



Radio Intentional EMC Test Report: EDCS - 1206158

For

CP-DX650

2.4GHz Radio

Against the following Specifications :

47 CFR 15.247

RSS-210

RSS-102

Cisco Systems

EMC Laboratory

170 West Tasman Drive

San Jose, CA 95134

Author: Phillip Carranco

Approved By: Dilip Patel

Title: Regulatory Compliance Manager

This report replaces any previously entered test report under EDCS - 1206158



This test report has been electronically authorized and archived using the CISCO Engineering Document Control system.

SECTION 1: OVERVIEW	3
TEST SUMMARY	3
2.3 REPORT ISSUE DATE	5
2.4 TESTING FACILITIES	5
2.6 EUT DESCRIPTION	6
2.7 SCOPE OF ASSESSMENT	6
2.8 UNITS OF MEASUREMENT	6
2.9 REPORT TEMPLATE CONTROL NO.	7
EDCS#: 703456	7
SECTION 3: RESULT SUMMARY	7
3.1 RESULTS SUMMARY TABLE	7
SECTION 4: SAMPLE DETAILS	8
4.1 SAMPLE DETAILS	8
4.2 SYSTEM DETAILS	8
4.3 MODE OF OPERATION DETAILS	8
SECTION 5: MODIFICATIONS	8
5.1 SAMPLE MODIFICATIONS PERFORMED DURING ASSESSMENT	8
APPENDIX A: FORMAL TEST RESULTS	9
6 DB BANDWIDTH	9
PEAK OUTPUT POWER	23
POWER SPECTRAL DENSITY	31
CONDUCTED SPURIOUS EMISSIONS	38
CONDUCTED BAND EDGE MEASUREMENTS	46
RADIATED SPURIOUS AND HARMONICS EMISSIONS	60
RADIATED RECEIVER SPURIOUS MEASUREMENTS	86
CO-LOCATOR RADIATED SPURIOUS EMISSIONS	88
APPENDIX B: ABBREVIATION KEY AND DEFINITIONS	102
APPENDIX C: TEST EQUIPMENT USED TO PERFORM THE TEST	103
APPENDIX D: TEST PROCEDURES	104



Section 1: Overview

Test Summary

The samples were assessed against the tests detailed in section 3 under the requirements of the following standards:

Emissions:

CFR47 Part 15.247

RSS-210

RSS102

Notes:

- 1) Measurements were made in accordance with ET docket 96-8, KDB Publication No. 558074& measurement method of spurious emission tolerance to the International Telecommunication Union (ITU) Recommendation SM329.



Section 2: Assessment Information

2.1 General

This report must not be used to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the federal Government.

With regard to this assessment, the following points should be noted:

- a) The results contained in this report relate only to the items tested and were obtained in the period between the date of the initial assessment and the date of issue of the report. Manufactured products will not necessarily give identical results, due to production tolerances and measurement uncertainties.
- b) The apparatus was set up and exercised using the configuration and modes of operation defined in this report only.
- c) Where relevant, the apparatus was only assessed using the susceptibility criteria defined in this report and the Test Assessment Plan (TAP).
- d) All testing was performed under the following environmental conditions:

Temperature	15°C to 35°C (54°F to 95°F)
Atmospheric Pressure	860mbar to 1060mbar (25.4" to 31.3")
Humidity	10% to 75*%
- e) All AC testing was performed at one or more of the following supply voltages:

110V (+/-10%) 60Hz
220V (+/-10%) 50 or 60Hz
- f) Cisco Systems, Inc. is accredited by the American Association for Laboratory Accreditation (A2LA). The scope of accreditation, certificate number 1178-01 is referenced in appendix C, along with further details.

This report must not be reproduced except in full, without written approval of Cisco Systems, Inc.



2.2 Start Date of Testing

15-Oct-2012

2.3 Report Issue Date

Cisco Systems, Inc. uses an electronic system to issue, store and control the revision of test reports. This system is called the Engineering Document Control System (EDCS). The actual report issue date is embedded into the original file on EDCS. Any copies of this report, either electronic or paper, that are not on EDCS must be considered uncontrolled

2.4 Testing facilities

This assessment was performed by:

Testing Laboratory

Cisco Systems, Inc.,
170 West Tasman Drive
San Jose, CA 95134,
USA

Registration Numbers for Industry Canada

Cisco System Site	Site Identifier
Building P, 10m Chamber	Company #: 4624-2
Building P, 5m Chamber	Company #: 4624-1
Building N, 5m Chamber	Company #: 6111
Building I, 5m Chamber	Company #: 6112

Test Engineers

Phillip Carranco

2.5 Equipment Assessed (EUT)

CP-DX650



2.6 EUT Description

The CP-DX650 is the next generation 1080p Video Endpoint with key expansion module support. This new generation of desktop phone incorporates an Android based operating system. Three USB ports, one micro OTG USB port, one higher powered USB-proprietary connector combination (AUX) and one standard USB Port. Support HDMI with a maximum external resolution of 1920 x 1200, also includes a single 3.5mm headset jack.

WiFi (802.11 A/B/G/N) & Bluetooth 3.0 capabilities.

Murata module, LBEH1ZNSXC-526, supports for 802.11/a/b/g/n + Bluetooth 3.0 module

SDIO interface to WLAN – Omap4 SD host controller port 5

PCM (McBSP1) interface to Bluetooth

WiFi + BT chip - Marvell 88W8787

Clocks – 38.4MHz 20ppm for main clock, 32.768KHz sleep clock

Supports 802.11i security standard

Coexistence between WiFi and BT with one antenna to both connected to the 2.4GHz radios

Single antenna for 2.4 and 5GHz bands with diplex inside the module

Up to 72Mbps (20 MHz channel)

2.7 Scope of Assessment

Tests have been performed in accordance with the relevant Test and Assessment Plan (TAP), a copy of which is contained in Appendix F of this report, and the relevant Cisco Systems, Inc. radio test procedures (EDCS-420238). This test report may not cover all of the tests highlighted in the test plan.

2.8 Units of Measurement

The units of measurements defined in the appendices are reported in specific terms, which are test dependent. Where radiated measurements are concerned these are defined at a particular distance. Basic voltage measurements are defined in units of [dBuV]

As an example, the basic calculation for all measurements is as follows:

$$\text{Emission level [dBuV]} = \text{Indicated voltage level [dBuV]} + \text{Cable Loss [dB]} + \text{Other correction factors [dB]}$$

The combinations of correction factors are dependent upon the exact test configurations [see test equipment lists for further details] and may include:-

Antenna Factors, Pre Amplifier Gain, LISN Loss, Pulse Limiter Loss and Filter Insertion Loss..

Note: to convert the results from dBuV/m to uV/m use the following formula:-

$$\text{Level in uV/m} = \text{Common Antilogarithm} [(X \text{ dBuV/m})/20] = Y \text{ uV/m}$$



2.9 Report Template Control No.

EDCS#: 703456

Section 3: Result Summary

3.1 Results Summary Table

Conducted emissions

Basic Standard	Test Details / Comments	Result
Power Spectral Density	15.247: For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. (RSS-210 A8.2)	Pass
Peak Output Power	15.247: The maximum conducted output power of the intentional radiator for systems using digital modulation in the 2400-2483.5MHz band shall not exceed 1 Watt (30dBm). If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. (RSS-210 A8.4)	Pass
6dB Bandwidth	15.247: Systems using digital modulation techniques may operate in the 5725-5850MHz band. The minimum 6 dB bandwidth shall be at least 500 kHz. (RSS-210 A8.2)	Pass
Conducted Spurious Emissions	15.247: In any 100 kHz bandwidth outside the frequency band in which the digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. (RSS-210 A8.5)	Pass

Radiated emissions

Basic Standard	Test Details / Comments	Result
Radiated Spurious and Harmonic Emissions	Radiated emissions which fall in the restricted bands, as defined in Sec. 15.205(a), must also comply with the radiated emission limits specified in Sec. 15.209(a). (RSS-210 Sec2.7)	Pass
Restricted Bandedge Measurements	Radiated emissions which fall in the restricted bands, as defined in Sec. 15.205(a), must also comply with the radiated emission limits specified in Sec. 15.209(a). (RSS-210 Sec2.7)	Pass

* SAR measurements to reported in separate report



Section 4: Sample Details

Note: Each sample was evaluated to ensure that its condition was suitable to be used as a test sample prior to the commencement of testing. During preliminary testing all three planes (X, Y & Z) were evaluated to determine "Worst Case". The data collected determine that the orientation used for this report was demined "Worst Case".

4.1 Sample Details

Sample Number	Equipment Details	Serial Number	Part Number
S01	CP-DX650	FCH1627A5AU	73-15144-01

The following antennas were evaluated as part of this testing process. The antennas listed reflect the maximum gain allowed for each family type of antenna:

Fixed internal Amphenol Dual Band Antenna, Gain = 4.3dBi (no external antenna can be used.)

4.2 System Details

System #	Description	Samples
1	Radio Test Sample	S01

4.3 Mode of Operation Details

Mode#	Description	Comments
1	802.11B/G/N Test Mode	System is placed in a continuous Tx State at a Low, Middle, High Channel per Test Requirements. 802.11B running at 1Mbps while 802.11G running at 6Mbps, HT20 at 6.5Mbps & HT40 at 13.5Mbps

Section 5: Modifications

5.1 Sample Modifications Performed During Assessment

No modifications were performed during assessment.

Appendix A: Formal Test Results

6 dB Bandwidth

15.247 & RSS-210 A8.2:

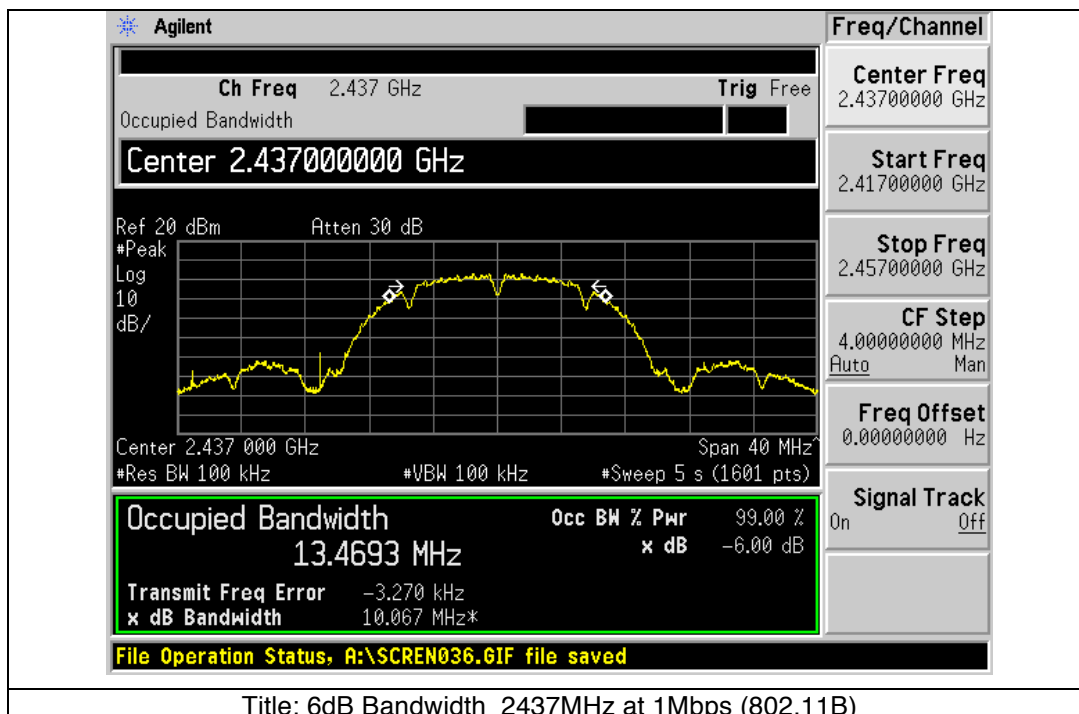
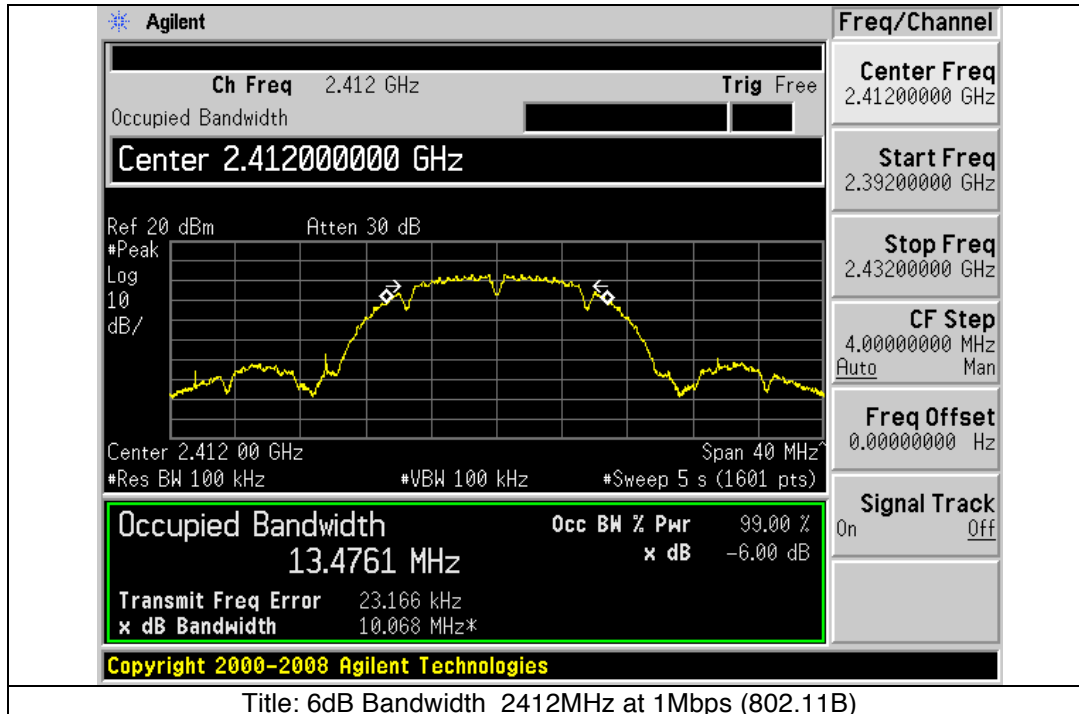
Systems using digital modulation techniques may operate in the 2400-2483.5MHz band. The minimum 6 dB bandwidth shall be at least 500 kHz

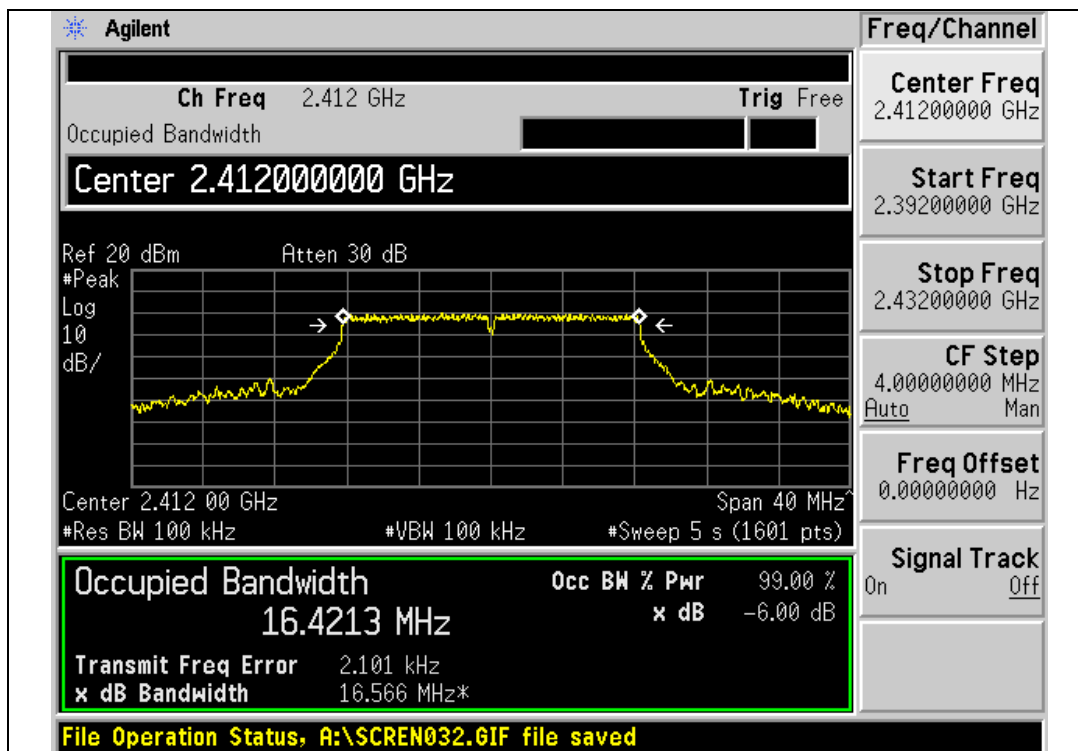
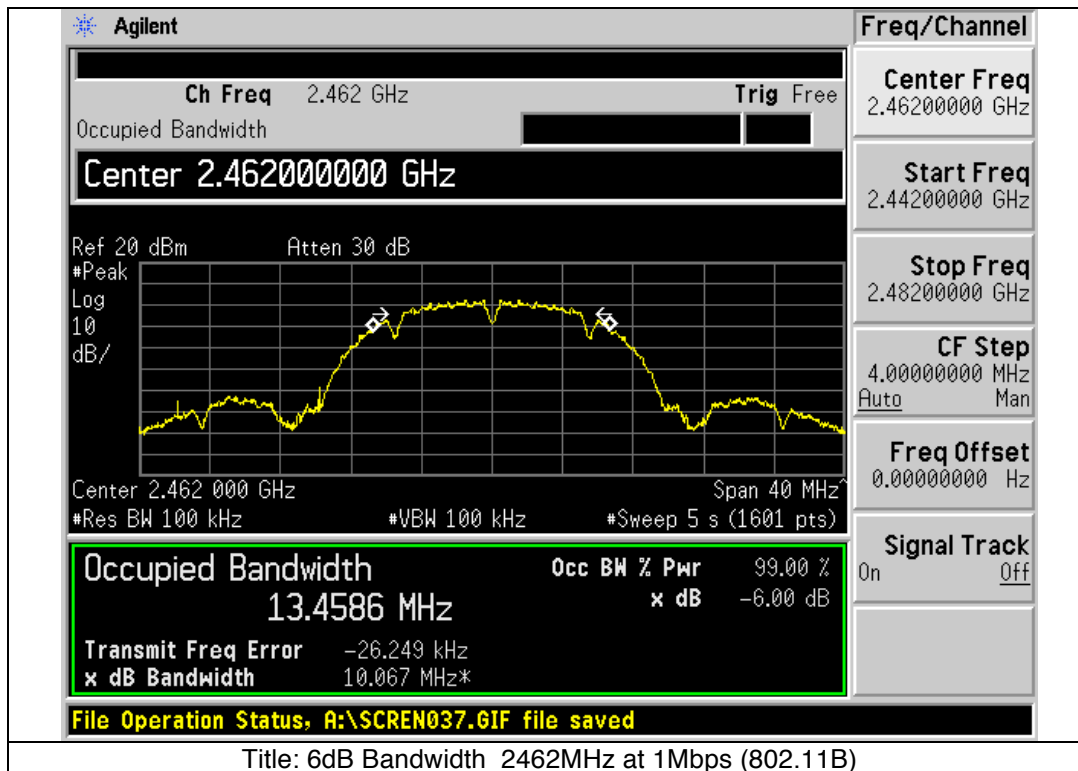
Frequency (MHz)	Data Rate (Mbps)	6dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)
2412	1	10068	500	-9568
2437	1	10067	500	-9567
2462	1	10067	500	-9567
2412	6	16566	500	-16066
2437	6	16530	500	-16030
2462	6	16567	500	-16067
2412	6.5	17817	500	-17317
2437	6.5	17810	500	-17310
2462	6.5	17804	500	-17304
2422	13.5	36543	500	-36043
2437	13.5	36556	500	-36056
2452	13.5	36575	500	-36075

Frequency (MHz)	Data Rate (Mbps)	99% Bandwidth (kHz)
2412	1	13476.1
2437	1	13469.3
2462	1	13458.6
2412	6	16423.1
2437	6	16430.2
2462	6	16429.4
2412	6.5	17655.4
2437	6.5	17651.4
2462	6.5	17642.5
2422	13.5	36195
2437	13.5	36196.3
2452	13.5	36194.4



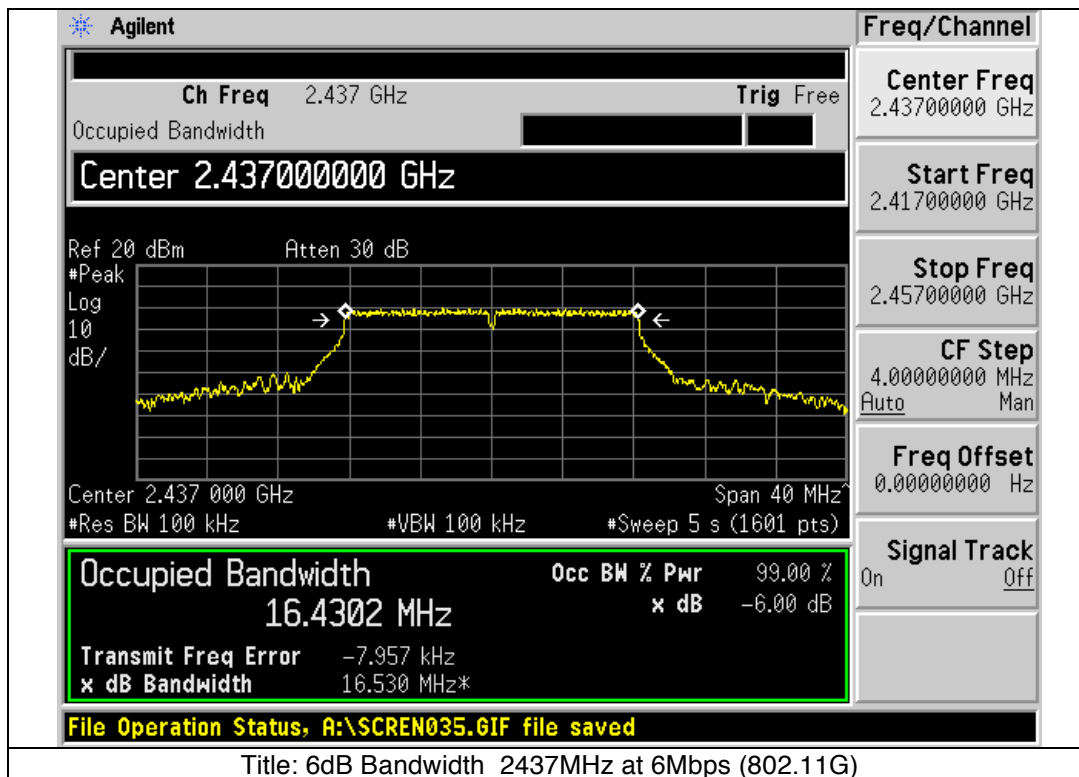
Graphical Test Results for 15.247 (6dB Bandwidth)

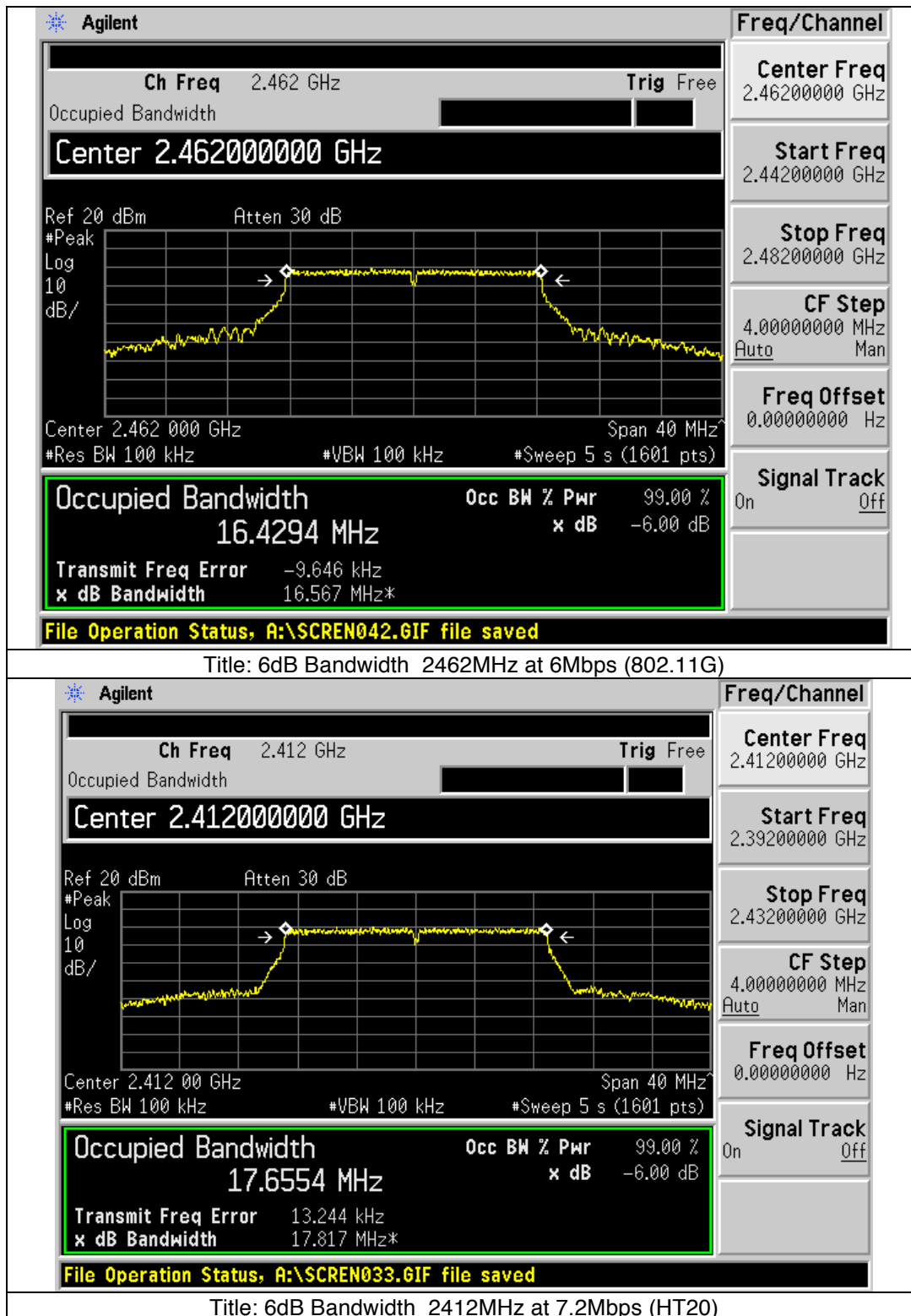


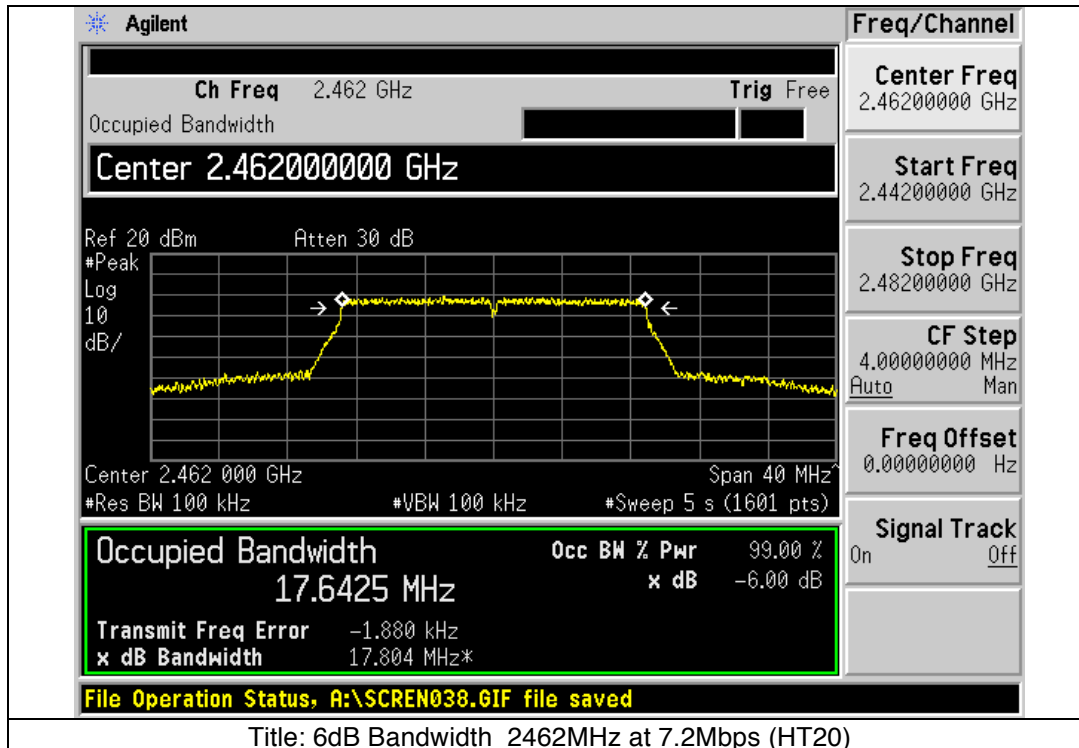
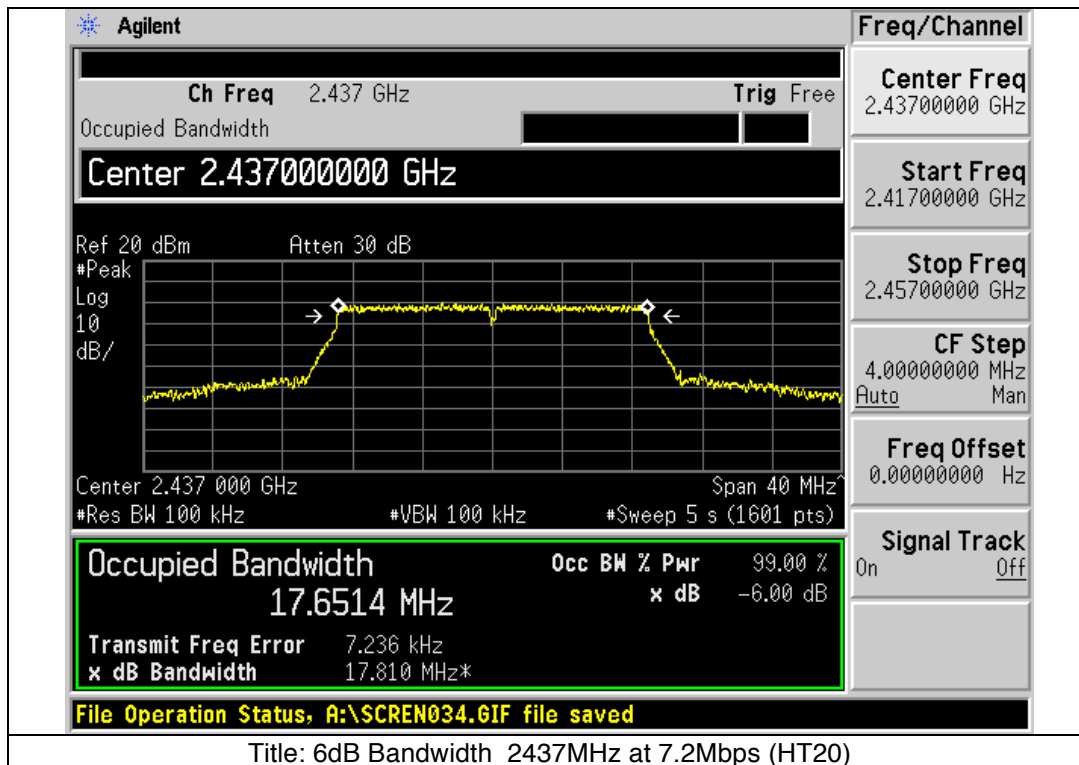


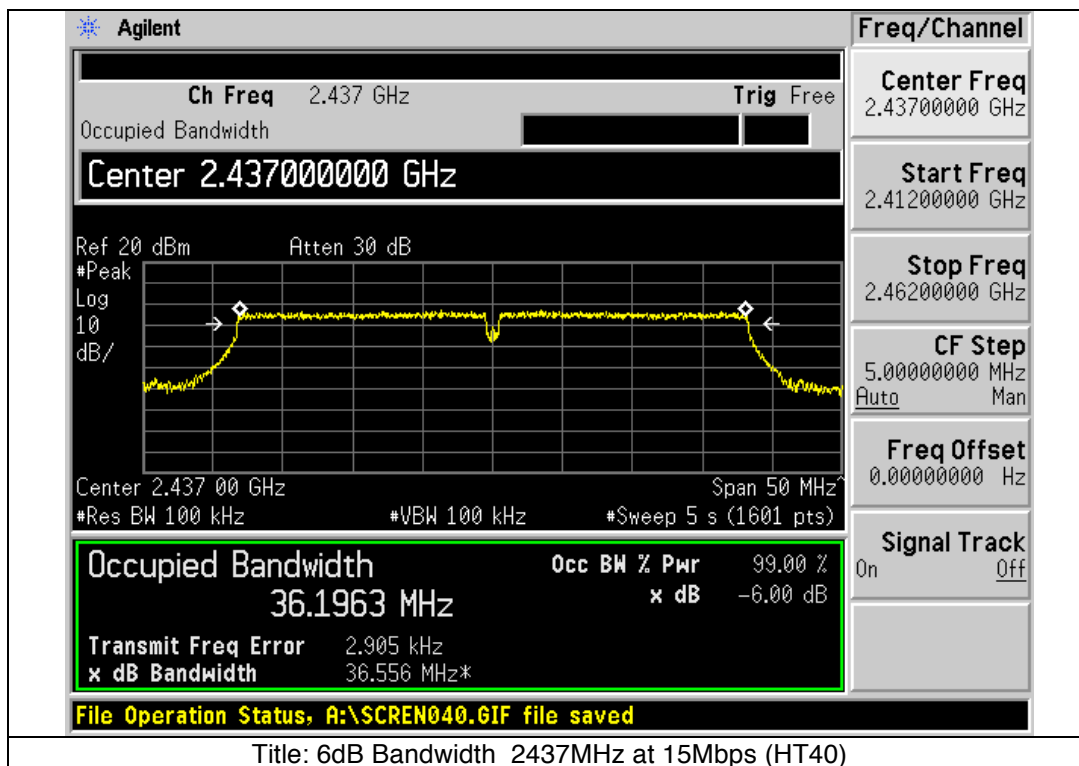
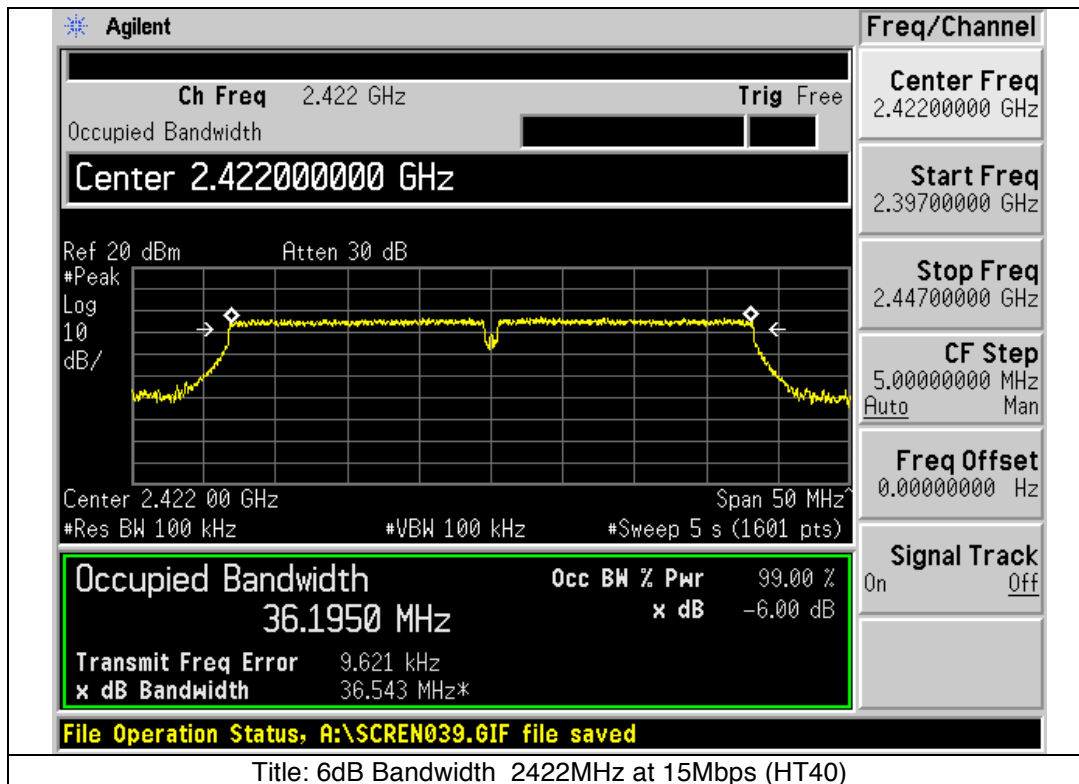


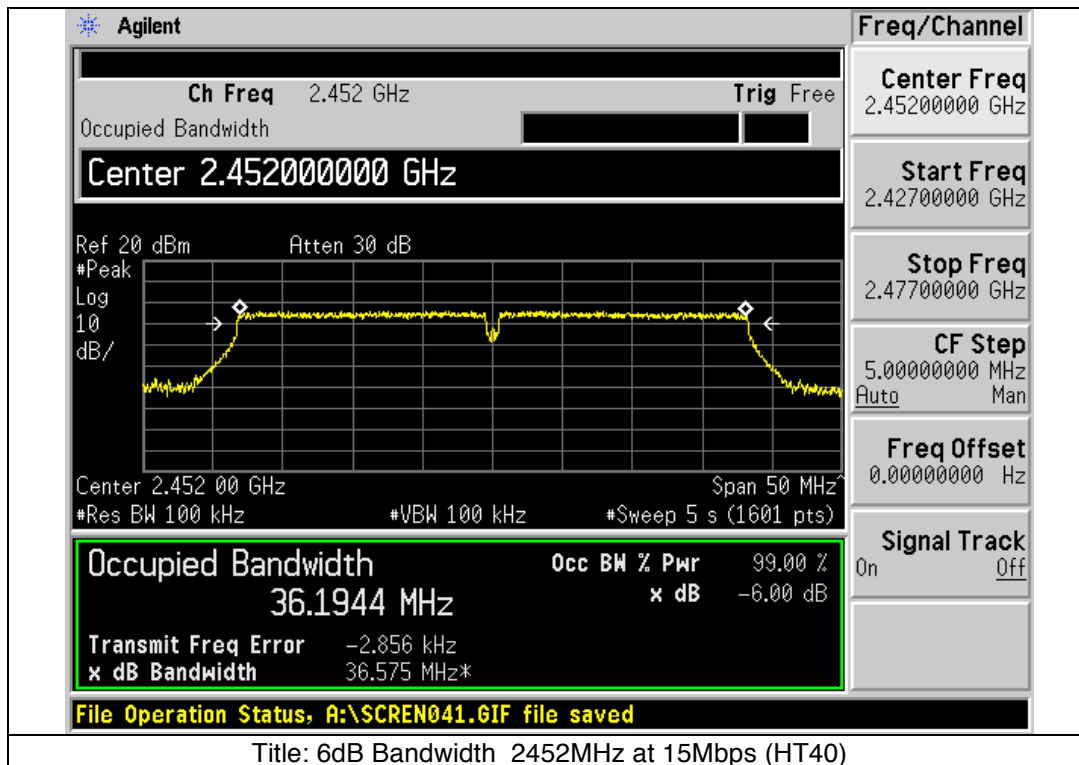
Title: 6dB Bandwidth 2412MHz at 6Mbps (802.11G)



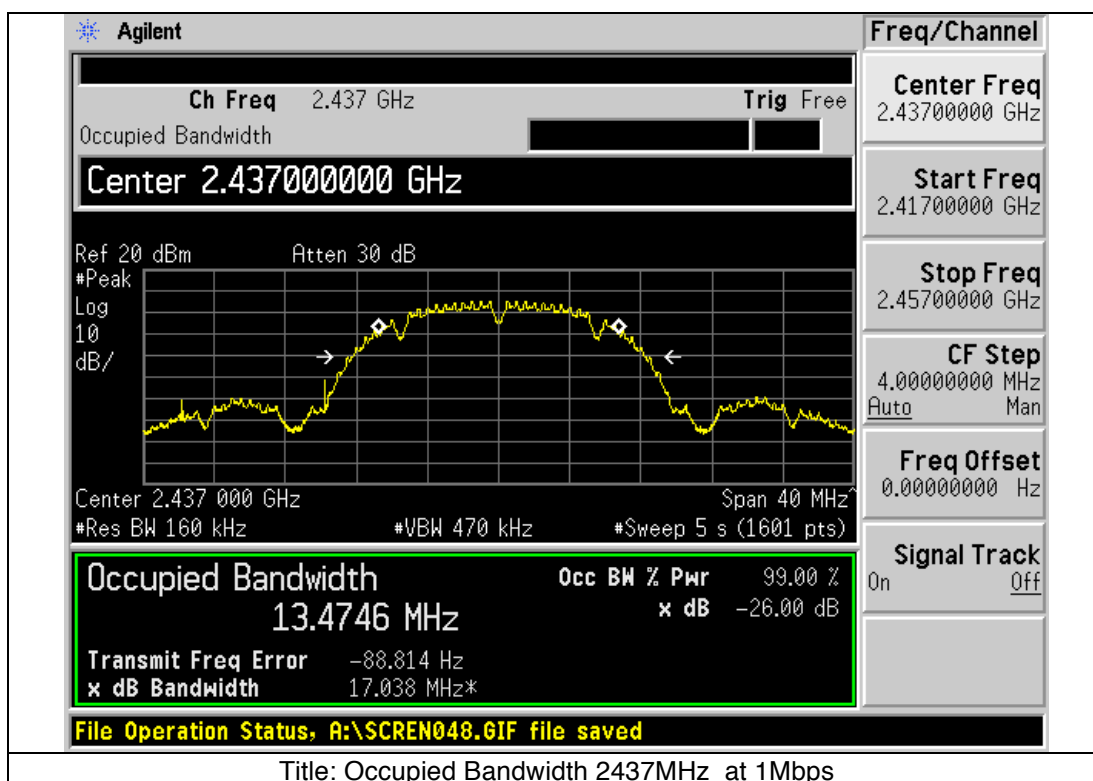
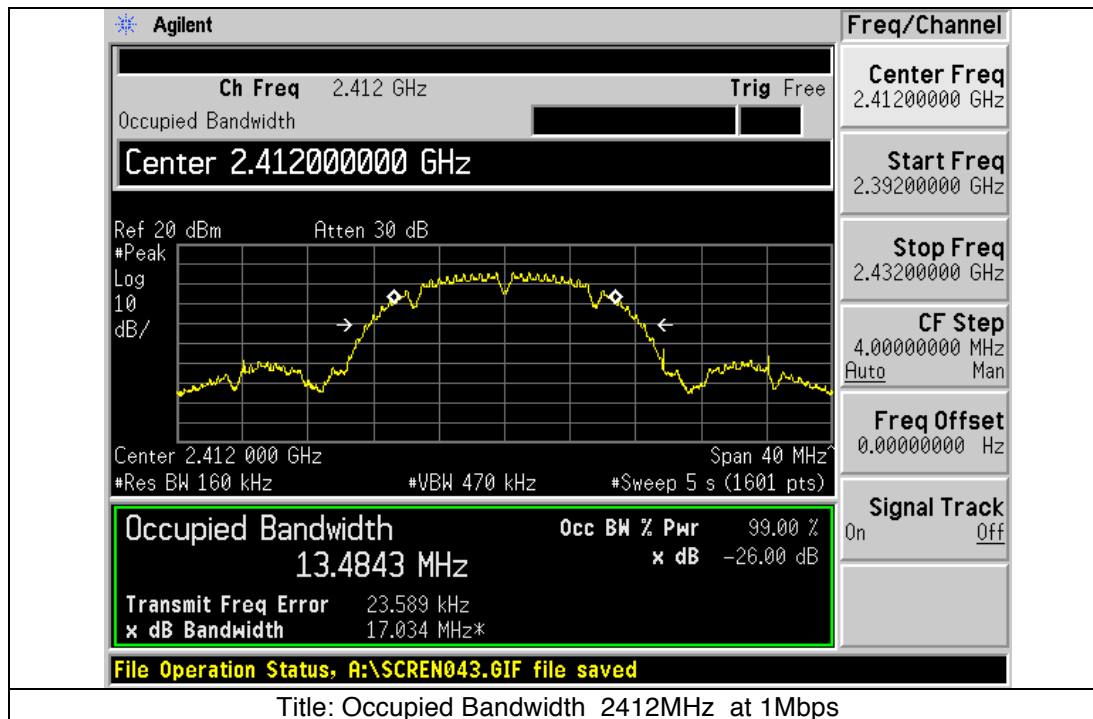


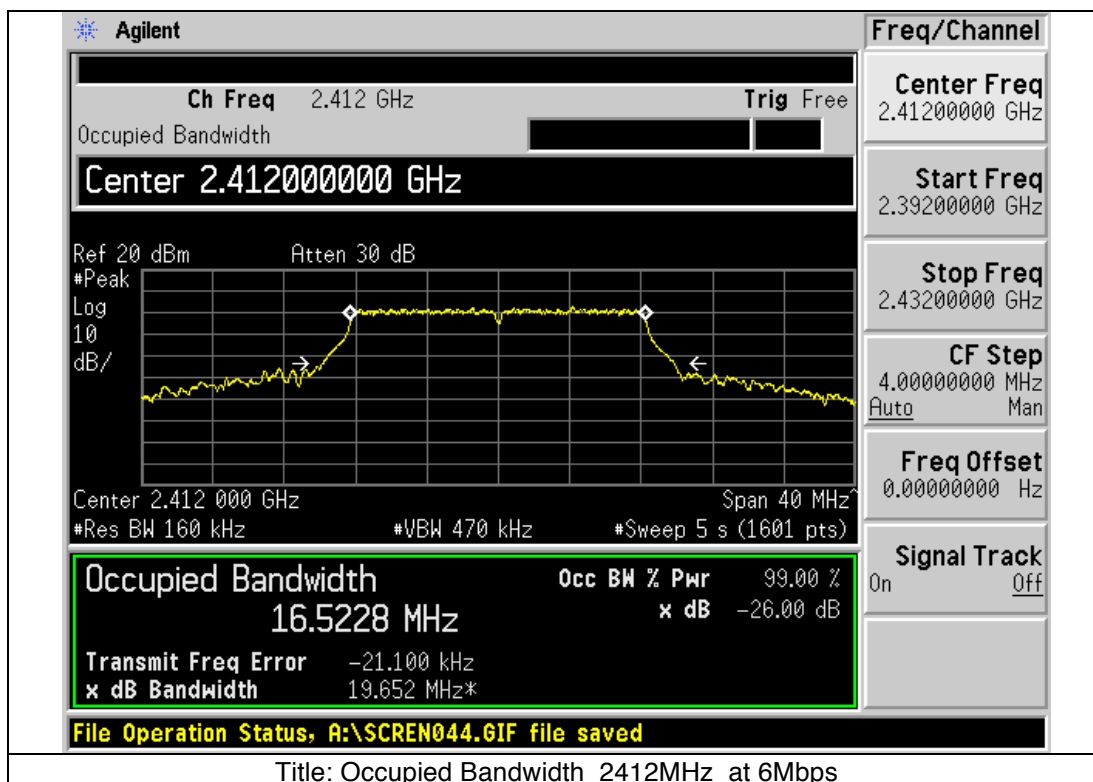
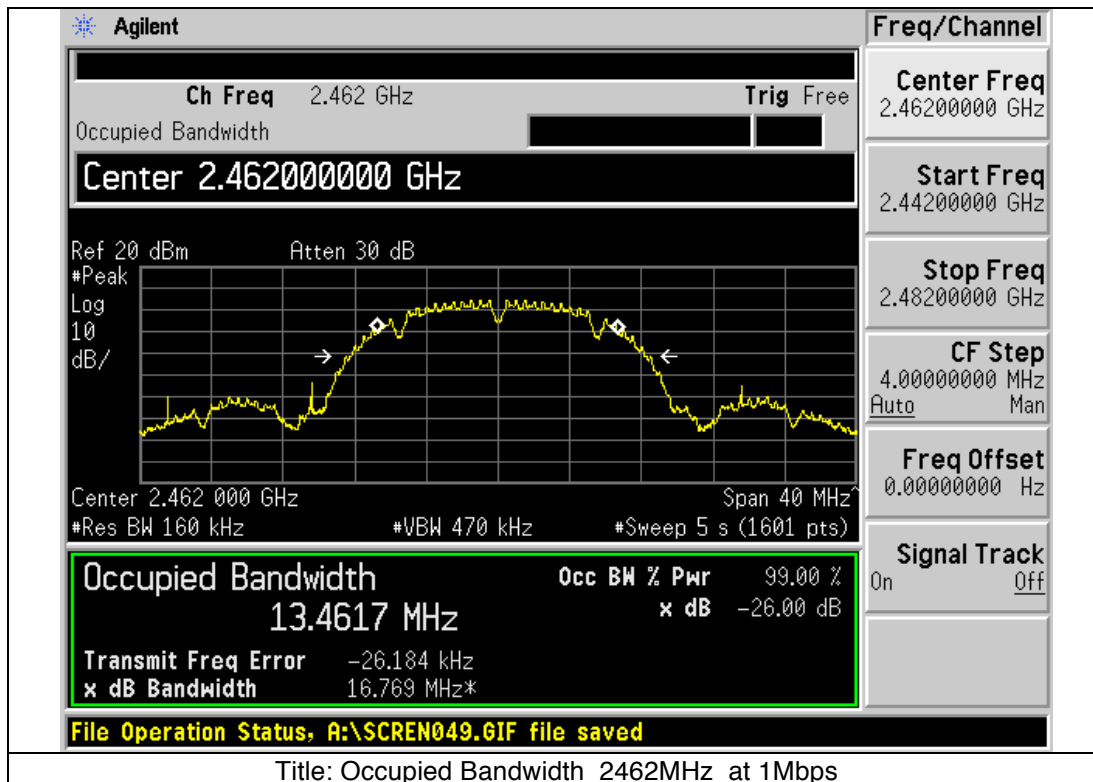


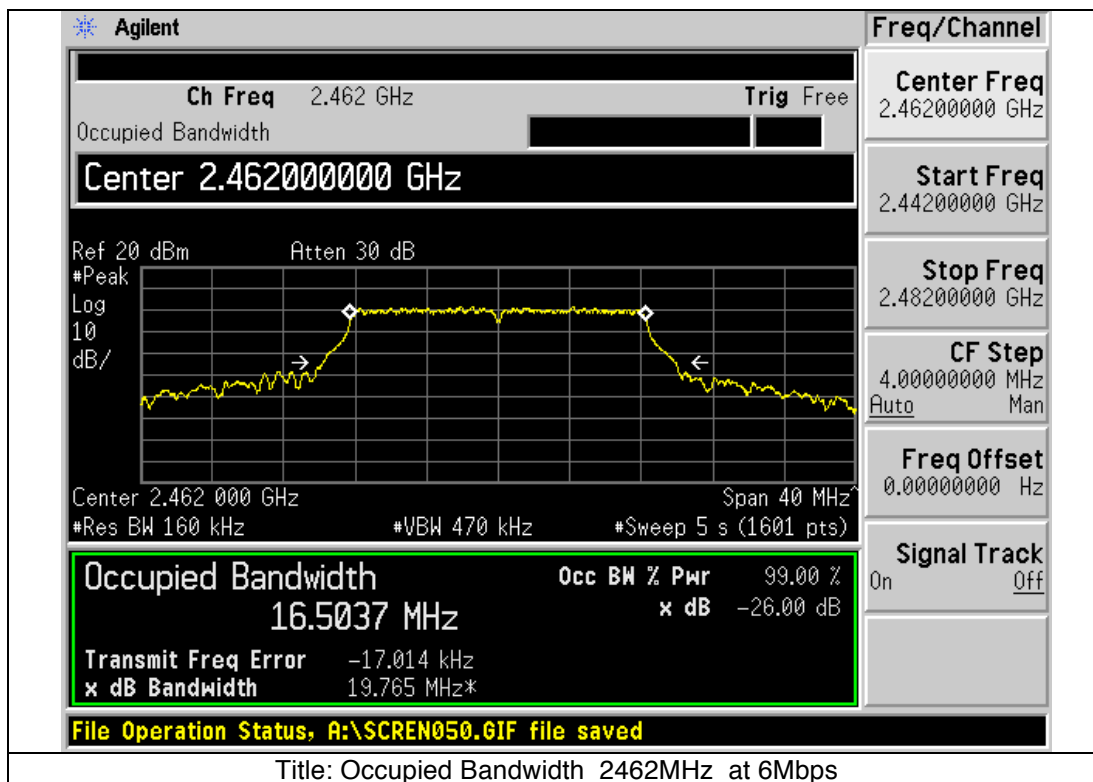
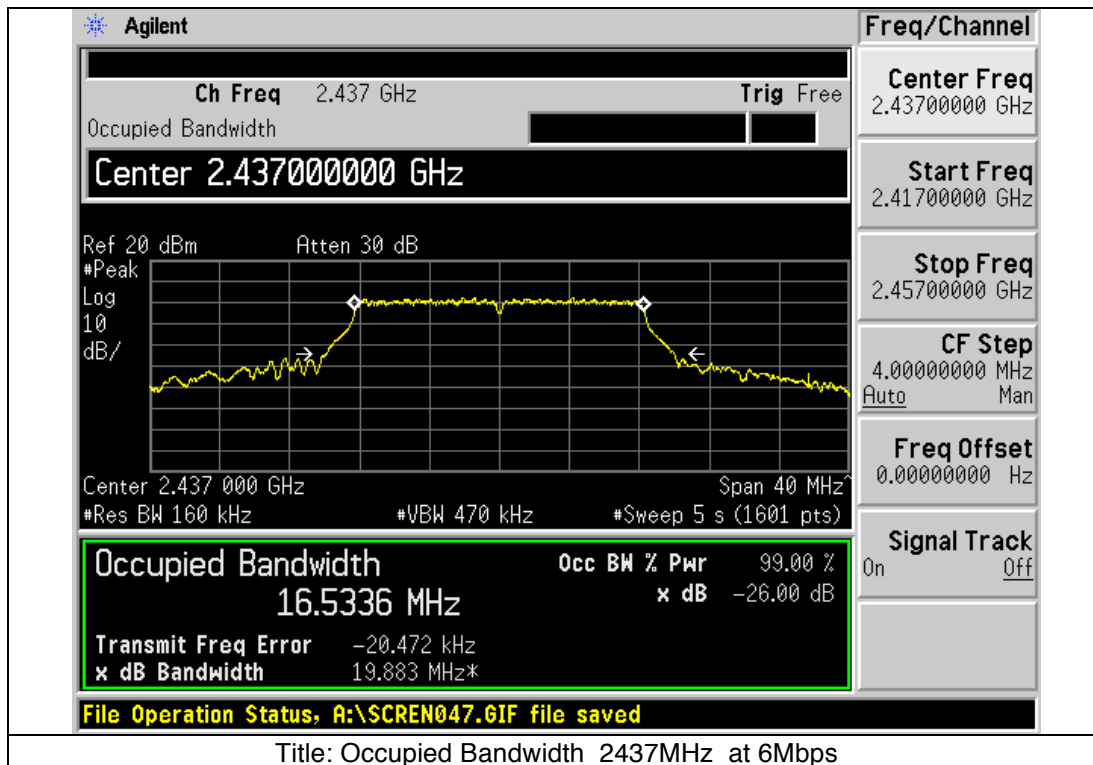


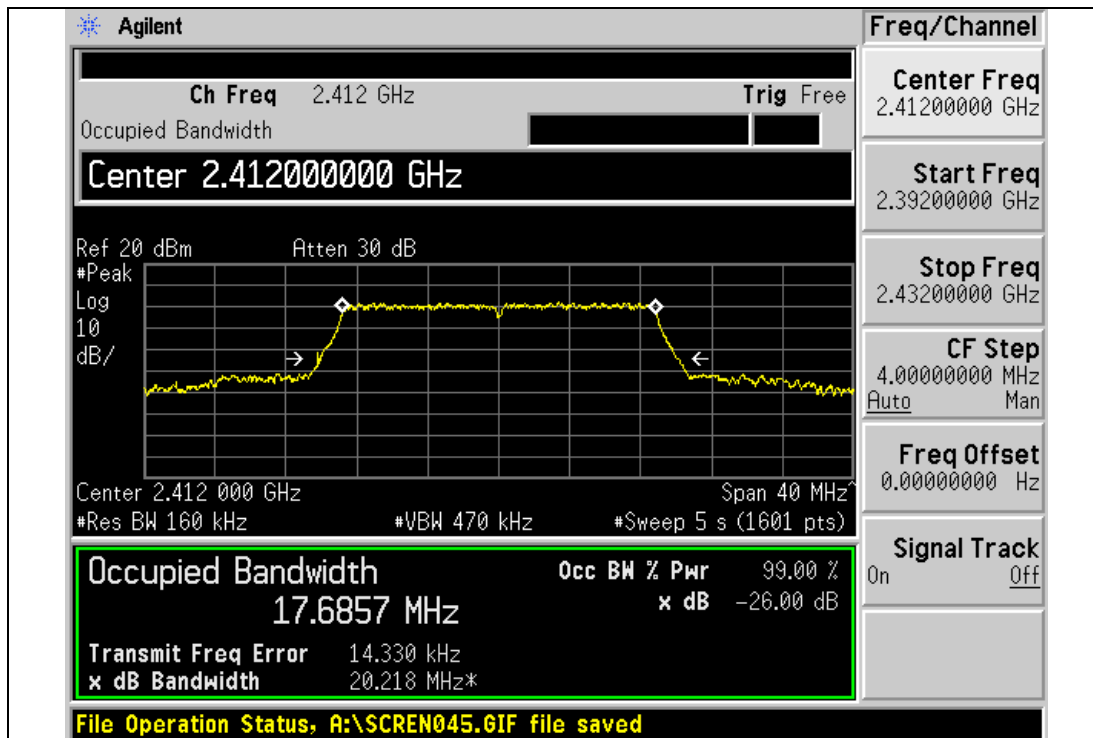


Graphical Test Results RSS210 (Occupied Bandwidth)

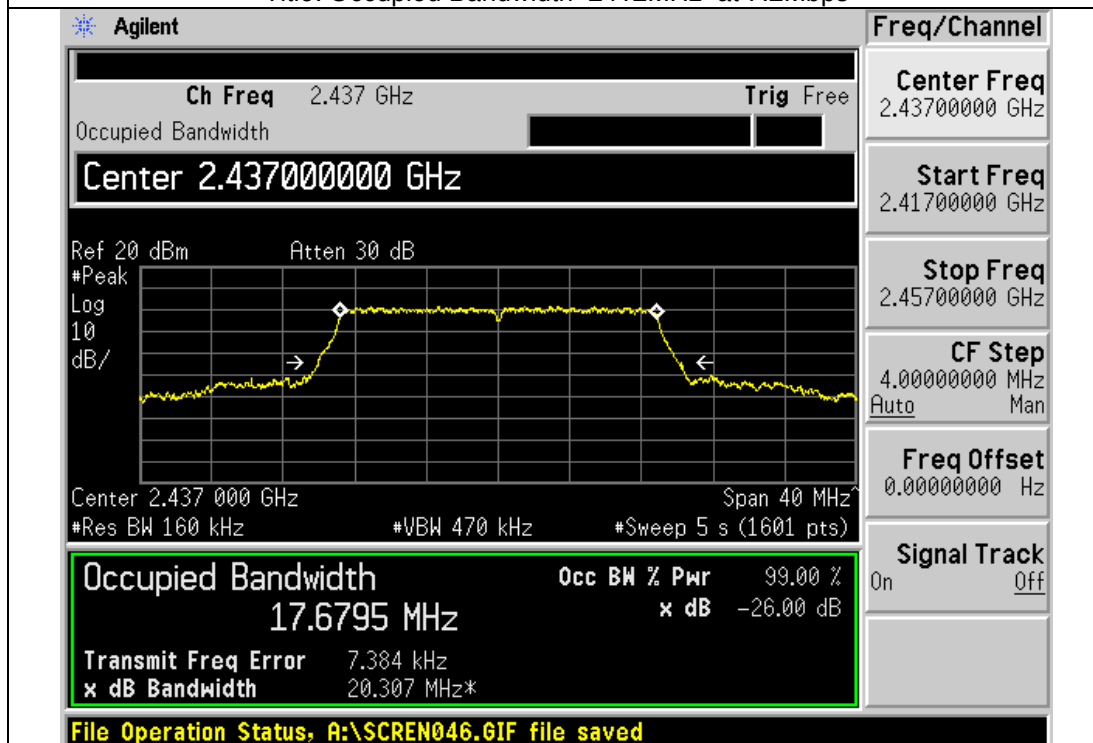




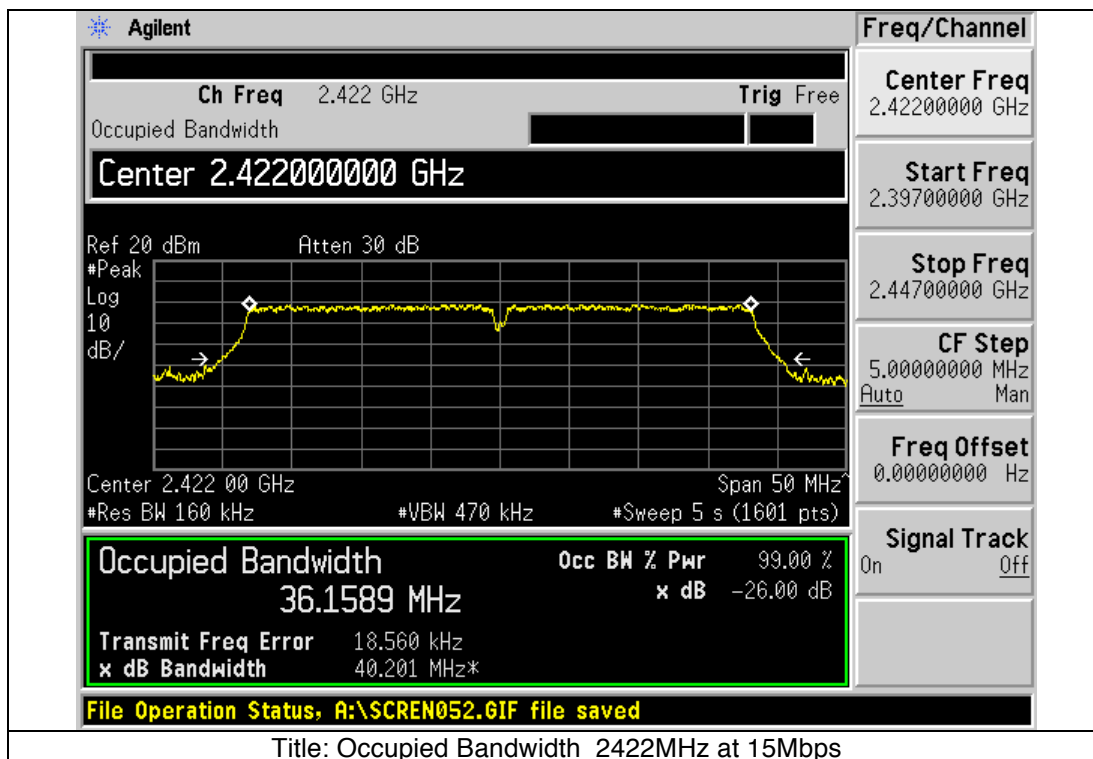
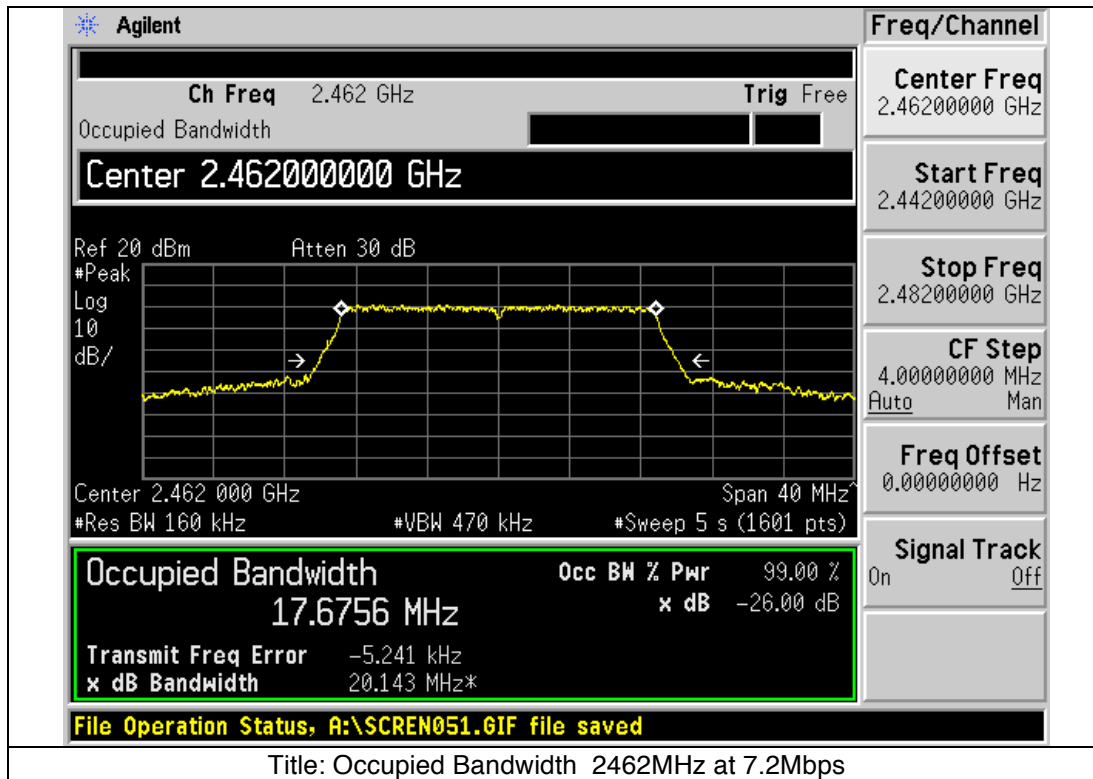


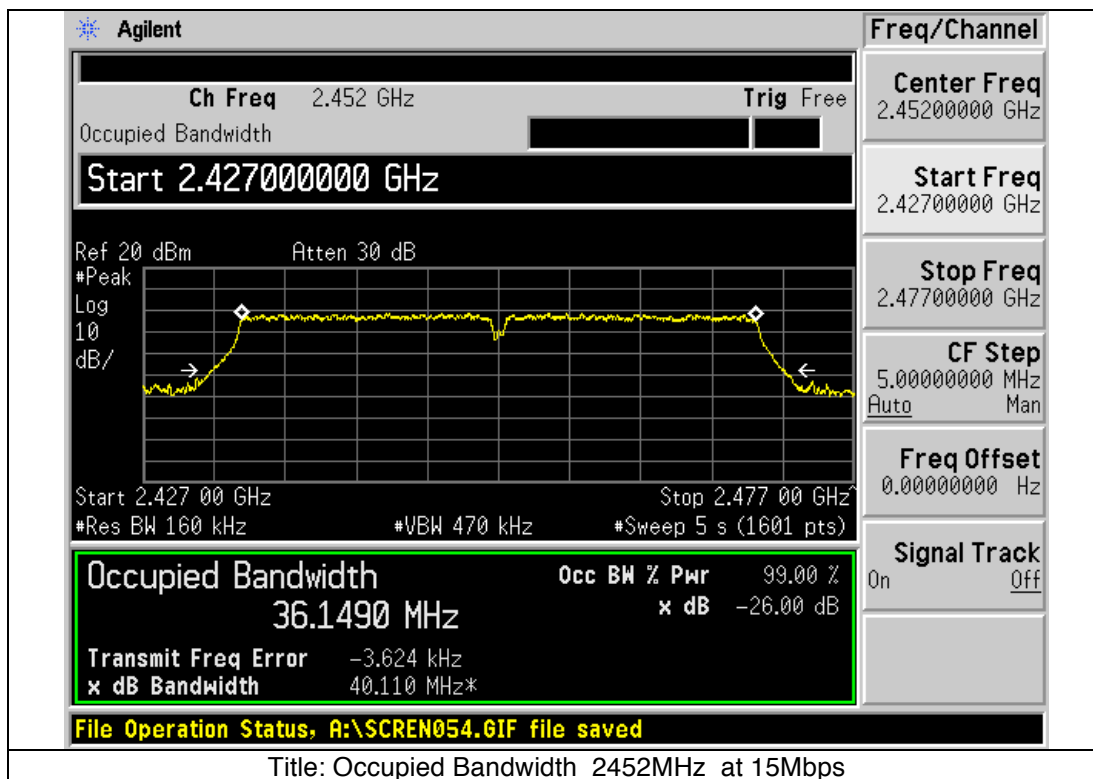
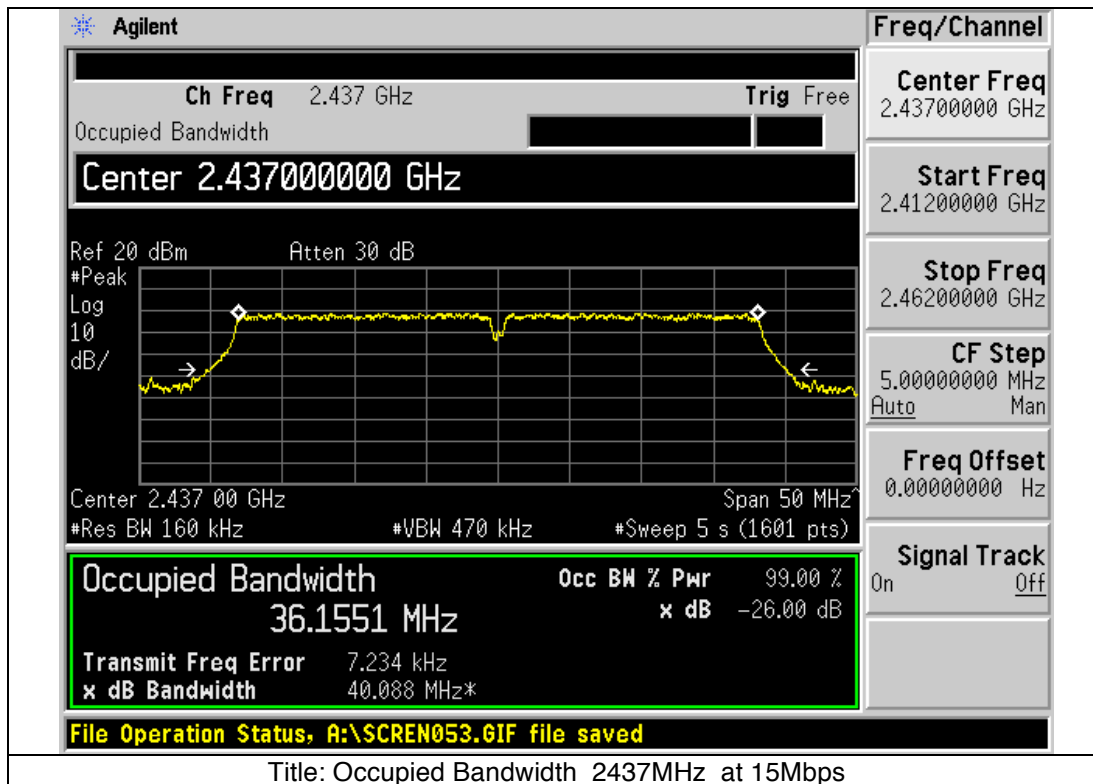


Title: Occupied Bandwidth 2412MHz at 7.2Mbps



Title: Occupied Bandwidth 2437MHz at 7.2Mbps







Peak Output Power

15.247 & RSS-210 A8.4:

The maximum conducted output power of the intentional radiator for systems using digital modulation in the 2400-2483.5MHz band shall not exceed 1 Watt (30dBm). If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum supported antenna gain is 4.3dBi. The peak correlated gain for each mode is listed in the table below. See the Theory of Operation for details on the correlated gain for each mode.

Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode. Configure the spectrum analyzer as shown below.

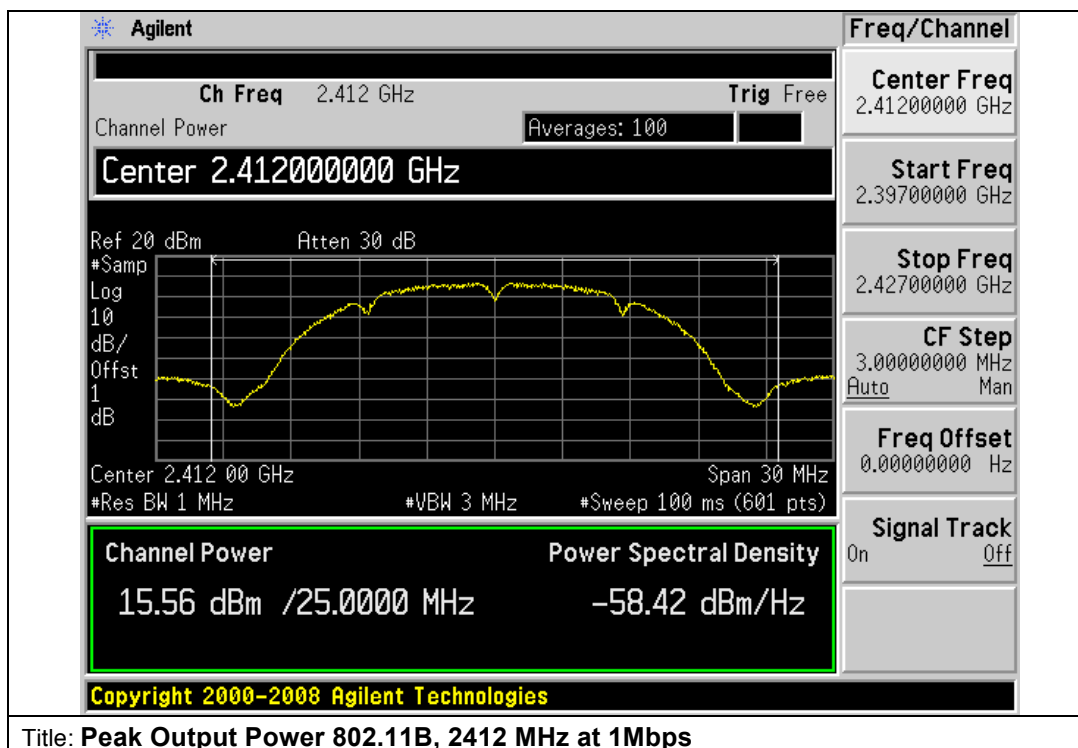
Enable "Channel Power" function of analyzer	
Center Frequency:	Frequency from table below
Span:	20 MHz (must be greater than 26dB bandwidth, adjust as necessary)
Ref Level Offset:	Correct for attenuator and cable loss.
Reference Level:	20 dBm
Attenuation:	20 dB
Sweep Time:	100ms, Single sweep
Resolution Bandwidth:	1 MHz
Video Bandwidth:	3 MHz
Detector:	Sample
Trace:	Trace Average 100 traces in Power Averaging Mode
Integration BW:	=26 dB BW from 26 dB Bandwidth Data

After averaging 100 traces of the transmitter waveform on the spectrum analyzer, record the spectrum analyzer Channel Power.

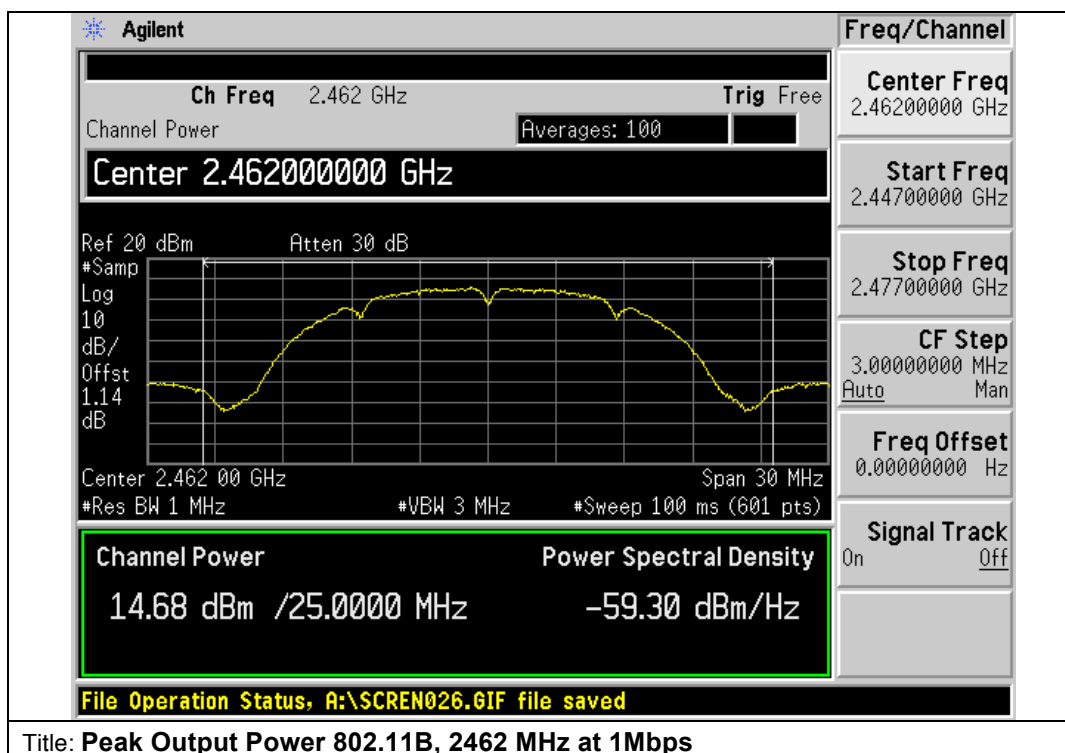
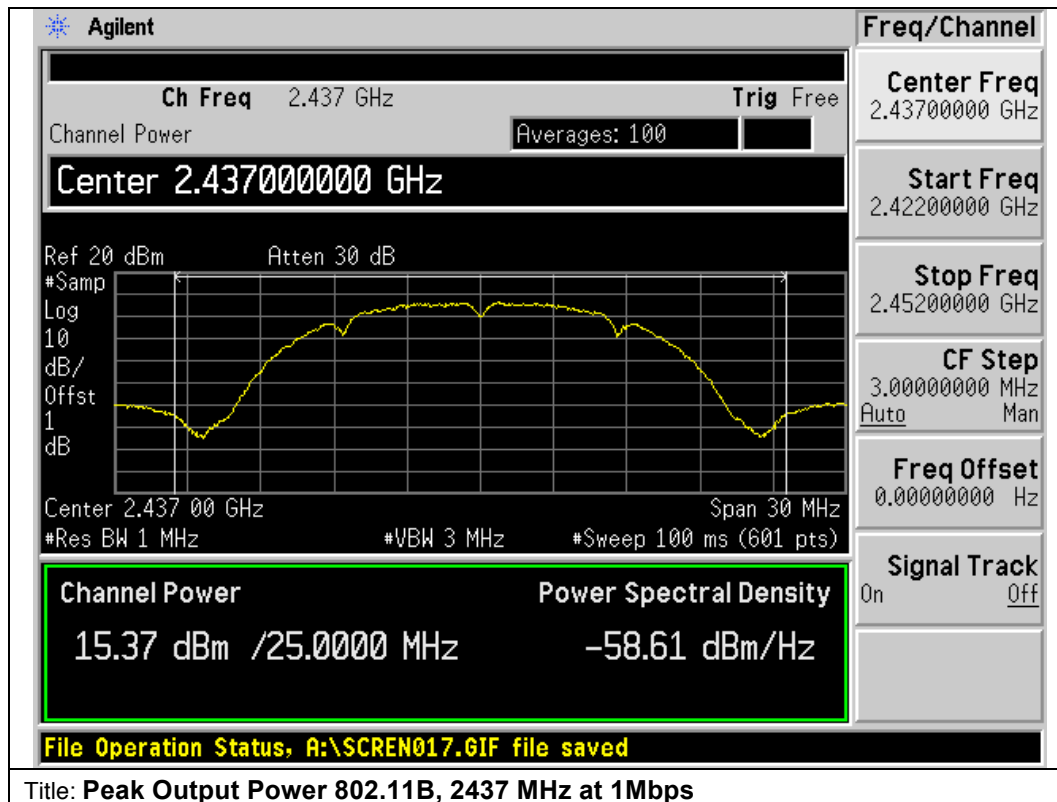
The "measure-and-sum technique" is used for measuring in-band transmit power of a device. In the measure-and-sum approach, the conducted emission level is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in linear power units.

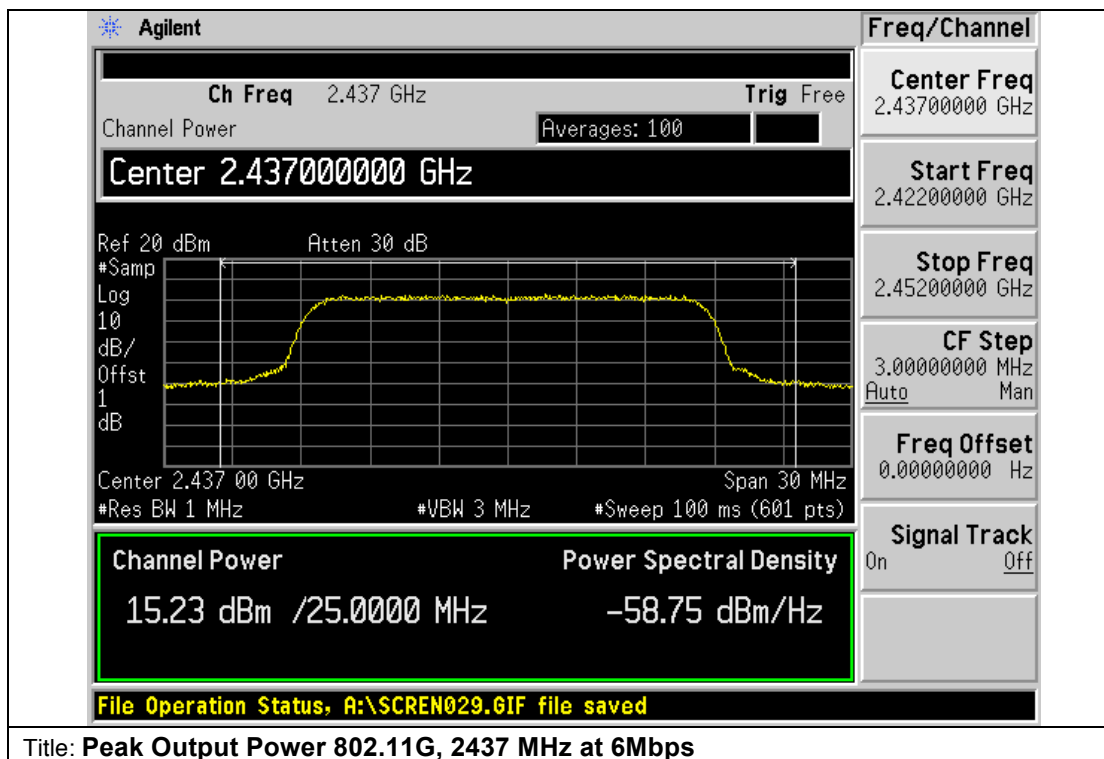
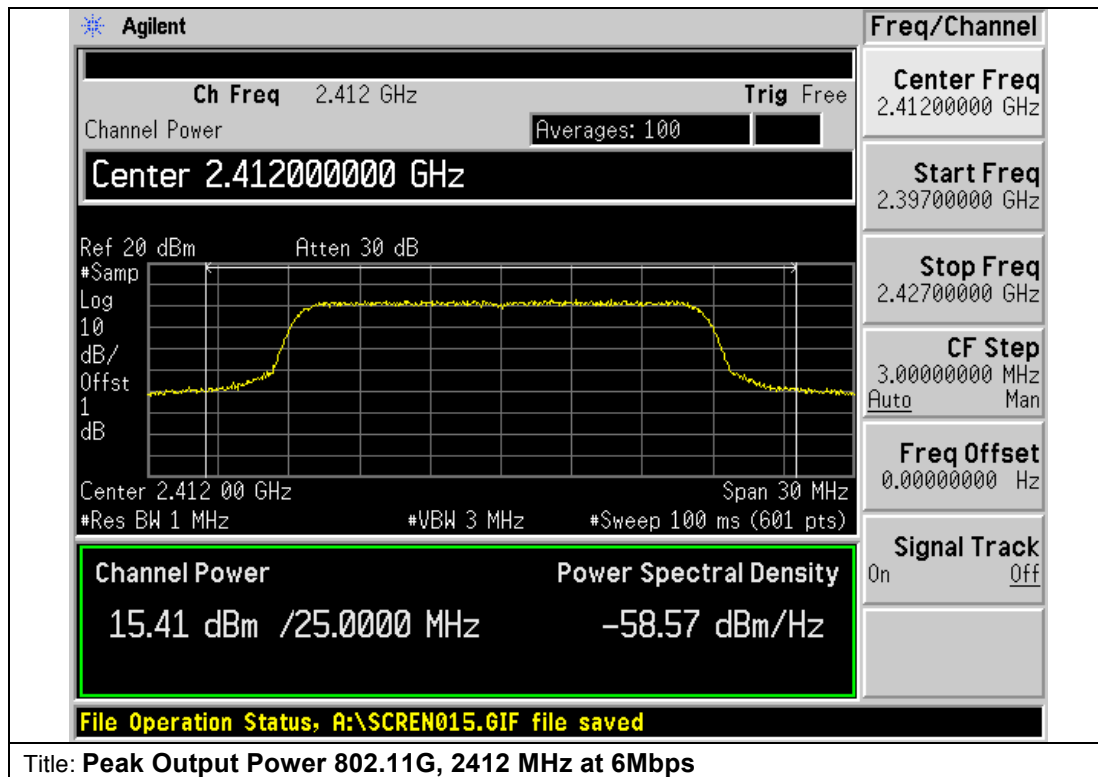


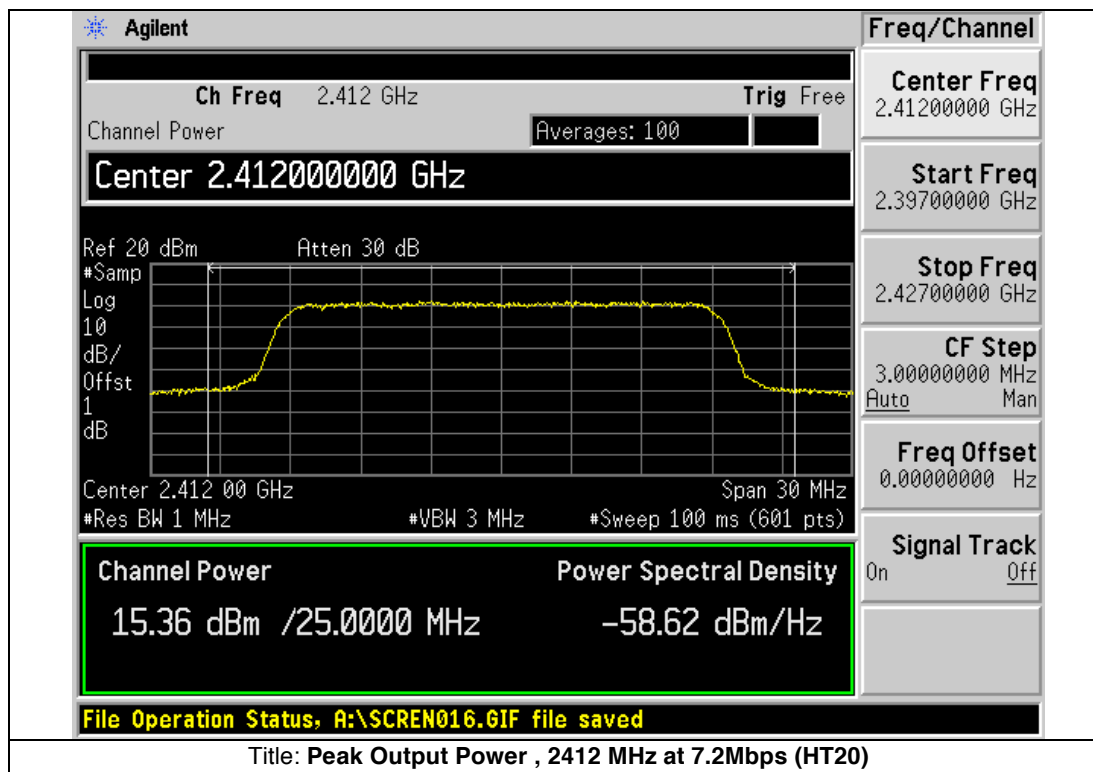
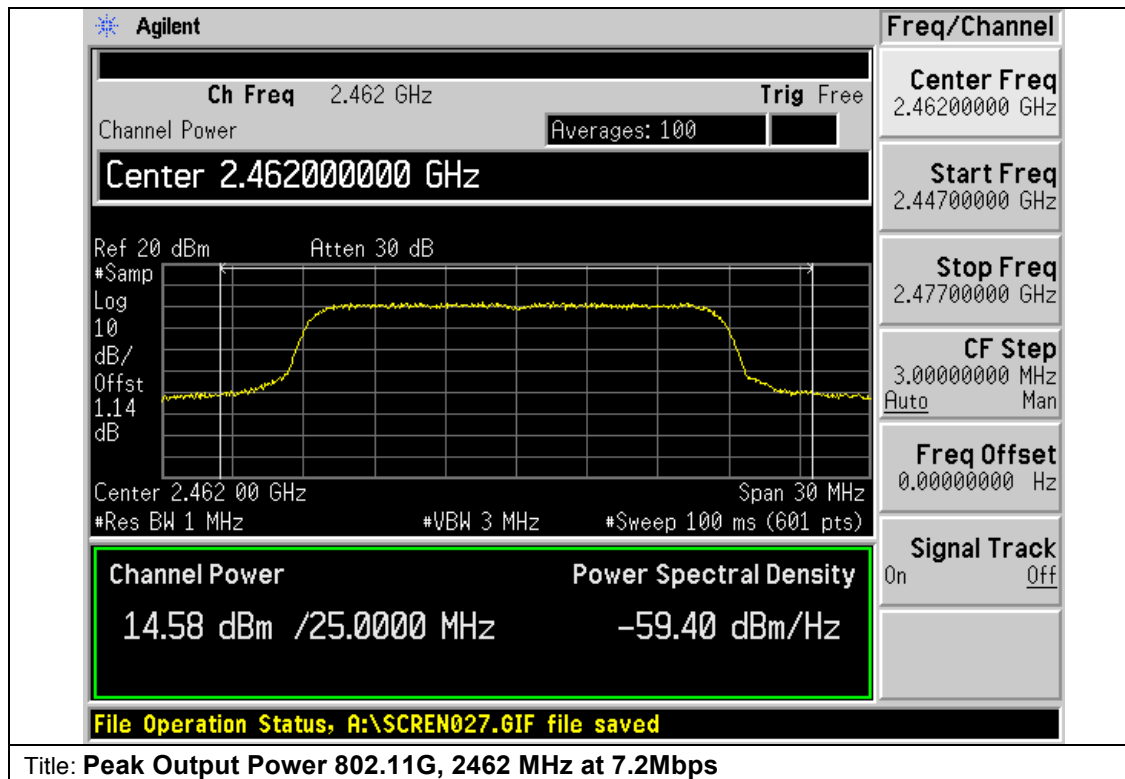
Frequency (MHz)	Data Rate (Mbps)	Peak Output Power (dBm)	Limit (dBm)	Margin (dB)
2412	1	15.56	30	-14.44
2437	1	15.37	30	-14.63
2462	1	14.68	30	-15.32
2412	6	15.41	30	-14.59
2437	6	15.23	30	-14.77
2462	6	14.58	30	-15.42
2412	6.5	15.36	30	-14.64
2437	6.5	15.11	30	-14.89
2462	6.5	14.52	30	-15.48
2422	13.5	15.43	30	-14.57
2437	13.5	15.52	30	-14.48
2452	13.5	14.94	30	-15.06

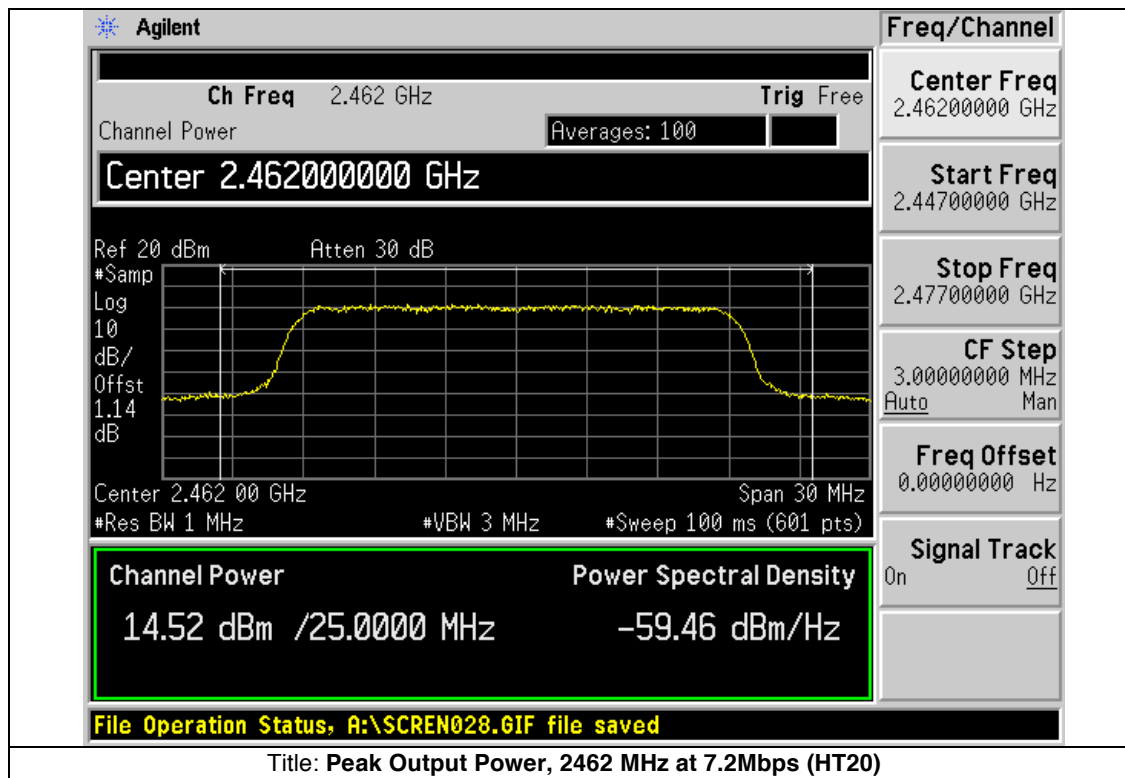
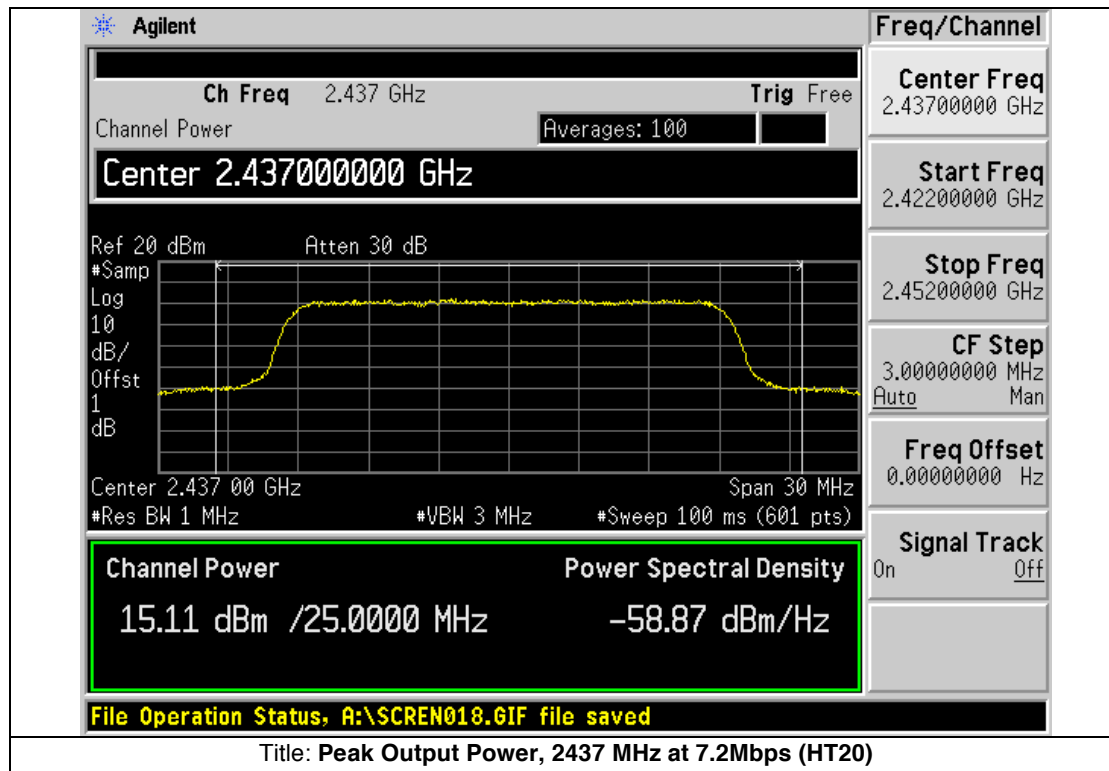


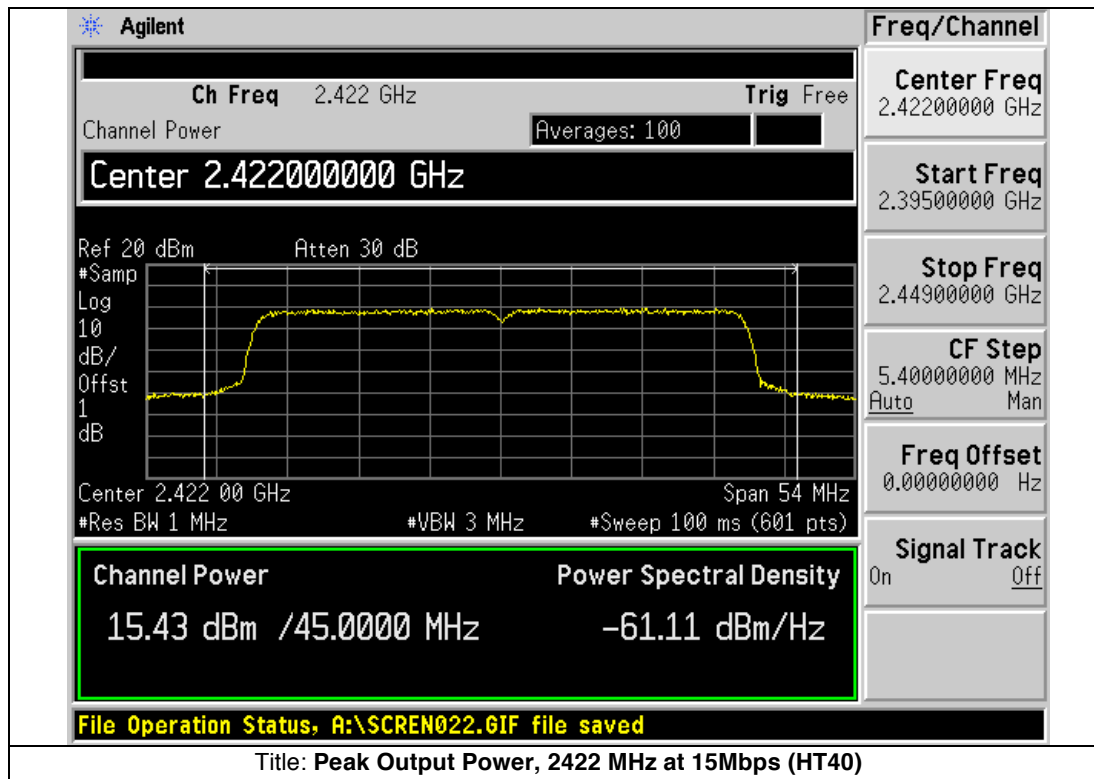
Title: **Peak Output Power 802.11B, 2412 MHz at 1Mbps**

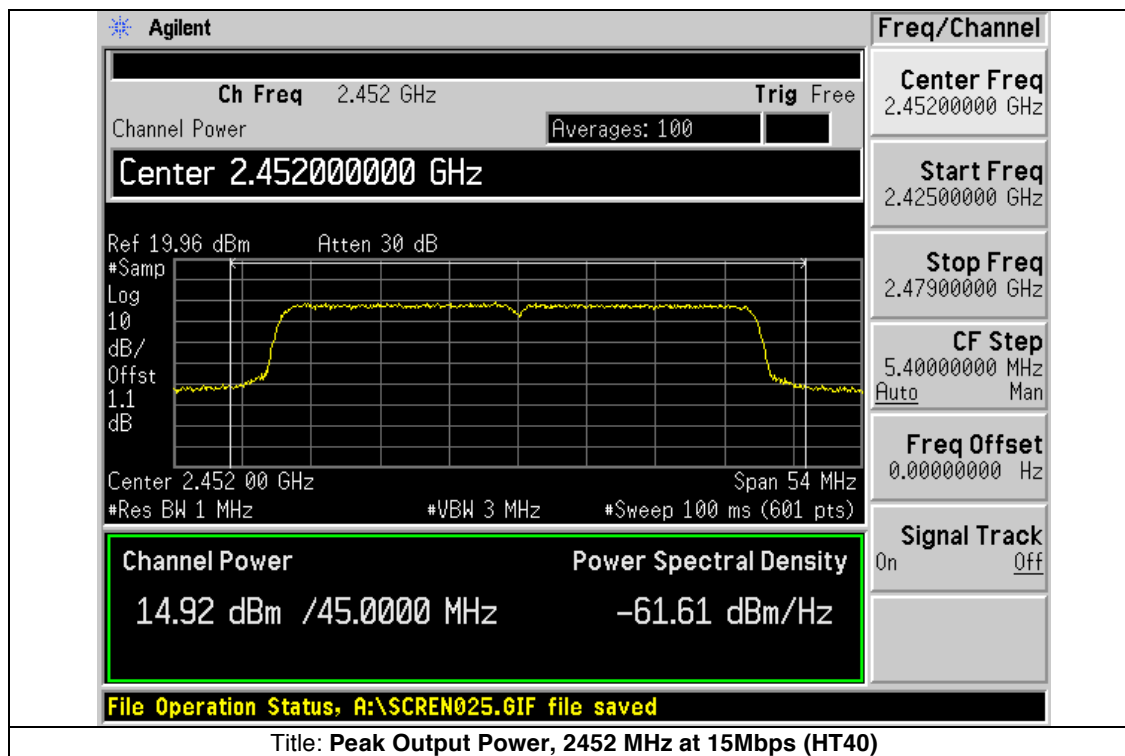
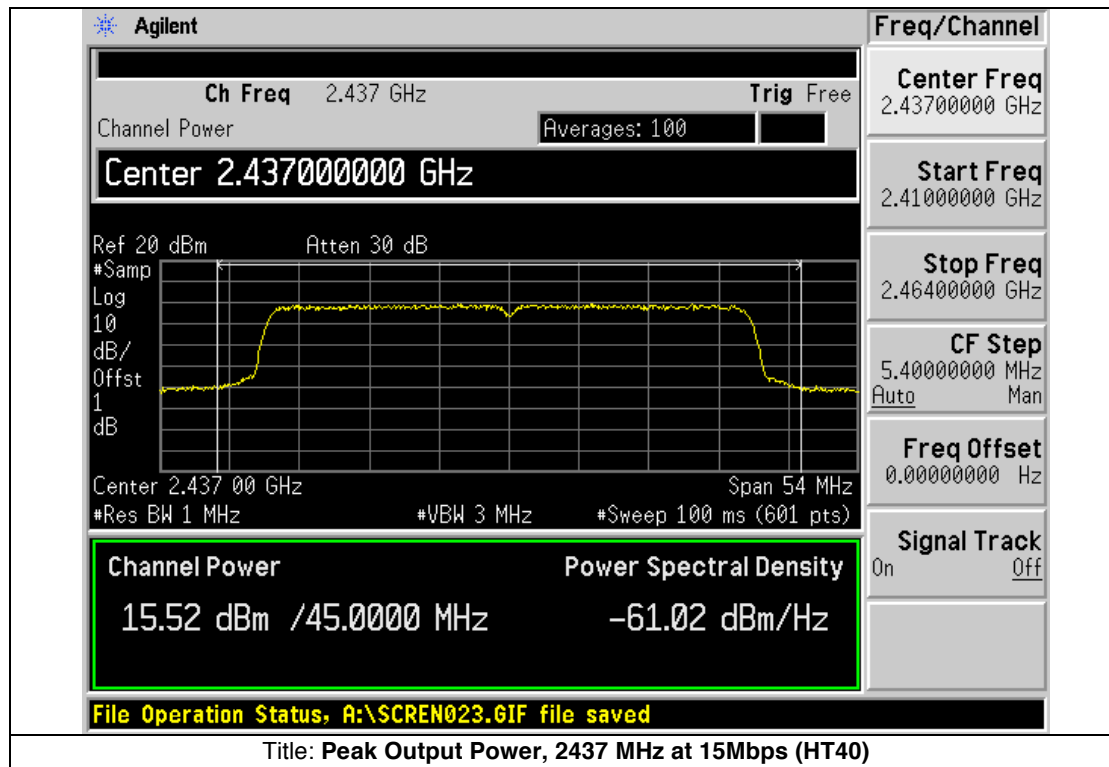














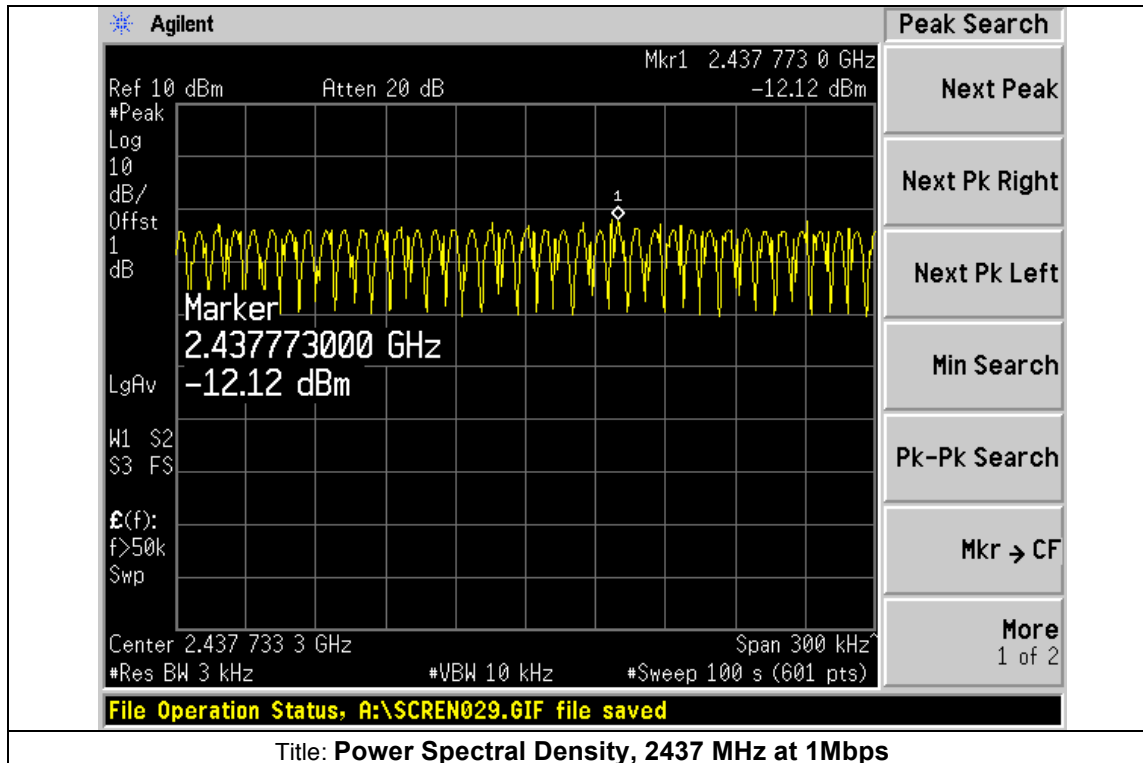
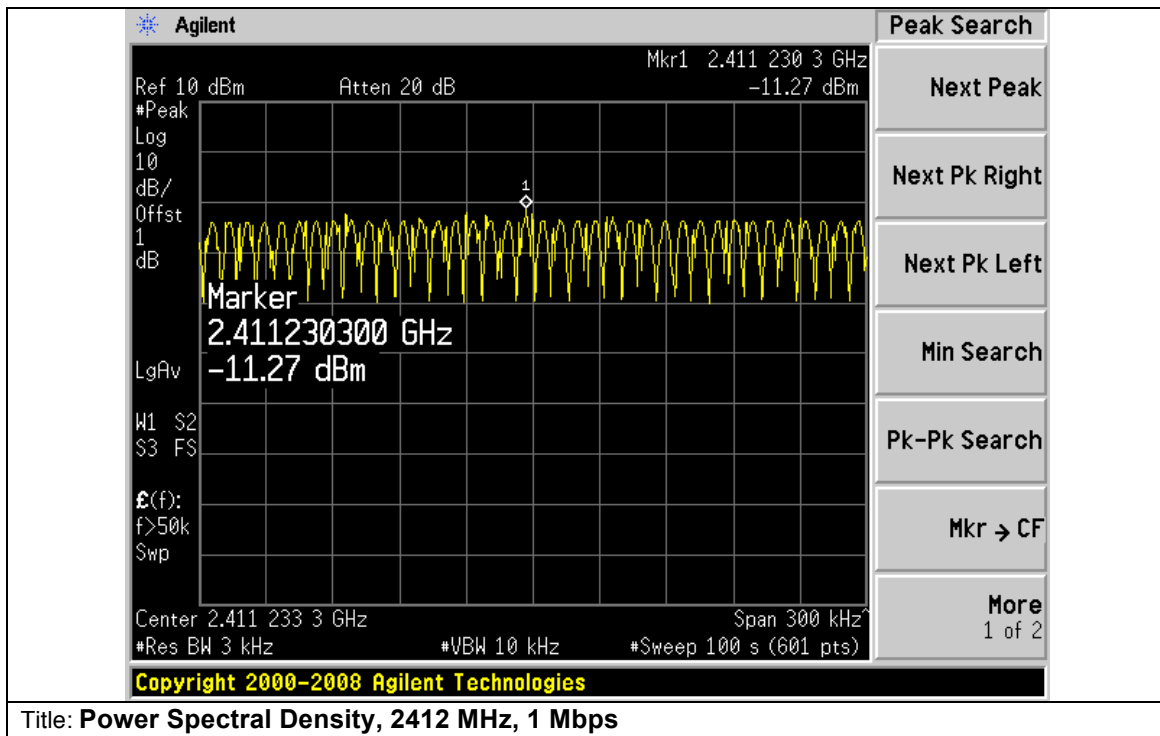
Power Spectral Density

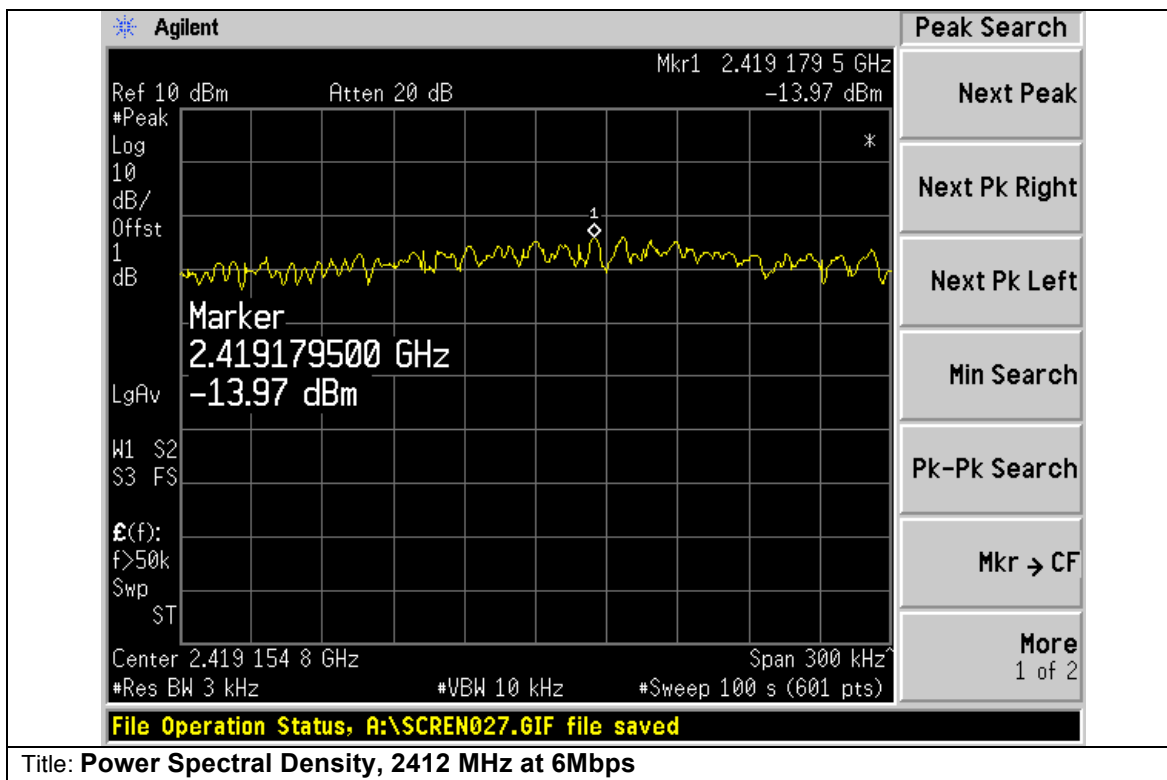
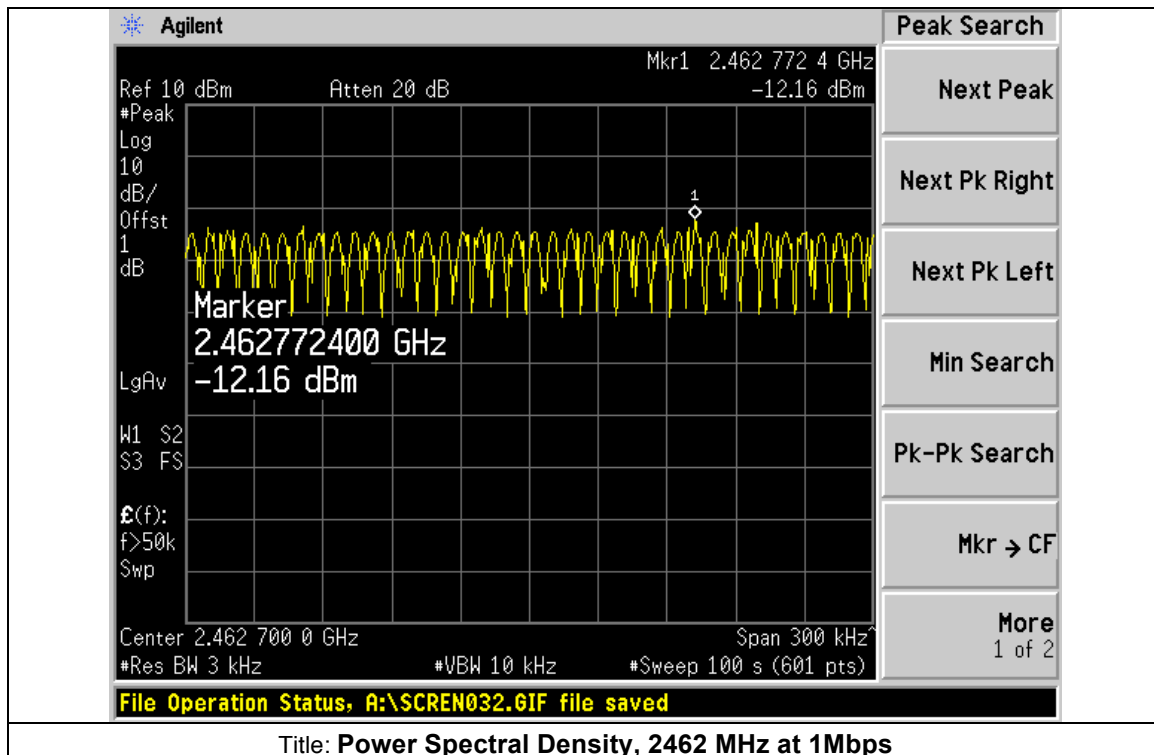
15.247 & RSS-210 A8.2:

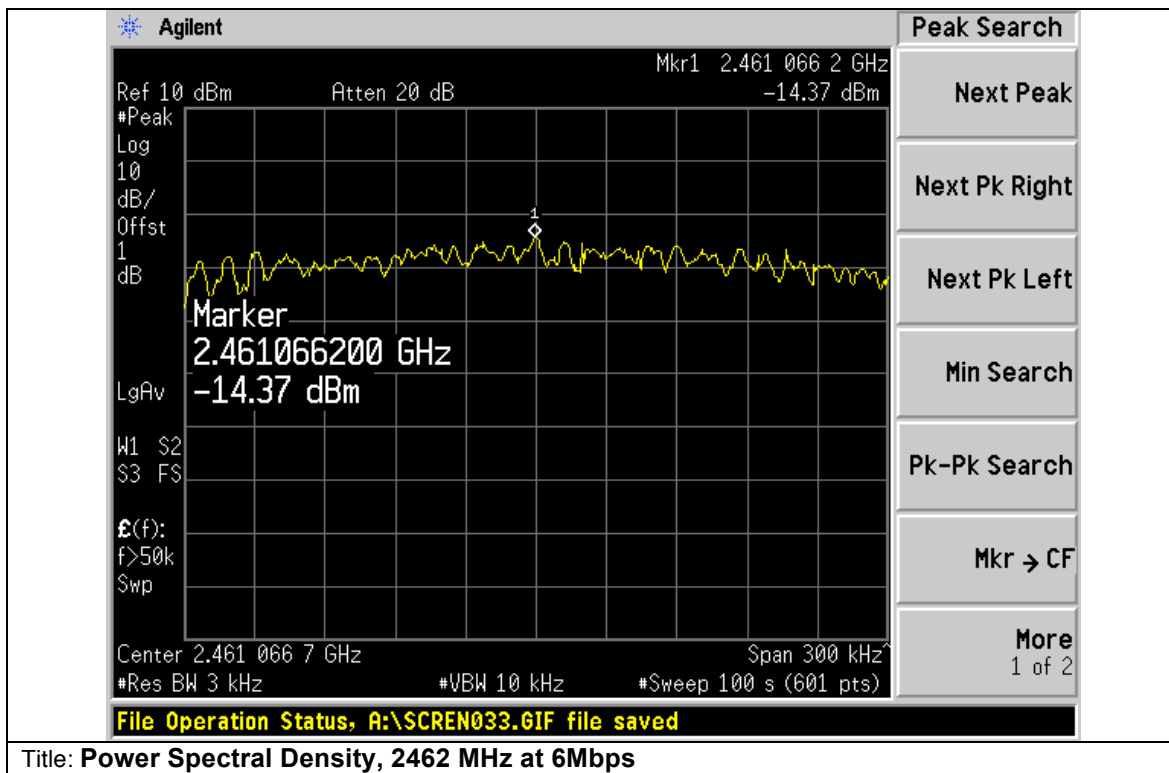
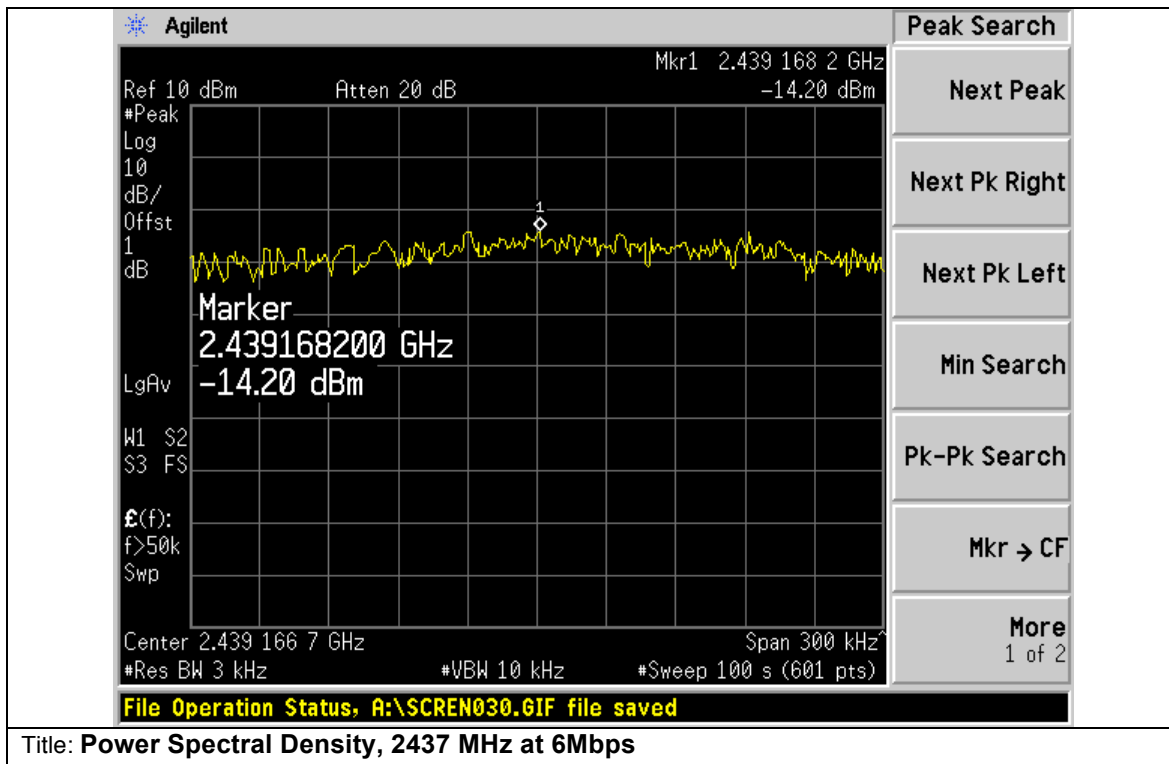
For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission

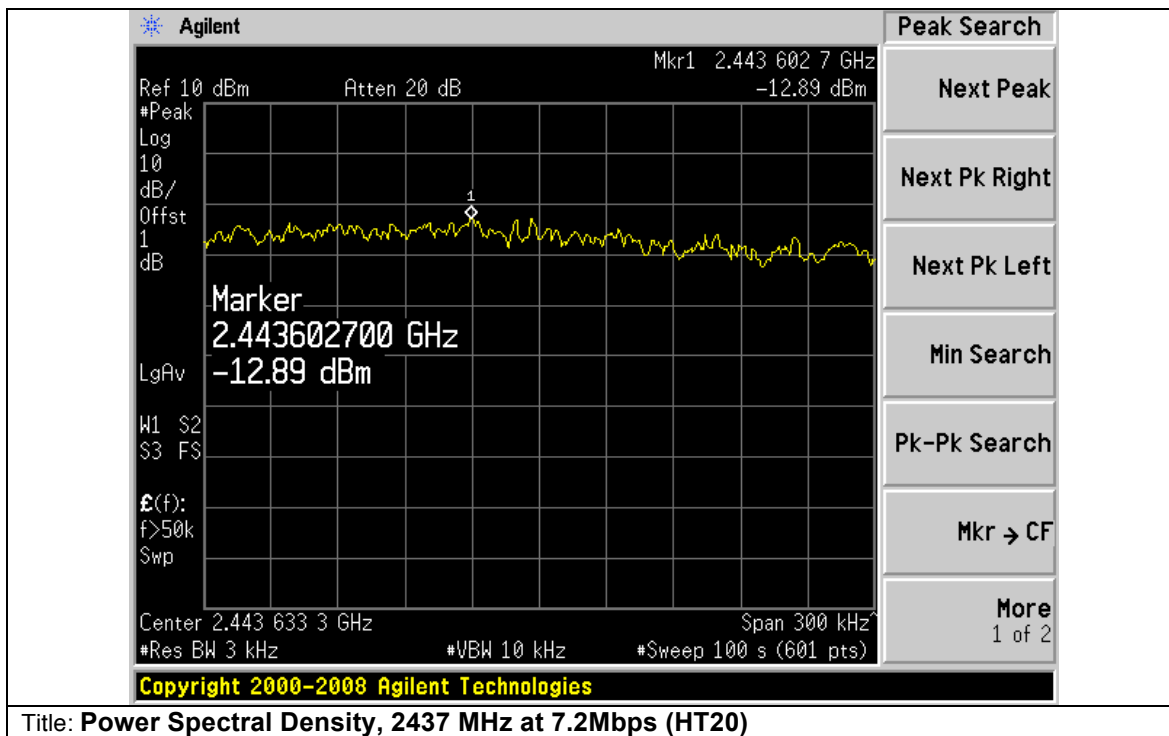
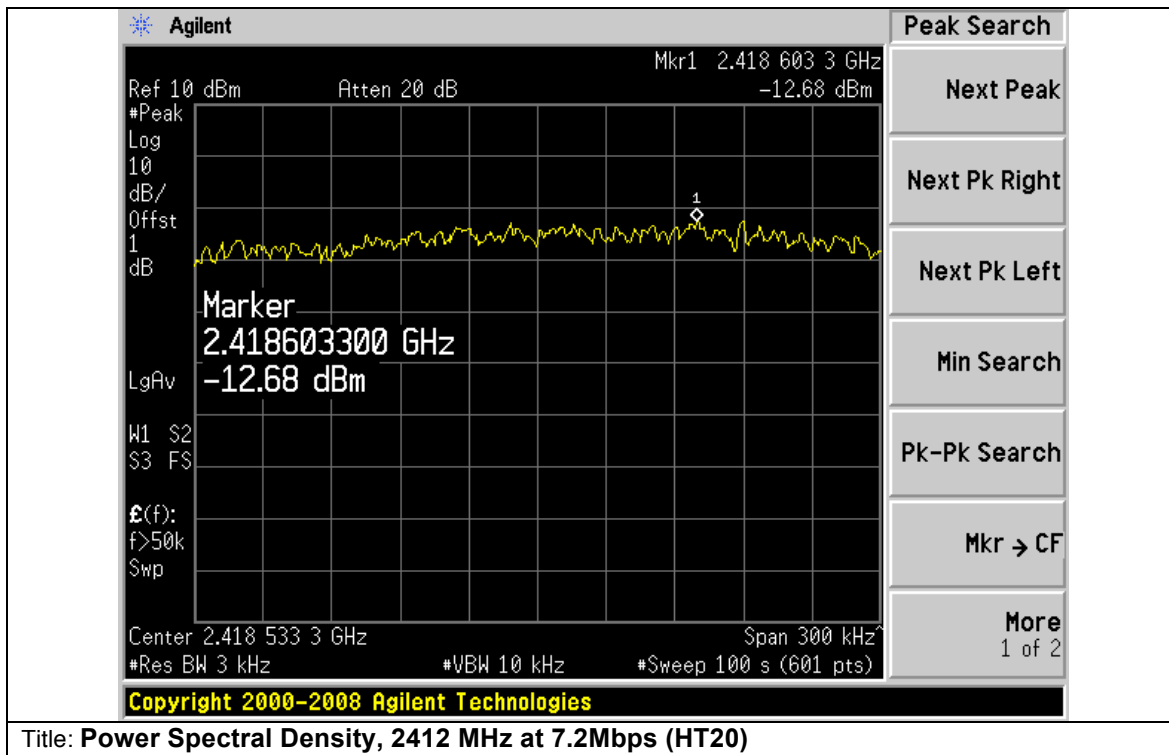
Frequency (MHz)	Data Rate (Mbps)	Peak Power Spectral Density (dBm/3kHz)	Limit (dBm)	Margin (dB)
2412	1	-11.27	8	-19.27
2437	1	-12.12	8	-20.12
2462	1	-12.16	8	-20.16
2412	6	-13.97	8	-21.97
2437	6	-14.20	8	-22.20
2462	6	-14.37	8	-22.37
2412	6.5	-12.68	8	-20.68
2437	6.5	-12.89	8	-20.89
2462	6.5	-13.66	8	-21.66
2422	13.5	-14.01	8	-22.01
2437	13.5	-14.49	8	-22.49
2452	13.5	-18.19	8	-26.19

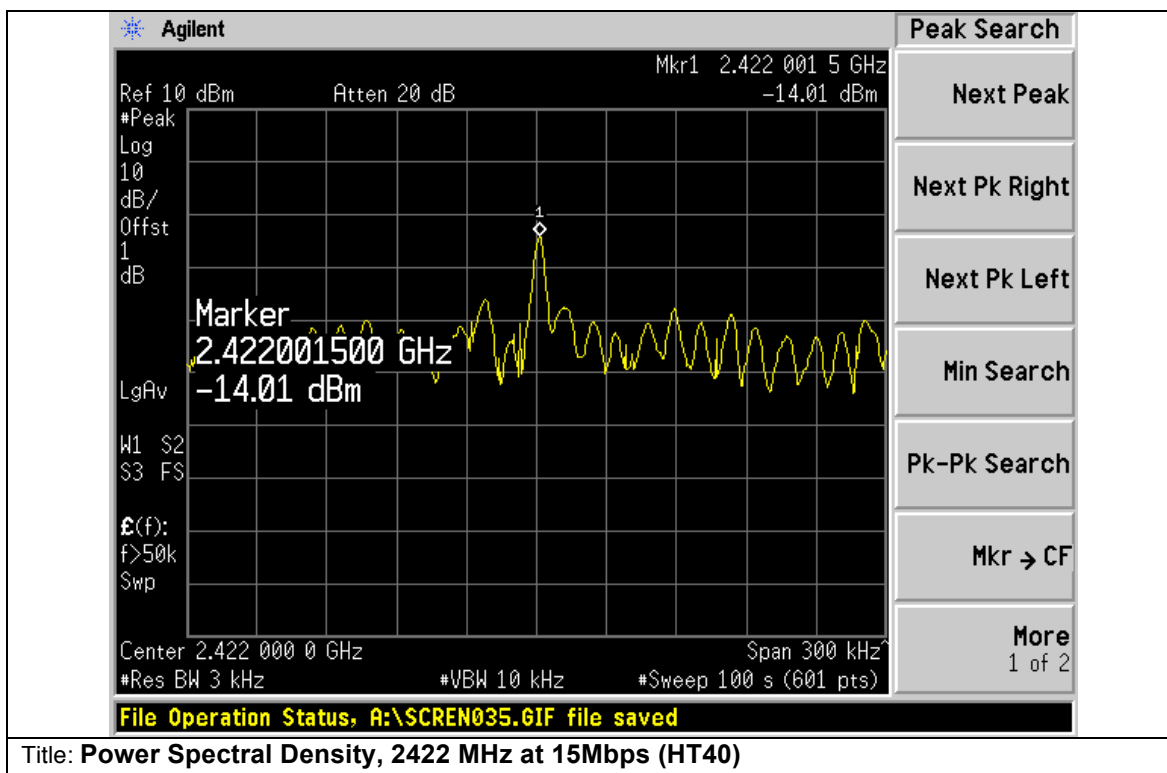
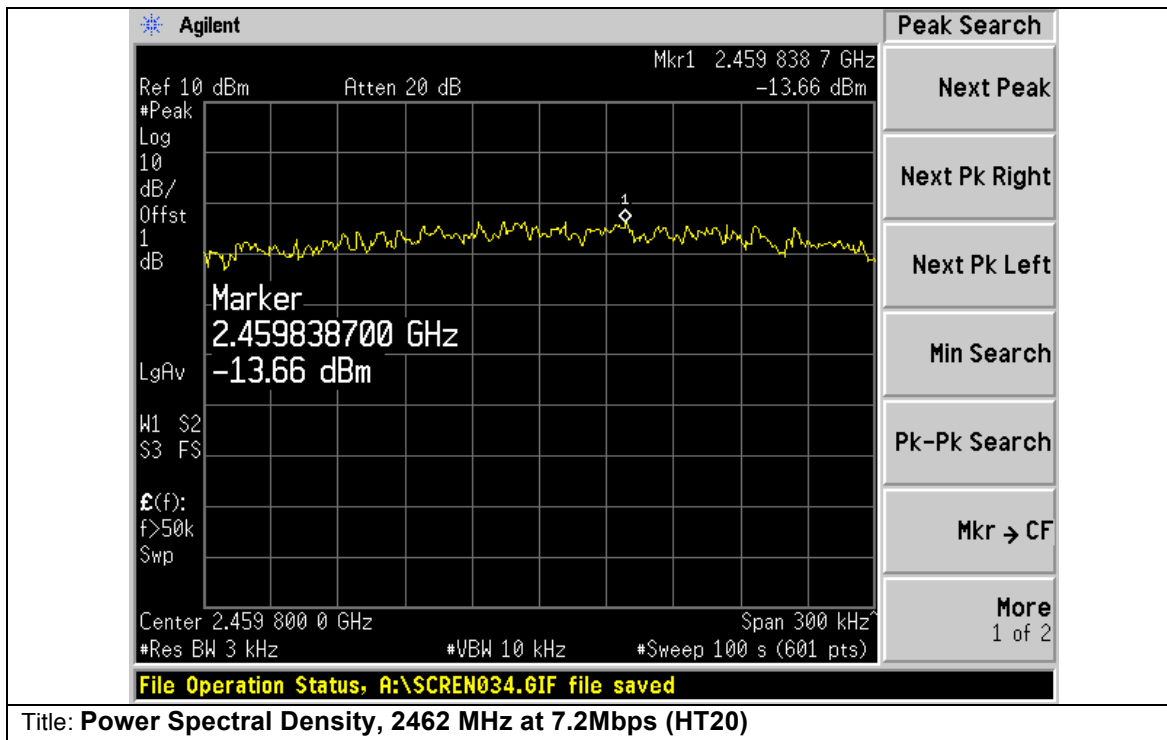
Graphical Test Results

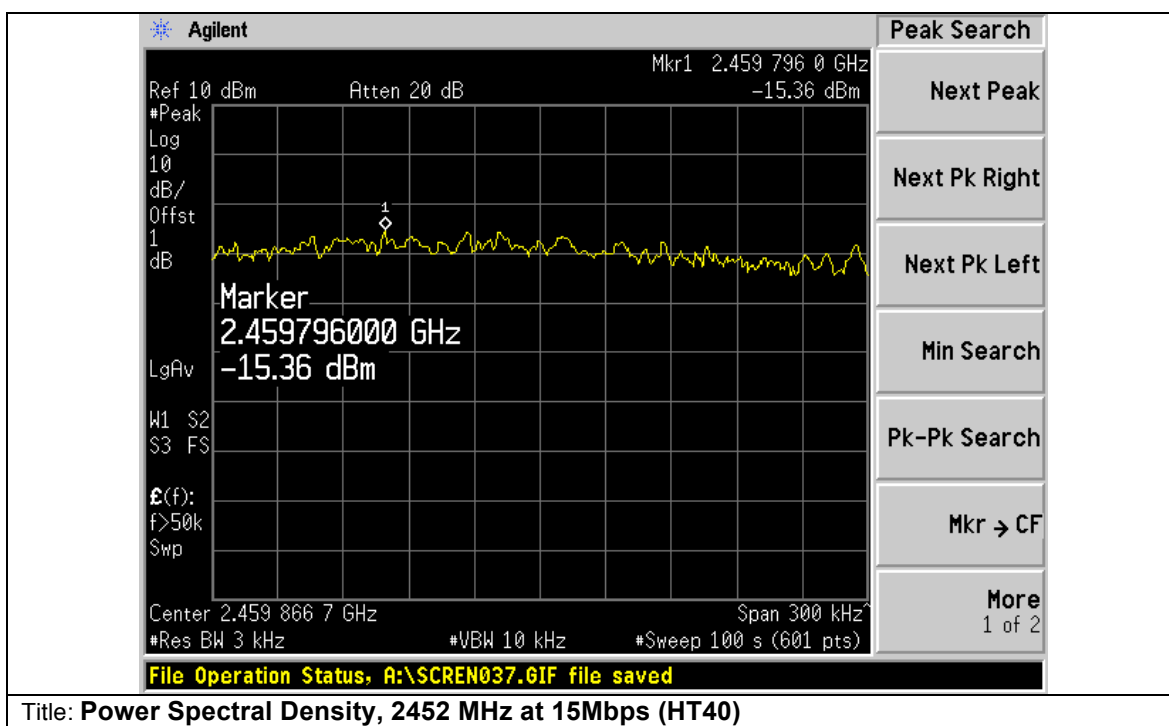
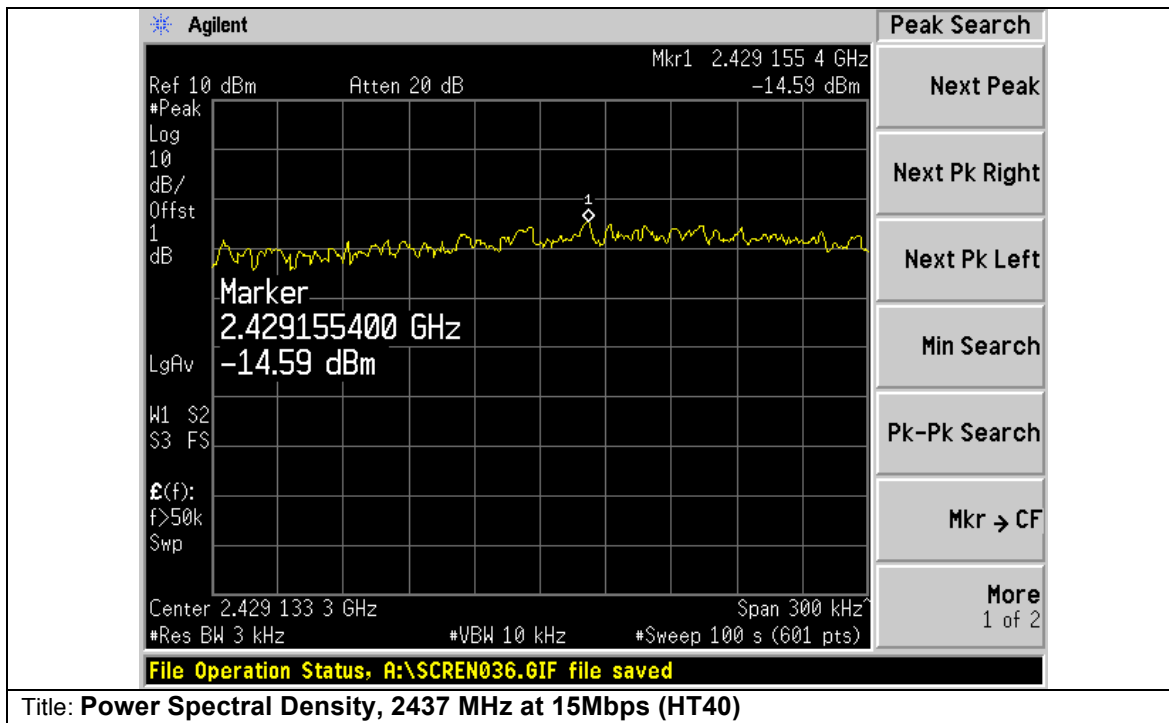














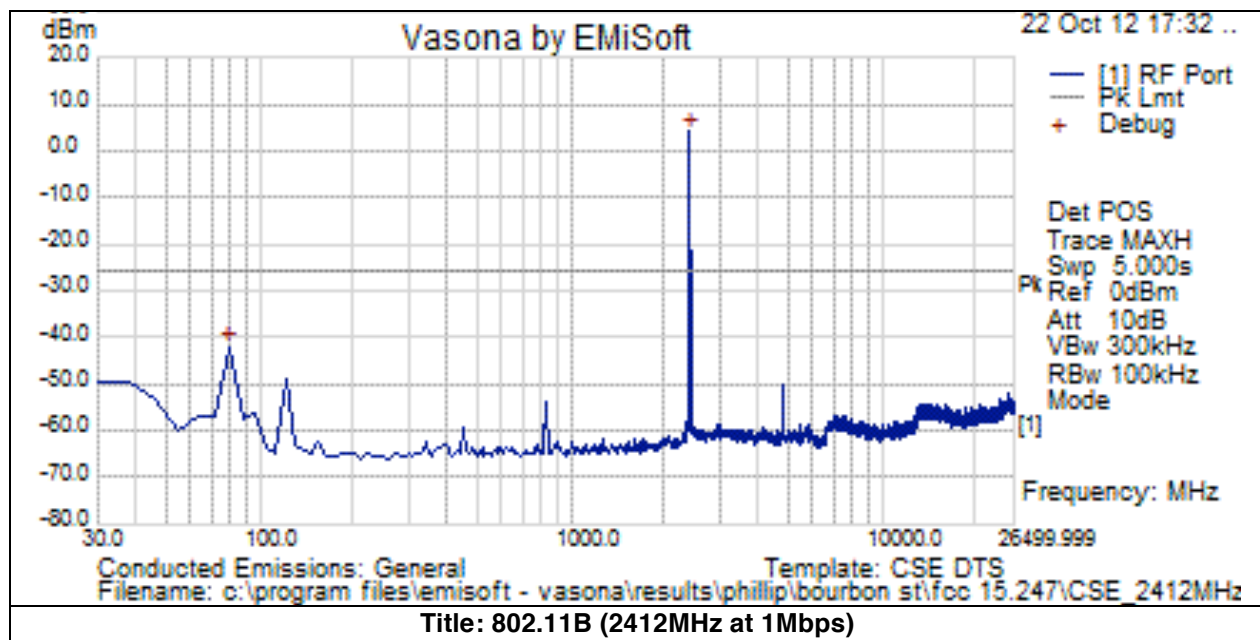
Conducted Spurious emissions

15.247 & RSS-210 A8.5:

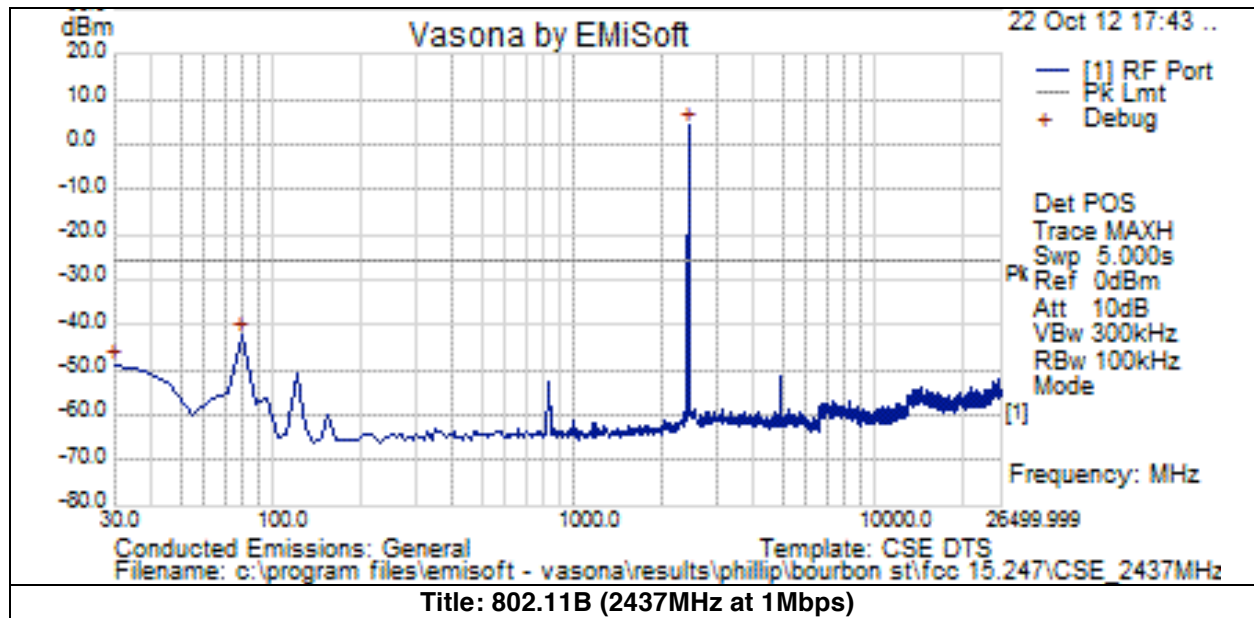
In any 100 kHz bandwidth outside the frequency band in which the digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

Graphical Test Results

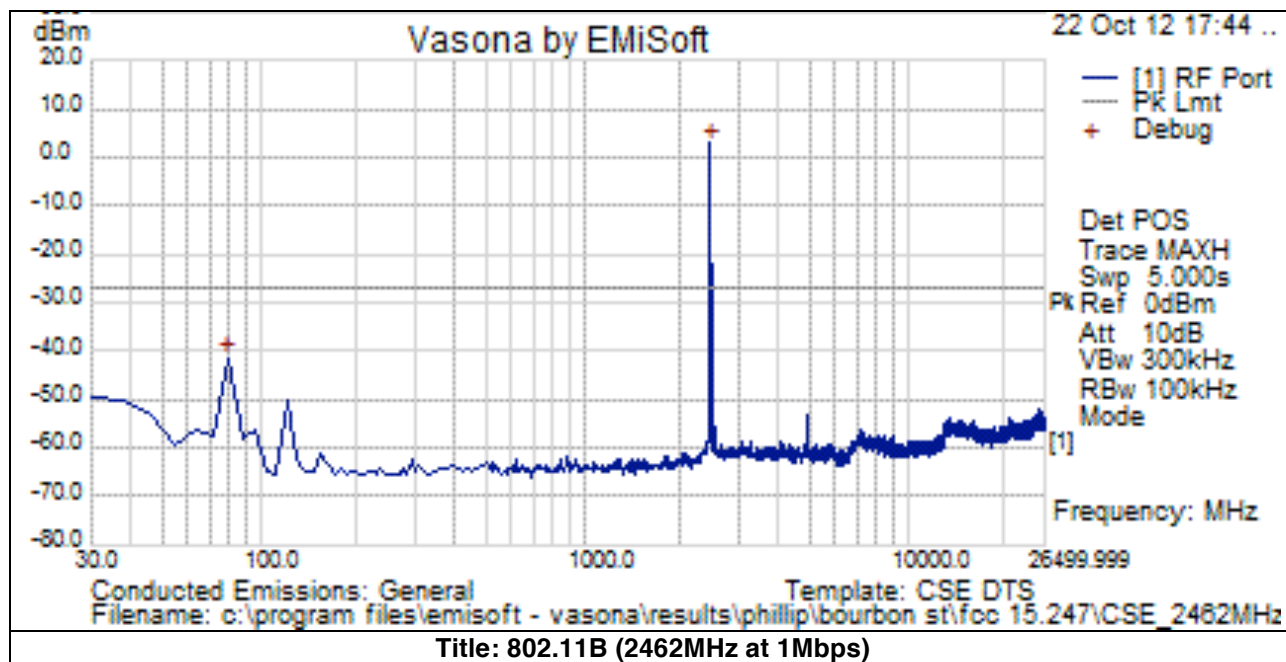
Note that the data displayed on the plots detailed in this appendix were measured using a 'Peak Detector'. Please refer to the results table for the detectors used during formal measurements



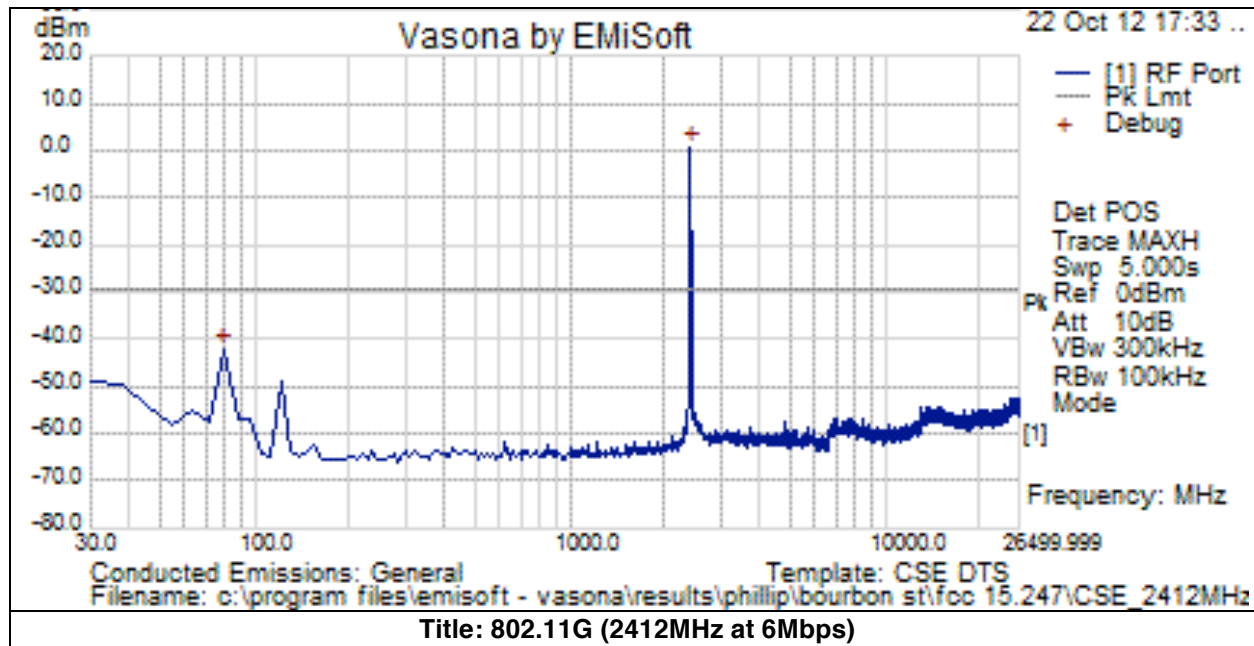
Comments: No Signals seen within 6dB of the Limit.



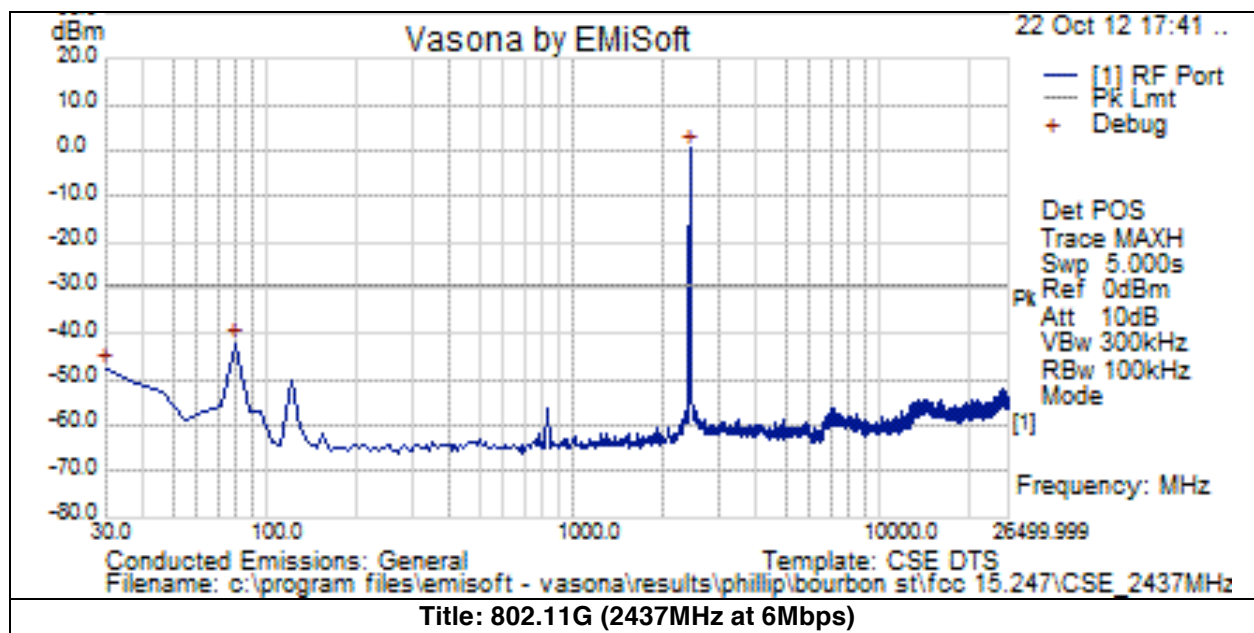
Comments: No Signals seen within 6dB of the Limit.



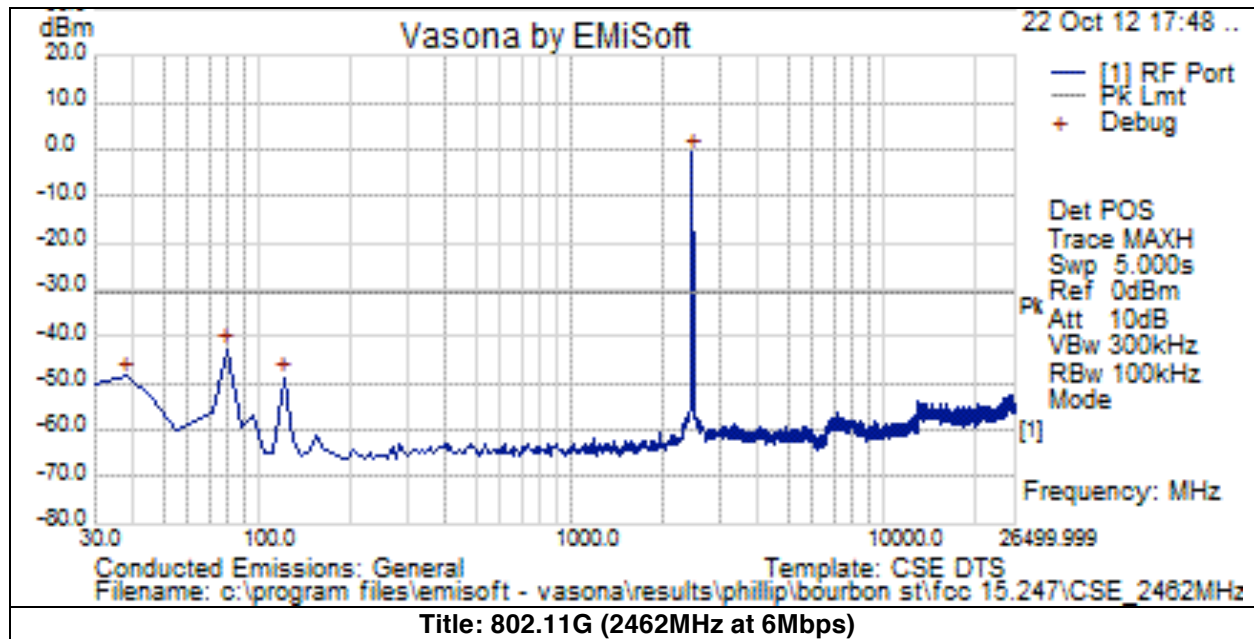
Comments: No Signals seen within 6dB of the Limit.



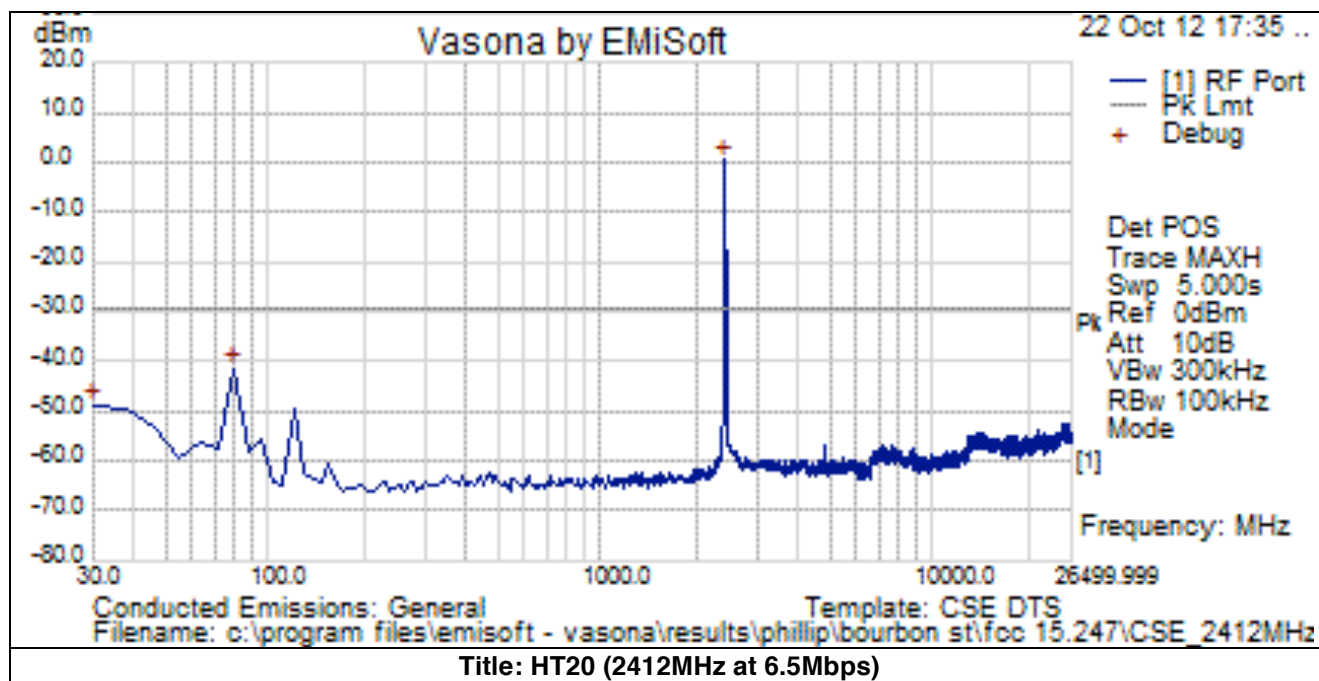
Comments: No Signals seen within 6dB of the Limit.



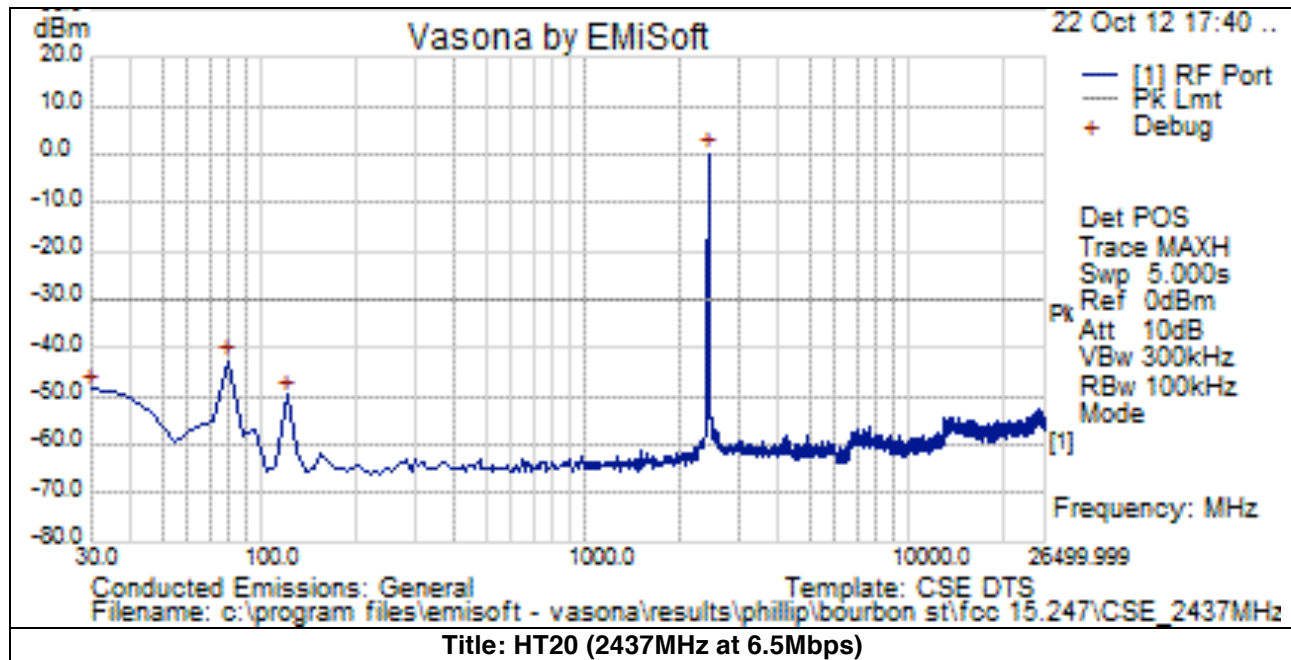
Comments: No Signals seen within 6dB of the Limit.



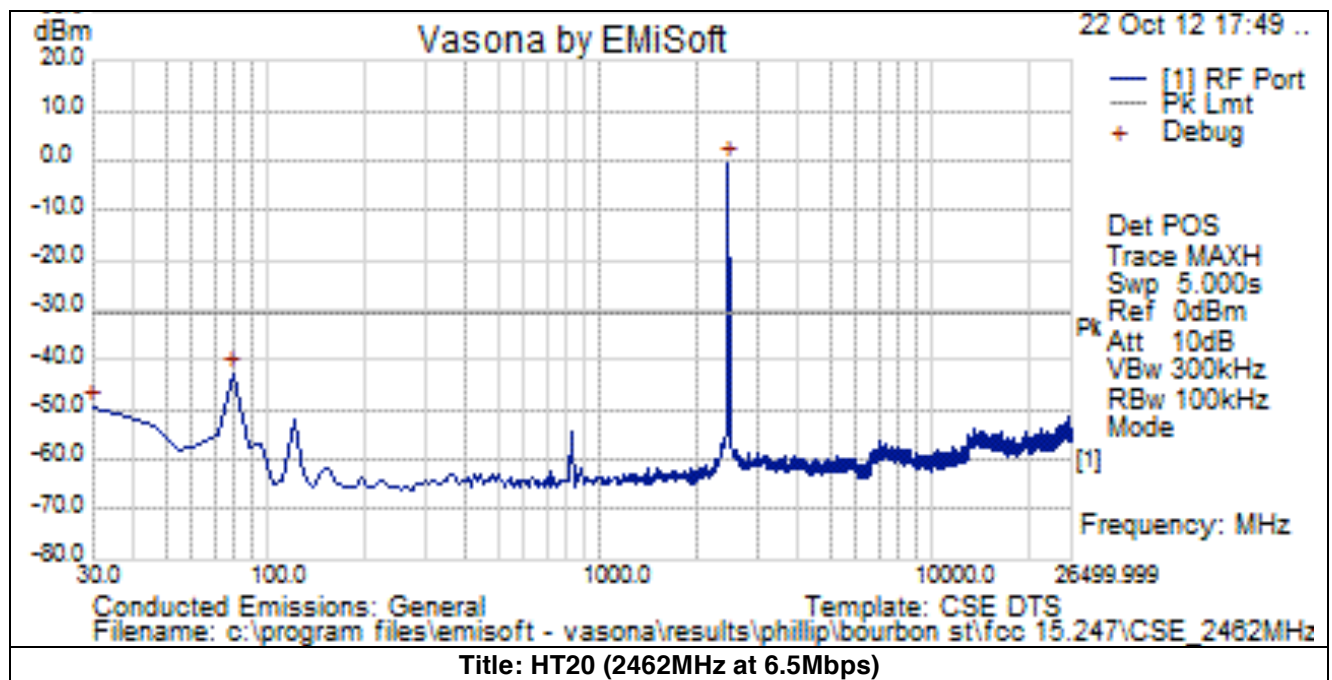
Comments: No Signals seen within 6dB of the Limit.



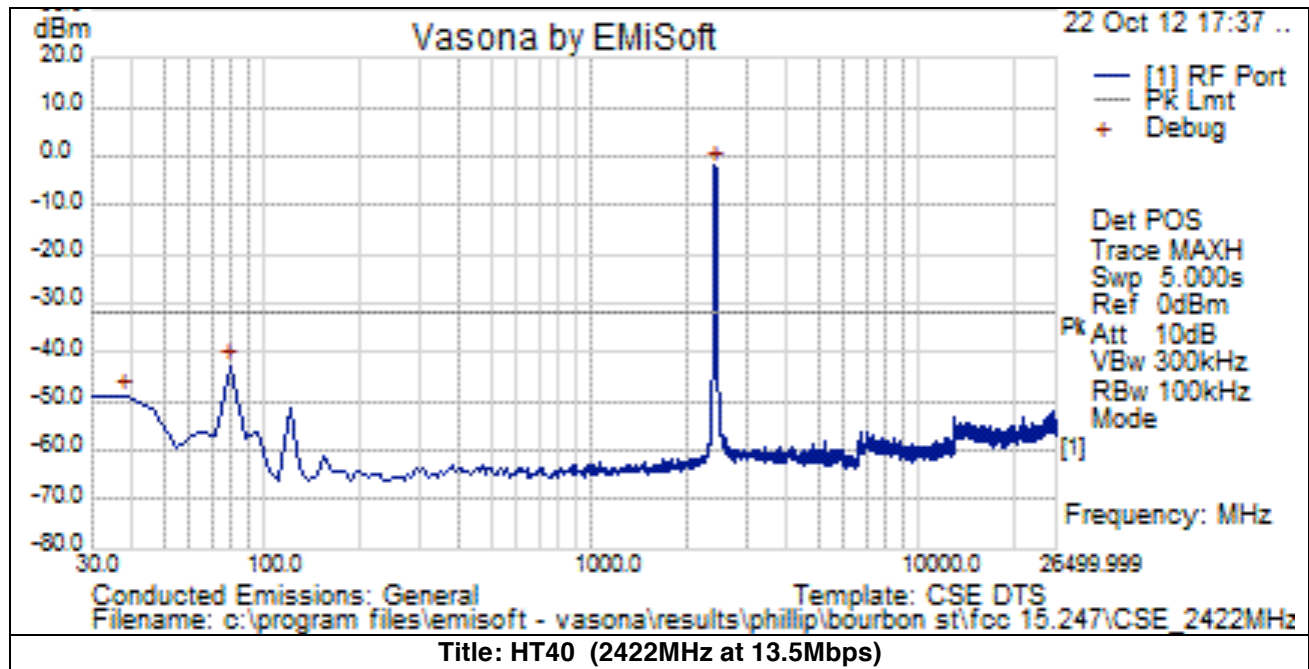
Comments: No Signals seen within 6dB of the Limit.



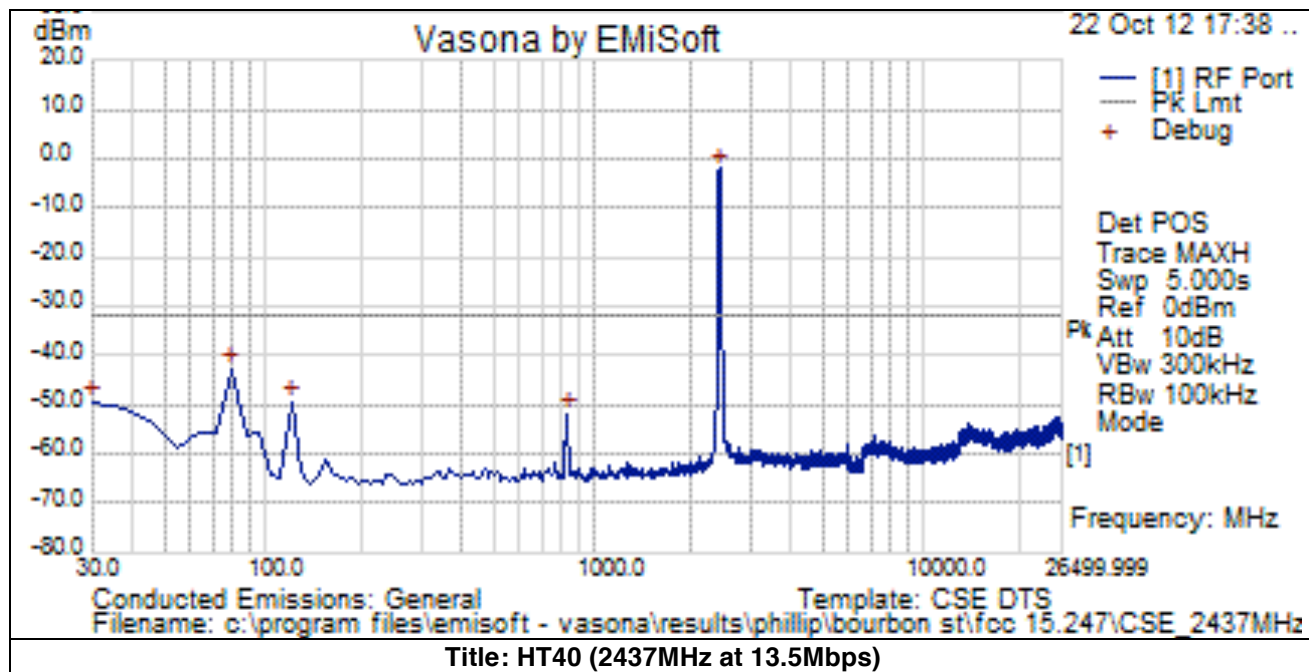
Comments: No Signals seen within 6dB of the Limit.



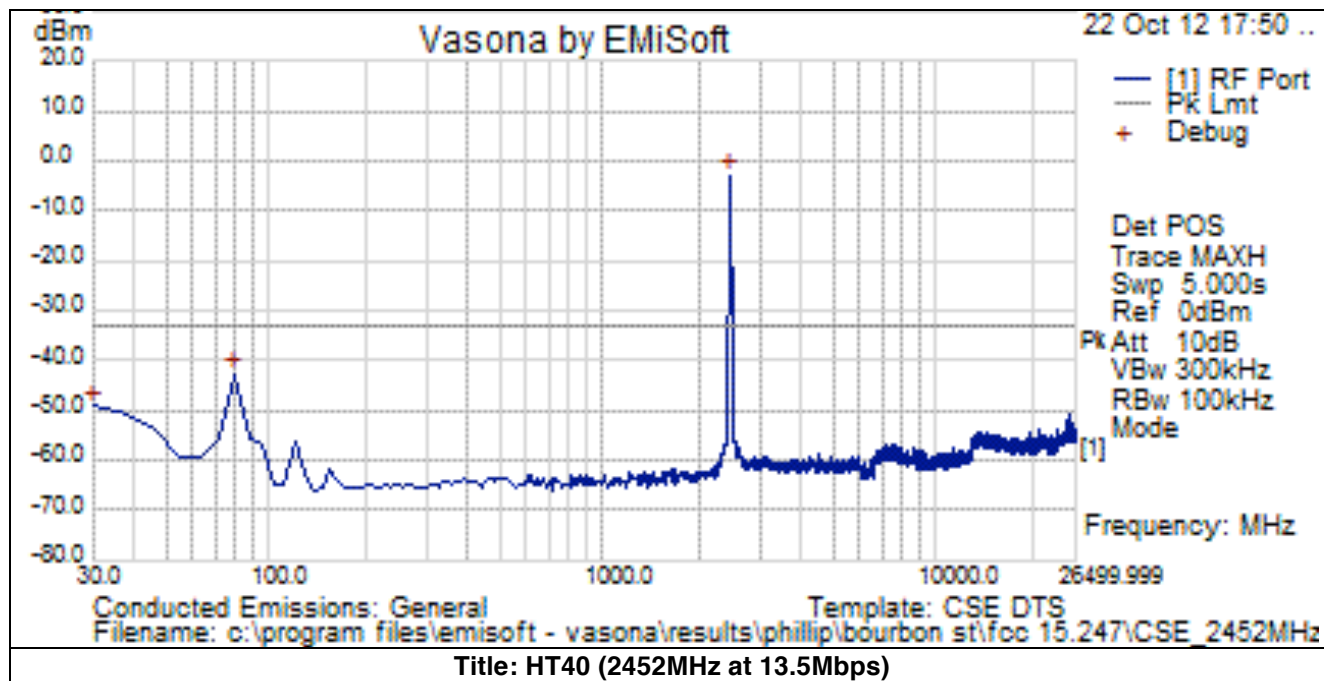
Comments: No Signals seen within 6dB of the Limit.



Comments: No Signals seen within 6dB of the Limit.

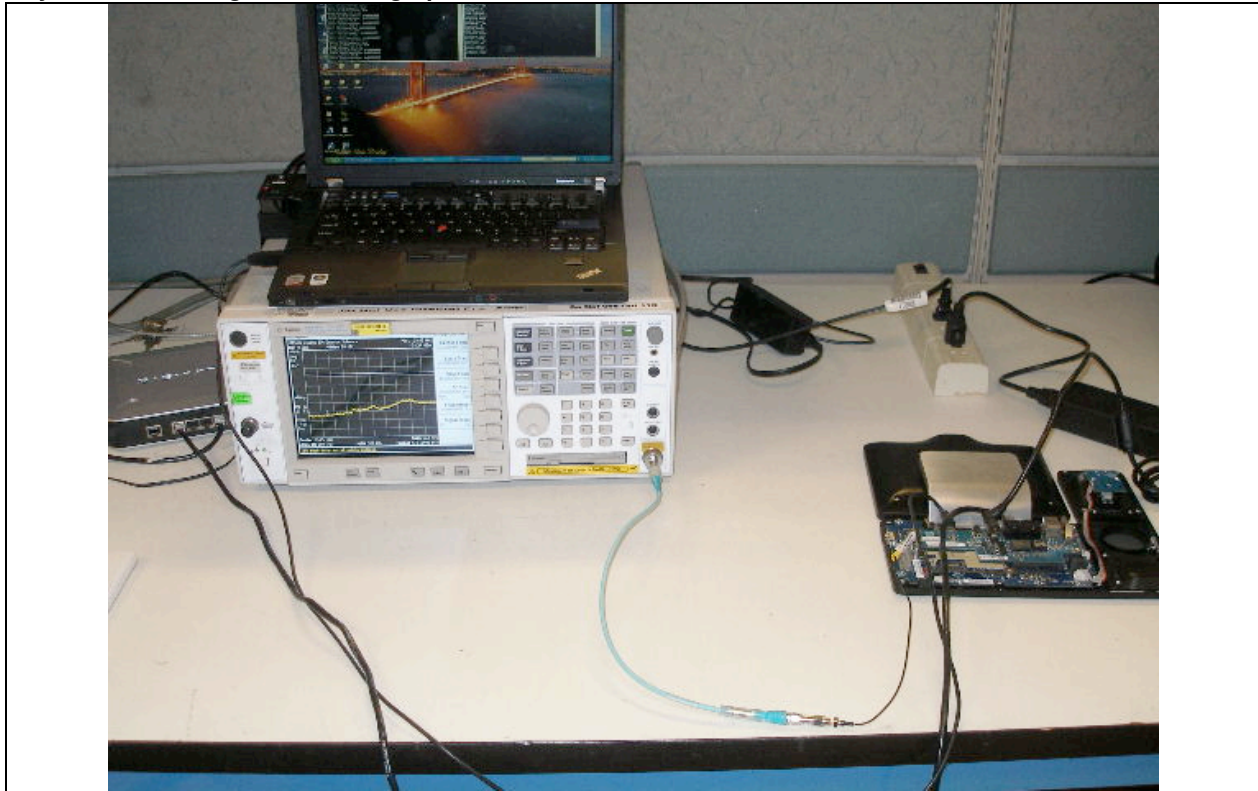


Comments: No Signals seen within 6dB of the Limit.



Comments: No Signals seen within 6dB of the Limit.

Physical Test arrangement Photograph:



Title: setup test Bench

Comments on the above Photograph:

No further comments



Conducted Band Edge Measurements

15.205 & RSS-210 sec2.7:

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

Use to substitute conducted measurements in place of radiated measurements.

Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode. Be sure to enter all losses between the transmitter output and the spectrum analyzer.

Reference Level: 20 dBm
Attenuation: 30 dB
Sweep Time: Coupled
Resolution Bandwidth: 1MHz
Video Bandwidth: 1 MHz for peak, 100 Hz for average
Detector: Peak

Save 2 plots: 1) Average Plot (Vertical and Horizontal), Limit= -41.25 dBm eirp (54dBuV/m @3m)
2) Peak plot (Vertical and Horizontal), Limit = -21.25 dBm eirp (74dBuV/m @3m)

Place a marker at the end of the restricted band closest to the transmit frequency to show compliance.

Also measure any emissions in the restricted bands.

NOTE: ALL Modes were evaluated but ONLY worse case was reported.

Frequency Measured	Frequency (MHz)	Data Rate (Mbps)	Peak or Average	Limit (dBm)	Margin (dBm)
2382.2	2412 (Peak)	1	-28.4	-21.2	7.2
2390	2412 (Ave)	1	-55.64	-41.2	14.44
2483.57	2462 (Peak)	1	-23.92	-21.2	2.72
2483.5	2462 (Ave)	1	-58.79	-41.2	17.59
2390	2412 (Peak)	6	-31.06	-21.2	9.86
2390	2412 (Ave)	6	-50.54	-41.2	9.34
2485.75	2462 (Peak)	6	-25.59	-21.2	4.39
2483.5	2462 (Ave)	6	-51.57	-41.2	10.37
2390	2412 (Peak)	6.5	-27.13	-21.2	5.93
2390	2412 (Ave)	6.5	-48.95	-41.2	7.75

Marker-Delta Method Results:

Frequency Tested	Radiated Pk Measurement	Radiated Ave Measurement	Conducted Delta Measurement	Limit (dBm)	Margin (dBm)
2462 (Horz)	103.97	97.16	-42.05	-74	-31.95
2462 (Vert)	103.7	96.88	-42.05	-54	-11.95
2422 (Horz)	103.29	96.34	-37.73	-74	-36.27
2422 (Vert)	102.89	95.98	-37.73	-54	-16.27
2452 (Horz)	101.42	94.33	-39.81	-74	-34.19
2452(Vert)	103.4	96.44	-39.81	-54	-14.19

