

Venstar, Inc.

REVISED TEST REPORT TO 102914-8

WiFi Thermostat
Model: Super Explorer Mini

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

15.207 & 15.247
(DTS 2400-2483.5 MHz)

Report No.: 102914-8A

Date of issue: October 24, 2019



Test Certificate # 803.01

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.

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ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

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Project Number: 102914

DATE OF EQUIPMENT RECEIPT:

July 29, 2019

DATE(S) OF TESTING:

July 29 – August 1, 2019

Revision History

Original: Testing of the WiFi Thermostat, Model: Super Explorer Mini to FCC Part 15 Subpart C Section(s) 15.207 & 15.247 (DTS 2400-2483.5 MHz).

Revision A: Updated Band Edge summary in Section 15.247(d) to clarify BE measurement.

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	5.03.12

Site Registration & Accreditation Information

Location	*NIST CB #	FCC	Japan
Canyon Park, Bothell, WA	US0081	US1022	A-0136
Brea, CA	US0060	US1025	A-0136
Fremont, CA	US0082	US1023	A-0136
Mariposa, CA	US0103	US1024	A-0136

*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	Pass
15.247(d)	Radiated Emissions & Band Edge	NA	Pass
15.207	AC Conducted Emissions	NA	Pass

NA = Not Applicable

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 Thermostat	Venstar, Inc.	Super Explorer Mini	NA

Support Equipment:

Device	Manufacturer	Model #	S/N
Development board	Texas Instrument	T005V0	NA
Mouse	Dell	MS111-P	71561-QAP-OA9P
Laptop	Lenovo	T500	2242CTO
Power Supply	Generic	MKA-412400200	NA

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	802.11 b/g/n20
Operating Frequency Range:	2412-2462MHz
Modulation Type(s):	CCK / OFDM/ 64QAM
Maximum Duty Cycle:	62%
Number of TX Chains:	1
Antenna Type(s) and Gain:	Integral 1.9dBi
Beamforming Type:	NA
Antenna Connection Type:	Integral (External connector provided to facilitate testing)
Nominal Input Voltage:	24Vac 60Hz
Firmware / Software used for Test:	TI CC31XX/CC32XX Radio tool V 1.0.3.11

FCC Part 15 Subpart C

15.247(a)(2) 6dB Bandwidth

Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	E. Wong
Test Method:	ANSI C63.10 (2013), KDB 558074 V05r02 (2019)	Test Date(s):	7/29/2019
Configuration:	1		
Test Setup:	The EUT is placed on test bench, connected to a laptop. The Laptop is running TI CC31XX/CC32XX Radio Tool V 1.0.3.11 to place the EUT in test mode. Freq range: 2400-2483.5MHz Freq: 2412- 2462 MHz Protocol: 802.11 b/g/n20 Packet size 1400 byte (max) infinite packet (0), delay 2 ms (worst case setting) Firmware Power setting listed below: range 0-15, 0 is max power setting. 802.11 b 2412, 2442, 2462 0,0,0 802.11g 2412, 2442, 2462 1,0,0 802.11n20 2412, 2442, 2462 0,0,0 The EUT has integral antenna however, conducted measurement was made with RF antenna test port. Frequency range of measurement = Fundamental		

Environmental Conditions			
Temperature (°C)	25	Relative Humidity (%):	55

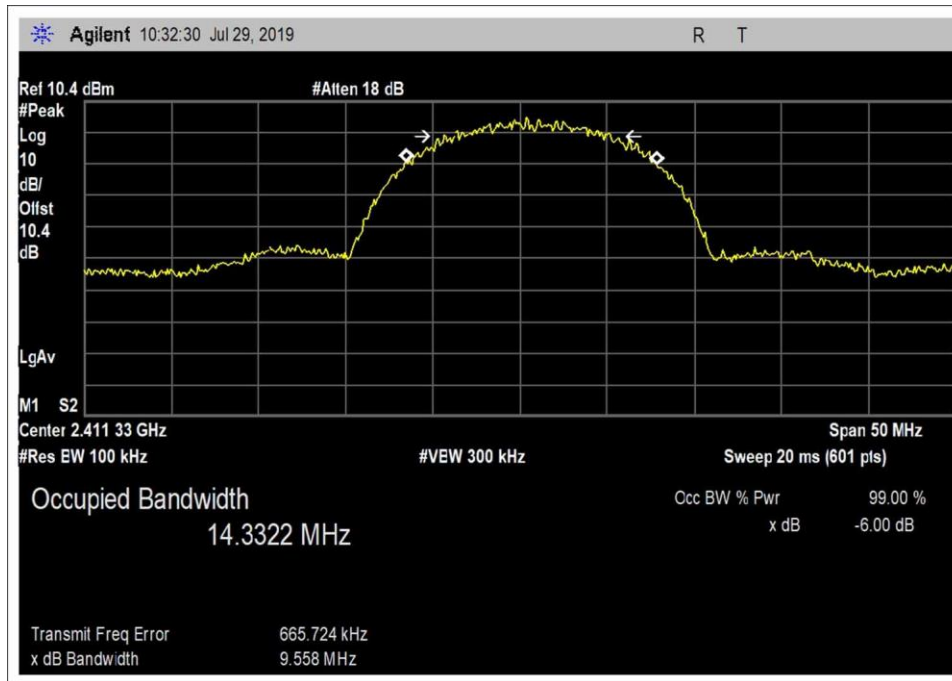
Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02672	Spectrum Analyzer	Agilent	E4446A	3/13/2019	3/13/2021
03430	Attenuator	Aeroflex/Weinschel	75A-10-12	12/19/2017	12/19/2019
P07246	Cable	H&S	32022-29094K-29094K-24TC	7/5/2018	7/5/2020

Test Data Summary					
Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
2412	1	802.11b/ CCK	9558	≥500	Pass
2442	1	802.11b/ CCK	9549	≥500	Pass
2462	1	802.11b/ CCK	9548	≥500	Pass

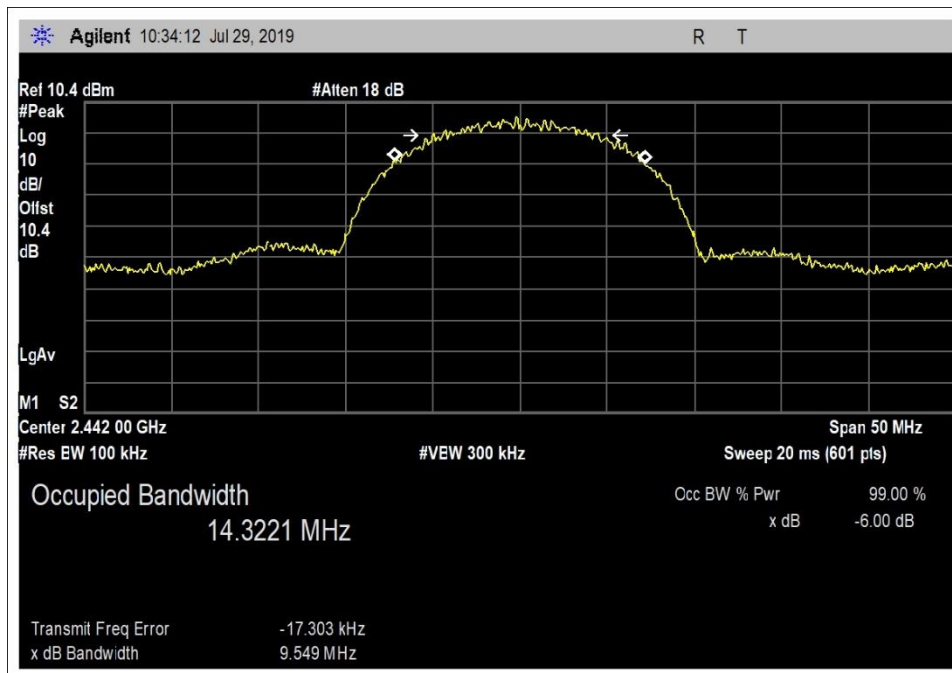
Test Data Summary					
Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
2412	1	802.11g/OFDM	16548	≥500	Pass
2442	1	802.11g/OFDM	16509	≥500	Pass
2462	1	802.11g/OFDM	16543	≥500	Pass

Test Data Summary					
Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
2412	1	802.11n20 / 64QAM	17771	≥500	Pass
2442	1	802.11n20 / 64QAM	17718	≥500	Pass
2462	1	802.11n20 / 64QAM	17706	≥500	Pass

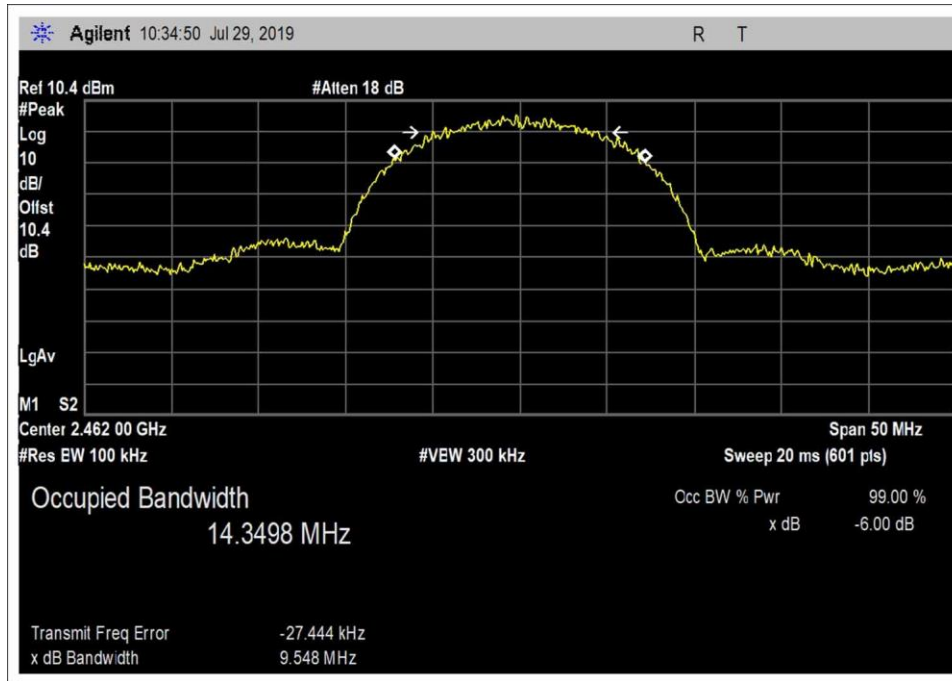
Plot(s)



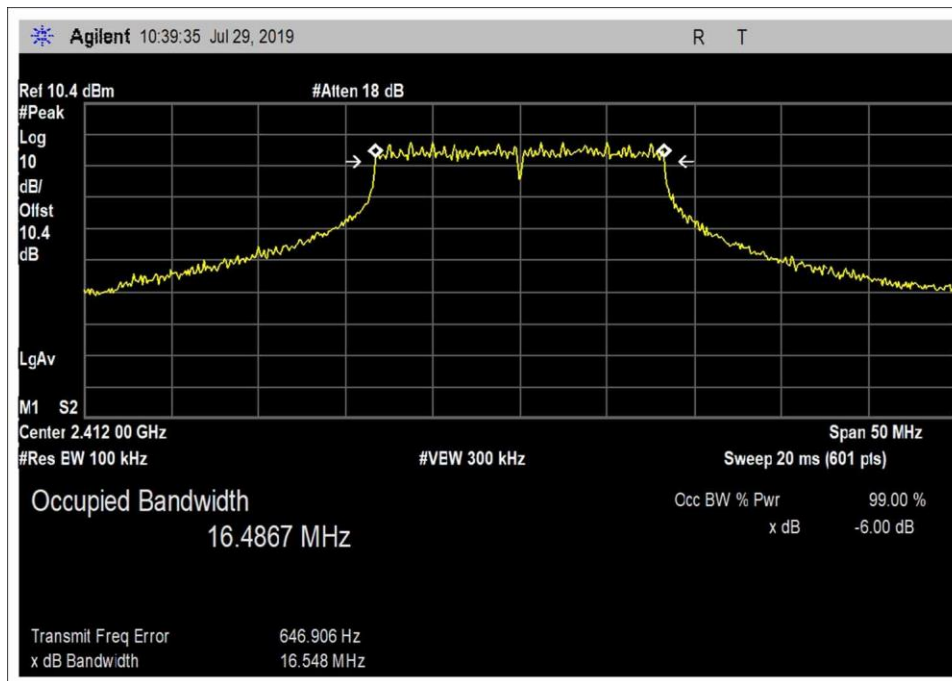
802.11b, Low Channel



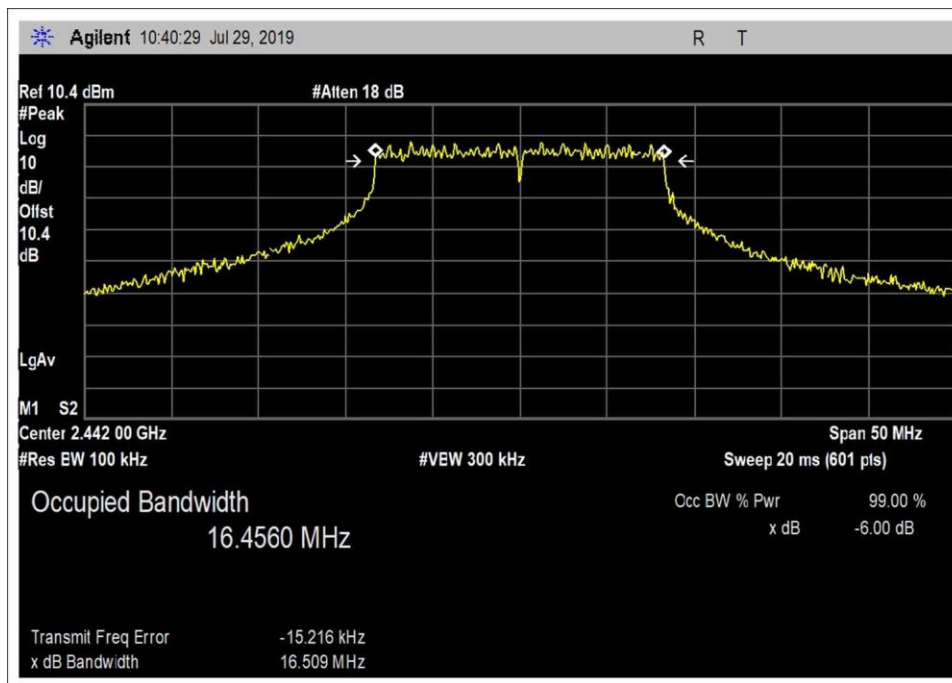
802.11b, Middle Channel



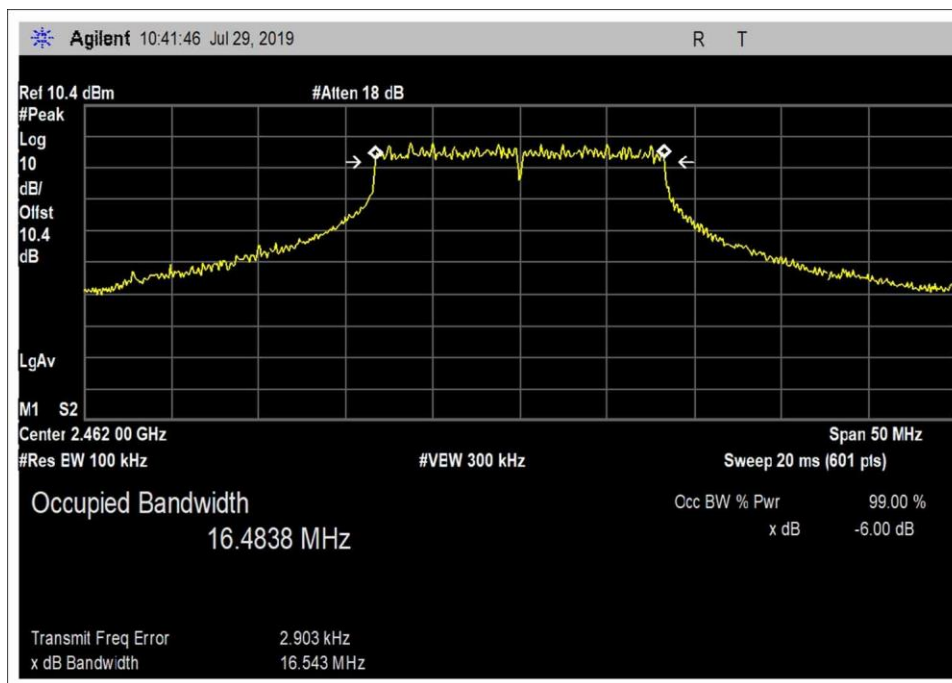
802.11b, High Channel



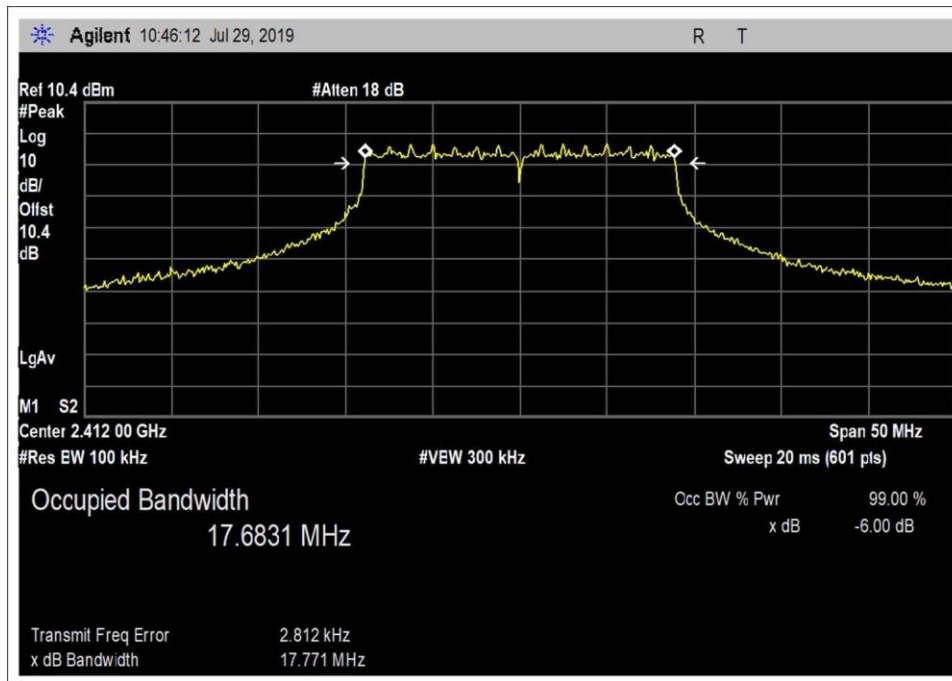
802.11g, Low Channel



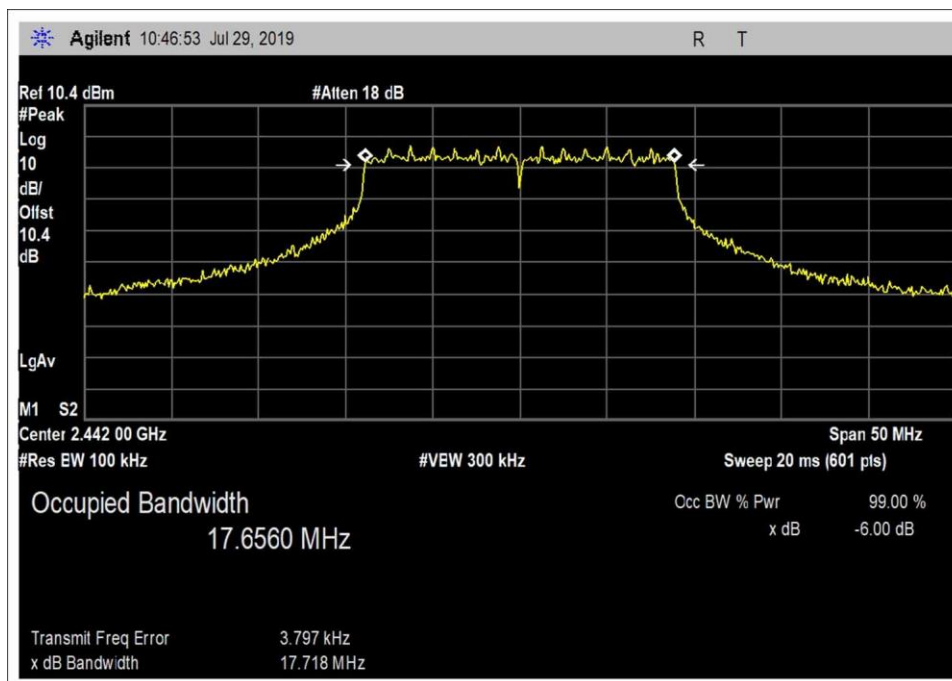
802.11g, Middle Channel



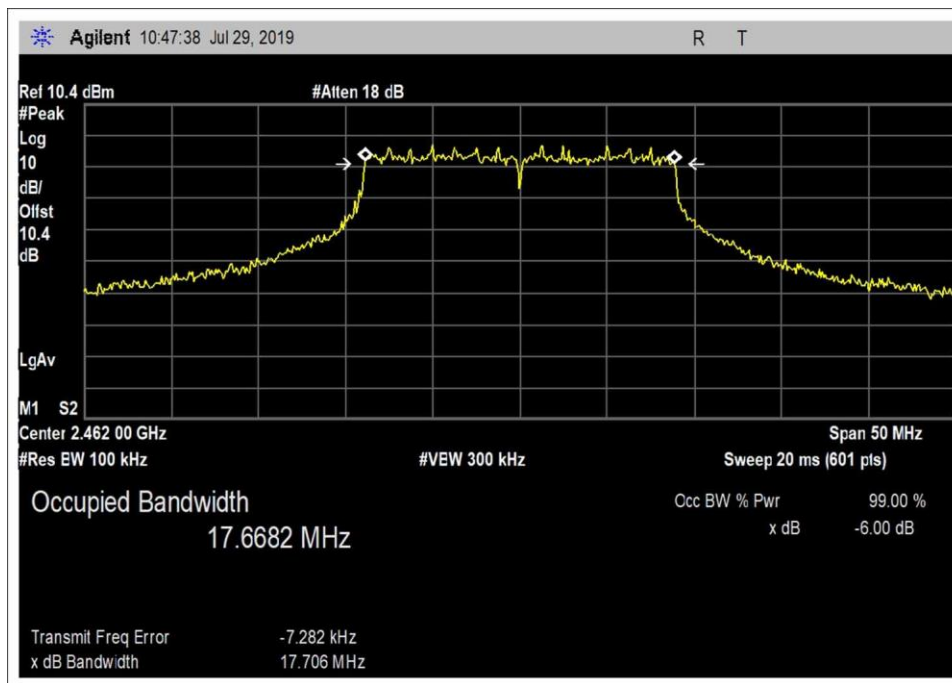
802.11g, High Channel



802.11n20, Low Channel

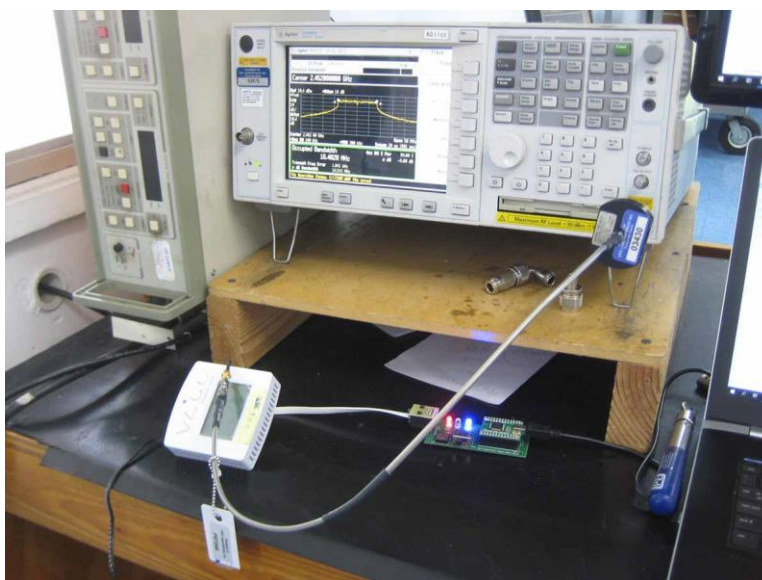


802.11n20, Middle Channel



802.11n20, High Channel

Test Setup Photo



15.247(b)(3) Output Power

Test Setup / Conditions												
Test Location:	Brea Lab A	Test Engineer:	E. Wong									
Test Method:	ANSI C63.10 (2013), KDB 558074 V05r02 (2019)	Test Date(s):	7/29/2019									
Configuration:	1											
Test Setup:	The EUT is placed on test bench, connected to a laptop. The Laptop is running TI CC31XX/CC32XX Radio Tool V 1.0.3.11 to place the EUT in test mode. Freq range: 2400-2483.5MHz Freq: 2412- 2462 MHz Protocol: 802.11 b/g/n20 Packet size 1400 byte (max) infinite packet (0), delay 2 ms (worst case setting) Firmware Power setting listed below: range 0-15, 0 is max power setting. <table><tr><td>802.11 b</td><td>2412, 2442, 2462</td><td>0,0,0</td></tr><tr><td>802.11g</td><td>2412, 2442, 2462</td><td>1,0,0</td></tr><tr><td>802.11n20</td><td>2412, 2442, 2462</td><td>0,0,0</td></tr></table> The EUT has integral antenna however, conducted measurement was made with RF antenna test port. Frequency range of measurement = Fundamental			802.11 b	2412, 2442, 2462	0,0,0	802.11g	2412, 2442, 2462	1,0,0	802.11n20	2412, 2442, 2462	0,0,0
802.11 b	2412, 2442, 2462	0,0,0										
802.11g	2412, 2442, 2462	1,0,0										
802.11n20	2412, 2442, 2462	0,0,0										

Environmental Conditions			
Temperature (°C)	26	Relative Humidity (%):	48

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02672	Spectrum Analyzer	Agilent	E4446A	3/13/2019	3/13/2021
03430	Attenuator	Aeroflex/Weinschel	75A-10-12	12/19/2017	12/19/2019
P07246	Cable	H&S	32022-29094K-29094K-24TC	7/5/2018	7/5/2020

Test Data Summary - Voltage Variations					
Frequency (MHz)	Modulation / Ant Port	V _{Minimum} (dBm)	V _{Nominal} (dBm)	V _{Maximum} (dBm)	Max Deviation from V _{Nominal} (dB)
2412	802.11b/ CCK	14.2	14.2	14.2	0
2442	802.11b/ CCK	14.4	14.4	14.4	0
2462	802.11b/ CCK	14.6	14.6	14.6	0

Test Data Summary - Voltage Variations					
Frequency (MHz)	Modulation / Ant Port	V _{Minimum} (dBm)	V _{Nominal} (dBm)	V _{Maximum} (dBm)	Max Deviation from V _{Nominal} (dB)
2412	802.11g /OFDM	10.4	10.4	10.4	0
2442	802.11g /OFDM	10.4	10.4	10.4	0
2462	802.11g /OFDM	9.8	9.8	9.8	0

Test Data Summary - Voltage Variations					
Frequency (MHz)	Modulation / Ant Port	V _{Minimum} (dBm)	V _{Nominal} (dBm)	V _{Maximum} (dBm)	Max Deviation from V _{Nominal} (dB)
2412	802.11n20 / 64QAM	9.0	9.0	9.0	0
2442	802.11n20 / 64QAM	9.2	9.2	9.2	0
2462	802.11n20 / 64QAM	9.2	9.2	9.2	0

Test performed using operational mode with the highest output power, representing worst case.

Parameter Definitions:

Measurements performed at input voltage V_{Nominal} ± 15%.

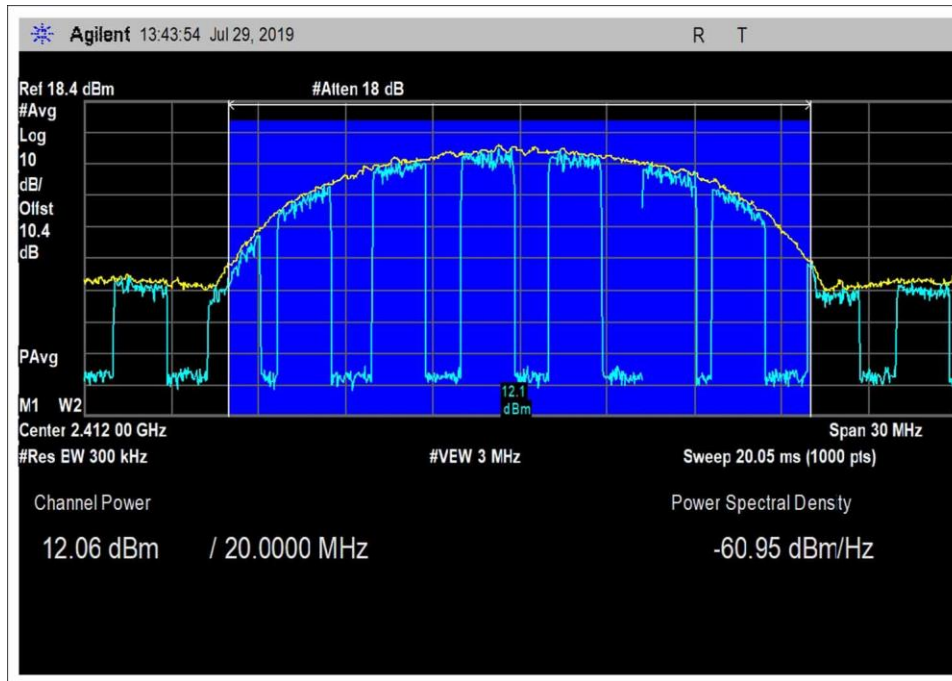
Parameter	Value
V _{Nominal} :	24
V _{Minimum} :	20.4
V _{Maximum} :	27.6

Power Output Test Data Summary - RF Conducted Measurement					
Measurement Option: AVGSA-2					
Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Measured (dBm)	Limit (dBm)	Results
2412	802.11b/ CCK	Integral/ 1.9dBi	14.2	≤ 30	Pass
2442	802.11b/ CCK	Integral/ 1.9dBi	14.4	≤ 30	Pass
2462	802.11b/ CCK	Integral/ 1.9dBi	14.6	≤ 30	Pass

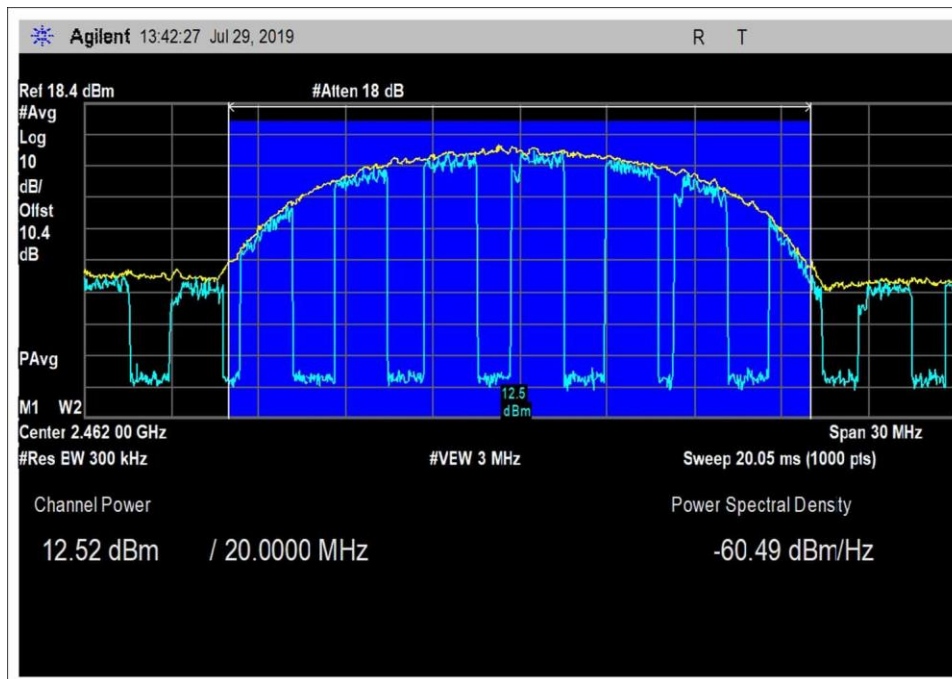
Power Output Test Data Summary - RF Conducted Measurement					
Measurement Option: AVGSA-2					
Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Measured (dBm)	Limit (dBm)	Results
2412	802.11g /OFDM	Integral/ 1.9dBi	10.4	≤ 30	Pass
2442	802.11g /OFDM	Integral/ 1.9dBi	10.4	≤ 30	Pass
2462	802.11g /OFDM	Integral/ 1.9dBi	9.8	≤ 30	Pass

Power Output Test Data Summary - RF Conducted Measurement					
Measurement Option: AVGSA-2					
Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Measured (dBm)	Limit (dBm)	Results
2412	802.11n20 / 64QAM	Integral/ 1.9dBi	9.0	≤ 30	Pass
2442	802.11n20 / 64QAM	Integral/ 1.9dBi	9.2	≤ 30	Pass
2462	802.11n20 / 64QAM	Integral/ 1.9dBi	9.2	≤ 30	Pass

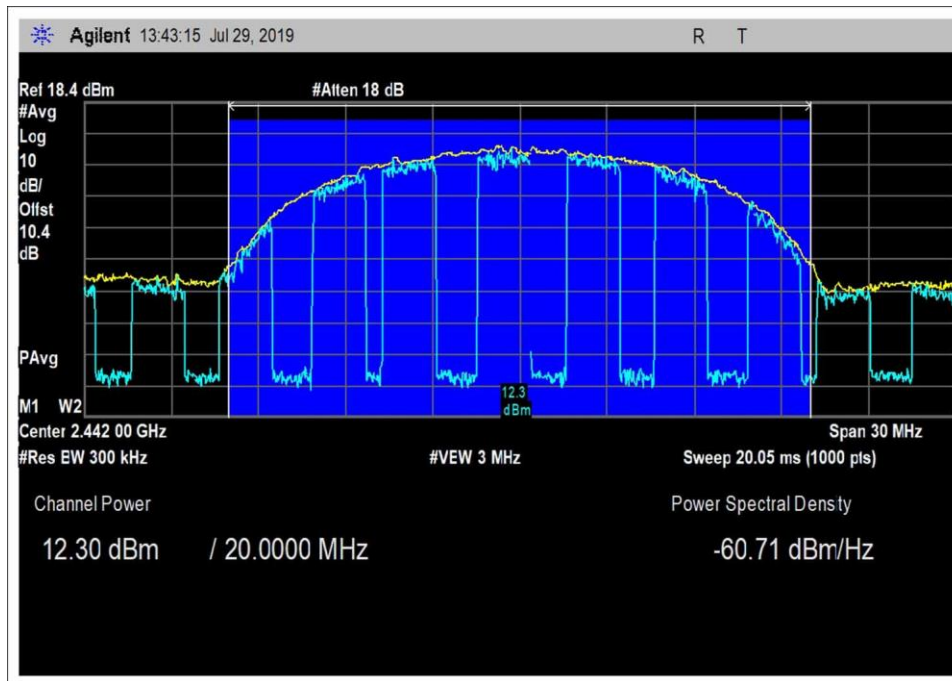
Plots



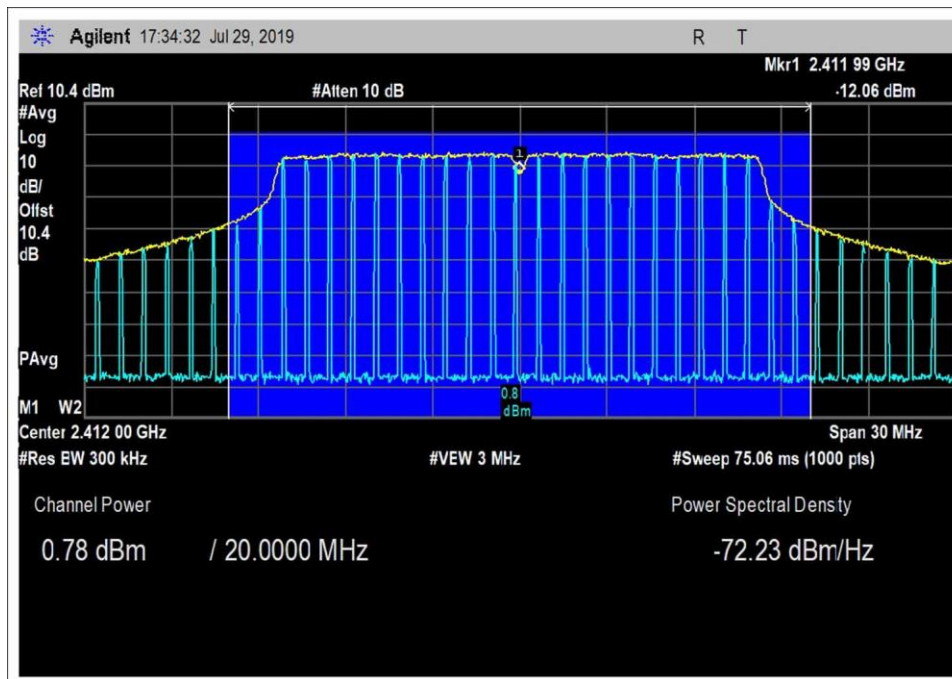
802.11b, Low Channel



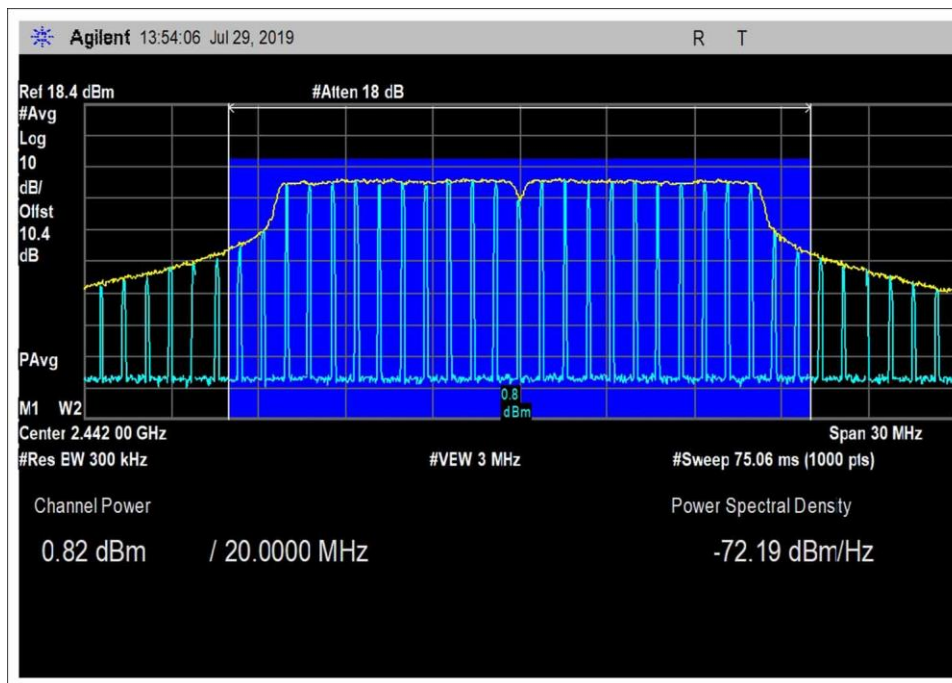
802.11b, Middle Channel



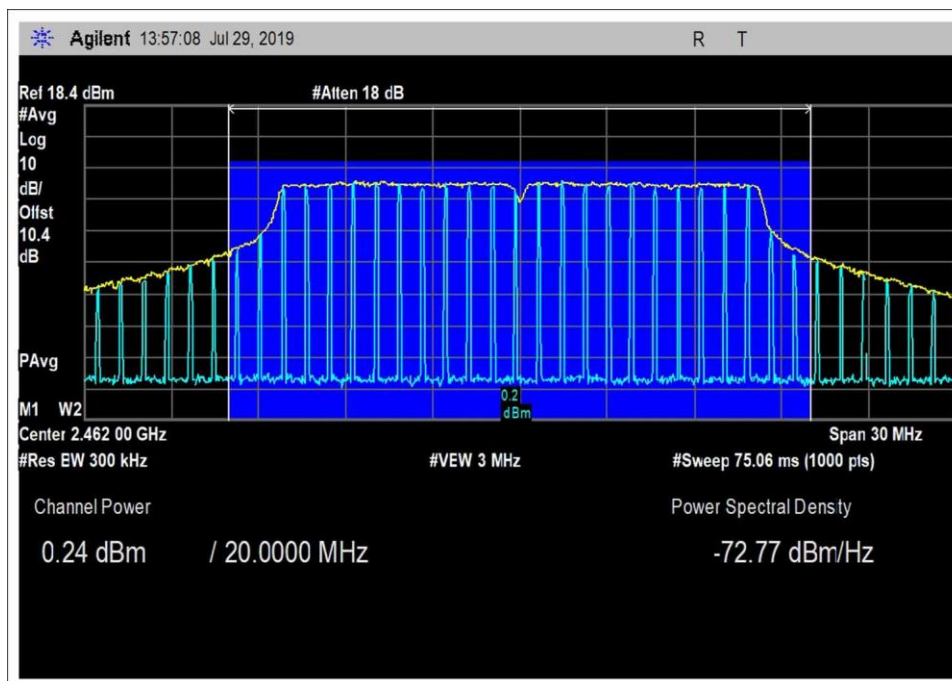
802.11b, High Channel



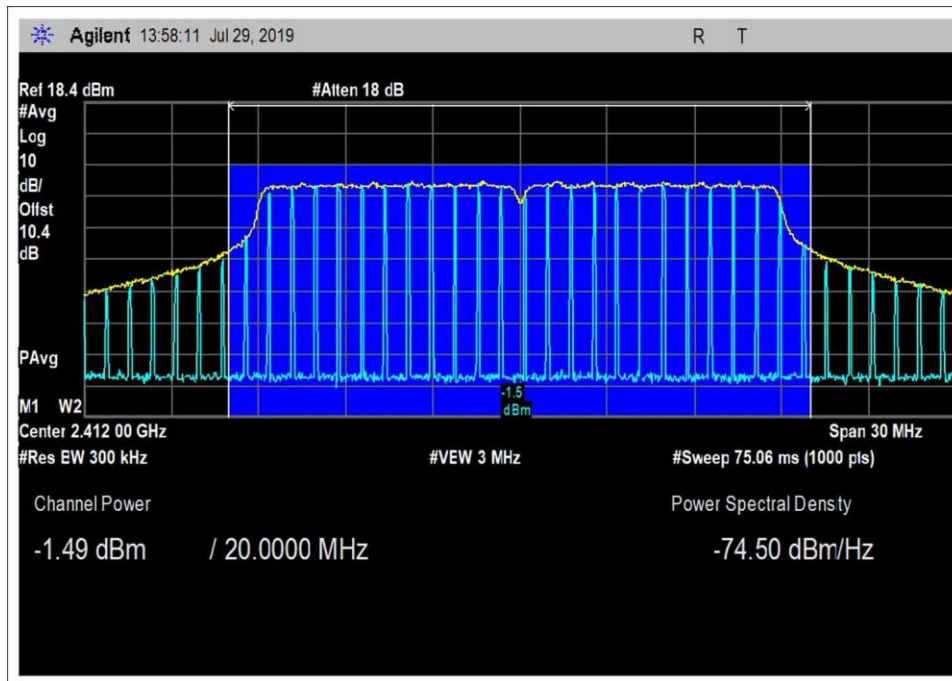
802.11g, Low Channel



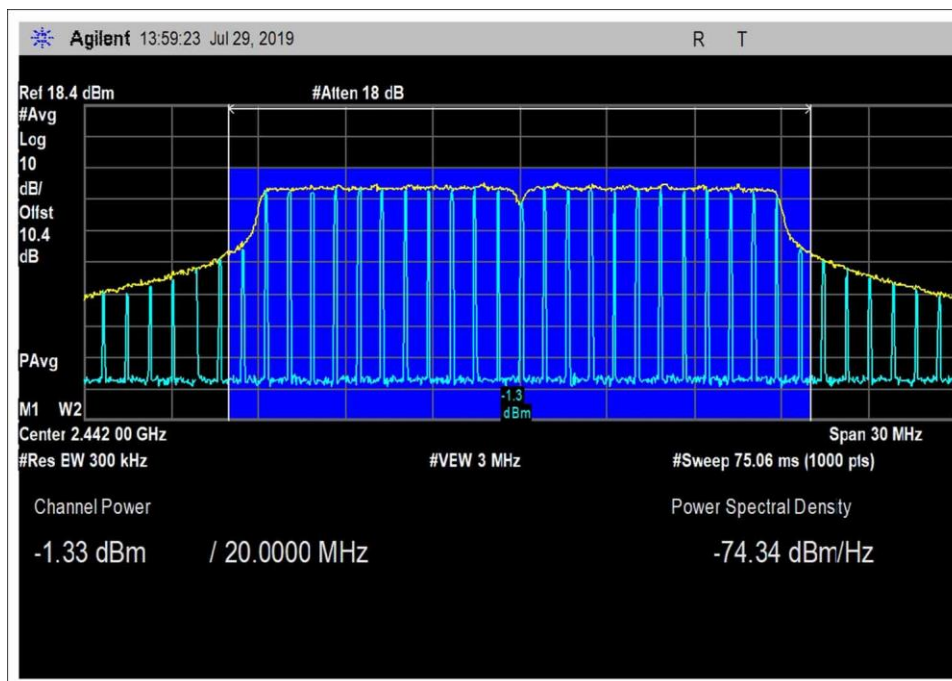
802.11g, Middle Channel



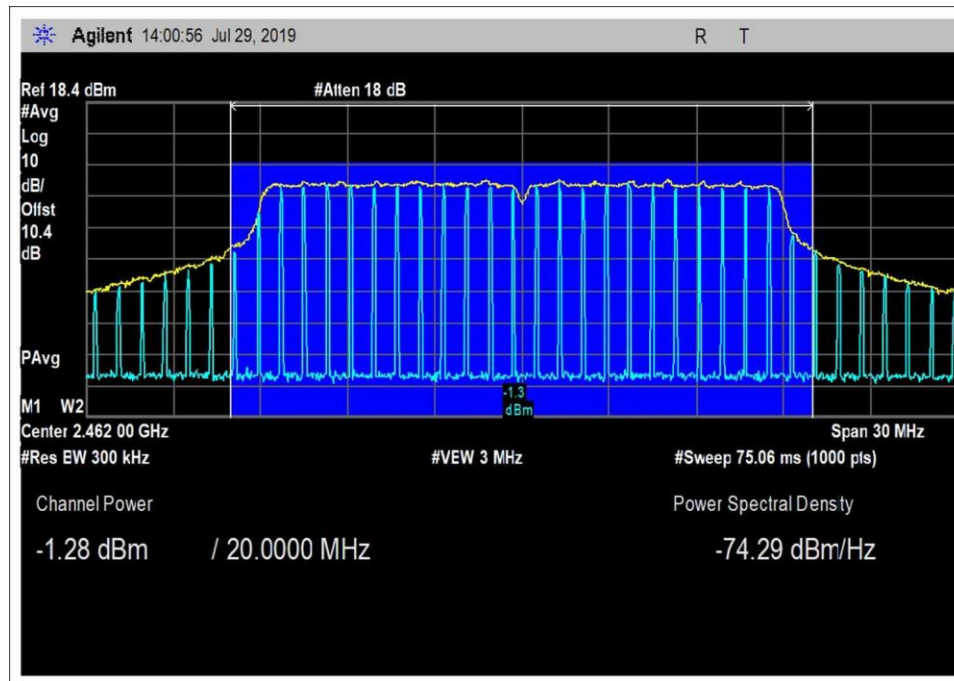
802.11g, High Channel



802.11n20, Low Channel



802.11n20, Middle Channel



802.11n20, High Channel

Duty Cycle Correction Factor Test Data

Duty Cycle				
Frequency (MHz)	Modulation	Measured dBm	Duty Cycle Correction	Corrected Power dBm
2412	802.11b/ CCK	12.1	2.1	14.2
2442	802.11b/ CCK	12.3	2.1	14.4
2462	802.11b/ CCK	12.5	2.1	14.6

802.11b (1.24 ms x 5) /10ms = 0.62,

Duty Cycle Correction factor, $10 \log 1/0.62 = 2.1\text{dB}$

Duty Cycle				
Frequency (MHz)	Modulation	Measured dBm	Duty Cycle Correction	Corrected Power dBm
2412	802.11g/ OFDM	0.8	9.6	10.4
2442	802.11g/ OFDM	0.8	9.6	10.4
2462	802.11g/ OFDM	0.2	9.6	9.8

802.11g (0.22ms) /1.97ms = 0.11

Duty Cycle Correction factor, $10 \log 1/0.11 = 9.6\text{dB}$

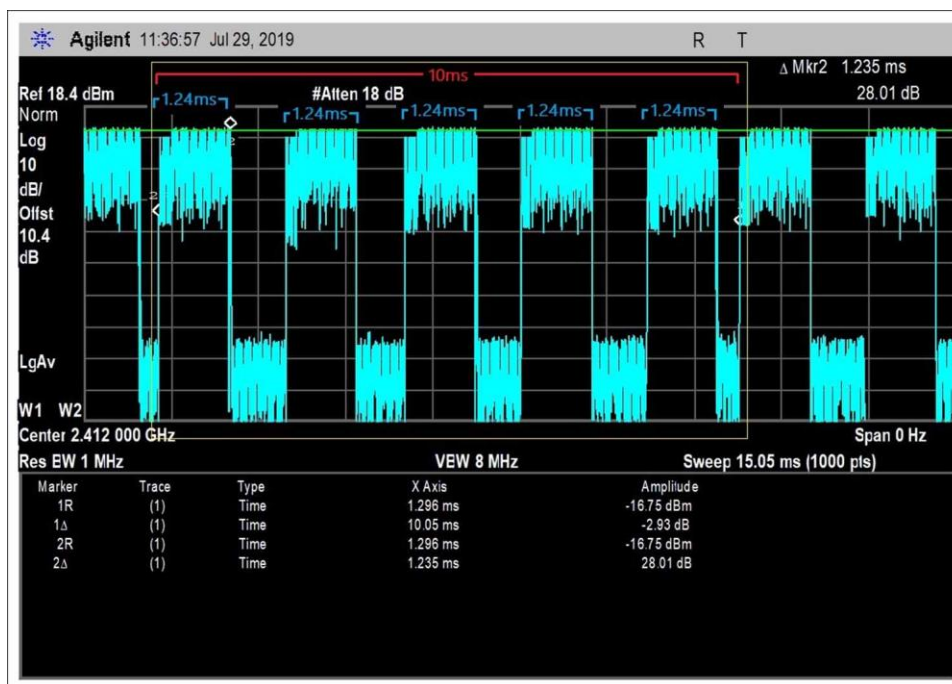
Duty Cycle				
Frequency (MHz)	Modulation	Measured dBm	Duty Cycle Correction	Corrected Power dBm
2412	802.11n20/ 64QAM	-1.5	10.5	9.0
2442	802.11n20/ 64QAM	-1.3	10.5	9.2
2462	802.11n20/ 64QAM	-1.3	10.5	9.2

802.11n20 (0.188ms)/1.999ms = 0.09.

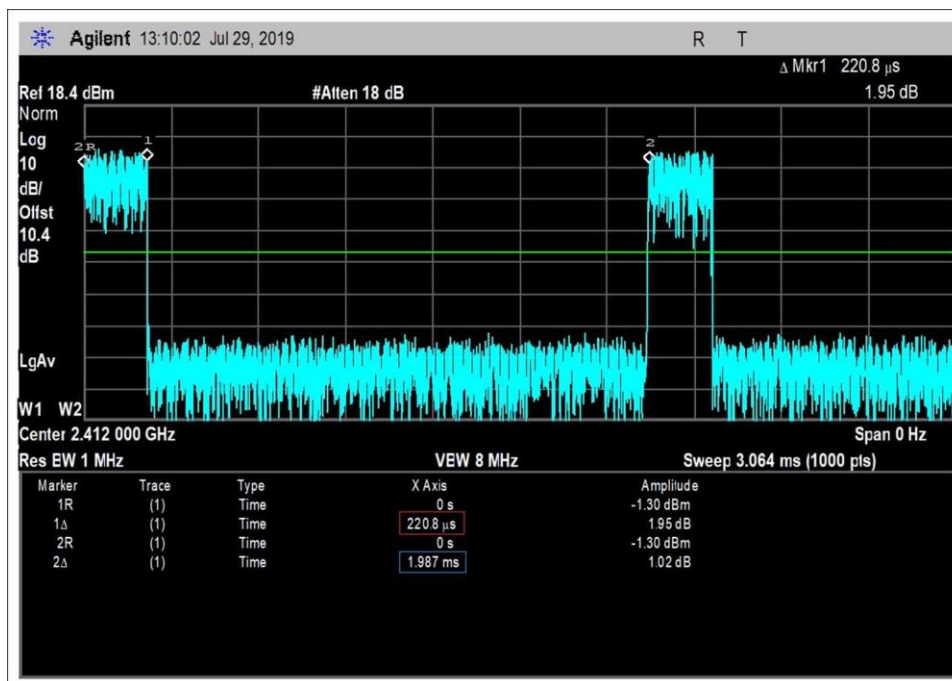
Duty Cycle Correction factor, $10 \log 1/0.09 = 10.5\text{dB}$

Note: $10 \log 1/x$, (where x is duty cycle) added to measured channel power in accordance with 9.2.2.4

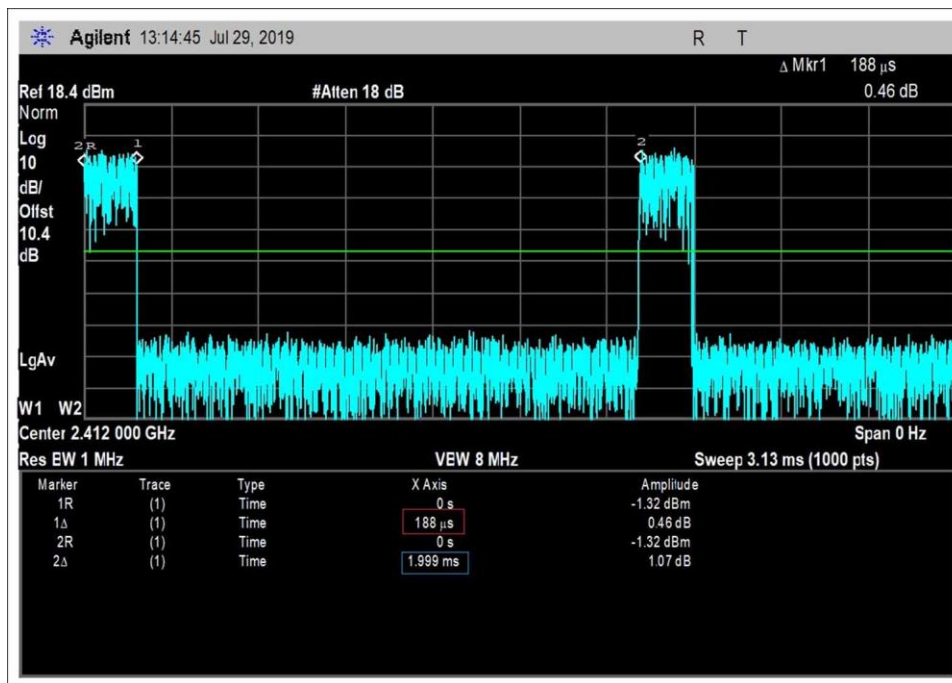
Plots



802.11b

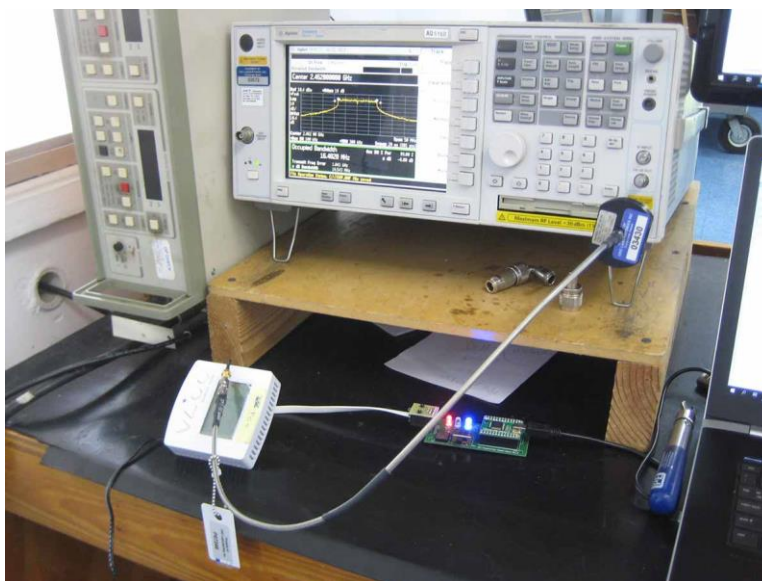


802.11g



802.11n20

Test Setup Photo



15.247(e) Power Spectral Density

Test Setup / Conditions / Data												
Test Location:	Brea Lab A	Test Engineer:	E. Wong									
Test Method:	ANSI C63.10 (2013), KDB 558074 v05r02 (2019)	Test Date(s):	7/29/2019									
Configuration:	1											
Test Setup:	The EUT is placed on test bench, connected to a laptop. The Laptop is running TI CC31XX/CC32XX Radio Tool V 1.0.3.11 to place the EUT in test mode. Freq range: 2400-2483.5MHz Freq: 2412- 2462 MHz Protocol: 802.11 b/g/n20 Packet size 1400 byte (max) infinite packet (0), delay 2 ms (worst case setting) Firmware Power setting listed below: range 0-15, 0 is max power setting. <table><tr><td>802.11b</td><td>2412, 2442, 2462</td><td>0,0,0</td></tr><tr><td>802.11g</td><td>2412, 2442, 2462</td><td>1,0,0</td></tr><tr><td>802.11n20</td><td>2412, 2442, 2462</td><td>0,0,0</td></tr></table> The EUT has integral antenna however, conducted measurement was made with RF antenna test port. Frequency range of measurement = Fundamental			802.11b	2412, 2442, 2462	0,0,0	802.11g	2412, 2442, 2462	1,0,0	802.11n20	2412, 2442, 2462	0,0,0
802.11b	2412, 2442, 2462	0,0,0										
802.11g	2412, 2442, 2462	1,0,0										
802.11n20	2412, 2442, 2462	0,0,0										

Environmental Conditions			
Temperature (°C)	26	Relative Humidity (%):	48

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02672	Spectrum Analyzer	Agilent	E4446A	3/13/2019	3/13/2021
03430	Attenuator	Aeroflex/Weinschel	75A-10-12	12/19/2017	12/19/2019
P07246	Cable	H&S	32022-29094K-29094K-24TC	7/5/2018	7/5/2020

PSD Test Data Summary - RF Conducted Measurement				
Measurement Method: AVGPSD-2				
Frequency (MHz)	Modulation	Measured (dBm/30kHz)	Limit (dBm/3kHz)	Results
2412	802.11b/ CCK	-10.4	≤8	Pass
2442	802.11b/ CCK	-9.8	≤8	Pass
2462	802.11b/ CCK	-11.0	≤8	Pass

PSD Test Data Summary - RF Conducted Measurement				
Measurement Method: AVGPSD-2				
Frequency (MHz)	Modulation	Measured (dBm/100kHz)	Limit (dBm/3kHz)	Results
2412	802.11g/ OFDM	-7.5	≤8	Pass
2442	802.11g/ OFDM	-7.4	≤8	Pass
2462	802.11g/ OFDM	-6.8	≤8	Pass

PSD Test Data Summary - RF Conducted Measurement				
Measurement Method: AVGPSD-2				
Frequency (MHz)	Modulation	Measured (dBm/100kHz)	Limit (dBm/3kHz)	Results
2412	802.11n20/ 64QAM	-7.8	≤8	Pass
2442	802.11n20/ 64QAM	-6.0	≤8	Pass
2462	802.11n20/ 64QAM	-7.9	≤8	Pass

Note: 10 Log 1/x, (where x is duty cycle) added to measured PSD in accordance with 11.10.5.

Note: Measurement made with different RBW.

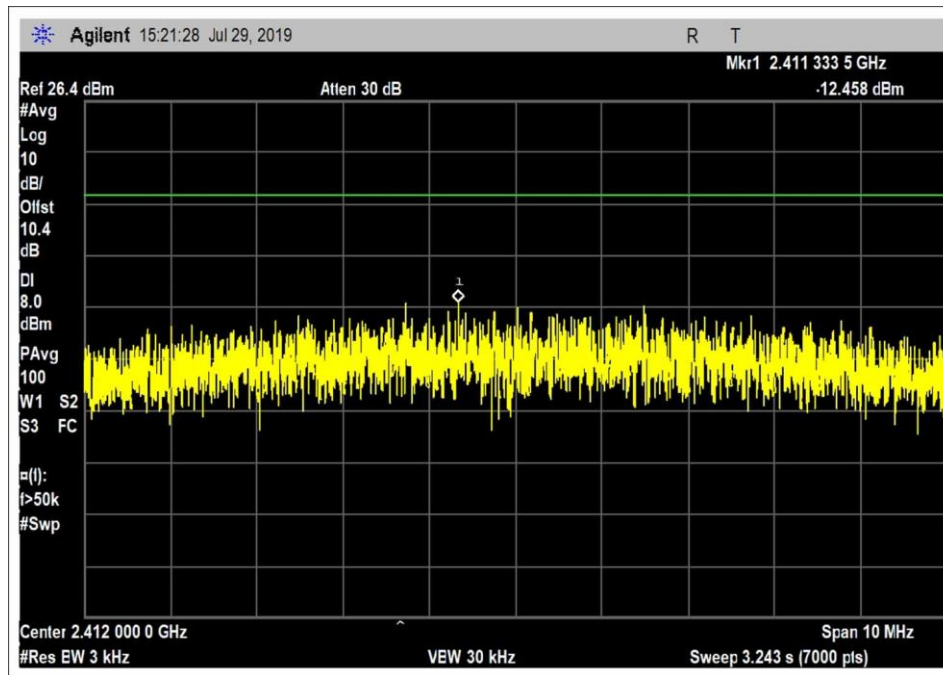
Duty Cycle Correction Factor Test Data

Duty Cycle				
Frequency (MHz)	Modulation	Measured dBm	Duty Cycle Corr.	Corrected Power dBm
2412	802.11b/ CCK	-12.5	2.1	-10.4
2442	802.11b/ CCK	-11.9	2.1	-9.8
2462	802.11b/ CCK	-13.1	2.1	-11.0

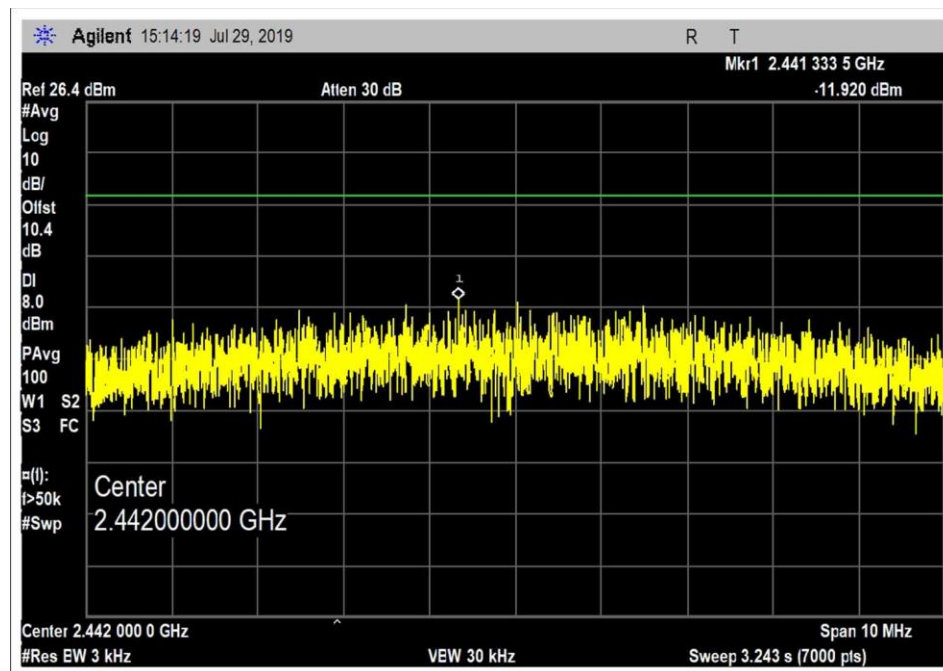
Duty Cycle				
Frequency (MHz)	Modulation	Measured dBm	Duty Cycle Corr.	Corrected Power dBm
2412	802.11g/ OFDM	-17.1	9.6	-7.5
2442	802.11g/ OFDM	-17.0	9.6	-7.4
2462	802.11g/ OFDM	-16.4	9.6	-6.8

Duty Cycle				
Frequency (MHz)	Modulation	Measured dBm	Duty Cycle Corr.	Corrected Power dBm
2412	802.11n20/ 64QAM	-18.3	10.5	-7.8
2442	802.11n20/ 64QAM	-16.5	10.5	-6.0
2462	802.11n20/ 64QAM	-18.4	10.5	-7.9

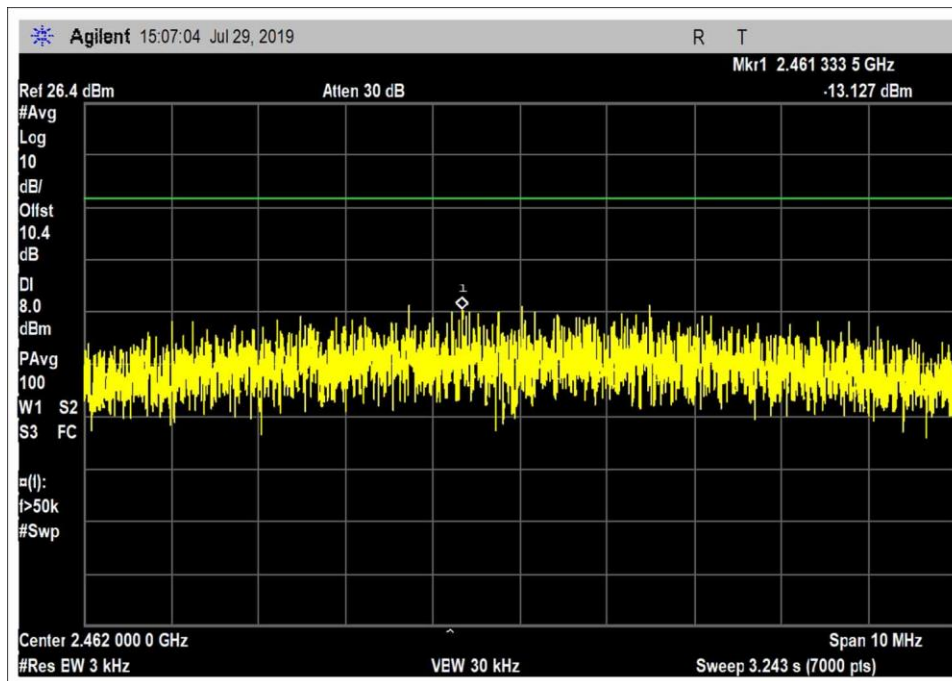
Plots



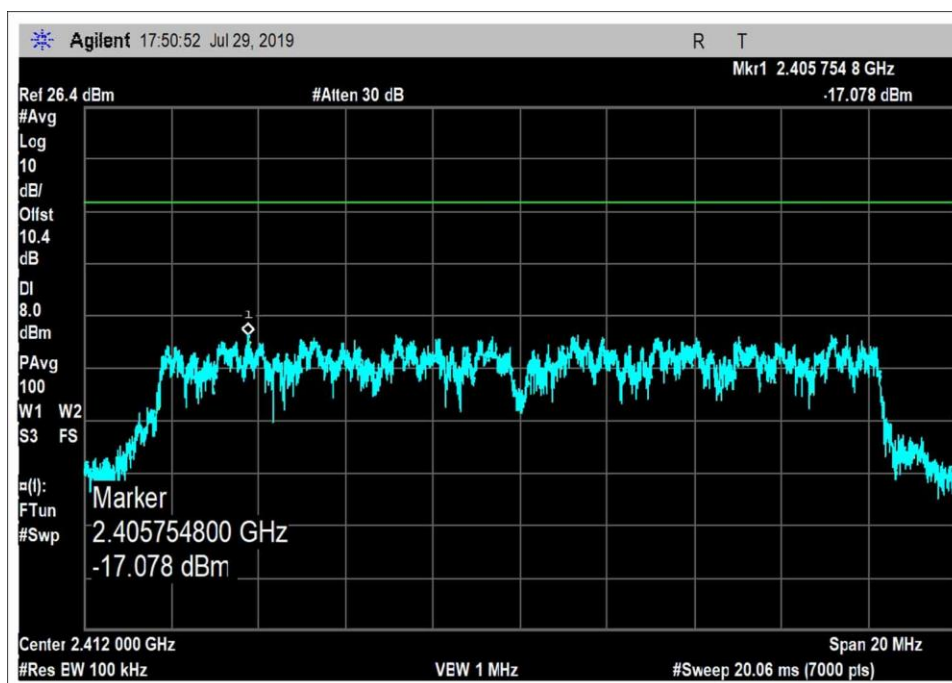
802.11b, Low Channel



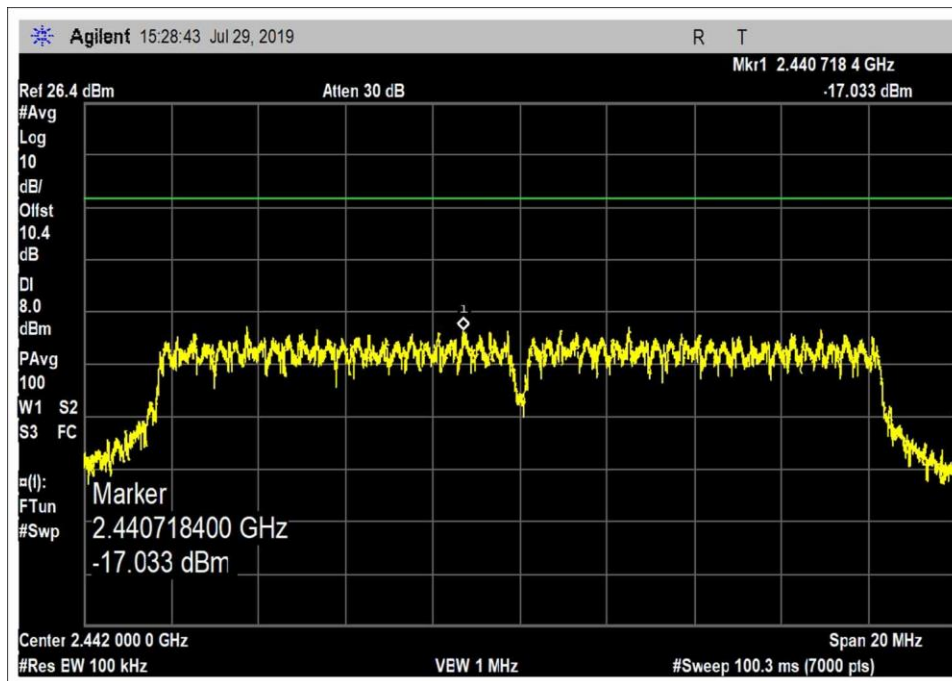
802.11b, Middle Channel



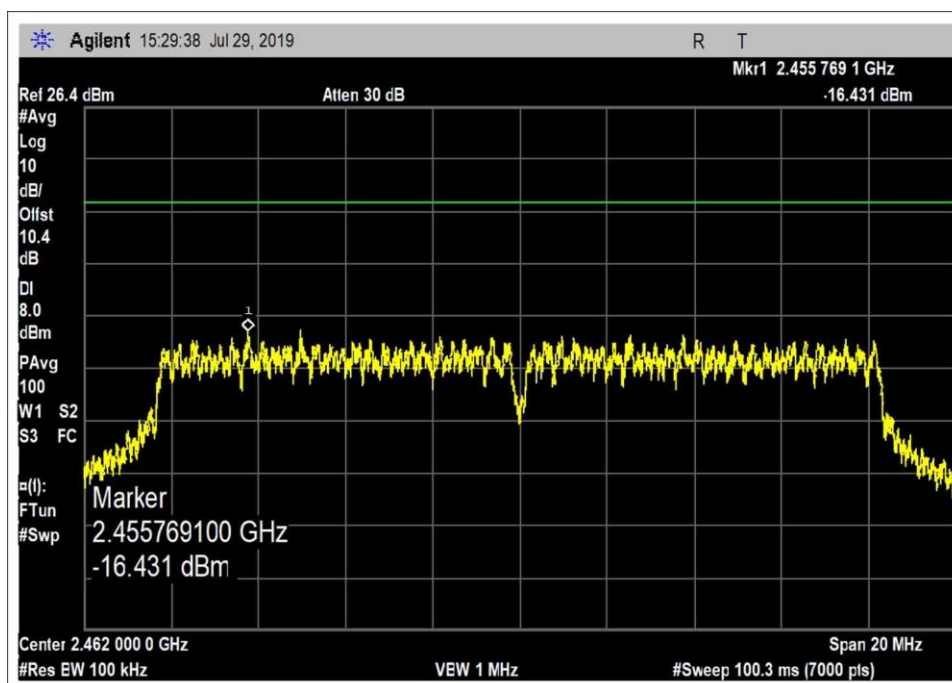
802.11b, High Channel



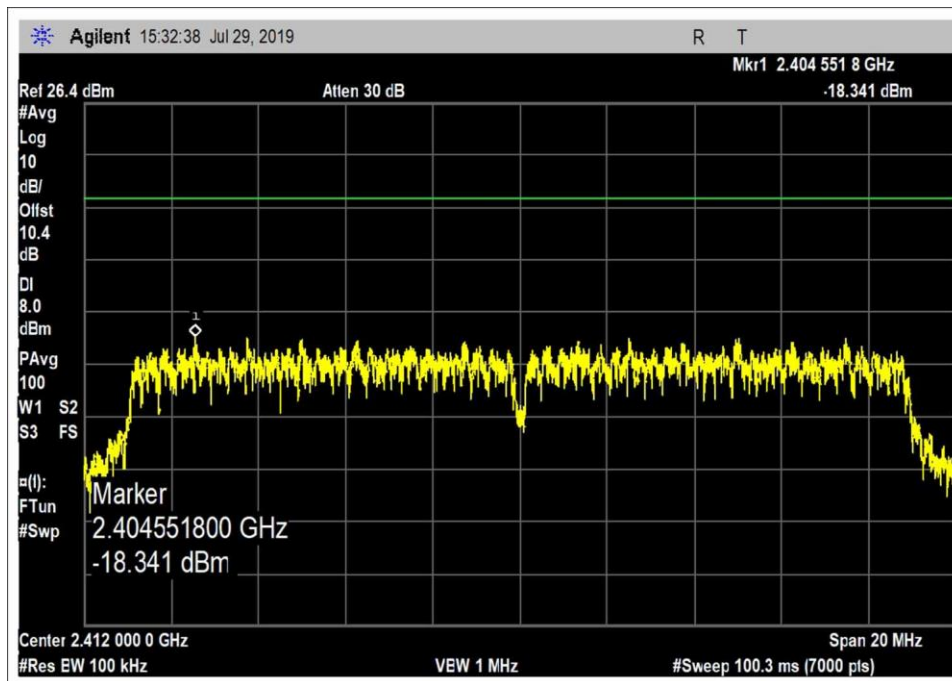
802.11g, Low Channel



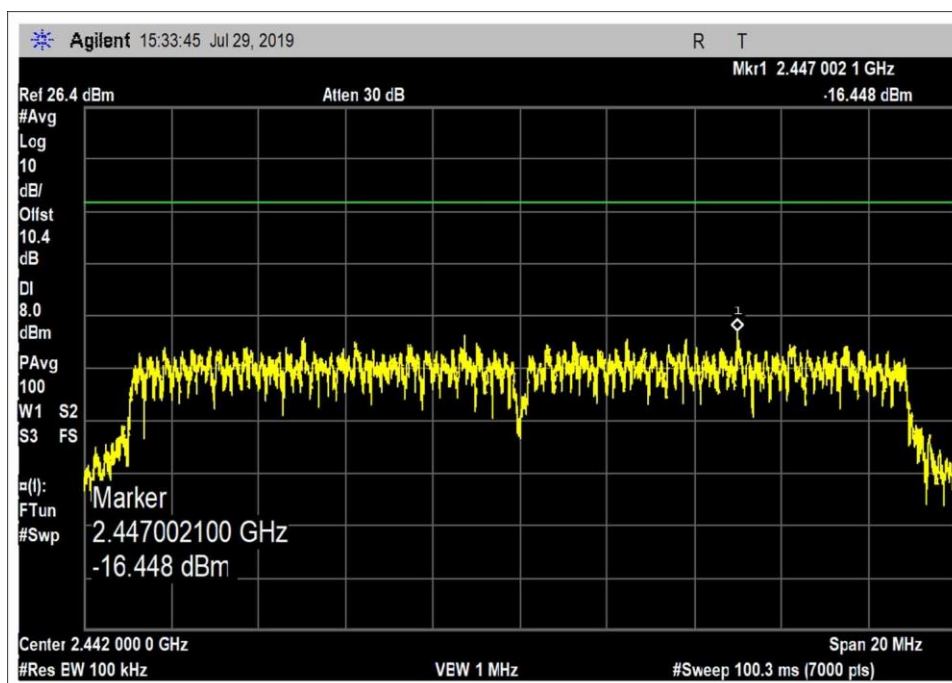
802.11g, Middle Channel



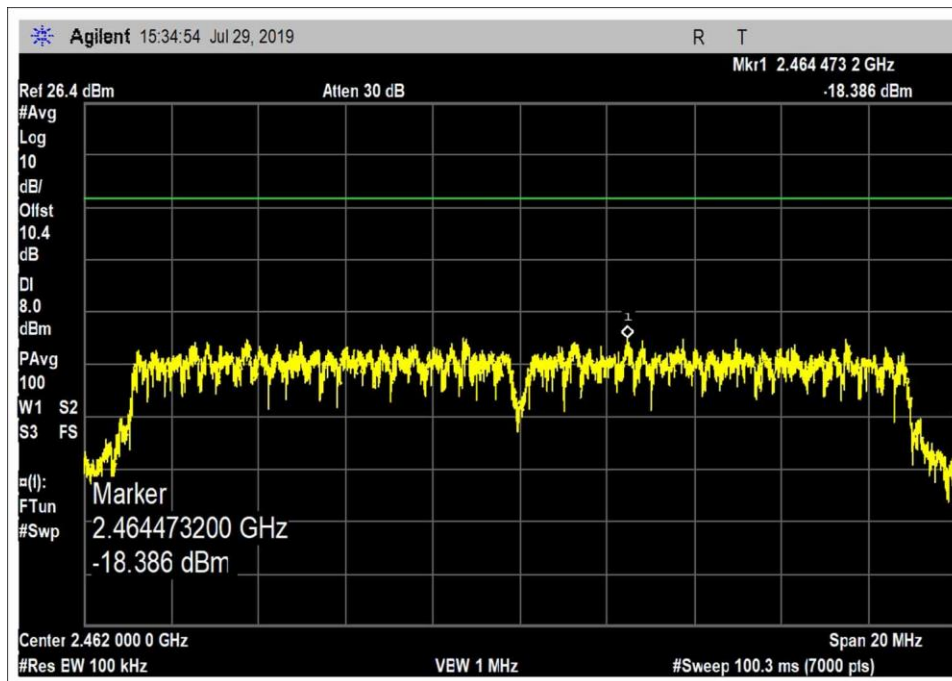
802.11g, High Channel



802.11n20, Low Channel

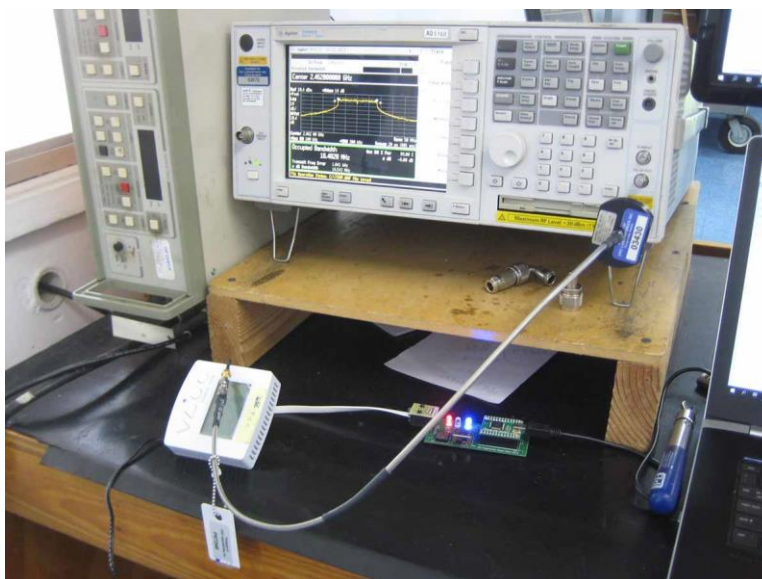


802.11n20, Middle Channel



802.11n20, High Channel

Test Setup Photo



15.247(d) RF Conducted Emissions & Band Edge

Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA • 714 993 6112
 Customer: **Venstar, Inc.**
 Specification: **15.247(d) Conducted Spurious Emissions**
 Work Order #: **102914** Date: 7/30/2019
 Test Type: **Conducted Emissions** Time: 11:20:34
 Tested By: S. Yamamoto Sequence#: 2
 Software: EMITest 5.03.12 120/60Hz

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 test bench, connected to a laptop. The Laptop is running TI CC31XX/CC32XX Radio Tool V 1.0.3.11 to place the EUT in test mode.

Freq range of test: 9kHz to 25GHz RBW=100kHz VBW=1MHz

Freq: 2412- 2462 MHz

Protocol: 802.11 b

Packet size 1400 byte (max) infinite packet (0), delay 2 ms (worst case setting)

Firmware Power setting listed below: range 0-15, 0 is max power setting.

802.11 b 2412, 2442, 2462 0,0,0

The EUT has integral antenna however, conducted measurement was made with RF antenna test port.

Test environment conditions:

Temperature: 23°C

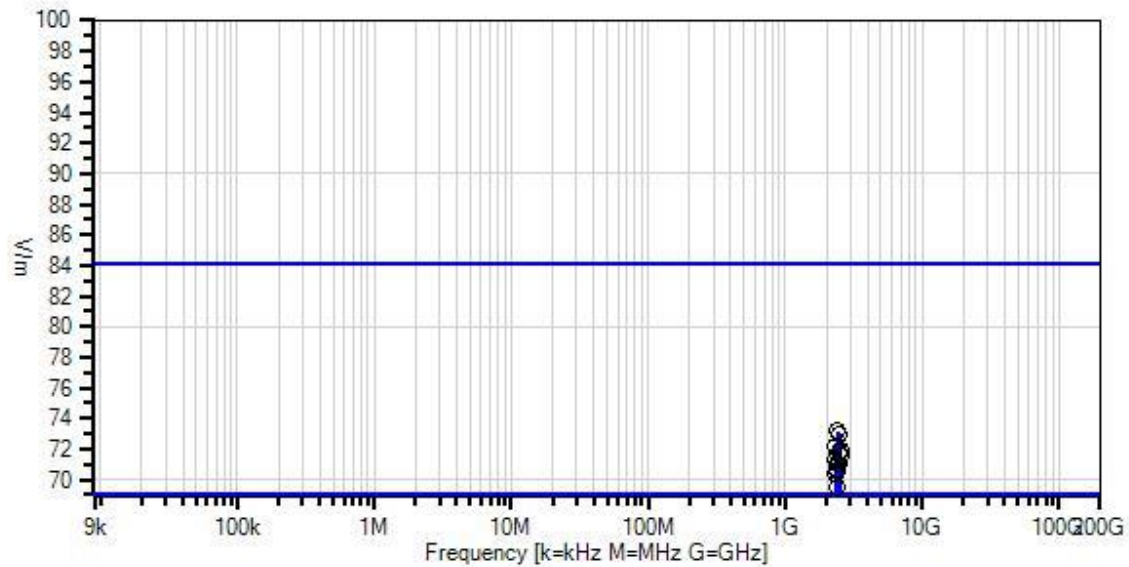
Relative Humidity: 48%

Atmospheric Pressure: 99kPa

All data rates / modulation types were evaluated during preliminary investigation. The test data represents worst case emissions for the investigated operational modes.

558074 D01 15.247 Meas Guidance v05r02 April 2, 2019

Venstar, Inc. WO#: 102914 Sequence#: 2 Date: 7/30/2019
15.247(d) Conducted Spurious Emissions Test Lead: 120/60Hz Antenna port



— Sweep Data
○ Peak Readings
* Average Readings
— Readings
× QP Readings
▼ Ambient
— 1 - 15.247(d) Conducted Spurious Emissions
Software Version: 5.03.12

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	3/13/2019	3/13/2021
T1	AN03430	Attenuator	75A-10-12	12/19/2017	12/19/2019
T2	ANP07246	Cable	32022-29094K- 29094K-24TC	7/5/2018	7/5/2020

Measurement Data:

Reading listed by margin.

Test Lead: Antenna port

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB		Dist Table	Corr V/m	Spec V/m	Margin dB	Polar Ant
1	2398.530M	62.8	+10.1	+0.3		+0.0	73.2	84.1	-10.9	Anten
2	2504.770M	62.5	+10.2	+0.3		+0.0	73.0	84.1	-11.1	Anten
3	2349.380M	61.8	+10.1	+0.3		+0.0	72.2	84.1	-11.9	Anten
4	2550.290M	61.4	+10.2	+0.3		+0.0	71.9	84.1	-12.2	Anten
5	2503.730M	61.3	+10.2	+0.3		+0.0	71.8	84.1	-12.3	Anten
6	2531.650M	61.1	+10.2	+0.3		+0.0	71.6	84.1	-12.5	Anten
7	2327.870M	60.9	+10.1	+0.3		+0.0	71.3	84.1	-12.8	Anten
8	2370.930M	60.7	+10.1	+0.3		+0.0	71.1	84.1	-13.0	Anten
9	2483.500M	60.6	+10.2	+0.3		+0.0	71.1	84.1	-13.0	Anten
10	2400.000M	60.3	+10.1	+0.3		+0.0	70.7	84.1	-13.4	Anten
11	2358.960M	60.1	+10.1	+0.3		+0.0	70.5	84.1	-13.6	Anten
12	2330.800M	60.0	+10.1	+0.3		+0.0	70.4	84.1	-13.7	Anten
13	2400.000M	59.1	+10.1	+0.3		+0.0	69.5	84.1	-14.6	Anten
14	2499.610M	58.2	+10.2	+0.3		+0.0	68.7	84.1	-15.4	Anten
15	2491.460M	57.9	+10.2	+0.3		+0.0	68.4	84.1	-15.7	Anten
16	2483.500M	56.2	+10.2	+0.3		+0.0	66.7	84.1	-17.4	Anten
17	2313.710M	55.8	+10.1	+0.3		+0.0	66.2	84.1	-17.9	Anten
18	2260.270M	55.2	+10.0	+0.3		+0.0	65.5	84.1	-18.6	Anten
19	4104.330M	45.3	+10.1	+0.5		+0.0	55.9	84.1	-28.2	Anten

20	4070.250M	44.5	+10.1	+0.5	+0.0	55.1	84.1	-29.0	Anten
21	4019.580M	42.8	+10.2	+0.5	+0.0	53.5	84.1	-30.6	Anten
22	4924.010M	41.3	+10.1	+0.4	+0.0	51.8	84.1	-32.3	Anten
23	4884.012M	40.6	+10.1	+0.4	+0.0	51.1	84.1	-33.0	Anten
24	4824.007M	38.7	+10.1	+0.4	+0.0	49.2	84.1	-34.9	Anten
25	3215.993M	35.4	+10.2	+0.6	+0.0	46.2	84.1	-37.9	Anten

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA • 714 993 6112
 Customer: **Venstar, Inc.**
 Specification: **15.247(d) Conducted Spurious Emissions**
 Work Order #: **102914** Date: 7/30/2019
 Test Type: **Conducted Emissions** Time: 13:40:47
 Tested By: S. Yamamoto Sequence#: 3
 Software: EMITest 5.03.12 120/60Hz

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 test bench, connected to a laptop. The Laptop is running TI CC31XX/CC32XX Radio Tool V 1.0.3.11 to place the EUT in test mode.

Freq range of test: 9kHz to 25GHz RBW=100kHz VBW=1MHz

Freq range of EUT: 2412MHz to 2462 MHz

Protocol: 802.11 g

Packet size 1400 byte (max) infinite packet (0), delay 2 ms (worst case setting)

Firmware Power setting listed below: range 0-15, 0 is max power setting.

802.11g 2412, 2442, 2462 1,0,0

The EUT has integral antenna however, conducted measurement was made with RF antenna test port.

Frequency range of measurement = Fundamental

Test environment conditions:

Temperature: 25°C

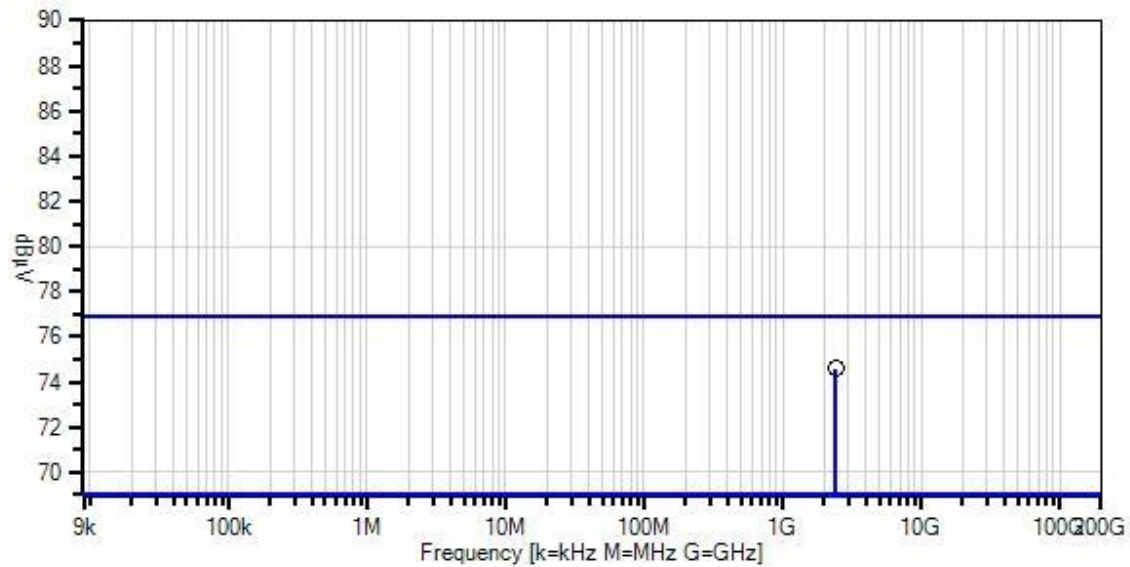
Relative Humidity: 58%

Atmospheric Pressure: 98.9kPa

All data rates / modulation types were evaluated during preliminary investigation. The test data represents worst case emissions for the investigated operational modes.

558074 D01 15.247 Meas Guidance v05r02 April 2, 2019

Venstar, Inc. W/O#: 102914 Sequence#: 3 Date: 7/30/2019
 15.247(d) Conducted Spurious Emissions Test Lead: 120/60Hz Antenna port



— Sweep Data
 ○ Peak Readings
 * Average Readings
 Software Version: 5.03.12

— Readings
 × QP Readings
 ▼ Ambient
 1 - 15.247(d) Conducted Spurious Emissions

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	3/13/2019	3/13/2021
T1	AN03430	Attenuator	75A-10-12	12/19/2017	12/19/2019
T2	ANP07246	Cable	32022-29094K- 29094K-24TC	7/5/2018	7/5/2020

Measurement Data:

Reading listed by margin.

Test Lead: Antenna port

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB		Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	2400.000M	64.2	+10.1	+0.3		+0.0	74.6	76.9	-2.3	Anten
2	2498.840M	56.8	+10.2	+0.3		+0.0	67.3	76.9	-9.6	Anten
3	2538.830M	56.7	+10.2	+0.3		+0.0	67.2	76.9	-9.7	Anten
4	2518.000M	56.6	+10.2	+0.3		+0.0	67.1	76.9	-9.8	Anten
5	2513.400M	55.9	+10.2	+0.3		+0.0	66.4	76.9	-10.5	Anten
6	2381.330M	55.6	+10.1	+0.3		+0.0	66.0	76.9	-10.9	Anten
7	2349.460M	54.8	+10.1	+0.3		+0.0	65.2	76.9	-11.7	Anten
8	2330.410M	54.2	+10.1	+0.3		+0.0	64.6	76.9	-12.3	Anten
9	2483.500M	54.1	+10.2	+0.3		+0.0	64.6	76.9	-12.3	Anten
10	2389.830M	52.3	+10.1	+0.3		+0.0	62.7	76.9	-14.2	Anten
11	2259.830M	49.2	+10.0	+0.3		+0.0	59.5	76.9	-17.4	Anten
12	2302.580M	49.1	+10.0	+0.3		+0.0	59.4	76.9	-17.5	Anten
13	2292.460M	48.8	+10.0	+0.3		+0.0	59.1	76.9	-17.8	Anten

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA • 714 993 6112
 Customer: **Venstar, Inc.**
 Specification: **15.247(d) Conducted Spurious Emissions**
 Work Order #: **102914** Date: 7/30/2019
 Test Type: **Conducted Emissions** Time: 14:17:42
 Tested By: S. Yamamoto Sequence#: 4
 Software: EMITest 5.03.12 120/60Hz

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 test bench, connected to a laptop. The Laptop is running TI CC31XX/CC32XX Radio Tool V 1.0.3.11 to place the EUT in test mode.

Freq range of test: 9kHz to 25GHz

Freq range of EUT: 2412MHz to 2462 MHz

Protocol: 802.11 n20

Packet size 1400 byte (max) infinite packet (0), delay 2 ms (worst case setting)

Firmware Power setting listed below: range 0-15, 0 is max power setting.

802.11n20 2412, 2442, 2462 0,0,0

The EUT has integral antenna however, conducted measurement was made with RF antenna test port.

Test environment conditions:

Temperature: 23°C

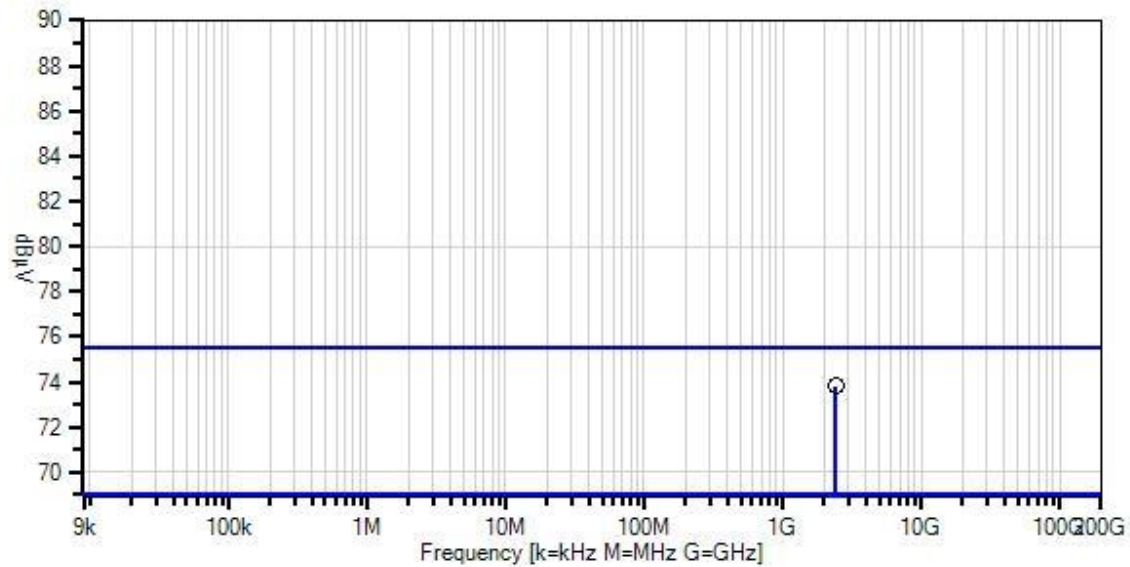
Relative Humidity: 49%

Atmospheric Pressure: 99kPa

All data rates / modulation types were evaluated during preliminary investigation. The test data represents worst case emissions for the investigated operational modes.

558074 D01 15.247 Meas Guidance v05r02 April 2, 2019

Venstar, Inc. W/O#: 102914 Sequence#: 4 Date: 7/30/2019
 15.247(d) Conducted Spurious Emissions Test Lead: 120/60Hz Antenna port



— Sweep Data
 ○ Peak Readings
 * Average Readings
 Software Version: 5.03.12

— Readings
 × QP Readings
 ▼ Ambient
 1 - 15.247(d) Conducted Spurious Emissions

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	3/13/2019	3/13/2021
T1	AN03430	Attenuator	75A-10-12	12/19/2017	12/19/2019
T2	ANP07246	Cable	32022-29094K- 29094K-24TC	7/5/2018	7/5/2020

Measurement Data:

Reading listed by margin.

Test Lead: Antenna port

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB		Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	2400.000M	63.4	+10.1	+0.3		+0.0	73.8	75.5	-1.7	Anten
2	2542.500M	57.2	+10.2	+0.3		+0.0	67.7	75.5	-7.8	Anten
3	2496.500M	57.2	+10.2	+0.3		+0.0	67.7	75.5	-7.8	Anten
4	2507.670M	57.1	+10.2	+0.3		+0.0	67.6	75.5	-7.9	Anten
5	2483.500M	56.4	+10.2	+0.3		+0.0	66.9	75.5	-8.6	Anten
6	2378.270M	55.2	+10.1	+0.3		+0.0	65.6	75.5	-9.9	Anten
7	2483.500M	54.9	+10.2	+0.3		+0.0	65.4	75.5	-10.1	Anten
8	2327.790M	53.3	+10.1	+0.3		+0.0	63.7	75.5	-11.8	Anten
9	2309.000M	51.8	+10.0	+0.3		+0.0	62.1	75.5	-13.4	Anten
10	2304.390M	49.5	+10.0	+0.3		+0.0	59.8	75.5	-15.7	Anten
11	2253.330M	48.8	+10.0	+0.3		+0.0	59.1	75.5	-16.4	Anten

Band Edge

Band Edge Summary

Limit applied: Max Power/100kHz - 30dB (When average power limit is applied).

Frequency (MHz)	Modulation	Measured (dBm)	Limit (dBm)	Results
2400.0	802.11b/ CCK	-45.3	< - 32.3	Pass
2483.5	802.11b/ CCK	-50.3	< - 32.3	Pass

Band Edge Summary

Limit applied: Max Power/100kHz - 30dB (When average power limit is applied).

Frequency (MHz)	Modulation	Measured (dBm)	Limit (dBm)	Results
2400.0	802.11g/ OFDM (CH power, PSet1)	-61.45**	< -60.68 *, **	Pass
2483.5	802.11g/ OFDM	-53.5	< - 40.1	Pass

*Measured Max power/100kHz = -30.68dBm/100kHz hence limit = -30.68 dBm-30 = -60.68dBm/kHz

**Measured power /100kHz for in-band and band edge is not duty cycle corrected as they are relative measurement.

Band Edge Summary

Limit applied: Max Power/100kHz - 30dB (When average power limit is applied).

Frequency (MHz)	Modulation	Measured (dBm)	Limit (dBm)	Results
2400.0	802.11n20/ 64QAM (CH power)	-62.79 **	< -60.59 *, **	Pass
2483.5	802.11n20/ 64QAM	-53.1	< -41.4	Pass

*Measured Max power/100kHz = -30.59dBm/100kHz hence limit = -30.59 dBm-30 = -60.59dBm/kHz

**Measured power /100kHz for in-band and band edge is not duty cycle corrected as they are relative measurement.

Band Edge Plots

