

## FCC - TEST REPORT

Report Number : **708881974806-00** Date of Issue: June 21, 2019

Model : TYGWZW-01; TYGWZW-01N

Product Type : Smart Gateway

FCC ID : 2ANDLTYGWZW-01

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 : 52

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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  
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Shanghai 201108,  
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### 3 Description of the Equipment under Test

#### Description of the Equipment Under Test

Product: Smart Gateway

Model no.: TYGWZW-01; TYGWZW-01N

FCC ID: 2ANDLTYGWZW-01

Trade Mark: NA

Options and accessories: NA

Input Rated Voltage: 100-240V~, 50/60Hz

RF Transmission Frequency: For 802.11b/g/n-HT20: 2412~2462 MHz  
 For 802.11n-HT40: 2422~2452 MHz  
 For 802.15.4: 2405~2480MHz

No. of Operated Channel: 2.4GHz WIFI: 11 for 802.11b/802.11g/802.11(H20)  
 7 for 802.11n(H40)  
 Zigbee: 5

Channel list: For 2.4GHz WIFI

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		

Operation Frequency each of channel For 802.11n(H40)							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
		4	2427MHz	7	2442MHz		
		5	2432MHz	8	2447MHz		
3	2422MHz	6	2437MHz	9	2452MHz		

For Zigbee:

Operation Frequency each of channel	
Channel	Frequency
11	2405MHz
15	2425MHz
20	2450MHz
25	2475MHz
26	2480MHz



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Radio technology:	For 2.4GHz WIFI: IEEE 802.11b/802.11g/802.11(H20)/802.11n(H40) For 2.4GHz Zigbee: IEEE IEEE802.15.4
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 Zigbee: 16-ary orthogonal modulation, O-QPSK PHY
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 150Mbps
Data speed (IEEE 802.15.4):	250kbps MAX
Antenna Type:	PCB antenna
Antenna Gain:	2.5dBi
Description of the EUT:	The Equipment Under Test (EUT) is a Smart Gateway supports 2.4GHz WIFI functions and 2.4GHz zigbee function. There are 2 models in all, only difference is the appearance. We chose model TYGWZW-01 to perform all tests.



## 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		Pages	Test Site	Test Result		
				Pass	Fail	N/A
§15.207	Conducted emission AC power port	13-15	---	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247 (b) (1)	Conducted peak output power	16	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(a)(1)	20dB bandwidth	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247(a)(1)	Carrier frequency separation	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247(a)(1)(iii)	Number of hopping frequencies	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247(a)(1)(iii)	Dwell Time	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247(e)	Power spectral density	22-26	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(a)(2)	6dB bandwidth and 99% Occupied Bandwidth	17-21	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(d)	Spurious RF conducted emissions	27-39	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(d)	Spurious radiated emissions and Band edge for transmitter	40-46	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.203	Antenna requirement	See note 1		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Remark 1: N/A – Not Applicable.

Note 1: The EUT uses a 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: 2ANDLTYGWZW-01, 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 Zigbee test report please refer to 708881974808-00.

### SUMMARY:

All tests according to the regulations cited on page 5 were

■ - Performed

□ - Not Performed

The Equipment under Test

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

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

Sample Received Date: June 6, 2019

Testing Start Date: June 6, 2019

Testing End Date: June 18, 2019

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

Reviewed by:

Prepared by:

Tested by:

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EMC Section Manager

Jiayi XU  
EMC Project Engineer

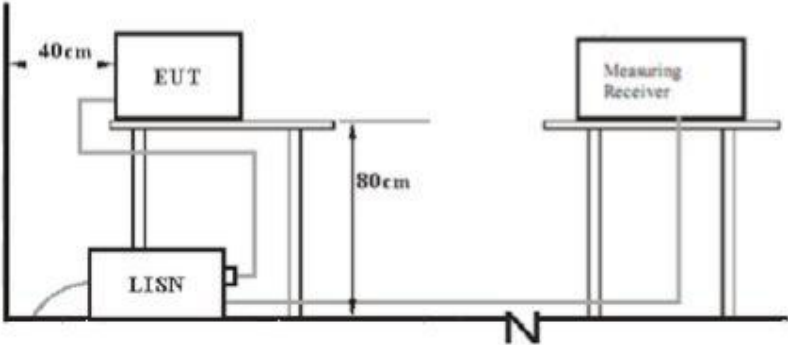
Wenqiang LU  
EMC Test Engineer





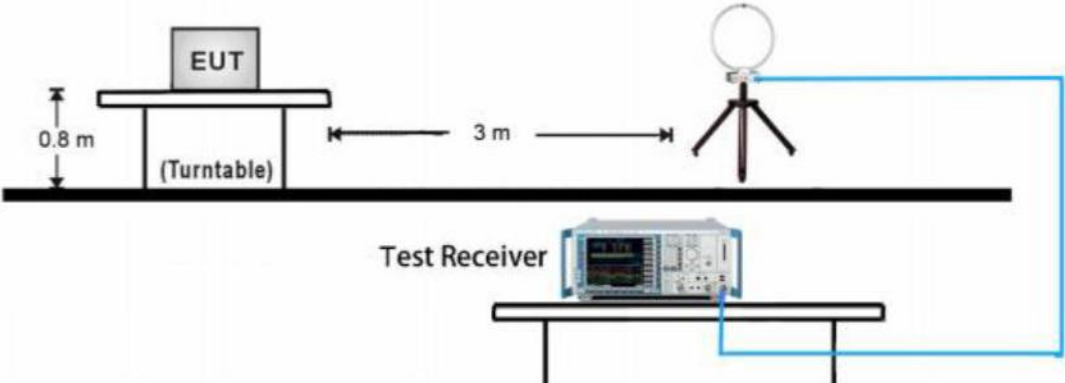
## 7 Test Setups

### 7.1 AC Power Line Conducted Emission test setups

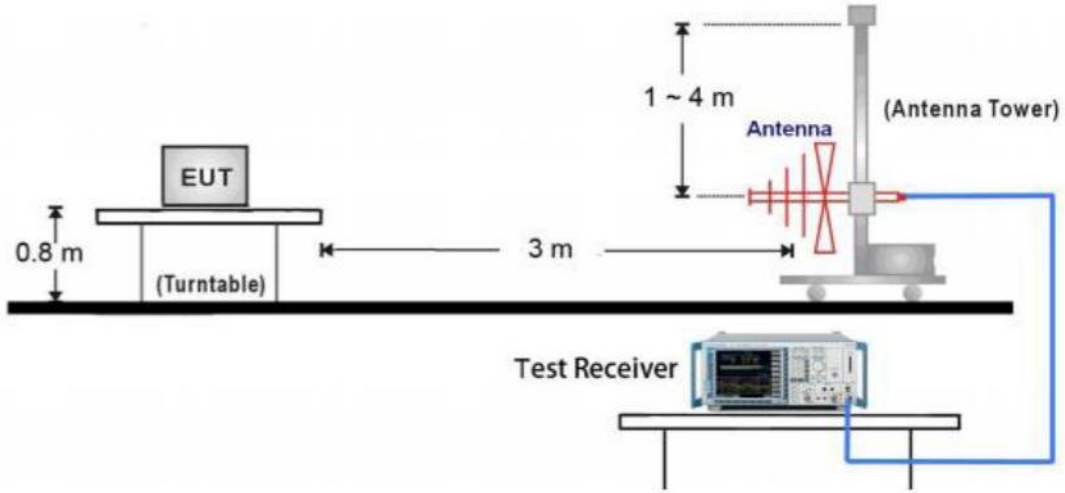


### 7.2 Radiated test setups

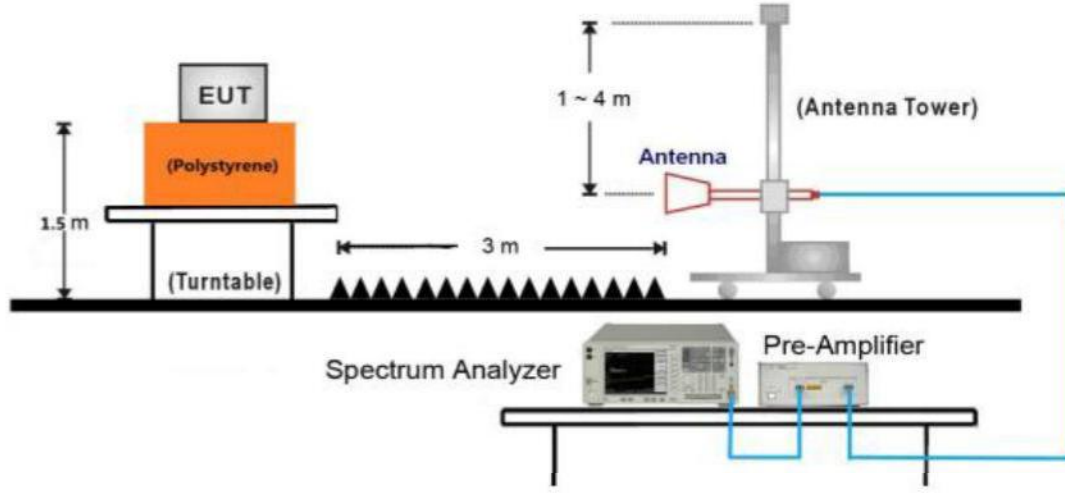
#### 9kHz ~ 30MHz Test Setup:



30MHz ~ 1GHz Test Setup:

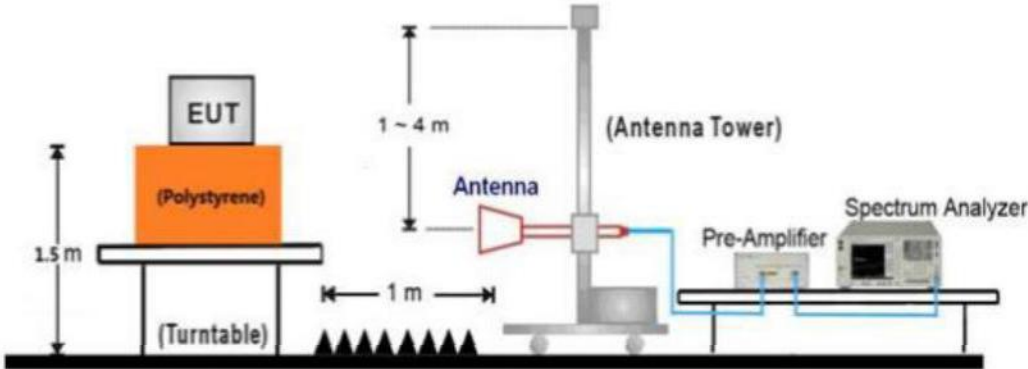


1GHz ~ 18GHz Test Setup:

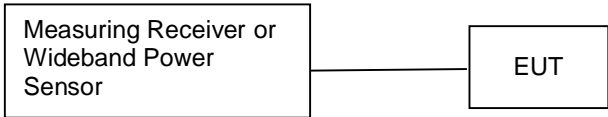




18GHz ~ 25GHz Test Setup:



7.3 Conducted RF test setups



## 8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.(SHIELD)
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	UI_mptool
---------------	-----------

802.11b/802.11g/802.11n-HT20

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

802.11n-HT40

Test mode	Channel	Frequency (MHz)
Tx	3	2422
Tx	6	2437
Tx	9	2452

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)
Low, Middle, High	802.11n (HT40): OFDM	MCS0 (13.5Mbps)

### Device Capabilities

This device contains the following capabilities:

802.11b/g/n-HT20/n-HT40 Wi-Fi Device.

Duty Cycle: 100%

**Note:** 2.4GHz WLAN (DTS) operation is possible in 20MHz, and 40MHz 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

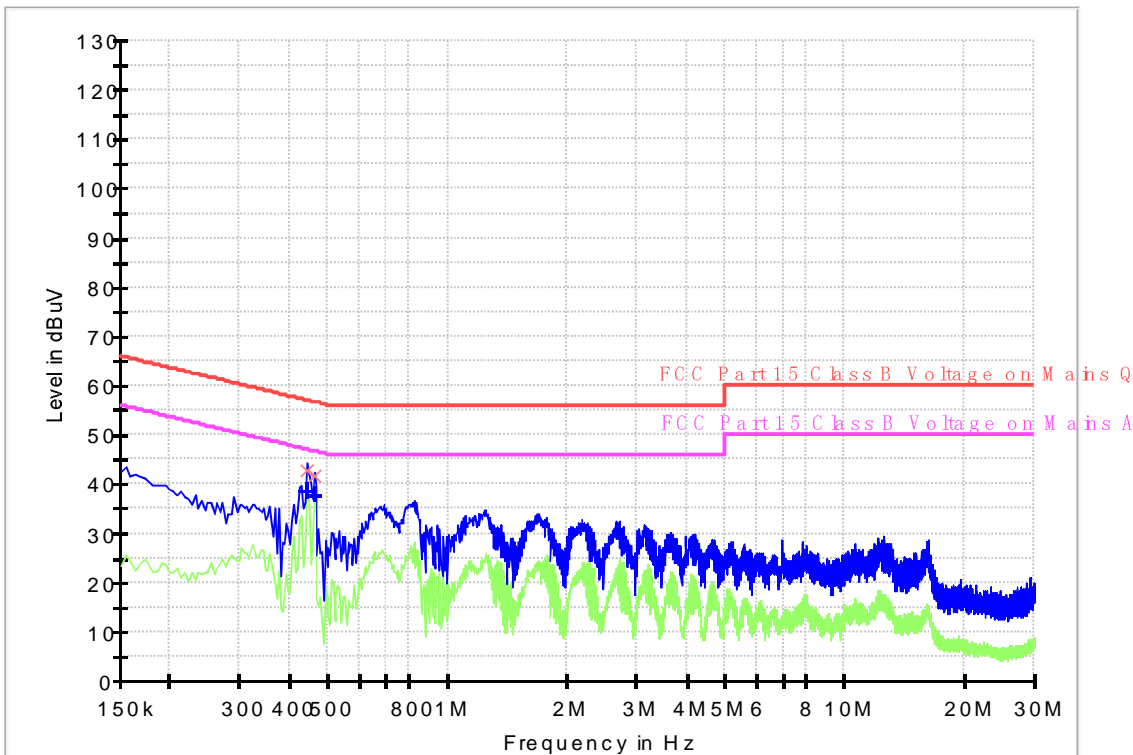
Frequency MHz	QP Limit dB $\mu$ V	AV Limit dB $\mu$ V
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

Decreasing linearly with logarithm of the frequency



## Conducted Emission

Product Type : Smart Gateway  
 M/N : TYGWZW-01  
 Operating Condition : Mode 1: Tx\_802.11g 2412MHz  
 Test Specification : FCC\_Part15.207  
 Comment : L-line, AC 120V/60Hz

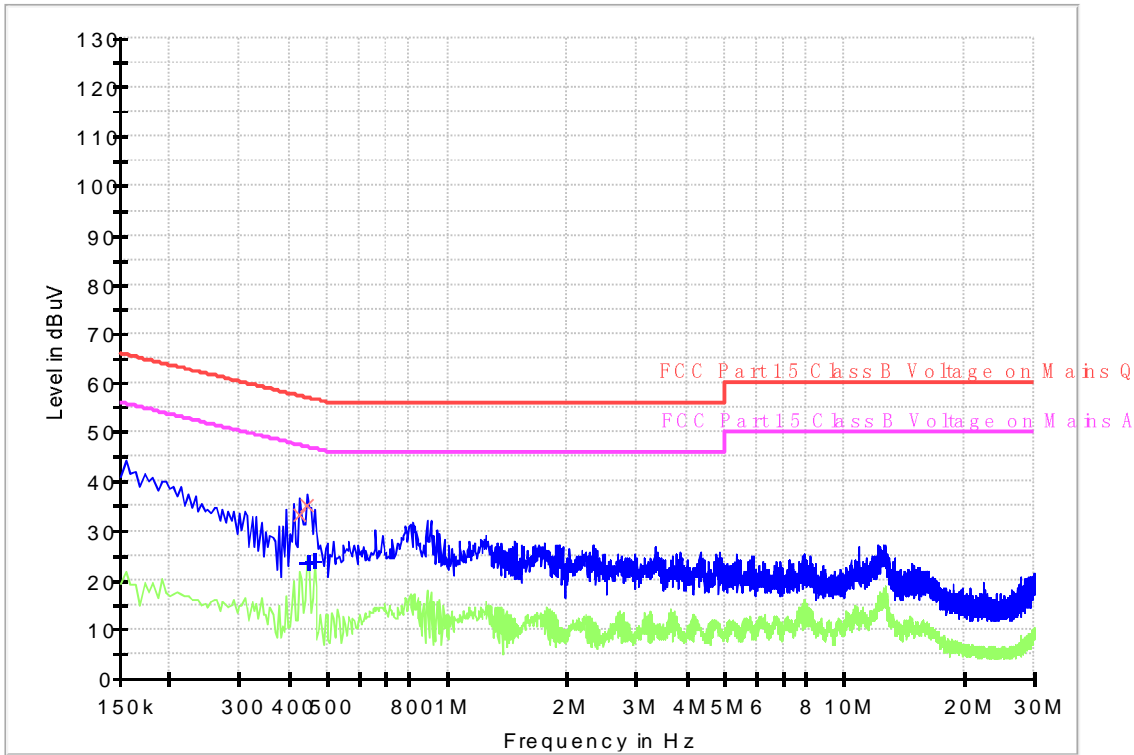


## Final Result

Frequency (MHz)	Quasi Peak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.442500	---	38.55	47.01	8.46	1000.0	9.000	L1	19.5
0.442500	42.98	---	57.01	14.03	1000.0	9.000	L1	19.5
0.460500	---	37.84	46.68	8.84	1000.0	9.000	L1	19.5
0.460500	41.77	---	56.68	14.91	1000.0	9.000	L1	19.5



Product Type : Smart Gateway  
 M/N : TYGWZW-01  
 Operating Condition : Mode 1: Tx\_802.11g 2412MHz  
 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)
0.424500	33.24	---	57.36	24.12	1000.0	9.000	N	19.4
0.442500	35.01	---	57.01	22.00	1000.0	9.000	N	19.4
0.447000	---	23.17	46.93	23.76	1000.0	9.000	N	19.4
0.460500	---	23.65	46.68	23.03	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 average power of the transmitter. This measurement is an average over both the on and off periods 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	15.80	30.00
		CH06	2437	16.32	30.00
		CH11	2462	17.69	30.00
g		CH01	2412	<b>20.84</b>	30.00
		CH06	2437	20.41	30.00
		CH11	2462	20.27	30.00
n-HT20		CH01	2412	20.59	30.00
		CH06	2437	19.67	30.00
		CH11	2462	19.87	30.00
n-HT40		CH03	2422	20.39	30.00
		CH06	2437	20.36	30.00
		CH09	2452	20.19	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]

$\geq 500$

#### Test result

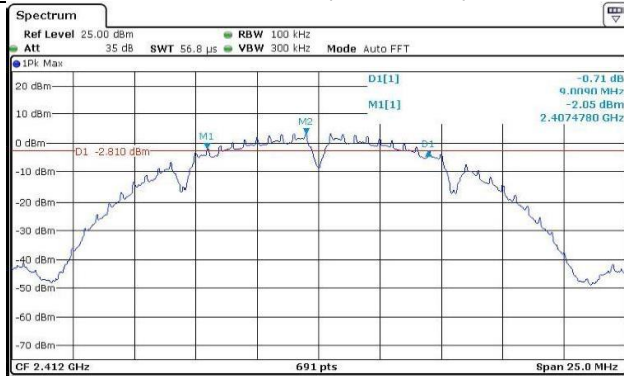
Test Mode	Data Rate / MCS	Channel No.	Freq. (MHz)	6db Bandwidth (MHz)	Limit (MHz)	Result
802.11b	1Mbps	01	2412	9.009	$\geq 0.5$	Pass
802.11b	1Mbps	06	2437	9.515	$\geq 0.5$	Pass
802.11b	1Mbps	11	2462	9.045	$\geq 0.5$	Pass
802.11g	6Mbps	01	2412	16.570	$\geq 0.5$	Pass
802.11g	6Mbps	06	2437	16.570	$\geq 0.5$	Pass
802.11g	6Mbps	11	2462	16.534	$\geq 0.5$	Pass
802.11n-HT20	6.5Mbps	01	2412	17.800	$\geq 0.5$	Pass
802.11n-HT20	6.5Mbps	06	2437	17.767	$\geq 0.5$	Pass
802.11n-HT20	6.5Mbps	11	2462	17.800	$\geq 0.5$	Pass
802.11n-HT40	13.5Mbps	03	2422	36.454	$\geq 0.5$	Pass
802.11n-HT40	13.5Mbps	06	2437	36.216	$\geq 0.5$	Pass
802.11n-HT40	13.5Mbps	09	2452	36.218	$\geq 0.5$	Pass



China

802.11b 6dB Bandwidth

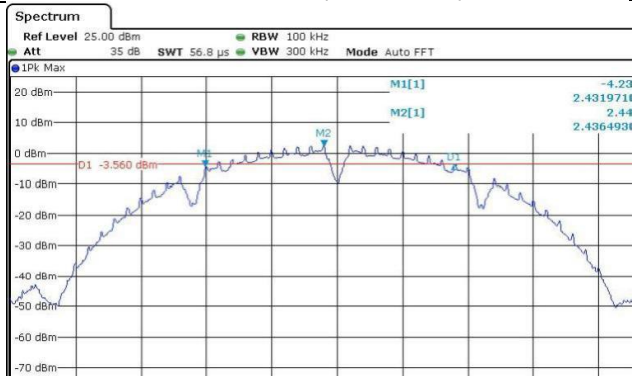
Channel 01 (2412MHz)



Marker	Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1				2.407478 GHz	-2.05 dBm		
D1	M1	1		9.009 MHz	-0.71 dB		
M2				2.411493 GHz	3.19 dBm		

Date: 18 JUN 2019 10:56:42

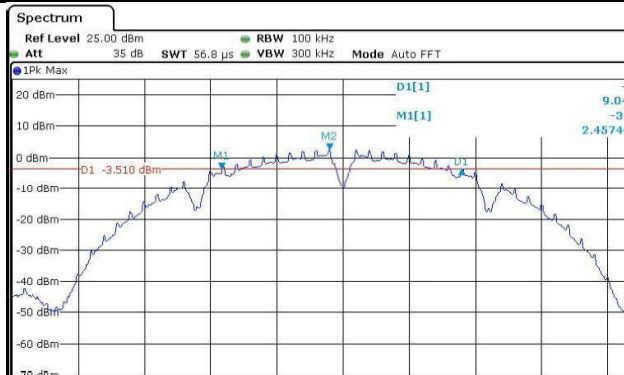
Channel 06 (2437MHz)



Marker	Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1				2.431971 GHz	-4.23 dBm		
D1	M1	1		9.515 MHz	0.68 dB		
M2				2.436493 GHz	2.44 dBm		

Date: 18 JUN 2019 10:58:37

Channel 11 (2462MHz)



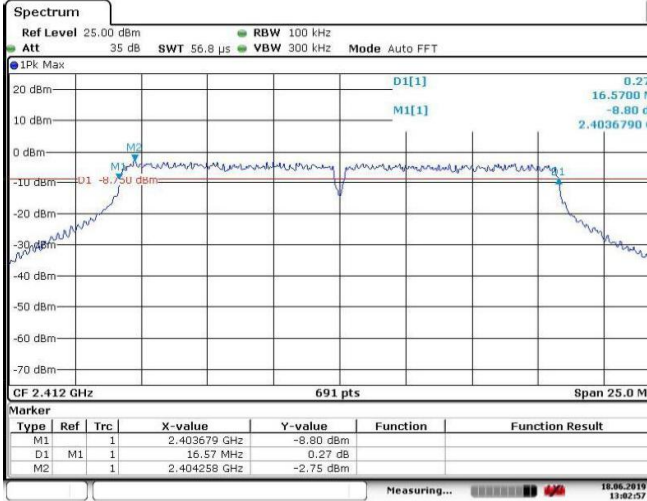
Marker	Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1				2.457441 GHz	-3.40 dBm		
D1	M1	1		9.045 MHz	-0.14 dB		
M2				2.461493 GHz	2.49 dBm		

Date: 18 JUN 2019 11:00:05



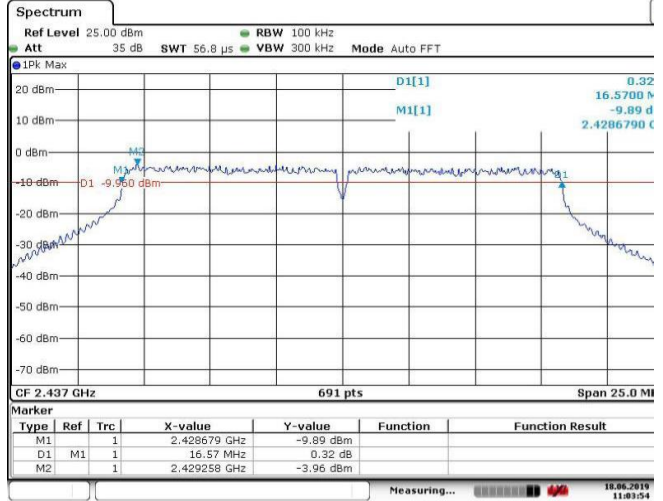
802.11g 6dB Bandwidth

Channel 01 (2412MHz)



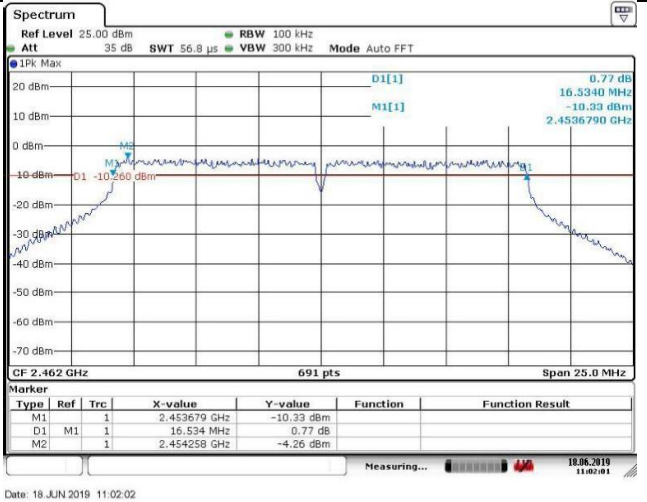
Date: 18 JUN 2019 13:02:57

Channel 06 (2437MHz)



Date: 18 JUN 2019 11:03:54

Channel 11 (2462MHz)

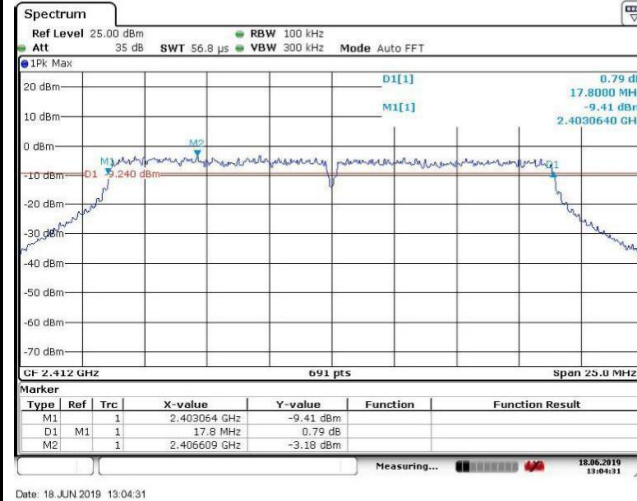


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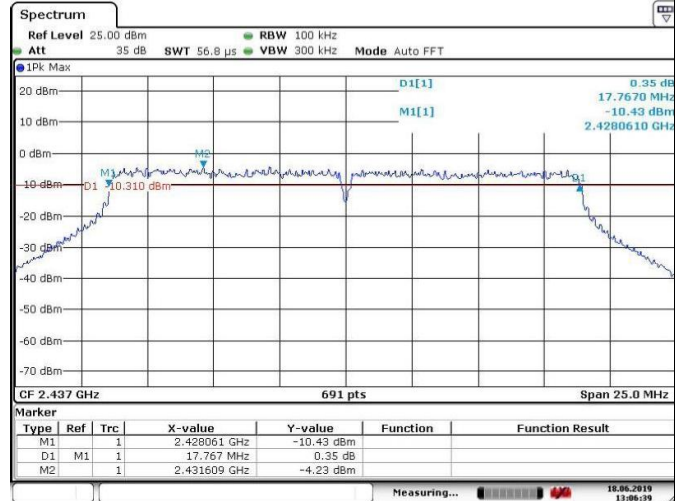


802.11n HT20 6dB Bandwidth

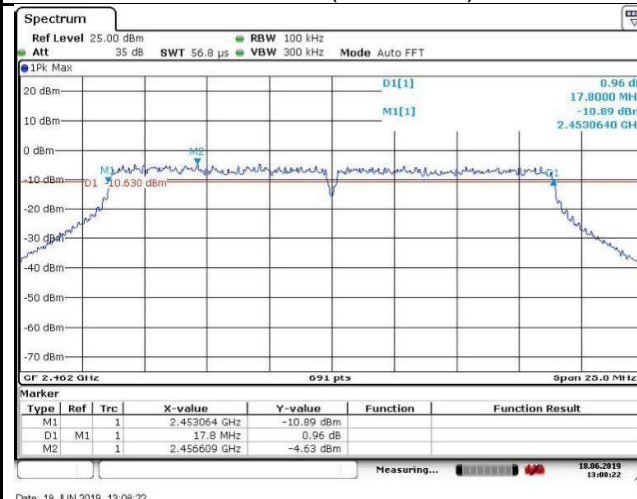
Channel 01 (2412MHz)



Channel 06 (2437MHz)



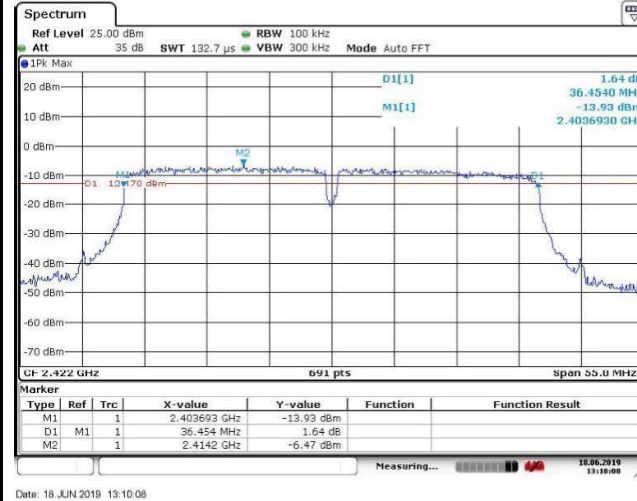
Channel 11 (2462MHz)



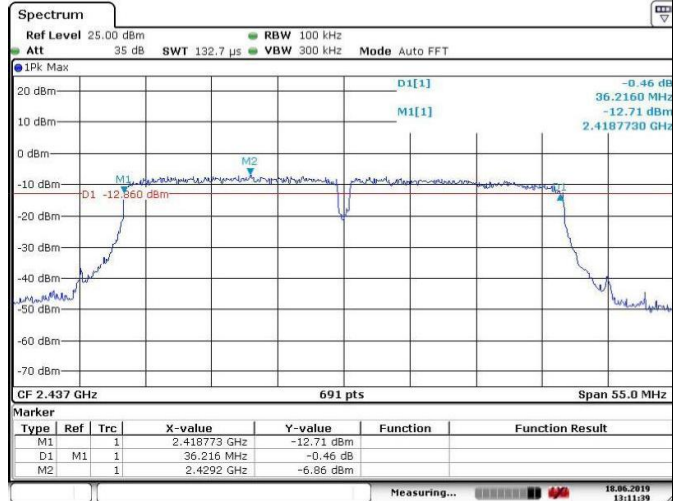


802.11n HT40 6dB Bandwidth

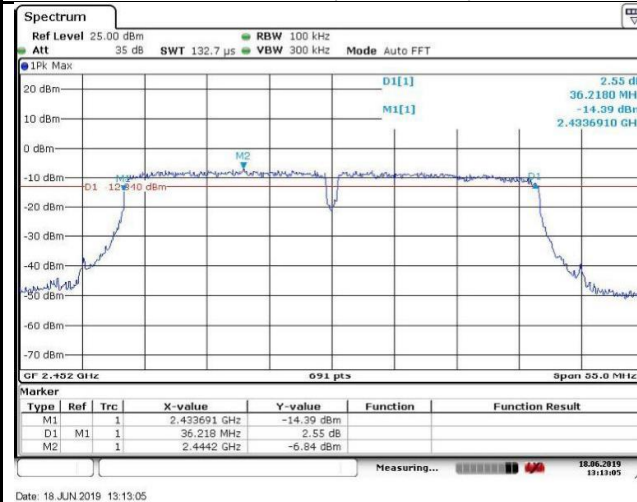
Channel 03 (2422MHz)



Channel 06 (2437MHz)



Channel 09 (2452MHz)



## 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]

$\leq 8$

### Test result

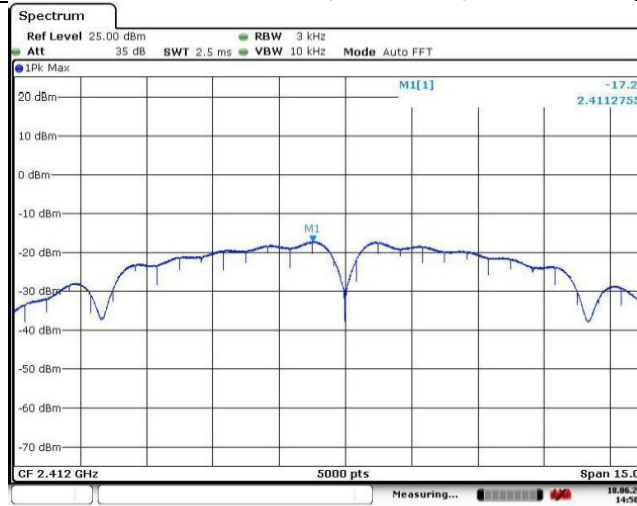
Test Mode	Data Rate / MCS	Channel No.	Freq. (MHz)	PSD (dBm / 10kHz)	Limit (dBm/3kHz)	Result
802.11b	1Mbps	01	2412	-17.25	$\leq 8$	Pass
802.11b	1Mbps	06	2437	-18.18	$\leq 8$	Pass
802.11b	1Mbps	11	2462	-17.42	$\leq 8$	Pass
802.11g	6Mbps	01	2412	-17.27	$\leq 8$	Pass
802.11g	6Mbps	06	2437	-18.26	$\leq 8$	Pass
802.11g	6Mbps	11	2462	-18.71	$\leq 8$	Pass
802.11n-HT20	6.5Mbps	01	2412	-16.91	$\leq 8$	Pass
802.11n-HT20	6.5Mbps	06	2437	-17.83	$\leq 8$	Pass
802.11n-HT20	6.5Mbps	11	2462	-18.23	$\leq 8$	Pass
802.11n-HT40	13.5Mbps	03	2422	-17.96	$\leq 8$	Pass
802.11n-HT40	13.5Mbps	06	2437	-18.38	$\leq 8$	Pass
802.11n-HT40	13.5Mbps	09	2452	-18.43	$\leq 8$	Pass



China

### 802.11b PSD

#### Channel 01 (2412MHz)



Date: 18 JUN 2019 14:50:38

#### Channel 06 (2437MHz)

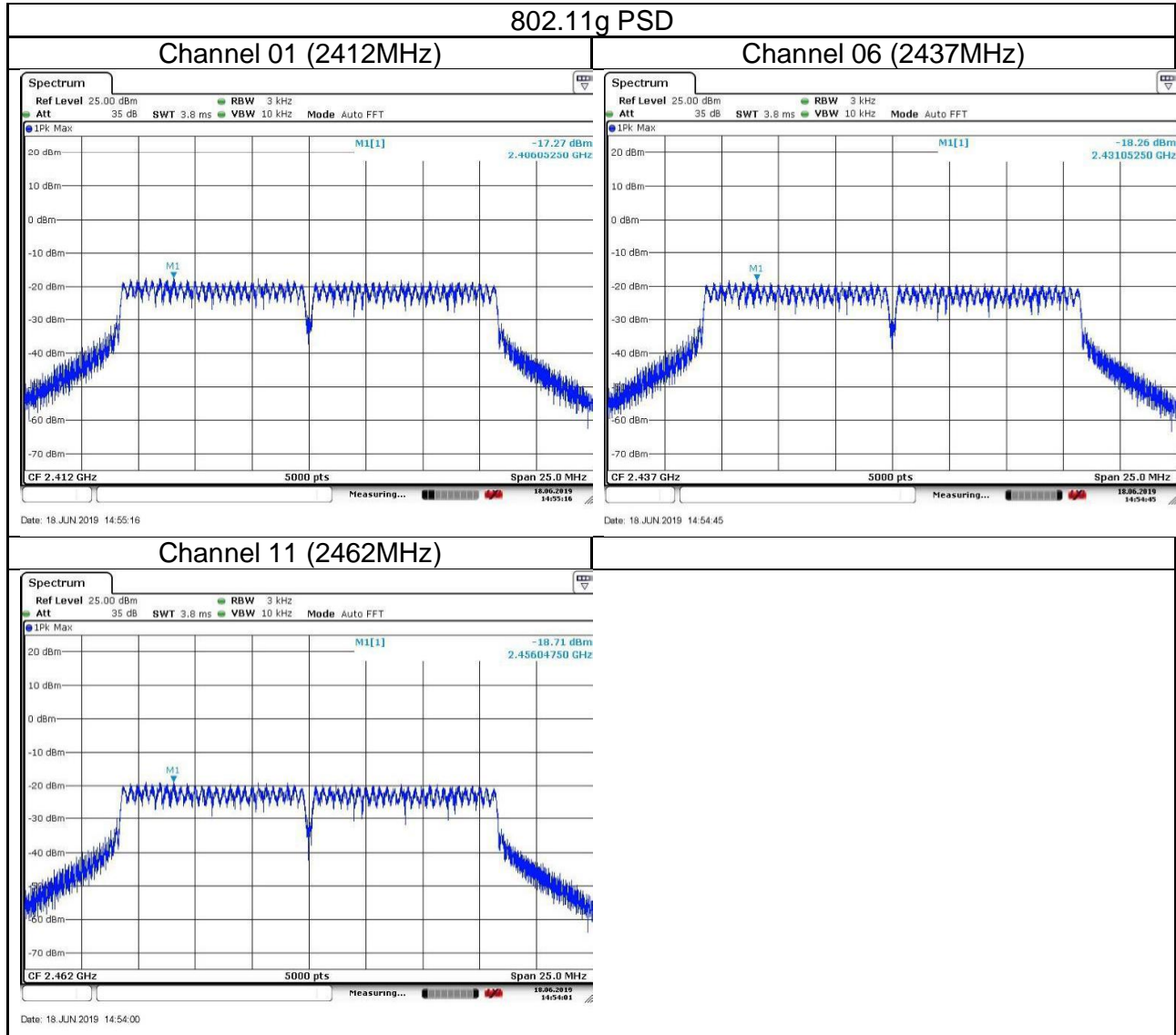


Date: 18 JUN 2019 14:51:25

#### Channel 11 (2462MHz)



Date: 18 JUN 2019 14:52:18

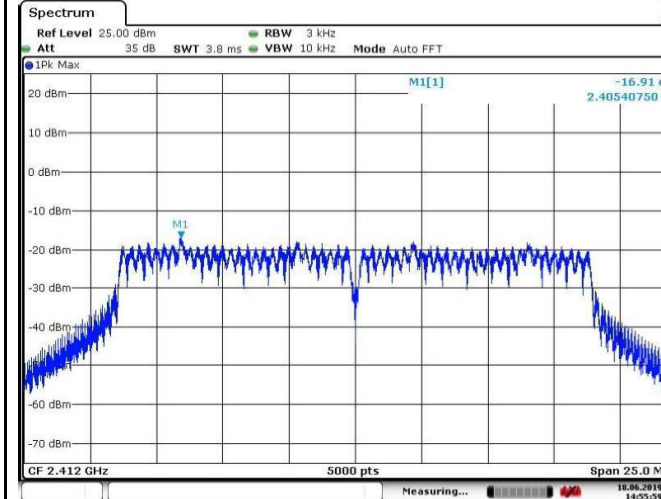






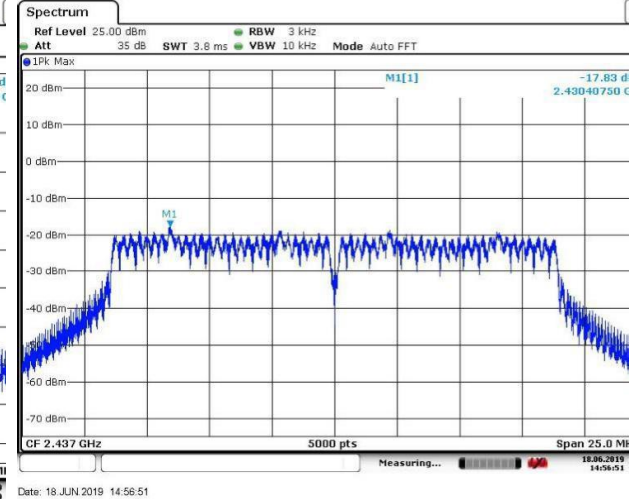
### 802.11n HT20 PSD

#### Channel 01 (2412MHz)



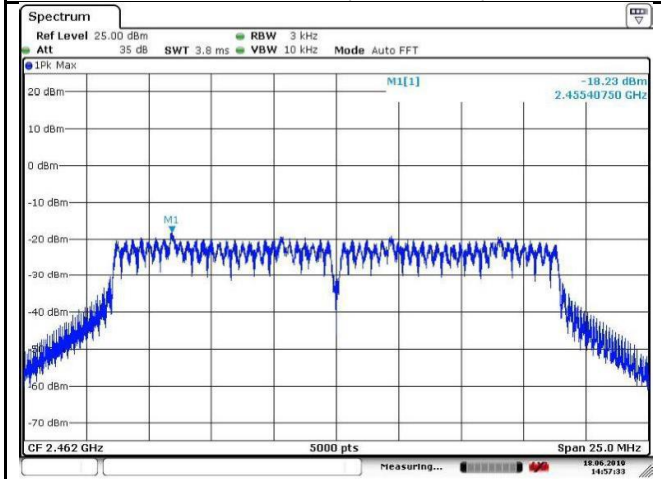
Date: 18 JUN 2019 14:55:59

#### Channel 06 (2437MHz)



Date: 18 JUN 2019 14:56:51

#### Channel 11 (2462MHz)

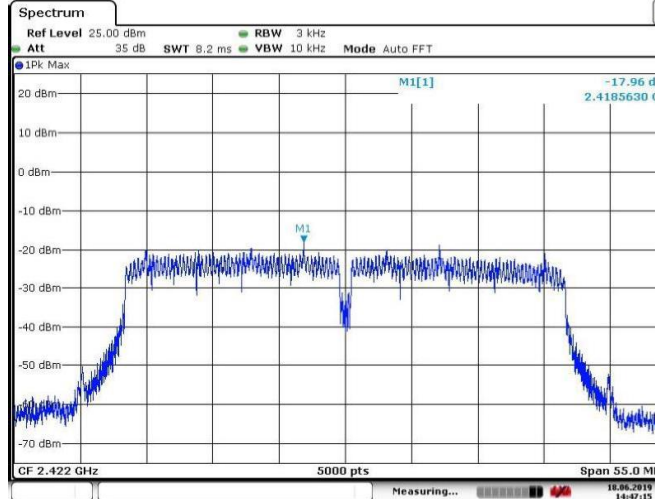


Date: 18 JUN 2019 14:57:34

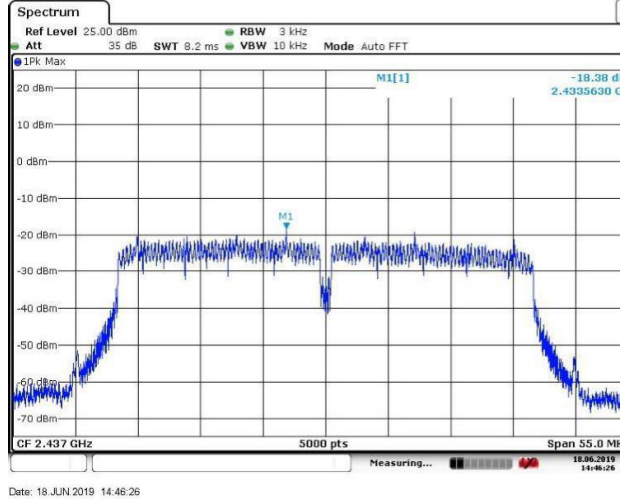


### 802.11n HT40 PSD

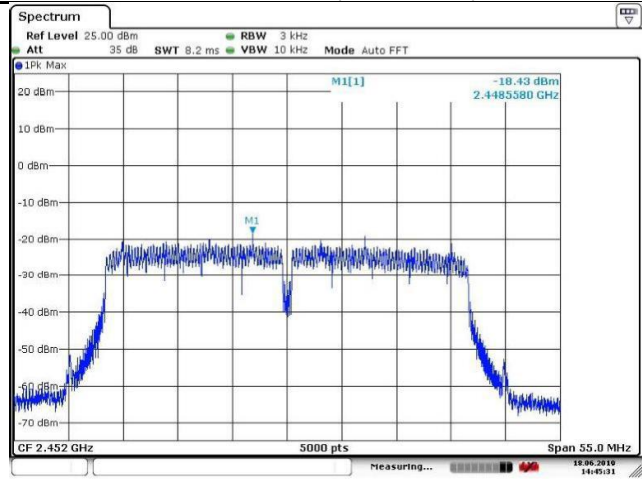
#### Channel 03 (2422MHz)



#### Channel 06 (2437MHz)



#### Channel 09 (2452MHz)



## 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

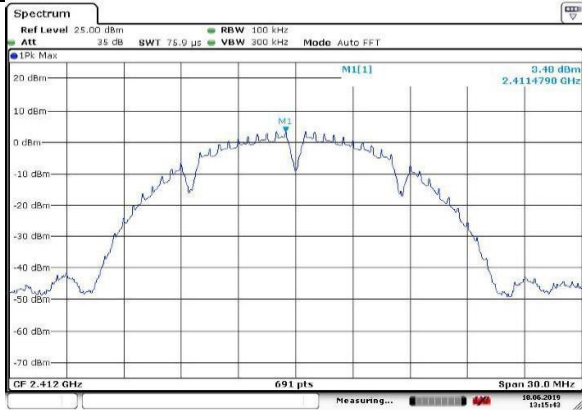
Test Mode	Data Rate / MCS	Channel No.	Freq. (MHz)	Limit	Result
802.11b	1Mbps	01	2412	20dBc	Pass
802.11b	1Mbps	06	2437	20dBc	Pass
802.11b	1Mbps	11	2462	20dBc	Pass
802.11g	6Mbps	01	2412	20dBc	Pass
802.11g	6Mbps	06	2437	20dBc	Pass
802.11g	6Mbps	11	2462	20dBc	Pass
802.11n-HT20	6.5Mbps	01	2412	20dBc	Pass
802.11n-HT20	6.5Mbps	06	2437	20dBc	Pass
802.11n-HT20	6.5Mbps	11	2462	20dBc	Pass
802.11n-HT40	13.5Mbps	03	2422	20dBc	Pass
802.11n-HT40	13.5Mbps	06	2437	20dBc	Pass
802.11n-HT40	13.5Mbps	09	2452	20dBc	Pass

**Spurious RF conducted emissions**

**802.11b Out-of-Band Emissions**

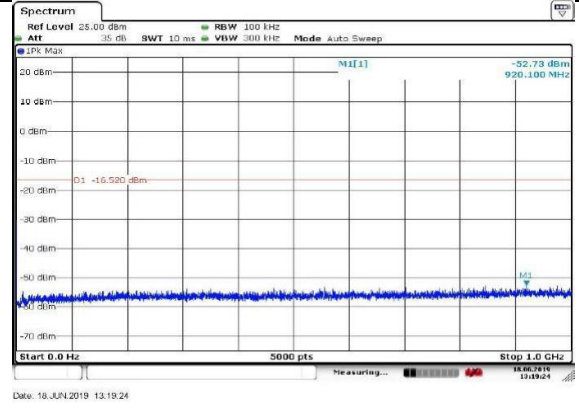
**Channel 01 (2412MHz)**

**Referencel point**



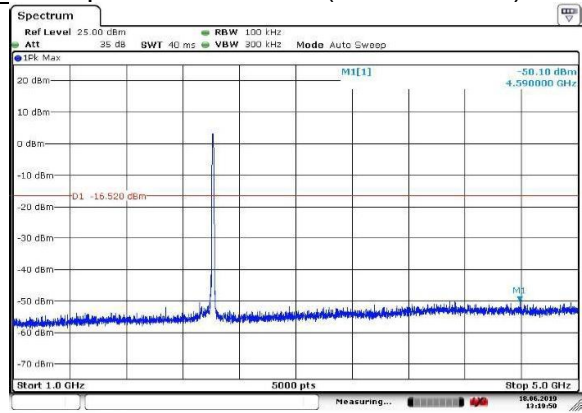
Date: 18 JUN 2019 13:15:43

**Spurious Emission (30MHz – 1GHz)**



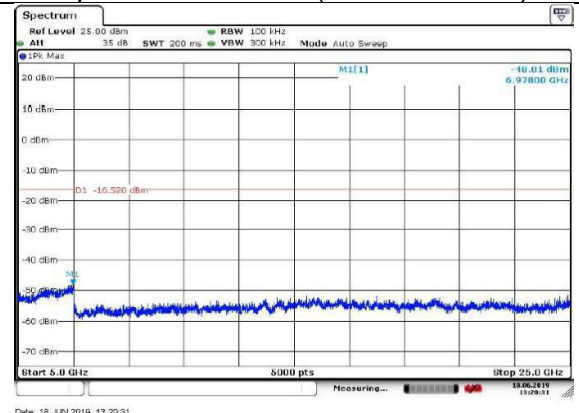
Date: 18 JUN 2019 13:19:24

**Spurious Emission (1GHz –5GHz)**



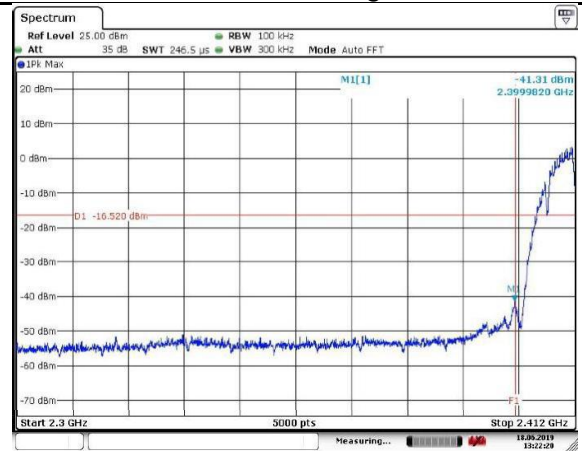
Date: 18 JUN 2019 13:19:51

**Spurious Emission (5GHz –25GHz)**



Date: 18 JUN 2019 13:20:31

**Low band edge**

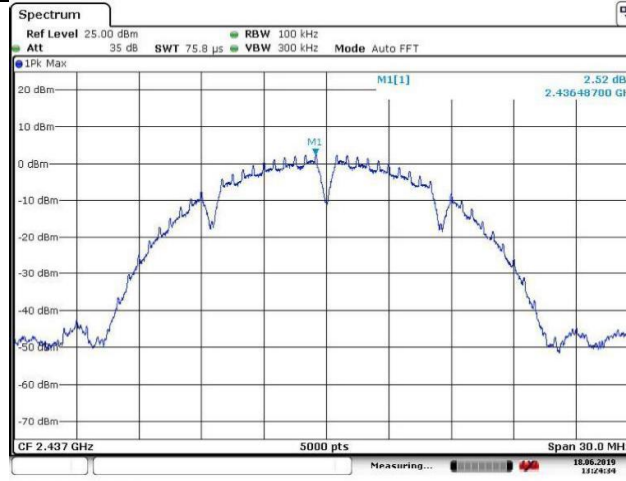


Date: 18 JUN 2019 13:22:20

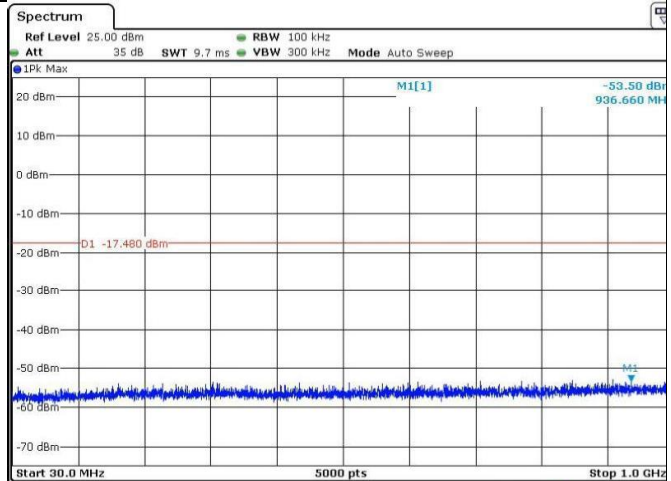


### 802.11b Out-of-Band Emission Channel 06 (2437MHz)

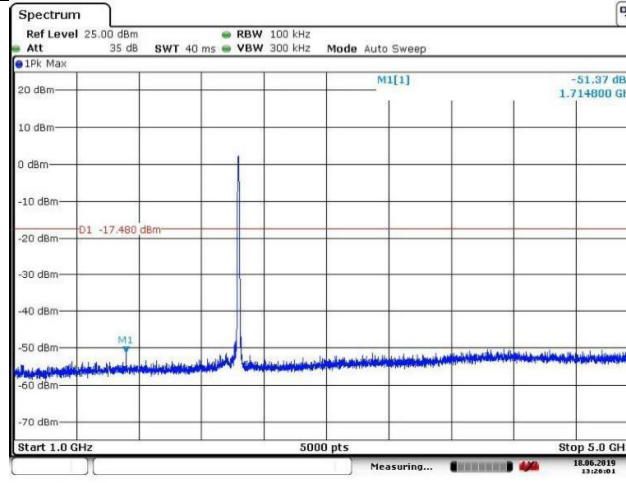
#### Referencel point



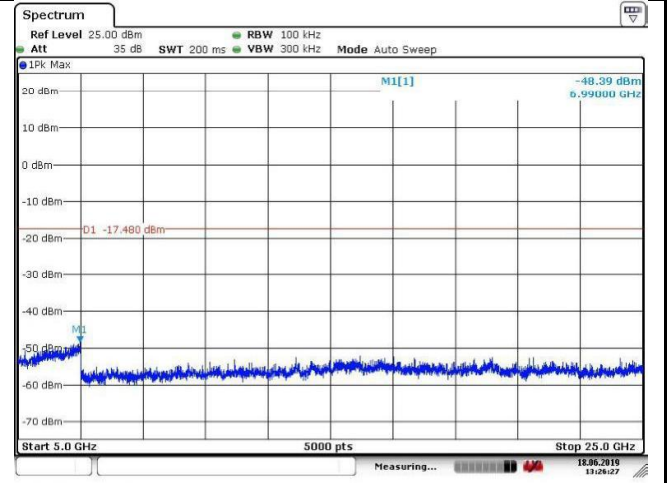
#### Spurious Emission (30MHz – 1GHz)



#### Spurious Emission (1GHz –5GHz)



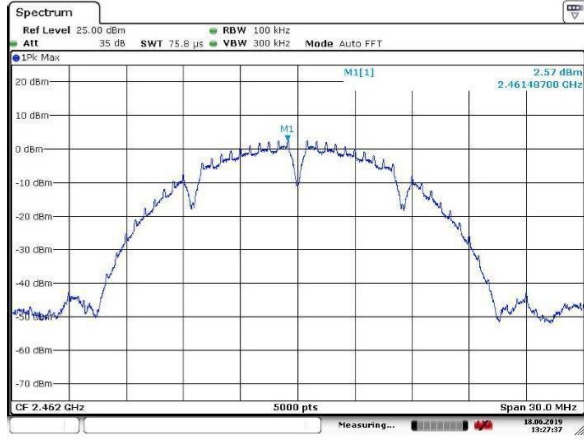
#### Spurious Emission (5GHz –25GHz)





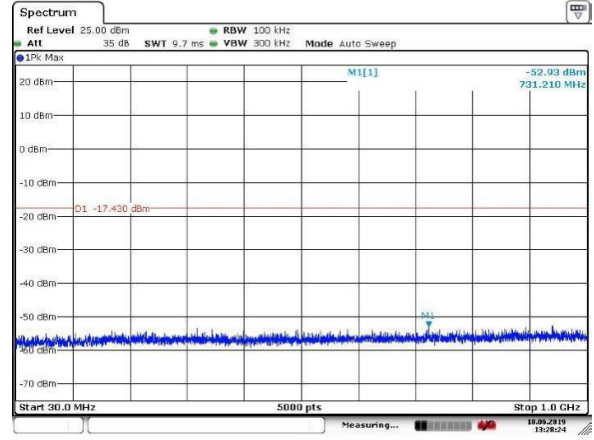
802.11b Out-of-Band Emissions  
Channel 01 (2462MHz)

Referencel point



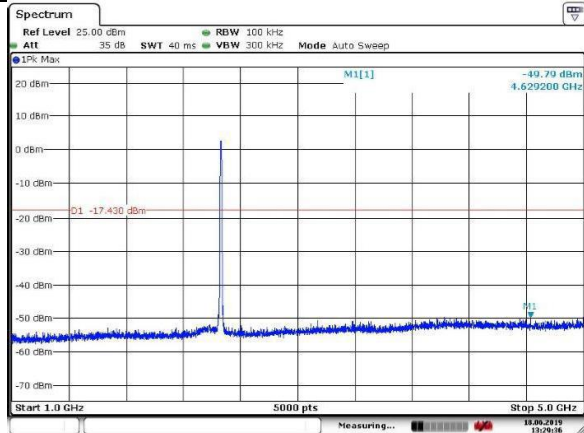
Date: 18 JUN.2019 13:27:37

Spurious Emission (30MHz – 1GHz)



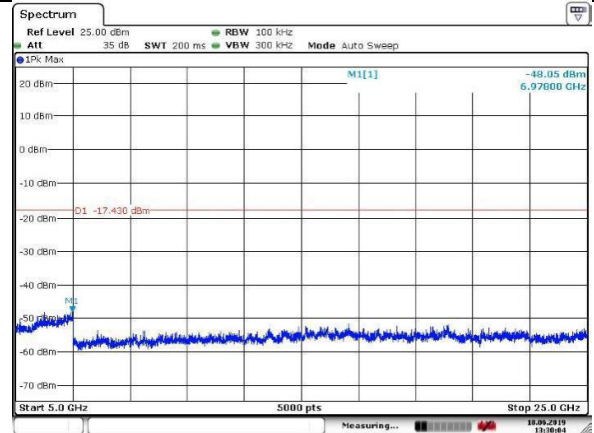
Date: 18 JUN.2019 13:28:24

Spurious Emission (1GHz –5GHz)



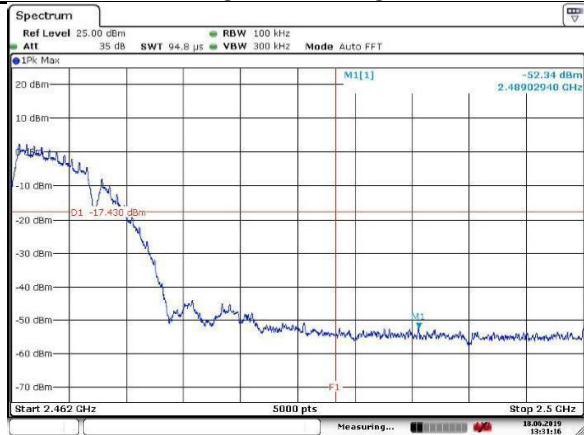
Date: 18 JUN.2019 13:29:37

Spurious Emission (5GHz –25GHz)



Date: 18 JUN.2019 13:30:04

High band edge

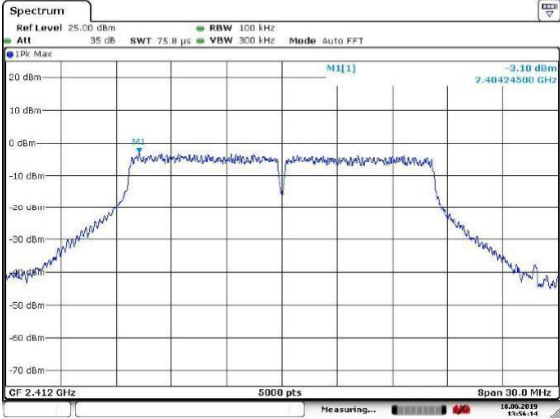


Date: 18 JUN.2019 13:31:16



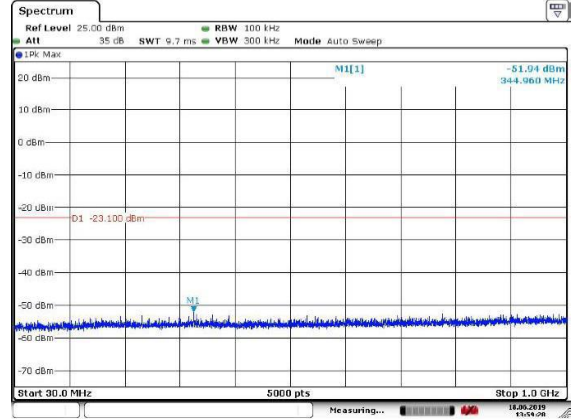
802.11g Out-of-Band Emissions  
Channel 01 (2412MHz)

Referencel point



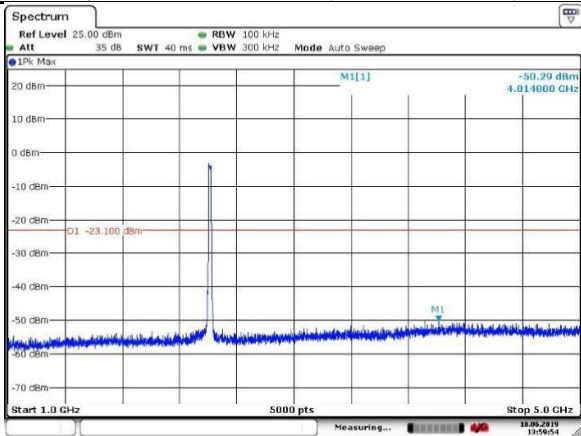
Date: 18 JUN 2019 13:58:14

Spurious Emission (30MHz – 1GHz)



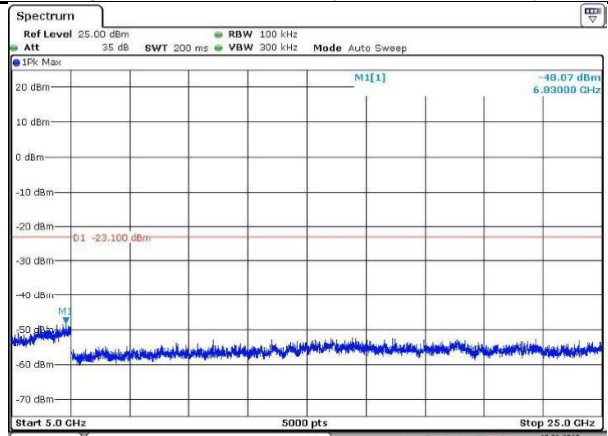
Date: 18 JUN 2019 13:59:29

Spurious Emission (1GHz –5GHz)



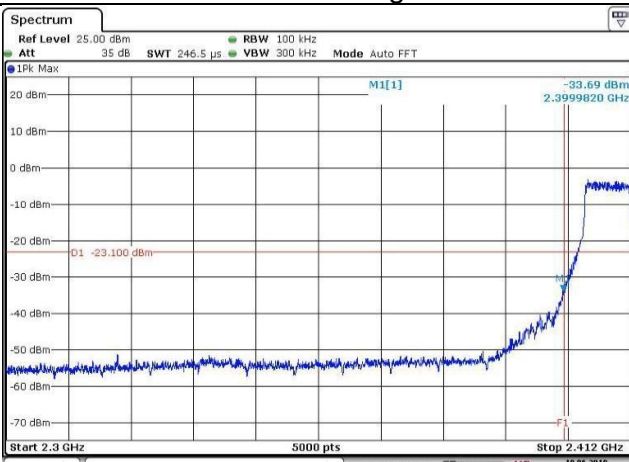
Date: 18 JUN 2019 13:59:54

Spurious Emission (5GHz –25GHz)



Date: 18 JUN 2019 14:00:17

Low band edge



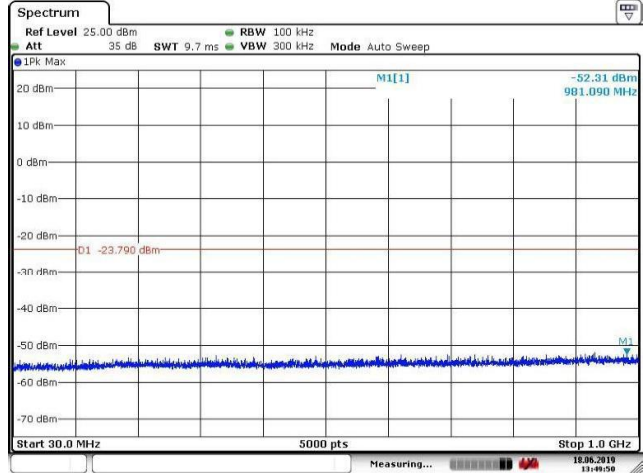
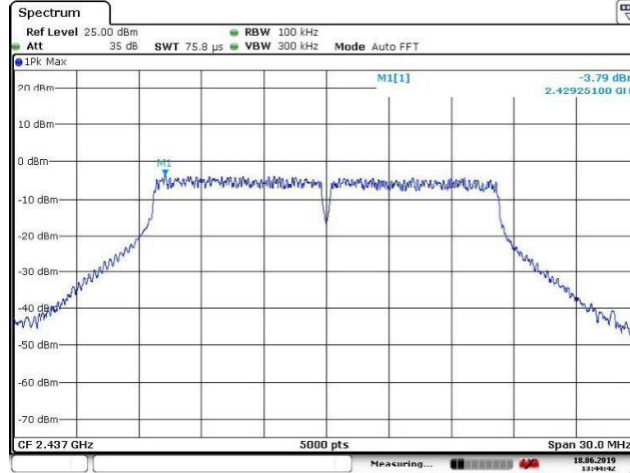
Date: 18 JUN 2019 14:01:33



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

Referencel point

Spurious Emission (30MHz – 1GHz)

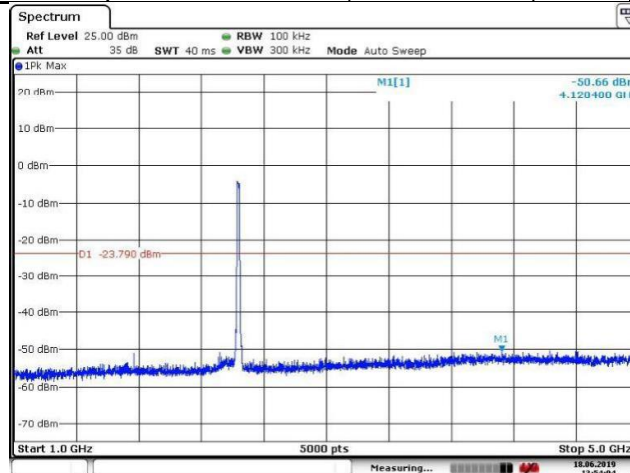


Date: 18 JUN 2019 13:44:43

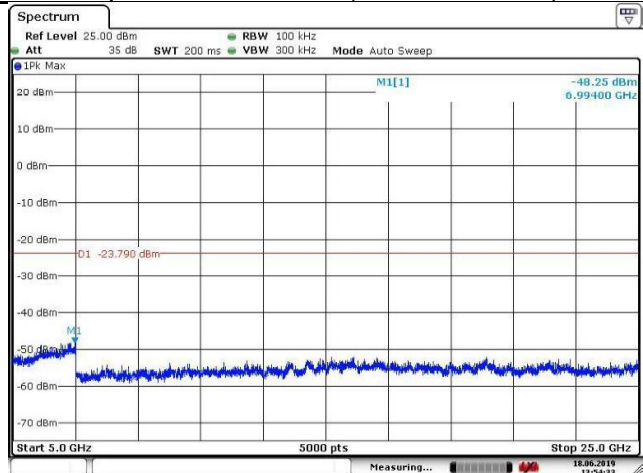
Date: 18 JUN 2019 13:49:50

Spurious Emission (1GHz –5GHz)

Spurious Emission (5GHz –25GHz)



Date: 18 JUN 2019 13:54:04

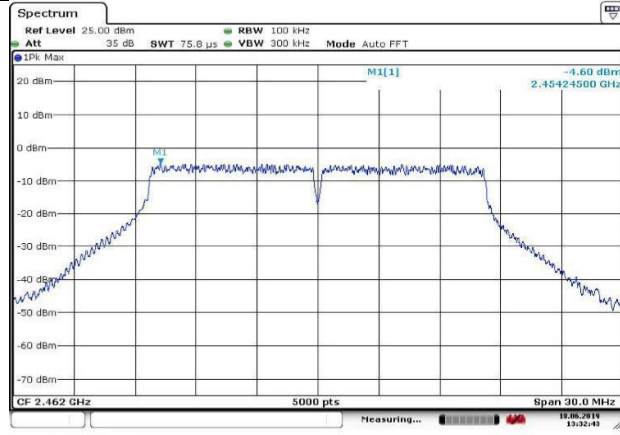


Date: 18 JUN 2019 13:54:33

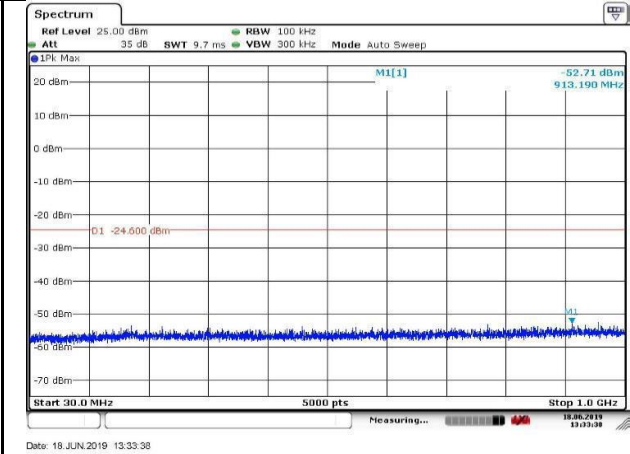


802.11g Out-of-Band Emissions  
Channel 11 (2462MHz)

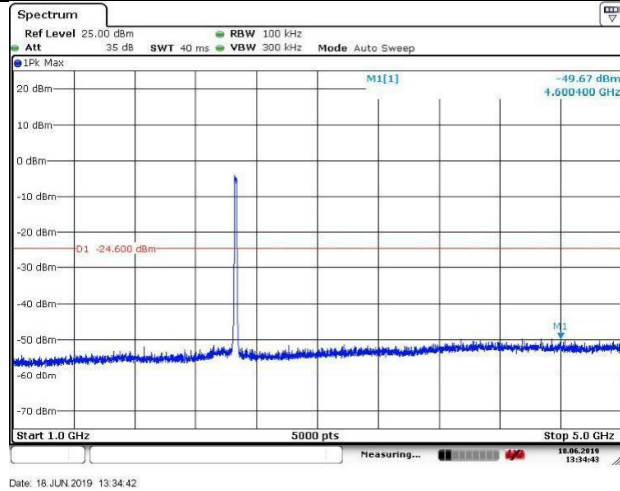
Referencel point



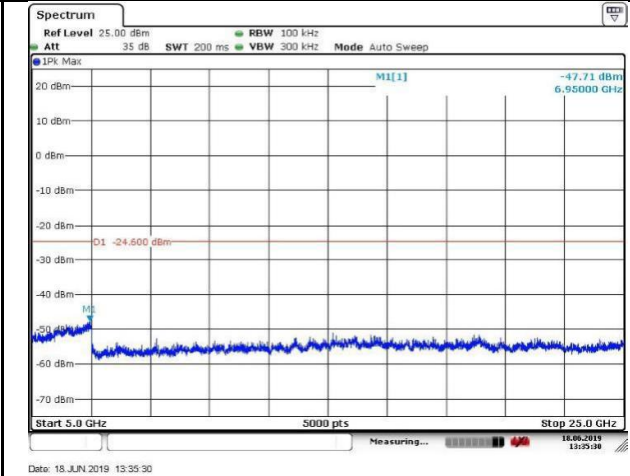
Spurious Emission (30MHz – 1GHz)



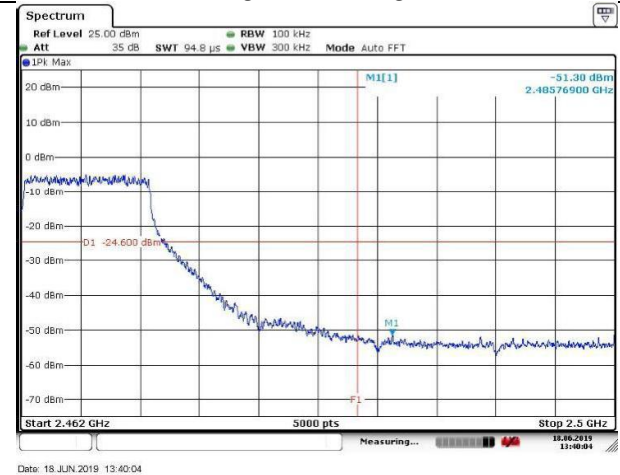
Spurious Emission (1GHz –5GHz)



Spurious Emission (5GHz –25GHz)



High band edge

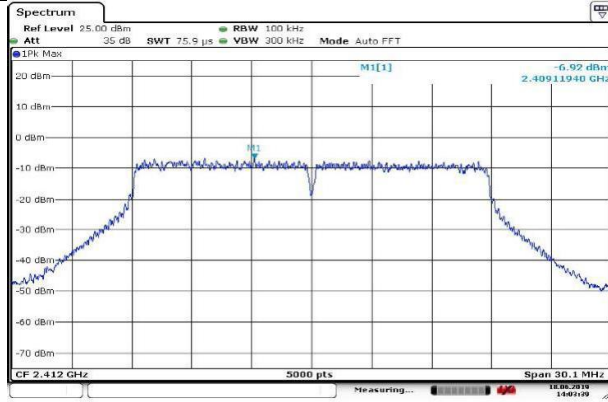




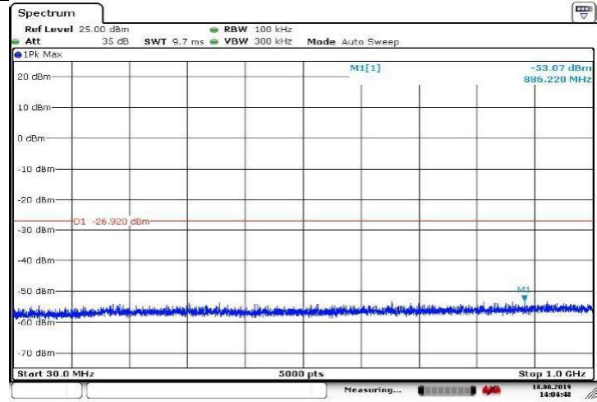
### 802.11n-HT20 Out-of-Band Emissions

#### Channel 01 (2412MHz)

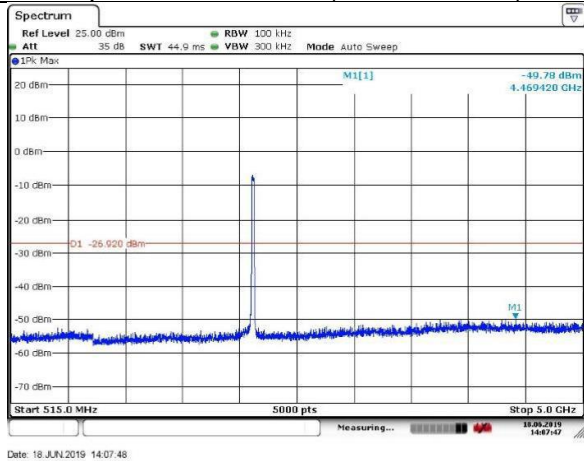
##### Referencel point



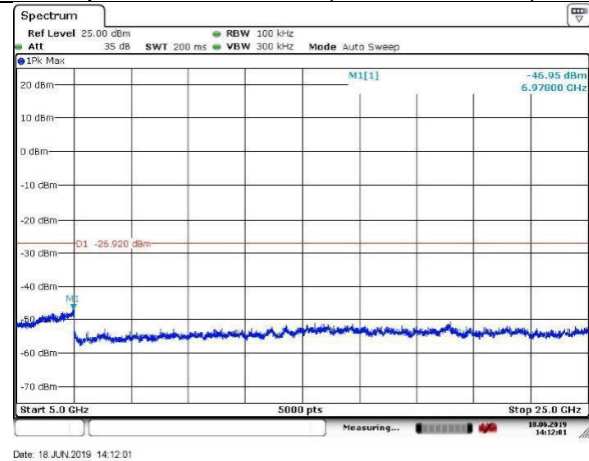
##### Spurious Emission (30MHz – 1GHz)



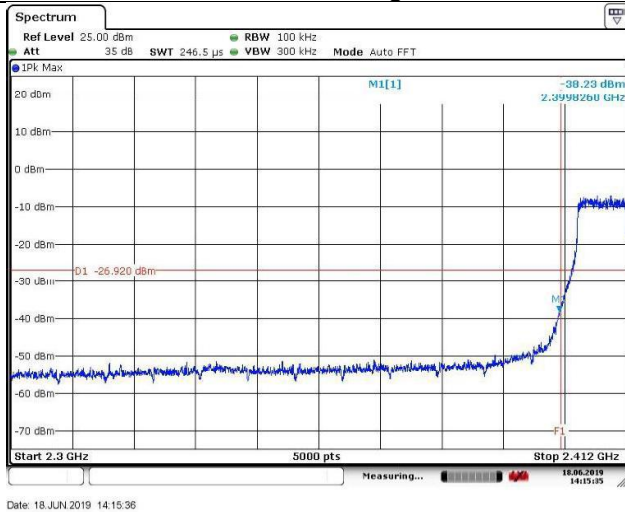
##### Spurious Emission (1GHz –5GHz)



##### Spurious Emission (5GHz –25GHz)



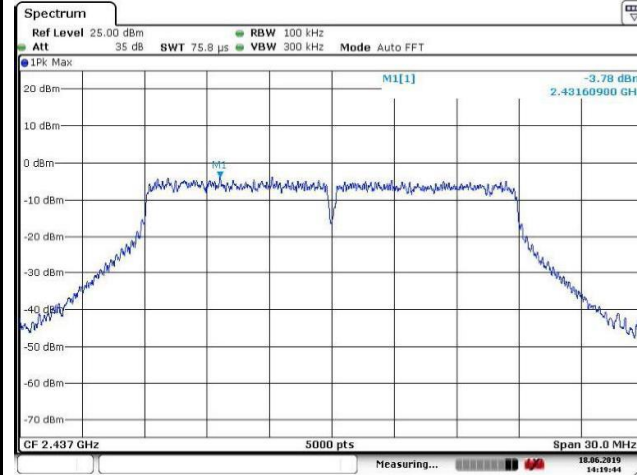
##### Low band edge





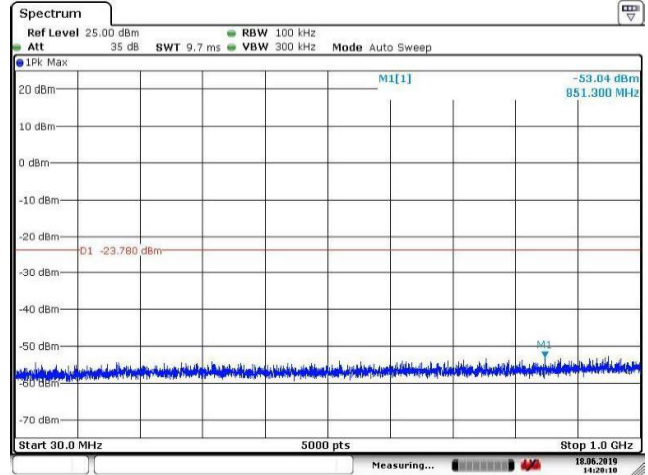
802.11n-HT20 Out-of-Band Emissions  
Channel 06 (2437MHz)

Referencel point



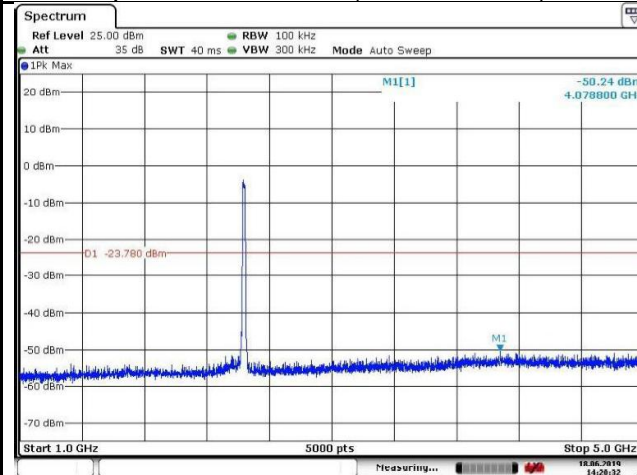
Date: 18 JUN 2019 14:19:44

Spurious Emission (30MHz – 1GHz)



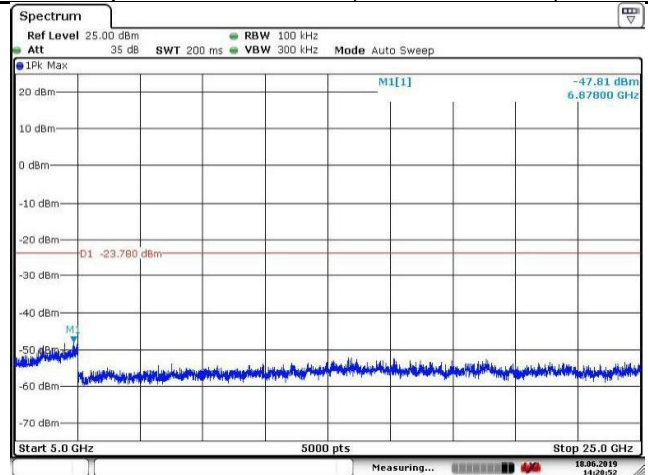
Date: 18 JUN 2019 14:20:10

Spurious Emission (1GHz –5GHz)



Date: 18 JUN 2019 14:20:32

Spurious Emission (5GHz –25GHz)



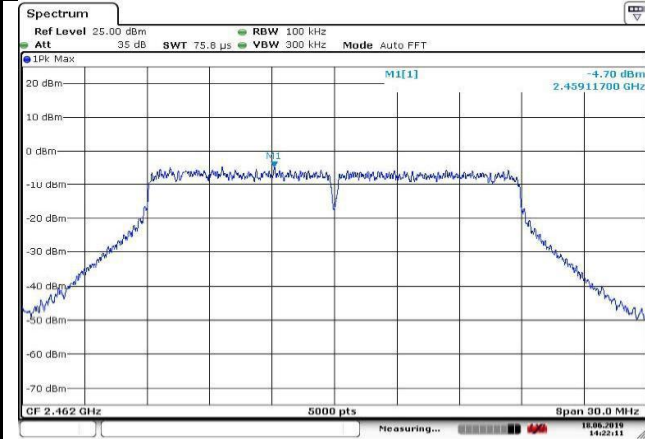
Date: 18 JUN 2019 14:20:52



### 802.11n-HT20 Out-of-Band Emissions

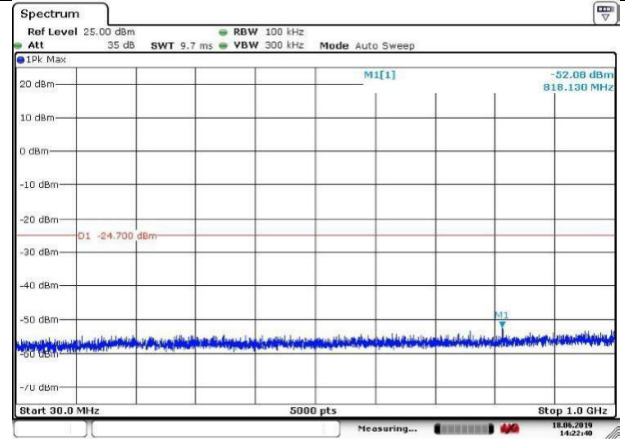
#### Channel 11 (2462MHz)

##### Referencel point



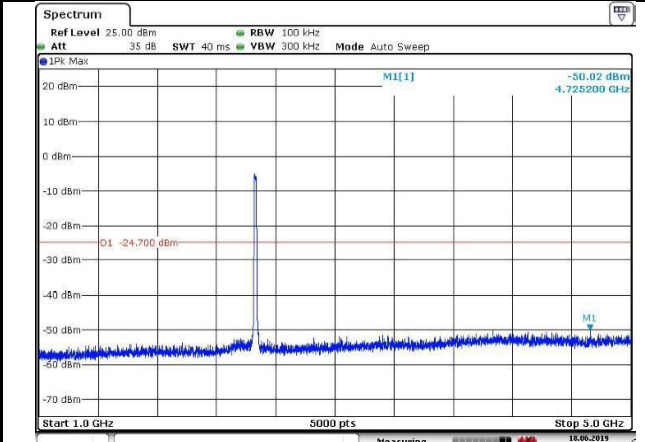
Date: 18.JUN.2019 14:22:11

##### Spurious Emission (30MHz – 1GHz)



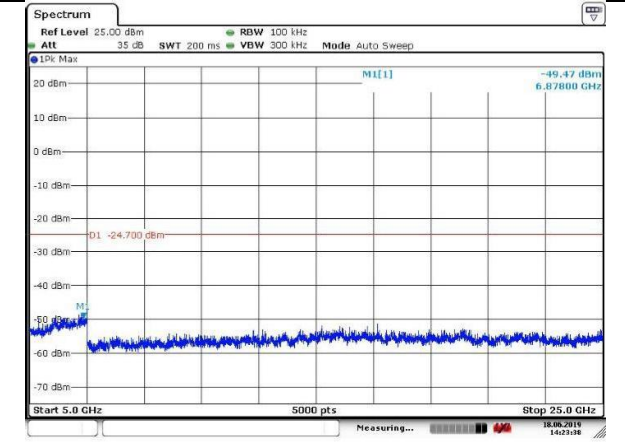
Date: 18.JUN.2019 14:22:40

##### Spurious Emission (1GHz –5GHz)



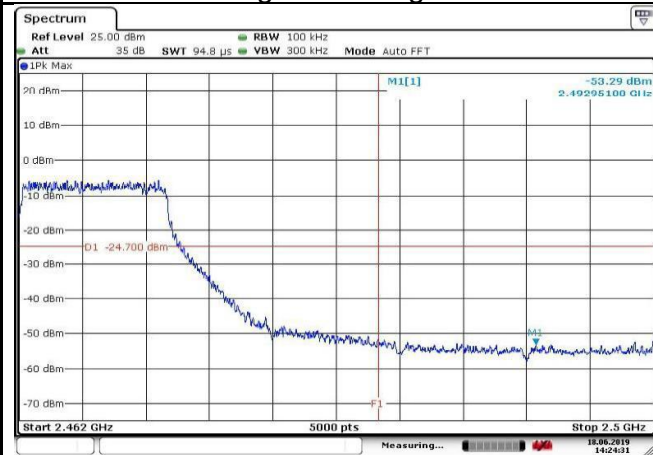
Date: 18.JUN.2019 14:23:18

##### Spurious Emission (5GHz –25GHz)



Date: 18.JUN.2019 14:23:38

##### High band edge



Date: 18.JUN.2019 14:24:31



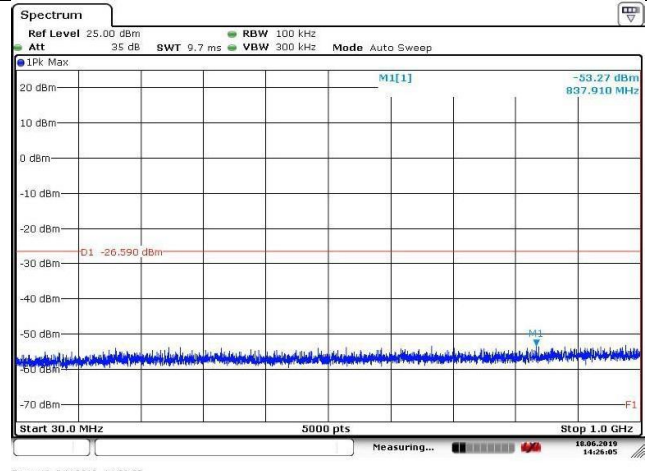
### 802.11n-HT40 Out-of-Band Emissions

#### Channel 03 (2422MHz)

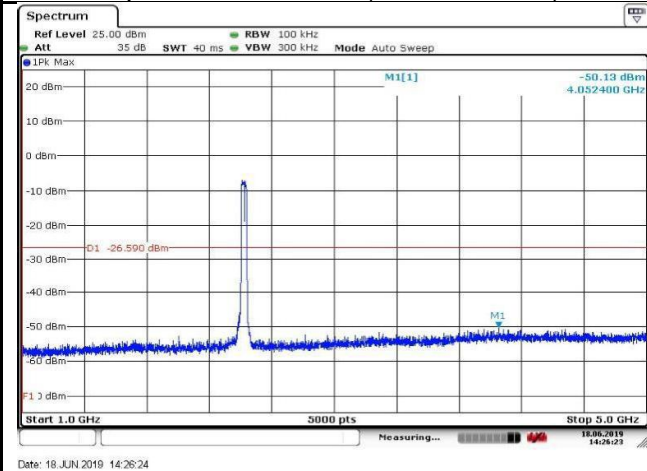
##### Referencel point



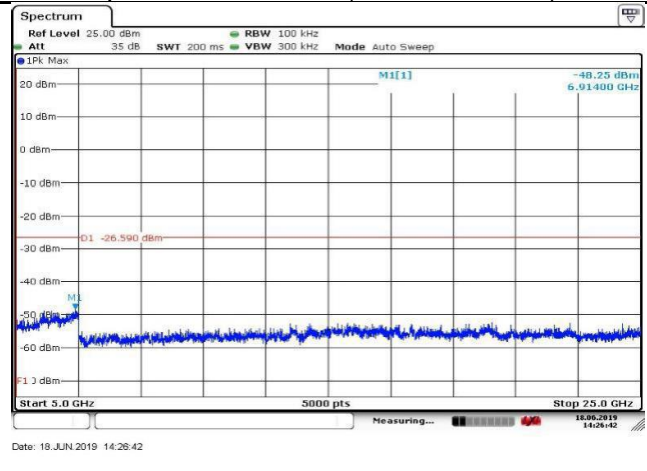
##### Spurious Emission (30MHz – 1GHz)



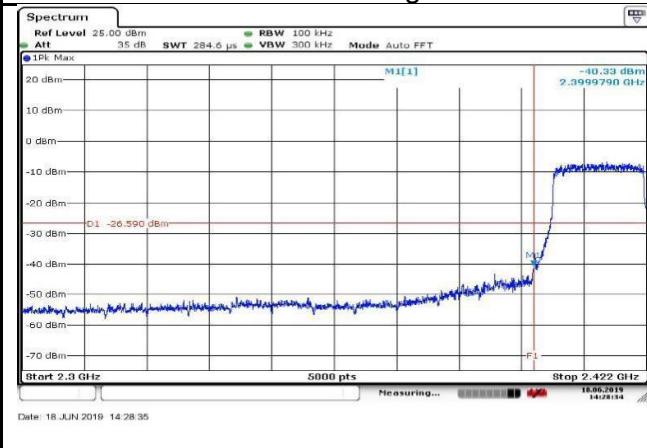
##### Spurious Emission (1GHz –5GHz)



##### Spurious Emission (5GHz –25GHz)



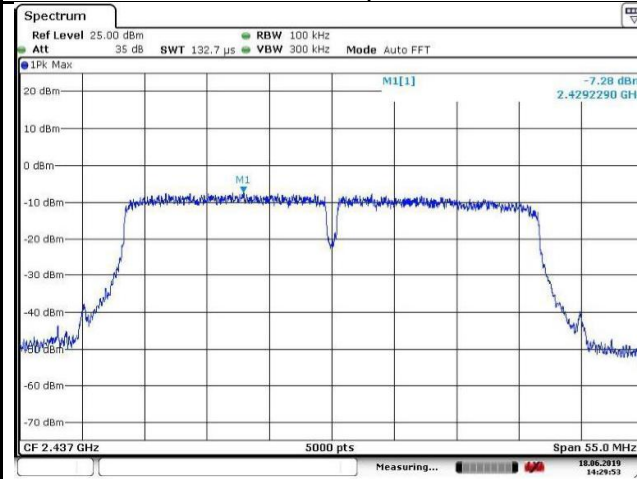
##### Low band edge





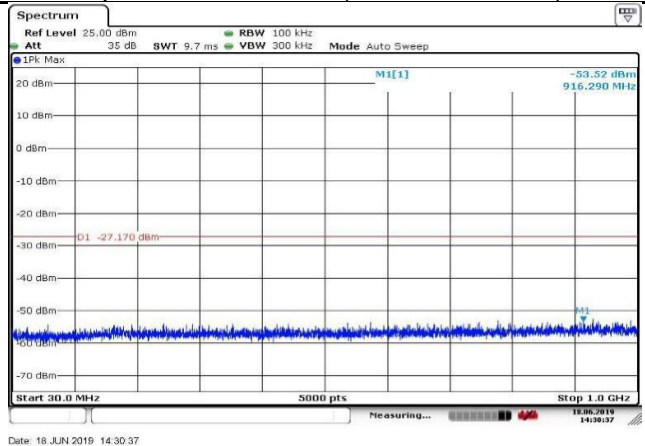
802.11n-HT40 Out-of-Band Emissions  
Channel 06 (2437MHz)

Referencel point



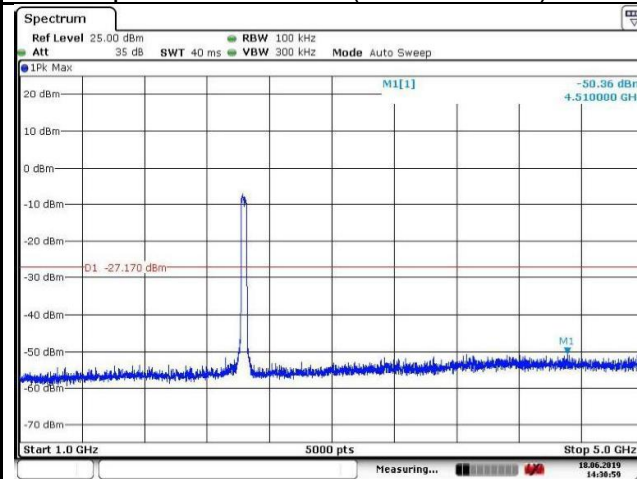
Date: 18 JUN 2019 14:29:53

Spurious Emission (30MHz – 1GHz)



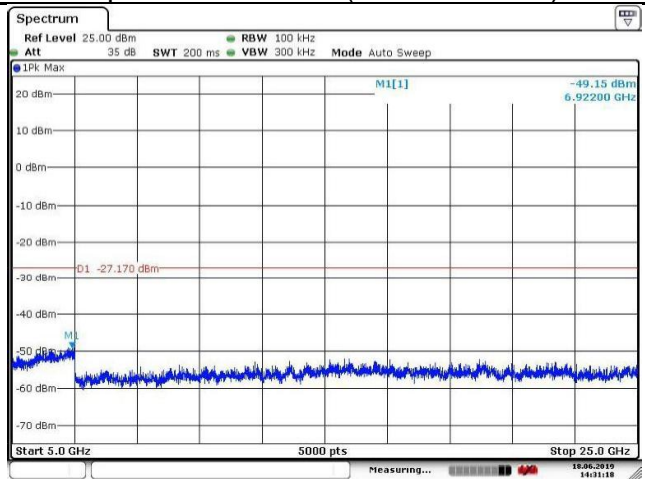
Date: 18 JUN 2019 14:30:37

Spurious Emission (1GHz –5GHz)



Date: 18 JUN 2019 14:30:59

Spurious Emission (5GHz –25GHz)

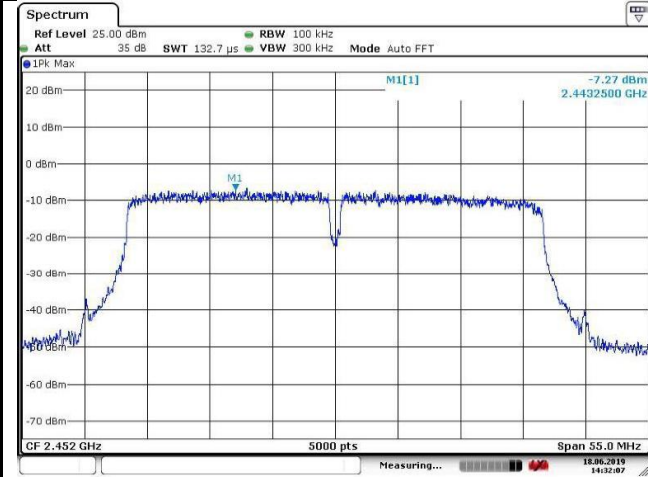


Date: 18 JUN 2019 14:31:18

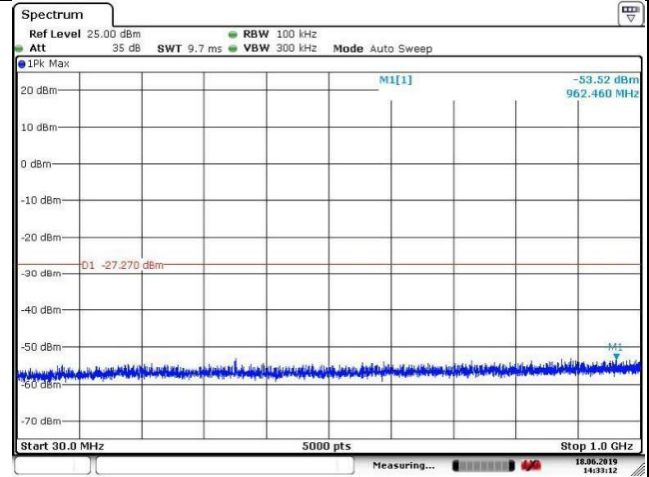
### 802.11n-HT40 Out-of-Band Emissions

#### Channel 09 (2452MHz)

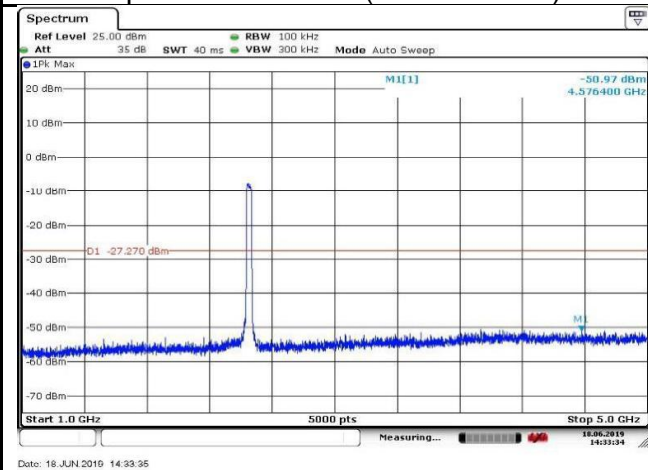
##### Referencel point



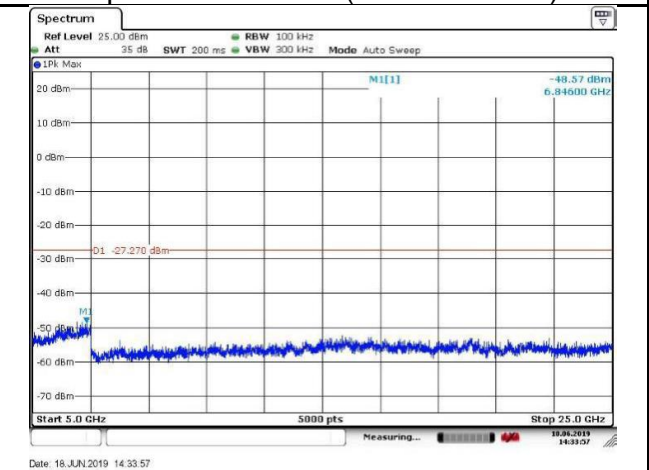
##### Spurious Emission (30MHz – 1GHz)



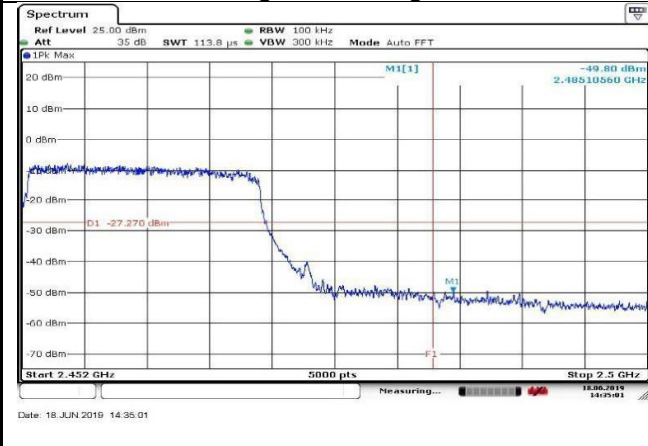
##### Spurious Emission (1GHz –5GHz)



##### 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 (20log(1/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
2384.2	41.30	74.0	-32.70	Peak	Horizontal
2388.7	43.12	74.0	-30.88	Peak	Horizontal
4823.9	45.21	74.0	-28.79	Peak	Horizontal
2389.2	41.01	74.0	-32.99	Peak	Vertical
4823.2	46.76	74.0	-27.24	Peak	Vertical
7235.9	48.52	74.0	-25.48	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	43.08	74.0	-30.92	Peak	Horizontal
7310.7	41.09	74.0	-32.91	Peak	Horizontal
4874.3	41.87	74.0	-32.13	Peak	Vertical
7310.7	43.27	74.0	-30.73	Peak	Vertical

Test mode: 802.11b					
Channel 11 (2462MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2484.6	43.11	74.0	-30.89	Peak	Horizontal
4923.6	40.33	74.0	-33.67	Peak	Horizontal
2485.7	42.43	74.0	-31.57	Peak	Vertical
4923.1	40.74	74.0	-33.26	Peak	Vertical
7385.8	42.61	74.0	-31.39	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



China

Test mode: 802.11g					
Channel 01 (2412MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2389.0	64.93	74.0	-9.07	Peak	Horizontal
2389.0	47.10	54.0	-6.90	Average	Horizontal
4823.5	42.21	74.0	-31.79	Peak	Horizontal
2389.6	63.22	74.0	-10.78	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
4878.4	41.67	74.0	-32.33	Peak	Horizontal
7311.5	40.77	74.0	-33.23	Peak	Horizontal
4878.2	43.58	74.0	-30.42	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	57.84	74.0	-16.16	Peak	Horizontal
2483.5	40.41	54.0	-13.59	Average	Horizontal
4924.2	41.61	74.0	-32.39	Peak	Horizontal
2483.5	57.59	74.0	-16.41	Peak	Vertical
2483.5	40.53	54.0	-13.47	Average	Vertical
4923.6	40.32	74.0	-33.68	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



China

Test mode: 802.11n-HT20					
Channel 01 (2412MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2389.0	58.22	74.0	-15.78	Peak	Horizontal
2389.0	47.60	54.0	-6.40	Average	Horizontal
4823.0	42.53	74.0	-31.47	Peak	Horizontal
7234.1	40.74	74.0	-33.26	Peak	Horizontal
2390.0	61.02	74.0	-12.98	Peak	Vertical
2390.0	49.70	54.0	-4.30	Average	Vertical
4823.6	40.32	74.0	-33.68	Peak	Vertical
7235.5	41.38	74.0	-32.62	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	41.65	74.0	-32.35	Peak	Horizontal
7312.8	41.02	74.0	-12.98	Peak	Horizontal
4872.5	40.02	74.0	-33.98	Peak	Vertical
7312.8	42.04	74.0	-31.96	Peak	Vertical

Test mode: 802.11n-HT20					
Channel 11 (2462MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2483.5	55.48	74.0	-18.52	Peak	Horizontal
2483.5	41.33	54.0	-12.67	Average	Horizontal
4925.4	41.41	74.0	-32.59	Peak	Horizontal
7335.2	40.51	74.0	-33.49	Peak	Horizontal
2483.5	56.48	74.0	-17.52	Peak	Vertical
2483.5	38.48	54.0	-15.52	Average	Vertical
4923.6	43.32	74.0	-30.68	Peak	Vertical
7333.5	41.39	74.0	-32.61	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: 802.11n-HT40					
Channel 01 (2422MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2390.0	68.59	74.0	-5.41	Peak	Horizontal
2390.0	51.25	54.0	-2.75	Average	Horizontal
4845.9	42.34	74.0	-31.66	Peak	Horizontal
2388.5	70.94	74.0	-3.06	Peak	Vertical
2388.5	52.90	54.0	-1.10	Average	Vertical
4845.9	41.38	74.0	-32.62	Peak	Vertical

Test mode: 802.11n-HT40					
Channel 06 (2437 MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
4873.7	41.28	74.0	-32.72	Peak	Horizontal
7311.5	42.33	74.0	-31.67	Peak	Horizontal
4875.5	40.97	74.0	-33.03	Peak	Vertical
7311.1	42.87	74.0	-31.13	Peak	Vertical

Test mode: 802.11n-HT40					
Channel 11 (2452MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2483.5	56.28	74.0	-17.72	Peak	Horizontal
2483.5	39.12	54.0	-14.88	Average	Horizontal
4904.5	41.18	74.0	-32.82	Peak	Horizontal
7325.7	38.71	74.0	-35.29	Peak	Vertical
2483.5	56.09	74.0	-17.91	Peak	Vertical
2483.5	40.00	54.0	-14.00	Average	Vertical
4905.8	39.66	74.0	-34.34	Peak	Vertical
7358.9	40.28	74.0	-33.72	Peak	Vertical

Remark:

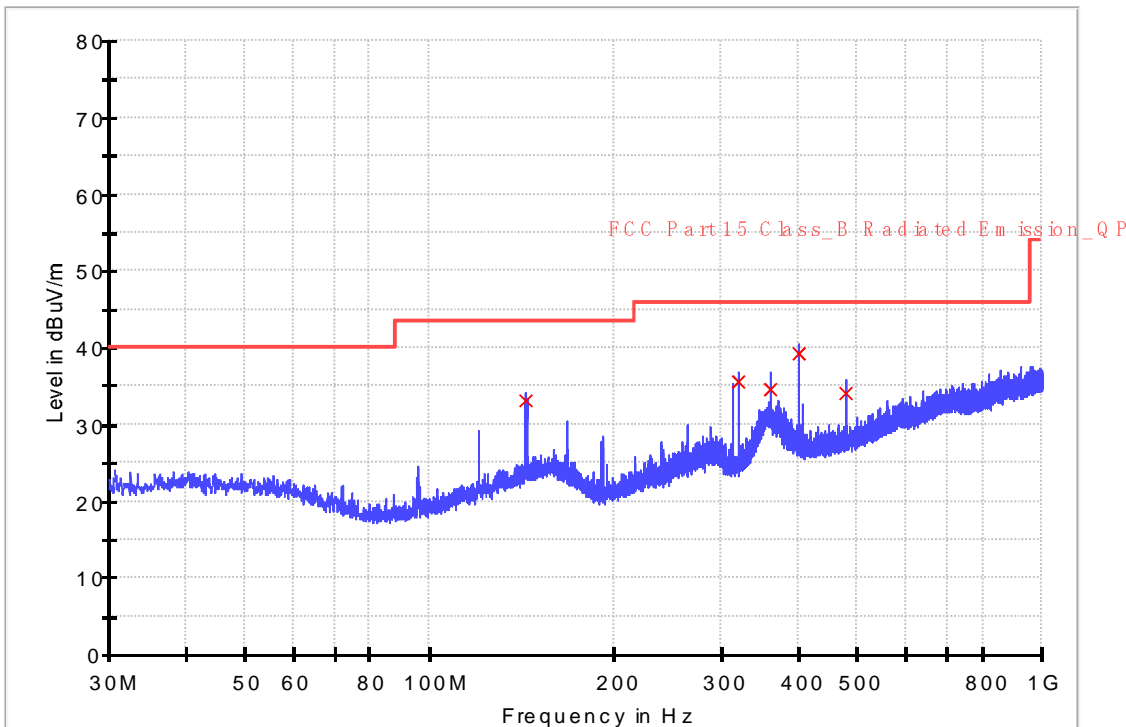
- (1) Emission level= Original Receiver Reading + Correct Factor
- (2) Correct Factor = Antenna Factor + Cable Loss -Amplifier gain
- (3) Margin = limit – Corrected Reading



The worst case of Radiated Emission below 1GHz:

Site: 3 meter chamber	Time: 2019/06/15 - 14:14
Limit: FCC_Part15.109_RE(3m)_ClassB	Engineer: Jiaxi XU
Probe: VULB9168	Polarity: Horizontal
EUT: Smart Gateway, Model no: TYGWZW-01	Power: 120VAC, 60Hz
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



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)
143.480000	33.2	1000.0	120.000	100.2	H	358.0	15.2	10.3	43.5
320.000000	35.6	1000.0	120.000	100.2	H	358.0	15.5	10.4	46.0
360.000000	34.6	1000.0	120.000	100.2	H	358.0	16.5	11.4	46.0
400.000000	39.2	1000.0	120.000	100.2	H	358.0	17.4	6.8	46.0
480.000000	34.1	1000.0	120.000	100.2	H	358.0	19.1	12.0	46.0

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

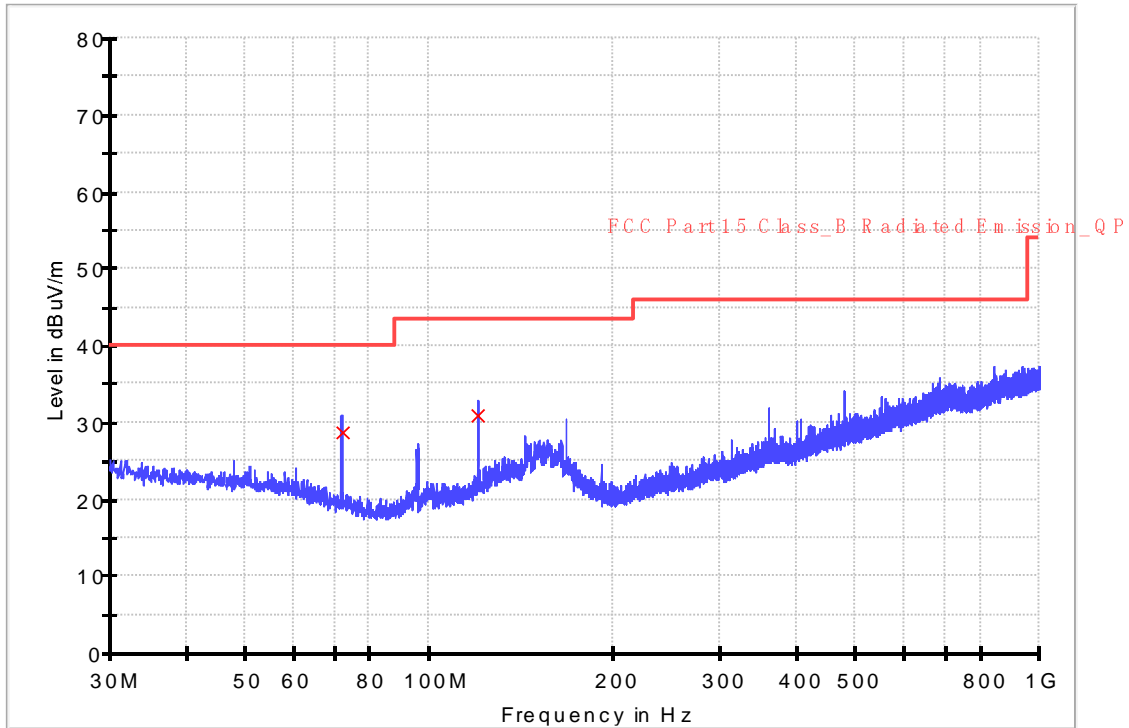
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

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



Site: 3 meter chamber	Time: 2019/06/15 - 14:18
Limit: FCC_Part15.109_RE(3m)_ClassB	Engineer: Jiaxi XU
Probe: VULB9168	Polarity: Vertical
EUT: Smart Gateway, Model no: TYGWZW-01	Power: 120VAC, 60Hz
Note: Transmit by 802.11b 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)
71.960000	28.7	1000.0	120.000	100.2	V	0.0	11.5	11.3	40.0
119.960000	30.9	1000.0	120.000	100.2	V	358.0	13.5	12.6	43.5

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, $\pm 5.03$ dB (Horizontal) $\pm 5.12$ dB (Vertical) 1GHz to 18GHz, $\pm 5.15$ dB (Horizontal) $\pm 5.12$ dB (Vertical) 18GHz to 25GHz, $\pm 4.76$ dB



## 12 Photographs of Test Set-ups

Refer to the < Test Setup photos >.



## 13 Photographs of EUT

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

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THE END