

7. Band Edge Spectrum

7.1 Test Specification

FCC, Part 15, Subpart C, Section 247(d)

7.2 Test Procedure

(Temperature (23°C)/ Humidity (70%RH))

The E.U.T operation mode and test set-up are as described in Section 2.

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (loss=32.0 dB). Special attention was taken to prevent Spectrum Analyzer RF input overload.

The RBW was set to 100 kHz.

7.3 Test Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

7.4 Test Results

Protocol Type	Operation Frequency (MHz)	Band Edge Frequency (MHz)	Spectrum Level (dBm)	Limit (dBm)	Margin (dB)
BLE	2402.0	2400.0	-34.9	-17.1	-17.8
	2480.0	2483.5	-47.3	-17.4	-29.9
Wi-fi/b(1Mbit/s)	2412.0	2400.0	-41.5	-15.5	-26.0
	2462.0	2483.5	-37.5	-16.5	-21.0
Wi-fi/b(11Mbit/s)	2412.0	2400.0	-39.8	-16.9	-22.9
	2462.0	2483.5	-37.0	-15.5	-21.5
Wi-fi/g(6Mbit/s)	2412.0	2400.0	-30.7	-18.8	-11.9
	2462.0	2483.5	-39.4	-19.0	-20.4
Wi-Fi/g(54Mbit/s)	2412.0	2400.0	-34.7	-17.4	-17.3
	2462.0	2483.5	-41.8	-21.6	-20.2
Wi-Fi/n(6.5Mbit/s)	2412.0	2400.0	-31.7	-19.4	-12.3
	2462.0	2483.5	-39.5	-19.4	-20.1
Wi-fi/n(65Mbit/s)	2412.0	2400.0	-33.2	-23.6	-9.6
	2462.0	2483.5	-41.8	-22.7	-19.1

Figure 63 Band Edge Spectrum

JUDGEMENT: Passed by 9.6 dB

For additional information see *Figure 64 to Figure 77*.

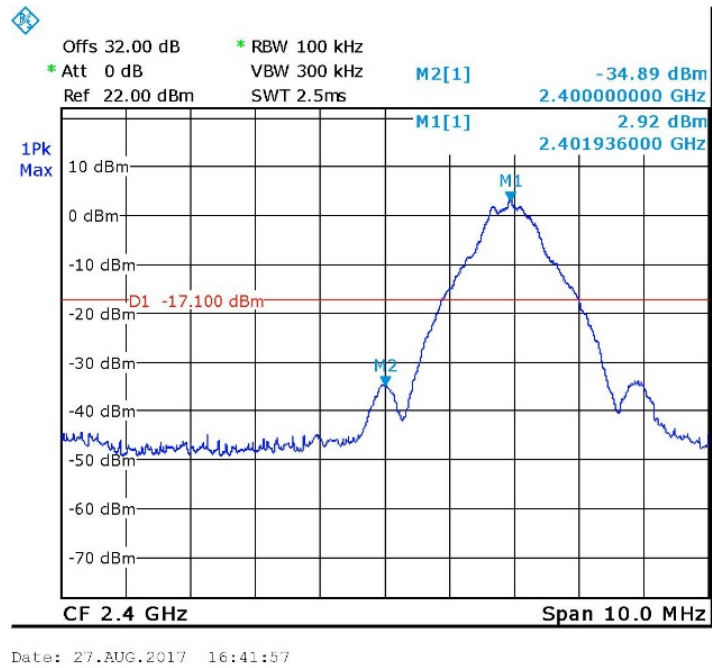


Figure 64 —Lower Band Edge, BLE

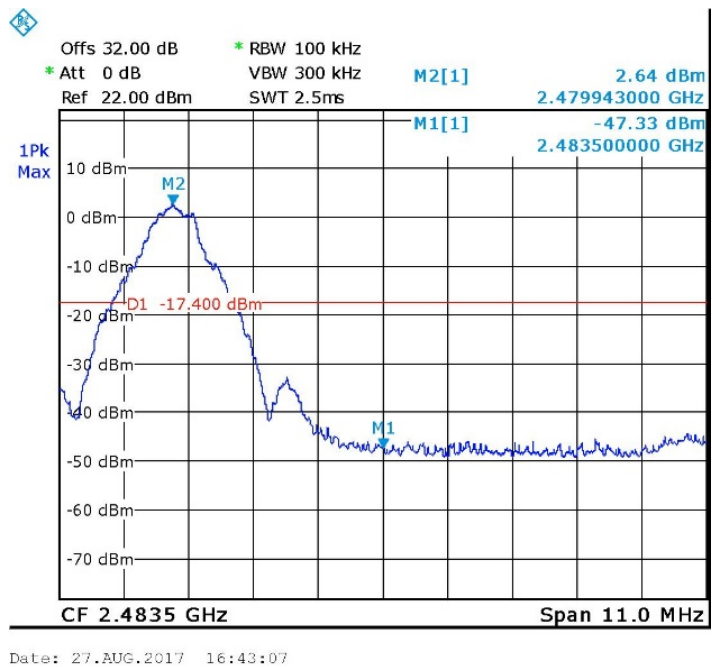


Figure 65 —Upper Band Edge, BLE

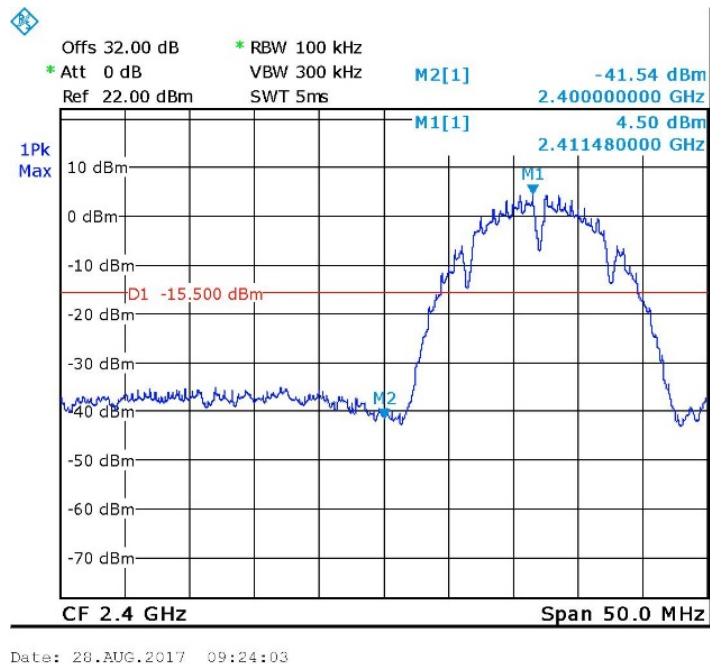


Figure 66 —Lower Band Edge, WI-FI/b(1Mbit/s)

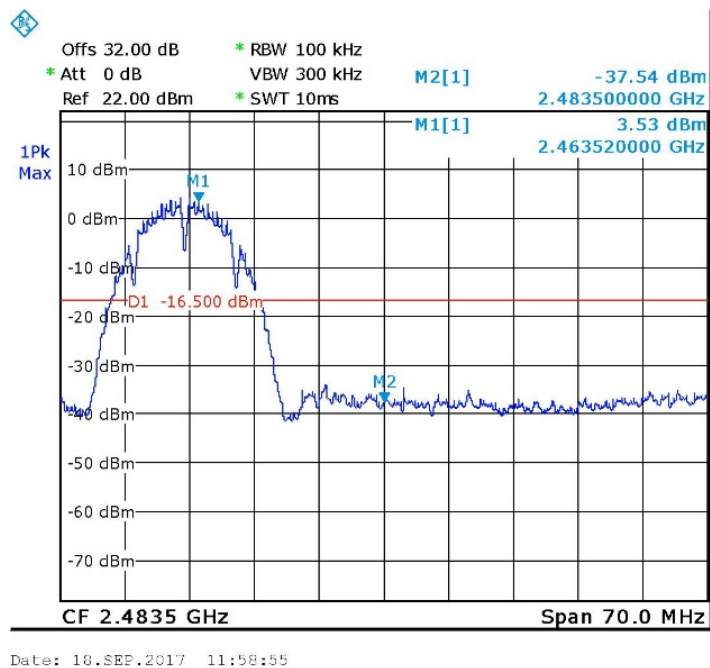


Figure 67 —Upper Band Edge, WI-FI/b(1Mbit/s)

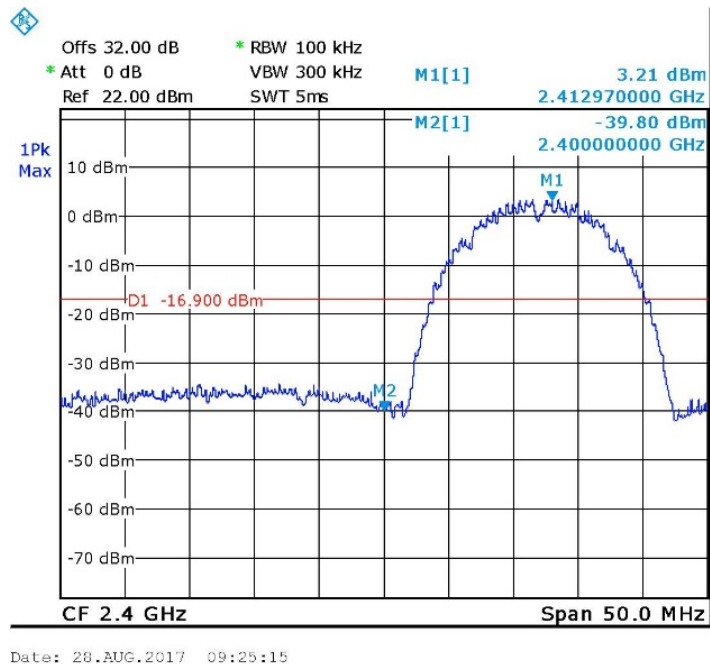


Figure 68 —Lower Band Edge, WI-FI/b(11Mbit/s)

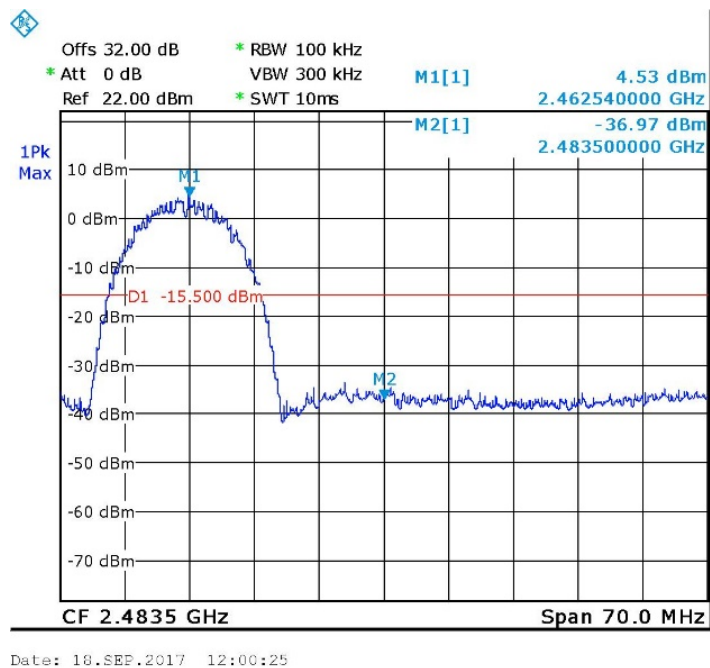


Figure 69 —Upper Band Edge, WI-FI/b(11Mbit/s)

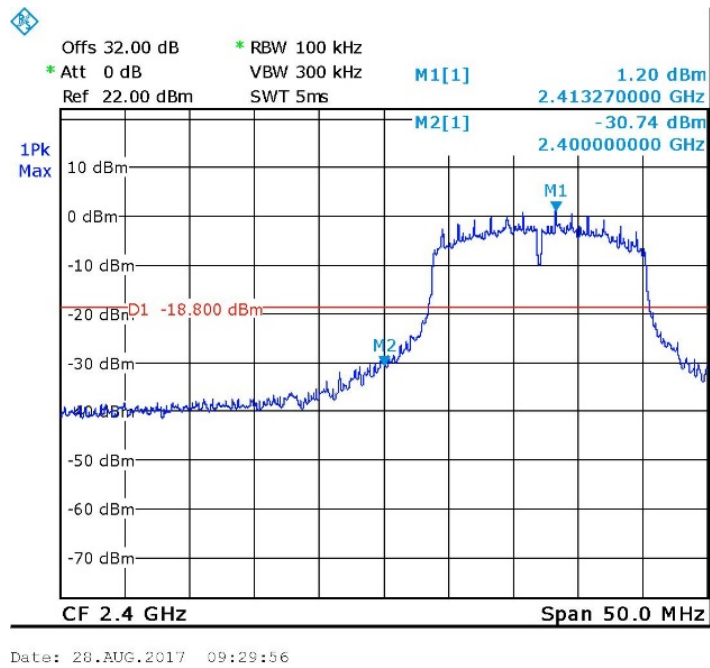


Figure 70 —Lower Band Edge, WI-FI/g(6Mbit/s)

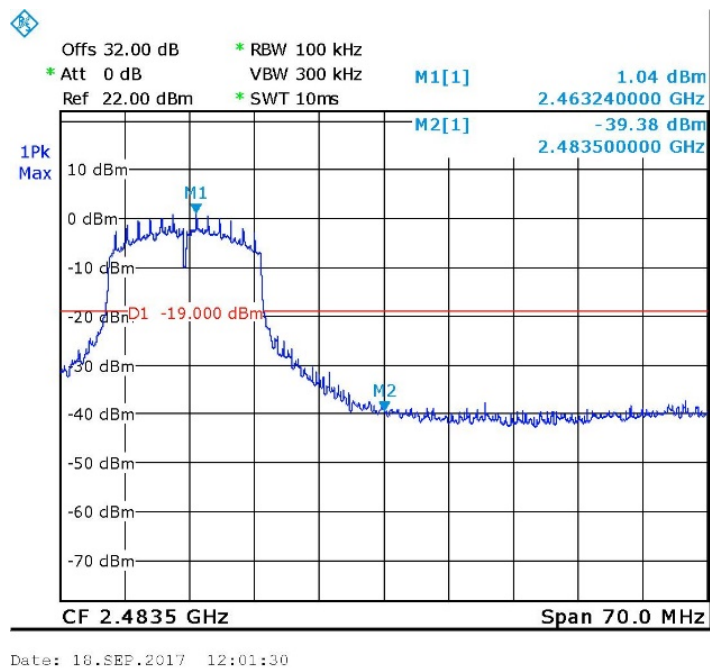
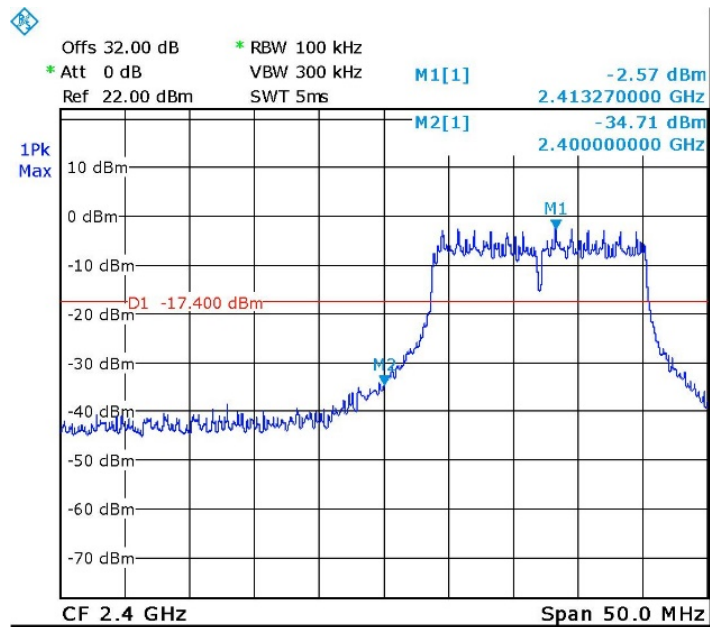
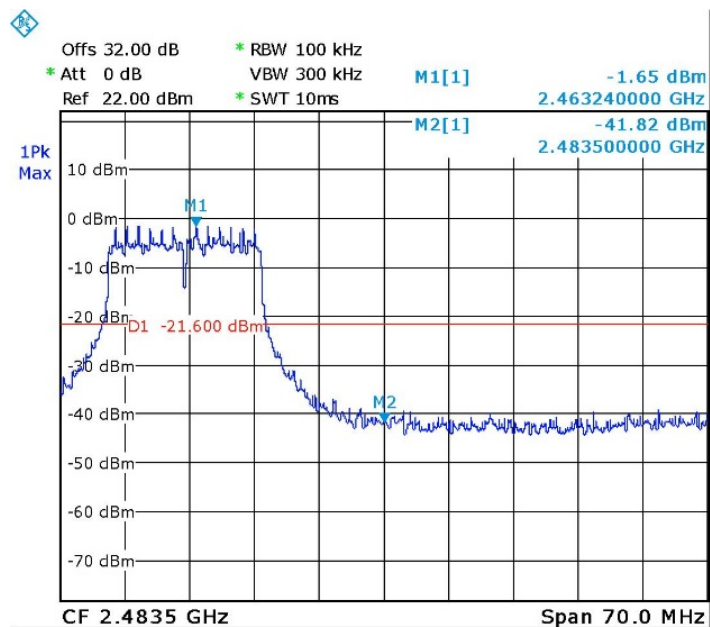


Figure 71 —Upper Band Edge, WI-FI/g(6Mbit/s)



Date: 28.AUG.2017 09:31:11

Figure 72 —Lower Band Edge, WI-FI/g(54Mbit/s)



Date: 18.SEP.2017 12:03:01

Figure 73 —Upper Band Edge, WI-FI/g(54Mbit/s)

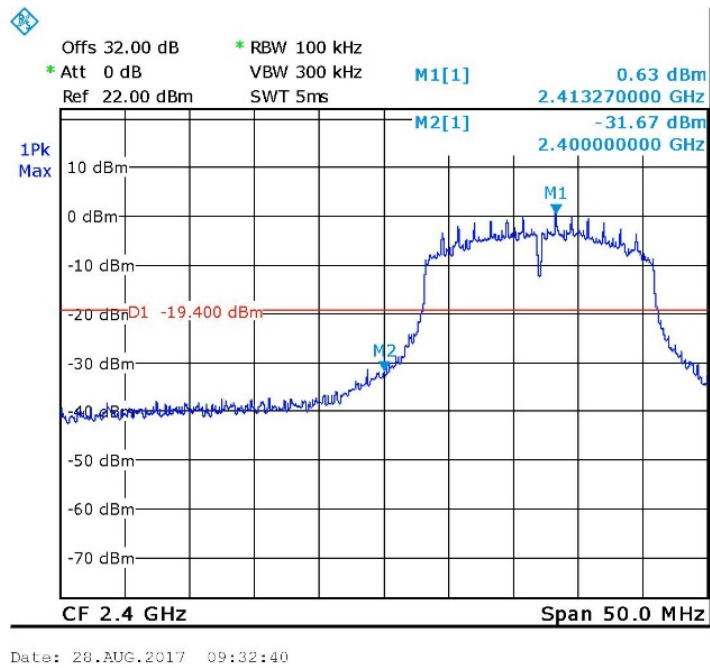


Figure 74 —Lower Band Edge, WI-FI/n(6.5Mbit/s)

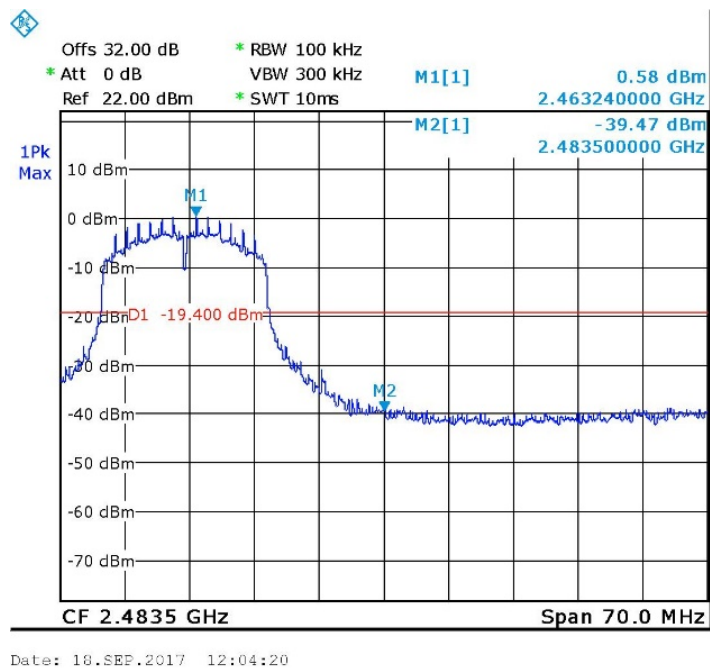


Figure 75 —Upper Band Edge, WI-FI/n(6.5Mbit/s)

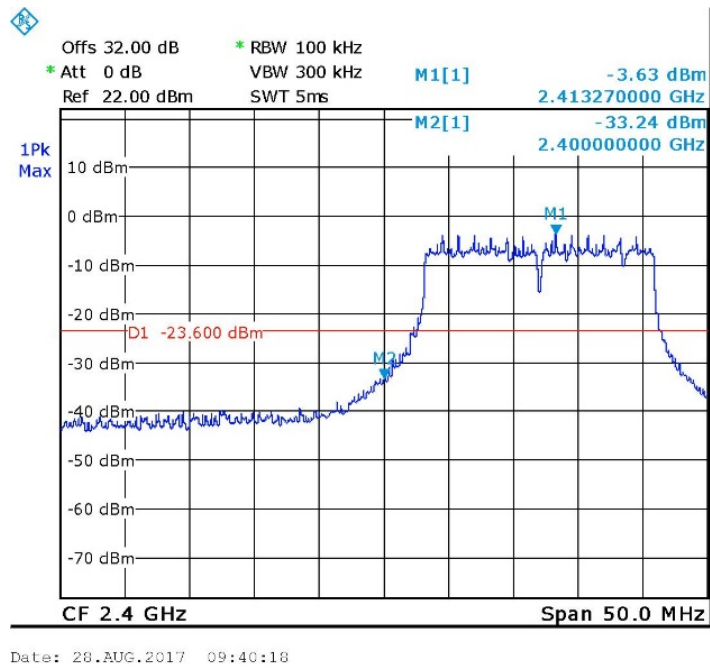


Figure 76 —Lower Band Edge, WI-FI/n(65Mbit/s)

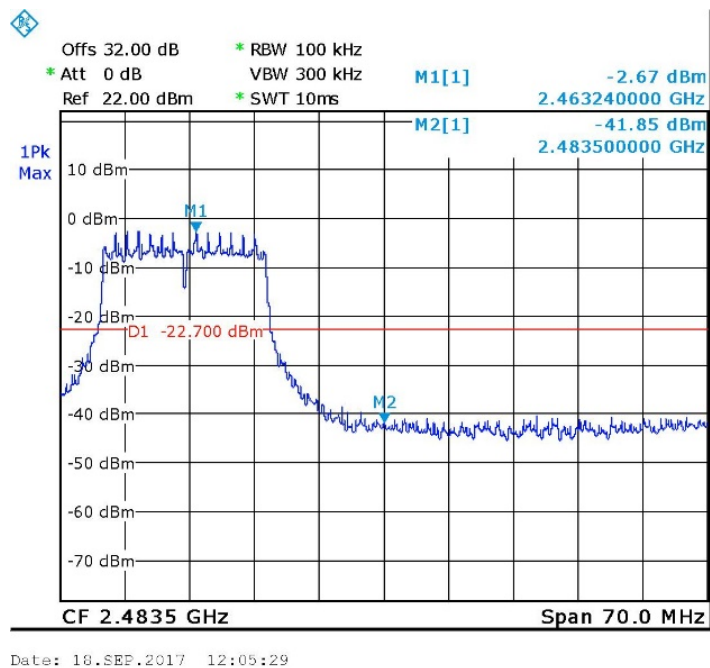


Figure 77 —Upper Band Edge, WI-FI/n(65Mbit/s)



7.5 Test Equipment Used; Band Edge Spectrum

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	March 2, 2017	March 2, 2018
30dB Attenuator	MCL	BW-S30W5	533	July 31, 2017	July 31, 2018

Figure 78 Test Equipment Used

8. Emissions in Non-Restricted Frequency Bands

8.1 Test Specification

FCC, Part 15, Subpart C, Section 247(d)

8.2 Test Procedure

(Temperature (20°C)/ Humidity (60%RH))

The E.U.T operation mode and test set-up are as described in Section 2.

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (max total loss=34.0 dB).

Special attention was taken to prevent Spectrum Analyzer RF input overload.

RBW was set to 100kHz, detector set to max peak and trace to “max hold”.

8.3 Test Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

8.4 Test Results

JUDGEMENT: Passed

All detected emissions were greater than 20dBc from fundamental level.

The EUT met the requirements of the F.C.C. Part 15, Subpart C, Section 247(d) specification.

Note: All peaks in plots are the fundamental transmission frequency.

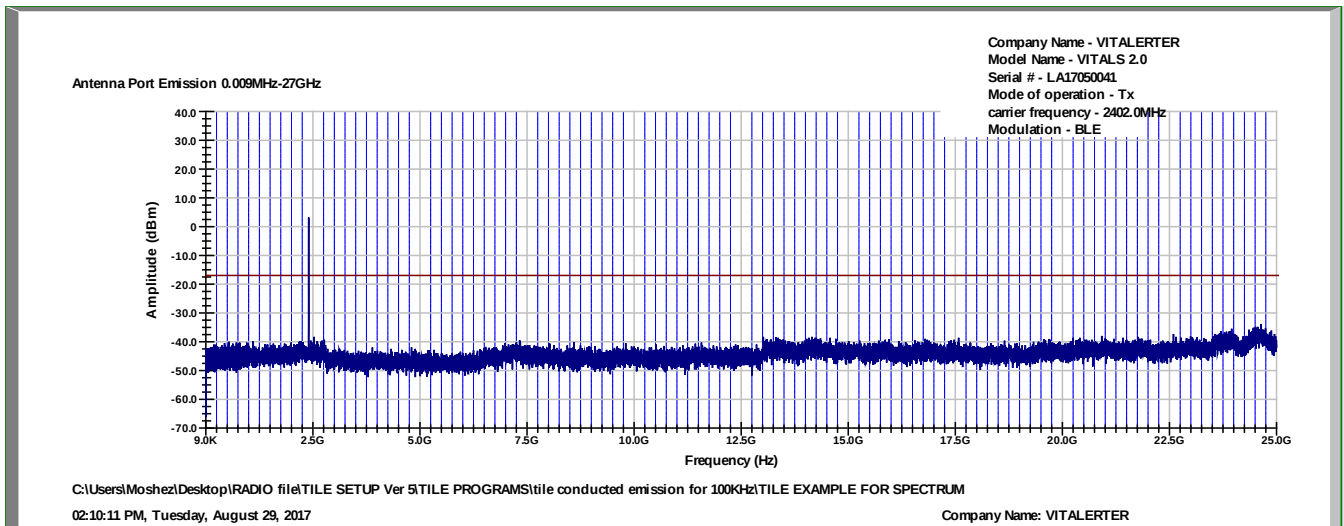


Figure 79 2402.0 MHz, BLE

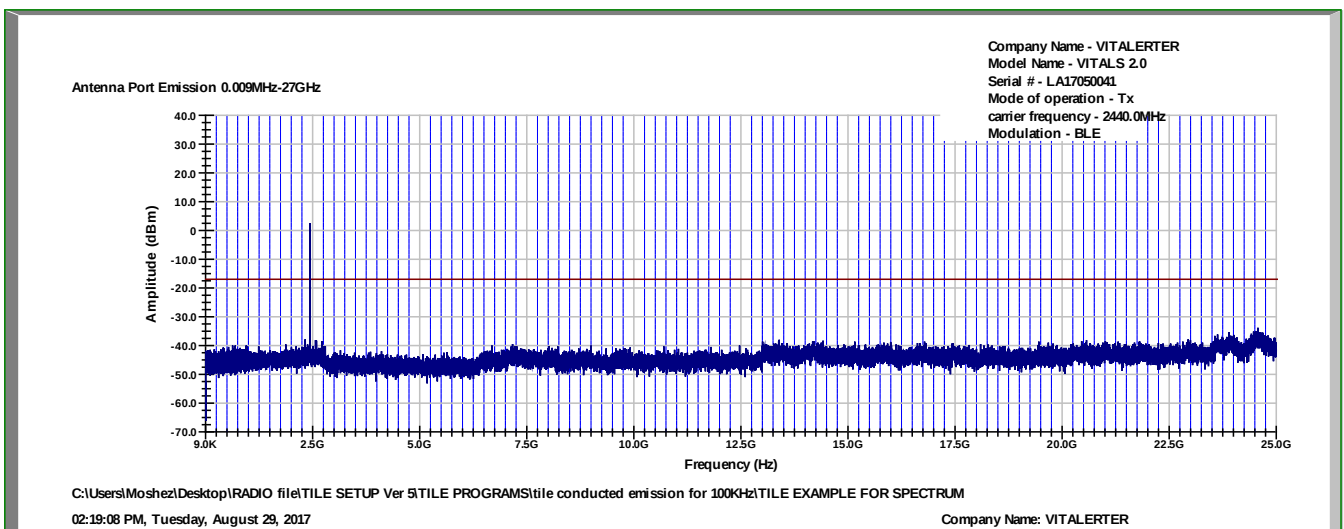


Figure 80 2440.0 MHz, BLE

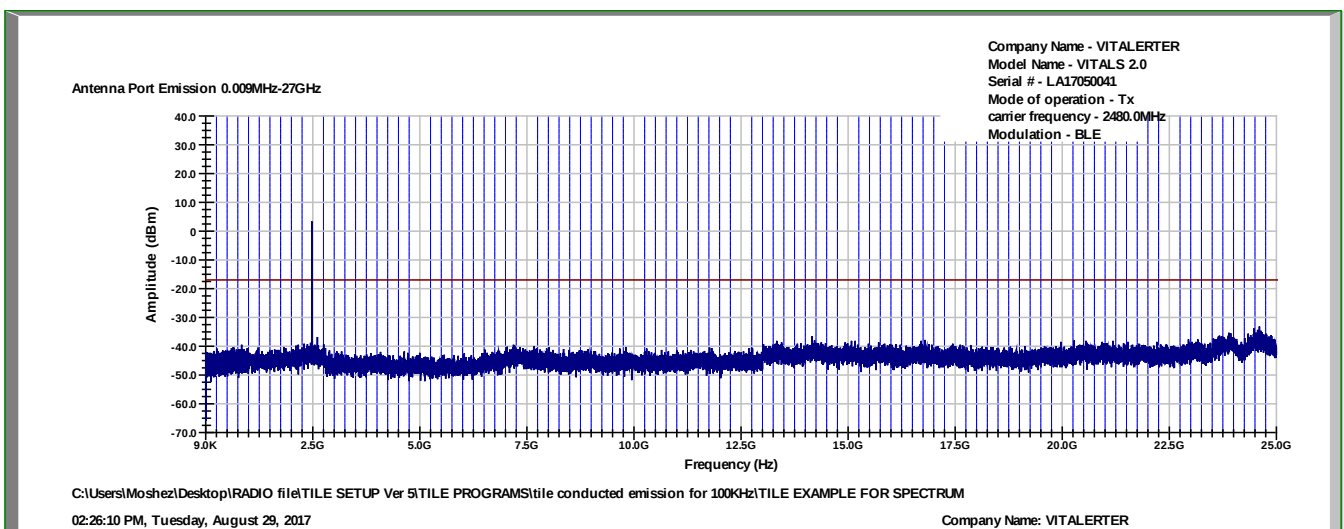


Figure 81 2480.0 MHz, BLE

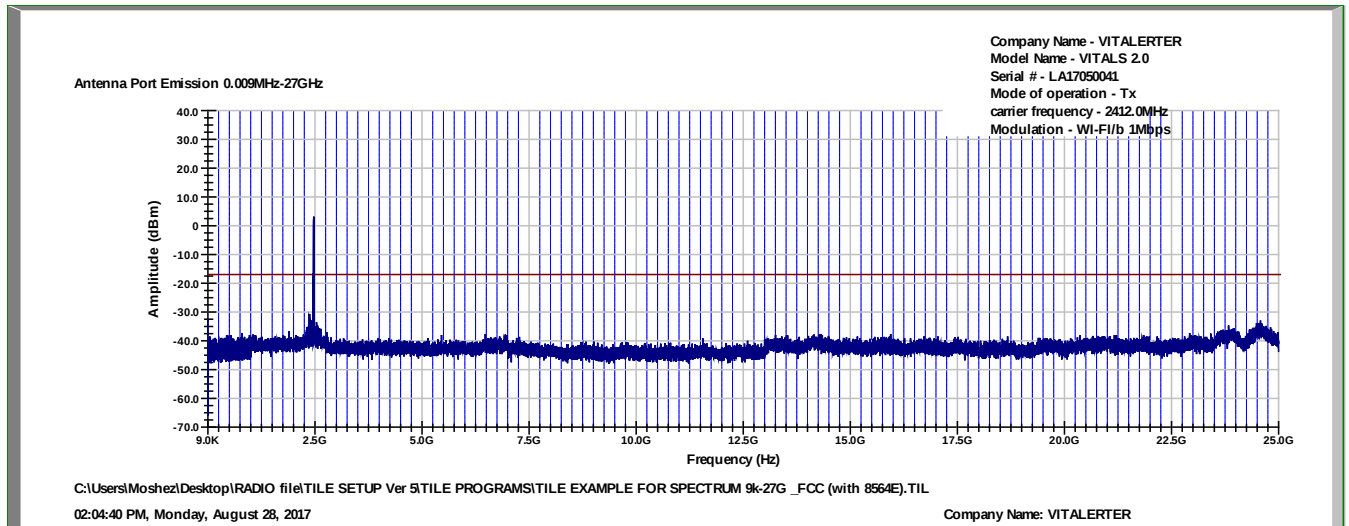


Figure 82 2412.0 MHz, WI-FI/b(1Mbit/s)

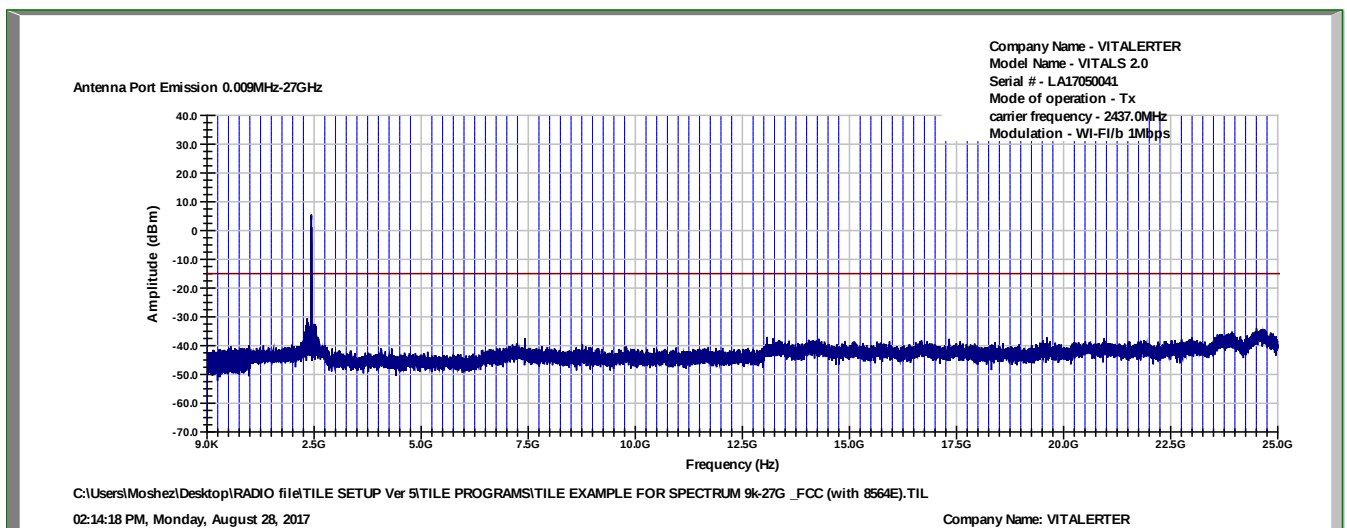


Figure 83 2437.0 MHz, WI-FI/b(1Mbit/s)

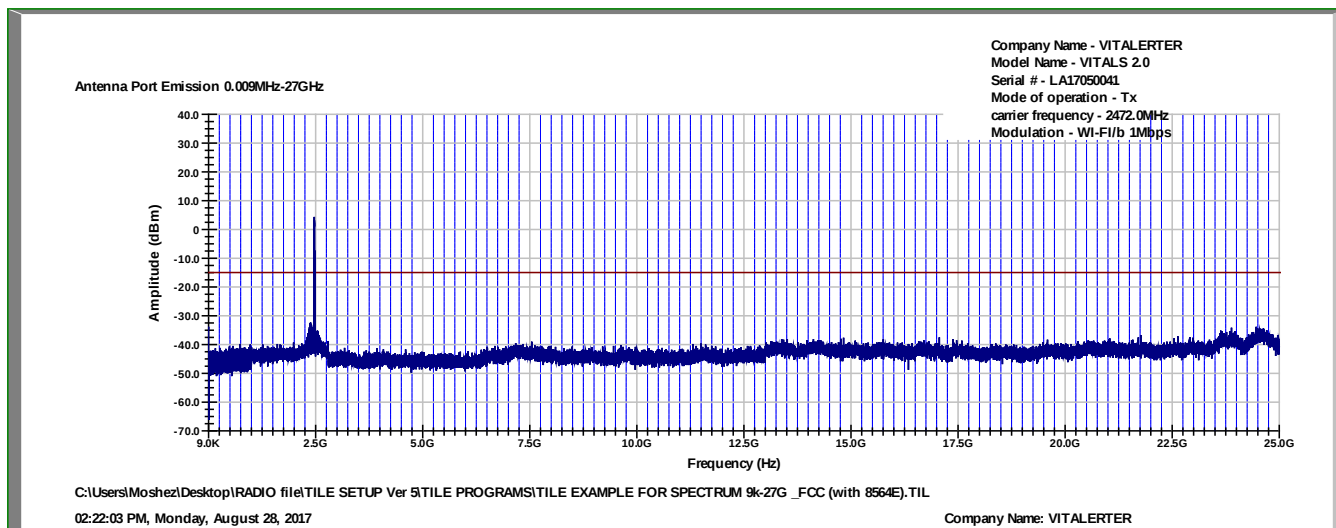


Figure 84 2462.0 MHz, WI-FI/b(1Mbit/s)

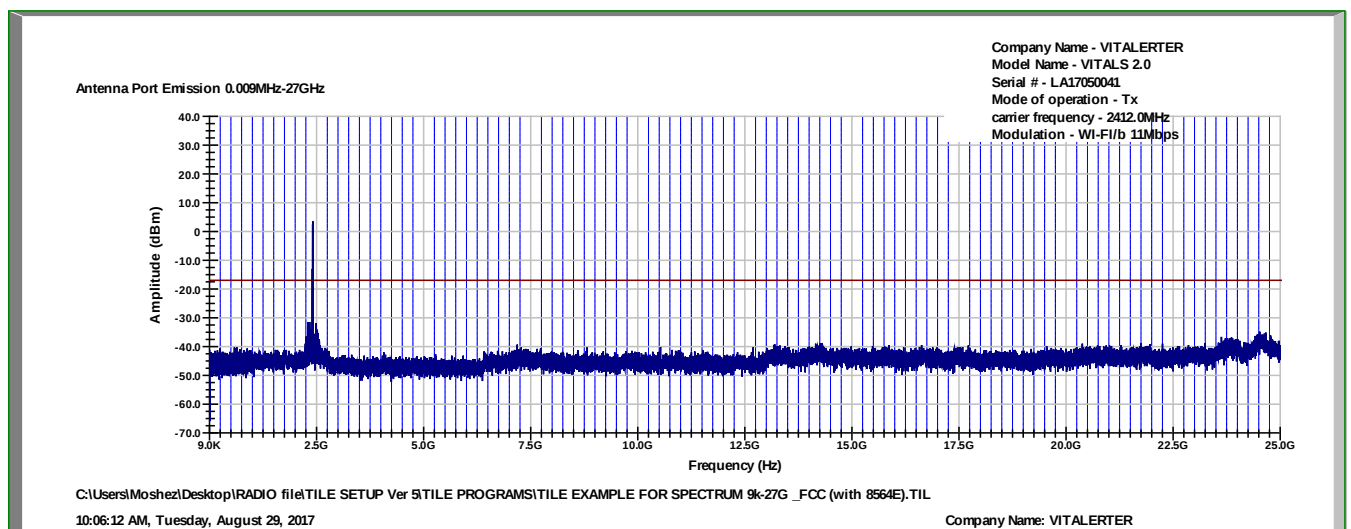


Figure 85 2412.0 MHz, WI-FI/b(11Mbit/s)

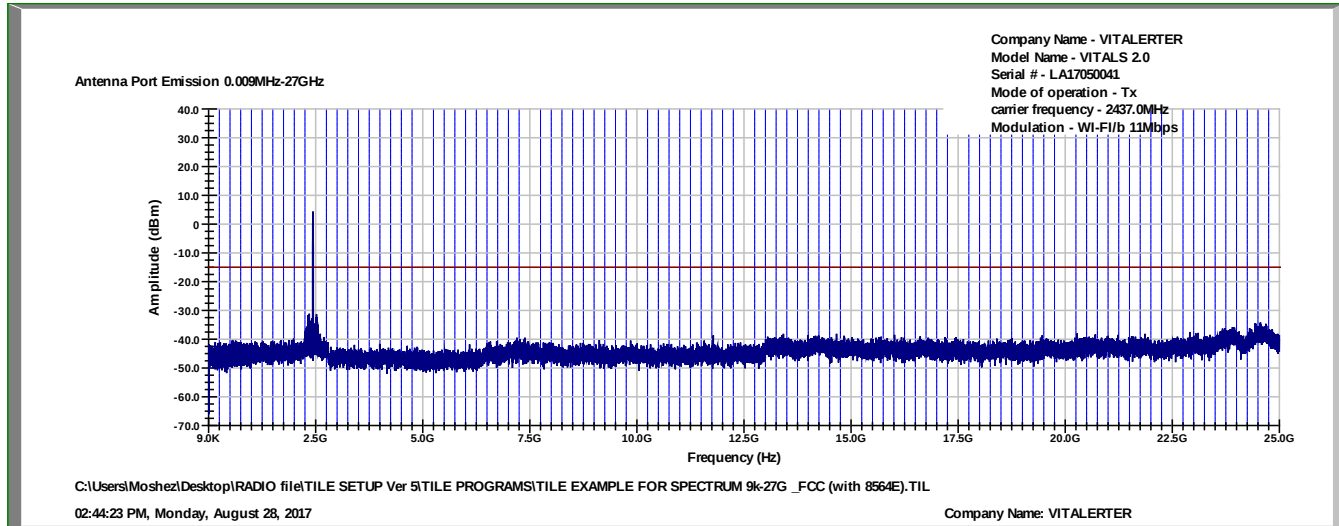


Figure 86 2437.0 MHz, WI-FI/b(11Mbit/s)

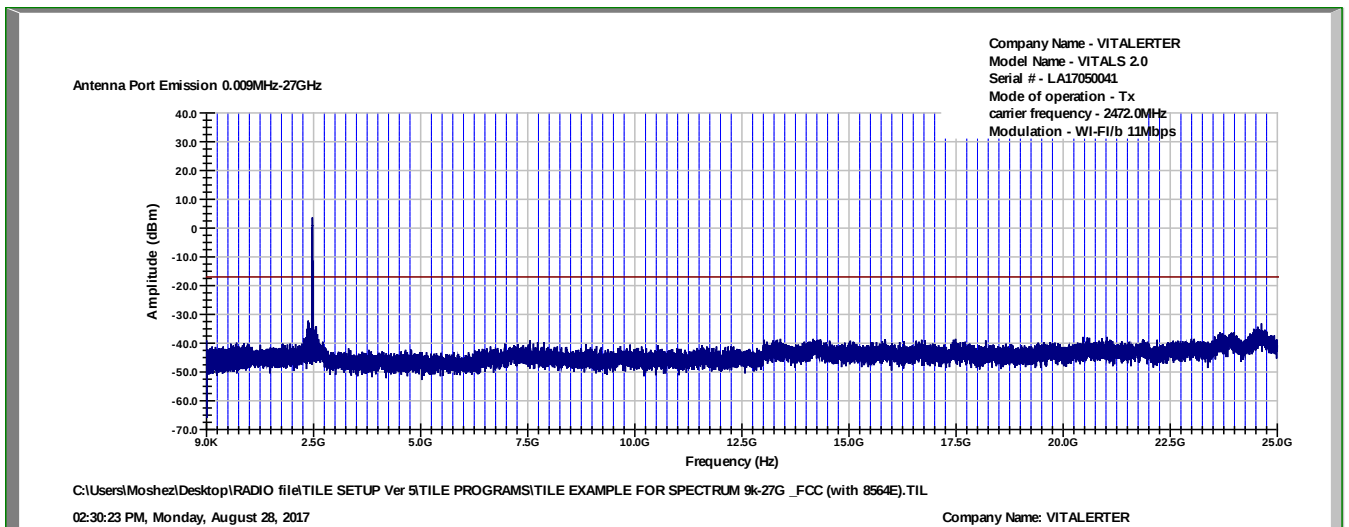


Figure 87 2462.0 MHz, WI-FI/b(11Mbit/s)

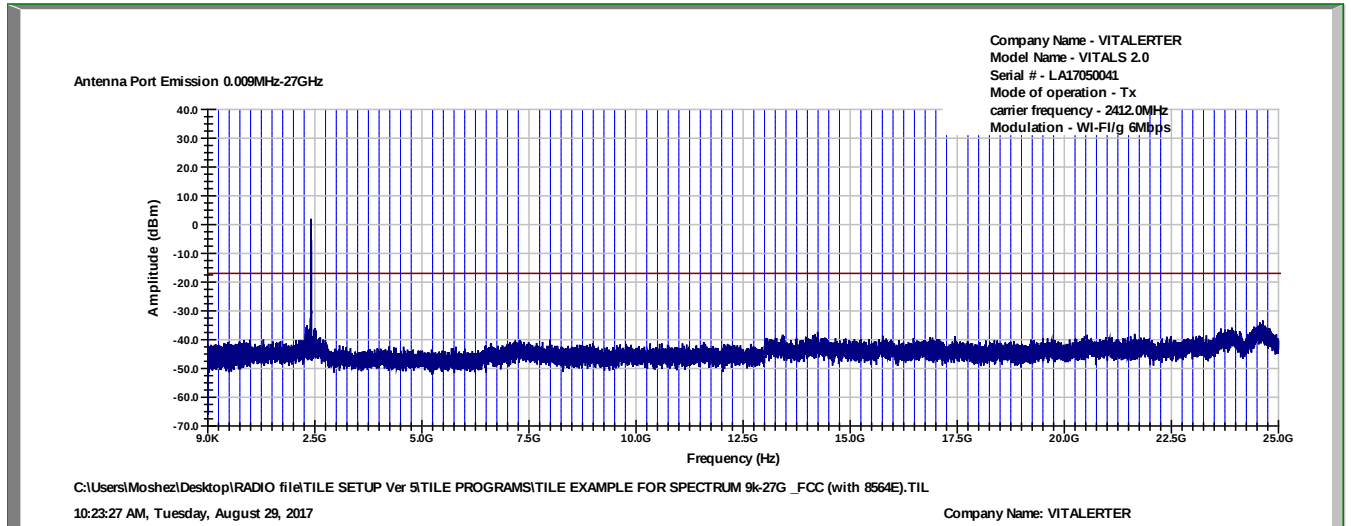


Figure 88 2412.0 MHz, WI-FI/g(6Mbit/s)

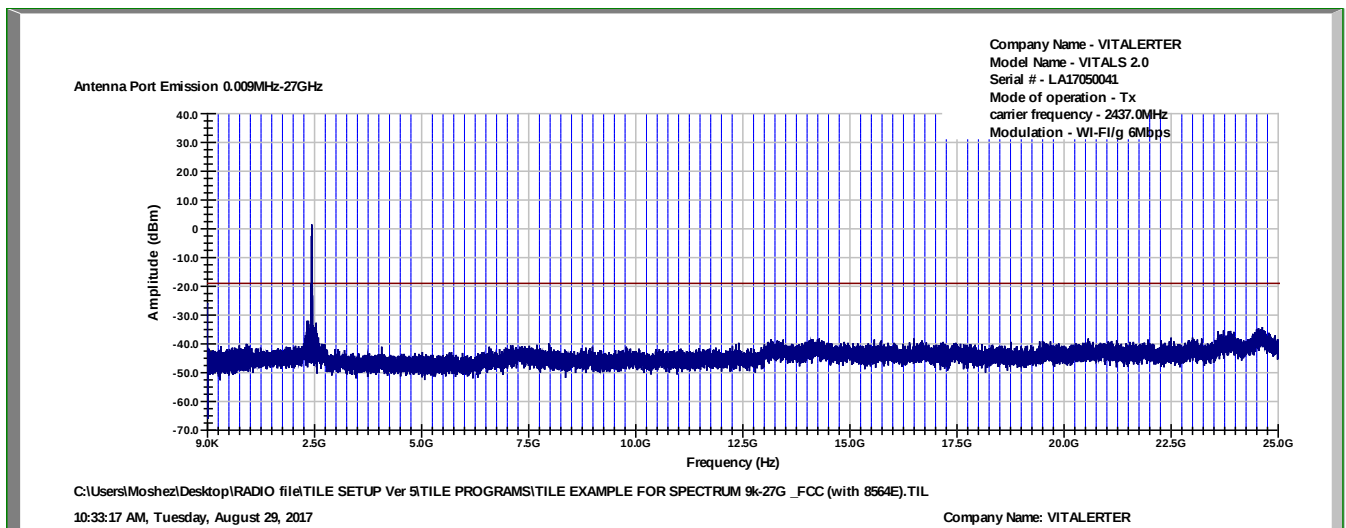


Figure 89 2437.0 MHz, WI-FI/g(6Mbit/s)

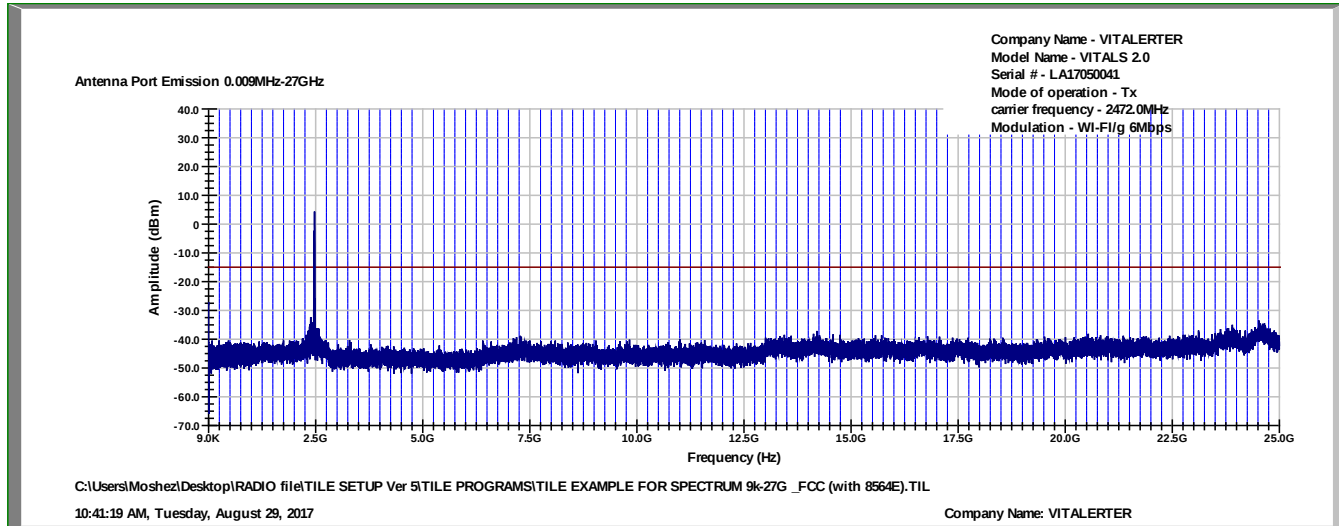


Figure 90 2462.0 MHz, WI-FI/g(6Mbit/s)

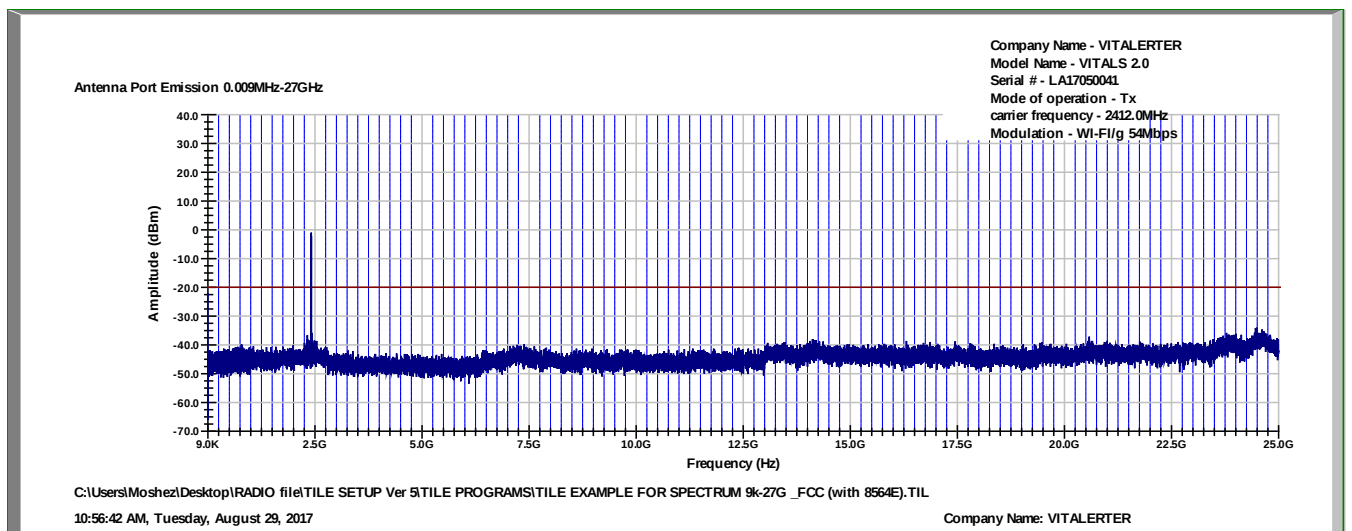


Figure 91 2412.0 MHz, WI-FI/g(54Mbit/s)

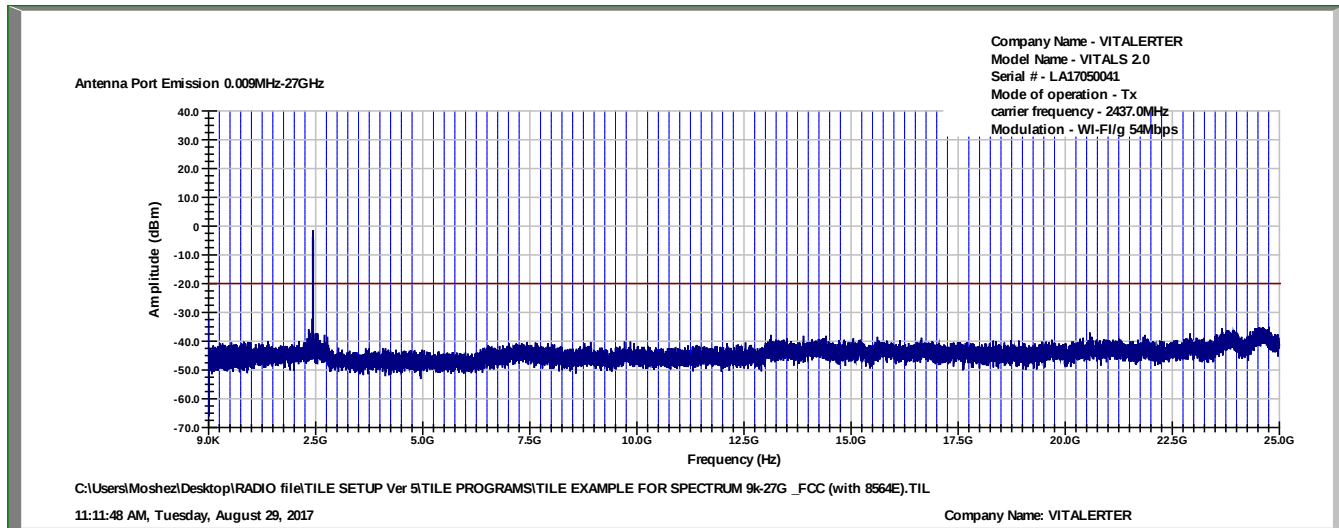


Figure 92 2437.0 MHz, WI-FI/g(54Mbit/s)

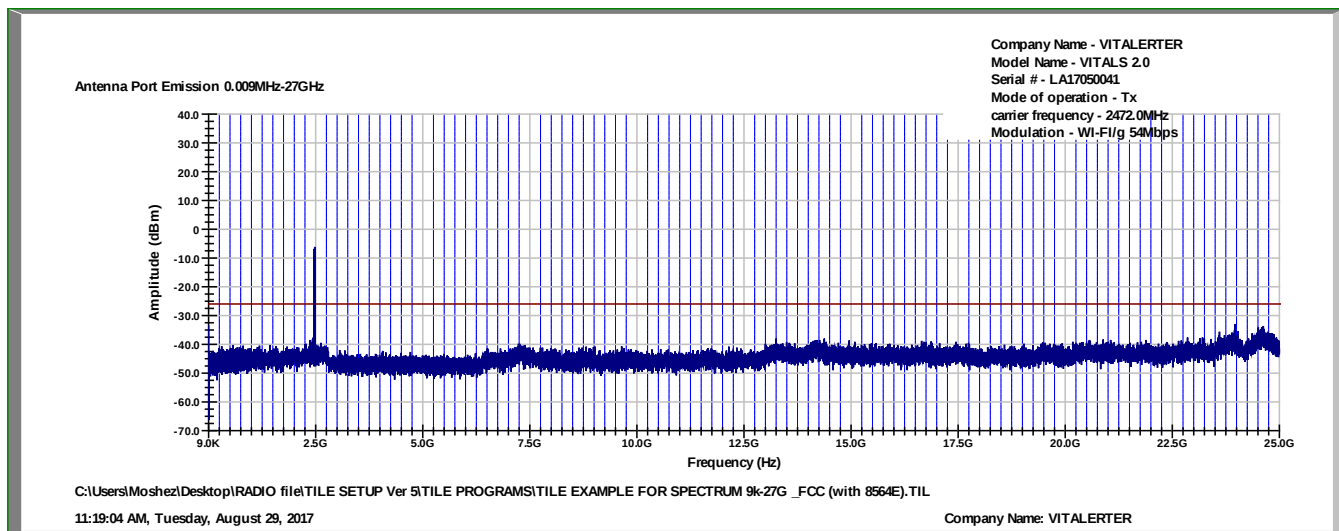


Figure 93 2462.0 MHz, WI-FI/g(54Mbit/s)

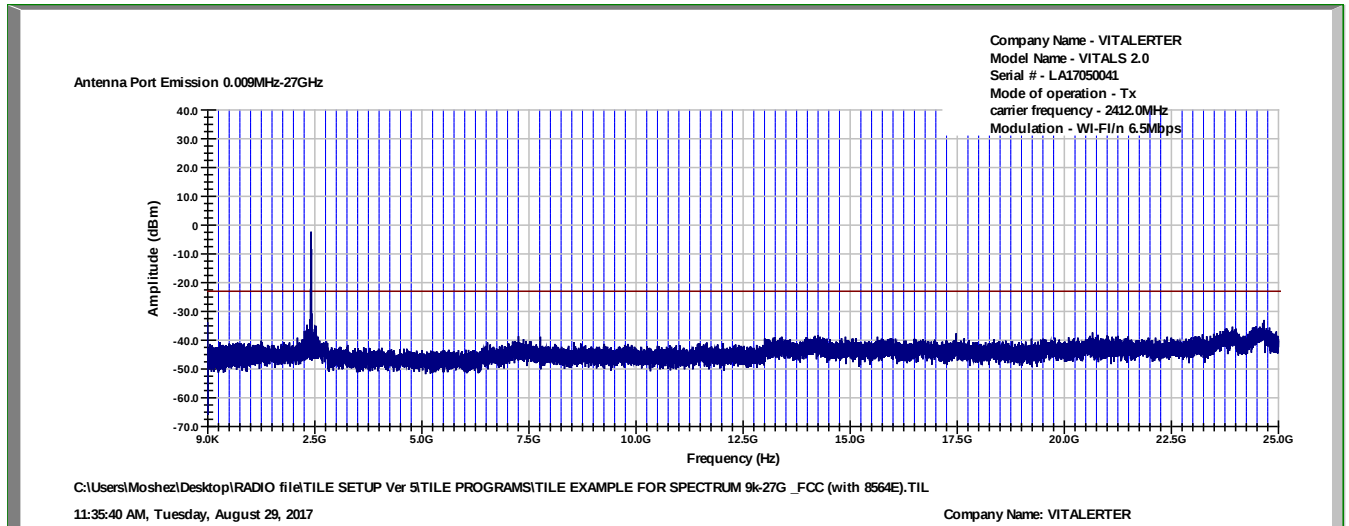


Figure 94 2412.0 MHz, WI-FI/n(6.5Mbit/s)

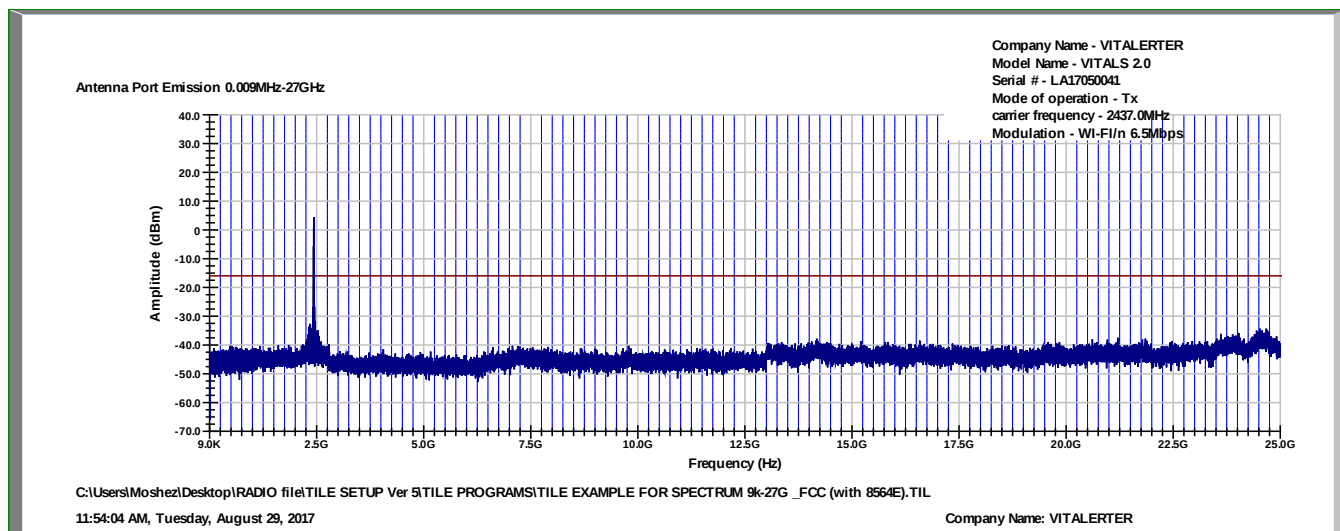


Figure 95 2437.0 MHz, WI-FI/n(6.5Mbit/s)

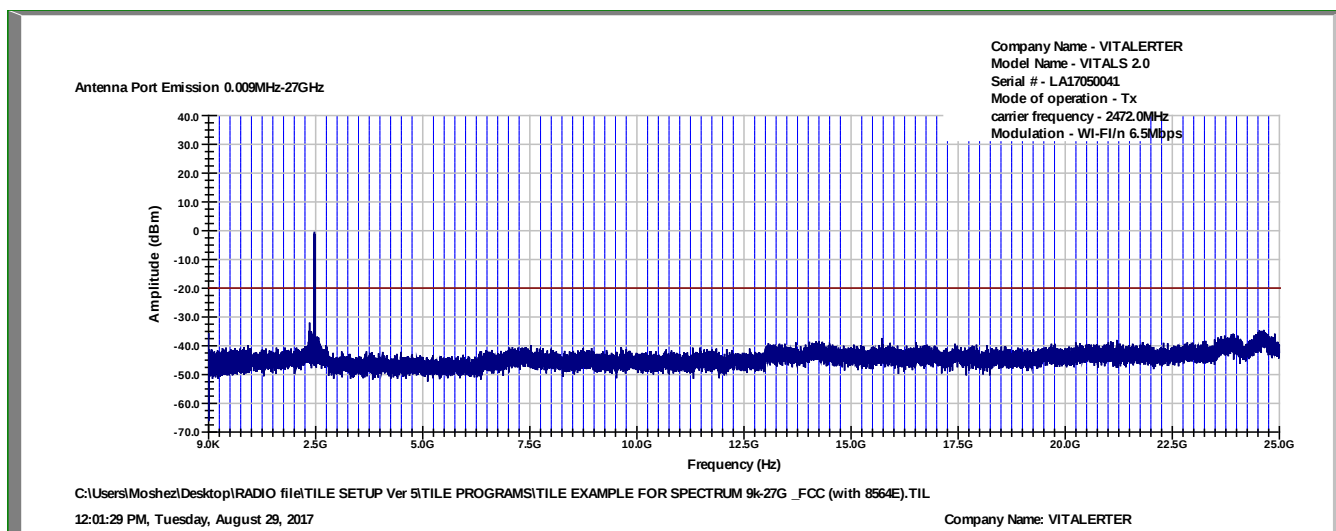


Figure 96 2462.0 MHz, WI-FI/n(6.5Mbit/s)

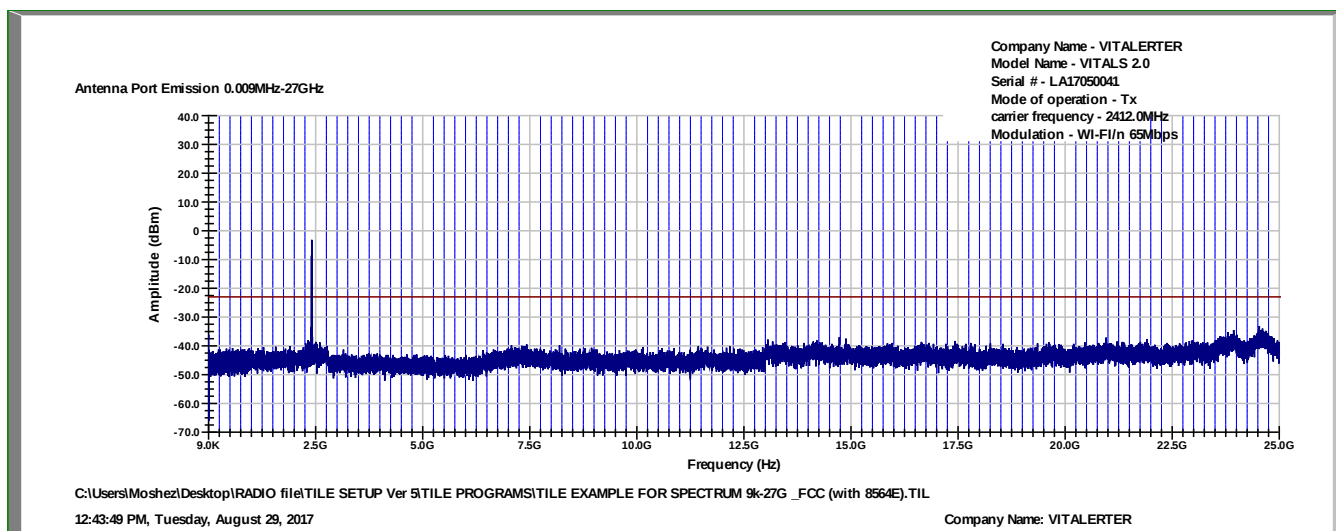


Figure 97 2412.0 MHz, WI-FI/n(65Mbit/s)

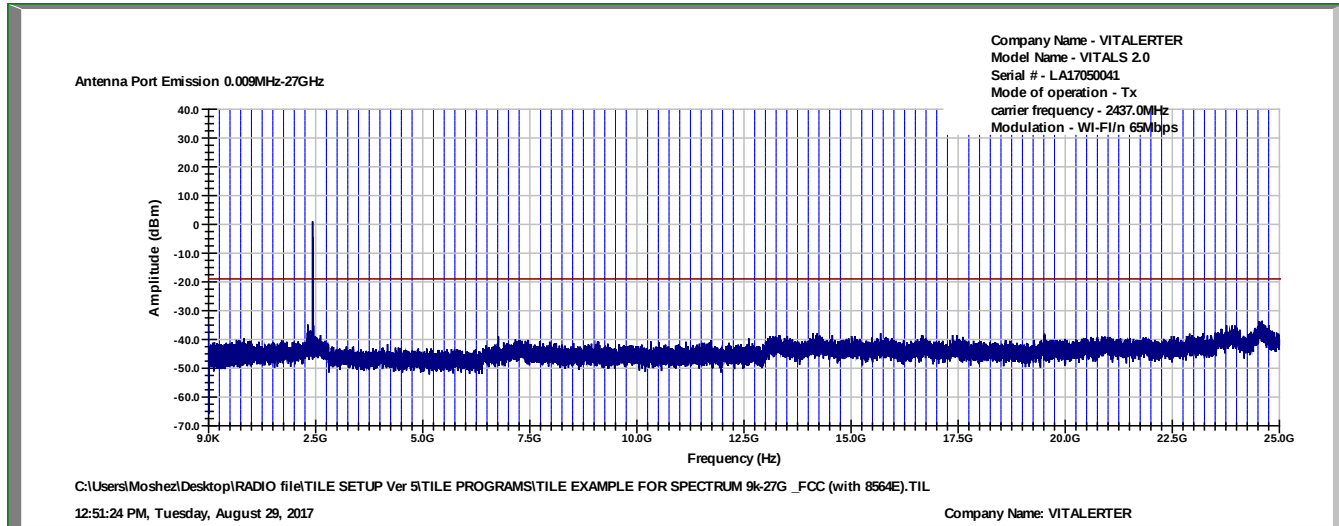


Figure 98 2437.0 MHz, WI-FI/n(65Mbit/s)

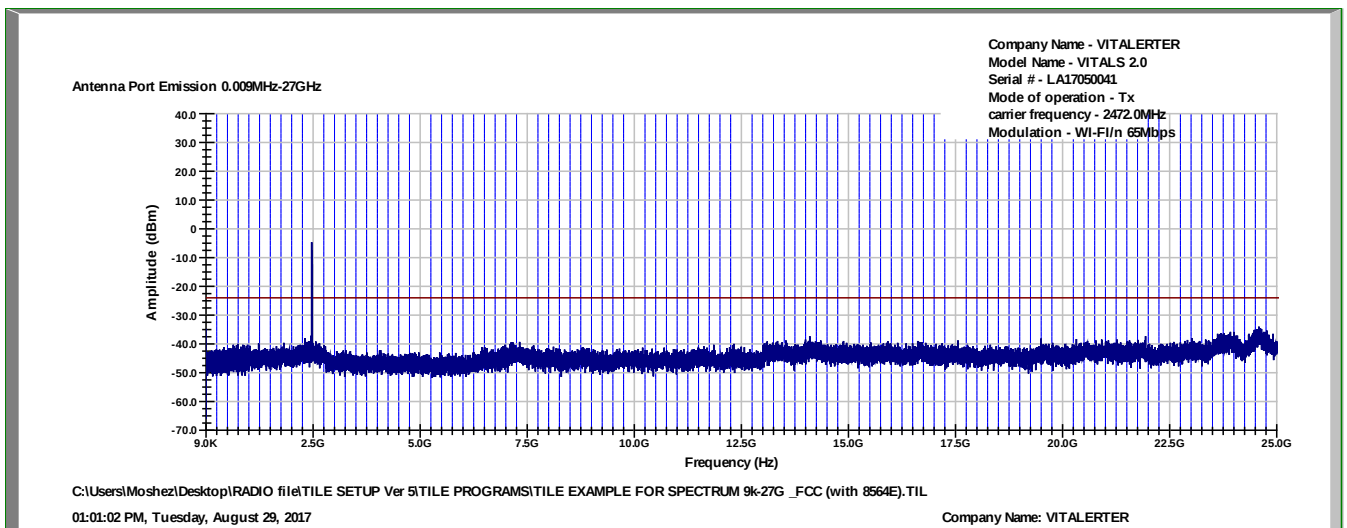


Figure 99 2462.0 MHz, WI-FI/n(65Mbit/s)



8.5 Test Instrumentation Used, Emission in Non Restricted Frequency Bands

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	HP	8564E	3442A00275	March 19, 2017	March 19, 2018
30dB Attenuator	MCL	BW-S30W5	533	July 31, 2017	July 31, 2018

Figure 100 Test Equipment Used

9. Emissions in Restricted Frequency Bands

9.1 Test Specification

FCC Part 15, Subpart C, Sections 15.209, 15.205, 15.247(d)

9.2 Test Procedure

(Temperature (23°C)/ Humidity (65%RH))

The E.U.T. operation mode and test set-up are as described in Section 2 of this report.

For measurements between 0.009-30MHz:

The E.U.T was tested inside the shielded room and placed on a non-metallic table, 0.8 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The frequency range 0.009MHz-30MHz was scanned.

For measurements between 30-1000MHz:

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization. The frequency range 30MHz -1000MHz was scanned and the list of the highest emissions was verified and updated accordingly.

For measurements between 1GHz-25GHz:

The E.U.T was tested inside the shielded room and placed on a non-metallic table, 1.5 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The frequency range 1GHz -25GHz was scanned.

The levels of the emissions within the frequency ranges of the restricted bands (Section 15.205 of FCC Part 15) were compared to the limits of the table in Section 15.209 (a), General Requirements.

9.3 Test Limit

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)	Field strength* (dBµV/m)	Field strength* (dBµV/m)@3m
0.009-0.490	2400/F(kHz)	300	48.5-13.8	128.5-73.8
0.490-1.705	24000/F(kHz)	30	33.8-23.0	73.8-63.0
1.705-30.0	30	30	29.5	69.5
30-88	100	3	40.0	40.0
88-216	150	3	43.5	43.5
216-960	200	3	46.0	46.0
Above 960	500	3	54.0	54.0

*The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector. For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

Figure 101 Table of Limits

9.4 Test Results

JUDGEMENT: Passed by 0.6 dB

For the operation frequency of 2402 MHz, the margin between the emission level and the specification limit is in the worst case 11.4 dB at the frequency of 2390.0 MHz, horizontal polarization.

For the operation frequency of 2480 MHz, the margin between the emission level and the specification limit is in the worst case 2.8 dB at the frequency of 2483.5 MHz, vertical polarization.

For the operation frequency of 2412 MHz, the margin between the emission level and the specification limit is in the worst case 0.6 dB at the frequency of 2390.0 MHz, vertical polarization.

For the operation frequency of 2462 MHz, the margin between the emission level and the specification limit is in the worst case 8.1 dB at the frequency of 2483.5 MHz, vertical polarization.

The EUT met the requirements of the F.C.C. Part 15, Subpart C Sections 15.209, 15.205, 15.247(d) specifications.

The details of the highest emissions are given in *Figure 102* to *Figure 108*.

Radiated Emission

E.U.T Description Sensor
Type Vitals v2.0
Serial Number: LA17050041

Specification: FCC, Part 15, Subpart C, Sections 15.209, 15.205, 15.247(d)

Antenna Polarization: Horizontal/Vertical Frequency Range: 9KHz to 25.0 GHz
Protocol Type: BLE Detector: Peak, Average

Operation Frequency	Freq.	Pol	Peak Reading	Peak Limit	Peak Margin	Average Reading	Average Limit	Average Margin
(MHz)	(MHz)	(H/V)	(dBμV/m)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2402.0	2390.0	V	52.5	74.0	-21.5	42.5	54.0	-11.5
	2390.0	H	52.4	74.0	-21.6	42.6	54.0	-11.4
	4804.0	V	47.9	74.0	-26.1	-	54.0	-
	4804.0	H	46.1	74.0	-27.9	-	54.0	-
2440.0	4880.0	V	44.3	74.0	-29.7	-	54.0	-
	4880.0	H	42.2	74.0	-31.8	-	54.0	-
	7320.0	V	51.0	74.0	-23.0	-	54.0	-
	7320.0	H	50.7	74.0	-23.3	-	54.0	-
2480.0	4960.0	V	43.1	74.0	-30.9	-	54.0	-
	4960.0	H	43.1	74.0	-30.9	-	54.0	-
	2483.5	V	58.8	74.0	-15.2	51.2	54.0	-2.8
	2483.5	H	54.3	74.0	-19.7	43.0	54.0	-11.0

Figure 102. Radiated Emission Results - BLE

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Amp” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss- Low Noise Amplifier Gain



Radiated Emission

E.U.T Description Sensor
Type Vitals v2.0
Serial Number: LA17050041

Specification: FCC, Part 15, Subpart C, Sections 15.209, 15.205, 15.247(d)

Antenna Polarization: Horizontal/Vertical Frequency Range: 9KHz to 25.0 GHz
Protocol type: WI-FI/b(1Mbps) Detector: Peak, Average

Operation Frequency	Freq.	Pol	Peak Reading	Peak Limit	Peak Margin	Average Reading	Average Limit	Average Margin
(MHz)	(MHz)	(H/V)	(dBμV/m)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2412.0	2390.0	V	62.2	74.0	-11.8	53.4	54.0	-0.6
	2390.0	H	54.5	74.0	-19.5	44.3	54.0	-9.7
	4824.0	V	47.3	74.0	-26.7	-	54.0	-
	4824.0	H	45.0	74.0	-29.0	-	54.0	-
	4000.0	H	47.8	74.0	-26.2	-	54.0	-
2437.0	4874.0	V	50.1	74.0	-23.9	-	54.0	-
	4874.0	H	47.7	74.0	-26.3	-	54.0	-
	4056.0	V	51.1	74.0	-22.9	-	54.0	-
	4056.0	H	47.5	74.0	-26.5	-	54.0	-
2462.0	4110.0	V	53.0	74.0	-21.0	47.5	54.0	-6.5
	4924.0	V	51.1	74.0	-22.9	-	54.0	
	4924.0	H	46.4	74.0	-27.6	-	54.0	
	2483.5	V	54.2	74.0	-19.8	40.9	54.0	-13.1
	2483.5	H	53.6	74.0	-20.4	40.4	54.0	-13.6

Figure 103. Radiated Emission Results - WI-FI/b(1Mbps)

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Amp” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

Radiated Emission

E.U.T Description Sensor
Type Vitals v2.0
Serial Number: LA17050041

Specification: FCC, Part 15, Subpart C, Sections 15.209, 15.205, 15.247(d)

Antenna Polarization: Horizontal/Vertical Frequency Range: 9KHz to 25.0 GHz
Protocol type: WI-FI/b(11Mbps) Detector: Peak, Average

Operation Frequency	Freq.	Pol	Peak Reading	Peak Limit	Peak Margin	Average Reading	Average Limit	Average Margin
(MHz)	(MHz)	(H/V)	(dBμV/m)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2412.0	2390.0	V	68.6	74.0	-5.4	53.1	54.0	-0.9
	2390.0	H	54.6	74.0	-19.4	44.4	54.0	-9.6
	4824.0	V	47.2	74.0	-26.8	-	54.0	-
	4824.0	H	49.4	74.0	-24.6	-	54.0	-
	4000.0	V	50.7	74.0	-23.3	-	54.0	-
	4000.0	H	48.5	74.0	-25.5	-	54.0	-
2437.0	4874.0	V	47.6	74.0	-26.4	-	54.0	-
	4874.0	H	51.6	74.0	-22.4	-	54.0	-
	4056.0	V	50.2	74.0	-23.8	-	54.0	-
2462.0	4118.5	V	51.3	74.0	-22.7	-	54.0	-
	4924.0	V	50.0	74.0	-24.0	-	54.0	-
	4924.0	H	54.0	74.0	-20.0	45.6	54.0	-8.4
	2483.5	V	55.3	74.0	-18.7	40.5	54.0	-13.5
	2483.5	H	55.2	74.0	-18.8	41.0	54.0	-13.0

Figure 104. Radiated Emission Results - WI-FI/b(11Mbps)

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Amp” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss- Low Noise Amplifier Gain



Radiated Emission

E.U.T Description Sensor
Type Vitals v2.0
Serial Number: LA17050041

Specification: FCC, Part 15, Subpart C, Sections 15.209, 15.205, 15.247(d)

Antenna Polarization: Horizontal/Vertical Frequency Range: 9KHz to 25.0 GHz
Protocol type: WI-FI/g(6Mbps) Detector: Peak, Average

Operation Frequency	Freq.	Pol	Peak Reading	Peak Limit	Peak Margin	Average Reading	Average Limit	Average Margin
(MHz)	(MHz)	(H/V)	(dBμV/m)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2412.0	2390.0	V	67.3	74.0	-6.7	49.2	54.0	-4.8
	2390.0	H	54.3	74.0	-19.7	44.1	54.0	-9.9
	4824.0	V	44.2	74.0	-29.8	-	54.0	-
	4824.0	H	44.6	74.0	-29.4	-	54.0	-
	4000.0	V	48.1	74.0	-25.9	-	54.0	-
2437.0	4874.0	V	45.8	74.0	-28.2	-	54.0	-
	4874.0	H	47.9	74.0	-26.1	-	54.0	-
	4056.0	V	48.6	74.0	-25.4	-	54.0	-
2462.0	4924.0	V	52.4	74.0	-21.6	-	54.0	-
	4924.0	H	47.2	74.0	-26.8	-	54.0	-
	2483.5	V	63.2	74.0	-10.8	43.9	54.0	-10.1
	2483.5	H	57.6	74.0	-16.4	42.4	54.0	-11.6

Figure 105. Radiated Emission Results - WI-FI/g(6Mbps)

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Amp” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

Radiated Emission

E.U.T Description Sensor
Type Vitals v2.0
Serial Number: LA17050041

Specification: FCC, Part 15, Subpart C, Sections 15.209, 15.205, 15.247(d)

Antenna Polarization: Horizontal/Vertical Frequency Range: 9KHz to 25.0 GHz
Protocol type: WI-FI/g(54Mbps) Detector: Peak, Average

Operation Frequency	Freq.	Pol	Peak Reading	Peak Limit	Peak Margin	Average Reading	Average Limit	Average Margin
(MHz)	(MHz)	(H/V)	(dBμV/m)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2412.0	2390.0	V	67.0	74.0	-7.0	50.5	54.0	-3.5
	2390.0	H	53.3	74.0	-20.7	44.1	54.0	-9.9
	4824.0	V	48.9	74.0	-25.1	-	54.0	-
	4824.0	H	49.3	74.0	-24.7	-	54.0	-
2437.0	4874.0	V	47.1	74.0	-26.9	-	54.0	-
	4874.0	H	41.4	74.0	-32.6	-	54.0	-
2462.0	4110.0	V	40.6	74.0	-33.4	-	54.0	-
	4924.0	V	49.3	74.0	-24.7	-	54.0	-
	4924.0	H	49.8	74.0	-24.2	-	54.0	-
	2483.5	V	57.6	74.0	-16.4	40.2	54.0	-13.8
	2483.5	H	53.8	74.0	-20.2	40.4	54.0	-13.6

Figure 106. Radiated Emission Results - WI-FI/g(54Mbps)

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Amp” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

Radiated Emission

E.U.T Description Sensor
Type Vitals v2.0
Serial Number: LA17050041

Specification: FCC, Part 15, Subpart C, Sections 15.209, 15.205, 15.247(d)

Antenna Polarization: Horizontal/Vertical Frequency Range: 9KHz to 25.0 GHz
Protocol type: WI-FI/n(6.5Mbps) Detector: Peak, Average

Operation Frequency	Freq.	Pol	Peak Reading	Peak Limit	Peak Margin	Average Reading	Average Limit	Average Margin
(MHz)	(MHz)	(H/V)	(dBμV/m)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2412.0	2390.0	V	66.4	74.0	-7.6	49.4	54.0	-4.6
	2390.0	H	53.6	74.0	-20.4	45.8	54.0	-8.2
	4824.0	V	42.6	74.0	-31.4	-	54.0	-
	4824.0	H	47.5	74.0	-26.5	-	54.0	-
2437.0	4874.0	V	45.9	74.0	-28.1	-	54.0	-
	4874.0	H	47.8	74.0	-26.2	-	54.0	-
	4056.0	V	50.0	74.0	-24.0	-	54.0	-
	4056.0	H	48.8	74.0	-25.2	-	54.0	-
2462.0	7386.0	V	47.6	74.0	-26.4	-	54.0	-
	4924.0	V	44.3	74.0	-29.7	-	54.0	-
	4924.0	H	45.6	74.0	-28.4	-	54.0	-
	2483.5	V	59.8	74.0	-14.2	42.4	54.0	-11.6
	2483.5	H	56.3	74.0	-17.7	43.1	54.0	-10.9

Figure 107. Radiated Emission Results - WI-FI/n(6.5Mbps)

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Amp” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss- Low Noise Amplifier Gain



Radiated Emission

E.U.T Description Sensor
Type Vitals v2.0
Serial Number: LA17050041

Specification: FCC, Part 15, Subpart C, Sections 15.209, 15.205, 15.247(d)

Antenna Polarization: Horizontal/Vertical Frequency Range: 9KHz to 25.0 GHz
Protocol type: WI-FI/n(65Mbps) Detector: Peak, Average

Operation Frequency	Freq.	Pol	Peak Reading	Peak Limit	Peak Margin	Average Reading	Average Limit	Average Margin
(MHz)	(MHz)	(H/V)	(dBμV/m)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2412.0	2390.0	V	63.5	74.0	-10.5	45.8	54.0	-8.2
	2390.0	H	53.7	74.0	-20.3	48.8	54.0	-5.2
	4824.0	V	41.5	74.0	-32.5	-	54.0	-
	4824.0	H	42.0	74.0	-32.0	-	54.0	-
	7236.0	H	45.6	74.0	-28.4	-	54.0	-
2437.0	4874.0	V	48.1	74.0	-25.9	-	54.0	-
	4874.0	H	50.4	74.0	-23.6	-	54.0	-
2462.0	4924.0	V	44.3	74.0	-29.7	-	54.0	-
	4924.0	H	43.2	74.0	-30.8	-	54.0	-
	2483.5	V	58.2	74.0	-15.8	45.9	54.0	-8.1
	2483.5	H	55.2	74.0	-18.8	41.0	54.0	-13.0

Figure 108. Radiated Emission Results - WI-FI/n(65Mbps)

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Amp” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

9.5 Test Instrumentation Used; Emissions in Restricted Frequency Bands

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 28, 2017	February 28, 2018
Spectrum Analyzer	HP	8592L	3826A01204	March 1, 2017	March 1, 2018
EMI Receiver	HP	8542E	3906A00276	March 1, 2017	March 1, 2018
RF Filter Section	HP	85420E	3705A00248	March 1, 2017	March 1, 2018
Spectrum Analyzer	HP	8564E	3442A00275	March 19, 2017	March 19, 2018
Biconical Antenna	EMCO	3110B	9912-3337	March 24, 2016	March 24, 2018
Log Periodic Antenna	EMCO	3146	9505-4081	May 15, 2017	May 15, 2018
Horn Antenna	ETS	3115	29845	May 19, 2015	May 19, 2018
Horn Antenna	ARA	SWH-28	1007	March 30, 2014	December 31, 2017
Active Loop Antenna	EMCO	6502	9506-2950	September 12, 2016	September 12, 2017*
MicroWave System Amplifier	HP	83006A	3104A00589	July 31, 2017	July 31, 2018
Low noise amplifier 1GHz-18GHz	Miteq itl # 1583	AFSX4-02001800-50-8P	-	July 31, 2017	July 31, 2018
Spectrum Analyzer	HP	8593EM	3536A00120 ADI	February 28, 2017	February 28, 2018
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	N/A	N/A
Antenna Mast	ETS	2070-2	9608-1497	N/A	N/A
Turntable	ETS	2087	-	N/A	N/A
Mast & Table Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

* Testing performed on September 11 2017.

Figure 109 Test Equipment Used

10. Transmitted Power Density

10.1 Test Specification

FCC, Part 15, Subpart C, Section 247(e)

10.2 Test Procedure

(Temperature (23°C)/ Humidity (70%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report.

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (total loss= 32.0dB). Special attention was taken to prevent Spectrum Analyzer RF input overload.

The spectrum analyzer was set to 3 kHz RBW and VBW to 10 kHz.

10.3 Test Limit

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

10.4 Test Results

Protocol Type	Operation Frequency	Power	Limit	Margin
	(MHz)	(dBm)	(dBm)	(dBm)
BLE	2402.0	-11.0	8.0	-19.0
	2440.0	-10.8	8.0	-18.8
	2480.0	-11.1	8.0	-19.1
Wi-fi/b(1Mbit/s)	2412.0	-11.1	8.0	-19.1
	2437.0	-9.6	8.0	-17.6
	2462.0	-10.5	8.0	-18.5
Wi-fi/b(11Mbit/s)	2412.0	-9.1	8.0	-17.1
	2437.0	-7.7	8.0	-15.7
	2462.0	-10.9	8.0	-18.9
Wi-fi/g(6Mbit/s)	2412.0	-14.5	8.0	-22.5
	2437.0	-11.3	8.0	-19.3
	2462.0	-15.9	8.0	-23.9
Wi-fi/g(54Mbit/s)	2412.0	-23.3	8.0	-31.3
	2437.0	-21.6	8.0	-29.6
	2462.0	-22.3	8.0	-30.3
Wi-fi/n(6.5Mbit/s)	2412.0	-15.8	8.0	-23.8
	2437.0	-12.7	8.0	-20.7
	2462.0	-16.3	8.0	-24.3
Wi-fi/n(65Mbit/s)	2412.0	-22.0	8.0	-30.0
	2437.0	-21.6	8.0	-29.6
	2462.0	-20.9	8.0	-28.9

Figure 110 Test Results

JUDGEMENT: Passed by 15.7 dB

For additional information see *Figure 111* to *Figure 131*.

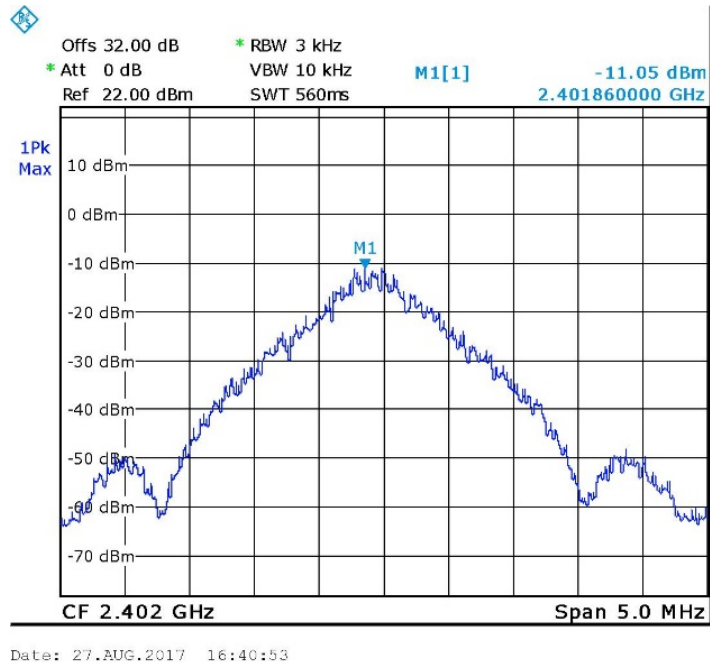


Figure 111 — 2402.0 MHz, BLE

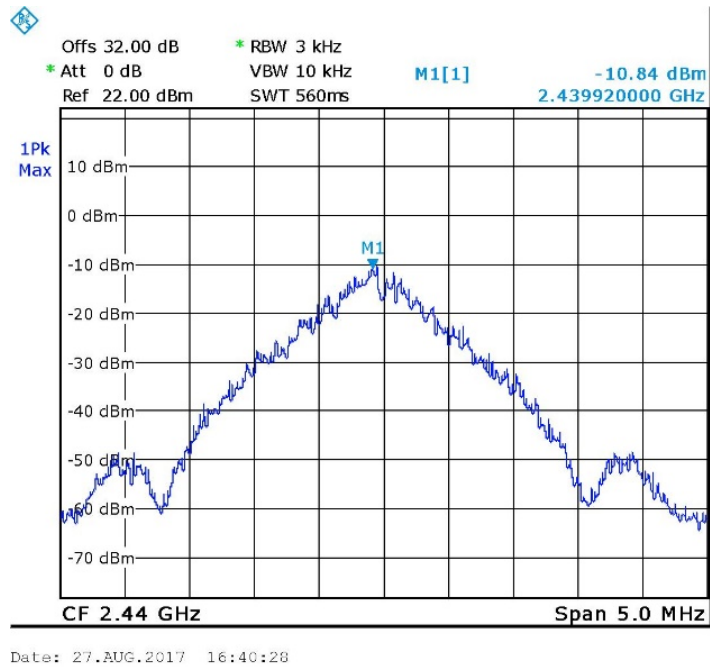


Figure 112 — 2440.0 MHz, BLE

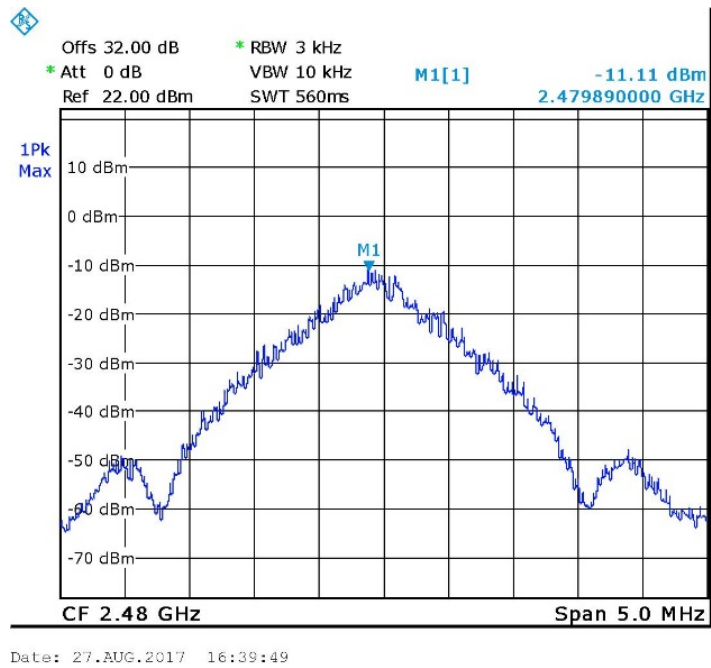


Figure 113 — 2480.0 MHz, BLE

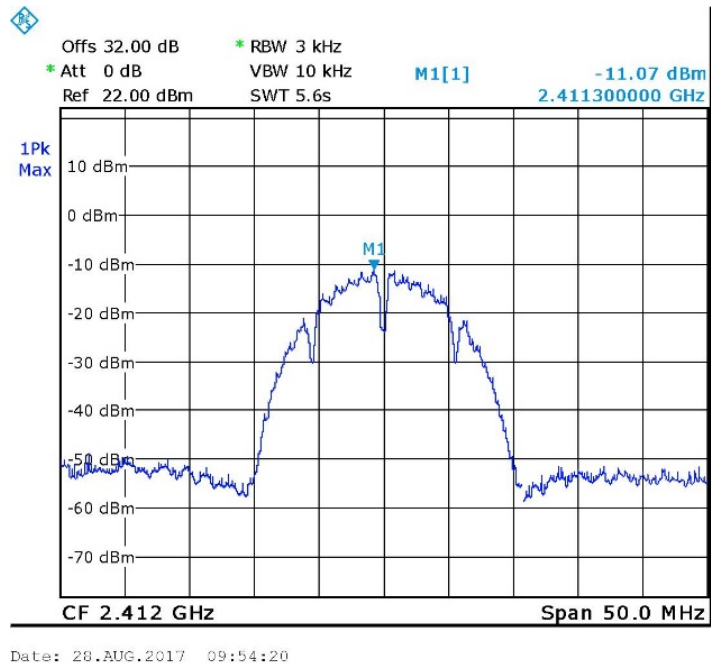


Figure 114 — 2412.0 MHz, WI-FI/b(1Mbit/s)

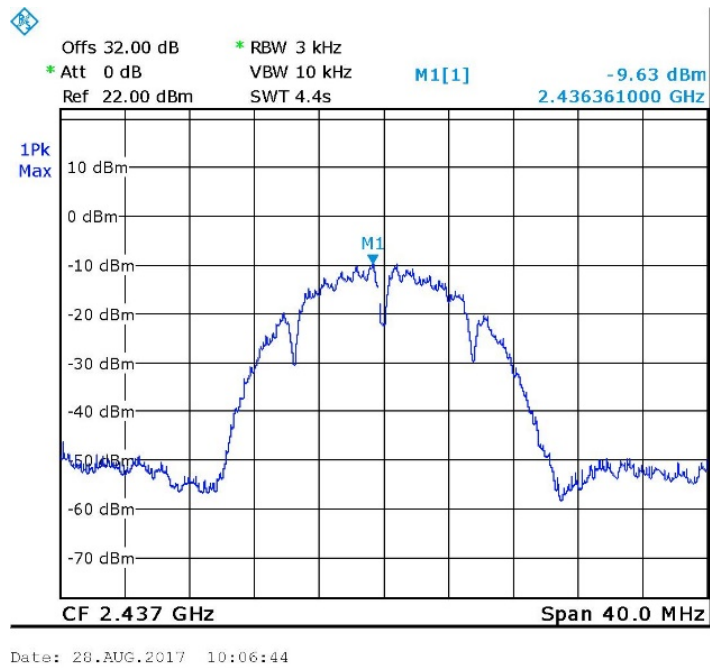


Figure 115 — 2437.0 MHz, WI-FI/b(1Mbit/s)

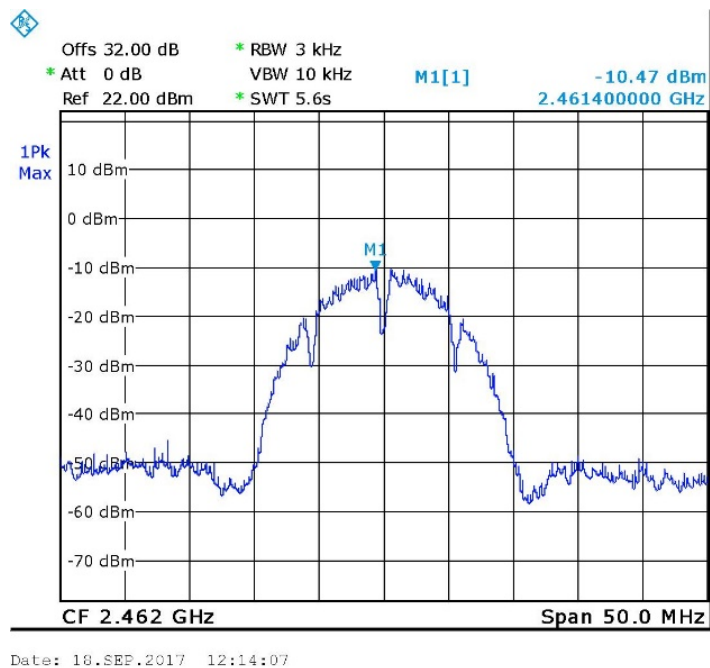


Figure 116 — 2462.0 MHz, WI-FI/b(1Mbit/s)

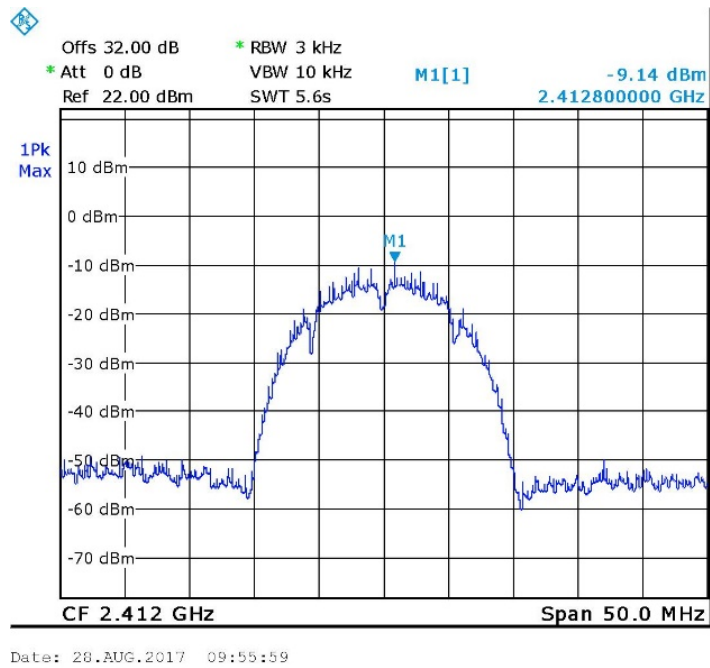


Figure 117 — 2412.0 MHz, WI-FI/b(11Mbit/s)

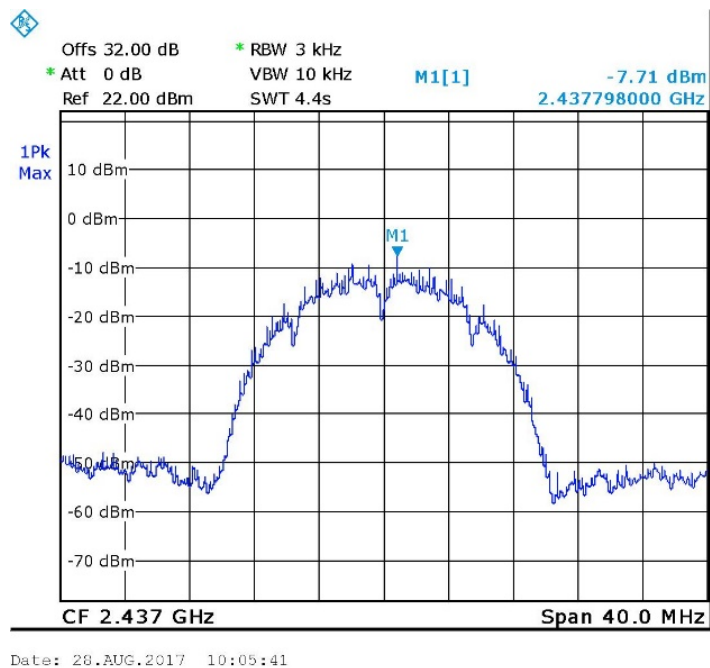


Figure 118 — 2437.0 MHz, WI-FI/b(11Mbit/s)

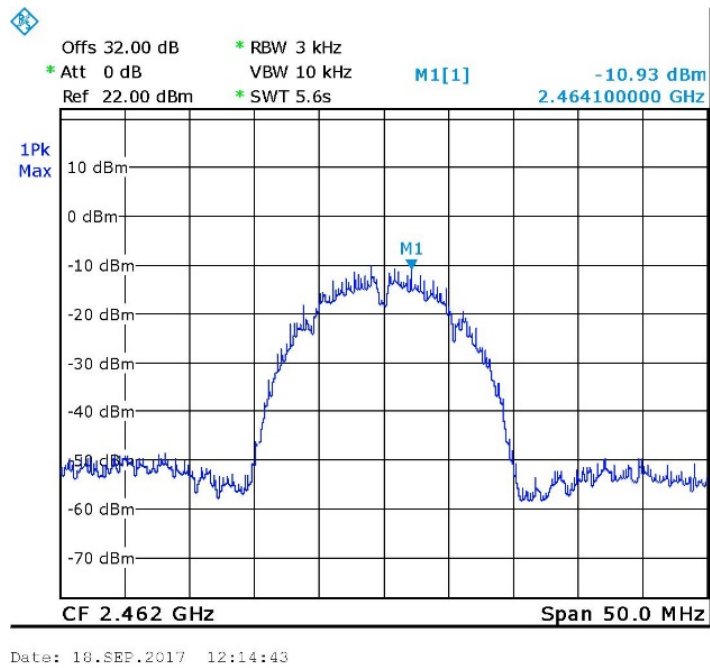


Figure 119 — 2462.0 MHz, WI-FI/b(11Mbit/s)

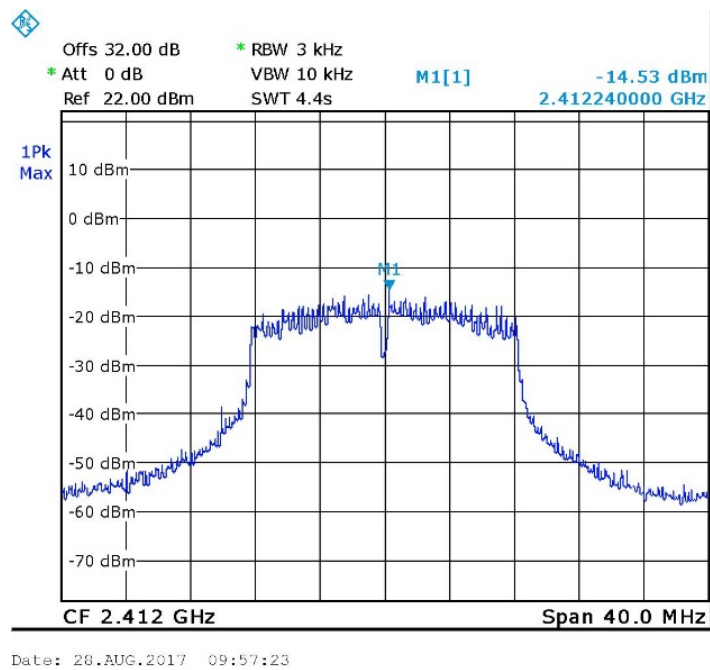


Figure 120 — 2412.0 MHz, WI-FI/g(6Mbit/s)

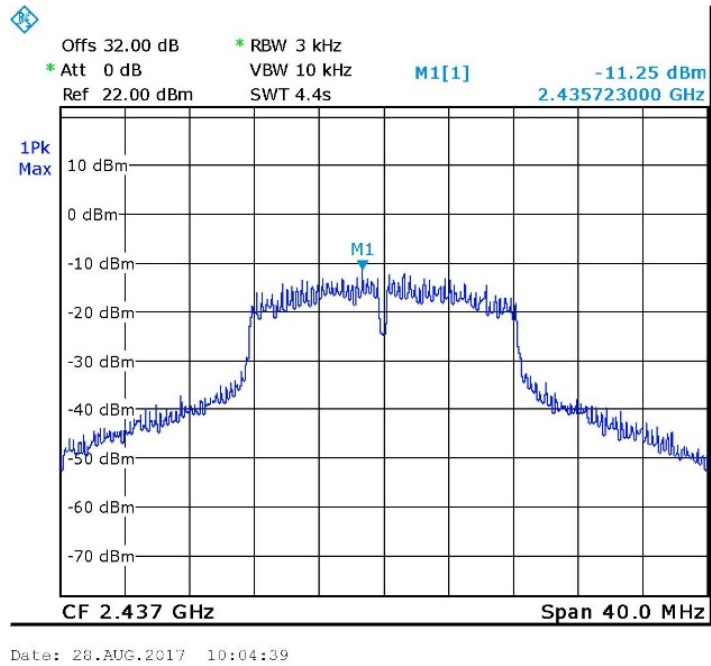


Figure 121 — 2437.0 MHz, WI-FI/g(6Mbit/s)

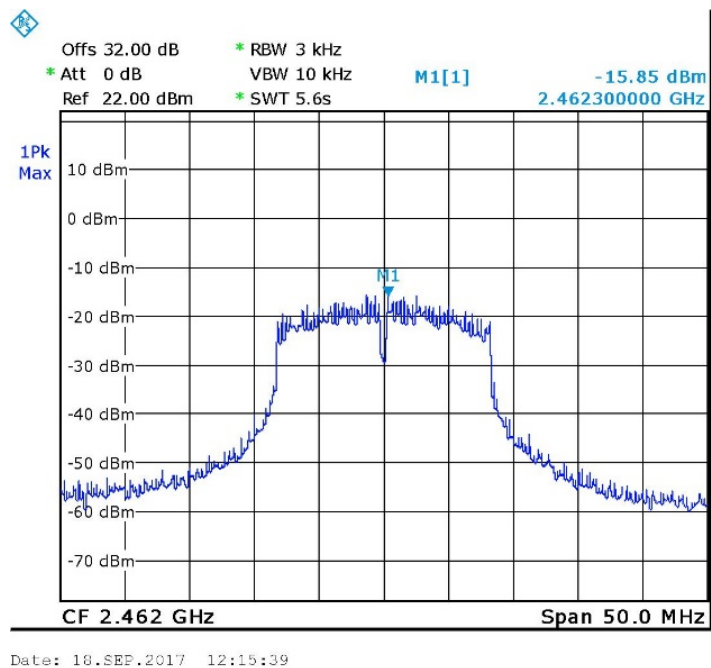


Figure 122 — 2462.0 MHz, WI-FI/g(6Mbit/s)

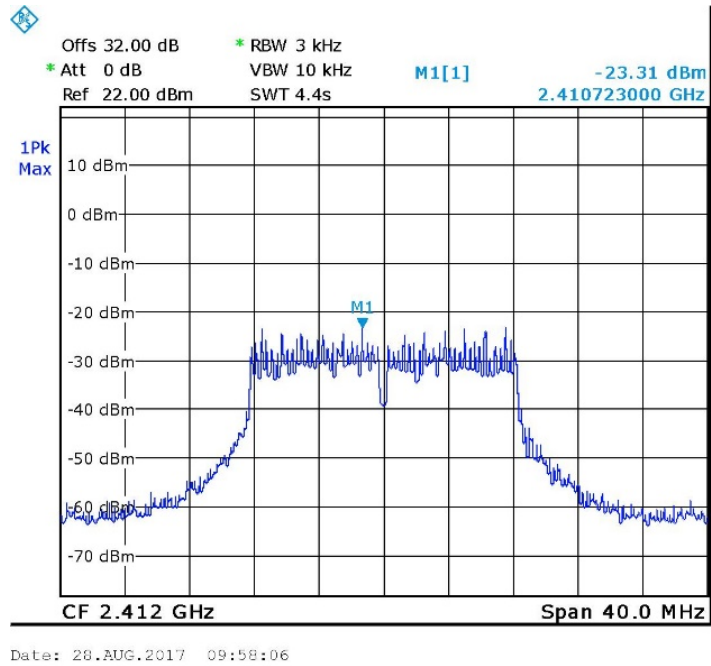


Figure 123 — 2412.0 MHz, WI-FI/g(54Mbit/s)

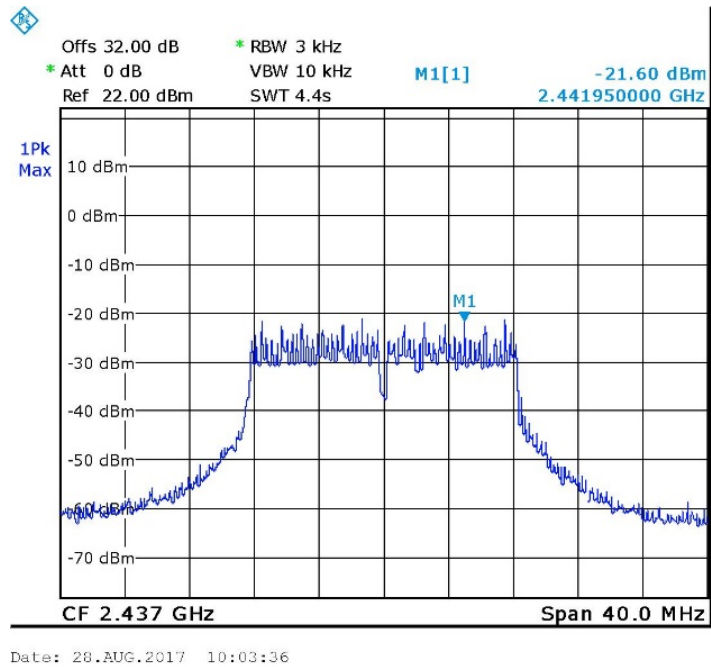


Figure 124 — 2437.0 MHz, WI-FI/g(54Mbit/s)

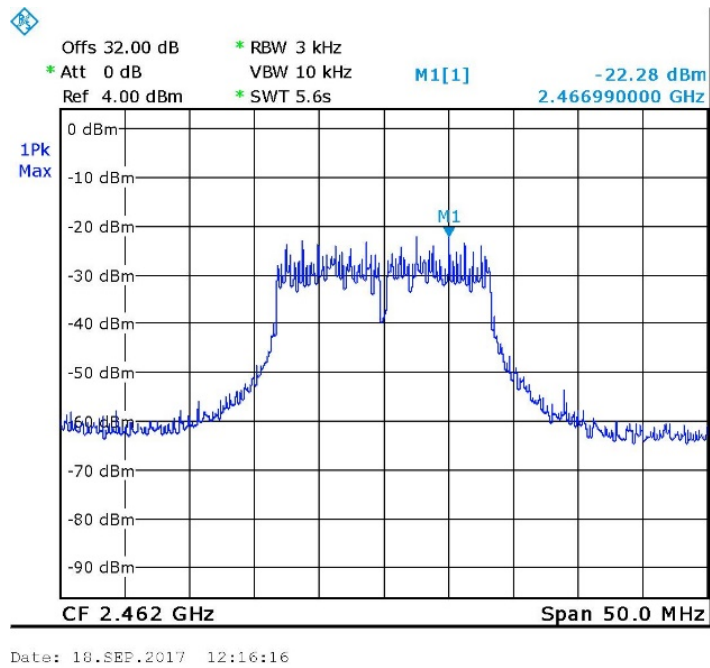


Figure 125 — 2462.0 MHz, WI-FI/g(54Mbit/s)

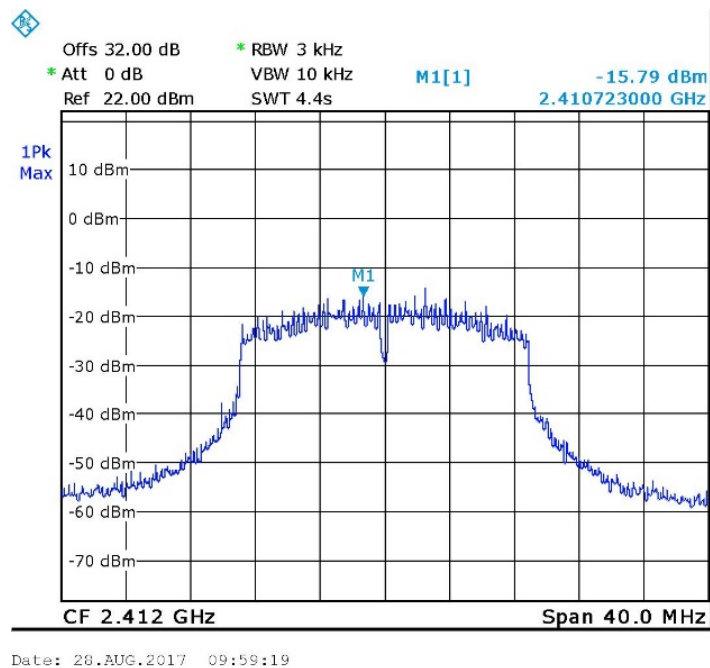


Figure 126 — 2412.0 MHz, WI-FI/n(6.5Mbit/s)

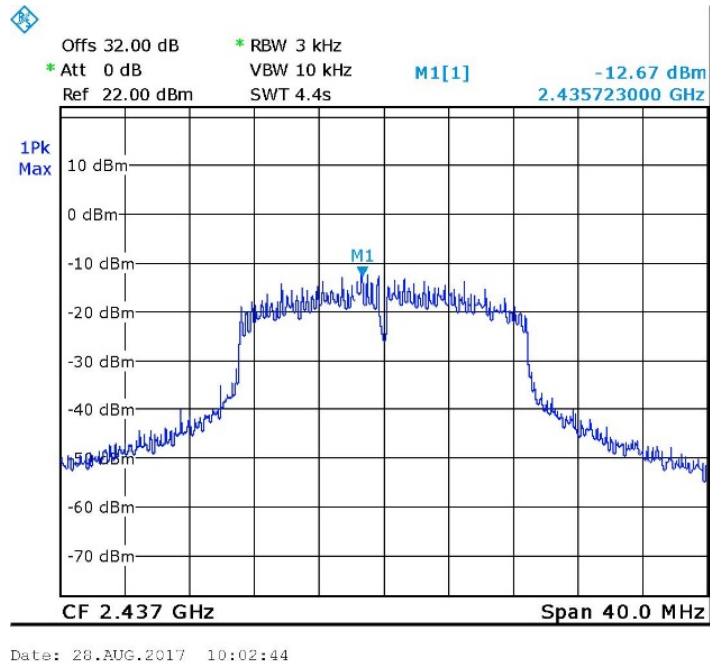


Figure 127 — 2437.0 MHz, WI-FI/n(6.5Mbit/s)

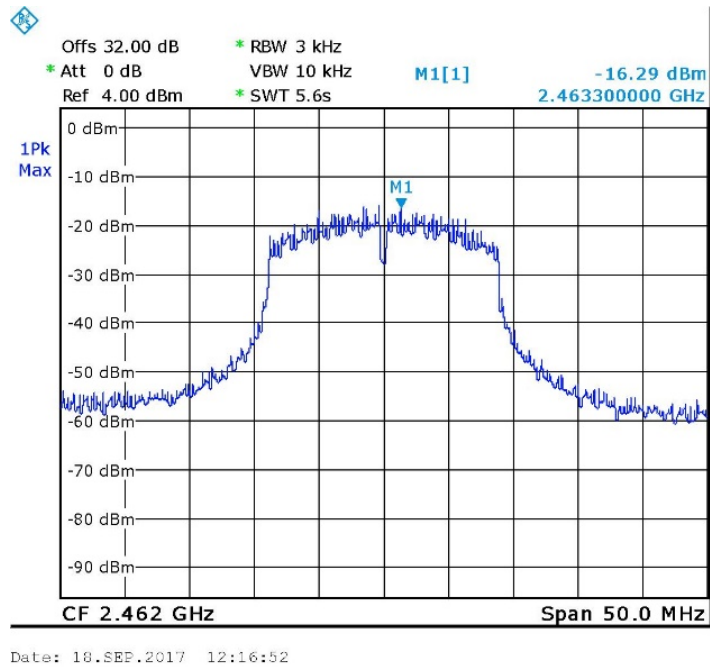


Figure 128 — 2462.0 MHz, WI-FI/n(6.5Mbit/s)

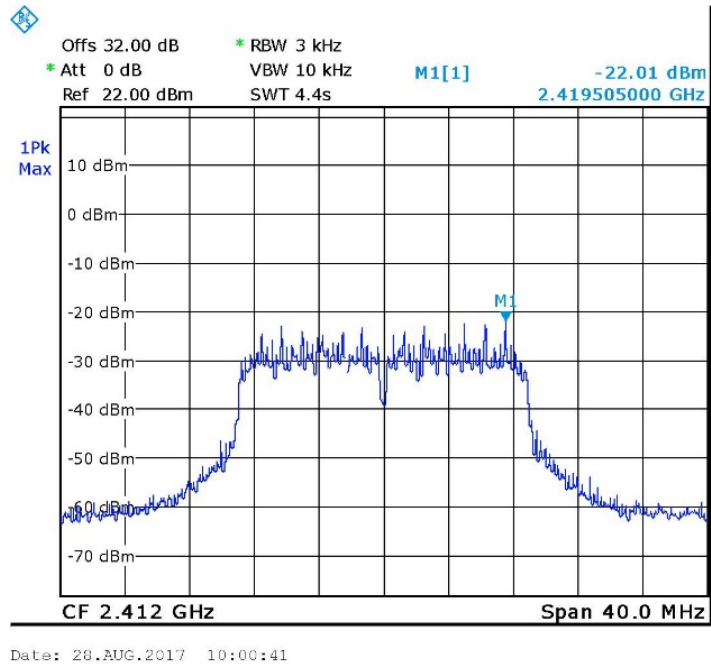


Figure 129 — 2412.0 MHz, WI-FI/n(65Mbit/s)

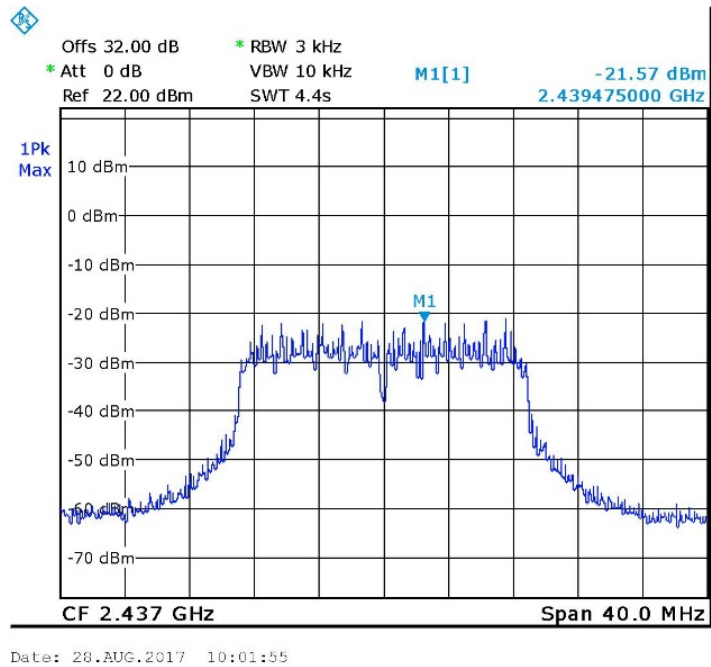


Figure 130 — 2437.0 MHz, WI-FI/n(65Mbit/s)

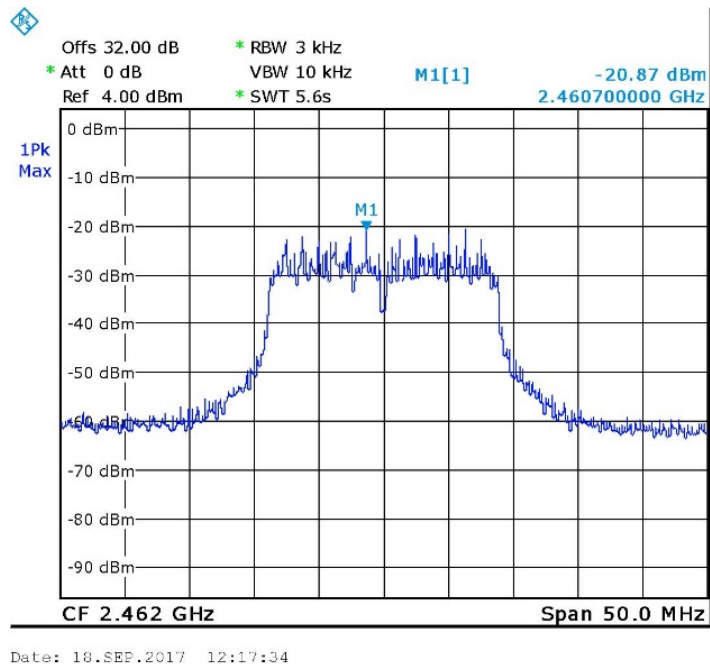


Figure 131 — 2462.0 MHz, WI-FI/n(65Mbit/s)

10.5 Test Equipment Used; Transmitted Power Density

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	March 2, 2017	March 2, 2018
30dB Attenuator	MCL	BW-S30W5	533	July 31, 2017	July 31, 2018

Figure 132 Test Equipment Used



11. Antenna Gain/Information

+1.9dBi, chip antenna

Chip Antennas(Multilayer)

AH316M245001-T

TAIYO YUDEN

12. R.F Exposure/Safety

Typical use of the E.U.T. is as a sensor on a bed or wheelchair.

The typical distance between the E.U.T. and the user is 8.0 cm.

Calculation of Maximum Permissible Exposure (MPE) Based on FCC Section 1.1310 Requirements

SAR Testing Exclusion Based on Section 4.3.1 and Appendix A of KDB 447498 D01 V05 Requirements

Section 4.3.1 and Appendix A of KDB447498 D01 V05 was used as the guidance as follows:

For Wifi -

Peak power output = 21.7 dBm (Peak) = 148.0mW.

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] * [\sqrt{f(\text{GHz})}]$

= $148.0/80 * 1.55 = 2.86$ this value is less than 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR.

The SAR measurement is not necessary

For BLE -

Peak power output = 3.2 dBm (Peak) = 2.1mW.

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] * [\sqrt{f(\text{GHz})}]$

= $2.1/80 * 1.55 = 0.04$ this value is less than 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR.

The SAR measurement is not necessary

RF Exposure Calculation Based on Section 1.1310 Requirements

(a) FCC limits at 2437 MHz is:

$$1 \frac{\text{mW}}{\text{cm}^2}$$

Using table 1 of Section 1.1310 limit for general population/uncontrolled exposures, the above level is an average over 30 minutes.

(b) The power density produced by the E.U.T. is

For Wifi -

P_T- Transmitted Power 21.7 dBm (Peak) = 148.0 mW

G_T- Antenna Gain, 1.9 dBi = 1.55dBi numeric

R- Distance from Transmitter using 8cm worst case

(c) The peak power density is:

$$S = \frac{(148.0 \times 1.55)}{4\pi(8)^2} = 0.29 \frac{mW}{cm^2}$$

(d) This is below the FCC limit.

For BLE -

P_T- Transmitted Power 3.2 dBm (Peak) = 2.1mW

G_T- Antenna Gain, 1.9 dBi = 1.55dBi numeric

R- Distance from Transmitter using 8cm worst case

(e) The peak power density is:

$$S = \frac{(2.1 \times 1.55)}{4\pi(8)^2} = 0.004 \frac{mW}{cm^2}$$

(f) This is below the FCC limit.

13. APPENDIX A - CORRECTION FACTORS

13.1 Correction factors for RF OATS Cable 35m ITL #1879

Frequency (MHz)	Cable loss (dB)
30.0	1.1
50.0	1.1
100.0	1.7
150.0	2.1
200.0	2.5
250.0	2.7
300.0	2.9
350.0	3.1
400.0	3.5
450.0	3.7
500.0	3.9
550.0	4.0
600.0	4.2
650.0	4.4
700.0	4.9
750.0	5.0
800.0	5.0
850.0	4.9
900.0	5.0
950.0	5.1
1000.0	5.4

13.2 Correction factors for RF CABLE for Semi Anechoic Chamber

ITL # 1841

FREQ (MHz)	LOSS (dB)
1000.0	1.5
2000.0	2.1
3000.0	2.7
4000.0	3.1
5000.0	3.5
6000.0	4.1
7000.0	4.6
8000.0	4.9
9000.0	5.7
10000.0	5.7
11000.0	6.1
12000.0	6.1
13000.0	6.2
14000.0	6.7
15000.0	7.4
16000.0	7.5
17000.0	7.9
18000.0	8.1
19000.0	8.8
20000.0	9.1

NOTES:

1. The cable is manufactured by Commscope
2. The cable type is 0623 WBC-400, serial # G020132 and 10m long



13.3 Correction factors for biconical antenna – ITL # 1356

Model: EMCO 3110B

Serial No.:9912-3337

Frequency	ITL 1356 AF
[MHz]	[dB/m]
30	13.00
35	10.89
40	10.59
45	10.63
50	10.12
60	9.26
70	7.74
80	6.63
90	8.23
100	11.12
120	13.16
140	13.07
160	14.80
180	16.95
200	17.17



13.4 Correction factors for log periodic antenna – ITL # 1349

Model: EMCO 3146

Serial No.:9505-4081

Frequency [MHz]	ITL 1349 AF [dB/m]
200	11.58
250	12.04
300	14.76
400	15.55
500	17.85
600	18.66
700	20.87
800	21.15
900	22.32
1000	24.22

**13.5 Correction factors for Active Loop Antenna ITL #1075:
Model 6502 S/N 9506-2950**

f(MHz)	MAF(dBs/m)	AF(dB/m)
0.01	-33.1	18.4
0.02	-37.2	14.3
0.03	-38.2	13.3
0.05	-39.8	11.7
0.1	-40.1	11.4
0.2	-40.3	11.2
0.3	-40.3	11.2
0.5	-40.3	11.2
0.7	-40.3	11.2
1	-40.1	11.4
2	-40	11.5
3	-40	11.5
4	-40.1	11.4
5	-40.2	11.3
6	-40.4	11.1
7	-40.4	11.1
8	-40.4	11.1
9	-40.5	11
10	-40.5	11
20	-41.5	10
30	-43.5	8

13.6 Correction factors for

Horn ANTENNA

Model: 3115 ITL # 1352
Antenna serial number: 29845
3 meter range

FREQUENCY	AFE	FREQUENCY	AFE
(GHz)	(dB/m)	(GHz)	(dB/m)
0.75	25	9.5	38
1.0	23.5	10.0	38.5
1.5	26.0	10.5	38.5
2.0	29.0	11.0	38.5
2.5	27.5	11.5	38.5
3.0	30.0	12.0	38.0
3.5	31.5	12.5	38.5
4.0	32.5	13.0	40.0
4.5	32.5	13.5	41.0
5.0	33.0	14.0	40.0
5.5	35.0	14.5	39.0
6.0	36.5	15.0	38.0
6.5	36.5	15.5	37.5
7.0	37.5	16.0	37.5
7.5	37.5	16.5	39.0
8.0	37.5	17.0	40.0
8.5	38.0	17.5	42.0
9.0	37.5	18.0	42.5

**13.7 Correction factors for Horn Antenna
Model: SWH-28 at 1 meter range**

Frequency, MHz	Measured antenna factor, dB/m ¹
18000	33.0
18500	32.9
19000	33.1
19500	33.3
20000	33.6
20500	33.6
21000	33.4
21500	33.8
22000	33.7
22500	33.9
23000	34.8
23500	34.5
24000	34.2
24500	34.8
25000	34.4
25500	35.2
26000	35.9
26500	36.0