Venstar, Inc.

TEST REPORT FOR

Thermostat with WiFi, Subgig, and BLE
Model: Explorer 2

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

15.207 & 15.247
(DTS 2400-2483.5 MHz)

Report No.: 104728-10

Date of issue: January 15, 2021

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 # 803.01

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ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

Venstar, Inc.
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Chatsworth, CA 91311

Representative: Alex Garashin

REPORT PREPARED BY:

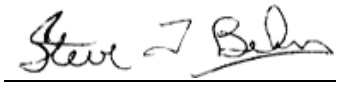
Kim Romero
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Project Number: 104728

DATE OF EQUIPMENT RECEIPT: November 17, 2020
DATE(S) OF TESTING: November 17, 20, and 24, 2020

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	5.03.19

Site Registration & Accreditation Information

Location	*NIST CB #	FCC	Canada	Japan
Canyon Park, Bothell, WA	US0103	US1024	3082C	A-0136
Brea, CA	US0103	US1024	3082D	A-0136
Fremont, CA	US0103	US1024	3082B	A-0136
Mariposa, CA	US0103	US1024	3082A	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
Thermostat with WiFi, Subgig, and BLE	Venstar, Inc.	Explorer 2	NA

Support Equipment:

Device	Manufacturer	Model #	S/N
Interface board	Texas Instruments	CC1352R1	NA
Wi-Fi Programming Adapter Board	Unbranded	NA	NA
24Vac Adapter	Unbranded	MKA-412400200	NA
Laptop	Lenovo	T500	NA
Laptop ACDC Adapter	Lenovo	92P1156	NA

Configuration 2

Equipment Tested:

Device	Manufacturer	Model #	S/N
Thermostat with WiFi, Subgig, and BLE	Venstar, Inc.	Explorer 2	NA

Support Equipment:

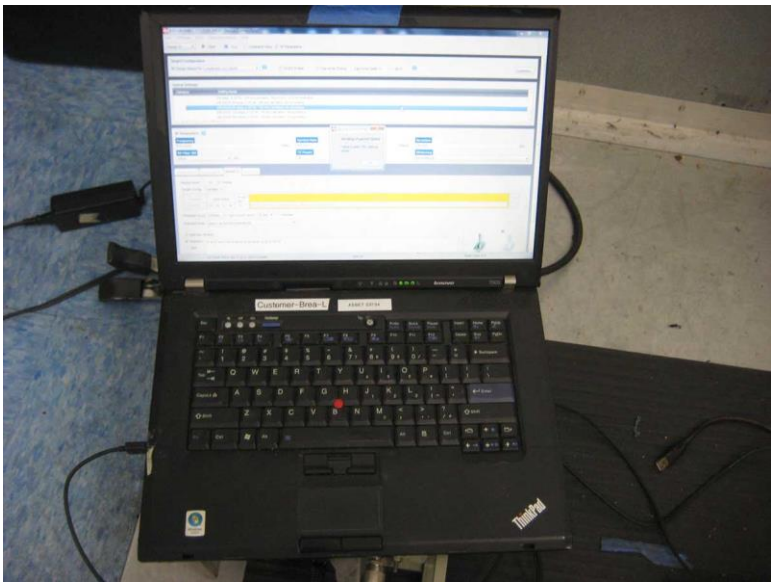
Device	Manufacturer	Model #	S/N
24Vac Adapter	Unbranded	MKA-412400200	NA

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):	802.11b: DSSS, CCK 802.11g: OFDM 802.11n20: BPSK, QPSK, 16-QAM, 64-QAM
Maximum Duty Cycle:	94%
Number of TX Chains:	1
Antenna Type(s) and Gain:	Chip Antenna/1.9dBi
Beamforming Type:	NA
Antenna Connection Type:	Integral (External connector provided to facilitate testing)
Nominal Input Voltage:	24Vac
Firmware / Software used for Test:	04-38-00

EUT Photo(s)

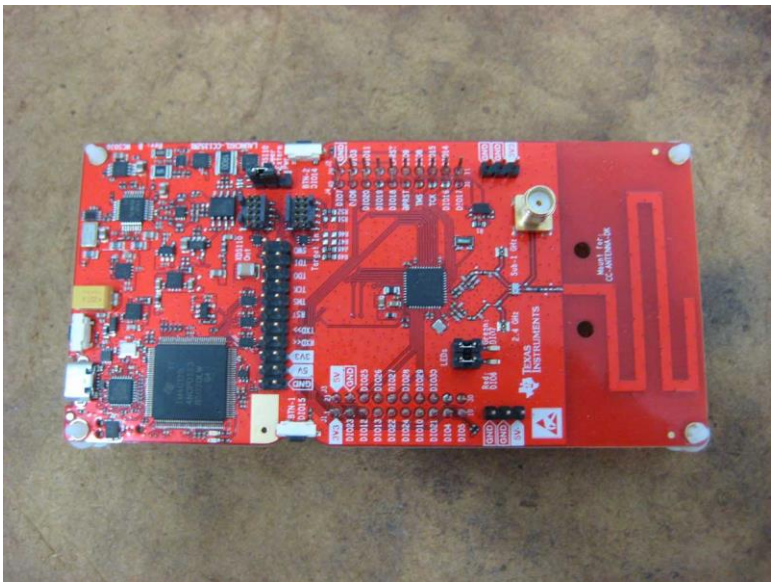
Support Equipment Photo(s)



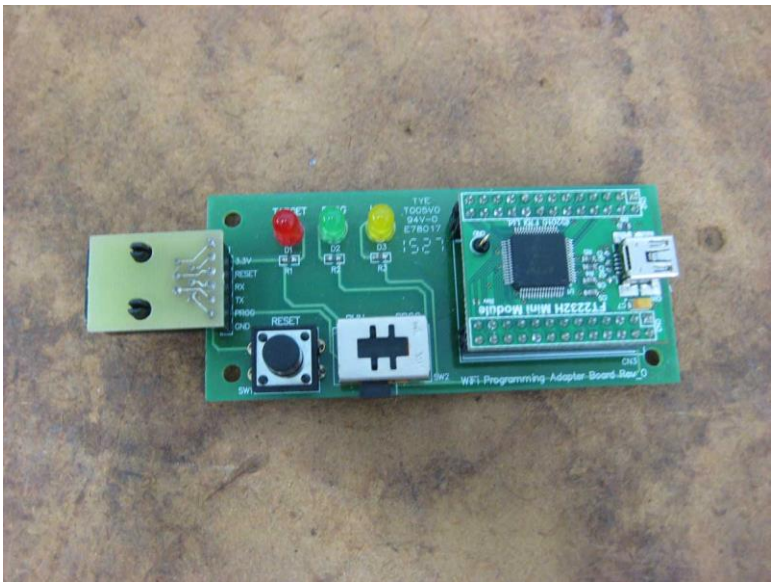
Laptop

AC/DC adapter

24Vac Adapter



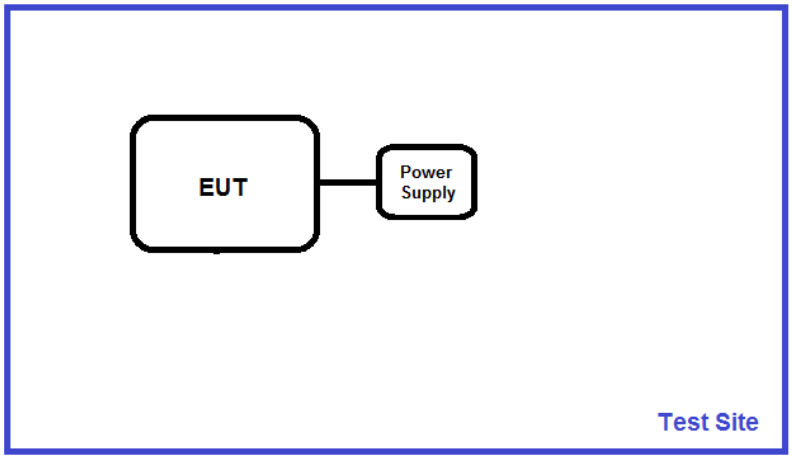
Interface Board



Wifi Prog Board

Block Diagram of Test Setup(s)

Test Setup Block Diagram



FCC Part 15 Subpart C

15.247(a)(2) 6dB Bandwidth

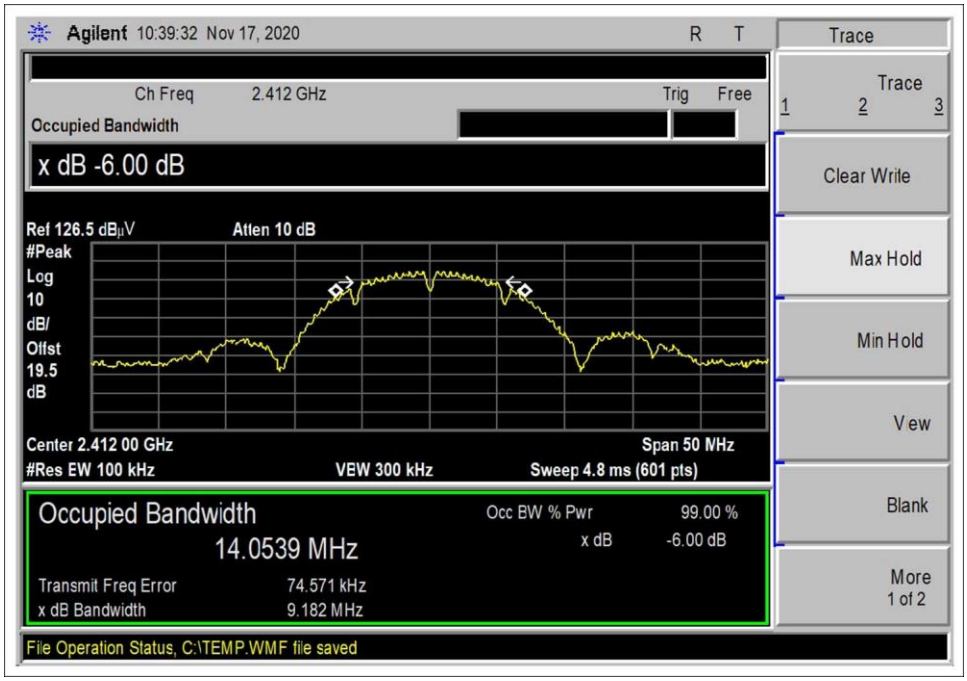
Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.10 (2013) KDB 558074 D01 15.247 Meas Guidance v05r02	Test Date(s):	11/17/2020
Configuration:	1		
Test Setup:	EUT is powered from 24Vac AC Adapter and connected to a laptop via USB cable and test board. The laptop is running software CC31XX/CC32XX Radio Tool ver.1.0.3.16 to activate transmitter. Software setting: Testing Frequency: 2412, 2437, 2462MHz Data Rate 802.11b: 1Mbps (DSSS), 11Mbps (CCK) 802.11g: 6Mbps (OFDM), 54Mbps (OFDM) 802.11n20: MCS0 (BPSK), MCS7 (64-QAM) Modulation: DSSS, CCK, OFDM, BPSK, 64-QAM Mode: Continuous TX/ Modulated Packet Size: 1400 Bytes TX Power Level: 0 Frequency of measurement: 2412, 2437, 2462MHz RBW=100kHz, VBW=300kHz		

Environmental Conditions			
Temperature (ºC)	23.5	Relative Humidity (%):	27

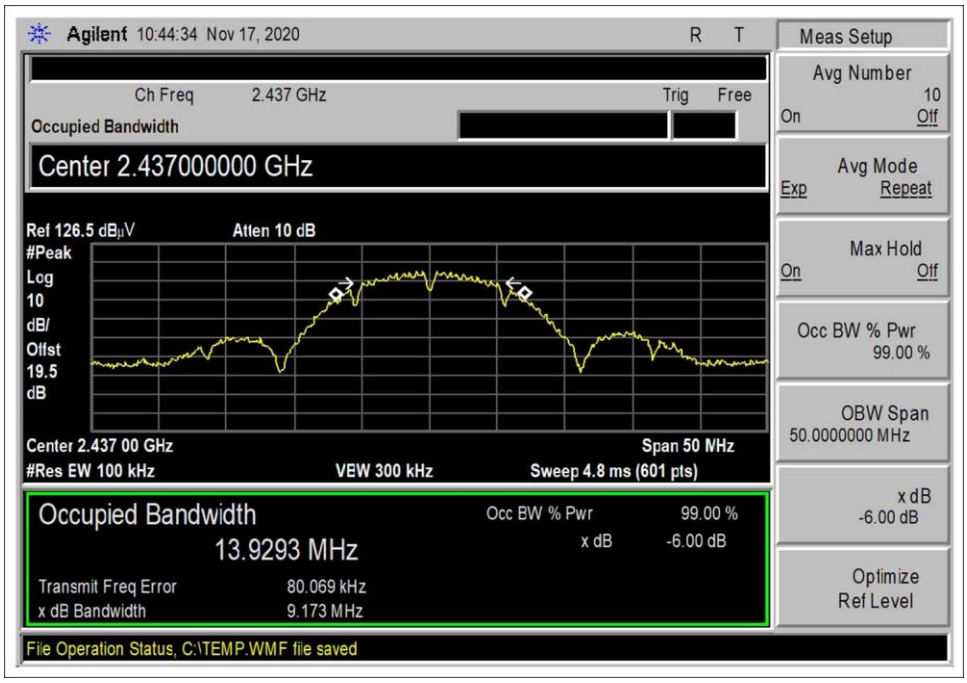
Test Equipment					
Asset #	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03643	Spectrum Analyzer	Agilent	E4440	5/20/2020	5/20/2021
03431	Attenuator	Aeroflex/Weinschel	89-20-21	12/20/2019	12/20/2021
P07246	Cable	H&S	32022-29094K-29094K-24TC	5/29/2020	5/29/2022

Test Data Summary					
Frequency (MHz)	**Antenna Port**	**Mode/Data Rate**	**Measured (kHz)**	**Limit (kHz)**	**Results**
2412	Wi-Fi	802.11b/1Mbps	9182	≥500	Pass
2437	Wi-Fi	802.11b/1Mbps	9173	≥500	Pass
2462	Wi-Fi	802.11b/1Mbps	9135	≥500	Pass
2412	Wi-Fi	802.11b/11Mbps	10094	≥500	Pass
2437	Wi-Fi	802.11b/11Mbps	10038	≥500	Pass
2462	Wi-Fi	802.11b/11Mbps	10061	≥500	Pass
2412	Wi-Fi	802.11g/6Mbps	15177	≥500	Pass
2437	Wi-Fi	802.11g/6Mbps	15167	≥500	Pass
2462	Wi-Fi	802.11g/6Mbps	15155	≥500	Pass
2412	Wi-Fi	802.11g/54Mbps	16046	≥500	Pass
2437	Wi-Fi	802.11g/54Mbps	16444	≥500	Pass
2462	Wi-Fi	802.11g/54Mbps	16372	≥500	Pass
2412	Wi-Fi	802.11n20/MCS0	15179	≥500	Pass
2437	Wi-Fi	802.11n20/MCS0	15135	≥500	Pass
2462	Wi-Fi	802.11n20/MCS0	15191	≥500	Pass
2412	Wi-Fi	802.11n20/MCS7	17509	≥500	Pass
2437	Wi-Fi	802.11n20/MCS7	17103	≥500	Pass
2462	Wi-Fi	802.11n20/MCS7	17648	≥500	Pass

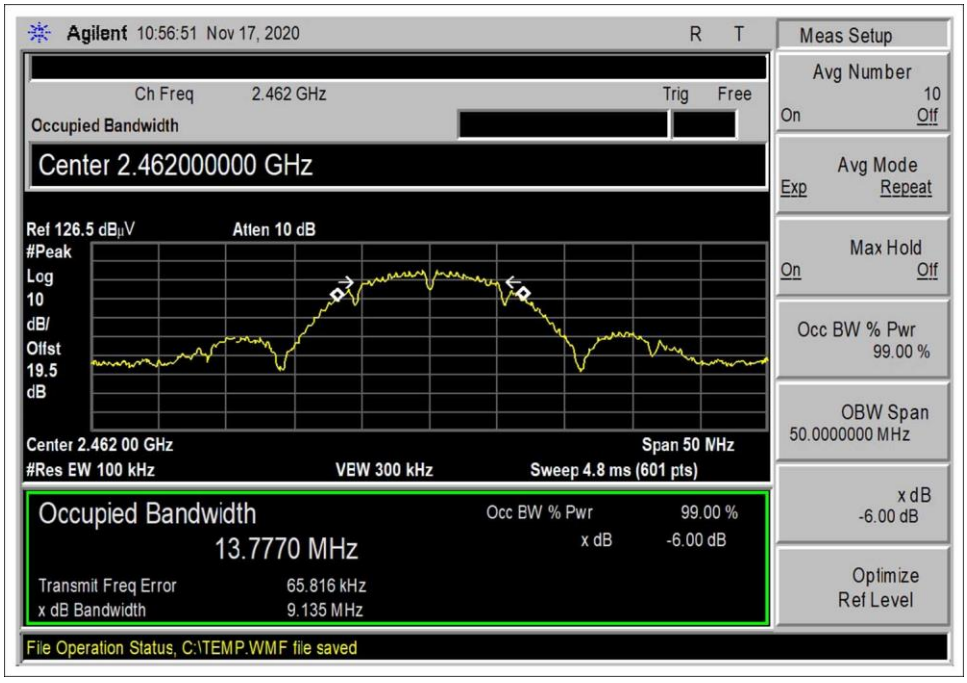
Plot(s)



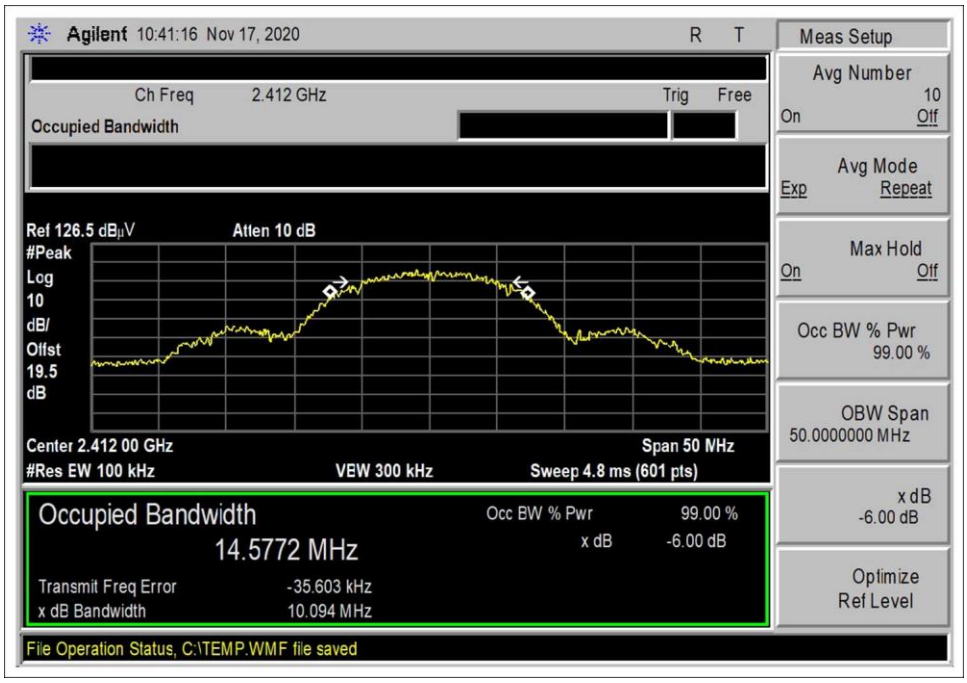
802.11b 1Mbps, Low Channel



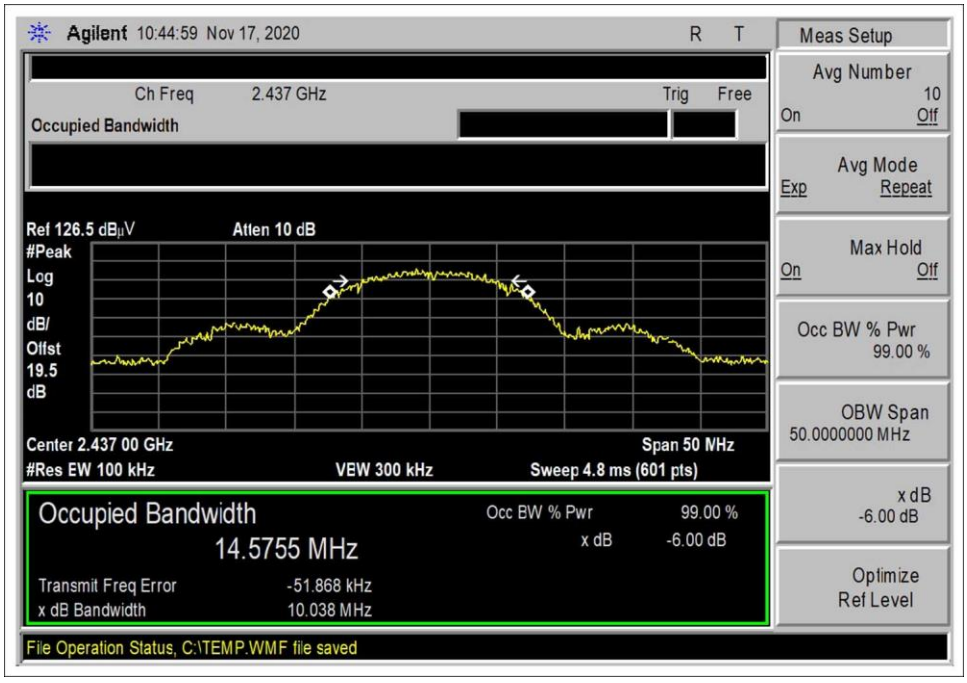
802.11b 1Mbps, Middle Channel



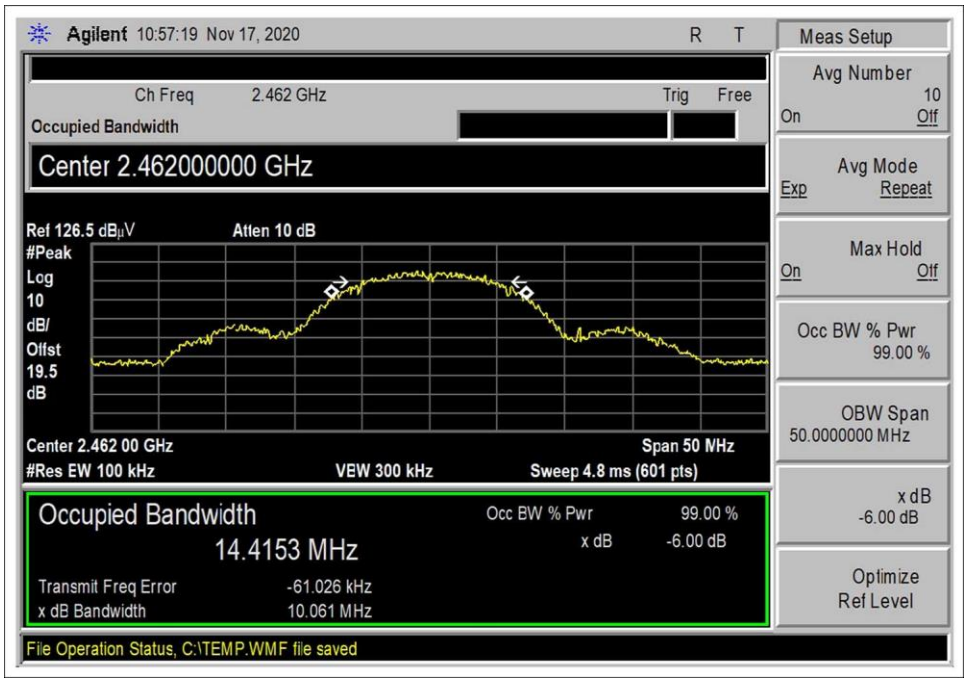
802.11b 1Mbps, High Channel



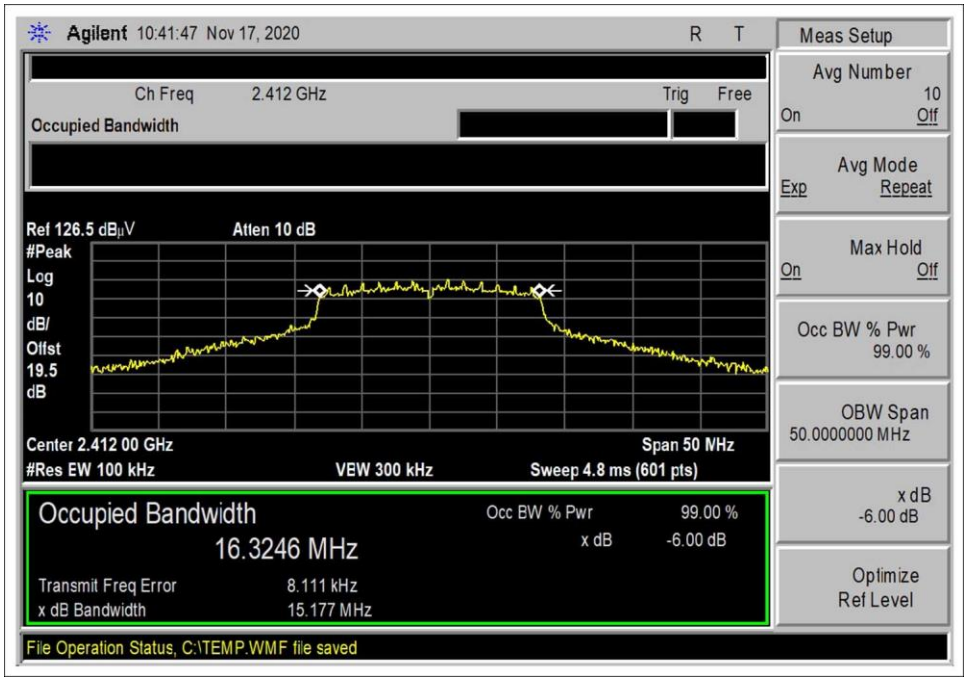
802.11b 11Mbps, Low Channel



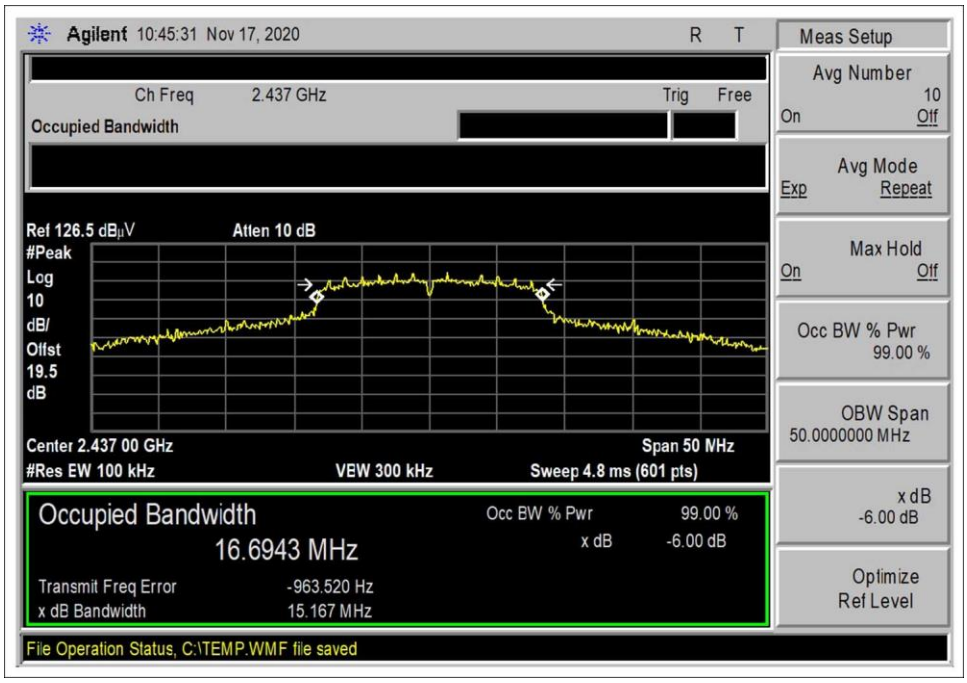
802.11b 11Mbps, Middle Channel



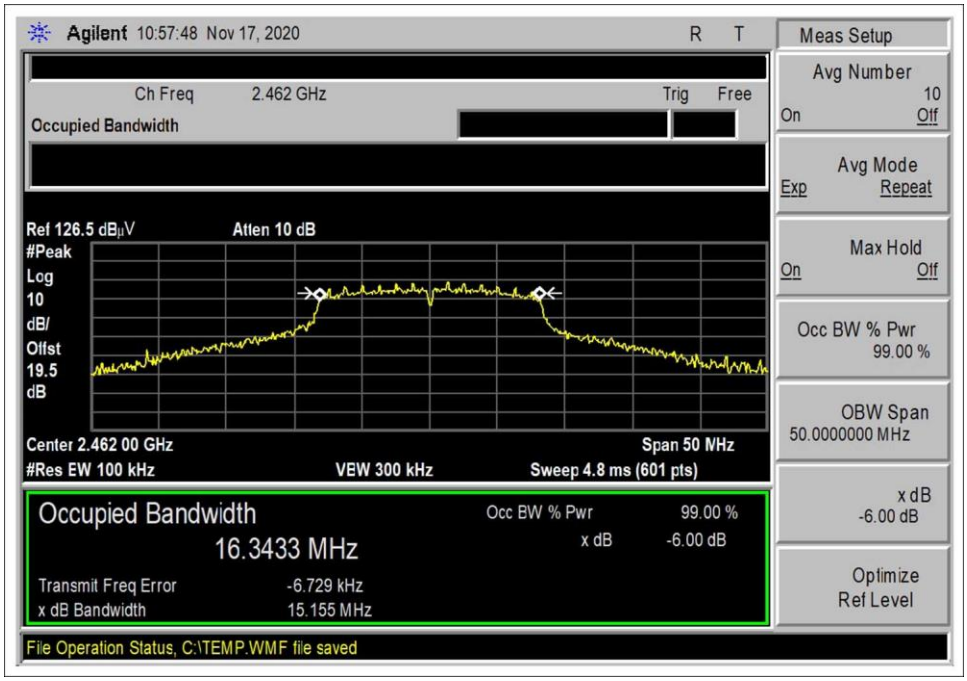
802.11b 11Mbps, High Channel



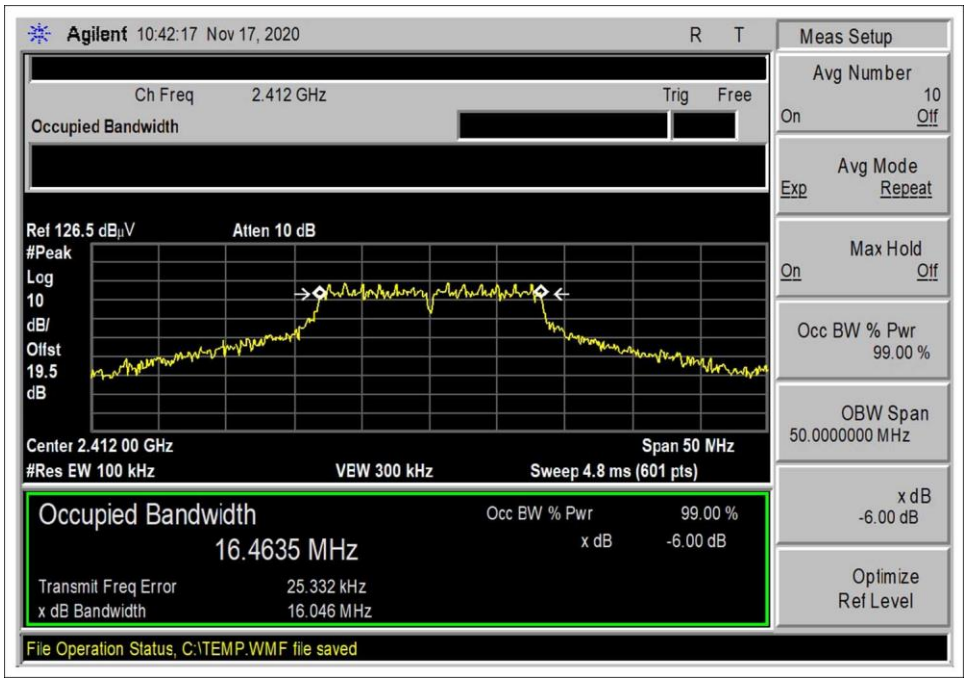
802.11g 6Mbps, Low Channel



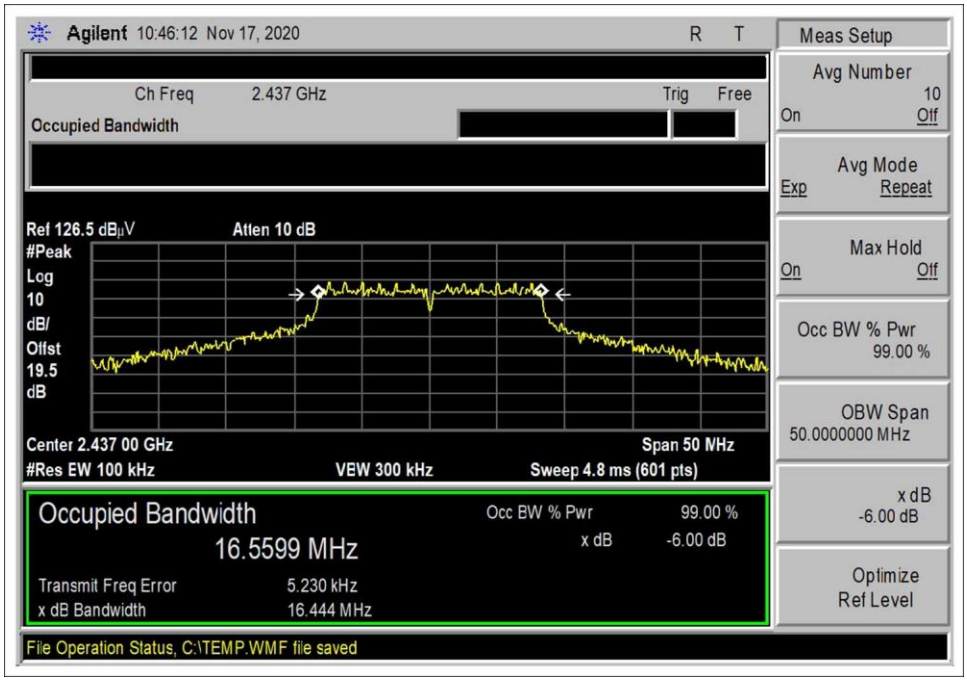
802.11g 6Mbps, Middle Channel



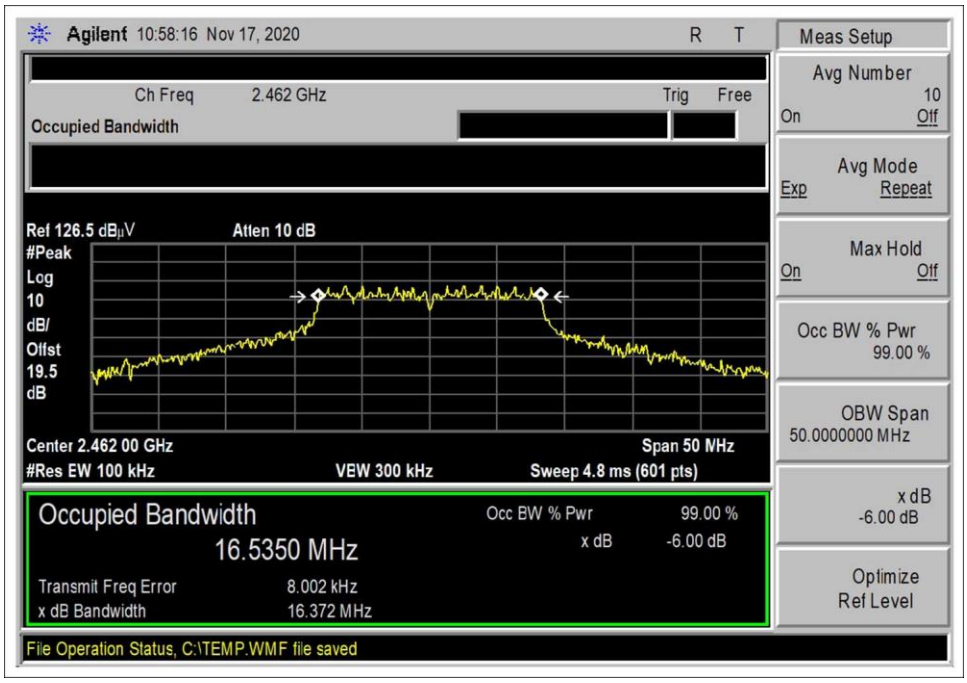
802.11g 6Mbps, High Channel



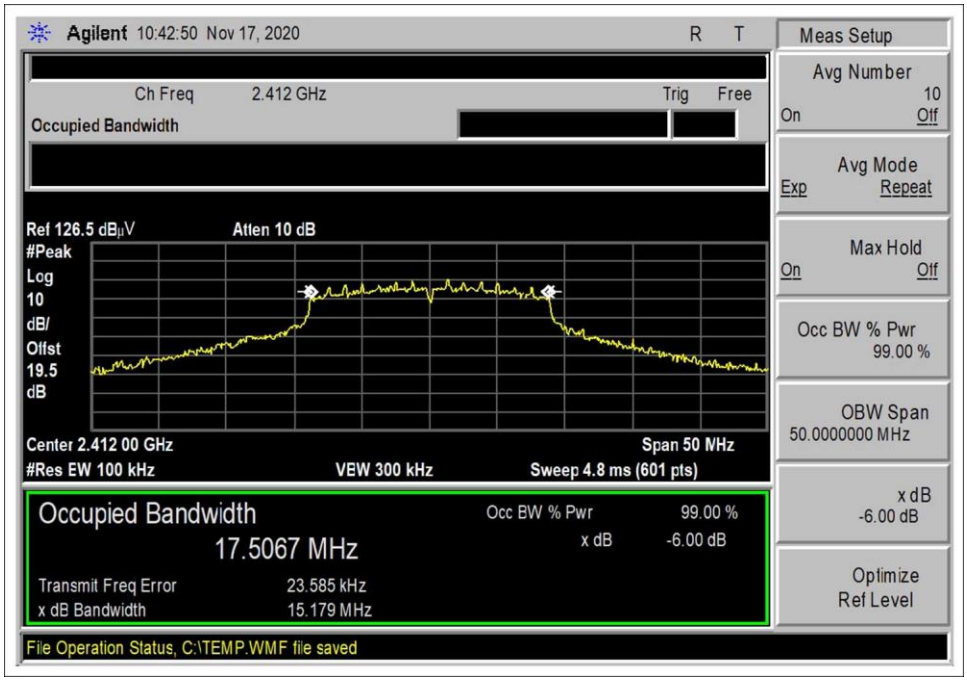
802.11g 54Mbps, Low Channel



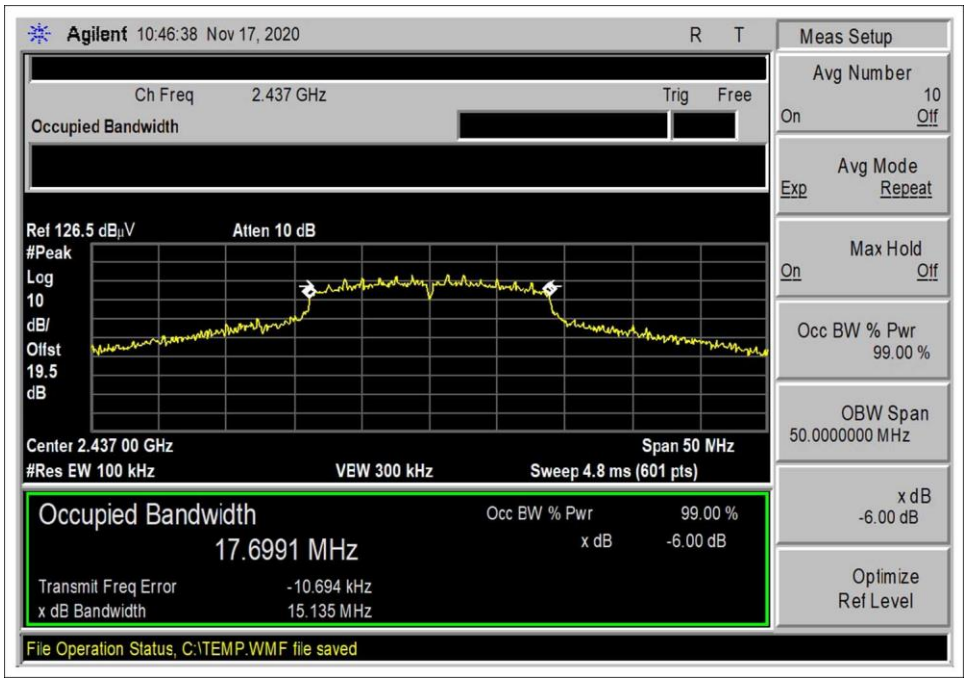
802.11g 54Mbps, Middle Channel



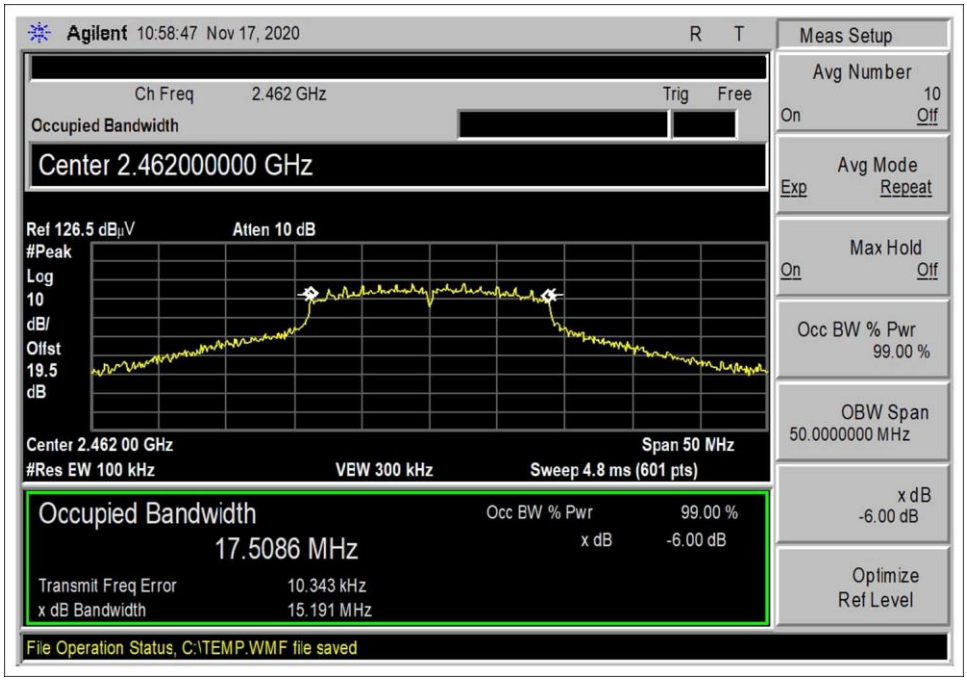
802.11g 54Mbps, High Channel



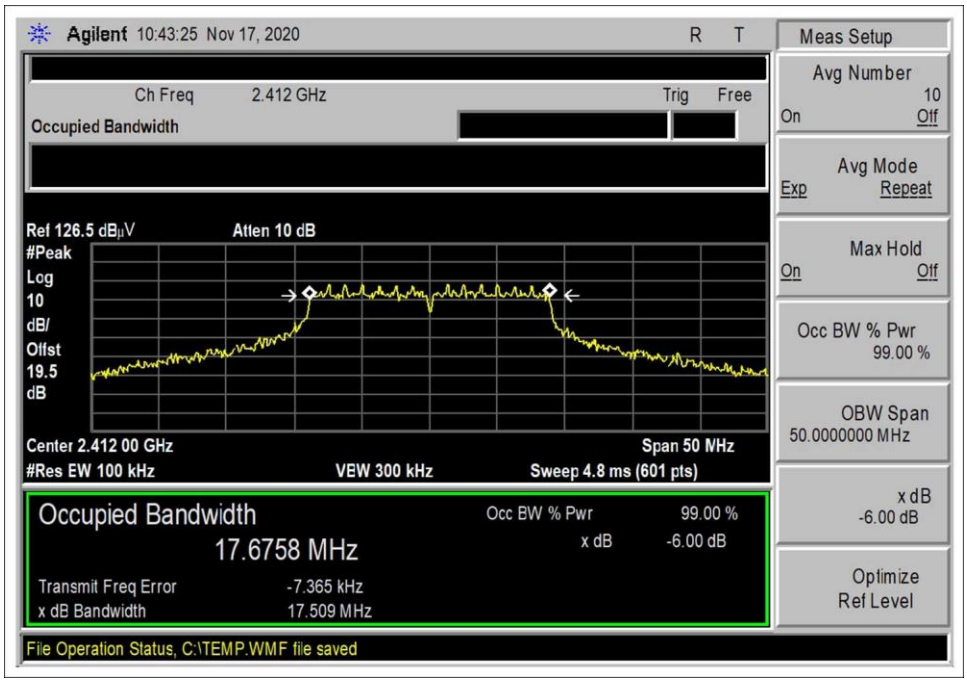
802.11n20 MCS0, Low Channel



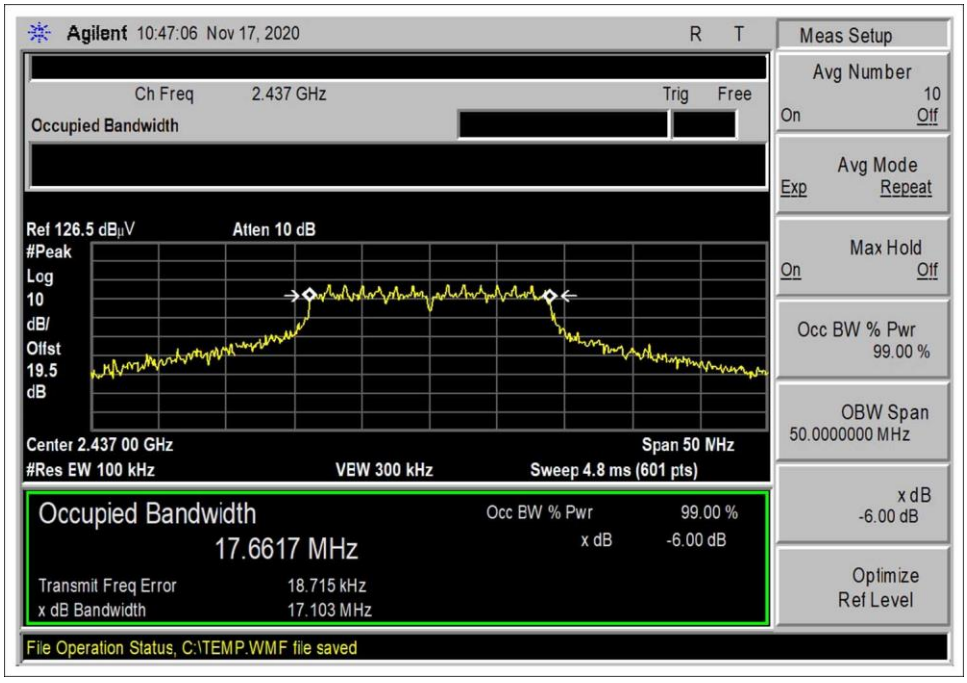
802.11n20 MCS0, Middle Channel



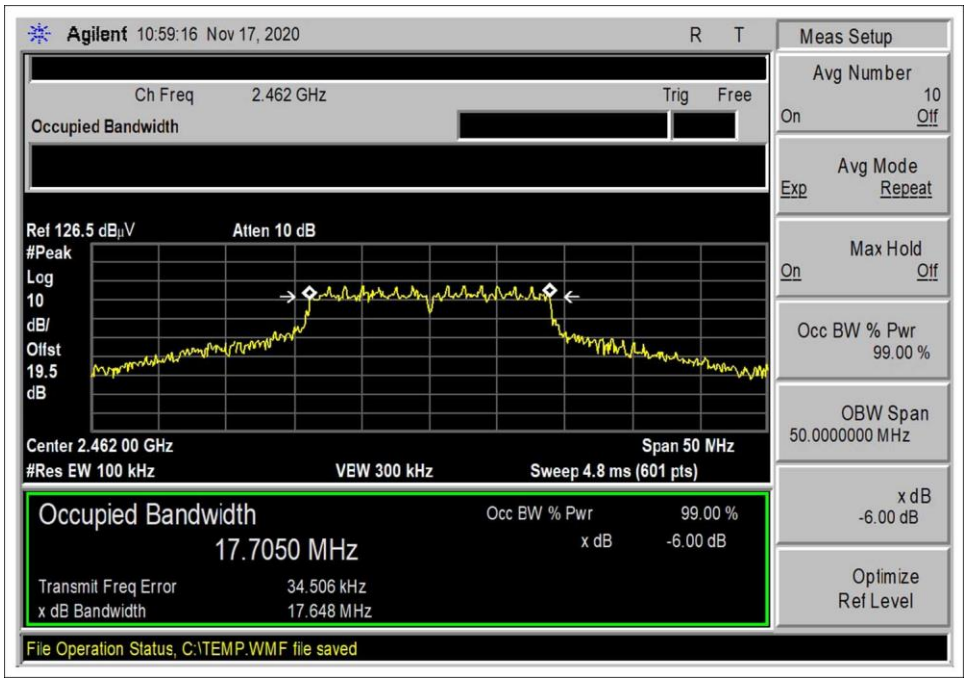
802.11n20 MCS0, High Channel



802.11n20 MCS7, Low Channel

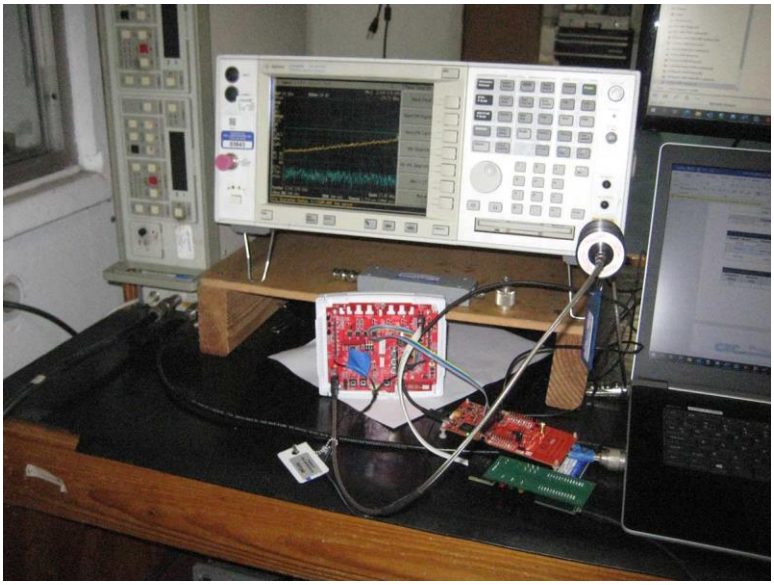


802.11n20 MCS7, Middle Channel



802.11n20 MCS7, High Channel

Test Setup Photo(s)



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 D01 15.247 Meas Guidance v05r02	Test Date(s):	11/17/2020
Configuration:	1		
Test Setup:	EUT is powered from 24Vac AC Adapter and connected to a laptop via USB cable and test board. The laptop is running software CC31XX/CC32XX Radio Tool ver.1.0.3.16 to activate transmitter. Software setting: Testing Frequency: 2412, 2437, 2462MHz Data Rate 802.11b: 1Mbps (DSSS), 11Mbps (CCK) 802.11g: 6Mbps (OFDM), 54Mbps (OFDM) 802.11n20: MCS0 (BPSK), MCS7 (64-QAM) Modulation: DSSS, CCK, OFDM, BPSK, 64-QAM Mode: Continuous TX/ Modulated Packet Size: 1400 Bytes TX Power Level: 0 Frequency of measurement: 2412, 2437, 2462MHz RBW=100kHz, VBW=300kHz		

Environmental Conditions			
Temperature (ºC)	23.5	Relative Humidity (%):	27

Test Equipment					
Asset #	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03643	Spectrum Analyzer	Agilent	E4440	5/20/2020	5/20/2021
03431	Attenuator	Aeroflex/Weinschel	89-20-21	12/20/2019	12/20/2021
P07246	Cable	H&S	32022-29094K-29094K-24TC	5/29/2020	5/29/2022

Test Data Summary - Voltage Variations					
Frequency (MHz)	Mode/Data Rate	$V_{Minimum}$ (dBm)	$V_{Nominal}$ (dBm)	$V_{Maximum}$ (dBm)	Max Deviation from $V_{Nominal}$ (dB)
2412	802.11b/11Mbps	13.70	13.70	13.80	0.10
2437	802.11b/1Mbps	13.59	13.71	13.78	0.12
2462	802.11b/11Mbps	13.61	13.53	13.64	0.11

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

Parameter Definitions:

Measurements performed at input voltage Vnominal ± 15%.

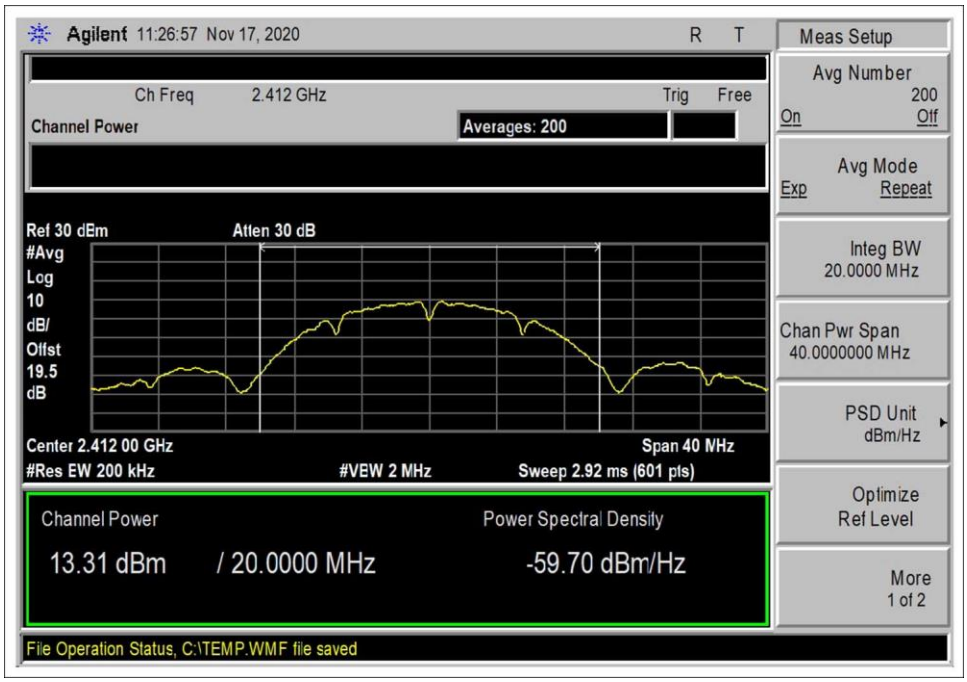
Parameter	Value
$V_{Nominal}$:	24.0Vac
$V_{Minimum}$:	20.4Vac
$V_{Maximum}$:	27.6Vac

Test Data Summary - RF Conducted Measurement

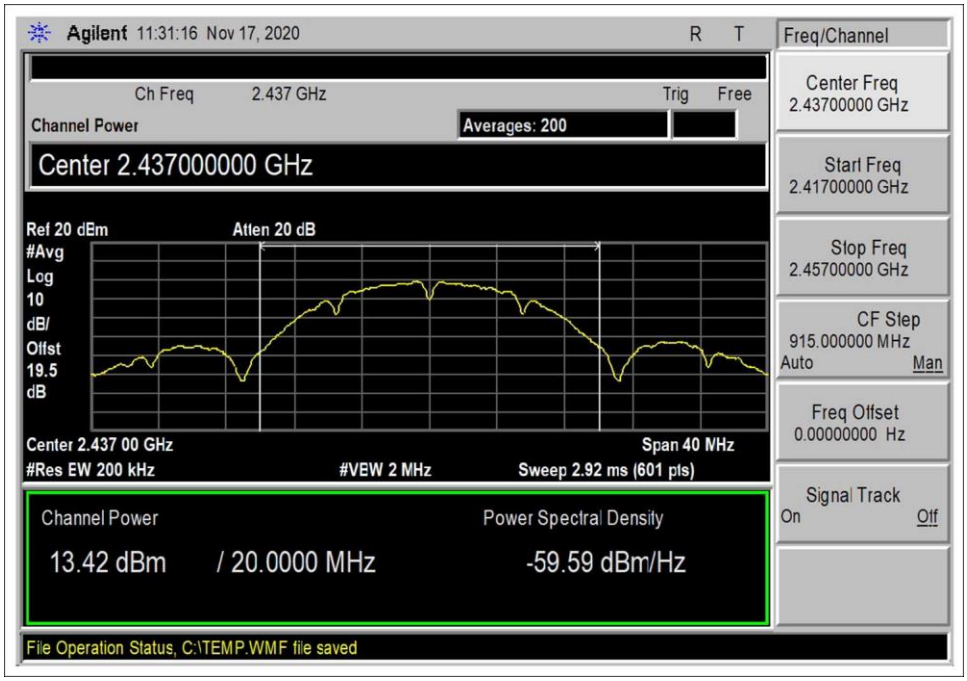
Measurement Option: AVGSA-2

Frequency (MHz)	Mode/Data Rate	Ant. Type / Gain (dBi)	Measured (dBm)	Measured + DDCF (dBm)	Limit (dBm)	Results
2412	802.11b/1Mbps	Chip/1.9	13.31	13.6	≤30	Pass
2437	802.11b/1Mbps	Chip/1.9	13.42	13.71	≤30	Pass
2462	802.11b/1Mbps	Chip/1.9	13.17	13.46	≤30	Pass
2412	802.11b/11Mbps	Chip/1.9	12.91	13.7	≤30	Pass
2437	802.11b/11Mbps	Chip/1.9	12.86	13.65	≤30	Pass
2462	802.11b/11Mbps	Chip/1.9	12.74	13.53	≤30	Pass
2412	802.11g/6Mbps	Chip/1.9	8.54	8.95	≤30	Pass
2437	802.11g/6Mbps	Chip/1.9	12.85	13.26	≤30	Pass
2462	802.11g/6Mbps	Chip/1.9	7.46	7.87	≤30	Pass
2412	802.11g/54Mbps	Chip/1.9	3.20	8.75	≤30	Pass
2437	802.11g/54Mbps	Chip/1.9	3.48	9.03	≤30	Pass
2462	802.11g/54Mbps	Chip/1.9	2.38	7.93	≤30	Pass
2412	802.11n20/MCS0	Chip/1.9	8.15	8.52	≤30	Pass
2437	802.11n20/MCS0	Chip/1.9	11.53	11.9	≤30	Pass
2462	802.11n20/MCS0	Chip/1.9	7.16	7.53	≤30	Pass
2412	802.11n20/MCS7	Chip/1.9	2.22	8.27	≤30	Pass
2437	802.11n20/MCS7	Chip/1.9	1.67	7.72	≤30	Pass
2462	802.11n20/MCS7	Chip/1.9	1.03	7.08	≤30	Pass

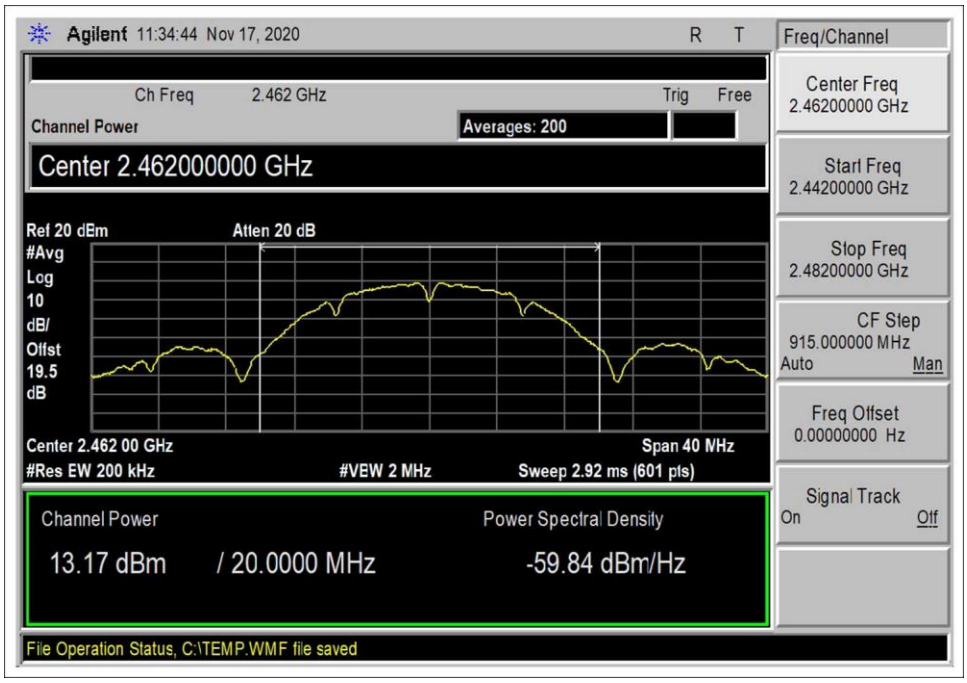
Plots



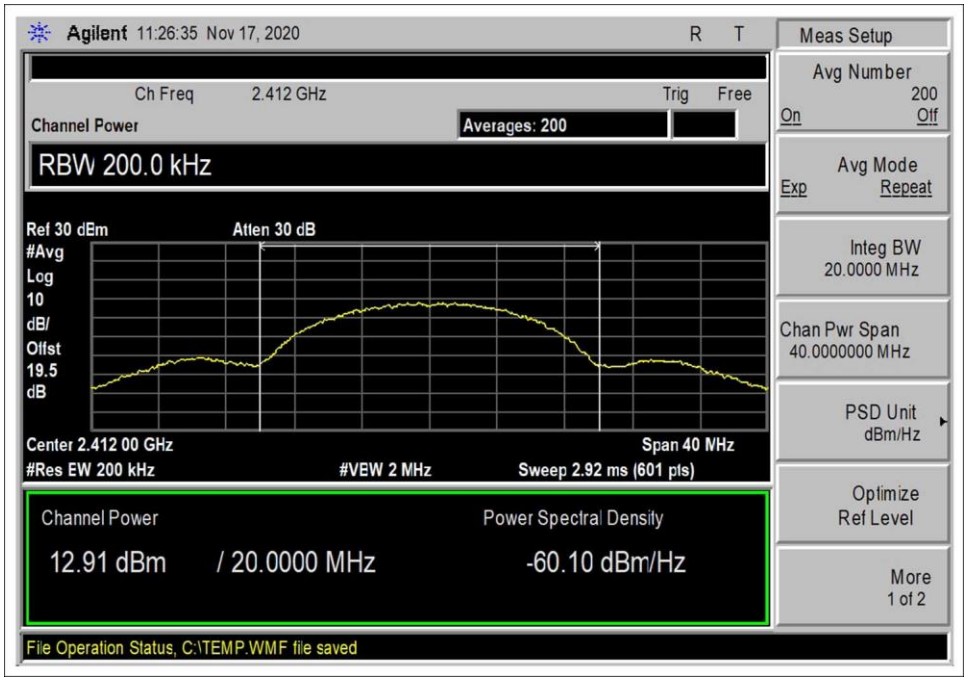
802.11b 1Mbps, Low Channel



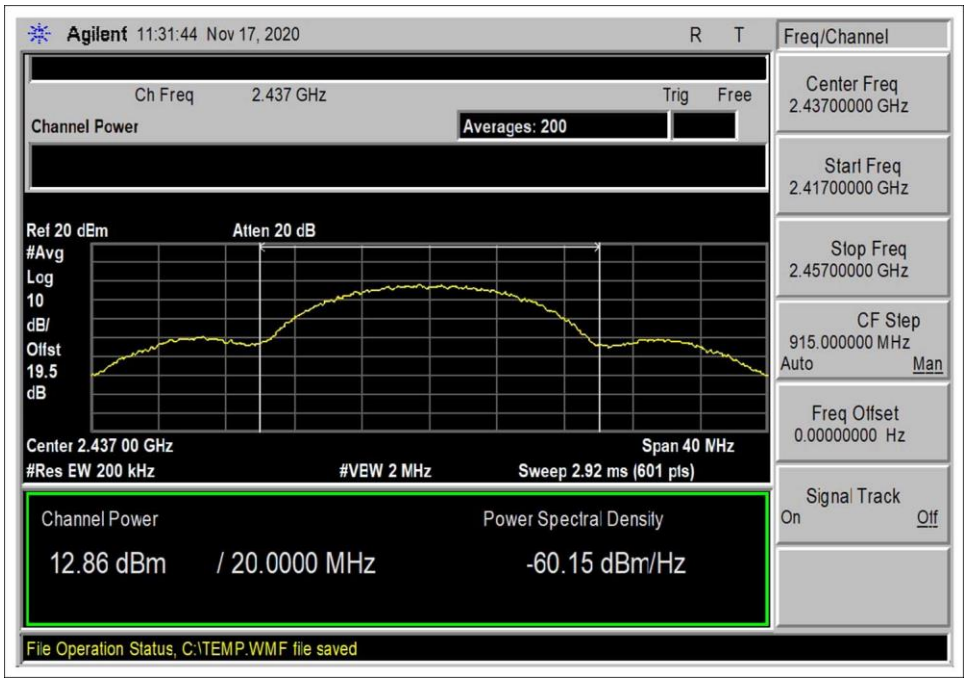
802.11b 1Mbps, Middle Channel



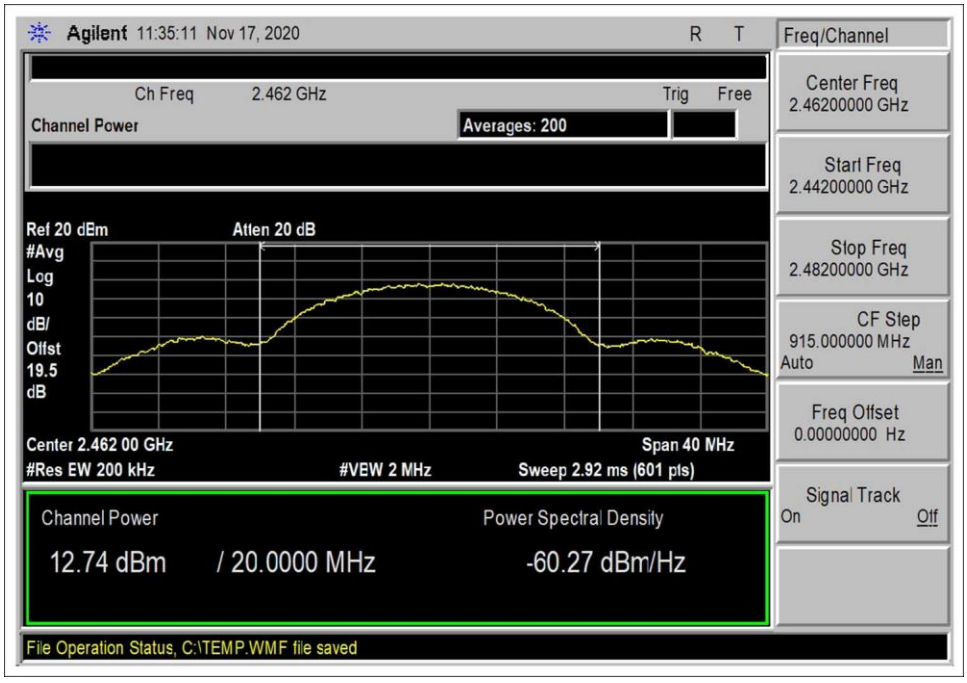
802.11b 1Mbps, High Channel



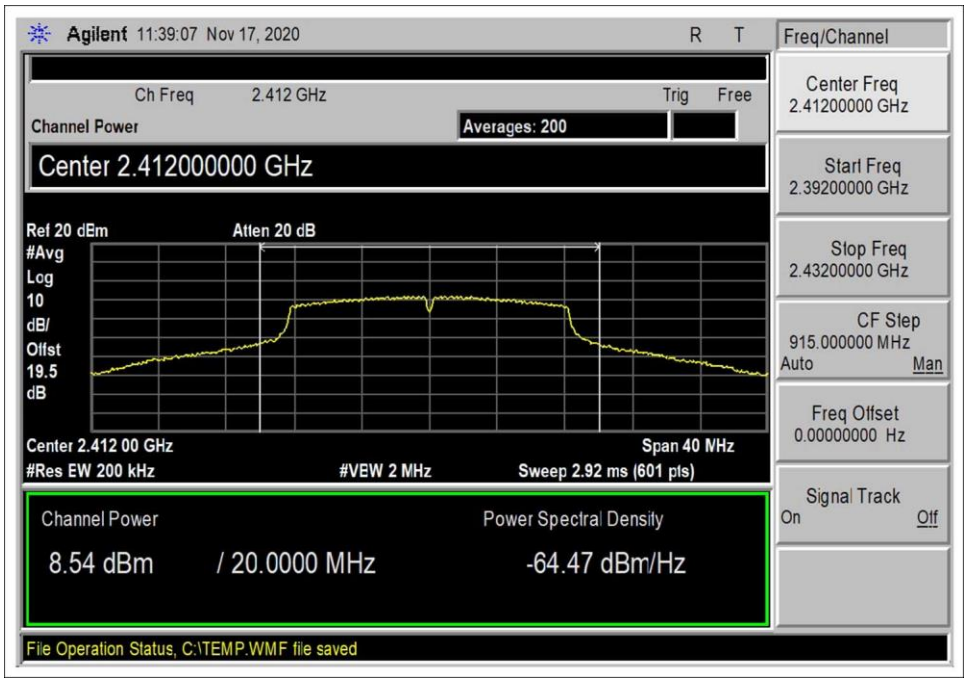
802.11b 11Mbps, Low Channel



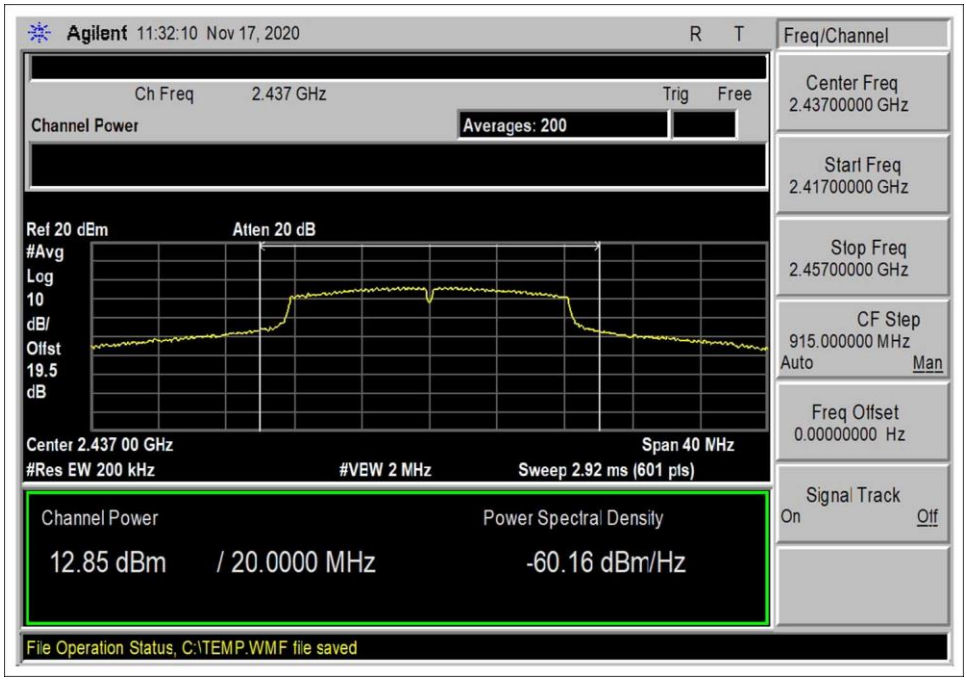
802.11b 11Mbps, Middle Channel



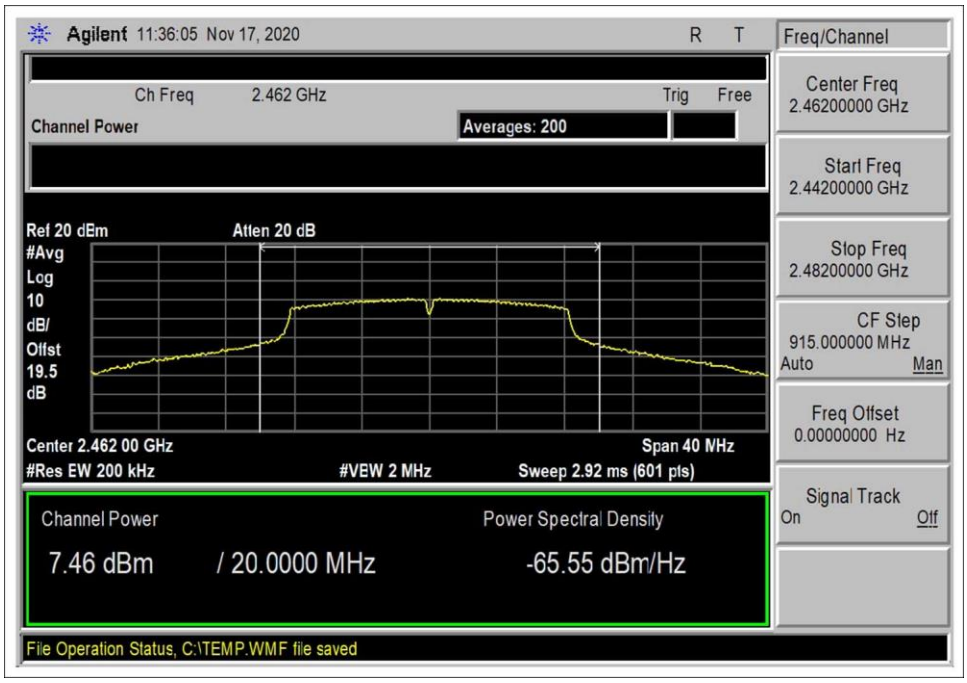
802.11b 11Mbps, High Channel



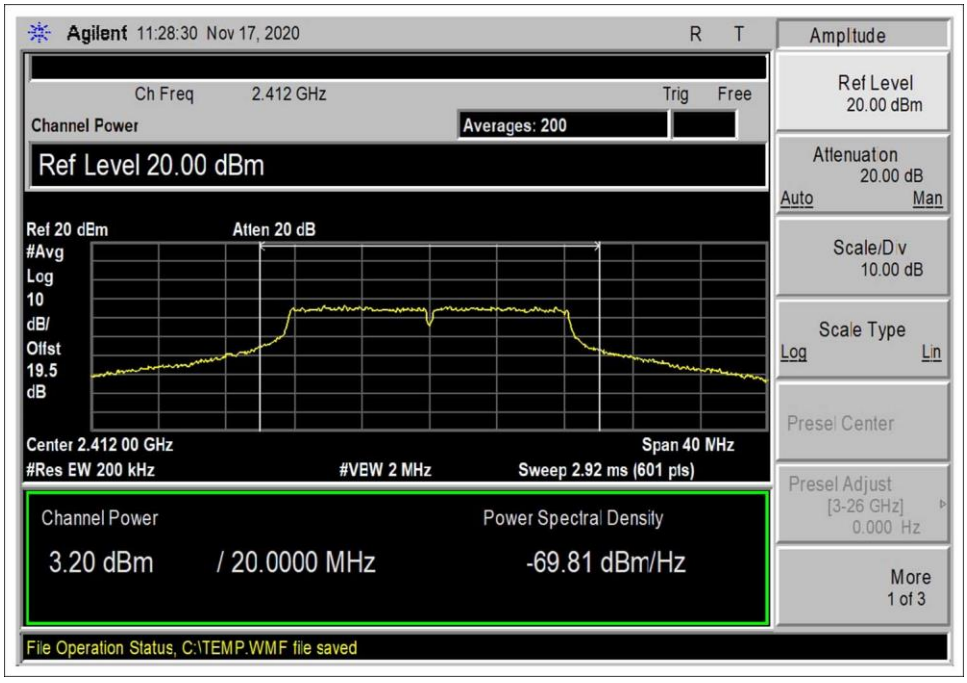
802.11g 6Mbps, Low Channel



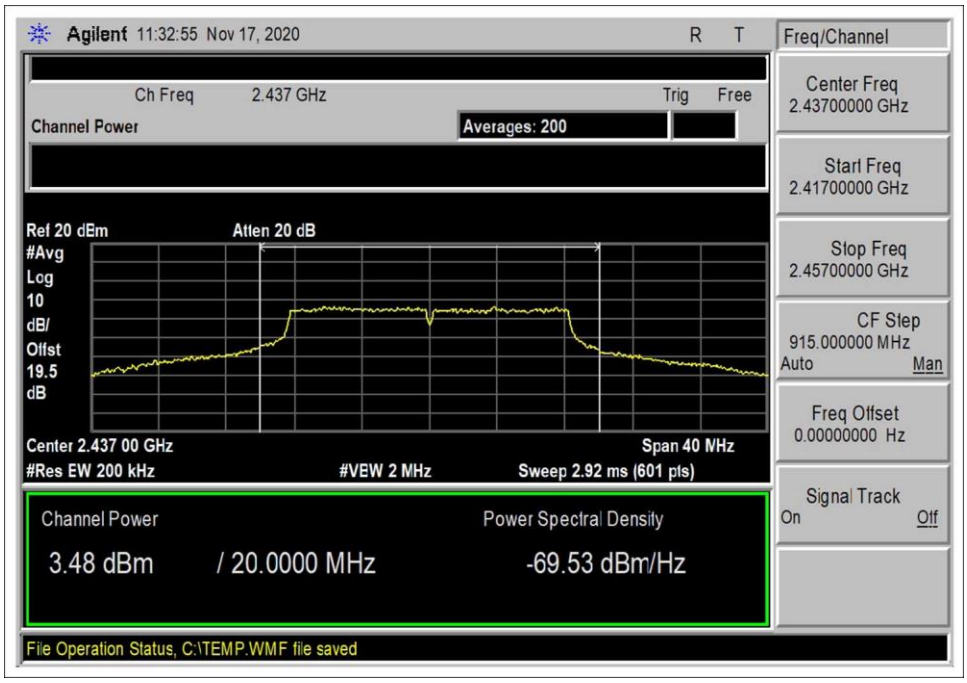
802.11g 6Mbps, Middle Channel



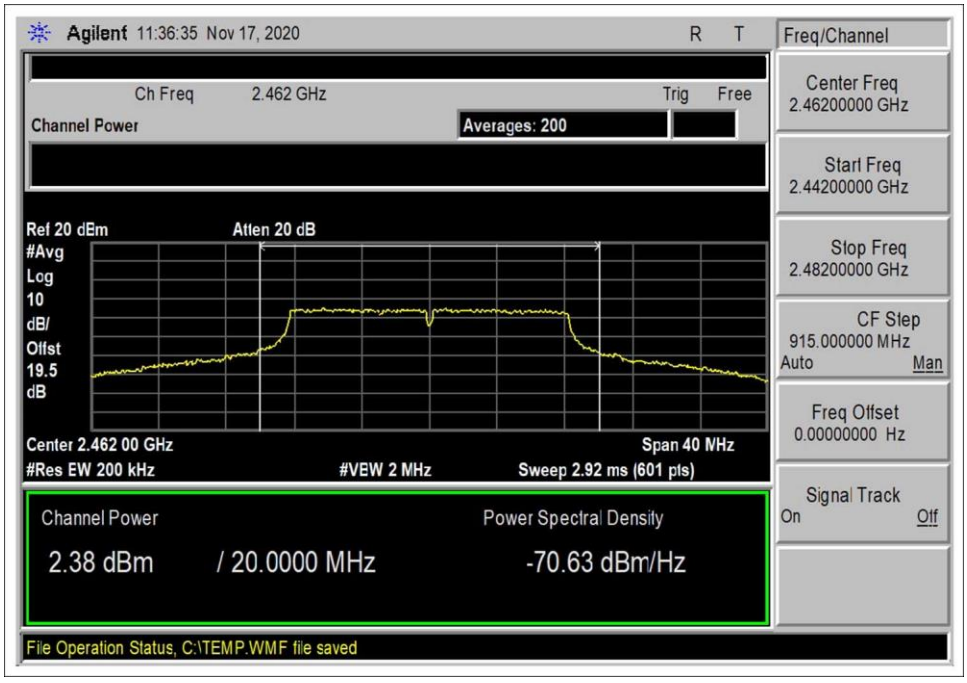
802.11g 6Mbps, High Channel



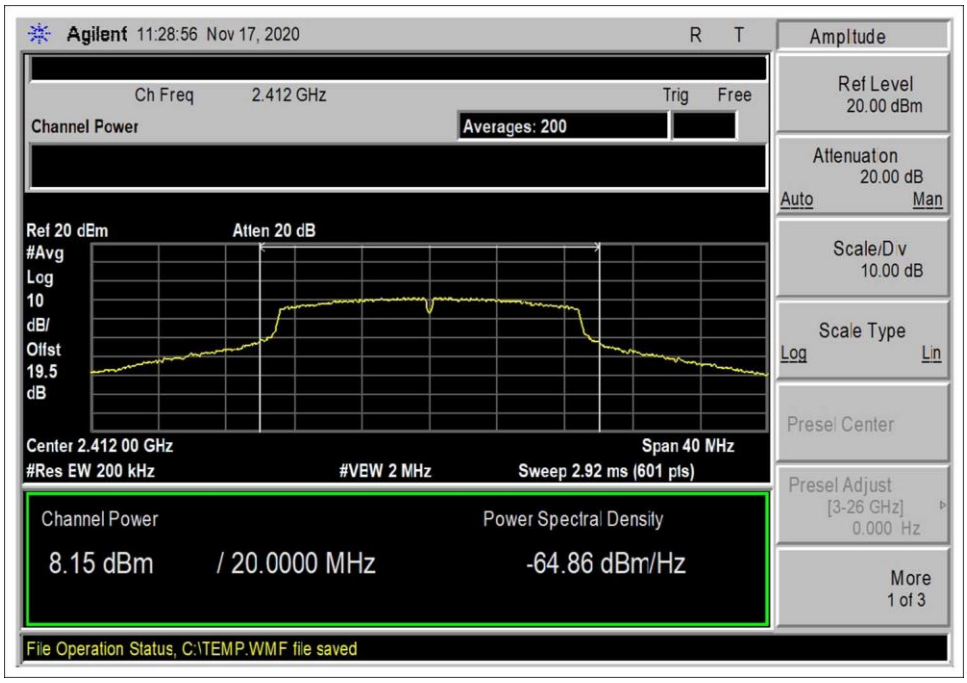
802.11g 54Mbps, Low Channel



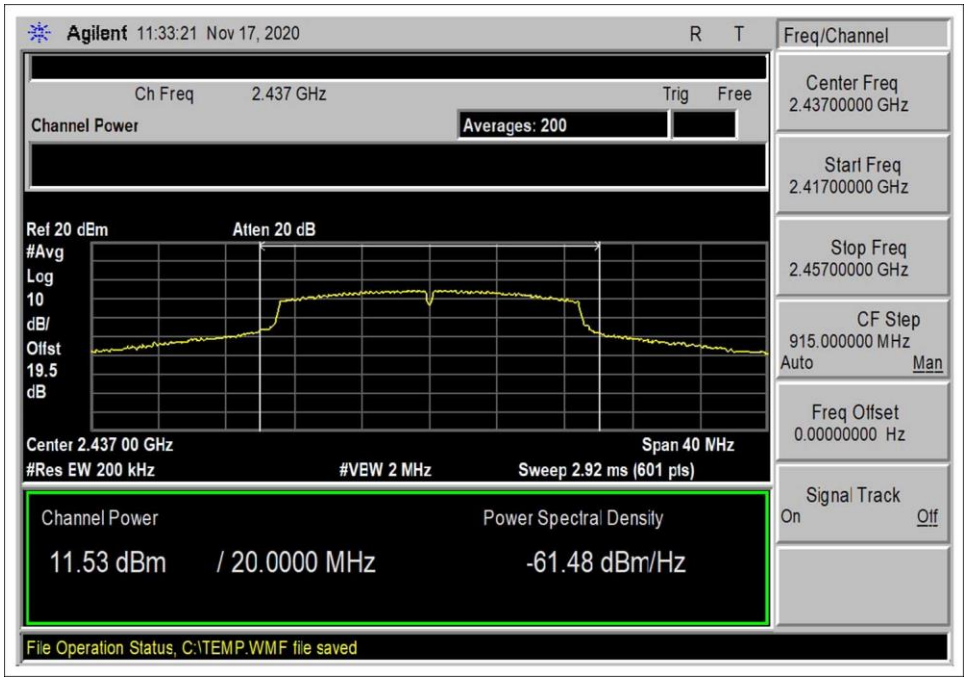
802.11g 54Mbps, Middle Channel



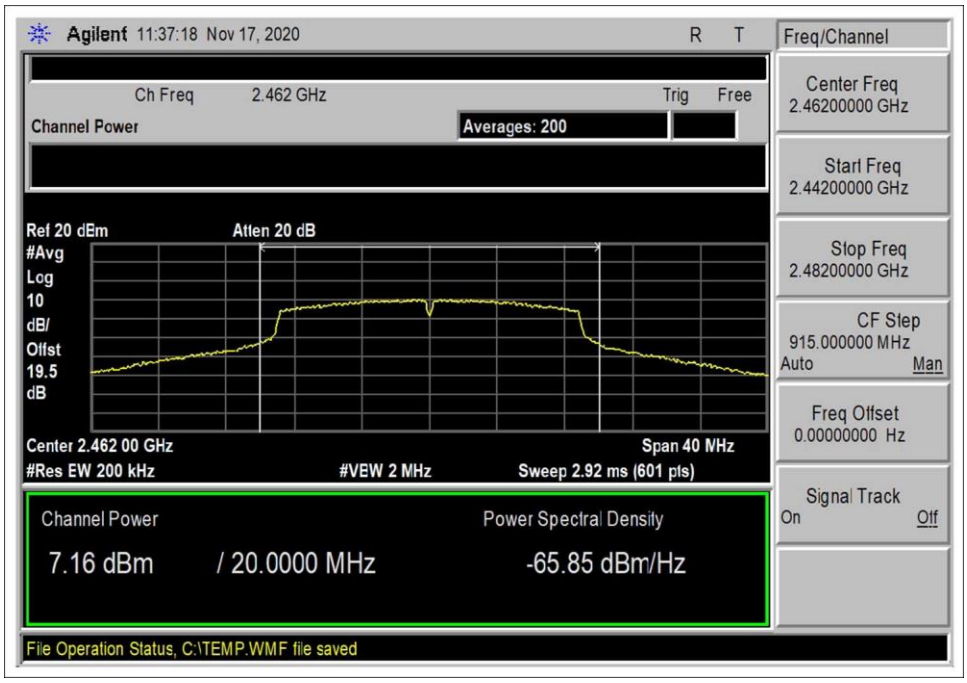
802.11g 54Mbps, High Channel



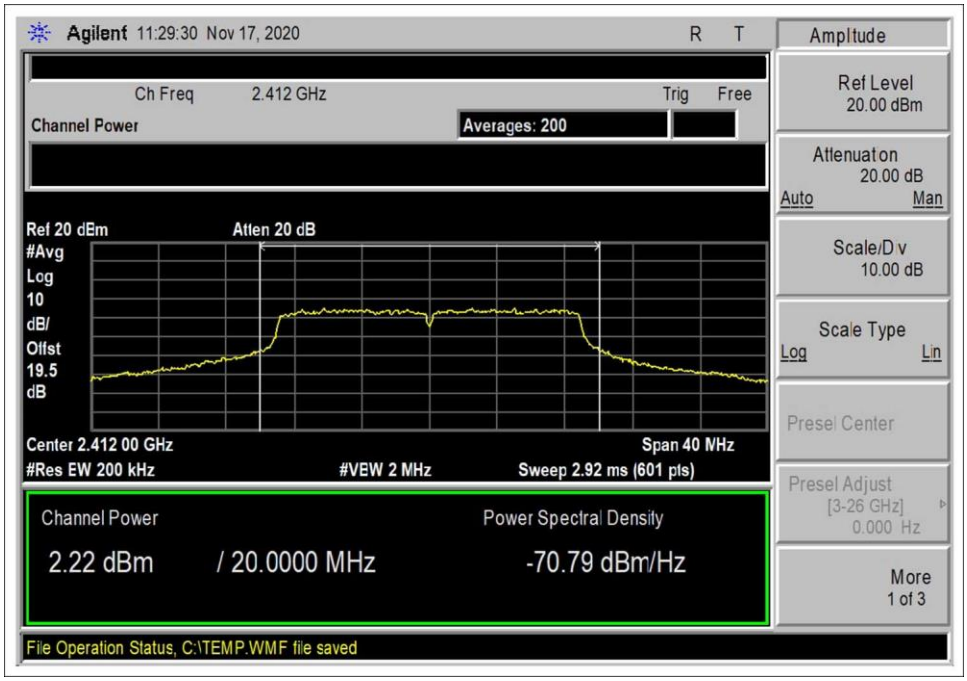
802.11n20 MCS0, Low Channel



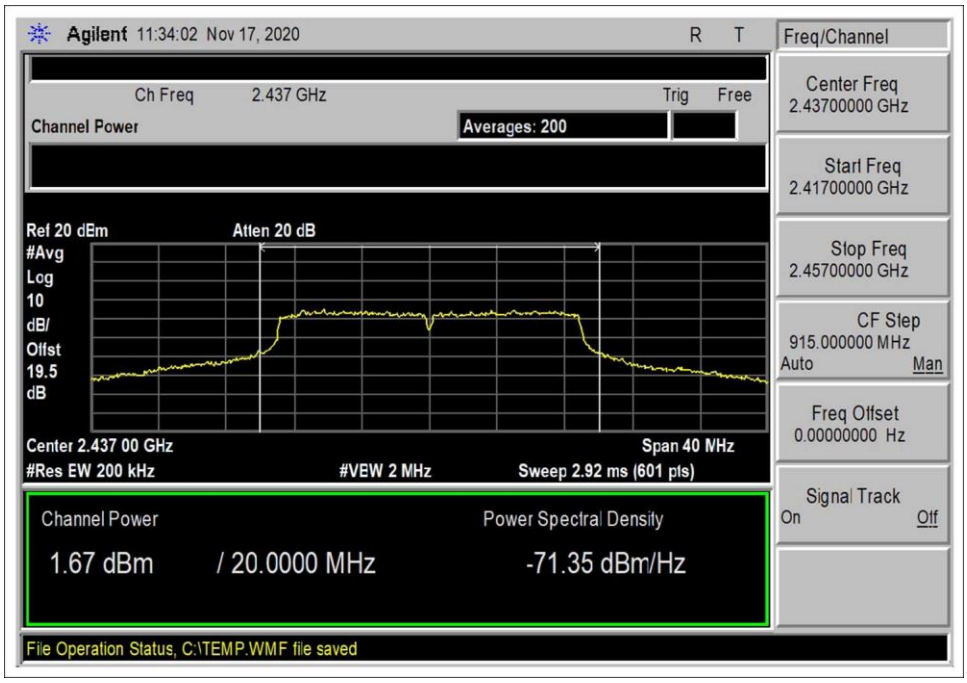
802.11n20 MCS0, Middle Channel



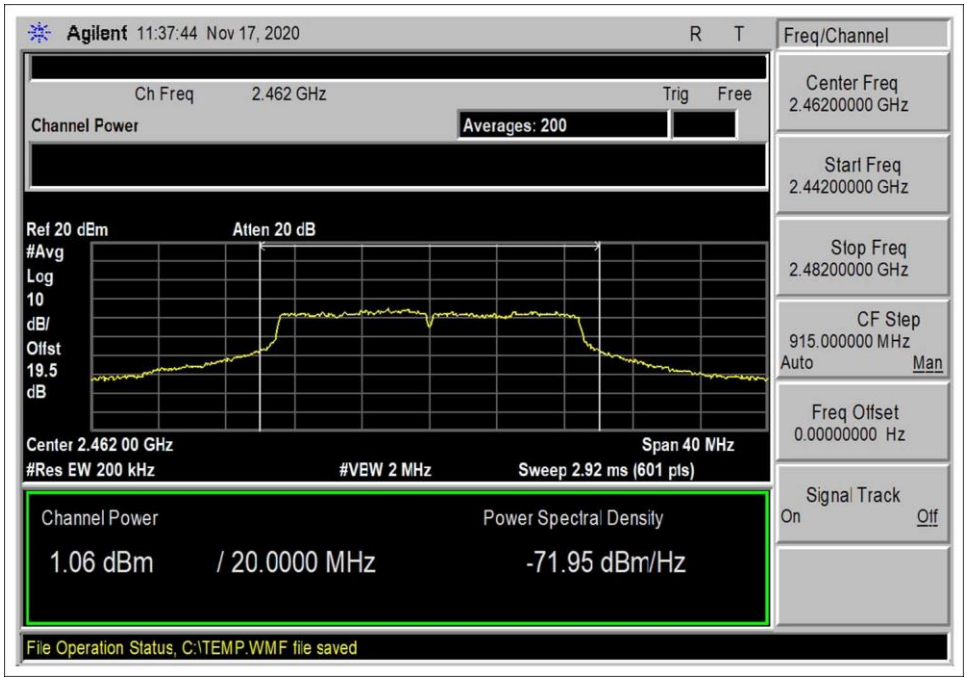
802.11n20 MCS0, High Channel



802.11n20 MCS7, low Channel



802.11n20 MCS7, Middle Channel



802.11n20 MCS7, High Channel