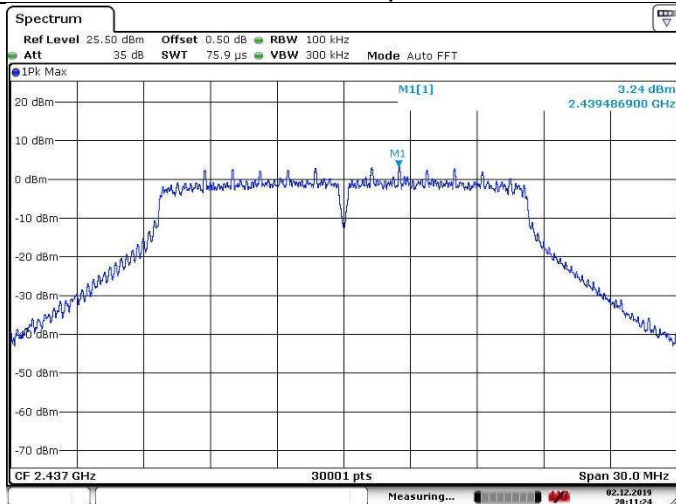


Out-of-Band Emissions

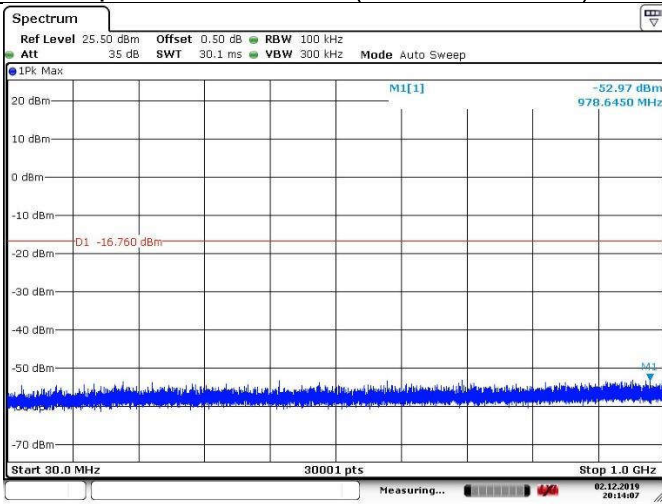
Channel 6 (2437MHz)

Reference point



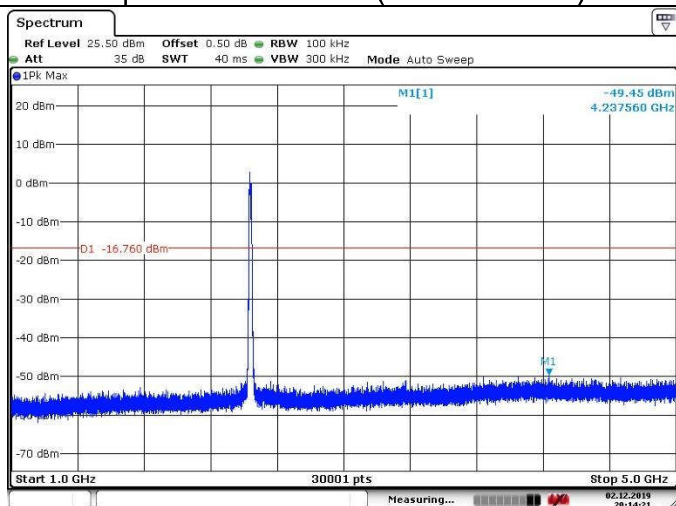
Date: 2 DEC 2019 20:11:24

Spurious Emission (30MHz – 1GHz)



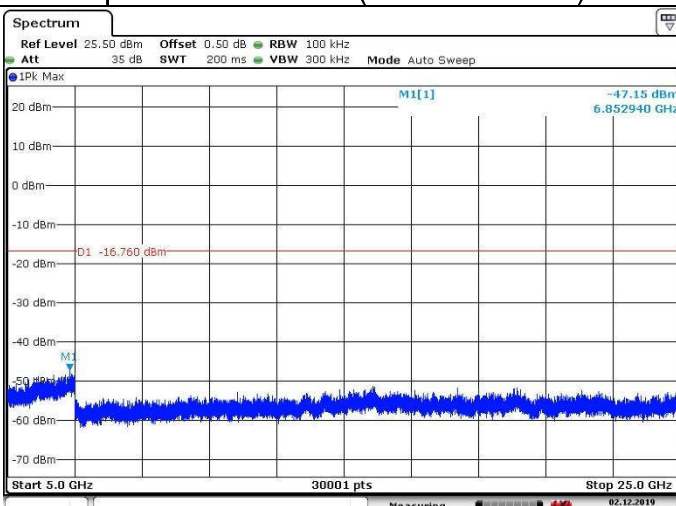
Date: 2 DEC 2019 20:14:07

Spurious Emission (1GHz – 5GHz)



Date: 2 DEC 2019 20:14:21

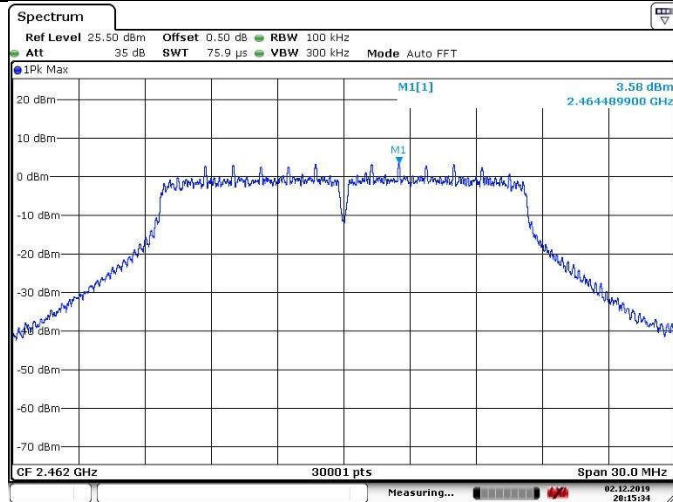
Spurious Emission (5GHz – 25GHz)



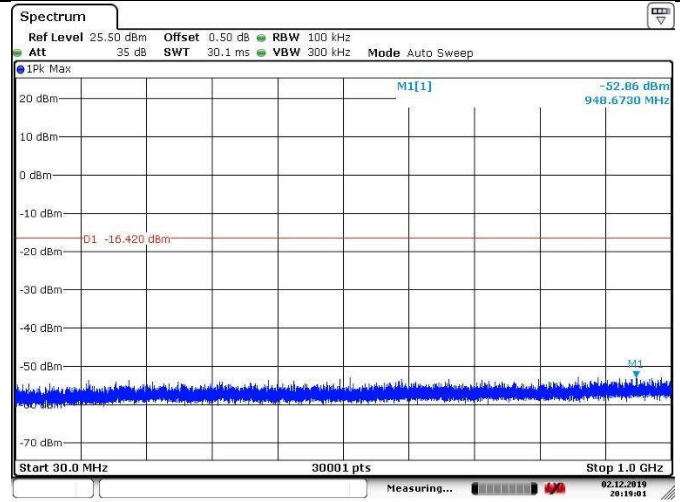
Date: 2 DEC 2019 20:14:41

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

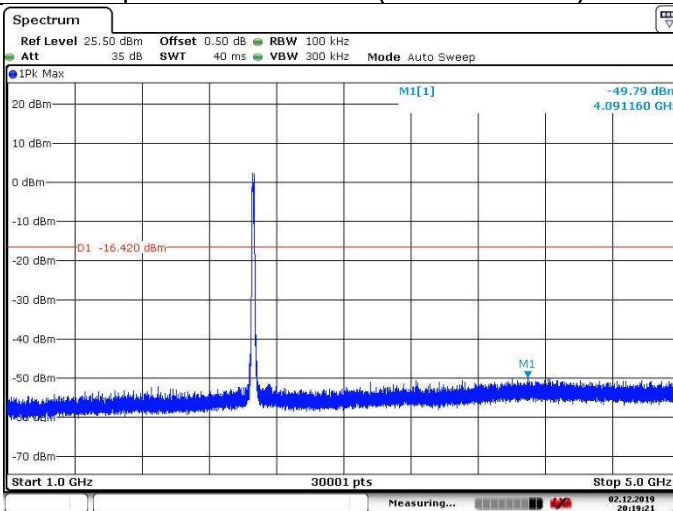
Reference point



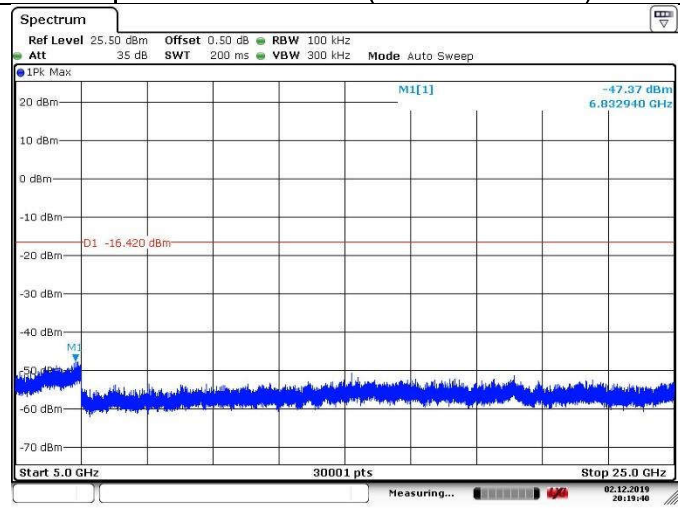
Spurious Emission (30MHz – 1GHz)



Spurious Emission (1GHz – 5GHz)



Spurious Emission (5GHz – 25GHz)

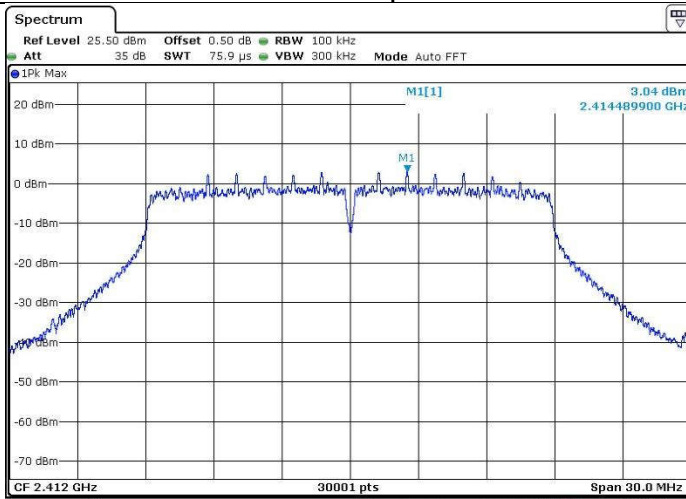


802.11 N20

Out-of-Band Emissions

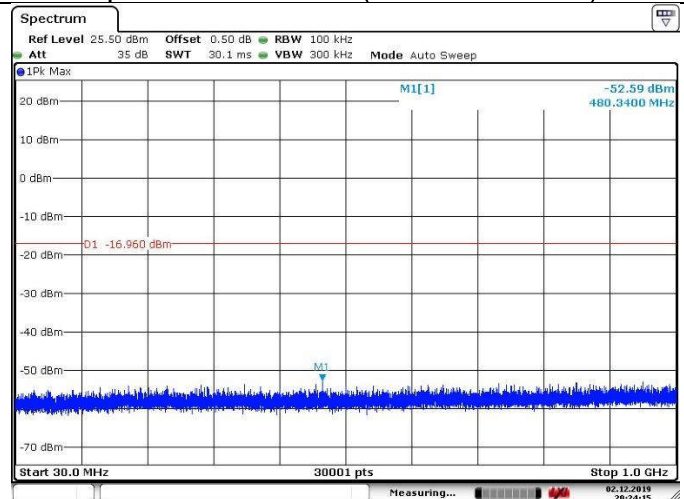
Channel 1 (2412MHz)

Reference point



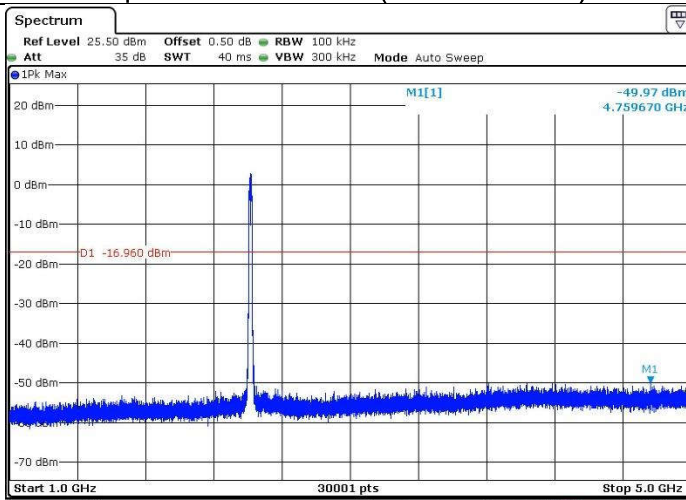
Date: 2 DEC 2019 20:20:37

Spurious Emission (30MHz – 1GHz)



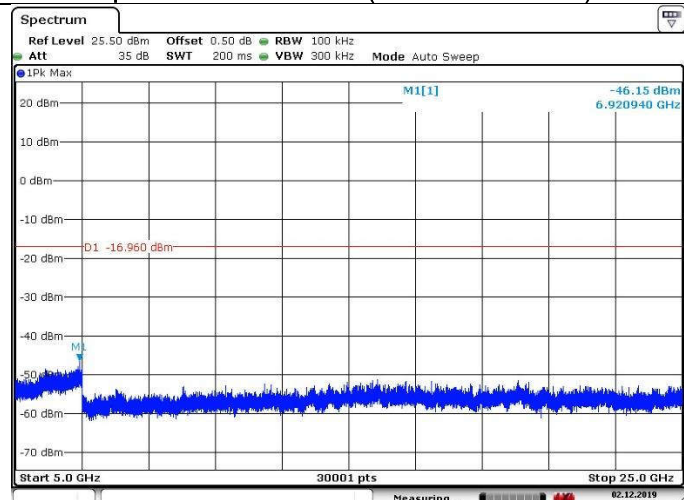
Date: 2 DEC 2019 20:24:15

Spurious Emission (1GHz – 5GHz)



Date: 2 DEC 2019 20:24:30

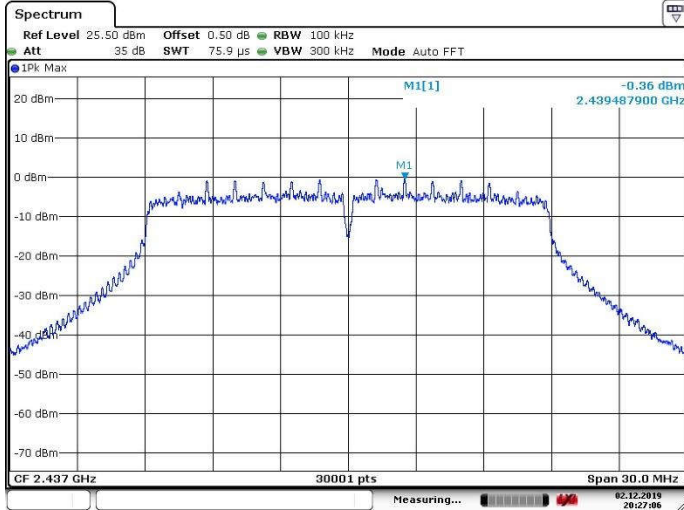
Spurious Emission (5GHz – 25GHz)



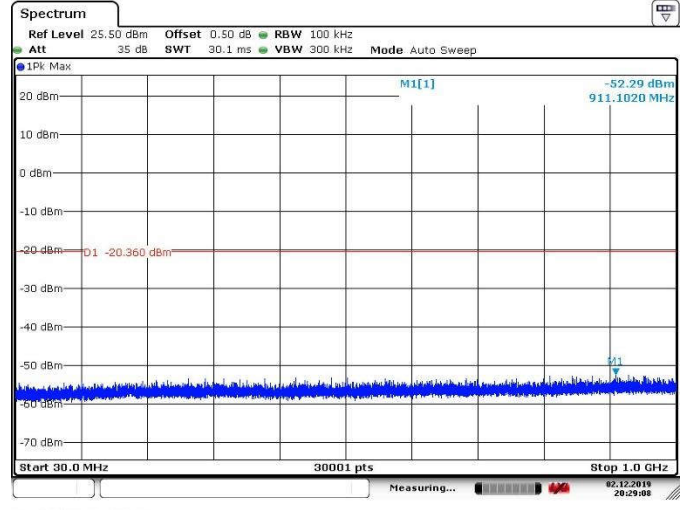
Date: 2 DEC 2019 20:24:49

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

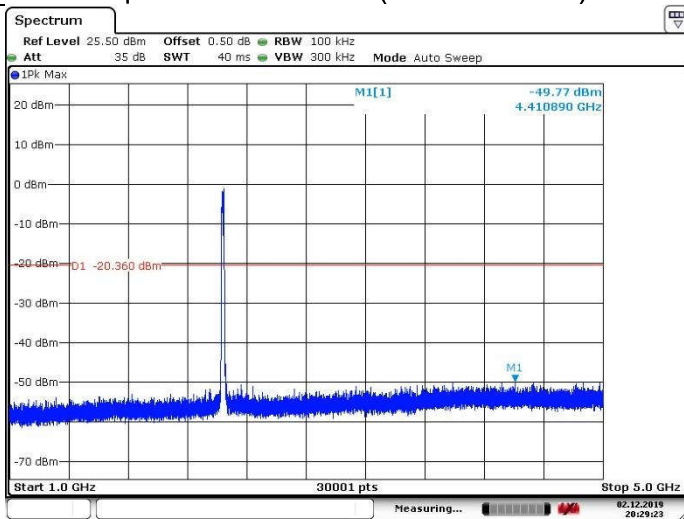
Reference point



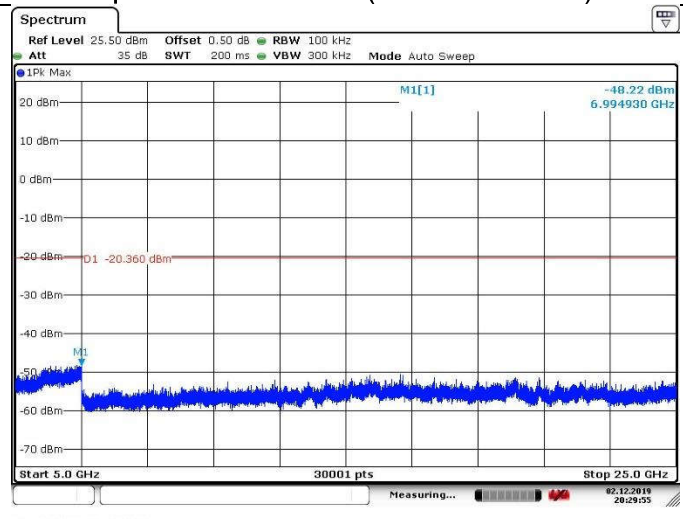
Spurious Emission (30MHz – 1GHz)



Spurious Emission (1GHz – 5GHz)

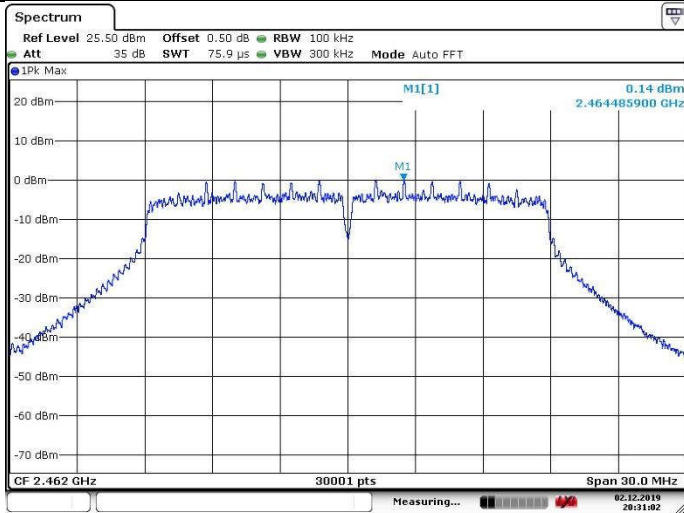


Spurious Emission (5GHz – 25GHz)



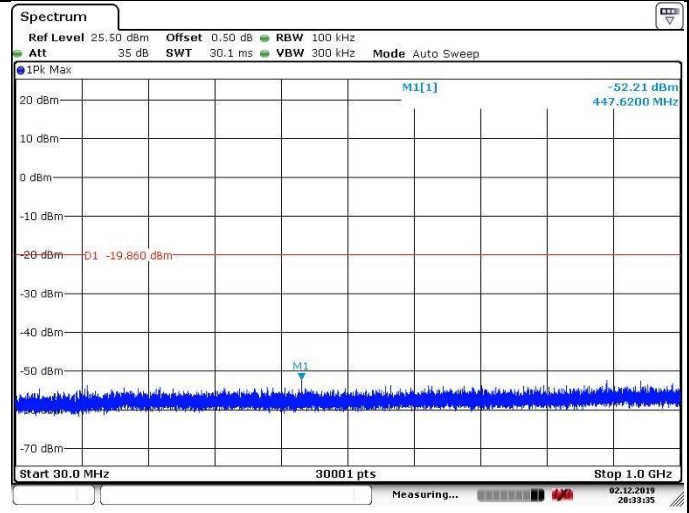
Out-of-Band Emissions Channel 11 (2462MHz)

Reference point



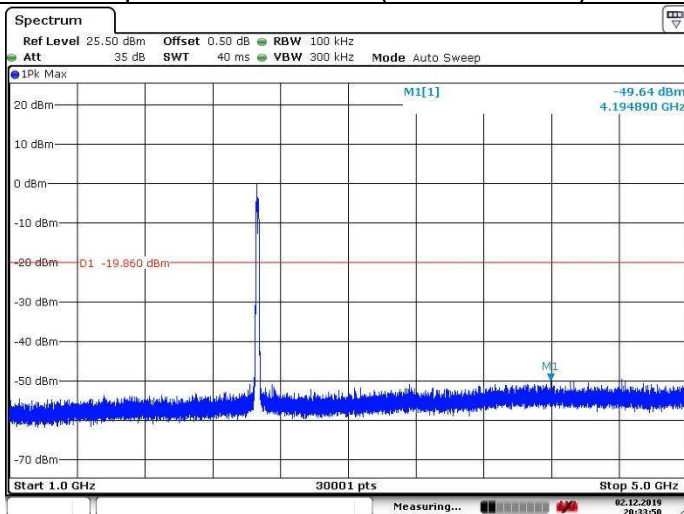
Date: 2 DEC 2019 20:31:02

Spurious Emission (30MHz – 1GHz)



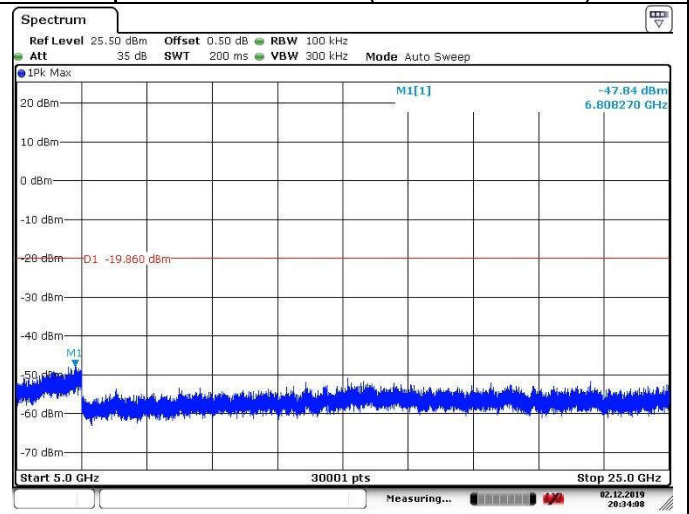
Date: 2 DEC 2019 20:33:35

Spurious Emission (1GHz –5GHz)



Date: 2 DEC 2019 20:33:50

Spurious Emission (5GHz –25GHz)



Date: 2 DEC 2019 20:34:08



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.

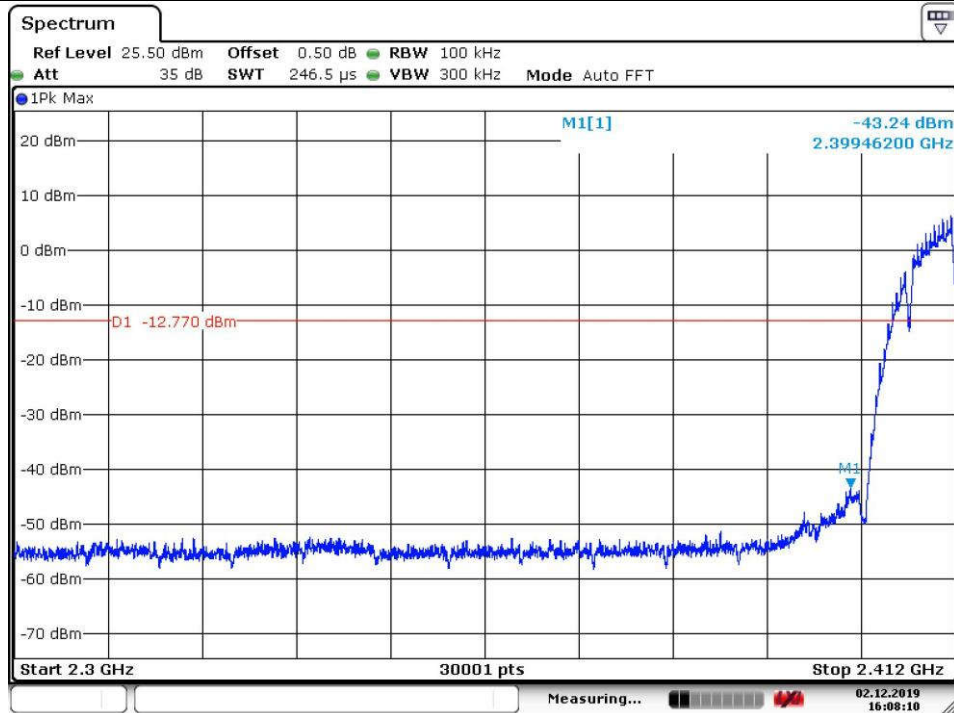
Limit

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

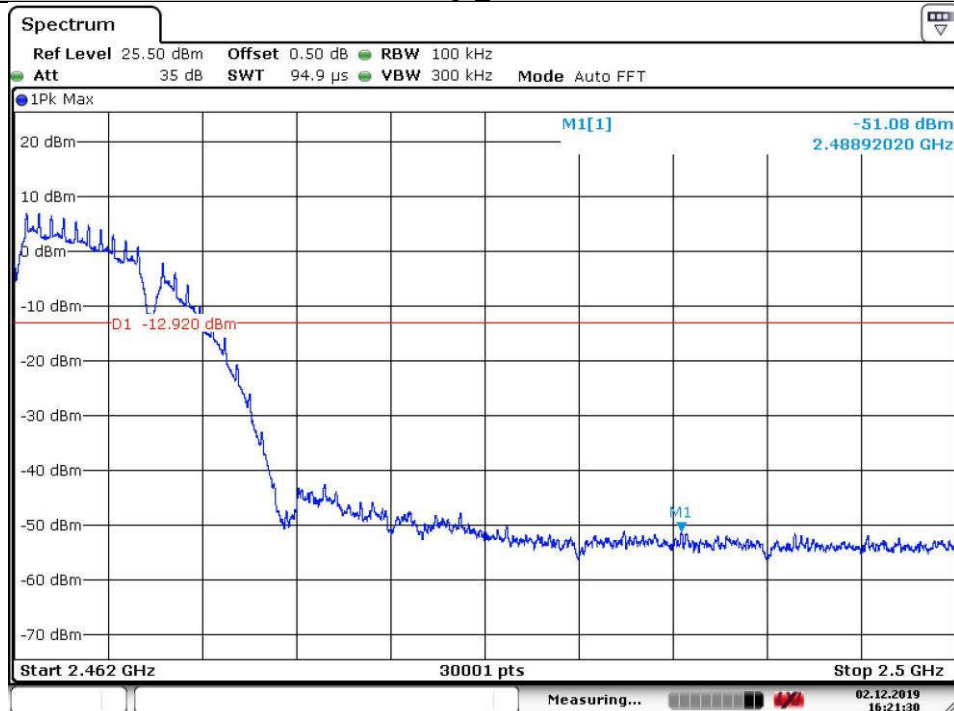
802.11 B

Low_2412



Date: 2.DEC.2019 16:08:10

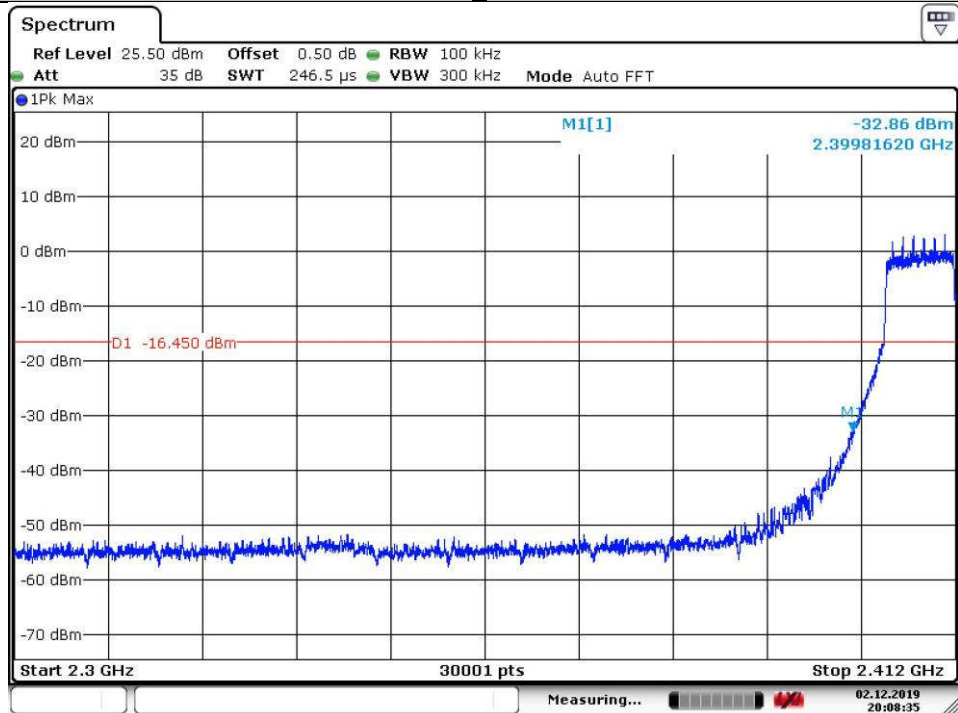
High_2462



Date: 2.DEC.2019 16:21:30

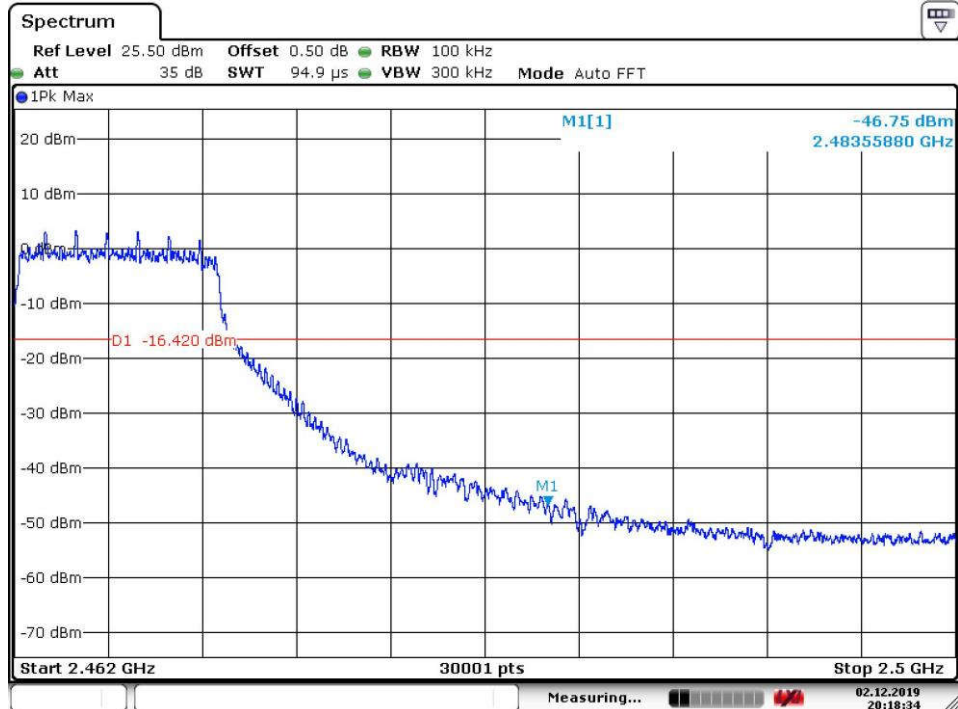
802.11 G

Low_2412



Date: 2.DEC.2019 20:08:35

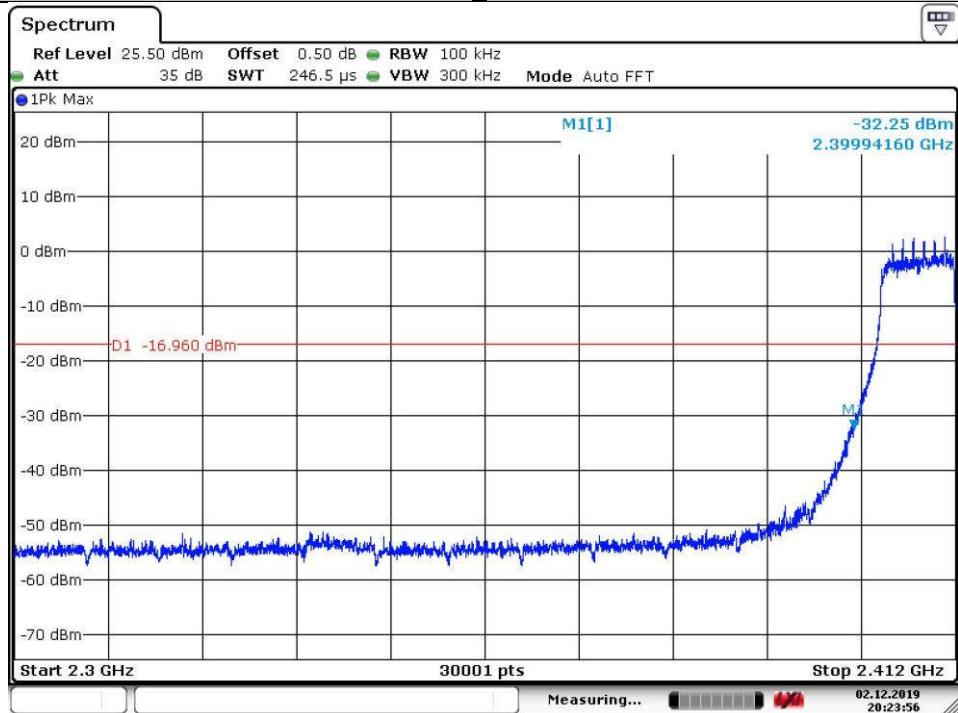
High_2462



Date: 2.DEC.2019 20:18:35

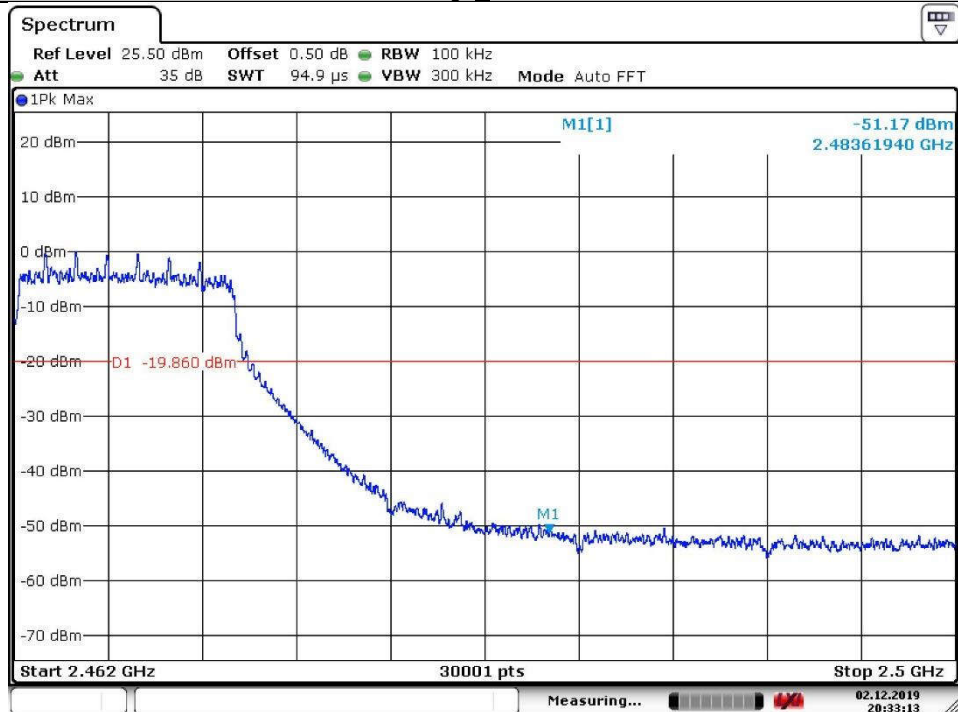
802.11 N20

Low_2412



Date: 2.DEC.2019 20:23:56

High_2462



Date: 2.DEC.2019 20:33:13

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
2390.0	40.20	74.0	33.80	Peak	Horizontal
4823.5	41.66	74.0	32.34	Peak	Horizontal
2389.5	39.88	74.0	34.12	Peak	Vertical
4823.3	43.58	74.0	30.42	Peak	Vertical

Test mode: 802.11B					
Channel 6 (2437MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
4873.3	41.20	74.0	32.80	Peak	Horizontal
4879.0	42.40	74.0	31.60	Peak	Vertical
7310.8	40.59	74.0	33.41	Peak	Vertical

Test mode: 802.11B					
Channel 11 (2462MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2483.5	42.41	74.0	31.59	Peak	Horizontal
4923.6	41.21	74.0	32.79	Peak	Horizontal
2483.5	43.10	74.0	30.90	Peak	Vertical
4923.6	40.61	74.0	33.39	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	52.49	74.0	21.51	Peak	Horizontal
2390.0	43.28	54.0	10.72	Average	Horizontal
4804.0	41.11	74.0	32.89	Peak	Horizontal
2389.5	53.19	74.0	20.81	Peak	Vertical
2389.5	41.21	54.0	12.79	Average	Vertical
4804.0	40.33	74.0	33.67	Peak	Vertical

Test mode: 802.11G					
Channel 6 (2437MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
4888.1	41.29	74.0	32.71	Peak	Horizontal
4874.1	42.11	74.0	31.89	Peak	Vertical
73219.5	40.91	74.0	33.09	Peak	Vertical

Test mode: 802.11G					
Channel 11 (2462MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2483.5	64.48	74.0	9.52	Peak	Horizontal
2483.5	43.21	54.0	10.79	Average	Horizontal
4923.4	40.11	74.0	33.89	Peak	Horizontal
2483.5	63.96	74.0	10.04	Peak	Vertical
2483.5	42.18	54.0	11.82	Average	Vertical
4923.8	40.82	74.0	33.18	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	61.20	74.0	12.80	Peak	Horizontal
2390.0	44.60	54.0	9.40	Average	Horizontal
4824.0	40.38	74.0	33.62	Peak	Horizontal
2389.5	58.40	74.0	15.60	Peak	Vertical
2389.5	43.69	54.0	10.31	Average	Vertical
4824.0	40.11	74.0	33.89	Peak	Vertical

Test mode: 802.11N20					
Channel 6 (2437MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
4873.0	40.12	74.0	33.88	Peak	Horizontal
4879.0	40.09	74.0	33.91	Peak	Vertical
73219.5	41.11	74.0	32.89	Peak	Vertical

Test mode: 802.11N20					
Channel 11 (2462MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2483.5	49.14	74.0	24.86	Peak	Horizontal
4924.2	40.67	74.0	33.33	Peak	Horizontal
2483.5	51.33	74.0	22.67	Peak	Vertical
4959.2	40.51	74.0	33.49	Peak	Vertical

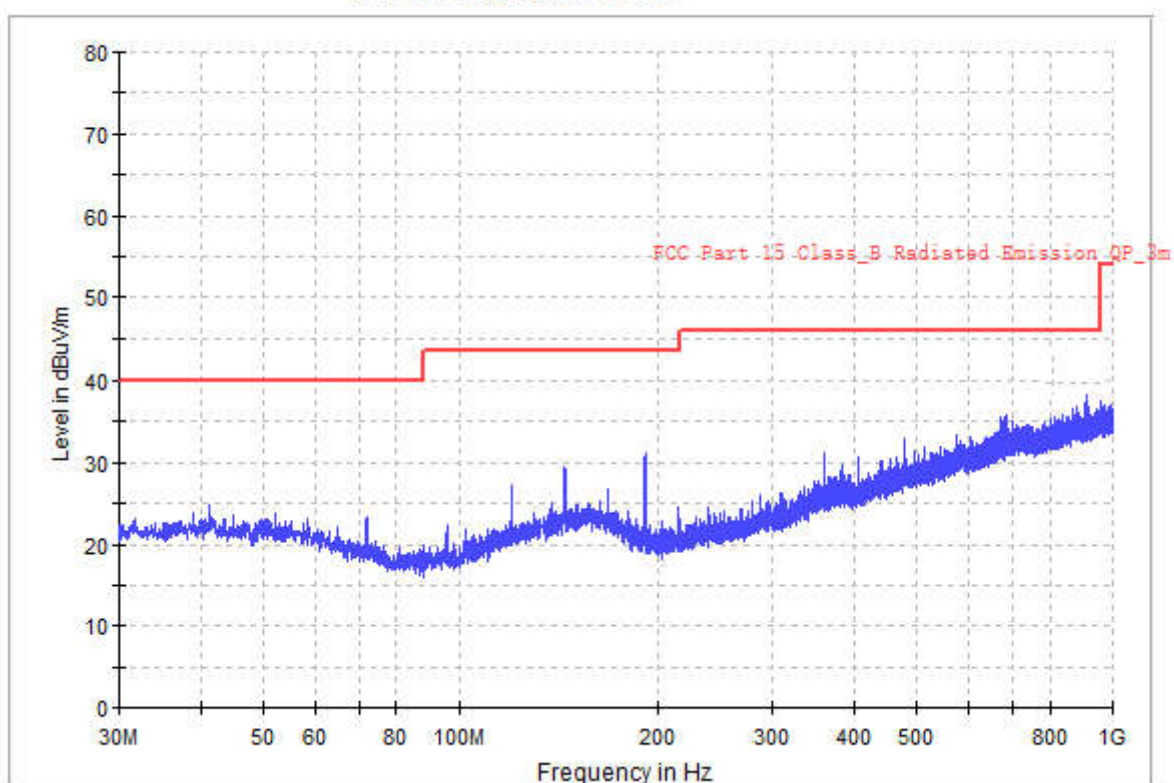
Remark:

- (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 - 15:23
Limit: FCC Part15.109 RE(3m) ClassB	Engineer: Jiaxi XU
Probe: VULB9168	Polarity: Horizontal
EUT: WiFi and BLE Module, Model no: WBR3	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



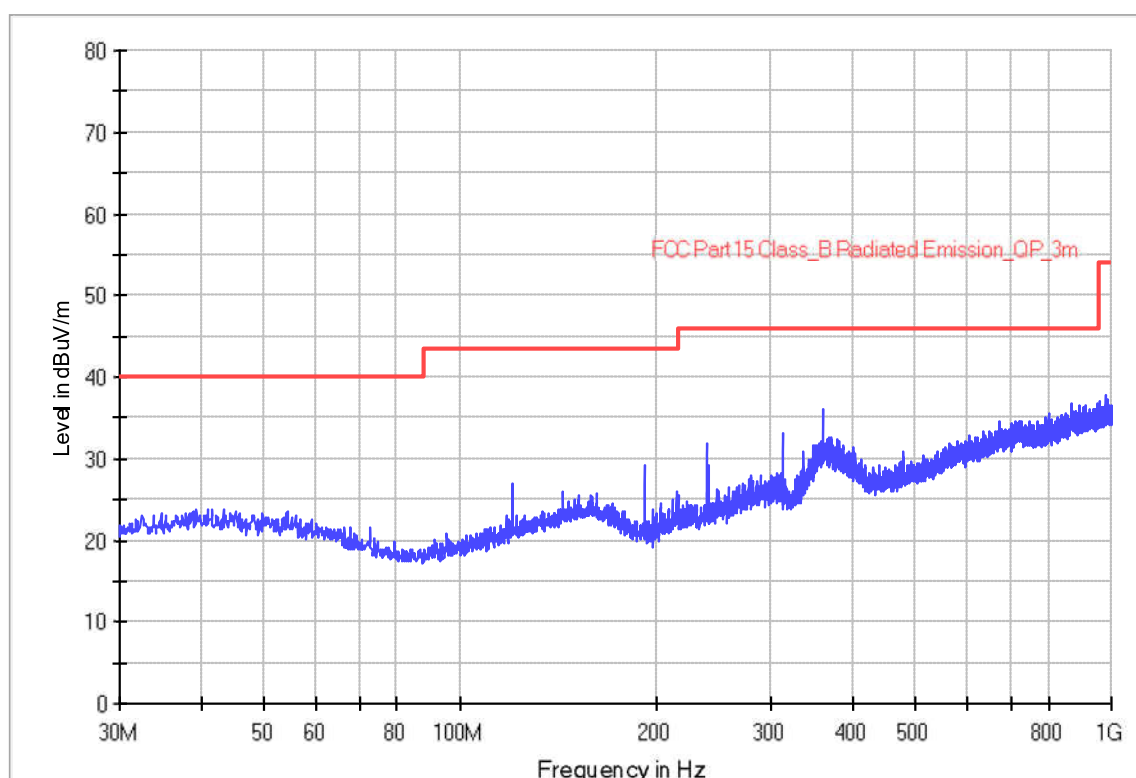
Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

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.

Site: 3-meter chamber	Time: 2019/12/06 - 15:08
Limit: FCC_Part15.109_RE(3m)_ClassB	Engineer: Jiaxi XU
Probe: VULB9168	Polarity: Vertical
EUT: WiFi and BLE Module, Model no: WBR3	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.

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