



REPORT No.: SZ16020033W01

# FCC RF TEST REPORT

**APPLICANT** : F-Secure Corporation

**PRODUCT NAME** : Router

**MODEL NAME** : FSEC-SE161

**TRADE NAME** : F-Secure

**BRAND NAME** : F-Secure

**FCC ID** : 2AGD5-FSECSE161

**STANDARD(S)** : 47 CFR Part 15 Subpart C

**ISSUE DATE** : 2016-11-07



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd.

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Change History		
Issue	Date	Reason for change
1.0	2016-11-07	First edition

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## TEST REPORT DECLARATION

Applicant	F-Secure Corporation
Applicant Address	Tammasaarenkatu 7, P.O. Box 24, 00181 Helsinki, Finland
Manufacturer Address	SHENZHEN SKYWORTH DIGITAL TECHNOLOGY CO.,LTD.
Manufacturer	Unit A 13/F Skyworth Bldg, Gaoxin Ave.1 S.,Nanshan District, Shenzhen, China.
Product Name	Router
Model Name	FSEC-SE161
Brand Name	F-Secure
HW Version	5800-2ARF10
SW Version	1.7.2.10
Test Standards	47 CFR Part 15 Subpart C
Test Date	2016-03-03 to 2016-10-17
Test Result	PASS

Tested by : Zou Jian  
Zou Jian

Reviewed by : Qiu Xiaojun  
Qiu Xiaojun

Approved by : Peng Huarui  
Peng Huarui



## 1. TECHNICAL INFORMATION

Note: Provide by applicant.

### 1.1 Applicant Information

Company:	F-Secure Corporation
Address	Tammasaarenkatu 7, P.O. Box 24, 00181 Helsinki, Finland

### 1.2 Equipment under Test (EUT) Description

Brand Name:	F-Secure
Trade Name:	F-Secure
Model Name:	FSEC-SE161
Frequency Range:	802.11b/g/n-20MHz: 2.412GHz - 2.462GHz 802.11n-40MHz: 2.422GHz - 2.452GHz
Channel Number:	802.11b/g/n-20MHz: 11 802.11n-40MHz: 7
Modulation Type:	DSSS, OFDM
Antenna Type:	PCB Antenna
Antenna Gain:	Ant1: 3.0dBi; Ant2: 3.0dBi; Ant3: 3.0dBi
Directional Gain:	7.77dBi <small>Note2</small>

#### NOTE:

1. The EUT is a Router, it contains WIFI Module operating at 2.4GHz ISM; it supports 802.11b, 802.11g, 802.11n and they are all tested in this report.

For 802.11b/g/n-20MHz (2.4GHz band), the frequencies allocated is  $F$  (MHz) = $2412+5*(n-1)$  ( $1 \leq n \leq 11$ ). The lowest, middle, highest channel numbers of the EUT used and tested in this report are separately 1 (2412MHz), 6 (2437MHz) and 11 (2462MHz).

For 802.11n-40MHz, the frequencies allocated is  $F$  (MHz) = $2412+5*(n-1)$  ( $3 \leq n \leq 9$ ). The lowest, middle, highest channel numbers of the EUT used and tested in this report are separately 3 (2422MHz), 6 (2437MHz) and 9 (2452MHz).



2. The EUT has 4 antennas, which are 3 main antennas and 1 auxiliary antenna, the EUT incorporates a MIMO function. Physically, the EUT provides three TX antennas and four Rx antennas (3T4R) for 2.4GHz band. And the auxiliary antenna only Rx.

Operation mode TX mode	1TX	3TX
802.11b	ANT1 or ANT2 or ANT3	
802.11g	ANT1 or ANT2 or ANT3	
802.11n(20MHz)		ANT1 & ANT2 & ANT3
802.11n(40MHz)		ANT1 & ANT2 & ANT3

According to KDB 662911 D01, the directional gain =  $G_{ANT} + 10\log(N_{ANT})$  dBi, where  $G_{ANT}$  is the antenna gain in dBi,  $N_{ANT}$  is the number of outputs.

3. The EUT operated in a continuous transmission mode and the duty cycle not less than 98% for all test item.
4. The EUT connected to the serial port of the computer with a serial communication cable, and then use the dedicated software to control the EUT into the test mode. In the software, there are Dev, Channel, Bandwidth, Power Index, Test Setting, Ant and Date setting items. According to these setting items, we can control wifi different frequency, rate, power, bandwidth to transmit. For example, we can set 5GHz band or 2.4GHz band in the Dev setting item, set different transmit antenna in the Ant setting item, set different rate in the Date setting item, set Packets Tx or Continuous transmission in the Test Setting item. We set power level of wifi in the Power Index setting item, and as follows, setting table of power level.

Mode	802.11b	802.11g	802.11n
Power Index	25	20	20

5. All different rates of wifi were pre-tested, and only the worst case was tested and recorded in the report. For example, 1Mbps of 802.11b, 6Mbps of 802.11g, 6.5Mbps of 802.11n20 and 13.5Mbps of 802.11n40 were tested and recorded in the report.
6. For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.
7. The antenna connector of EUT is designed with permanent attachment and no consideration of replacement.

### 1.2.1 Identification of all used EUTs

The EUT identity consists of numerical and letter characters, the letter character indicates the test sample, and the following two numerical characters indicate the software version of the test sample.

EUT Identity	Hardware Version	Software Version
A01	5800-2ARF10	1.7.2.10



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### 1.3 Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C (Bluetooth, 2.4GHz ISM band radiators) for the EUT FCC ID Certification:

No.	Identity	Document Title
1	47 CFR Part 15 (11-16-16 Edition)	Radio Frequency Devices

Test detailed items/section required by FCC rules and results are as below:

No.	Section	Description	Test Date	Result
1	15.203	Antenna Requirement	N.A	<u>PASS</u>
2	15.247(b)	Peak Output Power	Mar 07, 2016	<u>PASS</u>
3	15.247(a)	Bandwidth	Mar 07, 2016	<u>PASS</u>
4	15.247(d)	Conducted Spurious Emission and Band Edge	Mar 07, 2016	<u>PASS</u>
5	15.247(d)	Restricted Frequency Bands	Mar 08, 2016	<u>PASS</u>
6	15.207	Conducted Emission	Mar 08, 2016	<u>PASS</u>
7	15.209 ,15.247(d)	Radiated Emission	Mar 03, 2016	<u>PASS</u>
8	15.247(e)	Power spectral density (PSD)	Mar 05&07, 2016 Oct 17,2016	<u>PASS</u>

The tests of Conducted Emission and Radiated Emission were performed according to the method of measurements prescribed in ANSI C63.10 2013.

#### 1.3.1 Test Environment Conditions

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

Temperature (°C):	15 - 35
Relative Humidity (%):	30 -60
Atmospheric Pressure (kPa):	86-106



## 2. 47 CFR PART 15C REQUIREMENTS

### 2.1 Antenna requirement

#### 2.1.1 Applicable Standard

According to FCC 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 shall be considered sufficient to comply with the provisions of this section.

#### 2.1.2 Result: Compliant

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

### 2.2 Peak Output Power

#### 2.2.1 Requirement

According to FCC section 15.247(b)(3), For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: The maximum peak conducted output power of the intentional radiator shall not exceed 1 Watt.

#### 2.2.2 Test Description

KDB 558074 Section 9.1.3 was used in order to prove compliance.

The measured output power was calculated by the reading of the USB Wideband Power Sensor and calibration.

#### A. Test Setup:



The EUT (Equipment under the test) which is coupled to the USB Wideband Power Sensor; the RF load attached to the EUT antenna terminal is 50Ω; the path loss as the factor is calibrated to correct the reading, all test result in the USB Wideband Power Sensor.

#### B. Equipments List:

Please reference ANNEX A(1.5).



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## 2.2.3 Test Result

The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the Module.

### 2.2.3.1 Antenna 1 802.11b Test Mode

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	21.35	0.136	30	1	PASS
6	2437	21.28	0.134			PASS
11	2462	21.11	0.129			PASS

Channel	Frequency (MHz)	Measured Output Average Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	19.05	0.080	30	1	PASS
6	2437	18.95	0.079			PASS
11	2462	18.57	0.072			PASS

### 2.2.3.2 Antenna 2 802.11b Test Mode

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	19.56	0.090	30	1	PASS
6	2437	19.62	0.092			PASS
11	2462	19.67	0.093			PASS

Channel	Frequency (MHz)	Measured Output Average Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	17.36	0.054	30	1	PASS
6	2437	17.43	0.055			PASS
11	2462	17.32	0.054			PASS



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**2.2.3.3 Antenna 3 802.11b Test Mode**

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	24.32	0.270	30	1	PASS
6	2437	24.57	0.286			PASS
11	2462	24.47	0.280			PASS

Channel	Frequency (MHz)	Measured Output Average Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	22.23	0.167	30	1	PASS
6	2437	22.48	0.177			PASS
11	2462	22.32	0.171			PASS

**2.2.3.4 Antenna 1 802.11g Test mode**

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	22.56	0.180	30	1	PASS
6	2437	22.26	0.168			PASS
11	2462	22.38	0.173			PASS

Channel	Frequency (MHz)	Measured Output Average Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	12.87	0.019	30	1	PASS
6	2437	13.19	0.021			PASS
11	2462	13.21	0.021			PASS

**2.2.3.5 Antenna 2 802.11g Test mode**

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	21.85	0.153	30	1	PASS
6	2437	21.62	0.145			PASS
11	2462	21.54	0.143			PASS



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Channel	Frequency (MHz)	Measured Output Average Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	12.49	0.018	30	1	PASS
6	2437	12.49	0.018			PASS
11	2462	12.25	0.017			PASS

#### 2.2.3.6 Antenna 3 802.11g Test mode

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	26.89	0.489	30	1	PASS
6	2437	27.68	0.586			PASS
11	2462	26.59	0.456			PASS

Channel	Frequency (MHz)	Measured Output Average Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	17.96	0.063	30	1	PASS
6	2437	18.14	0.065			PASS
11	2462	17.89	0.062			PASS

#### 2.2.3.7 Antenna 1 802.11n-20MHz Test mode

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	20.75	0.119	30	1	PASS
6	2437	20.86	0.122			PASS
11	2462	20.49	0.112			PASS

Channel	Frequency (MHz)	Measured Output Average Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	12.25	0.017	30	1	PASS
6	2437	12.32	0.017			PASS
11	2462	11.81	0.015			PASS



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**2.2.3.8 Antenna 2 802.11n-20MHz Test mode**

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	19.23	0.084	30	1	PASS
6	2437	19.39	0.087			PASS
11	2462	19.86	0.097			PASS

Channel	Frequency (MHz)	Measured Output Average Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	10.84	0.012	30	1	PASS
6	2437	11.21	0.013			PASS
11	2462	11.07	0.013			PASS

**2.2.3.9 Antenna 3 802.11n-20MHz Test mode**

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	24.56	0.286	30	1	PASS
6	2437	24.41	0.276			PASS
11	2462	24.76	0.299			PASS

Channel	Frequency (MHz)	Measured Output Average Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	15.91	0.039	30	1	PASS
6	2437	16.21	0.042			PASS
11	2462	15.96	0.039			PASS



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**2.2.3.10 ANT1+ANT2+ANT3 802.11n-20MHz Test mode**

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	26.89	0.488	28.23	0.665	PASS
6	2437	26.86	0.485			PASS
11	2462	27.06	0.508			PASS

Channel	Frequency (MHz)	Measured Output Average Power		Limit		Verdict
		dBm	W	dBm	W	
1	2412	18.32	0.068	28.23	0.665	PASS
6	2437	18.58	0.072			PASS
11	2462	18.29	0.067			PASS

**2.2.3.11 Antenna 1 802.11n-40MHz Test mode**

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
3	2422	19.25	0.084	30	1	PASS
6	2437	19.73	0.094			PASS
9	2452	19.85	0.097			PASS

Channel	Frequency (MHz)	Measured Output Average Power		Limit		Verdict
		dBm	W	dBm	W	
3	2422	11.46	0.014	30	1	PASS
6	2437	11.36	0.014			PASS
9	2452	11.14	0.013			PASS



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**2.2.3.12 Antenna 2 802.11n-40MHz Test mode**

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
3	2422	15.76	0.038	30	1	PASS
6	2437	16.52	0.045			PASS
9	2452	16.34	0.043			PASS

Channel	Frequency (MHz)	Measured Output Average Power		Limit		Verdict
		dBm	W	dBm	W	
3	2422	8.83	0.008	30	1	PASS
6	2437	8.86	0.008			PASS
9	2452	8.89	0.008			PASS

**2.2.3.13 Antenna 3 802.11n-40MHz Test mode**

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
3	2422	20.98	0.125	30	1	PASS
6	2437	21.03	0.127			PASS
9	2452	20.97	0.125			PASS

Channel	Frequency (MHz)	Measured Output Average Power		Limit		Verdict
		dBm	W	dBm	W	
3	2422	17.54	0.057	30	1	PASS
6	2437	17.65	0.058			PASS
9	2452	17.48	0.056			PASS



## 2.2.3.14 ANT1+ANT2+ANT3 802.11n-40MHz Test mode

Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
		dBm	W	dBm	W	
3	2422	23.93	0.247	28.23	0.665	PASS
6	2437	24.24	0.266			PASS
9	2452	24.23	0.265			PASS

Channel	Frequency (MHz)	Measured Output Average Power		Limit		Verdict
		dBm	W	dBm	W	
3	2422	18.94	0.078	28.23	0.665	PASS
6	2437	19.01	0.080			PASS
9	2452	18.85	0.077			PASS

**Note:**

1. Each antenna port was measured individually, and the aggregated power was summed mathematically.

**Remark:**

The MIMO test requirement, RF conducted output power shall measure each transmitter chain. And after obtain each individual transmitter chain power, then sum the output power by using the following formula;

((dBm/Chain 1)/10^Log) + (dBm/Chain 2)/10^Log) + (dBm/Chain N)/10^Log))= Combined peak output power in mW.

2. According to KDB 558074 D01 v03r05, for those cases where the rule specifies that the conducted output power be reduced by the amount in dB that the directional gain of the transmitting antenna exceeds 6 dBi, the applicable output power limit shall be calculated as follows:

$$P_{\text{Out}} = P_{\text{Limit}} - (G_{\text{Tx}} - 6)$$

Where:

$P_{\text{Out}}$  is the maximum conducted output power in dBm,

$P_{\text{Limit}}$  is the output power limit in dBm,

$G_{\text{Tx}}$  is the maximum transmitting antenna directional gain in dBi



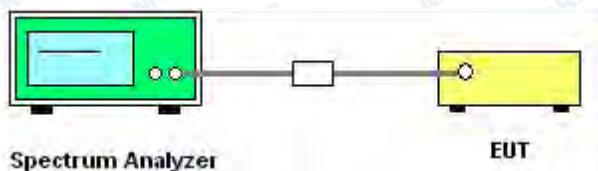
## 2.3 Bandwidth

### 2.3.1 Requirement

According to FCC section 15.247(a) (2), Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### 2.3.2 Test Description

#### A. Test Set:



The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ω; the path loss as the factor is calibrated to correct the reading.

Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW.

KDB 558074 Section 8.1 Option 1 was used in order to prove compliance.

#### B. Equipments List:

Please reference ANNEX A(1.5).

### 2.3.3 Test Result

The lowest, middle and highest channels are selected to perform testing to record the 6 dB bandwidth of the EUT.



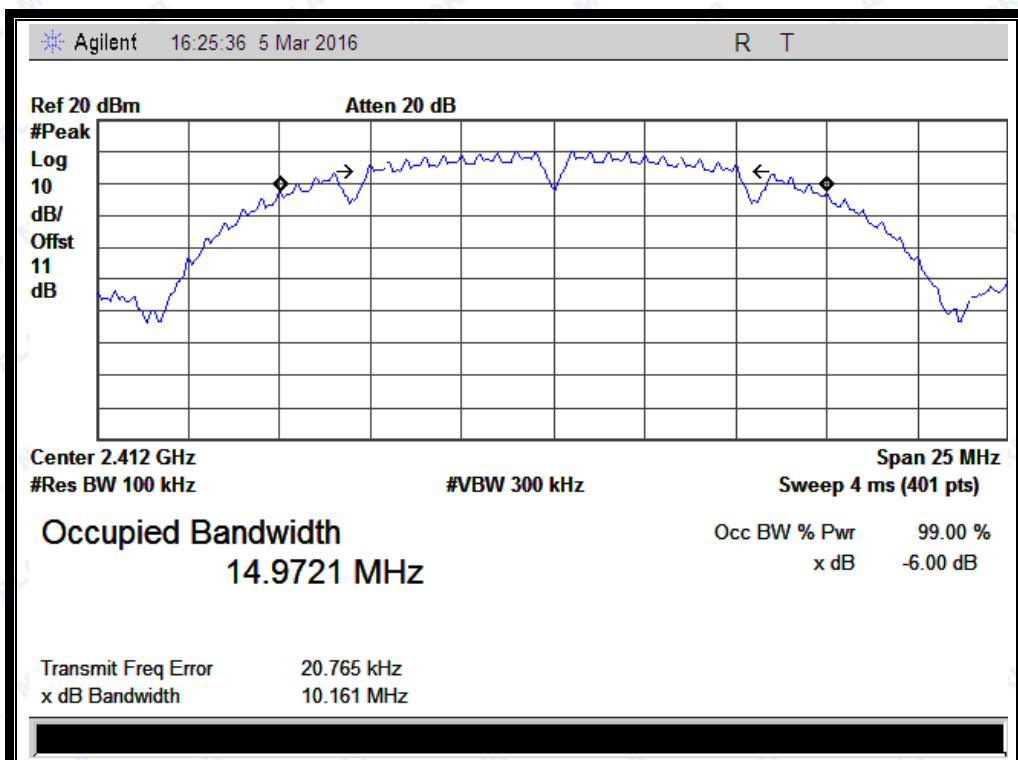
### 2.3.3.1 802.11b Test mode

#### Antenna 1:

##### A. Test Verdict:

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits(kHz)	Result
1	2412	10.161	≥500	PASS
6	2437	10.144	≥500	PASS
11	2462	10.148	≥500	PASS

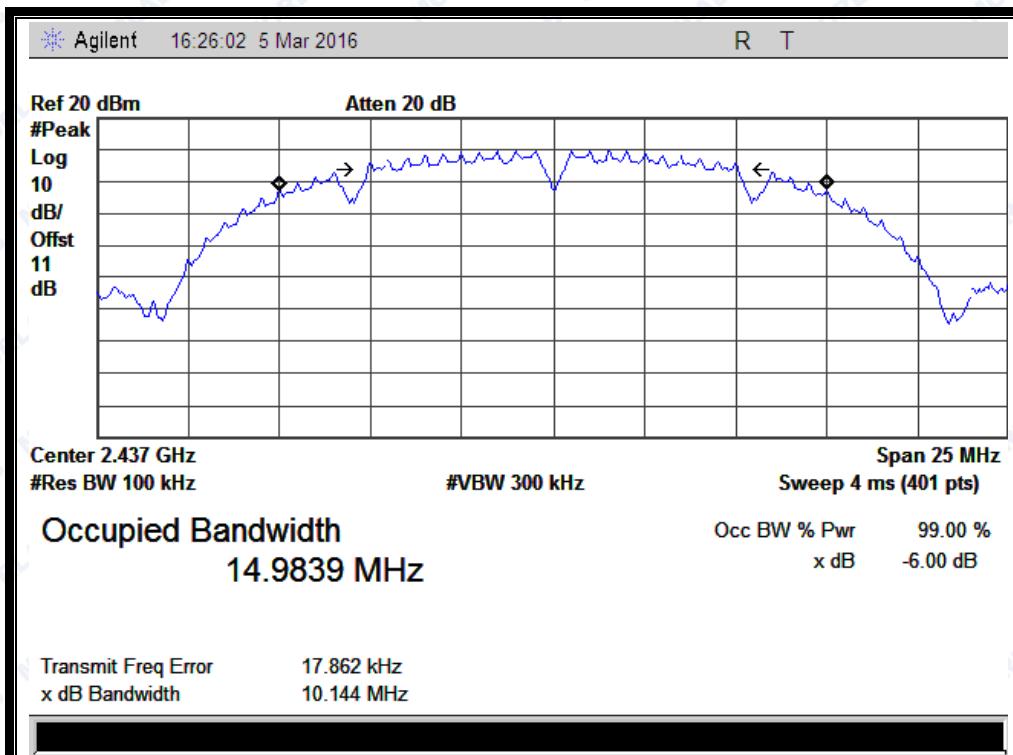
##### B. Test Plots:



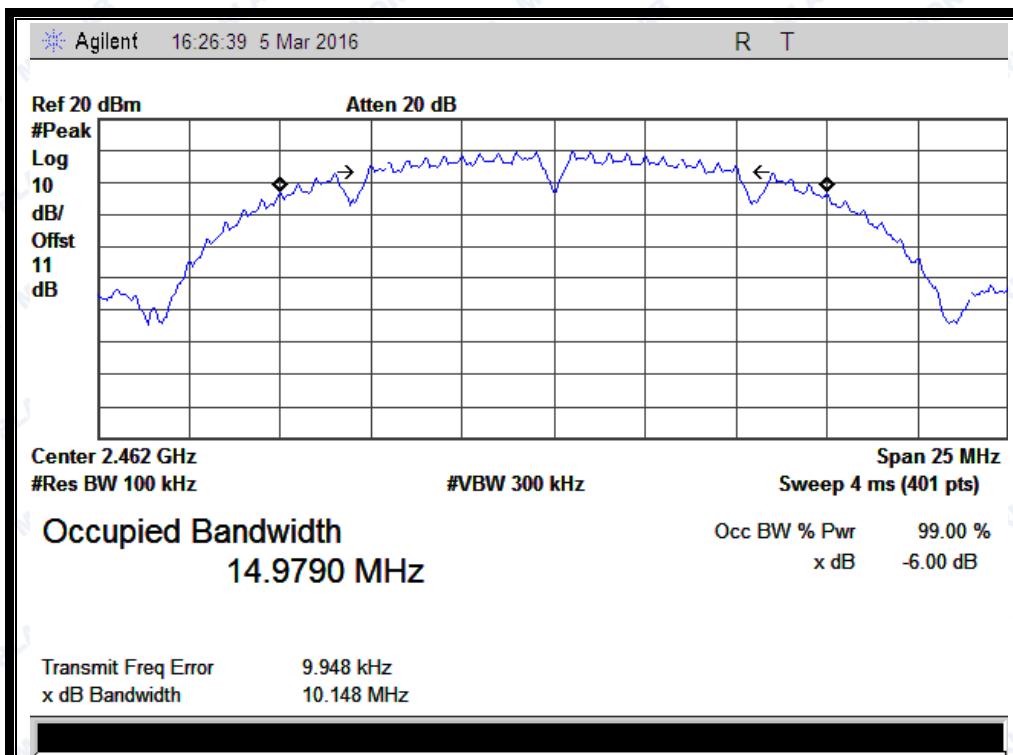
(Channel 1: 2412MHz @ 802.11b)



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(Channel 6: 2437 MHz @ 802.11b)



(Channel 11: 2462MHz @ 802.11b)

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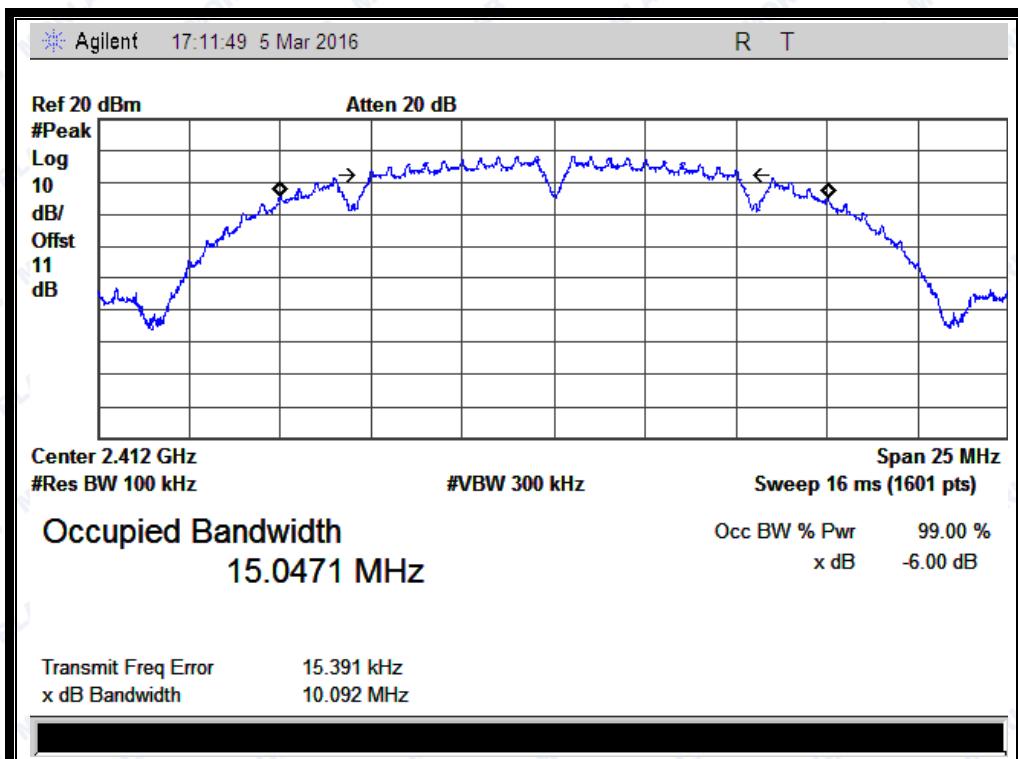
Fax: 86-755-36698525  
E-mail: service@morlab.cn



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**Antenna 2:****A. Test Verdict:**

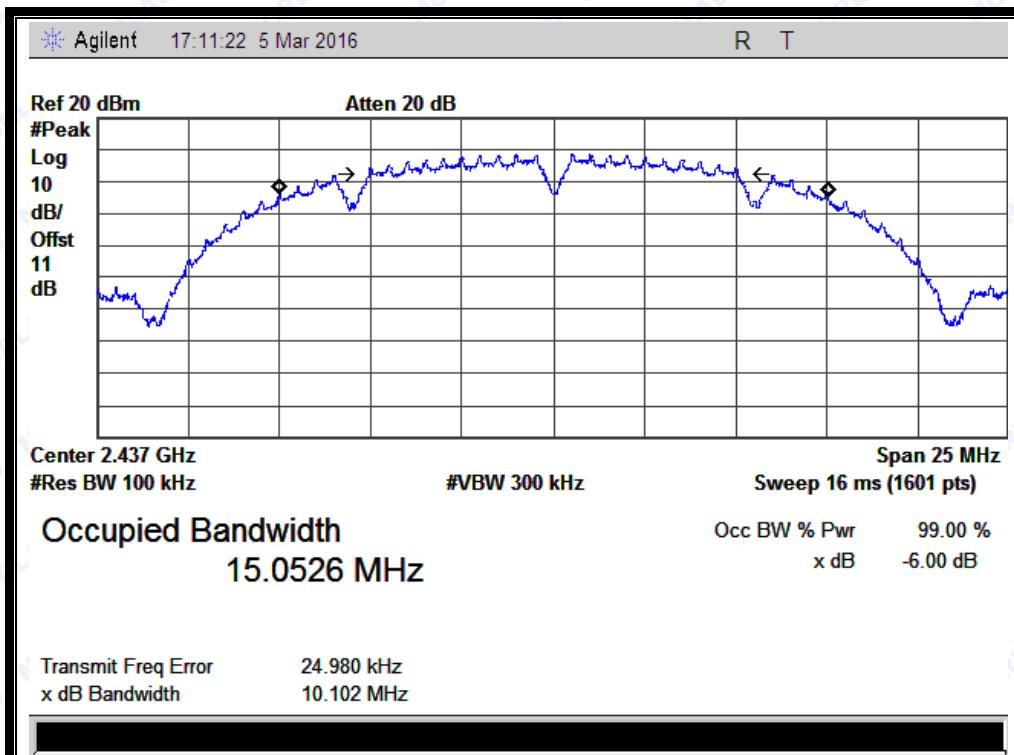
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits(kHz)	Result
1	2412	10.092	≥500	PASS
6	2437	10.102	≥500	PASS
11	2462	10.116	≥500	PASS

**B. Test Plots:**

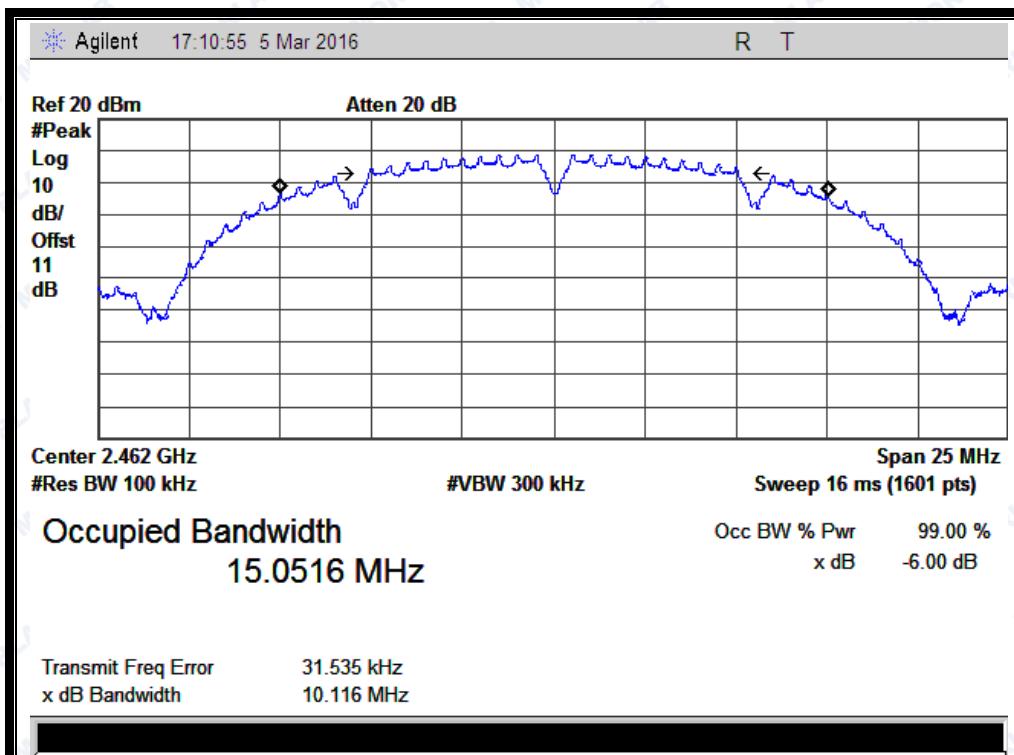
(Channel 1: 2412MHz @ 802.11b)



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(Channel 6: 2437 MHz @ 802.11b)



(Channel 11: 2462MHz @ 802.11b)

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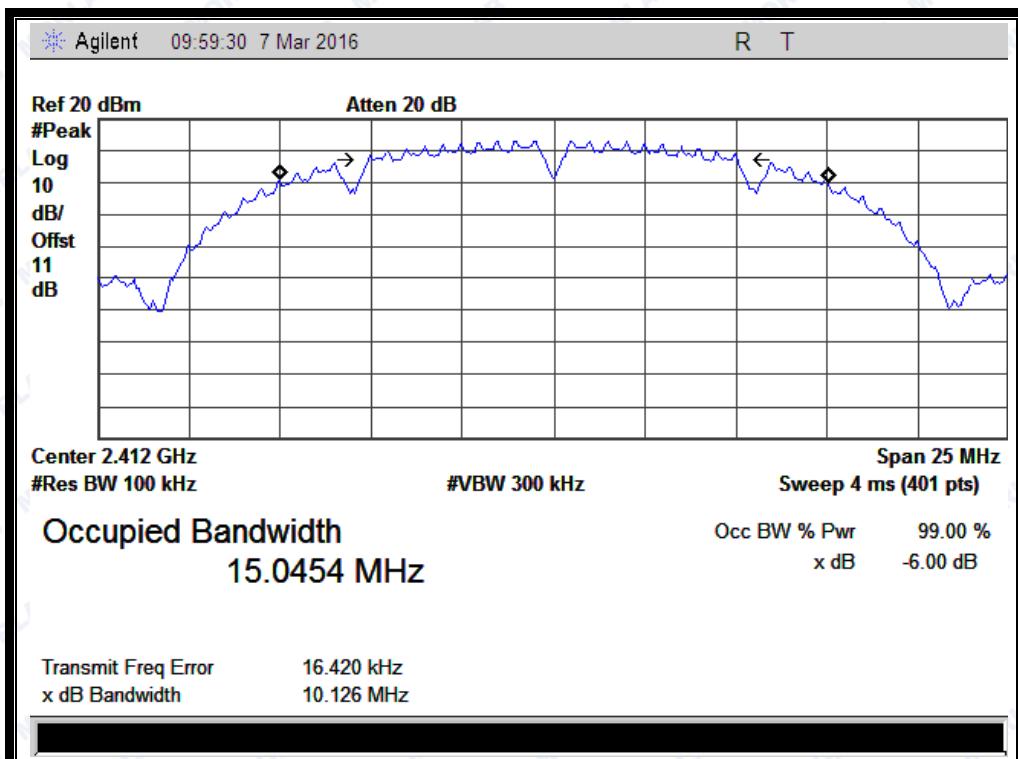
Fax: 86-755-36698525  
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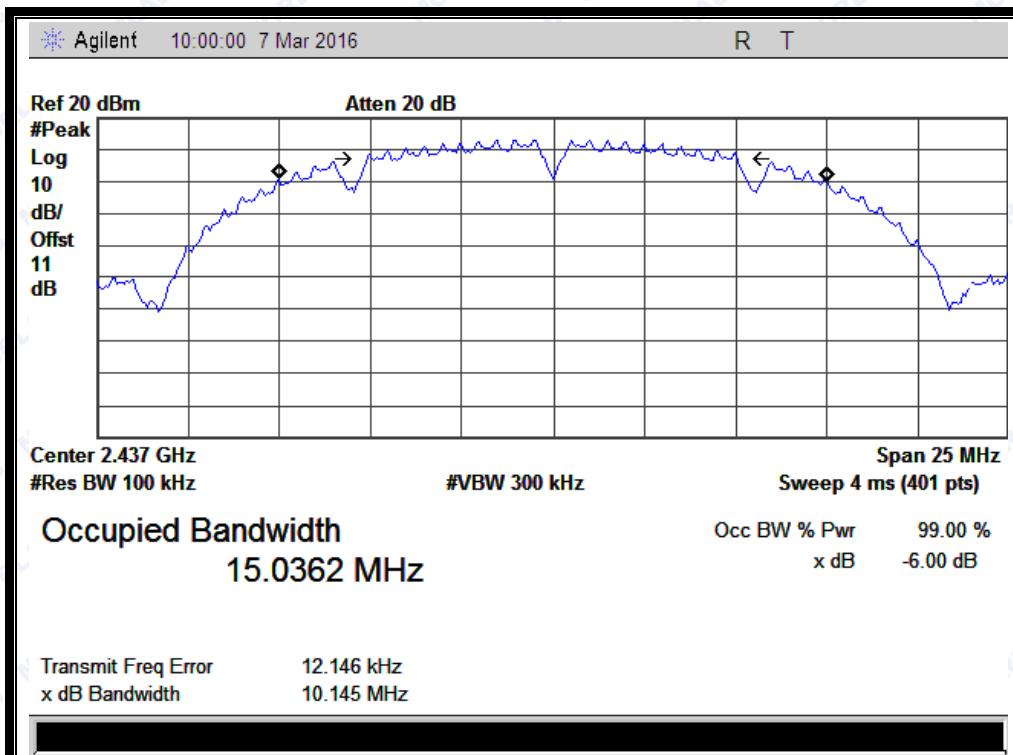
**Antenna 3:****A. Test Verdict:**

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits(kHz)	Result
1	2412	10.126	≥500	PASS
6	2437	10.145	≥500	PASS
11	2462	10.124	≥500	PASS

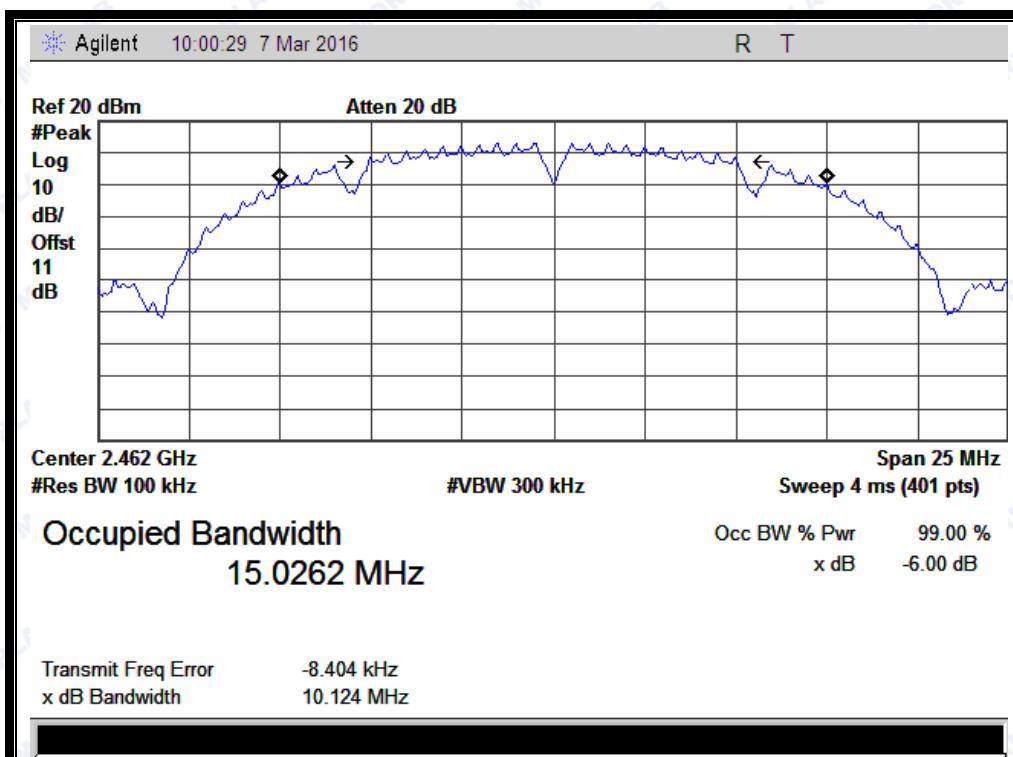
**B. Test Plots:**



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(Channel 6: 2437 MHz @ 802.11b)



(Channel 11: 2462MHz @ 802.11b)

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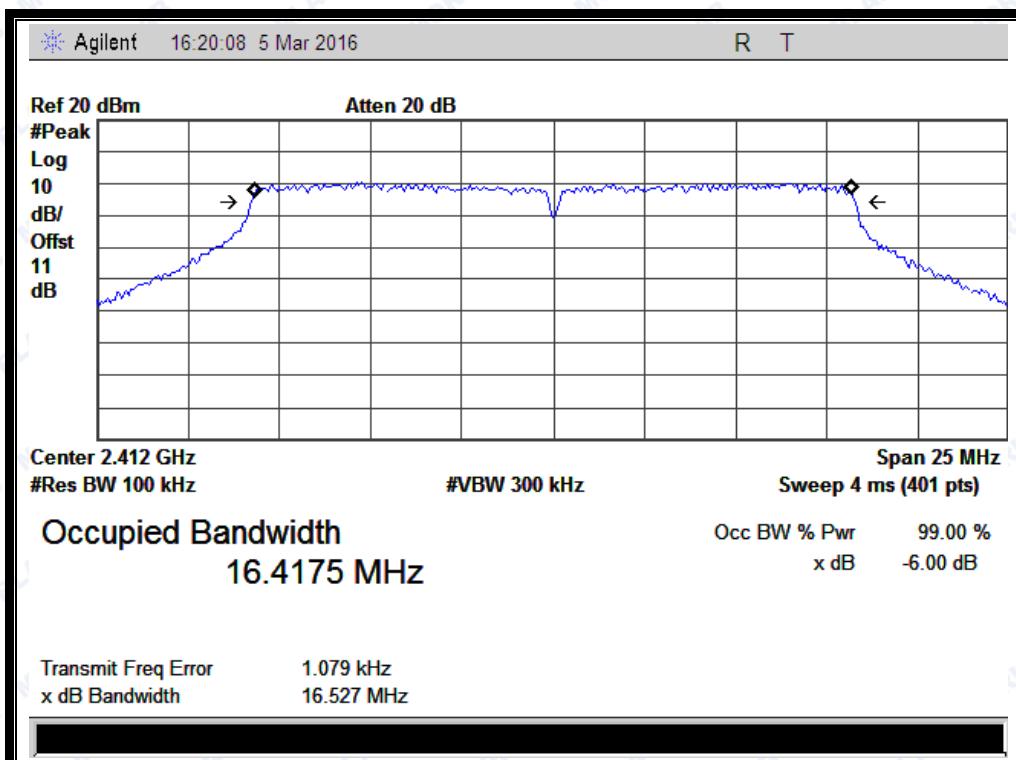
### 2.3.3.2 802.11g Test mode

Antenna 1:

#### A. Test Verdict:

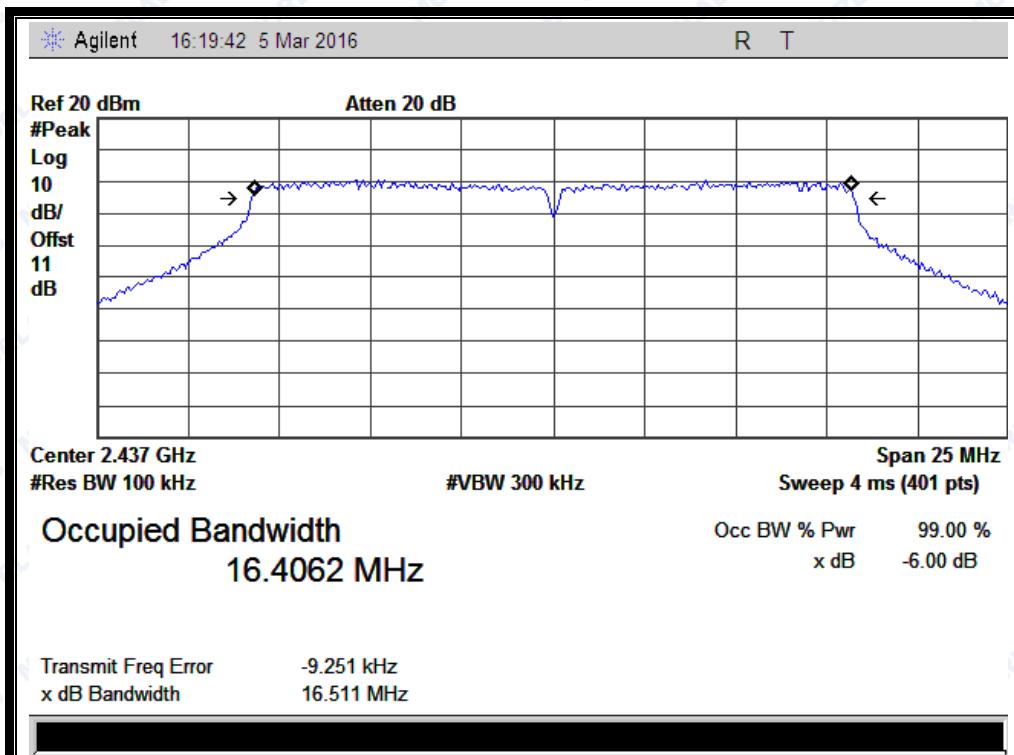
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits (kHz)	Result
1	2412	16.527	≥500	PASS
6	2437	16.511	≥500	PASS
11	2462	16.512	≥500	PASS

#### B. Test Plots:

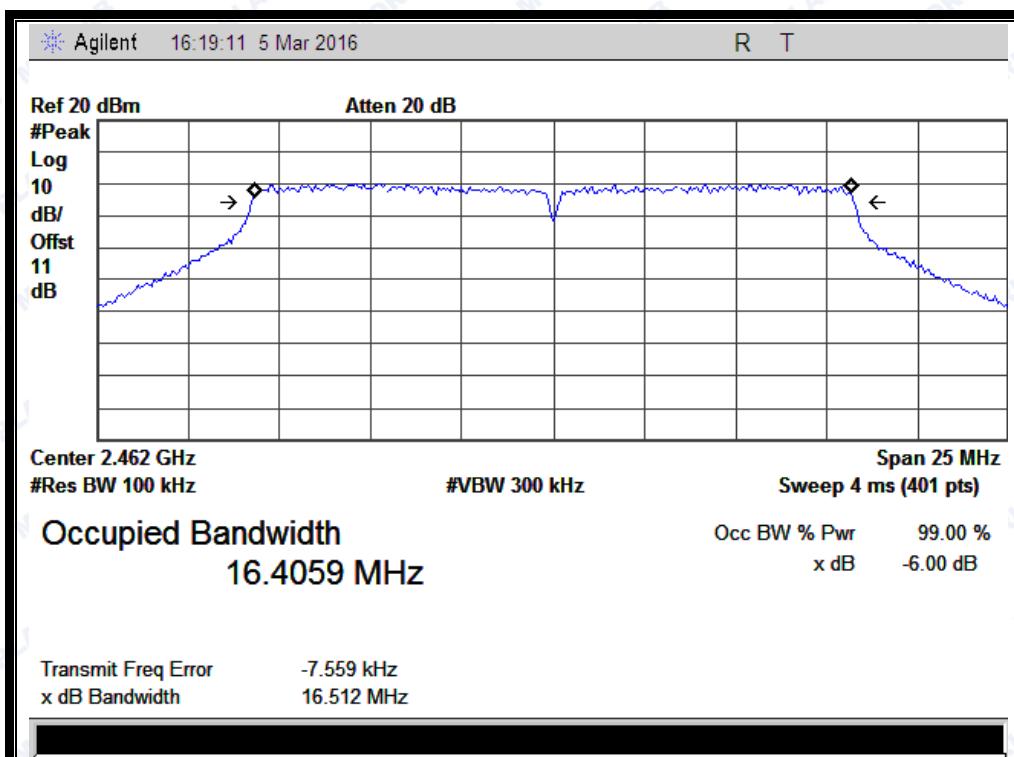




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(Channel 6: 2437MHz @ 802.11g)



(Channel 11: 2462MHz @ 802.11g)

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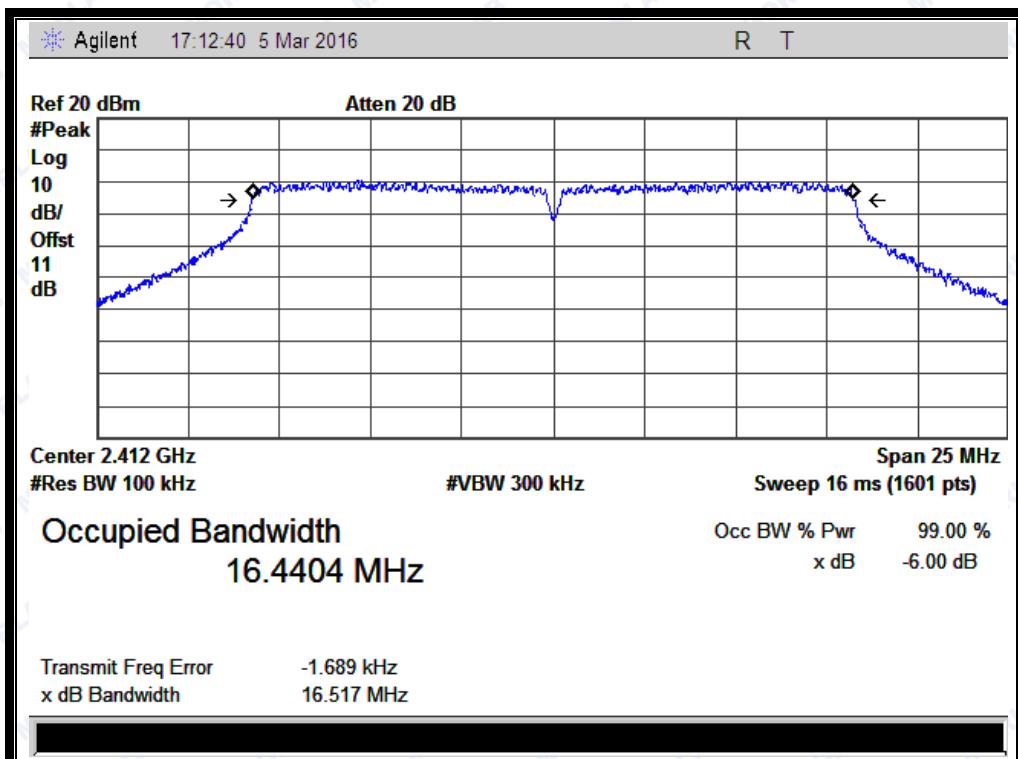
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**Antenna 2:****A. Test Verdict:**

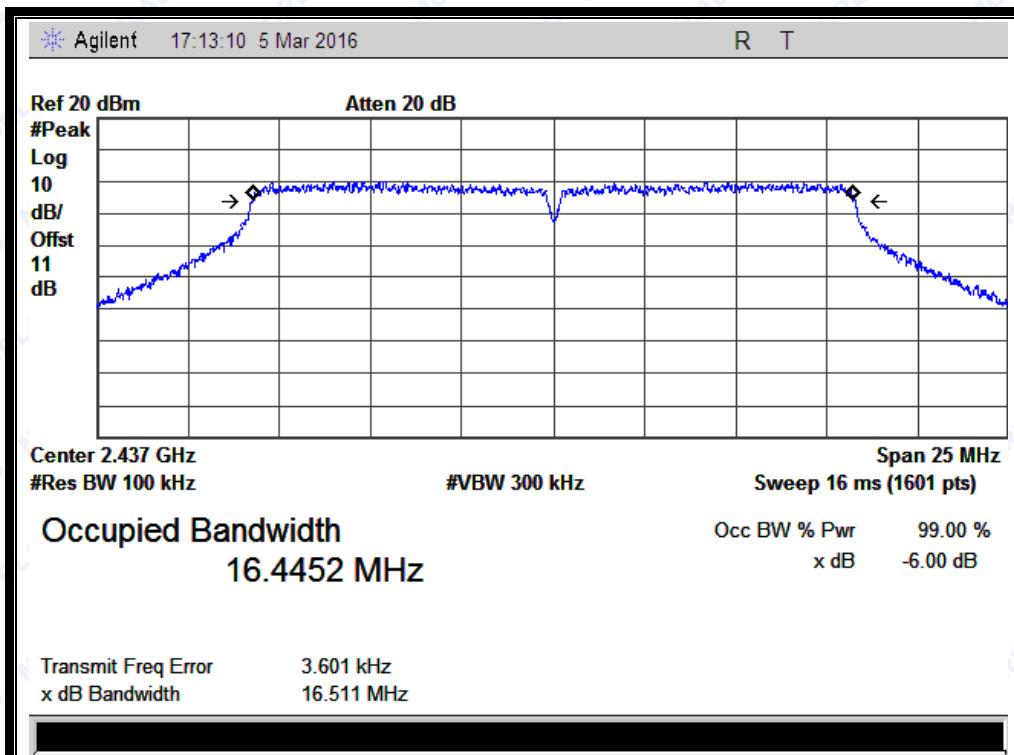
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits (kHz)	Result
1	2412	16.517	≥500	PASS
6	2437	16.511	≥500	PASS
11	2462	16.527	≥500	PASS

**B. Test Plots:**

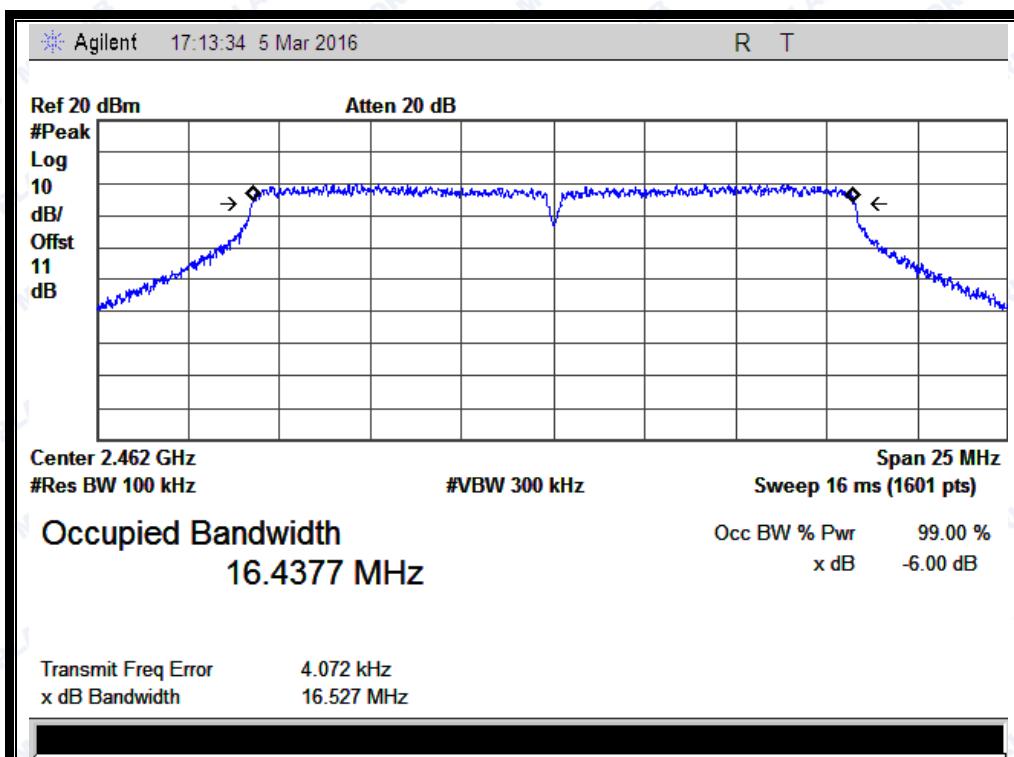
(Channel 1: 2412MHz @ 802.11g)



REPORT No.: SZ16020033W01



(Channel 6: 2437MHz @ 802.11g)



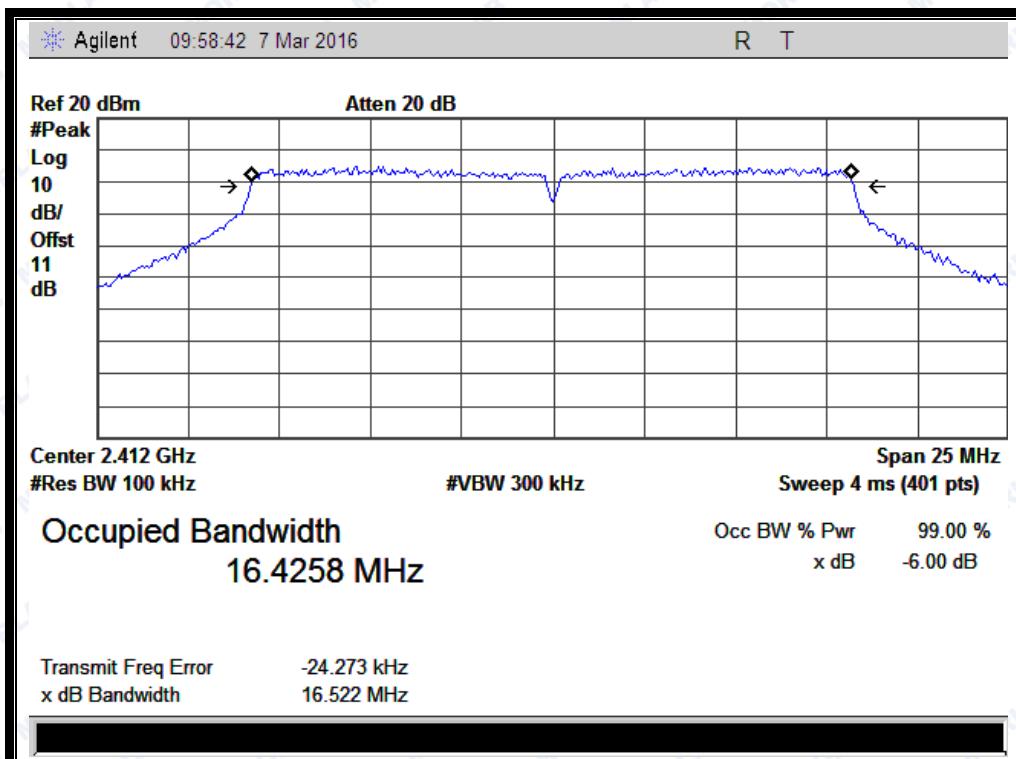
(Channel 11: 2462MHz @ 802.11g)



REPORT No.: SZ16020033W01

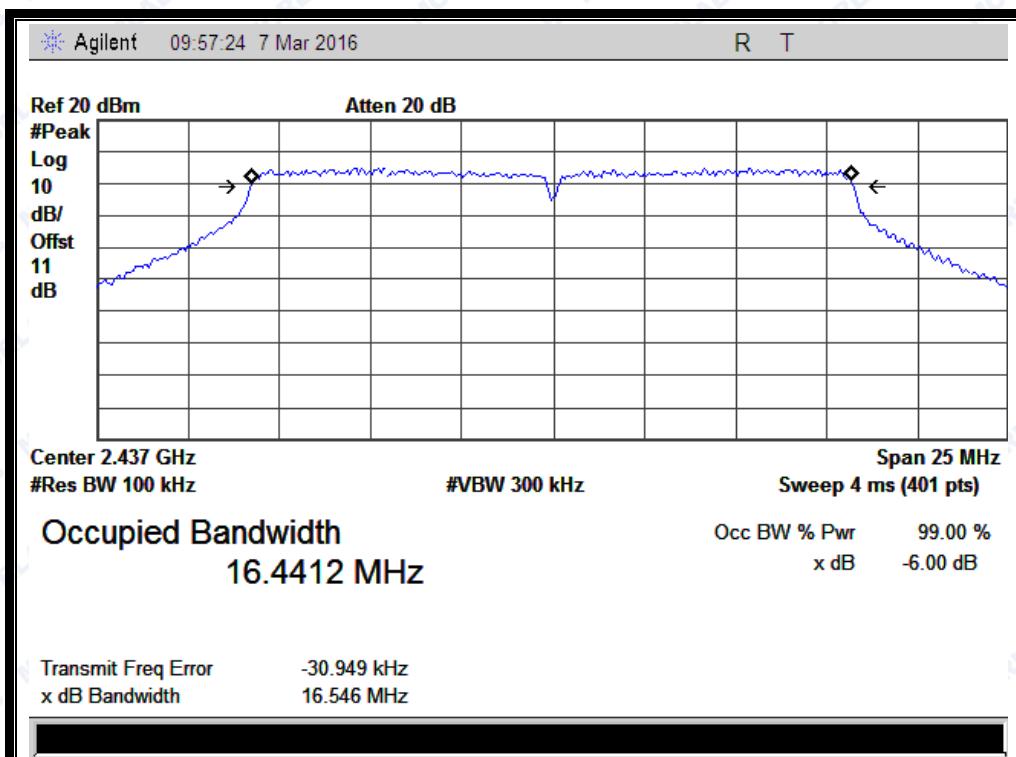
**Antenna 3:****A. Test Verdict:**

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits (kHz)	Result
1	2412	16.522	≥500	PASS
6	2437	16.546	≥500	PASS
11	2462	16.517	≥500	PASS

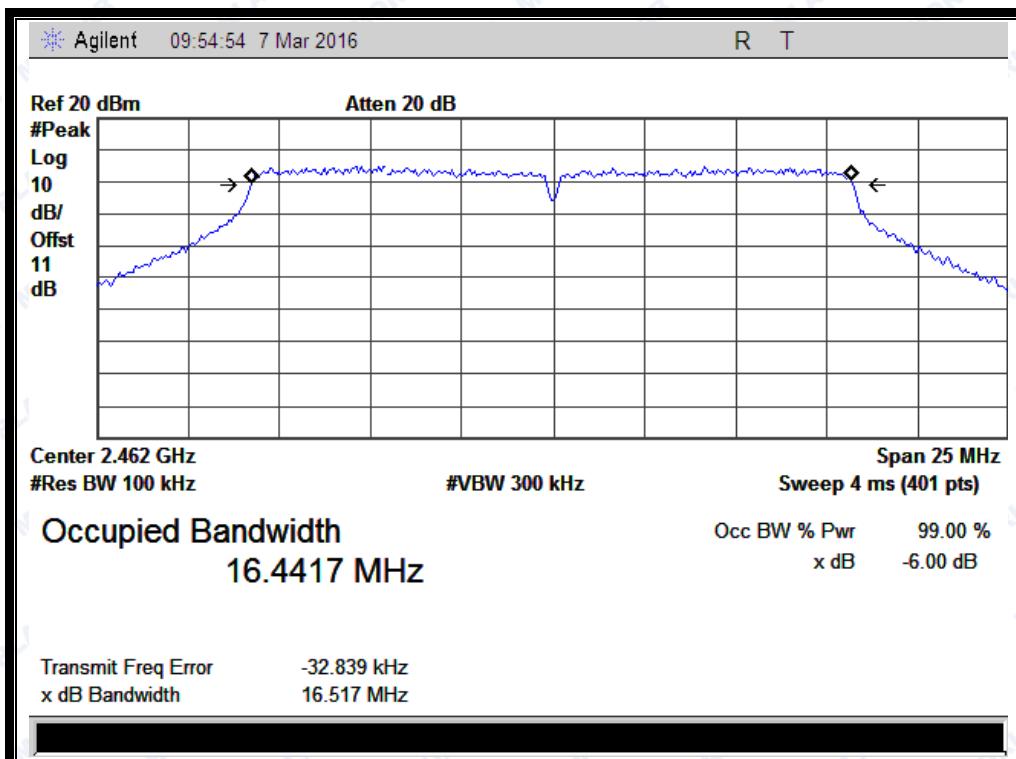
**B. Test Plots:**



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(Channel 6: 2437MHz @ 802.11g)



(Channel 11: 2462MHz @ 802.11g)

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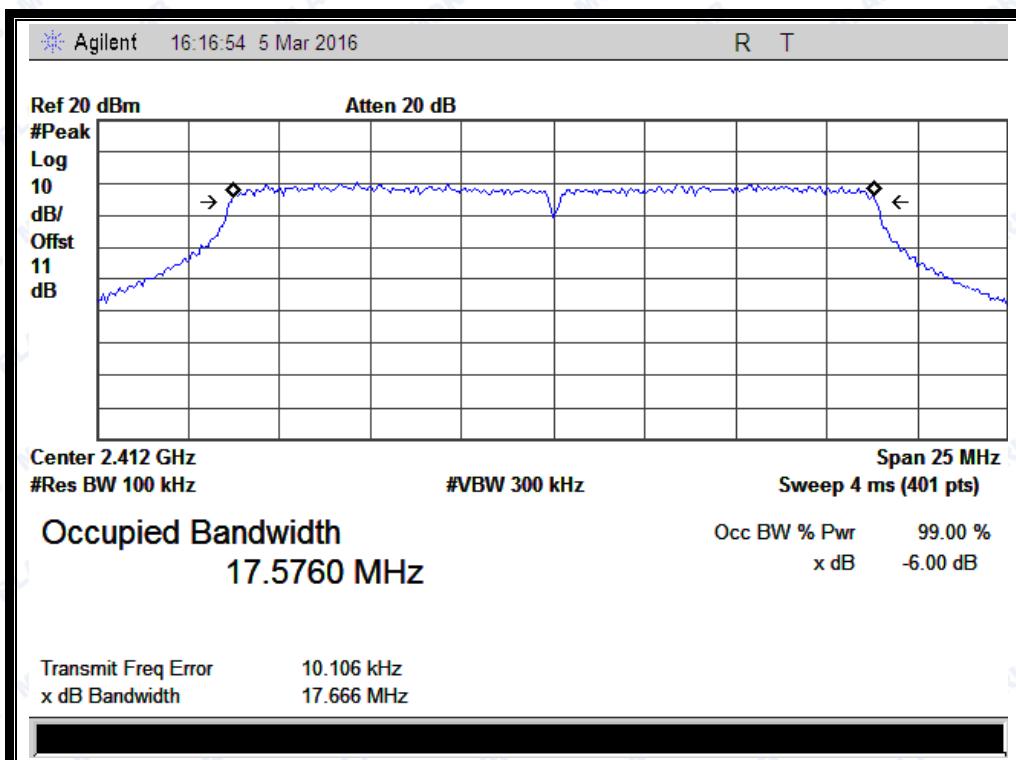
### 2.3.3.3 802.11n-20 Test mode

#### Antenna 1:

##### A. Test Verdict:

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits (kHz)	Result
1	2412	17.666	≥500	PASS
6	2437	17.683	≥500	PASS
11	2462	17.692	≥500	PASS

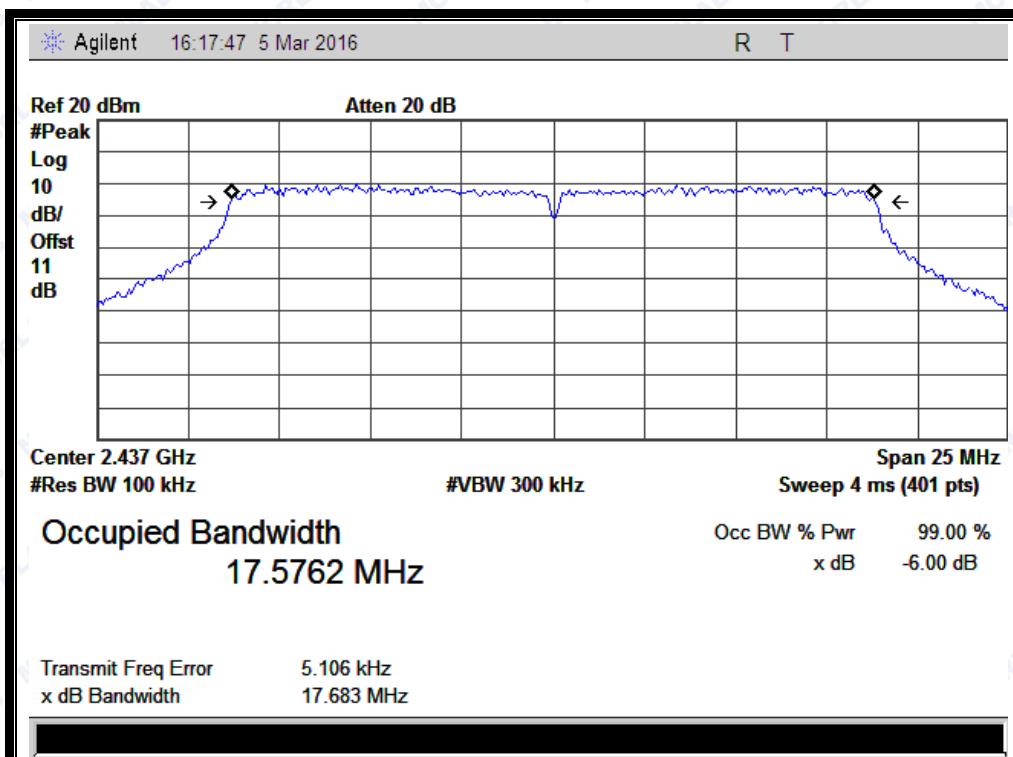
##### B. Test Plots:



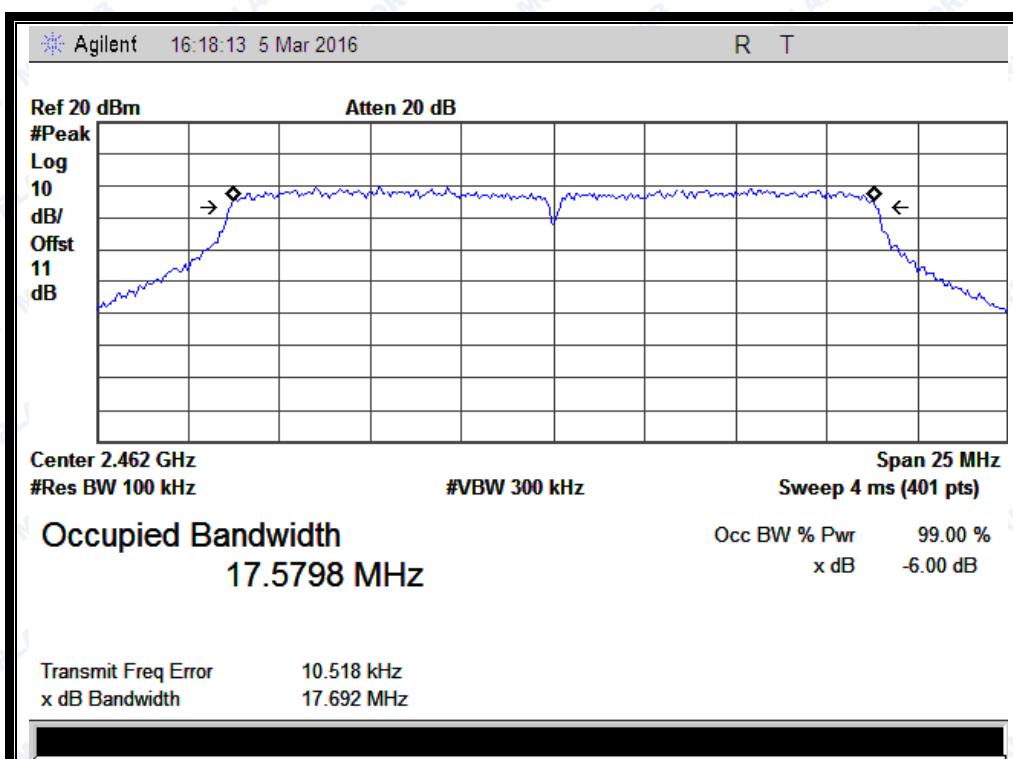
(Channel 1: 2412MHz @ 802.11n-20)



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(Channel 6: 2437MHz @ 802.11n-20)



(Channel 11: 2462MHz @ 802.11n-20)

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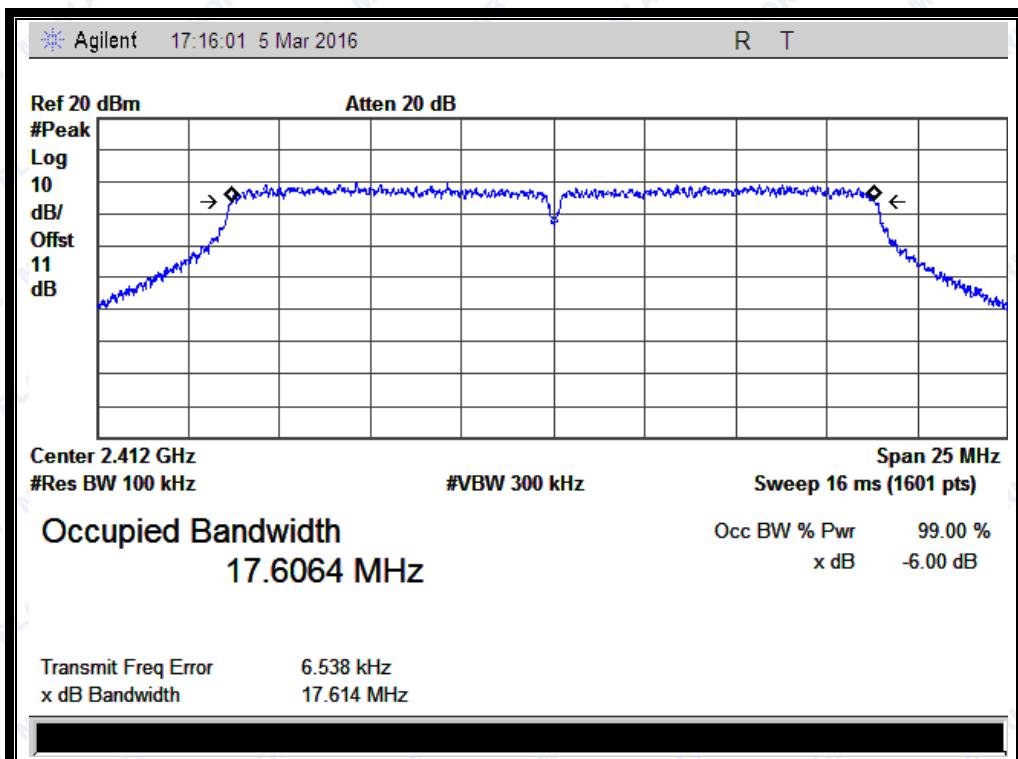
FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road,  
Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. ChinaTel: 86-755-36698555  
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**Antenna 2:****A. Test Verdict:**

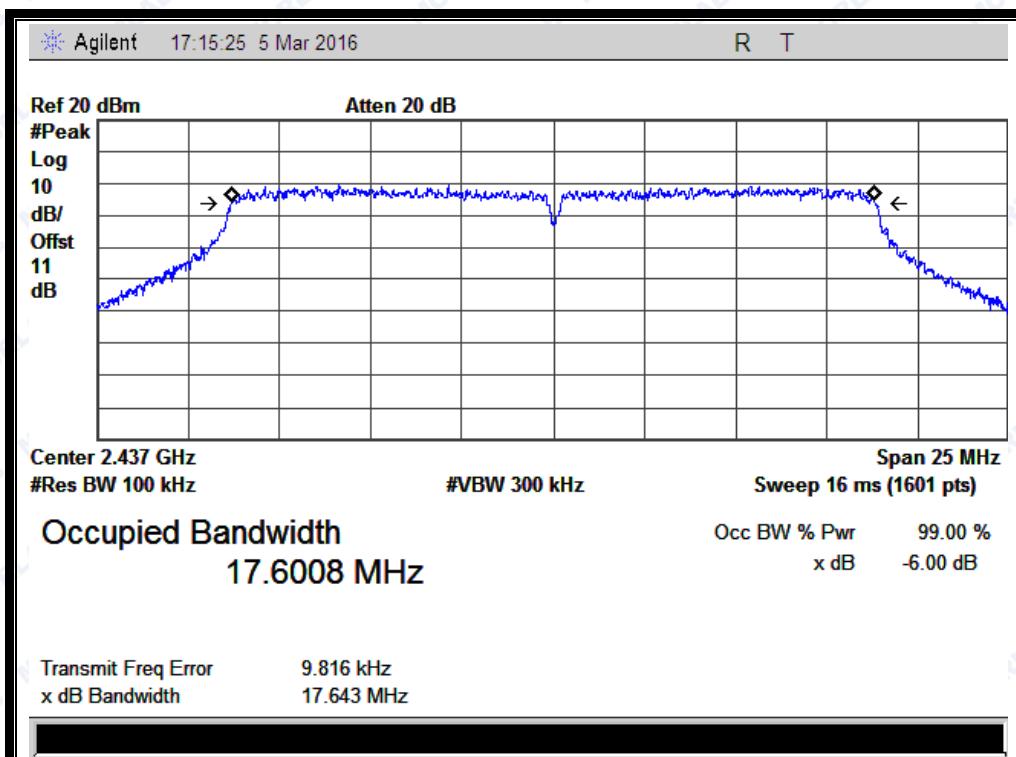
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits (kHz)	Result
1	2412	17.614	≥500	PASS
6	2437	17.643	≥500	PASS
11	2462	17.622	≥500	PASS

**B. Test Plots:**

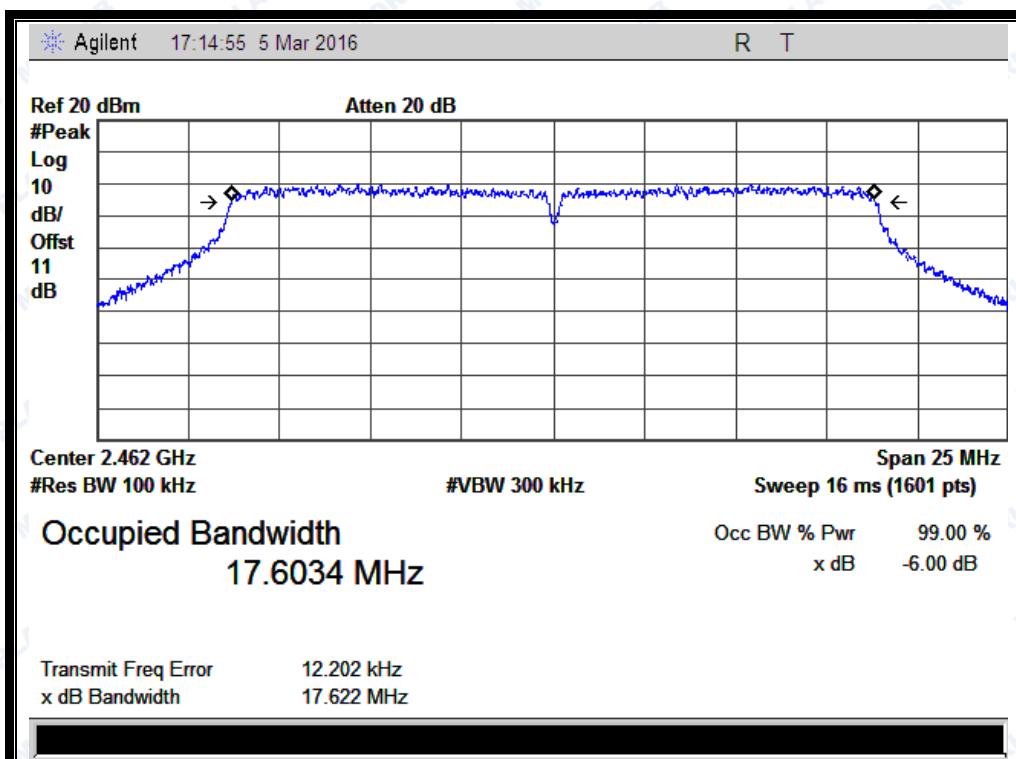
(Channel 1: 2412MHz @ 802.11n-20)



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(Channel 6: 2437MHz @ 802.11n-20)



(Channel 11: 2462MHz @ 802.11n-20)

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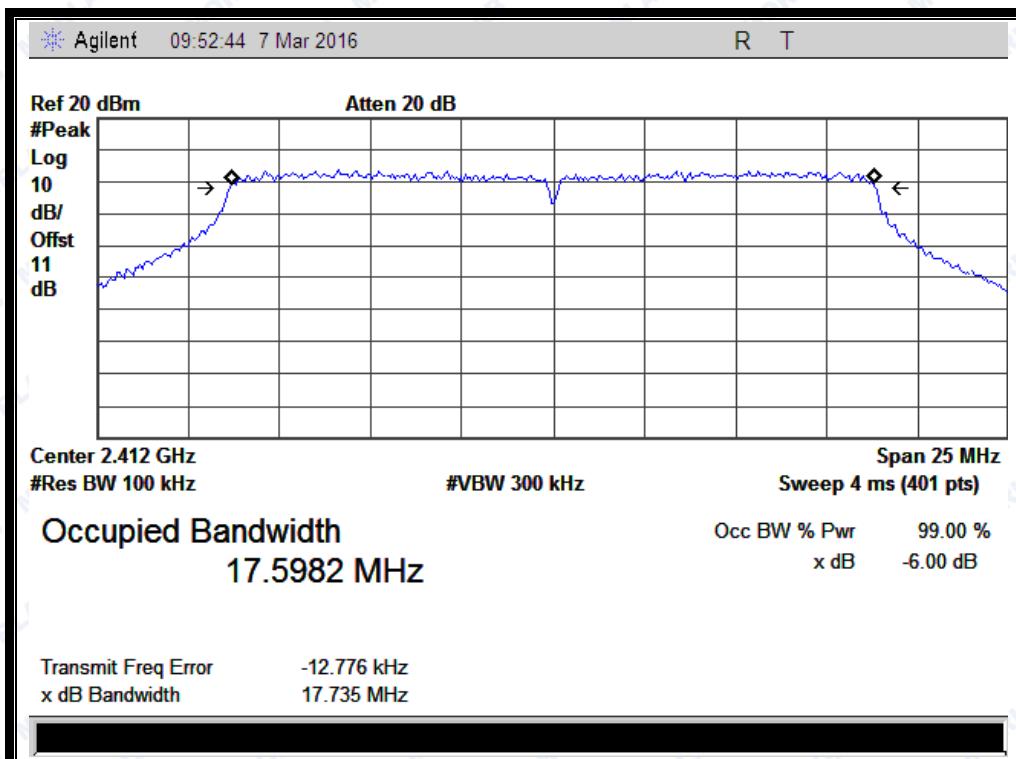
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**Antenna 3:****A. Test Verdict:**

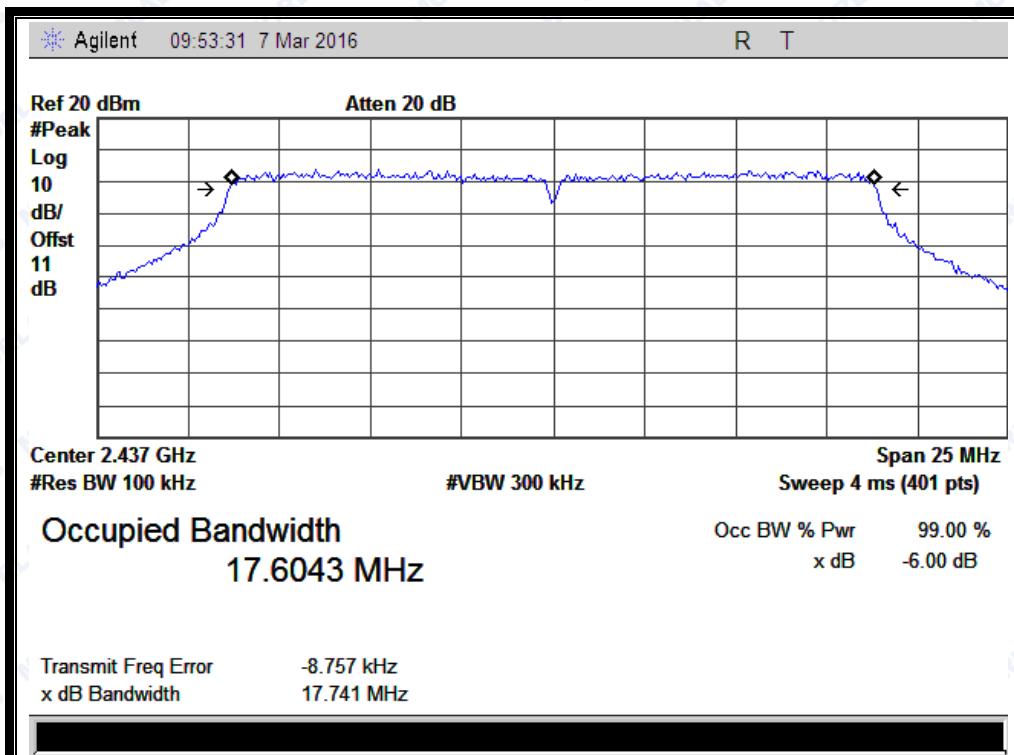
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits (kHz)	Result
1	2412	17.735	≥500	PASS
6	2437	17.741	≥500	PASS
11	2462	17.735	≥500	PASS

**B. Test Plots:**

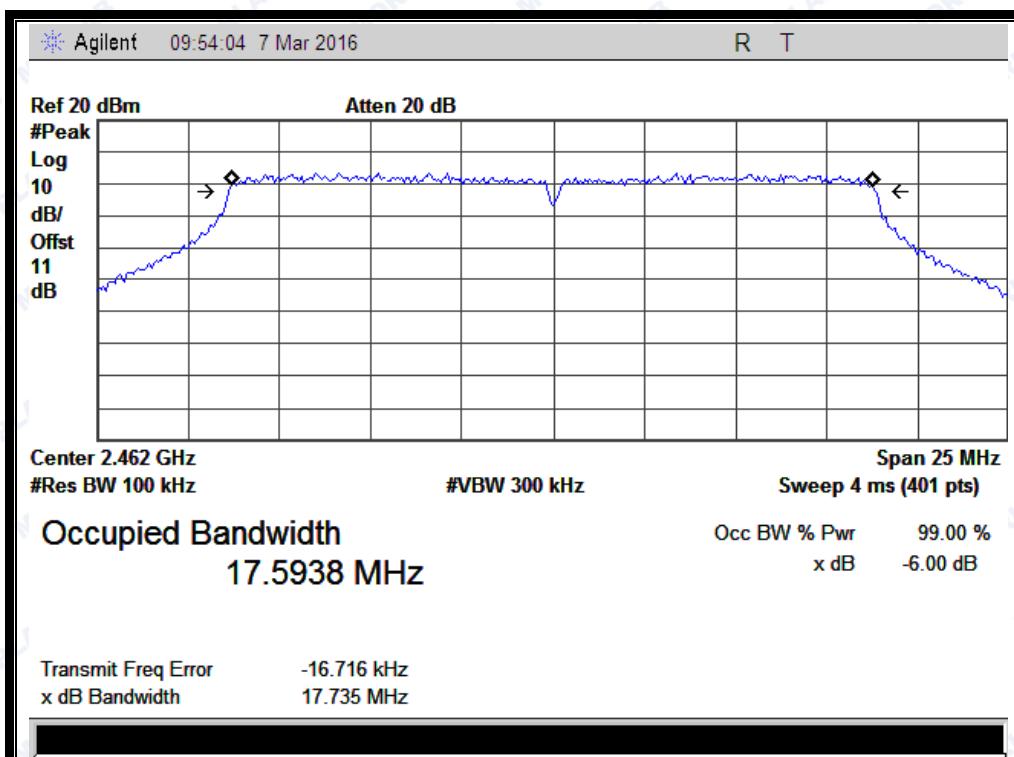
(Channel 1: 2412MHz @ 802.11n-20)



REPORT No.: SZ16020033W01



(Channel 6: 2437MHz @ 802.11n-20)



(Channel 11: 2462MHz @ 802.11n-20)

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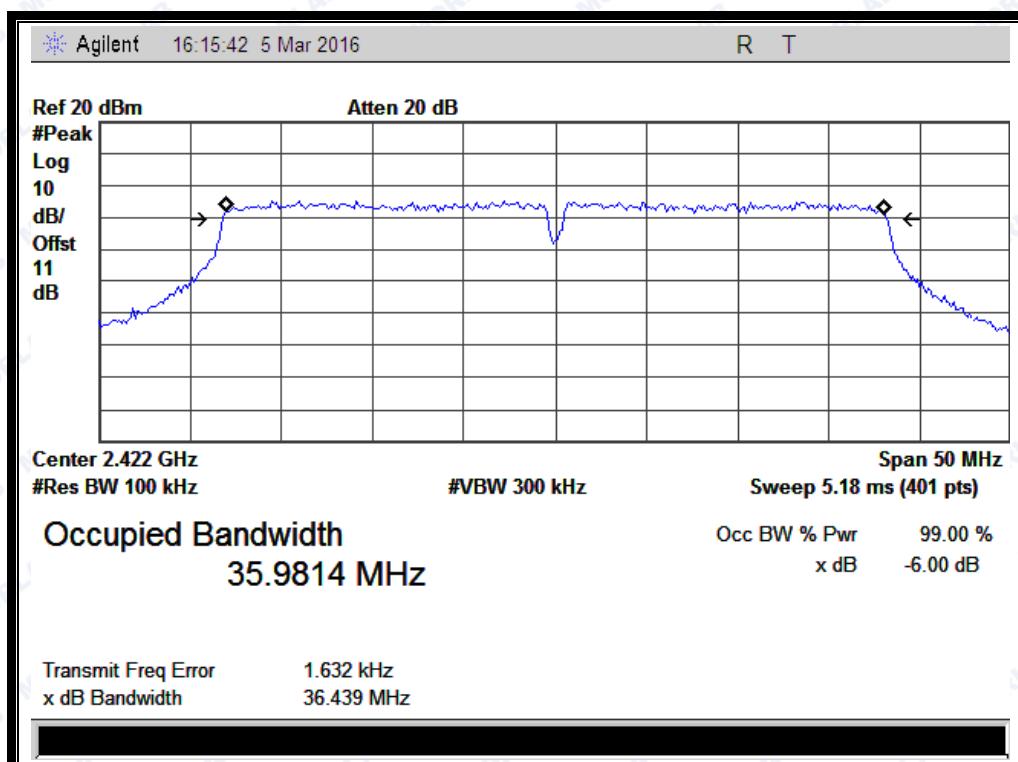
### 2.3.3.4 802.11n-40 Test mode

#### Antenna 1:

##### A. Test Verdict:

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits (kHz)	Result
3	2422	36.439	≥500	PASS
6	2437	36.434	≥500	PASS
9	2452	36.458	≥500	PASS

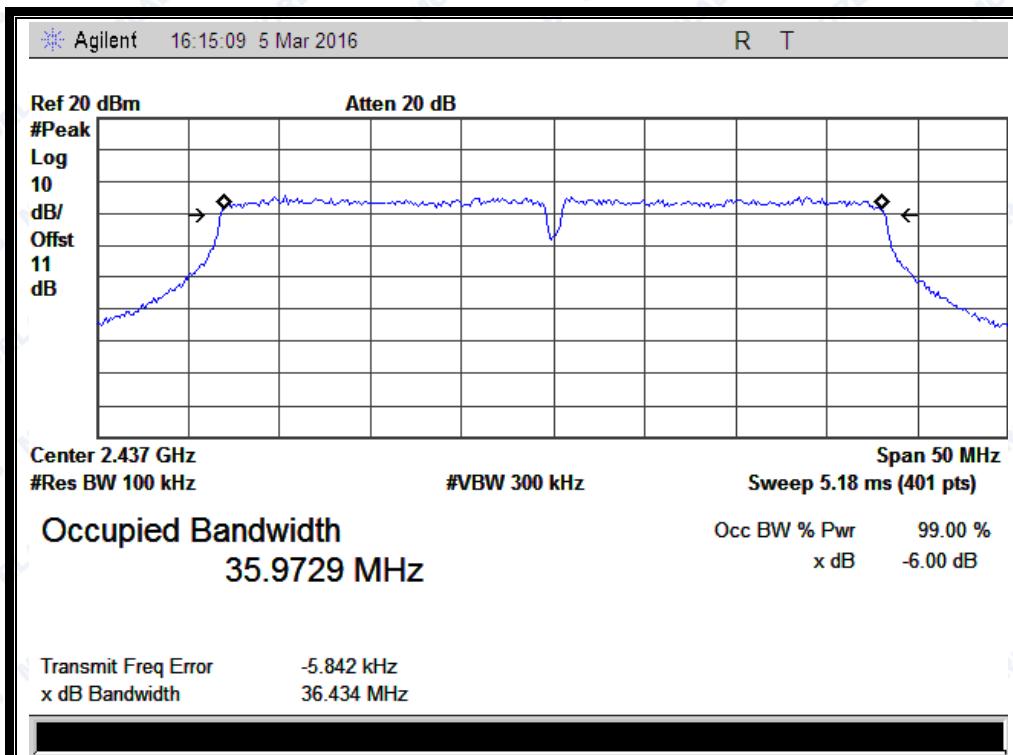
##### B. Test Plots:



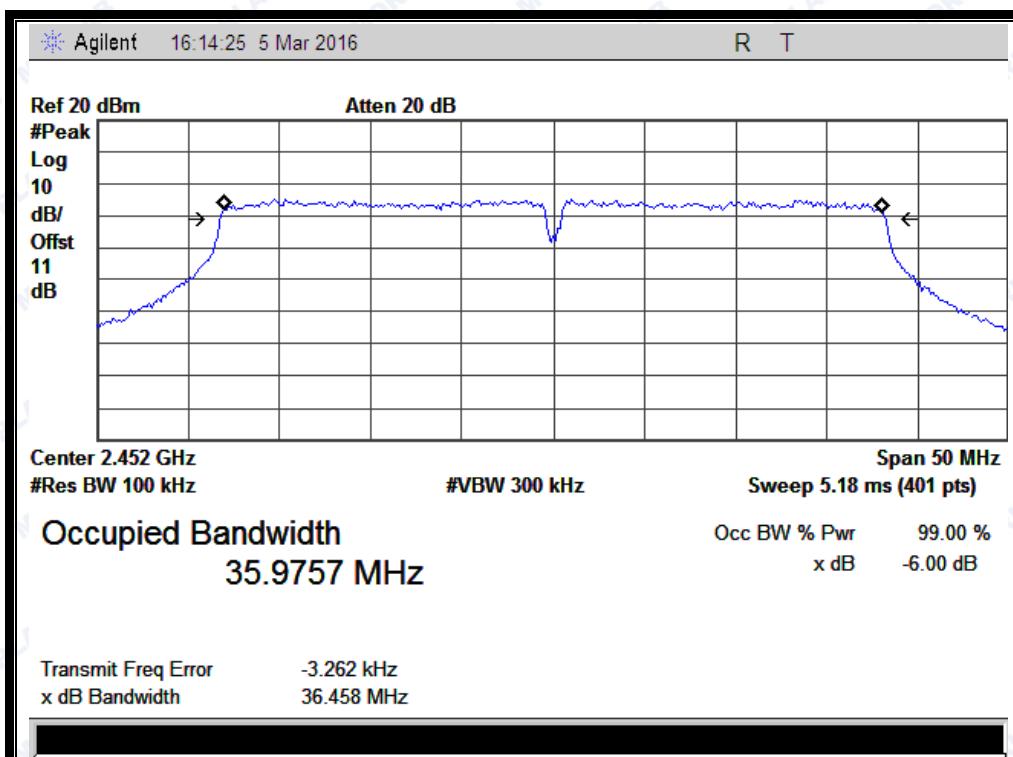
(Channel 3: 2422MHz @ 802.11n-40)



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(Channel 6: 2437MHz @ 802.11n-40)



(Channel 9: 2452MHz @ 802.11n-40)

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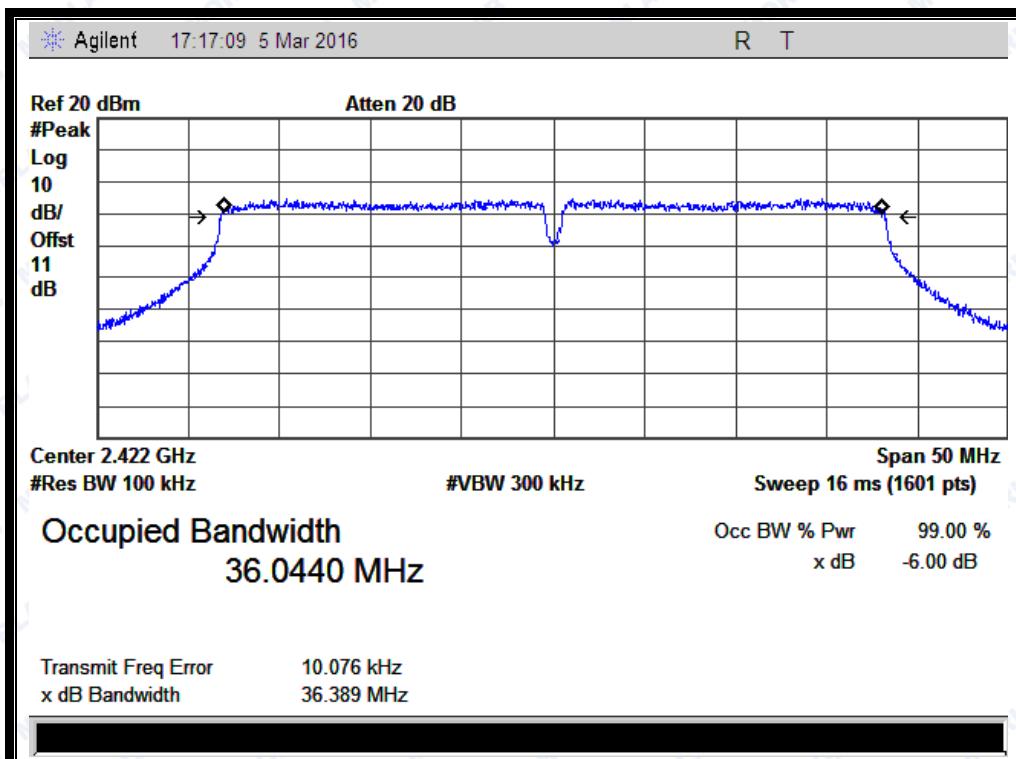
Fax: 86-755-36698525  
E-mail: service@morlab.cn



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**Antenna 2:****A. Test Verdict:**

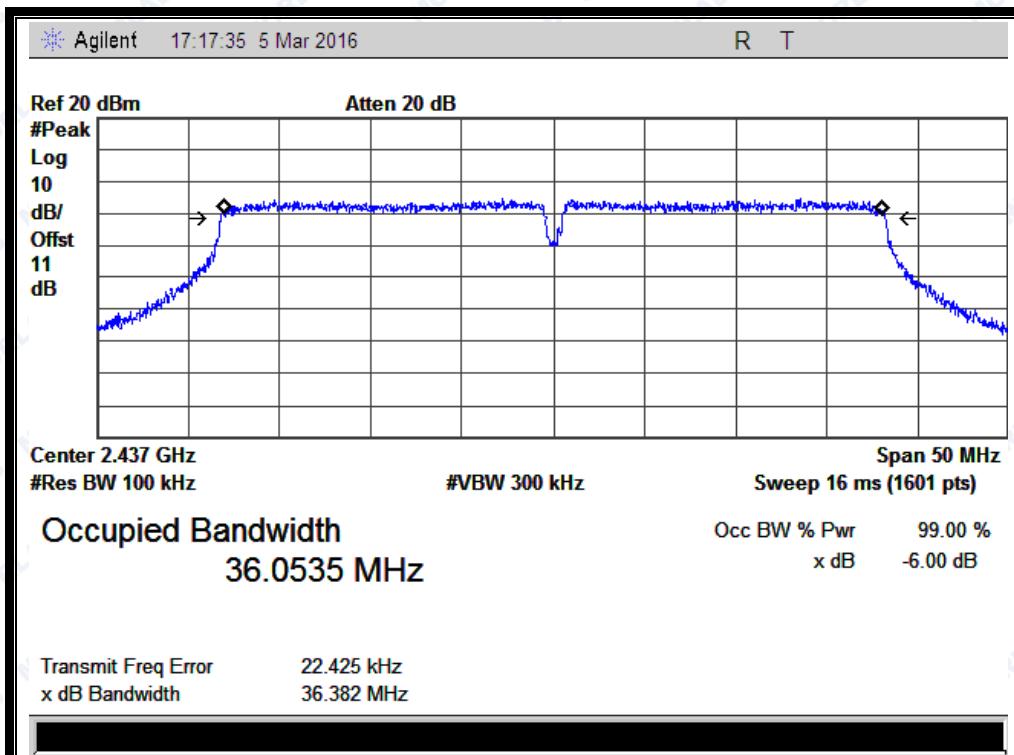
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits (kHz)	Result
3	2422	36.389	≥500	PASS
6	2437	36.382	≥500	PASS
9	2452	36.399	≥500	PASS

**B. Test Plots:**

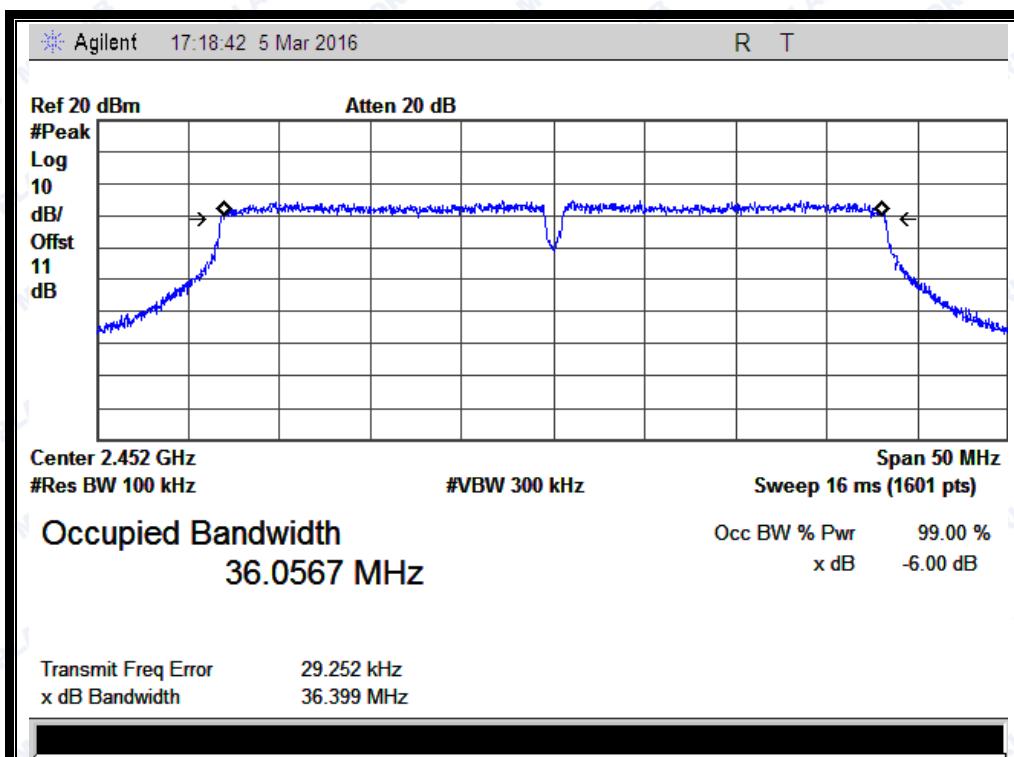
(Channel 3: 2422MHz @ 802.11n-40)



REPORT No.: SZ16020033W01



(Channel 6: 2437MHz @ 802.11n-40)



(Channel 9: 2452MHz @ 802.11n-40)

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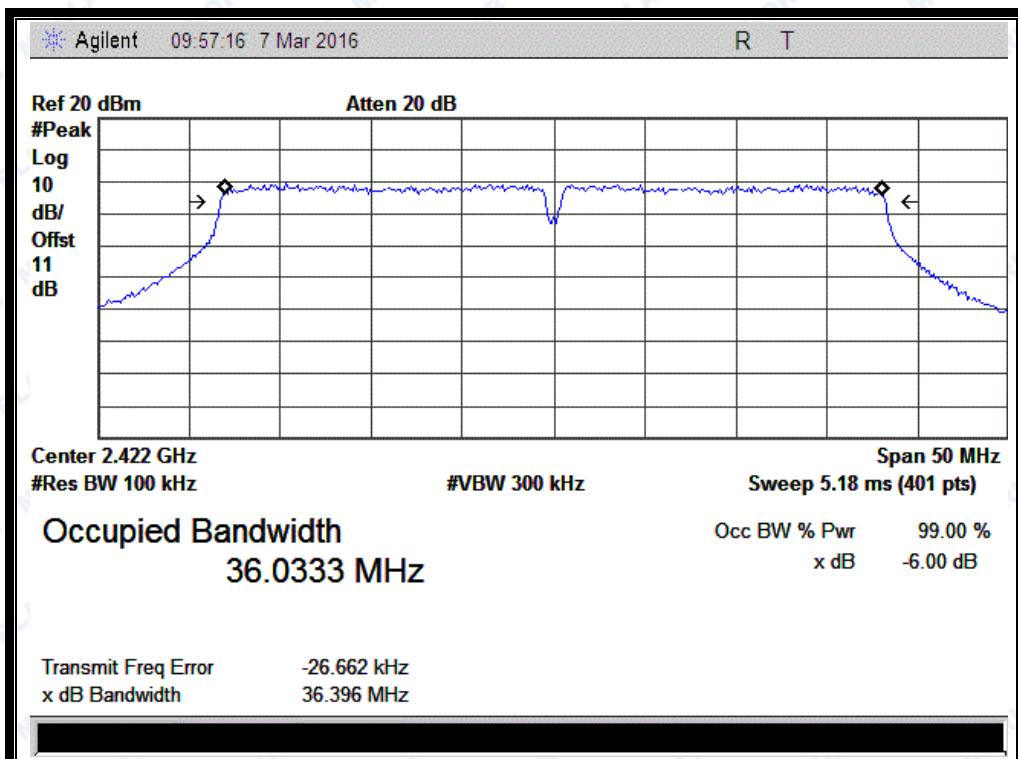
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**Antenna 3:****A. Test Verdict:**

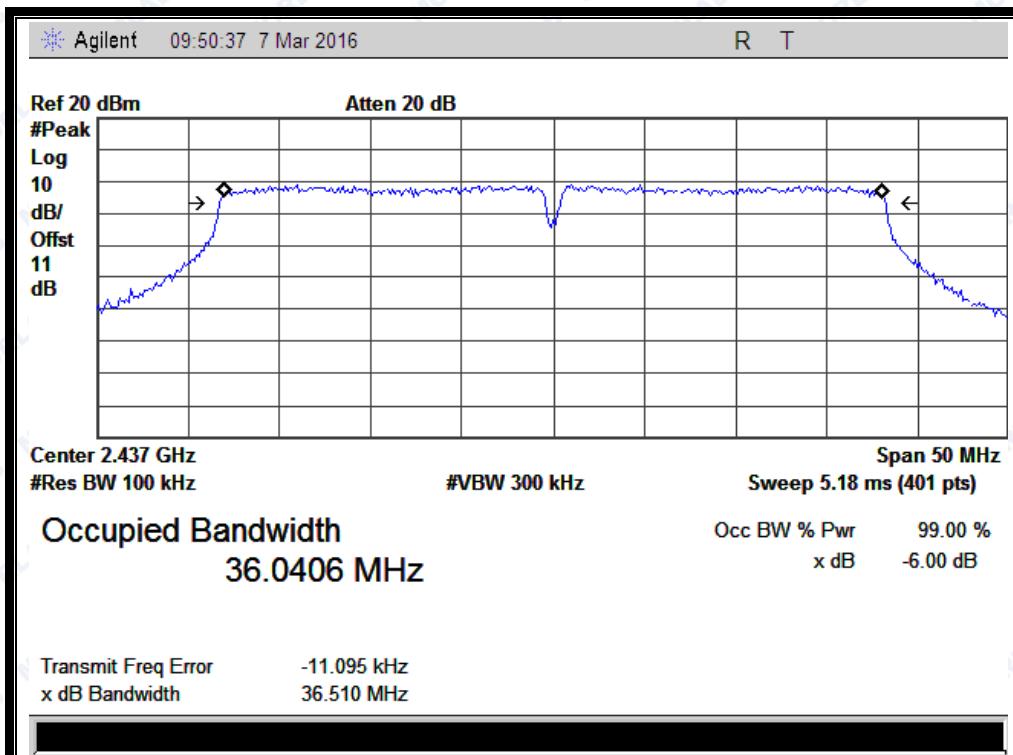
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits (kHz)	Result
3	2422	36.396	≥500	PASS
6	2437	36.510	≥500	PASS
9	2452	36.485	≥500	PASS

**B. Test Plots:**

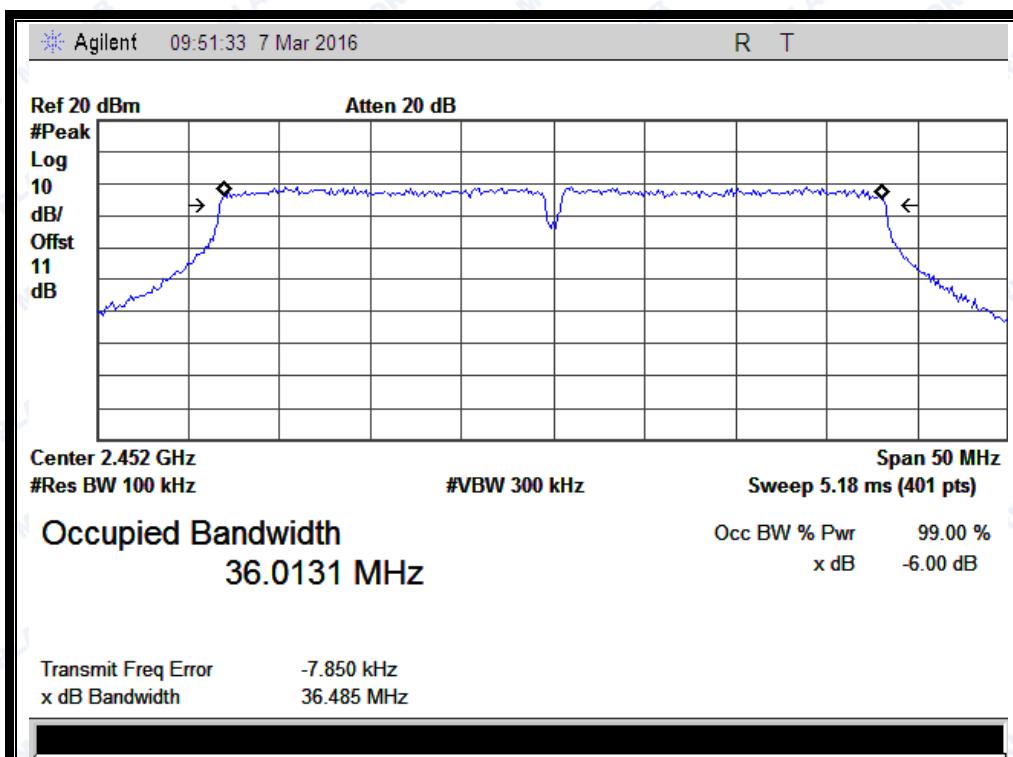
(Channel 3: 2422MHz @ 802.11n-40)



REPORT No.: SZ16020033W01



(Channel 6: 2437MHz @ 802.11n-40)



(Channel 9: 2452MHz @ 802.11n-40)



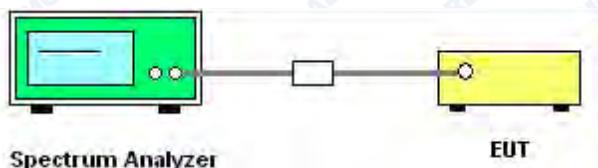
## 2.4 Conducted Spurious Emissions and Band Edge

### 2.4.1 Requirement

According to FCC section 15.247(c), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

### 2.4.2 Test Description

#### A. Test Set:



The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW.

KDB 558074 Section 11.0 was used in order to prove compliance.

#### B. Equipments List:

Please reference ANNEX A(1.5).

### 2.4.3 Test Result

The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions.

**Note:** Three Antennas were all tested, but only the worse case(Antenna 3) was recorded in this test result.



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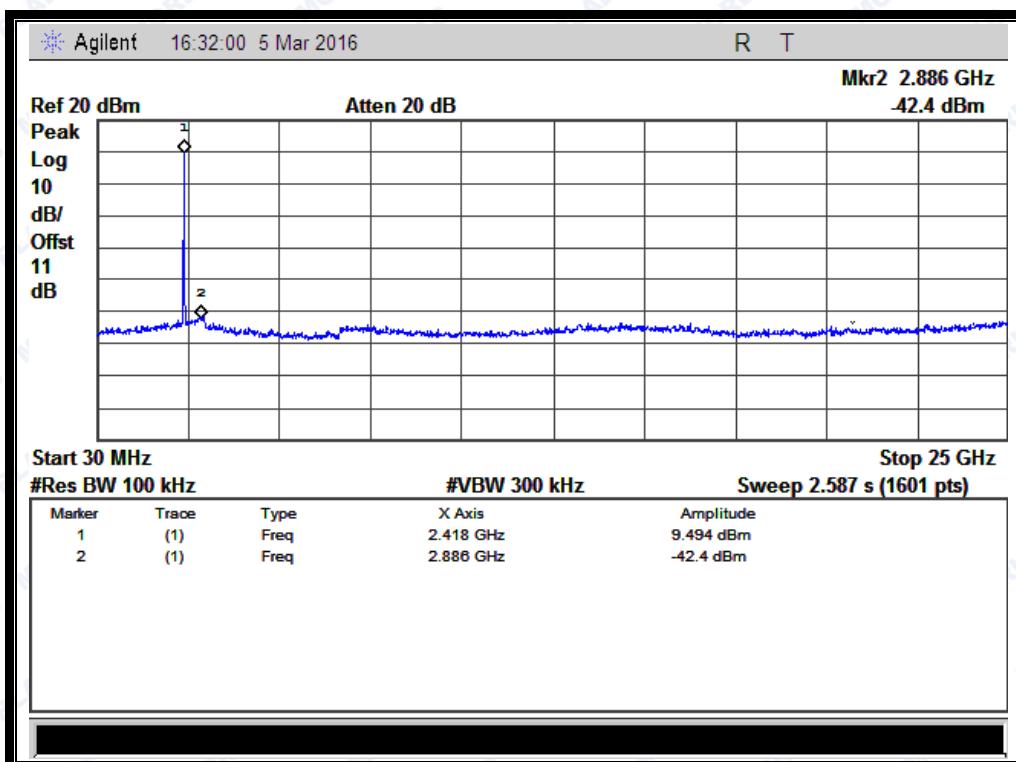
### 2.4.3.1 802.11b SISO Test mode (Antenna 3)

#### A. Test Verdict:

Channel	Frequency (MHz)	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
			Carrier Level	Calculated -20dBc Limit	
1	2412	-42.4	9.494	-10.506	PASS
6	2437	-42.82	8.486	-11.514	PASS
11	2462	-42.37	8.377	-11.623	PASS

#### B. Test Plots:

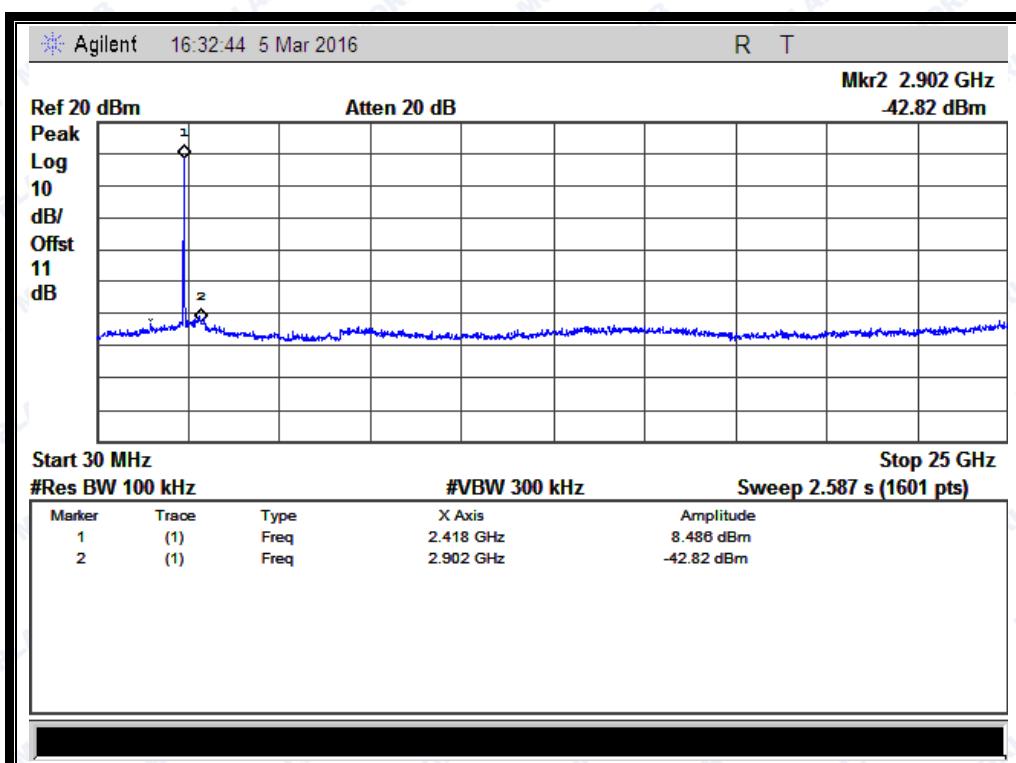
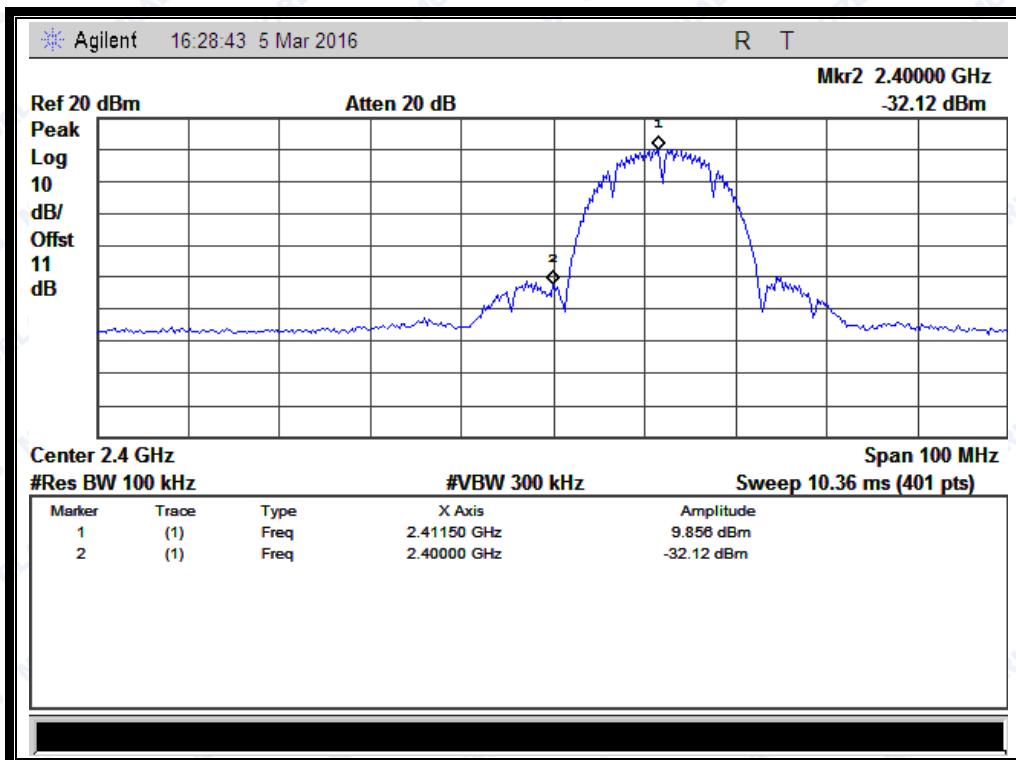
Note: the power of the Module transmitting frequency should be ignored.



(Channel = 1, 30MHz to 25GHz)

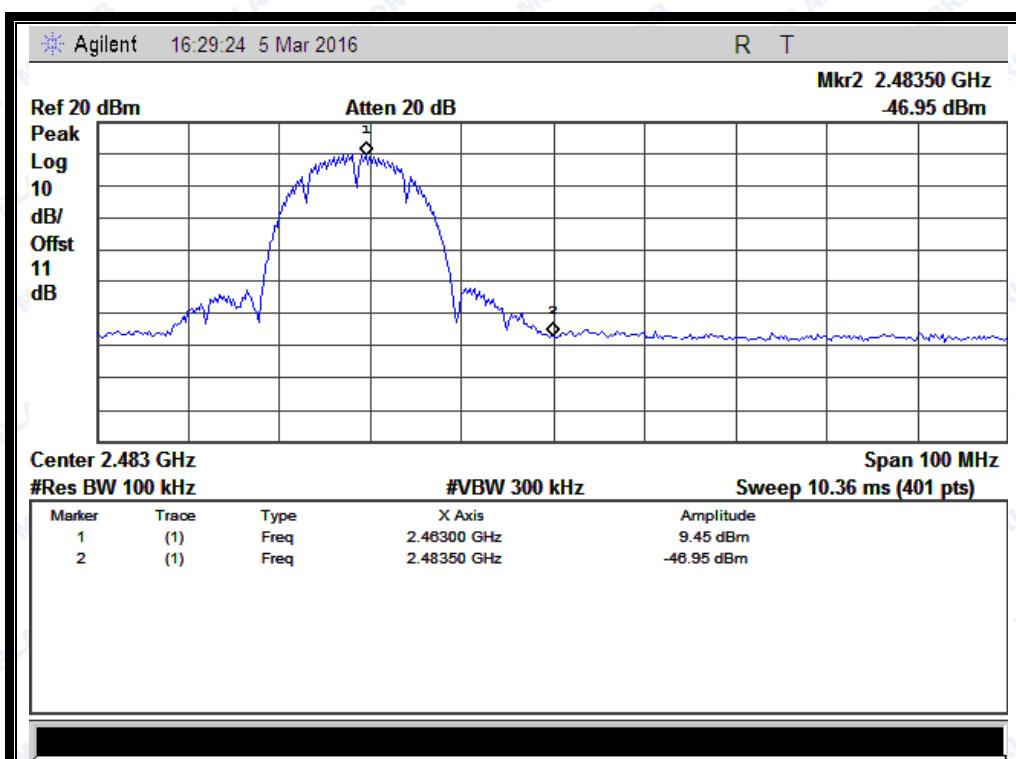
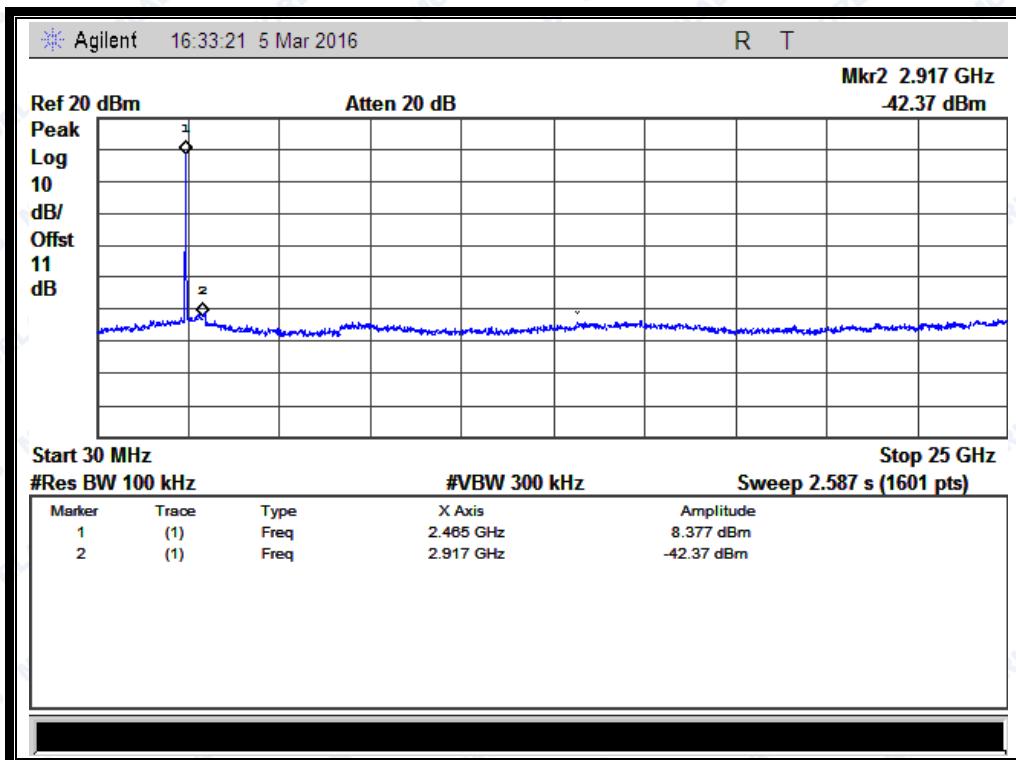


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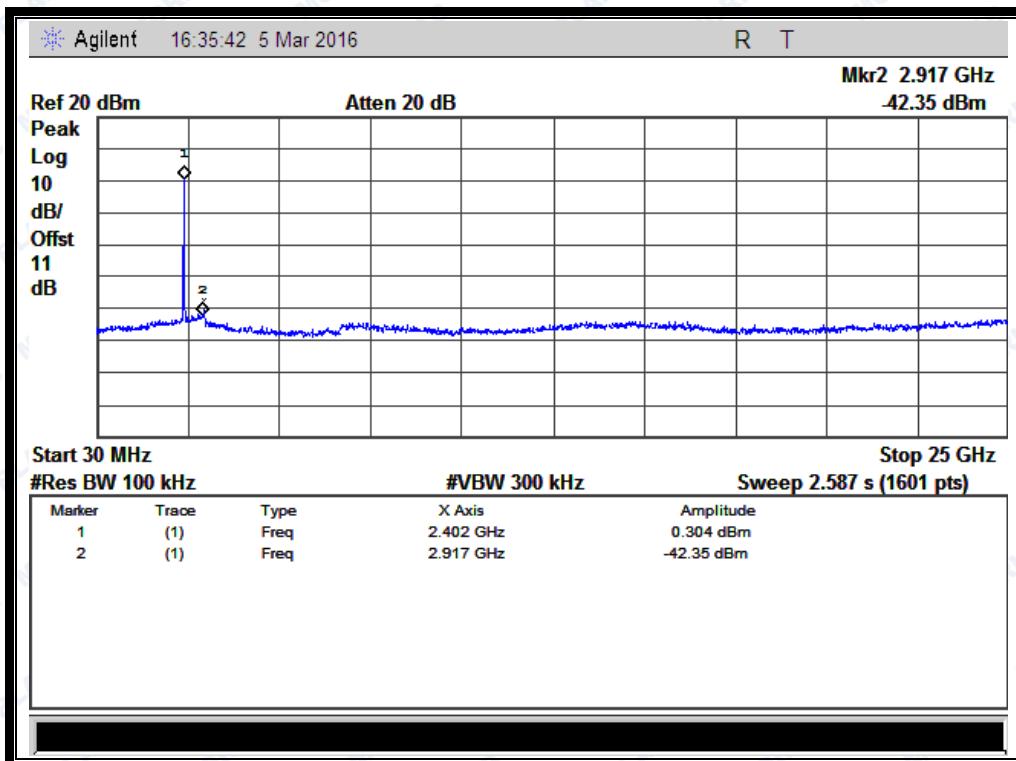
### 2.4.3.2 802.11g SISO Test mode (Antenna 3)

#### A. Test Verdict:

Channel	Frequency (MHz)	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
			Carrier Level	Calculated -20dBc Limit	
1	2412	-42.35	0.304	-19.696	PASS
6	2437	-46.48	0.588	-19.412	PASS
11	2462	-41.24	0.659	-19.341	PASS

#### B. Test Plots:

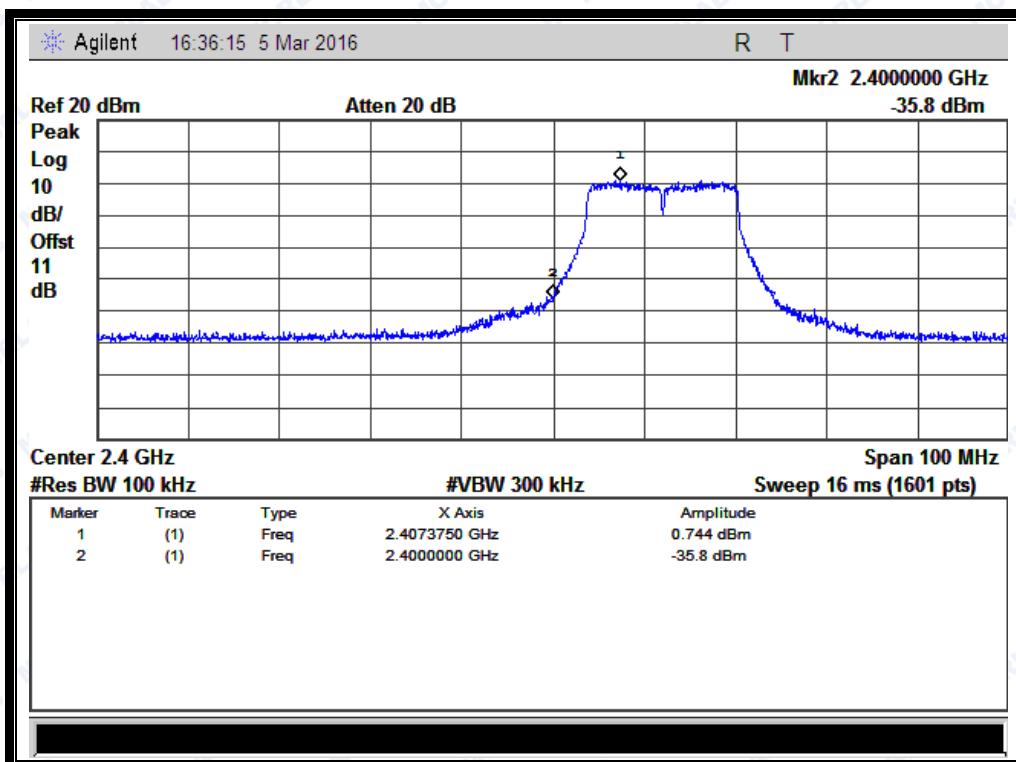
Note: the power of the Module transmitting frequency should be ignored.



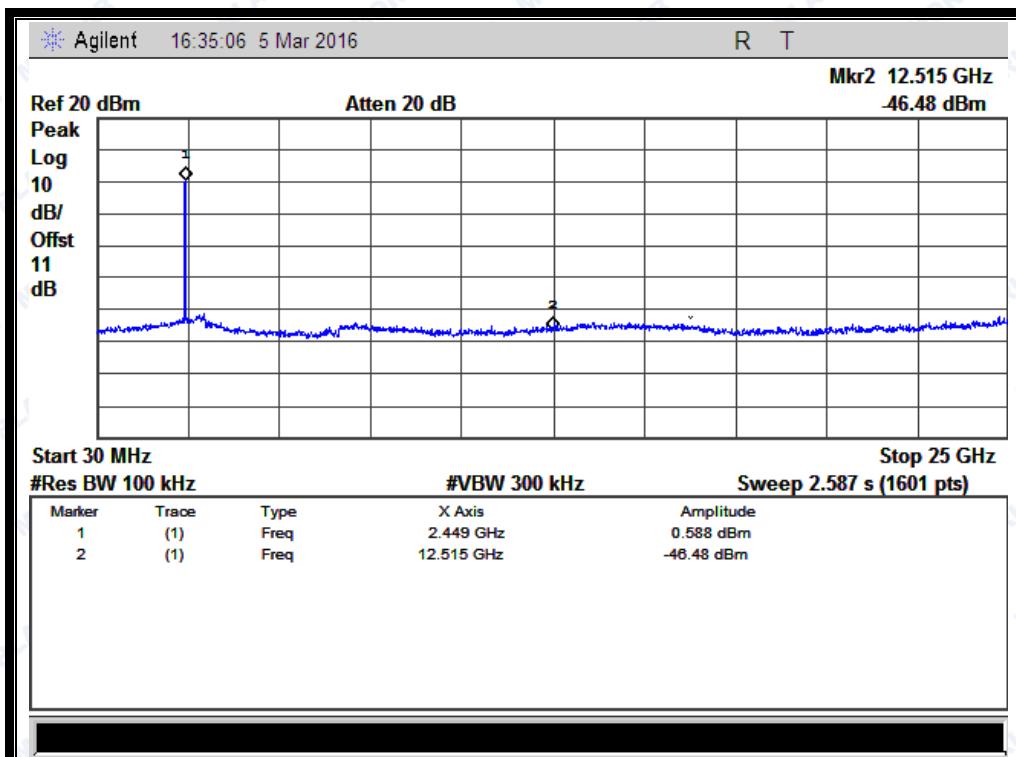
(Channel = 1, 30MHz to 25GHz)



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(Band Edge @ Channel = 1)



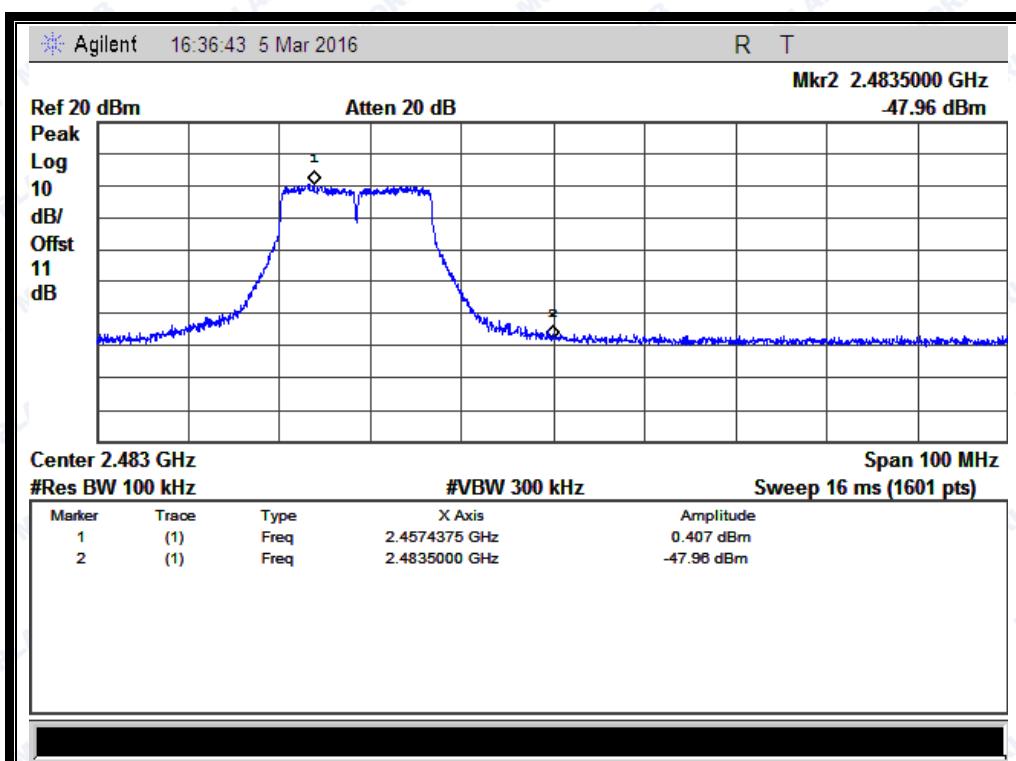
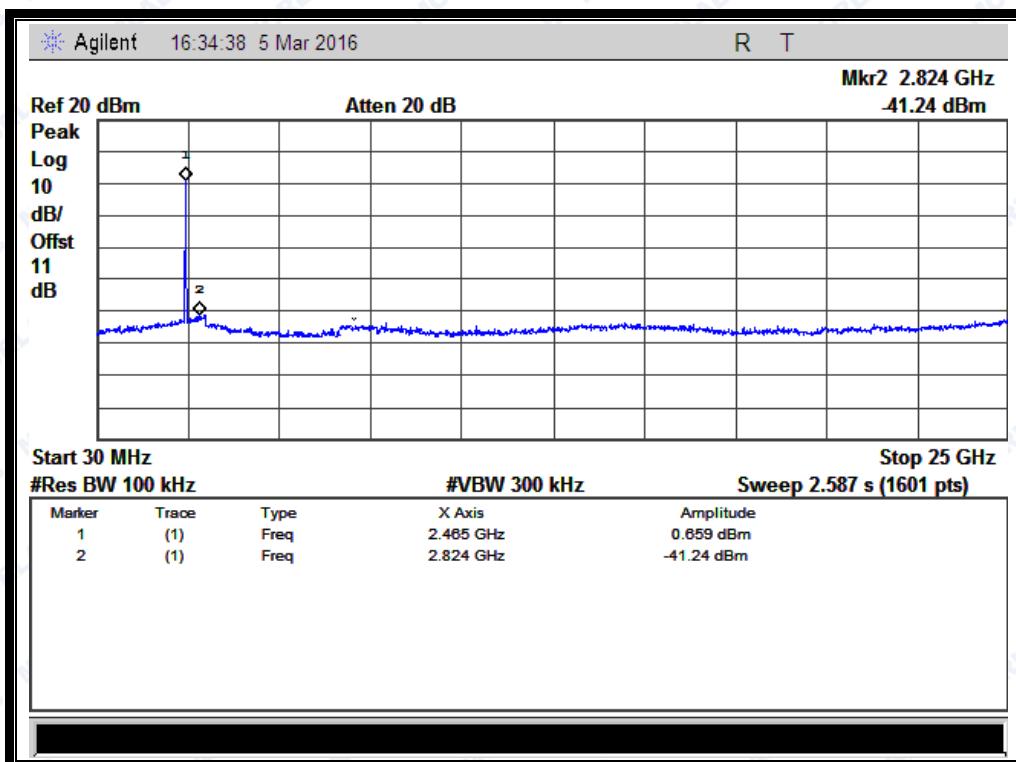
(Channel = 6, 30MHz to 25GHz)

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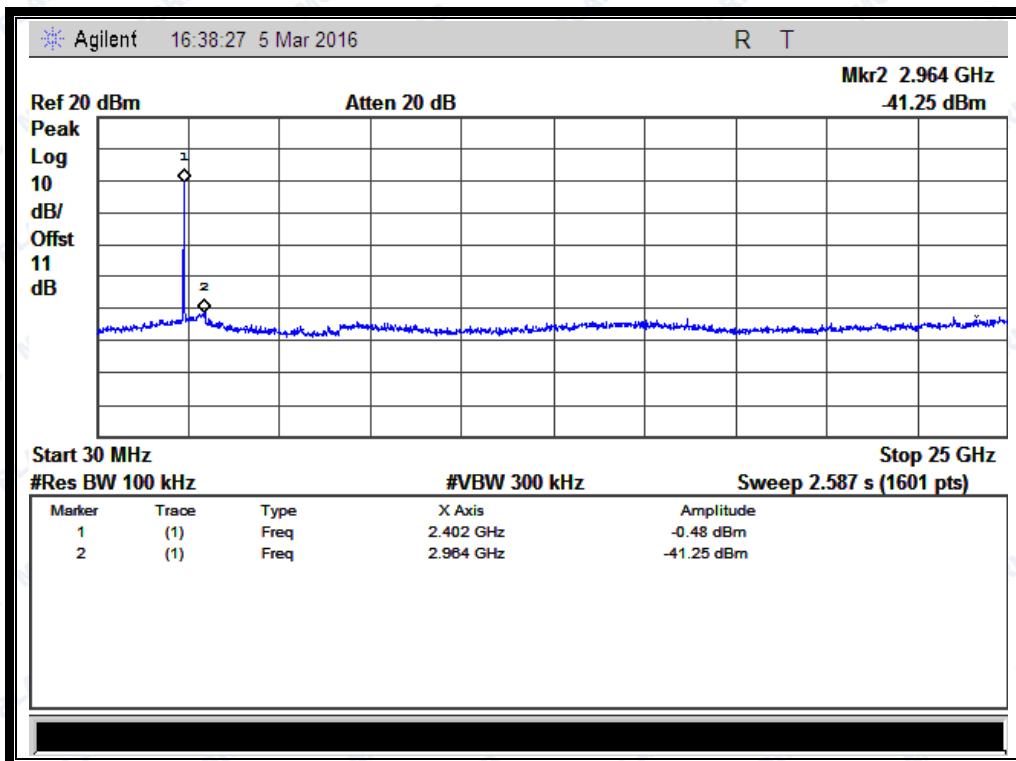
### 2.4.3.3 802.11n -20MHz SISO Test mode (Antenna 3)

#### A. Test Verdict:

Channel	Frequency (MHz)	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
			Carrier Level	Calculated -20dBc Limit	
1	2412	-41.25	-0.48	-20.48	PASS
6	2437	-43.18	-0.97	-20.97	PASS
11	2462	-44.35	-0.624	-20.624	PASS

#### B. Test Plots:

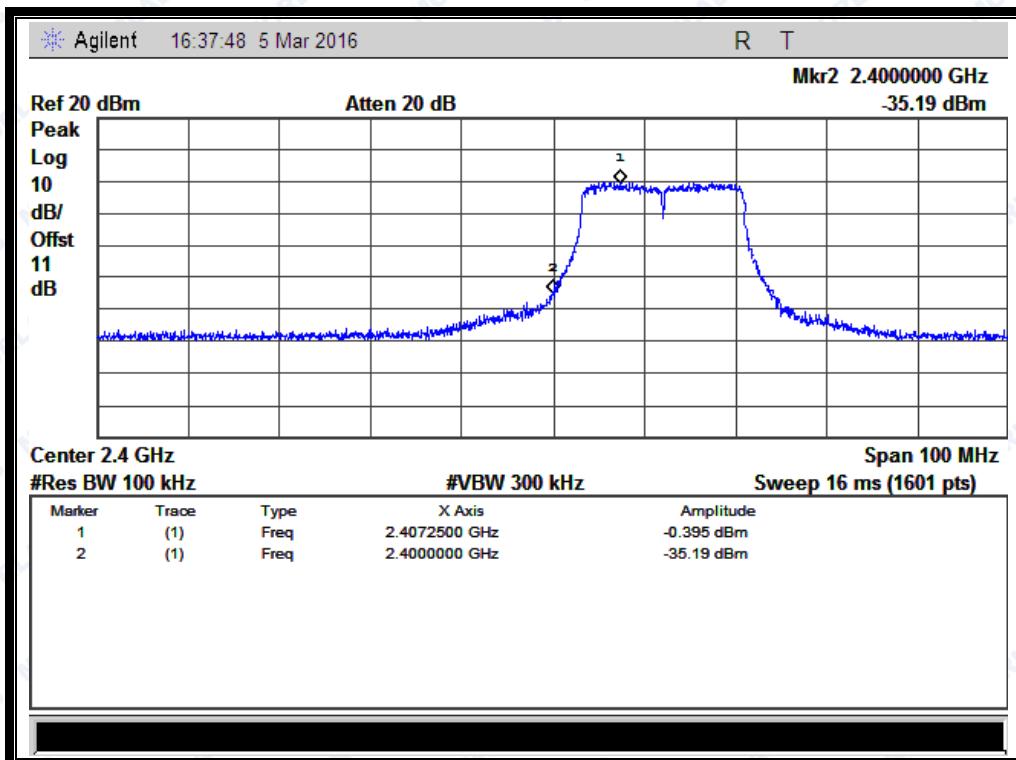
Note: the power of the Module transmitting frequency should be ignored.



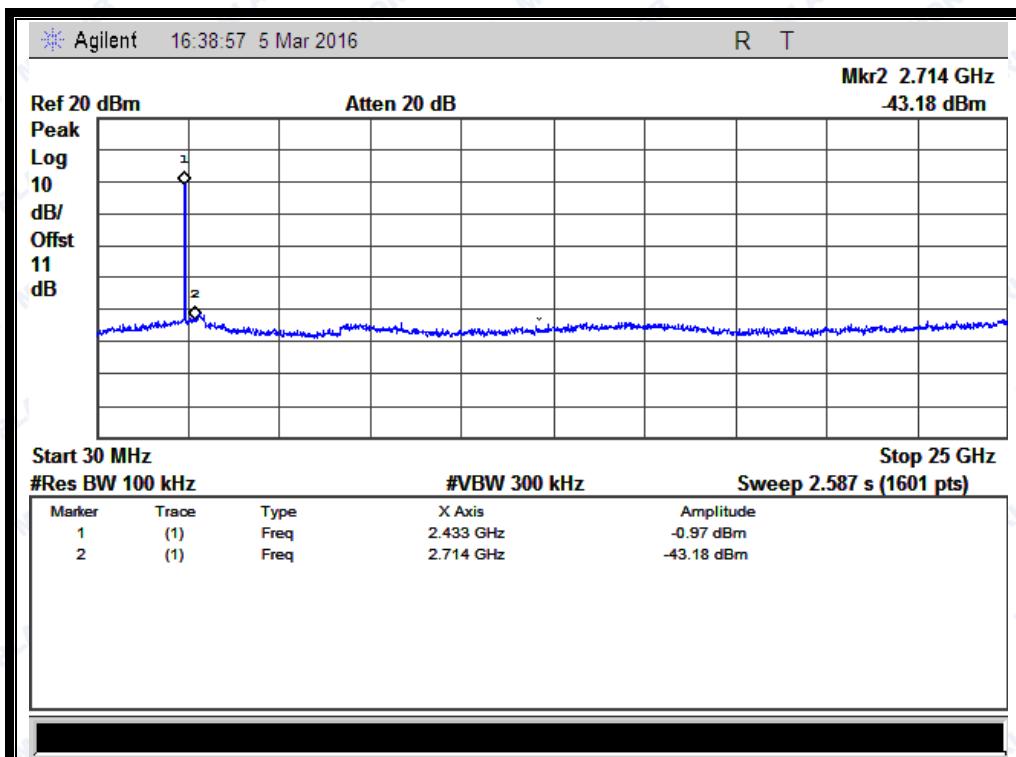
(Channel = 1, 30MHz to 25GHz)



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(Band Edge @ Channel = 1)



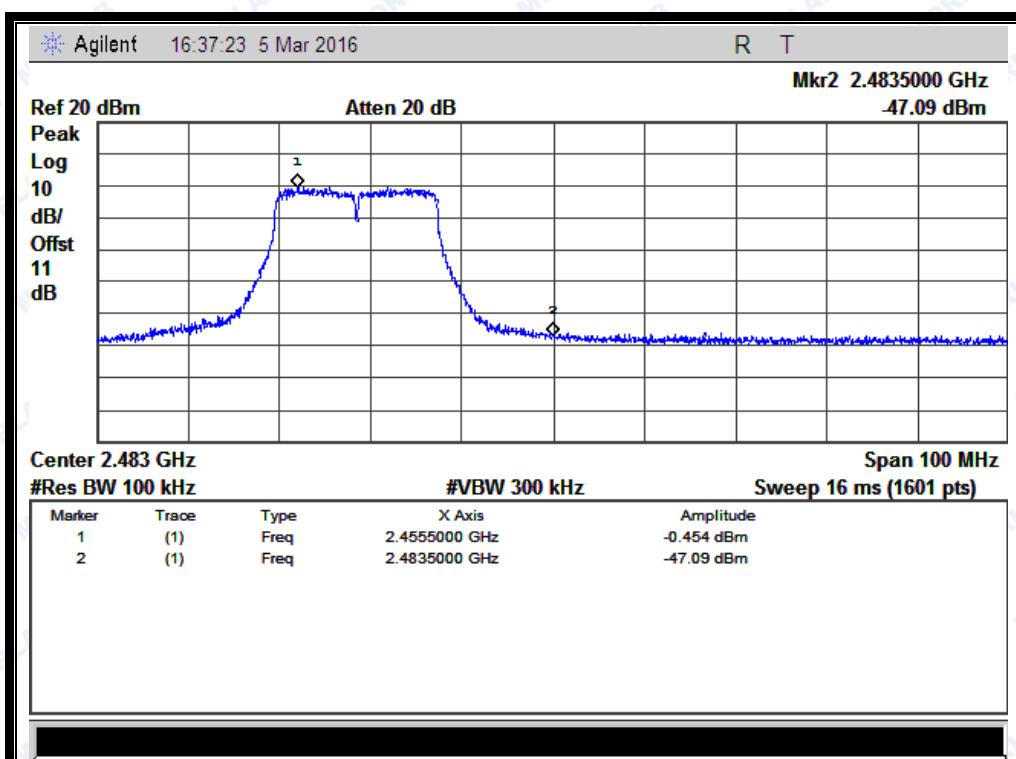
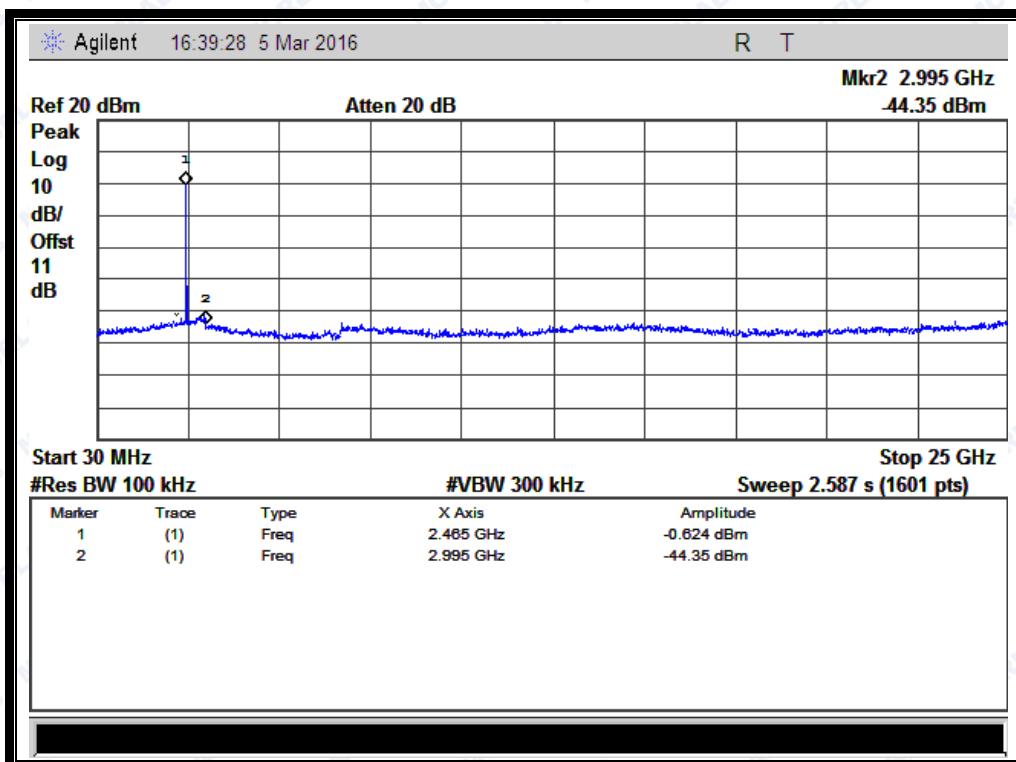
(Channel = 6, 30MHz to 25GHz)

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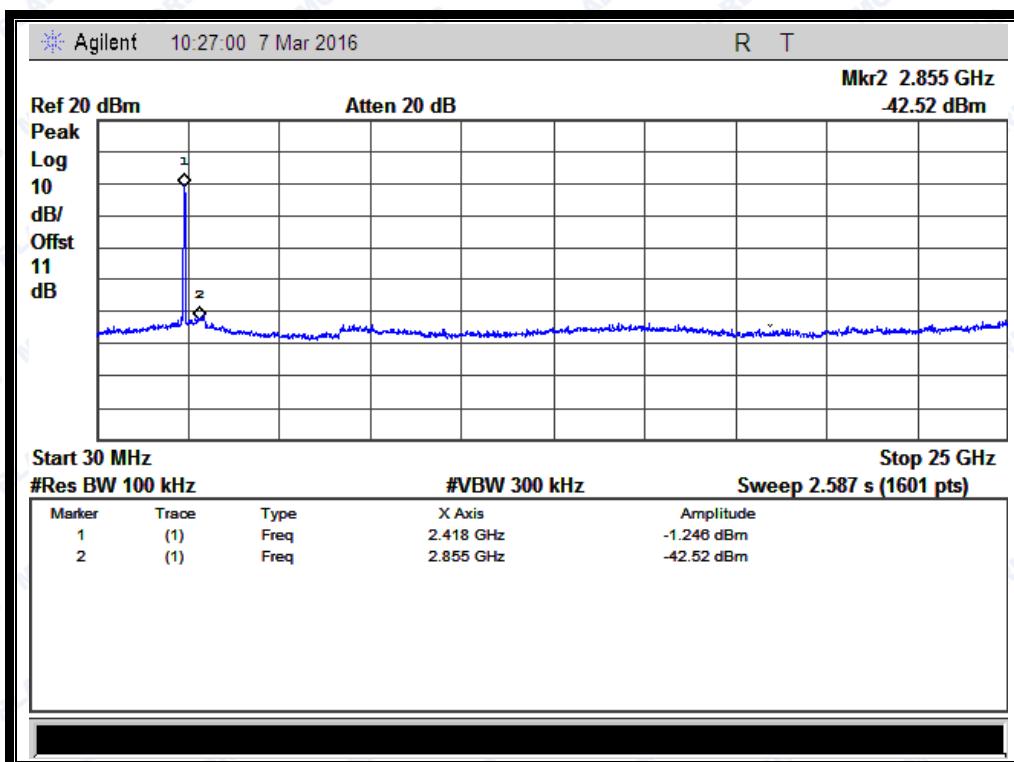
#### 2.4.3.4 802.11n -40MHz SISO Test mode (Antenna 3)

##### A. Test Verdict:

Channel	Frequency (MHz)	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
			Carrier Level	Calculated -20dBc Limit	
3	2422	-42.52	-1.246	-21.246	PASS
6	2437	-42.17	-0.286	-20.286	PASS
9	2452	-42.15	-1.313	-21.313	PASS

##### B. Test Plots:

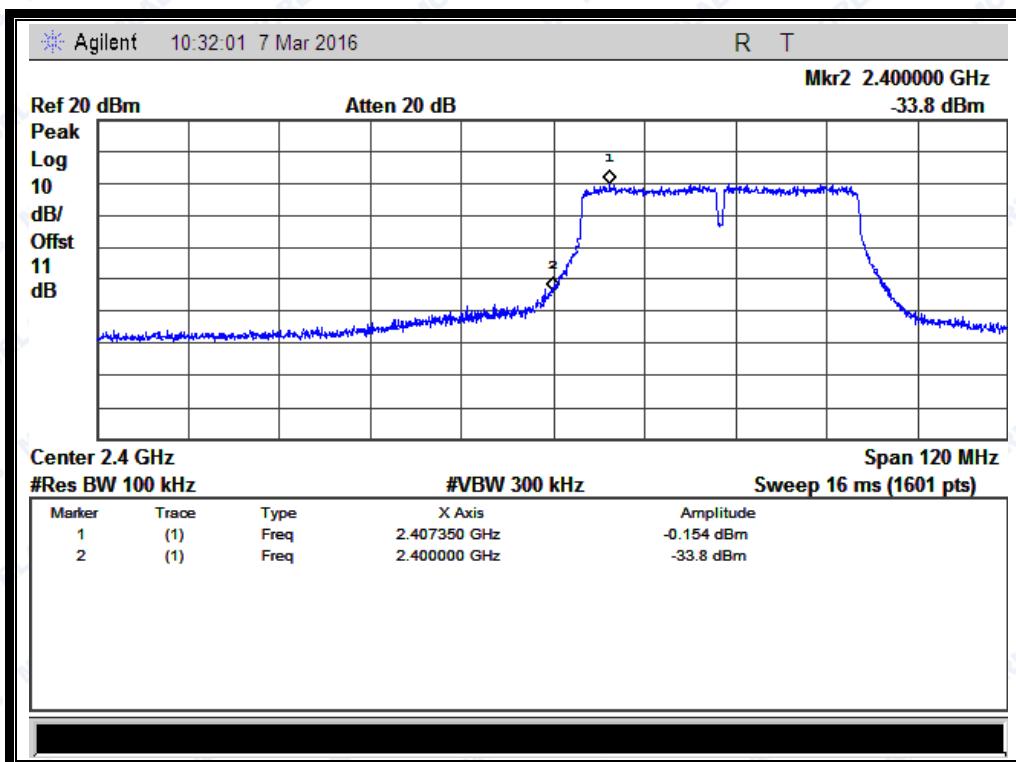
Note: the power of the Module transmitting frequency should be ignored.



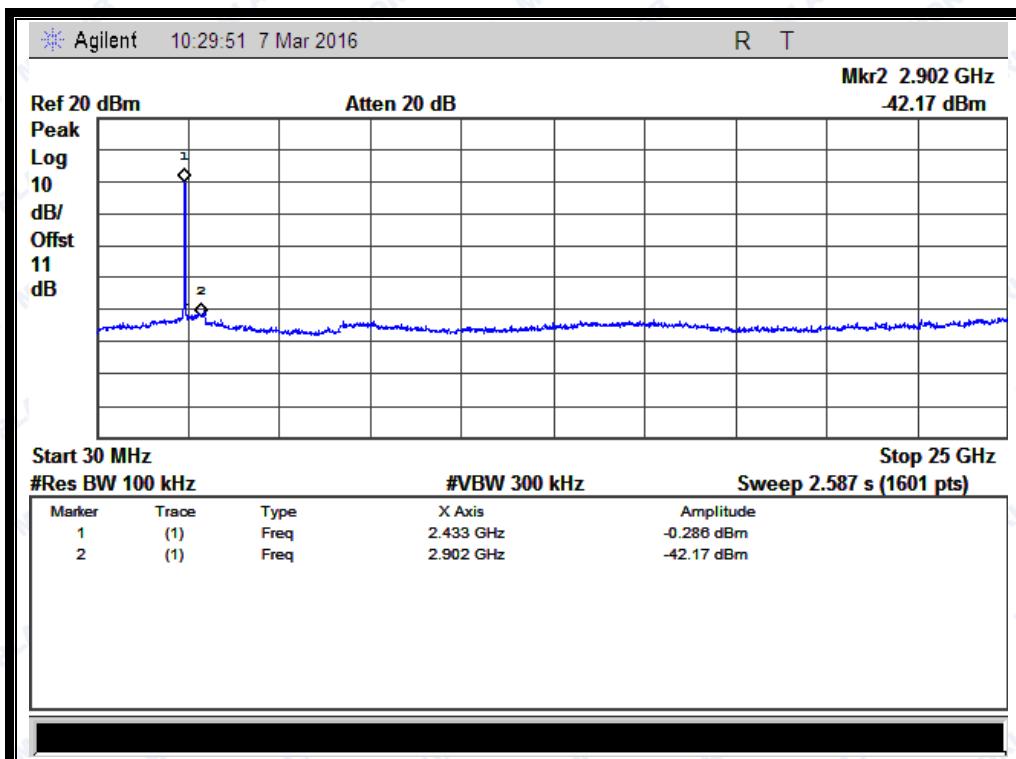
(Channel = 3, 30MHz to 25GHz)



REPORT No.: SZ16020033W01



(Band Edge @ Channel = 3)



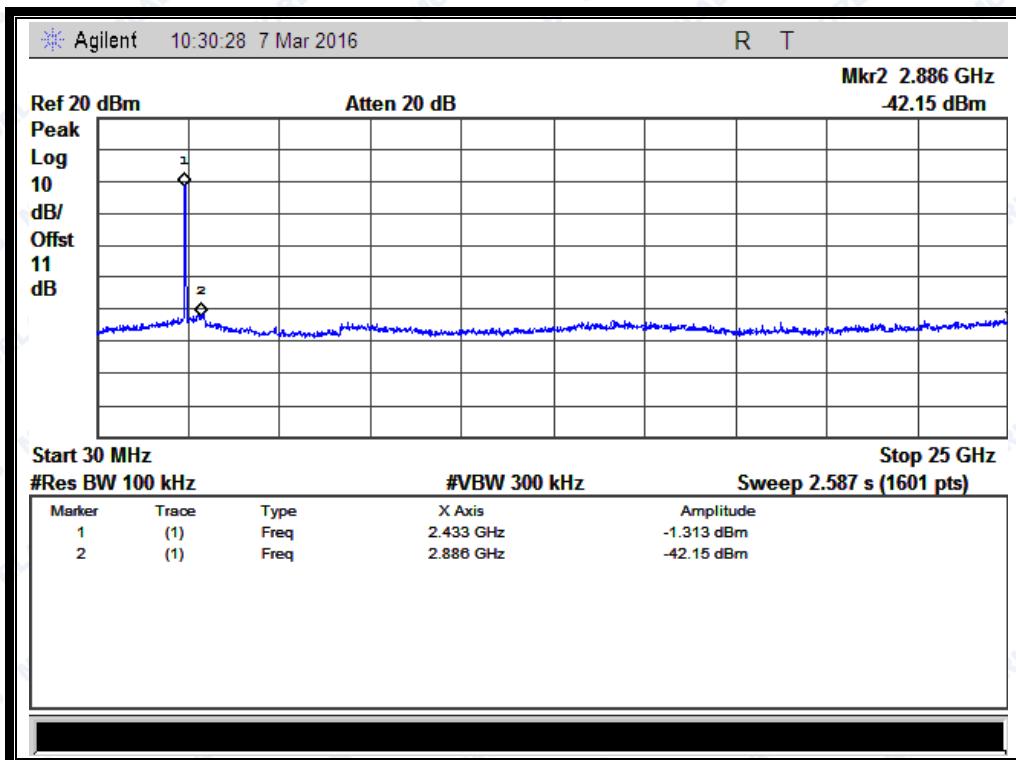
(Channel = 6, 30MHz to 25GHz)

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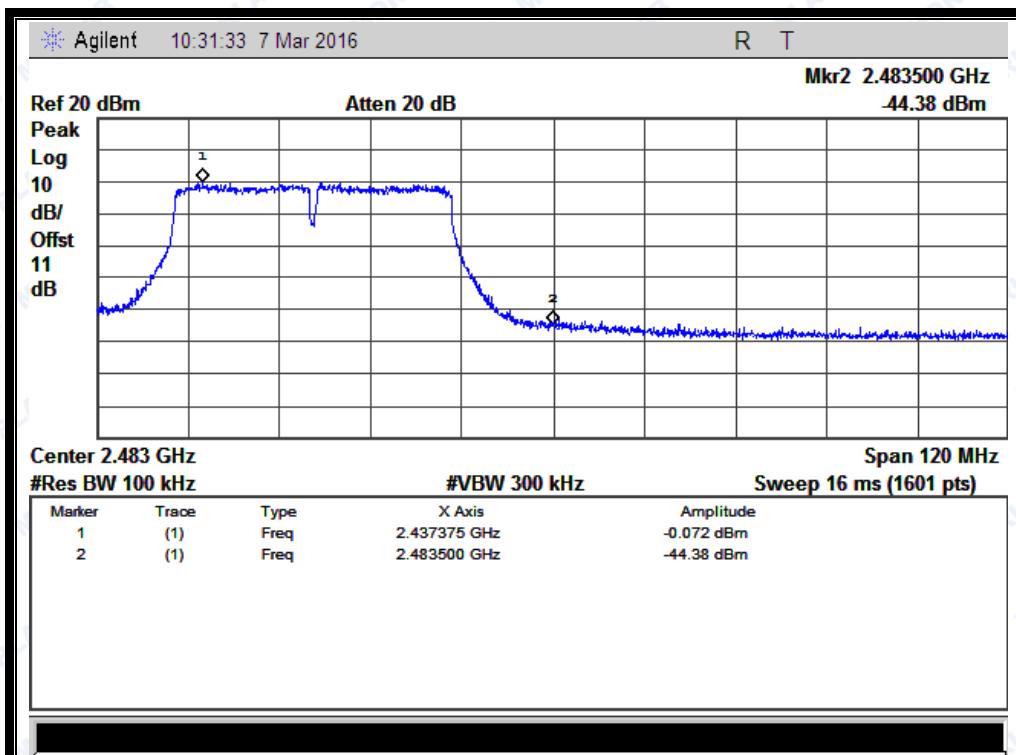
FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road,  
Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. ChinaTel: 86-755-36698555  
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REPORT No.: SZ16020033W01



(Channel = 9, 30MHz to 25GHz)



(Band Edge @ Channel = 9)



## 2.5 Power spectral density (PSD)

### 2.5.1 Requirement

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

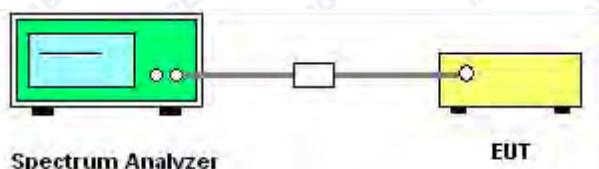
### 2.5.2 Test Description

#### A. Test procedure

The measured power spectral density was calculated by the reading of the spectrum analyzer and calibration. Following is the test procedure for PSD test:

- a) Set analyzer center frequency to channel center frequency.
- b) Set the span to 3MHz
- c) Set the RBW to 3 kHz
- d) Set the VBW to 10KHz
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum amplitude level within the RBW.

#### B. Test Set:



The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

KDB 558074 Section 10.2 was used in order to prove compliance.

#### C. Equipments List:

Please reference ANNEX A(1.5).



### 2.5.3 Test Result

#### 2.5.3.1 802.11b Test mode

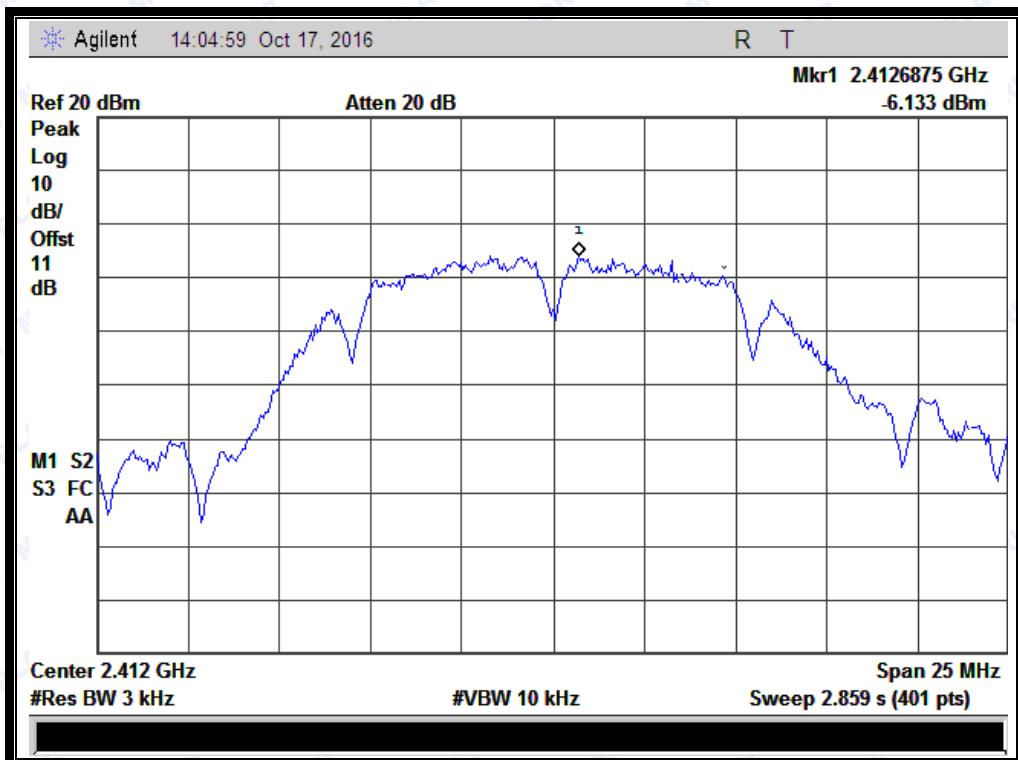
Antenna 1:

##### A. Test Verdict:

Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-6.133	8	PASS
6	2437	-6.275	8	PASS
11	2462	-5.695	8	PASS

Measurement uncertainty:  $\pm 1.3\text{dB}$

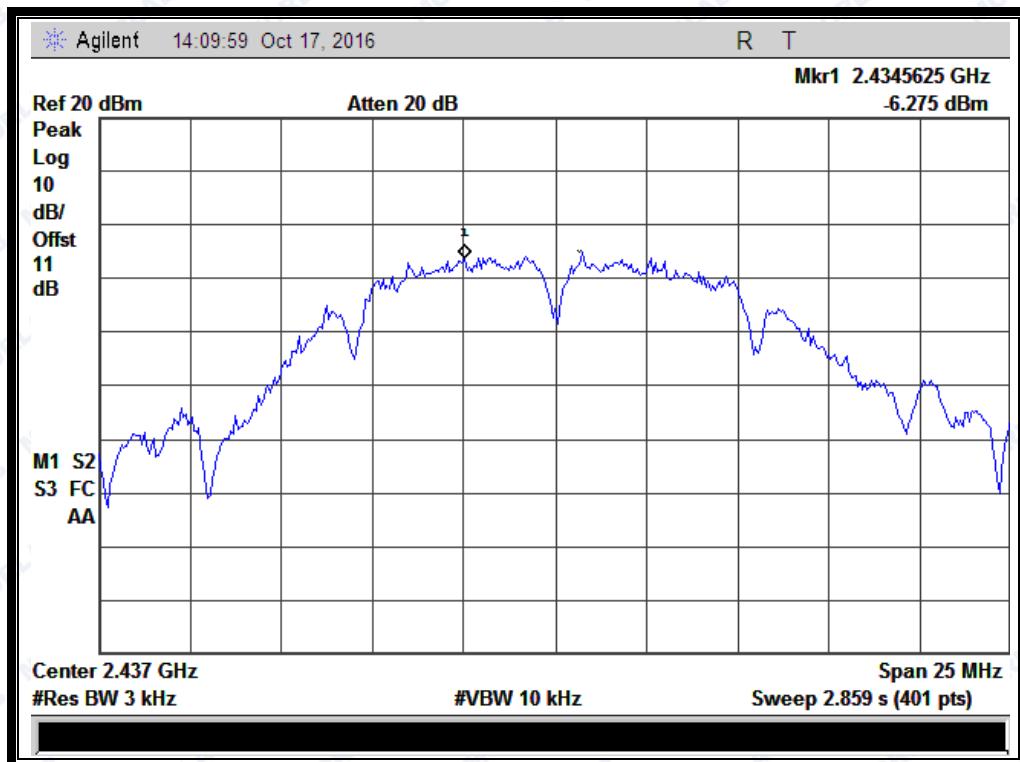
##### B. Test Plots:



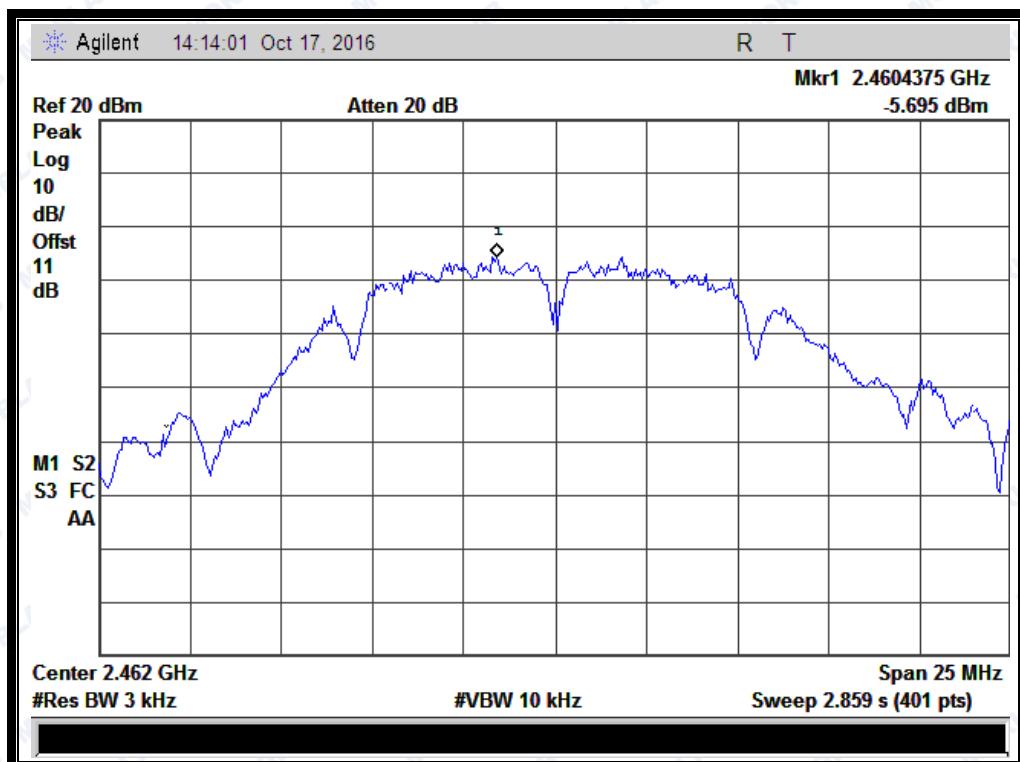
(Channel = 1 @ 802.11b)



REPORT No.: SZ16020033W01



(Channel = 6 @ 802.11b)



(Channel = 11 @ 802.11b)

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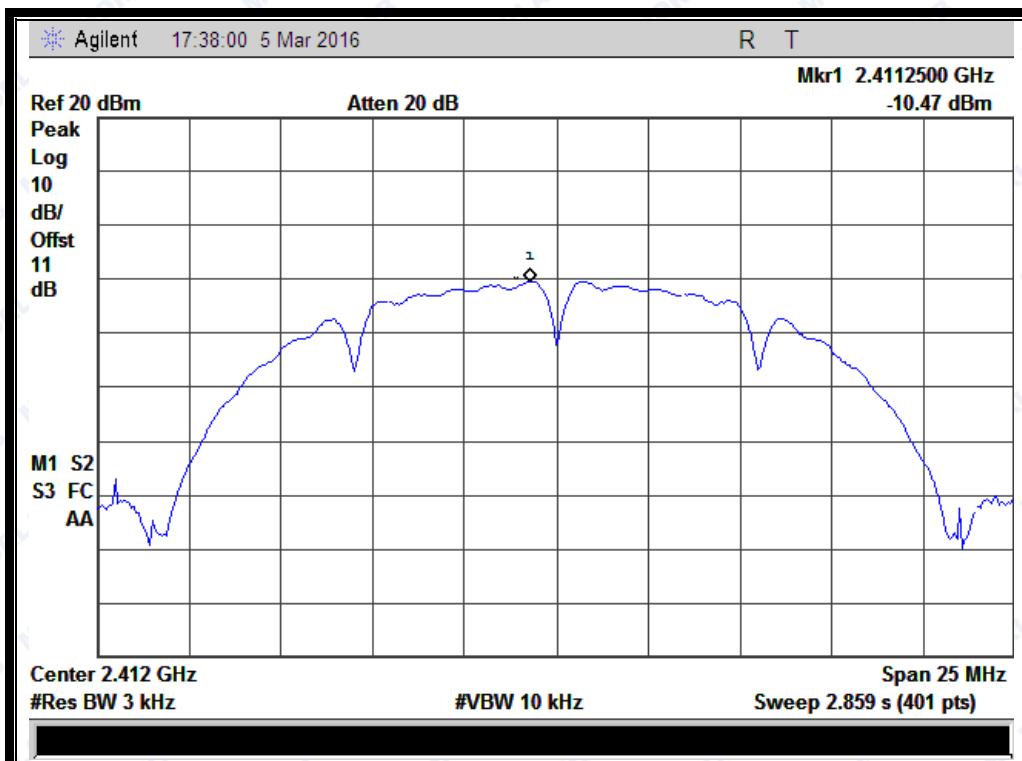
Fax: 86-755-36698525  
E-mail: service@morlab.cn



REPORT No.: SZ16020033W01

**Antenna 2:****A. Test Verdict:**

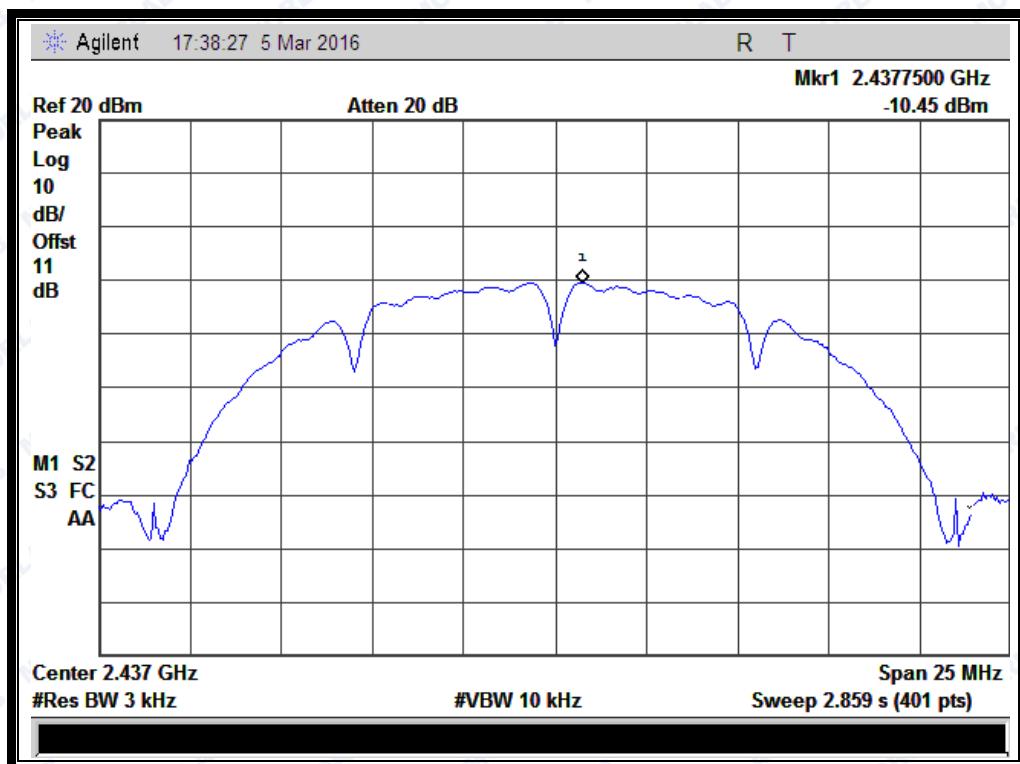
Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-10.47	8	PASS
6	2437	-10.45	8	PASS
11	2462	-10.37	8	PASS

Measurement uncertainty:  $\pm 1.3\text{dB}$ **B. Test Plots:**

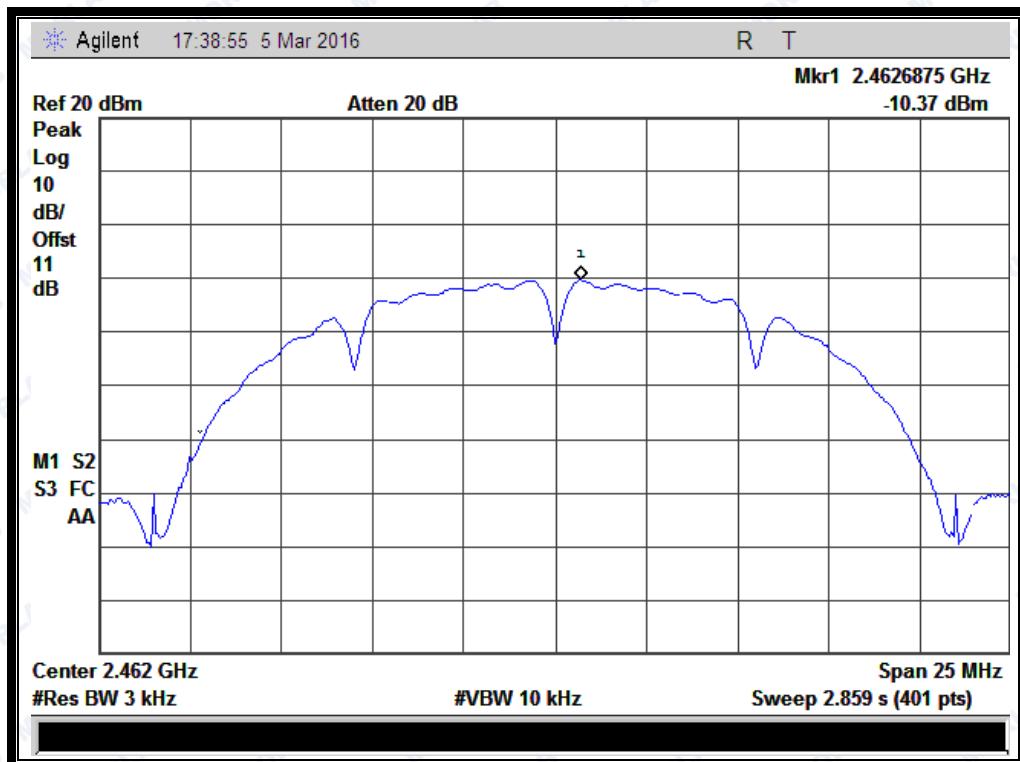
(Channel = 1 @ 802.11b)



REPORT No.: SZ16020033W01



(Channel = 6 @ 802.11b)



(Channel = 11 @ 802.11b)

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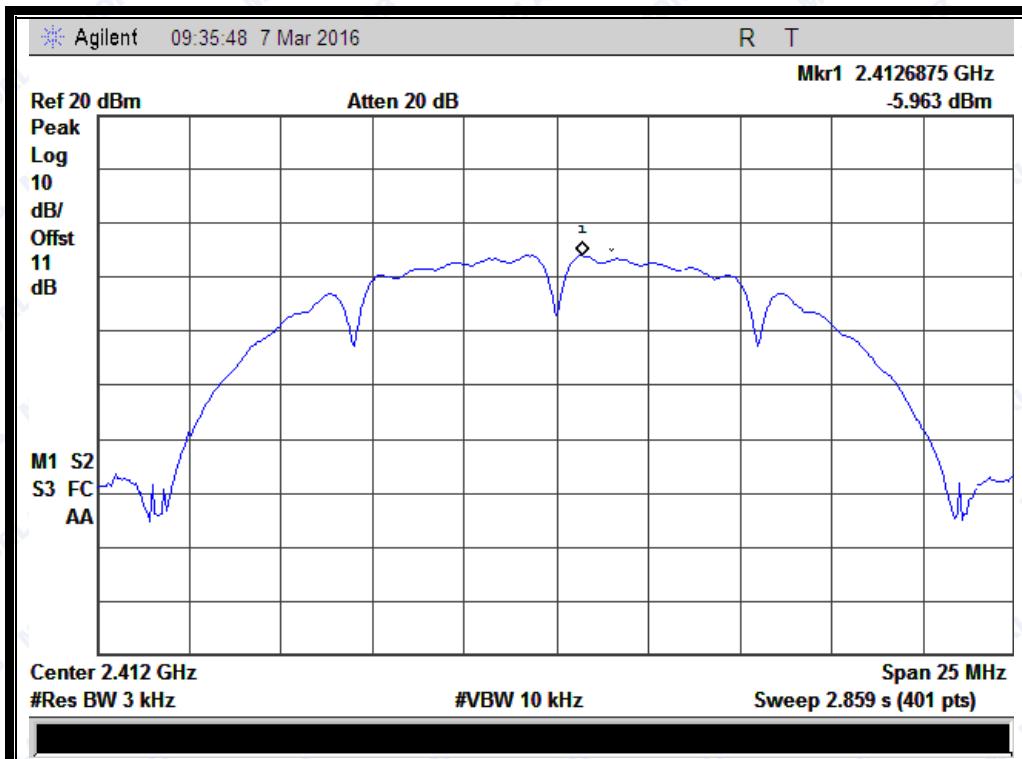
Fax: 86-755-36698525  
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REPORT No.: SZ16020033W01

**Antenna 3:****A. Test Verdict:**

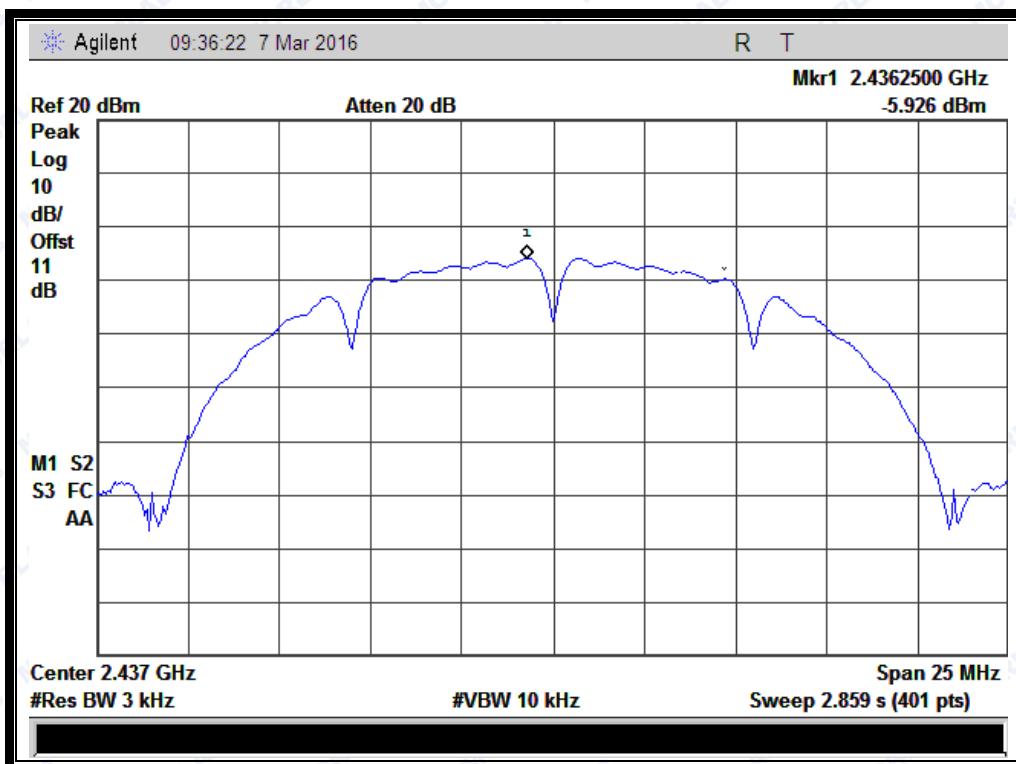
Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-5.963	8	PASS
6	2437	-5.926	8	PASS
11	2462	-6.171	8	PASS

Measurement uncertainty:  $\pm 1.3\text{dB}$ **B. Test Plots:**

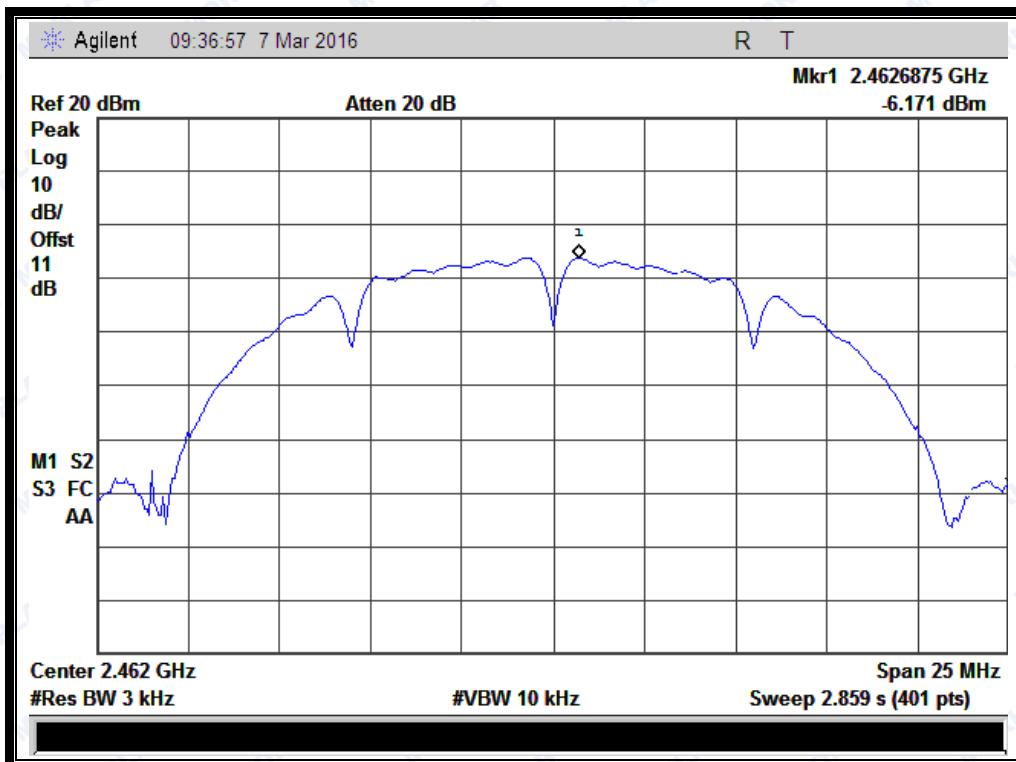
(Channel = 1 @ 802.11b)



REPORT No.: SZ16020033W01



(Channel = 6 @ 802.11b)



(Channel = 11 @ 802.11b)

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### 2.5.3.2 802.11g Test mode

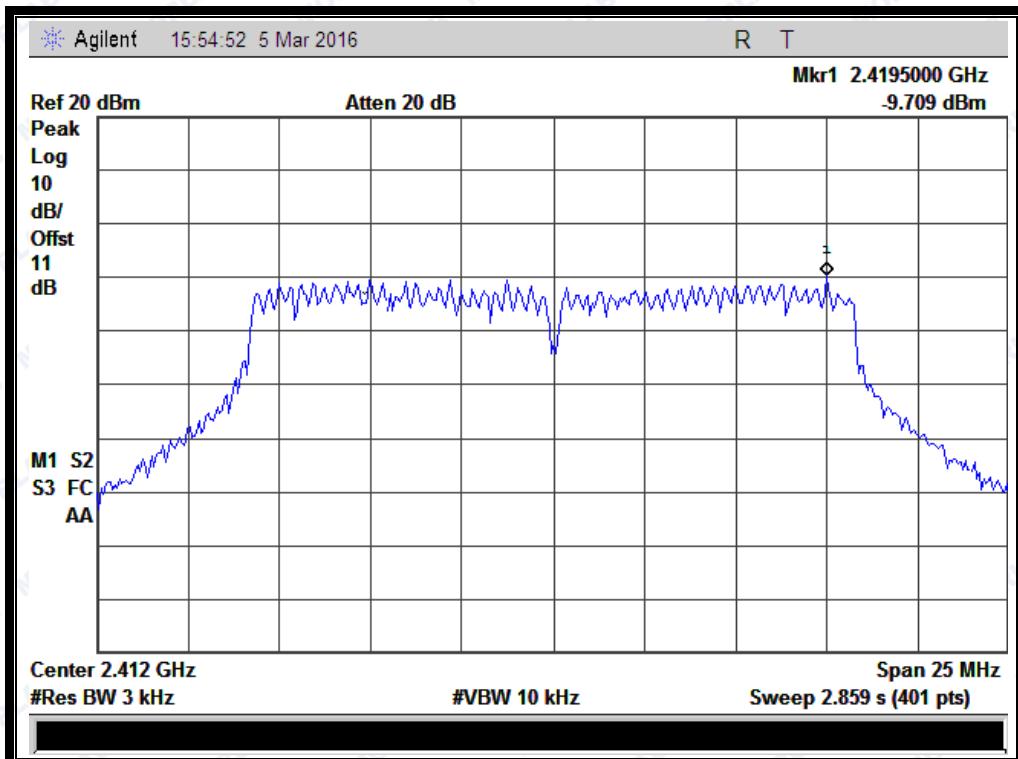
#### Antenna 1:

##### A. Test Verdict:

Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-9.709	8	PASS
6	2437	-8.755	8	PASS
11	2462	-10.94	8	PASS

Measurement uncertainty: ±1.3dB

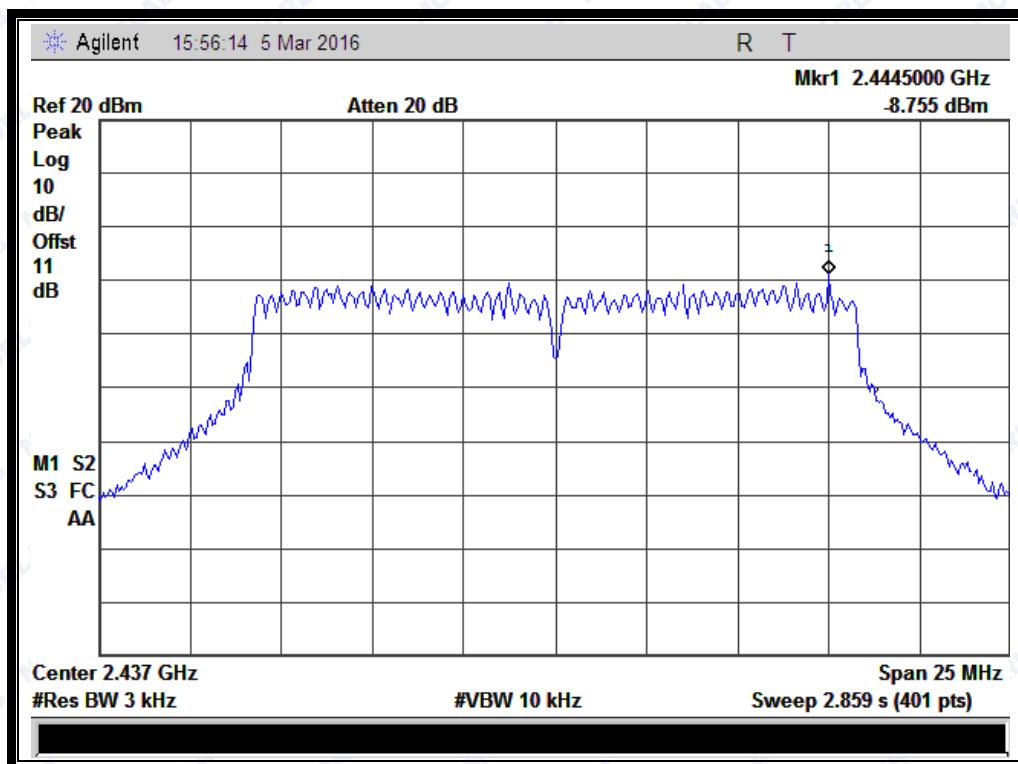
##### B. Test Plots:



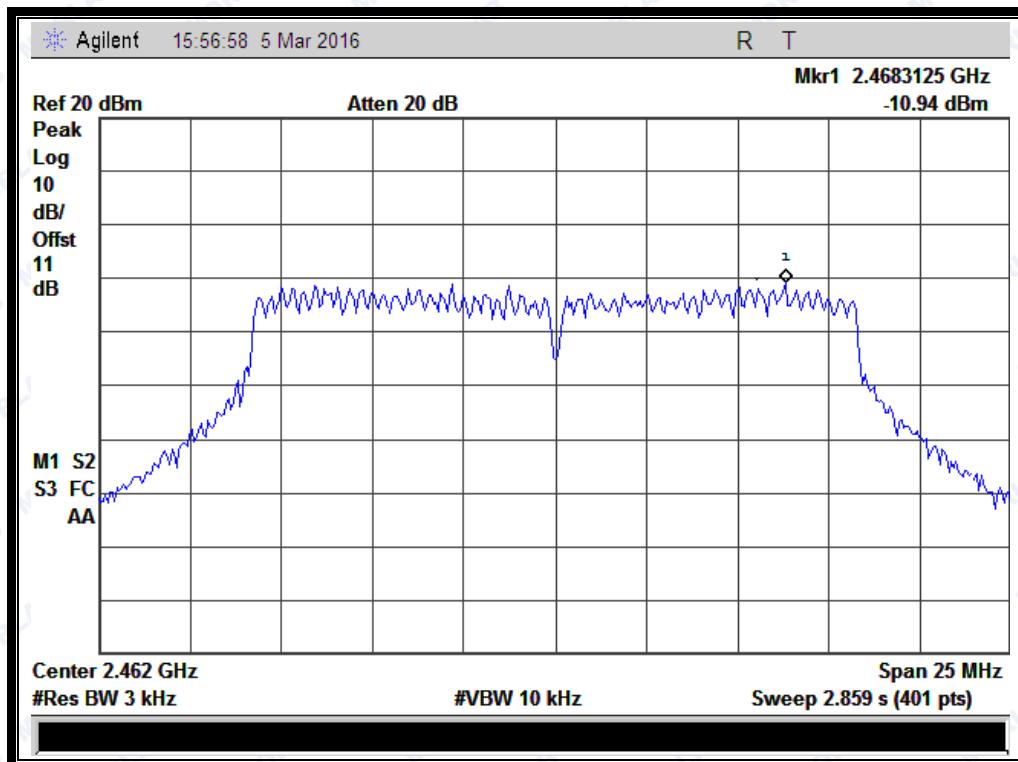
(Channel = 1 @ 802.11g)



REPORT No.: SZ16020033W01



(Channel = 6 @ 802.11g)



(Channel = 11 @ 802.11g)

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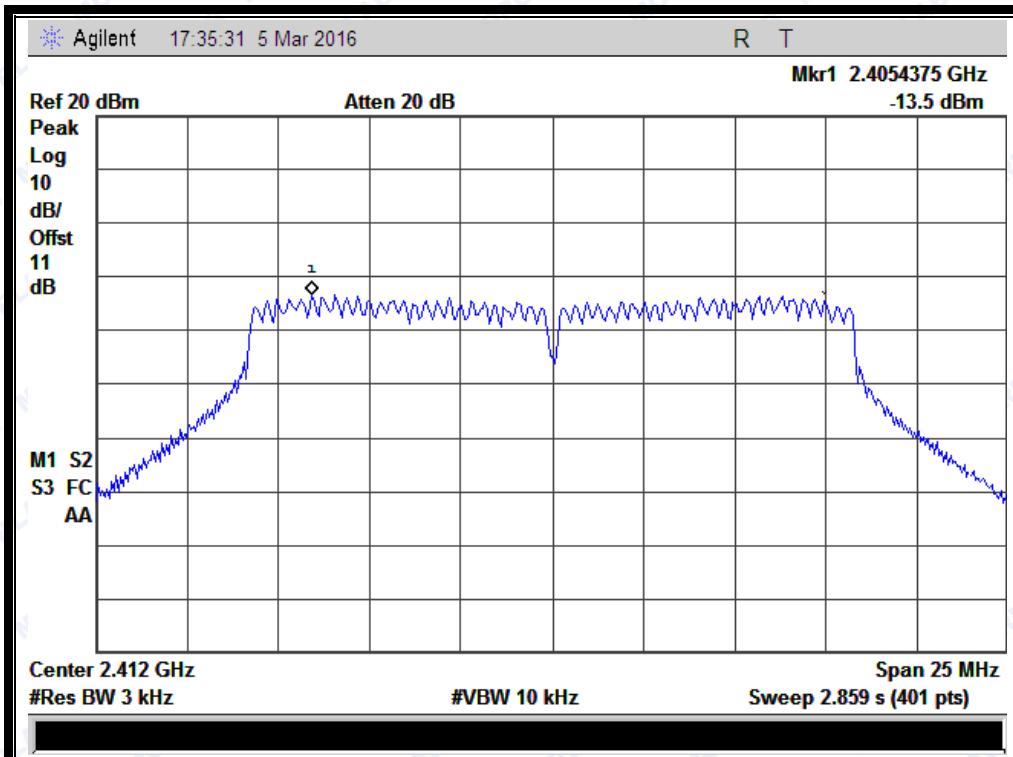


REPORT No.: SZ16020033W01

**Antenna 2:****A. Test Verdict:**

Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-13.5	8	PASS
6	2437	-13.49	8	PASS
11	2462	-13.31	8	PASS

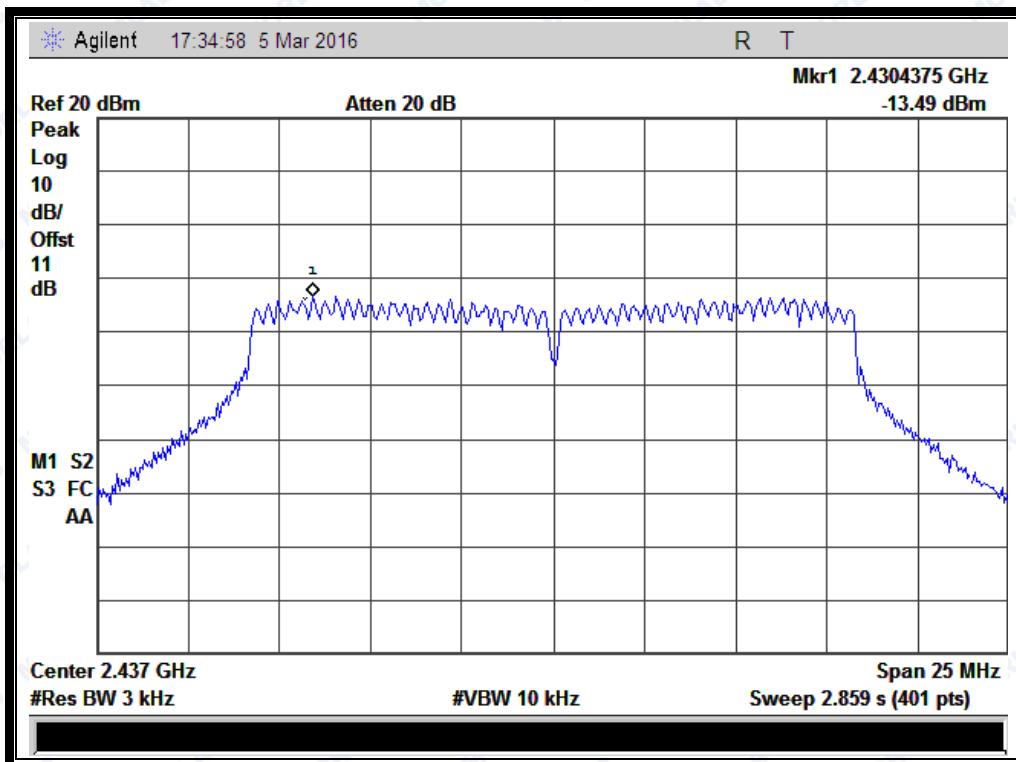
Measurement uncertainty: ±1.3dB

**B. Test Plots:**

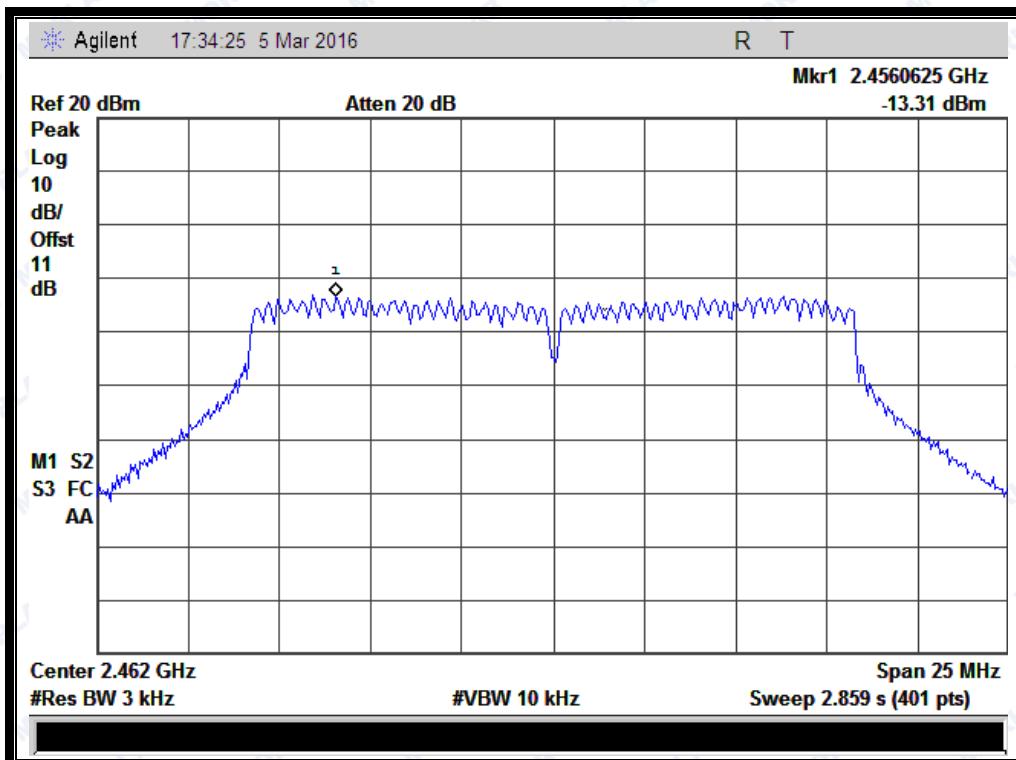
(Channel = 1 @ 802.11g)



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(Channel = 6 @ 802.11g)



(Channel = 11 @ 802.11g)

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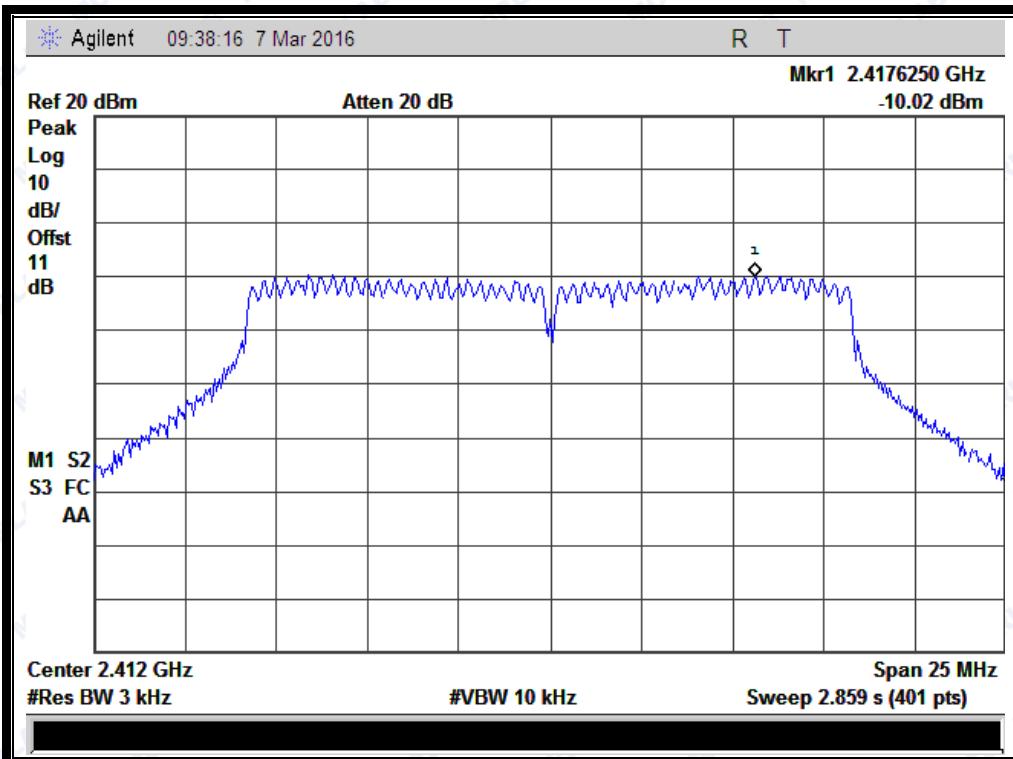


REPORT No.: SZ16020033W01

**Antenna 3:****A. Test Verdict:**

Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-10.02	8	PASS
6	2437	-9.312	8	PASS
11	2462	-9.771	8	PASS

Measurement uncertainty: ±1.3dB

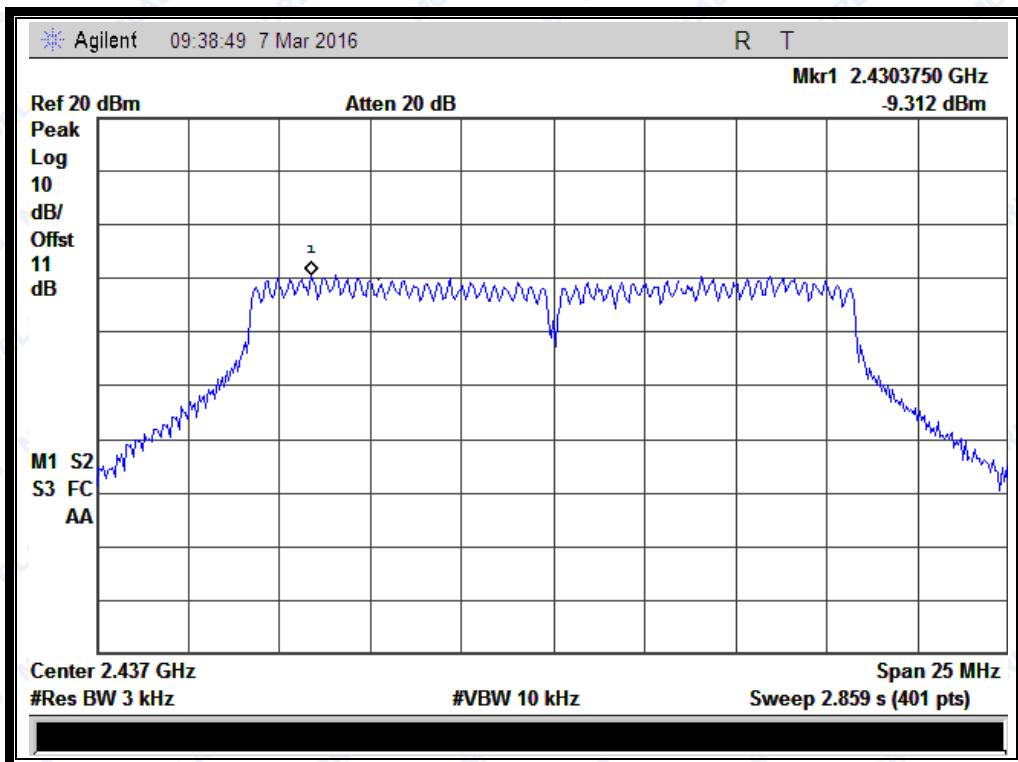
**B. Test Plots:**

(Channel = 1 @ 802.11g)

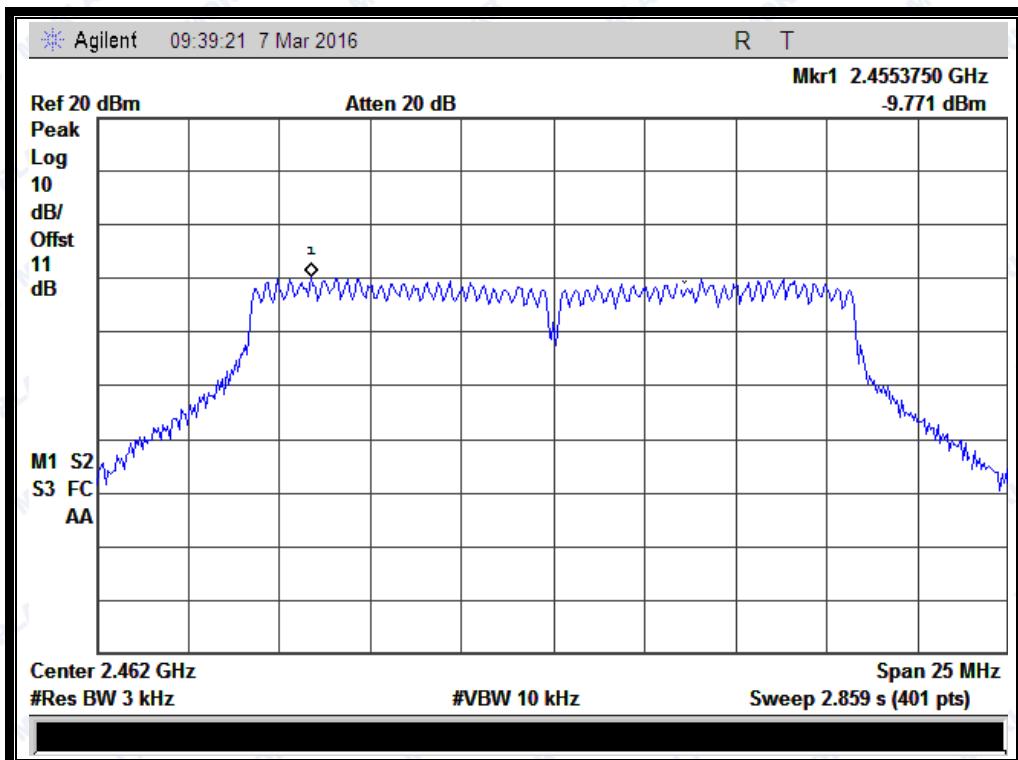
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(Channel = 6 @ 802.11g)



(Channel = 11 @ 802.11g)

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### 2.5.3.3 802.11n-20MHz Test mode

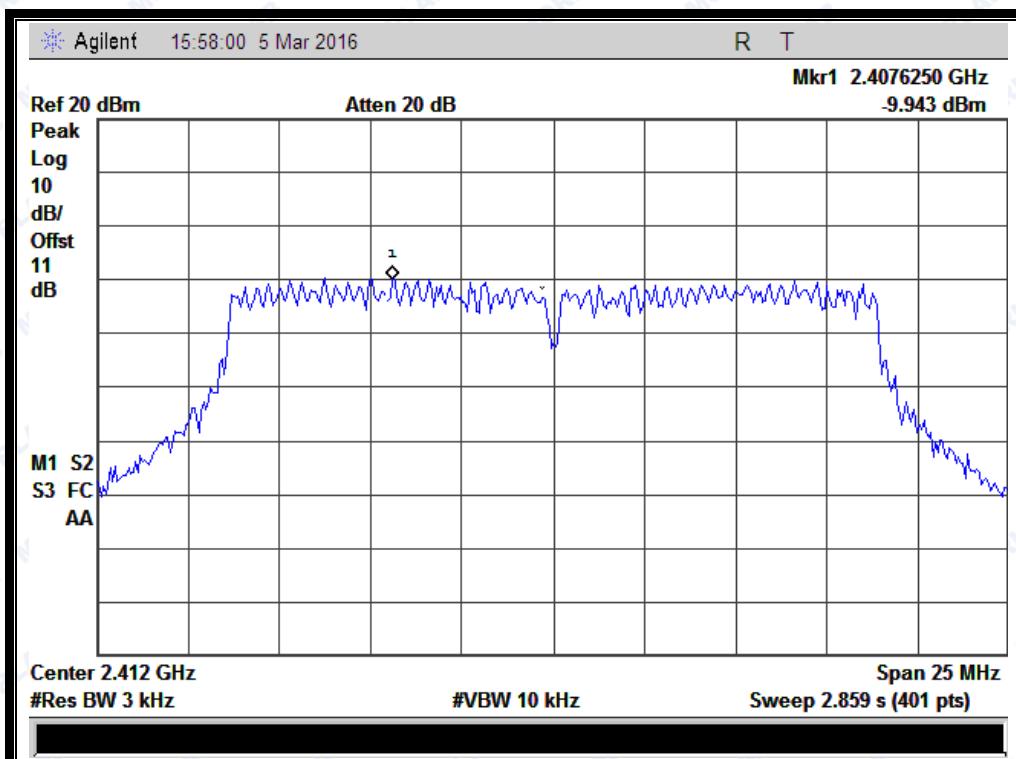
#### Antenna 1:

##### A. Test Verdict:

Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-9.943	8	PASS
6	2437	-10.66	8	PASS
11	2462	-11.32	8	PASS

Measurement uncertainty:  $\pm 1.3\text{dB}$

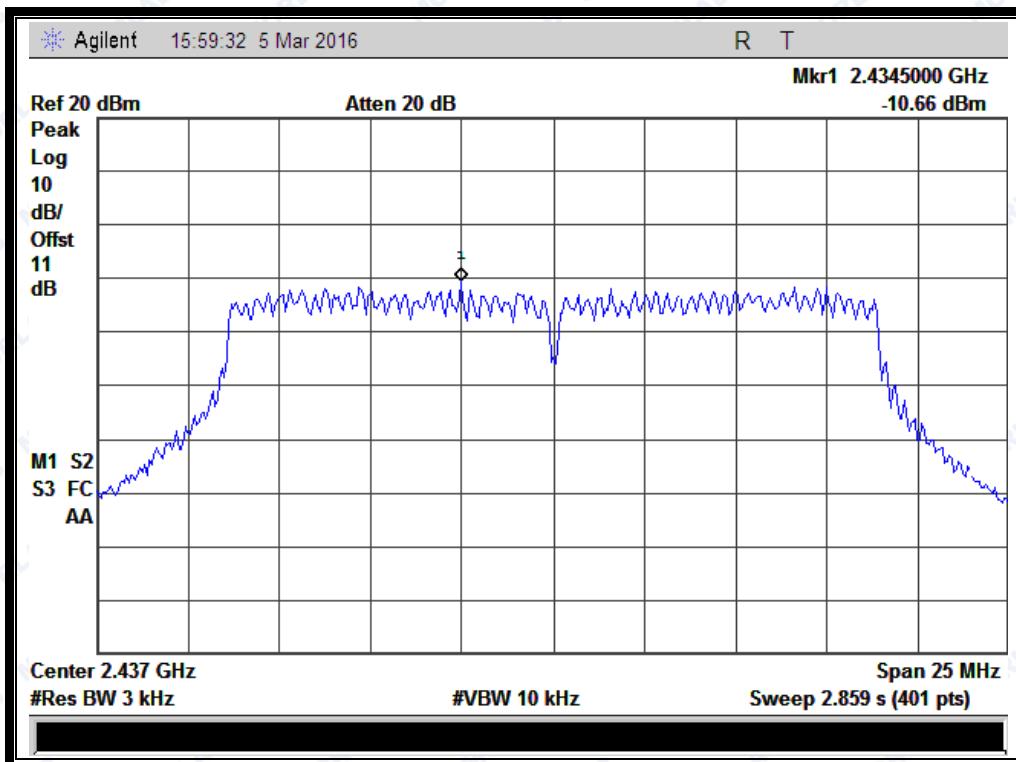
##### B. Test Plots:



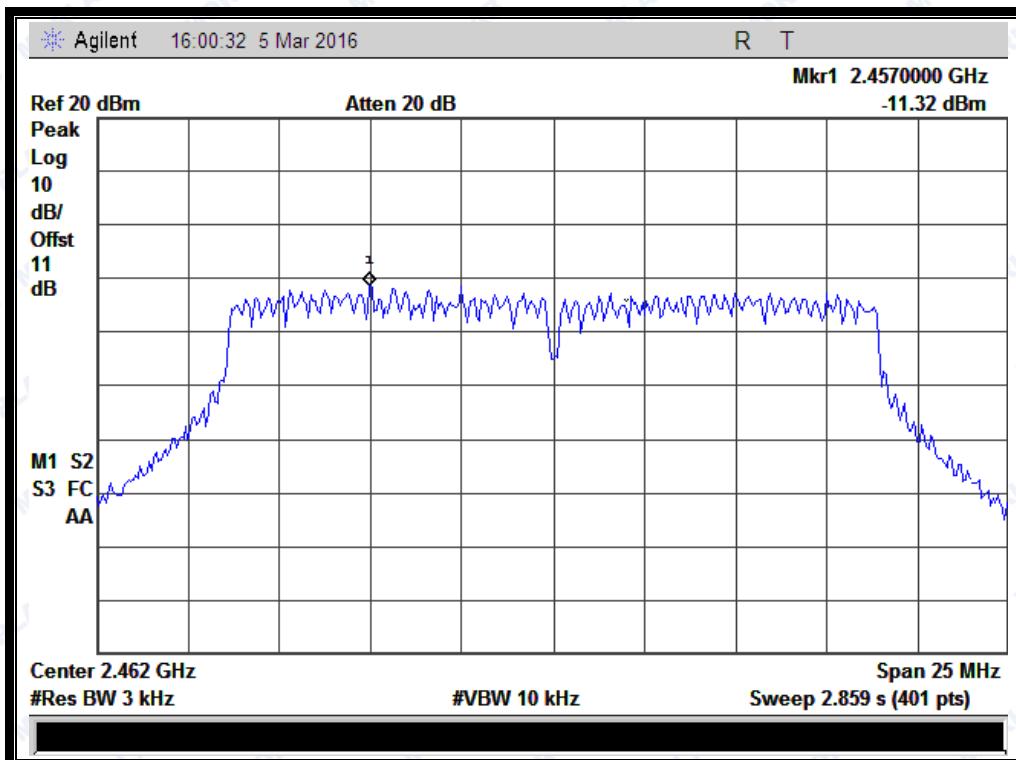
(Channel = 1 @ 802.11n-20MHz)



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(Channel = 6 @ 802.11n-20MHz)



(Channel = 11 @ 802.11n-20MHz)

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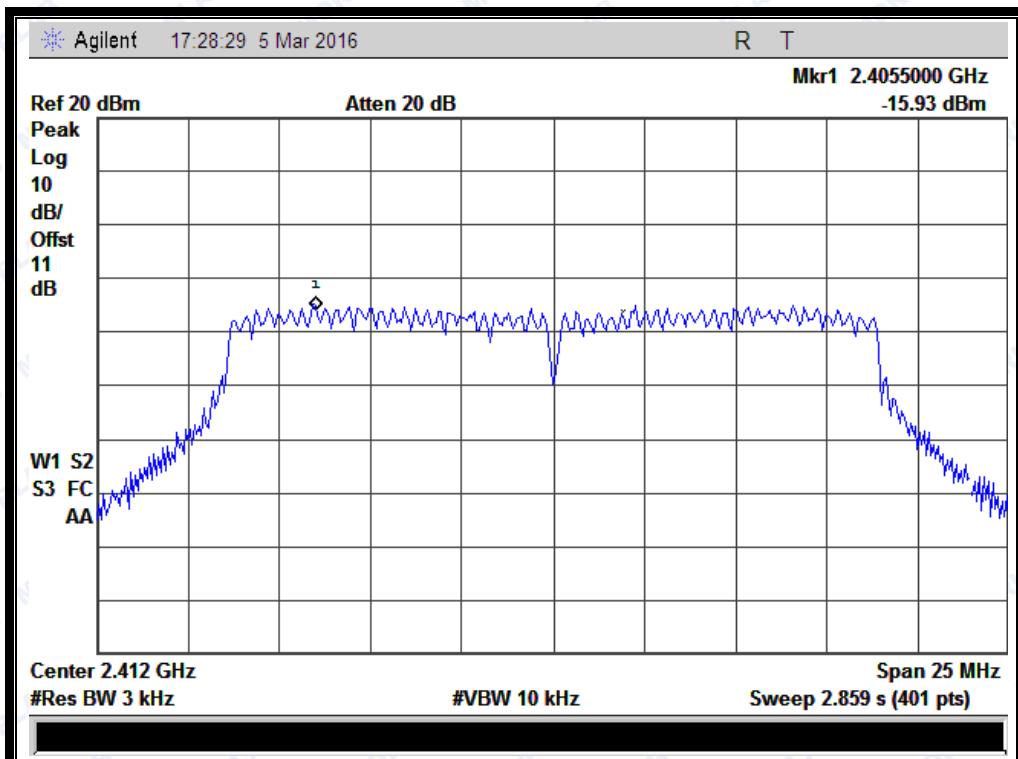


REPORT No.: SZ16020033W01

**Antenna 2:****A. Test Verdict:**

Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-15.93	8	PASS
6	2437	-15.44	8	PASS
11	2462	-14.22	8	PASS

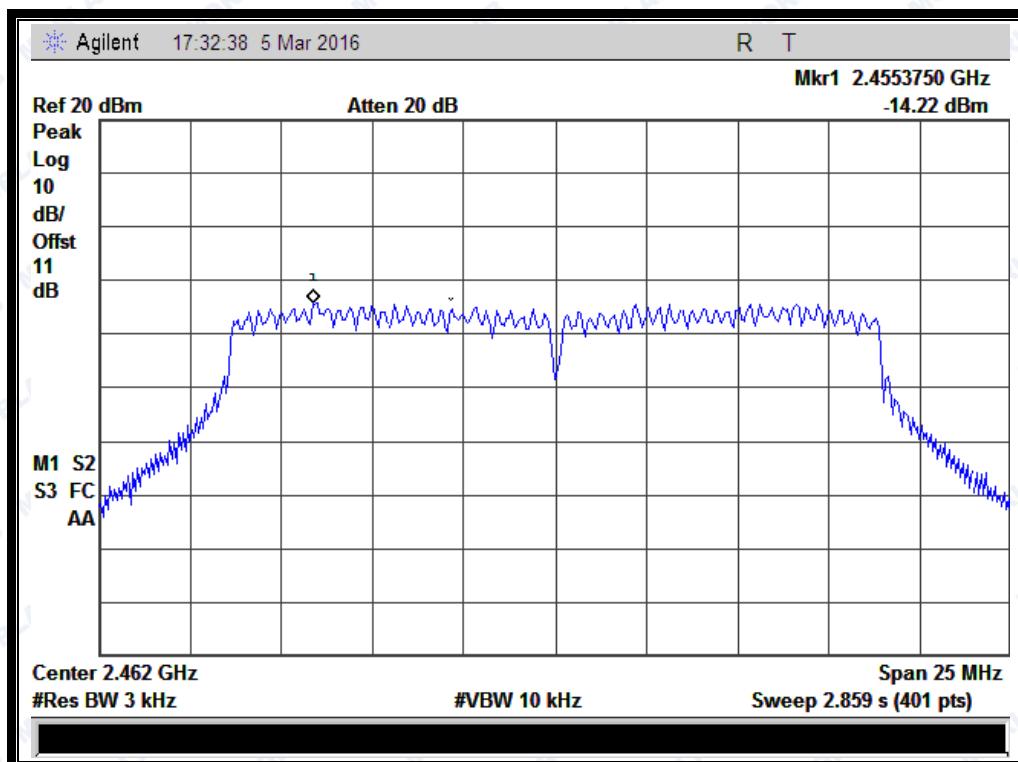
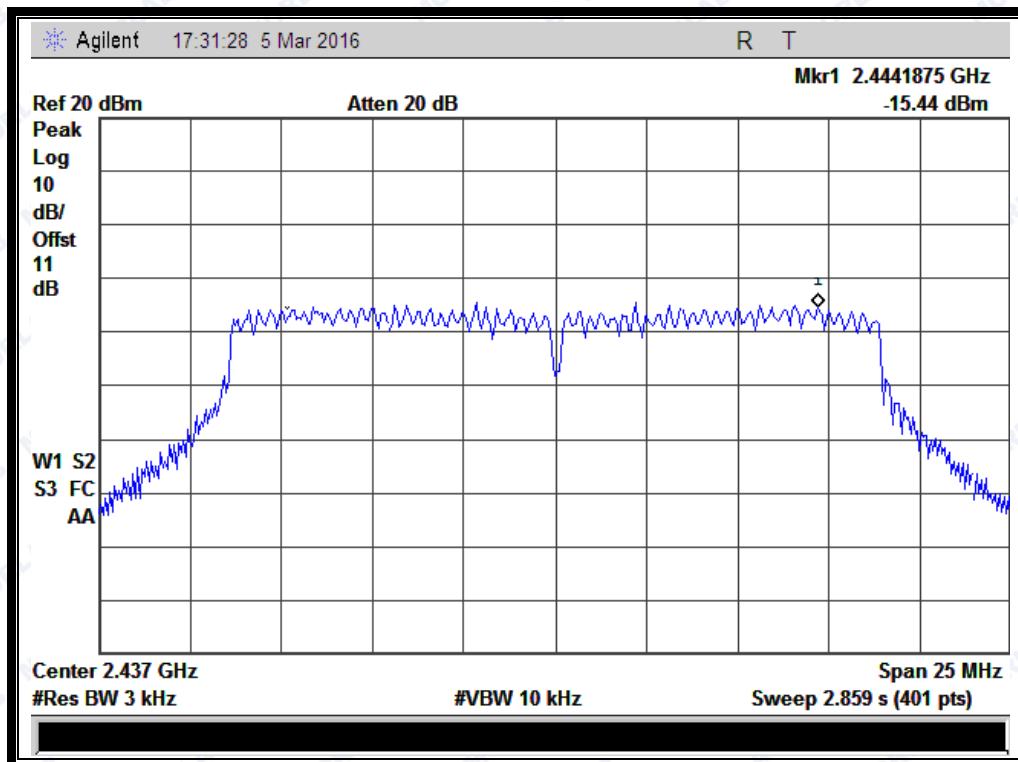
Measurement uncertainty:  $\pm 1.3\text{dB}$

**B. Test Plots:**

(Channel = 1 @ 802.11n-20MHz)



REPORT No.: SZ16020033W01

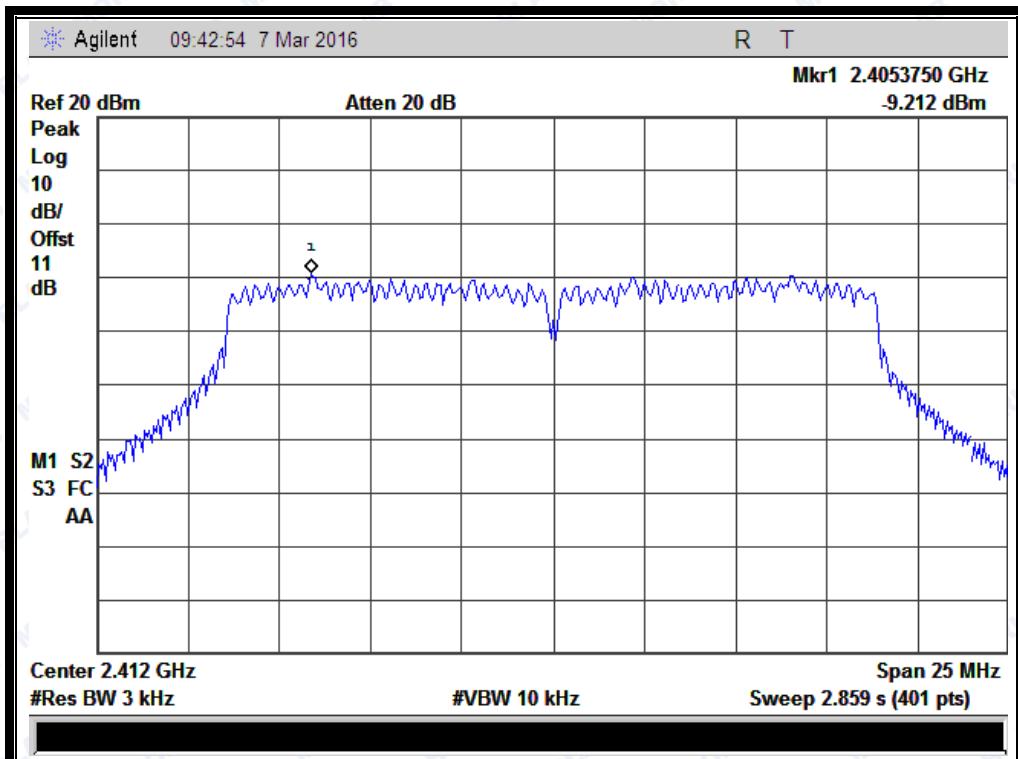




REPORT No.: SZ16020033W01

**Antenna 3:****A. Test Verdict:**

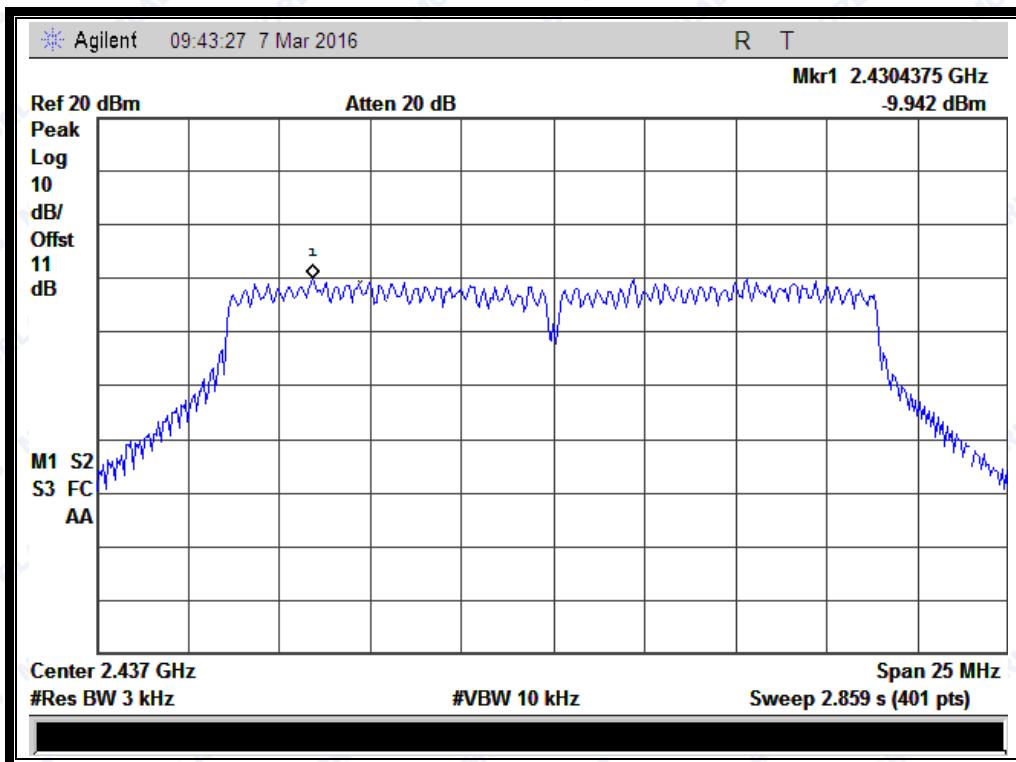
Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-9.212	8	PASS
6	2437	-9.942	8	PASS
11	2462	-9.752	8	PASS

Measurement uncertainty:  $\pm 1.3\text{dB}$ **B. Test Plots:**

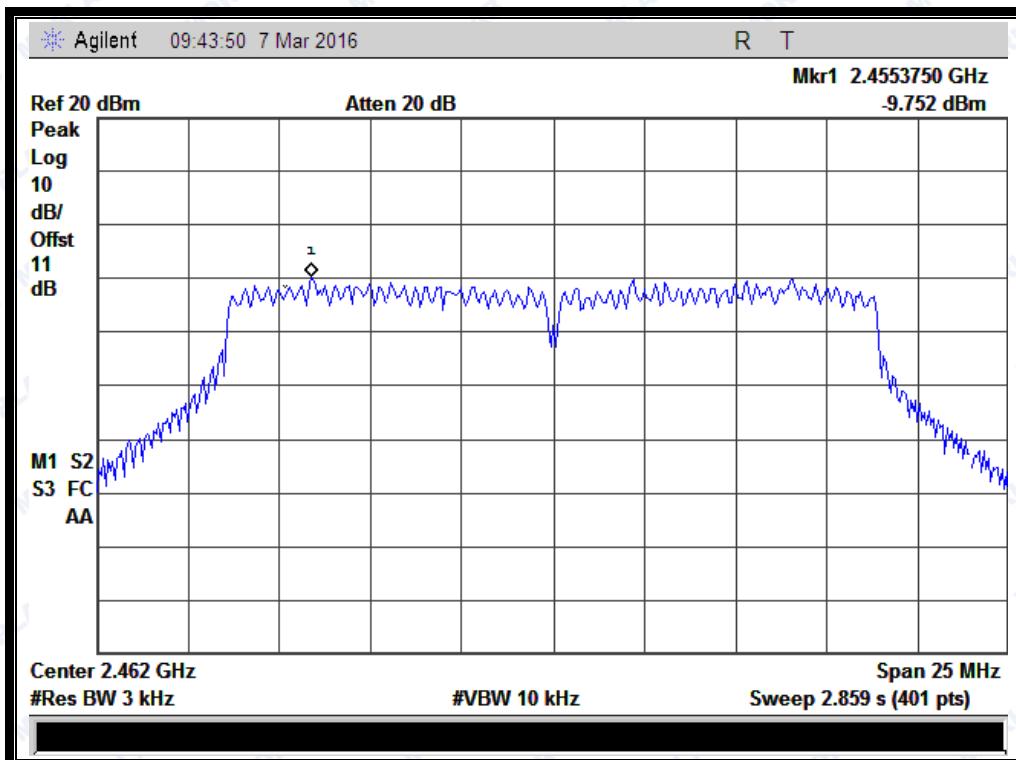
(Channel = 1 @ 802.11n-20MHz)



REPORT No.: SZ16020033W01



(Channel = 6 @ 802.11n-20MHz)



(Channel = 11 @ 802.11n-20MHz)

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**Antenna 1 + Antenna 2 + Antenna 3:****D. Test Verdict:**

Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
3	2422	-6.07	6.23 <sub>Note</sub>	PASS
6	2437	-6.66		PASS
9	2452	-6.62		PASS

Measurement uncertainty: ±1.3dB

Note: According to KDB 558074 D01 c03r05, for those cases where the rule specifies that the Spectral power density be reduced by the amount in dB that the directional gain of the transmitting antenna exceeds 6 dBi, the applicable Spectral power density limit shall be calculated as follows:

$$P_{\text{Out}} = P_{\text{Limit}} - (G_{\text{Tx}} - 6)$$

Where:

 $P_{\text{Out}}$  is the maximum Spectral power density in dBm/3KHz, $P_{\text{Limit}}$  is the Spectral power density limit in dBm/3KHz, $G_{\text{Tx}}$  is the maximum transmitting antenna directional gain in dBi.**2.5.3.4 802.11n-40MHz Test mode****Antenna 1:****A. Test Verdict:**

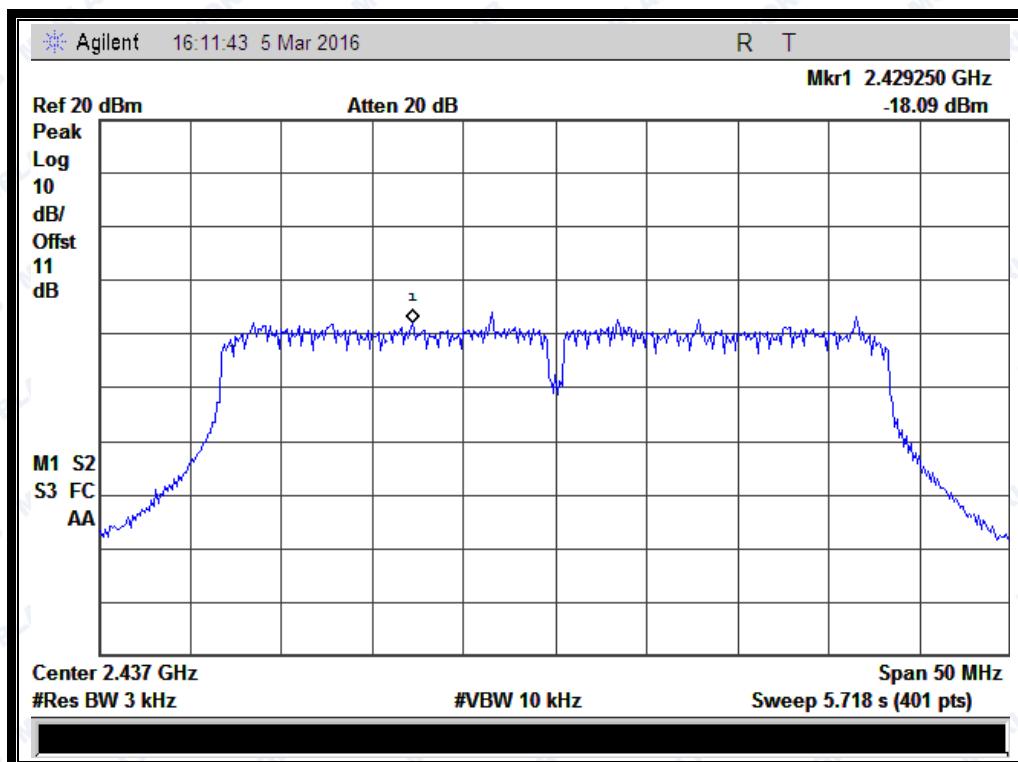
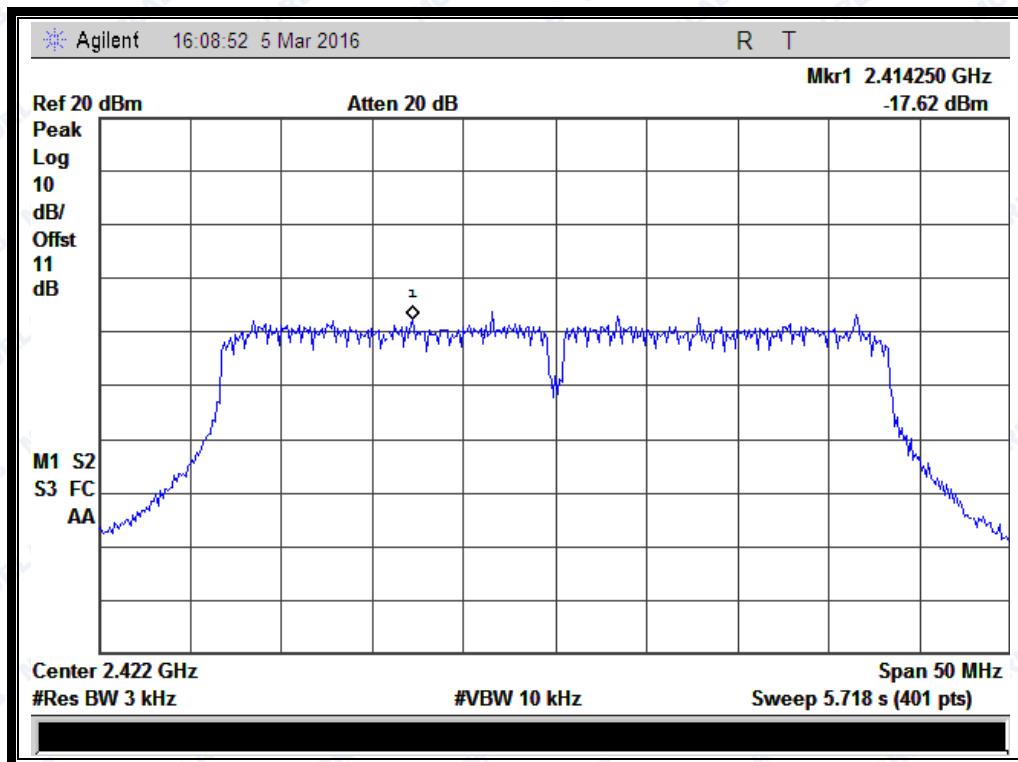
Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
3	2422	-17.62	8	PASS
6	2437	-18.09	8	PASS
9	2452	-18.76	8	PASS

Measurement uncertainty: ±1.3dB

**B. Test Plots:**

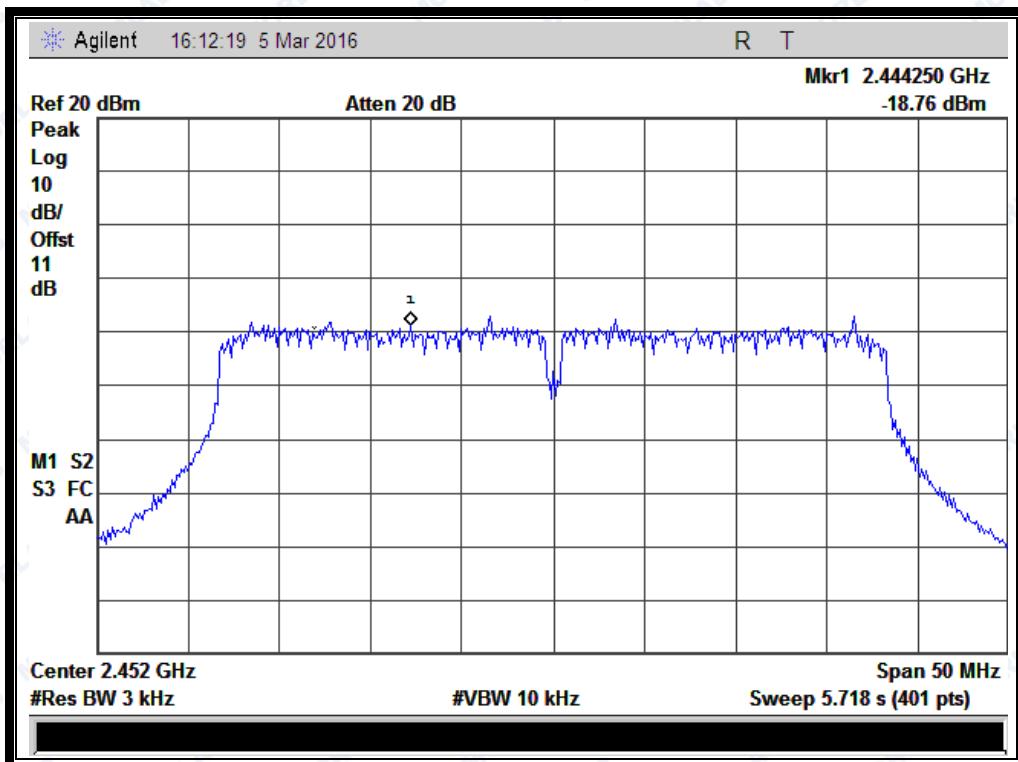


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REPORT No.: SZ16020033W01



(Channel = 9 @ 802.11n-40MHz)

## Antenna 2:

### A. Test Verdict:

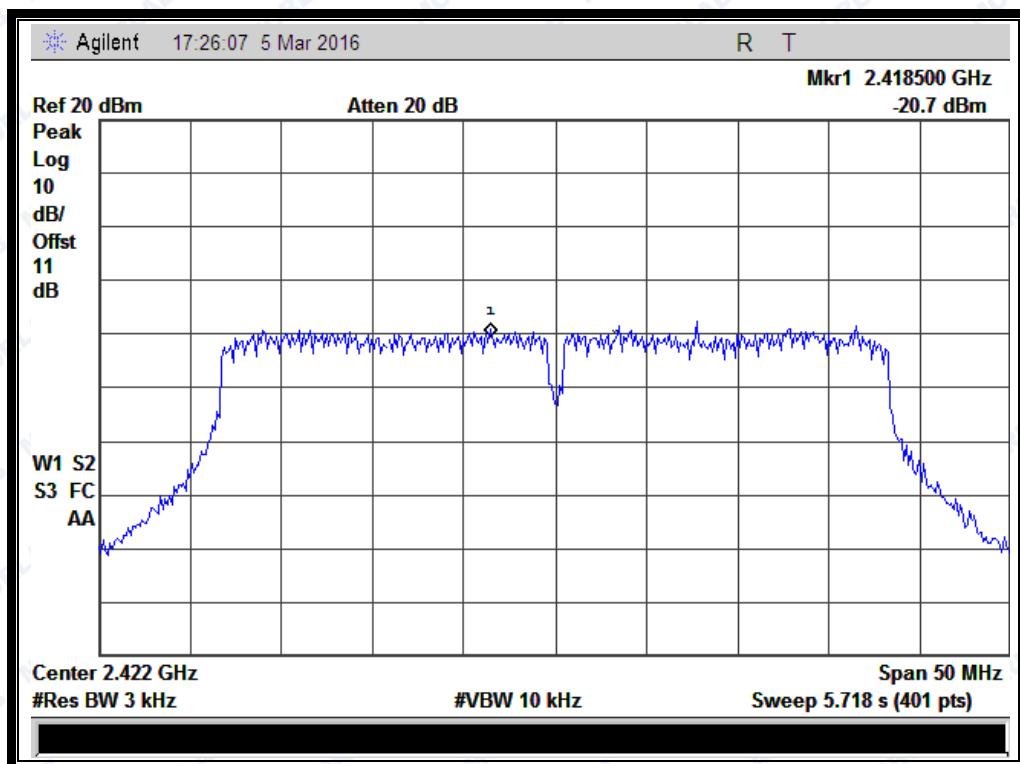
Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
3	2422	-20.7	8	PASS
6	2437	-19.66	8	PASS
9	2452	-19.28	8	PASS

Measurement uncertainty:  $\pm 1.3\text{dB}$

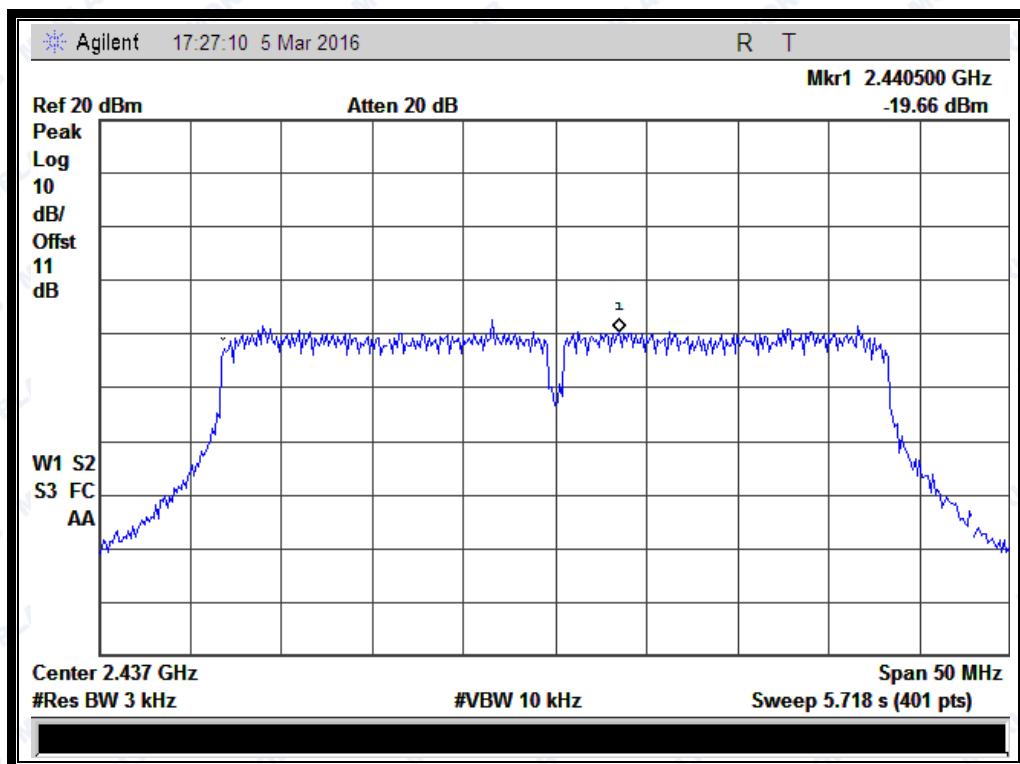
### B. Test Plots:



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(Channel = 3 @ 802.11n-40MHz)



(Channel = 6 @ 802.11n-40MHz)

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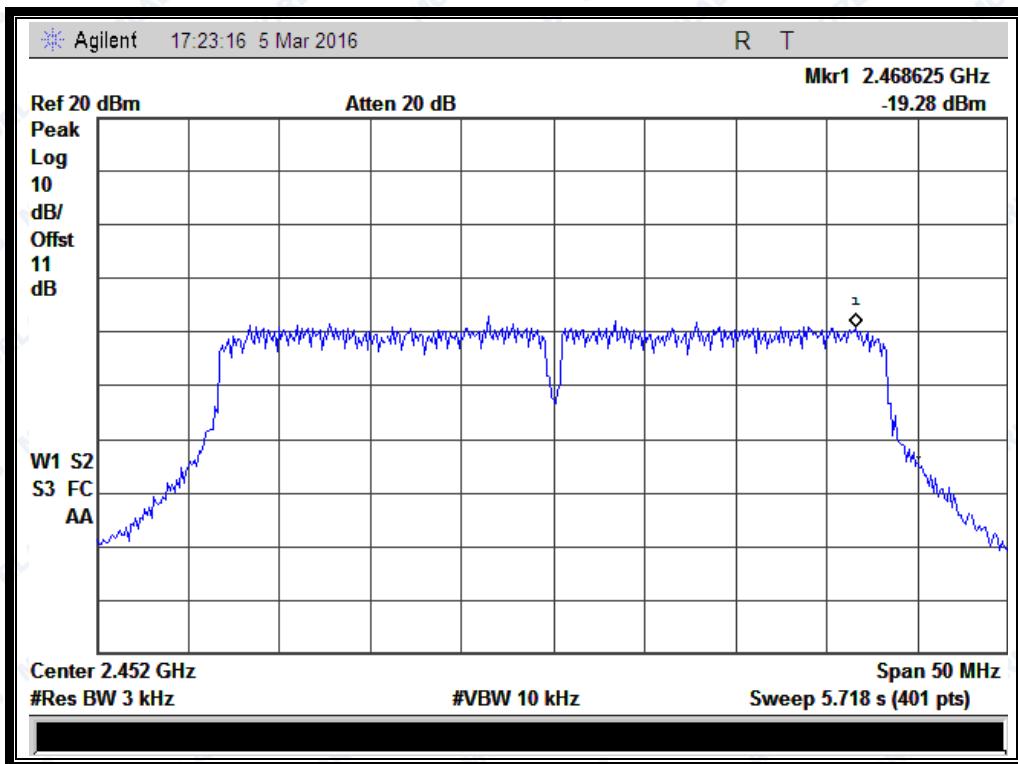
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(Channel = 9 @ 802.11n-40MHz)

### Antenna 3:

#### A. Test Verdict:

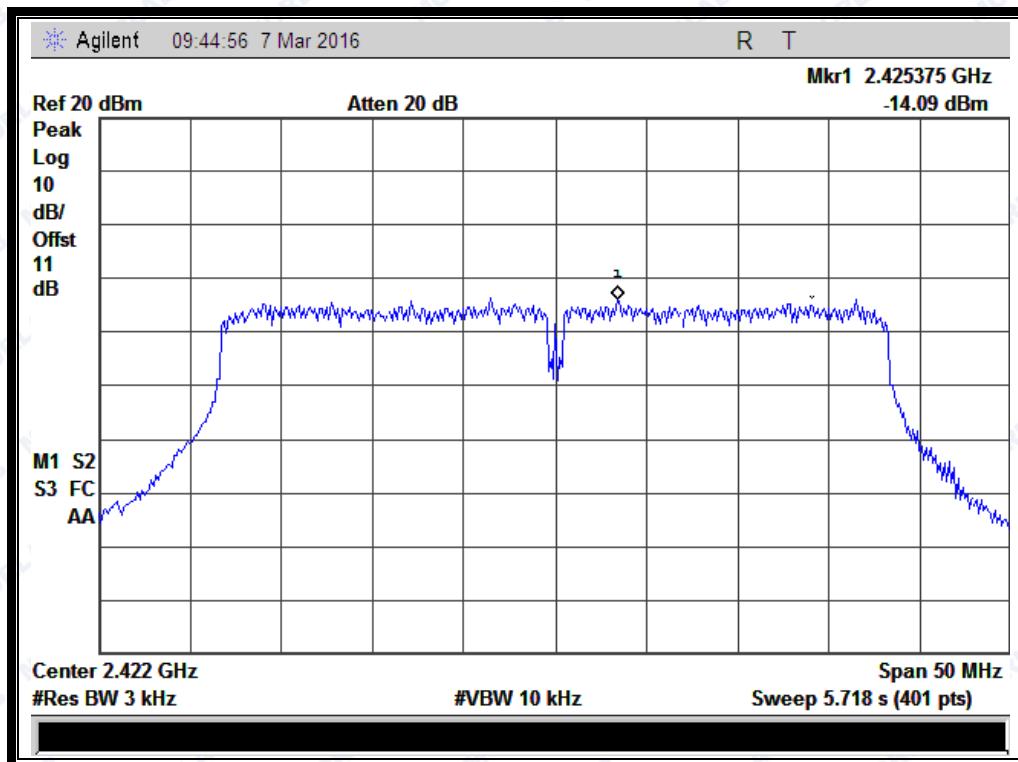
Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
3	2422	-14.09	8	PASS
6	2437	-14.12	8	PASS
9	2452	-13.00	8	PASS

Measurement uncertainty:  $\pm 1.3\text{dB}$

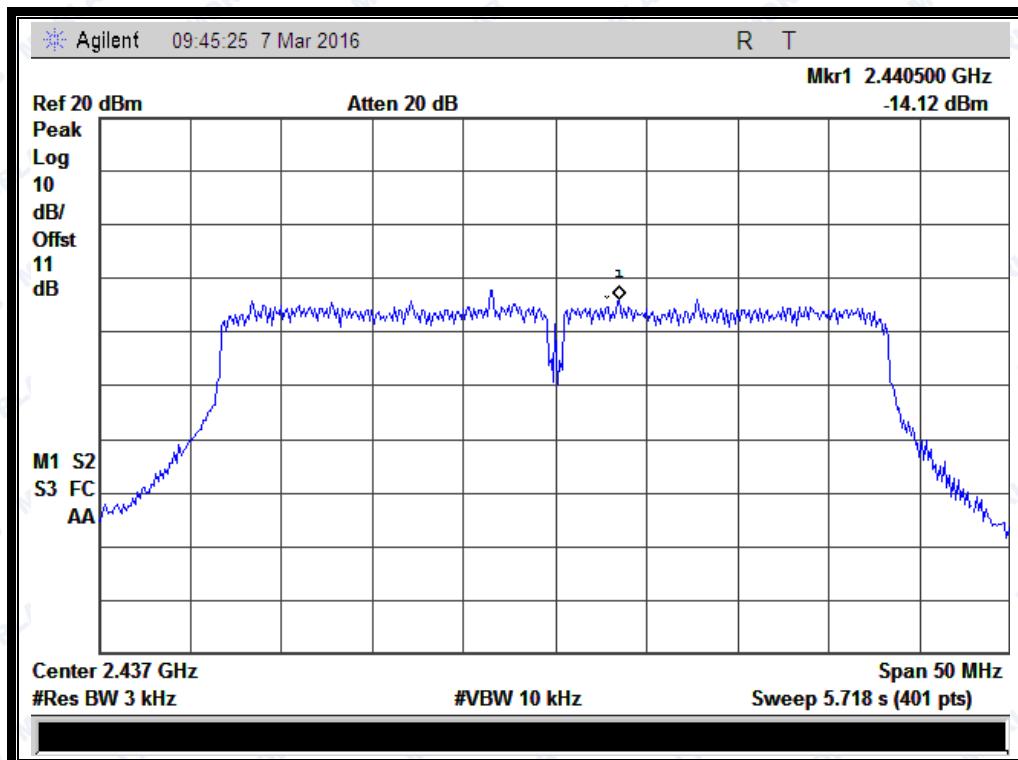
#### B. Test Plots:



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(Channel = 3 @ 802.11n-40MHz)



(Channel = 6 @ 802.11n-40MHz)

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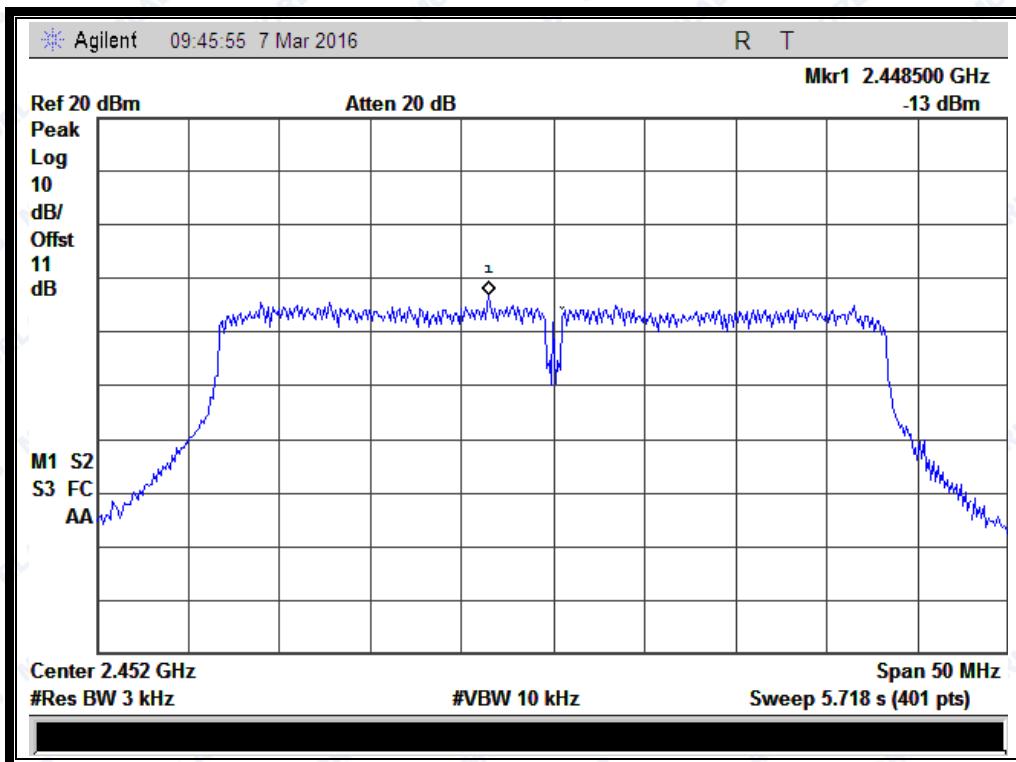
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(Channel = 9 @ 802.11n-40MHz)

### Antenna 1 + Antenna 2 + Antenna 3:

#### A. Test Verdict:

Spectral power density (dBm/3kHz)					
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict	
3	2422	-11.87	6.23 <small>Note</small>	PASS	
6	2437	-11.80		PASS	
9	2452	-11.25		PASS	

Measurement uncertainty: ±1.3dB

Note: According to KDB 558074 D01 v03r05, for those cases where the rule specifies that the Spectral power density be reduced by the amount in dB that the directional gain of the transmitting antenna exceeds 6 dBi, the applicable Spectral power density limit shall be calculated as follows:

$$P_{\text{Out}} = P_{\text{Limit}} - (G_{\text{Tx}} - 6)$$

Where:

$P_{\text{Out}}$  is the maximum Spectral power density in dBm/3KHz,

$P_{\text{Limit}}$  is the Spectral power density limit in dBm/3KHz,

$G_{\text{Tx}}$  is the maximum transmitting antenna directional gain in dBi.

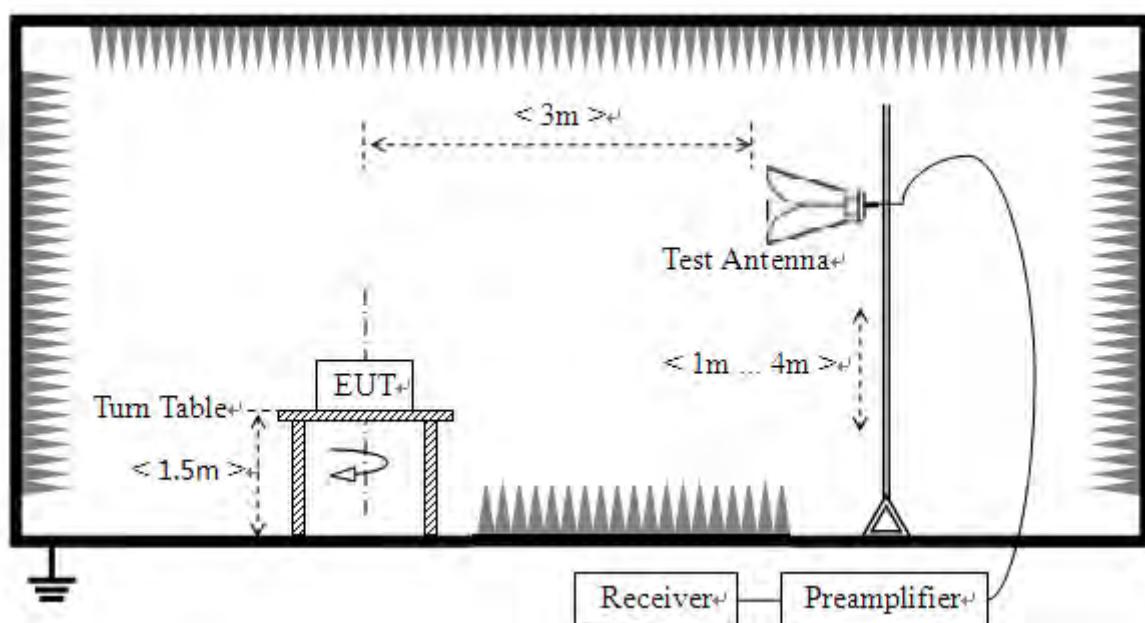
## 2.6 Restricted Frequency Bands

### 2.6.1 Requirement

According to FCC section 15.247(d), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a).

### 2.6.2 Test Description

#### A. Test Setup



The EUT is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading.

For the Test Antenna:

Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength.

KDB 558074 Section 12.1 was used in order to prove compliance.

#### B. Equipments List:

Please reference ANNEX A(1.5).



### 2.6.3 Test Result

The lowest and highest channels are tested to verify Restricted Frequency Bands.

The measurement results are obtained as below:

$$E [\text{dB}\mu\text{V}/\text{m}] = U_R + A_T + A_{\text{Factor}} [\text{dB}]; A_T = L_{\text{Cable loss}} [\text{dB}] - G_{\text{preamp}} [\text{dB}]$$

$A_T$ : Total correction Factor except Antenna

$U_R$ : Receiver Reading

$G_{\text{preamp}}$ : Preamplifier Gain

$A_{\text{Factor}}$ : Antenna Factor at 3m

**Note:** Restricted Frequency Bands were performed when antenna was at vertical and horizontal polarity, and only the worse test condition (vertical) was recorded in this test report.

#### 2.6.3.1 802.11b SISO Test mode (Antenna 3)

The lowest and highest channels are tested to verify the band edge emissions.

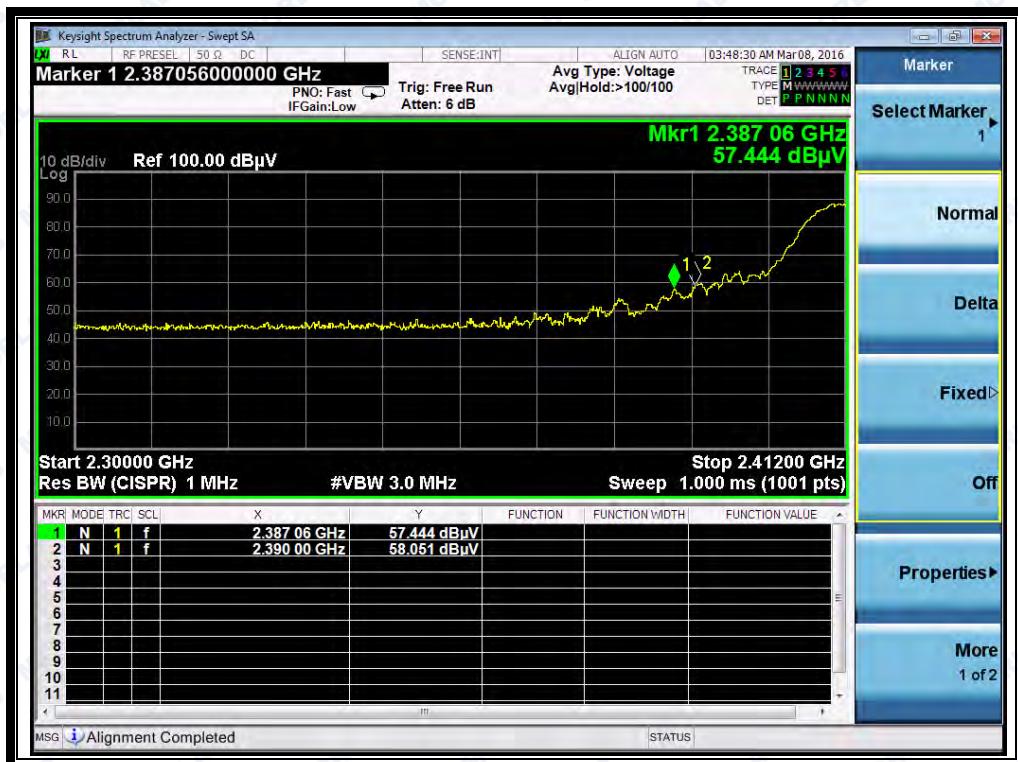
##### A. Test Verdict:

Channel	Frequency (MHz)	Detector	Receiver	$A_T$ (dB)	$A_{\text{Factor}}$ (dB@3m)	Max. Emission $E$ (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Verdict
			Reading $U_R$ (dB $\mu$ V)					
1	2387.06	PK	57.44	-33.63	32.56	56.37	74	Pass
1	2387.17	AV	43.70	-33.63	32.56	42.63	54	Pass
11	2483.85	PK	56.94	-33.18	32.5	56.26	74	Pass
11	2484.84	AV	36.49	-33.18	32.5	35.81	54	Pass

##### B. Test Plots:



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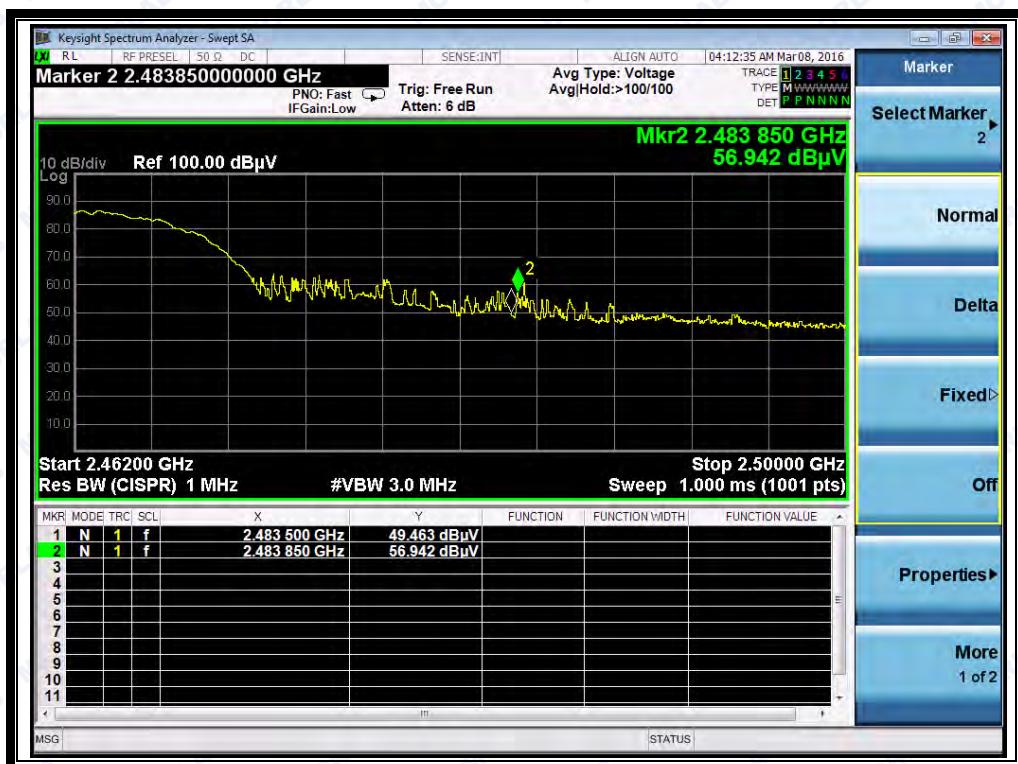
(Plot A1: Channel = 1 PEAK @ 802.11b)



(Plot A2: Channel = 1 AVG @ 802.11b)



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(Plot B1: Channel = 11 PEAK @ 802.11b)



(Plot B2: Channel = 11 AVG @ 802.11b)



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### 2.6.3.2 802.11g SISO Test mode (Antenna 3)

The lowest and highest channels are tested to verify the band edge emissions.

#### A. Test Verdict:

Channel	Frequency (MHz)	Detector	Receiver Reading	A <sub>T</sub> (dB)	A <sub>Factor</sub> (dB@3m)	Max. Emission E	Limit (dB $\mu$ V/m)	Verdict
		PK/ AV	U <sub>R</sub> (dB $\mu$ V)					
1	2386.72	PK	59.31	-33.63	32.56	58.24	74	Pass
1	2388.40	AV	38.36	-33.63	32.56	37.29	54	Pass
11	2484.80	PK	58.20	-33.18	32.5	57.52	74	Pass
11	2485.60	AV	38.99	-33.18	32.5	38.31	54	Pass

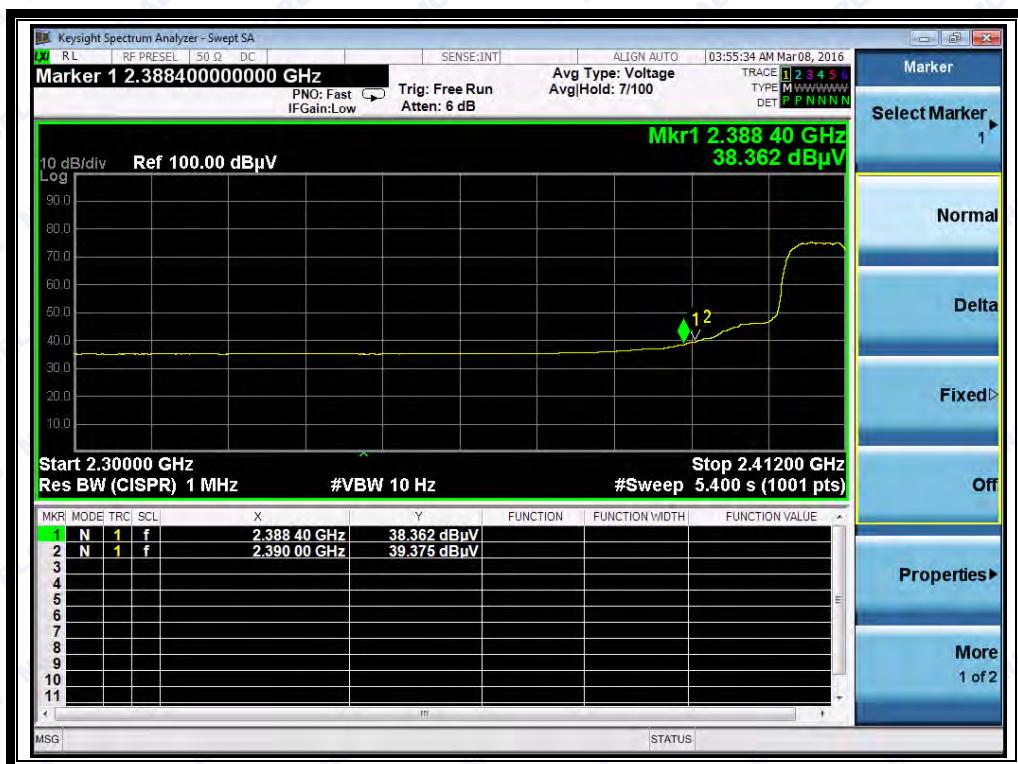
#### B. Test Plots:



(Plot C1: Channel = 1 PEAK @ 802.11g)



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(Plot C2: Channel = 1 AVG @ 802.11g)



(Plot D1: Channel = 11 PEAK @ 802.11g)



(Plot D2: Channel = 11 AVG @ 802.11g)

### 2.6.3.3 802.11n-20MHz MIMO Test mode

The lowest and highest channels are tested to verify the band edge emissions.

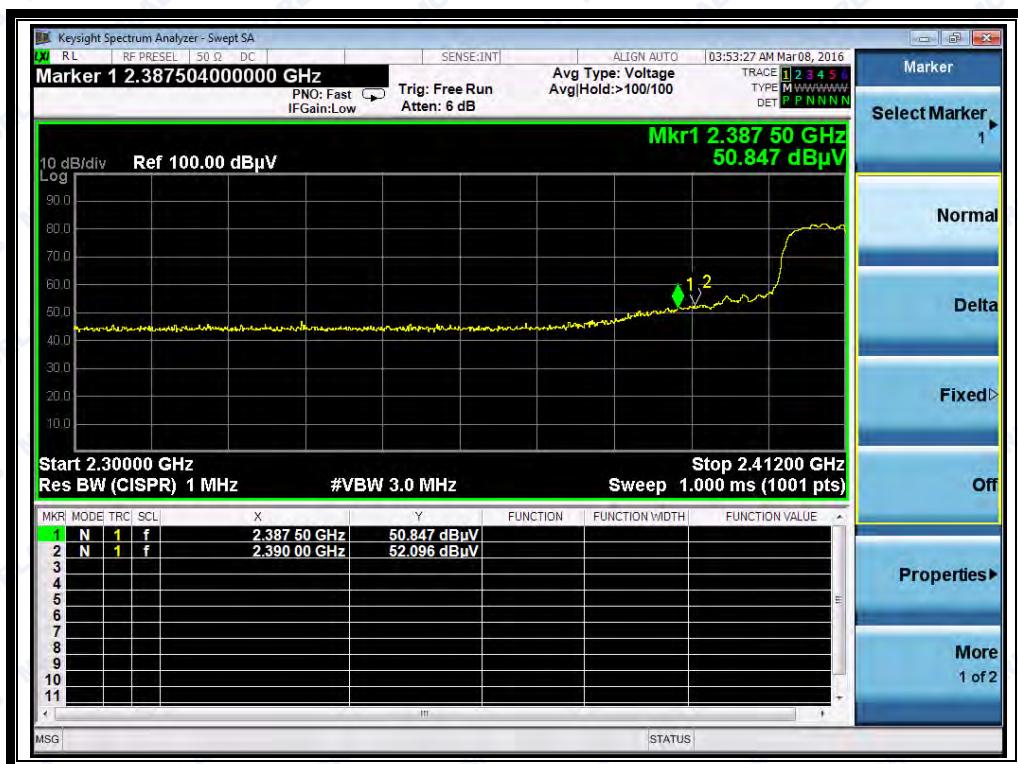
#### A. Test Verdict:

Channel	Frequency (MHz)	Detector	Receiver Reading U <sub>R</sub> (dB $\mu$ V)	A <sub>T</sub> (dB)	A <sub>Factor</sub> (dB@3m)	Max. Emission E (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Verdict
1	2387.50	PK	50.85	-33.63	32.56	49.78	74	Pass
1	2385.04	AV	34.88	-33.63	32.56	33.81	54	Pass
11	2484.76	PK	59.95	-33.18	32.5	59.27	74	Pass
11	2485.56	AV	37.29	-33.18	32.5	36.61	54	Pass

#### B. Test Plots:



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(Plot E1: Channel = 1 PEAK @ 802.11n-20)



(Plot E2: Channel = 1 AVG @ 802.11n-20)



REPORT No.: SZ16020033W01



(Plot F1: Channel = 11 PEAK @ 802.11n-20)



(Plot F2: Channel = 11 AVG @ 802.11n-20)



REPORT No.: SZ16020033W01

#### 2.6.3.4 802.11n-40MHz MIMO Test mode

The lowest and highest channels are tested to verify the band edge emissions.

#### A. Test Verdict:

Channel	Frequency (MHz)	Detector	Receiver	A <sub>T</sub> (dB)	A <sub>Factor</sub> (dB@3m)	Max. Emission E (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Verdict
			Reading U <sub>R</sub> (dB $\mu$ V)					
3	2390.00	PK	56.15	-33.63	32.56	55.08	74	Pass
3	2390.00	AV	54.19	-33.63	32.56	53.12	54	Pass
9	2489.63	PK	47.57	-33.18	32.5	46.89	74	Pass
9	2486.78	AV	33.31	-33.18	32.5	32.63	54	Pass

#### C. Test Plots:



(Plot E1: Channel = 3 PEAK @ 802.11n-40)



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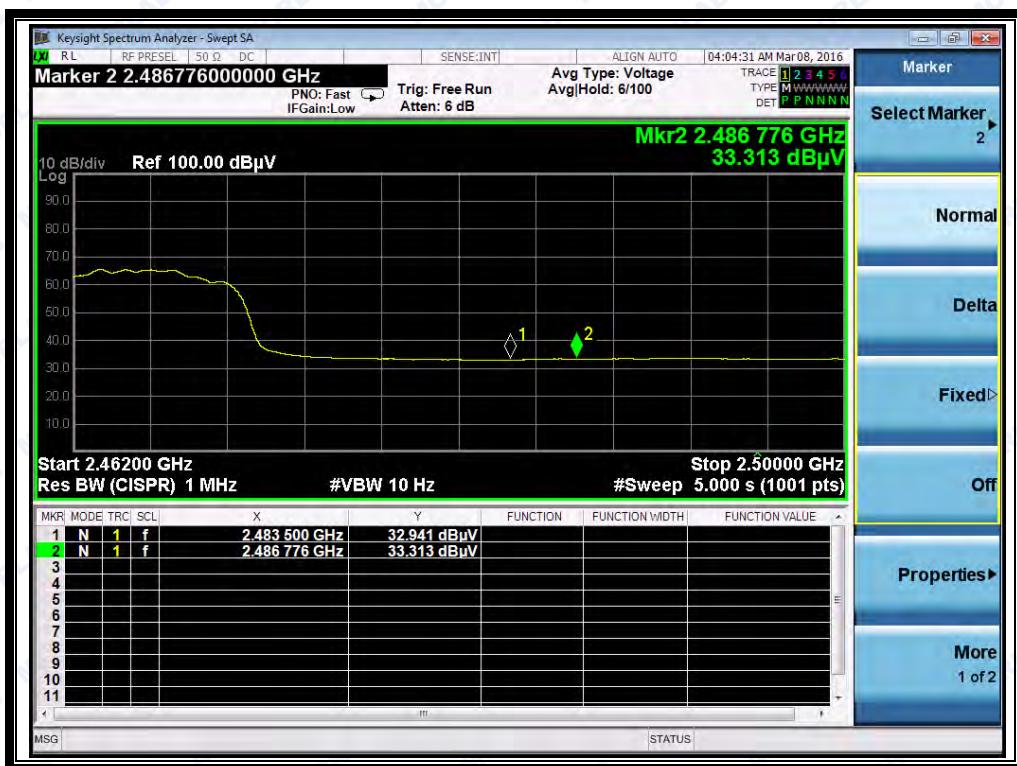
(Plot E2: Channel = 3 AVG @ 802.11n-40)



(Plot F1: Channel = 9 PEAK @ 802.11n-40)



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(Plot F2: Channel = 9 AVG @ 802.11n-40)

## 2.7 Conducted Emission

### 2.7.1 Requirement

According to FCC section 15.207, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50 $\mu$ H/50 $\Omega$  line impedance stabilization network (LISN).

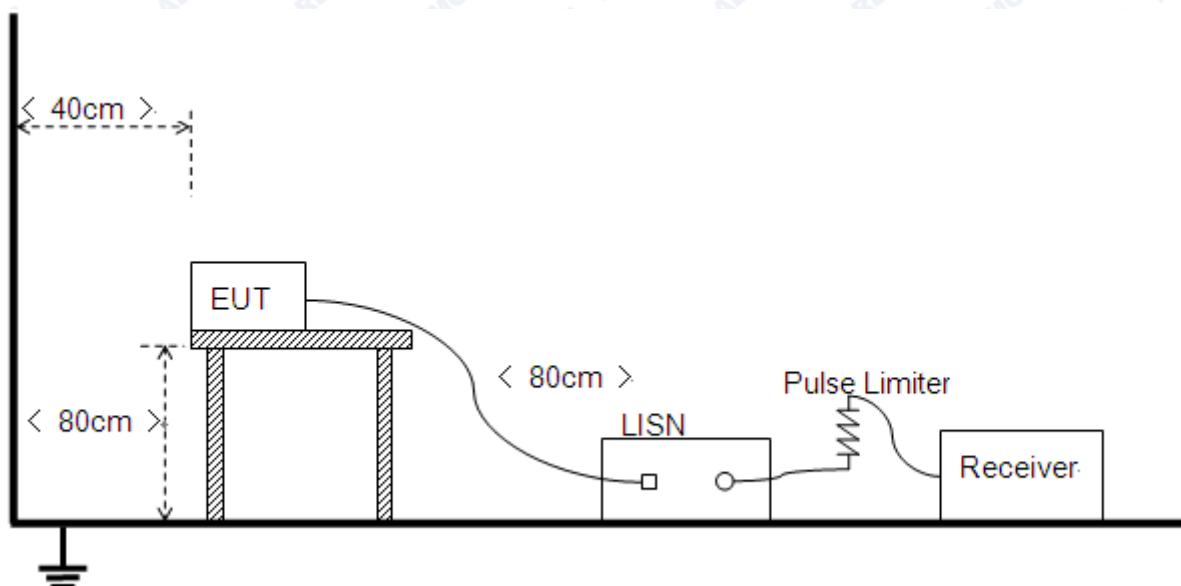
Frequency range (MHz)	Conducted Limit (dB $\mu$ V)	
	Quasi-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50

**NOTE:**

- (a) The lower limit shall apply at the band edges.
- (b) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

### 2.7.2 Test Description

#### A. Test Setup:



The Table-top EUT was placed upon a non-metallic table 0.8m above the horizontal metal reference ground plane. EUT was connected to LISN and LISN was connected to reference Ground Plane. EUT was 80cm from LISN. The set-up and test methods were according to ANSI C63.10: 2013.



## B. Equipments List:

Please reference ANNEX A(1.5).

### 2.7.3 Test Result

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

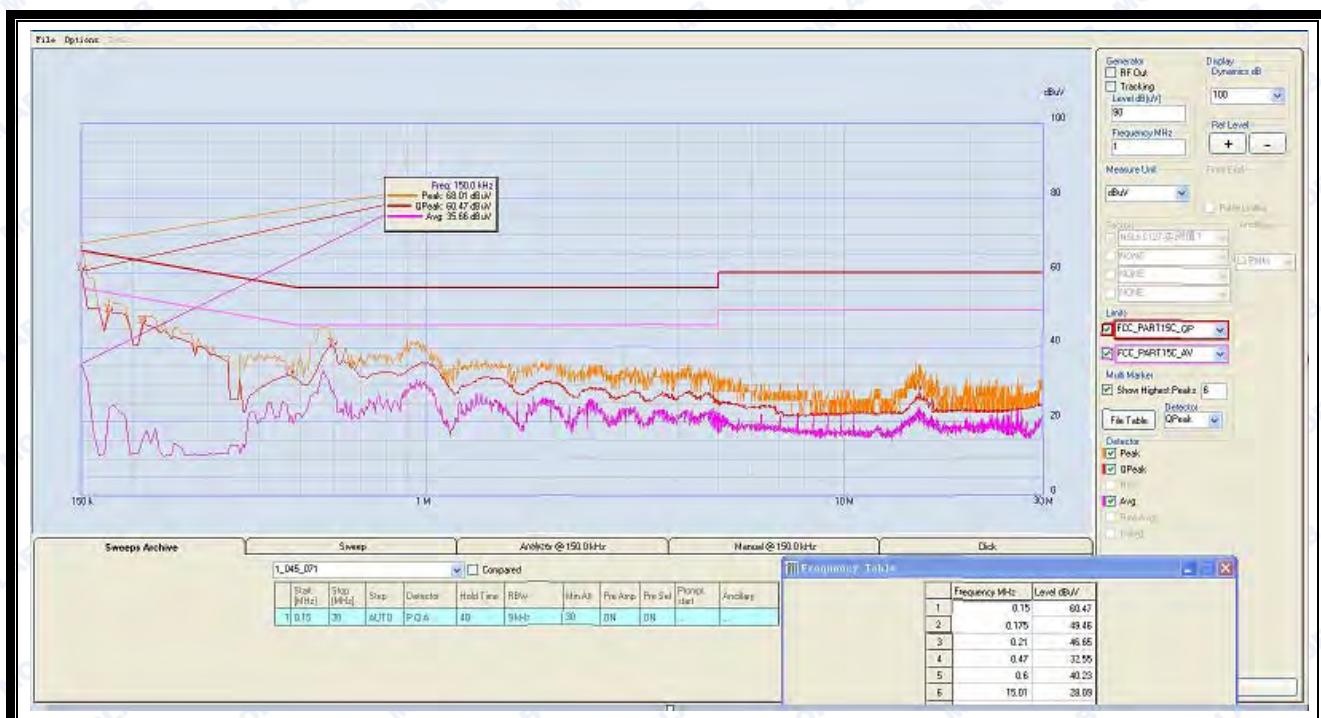
Note: All test modes are performed, only the worst case is recorded in this report.

#### A. Test setup:

The EUT configuration of the emission tests is EUT + Link.

**Note:** The test voltage is AC 120V/60Hz.

#### B. Test Plots:



(Plot A: L Phase)



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(Plot B: N Phase)

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## 2.8 Radiated Emission

### 2.8.1 Requirement

According to FCC section 15.247(d), radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength ( $\mu$ V/m)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

Note:

For Above 1000MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.

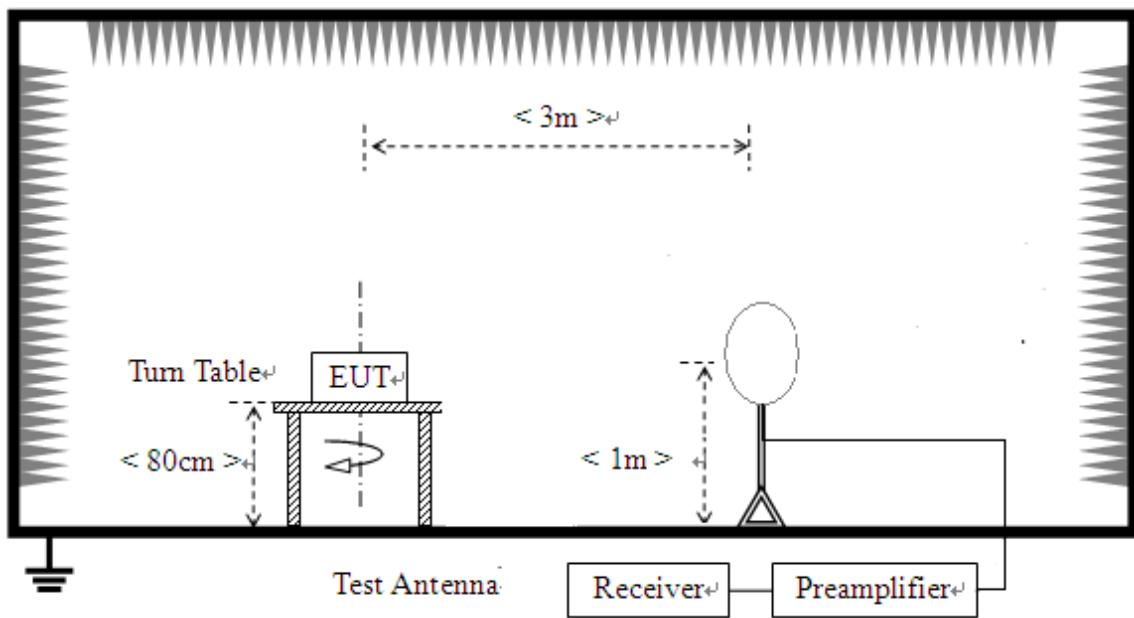
For above 1000MHz, limit field strength of harmonics: 54dB<sub>AV</sub>/m@3m (AV) and 74dB<sub>PK</sub>/m@3m (PK)

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), also should comply with the radiated emission limits specified in Section 15.209(a)(above table)

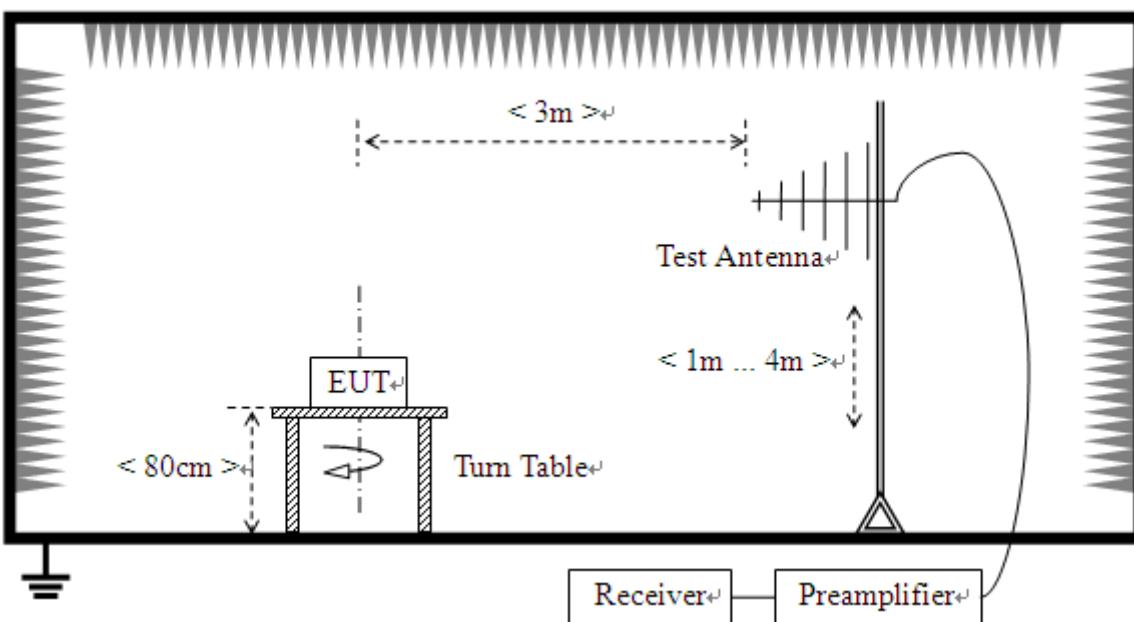
## 2.8.2 Test Description

### A. Test Setup:

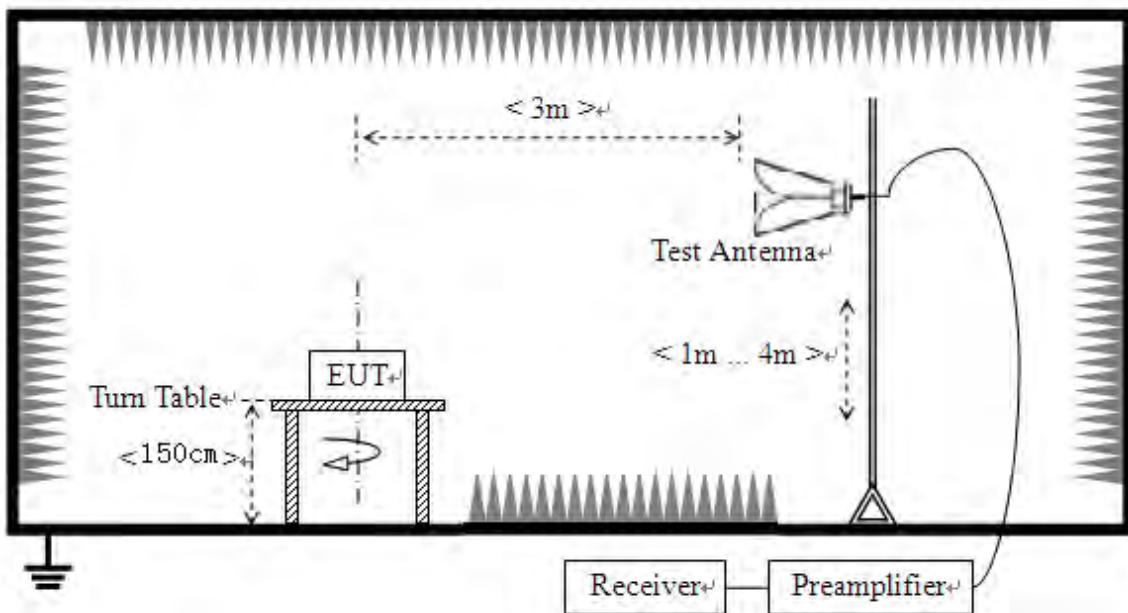
- 1) For radiated emissions from 9kHz to 30MHz



- 2) For radiated emissions from 30MHz to 1GHz



## 3) For radiated emissions above 1GHz



The test site semi-anechoic chamber has met the requirement of NSA tolerance 4dB according to the standards: ANSI C63.10 (2013). For radiated emissions below or equal to 1GHz, The EUT was set-up on insulator 80cm above the Ground Plane, For radiated emissions above 1GHz, The EUT was set-up on insulator 150cm above the Ground Plane. The set-up and test methods were according to ANSI C63.10

For the radiated emission test above 1GHz:

Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

The EUT is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading

For the Test Antenna:

- (a) In the frequency range of 9kHz to 30MHz, magnetic field is measured with Loop Test Antenna.



The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.

(b) In the frequency range above 30MHz, Bi-Log Test Antenna (30MHz to 1GHz) and Horn Test Antenna (above 1GHz) are used. Place the test antenna at 3m away from area of the EUT, while keeping the test antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The test antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final test antenna elevation shall be that which maximizes the emissions. The test antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. The emission levels at both horizontal and vertical polarizations should be tested.

## B. Equipments List:

Please reference ANNEX A(1.5).

### 2.8.3 Test Result

According to ANSI C63.10, because of peak detection will yield amplitudes equal to or greater than amplitudes measured with the quasi-peak (or average) detector, the measurement data from a spectrum analyzer peak detector will represent the worst-case results, if the peak measured value complies with the quasi-peak limit, it is unnecessary to perform an quasi-peak measurement.

The measurement results are obtained as below:

$$E [\text{dB}\mu\text{V/m}] = U_R + A_T + A_{\text{Factor}} [\text{dB}]; A_T = L_{\text{Cable loss}} [\text{dB}] - G_{\text{preamp}} [\text{dB}]$$

$A_T$ : Total correction Factor except Antenna

$U_R$ : Receiver Reading

$G_{\text{preamp}}$ : Preamplifier Gain

$A_{\text{Factor}}$ : Antenna Factor at 3m

During the test, the total correction Factor  $A_T$  and  $A_{\text{Factor}}$  were built in test software.

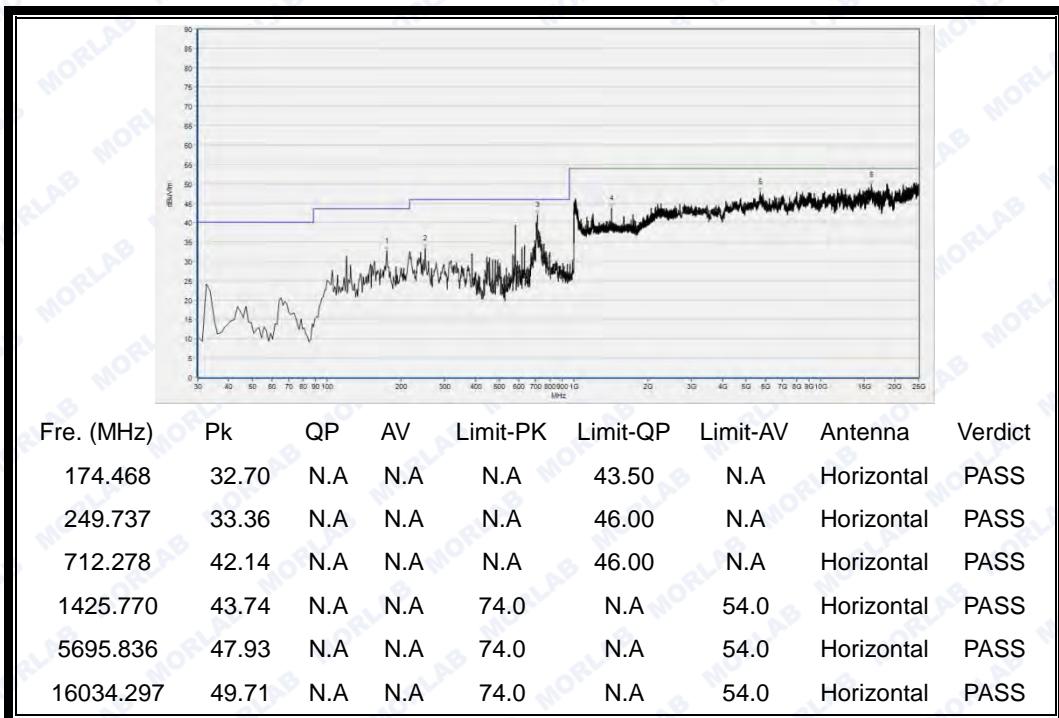
The low frequency, which started from 9KHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.



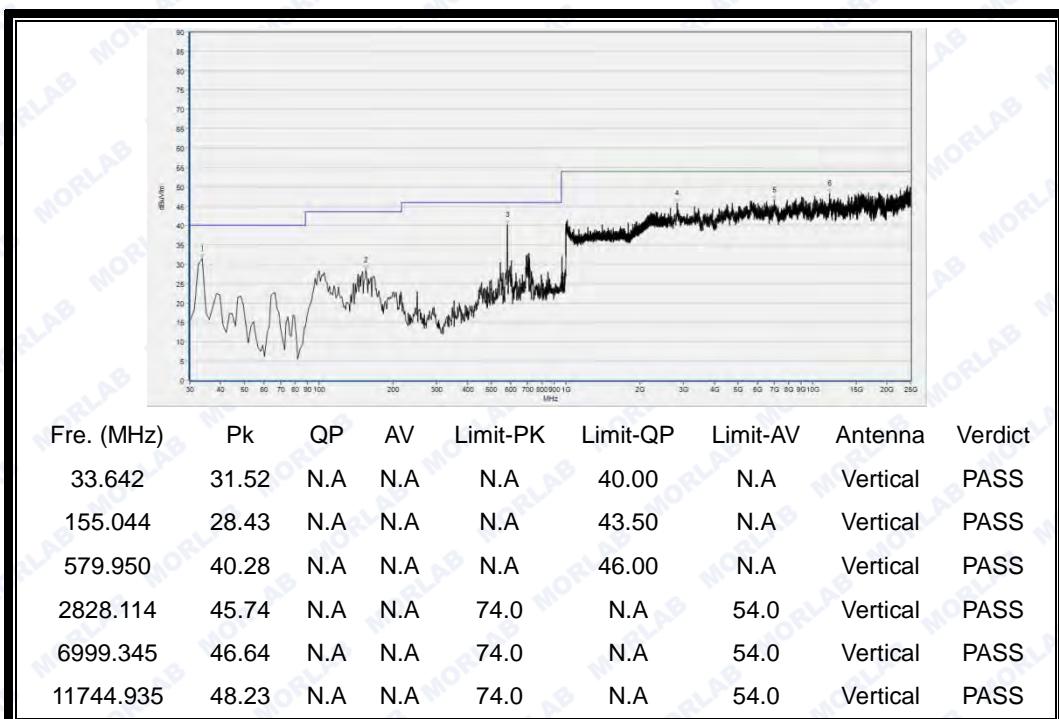
### 2.8.3.1 802.11b SISO Test mode (Antenna 3)

#### A. Test Plots for the Whole Measurement Frequency Range:

Plots for Channel = 1



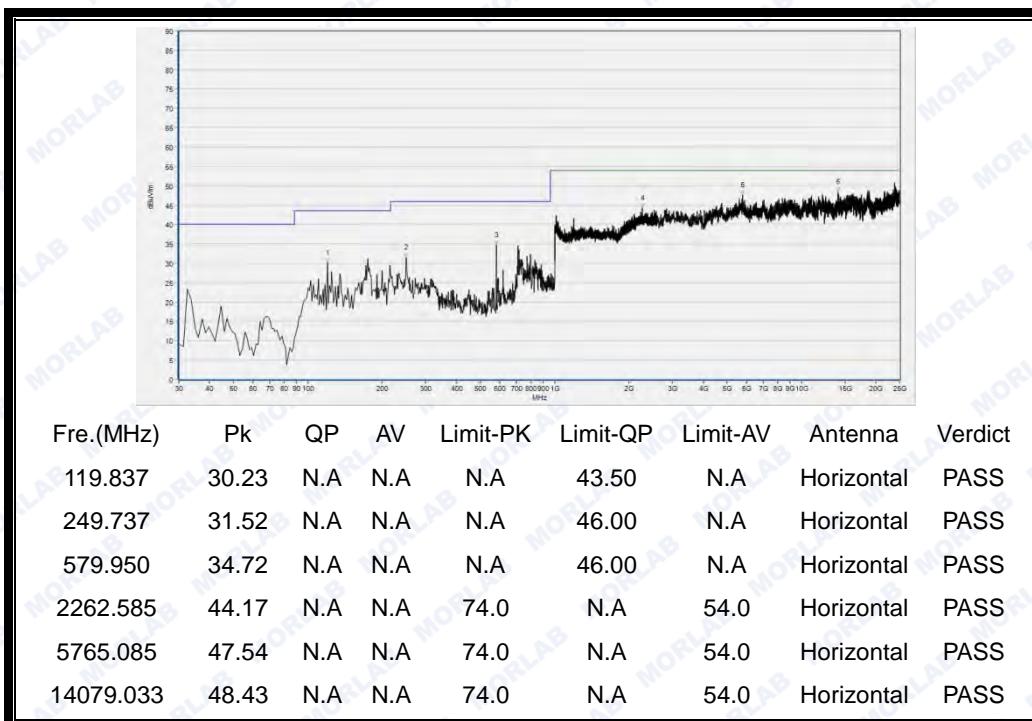
(Antenna Horizontal, 30MHz to 25GHz)



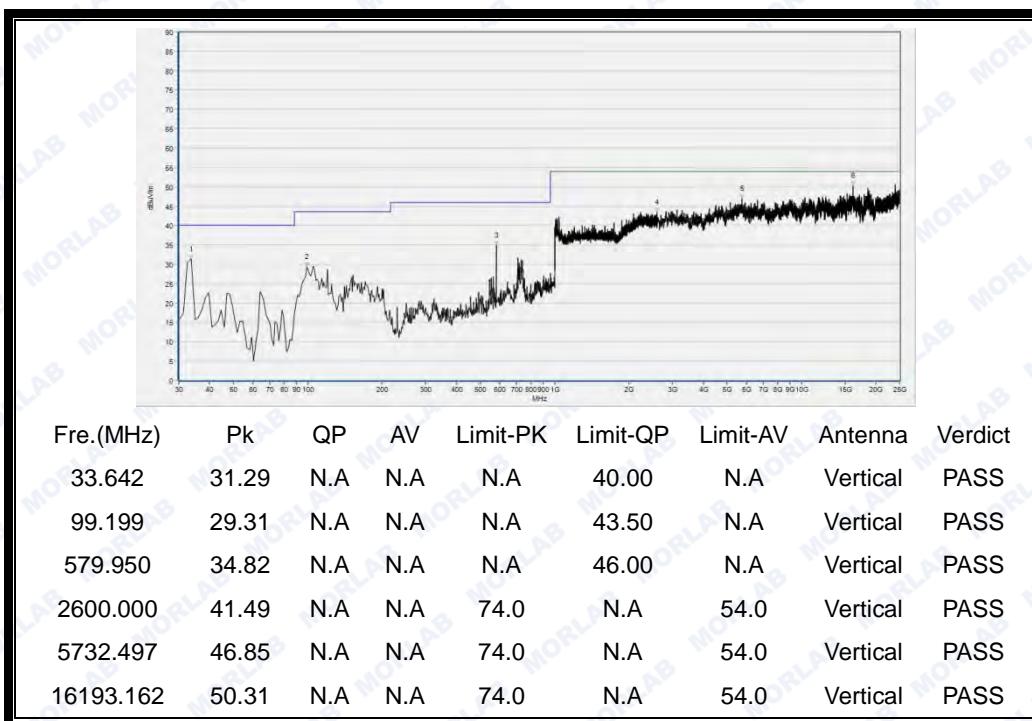
(Antenna Vertical, 30MHz to 25GHz)



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Plot for Channel = 6

(Antenna Horizontal, 30MHz to 25GHz)



(Antenna Vertical, 30MHz to 25GHz)

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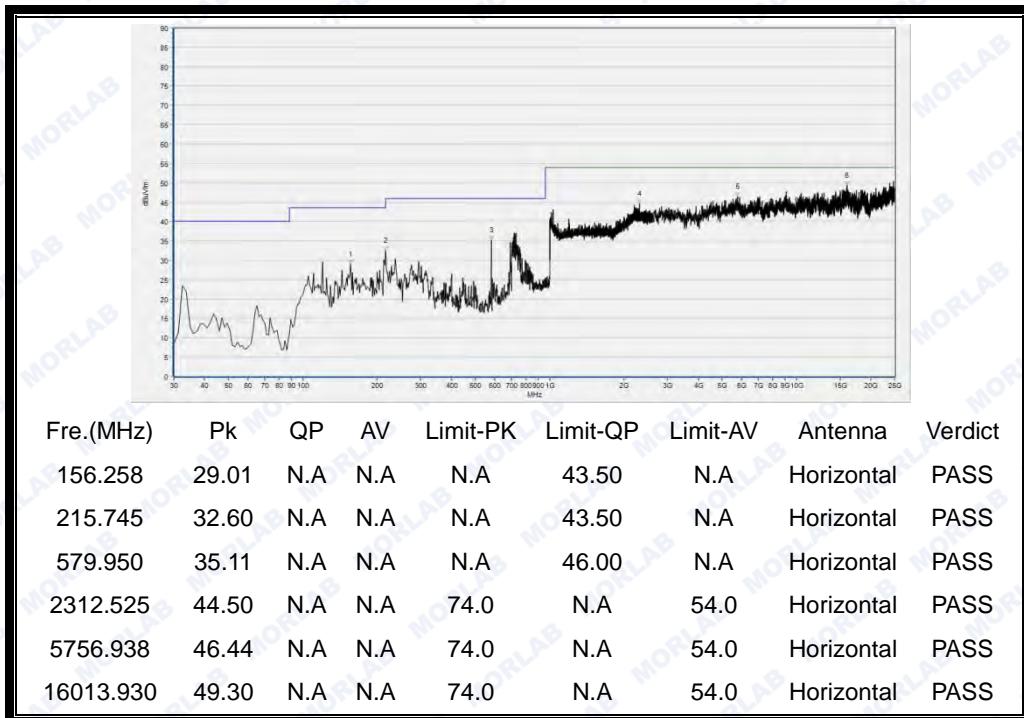
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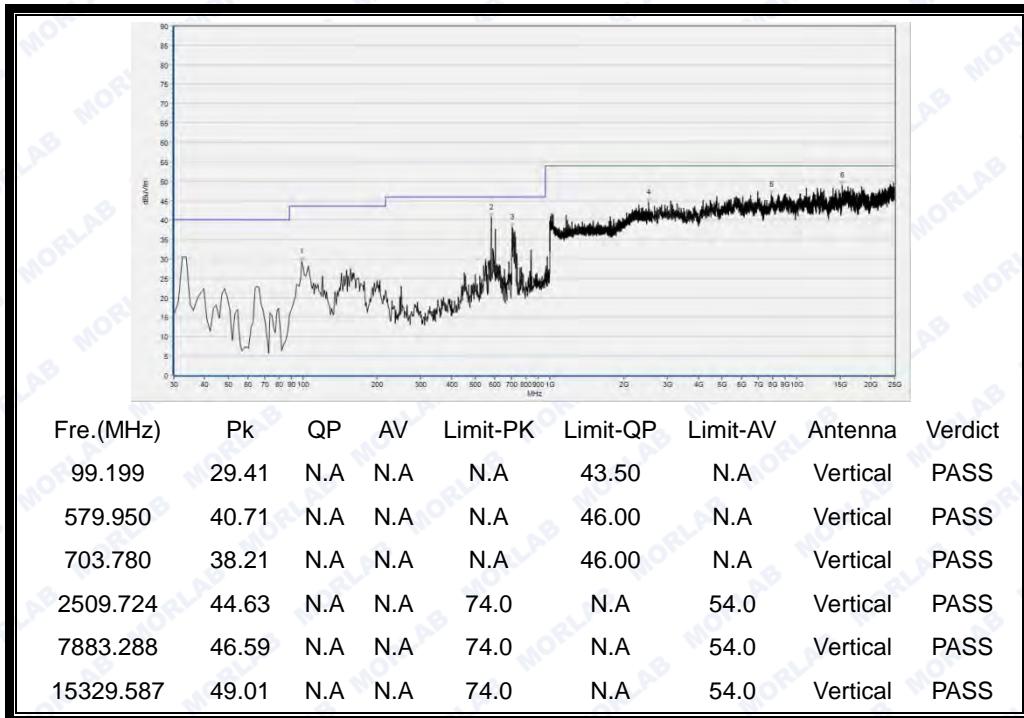


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Plot for Channel = 11



(Antenna Horizontal, 30MHz to 25GHz)



(Antenna Vertical, 30MHz to 25GHz)

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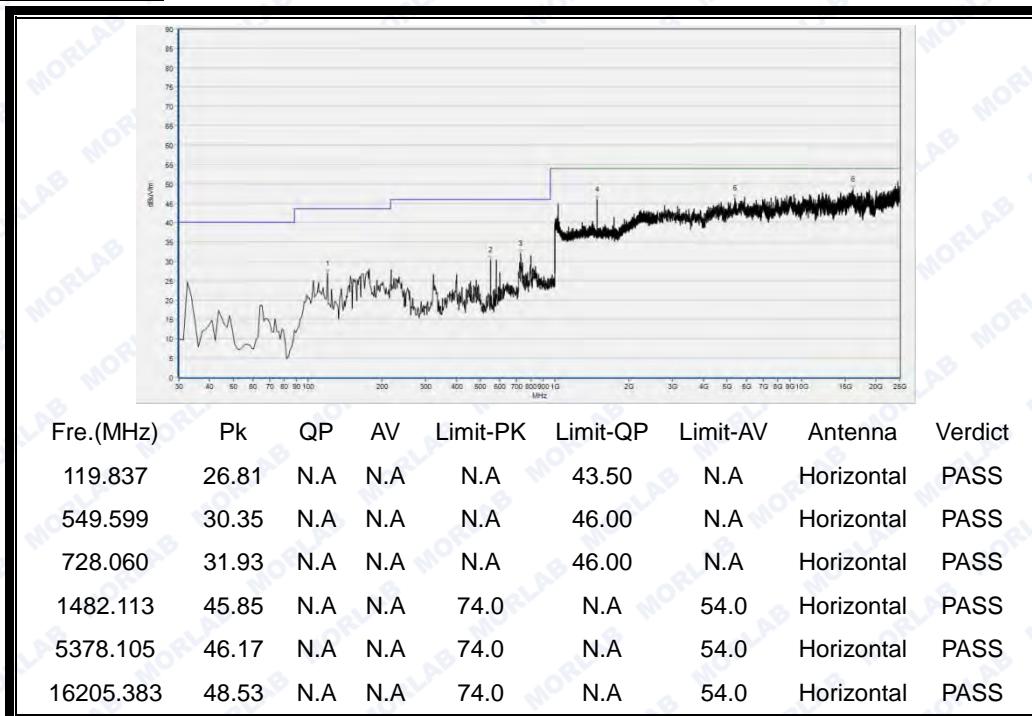
E-mail: service@morlab.cn



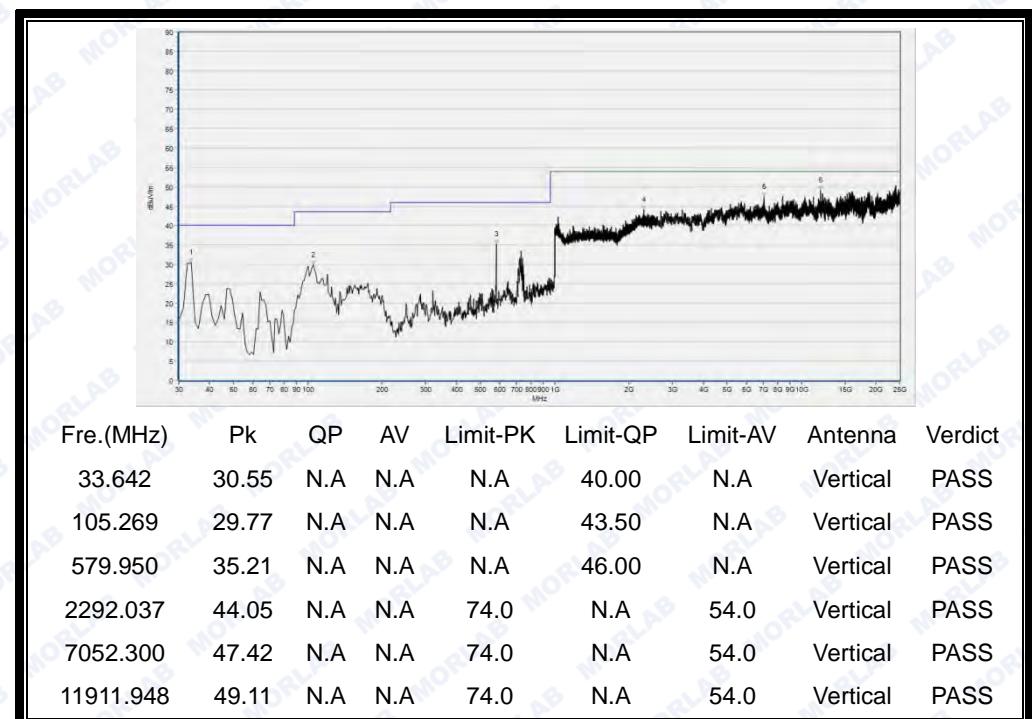
### 2.8.3.2 802.11g SISO Test mode (Antenna 3)

#### A. Test Plots for the Whole Measurement Frequency Range:

Plots for Channel = 1



(Antenna Horizontal, 30MHz to 25GHz)

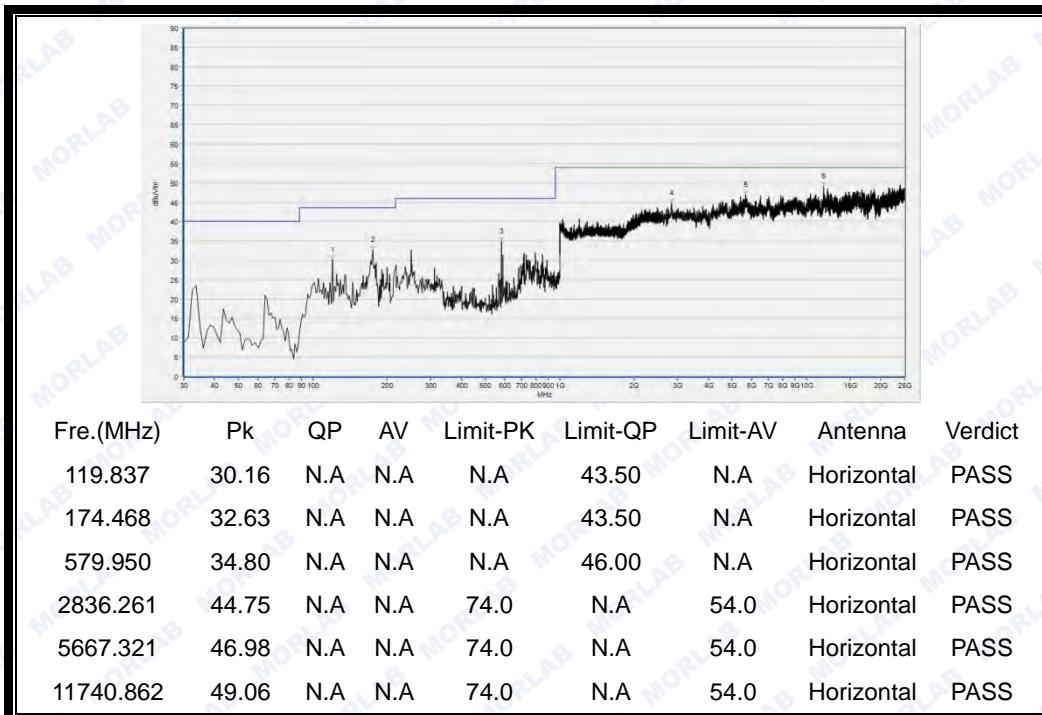


(Antenna Vertical, 30MHz to 25GHz)

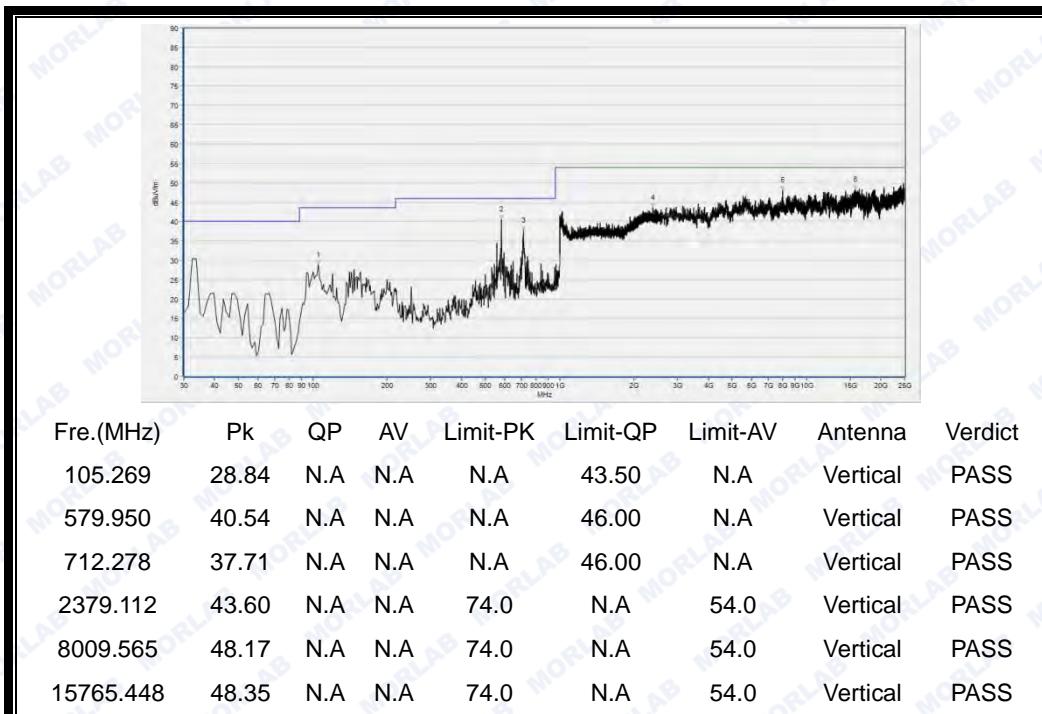


REPORT No.: SZ16020033W01

Plot for Channel = 6



(Antenna Horizontal, 30MHz to 25GHz)



(Antenna Vertical, 30MHz to 25GHz)

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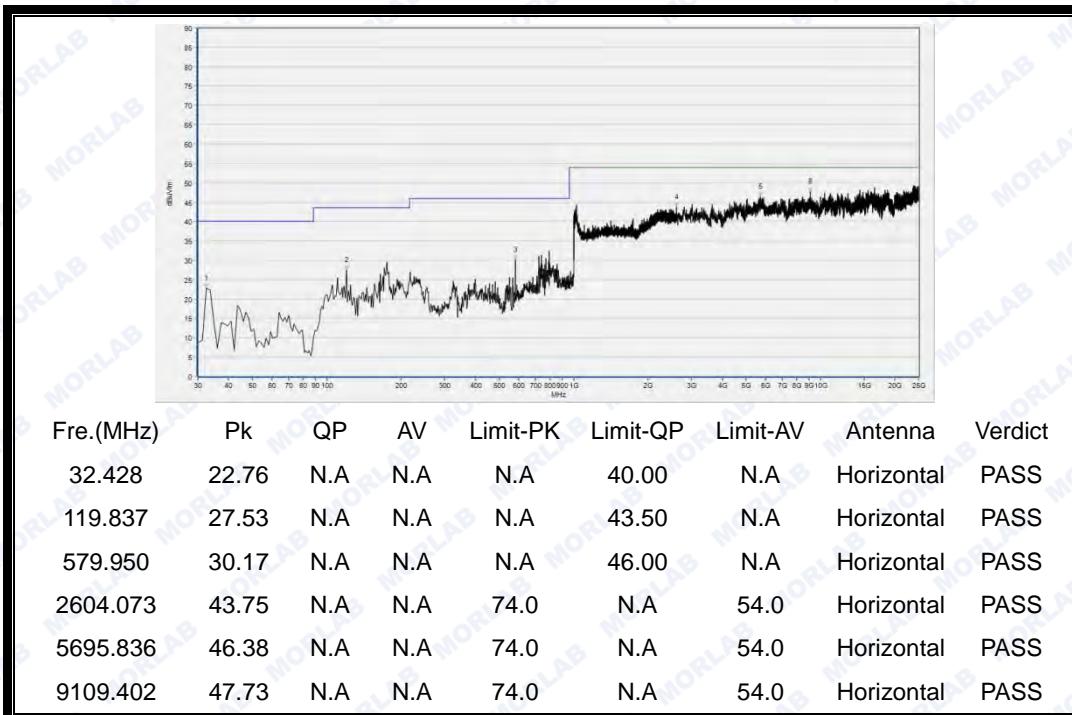
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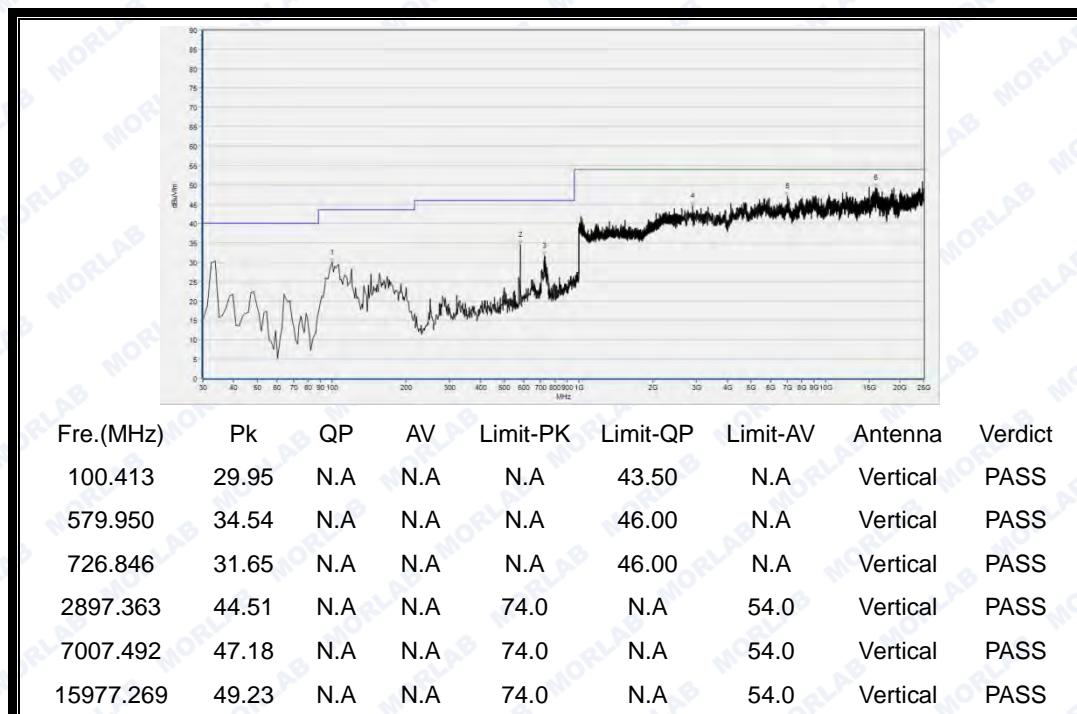


REPORT No.: SZ16020033W01

Plot for Channel = 11



(Antenna Horizontal, 30MHz to 25GHz)



(Antenna Vertical, 30MHz to 25GHz)

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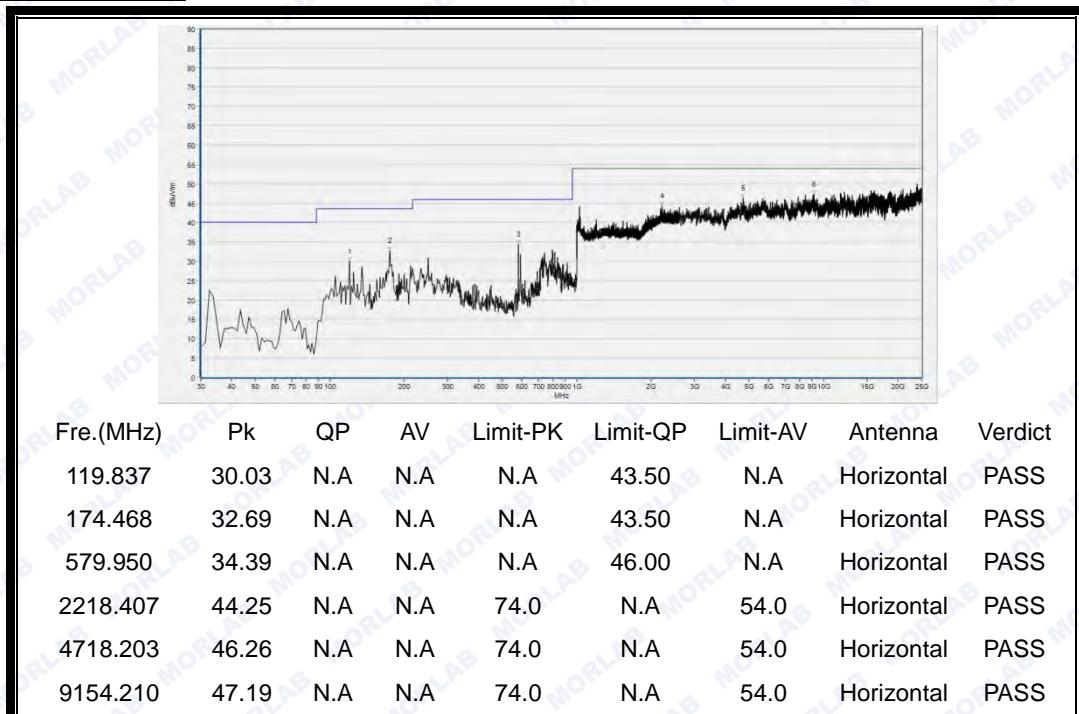


REPORT No.: SZ16020033W01

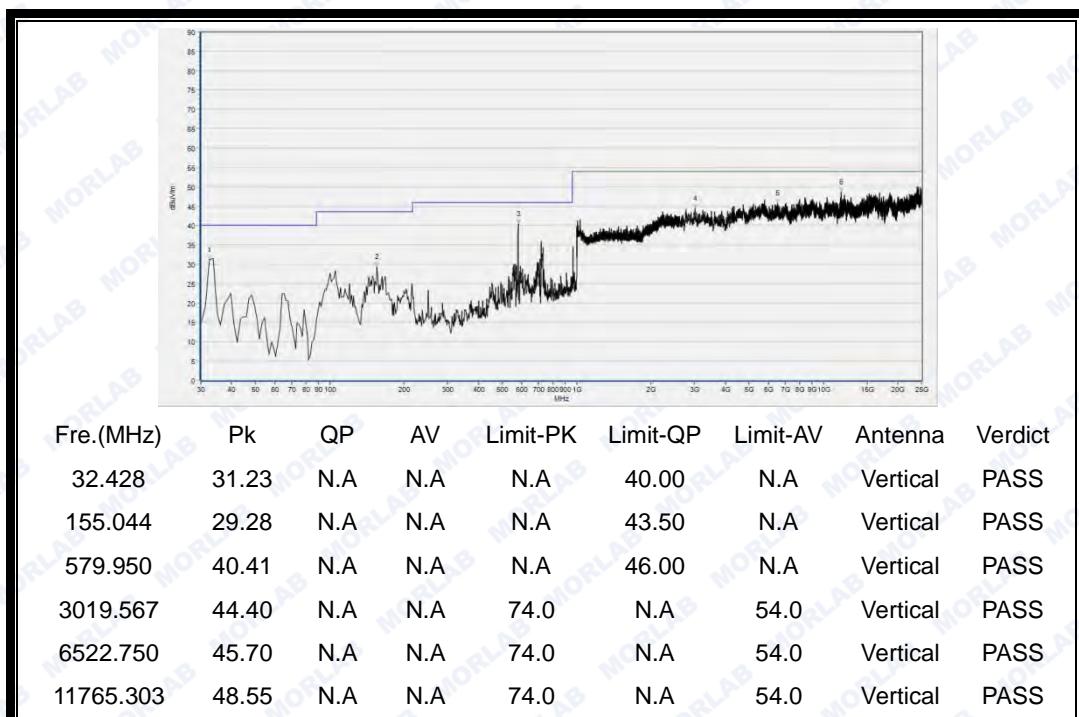
### 2.8.3.3 802.11n-20MHz MIMO Test mode

#### A. Test Plots for the Whole Measurement Frequency Range:

Plots for Channel = 1



(Antenna Horizontal, 30MHz to 25GHz)

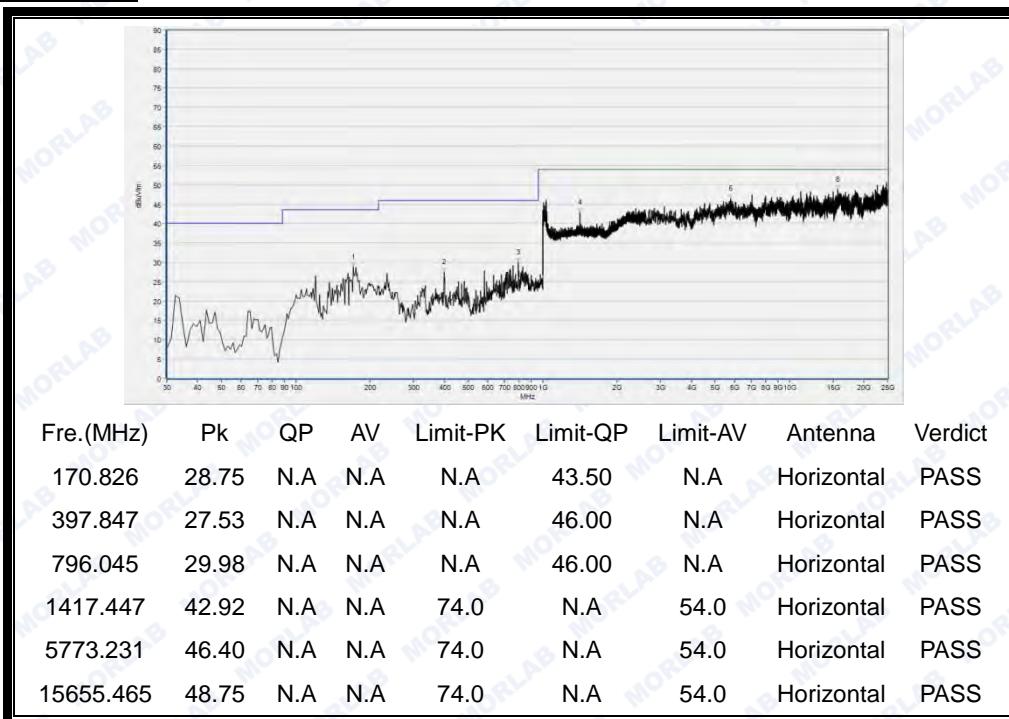


(Antenna Vertical, 30MHz to 25GHz)

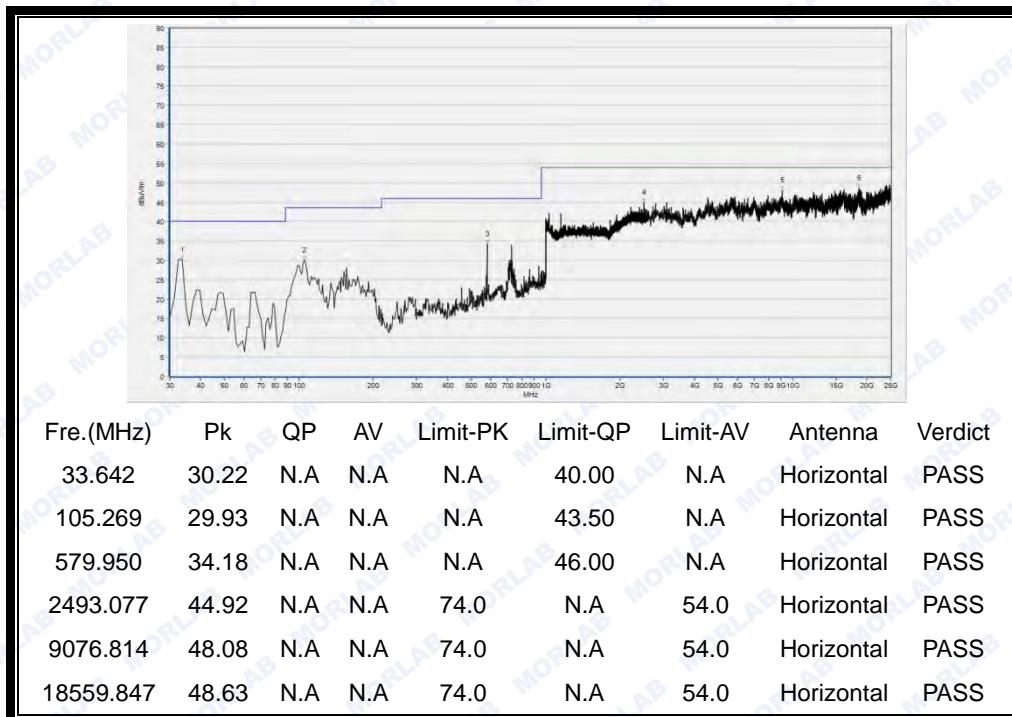


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Plot for Channel = 6



(Antenna Horizontal, 30MHz to 25GHz)



(Antenna Vertical, 30MHz to 25GHz)

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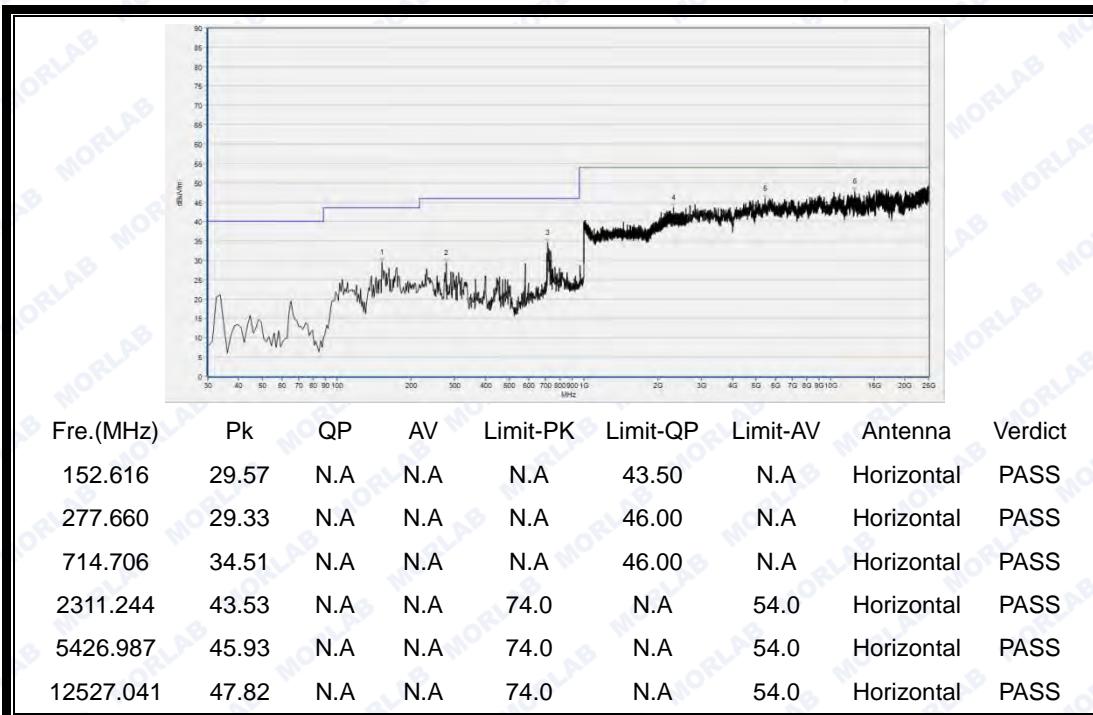
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E-mail: service@morlab.cn

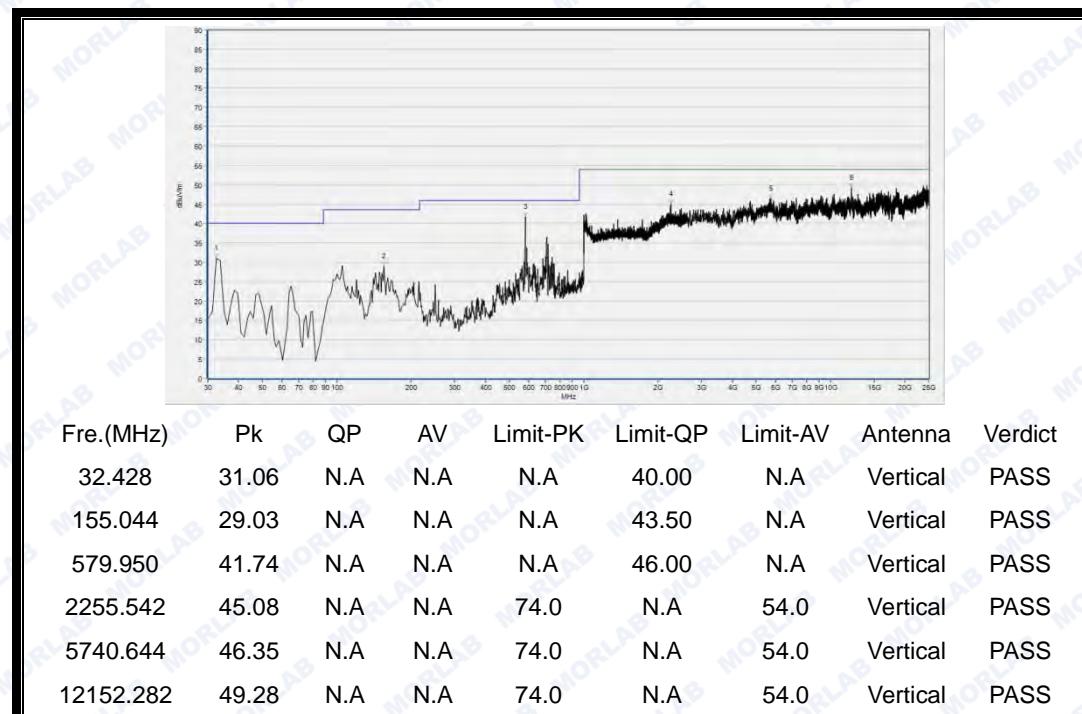


REPORT No.: SZ16020033W01

Plot for Channel = 11



(Antenna Horizontal, 30MHz to 25GHz)



(Antenna Vertical, 30MHz to 25GHz)

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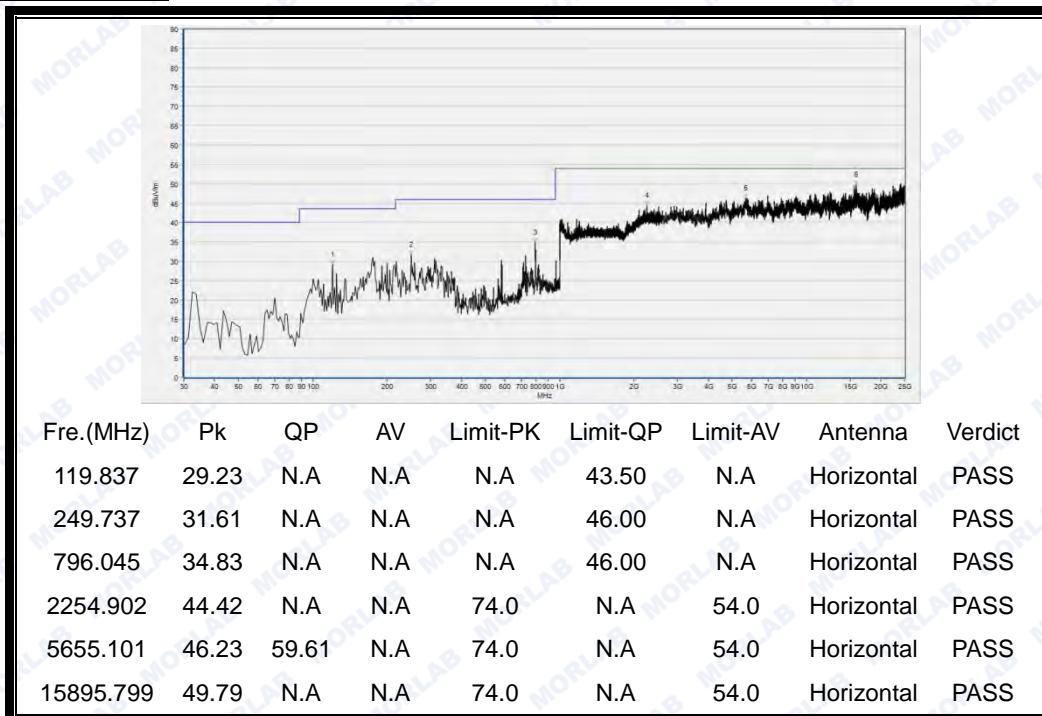


REPORT No.: SZ16020033W01

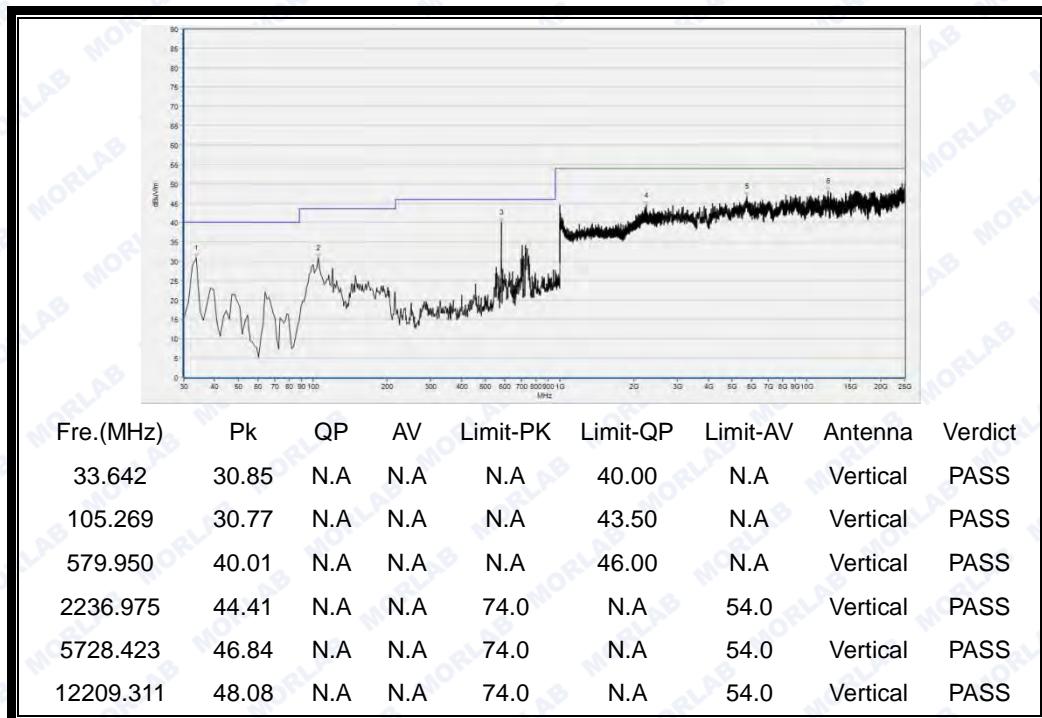
#### 2.8.3.4 802.11n-40MHz MIMO Test mode

##### A. Test Plots for the Whole Measurement Frequency Range:

Plots for Channel = 3



(Plot A.2: Antenna Horizontal, 30MHz to 25GHz)

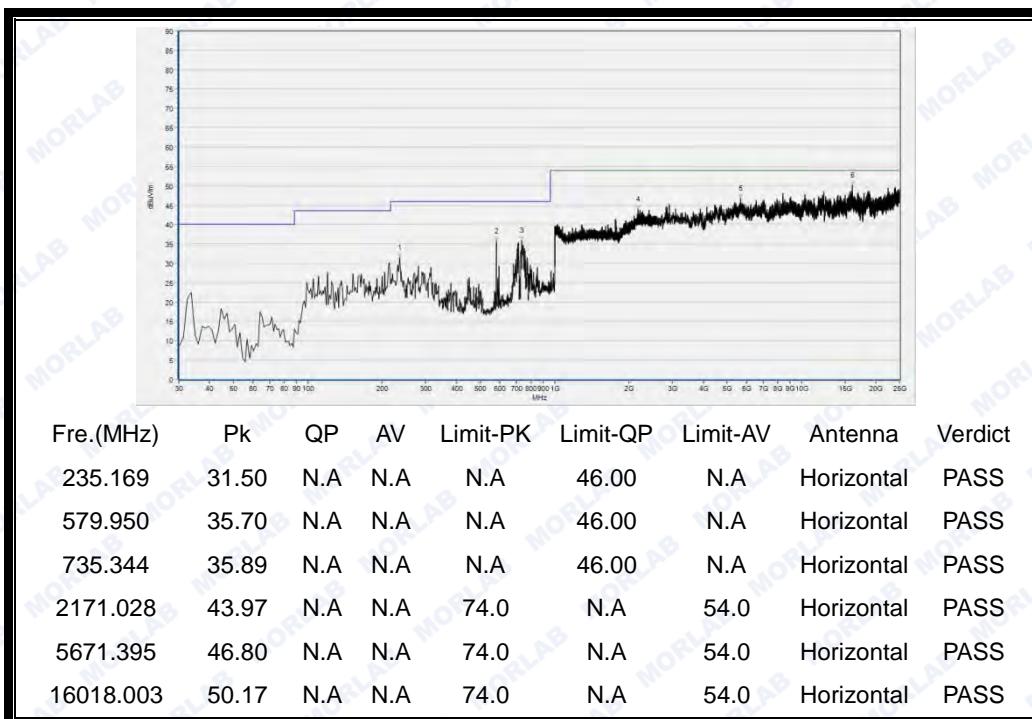


(Plot A.3: Antenna Vertical, 30MHz to 25GHz)

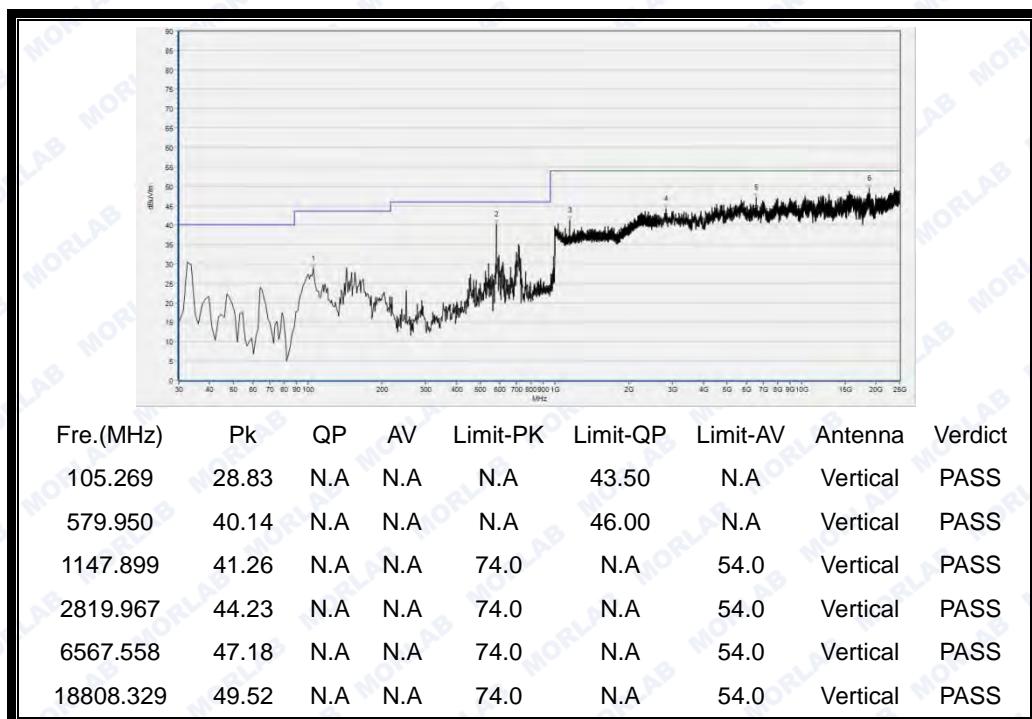


REPORT No.: SZ16020033W01

## Plots for Channel = 6



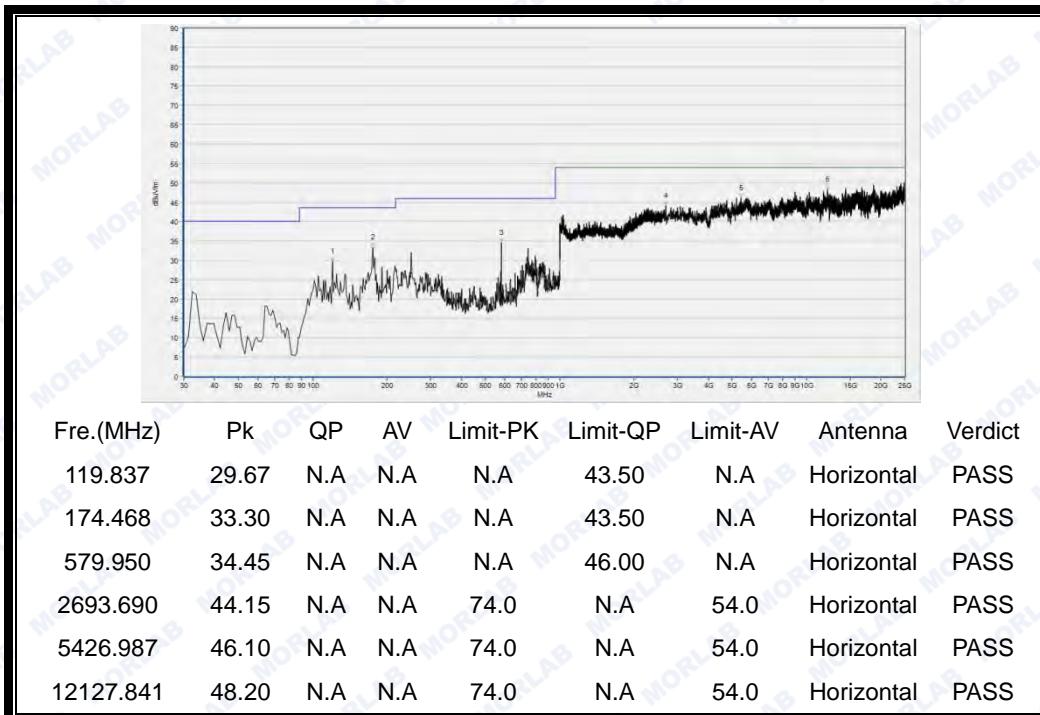
(Plot B.2: Antenna Horizontal, 30MHz to 25GHz)



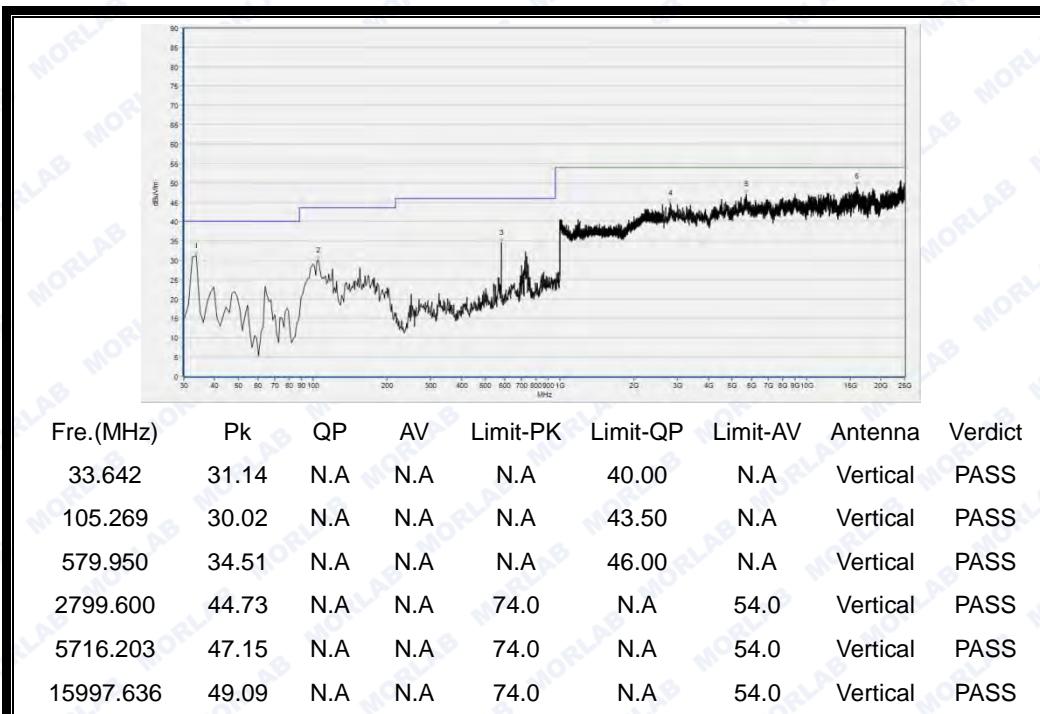
(Plot B.3: Antenna Vertical, 30MHz to 25GHz)



## Plots for Channel = 9



(Plot C.2: Antenna Horizontal, 30MHz to 25GHz)



(Plot C.3: Antenna Vertical, 30MHz to 25GHz)



## ANNEX A GENERAL INFORMATION

### 1.1 Identification of the Responsible Testing Laboratory

Company Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Department:	Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
Responsible Test Lab Manager:	Mr. Su Feng
Telephone:	+86 755 36698555
Facsimile:	+86 755 36698525

### 1.2 Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China

### 1.3 Facilities and Accreditations

Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L3572.

All measurement facilities used to collect the measurement data are located at FL.1, Building A, FeiYang Science Park, Block 67, BaoAn District, Shenzhen, 518101 P. R. China. The test site is constructed in conformance with the requirements of ANSI C63.10 2009, ANSI C63.4 2009 and CISPR Publication 22; the FCC registration number is 695796.

### 1.4 Maximum measurement uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for test performed on the EUT as specified in CISPR 16-1-2:

Measurements	Frequency	Uncertainty
Conducted emissions	9KHz~30MHz	2.44dB
Radiated emissions	30MHz~200MHz	2.93
	200MHz~1000MHz	2.95
	1GHz~18GHz	2.26
	18GHz~40GHz	1.94

This uncertainty represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2



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## 1.5 Test Equipments Utilized

### 1.5.1 Conducted Test Equipments

Conducted Test Equipment						
No.	Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Cal. Due
1	Spectrum Analyzer	MY45101810	E4407B	Agilent	2016.03.02	2017.03.01
2	USB Wideband Power Sensor	MY54210011	U2021XA	Agilent	2016.03.02	2017.03.01
3	EXA Signal Analyzer	MY53470838	N9010A	Agilent	2015.08.26	2016.08.25
4	RF cable (30MHz-26GHz)	CB01	RF01	Morlab	N/A	N/A
5	Attenuator	(n.a.)	10dB	Resnet	N/A	N/A
6	SMA connector <small>Note</small>	CN01	RF03	HUBER-SUHNER	N/A	N/A

**Note:** The SMA antenna connector is soldered on the PCB board in order to perform conducted tests and this SMA antenna connector is listed in the equipment list.

### 1.5.2 Radiated Test Equipments

Radiated Test Equipments						
No.	Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Cal.Due Date
1	System Simulator	GB45360846	8960-E5515 C	Agilent	2016.03.02	2017.03.01
2	Receiver	MY54130016	N9038A	Agilent	2016.03.02	2017.03.01
3	Test Antenna - Bi-Log	N/A	VULB9163	Schwarzbeck	2016.03.02	2017.03.01
4	Test Antenna - Horn	9170C-531	BBHA9170	Schwarzbeck	2016.03.02	2017.03.01
5	Test Antenna - Loop	1519-022	FMZB1519	Schwarzbeck	2016.03.02	2017.03.01
6	Test Antenna - Horn	71688	BBHA 9120D	Schwarzbeck	2016.03.02	2017.03.01
7	Coaxial cable (N male) (9KHz-30MHz)	CB04	EMC04	Morlab	N/A	N/A
8	Coaxial cable (N male) (30MHz-26GHz)	CB02	EMC02	Morlab	N/A	N/A
9	Coaxial cable (N male) (30MHz-26GHz)	CB03	EMC03	Morlab	N/A	N/A
10	1-18GHz pre-Amplifier	MA02	TS-PR18	Rohde&Schwarz	2016.03.02	2017.03.01



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11	18-26.5GHz pre-Amplifier	MA03	TS-PR18	Rohde&Schwarz	2016.03.02	2017.03.01
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#### 1.5.3 Climate Chamber

##### Climate Chamber

No.	Equipment Name	Serial No.	Type	Manufacturer	Cal.Date	Cal.Due Date
1	Climate Chamber	2004012	HL4003T	Yinhe	2016.03.02	2017.03.01

#### 1.5.4 Vibration Table

##### Vibration Table

No.	Equipment Name	Serial No.	Type	Manufacturer	Cal.Date	Cal.Due Date
1	Vibration Table	N/A	ACT2000-S015L	CMI-COM	2016.03.02	2017.03.01

#### 1.5.5 Anechoic Chamber

##### Anechoic Chamber

No.	Equipment Name	Serial No.	Type	Manufacturer	Cal.Date	Cal.Due Date
1	Anechoic Chamber	N/A	9m*6m*6m	Changning	2016.03.02	2017.03.01

#### 1.5.6 Auxiliary Test Equipment

##### Auxiliary Test Equipment

No.	Equipment Name	Model No.	Brand Name	Manufacturer	Cal.Date	Cal.Due Date
1	Computer	T430i	Think Pad	Lenovo	N.A	N.A
2	AC Adapter	GSCU2000S0 12V24G	GSP	N.A	N.A	N.A

Note: AC adapter rated input: ~ 100-240V, 50/60Hz, 800mA max; rated output: == 12V, 2000mA.

\*\*\*\*\* END OF REPORT \*\*\*\*\*