

# Zhejiang Kezheng Electronic Product Inspection

Building 5, No. 316, Jianghong South Road Binjiang District, Hangzhou 310052, China

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## TEST REPORT



**Report No.** .....: 2019-9023

**FCC ID** .....: 2AT9WMT-600668

**Applicant** .....: SHENZHEN CLOBOT INTELLIGENT TECHNOLOGY CO., LTD.

**Address** .....: Area A&B,7F. SZZT Industrial Park, No.3 Tongguan Road;  
Guangming New District Shenzhen, China

**Manufacturer** .....: SHENZHEN CLOBOT INTELLIGENT TECHNOLOGY CO., LTD.

**Address** .....: Area A&B,7F. SZZT Industrial Park, No.3 Tongguan Road;  
Guangming New District Shenzhen, China

**Product Name** .....: **Robotic Vacuum Cleaner**

**Trade Mark** .....: N/A

**Model/Type reference** .....: MT-600

**Listed Model(s)** .....: MT-610,MT-620,MT-630,MT-640,MT-650,MT-660,MT-670,  
MT-680,MT-690

**Standard** .....: **FCC CFR Title 47 Part 15 Subpart C Section 15.247**

**Date of receipt of test sample** .....: Jun.12, 2019

**Date of testing** .....: Jun.12, 2019 to Jul.11, 2019

**Date of issue** .....: Jul.11, 2019

**Result** .....: **PASS**

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Approved by:

(Printed name+signature) Wang Weixiong

**Testing Laboratory Name** .....: **Zhejiang Kezheng Electronic Product Inspection**

**Address** .....: Building 5, No. 316, Jianghong South Road Binjiang District,  
Hangzhou 310052, China

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# 1. TEST SUMMARY

## 1.1. Test Standards

The tests were performed according to following standards:

[FCC Rules Part 15.247](#): Operation within the bands of 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz.

[ANSI C63.10-2013](#): American National Standard for Testing Unlicensed Wireless Devices.

## 1.2. Report version

Revised No.	Date of issue	Description
01	Jul.11, 2019	Original

### 1.3. Test Description

FCC Part 15 Subpart C(15.247)			
Test Item	Standard Section	Result	Test Engineer
	FCC		
Antenna Requirement	15.203	Pass	John Xie
Conducted Emission	15.207	Pass	John Xie
6dB Bandwidth	15.247(a)(2)	Pass	John Xie
Peak Output Power	15.247(b)	Pass	John Xie
Power Spectral Density	15.247(e)	Pass	John Xie
Restricted Band	15.247(d)/15.205	Pass	John Xie
Band Edge and Spurious Emission(Conducted)	15.247(d)	Pass	John Xie
Spurious Emission(Radiated)	15.247(d)&15.209	Pass	John Xie

Note: The measurement uncertainty is not included in the test result.

## 1.4. Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to TR-100028-01 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 2" and is documented in the Zhejiang Kezheng Electronic Product Inspection quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device. Below is the best measurement capability for Zhejiang Kezheng Electronic Product Inspection.

Test Items	Measurement Uncertainty	Notes
Transmitter power conducted	0.42 dB	(1)
Transmitter power Radiated	2.14 dB	(1)
Conducted spurious emissions 9kHz~40GHz	1.60 dB	(1)
Radiated spurious emissions 9kHz~40GHz	2.20 dB	(1)
Conducted Emissions 9kHz~30MHz	3.20 dB	(1)
Radiated Emissions 30~1000MHz	4.70 dB	(1)
Radiated Emissions 1~18GHz	5.00 dB	(1)
Radiated Emissions 18~40GHz	5.54 dB	(1)
Occupied Bandwidth	-----	(1)

**Note (1):** This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=1.96$ .

## 1.5. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15~35°C
Relative Humidity:	30~60 %
Air Pressure:	950~1050mba

## 2. GENERAL INFORMATION

### 2.1. Client Information

Applicant:	SHENZHEN CLOBOT INTELLIGENT TECHNOLOGY CO., LTD.
Address:	Area A&B,7F. SZZT Industrial Park, No.3 Tongguan Road; Guangming New District Shenzhen, China
Manufacturer:	SHENZHEN CLOBOT INTELLIGENT TECHNOLOGY CO., LTD.
Address:	Area A&B,7F. SZZT Industrial Park, No.3 Tongguan Road; Guangming New District Shenzhen, China

### 2.2. General Description of EUT

Product Name:	Robotic Vacuum Cleaner
Model/Type reference:	MT-600
Marketing Name:	N/A
Listed Model(s):	MT-610,MT-620,MT-630,MT-640,MT-650,MT-660,MT-670, MT-680,MT-690
Adapter :	INPUT:100V~240V 50/60Hz 0.5A Max OUTPUT: DC19V 600mA
Power supply(Battery):	DC 14.8V 2200mAh
Hardware version:	MT-6S REV1.2
Software version:	1.5.15
<b>WIFI 802.11b/g/n(HT20)</b>	
Modulation:	802.11b: DSSS(CCK, DQPSK, DBPSK) 802.11g/n: OFDM(BPSK,QPSK,16QAM,64QAM)
Operation frequency:	802.11b/g/n(HT20): 2412MHz~2462MHz 802.11n(HT40): 2422MHz~2452MHz
Max Peak Output Power:	802.11b: 14.82dBm 802.11g: 12.30dBm 802.11n (HT20): 10.83dBm 802.11n (HT40): 9.47dBm
Channel number:	802.11b/g/n(HT20):11 channels 802.11n(HT40): 7 channels
Test frequency:	CH01/03: 2412M/2422MHz; CH06: 2437MHz; CH09/11: 2452M/2462MHz
Channel separation:	5MHz
Antenna type:	PCB Antenna
Antenna gain:	2.5dBi

## 2.3. Operation state

Operation Frequency List: The EUT has been tested under typical operating condition. The Applicant provides communication tools software to control the EUT for staying in continuous transmitting and receiving mode for testing.

Operation Frequency List:

Channel	Frequency (MHz)
01	2412
02	2417
03	2422
04	2427
05	2432
06	2437
07	2442
08	2447
09	2452
10	2457
11	2462

Note: 1.CH 01~CH 11 for 802.11b/g/n(HT20/HT40), CH03~CH09 for 802.11n(HT40).

2.The display in grey were the channel selected for testing.

Test mode

For RF test items
The engineering test program was provided and enabled to make EUT continuous transmit (duty cycle>98%).
For AC power line conducted emissions:
The EUT was set to connect with the WLAN AP under large package sizes transmission.
For Radiated suprious emissions test item:
The engineering test program was provided and enabled to make EUT continuous transmit(duty cycle>98%). The EUT in each of three orthogonal axis emissions had been tested ,but only the worst case (X axis) data Recorded in the report.

## 2.4. Measurement Instruments List

Tonscend JS0806-2 Test system					
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Cal. Until
1	Spectrum Analyzer	R&S	FSV40-N	101798	Apr.25, 2020
2	Vector Signal Generator	Agilent	N5182A	MY50142520	Apr.10, 2020
3	Analog Signal Generator	HP	83752A	3344A00337	Apr.10, 2020
4	Power Sensor	Agilent	E9304A	MY50390009	Apr.10, 2020
5	Power Sensor	Agilent	E9300A	MY41498315	Apr.10, 2020
6	Wideband Radio Communication Tester	R&S	CMU200	115297	Apr.10, 2020
7	Climate Chamber	Angul	AGNH80L	1903042120	Apr.10, 2020
8	Dual Output DC Power Supply	Agilent	E3646A	MY40009992	Apr.10, 2020
9	RF Control Unit	Tonscend	JS0806-2	/	Apr.10, 2020

Transmitter spurious emissions & Receiver spurious emissions					
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
1	EMI Test Receiver	R&S	ESR	102525	Apr.10, 2020
2	High Pass Filter	Chengdu E-Microwave	OHF-3-18-S	0E01901038	Apr.15, 2020
3	High Pass Filter	Chengdu E-Microwave	OHF-6.5-18-S	0E01901039	Apr.15, 2020
4	Spectrum Analyzer	HP	8593E	3831U02087	Apr.10, 2020
5	Ultra-Broadband logarithmic period Antenna	Schwarzbeck	VULB 9163	01230	Apr.17, 2020
6	Loop Antenna	Beijin ZHINAN	ZN30900C	18050	Apr.17, 2020
7	Spectrum Analyzer	R&S	FSV40-N	101798	Apr.25, 2020
8	Horn Antenna	Schwarzbeck	BBHA 9120 D	2023	Apr.10, 2020
9	Pre-Amplifier	Schwarzbeck	BBV 9745	9745#129	Apr.10, 2020
10	Pre-Amplifier	EMCI	EMC051835SE	980662	Apr.17, 2020
11	LISN	R&S	ENV216	DC0123-2	Sep.09, 2019

Note:

- 1)The Cal. Interval was one year.
- 2)The cable loss has calculated in test result which connection between each test instruments.

## 2.5. Test Software

Software name	Model	Version
Conducted emission Measurement Software	EZ-EMC	EMC-Con 3A1.1
Radiated emission Measurement Software	EZ-EMC	FA-03A.2.RE
Bluetooth and WIFI Test System	JS1120-3	2.5.77.0418

### 3. TEST ITEM AND RESULTS

#### 3.1. Antenna requirement

##### Requirement

##### **FCC CFR Title 47 Part 15 Subpart C Section 15.203:**

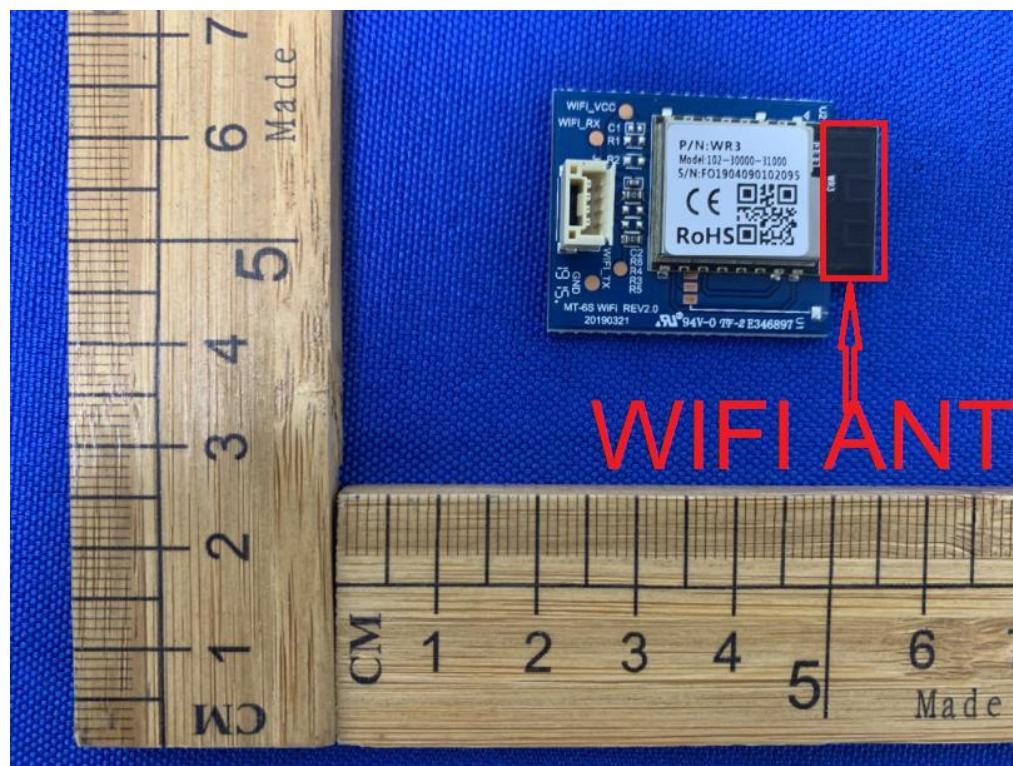
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

##### **FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1)(i):**

(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.

##### Test Result

The directional gain of the antenna less than 6dBi, please refer to the EUT internal photographs antenna photo.



### 3.2. Conducted Emission

## Limit

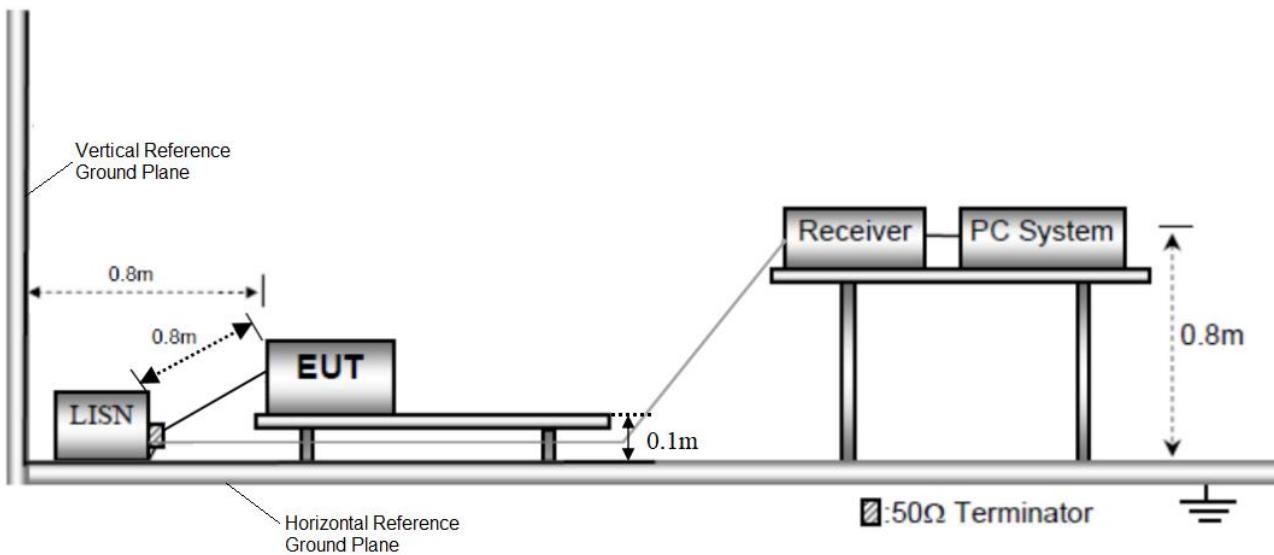
### Conducted Emission Test Limit

Frequency	Maximum RF Line Voltage (dB $\mu$ V)	
	Quasi-peak Level	Average Level
150kHz~500kHz	66 ~ 56 *	56 ~ 46 *
500kHz~5MHz	56	46
5MHz~30MHz	60	50

## Notes:

- (1) \*Decreasing linearly with logarithm of the frequency.
- (2) The lower limit shall apply at the transition frequencies.
- (3) The limit decrease in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

## Test Configuration



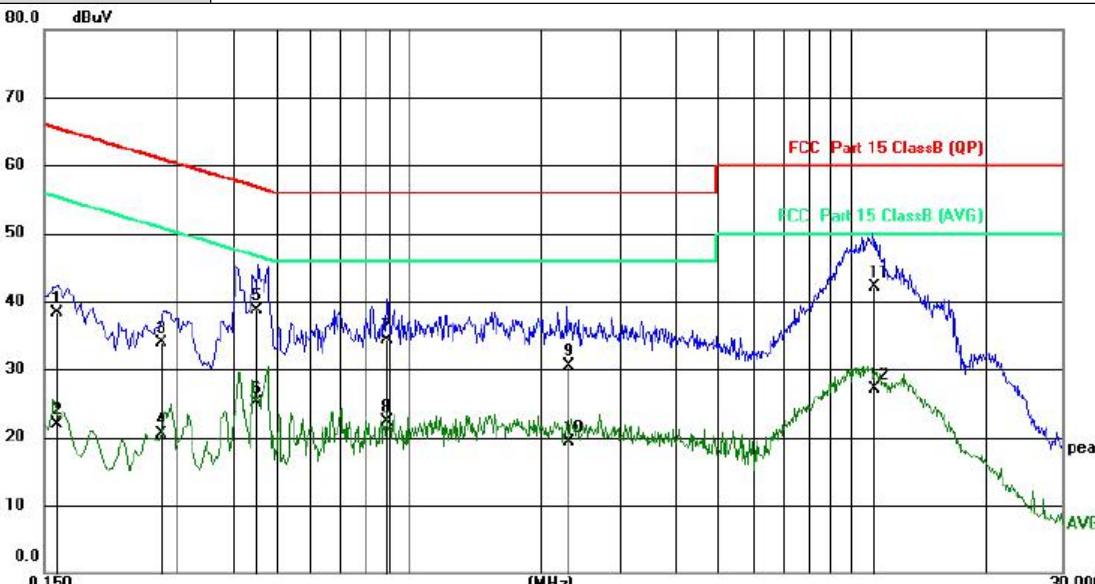
## **Test Procedure**

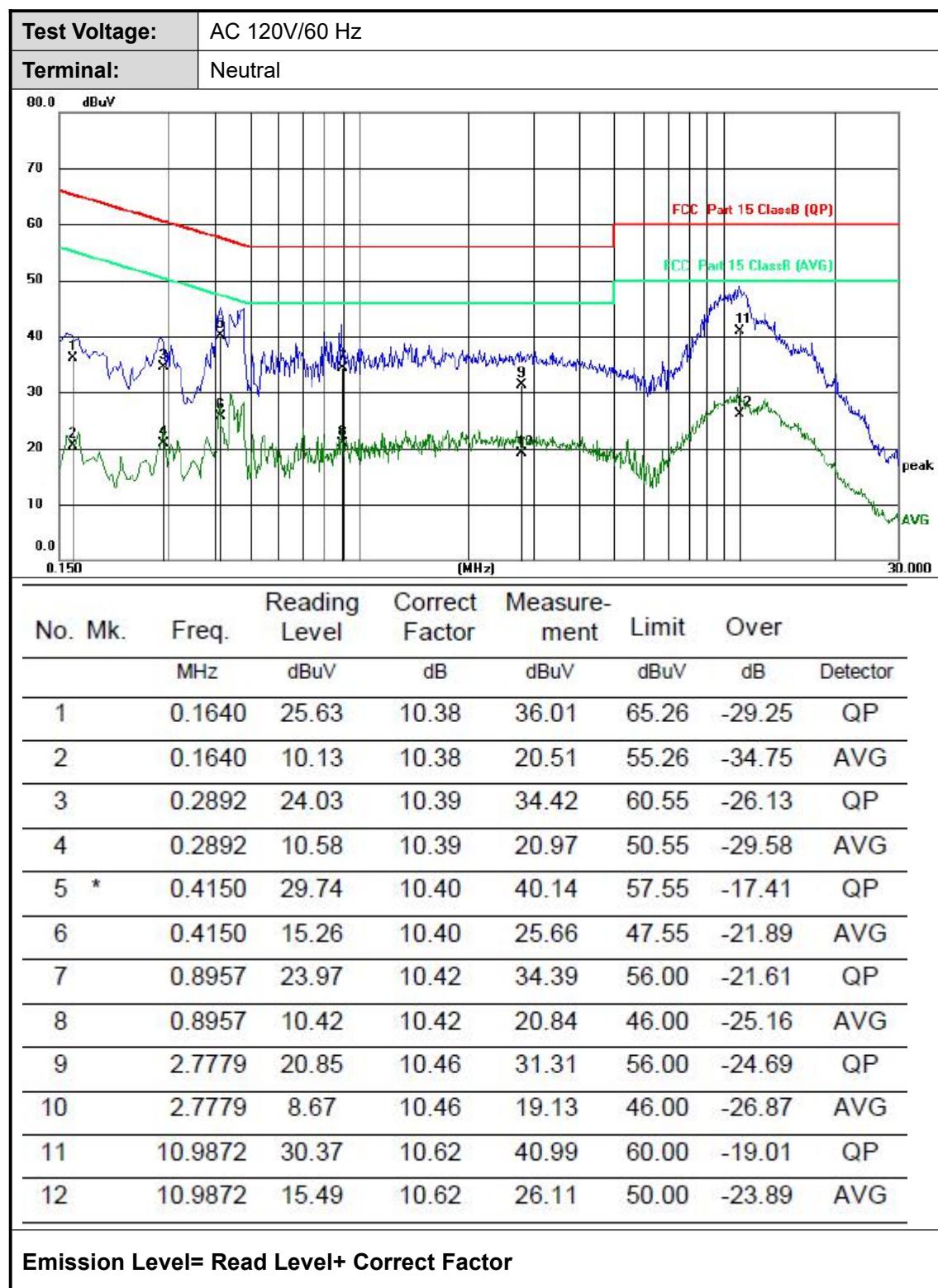
1. The EUT was setup according to ANSI C63.10:2013 requirements.
2. The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 0.1m above the conducting ground plane. The vertical conducting plane was located 80 cm to the rear of the EUT. All other surfaces of EUT were at least 0.8m from any other grounded conducting surface.
3. The EUT and simulators are connected to the main power through a line impedances stabilization network (LISN). The LISN provides a 50ohm /50uH coupling impedance for the measuring equipment.  
The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs)
4. Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source.
5. The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.
6. Conducted Emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.
7. During the above scans, the emissions were maximized by cable manipulation.

## **Test Mode:**

Please refer to the clause 2.3.

**Test Results**

<b>Test Voltage:</b>	AC 120V/60 Hz						
<b>Terminal:</b>	Line						
00.0							
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over
		MHz	dBuV	dB	dBuV	dBuV	dB
1	0.1593	27.88	10.38	38.26	65.50	-27.24	QP
2	0.1593	11.51	10.38	21.89	55.50	-33.61	AVG
3	0.2757	23.48	10.39	33.87	60.94	-27.07	QP
4	0.2757	10.19	10.39	20.58	50.94	-30.36	AVG
5	0.4537	28.33	10.41	38.74	56.81	-18.07	QP
6	0.4537	14.75	10.41	25.16	46.81	-21.65	AVG
7	0.8934	23.93	10.42	34.35	56.00	-21.65	QP
8	0.8934	11.87	10.42	22.29	46.00	-23.71	AVG
9	2.2886	20.15	10.45	30.60	56.00	-25.40	QP
10	2.2886	8.84	10.45	19.29	46.00	-26.71	AVG
11 *	11.2375	31.55	10.63	42.18	60.00	-17.82	QP
12	11.2375	16.56	10.63	27.19	50.00	-22.81	AVG
<b>Emission Level= Read Level+ Correct Factor</b>							

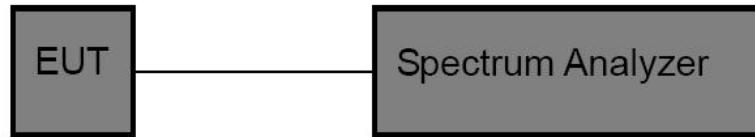


### 3.3. Bandwidth

#### Limit

Test Item	Limit	Frequency Range(MHz)
Bandwidth	>=500 KHz (6dB bandwidth)	2400~2483.5

#### Test Configuration



#### Test Procedure

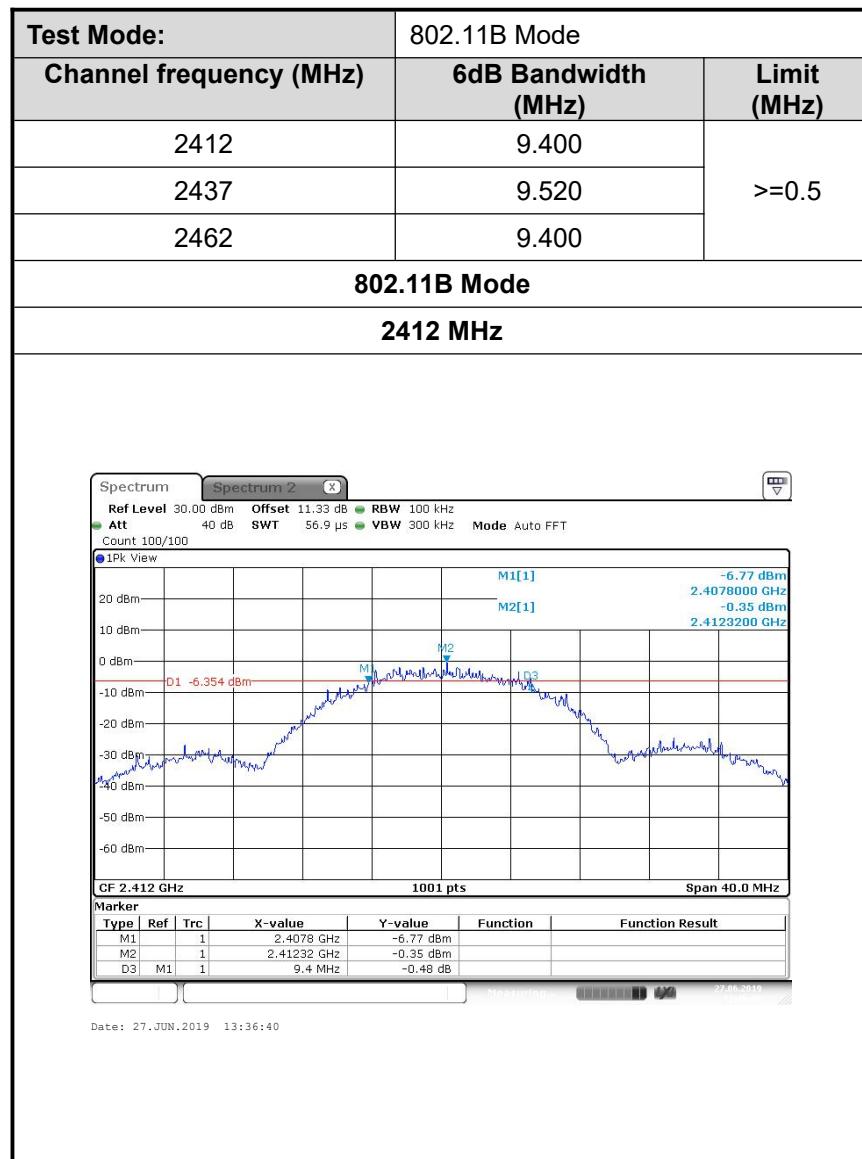
1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
2. Spectrum Setting:
  - (1) Set RBW = 100 kHz.
  - (2) Set the video bandwidth (VBW)  $\geq 3$  RBW.
  - (3) Detector = Peak.
  - (4) Trace mode = Max hold.
  - (5) Sweep = Auto couple.

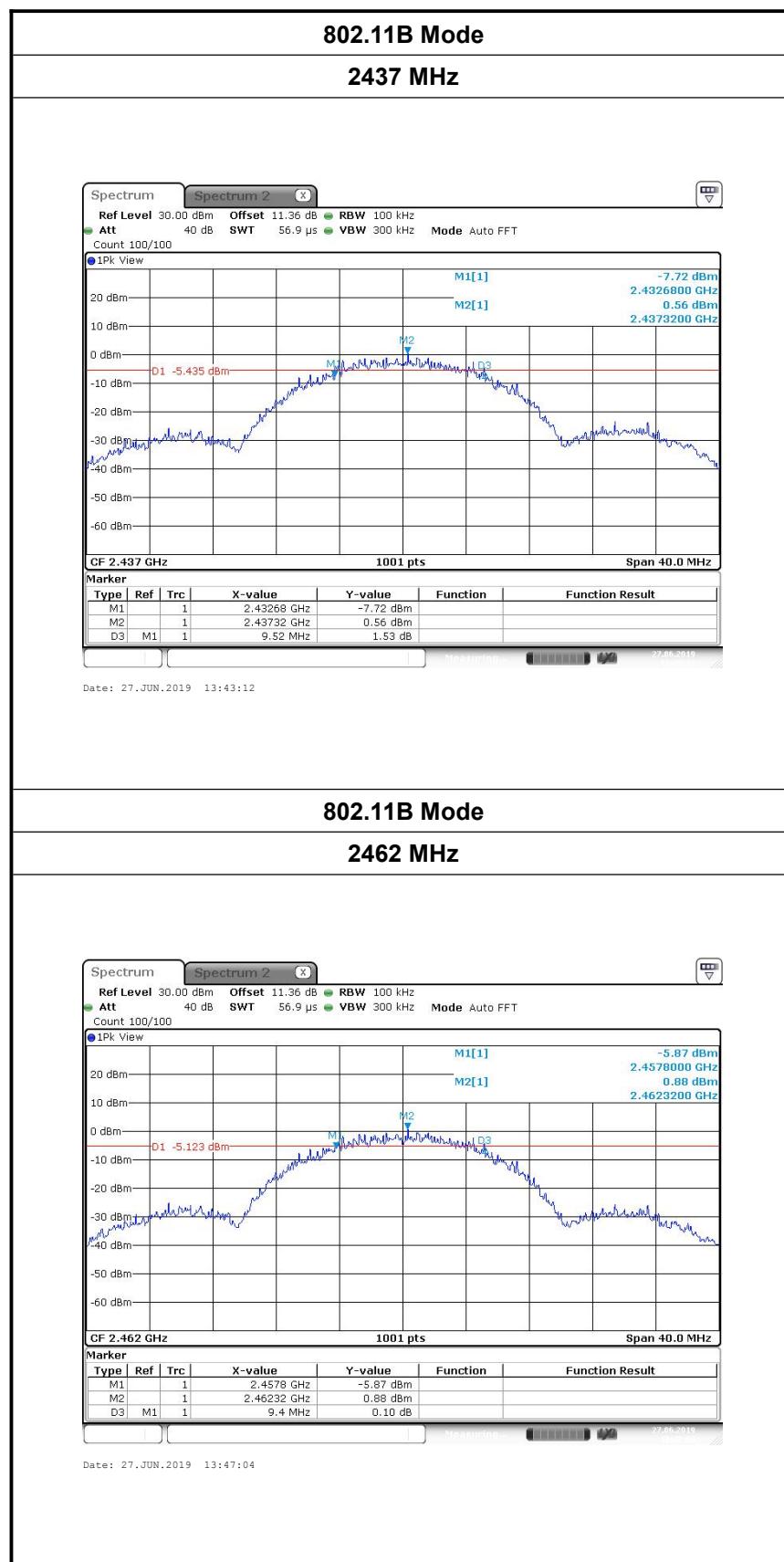
NOTE: The EUT was set to continuously transmitting in each mode and low, Middle and high channel for the test.

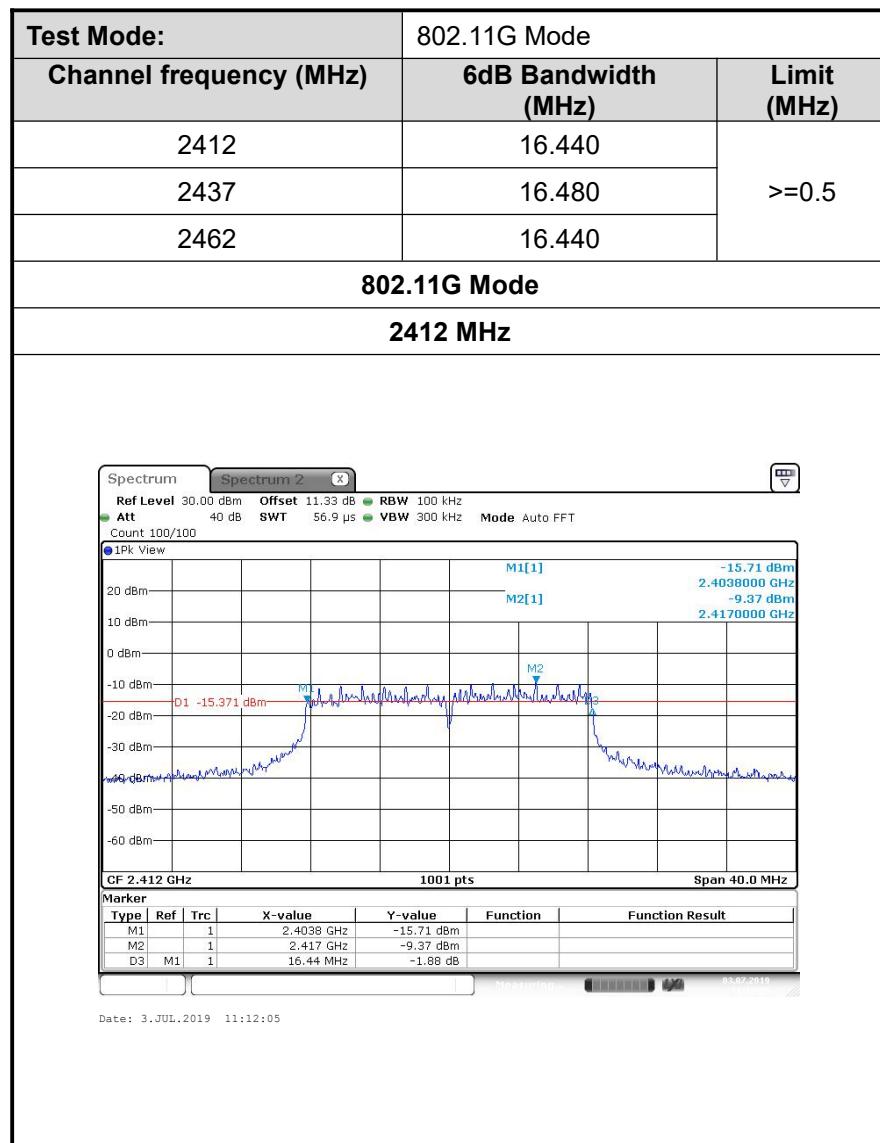
#### Test Mode

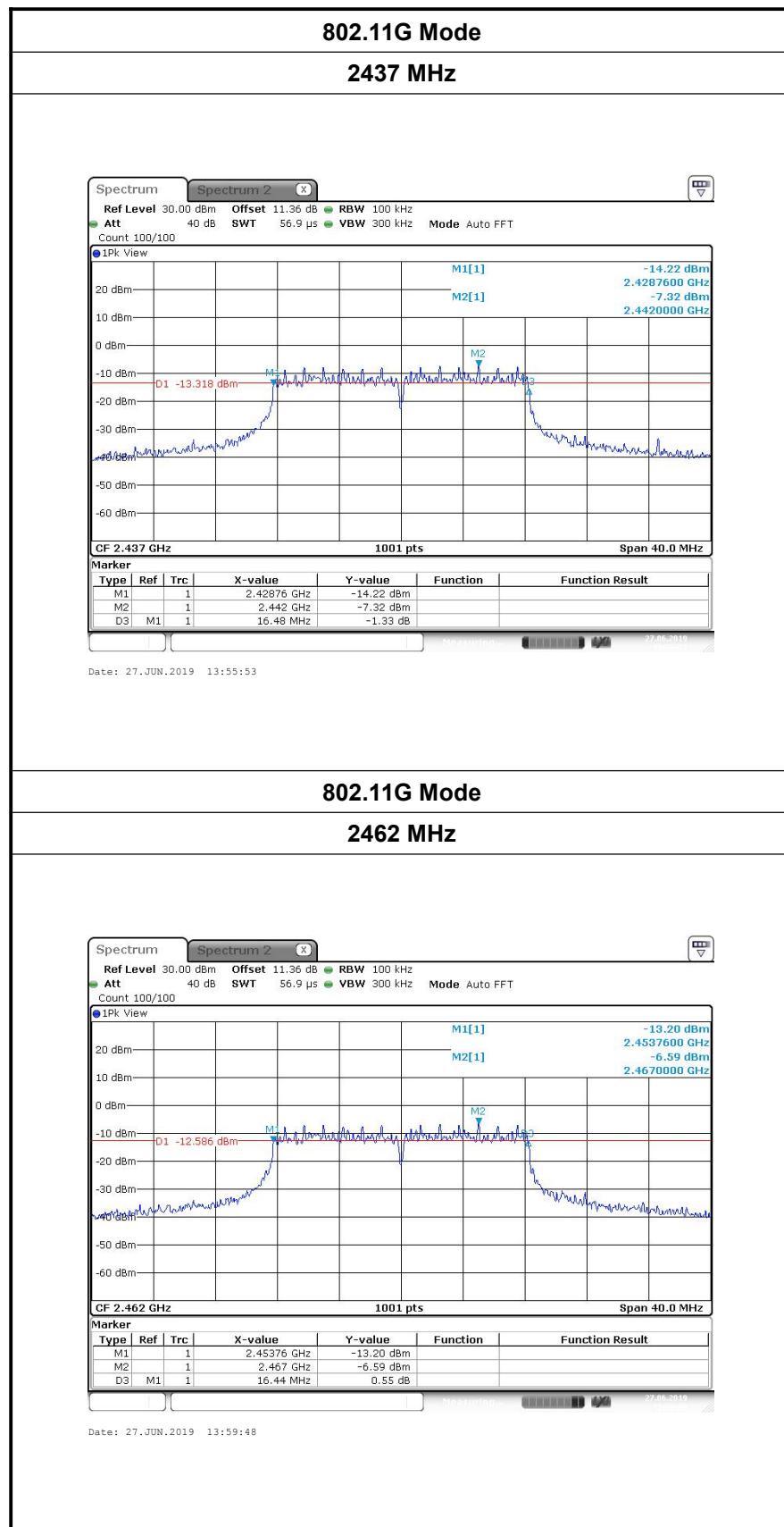
Please refer to the clause 2.3.

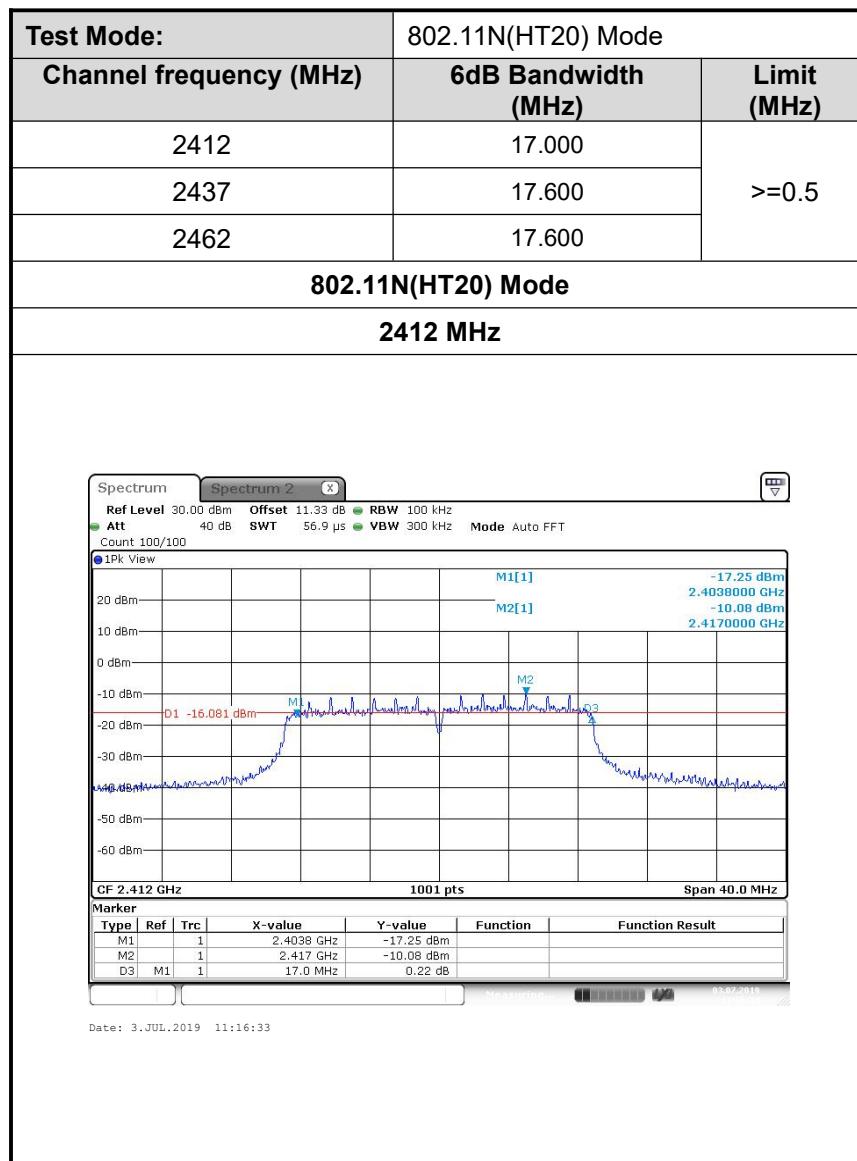
#### Test Results

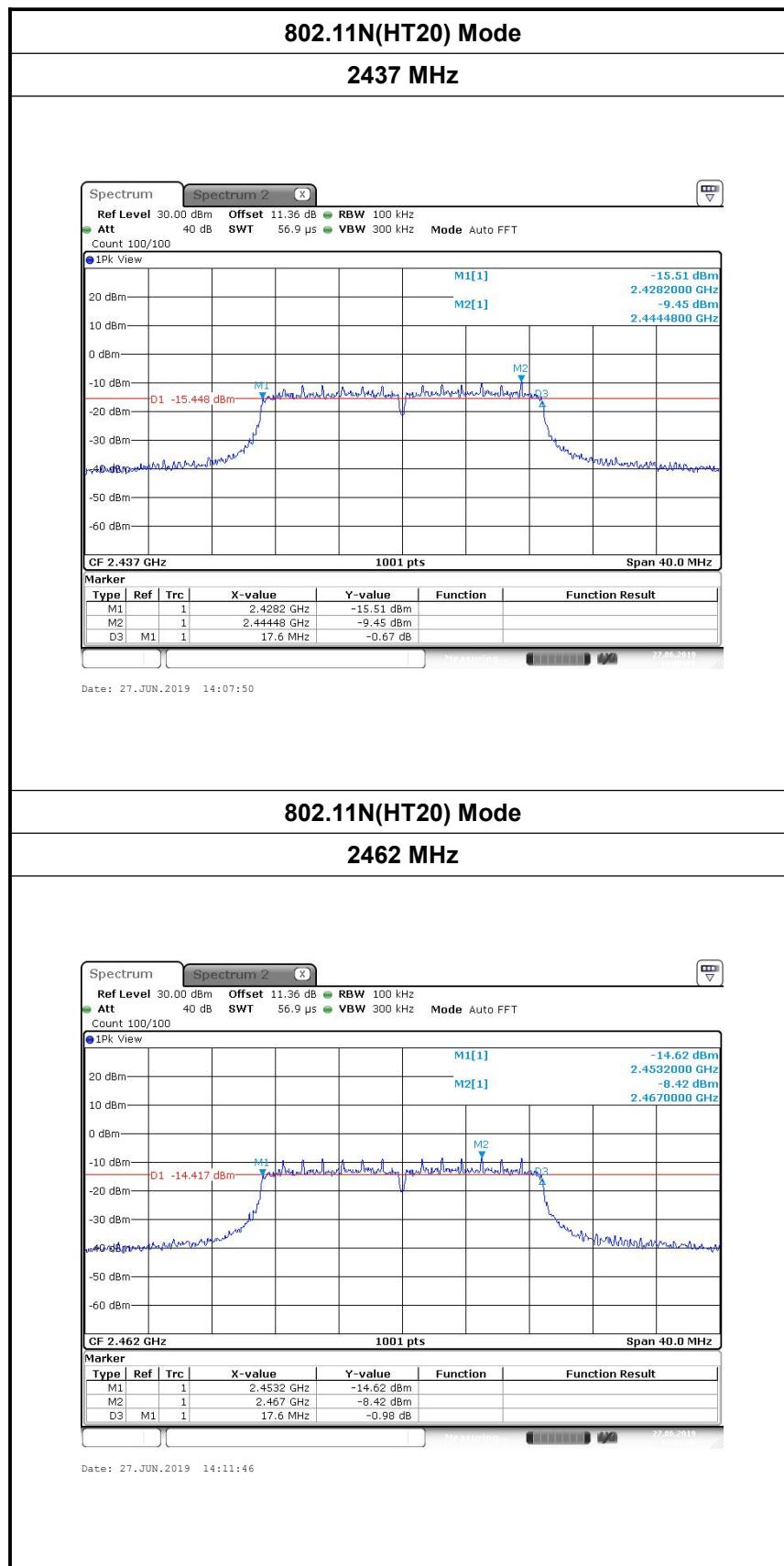


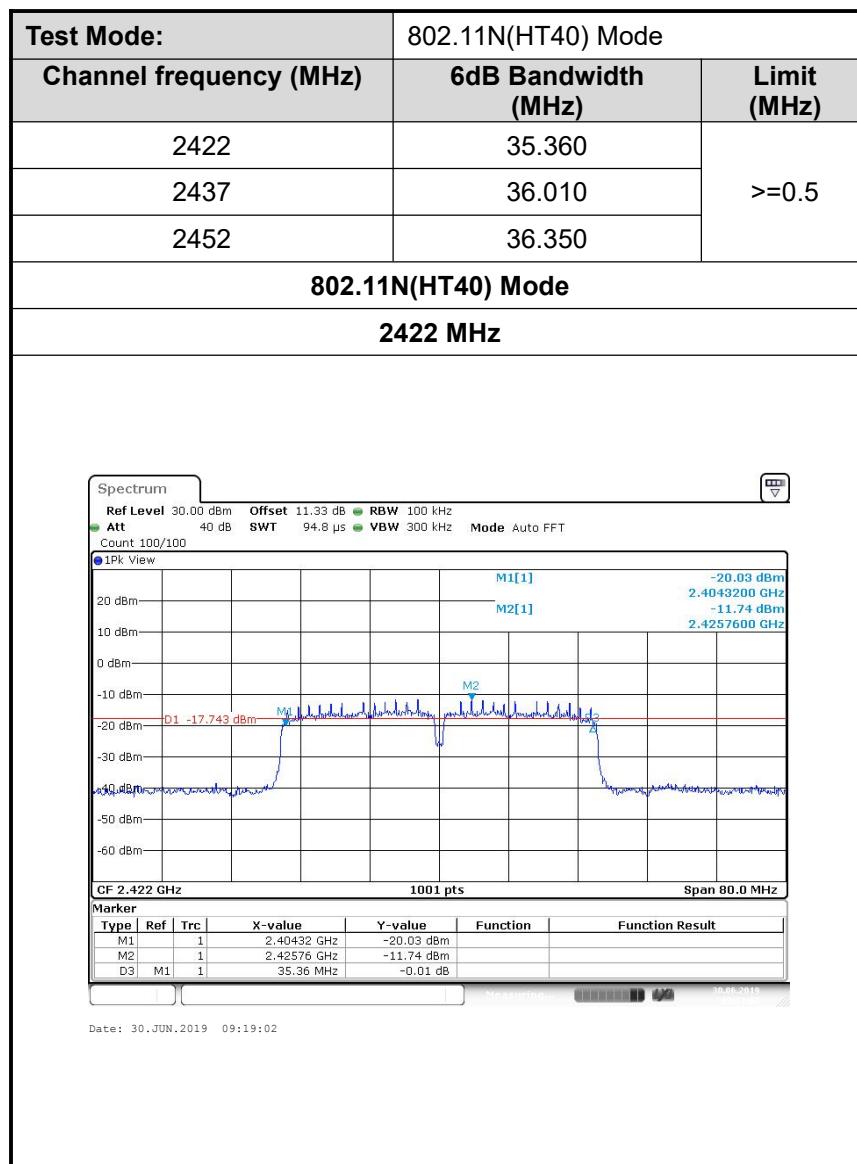


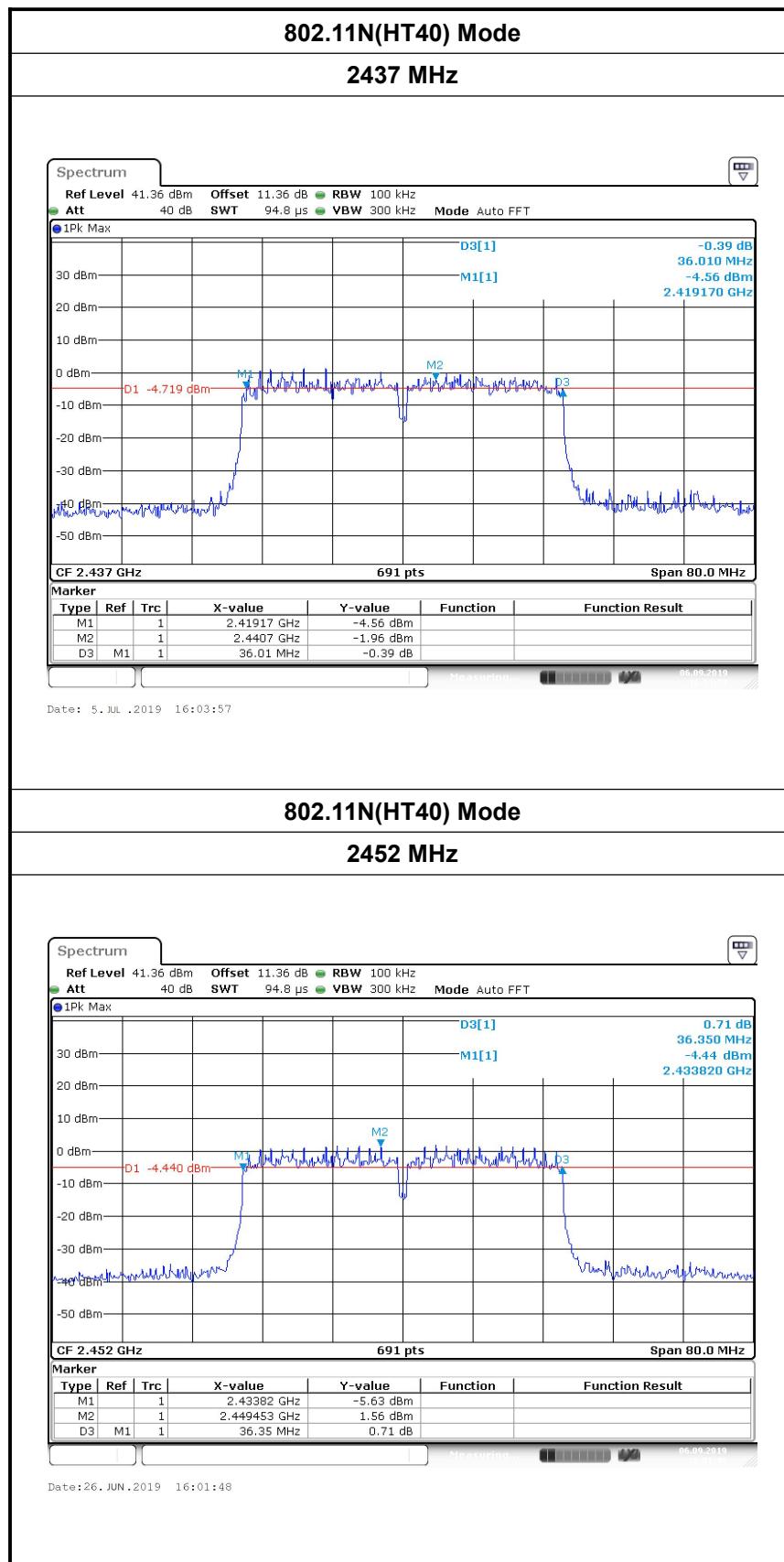


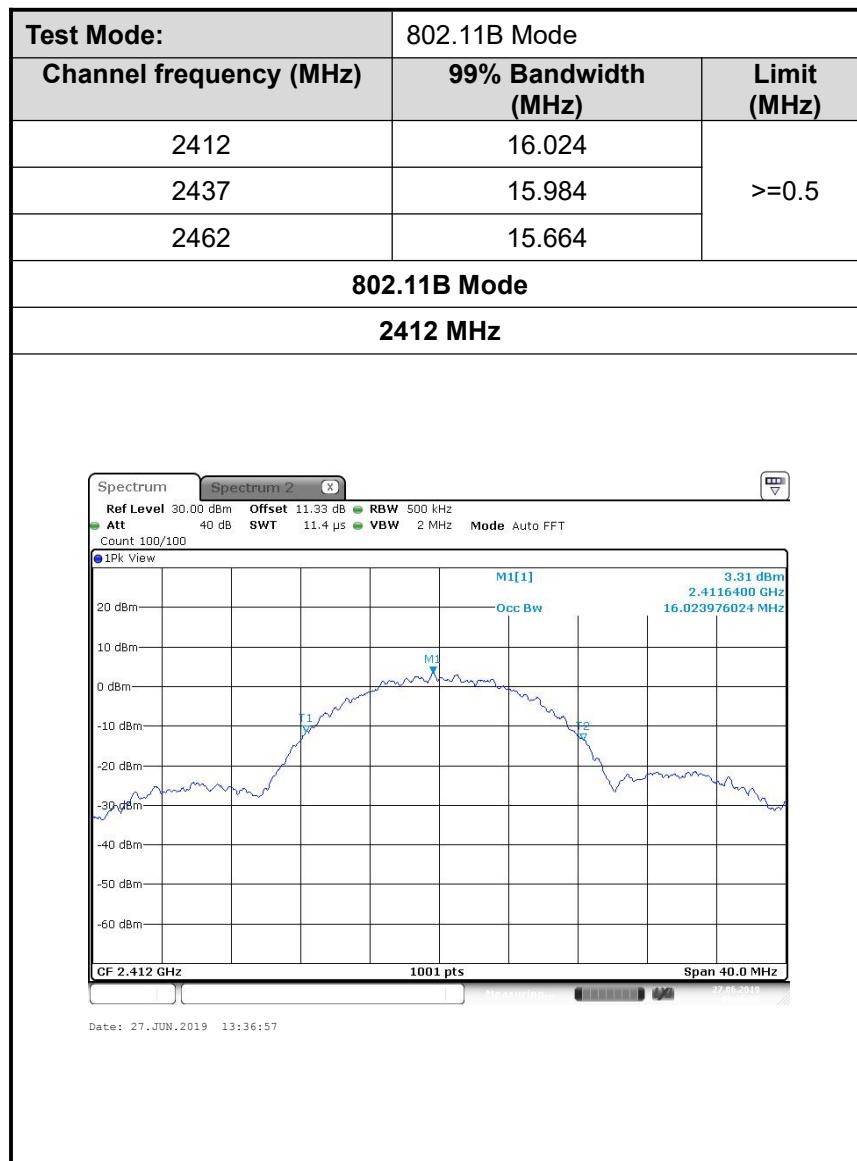


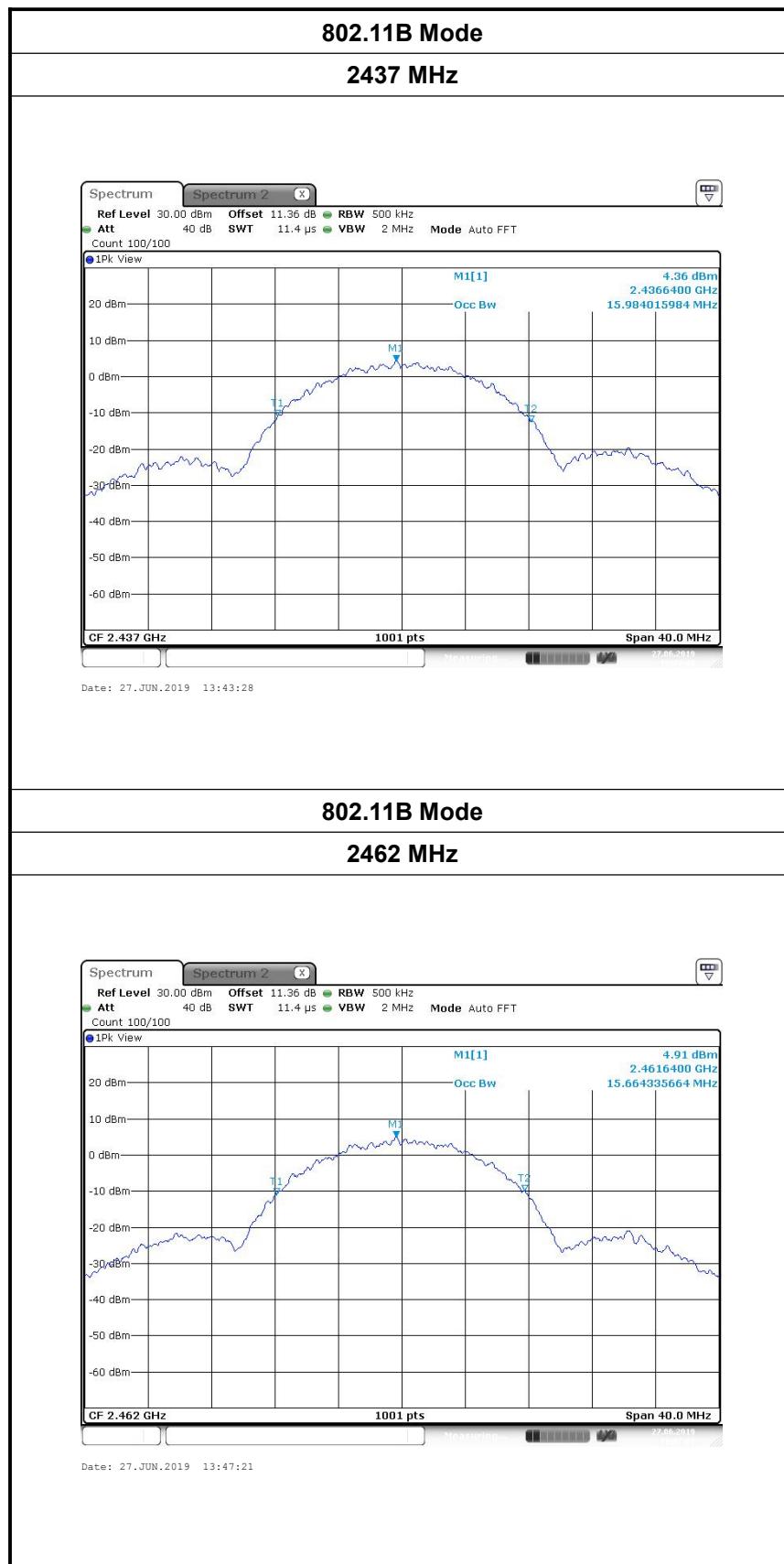


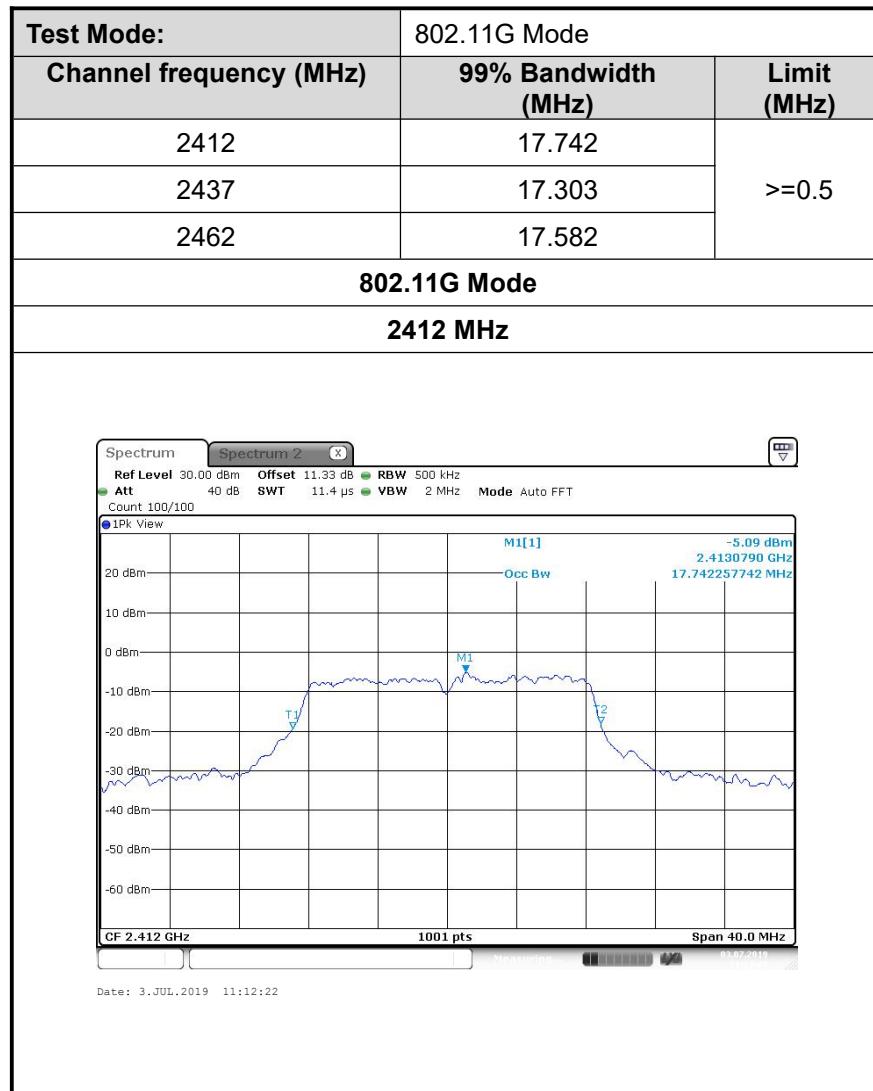


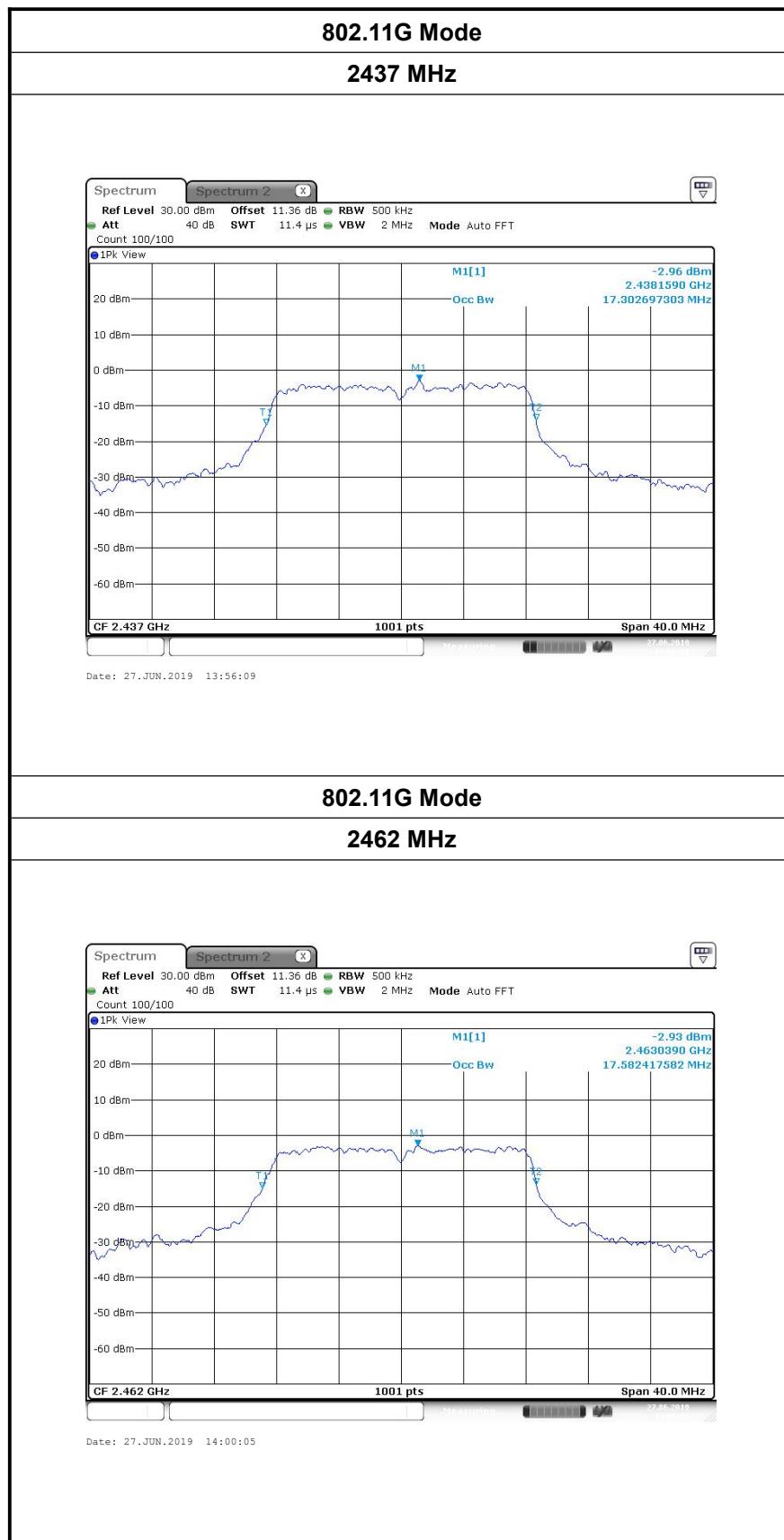


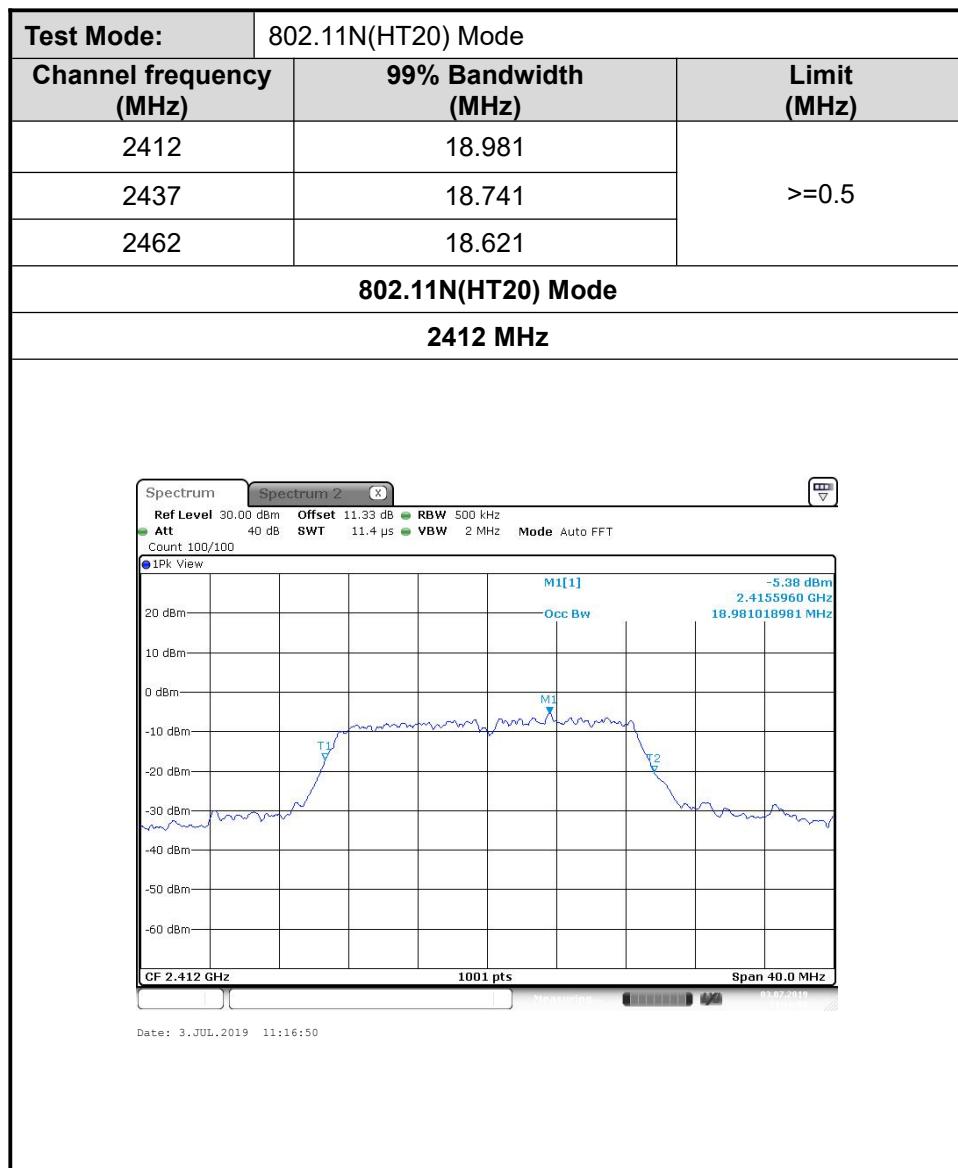






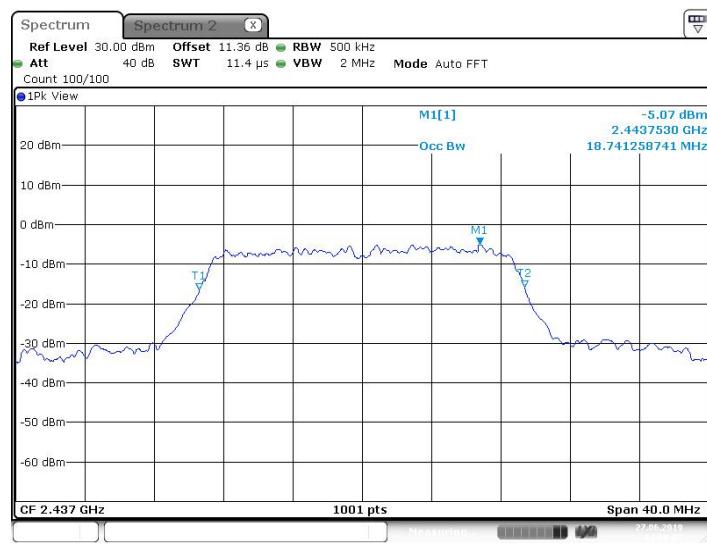






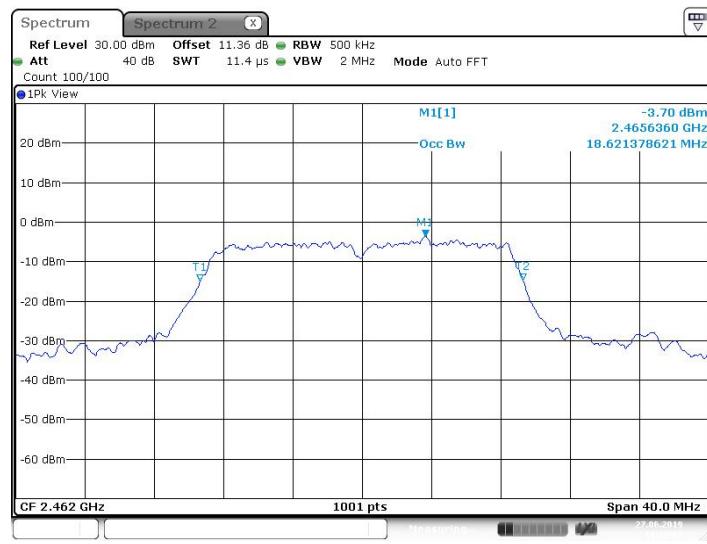
## 802.11N(HT20) Mode

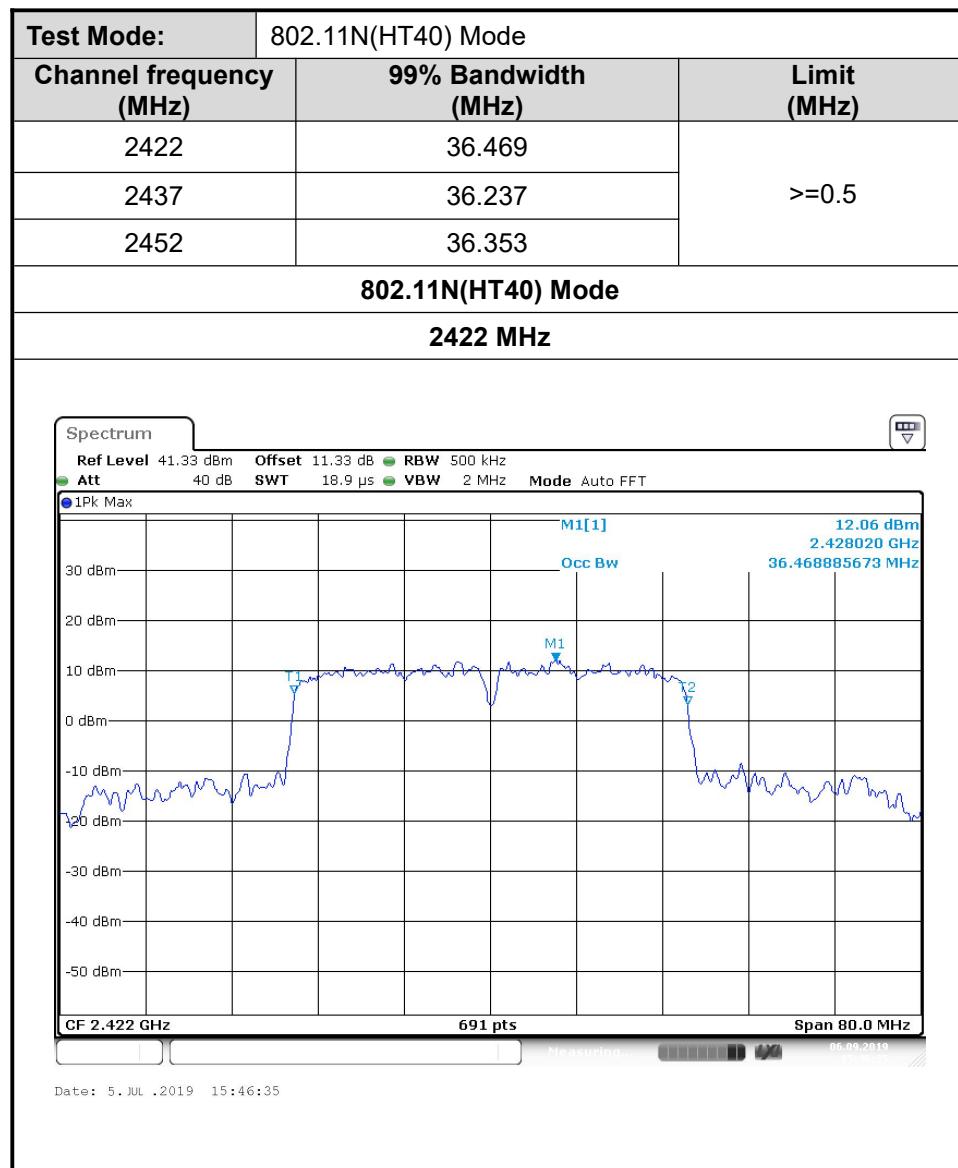
2437 MHz

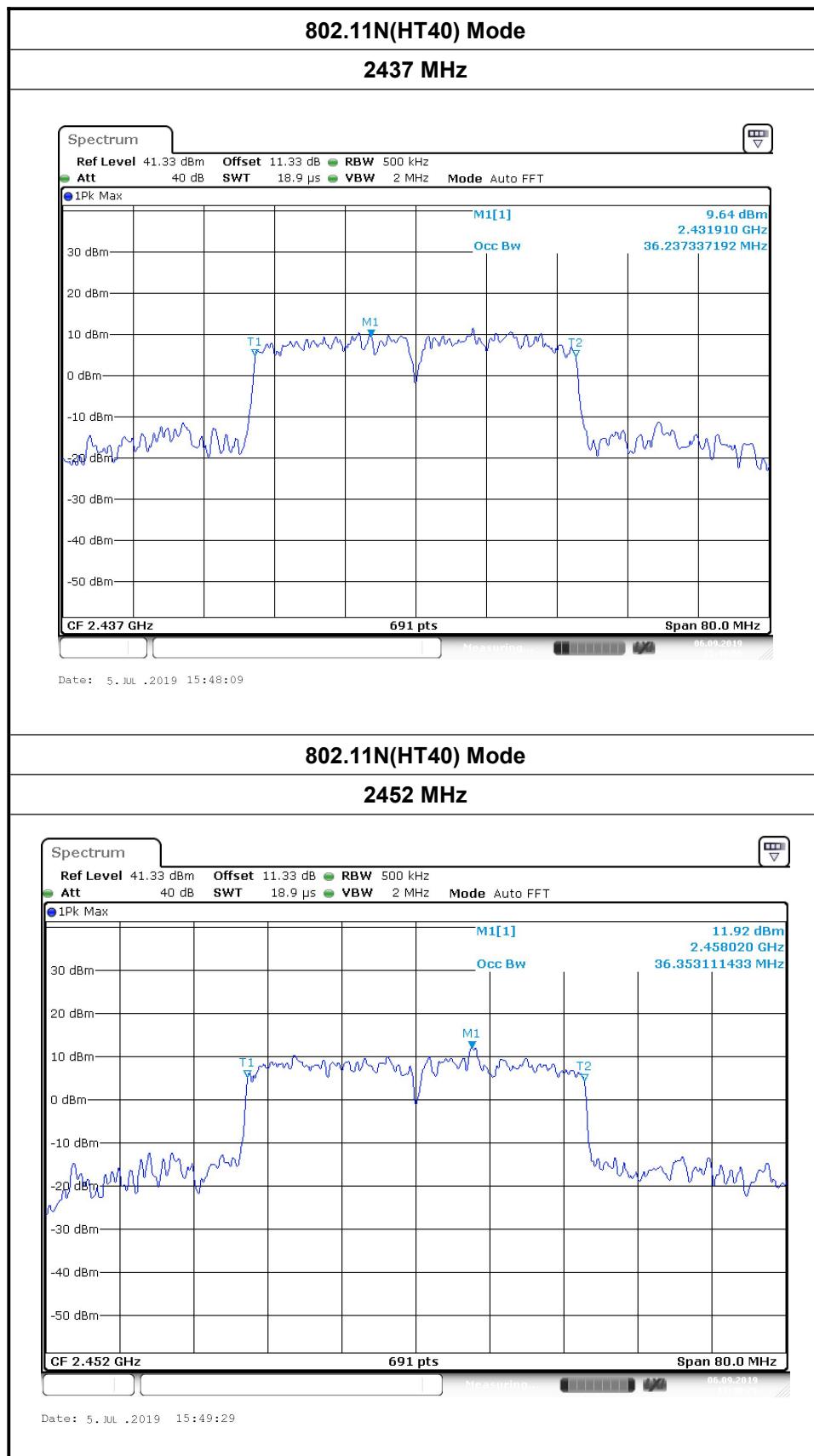


## 802.11N(HT20) Mode

2462 MHz





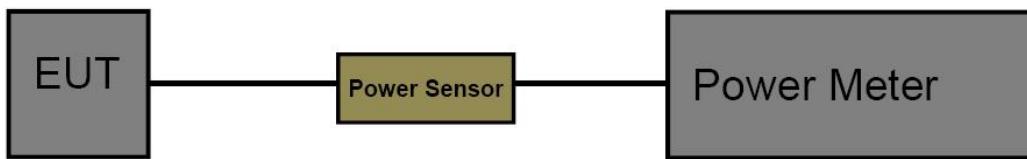


### 3.4. Peak Output Power

#### Limit

Test Item	Limit	Frequency Range(MHz)
Peak Output Power	1 Watt or 30 dBm	2400~2483.5

#### Test Configuration



#### Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
2. The measurement is according to section 9.1.2 of KDB 558074 D01 15.247 DTS Meas Guidance v05.
3. Spectrum Setting:
  - Set analyser center frequency to DTS channel center frequency.
  - Set the RBW to: 1MHz
  - Set the VBW to: 3MHz
  - Detector: peak
  - Sweep time: auto
  - Allow trace to fully stabilize. Then use the peak marker function to determine the maximum amplitude level.
4. The power sensor video bandwidth is greater than or equal to the DTS bandwidth of the equipment.

#### Test Mode

Please refer to the clause 2.3

#### Test Result

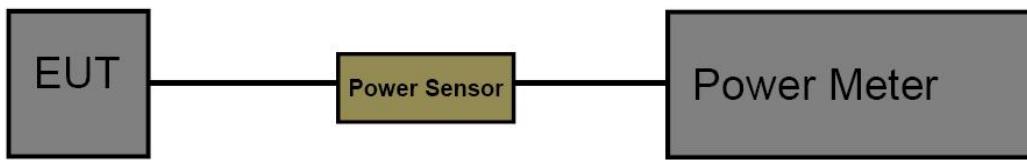
Mode	Channel frequency (MHz)	Test Result (dBm)	Limit (dBm)
802.11b	2412	13.40	30
	2437	14.35	
	2462	14.82	
802.11g	2412	10.82	30
	2437	11.47	
	2462	12.30	
802.11n (HT20)	2412	9.54	30
	2437	10.04	
	2462	10.83	
802.11n (HT40)	2422	8.06	30
	2437	8.65	
	2452	9.47	
Result : PASS			

### 3.5. Power Spectral Density

#### Limit

FCC Part 15 Subpart C(15.247)		
Test Item	Limit	Frequency Range(MHz)
Power Spectral Density	8dBm(in any 3 kHz)	2400~2483.5

#### Test Configuration



#### Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
2. The EUT was directly connected to the Spectrum Analyzer and antenna output port as show in the block diagram above. The measurement according to section 10.2 of KDB 558074 D01 15.247 DTS Meas Guidance v05.
3. Spectrum Setting:
  - Set analyser center frequency to DTS channel center frequency.
  - Set the span to 1.5 times the DTS bandwidth.
  - Set the RBW to: 10 kHz
  - Set the VBW to: 30 kHz
  - Detector: peak
  - Sweep time: auto
  - Allow trace to fully stabilize. Then use the peak marker function to determine the maximum amplitude level.

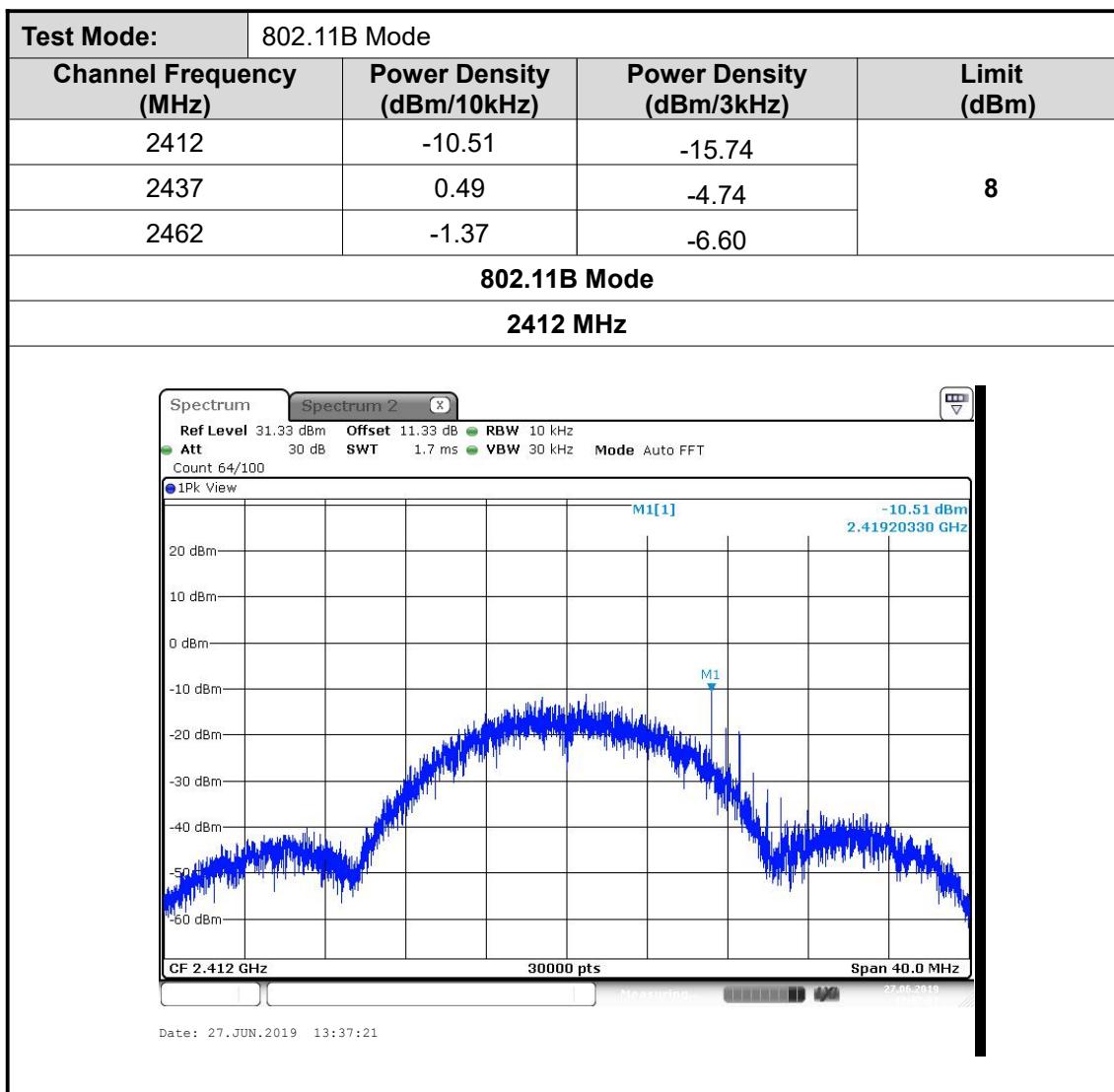
#### Test Mode

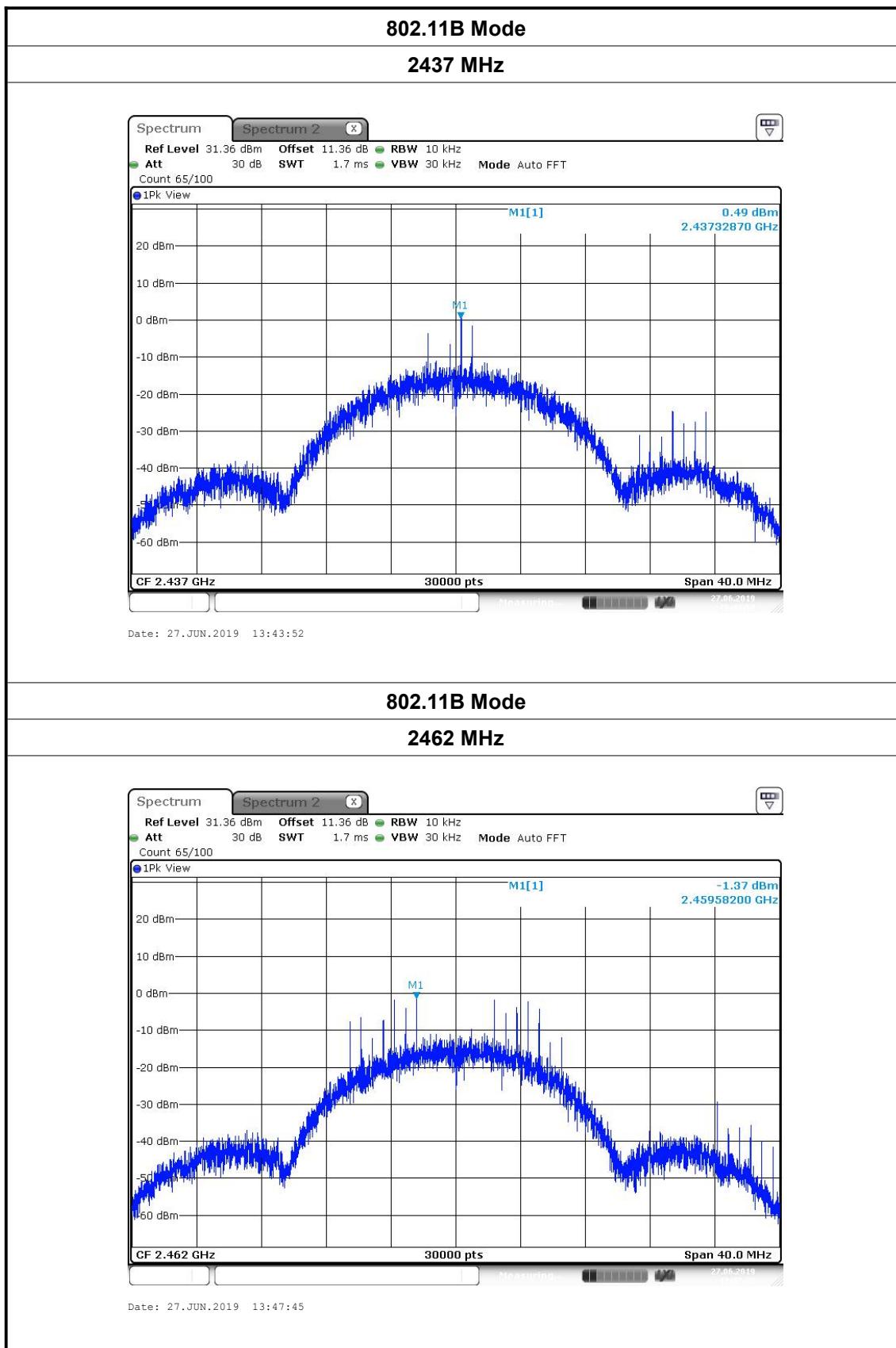
Please refer to the clause 2.3

#### Test Result

Note:

$$\text{Power Density(dBm/3kHz)} = \text{Power Density(dBm/10kHz)} - 10 \cdot \log(10/3)$$





802.11G Mode			
Channel Frequency (MHz)	Power Density (dBm/10 kHz)	Power Density (dBm/3 kHz)	Limit (dBm)
2412	-19.84	-25.07	8
2437	-17.40	-22.63	
2462	-16.46	-21.69	

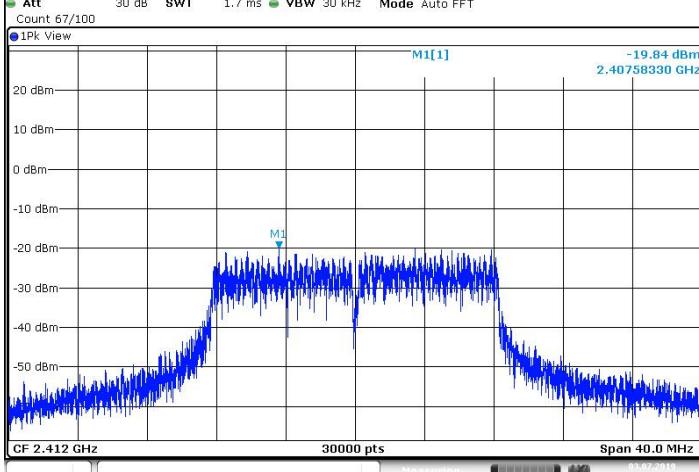
**802.11G Mode**

**2412 MHz**

Spectrum Spectrum 2 X ▼

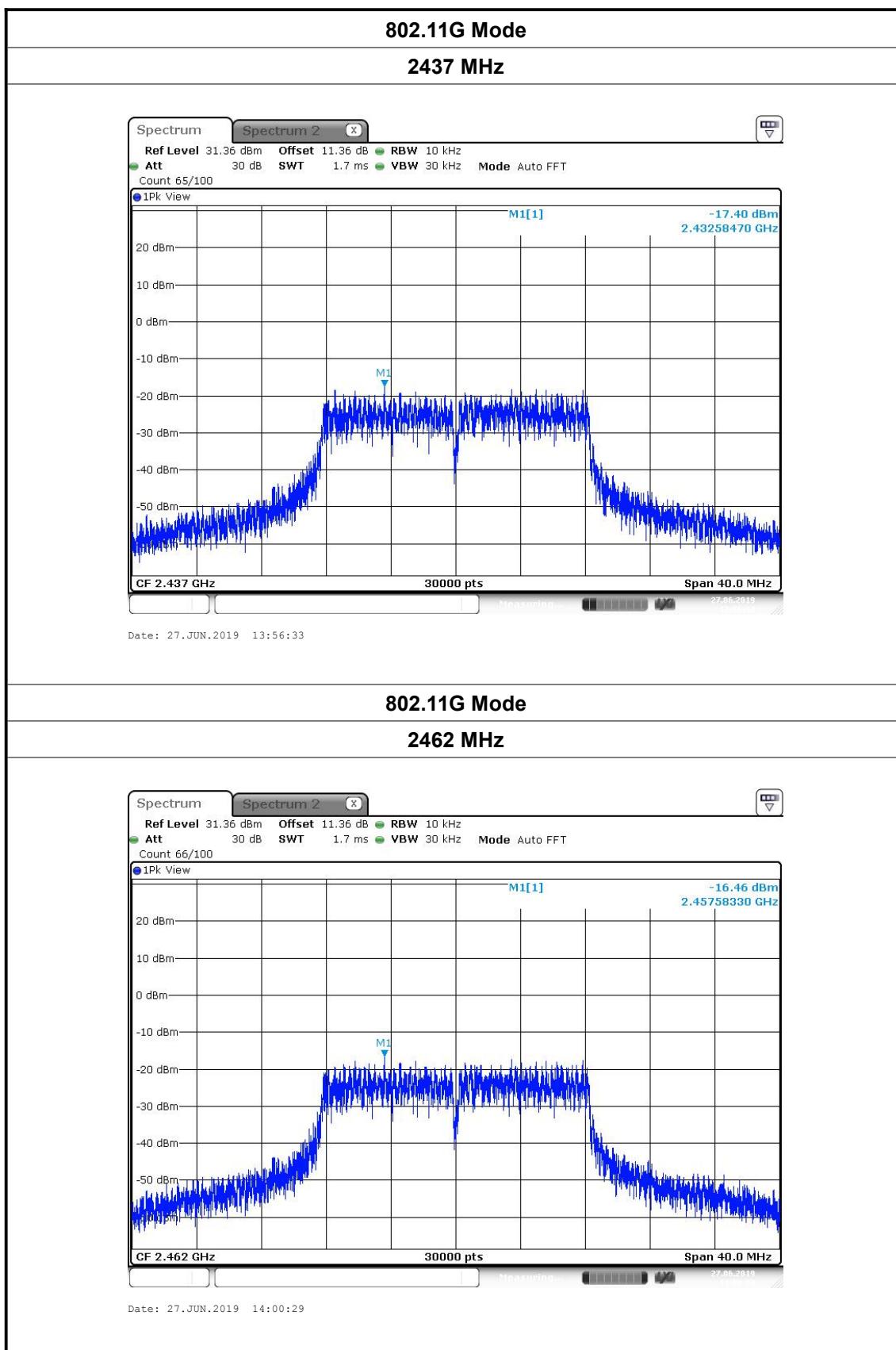
Ref Level 31.33 dBm Offset 11.33 dB RBW 10 kHz  
 Att 30 dB SWT 1.7 ms VBW 30 kHz Mode Auto FFT  
 Count 67/100

1Pk View



The plot shows a signal labeled 'M1' at approximately -19.84 dBm. The x-axis is labeled 'CF 2.412 GHz' and 'Span 40.0 MHz'. The y-axis ranges from -50 dBm to 20 dBm. The signal is centered around 2.40758330 GHz.

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802.11N(HT20) Mode			
Channel Frequency (MHz)	Power Density (dBm/10kHz)	Power Density (dBm/3 kHz)	Limit (dBm)
2412	-19.68	-24.91	8
2437	-18.66	-23.89	
2462	-18.90	-24.13	

**802.11N(HT20) Mode**

**2412 MHz**

Spectrum Spectrum 2 X ▼

Ref Level 31.33 dBm Offset 11.33 dB RBW 10 kHz  
 Att 30 dB SWT 1.7 ms VBW 30 kHz Mode Auto FFT  
 Count 66/100

1Pk View

-19.68 dBm  
 2.41537270 GHz

20 dBm  
 10 dBm  
 0 dBm  
 -10 dBm  
 -20 dBm  
 -30 dBm  
 -40 dBm  
 -50 dBm

CF 2.412 GHz 30000 pts Span 40.0 MHz

Date: 3.JUL.2019 11:17:13

