

FCC - TEST REPORT

Report Number : **708881974805-00** Date of Issue: June 28, 2019

Model : TYWE2L

Product Type : WIFI Module

FCC ID : 2ANDL-TYWE2L

Applicant : Hangzhou Tuya Information Technology Co.,Ltd

Address of Applicant : Room701,Building3,More Center,No.87 GuDun
: Road, Hangzhou, Zhejiang China

Manufacturer : Hangzhou Tuya Information Technology Co.,Ltd

Address of Manufacturer : Room701,Building3,More Center,No.87 GuDun
: Road, Hangzhou, Zhejiang China

Factory : Same as applicant

Address of Factory : Same as applicant

Test Result : ☒ **Positive** ☐ **Negative**

Total pages including
Appendices : 45

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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 Occupied Bandwidth	16
9.4	Power spectral density	20
9.5	Conducted Band Edge and Out-of-Band Emissions.....	24
9.6	Spurious radiated emissions for transmitter	34
10	Test Equipment List.....	42
11	System Measurement Uncertainty	43
12	Photographs of Test Set-ups	44
13	Photographs of EUT	45



2 Details about the Test Laboratory

Details about the Test Laboratory

Test Site 1

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

FCC Registration No.: 820234
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 Module

Model no.: TYWE2L

FCC ID: 2ANDL-TYWE2L

Trade Mark: NA

Options and accessories: NA

Input Rated Voltage: DC 3.0-3.6V

RF Transmission Frequency: 802.11b/g/n-HT20: 2412~2462 MHz

No. of Operated Channel: 11 for 802.11b/802.11g/802.11(H20)

Channel list:

Operation Frequency each of channel For 802.11b/g/n(H20)							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2412MHz	4	2427MHz	7	2442MHz	10	2457MHz
2	2417MHz	5	2432MHz	8	2447MHz	11	2462MHz
3	2422MHz	6	2437MHz	9	2452MHz		

Radio technology: IEEE 802.11b/802.11g/802.11(H20)

Modulation: Direct Sequence Spread Spectrum (DSSS) for 802.11b
Orthogonal Frequency Division Multiplexing(OFDM) for 802.11g/n

Data speed (IEEE 802.11b): 1Mbps, 2Mbps, 5.5Mbps, 11Mbps

Data speed (IEEE 802.11g): 6Mbps, 9Mbps, 12Mbps, 18Mbps, 24Mbps, 36Mbps,
48Mbps,54Mbps

Data speed (IEEE 802.11n): Up to 72Mbps

Antenna Type: PCB antenna

Antenna Gain: 2.5dBi

Description of the EUT: The Equipment Under Test (EUT) is a WIFI Module supports
2.4GHz WIFI functions



4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to KDB558074 D01 DTS Measurement Guidance v04 and ANSI C63.10 (2013).

5 Summary of Test Results

Technical Requirements						
FCC Part 15 Subpart C						
Test Condition		Page s	Test Site	Test Result		
				Pass	Fail	N/A
§15.207	Conducted emission AC power port	13-15	---	☒	☐	☐
§15.247 (b) (1)	Conducted peak output power	16	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(e)	Power spectral density	22-26	Site 1	☒	☐	☐
§15.247(a)(2)	6dB bandwidth and 99% Occupied Bandwidth	17-21	Site 1	☒	☐	☐
§15.247(d)	Spurious RF conducted emissions	27-39	Site 1	☒	☐	☐
§15.247(d)	Spurious radiated emissions and Band edge for transmitter	40-46	Site 1	☒	☐	☐
§15.203	Antenna requirement	See note 1		☒	☐	☐

Remark 1: N/A – Not Applicable.

Note 1: The EUT uses a permanently integral antenna, which gain is 2.5dBi. According to §15.203, it is considered sufficiently to comply with the provisions of this section.

15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. 15.247(c) (1)(i) requirement: (i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2ANDL-TYWE2L, complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C Rules.

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: June 6, 2019

Testing Start Date: June 6, 2019

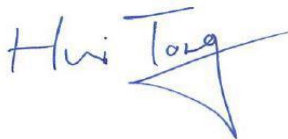
Testing End Date: June 26, 2019

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

Reviewed by:

Prepared by:

Tested by:



Hui TONG
EMC Section Manager



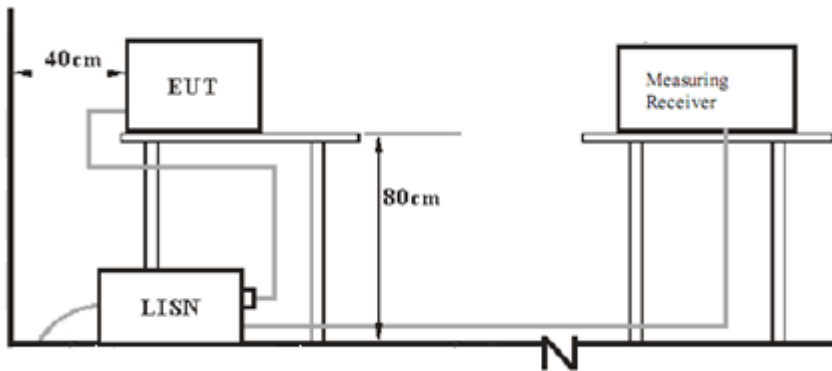
Jiaxi XU
EMC Project Engineer



Wengiang LU
EMC Test Engineer

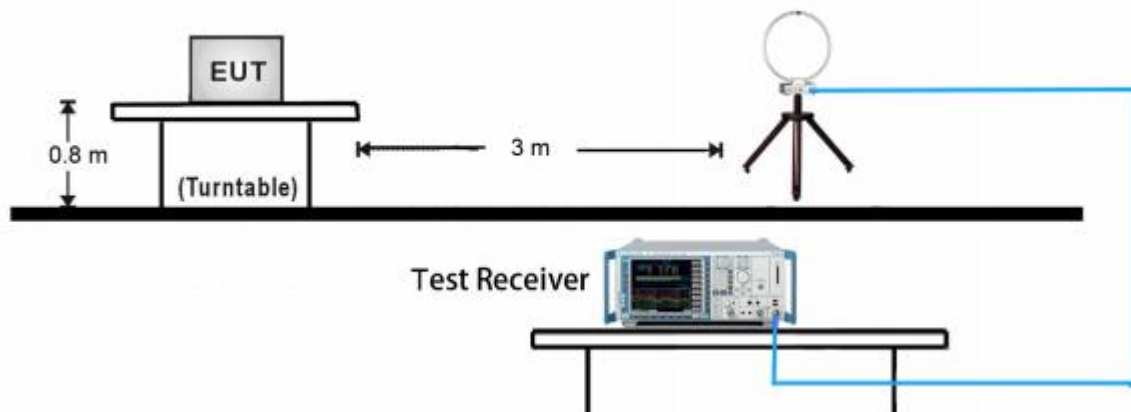
7 Test Setups

7.1 AC Power Line Conducted Emission test setups

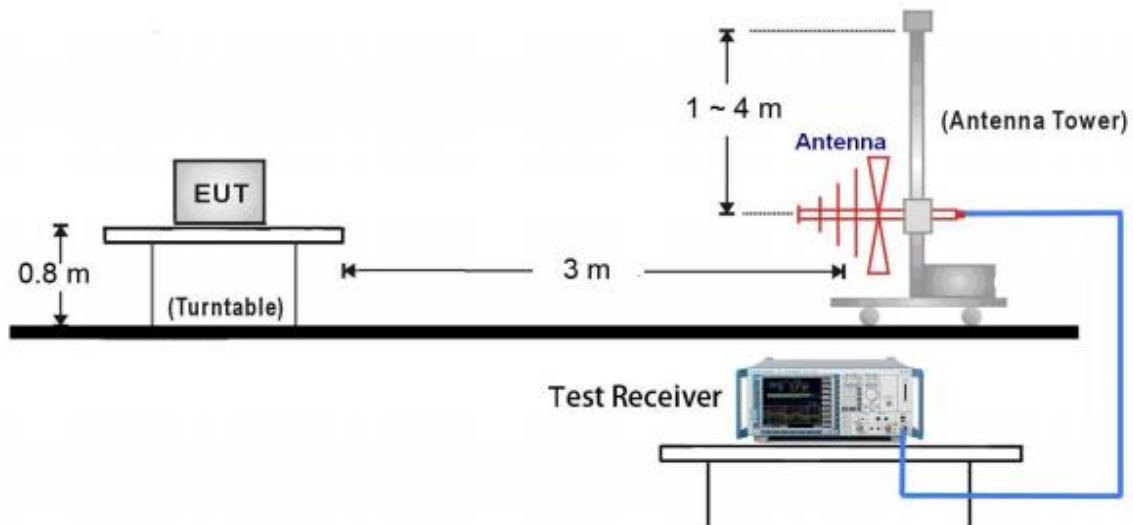


7.2 Radiated test setups

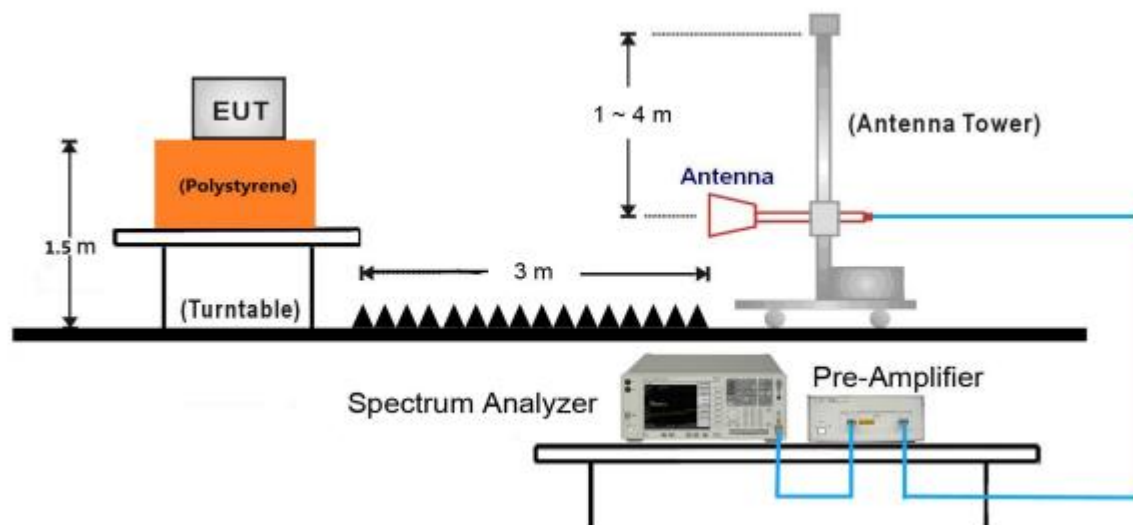
9kHz ~ 30MHz Test Setup:



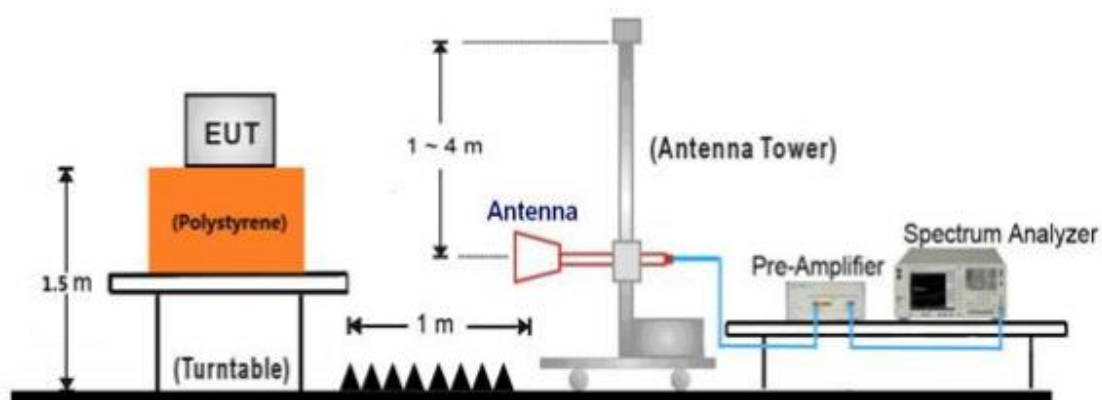
30MHz ~ 1GHz Test Setup:



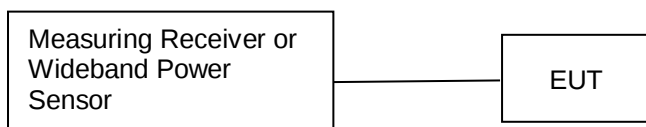
1GHz ~ 18GHz Test Setup:



18GHz ~ 25GHz Test Setup:



7.3 Conducted RF test setups



8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.(SHIELD)
Notebook	Lenove	X240

Test channel & mode:

The EUT configured using a proprietary communication interface provided by the client. The interface allows channel control required to support the evaluation.

Test software	SecureCRT
---------------	-----------

802.11b/802.11g/802.11n-HT20

Test mode	Channel	Frequency (MHz)
Tx	1	2412
Tx	6	2437
Tx	11	2462

The pre-test has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates.

Tested Channel	Modulation Type	Data Rate
Low, Middle, High	802.11b: DSSS	1Mbps
Low, Middle, High	802.11g: OFDM	6Mbps
Low, Middle, High	802.11n (HT20): OFDM	MCS0 (6.5Mbps)

Device Capabilities

This device contains the following capabilities:

802.11b/g/n-HT20 Wi-Fi Device.

Duty Cycle: 100%

Note: 2.4GHz WLAN (DTS) operation is possible in 20MHz channel bandwidths.

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

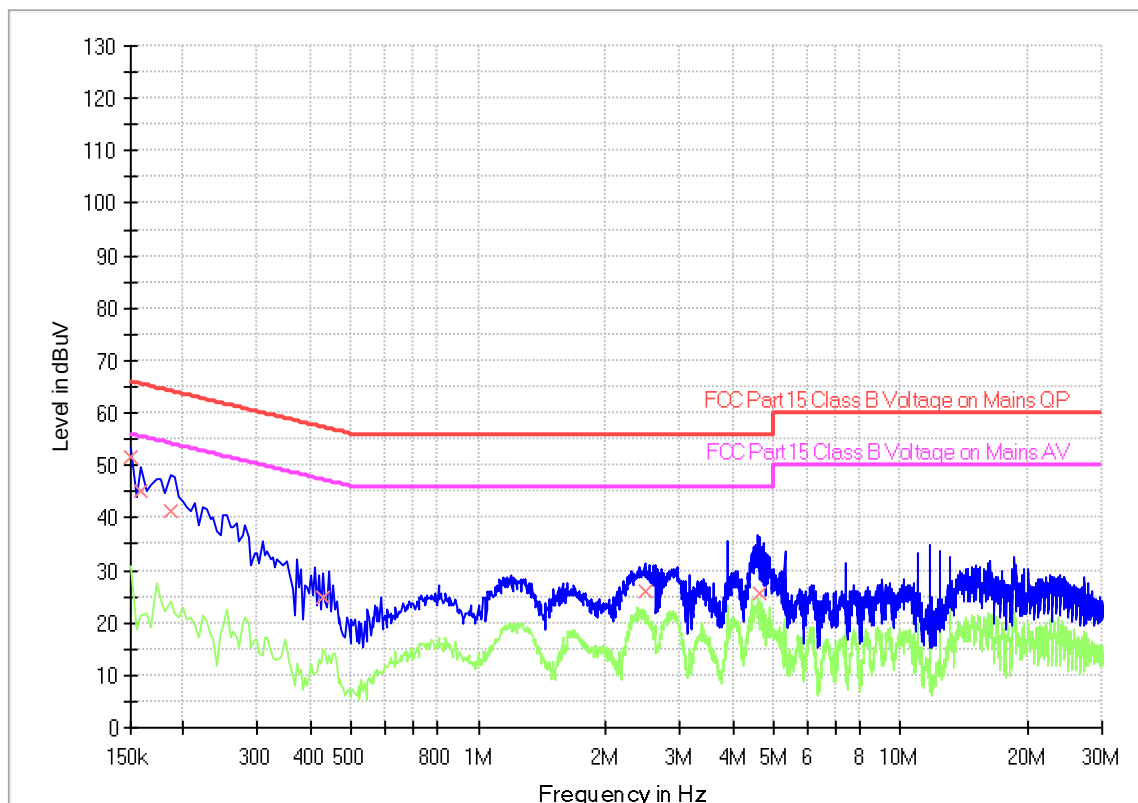
Limit

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

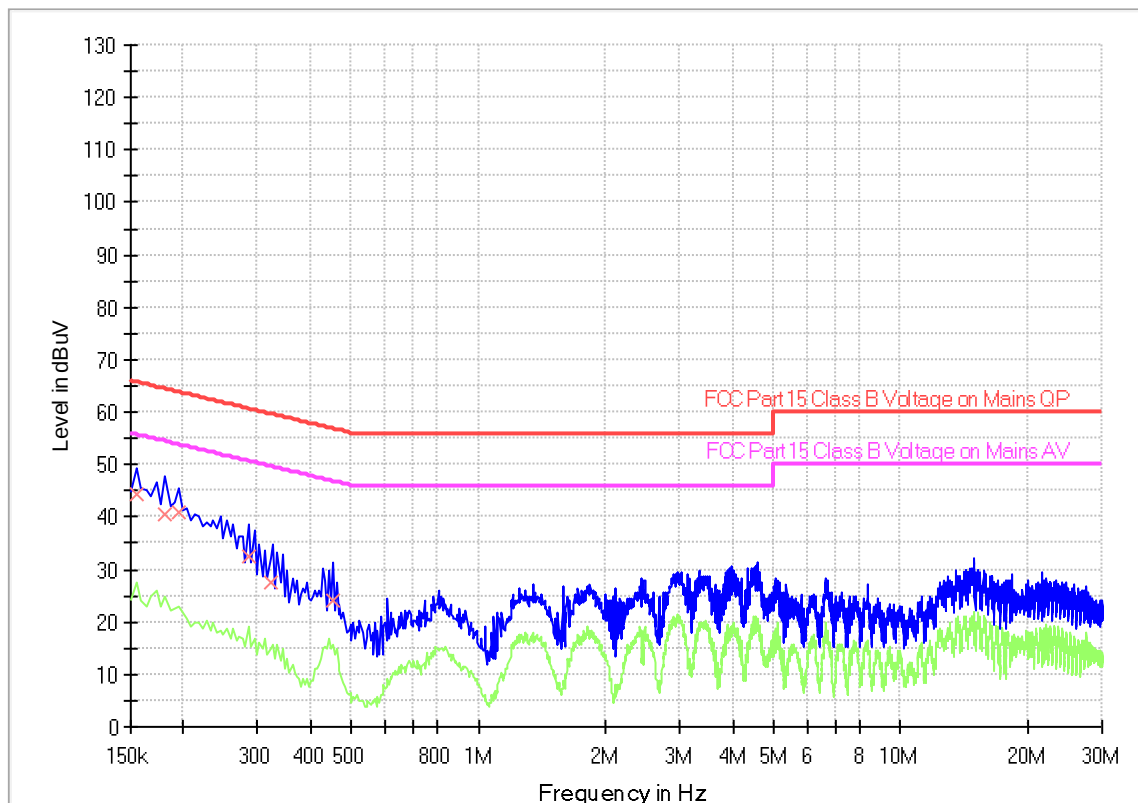
Product Type : WIFI Module
 M/N : TYWE2L
 Operating Condition : Mode 1: Tx_802.11n HT20 2437MHz, powered by notebook
 Test Specification : FCC_Part15.207
 Comment : L-line, AC 120V/60Hz



Final Result

Frequency (MHz)	Quasi Peak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.150000	51.68	---	66.00	14.32	1000.0	9.000	L1	19.5
0.159000	45.13	---	65.52	20.39	1000.0	9.000	L1	19.5
0.186000	41.28	---	64.21	22.93	1000.0	9.000	L1	19.5
0.429000	24.97	---	57.27	32.30	1000.0	9.000	L1	19.5
2.472000	26.12	---	56.00	29.88	1000.0	9.000	L1	19.5
4.645500	25.54	---	56.00	30.46	1000.0	9.000	L1	19.6

Product Type : WIFI Module
 M/N : TYWE2L
 Operating Condition : Mode 1: Tx_802.11n HT20 2437MHz, powered by notebook
 Test Specification : FCC_Part15.207
 Comment : N-line, AC 120V/60Hz



Final Result

Frequency (MHz)	Quasi Peak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.154500	44.42	---	65.75	21.33	1000.0	9.000	N	19.5
0.181500	40.50	---	64.42	23.92	1000.0	9.000	N	19.5
0.195000	40.88	---	63.82	22.94	1000.0	9.000	N	19.5
0.285000	32.53	---	60.67	28.14	1000.0	9.000	N	19.5
0.321000	27.57	---	59.68	32.11	1000.0	9.000	N	19.5
0.451500	23.95	---	56.85	32.90	1000.0	9.000	N	19.4

9.2 Conducted peak output power

Test Method

1. Connect the power meter to the EUT
 - a) The EUT is configured to transmit continuously, or to transmit with a constant duty factor.
 - b) At all times the EUT is transmitting at its maximum power control level.
 - c) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
2. Measure the peak power of the transmitter.
3. Adjust the measurement in dBm by adding $10\log(1/x)$, where x is the duty cycle to the measurement result.

Limits

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

Test result as below table

Mode	Antenna Gain (dBi)	Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)
b	N/A	CH01	2412	22.57	30.00
		CH06	2437	21.89	30.00
		CH11	2462	21.10	30.00
g		CH01	2412	23.32	30.00
		CH06	2437	23.43	30.00
		CH11	2462	23.30	30.00
n-HT20		CH01	2412	23.48	30.00
		CH06	2437	23.57	30.00
		CH11	2462	23.34	30.00

9.3 6dB bandwidth Occupied Bandwidth

Test Method

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

Limit

Limit [kHz]

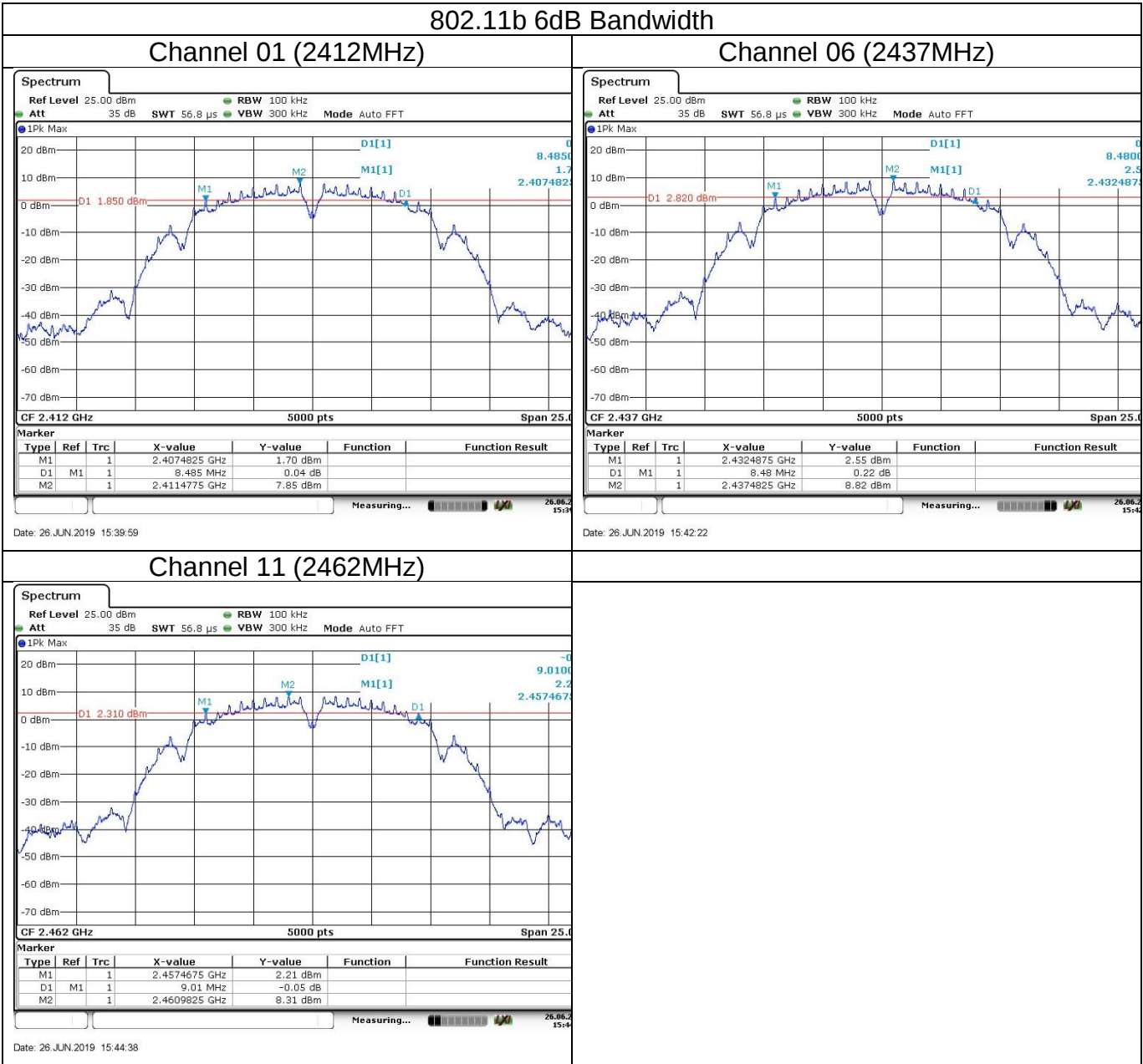
≥ 500

Test result

Test Mode	Data Rate / MCS	Channel No.	Freq. (MHz)	6db Bandwidth (MHz)	Limit (MHz)	Result
802.11b	1Mbps	01	2412	8.485	≥ 0.5	Pass
802.11b	1Mbps	06	2437	8.480	≥ 0.5	Pass
802.11b	1Mbps	11	2462	9.010	≥ 0.5	Pass
802.11g	6Mbps	01	2412	16.338	≥ 0.5	Pass
802.11g	6Mbps	06	2437	16.236	≥ 0.5	Pass
802.11g	6Mbps	11	2462	16.320	≥ 0.5	Pass
802.11n-HT20	6.5Mbps	01	2412	16.734	≥ 0.5	Pass
802.11n-HT20	6.5Mbps	06	2437	16.536	≥ 0.5	Pass
802.11n-HT20	6.5Mbps	11	2462	16.104	≥ 0.5	Pass



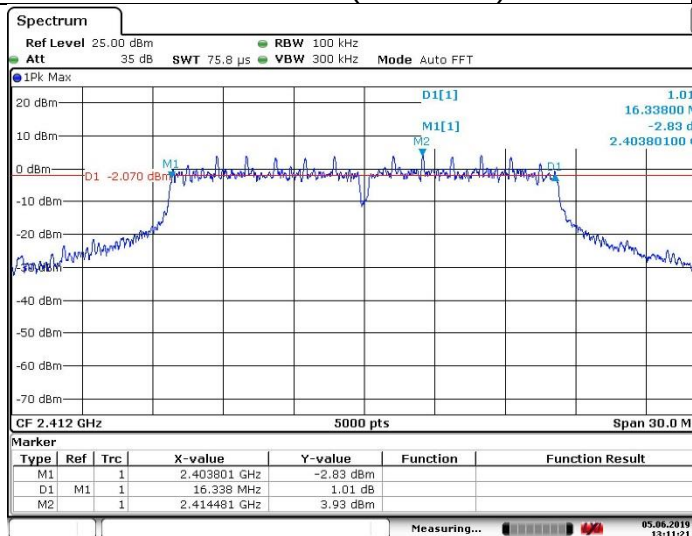
China



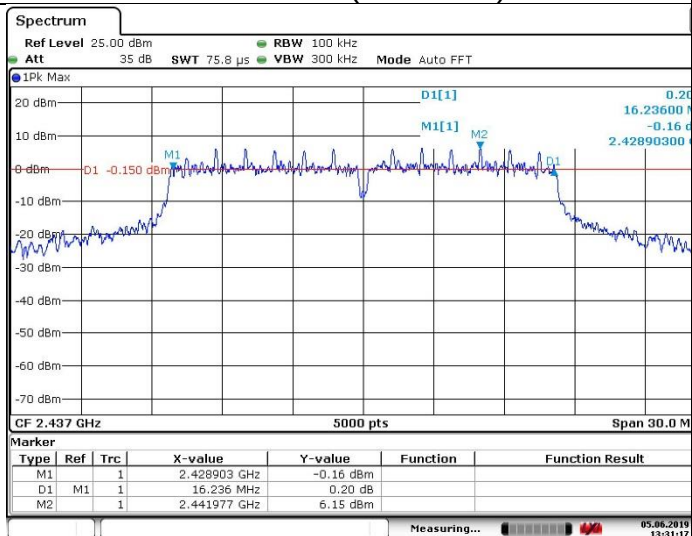
802.11g 6dB Bandwidth

Channel 01 (2412MHz)

Channel 06 (2437MHz)

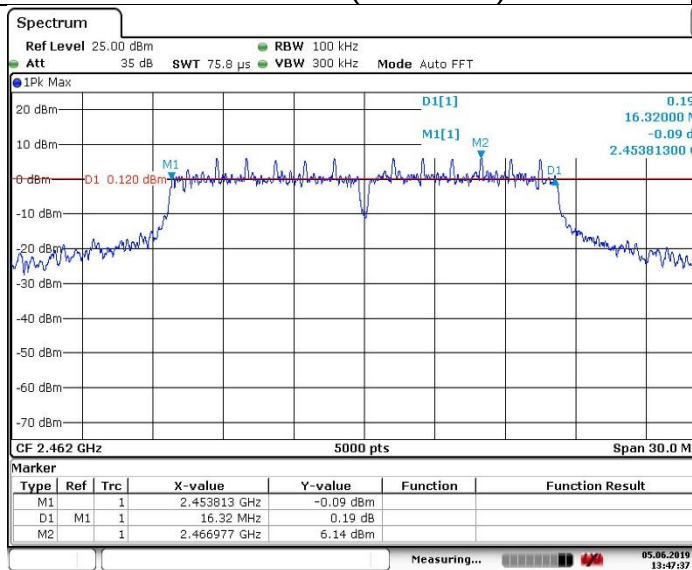


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Date: 5 JUN 2019 13:31:17

Channel 11 (2462MHz)

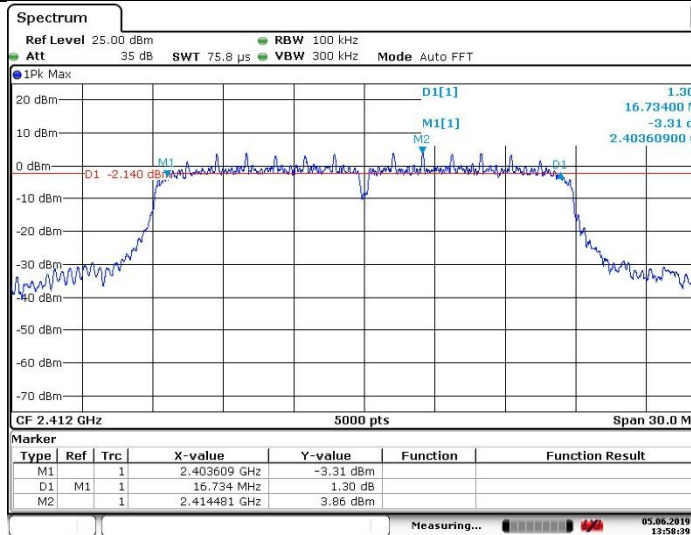


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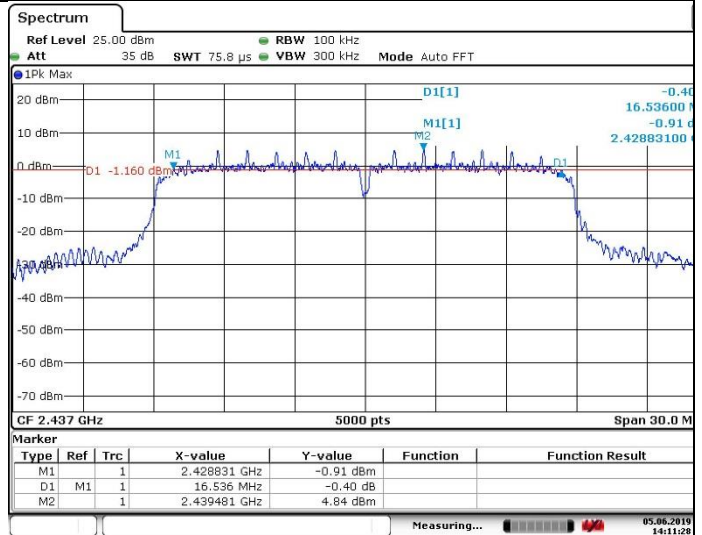
802.11n HT20 6dB Bandwidth

Channel 01 (2412MHz)

Channel 06 (2437MHz)

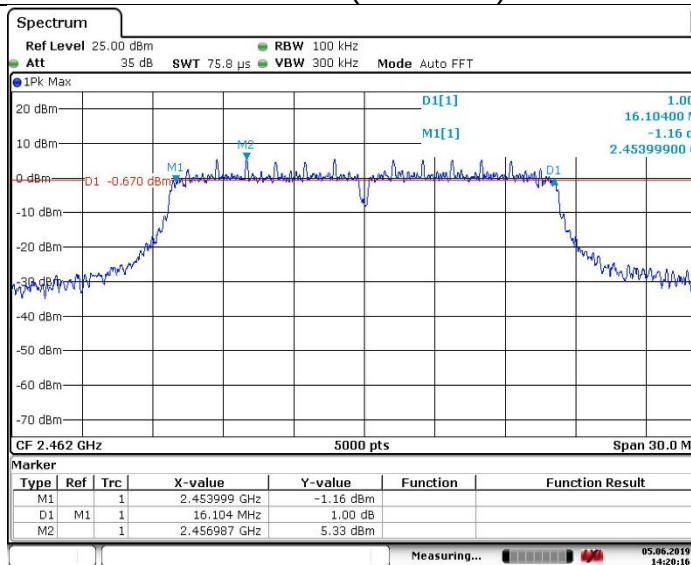


Date: 5 JUN 2019 13:58:39



Date: 5 JUN 2019 14:11:28

Channel 11 (2462MHz)



Date: 5 JUN 2019 14:20:15

9.4 Power spectral density

Test Method

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

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

Limit

Limit [dBm]

≤ 8

Test result

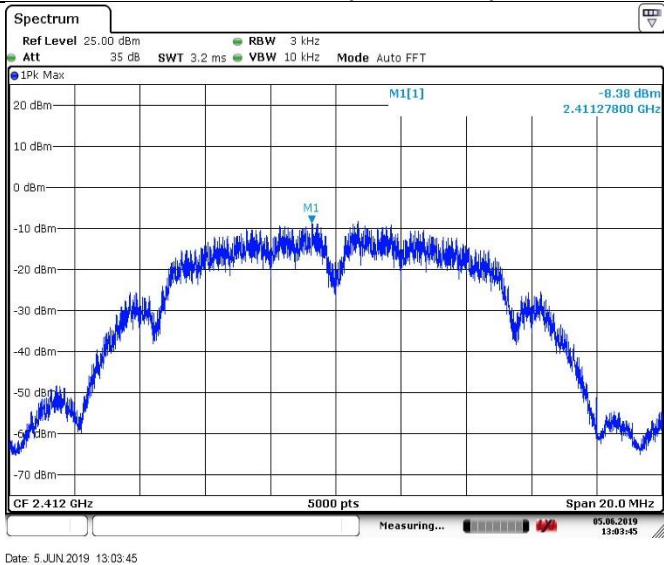
Test Mode	Data Rate / MCS	Channel No.	Freq. (MHz)	PSD (dBm / 10kHz)	Limit (dBm/3kHz)	Result
802.11b	1Mbps	01	2412	-8.38	≤ 8	Pass
802.11b	1Mbps	06	2437	-8.14	≤ 8	Pass
802.11b	1Mbps	11	2462	-8.06	≤ 8	Pass
802.11g	6Mbps	01	2412	-11.51	≤ 8	Pass
802.11g	6Mbps	06	2437	-10.17	≤ 8	Pass
802.11g	6Mbps	11	2462	-8.93	≤ 8	Pass
802.11n-HT20	6.5Mbps	01	2412	-11.13	≤ 8	Pass
802.11n-HT20	6.5Mbps	06	2437	-9.18	≤ 8	Pass
802.11n-HT20	6.5Mbps	11	2462	-10.25	≤ 8	Pass



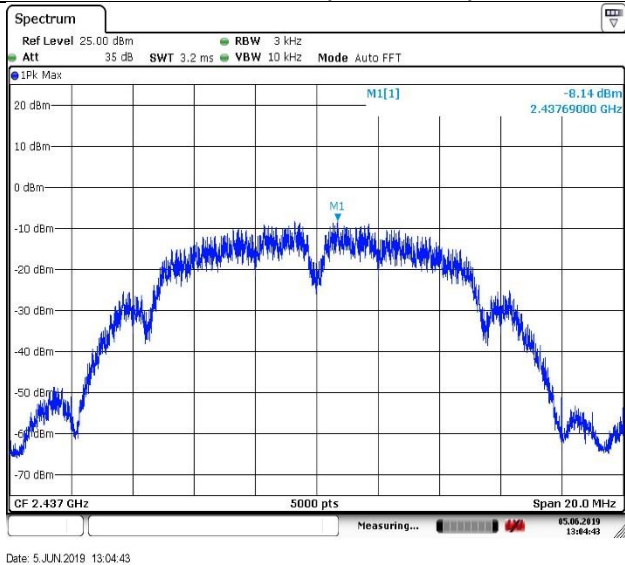
China

802.11b PSD

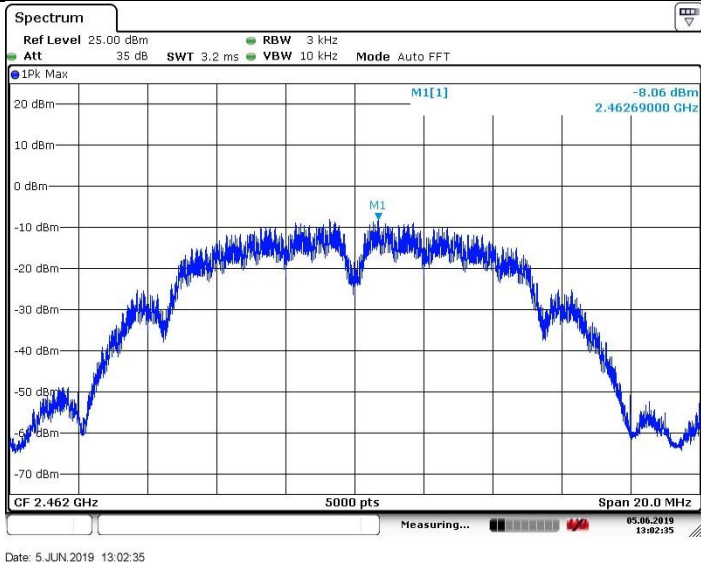
Channel 01 (2412MHz)



Channel 06 (2437MHz)

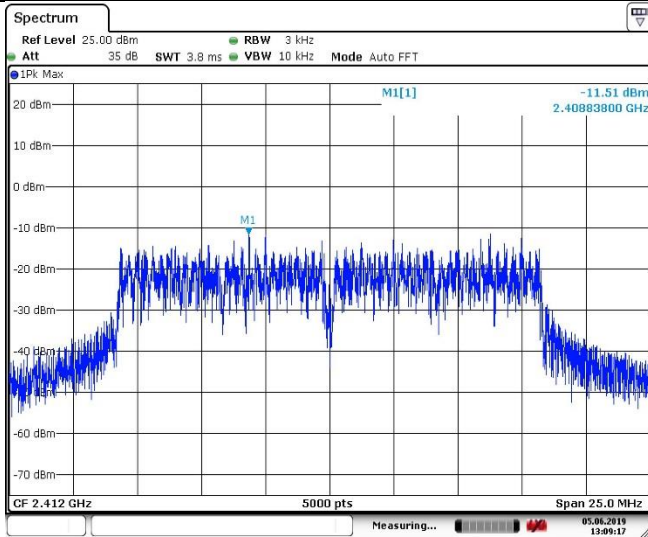


Channel 11 (2462MHz)



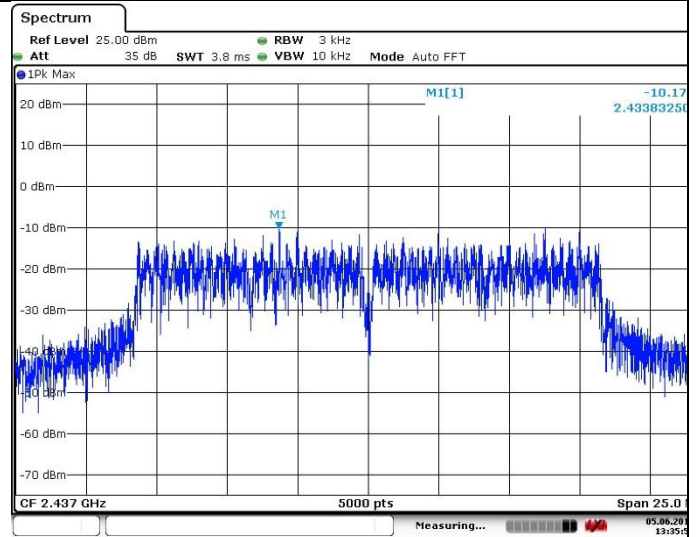
802.11g PSD

Channel 01 (2412MHz)



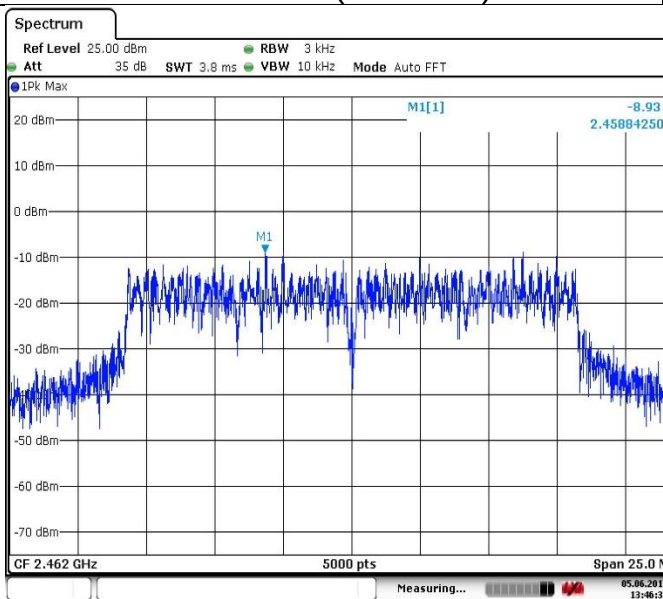
Date: 5 JUN 2019 13:09:16

Channel 06 (2437MHz)

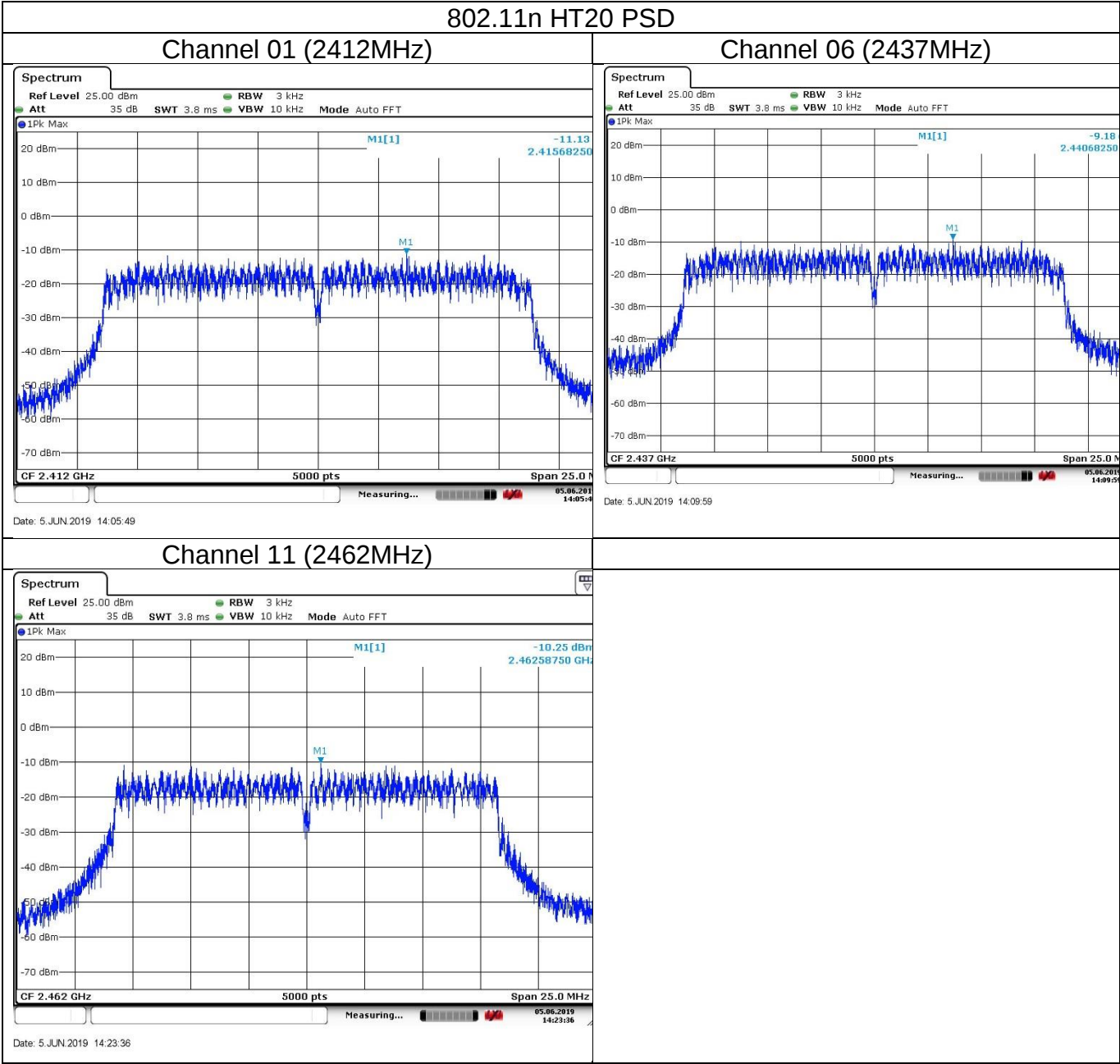


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Channel 11 (2462MHz)



Date: 5 JUN 2019 13:46:35



9.5 Conducted Band Edge and Out-of-Band Emissions

Test Method

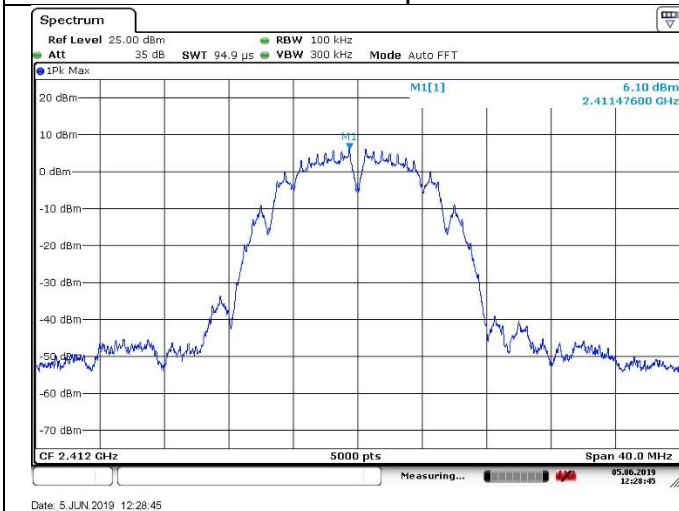
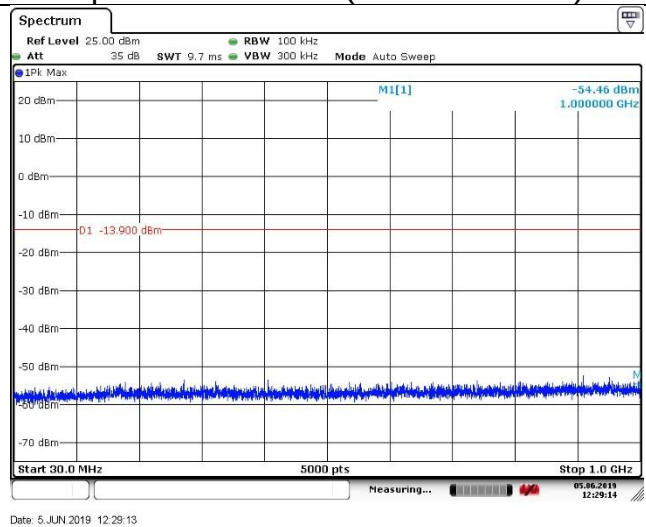
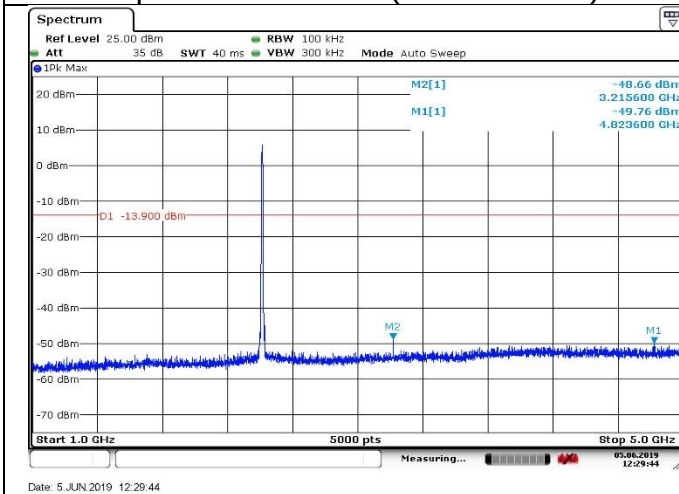
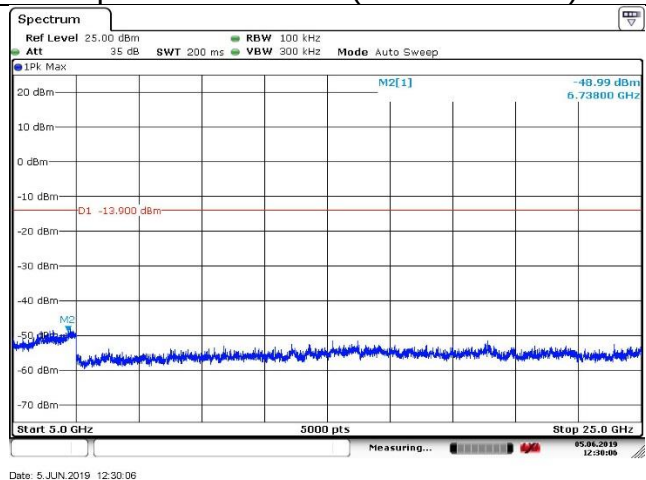
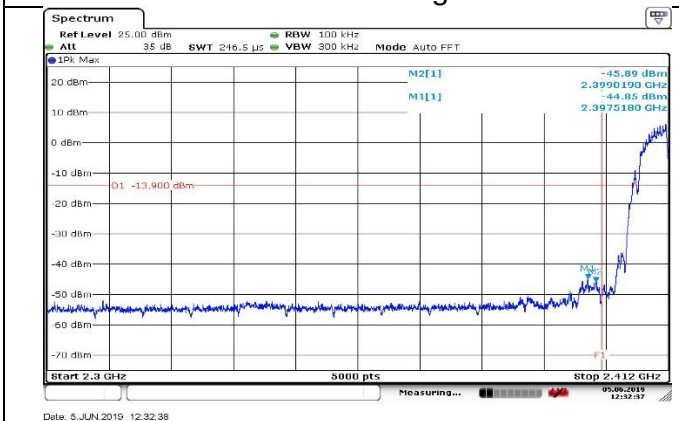
1. Establish a reference level by using the following procedure:
 - a. Set RBW=100 kHz. VBW $\geq$ 3RBW. Detector =peak, Sweep time = auto couple, Trace mode = max hold.
 - b. Allow trace to fully stabilize, use the peak marker function to determine the maximum PSD level.
2. Use the maximum PSD level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

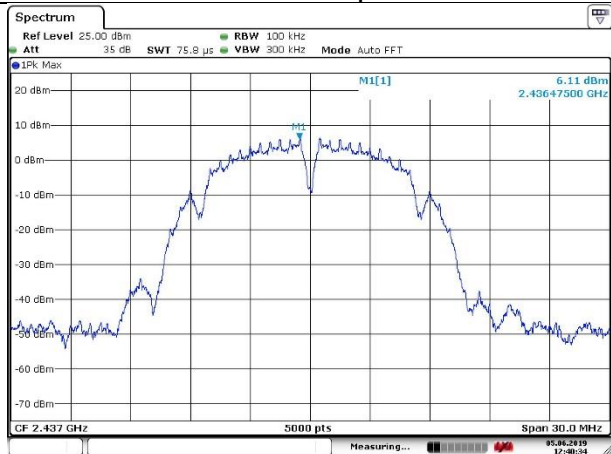
Test result

Test Mode	Data Rate / MCS	Channel No.	Freq. (MHz)	Limit	Result
802.11b	1Mbps	01	2412	20dBc	Pass
802.11b	1Mbps	06	2437	20dBc	Pass
802.11b	1Mbps	11	2462	20dBc	Pass
802.11g	6Mbps	01	2412	20dBc	Pass
802.11g	6Mbps	06	2437	20dBc	Pass
802.11g	6Mbps	11	2462	20dBc	Pass
802.11n-HT20	6.5Mbps	01	2412	20dBc	Pass
802.11n-HT20	6.5Mbps	06	2437	20dBc	Pass
802.11n-HT20	6.5Mbps	11	2462	20dBc	Pass

Spurious RF conducted emissions**802.11b Out-of-Band Emissions****Channel 01 (2412MHz)****Referencel point****Spurious Emission (30MHz – 1GHz)****Spurious Emission (1GHz – 5GHz)****Spurious Emission (5GHz – 25GHz)****Low band edge**

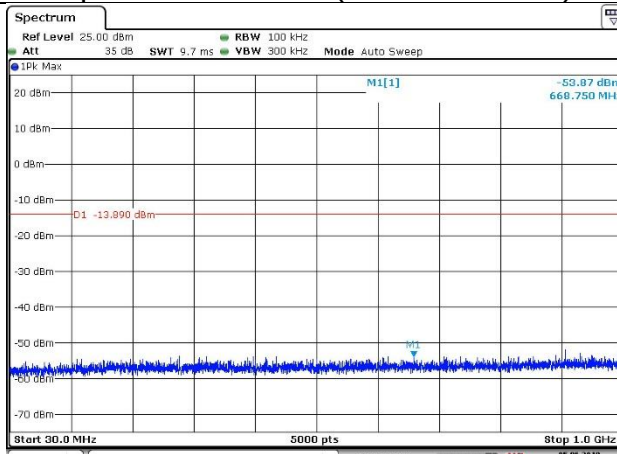
802.11b Out-of-Band Emission Channel 06 (2437MHz)

Referencel point



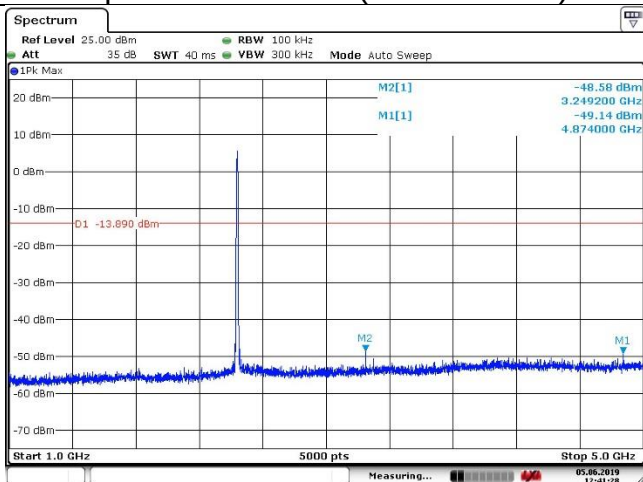
Date: 5 JUN 2019 12:40:34

Spurious Emission (30MHz – 1GHz)



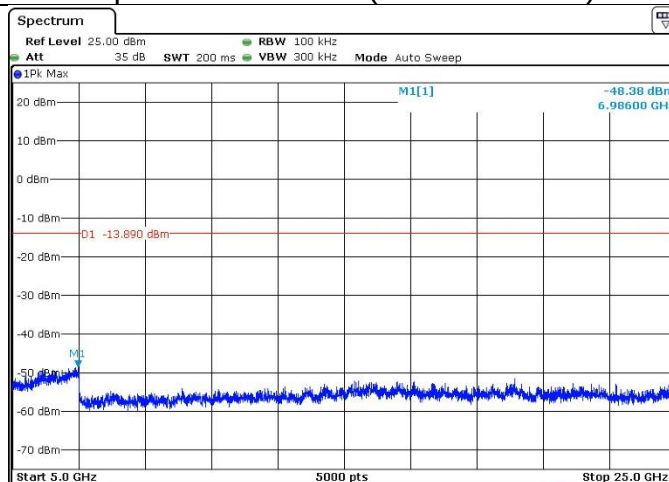
Date: 5 JUN 2019 12:40:59

Spurious Emission (1GHz –5GHz)



Date: 5 JUN 2019 12:41:28

Spurious Emission (5GHz –25GHz)

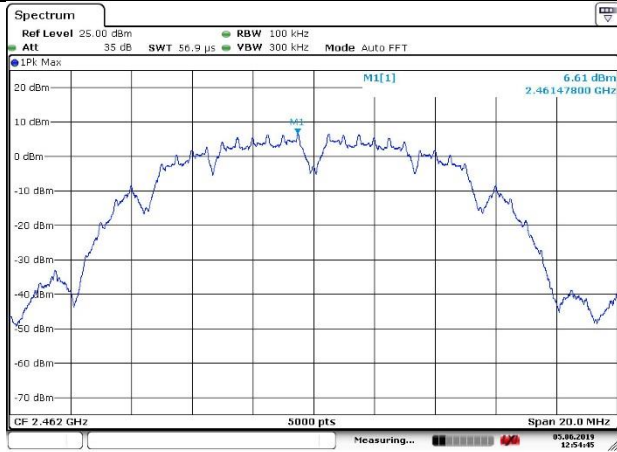


Date: 5 JUN 2019 12:41:44

802.11b Out-of-Band Emissions

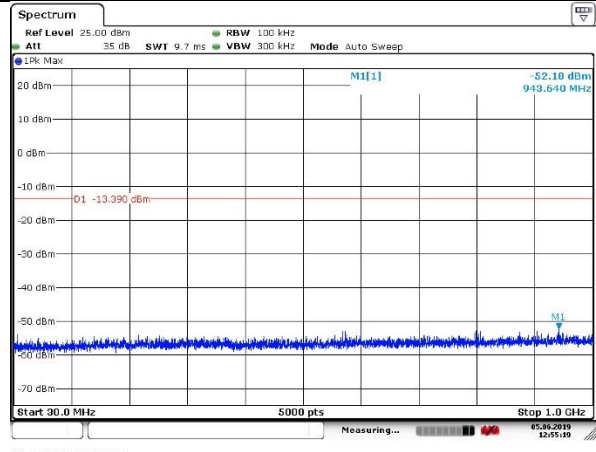
Channel 01 (2462MHz)

Referencel point



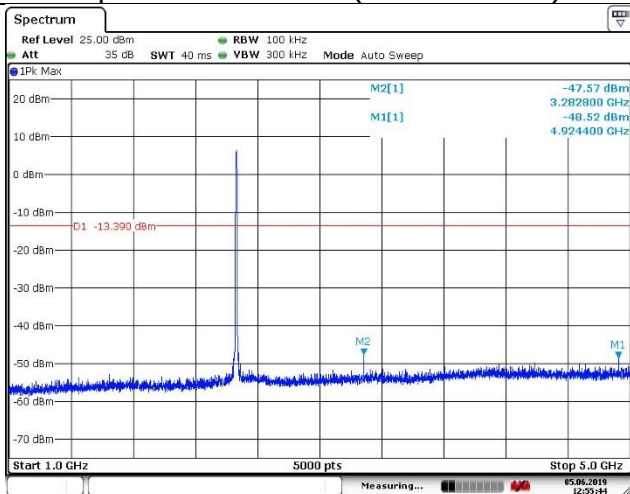
Date: 5 JUN 2019 12:54:05

Spurious Emission (30MHz – 1GHz)



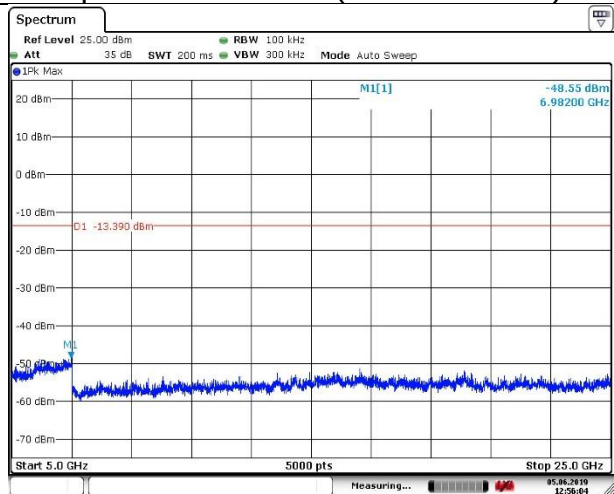
Date: 5 JUN 2019 12:55:19

Spurious Emission (1GHz – 5GHz)



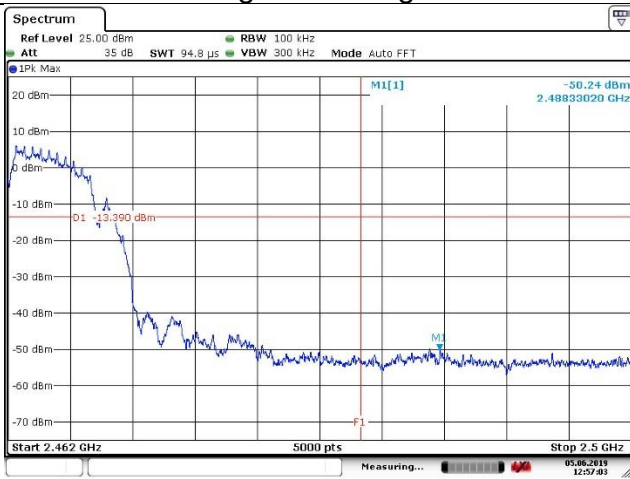
Date: 5 JUN 2019 12:55:44

Spurious Emission (5GHz – 25GHz)



Date: 5 JUN 2019 12:56:04

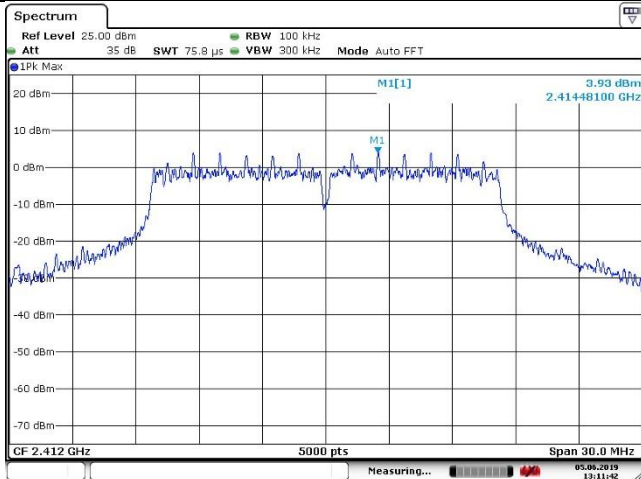
High band edge



Date: 5 JUN 2019 12:57:03

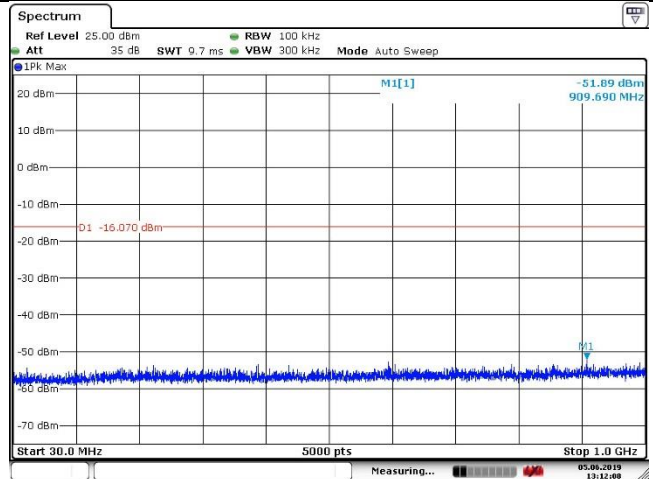
802.11g Out-of-Band Emissions Channel 01 (2412MHz)

Referencel point



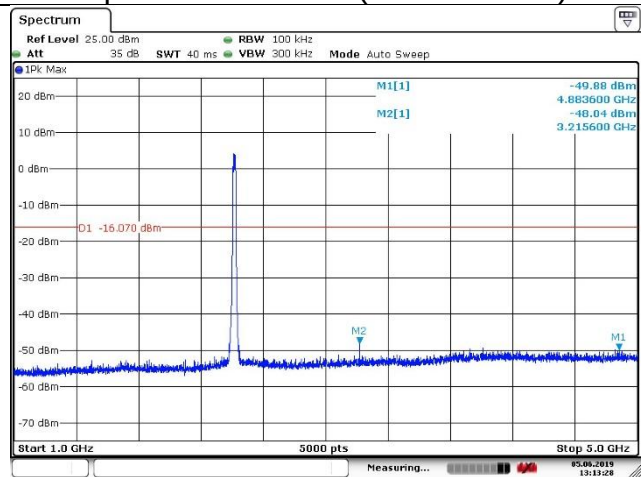
Date: 5 JUN 2019 13:11:42

Spurious Emission (30MHz – 1GHz)



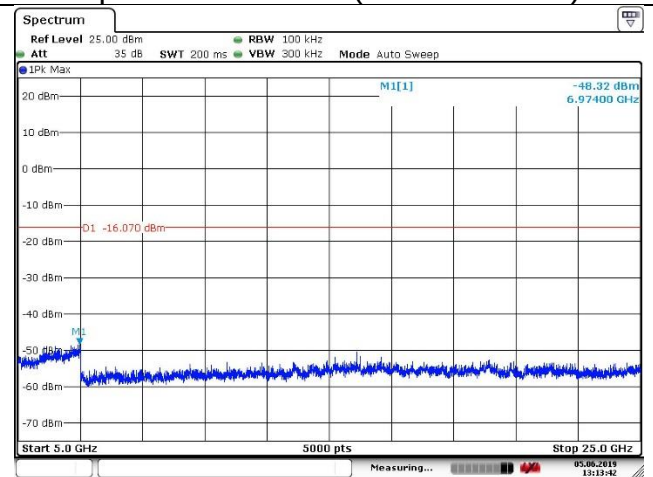
Date: 5 JUN 2019 13:12:08

Spurious Emission (1GHz – 5GHz)



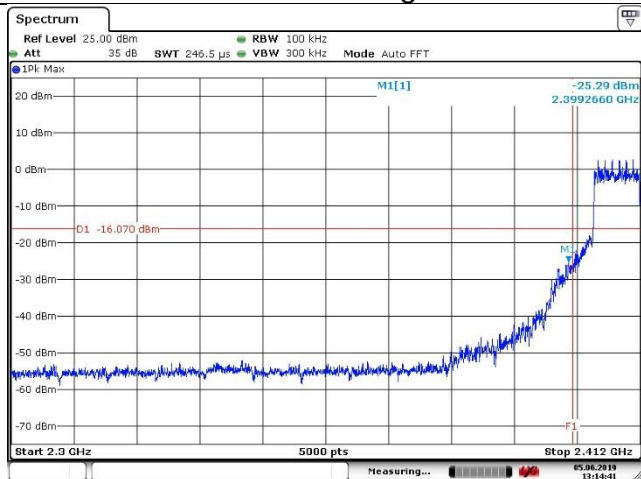
Date: 5 JUN 2019 13:13:28

Spurious Emission (5GHz – 25GHz)



Date: 5 JUN 2019 13:13:42

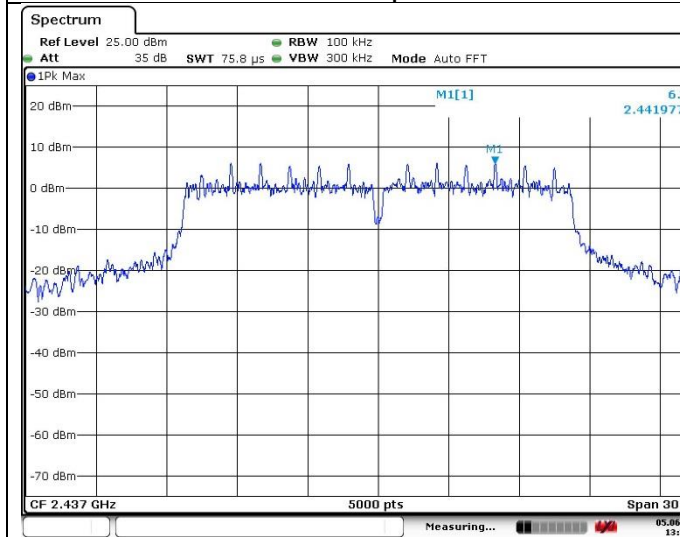
Low band edge



Date: 5 JUN 2019 13:14:41

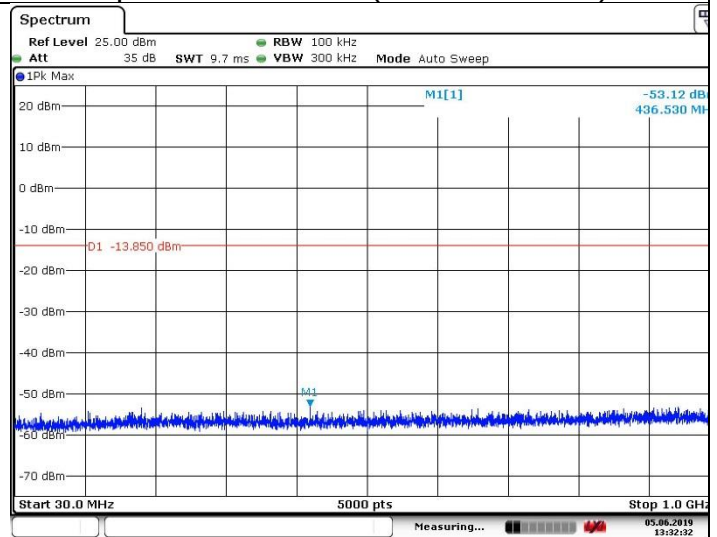
802.11g Out-of-Band Emissions Channel 06 (2437MHz)

Referencel point



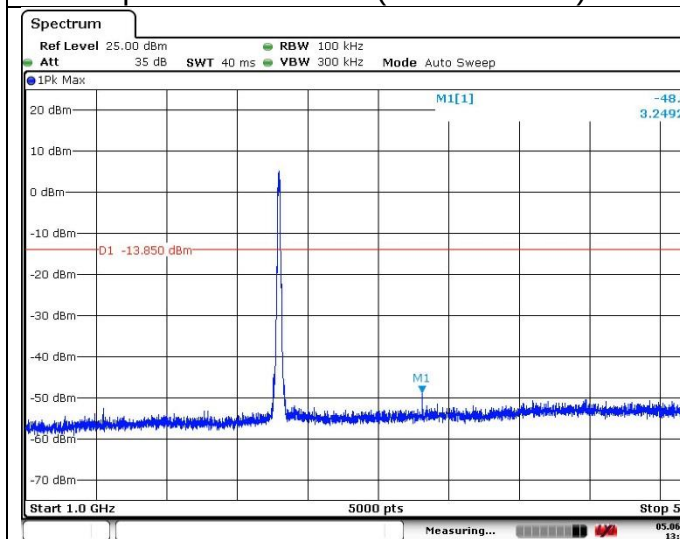
Date: 5 JUN 2019 13:32:02

Spurious Emission (30MHz – 1GHz)



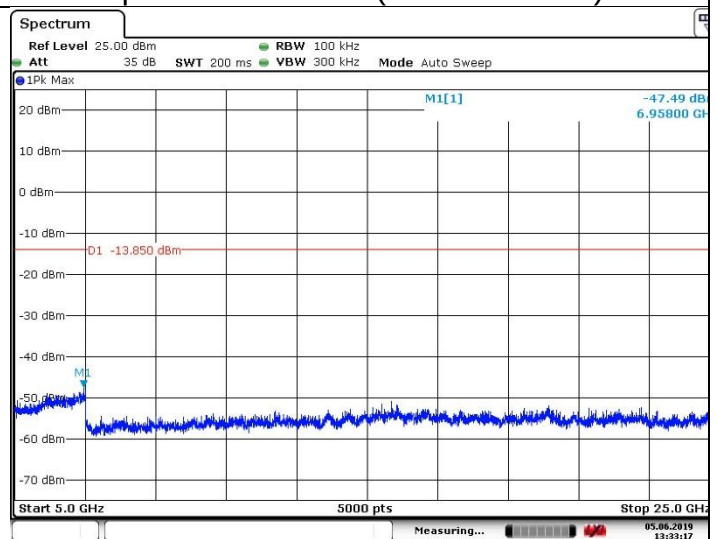
Date: 5 JUN 2019 13:32:32

Spurious Emission (1GHz –5GHz)



Date: 5 JUN 2019 13:32:54

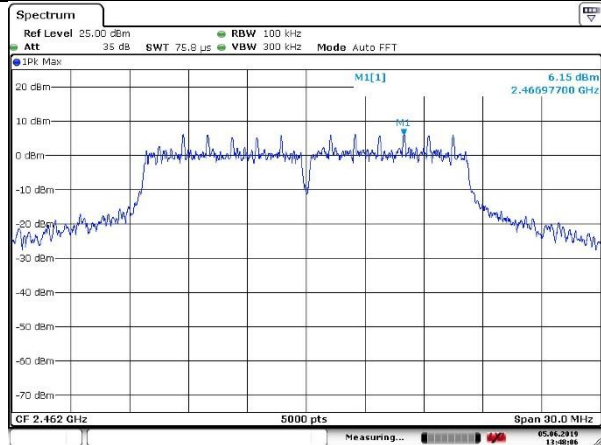
Spurious Emission (5GHz –25GHz)



Date: 5 JUN 2019 13:33:17

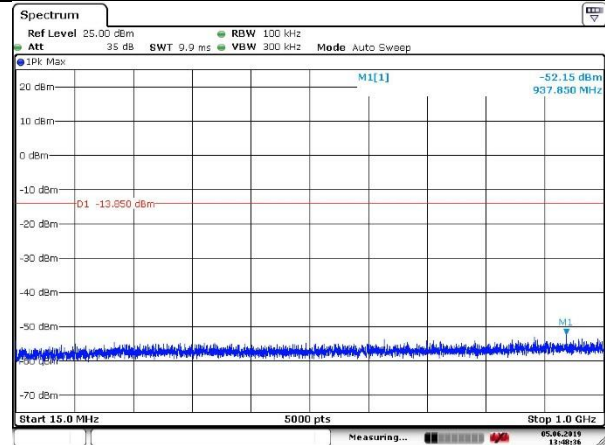
802.11g Out-of-Band Emissions Channel 11 (2462MHz)

Referencel point



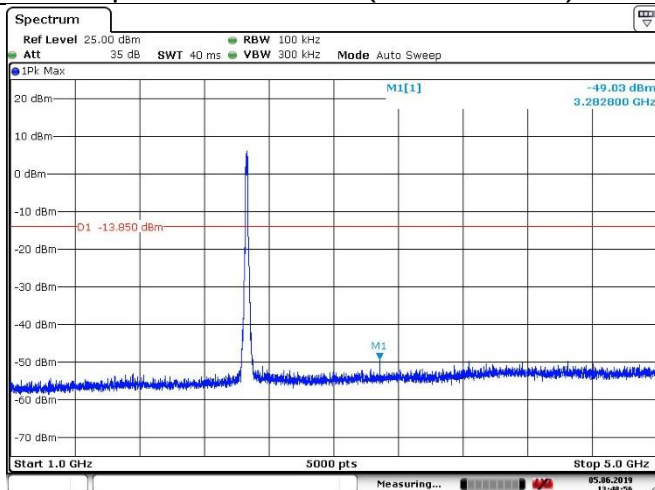
Date: 5 JUN 2019 13:48:06

Spurious Emission (30MHz – 1GHz)



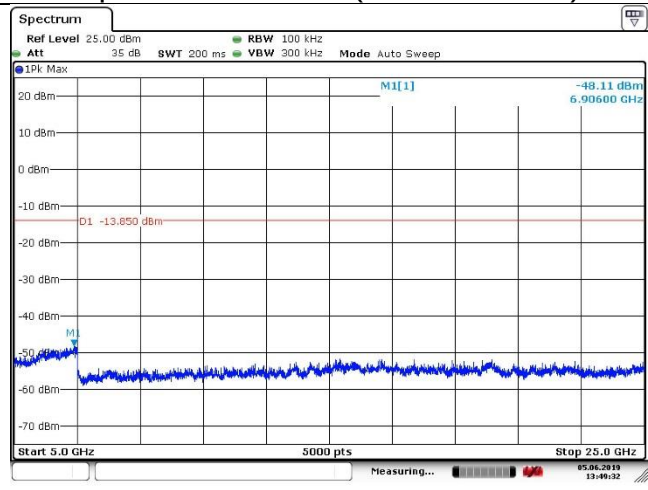
Date: 5 JUN 2019 13:48:37

Spurious Emission (1GHz –5GHz)



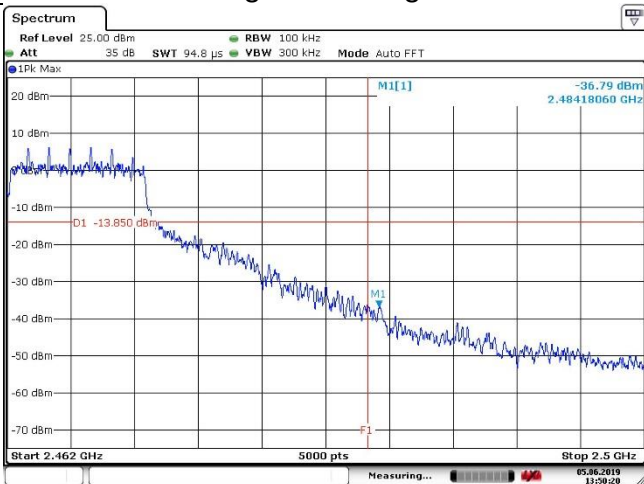
Date: 5 JUN 2019 13:48:56

Spurious Emission (5GHz –25GHz)



Date: 5 JUN 2019 13:49:32

High band edge

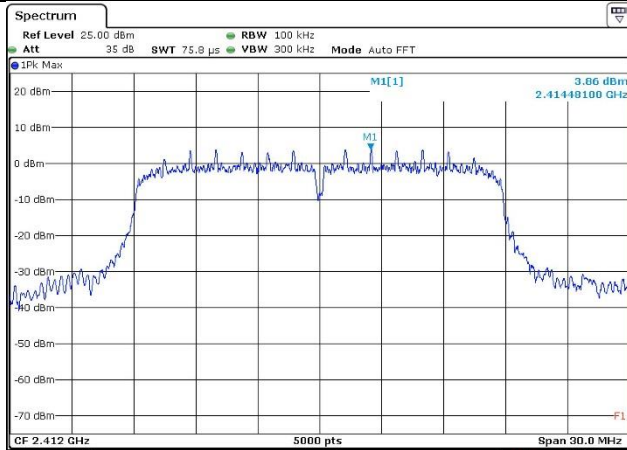


Date: 5 JUN 2019 13:50:20

802.11n-HT20 Out-of-Band Emissions

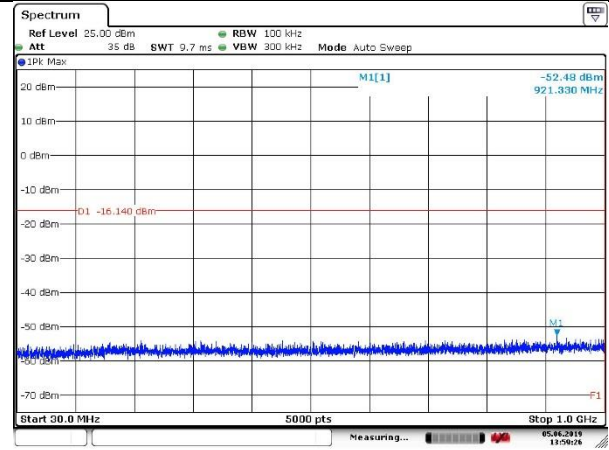
Channel 01 (2412MHz)

Referencel point



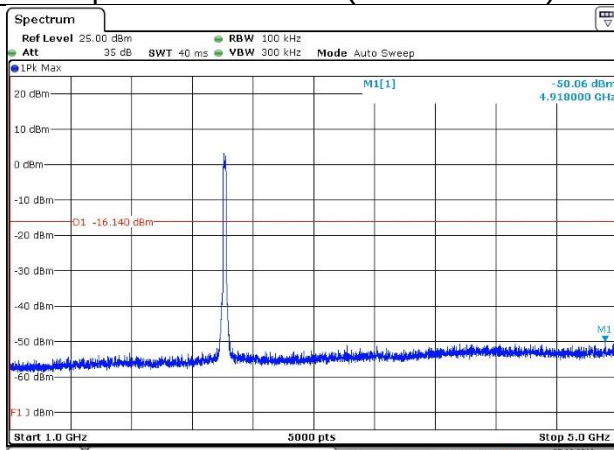
Date: 5 JUN 2019 13:58:58

Spurious Emission (30MHz – 1GHz)



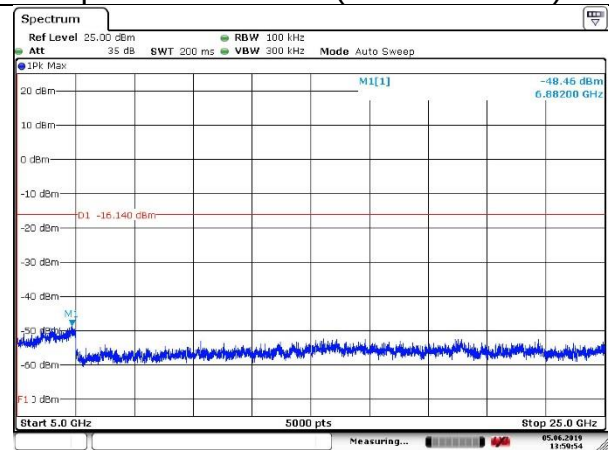
Date: 5 JUN 2019 13:59:26

Spurious Emission (1GHz –5GHz)



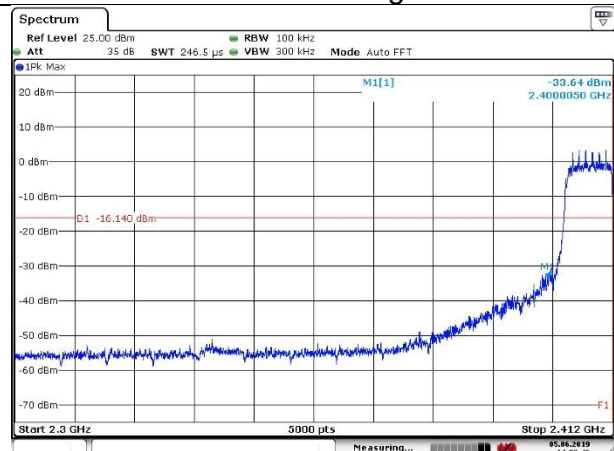
Date: 5 JUN 2019 13:59:43

Spurious Emission (5GHz –25GHz)



Date: 5 JUN 2019 13:59:54

Low band edge

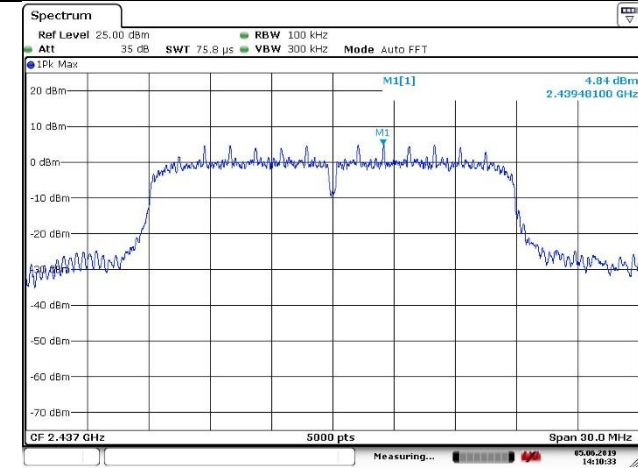


Date: 5 JUN 2019 14:00:46

802.11n-HT20 Out-of-Band Emissions

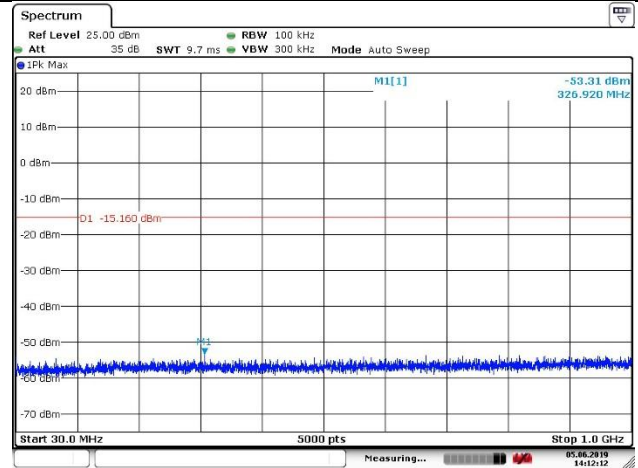
Channel 06 (2437MHz)

Referencel point



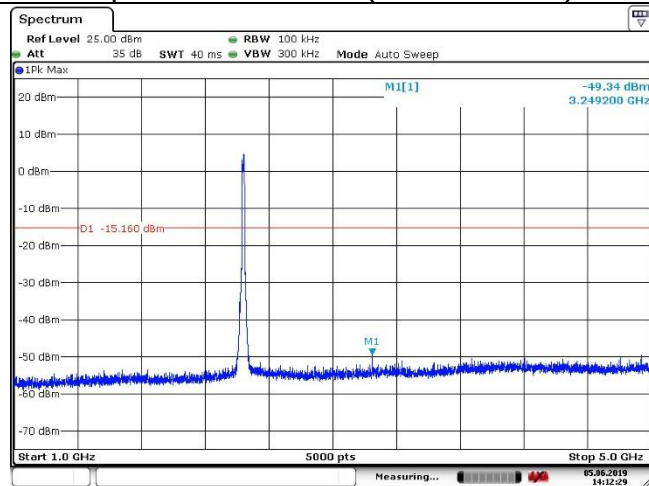
Date: 5 JUN 2019 14:10:34

Spurious Emission (30MHz – 1GHz)



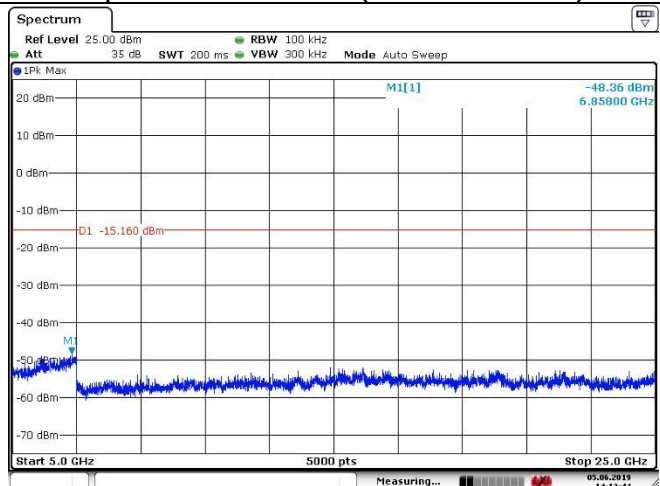
Date: 5 JUN 2019 14:12:12

Spurious Emission (1GHz – 5GHz)



Date: 5 JUN 2019 14:12:30

Spurious Emission (5GHz – 25GHz)

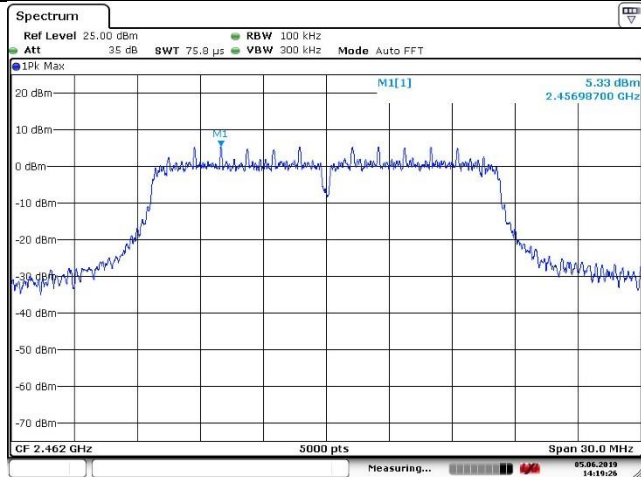


Date: 5 JUN 2019 14:12:45

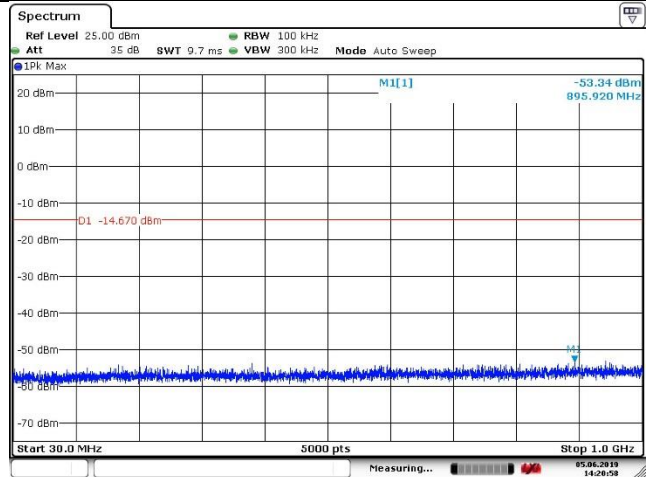
802.11n-HT20 Out-of-Band Emissions

Channel 11 (2462MHz)

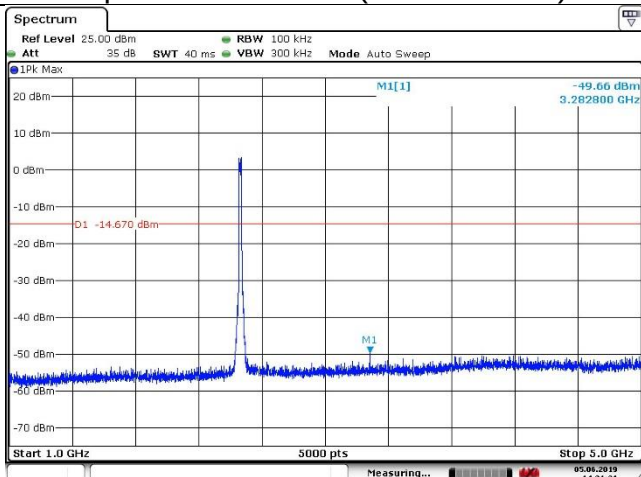
Referencel point



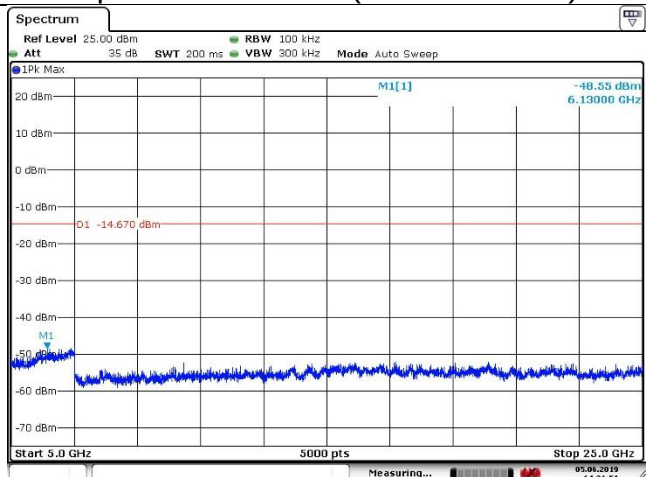
Spurious Emission (30MHz – 1GHz)



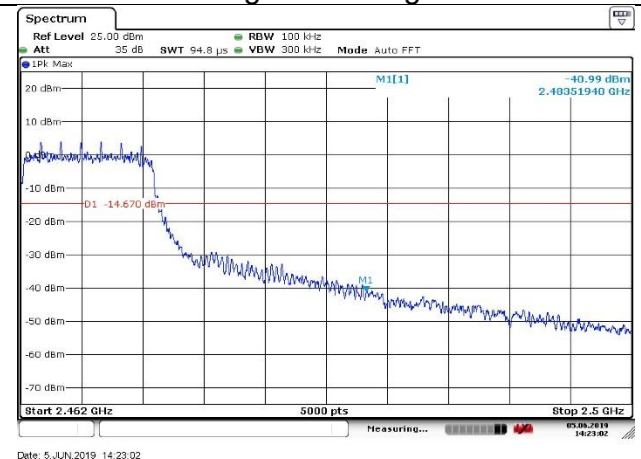
Spurious Emission (1GHz –5GHz)



Spurious Emission (5GHz –25GHz)



High band edge



9.6 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 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 and VBW = 10Hz for average measurement,
Sweep = auto, Detector function = peak, Trace = max hold.

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, VBW ≥ RBW for peak measurement, Sweep = auto, Detector function = peak,
Trace = max hold.

Note:

- 1: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 KHz for Quasi-peak detection (QP) at frequency below 1GHz.
- 2: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for peak detection (PK) at frequency above 1GHz.
- 3: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for RMS Average ((duty cycle < 98%) for Average detection (AV) at frequency above 1GHz, then the measurement results was added to a correction factor ($20\log(1/\text{duty cycle})$).
- 4: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz (duty cycle > 98%) for Average detection (AV) at frequency above 1GHz.

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.

LIMITS OF RADIATED EMISSION MEASUREMENT (Frequency Range 9kHz-1000MHz)

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
30~88	100	3
88~216	150	3
216~960	200	3
960~1000	500	3

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

Frequency MHz	Field Strength (dBuV/m) (at 3M)	
	PEAK	AVERAGE
Above 1000	74	54

Notes:

- (1) The limit for radiated test was performed according to FCC PART 15C.
- (2) The tighter limit applies at the band edges.
- (3) Emission level (dBuV/m)=20logEmission level (uV/m).

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:

Remark 1: There are the ambient noise within frequency range 9kHz ~ 30MHz and 18GHz ~ 25GHz, the permissible value is not show in the report.

Remark 2: Average measurement was not performed if peak level lower than average limit.

Remark 3: Other frequency was 20dB below limit line with 1-18GHz, there is not show in the report.

Test Result

Test mode: 802.11b					
Channel 01 (2412MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2385.2	61.30	74.0	-12.70	Peak	Horizontal
2385.2	45.80	54.0	-8.20	Average	Horizontal
4823.4	50.19	74.0	-23.81	Peak	Horizontal
2382.2	59.66	74.0	-14.34	Peak	Vertical
2382.2	45.70	54.0	-8.30	Average	Vertical
4823.3	52.16	74.0	-21.84	Peak	Vertical

Test mode: 802.11b					
Channel 06 (2437 MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
4874.3	53.11	74.0	-20.89	Peak	Horizontal
7310.7	46.09	74.0	-27.91	Peak	Horizontal
4874.3	51.87	74.0	-22.13	Peak	Vertical
7310.7	44.25	74.0	-29.75	Peak	Vertical

Test mode: 802.11b					
Channel 11 (2462MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2484.5	61.20	74.0	-12.80	Peak	Horizontal
2484.5	45.33	54.0	-8.67	Average	Horizontal
2485.7	59.11	74.0	-14.89	Peak	Vertical
2485.7	42.65	54.0	-11.35	Average	Vertical
4923.8	40.11	74.0	-33.89	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 01 (2412MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2389.4	60.93	74.0	-13.07	Peak	Horizontal
2389.4	45.10	54.0	-8.90	Average	Horizontal
4823.5	44.50	74.0	-29.50	Peak	Horizontal
2389.6	61.22	74.0	-12.78	Peak	Vertical
2389.6	42.30	54.0	-11.70	Average	Vertical
4823.2	40.09	74.0	-33.91	Peak	Vertical

Test mode: 802.11g					
Channel 06 (2437 MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
4869.4	45.15	74.0	-28.85	Peak	Horizontal
7311.5	40.77	74.0	-33.23	Peak	Horizontal
4878.2	43.32	74.0	-30.68	Peak	Vertical
7312.1	41.70	74.0	-32.30	Peak	Vertical

Test mode: 802.11g					
Channel 11 (2462MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2483.5	59.10	74.0	-14.90	Peak	Horizontal
2483.5	43.28	54.0	-10.72	Average	Horizontal
4926.2	45.35	74.0	-28.65	Peak	Horizontal
2483.5	57.88	74.0	-16.12	Peak	Vertical
2483.5	41.70	54.0	-12.30	Average	Vertical
4923.6	42.58	74.0	-31.42	Peak	Vertical

Remark:

- (4) Emission level= Original Receiver Reading + Correct Factor
- (5) Correct Factor = Antenna Factor + Cable Loss -Amplifier gain
- (6) Margin = limit – Corrected Reading

Test mode: 802.11n-HT20					
Channel 01 (2412MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2389.6	62.22	74.0	-11.78	Peak	Horizontal
2389.6	46.60	54.0	-7.40	Average	Horizontal
4822.3	47.04	74.0	-26.96	Peak	Horizontal
2380.0	60.02	74.0	-13.98	Peak	Vertical
2390.0	45.70	54.0	-8.30	Average	Vertical
4825.0	43.53	74.0	-30.47	Peak	Vertical

Test mode: 802.11n-HT20					
Channel 06 (2437 MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
4873.9	45.10	74.0	-28.90	Peak	Horizontal
7312.8	40.02	74.0	-33.98	Peak	Horizontal
4872.5	43.39	74.0	-30.61	Peak	Vertical
7312.8	40.04	74.0	-33.96	Peak	Vertical

Test mode: 802.11n-HT20					
Channel 11 (2462MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2484.0	58.69	74.0	-15.31	Peak	Horizontal
2484.0	46.33	54.0	-7.67	Average	Horizontal
4920.4	46.35	74.0	-27.65	Peak	Horizontal
7335.0	40.51	74.0	-33.49	Peak	Horizontal
2485.2	58.48	74.0	-15.52	Peak	Vertical
2483.5	46.20	54.0	-7.80	Average	Vertical
4923.6	44.24	74.0	-29.76	Peak	Vertical

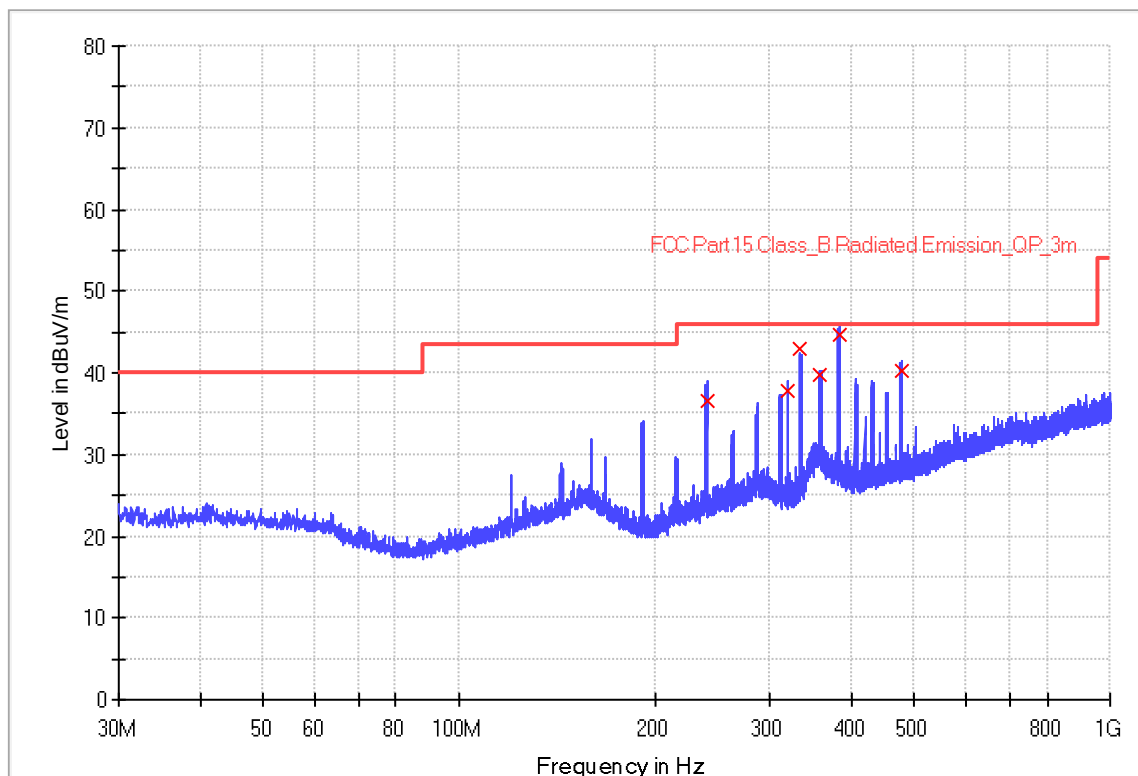
Remark:

- (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: 2019/06/15 - 14:12
Limit: FCC_Part15.109_RE(3m)_ClassB	Engineer: Jiayi XU
Probe: VULB9168	Polarity: Horizontal
EUT: WIFI Module, Model no: TYWE2L	Power: 120VAC, 60Hz (powered by notebook)
Note: Transmit by 802.11n HT20 at channel 2437MHz.	
Note: There is the worst case within frequency range 30MHz~1GHz.	

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)
240.040000	36.5	1000.0	120.000	100.0	H	359.0	13.4	9.5	46.0
320.000000	37.8	1000.0	120.000	100.0	H	359.0	15.5	8.2	46.0
334.640000	42.9	1000.0	120.000	100.0	H	181.0	15.9	3.1	46.0
359.280000	39.7	1000.0	120.000	100.0	H	181.0	16.5	6.3	46.0
384.160000	44.6	1000.0	120.000	100.0	H	181.0	17.0	1.4	46.0
479.000000	40.2	1000.0	120.000	100.0	H	181.0	19.1	5.8	46.0

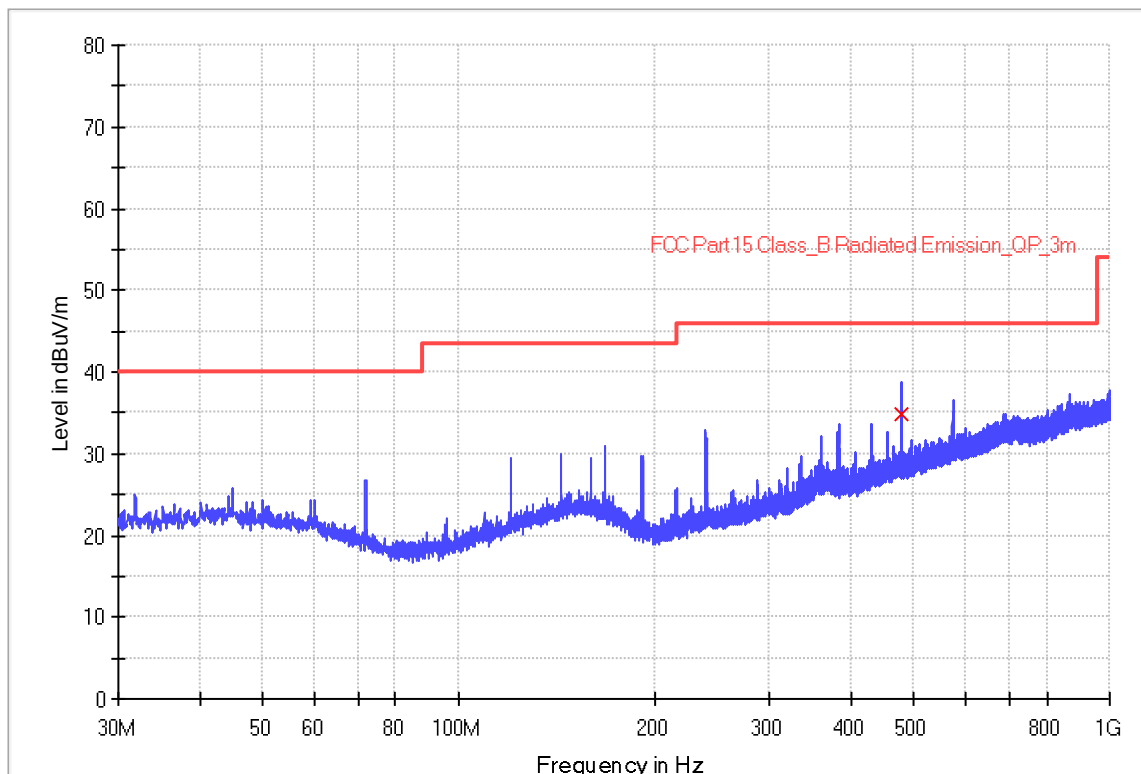
Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

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: 2019/06/15 - 14:38
Limit: FCC_Part15.109_RE(3m)_ClassB	Engineer: Jiayi XU
Probe: VULB9168	Polarity: Vertical
EUT: WIFI Module, Model no: TYWE2L	Power: 120VAC, 60Hz (powered by notebook)
Note: Transmit by 802.11n HT20 at channel 2437MHz.	
Note: There is the worst case within frequency range 30MHz~1GHz.	

PE_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)
478.800000	34.8	1000.0	120.000	100.0	V	359.0	19.0	46.0	11.2

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. DUE DATE
C	Signal Analyzer	Rohde & Schwarz	FSV40	101091	2019-8-6
	Wideband power sensor	Rohde & Schwarz	NRP-Z81	103140	2019-8-6
RE	EMI Test Receiver	Rohde & Schwarz	ESR3	101906	2019-8-6
	Signal Analyzer	Rohde & Schwarz	FSV40	101091	2019-8-6
	Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	848	2021-6-10
	Horn Antenna	Rohde & Schwarz	HF907	102393	2021-4-1
	Pre-amplifier	Rohde & Schwarz	SCU-18D	19006451	2019-8-6
	Loop antenna	Rohde & Schwarz	HFH2-Z2	100443	2019-7-8
	DOUBLE-RIDGED WAVEGUIDE HORN WITH PRE-AMPLIFIER (18 GHZ - 40 GHZ)	ETS-Lindgren	3116C-PA	E326	2021-1-28
	3m Semi-anechoic chamber	TDK	9X6X6	----	2021-5-10
CE	EMI Test Receiver	Rohde & Schwarz	ESR 3	101907	2019-8-6
	LISN	Rohde & Schwarz	ENV216	101924	2019-8-6

C - Conducted RF tests

- Conducted peak output power
- 6dB Occupied Bandwidth
- Power spectral density*
- Spurious RF conducted emissions
- Conducted 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:

Test Site1

Items	Extended Uncertainty
Conducted Disturbance at Mains Terminals	150kHz to 30MHz, LISN, 3.16dB
Radiated Disturbance	30MHz to 1GHz, $\pm 5.03\text{dB}$ (Horizontal) $\pm 5.12\text{dB}$ (Vertical) 1GHz to 18GHz, $\pm 5.15\text{dB}$ (Horizontal) $\pm 5.12\text{dB}$ (Vertical) 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