Venstar, Inc.

TEST REPORT FOR

WiFi Temperature Sensor
Model: WiFi Sensor Mini

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

15.247
(DTS 2400-2483.5 MHz)

Report No.: 102204-9

Date of issue: March 6, 2019

This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of testing for CKC Laboratories, Inc.

We strive to create long-term, trust based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.

Test Certificate # 803.02

This report contains a total of 74 pages and may be reproduced in full only. Partial reproduction may only be done with the written consent of CKC Laboratories, Inc.

Testing the Future
CKC LABORATORIES, INC.

TABLE OF CONTENTS

ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

Venstar, Inc.
9250 Owensmouth Avenue
Chatsworth CA 91311

Representative: Alex Garashin

REPORT PREPARED BY:

Terri Rayle
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Project Number: 102204

DATE OF EQUIPMENT RECEIPT: February 11, 2019
DATE(S) OF TESTING: February 11-19, 2019

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the equipment provided by the client, tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.

Steve Behm
Director of Quality Assurance & Engineering Services
CKC Laboratories, Inc.

Test Facility Information

Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable and affordable test results.

TEST LOCATION(S):
CKC Laboratories, Inc.
110 Olinda Place
Brea, CA 92823

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.11

Site Registration & Accreditation Information

Location	*NIST CB #	FCC	JAPAN
Brea A, CA	US0060	US1025	A-0147

*CKC's list of NIST designated countries can be found at: https://standards.gov/cabs/designations.html

SUMMARY OF RESULTS

Standard / Specification: FCC Part 15 Subpart C - 15.247 (DTS)

Test Procedure	Description	Modifications	Results
15.247(a)(2)	6dB Bandwidth	NA	Pass
15.247(b)(3)	Output Power	NA	Pass
15.247(e)	Power Spectral Density	NA	Pass
15.247(d)	RF Conducted Emissions & Band Edge	NA	NA1
15.247(d)	Radiated Emissions & Band Edge	NA	Pass
15.207	AC Conducted Emissions	NA	NA2

NA = Not Applicable
NA1 = Not applicable because the EUT does not have an external antenna.
NA2 = Not applicable because the EUT is battery powered.

ISO/IEC 17025 Decision Rule
The declaration of pass or fail herein is based upon assessment to the specification(s) listed above, including where applicable, assessment of measurement uncertainties. For performance related tests, equipment was monitored for specified criteria identified in that section of testing.

Modifications During Testing

This list is a summary of the modifications made to the equipment during testing.

Summary of Conditions
No modifications were made during testing.

Modifications listed above must be incorporated into all production units.

Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

Summary of Conditions
None

EQUIPMENT UNDER TEST (EUT)

During testing, numerous configurations may have been utilized. The configurations listed below support compliance to the standard(s) listed in the Summary of Results section.

Configuration 1

Equipment Tested:

Device	Manufacturer	Model #	S/N
WiFi Temperature Sensor	Venstar, Inc.	WiFi Sensor Mini	NA

Support Equipment:

Device	Manufacturer	Model #	S/N
Laptop	Lenovo	Thinkpad T500	L3B3906

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	802.11b, g, n20
Operating Frequency Range:	2412-2462MHz
Modulation Type(s):	CCK, OFDM
Maximum Duty Cycle:	98%
Number of TX Chains:	1
Antenna Type(s) and Gain:	PCB Trace, 2dBi
Beamforming Type:	NA
Antenna Connection Type:	Integral
Nominal Input Voltage:	2x AAA 1.5V battery
Firmware / Software used for Test:	Terra Term ver.4.86

FCC Part 15 Subpart C

15.247(a)(2) 6dB Bandwidth

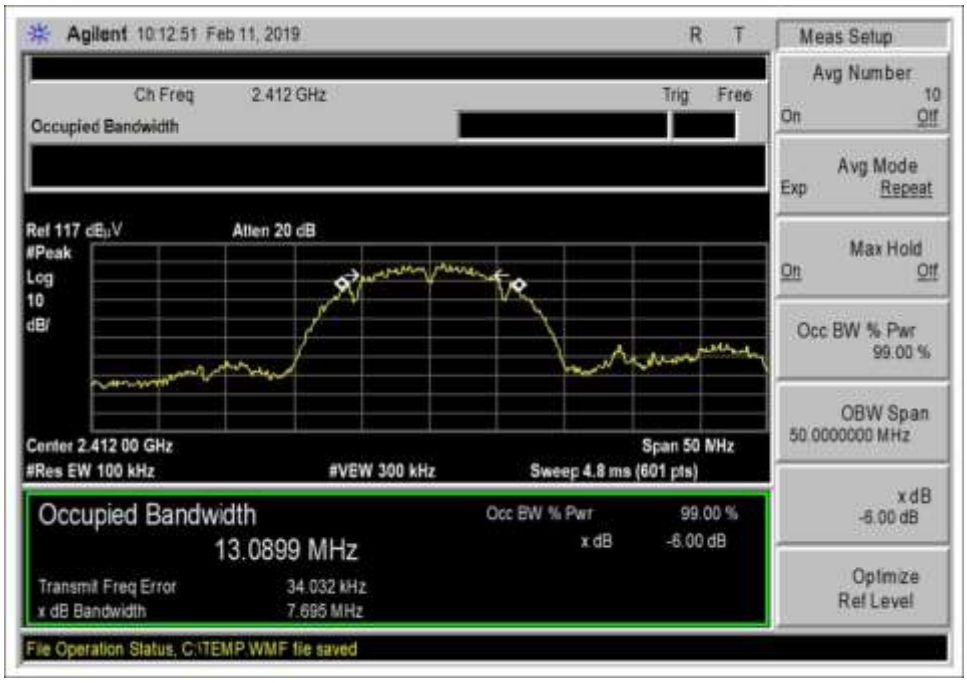
Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.10 (2013), KDB 558074 v05, February 11th, 2019	Test Date(s):	2/11/2019
Configuration:	1		
Test Setup:	The EUT is placed on Styrofoam block and set to transmit continuously at 98% duty cycle. The EUT is connected to remotely located laptop via serial to USB cable. The EUT is rotated in three orthogonal axes. Transmitting frequencies: 2412MHz (CH1), 2437MHz (CH6), 2462MHz (CH11) Modulation/Mode: 802.11g,b,n20 Lowest and highest data rate of each modulation are selected during test. 558074 D01 15.247 Measure Guidance v05, February 11th, 2019 Measurement frequencies: 2412, 2437, 2462MHz RBW=100kHz, VBW=300kHz		

Environmental Conditions			
Temperature (ºC)	18.5	Relative Humidity (%):	33.5

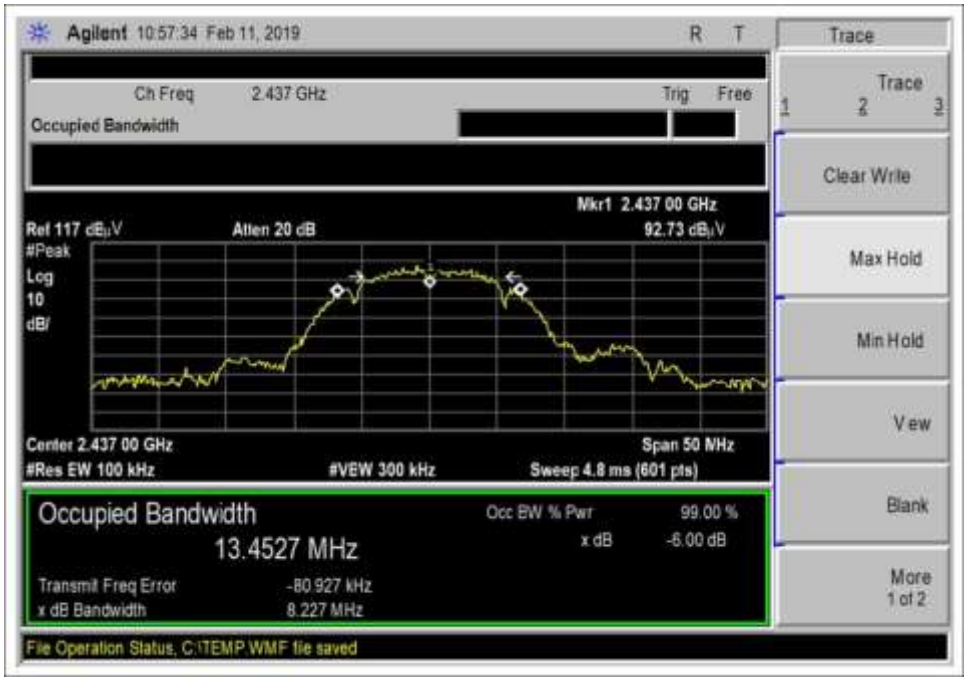
Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
00786	Preamp	HP	83017A	5/12/2018	5/12/2020
00849	Horn Antenna	ETS	3115	3/14/2018	3/14/2020
P07139	Cable	Andrew	ANDL1-PNMNM-48	3/1/2017	3/1/2019
P07246	Cable	H&S	32022-29094K-29094K-24TC	7/5/2018	7/5/2020
02869	Spectrum Analyzer	Agilent	E4440A	8/10/2018	8/10/2019

Test Data Summary					
Frequency (MHz)	**Antenna Port**	**Modulation**	**Measured (kHz)**	**Limit (kHz)**	**Results**
2412	1	802.11b, 1Mbps	7695	≥500	Pass
2437	1	802.11b, 1Mbps	8227	≥500	Pass
2462	1	802.11b, 1Mbps	8674	≥500	Pass
2412	1	802.11b, 11Mbps	9435	≥500	Pass
2437	1	802.11b, 11Mbps	8844	≥500	Pass
2462	1	802.11b, 11Mbps	9469	≥500	Pass
2412	1	802.11g, 6Mbps	16270	≥500	Pass
2437	1	802.11g, 6Mbps	14705	≥500	Pass
2462	1	802.11g, 6Mbps	14726	≥500	Pass
2412	1	802.11g, 54Mbps	15513	≥500	Pass
2437	1	802.11g, 54Mbps	16486	≥500	Pass
2462	1	802.11g, 54Mbps	16369	≥500	Pass
2412	1	802.11n20, MCS0	13997	≥500	Pass
2437	1	802.11n20, MCS0	15185	≥500	Pass
2462	1	802.11n20, MCS0	15482	≥500	Pass
2412	1	802.11n20, MCS7	17300	≥500	Pass
2437	1	802.11n20, MCS7	17218	≥500	Pass
2462	1	802.11n20, MCS7	16567	≥500	Pass

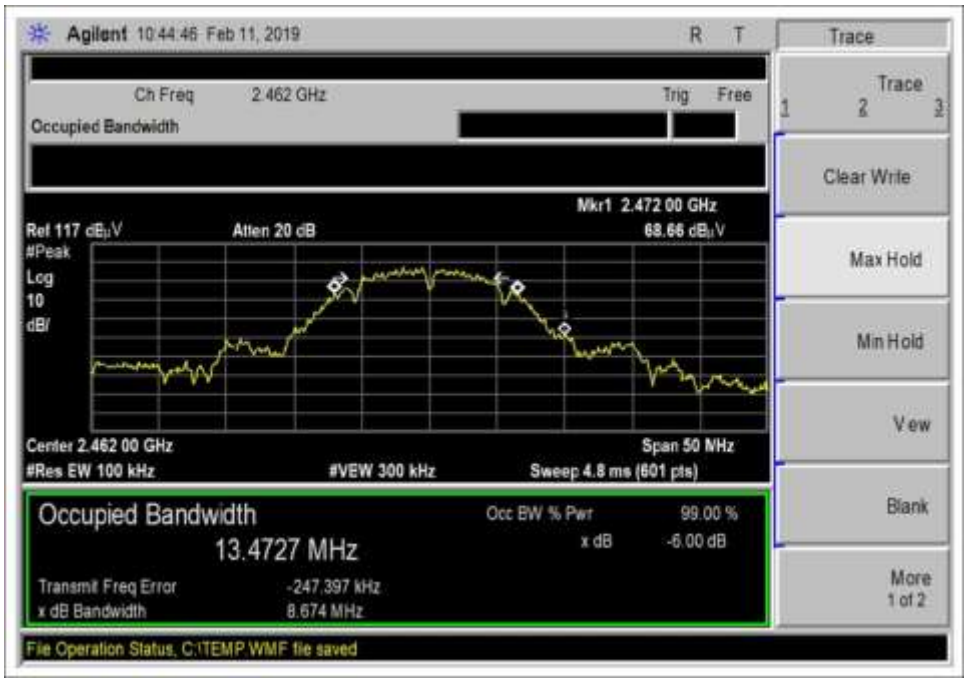
Plot(s)



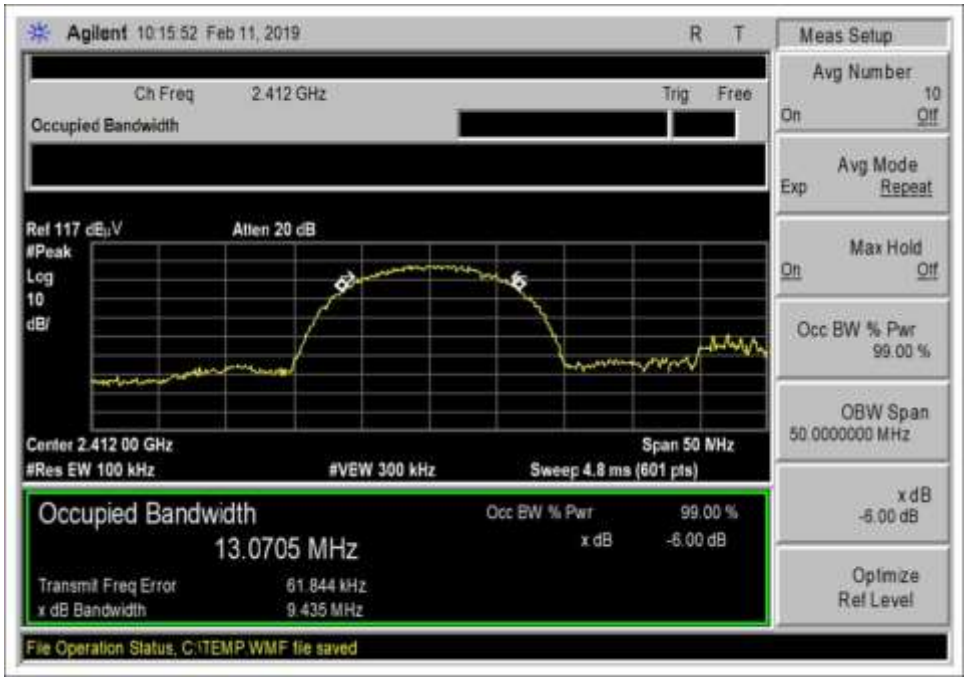
Low Channel_b_1Mbps



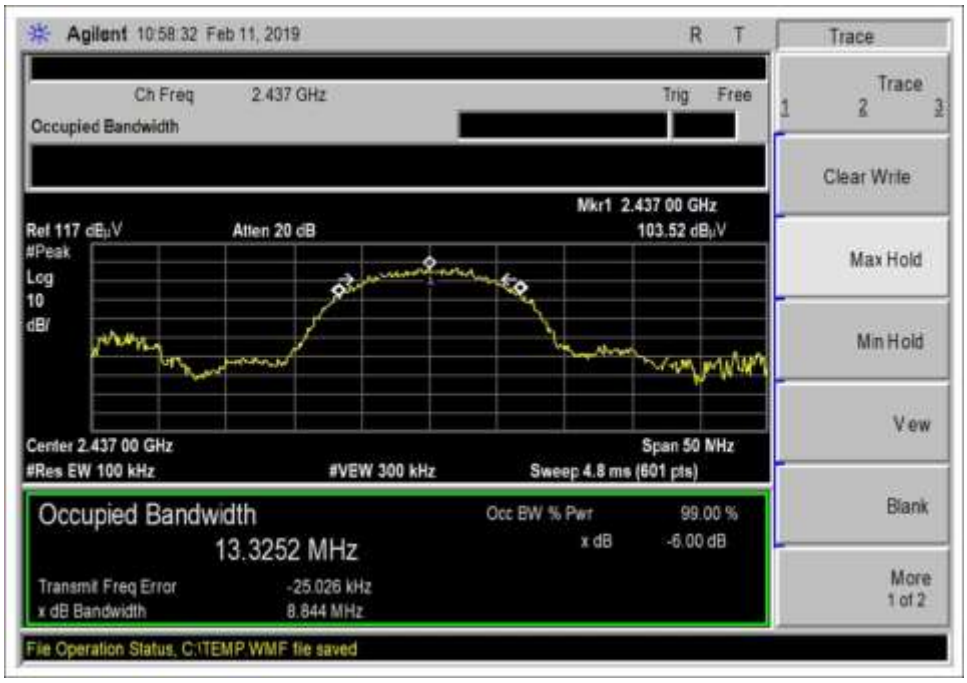
Middle Channel_b_1Mbps



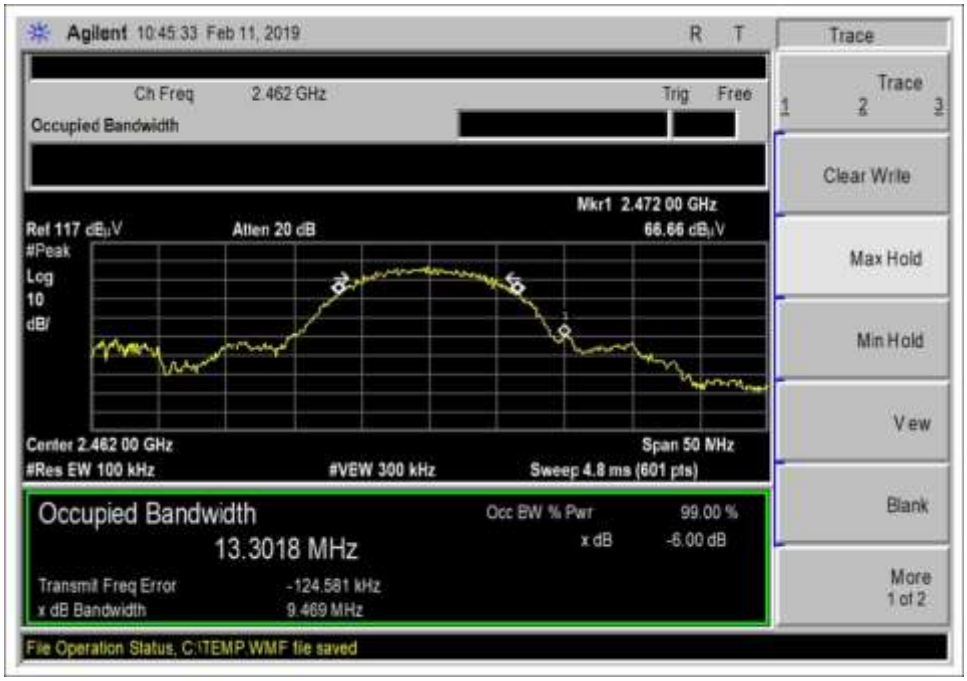
High Channel_b_1Mbps



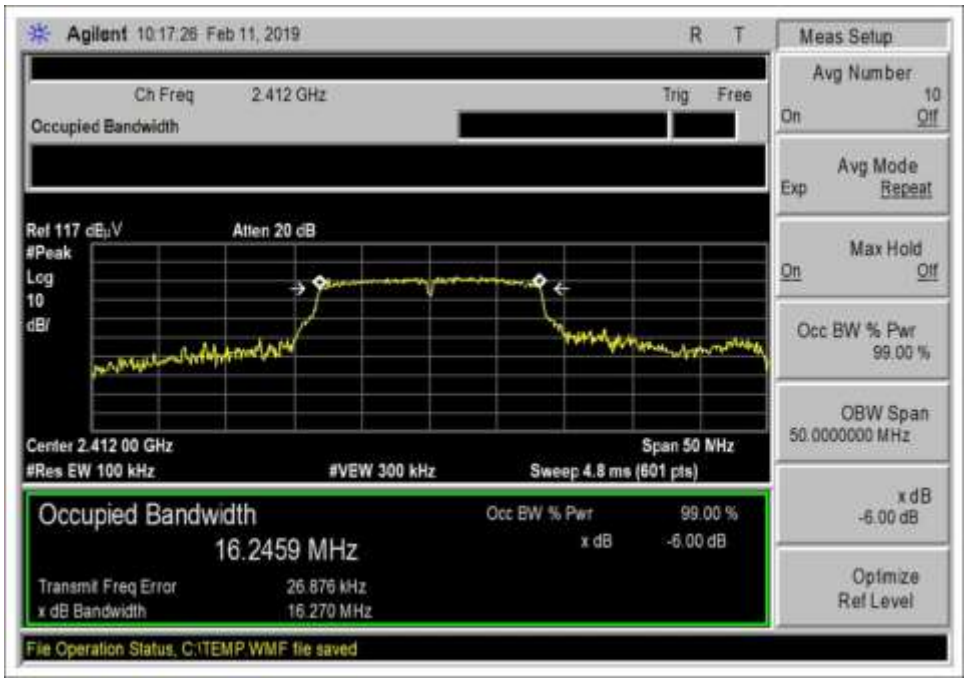
Low Channel_b_11Mbps



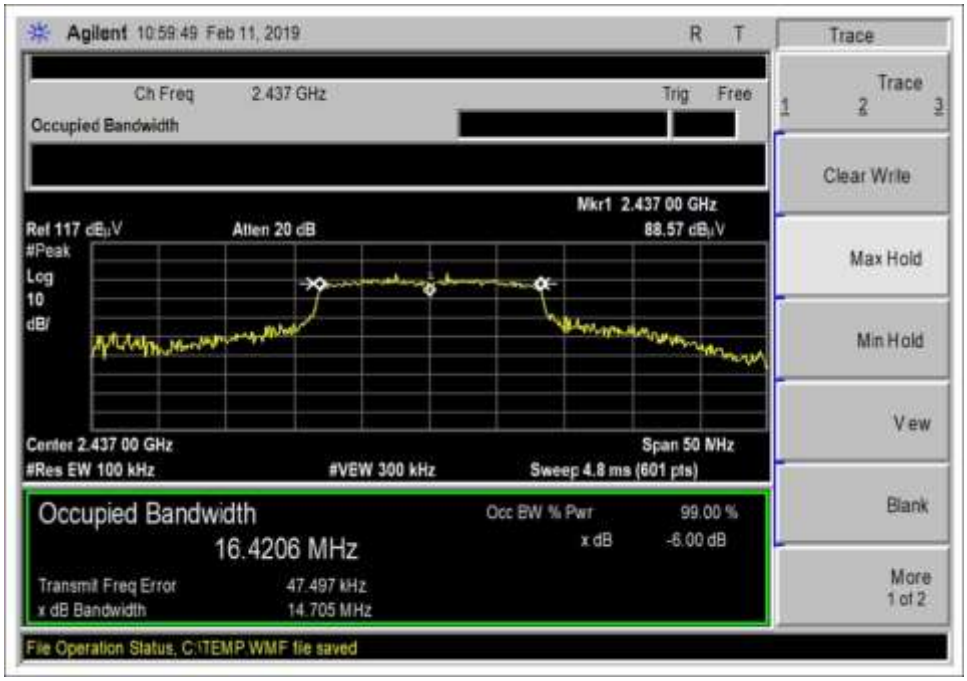
Middle Channel_b_11Mbps



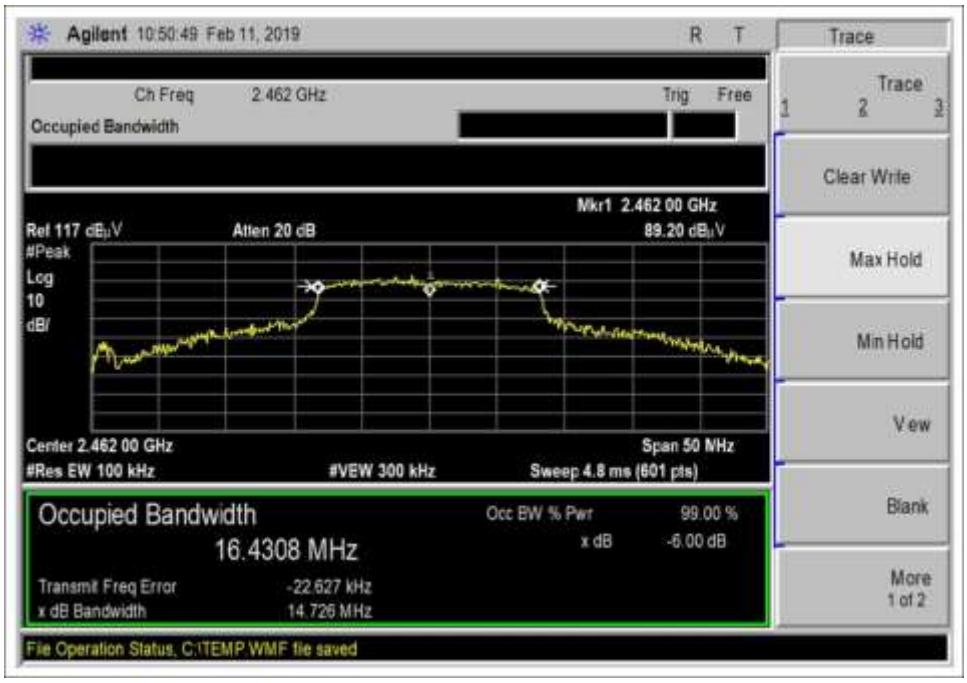
High Channel_b_11Mbps



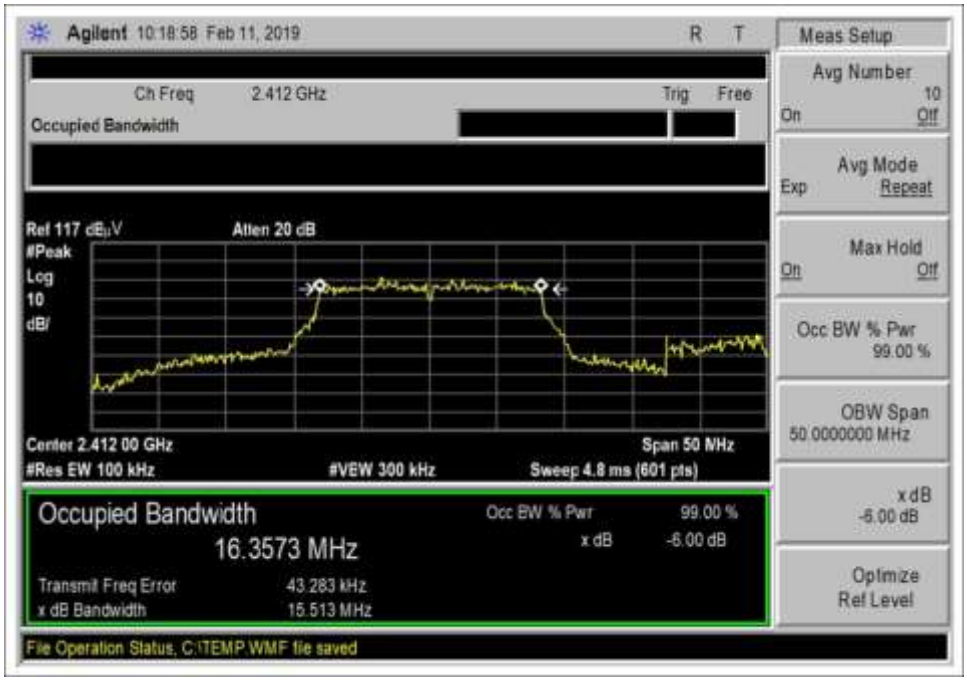
Low Channel_g_6Mbps



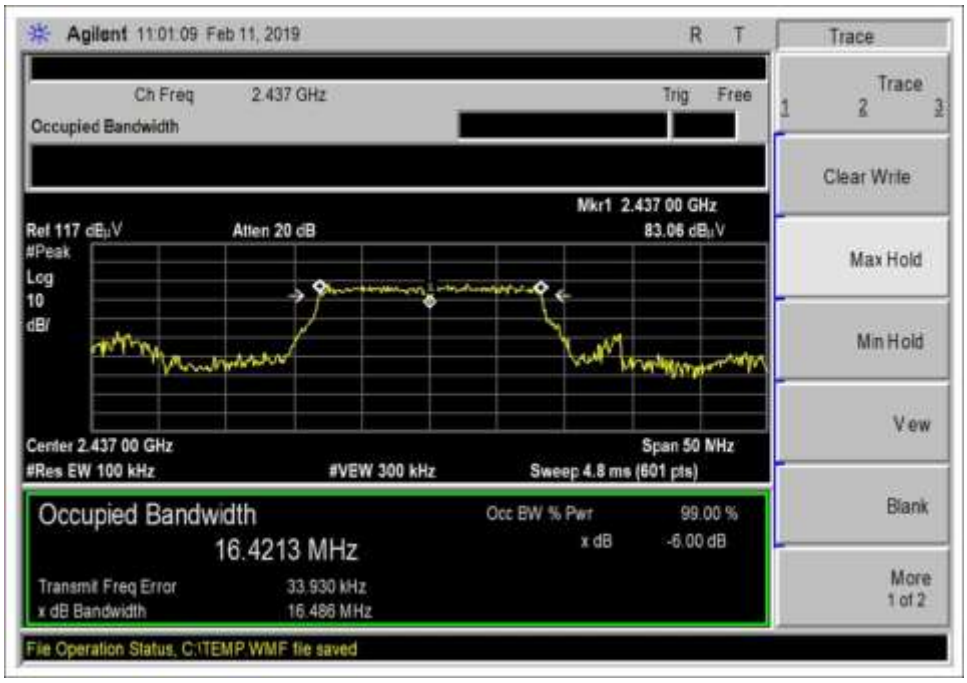
Middle Channel_g_6Mbps



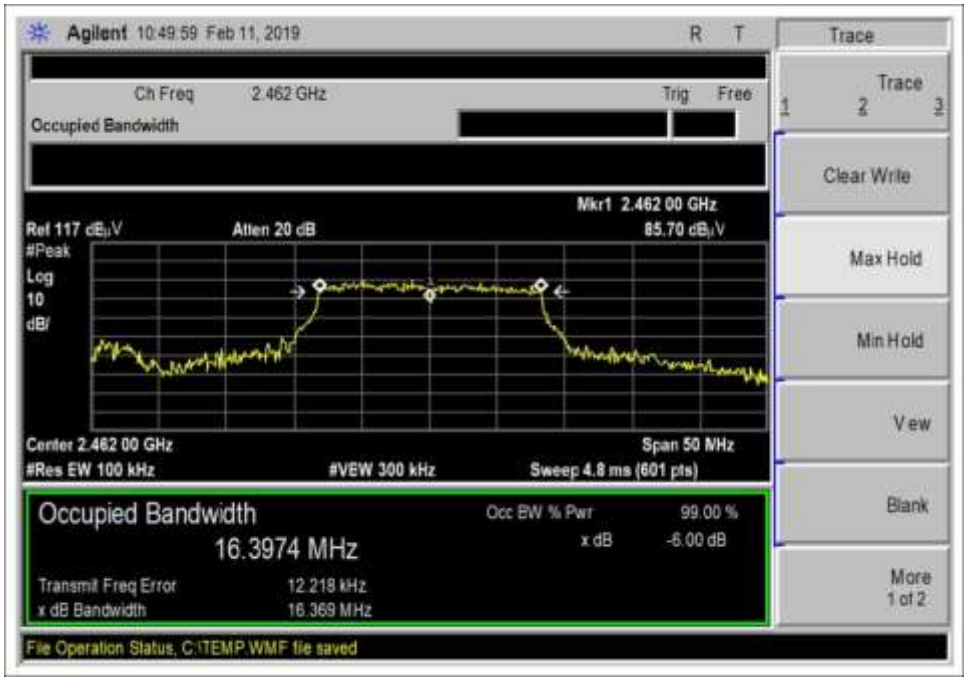
High Channel_g_6Mbps



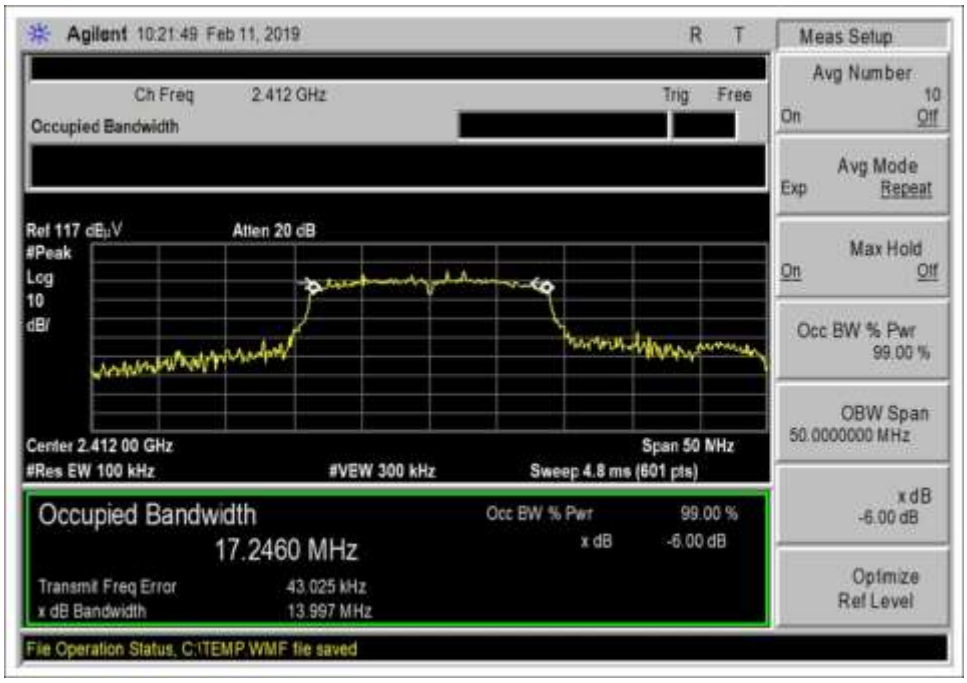
Low Channel_g_54Mbps



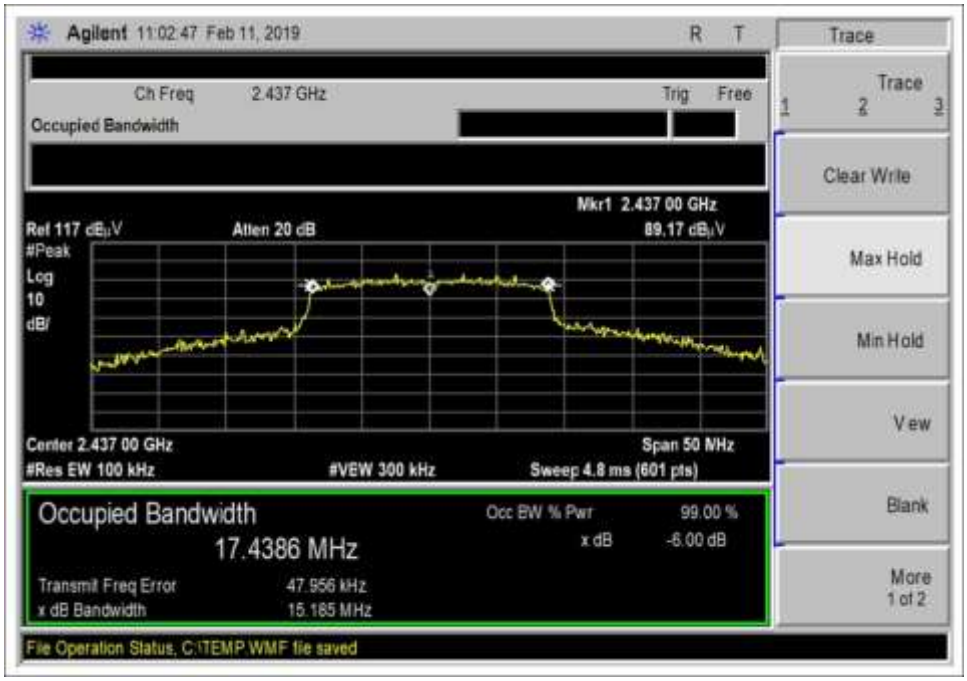
Middle Channel_g_54Mbps



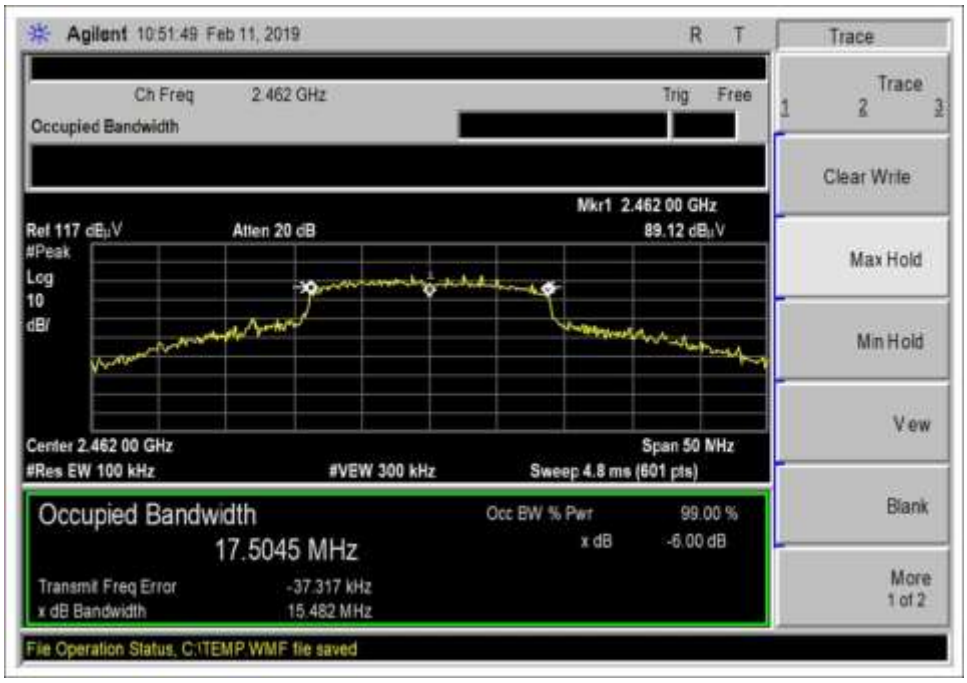
High Channel_g_54Mbps



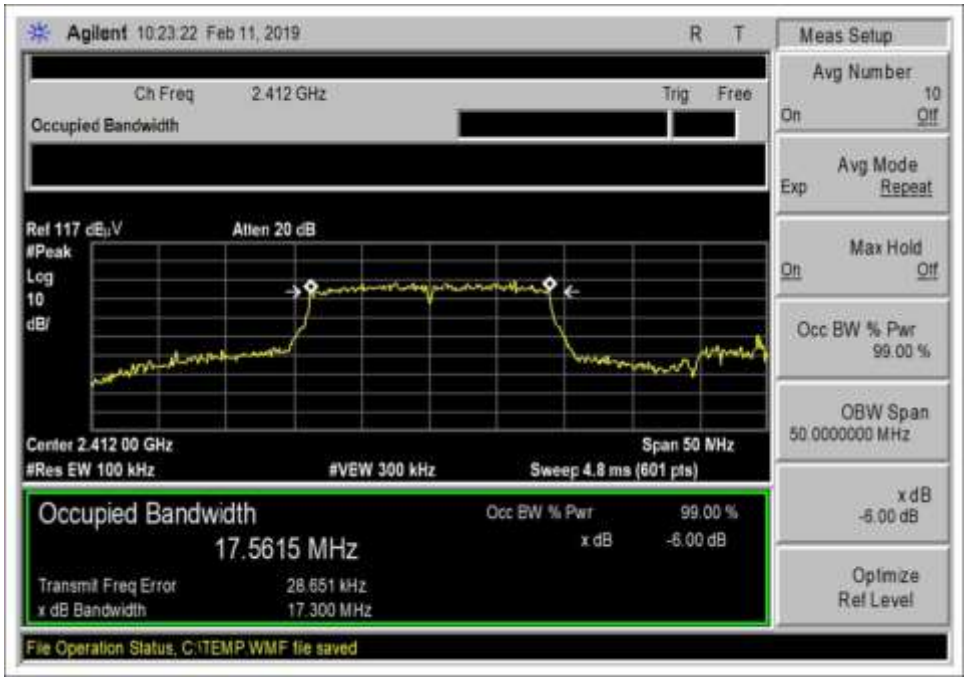
Low Channel_n20_MCS0



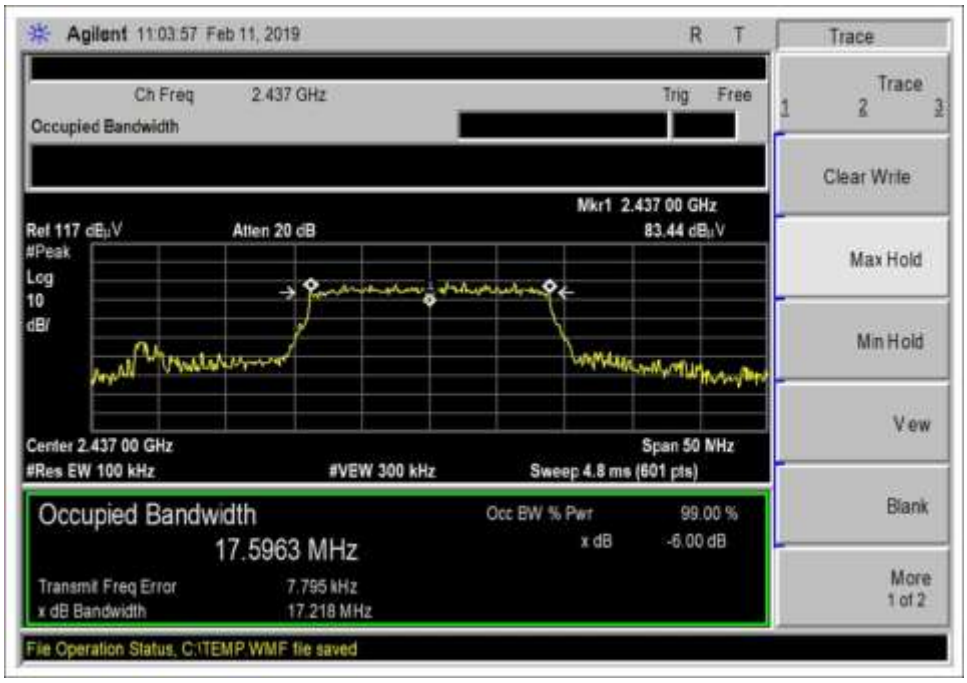
Middle Channel_n20_MCS0



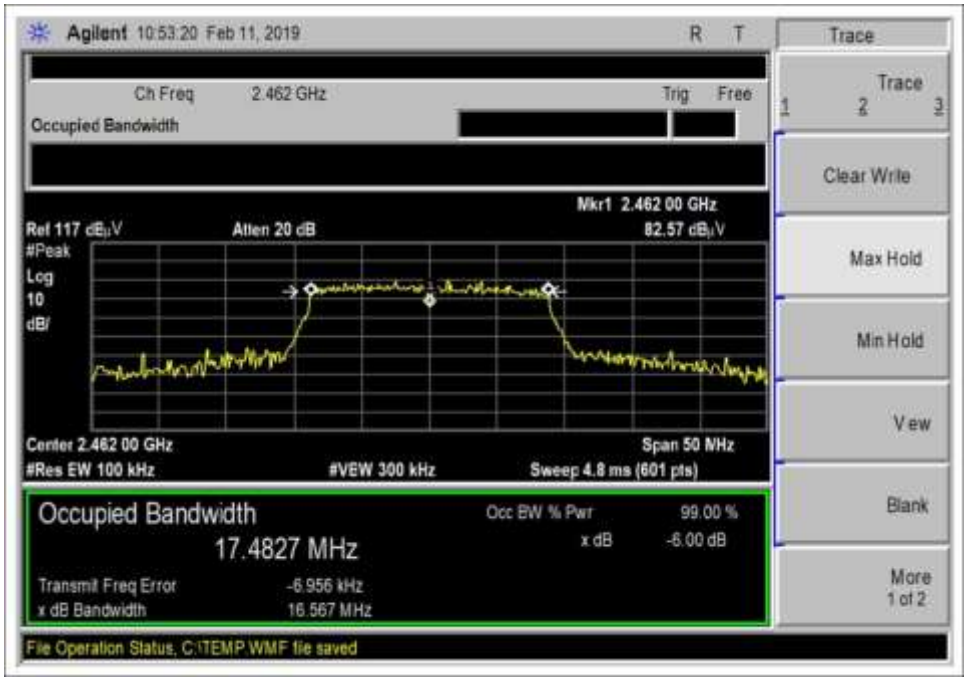
High Channel_n20_MCS0



Low Channel_n20_MCS7



Middle Channel_n20_MCS7



High Channel_n20_MCS7

Test Setup Photo(s)

Above 1GHz Cone placement

X Axis

Y Axis

Z Axis

15.247(b)(3) Output Power

Test Setup / Conditions			
Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.10 (2013), KDB 558074 v05, February 11th, 2019	Test Date(s):	2/11/2019
Configuration:	1		
Test Setup:	The EUT is placed on Styrofoam block and set to transmit continuously at 98% duty cycle. The EUT is connected to remotely located laptop via serial to USB cable. The EUT is rotated in three orthogonal axes. Transmitting frequencies: 2412MHz (CH1), 2437MHz (CH6), 2462MHz (CH11) Modulation/Mode: 802.11g,b,n20 Firmware power level: Power level 2 (CH1) Power level 0 (CH2-CH10) Power Level 3 (CH11) Lowest and highest data rate of each modulation are selected during test. 558074 D01 15.247 Measure Guidance v05, February 11th, 2019 Measurement frequencies: 2412, 2437, 2462MHz RBW=1-5% of OBW, VBW=3xRBW 15.31(e) This equipment is battery powered. Power output tests were performed using a fresh battery.		

Environmental Conditions			
Temperature (ºC)	18.5	Relative Humidity (%):	33.5

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
00786	Preamp	HP	83017A	5/12/2018	5/12/2020
00849	Horn Antenna	ETS	3115	3/14/2018	3/14/2020
P07139	Cable	Andrew	ANDL1-PNMNM-48	3/1/2017	3/1/2019
P07246	Cable	H&S	32022-29094K-29094K-24TC	7/5/2018	7/5/2020
02869	Spectrum Analyzer	Agilent	E4440A	8/10/2018	8/10/2019

Power Output Test Data Summary - Radiated Measurement						
Measurement Option: AVGSA-1						
Frequency (MHz)	**Modulation**	**Ant. Gain (dBi)**	**Field Strength (dBuV/m @3m)**	**Calculated (dBm)**	**Limit (dBm)**	**Results**
2412	802.11b, 1Mbps	2	112.69	15.46	≤ 30	Pass
2437	802.11b, 1Mbps	2	112.79	15.56	≤ 30	Pass
2462	802.11b, 1Mbps	2	111.20	13.97	≤ 30	Pass
2412	802.11b, 11Mbps	2	112.73	15.50	≤ 30	Pass
2437	802.11b, 11Mbps	2	113.44	16.21	≤ 30	Pass
2462	802.11b, 11Mbps	2	110.04	12.81	≤ 30	Pass
2412	802.11g, 6Mbps	2	110.24	13.01	≤ 30	Pass
2437	802.11g, 6Mbps	2	110.17	12.94	≤ 30	Pass
2462	802.11g, 6Mbps	2	107.83	10.60	≤ 30	Pass
2412	802.11g, 54Mbps	2	106.50	9.27	≤ 30	Pass
2437	802.11g, 54Mbps	2	103.80	6.57	≤ 30	Pass
2462	802.11g, 54Mbps	2	103.68	6.45	≤ 30	Pass
2412	802.11n20, MCS0	2	109.81	12.58	≤ 30	Pass
2437	802.11n20, MCS0	2	111.01	13.78	≤ 30	Pass
2462	802.11n20, MCS0	2	107.22	9.99	≤ 30	Pass
2412	802.11n20, MCS7	2	106.39	9.16	≤ 30	Pass
2437	802.11n20, MCS7	2	106.35	9.12	≤ 30	Pass
2462	802.11n20, MCS7	2	103.64	6.41	≤ 30	Pass

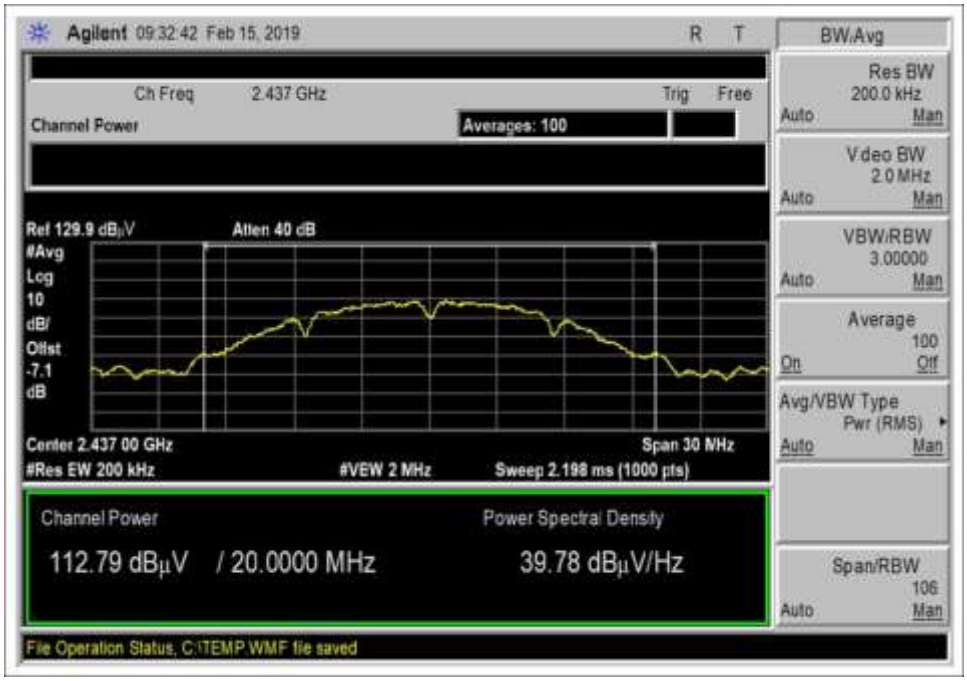
Conducted RF output power calculated in accordance with ANSI C63.10.

$$P(W) = \frac{(E \cdot d)^2}{30\ G}$$

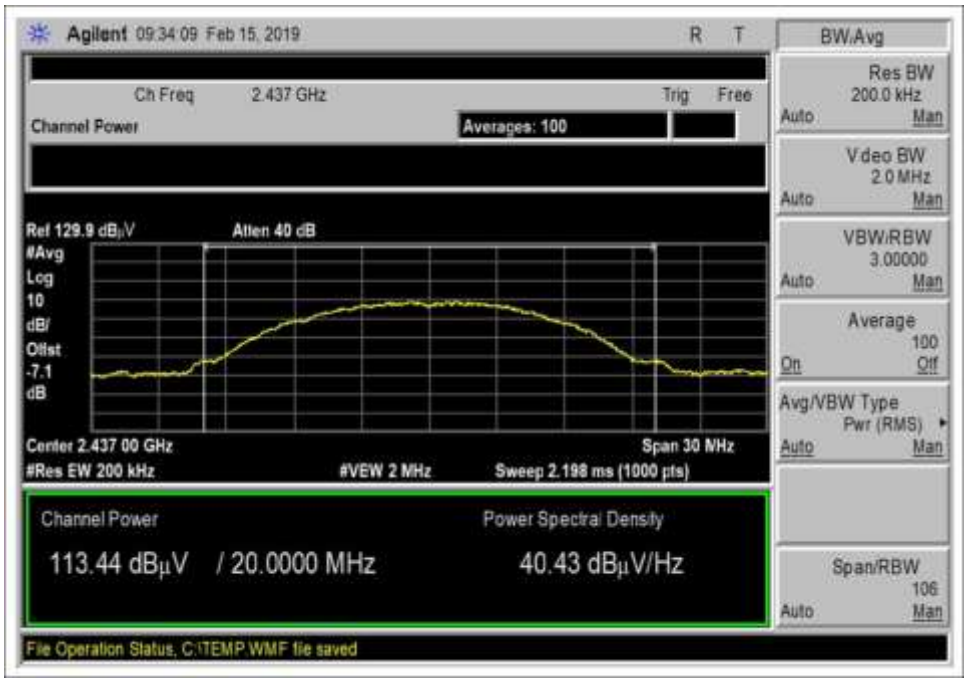
Or equivalently, in logarithmic form:

$$P(dBm) = E(dBuV/m) + 20LOG(d) - G\ - 104.77$$

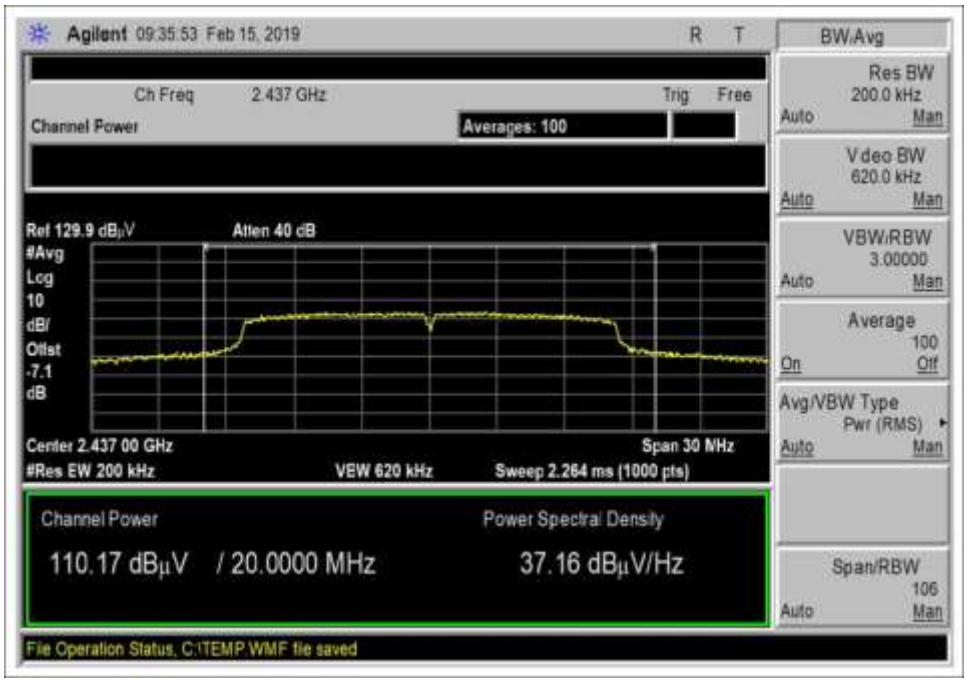
Plots



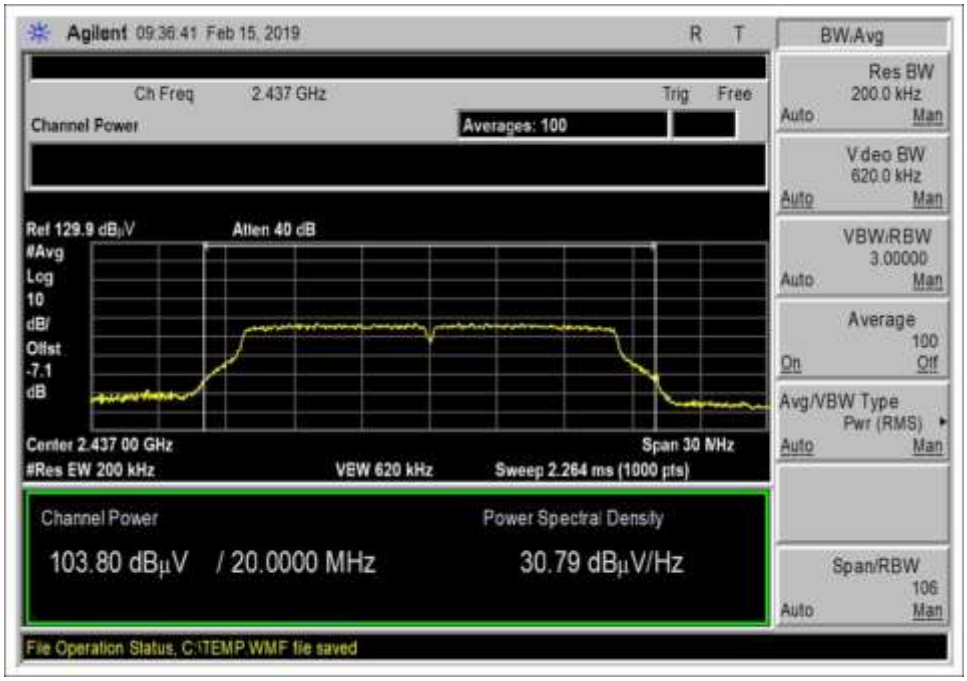
Power Level 0, Channel 6_b_1Mbps



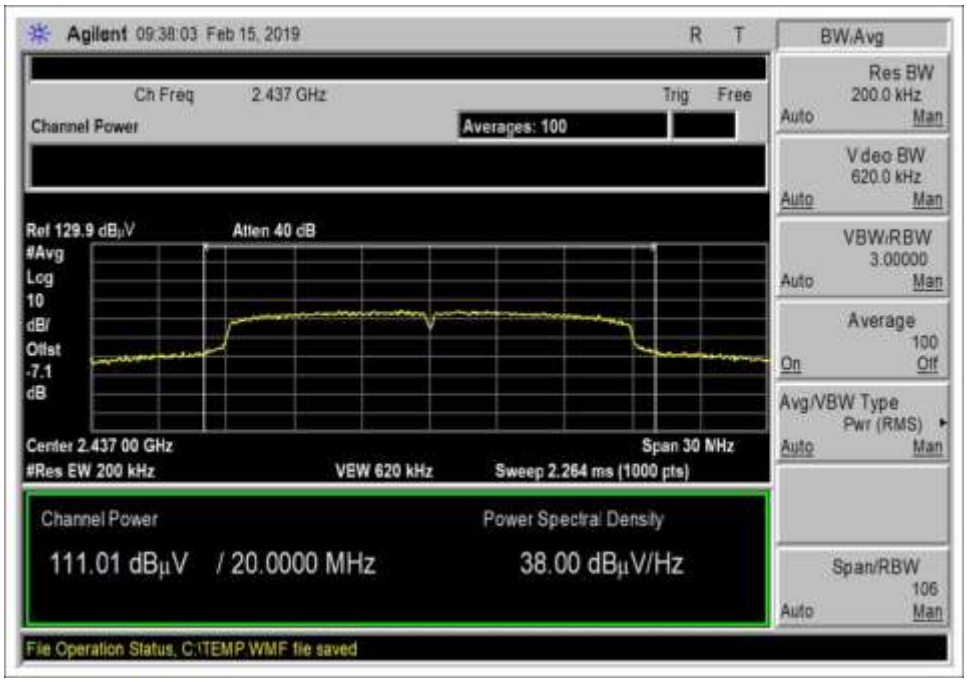
Power Level 0, Channel 6_b_11Mbps



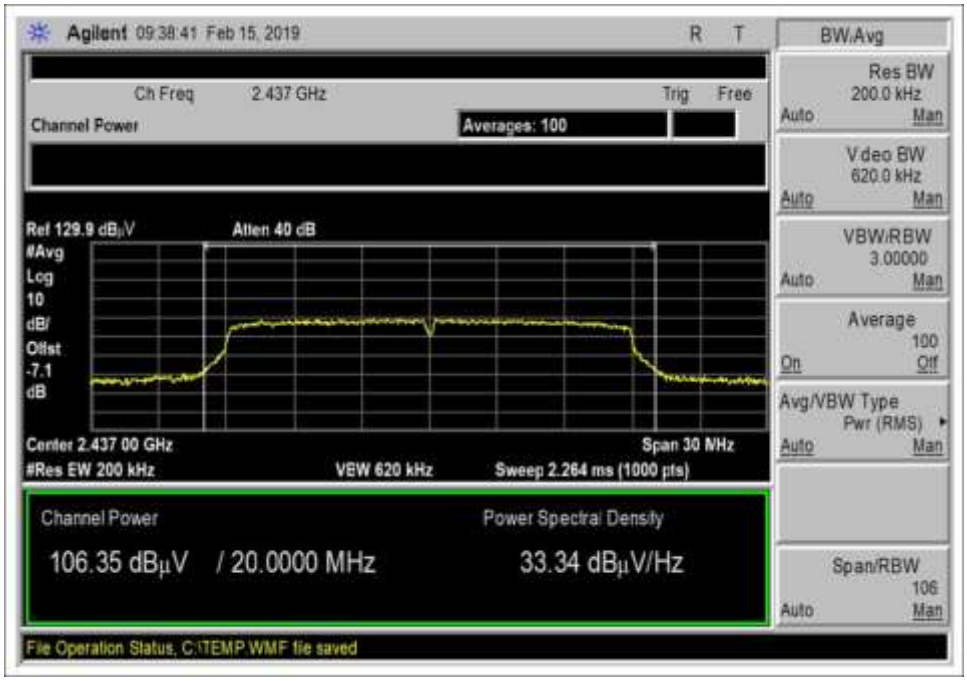
Power Level 0, Channel 6_g_6Mbps



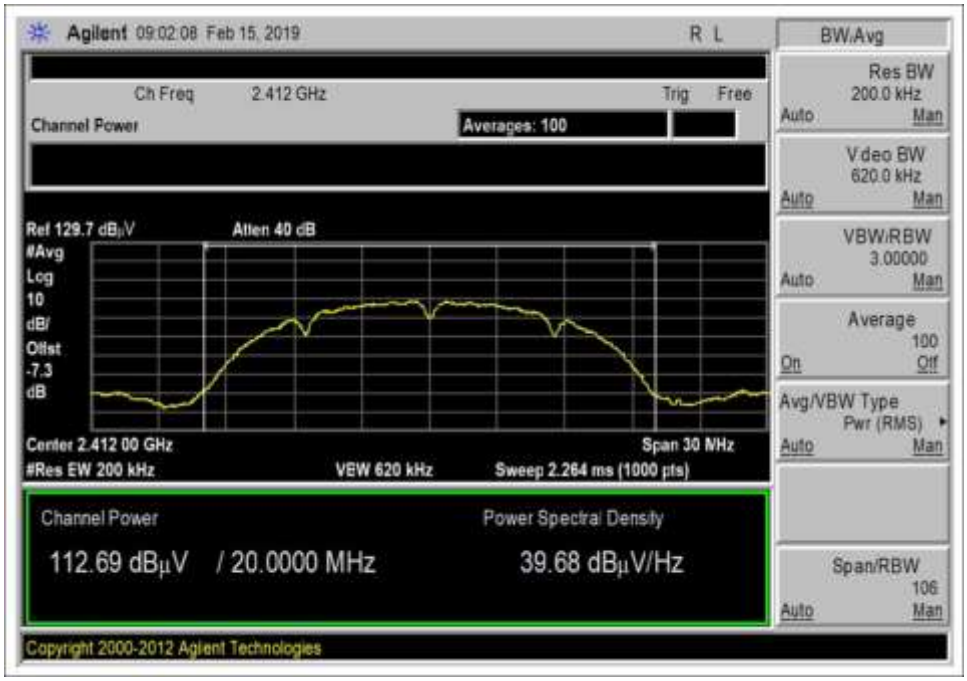
Power Level 0, Channel 6_g_54Mbps



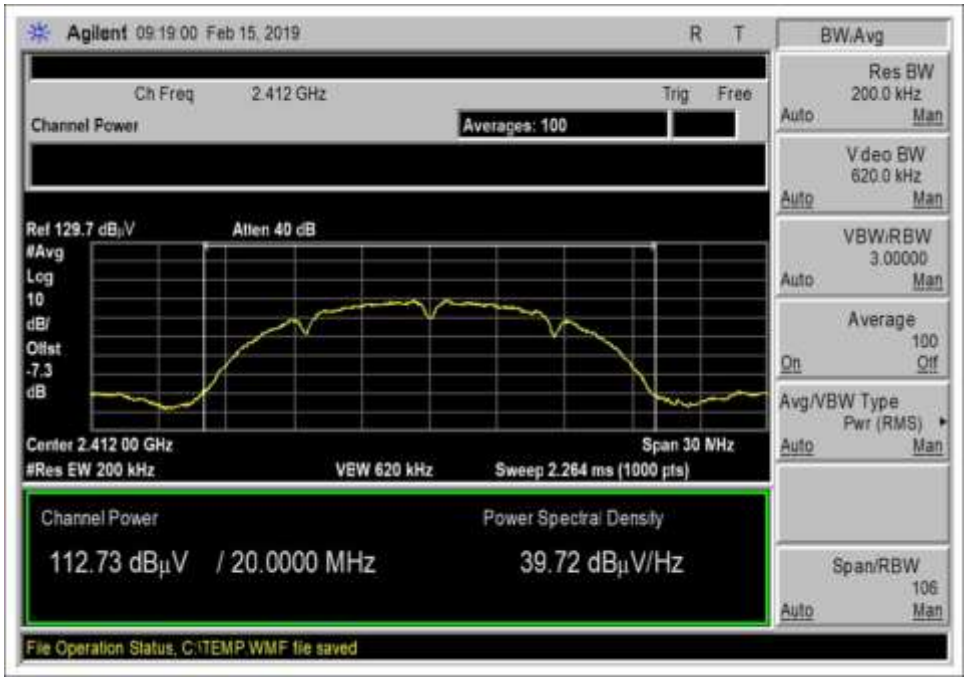
Power Level 0, Channel 6_n20_MCS0



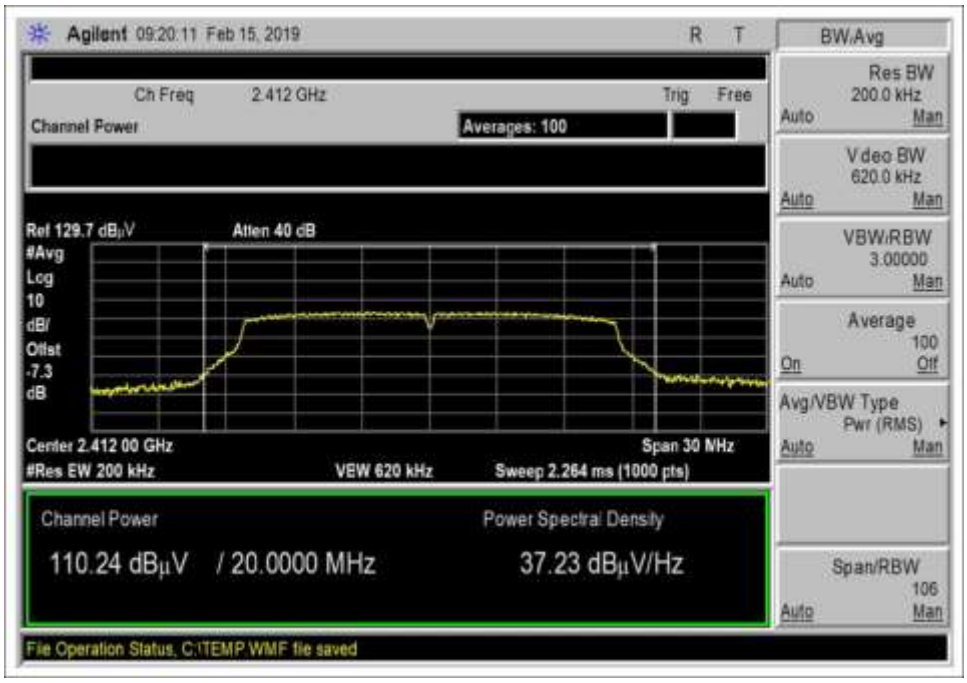
Power Level 0, Channel 6_n20_MCS7



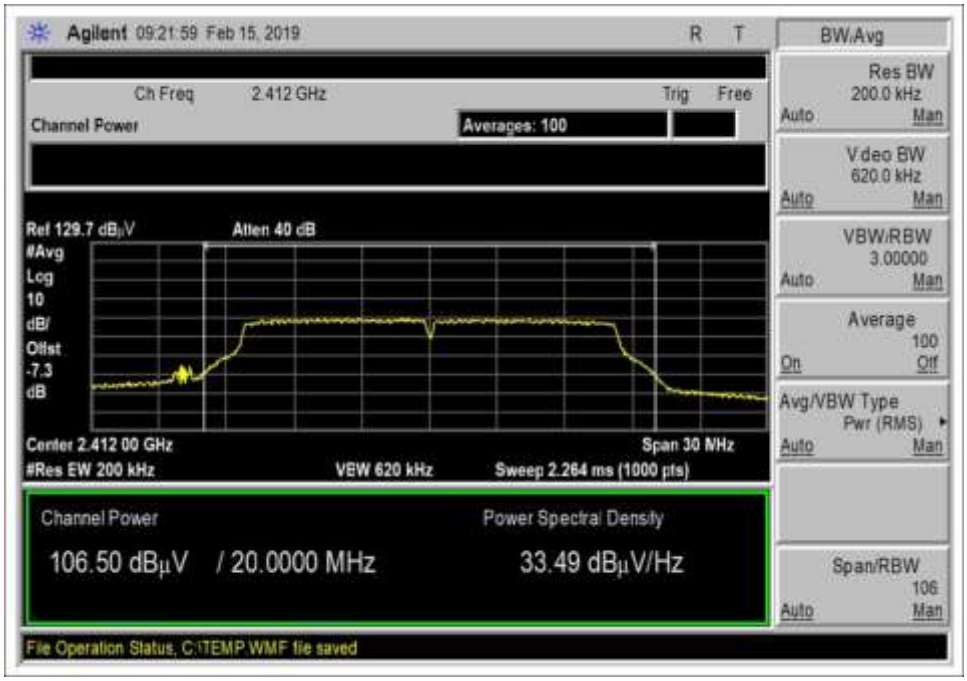
Power Level 2, Channel 1_b_1Mbps



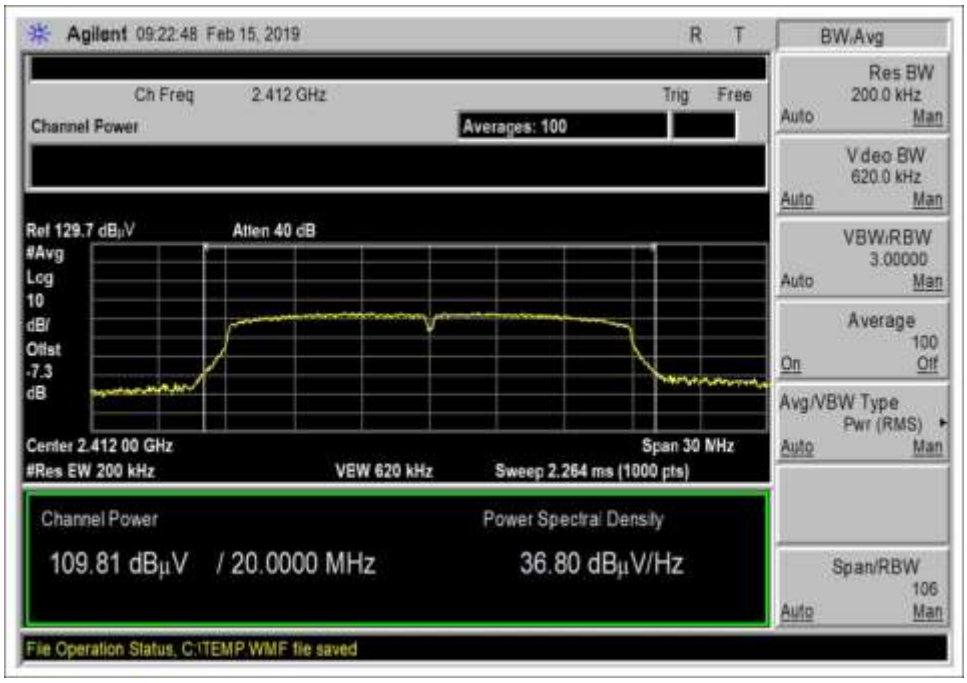
Power Level 2, Channel 1_b_11Mbps



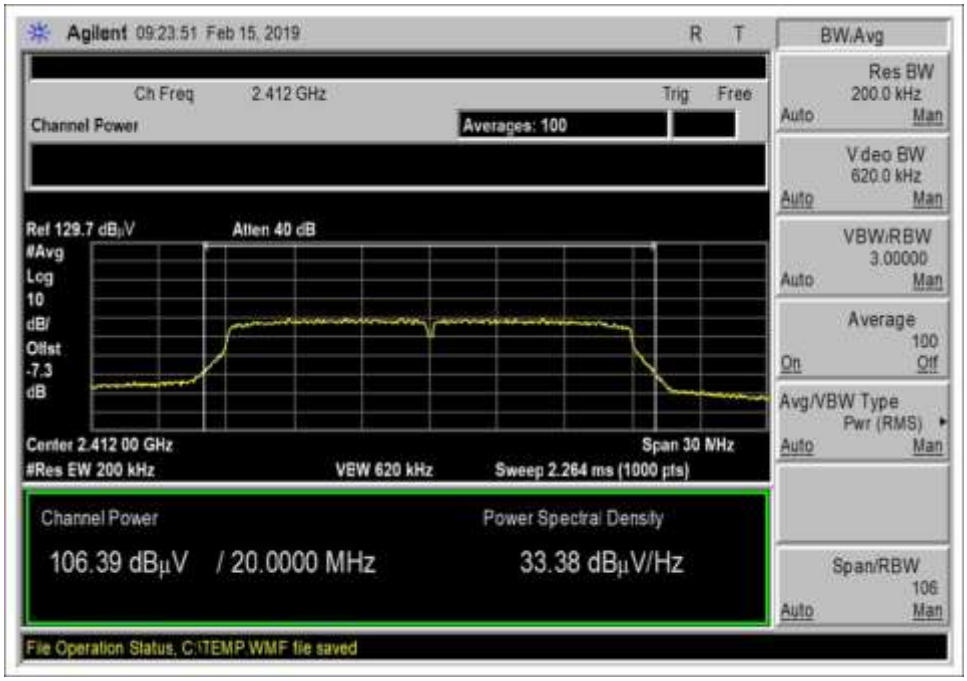
Power Level 2, Channel 1_g_6Mbps



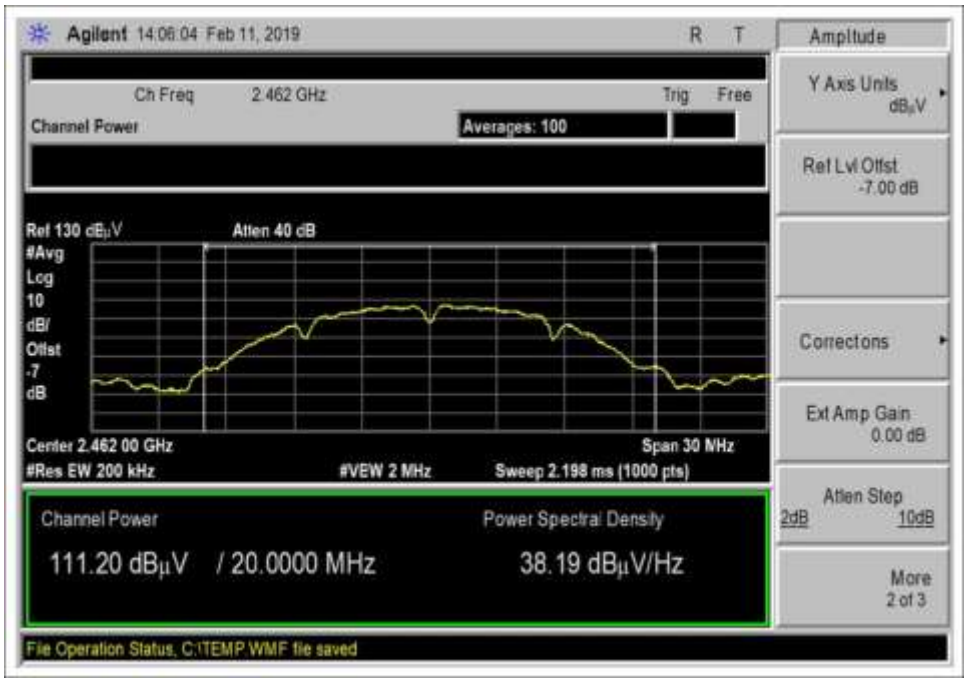
Power Level 2, Channel 1_g_54Mbps



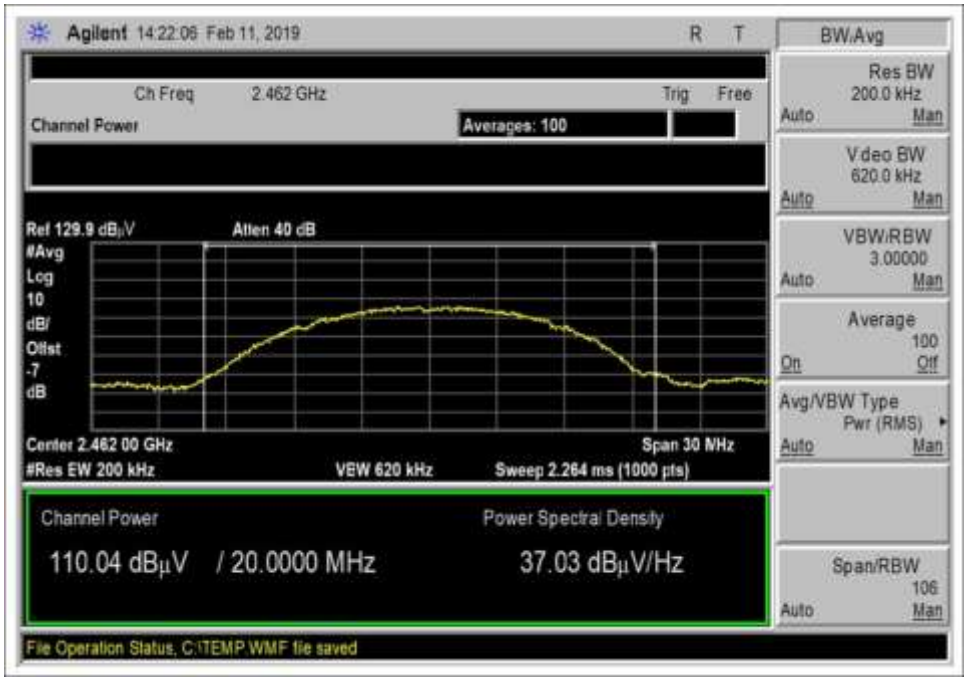
Power Level 2, Channel 1_n20_MCS0



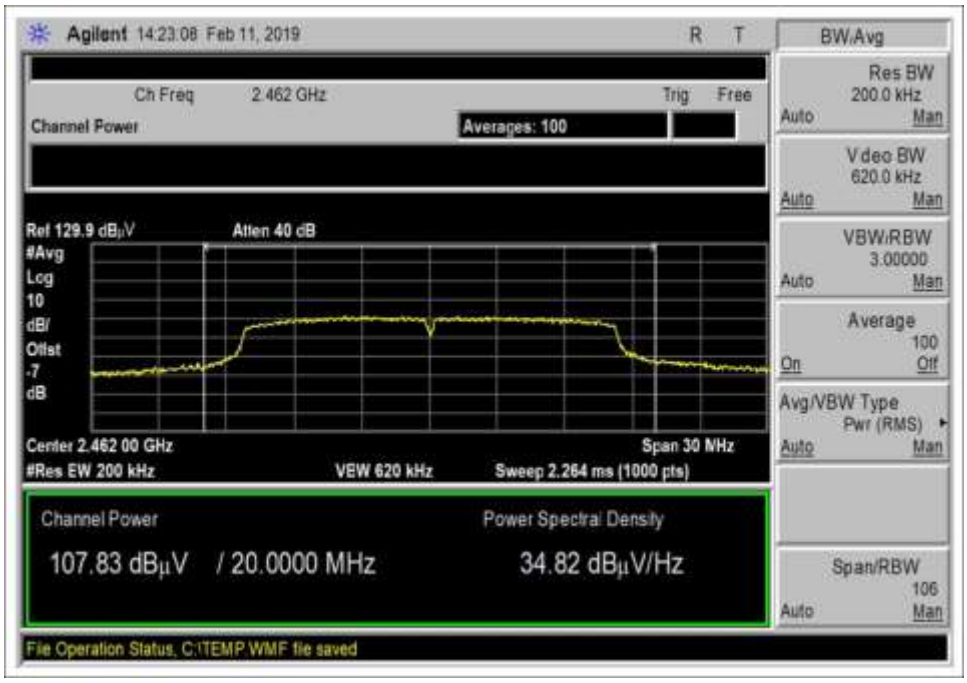
Power Level 2, Channel 1_n20_MCS7



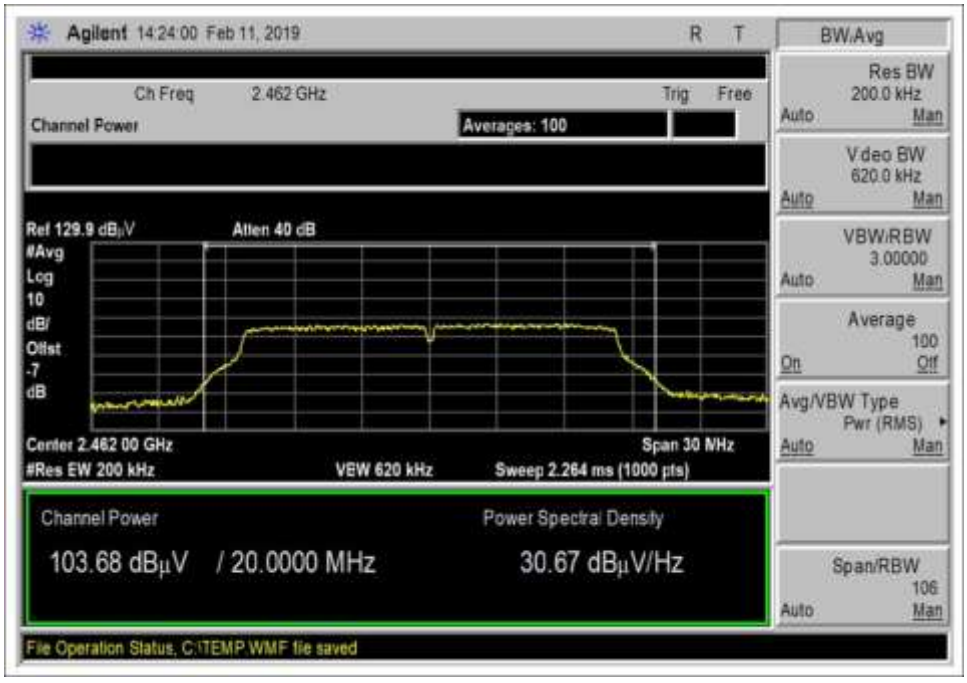
Power Level 3, Channel 11_b_1Mbps



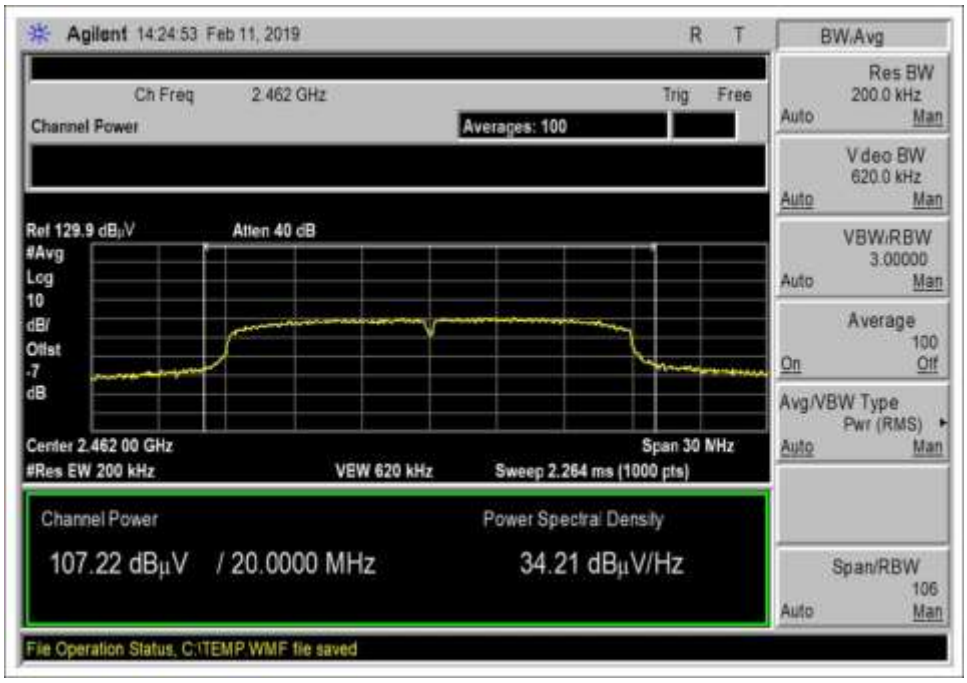
Power Level 3, Channel 11_b_11Mbps



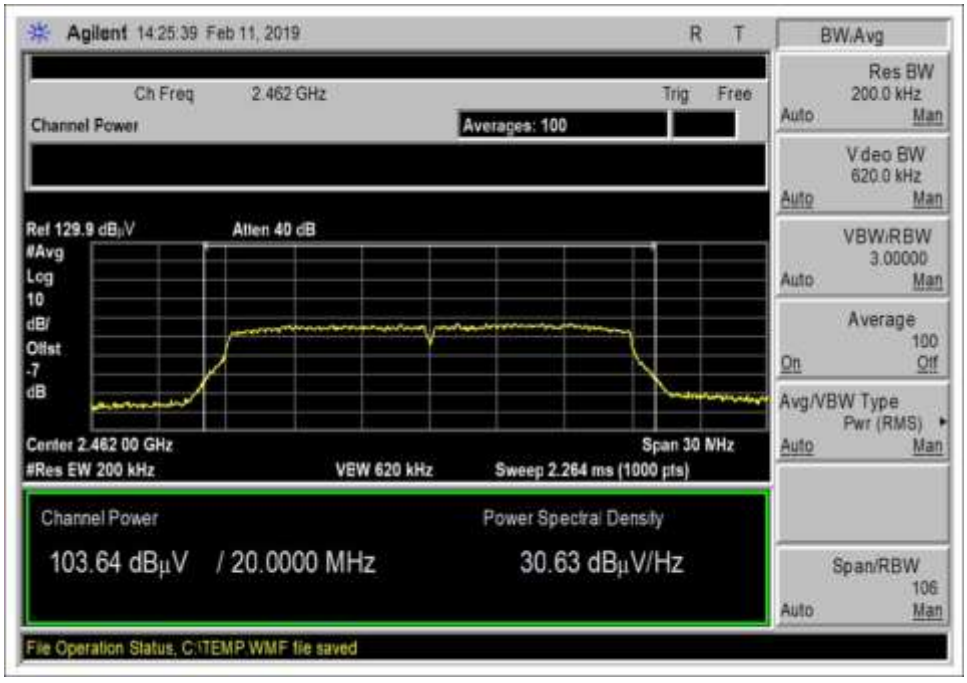
Power Level 3, Channel 11_g_6Mbps



Power Level 3, Channel 11_g_54Mbps



Power Level 3, Channel 11_n20_MCS0



Power Level 3, Channel 11_n20_MCS7

Test Setup Photo(s)

Above 1GHz Cone placement

X Axis

Y Axis

Z Axis

15.247(e) Power Spectral Density

Test Setup / Conditions / Data			
Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.10 (2013), KDB 558074 v05, February 11th, 2019	Test Date(s):	2/11/2019
Configuration:	1		
Test Setup:	The EUT is placed on Styrofoam block and set to transmit continuously at 98% duty cycle. The EUT is connected to remotely located laptop via serial to USB cable. The EUT is rotated in three orthogonal axes. Transmitting frequencies: 2412MHz (CH1), 2437MHz (CH6), 2462MHz (CH11) Modulation/Mode: 802.11g,b,n20 Lowest and highest data rate of each modulation are selected during test. 558074 D01 15.247 Measure Guidance v05, February 11th, 2019 Measurement frequencies: 2412, 2437, 2462MHz RBW=100kHz, VBW=300kHz		

Environmental Conditions			
Temperature (ºC)	18.5	Relative Humidity (%):	33.5

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
00786	Preamp	HP	83017A	5/12/2018	5/12/2020
00849	Horn Antenna	ETS	3115	3/14/2018	3/14/2020
P07139	Cable	Andrew	ANDL1-PNMNM-48	3/1/2017	3/1/2019
P07246	Cable	H&S	32022-29094K-29094K-24TC	7/5/2018	7/5/2020
02869	Spectrum Analyzer	Agilent	E4440A	8/10/2018	8/10/2019

PSD Test Data Summary - RF Conducted Measurement						
Measurement Method: AVGPSD-1						
Frequency (MHz)	**Modulation**	**Ant. Type / Gain (dBi)**	**Field Strength (dBuV/m @3m)**	**Calculated (dBm/100kHz)**	**Limit (dBm/3kHz)**	**Results**
2412	802.11b, 1Mbps	2	94.127	-3.10	≤8	Pass
2437	802.11b, 1Mbps	2	93.835	-3.39	≤8	Pass
2462	802.11b, 1Mbps	2	93.383	-3.84	≤8	Pass
2412	802.11b, 11Mbps	2	93.646	-3.58	≤8	Pass
2437	802.11b, 11Mbps	2	93.673	-3.55	≤8	Pass
2462	802.11b, 11Mbps	2	93.013	-4.21	≤8	Pass
2412	802.11g, 6Mbps	2	90.164	-7.06	≤8	Pass
2437	802.11g, 6Mbps	2	87.827	-9.40	≤8	Pass
2462	802.11g, 6Mbps	2	89.768	-7.46	≤8	Pass
2412	802.11g, 54Mbps	2	85.346	-11.88	≤8	Pass
2437	802.11g, 54Mbps	2	84.973	-12.25	≤8	Pass
2462	802.11g, 54Mbps	2	85.811	-11.42	≤8	Pass
2412	802.11n20, MCS0	2	89.493	-7.73	≤8	Pass
2437	802.11n20, MCS0	2	87.887	-9.34	≤8	Pass
2462	802.11n20, MCS0	2	88.000	-9.23	≤8	Pass
2412	802.11n20, MCS7	2	84.149	-13.08	≤8	Pass
2437	802.11n20, MCS7	2	83.890	-13.34	≤8	Pass
2462	802.11n20, MCS7	2	83.175	-14.05	≤8	Pass

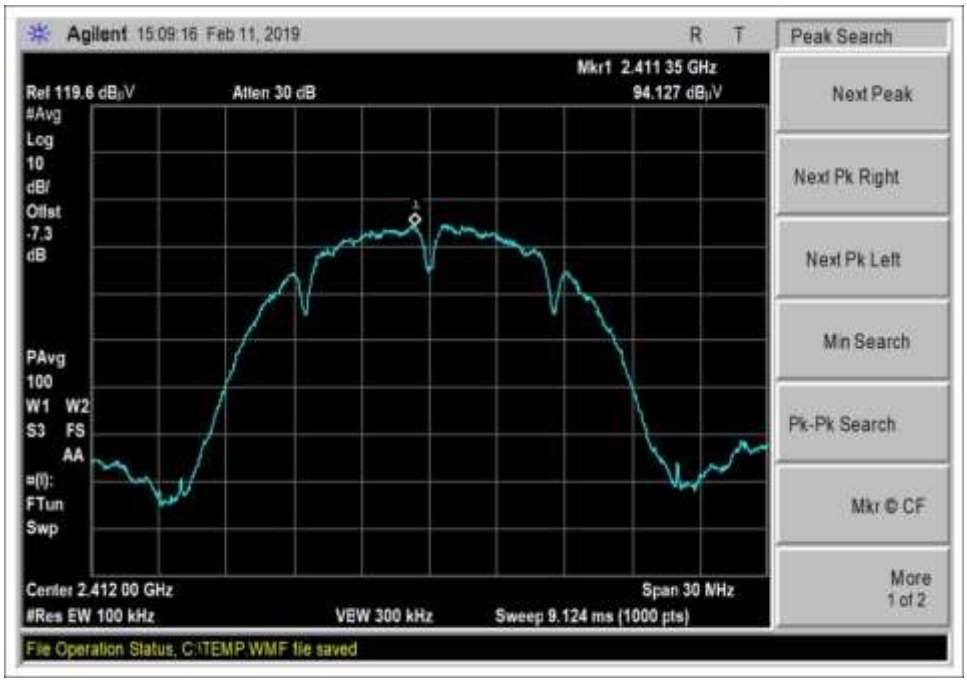
Conducted RF output power calculated in accordance with ANSI C63.10.

$$P(W) = \frac{(E \cdot d)^2}{30\ G}$$

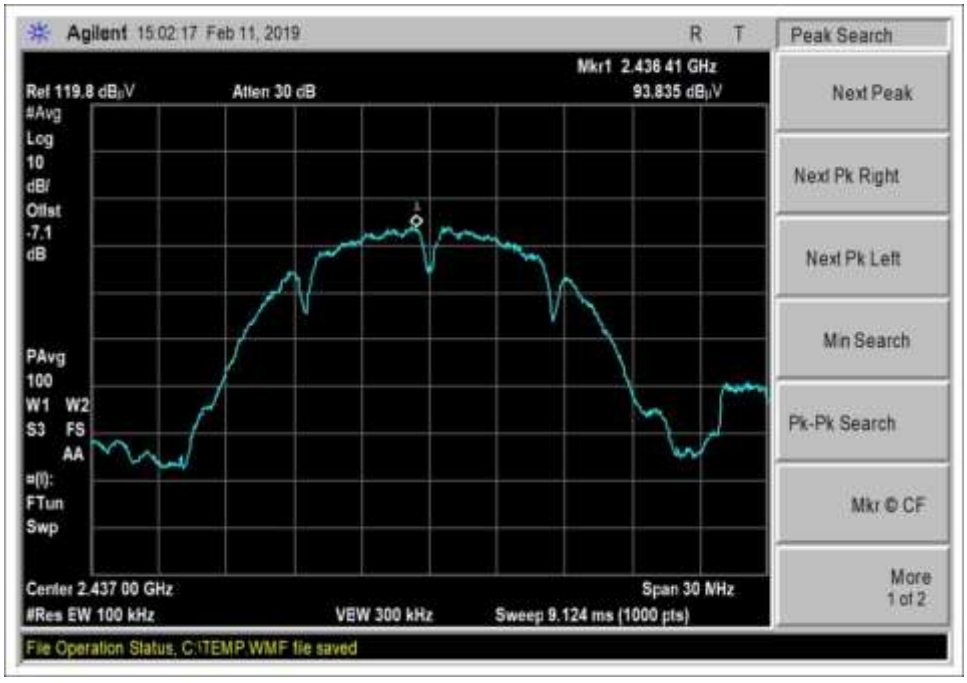
Or equivalently, in logarithmic form:

$$P(dBm) = E(dBuV/m) + 20LOG(d) - G\ - 104.77$$

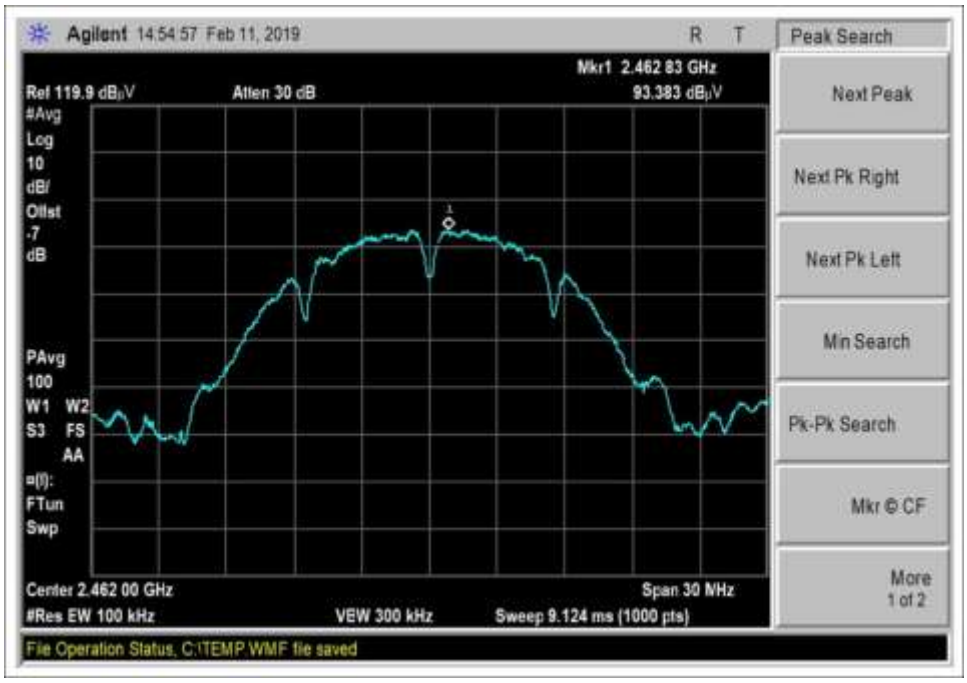
Plots



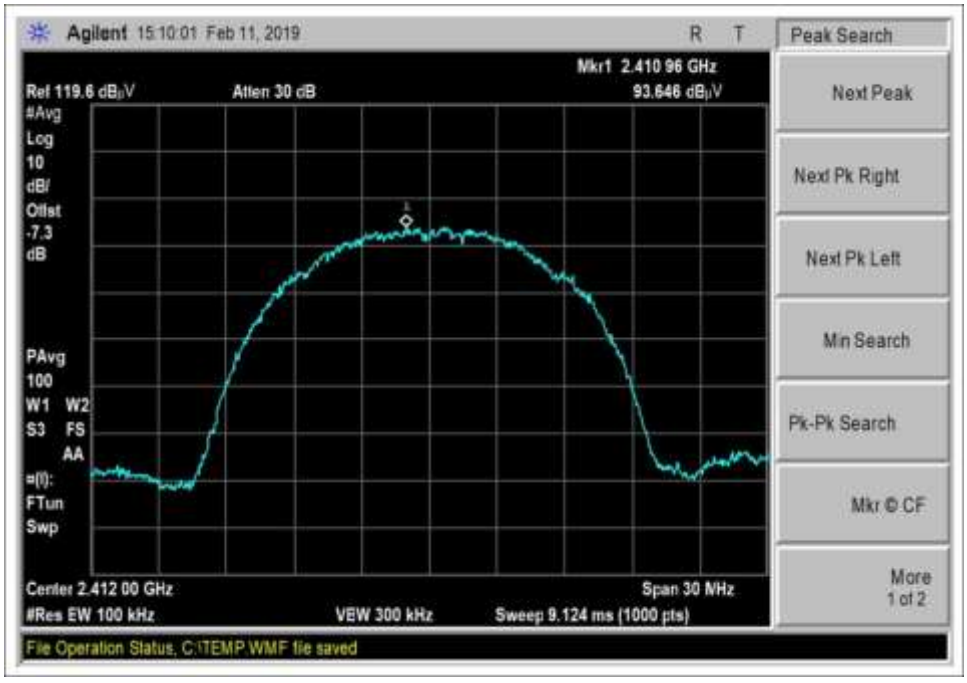
Low Channel_b_1Mbps



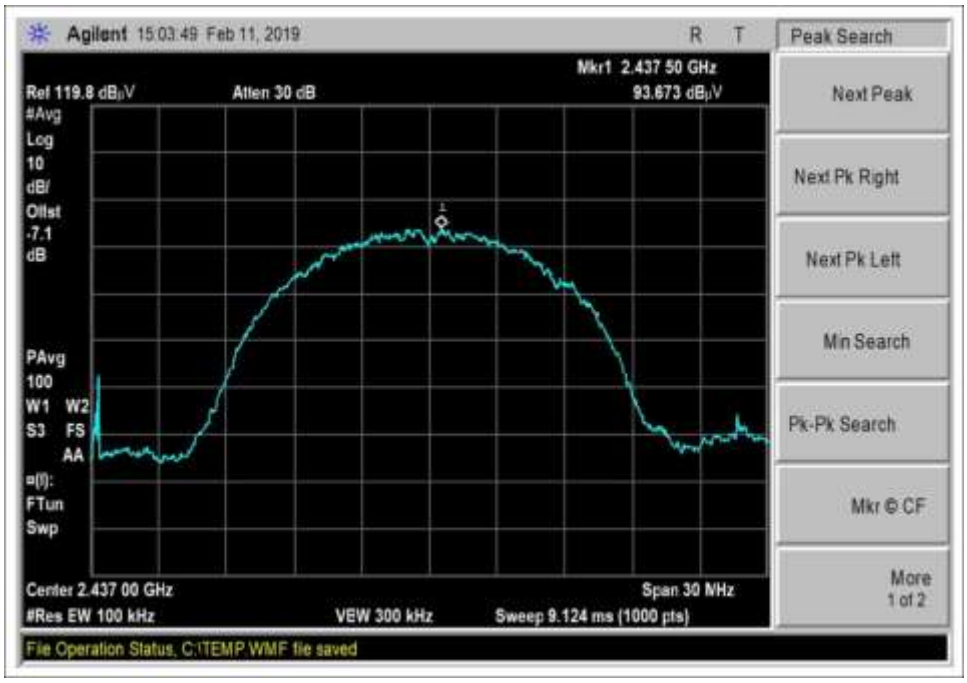
Middle Channel_b_1Mbps



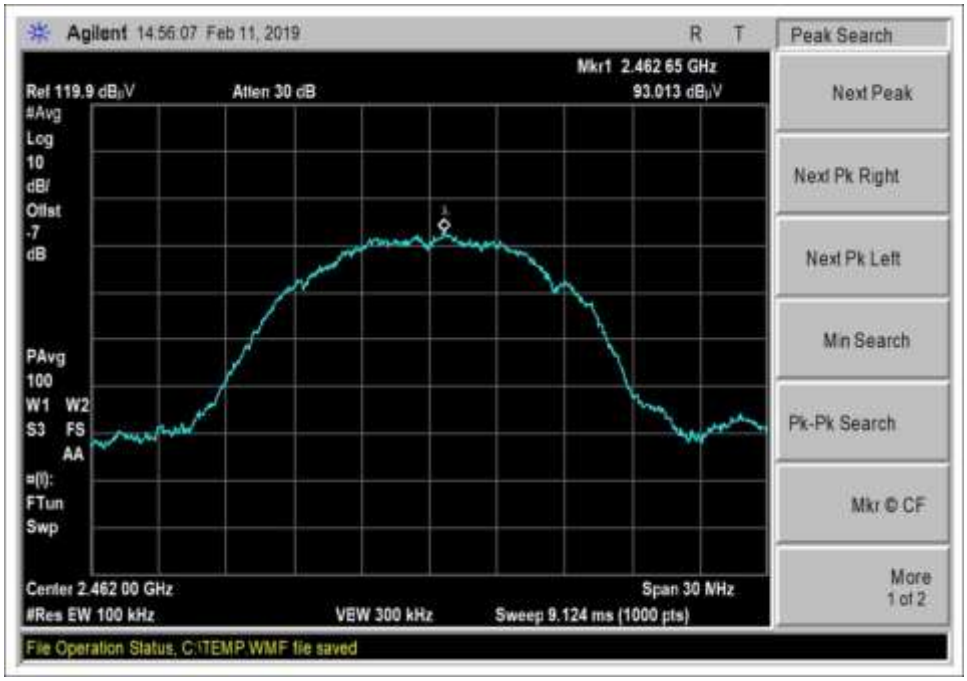
High Channel_b_1Mbps



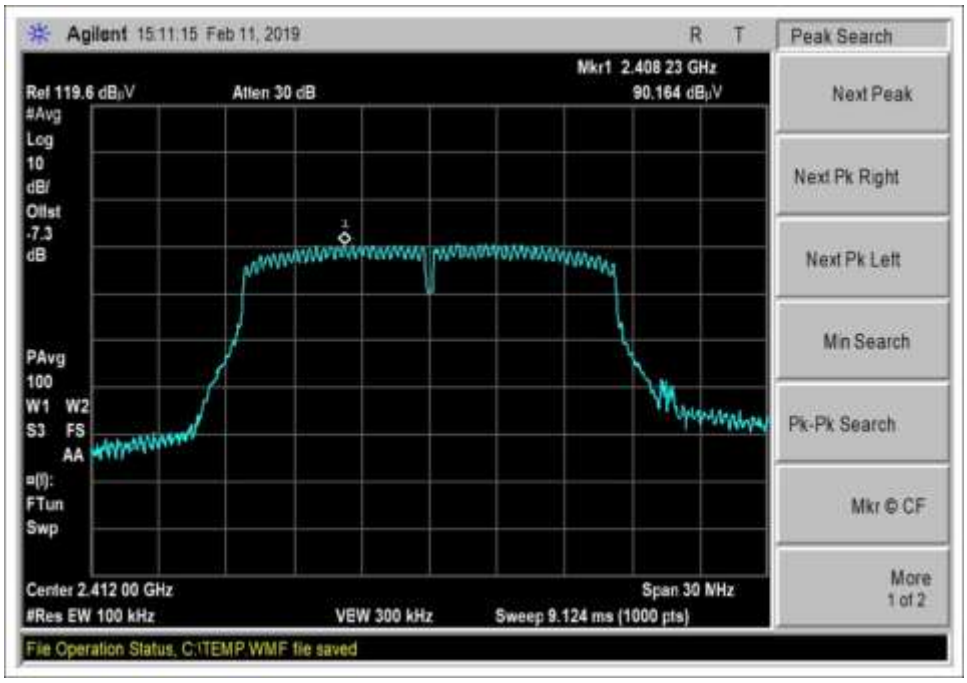
Low Channel_b_11Mbps



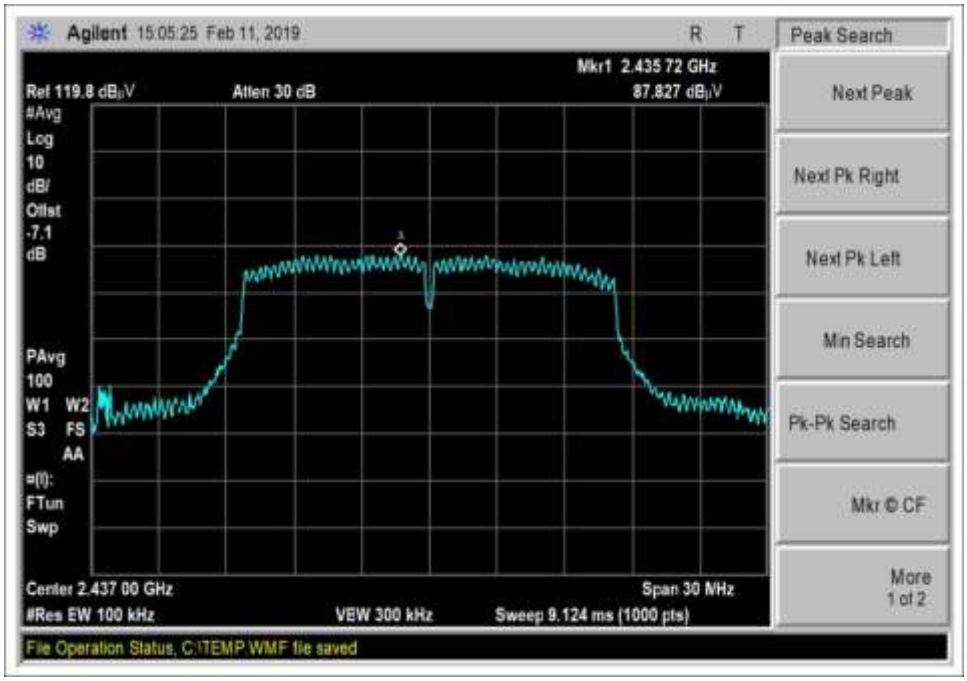
Middle Channel_b_11Mbps



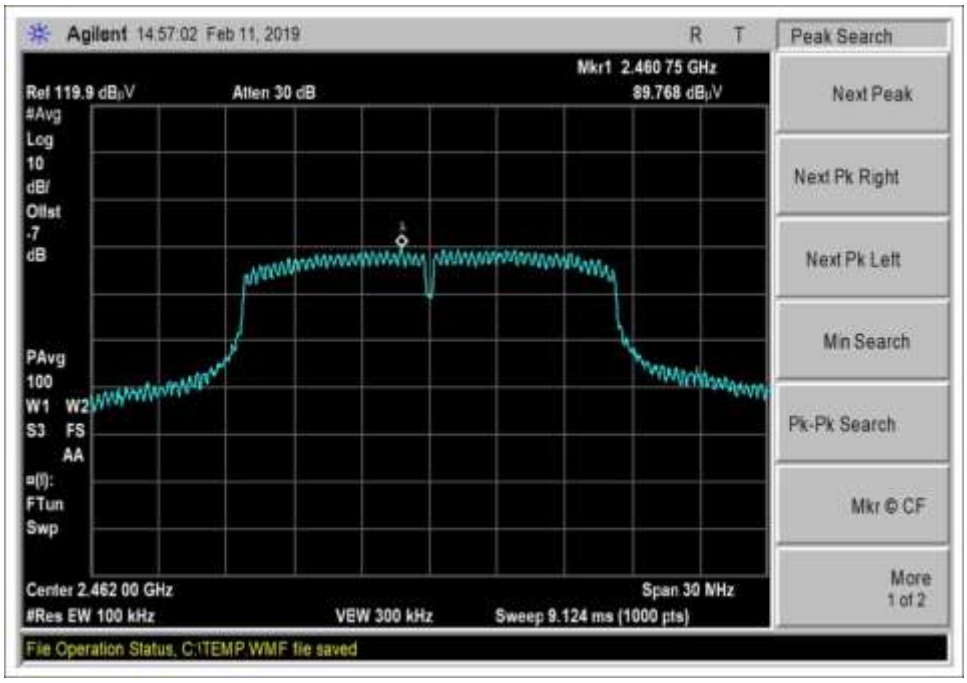
High Channel_b_11Mbps



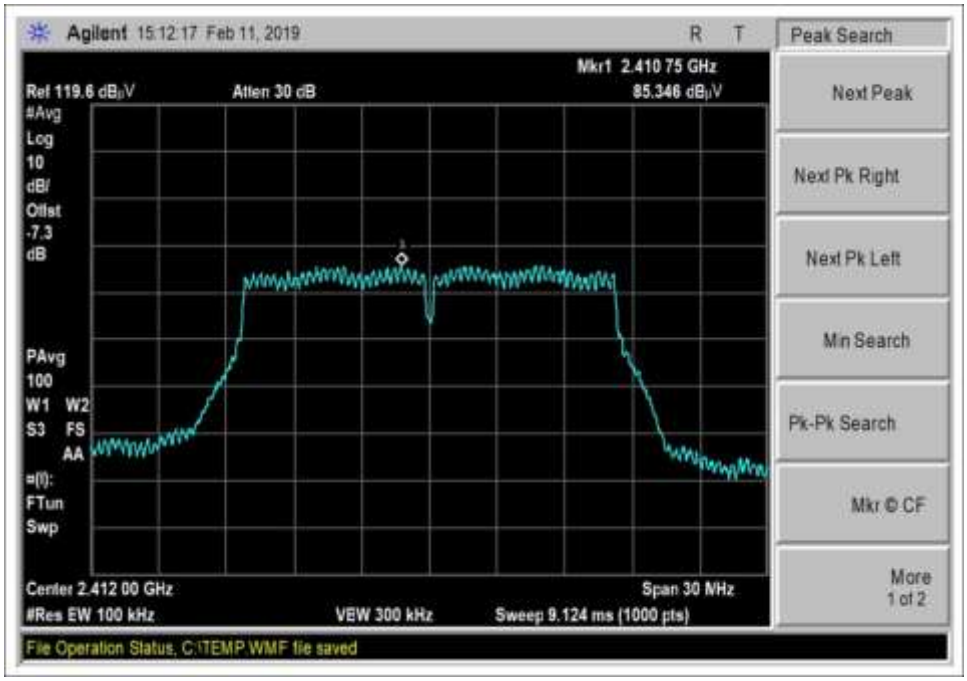
Low Channel_g_6Mbps



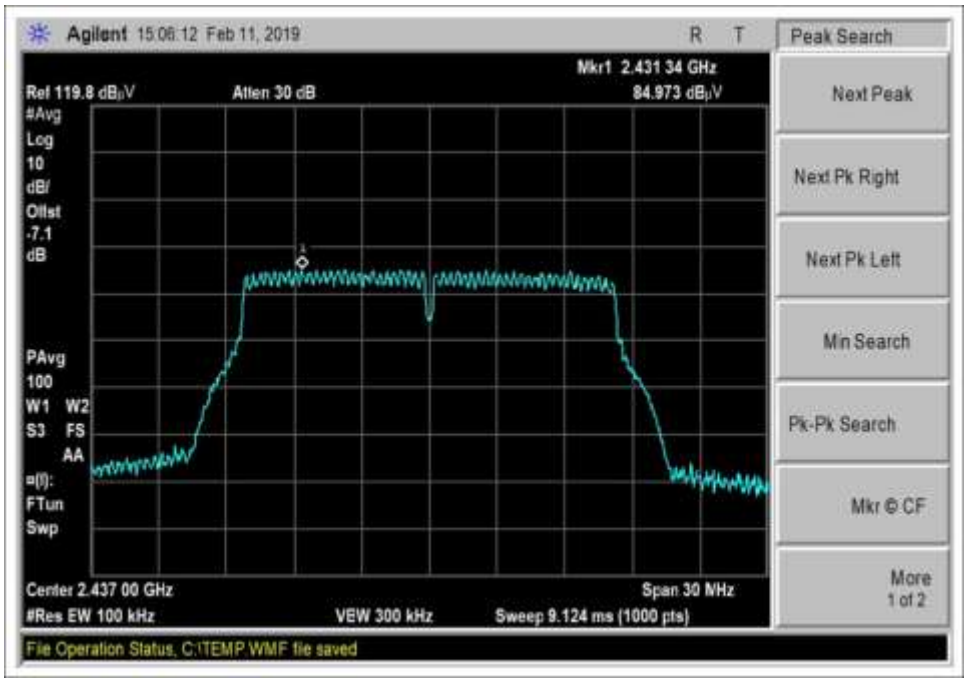
Middle Channel_g_6Mbps



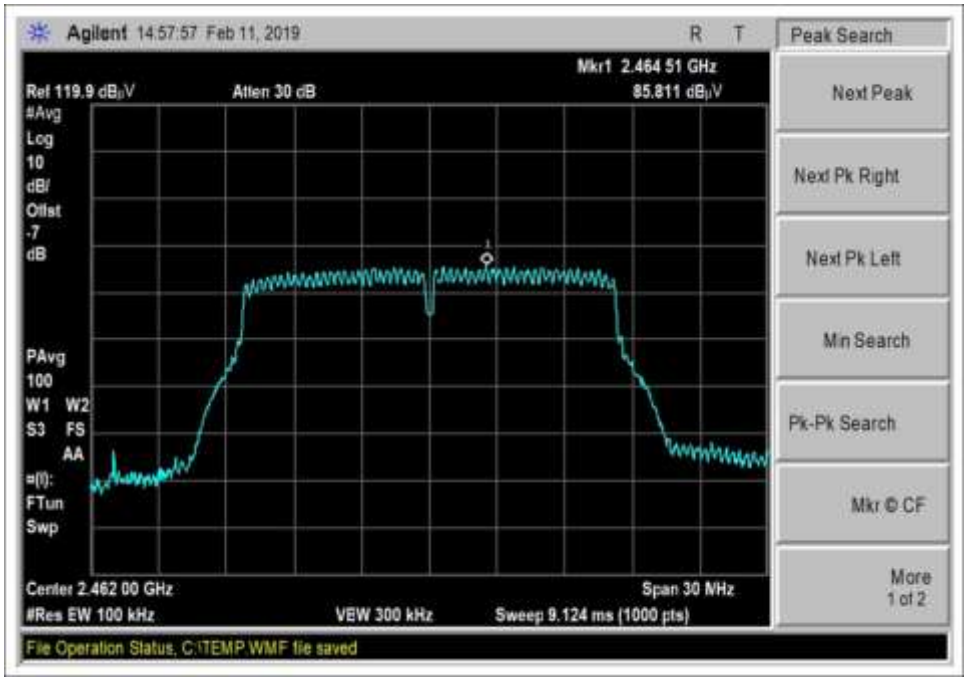
High Channel_g_6Mbps



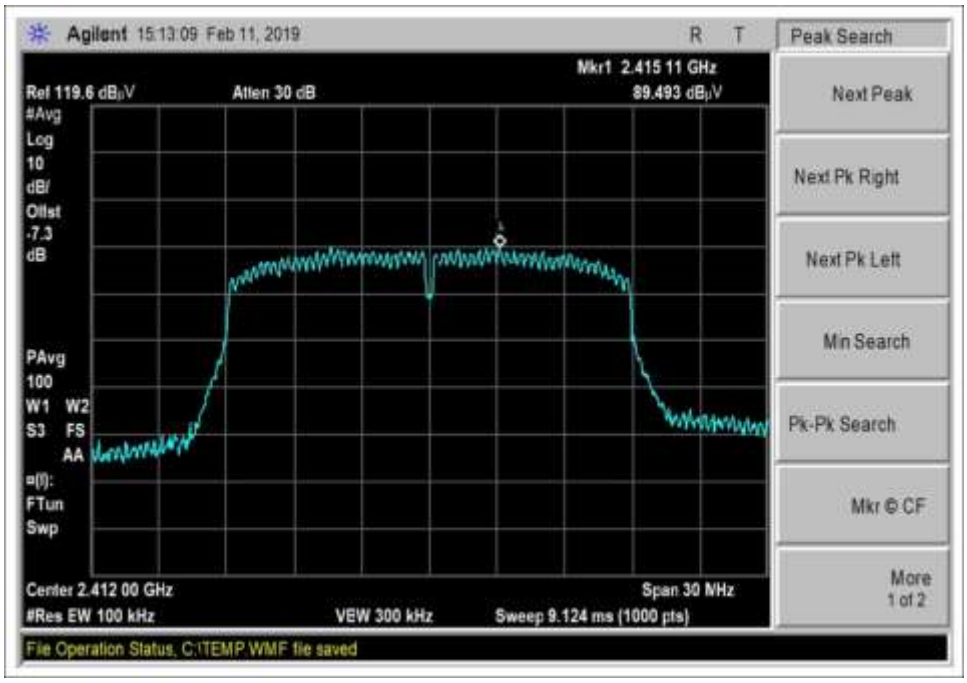
Low Channel_g_54Mbps



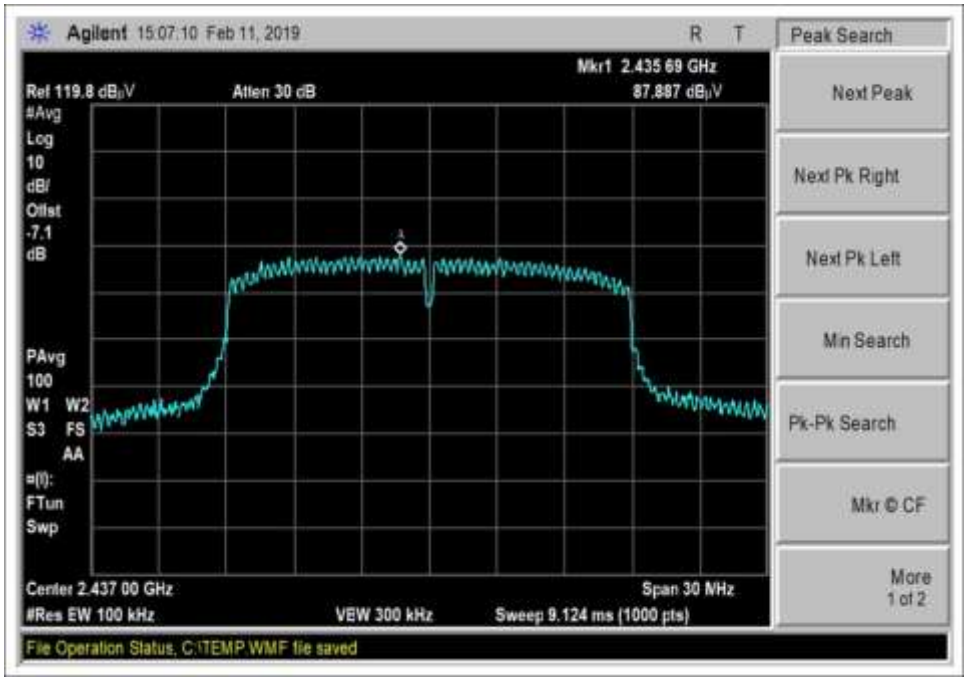
Middle Channel_g_54Mbps



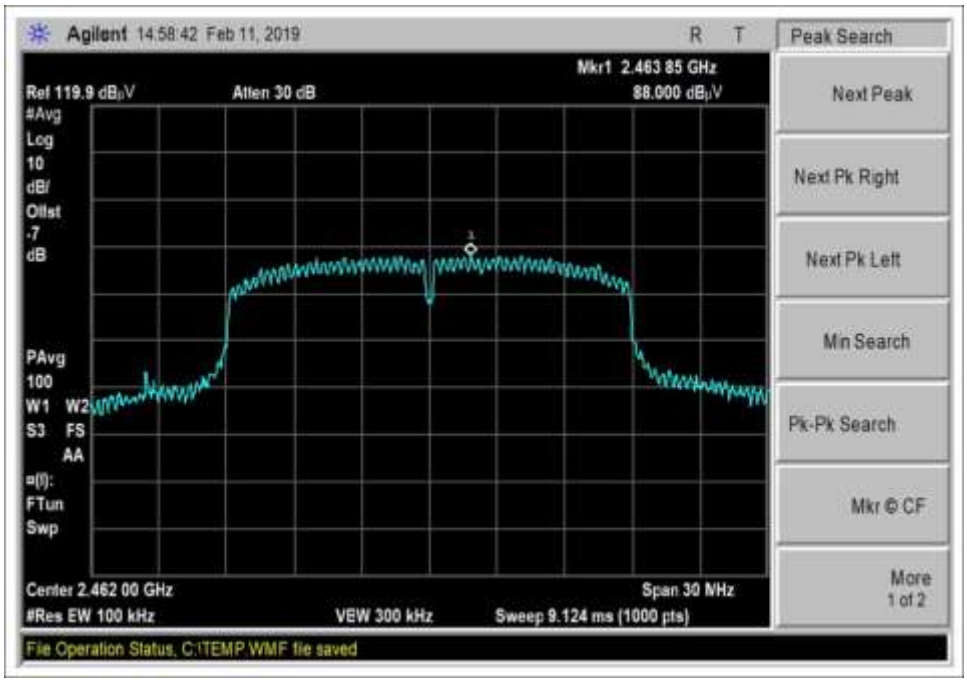
High Channel_g_54Mbps



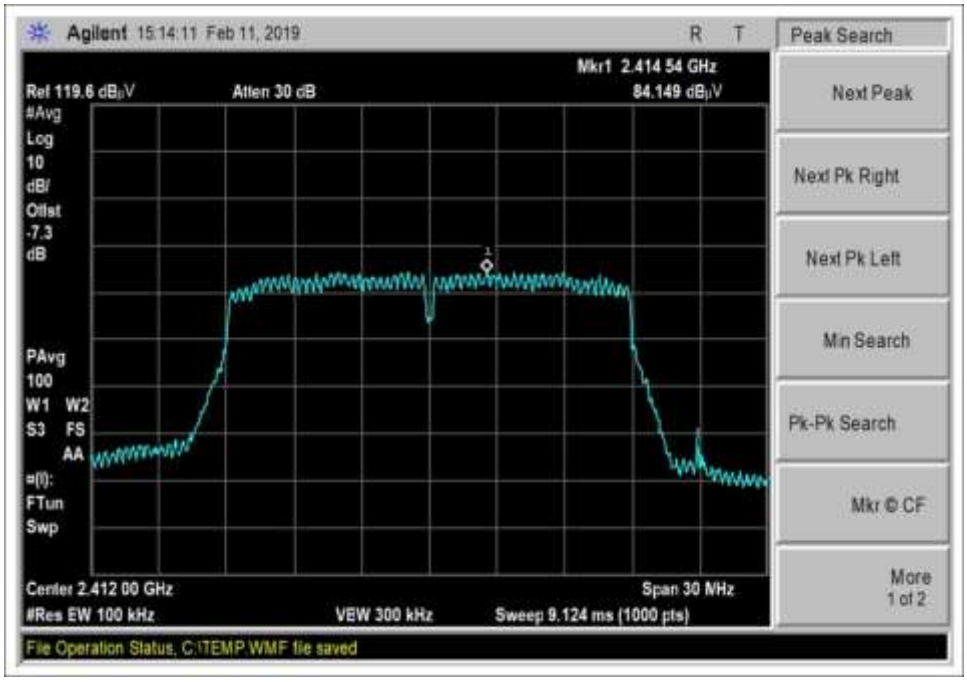
Low Channel_n20_MCS0



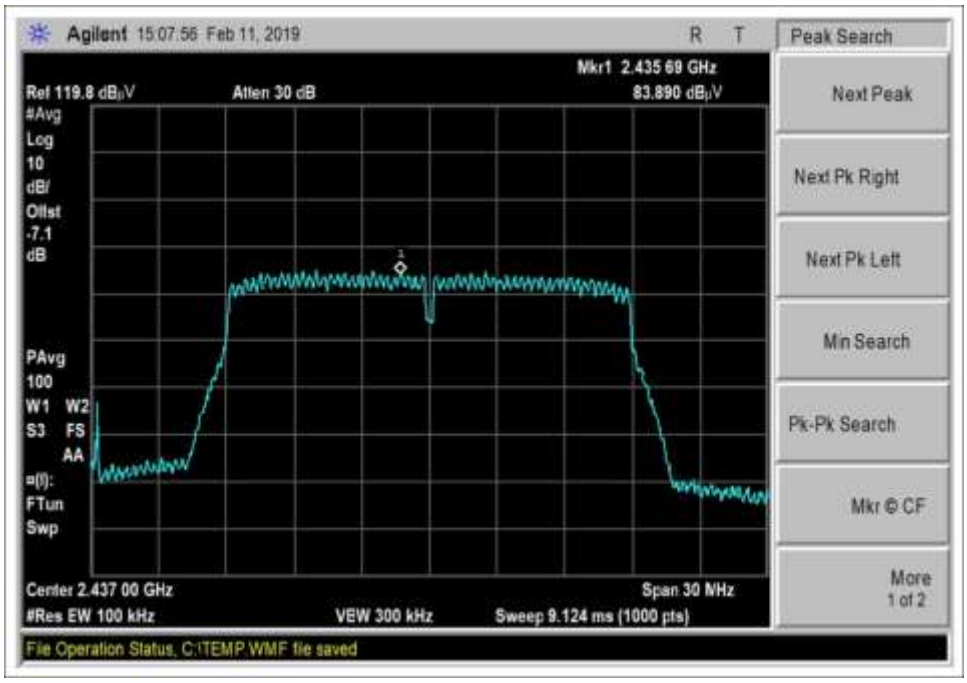
Middle Channel_n20_MCS0



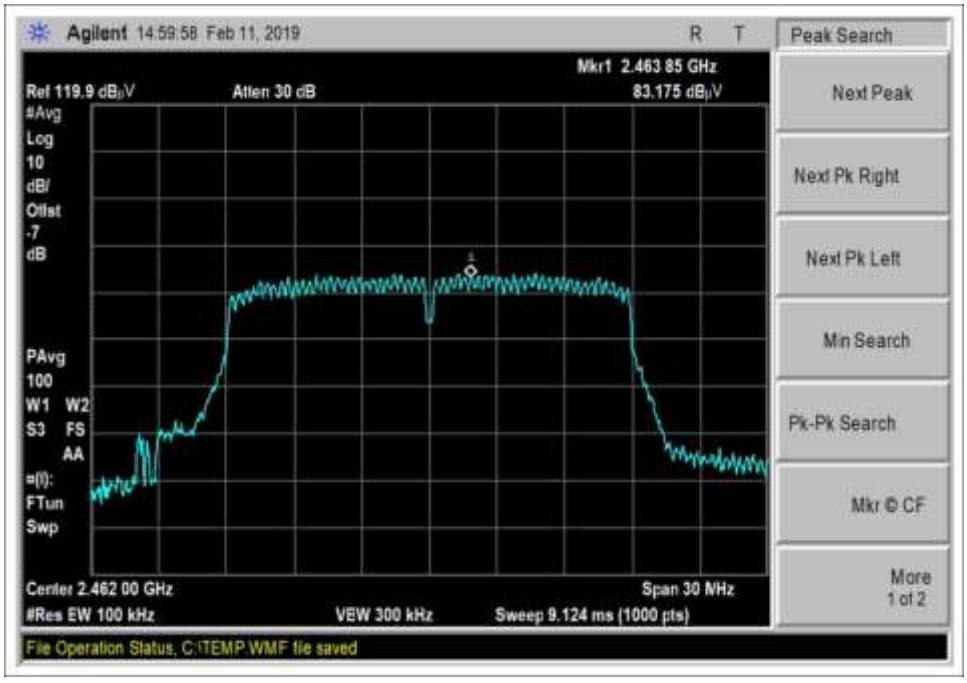
High Channel_n20_MCS0



Low Channel_n20_MCS7



Middle Channel_n20_MCS7



High Channel_n20_MCS7

Test Setup Photo(s)

Above 1GHz Cone placement

X Axis

Y Axis

Z Axis

15.247(d) Radiated Emissions & Band Edge

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112		
Customer:	**Venstar, Inc.**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**102204**	Date:	2/19/2019
Test Type:	**Maximized Emissions**	Time:	08:49:54
Tested By:	Don Nguyen	Sequence#:	2
Software:	EMITest 5.03.11		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

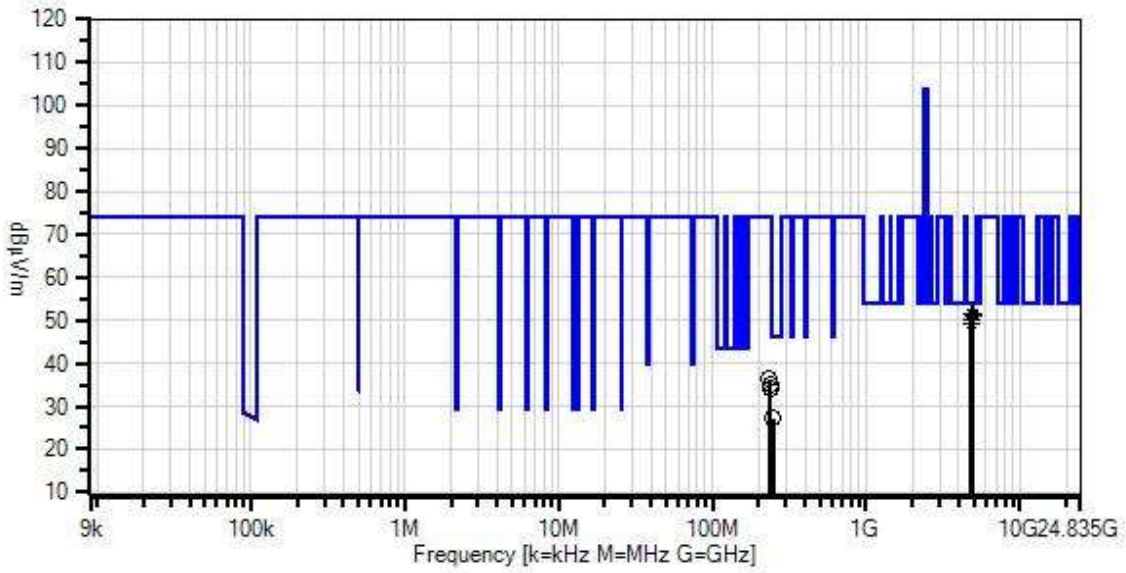
The EUT is placed on Styrofoam block and set to transmit continuously at 98% duty cycle. The EUT is connected to remotely located laptop via serial to USB cable.
The EUT is rotated in three orthogonal axes.
Transmitting frequencies: 2412MHz (CH1), 2437MHz (CH6), 2462MHz (CH11)
Modulation/Mode: 802.11b
558074 D01 15.247 Measure Guidance v05, Feb 11th, 2019

Measurement frequencies: 9kHz-25GHz
9 kHz - 150 kHz, RBW=200 Hz, VBW=600 Hz
150 kHz -30 MHz, RBW=9 kHz, VBW=27 kHz
30 MHz - 1000MHz, RBW=120 kHz, VBW=360 kHz
1000 MHz - 25000MHz, RBW=1 MHz, VBW=3 MHz
RBW=100kHz, VBW=300kHz (-30dBc limit)

Power level 2 (CH1)
Power level 0 (CH2-CH10)
Power Level 3 (CH11)
Temperature (ºC): 20.5
Relative Humidity (%): 22.1

Note: Data represents the worst case orientation/data rate.

Venstar, Inc. WO#: 102204 Sequence#: 2 Date: 2/19/2019
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Horiz



Readings
QP Readings
Ambient
1 - 15.247(d) / 15.209 Radiated Spurious Emissions
Peak Readings
Average Readings
Software Version: 5.03.11

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN00786	Preamp	83017A	5/12/2018	5/12/2020
T2	AN00849	Horn Antenna	3115	3/14/2018	3/14/2020
T3	ANP07139	Cable	ANDL1-PNMNM-48	3/1/2017	3/1/2019
T4	ANP07246	Cable	32022-29094K-29094K-24TC	7/5/2018	7/5/2020
T5	AN03385	High Pass Filter	11SH10-3000/T10000-O/O	6/2/2017	6/2/2019
	AN01413	Horn Antenna-ANSI C63.5 (dB/m)	84125-80008	10/17/2018	10/17/2020
	AN03367	Horn Antenna-ANSI C63.5 Calibration	62-GH-62-25.	8/24/2017	8/24/2019
	AN02869	Spectrum Analyzer	E4440A	8/10/2018	8/10/2019
T6	AN00309	Preamp	8447D	2/19/2018	2/19/2020
T7	AN01995	Biconilog Antenna	CBL6111C	4/23/2018	4/23/2020
T8	ANP05275	Attenuator	1W	4/5/2018	4/5/2020
T9	ANP05050	Cable	RG223/U	12/24/2018	12/24/2020
T10	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/4/2018	12/4/2020
	AN00314	Loop Antenna	6502	5/13/2018	5/13/2020

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5 T9	T2 T6 T10	T3 T7	T4 T8	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	4824.000M Ave	51.0	-37.6 +0.3 +0.0	+33.4 +0.0 +0.0	+4.2 +0.0	+0.4 +0.0	+0.0	51.7	54.0	-2.3	Vert
^	4824.000M	54.3	-37.6 +0.3 +0.0	+33.4 +0.0 +0.0	+4.2 +0.0	+0.4 +0.0	+0.0	55.0	54.0	+1.0	Vert
3	4924.000M Ave	50.3	-37.6 +0.3 +0.0	+33.6 +0.0 +0.0	+4.3 +0.0	+0.4 +0.0	+0.0	51.3	54.0	-2.7	Horiz
^	4924.000M	56.3	-37.6 +0.3 +0.0	+33.6 +0.0 +0.0	+4.3 +0.0	+0.4 +0.0	+0.0	57.3	54.0	+3.3	Horiz
5	4924.000M Ave	50.0	-37.6 +0.3 +0.0	+33.6 +0.0 +0.0	+4.3 +0.0	+0.4 +0.0	+0.0	51.0	54.0	-3.0	Vert
^	4924.000M	54.4	-37.6 +0.3 +0.0	+33.6 +0.0 +0.0	+4.3 +0.0	+0.4 +0.0	+0.0	55.4	54.0	+1.4	Vert

7	4824.000M Ave	49.6	-37.6 +0.3 +0.0	+33.4 +0.0 +0.0	+4.2 +0.0	+0.4 +0.0	+0.0	50.3	54.0	-3.7	Horiz
^	4824.000M	54.2	-37.6 +0.3 +0.0	+33.4 +0.0 +0.0	+4.2 +0.0	+0.4 +0.0	+0.0	54.9	54.0	+0.9	Horiz
9	4874.000M Ave	49.1	-37.6 +0.3 +0.0	+33.5 +0.0 +0.0	+4.3 +0.0	+0.4 +0.0	+0.0	50.0	54.0	-4.0	Vert
^	4874.000M	53.8	-37.6 +0.3 +0.0	+33.5 +0.0 +0.0	+4.3 +0.0	+0.4 +0.0	+0.0	54.7	54.0	+0.7	Vert
11	4874.000M Ave	48.5	-37.6 +0.3 +0.0	+33.5 +0.0 +0.0	+4.3 +0.0	+0.4 +0.0	+0.0	49.4	54.0	-4.6	Horiz
^	4874.000M	53.1	-37.6 +0.3 +0.0	+33.5 +0.0 +0.0	+4.3 +0.0	+0.4 +0.0	+0.0	54.0	54.0	+0.0	Horiz
13	247.900M	33.2	+0.0 +0.0 +0.2	+0.0 -28.0 +2.9	+0.0 +12.8	+0.0 +6.0	+0.0	27.1	46.0	-18.9	Horiz
14	235.300M	43.4	+0.0 +0.0 +0.2	+0.0 -28.0 +2.8	+0.0 +11.9	+0.0 +6.0	+0.0	36.3	74.0	-37.7	Horiz
15	237.600M	42.0	+0.0 +0.0 +0.2	+0.0 -28.0 +2.8	+0.0 +12.0	+0.0 +6.0	+0.0	35.0	74.0	-39.0	Horiz
16	239.000M	41.0	+0.0 +0.0 +0.2	+0.0 -28.0 +2.8	+0.0 +12.1	+0.0 +6.0	+0.0	34.1	74.0	-39.9	Horiz

Test Location:	CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112		
Customer:	**Venstar, Inc.**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**102204**	Date:	2/12/2019
Test Type:	**Maximized Emissions**	Time:	10:12:14
Tested By:	Don Nguyen	Sequence#:	3
Software:	EMITest 5.03.11		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

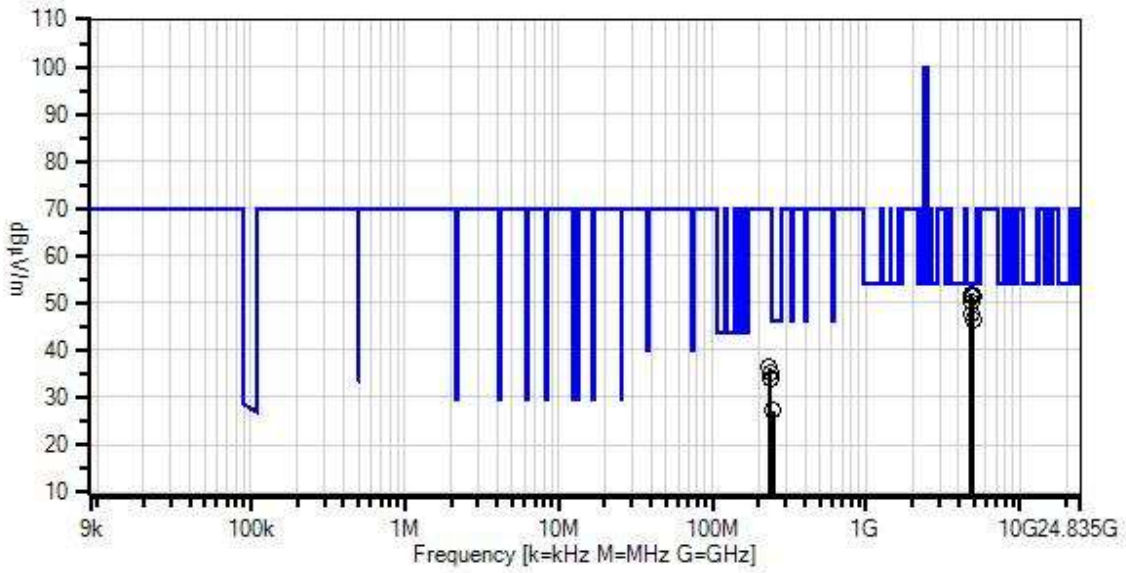
The EUT is placed on Styrofoam block and set to transmit continuously at 98% duty cycle. The EUT is connected to remotely located laptop via serial to USB cable.
The EUT is rotated in three orthogonal axes.
Transmitting frequencies: 2412MHz (CH1), 2437MHz (CH6), 2462MHz (CH11)
Modulation/Mode: 802.11g
558074 D01 15.247 Measure Guidance v05, Feb 11th, 2019

Measurement frequencies: 9kHz-25GHz
9 kHz - 150 kHz, RBW=200 Hz, VBW=600 Hz
150 kHz -30 MHz, RBW=9 kHz, VBW=27 kHz
30 MHz - 1000MHz, RBW=120 kHz, VBW=360 kHz
1000 MHz - 25000MHz, RBW=1 MHz, VBW=3 MHz
RBW=100kHz, VBW=300kHz (-30dBc limit)

Power level 2 (CH1)
Power level 0 (CH2-CH10)
Power Level 3 (CH11)
Temperature (ºC): 20.5
Relative Humidity (%): 22.1

Note: Data represents the worst case orientation/data rate.

Venstar, Inc. WO#: 102204 Sequence#: 3 Date: 2/12/2019
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Vert



Readings
QP Readings
Ambient
1 - 15.247(d) / 15.209 Radiated Spurious Emissions
Peak Readings
Average Readings
Software Version: 5.03.11

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN00786	Preamp	83017A	5/12/2018	5/12/2020
T2	AN00849	Horn Antenna	3115	3/14/2018	3/14/2020
T3	ANP07139	Cable	ANDL1-PNMNM-48	3/1/2017	3/1/2019
T4	ANP07246	Cable	32022-29094K-29094K-24TC	7/5/2018	7/5/2020
T5	AN03385	High Pass Filter	11SH10-3000/T10000-O/O	6/2/2017	6/2/2019
	AN01413	Horn Antenna-ANSI C63.5 (dB/m)	84125-80008	10/17/2018	10/17/2020
	AN03367	Horn Antenna-ANSI C63.5 Calibration	62-GH-62-25.	8/24/2017	8/24/2019
T6	AN02869	Spectrum Analyzer	E4440A	8/10/2018	8/10/2019
T7	AN00309	Preamp	8447D	2/19/2018	2/19/2020
T8	AN01995	Biconilog Antenna	CBL6111C	4/23/2018	4/23/2020
T9	ANP05275	Attenuator	1W	4/5/2018	4/5/2020
T10	ANP05050	Cable	RG223/U	12/24/2018	12/24/2020
T11	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/4/2018	12/4/2020
	AN00314	Loop Antenna	6502	5/13/2018	5/13/2020

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5 T9	T2 T6 T10	T3 T7 T11	T4 T8	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	4824.000M	51.0	-37.6 +0.3 +0.0	+33.4 +0.0 +0.0	+4.2 +0.0 +0.0	+0.4 +0.0	+0.0	51.7	54.0	-2.3	Vert
2	4824.000M	50.6	-37.6 +0.3 +0.0	+33.4 +0.0 +0.0	+4.2 +0.0 +0.0	+0.4 +0.0	+0.0	51.3	54.0	-2.7	Horiz
3	4924.000M	50.2	-37.6 +0.3 +0.0	+33.6 +0.0 +0.0	+4.3 +0.0 +0.0	+0.4 +0.0	+0.0	51.2	54.0	-2.8	Horiz
4	4874.000M	49.4	-37.6 +0.3 +0.0	+33.5 +0.0 +0.0	+4.3 +0.0 +0.0	+0.4 +0.0	+0.0	50.3	54.0	-3.7	Vert
5	4874.000M	46.9	-37.6 +0.3 +0.0	+33.5 +0.0 +0.0	+4.3 +0.0 +0.0	+0.4 +0.0	+0.0	47.8	54.0	-6.2	Horiz
6	4924.000M	45.6	-37.6 +0.3 +0.0	+33.6 +0.0 +0.0	+4.3 +0.0 +0.0	+0.4 +0.0	+0.0	46.6	54.0	-7.4	Vert

7	247.900M	33.2	+0.0 +0.0 +6.0	+0.0 +0.0 +0.2	+0.0 -28.0 +2.9	+0.0 +12.8	+0.0	27.1	46.0	-18.9	Horiz
8	235.300M	43.4	+0.0 +0.0 +6.0	+0.0 +0.0 +0.2	+0.0 -28.0 +2.8	+0.0 +11.9	+0.0	36.3	74.0	-37.7	Horiz
9	237.600M	42.0	+0.0 +0.0 +6.0	+0.0 +0.0 +0.2	+0.0 -28.0 +2.8	+0.0 +12.0	+0.0	35.0	74.0	-39.0	Horiz
10	239.000M	41.0	+0.0 +0.0 +6.0	+0.0 +0.0 +0.2	+0.0 -28.0 +2.8	+0.0 +12.1	+0.0	34.1	74.0	-39.9	Horiz

Test Location:	CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112		
Customer:	**Venstar, Inc.**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**102204**	Date:	2/12/2019
Test Type:	**Maximized Emissions**	Time:	13:13:31
Tested By:	Don Nguyen	Sequence#:	4
Software:	EMITest 5.03.11		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

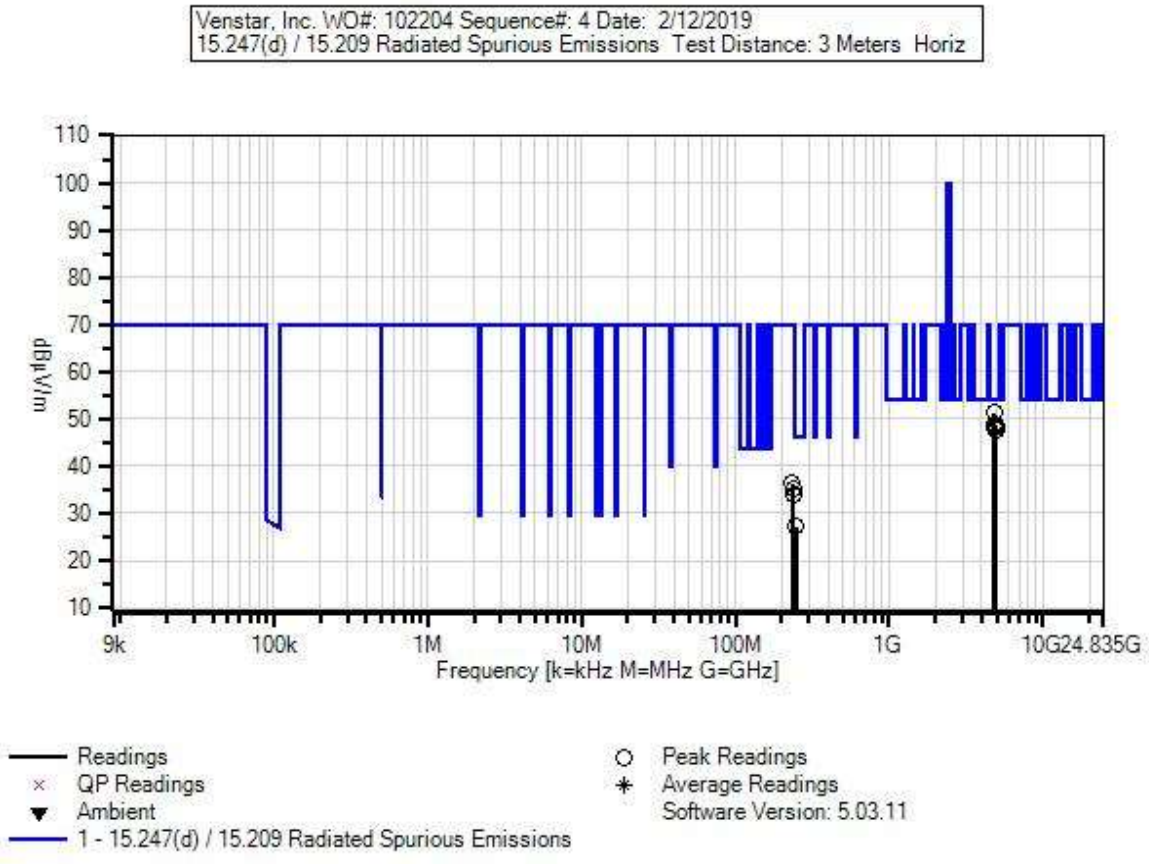
Test Conditions / Notes:

The EUT is placed on Styrofoam block and set to transmit continuously at 98% duty cycle. The EUT is connected to remotely located laptop via serial to USB cable.
The EUT is rotated in three orthogonal axes.
Transmitting frequencies: 2412MHz (CH1), 2437MHz (CH6), 2462MHz (CH11)
Modulation/Mode: 802.11n20
558074 D01 15.247 Measure Guidance v05, Feb 11th, 2019

Measurement frequencies: 9kHz-25GHz
9 kHz - 150 kHz, RBW=200 Hz, VBW=600 Hz
150 kHz -30 MHz, RBW=9 kHz, VBW=27 kHz
30 MHz - 1000MHz, RBW=120 kHz, VBW=360 kHz
1000 MHz - 25000MHz, RBW=1 MHz, VBW=3 MHz
RBW=100kHz, VBW=300kHz (-30dBc limit)

Power level 2 (CH1)
Power level 0 (CH2-CH10)
Power Level 3 (CH11)
Temperature (ºC): 20.5
Relative Humidity (%): 22.1

Note: Data represents the worst case orientation/data rate.


Venstar, Inc. WO#: 102204 Sequence#: 4 Date: 2/12/2019
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Horiz
110
100
90
80
70
60
50
40
30
20
10
dBµV/m
9k
100k
1M
10M
100M
1G
10G24.835G
Frequency [k=kHz M=MHz G=GHz]
Readings
QP Readings
Ambient
1 - 15.247(d) / 15.209 Radiated Spurious Emissions
Peak Readings
Average Readings
Software Version: 5.03.11

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN00786	Preamp	83017A	5/12/2018	5/12/2020
T2	AN00849	Horn Antenna	3115	3/14/2018	3/14/2020
T3	ANP07139	Cable	ANDL1-PNMNM-48	3/1/2017	3/1/2019
T4	ANP07246	Cable	32022-29094K-29094K-24TC	7/5/2018	7/5/2020
T5	AN03385	High Pass Filter	11SH10-3000/T10000-O/O	6/2/2017	6/2/2019
	AN01413	Horn Antenna-ANSI C63.5 (dB/m)	84125-80008	10/17/2018	10/17/2020
	AN03367	Horn Antenna-ANSI C63.5 Calibration	62-GH-62-25.	8/24/2017	8/24/2019
T6	AN02869	Spectrum Analyzer	E4440A	8/10/2018	8/10/2019
T7	AN00309	Preamp	8447D	2/19/2018	2/19/2020
T8	AN01995	Biconilog Antenna	CBL6111C	4/23/2018	4/23/2020
T9	ANP05275	Attenuator	1W	4/5/2018	4/5/2020
T10	ANP05050	Cable	RG223/U	12/24/2018	12/24/2020
T11	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/4/2018	12/4/2020
	AN00314	Loop Antenna	6502	5/13/2018	5/13/2020

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5 T9	T2 T6 T10	T3 T7 T11	T4 T8	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	4824.000M	50.6	-37.6 +0.3 +0.0	+33.4 +0.0 +0.0	+4.2 +0.0 +0.0	+0.4 +0.0	+0.0	51.3	54.0	-2.7	Horiz
2	4824.000M	48.2	-37.6 +0.3 +0.0	+33.4 +0.0 +0.0	+4.2 +0.0 +0.0	+0.4 +0.0	+0.0	48.9	54.0	-5.1	Vert
3	4924.000M	47.6	-37.6 +0.3 +0.0	+33.6 +0.0 +0.0	+4.3 +0.0 +0.0	+0.4 +0.0	+0.0	48.6	54.0	-5.4	Vert
4	4874.000M	47.7	-37.6 +0.3 +0.0	+33.5 +0.0 +0.0	+4.3 +0.0 +0.0	+0.4 +0.0	+0.0	48.6	54.0	-5.4	Horiz
5	4874.000M	47.2	-37.6 +0.3 +0.0	+33.5 +0.0 +0.0	+4.3 +0.0 +0.0	+0.4 +0.0	+0.0	48.1	54.0	-5.9	Vert
6	4924.000M	46.8	-37.6 +0.3 +0.0	+33.6 +0.0 +0.0	+4.3 +0.0 +0.0	+0.4 +0.0	+0.0	47.8	54.0	-6.2	Horiz

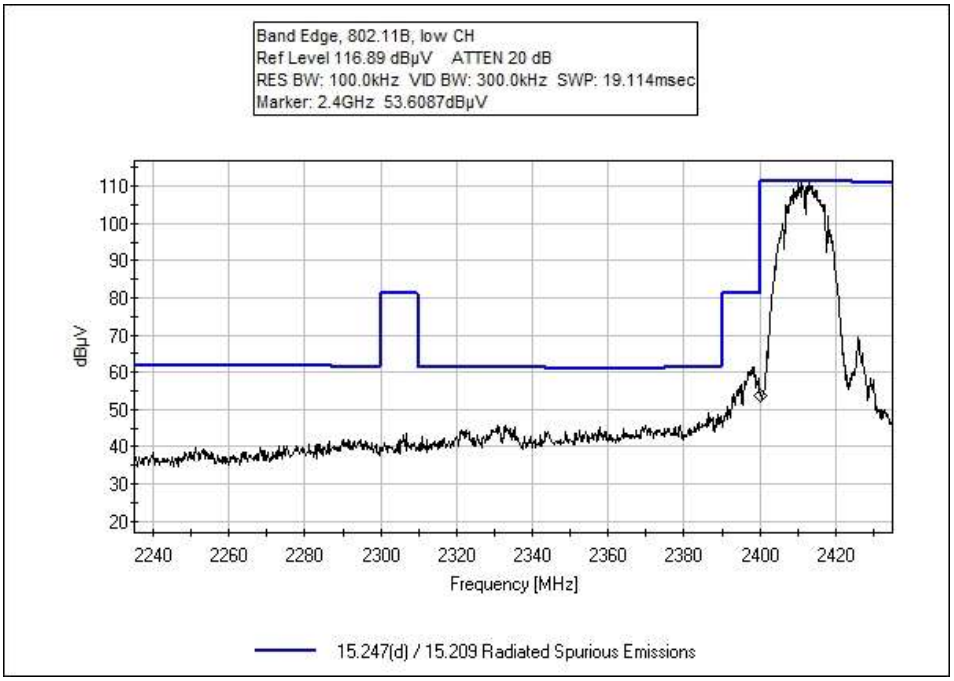
7	247.900M	33.2	+0.0 +0.0 +6.0	+0.0 +0.0 +0.2	+0.0 -28.0 +2.9	+0.0 +12.8	+0.0	27.1	46.0	-18.9	Horiz
8	235.300M	43.4	+0.0 +0.0 +6.0	+0.0 +0.0 +0.2	+0.0 -28.0 +2.8	+0.0 +11.9	+0.0	36.3	74.0	-37.7	Horiz
9	237.600M	42.0	+0.0 +0.0 +6.0	+0.0 +0.0 +0.2	+0.0 -28.0 +2.8	+0.0 +12.0	+0.0	35.0	74.0	-39.0	Horiz
10	239.000M	41.0	+0.0 +0.0 +6.0	+0.0 +0.0 +0.2	+0.0 -28.0 +2.8	+0.0 +12.1	+0.0	34.1	74.0	-39.9	Horiz

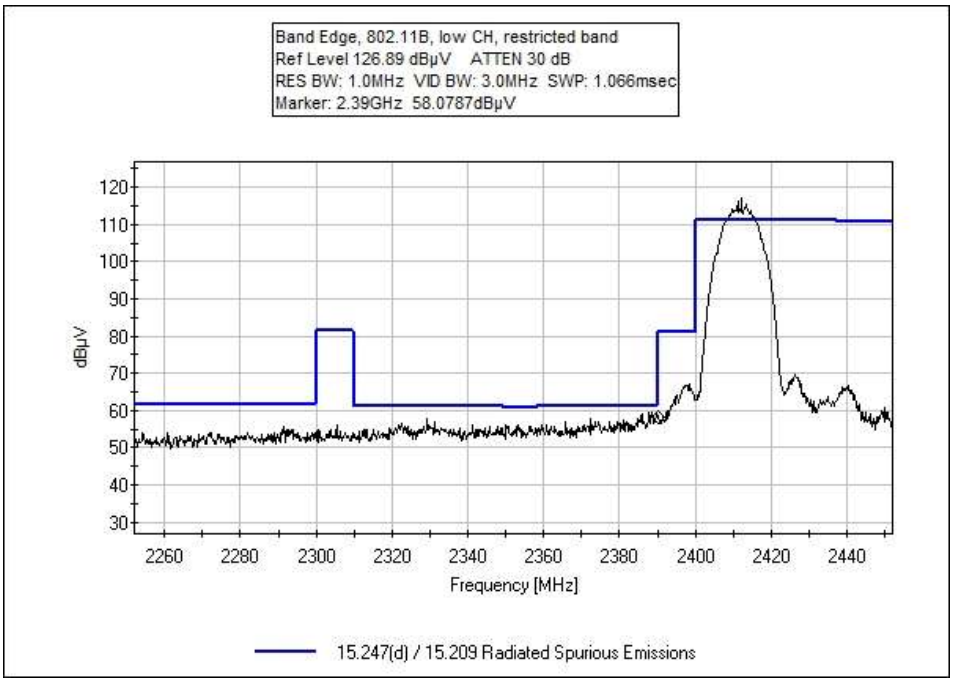
Band Edge

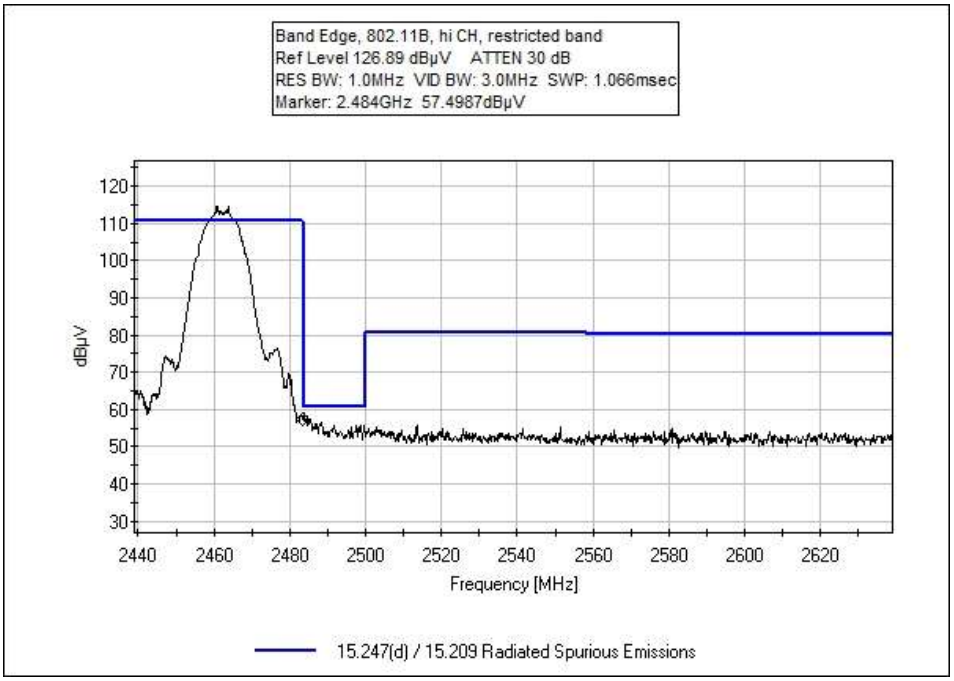
Band Edge Summary					
Frequency (MHz)	**Modulation**	**Ant. Type**	**Field Strength (dBuV/m @3m)**	**Limit (dBuV/m @3m)**	**Results**
2390.0	802.11b	PCB Trace	50.9	<54.0	Pass
2400.0	802.11b	PCB Trace	46.3	<74.0	Pass
2483.5	802.11b	PCB Trace	50.7	<54.0	Pass
2390.0	802.11g	PCB Trace	42.1*	<54.0	Pass
2400.0	802.11g	PCB Trace	66.6	<69.7	Pass
2483.5	802.11g	PCB Trace	52.0*	<54.0	Pass
2390.0	802.11n20	PCB Trace	43.2*	<54.0	Pass
2400.0	802.11n20	PCB Trace	65.0	<71.0	Pass
2483.5	802.11n20	PCB Trace	52.5*	<54.0	Pass

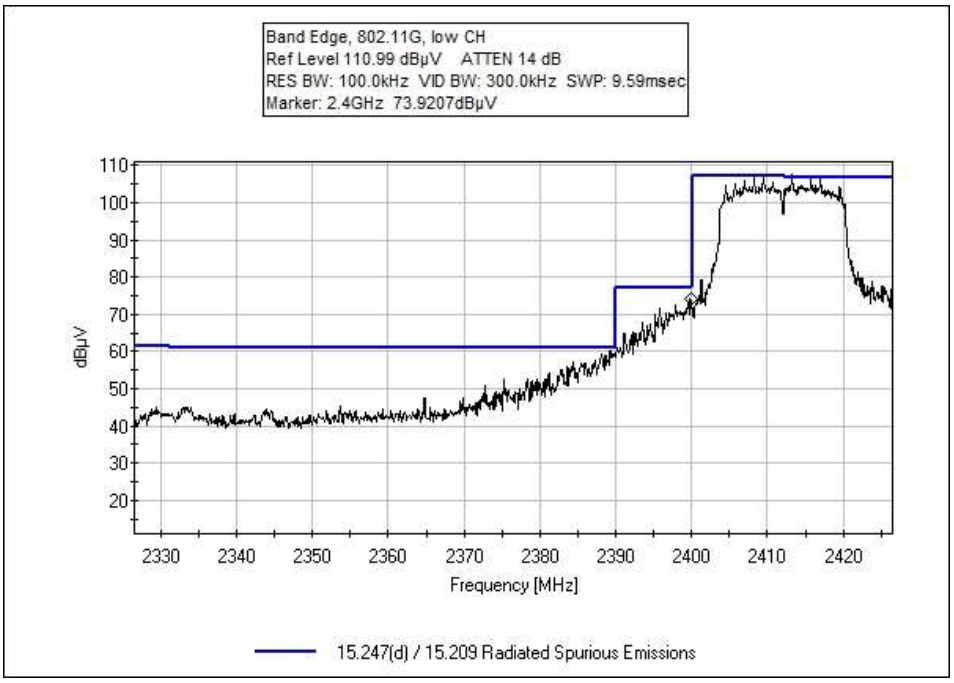
*Average detector

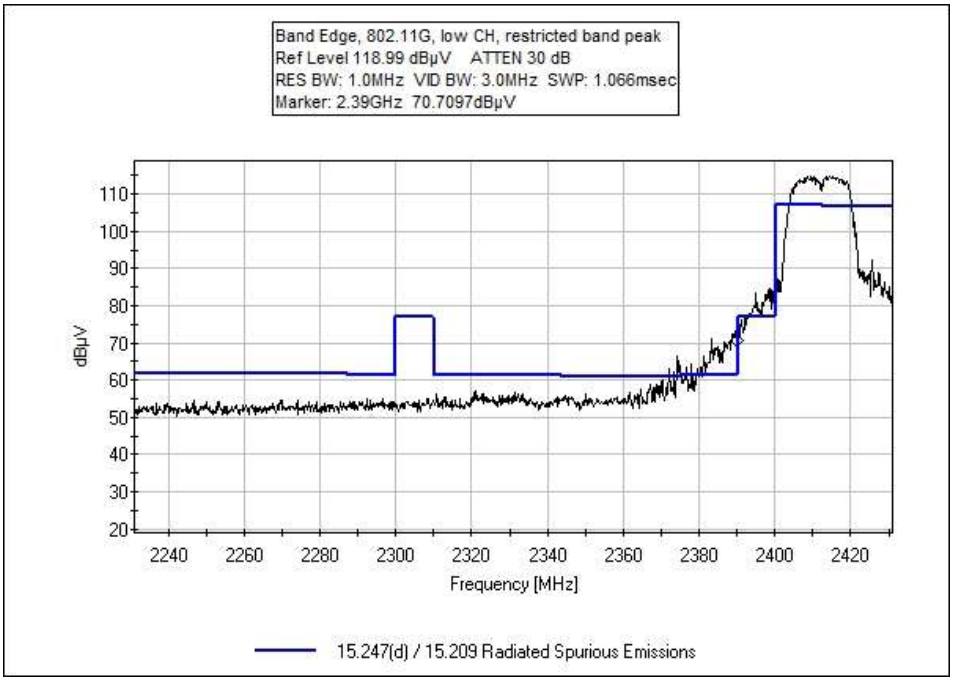
Band Edge Plots

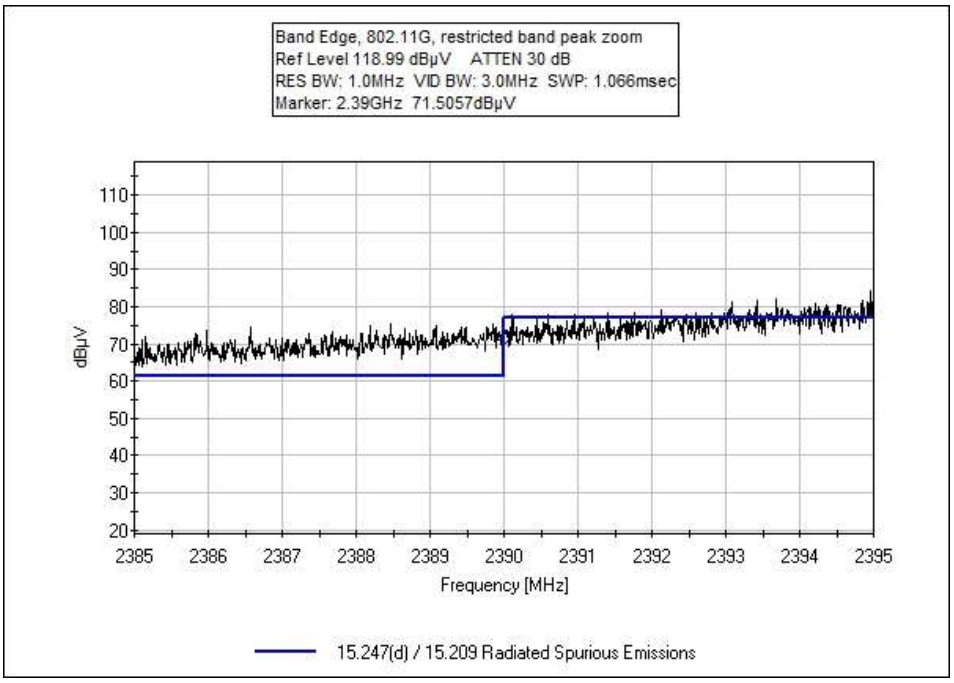


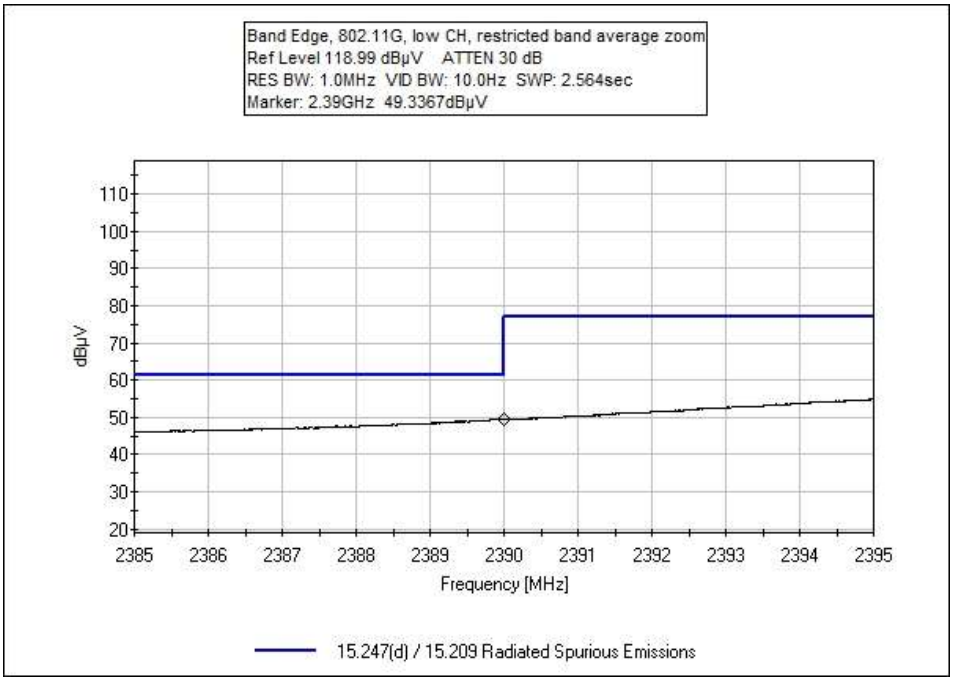

Band Edge, 802.11B, low CH, restricted band
Ref Level 126.89 dBµV ATTEN 30 dB
RES BW: 1.0MHz VID BW: 3.0MHz SWP: 1.066msec
Marker: 2.39GHz 58.0787dBµV
dBµV
120
110
100
90
80
70
60
50
40
30
2260
2280
2300
2320
2340
2360
2380
2400
2420
2440
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

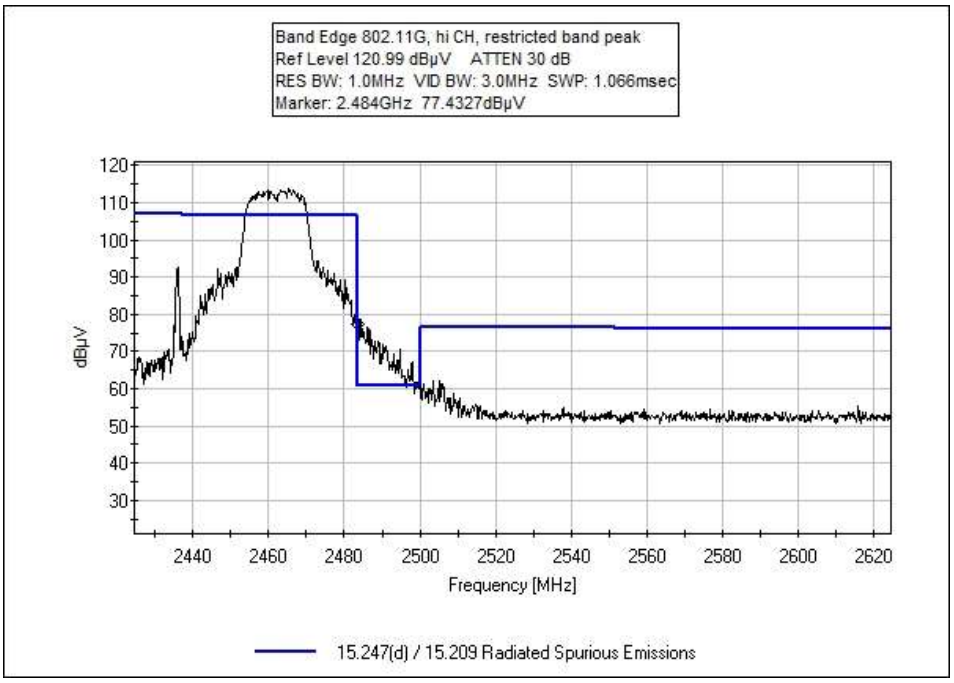

Band Edge, 802.11B, hi CH, restricted band
Ref Level 126.89 dBµV ATTEN 30 dB
RES BW: 1.0MHz VID BW: 3.0MHz SWP: 1.066msec
Marker: 2.484GHz 57.4987dBµV
dBµV
120
110
100
90
80
70
60
50
40
30
2440
2460
2480
2500
2520
2540
2560
2580
2600
2620
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

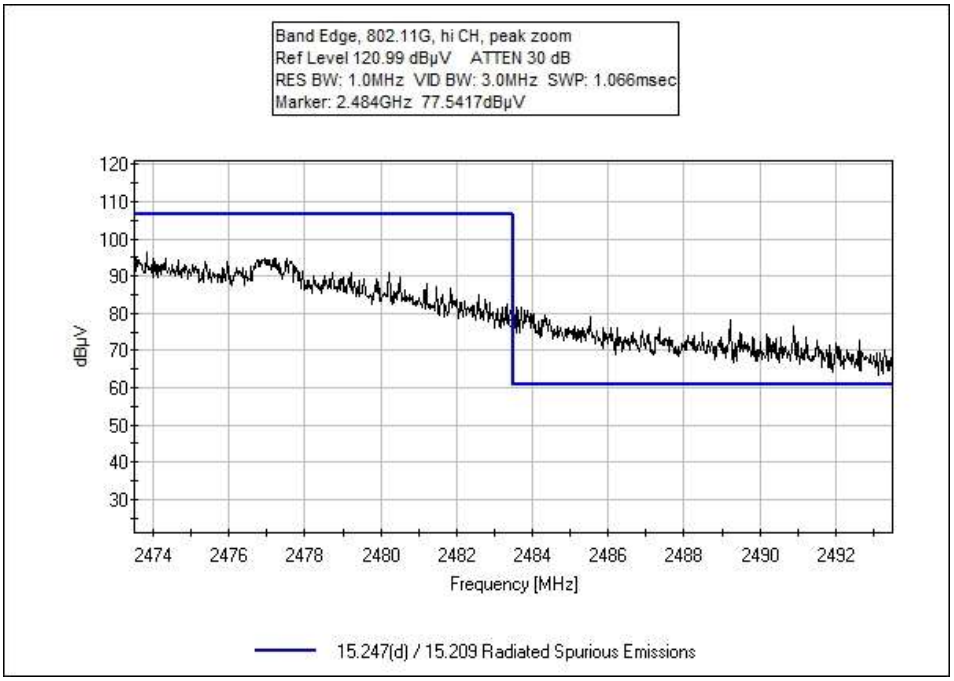

Band Edge, 802.11G, low CH
Ref Level 110.99 dBµV ATTEN 14 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 9.59msec
Marker: 2.4GHz 73.9207dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

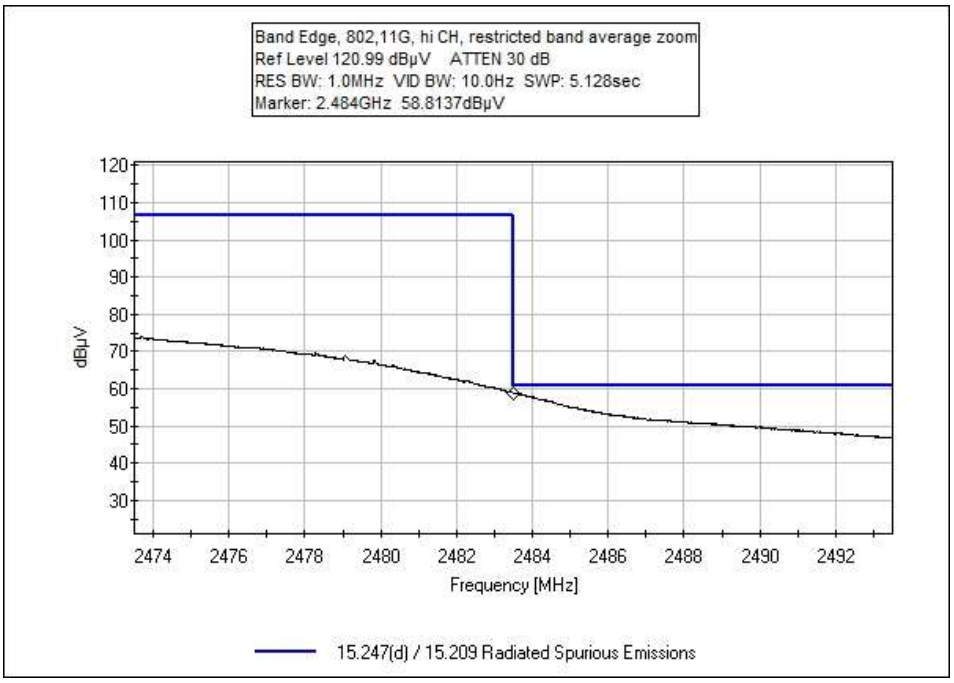

Band Edge, 802.11G, low CH, restricted band peak
Ref Level 118.99 dBµV ATTEN 30 dB
RES BW: 1.0MHz VID BW: 3.0MHz SWP: 1.066msec
Marker: 2.39GHz 70.7097dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

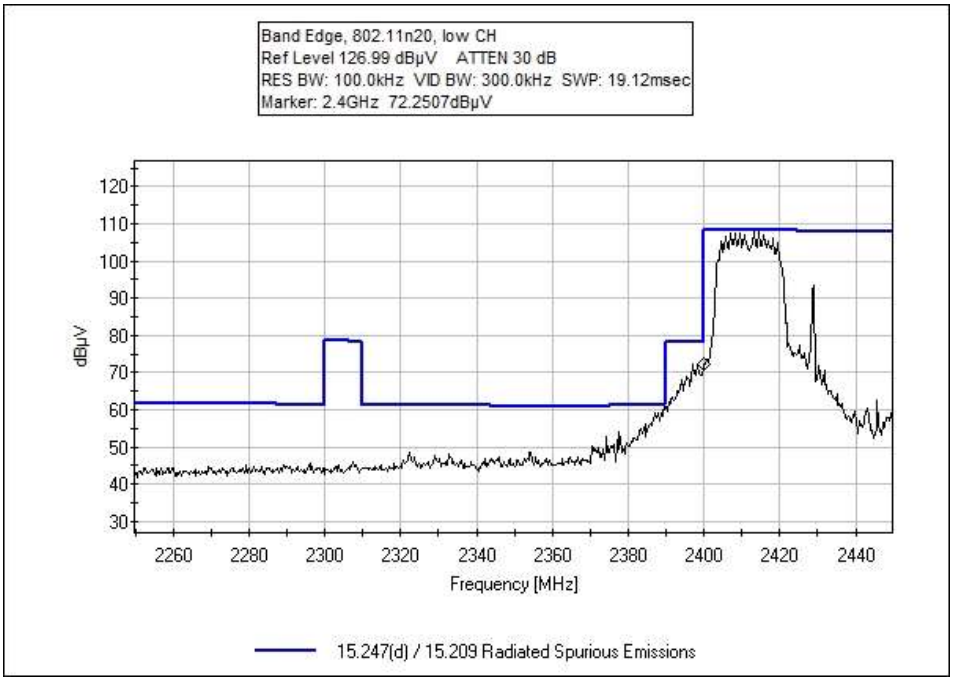

Band Edge, 802.11G, restricted band peak zoom
Ref Level 118.99 dBµV ATTEN 30 dB
RES BW: 1.0MHz VID BW: 3.0MHz SWP: 1.066msec
Marker: 2.39GHz 71.5057dBµV
dBµV
110
100
90
80
70
60
50
40
30
20
2385
2386
2387
2388
2389
2390
2391
2392
2393
2394
2395
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

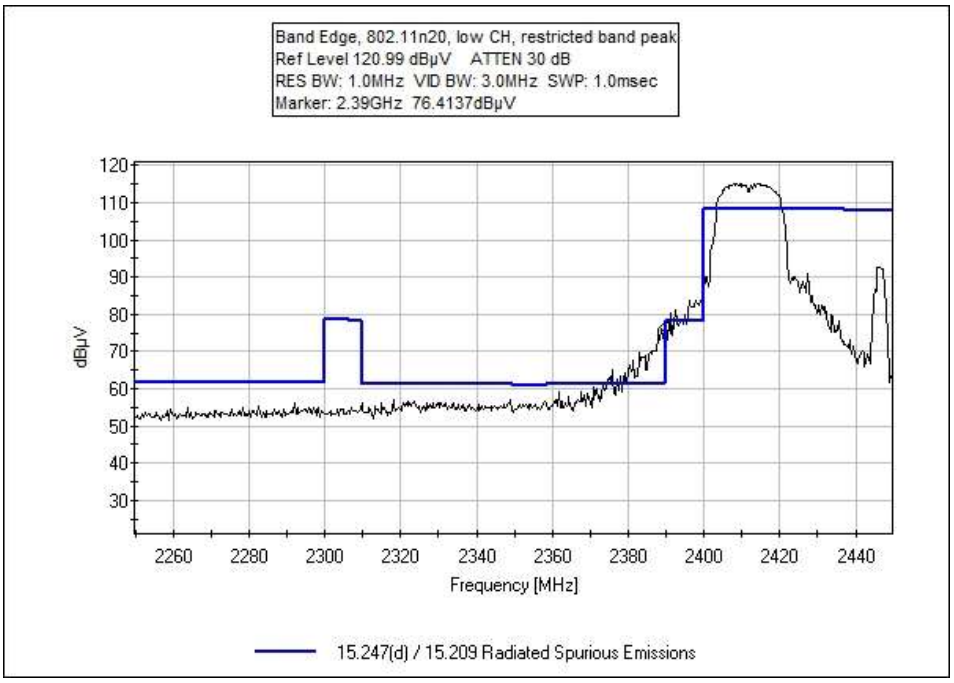

Band Edge, 802.11G, low CH, restricted band average zoom
Ref Level 118.99 dBµV ATTEN 30 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 2.564sec
Marker: 2.39GHz 49.3367dBµV
dBµV
110
100
90
80
70
60
50
40
30
20
2385
2386
2387
2388
2389
2390
2391
2392
2393
2394
2395
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

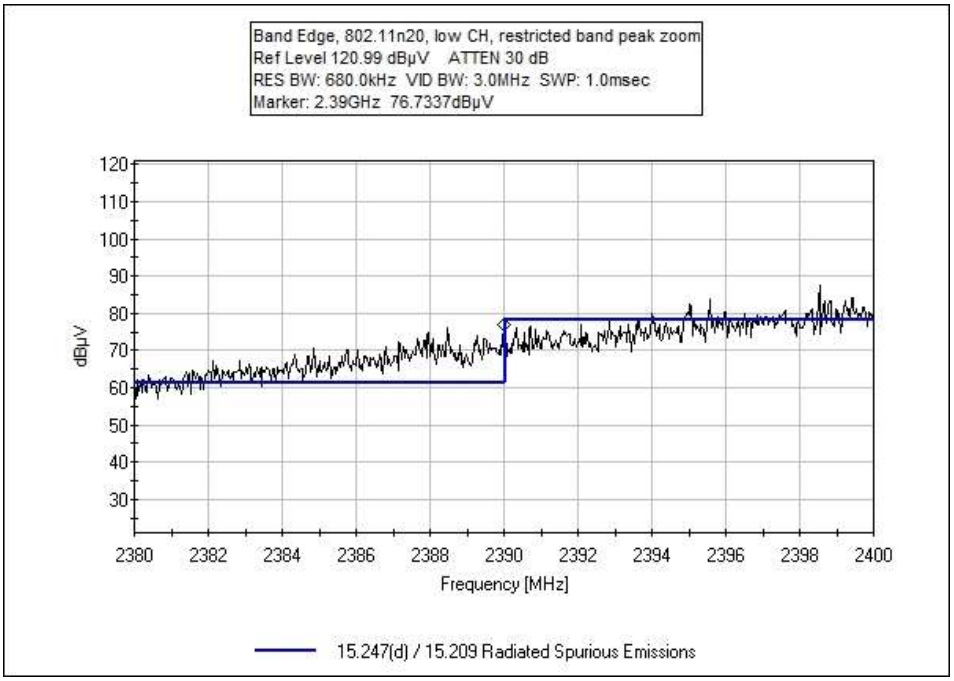

Band Edge 802.11G, hi CH, restricted band peak
Ref Level 120.99 dBµV ATTEN 30 dB
RES BW: 1.0MHz VID BW: 3.0MHz SWP: 1.066msec
Marker: 2.484GHz 77.4327dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

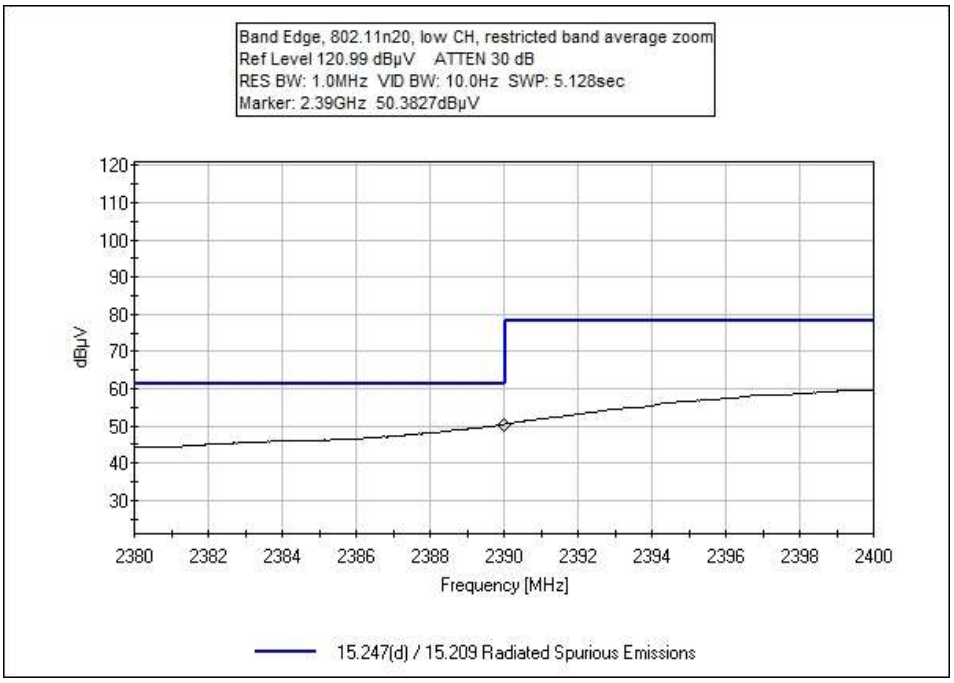

Band Edge, 802.11G, hi CH, peak zoom
Ref Level 120.99 dBµV ATTEN 30 dB
RES BW: 1.0MHz VID BW: 3.0MHz SWP: 1.066msec
Marker: 2.484GHz 77.5417dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

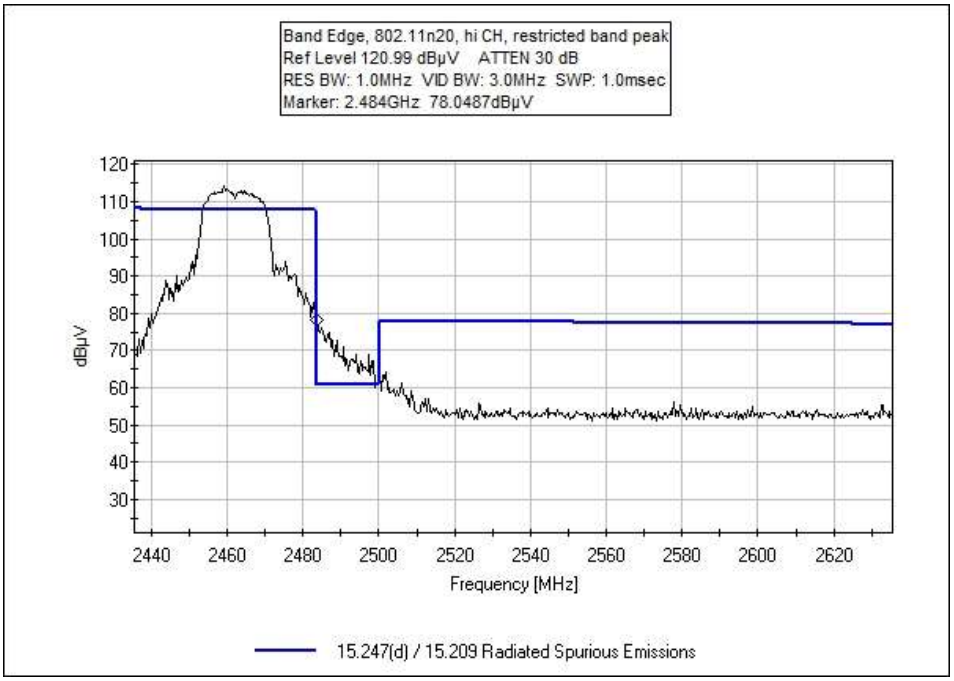

Band Edge, 802,11G, hi CH, restricted band average zoom
Ref Level 120.99 dBµV ATTEN 30 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 5.128sec
Marker: 2.484GHz 58.8137dBµV
dBµV
120
110
100
90
80
70
60
50
40
30
2474
2476
2478
2480
2482
2484
2486
2488
2490
2492
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

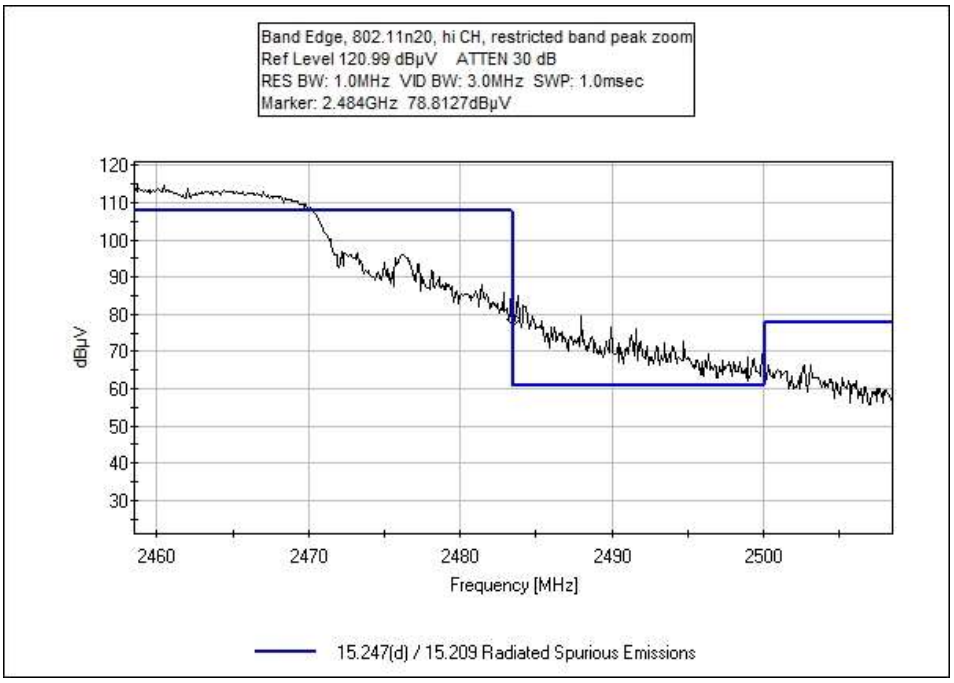

Band Edge, 802.11n20, low CH
Ref Level 126.99 dBµV ATTEN 30 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 19.12msec
Marker: 2.4GHz 72.2507dBµV
dBµV
120
110
100
90
80
70
60
50
40
30
2260
2280
2300
2320
2340
2360
2380
2400
2420
2440
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

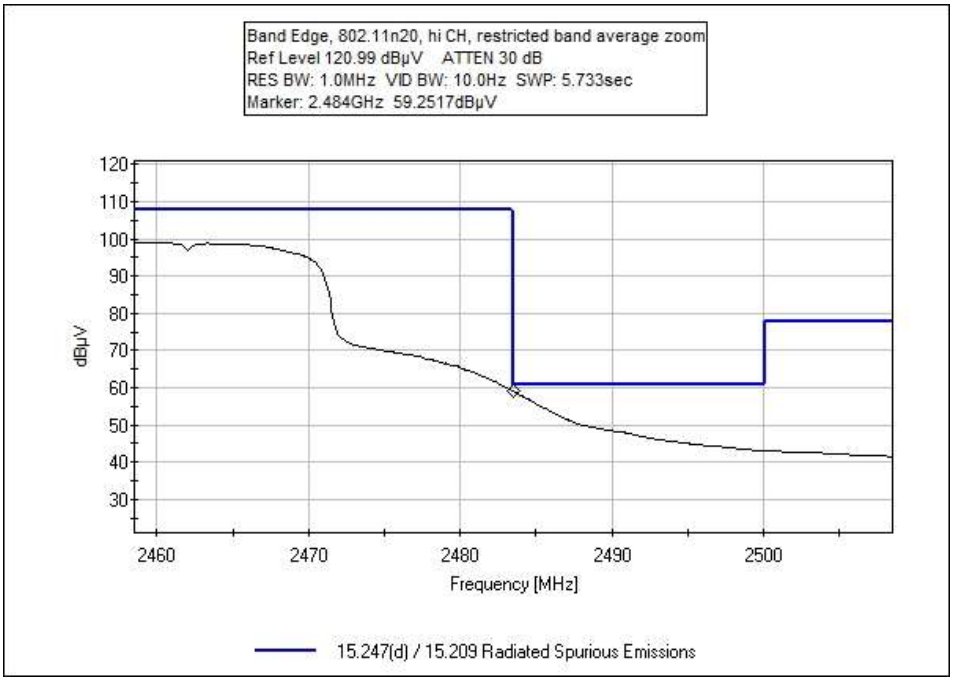

Band Edge, 802.11n20, low CH, restricted band peak
Ref Level 120.99 dBµV ATTEN 30 dB
RES BW: 1.0MHz VID BW: 3.0MHz SWP: 1.0msec
Marker: 2.39GHz 76.4137dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Band Edge, 802.11n20, low CH, restricted band peak zoom
Ref Level 120.99 dBµV ATTEN 30 dB
RES BW: 680.0kHz VID BW: 3.0MHz SWP: 1.0msec
Marker: 2.39GHz 76.7337dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Band Edge, 802.11n20, low CH, restricted band average zoom
Ref Level 120.99 dBµV ATTEN 30 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 5.128sec
Marker: 2.39GHz 50.3827dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Band Edge, 802.11n20, hi CH, restricted band peak
Ref Level 120.99 dBµV ATTEN 30 dB
RES BW: 1.0MHz VID BW: 3.0MHz SWP: 1.0msec
Marker: 2.484GHz 78.0487dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Band Edge, 802.11n20, hi CH, restricted band peak zoom
Ref Level 120.99 dBµV ATTEN 30 dB
RES BW: 1.0MHz VID BW: 3.0MHz SWP: 1.0msec
Marker: 2.484GHz 78.8127dBµV
120
110
100
90
80
70
60
50
40
30
dBµV
2460
2470
2480
2490
2500
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Band Edge, 802.11n20, hi CH, restricted band average zoom
Ref Level 120.99 dBµV ATTEN 30 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 5.733sec
Marker: 2.484GHz 59.2517dBµV
120
110
100
90
80
70
60
50
40
30
dBµV
2460
2470
2480
2490
2500
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112		
Customer:	**Venstar, Inc.**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**102204**	Date:	2/11/2019
Test Type:	**Maximized Emissions**	Time:	16:13:10
Tested By:	Don Nguyen	Sequence#:	1
Software:	EMITest 5.03.11		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The EUT is placed on Styrofoam block and set to transmit continuously at 98% duty cycle. The EUT is connected to remotely located laptop via serial to USB cable.
The EUT is rotated in three orthogonal axes.
Transmitting frequencies: 2412MHz (CH1), 2462MHz (CH11)
Modulation/Mode: 802.11b
558074 D01 15.247 Measure Guidance v05, Feb 11th, 2019
Measurement frequencies: 2390-2483.5MHz
RBW=100kHz, VBW=300kHz (-30dBc limit)
RBW=1MHz, VBW=3MHz (restricted band)

Note: Data represents the worst case orientation/data rate.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN00786	Preamp	83017A	5/12/2018	5/12/2020
T2	AN00849	Horn Antenna	3115	3/14/2018	3/14/2020
T3	ANP07139	Cable	ANDL1-PNMNM-48	3/1/2017	3/1/2019
T4	ANP07246	Cable	32022-29094K-29094K-24TC	7/5/2018	7/5/2020
T5	AN02869	Spectrum Analyzer	E4440A	8/10/2018	8/10/2019

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	2390.000M	58.1	-38.7 +0.0	+28.3	+2.9	+0.3	+0.0	50.9	54.0	-3.1	Vert
2	2483.500M	57.5	-38.7 +0.0	+28.5	+3.1	+0.3	+0.0	50.7	54.0	-3.3	Vert
3	2400.000M	53.6	-38.7 +0.0	+28.2	+2.9	+0.3	+0.0	46.3	74.0	-27.7	Vert

Test Location:	CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112		
Customer:	**Venstar, Inc.**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**102204**	Date:	2/15/2019
Test Type:	**Maximized Emissions**	Time:	10:46:23
Tested By:	Don Nguyen	Sequence#:	2
Software:	EMITest 5.03.11		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The EUT is placed on Styrofoam block and set to transmit continuously at 98% duty cycle. The EUT is connected to remotely located laptop via serial to USB cable.
The EUT is rotated in three orthogonal axes.
Transmitting frequencies: 2412MHz (CH1), 2462MHz (CH11)
Modulation/Mode: 802.11g
558074 D01 15.247 Measure Guidance v05, Feb 11th, 2019
Measurement frequencies: 2390-2483.5MHz
RBW=100kHz, VBW=300kHz (-30dBc limit)
RBW=1MHz, VBW=3MHz (restricted band)

Note: Data represents the worst case orientation/data rate.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN00786	Preamp	83017A	5/12/2018	5/12/2020
T2	AN00849	Horn Antenna	3115	3/14/2018	3/14/2020
T3	ANP07139	Cable	ANDL1-PNMNM-48	3/1/2017	3/1/2019
T4	ANP07246	Cable	32022-29094K-29094K-24TC	7/5/2018	7/5/2020
T5	AN02869	Spectrum Analyzer	E4440A	8/10/2018	8/10/2019

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	2483.500M Ave	58.8	-38.7 +0.0	+28.5	+3.1	+0.3	+0.0	52.0	54.0	-2.0	Vert
^	2483.500M	60.8	-38.7 +0.0	+28.5	+3.1	+0.3	+0.0	54.0	54.0	+0.0	Vert
3	2400.000M	73.9	-38.7 +0.0	+28.2	+2.9	+0.3	+0.0	66.6	69.7	-3.1	Vert
4	2390.000M Ave	49.3	-38.7 +0.0	+28.3	+2.9	+0.3	+0.0	42.1	54.0	-11.9	Vert

Test Location:	CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112		
Customer:	**Venstar, Inc.**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**102204**	Date:	2/12/2019
Test Type:	**Maximized Emissions**	Time:	08:50:17
Tested By:	Don Nguyen	Sequence#:	3
Software:	EMITest 5.03.11		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The EUT is placed on Styrofoam block and set to transmit continuously at 98% duty cycle. The EUT is connected to remotely located laptop via serial to USB cable.
The EUT is rotated in three orthogonal axes.
Transmitting frequencies: 2412MHz (CH1), 2462MHz (CH11)
Modulation/Mode: 802.11n20
558074 D01 15.247 Measure Guidance v05, Feb 11th, 2019
Measurement frequencies: 2390-2483.5MHz
RBW=100kHz, VBW=300kHz (-30dBc limit)
RBW=1MHz, VBW=3MHz (restricted band)

Note: Data represents the worst case orientation/data rate.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN00786	Preamp	83017A	5/12/2018	5/12/2020
T2	AN00849	Horn Antenna	3115	3/14/2018	3/14/2020
T3	ANP07139	Cable	ANDL1-PNMNM-48	3/1/2017	3/1/2019
T4	ANP07246	Cable	32022-29094K-29094K-24TC	7/5/2018	7/5/2020
T5	AN02869	Spectrum Analyzer	E4440A	8/10/2018	8/10/2019

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	2483.500M Ave	59.3	-38.7 +0.0	+28.5	+3.1	+0.3	+0.0	52.5	54.0	-1.5	Vert
2	2400.000M	72.3	-38.7 +0.0	+28.2	+2.9	+0.3	+0.0	65.0	71.0	-6.0	Vert
3	2390.000M Ave	50.4	-38.7 +0.0	+28.3	+2.9	+0.3	+0.0	43.2	54.0	-10.8	Vert

Test Setup Photo(s)

Below 1GHz

Below 1GHz

Above 1GHz Cone placement

X Axis

Y Axis

Z Axis

SUPPLEMENTAL INFORMATION

Measurement Uncertainty

Uncertainty Value	Parameter
4.73 dB	Radiated Emissions
3.34 dB	Mains Conducted Emissions
3.30 dB	Disturbance Power

Uncertainties reported are worst case for all CKC Laboratories' sites and represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2. Compliance is deemed to occur provided measurements are below the specified limits.

Emissions Test Details

TESTING PARAMETERS

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in dBµV/m, the spectrum analyzer reading in dBµV was corrected by using the following formula. This reading was then compared to the applicable specification limit. Individual measurements were compared with the displayed limit value in the margin column. The margin was calculated based on subtracting the limit value from the corrected measurement value; a positive margin represents a measurement exceeding the limit, while a negative margin represents a measurement less than the limit.

SAMPLE CALCULATIONS		
	Meter reading	(dBµV)
+	Antenna Factor	(dB/m)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dBµV/m)

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE			
TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	9 kHz	150 kHz	200 Hz
RADIATED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	>1 GHz	1 MHz

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or caret ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

Peak

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

Average

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point, the measuring device is set into the linear mode and the scan time is reduced.