Certificate No.: 3745.01

China

FCC - TEST REPORT

Report Number	:	**709502102957-00**	Date of Issue:	June 21, 2021

Model	:	WBRU
Product Type	:	Wi-Fi and Bluetooth Module
Applicant	:	Hangzhou Tuya Information Technology Co.,Ltd
Address	:	Room701,Building3,More Center,No.87 GuDun Road,Hangzhou,Zhejiang China
Manufacturer	:	Hangzhou Tuya Information Technology Co.,Ltd
Address	:	Room701,Building3,More Center,No.87 GuDun Road,Hangzhou,Zhejiang China

Test Result	:	**n Positive**	**o Negative**
Total pages including Appendices	:	48	

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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 FCC Registration Number:	820234
Test Firm IC Registration Number:	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:	Wi-Fi and Bluetooth Module
Model no.:	WBRU
FCC ID:	2ANDL-WBRU
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 for 802.11b/802.11g/802.11n(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:	Onboard PCB antenna
Antenna Gain:	1.2dBi
Description of the EUT:	The Equipment Under Test (EUT) is a low-power embedded Wi-Fi and Bluetooth Module 4.2(only support 1Mbps data rate). We tested it and listed the worst data in this report.
Test sample no.:	SHA-579630-1

The sample's mentioned in this report is/are submitted/ supplied/ manufactured 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

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

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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) (3)	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 an PCB antenna, which gain is 1.2dBi. In accordance to §15.203, It is considered sufficiently to comply with the provisions of this section.

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6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2ANDL-WBRU, 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 Wi-Fi test report, for the 2.4GHz BLE test report please refer to 709502102963-00.

SUMMARY:

All tests according to the regulations cited on page 5 were

n - Performed

o - **Not** Performed

The Equipment under Test

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

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

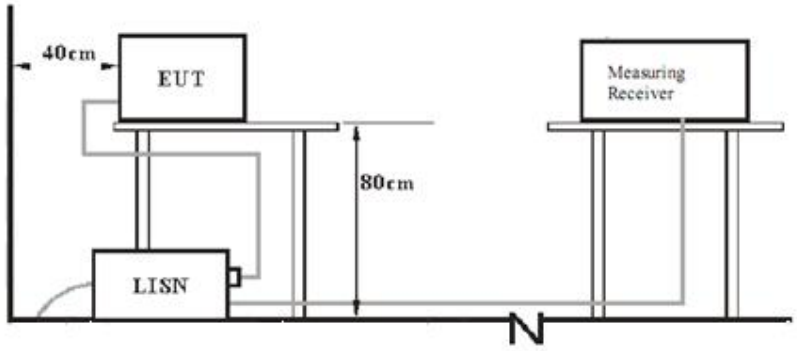
Sample Received Date:	June 4, 2021
Testing Start Date:	June 7, 2021
Testing End Date:	June 16, 2021

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

Reviewed by:	Prepared by:	Tested by:
Hui TONG	Jiaxi XU	Wenqiang LU
EMC Section Manager	EMC Project Engineer	EMC Test Engineer

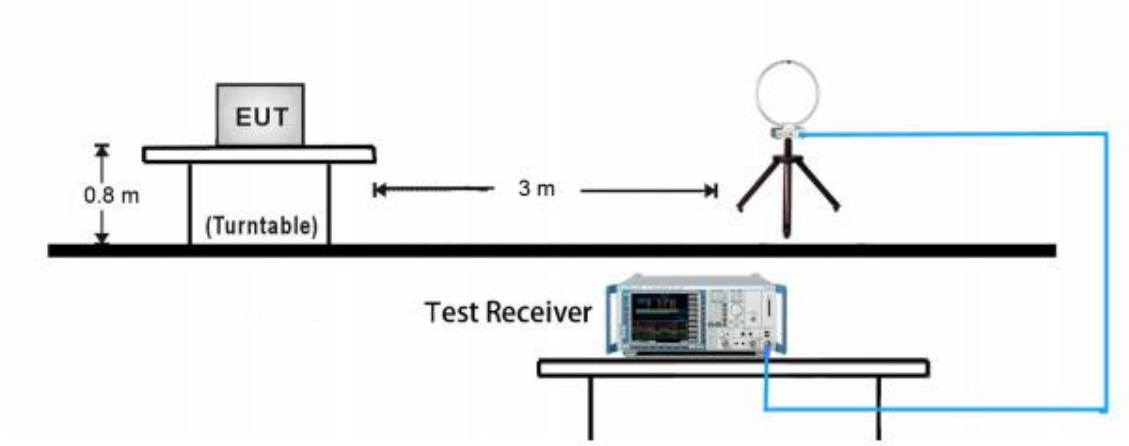
7 Test Setups

7.1 AC Power Line Conducted Emission test setups

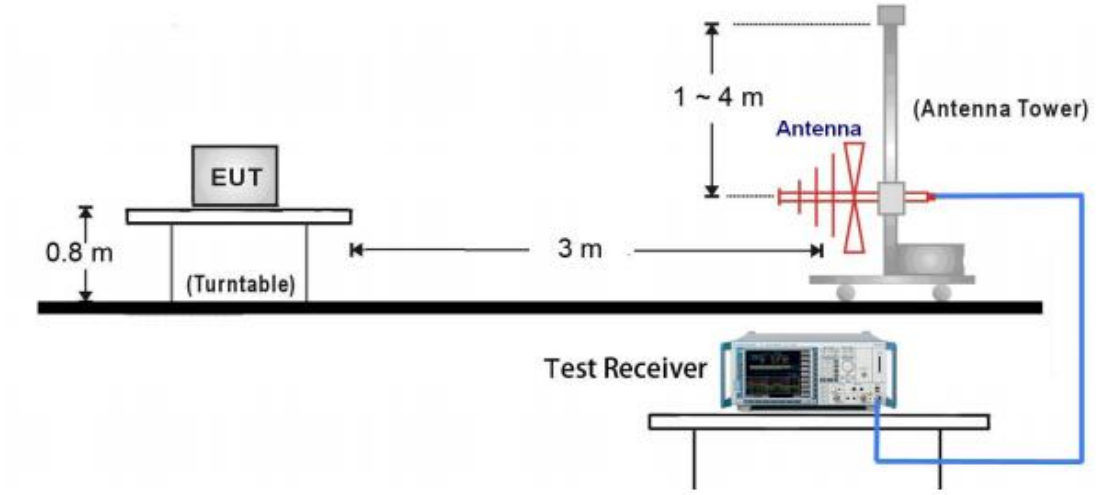


7.2 Radiated test setups

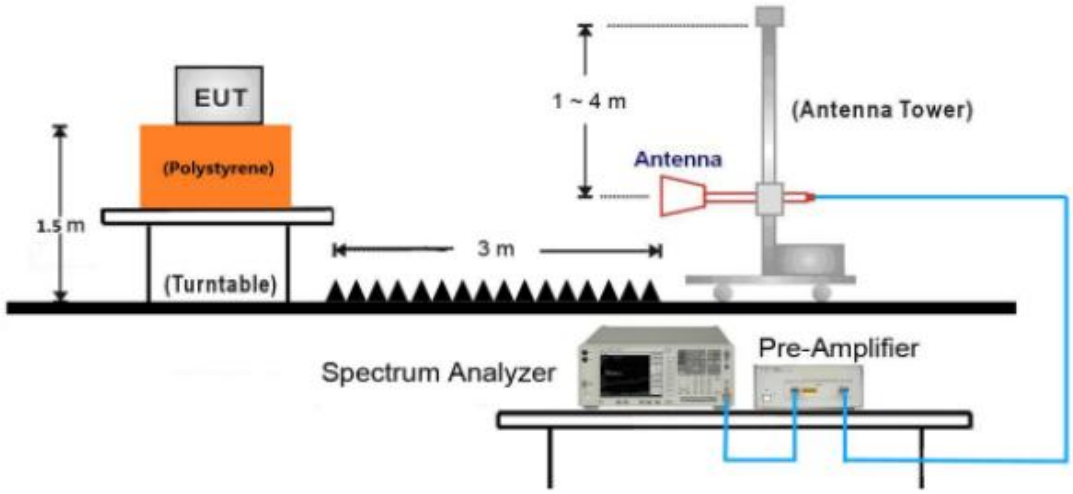
9kHz ~ 30MHz Test Setup:



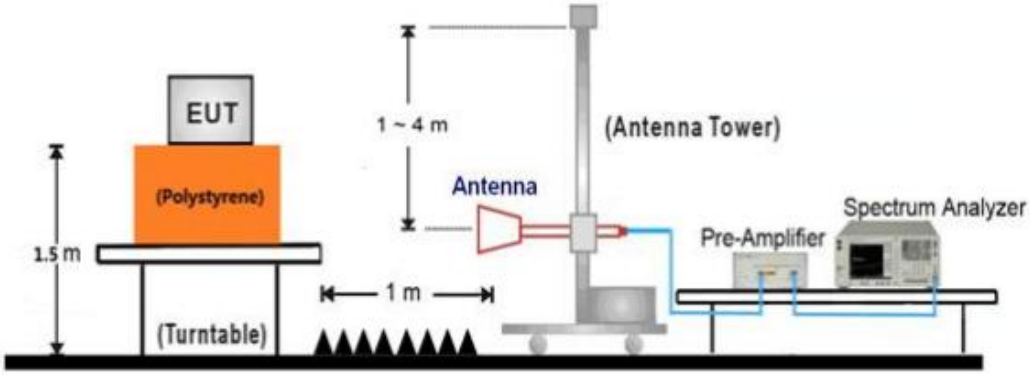
30MHz ~ 1GHz Test Setup:



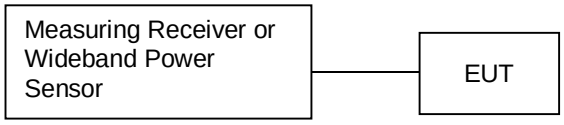
1GHz ~ 18GHz Test Setup:



18GHz ~ 25GHz Test Setup:



7.3 Conducted RF test setups



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8 Systems test configuration

Auxiliary Equipment Used during Test:

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

Test software: Wi-Fi test tool V1.4.2

The system was configured to channel 1(2412MHz), 6(2437MHz), and 11(2462MHz) for 802.11 b/g/n HT20 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. An EMI test receiver is used to test the emissions from both sides of AC line

Limit

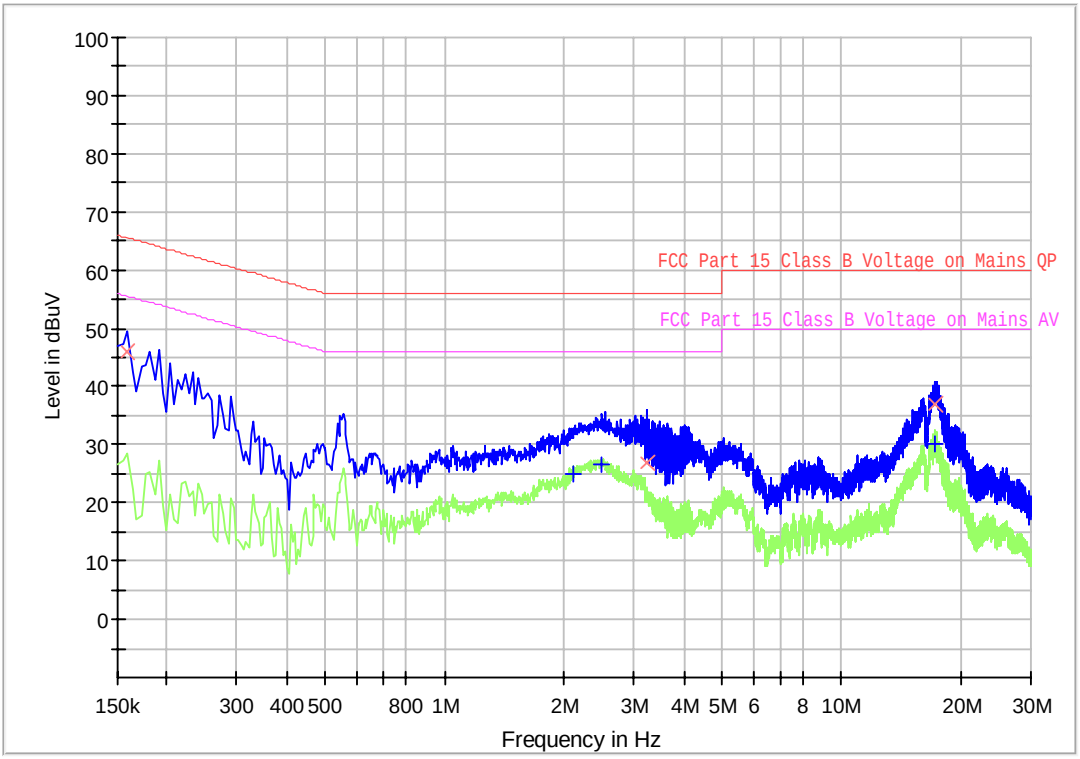
According to §15.207, conducted emissions limit as below:

Frequency MHz	QP Limit dBµV	AV Limit dBµV
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

Decreasing linearly with logarithm of the frequency

China

Product Type	:	Wi-Fi and Bluetooth Module
M/N	:	WBRU
Operating Condition	:	Mode 1: Tx_2437MHz for 802.11G (worst case)
Test Specification	:	L-line
Comment	:	AC 120V/60Hz (powered by notebook)



Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.159000	45.84	---	65.52	19.68	1000.0	9.000	N	19.5
2.107500	---	25.05	46.00	20.95	1000.0	9.000	N	19.5
2.490000	---	26.56	46.00	19.44	1000.0	9.000	N	19.6
3.232500	26.97	---	56.00	29.03	1000.0	9.000	N	19.6
17.151000	---	30.21	50.00	19.79	1000.0	9.000	N	19.8
17.254500	36.99	---	60.00	23.01	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

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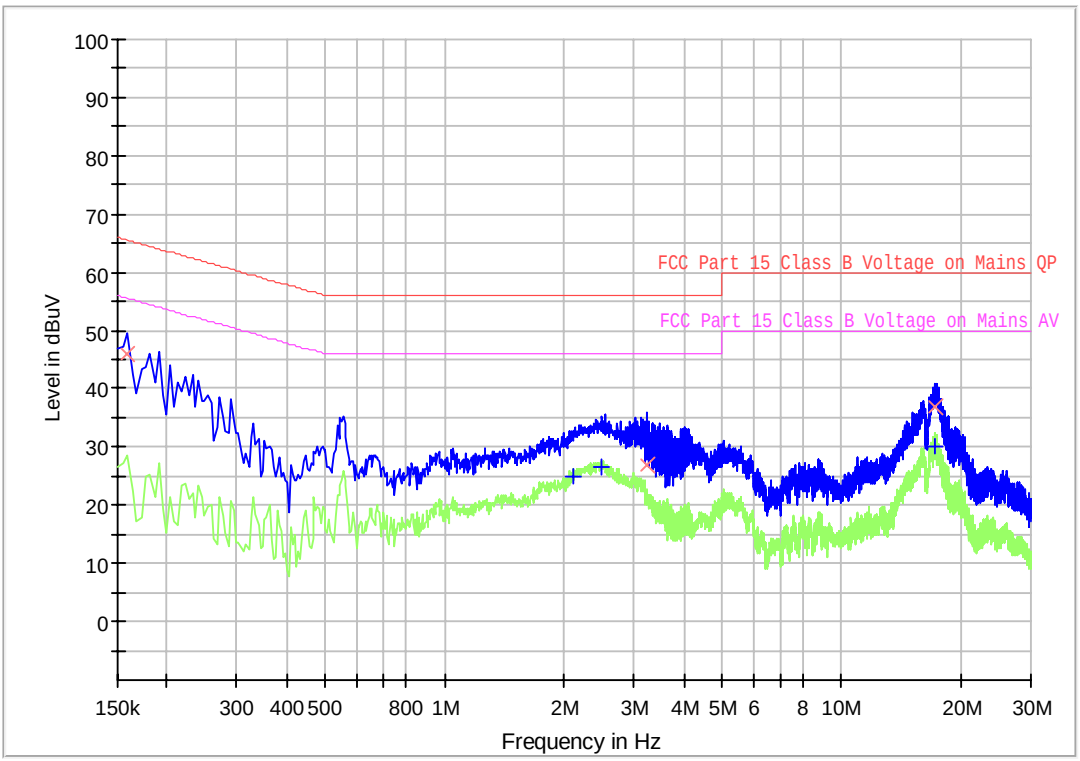
Product Type	:	Wi-Fi and Bluetooth Module
M/N	:	WBRU
Operating Condition	:	Mode 1: Tx_2437MHz for 802.11G (worst case)
Test Specification	:	N-line
Comment	:	AC 120V/60Hz (powered by notebook)



Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
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2.107500	---	25.05	46.00	20.95	1000.0	9.000	N	19.5
2.490000	---	26.56	46.00	19.44	1000.0	9.000	N	19.6
3.232500	26.97	---	56.00	29.03	1000.0	9.000	N	19.6
17.151000	---	30.21	50.00	19.79	1000.0	9.000	N	19.8
17.254500	36.99	---	60.00	23.01	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≥3RBW, Span≥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

According to §15.247 (b) (3), conducted peak output power limit as below:

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	19.12	Pass
Middle channel 2437MHz	19.17	Pass
High channel 2462MHz	19.37	Pass

802.11G

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2412MHz	25.77	Pass
Middle channel 2437MHz	**25.89**	Pass
High channel 2462MHz	25.83	Pass

802.11N20

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2412MHz	25.32	Pass
Middle channel 2437MHz	25.30	Pass
High channel 2462MHz	25.21	Pass

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9.3 6dB bandwidth

Test Method

1. Use the following spectrum analyzer settings:
   RBW=100K, VBW≥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 ≥ 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	9.081	Pass
Middle channel 2437MHz	9.080	Pass
High channel 2462MHz	9.080	Pass

802.11G

Frequency MHz	6dB bandwidth MHz	Result
Low channel 2412MHz	16.559	Pass
Middle channel 2437MHz	16.559	Pass
High channel 2462MHz	16.561	Pass

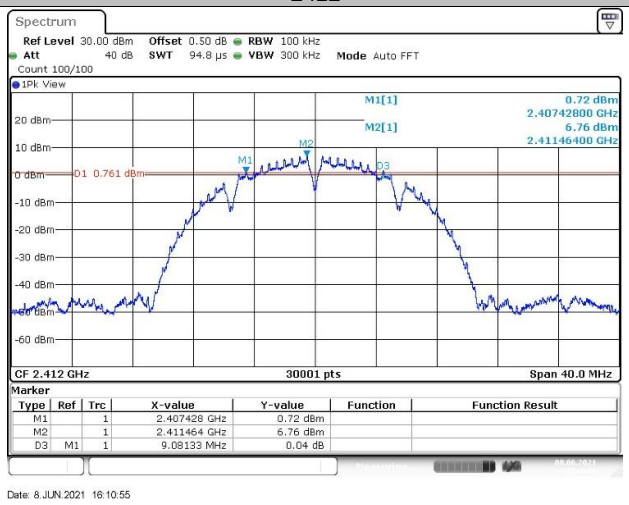
802.11N20

Frequency MHz	6dB bandwidth MHz	Result
Low channel 2412MHz	17.793	Pass
Middle channel 2437MHz	17.777	Pass
High channel 2462MHz	17.787	Pass

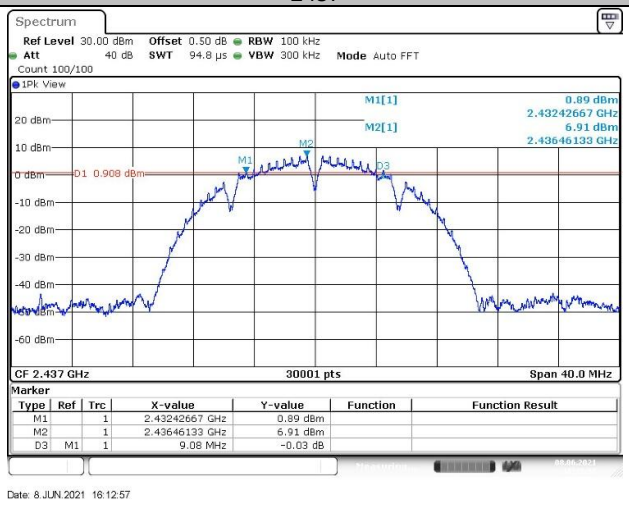
6 dB Bandwidth

802.11B

2412



2437



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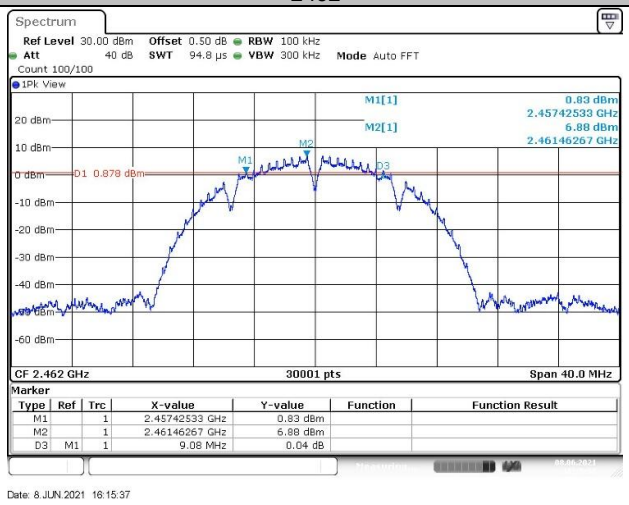
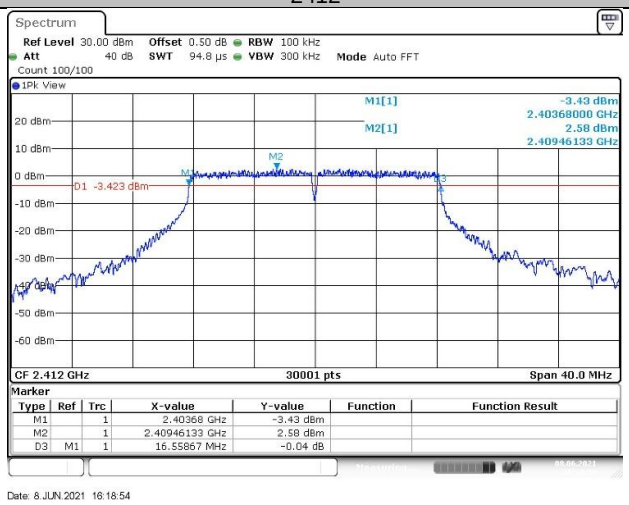


802.11G

2412



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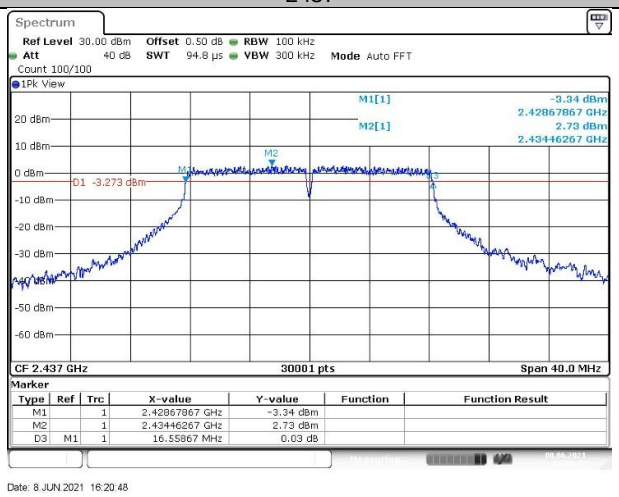

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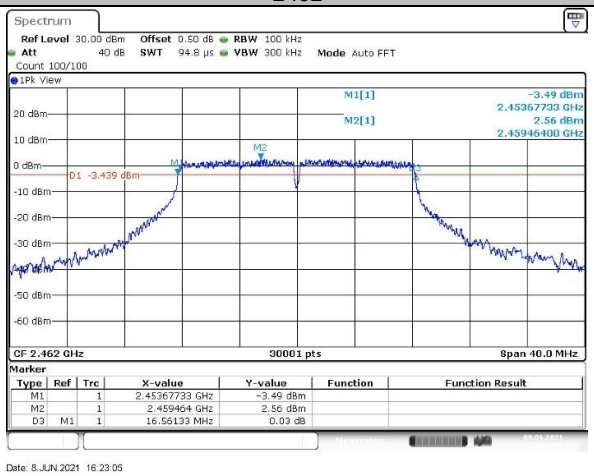
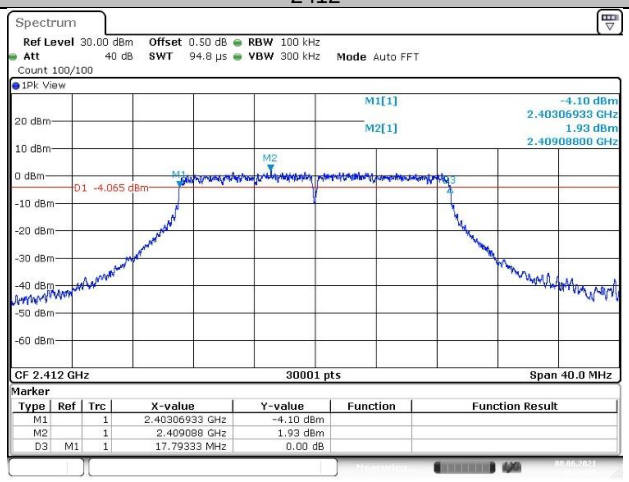


802.11N20

2412



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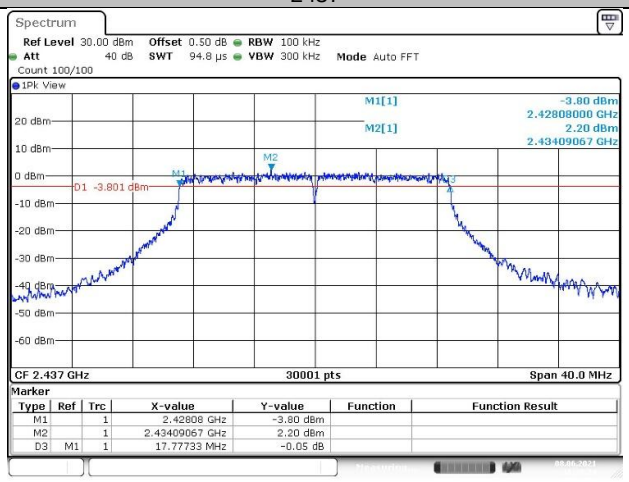

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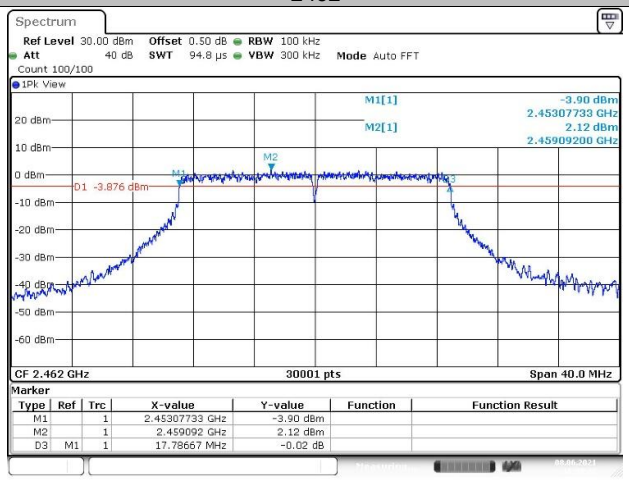

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9.4 Power spectral density

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/3kHz]
≤8

Test result

802.11 B

Frequency MHz	Power spectral density dBm/3kHz	Result
Low channel 2412MHz	-13.87	Pass
Middle channel 2437MHz	-13.84	Pass
High channel 2462MHz	-13.95	Pass

802.11 G

Frequency MHz	Power spectral density dBm/3kHz	Result
Low channel 2412MHz	-11.87	Pass
Middle channel 2437MHz	-11.86	Pass
High channel 2462MHz	-12.01	Pass

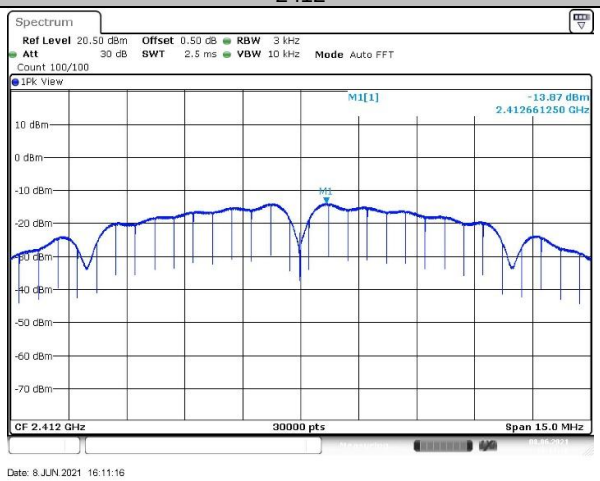
802.11 N20

Frequency MHz	Power spectral density dBm/3kHz	Result
Low channel 2412MHz	-12.17	Pass
Middle channel 2437MHz	-12.22	Pass
High channel 2462MHz	-12.25	Pass

Power spectral density

802.11B

2412



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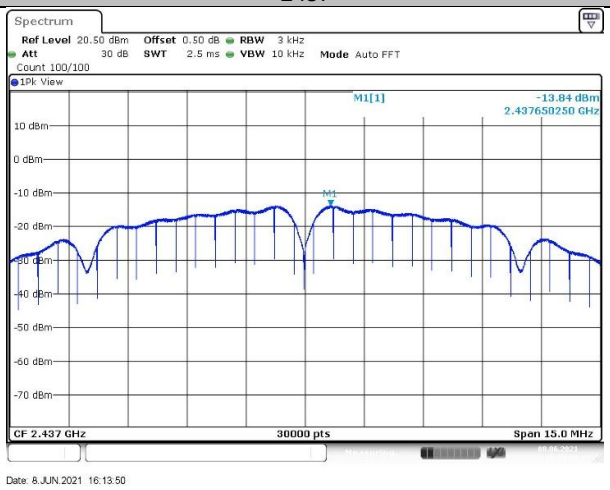

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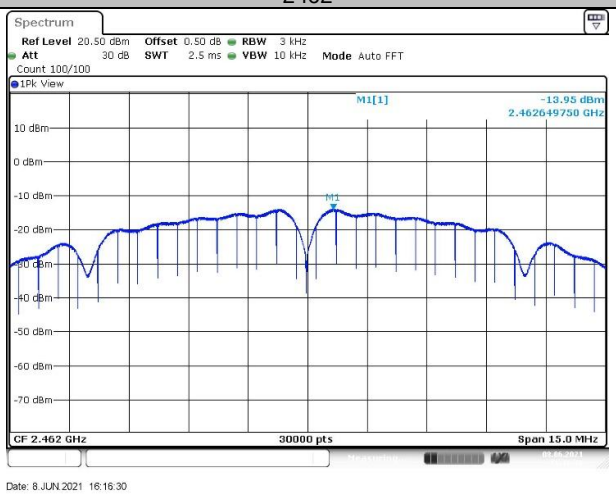
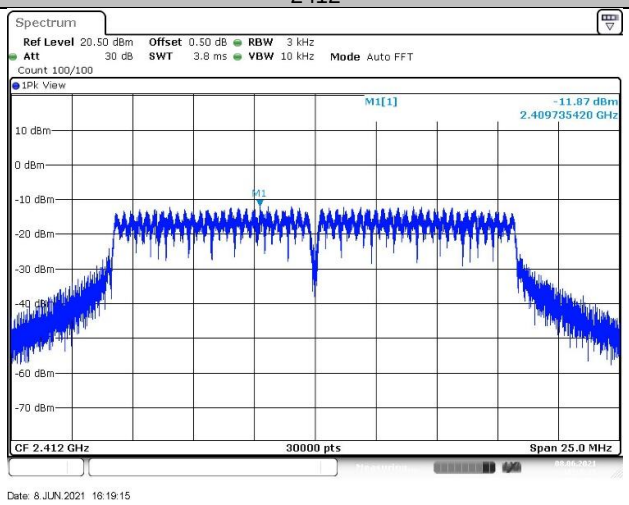


802.11G

2412



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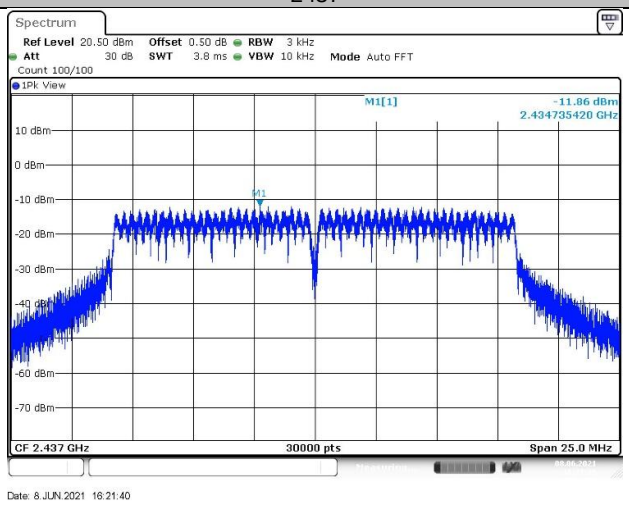

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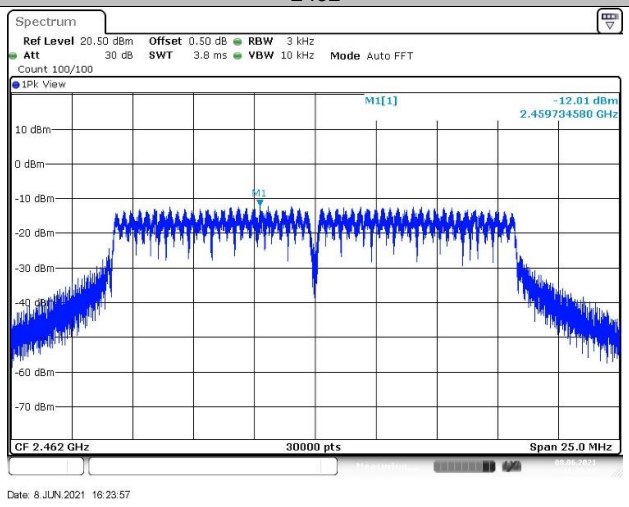
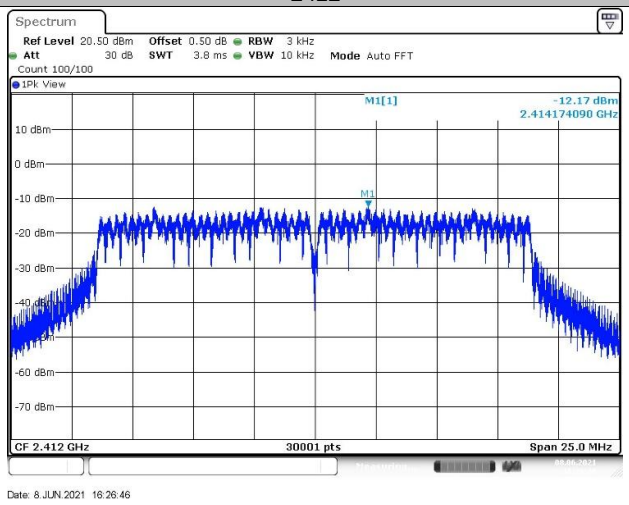
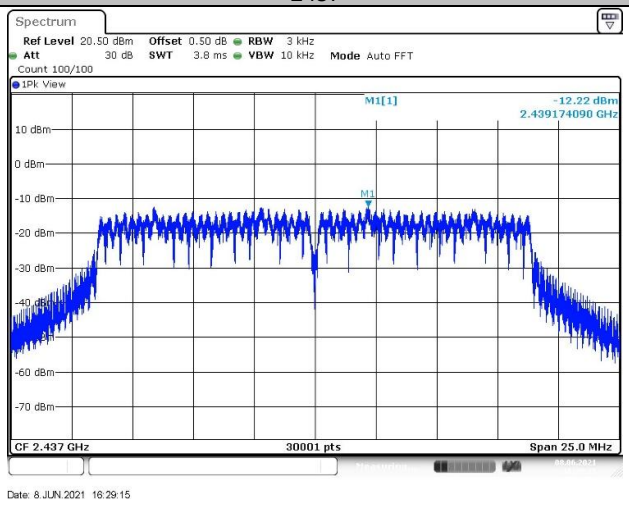


802.11N20

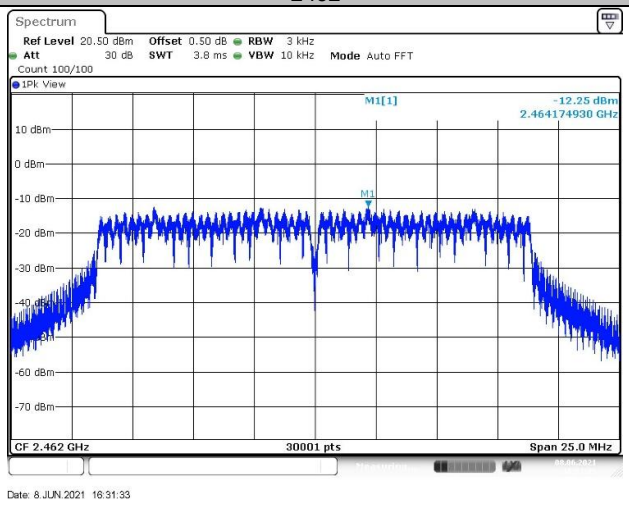
2412



2437



2462



9.5 Spurious RF conducted emissions

Test Method

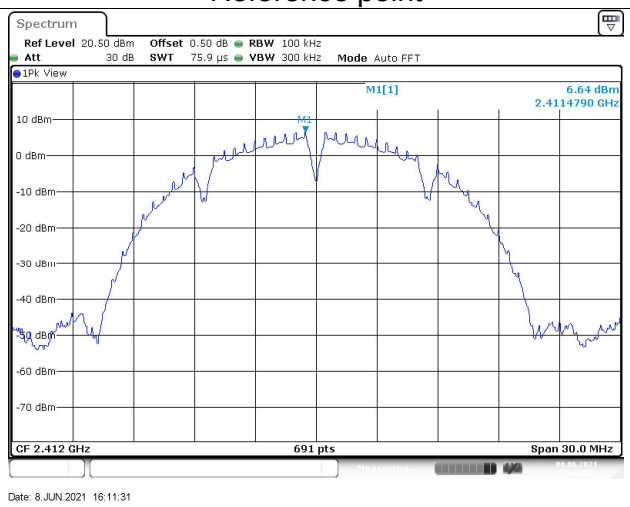
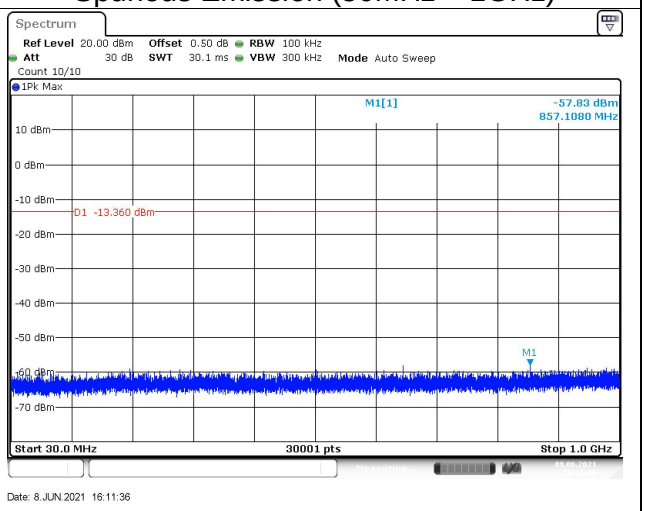
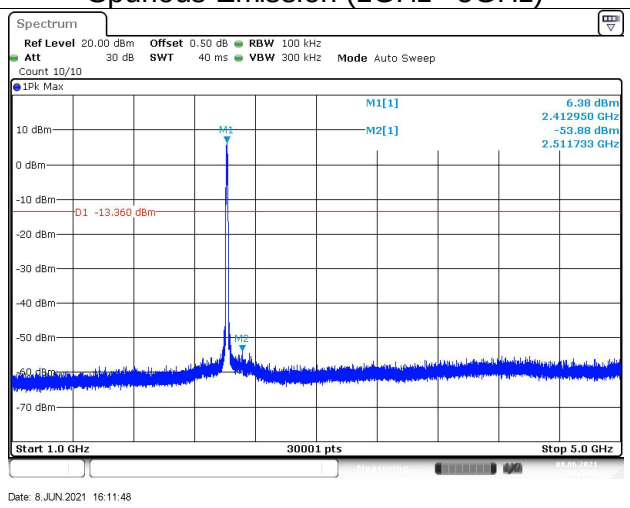
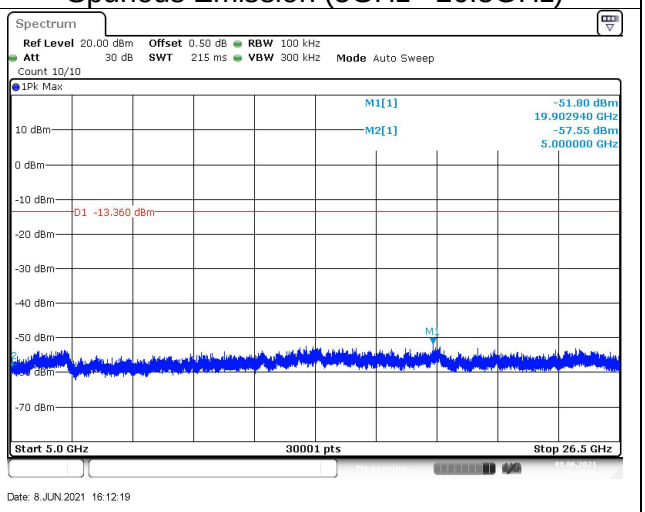
1. Establish a reference level by using the following procedure:
   a. Set RBW=100 kHz. VBW≥3RBW. Detector =peak, Sweep time = auto couple, Trace mode = max hold.
   b. Allow trace to fully stabilize, use the peak marker function to determine the maximum PSD level.
2. Use the maximum PSD level to establish 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

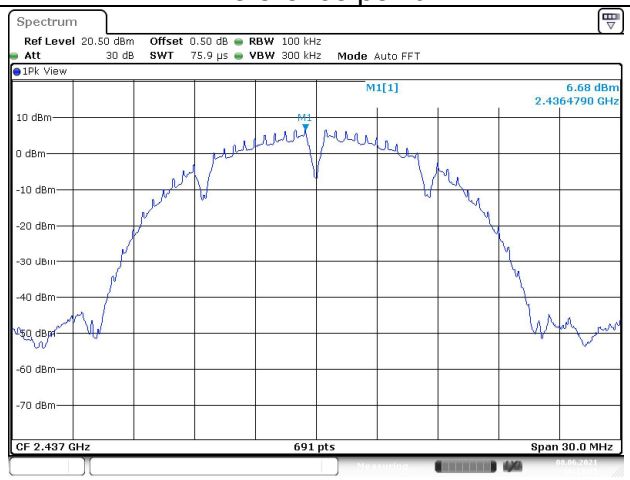
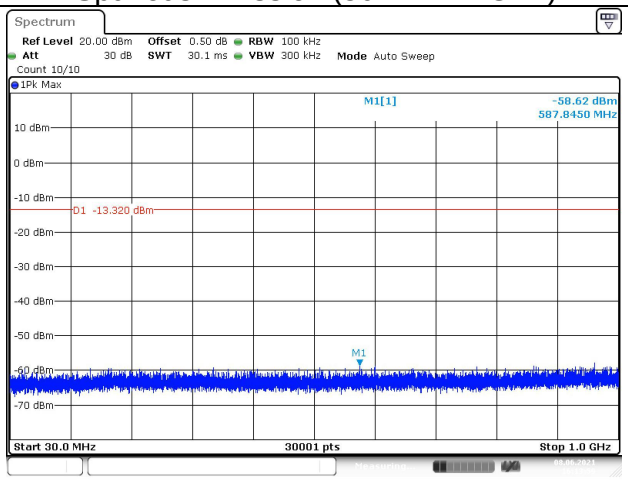
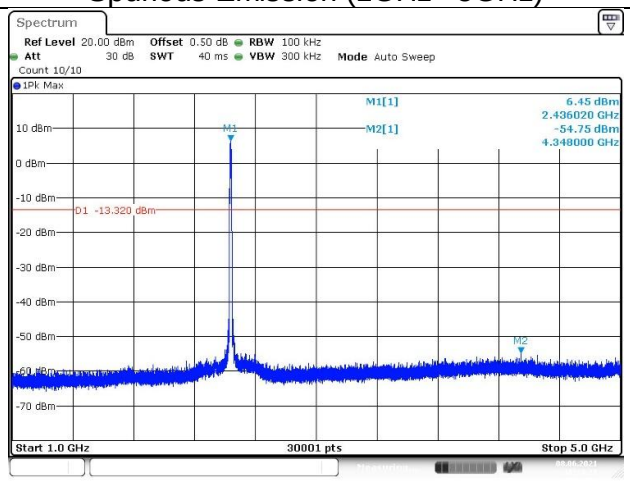
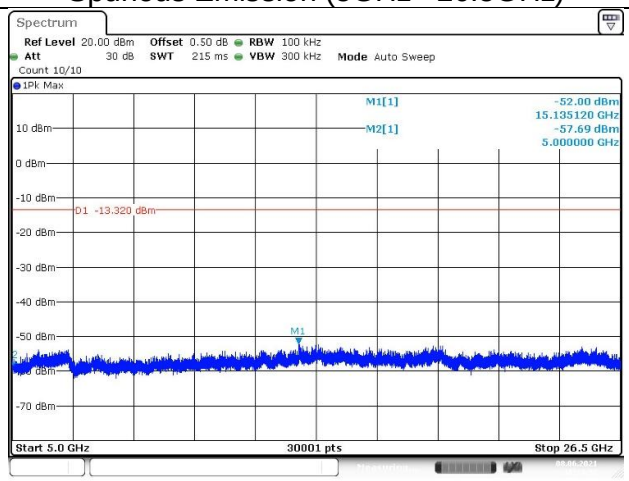
Frequency Range MHz	Limit (dBc)
30-25000	-20

Spurious RF conducted emissions

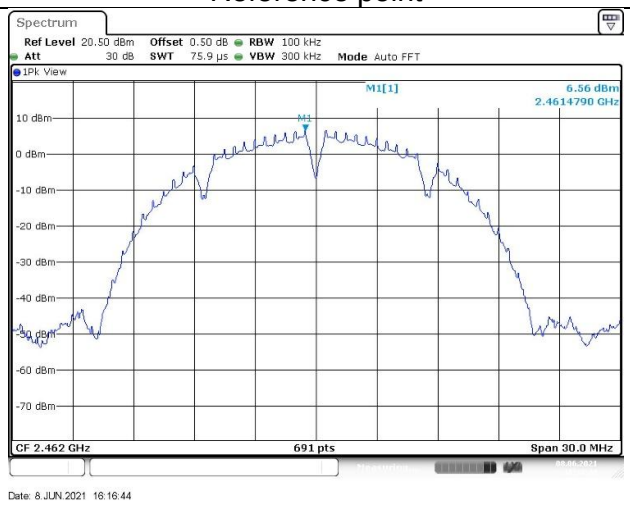
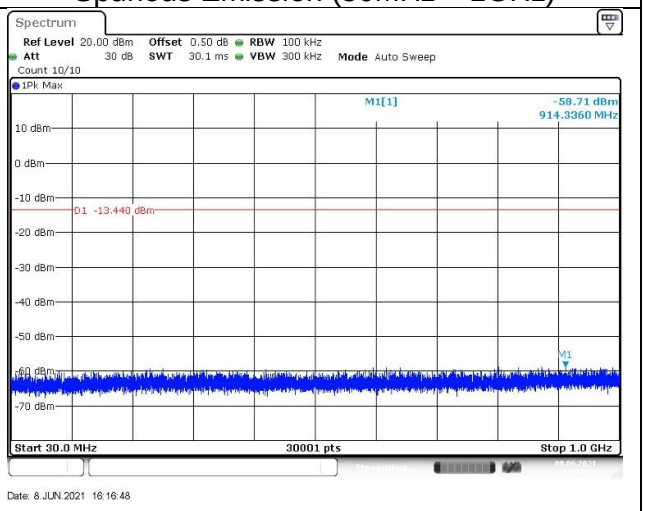
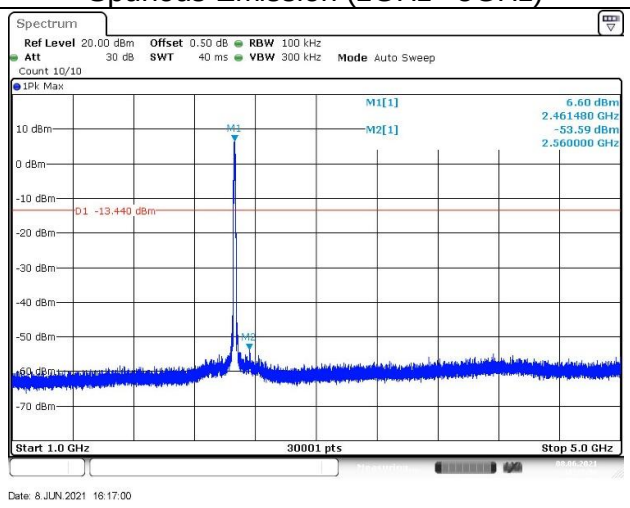
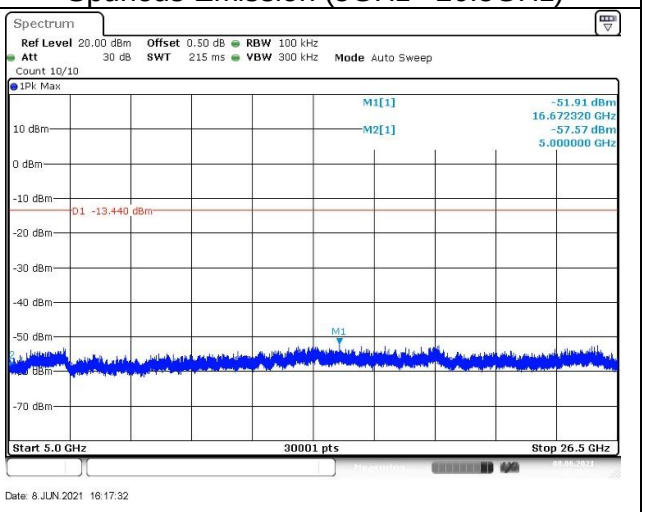
802.11 B

Out-of-Band Emissions	
Channel 1 (2412MHz)	
Reference point	Spurious Emission (30MHz – 1GHz)
	
Spurious Emission (1GHz –5GHz)	Spurious Emission (5GHz –26.5GHz)
	

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

Out-of-Band Emissions	
Channel 6 (2437MHz)	
Reference point	Spurious Emission (30MHz – 1GHz)
	
Spurious Emission (1GHz –5GHz)	Spurious Emission (5GHz –26.5GHz)
	

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

Out-of-Band Emissions	
Channel 11 (2462MHz)	
Reference point	Spurious Emission (30MHz – 1GHz)
	
Spurious Emission (1GHz –5GHz)	Spurious Emission (5GHz –26.5GHz)
	

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

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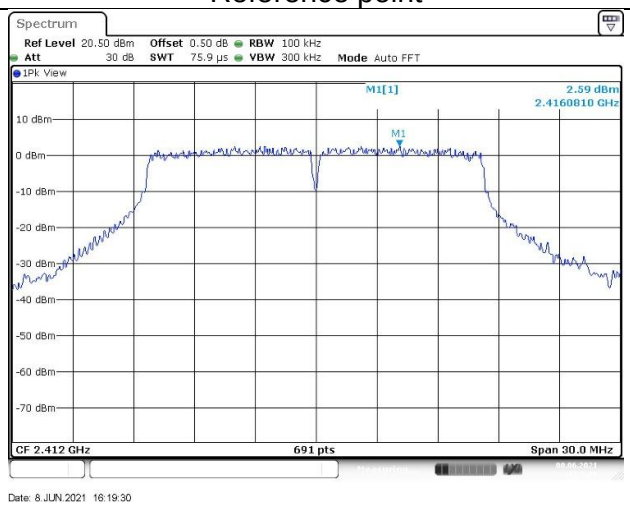
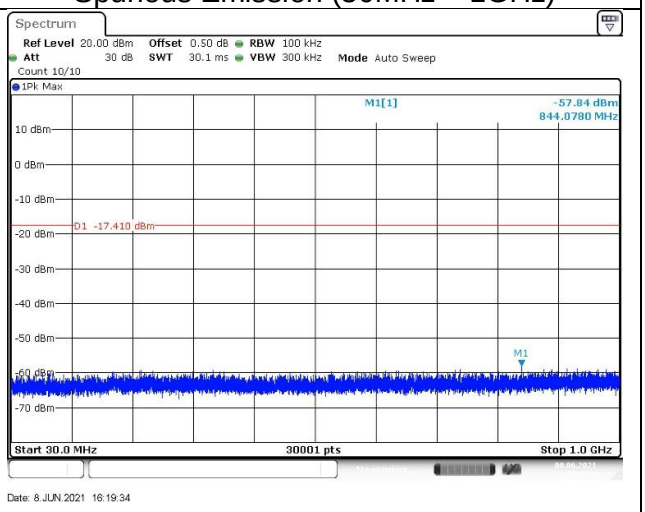
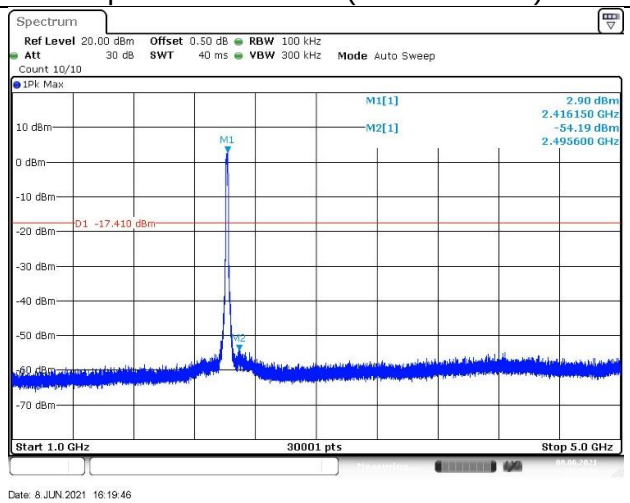
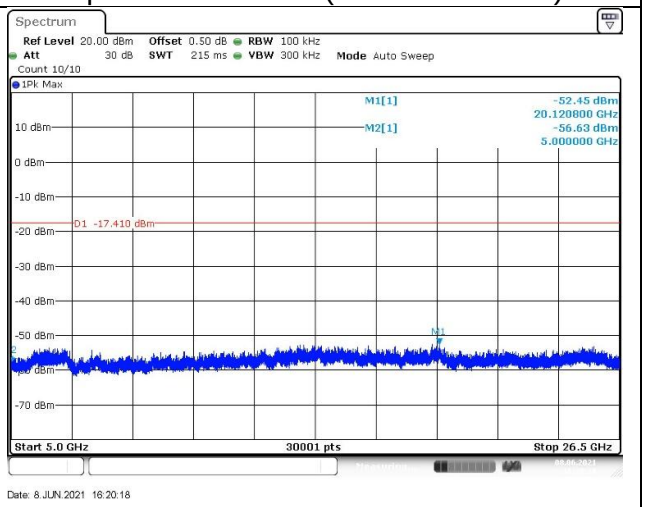
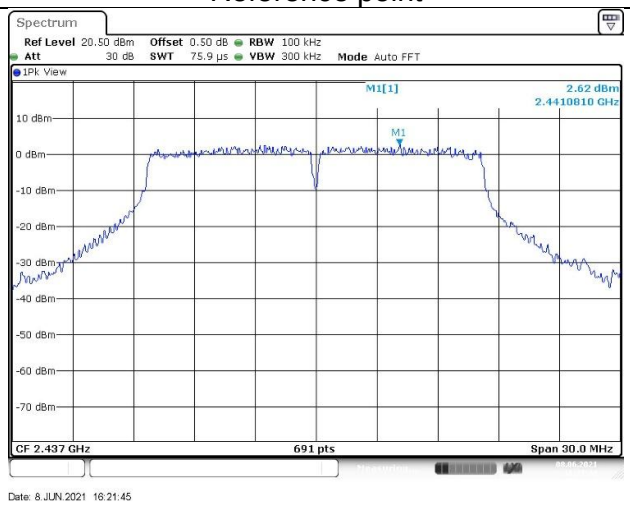
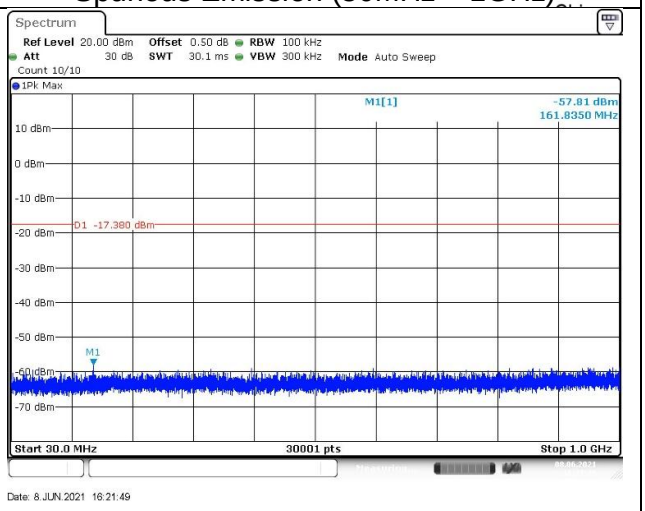
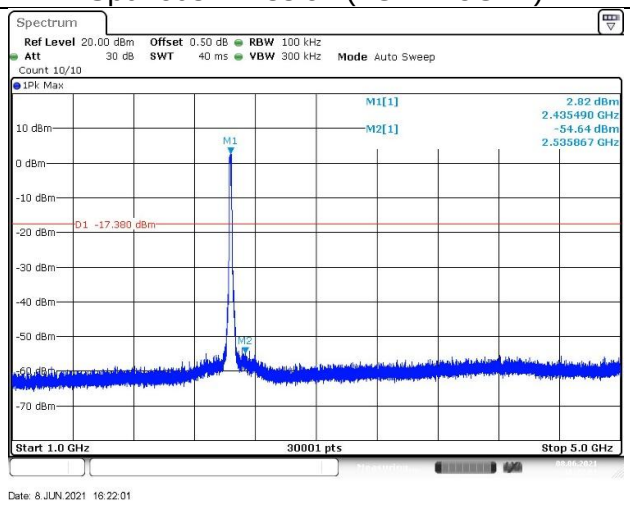
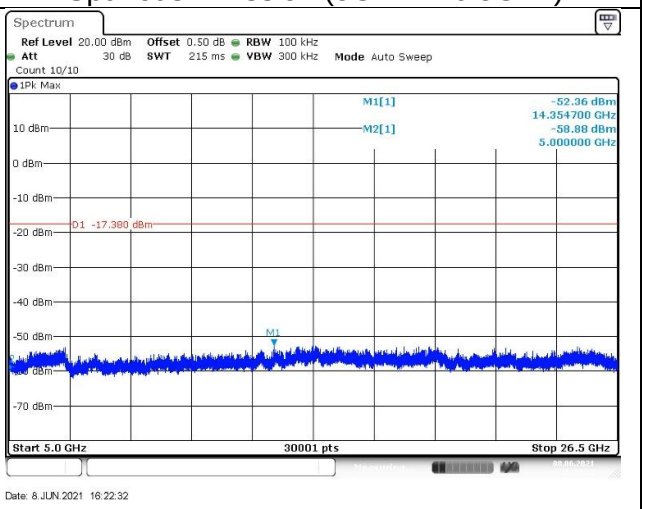
Out-of-Band Emissions	
Channel 1 (2412MHz)	
Reference point	Spurious Emission (30MHz – 1GHz)
	
Spurious Emission (1GHz –5GHz)	Spurious Emission (5GHz –26.5GHz)
	

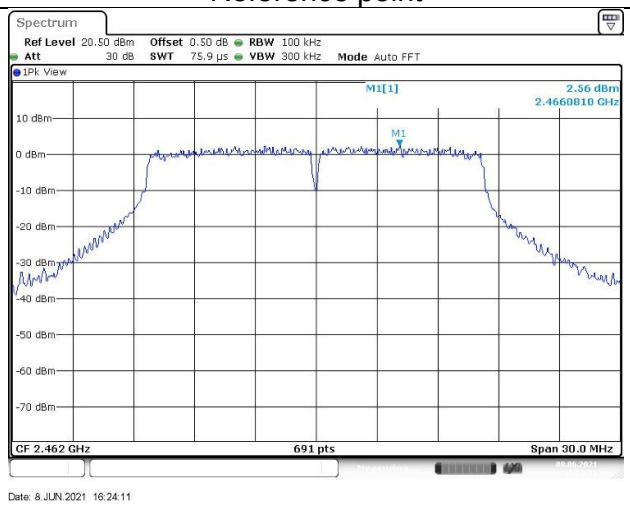
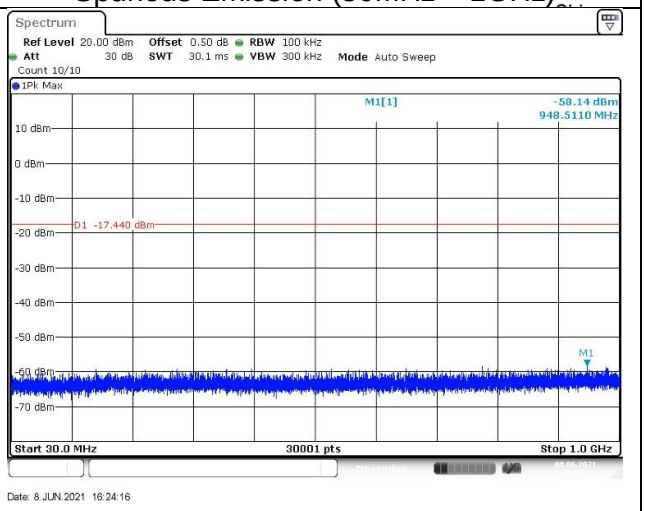
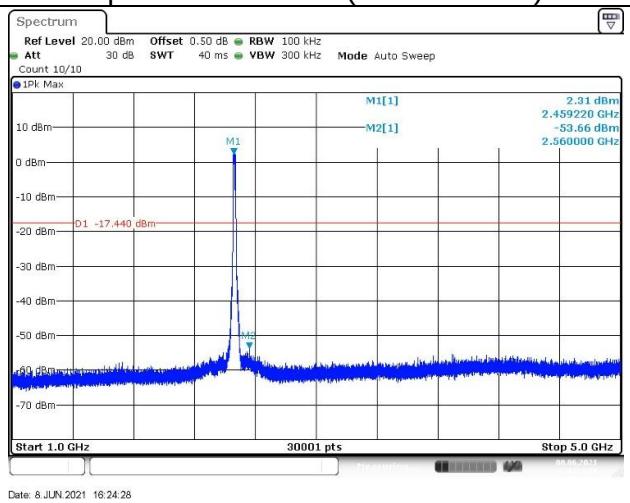
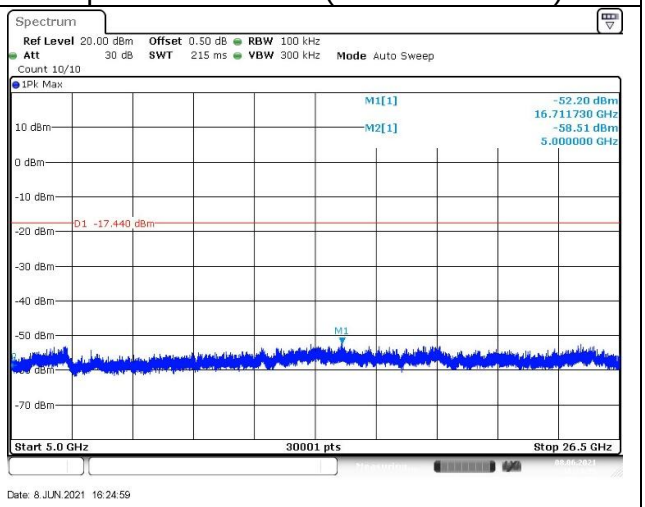
Note: The emission which exceed the limit is the fundamental.

Out-of-Band Emissions

Channel 6 (2437MHz)	
Reference point	Spurious Emission (30MHz – 1GHz)
	
Spurious Emission (1GHz –5GHz)	Spurious Emission (5GHz –26.5GHz)
	

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

Out-of-Band Emissions

Channel 11 (2462MHz)	
Reference point	Spurious Emission (30MHz – 1GHz)
	
Spurious Emission (1GHz –5GHz)	Spurious Emission (5GHz –26.5GHz)
	

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

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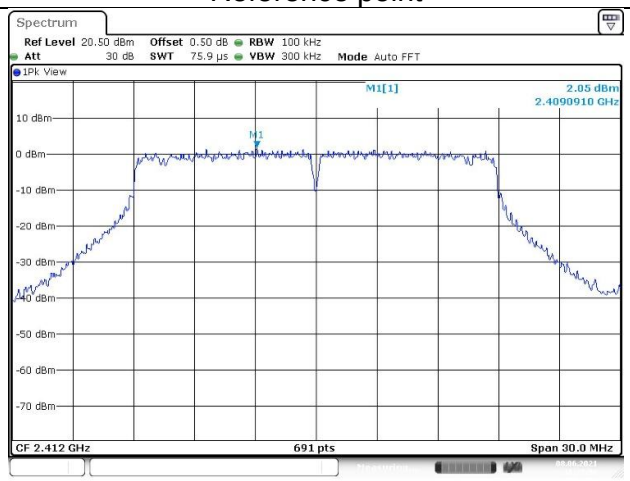
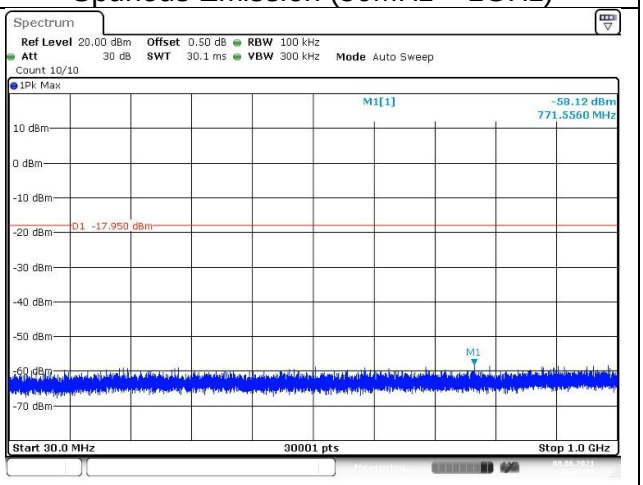
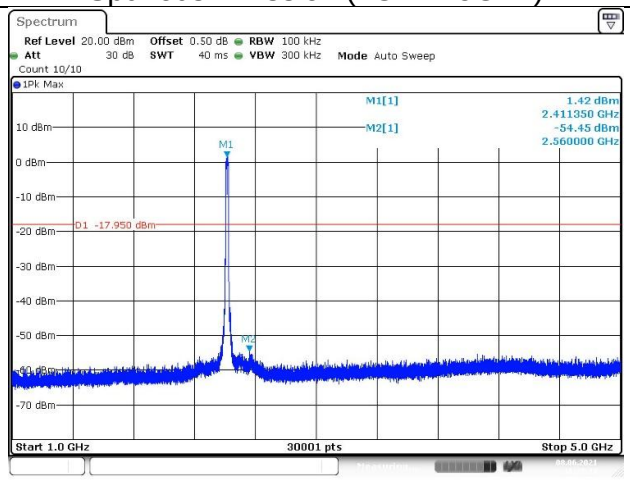
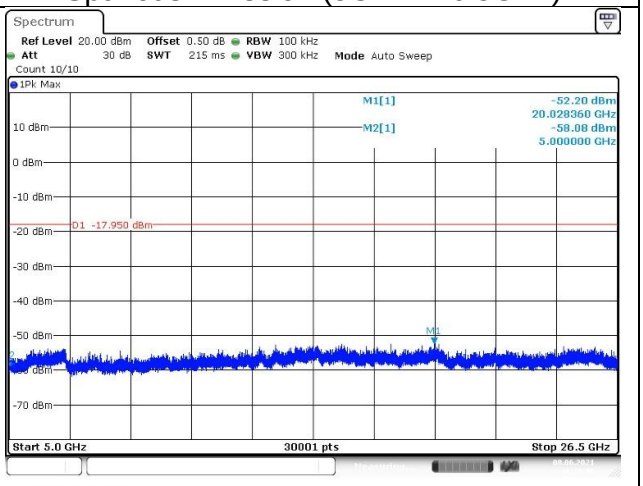
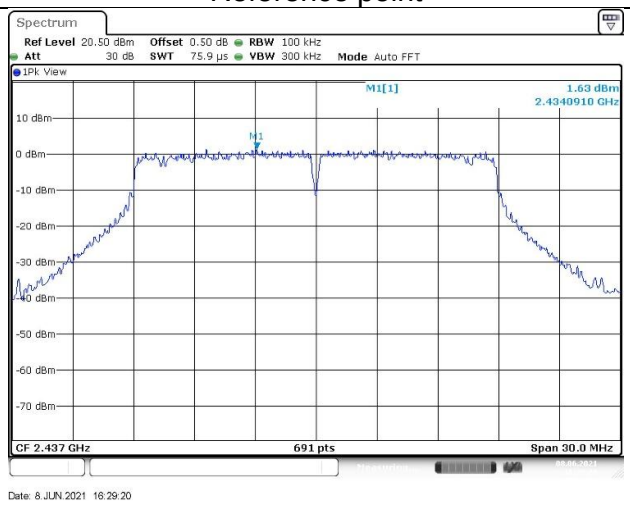
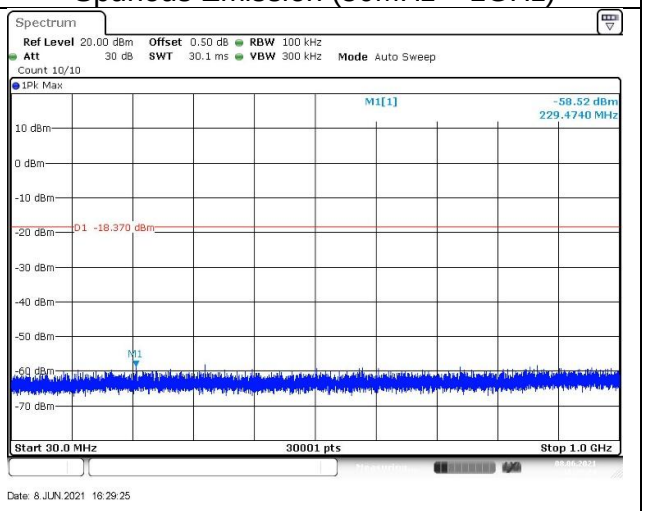
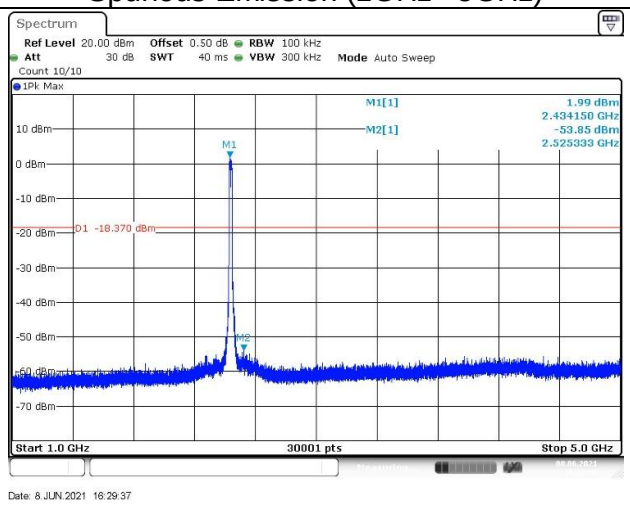
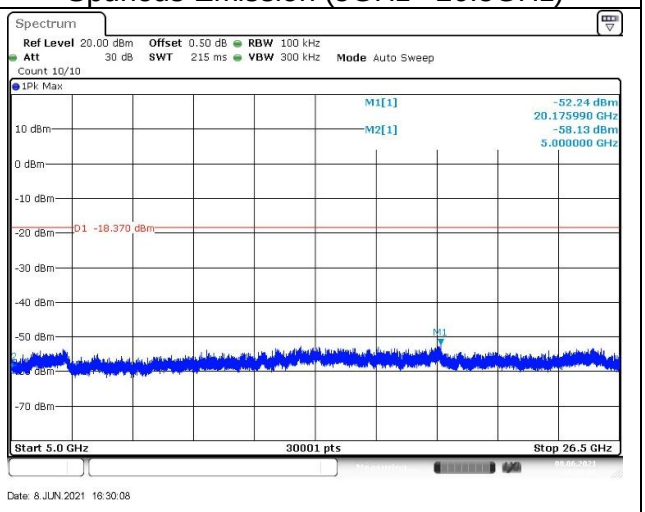
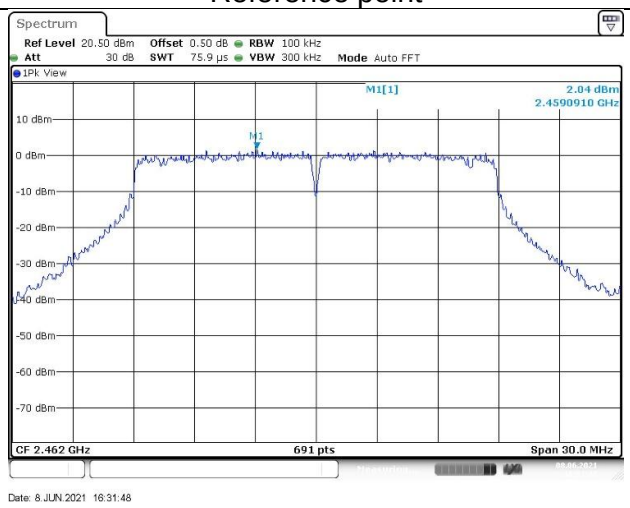
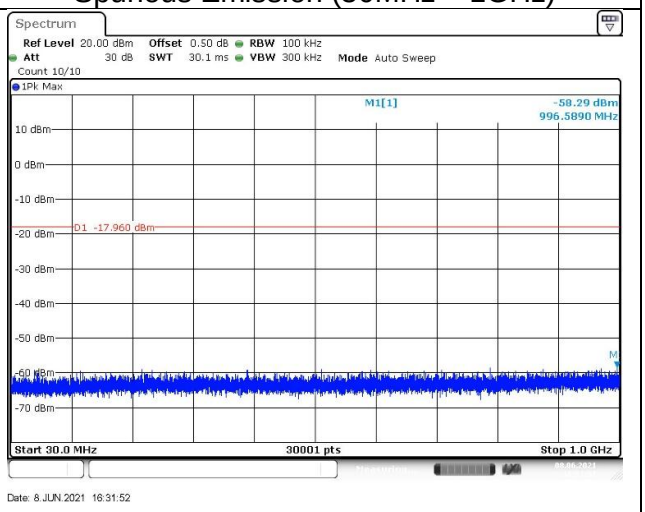
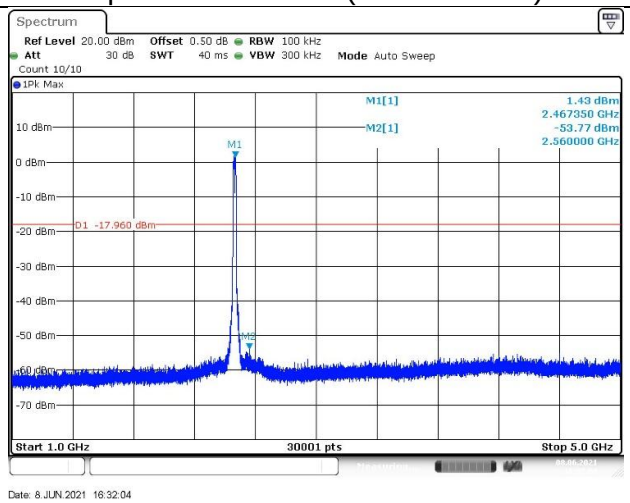
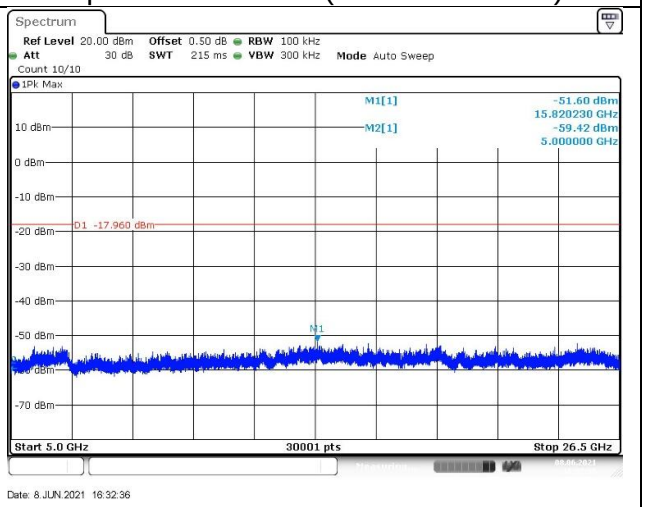
Out-of-Band Emissions	
Channel 1 (2412MHz)	
Reference point	Spurious Emission (30MHz – 1GHz)
 Date: 8.JUN.2021 16:27:01	 Date: 8.JUN.2021 16:27:05
Spurious Emission (1GHz –5GHz)	Spurious Emission (5GHz –26.5GHz)
 Date: 8.JUN.2021 16:27:17	 Date: 8.JUN.2021 16:27:48

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

Out-of-Band Emissions	
Channel 6 (2437MHz)	
Reference point	Spurious Emission (30MHz – 1GHz)
	
Spurious Emission (1GHz –5GHz)	Spurious Emission (5GHz –26.5GHz)
	

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

Out-of-Band Emissions	
Channel 11 (2462MHz)	
Reference point	Spurious Emission (30MHz – 1GHz)
	
Spurious Emission (1GHz –5GHz)	Spurious Emission (5GHz –26.5GHz)
	

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≥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.

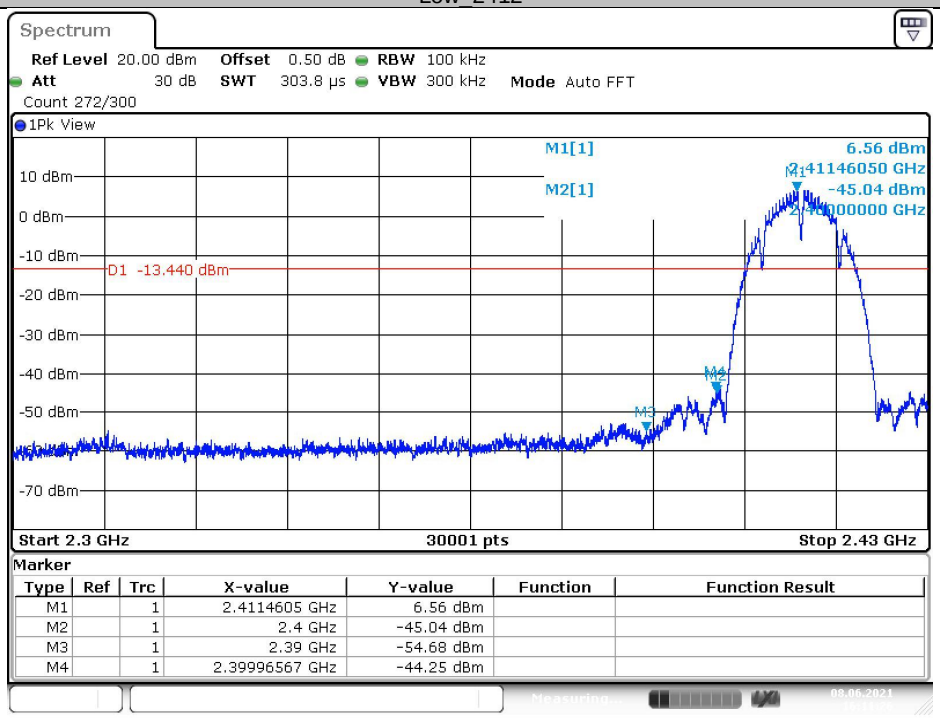
Limit

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in 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), must also comply with the radiated emission limits specified in 15.209(a) (see Section 15.205(c)).

Test result

802.11 B

Low_2412

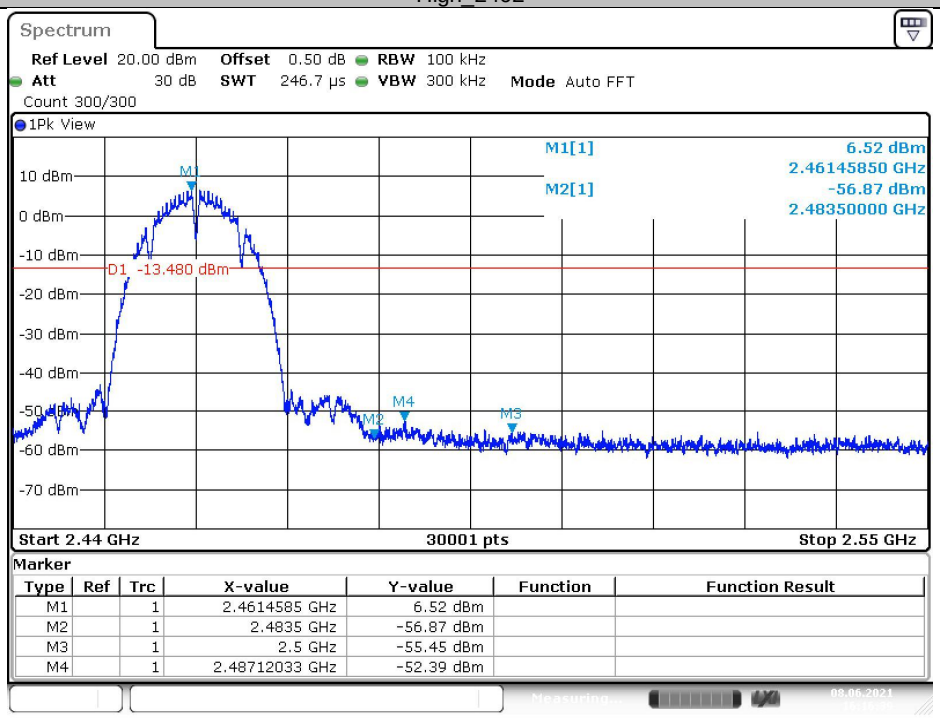


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4114605 GHz	6.56 dBm		
M2		1	2.4 GHz	-45.04 dBm		
M3		1	2.39 GHz	-54.68 dBm		
M4		1	2.39996567 GHz	-44.25 dBm		

Date: 8.JUN.2021 16:11:26

High_2462



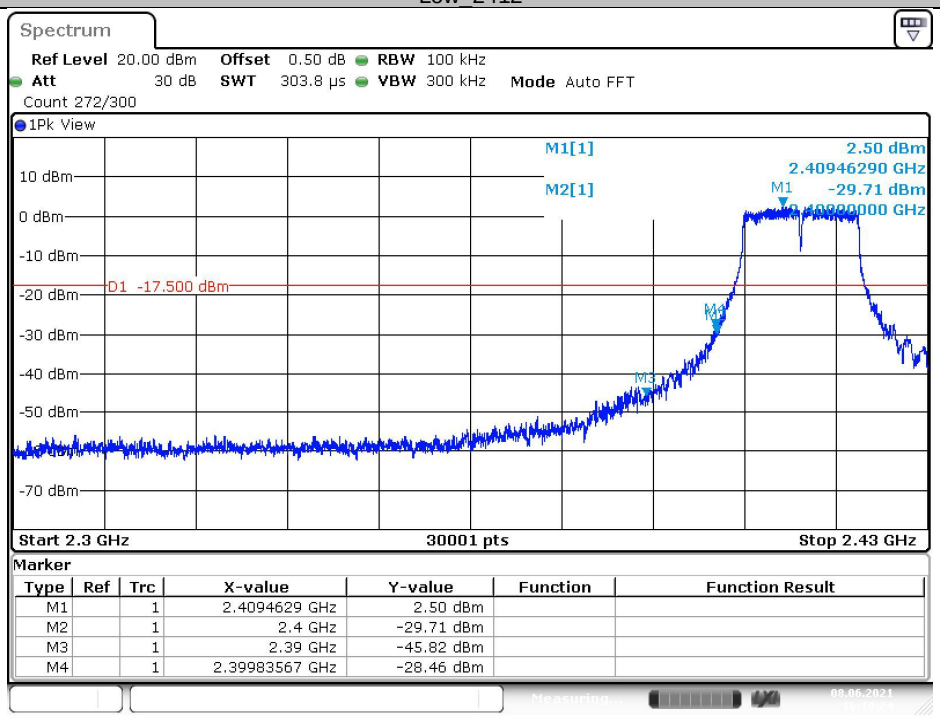
Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4614585 GHz	6.52 dBm		
M2		1	2.4835 GHz	-56.87 dBm		
M3		1	2.5 GHz	-55.45 dBm		
M4		1	2.48712033 GHz	-52.39 dBm		

Date: 8.JUN.2021 16:16:39

802.11 G

Low_2412

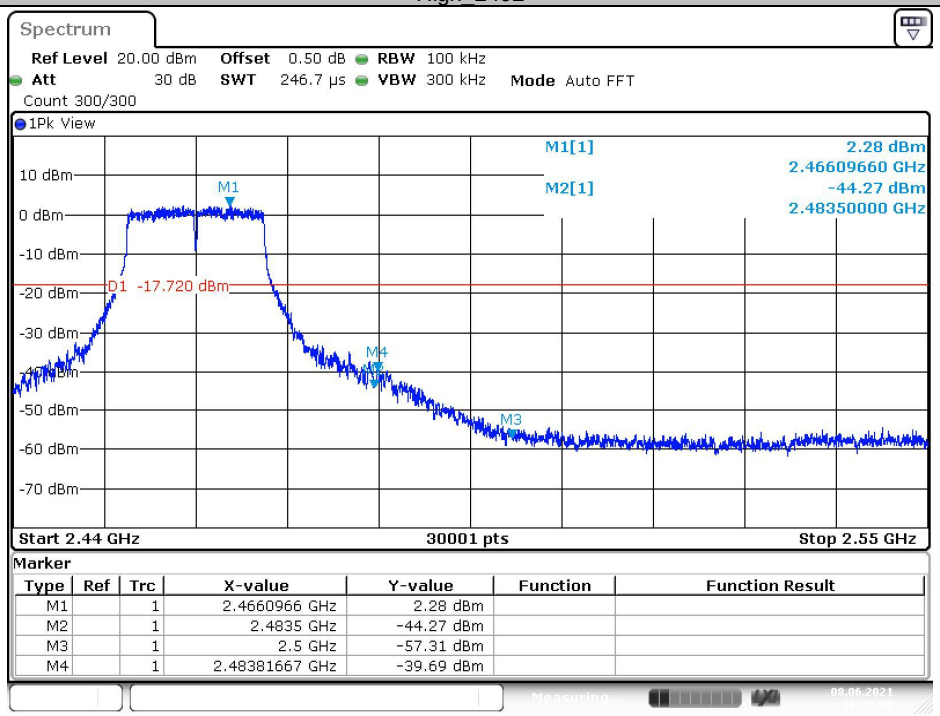


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4094629 GHz	2.50 dBm		
M2		1	2.4 GHz	-29.71 dBm		
M3		1	2.39 GHz	-45.82 dBm		
M4		1	2.39983567 GHz	-28.46 dBm		

Date: 8.JUN.2021 16:19:25

High_2462



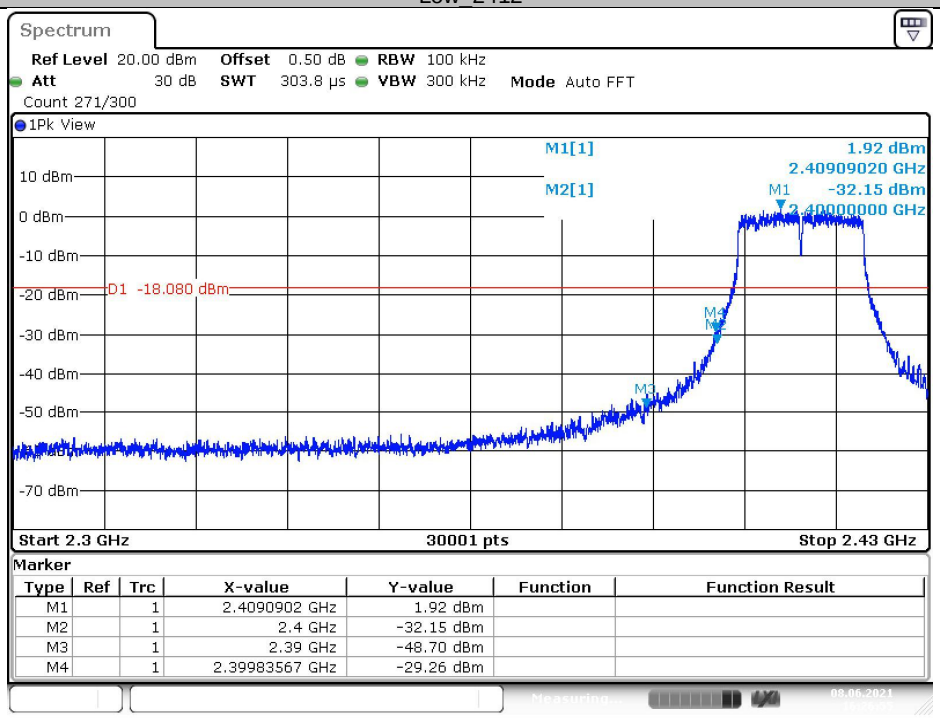
Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4660966 GHz	2.28 dBm		
M2		1	2.4835 GHz	-44.27 dBm		
M3		1	2.5 GHz	-57.31 dBm		
M4		1	2.48381667 GHz	-39.69 dBm		

Date: 8.JUN.2021 16:24:06

802.11 N20

Low_2412

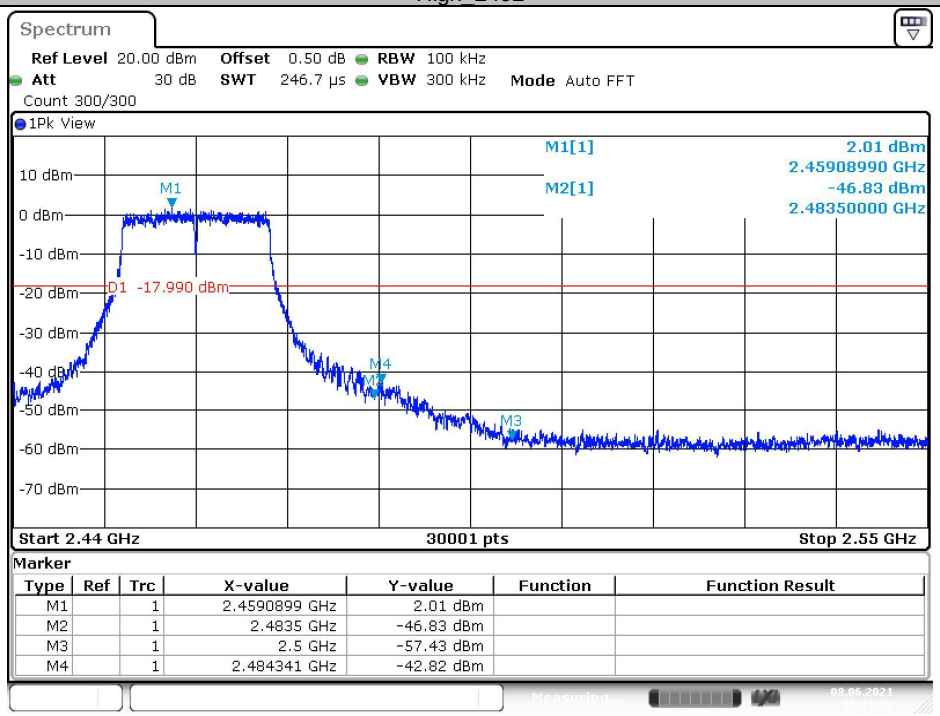


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4090902 GHz	1.92 dBm		
M2		1	2.4 GHz	-32.15 dBm		
M3		1	2.39 GHz	-48.70 dBm		
M4		1	2.39983567 GHz	-29.26 dBm		

Date: 8.JUN.2021 16:26:55

High_2462



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4590899 GHz	2.01 dBm		
M2		1	2.4835 GHz	-46.83 dBm		
M3		1	2.5 GHz	-57.43 dBm		
M4		1	2.484341 GHz	-42.82 dBm		

Date: 8.JUN.2021 16:31:42

9.7 Spurious radiated emissions for transmitter

Test Method

1. The EUT was place 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 ≥ [3 × RBW].
c) Detector = RMS (power averaging), if [span / (# of points in sweep)] ≤ 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 section15.205 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 dBµV/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

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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: 802.11B					
Channel 1 (2412MHz)					
Frequency (MHz)	**Measure Level (dBuV/m)**	**Limit (dBuV/M)**	**Margin (dB)**	**Detector**	**Polarization**
2385.9	48.27	74.0	25.73	Peak	Horizontal
4823.8	47.02	74.0	26.98	Peak	Horizontal
2386.5	45.93	74.0	28.07	Peak	Vertical
4823.8	44.34	74.0	29.66	Peak	Vertical

Test mode: 802.11B					
Channel 6 (2437MHz)					
Frequency (MHz)	**Measure Level (dBuV/m)**	**Limit (dBuV/M)**	**Margin (dB)**	**Detector**	**Polarization**
4873.7	46.33	74.0	27.67	Peak	Horizontal
4873.2	44.23	74.0	29.77	Peak	Vertical

Test mode: 802.11B					
Channel 11 (2462MHz)					
Frequency (MHz)	**Measure Level (dBuV/m)**	**Limit (dBuV/M)**	**Margin (dB)**	**Detector**	**Polarization**
2483.5	47.91	74.0	26.09	Peak	Horizontal
4924.1	46.91	74.0	27.09	Peak	Horizontal
2483.5	46.79	74.0	27.21	Peak	Vertical
4923.6	46.74	74.0	27.26	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**
2389.6	55.46	74.0	18.54	Peak	Horizontal
2389.6	44.96	54.0	9.04	Average	Horizontal
4815.3	44.23	74.0	29.77	Peak	Horizontal
2388.6	51.09	74.0	22.91	Peak	Vertical
4825.0	42.72	74.0	31.28	Peak	Vertical

Test mode: 802.11G					
Channel 6 (2437MHz)					
Frequency (MHz)	**Measure Level (dBuV/m)**	**Limit (dBuV/M)**	**Margin (dB)**	**Detector**	**Polarization**
4876.7	44.22	74.0	29.78	Peak	Horizontal
4835.7	42.49	74.0	31.51	Peak	Vertical
Test mode: 802.11G					
Channel 11 (2462MHz)					
Frequency (MHz)	**Measure Level (dBuV/m)**	**Limit (dBuV/M)**	**Margin (dB)**	**Detector**	**Polarization**
2483.6	62.75	74.0	11.25	Peak	Horizontal
2483.6	50.80	54.0	3.20	Average	Horizontal
2484.8	61.81	74.0	12.19	Peak	Horizontal
2484.8	48.80	54.0	5.20	Average	Horizontal
4927.0	44.62	74.0	29.38	Peak	Horizontal
2483.6	61.31	74.0	12.69	Peak	Vertical
2483.6	49.60	54.0	4.40	Average	Vertical
2484.8	59.58	74.0	12.69	Peak	Vertical
2484.8	47.70	54.0	6.30	Average	Vertical
4921.9	44.69	74.0	29.31	Peak	Vertical
8026.6	50.13	74.0	23.87	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
2389.3	57.89	74.0	16.11	Peak	Horizontal
2389.3	48.00	54.0	6.00	Average	Horizontal
6952.8	48.43	74.0	25.57	Peak	Horizontal
2389.1	49.02	74.0	24.98	Peak	Vertical
2389.1	45.30	54.0	8.70	Average	Vertical
4630.6	46.49	74.0	27.51	Peak	Vertical
7495.7	44.64	74.0	29.36	Peak	Vertical

Test mode: 802.11N20					
Channel 6 (2437MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
4876.0	44.81	74.0	29.19	Peak	Horizontal
5108.3	45.21	74.0	28.79	Peak	Vertical

Test mode: 802.11N20					
Channel 11 (2462MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2483.6	59.14	74.0	14.86	Peak	Horizontal
2483.6	48.20	54.0	5.80	Average	Horizontal
2484.0	59.68	74.0	14.32	Peak	Horizontal
2484.0	47.40	54.0	6.60	Average	Horizontal
4917.9	45.60	74.0	28.40	Peak	Horizontal
2483.5	57.22	74.0	16.78	Peak	Vertical
2483.5	44.20	54.0	9.80	Average	Vertical
2484.2	54.97	74.0	19.03	Peak	Vertical
2484.2	42.40	54.0	11.60	Average	Vertical
4928.1	45.15	74.0	28.85	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

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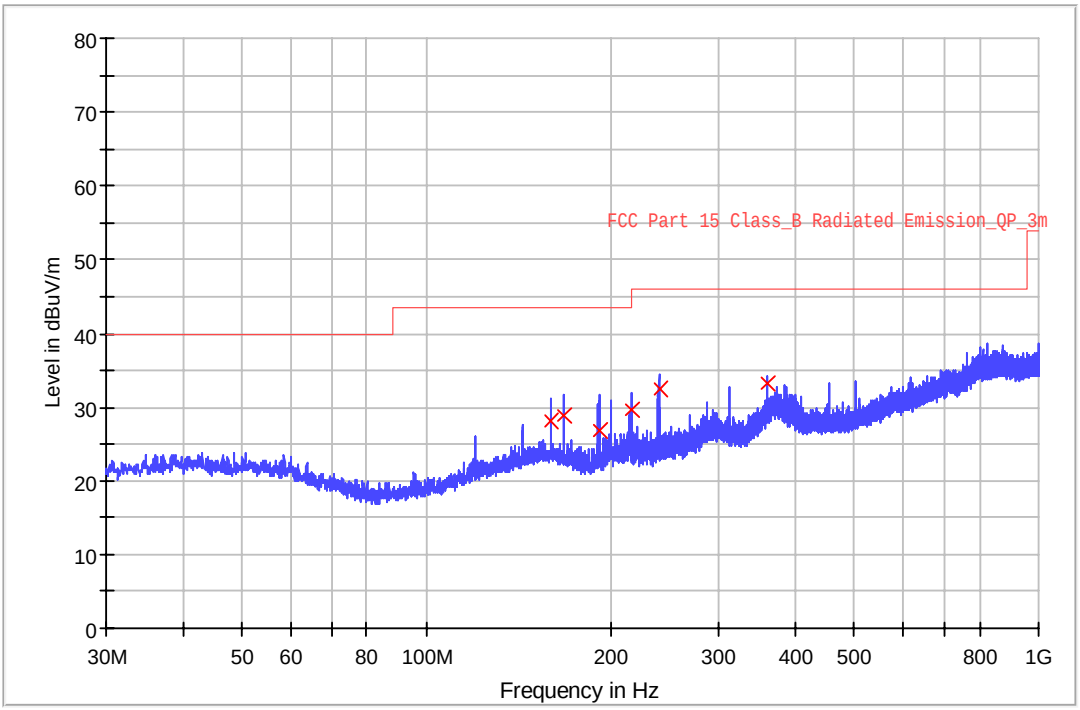
The worst case of Radiated Emission below 1GHz:

Site: 3 meter chamber	Time: 2021/06/07 - 14:09
Limit: FCC_Part15.209 and RSS-GEN 8.8_RE(3m)	Engineer: Wenqiang LU
Probe: VULB9168	Polarity: Horizontal
UT: Wi-Fi and Bluetooth Module, Model no: WBRU	Power: 120VAC, 60Hz
Note: Transmit by at channel 2437MHz 802.11G (worst case). Note: Pre-scan with three orthogonal axis and worst case as X axis.	

RE_VULB9168_pre_Cont_30-1000



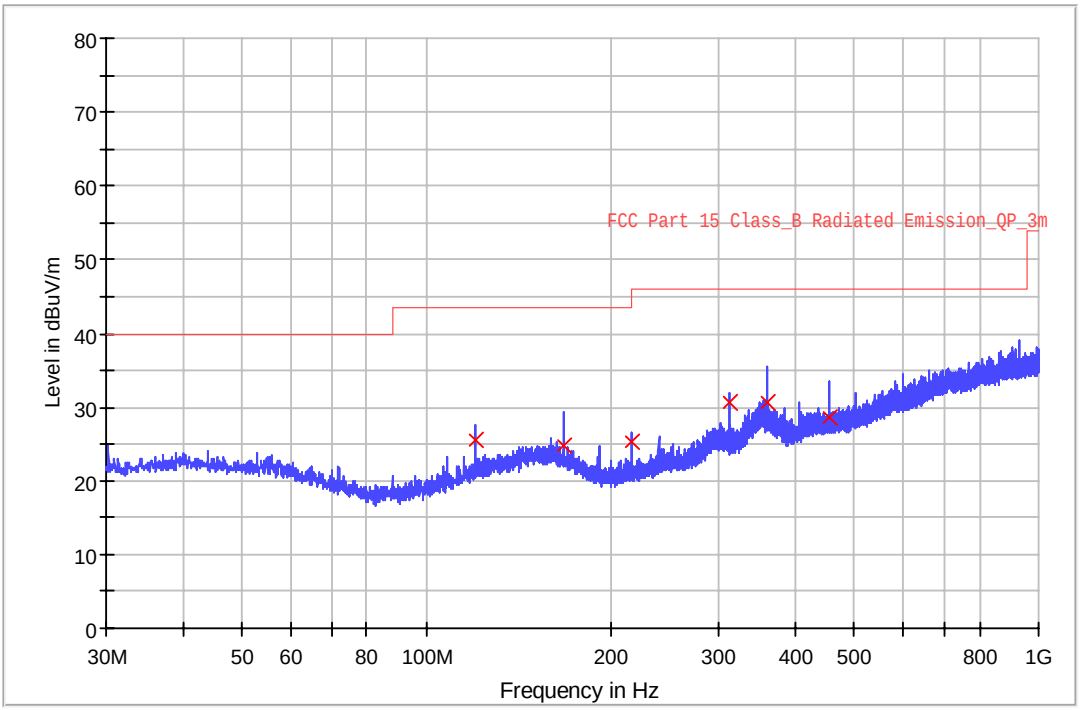
Limit and Margin

Frequency (MHz)	QuasiPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBuV/m)
159.960000	28.2	1000.0	120.000	100.0	H	0.0	15.7	15.3	43.5
168.000000	28.9	1000.0	120.000	100.0	H	0.0	14.9	14.6	43.5
191.840000	26.9	1000.0	120.000	100.0	H	0.0	12.2	16.6	43.5
216.000000	29.6	1000.0	120.000	100.0	H	0.0	12.3	16.4	46.0
240.000000	32.4	1000.0	120.000	100.0	H	0.0	13.4	13.6	46.0
360.000000	33.3	1000.0	120.000	100.0	H	0.0	16.5	12.7	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: 2021/06/07 - 14:37
Limit: FCC_Part15.209 and RSS-GEN 8.8_RE(3m)	Engineer: Wenqiang LU
Probe: VULB9168	Polarity: Vertical
UT: Wi-Fi and Bluetooth Module, Model no: WBRU	Power: 120VAC, 60Hz
Note: Transmit by at channel 2437MHz 802.11G (worst case). 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)
119.960000	25.6	1000.0	120.000	150.0	V	359.0	13.5	17.9	43.5
168.000000	24.7	1000.0	120.000	150.0	V	359.0	14.9	18.8	43.5
216.000000	25.4	1000.0	120.000	150.0	V	359.0	12.3	20.6	46.0
311.960000	30.8	1000.0	120.000	150.0	V	359.0	15.3	15.2	46.0
360.040000	30.6	1000.0	120.000	150.0	V	359.0	16.5	15.4	46.0
455.960000	28.6	1000.0	120.000	150.0	V	359.0	18.6	17.4	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
	Wideband power sensor	Rohde & Schwarz	NRP-Z81	104782	2020-12-23	2021-12-22
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	NIB1910049-YQ-EMC	2020-4-23	2023-4-22
	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	2020-9-23	2021-9-22
	3m Semi-anechoic chamber	TDK	9X6X6	----	2021-05-08	2024-05-07
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	Power Viewer	Rohde & Schwarz	V 11.0
C	Bluetooth and WiFi Test System	Shenzhen JS tonscend 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, ±3.16dB
Radiated Disturbance	30MHz to 1GHz, ±5.03dB (Horizontal) ±5.12dB (Vertical) 1GHz to 18GHz, ±5.49dB 18GHz to 40GHz, ±5.63dB
Carrier power conducted measurement	50MHz~18GHz, ±1.238dB
Spurious Emission Conducted Measurement	9kHz ~40GHz, ± 1.224dB

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12 Photographs of Test Set-ups

Refer to the < Test Setup photos >.

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13 Photographs of EUT

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

THE END

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