Electromagnetic Compatibility
Test Report

Test Report No: SLR 070714
Issued on: December 08, 2014

Product Name
Cubox (Stand-alone Board)

Tested According to
FCC 47 CFR, Part 15, Subpart C
IC RSS-210, Issue 8

Tests Performed for
Solid-run
3 Plane, Tafen Tower 24959
Tel: +972-4-0009444

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Certificate 1633.01
Electrical Testing

Test Personnel

Tests Performed By: ----------

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QualiTech EMC Laboratory

Test Report details:

Test commencement date: 01.05.2014

Test completion date: 27.05.2014

Customer's Representative: Kossay Omary

Issued on: 08.12.2014

Revision details:

Version	Date	Details/Reasons
Rev. 1	07.07.2014	-
Rev. 2	09.12.2014	Added Power Line Emissions measurements to the test report, correct a maximum conducted output power measurement, add a calibration list table

Assessment information:

This report contains an assessment of the EUT against Electromagnetic Compatibility based upon tests carried out on the samples submitted. The results contained in this report relate only to the items tested. Manufactured products will not necessarily give identical results due to production and measurement tolerances. QualiTech, EMC Lab does not assume responsibility for any conclusion and generalization drawn from the test results with regards to other specimens or samples of type of the equipment represented by test item.

The EUT was set up and exercised using the configuration, modes of operation and arrangements defined in this report only.

Modifications:

Modifications made to the EUT

None

Modifications made to the Test Standard

None

Summary of Compliance Status

WLAN 802.11b/g/n

Test Spec. Clause	Test Case	Remarks
47 CFR §15.247 (a) (2) RSS-210 section A8.2 (a)	6 dB Bandwidth	Pass
47 CFR §15.247 (b) (3) & RSS-210 section A8.4 (4)	Maximum Conducted (Peak) Output Power, 2400-2483.5 MHz	Pass
47 CFR §15.247 (e) & RSS-210 Section A8.2 (b)	Peak Power Spectral Density(peak PSD)	Pass
47 CFR §15.247 (d) & RSS-210 Section A8.5	Conducted Spurious Emissions	Pass
47 CFR §15.247 (d) & §15.205 & RSS-210 section A8.5	Radiated Spurious Emissions, Restricted Bands 2310-2390MHz & 2483.5-2500MHz	Pass
47 CFR §15.247 (d), & §15.205, & §15.209(a)	Radiated Spurious Emissions	Pass
47 CFR §15.407(b)(6) & §15.107/207, ICES-003 RSS-GEN section 7.2.3.2	Power Line Emissions measurements	Pass

Table of Contents

1. General Description

Description of the EUT system/test Item:

The SolidRun SR-uSOM-MX6 is a high performance micro system on module that is based on the highly integrated Freescale i.MX6 family of products.

Product name: CuBox

Model: SR-uSOM-MX6

FCC ID: 2ACMW-MX6

IC ID: 12107A-MX6

Maximum Peak Output Power: 152.405 mW

Frequency range:

2412-2462 MHz

Transmit Data rate: Protocol 802.11b 1-6 [Mbps], 802.11g 11g 6-54 [Mbps], 802.11n MCS1- MCS7

Antenna Specification:

Type: SRT-2.4G-PCB-8

Antenna Gain: 3dBi in the range 2.4 – 2.5 GHz

2. Method of Measurements

2.1. Conducted RF Measurements:

The RF output of the transmitter under test was directly connected to the input of the Spectrum analyzer through a specialized antenna connector provided by the manufacturer, and an attenuator as specified. The external attenuator and cable loss were added to the reading. Worst-case results of the various modulation modes (where applicable) were reported.

For PSD, emission peak was zoomed within the pass band with spectrum analyzer's settings as reported (Sweep time=Span/3kHz). Transmitter outputs transmitting simultaneously were aggregated through a combiner.

For Maximum Conducted Output Power, the spectrum analyzer was set for free ran, and 100 traces were averaged in power averaging mode. The transmitter was continuously transmitting, at a duty cycle of about 99%, and power was integrated across a bandwidth of the 26dB EBW of the signal, using the spectrum analyzer's band power measurement function with band limits set equal to the EBW band edges. Alternatively, Peak Output Power was measured using a Peak Power Meter.

For spurious emissions measurement, the spectrum from 9 kHz to 25GHz was investigated with the transmitter set to the lowest, middle and highest channel frequencies.

2.2. Radiated Emissions Measurements in the restricted bands:

For radiated emissions, which fall in the restricted bands the spectrum from 30MHz to 25GHz was investigated following the guidelines in ANSI C63.4-2003, with the transmitter set to the lowest, middle and highest channel frequencies. Measurements were performed with peak detector and repeated averaged with VBW=10Hz. Only Peak detection plots are presented.

2.3. Radiated Emission measurements:

Measurements were performed at a 3-meter measurement distance in the semi-anechoic chamber in order to evaluate the radiated electromagnetic interference characteristics of the EUT. The EUT was placed on a non-metallic table/support, 0.8m above the turntable, was configured, arranged and operated in a manner consistent with typical application and load conditions. The test program of exercising the equipment ensured that various parts of the EUT were exercised to permit detection of all EUT disturbances.
An appropriate antenna depending upon the frequency range, per ANSI C63.4-2003 clause 4.1.5 was used. While the turntable was being rotated, the height of the antenna was varied from 1 to 4m for the frequency range of 30MHz to 1GHz. The highest radiated emission was detected by manipulating the system cables to the worst-case position. This process was repeated for both antenna polarizations. The spectrum up to 25GHz was investigated for spurious emissions, using a band-reject filter where appropriate.
The amplitudes of worst-case emission were measured with the detector modes and resolution bandwidths over various frequency ranges according to the requirements of ANSI C63.4-2003 clause 4.2.

2.4. Worst Case Results:

Worst case result is determined as the channel with the highest output power. Pre-scan has been conducted to determine the worst-case. Worst-case results of various modulation modes/data rates were determined as the modulation with the highest output power, and that was reported.

2.5. Power Line Emission measurements:

The EUT was placed on a non-conductive table/support 80 cm above the reference ground plane. The EUT was configured in accordance with ANSI C63.4-2003 using a 50μH/50 ohm LISN.

Compliance with the provisions was based on the measurements of the radio frequency voltage between each line and the ground at the power terminal.

The EUT was operated in receive mode and then with both DSS and DTS transmitters operating alternately and the worst case results were presented.

3. Test Facility & Uncertainty of Measurement

3.1. Accreditation/ Registration reference:

- *A2LA Certificate Number: 1633.01*

3.2. Test Facility description

The tests were performed at the EMC Laboratory, QualiTech Division, ECI Telecom Group

Address: 30, Hasivim St., Petah Tikva, Israel.
Tel: 972-3-926-8443

3m Anechoic Chamber:

The 3m-screened chamber is used in two configurations: the semi-anechoic configuration for Radiated Emission measurements and the full-anechoic configuration for Radiated Immunity tests.

Semi Anechoic Configuration:

Measurement distance	3m
Chamber dimensions	9.5m x 6.5m x 5.2m
Antenna height	1 - 4m
Shielding Effectiveness	Magnetic field ≥80dB at 15 kHz ≥90dB at 100 kHz Electric field >120dB from 1MHz to 1GHz >110dB from 1GHz to 10GHz
Absorbing material	Ferrite tiles on the walls and ceiling Emerson and Cuming absorbing material in selected positions on the walls
Normalized Site Attenuation measured at 5 positions	±3.9dB, 30MHz to 200MHz ±3dB, 200MHz to 1000MHz
Transmission Loss measured at 5 positions, at 1.5m height	±3dB, 1GHz to 18GHz

Full-Anechoic Configuration:

Measurement distance	3m
Chamber dimensions	7m x 4m x 3m
Antenna height	1.55m at Horizontal & Vertical polarizations
Shielding Effectiveness	Magnetic field ≥80dB at 15 kHz ≥90dB at 100 kHz Electric field >120dB from 1MHz to 1GHz >110dB from 1GHz to 10GHz
Absorbing material	Ferrite tiles on the walls and ceiling Emerson and Cuming absorbing material in selected positions on the walls and floor
Field Uniformity to EN61000-4-3	±3dB 80MHz to 18GHz

3.3. Uncertainty of Measurement:

Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report according to CISPR 16-4-2 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements ". Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Test Name	Range	Expanded U lab Uncertainty	U CISPR Uncertainty
Radiated Emission	30MHz÷200MHz, Horiz. Polar.	± 4.77 dB	±5.06
	30MHz÷200MHz, Ver. Polar.	± 4.90 dB	±5.17
	200MHz÷1000MHz, Horiz. Polar.	± 4.96 dB	±5.34
	200MHz÷1000MHz, Vert. Polar.	± 6.15 dB	±6.32
	1.0GHz -6.0GHz	± 4.33 dB	±5.18
	6.0GHz-18.0GHz	± 4.75 dB	±5.48
Conducted Emission	9 kHz÷150 kHz	± 3.47 dB	±3.83
	150 kHz÷30MHz	± 3.18 dB	±3.44

Note: QualiTech EMC labs expanded measurement instrumentation has less uncertainty than the industry norm and compliance is deemed to occur as no measured disturbance exceeds the disturbance limit.

Note: The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

4. WLAN 802.11b/g/n: Report of Measurements and Examinations

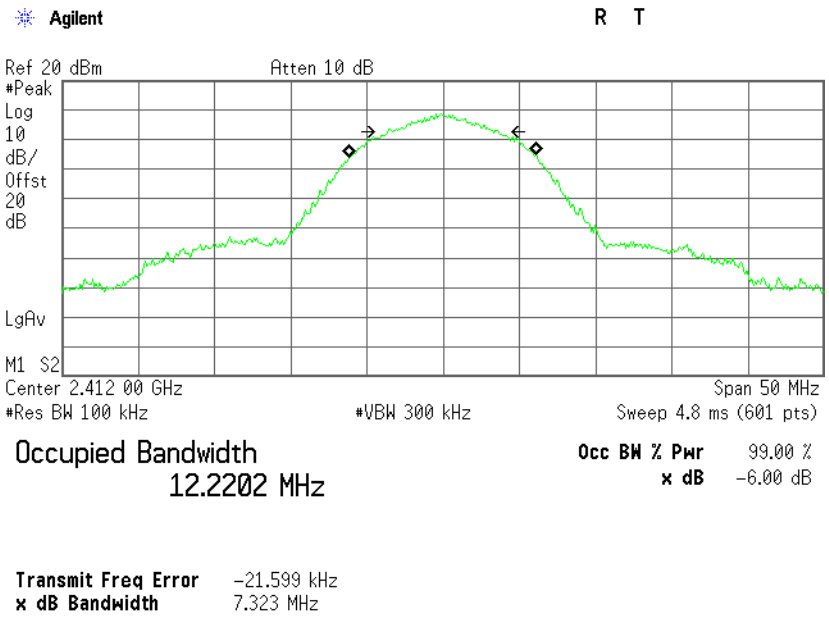
4.1. 6 dB Bandwidth

Reference document:	**47 CFR §15.247 (a) (2)**		
Test Requirements:	For systems using digital modulation techniques may operate in 2400-2483.5 MHz band the minimum 6dB bandwidth shall be at least 500 kHz.		
Test setup:	See sec 2.1	Pass	
Method of testing:	KDB 558074 D01 v03, Sec.8, option 2-Conducted		
Operating conditions:	Under normal test conditions		
S.A. Settings:	RBW: 100kHz, VBW: 300kHz		
Environment conditions:	Ambient Temperature: 24.4 °C	Relative Humidity: 51.2%	Atmospheric Pressure: hPa
Test Result:	See below	See Plot 4.1.1 - Plot 4.1.9	

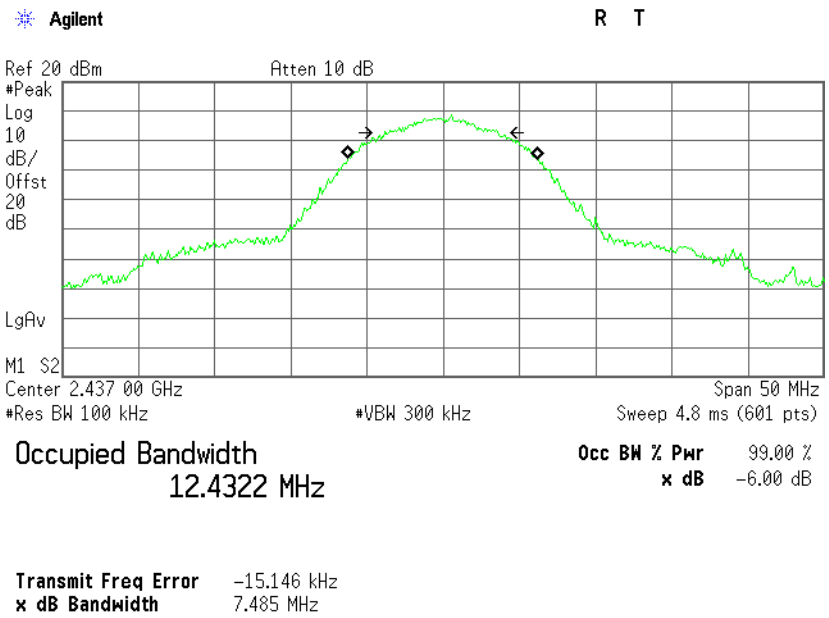
Test results

Frequency [MHz]	Data Rate [Mbps]	6 dB Bandwidth [kHz]	Limit [kHz]
802.11b Mode			
2412	11	7323	>500
2437	11	7485	>500
2462	11	7445	>500
802.11g Mode			
2412	54	15201	>500
2437	54	15444	>500
2462	54	15207	>500
802.11n -20 MHz Mode			
2412	MCS7	17345	>500
2437	MCS7	17018	>500
2462	MCS7	16695	>500

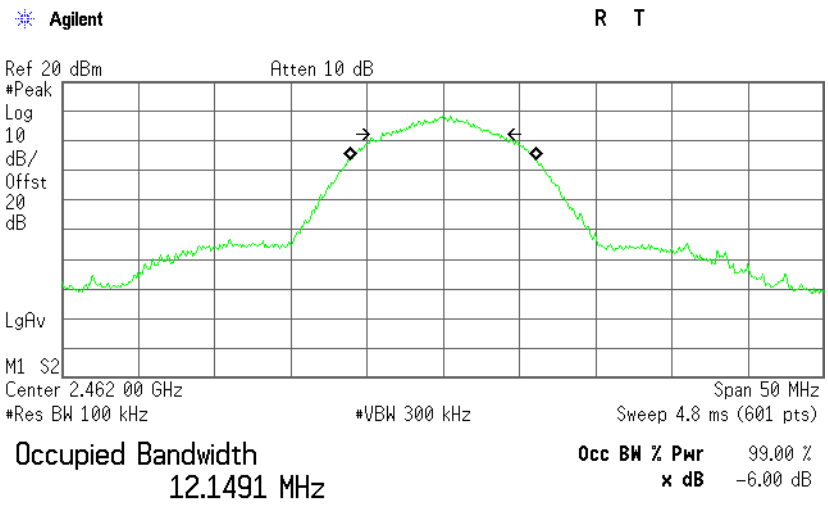
Plot 4.1.1 6dB bandwidth test results, 802.11b Mode, F = 2412 MHz



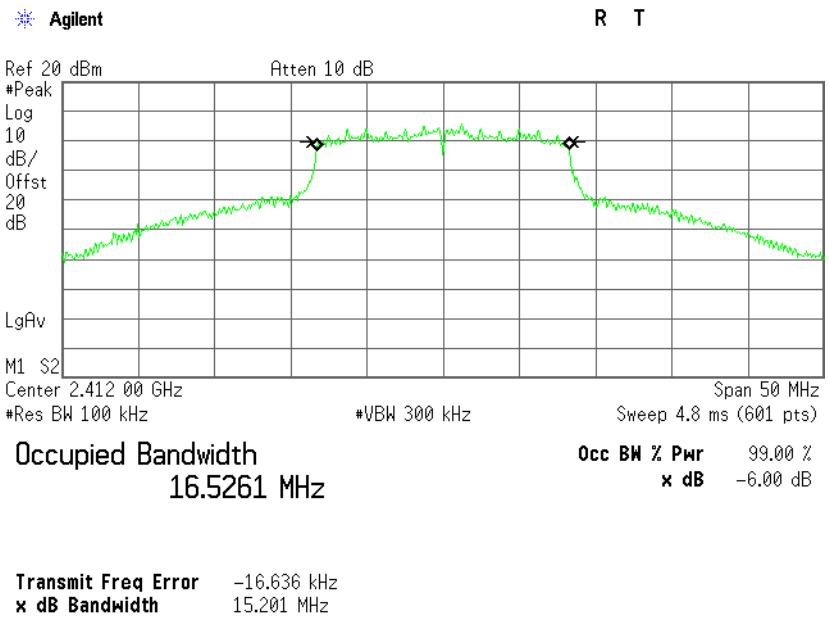
Plot 4.1.2 6dB bandwidth test results, 802.11b Mode, F = 2437 MHz



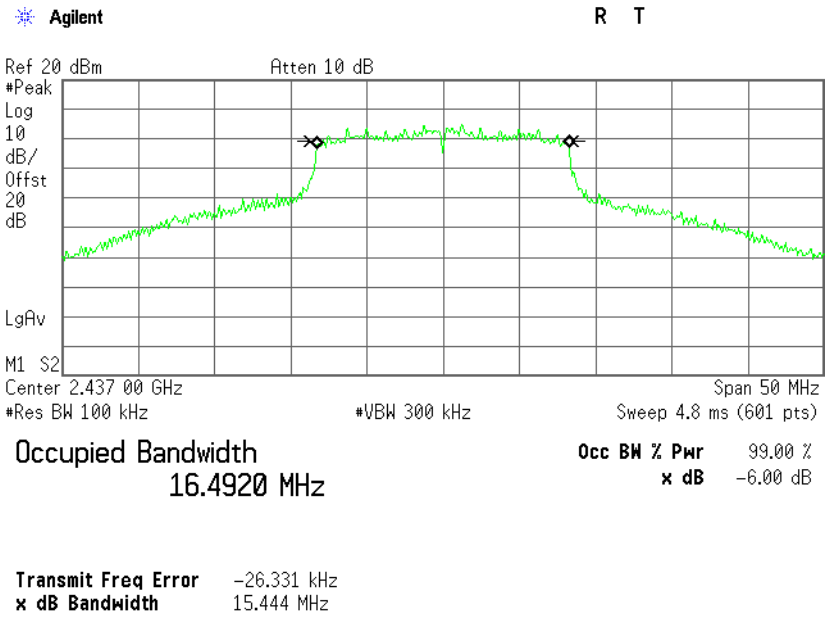
Plot 4.1.3 6dB bandwidth test results, 802.11b Mode, F = 2462 MHz



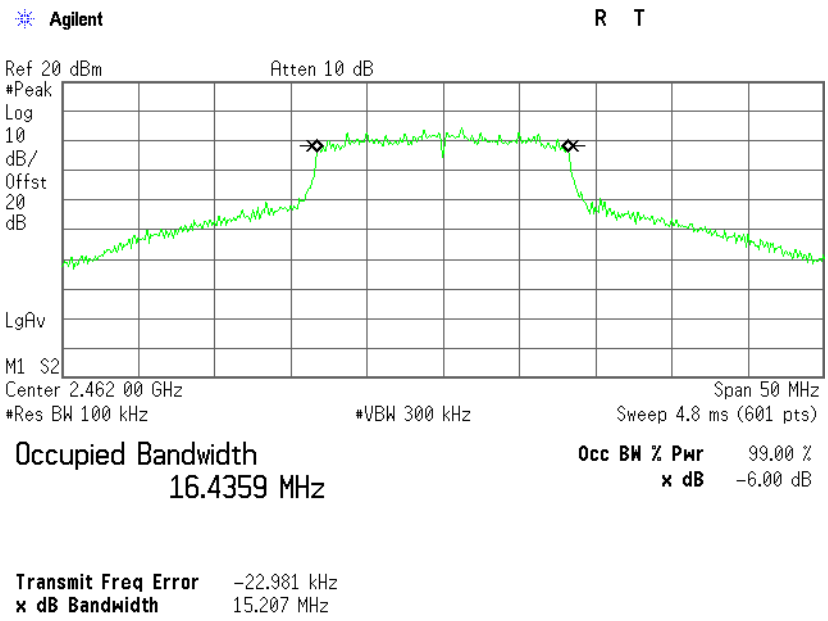
Plot 4.1.4 6dB bandwidth test results, 802.11g Mode, F = 2412 MHz



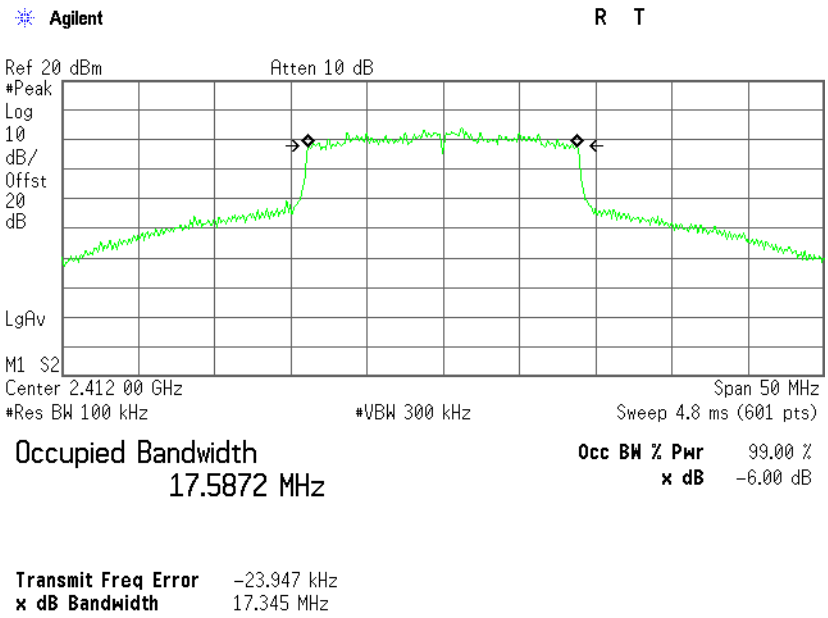
Plot 4.1.5 6dB bandwidth test results, 802.11g Mode, F = 2437 MHz



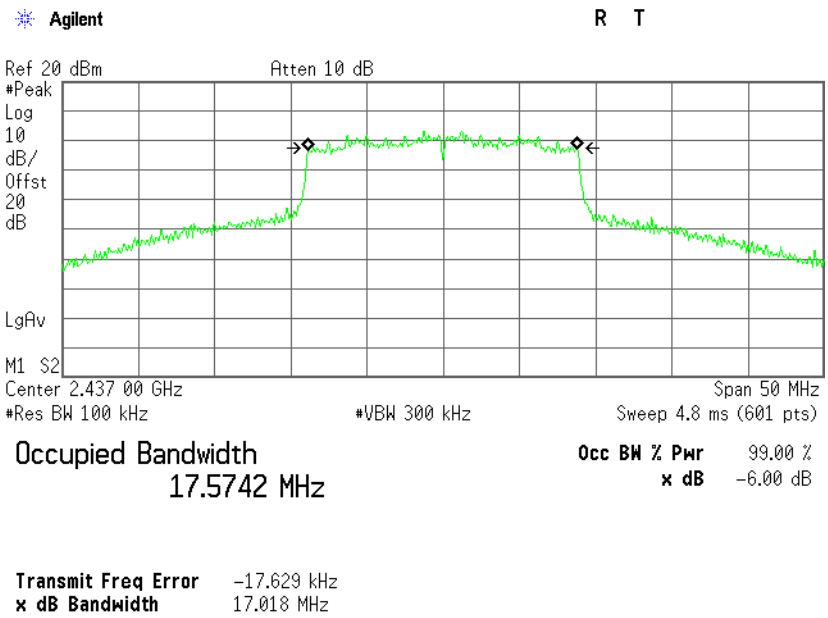
Plot 4.1.6 6dB bandwidth test results, 802.11g Mode, F = 2462 MHz



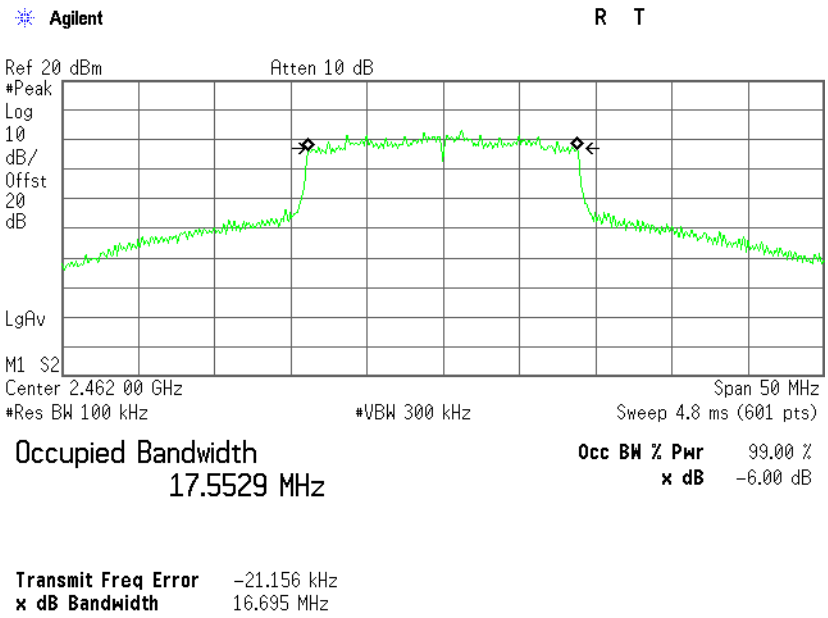
Plot 4.1.7 6dB bandwidth test results, 802.11n 20MHz Mode, MSC7, Fc = 2412 MHz



Plot 4.1.8 6dB bandwidth test results, 802.11n 20MHz Mode, MSC7, Fc = 2437 MHz



Plot 4.1.9 6dB bandwidth test results, 802.11n 20MHz Mode, MCS7, Fc = 2462 MHz



4.2. Maximum conducted (peak) output power, 2400-2483.5 MHz

Reference document:	**47 CFR §15.247 (b) (3)**		
Test Requirements:	The maximum peak output power of the intentional radiator for systems using digital modulation in the 2400-2483.5 MHz & 5725-5850 MHz bands shall not exceed 1 Watt. Transmitters operating in the 2400-2483.5 & 5725-5850 MHz bands that emits multiple directional beams but does not emit multiple directional beams simultaneously, the total output power conducted to the arrays, i.e. the sum of the power sullied to the antenna elements, shall not exceed the limit calculated below. The total conducted output power shall be reduced by 1dB below the specified limit for each 3 dB that the directional gain of the antenna array exceeds 6dBi.		
Test setup:	See sec 2.1	Pass	
Method of testing:	Conducted KDB 558074 D01 v03, Sec.9.1.3(peak)		
Operating conditions:	Under normal test conditions		
Environment conditions:	Ambient Temperature: 24.4 °C	Relative Humidity: 51.2%	Atmospheric Pressure: hPa
Test Result:	See below	---	

Test Results:

Frequency, [MHz]	Data Rate, [Mbps]	Measured Output (peak) Power*, [dBm]	Measured Output (peak) Power*, [W]	Limit, [dBm]	Delta, [dB]	Pass/Fail
802.11b Mode						
2412	11	19.97	0.099	30.00	-10.03	Pass
2437	11	19.72	0.094	30.00	-10.28	Pass
2462	11	19.31	0.085	30.00	-10.69	Pass
802.11g Mode						
2412	54.00	21.42	0.139	30.00	-8.58	Pass
2437	54.00	21.11	0.129	30.00	-8.89	Pass
2462	54.00	20.79	0.120	30.00	-9.21	Pass
802.11n Mode						
2412	MCS7	21.66	0.147	30.00	-8.34	Pass
2437	MCS7	21.83	0.152	30.00	-8.17	Pass
2462	MCS7	21.37	0.137	30.00	-8.63	Pass

*Corrected for external attenuations.

4.3. Peak power spectral density (peak PSD)

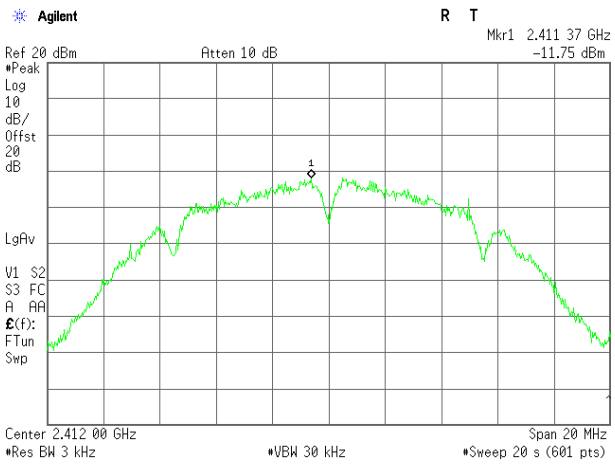
Reference document:	**47 CFR §15.247 (e)**		
Test Requirements:	For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.		
Test setup:	See sec 2.1	**Pass**	
Method of testing:	Conducted KDB 558074 D01 v03, Sec.10.2		
Operating conditions:	Under normal test conditions		
S.A. Settings:	RBW: 3 kHz, VBW: 10 kHz, Sweep Time: Auto		
Environment conditions:	Ambient Temperature: 24.4 °C	Relative Humidity: 51.2%	Atmospheric Pressure: hPa
Test Result:	See below	See Plot 4.3.1 - Plot 4.3.9	

Test Results:

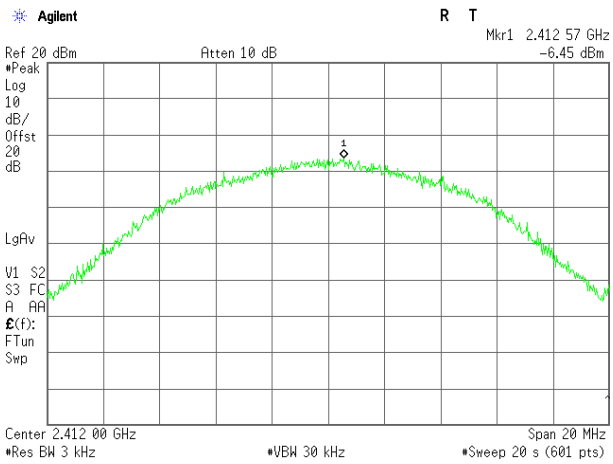
Frequency, [MHz]	Data Rate, [Mbps]*	Measured PSD, [dBm/3kHz]	Limit PSD, [dBm/3kHz]	Delta, [dB]	Pass/Fail
802.11b Mode					
2412	11	-6.45	8.00	-14.45	Pass
2437	11	-6.00	8.00	-14.00	Pass
2462	11	-7.18	8.00	-15.18	Pass
802.11g Mode					
2412	6	-9.40	8.00	-17.40	Pass
2437	6	-8.80	8.00	-16.80	Pass
2462	6	-10.41	8.00	-18.41	Pass
802.11n 20MHz Mode					
2412	MCS0	-9.99	8.00	-17.99	Pass
2437	MCS0	-10.26	8.00	-18.26	Pass
2462	MCS0	-11.50	8.00	-19.50	Pass

*The worst case of Data rate

Plot 4.3.1 Peak PSD test results, 802.11b Mode, Fc = 2412 MHz

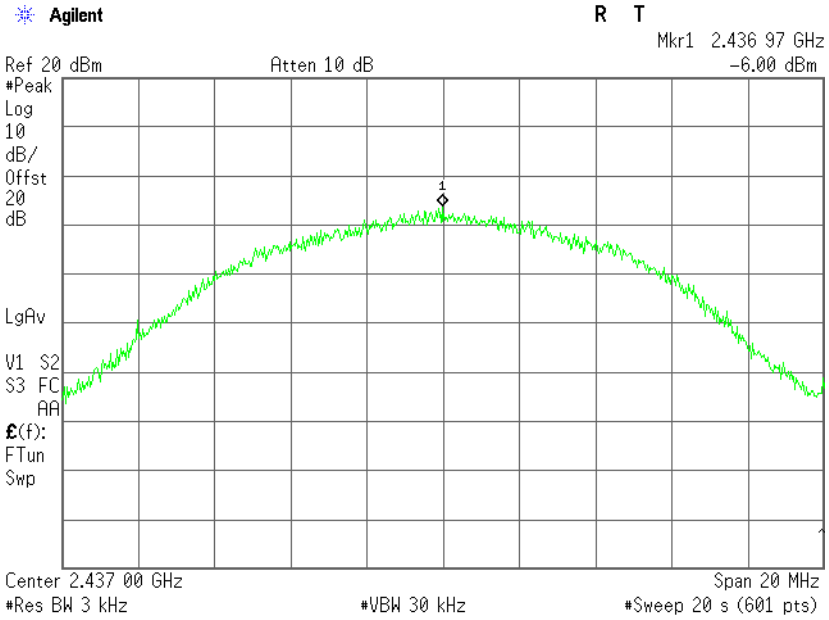


1Mbps(for reference only)

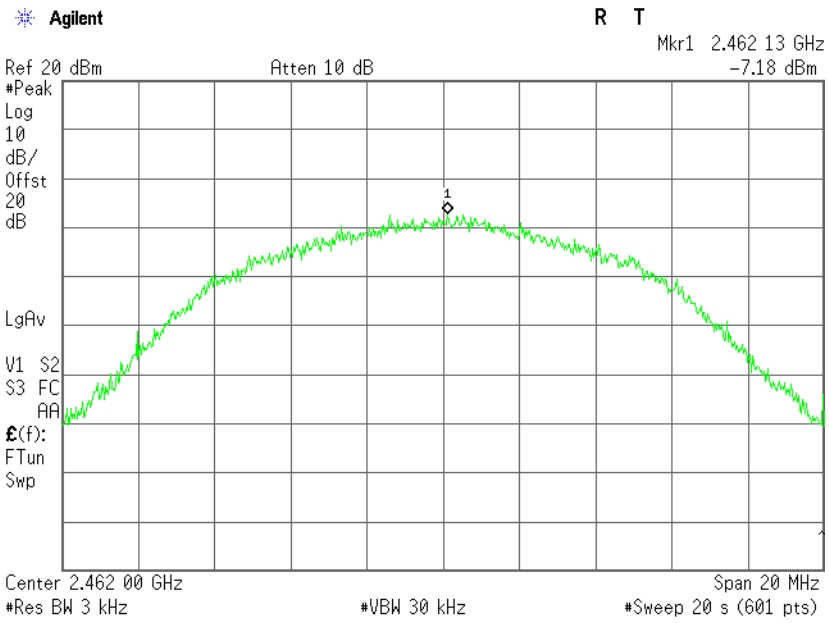


11Mbps

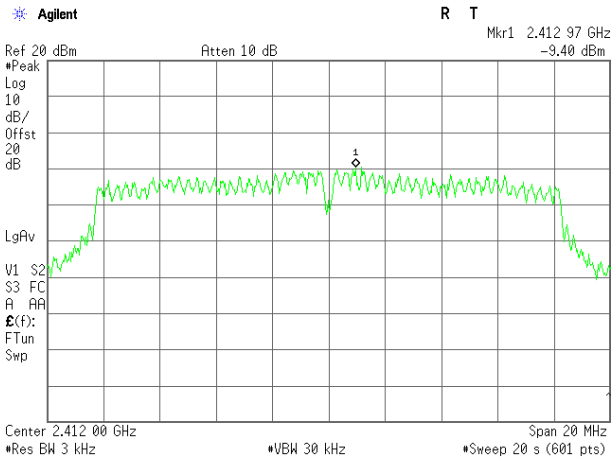
Plot 4.3.2 Peak PSD test results, 802.11b Mode, Fc = 2437 MHz



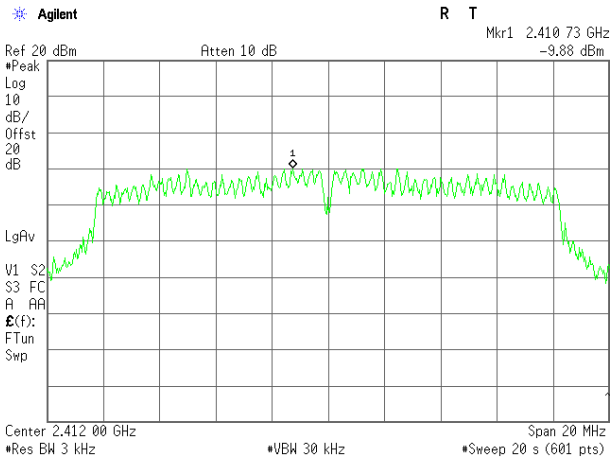
Plot 4.3.3 Peak PSD test results, 802.11b Mode, Fc = 2462 MHz



Plot 4.3.4 Peak PSD test results, 802.11g 20MHz Mode, Fc = 2412 MHz

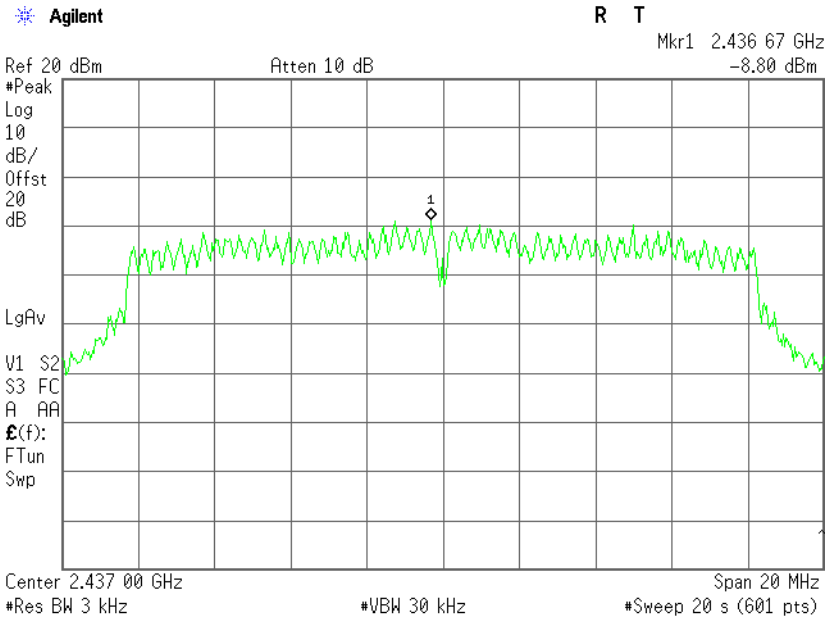


6Mbps

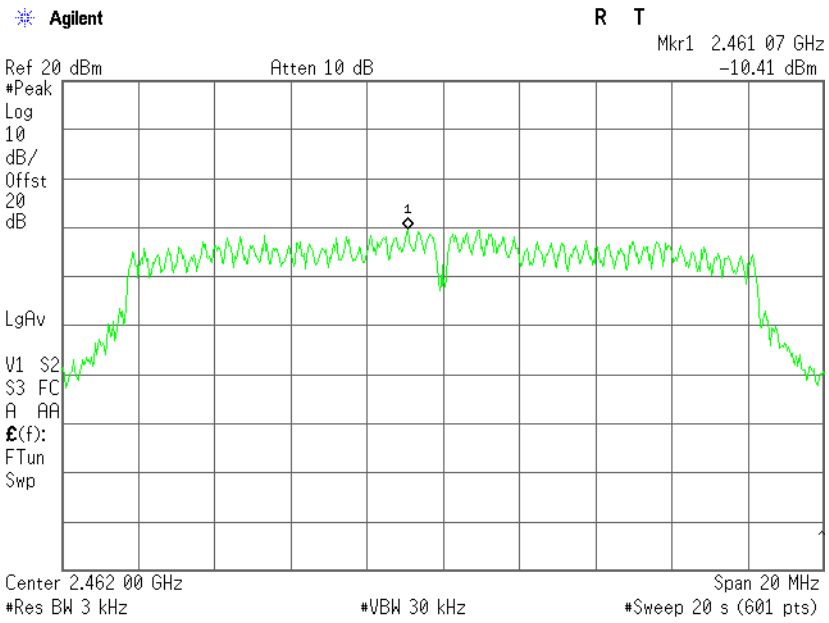


54Mbps(for reference only)

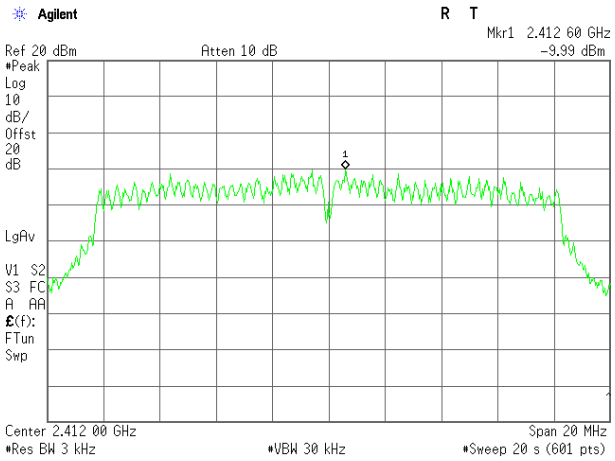
Plot 4.3.5 Peak PSD test results, 802.11g Mode, Fc = 2437 MHz



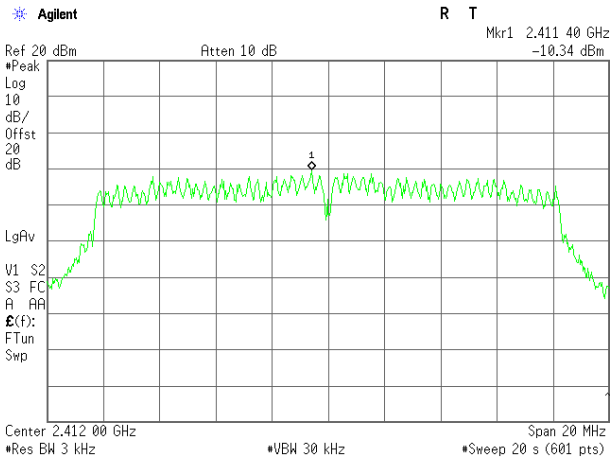
Plot 4.3.6 Peak PSD test results, 802.11g Mode, Fc = 2462 MHz



Plot 4.3.7 Peak PSD test results, 802.11n 20MHz Mode, Fc = 2412 MHz

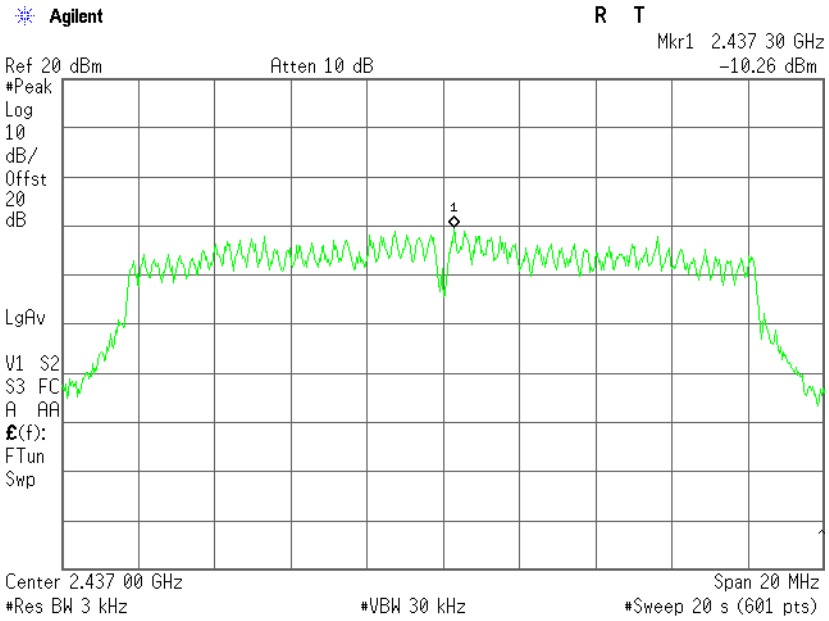


MCS0

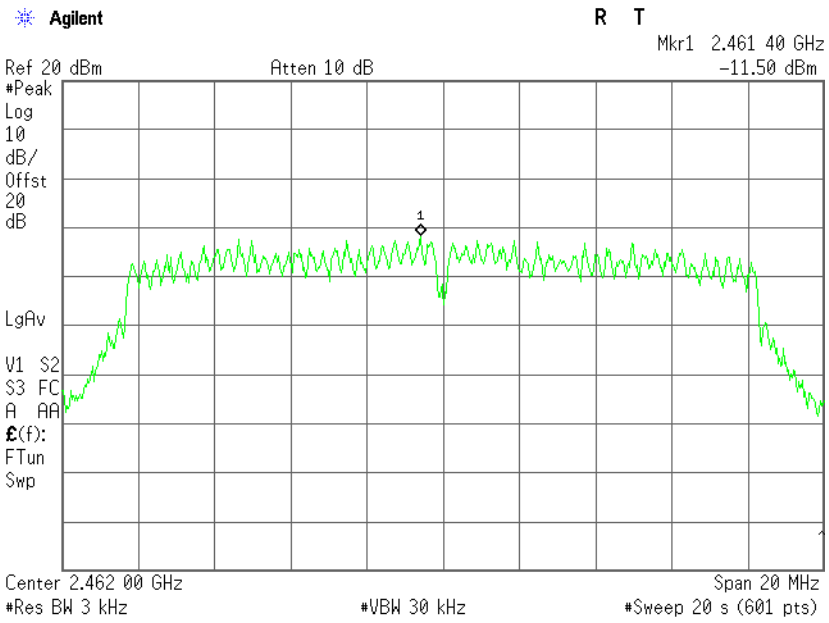


MCS7 (for reference only)

Plot 4.3.8 Peak PSD test results, 802.11n 20MHz Mode, Fc = 2437 MHz



Plot 4.3.9 Peak PSD test results, 802.11n 20MHz Mode, Fc = 2462 MHz



4.4. Conducted Spurious Emissions

Reference document:	**47 CFR §15.247 (d)**		
Test Requirements:	In any 100 kHz bandwidth outside the frequency band in which the digitally modulated 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB. Attenuation below the general limits specified in Section §15.209(a) is not required. In addition, 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).		
Test setup:	See sec 2.1		
Method of testing:	Conducted KDB 558074 D01 v03, Sec.11.0		
Operating conditions:	Under normal test conditions		
S.A. Settings:	RBW: 100kHz, VBW:300kHz		
Environment conditions:	Ambient Temperature: 24.4 °c	Relative Humidity: 51.2%	Atmospheric Pressure: hPa
Test Result:	See below	See Plot 4.4.1- Plot 4.4.33	

Test Results:

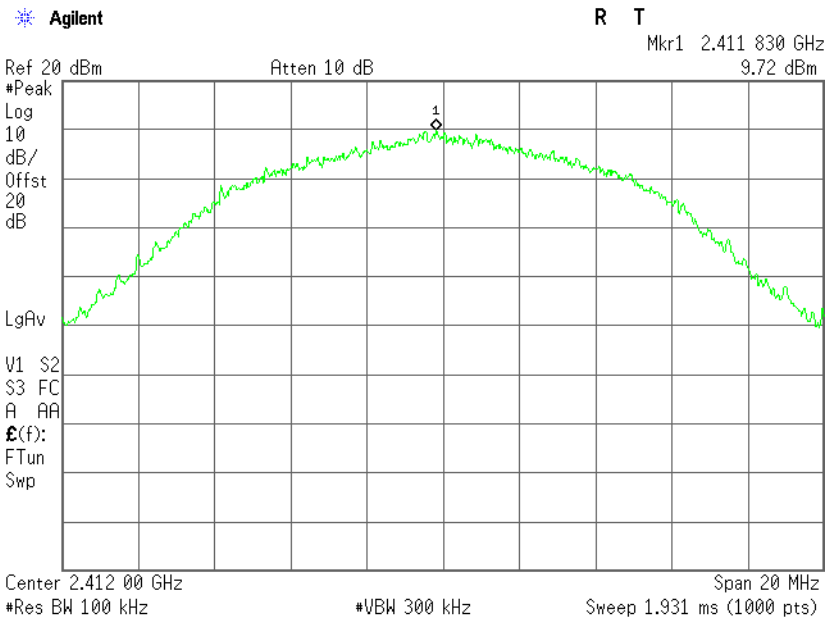
Fundamental Frequency, [MHz]	Data Rate, [Mbps]	Fundamental Emission Reference Level, [dBm]	Unwanted Emissions Frequency, [MHz]	Unwanted Emissions Level, [dBm]	Attenuation below Reference Level, [dBc]	Limit, [dBc]	Delta, [dB]	Pass/Fail
802.11b Mode								
2412	11	9.72	*	*	*	20.00	>20	Pass
2437	11	9.28	*	*	*	20.00	>20	Pass
2462	11	8.58	*	*	*	20.00	>20	Pass
802.11g Mode								
2412	54	5.30	*	*	*	20.00	>20	Pass
2437	54	4.93	*	*	*	20.00	>20	Pass
2462	54	4.41	*	*	*	20.00	>20	Pass
802.11n – 20MHz mode								
2412	MCS7	3.84	*	*	*	20.00	>20	Pass
2437	MCS7	3.46	*	*	*	20.00	>20	Pass
2462	MCS7	2.75	*	*	*	20.00	>20	Pass

*All emissions at least 20 dB below the limit

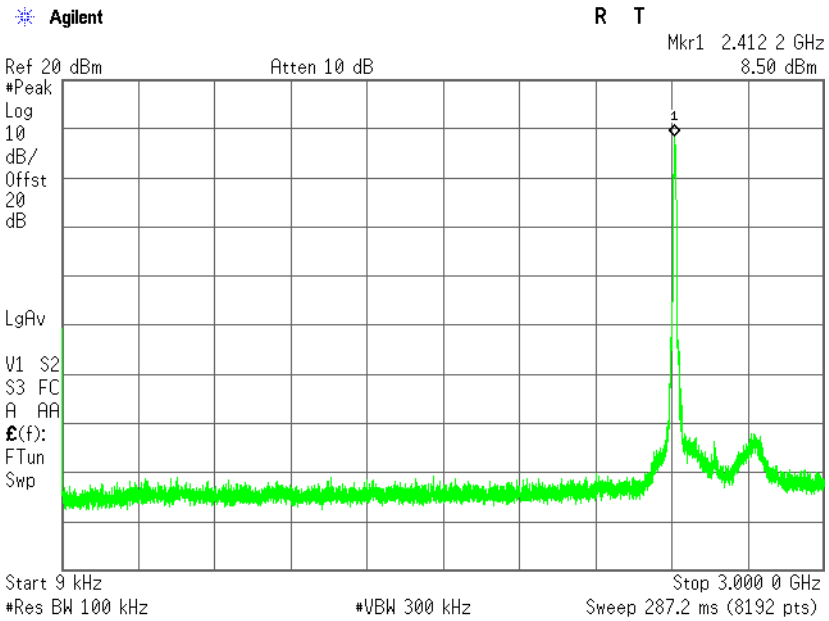
Band Edge

Frequency, [MHz]	Data Rate, [Mbps]	Measured, [dBc]	Limit, [dBc]	Delta, dB	Pass/Fail
802.11b Mode					
2412	11	-41.48	-20.00	-21.48	Pass
2462	11	-55.00	-20.00	-35.00	Pass
802.11g Mode					
2412	54	-28.28	-20.00	-8.28	Pass
2462	54	-40.04	-20.00	-20.04	Pass
802.11n Mode					
2412	MCS7	-30.65	-20.00	-10.65	Pass
2462	MCS7	-40.36	-20.00	-20.36	Pass

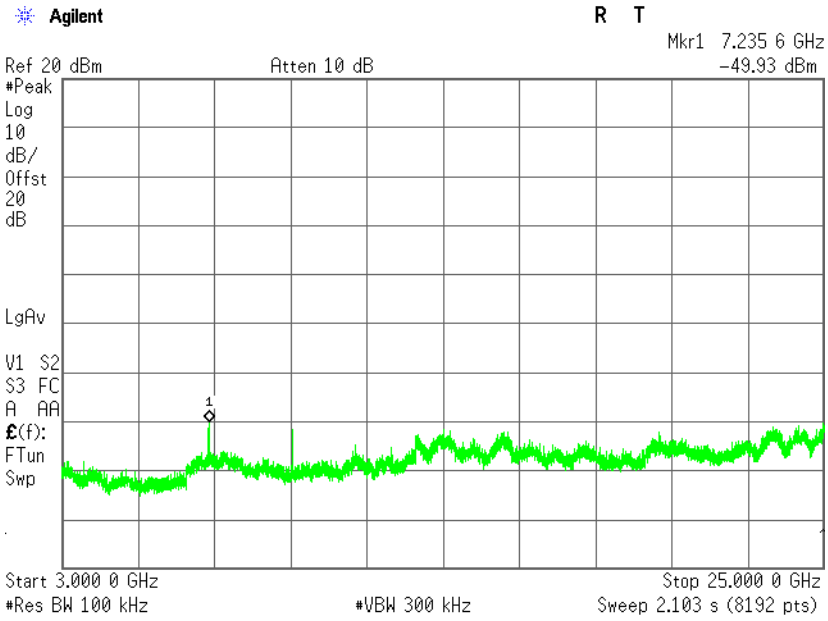
Plot 4.4.1 Conducted Spurious Emissions test results, 802.11b Mode, Fc = 2412 MHz, reference level



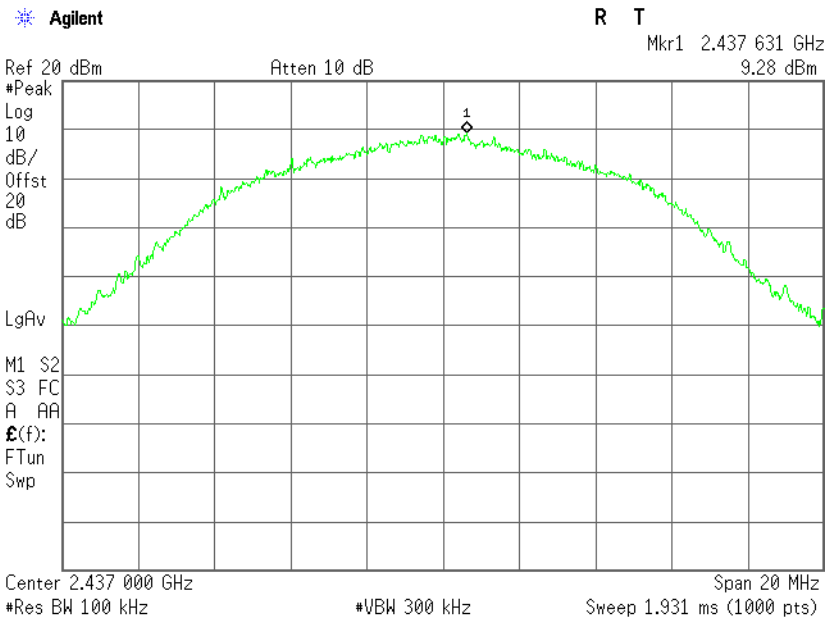
Plot 4.4.2 Conducted Spurious Emissions test results, 802.11b Mode, Fc = 2412 MHz, 9 kHz – 3 GHz range



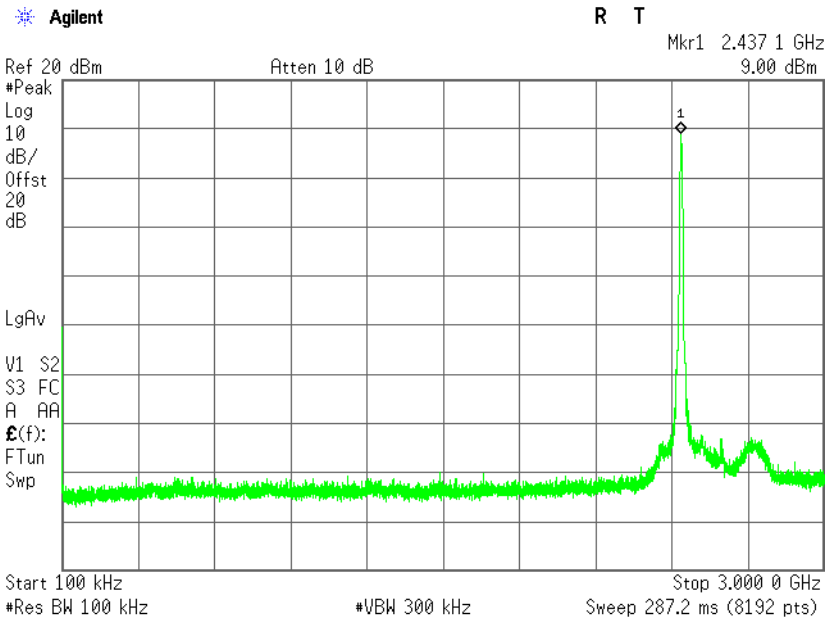
Plot 4.4.3 Conducted Spurious Emissions test results, 802.11b Mode, Fc = 2412 MHz, 3 GHz – 25 GHz range



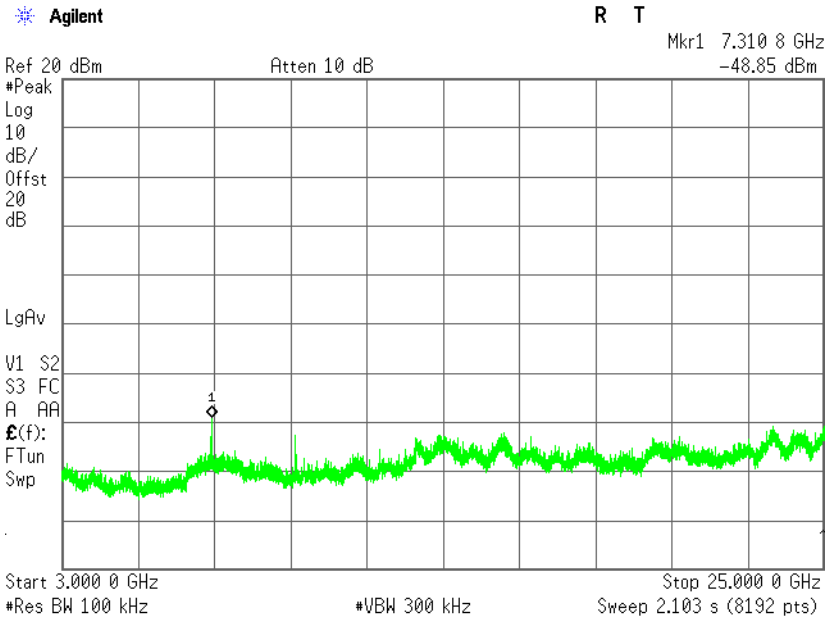
Plot 4.4.4 Conducted Spurious Emissions test results, 802.11b Mode, Fc = 2437 MHz, reference level



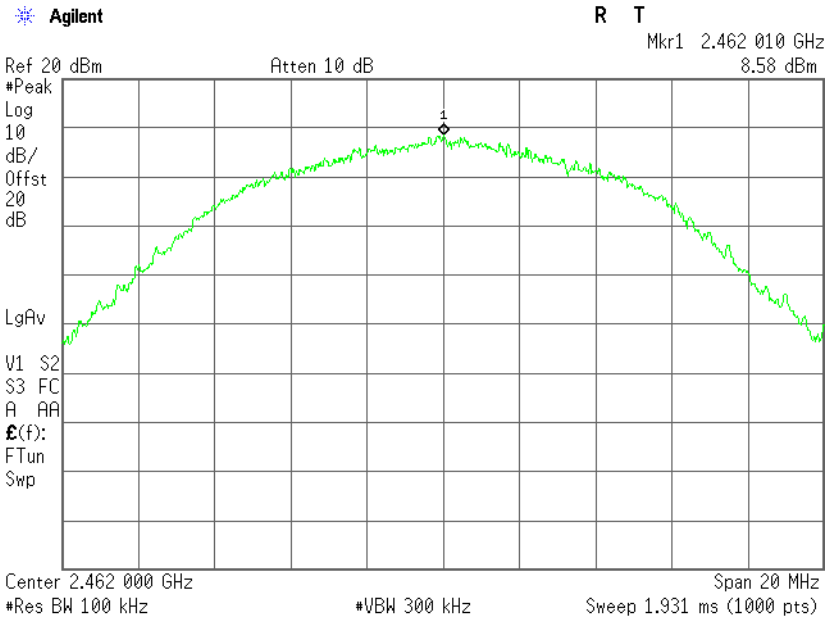
Plot 4.4.5 Conducted Spurious Emissions test results, 802.11b Mode, Fc = 2437 MHz, 9 kHz – 3 GHz range



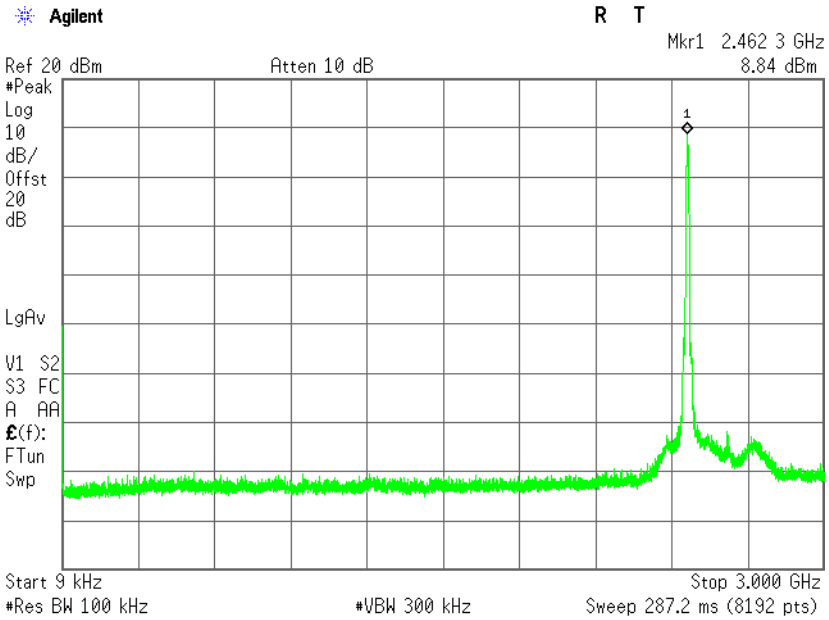
Plot 4.4.6 Conducted Spurious Emissions test results, 802.11b Mode, Fc = 2437 MHz, 3 GHz – 25 GHz range



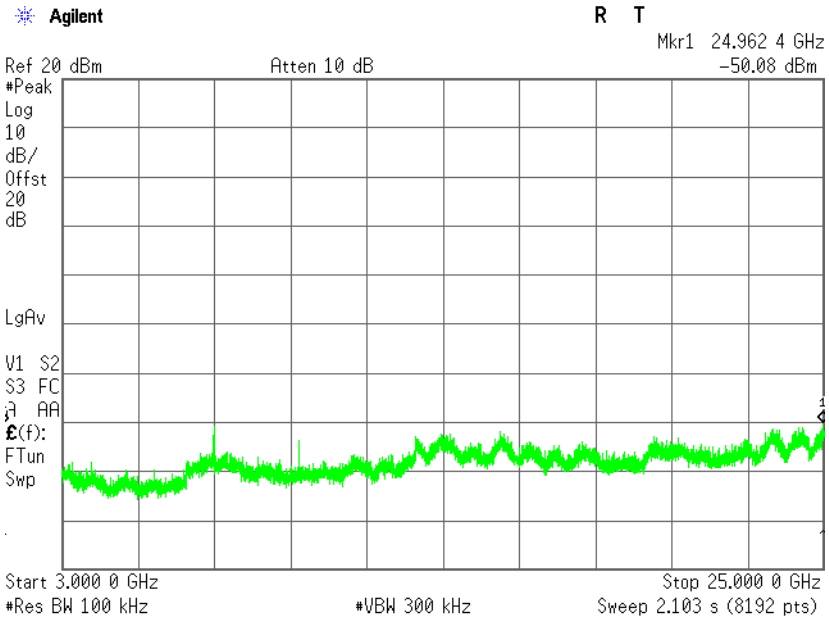
Plot 4.4.7 Conducted Spurious Emissions test results, 802.11b Mode, Fc = 2462 MHz, reference level



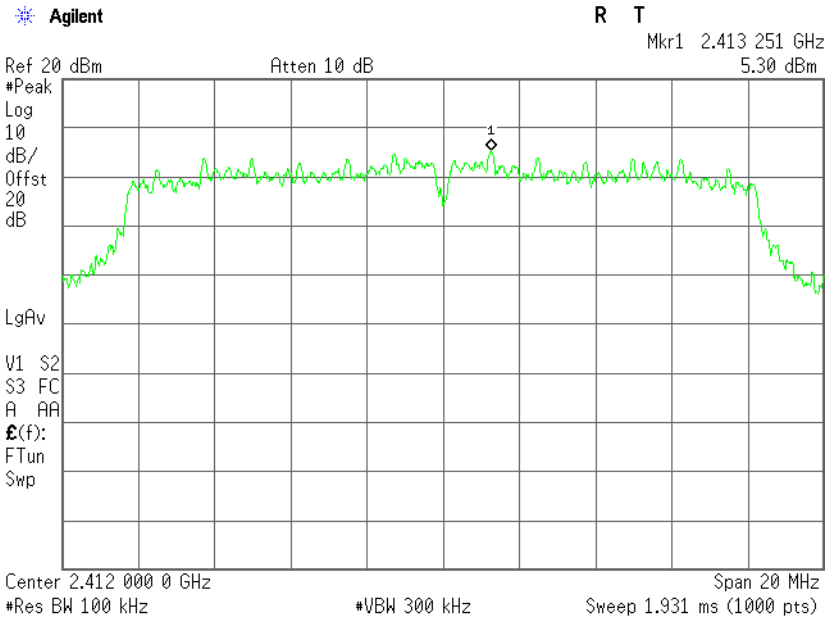
Plot 4.4.8 Conducted Spurious Emissions test results, 802.11b Mode, Fc = 2462 MHz, 9 kHz – 3 GHz range



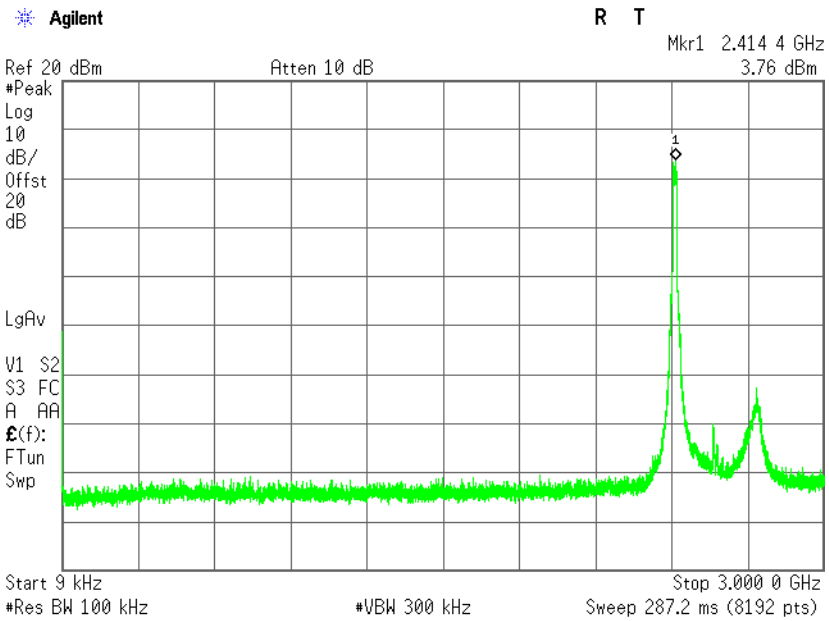
Plot 4.4.9 Conducted Spurious Emissions test results, 802.11b Mode, Fc = 2462 MHz, 3 GHz – 25 GHz range



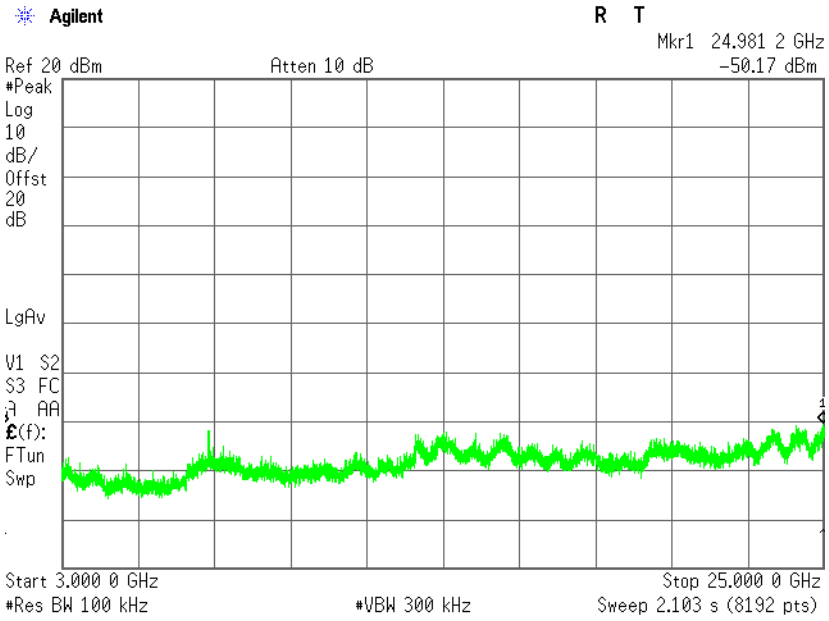
Plot 4.4.10 Conducted Spurious Emissions test results, 802.11g Mode, Fc = 2412 MHz, reference level



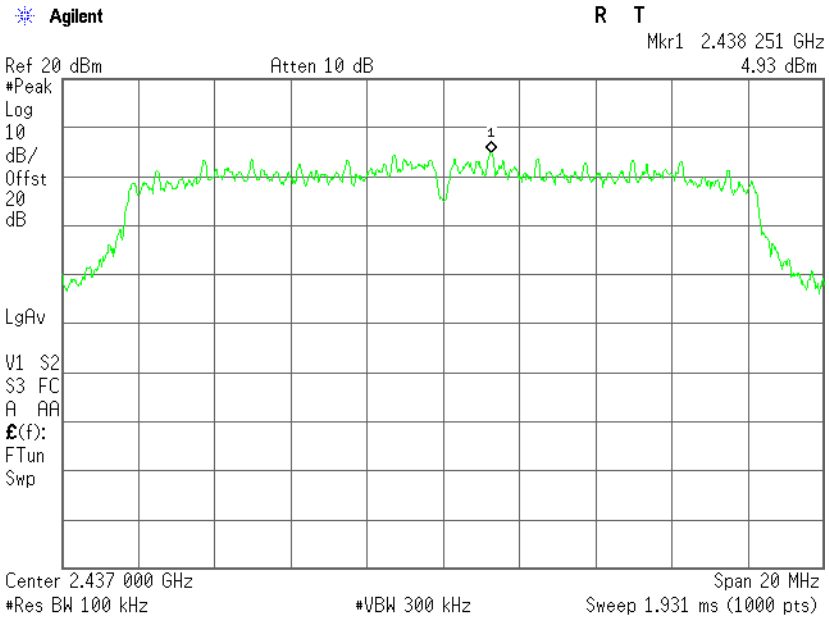
Plot 4.4.11 Conducted Spurious Emissions test results, 802.11g Mode, Fc = 2412 MHz, 9 kHz – 3 GHz range



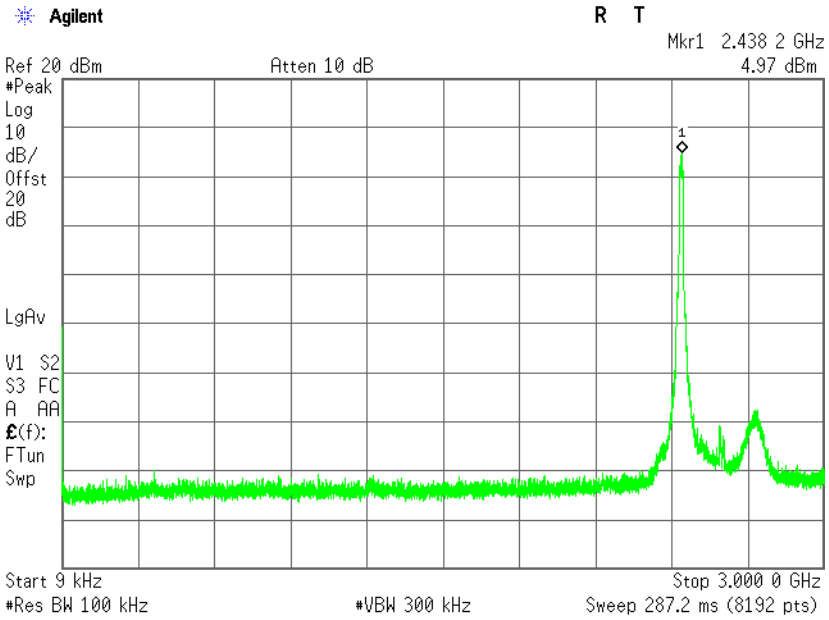
Plot 4.4.12 Conducted Spurious Emissions test results, 802.11g Mode, Fc = 2412 MHz, 3 GHz – 25 GHz range



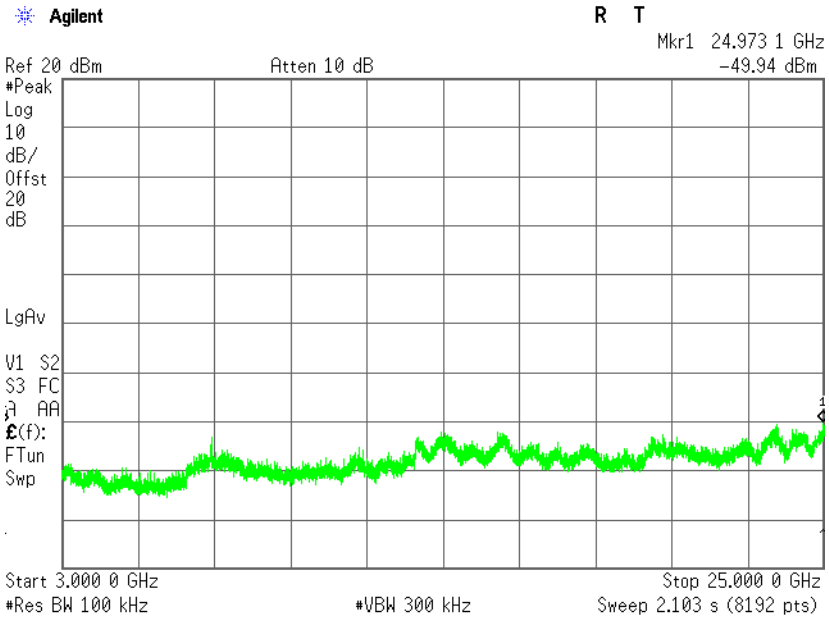
Plot 4.4.13 Conducted Spurious Emissions test results, 802.11g Mode, Fc = 2437 MHz, reference level



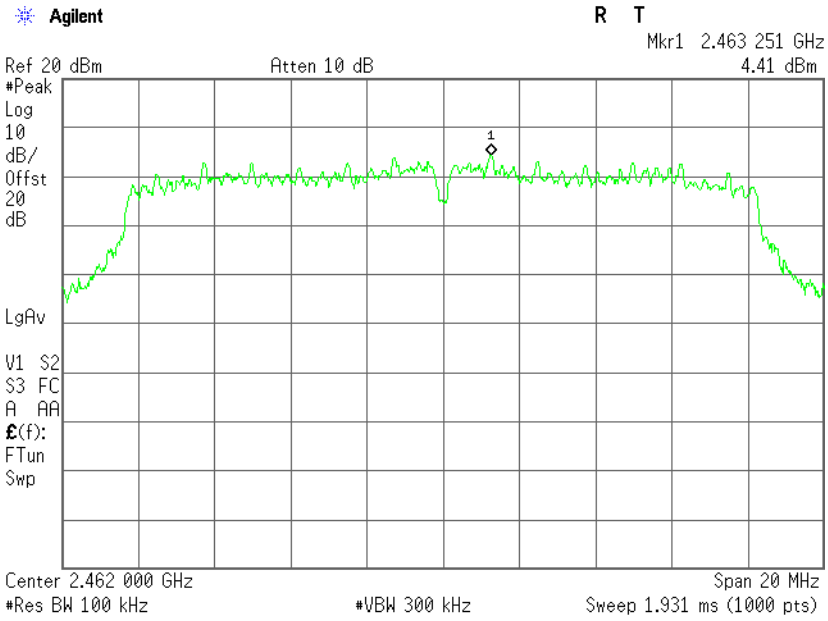
Plot 4.4.14 Conducted Spurious Emissions test results, 802.11g Mode, Fc = 2437 MHz, 9 kHz – 3 GHz range



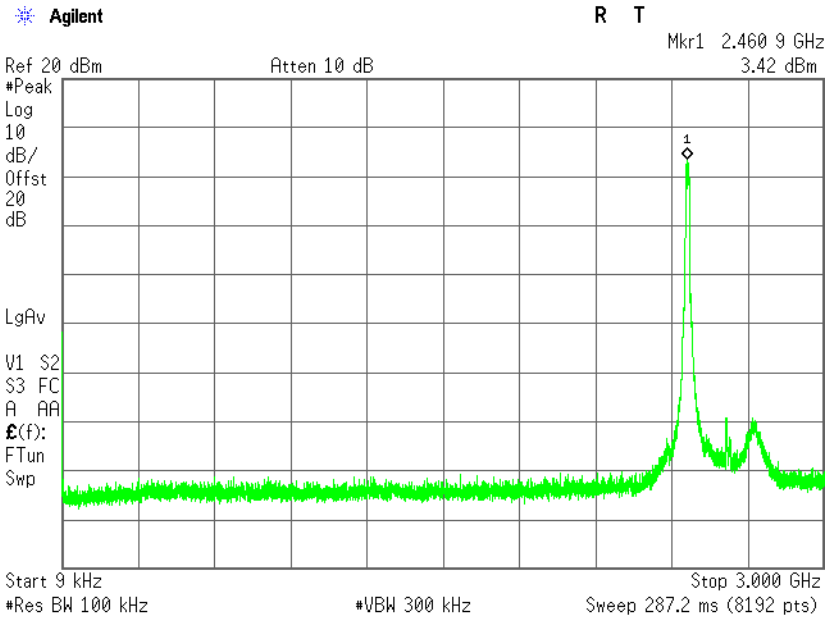
Plot 4.4.15 Conducted Spurious Emissions test results, 802.11g Mode, Fc = 2437 MHz, 3 GHz – 25 GHz range



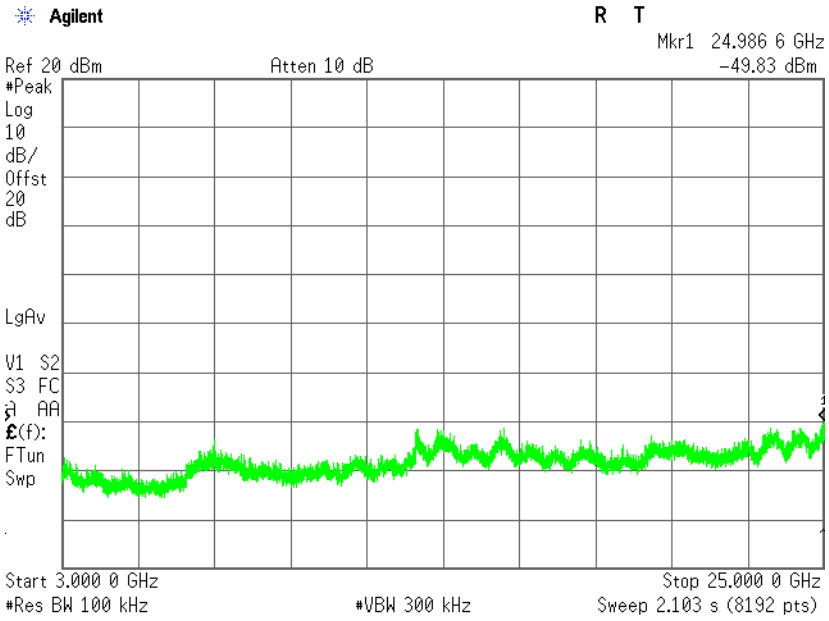
Plot 4.4.16 Conducted Spurious Emissions test results, 802.11g Mode, Fc = 2462 MHz, reference level



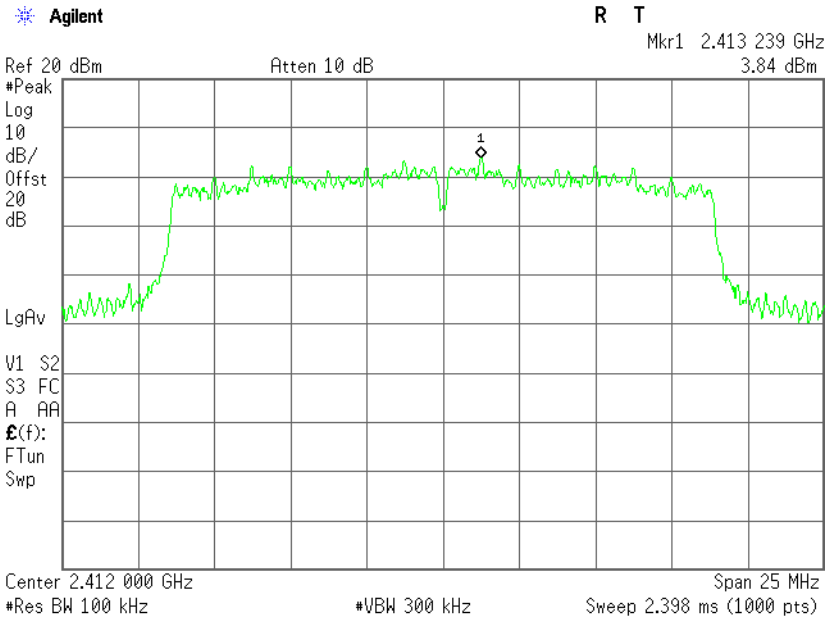
Plot 4.4.17 Conducted Spurious Emissions test results, 802.11g Mode, Fc = 2462 MHz, 9 kHz – 3 GHz range



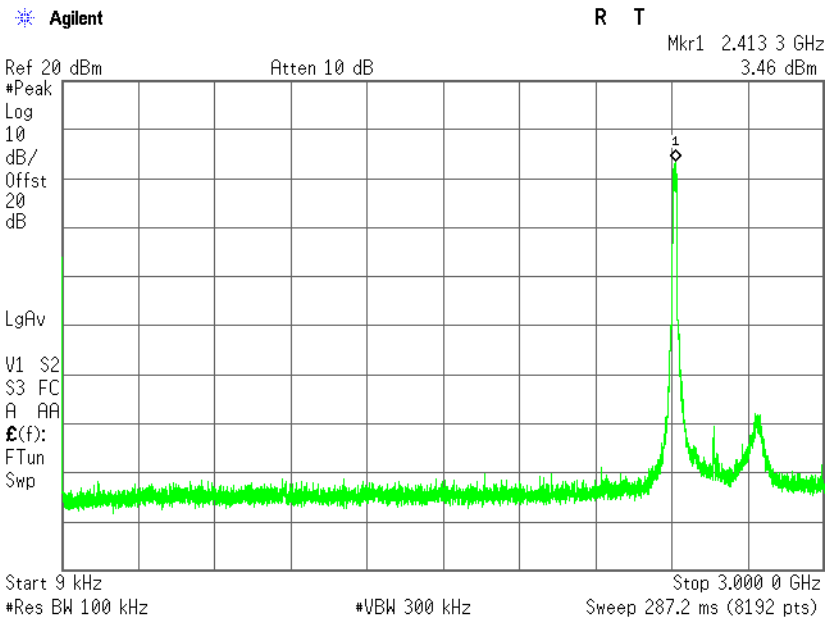
Plot 4.4.18 Conducted Spurious Emissions test results, 802.11g Mode, Fc = 2462 MHz, 3 GHz – 25 GHz range



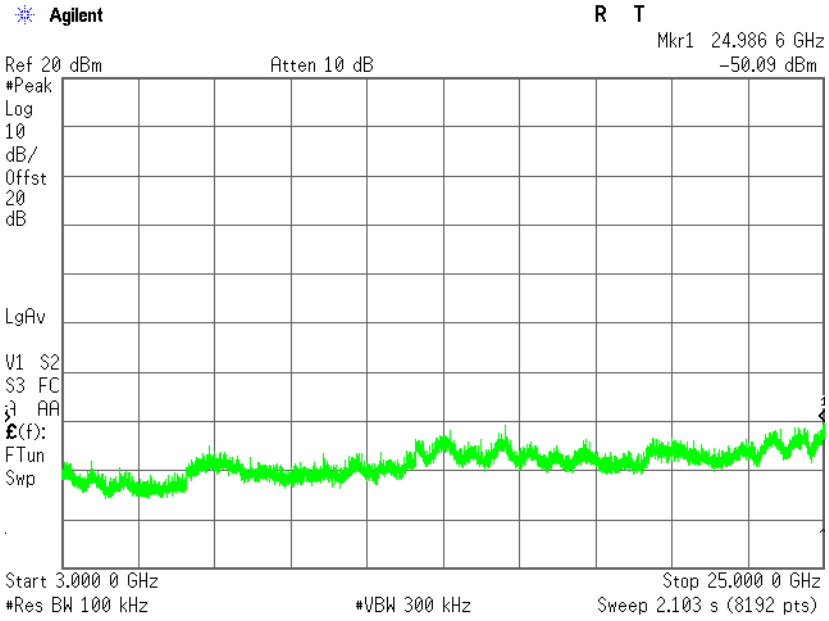
Plot 4.4.19 Conducted Spurious Emissions test results, 802.11n 20MHz Mode, Fc = 2412 MHz, reference level



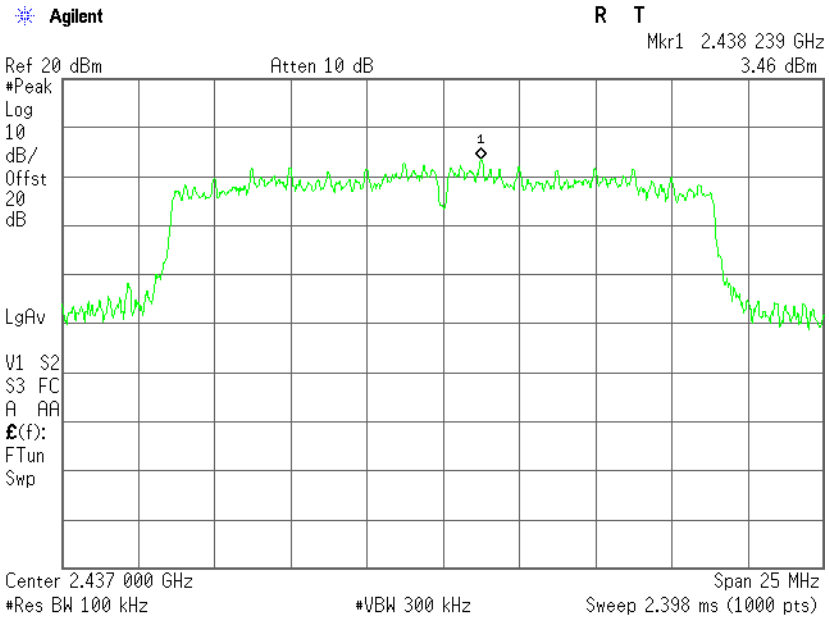
Plot 4.4.20 Conducted Spurious Emissions test results, 802.11n 20MHz Mode, Fc = 2412 MHz, 9 kHz – 3 GHz range



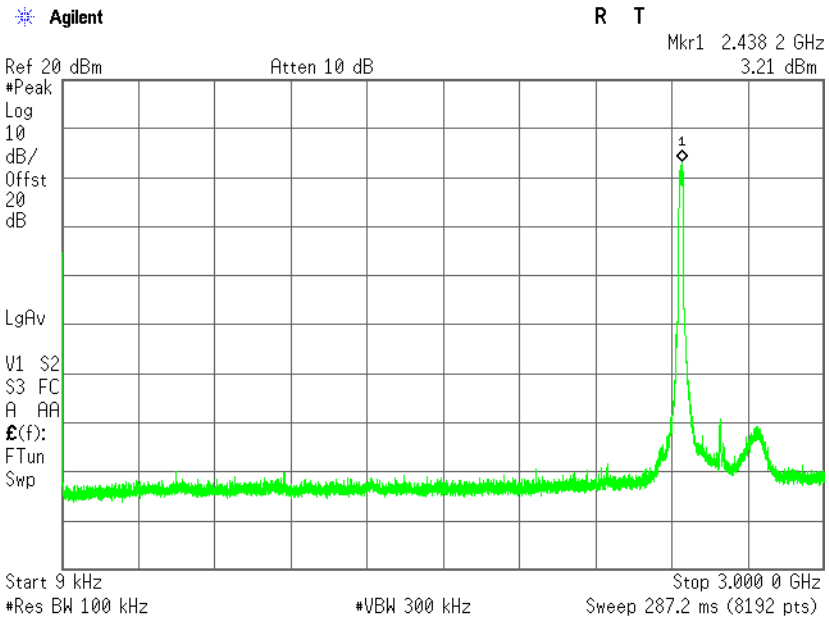
Plot 4.4.21 Conducted Spurious Emissions test results, 802.11n 20MHz Mode, Fc = 2412 MHz, 3 GHz – 25 GHz range



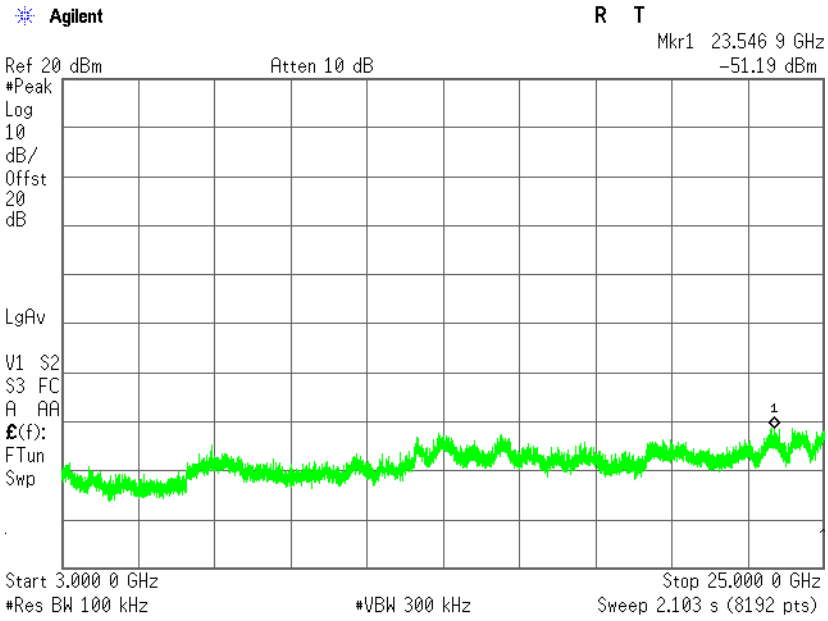
Plot 4.4.22 Conducted Spurious Emissions test results, 802.11n 20MHz Mode, Fc = 2437 MHz, reference level



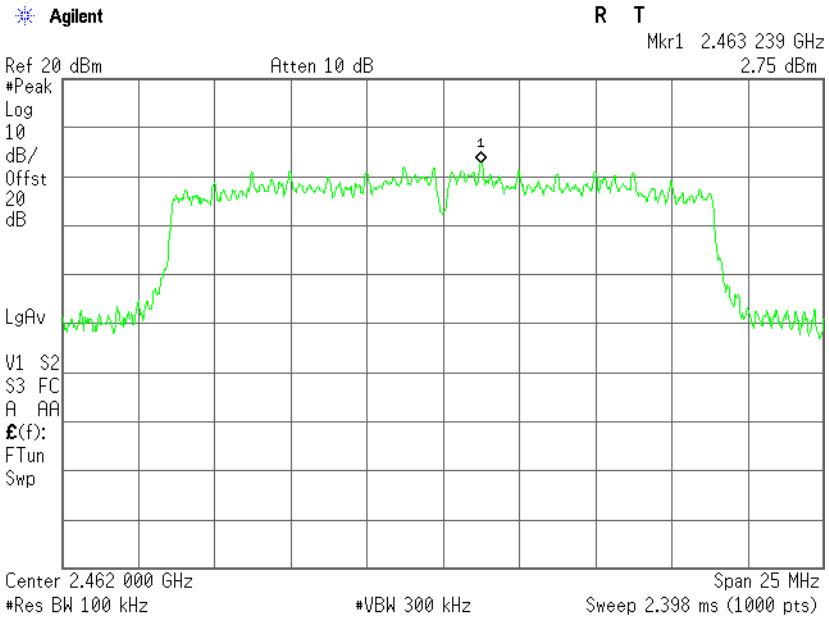
Plot 4.4.23 Conducted Spurious Emissions test results, 802.11n 20MHz Mode, Fc = 2437 MHz, 9 kHz – 3 GHz range



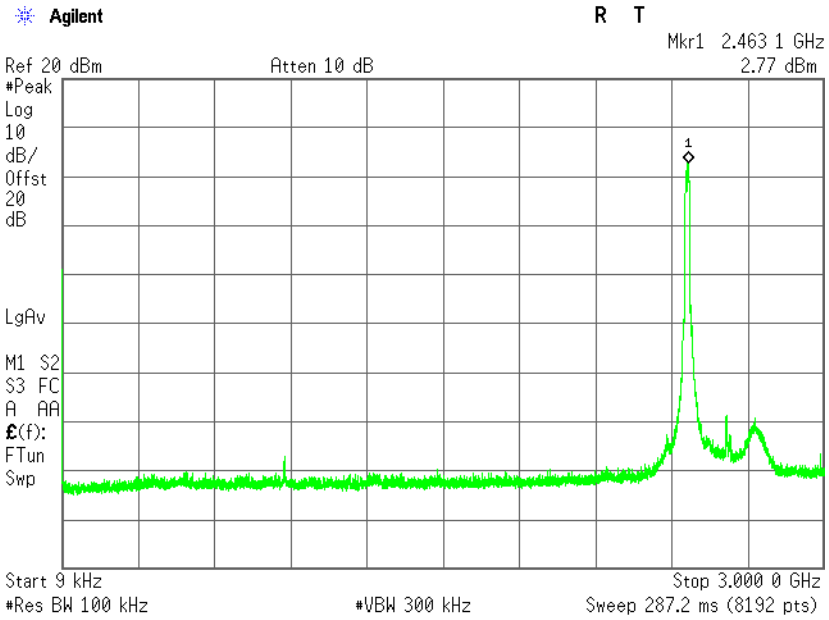
Plot 4.4.24 Conducted Spurious Emissions test results, 802.11n 20MHz Mode, Fc = 2437 MHz, 3 GHz – 25 GHz range



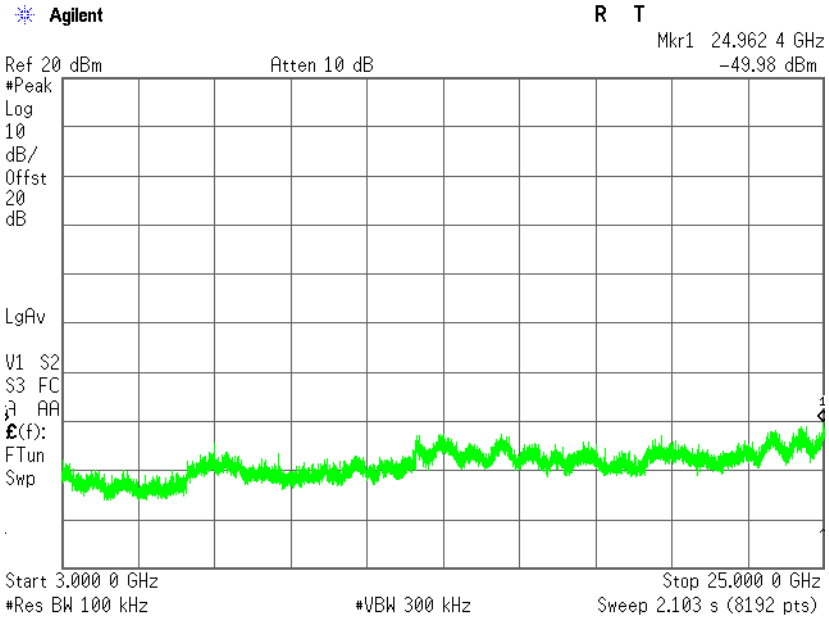
Plot 4.4.25 Conducted Spurious Emissions test results, 802.11n 20MHz Mode, Fc = 2462 MHz, reference level



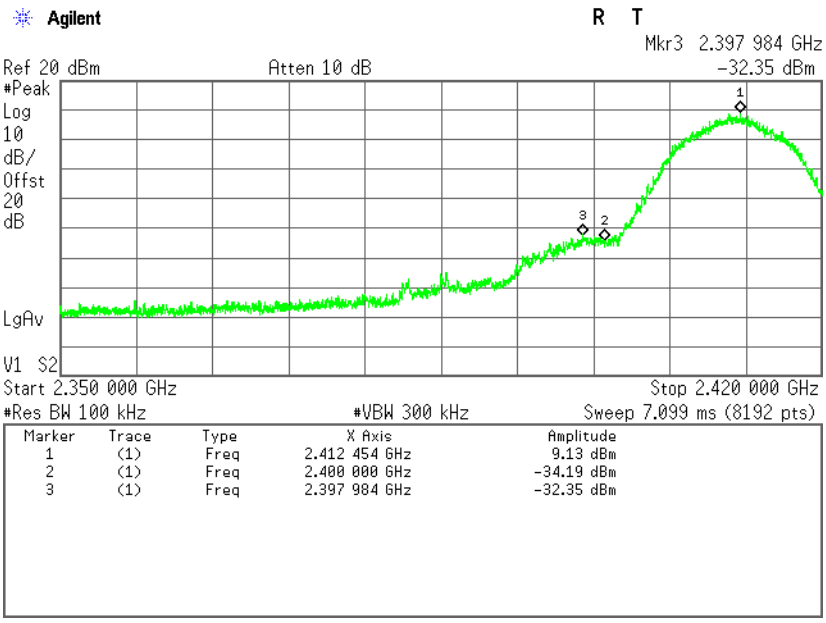
Plot 4.4.26 Conducted Spurious Emissions test results, 802.11n 20MHz Mode, Fc = 2462 MHz, 9 kHz – 3 GHz range



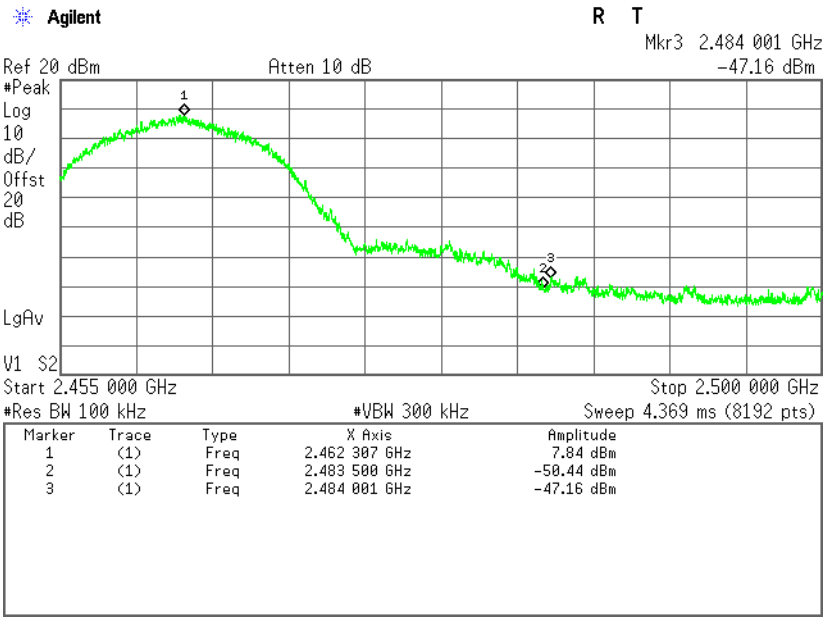
Plot 4.4.27 Conducted Spurious Emissions test results, 802.11n 20MHz Mode, Fc = 2462 MHz, 3 GHz – 25 GHz range



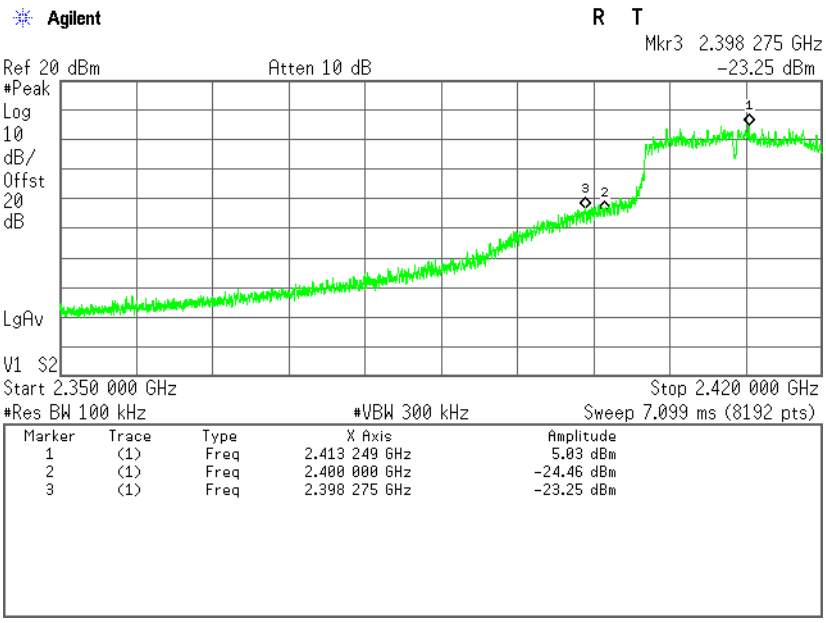
Plot 4.4.28 Band Edge test results, 802.11b Mode, F = 2412 MHz



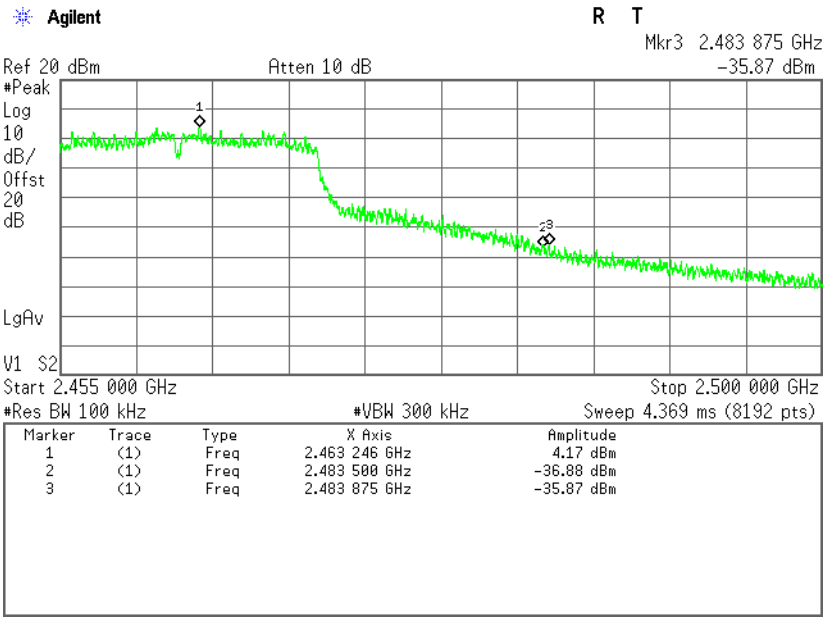
Plot 4.4.29 Band Edge test results, 802.11b Mode, F = 2462 MHz



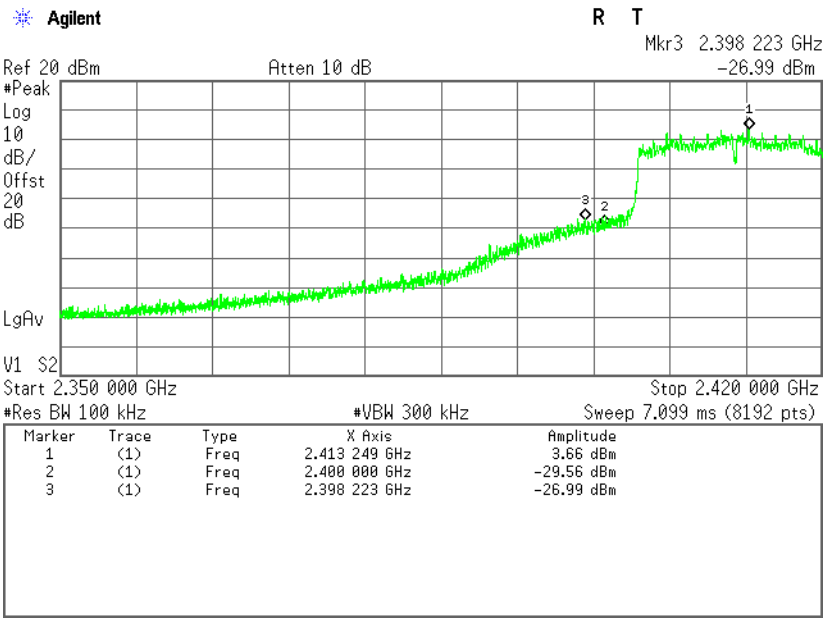
Plot 4.4.30 Band Edge test results, 802.11g Mode, F = 2412 MHz



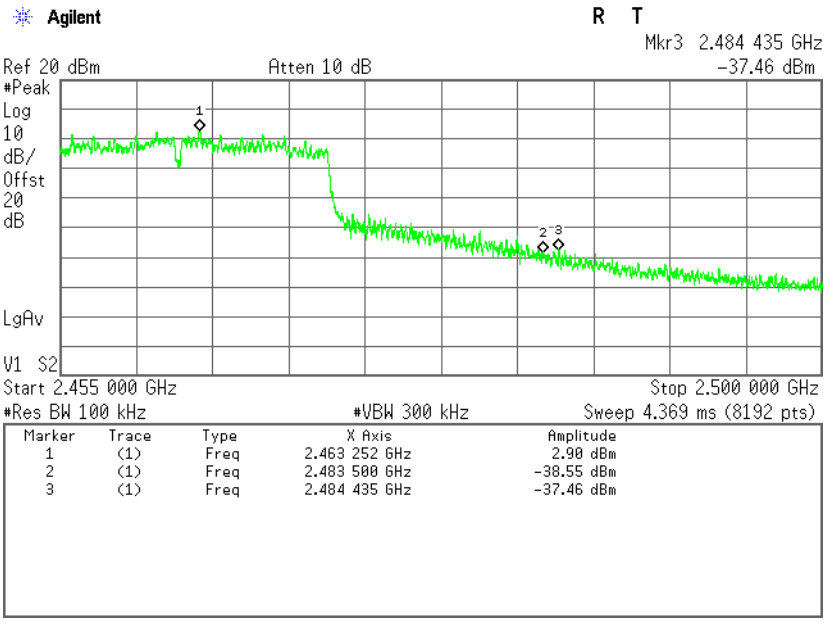
Plot 4.4.31 Band Edge test results, 802.11g Mode, F = 2462 MHz



Plot 4.4.32 Band Edge test results, 802.11n 20MHz Mode, MCS7, Fc = 2412 MHz



Plot 4.4.33 Band Edge test results, 802.11n 20MHz Mode, MCS7, Fc = 2462 MHz



4.5. Radiated Spurious Emissions, Restricted Bands 2310-2390MHz & 2483.5-2500MHz

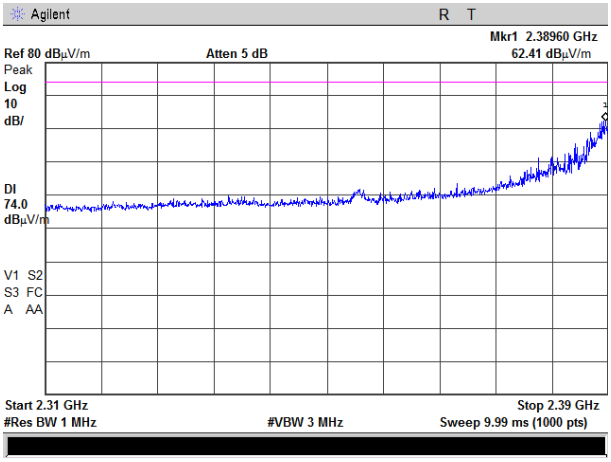
Reference document:	**47 CFR §15.247 (d) & §15.205**		
Test Requirements:	Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (See §15.205(c)).		
Test setup:	See sec 2.2	**Pass**	
Method of testing:	Radiated		
Operating conditions:	Under normal test conditions		
S.A. Settings:	Peak: RBW= 1MHz, VBW= 3MHz, Average: VBW= 30 Hz		
Environment conditions:	Ambient Temperature: 24.3 °c	Relative Humidity: 49.4%	Atmospheric Pressure: hPa
Test Result:	See below	See Plot 4.5.1 to Plot 4.5.4	

Test results:
All measurements were done in horizontal and vertical polarizations and 3 orientation axis X,Y & Z; the results show the worst case.

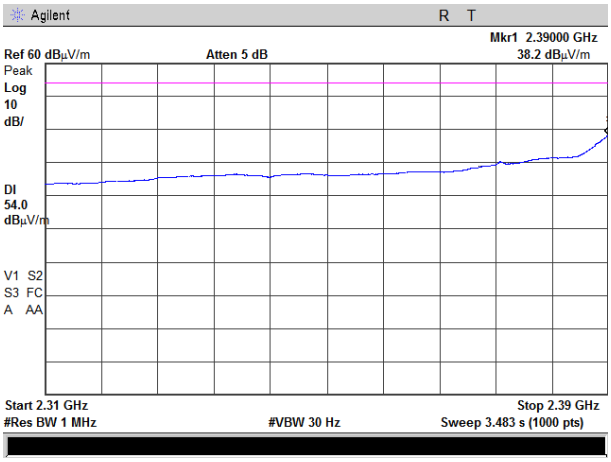
Frequency, [MHz]	Data Rate, [Mbps]	Emission Frequency, [MHz]	Detector Type	Antenna Polarization	Emission Level, [dBµV/m]	Limit, [dBµV/m]	Delta, [dB]	Pass/Fail
802.11n 20MHz Mode								
2412	MCS7	2389.600	Peak	H	62.41	74.00	-11.59	Pass
		2390.000	Average	H	38.20	54.00	-15.80	Pass
		2390.000	Peak	V	63.66	74.00	-10.34	Pass
		2389.920	Average	V	41.91	54.00	-12.09	Pass
2462	MCS7	2483.517	Peak	H	66.11	74.00	-7.85	Pass
		2483.583	Average	H	42.16	54.00	-11.84	Pass
		2484.342	Peak	V	68.40	74.00	-5.60	Pass
		2483.533	Average	V	46.69	54.00	-7.31	Pass

Note: Emission Level [dBµV/m] = Measured Level [dBµV] + Correction-factor [dB (1/m)]
Correction Factor = Antenna factor + Cable Loss

Plot 4.5.1 Radiated Spurious Emission, 802.11n 20MHz, Fc = 2412 MHz, MCS7, 2.31 – 2.39 GHz range, horizontal

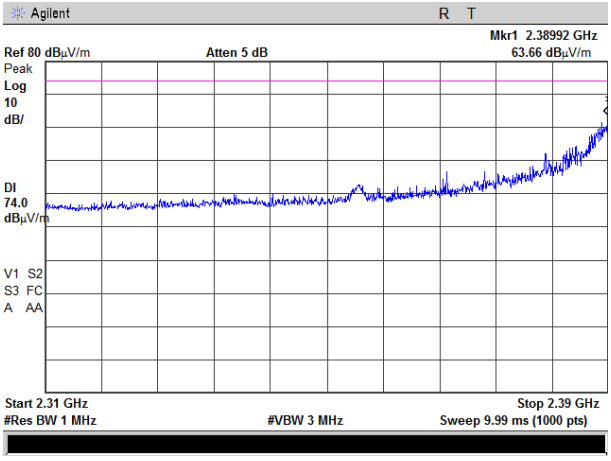


Peak

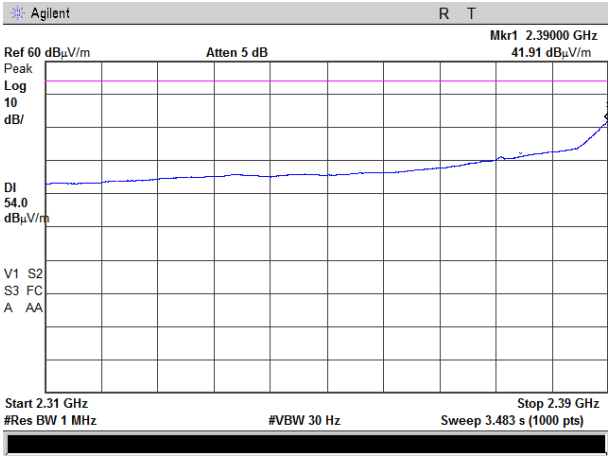


Average

Plot 4.5.2 Radiated Spurious Emission, 802.11n 20MHz, Fc = 2412 MHz, MCS7, 2.31 – 2.39 GHz range, vertical

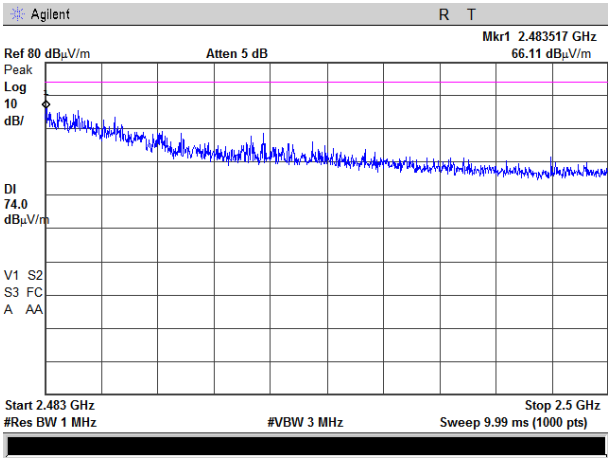


Peak

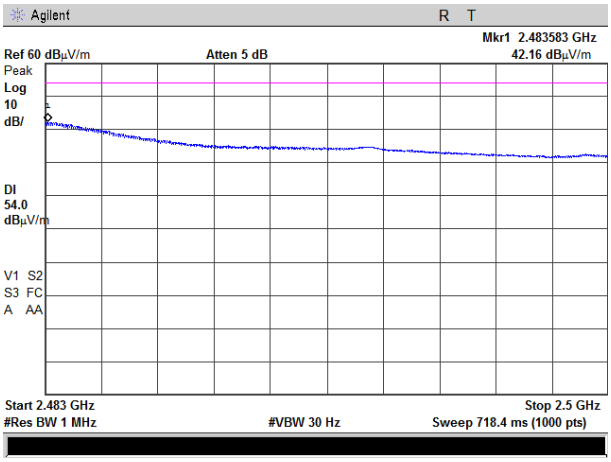


Average

Plot 4.5.3 Radiated Spurious Emission, 802.11n 20MHz, Fc = 2462 MHz, MCS7, 2.4835 – 2.5 GHz range, Horizontal

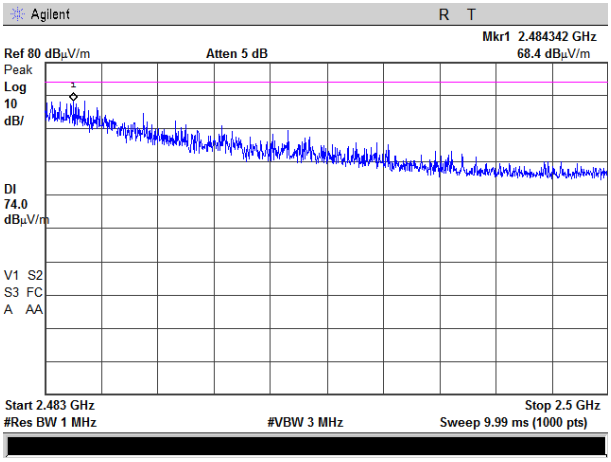


Peak

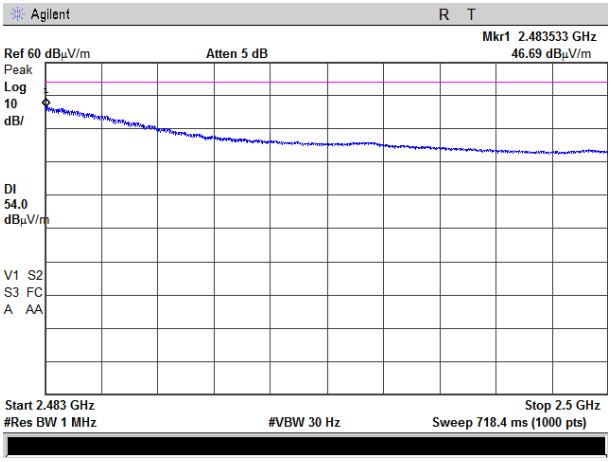


Average

Plot 4.5.4 Radiated Spurious Emission, 802.11n 20MHz, Fc = 2462 MHz, MCS7, 2.4835 – 2.5 GHz range, Vertical



Peak



Average

4.6. Radiated Spurious Emissions

Reference document:	**47 CFR §15.247 (d), & §15.205, & §15.209(a)**		
Test Requirements:	The emissions from an intentional radiator shall not exceed the field strength levels specified in §15.209(a).		
Test setup:	See sec 2.2, with Band Reject filter	**Pass**	
Method of testing:	Radiated		
Operating conditions:	Under normal test conditions		
S.A. Settings:	f >1GHz: Peak: RBW= 1MHz, VBW= **3**MHz, Average: VBW= 10 Hz f<1GHz: RBW: 120kHz,VBW: 300kHz		
Environment conditions:	Ambient Temperature: 24.3 °c	Relative Humidity: 49.4%	Atmospheric Pressure: hPa
Test Result:	See below	See Plot 4.6.1 - Plot 4.6.17	

All measurements were done in horizontal and vertical polarizations and 3 orientation axis X,Y & Z; the results show the worst case.

Test results below 1GHz:

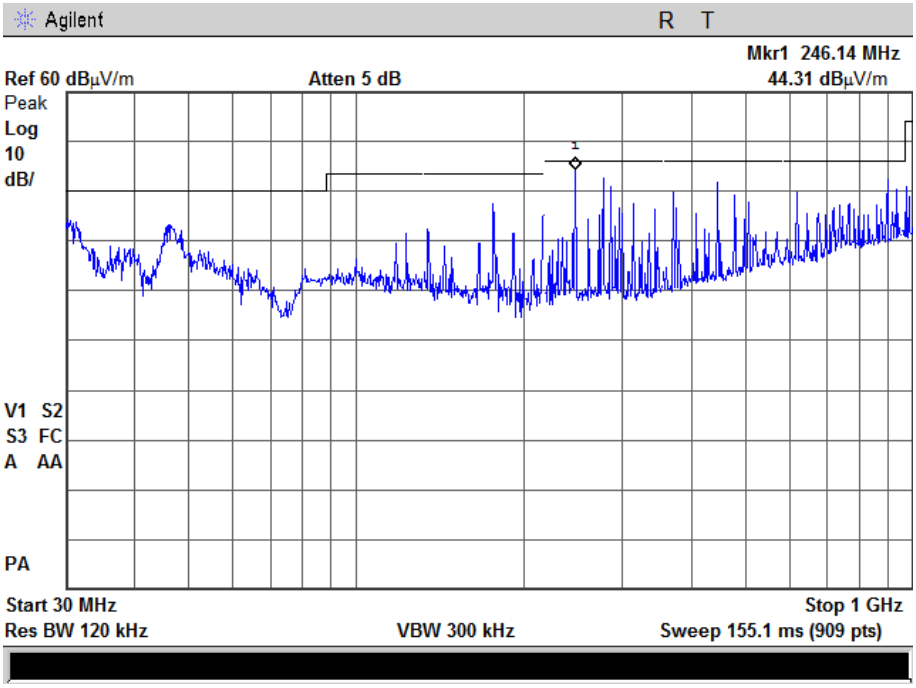
Emission Frequency, [MHz]	Detector Type	Antenna Polarization	Emission Level, [dBµV/m]	Limit, [dBµV/m]	Delta, [dB]	Pass/Fail
250.000	QP	H	45.41	46.00	-0.59	Pass
288.000	QP	H	45.35	46.00	-0.65	Pass
375.000	QP	H	40.44	46.00	-5.56	Pass
412.500	QP	H	42.45	46.00	-3.55	Pass
445.500	QP	H	45.33	46.00	-0.67	Pass
478.500	QP	H	45.57	46.00	-0.43	Pass

Test results above 1GHz:

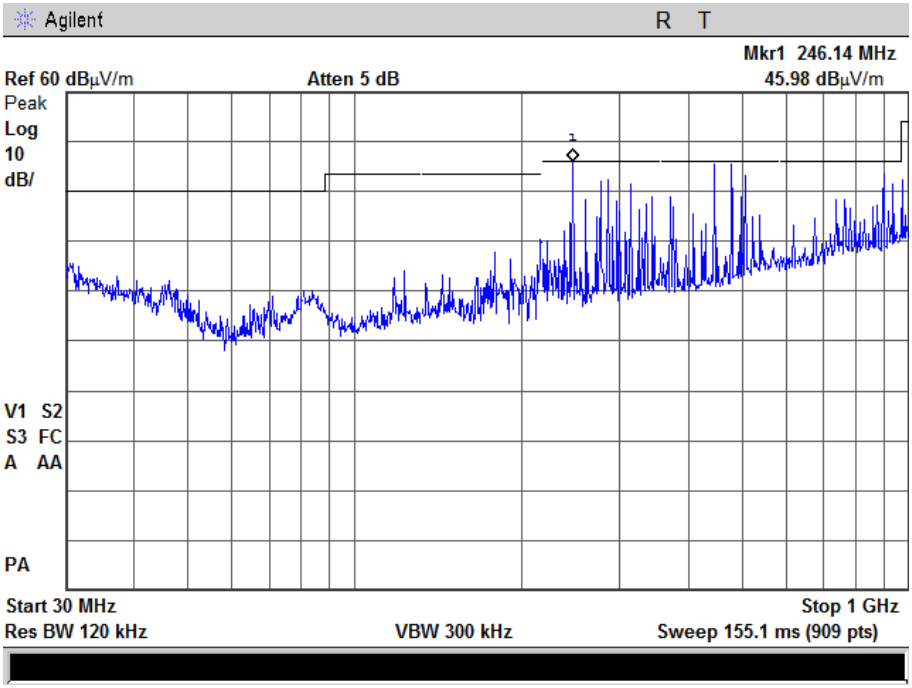
Emission Frequency, [MHz]	Detector Type	Antenna Polarization	Emission Level, [dBµV/m]	Limit, [dBµV/m]	Delta, [dB]	Pass/Fail
802.11 20MHz Mode, lower frequency Fc = 2412MHz						
1248.000	Peak	V&H	36.39	74.00	-37.61	Pass
1249.000	AVG	V&H	35.55	54.00	-18.45	Pass
4924.000	AVG	V&H	42.51	54.00	-11.49	Pass
7386.000	Peak	V&H	61.11	74.00	-12.89	Pass
7386.000	AVG	V&H	51.17	54.00	-2.83	Pass
802.11 20MHz Mode, middle frequency Fc = 2437MHz						
1248.000	Peak	V&H	37.54	74.00	-36.46	Pass
1249.000	AVG	V&H	35.10	54.00	-18.90	Pass
7386.000	Peak	V&H	64.37	74.00	-9.63	Pass
7386.000	AVG	V&H	51.31	54.00	-2.69	Pass
802.11 20MHz Mode, middle frequency Fc = 2480MHz						
1248.000	Peak	V&H	38.35	74.00	-35.65	Pass
1249.000	AVG	V&H	35.96	54.00	-18.04	Pass
7386.000	Peak	V&H	62.51	74.00	-11.49	Pass
7386.000	AVG	V&H	51.10	54.00	-2.90	Pass

Note: Emission Level [dBµV/m] = Measured Emission [dBµV] + Correction-factor [dB (1/m)]
Correction Factor = Antenna factor + Cable Loss +Filter I/L.

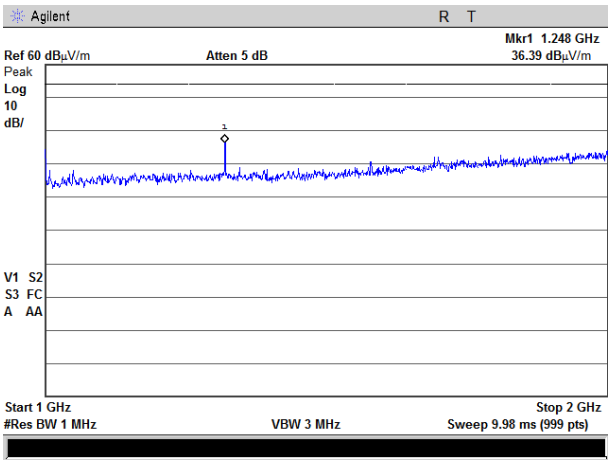
Plot 4.6.1 Radiated Spurious Emission in 30MHz-1GHz range, Worst case for all modes and all frequencies, Vertical



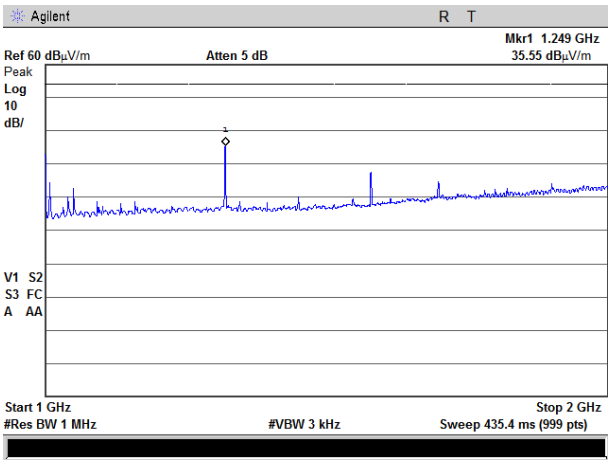
Plot 4.6.2 Radiated Spurious Emission in 30MHz-1GHz range, Worst case for all modes and all frequencies, Horizontal



Plot 4.6.3 Radiated Spurious Emission in 1 – 2 GHz range, 802.11n 20MHz, Fc = 2412 MHz, MCS7, Horizontal & Vertical

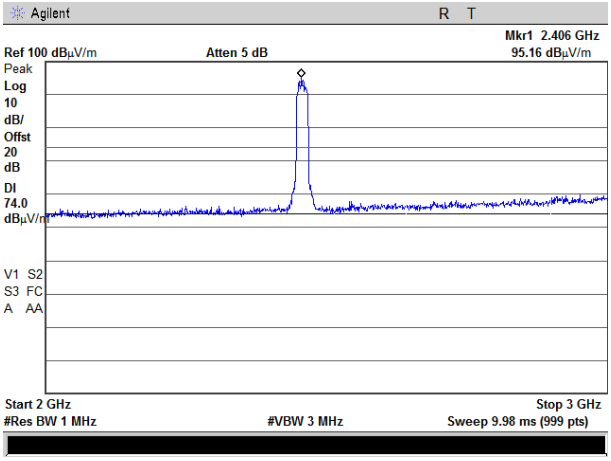


Peak

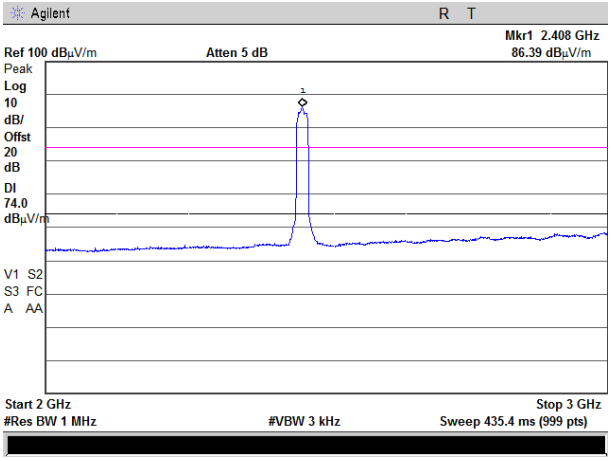


Average

Plot 4.6.4 Radiated Spurious Emission in 2 – 3 GHz range, 802.11n 20MHz, Fc = 2412 MHz, MCS7, Horizontal & Vertical

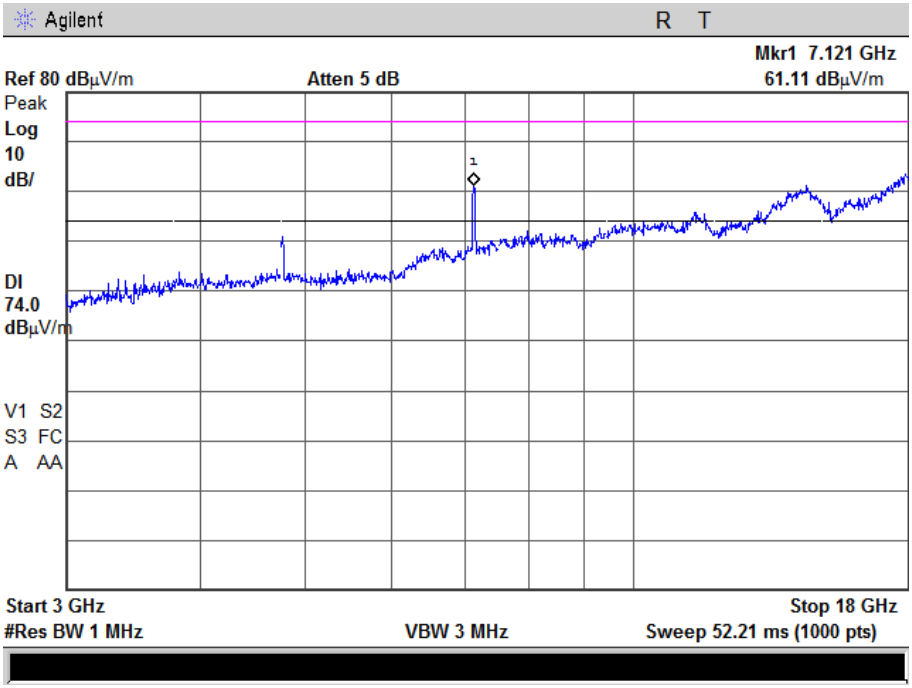


Peak

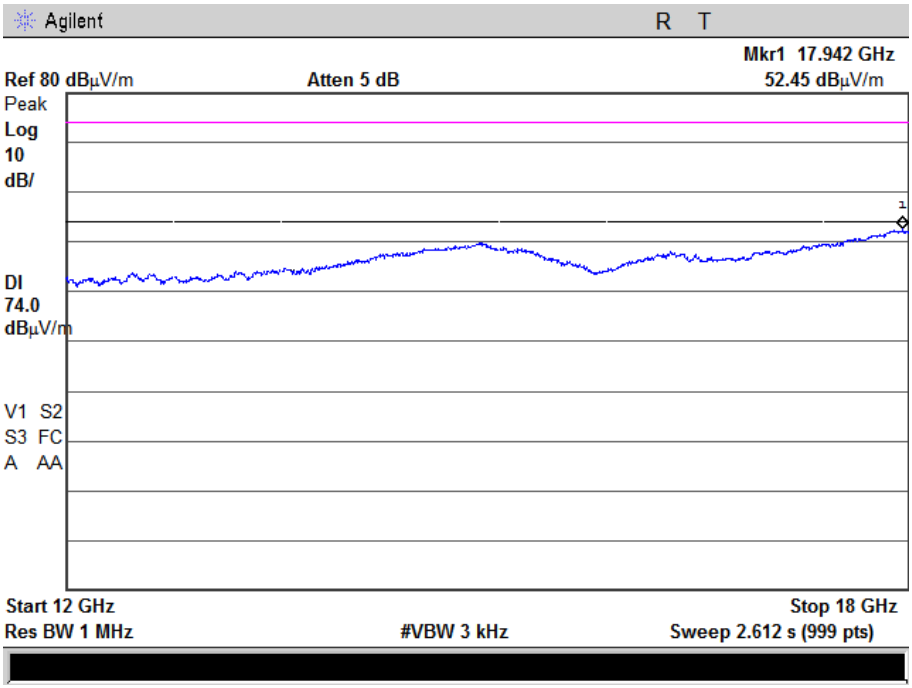


Average

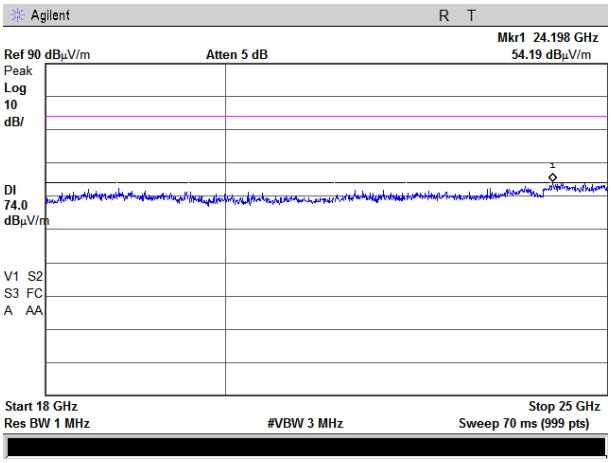
Plot 4.6.5 Radiated Spurious Emission in 3 – 18 GHz range, 802.11n 20MHz, Fc = 2412 MHz, MCS7, Horizontal & Vertical, Peak



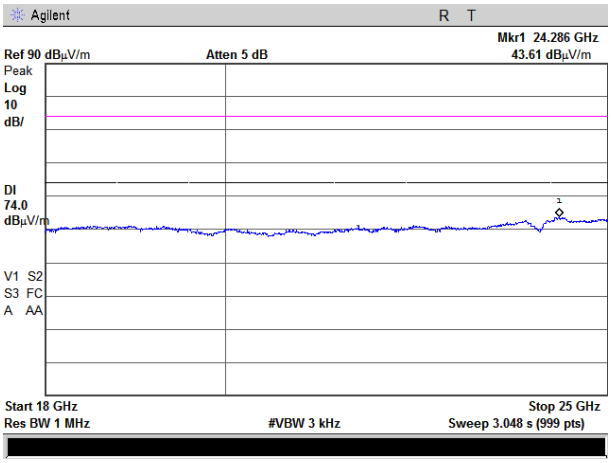
Plot 4.6.6 Radiated Spurious Emission in 3 – 18 GHz range, 802.11n 20MHz, Fc = 2412 MHz, MCS7, Horizontal & Vertical, Average



Plot 4.6.7 Radiated Spurious Emission in 18 – 25 GHz range, 802.11n 20MHz, Fc = 2412 MHz, MCS7, Horizontal & Vertical

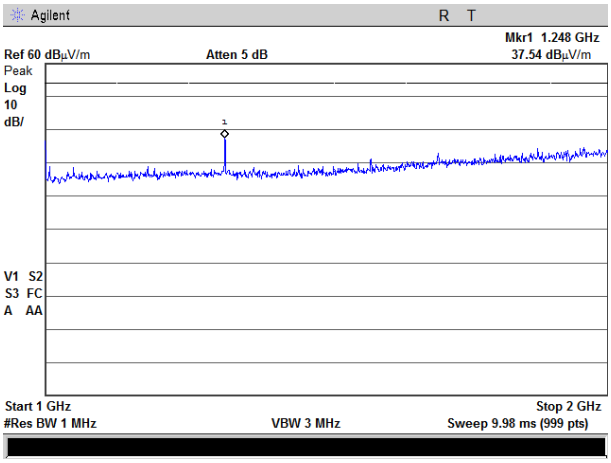


Peak

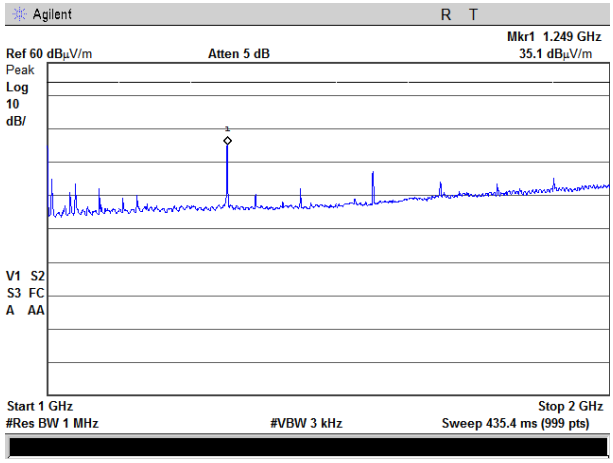


Average

Plot 4.6.8 Radiated Spurious Emission in 1 – 2 GHz range, 802.11n 20MHz, Fc = 2437 MHz, MCS7, Horizontal & Vertical

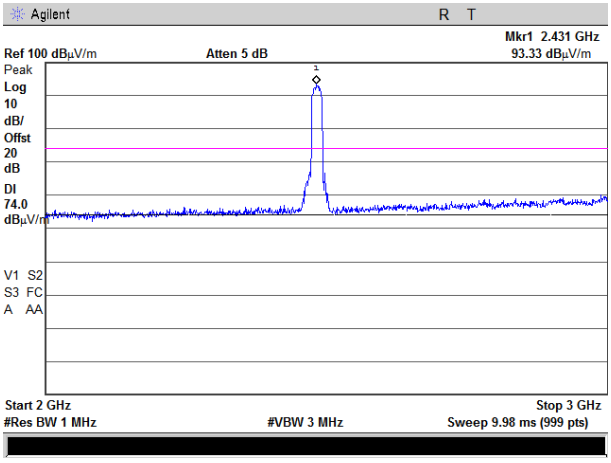


Peak

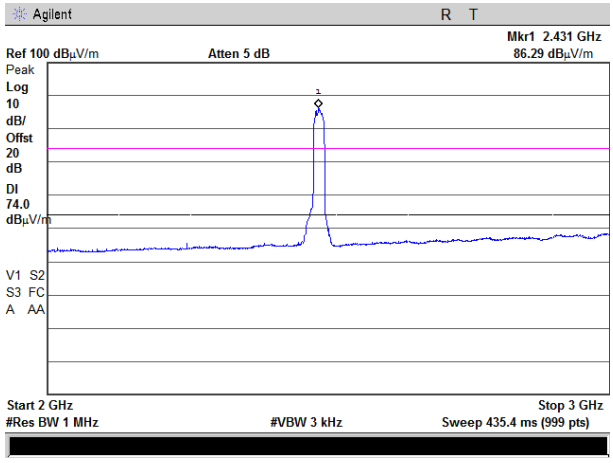


Average

Plot 4.6.9 Radiated Spurious Emission in 2 – 3 GHz range, 802.11n 20MHz, Fc = 2437 MHz, MCS7, Horizontal & Vertical

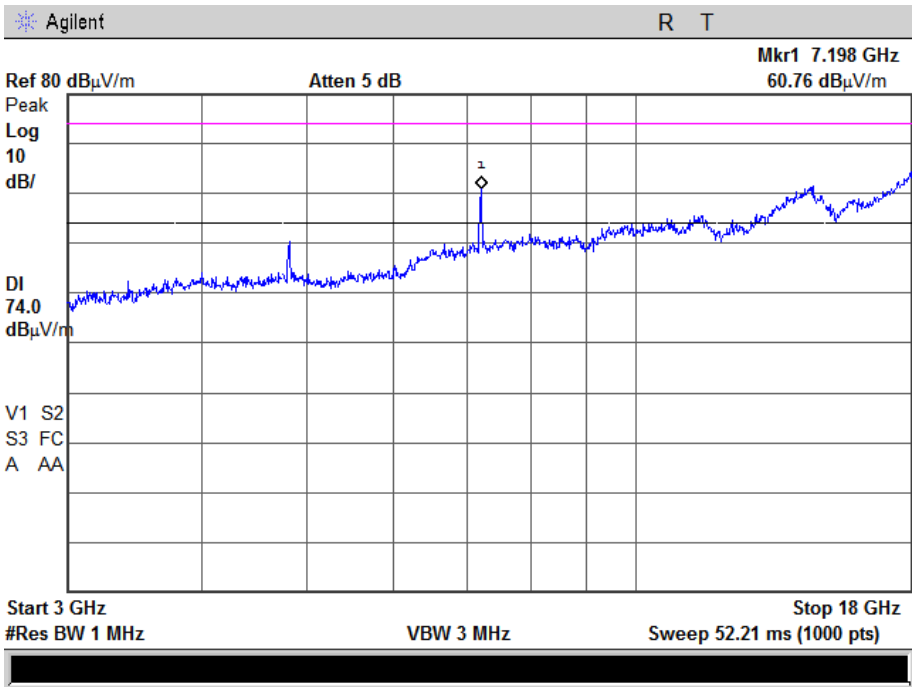


Peak

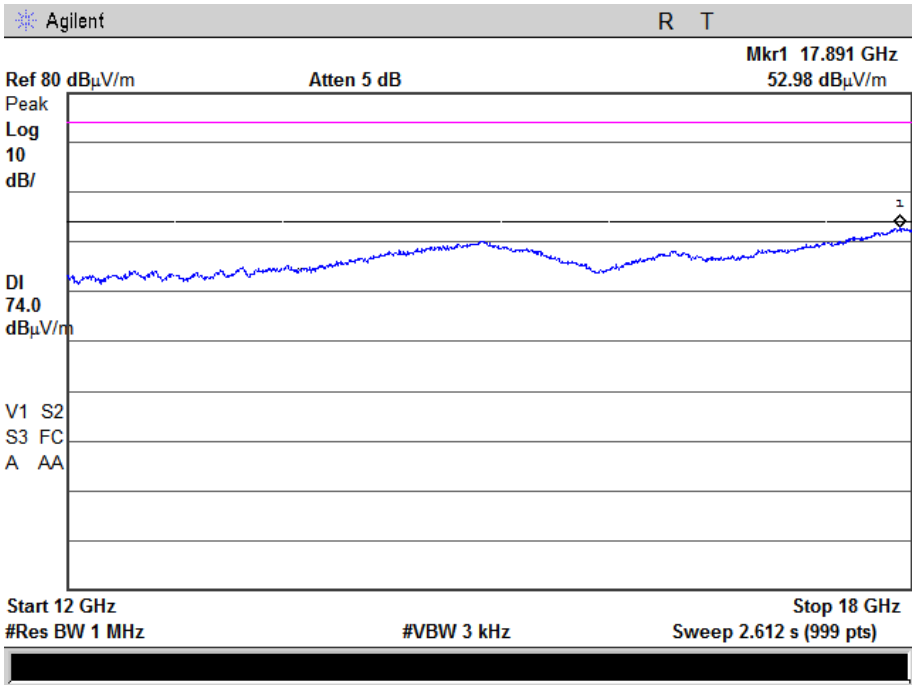


Average

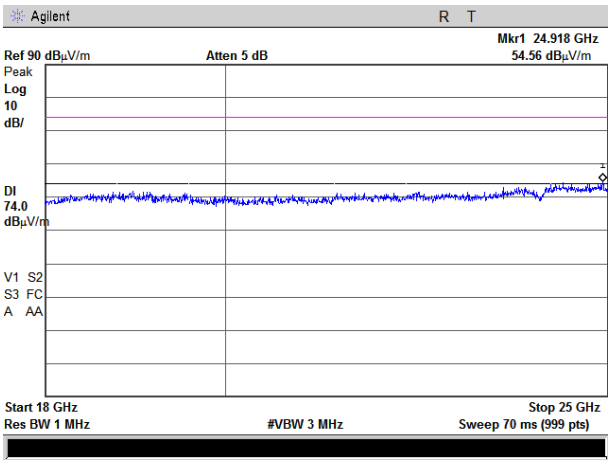
Plot 4.6.10 Radiated Spurious Emission in 3 – 18 GHz range, 802.11n 20MHz, Fc = 2437 MHz, MCS7, Horizontal & Vertical, Peak



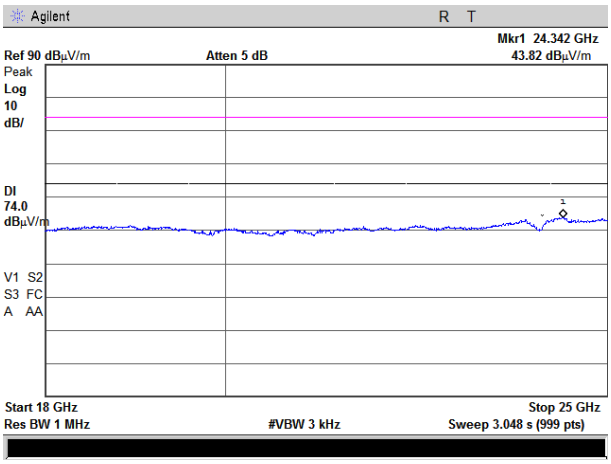
Plot 4.6.11 Radiated Spurious Emission, 802.11n 20MHz, Fc = 2437 MHz, MCS7, 12 – 18 GHz range, Horizontal & Vertical, Average



Plot 4.6.12 Radiated Spurious Emission in 18 – 25 GHz range, 802.11n 20MHz, Fc = 2437 MHz, MCS7, Horizontal & Vertical

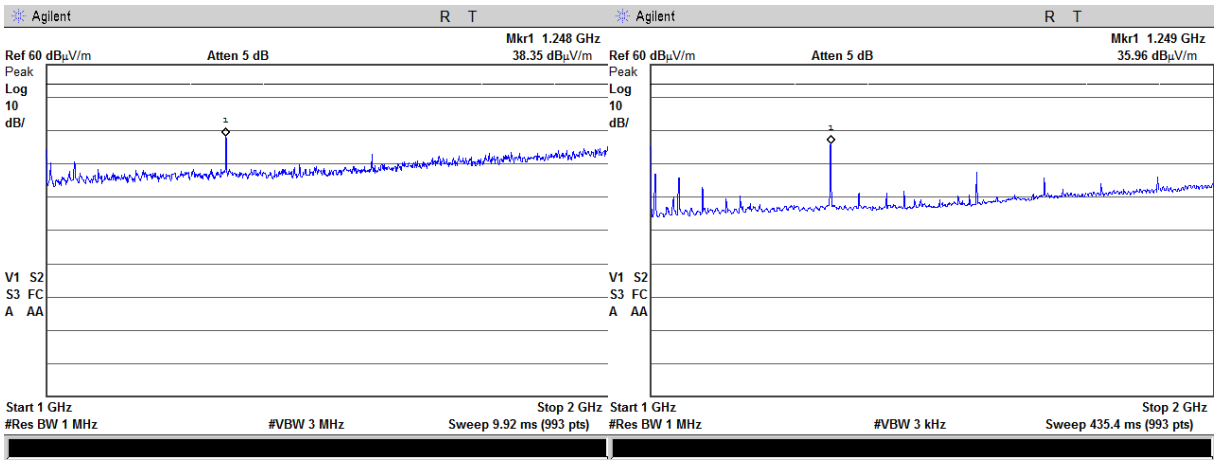


Peak



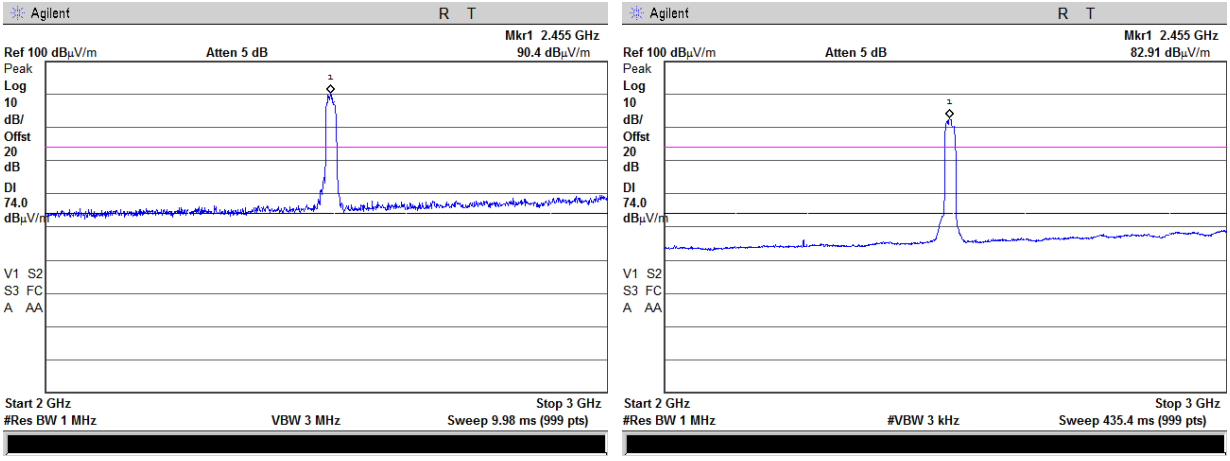
Average

Plot 4.6.13 Radiated Spurious Emission in 1 – 2 GHz range, 802.11n 20MHz, Fc = 2462 MHz, MCS7, Horizontal & Vertical



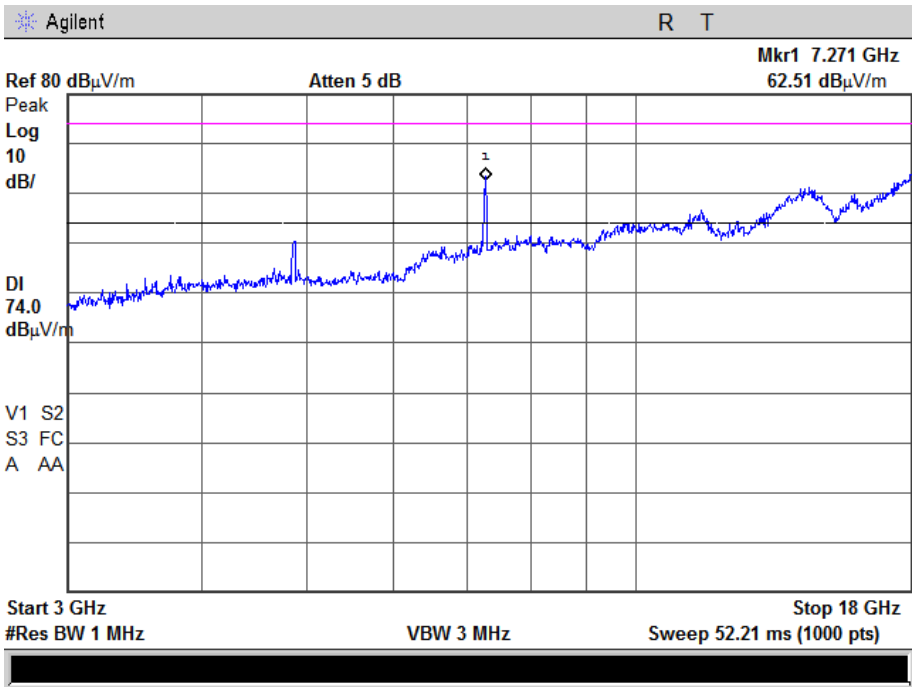
Peak Average

Plot 4.6.14 Radiated Spurious Emission in 2 – 3 GHz range, 802.11n 20MHz, Fc = 2462 MHz, MCS7, Horizontal & Vertical

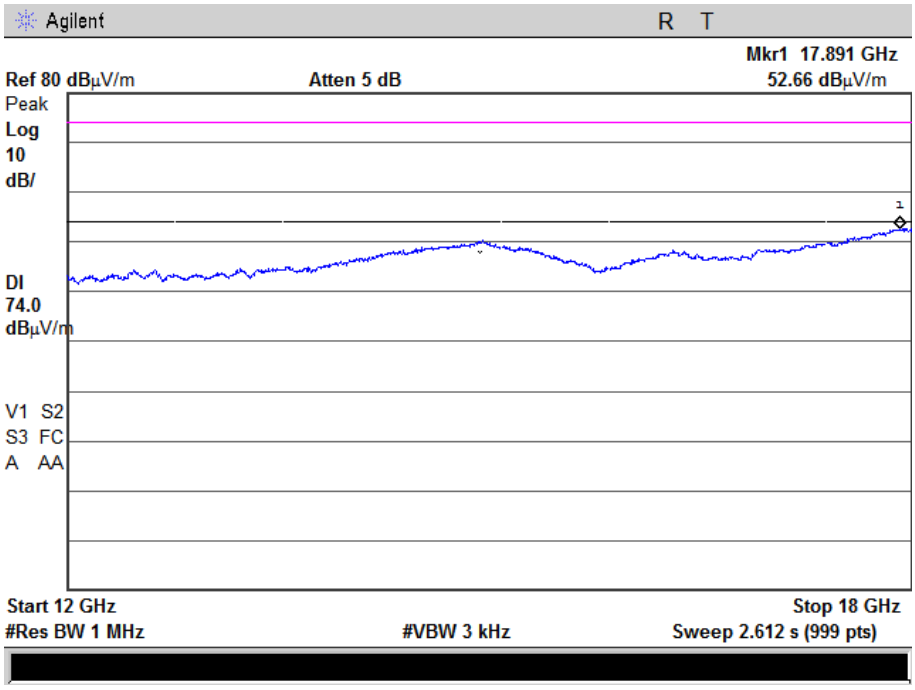


Peak Average

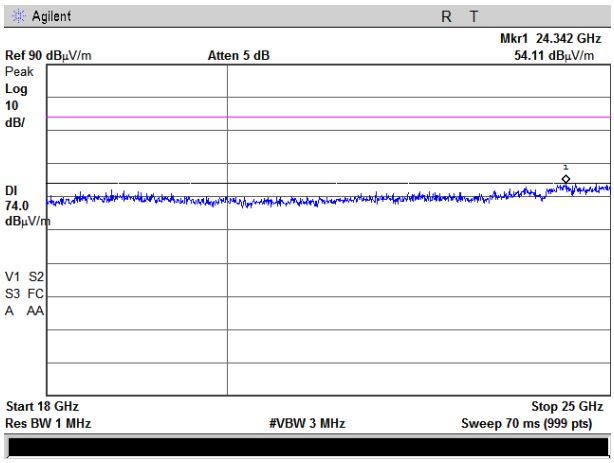
Plot 4.6.15 Radiated Spurious Emission in 3 – 18 GHz range, 802.11n 20MHz, Fc = 2462 MHz, MCS7, Horizontal & Vertical, Peak



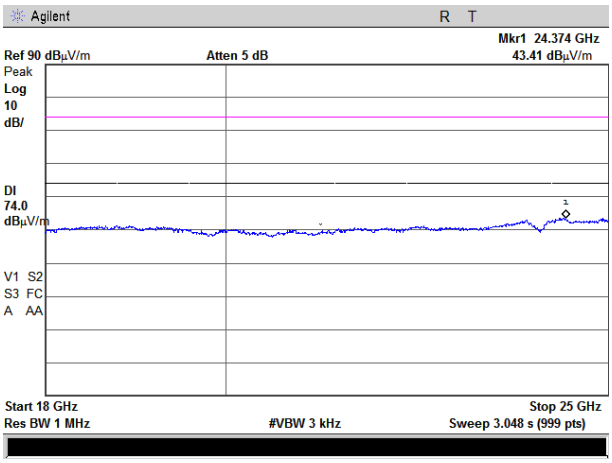
Plot 4.6.16 Radiated Spurious Emission, 802.11n 20MHz, Fc = 2437 MHz, MCS7, 12 – 18 GHz range, Horizontal & Vertical, Average



Plot 4.6.17 Radiated Spurious Emission in 18 – 25 GHz range, 802.11n 20MHz, Fc = 2462 MHz, MCS7, Horizontal & Vertical



Peak



Average

4.7. Power Line Emissions measurements

Reference document:	**47 CFR §15.107/207**		
Test Requirements:	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 §15.107. The emissions from an intentional radiator shall not exceed the field strength levels specified in §15.207. Any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in Sec.15.207.		
Test setup:	See Sec. 2.5	**Pass**	
Operating conditions:	Under normal test conditions		
Method of testing:	Conducted Emissions		
S.A. Settings:	f <30MHz: RBW: 9kHz, VBW:30kHz		
Radio device:	Idle		
Environment conditions:	Ambient Temperature: 23.2°c	Relative Humidity: 48.1%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 4.7.1 - Plot 4.7.2	

Test Results:
Worst case results of unintentional emissions and emissions while NII, DTS and BT transmitters are operating alternately, measured at the charger 220VAC port.

"Phase" Lead

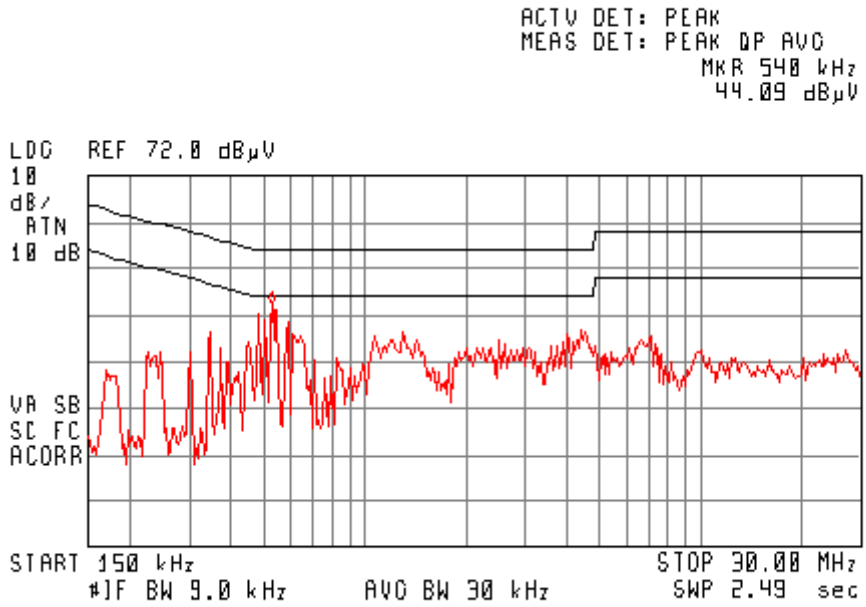
Frequency [MHz]	Measured Result [dBµV]		Limit [dBµV]		Margin [dB]		Pass/Fail
	QP	AVR	QP	AVR	QP	AVR	
0.535394	42.9	29.9	56.00	46.00	-13.10	-16.10	**Pass**
0.18514	36.3	25.7	64.25	54.25	-27.95	-28.55	**Pass**
0.627426	38.4	24.7	56.00	46.00	-17.60	-21.30	**Pass**
4.495906	34.6	24	56.00	46.00	-21.40	-22.00	**Pass**
7.28725	33.3	22.4	60.00	50.00	-26.70	-27.60	**Pass**

"Neutral" Lead

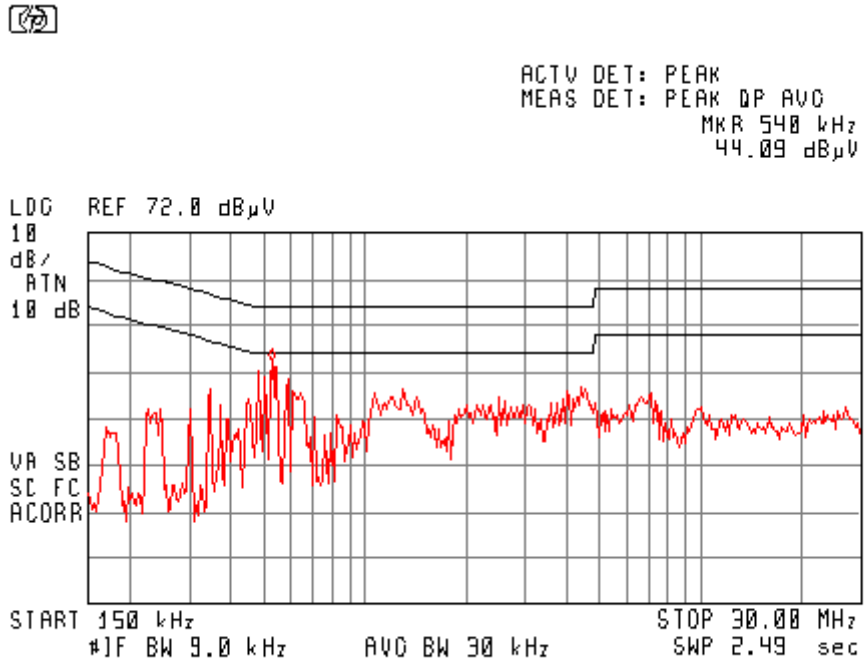
Frequency [MHz]	Measured Result [dBµV]		Limit [dBµV]		Margin [dB]		Pass/Fail
	QP	AVR	QP	AVR	QP	AVR	
0.523548	42	26.7	56.00	46.00	-14.00	-19.30	**Pass**
0.613514	40.4	27.4	56.00	46.00	-15.60	-18.60	**Pass**
1.372389	35.8	25.7	56.00	46.00	-20.20	-20.30	**Pass**
1.073067	35.6	23.6	56.00	46.00	-20.40	-22.40	**Pass**
4.155266	29.9	22.8	56.00	46.00	-26.10	-23.20	**Pass**

Measured at the charger 220VAC port

Plot 4.7.1: Phase Lead



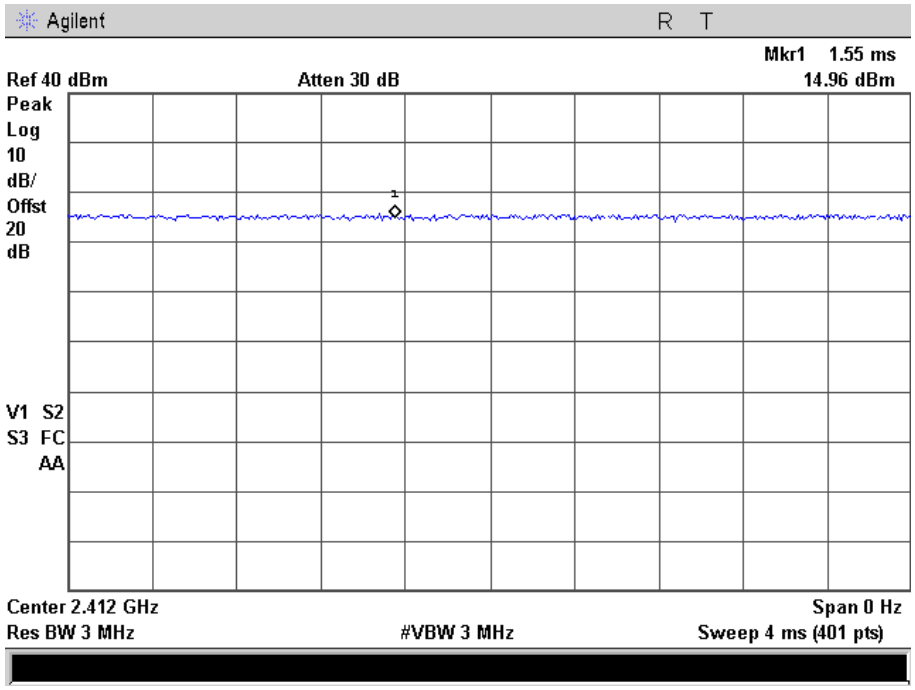
Plot 4.7.2: Neutral Lead

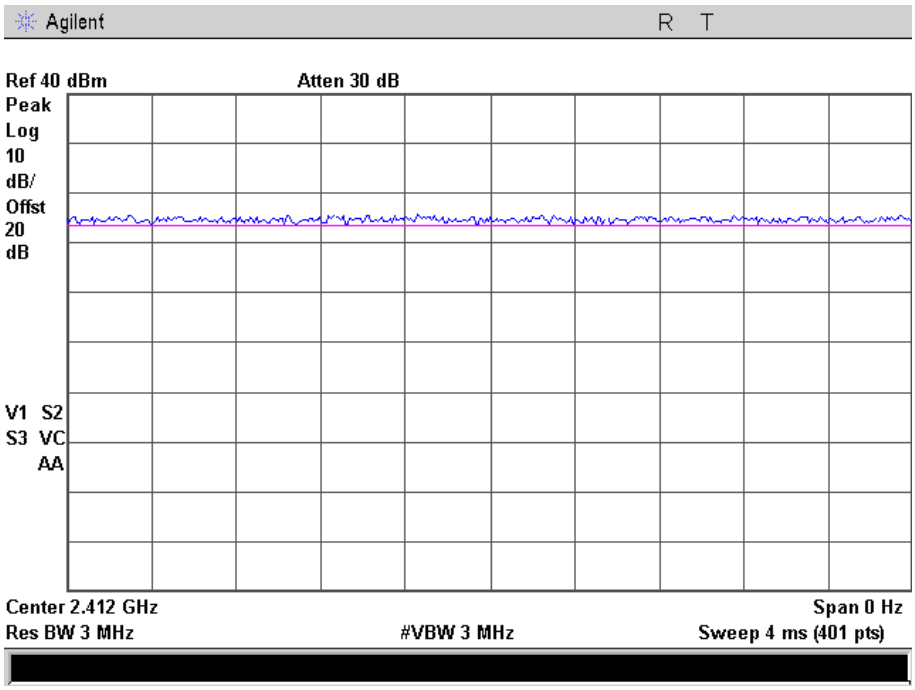


5. Appendix

Appendix A: Duty Cycle

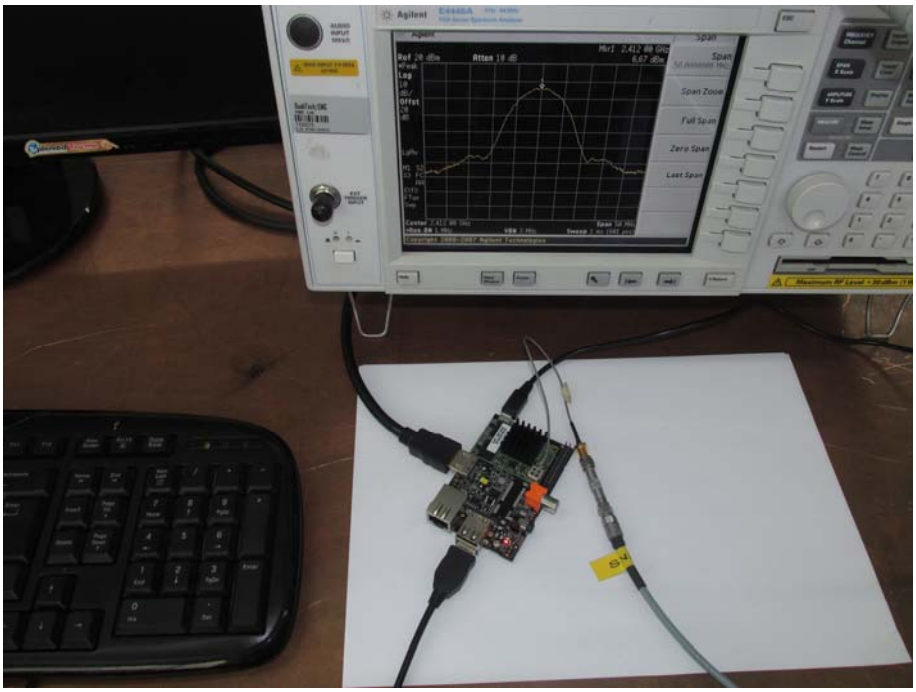
Plot 4.6.18 Duty Cycle 100%, 802.11n Mode



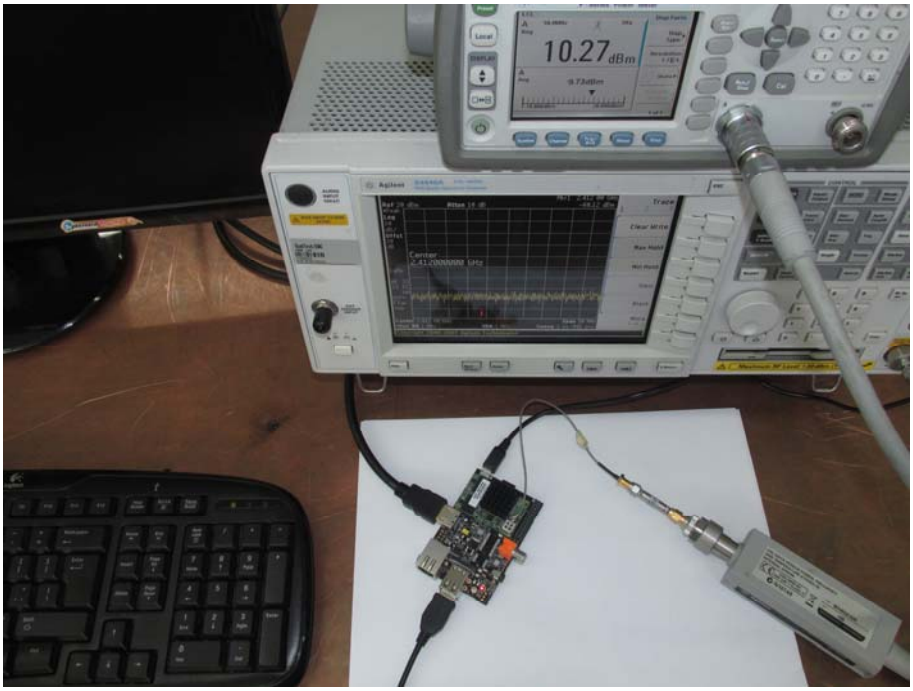


Appendix A: Test Photographs

Photograph 1



Photograph 2



Photograph 3




Appendix A: List of test equipment used

Manufacturer	Model	Description	Serial No.	Cal Due
HP	8546A	EMI Receiver (6.5GHz)	3710A00392	29/12/2015
A.R.A	DRG 118/A	Dual Ridged Guide Ant.1-18 GHz	17188	23/05/2015
Schwarzbeck	VUSLP9111	Log-Periodic 200 – 1000 MHz	9111184	20/05/2015
Agilent	N1911A	Power Meter	MY45100784	25/05/2015
Miteq	AMF-5F-18002650-30-10P	Low-Noise Amplifier 18 - 26.5 GHz	945372	07/07/2015
Agilent	E4446A	Spectrum Analyzer 3Hz-44GHz	MY46180602	13/11/2016
Schwarzbeck	BBHA9170214	Horn Antenna 15-40 GHz	BBHA9170214	03/05/2015
AMP	7D-010180-30-10P-GW	LNA Amplifier 1 GHz to 18 GHz	618653	05/05/2015
K&L	3TNF-800/1000-0.2-N/N	Tunable Bandreject Filter	336	14/01/2016
K&L	5TNF-1700/2000-0.1-N/N	Tunable Bandreject Filter	212	14/01/2016
Micro-Tronics	BRM50702-05	Notch Filter	1	14/01/2016
WAINWRIGHT	WHK1.2/15G-10EF	Highpass Filter, 1.2 ¸ 15 GHz	3	14/01/2016
WAINWRIGHT	WHK2.4/18G-10EF	Highpass Filter, 2.4 ¸ 18 GHz	1	14/01/2016
WAINWRIGHT	WHKX7.0/18G-8SS	Highpass Filter, 7 ¸ 18 GHz	12	14/01/2016
HP	8546A	EMI Receiver (6.5GHz)	3710A00392	29/12/2015
A.R.A	DRG 118/A	Dual Ridged Guide Ant.1-18 GHz	17188	23/05/2015
Schwarzbeck	VUSLP9111	Log-Periodic 200 – 1000 MHz	9111184	20/05/2015
Agilent	N1911A	Power Meter	MY45100784	25/05/2015
Miteq	AMF-5F-18002650-30-10P	Low-Noise Amplifier 18 - 26.5 GHz	945372	07/07/2015
Agilent	E4446A	Spectrum Analyzer 3Hz-44GHz	MY46180602	13/11/2016
Schwarzbeck	BBHA9170214	Horn Antenna 15-40 GHz	BBHA9170214	03/05/2015
AMP	7D-010180-30-10P-GW	LNA Amplifier 1 GHz to 18 GHz	618653	05/05/2015
K&L	3TNF-800/1000-0.2-N/N	Tunable Bandreject Filter	336	14/01/2016
K&L	5TNF-1700/2000-0.1-N/N	Tunable Bandreject Filter	212	14/01/2016
Micro-Tronics	BRM50702-05	Notch Filter	1	14/01/2016
WAINWRIGHT	WHK1.2/15G-10EF	Highpass Filter, 1.2 ¸ 15 GHz	3	14/01/2016
WAINWRIGHT	WHK2.4/18G-10EF	Highpass Filter, 2.4 ¸ 18 GHz	1	14/01/2016
WAINWRIGHT	WHKX7.0/18G-8SS	Highpass Filter, 7 ¸ 18 GHz	12	14/01/2016
HP	8546A	EMI Receiver (6.5GHz)	3710A00392	29/12/2015

Appendix B: Accreditation Certificate

American Association for Laboratory Accreditation

Accredited Laboratory

A2LA has accredited

QUALITECH

Petach-Tikva, Israel

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

Presented this 16th day of October 2014.

President & CEO
For the Accreditation Council
Certificate Number 1633.01
Valid to June 30, 2016

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

End of the Test Report