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HEADQUARTERS: 914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230 • PHONE (410) 354-3300 • FAX (410) 354-3313

November 4, 2019

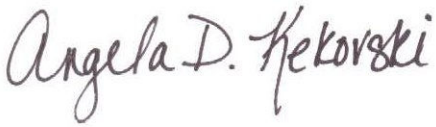
Rajant Corporation
200 Chesterfield Parkway
Malvern, Pennsylvania 19355

Dear Keith Sullivan,

Enclosed is the EMC Wireless test report for compliance testing of the Rajant Corporation, Rajant/Compex WLM200N226 Mini-PCI radio module as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15 Subpart C for Intentional Radiators.

Thank you for using the services of Eurofins MET Labs, Inc. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,
EUROFINS MET LABS, INC.



Angela D. Kekovski
Documentation Department

Reference: (\Rajant Corporation\EMC96859-FCC247 DTS Rev. 2)

Electromagnetic Compatibility Criteria
Test Report

for the

Rajant Corporation
Rajant/Compex WLM200N226 Mini-PCI radio module

Tested under
the FCC Certification Rules
contained in
15.247 Subpart C for Intentional Radiators

MET Report: EMC96859-FCC247 DTS Rev. 2

November 4, 2019

Prepared For:

Rajant Corporation
200 Chesterfield Parkway
Malvern, Pennsylvania 19355

Prepared By:
Eurofins MET Labs, Inc.
914 W. Patapsco Avenue
Baltimore, MD 21230

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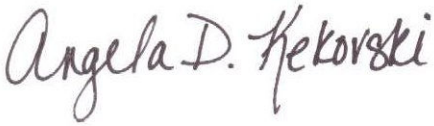
Donald Salguero, Project Engineer
Electromagnetic Compatibility Lab



Angela D. Kekovski
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules Part 15.247 under normal use and maintenance.

Chris Dennison,
Manager, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	August 11, 2019	Initial Issue.
1	September 3, 2019	Customer Requested Changes
2	November 4, 2019	TCB Comments

Table of Contents

List of Tables

List of Plots

List of Figures

List of Photographs

List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**Cal**ibration
d	**M**easurement **D**istance
dB	**D**eci**b**els
dBµA	**D**eci**b**els above one **micro**amp
dBµV	**D**eci**b**els above one **micro**volt
dBµA/m	**D**eci**b**els above one **micro**amp **per m**eter
dBµV/m	**D**eci**b**els above one **micro**volt **per m**eter
DC	**D**irect **C**urrent
E	**E**lectric Field
DSL	**D**igital **S**ubscriber **L**ine
ESD	**E**lectro**s**tatic **D**ischarge
EUT	**E**quipment **U**nder **T**est
f	**F**requency
FCC	**F**ederal **C**ommunications **C**ommission
GRP	**G**round **R**eference **P**lane
H	Magnetic Field
HCP	**H**orizontal **C**oupling **P**lane
Hz	**H**ertz
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**h**ertz
kPa	**k**ilo**pa**scal
kV	**k**ilovolt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
µH	**micro**henry
µ	**micro**farad
µs	**micro**seconds
NEBS	**N**etwork **E**quipment-**B**uilding **S**ystem
PRF	**P**ulse **R**epetition **F**requency
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
TWT	**T**raveling **W**ave **T**ube
V/m	**V**olts **per m**eter
VCP	**V**ertical **C**oupling **P**lane

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Rajant Corporation Rajant/Compex WLM200N226 Mini-PCI radio module, with the requirements of Part 15, §15.247. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the Rajant/Compex WLM200N226 Mini-PCI radio module. Rajant Corporation should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Rajant/Compex WLM200N226 Mini-PCI radio module, has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.247, in accordance with Rajant Corporation, purchase order number 2017382. All tests were conducted using measurement procedure ANSI C63.10-2013.

FCC Reference 47 CFR Part 15.247:2005	Description	Compliance
Title 47 of the CFR, Part 15 §15.203	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15 §15.207(a)	Conducted Emission Limits	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(2)	6dB Occupied Bandwidth	Compliant
Title 47 of the CFR, Part 15 §15.247(b)	Conducted Power Output	Compliant
Title 47 of the CFR, Part 15 §15.247(c)	Spurious Emissions in Non-restricted Bands	Compliant
Title 47 of the CFR, Part 15 §15.247(d); §15.209; §15.205	Radiated Spurious Emissions Requirements	Compliant
Title 47 of the CFR, Part 15; §15.247(e)	Peak Power Spectral Density	Compliant
Title 47 of the CFR, Part 15 §15.247(i)	Maximum Permissible Exposure (MPE)	Compliant

Table 1. Executive Summary of EMC Part 15.247 ComplianceTesting

II. Equipment Configuration

A. Overview

Eurofins MET Labs, Inc. was contracted by Rajant Corporation to perform testing on the Rajant/Compex WLM200N226 Mini-PCI radio module, under Rajant Corporation's purchase order number 2017382.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Rajant Corporation, Rajant/Compex WLM200N226 Mini-PCI radio module.

The results obtained relate only to the item(s) tested.

Model(s) Tested:	Rajant/Compex WLM200N226 Mini-PCI radio module	
Model(s) Covered:	Rajant/Compex WLM200N226 Mini-PCI radio module	
EUT Specifications:	Primary Power: 110 VAC, 60 Hz	
	FCC ID: VJA-WLM200N226	
	Type of Modulations:	OFDM, DSSS
	Equipment Code:	DTS
	RF Output Power:	26.58 dBm
	EUT Frequency Ranges:	2.412 – 2.462 GHz; 2.422 – 2.452 GHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35º C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Donald Salguero	
Report Date(s):	August 11, 2019	

Table 2. EUT Summary Table

B. References

CFR 47, Part 15, Subpart C	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
ANSI C63.4:2014	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ISO/IEC 17025:2017	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
KDB 558074 v05r02	Guidance For Performing Compliance Measurements On Digital Transmission Systems (DTS) Operating Under Section 15.247

Table 3. References

C. Test Site

All testing was performed at Eurofins MET Labs, Inc., 914 W. Patapsco Avenue, Baltimore, MD 21230. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a 3 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

D. Measurement Uncertainty

Test Method	Typical Expanded Uncertainty	K	Confidence Level
RF Frequencies	±4.52 Hz	2	95%
RF Power Conducted Emissions	±2.32 dB	2	95%
RF Power Conducted Spurious Emissions	±2.25 dB	2	95%
RF Power Radiated Emissions	±3.01 dB	2	95%

Table 4. Uncertainty Calculations Summary

E. Description of Test Sample

The Rajant Corporation Rajant/Compex WLM200N226 Mini-PCI radio module, Equipment Under Test (EUT), is a high powered DTS radio module operating on 2.4 GHz band . The radio features integrated Lightning & ESD* protection. The radio module is designed for reliable fixed, and portable wireless data networking applications.

F. Equipment Configuration

The EUT was set up as outlined in **Error! Reference source not found.**Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

Ref. ID	Name / Description	Model Number	Part Number	Serial Number	Revision
2	AC/DC POE	Tycon Power	TP-POE-HP-48G-RC	1	
3	Rajant Multi IO Cable	Rajant	06-100055-603	1	
4	Modular Host	Rajant	ME4-2450R	1	Modified with PCI Extender and non-anodized case
4	Mini PCI Extender	Adex		1	
5	mini PCI Radio Card (EUT)	Compex Systems / Rajant	WLM200N226	1	
6	Antenna Fixture	Rajant	Development	1	
7	Antenna 2400 MHz 5dBi Omni	Rajant	KMA-2400-5-NM	2	

Table 5. Equipment Configuration

G. Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

Ref. ID	Name / Description	Model Number	Part Number	Serial Number	Revision
1	Test PC	Lenovo	T530	1	
2	AC/DC POE	Tycon Power	TP-POE-HP-48G-RC	1	
3	Rajant Multi IO Cable	Rajant	06-100055-603	1	
4	Modular Host	Rajant	ME4-2450R	1	Modified with PCI Extender and non-anodized case
4	Mini PCI Extender	Adex		1	
5	mini PCI Radio Card (EUT)	Compex Systems / Rajant	WLM200N226	1	
6	Antenna Fixture	Rajant	Development	1	
7	Antenna 2400 MHz 5dBi Omni	Rajant	KMA-2400-5-NM	2	

Table 6. Support Equipment

H. Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty	Length as tested (m)	Max Length (m)	Shielded? (Y/N)	Termination Box ID & Port Name
A	Laptop Ethernet	Connects Laptop Ethernet to AC/DC POE Input	1	1m		Y	Item 1A to Item 2C
B	Laptop PWR In	PC Power Adapter to PC	1	3m		N	B
C	POE Data Input	Connects Laptop Ethernet to AC/DC POE Data input	1	1m		Y	Item 1A to Item 2C
D	POE Data/Pwr Out	Data I/O, PWR Out of POE, connects to ETH0 of modular host.	1	1m, 30m		Y	Item 2D to Item 3E
J	POE AC PWR input	AC Power input Item 2	1	3m		N	
E	Modular Host Eth0	Data I/O, PWR input modular host, Port ETH0	1	1m, 30m		Y	Item 3E to Item 2D
F	Modular Host Multi IO	Multi IO connector	1	1m		Y	Item 3 to Item 4
J	Radio Chain 0	Radio Chain 0 to antenna	1	.3m		Y	Item 5H to Item 6H
K	Radio Chain 1	Radio Chain 1 to antenna	1	.3m		Y	Item 5I to Item 6I
H	Chain 0 antenna	Antenna					Item 6H to Item7
I	Chain 1 antenna	Antenna					Item 6 I to Item 7

Table 7. Ports and Cabling Information

I. Mode of Operation

The EUT will be controlled and monitored from a laptop PC using Rajant BCCommander network management software. The EUT will operate in the worst case condition as required to determine compliance.

J. Method of Monitoring EUT Operation

Operation of the test article will be verified by two methods. The EUT will be observed from BCCommander network management software running on a laptop computer configured for a wired bridge Ethernet connection to the EUT. The status indicator on the ME4-2450R host will be monitored to verify normal operation.

K. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

L. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Rajant Corporation upon completion of testing.

III. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

Test Requirement: **§ 15.203:** An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

The structure and application of the EUT were analyzed to determine compliance with Section 15.203 of the Rules. Section 15.203 states that the subject device must meet at least one of the following criteria:

a.) Antenna must be permanently attached to the unit.

b.) Antenna must use a unique type of connector to attach to the EUT.

c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

Results: The EUT as tested is compliant the criteria of §15.203. The EUT is professionally installed.

Test Engineer(s): Donald Salguero

Test Date(s): July 1, 2019

Name / Description	Manufacturer	Model Number
Antenna 2400 MHz 5dBi Omni	Rajant	KMA-2400-5-NM

Table 8. Antenna List

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207(a) Conducted Emissions Limits

Test Requirement(s): **§ 15.207 (a):** 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 30MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 Ω 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 range (MHz)	§ 15.207(a), Conducted Limit (dBμV)	
	Quasi-Peak	Average
* 0.15- 0.5	66 - 56	56 - 46
0.5 - 5	56	46
5 - 30	60	50

Table 9. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was placed on a 0.8 m-high wooden table inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 μH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.10-2013*

Test Results: The EUT was compliant with this requirement.

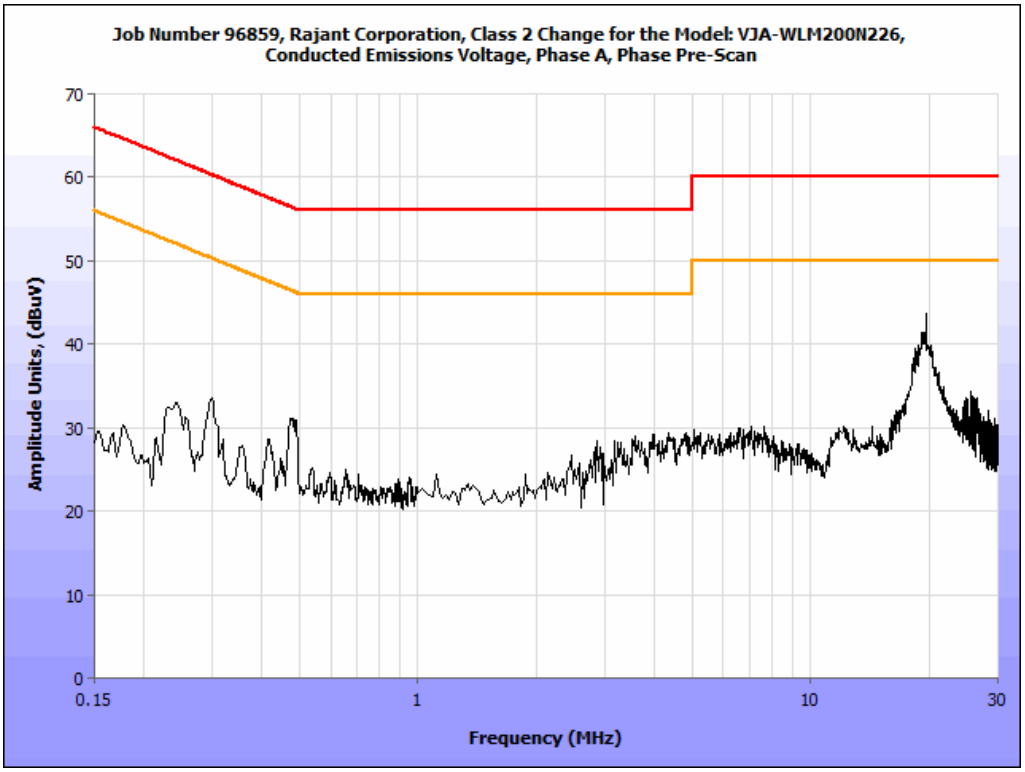
Test Engineer(s): Donald Salguero

Test Date(s): July 1, 2019

15.207(a) Conducted Emissions Test Results

Frequency (MHz)	Uncorrected Meter Reading (dBµV) QP	Cable Loss (dB)	Corrected Measurement (dBµV) QP	Limit (dBµV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBµV) Avg.	Cable Loss (dB)	Corrected Measurement (dBµV) AVG	Limit (dBµV) AVG	Margin (dB) AVG
19.71	27.14	0.07	37.21	60	-22.79	21.42	0.07	31.49	50	-18.51
25.21	17.31	0.11	27.42	60	-32.58	11.7	0.11	21.81	50	-28.19
19.16	25.67	0.06	35.73	60	-24.27	18.56	0.06	28.62	50	-21.38
12.1	16.77	0	26.77	60	-33.23	7.127	0	17.127	50	-32.873
7.655	12.74	0	22.74	60	-37.26	4.575	0	14.575	50	-35.425
0.2968	21.21	0	31.21	60.33	-29.12	17.42	0	27.42	50.33	-22.91

Table 10. Conducted Emissions, 15.207(a), Phase Line, Test Results

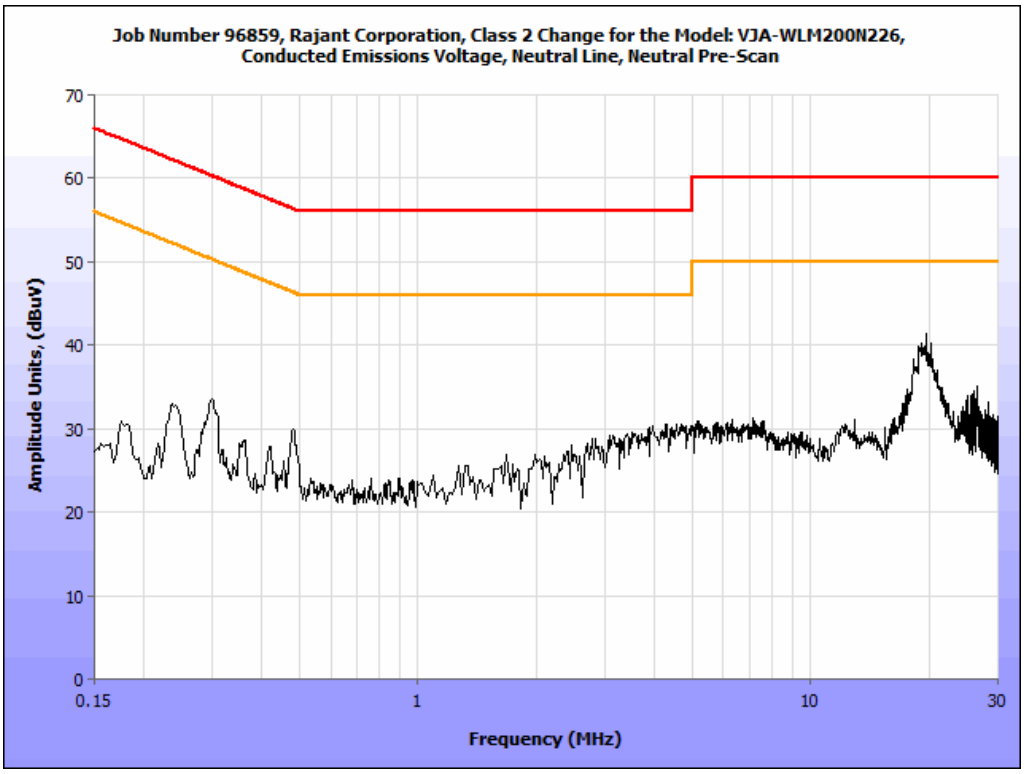


Plot 1. Conducted Emissions, 15.207(a), Phase Line

15.207(a) Conducted Emissions Test Results

Frequency (MHz)	Uncorrected Meter Reading (dBµV) QP	Cable Loss (dB)	Corrected Measurement (dBµV) QP	Limit (dBµV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBµV) Avg.	Cable Loss (dB)	Corrected Measurement (dBµV) AVG	Limit (dBµV) AVG	Margin (dB) AVG
19.7	24.85	0.07	34.92	60	-25.08	17.1	0.07	27.17	50	-22.83
26.61	22.57	0.11	32.68	60	-27.32	17.23	0.11	27.34	50	-22.66
18.98	24.65	0.06	34.71	60	-25.29	16.9	0.06	26.96	50	-23.04
12.31	16.06	0	26.06	60	-33.94	7.615	0	17.615	50	-32.385
4.747	16.58	0	26.58	56	-29.42	8.645	0	18.645	46	-27.355
0.2985	21.59	0	31.59	60.28	-28.69	17.96	0	27.96	50.28	-22.32

Table 11. Conducted Emissions, 15.207(a), Neutral Line, Test Results



Plot 2. Conducted Emissions, 15.207(a), Neutral Line

15.207(a) Conducted Emissions Test Setup Photo

Photograph 1. Conducted Emissions, 15.207(a), Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a)(2) 6 dB Bandwidth

Test Requirements: **§ 15.247(a)(2):** Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

For systems using digital modulation techniques, the EUT may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

Test Procedure: The transmitter was on and transmitting at the highest output power. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW = 100kHz, VBW = 3*RBW. The 6 dB Bandwidth was measured and recorded. The measurements were performed on the low, mid and high channels.

Test Results The EUT was compliant with § 15.247 (a)(2).

The 6 dB Bandwidth was determined from the plots on the following pages.

Test Engineer(s): Donald Salguero

Test Date(s): June 7, 2019

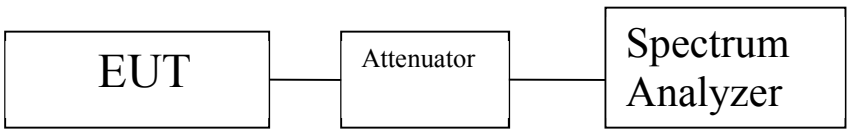


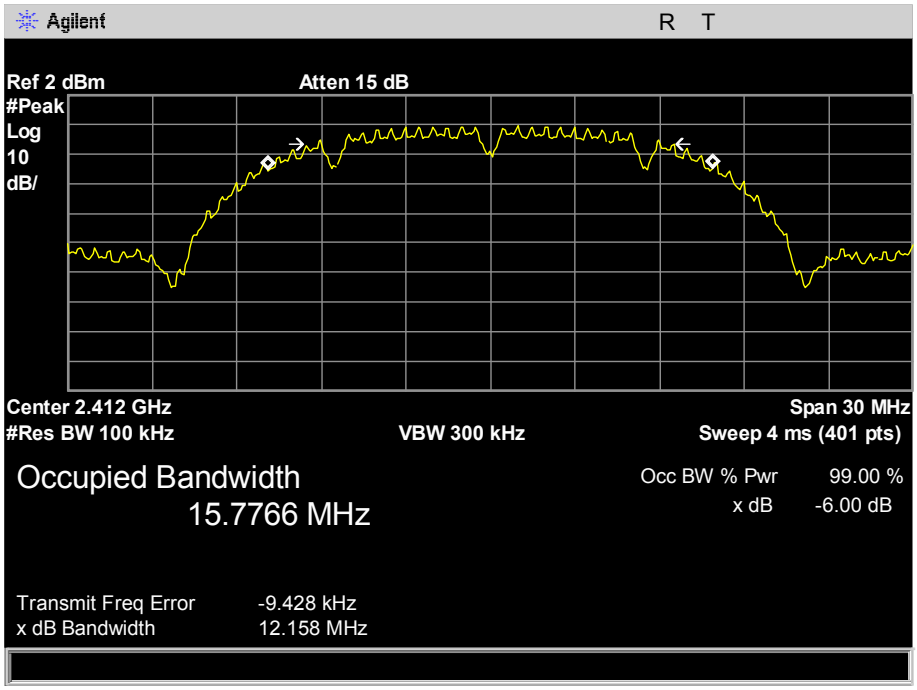
Figure 1. Block Diagram, Occupied Bandwidth Test Setup

Occupied Bandwidth Test Results

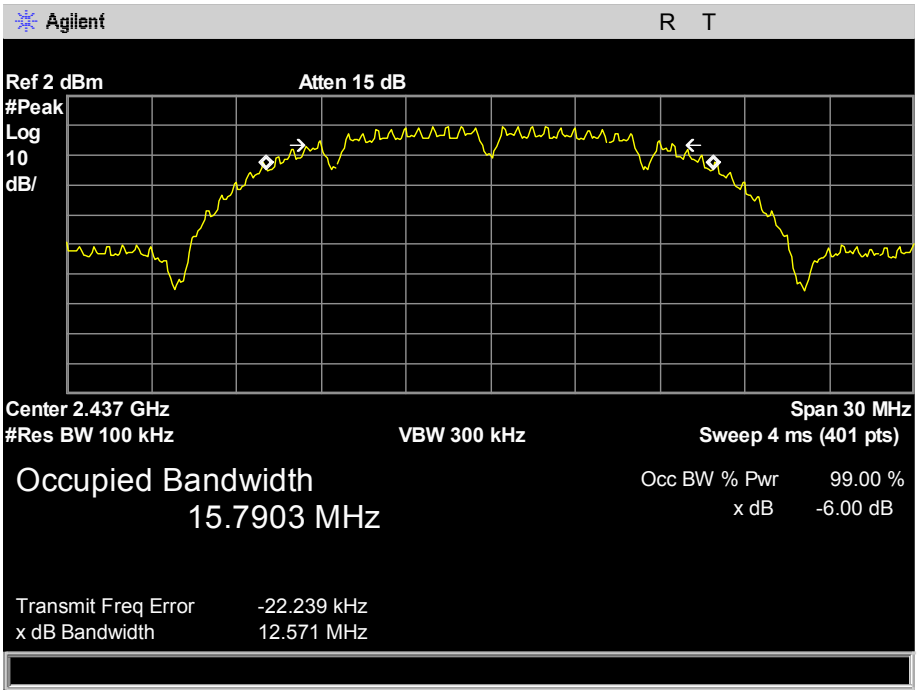
Mode	Nominal Bandwidth (MHz)	Center Frequency (MHz)	6dB Bandwidth (MHz)
802.11b	20	2412	12.158
		2437	12.571
		2462	12.566
802.11g	20	2412	16.602
		2437	16.585
		2462	16.605
802.11n	20	2412	17.835
		2437	17.837
		2462	17.84
	40	2422	36.551
		2437	36.518
		2452	36.554

Table 12. 6 dB Occupied Bandwidth, Test Results

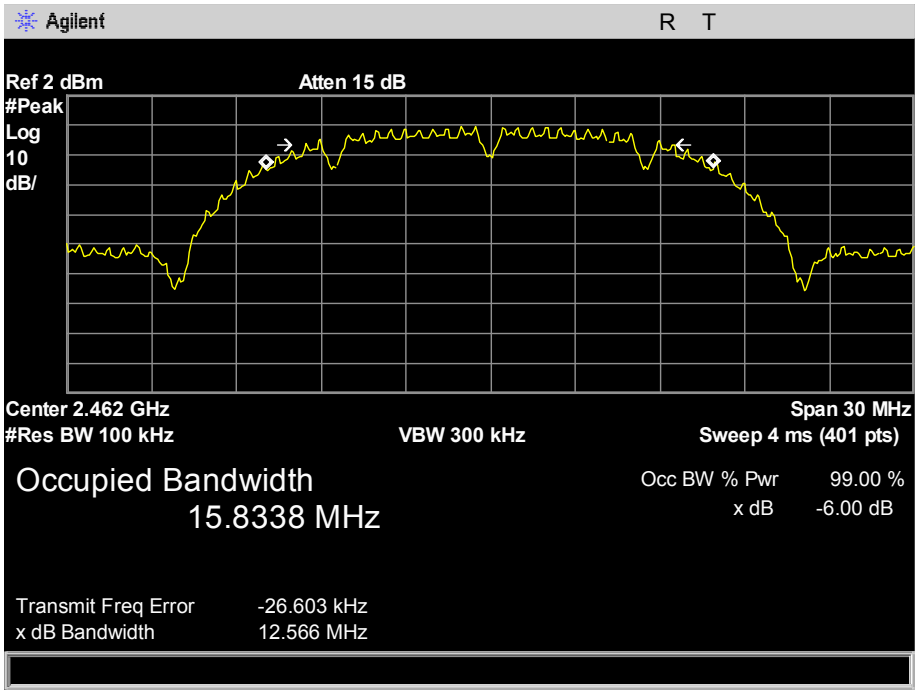
6 dB Occupied Bandwidth Test Results



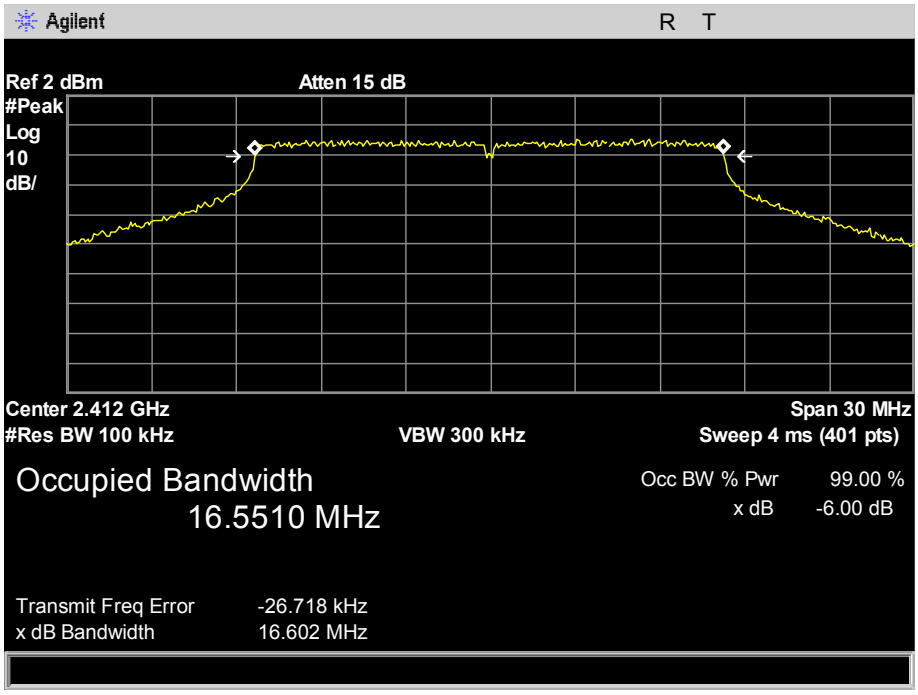
Plot 3. 6 dB Occupied Bandwidth, 802.11b, Low Channel, 20 MHz – 2412 MHz



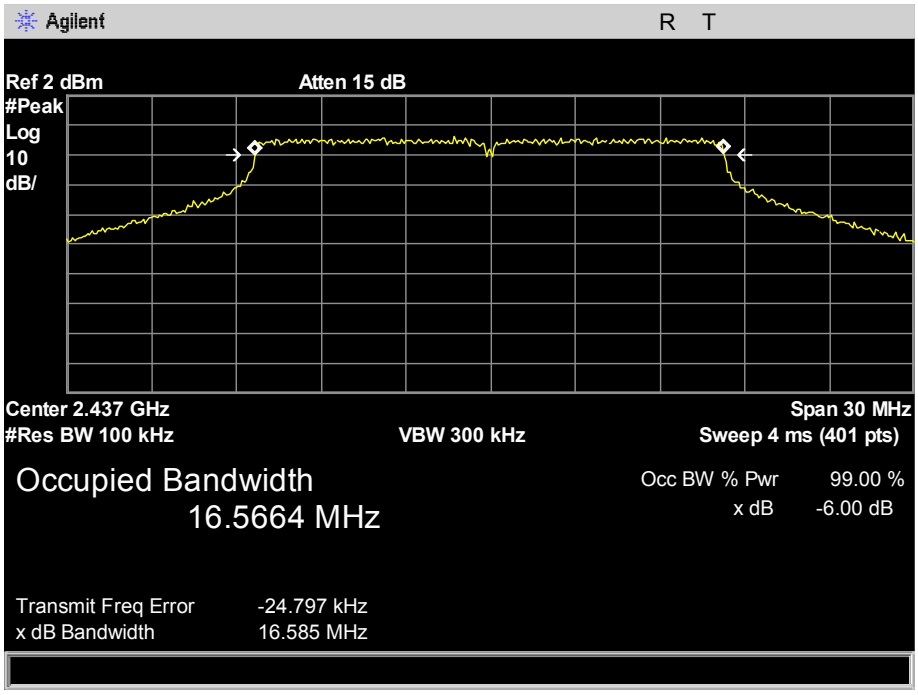
Plot 4. 6 dB Occupied Bandwidth, 802.11b, Mid Channel, 20 MHz – 2437 MHz



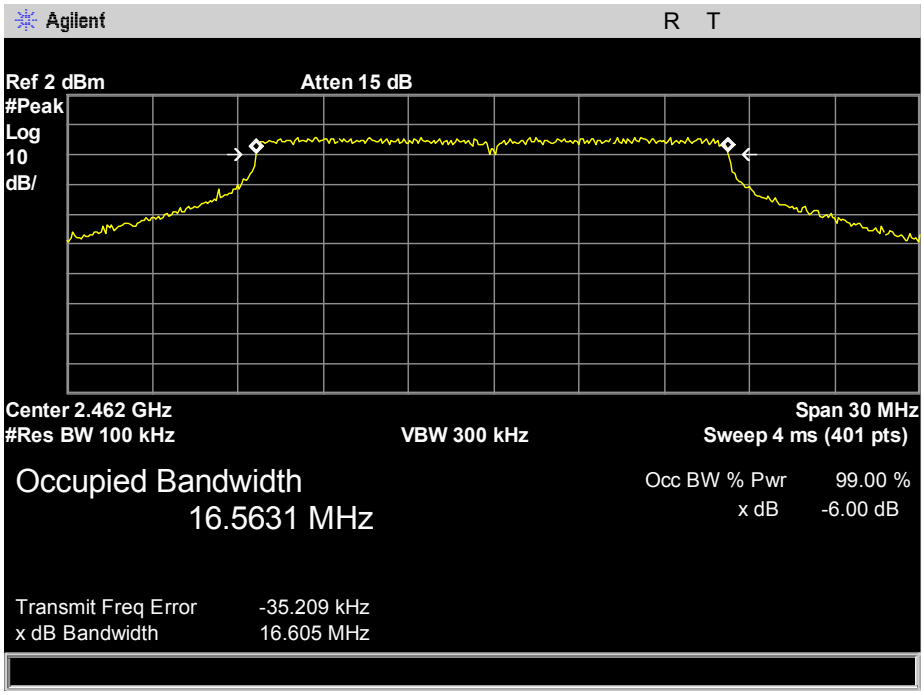
Plot 5. 6 dB Occupied Bandwidth, 802.11b, High Channel, 20 MHz – 2462 MHz



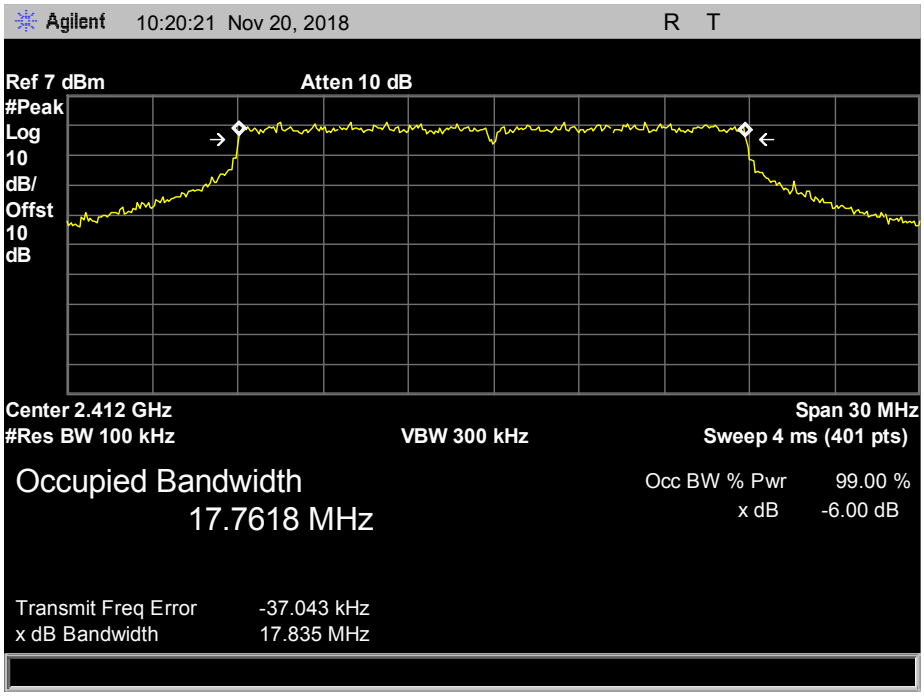
Plot 6. 6 dB Occupied Bandwidth, 802.11g, Low Channel, 20 MHz – 2412 MHz



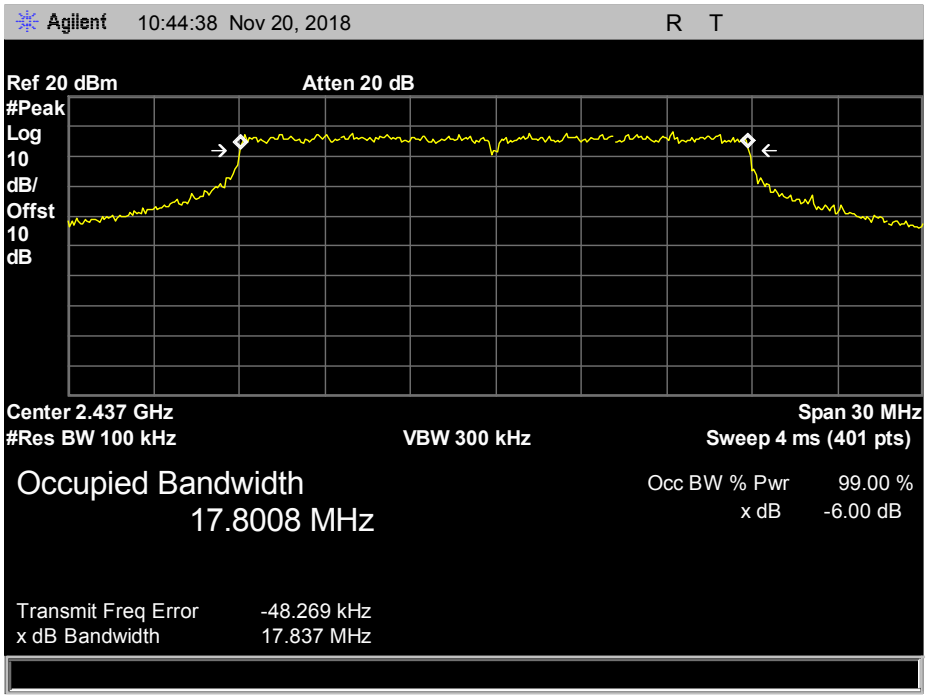
Plot 7. 6 dB Occupied Bandwidth, 802.11g, Mid Channel, 20 MHz – 2437 MHz



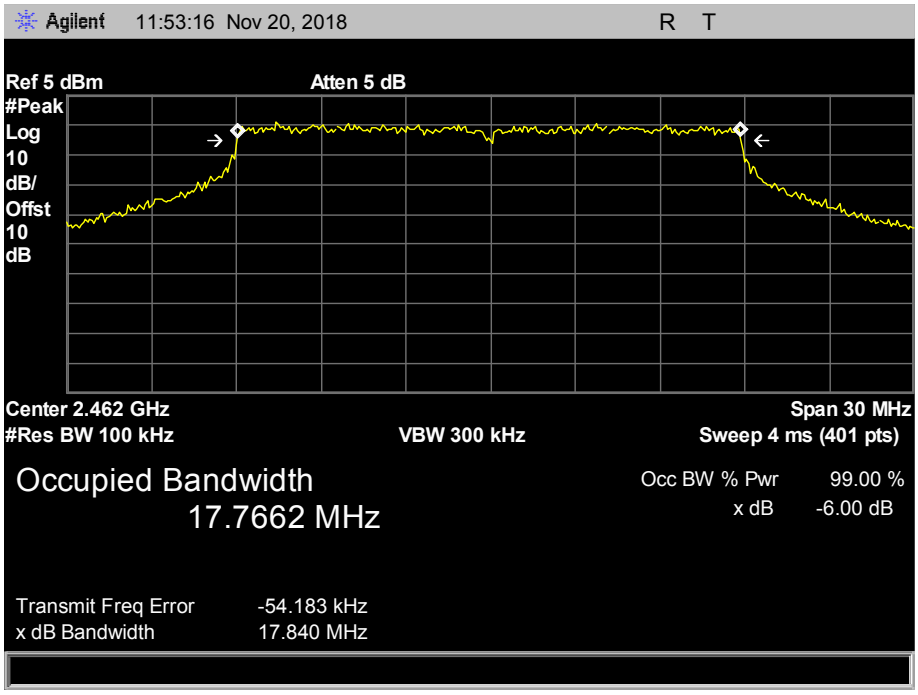
Plot 8. 6 dB Occupied Bandwidth, 802.11g, High Channel, 20 MHz – 2462 MHz



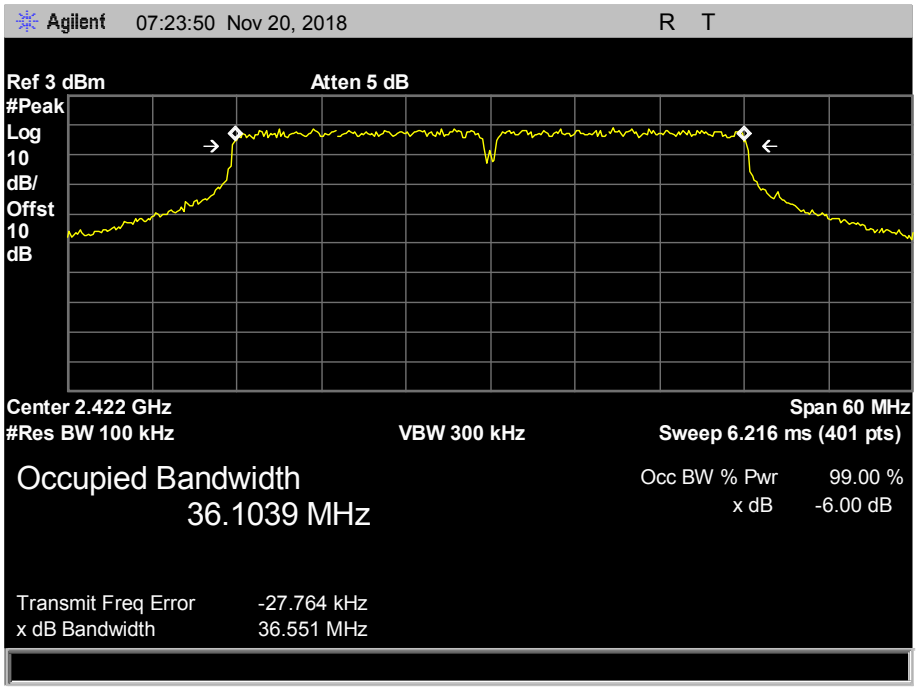
Plot 9. 6 dB Occupied Bandwidth, 802.11n, Low Channel, 20 MHz – 2412 MHz



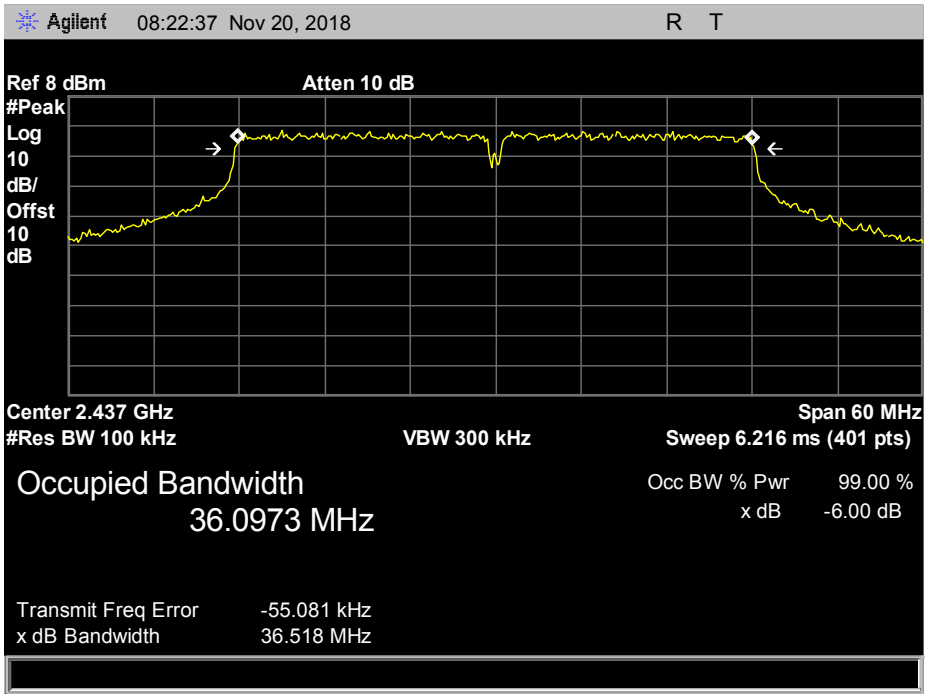
Plot 10. 6 dB Occupied Bandwidth, 802.11n, Mid Channel, 20 MHz – 2437 MHz



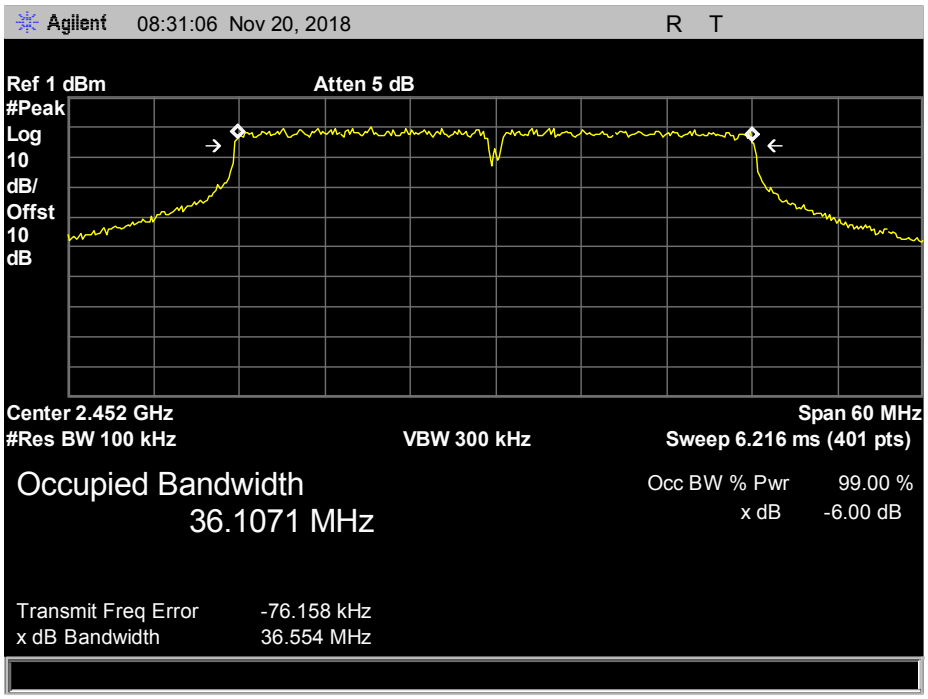
Plot 11. 6 dB Occupied Bandwidth, 802.11n, High Channel, 20 MHz – 2462 MHz



Plot 12. 6 dB Occupied Bandwidth, 802.11n, Low Channel, 40 MHz – 2422 MHz



Plot 13. 6 dB Occupied Bandwidth, 802.11n, Mid Channel, 40 MHz – 2437 MHz



Plot 14. 6 dB Occupied Bandwidth, 802.11n, High Channel, 40 MHz – 2452 MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

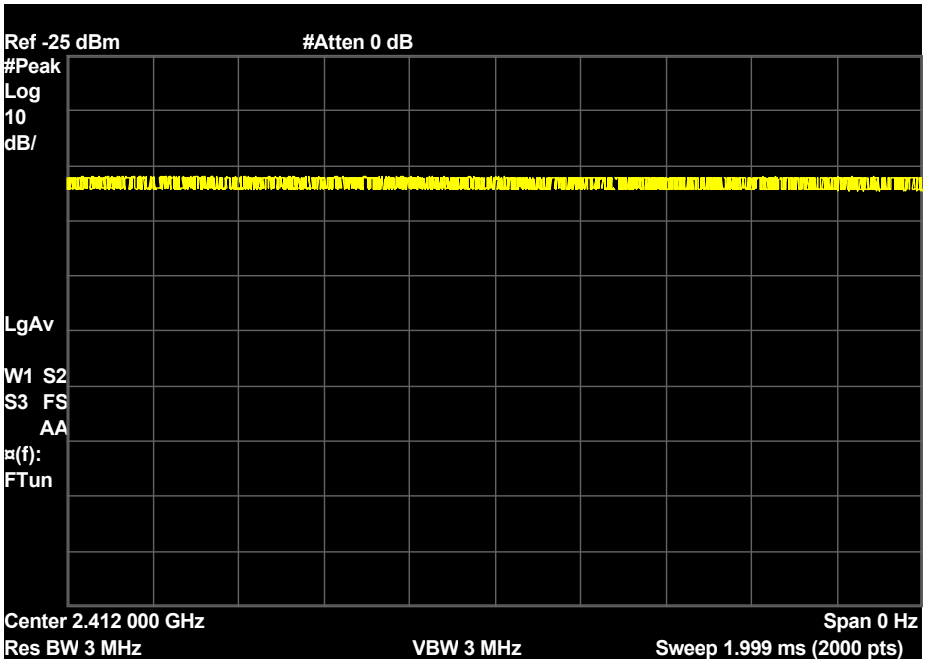
Duty Cycle

Test Procedure: The EUT was connected to a spectrum analyzer and was ran at maximum achievable duty cycle for all modes. The duty cycle was measured in accordance with section 11.6 of ANSI C63.10-2013.

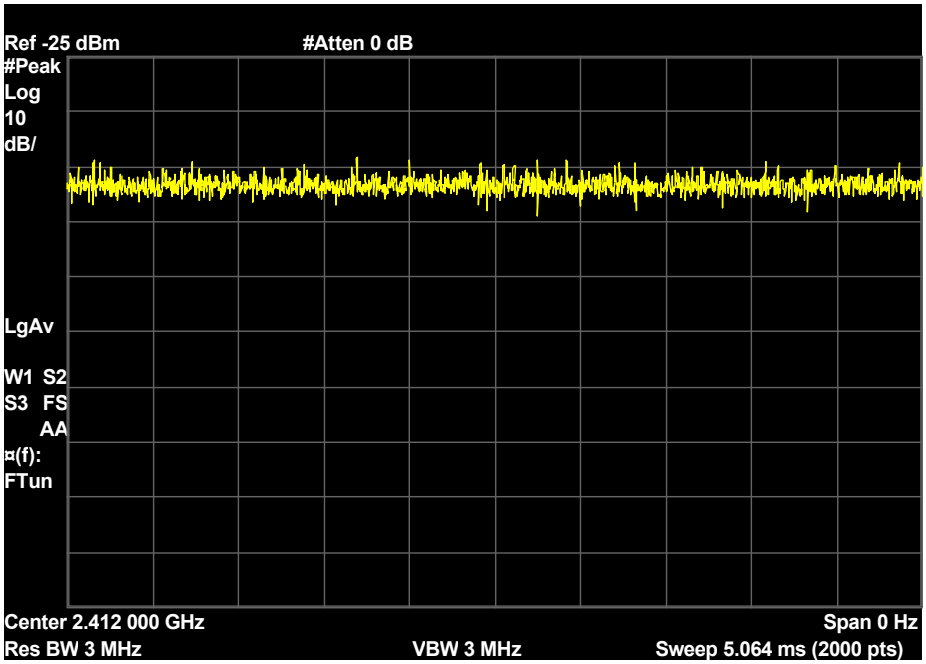
Test Engineer(s): Donald Salguero

Test Date(s): June 11, 2019

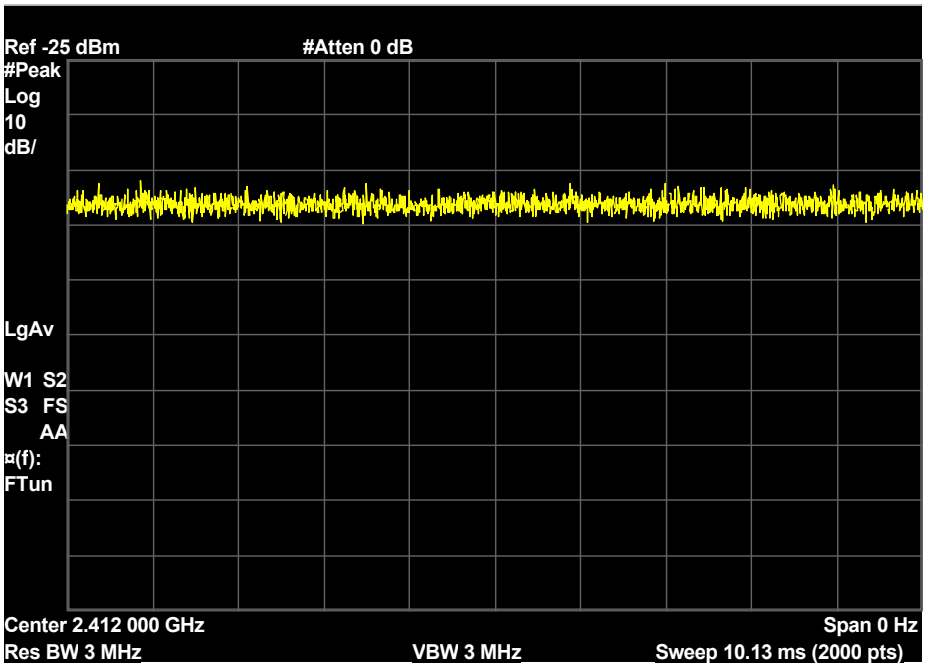
Mode	Duty Cycle (%)	DCCF (dB)	1/T Minimum VBW (Hz)
802.11b	100.00	NA	10
802.11g	100.00	NA	10
802.11n (20MHz)	100.00	NA	10
802.11n (40MHz)	100.00	NA	10



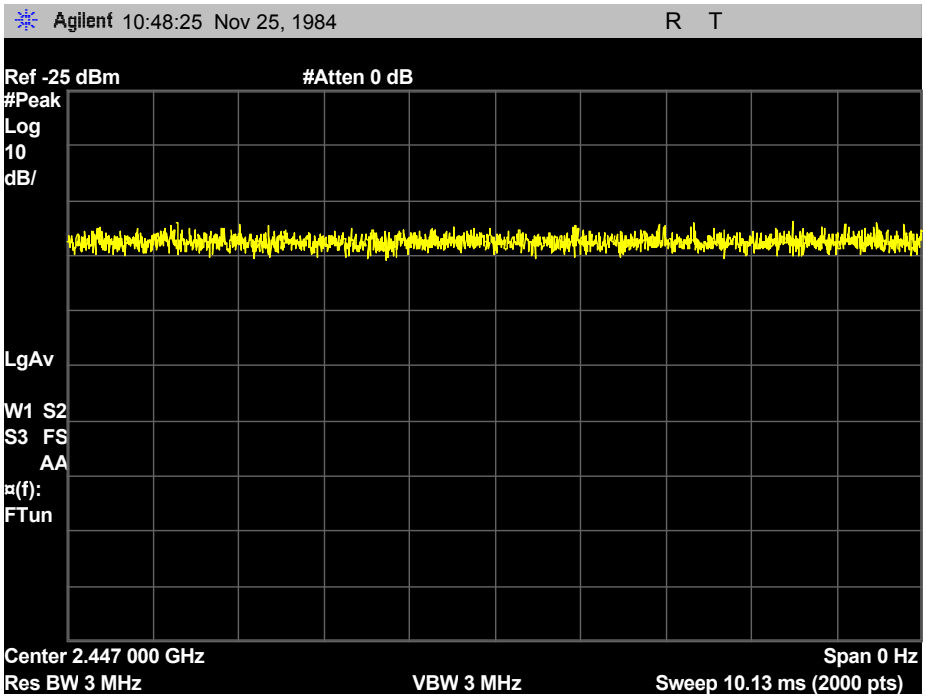
Plot 15. Duty Cycle, 801.11b



Plot 16. Duty Cycle, 801.11g



Plot 17. Duty Cycle, 801.11n (20 MHz)



Plot 18. Duty Cycle, 801.11n (40 MHz)

§ 15.247(b) Conducted Power Output

Test Requirements: **§15.247(b)(3):** The maximum output power of the intentional radiator shall not exceed the following:

Digital Transmission Systems (MHz)	Output Limit (Watts)
2400–2483.5	1.000

Table 13. Output Power Requirements from §15.247(b)

§15.247(b)(4): The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Test Procedure: The EUT was measured at the low, mid and high channels of each band at the maximum power level. Measurements were performed on a conducted setup. EUT was connected directly to a spectrum analyzer thru an attenuator. Measurements were performed using procedure AVGSA-1 from ANSI C63.10 section 11.9.2.2

Test Results: The EUT was compliant with the Peak Power Output limits of **§15.247(b)**.

Test Engineer(s): Donald Salguero

Test Date(s): June 18, 2019

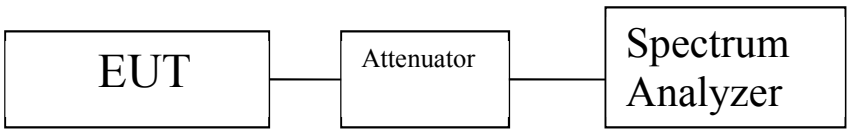


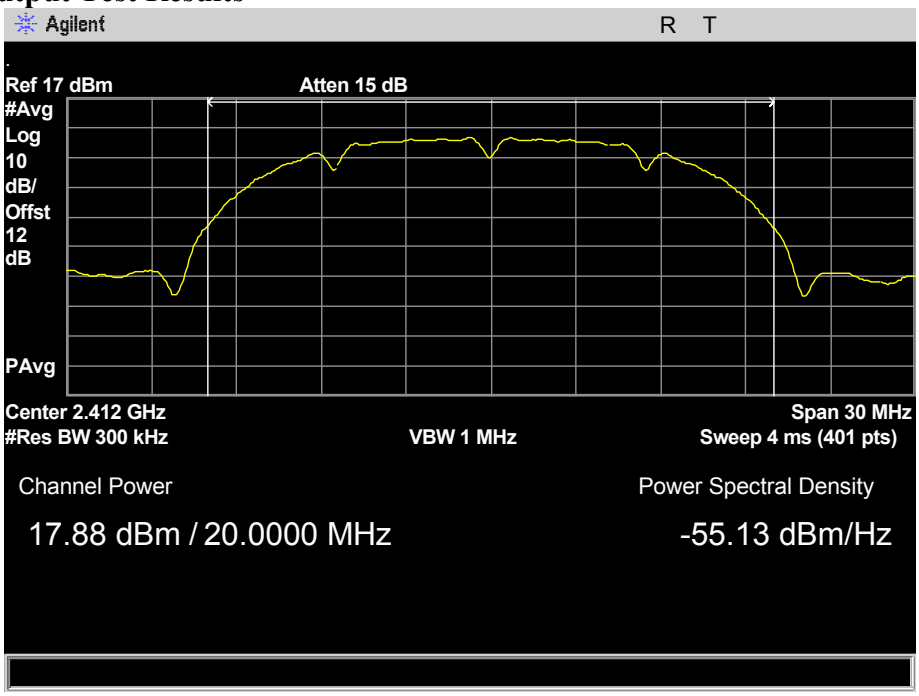
Figure 2. Block Diagram, Output Power Test Setup

Conducted Power Output Test Results

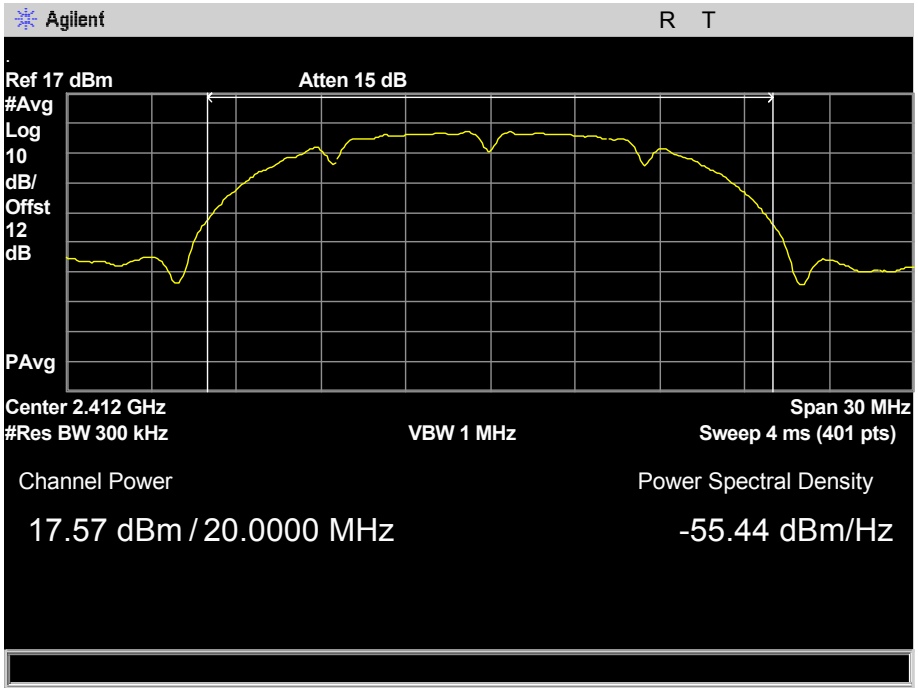
Mode	Nominal Bandwidth (MHz)	Center Frequency (MHz)	Chain 0 (dBm)	Chain 1 (dBm)	Sum (dBm)	Antenna Gain (dBi)	Limit (dBm)	Margin (dB)
802.11b	20	2412	17.88	17.57	20.74	5	30	-9.26
		2437	23.98	23.12	26.58	5	30	-3.42
		2462	18.02	17.04	20.57	5	30	-9.43
802.11g	20	2412	14.4	14.83	17.63	5	30	-12.37
		2437	23.54	22.73	26.16	5	30	-3.84
		2462	14.37	12.82	16.67	5	30	-13.33
802.11n	20	2412	13.69	13.7	16.71	5	30	-13.29
		2437	22.02	23.23	25.68	5	30	-4.32
		2462	13.13	12.46	15.82	5	30	-14.18
	40	2422	10.25	10.77	13.53	5	30	-16.47
		2437	13.57	14.31	16.97	5	30	-13.03
		2452	11.73	10.18	14.03	5	30	-15.97

Table 14. Peak Power Output, Test Results

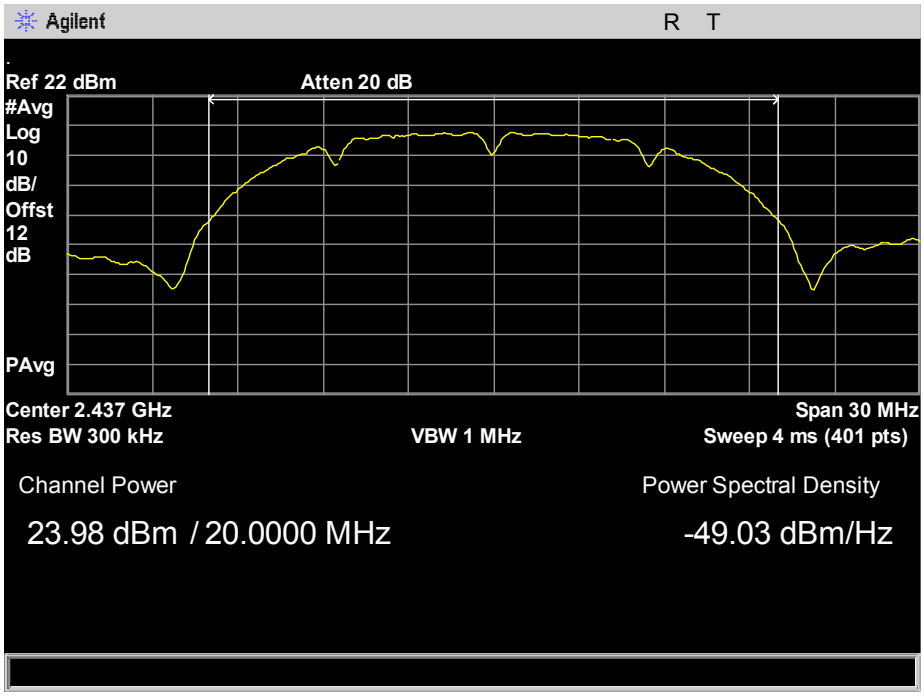
Peak Power Output Test Results



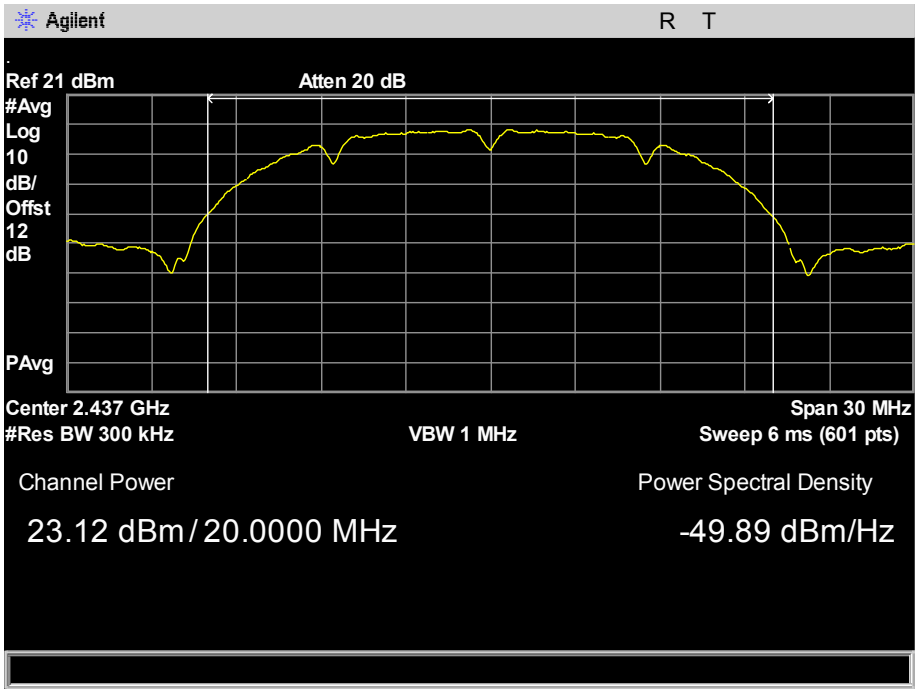
Plot 19. Peak Power Output, 801.11b, Low Channel, 20 MHz to 2412 MHz, Channel 0



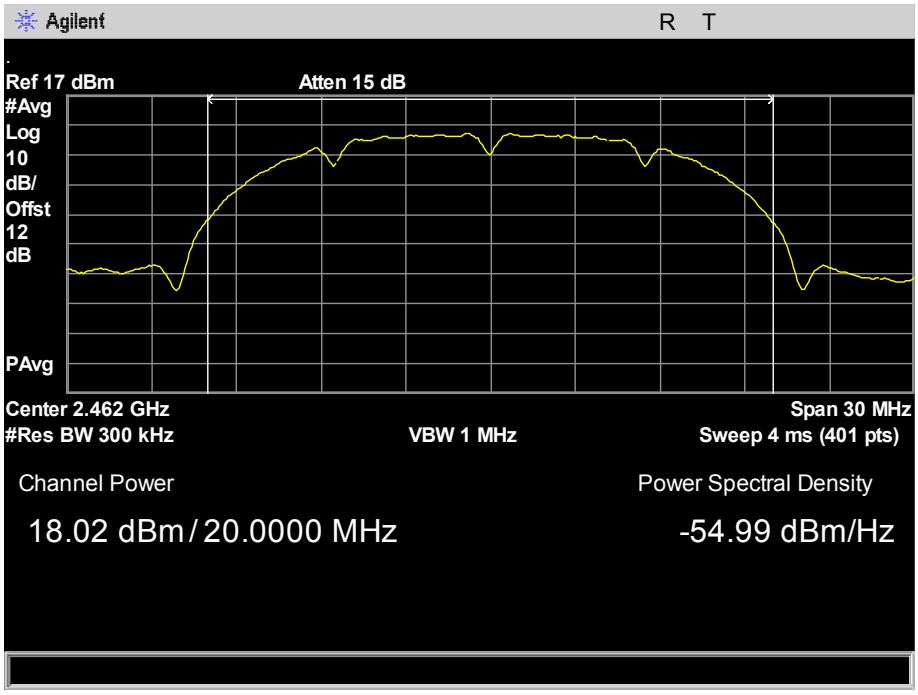
Plot 20. Peak Power Output, 801.11b, Low Channel, 20 MHz to 2412 MHz, Channel 1



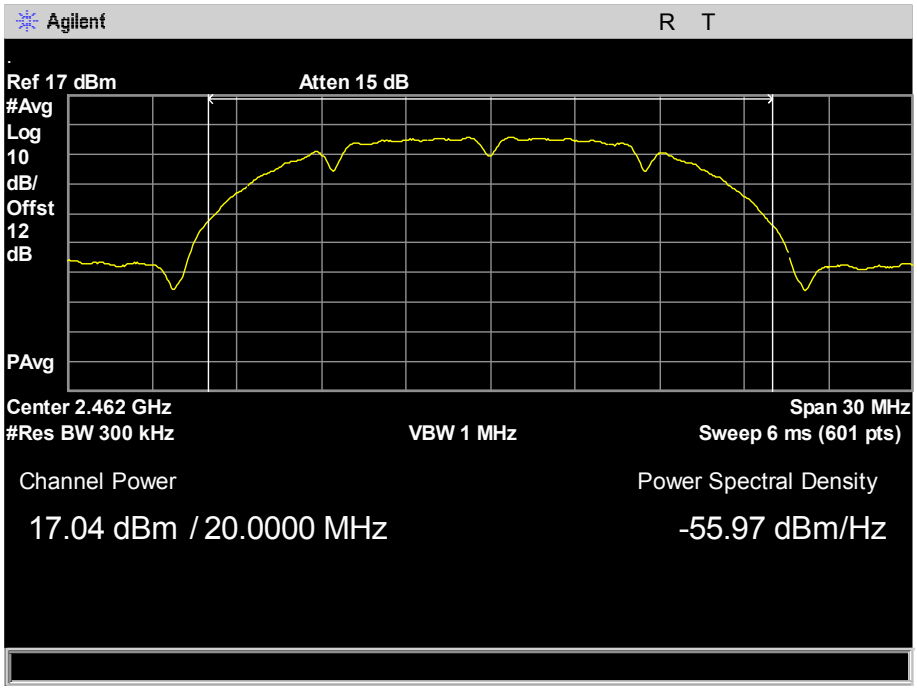
Plot 21. Peak Power Output, 801.11b, Mid Channel, 20 MHz to 2437 MHz, Channel 0



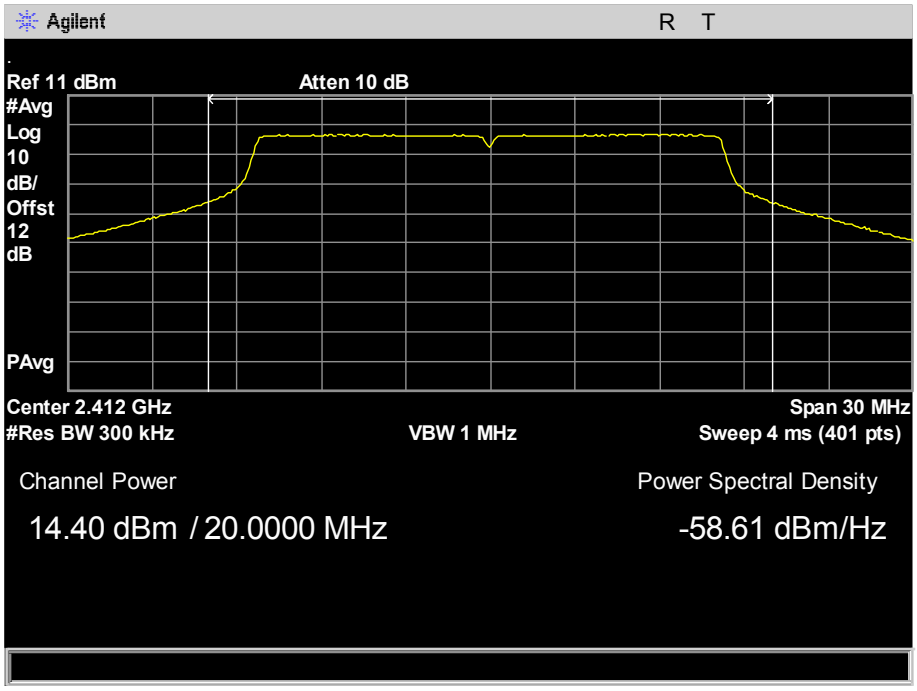
Plot 22. Peak Power Output, 801.11b, Mid Channel, 20 MHz to 2437 MHz, Channel 1



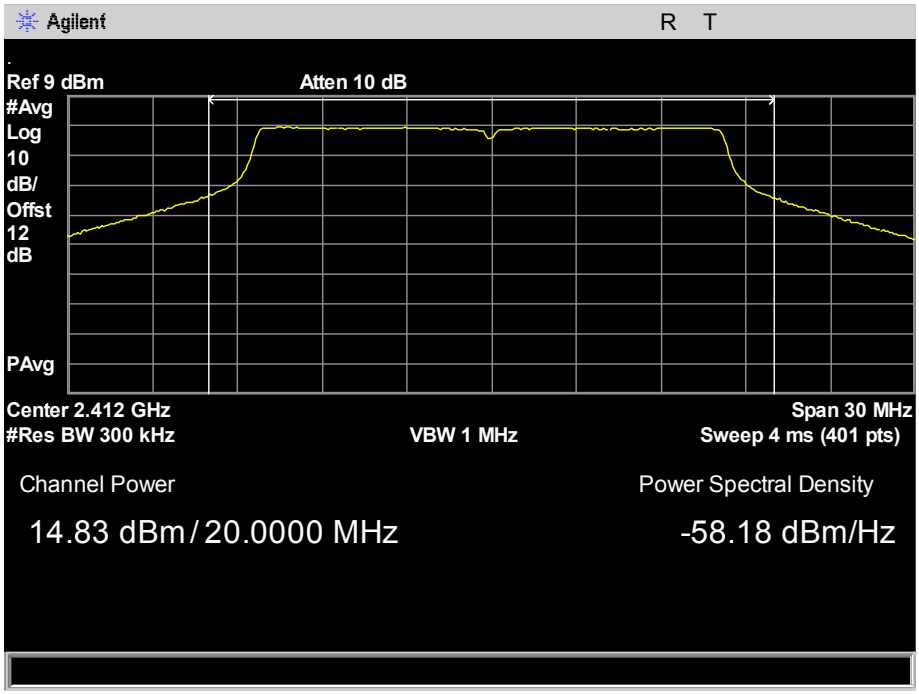
Plot 23. Peak Power Output, 801.11b, High Channel, 20 MHz to 2462 MHz, Channel 0



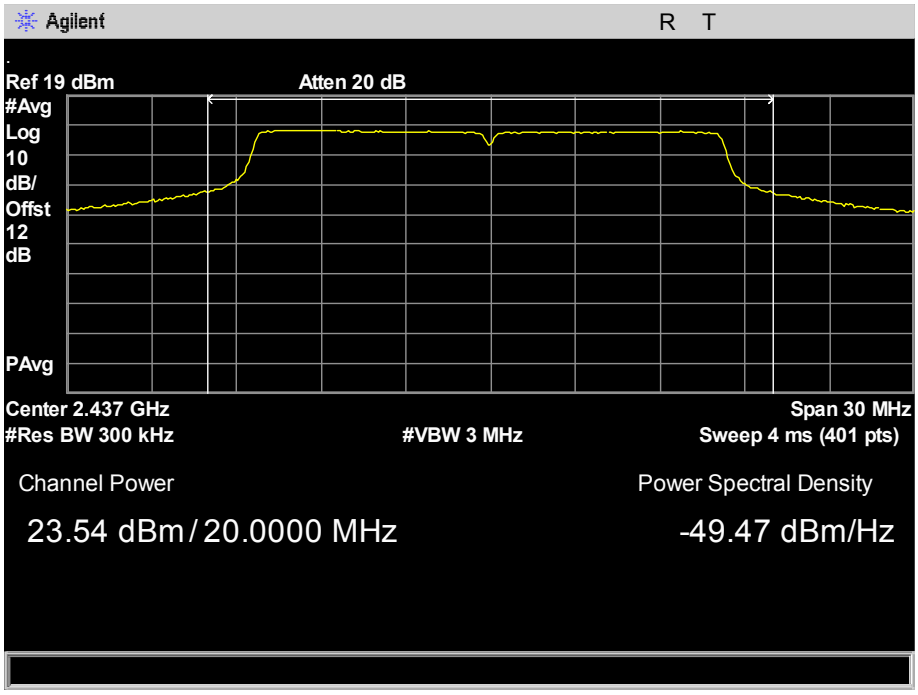
Plot 24. Peak Power Output, 801.11b, High Channel, 20 MHz to 2462 MHz, Channel 1



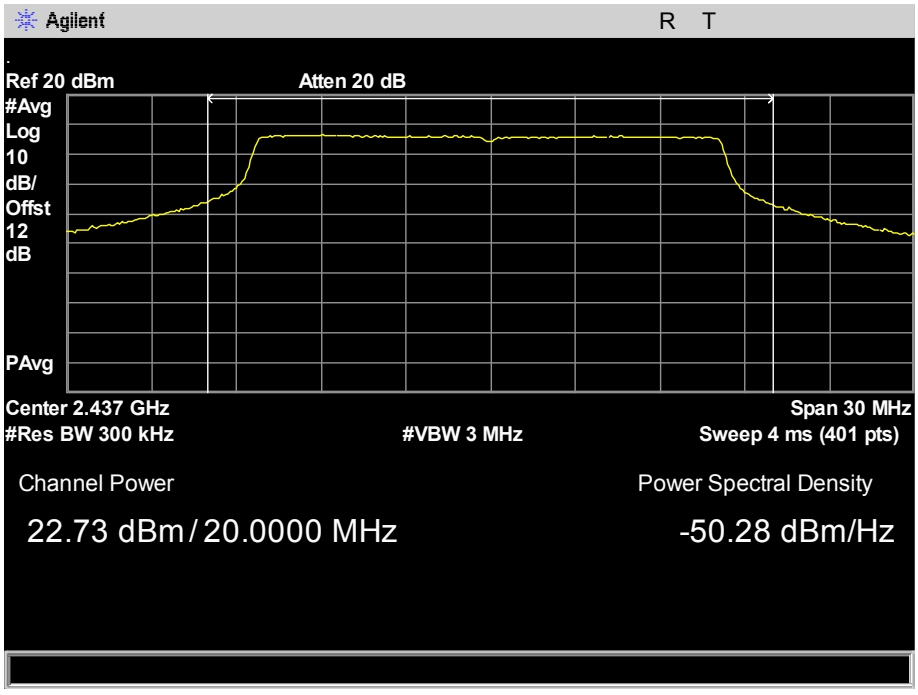
Plot 25. Peak Power Output, 801.11g, Low Channel, 20 MHz to 2412 MHz, Channel 0



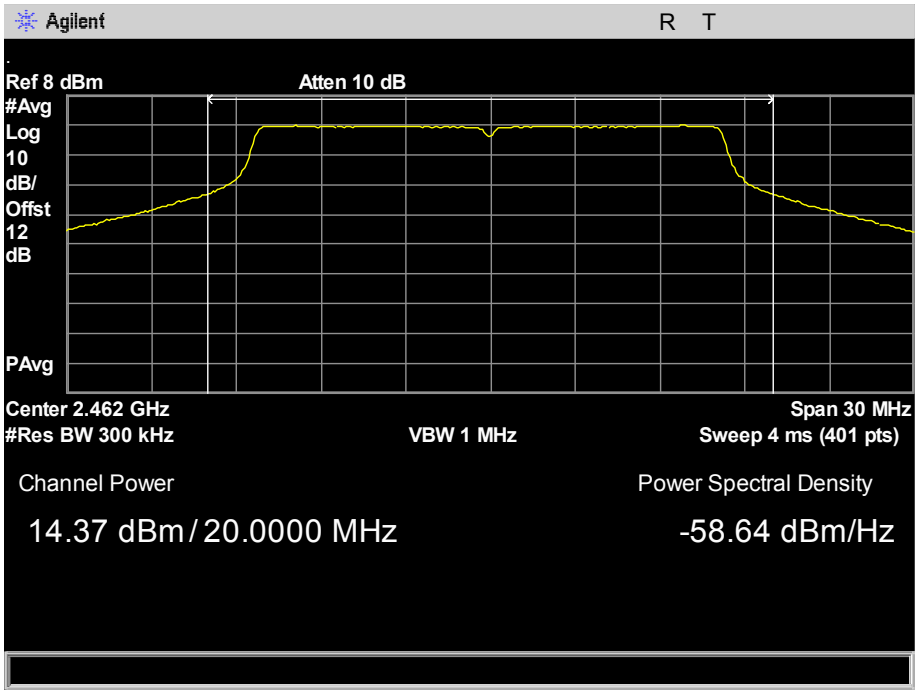
Plot 26. Peak Power Output, 801.11g, Low Channel, 20 MHz to 2412 MHz, Channel 1



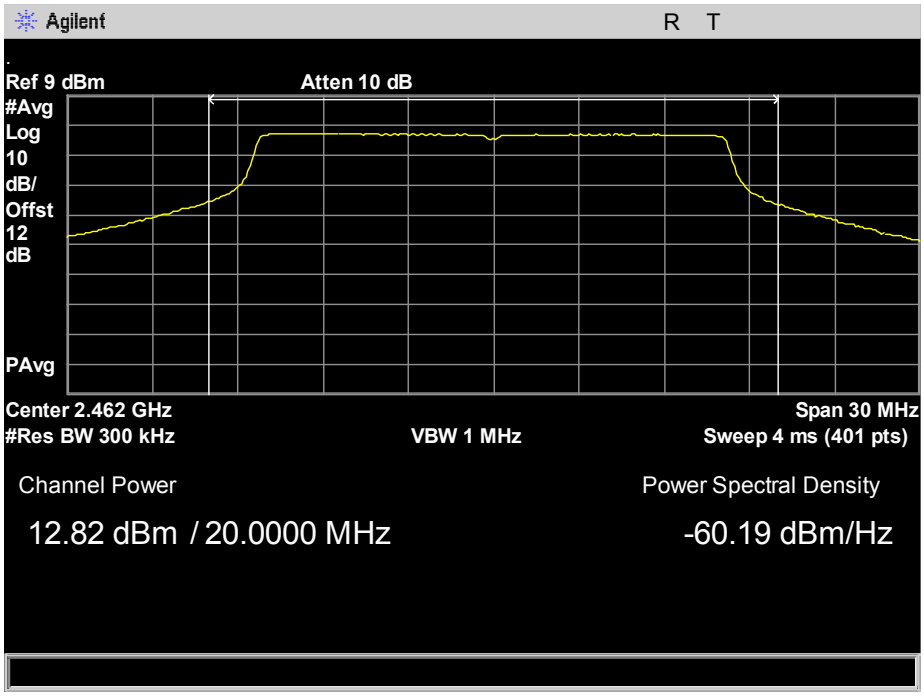
Plot 27. Peak Power Output, 801.11g, Mid Channel, 20 MHz to 2437 MHz, Channel 0



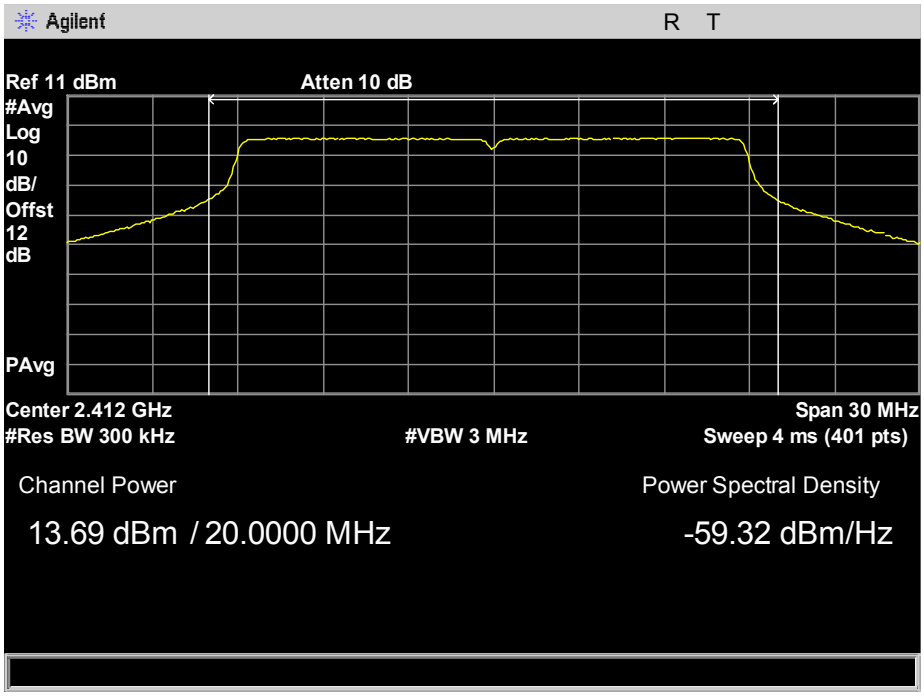
Plot 28. Peak Power Output, 801.11g, Mid Channel, 20 MHz to 2437 MHz, Channel 1



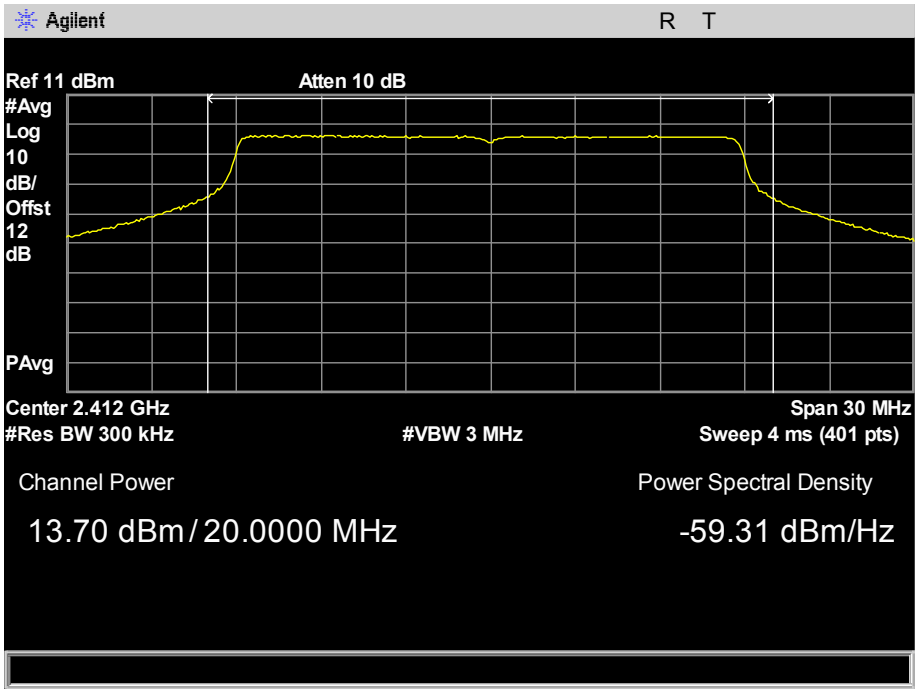
Plot 29. Peak Power Output, 801.11g, High Channel, 20 MHz to 2462 MHz, Channel 0



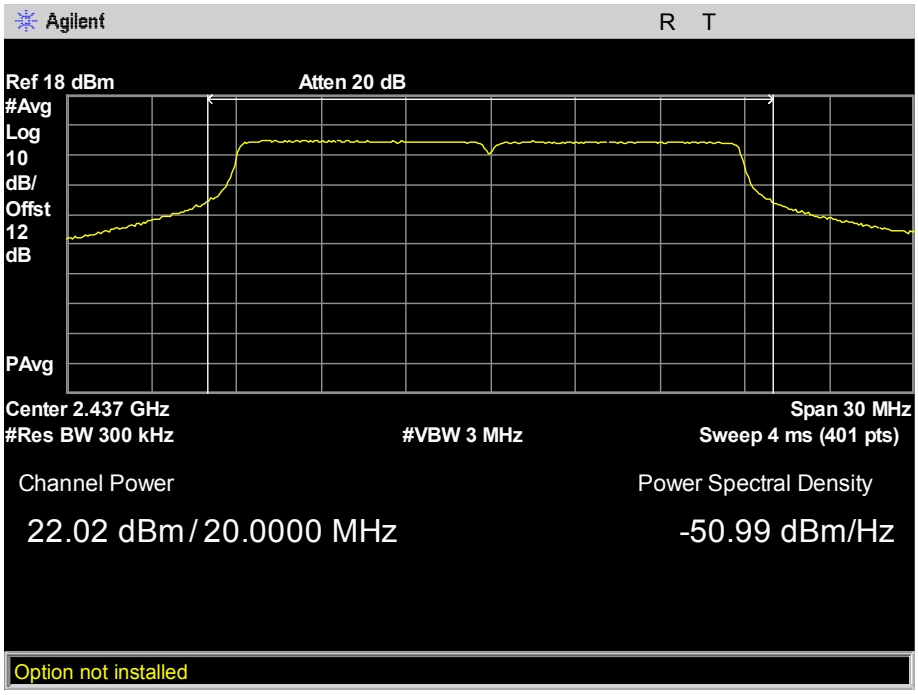
Plot 30. Peak Power Output, 801.11g, High Channel, 20 MHz to 2462 MHz, Channel 1



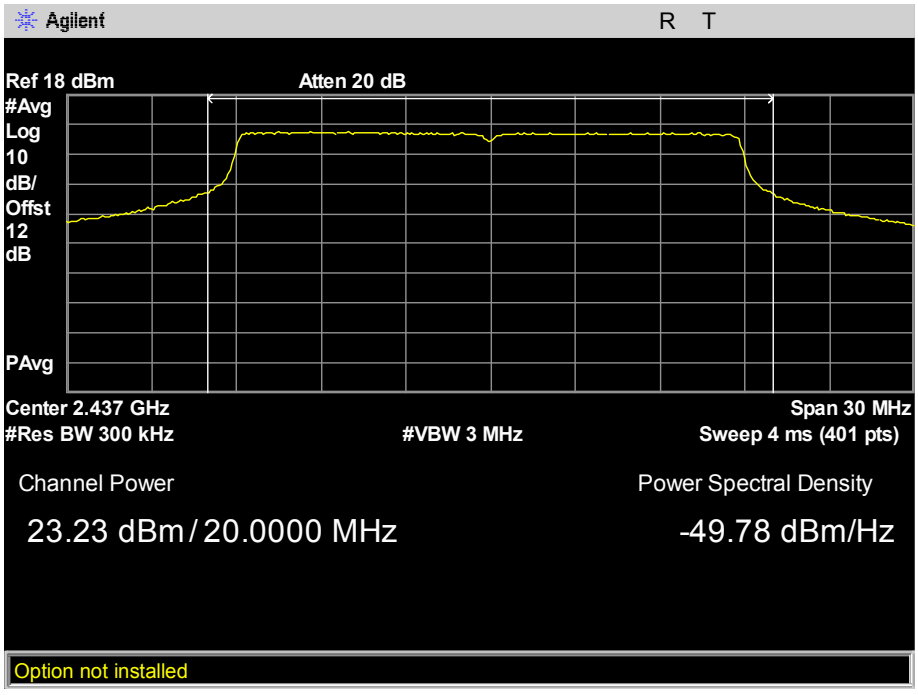
Plot 31. Peak Power Output, 801.11n, Low Channel, 20 MHz to 2412 MHz, Channel 0



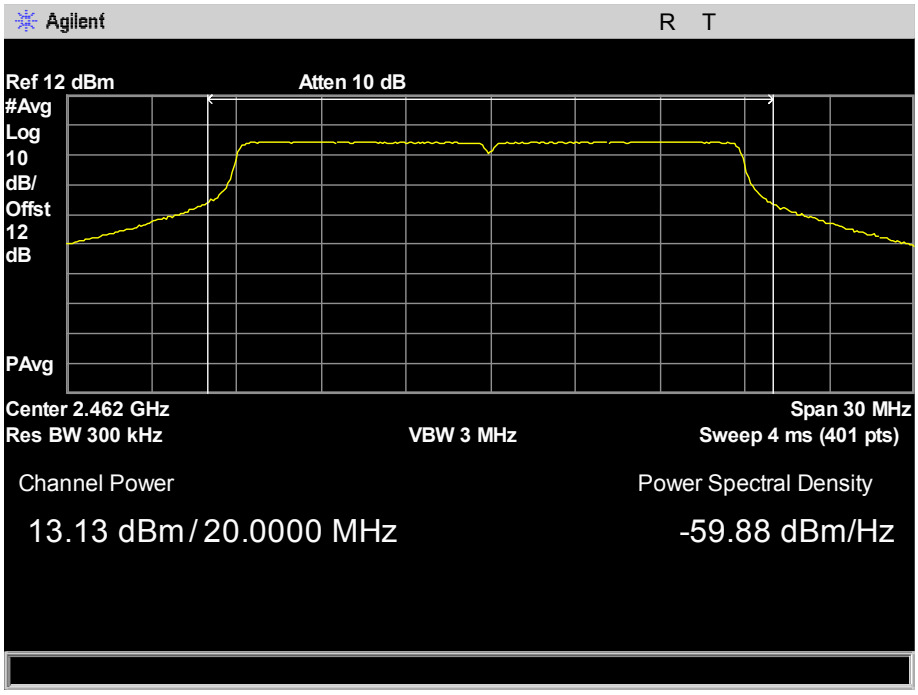
Plot 32. Peak Power Output, 801.11n, Low Channel, 20 MHz to 2412 MHz, Channel 1



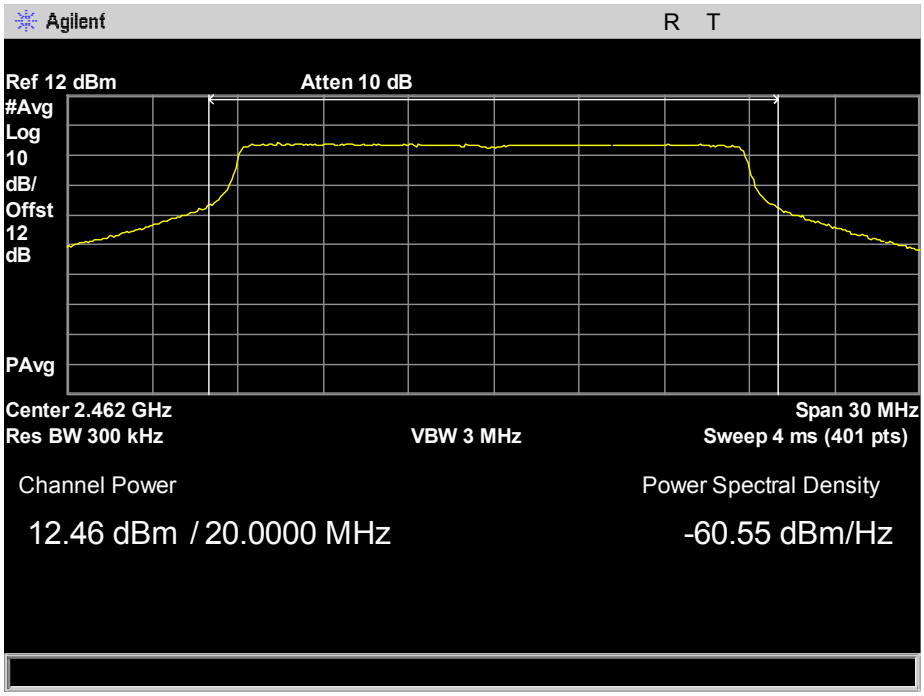
Plot 33. Peak Power Output, 801.11n, Mid Channel, 20 MHz to 2437 MHz, Channel 0



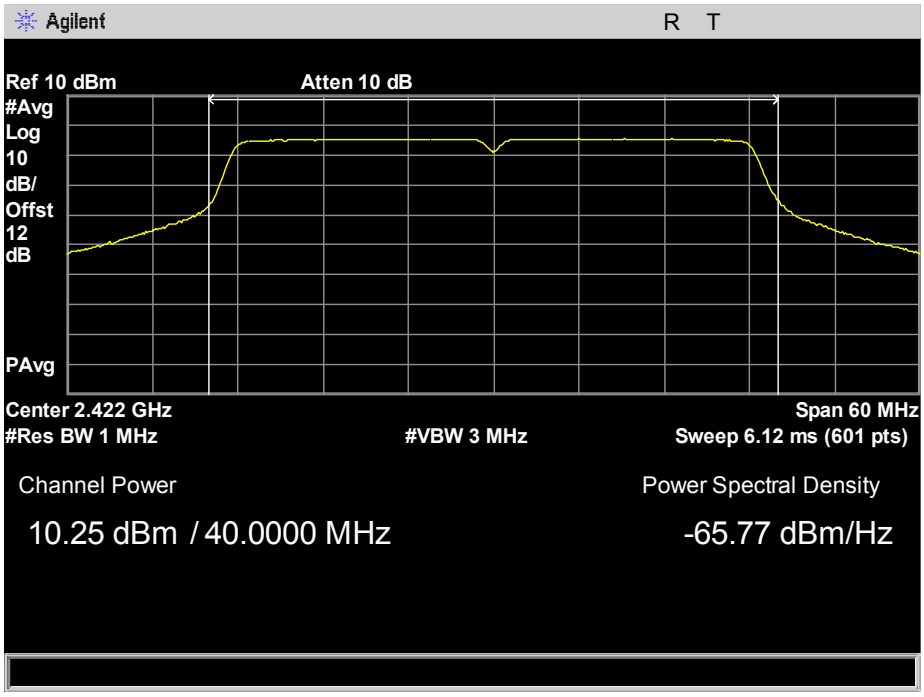
Plot 34. Peak Power Output, 801.11n, Mid Channel, 20 MHz to 2437 MHz, Channel 1



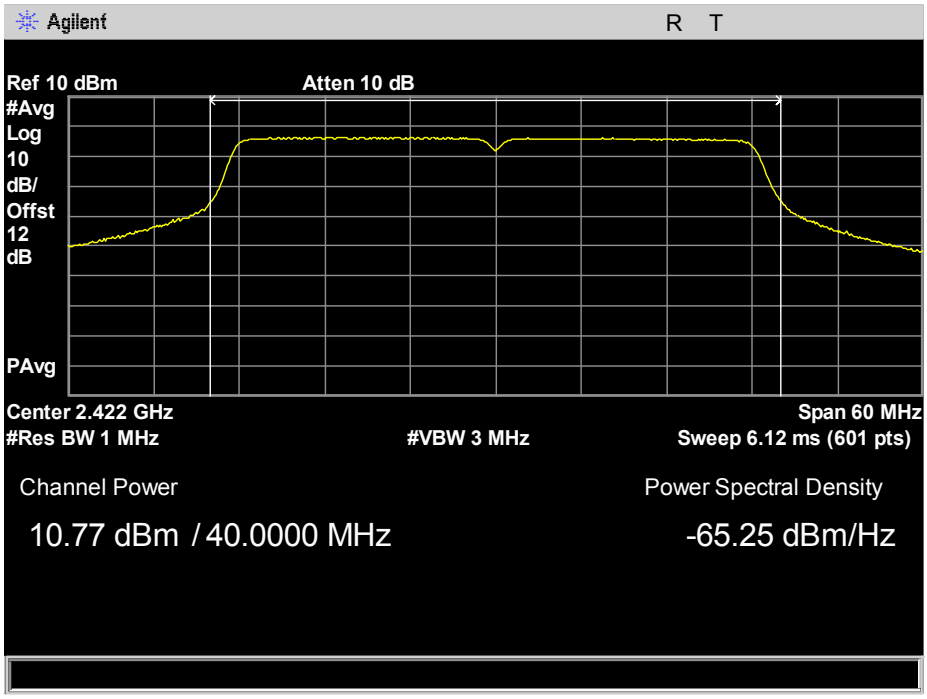
Plot 35. Peak Power Output, 801.11n, High Channel, 20 MHz to 2462 MHz, Channel 0



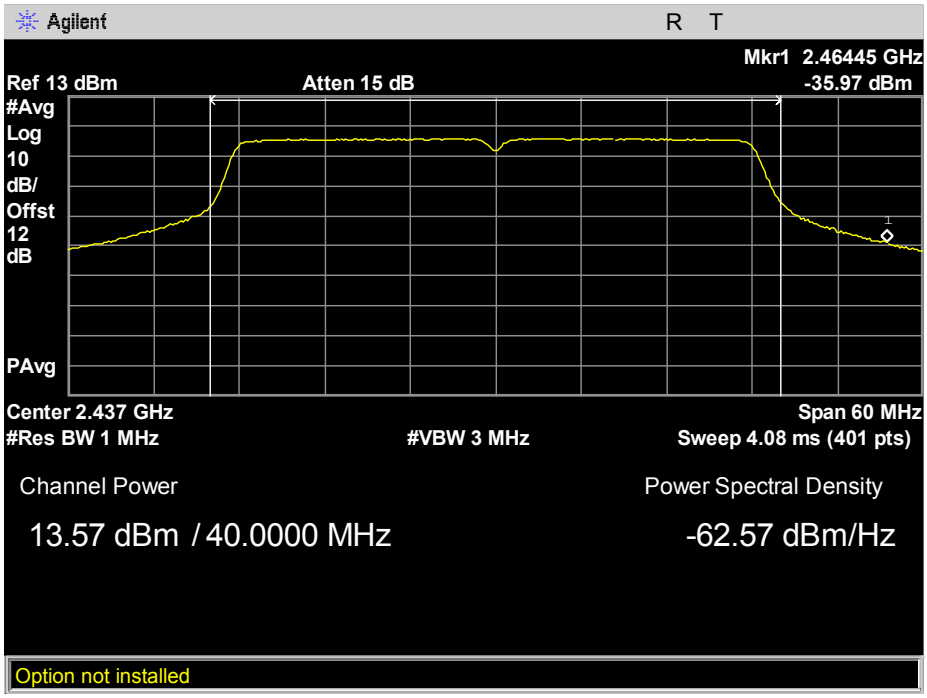
Plot 36. Peak Power Output, 801.11n, High Channel, 20 MHz to 2462 MHz, Channel 1



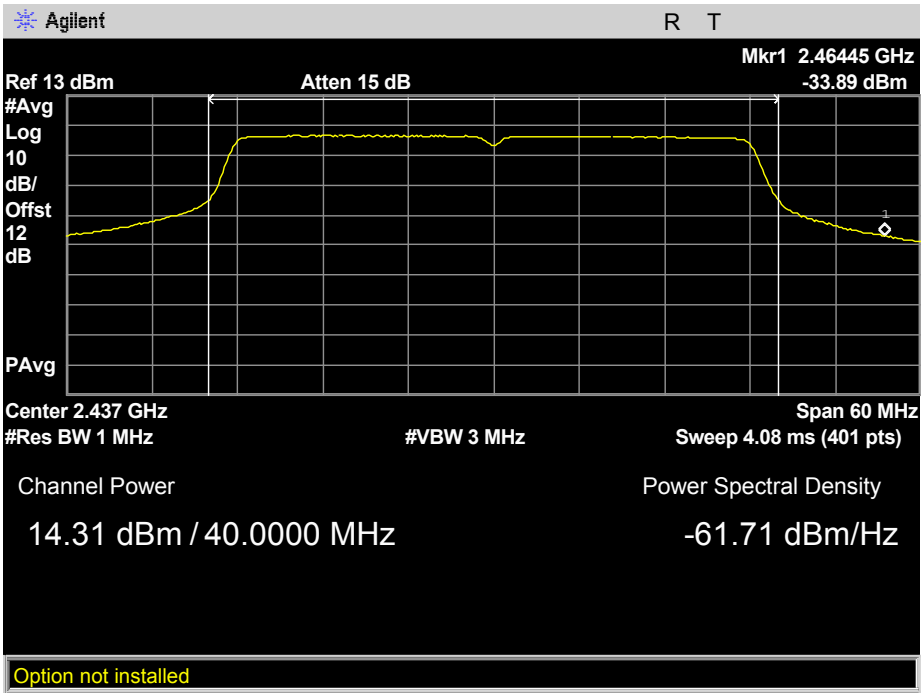
Plot 37. Peak Power Output, 801.11n, Low Channel, 40 MHz to 2422 MHz, Channel 0



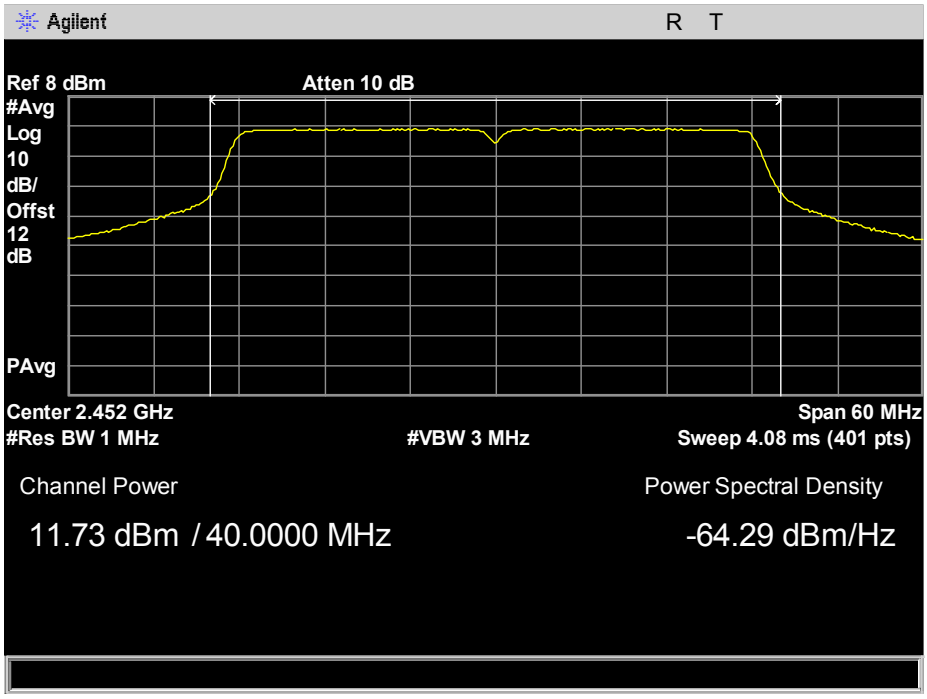
Plot 38. Peak Power Output, 801.11n, Low Channel, 40 MHz to 2422 MHz, Channel 1



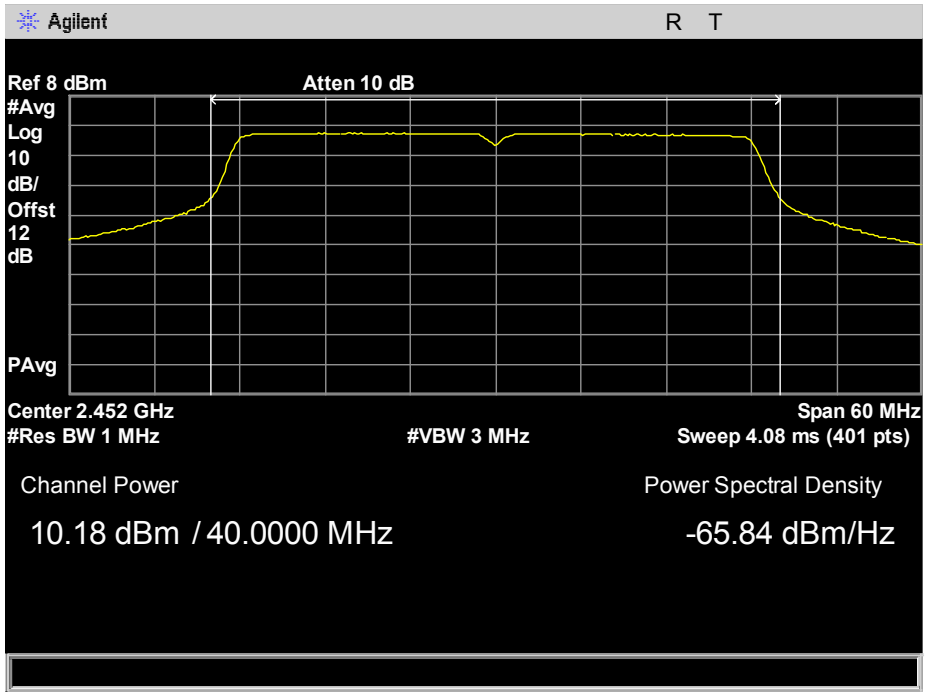
Plot 39. Peak Power Output, 801.11n, Mid Channel, 40 MHz to 2437 MHz, Channel 0



Plot 40. Peak Power Output, 801.11n, Mid Channel, 40 MHz to 2437 MHz, Channel 1



Plot 41. Peak Power Output, 801.11n, High Channel, 40 MHz to 2452 MHz, Channel 0



Plot 42. Peak Power Output, 801.11n, High Channel, 40 MHz to 2452 MHz, Channel 1

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.209 Radiated Spurious Emissions Requirements and Band Edge

Test Requirements: **§15.247(d); §15.205:** Emissions outside the frequency band.

§15.205(a): Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090–0.110----------	16.42–16.423	399.9–410	4.5–5.15
[1] 0.495–0.505----------	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905----------	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128----------	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775----------	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775----------	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218----------	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825----------	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225----------	123–138	2200–2300	14.47–14.5
8.291–8.294----------	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366----------	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675----------	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475----------	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293----------	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025----------	240–285	3345.8–3358 36.	43–36.5
12.57675–12.57725----------	322–335.4	3600–4400	([2])

Table 15. Restricted Bands of Operation

[1] Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz.
[2] Above 38.6

Test Requirement(s): **§ 15.209 (a):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 16.

Frequency (MHz)	§ 15.209(a),Radiated Emission Limits (dBµV) @ 3m
30 - 88	40.00
88 - 216	43.50
216 - 960	46.00
Above 960	54.00

Table 16. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

Test Procedures: The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line. Only noise floor was measured above 18 GHz.

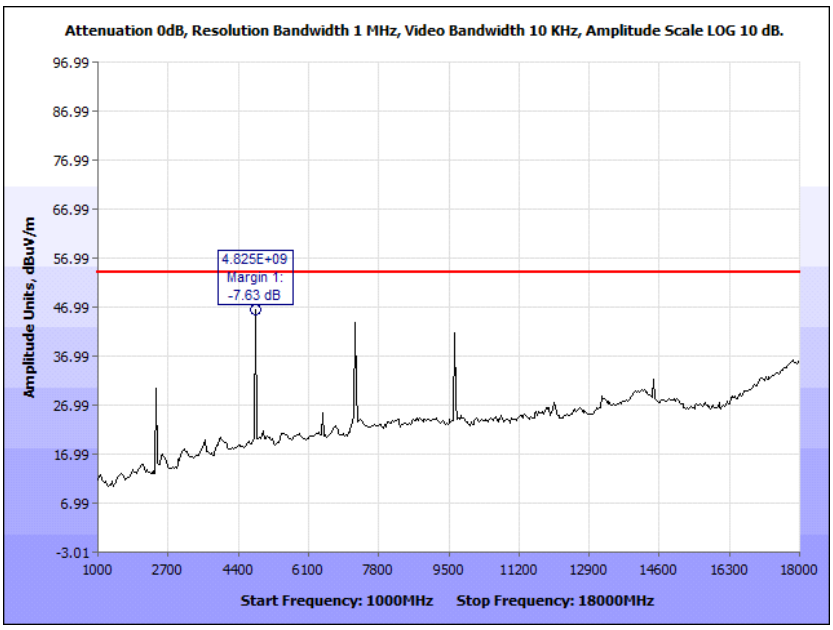
Test Results: The EUT was conducted with the Radiated Spurious Emission limits of **§ 15.247(d) and § 15.209**.

For emissions below 1GHz, apparent spurious emissions above the limit, specifically 249.984MHz one, remain even when radio transmitter is powered off; therefore, spurious emissions are subject to Class A digital emissions limits.

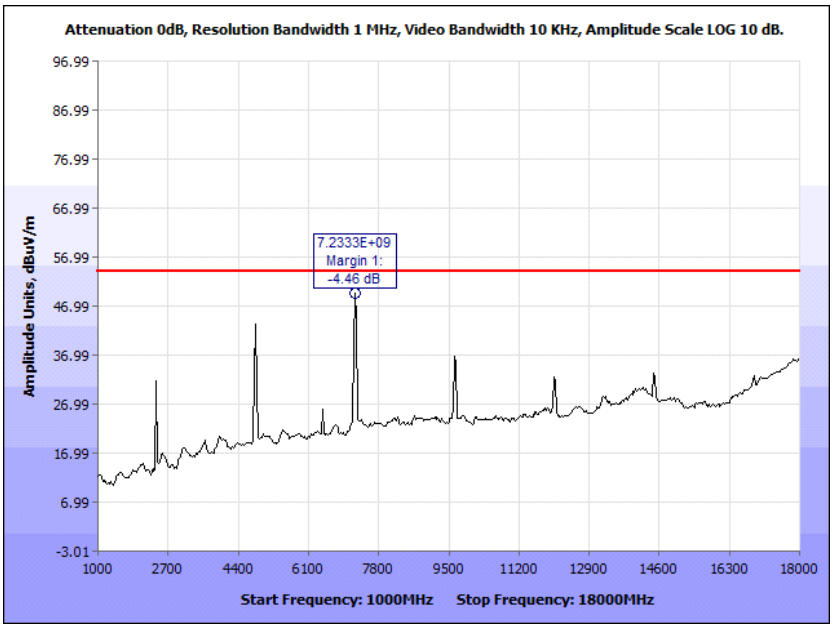
Test Engineer(s): Donald Salguero

Test Date(s): June 18, 2019

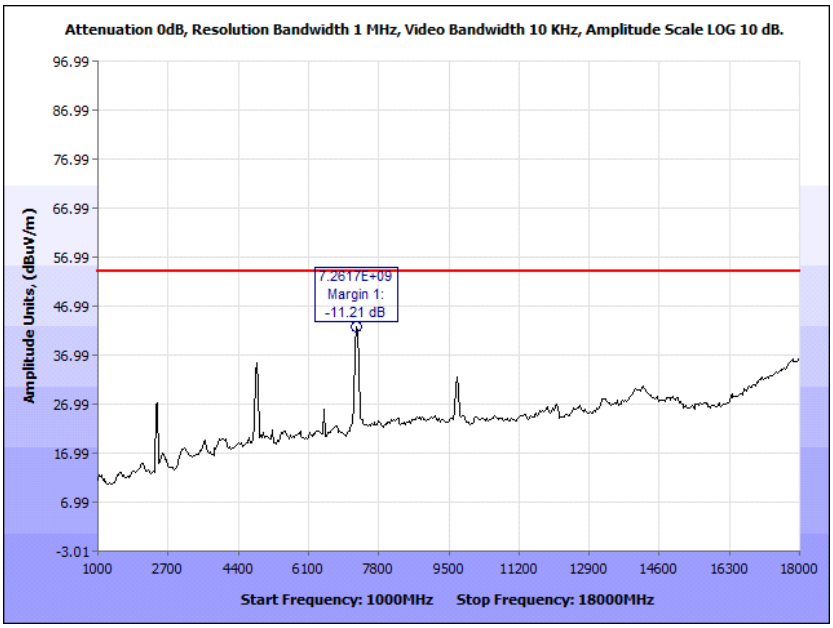
Radiated Spurious Emissions, Test Results



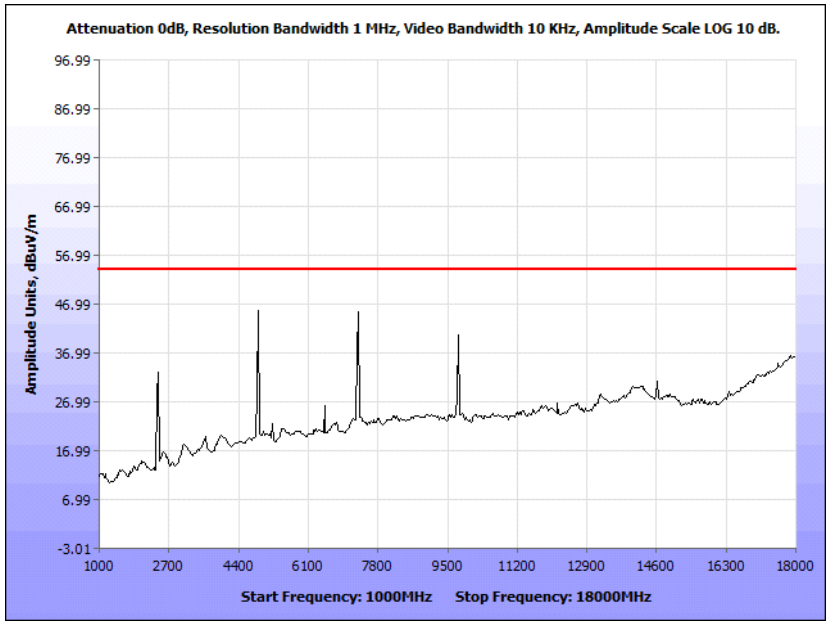
Plot 43. Radiated Emissions, Average Radiated Spurious, 1 GHz – 18 GHz, Channel 1, B



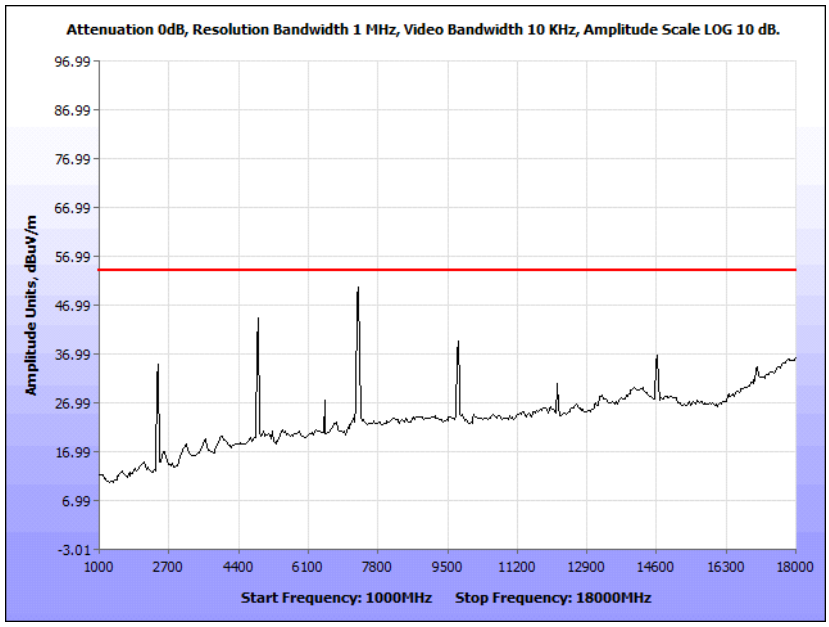
Plot 44. Radiated Emissions, Average Radiated Spurious, 1 GHz – 18 GHz,Channel 1, G



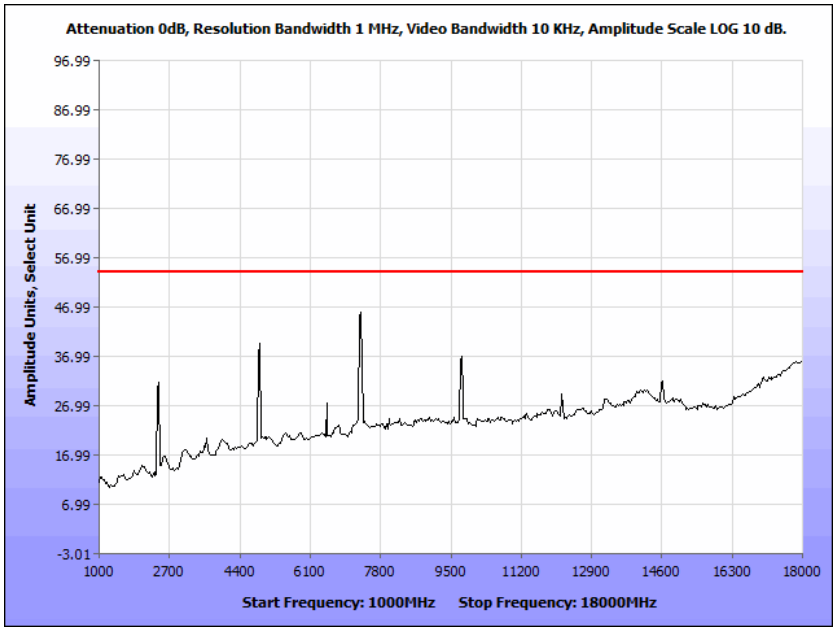
Plot 45. Radiated Emissions, Average Radiated Spurious, 1 GHz – 18 GHz, Channel 1, N 40 M



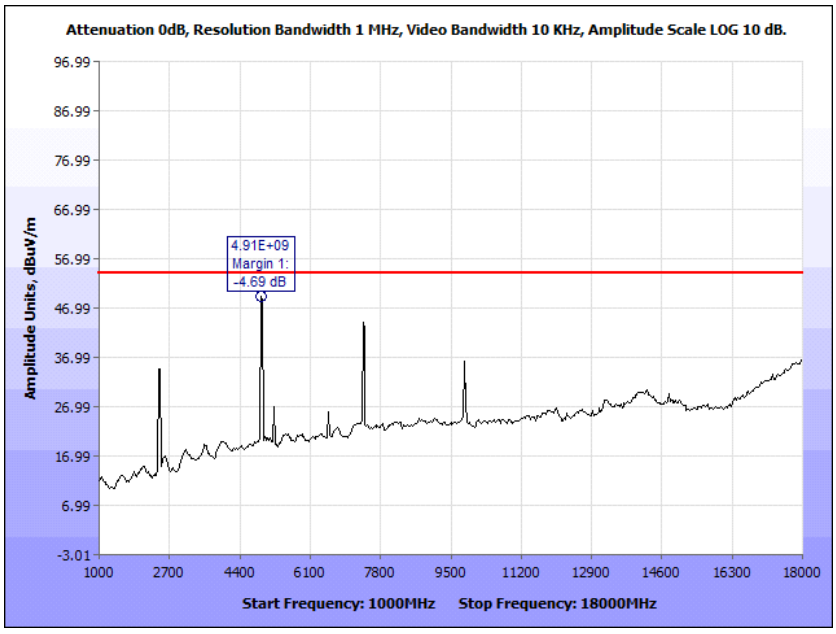
Plot 46. Radiated Emissions, Average Radiated Spurious, 1 GHz – 18 GHz, Channel 6, B



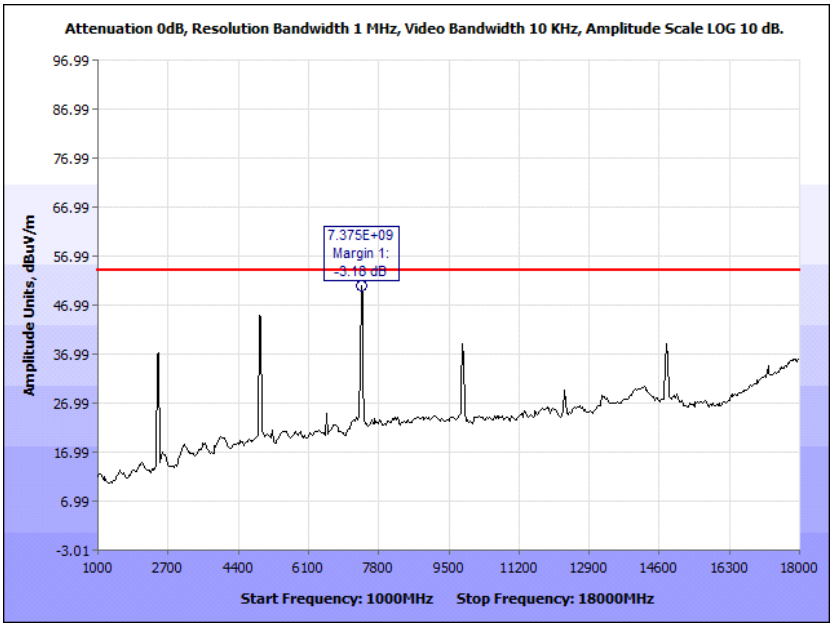
Plot 47. Radiated Emissions, Average Radiated Spurious, 1 GHz – 18 GHz, Channel 6, G



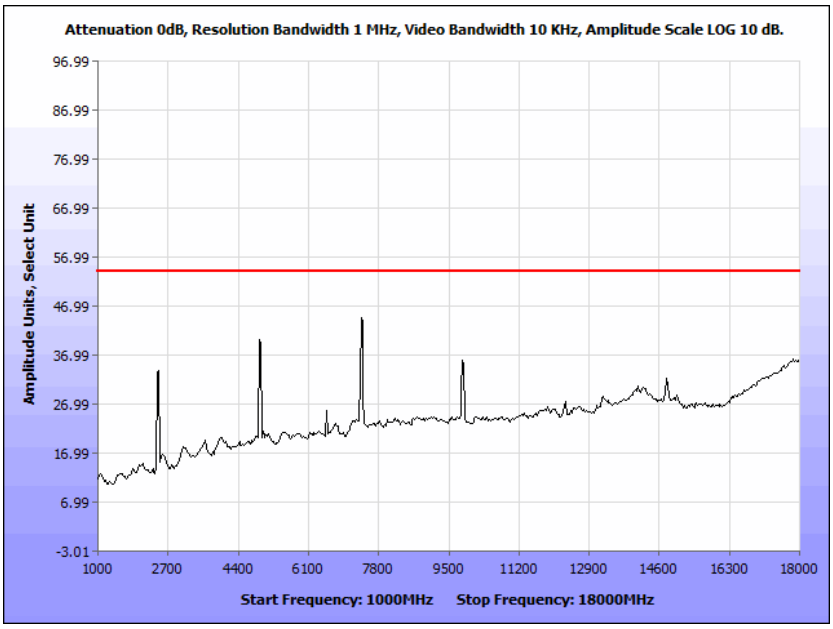
Plot 48. Radiated Emissions, Average Radiated Spurious, 1 GHz – 18 GHz, Channel 6, N, 20 M



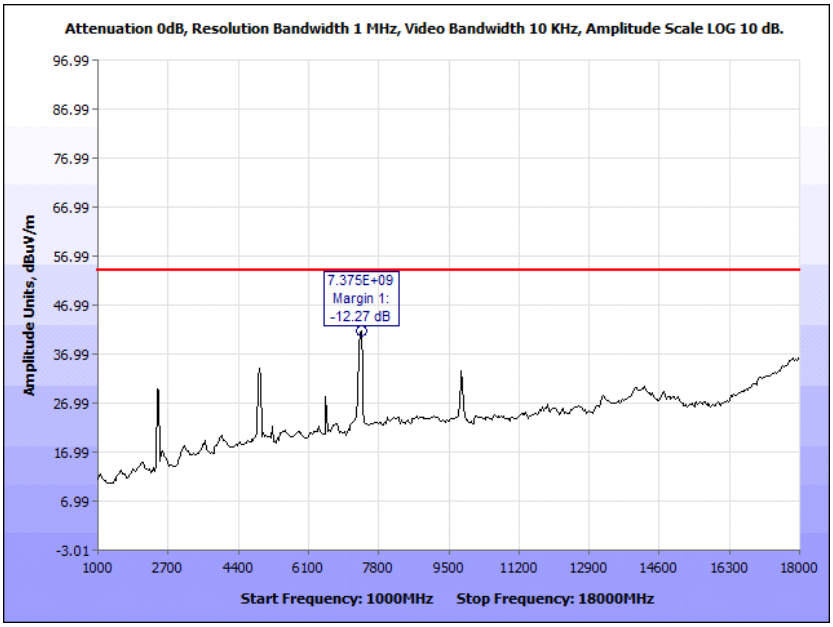
Plot 49. Radiated Emissions, Average Radiated Spurious, 1 GHz – 18 GHz, Channel 11, B



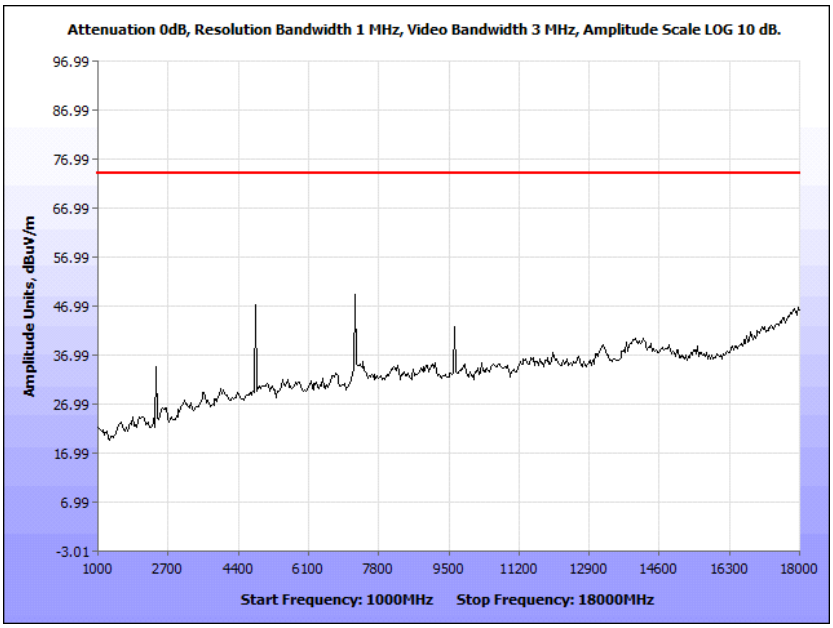
Plot 50. Radiated Emissions, Average Radiated Spurious, 1 GHz – 18 GHz, Channel 11, G



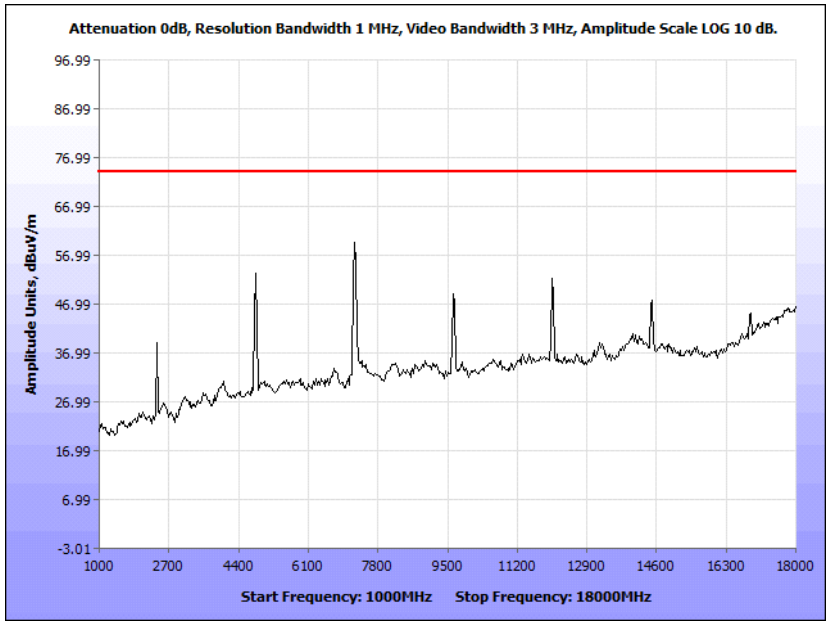
Plot 51. Radiated Emissions, Average Radiated Spurious, 1 GHz – 18 GHz, Channel 11, N 20M



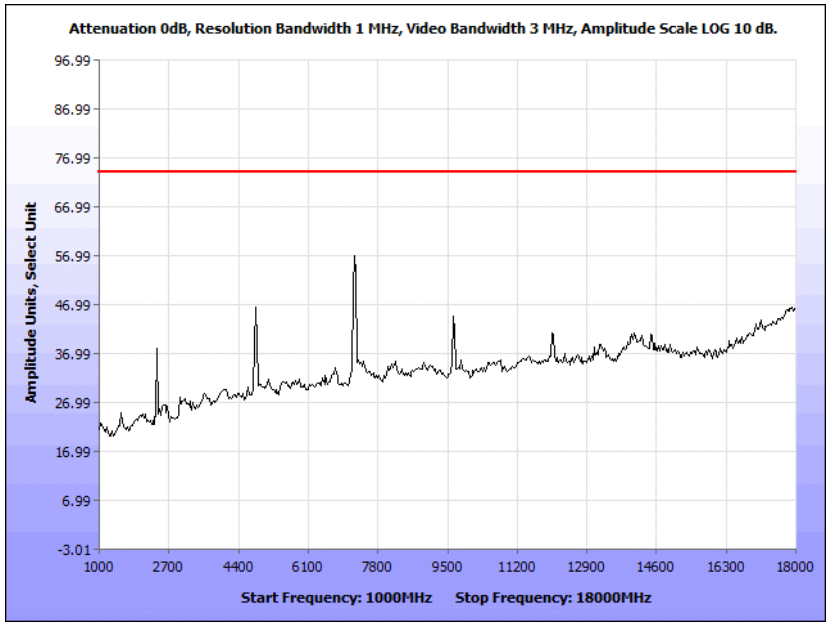
Plot 52. Radiated Emissions, Average Radiated Spurious, 1 GHz – 18 GHz, Channel 11, N 40M



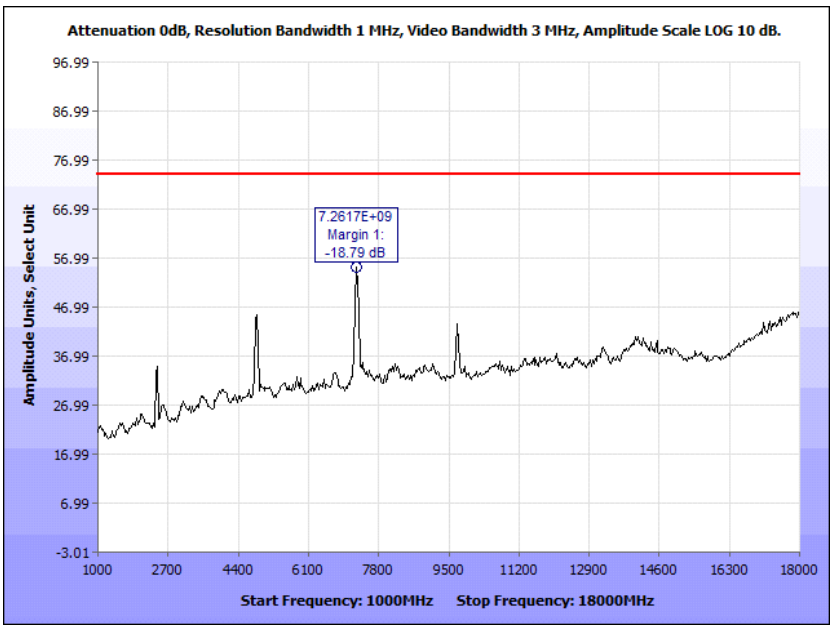
Plot 53. Radiated Emissions, Peak Radiated Spurious, 1 GHz – 18 GHz, Channel 1, B



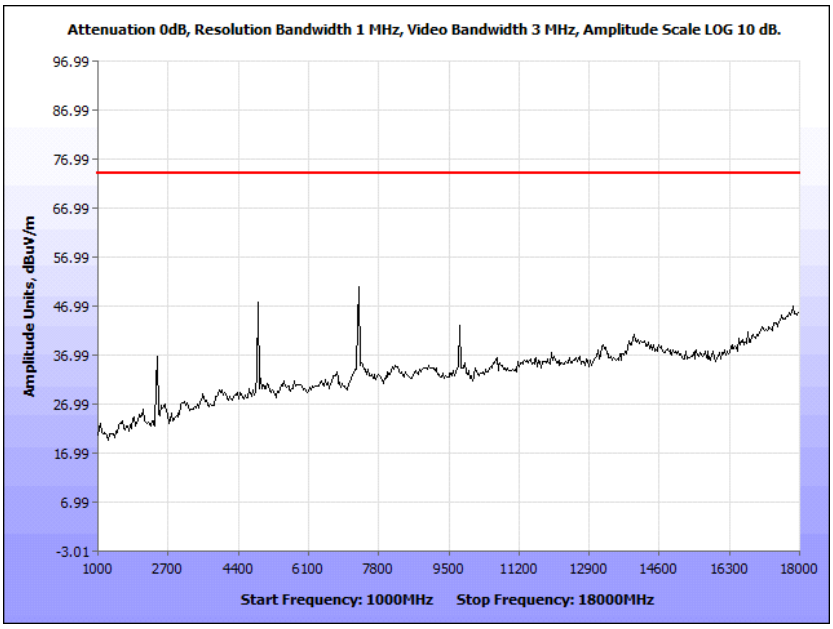
Plot 54. Radiated Emissions, Peak Radiated Spurious, 1 GHz – 18 GHz, Channel 1, G



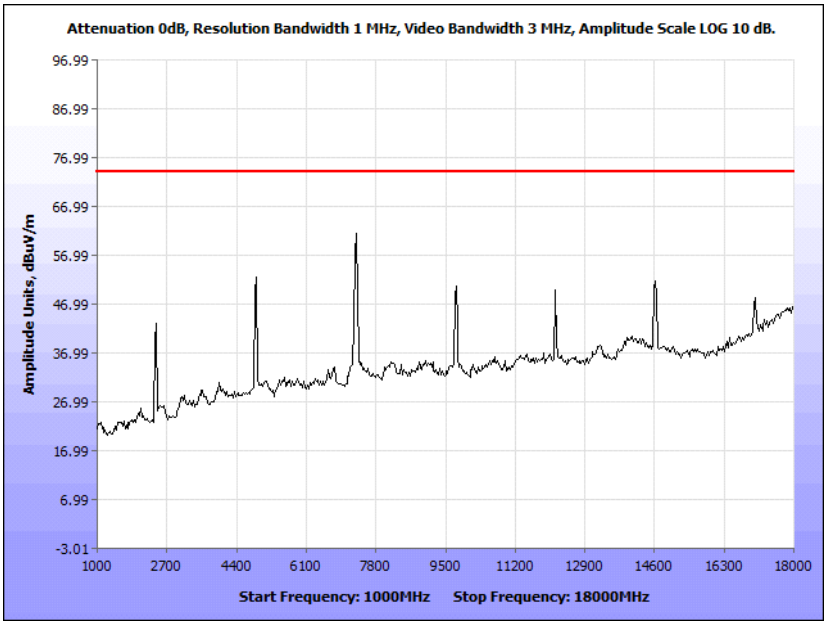
Plot 55. Radiated Emissions, Peak Radiated Spurious, 1 GHz – 18 GHz, Channel 1, N 20 M



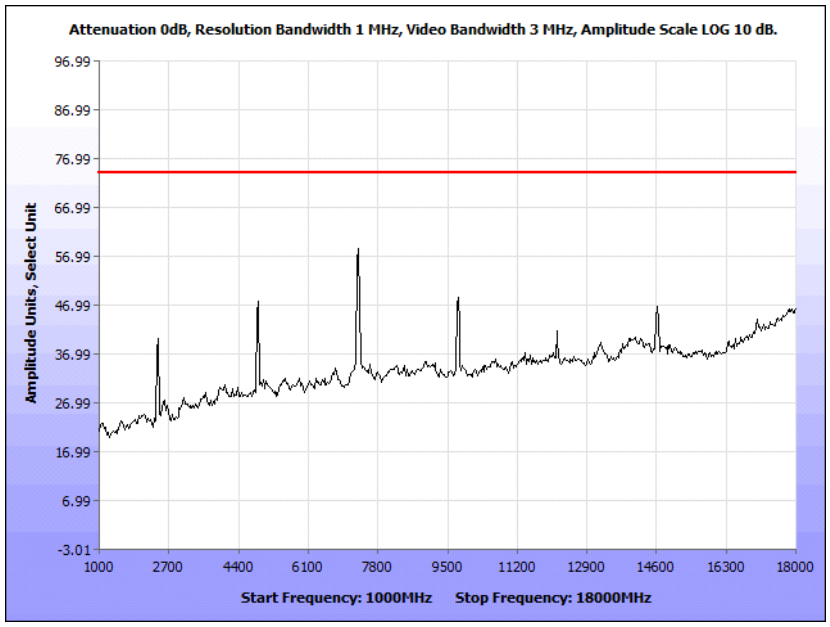
Plot 56. Radiated Emissions, Peak Radiated Spurious, 1 GHz – 18 GHz, Channel 1, N 40 M



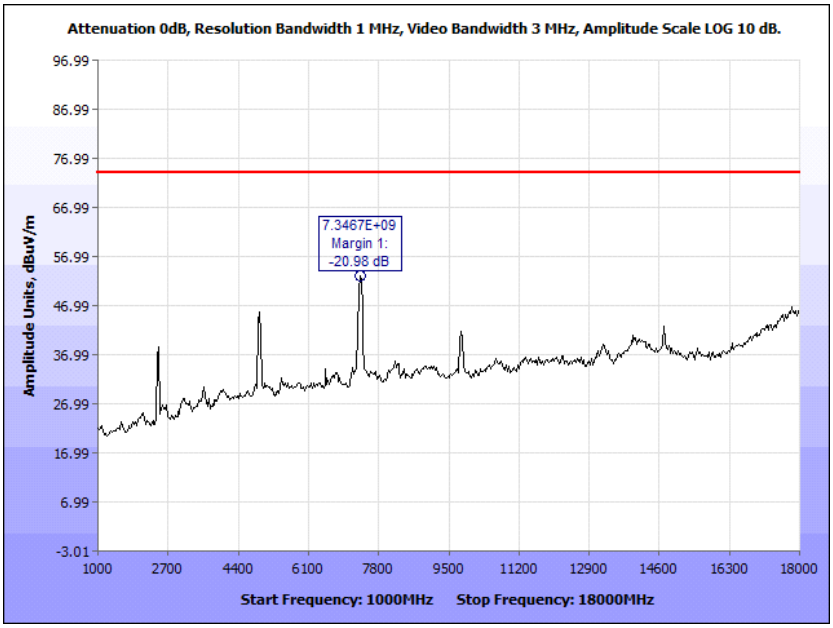
Plot 57. Radiated Emissions, Peak Radiated Spurious, 1 GHz – 18 GHz, Channel 6, B



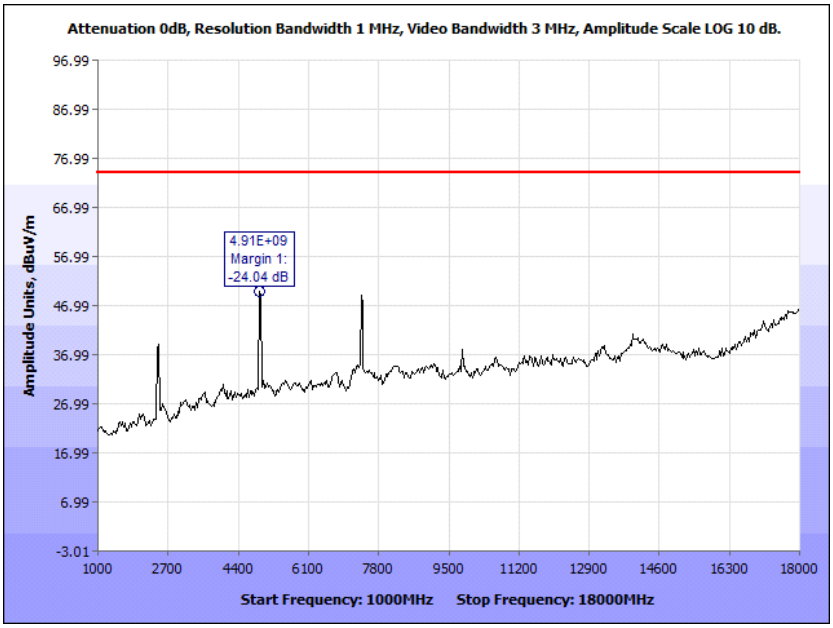
Plot 58. Radiated Emissions, Peak Radiated Spurious, 1 GHz – 18 GHz, Channel 6, G



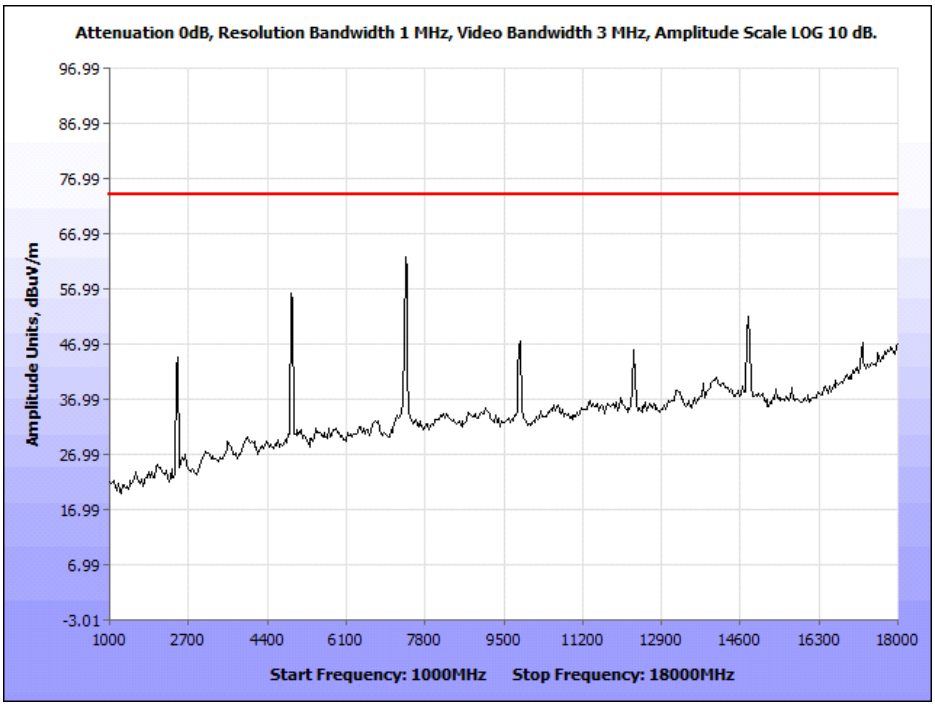
Plot 59. Radiated Emissions, Peak Radiated Spurious, 1 GHz – 18 GHz, Channel 6, N, 20 M



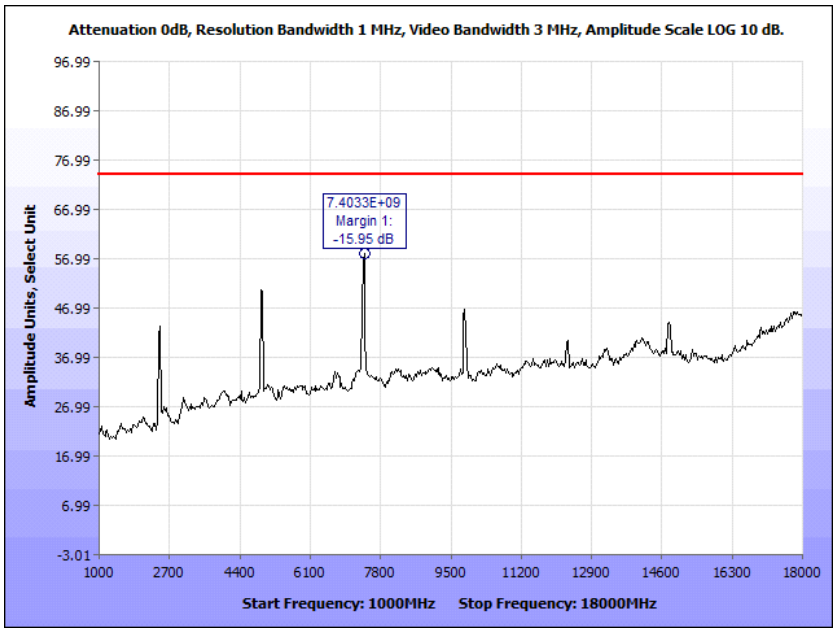
Plot 60. Radiated Emissions, Peak Radiated Spurious, 1 GHz – 18 GHz, Channel 6, N, 40 M



Plot 61. Radiated Emissions, Peak Radiated Spurious, 1 GHz – 18 GHz, Channel 11, B



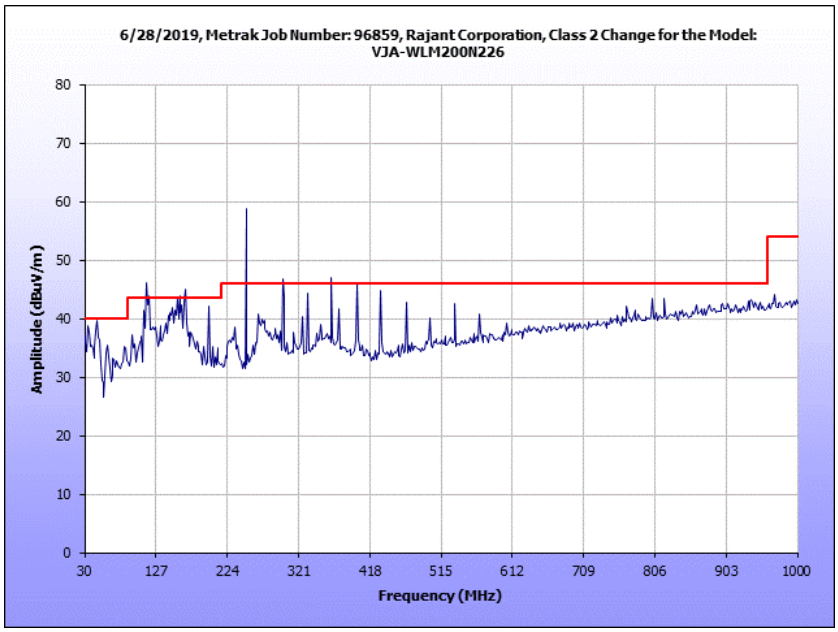
Plot 62. Radiated Emissions, Peak Radiated Spurious, 1 GHz – 18 GHz, Channel 11, G



Plot 63. Radiated Emissions, Peak Radiated Spurious, 1 GHz – 18 GHz, Channel 11, N 20M

Frequency (MHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna HEIGHT (m)	Uncorrected Amplitude (dBµV)	Antenna Correction Factor (dB) (+)	Cable Loss (dB) (+)	Distance Correction Factor (dB) (-)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
*249.984	92.1	H	1.3256	38.02	16.30	2.34	10.46	46.20	46.4	-0.20
249.984	179.5	V	1.0013	34.39	16.30	2.34	10.46	42.57	46.4	-3.83
299.992	292.4	H	1.6386	22.01	18.30	2.52	10.46	32.37	46.4	-14.03
299.992	76.3	V	1.0091	27.13	18.30	2.52	10.46	37.49	46.4	-8.91
366.681	297	H	1.0026	20.49	19.67	2.85	10.46	32.55	46.4	-13.85
366.681	358.6	V	1.3882	25.18	19.67	2.85	10.46	37.24	46.4	-9.16
166.679	96.6	H	1.9747	28.75	16.73	1.84	10.46	36.86	43.5	-6.64
166.679	177.8	V	2.3147	25.34	16.73	1.84	10.46	33.45	43.5	-10.05
433.352	299	H	2.3013	13.02	21.04	3.16	10.46	26.76	46.4	-19.64
433.352	166.3	V	1.4165	22.64	21.04	3.16	10.46	36.38	46.4	-10.02
800.02	242.5	H	1.0791	14.15	26.10	4.36	10.46	34.15	46.4	-12.25
800.02	264.2	V	1.0095	13.58	26.10	4.36	10.46	33.58	46.4	-12.82

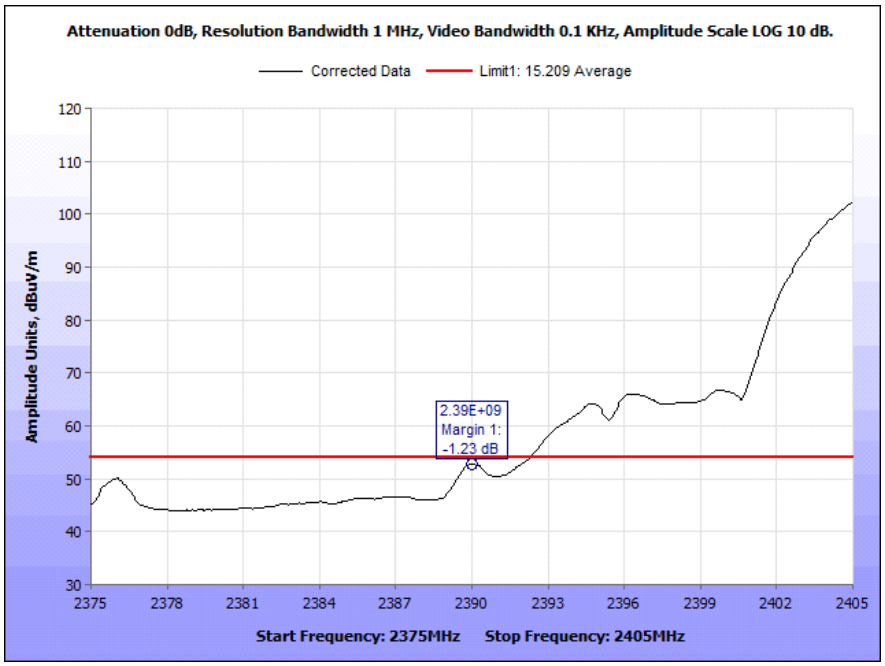
Table 17. Radiated Spurious Emissions, Test Results



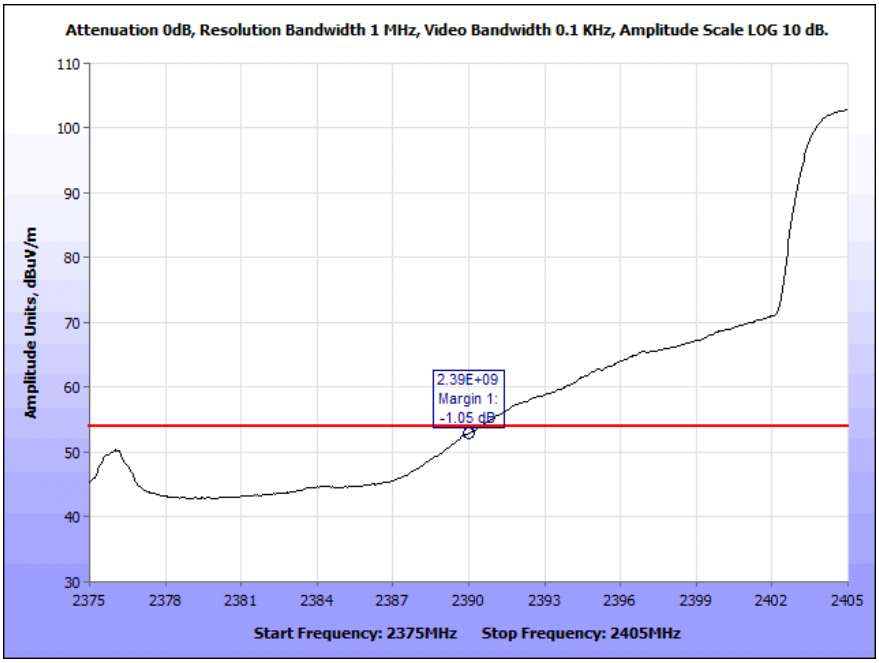
Plot 64. Radiated Emissions

Radiated Band Edge Measurements

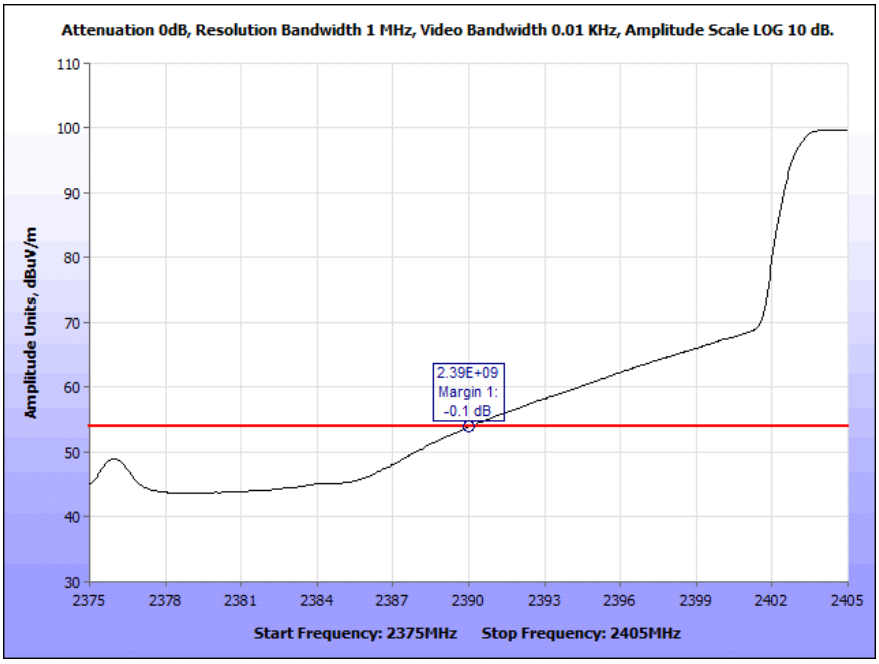
Test Procedures: The transmitter was turned on. Measurements were performed of the low and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line.



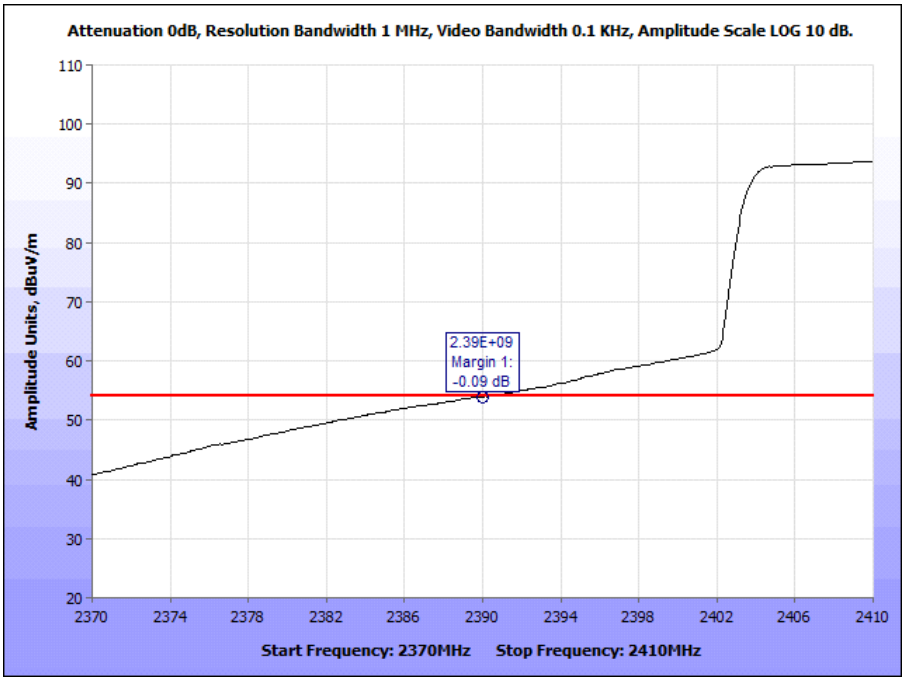
Plot 65. Radiated Restricted Bandedge, Average, 2390MHz , Channel 1, B



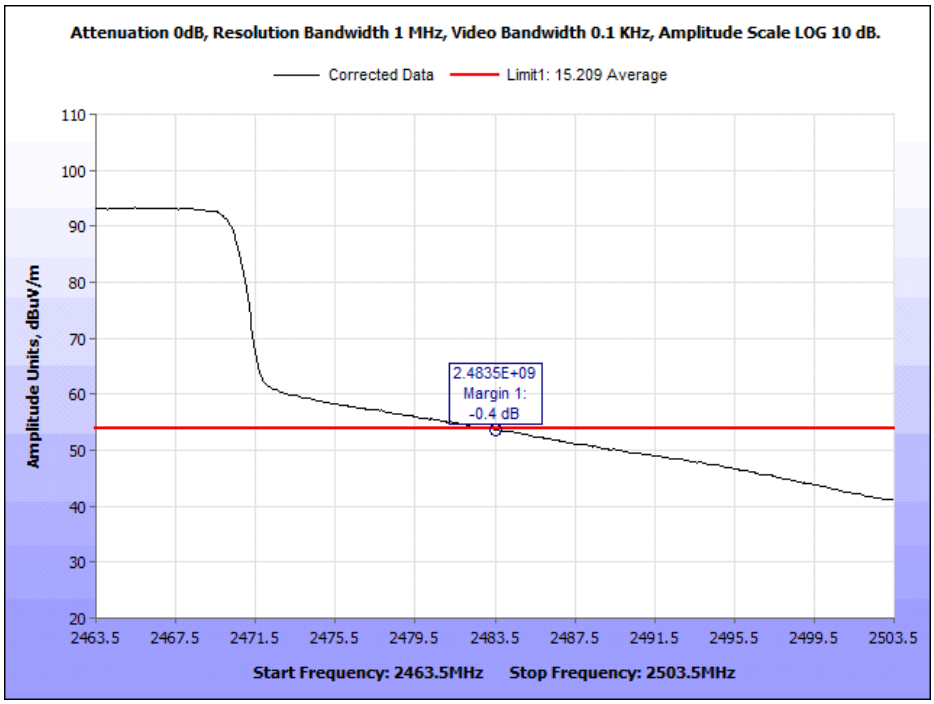
Plot 66. Radiated Restricted Bandedge, Average, 2390, Channel 1, G



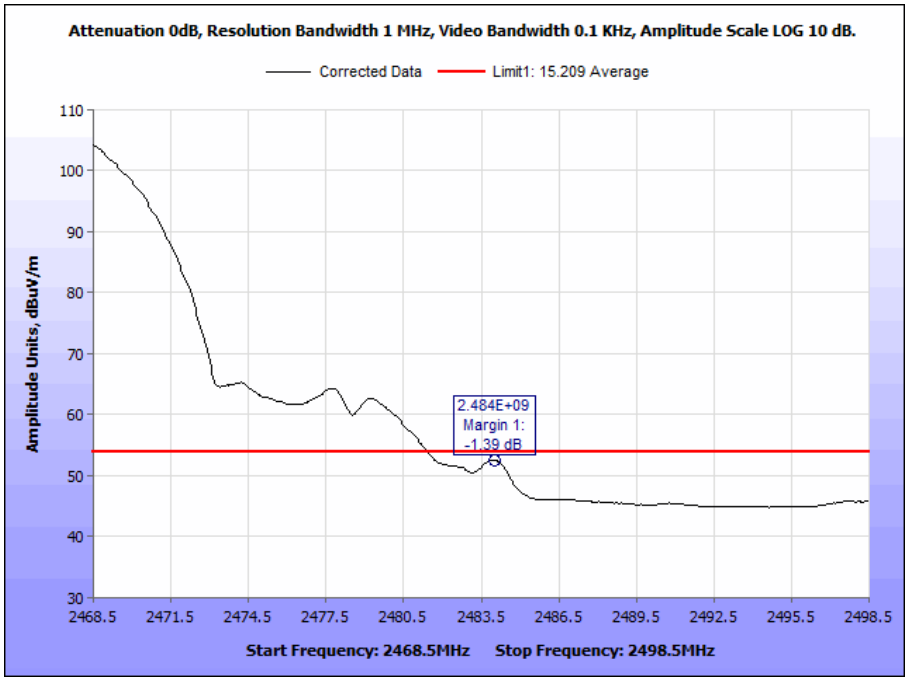
Plot 67. Radiated Restricted Bandedge, Average, 2390, Channel 1, N 20 MHz



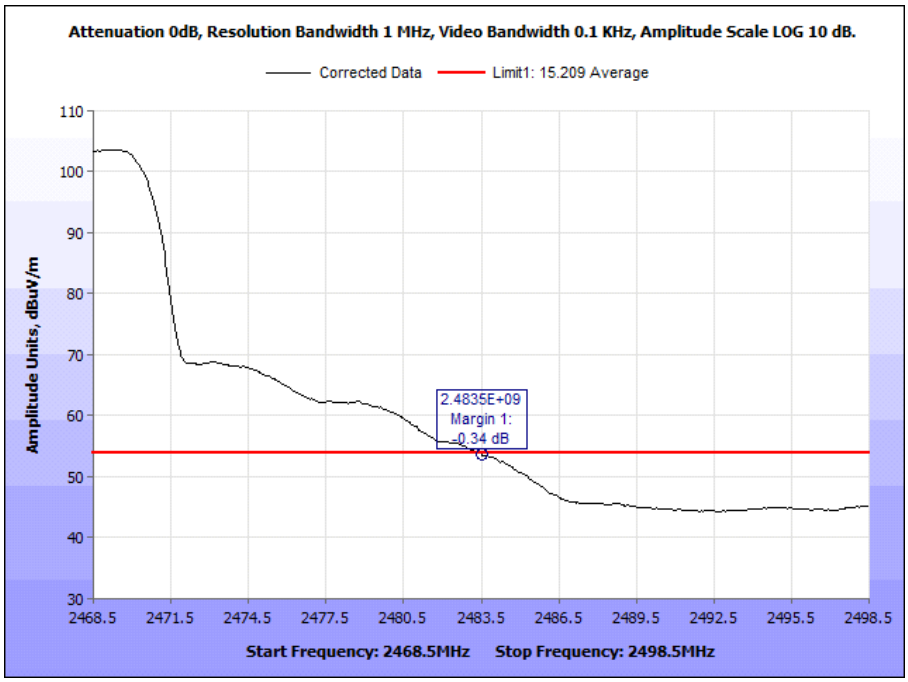
Plot 68. Radiated Restricted Bandedge, Average, 2390, Channel 3, N 40 MHz



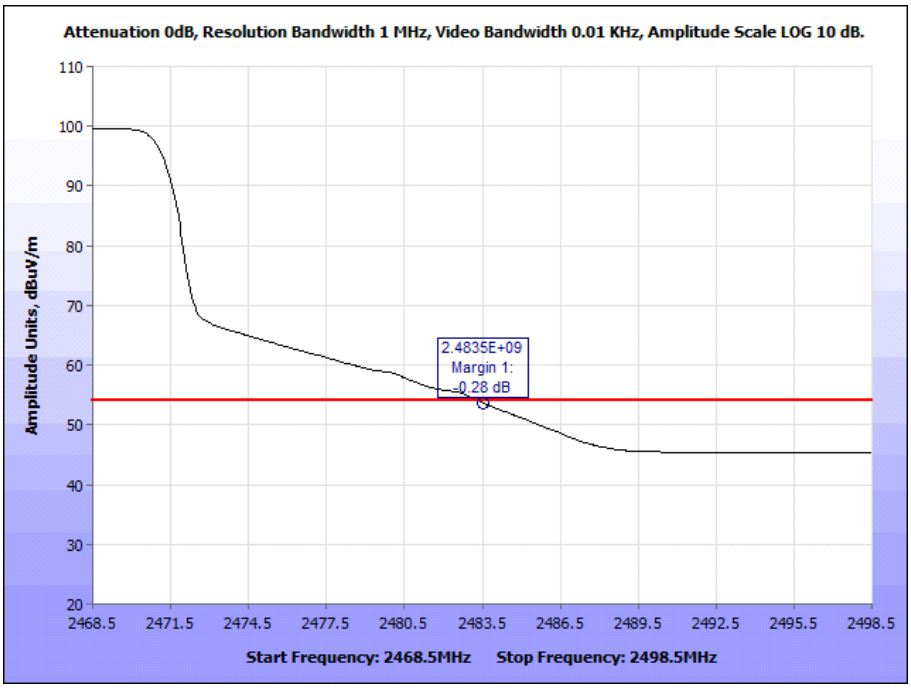
Plot 69. Radiated Restricted Bandedge, Average, 2483.5, Channel 9, N 40 MHz



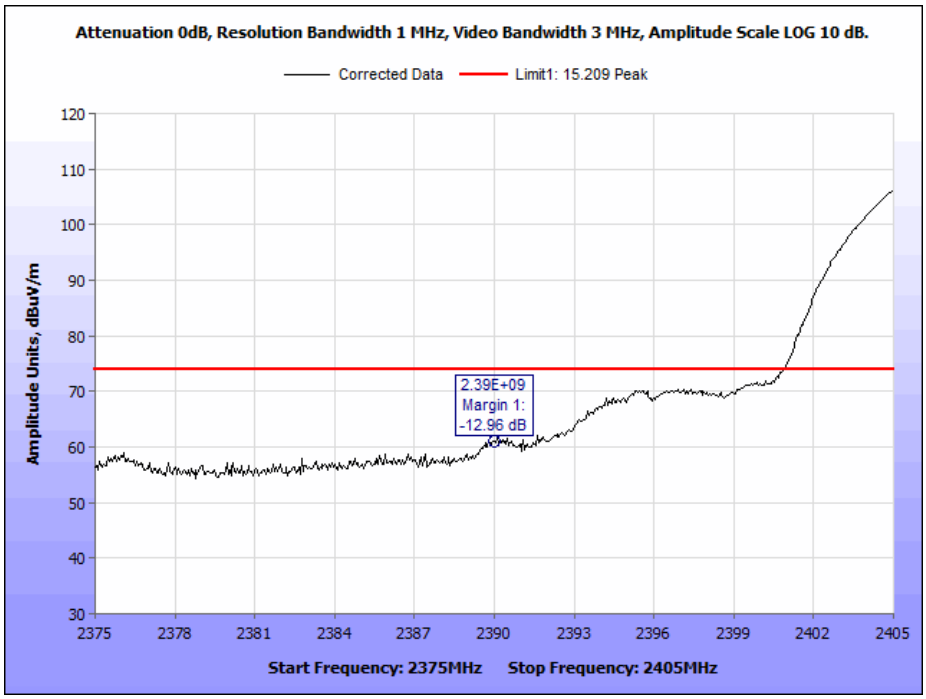
Plot 70. Radiated Restricted Bandedge, Average, 2483.5, Channel 11, B



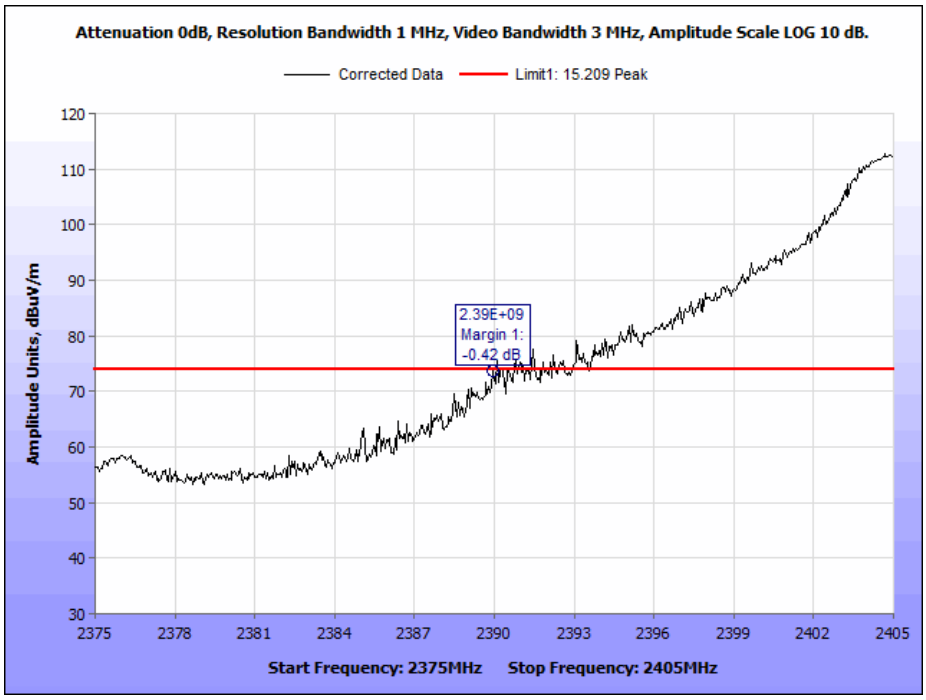
Plot 71. Radiated Restricted Bandedge, Average, 2483.5, Channel 11, G



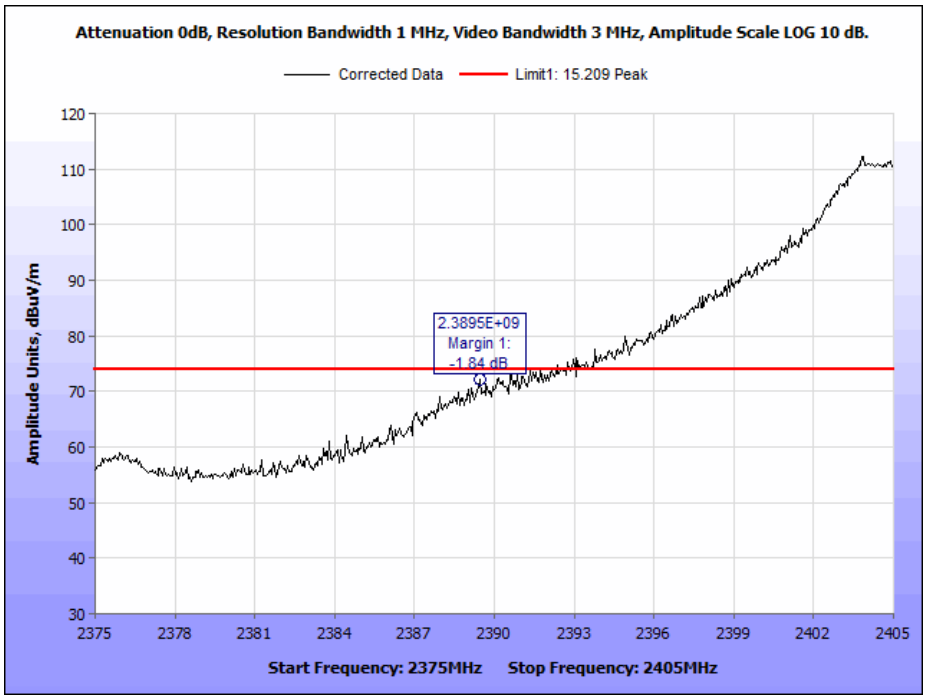
Plot 72. Radiated Restricted Bandedge, Average, 2483.5, Channel 11, N 20 MHz



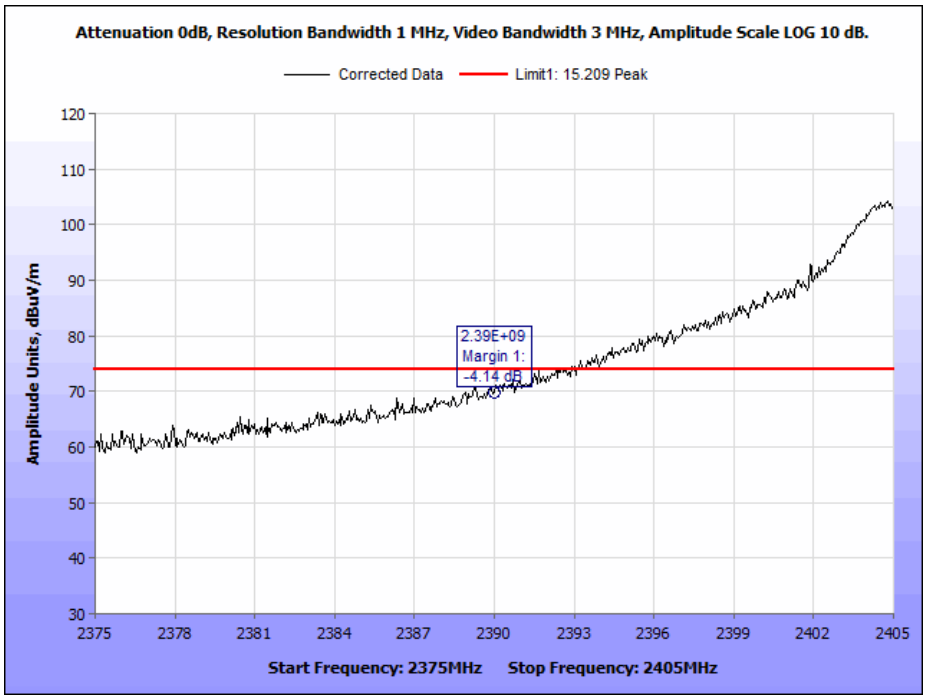
Plot 73. Radiated Restricted Bandedge, Peak, 2390, Channel 1, B



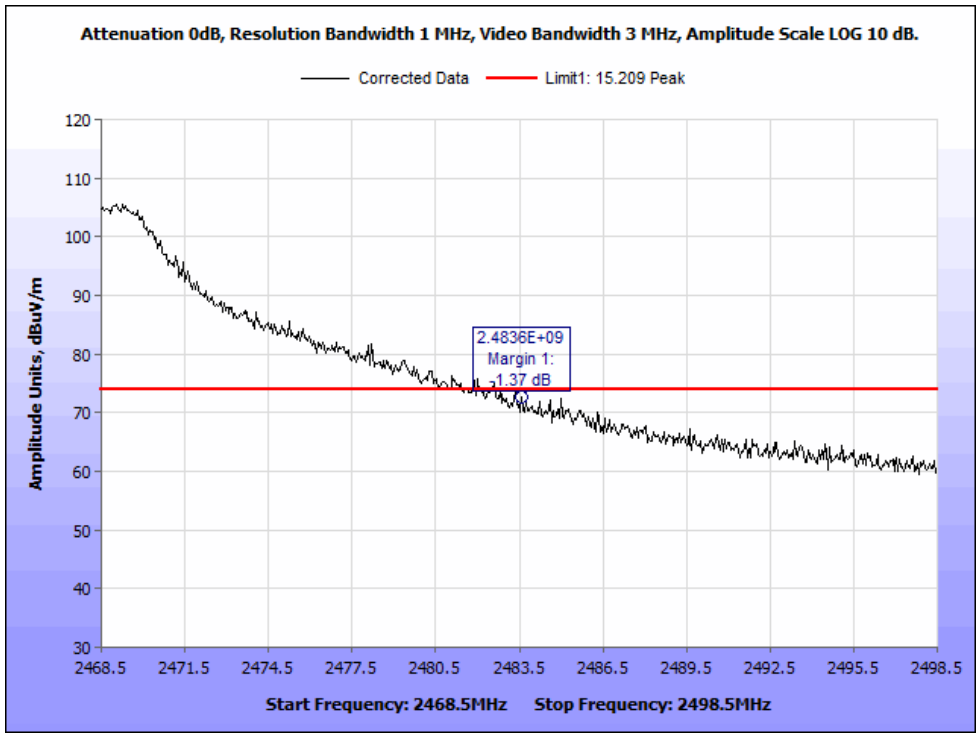
Plot 74. Radiated Restricted Bandedge, Peak, 2390, Channel 1, G



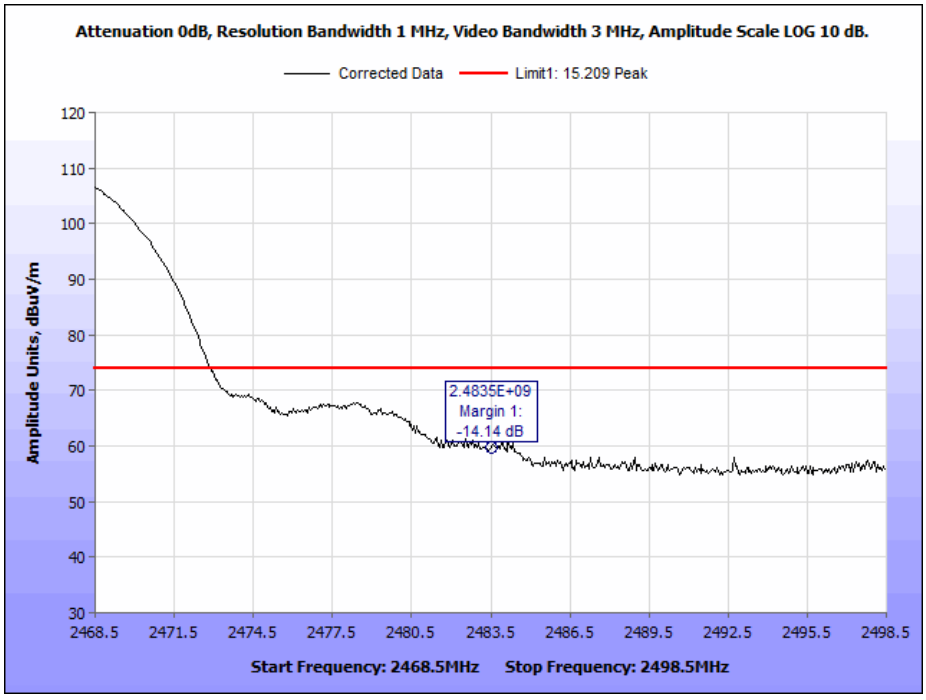
Plot 75. Radiated Restricted Bandedge, Peak, 2390, Channel 1, N 20 MHz



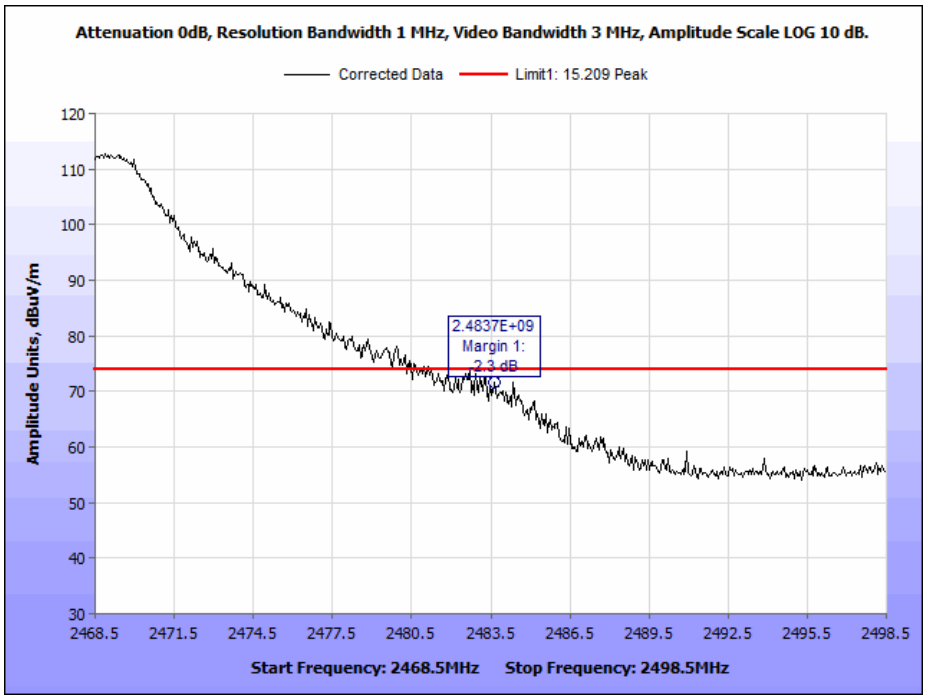
Plot 76. Radiated Restricted Bandedge, Peak, 2390, Channel 3, N 40 MHz



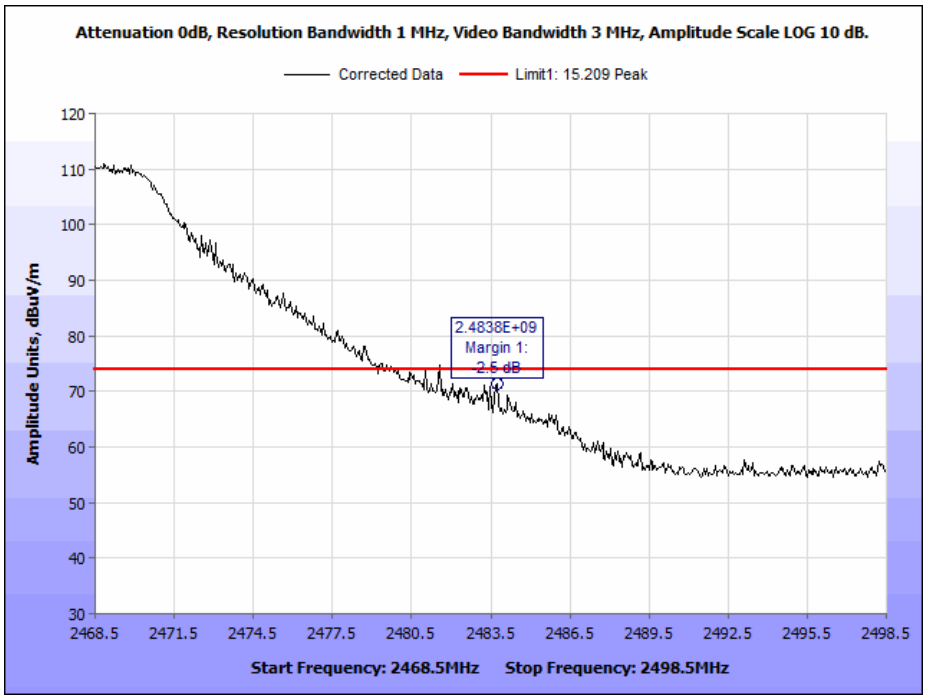
Plot 77. Radiated Restricted Bandedge, Peak, 2483.5, Channel 9, N 40 MHz



Plot 78. Radiated Restricted Bandedge, Peak, 2483.5, Channel 11, B

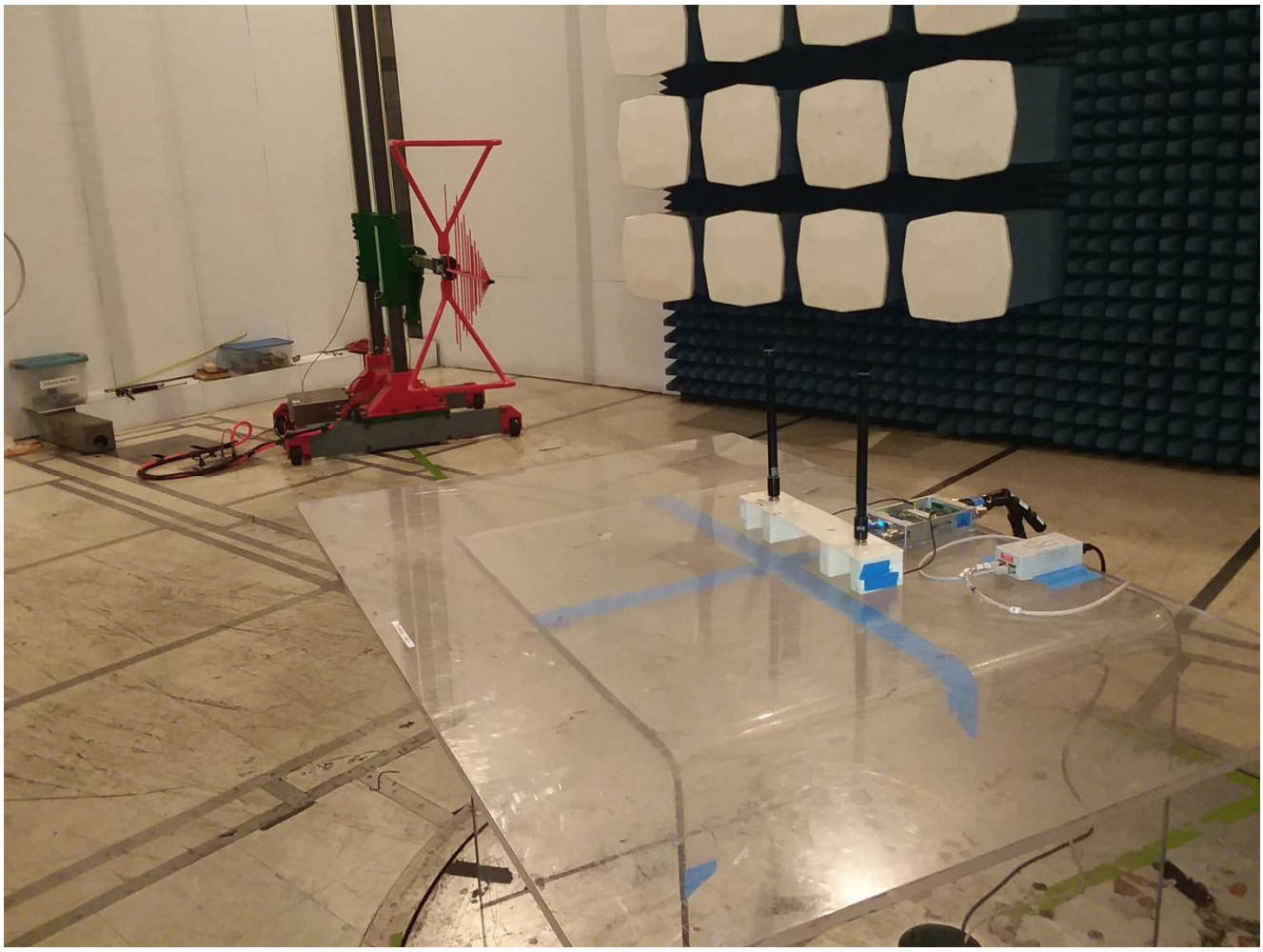


Plot 79. Radiated Restricted Bandedge, Peak, 2483.5, Channel 11, G

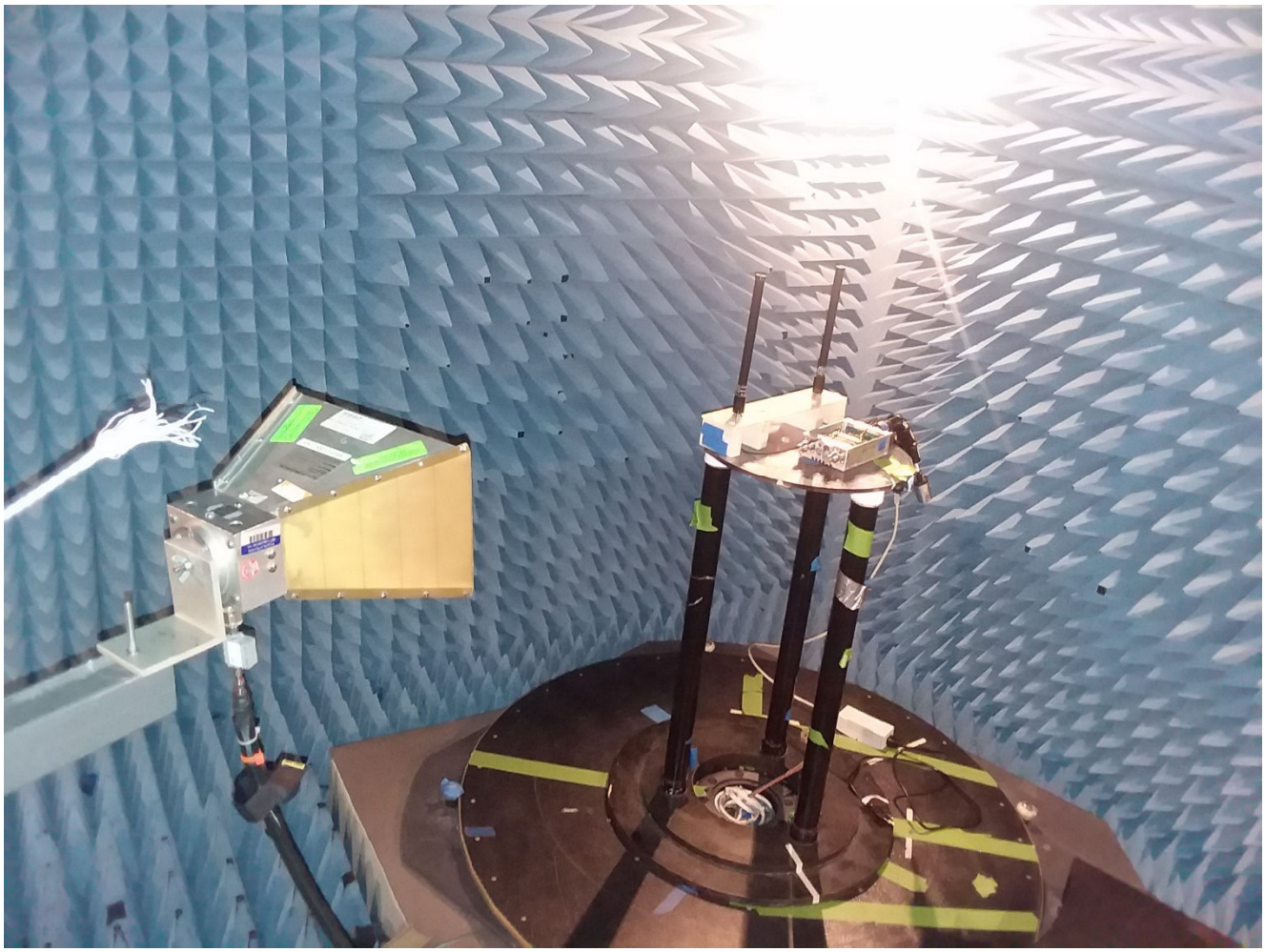


Plot 80. Radiated Restricted Bandedge, Peak, 2483.5, Channel 11, N 20 MHz

Radiated Spurious Emissions Test Setup



Photograph 2. Radiated Emissions, Setup Below 1GHz



Photograph 3. Radiated Emissions, Setup Above 1GHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Spurious Emissions in Non-restricted Bands

Test Requirement: **15.247(d)** 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, 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 30 dB instead of 20 dB.

Test Procedure: For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

Test Results: The EUT was compliant with the Spurious Emission limits of **§15.247(d)**.

Test Engineer(s): Donald Salguero

Test Date(s): June 17 and 18, 2019

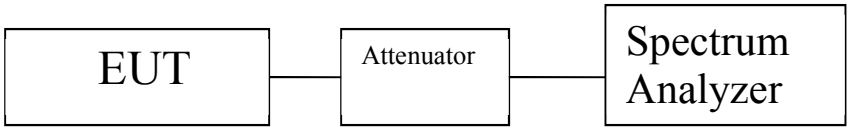
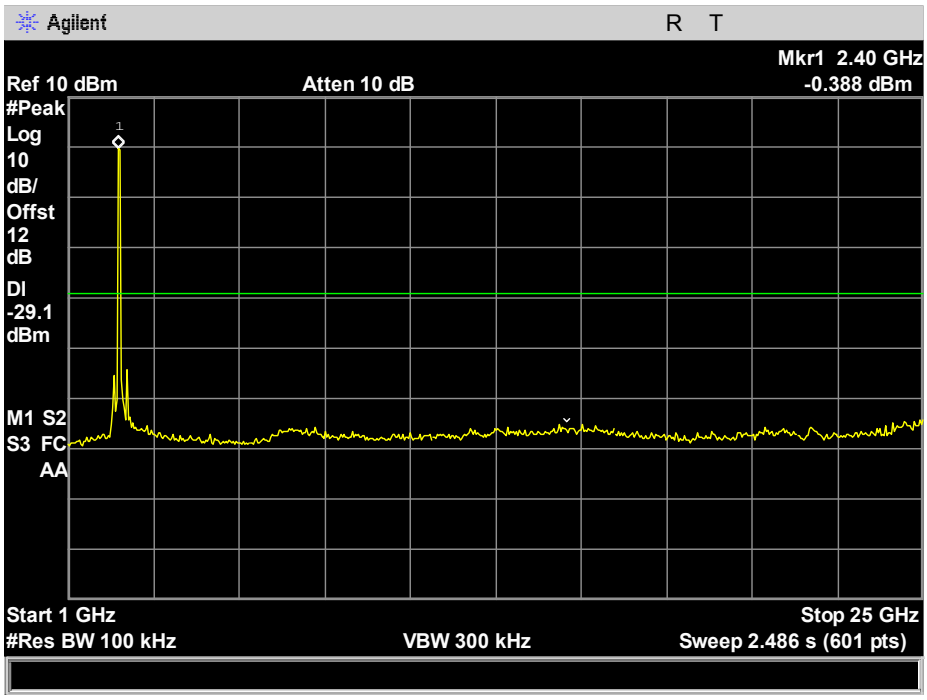
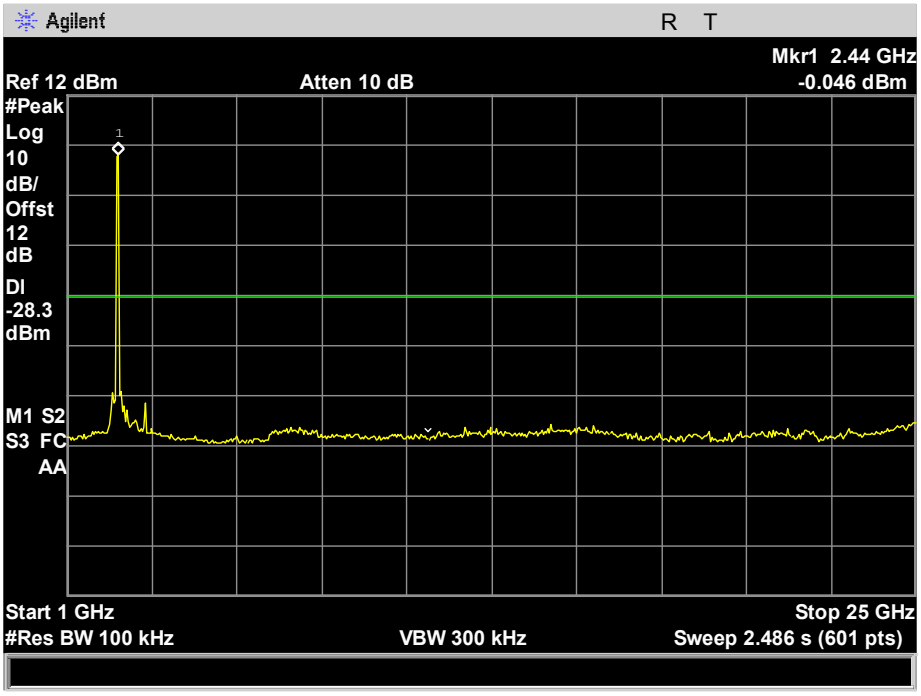


Figure 3. Block Diagram, 100kHz Conducted Spurious Test Setup

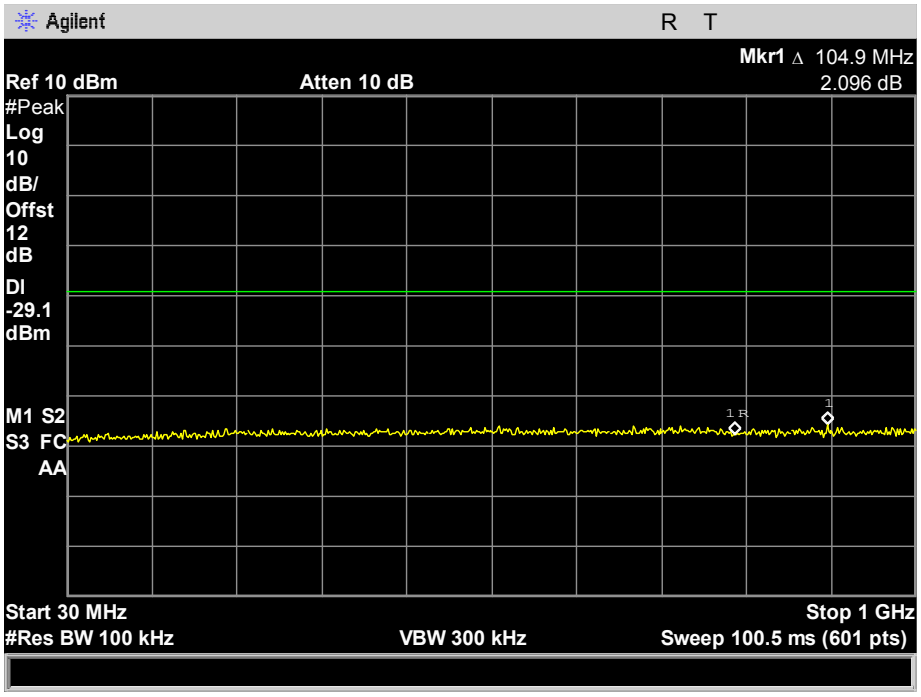
Spurious Emissions in Non-restricted Bands, Test Results



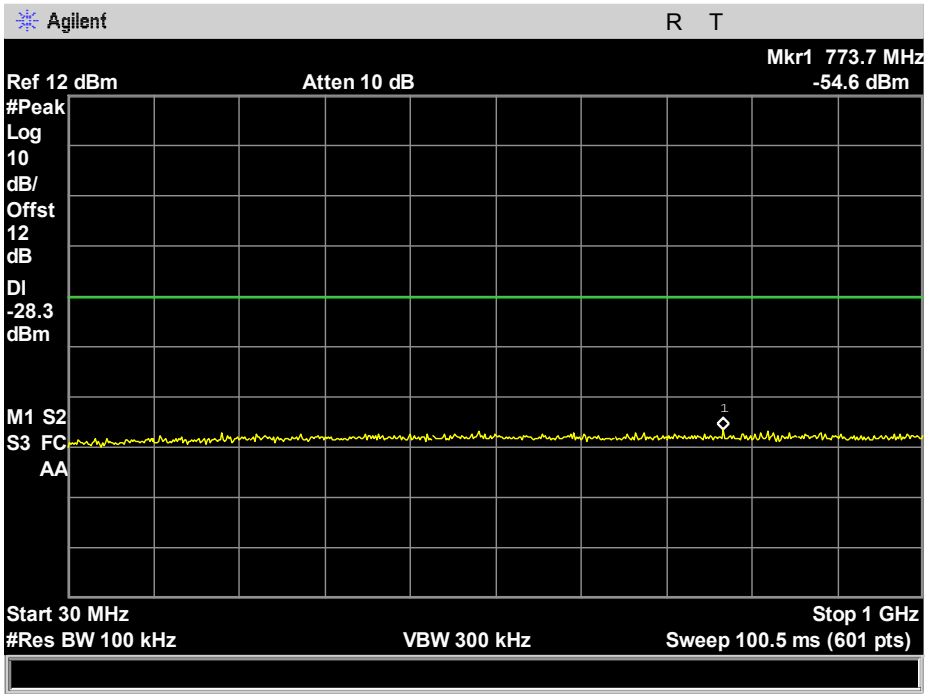
Plot 81. 100 kHz Spurious Emissions, 802.11n, 20M, 2412, 1 – 25 GHz, ch 0



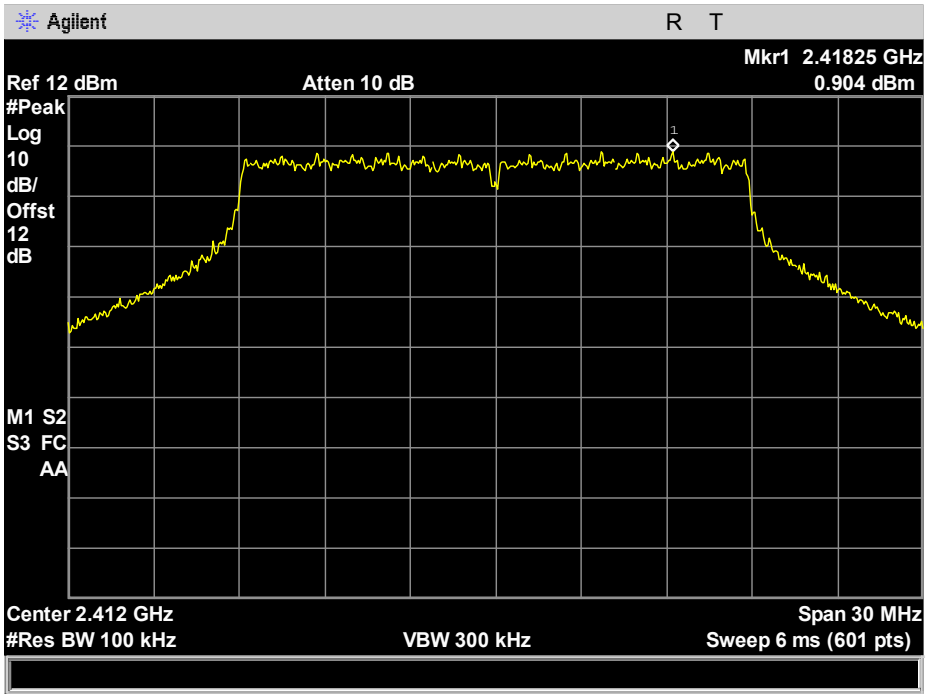
Plot 82. 100 kHz Spurious Emissions, 802.11n, 20M, 2412, 1 – 25 GHz, ch 1



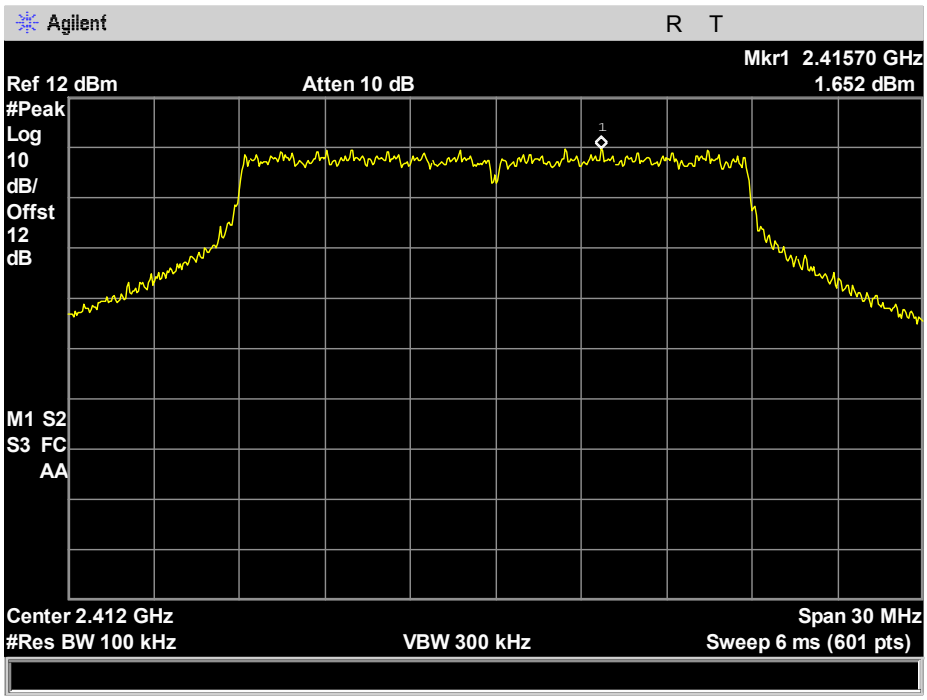
Plot 83. 100 kHz Spurious Emissions, 802.11n, 20M, 2412, 30 – 1000 MHz, ch 0



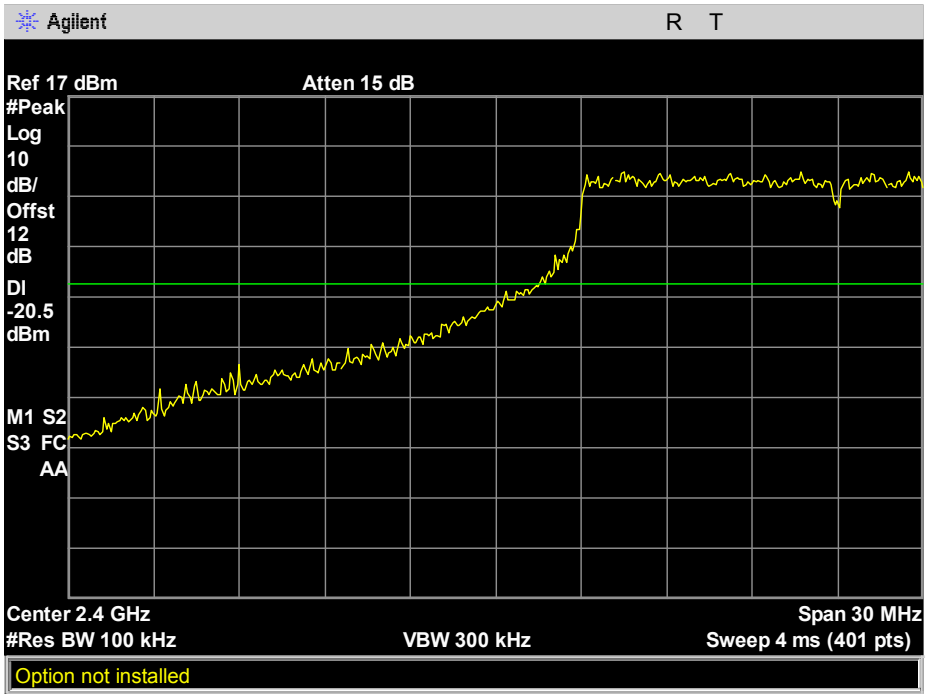
Plot 84. 100 kHz Spurious Emissions, 802.11n, 20M, 2412, 30 – 1000 MHz, ch 1



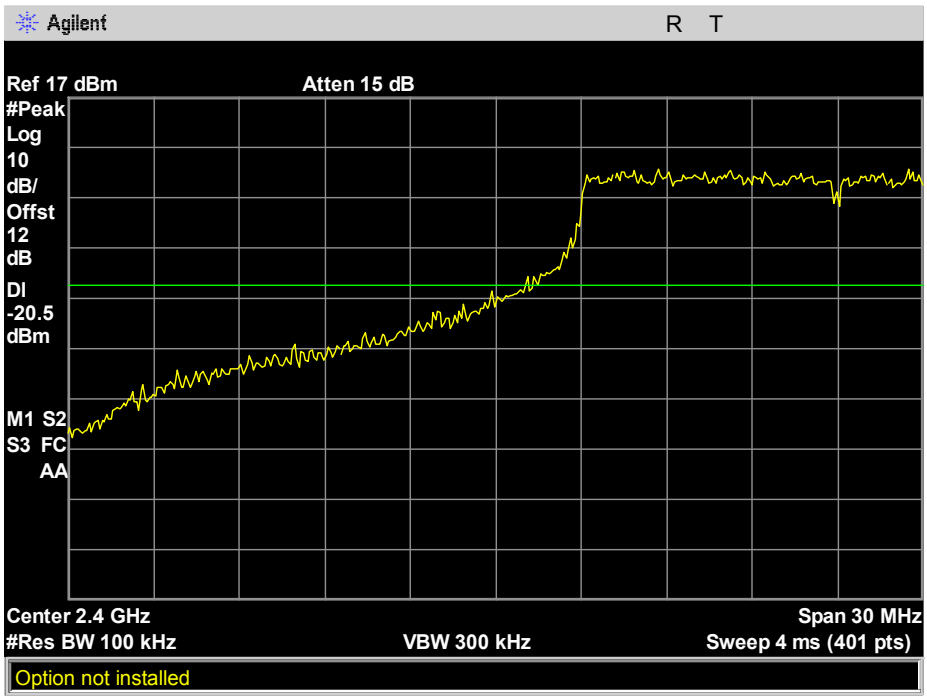
Plot 85. 100 kHz Spurious Emissions, 802.11n, 20M, 2412, Reference Level, ch 0



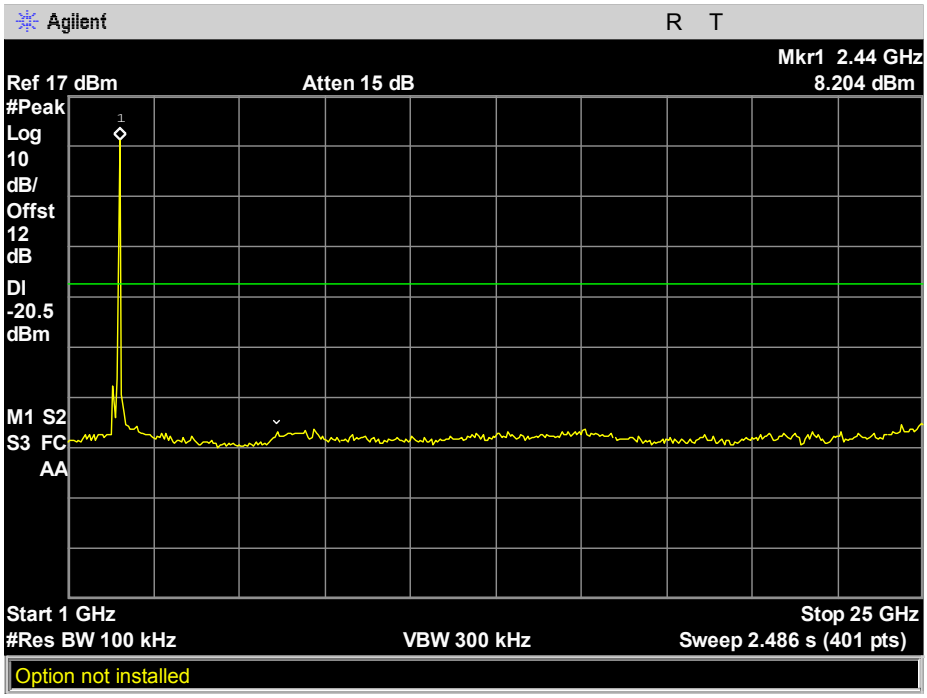
Plot 86. 100 kHz Spurious Emissions, 802.11n, 20M, 2412, Reference Level, ch 1



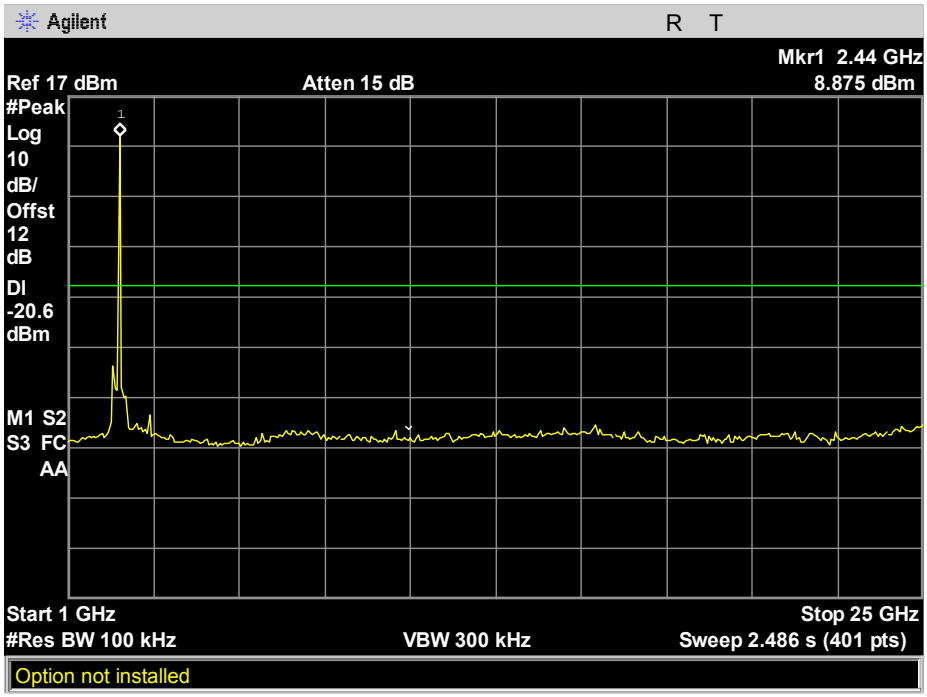
Plot 87. 100 kHz Spurious Emissions, 802.11n, 20M, 2412, Reference Level low bandedge, ch 0



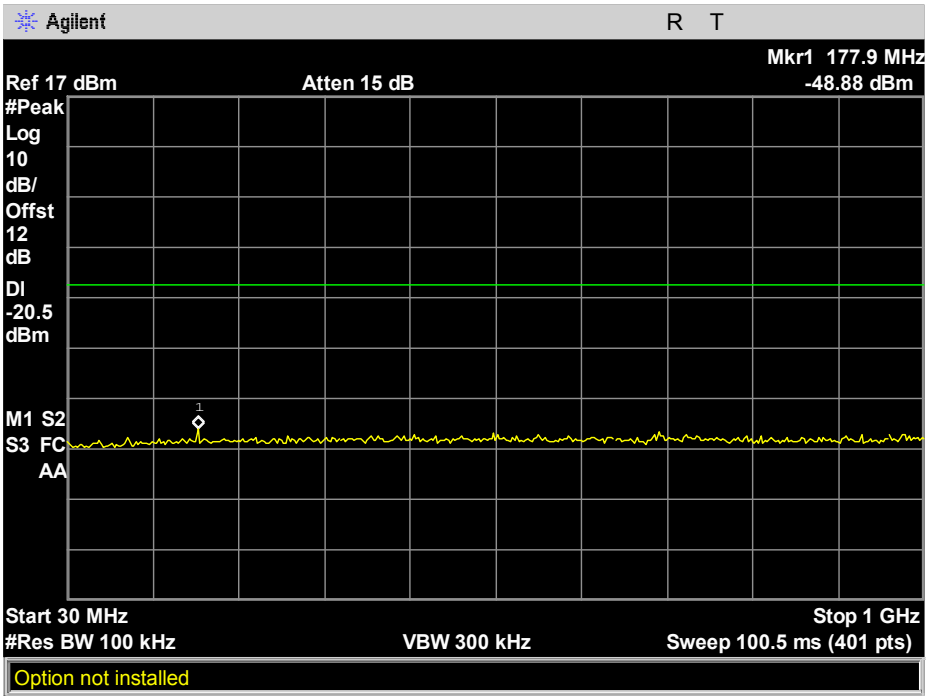
Plot 88. 100 kHz Spurious Emissions, 802.11n, 20M, 2412, Reference Level low bandedge, ch 1



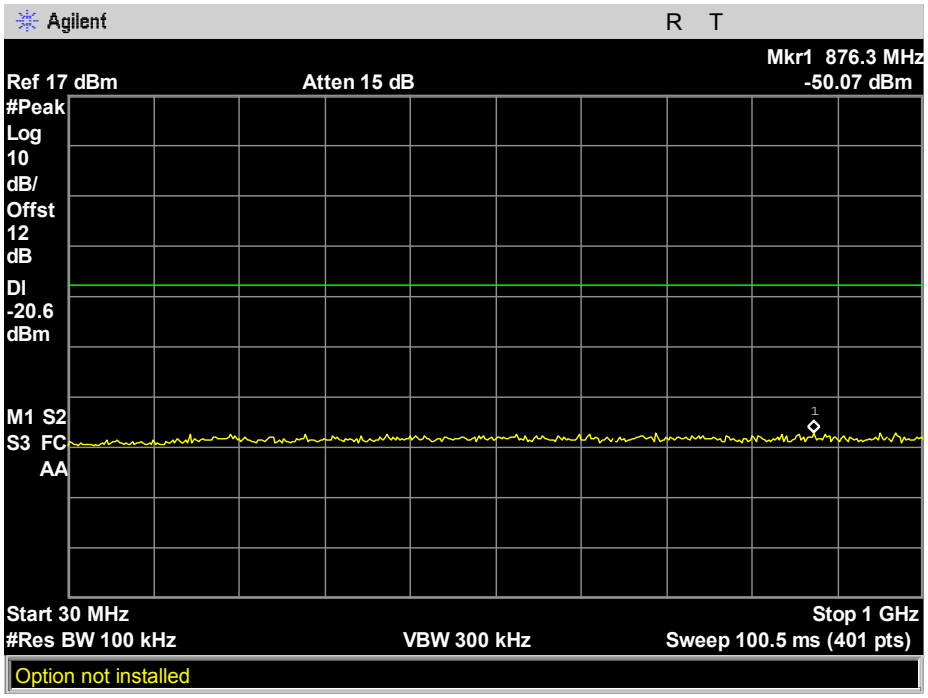
Plot 89. 100 kHz Spurious Emissions, 802.11n, 20M, 2437, 1 – 25 GHz, ch 0



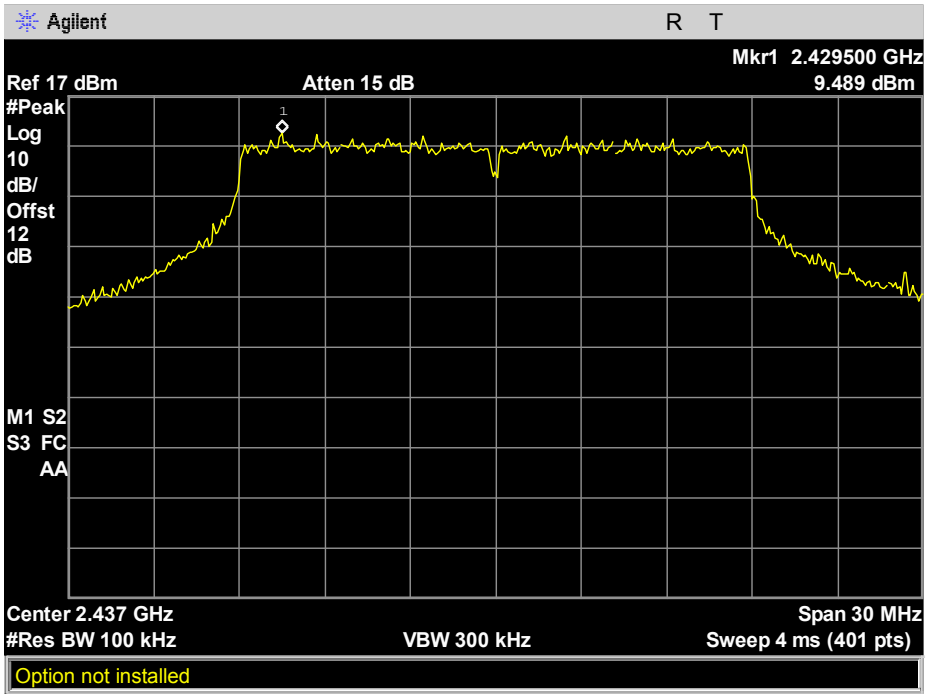
Plot 90. 100 kHz Spurious Emissions, 802.11n, 20M, 2437, 1 – 25 GHz, ch 1



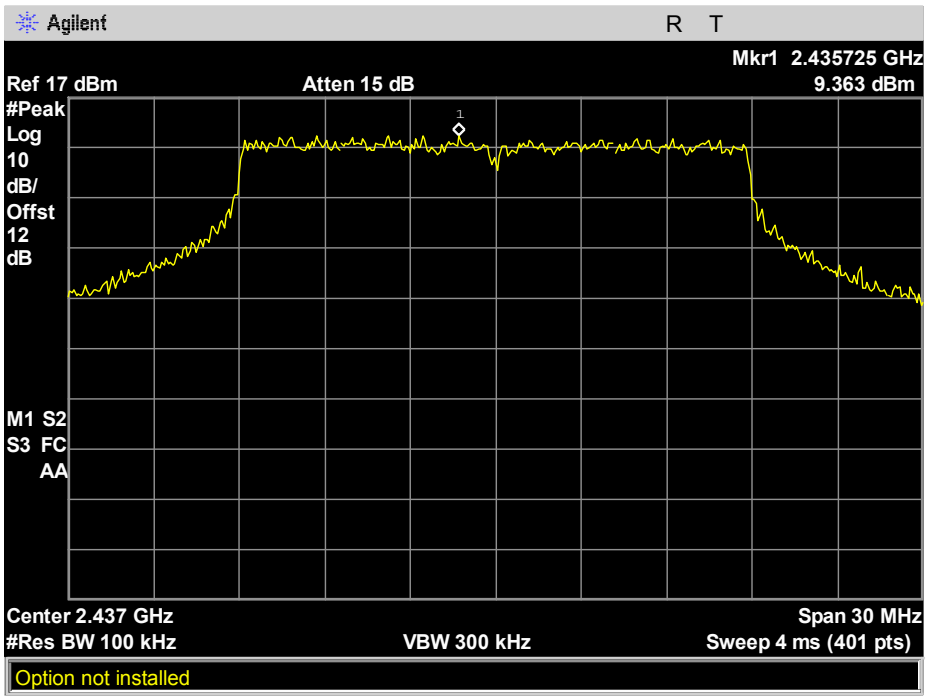
Plot 91. 100 kHz Spurious Emissions, 802.11n, 20M, 2437, 30 – 1000 MHz, ch 0



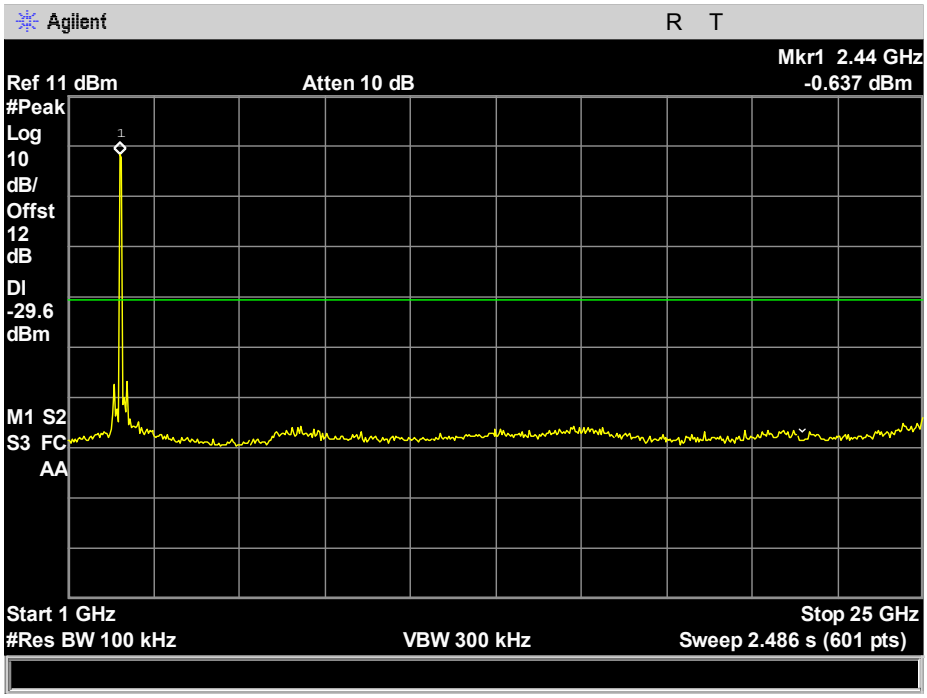
Plot 92. 100 kHz Spurious Emissions, 802.11n, 20M, 2437, 30 – 1000 MHz, ch 1



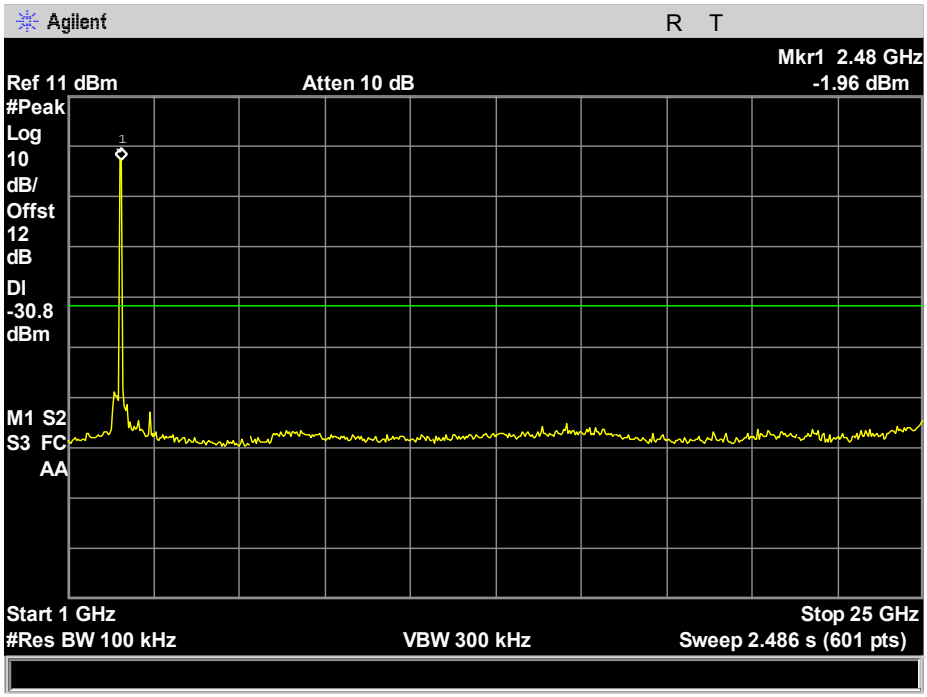
Plot 93. 100 kHz Spurious Emissions, 802.11n, 20M, 2437, Reference Level, ch 0



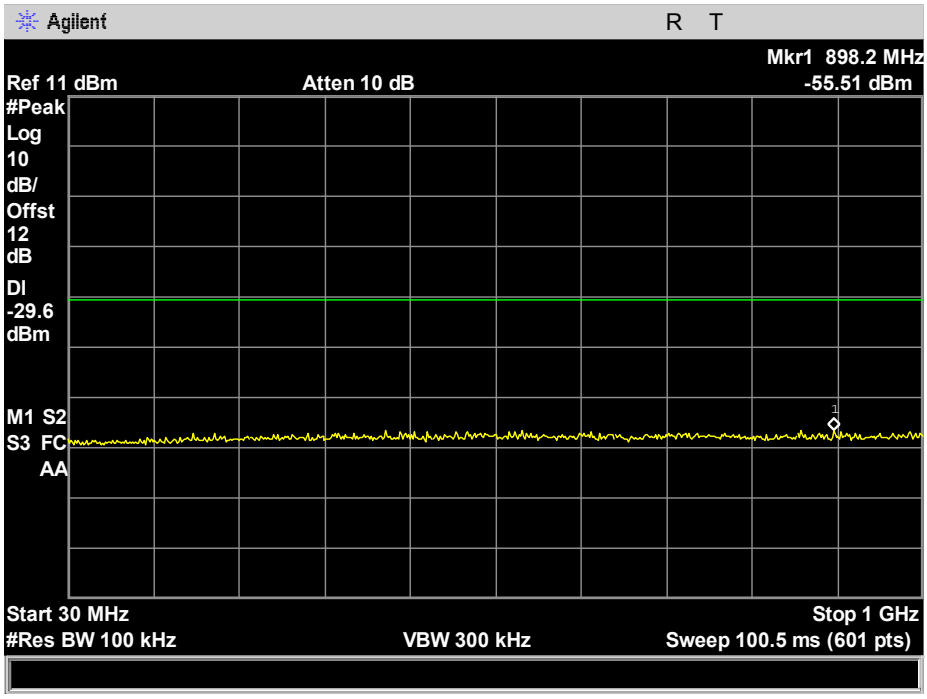
Plot 94. 100 kHz Spurious Emissions, 802.11n, 20M, 2437, Reference Level, ch 1



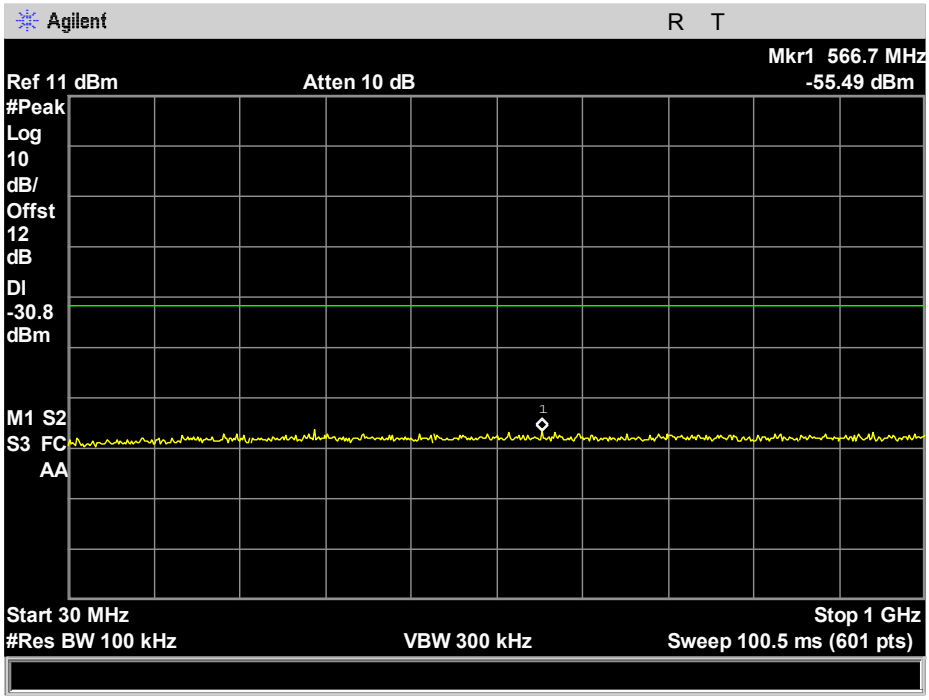
Plot 95. 100 kHz Spurious Emissions, 802.11n, 20M, 2462, 1 – 25 GHz, ch 0



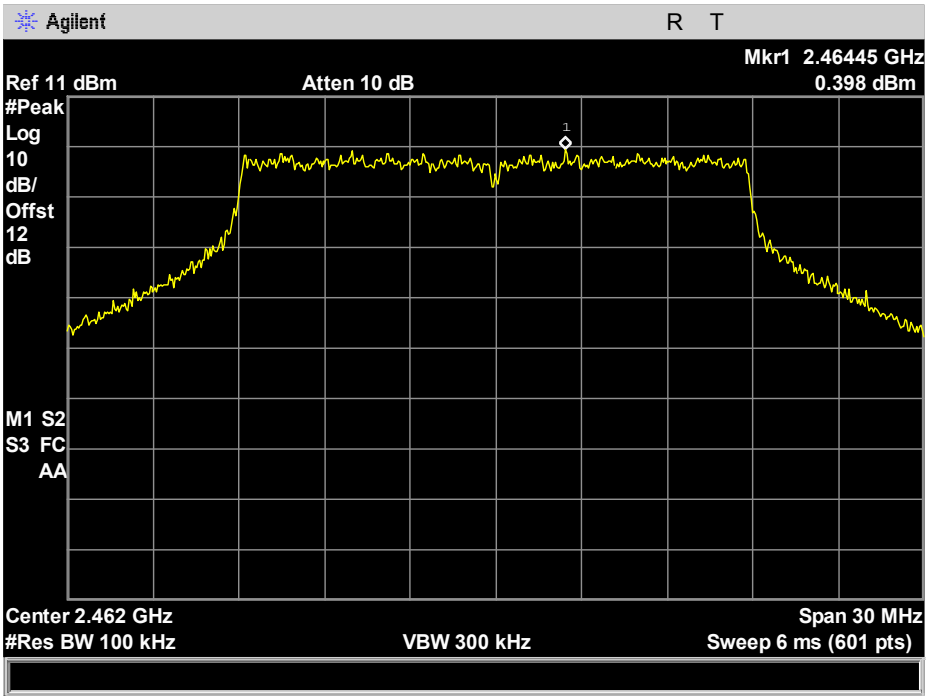
Plot 96. 100 kHz Spurious Emissions, 802.11n, 20M, 2462, 1 – 25 GHz, ch 1



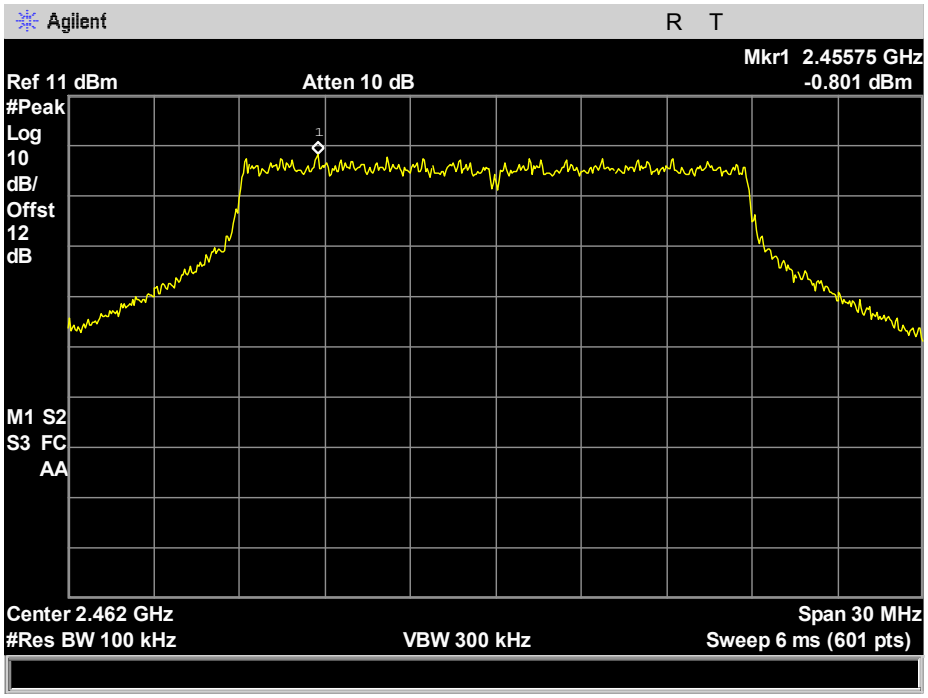
Plot 97. 100 kHz Spurious Emissions, 802.11n, 20M, 2462, 30 – 1000 MHz, ch 0



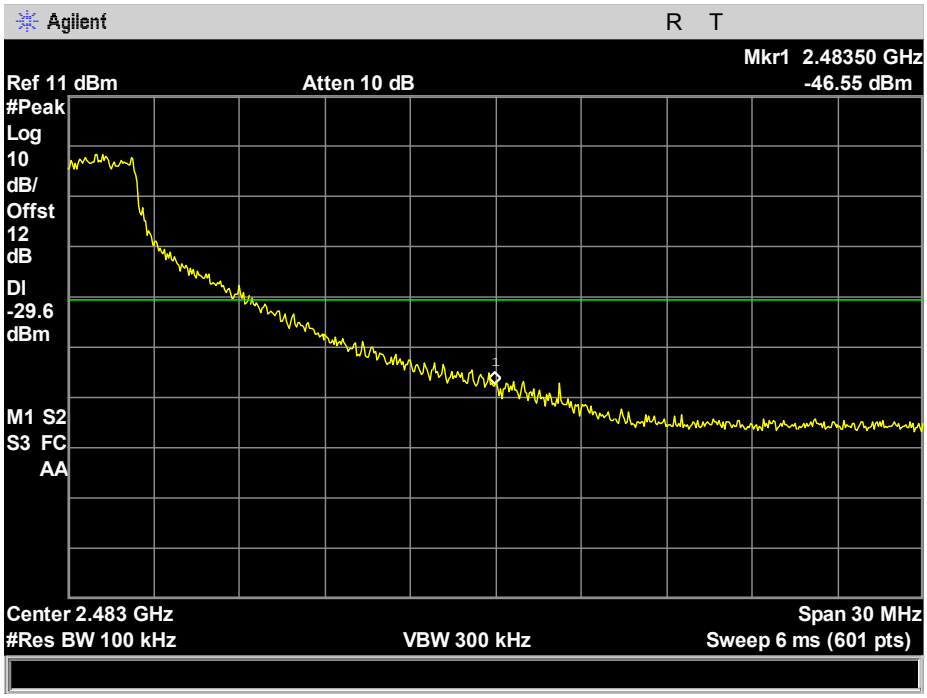
Plot 98. 100 kHz Spurious Emissions, 802.11n, 20M, 2462, 30 – 1000 MHz, ch 1



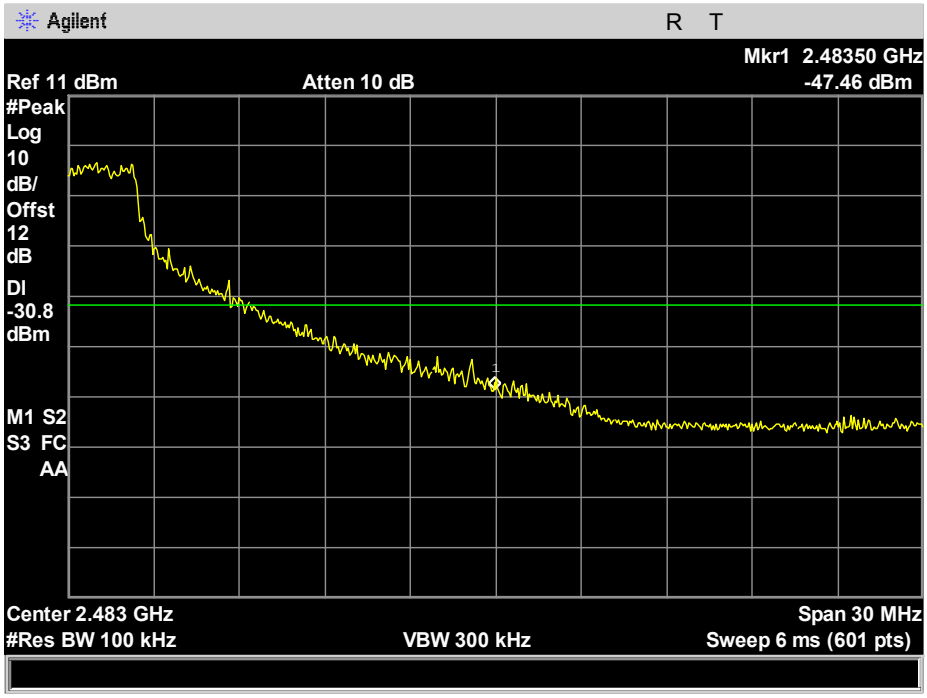
Plot 99. 100 kHz Spurious Emissions, 802.11n, 20M, 2462, Reference Level, ch 0



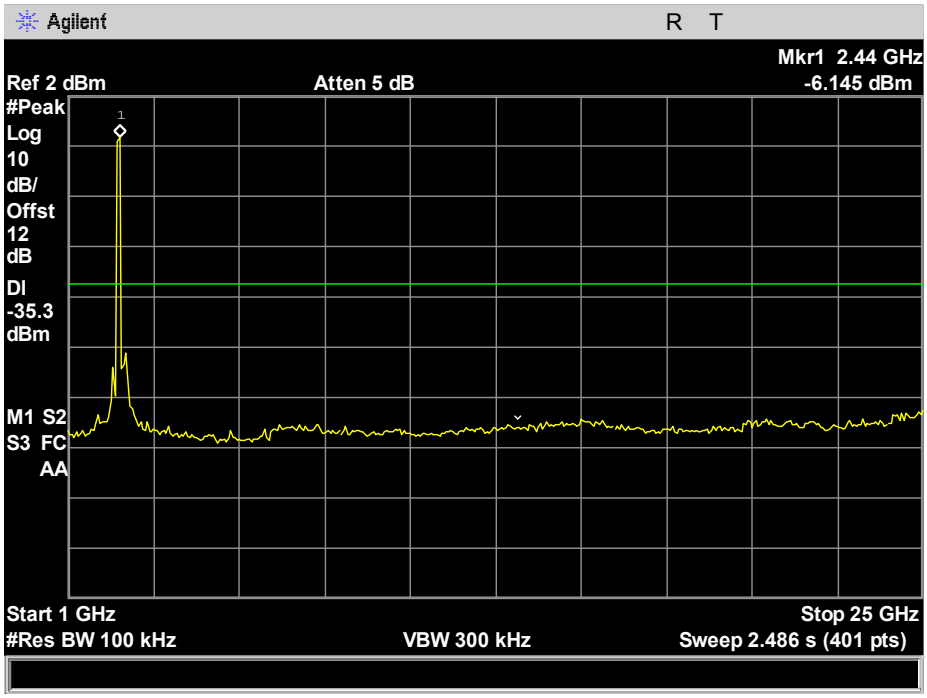
Plot 100. 100 kHz Spurious Emissions, 802.11n, 20M, 2462, Reference Level, ch 1



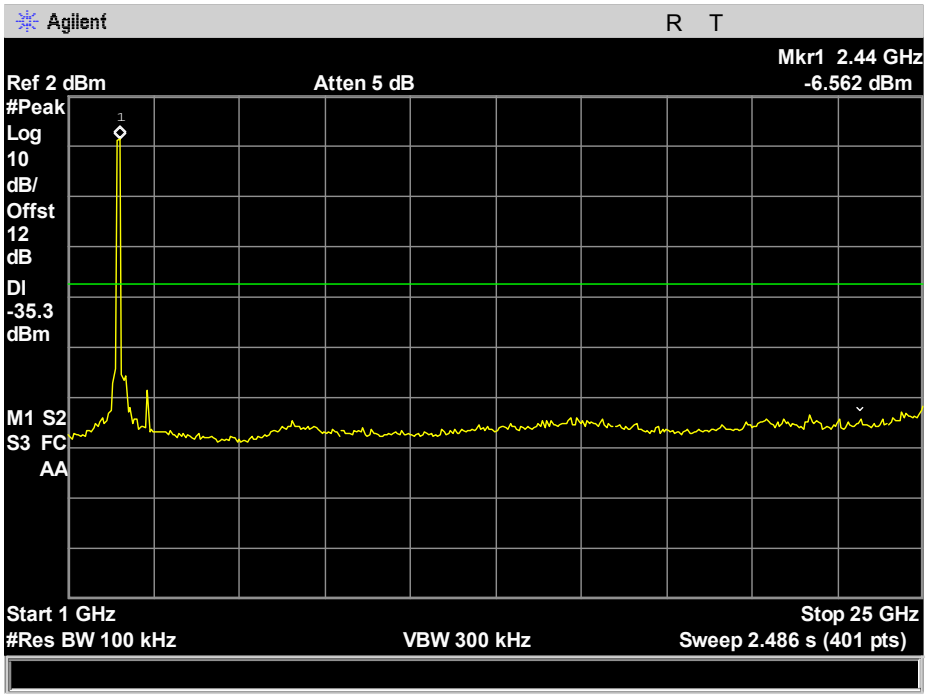
Plot 101. 100 kHz Spurious Emissions, 802.11n, 20M, 2462, high bandedge, ch 0



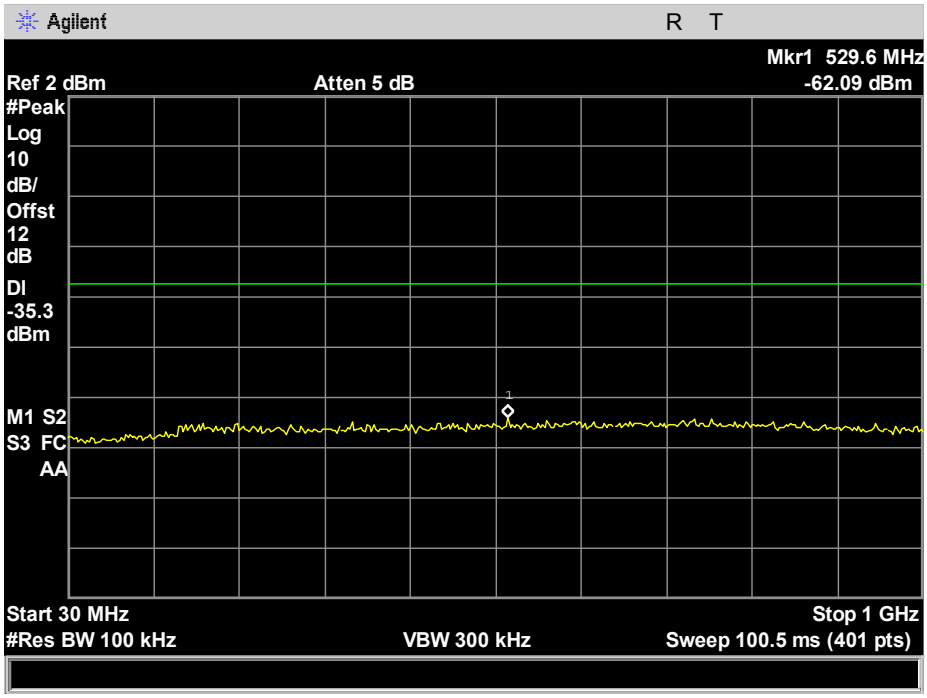
Plot 102. 100 kHz Spurious Emissions, 802.11n, 20M, 2462, high bandedge, ch 1



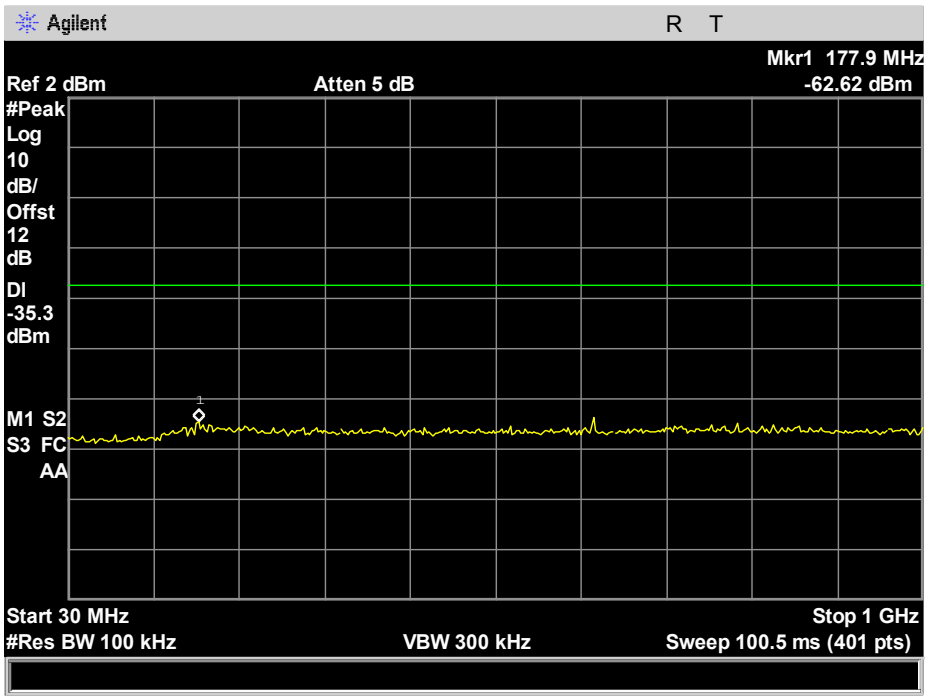
Plot 103. 100 kHz Spurious Emissions, 802.11n, 40M, 2422, 1 – 25 GHz, ch 0



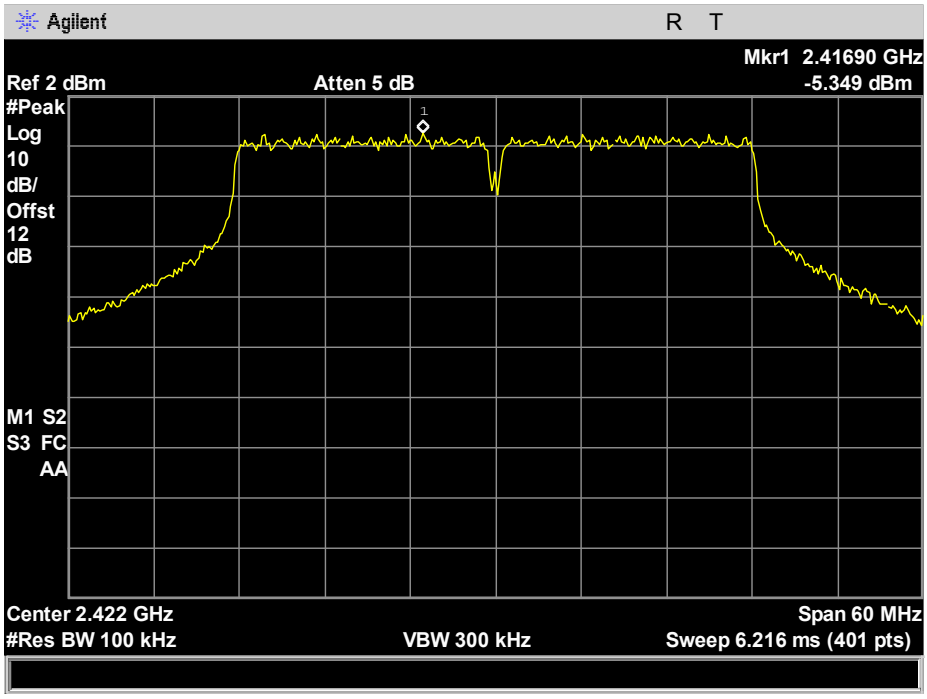
Plot 104. 100 kHz Spurious Emissions, 802.11n, 40M, 2422, 1 – 25 GHz, ch 1



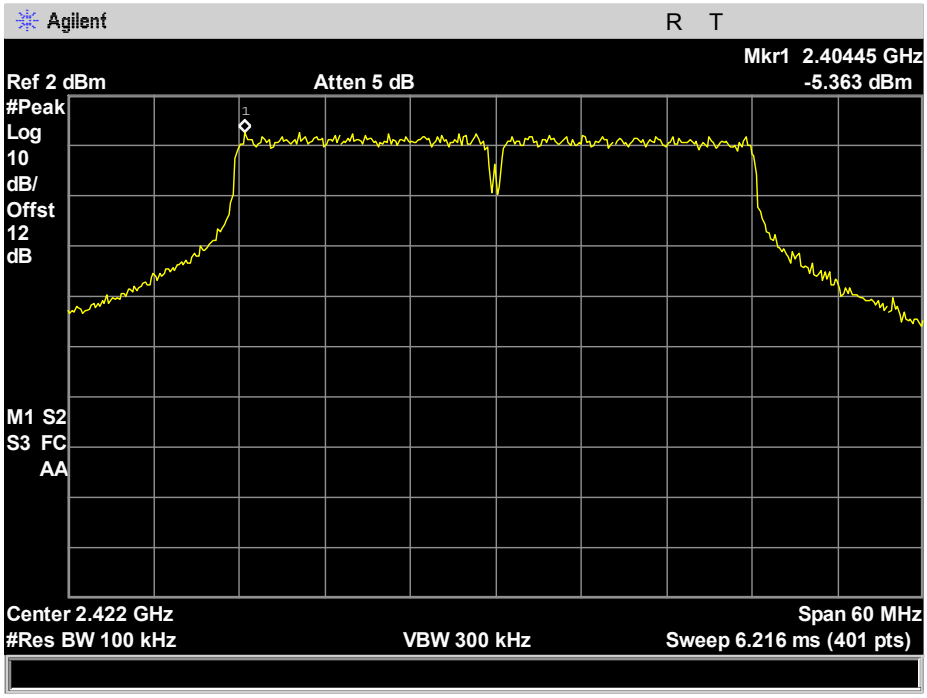
Plot 105. 100 kHz Spurious Emissions, 802.11n, 40M, 2422, 30 – 1000 MHz, ch 0



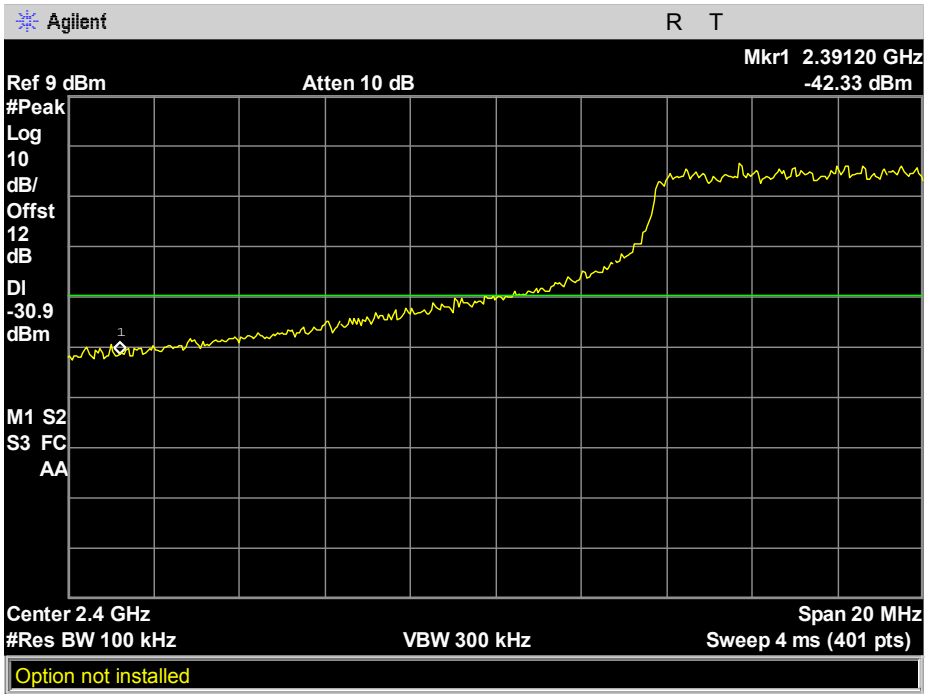
Plot 106. 100 kHz Spurious Emissions, 802.11n, 40M, 2422, 30 – 1000 MHz, ch 1



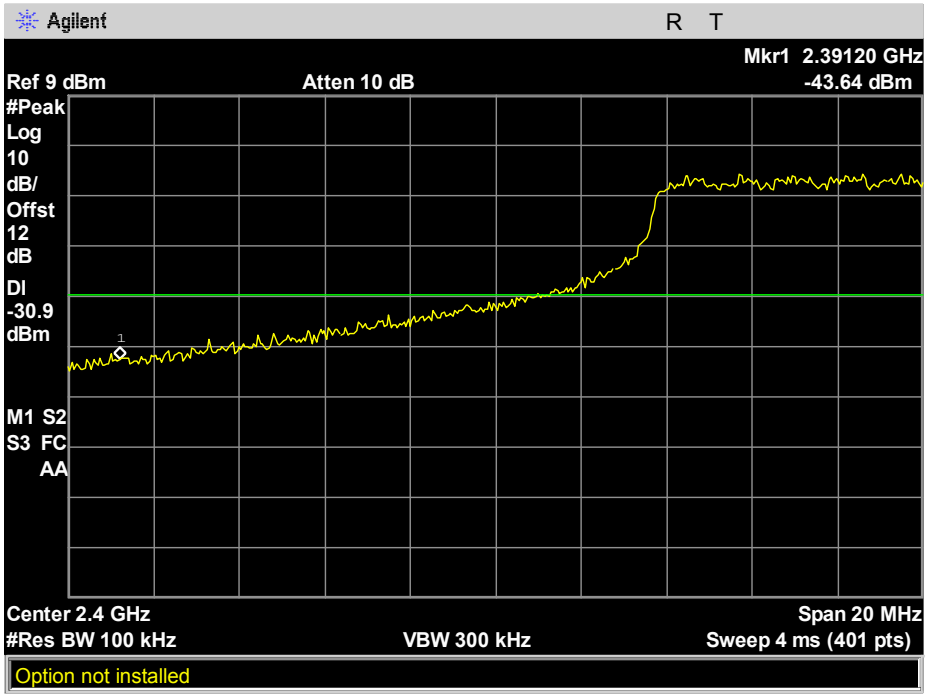
Plot 107. 100 kHz Spurious Emissions, 802.11n, 40M, 2422, Reference Level, ch 0



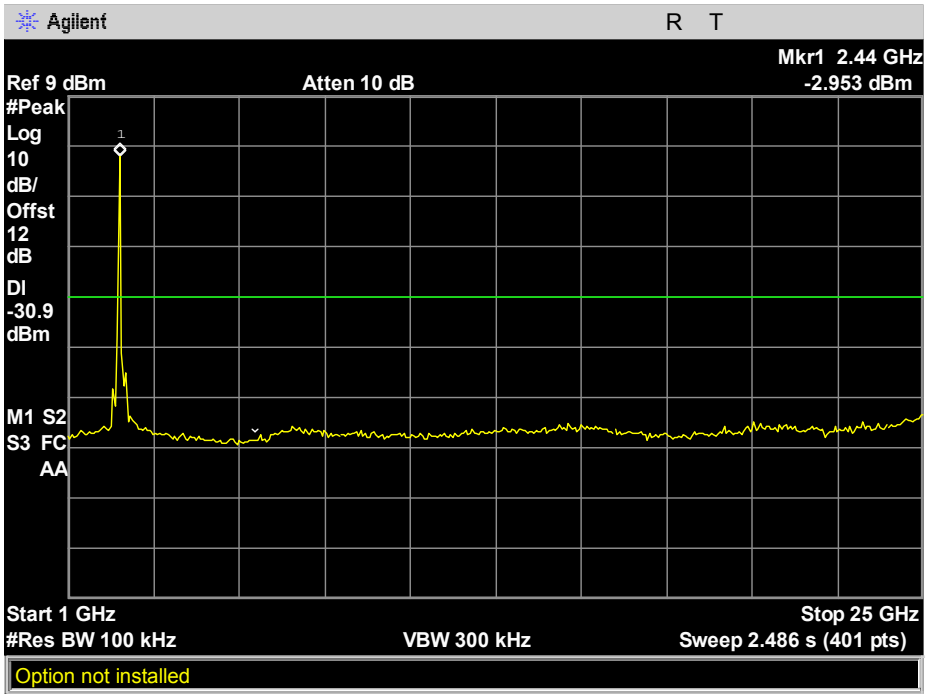
Plot 108. 100 kHz Spurious Emissions, 802.11n, 40M, 2422, Reference Level, ch 1



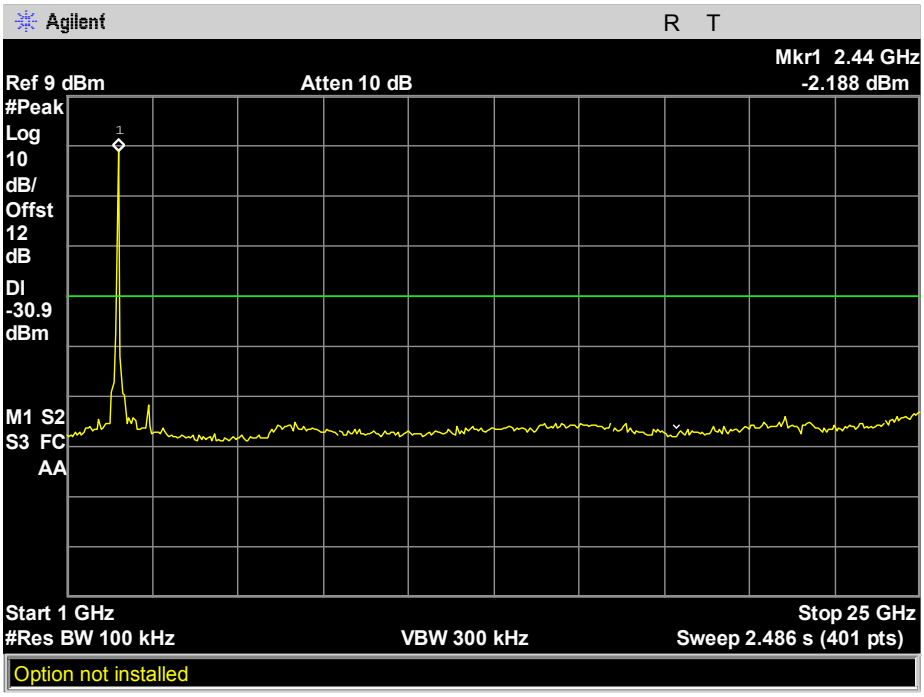
Plot 109. 100 kHz Spurious Emissions, 802.11n, 40M, 2422, Reference Level low bandedge, ch 0



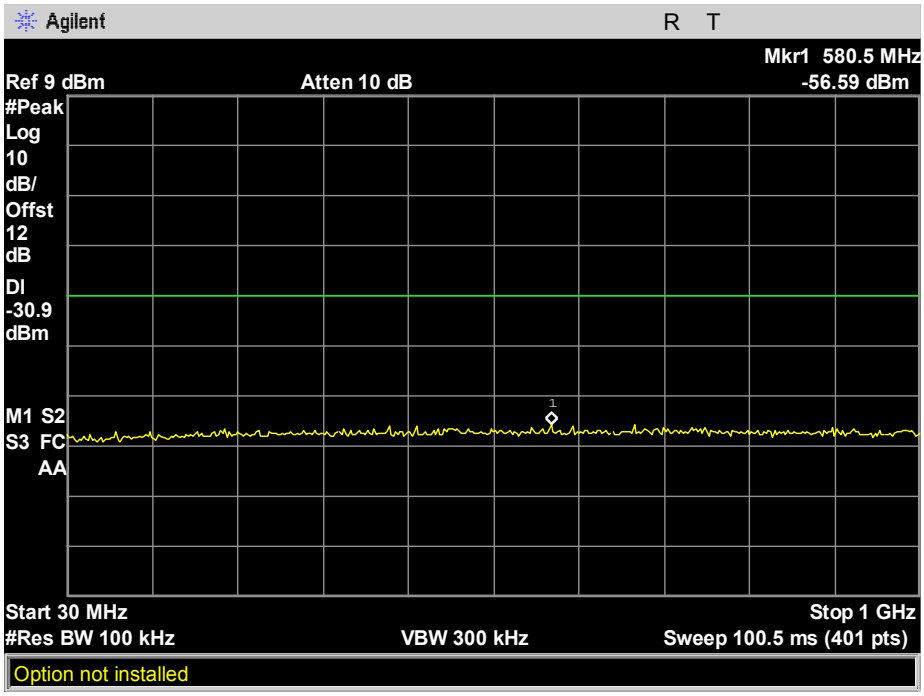
Plot 110. 100 kHz Spurious Emissions, 802.11n, 40M, 2422, Reference Level low bandedge, ch 1



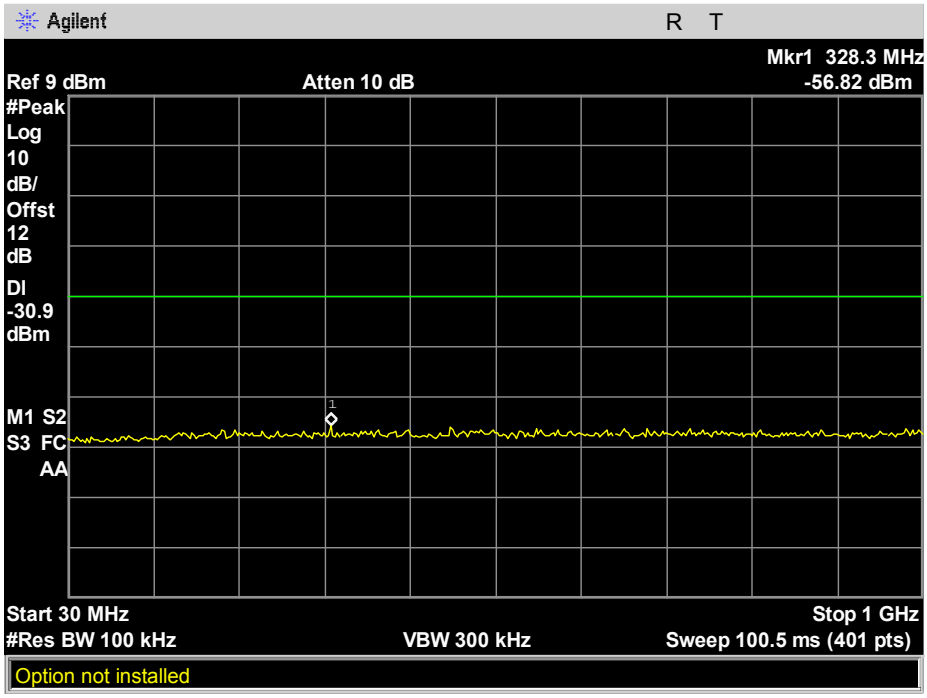
Plot 111. 100 kHz Spurious Emissions, 802.11n, 40M, 2437, 1 – 25 GHz, ch 0



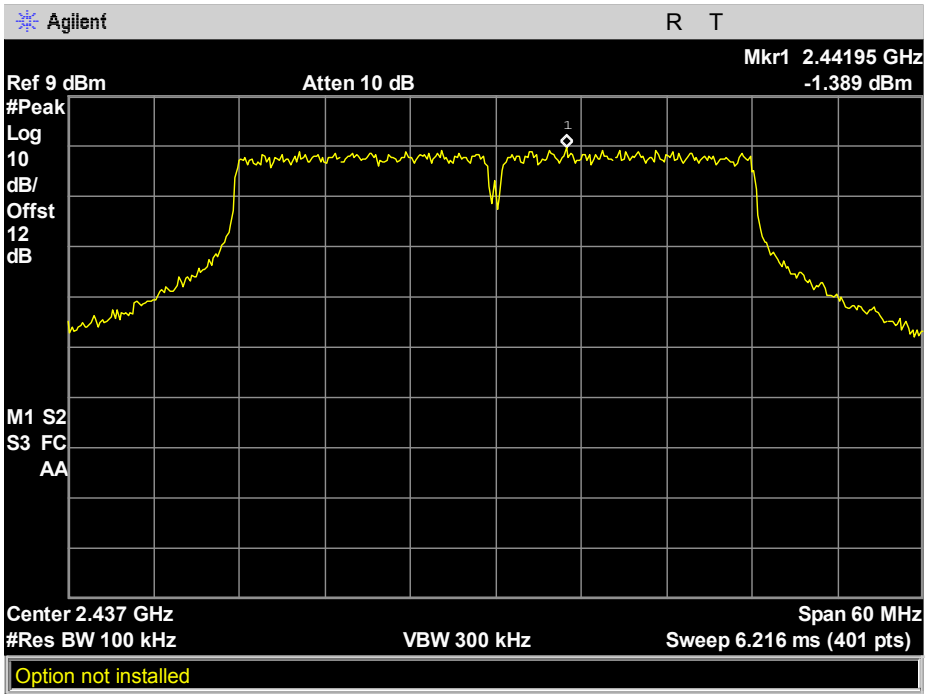
Plot 112. 100 kHz Spurious Emissions, 802.11n, 40M, 2437, 1 – 25 GHz, ch 1



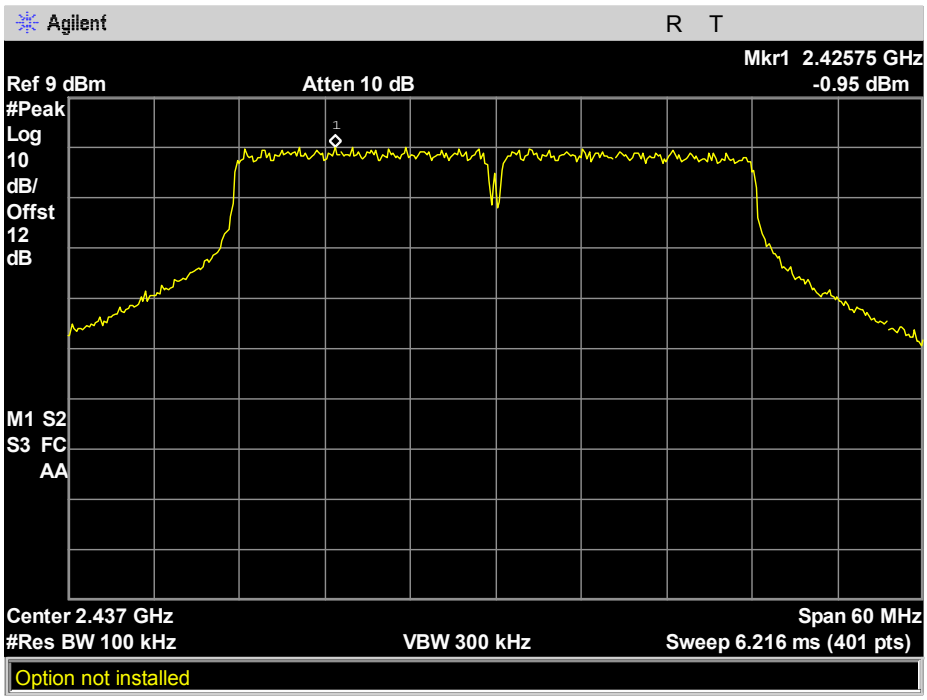
Plot 113. 100 kHz Spurious Emissions, 802.11n, 40M, 2437, 30 – 1000 MHz, ch 0



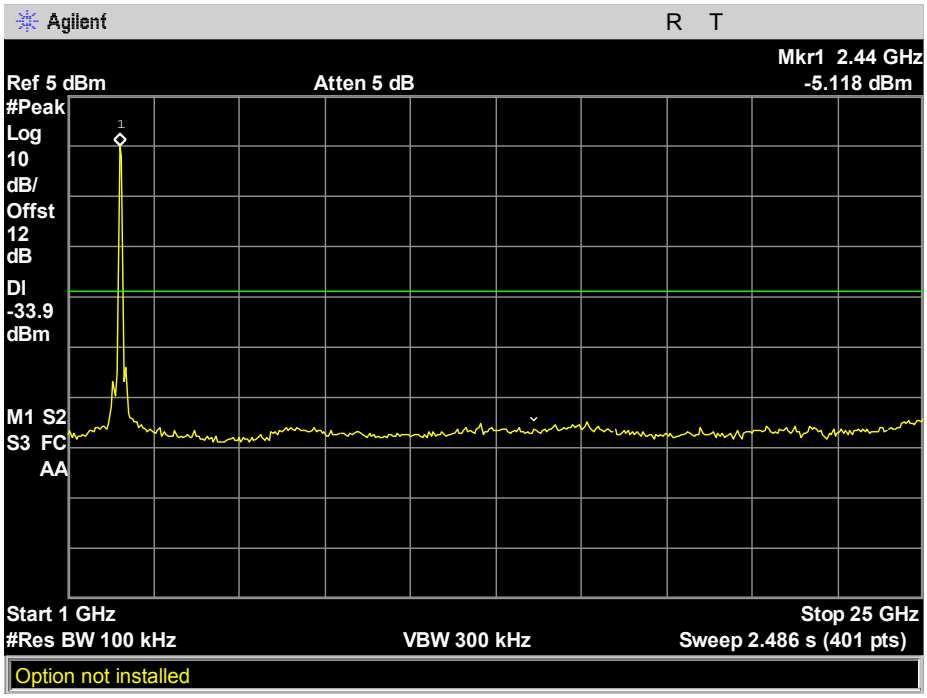
Plot 114. 100 kHz Spurious Emissions, 802.11n, 40M, 2437, 30 – 1000 MHz, ch 1



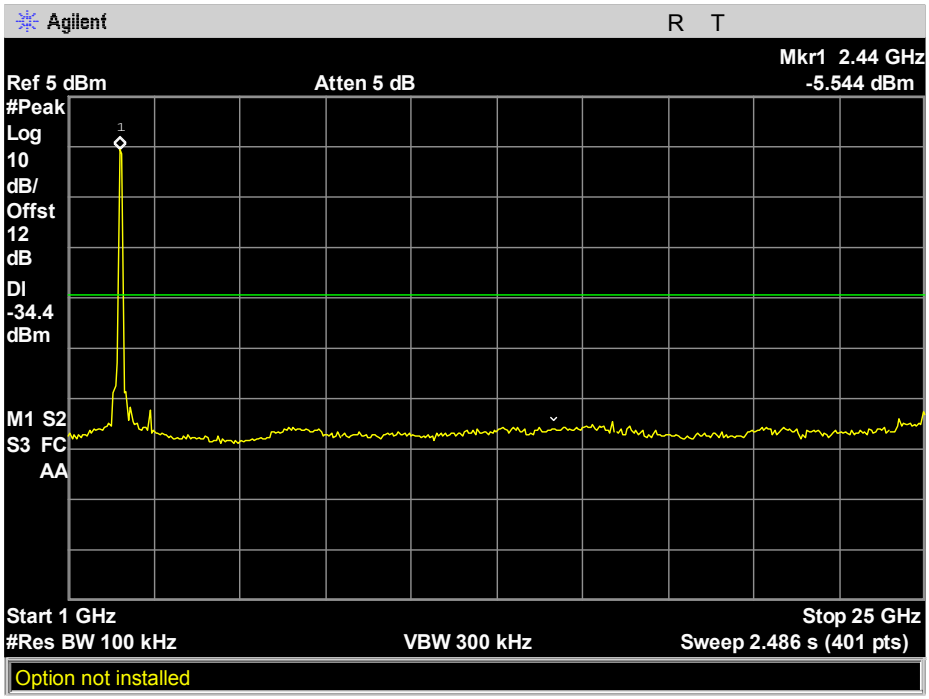
Plot 115. 100 kHz Spurious Emissions, 802.11n, 40M, 2437, Reference Level, ch 0



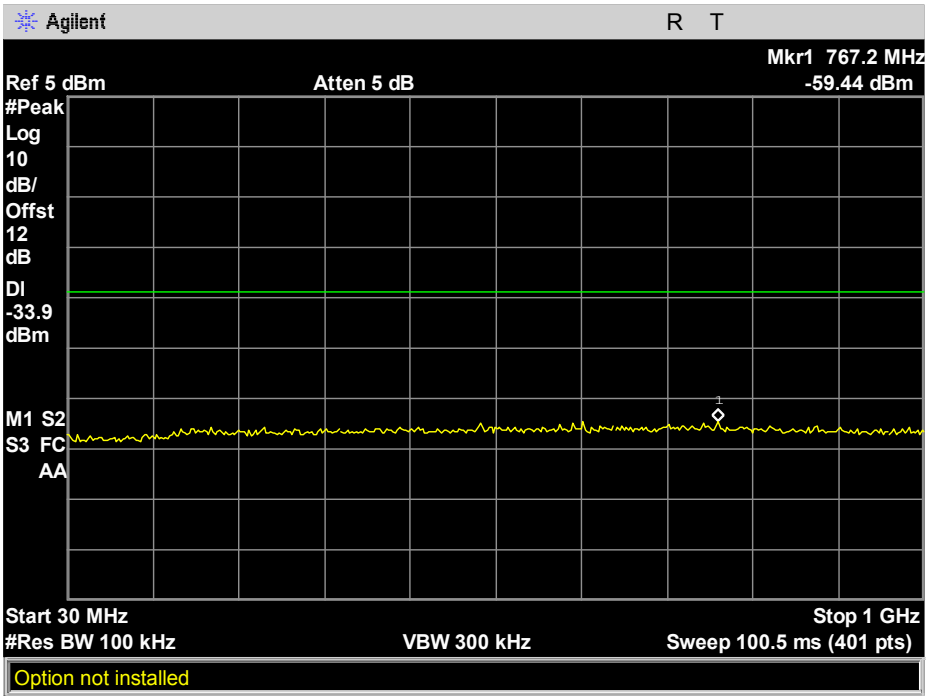
Plot 116. 100 kHz Spurious Emissions, 802.11n, 40M, 2437, Reference Level, ch 1



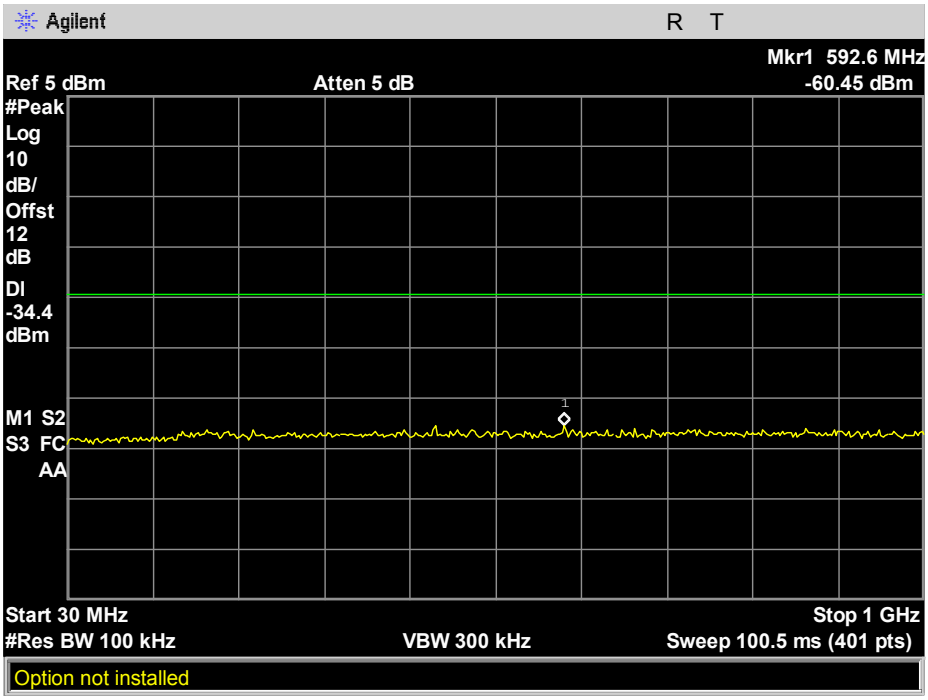
Plot 117. 100 kHz Spurious Emissions, 802.11n, 40M, 2452, 1 – 25 GHz, ch 0



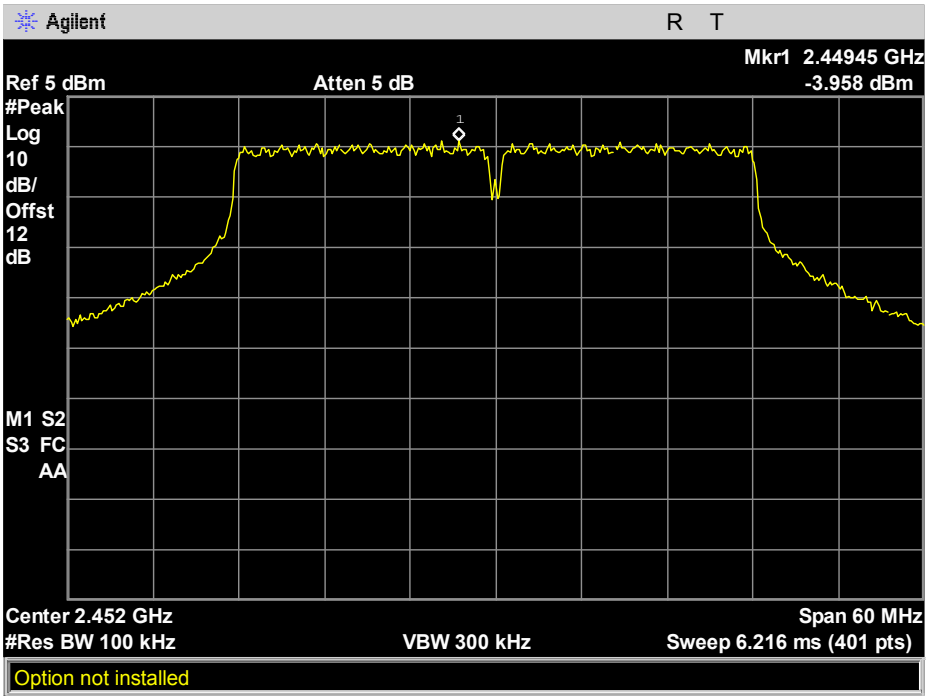
Plot 118. 100 kHz Spurious Emissions, 802.11n, 40M, 2452, 1 – 25 GHz, ch 1



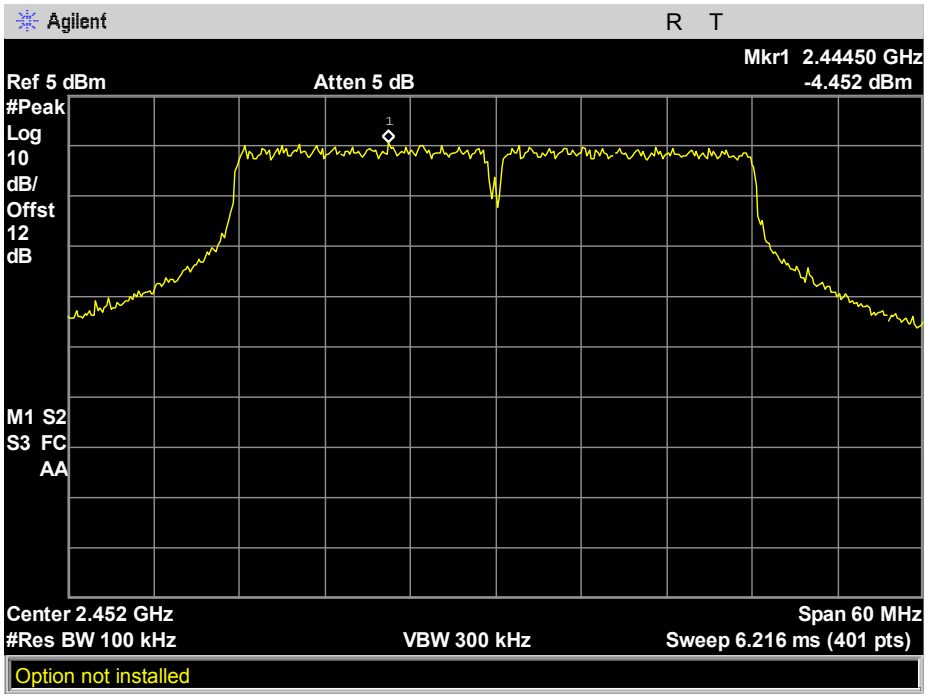
Plot 119. 100 kHz Spurious Emissions, 802.11n, 40M, 2452, 30 – 1000 MHz, ch 0



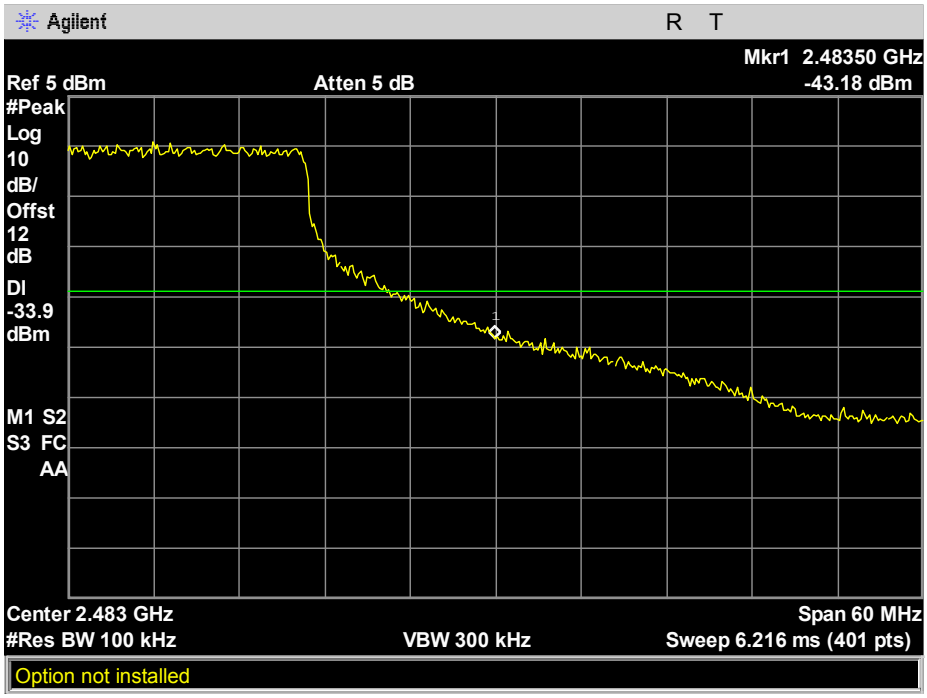
Plot 120. 100 kHz Spurious Emissions, 802.11n, 40M, 2452, 30 – 1000 MHz, ch 1



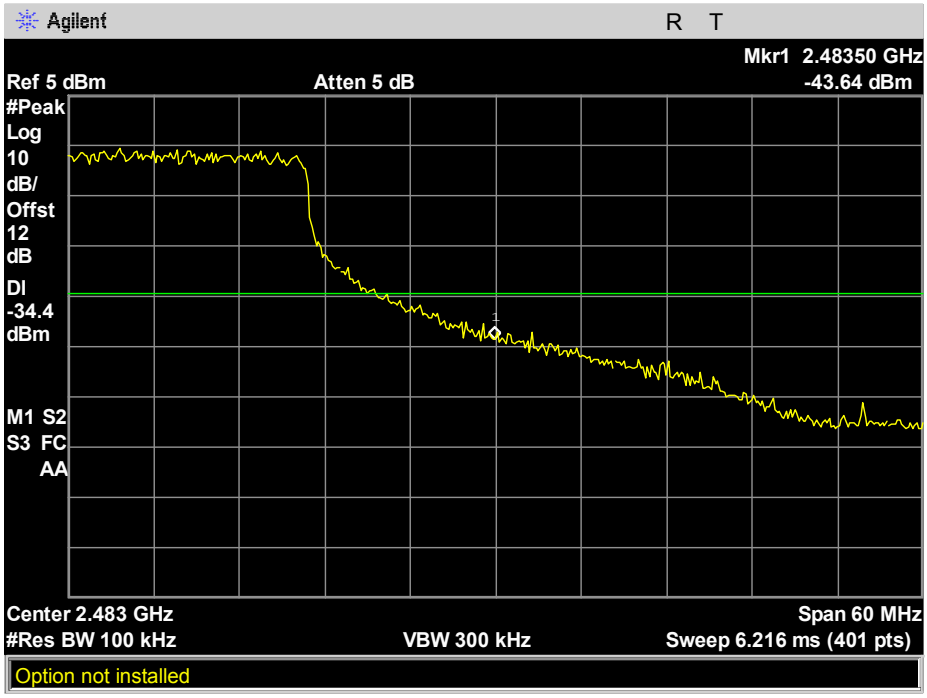
Plot 121. 100 kHz Spurious Emissions, 802.11n, 40M, 2452, Reference Level, ch 0



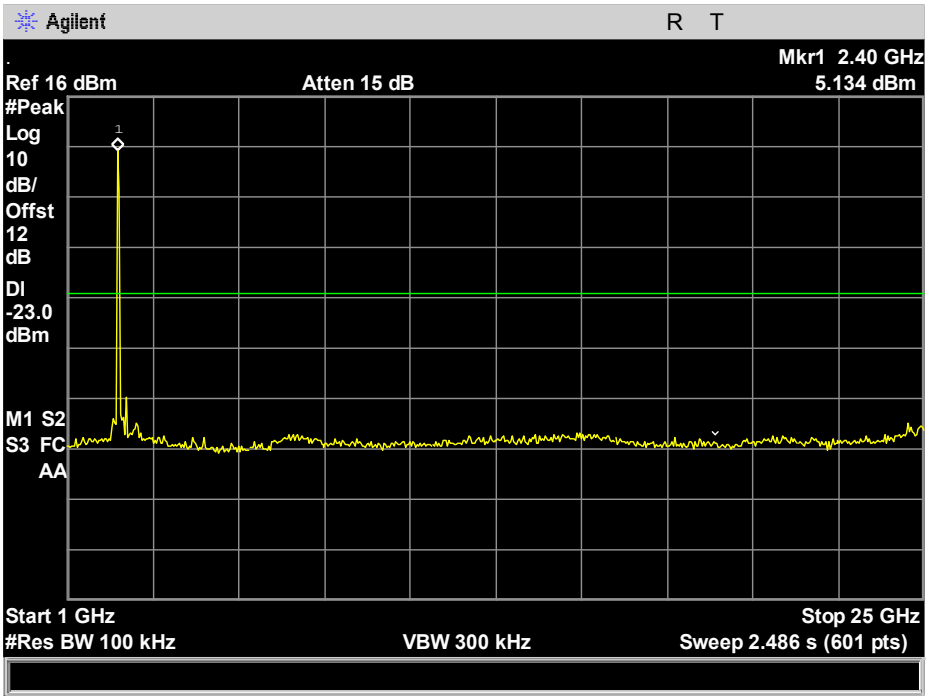
Plot 122. 100 kHz Spurious Emissions, 802.11n, 40M, 2452, Reference Level, ch 1



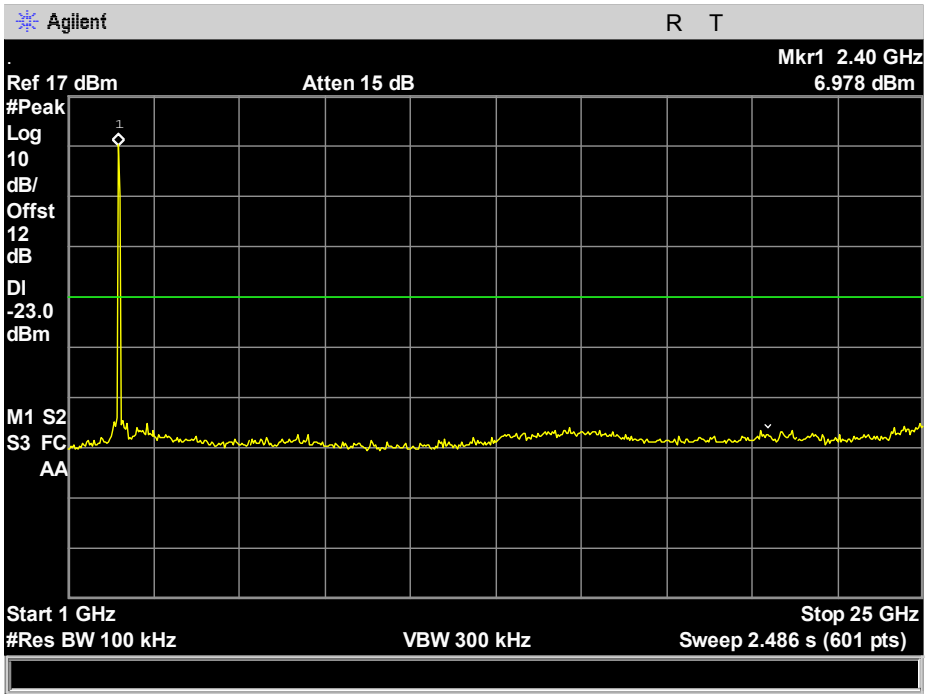
Plot 123. 100 kHz Spurious Emissions, 802.11n, 40M, 2452, high bandedge, ch 0



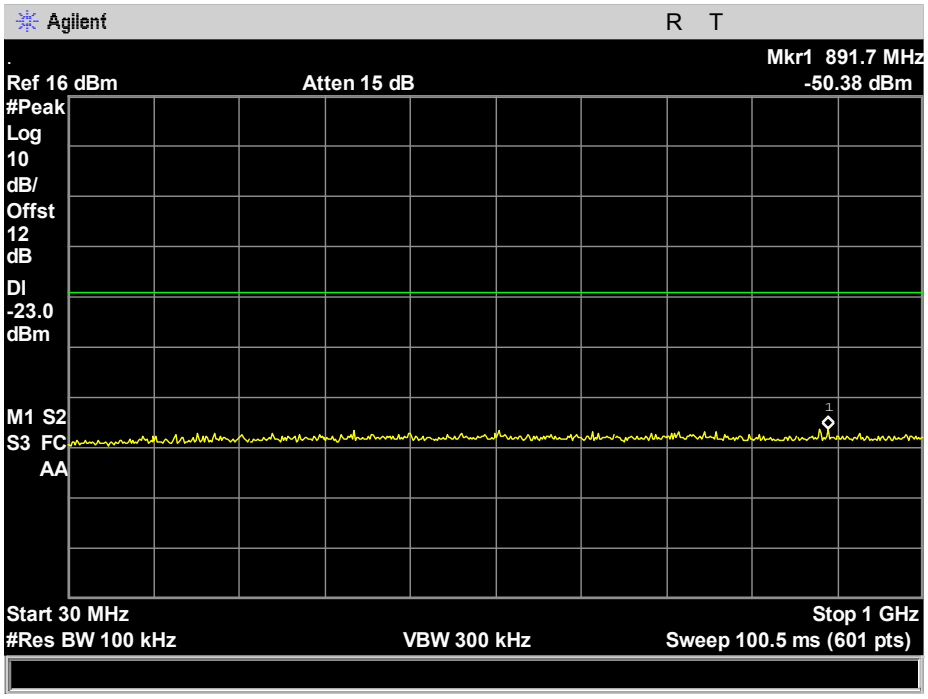
Plot 124. 100 kHz Spurious Emissions, 802.11n, 40M, 2452, high bandedge, ch 1



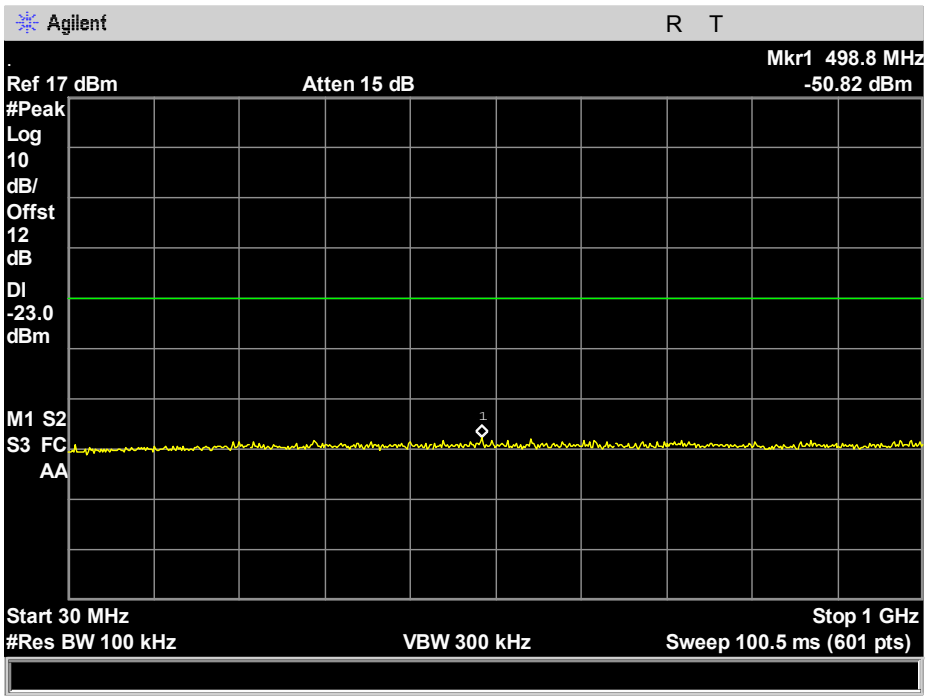
Plot 125. 100 kHz Spurious Emissions, 802.11b, 2412, 1 – 25 GHz, ch 0



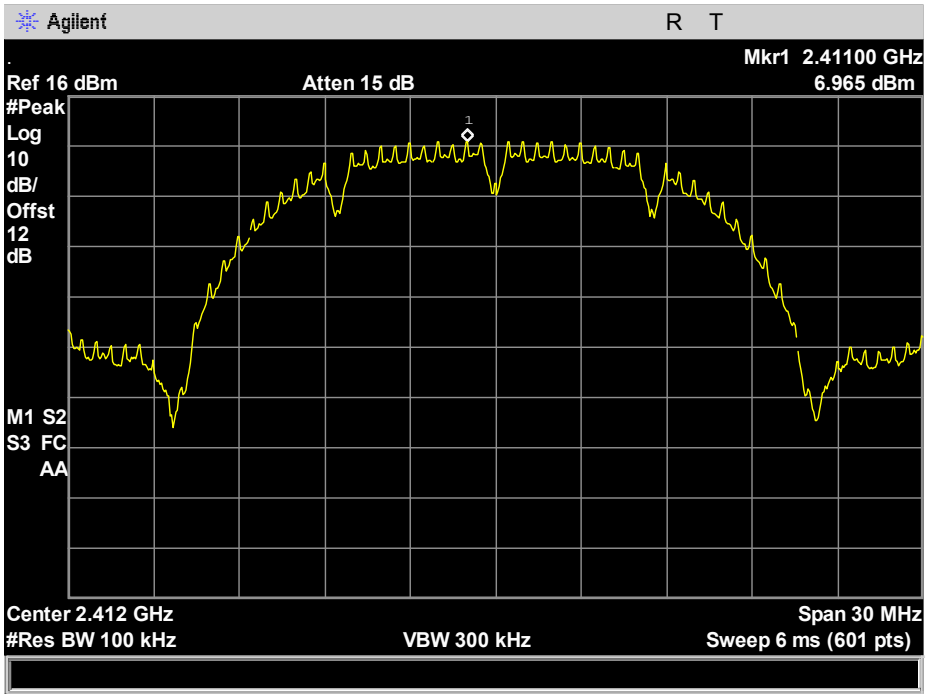
Plot 126. 100 kHz Spurious Emissions, 802.11b, 2412, 1 – 25 GHz, ch 1



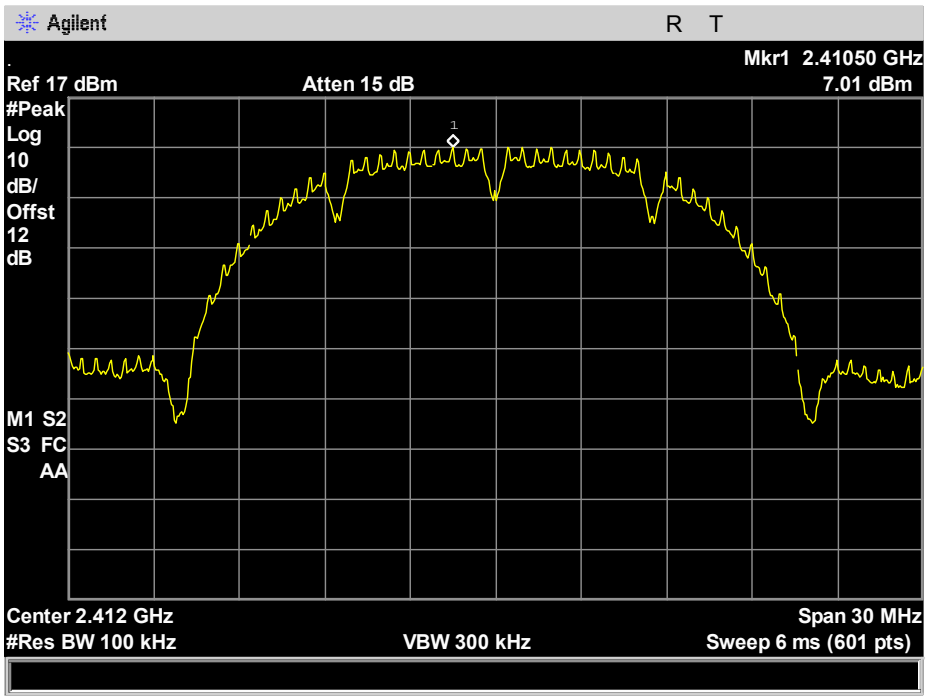
Plot 127. 100 kHz Spurious Emissions, 802.11b, 2412, 30 – 1000 MHz, ch 0



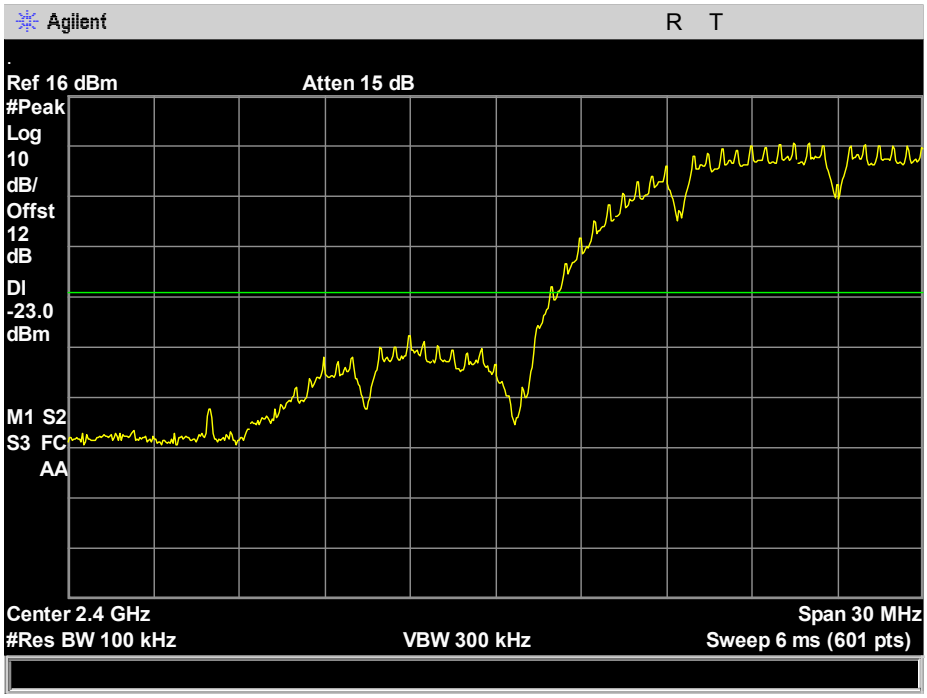
Plot 128. 100 kHz Spurious Emissions, 802.11b, 2412, 30 – 1000 MHz, ch 1



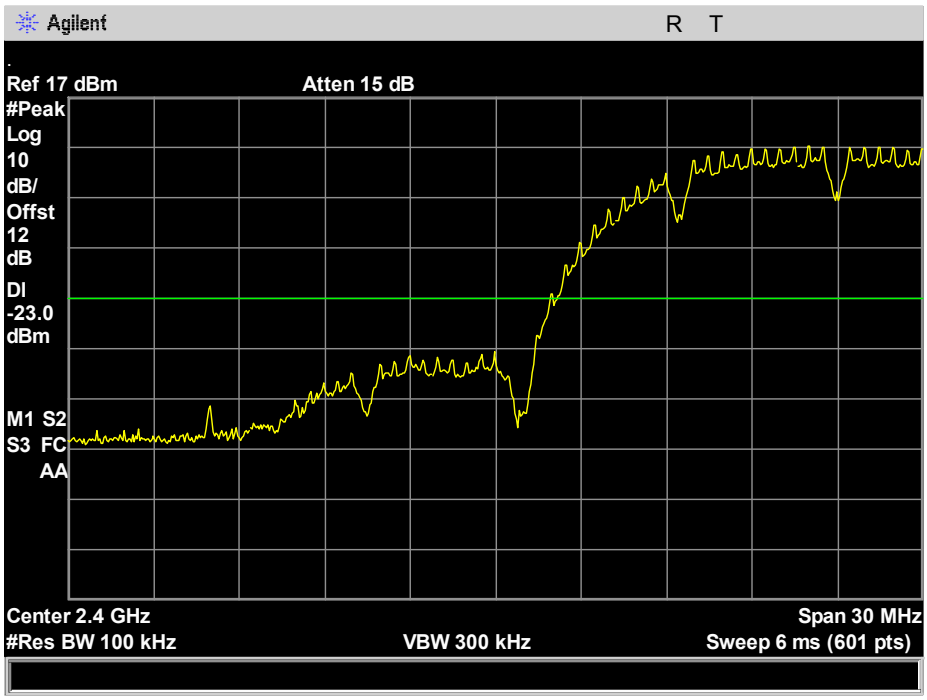
Plot 129. 100 kHz Spurious Emissions, 802.11b, 2412, Reference Level, ch 0



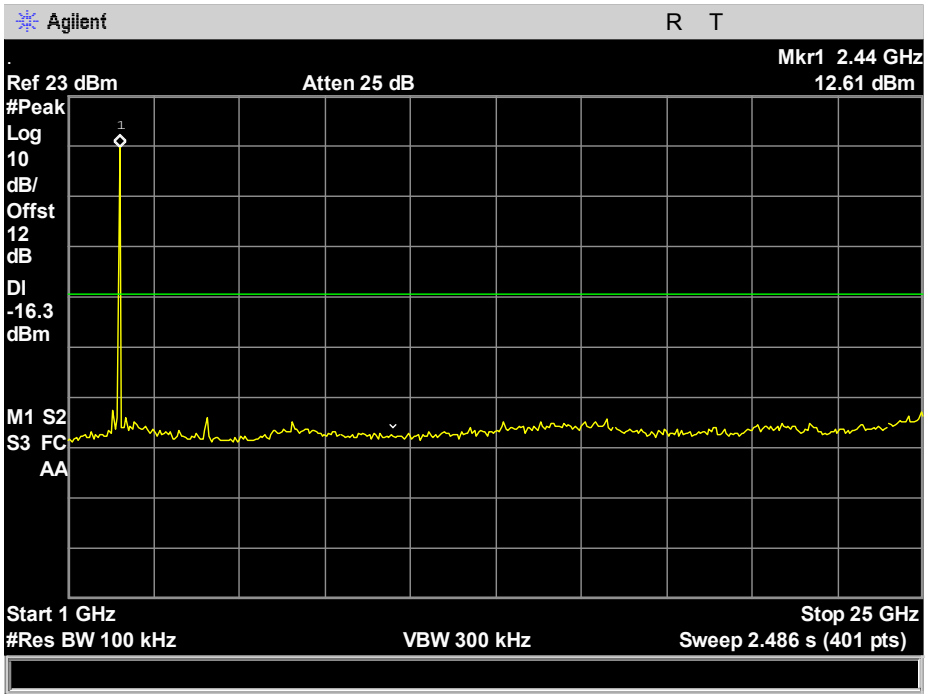
Plot 130. 100 kHz Spurious Emissions, 802.11b, 2412, Reference Level, ch 1



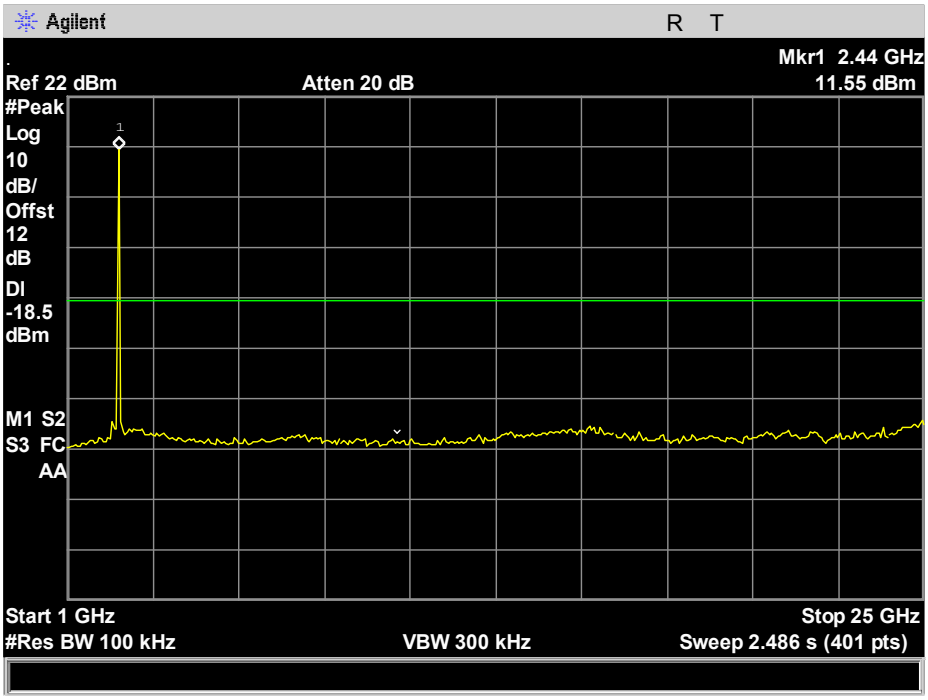
Plot 131. 100 kHz Spurious Emissions, 802.11b, 2412, Reference Level low bandedge, ch 0



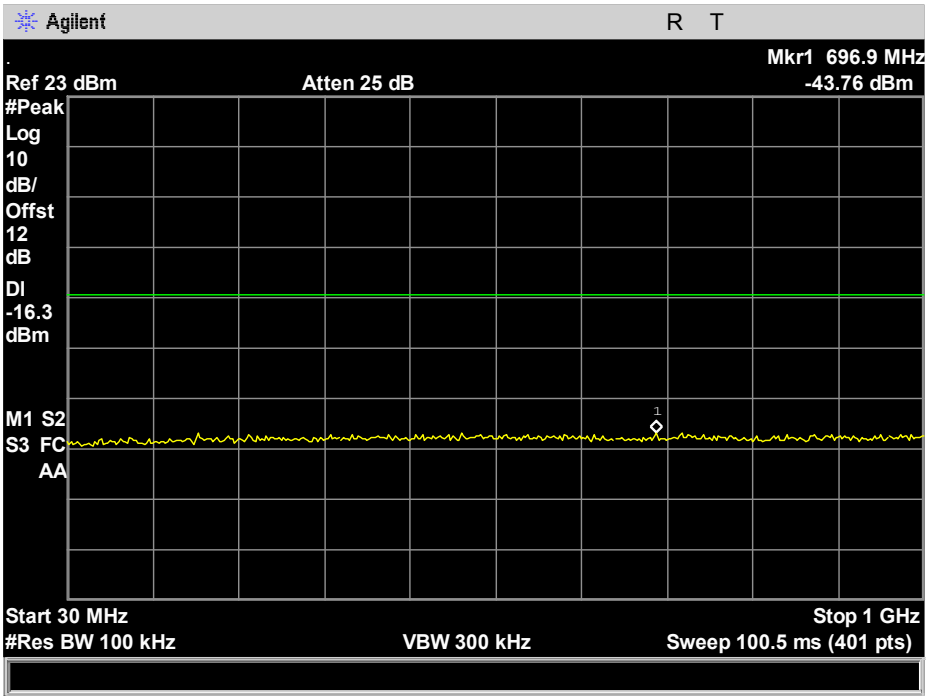
Plot 132. 100 kHz Spurious Emissions, 802.11b, 2412, Reference Level low bandedge, ch 1



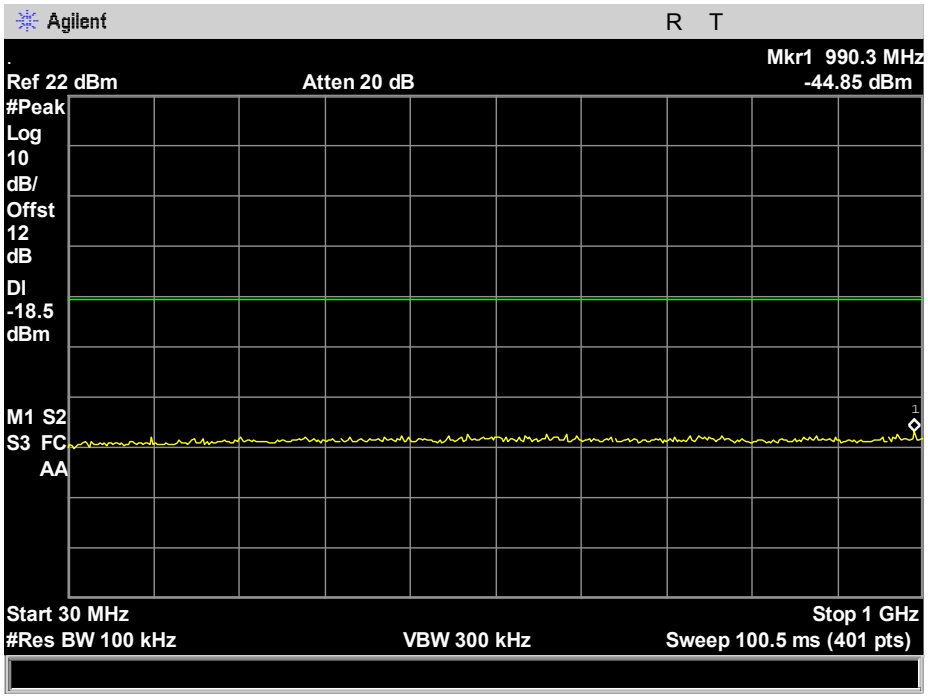
Plot 133. 100 kHz Spurious Emissions, 802.11b, 2437, 1 – 25 GHz, ch 0



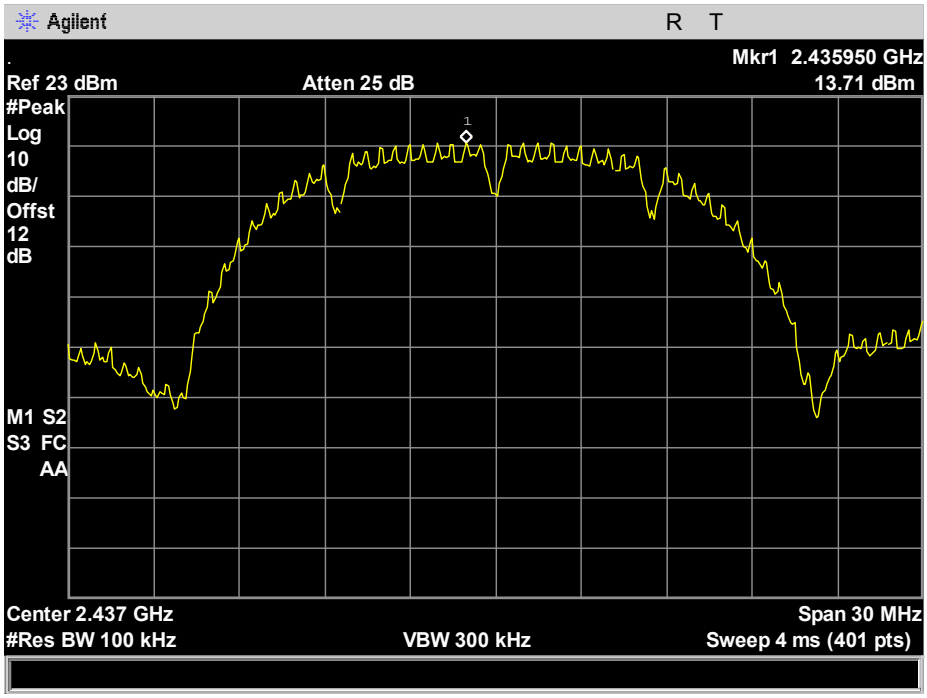
Plot 134. 100 kHz Spurious Emissions, 802.11b, 2437, 1 – 25 GHz, ch 1



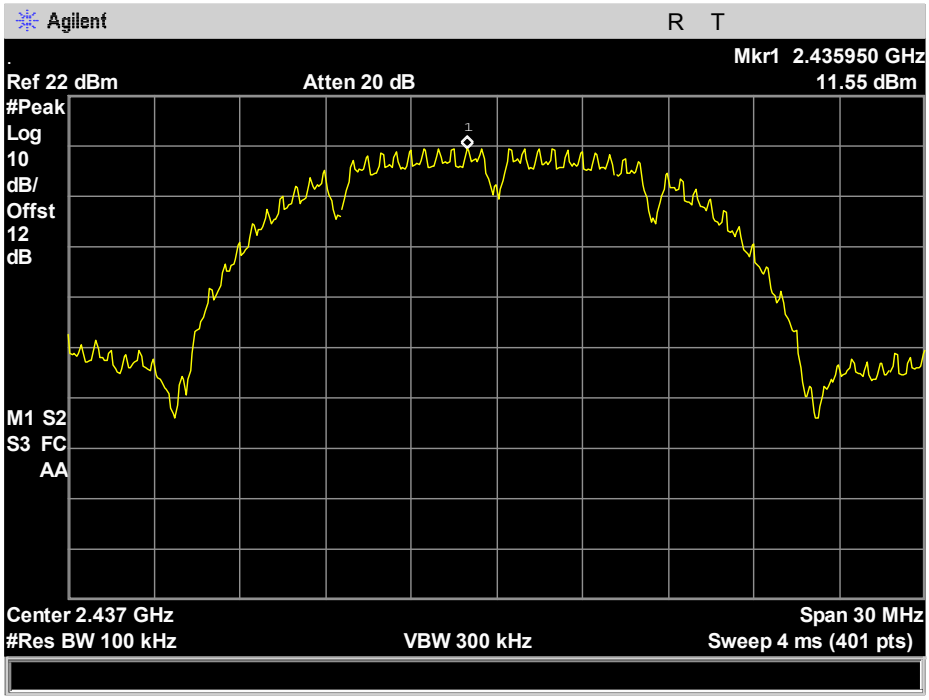
Plot 135. 100 kHz Spurious Emissions, 802.11b, 2437, 30 – 1000 MHz, ch 0



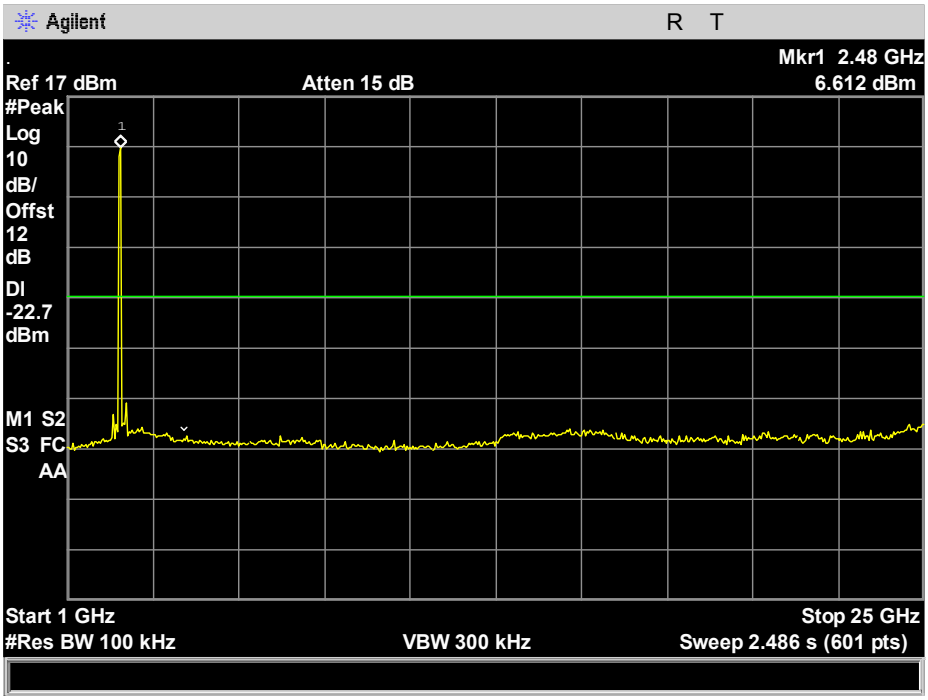
Plot 136. 100 kHz Spurious Emissions, 802.11b, 2437, 30 – 1000 MHz, ch 1



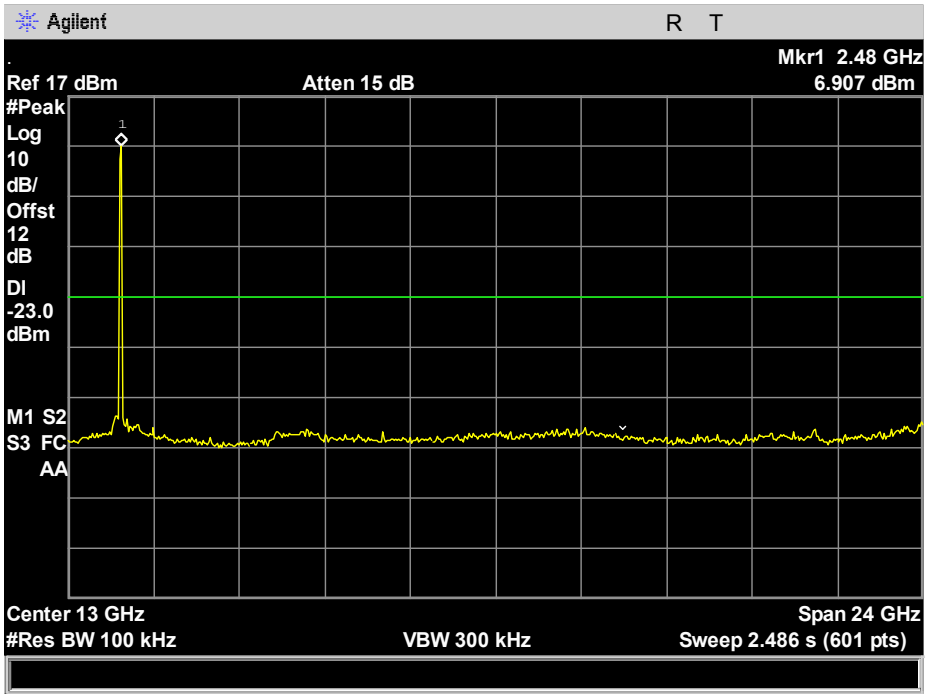
Plot 137. 100 kHz Spurious Emissions, 802.11b, 2437, Reference Level, ch 0



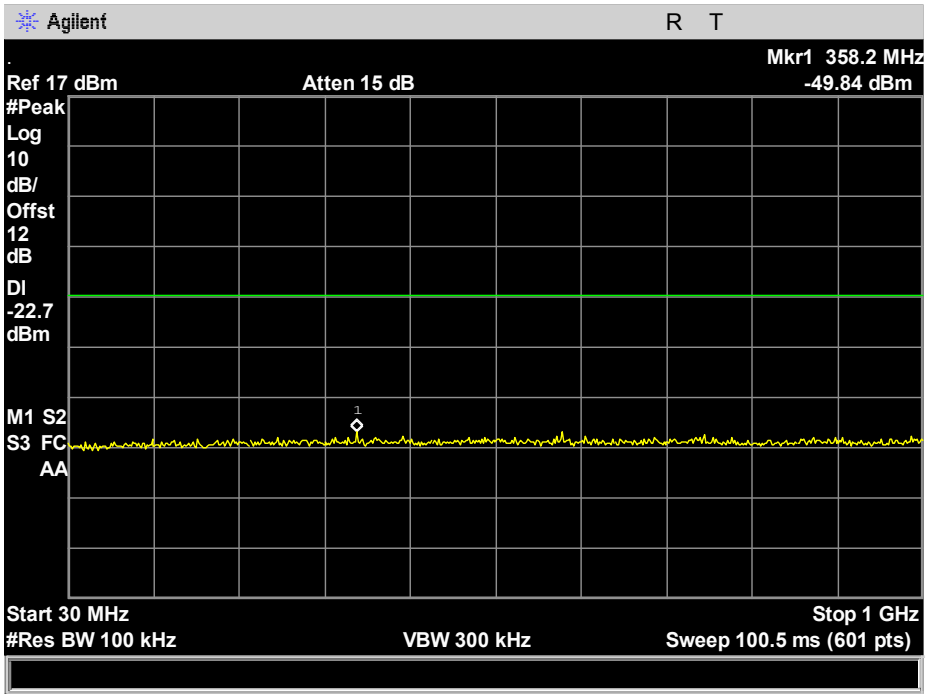
Plot 138. 100 kHz Spurious Emissions, 802.11b, 2437, Reference Level, ch 1



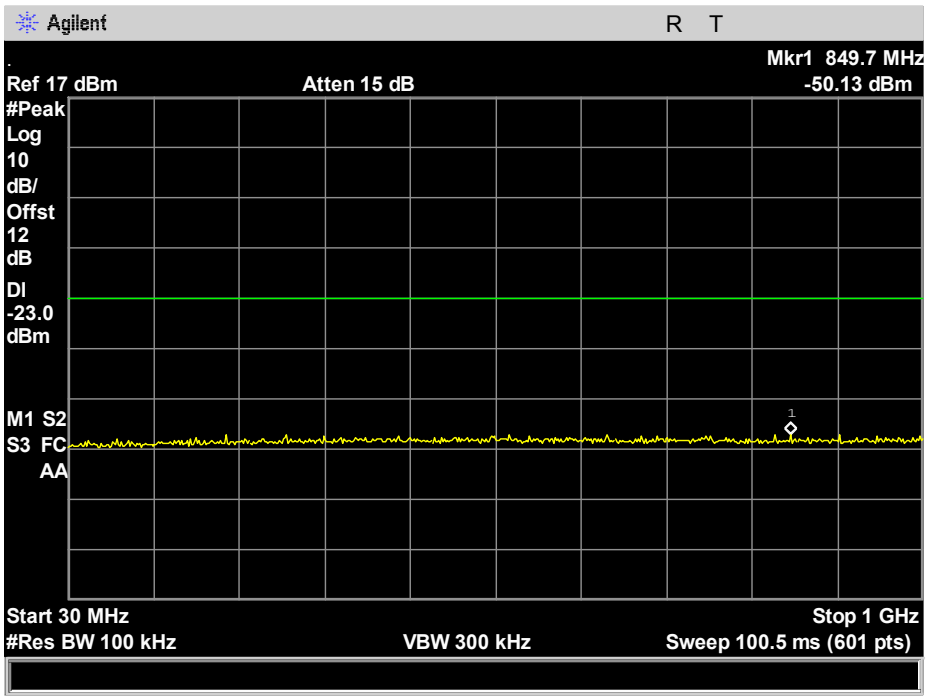
Plot 139. 100 kHz Spurious Emissions, 802.11b, 2462, 1 – 25 GHz, ch 0



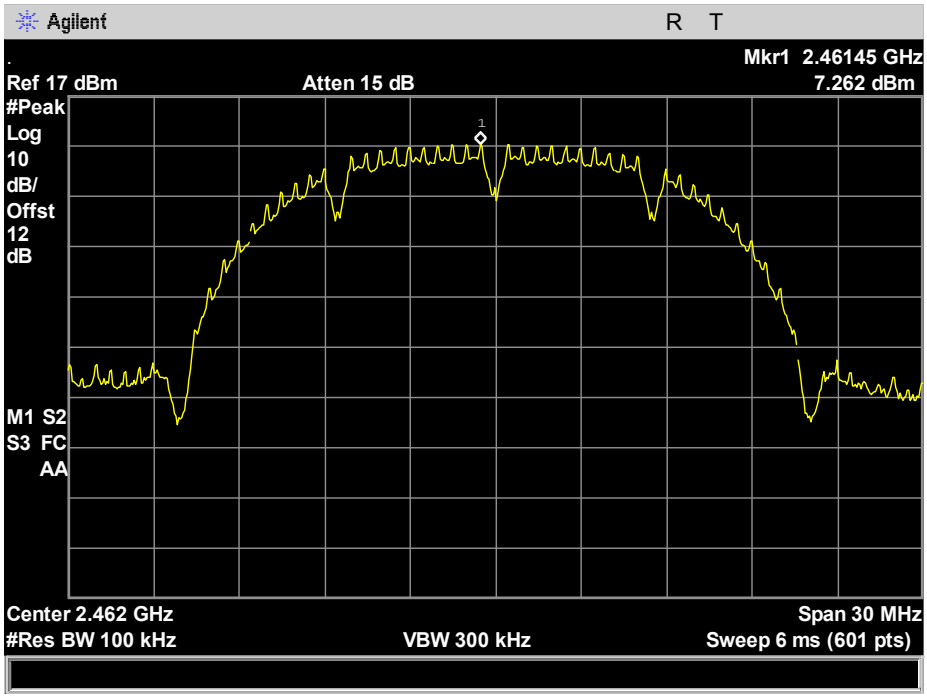
Plot 140. 100 kHz Spurious Emissions, 802.11b, 2462, 1 – 25 GHz, ch 1



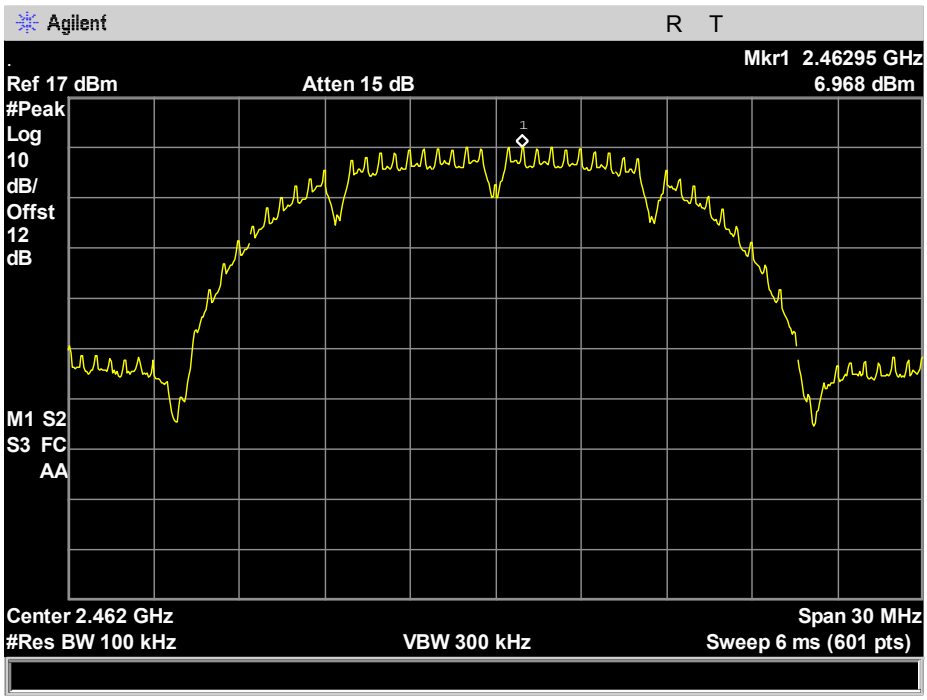
Plot 141. 100 kHz Spurious Emissions, 802.11b, 2462, 30 – 1000 MHz, ch 0



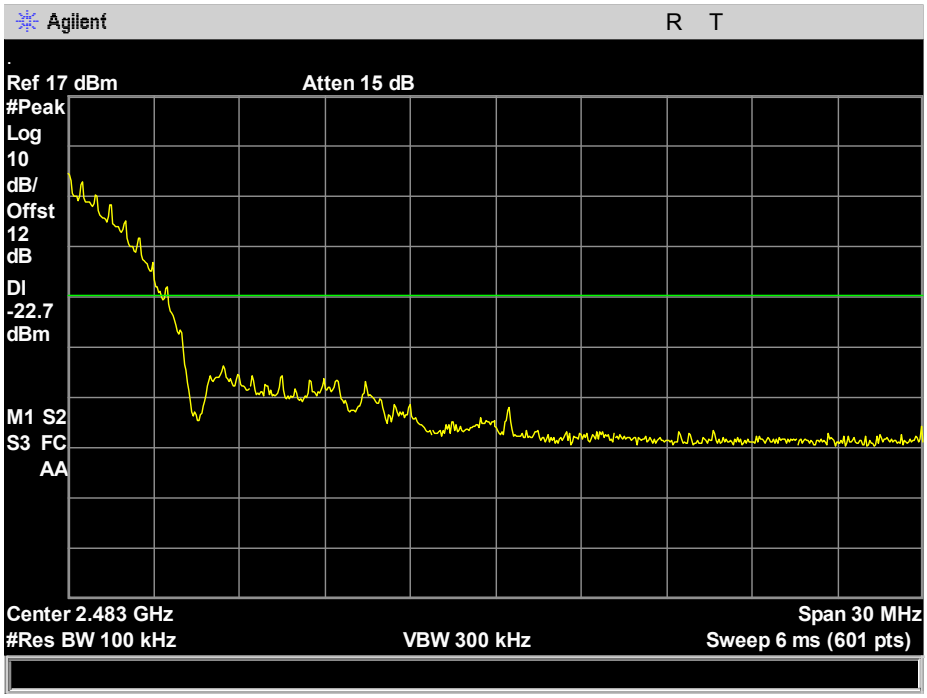
Plot 142. 100 kHz Spurious Emissions, 802.11b, 2462, 30 – 1000 MHz, ch 1



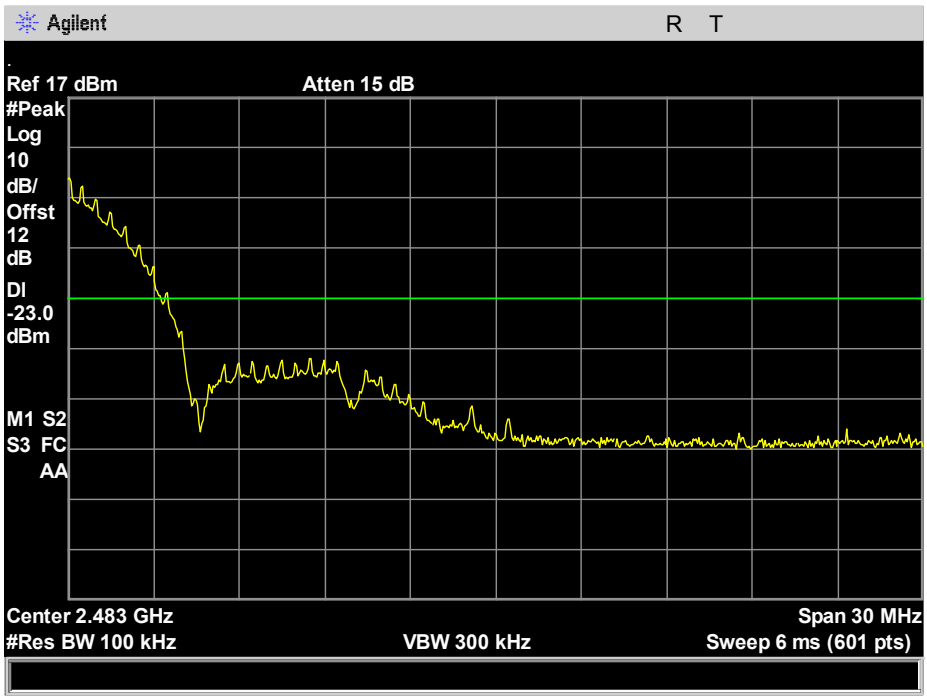
Plot 143. 100 kHz Spurious Emissions, 802.11b, 2462, Reference Level, ch 0



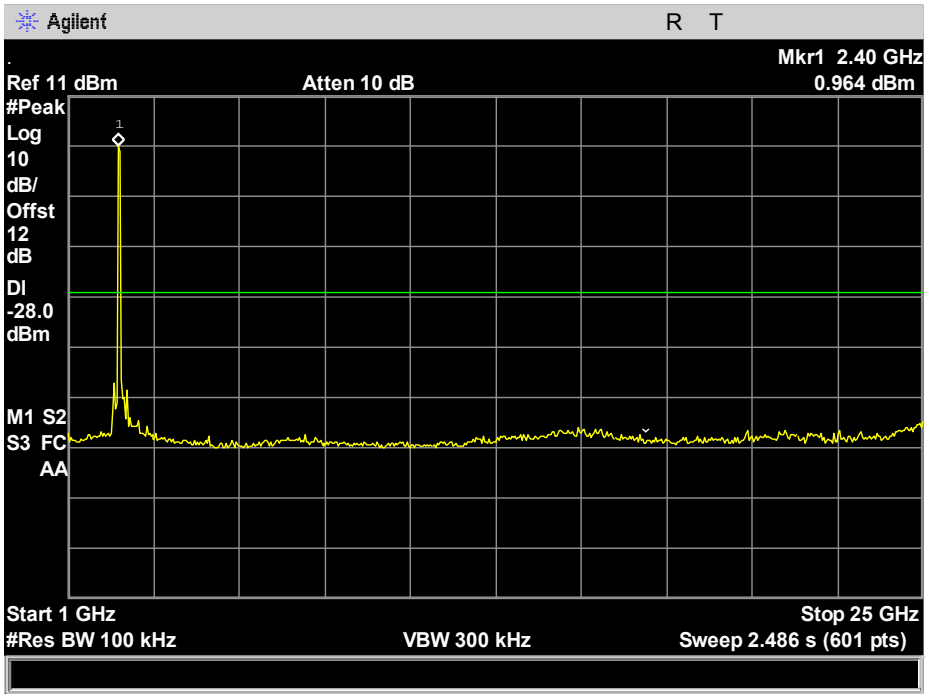
Plot 144. 100 kHz Spurious Emissions, 802.11b, 2462, Reference Level, ch 1



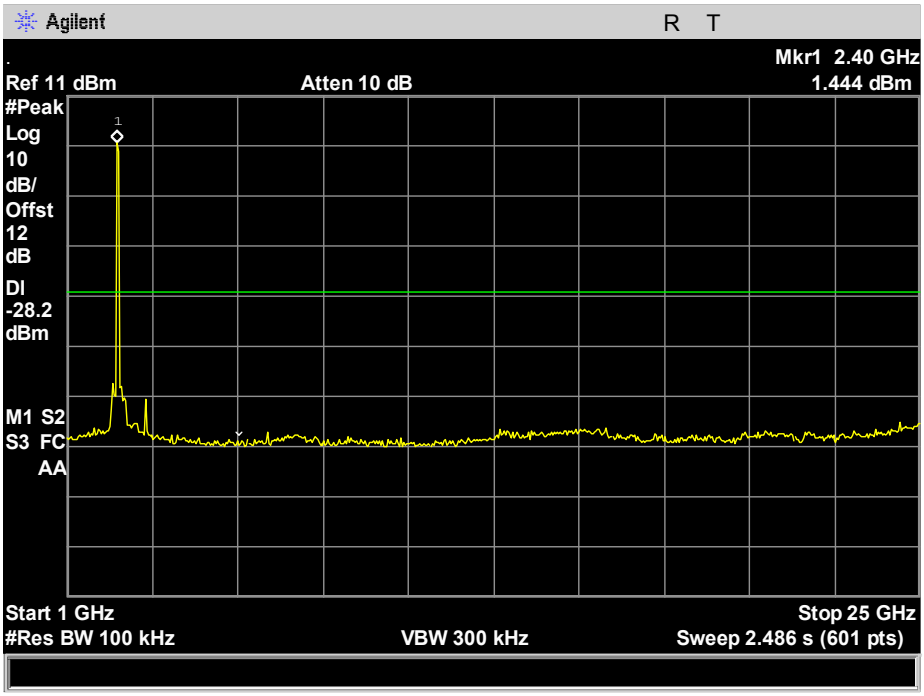
Plot 145. 100 kHz Spurious Emissions, 802.11b, 2462, high bandedge, ch 0



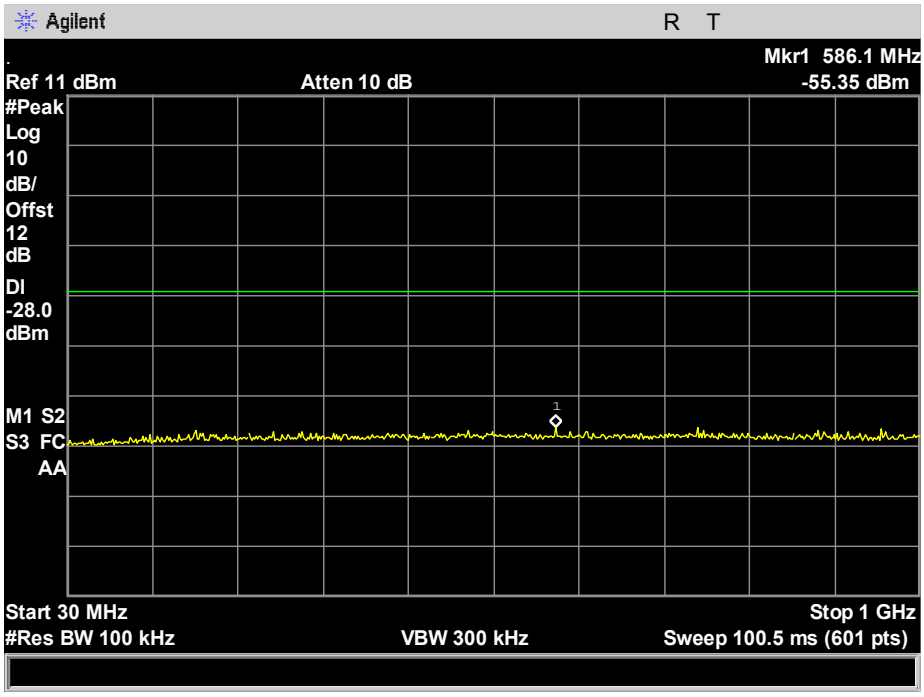
Plot 146. 100 kHz Spurious Emissions, 802.11b, 2462, high bandedge, ch 1



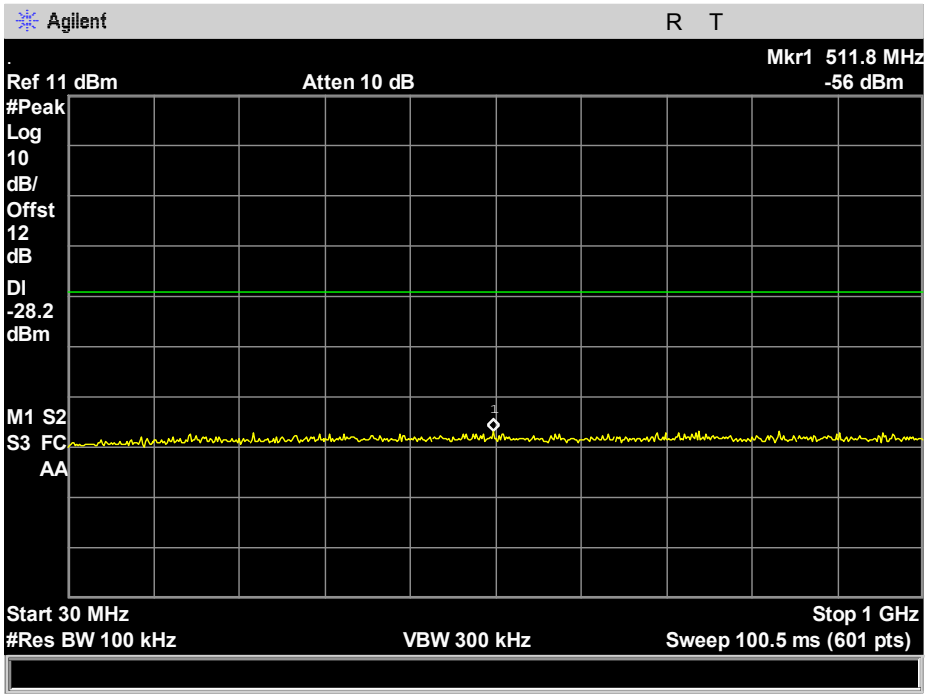
Plot 147. 100 kHz Spurious Emissions, 802.11g, 2412, 1 – 25 GHz, ch 0



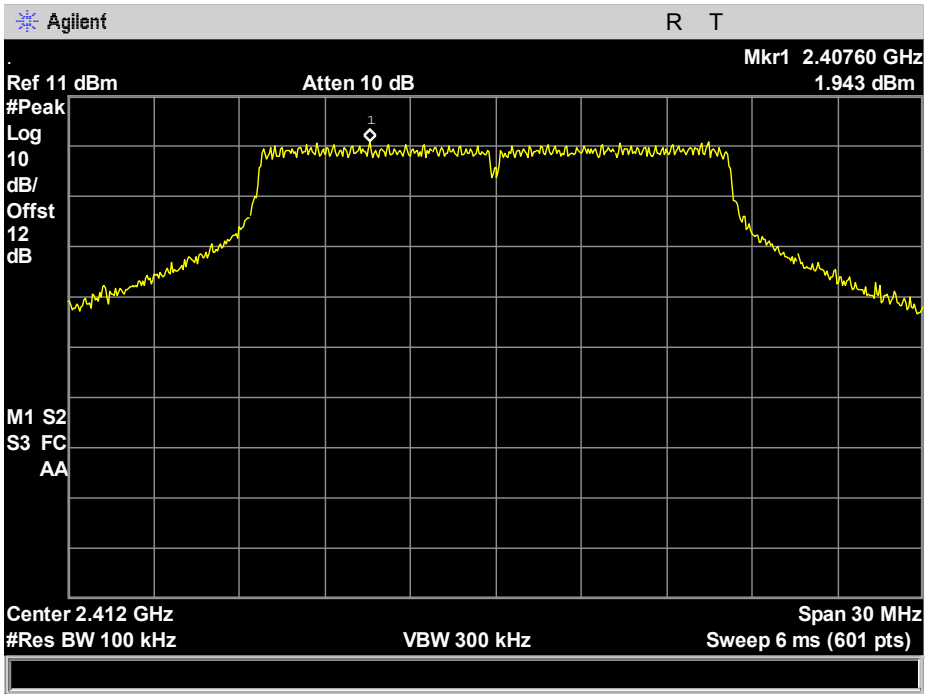
Plot 148. 100 kHz Spurious Emissions, 802.11g, 2412, 1 – 25 GHz, ch 1



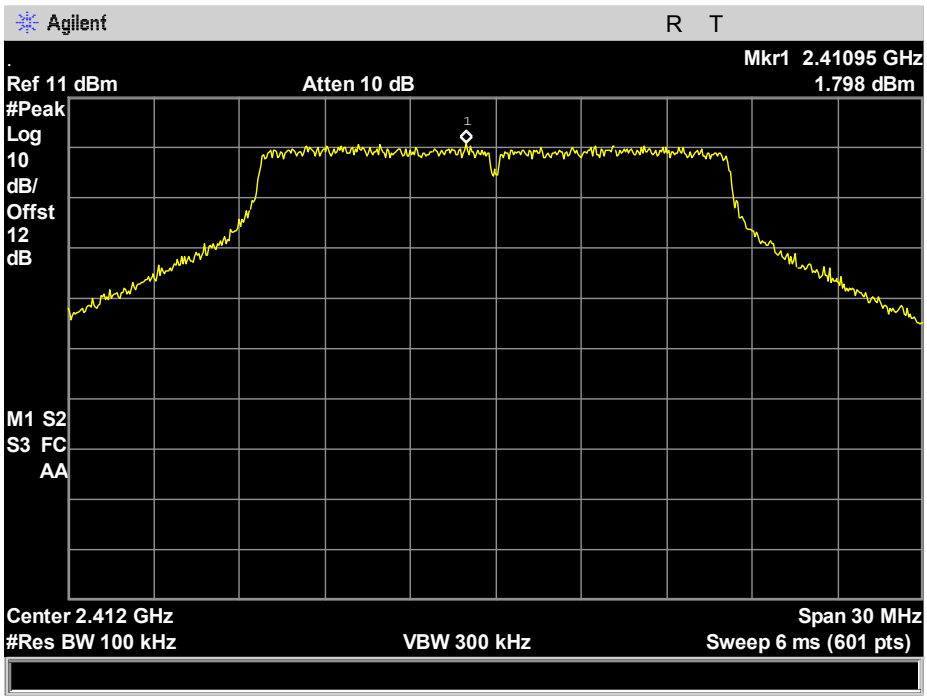
Plot 149. 100 kHz Spurious Emissions, 802.11g, 2412, 30 – 1000 MHz, ch 0



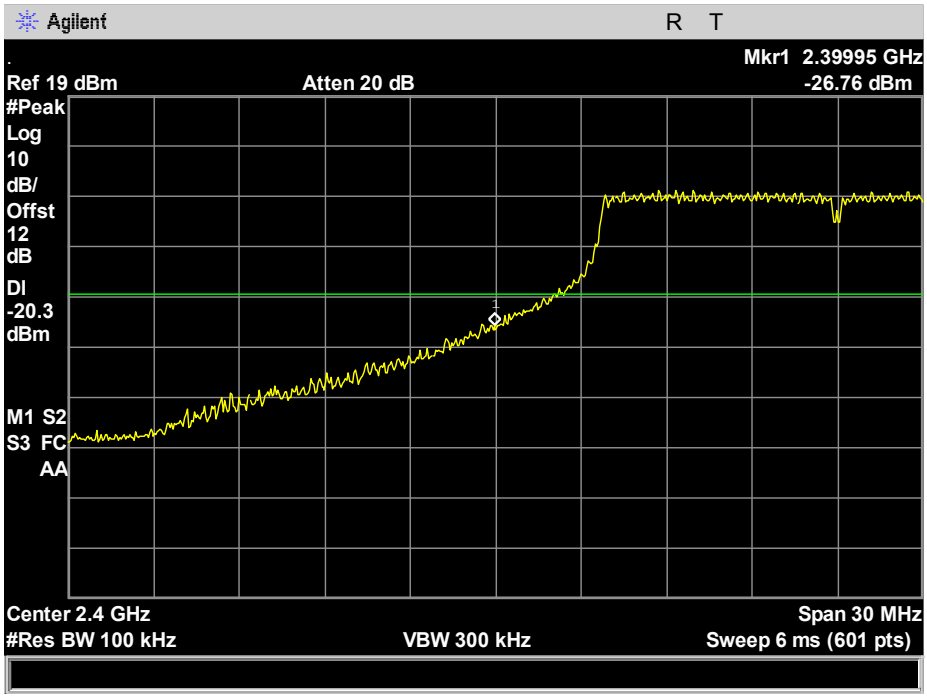
Plot 150. 100 kHz Spurious Emissions, 802.11g, 2412, 30 – 1000 MHz, ch 1



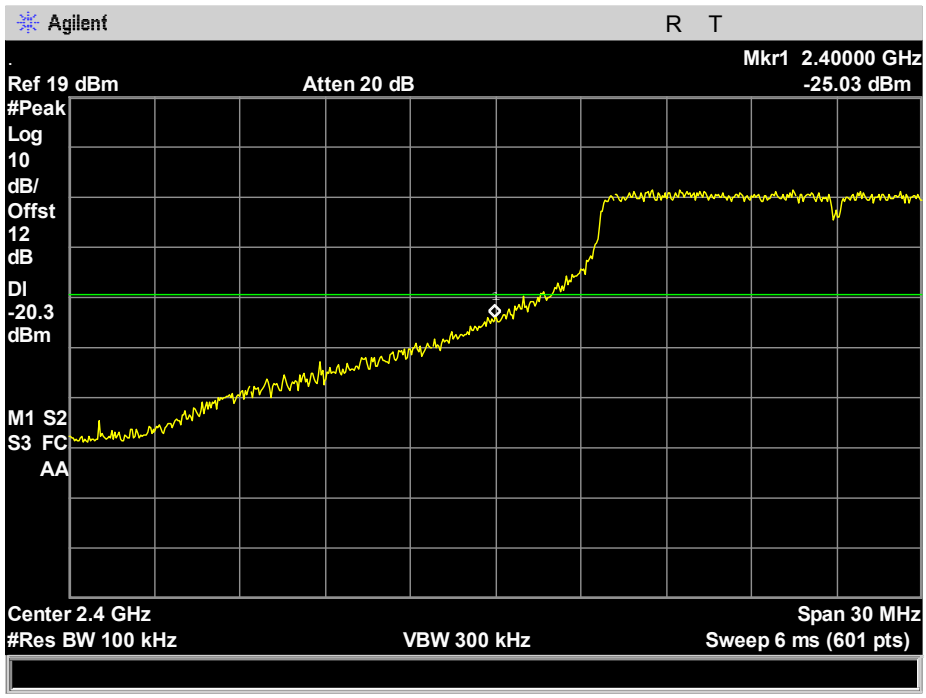
Plot 151. 100 kHz Spurious Emissions, 802.11g, 2412, Reference Level, ch 0



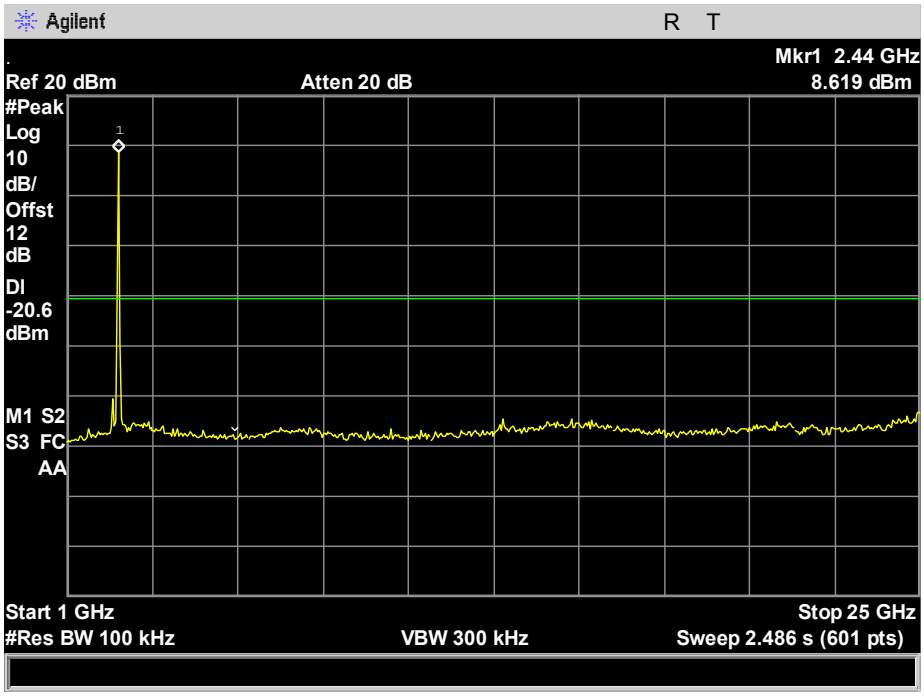
Plot 152. 100 kHz Spurious Emissions, 802.11g, 2412, Reference Level, ch 1



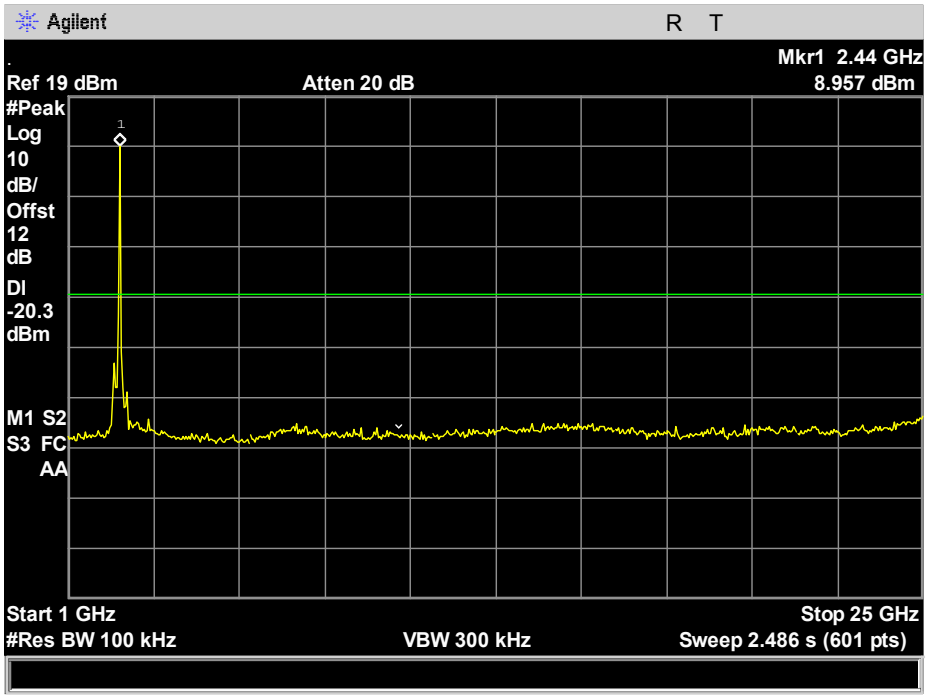
Plot 153. 100 kHz Spurious Emissions, 802.11g, 2412, Reference Level low bandedge, ch 0



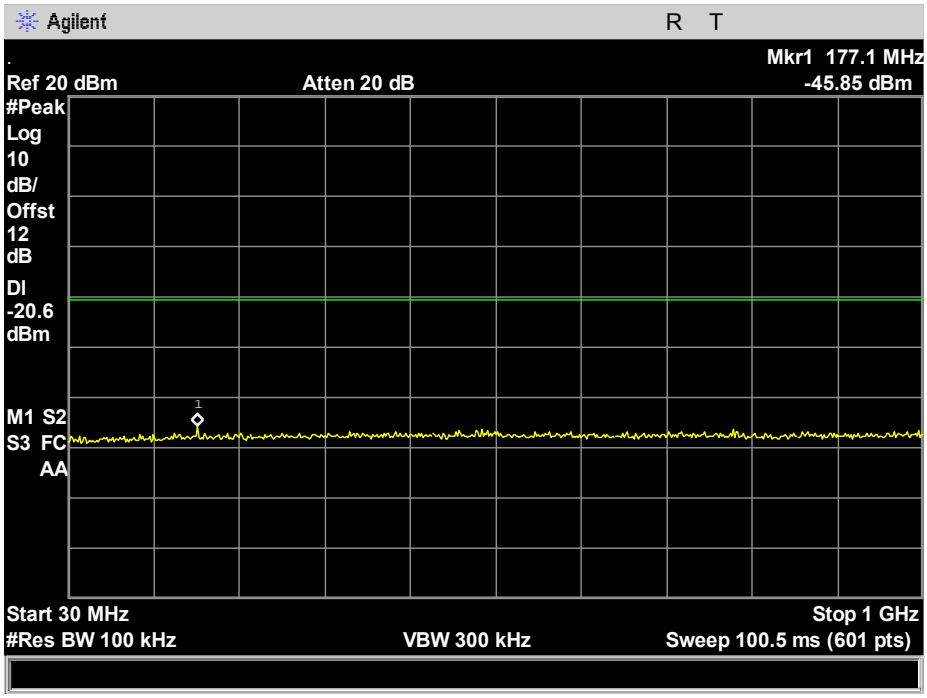
Plot 154. 100 kHz Spurious Emissions, 802.11g, 2412, Reference Level low bandedge, ch 1



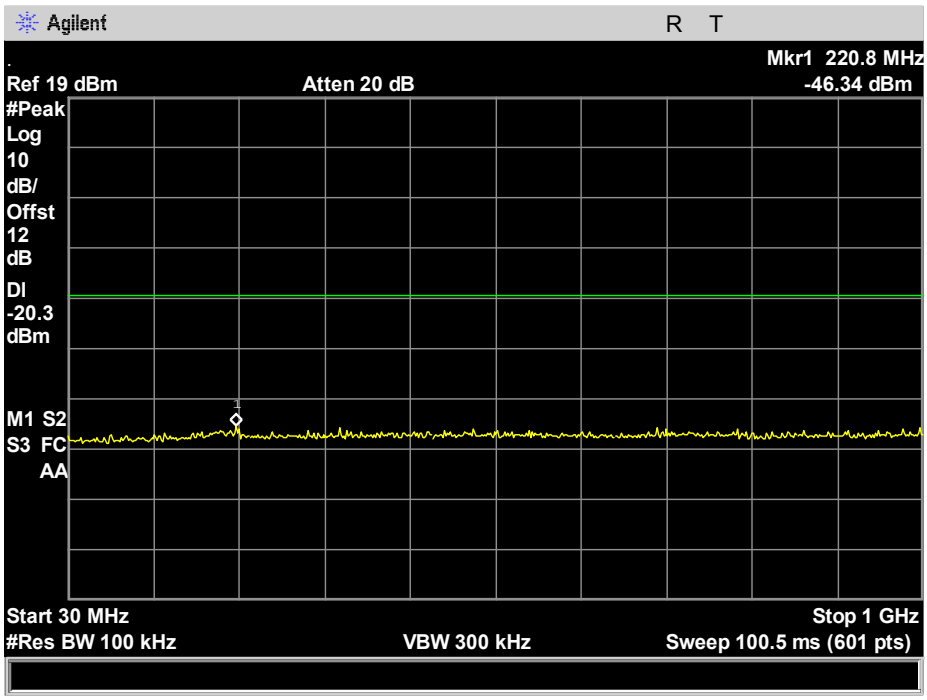
Plot 155. 100 kHz Spurious Emissions, 802.11g, 2437, 1 – 25 GHz, ch 0



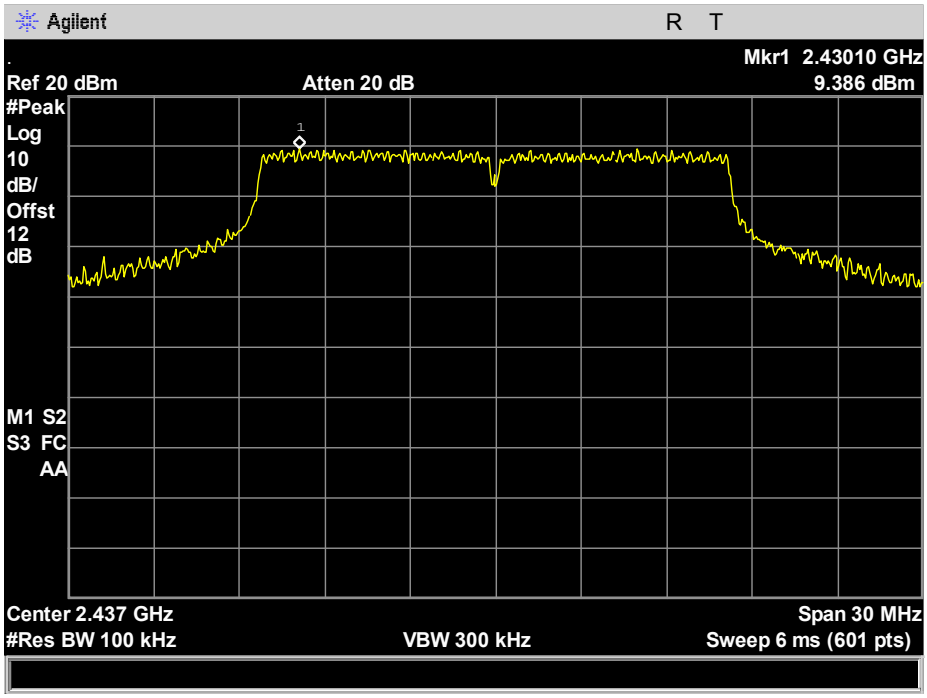
Plot 156. 100 kHz Spurious Emissions, 802.11g, 2437, 1 – 25 GHz, ch 1



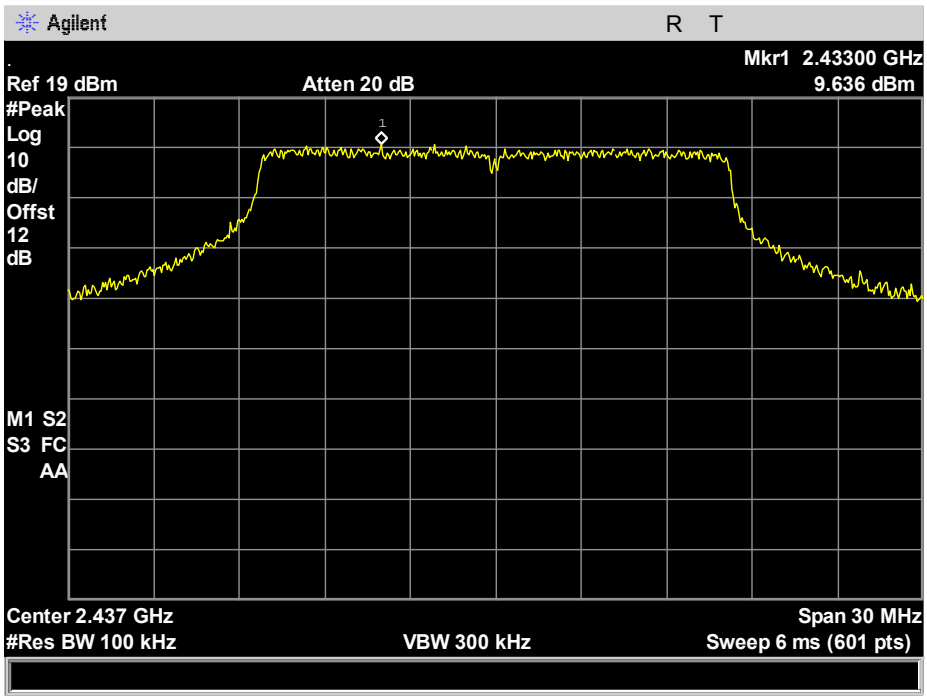
Plot 157. 100 kHz Spurious Emissions, 802.11g, 2437, 30 – 1000 MHz, ch 0



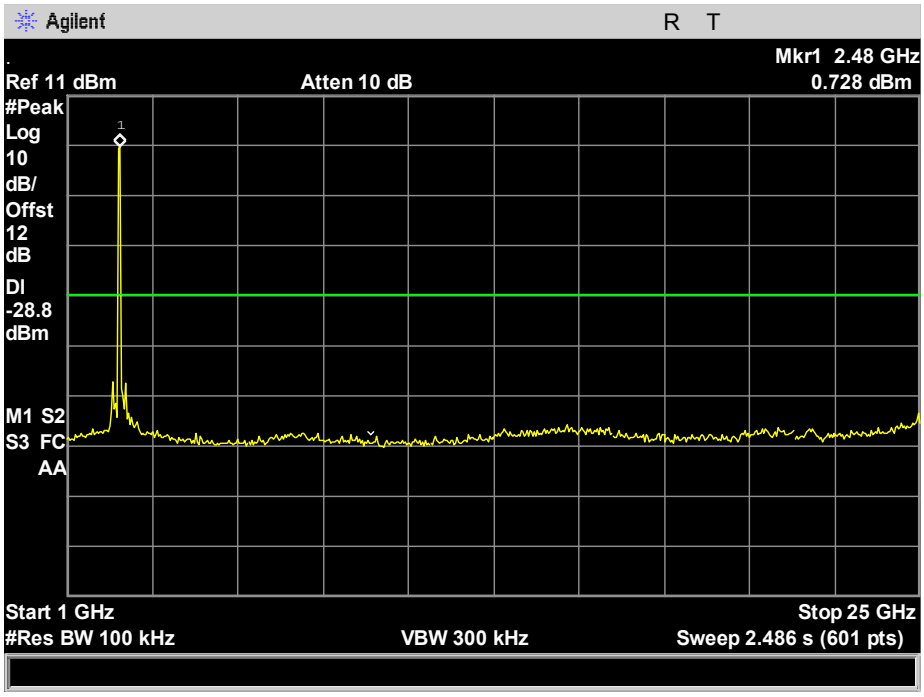
Plot 158. 100 kHz Spurious Emissions, 802.11g, 2437, 30 – 1000 MHz, ch 1



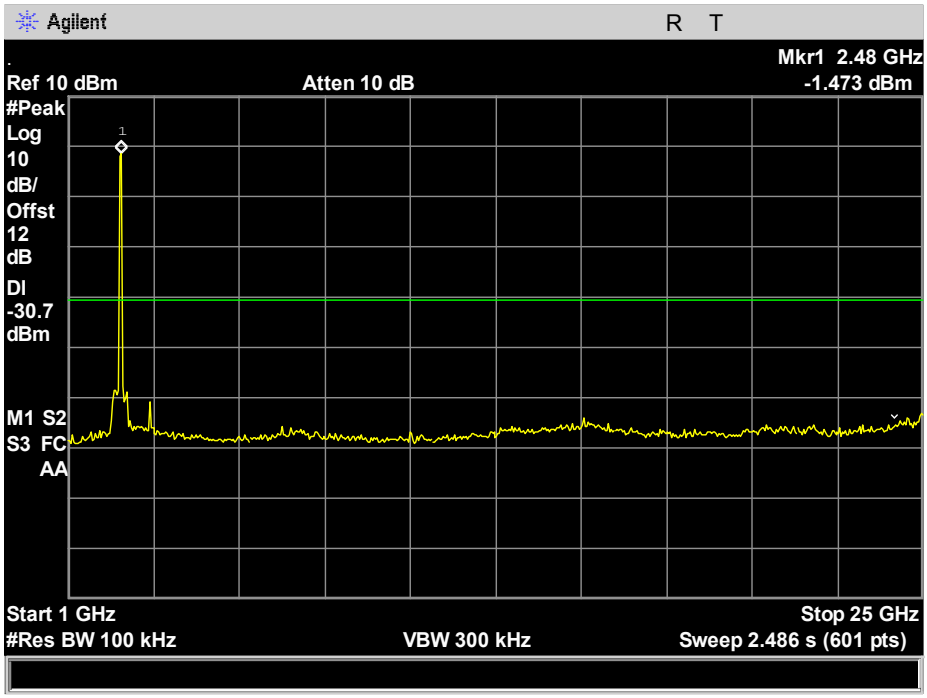
Plot 159. 100 kHz Spurious Emissions, 802.11g, 2437, Reference Level, ch 0



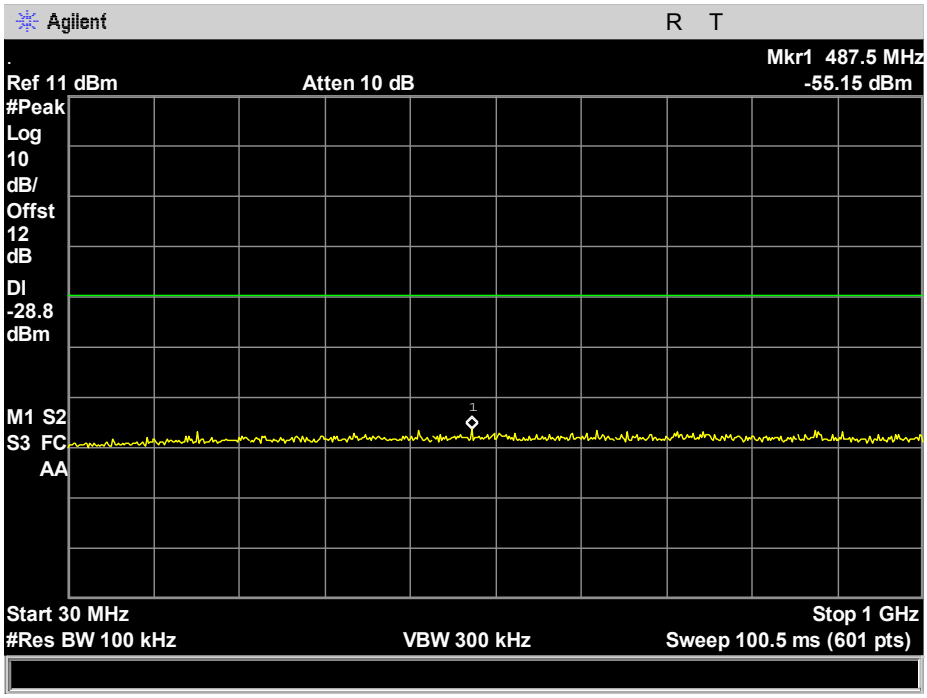
Plot 160. 100 kHz Spurious Emissions, 802.11g, 2437, Reference Level, ch 1



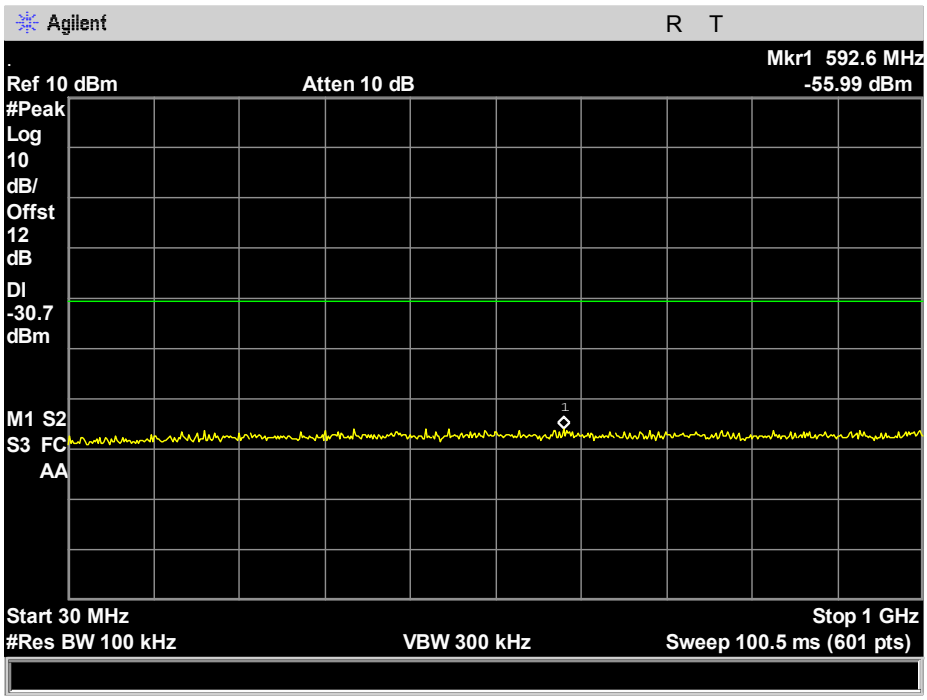
Plot 161. 100 kHz Spurious Emissions, 802.11g, 2462, 1 – 25 GHz, ch 0



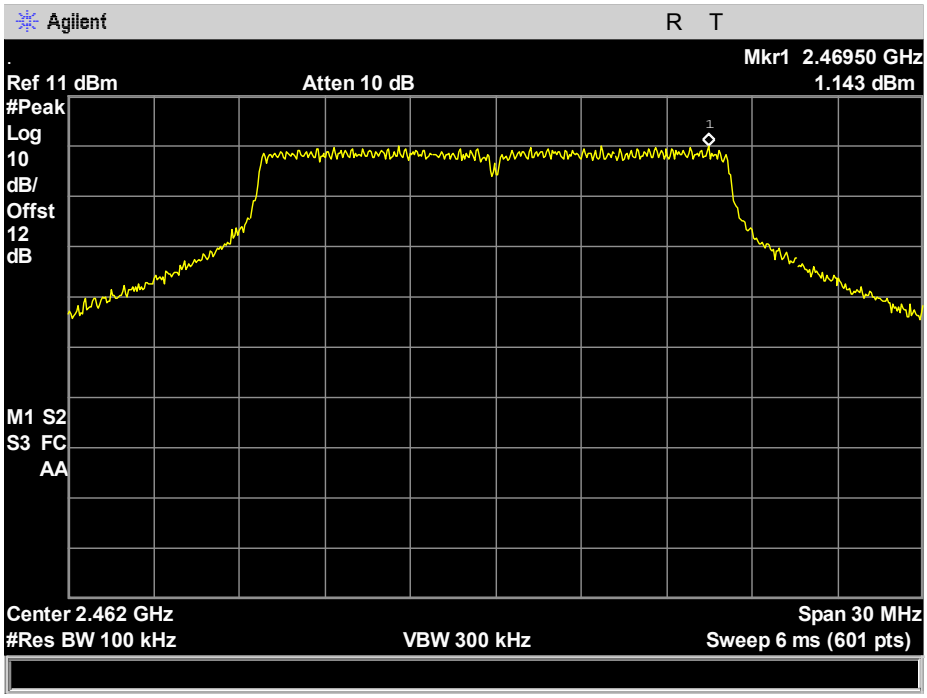
Plot 162. 100 kHz Spurious Emissions, 802.11g, 2462, 1 – 25 GHz, ch 1



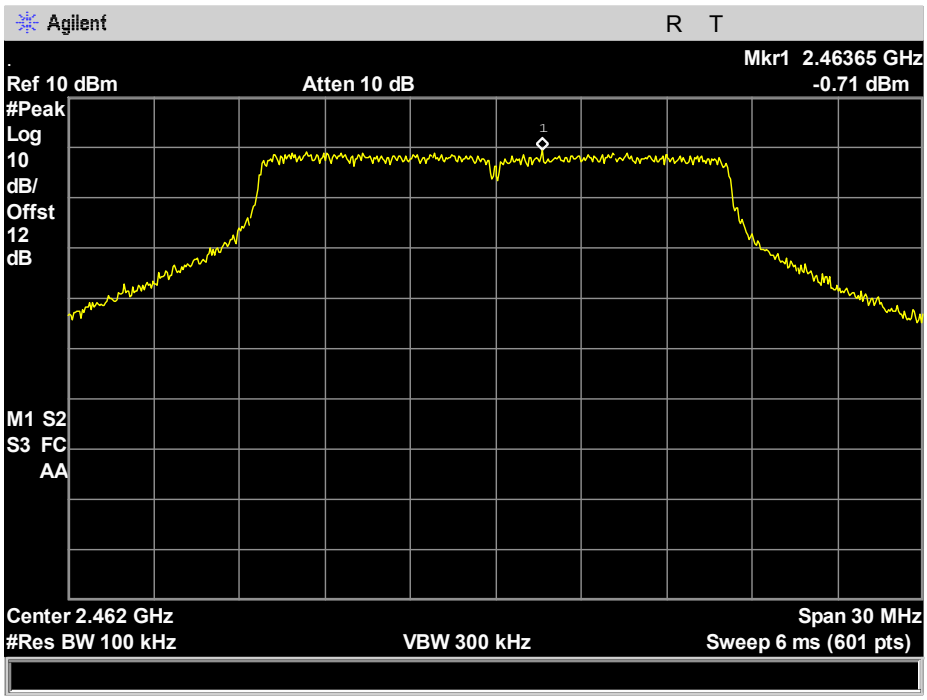
Plot 163. 100 kHz Spurious Emissions, 802.11g, 2462, 30 – 1000 MHz, ch 0



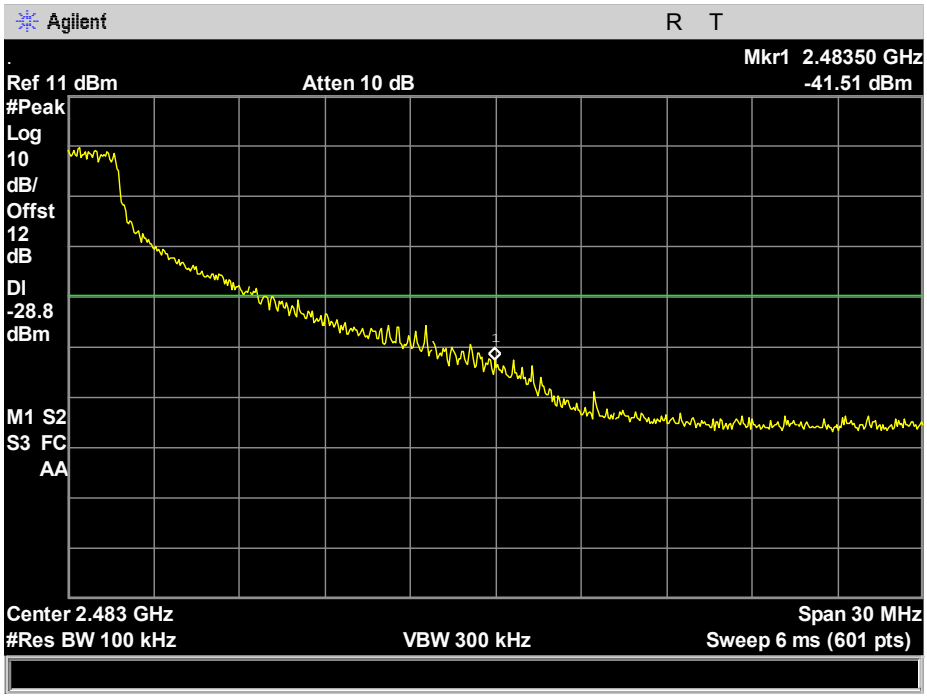
Plot 164. 100 kHz Spurious Emissions, 802.11g, 2462, 30 – 1000 MHz, ch 1



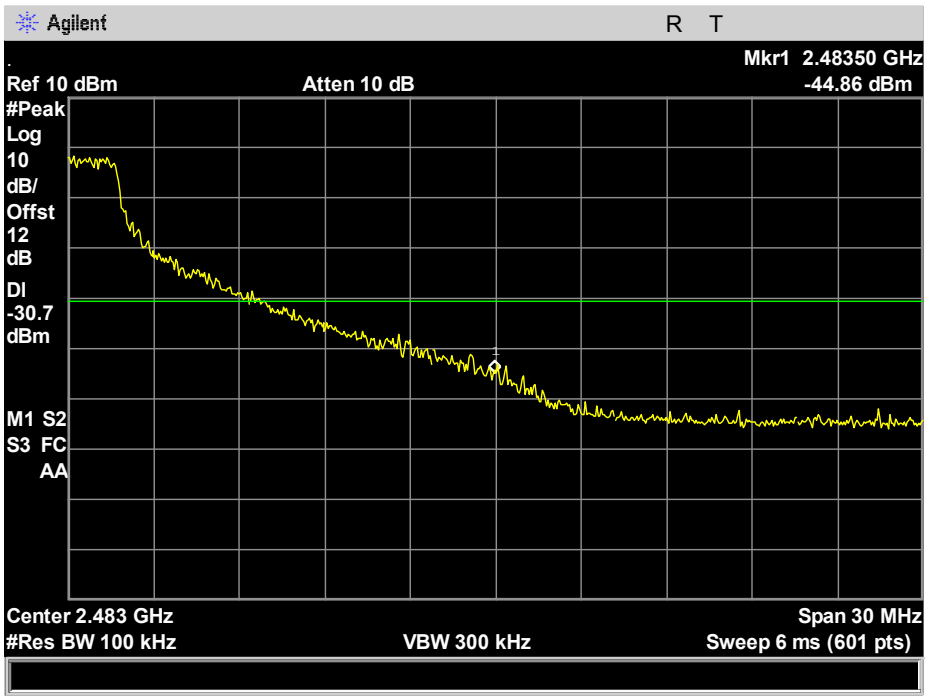
Plot 165. 100 kHz Spurious Emissions, 802.11g, 2462, Reference Level, ch 0



Plot 166. 100 kHz Spurious Emissions, 802.11g, 2462, Reference Level, ch 1



Plot 167. 100 kHz Spurious Emissions, 802.11g, 2462, high bandedge, ch 0



Plot 168. 100 kHz Spurious Emissions, 802.11g, 2462, high bandedge, ch 1

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(e) Peak Power Spectral Density

Test Requirements: **§15.247(e):** For digitally modulated systems, the peak 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 Procedure: The power level was set to the maximum level throughout each of the 100 sweeps of power averaging. The RBW was set betweem 3 kHz or 100 kHz and a VBW set 3xRBW or greater. The spectrum analyzer was set to an auto sweep time and a average detector was used. Measurements were carried out at the low, mid and high channels. Measurements were performed on a conducted setup. EUT was connected directly to a spectrum analyzer thru an attenuator. Measurements were performed using procedure AVGSA-1 from ANSI C63.10 section 11.10.3

Test Results: The EUT was compliant with the peak power spectral density limits of **§ 15.247 (e)**.

The peak power spectral density was determined from plots on the following page(s).

Test Engineer: Donald Salguero

Test Date: June 17 – 18, 2019

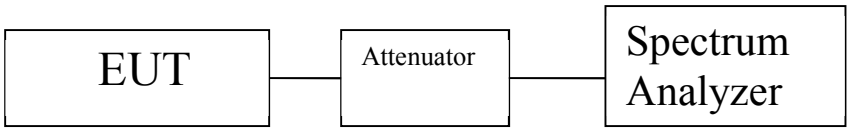


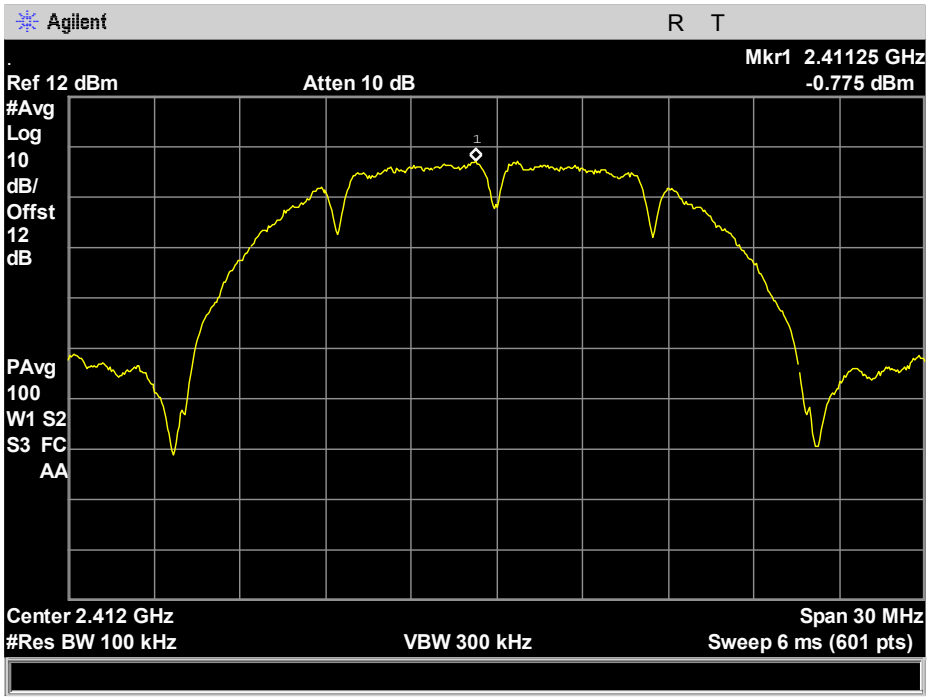
Figure 4. Block Diagram, Power Spectral Density Test Setup

Peak Power Spectral Density Test Results

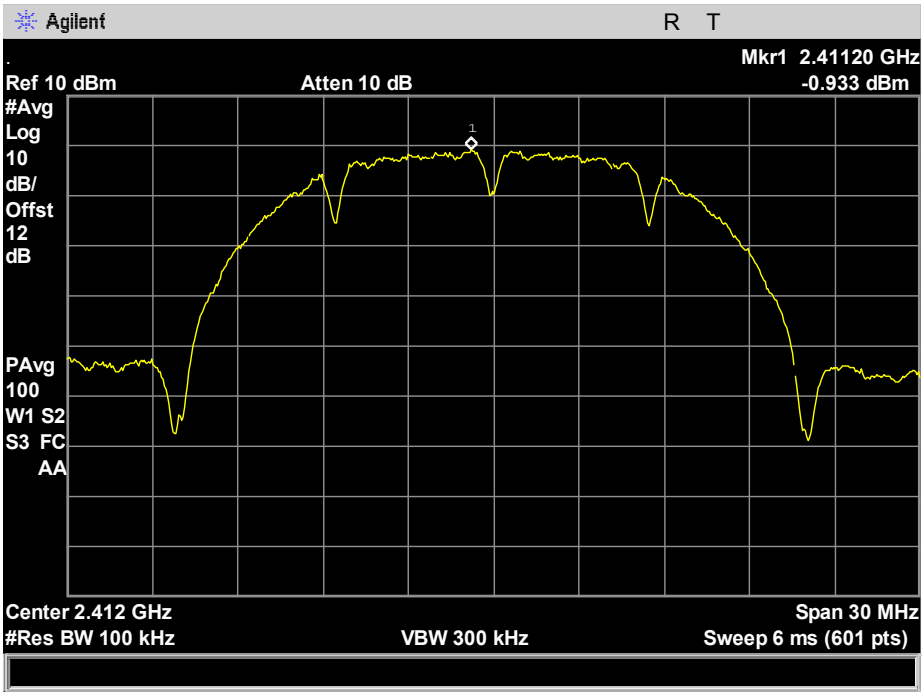
Mode	Nominal Bandwidth (MHz)	Center Frequency (MHz)	Port0 (dBm)	Port1 (dBm)	Sum (dBm)	Antenna Gain (dBi)	Limit (dBm)	Margin (dB)
802.11b	20	2412	-0.775	-0.933	2.16	5	8	-5.84
		2437	0.013	-1.45	2.35	5	8	-5.65
		2462	-1.098	-1.688	1.63	5	8	-6.37
802.11g	20	2412	-5.312	-5.485	-2.39	5	8	-10.39
		2437	2.697	2.045	5.39	5	8	-2.61
		2462	-6.104	-7.405	-3.7	5	8	-11.7
802.11n	20	2412	-7.531	-7.358	-4.43	5	8	-12.43
		2437	-3.665	-1.987	0.26	5	8	-7.74
		2462	-8.417	-9.648	-5.98	5	8	-13.98
	40	2422	-13.77	-13.97	-10.86	5	8	-18.86
		2437	-10.34	-10.06	-7.19	5	8	-15.19
		2452	-12.86	-13.64	-10.22	5	8	-18.22

Table 18. Peak Power Spectral Density, Test Results

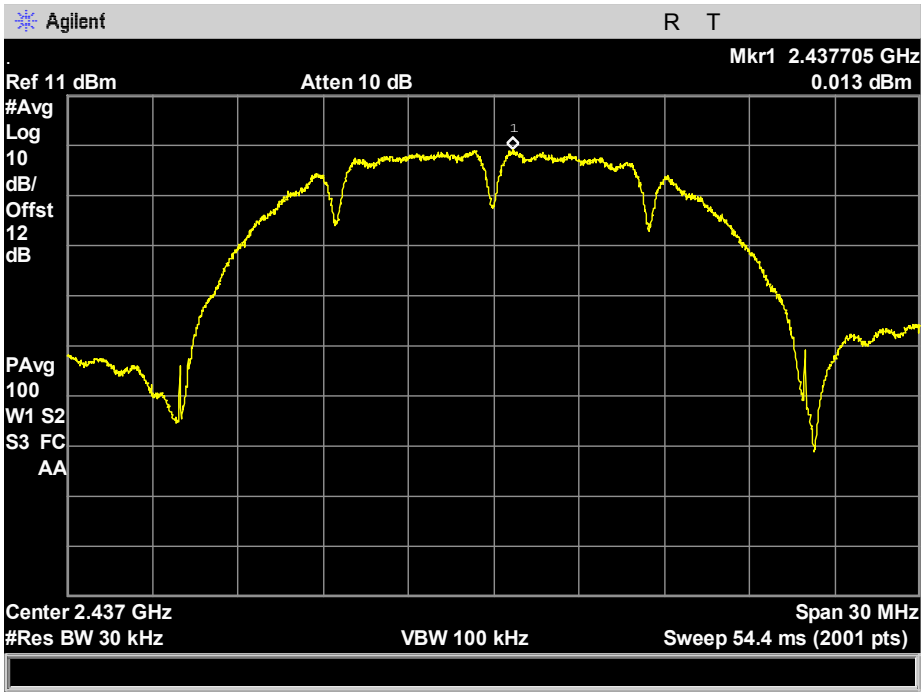
Peak Power Spectral Density



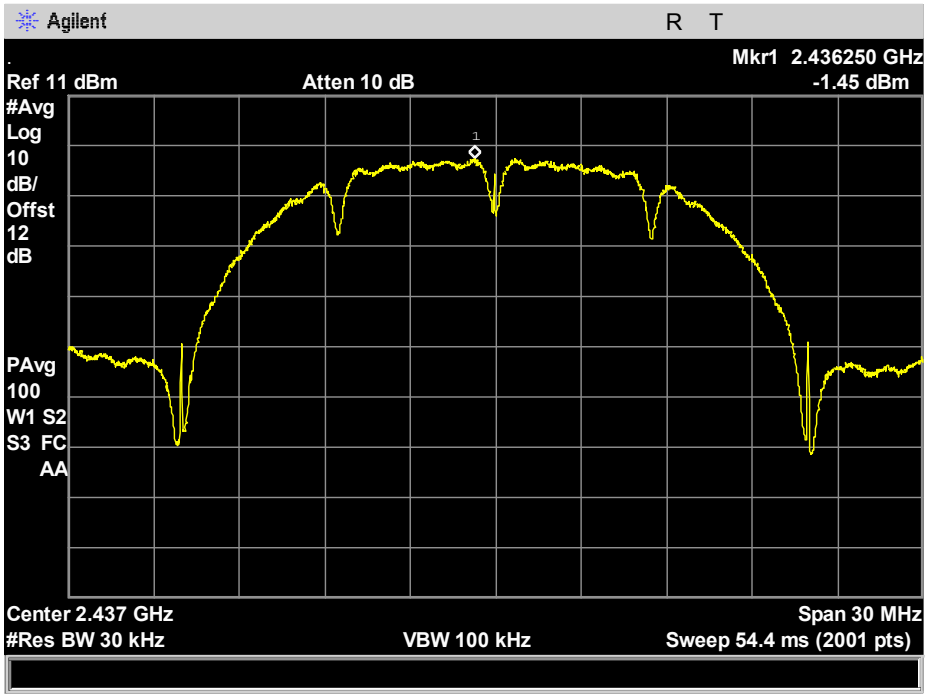
Plot 169. Power Density, 801.11b, 20, 2412, ch. 0



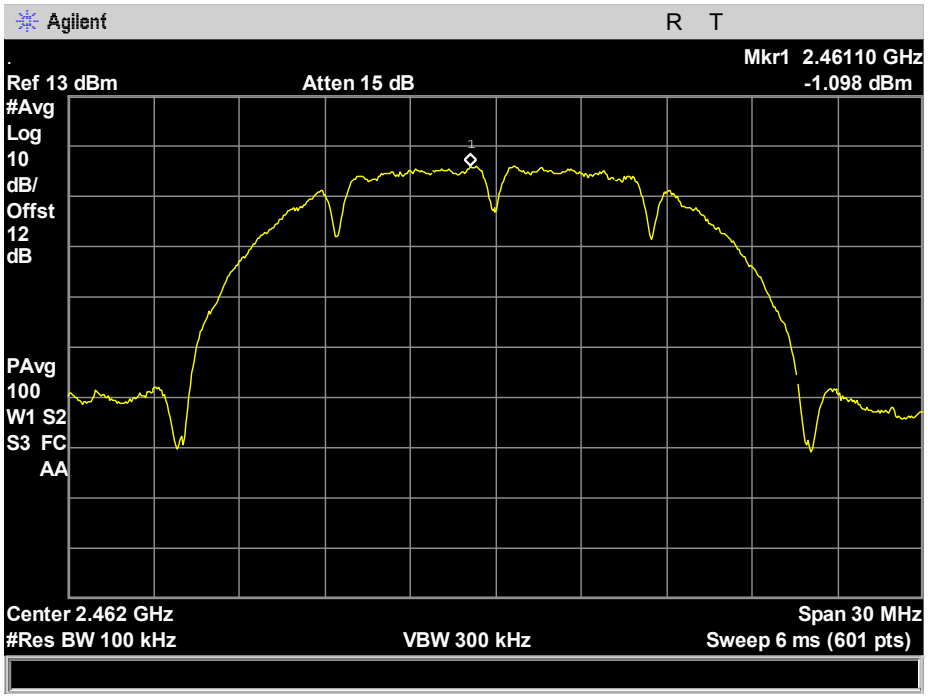
Plot 170. Power Density, 801.11b, 20, 2412, ch.1



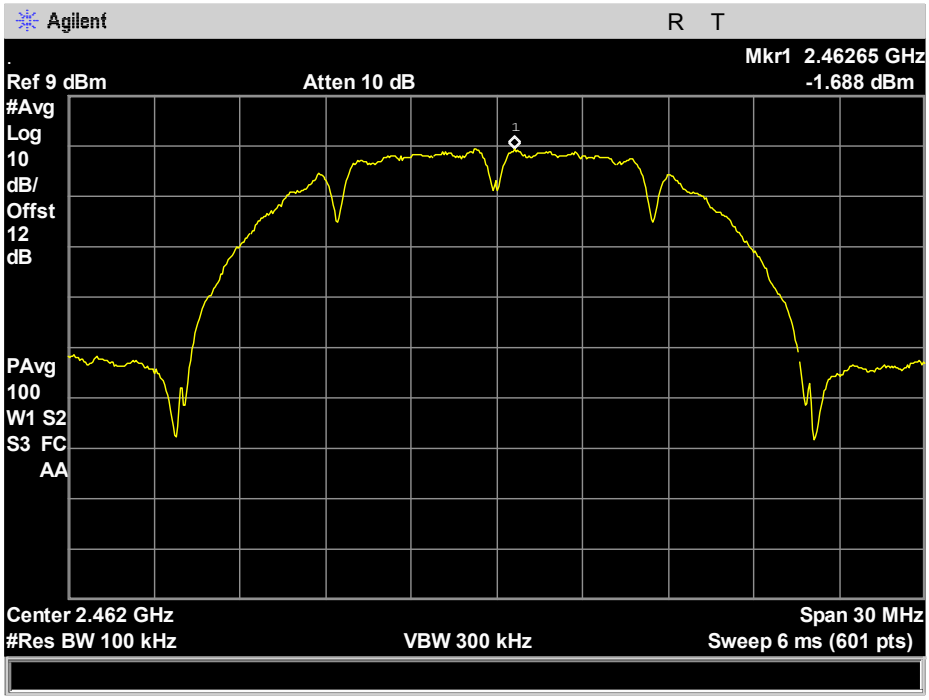
Plot 171. Power Density, 801.11b, 20, 2437, ch. 0



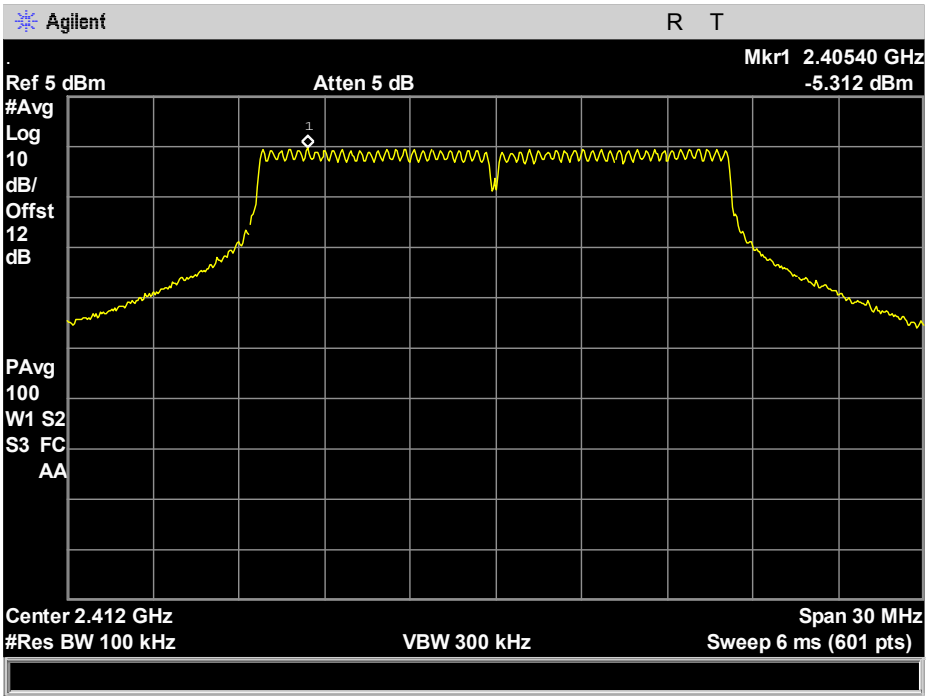
Plot 172. Power Density, 801.11b, 20, 2437, ch. 1



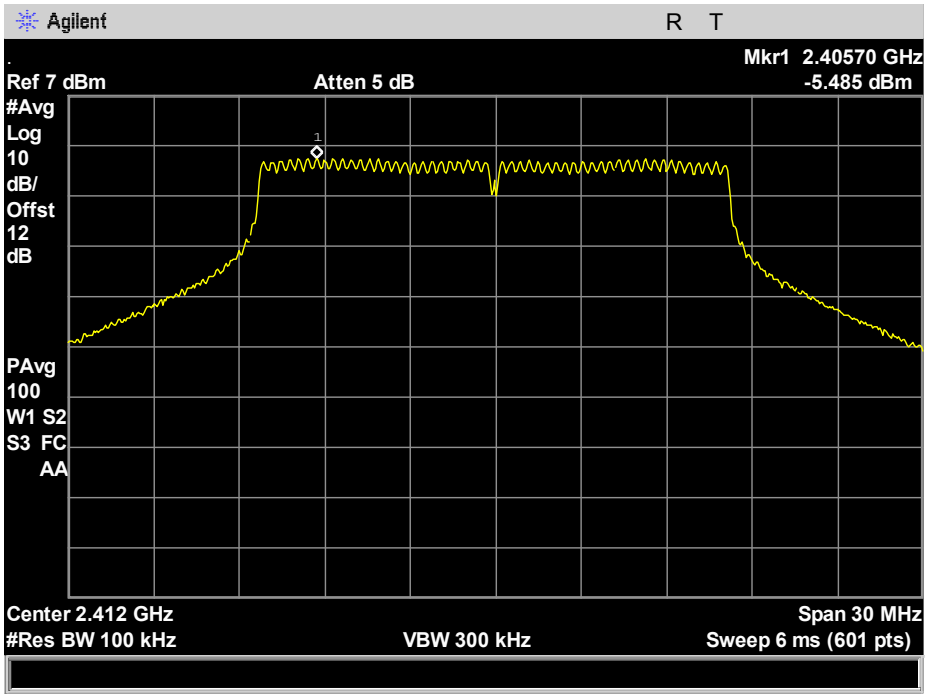
Plot 173. Power Density, 801.11b, 20, 2462, ch. 0



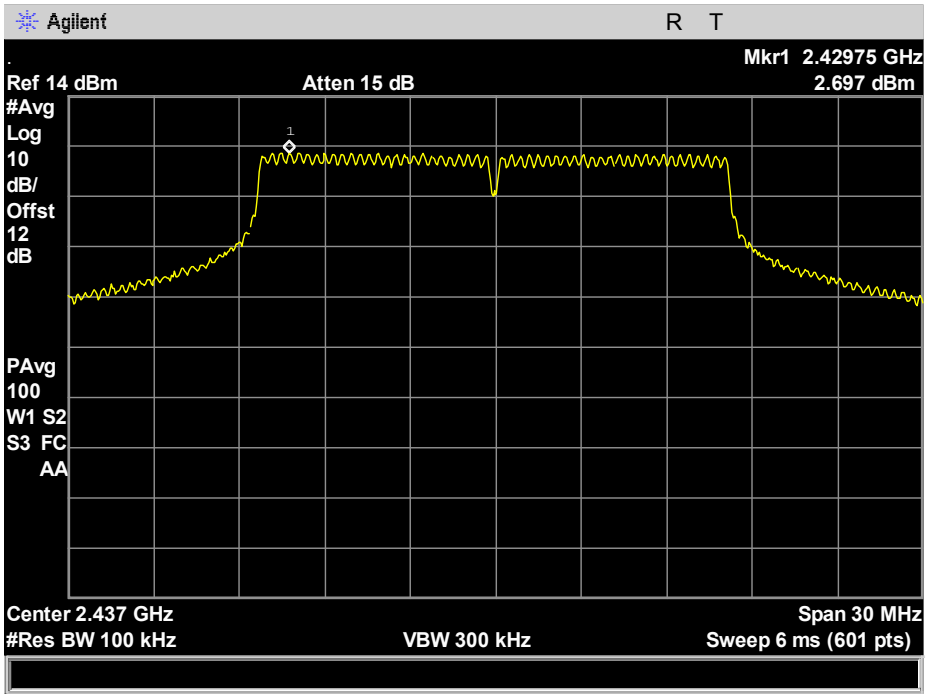
Plot 174. Power Density, 801.11b, 20, 2462, ch. 1



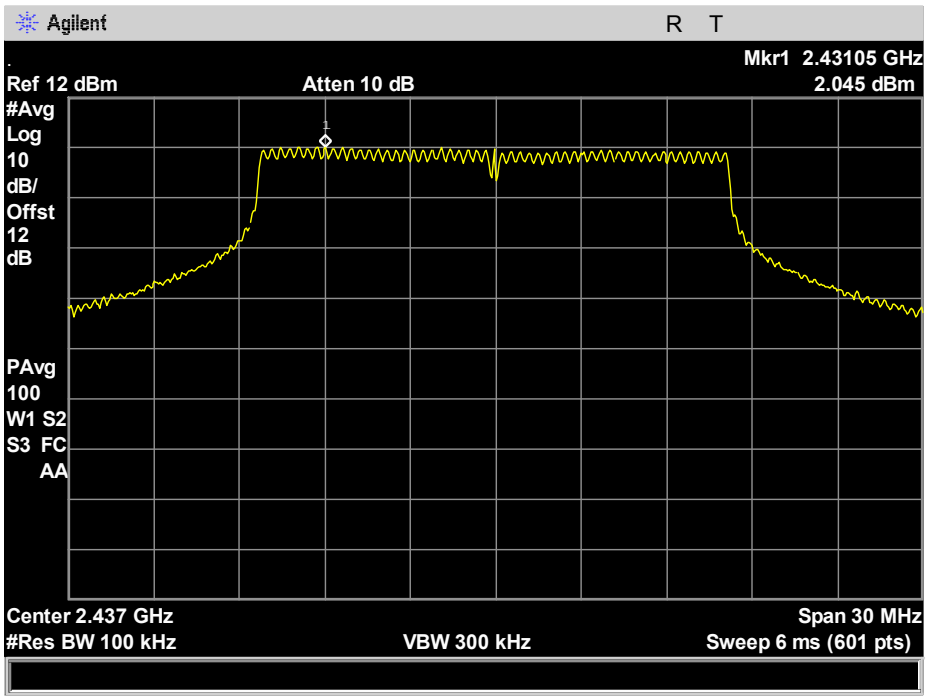
Plot 175. Power Density, 801.11g, 20, 2412, ch. 0



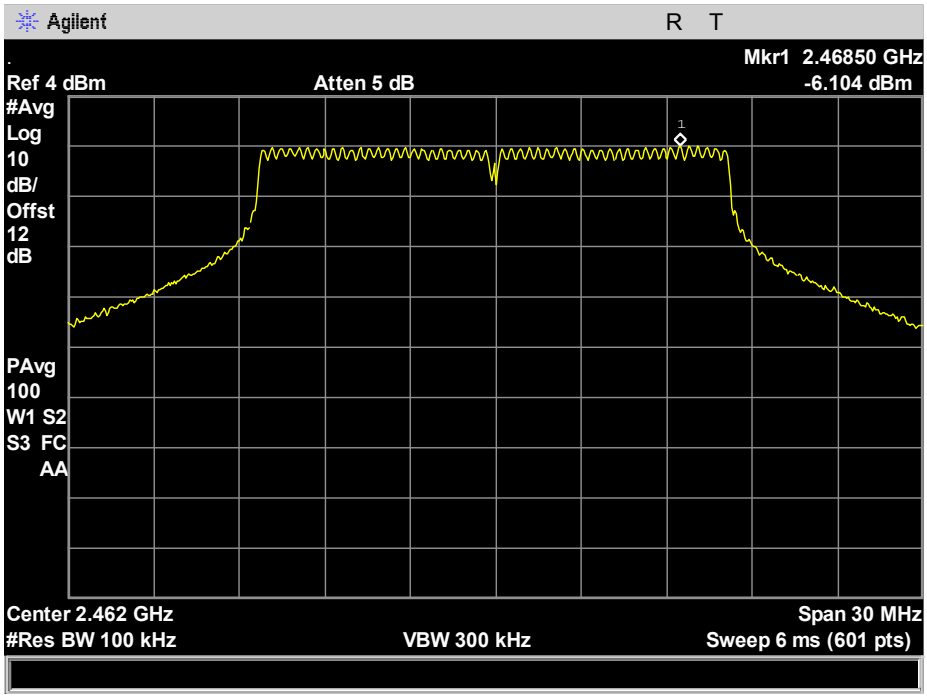
Plot 176. Power Density, 801.11g, 20, 2412, ch.1



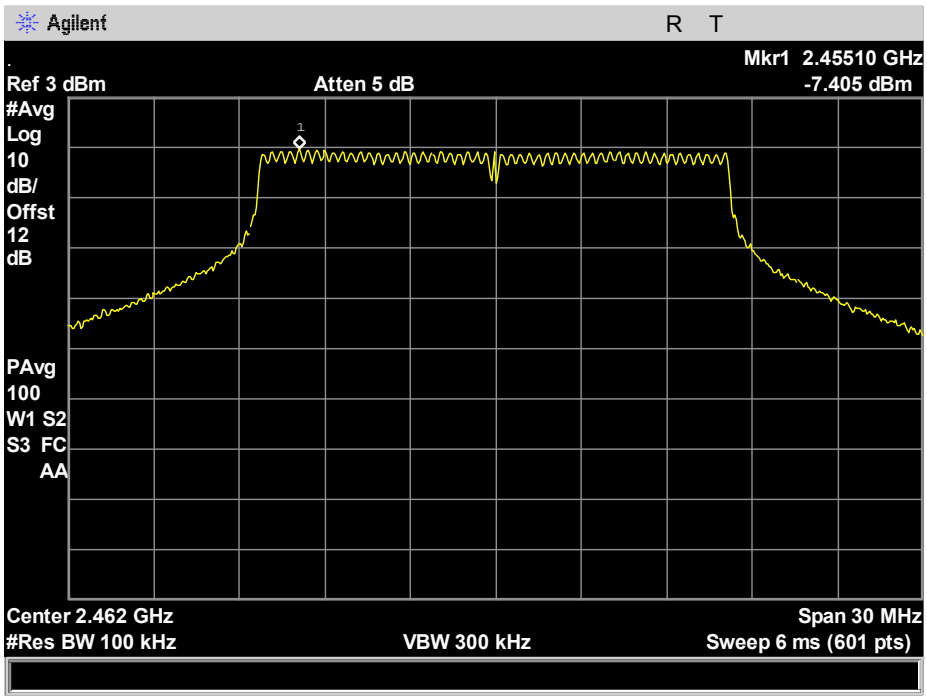
Plot 177. Power Density, 801.11g, 20, 2437, ch. 0



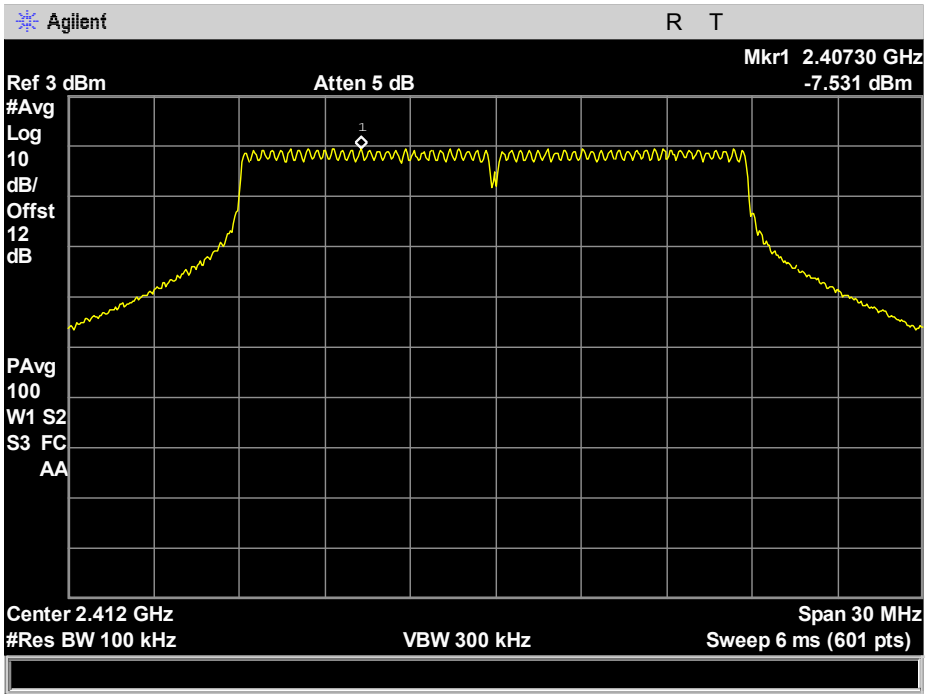
Plot 178. Power Density, 801.11g, 20, 2437, ch. 1



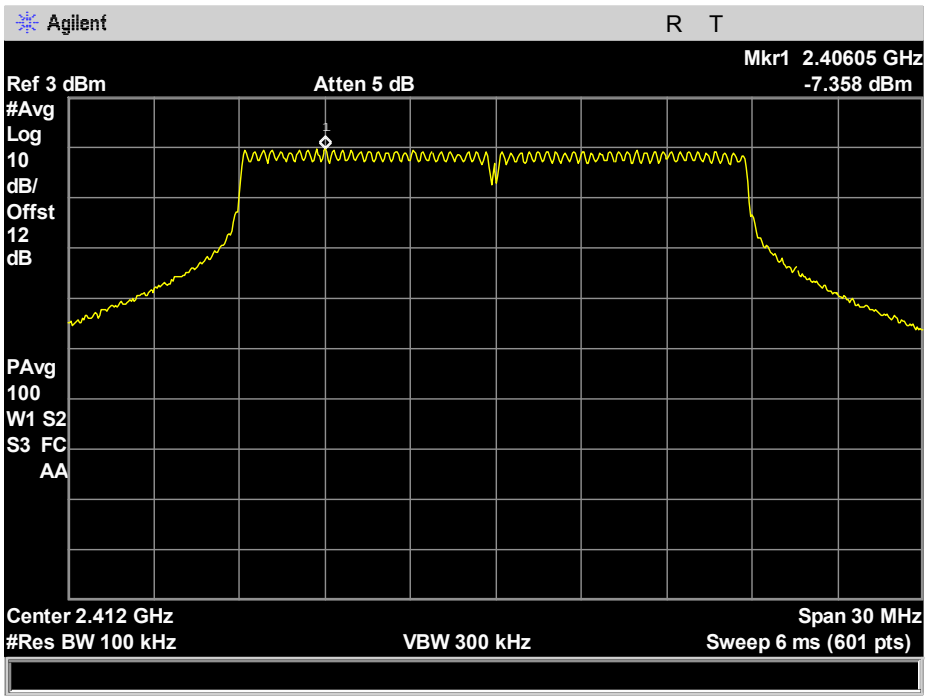
Plot 179. Power Density, 801.11g, 20, 2462, ch. 0



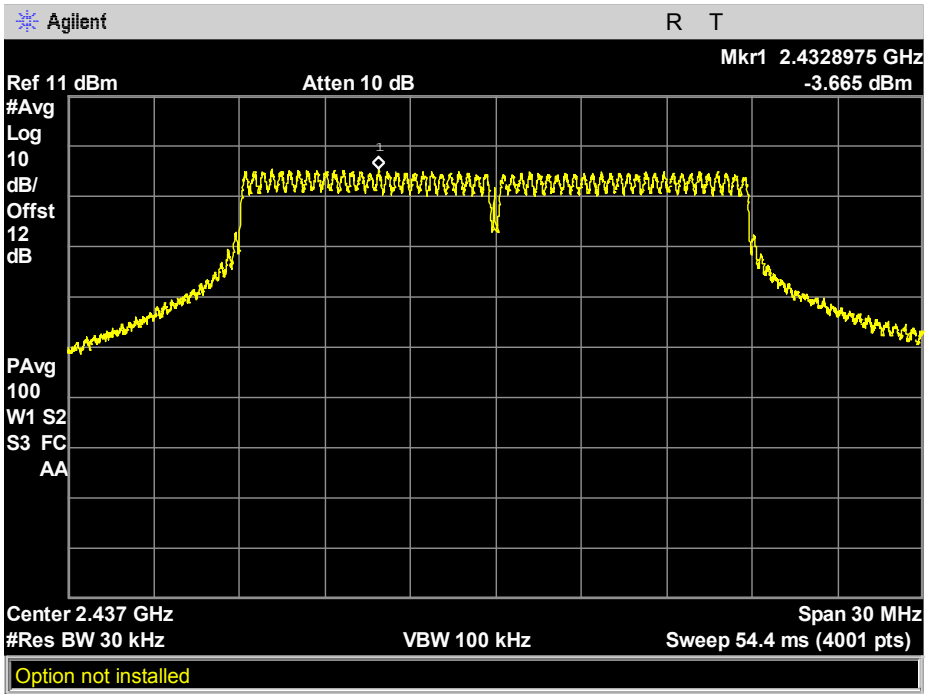
Plot 180. Power Density, 801.11g, 20, 2462, ch. 1



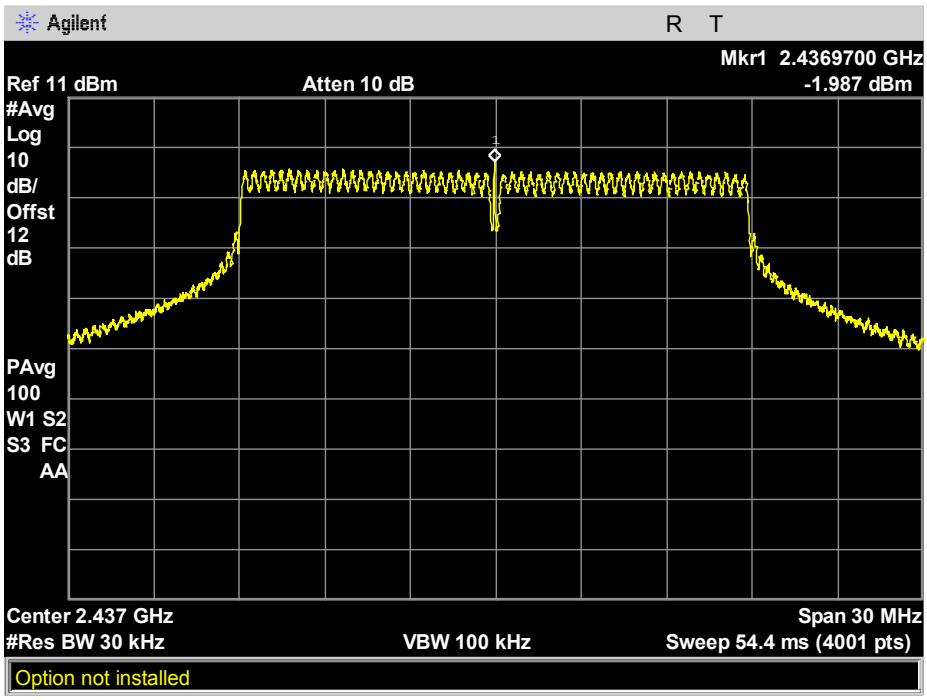
Plot 181. Power Density, 801.11n, 20, 2412, ch. 0



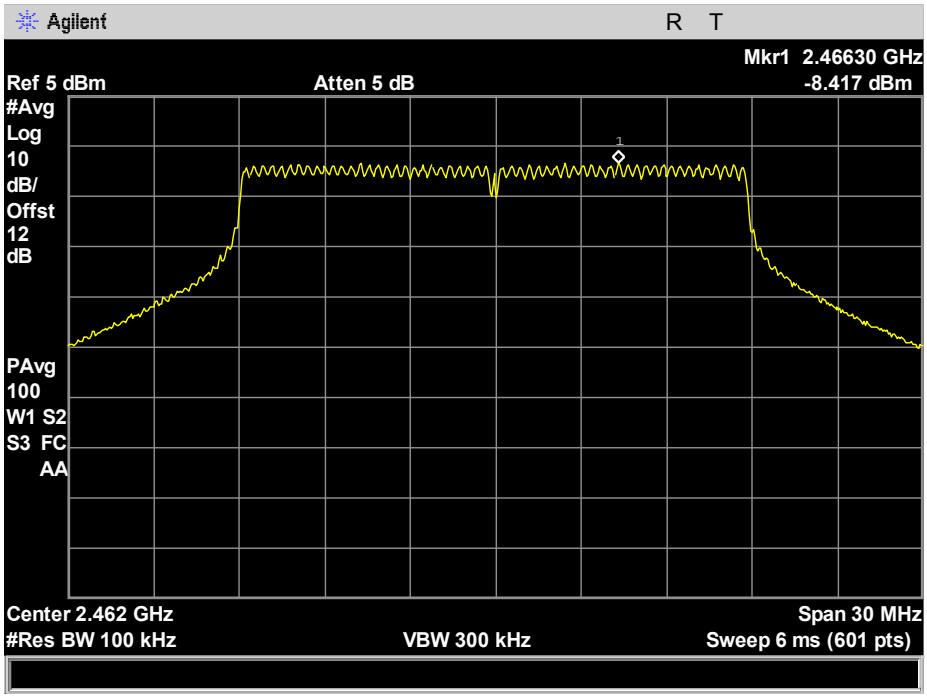
Plot 182. Power Density, 801.11n, 20, 2412, ch.1



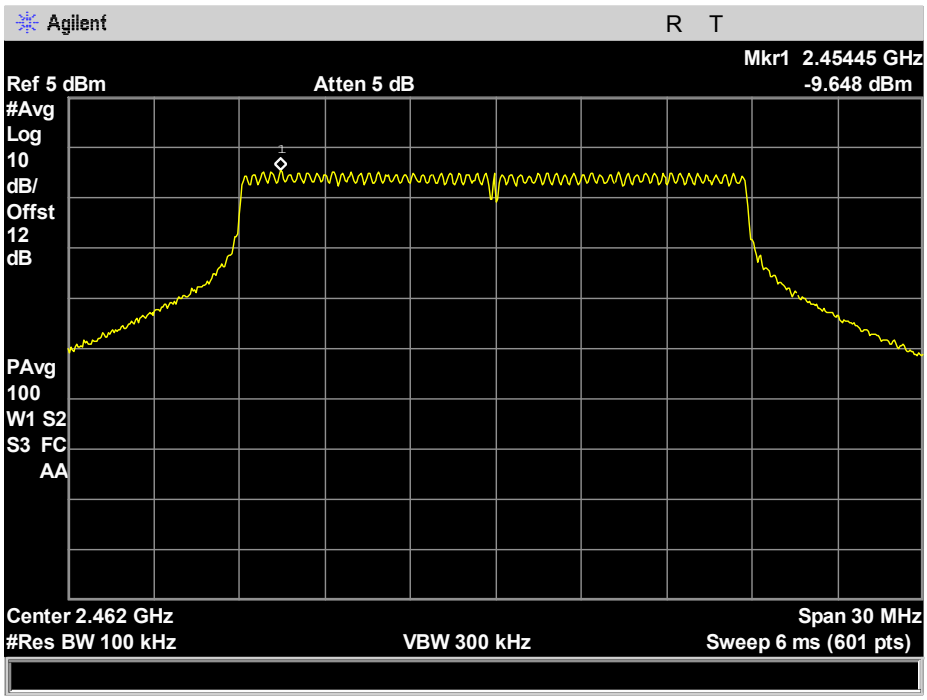
Plot 183. Power Density, 801.11n, 20, 2437, ch. 0



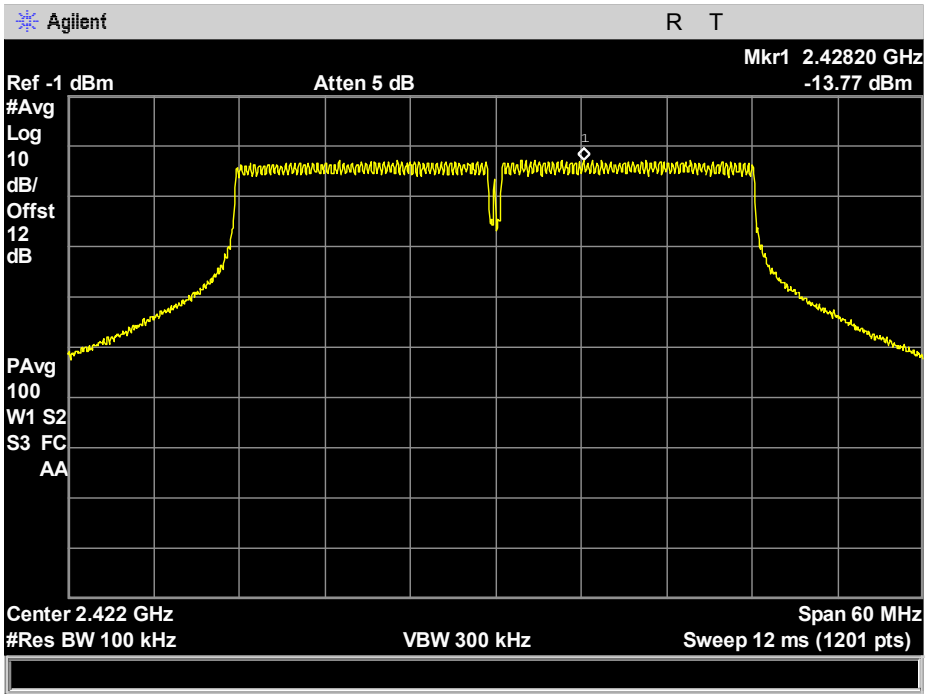
Plot 184. Power Density, 801.11n, 20, 2437, ch. 1



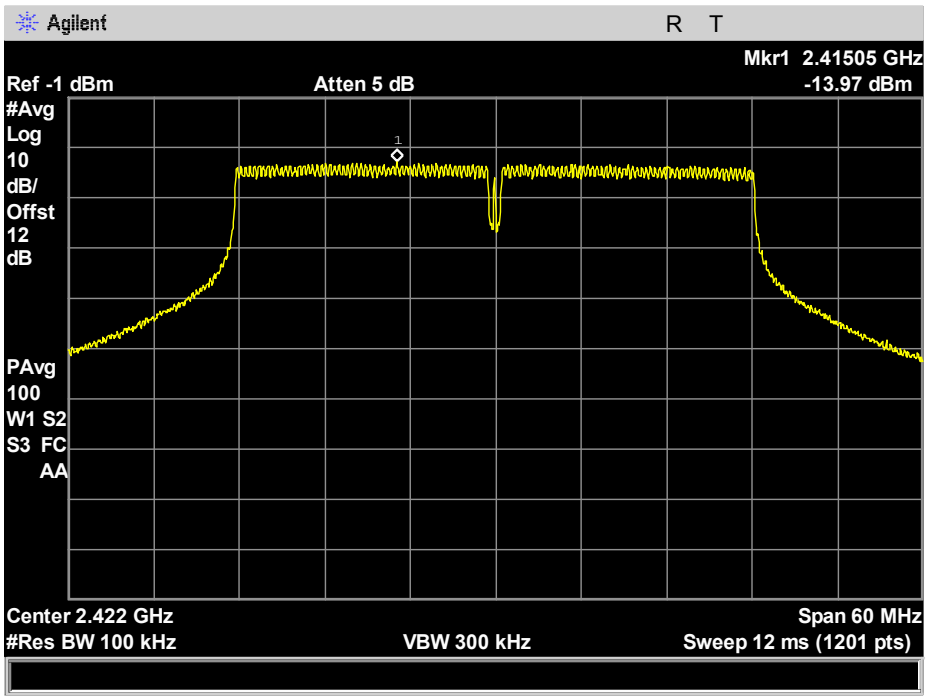
Plot 185. Power Density, 801.11n, 20, 2462, ch. 0



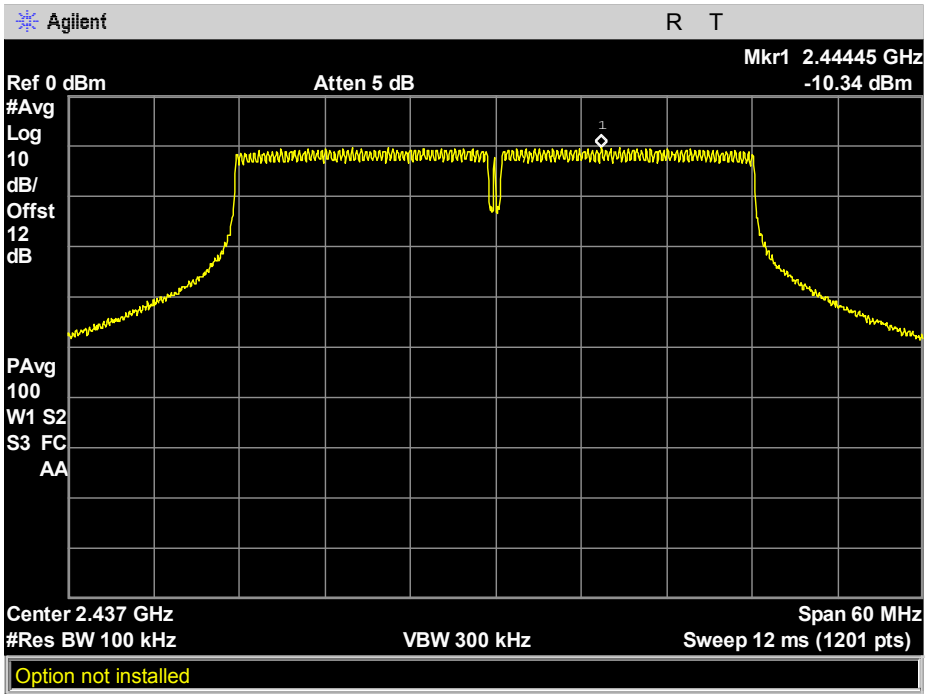
Plot 186. Power Density, 801.11n, 20, 2462, ch. 1



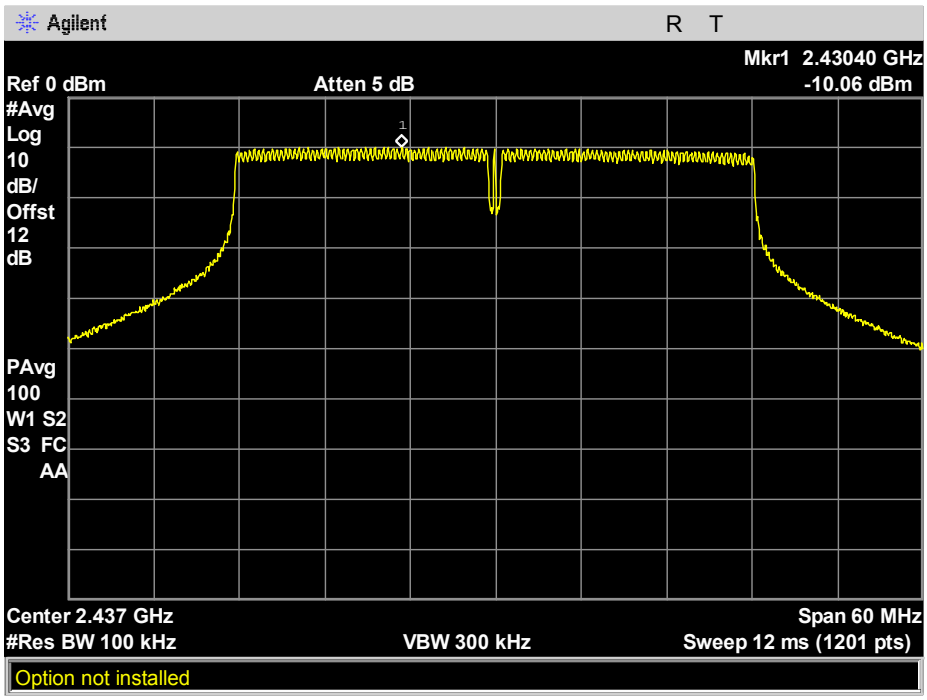
Plot 187. Power Density, 801.11n, 40, 2422, ch. 0



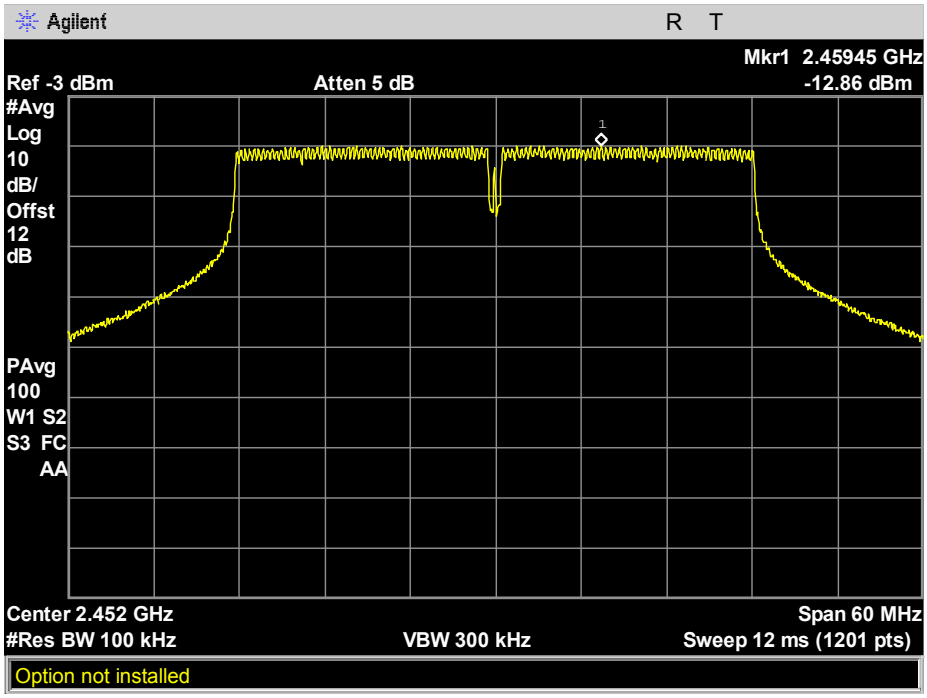
Plot 188. Power Density, 801.11n, 40, 2422, ch.1



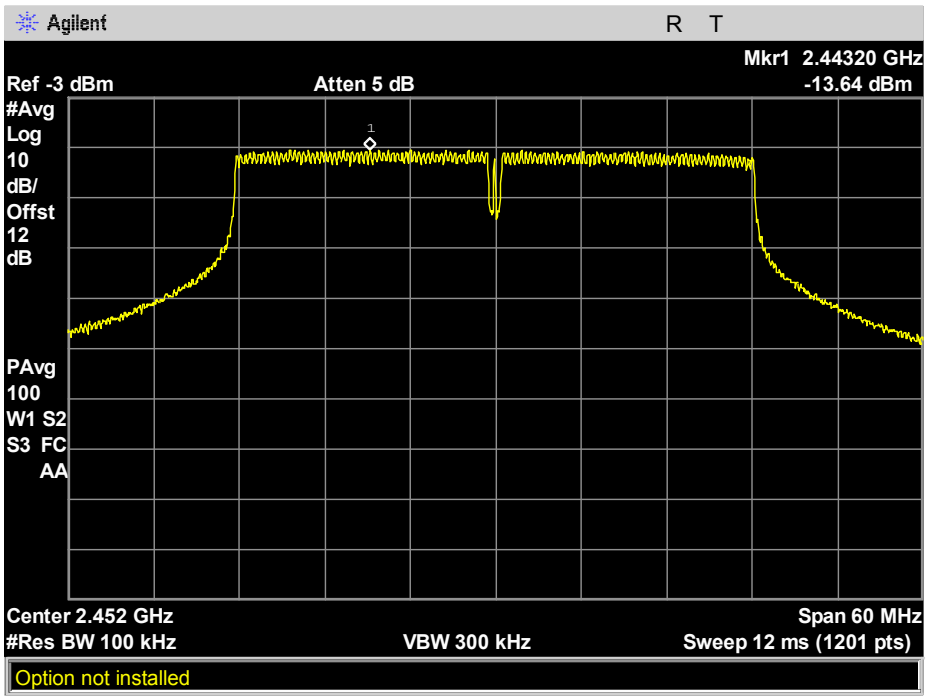
Plot 189. Power Density, 801.11n, 40, 2437, ch. 0



Plot 190. Power Density, 801.11n, 40, 2437, ch. 1



Plot 191. Power Density, 801.11n, 40, 2452, ch. 0



Plot 192. Power Density, 801.11n, 40, 2452, ch. 1

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(i) Maximum Permissible Exposure

RF Exposure Requirements: **§1.1307(b)(1) and §1.1307(b)(2):** Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

RF Radiation Exposure Limit: **§1.1310:** As specified in this section, the Maximum Permissible Exposure (MPE) Limit shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter.

MPE Limit: EUT's operating frequencies @ 2400-2483.5 MHz; **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

Test Results:

FCC									
Frequency (MHz)	**Con. Pwr. (dBm)**	**Con. Pwr. (mW)**	**Ant. Gain (dBi)**	**Ant. Gain numeric**	**Pwr. Density (mW/cm^2)**	**Limit (mW/cm^2)**	**Margin**	**Distance (cm)**	**Result**
2437	26.58	454.988	8	6.31	0.57112	1	0.42888	20	Pass

The safe distance where Power Density is less than the MPE Limit listed above was found to be 20 cm.

IV. Test Equipment

Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2005.

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1T4753	Antenna - Bilog	Sunol Sciences	JB6	8/30/2018	2/29/2020
1T2665	Antenna; Horn	EMCO	3115	6/22/2017	6/22/2019
1T4409	EMI Receiver	Rohde & Schwarz	ESIB7	1/4/2019	1/4/2021
1T4771	PSA Spectrum Analyzer	Agilent Technologies	E4446A	5/16/2018	11/16/2019
1T4300	SEMI-ANECHOIC CHAMBER (NSA)	EMC TEST SYSTEMS	NONE	1/30/2019	6/30/2020
1T4149	High-Frequency Anechoic Chamber	Ray Proof	81	Not Required	
1T8743	Preamplifier	A.H. Systems, Inc.	PAM-0118P	Func. Verify	
1T4612	Spectrum Analyzer	Agilent Technologies	E4407B	5/15/2018	11/15/2019
1T2947	LISN	Solar Electronics Company	8028-50-TS-24-BNC	8/31/2018	2/29/2020
1T2948	LISN	Solar Electronics Company	8028-50-TS-24-BNC	8/31/2018	2/29/2020

Table 19. Test Equipment List

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

V. Certification & User's Manual Information

Certification & User's Manual Information

A. Certification Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart I — Marketing of Radio frequency devices:

§ 2.801 Radio-frequency device defined.

As used in this part, a radio-frequency device is any device which in its operation is capable of Emitting radio-frequency energy by radiation, conduction, or other means. Radio- frequency devices include, but are not limited to:

(a) The various types of radio communication transmitting devices described throughout this chapter.

(b) The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.

(c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.

(d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

§ 2.803 Marketing of radio frequency devices prior to equipment authorization.

(a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:

(1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or

(2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.

(d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or pre-production stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.

(e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:

(i) Compliance testing;

(ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production states; or

(v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.

(e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.

(f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.

Certification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart J — Equipment Authorization Procedures:

§ 2.901 Basis and Purpose

(a) In order to carry out its responsibilities under the Communications Act and the various treaties and international regulations, and in order to promote efficient use of the radio spectrum, the Commission has developed technical standards for radio frequency equipment and parts or components thereof. The technical standards applicable to individual types of equipment are found in that part of the rules governing the service wherein the equipment is to be operated.[1] *In addition to the technical standards provided, the rules governing the service may require that such equipment be verified by the manufacturer or importer*, be authorized under a Declaration of Conformity, or receive an equipment authorization from the Commission by one of the following procedures: certification or registration.

(b) The following sections describe the verification procedure, the procedure for a Declaration of Conformity, and the procedures to be followed in obtaining certification from the Commission and the conditions attendant to such a grant.

§ 2.907 Certification.

(a) Certification is an equipment authorization issued by the Commission, based on representation and test data submitted by the applicant.

(b) Certification attaches to all units subsequently marketed by the grantee which are identical (see Section 2.908) to the sample tested except for permissive changes or other variations authorized by the Commission pursuant to Section 2.1043.

[1] In this case, the equipment is subject to the rules of Part 15. More specifically, the equipment falls under Subpart B (of Part 15), which deals with unintentional radiators.

Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

(a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.

(1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.

(i) If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.

(ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.

(2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but must be updated as changes are made to the measurement facilities or as otherwise described in this section. At least every three years, the organization responsible for filing the data with the Commission shall certify that the data on file is current.

Certification & User's Manual Information

1. Label and User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart A — General:

§ 15.19 Labeling requirements.

(a) In addition to the requirements in Part 2 of this chapter, a device subject to certification or verification shall be labeled as follows:

(1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

(2) A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

This device is verified to comply with Part 15 of the FCC Rules for use with cable television service.

(3) All other devices shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

(4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.

(5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

§ 15.21 Information to user.

The user's manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Verification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart B — Unintentional Radiators:

§ 15.105 Information to the user.

(a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expense.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

– Reorient or relocate the receiving antenna.

– Increase the separation between the equipment and receiver.

– Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

– Consult the dealer or an experienced radio/TV technician for help.

End of Report

