

RF TEST REPORT

Test item : G-PON ONT
Model No. : H640W
Order No. : DEMC1309-02988
Date of receipt : 2013-09-27
Test duration : 2013-10-02 ~ 2013-10-24
Date of issue : 2013-11-11
Use of report : FCC Original Grant

Applicant : Dasan Networks, Inc.

DASAN Tower, 49, Daewangpangyo-ro 644Beon-gil, Bundang-gu, Seongnam-si,
Gyeonggi-do, 463-400 KOREA

Test laboratory : Digital EMC Co., Ltd.

683-3, Yubang-Dong, Cheoin-Gu, Yongin-Si, Gyeonggi-Do, 449-080, Korea

Test specification : FCC Part 15 Subpart C 247
KDB558074 v03r01

Test environment : See appended test report

Test result : ☒ Pass ☐ Fail

The test results presented in this test report are limited only to the sample supplied by applicant and the use of this test report is inhibited other than its purpose. This test report shall not be reproduced except in full, without the written approval of DIGITAL EMC CO., LTD.

Tested by:



Engineer
JaeJin Lee

Witnessed by:

N/A

Reviewed by:



Deputy General Manager
HongHee Lee

Test Report Version

Test Report No.	Date	Description
DRTFCC1311-1078	Nov. 11, 2013	Initial issue

Table of Contents

1. GENERAL INFORMATION	4
2. EUT DESCRIPTION	4
3. SUMMARY OF TESTS	5
4. TEST METHODOLOGY	6
4.1 EUT CONFIGURATION	6
4.2 EUT EXERCISE	6
4.3 GENERAL TEST PROCEDURES	6
4.4 DESCRIPTION OF TEST MODES	6
5. INSTRUMENT CALIBRATION	7
6. FACILITIES AND ACCREDITATIONS	7
6.1 FACILITIES	7
6.2 EQUIPMENT	7
7. ANTENNA REQUIREMENTS	7
8. TEST RESULT	8
8.1 6dB Bandwidth	8
8.2 Maximum Peak Conducted Output Power	21
8.3 Maximum Power Spectral Density	25
8.4 Out of Band Emissions at the Band Edge / Conducted Spurious Emissions	38
8.5 Radiated Spurious Emissions	75
8.6 Power-line Conducted Emissions	81
8.7 Occupied Bandwidth	84
9. LIST OF TEST EQUIPMENT	85
APPENDIX I	86

1. GENERAL INFORMATION

Applicant : DASAN Networks Inc.

Address : DASAN Tower, 49, Daewangpangyo-ro 644Beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, 463-400 KOREA

FCC ID : 2AAQH640W

EUT : G-PON ONT

Model : H640W

Additional Model(s) : N/A

Data of Test : 2013-10-02 ~ 2013-10-24

Contact person : YangSik Ryu

2. EUT DESCRIPTION

Product	G-PON ONT
Model Name	H640W
Power Supply	DC 12 V
Frequency Range	2.4GHz Band ▪ 802.11b/g/n(20MHz): 2412 MHz ~ 2462 MHz ▪ 802.11n(40MHz): 2422 MHz ~ 2452 MHz
Max. RF Output Power	2.4GHz Band ▪ 802.11b: 20.15 dBm ▪ 802.11g: 23.32 dBm ▪ 802.11n (HT20): 24.43 dBm ▪ 802.11n (HT40): 22.43 dBm
Modulation Type	802.11b: DSSS/CCK 802.11g/n: OFDM
Antenna Specification	Antenna type: Dipole antenna Antenna gain: Chain 1 : 4.68 dBi & Chain 2 : 4.68 dBi Directional Antenna gain for MIMO with uncorrelated signals : 4.68 dBi Antenna configuration ▪ 802.11b/g: Single Transmitting (chain 1 only) ▪ 802.11n(MCS0 ~ 7) : Single Transmitting (chain 1 or 2) ▪ 802.11n(MCS8 ~ 15): Multiple Transmitting (chain 1 and 2)

3. SUMMARY OF TESTS

FCC Part Section(s)	RSS Section(s)	Parameter	Limit	Test Condition	Status Note 1
I. Transmitter Mode (TX)					
15.247(a)	RSS-210 [A8.2]	6 dB Bandwidth	> 500 kHz	Conducted	C
15.247(b)	RSS-210 [A8.4]	Transmitter Output Power	< 1Watt		C
15.247(d)	RSS-210 [A8.5]	Out of Band Emissions / Band Edge	20dBc in any 100kHz BW		C
15.247(e)	RSS-210 [A8.2]	Transmitter Power Spectral Density	< 8dBm / 3kHz		C
-	RSS Gen [4.6.1]	Occupied Bandwidth (99%)	RSS-Gen(4.6.1)		NA
15.205 15.209	RSS-210 [A8.5]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	< FCC 15.209 limits	Radiated	C ^{Note2}
15.207	RSS-Gen [7.2.4]	AC Conducted Emissions	< FCC 15.207 limits	AC Line Conducted	C
15.203	-	Antenna Requirements	FCC 15.203	-	C
<p>Note 1: C=Comply NC=Not Comply NT=Not Tested NA=Not Applicable</p> <p>Note 2: This test item was performed in each axis and the worst case data was reported.</p>					

4. TEST METHODOLOGY

Generally the tests were performed according to the KDB558074 v03r1. And ANSI C63.10-2009 was used to reference appropriate EUT setup and maximizing procedures of radiated spurious emission and AC line conducted emission testing

4.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

4.2 EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

4.3 GENERAL TEST PROCEDURES

Conducted Emissions

The power-line conducted emission test procedure is not described on the KDB 558074 v03r1. So this test was fulfilled with the requirements in Section 6.2 of ANSI C63.10.

The EUT is placed on the turntable, which is 0.8 m above ground plane and the conducted emissions from the EUT measured in the frequency range between 0.15MHz and 30MHz using CISPR Quasi-peak and Average detector.

Radiated Emissions

Basically the radiated tests were performed with KDB 558074 v03r1. But some requirements and procedures like test site requirements, EUT setup and maximizing procedure were fulfilled with the requirements in Section 5 and 6 of the ANSI C63.10 as stated on section 12.1 of the KDB 558074 v03r1.

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the highest emission, the relative positions of the EUT were rotated through three orthogonal axes..

4.4 DESCRIPTION OF TEST MODES

The EUT has been tested with all modes of operating conditions to determine the worst case emission characteristics. A test program is used to control the EUT for staying in continuous transmitting mode.

5. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipments, which is traceable to recognized national standards.

6. FACILITIES AND ACCREDITATIONS

6.1 FACILITIES

The open area test site(OATS) or semi anechoic chamber and conducted measurement facility used to collect the radiated and conducted test data are located at the 683-3, Yubang-Dong, Yongin-Si, Gyunggi-Do, 449-080, South Korea. The site is constructed in conformance with the requirements.

- Semi anechoic chamber registration Number : 678747

6.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and peak, quasi-peak detectors are used to perform radiated measurements. Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

7. ANTENNA REQUIREMENTS

7.1 According to FCC 47 CFR §15.203& RSS-Gen [7.1.2]:

An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 external antenna cable of this E.U.T is uniquely attached on the PCB by soldering..

Therefore this E.U.T Complies with the requirement of §15.203

7.2 Directional Antenna Gain for MIMO :

Bands	Chain 1 [dBi]	Chain 2 [dBi]	Directional Gain for uncorrelated signals [dBi]
2.4 GHz	4.68	4.68	4.68 < 6

Directional gain = $10 \log[(10^{G1/10} + 10^{G2/10} + \dots + 10^{GN/10})/N_{ANT}]$ dBi for MIMO uncorrelated signals

8. TEST RESULT

8.1 6dB Bandwidth

Test Requirements and limit, §15.247(a) & RSS-210 [A8.2]

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequencies.

The minimum permissible 6dB bandwidth is 500 kHz.

■ TEST CONFIGURATION

Refer to the APPENDIX I.

■ TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer and used following test procedure of **KDB558074 v03r1**.

1. Set resolution bandwidth (RBW) = 100 KHz
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
(**RBW:100KHz/VBW:300KHz**)
3. Detector = **Peak**.
4. Trace mode = **max hold**.
5. Sweep = **auto couple**.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

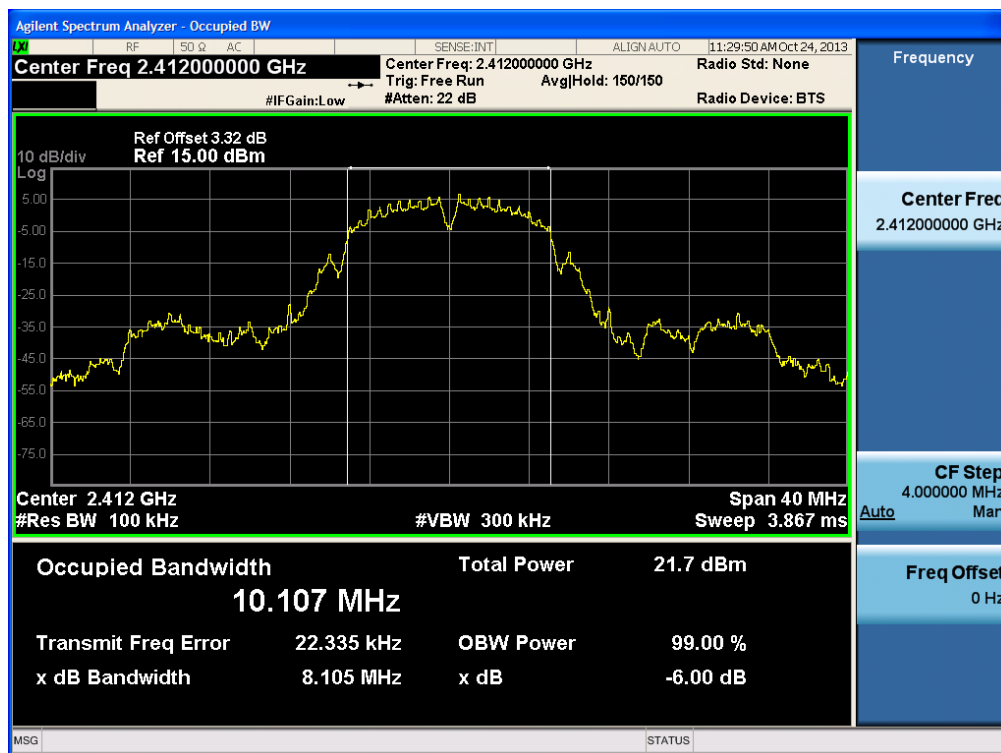
■ TEST RESULTS: **Comply**

Test Mode	Data Rate	Frequency [MHz]	Test Results[MHz]	
			Chain 1	Chain 2
802.11b	1 Mbps	2412	8.105	-
		2437	8.141	-
		2462	8.115	-
802.11g	6 Mbps	2412	15.160	-
		2437	15.110	-
		2462	15.140	-
802.11n (HT20)	MCS8	2412	15.140	15.120
		2437	15.160	15.130
		2462	15.120	15.320
802.11n (HT40)	MCS8	2422	35.230	35.140
		2437	35.190	35.720
		2452	35.130	35.750

■ RESULT PLOTS

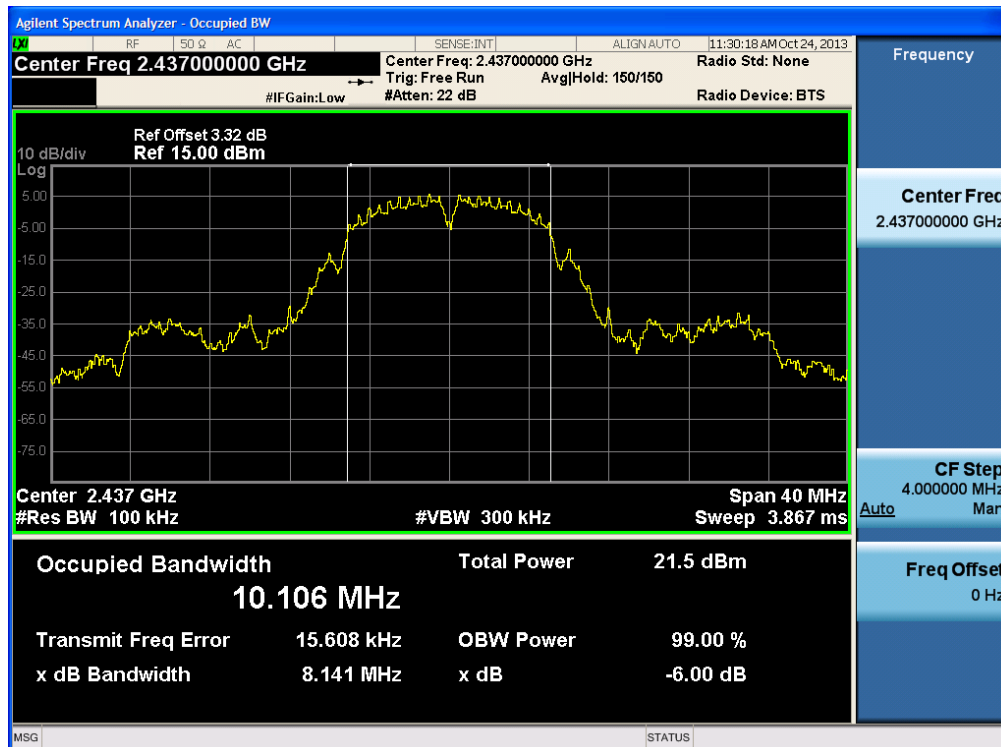
6 dB Bandwidth

Test Mode: Chain 1 & 802.11b & 1 Mbps & 2412MHz



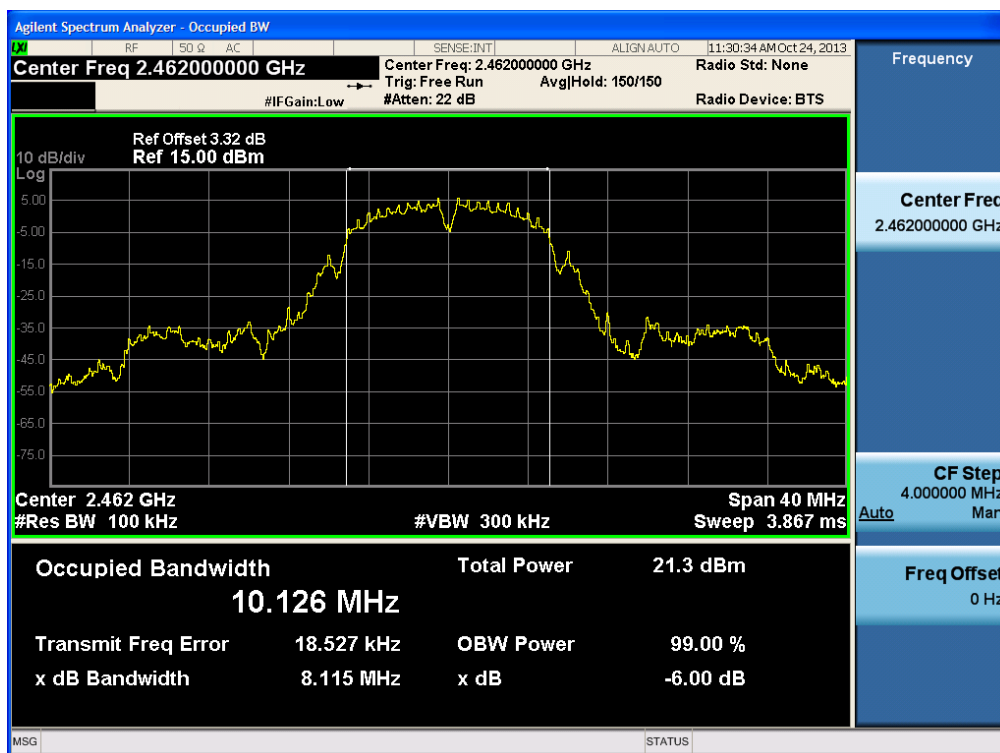
6 dB Bandwidth

Test Mode: Chain 1 & 802.11b & 1 Mbps & 2437MHz



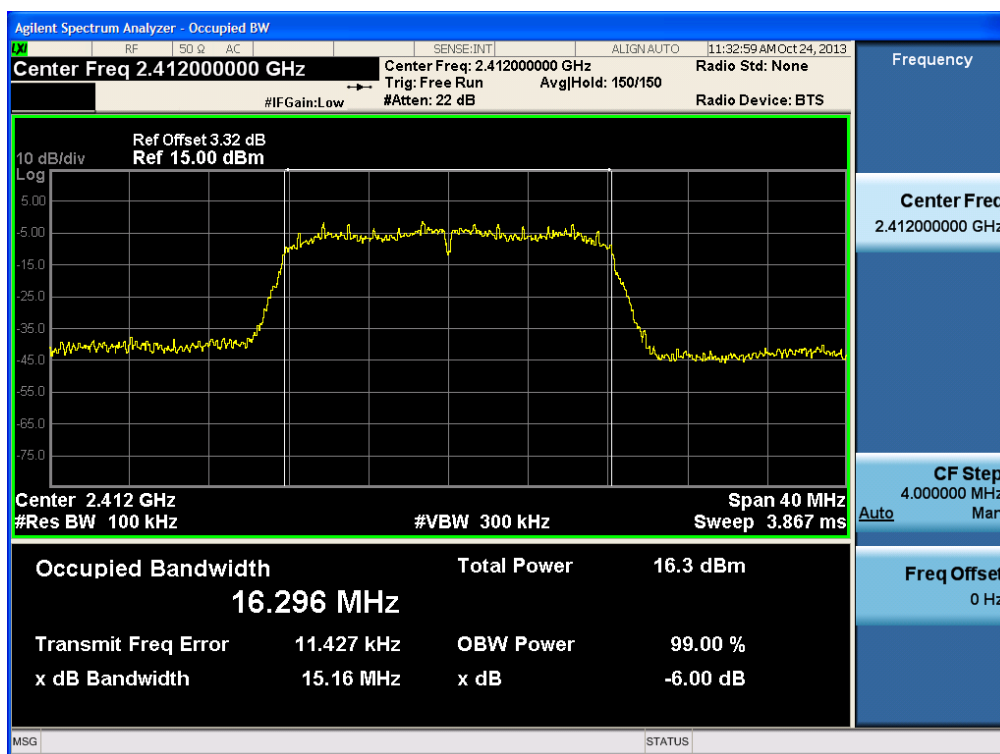
6 dB Bandwidth

Test Mode: Chain 1 & 802.11b & 1 Mbps & 2462MHz



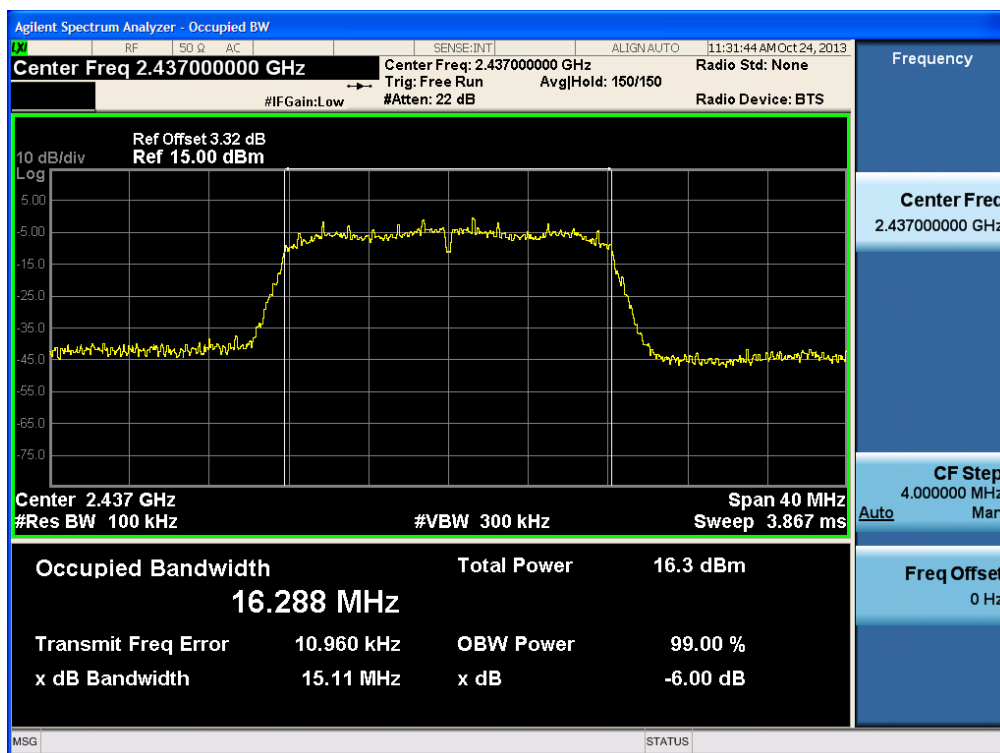
6 dB Bandwidth

Test Mode: Chain 1 & 802.11g & 6 Mbps & 2412MHz



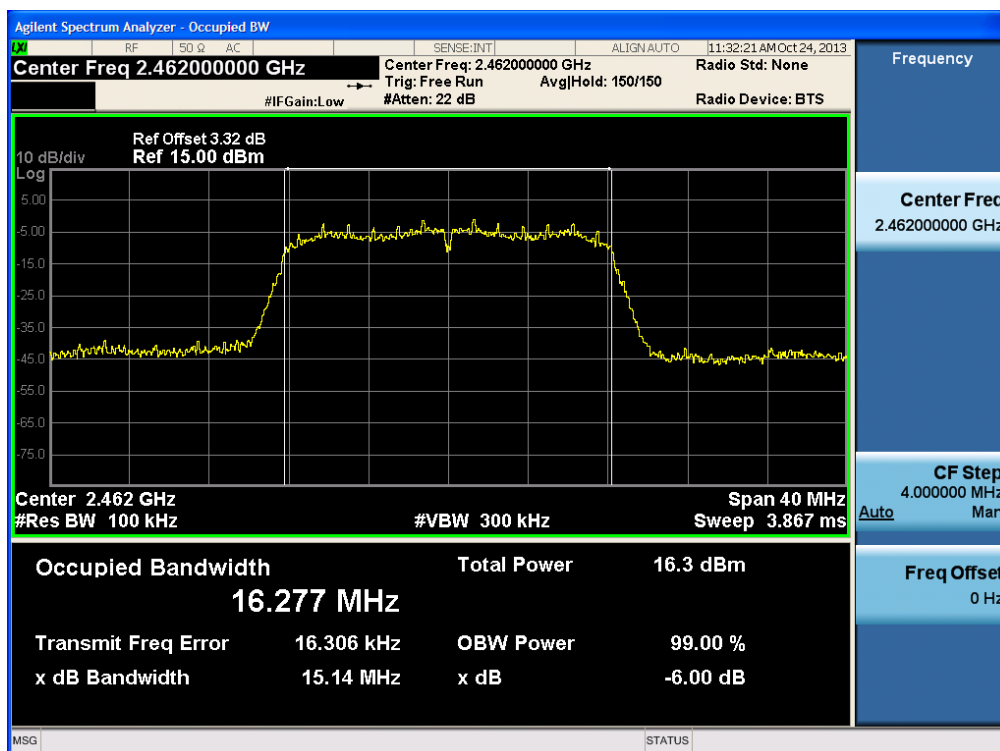
6 dB Bandwidth

Test Mode: Chain 1 & 802.11g & 6 Mbps & 2437MHz



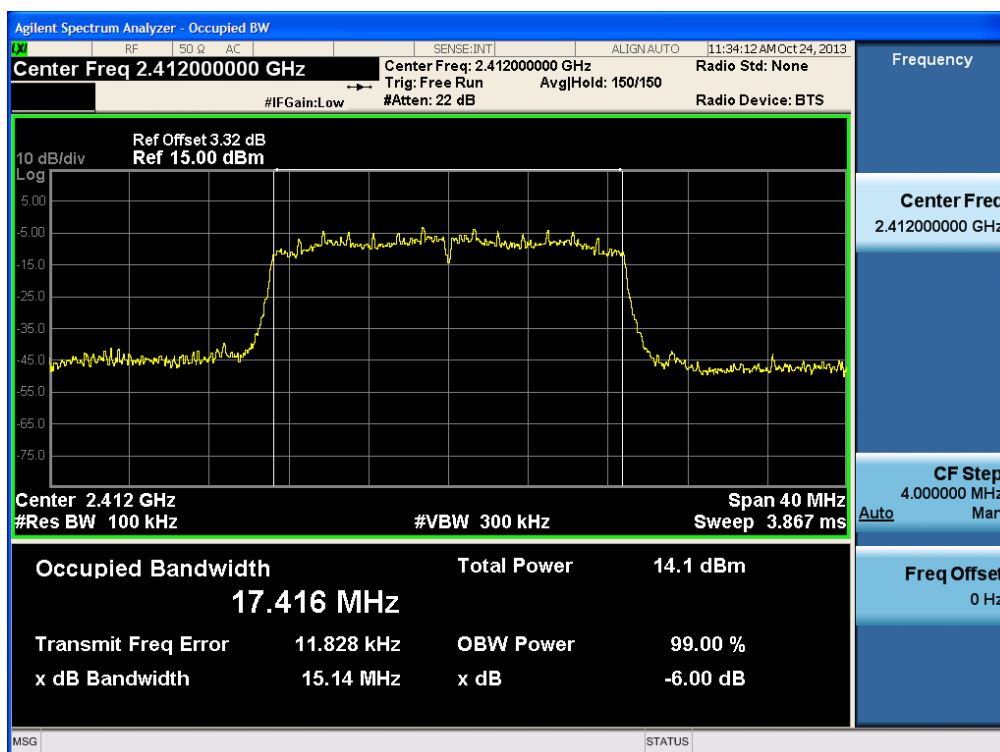
6 dB Bandwidth

Test Mode: Chain 1 & 802.11g & 6 Mbps & 2462MHz



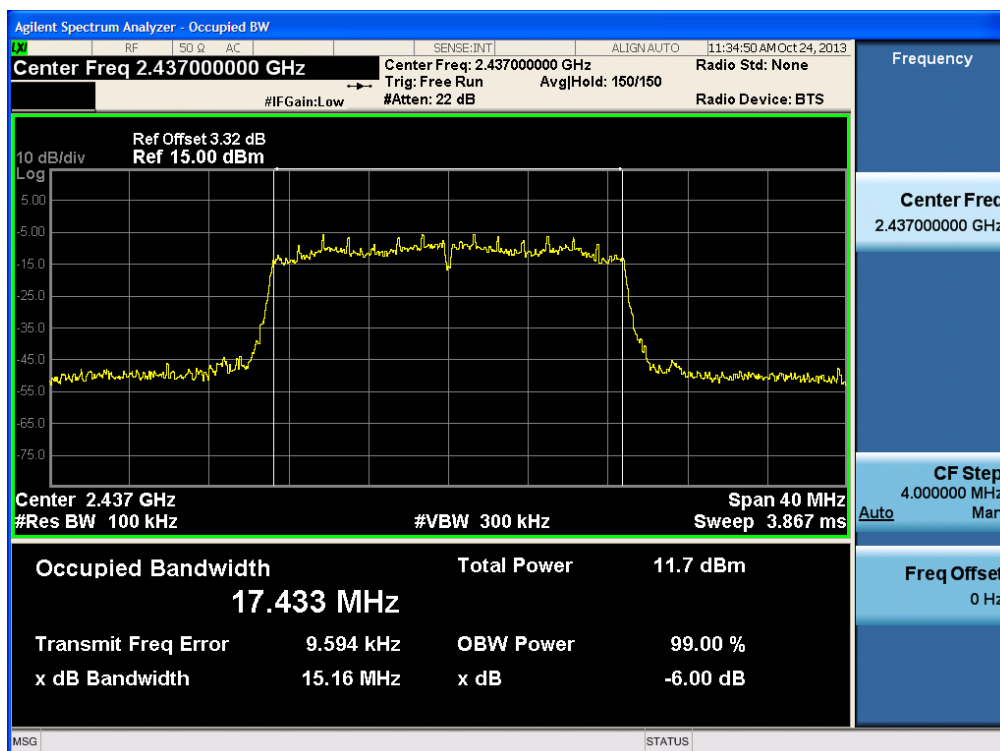
6 dB Bandwidth

Test Mode: Chain 1 & 802.11n HT20 & MCS8 & 2412MHz



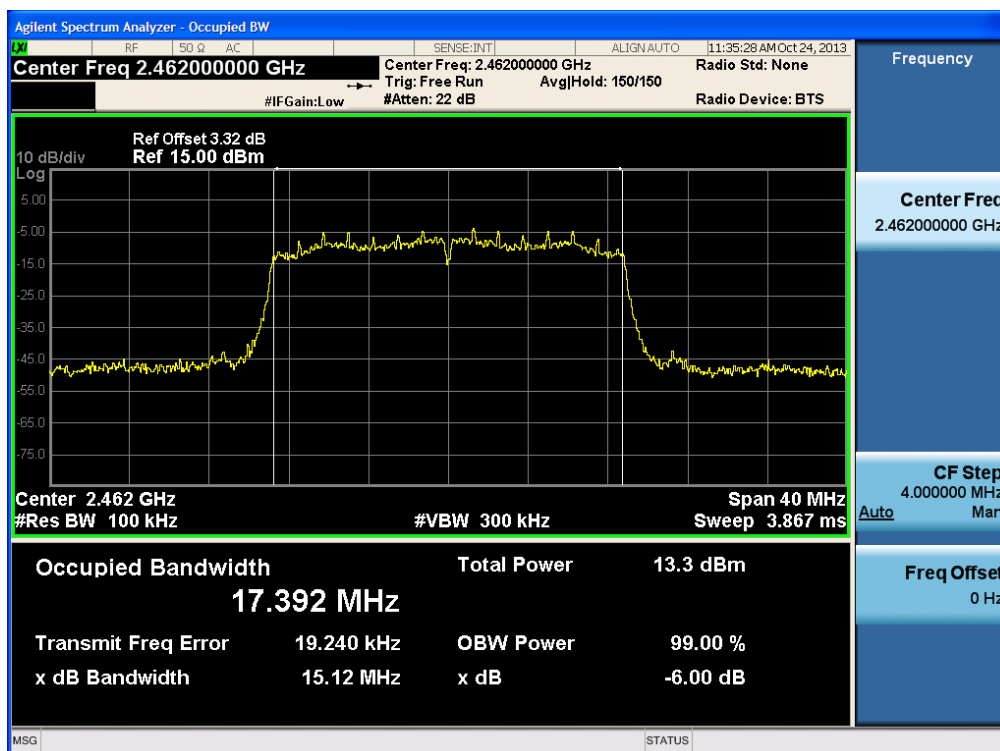
6 dB Bandwidth

Test Mode: Chain 1 & 802.11n HT20 & MCS8 & 2437MHz



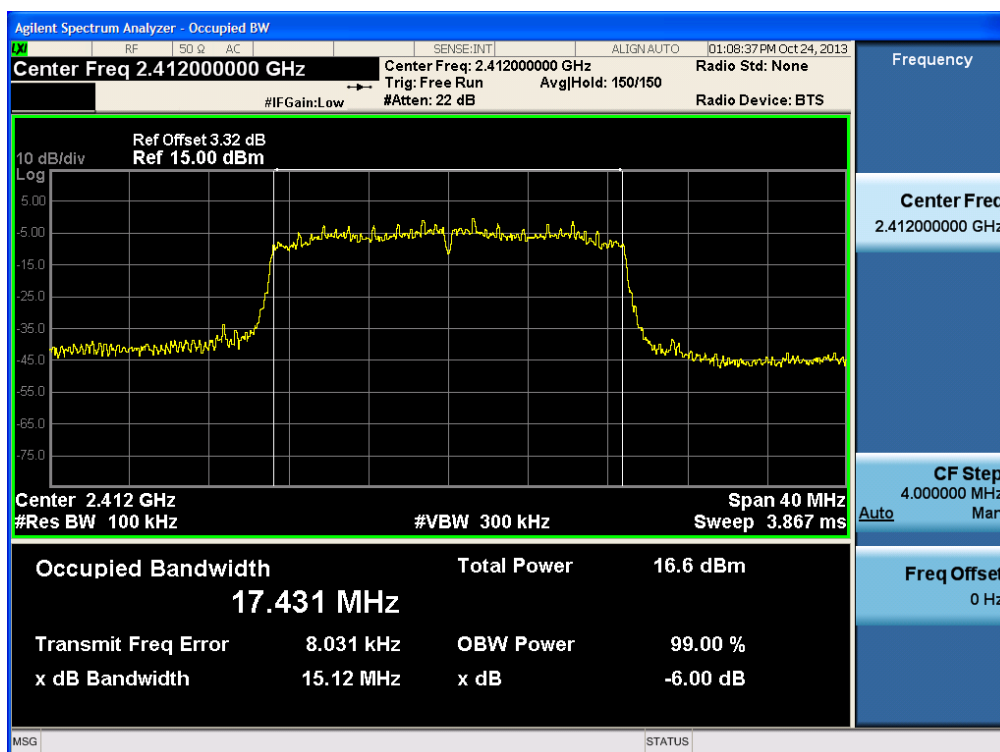
6 dB Bandwidth

Test Mode: Chain 1 & 802.11n HT20 & MCS8 & 2462MHz



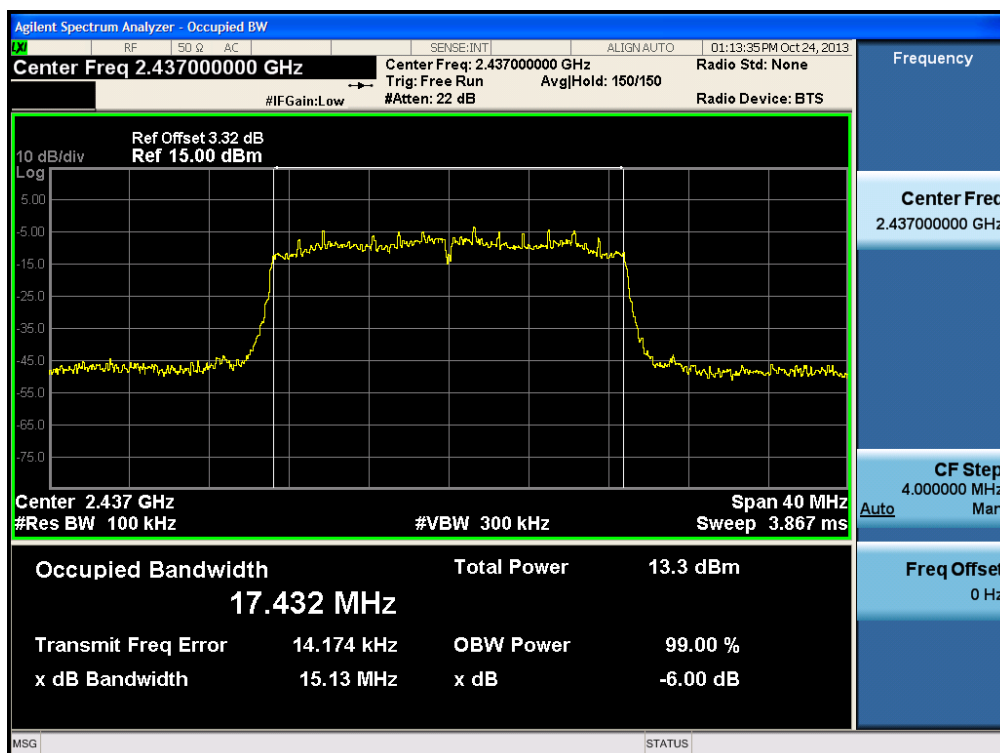
6 dB Bandwidth

Test Mode: Chain 2 & 802.11n HT20 & MCS8 & 2412MHz



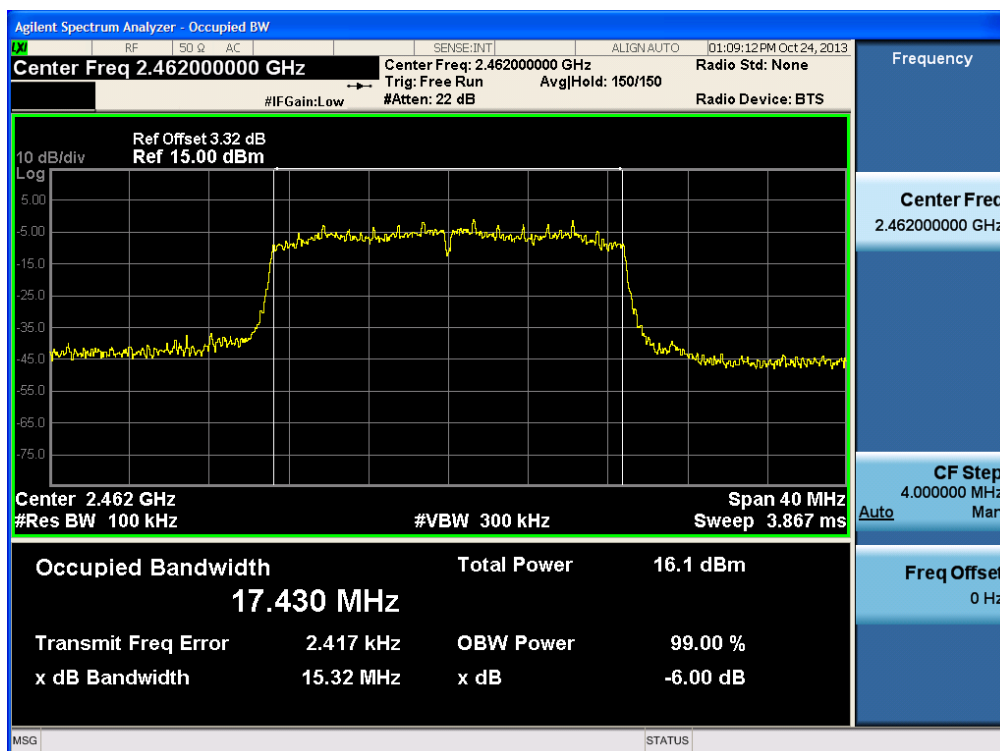
6 dB Bandwidth

Test Mode: Chain 2 & 802.11n HT20 & MCS8 & 2437MHz



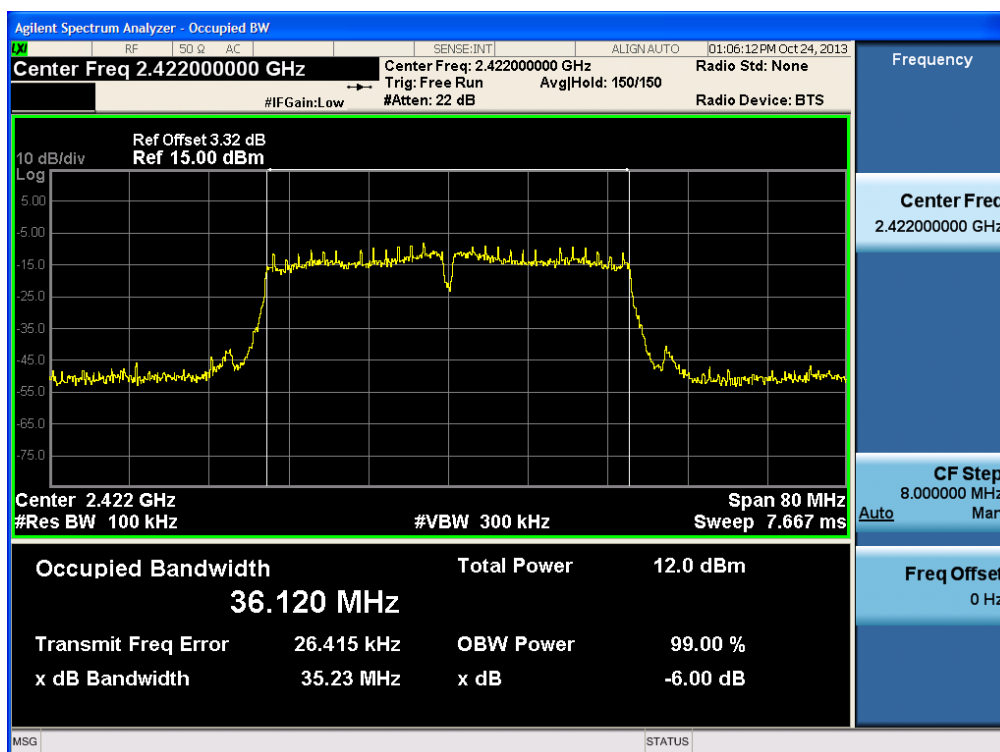
6 dB Bandwidth

Test Mode: Chain 2 & 802.11n HT20 & MCS8 & 2462MHz



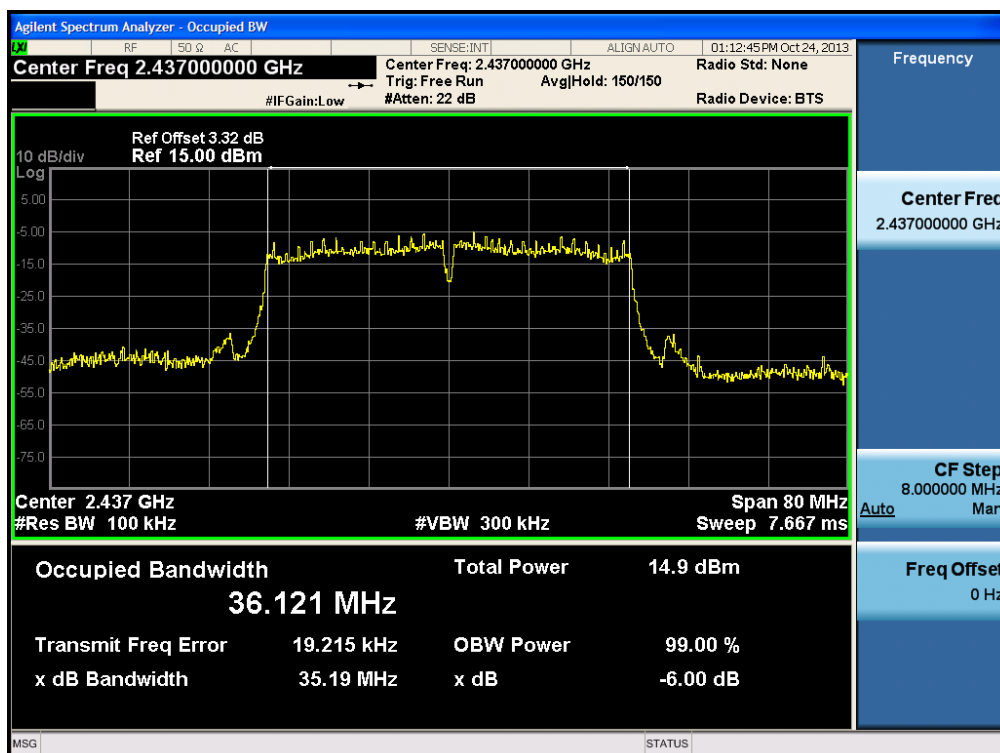
6 dB Bandwidth

Test Mode: Chain 1 & 802.11n HT40 & MCS8 & 2422MHz



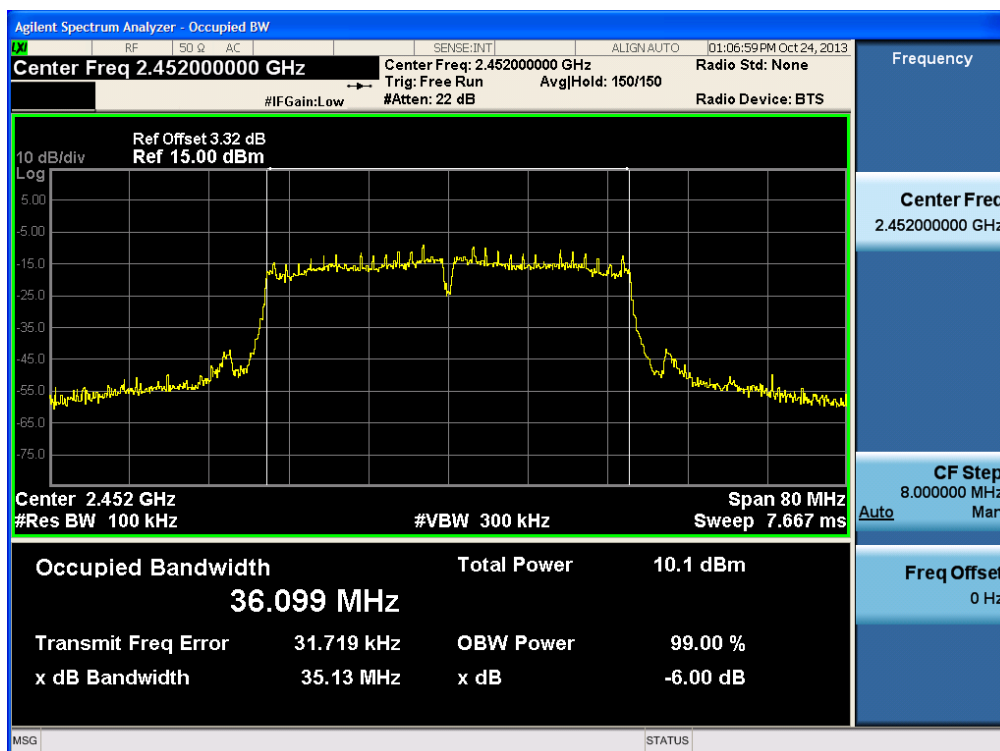
6 dB Bandwidth

Test Mode: Chain 1 & 802.11n HT40 & MCS8 & 2437MHz



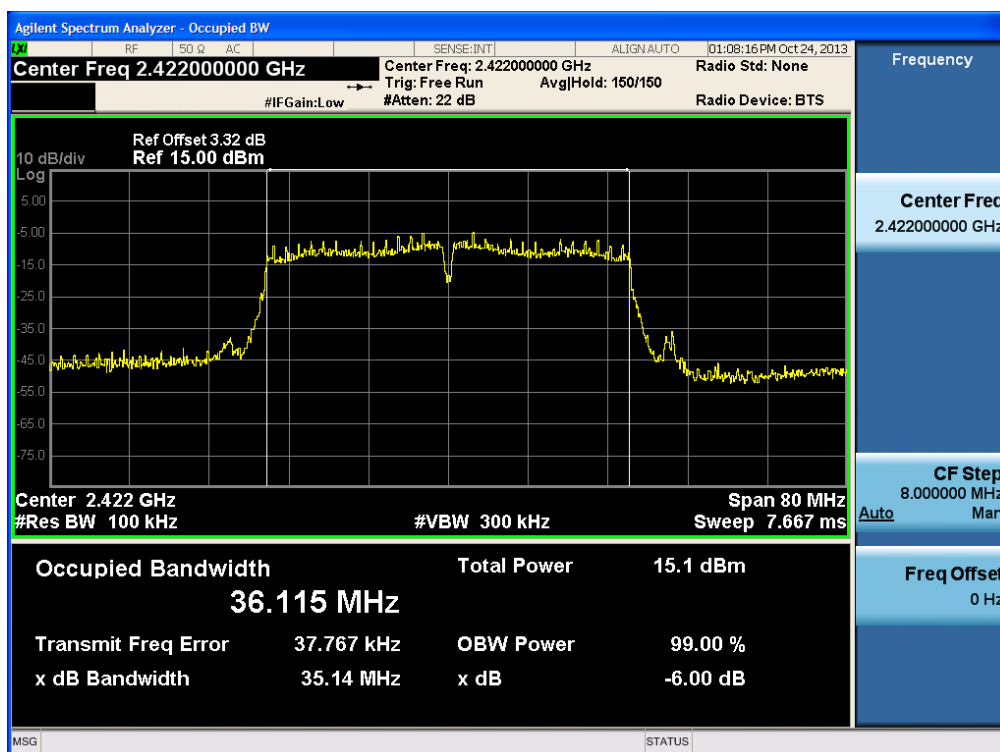
6 dB Bandwidth

Test Mode: Chain 1 & 802.11n HT40 & MCS8 & 2452MHz



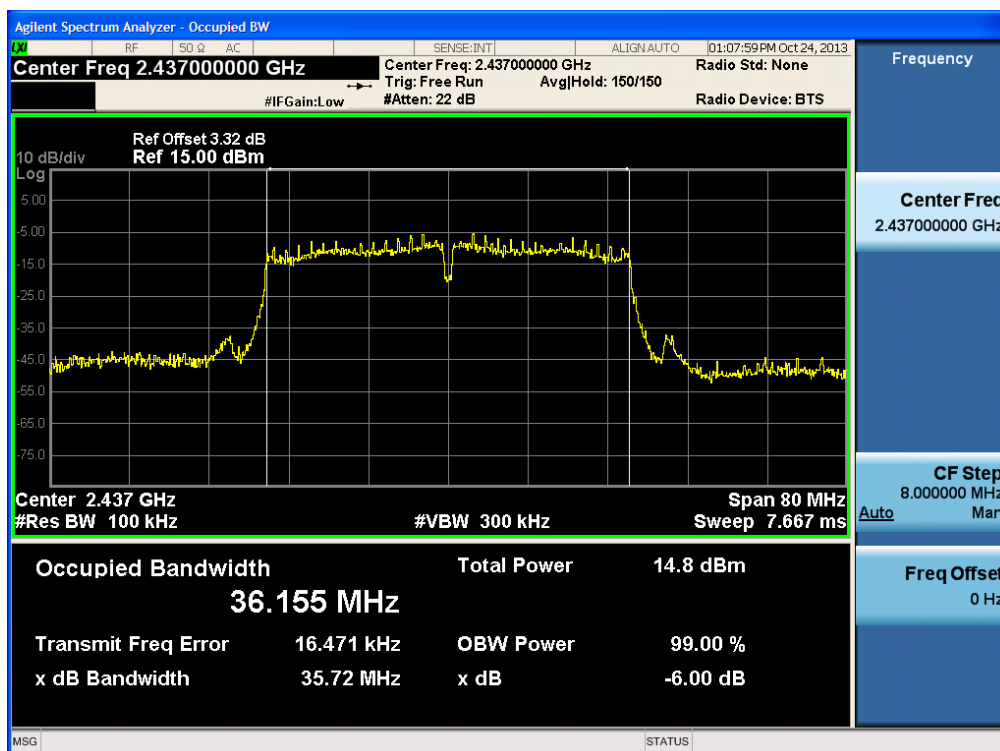
6 dB Bandwidth

Test Mode: Chain 2 & 802.11n HT40 & MCS8 & 2422MHz



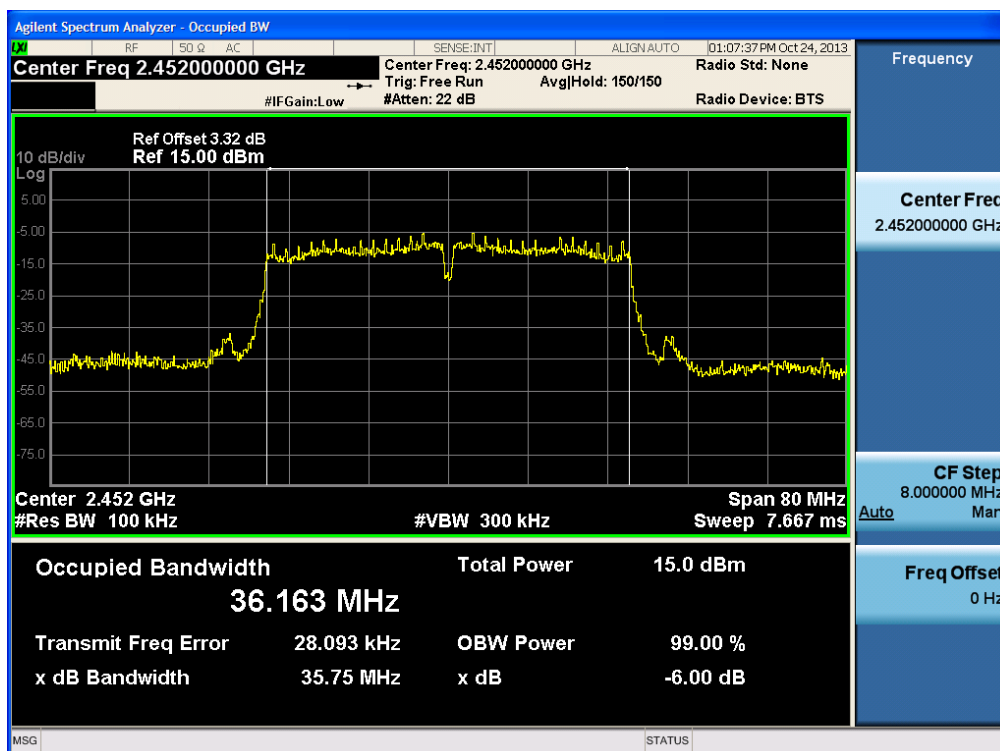
6 dB Bandwidth

Test Mode: Chain 2 & 802.11n HT40 & MCS8 & 2437MHz



6 dB Bandwidth

Test Mode: Chain 2 & 802.11n HT40 & MCS8 & 2452MHz

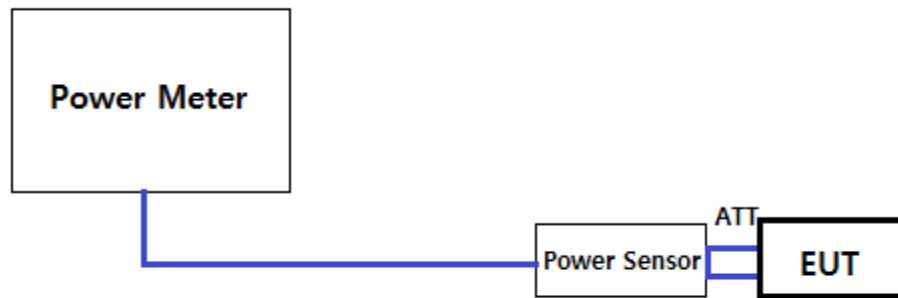


8.2 Maximum Peak Conducted Output Power

Test Requirements and limit, §15.247(b) & RSS-210 [A8.4]

The maximum permissible conducted output power is **1 Watt**.

■ TEST CONFIGURATION



■ TEST PROCEDURE:

PKPM1 Peak power meter method of KDB558074 v03r1

The maximum conducted output powers were measured using a broadband peak RF power meter which has greater video bandwidth than DUT's DTS bandwidth and utilize a fast-responding diode detector.

■ TEST RESULTS: **Comply**

- Measurement Data: **Comply**

Test Mode: 802.11b

Mode	Chain	Channel	Frequency [MHz]	Detector	Test Result [dBm]							
					DATA RATE [Mbps]							
					1	2	5.5	11	N/A	N/A	N/A	N/A
802.11b	1	1	2412	PK	20.15	20.15	20.09	20.12	-	-	-	-
		6	2437		19.91	19.72	19.76	19.65	-	-	-	-
		11	2462		19.96	19.87	19.86	19.91	-	-	-	-

Test Mode: 802.11g

Mode	Chain	Channel	Frequency [MHz]	Detector	Test Result [dBm]							
					DATA RATE [Mbps]							
					6	9	12	18	24	36	48	54
802.11g	1	1	2412	PK	23.32	22.77	22.26	22.74	22.44	22.78	22.16	22.15
		6	2437		23.15	23.06	22.56	22.48	22.46	23.01	22.46	22.18
		11	2462		22.83	22.63	22.28	22.36	22.00	22.78	21.67	21.99

Test Mode: 802.11n(HT20) / MCS0~7 (1TX)

Mode	Chain	Channel	Frequency [MHz]	Detector	Test Result [dBm]							
					DATA RATE [MCS]							
					0	1	2	3	4	5	6	7
802.11n (HT20)	1	1	2412	PK	19.94	19.63	19.45	19.37	19.18	19.45	19.06	18.96
		6	2437		19.73	19.53	19.69	19.34	18.98	18.58	19.63	19.32
		11	2462		19.91	19.74	19.75	18.80	19.16	18.92	19.96	19.25
	2	1	2412		22.70	22.47	21.96	21.65	22.31	22.03	21.81	21.93
		6	2437		23.34	22.85	22.60	22.59	23.01	22.49	22.40	22.55
		11	2462		22.56	22.17	22.19	21.84	22.06	21.76	21.55	21.84

Test Mode: 802.11n(HT20) / MCS8~15 (2TX)

Mode	Chain	Channel	Frequency [MHz]	Detector	Test Result [dBm]							
					DATA RATE [MCS]							
					8	9	10	11	12	13	14	15
802.11n (HT20)	1	1	2412	PK	20.01	19.95	19.61	19.42	19.12	19.98	19.00	18.83
		6	2437		19.74	19.37	19.12	19.31	18.99	20.02	19.06	19.00
		11	2462		19.52	18.54	18.96	19.04	18.92	19.26	18.49	18.67
	2	1	2412		22.48	22.36	22.14	21.92	22.13	22.36	22.35	21.96
		6	2437		22.25	21.86	21.74	21.61	21.75	21.68	21.58	21.45
		11	2462		22.35	22.13	22.14	21.89	21.78	21.38	21.58	21.23
	1+2 (Sum)	1	2412		24.43	24.33	24.07	23.86	23.89	24.34	24.00	23.68
		6	2437		24.18	23.80	23.63	23.62	23.60	23.94	23.51	23.41
		11	2462		24.17	23.71	23.85	23.71	23.59	23.46	23.31	23.15

Test Mode: 802.11n(HT40) / MCS0~7 (1TX)

Mode	Chain	Channel	Frequency [MHz]	Detector	Test Result [dBm]							
					DATA RATE [MCS]							
					0	1	2	3	4	5	6	7
802.11n (HT40)	1	3	2422	PK	18.35	18.22	18.23	18.21	18.07	17.93	17.95	17.34
		6	2437		18.76	18.60	18.13	18.18	18.08	18.26	17.22	17.42
		9	2452		19.00	18.74	18.66	18.50	18.66	17.97	17.59	17.17
	2	3	2422		20.19	19.99	19.71	19.23	19.50	19.24	19.39	19.14
		6	2437		19.98	19.67	19.68	18.82	19.25	19.05	19.14	19.11
		9	2452		19.50	19.16	18.72	18.55	18.84	18.34	18.28	17.95

Test Mode: 802.11n(HT40) / MCS8~15 (2TX)

Mode	Chain	Channel	Frequency [MHz]	Detector	Test Result [dBm]							
					DATA RATE [MCS]							
					8	9	10	11	12	13	14	15
802.11n (HT40)	1	3	2422	PK	18.24	18.07	17.88	18.11	17.70	17.41	17.36	17.47
		6	2437		17.93	17.77	17.76	17.91	17.40	16.88	17.04	17.27
		9	2452		17.73	17.34	17.61	17.47	17.47	16.70	16.96	16.99
	2	3	2422		20.34	19.58	19.62	20.13	19.80	19.80	19.24	19.04
		6	2437		19.88	18.97	18.90	19.44	19.03	19.23	18.68	18.39
		9	2452		19.54	19.11	18.83	18.75	18.90	18.77	18.75	18.92
	1+2 (Sum)	3	2422		22.43	21.90	21.85	22.25	21.89	21.78	21.41	21.34
		6	2437		22.02	21.42	21.38	21.75	21.30	21.22	20.95	20.88
		9	2452		21.74	21.32	21.27	21.17	21.25	20.87	20.96	21.07

8.3 Maximum Power Spectral Density

Test requirements and limit, §15.247(e) & RSS-210 [A8.2]

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

Minimum Standard –specifies a conducted power spectral density (PSD) limit of 8 dBm in any 3 kHz band segment within the fundamental EBW during any time interval of continuous transmission.

■ TEST CONFIGURATION

Refer to the APPENDIX I.

■ TEST PROCEDURE:

The Measurement Procedure **Method PKPSD of KDB558074 v03r1** is used.

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to **1.5 times** the DTS bandwidth.
3. Set the RBW to: **3 kHz ≤ RBW ≤ 100 kHz**.
4. Set the VBW ≥ **3 x RBW**.
5. Detector = **peak**.
6. Sweep time = **auto couple**.
7. Trace mode = **max hold**.
8. Allow trace to fully stabilize.
9. Use the **peak marker function** to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

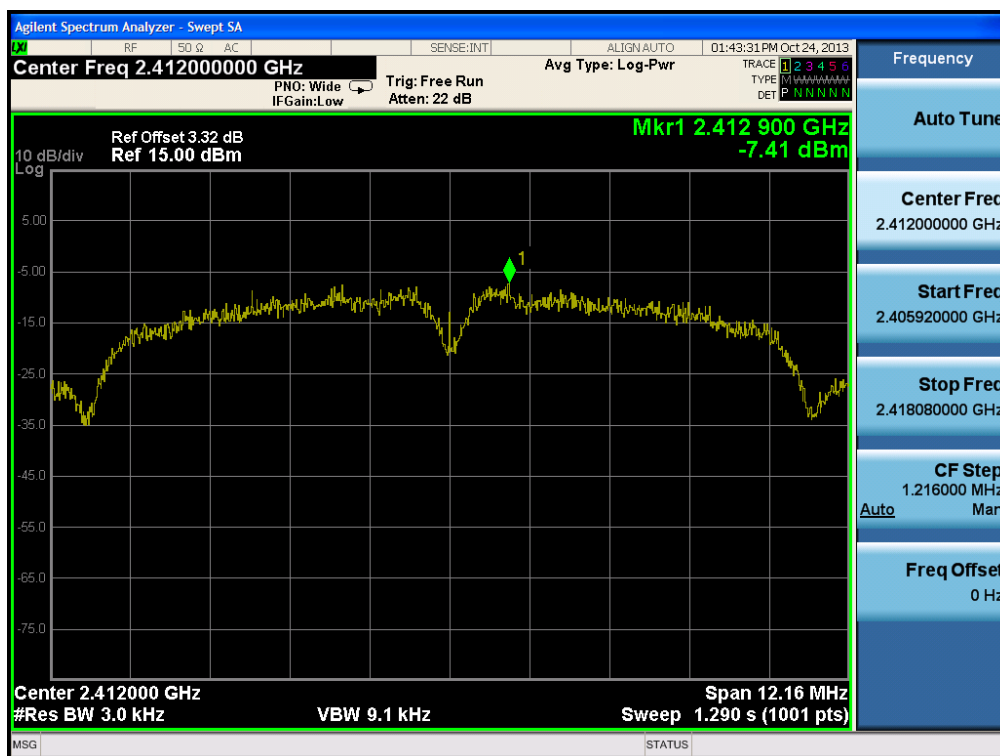
■ TEST RESULTS: **Comply**

Test Mode	Data Rate	Frequency [MHz]	RBW	PKPSD[dBm]		
				Chain 1	Chain 2	Chain1+2 (Sum)
802.11b	1 Mbps	2412	3 kHz	- 7.41	-	-
		2437	3 kHz	- 7.34	-	-
		2462	3 kHz	- 6.51	-	-
802.11g	6 Mbps	2412	3 kHz	- 13.69	-	-
		2437	3 kHz	- 13.82	-	-
		2462	3 kHz	- 14.90	-	-
802.11n (HT20)	MCS8	2412	3 kHz	- 16.26	- 15.29	- 12.74
		2437	3 kHz	- 17.80	- 14.21	- 12.64
		2462	3 kHz	- 17.91	- 14.89	- 13.14
802.11n (HT40)	MCS8	2422	3 kHz	- 22.05	- 19.41	- 17.53
		2437	3 kHz	- 23.59	- 20.27	- 18.61
		2452	3 kHz	- 22.03	- 18.95	- 17.22

■ RESULT PLOTS

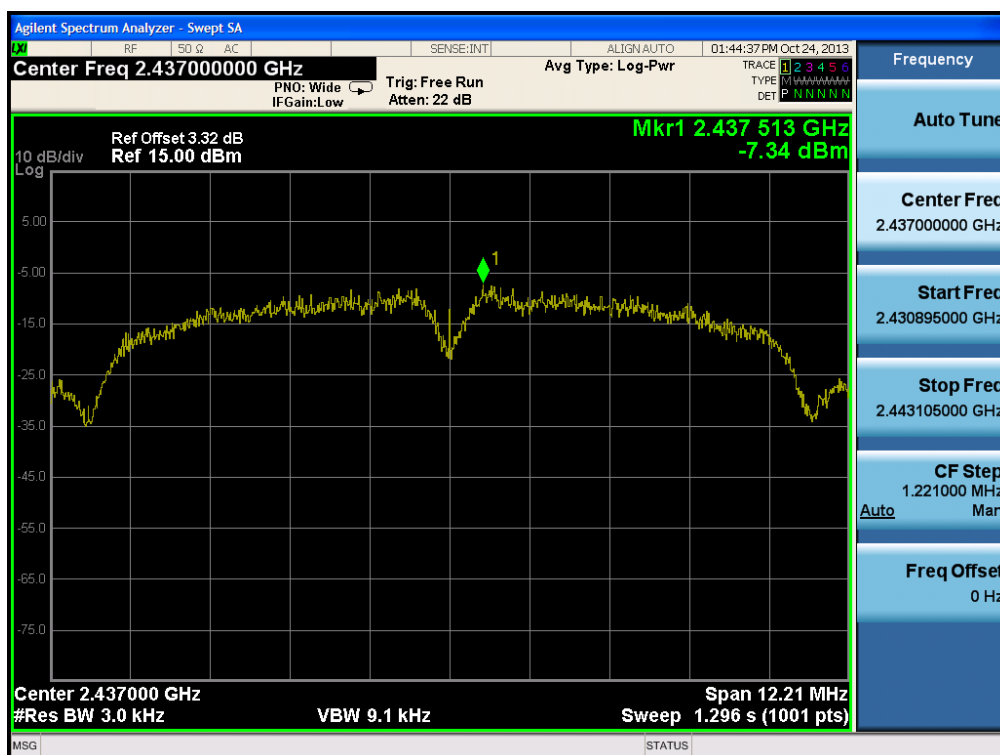
Maximum PPSP

Test Mode: Chain 1 & 802.11b & 1 Mbps & 2412MHz



Maximum PPSP

Test Mode: Chain 1 & 802.11b & 1 Mbps & 2437MHz



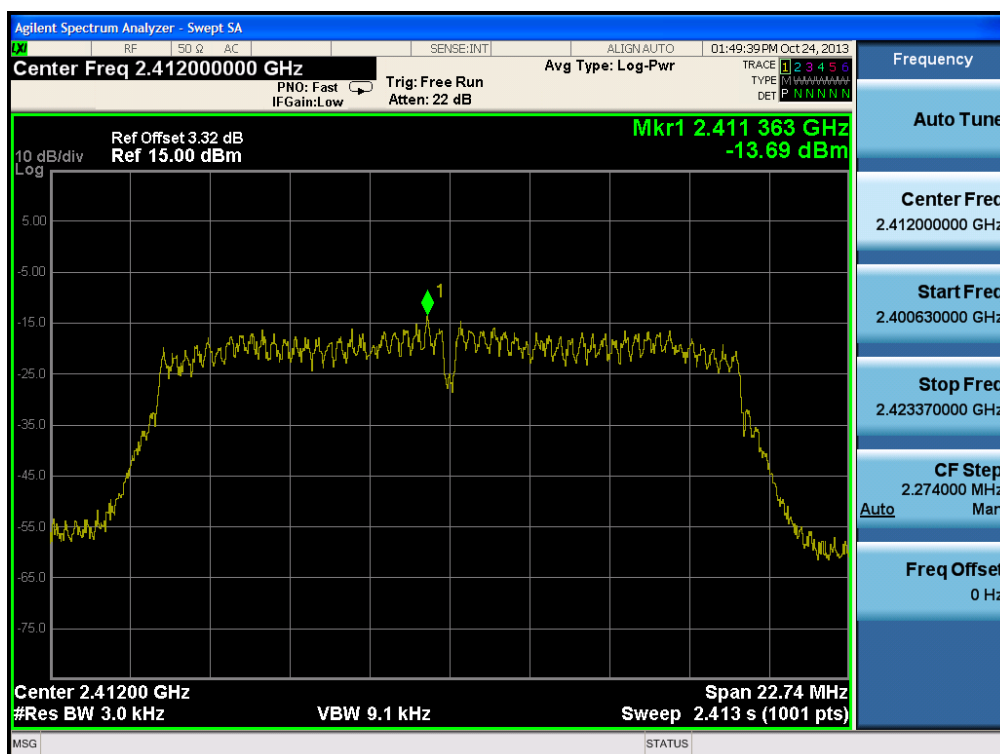
Maximum PPSD

Test Mode: Chain 1 & 802.11b & 1 Mbps & 2462MHz



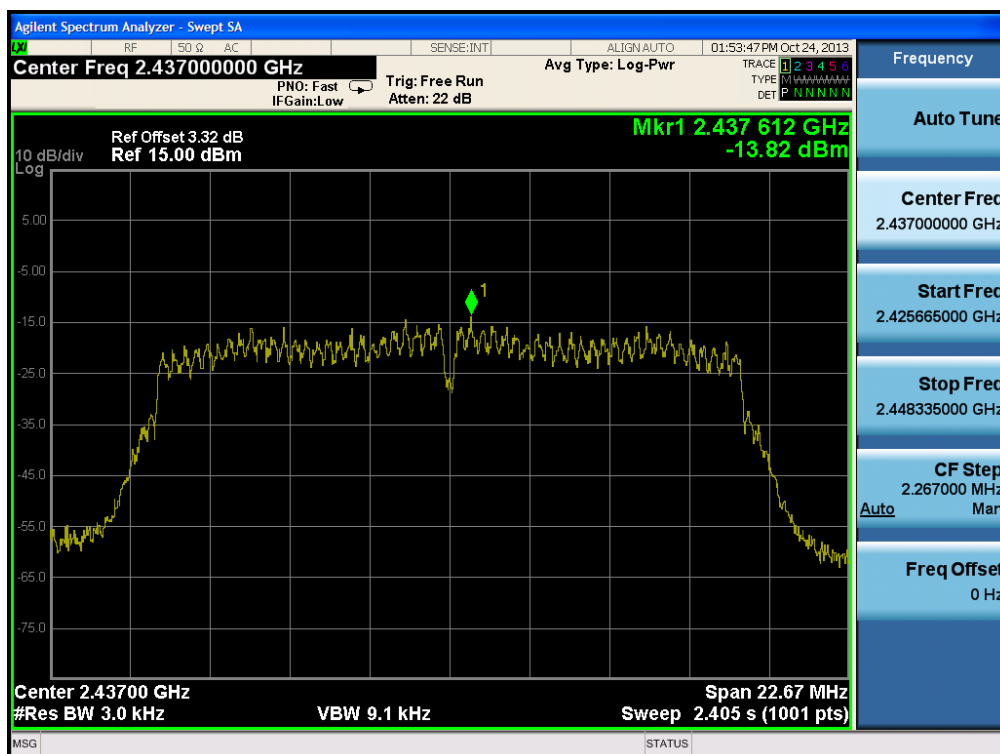
Maximum PPSD

Test Mode: Chain 1 & 802.11g & 6 Mbps & 2412MHz



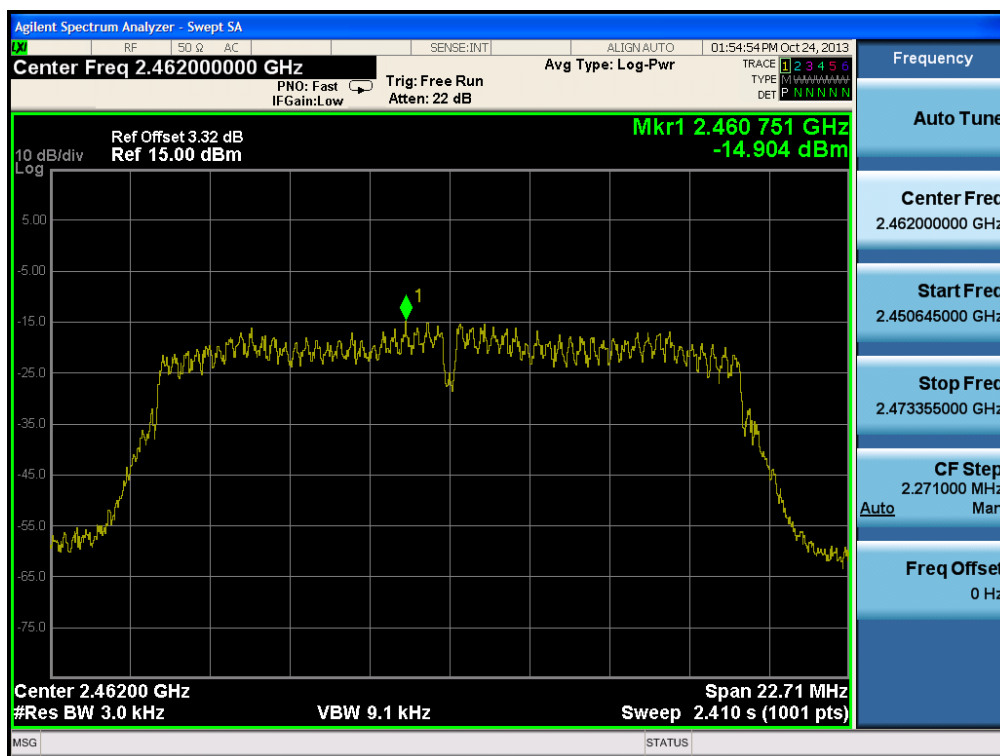
Maximum PPSD

Test Mode: Chain 1 & 802.11g & 6 Mbps & 2437MHz



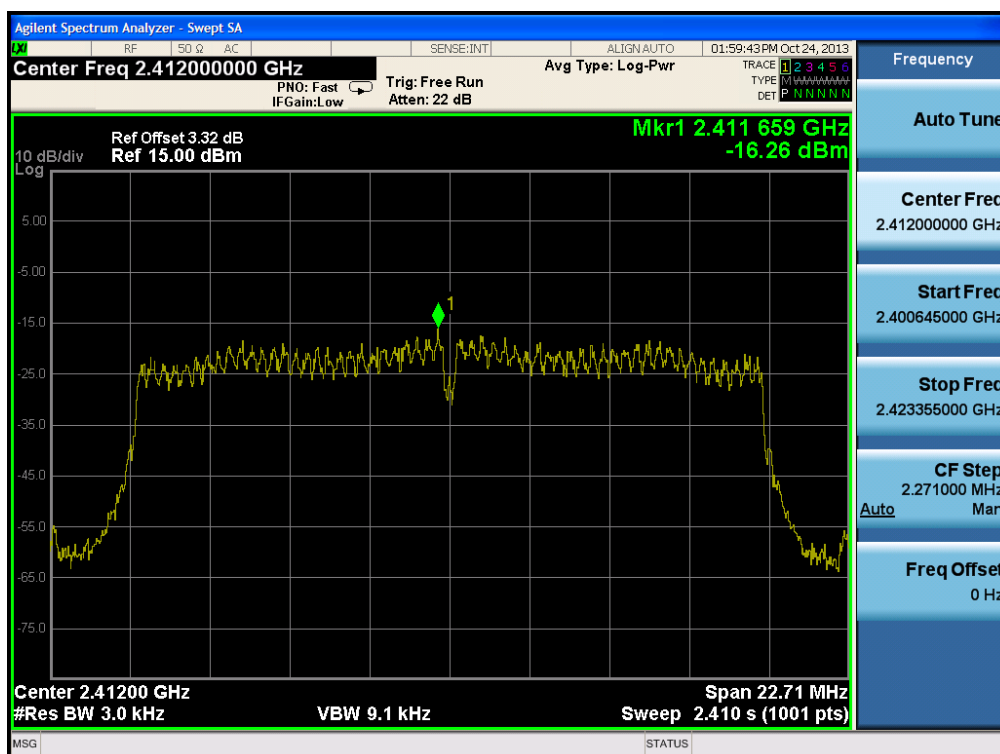
Maximum PPSD

Test Mode: Chain 1 & 802.11g & 6 Mbps & 2462MHz



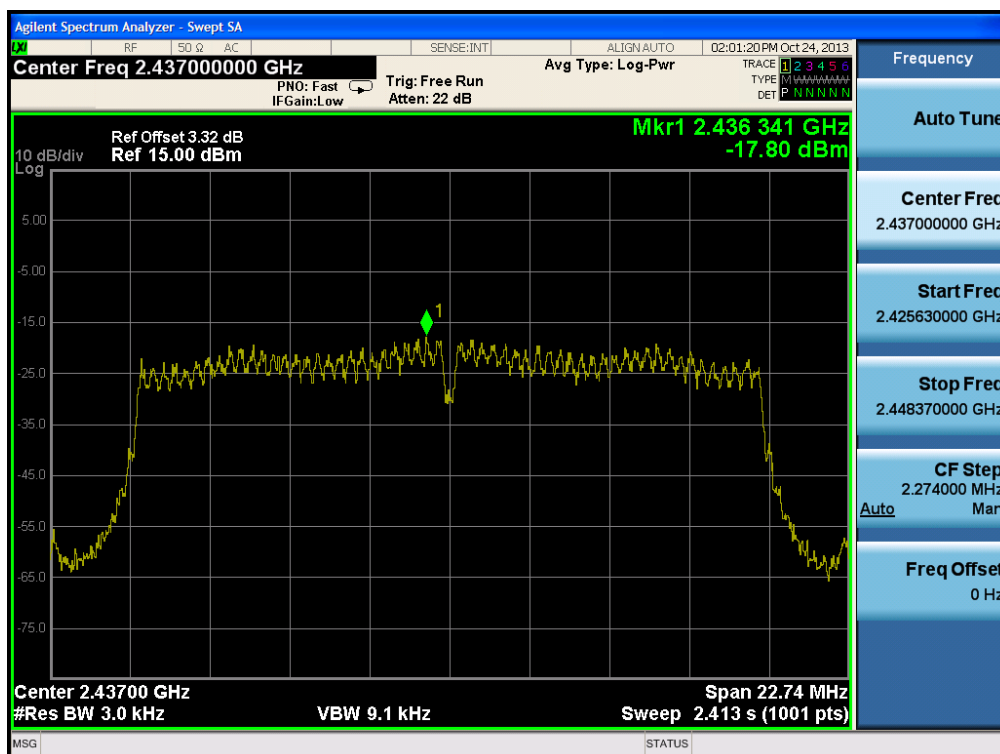
Maximum PPSD

Test Mode: Chain 1 & 802.11n HT20 & MCS8 & 2412MHz



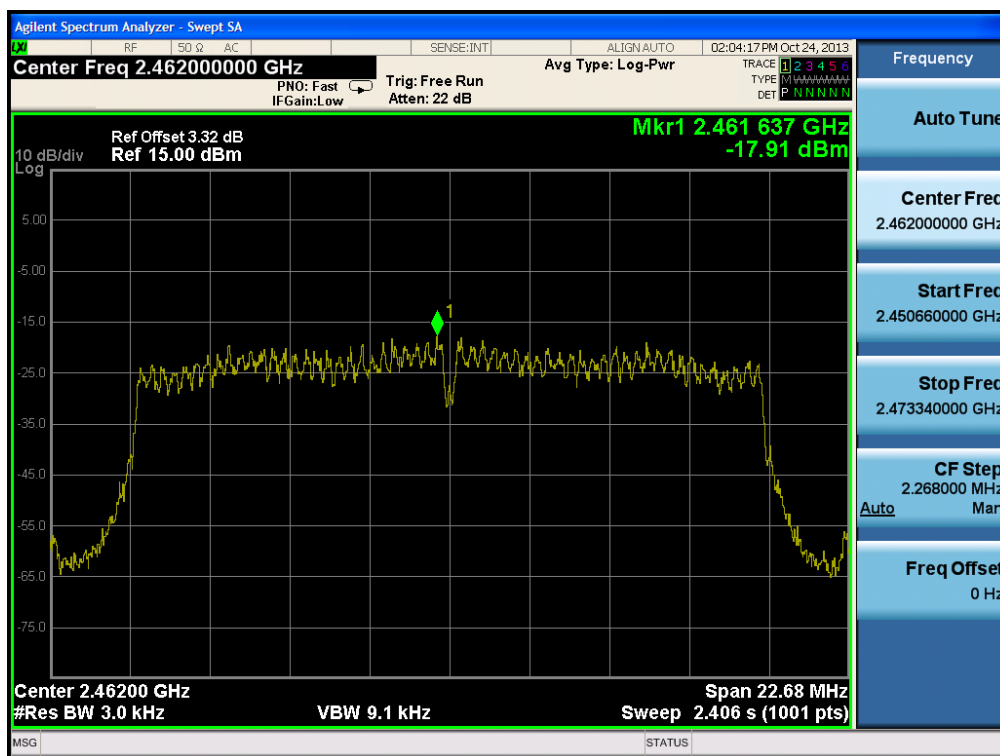
Maximum PPSD

Test Mode: Chain 1 & 802.11n HT20 & MCS8 & 2437MHz



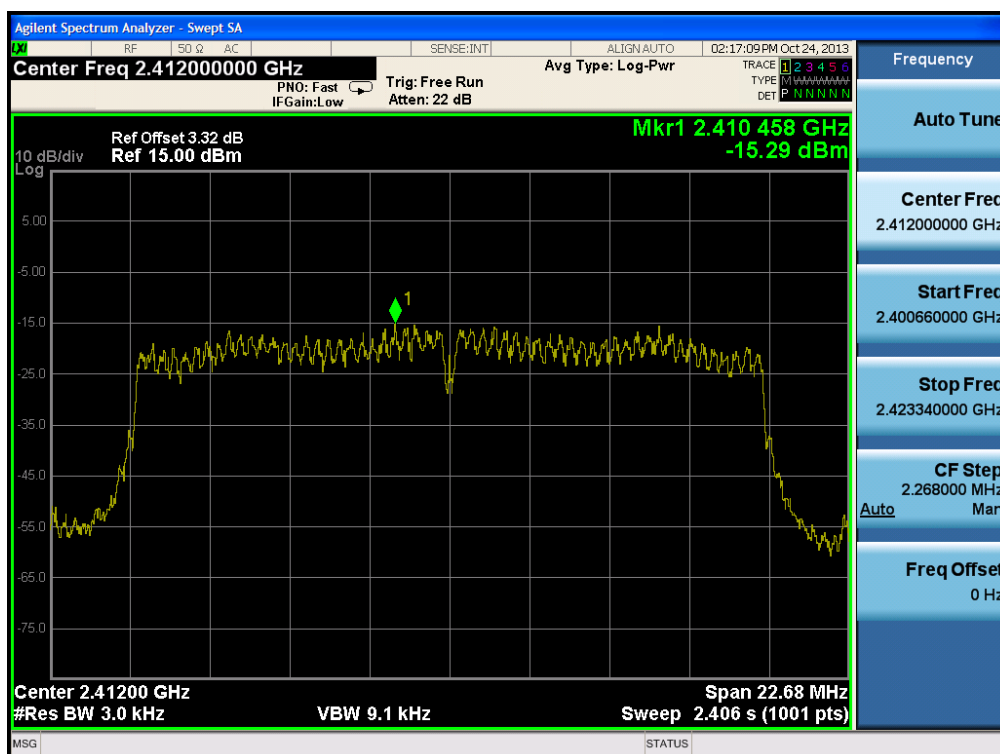
Maximum PPSD

Test Mode: Chain 1 & 802.11n HT20 & MCS8 & 2462MHz



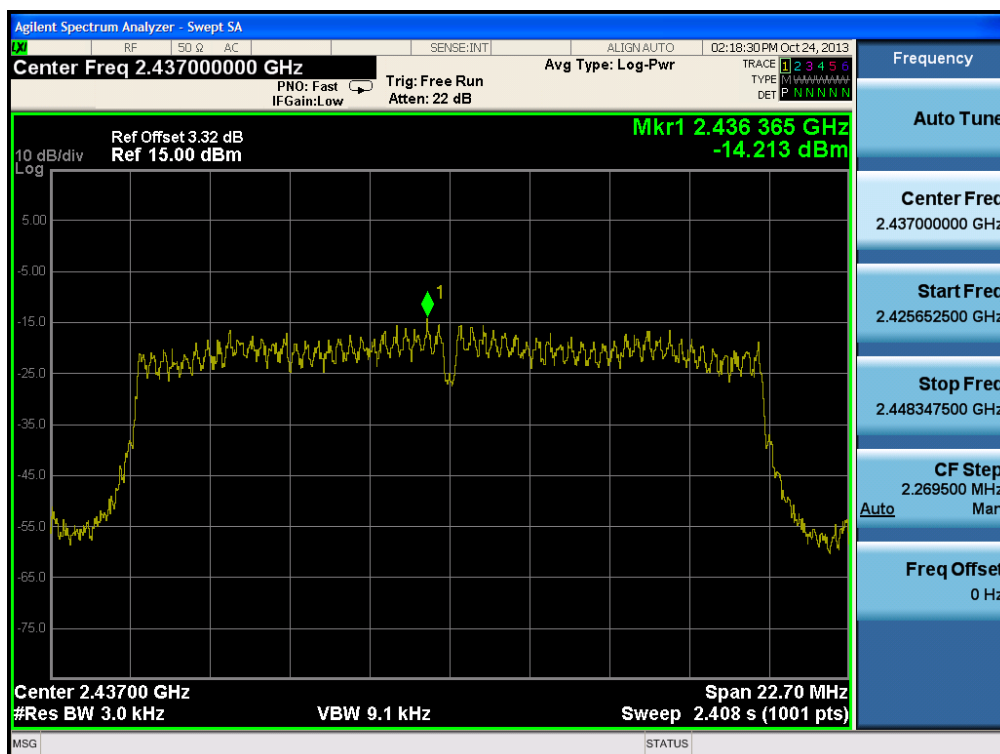
Maximum PPSD

Test Mode: Chain 2 & 802.11n HT20 & MCS8 & 2412MHz



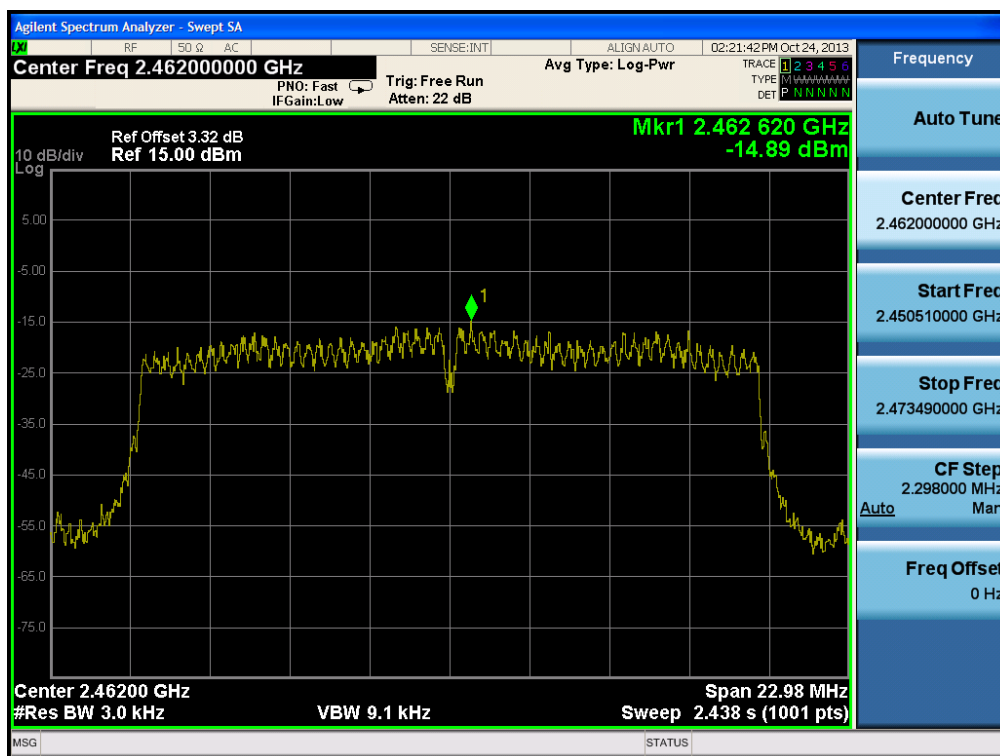
Maximum PPSD

Test Mode: Chain 2 & 802.11n HT20 & MCS8 & 2437MHz



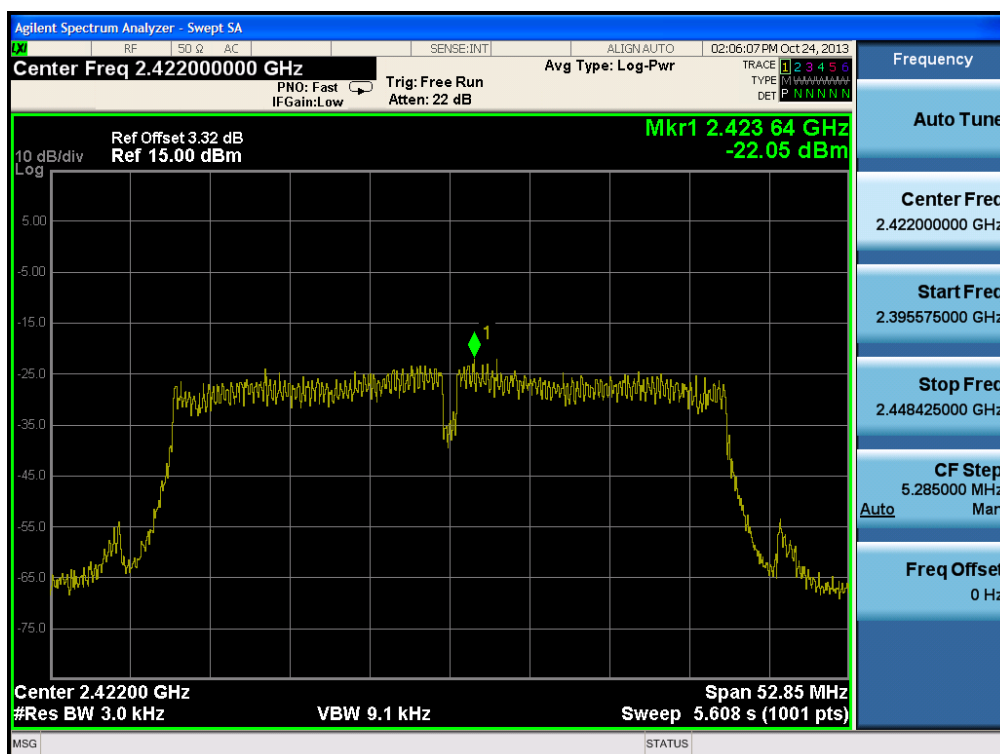
Maximum PPSD

Test Mode: Chain 2 & 802.11n HT20 & MCS8 & 2462MHz



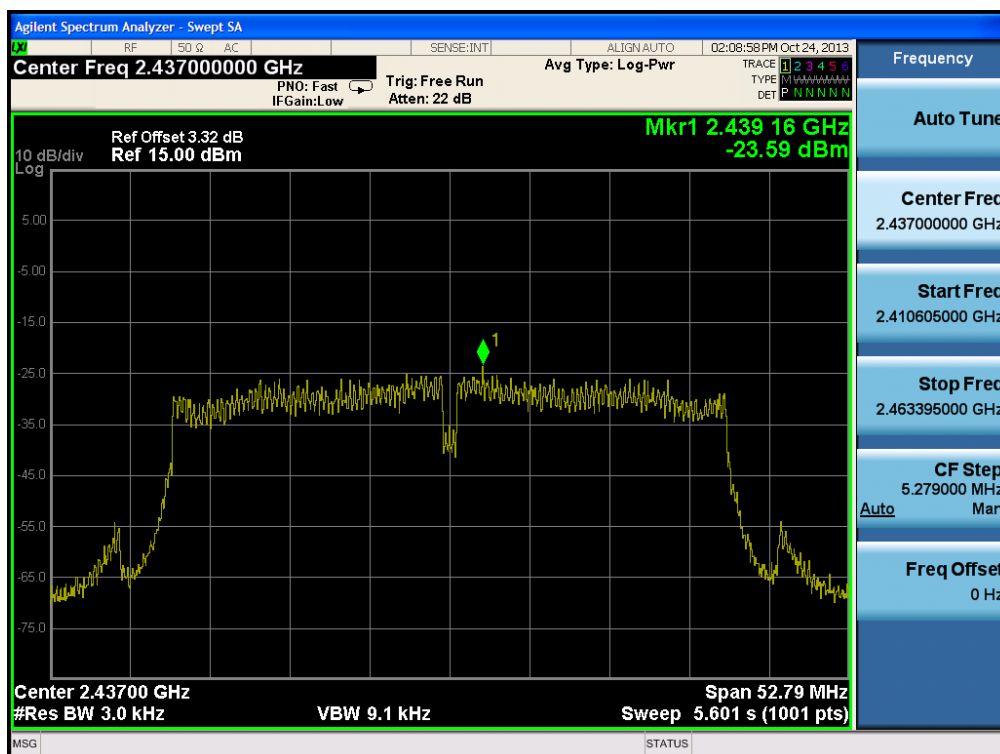
Maximum PPSD

Test Mode: Chain 1 & 802.11n HT40 & MCS8 & 2422MHz



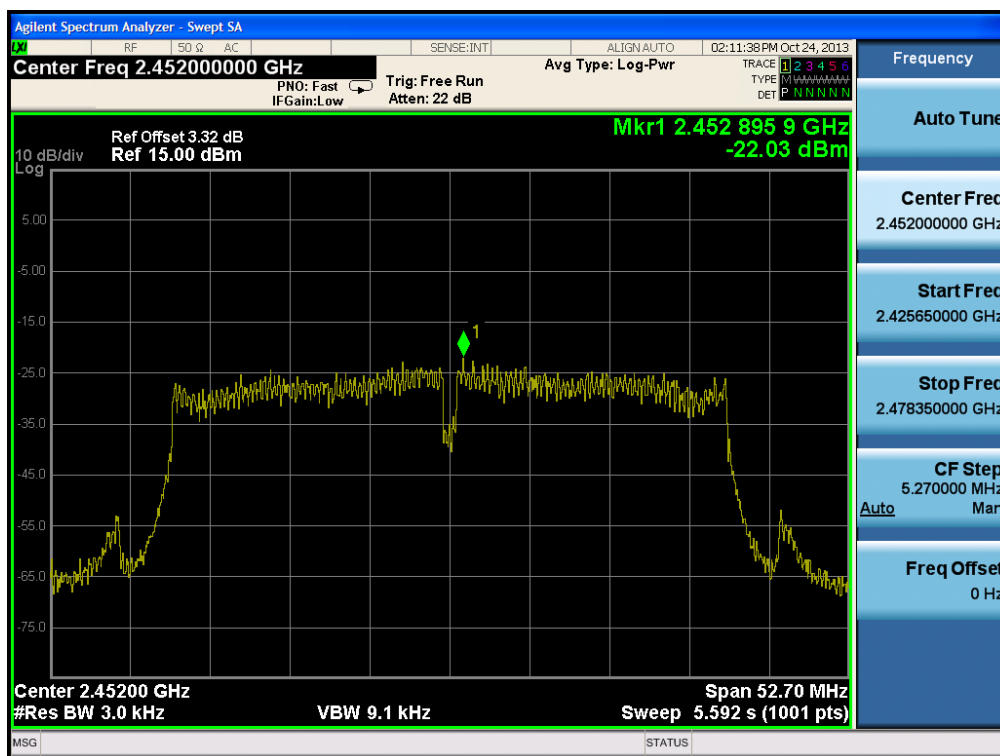
Maximum PPSD

Test Mode: Chain 1 & 802.11n HT40 & MCS8 & 2437MHz



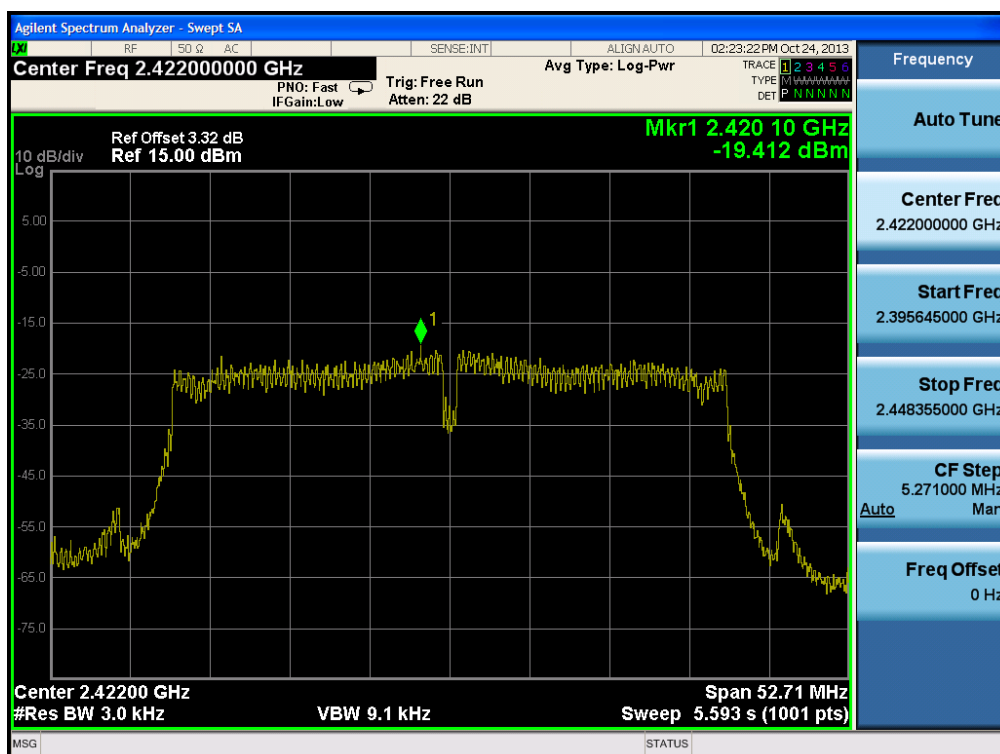
Maximum PPSD

Test Mode: Chain 1 & 802.11n HT40 & MCS8 & 2452MHz



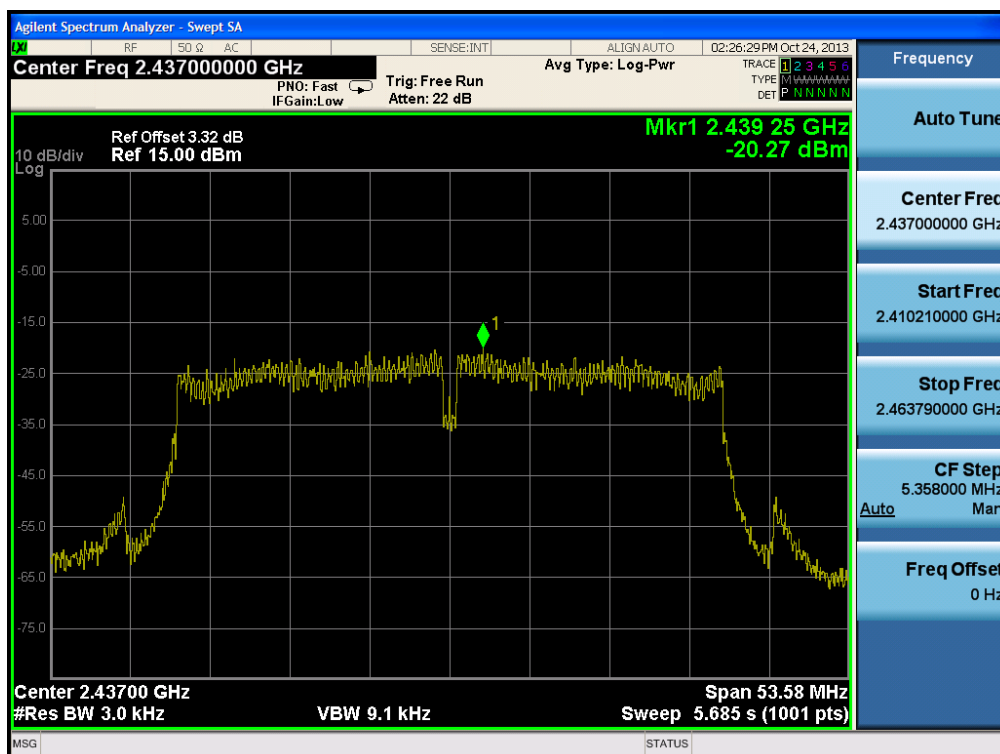
Maximum PPSD

Test Mode: Chain 2 & 802.11n HT40 & MCS8 & 2422MHz



Maximum PPSD

Test Mode: Chain 2 & 802.11n HT40 & MCS8 & 2437MHz



Maximum PPSD

Test Mode: Chain 2 & 802.11n HT40 & MCS8 & 2452MHz

