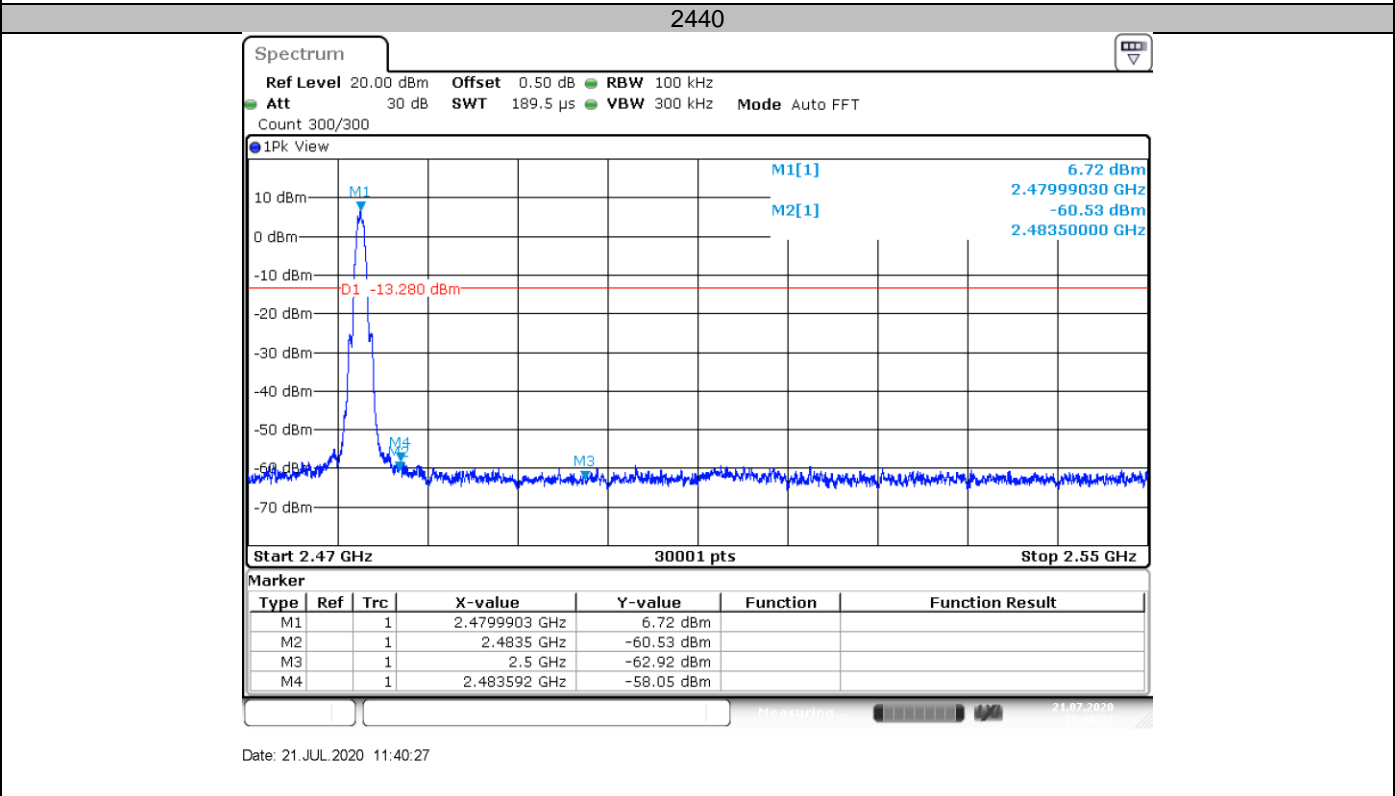
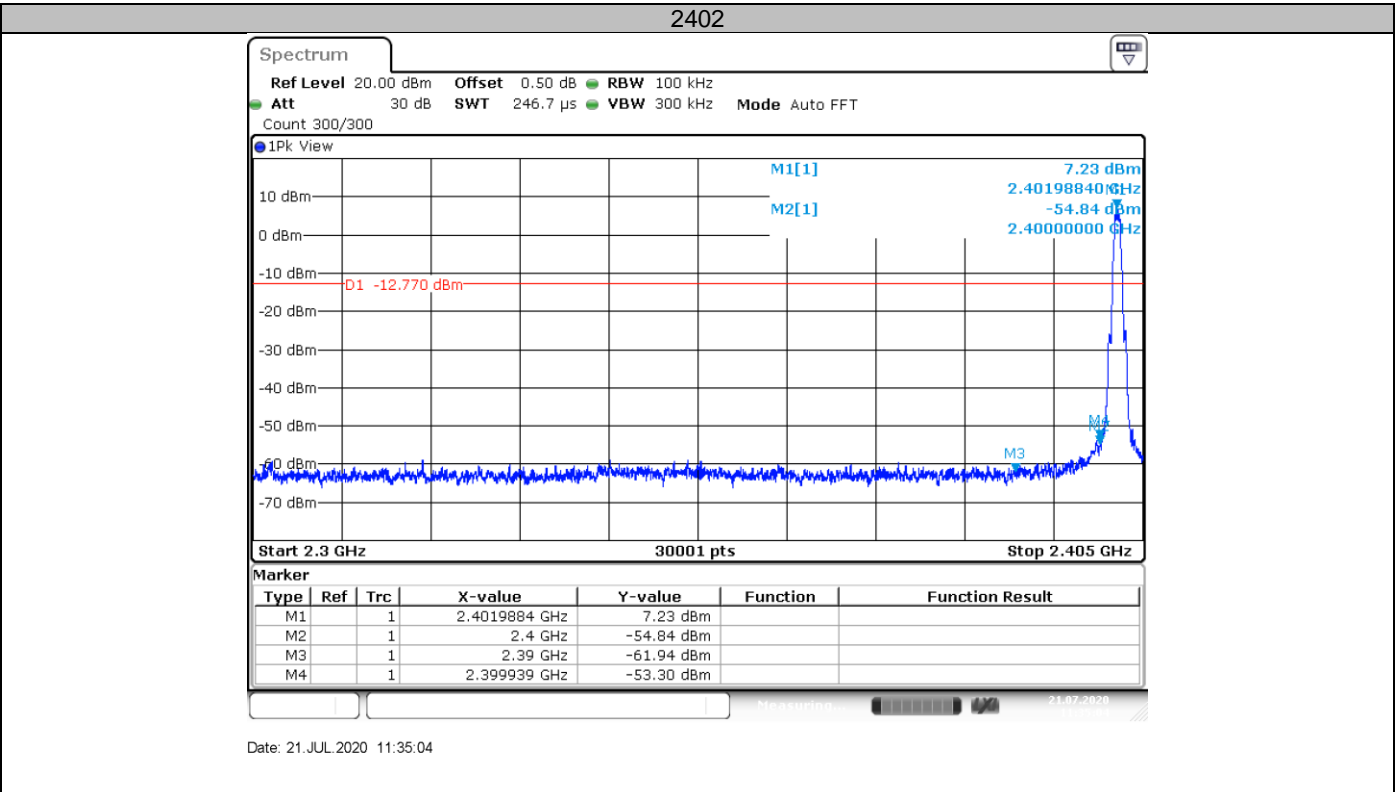
### Limit

According to §15.247(d) and RSS-247 5.5, in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a) and RSS-Gen 8.10, must also comply with the radiated emission limits specified in 15.209(a) (see Section 15.205(c)) and RSS-Gen.



China

Test result



## 9.7 Spurious radiated emissions for transmitter

### Test Method

1. The EUT was placed on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
3. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. Use the following spectrum analyzer settings According to C63.10:

#### For Below 1GHz

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious  
 RBW = 100 kHz to 120 kHz, VBW ≥ RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

#### For Peak unwanted emissions Above 1GHz:

Span = wide enough to capture the peak level of the in-band emission and all spurious  
 RBW = 1MHz, VBW ≥ RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

#### Procedures for average unwanted emissions measurements above 1000 MHz

- a) RBW = 1MHz.
- b)  $VBW \geq [3 \times RBW]$ .
- c) Detector = RMS (power averaging), if  $[\text{span} / (\# \text{ of points in sweep})] \leq RBW / 2$ .  
 Satisfying this condition can require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, then the detector mode shall be set to peak.
- d) Averaging type = power (i.e., rms) (As an alternative, the detector and averaging type may be set for linear voltage averaging. Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.)
- e) Sweep time = auto.
- f) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, then the number of traces shall be increased by a factor of  $1 / D$ , where  $D$  is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 100 traces shall be averaged.)
- g) If tests are performed with the EUT transmitting at a duty cycle less than 98%, then a correction factor shall be added to the measurement results prior to comparing with the emission limit, to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:
  - 1) If power averaging (rms) mode was used in the preceding step e), then the correction

factor is  $[10 \log (1 / D)]$ , where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 3 dB shall be added to the measured emission levels.

2) If linear voltage averaging mode was used in the preceding step e), then the correction factor is  $[20 \log (1 / D)]$ , where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 6 dB shall be added to the measured emission levels.

3) If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

## Limit

The radio emission outside the operating frequency band shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. Radiated emissions which fall in the restricted bands, as defined in section 15.205 and RSS-GEN 8.10 must comply with the radiated emission limits specified in section 15.209.

Frequency MHz	Field Strength uV/m	Measured Distance Meters
0.009~0.490	2400/F (kHz)	300
0.490~1.705	24000/F (kHz)	30
1.705~30	30	30

Frequency MHz	Field Strength uV/m	Field Strength dBuV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

### Spurious radiated emissions for transmitter

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

#### Transmitting spurious emission test result as below:

Test mode: GFSK Channel (2402MHz)					
Frequency MHz	Mmission Level dBuV/m	Limit dBuV/m	Margin dB	Detector	Polarization
2382.8	43.75	74.0	30.25	Peak	Horizontal
4809.7	40.91	74.0	33.09	Peak	Horizontal
2383.4	43.90	74.0	30.1	Peak	Vertical
4806.9	40.06	74.0	33.94	Peak	Vertical

Test mode: GFSK (1 Mbit/s) Channel (2440MHz)					
Frequency MHz	Mmission Level dBuV/m	Limit dBuV/m	Margin dB	Detector	Polarization
4880.0	39.86	74.0	34.14	Peak	Horizontal
4878.3	40.95	74.0	33.05	Peak	Vertical

Test mode: GFSK (1 Mbit/s) Channel (2480MHz)					
Frequency MHz	Mmission Level dBuV/m	Limit dBuV/m	Margin dB	Detector	Polarization
2483.7	51.71	74.0	22.29	Peak	Horizontal
4955.3	40.04	74.0	33.96	Peak	Horizontal
2483.6	45.70	74.0	28.3	Peak	Vertical
4961.6	40.87	74.0	33.13	Peak	Vertical

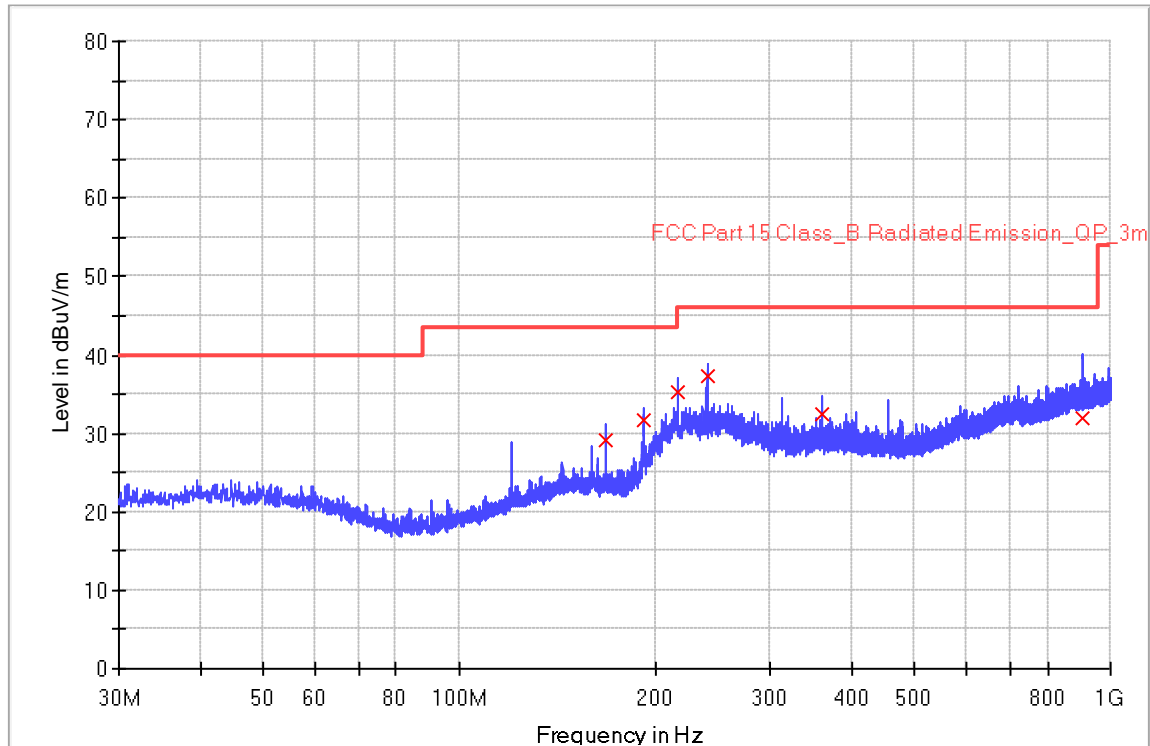
#### Remark:

- (1) Emission level= Original Receiver Reading + Correct Factor
- (2) Correct Factor = Antenna Factor + Cable Loss -Amplifier gain
- (3) Margin = limit – Corrected Reading

The worst case of Radiated Emission below 1GHz:

Site: 3 meter chamber	Time: 2020/07/19 - 13:07
Limit: FCC_Part15.209 and RSS-GEN 8.8_RE(3m)	Engineer: Wenqiang LU
Probe: VULB9168	Polarity: Horizontal
UT: WIFI and Bluetooth module, Model no: TCWBRCU1	Power: 120VAC, 60Hz
Note: Transmit by at channel 2402MHz.	
Note: Pre-scan with three orthogonal axis and worst case as X axis.	

RE\_VULB9168\_pre\_Cont\_30-1000



## Limit and Margin

Frequency (MHz)	QuasiPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBuV/m)
167.920000	29.0	1000.0	120.000	100.1	H	359.0	14.9	14.5	43.5
192.000000	31.7	1000.0	120.000	100.1	H	359.0	12.1	11.8	43.5
215.960000	35.3	1000.0	120.000	100.1	H	359.0	12.3	8.2	43.5
239.960000	37.2	1000.0	120.000	100.1	H	359.0	13.4	8.8	46.0
359.960000	32.6	1000.0	120.000	100.1	H	359.0	16.5	13.4	46.0
905.120000	32.0	1000.0	120.000	100.1	H	359.0	25.9	14.0	46.0

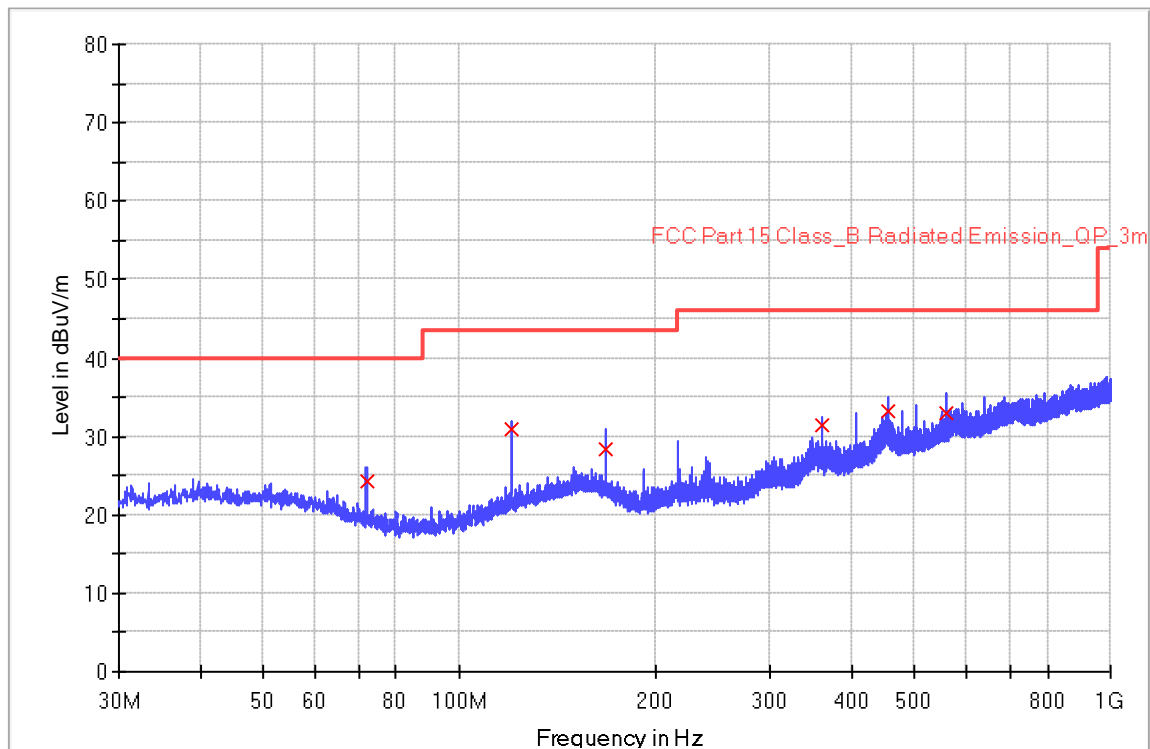
Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Note 2: The test trace is same as the ambient noise and the amplitude of the emissions are attenuated more than 20dB below the permissible (the test frequency range: 9kHz ~ 30MHz, 18GHz ~ 25GHz), therefore no data appear in the report.

Site: 3 meter chamber	Time: 2020/07/19 - 14:03
Limit: FCC_Part15.209 and RSS-GEN 8.8_RE(3m)	Engineer: Wenqiang LU
Probe: VULB9168	Polarity: Vertical
UT: WIFI and Bluetooth module, Model no: TCWBRCU1	Power: 120VAC, 60Hz
Note: Transmit by at channel 2402MHz.	
Note: Pre-scan with three orthogonal axis and worst case as X axis.	

RE\_VULB9168\_pre\_Cont\_30-1000



## Limit and Margin

Frequency (MHz)	QuasiPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBuV/m)
71.960000	24.2	1000.0	120.000	100.1	V	0.0	11.5	15.8	40.0
119.960000	30.9	1000.0	120.000	100.1	V	0.0	13.5	12.6	43.5
168.000000	28.3	1000.0	120.000	100.1	V	0.0	14.9	15.2	43.5
359.960000	31.5	1000.0	120.000	100.1	V	0.0	16.5	14.5	46.0
455.920000	33.2	1000.0	120.000	100.1	V	0.0	18.6	12.8	46.0
560.000000	32.9	1000.0	120.000	100.1	V	0.0	20.8	13.1	46.0

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Note 2: The test trace is same as the ambient noise and the amplitude of the emissions are attenuated more than 20dB below the permissible (the test frequency range: 9kHz ~ 30MHz, 18GHz ~ 25GHz), therefore no data appear in the report.



## 10 Test Equipment List

### List of Test Instruments

Test Site1

	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DATE	CAL. DUE DATE
C	Signal Analyzer	Rohde & Schwarz	FSV40	101091	2020-8-4	2021-8-3
RE	EMI Test Receiver	Rohde & Schwarz	ESR3	101906	2020-8-4	2021-8-3
	Signal Analyzer	Rohde & Schwarz	FSV40	101091	2020-8-4	2021-8-3
	Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9168	961	2019-3-16	2022-3-15
	Horn Antenna	Rohde & Schwarz	HF907	102393	2018-6-11	2021-4-1
	Pre-amplifier	Rohde & Schwarz	SCU-18D	19006451	2020-8-4	2021-8-3
	Loop antenna	Rohde & Schwarz	HFH2-Z2	100443	2020-6-28	2021-6-27
	DOUBLE-RIDGED WAVEGUIDE HORN WITH PRE-AMPLIFIER (18 GHZ - 40 GHZ)	ETS-Lindgren	3116C-PA	002222727	2018-1-29	2021-1-28
	3m Semi-anechoic chamber	TDK	9X6X6	----	2018-5-11	2021-5-10
CE	EMI Test Receiver	Rohde & Schwarz	ESR3	101907	2020-8-4	2021-8-3
	LISN	Rohde & Schwarz	ENV216	101924	2020-8-4	2021-8-3
Measurement Software Information						
Test Item	Software	Manufacturer	Version			
C	Bluetooth and WiFi Test System	Shenzhen JS tonscent co.,ltd	2.6.77.0518			
RE	EMC 32	Rohde & Schwarz	V9.15.00			
CE	EMC 32	Rohde & Schwarz	V9.15.03			

#### C - Conducted RF tests

- Conducted peak output power
- 6dB bandwidth and 99% Occupied Bandwidth
- Power spectral density\*
- Spurious RF conducted emissions
- Band edge

## 11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

Items	Extended Uncertainty
Conducted Disturbance at Mains Terminals	150kHz to 30MHz, LISN, $\pm 3.16\text{dB}$
Radiated Disturbance	30MHz to 1GHz, $\pm 5.03\text{dB}$ (Horizontal) $\pm 5.12\text{dB}$ (Vertical) 1GHz to 18GHz, $\pm 5.49\text{dB}$ 18GHz to 40GHz, $\pm 5.63\text{dB}$
Carrier power conducted measurement	50MHz~18GHz, $\pm 1.238\text{dB}$
Spurious Emission Conducted Measurement	9kHz ~40GHz, $\pm 1.224\text{dB}$



## 12 Photographs of Test Set-ups

Refer to the < Test Setup photos >.



## 13 Photographs of EUT

Refer to the < External Photos > & < Internal Photos >.

---

THE END