

FCC- TEST REPORT

Report Number	:	708881974887-00	Date of Issue:	<u>December 24, 2019</u>
Model	:	<u>WBR1</u>		
Product Type	:	<u>WiFi and Bluetooth module</u>		
FCC ID	:	<u>2ANDL-WBR1</u>		
Applicant	:	<u>Hangzhou Tuya Information Technology Co.,Ltd</u>		
Address of Applicant	:	<u>Room701,Building3,More Center,No.87 GuDun</u>		
	:	<u>Road, Hangzhou, Zhejiang China</u>		
Manufacturer	:	<u>Hangzhou Tuya Information Technology Co.,Ltd</u>		
Address of Manufacturer	:	<u>Room701,Building3,More Center,No.87 GuDun</u>		
	:	<u>Road, Hangzhou, Zhejiang China</u>		
Factory	:	<u>Newtronics Hangzhou Co.,Ltd</u>		
Address of Factory	:	<u>No.15,Jiu zhou Road,Jiang Gan Science&Technology Economic Park Hangzhou</u>		
Test Result	:	☒ Positive ☐ Negative		
Total pages including Appendices	:	<u>48</u>		

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	16
9.4	Power spectral density.....	20
9.5	Spurious RF conducted emissions	24
9.6	Band edge	34
9.7	Spurious radiated emissions for transmitter	38
10	Test Equipment List.....	45
11	System Measurement Uncertainty	46
12	Photographs of Test Set-ups	47
13	Photographs of EUT	48



China

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

Test Firm 820234
Registration
Number:
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.:	WBR1
FCC ID:	2ANDL-WBR1
IC:	NA
Options and accessories:	NA
Rating:	DC 3.0-3.6V
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 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:	2.5dBi
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.



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

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		Conducted emission AC power port	12-14	Site 1	☒	☐	☐
§15.247 (b) (1)		Conducted peak output power	15	Site 1	☒	☐	☐
§15.247(a)(1)		20dB bandwidth	---	---	☐	☐	☒
§15.247(a)(1)		Carrier frequency separation	---	---	☐	☐	☒
§15.247(a)(1)(iii)		Number of hopping frequencies	---	---	☐	☐	☒
§15.247(a)(1)(iii)		Dwell Time	---	---	☐	☐	☒
§15.247(a)(2)		6dB bandwidth	16-19	Site 1	☒	☐	☐
§15.247(e)		Power spectral density	20-23	Site 1	☒	☐	☐
§15.247(d)		Spurious RF conducted emissions	24-33	Site 1	☒	☐	☐
§15.247(d)		Band edge	34-37	Site 1	☒	☐	☐
§15.247(d) & §15.209		Spurious radiated emissions for transmitter	38-44	Site 1	☒	☐	☐
§15.203		Antenna requirement	See note 1		☒	☐	☐

Remark 1: N/A – Not Applicable.

Note 1: The EUT uses a patch antenna, which gain is 2.5dBi. In accordance to §15.203, 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-WBR1 complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C Rules.

This report is only for the 2.4GHz WiFi test report, for the 2.4GHz BLE test report please refer to 708881974875-00.

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: November 30, 2019

Testing Start Date: November 30, 2019

Testing End Date: December 6, 2019

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

Reviewed by:

Prepared by:

Tested by:

Hui TONG

EMC Section Manager
Date: 2019-12-24

Jiaxi XU

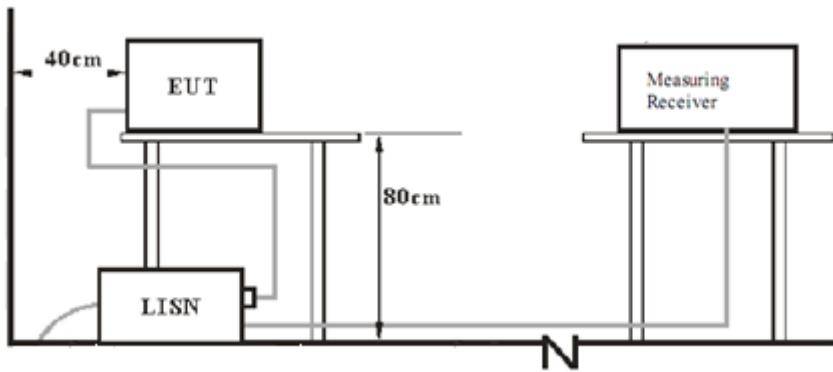
EMC Project Engineer
Date: 2019-12-24

Wenqiang LU

EMC Test Engineer
Date: 2019-12-24

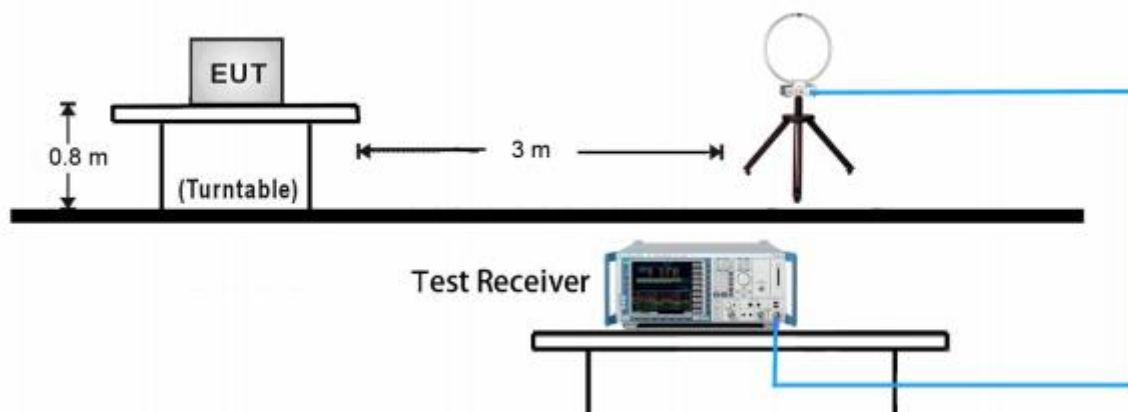
7 Test Setups

7.1 AC Power Line Conducted Emission test setups

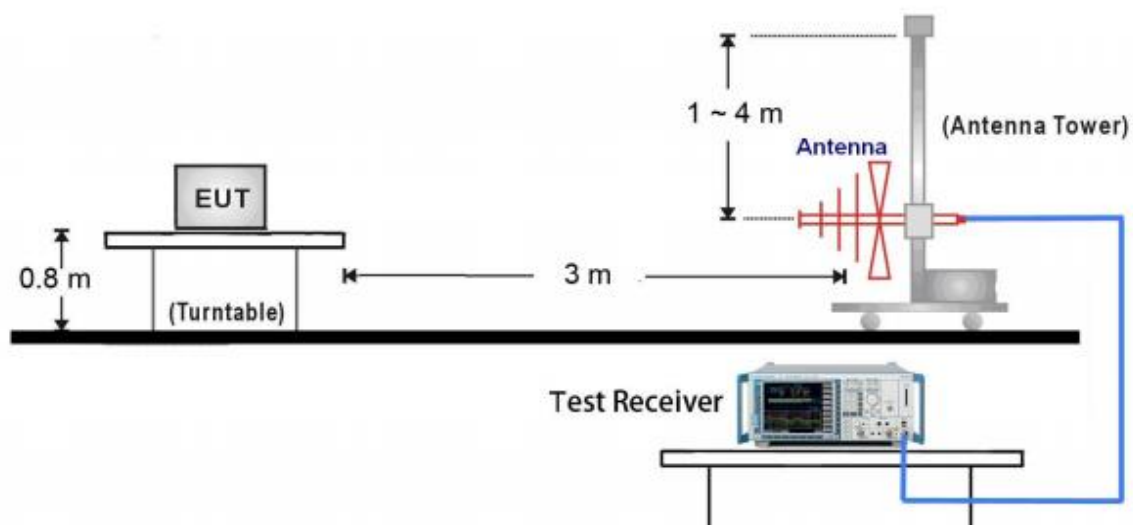


7.2 Radiated test setups

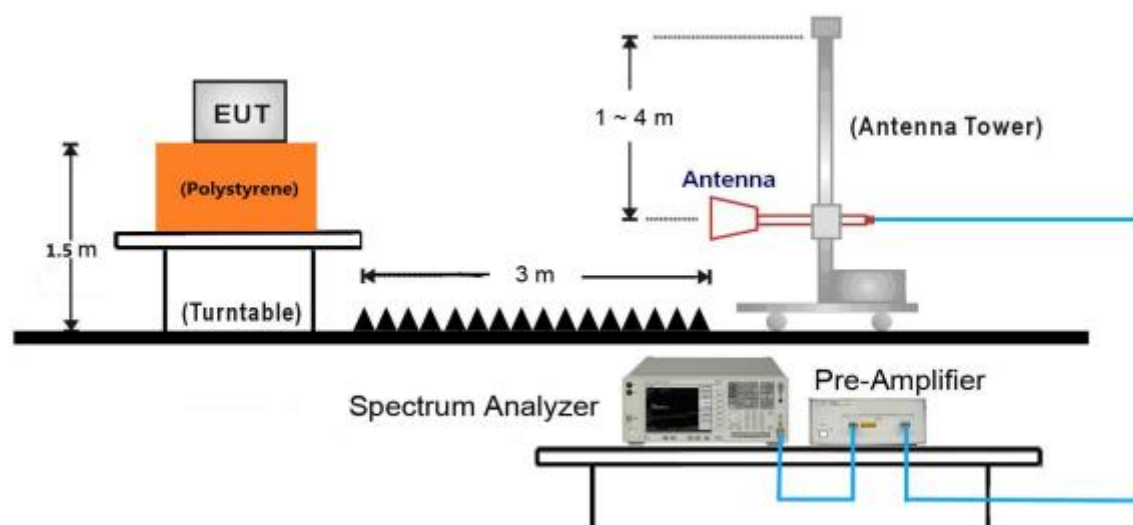
9kHz ~ 30MHz Test Setup:



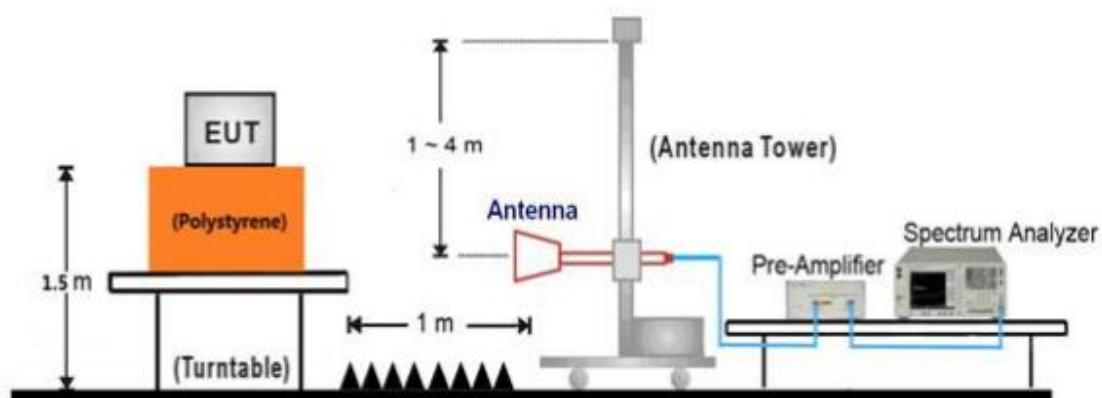
30MHz ~ 1GHz Test Setup:



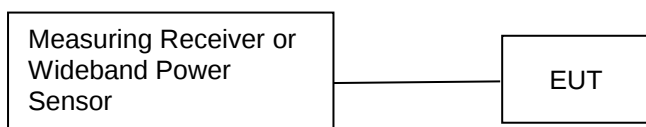
1GHz ~ 18GHz Test Setup:



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)
PC	Lenovo	X240	---

Test software: UI_mptool

The system was configured to channel 1(2412MHz), 6(2437MHz), and 11(2462MHz) 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 a 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

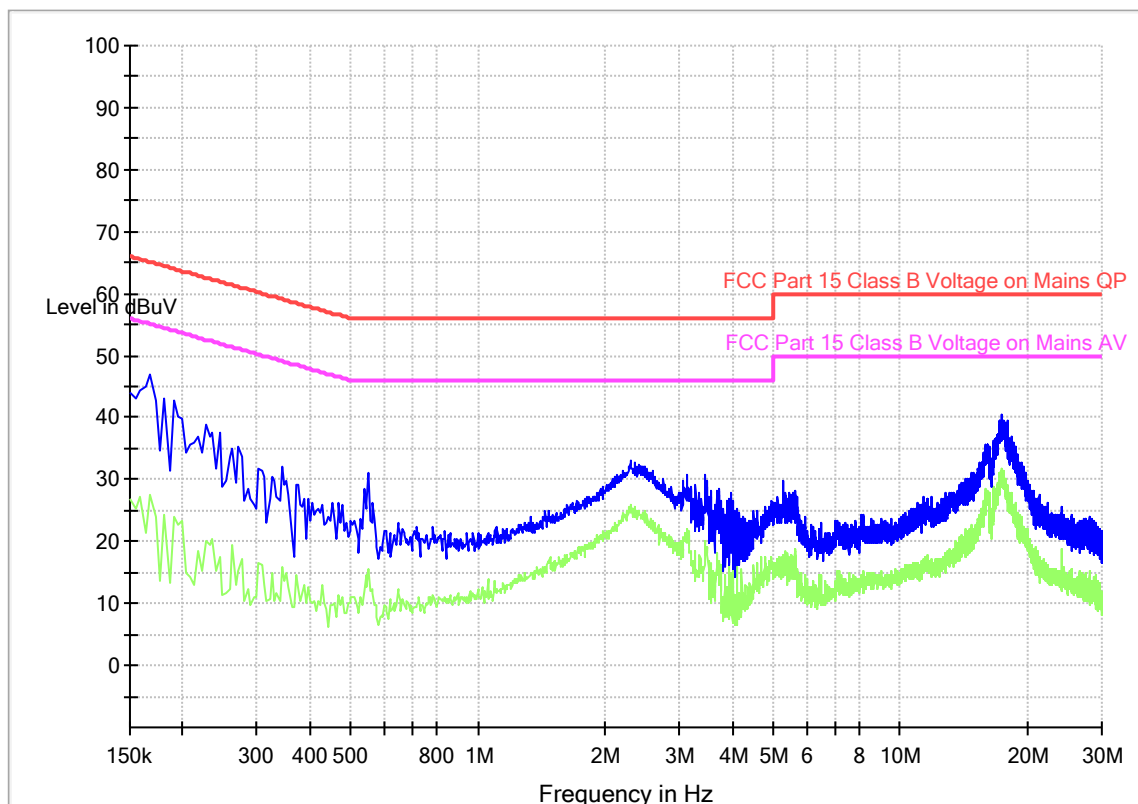
Limit

Frequency MHz	QP Limit dB μ V	AV Limit dB μ 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

Conducted Emission

Product Type : WiFi and BLE Module
M/N : WBR1
Operating Condition : Mode 1: Tx_2437MHz for 802.11g
Test Specification : L-line
Comment : AC 120V/60Hz (powered by notebook)

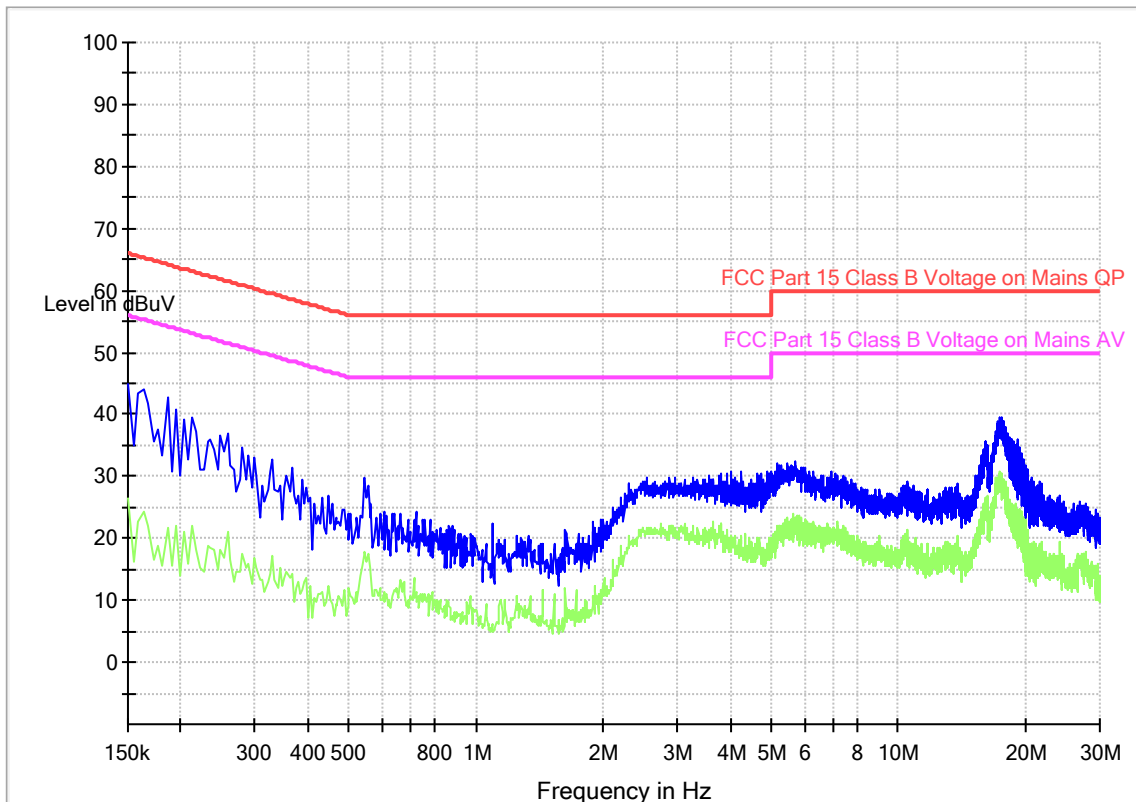


Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + LISN Factor (dB) + 10dB Attenuator



China

Product Type : WiFi and BLE Module
M/N : WBR1
Operating Condition : Mode 1: Tx_2437MHz for 802.11g
Test Specification : N-line
Comment : AC 120V/60Hz (powered by notebook)



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. Use a power meter to measure the conducted peak output power.

Limits

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤ 1	≤ 30

Test result as below table

802.11B

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2412MHz	19.02	Pass
Middle channel 2437MHz	19.88	Pass
High channel 2462MHz	19.65	Pass

802.11G

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2412MHz	24.22	Pass
Middle channel 2437MHz	24.89	Pass
High channel 2462MHz	24.78	Pass

802.11N20

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2412MHz	23.45	Pass
Middle channel 2437MHz	22.70	Pass
High channel 2462MHz	23.18	Pass

9.3 6dB 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.

Limit

Limit [kHz]

≥ 500

Test result 802.11B

Frequency MHz	6dB bandwidth MHz	Result
Low channel 2412MHz	9.0537	Pass
Middle channel 2437MHz	9.0587	Pass
High channel 2462MHz	9.0547	Pass

802.11G

Frequency MHz	6dB bandwidth MHz	Result
Low channel 2412MHz	16.3175	Pass
Middle channel 2437MHz	16.3195	Pass
High channel 2462MHz	16.3245	Pass

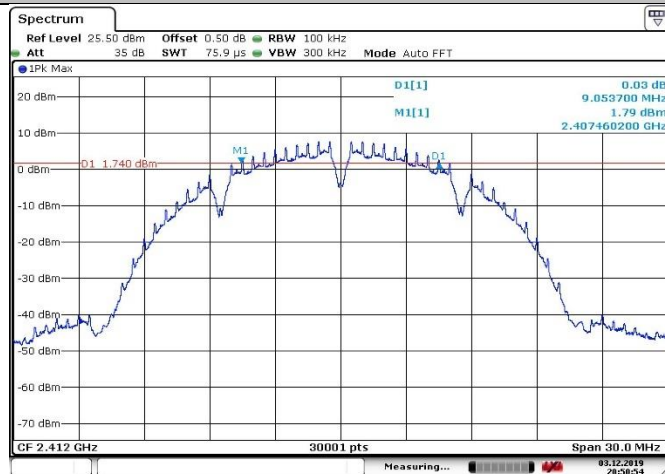
802.11N20

Frequency MHz	6dB bandwidth MHz	Result
Low channel 2412MHz	17.5424	Pass
Middle channel 2437MHz	17.5474	Pass
High channel 2462MHz	17.5564	Pass

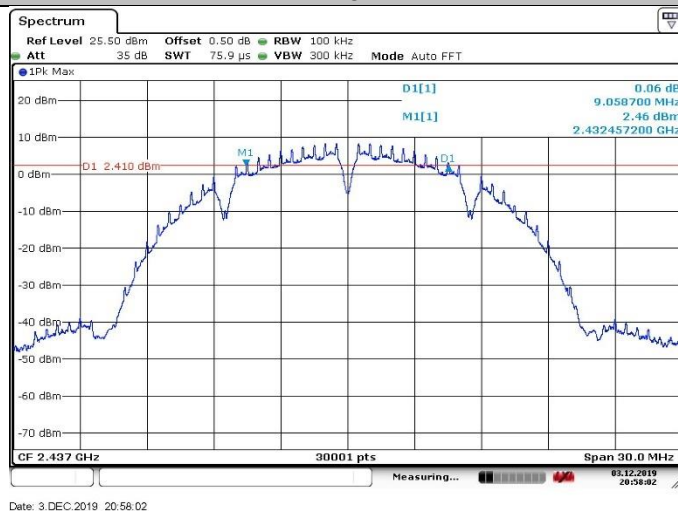
6 dB Bandwidth

802.11B

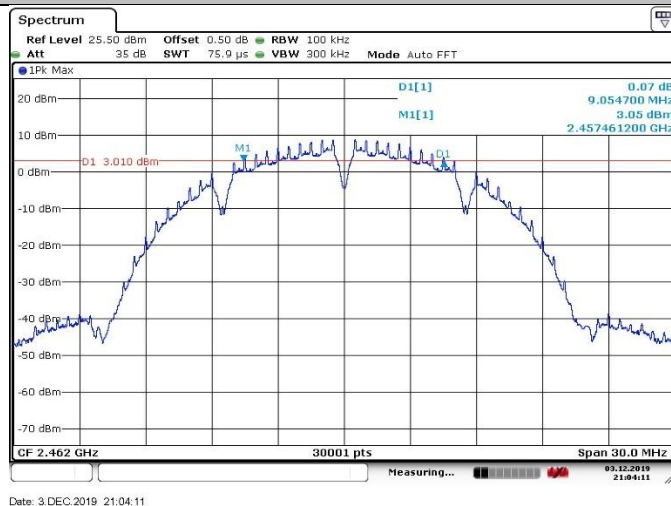
2412



2437

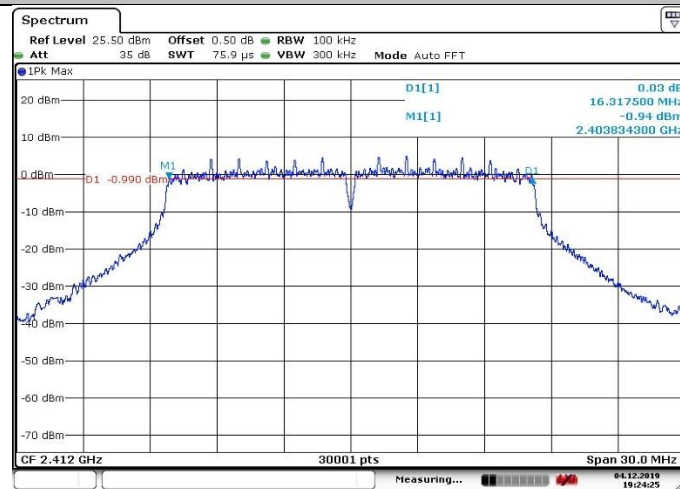


2462



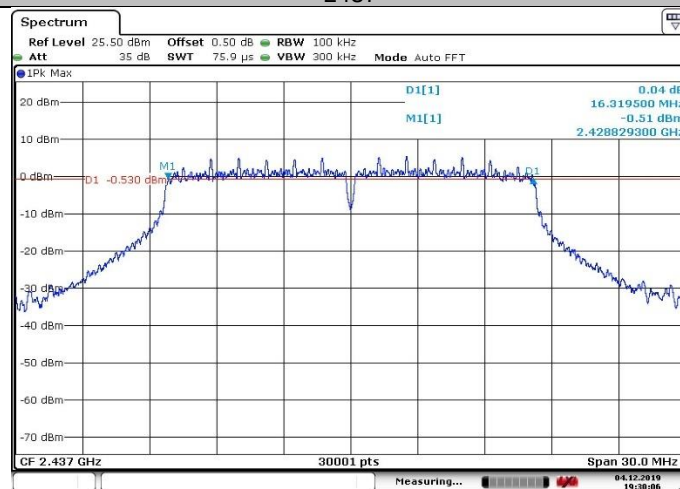
802.11G

2412



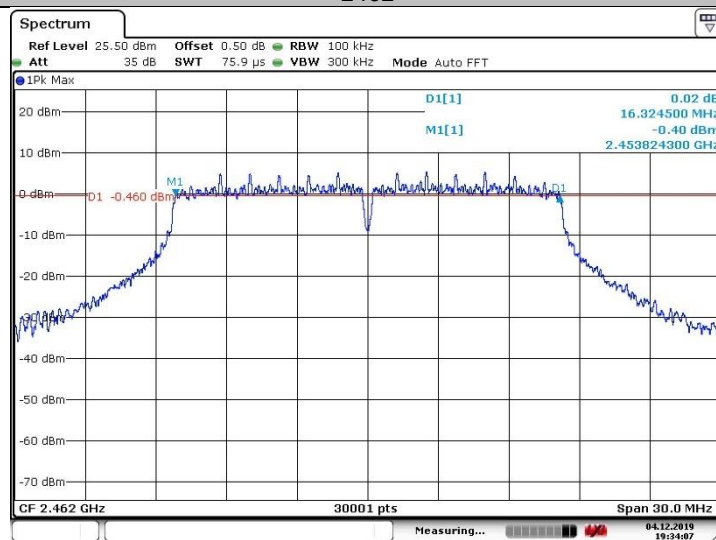
Date: 4 DEC 2019 19:24:25

2437



Date: 4 DEC 2019 19:30:07

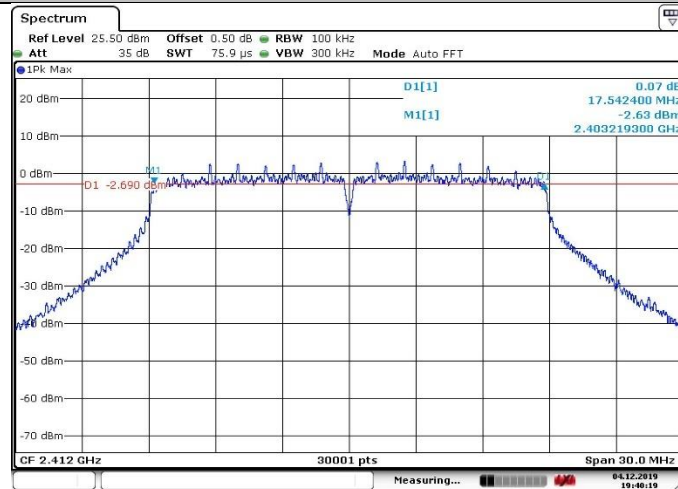
2462



Date: 4 DEC 2019 19:34:07

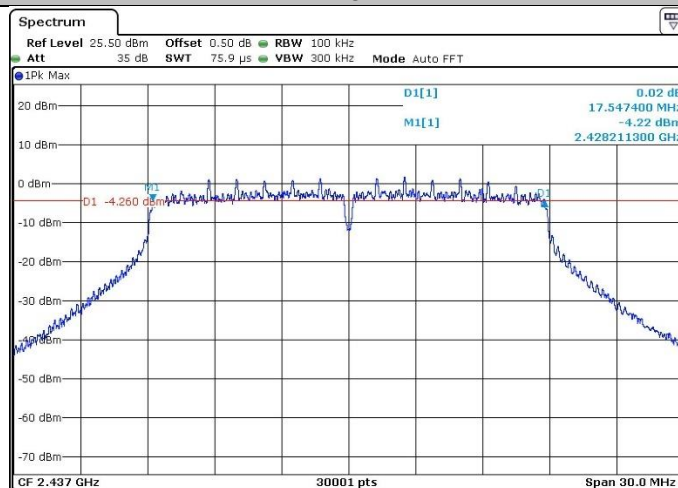
802.11N20

2412



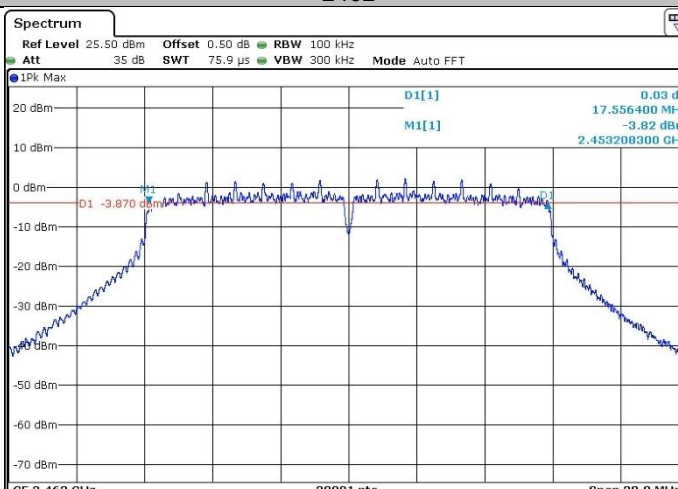
Date: 4 DEC 2019 19:40:19

2437



Date: 4 DEC 2019 19:45:09

2462



Date: 4 DEC 2019 19:50:18

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≥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]

≤8

Test result
802.11 B

Frequency MHz	Power spectral density dBm	Result
Low channel 2412MHz	-5.34	Pass
Middle channel 2437MHz	-3.51	Pass
High channel 2462MHz	-4.37	Pass

802.11 G

Frequency MHz	Power spectral density dBm	Result
Low channel 2412MHz	-9.82	Pass
Middle channel 2437MHz	-8.56	Pass
High channel 2462MHz	-9.25	Pass

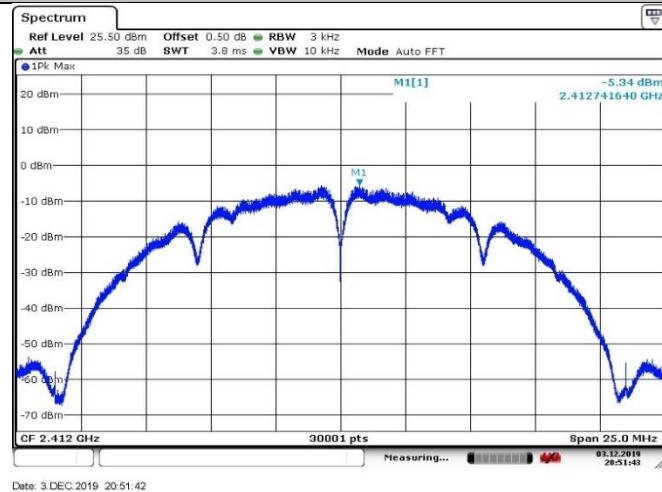
802.11 N20

Frequency MHz	Power spectral density dBm	Result
Low channel 2412MHz	-11.57	Pass
Middle channel 2437MHz	-12.83	Pass
High channel 2462MHz	-12.39	Pass

Power spectral density

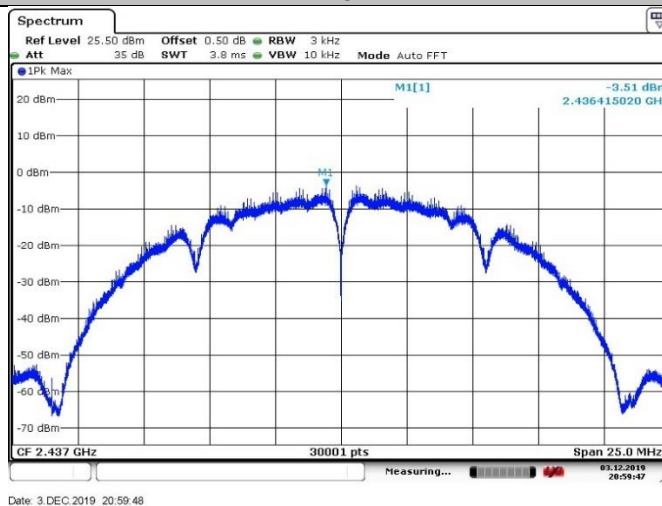
802.11B

2412



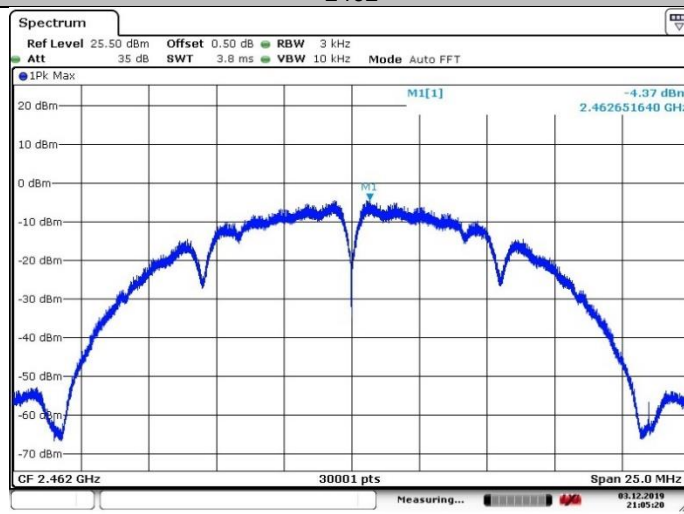
Date: 3 DEC. 2019 20:51:42

2437



Date: 3 DEC. 2019 20:59:48

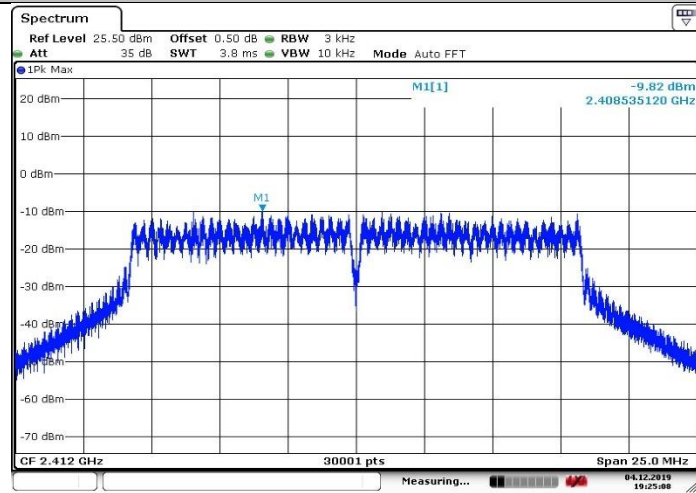
2462



Date: 3 DEC. 2019 21:05:20

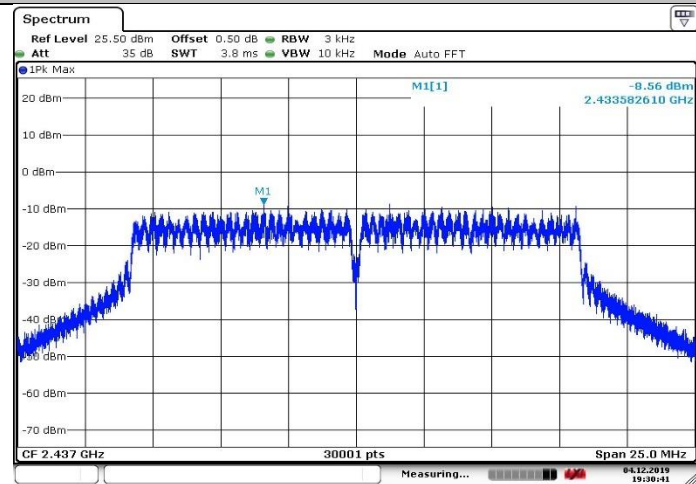
802.11G

2412



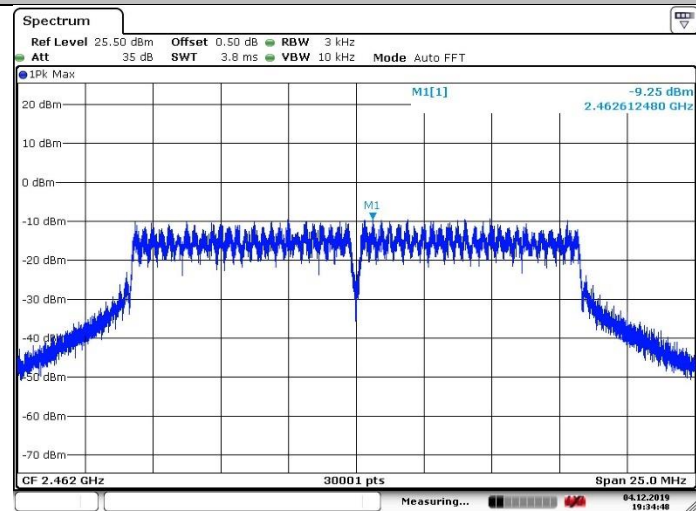
Date: 4 DEC 2019 19:25:08

2437



Date: 4 DEC 2019 19:30:41

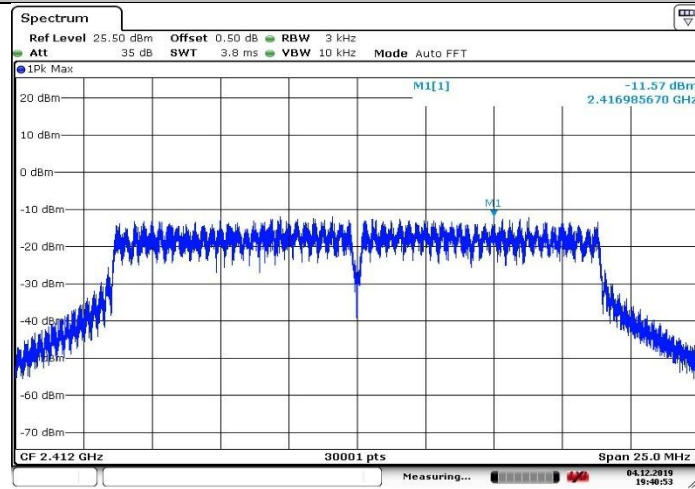
2462



Date: 4 DEC 2019 19:34:48

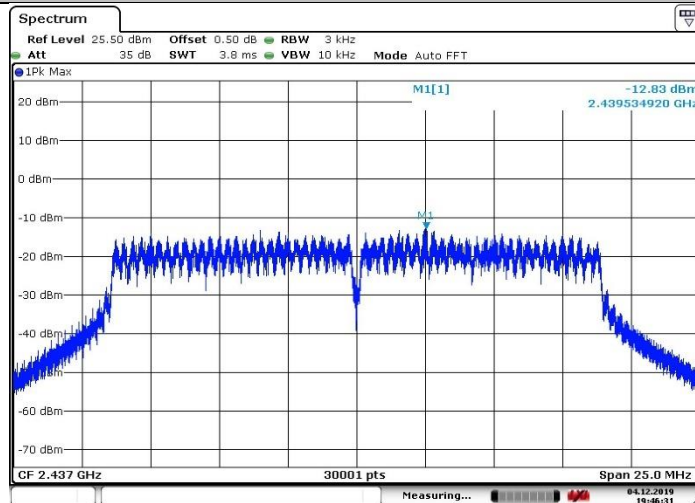
802.11N20

2412



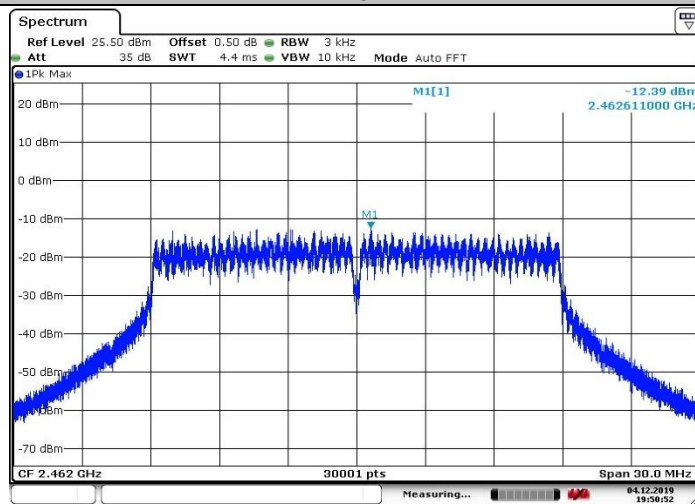
Date: 4 DEC 2019 19:40:54

2437



Date: 4 DEC 2019 19:46:31

2462



Date: 4 DEC 2019 19:50:51



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

Spurious RF conducted emissions

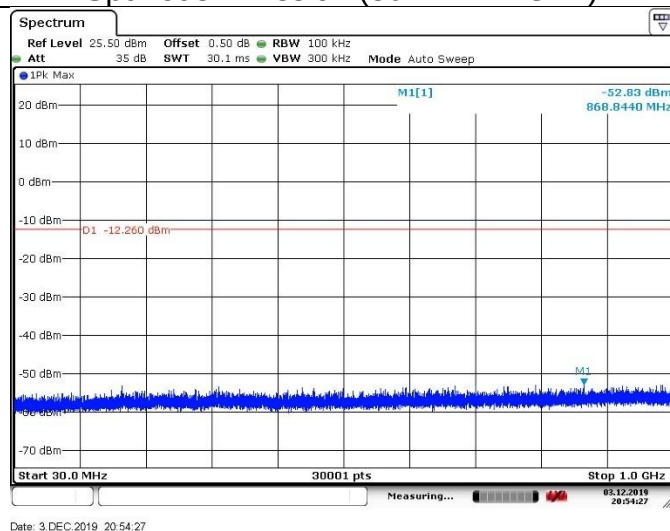
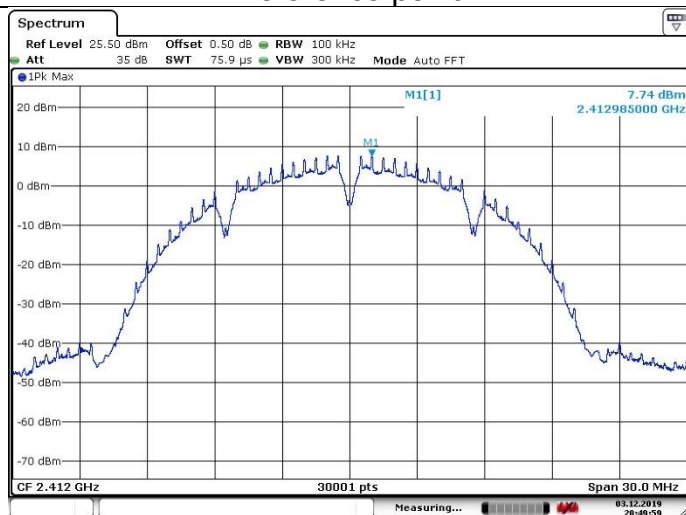
802.11 B

Out-of-Band Emissions

Channel 1 (2412MHz)

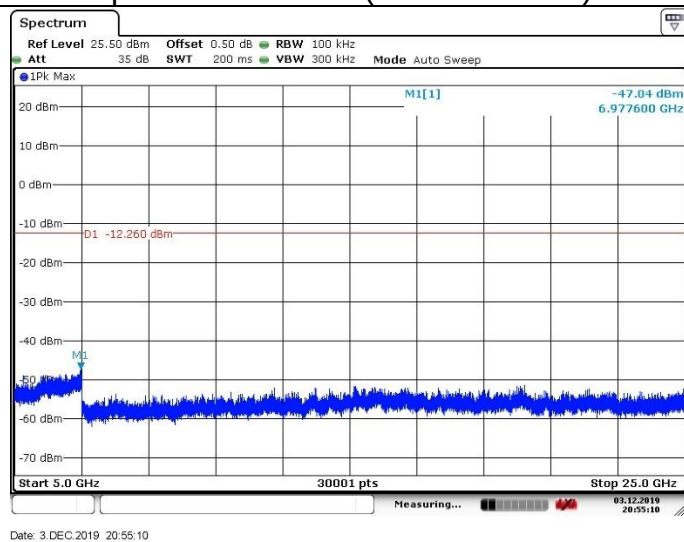
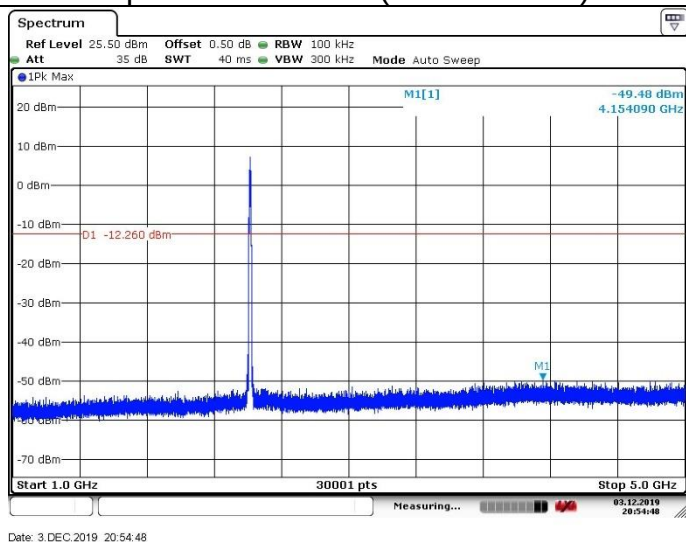
Reference point

Spurious Emission (30MHz – 1GHz)



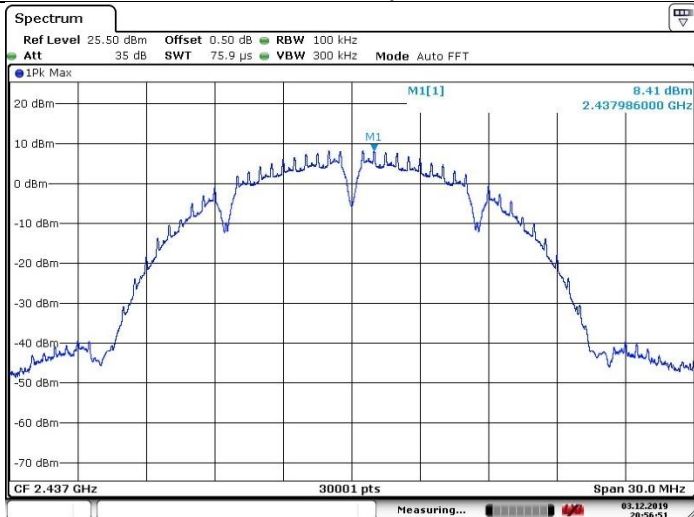
Spurious Emission (1GHz – 5GHz)

Spurious Emission (5GHz – 25GHz)



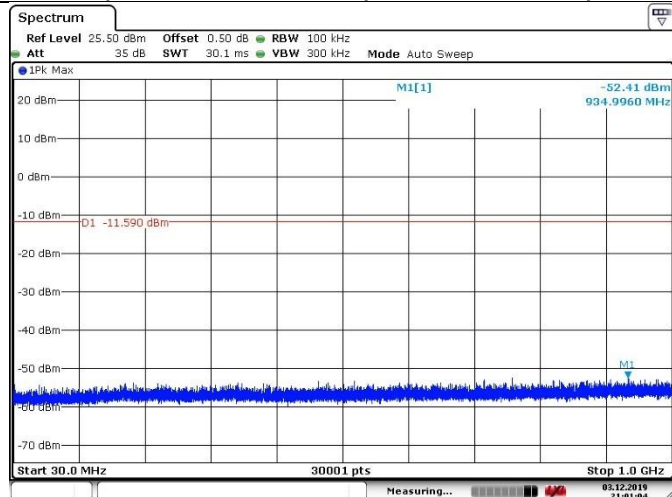
Out-of-Band Emissions Channel 6 (2437MHz)

Reference point



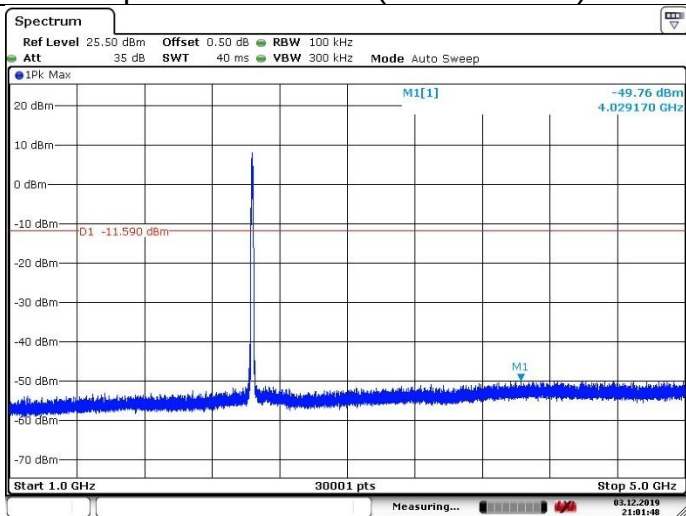
Date: 3. DEC.2019 20:56:50

Spurious Emission (30MHz – 1GHz)



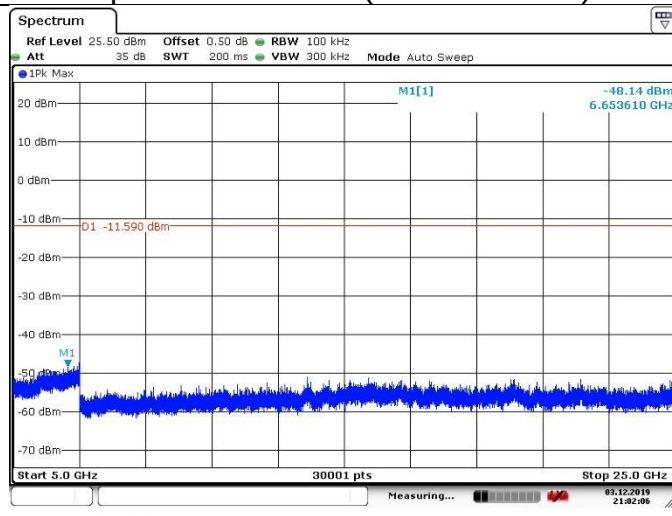
Date: 3. DEC.2019 21:01:05

Spurious Emission (1GHz – 5GHz)



Date: 3. DEC.2019 21:01:48

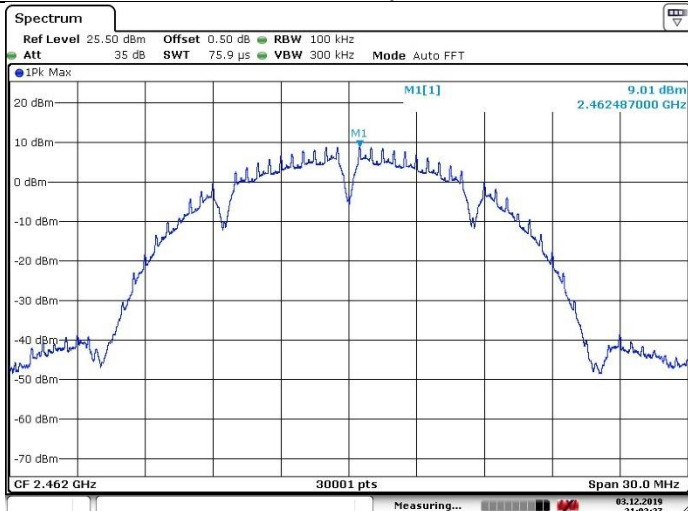
Spurious Emission (5GHz – 25GHz)



Date: 3. DEC.2019 21:02:06

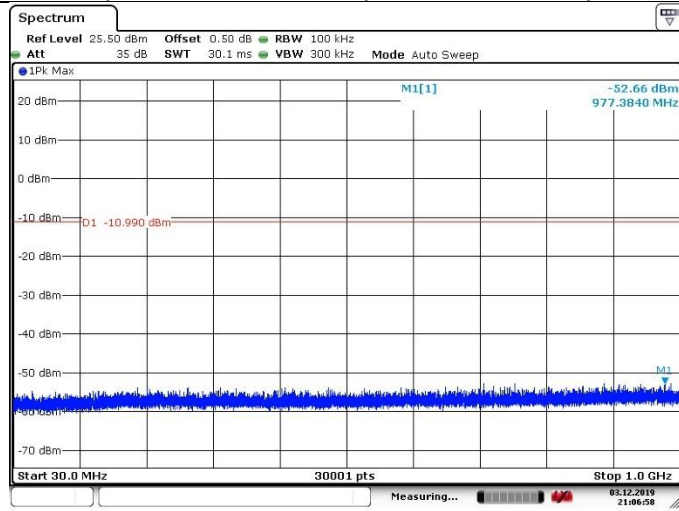
Out-of-Band Emissions Channel 11 (2462MHz)

Reference point



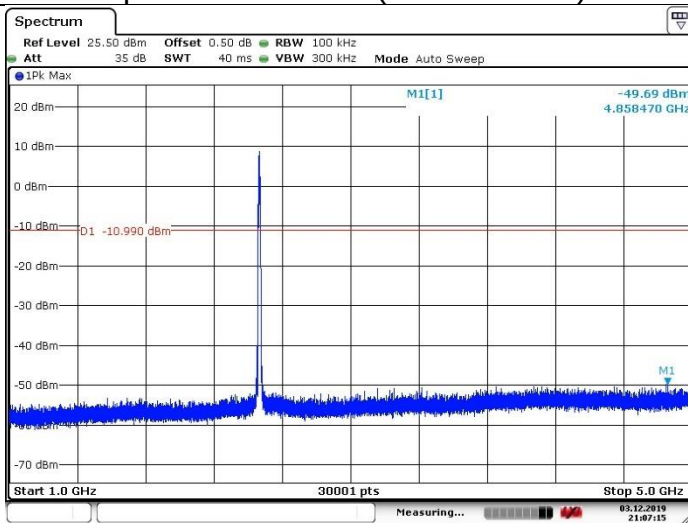
Date: 3.DEC.2019 21:03:27

Spurious Emission (30MHz – 1GHz)



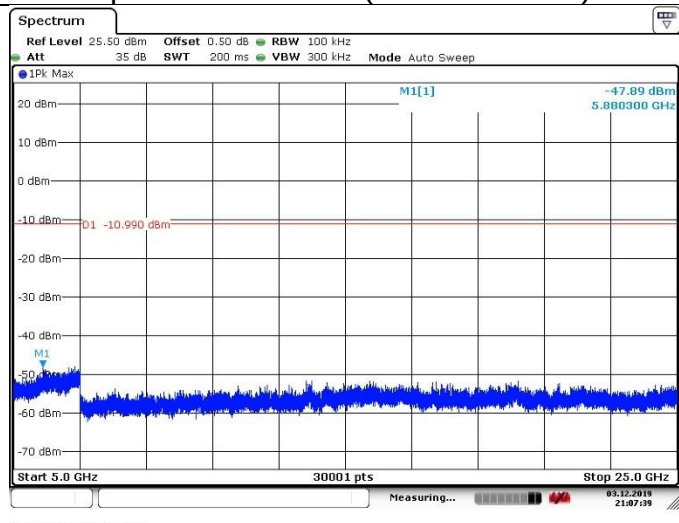
Date: 3.DEC.2019 21:06:58

Spurious Emission (1GHz – 5GHz)



Date: 3.DEC.2019 21:07:16

Spurious Emission (5GHz – 25GHz)



Date: 3.DEC.2019 21:07:39

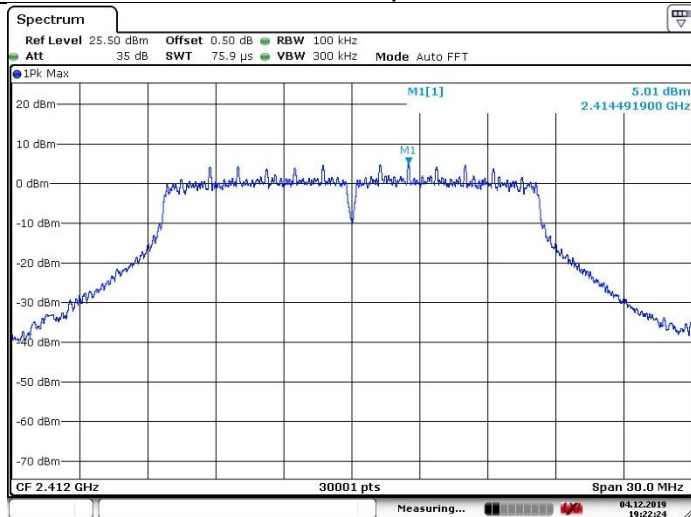
802.11 G

Out-of-Band Emissions

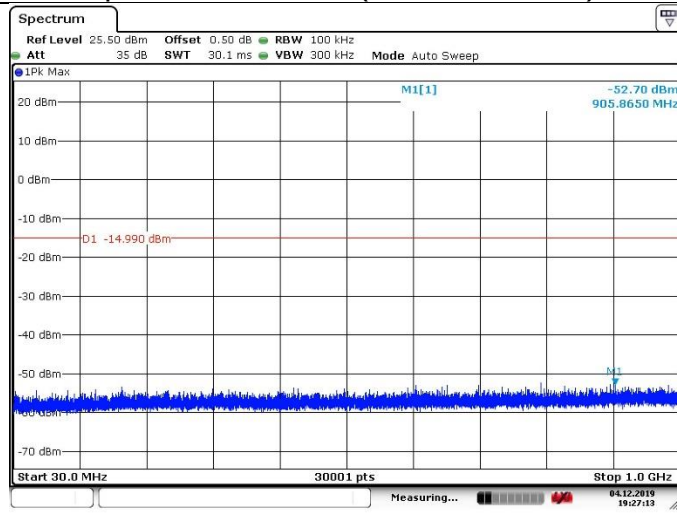
Channel 1 (2412MHz)

Reference point

Spurious Emission (30MHz – 1GHz)



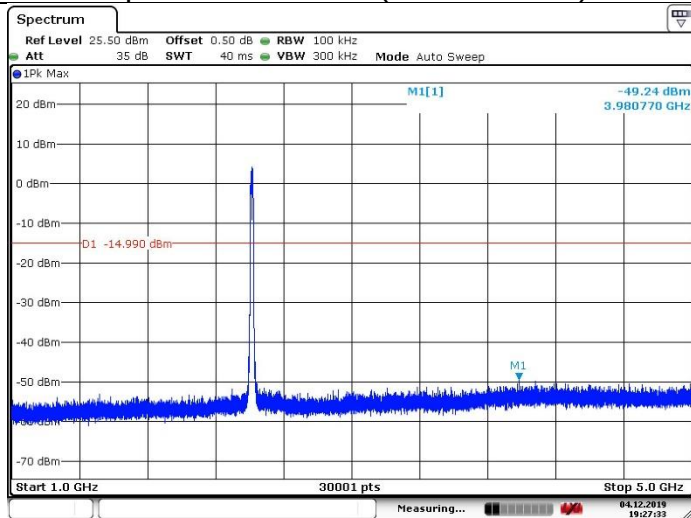
Date: 4 DEC 2019 19:22:24



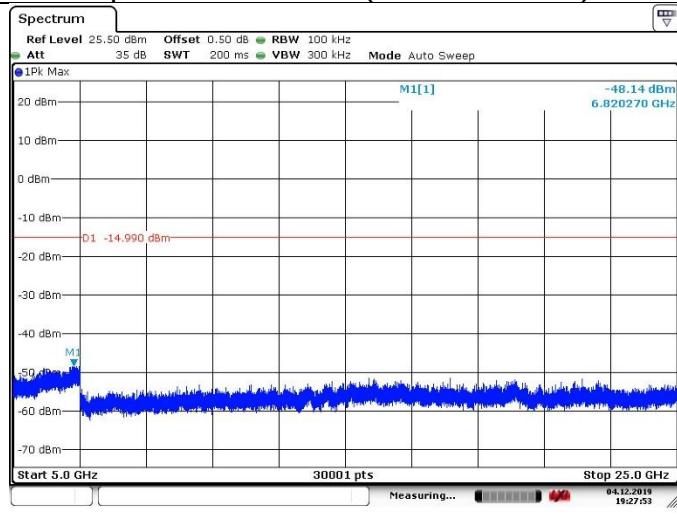
Date: 4 DEC 2019 19:27:13

Spurious Emission (1GHz – 5GHz)

Spurious Emission (5GHz – 25GHz)



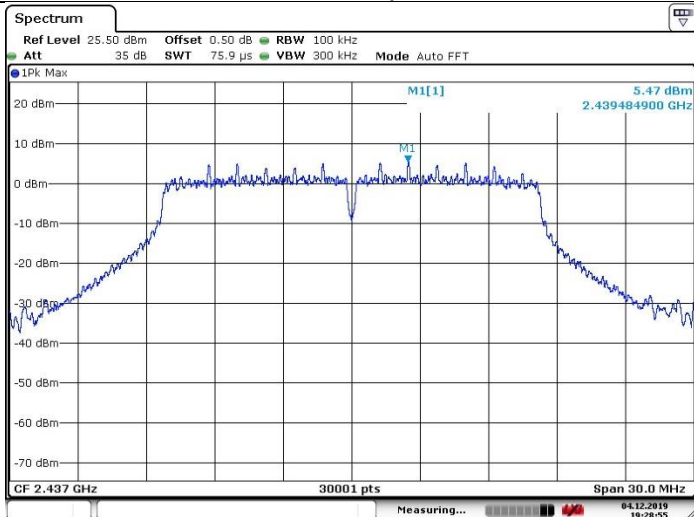
Date: 4 DEC 2019 19:27:34



Date: 4 DEC 2019 19:27:53

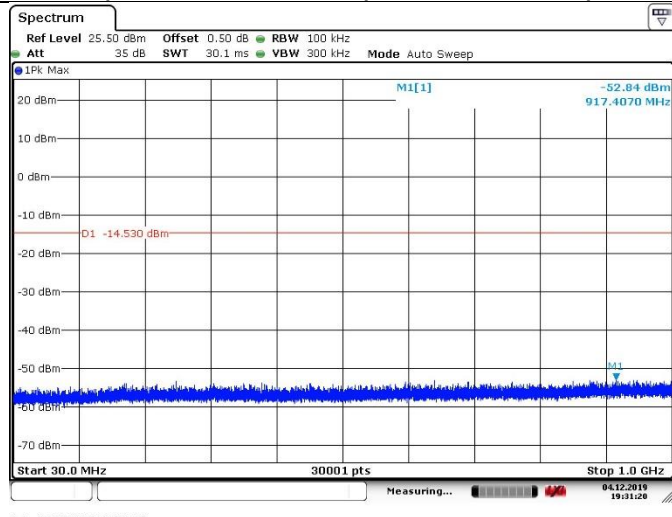
Out-of-Band Emissions Channel 6 (2437MHz)

Reference point



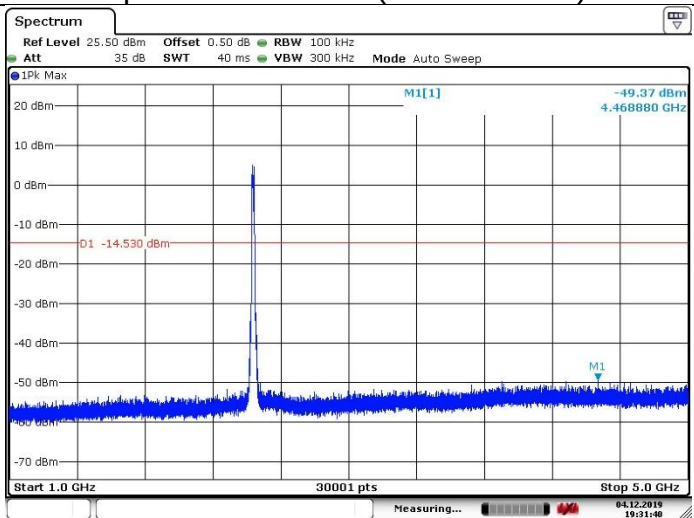
Date: 4 DEC 2019 19:28:56

Spurious Emission (30MHz – 1GHz)



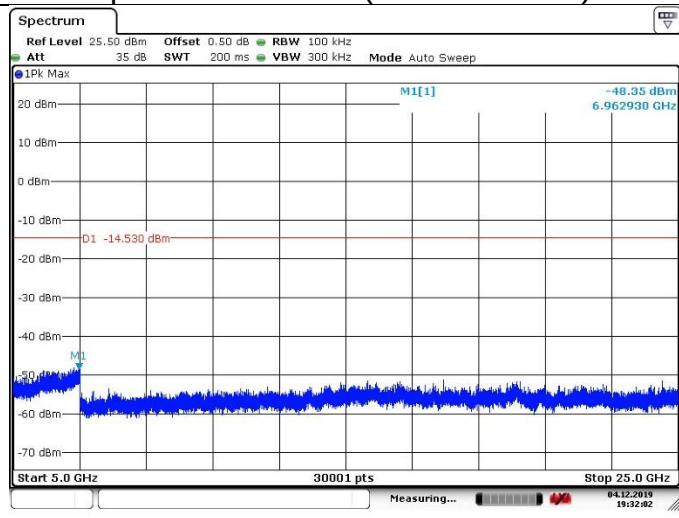
Date: 4 DEC 2019 19:31:20

Spurious Emission (1GHz – 5GHz)



Date: 4 DEC 2019 19:31:40

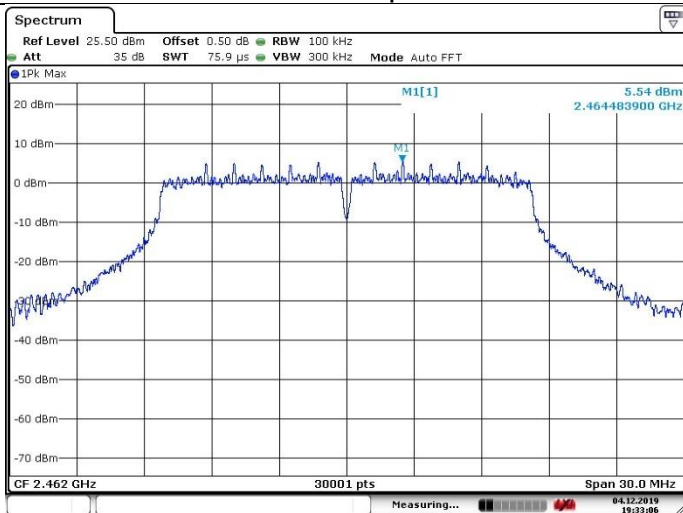
Spurious Emission (5GHz – 25GHz)



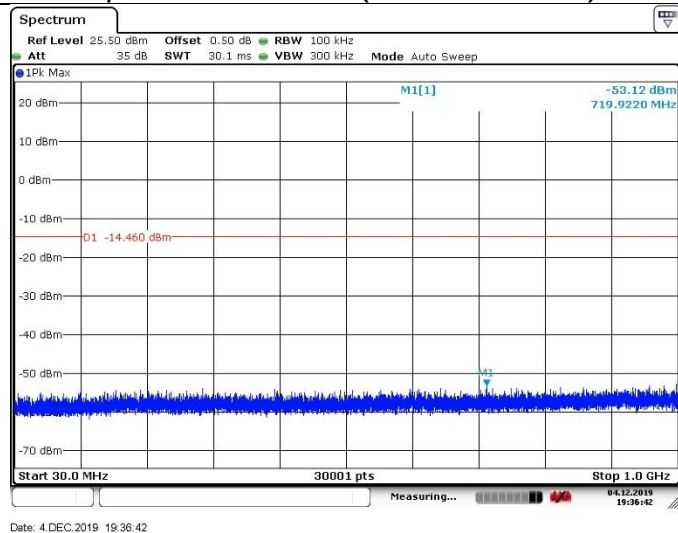
Date: 4 DEC 2019 19:32:02

Out-of-Band Emissions Channel 11 (2462MHz)

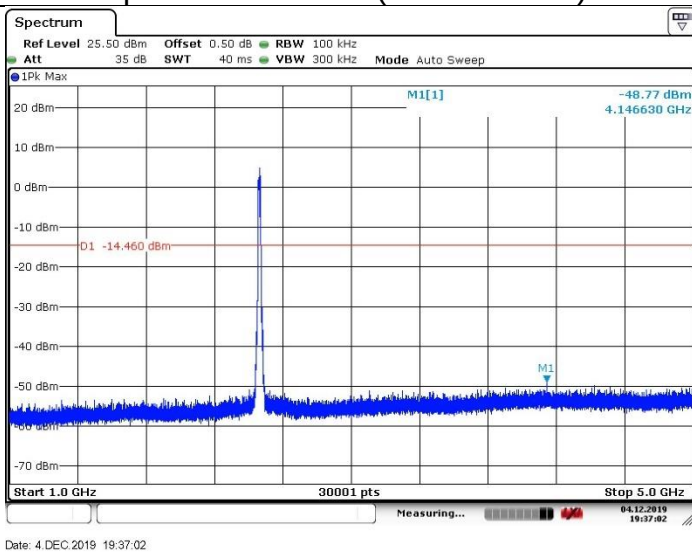
Reference point



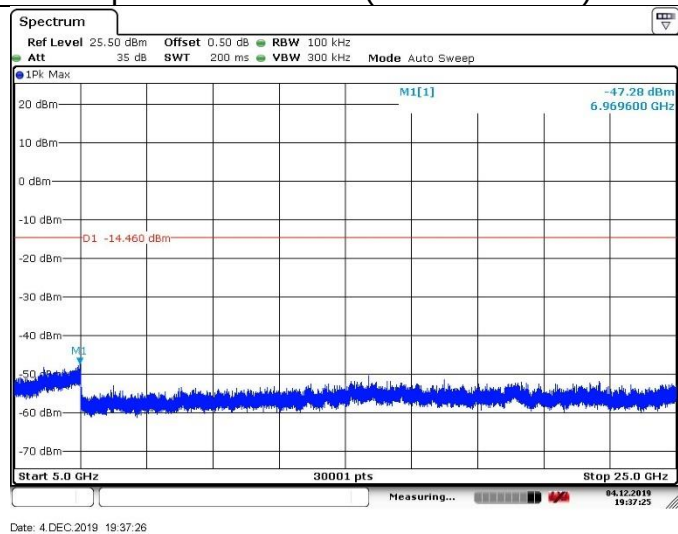
Spurious Emission (30MHz – 1GHz)



Spurious Emission (1GHz –5GHz)



Spurious Emission (5GHz –25GHz)

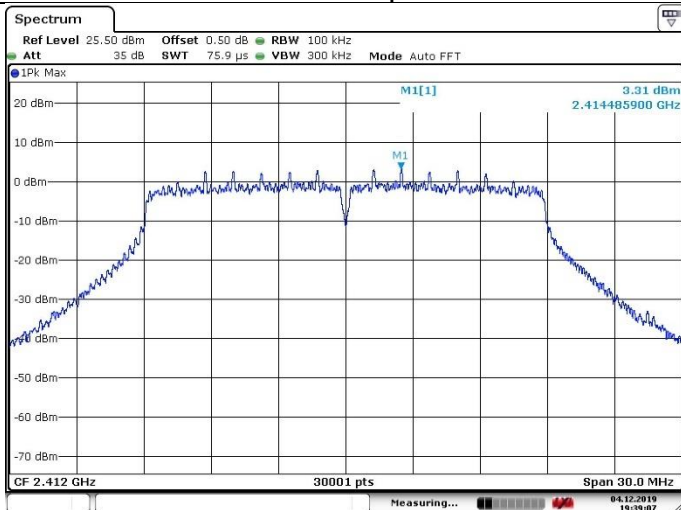


802.11 N20

Out-of-Band Emissions

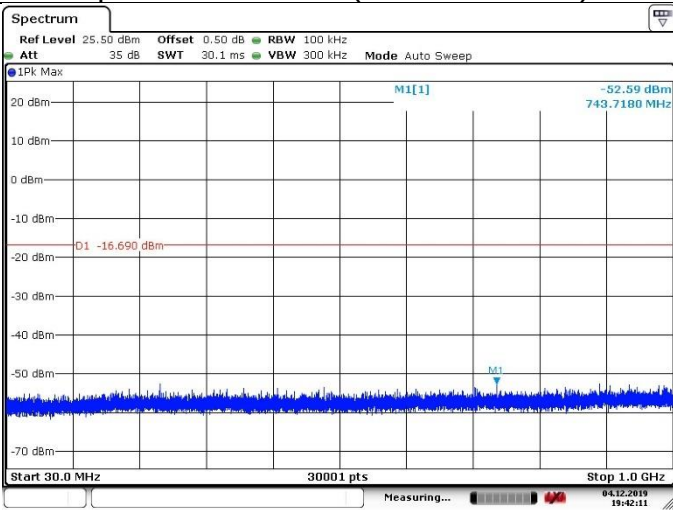
Channel 1 (2412MHz)

Reference point



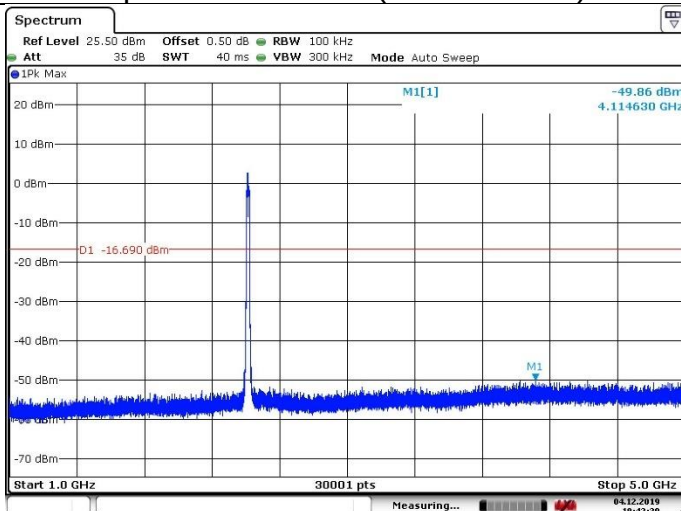
Date: 4 DEC 2019 19:39:07

Spurious Emission (30MHz – 1GHz)



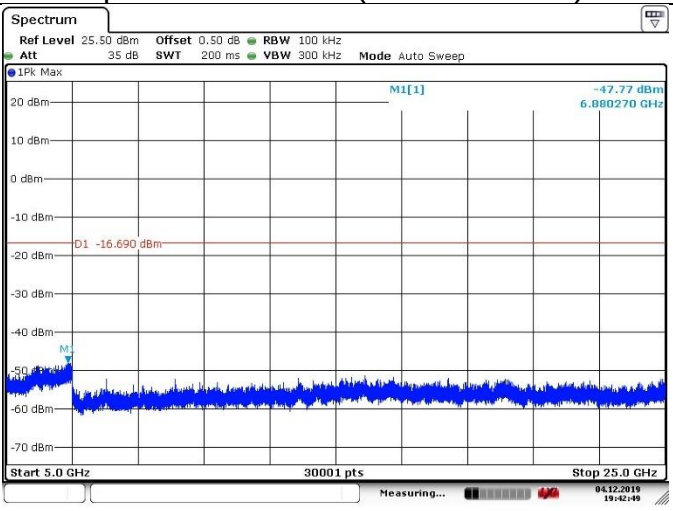
Date: 4 DEC 2019 19:42:12

Spurious Emission (1GHz – 5GHz)



Date: 4 DEC 2019 19:42:30

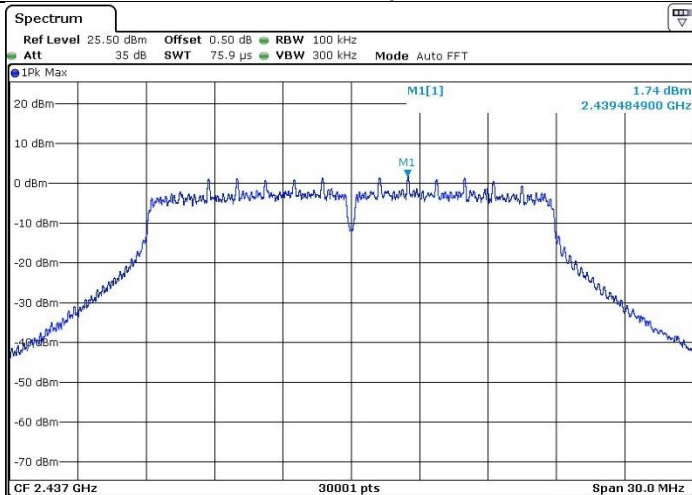
Spurious Emission (5GHz – 25GHz)



Date: 4 DEC 2019 19:42:50

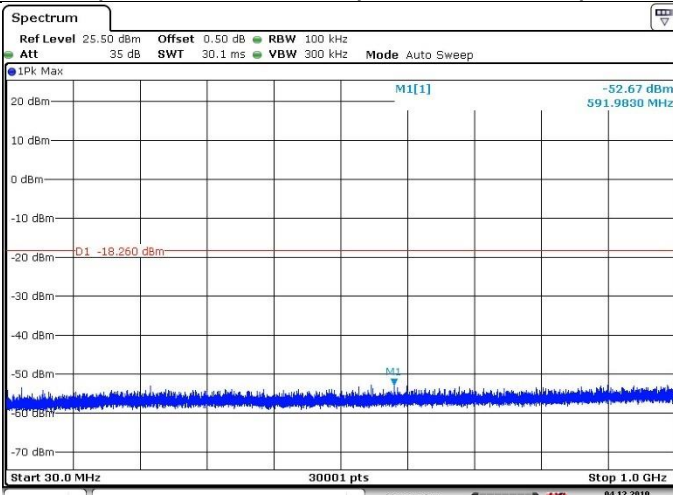
Out-of-Band Emissions Channel 6 (2437MHz)

Reference point



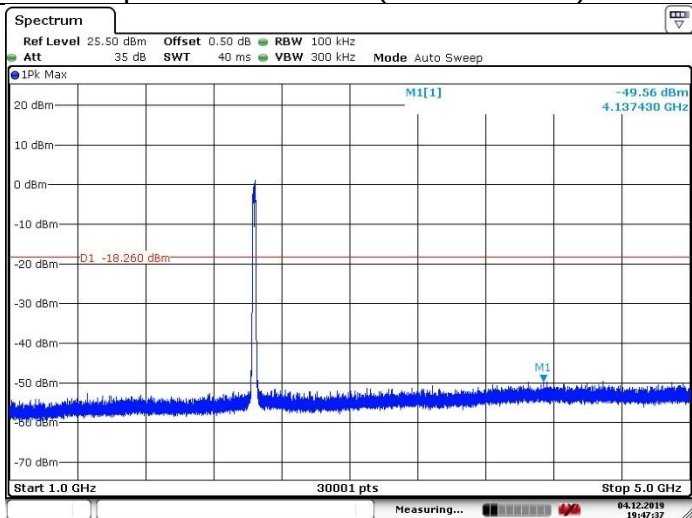
Date: 4 DEC.2019 19:44:19

Spurious Emission (30MHz – 1GHz)



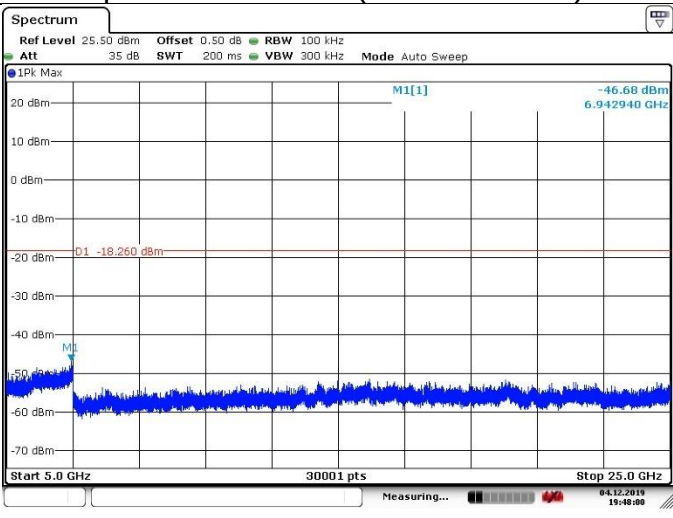
Date: 4 DEC.2019 19:47:07

Spurious Emission (1GHz – 5GHz)



Date: 4 DEC.2019 19:47:37

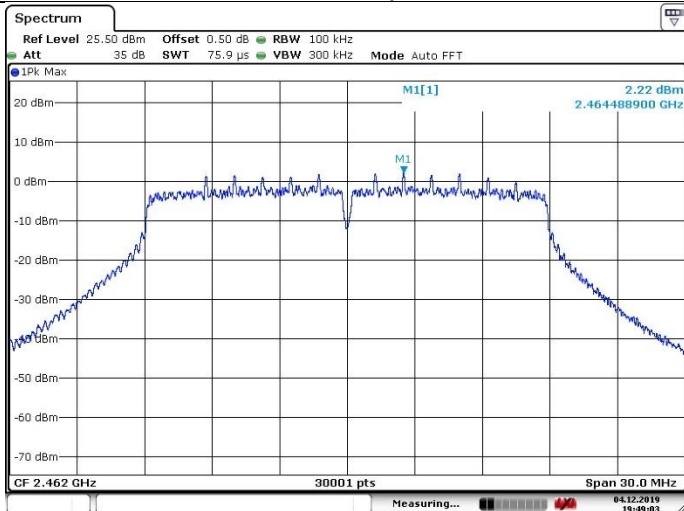
Spurious Emission (5GHz – 25GHz)



Date: 4 DEC.2019 19:48:01

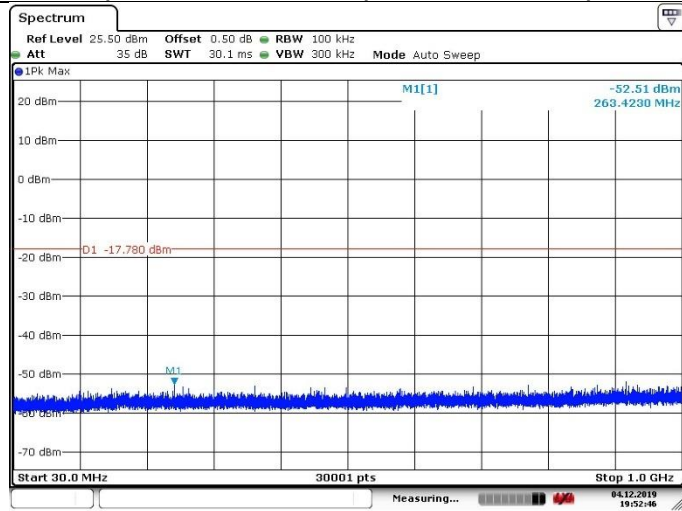
Out-of-Band Emissions Channel 11 (2462MHz)

Reference point



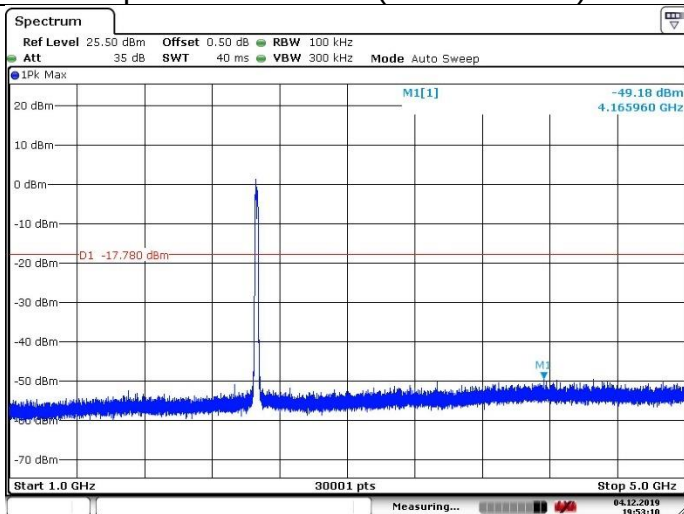
Date: 4 DEC 2019 19:49:03

Spurious Emission (30MHz – 1GHz)



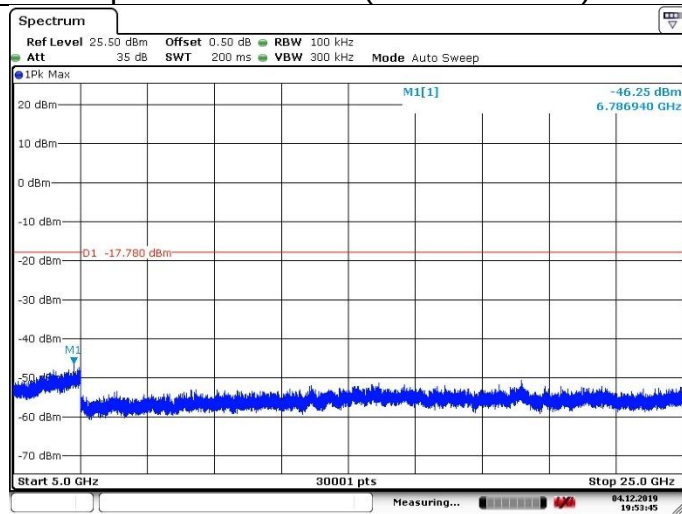
Date: 4 DEC 2019 19:52:47

Spurious Emission (1GHz –5GHz)



Date: 4 DEC 2019 19:53:10

Spurious Emission (5GHz –25GHz)



Date: 4 DEC 2019 19:53:45



9.6 Band edge

Test Method

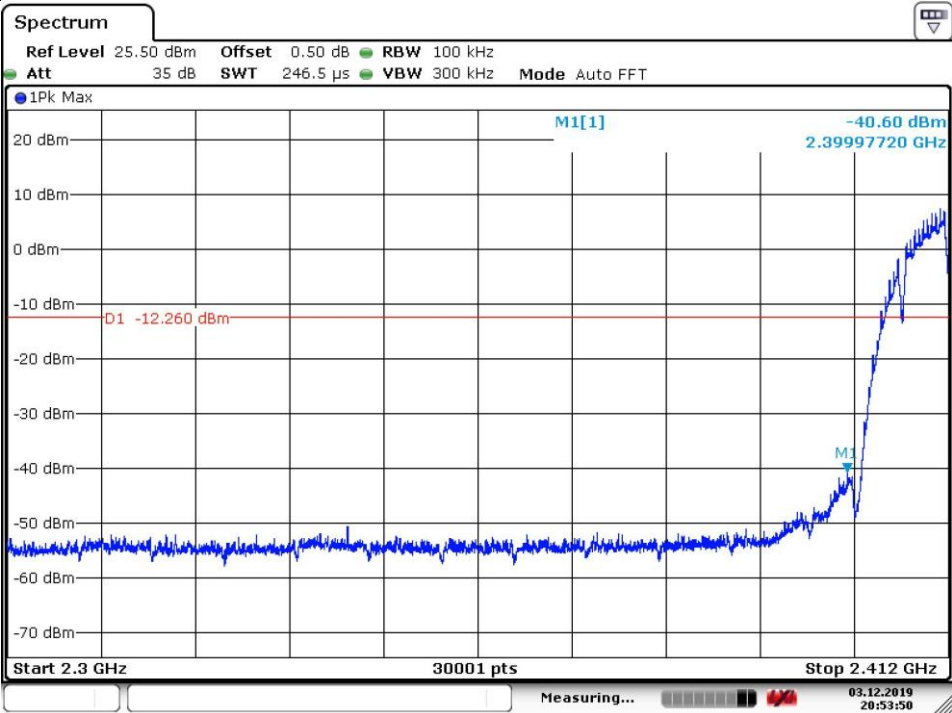
- 1 Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 kHz, VBW $\geq$ RBW, Sweep = auto, Detector function = peak, Trace = max hold.
- 2 Allow the trace to stabilize, use the peak and delta measurement to record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

Limit

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-Gen8.10, must also comply with the radiated emission limits specified in 15.209(a) (see Section 15.205(c)) and RSS-Gen.

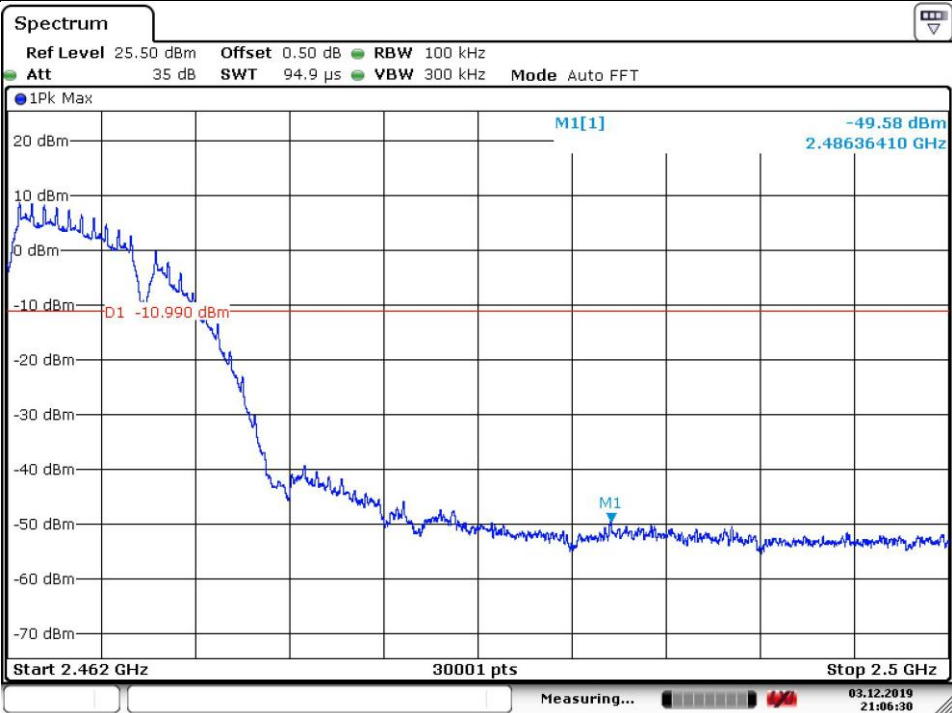
Test result

802.11 B
Low_2412



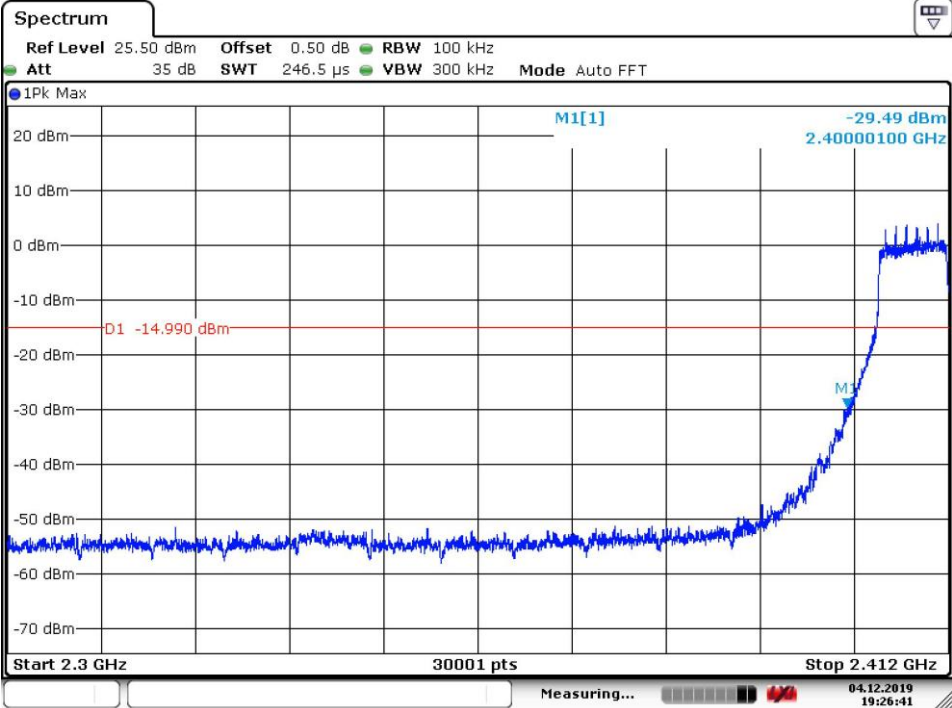
Date: 3.DEC.2019 20:53:51

High_2462



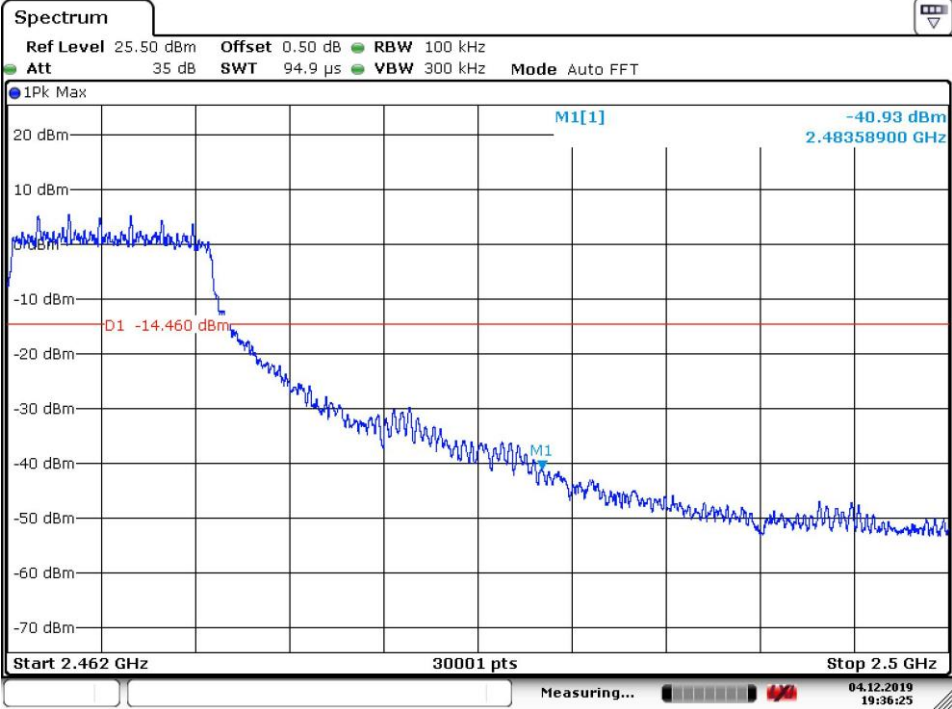
Date: 3.DEC.2019 21:06:30

802.11 G
Low 2412



Date: 4.DEC.2019 19:26:42

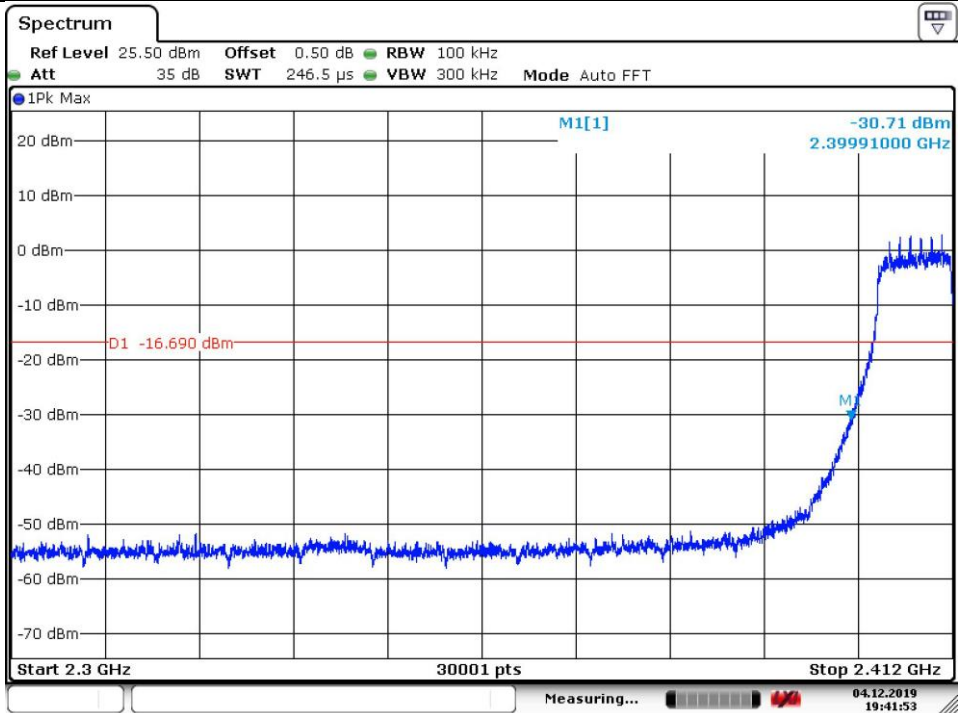
High 2462



Date: 4.DEC.2019 19:36:24

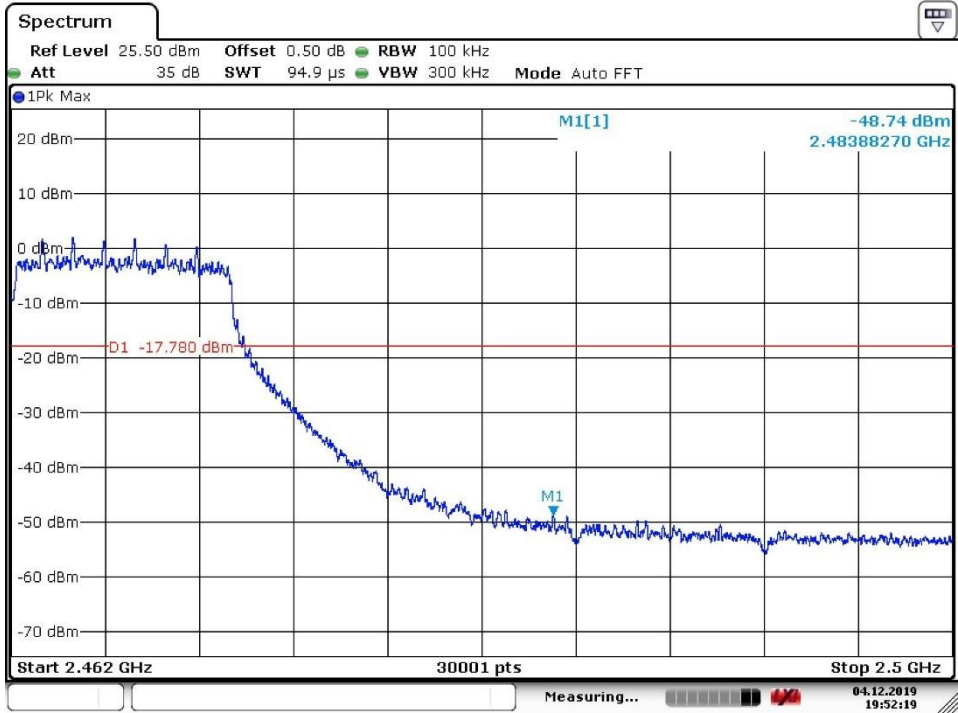
802.11 N20

Low 2412



Date: 4.DEC.2019 19:41:53

High 2462



Date: 4.DEC.2019 19:52:19

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, 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.

The only worse case (which is subject to the maximum EIRP, B mode) test result is listed in the report.

Transmitting spurious emission test result as below:

Test mode: 802.11B					
Channel 1 (2412MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2389.6	42.81	74.0	31.19	Peak	Horizontal
4823.3	49.14	74.0	24.86	Peak	Horizontal
2389.5	41.71	74.0	32.29	Peak	Vertical
4823.3	47.74	74.0	26.26	Peak	Vertical

Test mode: 802.11B					
Channel 6 (2437MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
4874.3	52.09	74.0	21.91	Peak	Horizontal
4874.3	43.28	54.0	10.72	Average	Horizontal
4879.0	50.27	74.0	23.73	Peak	Vertical
4879.0	40.67	54.0	13.33	Average	Vertical

Test mode: 802.11B					
Channel 11 (2462MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2483.5	43.22	74.0	30.78	Peak	Horizontal
4923.6	50.24	74.0	23.76	Peak	Horizontal
4923.6	42.28	54.0	11.72	Average	Horizontal
2483.5	40.28	74.0	33.72	Peak	Vertical
4923.6	42.60	74.0	31.40	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

Test mode: 802.11G					
Channel 1 (2412MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2390.0	53.64	74.0	20.36	Peak	Horizontal
2390.0	43.60	54.0	10.40	Average	Horizontal
4804.0	42.88	74.0	31.12	Peak	Horizontal
2389.5	47.23	74.0	26.77	Peak	Vertical
4804.0	43.71	74.0	30.29	Peak	Vertical

Test mode: 802.11G					
Channel 6 (2437MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
4873.1	45.23	74.0	28.77	Peak	Horizontal
4874.1	42.36	74.0	31.64	Peak	Vertical
73219.5	40.17	74.0	33.83	Peak	Vertical

Test mode: 802.11G					
Channel 11 (2462MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2483.5	48.20	74.0	25.80	Peak	Horizontal
4923.4	43.79	74.0	30.21	Peak	Horizontal
2483.5	46.98	74.0	27.02	Peak	Vertical
4923.8	44.17	74.0	29.83	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

Test mode: 802.11N20					
Channel 1 (2412MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2390.0	53.20	74.0	20.80	Peak	Horizontal
2390.0	43.23	54.0	10.77	Average	Horizontal
4824.0	40.38	74.0	33.62	Peak	Horizontal
2389.5	48.67	74.0	25.33	Peak	Vertical
4824.0	40.65	74.0	33.35	Peak	Vertical

Test mode: 802.11N20					
Channel 6 (2437MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
4873.0	45.23	74.0	28.77	Peak	Horizontal
4879.0	43.28	74.0	30.72	Peak	Vertical
73219.5	40.17	74.0	33.83	Peak	Vertical

Test mode: 802.11N20					
Channel 11 (2462MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2483.5	48.64	74.0	25.36	Peak	Horizontal
4924.2	40.09	74.0	33.91	Peak	Horizontal
2483.5	45.29	74.0	28.71	Peak	Vertical
4959.2	43.22	74.0	30.78	Peak	Vertical

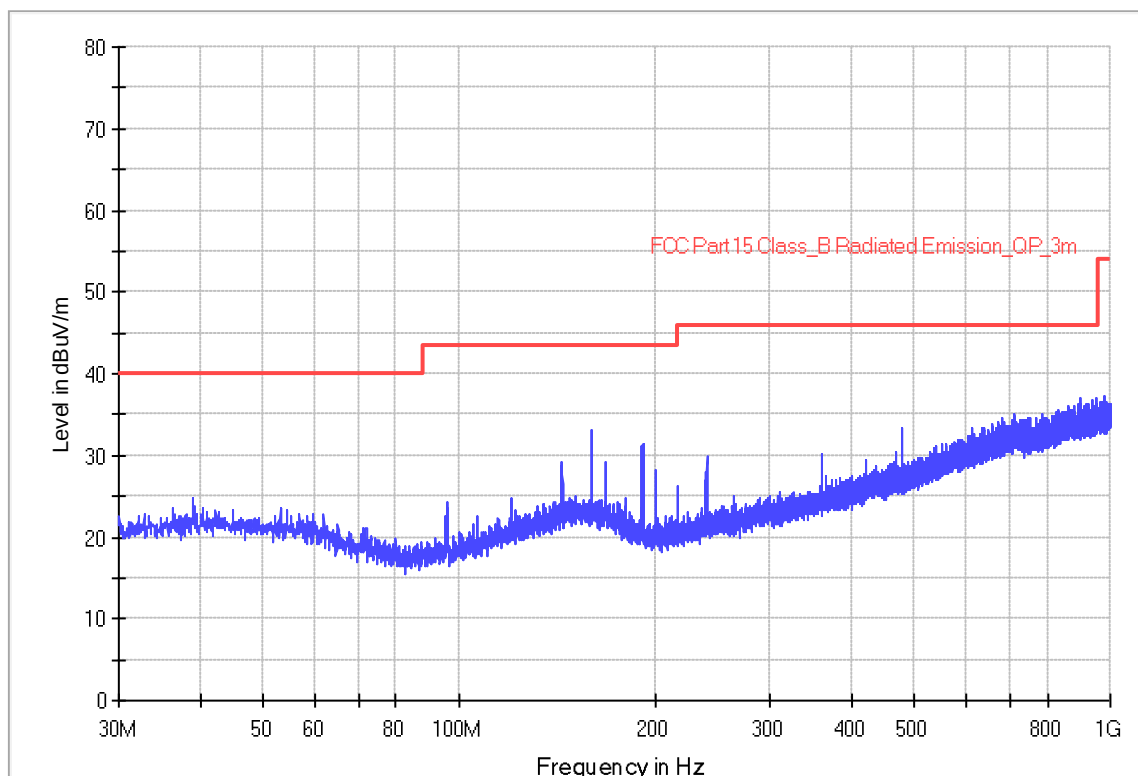
Remark:

- (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: 2019/12/06 - 10:40
Limit: FCC Part15.109 RE(3m)_ClassB	Engineer: Jiaxi XU
Probe: VULB9168	Polarity: Horizontal
EUT: WiFi and BLE Module, Model no: WBR1	Power: 120VAC, 60Hz (powered by notebook)
Note: Transmit by 802.11g at channel 2437MHz.	
Note: There is the worst case within frequency range 30MHz~1GHz.	

RE_VULB9168_pre_Cont_30-1000



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

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

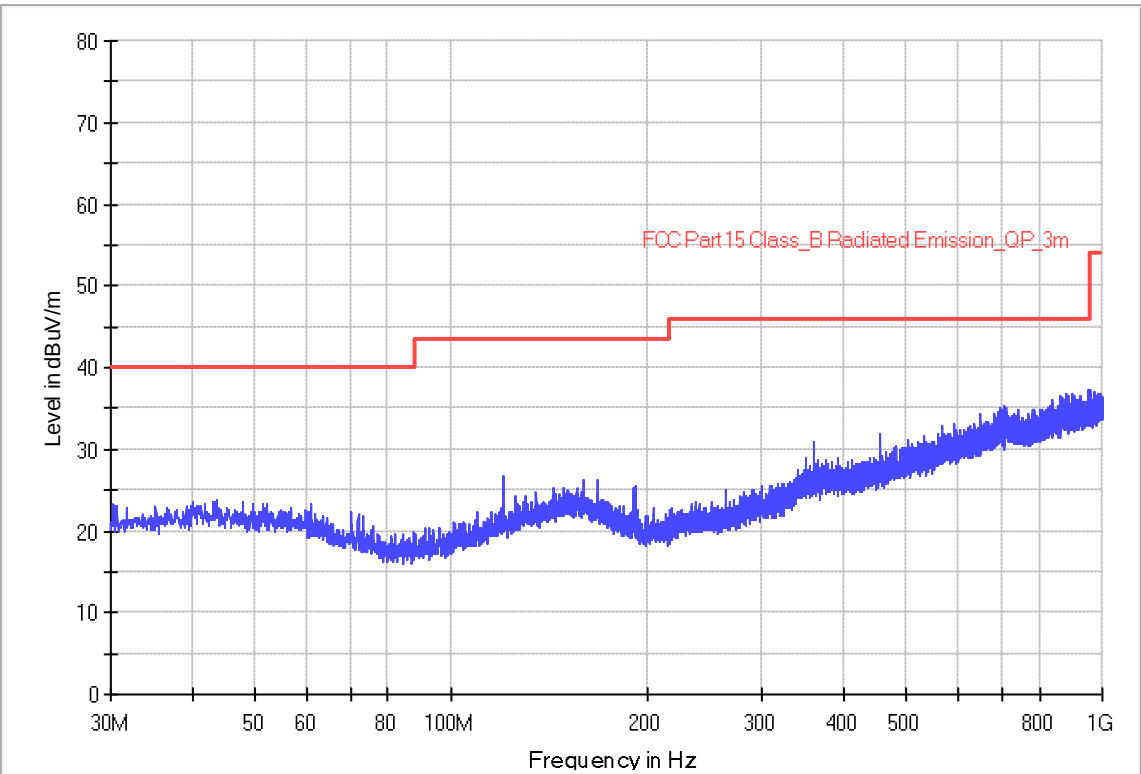
Note 2: The test trace is same as the ambient noise and the amplitude of the emissions are attenuated more than 20dB below the permissible (the test frequency range: 9kHz ~ 30MHz, 18GHz ~ 25GHz), therefore no data appear in the report.



China

Site: 3-meter chamber	Time: 2019/12/06 - 10:33
Limit: FCC Part15.109_RE(3m)_ClassB	Engineer: Jiaxi XU
Probe: VULB9168	Polarity: Vertical
EUT: WiFi and BLE Module, Model no: WBR1	Power: 120VAC, 60Hz (powered by notebook)
Note: Transmit by 802.11g at channel 2437MHz.	
Note: There is the worst case within frequency range 30MHz~1GHz.	

RE_VULB9168_pre_Cbnt_30-1000



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	2019-8-5	2020-8-4
	Wideband power sensor	Rohde & Schwarz	NRP-Z81	104782	2018-12-28	2019-12-27
RE	EMI Test Receiver	Rohde & Schwarz	ESR3	101906	2019-8-5	2020-8-4
	Signal Analyzer	Rohde & Schwarz	FSV40	101091	2019-8-5	2020-8-4
	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	2019-8-5	2020-8-4
	Loop antenna	Rohde & Schwarz	HFH2-Z2	100443	2019-6-28	2020-6-27
	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	2019-8-5	2020-8-4
	LISN	Rohde & Schwarz	ENV216	101924	2019-8-5	2020-8-4
Measurement Software Information						
Test Item	Software	Manufacturer	Version			
C	Power Viewer	Rohde & Schwarz	V 11.0			
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 25GHz, $\pm 4.76\text{dB}$



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