ISED Certification Test Report

BEIJING INHAND NETWORKS TECHNOLOGY CO., LTD.

INDUSTRIAL CELLULAR ROUTER

MODEL: IR601-S, IR611-S, IR691-S

IC: 11594A-IR611S

REPORT# **17WB1024358I Rev. 0**
Mar. 13, 2018

Prepared for:

Beijing Inhand Networks Technology Co., Ltd.
101, West Wing, 11th Floor, No.101 Lize central Park, Wangjing
Chaoyang District, Beijing 100102 China

Prepared By:

Washington International Technology Limited

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For the

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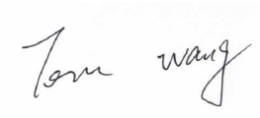

Tom Wang

Reviewed by:

Steven yang

Abstract

This report has been prepared on behalf of Beijing Inhand Networks Technology Co., Ltd. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Spread Spectrum Transceiver under RSS-Gen Issue 4 & RSS-247 Issue 2 of the ISED Rules and Regulations. This Innovation, Science and Economic Development Canada (ISED) Certification Test Report documents the test configuration and test results for a Beijing Inhand Networks Technology Co., Ltd. Industrial Cellular Router.

And Testing was performed by:

Shenzhen UnionTrust Quality and Technology Co., Ltd. has been accepted by the A2LA, the A2LA-Lab Certificate Number is 4312.01, the FCC Accredited Lab. Designation Number: CN1194, the ISED-Registration No.: 21600-1.

The Industrial Cellular Router is an IEEE 802.11b/802.11g/802.11n compliant device and complies with the limits for a Direct Sequence Spread Spectrum Transmitter device under RSS-247 of the ISED Rules and Regulations.

Revision History	Reason	Date
Rev. 0	Initial Release	Mar. 13, 2018
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Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 Compliance Statement

After the modifications listed in Section 2.7 were installed:

The Beijing Inhand Networks Technology Co., Ltd. Industrial Cellular Router complies with the limits for a Spread Spectrum Transceiver device under RSS-Gen Issue 4 & RSS-247 Issue 2 of the ISED Rules and Regulations.

1.2 Test Scope Summary

Tests for radiated and conducted emissions were performed. All measurements were performed according to the 2013 version of ANSI C63.10

Test Specification	Specific Description	Result	Modifications (Y/N)	Test Location
RSS-Gen Issue 4, Section 8.8	Conducted Emissions – AC Power Ports	Complied	N	Shenzhen UnionTrust Quality and Technology Co., Ltd.
RSS-247 Issue 2, Section 5.4(d)	RF Output Power	Complied	N	Shenzhen UnionTrust Quality and Technology Co., Ltd.
RSS-247 Issue 2, Section 5.2(b)	RF Power Spectral Density	Complied	N	Shenzhen UnionTrust Quality and Technology Co., Ltd.
RSS-247 Issue 2, Section 5.5	Conducted Out of Band Emission	Complied	N	Shenzhen UnionTrust Quality and Technology Co., Ltd.
RSS-Gen Issue 4, Section 6.13/8.9/8.10	Radiated spurious emissions	Complied	N	Shenzhen UnionTrust Quality and Technology Co., Ltd.
RSS-Gen section 6.6, RSS-247 Issue 2, Section 5.2(a)	Occupied Bandwidth	Complied	N	Shenzhen UnionTrust Quality and Technology Co., Ltd.
RSS-247 Issue 2, Section 5.5	Band Edge Measurements (Radiated)	Complied	N	Shenzhen UnionTrust Quality and Technology Co., Ltd.
NOTE: The EUT is also considered as a kind of other class A digital device it has been verified to comply with the requirements of ISED Regulation ICES-003 Issue 6 Class A(Verification) the test report has been issued by Washington Technology International Limited.				

1.3 Contract Information

Customer: Beijing Inhand Networks Technology Co., Ltd.

101, West Wing, 11th Floor, No.101 Lize central Park, Wangjing Chaoyang District, Beijing 100102 China

1.4 Test and Support Personnel

Warlen Song — Shenzhen UnionTrust Quality and Technology Co., Ltd.

Address: 16/F, Block A, Building 6, Baoneng Science and Technology Park, Qingxiang Road No.1, Longhua New District, Shenzhen, China 518109

Senior Test Engineer

1.5 Abbreviations

A	**A**mpere
ac	**a**lternating **c**urrent
AM	Amplitude Modulation
Amps	**Amp**eres
b/s	**b**its per **s**econd
BW	**B**and**W**idth
CE	**C**onducted **E**mission
cm	**C**enti**m**eter
CW	**C**ontinuous **W**ave
dB	**decibel**
dc	**d**irect **c**urrent
EMI	**E**lectro**m**agnetic **I**nterference
EUT	**E**quipment **U**nder **T**est
FM	**F**requency **M**odulation
G	**g**iga - prefix for 10^9 multiplier
Hz	**H**ertz
IF	**I**ntermediate **F**requency
k	**k**ilo - prefix for 10^3 multiplier
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
M	**M**ega - prefix for 10^6 multiplier
m	**M**eter
µ	**m**icro - prefix for 10^{-6} multiplier
NB	**N**arrow**b**and
QP	**Q**uasi-**P**eak
RE	**R**adiated **E**missions
RF	**R**adio **F**requency
rms	**r**oot-**m**ean-**s**quare
SN	**S**erial **N**umber
S/A	**S**pectrum **A**nalyzer
V	**V**olt

2 Equipment Under Test

2.1 EUT Identification

The results obtained relate only to the item(s) tested.

Table 1: Overview of Industrial Cellular Router, Equipment Under Test

ITEM	DESCRIPTION
Manufacturer:	Beijing Inhand Networks Technology Co., Ltd.
IC Number:	11594A-IR611S
Trade Mark:	N/A
EUT Name:	Industrial Cellular Router
Test Model:	IR611-S
ISED Rule Parts:	RSS-247
Frequency Range:	IEEE 802.11b/g/n(HT20): 2412 – 2462MHz IEEE 802.11n (HT40): 2422 – 2452 MHz
Maximum Output Power:	IEEE 802.11b: 20.24dBm IEEE 802.11g: 24.08dBm IEEE 802.11n (HT20): 23.88dBm IEEE 802.11n (HT40): 23.18dBm
Modulation:	Direct Sequence Spread Spectrum & Orthogonal Frequency Division Multiplexing
Necessary Bandwidth:	IEEE 802.11b/g/n(HT20): 20 MHz IEEE 802.11n (HT40): 40 MHz
Keying:	Automatic
Type of Information:	IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n (HT20), HT40: OFDM (64QAM, 16QAM, QPSK,BPSK)
Number of Channels:	IEEE 802.11b/g/n(HT20): 11 IEEE 802.11n (HT40): 7
Antenna Type	Sucker antenna
Frequency Tolerance:	N/A
Emission Type(s):	N/A
Interface Cables:	None
Power Source & Voltage:	DC 12V from AC adapter
Sample Received Date:	Jan. 20, 2018

Sample tested Date:	Jan. 21, 2018~ Mar. 12, 2018

2.2 EUT Description

The Industrial Cellular Router is a network Router for household users. By connecting it to IP network through Ethernet interface or Wi-Fi, it can stream videos over the network to TV display panel via network cable connection.

Product Name: Industrial Cellular Router

Model No. : IR601-S, IR611-S, IR691-S (These models are identical in interior structure, electrical circuits and components, and the differences as follows: software, the number of network ports and model name, declared by the manufacturer.)

Tested Model No.: IR611-S

EUT Rated Voltage: DC 12V from AC adapter

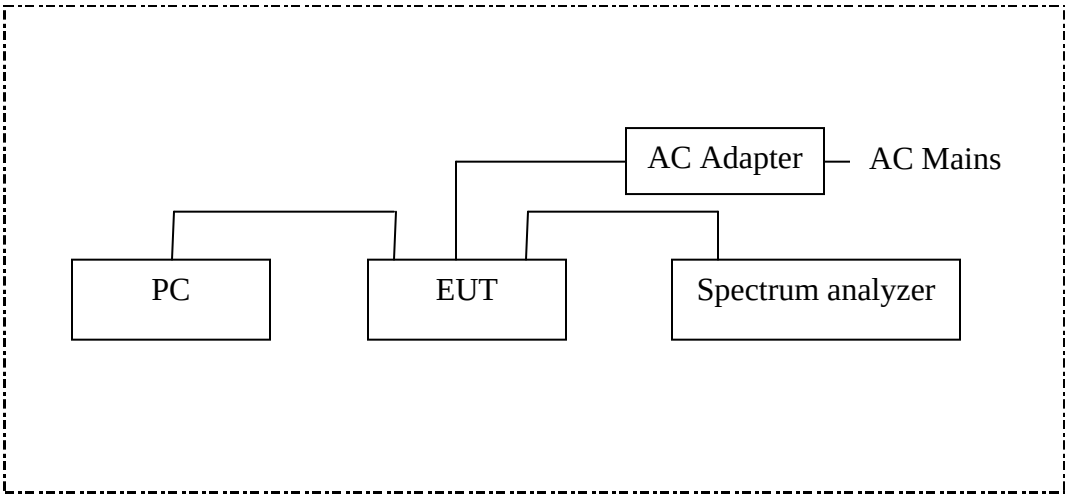
I/O Ports: Front Side: (1) RJ-45 Port*1; (2) SMA connection Port*4

2.3 Test Configuration

The Beijing Inhand Networks Technology Co., Ltd. Industrial Cellular Router, Equipment Under Test (EUT), was operated by DC 12V from AC adapter.

The EUT was configured with AC adapter, an antenna, a support PC with network cable. The EUT firmware/software was set up to control power, bit rate, and channel selection.

RF test setup



AC Conducted Emission& Radiated Emission test setup:

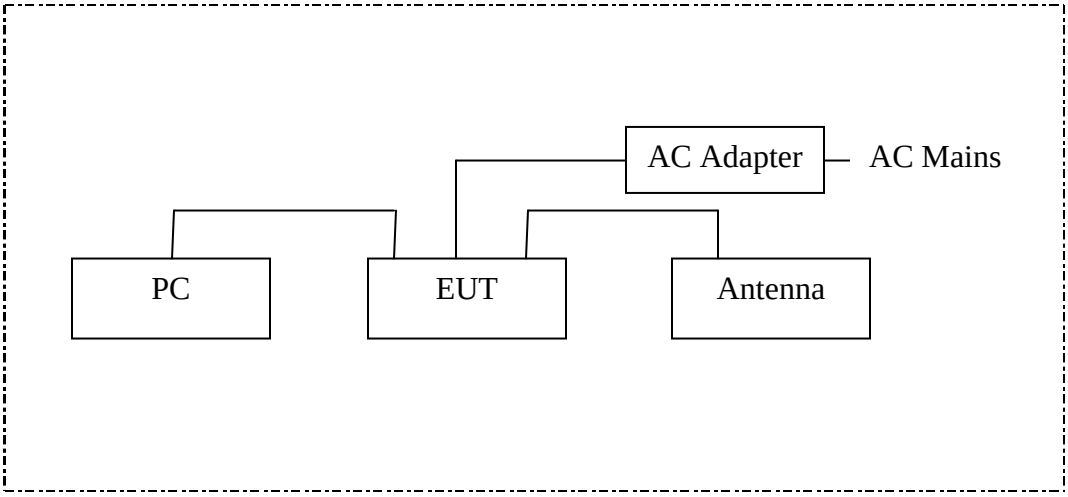


Figure 1: Test Configuration

2.4 Equipment Configuration

The EUT was set up as outlined in Radiated Emission Test Configuration photo. The EUT was comprised of the following equipment. (All Modules, PCBs, etc. listed were considered as part of the EUT, as tested.)

Table 2: Equipment Configuration

Name / Description	Model Number	Part Number	Serial Number	Revision
Industrial Cellular Router	IR611-S	N/A	N/A	N/A

2.5 Interface Cables

Table 3: Interface Cables

Port Identification	Connector Type	Cable Length	Shielded (Y/N)	Termination Point
WIFI Antenna	SMA	2.5m	Y	N/A
WIFI Antenna	SMA	2.5m	Y	N/A
4G Antenna	SMA-J	2.0m	Y	N/A
4G Antenna	SMA-J	2.0m	Y	N/A
Antenna cable	SMA	0.3m	Y	N/A
Antenna cable	SMA	0.3m	Y	N/A
Network cable	RJ45	1.5m	N	N/A

2.6 Support Equipment

The following support equipment was used during testing:

No.	Support Equipment	Model/Part Number	Serial Number
1	Lenovo Notebook	B40-80	MP12NEQ6
2	AC Adaptor	KT10W120100CHD	N/A

2.7 EUT Modifications

No modifications were performed in order to meet the test requirements:

2.8 Testing Algorithm

The Industrial Cellular Router was operated using and drivers.

2.9 Test Location

Shenzhen UnionTrust Quality and Technology Co., Ltd.

Address: 16/F, Block A, Building 6, Baoneng Science and Technology Park, Qingxiang Road No.1, Longhua New District, Shenzhen, China 518109

2.10 Measurements

2.10.1 Measurement Method

All measurements were performed according to the 2013 version of ANSI C63.10 for testing compliance of a wide variety of unlicensed wireless devices

2.11 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in Equation 1 to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned (see Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

Equation 1: Standard Uncertainty

$$u_c = \pm\sqrt{\frac{a^2}{div_a{}^2} + \frac{b^2}{div_b{}^2} + \frac{c^2}{div_c{}^2} + ...}$$

where u_c = standard uncertainty

a, b, c,.. = individual uncertainty elements

$div_{a, b, c}$ = the individual uncertainty element divisor based on the probability distribution

divisor = 1.732 for rectangular distribution

divisor = 2 for normal distribution

divisor = 1.414 for trapezoid distribution

Equation 2: Expanded Uncertainty

$$U = ku_c$$

where U = expanded uncertainty

k = coverage factor

$k \leq 2$ for 95% coverage (ANSI/NCSL Z540-2 Annex G)

u_c = standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is not used to adjust the measurements to determine compliance. The expanded uncertainty values for the various scopes in the WLL accreditation are provided in Table 4 below.

Table 4: Expanded Uncertainty List

Scope	Expanded Uncertainty
Conducted emission	±3.80dB(9KHz-150KHz)
	±3.40dB(150KHz-30MHz)
Uncertainty for Radiation Emission test in 3m chamber	±4.90dB(9KHz-30MHz)
	±4.70dB(30MHz-1GHz)
	±5.10dB(1GHz-18GHz)
	±5.20dB(18GHz-26GHz)
	±5.20dB(26GHz-40GHz)

3 Test Equipment

Table 5 shows a list of the test equipment used for measurements along with the calibration information.

Table 5: Test Equipment List

Conducted Emission Test Equipment List

Item	Instrument	Manufacturer	Type No./Serial No	Last Cal.	Calibration interval
1	Receiver	R&S	ESR7/1316.3003K07-101181-K3	Dec. 10, 2017	1 Year
2	Pulse Limiter	R&S	ESH3-Z2/0357.8810.54	Dec. 10, 2017	1 Year
3	LISN	R&S	ESH2-Z5/860014/024	Dec. 10, 2017	1 Year
4	LISN	ETS-Lindgren	3816/2SH/00201088	Dec. 10, 2017	1 Year
5	Test Software	Audix	e3	Software Version: 9.160323	

Radiated Test Equipment Lis

Item	Instrument	Manufacturer	Type No./Serial No	Last Cal.	Calibration interval
1	3M Chamber & Accessory Equipment	ETS-LINDGREN	3M/N/A	Dec. 20, 2015	3 Years
2	Receiver	R&S	ESIB26/100114	Dec. 10, 2017	1 Year
3	EXA Spectrum Analyzer	KEYSIGHT	N9010A/ MY51440197	Dec. 10, 2017	1 Year
4	Broadband Antenna	ETS-LINDGREN	3142E/00201891	Dec. 17, 2017	1 Year
5	Preamplifier	HP	8447F/2805A02960	Dec. 10, 2017	1 Year
6	Horn Antenna	ETS-LINDGREN	3117/00164202	Dec. 17, 2017	1 Year
7	Multi device Controller	ETS-LINDGREN	7006-001/00160105	N/A	N/A

8	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3116C-PA/00202652	Dec. 17, 2017	1 Year
9	Band Rejection Filter (2400MHz~2500MHz)	Micro-Tronics	BRM50702/ G248	Jun. 21, 2017	1 Year
10	Test Software	Audix	e3/ Software Version: 9.160323		

RF Test Equipment List

Item	Instrument	Manufacturer	Type No./Serial No	Last Cal.	Calibration interval
1	EXA Spectrum Analyzer	KEYSIGHT	N9010A/ MY51440197	Dec. 10, 2017	1 Year
2	USB Wideband Power Sensor	KEYSIGHT	U2021XA/ MY55430035	Dec. 10, 2017	1 Year
3	Power Meter	Anritsu	ML2495A/1204003	Feb. 21, 2017	1 Year
4	Power Sensor	Anritsu	MA2411B/1126150	Feb. 21, 2017	1 Year

4 System Test Configuration

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, conducted and radiated emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario. It was powered by an AC adapter. Only the worst case data were recorded in this test report.

For STBC modes (2Tx), there are two transmission antennas. Both Chain 1 and Chain 2 used at the same time and antenna ports have uniform output powers. The Chain 1 and Chain 2 antenna ports cannot be used alone.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. Therefore, all final radiated testing was performed with the EUT in (see table below) orientation.

Frequency Band(GHz)	Mode	Antenna Port	Worst-case Orientation
2.4~2.4835	1TX SISO	Chain 1	Y-Portrait
		Chain 2	Y-Portrait
	2TX STBC	Chain 1 + Chain 2	Y-Portrait

Worst-case data rates see table below:

Mode	Worst-case data rates		
	SISO Mode		STBC Mode
	Chain 1	Chain 2	Chain 1+2
802.11b	1 Mbps	1 Mbps	--
802.11g	6 Mbps	6 Mbps	--
802.11n HT20	--	--	MCS 8
802.11n HT40	--	--	MCS 8

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000MHz. The resolution is 1 MHz or greater for frequencies above 1000MHz. The spurious emissions more than 20 dB below the permissible value are not reported.

Radiated emission measurement were performed from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

5 Duty Cycle of Test Signal and Measurement Methods

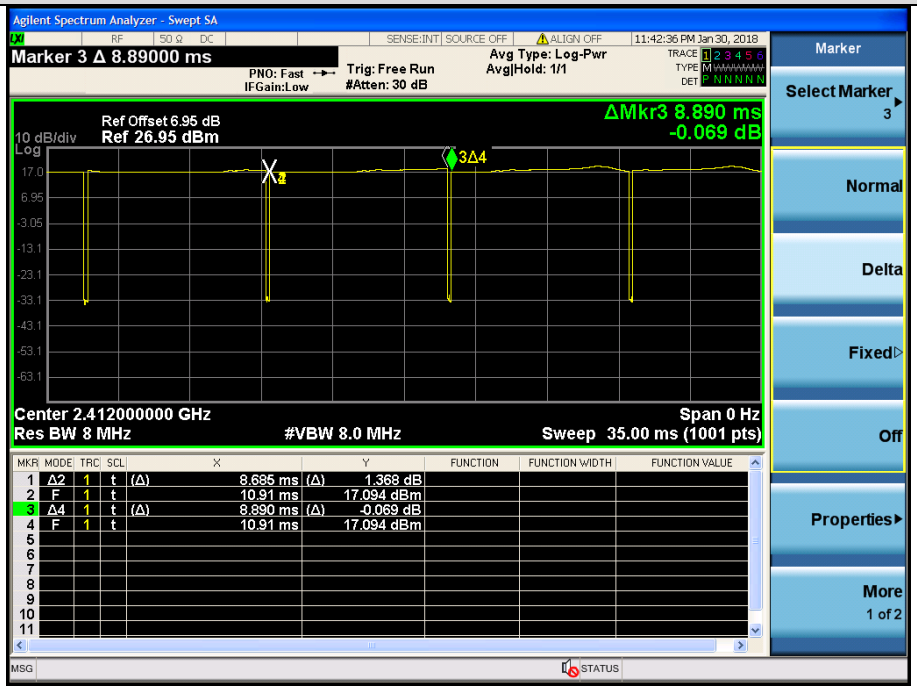
5.1 Duty Cycle

Mode	Data rates (Mbps)	Transmission Duration T (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/ T Minimum VBW (kHz)
802.11b	1Mbps	8.685	8.890	0.98	97.69	0.10	0.12
802.11g	1Mbps	1.440	1.645	0.88	87.54	0.58	0.69
802.11n(HT20)	MCS0	0.695	0.895	0.78	77.65	1.10	1.44
802.11n(HT40)	MCS0	0.352	0.552	0.64	63.77	1.95	2.84

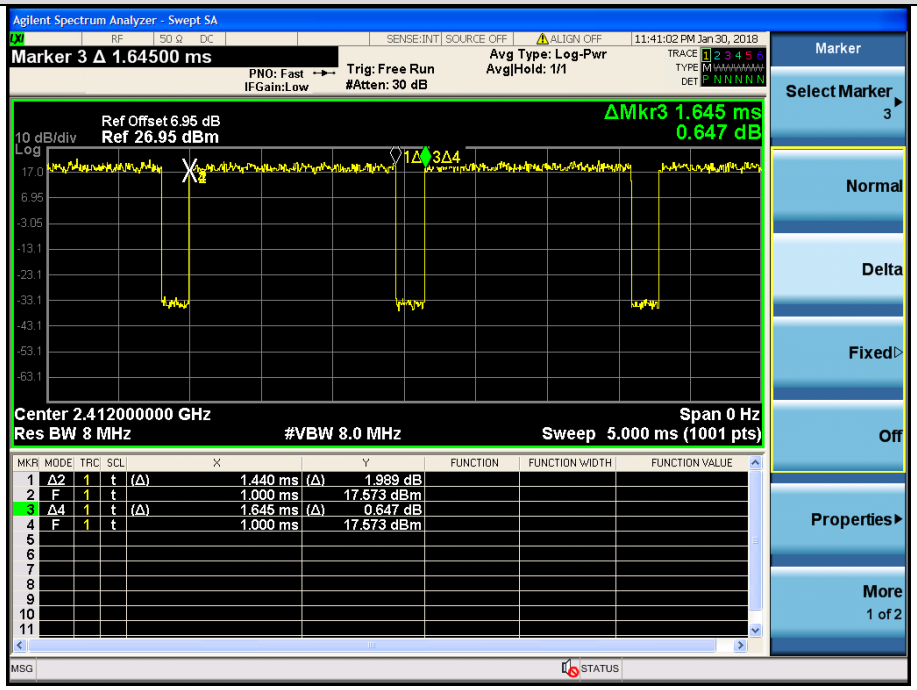
Remark:

1. Duty cycle = On Time/ Period;
2. Duty Cycle factor = 10 * log(1/ Duty cycle)
3. Period = Mkr3 - Mkr1
4. Transmission Duration = Mkr2 - Mkr1

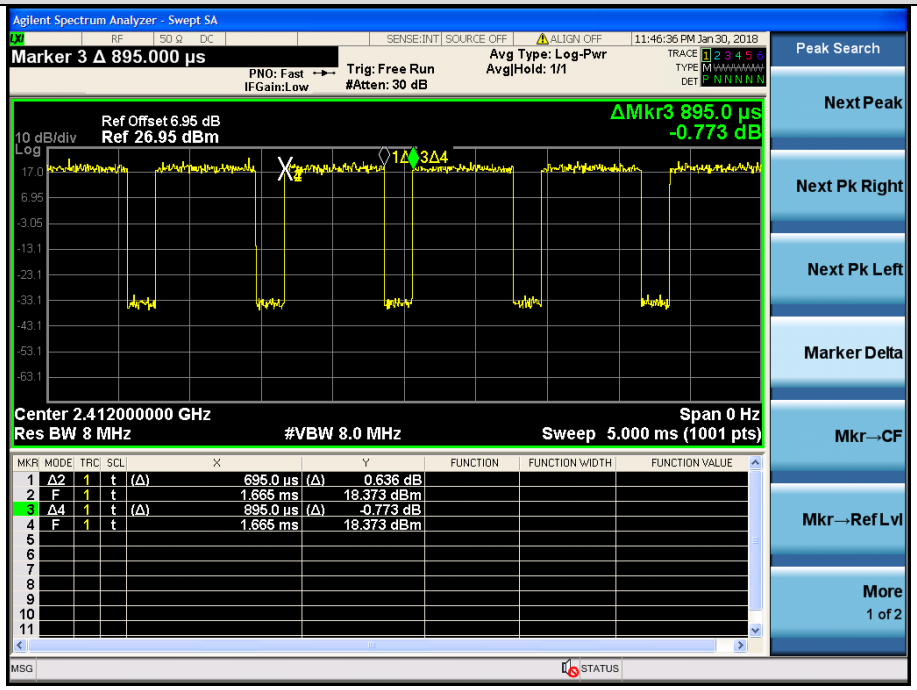
Test Mode: 802.11b_ 1Mbps



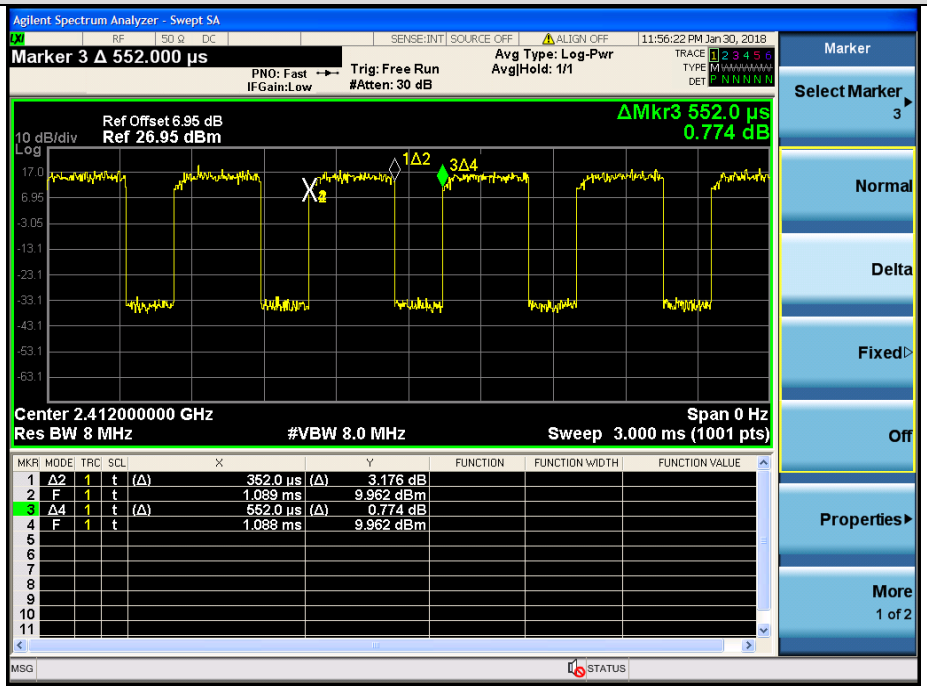
Test Mode: 802.11g_6Mbps



Test Mode: 802.11n(HT20)_MCS0



Test Mode: 802.11n(HT40) _MCS0



5.2 Measurement Methods

KDB 558074 D01 DTS Meas Guidance v04

KDB 662911 D01 Multiple Transmitter Output v02r01

ANSI C63.10-2013

6 Test Results

6.1 RF Power Output

To measure the output power the unit was set to transmit on a low, high and middle channel. The output from the transmitter was connected to an attenuator and then to the input of a detector diode. The output of the detector diode was displayed on an oscilloscope. The trace deflection was recorded and the transmitter was replaced with a signal generator at the same frequency. The output of the signal generator was increased until the trace deflection was the same as it was with the transmitter. The signal from the generator was then connected to a power meter and the level was taken.

6.1.1 Limit

For systems using digital modulation in the 2400—2483.5MHz, The Peak output Power shall not exceed 1W (30dBm). The e.i.r.p. shall not exceed 4W (36dBm), except as fixed point-to-point systems.

6.1.2 Test Procedure(KDB 558074 D01 v04, Section 9.1.3)

1, Connected the EUT's antenna port to measure device by 10dB attenuator.

2, For IEEE 802.11b/g and IEEE802.11n HT20 and HT40 mode, use a PK or Average power meter which's bandwidth is 20MHz up to 40MHz and above 6dB bandwidth of signal to measure out each test modes' PK or Average output power.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

6.1.3 Test Data

The EUT complied with the ISED RSS-247 RF Power Output requirements.

Table 6 provides the test results for RF Power Output. (All the data attached was use the worst case data rate data)

6.1.4 Areas of Concern

None.

Table 6: RF Output Peak Power

Chain 1 and Chain 2 (SISO Mode)-Test Data

IEEE 802.11b

Channel	Freq. (MHz)	Chain	RF Output Peak Power (dBm)			
			DSSS Data Rate			
			1 Mbps	2 Mbps	5.5Mbps	11 Mbps
1	2412	1	**19.59**	19.31	19.26	19.23
		2	**19.46**	19.35	19.32	19.21
6	2437	1	**19.47**	19.34	19.22	19.13
		2	**19.25**	19.12	19.02	19.07
11	2462	1	**20.24**	20.18	20.09	19.99
		2	**19.83**	19.69	19.49	19.41

IEEE 802.11g

Channel	Freq. (MHz)	Chain	RF Output Peak Power (dBm)							
			OFDM Data Rate							
			6 Mbps	9 Mbps	12 Mbps	18 Mbps	24 Mbps	36 Mbps	48 Mbps	54 Mbps
1	2412	1	**23.75**	23.53	23.46	23.41	23.35	23.28	23.16	23.22
		2	**23.25**	23.17	23.09	23.01	22.88	22.75	22.70	22.62
6	2437	1	**23.80**	23.62	23.51	23.48	23.39	23.31	23.22	23.17
		2	**23.36**	23.21	23.18	23.11	23.02	22.97	22.83	22.76
11	2462	1	**24.08**	23.88	23.76	23.54	23.36	23.33	23.29	23.31
		2	**23.69**	23.51	23.46	23.39	23.31	23.16	23.25	23.17

IEEE 802.11n (HT20)

Channel	Freq. (MHz)	Chain	RF Output Peak Power (dBm)							
			OFDM Data Rate							
			MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
1	2412	1	**23.19**	23.11	23.04	22.98	22.85	22.76	22.61	22.46
		2	**22.92**	22.87	22.76	22.69	22.61	22.53	22.41	22.30
6	2437	1	**23.29**	23.18	23.11	23.02	22.91	22.83	22.65	22.72
		2	**23.01**	22.89	22.63	22.45	22.57	22.48	22.31	22.39
11	2462	19.57	**23.88**	23.69	23.54	23.69	23.58	23.47	23.39	23.26
		2	**23.39**	23.31	23.27	23.05	23.13	23.19	23.28	23.02

IEEE 802.11(HT40)

Channel	Freq. (MHz)	Chain	RF Output Peak Power (dBm)							
			OFDM Data Rate							
			MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
3	2422	1	**22.91**	22.76	22.63	22.58	22.43	22.37	22.31	22.26
		2	**21.83**	21.65	21.71	21.60	21.52	21.38	21.33	21.20
6	2437	1	**22.97**	22.87	22.61	22.46	22.41	22.36	22.23	22.09
		2	**22.03**	21.88	21.76	21.53	21.59	21.43	21.36	21.31
9	2452	1	**23.18**	23.02	23.09	22.89	22.81	22.68	22.53	22.40
		2	**22.33**	22.20	22.11	22.03	21.87	21.79	21.71	21.68

Chain 1 + Chain 2 (MIMO Mode)-Test Data

Mode	Channel /Freq. (MHz)	RF Output Peak Power (dBm)			Limit (dBm)	Pass/Fail
		Chain 1 Power	Chain 2 Power	Total Power (Chain 1+2)		
IEEE 802.11n (HT20)	1/2412	23.19	22.92	26.07	30	Pass
	6/2437	23.29	23.01	26.16	30	Pass
	11/2462	23.88	23.39	26.65	30	Pass
IEEE 802.11n (HT40)	3/2422	22.91	21.83	25.41	30	Pass
	6/2437	22.97	22.03	25.54	30	Pass
	9/2452	23.18	22.33	25.79	30	Pass

Remark:

1. According exploratory test, EUT will have maximum output power as above bolded data rate, so those data rate were used for all test.
2. Total Power (Chain 1+2) = $10*\log[(10^{\text{Chain 1}/10})+(10^{\text{Chain 2}/10})]$
3. Directional gain and the maximum conducted output power see table below:

Frequency	Chain 1 Antenna Gain (dBi)	Chain 2 Antenna Gain (dBi)	Directional gain (dBi)	Peak Power Limits (dBm)
2.4 GHz	2	2	2	30
NOTE: All transmit signals are uncorrelated with each other. The directional gain = G_{ANT} = 2dBi				

RF Output Average Power

Mode	Channel /Freq. (MHz)	RF Output Average Power (dBm)				
		Measured Power		Power with Duty Factor		Total Power
		Chain 1	Chain 2	Chain 1	Chain 2	(Chain 1+2)
IEEE 802.11b	1/2412	16.77	16.28	16.57	16.08	--
	6/2437	16.47	15.94	16.27	15.74	--
	11/2462	17.33	16.70	17.13	16.50	--
IEEE 802.11g	1/2412	16.69	15.71	15.53	14.55	--
	6/2437	16.79	15.97	15.63	14.81	--
	11/2462	17.41	16.73	16.25	15.57	--
IEEE 802.11n (HT20)	1/2412	15.06	15.25	12.86	13.05	15.97
	6/2437	15.05	15.53	12.85	13.33	16.11
	11/2462	16.61	16.14	14.41	13.94	**17.19**
IEEE 802.11n (HT40)	3/2422	14.66	13.81	10.75	9.90	13.36
	6/2437	14.69	14.04	10.78	10.13	13.48
	9/2452	14.99	14.93	11.08	11.02	14.06

Remark:

1. All the data attached was use the worst case data rate.
2. Power with Duty Factor = Measured Power + Duty Cycle Factor.(The Duty Cycle Factor See Section 5.1)
3. Total Power (Chain 1+2) = $10*\log[(10^{\text{Chain 1}/10})+(10^{\text{Chain 2}/10})]$.

6.2 RF Power Spectral Density

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer. The analyzer offset was adjusted to compensate for the attenuator and other losses in the system.

6.2.1 Limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

6.2.2 Test Procedure(KDB 558074 D01 v04, Section 10.2)

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance, and is optional if the maximum conducted (average) output power was used to demonstrate compliance.

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.
c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ 3 x RBW.
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.

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

6.2.3 Test Data

The EUT complied with the RSS-247 RF Power Spectral Density requirements.

Table 7 provides the test results for RF Power Spectral Density. (All the data attached was use the worst case data rate data)

6.2.4 Areas of Concern

None.

Table 7: RF Power Spectral Density

Mode	Channel /Freq. (MHz)	PSD (dBm)			Limit (dBm)	Pass/Fail
		SISO Mode		STBC Mode		
		Chain 1 PSD	Chain 2 PSD	Total PSD (Chain 1+2)		
IEEE 802.11b	1/2412	-10.975	-9.902	/	8	Pass
	6/2437	-10.760	-10.362	/	8	Pass
	11/2462	-8.410	-9.335	/	8	Pass
IEEE 802.11g	1/2412	-9.653	-14.178	/	8	Pass
	6/2437	-9.358	-9.149	/	8	Pass
	11/2462	-8.332	-9.861	/	8	Pass
IEEE 802.11n (HT20)	1/2412	-9.444	-10.301	-6.84	8	Pass
	6/2437	-10.189	-9.769	-6.96	8	Pass
	11/2462	-9.058	**-7.693**	-5.31	8	Pass
IEEE 802.11n (HT40)	3/2422	-12.624	-12.495	-9.55	8	Pass
	6/2437	-12.743	-12.439	-9.58	8	Pass
	9/2452	-11.723	-13.681	-9.58	8	Pass

Remark:

1. All the data attached was use the worst case data rate.
2. Total PSD (Chain 1+2) = $10*\log[(10^{\text{Chain 1}/10})+(10^{\text{Chain 2}/10})]$

Chain 1-Test plot as follows

Test Mode: IEEE 802.11b TX

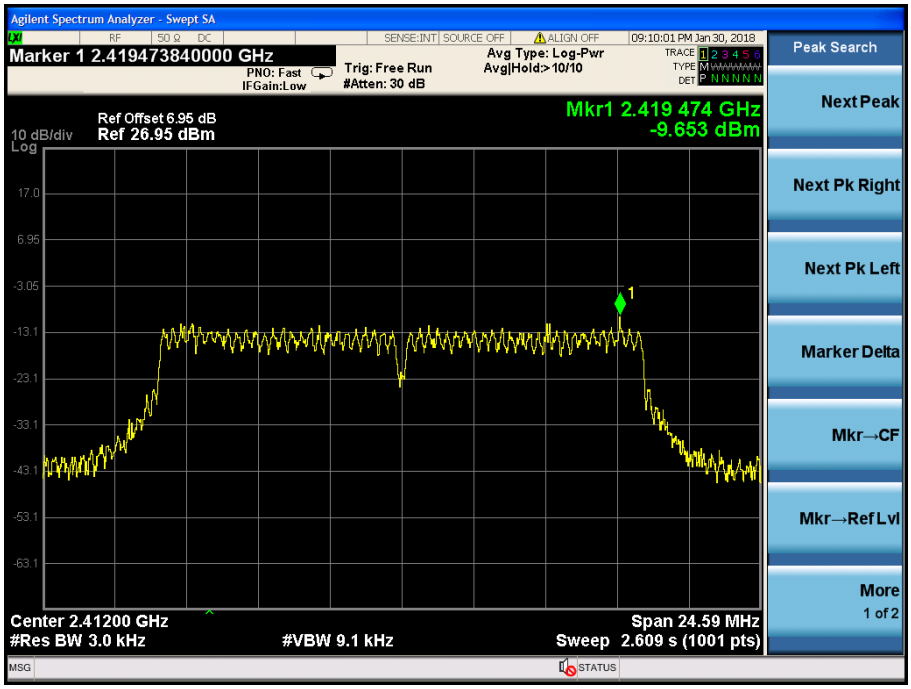
Test CH1: 2412MHz

Test CH6: 2437MHz

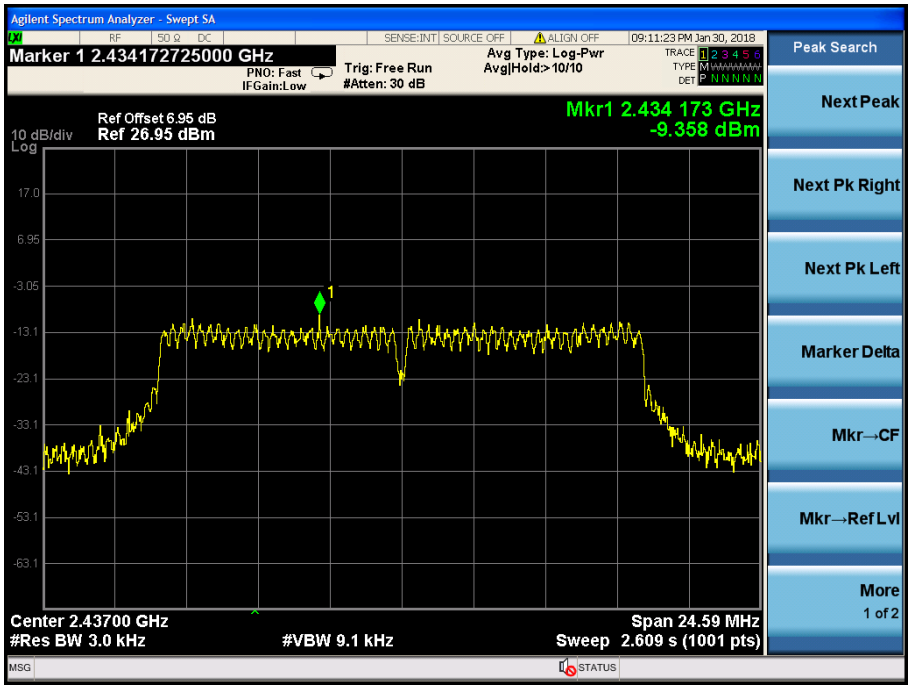
Test CH11: 2462MHz

Test Mode: IEEE 802.11g TX

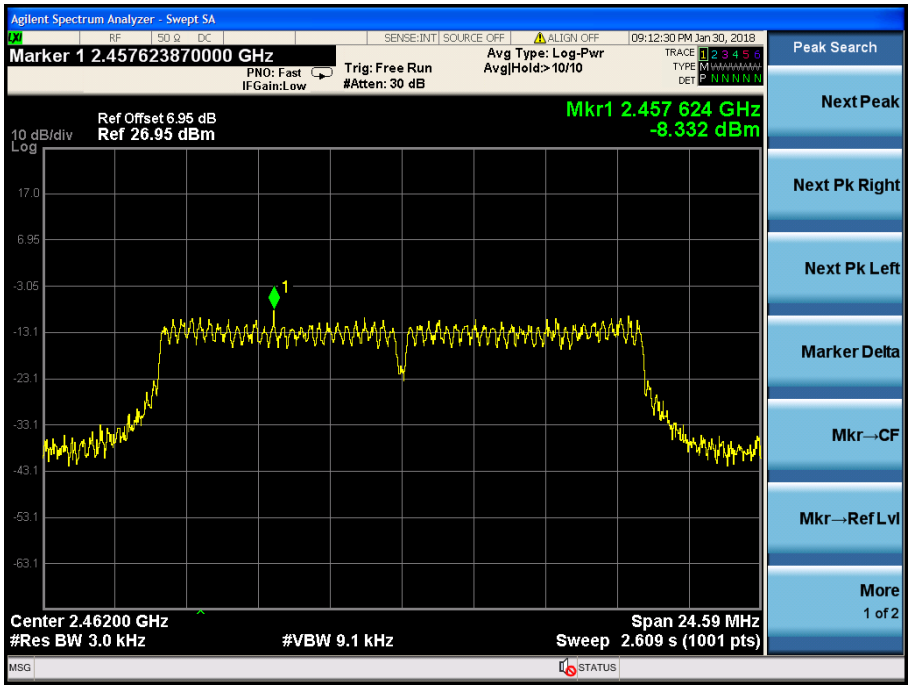
Test CH1: 2412MHz



Test CH6: 2437MHz

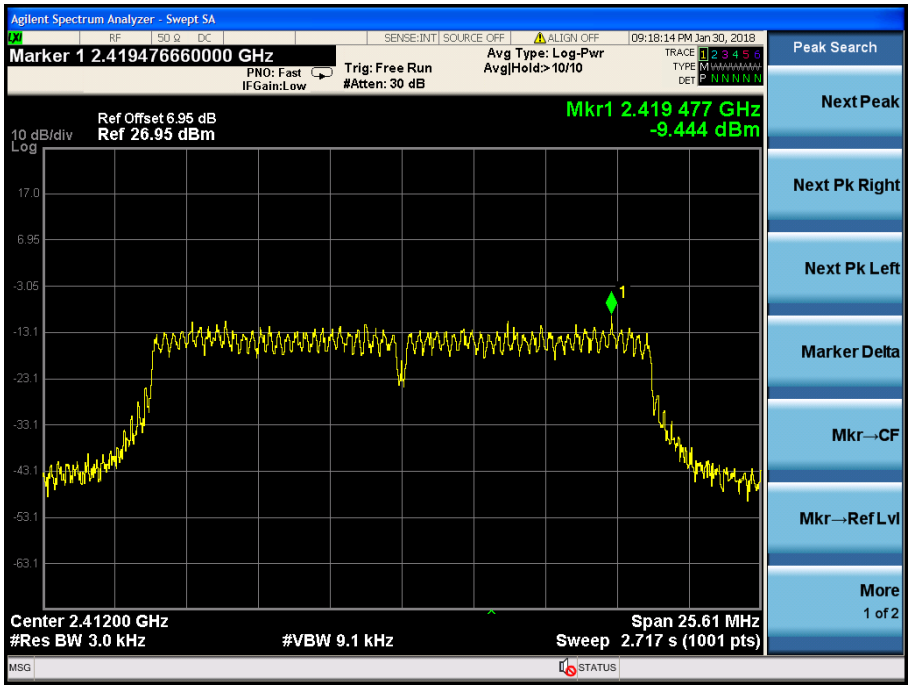


Test CH11: 2462MHz

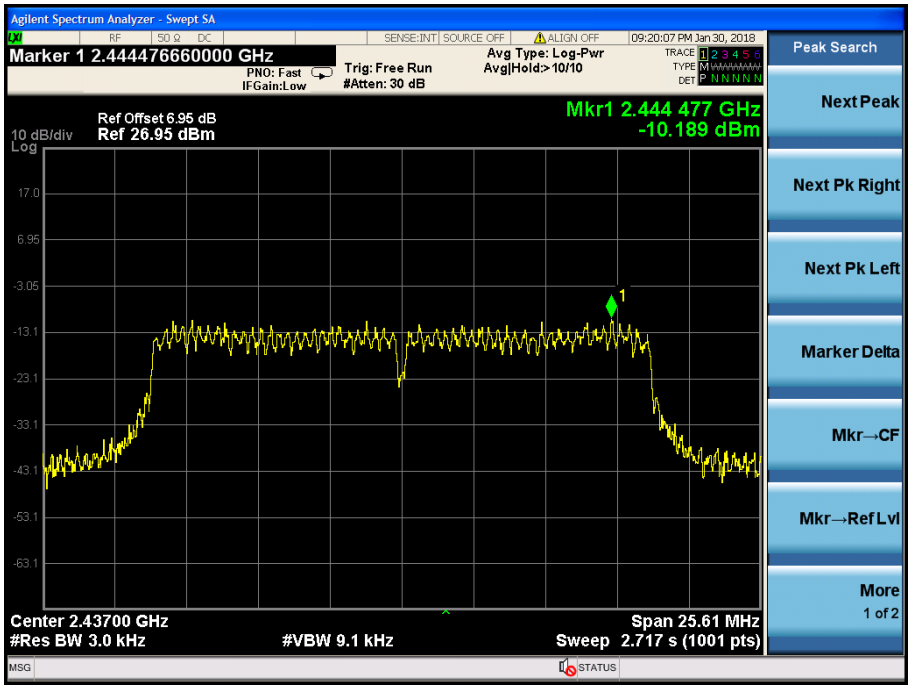


Test Mode: IEEE 802.11n (HT20) TX

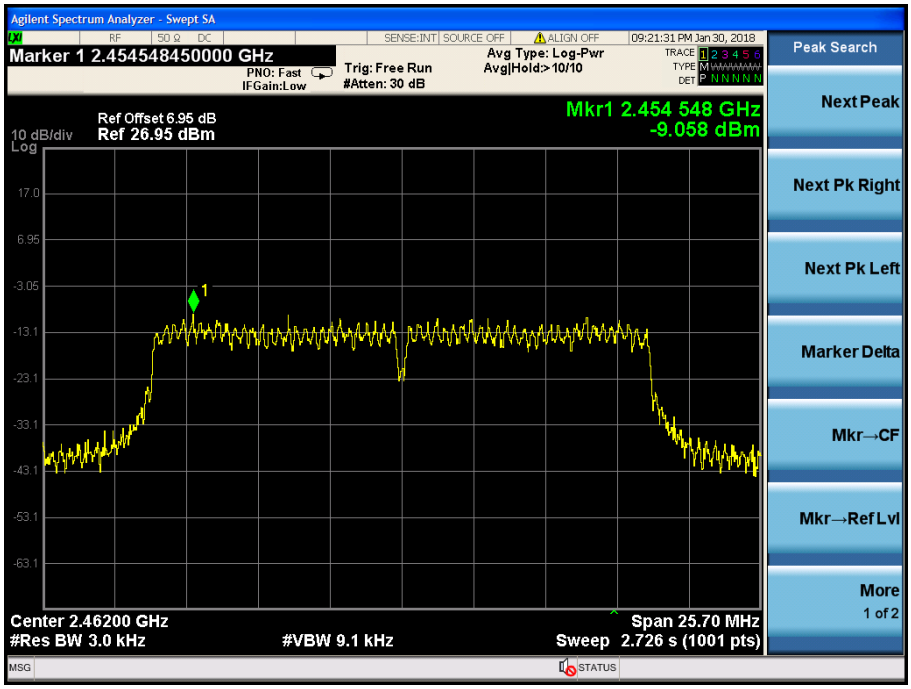
Test CH1: 2412MHz



Test CH6: 2437MHz

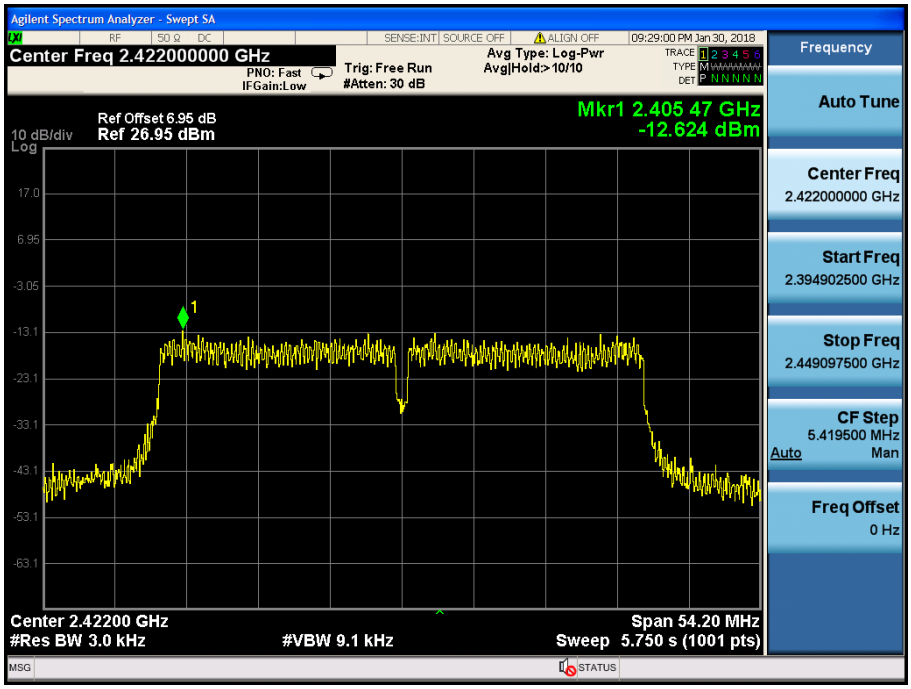


Test CH11: 2462MHz

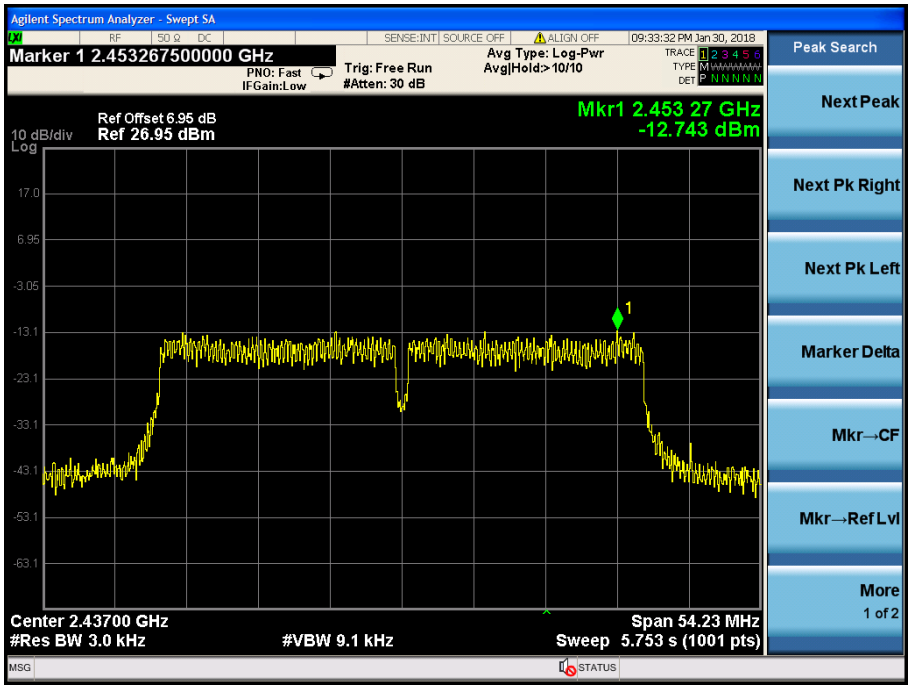


Test Mode: IEEE 802.11n (HT40) TX

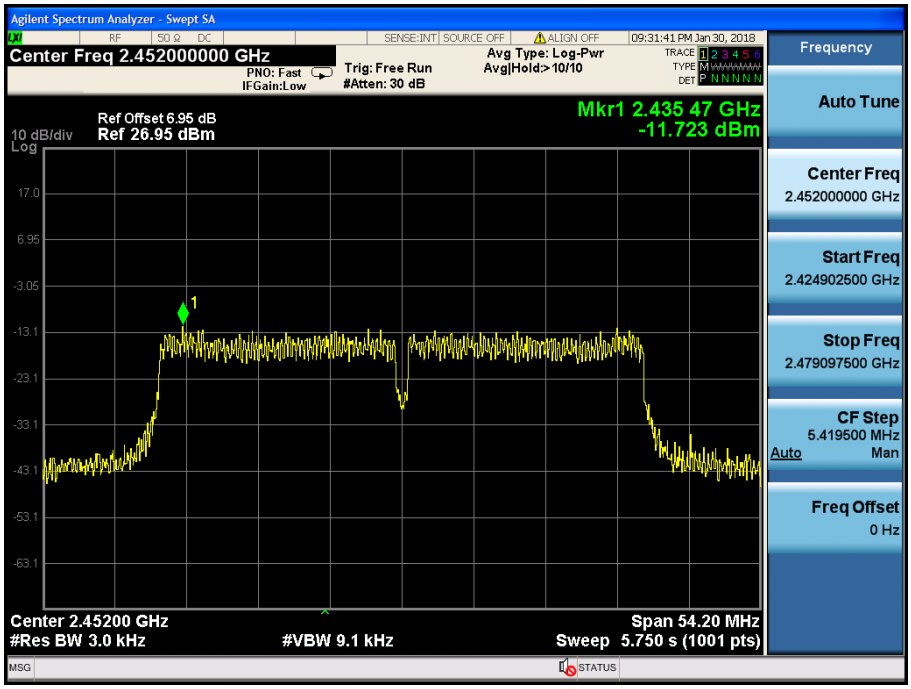
Test CH3: 2422MHz



Test CH6: 2437MHz



Test CH9: 2452MHz

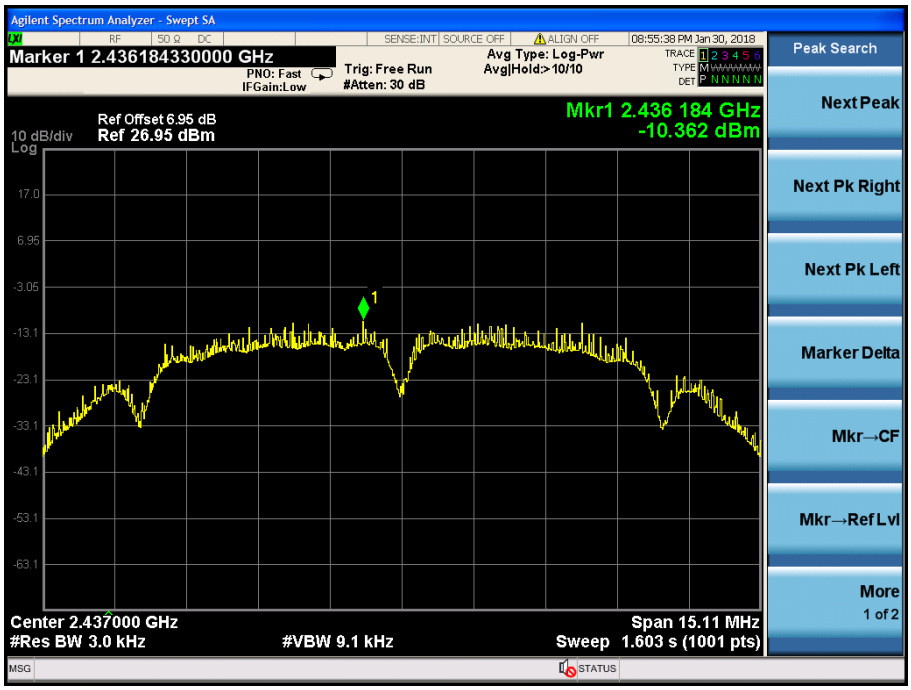


Chain 2-Test plot as follows

Test Mode: IEEE 802.11b TX

Test CH1: 2412MHz

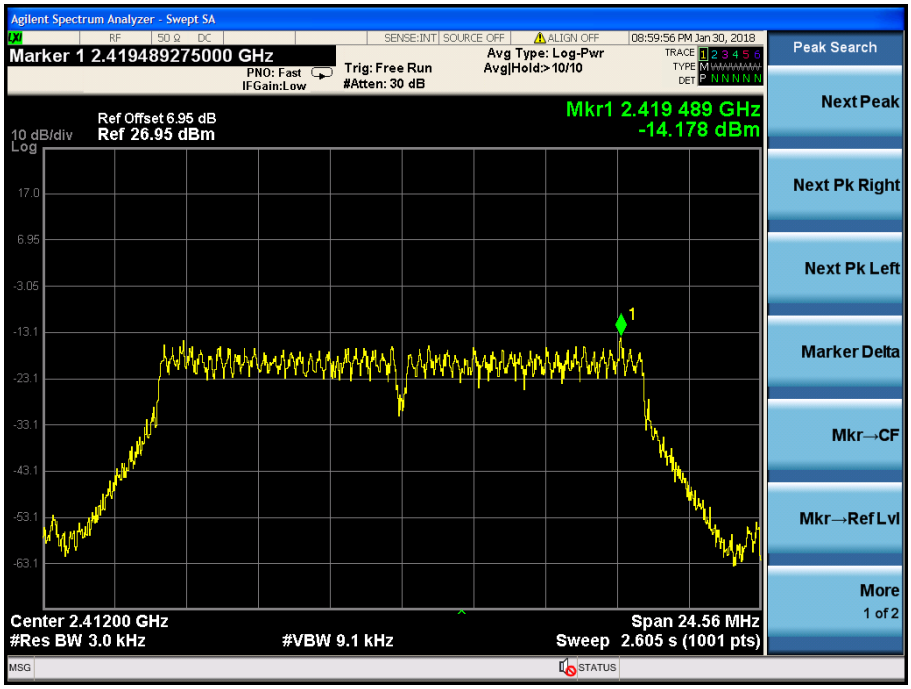
Test CH6: 2437MHz



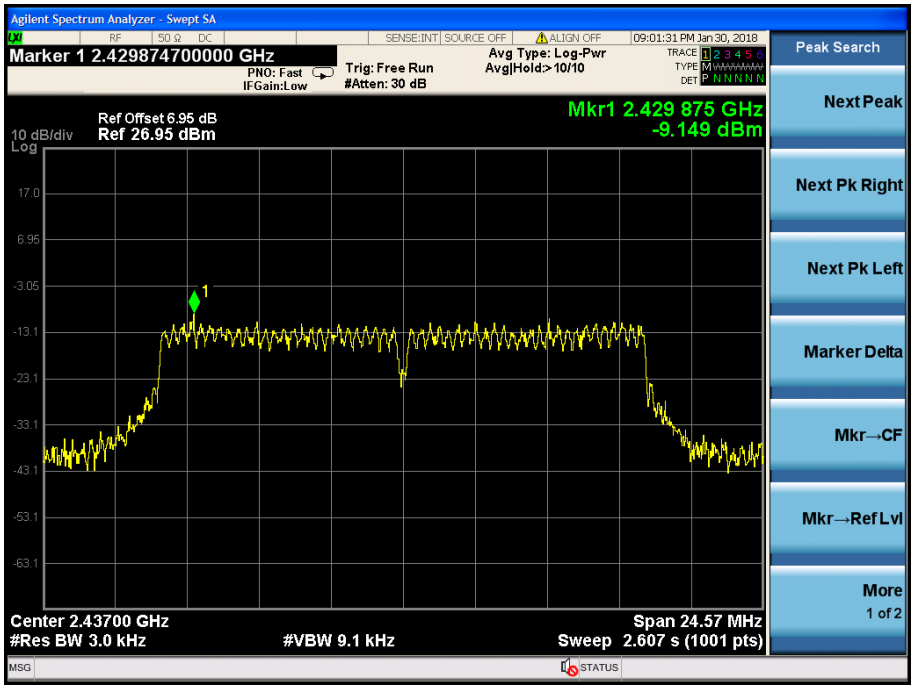
Test CH11: 2462MHz

Test Mode: IEEE 802.11g TX Test

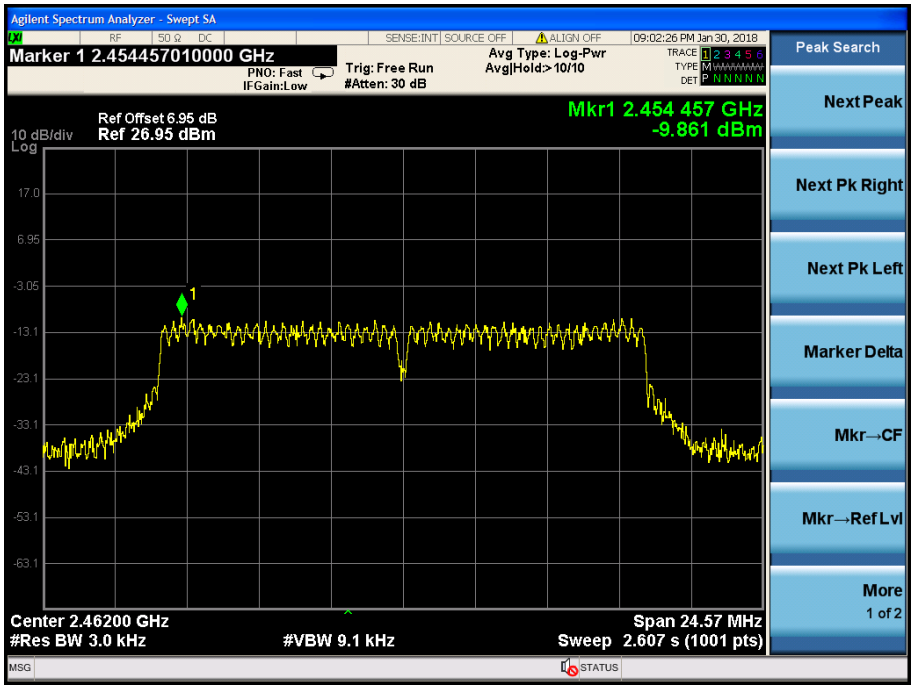
CH1: 2412MHz



Test CH6: 2437MHz

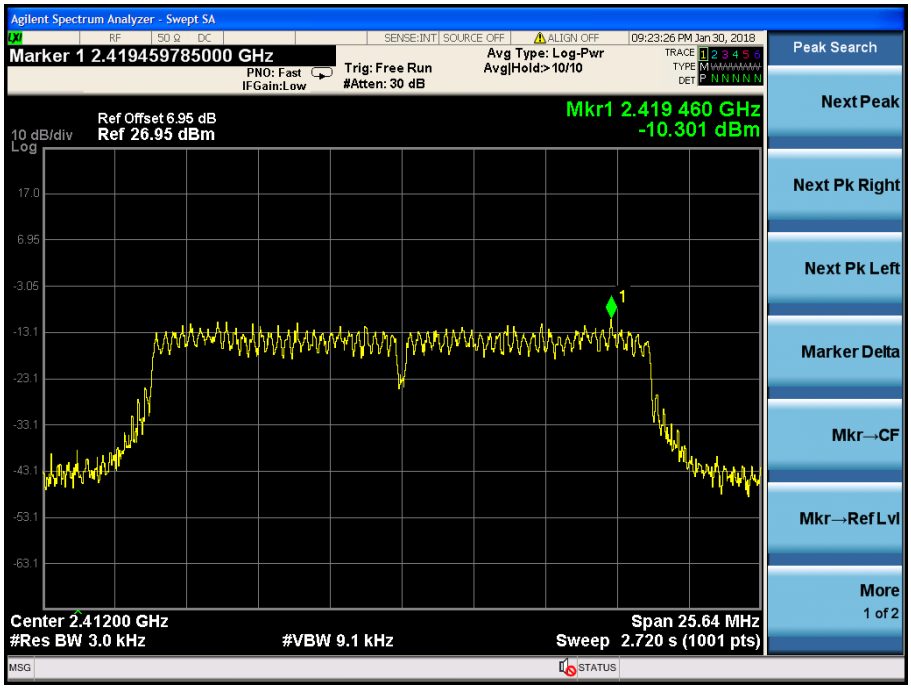


Test CH11: 2462MHz

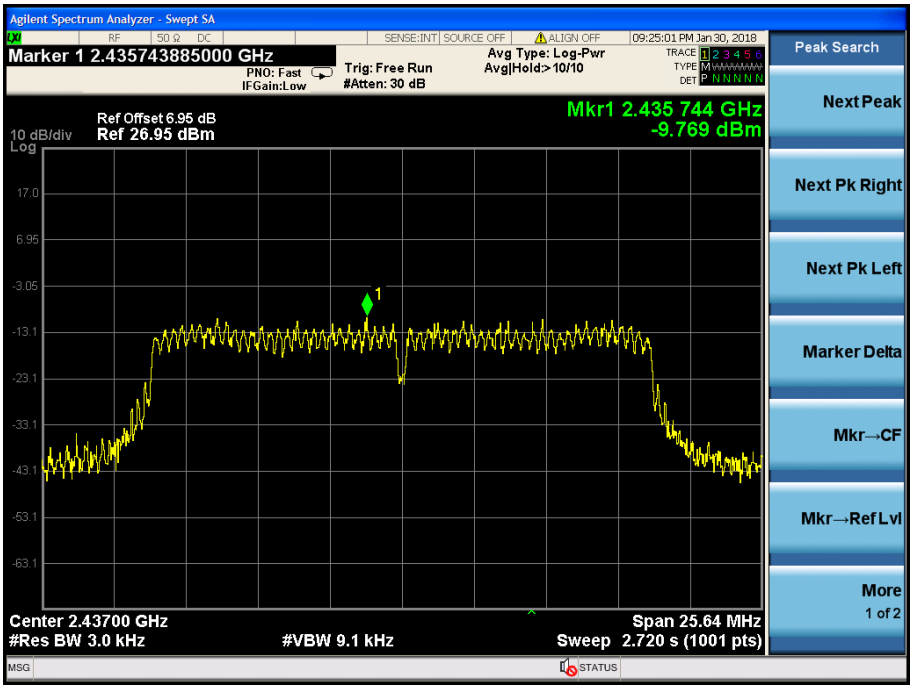


Test Mode: IEEE 802.11n (HT20) TX

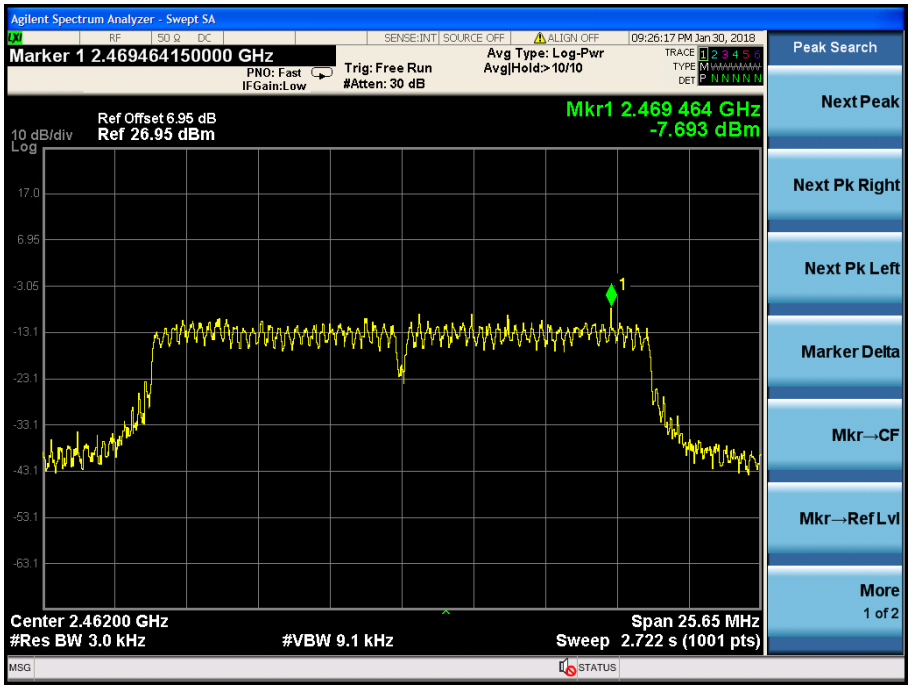
Test CH1: 2412MHz



Test CH6: 2437MHz

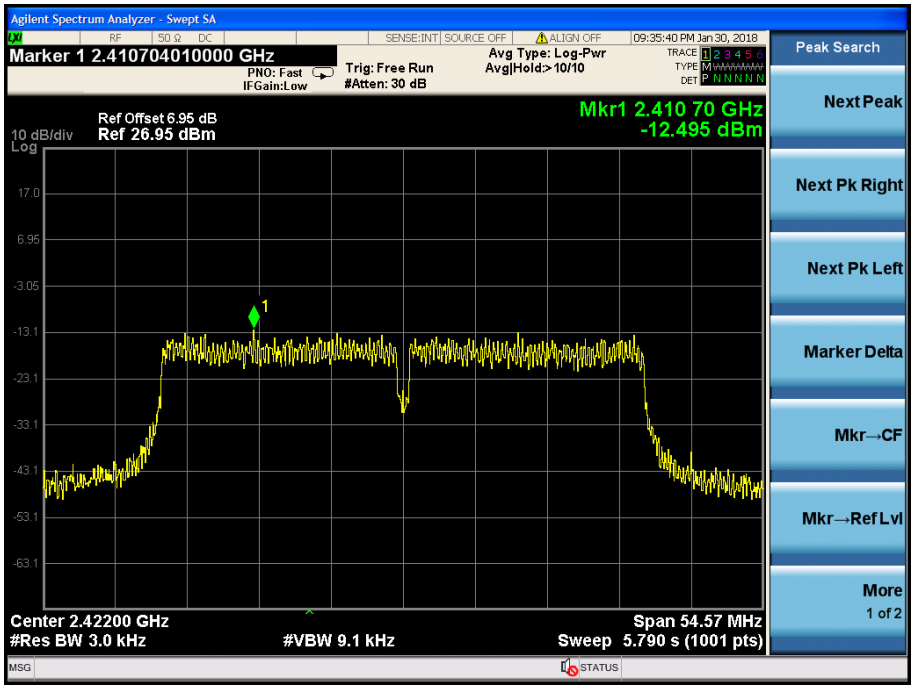


Test CH11: 2462MHz

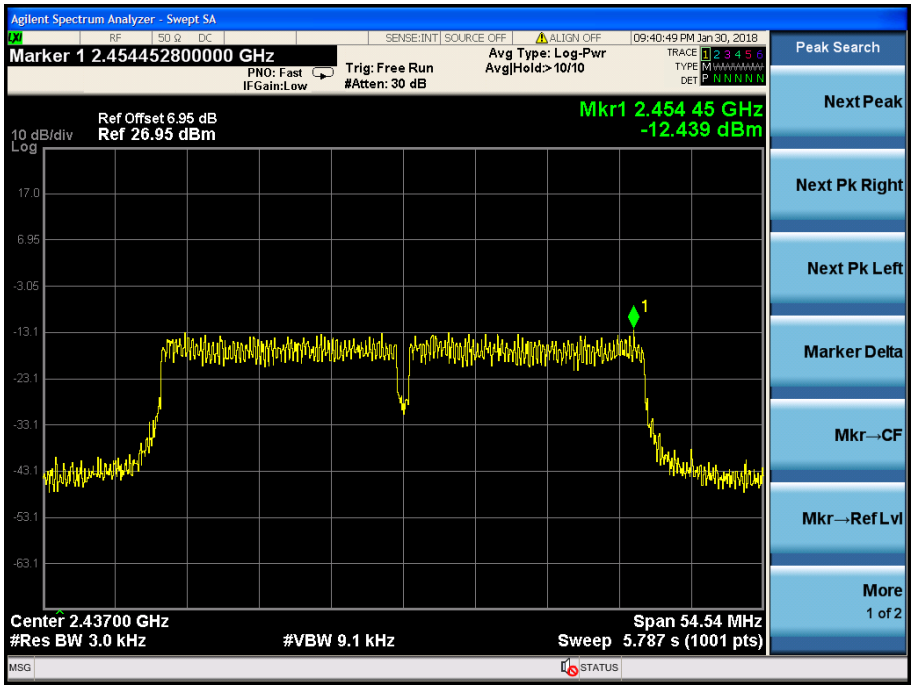


Test Mode: IEEE 802.11n (HT40) TX

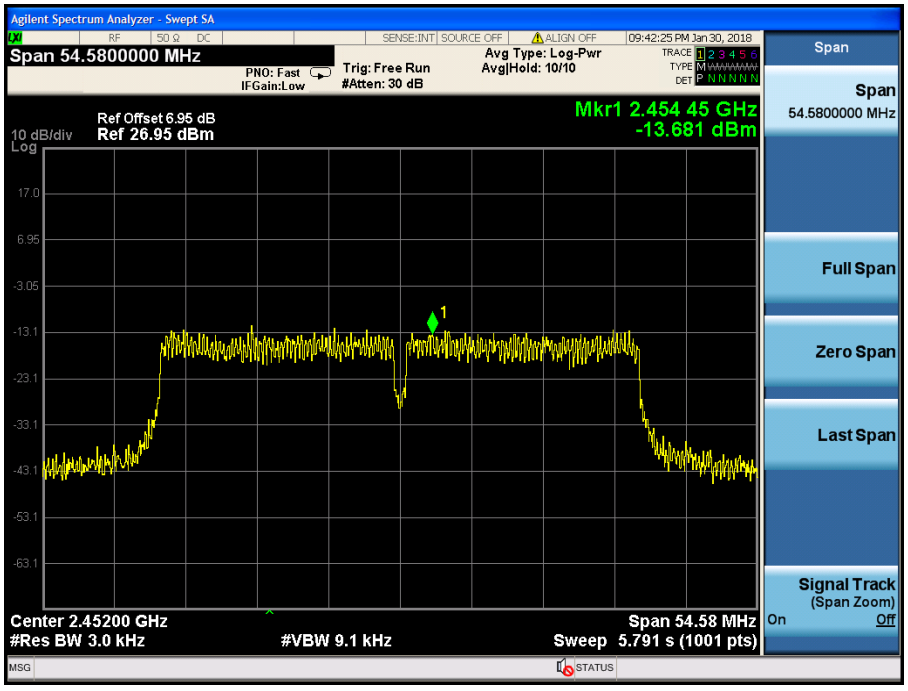
Test CH3: 2422MHz



Test CH6: 2437MHz



Test CH9: 2452MHz



6.3 Occupied Bandwidth

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer.

6.3.1 Limit

For direct sequence systems, the minimum 6dB bandwidth shall be at least 500 kHz

6.3.2 Test Procedure(KDB 558074 D01 v04, Section 8.1)

a) Set RBW = 100 kHz.

b) Set the video bandwidth (VBW) ≥ 3 x RBW.

c) Detector = Peak.

d) Trace mode = max hold.

e) Sweep = auto couple.

f) Allow the trace to stabilize.

g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

6.3.3 Test Data

The EUT complied with the RSS-247 Issue 2 & RSS-Gen Issue 4 Occupied bandwidth requirements.

Table 8 provides the test results for occupied bandwidth. (All the data attached was use the worst case data rate as in table 6)

6.3.4 Areas of Concern

None.

Table 8: Occupied Bandwidth Results

Mode	Channel /Freq. (MHz)	6dB BW (MHz)		OBW (MHz)		6dB BW Limit	Pass/Fail
		Chain 1	Chain 2	Chain 1	Chain 2		
IEEE 802.11b	1/2412	10.10	10.05	12.273	12.324	> 500 kHz	Pass
	6/2437	10.10	10.07	12.313	12.385	> 500 kHz	Pass
	11/2462	10.10	10.07	12.651	12.377	> 500 kHz	Pass
IEEE 802.11g	1/2412	16.39	16.37	16.631	16.557	> 500 kHz	Pass
	6/2437	16.39	16.38	16.739	16.618	> 500 kHz	Pass
	11/2462	16.39	16.38	18.399	16.622	> 500 kHz	Pass
IEEE 802.11n (HT20)	1/2412	17.07	17.09	17.677	17.618	> 500 kHz	Pass
	6/2437	17.07	17.09	17.711	17.657	> 500 kHz	Pass
	11/2462	17.13	17.10	18.214	17.679	> 500 kHz	Pass
IEEE 802.11n (HT40)	3/2422	36.13	36.38	36.296	36.264	> 500 kHz	Pass
	6/2437	36.15	36.36	36.336	36.287	> 500 kHz	Pass
	9/2452	36.13	36.39	36.461	36.329	> 500 kHz	Pass

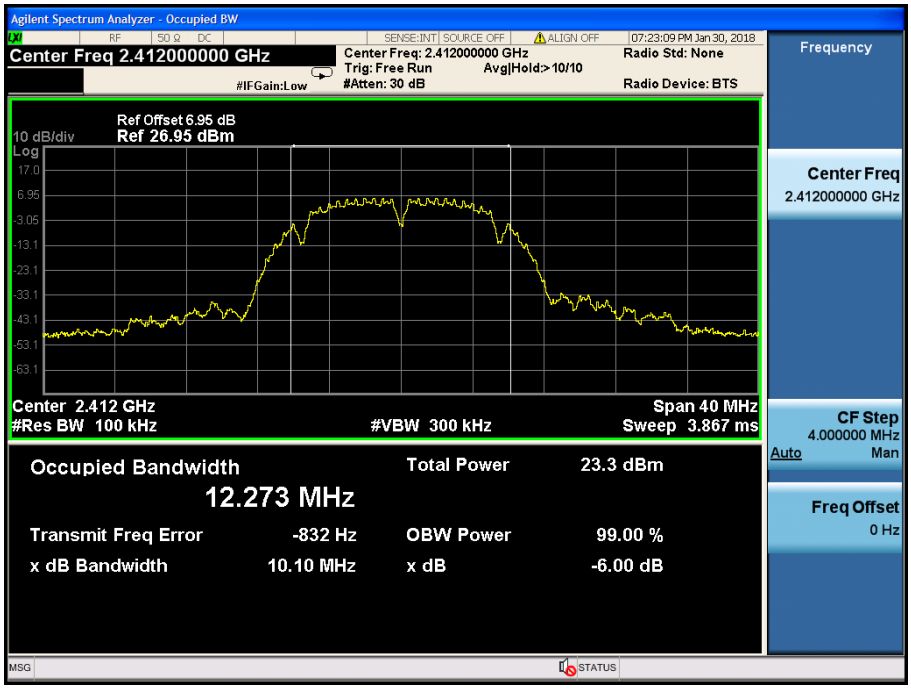
Remark:

1. All the data attached was use the worst case data rate.

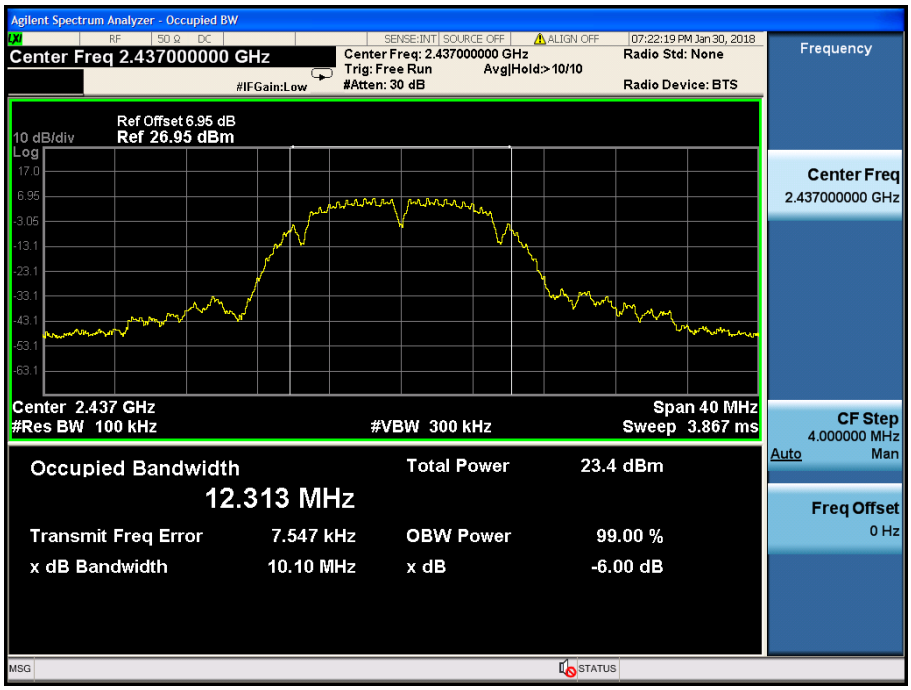
Chain 1-Test plot as follows

Test Mode: IEEE 802.11b TX

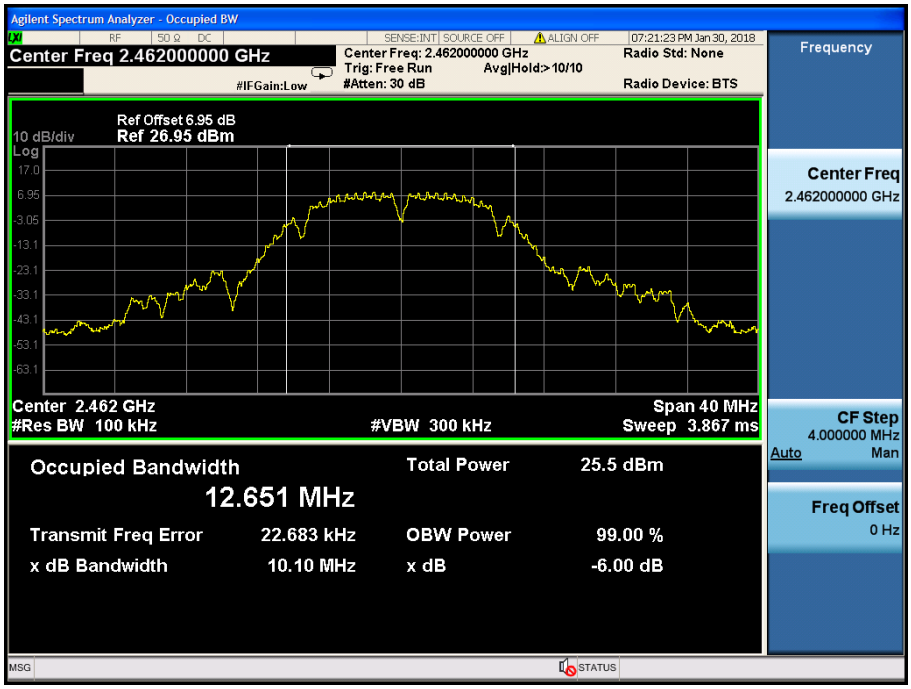
Test CH1: 2412MHz



Test CH6: 2437MHz

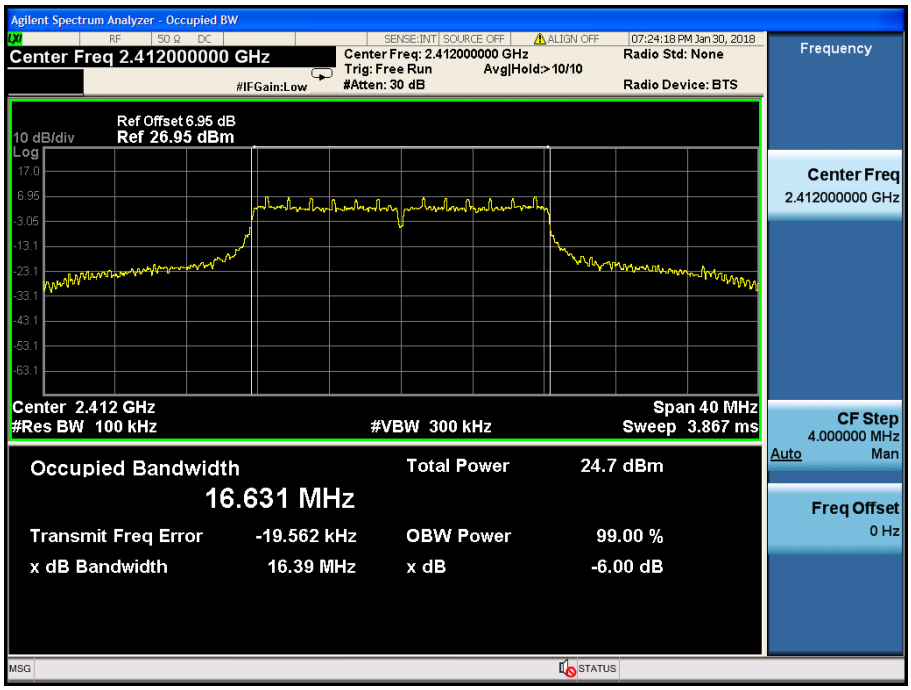


Test CH11: 2462MHz

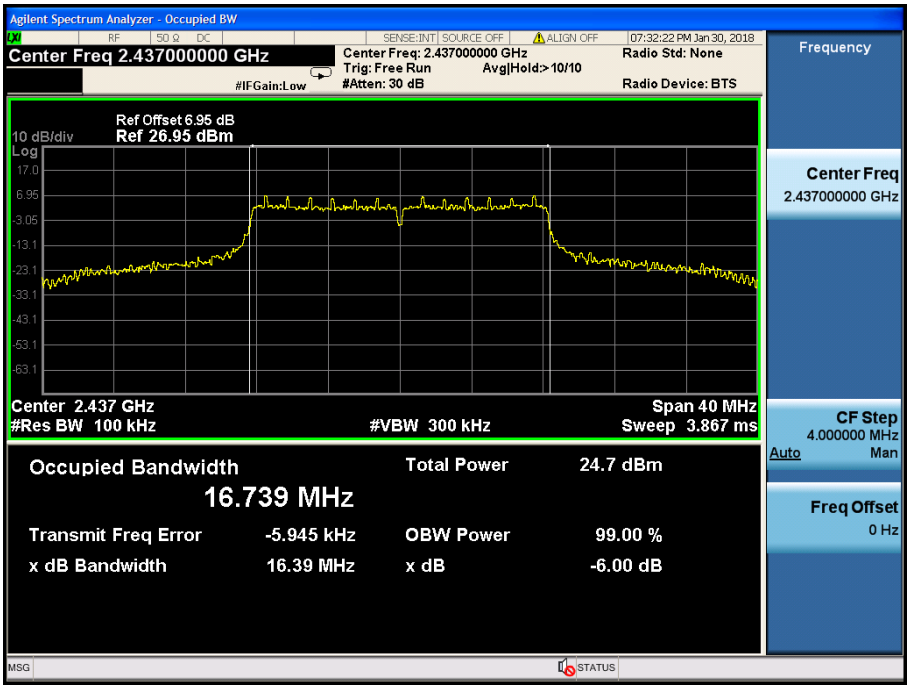


Test Mode: IEEE 802.11g TX

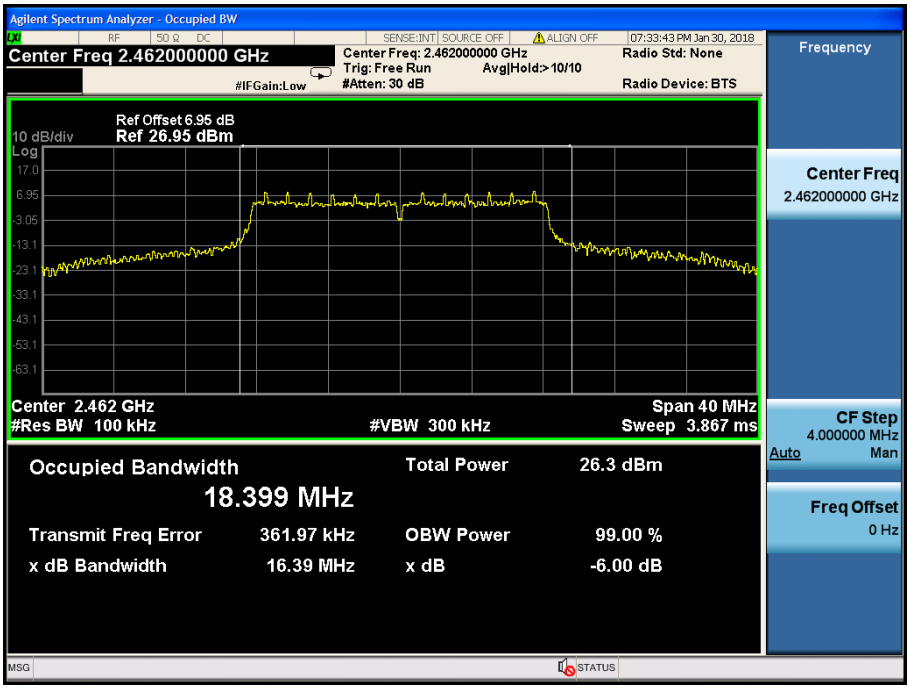
Test CH1: 2412MHz



Test CH6: 2437MHz

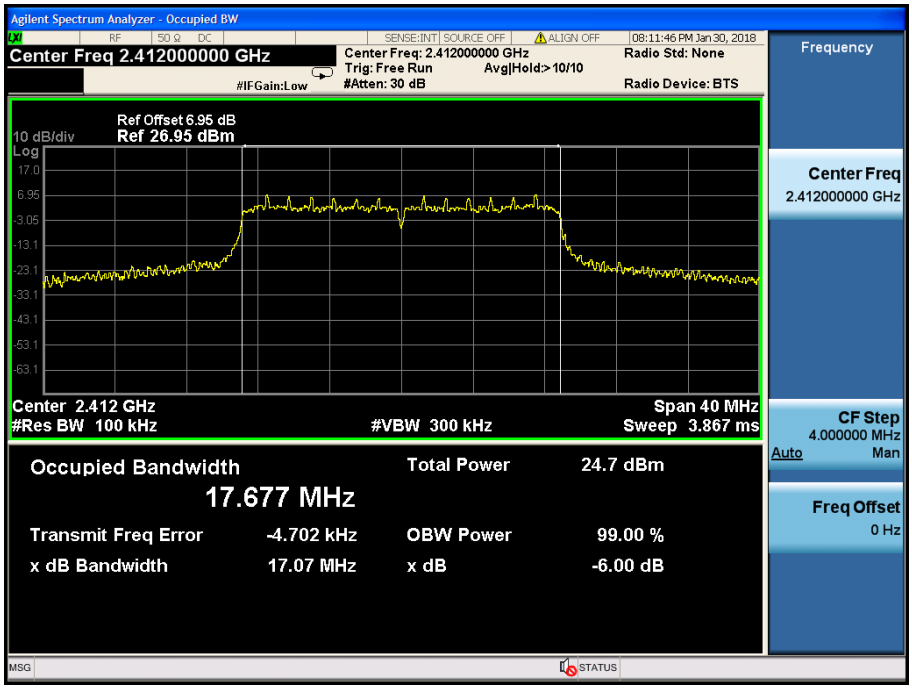


Test CH11: 2462MHz

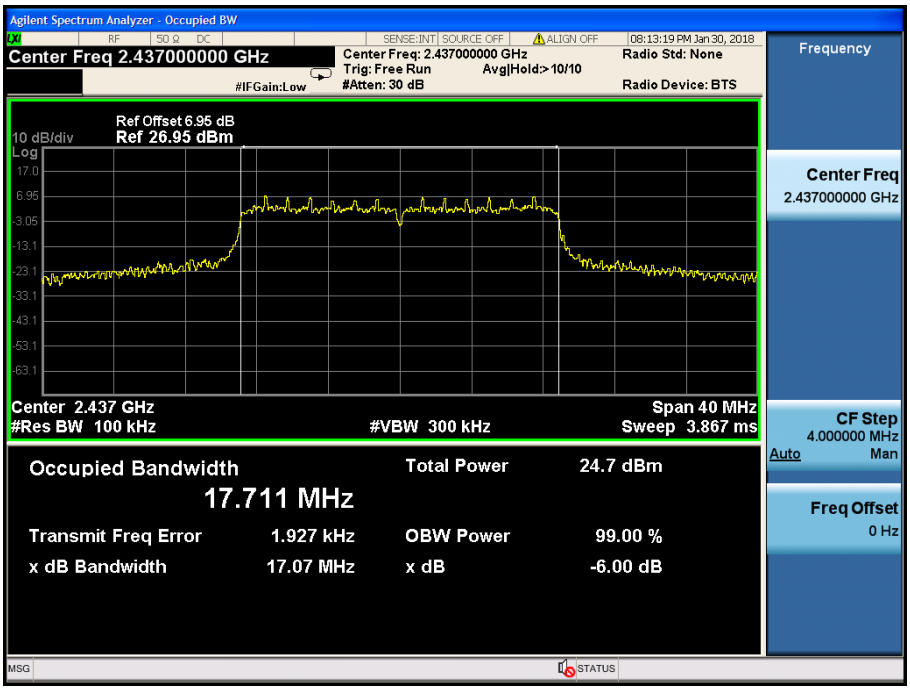


Test Mode: IEEE 802.11n (HT20) TX Test

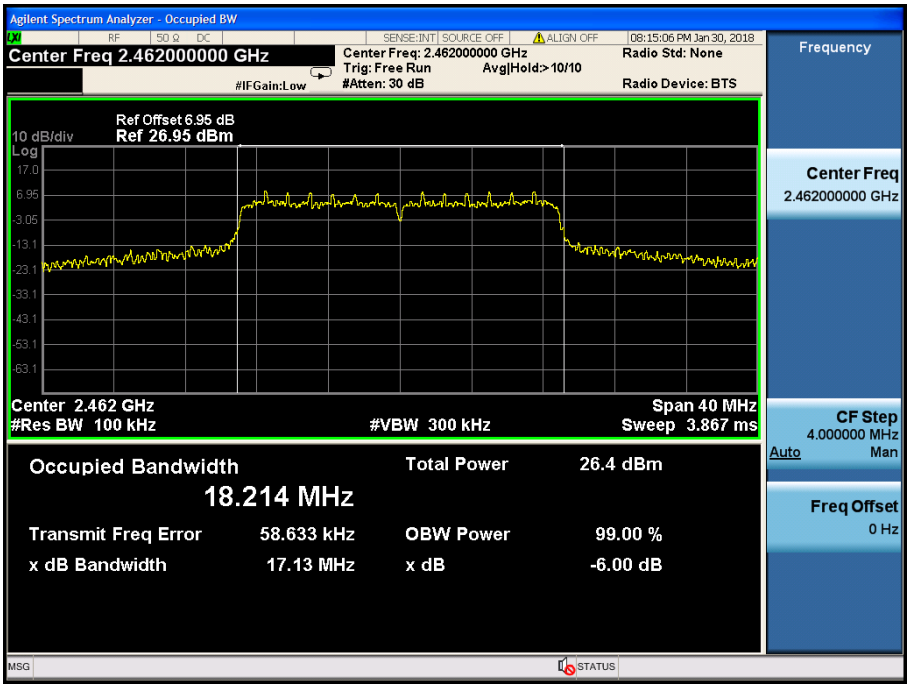
CH1: 2412MHz



Test CH6: 2437MHz

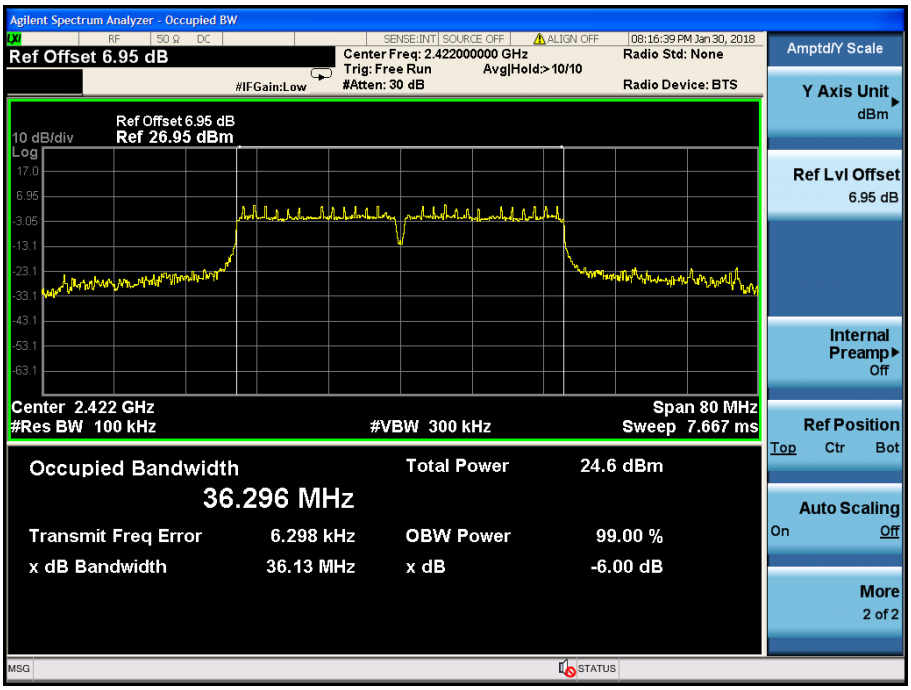


Test CH11: 2462MHz

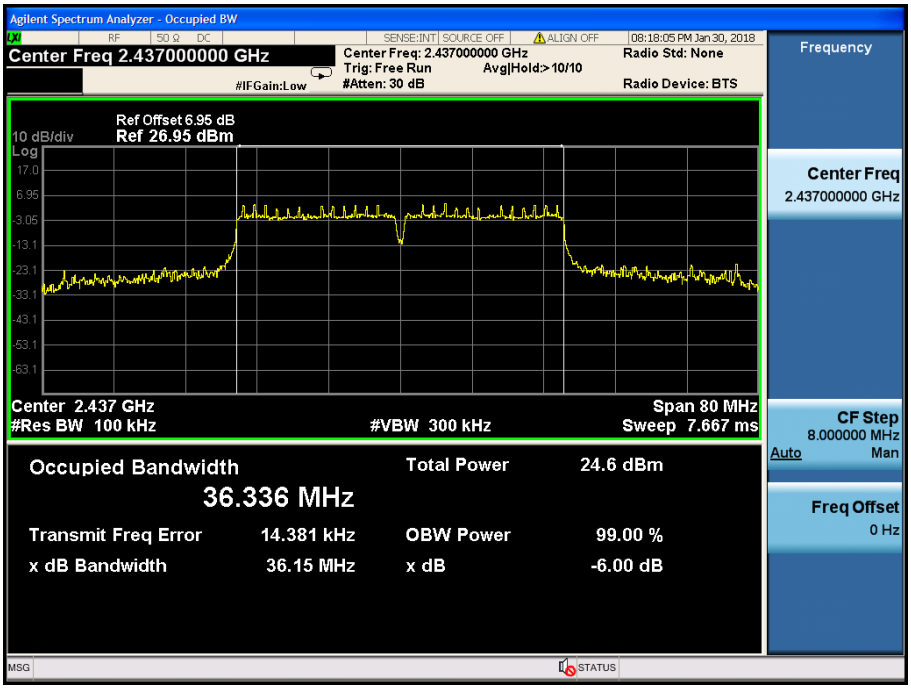


Test Mode: IEEE 802.11n (HT40) TX

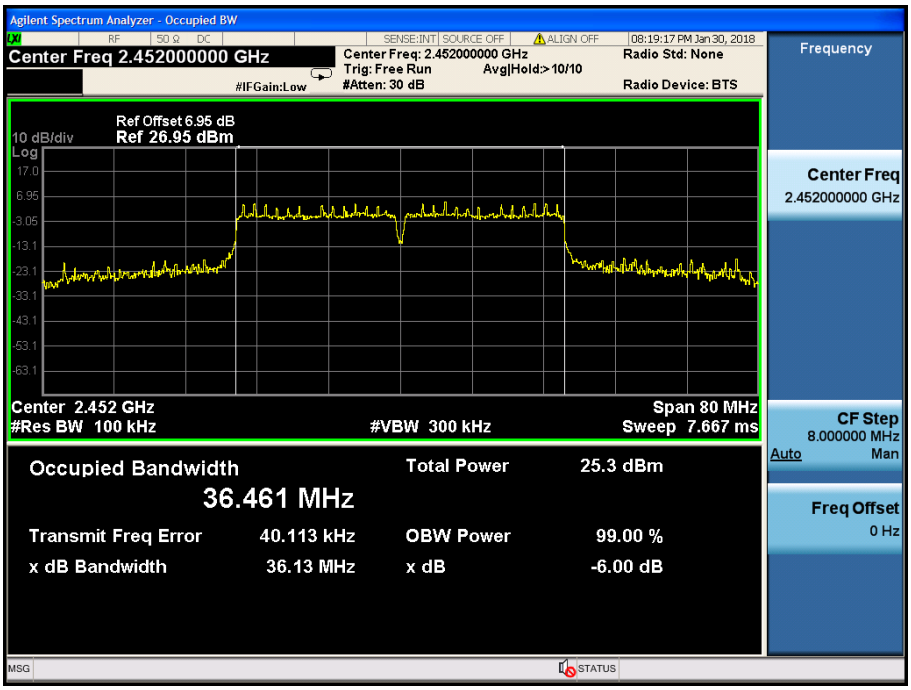
Test CH3: 2422MHz



Test CH6: 2437MHz



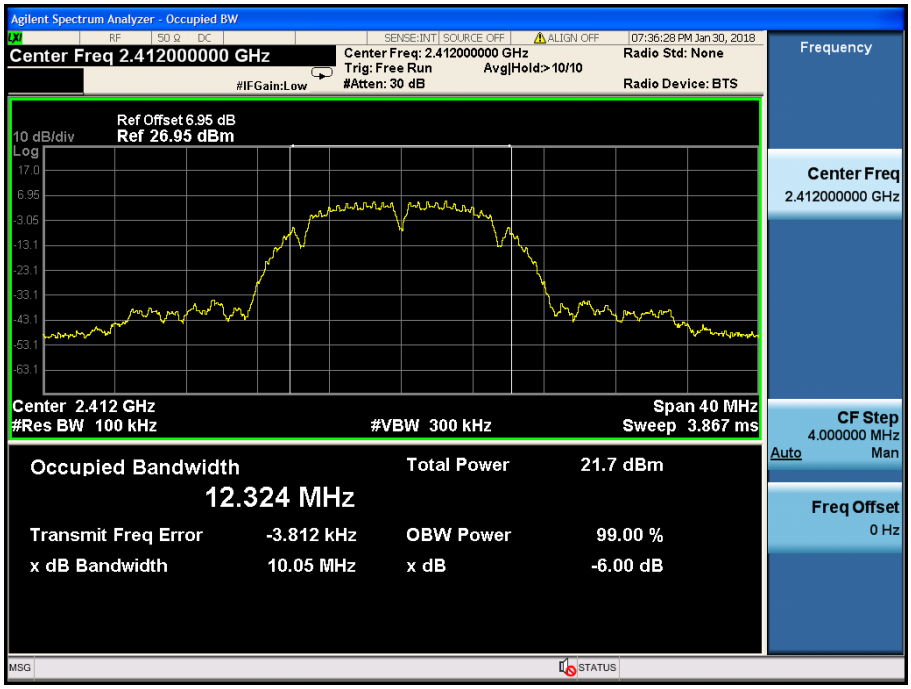
Test CH9: 2452MHz



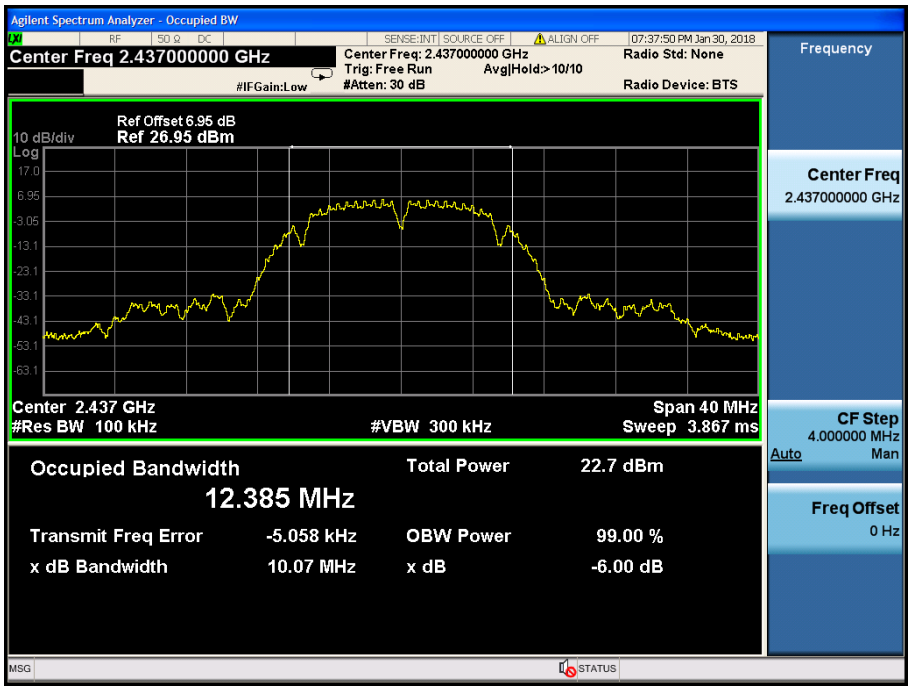
Chain 2-Test plot as follows

Test Mode: IEEE 802.11b TX

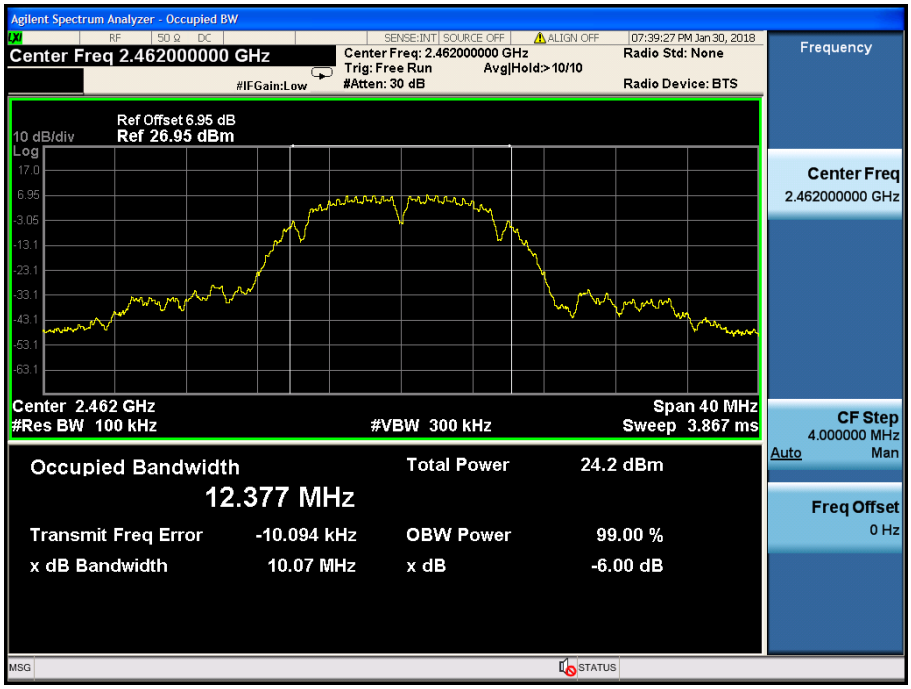
Test CH1: 2412MHz



Test CH6: 2437MHz

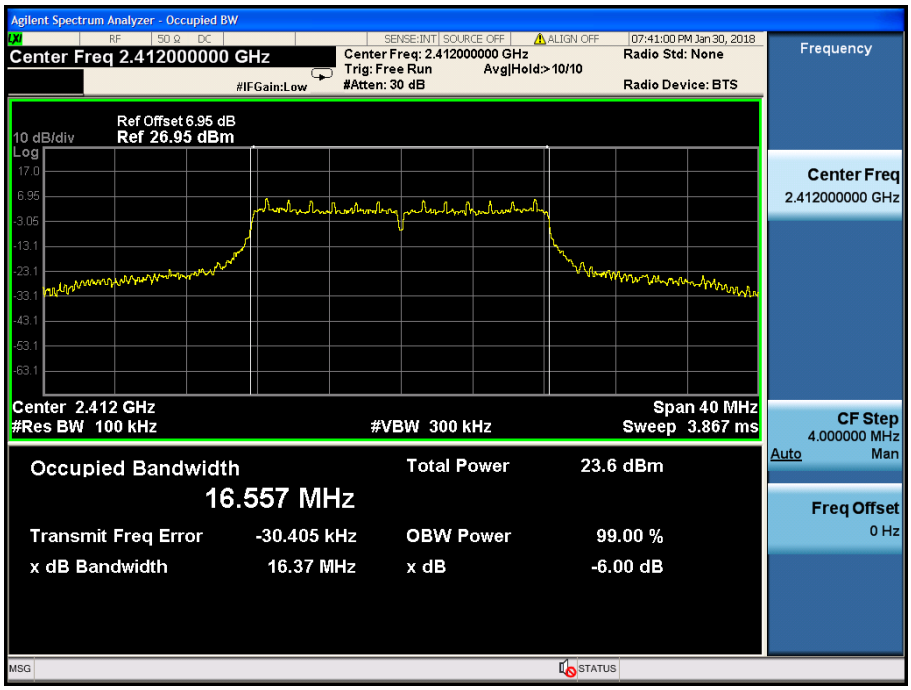


Test CH11: 2462MHz

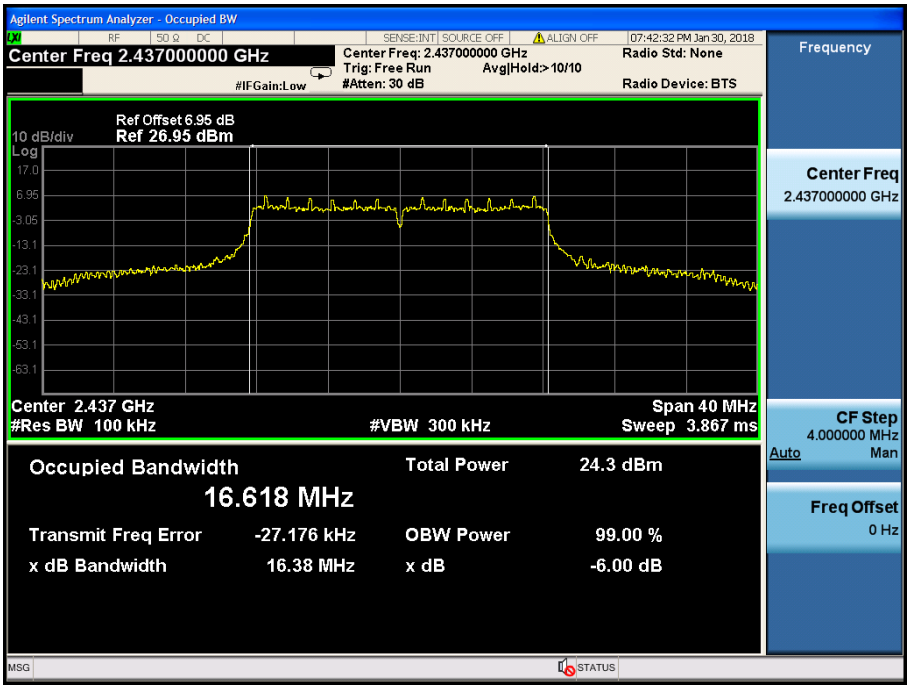


Test Mode: IEEE 802.11g TX

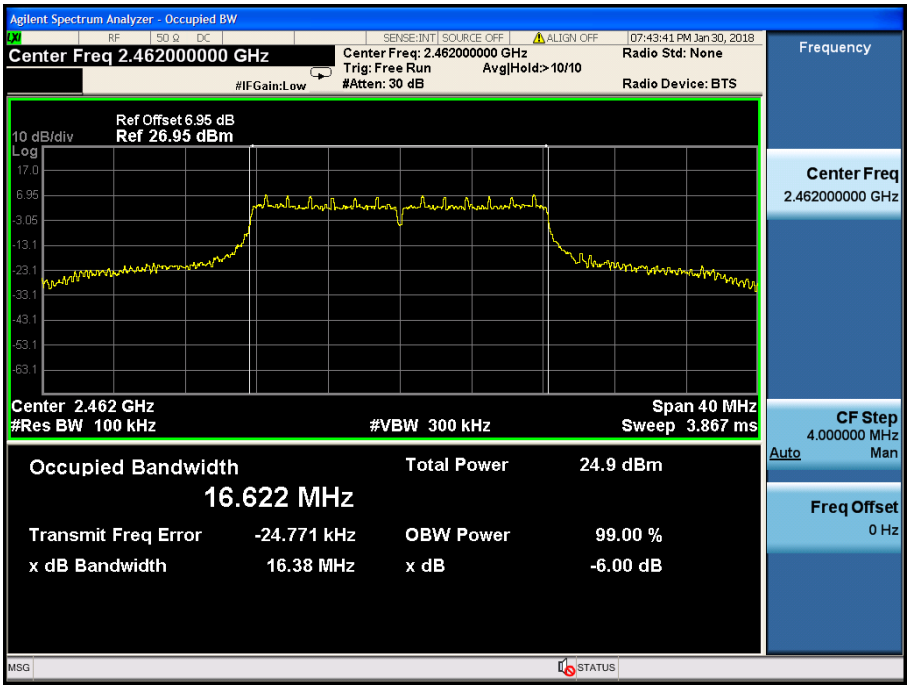
Test CH1: 2412MHz



Test CH6: 2437MHz

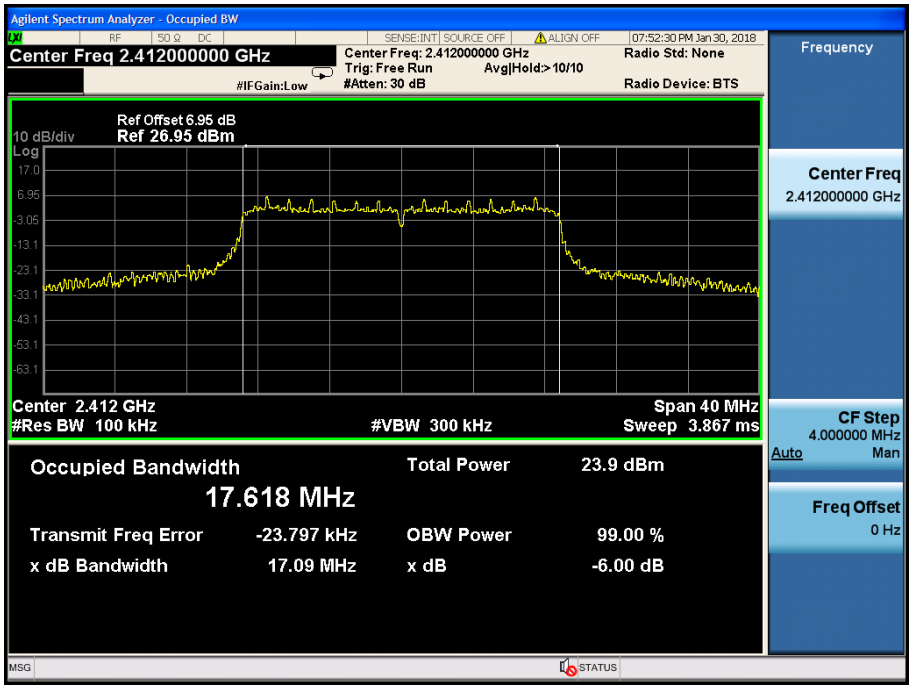


Test CH11: 2462MHz

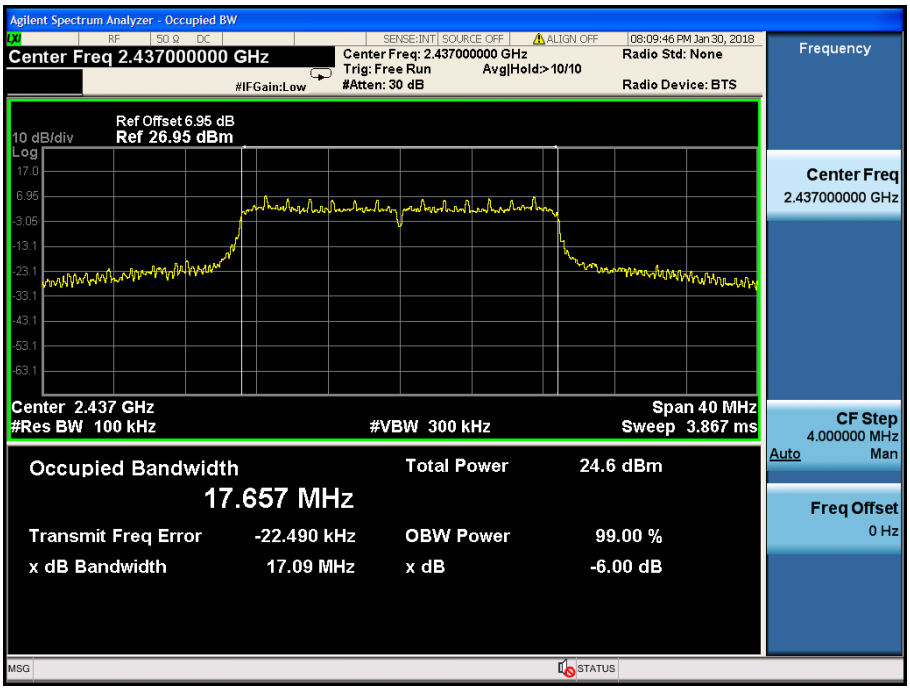


Test Mode: IEEE 802.11n (HT20) TX Test

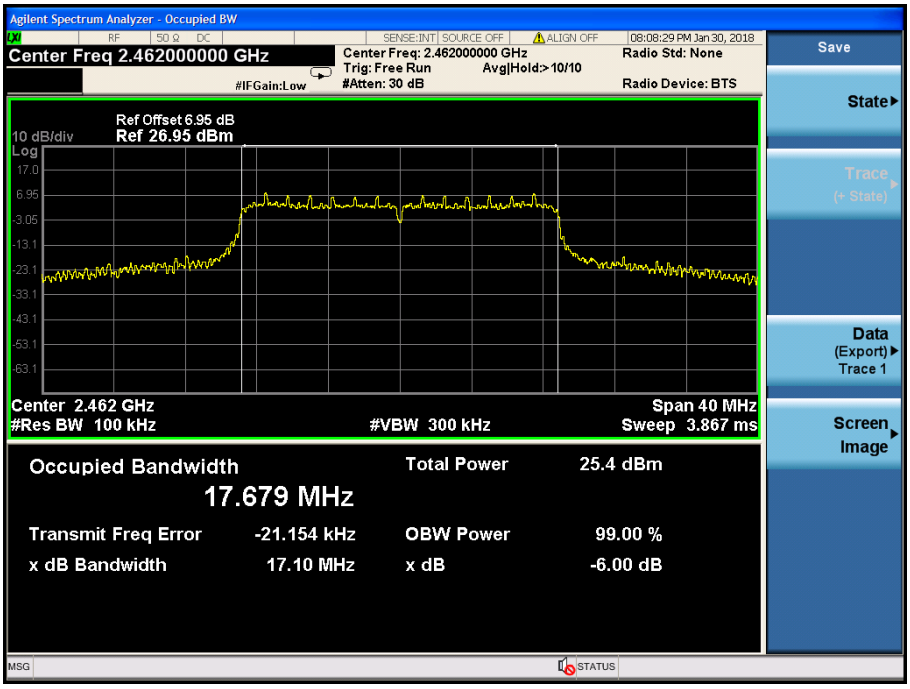
CH1: 2412MHz



Test CH6: 2437MHz

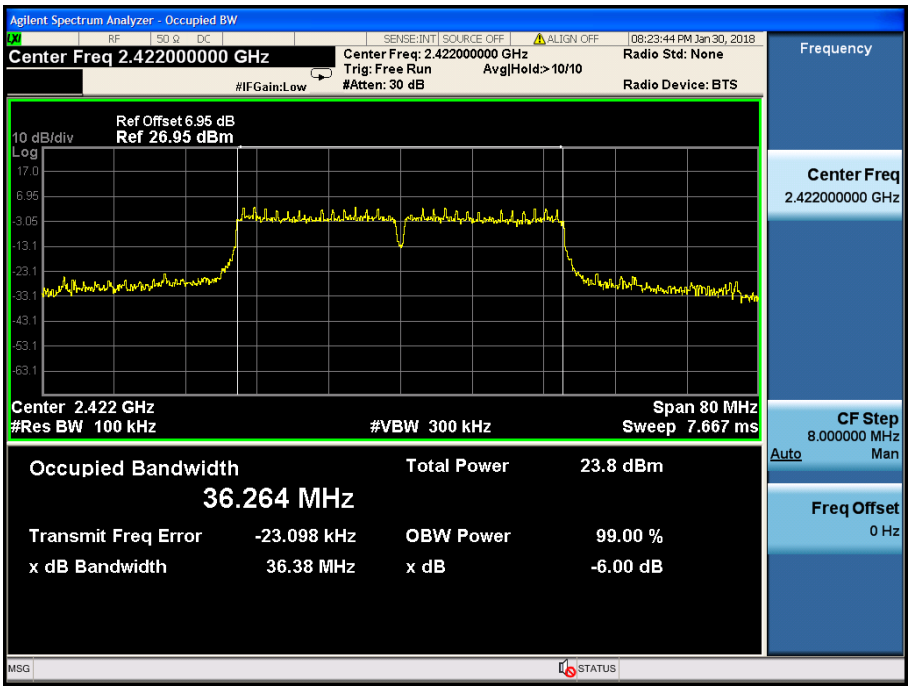


Test CH11: 2462MHz

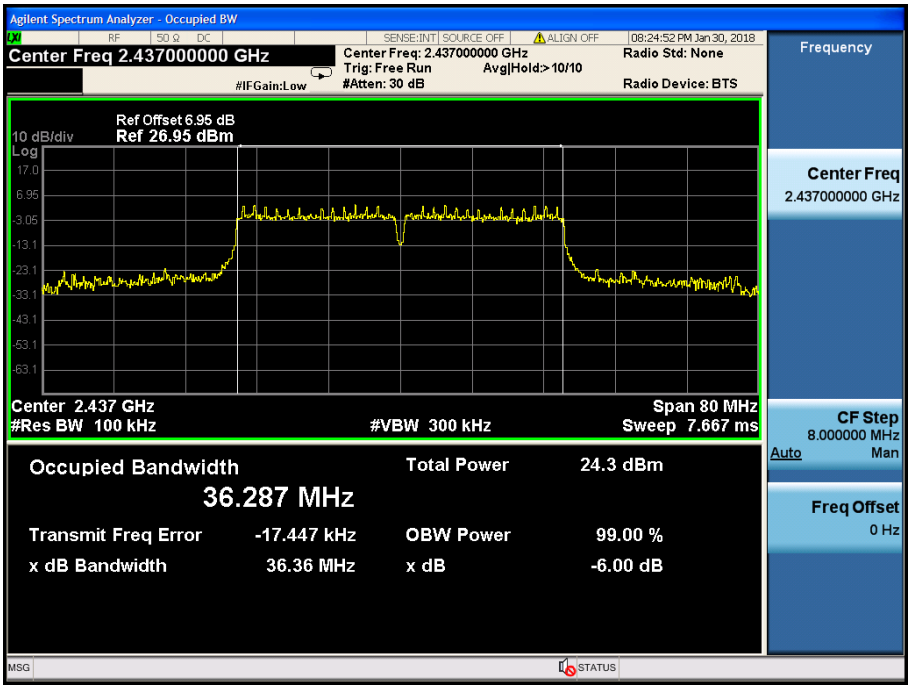


Test Mode: IEEE 802.11n (HT40) TX

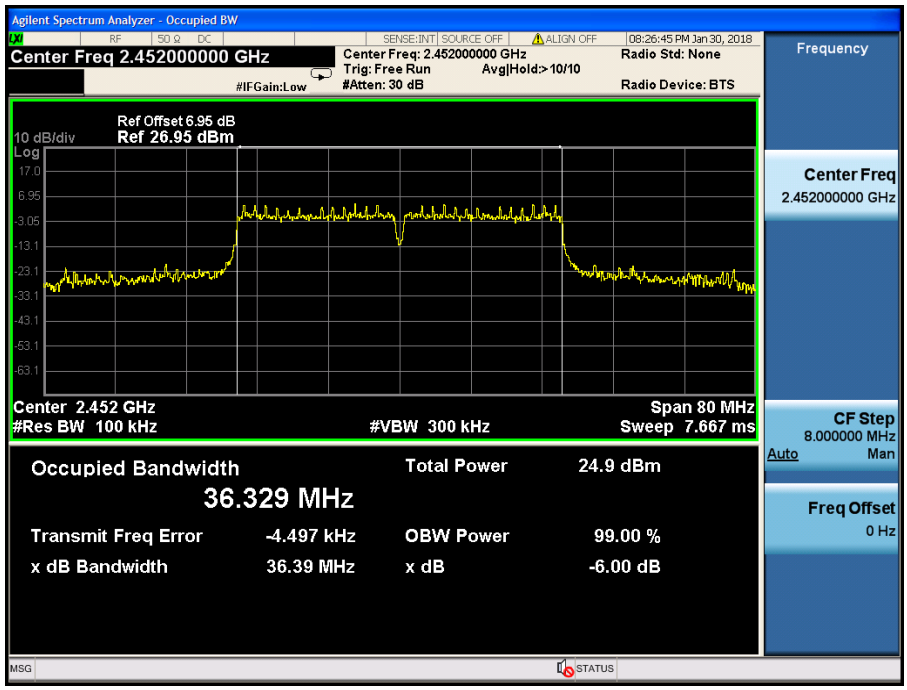
Test CH3: 2422MHz



Test CH6: 2437MHz



Test CH9: 2452MHz



6.4 Radiated Spurious Emissions

6.4.1 Limits

Radiated emissions that fall in the restricted bands must comply with the general emissions limits in RSS-Gen Issue 4, Section 6.13/8.9/8.10 as below table. Other emissions shall be at least 20 dB below the highest level of the desired power.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
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

Remark:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

The emissions were measured using the following resolution bandwidths:

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>30 kHz
>1000 MHz	1 MHz	<30 Hz

Harmonic and Spurious emissions that were identified as coming from the EUT were checked in Peak and in Average Mode. The high frequency, which started from 10 to26.5GHz, which above 10GHz are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured was not reported.

Peak measurements and average measurements are made. All emissions were determined to have a peak-to-average ratio of less than 20dB.

6.4.2 Test Procedure(KDB 558074 D01 v04, Section 12.1 and Section12.2.5.3)

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.10-2013. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

6.4.3 Test Data

The EUT complied with the RSS-Gen Issue 4 Radiated Spurious Emissions requirements. Table 9 provide the test results for Radiated Spurious Emissions. (All the data attached was use the worst case data rate as in table 6)

6.4.4 Areas of Concern

None

Table 9: Radiated Emission Test Data

Radiated Emission Test Data (Below 30 MHz)

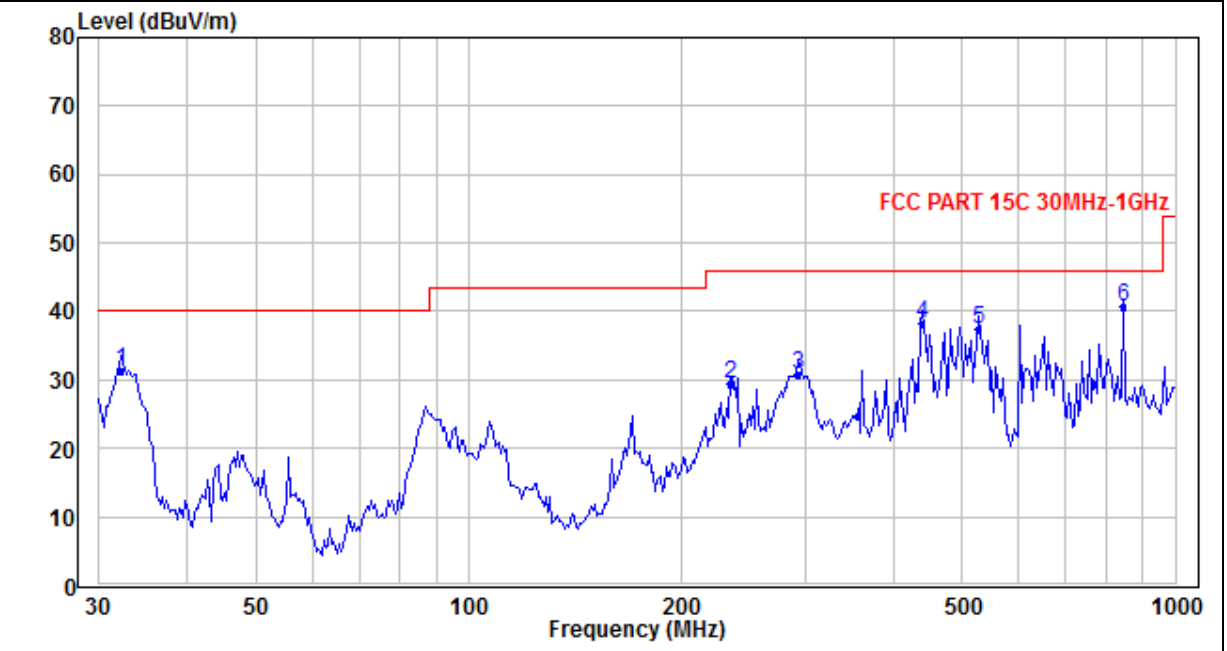
The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

Radiated Emission Test Data (Above 18 GHz)

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

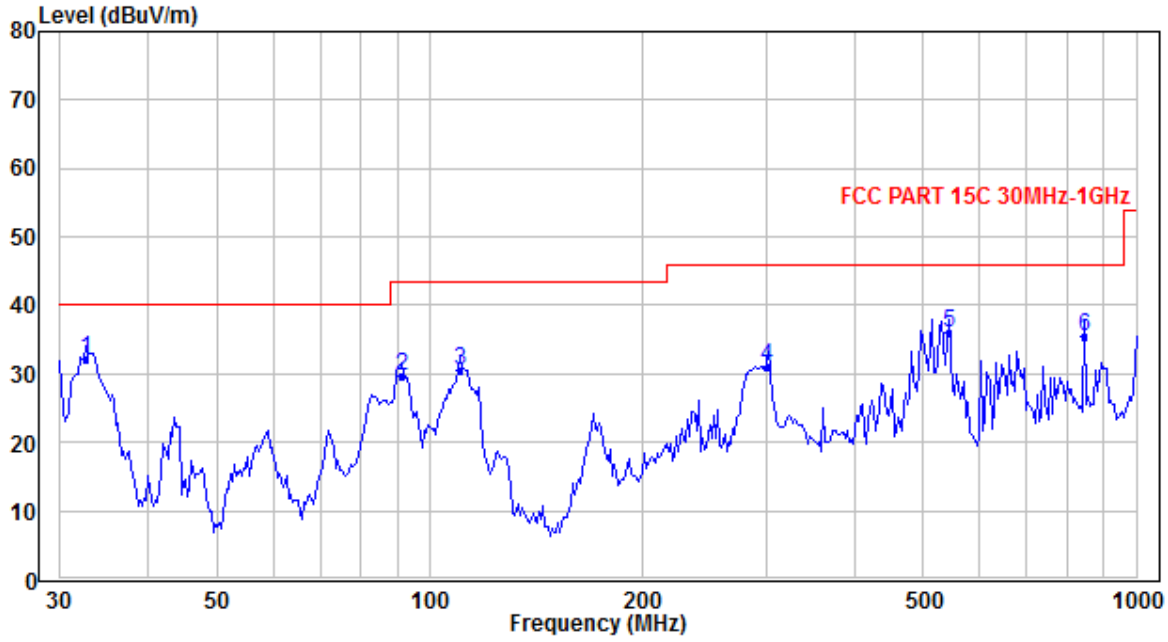
Radiated Emission Test Data (30 MHz~1 GHz Worst Case)

Mode	802.11b	Ant. Polar.	Horizontal
Antenna	Chain 1	Channel	1



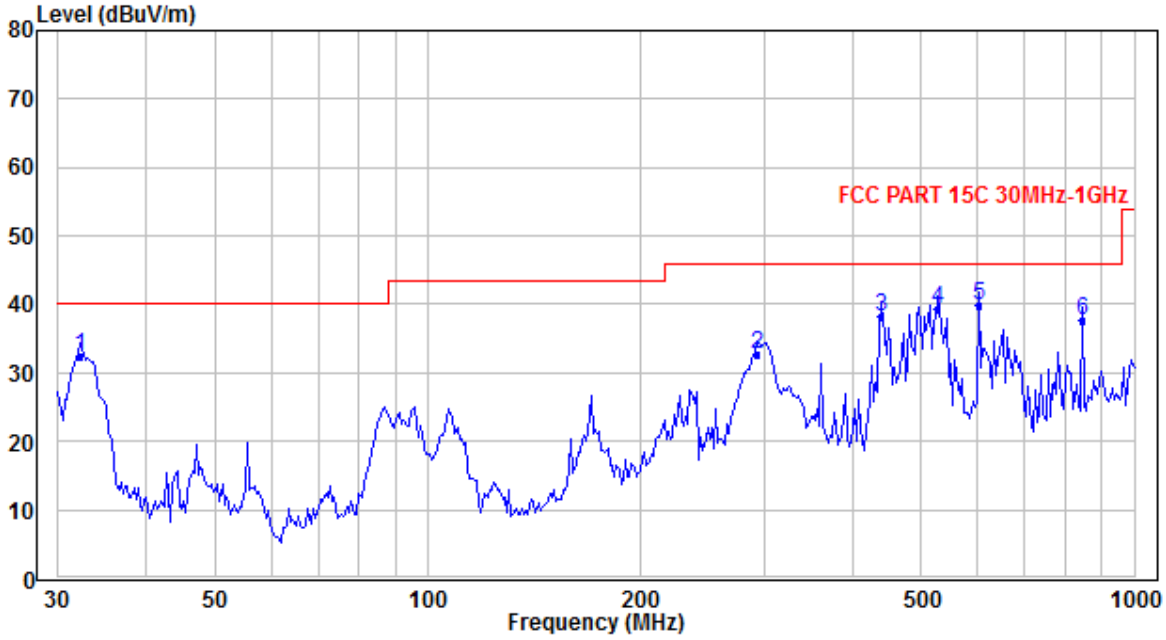
.No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	32.184	43.81	-12.37	31.44	40.00	-8.56	QP
2	235.135	43.10	-13.55	29.55	46.00	-16.45	QP
3	292.364	42.05	-11.40	30.65	46.00	-15.35	QP
4	439.473	46.40	-8.27	38.13	46.00	-7.87	QP
5	527.571	43.19	-5.94	37.25	46.00	-8.75	QP
6*	844.803	42.23	-1.68	40.55	46.00	-5.45	QP

Mode	802.11b	Ant. Polar.	Vertical
Antenna	Chain 1	Channel	1



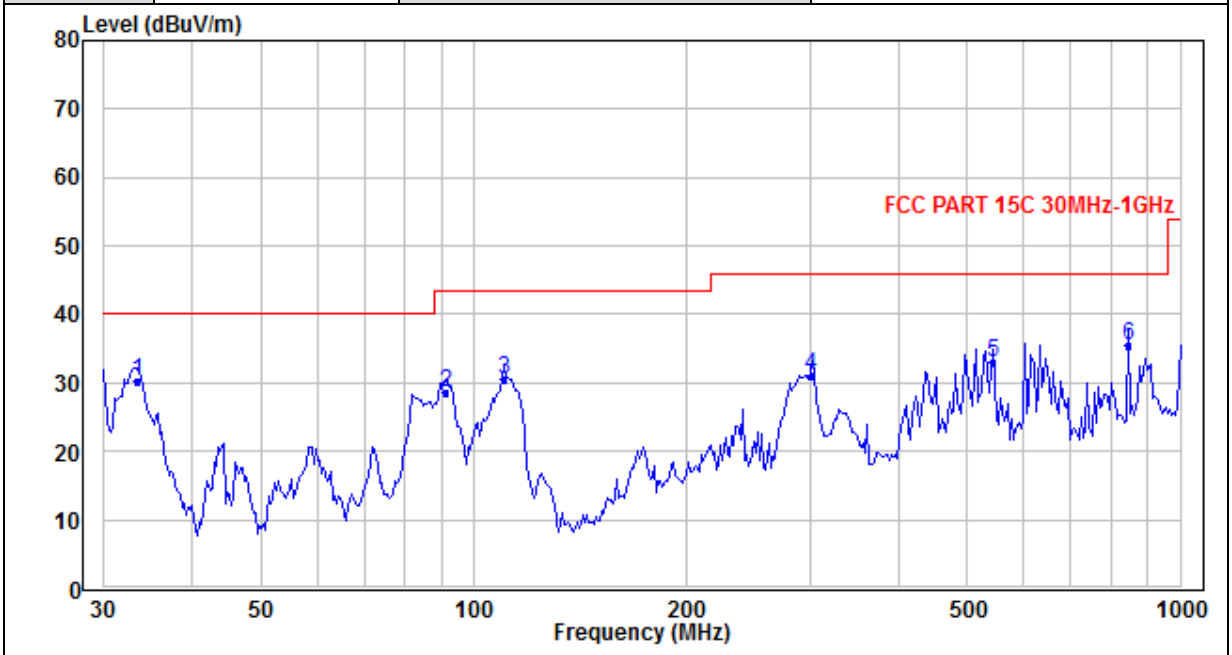
.No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1*	32.640	45.67	-13.58	32.09	40.00	-7.91	QP
2	91.057	48.98	-19.41	29.57	43.50	-13.93	QP
3	110.082	49.26	-18.67	30.59	43.50	-12.91	QP
4	300.699	42.50	-11.31	31.19	46.00	-14.81	QP
5	542.610	42.05	-6.00	36.05	46.00	-9.95	QP
6	844.803	37.39	-1.80	35.59	46.00	-10.41	QP

Mode	802.11g	Ant. Polar.	Horizontal
Antenna	Chain 1	Channel	1



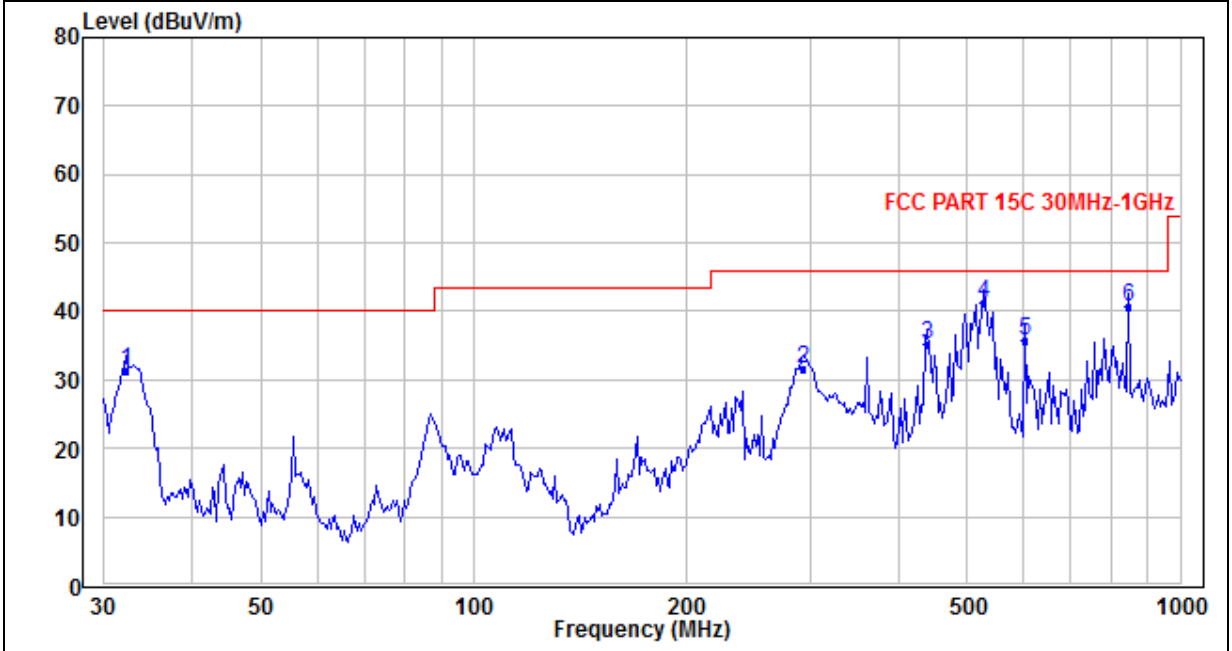
.No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	32.184	44.81	-12.37	32.44	40.00	-7.56	QP
2	292.364	44.05	-11.40	32.65	46.00	-13.35	QP
3	439.473	46.40	-8.27	38.13	46.00	-7.87	QP
4	527.571	45.19	-5.94	39.25	46.00	-6.75	QP
5*	602.929	44.21	-4.38	39.83	46.00	-6.17	QP
6	844.803	39.23	-1.68	37.55	46.00	-8.45	QP

Mode	802.11g	Ant. Polar.	Vertical
Antenna	Chain 1	Channel	1



.No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1*	33.335	44.05	-13.94	30.11	40.00	-9.89	QP
2	91.057	47.98	-19.41	28.57	43.50	-14.93	QP
3	110.082	49.26	-18.67	30.59	43.50	-12.91	QP
4	300.699	42.50	-11.31	31.19	46.00	-14.81	QP
5	542.610	39.05	-6.00	33.05	46.00	-12.95	QP
6	844.803	37.39	-1.80	35.59	46.00	-10.41	QP

Mode	802.11n(HT20)	Ant. Polar.	Horizontal
Antenna	Chain 1+2	Channel	1



.No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	32.184	43.81	-12.37	31.44	40.00	-8.56	QP
2	292.364	43.05	-11.40	31.65	46.00	-14.35	QP
3	439.473	43.40	-8.27	35.13	46.00	-10.87	QP
4*	527.571	47.19	-5.94	41.25	46.00	-4.75	QP
5	602.929	40.21	-4.38	35.83	46.00	-10.17	QP
6	844.803	42.23	-1.68	40.55	46.00	-5.45	QP