Testing Tomorrow's Technology

Application
For

Title 47 USC, Part 2, Subpart J, Paragraph 2.902, Equipment Authorization of Verification for an Unintentional Radiator per Part 15, Subpart B, Paragraphs 15.107 and 15.109

And

Part 2, Subpart J, Paragraph 2.907 Equipment Authorization of Certification for an Intentional Radiator per Part 15, Subpart C, paragraph 15.247

For the

Inventek Systems
Model: ISM4319-E, ISM4319-U, ISM4319-C

FCC ID: O7P-ISM4319F1
IC: 10147A-ISM4319F1

UST Project: 11-0263
Issue Date: August 10, 2012

Total Pages: 121

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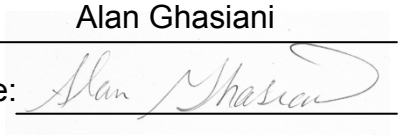
I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: Alan Ghasiani

Name: 

Title: Compliance Engineer – President

Date August 10, 2012

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MEASUREMENT TECHNICAL REPORT

COMPANY NAME: Inventek Systems
MODEL: ISM4319-E, ISM4319-U, ISM4319-C
FCC ID: O7P-ISM4319F1
IC ID: 10147A-ISM4319F1
DATE: August 10, 2012

This report concerns (check one): Original grant [X]
Class II change

Equipment type: WiFi module for use in other devices.

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No X

If yes, defer until: _____N/A_____
date
agrees to notify the Commission by N/A
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

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1 General Information

1.1 Purpose of this Report

This report is prepared as a means of conveying test results for the 2.4 GHz WiFi (802.11b, 802.11g, and 802.11n) information concerning the suitability of this exact product for public distribution according to the FCC Rules and Regulations Part 15, Section 247.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on November 29, 2011 in good operating condition.

1.3 Product Description

The Equipment Under Test (EUT) is the Inventek Systems Models ISM4319-E, ISM4319-U and ISM4319-C. All three models use the same radio module: ISM4319F1-T1. The module (ISM4319F1-T1) is part of Inventek Systems Ez-WiFi module family targeting embedded WiFi 802.11 b/g/n applications. Ez-WiFi modules offer the first plug and play WiFi solution that enables the embedded sector to integrate WiFi. The Ez-WiFi module hardware system consists of a host processor, integrated antenna and Broadcom WiFi device. The module provides SPI and UART interfaces. The module requires no operation system and has a completely integrated TCP/IP stack that only requires a simple AT command set to establish connectivity.

Ez-WiFi modules are offered in three configurations: 15x30mm module with integrated trace antenna, part number ISM4319-E; 15x28mm module with ceramic antenna, part number ISM4319-C; and 15x28mm module with U.FL connector for connection to an external 2.15 dBi dipole antenna, part number ISM4319-U. All configurations have been examined and the test data is provided herein for consideration for modular approval.

In addition, Inventek offers two development boards for customer evaluation and integration of the Ez-WiFi module into their system.

The EUT was placed into a test mode for measuring the output characteristics of the 2.4 GHz transceiver. All three antennas were tested and data for all three antennas is presented herein. The module is the same module, but is incorporated on different application boards, depending on the type of antenna to be used.

1.4 Configuration of Tested System

The Test Samples were tested per *ANSI C63.4, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2003)* for FCC subpart B Digital equipment Verification requirements and per FCC KDB Publication number 558074 for Digital Transmission Systems Operating Under section 15.247. Also, FCC, KDB Publication No. 558074 was used as a test procedure guide.

Digital RF conducted and radiated Verification emissions data (FCC 15.107 and 109) below 1 GHz were taken with the measuring receiver (or spectrum analyzer's) resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements performed above 1.0 GHz were made with a RBW of 1 MHz. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process.

A list of EUT and Peripherals is found in Table 1 below. A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious and fundamental emissions are provided in separate Appendices.

1.5 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA 30004. This site has been fully described and registered with the FCC. Its designation number is 0021249222. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 9991A.

1.6 Related Submittal(s)/Grant(s)

The EUT will be used to wirelessly send/receive data. The transceiver presented in this report will be used with other like transceivers:

The EUT is subject to the following FCC Equipment Authorizations:

a) Certification of the transmitter for Wifi.

b) Verification as a Class B digital device.

The manufacturer desires to seek a modular approval on this device.

Table 1. EUT and Peripherals

PERIPHERAL MANUFACTURER.	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
Inventek Systems (EUT)	ISM4319-E, ISM4319-U, ISM4319-C	Engineering Sample	Pending O7P-ISM4319F1	USB to Micro USB 3' U - P
Asus Netbook	Various	--	--	6' U - P
Power Supply Asus	Various	--	None	6' U - P 120 VAC/ 60 Hz
Laptop Computer IBM	Various	--	--	6' U - P
Power Supply IBM	Various	--	None	6' U - P 120 VAC/ 60 Hz

2 Tests and Measurements

2.1 Test Equipment

Table 2 below lists test equipment used to evaluate this product. Model numbers, serial numbers and their calibration status are included herein.

Table 2. Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	DATE OF LAST CALIBRATION*
SPECTRUM ANALYZER	8593E	HEWLETT-PACKARD	3205A00124	10/26/2011
SPECTRUM ANALYZER	8566B	HEWLETT-PACKARD	2410A00109	11/4/2011
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	2944A06291	10/07/11
LOOP ANTENNA 0.09 MHz to 30 MHz	SAS-200/562	Electro-Metrics	142	08/09/11 2 Year
BICONICAL ANTENNA 25 MHz to 200 MHz	BIA-25	Electro-Metrics	2451	12/29/09 2 Yr * Extended 90 days
LOG PERIODIC 100 MHz to 1000 MHz	3146	EMCO	3110-3236	1/22/10 2 Yr*
HORN ANTENNA 1 GHz to 18 GHz	SAS-571	A. H. Systems	605	2/9/2010 2 Year*
HORN ANTENNA 1 GHz to 18 GHz	EMCO 3115	EMCO	9107-3723	8/10/2011 2 Year
HORN ANTENNA 18 GHz to 25 GHz	EMCO 3116	EMCO	9505-2255	8/09/2012 2 Year
PREAMP 1 GHz to 26.5 GHz	8449B	HEWLETT-PACKARD	3008A00480	11/21/2011
CALCULATION PROGRAM	N/A	N/A	Ver. 6.0	N/A

***ALL EQUIPMENT USED WAS WITHIN CALIBRATION AT THE TIME OF TESTING (testing was completed in December, 2011)**
Note: The calibration interval of the above test instruments are 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

2.2 Modifications to EUT Hardware

No modifications were made by US Tech in order to bring the EUT into compliance with FCC Part 15, Subpart C Intentional Radiator Limits for the transmitter portion of the EUT or the Subpart B Unintentional Radiator Limits (Receiver and Digital Device) Requirements.

2.3 Number of Measurements for Intentional Radiators (15.31(m))

Measurements of intentional radiators or receivers shall be performed and reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in Table 3 as follows:

Table 3. Number of Test Frequencies for Intentional Radiators

Frequency Range over which the device operates	Number of Frequencies	Location in the Range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near the top 1 near the bottom
Greater than 10 MHz	3	1 near top 1 near middle 1 near bottom

Because the EUT operates over 2.4 GHz to 2.4835 GHz, 3 test frequencies will be used.

2.4 Frequency Range of Radiated Measurements (Part 15.33)

2.4.1 Intentional Radiator

The spectrum shall be investigated for the intentional radiator from the lowest RF signal generated in the EUT, without going below 9 kHz to the 10^{th} harmonic of the highest fundamental frequency generated or 40 GHz, whichever is the lowest.

2.4.2 Unintentional Radiator

For the digital device, an unintentional radiator, the frequency range shall be 30 MHz to 1000 MHz, or to the range specified in 2.4.1 above, whichever is the higher range of investigation.

2.5 Measurement Detector Function and Bandwidth (CFR 15.35)

The radiated and conducted emissions limits shown herein are based on the following:

2.5.1 Detector Function and Associated Bandwidth

On frequencies below 1000 MHz, the limits herein are based upon measurement equipment employing a CISPR Quasi-peak detector function and related measurement bandwidths (i.e. 9 kHz from 150 kHz to 30 MHz and 120 kHz from 30 MHz to 1000 MHz). Alternatively, measurements may be made with equipment employing a peak detector function as long as the same bandwidths specified for the Quasi-peak device are used.

2.5.2 Corresponding Peak and Average Requirements

Above 1000 MHz, radiated limits are based on measuring instrumentation employing an average detector function. When average radiated emissions are specified there is also a corresponding Peak requirement, as measured using a peak detector, of 20 dB greater than the average limit. For all measurements above 1000 MHz the Resolution Bandwidth shall be at least 1 MHz.

2.5.3 Pulsed Transmitter Averaging

When the radiated emissions limit is expressed as an average value, and the transmitter is pulsed, the measured field strength shall be determined by applying a Duty Cycle Correction Factor based upon dividing the total ON time during the first 100 ms period by 100 ms (or by the period if less than 100 ms). The duty cycle may also be expressed logarithmically in dB. Please section 2.8 herein for details.

2.6 EUT Antenna Requirements (CFR 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 EUT has a built in antenna; there is no obvious method of attaching a different antenna.

Table 4. Allowed Antenna(s)

MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB_i	TYPE OF CONNECTOR	Report Reference
Inventek Systems	U.fl port antenna (Dipole)	ISM4319-U	2.15	Unique connector	Antenna 1
Pulse Technology	surface mount	ISM4319-C	1.85 (4dBic)	Permanent integral	Antenna 2
Inventek Systems	trace antenna	ISM4319-E	0	Permanent integral	Antenna 3

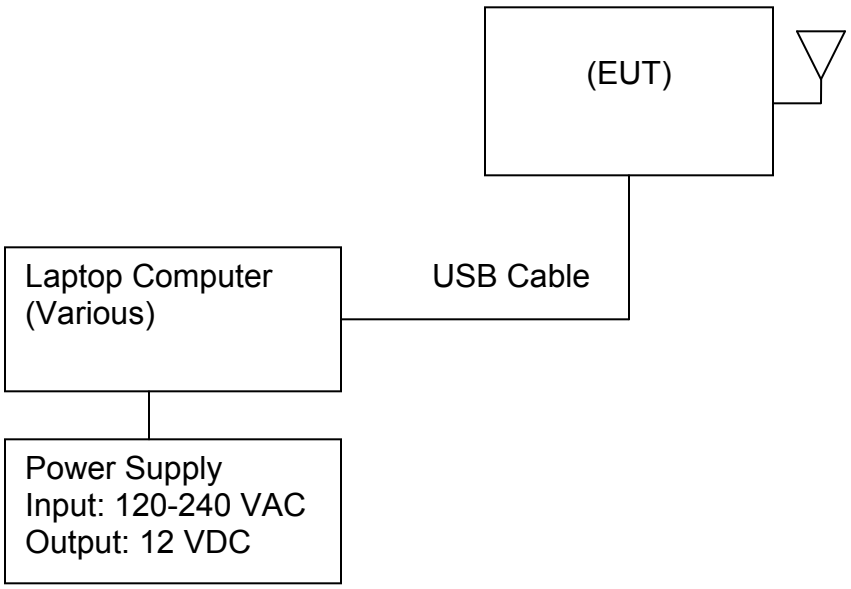


Figure 1. Test Configuration

2.7 Restricted Bands of Operation (Part 15.205)

Only spurious emissions can fall in the frequency bands of CFR 15.205. The field strength of these spurious cannot exceed the limits of 15.209. Radiated harmonics and other Spurious are examined for this requirement see paragraph 2.10.

2.8 Transmitter Duty Cycle (CFR 35 (c))

The duty cycle de-rating factor used in the calculation of average radiated limits (per CFR 15.209 and 15.35(c)) is described below. This factor was calculated by first determining the worst case scenario for system operation.

The worst-case scenario in any 100 ms timeslot, along with all transmission lengths, will be as follows:

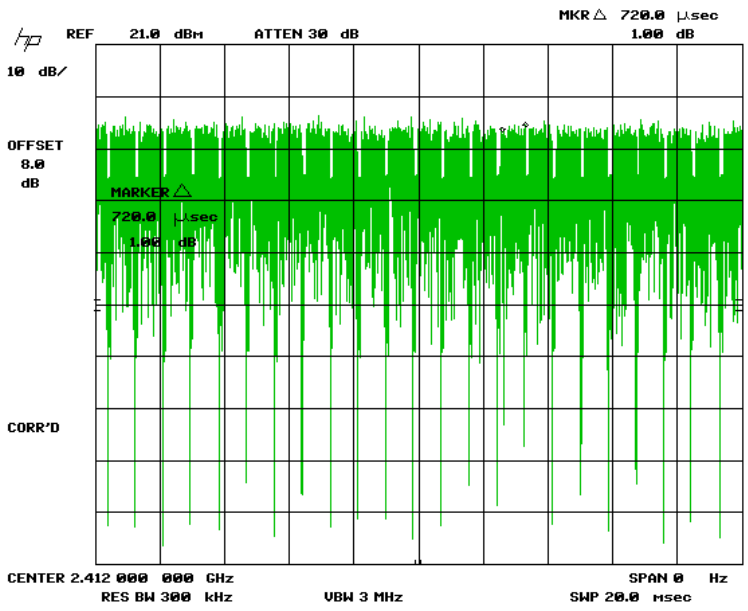


Figure 2. Duty Cycle

The duty cycle is computed as follows (in any 100 ms period):

Duty Cycle = (720usec *23) = 0.01656 * 5 = 82.8 msec in 100 msec

Correction Factor = $20\log_{10}(82.8/100\text{ms})$ = **[-1.64 dB]**

2.9 Intentional Radiator, Power Lines Conducted Emissions (CFR 15.207)

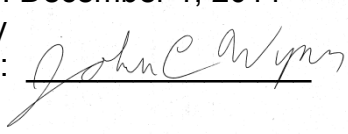
The power line conducted voltage emission measurements have been carried out in accordance with CFR 15.207, per ANSI C63.4, Paragraph 7, with a spectrum analyzer connected to an LISN and the EUT placed into a continuous mode of transmission.

The worst-case results for conducted emissions were determined to be produced when the EUT was operating under continuous transmission on the low channel.

Table 5. Intentional Conducted Emissions

Intentional Conducted Emissions Tested from 150 KHz to 30 MHz						
Tested By: JCW	**Specification Requirement: FCC Part 15.207 Class B**		**Project No.: 11-0263**	**Manufacturer: Inventek Systems Model: ISM4319-E, ISM4319-U, ISM4319-C**		
Frequency (MHz)	**Test Data (dBuV)**	**LISN+CL-PA (dB)**	**Corrected Results (dBuV)**	**Avg Limits (dBuV)**	**Margin (dB)**	**Detector**
120 VAC, 60 Hz, Phase Line						
0.1968	54.50	0.39	54.89	*63.7	8.9	**QP**
0.1968	48.90	0.30	49.20	53.7	4.5	**AVG**
0.9570	40.50	0.10	40.60	46.0	5.4	**PK**
3.1840	36.30	0.10	36.40	46.0	9.6	**QP**
9.5400	42.40	0.10	42.50	50.0	7.5	**PK**
10.5200	40.50	0.10	40.60	50.0	9.4	**PK**
24.0100	39.10	0.30	39.40	50.0	10.6	**PK**
120 VAC, 60 Hz, Neutral Line						
0.1563	48.90	0.40	49.30	55.7	6.4	**QP**
0.5024	37.10	0.20	37.30	46.0	8.7	**PK**
1.0240	34.00	0.20	34.20	46.0	11.8	**PK**
6.1000	34.60	0.10	34.70	50.0	15.3	**PK**
10.3700	30.50	0.20	30.70	50.0	19.3	**PK**
23.9800	34.40	0.39	34.79	50.0	15.2	**PK**

SAMPLE CALCULATIONS: At 0.1968 MHz = 54.50 + (0.39) = 54.89 dBuV
(*)= denotes quasi-peak measurement used.

Test Date: December 1, 2011
Tested By
Signature:  Name: John C. Wynn

2.10 **Intentional Radiator, Radiated Emissions (Antenna Conducted) (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a))**

The EUT was put into a continuous-transmit mode of operation and tested per FCC KDB Publication 558074 for conducted out of band emissions emanating from the antenna port over the frequency range of 30 MHz to 25.0 GHz. A conducted scan was performed on the EUT to identify and record spurious signals that were related to the transmitter. Antenna Conducted Emissions of a significant magnitude that fell within restricted bands were then measured as radiated emissions on the OATS. The conducted emissions graphs for 802.11b are found in Figures 4 through 12 below. The conducted emissions graphs for 802.11g are found in Figures 13 through 21. The conducted emissions graphs for 802.11n are found in Figures 22 through 24. The limit for antenna conducted power is 1 Watt (30 dBm) per 15.247 (b)(3).

For radiated measurements, the EUT was set into a continuous transmission mode. Below 1 GHz, the RBW of the measuring instrument was set equal to 120 kHz. Peak measurements above 1 GHz were measured using a RBW = 1 MHz, with a VBW ≥ RBW. The results of peak radiated spurious emissions falling within restricted bands are given in Table 6 below.

For Average Voltage measurements above 1 GHz, the emissions were measured using RBW = 1 MHz and VBW = 10 Hz. For a pulse-modulated transmitter, the EUT's average emissions are further modified by adding to them the worst-case duty cycle, determined by adding the EUT's total pulse widths (on time) over a 100 ms period and dividing by 100 ms.

2.10 **Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).**

On the OATS, the EUT was mounted on top of a non-conductive table, 80 cm above the floor, by placing it in the X-Z plane along the Z axis with its bottom cover in parallel with the ground. The front of the EUT faced the measurement antenna located 3 meters away. Each signal measured was maximized by raising and lowering the receive antenna between 1 and 4 meters in height while monitoring the ever changing spectrum analyzer display (with channel A in the Clear-Write mode and channel B in the Max-Hold mode) for the largest signal visible. That exact antenna height where the signal was maximized was recorded for reproducibility purposes. Also, the EUT was rotated about its Y-axis while monitoring the Spectrum Analyzer display for maximum. The EUT azimuth was recorded for reproducibility purposes. The EUT was measured when both maxima were simultaneously satisfied.

The test data is detailed below in for this section. Several radiated emissions above 1 GHz were measured at a distance of 1 meter. The measured value at 1 meter was then extrapolated to the resultant at 3 meters using an inverse distance extrapolation factor of -20 dB/decade. There were no test failures.

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

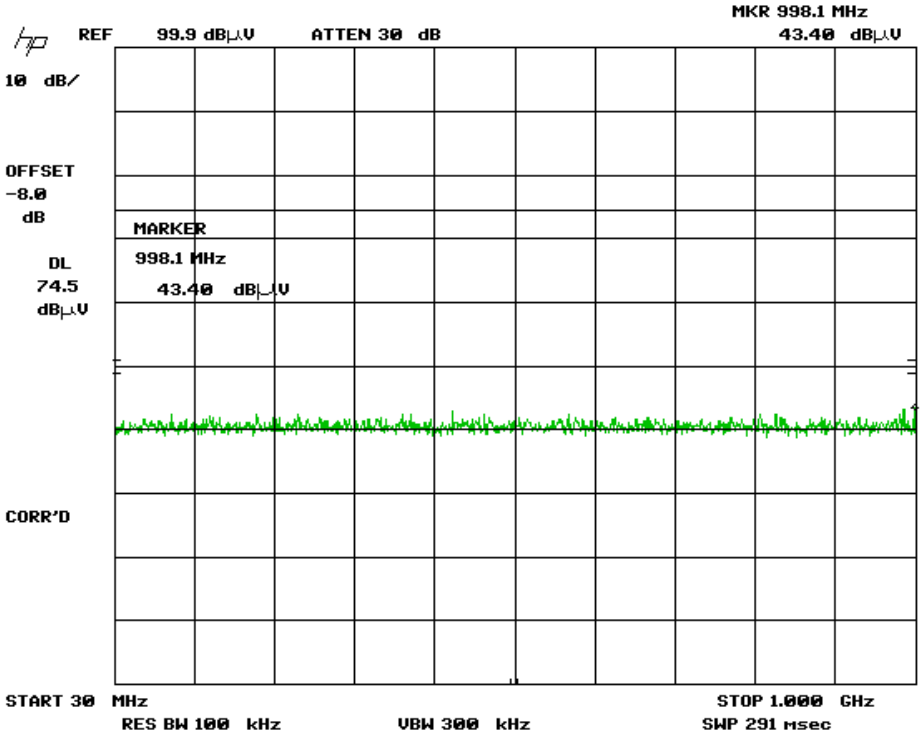


Figure 3. Emissions 802.11b - Low Channel, Part 1

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

Note: Large Signal shown is Fundamental Frequency

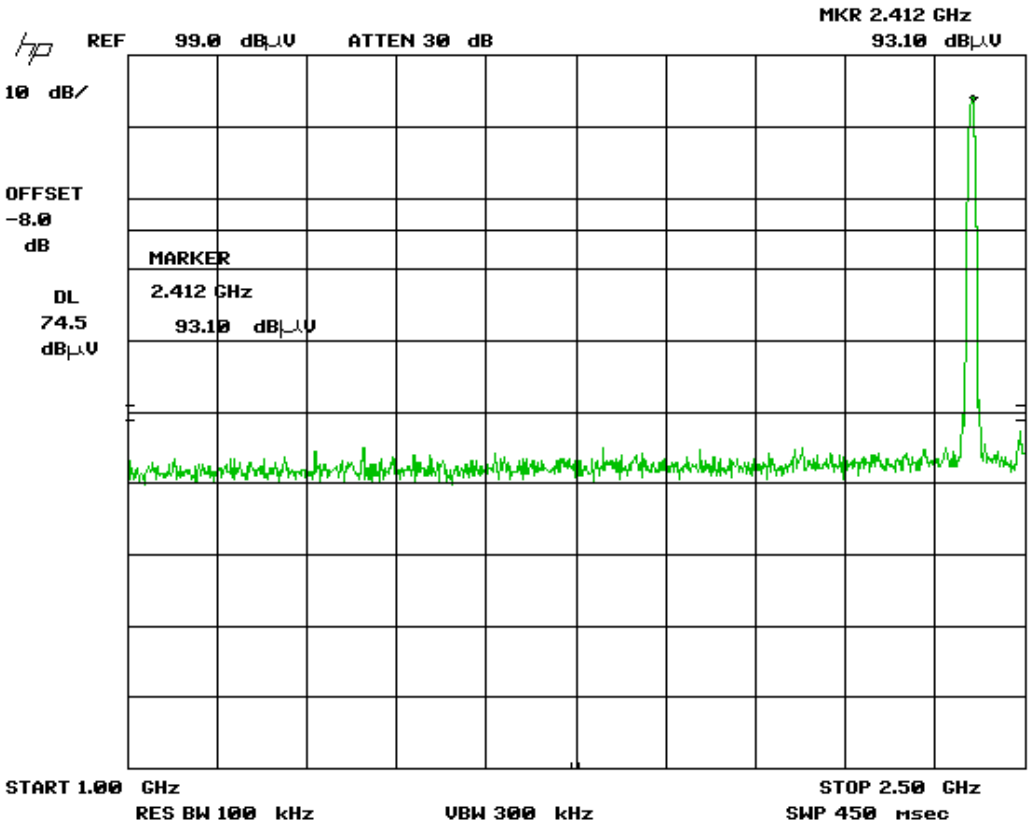


Figure 4. Emissions 802.11b - Low Channel, Part 2

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

Note: Large Signal shown is Fundamental Frequency

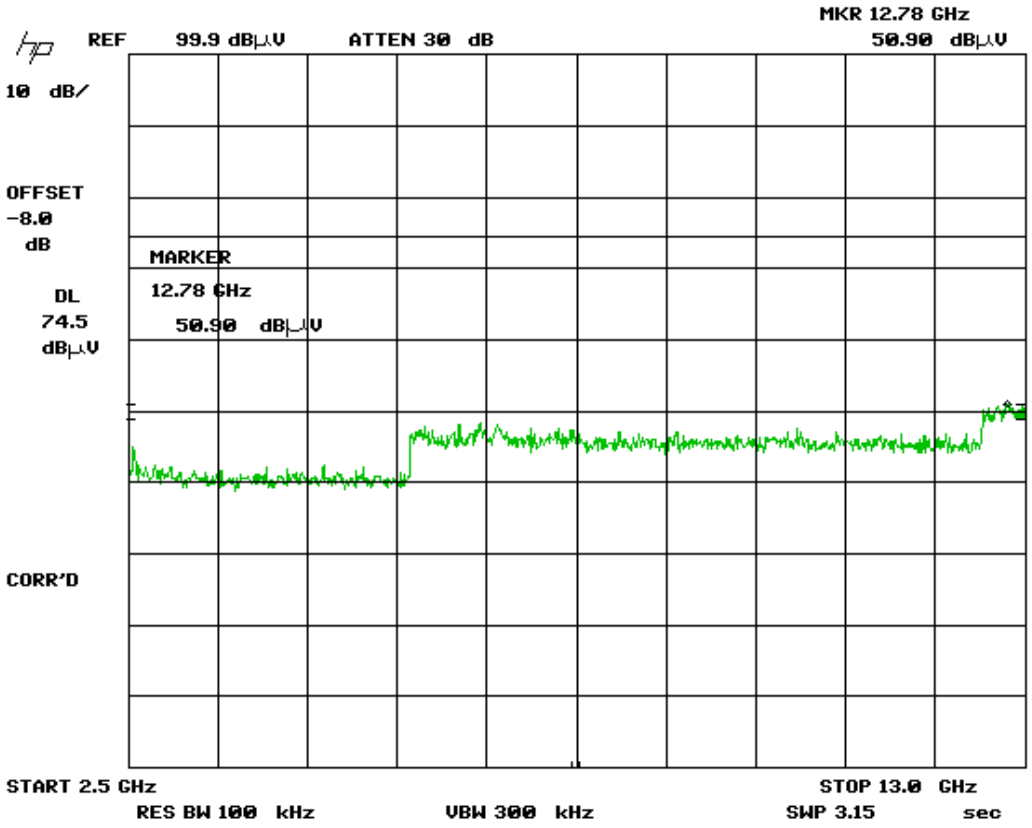


Figure 5. Emissions 802.11b - Low Channel, Part 3

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

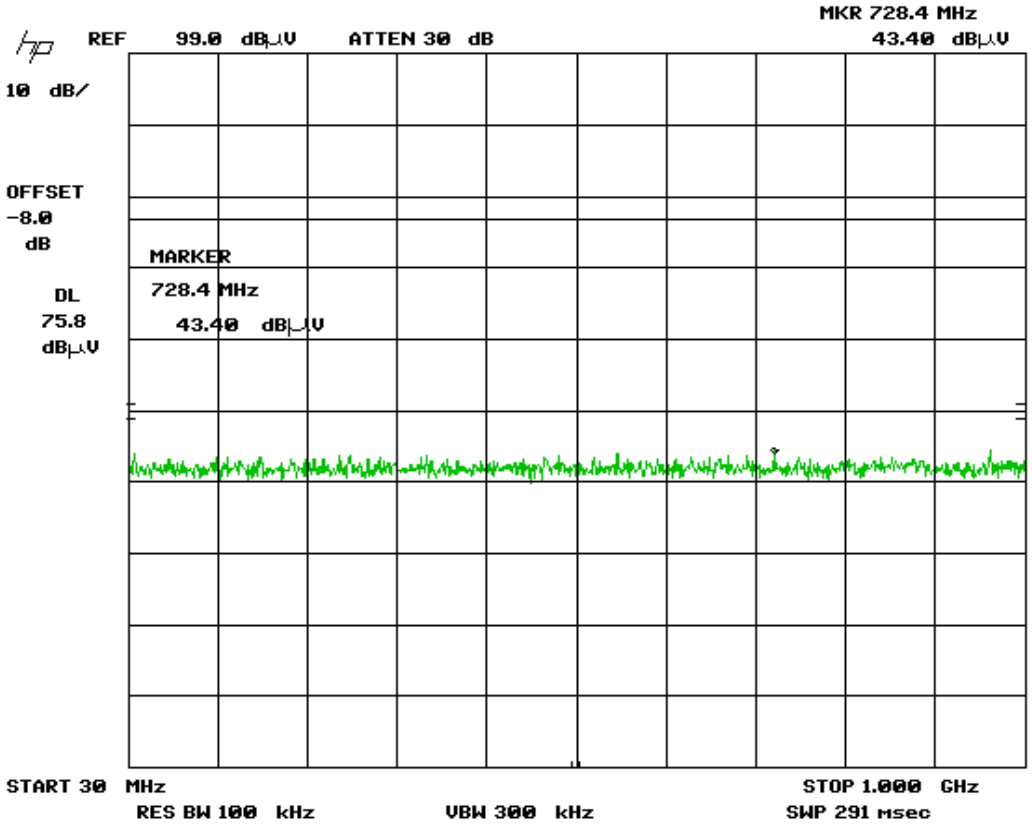


Figure 6. Emissions 802.11b - Mid Channel, Part 1

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

Note: Large Signal shown is Fundamental Frequency

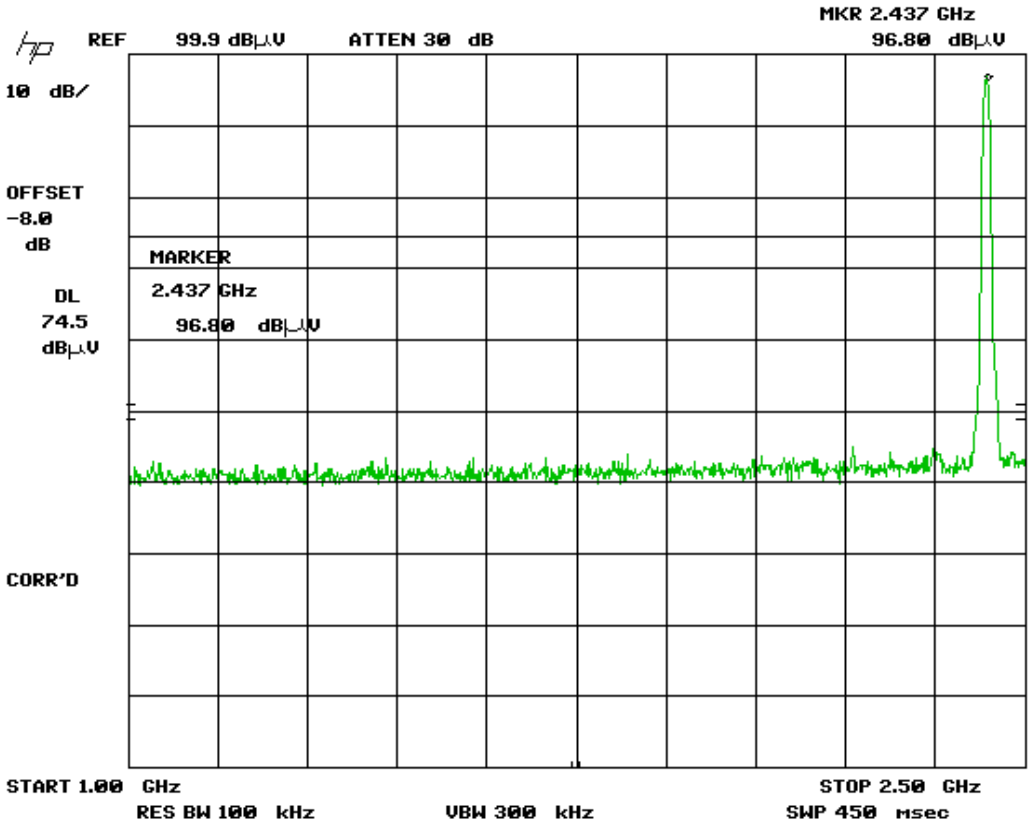


Figure 7. Emissions 802.11b - Mid Channel, Part 2

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

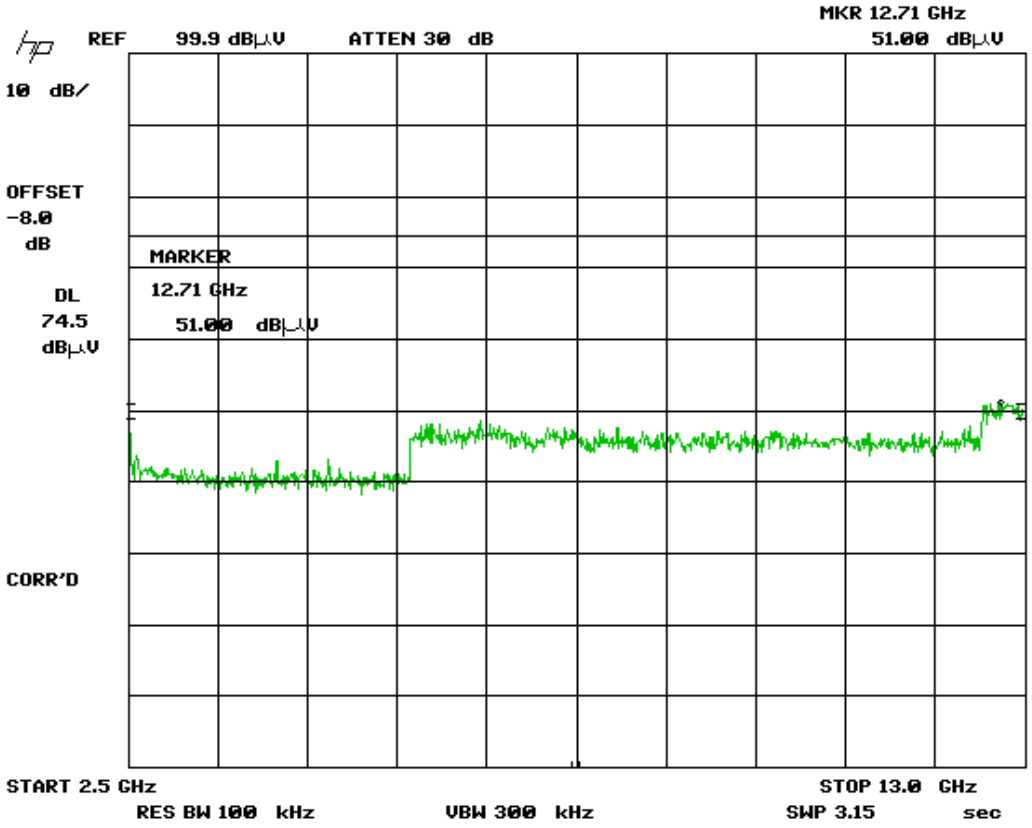


Figure 8. Emissions 802.11b - Mid Channel, Part 3

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

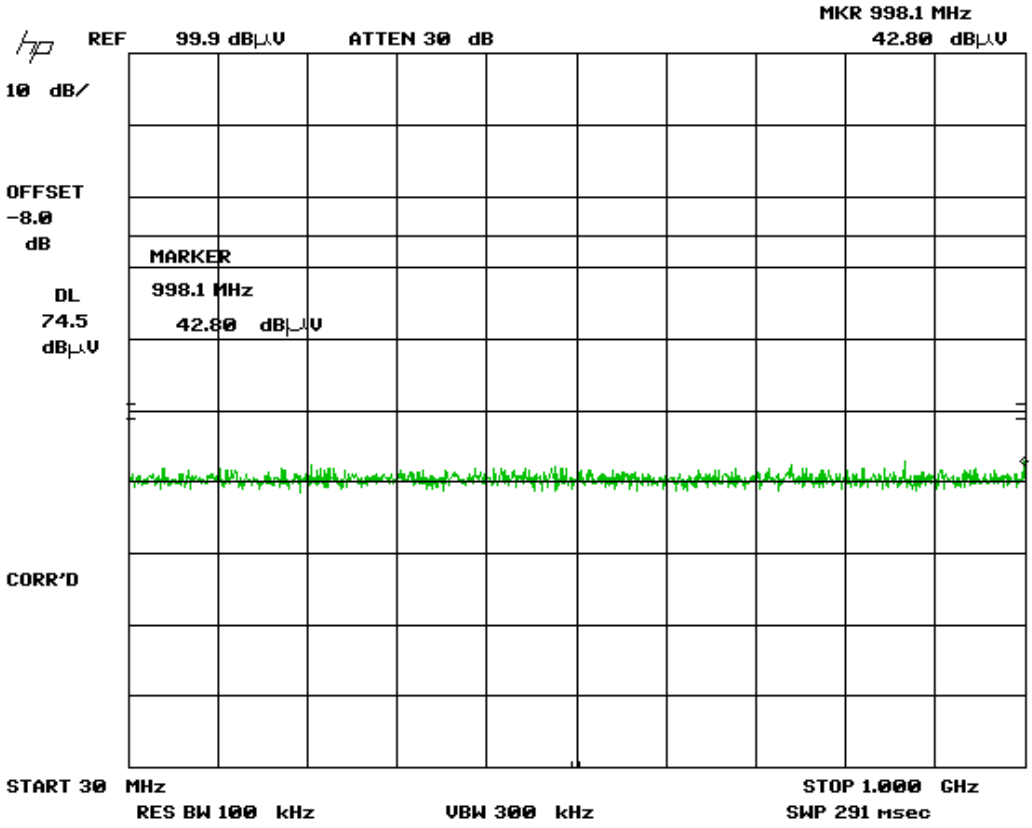


Figure 9. Emissions 802.11b - High Channel, Part 1

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

Note: Large Signal shown is Fundamental Frequency

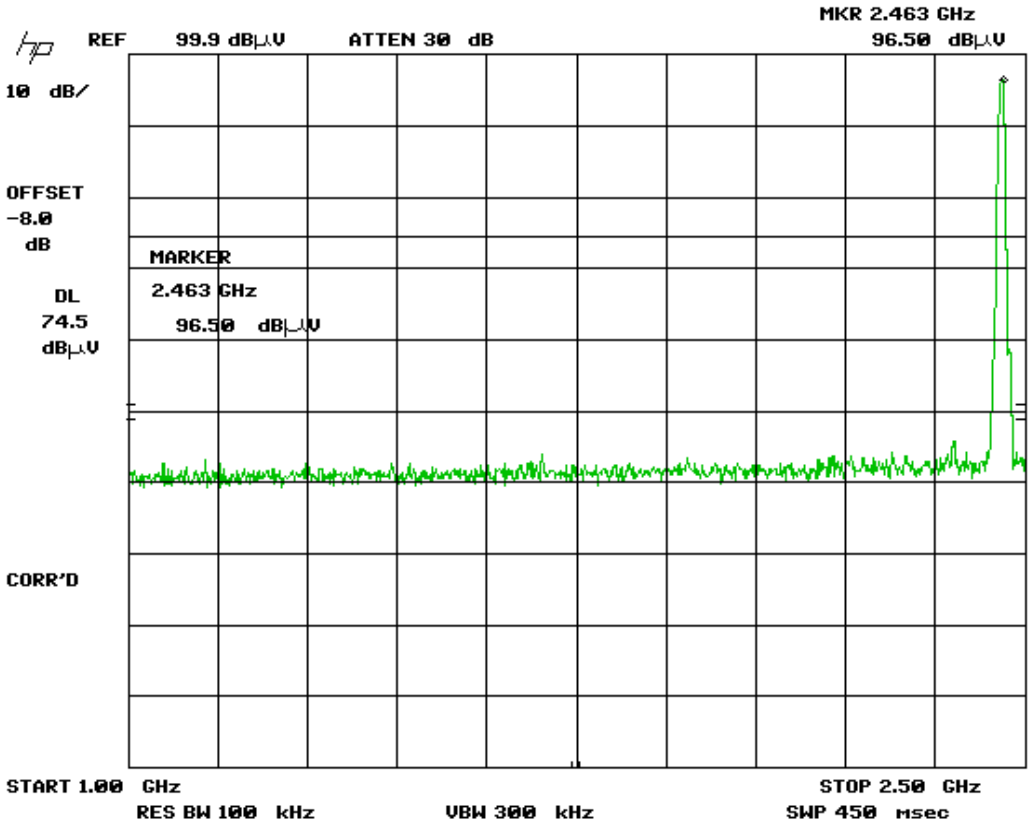


Figure 10. Emissions 802.11b - High Channel, Part 2

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd)

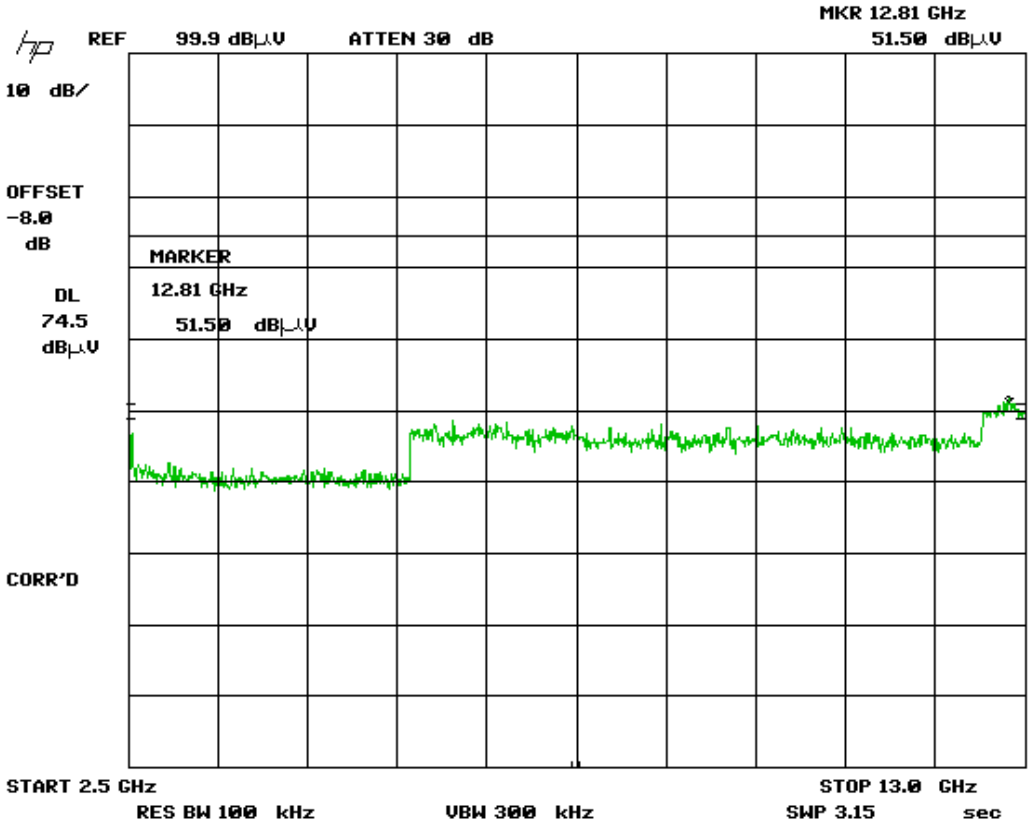


Figure 11. Emissions 802.11b - High Channel, Part 3

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd)

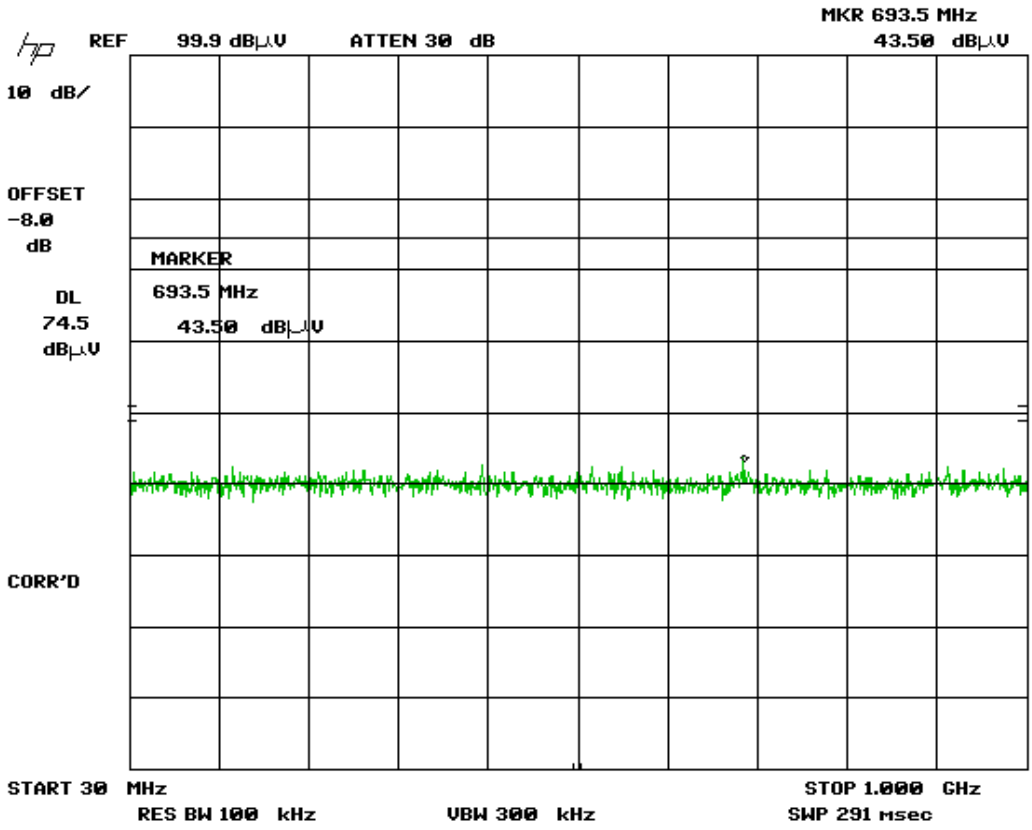


Figure 12. Emissions 802.11g - Low Channel, Part 1

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

Note: Large Signal shown is Fundamental Frequency

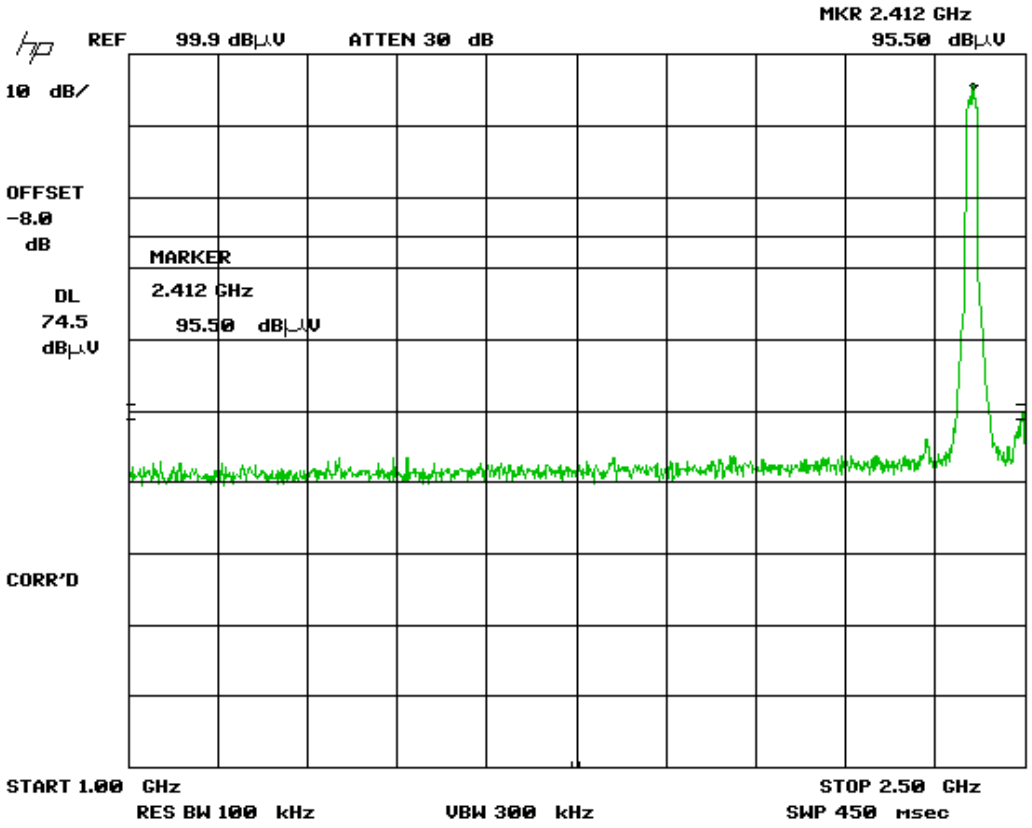


Figure 13. Emissions 802.11g - Low Channel, Part 2

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

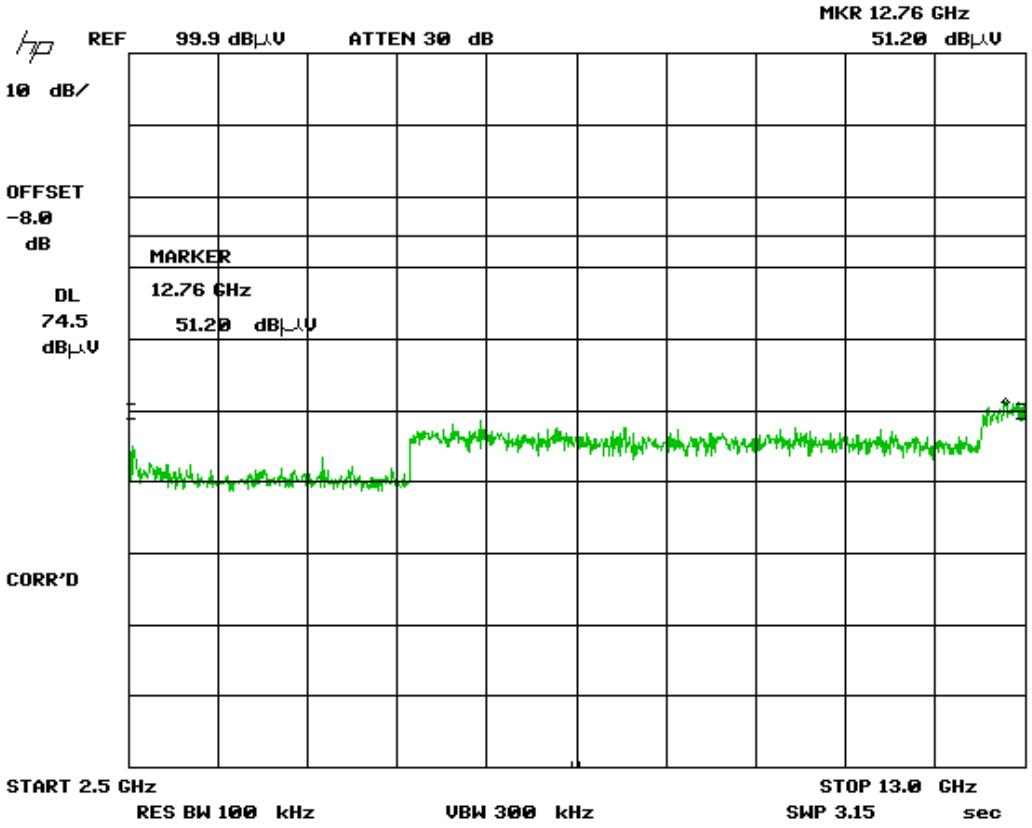


Figure 14. Emissions 802.11g - Low Channel, Part 3

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

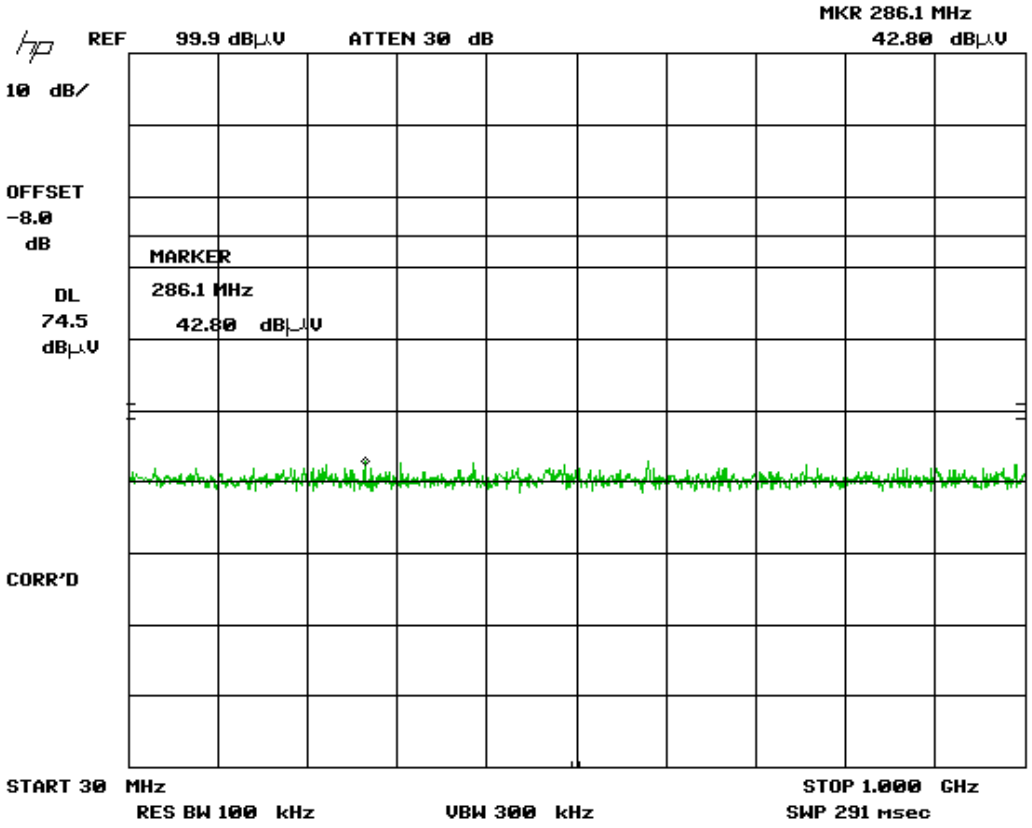


Figure 15. Emissions 802.11g - Mid Channel, Part 1

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

Note: Large Signal shown is Fundamental Frequency

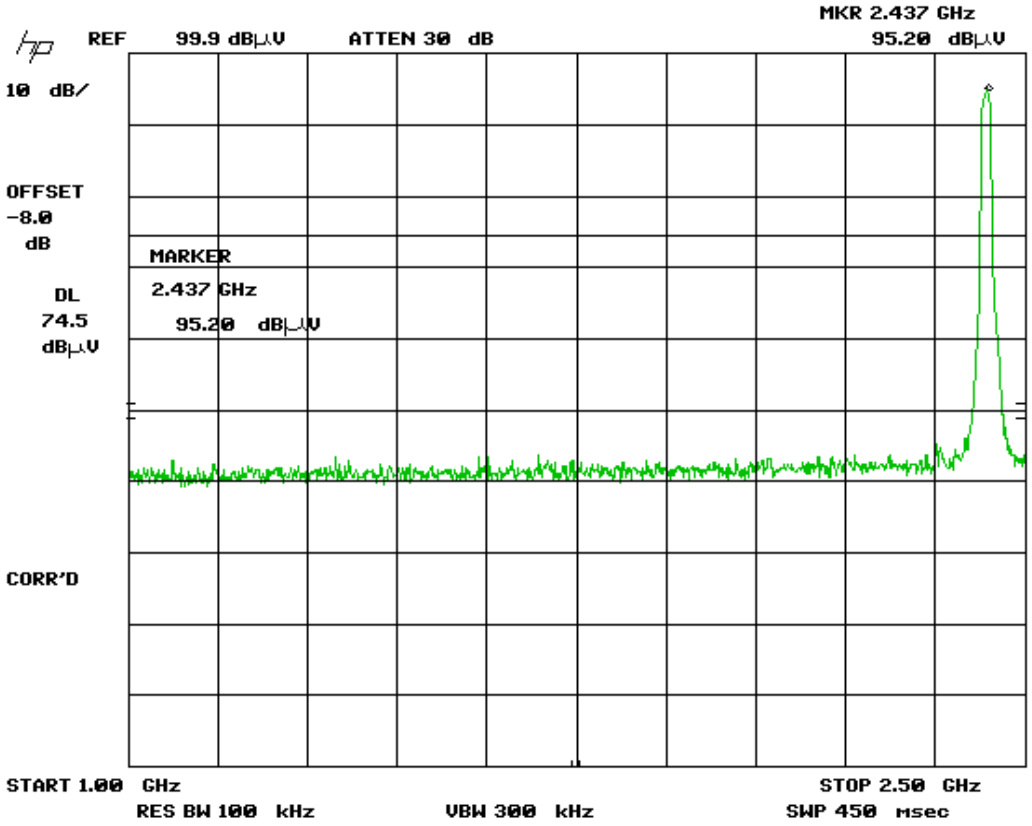


Figure 16. Emissions 802.11g - Mid Channel, Part 2

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

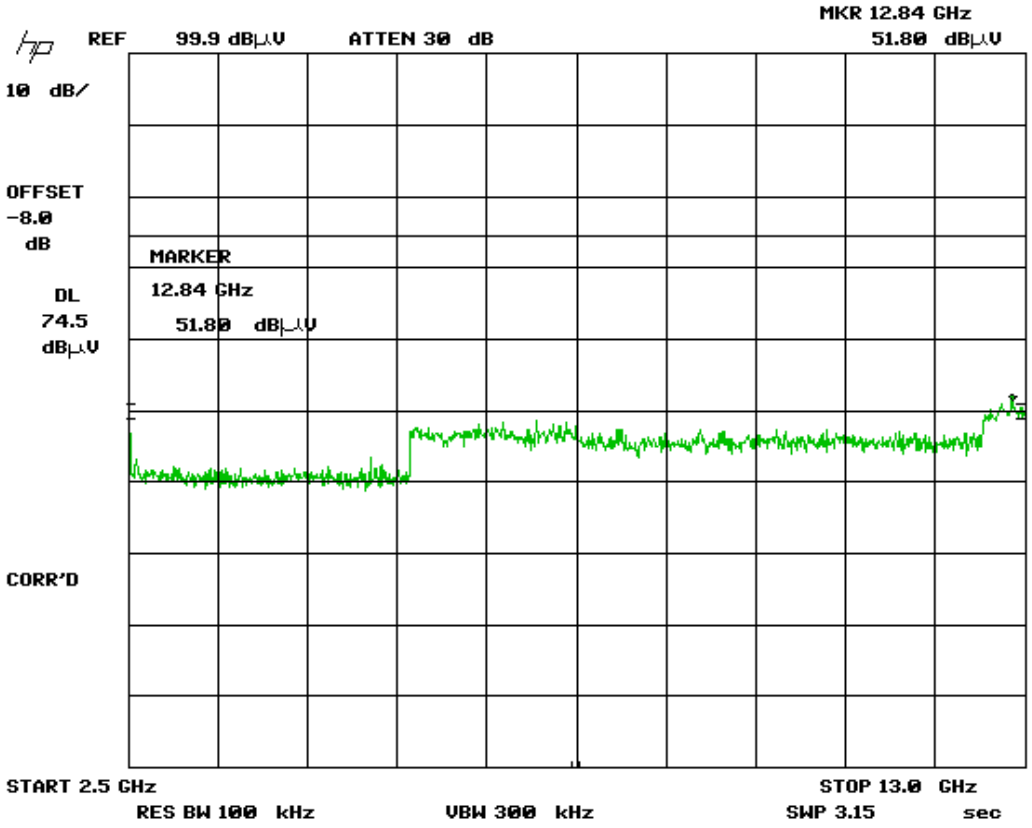


Figure 17. Emissions 802.11g - Mid Channel, Part 3

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

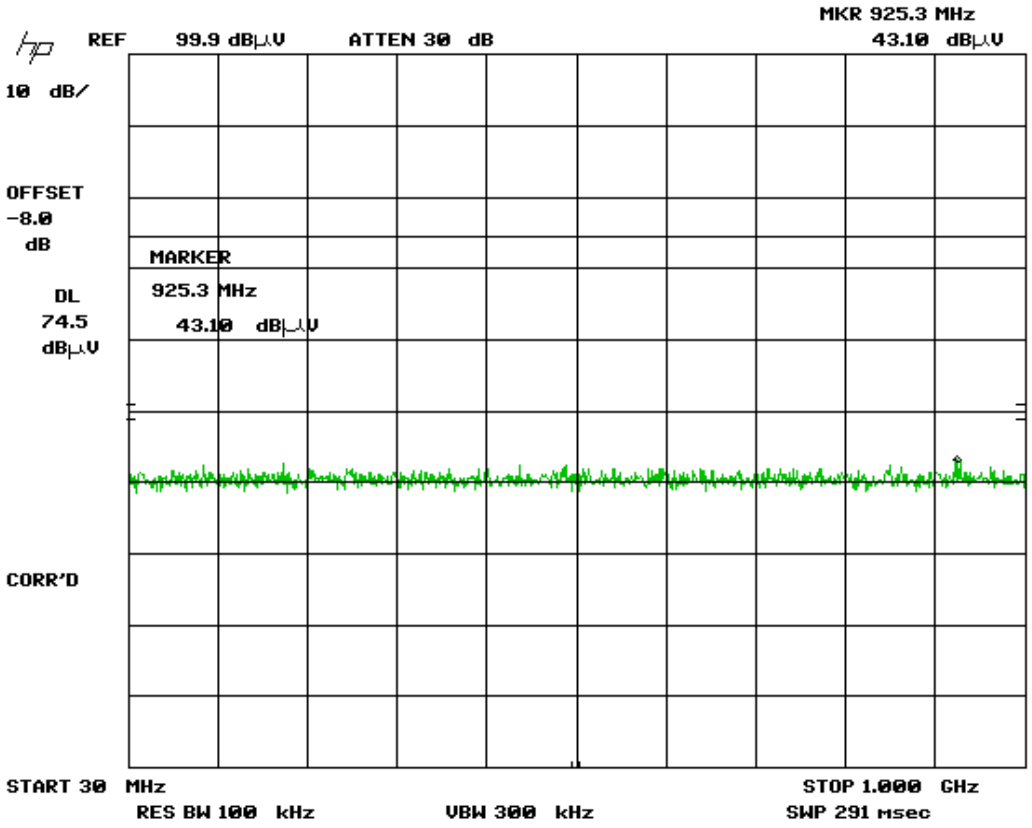


Figure 18. Emissions 802.11g - High Channel, Part 1

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

Note: Large Signal shown is Fundamental Frequency

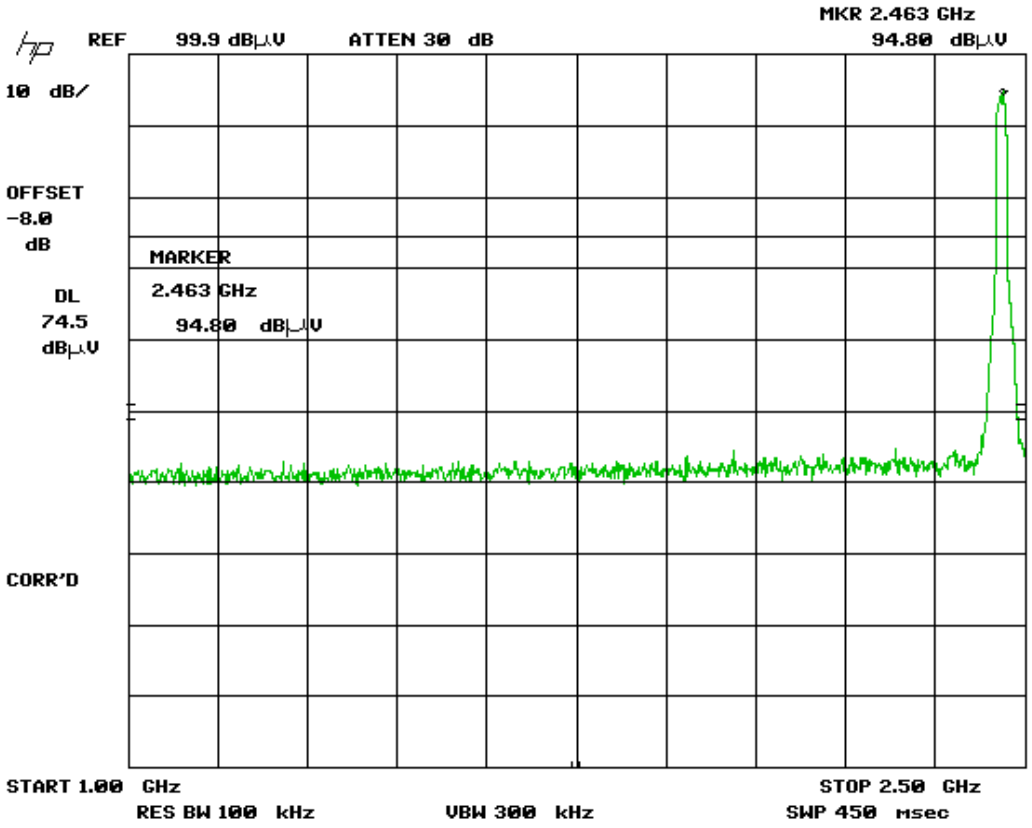


Figure 19. Emissions 802.11g - High Channel, Part 2

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

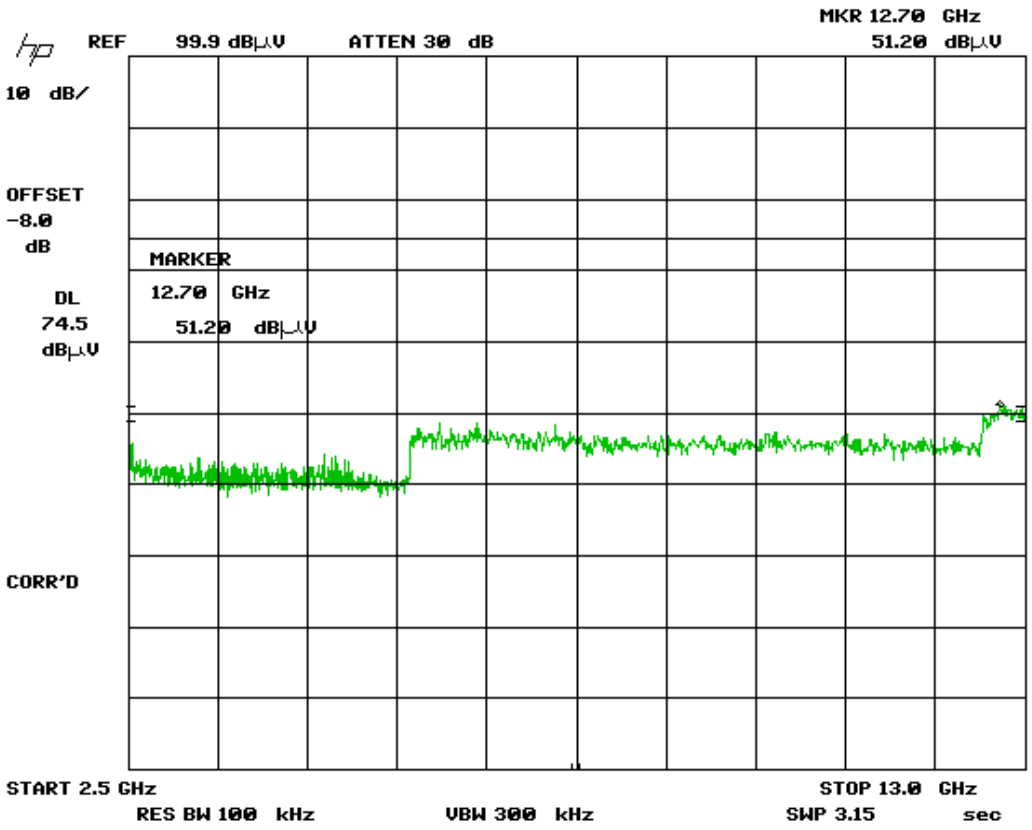


Figure 20. Emissions 802.11g - High Channel, Part 3

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

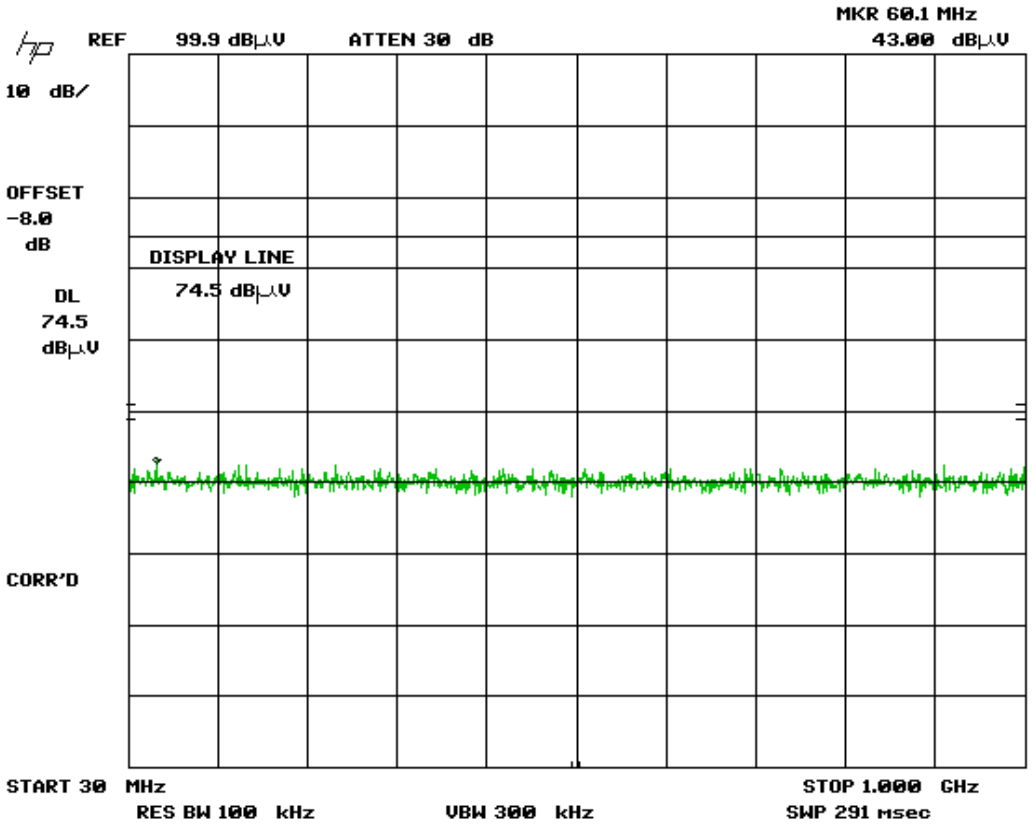


Figure 21. Emissions 802.11n - Low Channel, Part 1

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

Note: Large Signal shown is Fundamental Frequency

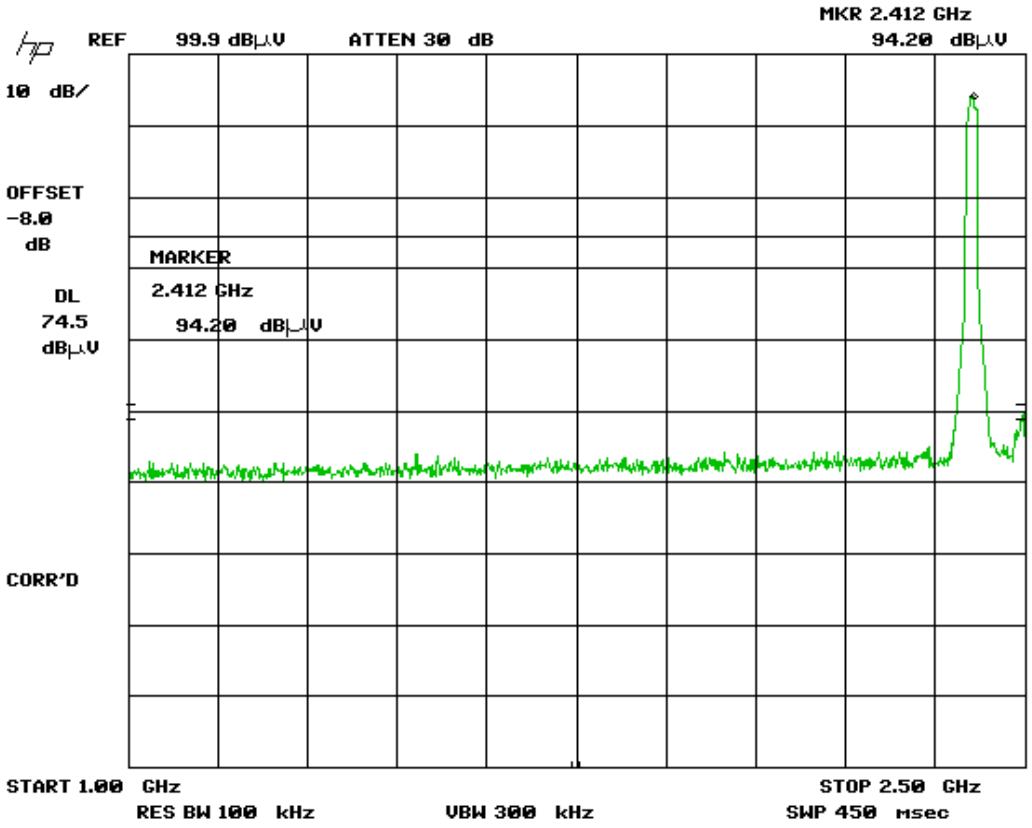


Figure 22. Emissions 802.11n - Low Channel, Part 2

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

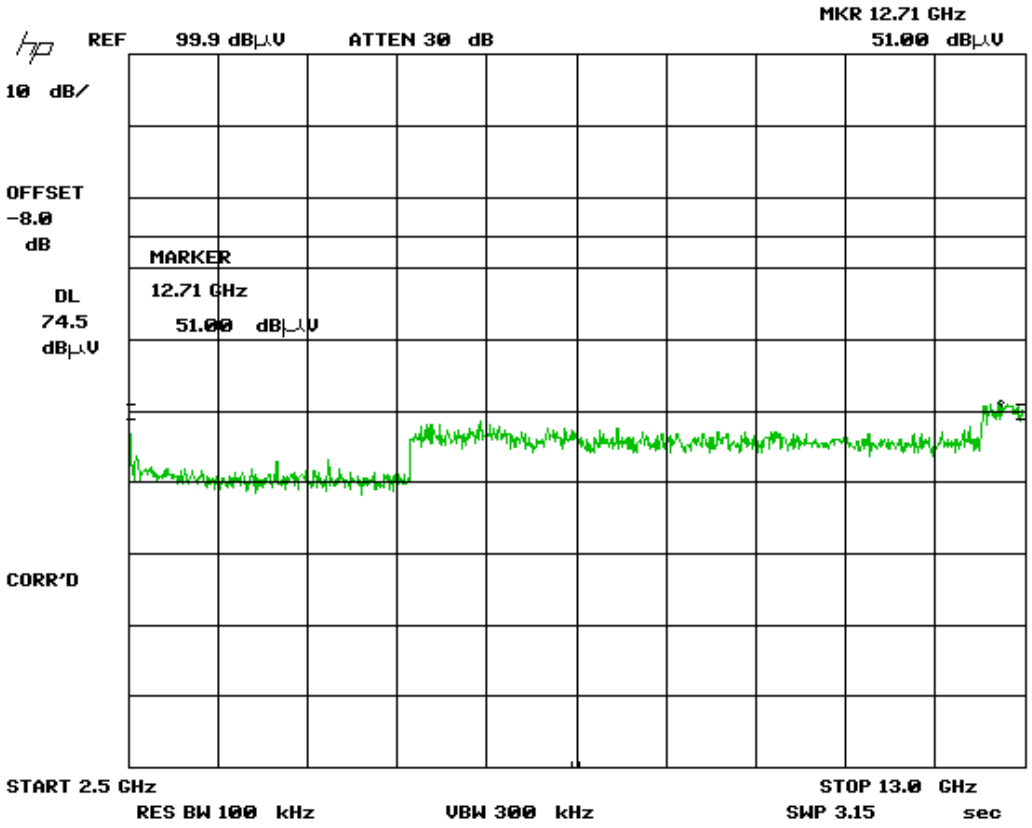


Figure 23. Emissions 802.11n - Low Channel, Part 3

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).-

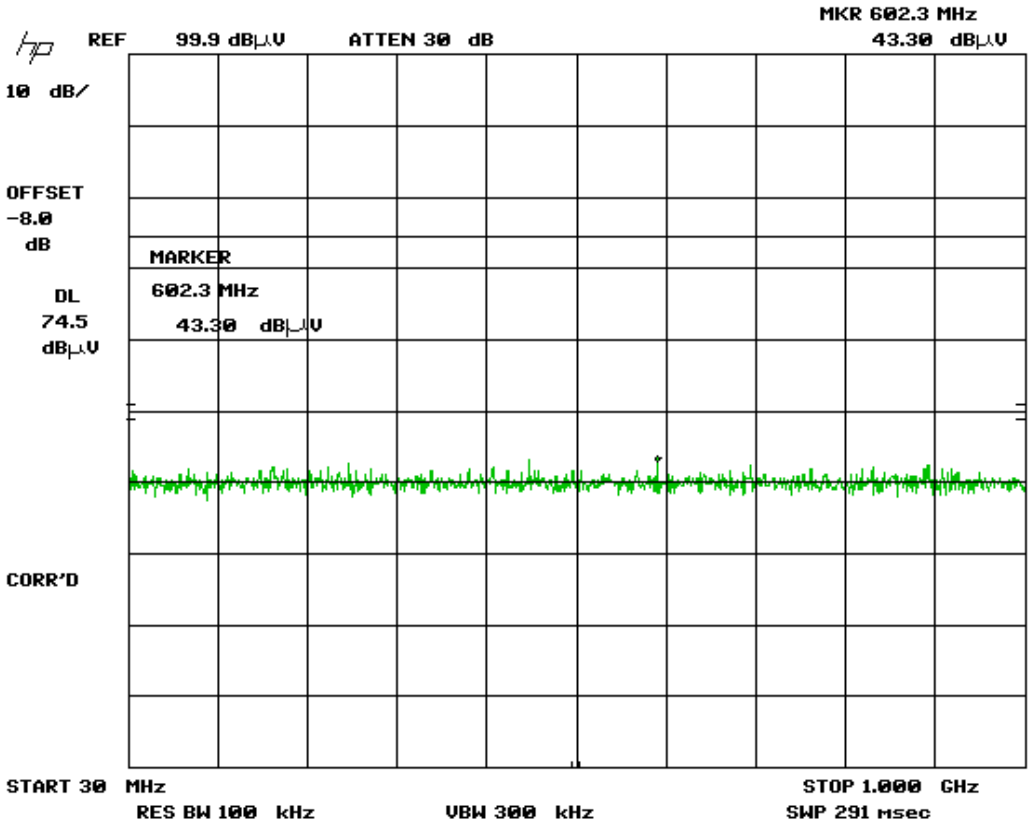


Figure 24. Emissions 802.11n - Mid Channel, Part 1

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

Note: Large Signal shown is Fundamental Frequency

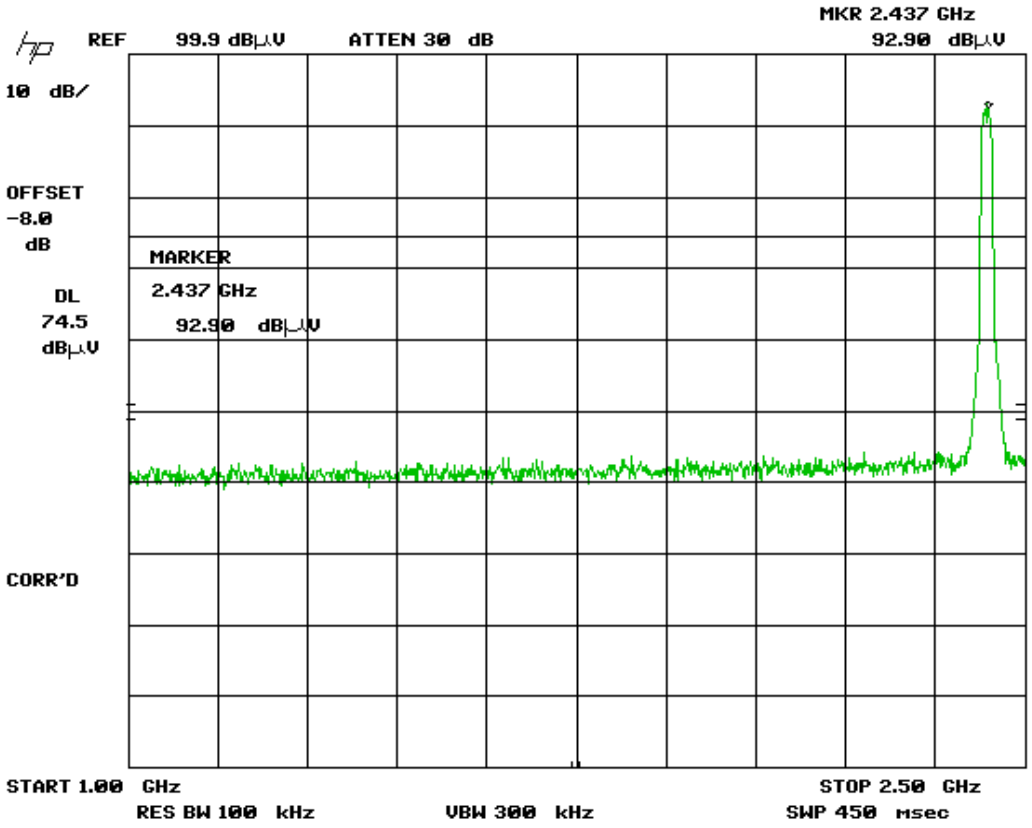


Figure 25. Emissions 802.11n - Mid Channel, Part 2

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).-

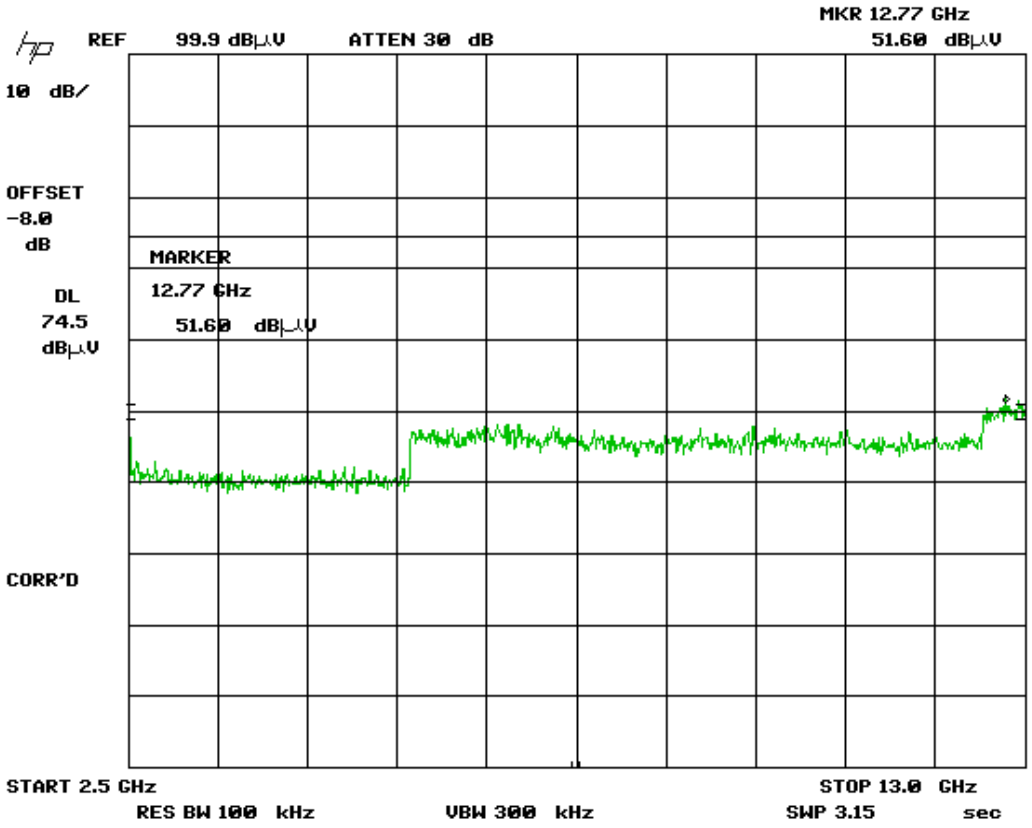


Figure 26. Emissions 802.11n - Mid Channel, Part 3

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).-

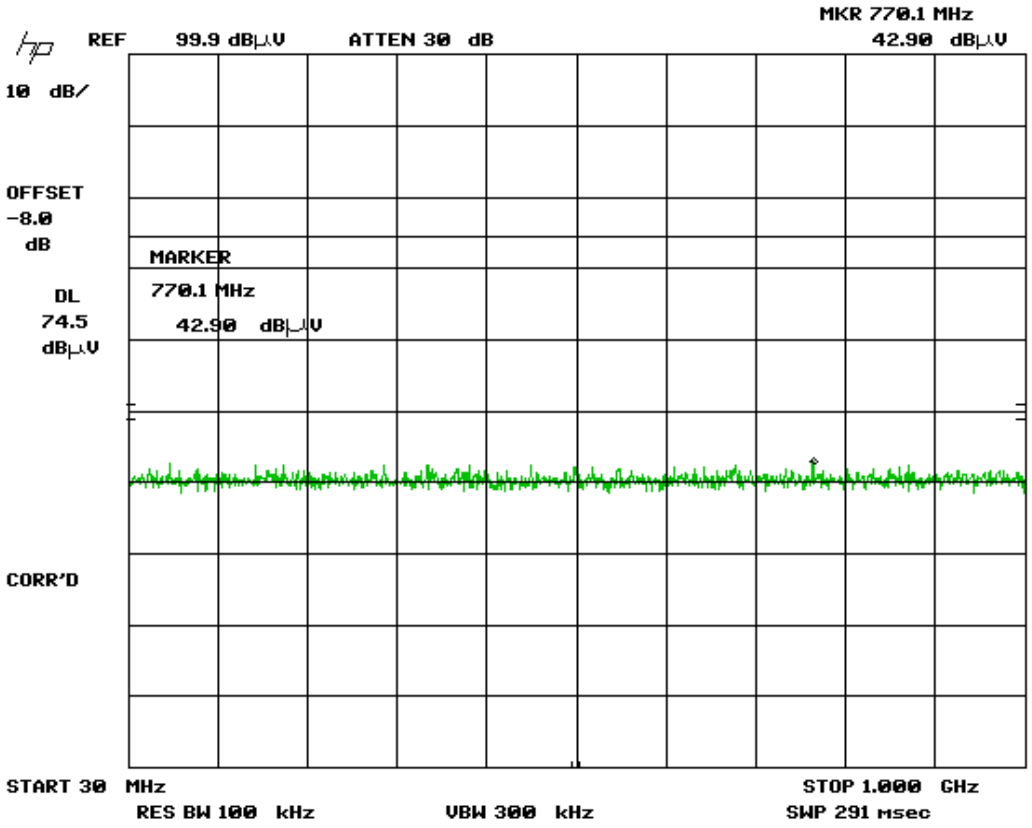


Figure 27. Emissions 802.11n - High Channel, Part 1

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

Note: Large Signal shown is Fundamental Frequency

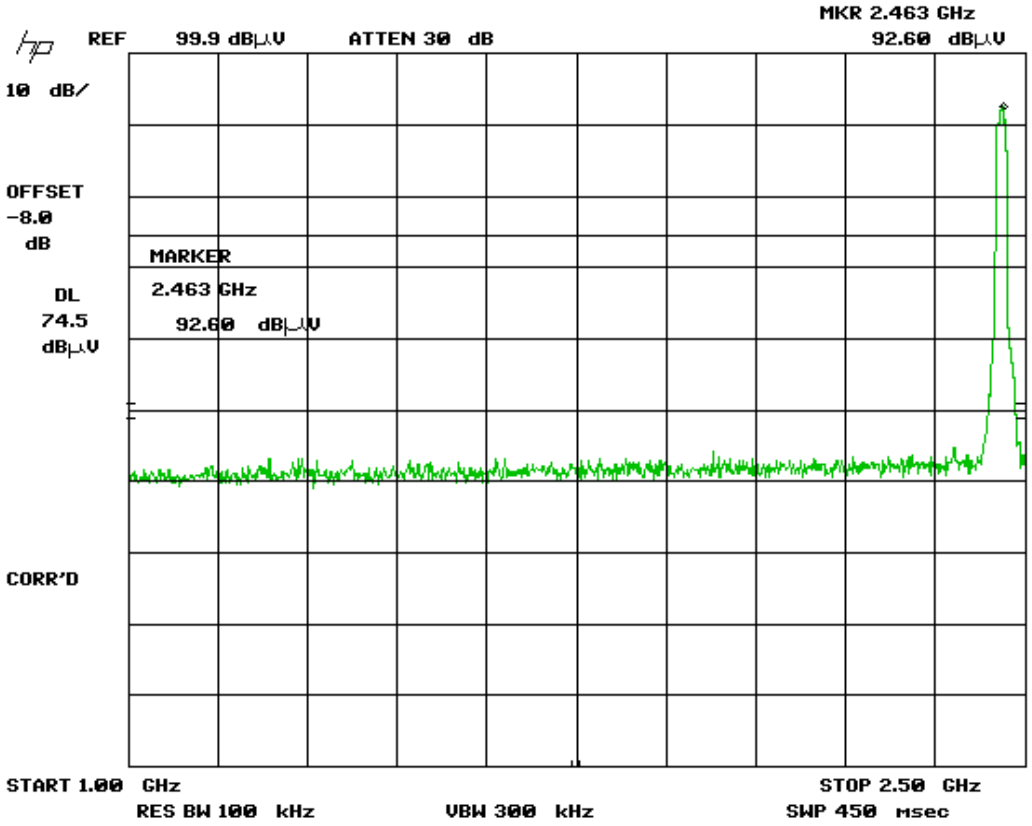


Figure 28. Emissions 802.11n - High Channel, Part 2

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

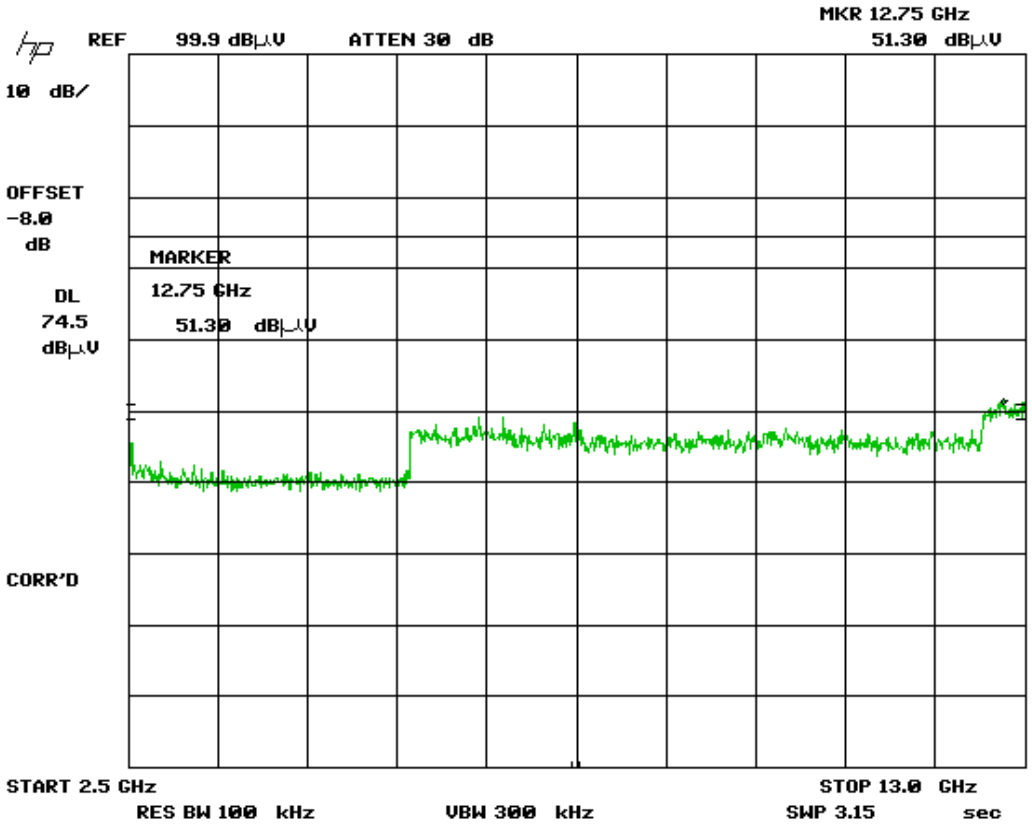


Figure 29. Emissions 802.11n - High Channel, Part 3

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd)

Table 6. 802.11b Radiated Harmonic & Spurious Emissions-Antenna 1

Radiated Harmonic and Spurious Emissions, Tested from 30 MHz – 24 GHz							
Tested By: JCW	**Test: FCC Part 15, Para 15.247(d)**			**Client: Inventek Systems**			
	Project: 11-0263			**Model: ISM4319-E, ISM4319-U, ISM4319-C**			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance /**	**Pass Margin (dB)**	**Detector PK / AVG**
LOW BAND - PEAK							
2413.40	78.50	31.84	110.34	--	3.0m./ver	--	**PK**
4824.00	54.94	-3.86	50.26	54.0	1.0m./ver	3.7	**PK**
7233.14	45.67	9.63	46.76	54.0	1.0m./ver	7.2	**PK**
MID BAND- PEAK							
2438.20	78.10	31.84	109.94	--	3.0m./ver	--	**PK**
4874.13	54.99	3.80	50.25	54.0	1.0m./ver	3.8	**PK**
7301.71	45.04	10.17	46.67	54.0	1.0m./ver	7.3	**PK**
HIGH BAND- PEAK							
2463.40	78.90	31.87	110.77	--	3.0m./ver	--	**PK**
4923.94	53.88	3.78	49.12	54.0	1.0m./ver	4.9	**PK**
7385.09	45.30	10.44	47.20	54.0	1.0m./ver	6.8	**PK**

SAMPLE CALCULATION:
Measurements taken at 1 meter distance were extrapolated to 3 meter using a factor of (-9.54 dB).
Loss factor of 1 dB is added for all measurement using the high pass filter.
RESULTS: At 4824.00 MHz: = 54.94 dBuV + 3.86 dB/m – 9.54 dB + 1.0 dB = 50.26 dBuV/m @ 3m
Margin = (54.0 – 50.26) = 3.70 dB

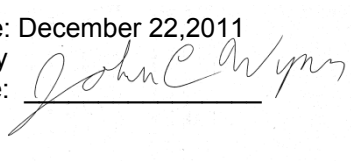
Test Date: December 22,2011
Tested By
Signature:  Name: John C. Wynn

Table 7. 802.11g Radiated Harmonic & Spurious Emissions- Antenna 1

Radiated Harmonic and Spurious Emissions, Tested from 30 MHz – 24 GHz							
Tested By: JCW	**Test: FCC Part 15, Para 15.247(d)**			**Client: Inventek Systems**			
	Project: 11-0263			**Model: ISM4319-E, ISM4319-U, ISM4319-C**			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance /**	**Pass Margin (dB)**	**Detector PK / AVG**
LOW BAND - PEAK							
2412.90	77.20	31.84	109.04	--	3.0m/Ver	--	**PK**
4825.04	49.67	3.86	44.99	54.0	1.0m./Ver	9.0	**PK**
MID BAND- PEAK							
2436.20	77.40	31.84	109.24	--	3.0/Ver	--	**PK**
4875.24	49.09	3.80	44.35	54.0	1.0/Ver	29.7	**PK**
HIGH BAND- PEAK							
2461.21	76.40	31.87	108.27	--	3.0/Ver	--	**PK**
4925.24	49.57	3.78	44.81	54.0	1.0/Ver	9.2	**PK**

SAMPLE CALCULATION:
Measurements taken at 1 meter distance were extrapolated to 3 meter using a factor of (-9.54 dB).
Loss factor of 1 dB is added for all measurement using the high pass filter.
RESULTS: At 4825.04 MHz: = 49.67 dBuV + 3.86 dB/m - 9.54 dB + 1 dB = 44.99 dBuV/m @ 3m
Margin = (54.0 – 44.99) = 9.0 dB

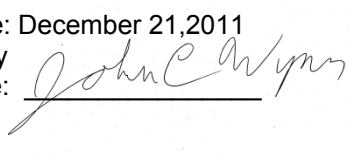
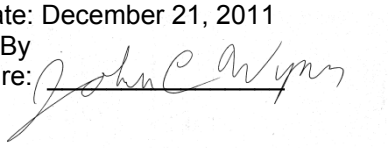
Test Date: December 21,2011
Tested By
Signature:  Name: John C. Wynn

Table 8. 802.11n Radiated Harmonic & Spurious Emissions- Antenna 1

Radiated Harmonic and Spurious Emissions, Tested from 30 MHz – 24 GHz							
Tested By: JCW	**Test: FCC Part 15, Para 15.247(d)**			**Client: Inventek Systems**			
	Project: 11-0263			**Model: ISM4319-E, ISM4319-U, ISM4319-C**			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance /**	**Pass Margin (dB)**	**Detector PK / AVG**
LOW BAND - PEAK							
2413.34	75.3	31.84	107.14	--	3.0/Ver	--	**PK**
4825.24	47.59	3.86	42.91	54.0	1.0/Ver	11.1	**PK**
MID BAND- PEAK							
2438.27	75.20	31.84	107.04	--	3.0/Ver	--	**PK**
4875.17	47.05	3.80	42.31	54.0	1.0/Ver	11.7	**PK**
HIGH BAND- PEAK							
2462.77	71.49	31.87	103.36	--	3.0/Ver	--	**PK**
4925.43	46.83	3.78	42.07	54.0	1.0/Ver	11.9	**PK**

SAMPLE CALCULATION:
Measurements taken at 1 meter distance were extrapolated to 3 meter using a factor of (-9.54 dB).
Loss factor of 1 dB is added for all measurement using the high pass filter.
RESULTS: At 4825.24 MHz: = 47.59 dBuV + 3.86 dB/m -9.54 dB + 1.0 dB = 42.91 dBuV/m @ 3m
Margin = (54.0 – 42.91) = 11.1 dB

Test Date: December 21, 2011
Tested By
Signature:  Name: John C. Wynn

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd)

Table 9. 802.11b Radiated Harmonic & Spurious Emissions-Antenna 2

Radiated Harmonic and Spurious Emissions, Tested from 30 MHz – 24 GHz							
Tested By: JCW	**Test: FCC Part 15, Para 15.247(d)**			**Client: Inventek Systems**			
	Project: 11-0263			**Model: ISM4319-E, ISM4319-U, ISM4319-C**			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance /**	**Pass Margin (dB)**	**Detector PK / AVG**
LOW BAND - PEAK							
2411.25	67.84	31.84	99.68	--	3.0/Ver	--	**PK**
4823.94	50.29	3.86	45.61	54.0	1.0/Ver	8.4	**PK**
MID BAND- PEAK							
2437.38	67.98	31.84	99.82	--	3.0/Ver	--	**PK**
4874.07	48.94	3.80	44.20	54.0	1.0/Ver	9.8	**PK**
HIGH BAND- PEAK							
2461.88	66.58	31.87	98.45	--	3.0/Ver	--	**PK**
4924.20	48.77	3.78	44.01	54.0	1.0/Ver	10.0	**PK**

SAMPLE CALCULATION:
Measurements taken at 1 meter distance were extrapolated to 3 meter using a factor of (-9.54 dB).
Loss factor of 1 dB is added for all measurement using the high pass filter.
RESULTS: At 4823.94 MHz: = 50.29 dBuV+ 3.86 dB/m -9.54 dB + 1.0 dB = 45.61 dBuV/m @ 3m
Margin = (54.0 – 45.61) = 8.4 dB

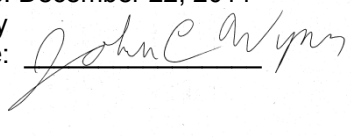
Test Date: December 22, 2011
Tested By
Signature:  Name: John C. Wynn

Table 10. 802.11g Radiated Harmonic & Spurious Emissions- Antenna 2

Radiated Harmonic and Spurious Emissions, Tested from 30 MHz – 24 GHz							
Tested By: JCW	**Test: FCC Part 15, Para 15.247(d)**			**Client: Inventek Systems**			
	Project: 11-0263			**Model: ISM4319-E, ISM4319-U, ISM4319-C**			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance /**	**Pass Margin (dB)**	**Detector PK / AVG**
LOW BAND - PEAK							
2410.00	68.75	31.84	100.59	--	3.0/Ver	--	**PK**
4822.77	44.51	3.86	39.83	54.0	1.0/Ver	14.2	**PK**
MID BAND- PEAK							
2435.25	67.18	31.84	99.02	--	3.0/Ver	--	**PK**
4872.83	44.44	3.80	39.70	54.0	1.0/Ver	14.3	**PK**
HIGH BAND- PEAK							
2461.25	65.23	31.87	97.10	--	3.0/Ver	--	**PK**
4925.17	44.26	3.78	39.50	54.0	1.0/Ver	14.5	**PK**

SAMPLE CALCULATION:
Measurements taken at 1 meter distance were extrapolated to 3 meter using a factor of (-9.54 dB).
Loss factor of 1 dB is added for all measurement using the high pass filter.
RESULTS: At 4822.77 MHz: = 44.51 dBuV + 3.86 dB/m – 9.54 dB + 1 dB = 39.83 dBuV/m @ 3m
Margin = (54.0 – 39.83) = 14.2 dB

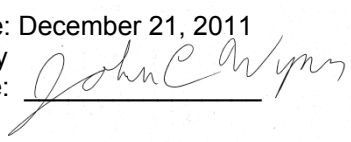
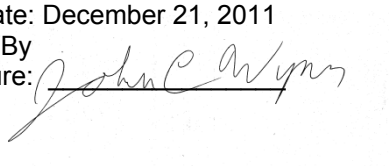
Test Date: December 21, 2011
Tested By
Signature:  Name: John C. Wynn

Table 11. 802.11n Radiated Harmonic & Spurious Emissions- Antenna 2

Radiated Harmonic and Spurious Emissions, Tested from 30 MHz – 24 GHz							
Tested By: JCW	**Test: FCC Part 15, Para 15.247(d)**			**Client: Inventek Systems**			
	Project: 11-0263			**Model: ISM4319-E, ISM4319-U, ISM4319-C**			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance /**	**Pass Margin (dB)**	**Detector PK / AVG**
LOW BAND - PEAK							
2412.63	65.00	31.84	96.84	--	3.0/Ver	--	**PK**
4825.17	44.07	3.86	39.39	54.0	1.0/Ver	14.6	**PK**
MID BAND- PEAK							
2435.88	64.49	31.84	96.33	--	3.0/Ver	--	**PK**
4875.30	43.78	3.80	39.04	54.0	1.0/Ver	15.0	**PK**
HIGH BAND- PEAK							
2462.50	62.50	31.87	94.37	--	3.0/Ver	--	**PK**
4925.17	43.24	3.78	38.48	54.0	1.0/Ver	15.5	**PK**

SAMPLE CALCULATION:
Measurements taken at 1 meter distance were extrapolated to 3 meter using a factor of (-9.54 dB).
Loss factor of 1 dB is added for all measurement using the high pass filter.
RESULTS: At 4825.17MHz: = 44.07 dBuV + 3.68 dB/m – 9.54 dB + 1 dB = 39.39 dBuV/m @ 3m
Margin = (54.0 – 39.39) = 14.6 dB

Test Date: December 21, 2011
Tested By
Signature:  Name: John C. Wynn

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd)

Table 12. 802.11b Radiated Harmonic & Spurious Emissions-Antenna 3

Radiated Harmonic and Spurious Emissions, Tested from 30 MHz – 24 GHz							
Tested By: JCW	Test: FCC Part 15, Para 15.247(d)			Client: Inventek Systems			
	Project: 11-0263			Model: ISM4319-E, ISM4319-U, ISM4319-C			
Frequency (MHz)	Test Data (dBuV)	AF+CL-PA (dB/m)	Corrected Results (dBuV/m)	Limits (dBuV/m)	Distance /	Pass Margin (dB)	Detector PK / AVG
LOW BAND - PEAK							
2411.25	72.66	31.84	104.50	--	3.0/Ver	--	**PK**
4824.07	43.65	3.23	46.47	54.0	1.0/Ver	7.5	**PK**
MID BAND- PEAK							
2437.38	67.98	31.84	99.82	--	3.0/Ver	--	**PK**
4873.98	43.45	3.24	46.28	54.0	1.0/Ver	7.7	**PK**
HIGH BAND- PEAK							
2462.76	70.22	31.87	102.09	--	3.0/Ver	--	**PK**
4923.80	41.80	3.11	44.50	54.0	1.0/Ver	9.5	**PK**

SAMPLE CALCULATION:
Measurements taken at 1 meter distance were extrapolated to 3 meter using a factor of (-9.54 dB).
Loss factor of 1 dB is added for all measurement using the high pass filter.
RESULTS: At 4824.07 MHz: = 43.65 dBuV+ 3.23 dB/m - 9.54 dB +1 dB =46.47 dBuV/m @ 3m
Margin = (54.0 – 46.47) = 7.5 dB

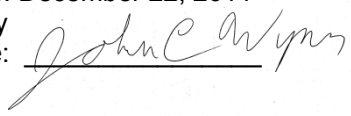
Test Date: December 22, 2011
Tested By
Signature:  Name: John C. Wynn

Table 13. 802.11g Radiated Harmonic & Spurious Emissions- Antenna 3

Radiated Harmonic and Spurious Emissions, Tested from 30 MHz – 24 GHz							
Tested By: JCW	Test: FCC Part 15, Para 15.247(d)			Client: Inventek Systems			
	Project: 11-0263			Model: ISM4319-E, ISM4319-U, ISM4319-C			
Frequency (MHz)	Test Data (dBuV)	AF+CL-PA (dB/m)	Corrected Results (dBuV/m)	Limits (dBuV/m)	Distance /	Pass Margin (dB)	Detector PK / AVG
LOW BAND - PEAK							
2413.37	68.58	31.84	100.42	--	3.0m./	--	**PK**
4825.10	44.63	3.86	39.95	54.0	1.0m/	14.1	**PK**
MID BAND- PEAK							
2438.02	68.94	31.84	100.78	--	3.0m./	--	**PK**
4872.20	44.63	3.86	39.95	54.0	1.0m/	15.6	**PK**
HIGH BAND- PEAK							
2463.04	68.15	31.87	100.02	--	3.0m./	--	**PK**
4922.95	43.19	3.80	38.45	54.0	1.0m/	17.2	**PK**

SAMPLE CALCULATION:
Measurements taken at 1 meter distance were extrapolated to 3 meter using a factor of (-9.54 dB).
Loss factor of 1 dB is added for all measurement using the high pass filter.
RESULTS: At 4825.10 MHz: = 44.63 dBuV + 3.86 dB/m -9.54 dB + 1 dB = 39.95 dBuV/m @ 3m
Margin = (54.0 – 39.95) = 14.1 dB

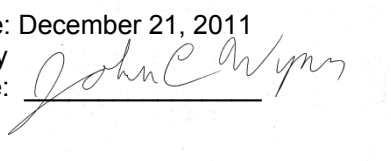
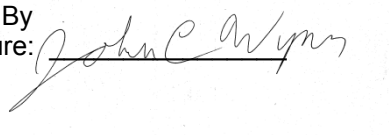
Test Date: December 21, 2011
Tested By
Signature:  Name: John C. Wynn

Table 14. 802.11n Radiated Harmonic & Spurious Emissions- Antenna 3

Radiated Harmonic and Spurious Emissions, Tested from 30 MHz – 24 GHz							
Tested By: JCW	**Test: FCC Part 15, Para 15.247(d)**			**Client: Inventek Systems**			
	Project: 11-0263			**Model: ISM4319-E, ISM4319-U, ISM4319-C**			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance /**	**Pass Margin (dB)**	**Detector PK / AVG**
LOW BAND - PEAK							
2412.91	66.42	31.84	98.26	--	3.0/Ver	--	**PK**
4822.81	42.77	3.86	38.09	54.0	1.0/Ver	15.9	**PK**
MID BAND- PEAK							
2438.47	66.00	31.84	97.84	--	3.0/Ver	--	**PK**
4875.45	42.24	3.80	37.50	54.0	1.0/Ver	16.5	**PK**
HIGH BAND- PEAK							
2463.56	65.37	31.87	97.24	--	3.0/Ver	--	**PK**
4925.38	41.76	3.78	37.00	54.0	1.0/Ver	17.0	**PK**

SAMPLE CALCULATION:
Measurements taken at 1 meter distance were extrapolated to 3 meter using a factor of (-9.54 dB).
Loss factor of 1 dB is added for all measurement using the high pass filter.
RESULTS: At 4822.81MHz: = 42.77 dBuV + 3.86 dB/m - 9.54 dB + 1 dB= 38.09 dBuV/m @ 3m
Margin = (54.0 – 38.09) = 15.9 dB

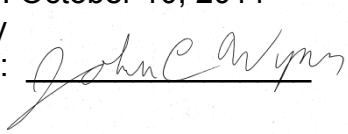
Test Date: December 21,2011
Tested By
Signature:  Name: John C. Wynn

2.11 6 dB Bandwidth per CFR 15.247(a)(2), (IC RSS 210, A8.2(a))

The EUT does not have an antenna port; therefore the EUT could not be connected to a spectrum analyzer. Measurements were performed with an alternative method. The RBW was set to approximately 1/100 of the manufacturers claimed RBW and with the VBW ≥ RBW. The results of this test are given in Table 9 and Figures 31 through 39.

Table 15. 6 dB Bandwidth

Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum FCC Bandwidth (MHz)
802.11b		
2412	6.42	0.5
2442	5.15	0.5
2462	5.8	0.5
802.11g		
2412	6.15	0.5
2442	6.45	0.5
2462	6.26	0.5
802.11n		
2412	17.25	0.5
2442	17.55	0.5
2462	17.6	0.5

Test Date: October 10, 2011
Tested By
Signature:  Name: John C. Wynn

2.11 6 dB Bandwidth per CFR 15.247(a)(2), (IC RSS 210, A8.2(a)), (Cont'd)

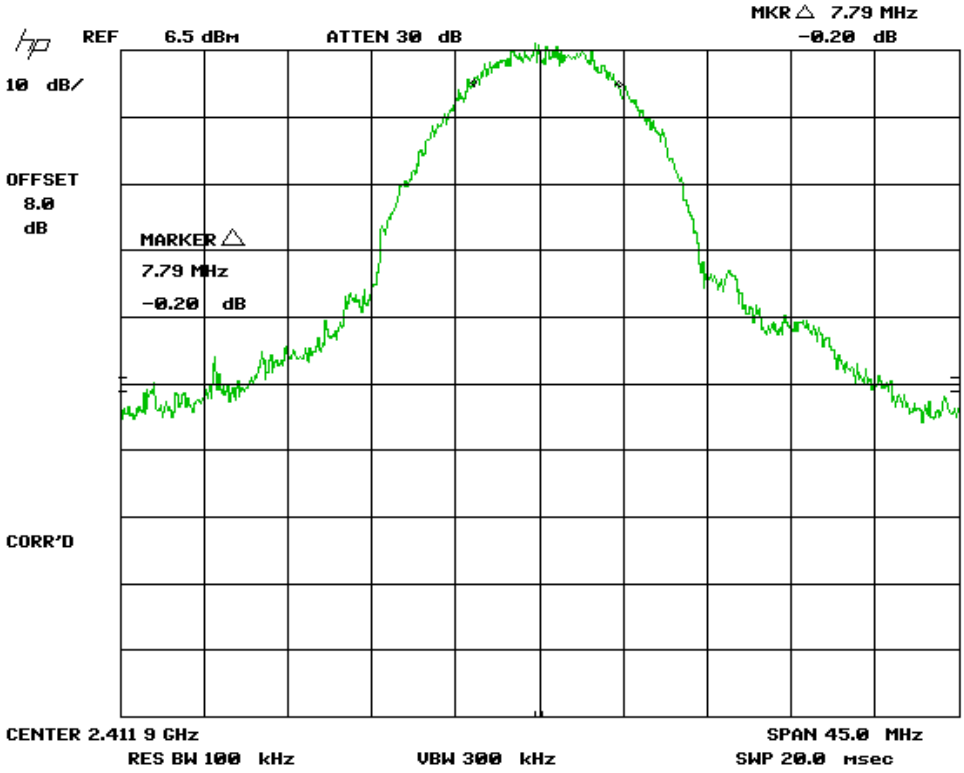


Figure 30. 6 dB Bandwidth - 15.247 (a) (2) – 802.11b – Low Channel

2.11 6 dB Bandwidth per CFR 15.247(a)(2), (IC RSS 210, A8.2(a)), (Cont'd)

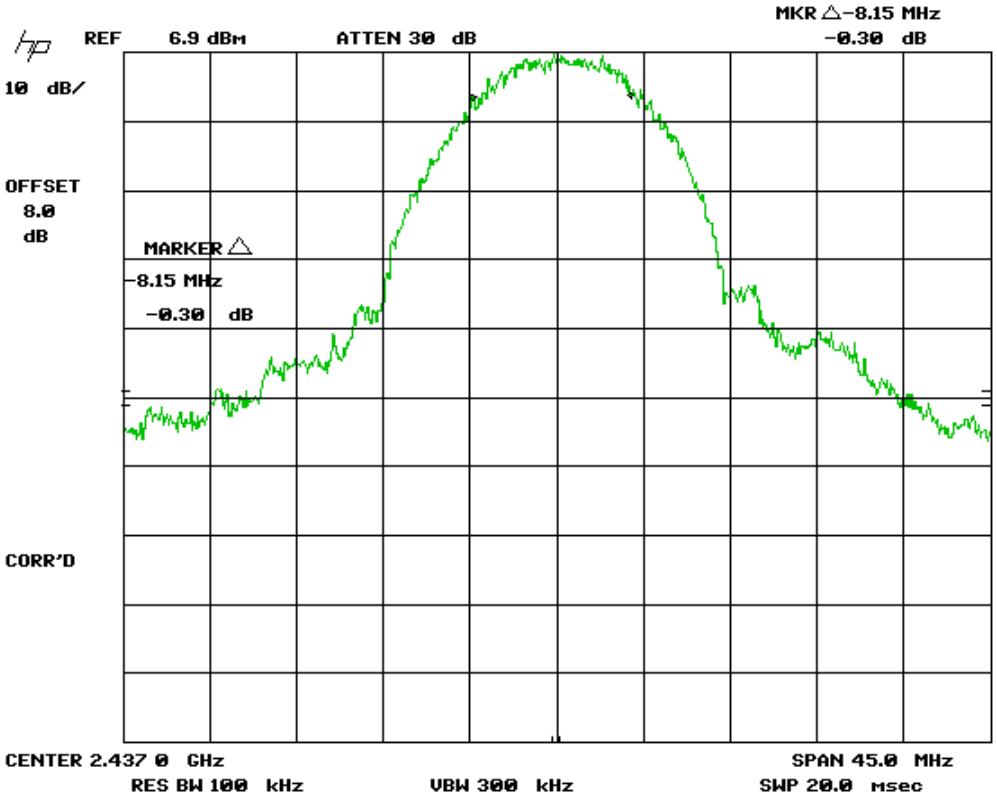


Figure 31. 6 dB Bandwidth - 15.247 (a) (2) – 802.11b – Mid Channel

2.11 6 dB Bandwidth per CFR 15.247(a)(2), (IC RSS 210, A8.2(a)), (Cont'd)

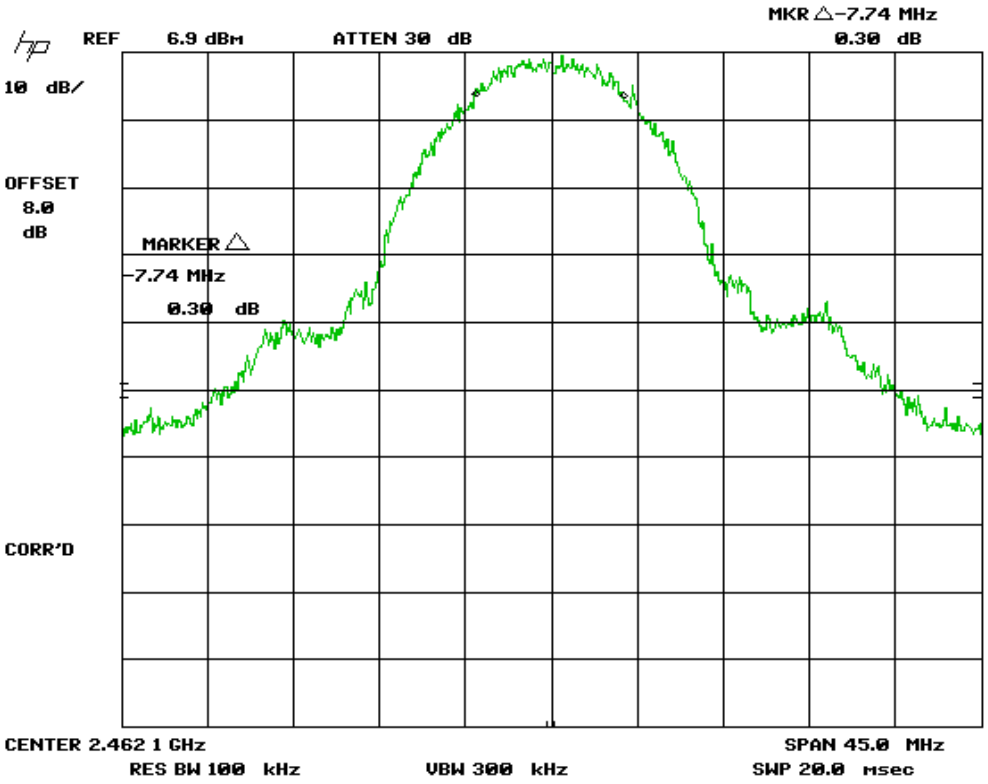


Figure 32. 6 dB Bandwidth - 15.247 (a) (2) – 802.11b – High Channel

2.11 6 dB Bandwidth per CFR 15.247(a)(2), (IC RSS 210, A8.2(a)), (Cont'd)

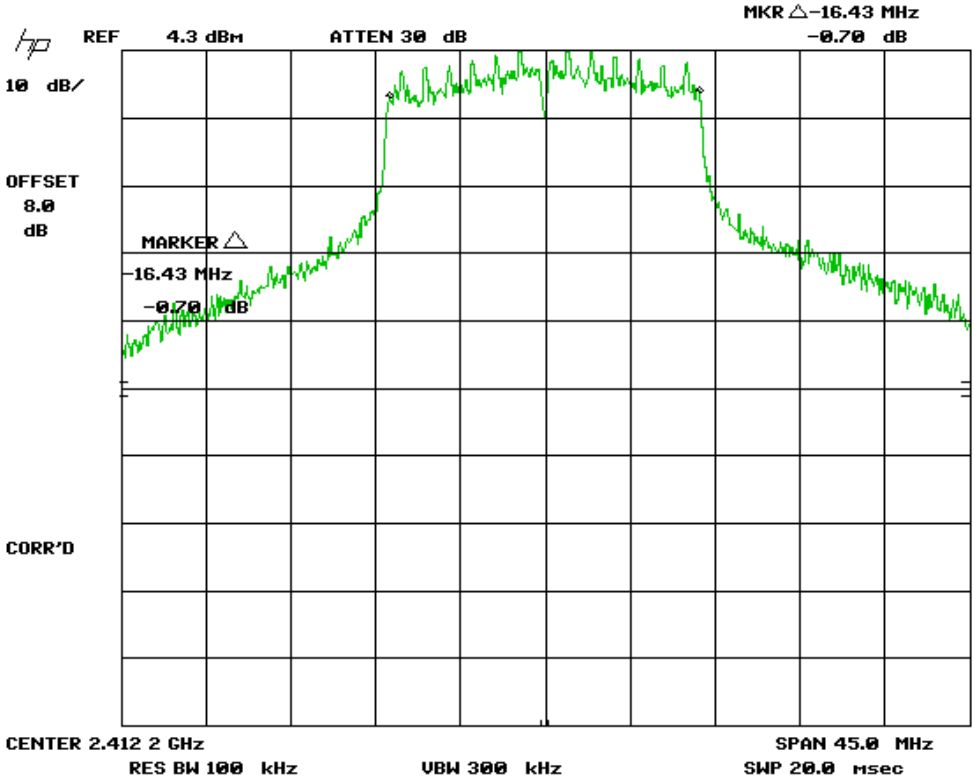


Figure 33. 6 dB Bandwidth - 15.247 (a) (2) – 802.11g – Low Channel

2.11 6 dB Bandwidth per CFR 15.247(a)(2), (IC RSS 210, A8.2(a)), (Cont'd)

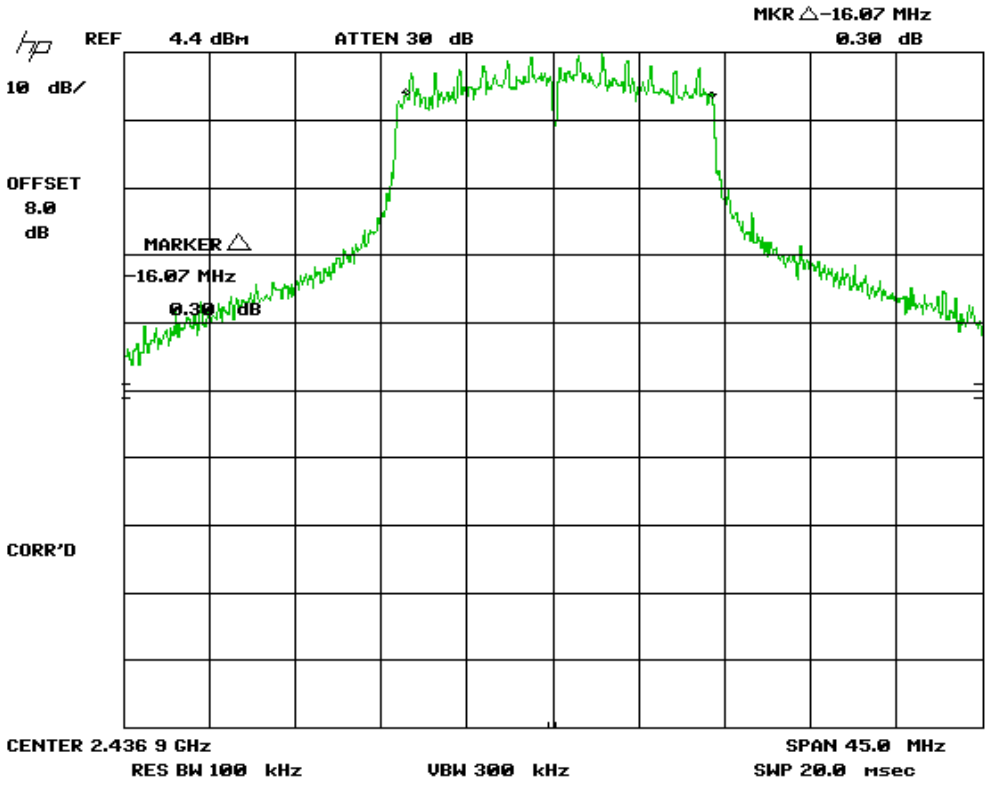


Figure 34. 6 dB Bandwidth - 15.247 (a) (2) – 802.11g – Mid Channel

2.11 6 dB Bandwidth per CFR 15.247(a)(2), (IC RSS 210, A8.2(a)), (Cont'd)

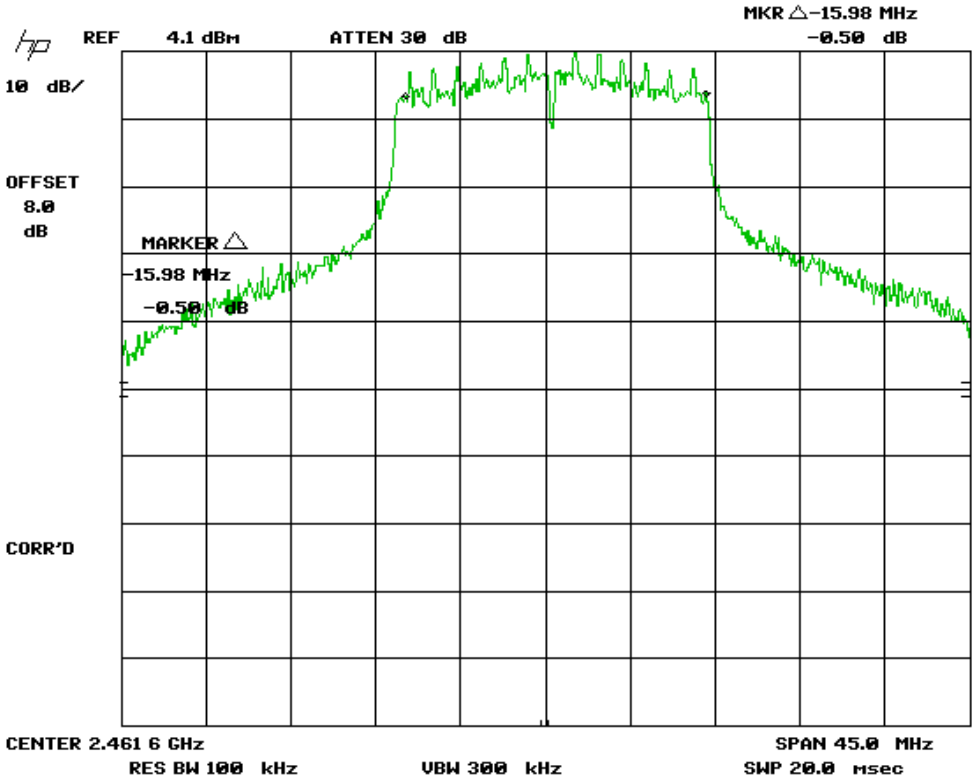


Figure 35. 6 dB Bandwidth - 15.247 (a) (2) – 802.11g – High Channel

2.11 6 dB Bandwidth per CFR 15.247(a)(2), (IC RSS 210, A8.2(a)), (Cont'd)

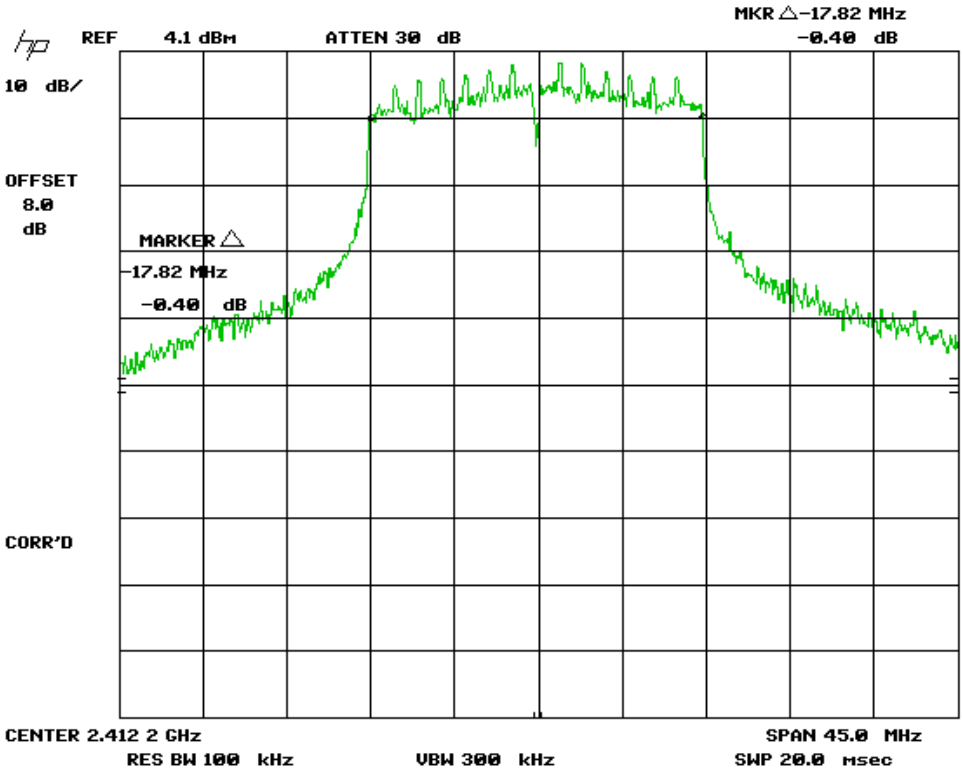


Figure 36. 6 dB Bandwidth - 15.247 (a) (2) – 802.11n – Low Channel

2.11 6 dB Bandwidth per CFR 15.247(a)(2), (IC RSS 210, A8.2(a)), (Cont'd)

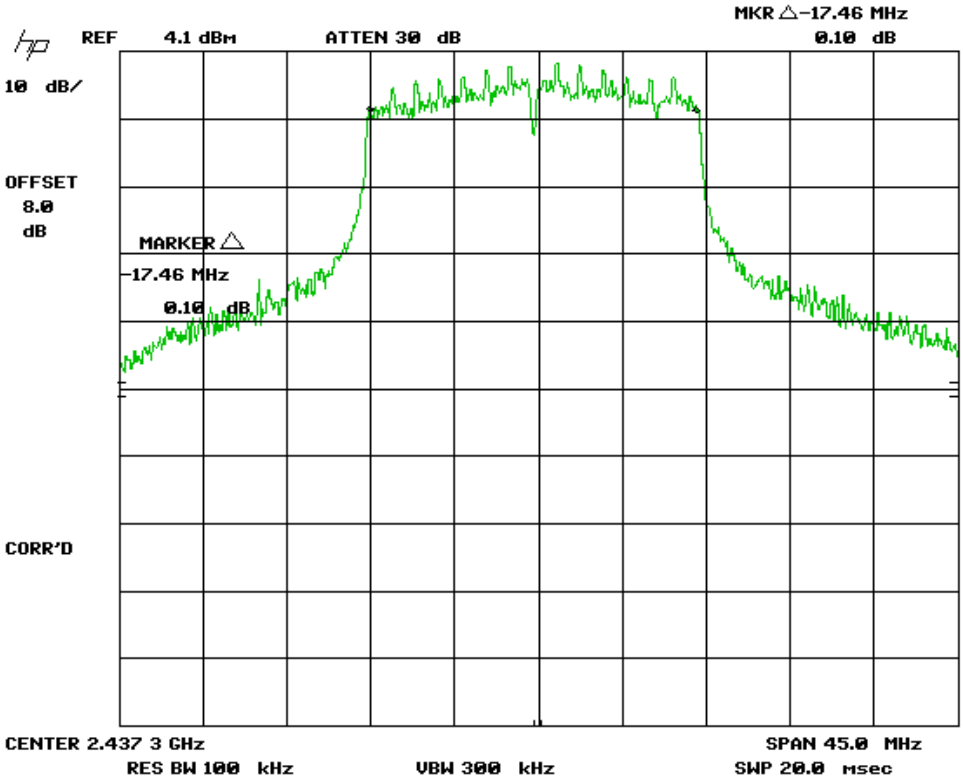


Figure 37. 6 dB Bandwidth - 15.247 (a) (2) – 802.11n – Mid Channel

2.11 6 dB Bandwidth per CFR 15.247(a)(2), (IC RSS 210, A8.2(a)), (Cont'd)

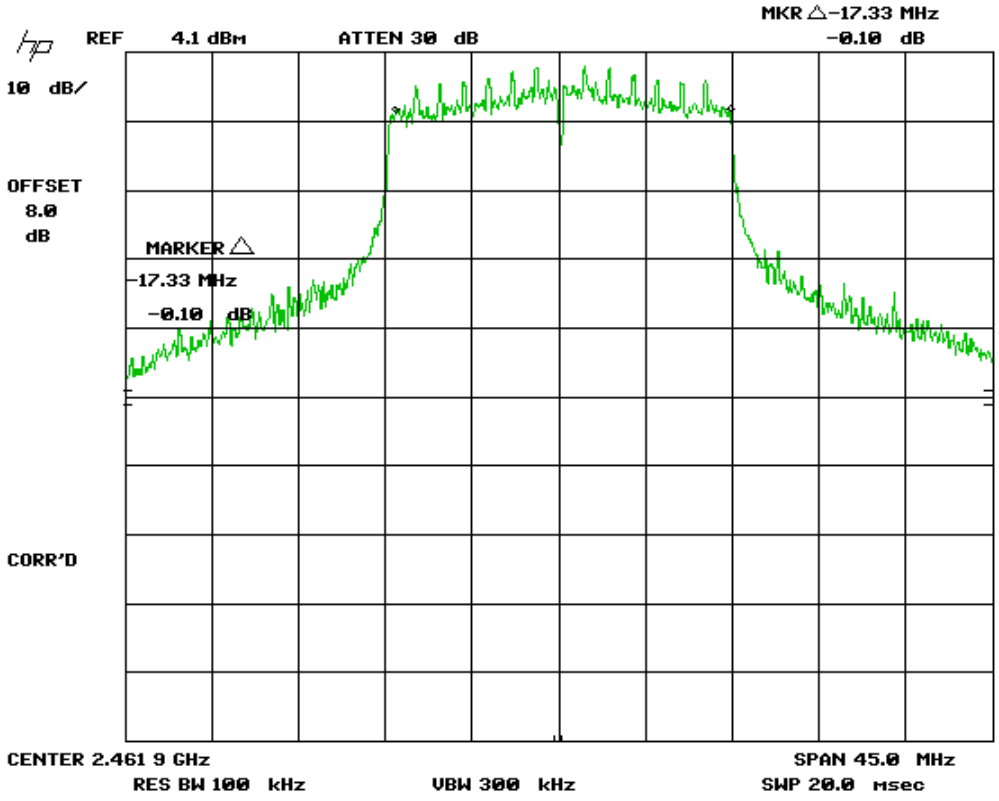


Figure 38. 6 dB Bandwidth - 15.247 (a) (2) – 802.11n – High Channel

2.12 **Maximum Peak Conducted Output Power (CFR 15.247 (b) (3))**

For the ISM4319-E, ISM4319-U, and ISM4319-C, the transmitter was programmed to operate at a maximum of +13 dBm across the bandwidth. For this test the unit was set at 13 dBm for the lower and up channels and 20dBm for the mid channel.

Peak power within the band 2400 MHz to 2483.5 MHz was measured per FCC KDB Publication 558074 alternative measurements as an Antenna Conducted test with a spectrum analyzer by connecting the spectrum analyzer directly, via a short RF cable, to the antenna output terminals on the EUT. The spectrum analyzer was set for an impedance of 50 Ω with the RBW set greater than the 6 dB bandwidth of the EUT, and the VBW ≥ RBW. The loss of the short cable is 0.3 dB, and addition of an attenuator, 8.0 dB and the final corrected measurements were determined by adding 8.3 dB to the raw data measured values of Figures 18 to 20. Peak antenna conducted output power is tabulated in Table 15 below.

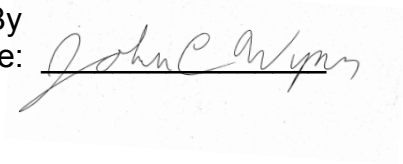
Peak power within the band 2400 MHz to 2483.5 MHz was measured with the FCC 15.247 Alternative Test Procedures. Using the peak field strength measurements from the intentional radiated test, the maximum conducted output power can be calculated. The following tables list the measured data and the calculated results for 802.11b, 802.11g, and 802.11n. The gain on the transmitter is assumed to be worst case, a dipole antenna (1.64).

Antenna Conducted Output Power was measured at Low Channel, Mid Channel and High Channel frequencies. See Figures 18 to 20 above. The 0.3 dB loss for the RF wire is taken into consideration here (Corrected Measurement column).

2.12 Maximum Peak Conducted Output Power (CFR 15.247 (b) (3)) (Cont'd)

Table 16. Peak Antenna Conducted Output Power per Part 15.247 (b) (3)

Frequency of Fundamental (MHz)	Corrected Measurement (dBm)	Calculated Power Output (mW)	FCC Limit (mW Maximum)
802.11b			
2412.00	17.70	58.88	1000
2436.00	17.30	53.70	1000
2462.00	17.10	51.29	1000
802.11g			
2412.00	17.00	50.12	1000
2436.00	16.90	48.98	1000
2462.00	16.50	44.67	1000
802.11n			
2412.00	15.20	33.11	1000
2436.00	15.10	32.36	1000
2462.00	15.00	31.62	1000

Test Date: December 19, 2011
Tested By
Signature: 

Name: John C. Wynn

2.12 Maximum Peak Conducted Output Power (CFR 15.247 (b) (3)) (Cont'd)

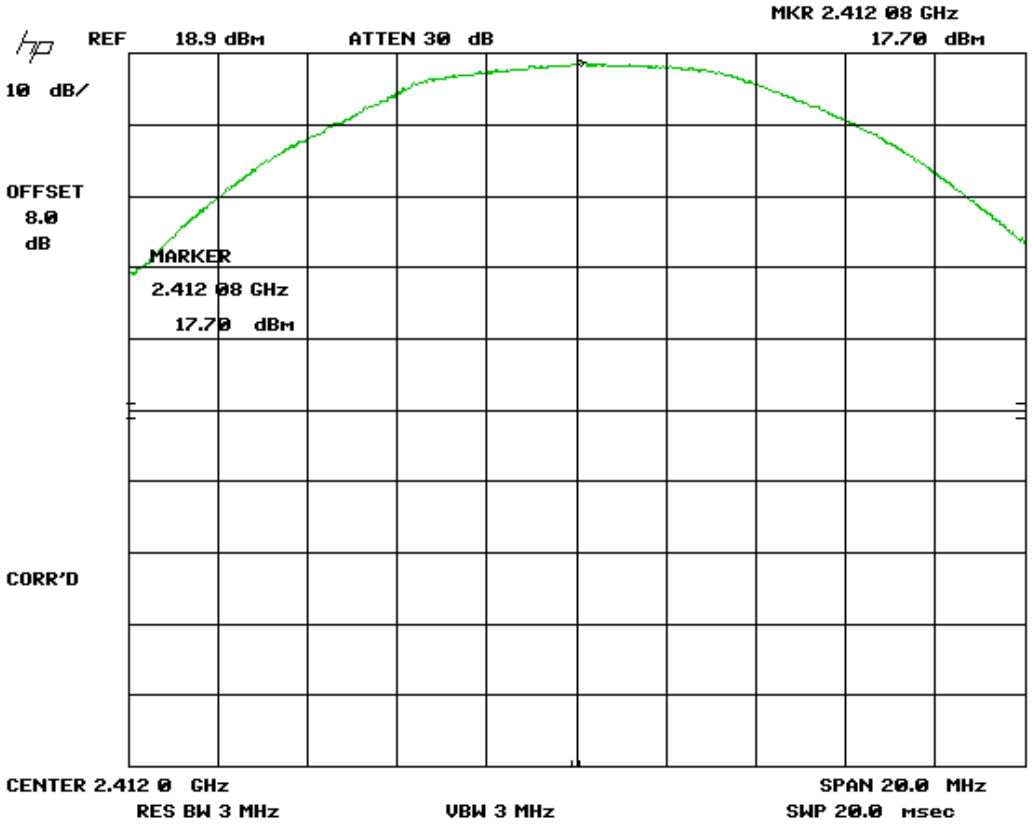


Figure 39- 802.11b, Low Channel

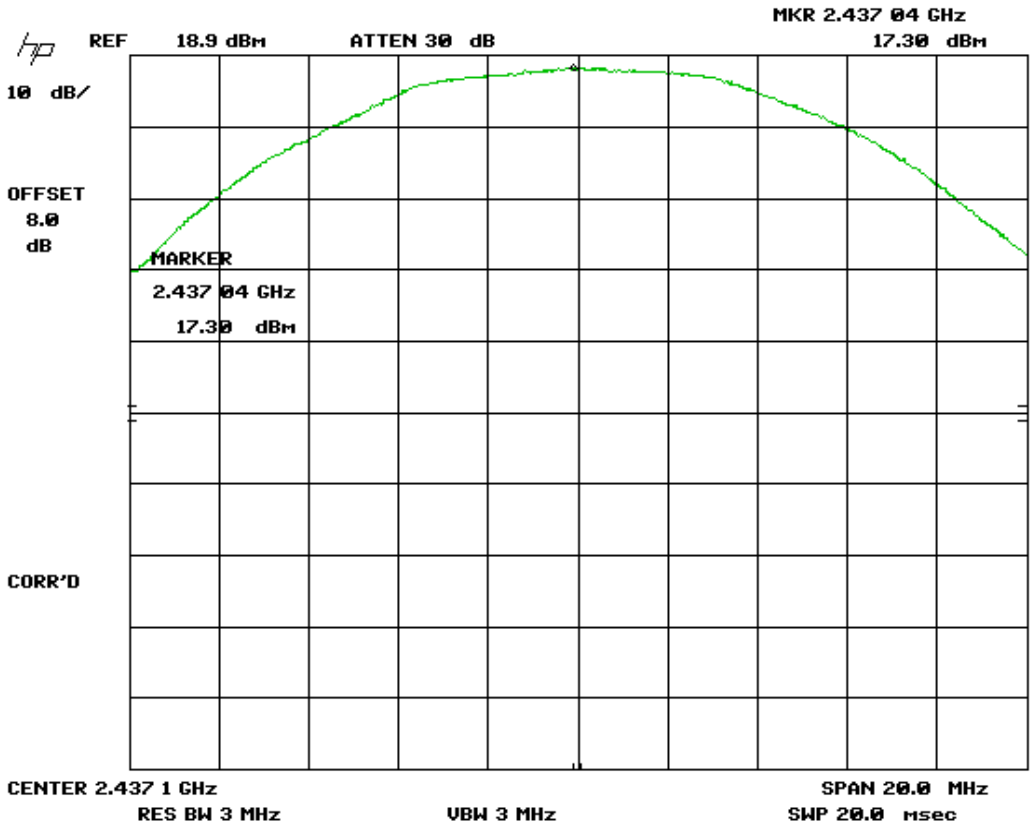


Figure 40- 802.11b, Mid Channel

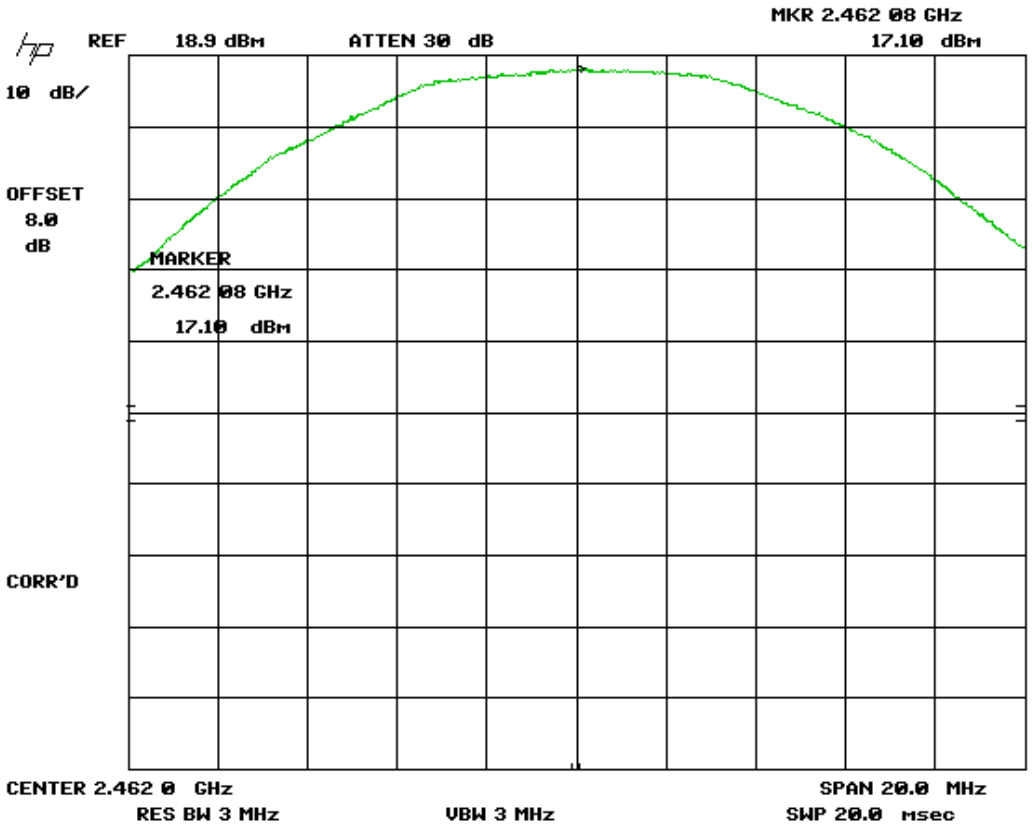


Figure 41- 802.11b, High Channel

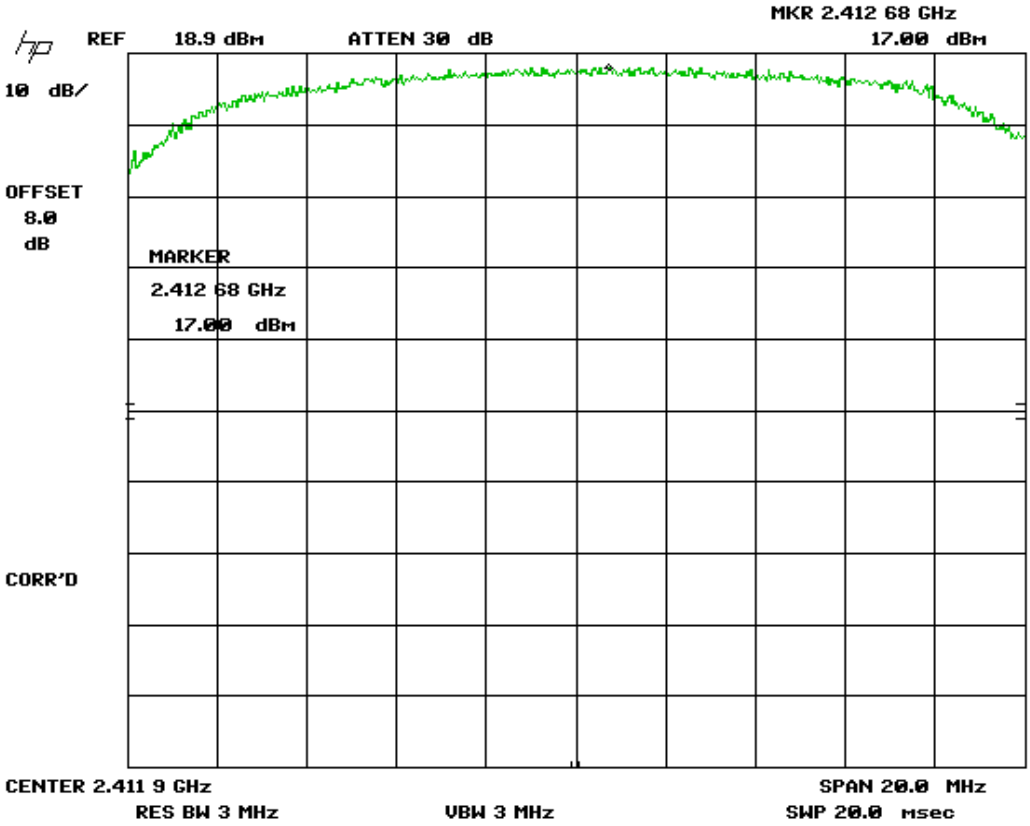


Figure 42- 802.11g, Low Channel

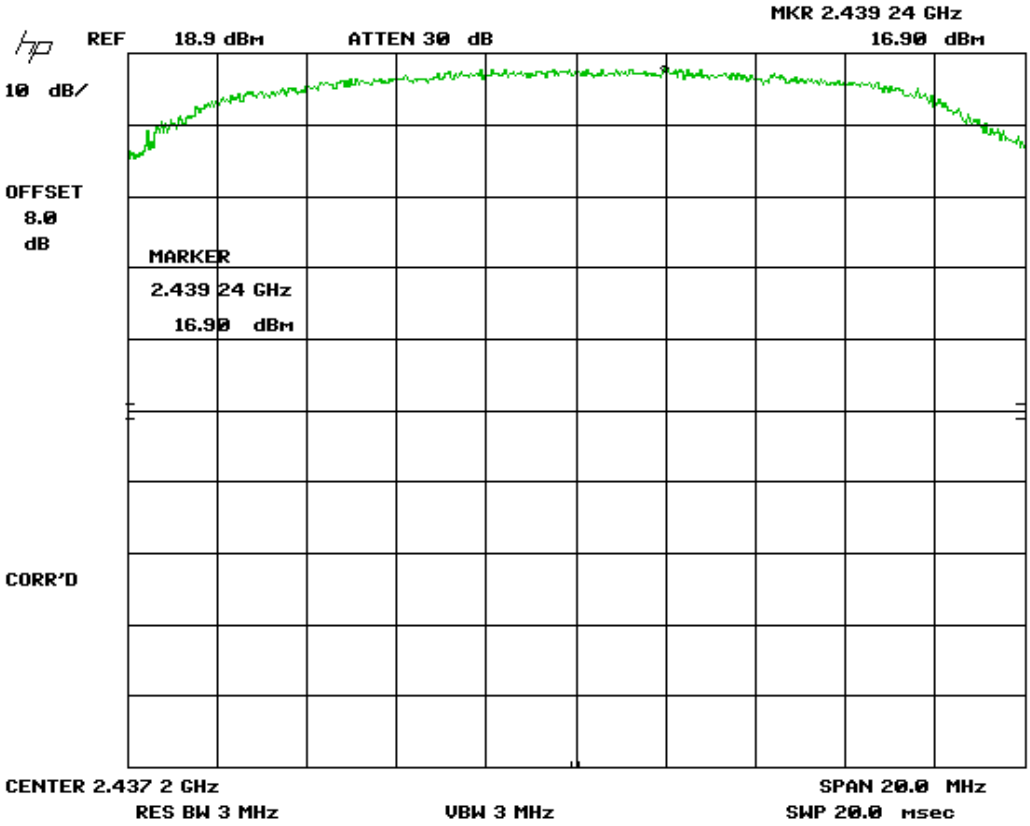


Figure 43- 802.11g, Mid Channel

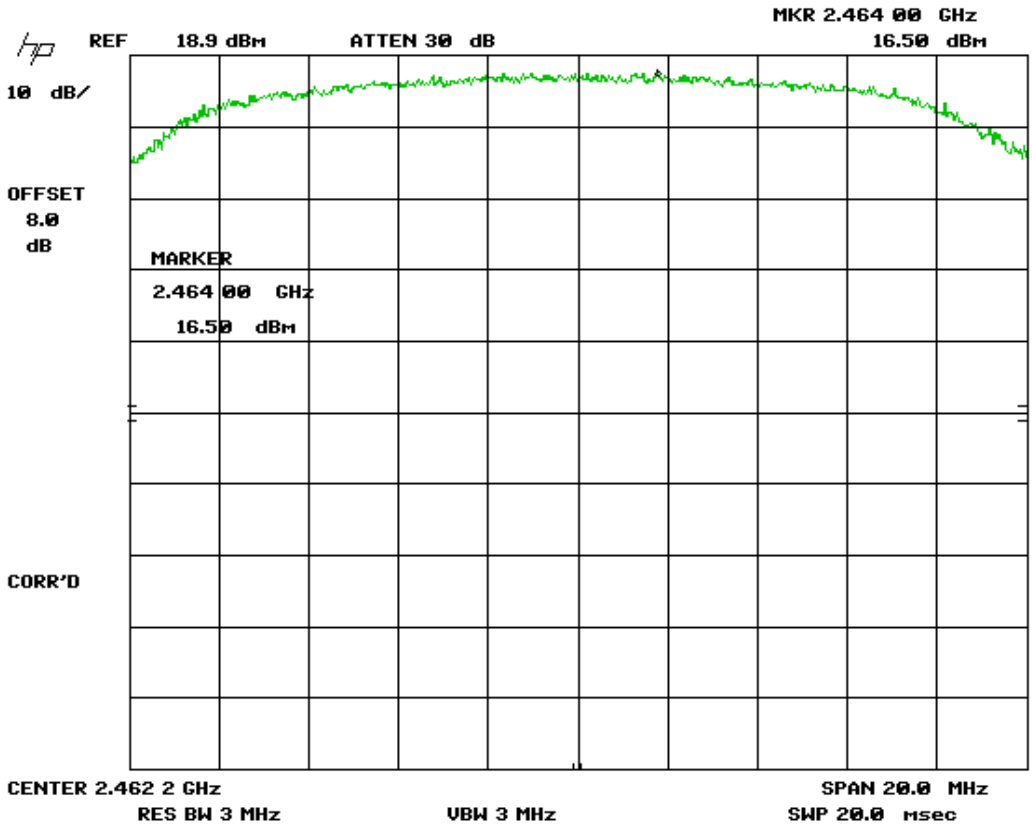


Figure 44- 802.11g, High Channel

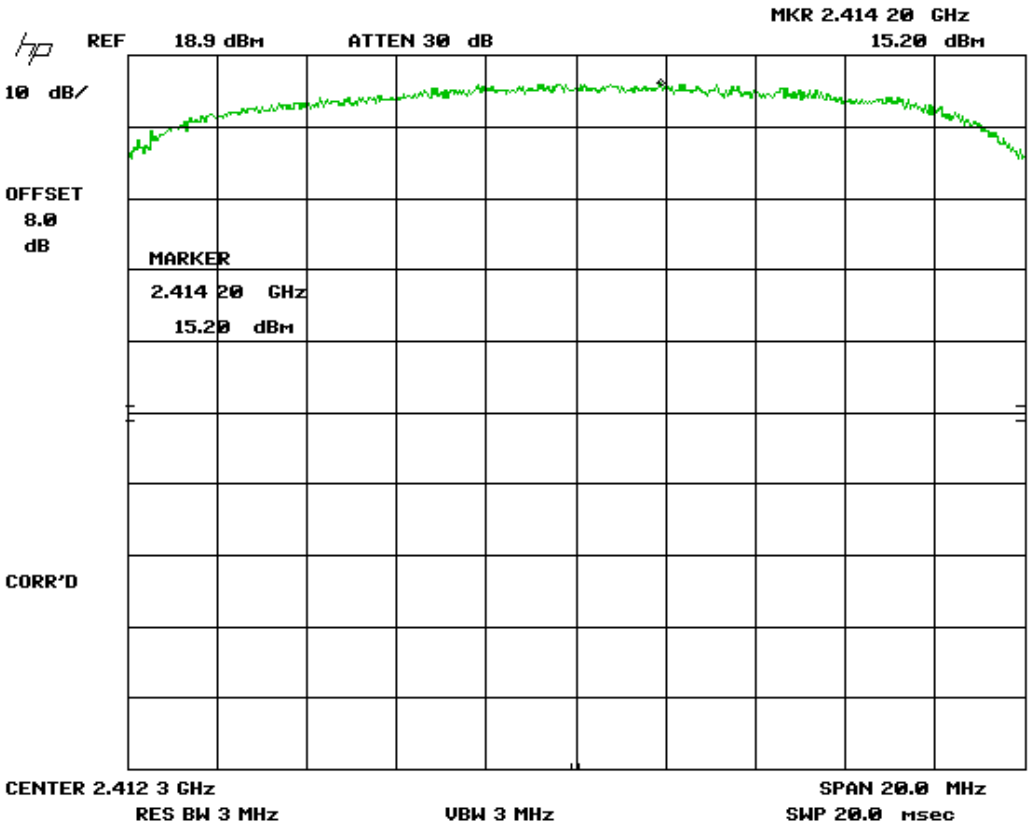


Figure 45- 802.11n, Low Channel

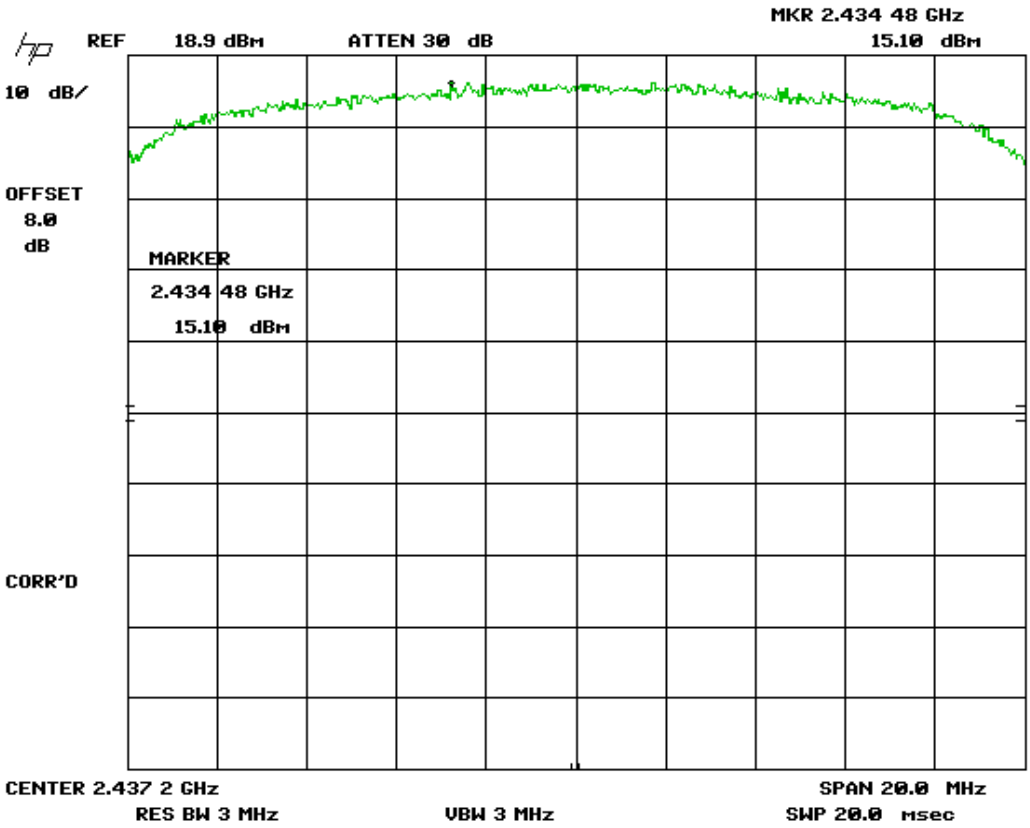


Figure 46- 802.11n, Mid Channel

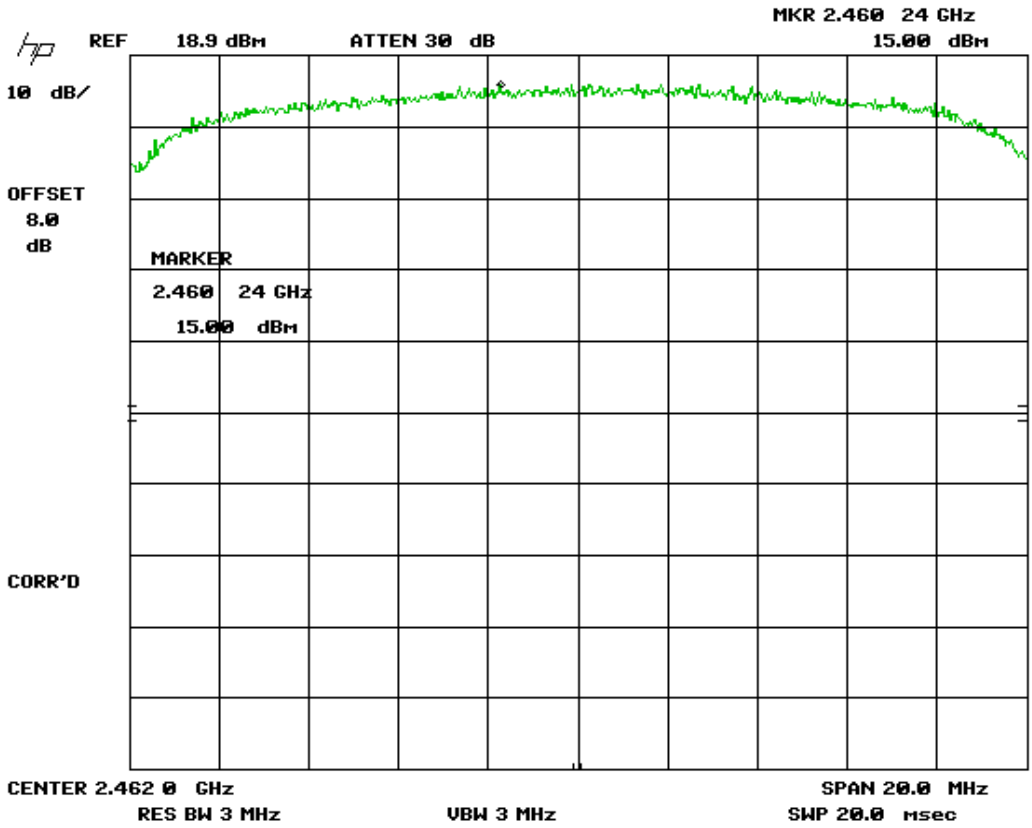


Figure 47- 802.11n, High Channel

Power Spectral Density (CFR 15.247(e)) (IC RSS 210 A8.5)

The transmitter was placed into a continuous mode of operation at all applicable frequencies. The measurements were performed per the procedures of FCC KDB Procedure 558074. The RBW was set to 3 kHz and the Video Bandwidth was set to ≥ RBW. The trace capture time was set to (Span/3 kHz).

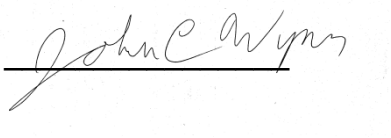
In accordance with 15.247 (e), the power spectral density shall be no greater than +8 dBm per any 3 kHz band.

Results are shown in Table 12, 13 and 14 and Figures 40 through 48 below. Results are corrected by adding 8.0 dB to the measured value to account for the cable loss and attenuator used. All are less than +8 dBm per 3 kHz band.

Table 17. Power Spectral Density for 802.11b Low, Mid and High Bands

Frequency (MHz)	Test Data (dBm/3 KHz)	Results (dBm/3 kHz)	FCC Limit (dBm/3 kHz)
Low-2412	-5.50	-5.50	+8.0
Mid-2442	-5.30	-5.30	+8.0
High- 2462	-6.20	-6.20	+8.0

Note: reference adjusted for correction factor of 8.0 dB for attenuator.

Test Date: December 19, 2011
Tested By
Signature:  Name: John C. Wynn

2.13 Power Spectral Density (CFR 15.247(e)) (IC RSS 210 A8.5), (Cont'd).

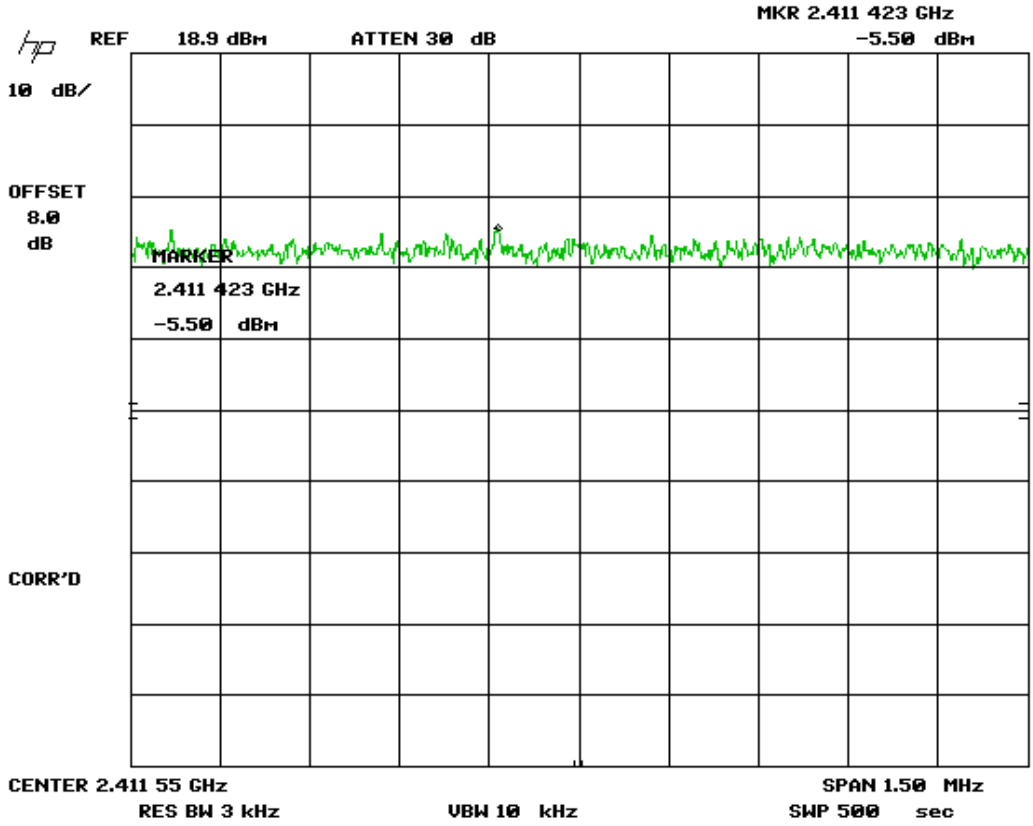


Figure 48. Peak Power Spectral Density - Part 15.247 (e) - Low Channel

2.13 Power Spectral Density (CFR 15.247(e)) (IC RSS 210 A8.5), (Cont'd).

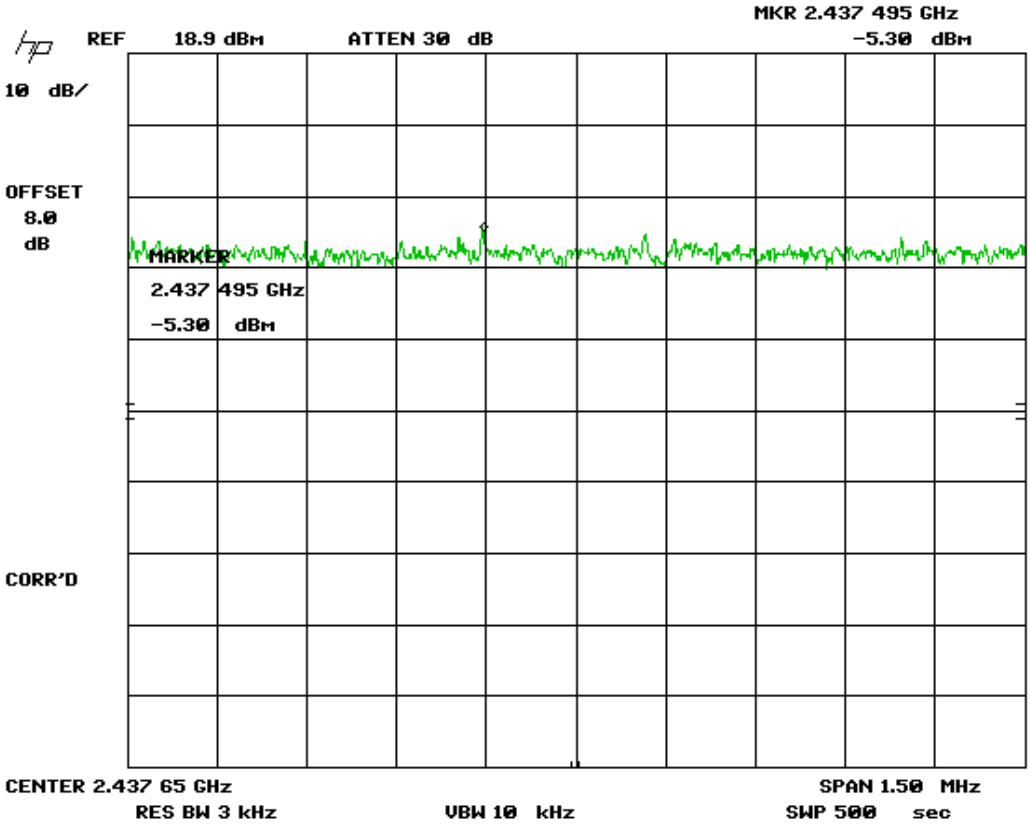


Figure 49. Power Spectral Density - Part 15.247 (e) - Mid Channel

2.13 Power Spectral Density (CFR 15.247(e)) (IC RSS 210 A8.5), (Cont'd).

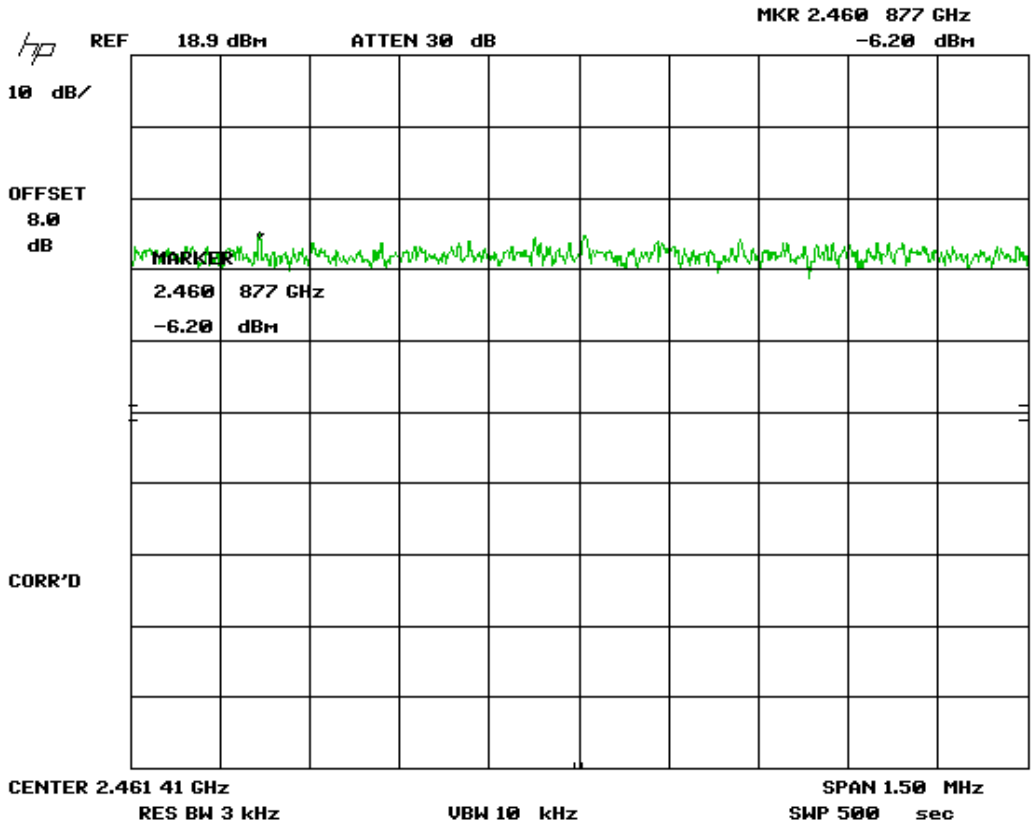
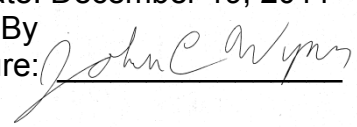


Figure 50. Peak Power Spectral Density - Part 15.247 (e) - High Channel

Table 18. Power Spectral Density for 802.11g Low, Mid and High Bands

Frequency (MHz)	Test Data (dBm/3 KHz)	Results (dBm/3 kHz)	FCC Limit (dBm/3 kHz)
Low-2414	-9.60	-9.60	+8.0
Mid-2444	-9.80	-9.80	+8.0
High- 2464	-9.80	-9.80	+8.0

Note: Reference adjusted for correction factor of 8 dBm for attenuator.

Test Date: December 19, 2011
Tested By
Signature:  Name: John C. Wynn

2.13 Power Spectral Density (CFR 15.247(e)) (IC RSS 210 A8.5), (Cont'd).

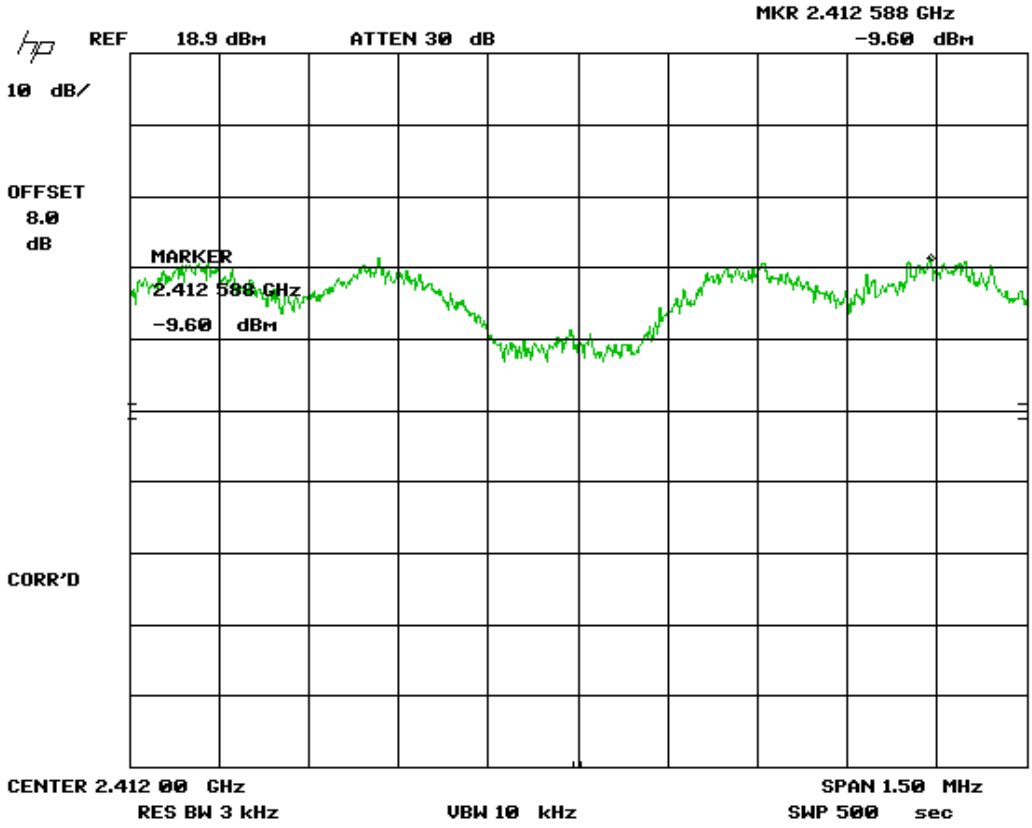


Figure 51. Peak Power Spectral Density - Part 15.247 (e) - Low Channel

2.13 Power Spectral Density (CFR 15.247(e)) (IC RSS 210 A8.5), (Cont'd).

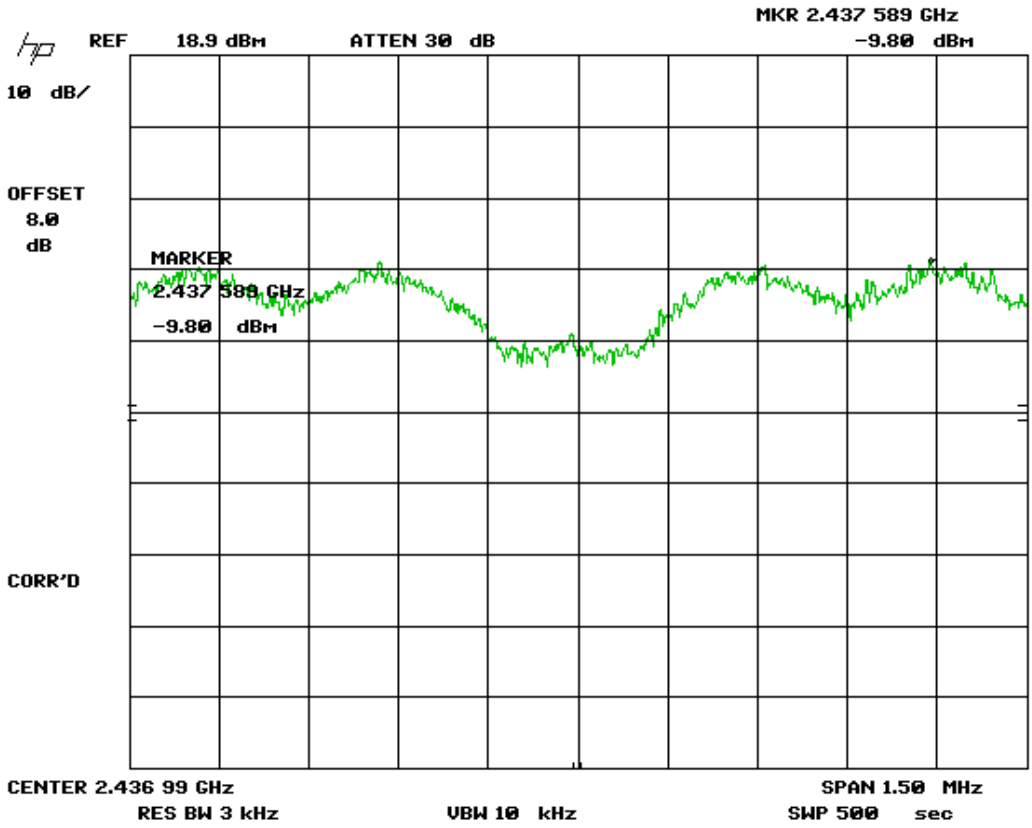


Figure 52. Peak Power Spectral Density - Part 15.247 (e) - Mid Channel

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2.13 Power Spectral Density (CFR 15.247(e)) (IC RSS 210 A8.5), (Cont'd).

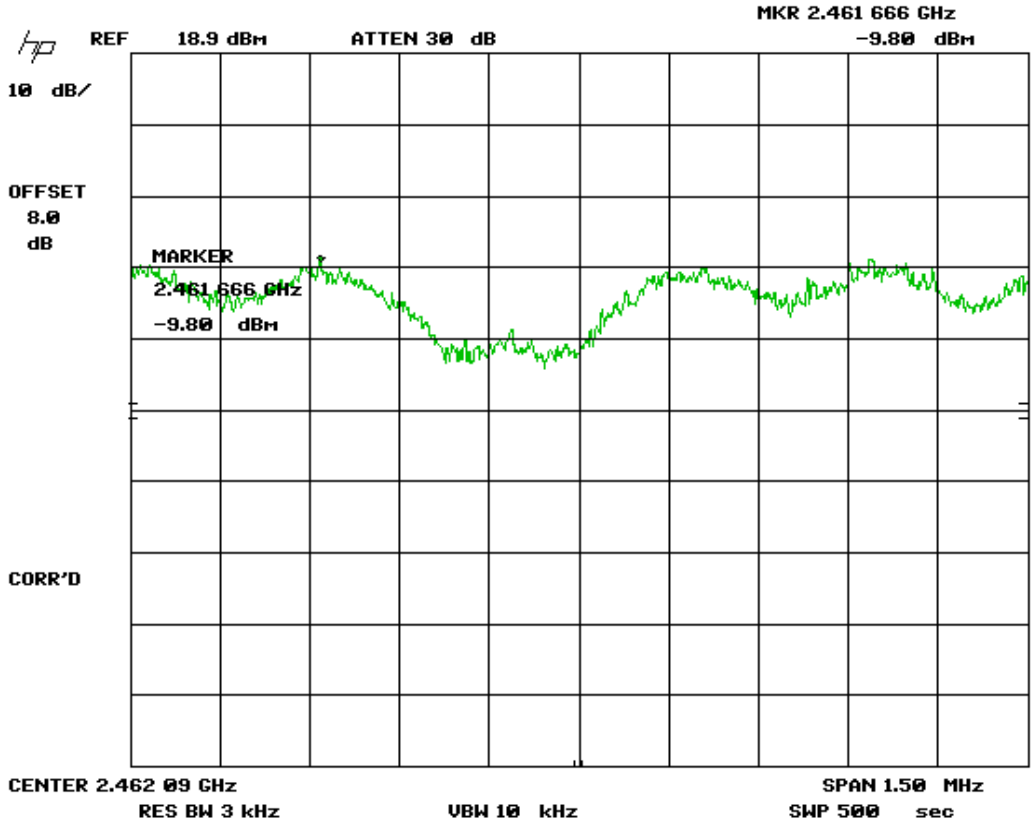
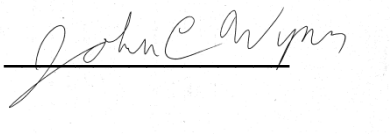


Figure 53. Peak Power Spectral Density - Part 15.247 (e) - High Channel

Table 19. Power Spectral Density for 802.11n Low, Mid and High Bands

Frequency (MHz)	Test Data (dBm/3 KHz)	Results (dBm/3 kHz)	FCC Limit (dBm/3 kHz)
Low-2410	-13.10	-13.10	+8.0
Mid-2444	-13.20	-13.20	+8.0
High- 2460	-13.30	-13.30	+8.0

Note: Reference adjusted for correction factor of 8 dBm for attenuator.

Test Date: December 19, 2011
Tested By
Signature:  Name: John C. Wynn

2.13 Power Spectral Density (CFR 15.247(e)) (IC RSS 210 A8.5), (Cont'd).

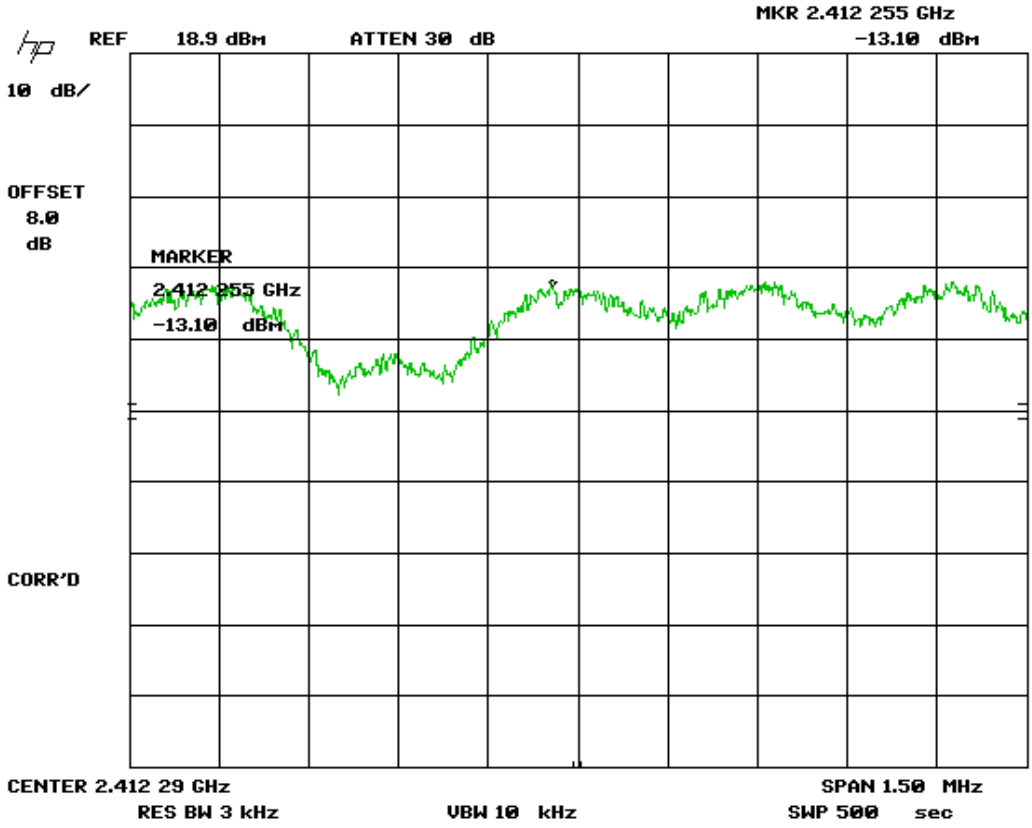


Figure 54. Peak Power Spectral Density - Part 15.247 (e) - Low Channel

2.13 Power Spectral Density (CFR 15.247(e)) (IC RSS 210 A8.5), (Cont'd).

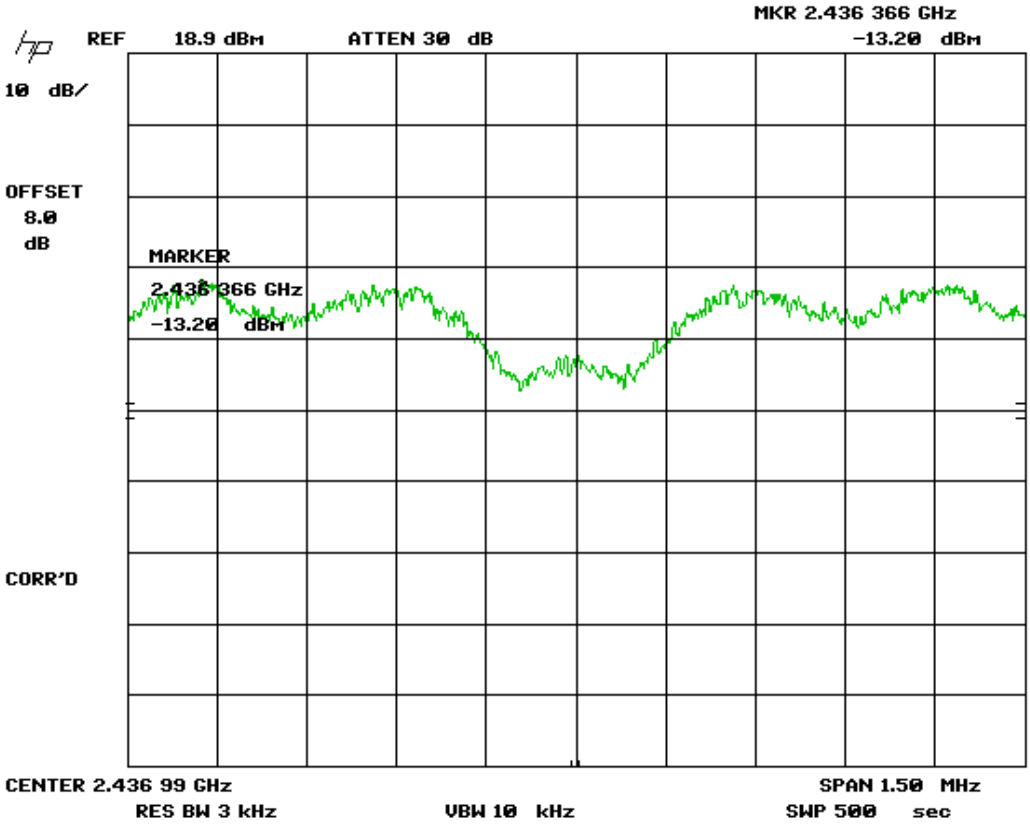


Figure 55. Peak Power Spectral Density - Part 15.247 (e) - Mid Channel

2.13 Power Spectral Density (CFR 15.247(e)) (IC RSS 210 A8.5), (Cont'd).

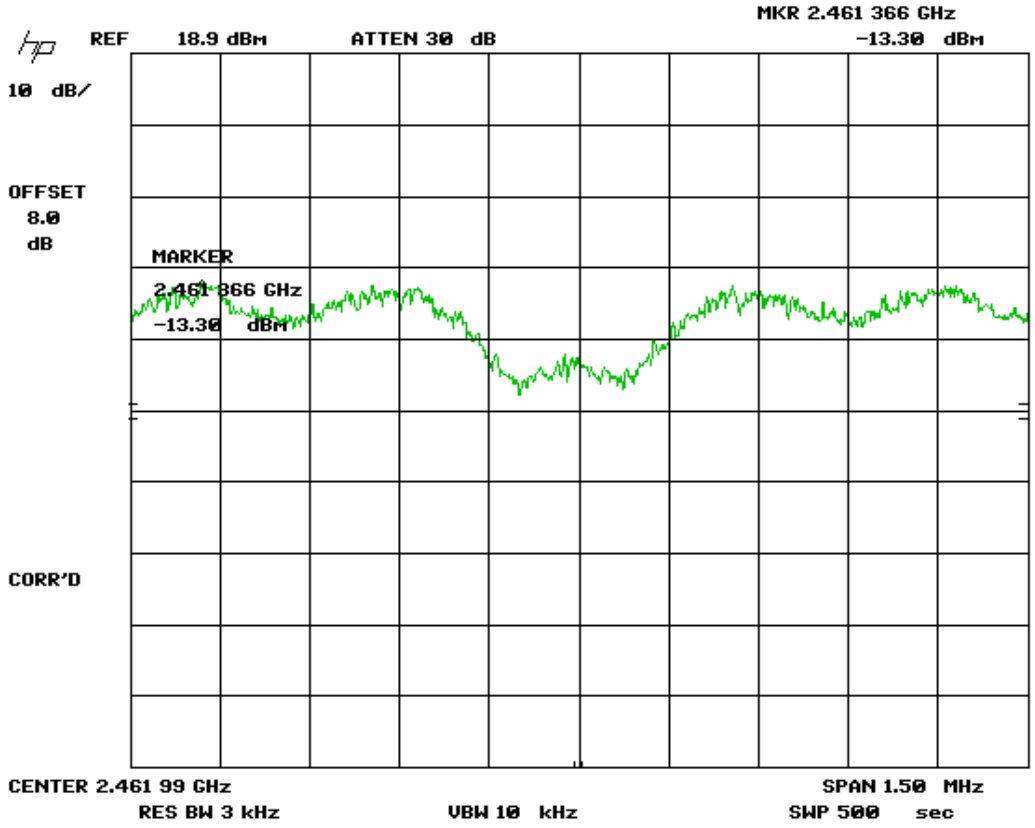


Figure 56. Peak Power Spectral Density - Part 15.247 (e) - High Channel

2.13 **Band Edge Measurements – (CFR 15.247 (d))**

Band Edge measurements are made following the guidelines in FCC KDB Publication No. 558074 with the EUT initially operating on the Lowest Channel and then operating on the Highest Channel within its band of operation. Antenna port conducted measurements are performed to demonstrate compliance with the requirement of 15.247(d) that all emissions outside of the band edges be attenuated by at least 20 dB when compared to its highest in-band value (contained in a 100 kHz band). Because these frequencies occur above 1000 MHz they have both a peak and average requirement.

To capture the band edge set the Spectrum Analyzer frequency span large enough (usually around 10 MHz) to capture the peak level of the emission operating on the channel closest to the band edge as well as any modulation products falling outside of the authorized band of operation. Conducted measurements are performed with RBW ≥1% of the frequency span. In all cases, the VBW is set ≥ RBW. See figure 24 and 25 below.

2.14 Band Edge (Cont'd)

Table 20. 802.11b Upper Band Edge - Radiated Emissions

Peak Radiated Higher Band Edge Measurements								
Test By: JCW	**Test: FCC Part 15.247**				**Client: Inventek Systems**			
	Project: 11-0263		**Class: B**		**Model: ISM4319-E, ISM4319-U, ISM4319-C**			
Frequency (MHz)	**AF table**	**Test data**	**AF+CA-AMP+DC dB/m**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance**	**Margin (dB)**	**Detector PK / AVG**
Internal Antenna								
Fund. 2464.00	1HN3mV	69.10	31.87	100.97	--	3m	--	**AVG**
Band Edge 2483.5	--	(100.97 -58.00)	--	42.97	54.0	3m	12.67	**PK**

Note: Row two includes calculations using the correct fundamental value from row one.

The limit for the average value of radiated emissions in a Restricted Band is 54 dBuV/m. To compute the average values of the band edge emissions, the duty cycle correction factor of -1.64 dB is applied to the values in the Corrected Results column. After this correction the EUT is found to have met the restrictions placed on average radiated emissions in Restricted Bands. The worst-case measurement is computed below.

CALCULATION OF WORST-CASE AVERAGE UPPER BAND EDGE MEASUREMENT:
Results = Peak Corrected Results + Duty Cycle Correction Factor
Results = 42.97+ (-1.64) = 41.33 dBuV/m
Margin = Limit – Results = 54 – 41.33= 12.67 dB

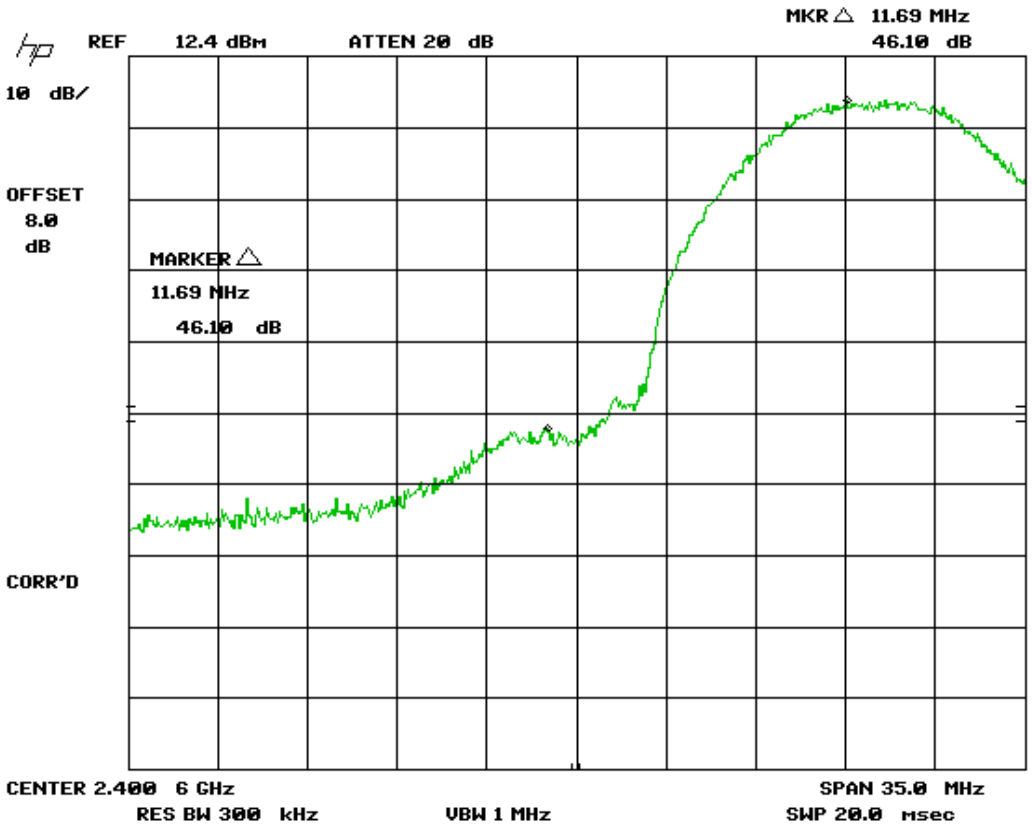


Figure 57. 802.11b – Band Edge Compliance – Low Channel Delta - Peak

Note: Conducted emissions shown here are worst case.

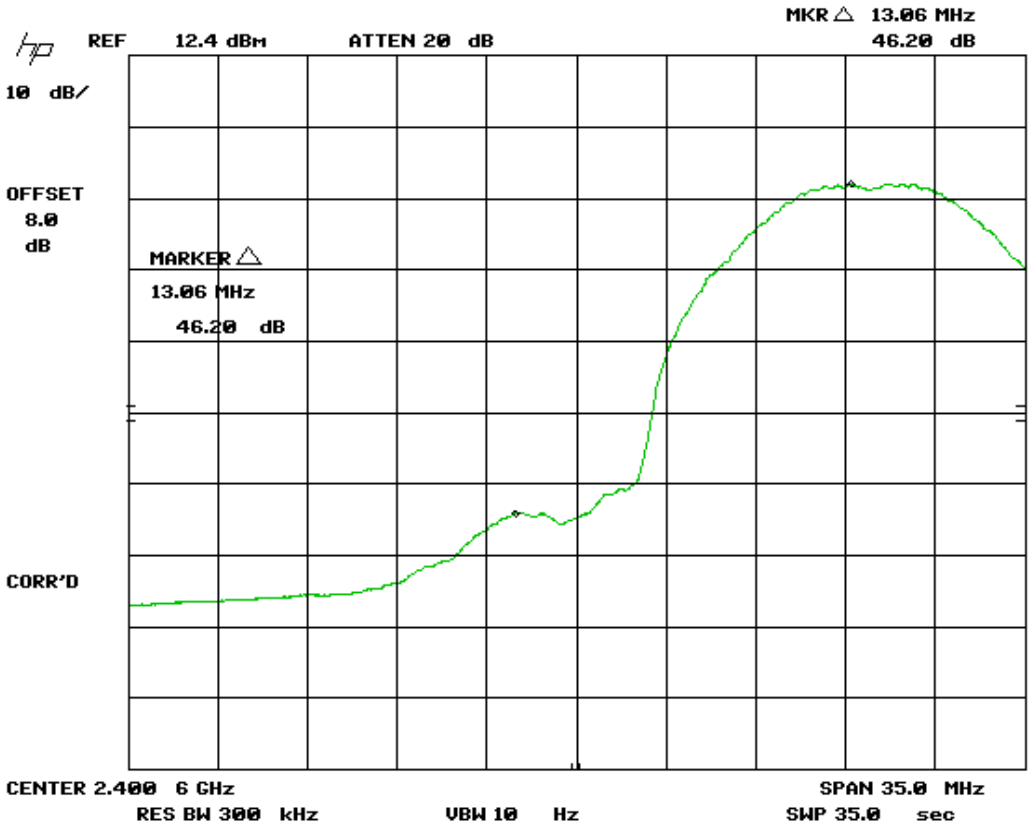


Figure 58. 802.11b – Band Edge Compliance – Low Channel Delta - AVG

Note: Conducted emissions shown here are worst case.

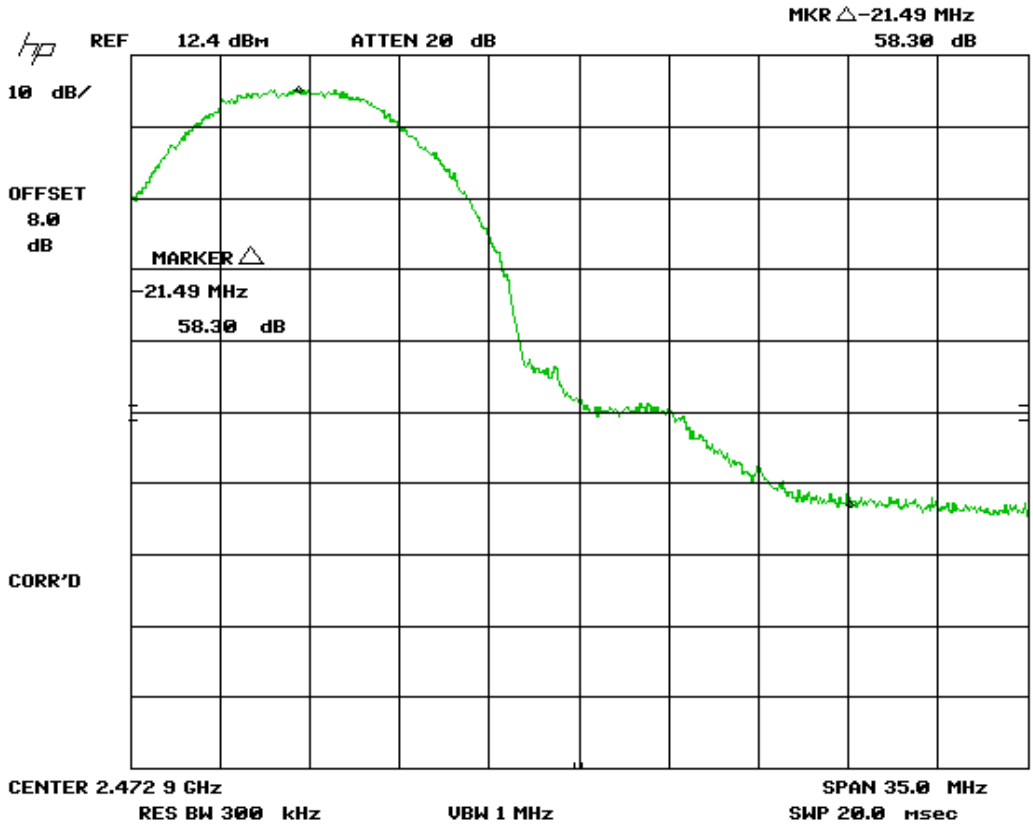


Figure 59. 802.11b – Band Edge Compliance – High Channel Delta - Peak

Note: Conducted emissions shown here are worst case.

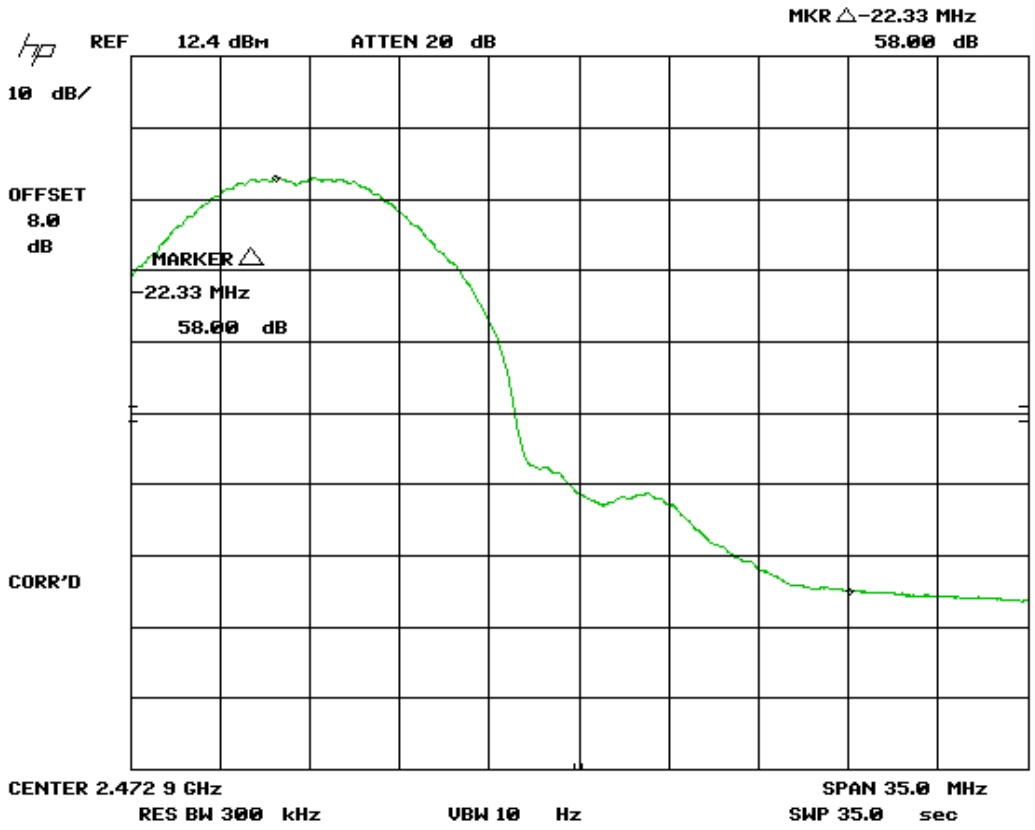


Figure 60. 802.11b – Band Edge Compliance – High Channel Delta - AVG

Note: Conducted emissions shown here are worst case.

2.14 Band Edge (Cont'd)

Table 13. 802.11g Upper Band Edge - Radiated Emissions

Peak Radiated Higher Band Edge Measurements								
Test By: JCW	**Test: FCC Part 15.247**				**Client: Inventek Systems**			
	Project: 11-0263		**Class: B**			**Model: ISM4319-E, ISM4319-U, ISM4319-C**		
Frequency (MHz)	**AF table**	**Test data**	**AF+CA-AMP+DC dB/m**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance /**	**Margin (dB)**	**Detector PK / AVG**
Internal Antenna								
Fund. 2461.21	1HN3mV	59.00	31.87	90.87	--	3m./	--	**AVG**
Band Edge 2483.5	--	(90.87 - 38.40)	--	52.47	54.0	3m./	3.17	**PK**

Note: Row two includes calculations using the correct fundamental value from row one.

The limit for the average value of radiated emissions in a Restricted Band is 54 dBuV/m. To compute the average values of the band edge emissions, the duty cycle correction factor of -1.64 dB is applied to the values in the Corrected Results column. After this correction the EUT is found to have met the restrictions placed on average radiated emissions in Restricted Bands. The worst-case measurement is computed below.

CALCULATION OF WORST-CASE AVERAGE UPPER BAND EDGE MEASUREMENT:
Results = Peak Corrected Results + Duty Cycle Correction Factor
Results = 52.47+ (-1.64) = 50.83 dBuV/m
Margin = Limit – Results = 54 – 50.83 = 3.17 dB

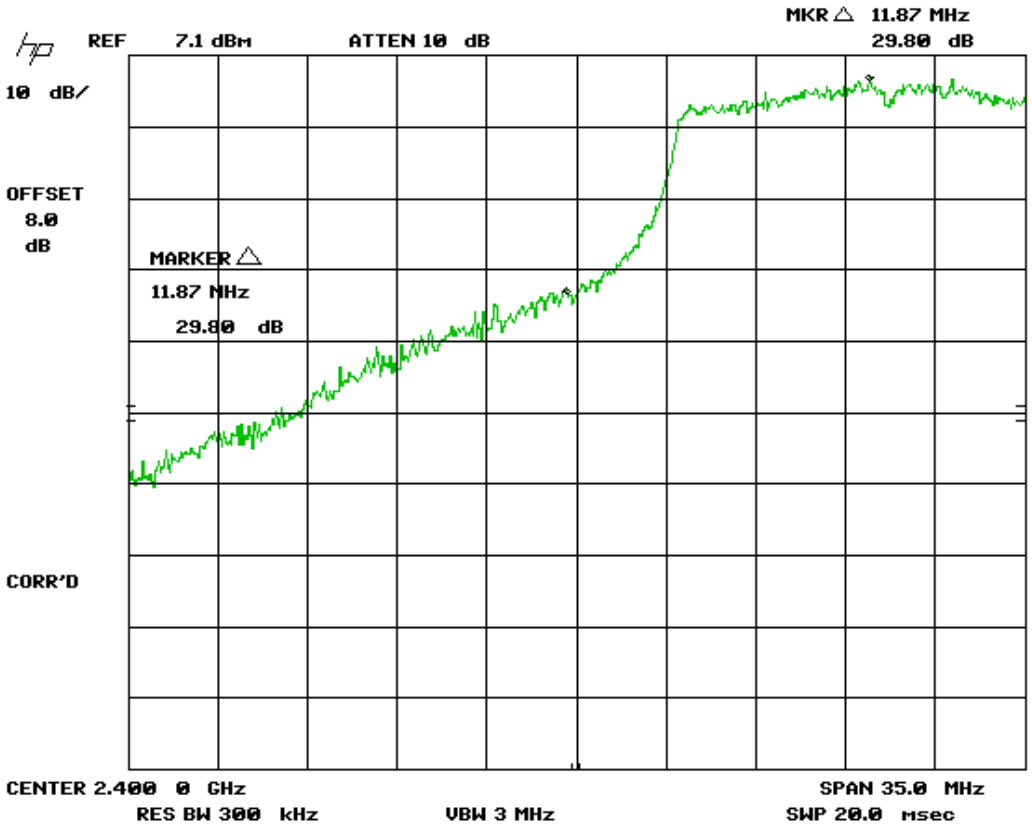


Figure 61. 802.11g – Band Edge Compliance – Low Channel Delta - Peak

Note: Conducted emissions shown here are worst case.

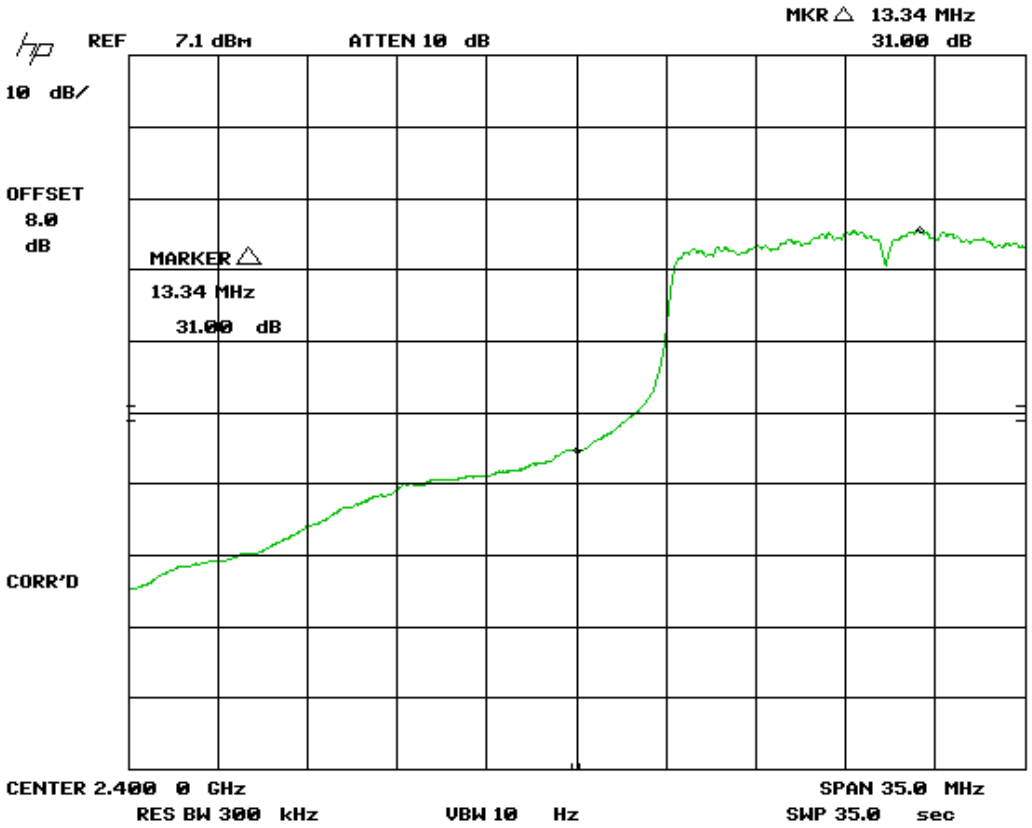


Figure 62. 802.11g – Band Edge Compliance – Low Channel Delta - AVG

Note: Conducted emissions shown here are worst case.

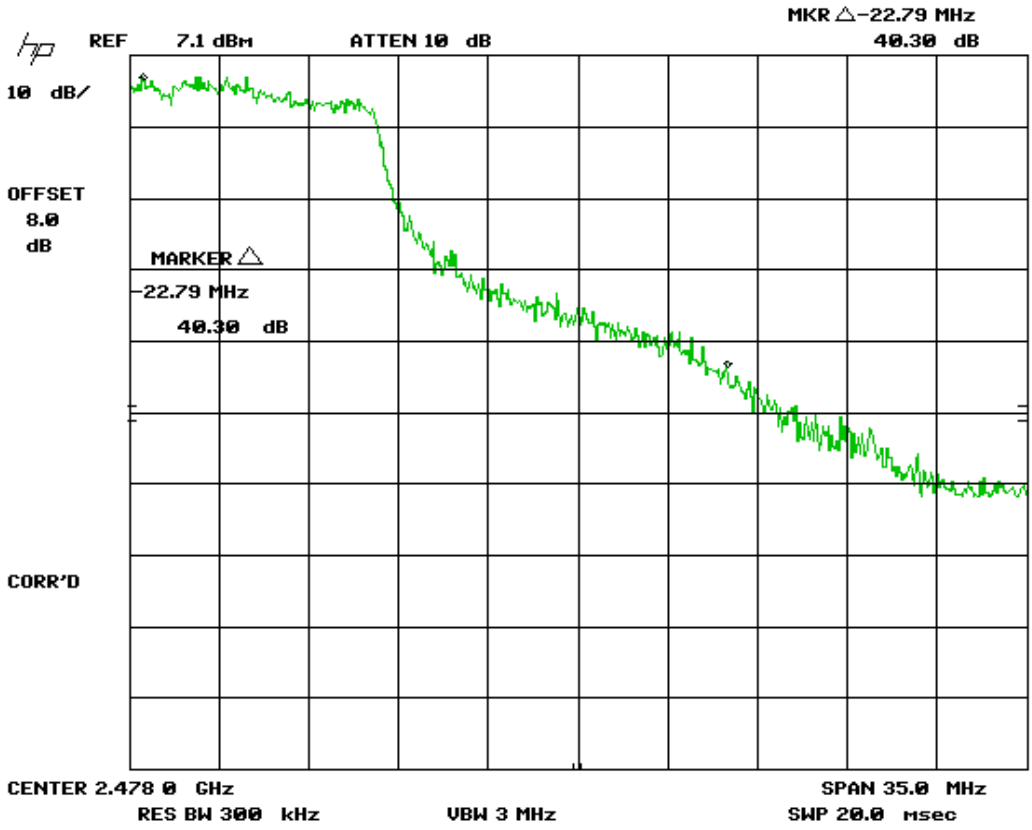


Figure 63. 802.11g – Band Edge Compliance – High Channel Delta - Peak

Note: Conducted emissions shown here are worst case.

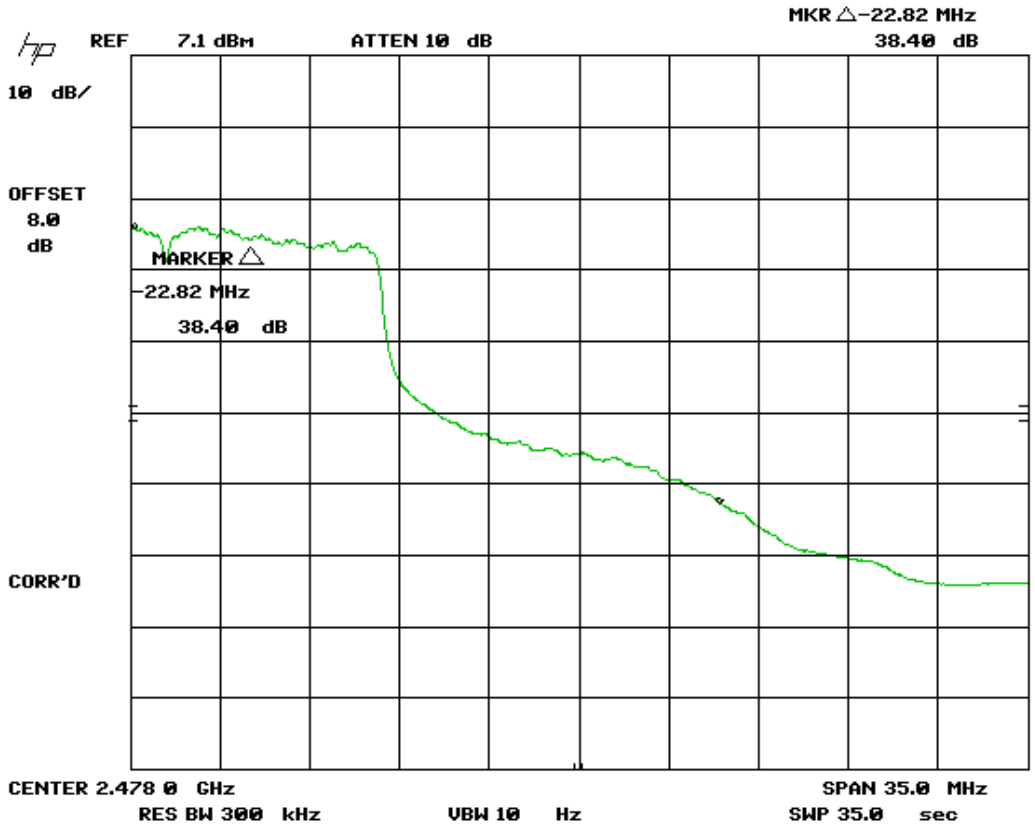


Figure 64. 802.11g – Band Edge Compliance – High Channel Delta - AVG

Note: Conducted emissions shown here are worst case.

2.14 Band Edge (Cont'd)

Table 21. 802.11n Upper Band Edge - Radiated Emissions

Peak Radiated Higher Band Edge Measurements								
Test By: JCW	**Test: FCC Part 15.247**				**Client: Inventek Systems**			
	Project: 11-0263		**Class: B**		**Model: ISM4319-E, ISM4319-U, ISM4319-C**			
Frequency (MHz)	**AF table**	**Test data**	**AF+CA-AMP+DC dB/m**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance /**	**Margin (dB)**	**Detector PK / AVG**
Internal Antenna								
Fund. 2462.77	1HN3mV	58.20	31.87	90.07	--	3m./	--	**AVG**
Band Edge 2483.5	--	(90.07 -38.8)	--	51.27	54.0	3m./	4.37	**PK**

Note: Row two includes calculations using the correct fundamental value from row one.

The limit for the average value of radiated emissions in a Restricted Band is 54 dBuV/m. To compute the average values of the band edge emissions, the duty cycle correction factor of -1.64 dB is applied to the values in the Corrected Results column. After this correction the EUT is found to have met the restrictions placed on average radiated emissions in Restricted Bands. The worst-case measurement is computed below.

CALCULATION OF WORST-CASE AVERAGE UPPER BAND EDGE MEASUREMENT:
Results = Peak Corrected Results + Duty Cycle Correction Factor
Results = 51.27+ (-1.64) = 49.63 dBuV/m
Margin = Limit – Results = 54 – 49.63 = 4.37 dB

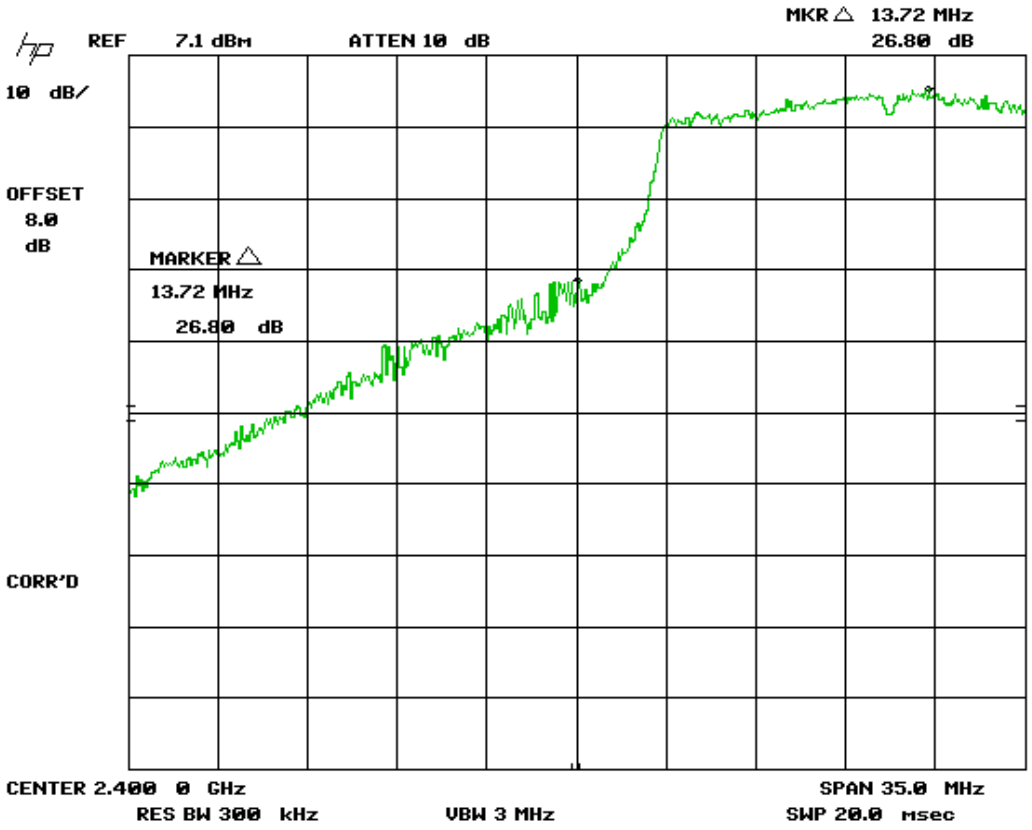


Figure 65. 802.11n – Band Edge Compliance – Low Channel Delta - Peak

Note: Conducted emissions shown here are worst case.

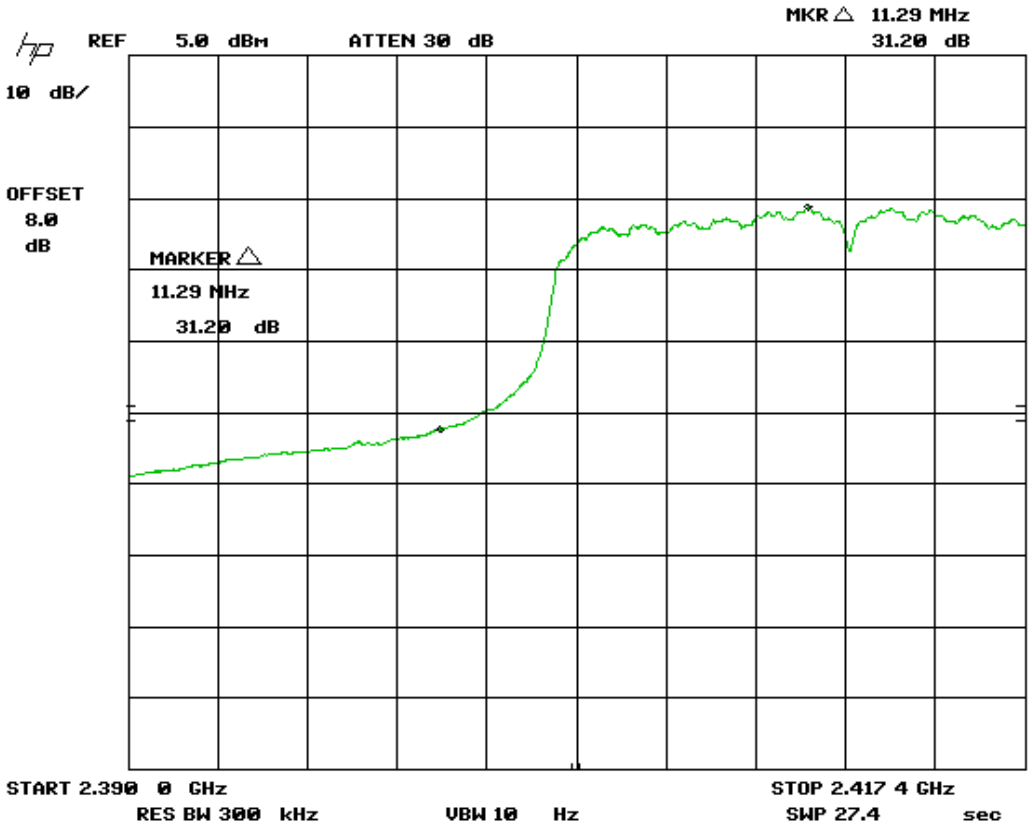


Figure 66. 802.11n – Band Edge Compliance – Low Channel Delta - AVG

Note: Conducted emissions shown here are worst case.

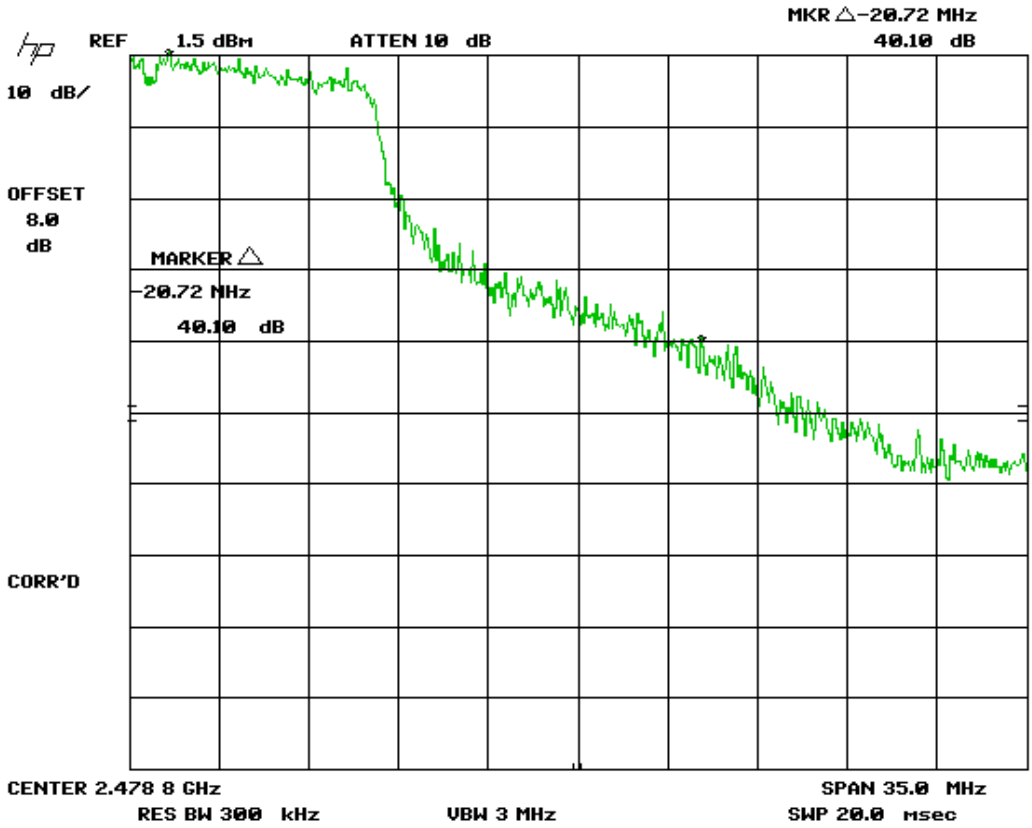


Figure 67. 802.11n – Band Edge Compliance – High Channel Delta - Peak

Note: Conducted emissions shown here are worst case.

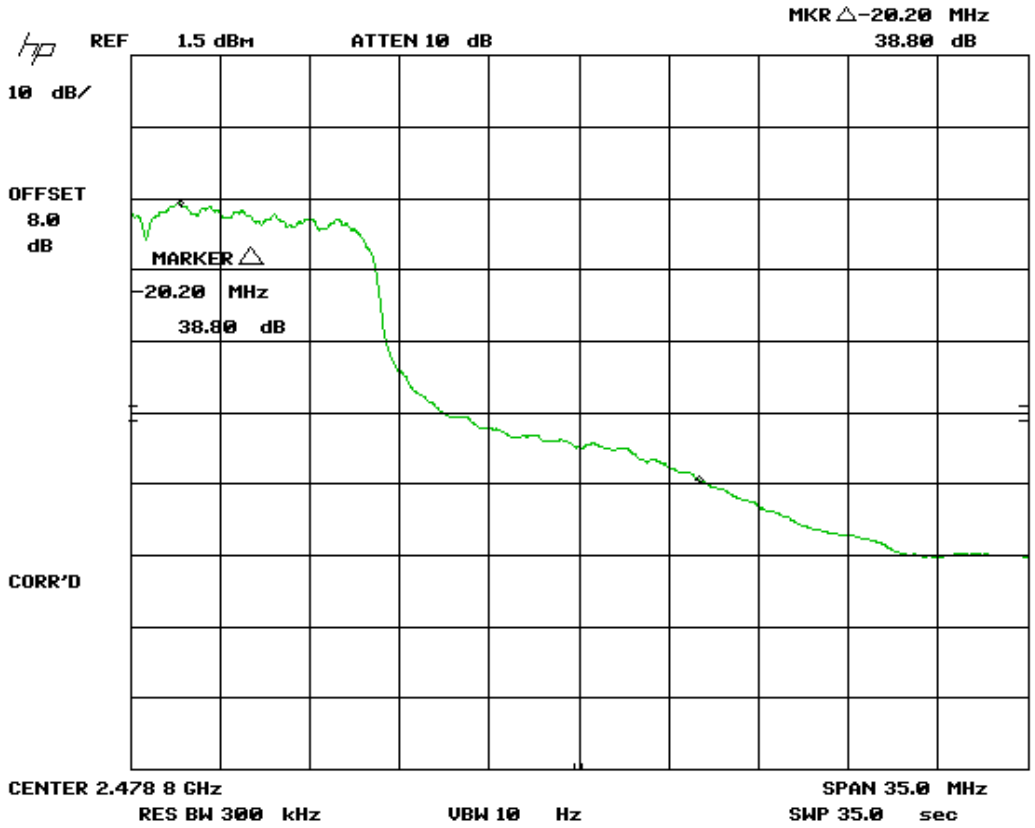


Figure 68. 802.11n – Band Edge Compliance – High Channel Delta - AVG

Note: Conducted emissions shown here are worst case.

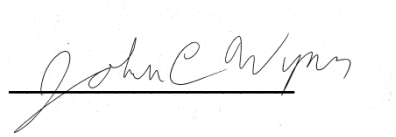
2.14 **20 dB Bandwidth Measurement per CFR 15.247, 99% Occupied Bandwidth (IC RSS 210, A8.1)**

The EUT antenna port was connected to a spectrum analyzer having a 50 Ω input impedance. Measurements were performed similar to the method of FCC, KDB Publication No. 558074 for a bandwidth of 20 dB. The RBW was set to approximately 1/100 of the manufacturers claimed RBW and with the VBW ≥ RBW. The results of this test are given in Table 12 and Figures 23 through 25.

Table 22. 802.11b 20 dB Bandwidth and 99% Occupied Bandwidth

Frequency (MHz)	20 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2412.0	14.49	14.49
2436.0	14.49	14.49
2462.0	14.63	14.63

Test Date: December 19, 2011

Tested By
Signature:  Name: John C. Wynn

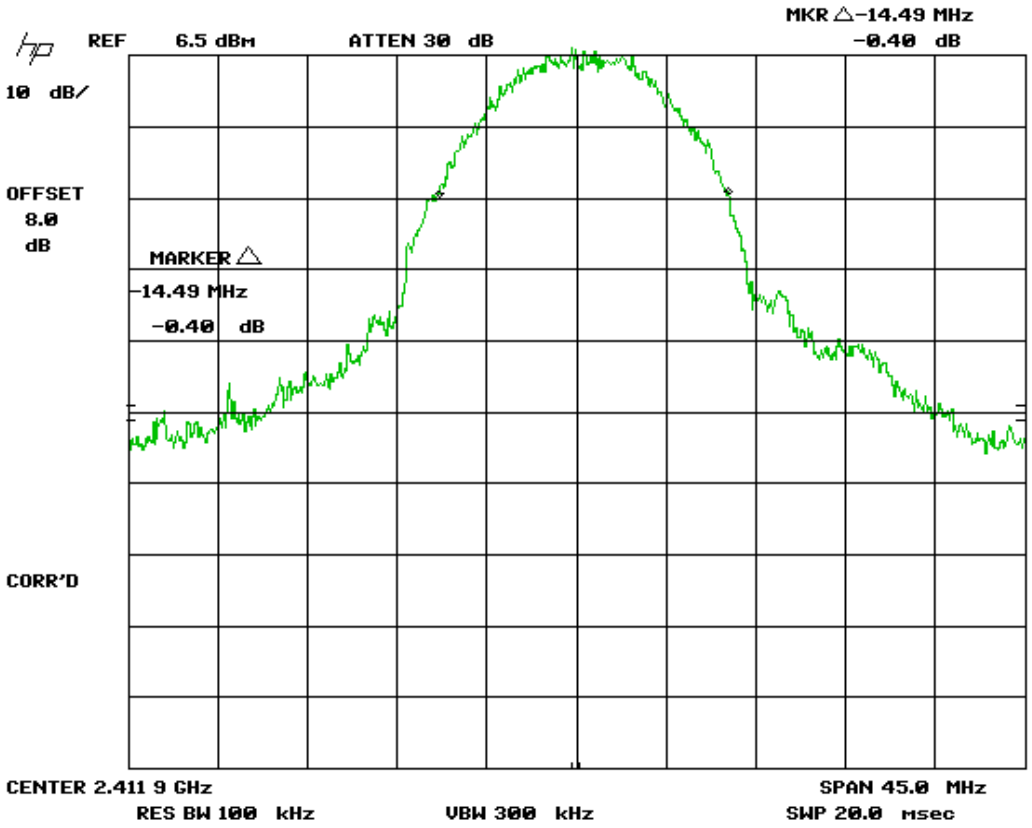


Figure 69. 802.11b - Low Channel 99% Bandwidth

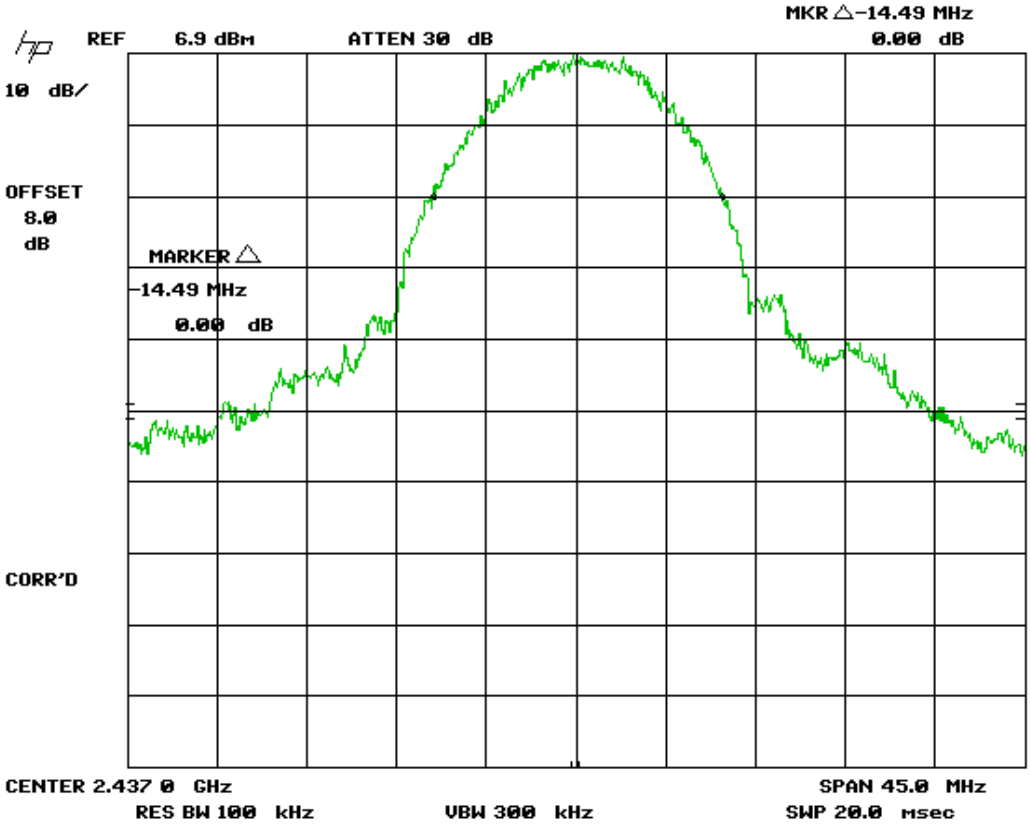


Figure 70. 802.11b - Mid Channel 99% Bandwidth

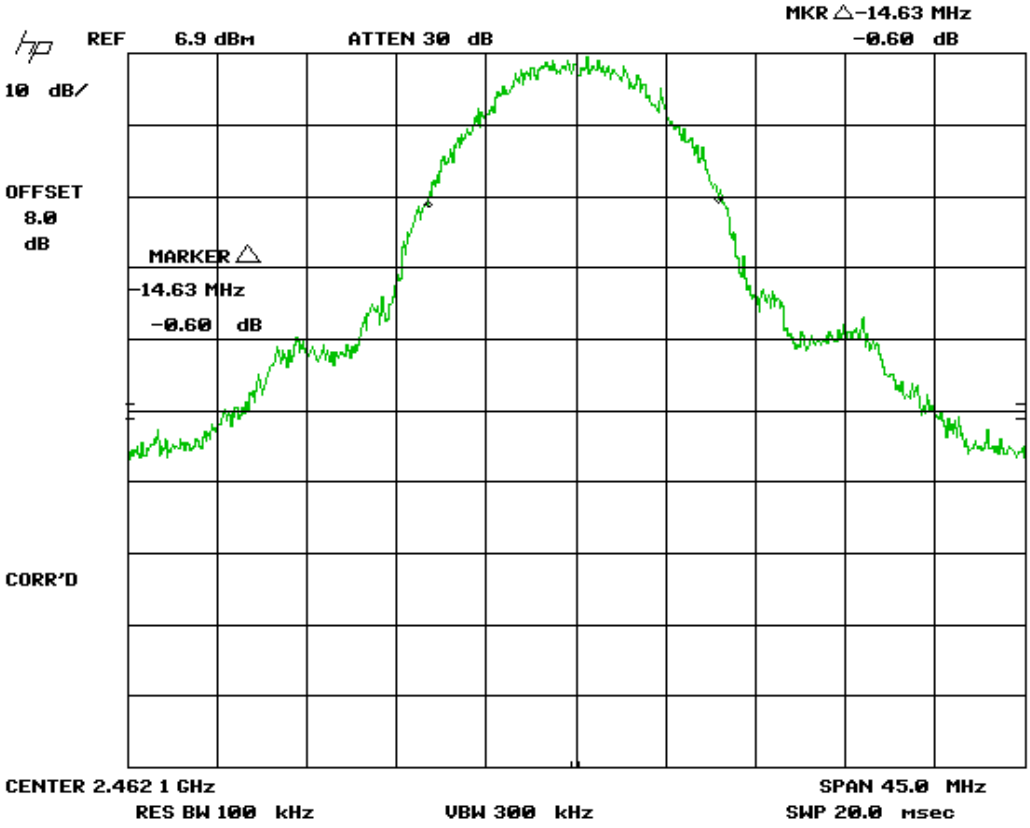
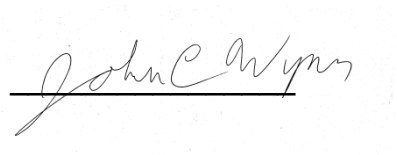


Figure 71. 802.11b - High Channel 99% Bandwidth

Table 23. 802.11g 20 dB Bandwidth and 99% Occupied Bandwidth

Frequency (MHz)	20 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2412.0	17.28	17.28
2436.0	17.33	17.33
2462.0	18.14	18.14

Test Date: December 19, 2011

Tested By
Signature:  Name: John C. Wynn

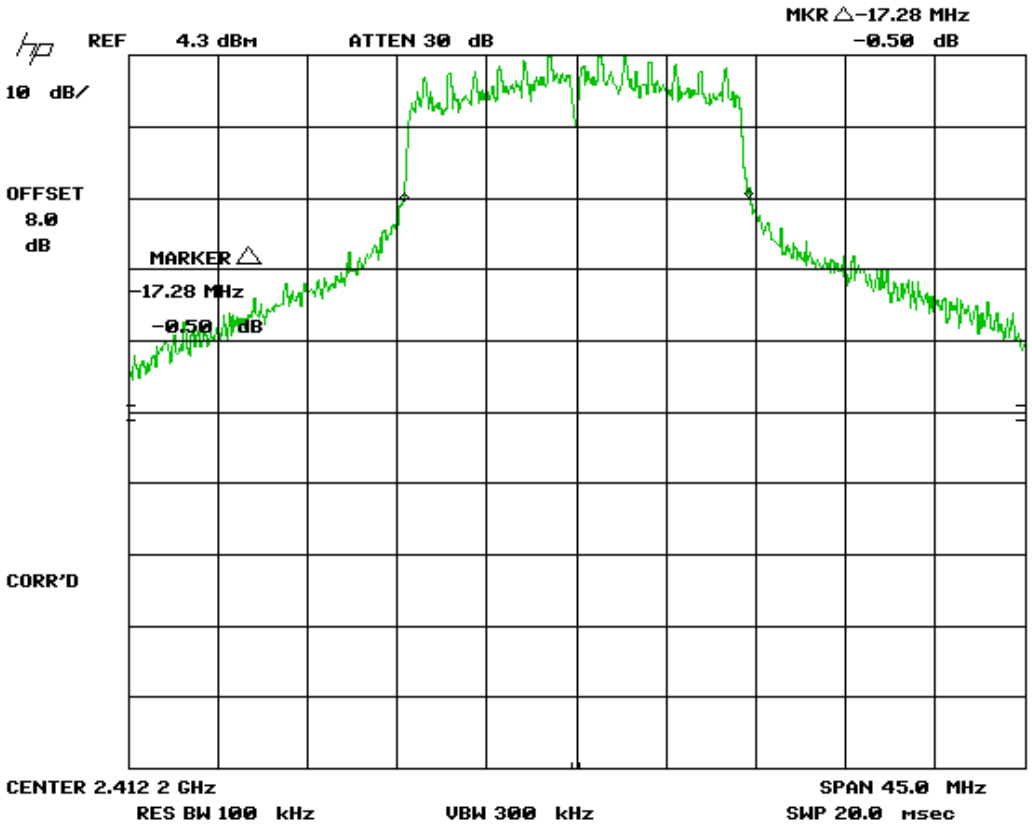


Figure 72. 802.11g - Low Channel 99% Bandwidth

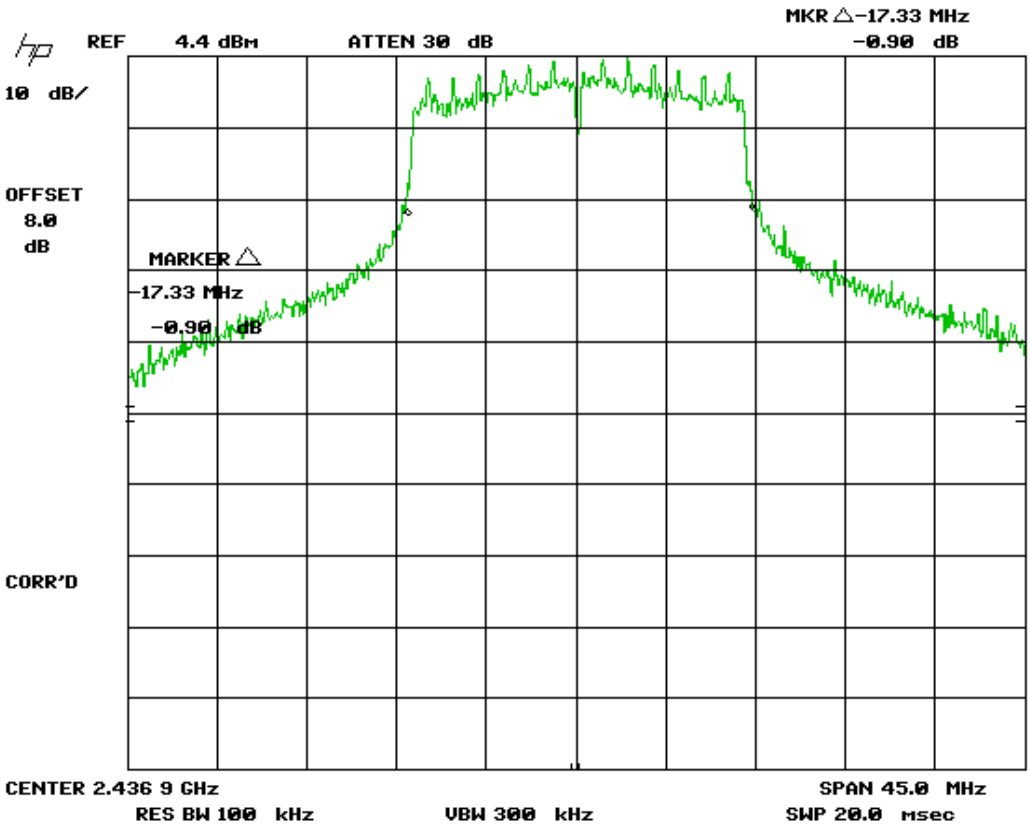


Figure 73. 802.11g - Mid Channel 99% Bandwidth

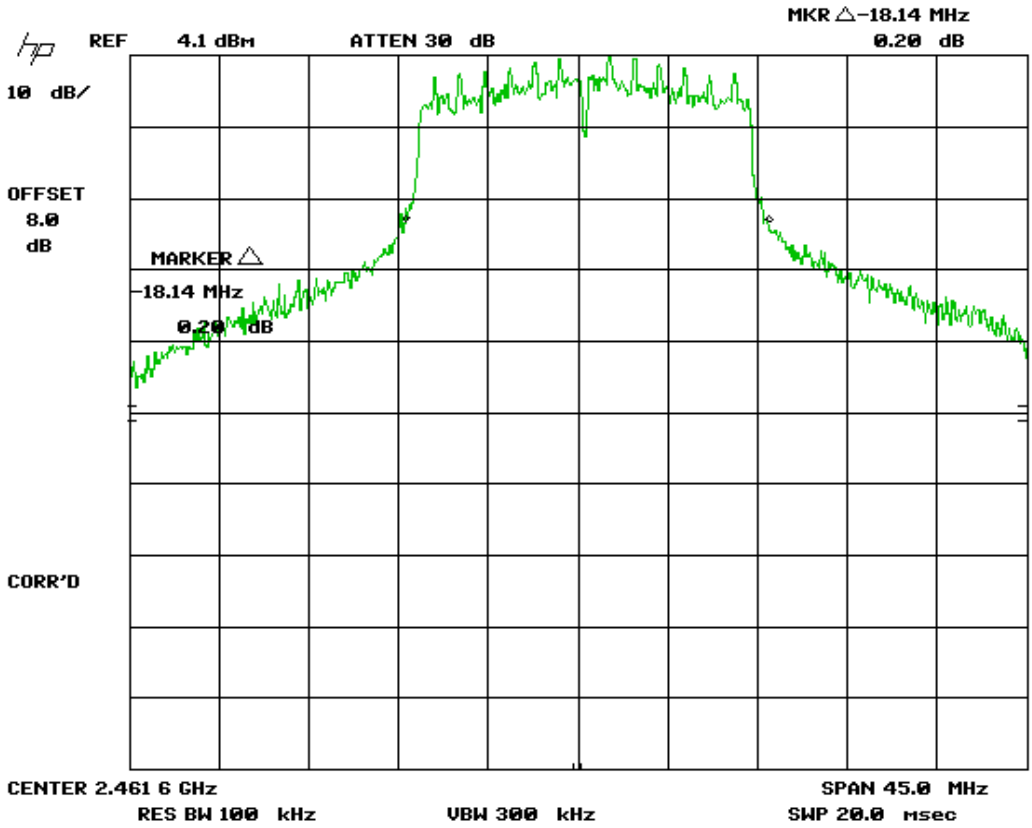
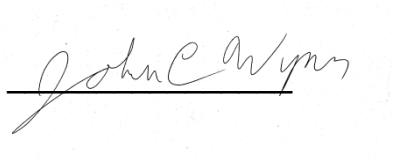


Figure 74. 802.11g - High Channel 99% Bandwidth

Table 24. 802.11n 20 dB Bandwidth and 99% Occupied Bandwidth

Frequency (MHz)	20 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2412.0	18.36	18.36
2436.0	18.90	18.90
2462.0	18.36	18.36

Test Date: December 19, 2011

Tested By
Signature:  Name: John C. Wynn

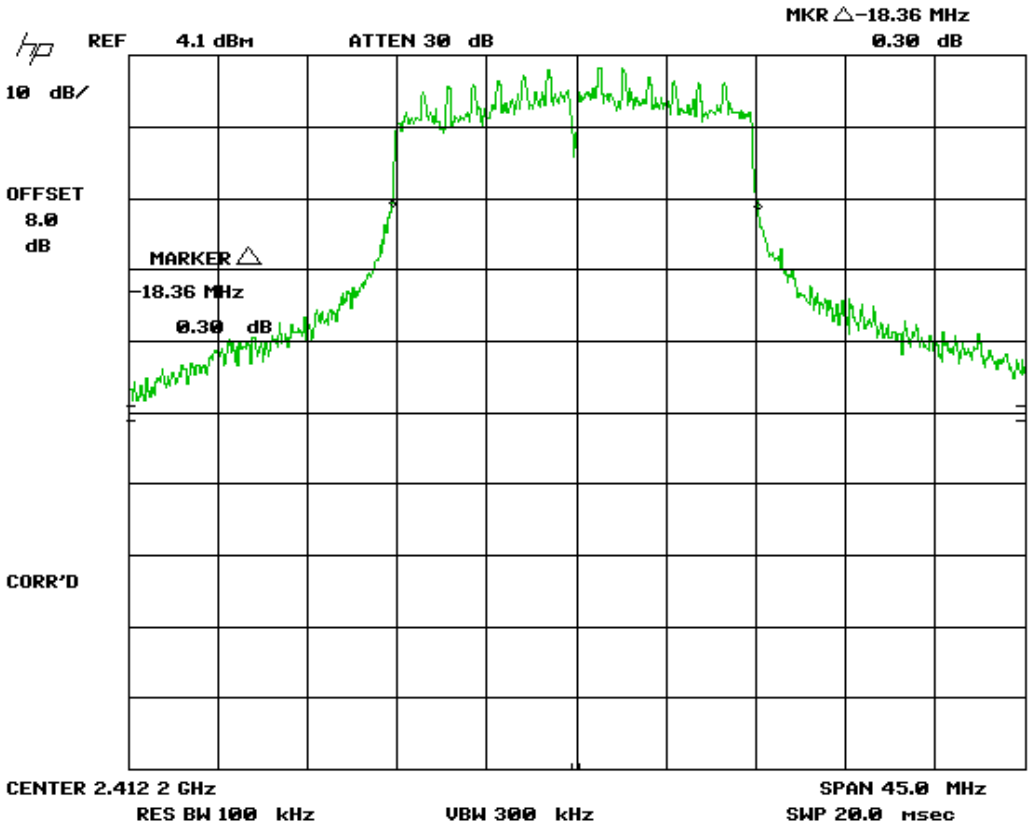


Figure 75. 802.11n - Low Channel 99% Bandwidth

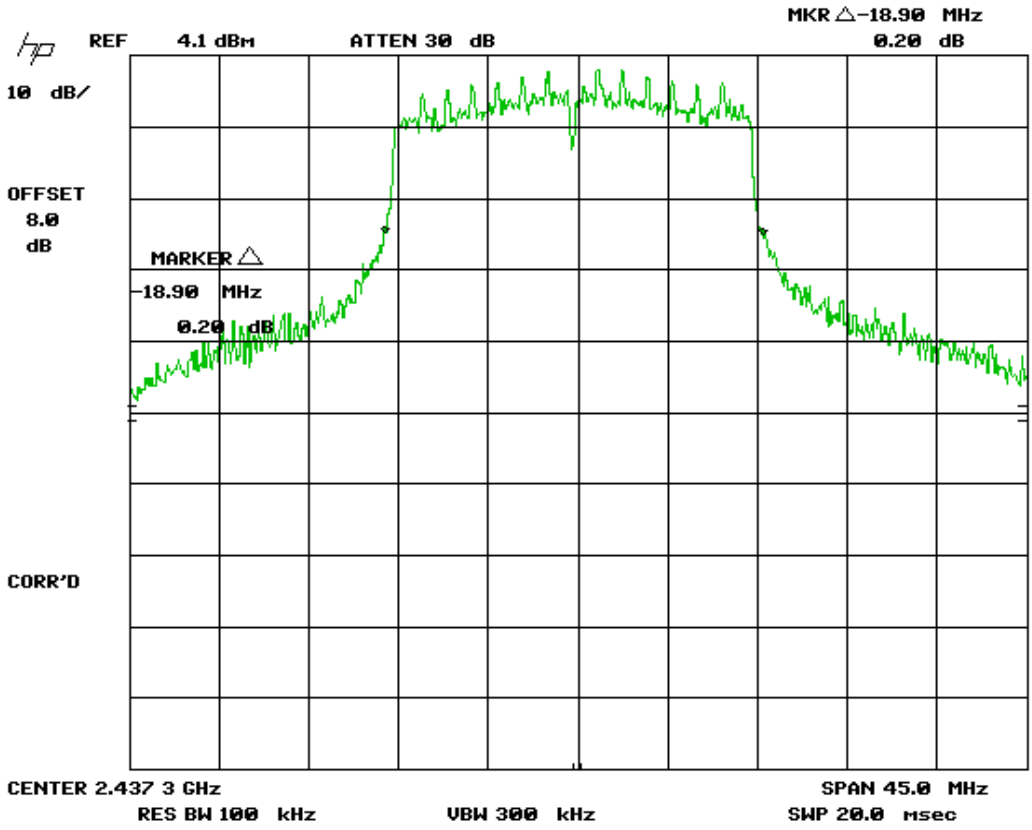


Figure 76. 802.11n - Mid Channel 99% Bandwidth

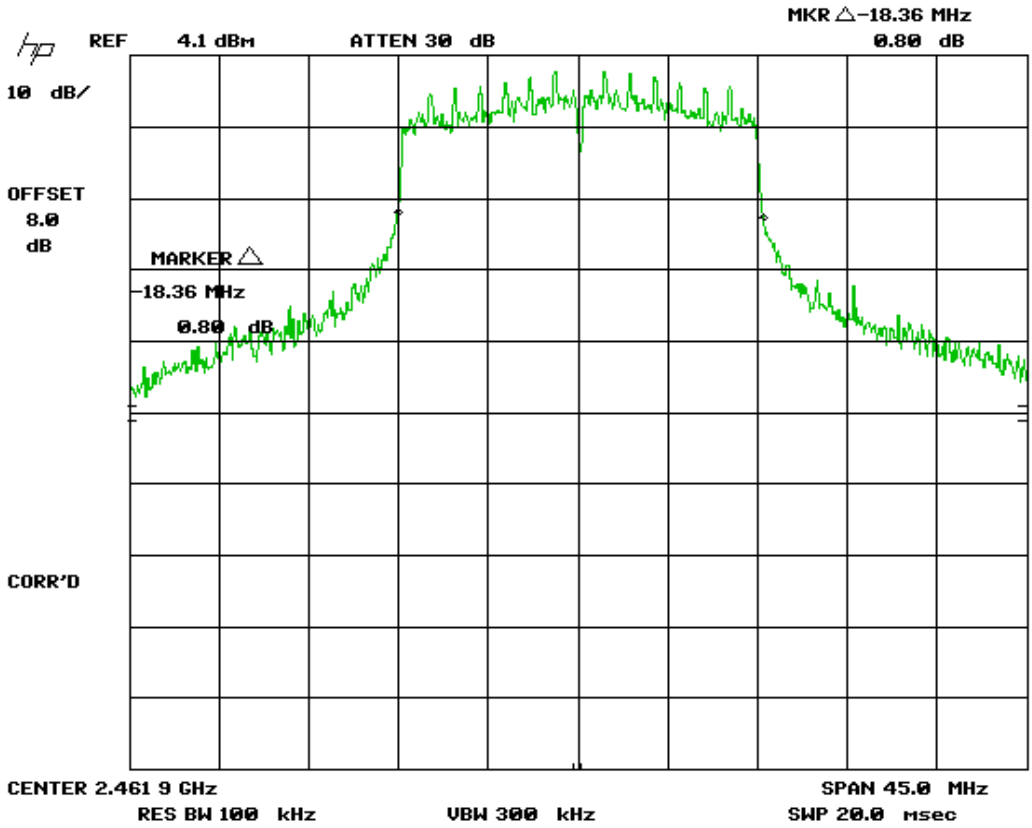


Figure 77. 802.11n - High Channel 99% Bandwidth

2.15 **Unintentional Radiator Power Lines Conducted Emissions (CFR 15.107)**

The test data provided herein is to support the Verification requirement for the digital apparatus. The power line conducted voltage measurements for Receiver and Digital Devices have been carried out in accordance with CFR 15.107 and ANSI C63.4, Paragraph 7, with a spectrum analyzer connected to an LISN and the EUT placed into an idle condition or a continuous mode of receive (non-transmitting). Please refer to the results as shown in Table 18 below.

The testing was done with the WiFi turned on to expedite the testing. This was considered the worst case scenario. The worst case emission are as follows: there were no signals within 4.5 dB of the average limits. Those results are given in the following Table.

2.16 Unintentional Radiator Power Lines Conducted Emissions (Cont'd)

Table 25. Power Line Conducted Emissions Data, Class B Part 15.107, Peak Measurement vs. Avg. Limits

CONDUCTED EMISSIONS 150 kHz to 30 MHz						
Tested By: SS	**Specification Requirement: FCC Part 15.207 Class B**		**Project No.: 11-0263**	**Manufacturer: Inventek Systems Model: ISM4319-E, ISM4319-U, ISM4319-C**		
Frequency (MHz)	**Test Data (dBuV)**	**LISN+CL-PA (dB)**	**Corrected Results (dBuV)**	**Avg Limits (dBuV)**	**Margin (dB)**	**Detector**
120 VAC, 60 Hz, Phase Line						
0.1968	54.50	0.39	54.89	63.7*	8.9	**QP**
0.1968	48.90	0.30	49.20	53.7	4.5	**AVG**
0.9570	40.50	0.10	40.60	46.0	5.4	**PK**
3.1840	36.30	0.10	36.40	46.0	9.6	**QP**
9.5400	42.40	0.10	42.50	50.0	7.5	**PK**
10.5200	40.50	0.10	40.60	50.0	9.4	**PK**
24.0100	39.10	0.30	39.40	50.0	10.6	**PK**
120 VAC, 60 Hz, Neutral Line						
0.1563	48.90	0.40	49.30	55.7	6.4	**QP**
0.5024	37.10	0.20	37.30	46.0	8.7	**PK**
1.0240	34.00	0.20	34.20	46.0	11.8	**PK**
6.1000	34.60	0.10	34.70	50.0	15.3	**PK**
10.3700	30.50	0.20	30.70	50.0	19.3	**PK**
23.9800	34.40	0.39	34.79	50.0	15.2	**PK**

(*)= quasi-peak limit used.
SAMPLE CALCULATIONS: At 0.1968 MHz = 54.5 + (0.39) = 54.89 dBuV
Margin = (63.7 – 54.89) = 8.9 dB

Test Date: December 01, 2011
Tested By
Signature: Sina Sobhaniyan Name: Sina Sobhaniyan

2.16 **Unintentional Radiator, Radiated Emissions (CFR 15.109, 15.209)**

The test data provided herein supports the verification requirement for digital devices. Radiated emissions coming from the EUT in a non-transmit state per 15.109 and radiated emissions coming for the EUT in a transmitting state per 15.209 were evaluated from 9 kHz to 25 GHz as detailed in ANSI C63.4, Paragraph 8 and per Part 15.33. The worst case is presented herein.

Measurements were made with the analyzer's resolution bandwidth set to:

RBW	Frequency Range
200 Hz	9kHz to 150 kHz
9 kHz	150 kHz to 30 MHz
120 kHz	30 MHz to 1 GHz
1 MHz	Above 1 GHz

The video bandwidth was set to three times the resolution bandwidth; 1 MHz RBW and 3 MHz VBW. The test data were maximized for magnitude by rotating the turn-table through 360 degrees and raising and lowering the receiving antenna between 1 to 4 meters in height as a part of the measurement procedure. All measured signals were at least 15.1 dB below the specification limit. The results are shown in Table 20 below.

For EUT with oscillator circuits that generate a frequency below 30 MHz, measurements were made with the analyzer's resolution bandwidth set to 9 KHz and a calibrated Loop Antenna was used. At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. O7P-ISM4319F1 the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade) (CFR15.31f(2)).

All emissions within the range of 9 kHz to 30 MHz were less than 20 dBm from the applicable limit. The test was conducted using a calibrated loop antenna on US Tech's OATS site at a distance of 3 meters.

Table 26 . Unintentional Radiator, Radiated Emissions.

Unintentional Radiator, Radiated Emissions							
Test By: SS	**Test: FCC Part 15.109, 15.209**			**Client: Inventek Systems**			
	Project: 11-0263 Class: B			**Model: ISM4319-E, ISM4319-U, ISM4319-C**			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance /**	**Margin (dB)**	**DETECTOR PK / QP**
Tested from 9 kHz to 25 GHz							
133.4990	46.30	-12.73	33.57	43.5	3m./HORZ	9.9	**PK**
168.0010	48.90	-11.61	37.29	43.5	3m./HORZ	6.2	**QP**
32.5180	51.00	-13.84	37.16	40.0	3m./VERT	2.8	**PK**
48.0040	51.90	-16.65	35.25	40.0	3m./VERT	4.8	**QP**
114.1450	53.00	-13.64	39.36	43.5	3m./VERT	4.1	**QP**
144.0210	52.00	-11.99	40.01	43.5	3m./VERT	3.5	**QP**
166.8620	49.80	-10.53	39.27	43.5	3m./VERT	4.2	**PK**
200.0870	48.40	-12.09	36.31	43.5	3m./HORZ	7.2	**PK**
264.0500	47.00	-9.42	37.58	46.0	3m./HORZ	8.4	**QP**
275.9000	48.30	-8.93	39.37	46.0	3m./HORZ	6.6	**PK**
400.2000	47.00	-7.25	39.75	46.0	3m./HORZ	6.3	**PK**
456.7500	46.40	-6.31	40.09	46.0	3m./HORZ	5.9	**PK**
479.9900	45.60	-5.87	39.73	46.0	3m./HORZ	6.3	**QP**
200.1000	51.70	-12.29	39.41	43.5	3m./VERT	4.1	**PK**
233.6900	50.60	-11.44	39.16	46.0	3m./VERT	6.8	**QP**
364.4950	49.90	-8.17	41.73	46.0	3m./VERT	4.3	**QP**
1893.0000	55.00	-6.62	48.38	54.0	3m./VERT	5.6	**PK**
1328.1000	56.10	-9.46	46.64	54.0	3m./HORT	7.4	**PK**
1858.8600	53.30	-6.68	46.62	54.0	3m./HORT	7.4	**PK**

No other emissions detected within 20 dB of the FCC Part 15.109 &15.209 limits
AF is antenna factor. CL is cable loss. PA is preamplifier gain
SAMPLE CALCULATION: At 133.499 MHz: = 46.3 + (-12.73) = 33.57 dBuV/m @ 3m
Margin = (43.5 – 33.57) = 9.9 dB

Test Date: December 01, 2011

Tested By Signature: Sina Sobhaniyan Name: Sina Sobhaniyan