F2 Labs
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CERTIFICATION TEST REPORT

Manufacturer:	**Avnet Inc.** **2211 South 47th Street** **Phoenix, Arizona 85034 USA**
Applicant:	**Same as Above**
Product Name:	**Azure Sphere MT3620 Modules**
Product Description:	Microsoft Azure Sphere certified Wi-Fi SoC module for highly-secured IoT applications (Dual UFL connector version for external antennas, RX and TX diversity and Industrial temperature operating range)
Operating Voltage/Frequency:	3.3V DC
Model:	**AES-MS-MT3620-M-G**
FCC ID:	**2AF62-AVT3620C**
Testing Commenced:	Mar. 11, 2019
Testing Ended:	May 7, 2019
Summary of Test Results:	**In Compliance** The EUT complies with the EMC requirements when manufactured identically as the unit tested in this report, including any required modifications and/or manufacturer's statement. Any changes to the design or build of this unit subsequent to this testing may deem it non-compliant.

Standards:

- **FCC Part 15 Subpart C, Section 15.249**
- **FCC Part 15 Subpart C, Section 15.215(c) – Additional provisions to the general radiated emission limitations**
- **FCC15.207 - Conducted Limits**
- **FCC Part 15 Subpart A, Section 15.31(e) – Measurement Standards**

Evaluation Conducted by:

Julius Chiller, EMC/Wireless Engineer

Report Reviewed by:

Ken Littell, Director of EMC & Wireless Operations

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1 ADMINISTRATIVE INFORMATION

1.1 Measurement Location:

F2 Labs in Middlefield, Ohio. Site description and attenuation data are on file with the FCC's Sampling and Measurement Branch at the FCC Laboratory in Columbia, MD**.**

1.2 Measurement Procedure:

All measurements were performed according to ANSI C63.10:2013 and recommended FCC procedure of measurement of DTS operating under Section 15.249. A list of the measurement equipment can be found in Section 6.

1.3 Uncertainty Budget:

The uncertainty in EMC measurements arises from several factors which affect the results, some associated with environmental conditions in the measurement room, the test equipment being used, and the measurement techniques adopted.

The measurement uncertainty budgets detailed below are calculated from the test and calibration data and are expressed with a 95% confidence factor using a coverage factor of k=2. The Uncertainty for a laboratory are referred to as *U*lab. For Radiated and Conducted Emissions, the Expanded Uncertainty is compared to the *U*cispr values to determine if a specific margin is required to deem compliance.

*U*lab

Measurement Range	Combined Uncertainty	Expanded Uncertainty
Radiated Emissions <1 GHz @ 3m	2.54	5.07dB
Radiated Emissions <1 GHz @ 10m	2.55	5.09dB
Radiated Emissions 1 GHz to 2.7 GHz	1.81	3.62dB
Radiated Emissions 2.7 GHz to 18 GHz	1.55	3.10dB
AC Power Line Conducted Emissions, 150kHz to 30 MHz	1.38	2.76dB
AC Power Line Conducted Emissions, 9kHz to 150kHz	1.66	3.32dB

*U*cispr

Measurement Range	Expanded Uncertainty
Radiated Emissions <1 GHz @ 3m	5.2dB
Radiated Emissions <1 GHz @ 10m	5.2dB
Radiated Emissions 1 GHz to 2.7 GHz	Under Consideration
Radiated Emissions 2.7 GHz to 18 GHz	Under Consideration
AC Power Line Conducted Emissions, 150kHz to 30 MHz	3.6dB
AC Power Line Conducted Emissions, 9kHz to 150kHz	4.0dB

If *U*lab is less than or equal to *U*cispr, then:
- compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

If *U*lab is greater than *U*cispr in table 1, then:
- compliance is deemed to occur if no measured disturbance, increased by (*U*lab – *U*cispr), exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance, increased by (*U*lab – *U*cispr), exceeds the disturbance limit.

Note: Only measurements listed in the tables above that relate to tests included in this Test Report are applicable.

1.4 Document History:

Document Number	Description	Issue Date	Approved By
F2P20567A-01E	First Issue	May 9, 2019	K. Littell

2 SUMMARY OF TEST RESULTS

Test Name	Standard(s)	Results
-20dB Occupied Bandwidth	CFR 47 Part 15.215(c)	Complies
Field Strength of Emissions	CFR 47 Part 15.249(a)(d)	Complies
Variation of the Input Power	CFR 47 Part 15.231(e)	Complies
Conducted Emissions	CFR 47 Part 15.207(a)	Complies

Modifications Made to the Equipment
None

3 TABLE OF MEASURED RESULTS

Test			Low Channel 2412 MHz	Mid Channel 2442 MHz	High Channel 2462 MHz
-20dB Occupied Bandwidth (MHz)	CCK11		15.504	15.423	15.389
	OFDM54		18.732	18.555	18.450
	HT20		18.297	18.571	18.447
Average Field Strength of Fundamental	CCK11		7.04 mV/m 76.96 dBµV/m	7.85 mV/m 77.9 dBµV/m	7.41 mV/m 77.4 dBµV/m
	OFDM54		6.76 mV/m 76.6 dBµV/m	5.69 mV/m 75.1 dBµV/m	5.07 mV/m 74.1 dBµV/m
	HT20		5.5 mV/m 74.8 dBµV/m	5.01 mV/m 74.0 dBµV/m	5.56 mV/m 74.9 dBµV/m
Average Limit for Fundamental			50 millivolts/meter (93.97 dBµV/m)	50 millivolts/meter (93.97 dBµV/m)	50 millivolts/meter (93.97 dBµV/m)
Peak Limit for Fundamental			(113.97dBuV/m)	(113.97dBuV/m)	(113.97dBuV/m)
Voltage Variations	CCK11	3.3V	9.074 dBm 2.412 GHz	8.072 dBm 2.441775 GHz	12.92 dBm 2.461775 GHz
		@ 85%	8.845 dBm 2.41275 GHz	8.072 dBm 2.441775 GHz	12.92 dBm 2.461775 GHz
		@ 115%	9.074 dBm 2.412 GHz	8.072 dBm 2.441775 GHz	12.92 dBm 2.461775 GHz
	OFDM54	3.3V	6.143 dBm 2.410575 GHz	6.759 dBm 2.441325 GHz	5.44 dBm 2.461025 GHz
		@ 85%	6.143 dBm 2.410575 GHz	5.034 dBm 2.44125 GHz	5.44 dBm 2.461025 GHz
		@ 115%	6.143 dBm 2.410575 GHz	5.09 dBm 2.440575 GHz	6.421 dBm 2.460425 GHz
	HT20	3.3V	6.093 dBm 2.411025 GHz	6.867 dBm 2.441325 GHz	6.649 dBm 2.4629 GHz
		@ 85%	6.059 dBm 2.410425 GHz	4.855 dBm 2.441475 GHz	4.742 dBm 2.46275 GHz
		@ 115%	6.093 dBm 2.411025 GHz	6.867 dBm 2.441325 GHz	5.506 dBm 2.4638 GHz

4 ENGINEERING STATEMENT

This report has been prepared on behalf of Avnet Inc. to provide documentation for the testing described herein. This equipment has been tested and found to comply with part 15.249 of the FCC Rules using ANSI C63.10 2013 standard. The test results found in this test report relate only to the items tested.

5 EUT INFORMATION AND DATA

5.1 Equipment Under Test:

Product: Azure Sphere MT3620 Modules
Model: AES-MS-MT360-M-G
Serial No.: 0002B501E625
FCC ID: 2AF62-AVT3620C

5.2 Trade Name:

Avnet Inc.

5.3 Power Supply:

3.3V DC

5.4 Applicable Rules:

CFR 47, Part 15.249

5.5 Equipment Category:

Radio Transmitter-DTS

5.6 Antenna:

2.2dBi Gain Integral Antenna

5.7 Accessories:

PC: Dell 15-3000, ser. no. 8486780294
Charger: Dell OKXITW

5.8 Test Item Condition:

The equipment to be tested was received in good condition.

5.9 Testing Algorithm:

Transmitter was operated in the Continuous mode. Measurements were taken on low, mid and high channels in each appropriate band and on each applicable modulation.

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6 LIST OF MEASUREMENT INSTRUMENTATION

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Spectrum Analyzer	CL147	Agilent	E7402A	MY45101241	Jan. 25, 2020
Spectrum Analyzer	CL138	Agilent Technologies	E4407B	US41192779	June 19, 2019
LISN	CL181	Com-Power	LI-125A	191226	July 3, 2021
LISN	CL182	Com-Power	LI-125A	191225	July 3, 2021
Shielded Chamber 2014	CL166-E	AlbatrossProjects	B83117-DF435-T261	US140023	Aug. 30, 2019
Shield Room	0175-3V	Ray Proof	N/A	11645	May 31, 2019
Temp/Hum. Recorder	CL234	Extech	445814	03	Mar. 22, 2019
Receiver	CL151	Rohde & Schwarz	ESU40	100319	Oct. 25, 2019
Receiver	CL204	Rohde & Schwarz	ESR7	101714	Oct. 29, 2019
Antenna, JB3 Combination	CL175	Sunol Sciences	JB3	A030315	Oct. 11, 2019
Horn Antenna	CL098	Emco	3115	9809-5580	Jan. 31, 2021
Antenna, Horn	CL114	A. H. Systems, Inc.	SAS-572	237	Feb. 4, 2021
Pre-Amplifier	0197	Hewlett Packard	8447D	1726A01006	Oct. 25, 2019
Pre-Amplifier	CL153	Agilent	83006-69007	MY39500791	Aug. 24, 2019
Antenna, Horn	CL188	Com-Power	AH-640	091065	June 16, 2019
Antenna, 18” Active Loop	CL194	A.H. Systems, Inc.	SAS-562B	281	May 23, 2020
Software:	Tile Version 3.4.B.3.		Software Verified: Mar. 11-12, 2019		
Software:	EMC 32, Version 8.53.0		Software Verified: Mar. 11-12, 2019		

7 OCCUPIED BANDWIDTH

7.1 Requirements:

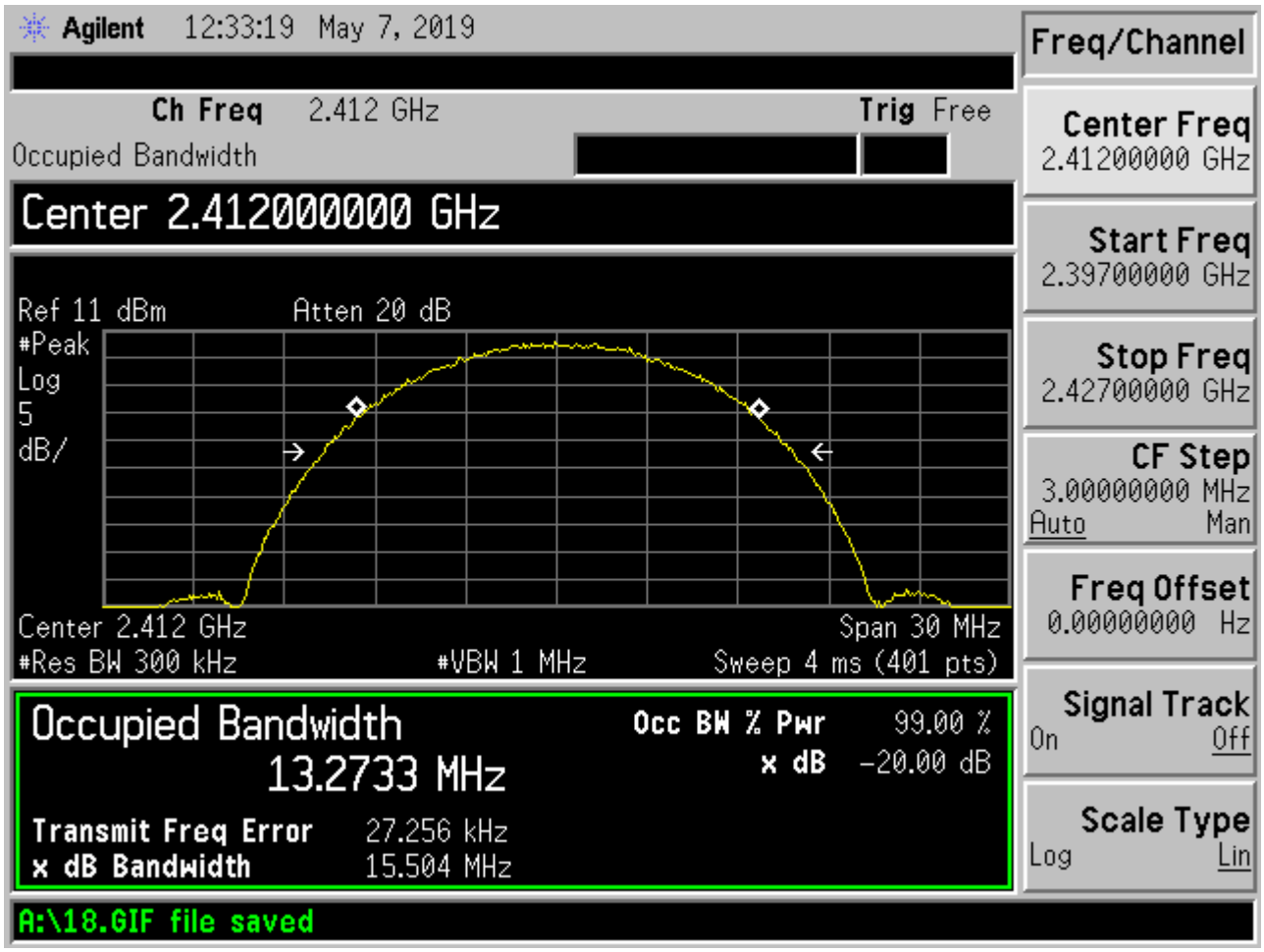
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the -20dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

Bandwidth measurements were made at the low, mid and high frequencies. The bandwidth was measured using the analyzer's marker function.

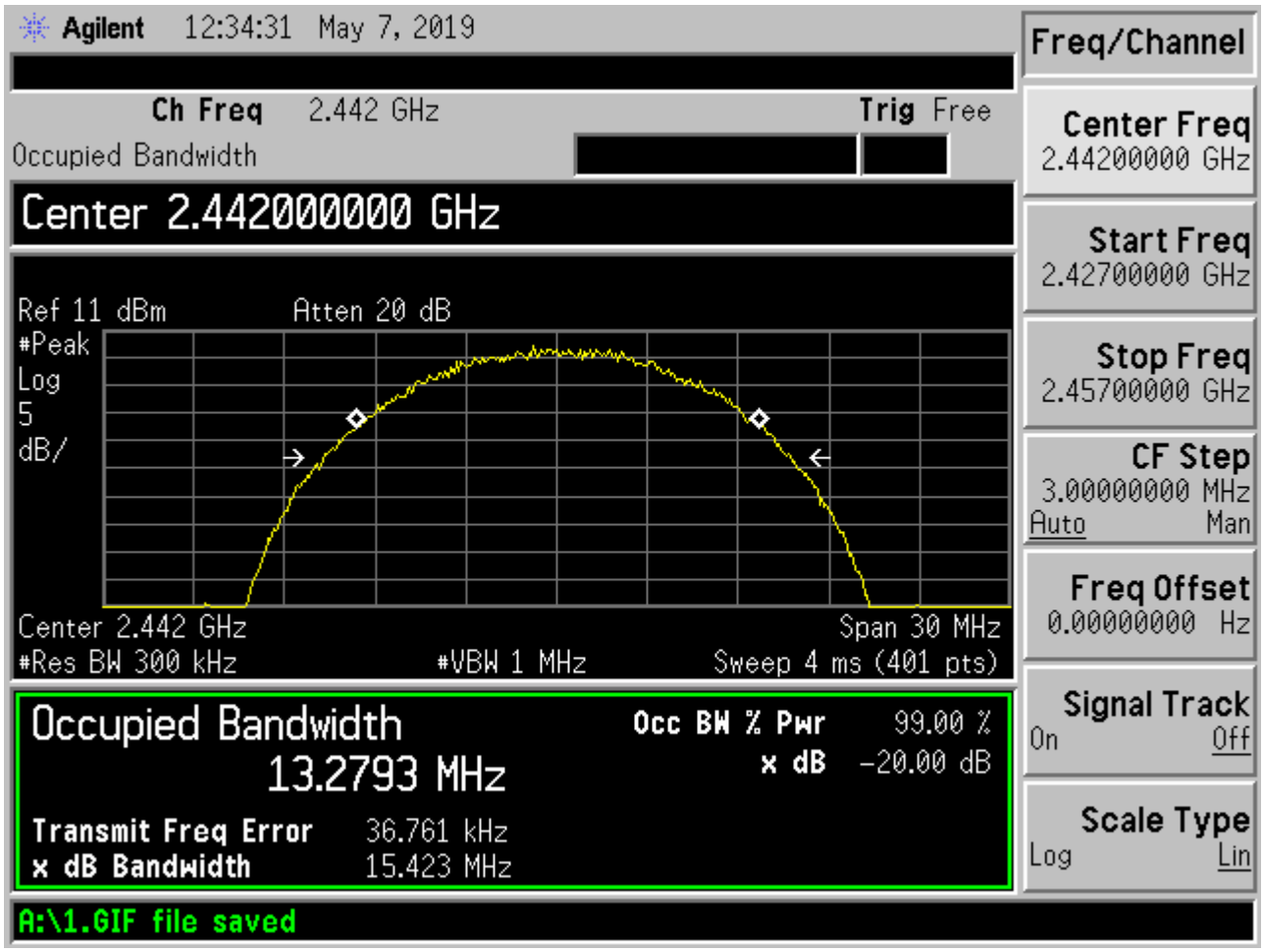
7.2 Occupied Bandwidth Test Data

Test Date(s):	May 7, 2019	**Test Engineer(s):**	J. Chiller
Standards:	CFR 47 Part 15.215(c)	**Air Temperature:**	21.2ºC
		Relative Humidity:	43%

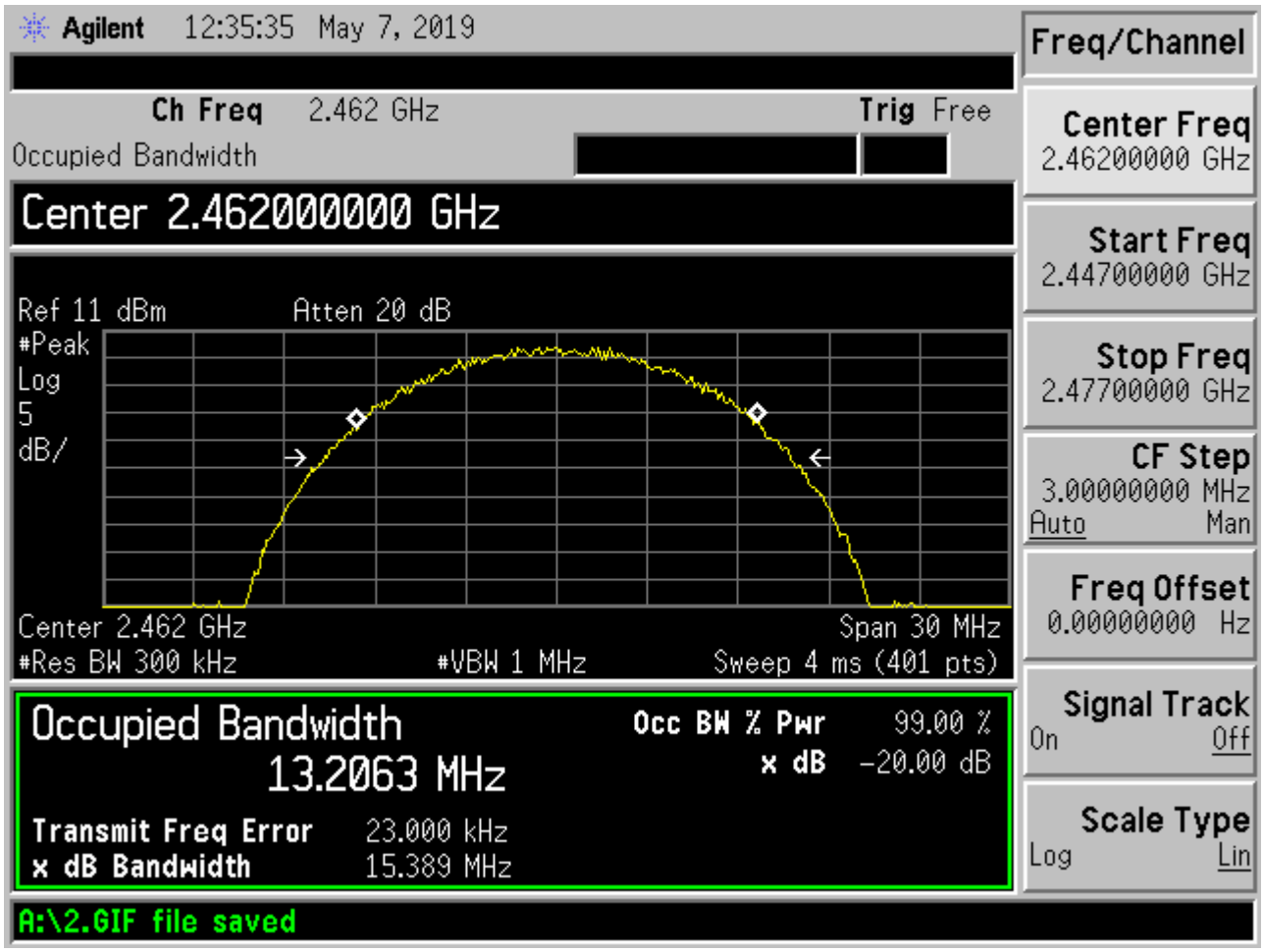
-20dB, CCK11: Low Channel



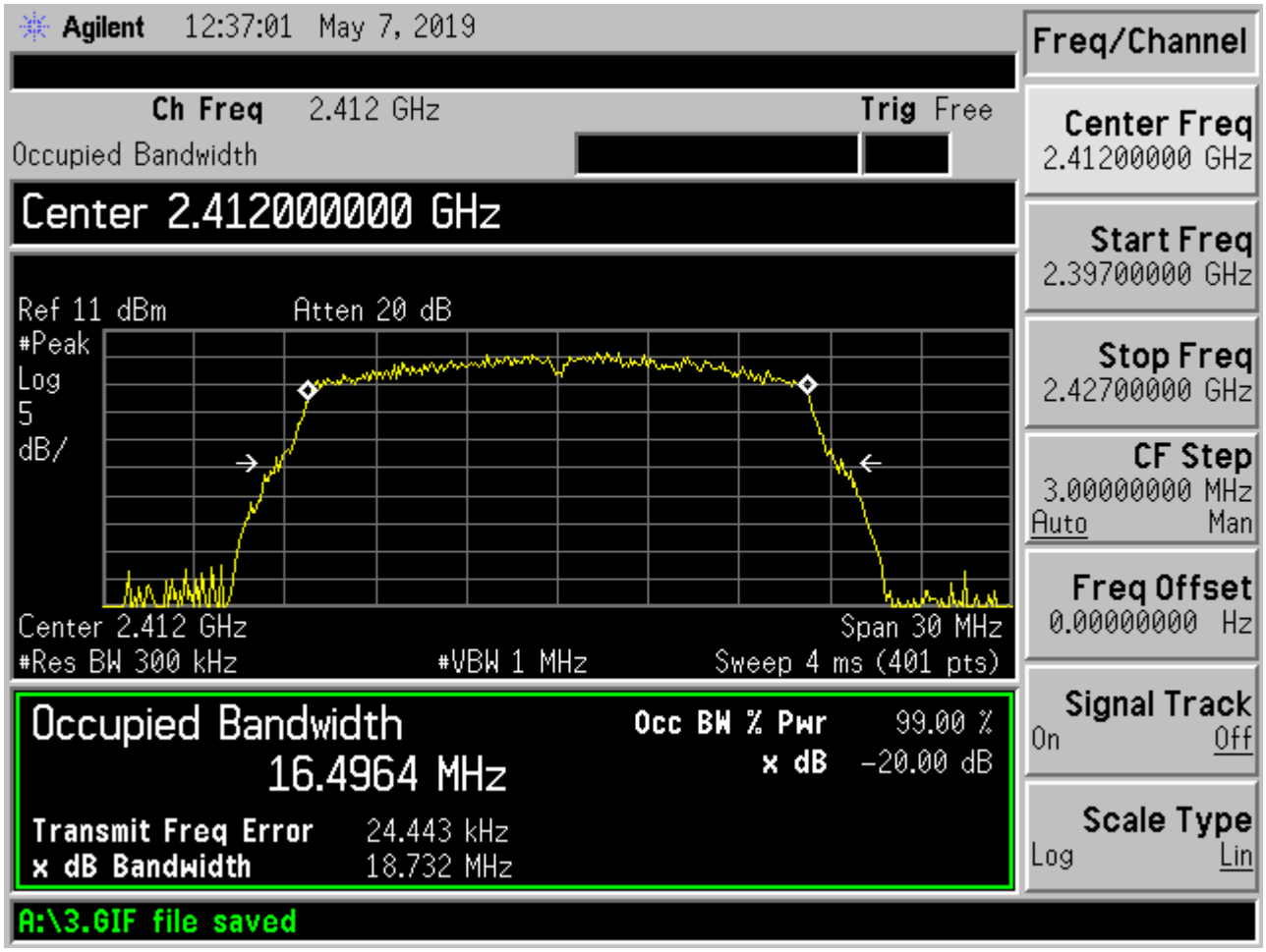
-20dB, CCK11: Mid Channel



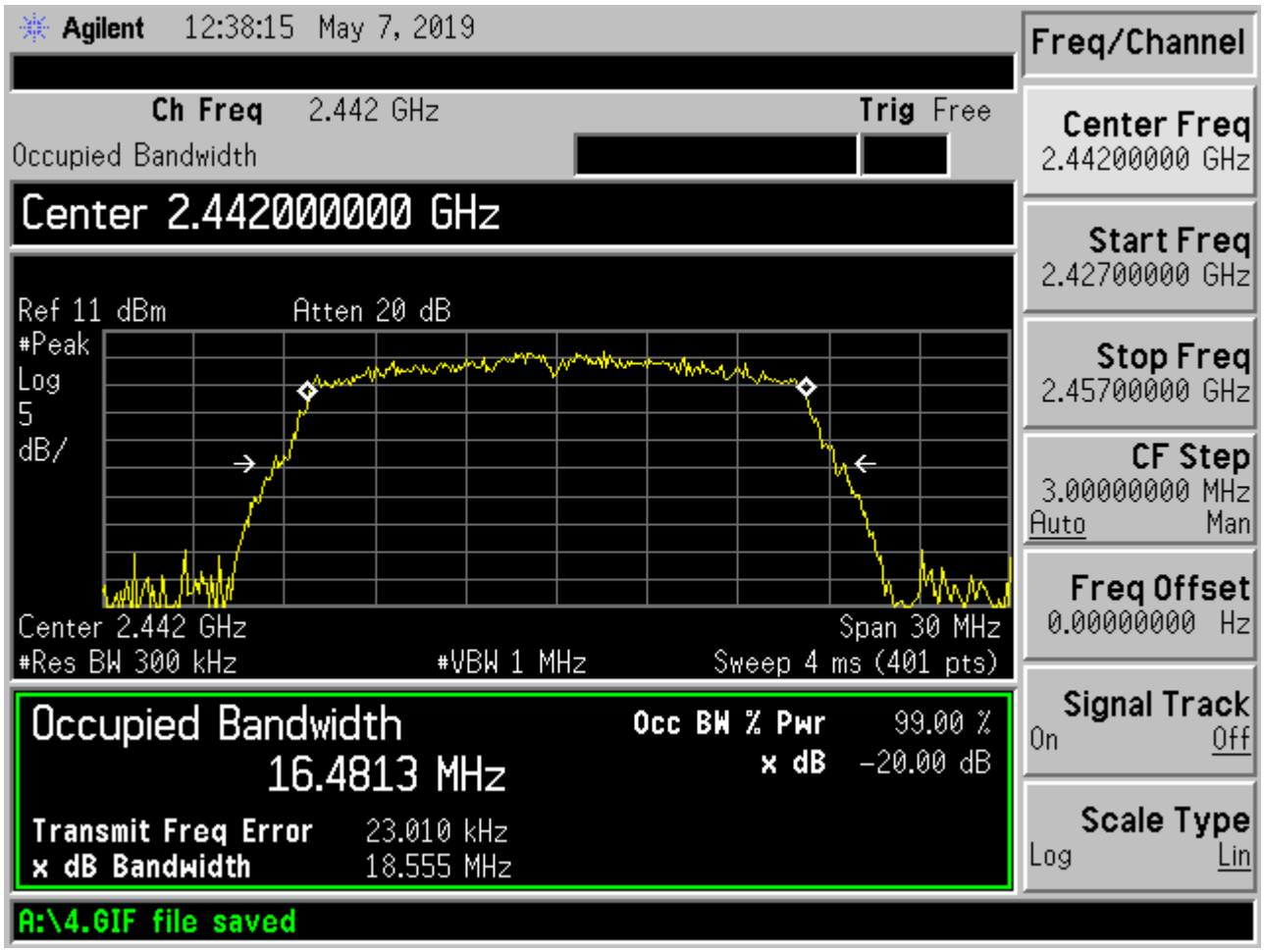
-20dB, CCK11: High Channel



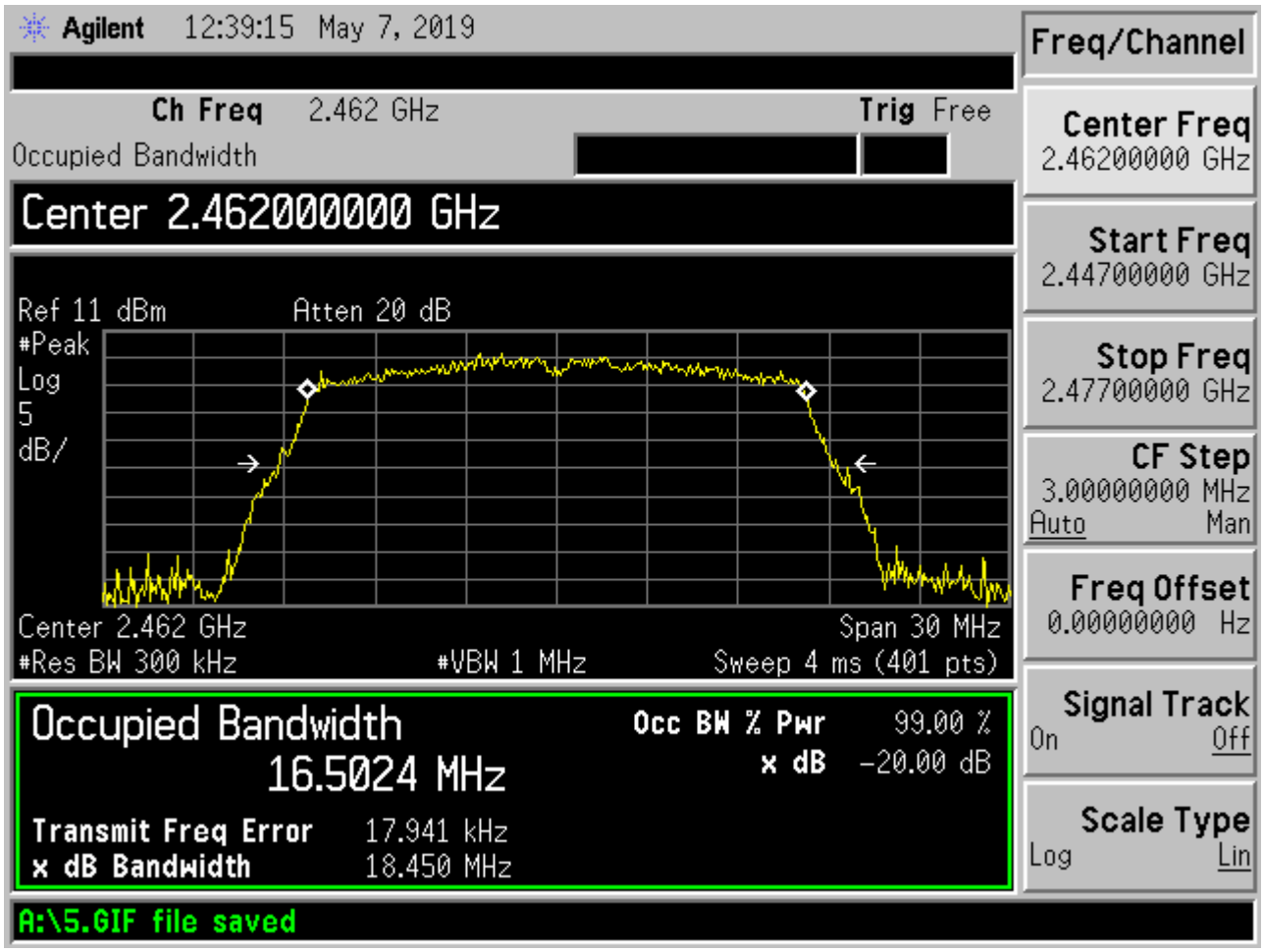
-20dB, OFDM54: Low Channel



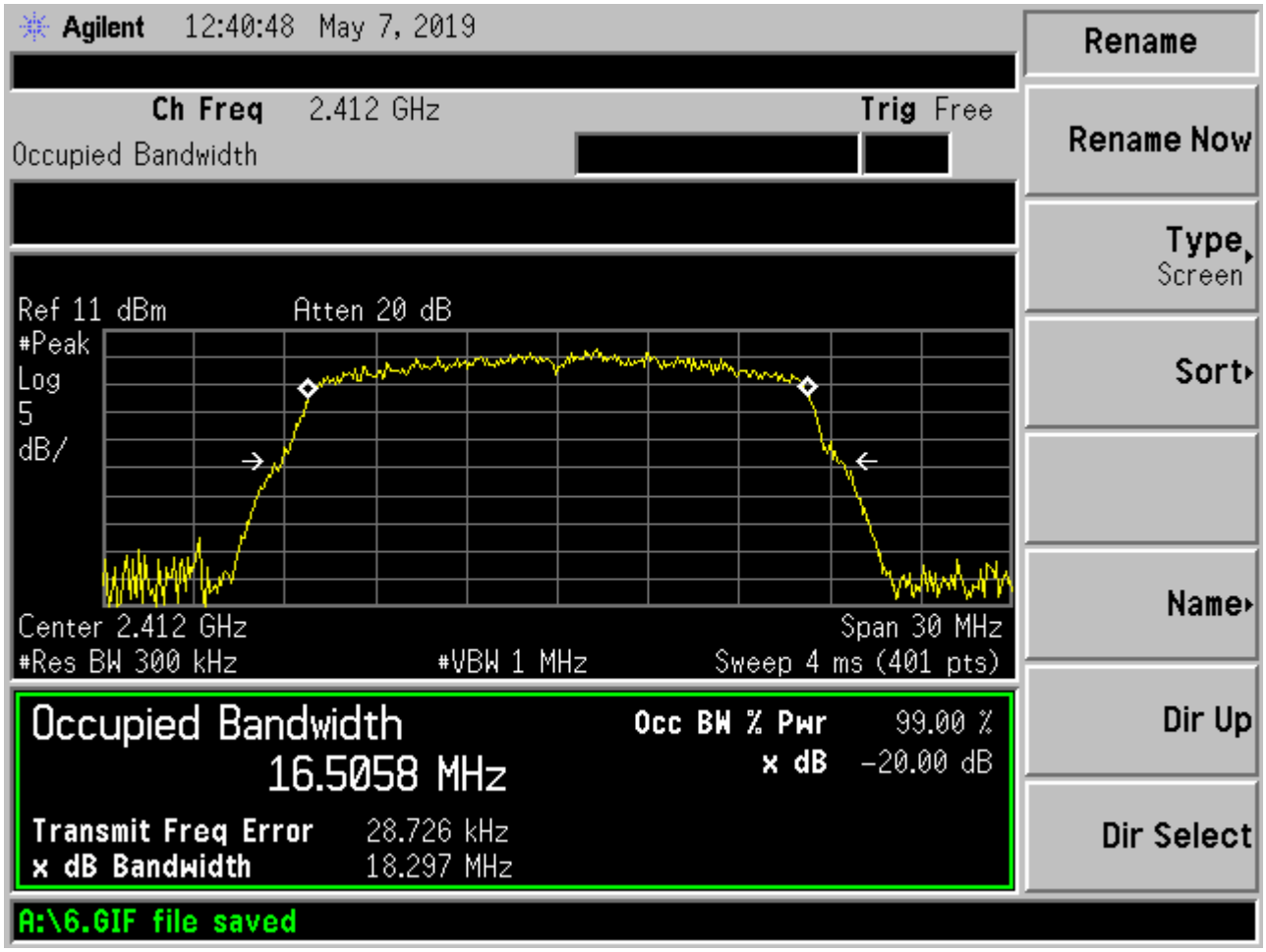
-20dB, OFDM54: Mid Channel



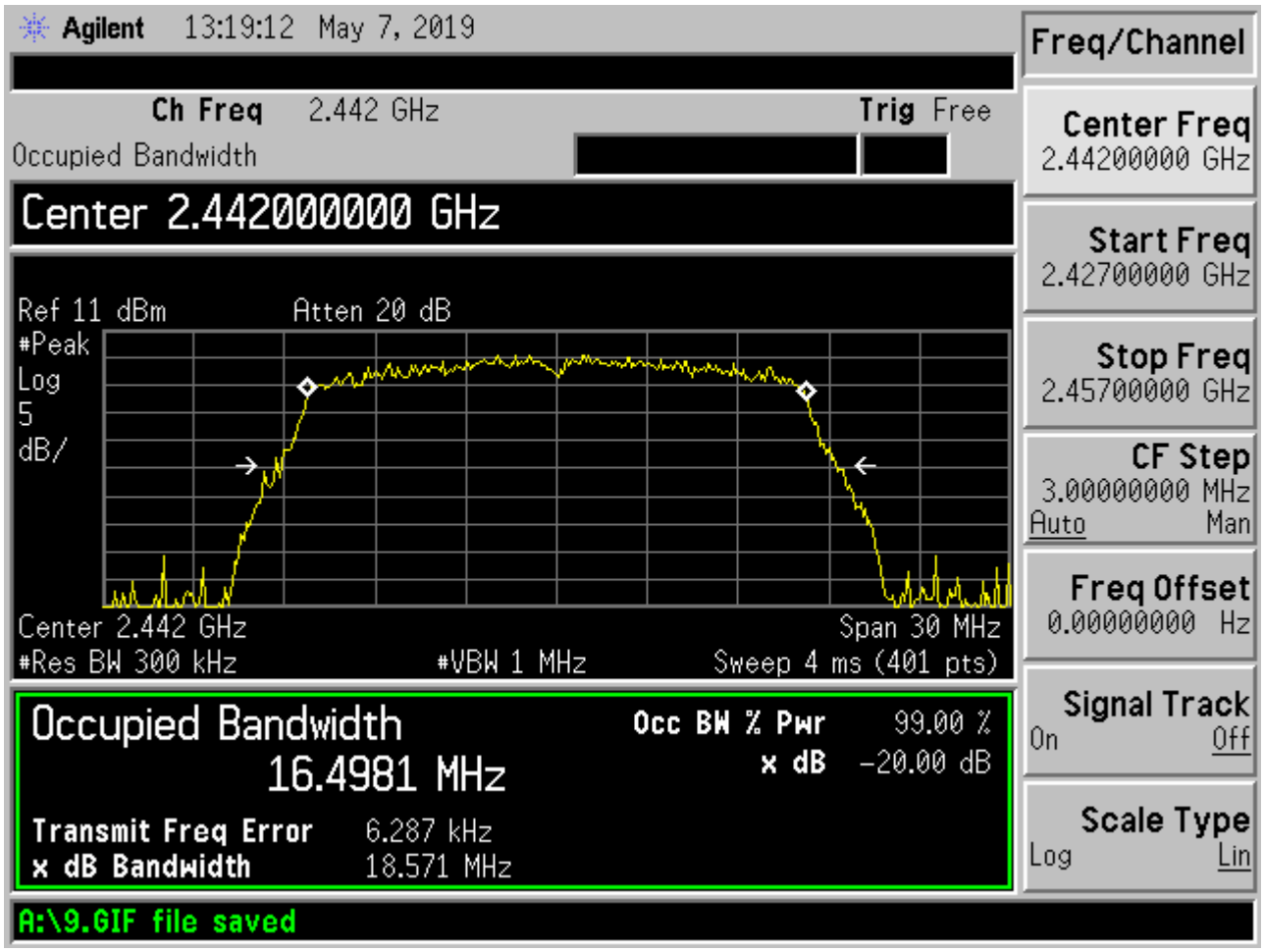
-20dB, OFDM54: High Channel



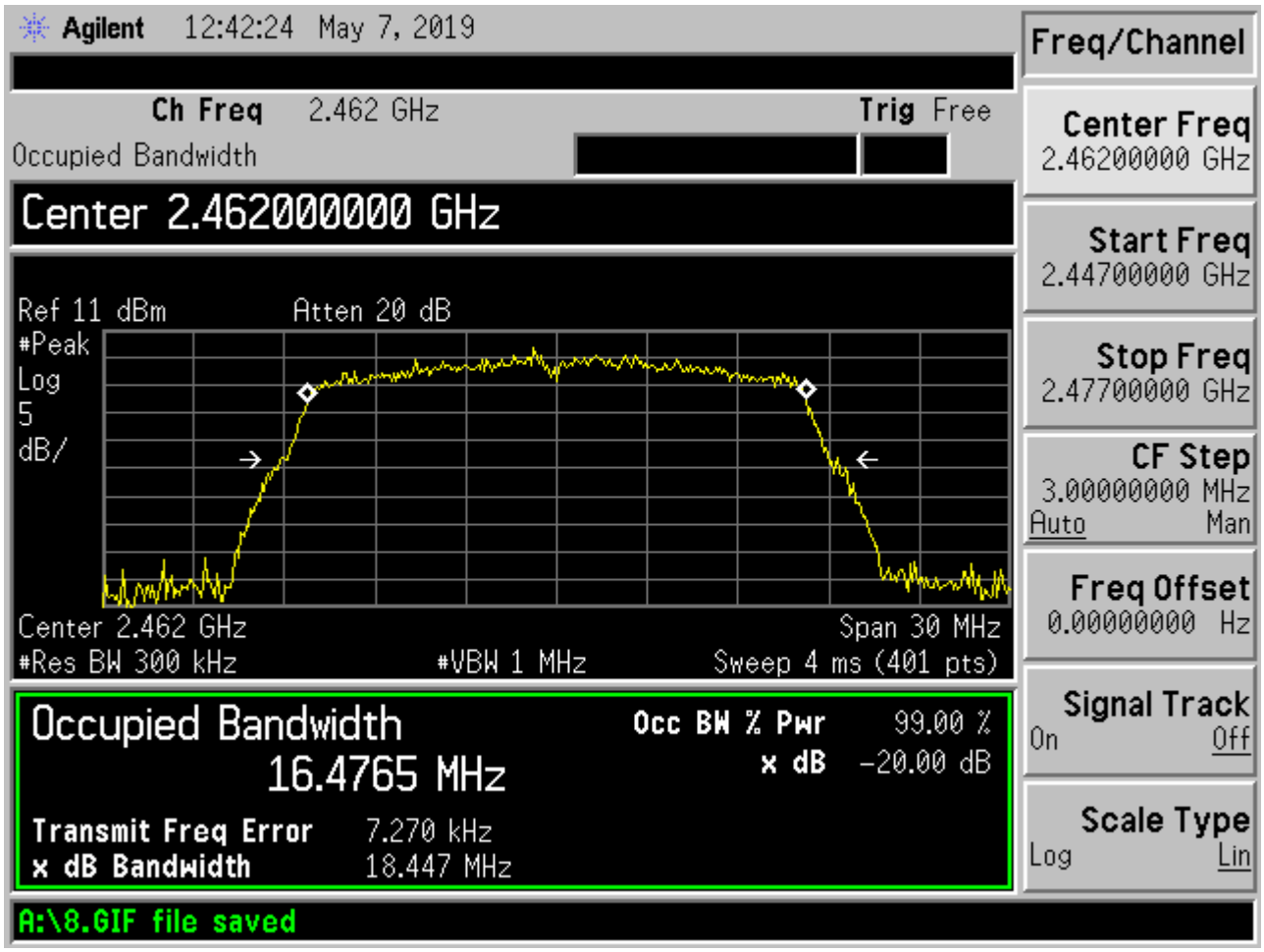
-20dB, HT20: Low Channel



-20dB, HT20: Mid Channel



-20dB, HT20: High Channel



8 FIELD STRENGTH OF EMISSIONS FROM INTENTIONAL RADIATORS

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

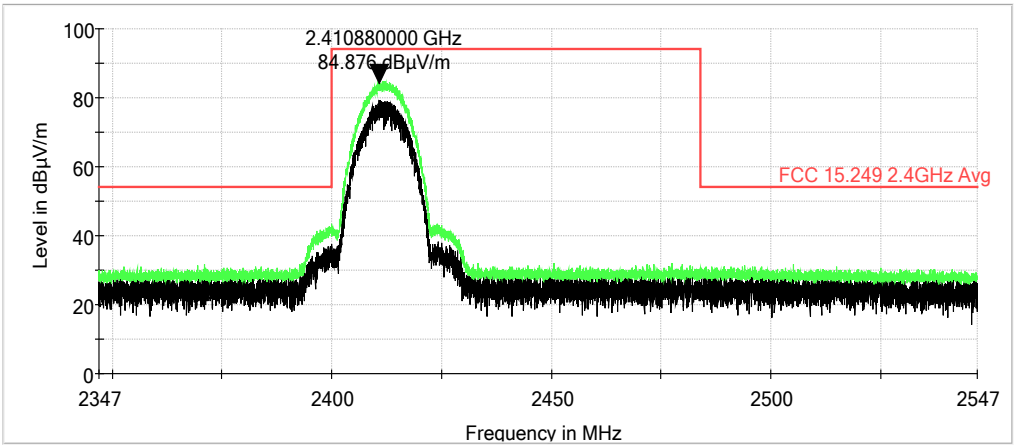
NOTE: During the pre-scan evaluation, the EUT was rotated in all possible directions to find the maximum emissions. The orthogonal position that showed the highest emissions was used. The antenna was raised between 1 and 4 meters and the EUT turntable was rotated 360 degrees to maximize the emissions.

The pre-scans were taken using a Max-Peak detector and indicate the maximum peak emissions are below the Average limit.

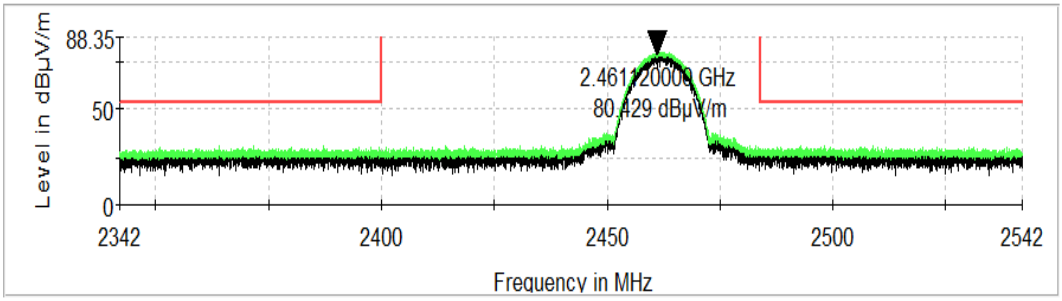
8.1 Test Data - Field Strength of Emissions from Intentional Radiators

Test Date(s):	Mar. 11, 2019	**Test Engineer(s):**	J. Chiller
Standards:	CFR 47 Part 15.249(a)	**Air Temperature:**	24.5ºC
		Relative Humidity:	22%

CCK11: Low Channel, Vertical

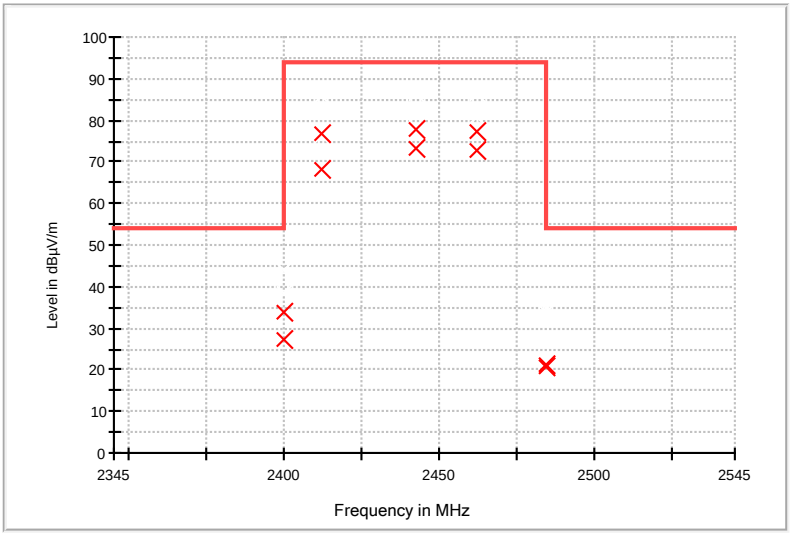


CCK11: High Channel, Vertical

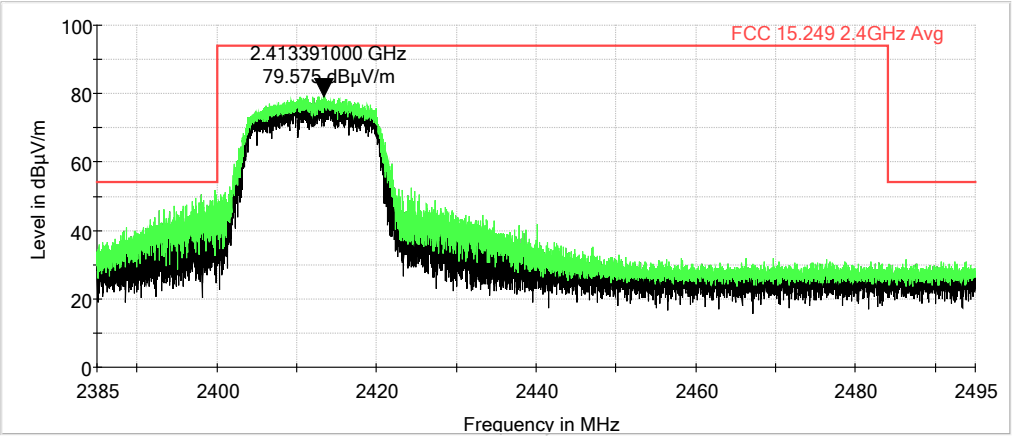


CCK11: Measurements – Field and Band Edge

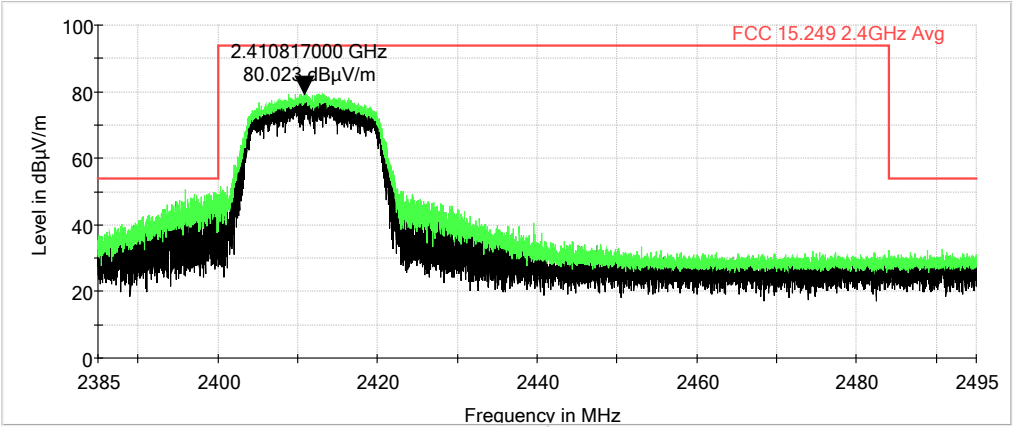
Frequency (MHz)	Polarity	Amtenna Height (cm)	Azimuth (deg)	Corr. (dB)	Average (dBµV/m)	Average (dBµV/m) Limit	Average Margin	Bandwidth (kHz)
2400.000000	H	150.0	335.0	-4.70	27.2	54	-26.8	1000.000
2400.000000	V	150.0	98.0	-4.70	34	54	-20.0	1000.000
2412.000000	V	150.0	98.0	-4.60	77	94	-17.0	1000.000
2412.000000	H	150.0	335.0	-4.60	68.4	94	-25.6	1000.000
2442.000000	H	245.0	335.0	-4.30	73.4	94	-20.6	1000.000
2442.000000	V	150.0	98.0	-4.30	77.9	94	-16.1	1000.000
2462.000000	H	280.0	335.0	-4.40	72.6	94	-21.4	1000.000
2462.000000	V	150.0	98.0	-4.40	77.4	94	-16.6	1000.000
2484.000000	H	280.0	335.0	-4.20	20.7	54	-33.3	1000.000
2484.000000	V	150.0	98.0	-4.20	21.5	54	-32.5	1000.000



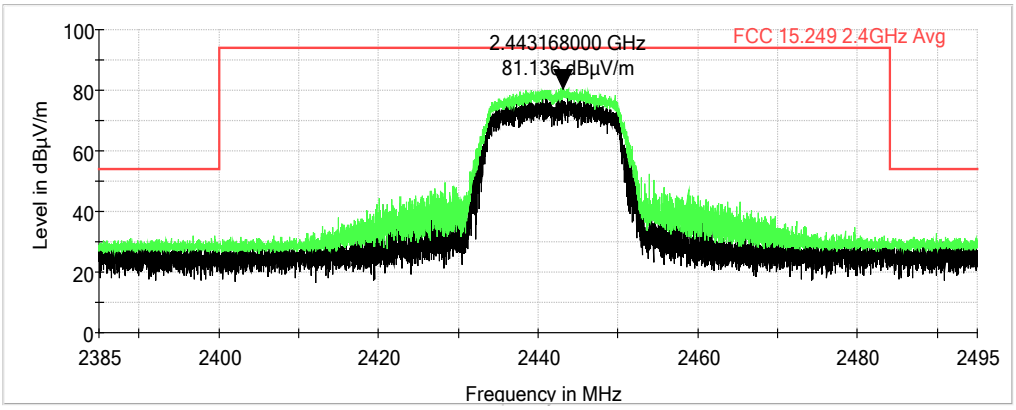
OFDM54: Low Channel, Horizontal



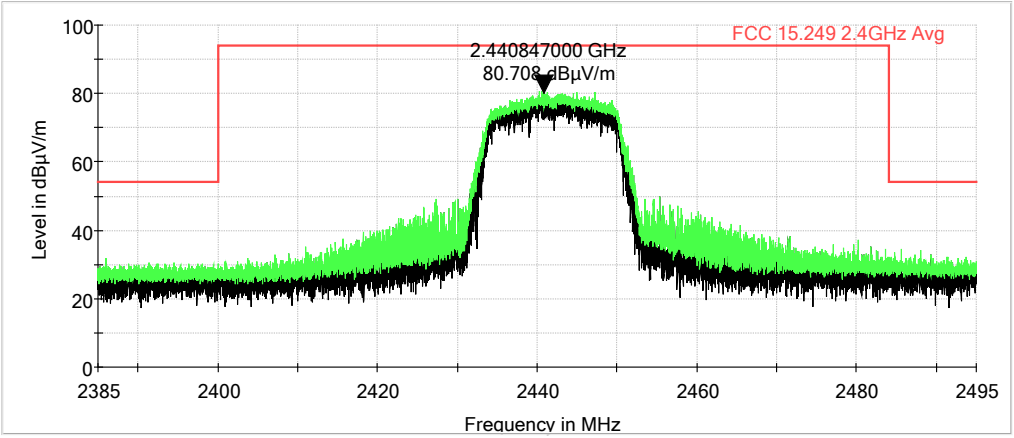
OFDM54: Low Channel, Vertical



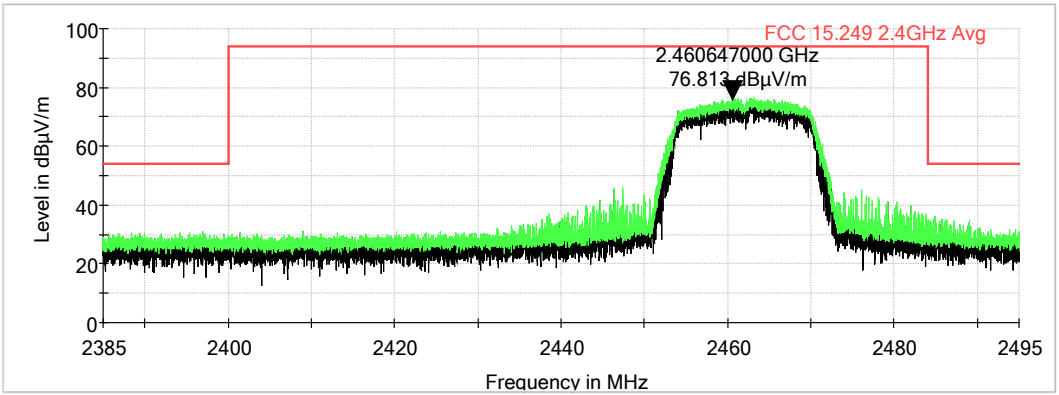
OFDM54: Mid Channel, Horizontal



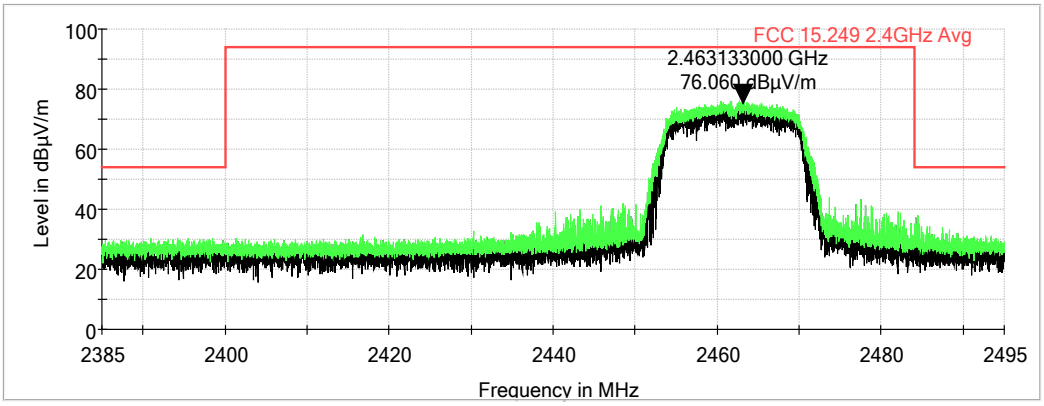
OFDM54: Mid Channel, Vertical



OFDM54: High Channel, Horizontal

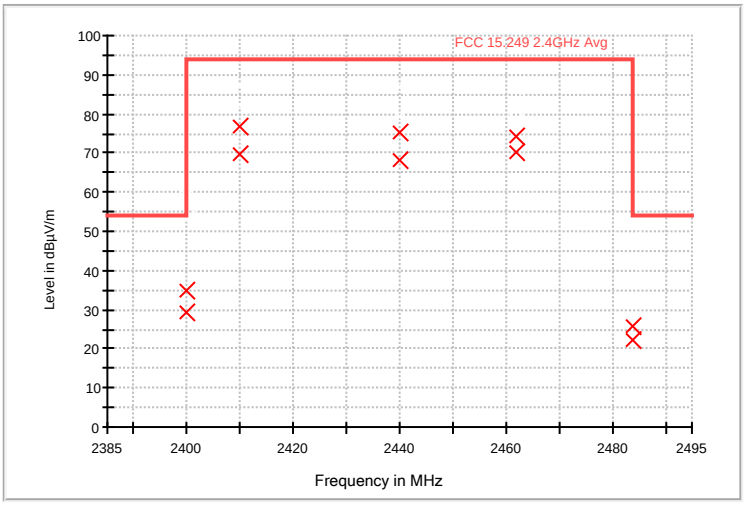


OFDM54: High Channel, Vertical

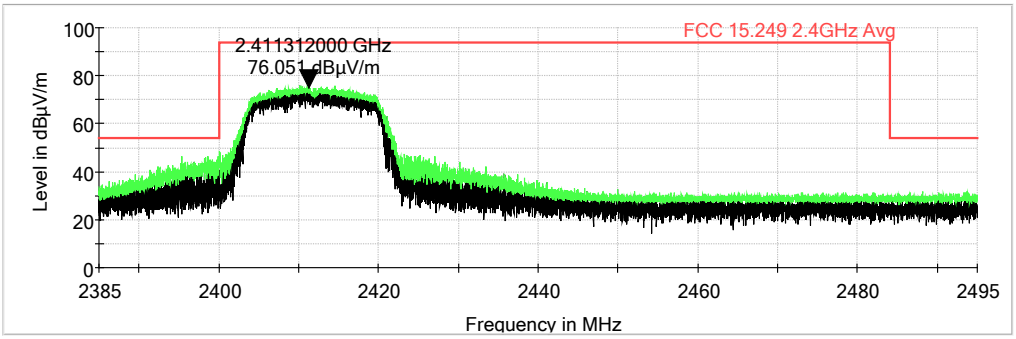


OFDM54: Measurements – Field and Band Edge

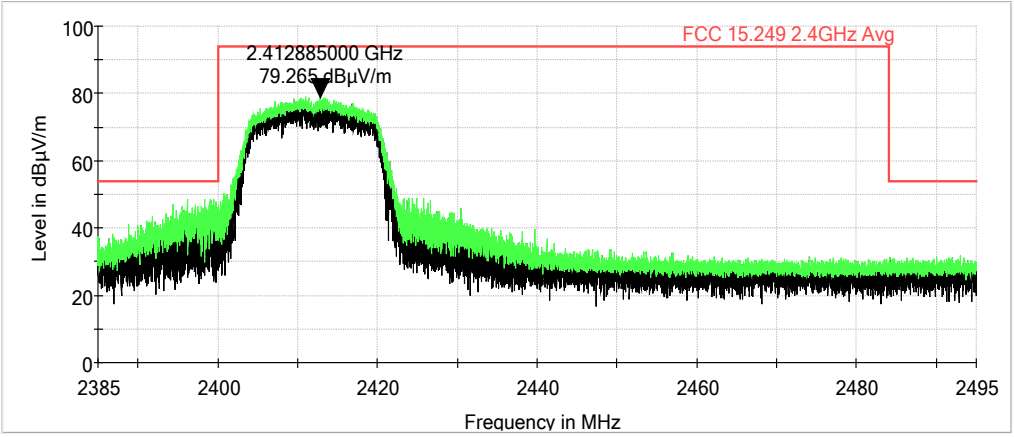
Frequency (MHz)	Polarity	Amtenna Height (cm)	Azimuth (deg)	Corr. (dB)	Average (dBµV/m)	Average (dBµV/m) Limit	Average Margin	Bandwidth (kHz)
2400.000000	V	150.0	98.0	-4.70	35	54	-19.0	1000.000
2400.000000	H	208.0	332.0	-4.70	29.4	54	-24.6	1000.000
2410.000000	H	208.0	332.0	-4.60	69.9	94	-24.1	1000.000
2410.000000	V	150.0	98.0	-4.60	76.6	94	-17.4	1000.000
2440.000000	H	208.0	333.0	-4.30	68.3	94	-25.7	1000.000
2440.000000	V	150.0	98.0	-4.30	75.1	94	-18.9	1000.000
2462.000000	V	150.0	98.0	-4.40	74.1	94	-19.9	1000.000
2462.000000	H	250.0	333.0	-4.40	70	94	-24.0	1000.000
2484.000000	H	208.0	325.0	-4.20	22.1	54	-31.9	1000.000
2484.000000	V	150.0	98.0	-4.20	26	54	-28.0	1000.000



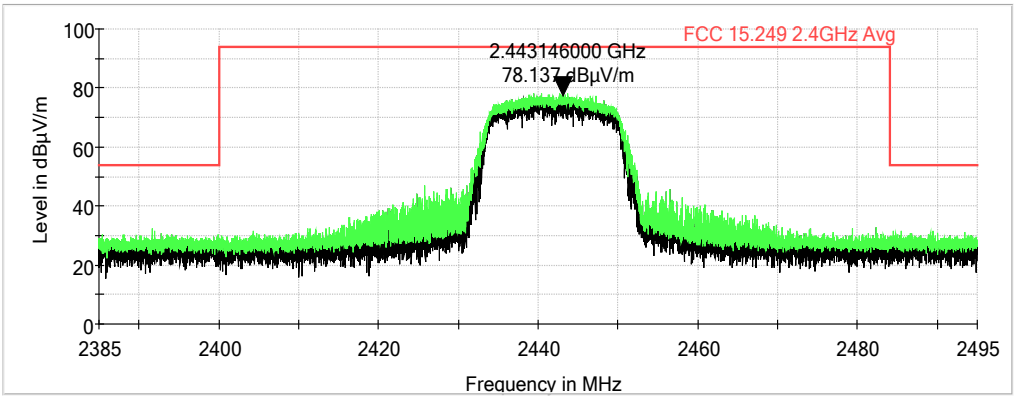
HT20: Low Channel, Horizontal



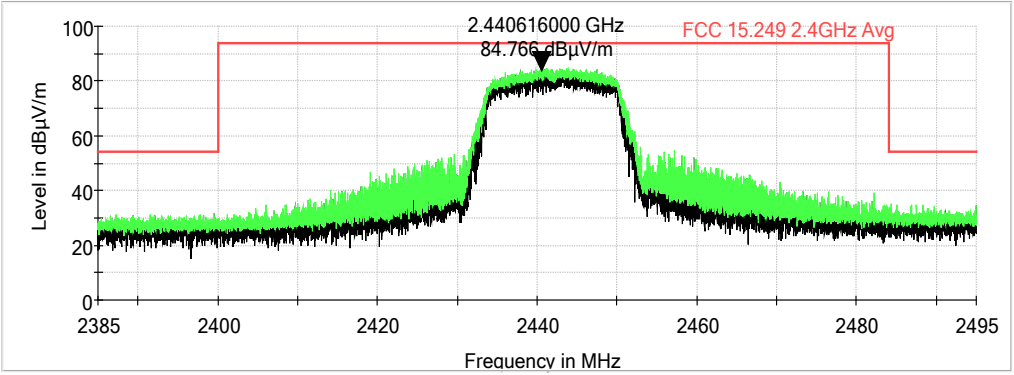
HT20: Low Channel, Vertical



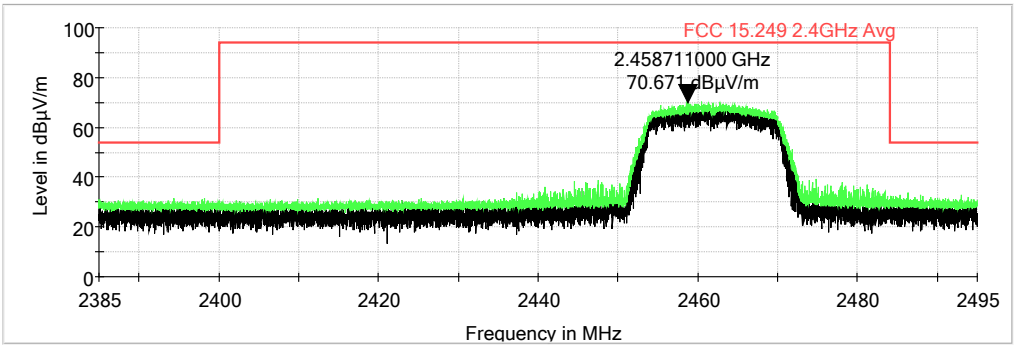
HT20: Mid Channel, Horizontal



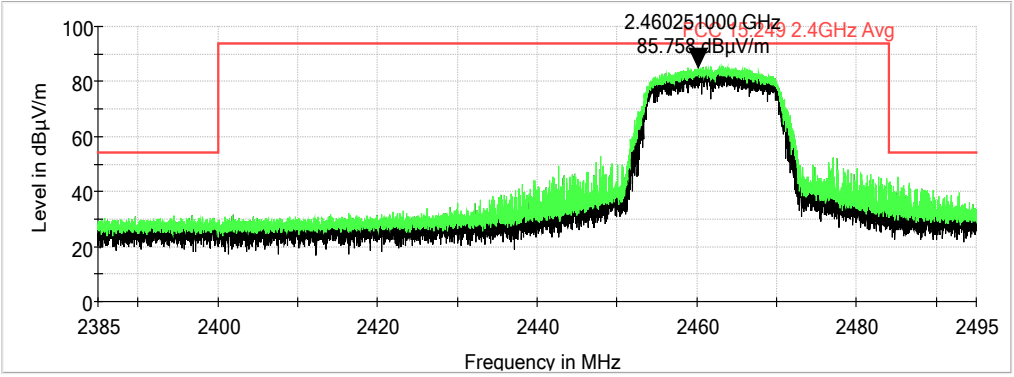
HT20: Mid Channel, Vertical



HT20: High Channel, Horizontal

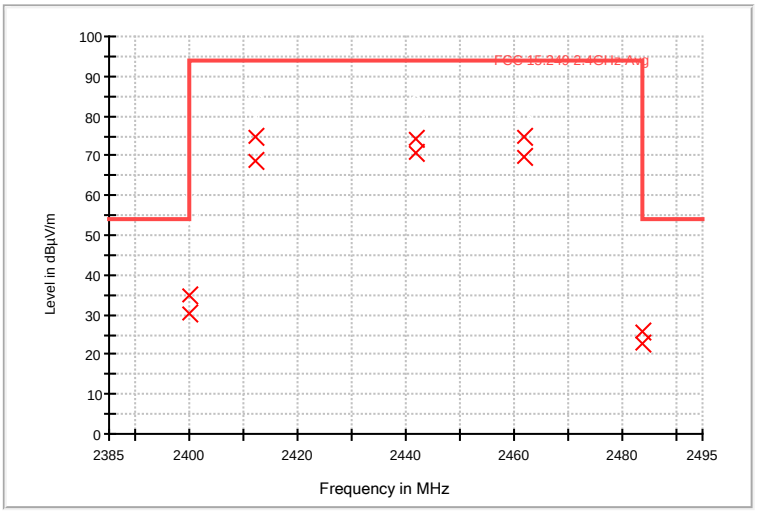


HT20: High Channel, Vertical



HT20: Measurements – Field and Band Edge

Frequency (MHz)	Polarity	Amtenna Height (cm)	Azimuth (deg)	Corr. (dB)	MaxPeak Margin	Average (dBµV/m)	Average (dBµV/m) Limit	Average Margin	Bandwidth (kHz)
2400.000000	V	150.0	98.0	-4.70	58.4	35.1	54	-18.9	1000.000
2400.000000	H	210.0	330.0	-4.70	53.2	30.2	54	-23.8	1000.000
2412.000000	H	210.0	330.0	-4.60	79.9	68.5	94	-25.5	1000.000
2412.000000	V	150.0	98.0	-4.60	86.2	74.8	94	-19.2	1000.000
2442.000000	V	150.0	85.0	-4.30	85.3	74	94	-20.0	1000.000
2442.000000	H	230.0	328.0	-4.30	82.0	70.7	94	-23.3	1000.000
2462.000000	H	230.0	328.0	-4.40	81.2	69.9	94	-24.1	1000.000
2462.000000	V	150.0	85.0	-4.40	86.6	74.9	94	-19.1	1000.000
2484.000000	H	230.0	328.0	-4.20	42.5	22.6	54	-31.4	1000.000
2484.000000	V	150.0	85.0	-4.20	48.0	25.8	54	-28.2	1000.000



8.2 Test Data – Spurious Emissions

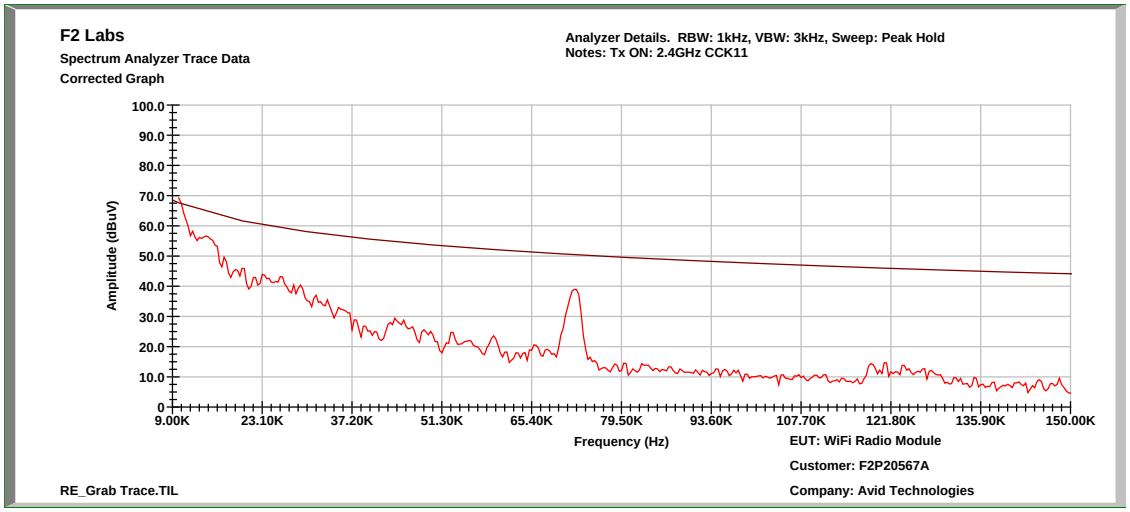
Notes: Plots are peak, max hold pre-scan data included only to determine what frequencies to investigate and measure. During the pre-scan evaluation, the EUT was rotated in all possible directions to find the maximum emissions. The orthogonal position that showed the highest emissions was used. At some frequencies, no emissions from the EUT were measurable over the ambient noise floor. The readings did not change with EUT on and EUT off.

At least 6 of the highest frequencies were measured per ANSI 63.4 in a 3-meter anechoic chamber. Frequencies below 1GHz were measured using a quasi-peak detector. The antenna was raised between 1 and 4 meters and the EUT turntable was rotated 360 degrees to maximize the emissions. Some of the frequencies did not change with the EUT on or off. At those frequencies, the test distance was shortened to 1 meter and still no emissions from the EUT were visible or over the ambient or limit. Frequencies were scanned from 9kHz to 26 GHz and the highest emissions are listed below.

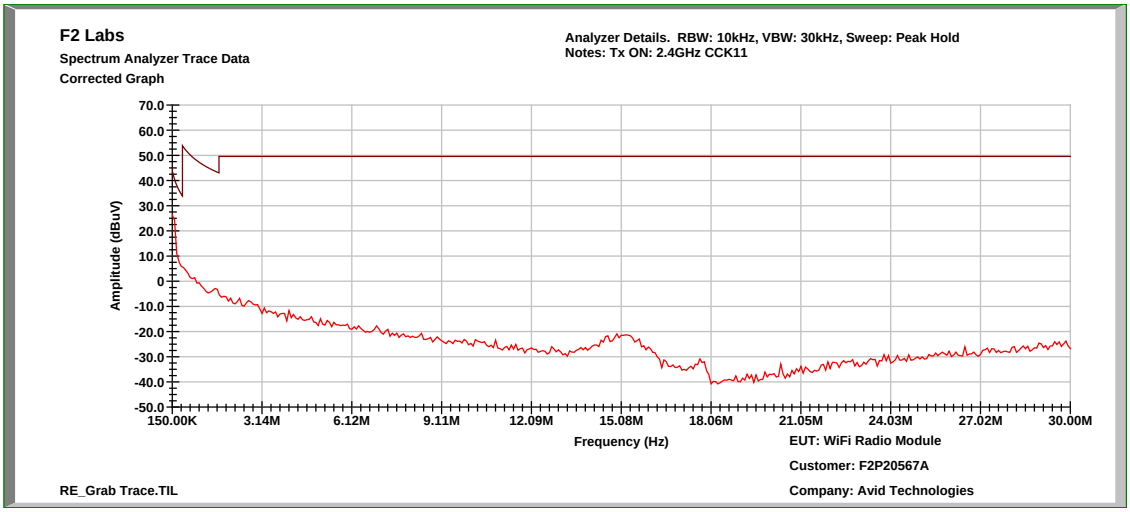
In the following plots, the black line indicates the active scan and the green line indicates the **MaxPk** level with the EUT on. Emissions to be found by the EUT were measured and presented in the data below.

Test Date(s):	Mar. 11, 2019	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.249(d) / Part 15.209	Air Temperature:	24.5ºC
		Relative Humidity:	22%

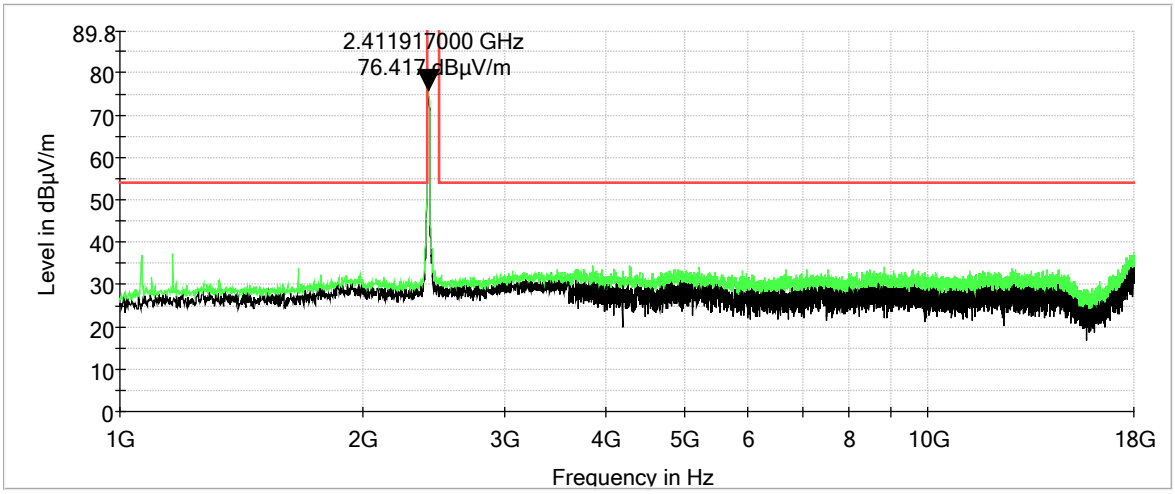
CCK11: Characterization Scan, Low Channel, 0.009 MHz to 0.15 MHz



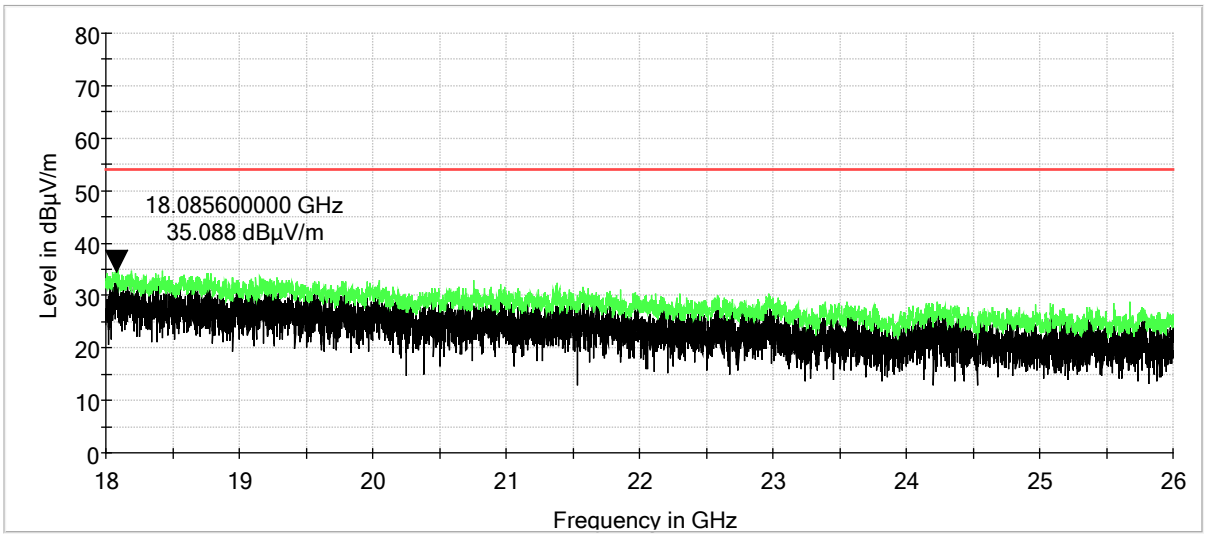
CCK11: Characterization Scan, Low Channel, 0.15 MHz to 30 MHz



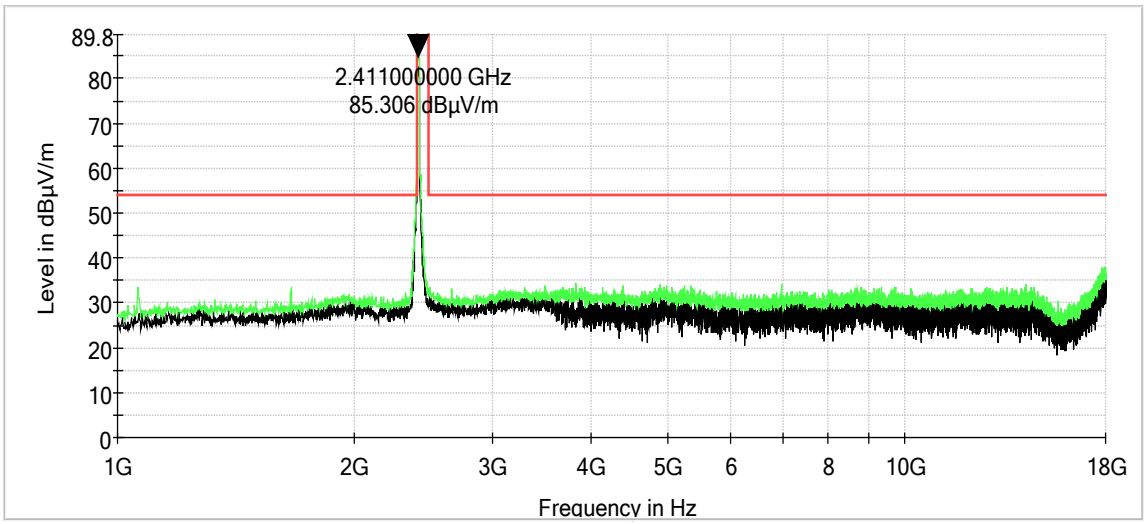
CCK11: Characterization Scan, Low Channel, 1 GHz to 18 GHz, Horizontal



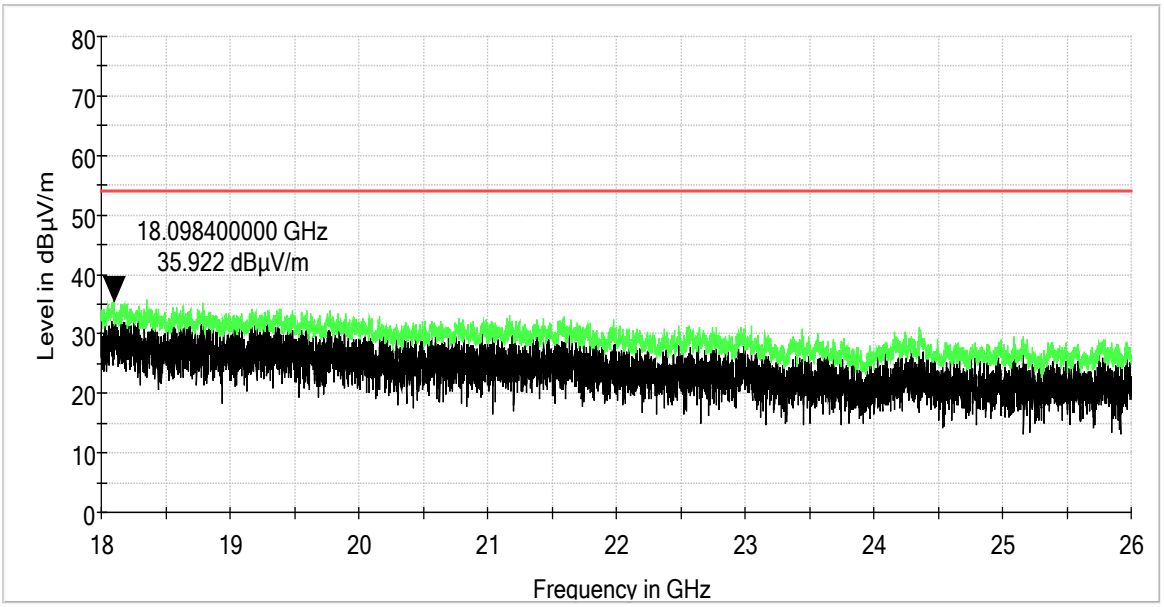
CCK11: Characterization Scan, Low Channel, 18 GHz to 26 GHz, Horizontal



CCK11: Characterization Scan, Low Channel, 1 GHz to 18 GHz, Vertical

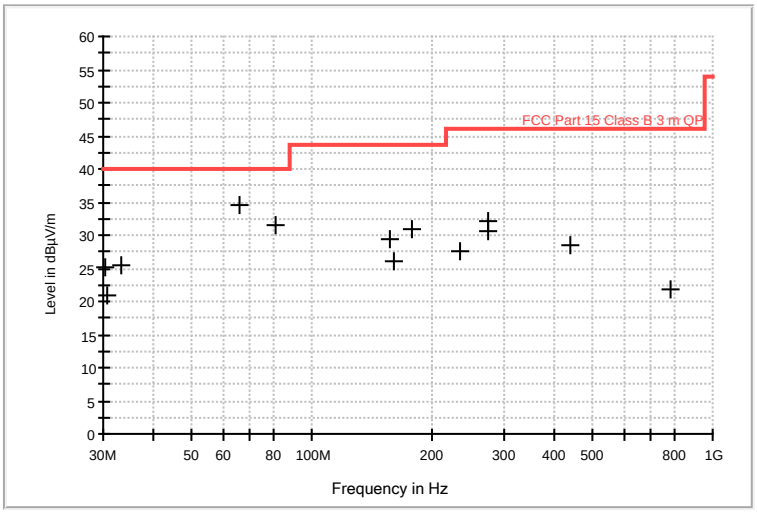


CCK11: Characterization Scan, Low Channel, 18 GHz to 26 GHz, Vertical

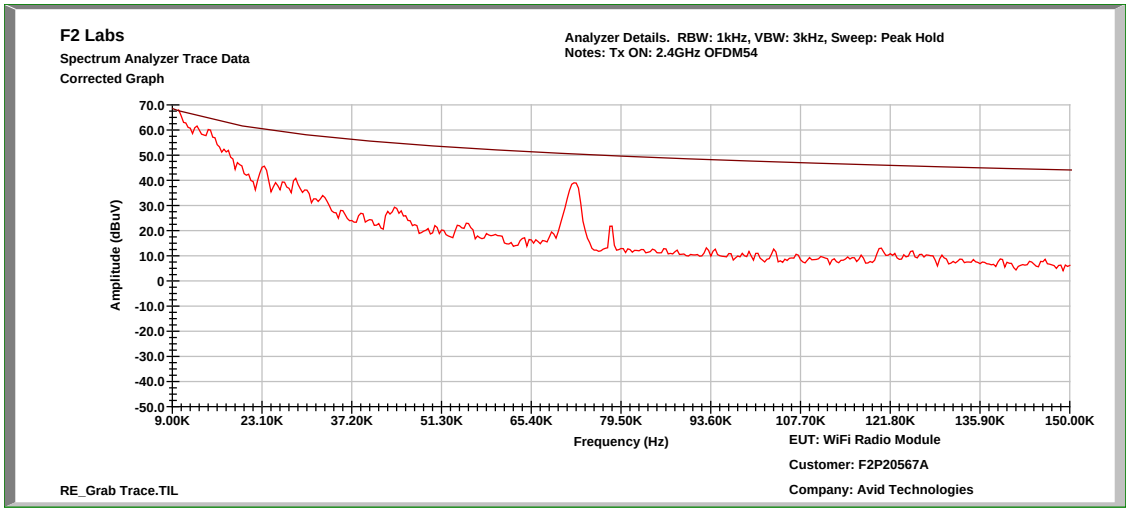


CCK11: Measurements - Low Channel, 30 MHz to 1000 MHz

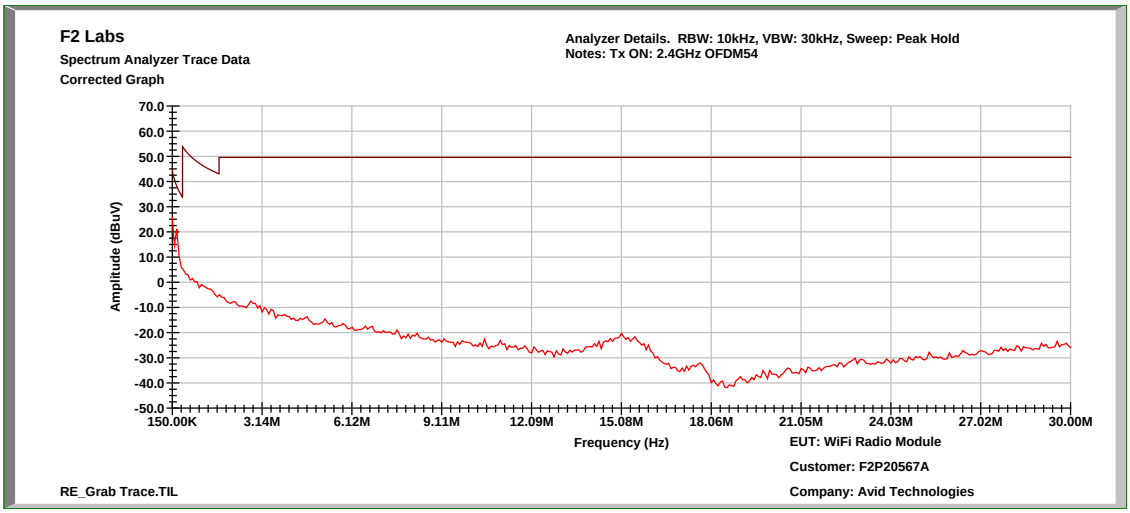
Frequency (MHz)	Antenna Polarization	Azimuth (degrees)	Reading (dBµV)	Correction Factors (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30.200000	V	357.00	25.1	5.3	30.40	40.0	-9.6
30.760000	H	3.00	20.9	4.9	25.80	40.0	-14.2
33.120000	V	66.00	25.4	3.0	28.40	40.0	-11.6
65.880000	V	110.00	34.6	-8.2	26.40	40.0	-13.6
81.200000	V	338.00	31.4	-8.4	23.00	40.0	-17.0
155.920000	H	297.00	29.4	-2.7	26.70	43.5	-16.8
159.800000	V	75.00	26.1	-2.8	23.30	43.5	-20.2
178.040000	H	242.00	30.9	-3.7	27.20	43.5	-16.3
232.520000	H	287.00	27.7	-2.8	24.90	46.0	-21.1
274.240000	V	339.00	32.1	-0.6	31.50	46.0	-14.5
276.200000	H	165.00	30.6	-0.6	30.00	46.0	-16.0
439.360000	H	182.00	28.4	3.3	31.70	46.0	-14.3
784.080000	V	356.00	21.8	9.5	31.30	46.0	-14.7



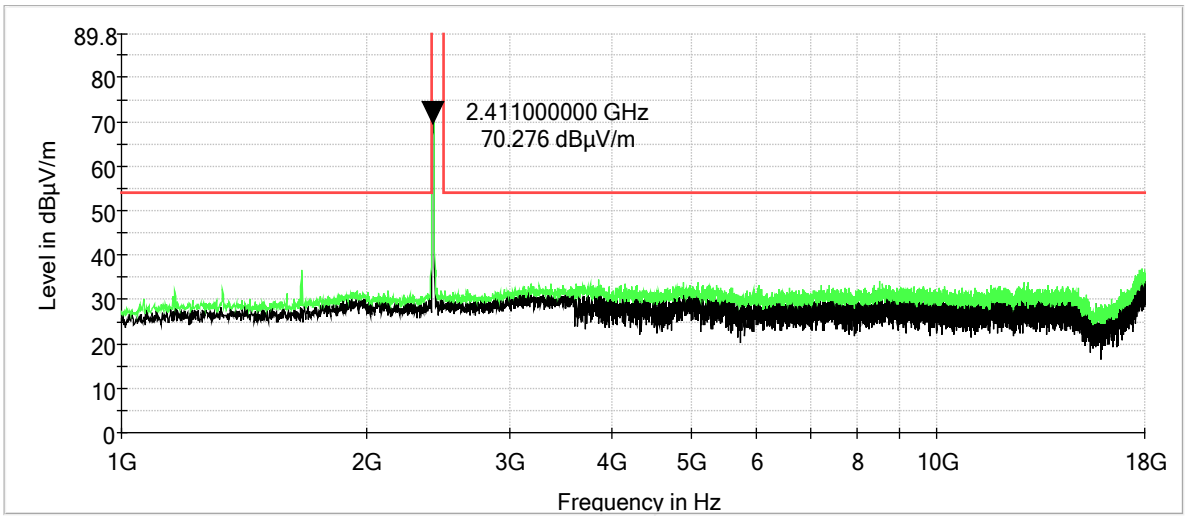
OFDM54: Characterization Scan, Low Channel, 0.009 MHz to 0.15 MHz



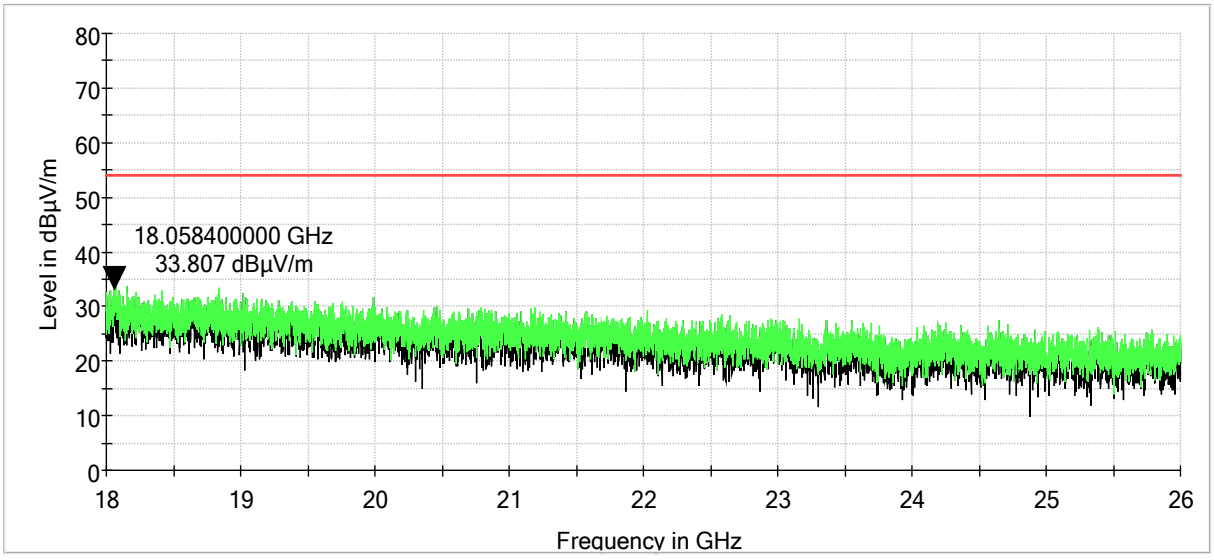
OFDM54: Characterization Scan, Low Channel, 0.15 MHz to 30 MHz



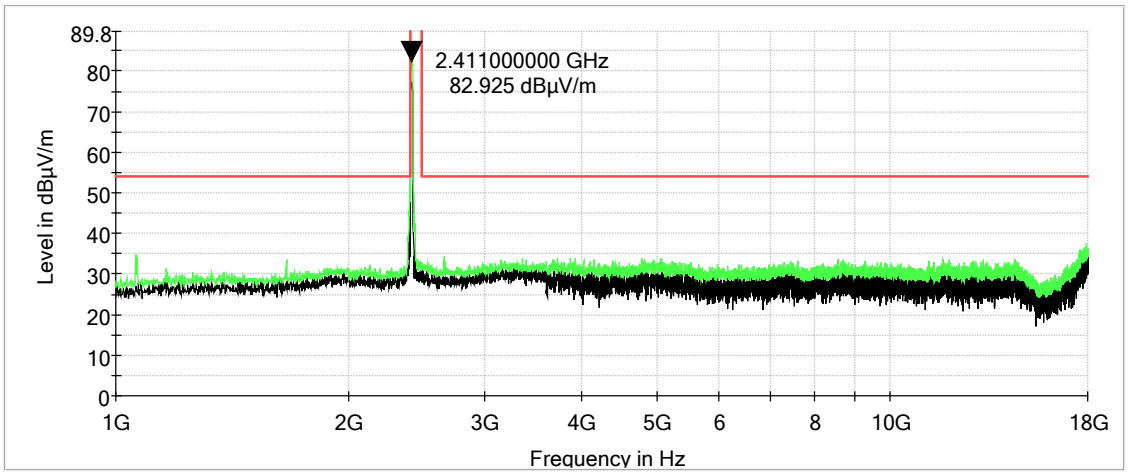
OFDM54: Characterization Scan, Low Channel, 1 GHz to 18 GHz, Horizontal



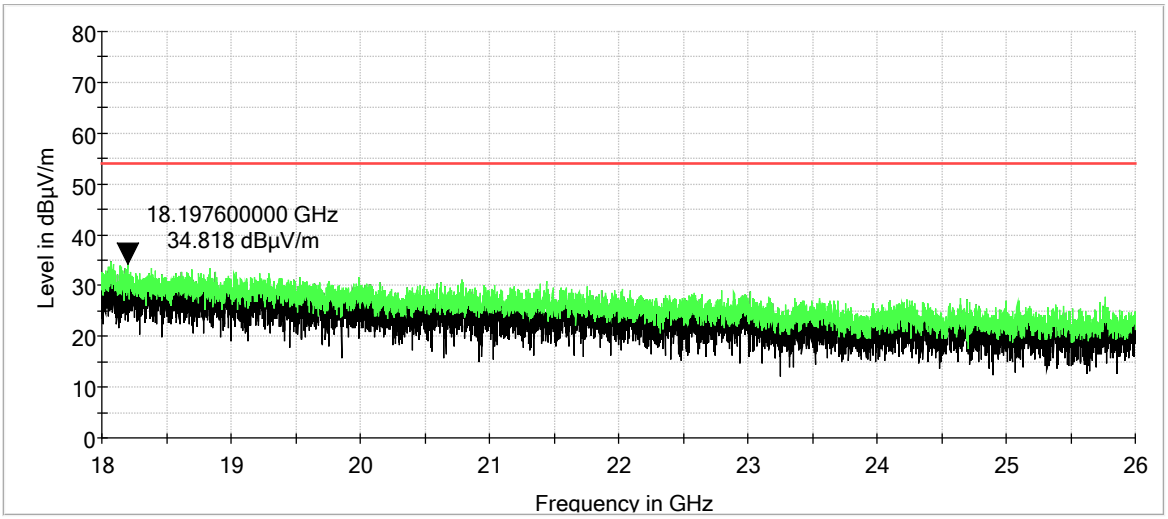
OFDM54: Characterization Scan, Low Channel, 18 GHz to 26 GHz, Horizontal



OFDM54: Characterization Scan, Low Channel, 1 GHz to 18 GHz, Vertical

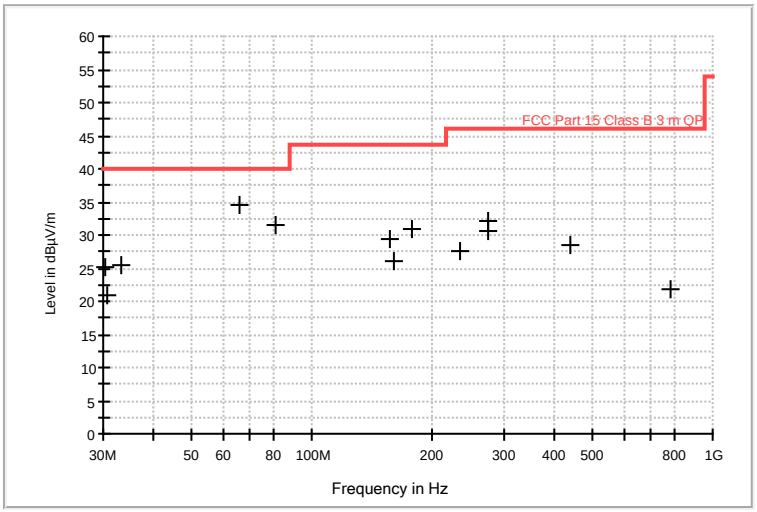


OFDM54: Characterization Scan, Low Channel, 18 GHz to 26 GHz, Vertical

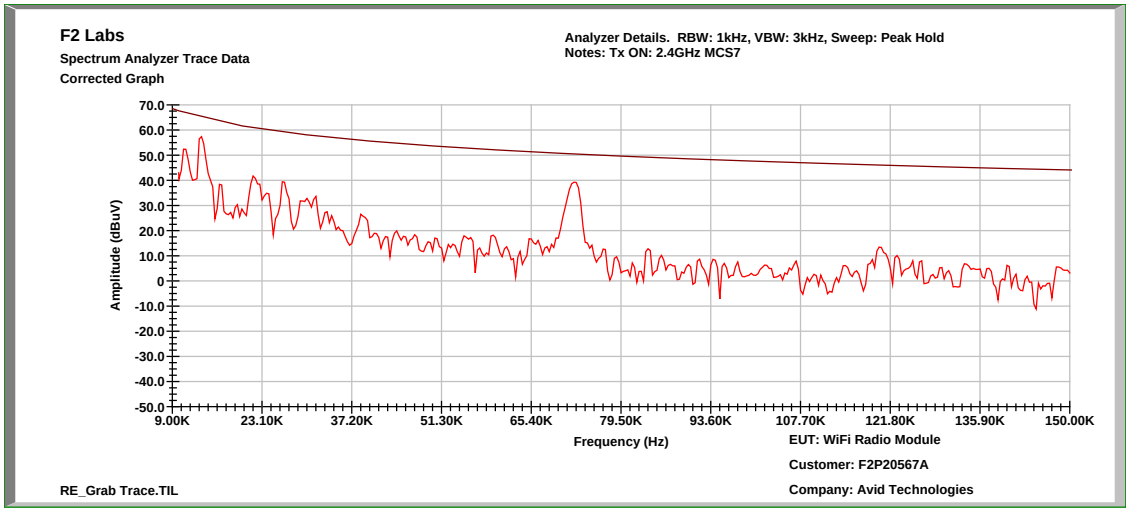


OFDM54: Measurements - Low Channel, 30 MHz to 1000 MHz

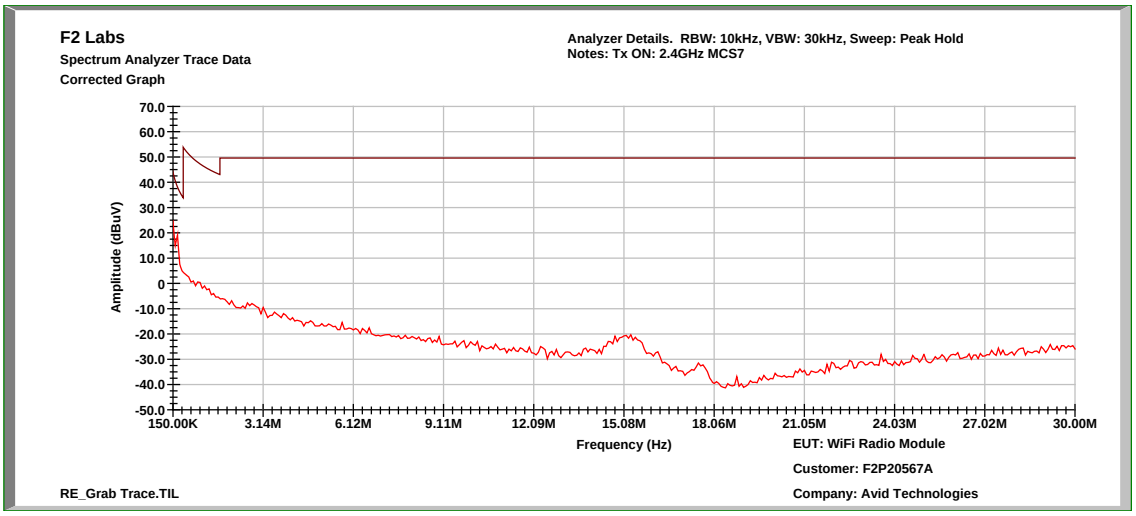
Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dBµV)	Correction Factors (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30.200000	V	100.00	357.00	25.1	5.3	30.40	40.0	-9.6
30.760000	H	100.00	3.00	20.9	4.9	25.80	40.0	-14.2
33.120000	V	100.00	66.00	25.4	3.0	28.40	40.0	-11.6
65.880000	V	100.00	110.00	34.6	-8.2	26.40	40.0	-13.6
81.200000	V	100.00	338.00	31.4	-8.4	23.00	40.0	-17.0
155.920000	H	100.00	297.00	29.4	-2.7	26.70	43.5	-16.8
159.800000	V	100.00	75.00	26.1	-2.8	23.30	43.5	-20.2
178.040000	H	100.00	242.00	30.9	-3.7	27.20	43.5	-16.3
232.520000	H	100.00	287.00	27.7	-2.8	24.90	46.0	-21.1
274.240000	V	100.00	339.00	32.1	-0.6	31.50	46.0	-14.5
276.200000	H	100.00	165.00	30.6	-0.6	30.00	46.0	-16.0
439.360000	H	100.00	182.00	28.4	3.3	31.70	46.0	-14.3
784.080000	V	100.00	356.00	21.8	9.5	31.30	46.0	-14.7



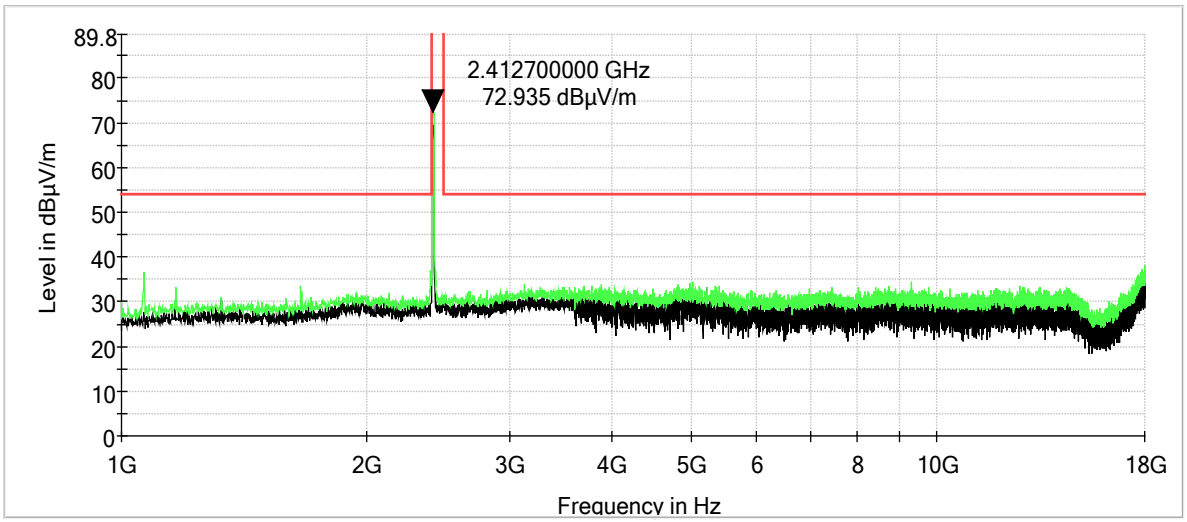
HT20: Characterization Scan, Low Channel, 0.009 MHz to 0.15 MHz



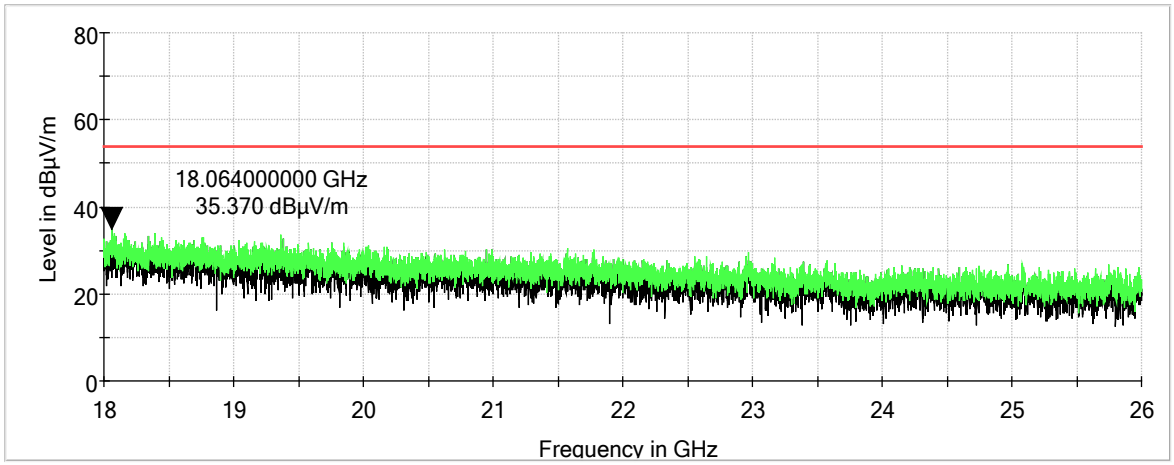
HT20: Characterization Scan, Low Channel, 0.15 MHz to 30 MHz



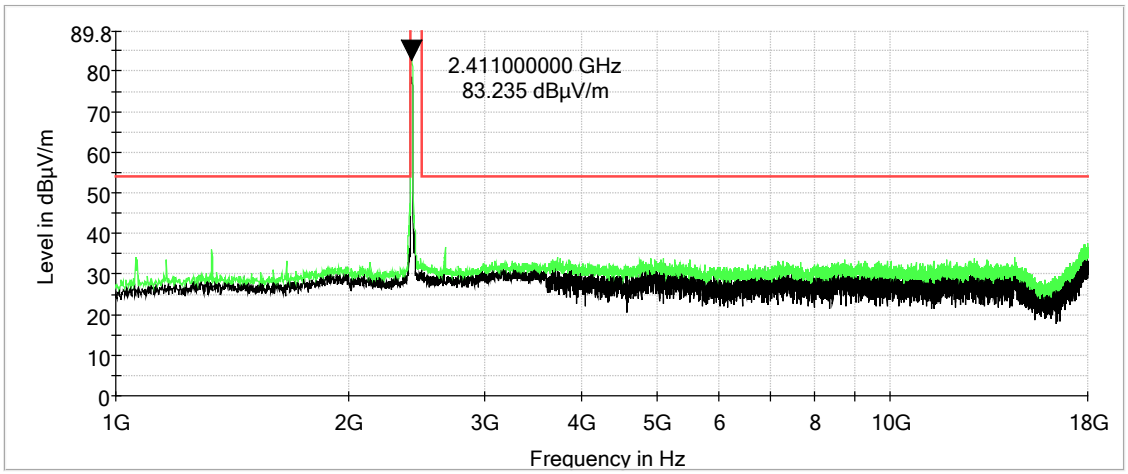
HT20: Characterization Scan, Low Channel, 1 GHz to 18 GHz, Horizontal



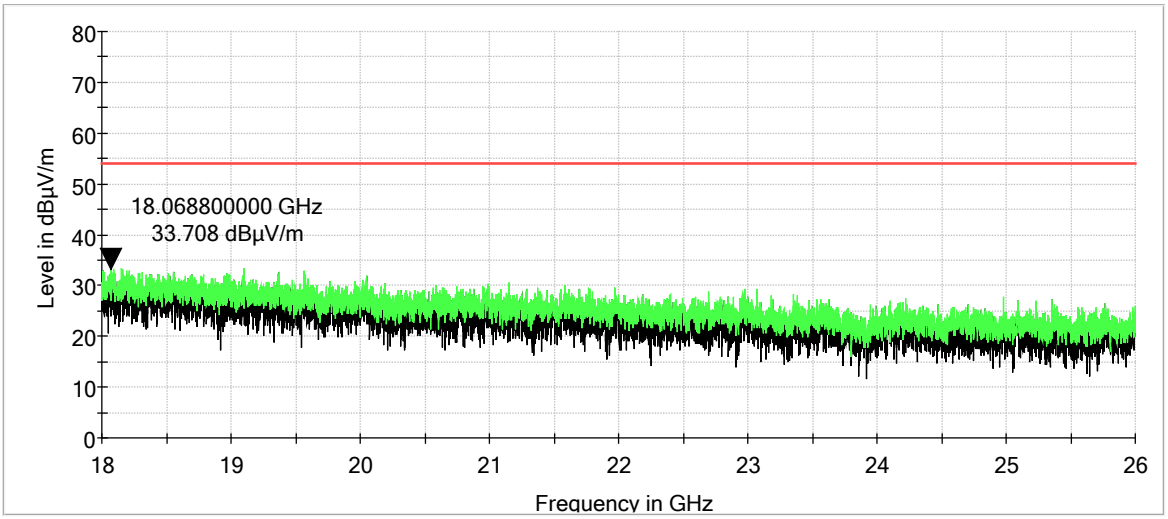
HT20: Characterization Scan, Low Channel, 18 GHz to 26 GHz, Horizontal



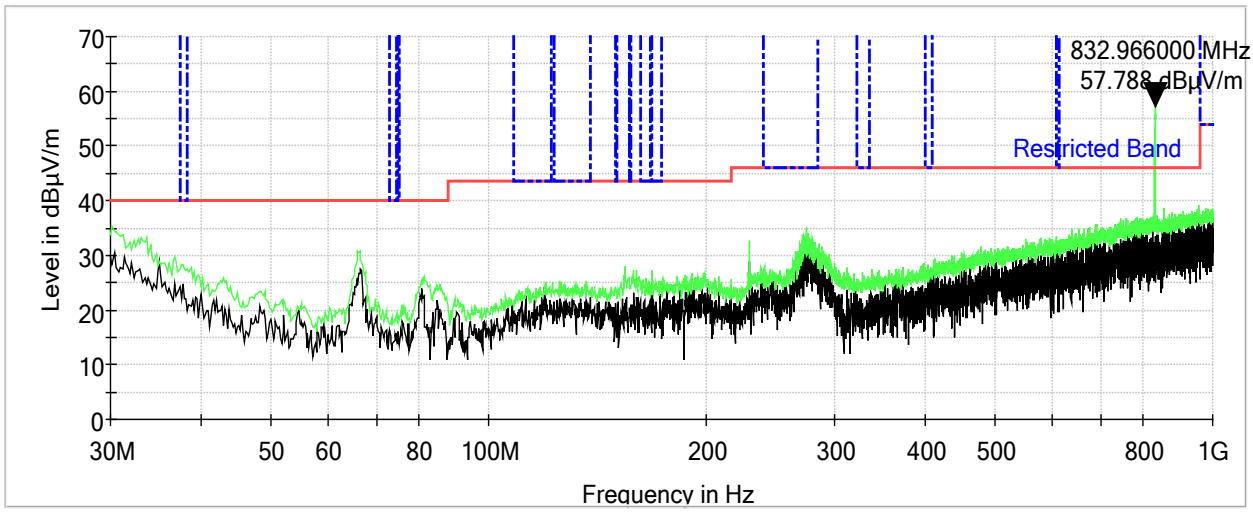
HT20: Characterization Scan, Low Channel, 1 GHz to 18 GHz, Vertical



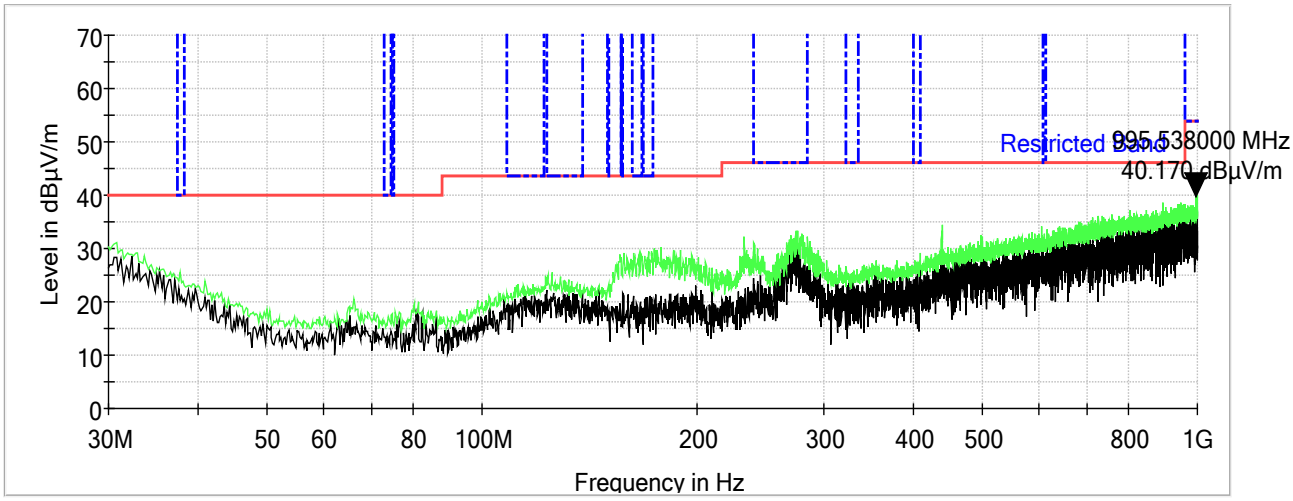
HT20: Characterization Scan, Low Channel, 18 GHz to 26 GHz, Vertical



HT20 - Low Channel, 30 MHz to 1000 MHz, Vertical



HT20 - Low Channel, 30 MHz to 1000 MHz, Horizontal



HT20: Measurements - Low Channel, 30 MHz to 1000 MHz

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dBµV)	Correction Factors (dB)	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30.200000	V	100.00	357.00	25.1	5.3	30.40	40.0	-9.6
30.760000	H	100.00	3.00	20.9	4.9	25.80	40.0	-14.2
33.120000	V	100.00	66.00	25.4	3.0	28.40	40.0	-11.6
65.880000	V	100.00	110.00	34.6	-8.2	26.40	40.0	-13.6
81.200000	V	100.00	338.00	31.4	-8.4	23.00	40.0	-17.0
155.920000	H	100.00	297.00	29.4	-2.7	26.70	43.5	-16.8
159.800000	V	100.00	75.00	26.1	-2.8	23.30	43.5	-20.2
178.040000	H	100.00	242.00	30.9	-3.7	27.20	43.5	-16.3
232.520000	H	100.00	287.00	27.7	-2.8	24.90	46.0	-21.1
274.240000	V	100.00	339.00	32.1	-0.6	31.50	46.0	-14.5
276.200000	H	100.00	165.00	30.6	-0.6	30.00	46.0	-16.0
439.360000	H	100.00	182.00	28.4	3.3	31.70	46.0	-14.3
784.080000	V	100.00	356.00	21.8	9.5	31.30	46.0	-14.7

7 VOLTAGE VARIATIONS, 15.31(e)

For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery. A nominal voltage of 3.3VDC was used and then 2.9VDC* and 3.8VDC were used as the 85% and 115% variations.

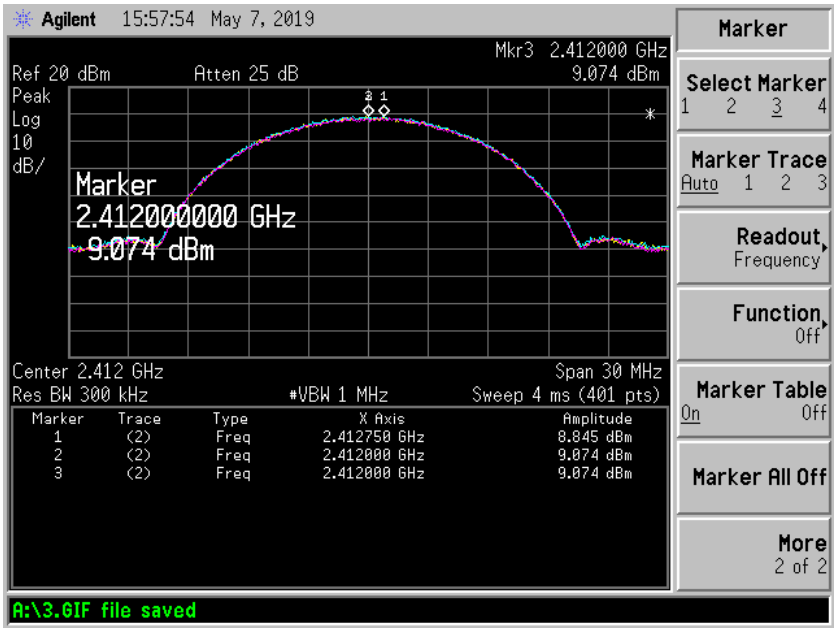
RESULTS: The results show that the fundamental frequency did not move outside the frequency band and the field strength did not increase above the limit during the variations.

These measurements were taken at the same power settings that produced the in-band field strength results in Section 8.

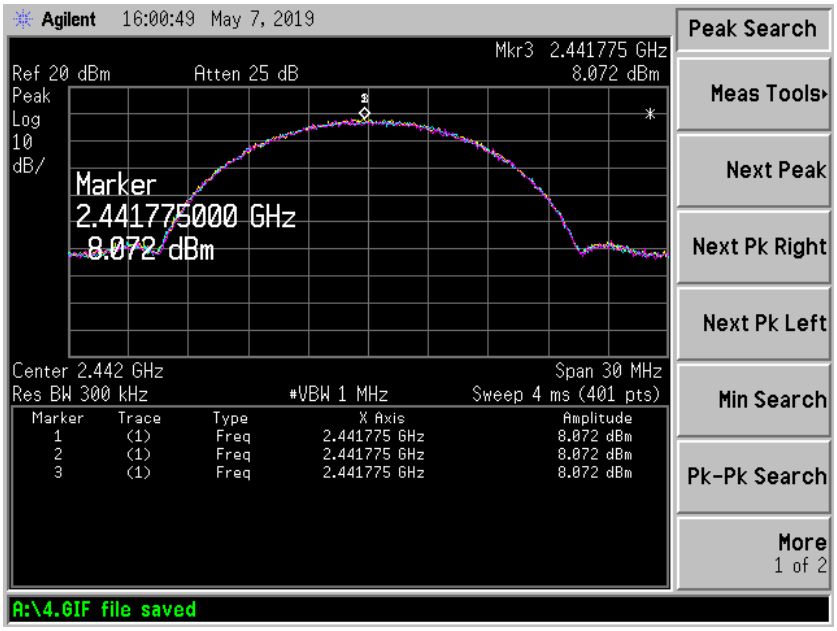
**2.9VDC was used for the low variation since the EUT shut off at 2.85VDC.*

Test Date(s):	May 7, 2019	**Test Engineer(s):**	J. Chiller
Standards:	CFR 47 Part 15.31(e)	**Air Temperature:**	24.5ºC
		Relative Humidity:	31%

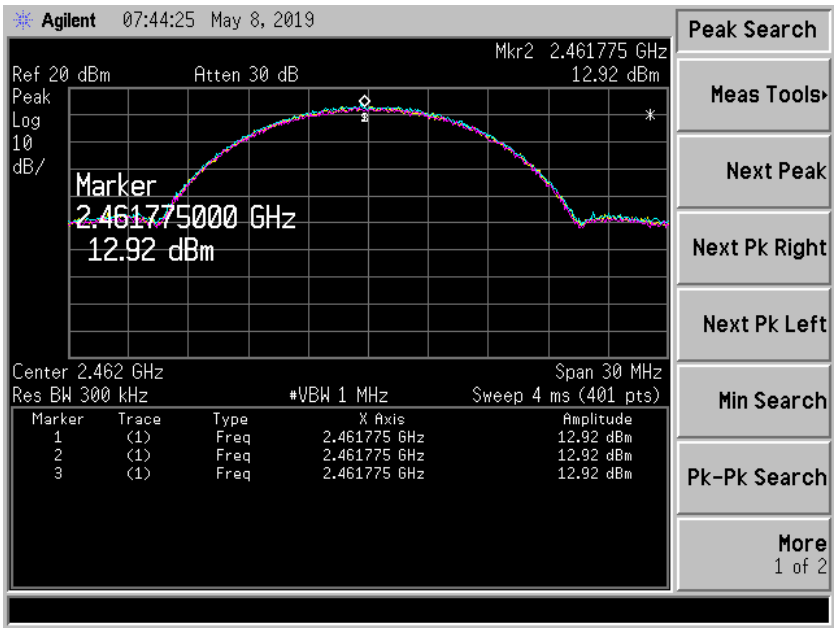
2.4 GHz, CCK: Low



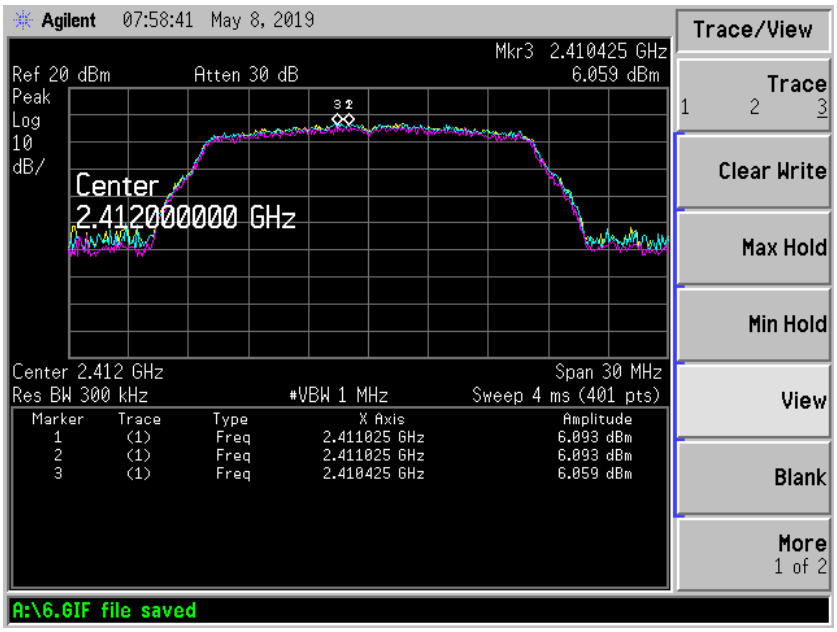
2.4 GHz, CCK: Mid



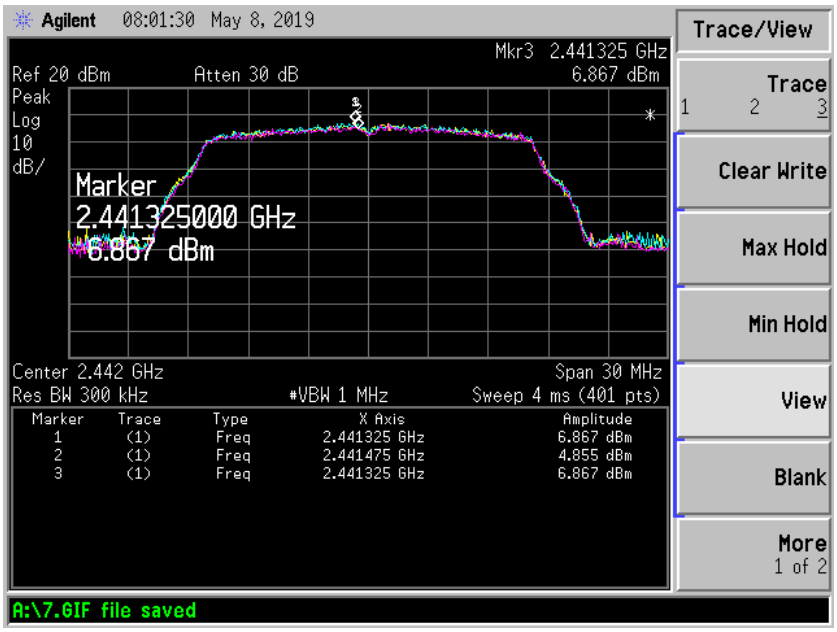
2.4 GHz, CCK: High



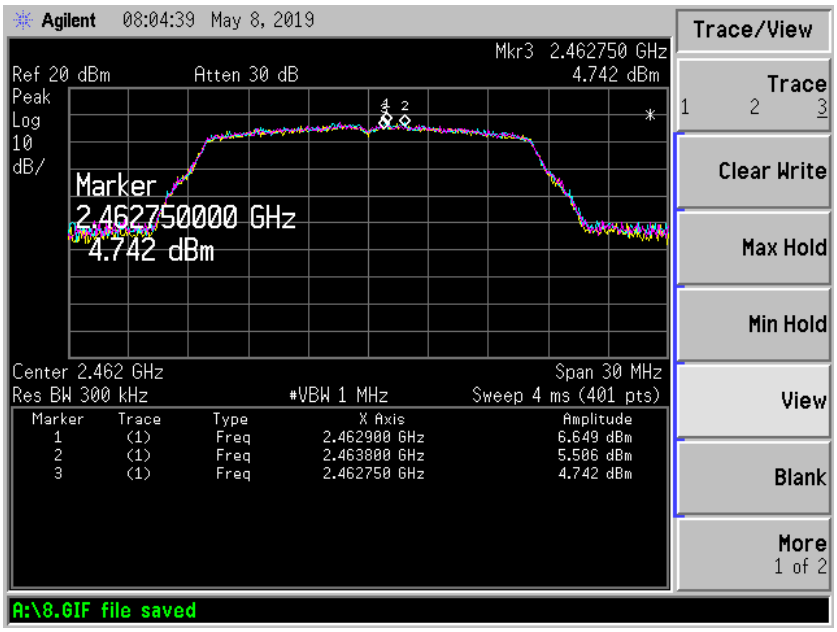
2.4 GHz, HT20: Low



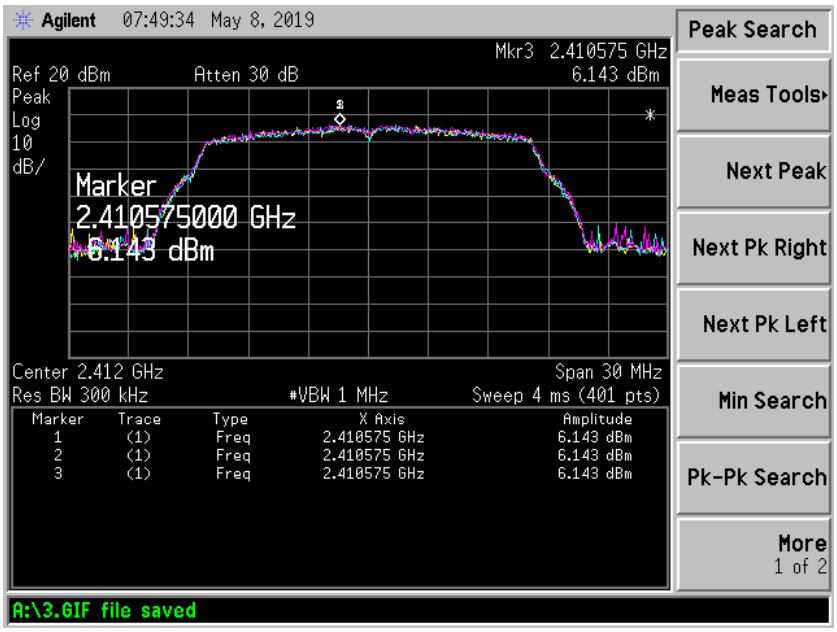
2.4 GHz, HT20: Mid



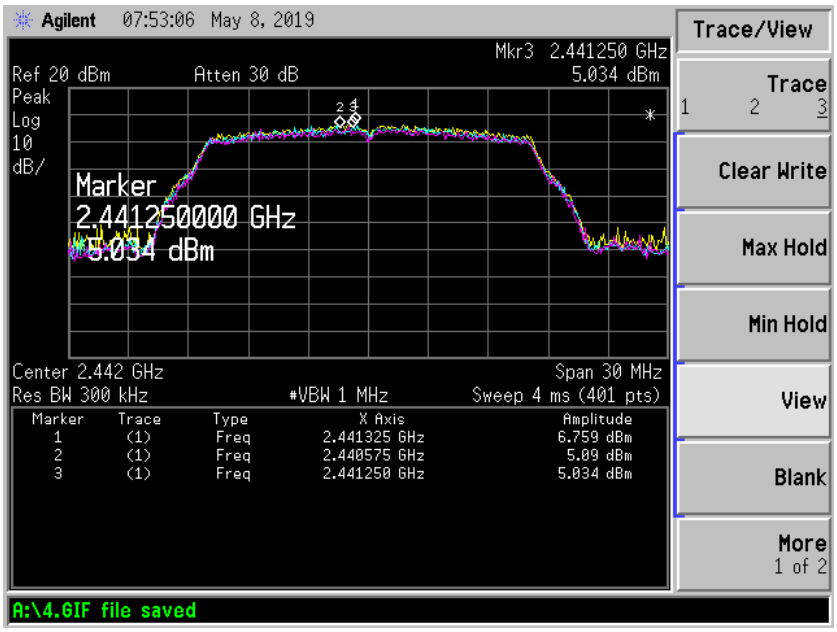
2.4 GHz, HT20: High



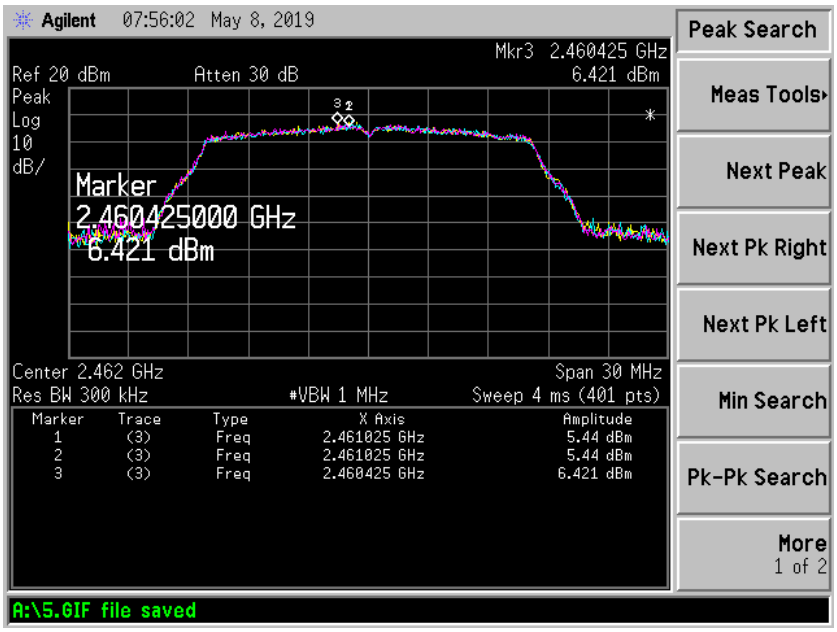
2.4 GHz, OFDM: Low



2.4 GHz, OFDM: Mid



2.4 GHz, OFDM: High



9 CONDUCTED EMISSIONS

9.1 Requirements

In accordance with FCC CFR 47 Part 15.207(a), “Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

9.2 Procedure

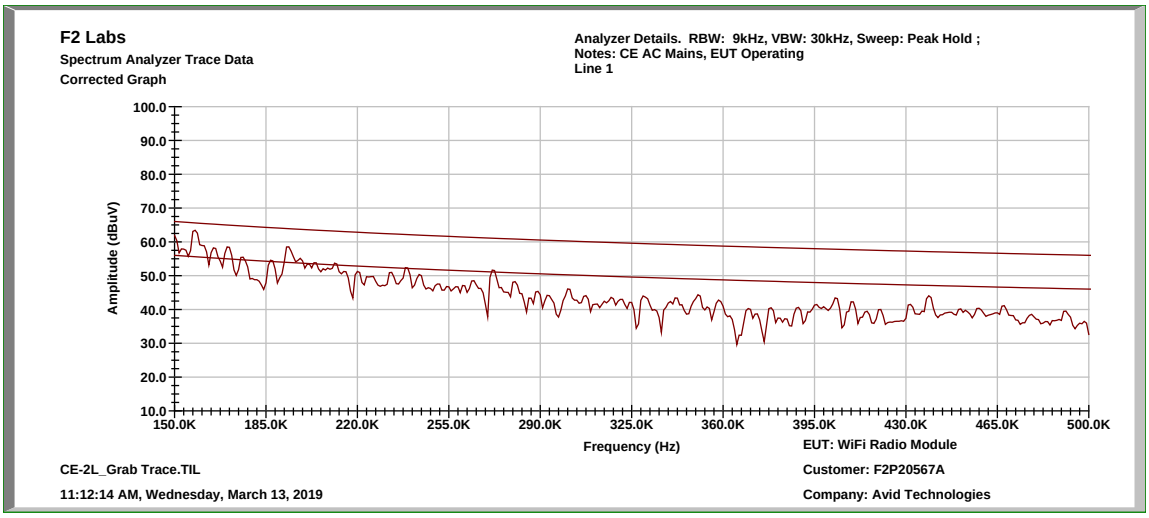
The EUT was placed on a 1.0 x 1.5 meter non-conductive table, 0.8 meter above a horizontal ground plane and 0.4 meter from a vertical ground plane. Power was provided to the EUT through a LISN bonded to a 3 x 2 meter ground plane. The LISN and peripherals were supplied power through a filtered AC power source. The output of the LISN was connected to the input of the receiver via a transient limiter, and emissions in the range 150 kHz to 30 MHz were measured using a peak detector. The highest measurements were recorded and measured using the quasi-peak and average detectors as directed by the standard, and the resolution bandwidth during testing was 9 kHz. The raw measurements were corrected to allow for attenuation from the LISN, transient limiter and cables.

9.3 Conducted Emissions Test Data

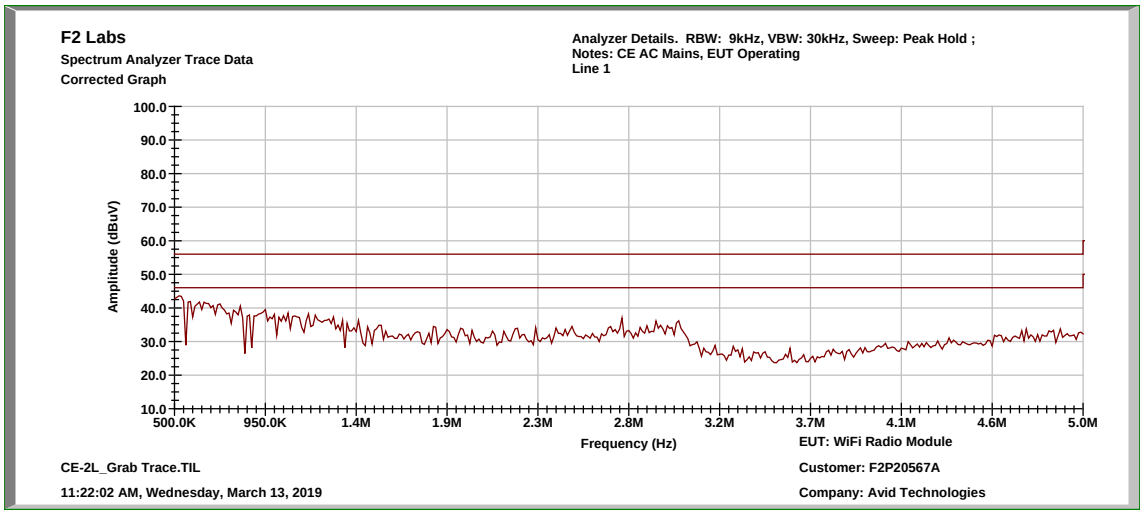
Test Date(s):	Mar. 13, 2019	**Test Engineer:**	J. Chiller
Rule:	15.207	**Air Temperature:**	20.5º C
Test Results:	Complies	**Relative Humidity:**	34%

Note: The data below represents worst case results.

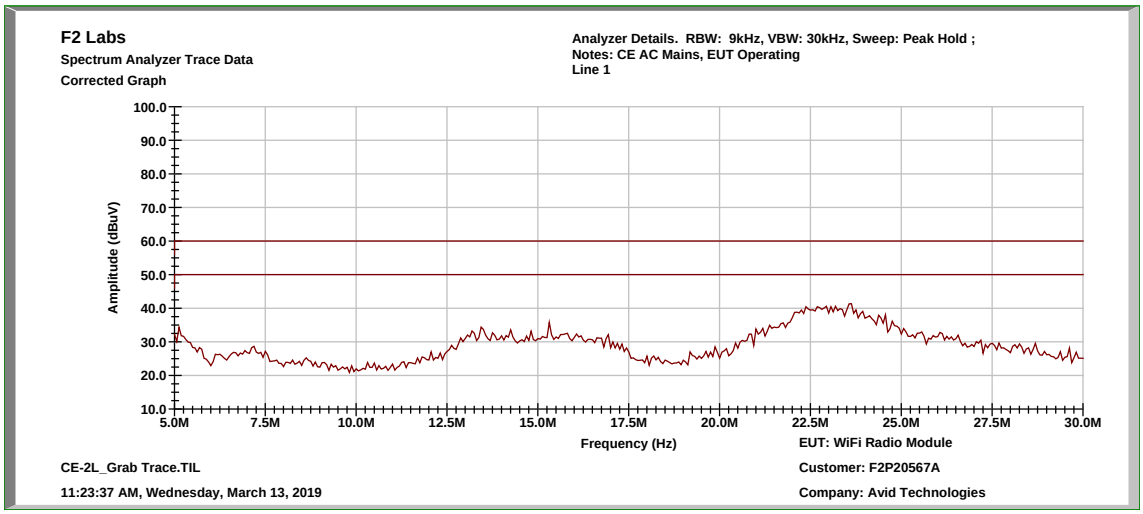
Conducted Test – Line 1: 0.15 MHz to 0.5 MHz



Conducted Test – Line 1: 0.5 MHz to 5.0 MHz

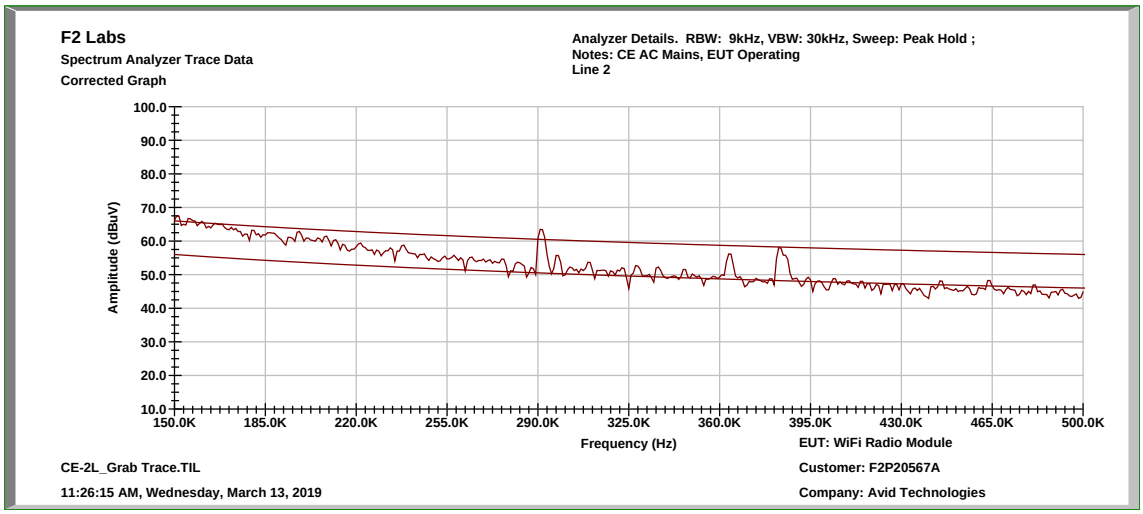


Conducted Test – Line 1: 5.0 MHz to 30.0 MHz

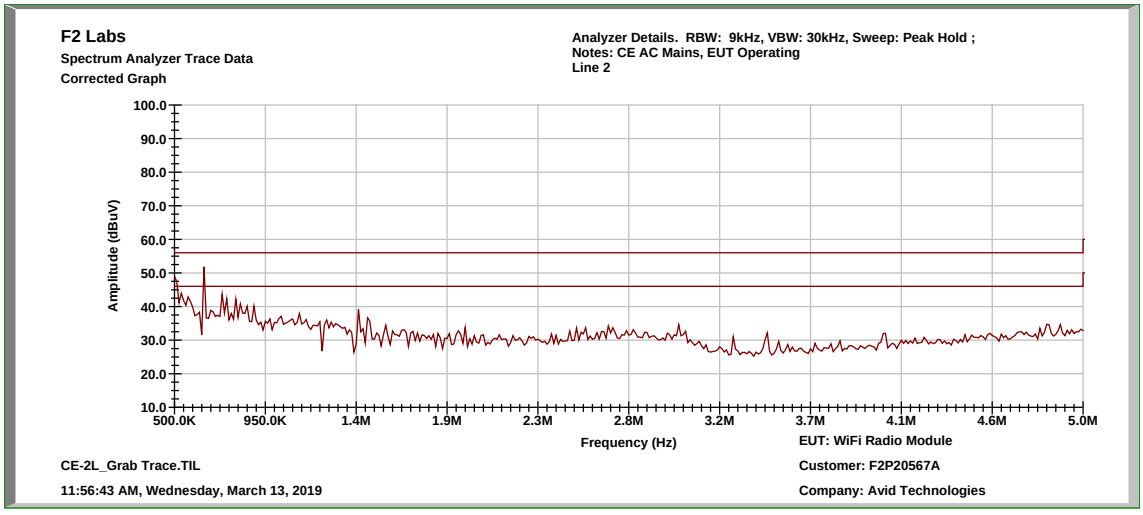


Top Discrete Measurements								
No.	Conductor	Frequency (MHz)	Detector	Level (dBµV)	Adjustment (dB)	Results (dBµV)	Limit (dBµV)	Margin (dB)
1	Line 1	0.15875	Quasi-Peak	43.4	11.547	54.95	65.530	-10.6
			Average	27.33	11.547	38.88	55.530	-16.7
2	Line 1	0.16575	Quasi-Peak	42.13	11.473	53.60	65.171	-11.6
			Average	25.60	11.473	37.07	55.171	-18.1
3	Line 1	0.171000	Quasi-Peak	40.92	11.417	52.34	64.913	-12.6
			Average	22.2	11.417	33.62	54.913	-21.3
4	Line 1	0.19375	Quasi-Peak	39.15	11.176	50.33	63.875	-13.5
			Average	19.04	11.176	30.22	53.875	-23.7
5	Line 1	0.20400	Quasi-Peak	37.44	11.070	48.51	63.437	-14.9
			Average	20.4	11.070	31.47	53.437	-22.0
6	Line 1	0.212125	Quasi-Peak	36.31	10.996	47.31	63.122	-15.8
			Average	20.31	10.996	31.31	53.122	-21.8
7	Line 1	0.2725	Quasi-Peak	31.29	10.631	41.92	61.042	-19.1
			Average	13.95	10.631	24.58	51.042	-26.5

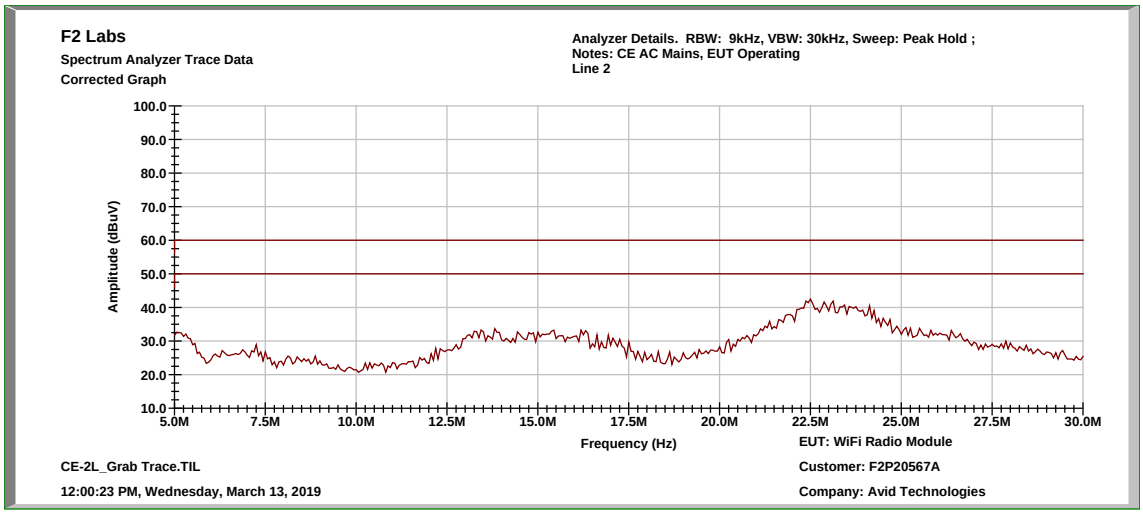
Conducted Test – Line 2: 0.15 MHz to 0.5 MHz



Conducted Test – Line 2: 0.5 MHz to 5.0 MHz



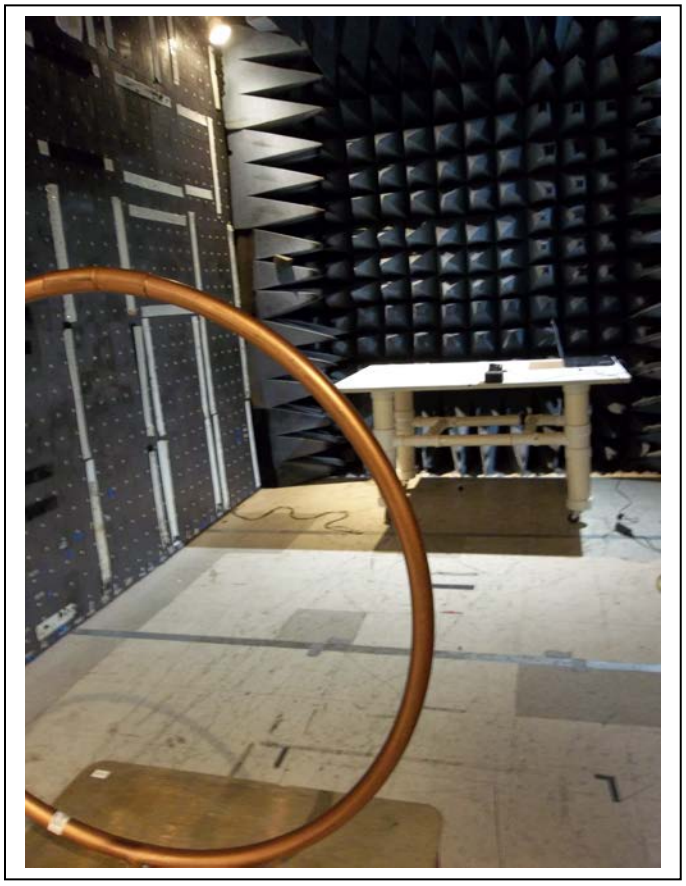
Conducted Test – Line 2: 5.0 MHz to 30.0 MHz



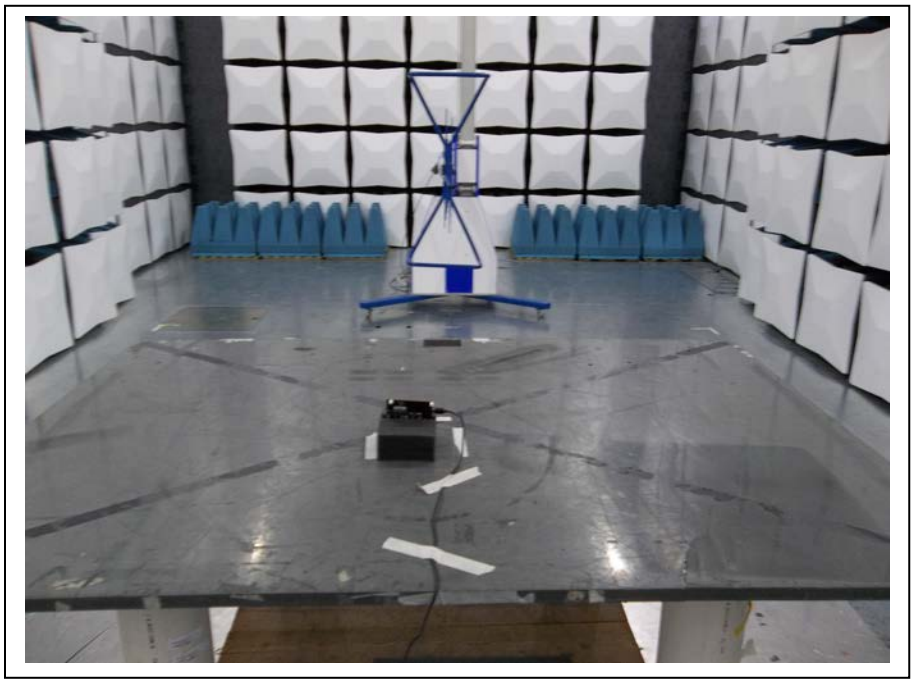
Top Discrete Measurements								
No.	Conductor	Frequency (MHz)	Detector	Level (dBµV)	Adjustment (dB)	Results (dBµV)	Limit (dBµV)	Margin (dB)
1	Line 2	0.15175	Quasi-Peak	49.78	11.640	61.42	66.00	-4.6
			Average	27.79	11.640	39.43	56.00	-16.6
2	Line 2	0.156125	Quasi-Peak	41.44	11.575	53.02	65.669	-12.7
			Average	22.7	11.575	34.28	55.669	-21.4
3	Line 2	0.161375	Quasi-Peak	42.90	11.519	54.42	65.394	-11.0
			Average	26.11	11.519	37.63	55.394	-17.8
4	Line 2	0.166625	Quasi-Peak	42.34	11.464	53.80	65.128	-11.3
			Average	25.06	11.464	36.52	55.128	-18.6
5	Line 2	0.198125	Quasi-Peak	37.6	11.310	48.91	63.690	-14.8
			Average	21.48	11.130	32.61	53.690	-21.1
6	Line 2	0.29175	Quasi-Peak	30.87	10.623	41.49	60.475	-19.0
			Average	12.55	10.623	23.17	50.475	-27.3
7	Line 2	0.297875	Quasi-Peak	32.67	10.621	43.29	60.302	-17.0
			Average	13.64	10.621	24.26	50.302	-26.0
8	Line 2	0.364375	Quasi-Peak	27.84	10.588	38.43	58.625	-20.2
			Average	7.323	10.588	17.91	48.625	-30.7
9	Line 2	0.383625	Quasi-Peak	27.56	10.578	38.14	58.201	-20.1
			Average	9.982	10.578	20.56	48.201	-27.6
10	Line 2	0.500	Quasi-Peak	23.15	10.540	33.69	56.0	-22.3
			Average	10.07	10.540	20.61	46.0	-25.4
11	Line 2	0.64625	Quasi-Peak	21.36	10.446	31.81	56.0	-24.2
			Average	6.536	10.446	16.98	46.0	-29.0

10 PHOTOGRAPHS

Radiated Spurious Emissions, Less Than 30 MHz

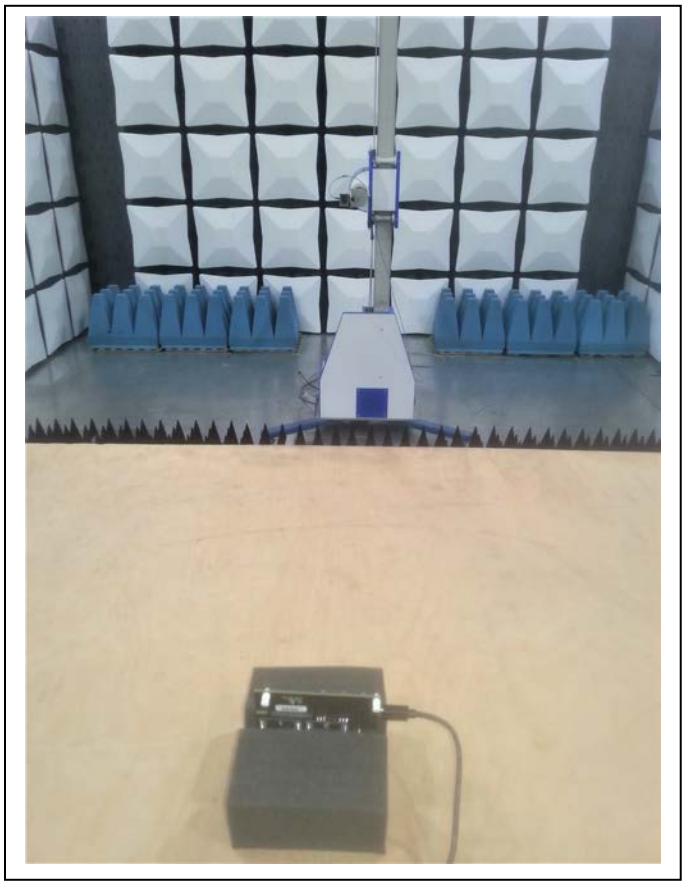


Radiated Spurious Emissions, 30 MHz to 1000 MHz

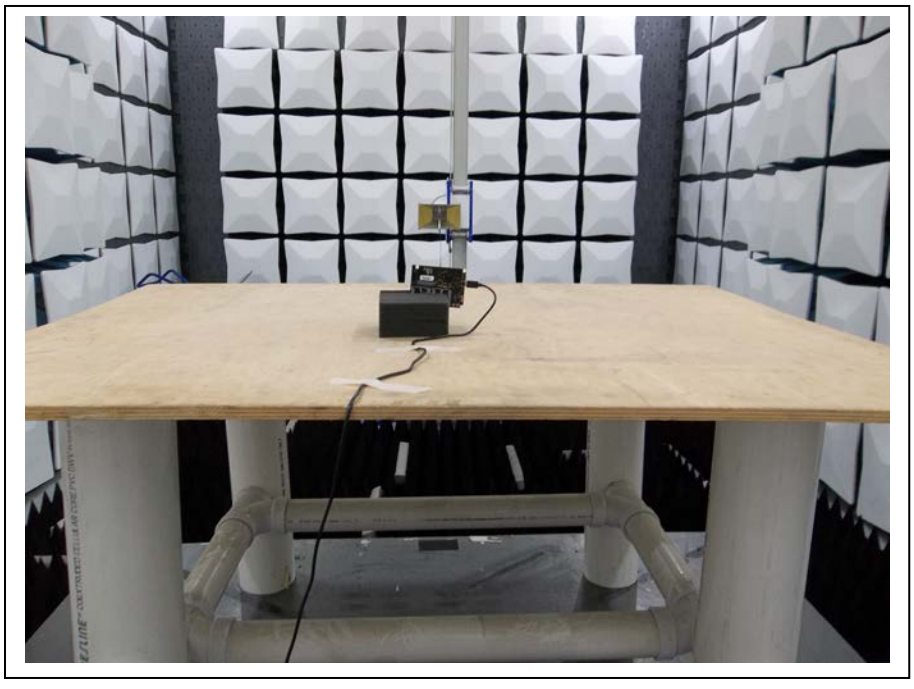


Radiated Spurious Emissions, 1 GHz to 18 GHz

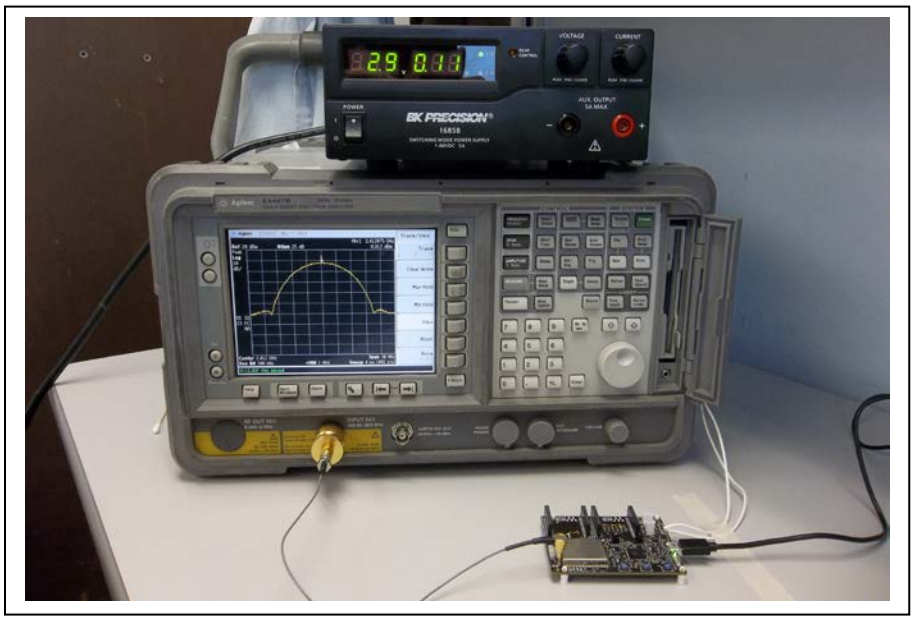
Radiated Spurious Emissions, 18 GHz to 26 GHz



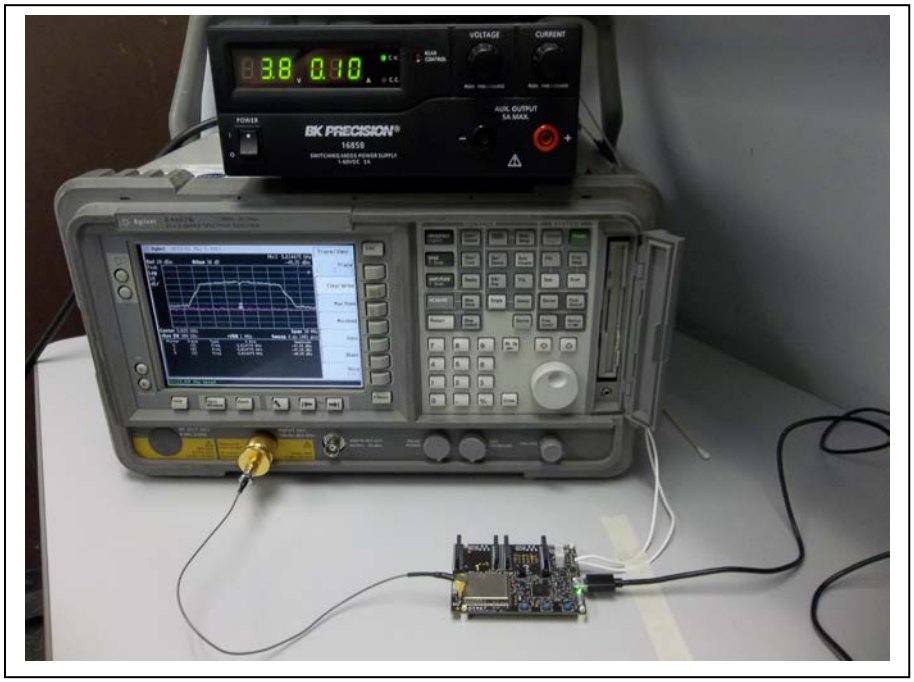
Field Strength of Emissions, Occupied Bandwidth



Low Voltage



High Voltage



Conducted Emissions