



TEST REPORT

APPLICANT : Nanjing Juplink Intelligent Technologies Co., Ltd.

PRODUCT NAME : Dual-band Gigabit Router

MODEL NAME : RX4-1800

BRAND NAME : JupLink

FCC ID : 2AT9Z-RX4-1800

STANDARD(S) : 47 CFR Part 15 Subpart C

RECEIPT DATE : 2020-01-07

TEST DATE : 2020-02-18 to 2020-05-26

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Change History		
Version	Date	Reason for change
1.0	2020-06-15	First edition



1. Technical Information

Note: Provide by applicant.

1.1. Applicant and Manufacturer Information

Applicant:	Nanjing Juplink Intelligent Technologies Co., Ltd.
Applicant Address:	No. 757, Dixiu Road, Binjiang Economic Development Zone, Jiangning District, Nanjing China
Manufacturer:	Sichuan Tianyi Comheart Telecom Co., Ltd.
Manufacturer Address:	No. 198, Section 1, Xueshan Avenue, Dayi County, Chengdu, Sichuan, China

1.2. Equipment Under Test (EUT) Description

Product Name:	Dual-band Gigabit Router
Serial No:	(N/A, marked #1 by test site)
Hardware Version:	V1.0.0
Software Version:	V1.0.1
Modulation Type:	DSSS, OFDM
Operating 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
Antenna Type:	Dipole Antenna
Antenna Gain:	Ant 5 dBi

Note 1: The EUT is 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 $F \text{ (MHz)} = 2412 + 5 * (n - 1)$ ($1 \leq n \leq 11$). 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 $F \text{ (MHz)} = 2412 + 5 * (n - 1)$ ($3 \leq n \leq 9$). The lowest, middle, highest channel numbers of the EUT used and tested in this report are separately 3 (2422MHz), 6 (2437MHz) and 9 (2452MHz).

Note 2: During test, the duty cycle of the EUT was setting to 100%.

Note 3: The EUT has two antennas and supports a MIMO function.



Modulation Mode:	TX Function
802.11b	1TX
802.11g	1TX
802.11n20	2TX
802.11n40	2TX

Note 4: The EUT connected to the serial port of the computer with a serial communication cable, we use the dedicated software to control the EUT continuous transmission.

Note 5: For conducted test item Maximum conducted output Power and Peak Power spectral density of each modulation mode, we recorded the test result of two antennas separately, for other conducted test items both of the two antennas were tested separately, we only recorded the worst test result(Ant 0) in this report.

Note 6:All radiation test items for 802.11n modulation mode operate at MIMO mode during the test. Other modulation mode operate at SISO mode, both of the two antennas were tested separately, we only recorded the worst test result(ANT0) in this report.

Note 7: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

1.3. Modulation Type and Data Rate of EUT

Modulation technology	Modulation Type	Data Rate (Mbps) <small>Note1</small>
DSSS (802.11b)	DBPSK	1
	DQPSK	2
	CCK	5.5/ 11
OFDM (802.11g)	BPSK	6 / 9
	QPSK	12 / 18
	16QAM	24 / 36
	64QAM	48 / 54
OFDM (802.11n-20/40MHz)	BPSK	6.5
	QPSK	13/19.5
	16QAM	26/39
	64QAM	52/58.5/65

Note1: The worst-case mode (bold face) in all data rates has been determined during the pre-scan, only the test data of the worst-case were recorded in this report.



1.4. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C for the EUT FCC ID Certification:

No	Identity	Document Title
1	47 CFR Part 15	Radio Frequency Devices

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

No.	Section	Description	Test Date	Test Engineer	Result
1	15.203	Antenna Requirement	N/A	N/A	PASS
2	15.247(b)	Output Power	Feb 18, 2020 Feb 21, 2020	Lai Huihuang	PASS
3	15.247(a)	Bandwidth	Feb 18, 2020 Feb 21, 2020	Lai Huihuang	PASS
4	15.247(d)	Conducted Spurious Emission and Band Edge	Feb 18, 2020 Feb 21, 2020	Lai Huihuang	PASS
5	15.247(e)	Power spectral density (PSD)	Feb 18, 2020 Feb 21, 2020	Lai Huihuang	PASS
6	15.247(d)	Restricted Frequency Bands	May 19, 2020 May 26, 2020	Yaming Luo	PASS
7	15.207	Conducted Emission	May 25, 2020	Yaming Luo	PASS
8	15.209, 15.247(d)	Radiated Emission	May 19, 2020 May 26, 2020	Yaming Luo	PASS

Note: The tests of Conducted Emission and Radiated Emission were performed according to the method of measurements prescribed in ANSI C63.10 2013 and KDB558074 D01 v04.

1.5. Environmental 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. 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

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 50Ohm; the path loss as the factor is calibrated to correct the reading.

B. Equipments List:

Please refer ANNEX B(4).

2.2.3. Test Result

Duty Cycle Factor

Mode	Channel	Frequency (MHz)	T _{on} (ms)	T _(on+off) (ms)	Duty Cycle (%)	Duty Cycle Factor
802.11b	6	2437	100	100	100	0
802.11g	6	2437	100	100	100	0
802.11n-20MHz	6	2437	100	100	100	0
802.11n-40MHz	6	2437	100	100	100	0



Output Average Power ANT0

Mode	Channel	Frequency (MHz)	Output Average Power		Limit		Verdict
			dBm	W	dBm	W	
802.11 b	1	2412	17.52	0.056	30	1	PASS
	6	2437	17.47	0.056			PASS
	11	2462	17.30	0.054			PASS
802.11 g	1	2412	16.56	0.045			PASS
	6	2437	16.69	0.047			PASS
	11	2462	16.49	0.045			PASS
802.11 HT20	1	2412	16.65	0.046			PASS
	6	2437	16.51	0.045			PASS
	11	2462	16.38	0.043			PASS
802.11 HT40	3	2422	16.91	0.049			PASS
	6	2437	16.74	0.047			PASS
	9	2452	16.68	0.047			PASS

Output Average Power ANT1

Mode	Channel	Frequency (MHz)	Output Average Power		Limit		Verdict
			dBm	W	dBm	W	
802.11 b	1	2412	17.41	0.055	30	1	PASS
	6	2437	17.18	0.052			PASS
	11	2462	17.13	0.052			PASS
802.11 g	1	2412	16.57	0.045			PASS
	6	2437	16.55	0.045			PASS
	11	2462	16.39	0.044			PASS
802.11 HT20	1	2412	16.65	0.046			PASS
	6	2437	16.48	0.044			PASS
	11	2462	16.29	0.043			PASS
802.11 HT40	3	2422	16.39	0.044			PASS
	6	2437	16.38	0.043			PASS
	9	2452	16.36	0.043			PASS



Total Average Power (ANT0+ANT1)

Mode	Channel	Frequency (MHz)	Output Average Power		Limit		Verdict
			dBm	W	dBm	W	
802.11 HT20	1	2412	20.360	0.109	30	1	PASS
	6	2437	20.378	0.109			PASS
	11	2462	20.487	0.112			PASS
802.11 HT40	3	2422	20.385	0.109			PASS
	6	2437	20.300	0.107			PASS
	9	2452	20.332	0.108			PASS

Output Peak Power ANT0

Mode	Channel	Frequency (MHz)	Output Peak Power		Limit		Verdict
			dBm	W	dBm	W	
802.11 b	1	2412	17.72	0.059	30	1	PASS
	6	2437	17.49	0.056			PASS
	11	2462	17.39	0.055			PASS
802.11 g	1	2412	16.63	0.046			PASS
	6	2437	16.85	0.048			PASS
	11	2462	16.81	0.048			PASS
802.11 HT20	1	2412	16.83	0.048			PASS
	6	2437	16.79	0.048			PASS
	11	2462	16.70	0.047			PASS
802.11 HT40	3	2422	16.92	0.049			PASS
	6	2437	16.94	0.049			PASS
	9	2452	16.78	0.048			PASS



Output Peak Power ANT1

Mode	Channel	Frequency (MHz)	Output Peak Power		Limit		Verdict
			dBm	W	dBm	W	
802.11 b	1	2412	17.50	0.056	30	1	PASS
	6	2437	17.43	0.055			PASS
	11	2462	17.32	0.054			PASS
802.11 g	1	2412	16.67	0.046			PASS
	6	2437	16.57	0.045			PASS
	11	2462	16.46	0.044			PASS
802.11 HT20	1	2412	16.70	0.047			PASS
	6	2437	16.55	0.045			PASS
	11	2462	16.35	0.043			PASS
802.11 HT40	3	2422	16.77	0.048	PASS		
	6	2437	16.72	0.047	PASS		
	9	2452	16.71	0.047	PASS		

Total Peak Power (ANT0+ANT1)

Mode	Channel	Frequency (MHz)	Output Peak Power		Limit		Verdict
			dBm	W	dBm	W	
802.11 HT20	1	2412	20.418	0.110	30	1	PASS
	6	2437	20.383	0.109			PASS
	11	2462	20.524	0.113			PASS
802.11 HT40	3	2422	20.441	0.111			PASS
	6	2437	20.324	0.108			PASS
	9	2452	20.447	0.111			PASS

Note: The duty cycle factor has been compensated into the test result

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 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 8.1 Option 1 was used in order to prove compliance.

B. Equipments List:

Please refer ANNEX B(4).



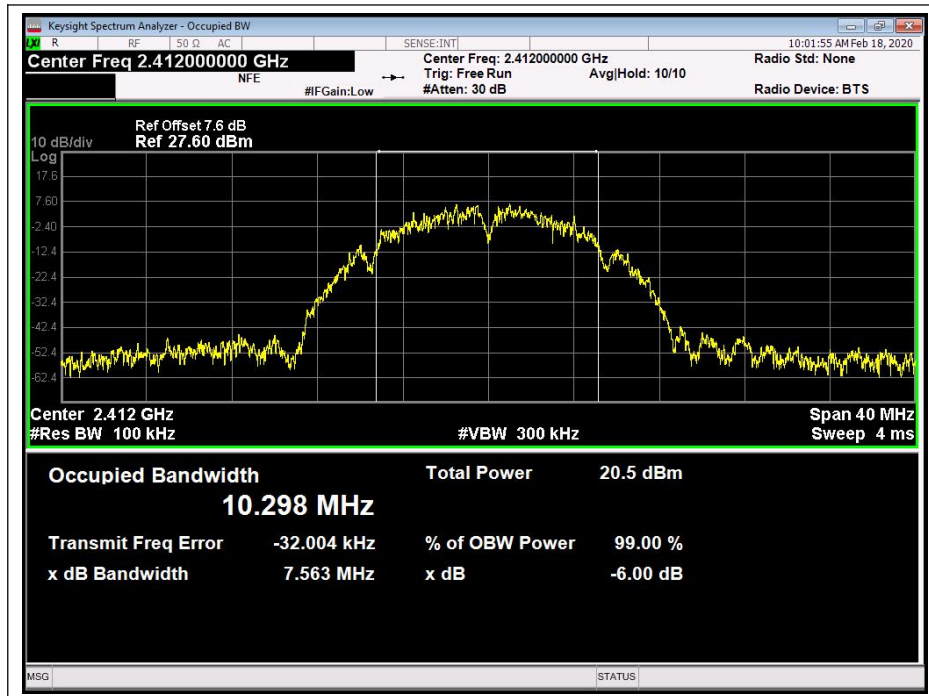
2.3.3. Test Result

802.11b Test mode

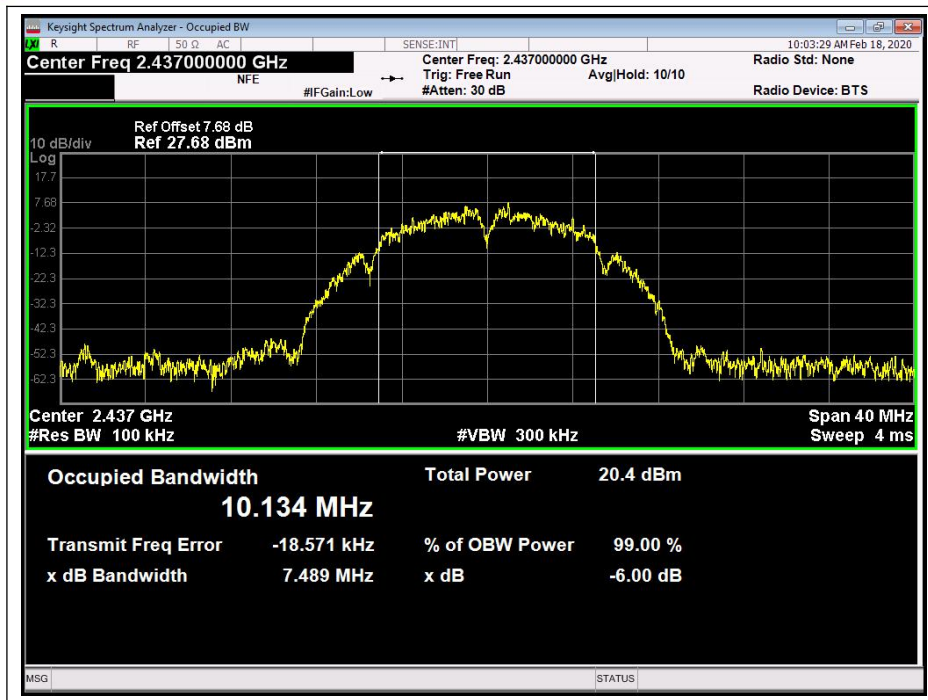
A. Test Verdict:

Channel	Frequency (MHz)	ANT0 6 dB Bandwidth (MHz)	Limits(kHz)	Result
1	2412	7.56	≥500	PASS
6	2437	7.49	≥500	PASS
11	2462	6.11	≥500	PASS

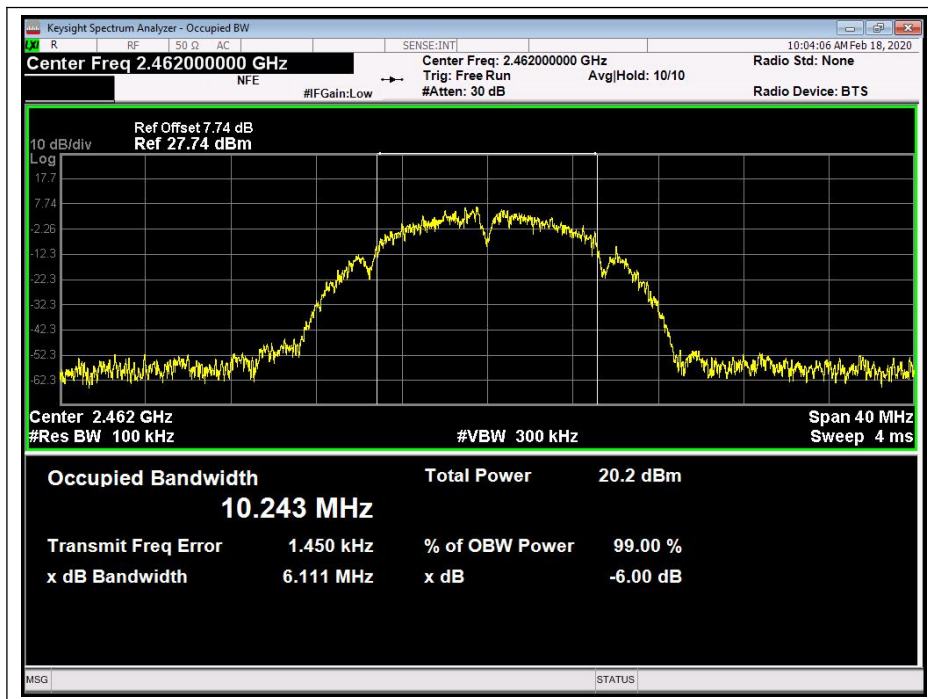
B. Test Plots



(Channel 1, 2412MHz, 802.11b)



(Channel 6, 2437 MHz, 802.11b)



(Channel 11, 2462MHz, 802.11b)

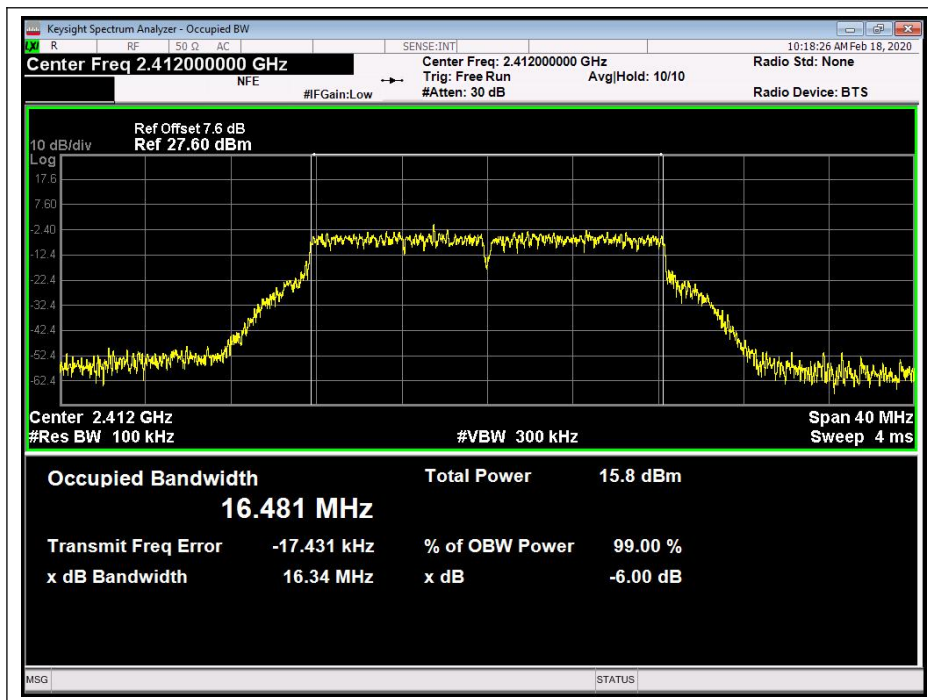


802.11g Test mode

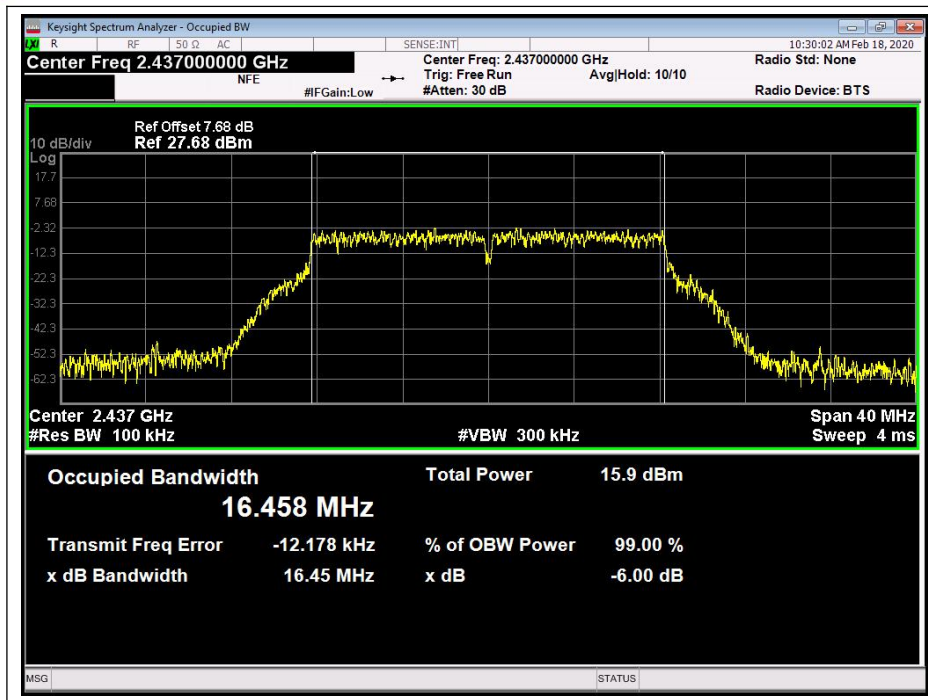
A. Test Verdict:

Channel	Frequency (MHz)	ANT0 6 dB Bandwidth (MHz)	Limits (kHz)	Result
1	2412	16.34	≥500	PASS
6	2437	16.45	≥500	PASS
11	2462	16.29	≥500	PASS

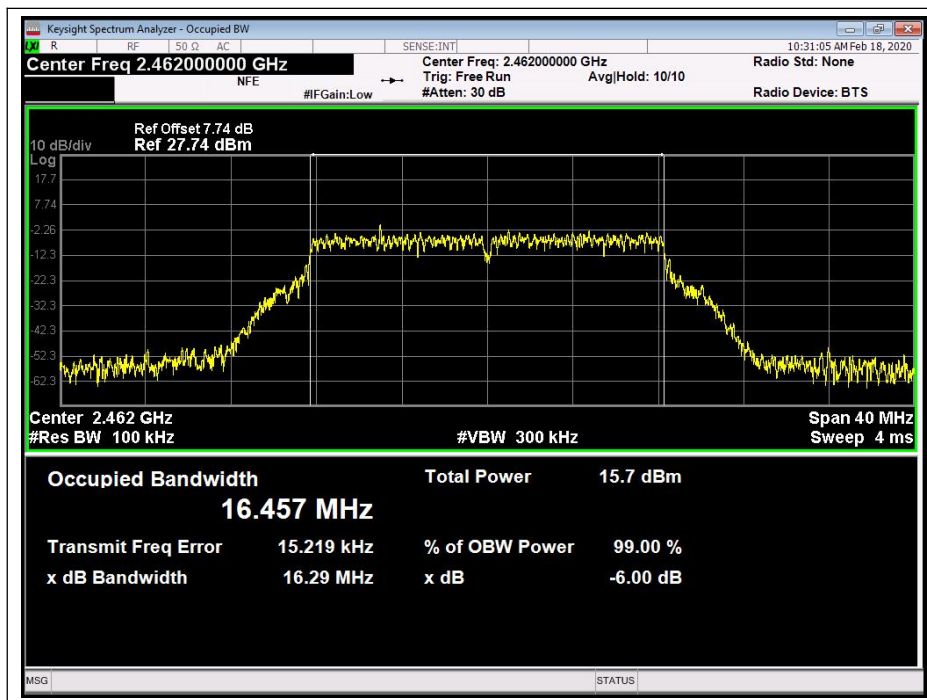
B. Test Plots:



(Channel 1, 2412MHz, 802.11g)



(Channel 6, 2437MHz, 802.11g)



(Channel 11, 2462MHz, 802.11g)

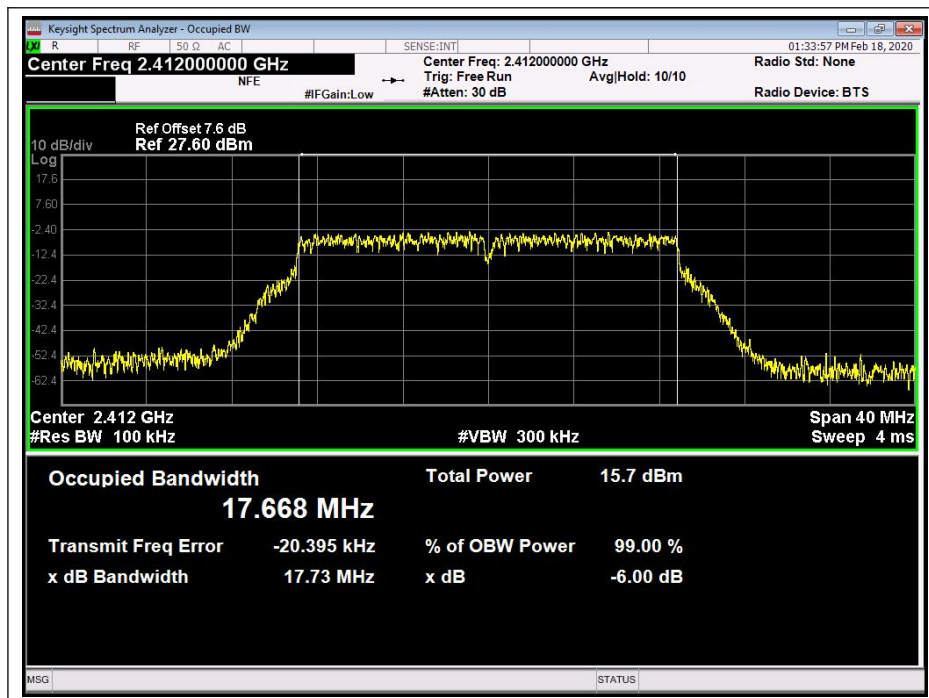


802.11n-20 Test mode

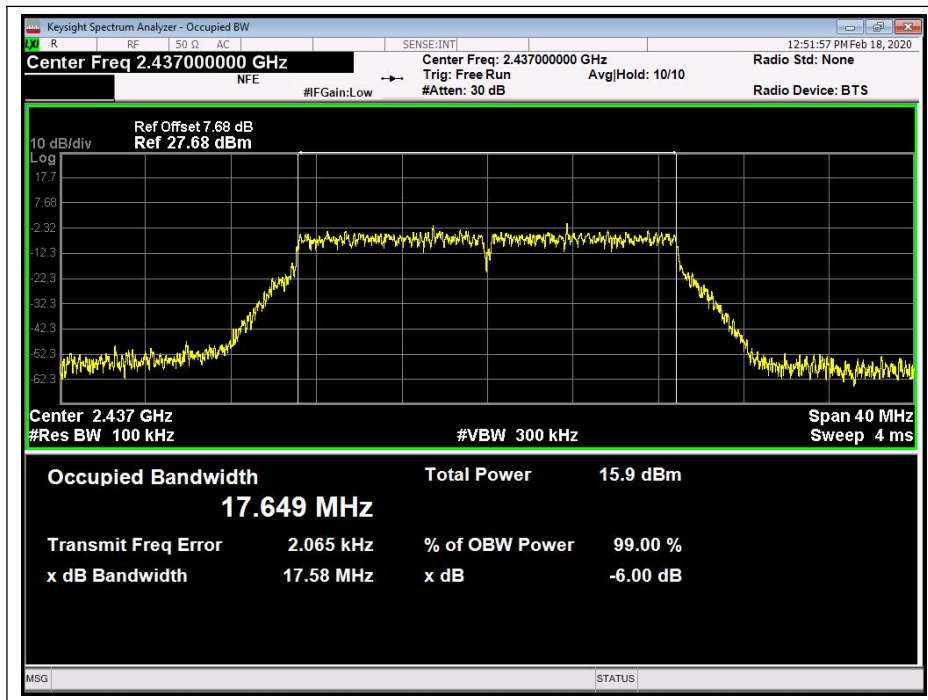
A. Test Verdict:

Channel	Frequency (MHz)	ANT0 6 dB Bandwidth (MHz)	Limits (kHz)	Result
1	2412	17.73	≥500	PASS
6	2437	17.58	≥500	PASS
11	2462	17.56	≥500	PASS

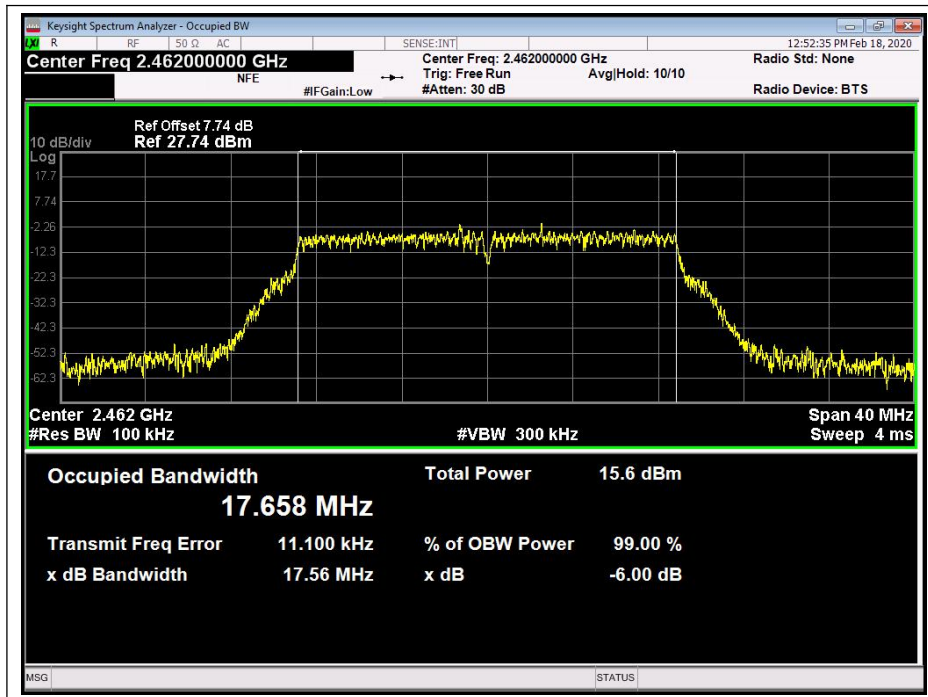
B. Test Plots:



(Channel 1, 2412MHz, 802.11n-20)



(Channel 6, 2437MHz, 802.11n-20)



(Channel 11, 2462MHz, 802.11n-20)

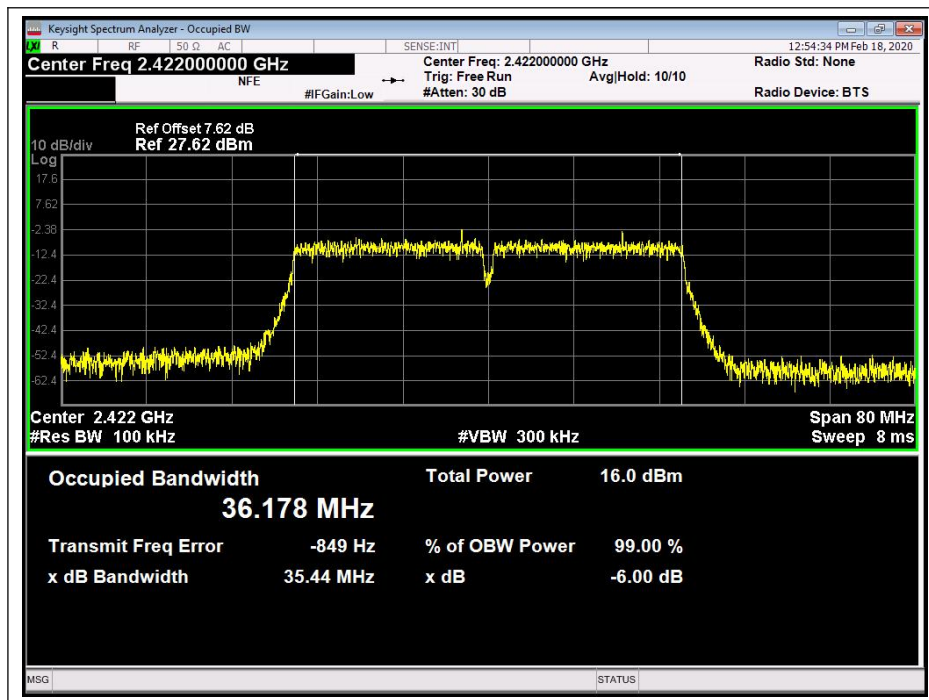


802.11n-40 Test mode

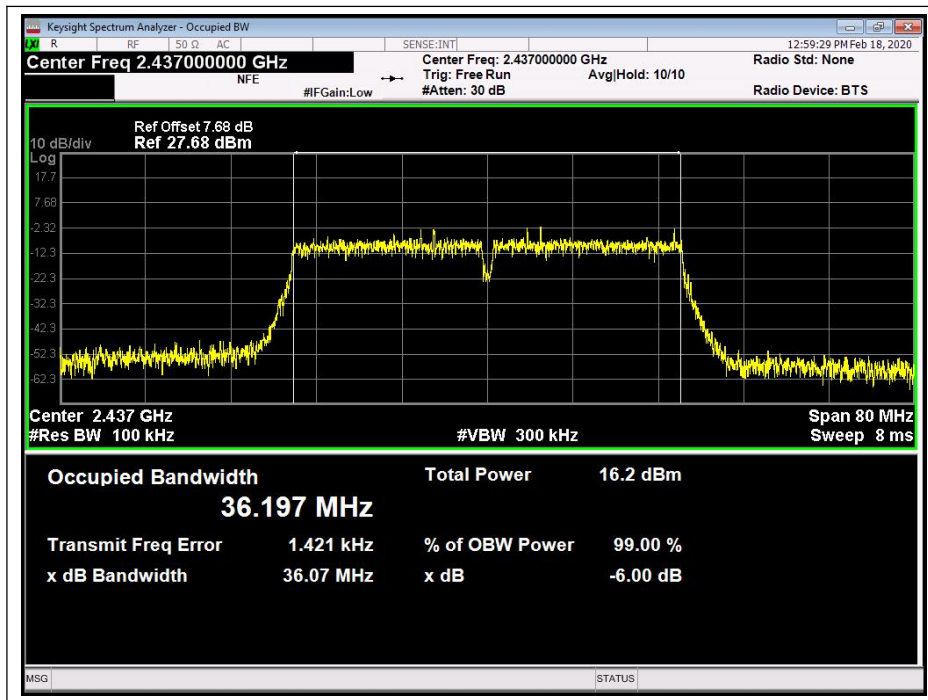
A. Test Verdict:

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits (kHz)	Result
3	2422	35.44	≥500	PASS
6	2437	36.07	≥500	PASS
9	2452	36.13	≥500	PASS

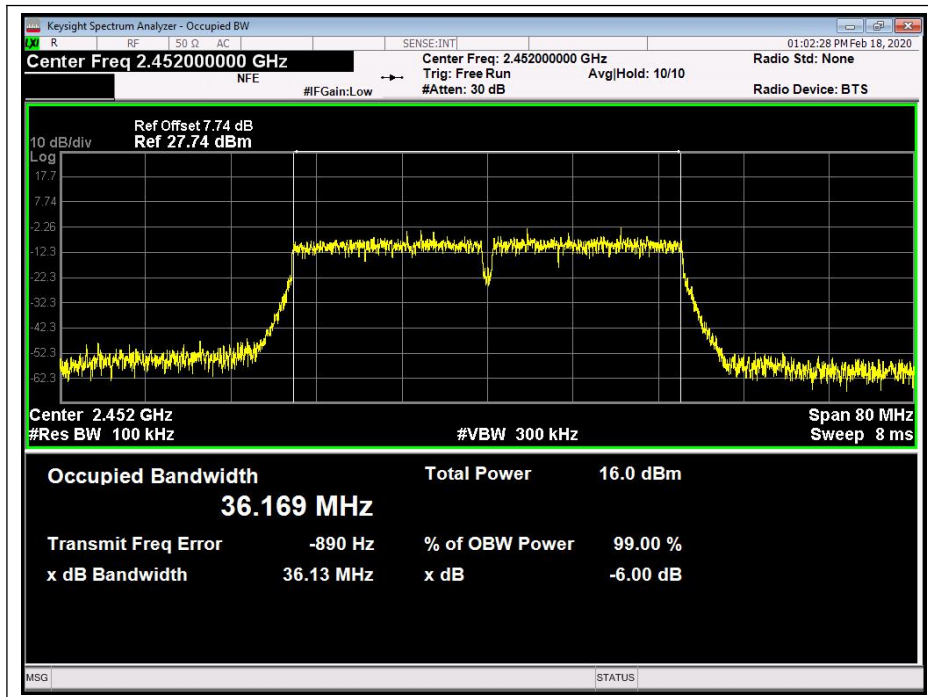
B. Test Plots:



(Channel 3, 2422Mz, 802.11n-40)



(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.

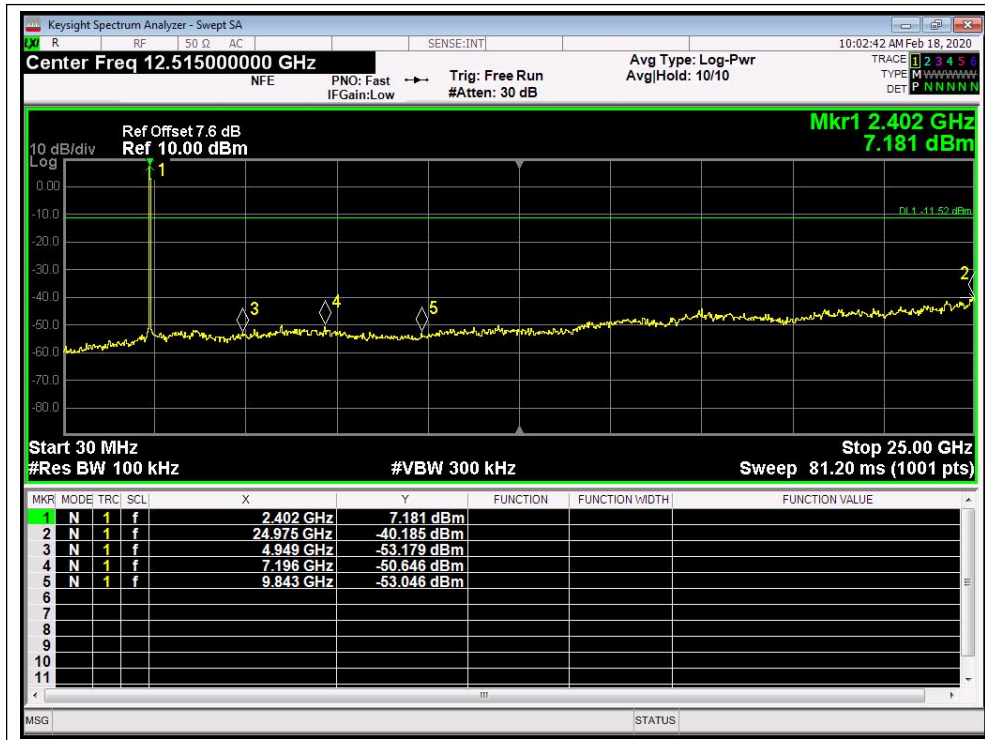
KDB 558074 Section 11.0 was used in order to prove compliance.

B. Equipments List:

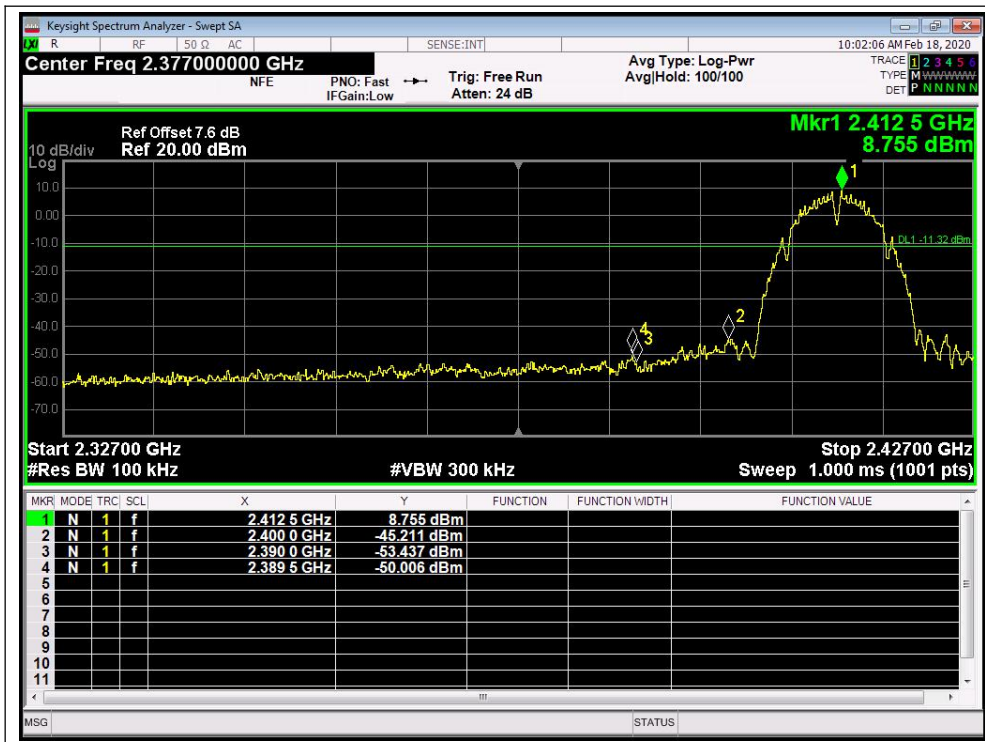
Please refer ANNEX B(4).



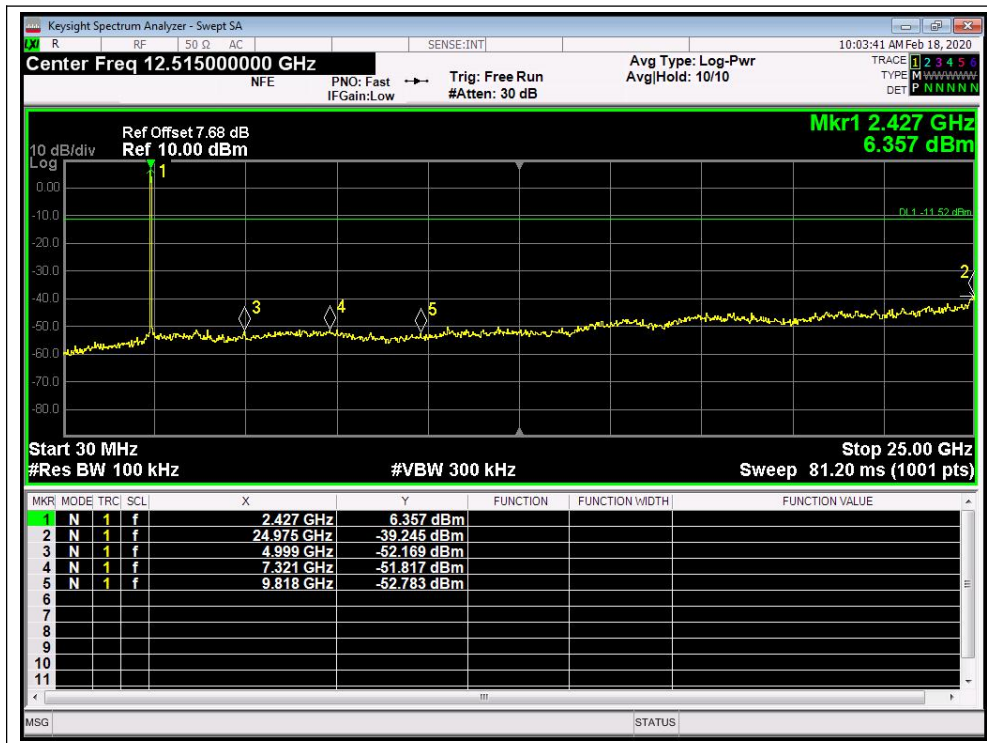
2.4.3. Test Result



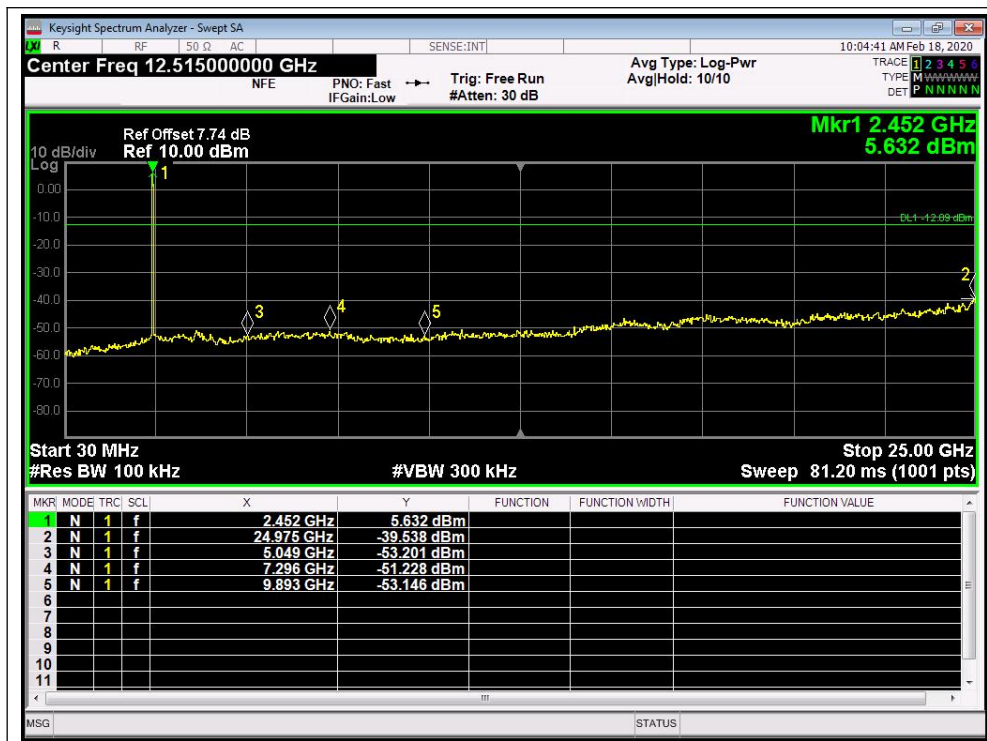
(802.11 b, Channel = 1, 30MHz to 25GHz)



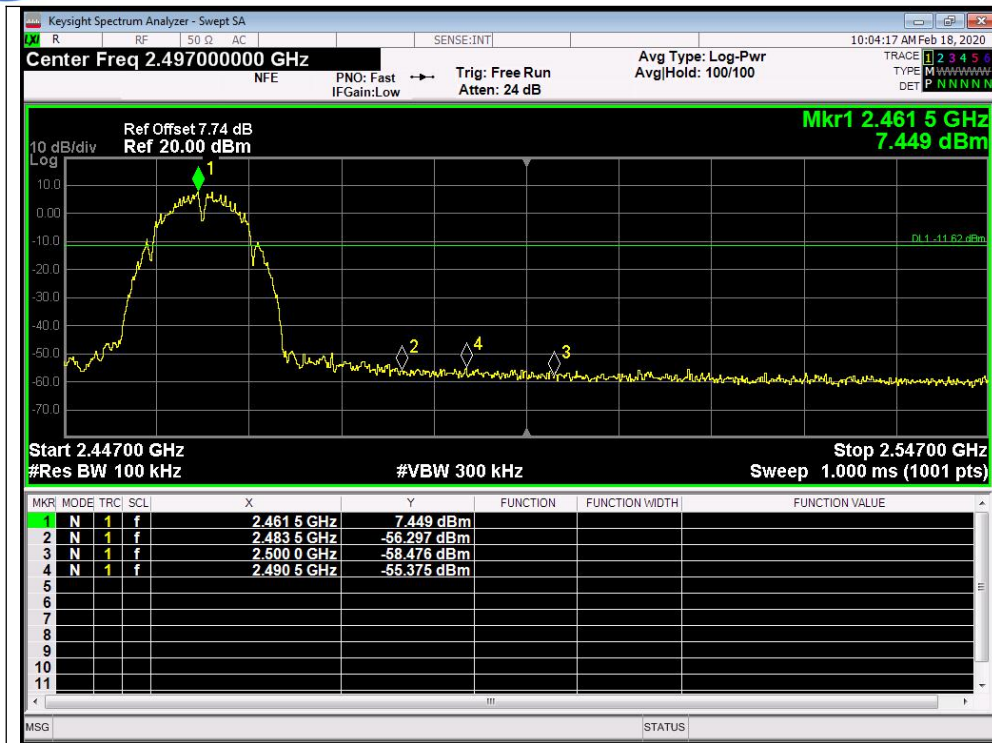
(802.11 b, Band Edge @ Channel = 1)



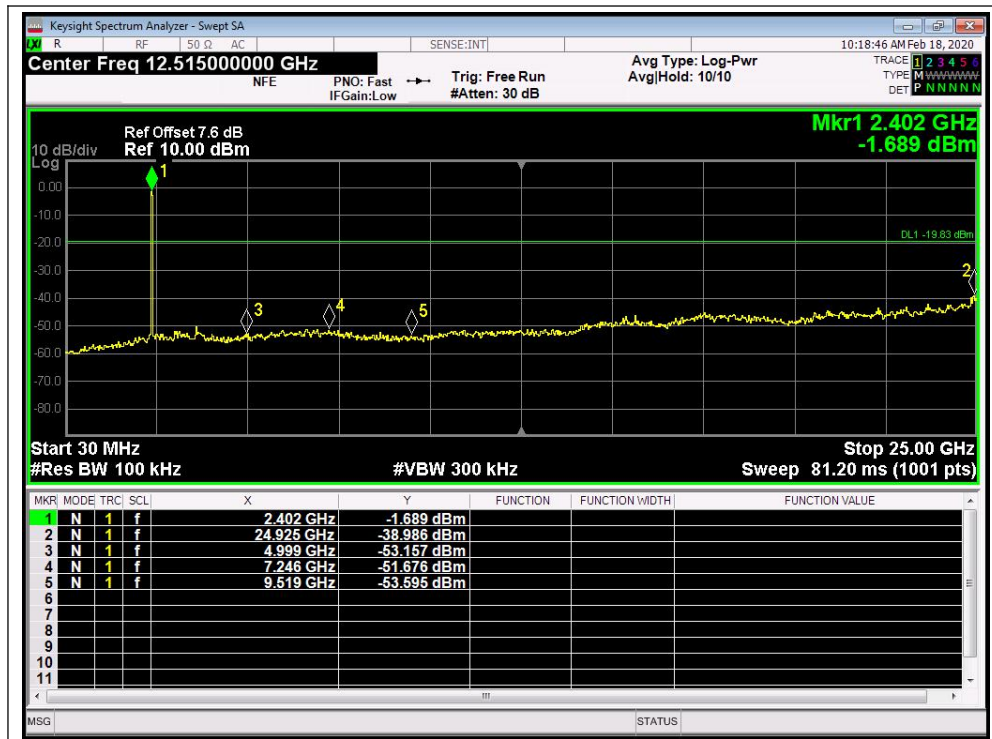
(802.11 b, Channel = 6, 30MHz to 25GHz)



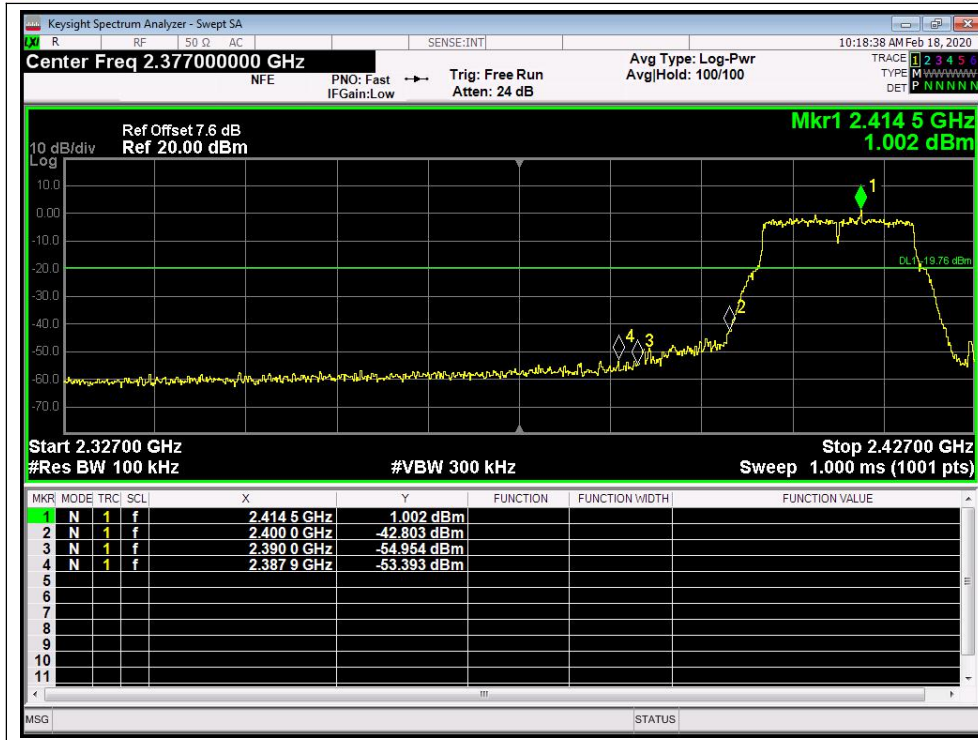
(802.11 b, Channel = 11, 30MHz to 25GHz)



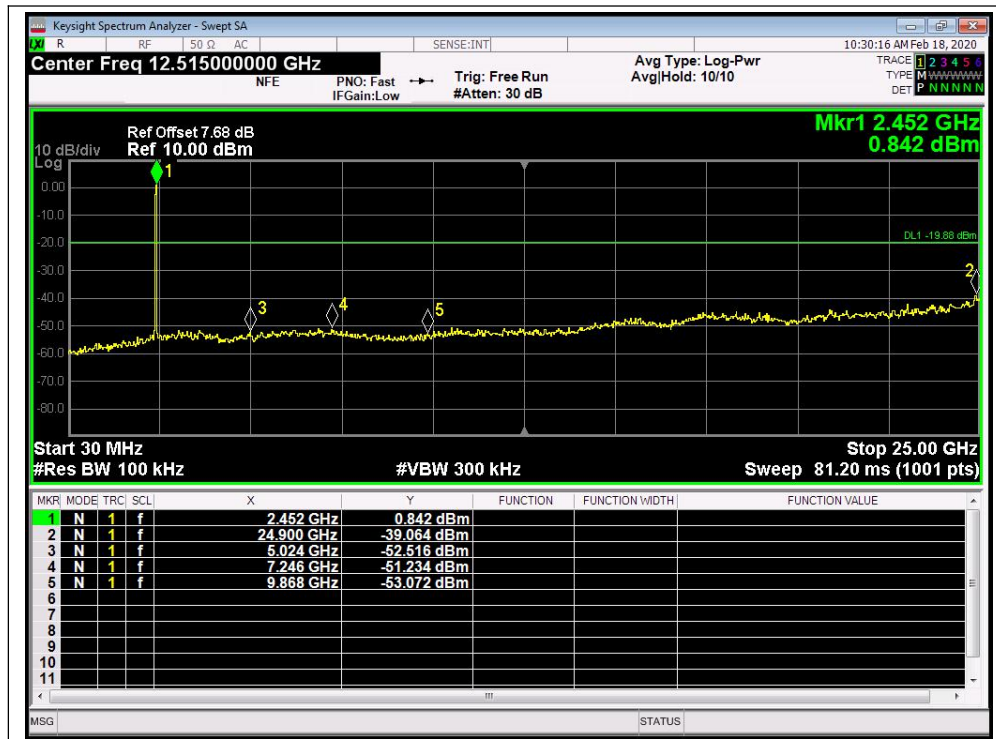
(802.11 b, Band Edge @ Channel = 11)



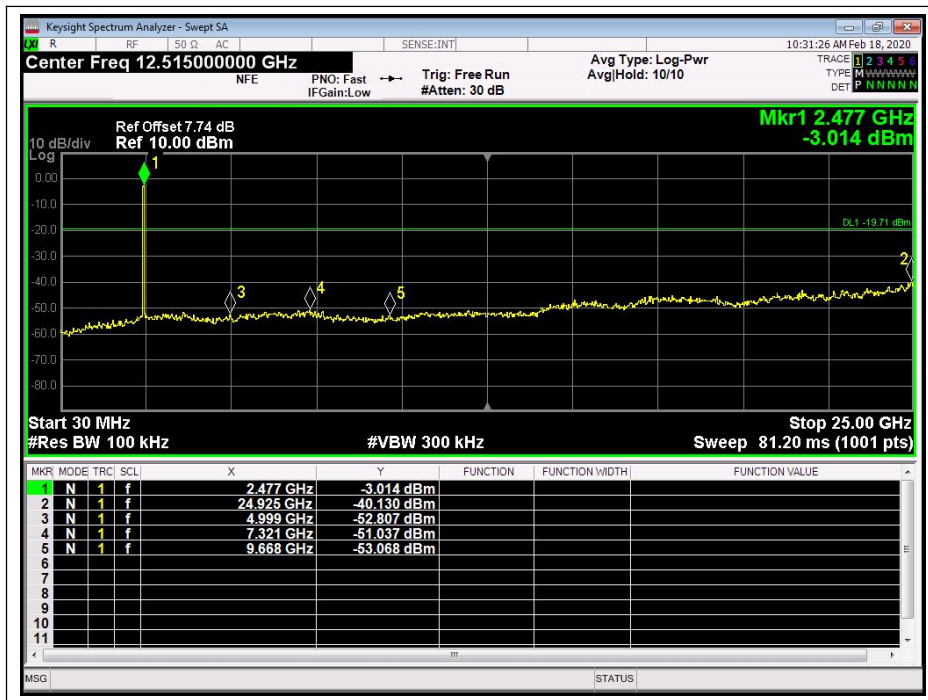
(802.11 g, Channel = 1, 30MHz to 25GHz)



(802.11 g, Band Edge @ Channel = 1)



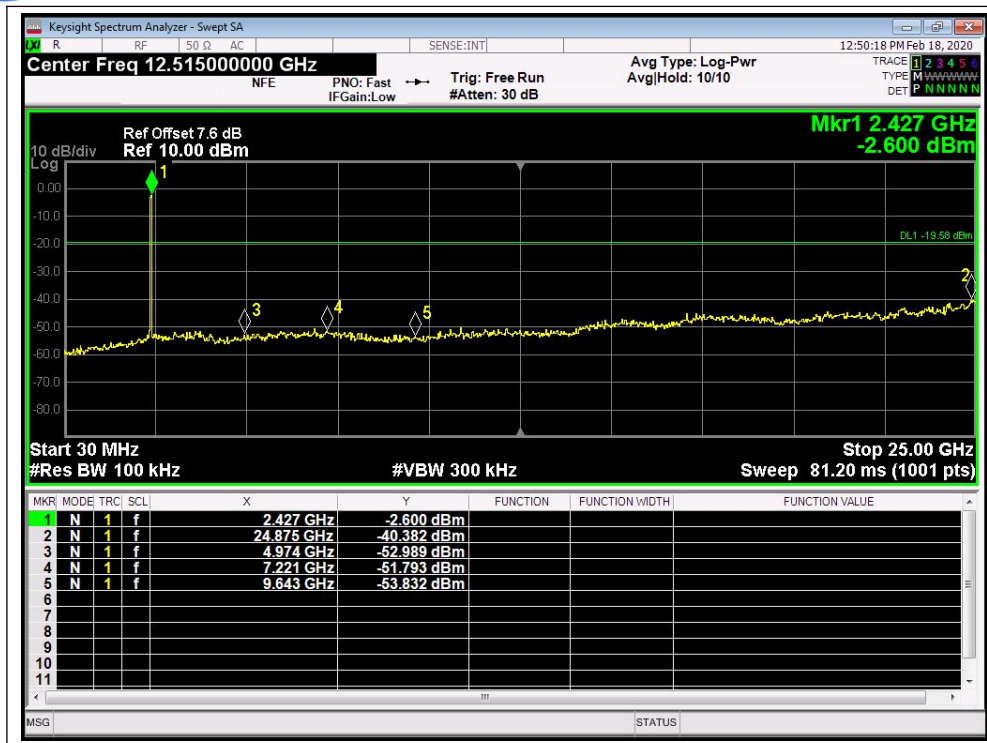
(802.11 g, Channel = 6, 30MHz to 25GHz)



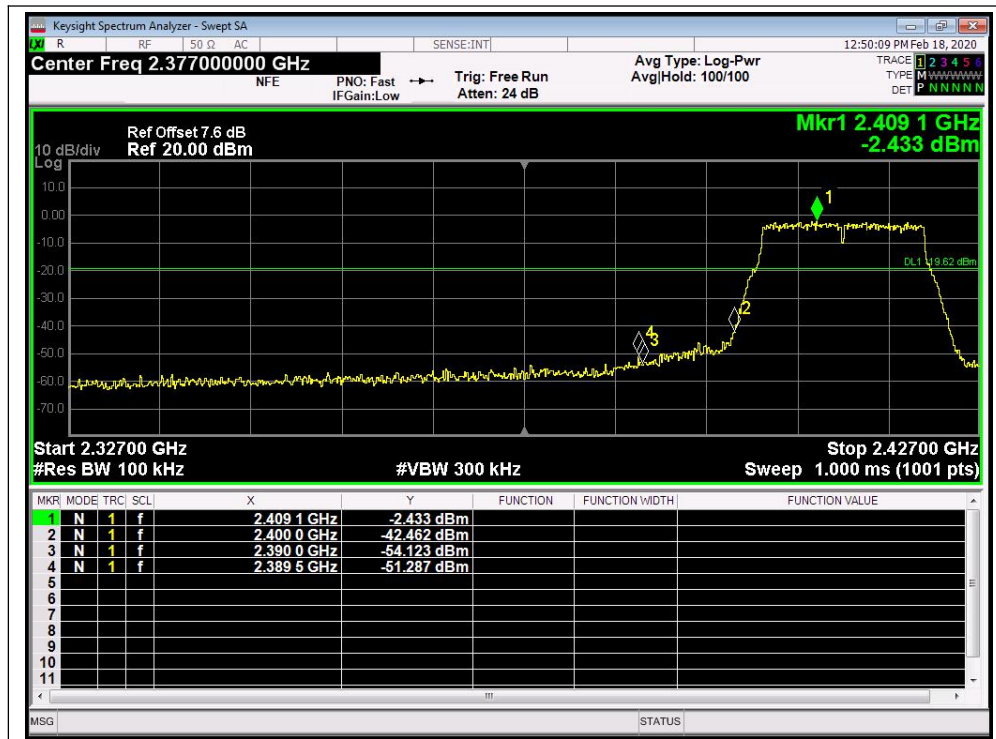
(802.11 g, Channel = 11, 30MHz to 25GHz)



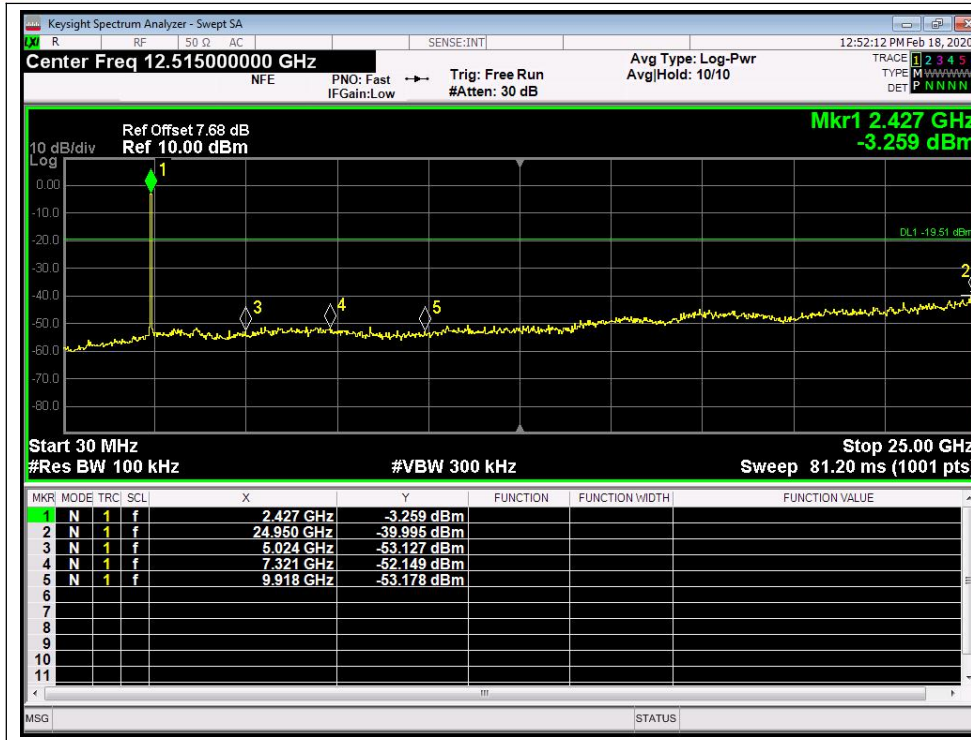
(802.11 g, Band Edge @ Channel = 11)



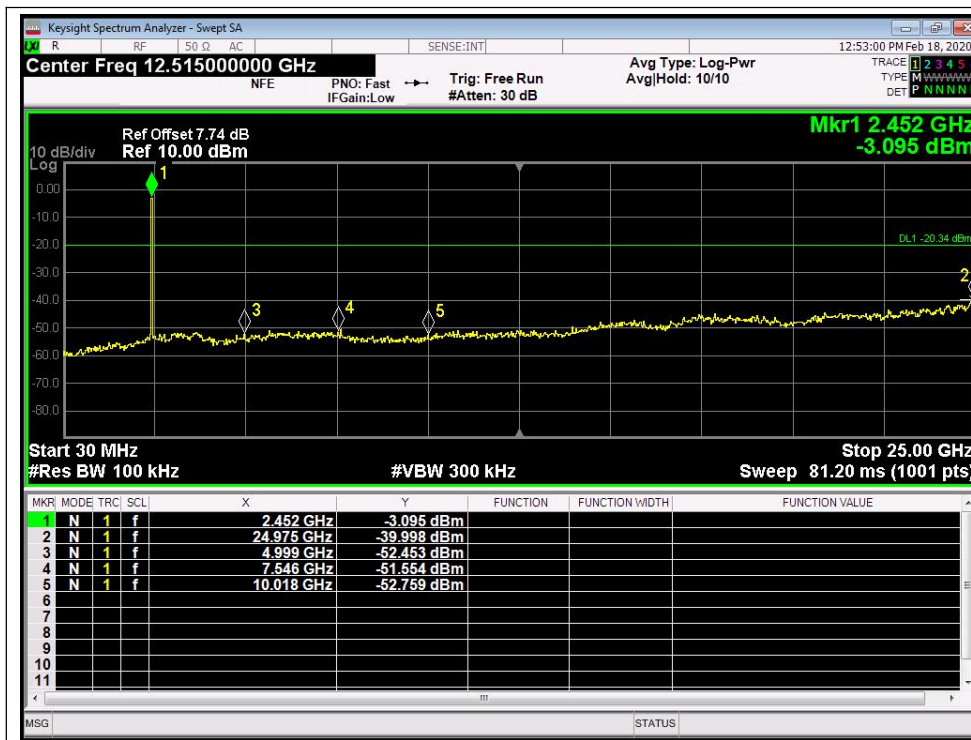
(802.11 HT20, Channel = 1, 30MHz to 25GHz)



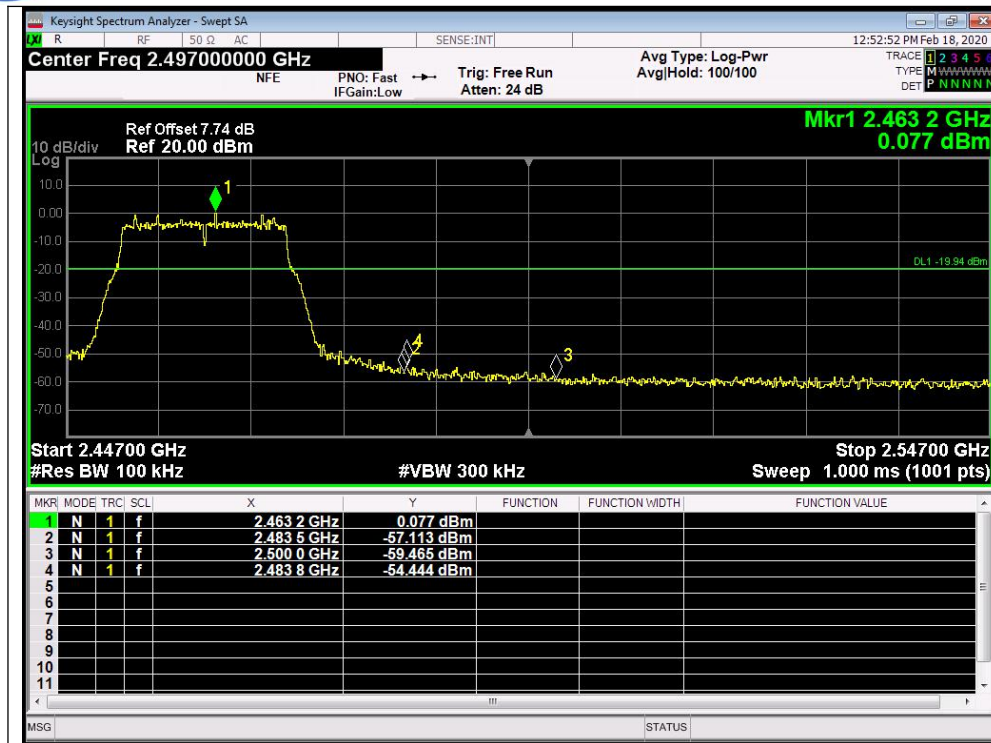
(802.11 HT20, Band Edge @ Channel = 1)



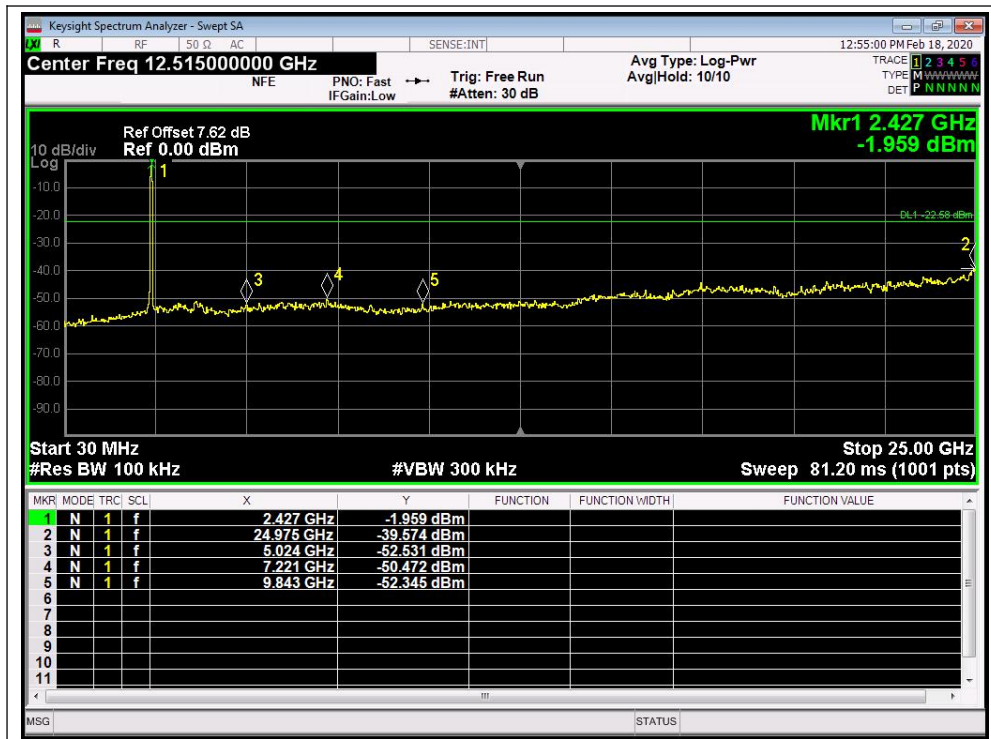
(802.11 HT20, Channel = 6, 30MHz to 25GHz)



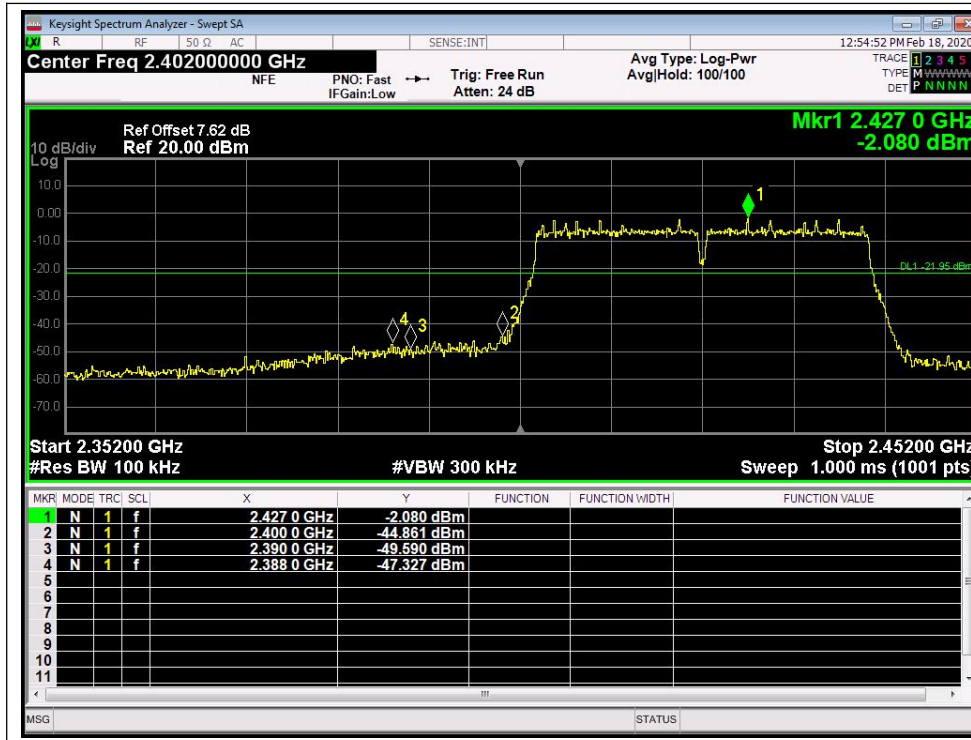
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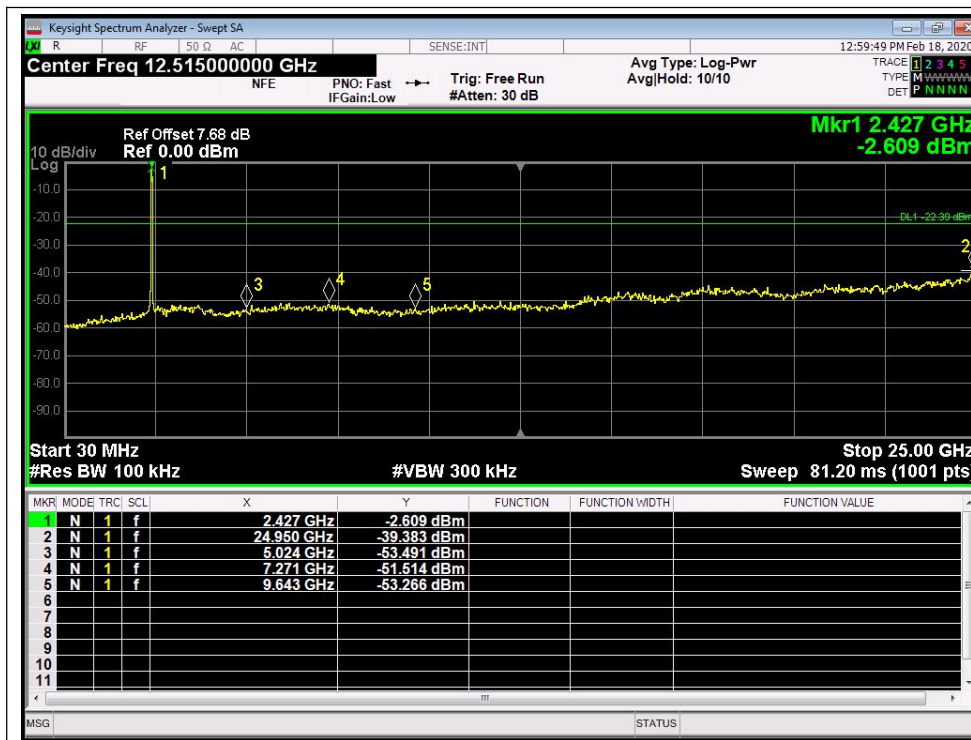
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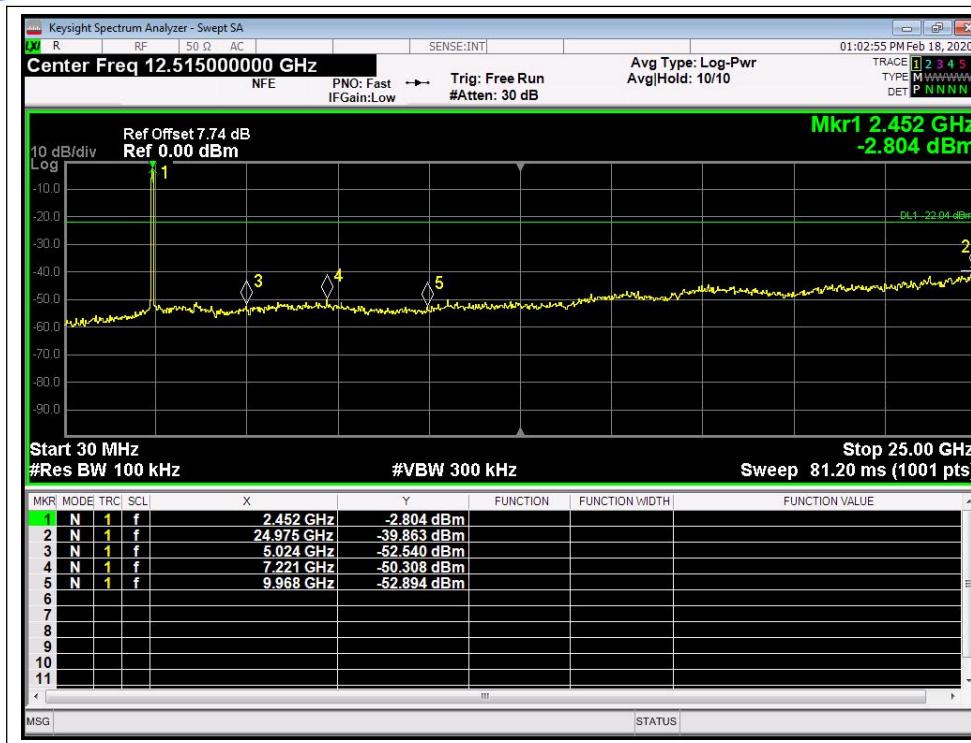
(802.11 HT40, Channel = 3, 30MHz to 25GHz)



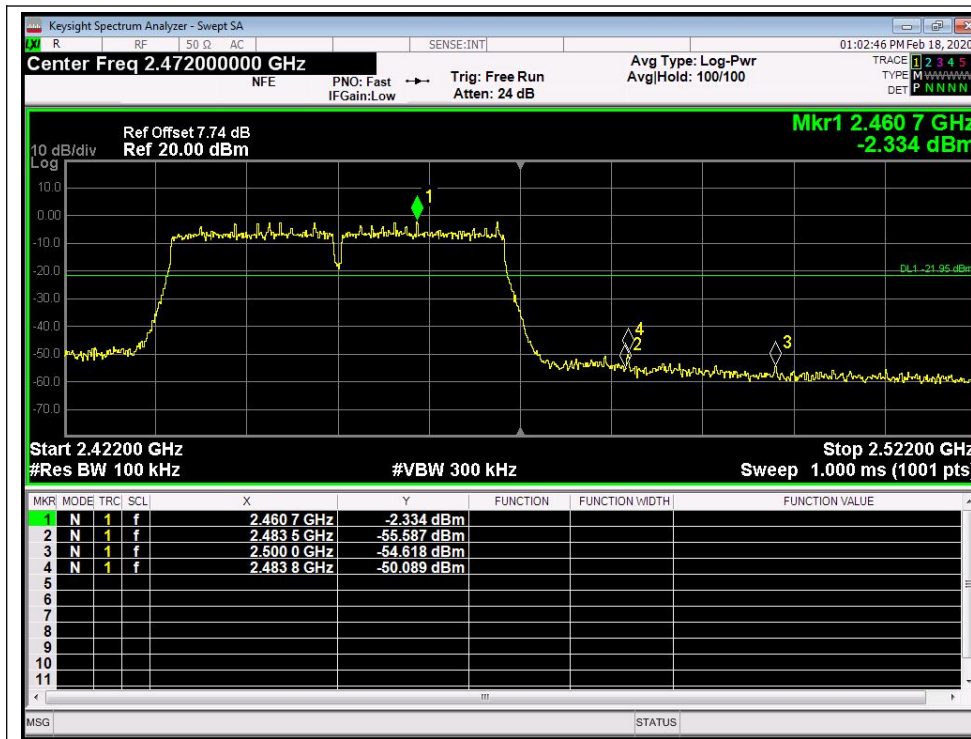
(802.11 HT40, Band Edge @ Channel = 3)



802.11 HT40, Channel = 6, 30MHz to 25GHz)



(802.11 HT40, Channel = 9, 30MHz to 25GHz)



(802.11 HT40, 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 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.

B. Equipments List:

Please refer ANNEX B(4).



2.5.3. Test Result

802.11b Test mode

A. Test Verdict:

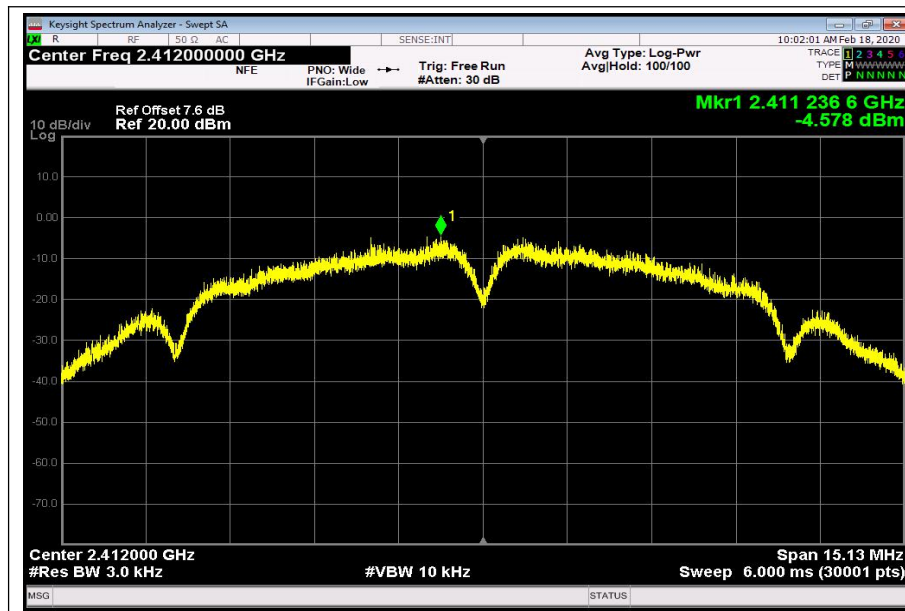
ANT 0

Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-4.57	8	PASS
6	2437	-4.82	8	PASS
11	2462	-4.70	8	PASS

ANT 1

Spectral power density (dBm/3kHz)				
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1	2412	-5.10	8	PASS
6	2437	-5.83	8	PASS
11	2462	-5.50	8	PASS

B. Test Plots:



(Channel = 1, 802.11b;ANT0)