

RF TEST REPORT



Report No.: 17070869-CE-R1

Supersede Report No.:N/A

Applicant	Humax Co., Ltd.	
Product Name	Wi-Fi Router	
Model No.	QUANTUM T9x (WLAN 2G : 3T3R, 5G : 4T4R)	
Serial No.	QUANTUM T7x(WLAN 2G : 3T3R, 5G : 3T3R); QUANTUM T5x(WLAN 2G : 2T2R, 5G : 3T3R)	
Test Standard	FCC Part 15.247: 2016, ANSI C63.10: 2013	
Test Date	October 09 to December 11, 2017	
Issue Date	November 16,2017	
Test Result	☒ Pass ☐ Fail	
Equipment complied with the specification ☒		
Equipment did not comply with the specification ☐		
		
Aaron Liang Test Engineer	David Huang Checked By	
This test report may be reproduced in full only Test result presented in this test report is applicable to the tested sample only		

Issued by:

SIEMIC (SHENZHEN-CHINA) LABORATORIES

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Laboratories Introduction

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Accreditations for Conformity Assessment

Country/Region	Scope
USA	EMC, RF/Wireless, SAR, Telecom
Canada	EMC, RF/Wireless, SAR, Telecom
Taiwan	EMC, RF, Telecom, SAR, Safety
Hong Kong	RF/Wireless, SAR, Telecom
Australia	EMC, RF, Telecom, SAR, Safety
Korea	EMI, EMS, RF, SAR, Telecom, Safety
Japan	EMI, RF/Wireless, SAR, Telecom
Singapore	EMC, RF, SAR, Telecom
Europe	EMC, RF, SAR, Telecom, Safety

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1. Report Revision History

Report No.	Report Version	Description	Issue Date
17070869-CE-R1	NONE	Original	November 16,2017

2. Customer information

Applicant Name	Humax Co., Ltd.
Applicant Add	HUMAX Village, 11-4, Sunae-dong, Bundang-gu, Seongnam city, Gyeonggi-do, South Korea
Manufacturer	Humax Co., Ltd.
Manufacturer Add	HUMAX Village, 11-4, Sunae-dong, Bundang-gu, Seongnam city, Gyeonggi-do, South Korea

3. Test site information

Test Lab A:

Lab performing tests	SIEMIC (Shenzhen-China) LABORATORIES
Lab Address	Zone A, Floor 1, Building 2 Wan Ye Long Technology Park South Side of Zhoushi Road, Bao' an District, Shenzhen, Guangdong China 518108
FCC Test Site No.	535293
IC Test Site No.	4842E-1
Test Software	Radiated Emission Program-To Shenzhen v2.0

Test Lab B:

Lab performing tests	SIEMIC (Nanjing-China) Laboratories
Lab Address	2-1 Longcang Avenue Yuhua Economic and Technology Development Park, Nanjing, China
FCC Test Site No.	694825
IC Test Site No.	4842B-1
Test Software	EZ_EMG(ver.lcp-03A1)

Note: We just perform Radiated Spurious Emission above 18GHz in the test Lab. B.

4. Equipment under Test (EUT) Information

Description of EUT:	Wi-Fi Router
Main Model:	QUANTUM T9x (WLAN 2G : 3T3R, 5G : 4T4R)
Serial Model:	QUANTUM T7x(WLAN 2G : 3T3R, 5G : 3T3R); QUANTUM T5x(WLAN 2G : 2T2R, 5G : 3T3R)
Date EUT received:	September 15, 2017
Test Date(s):	October 09 to December 11, 2017
Equipment Category :	DTS
Antenna Gain:	WIFI(2.4G): Antenna (White): 3.5 dBi
	Antenna (Blue): 3.5 dBi
	Antenna (Black): 3.5 dBi
	WIFI(5150-5250MHz): Antenna (Gray): 4.5 dBi
	Antenna (Black): 4.5 dBi
	Antenna (Blue): 4.5 dBi
	Antenna (White): 4.5 dBi
	WIFI(5725-5875MHz): Antenna (Gray): 4.5 dBi
	Antenna (Black): 4.5 dBi
	Antenna (Blue): 4.5 dBi
	Antenna (White): 4.5 dBi
Antenna Type:	Dipole antenna
Type of Modulation:	802.11b: DSSS
	802.11g/n20/n40/a/ac20/ac40/ac80: OFDM

RF Operating Frequency (ies):

WIFI: 802.11b/g: 2412-2462 MHz(TX/RX)
WIFI: 802.11n(20M): 2412-2462 MHz; 5180-5240 MHz;
5745-5825 MHz; (TX/RX)
WIFI: 802.11n(40M): 2422-2452 MHz; 5190-5230 MHz;
5755-5795 MHz (TX/RX)
802.11a: 5180-5240 MHz;5745-5825 MHz; (TX/RX)
802.11ac 20: 5180-5240 MHz;5745-5825 MHz; (TX/RX)
802.11ac 40: 5190-5230 MHz;5755-5795 MHz; (TX/RX)
802.11ac 80: 5210 MHz; 5775 MHz; (TX/RX)

Max. Output Power:

802.11b: 21.97 dBm
802.11g: 23.03 dBm
802.11n(20M): 23.71dBm
802.11n(40M): 21.27 dBm

Number of Channels:

WIFI :802.11b/g/n(20M): 11CH
WIFI :802.11n(40M): 7CH
WIFI :802.11a: 9CH
WIFI :802.11ac20: 9CH
WIFI :802.11ac40: 4CH
WIFI :802.11ac80: 1CH

Port: Power Port; Ethernet Port; WAN Port

Adapter
Model: ADS-3DFD-12 12030E
Input Power: Input: 100-240V~50/60Hz, Max: 0.8A;
Output: 12V DC,2.5A

Trade Name : N/A

GPRS/EGPRS Multi-slot class N/A

FCC ID: O6ZT9X

5 Power level in software

Power level setup in software						
Mode	Antenna Path	Channel	Software setup			
			Antenna (White) (dBm)	Antenna (Blue) (dBm)	Antenna (Black) (dBm)	Antenna (Gray) (dBm)
b	SISO	1~11	23.0	23	23	/
g	SISO	1	19	20	17.5	/
	SISO	2	21	28	22	/
	SISO	3~9	28	28	28	/
	SISO	10	23	21.5	22.0	/
	SISO	11	20	18.5	20.0	/
n(HT20)	MIMO(3TX 0-1-2)	1	15	15	15	/
		2~10	20	20	20	/
		11	17.5	17.5	17.5	/
	MIMO(2TX 0-1)	1	15	15	/	/
		2~10	20	20	/	/
		11	17.5	17.5	/	/
	MIMO(2TX 0-2)	1	15	/	15	/
		2~10	20	/	20	/
		11	17.5	/	17.5	/
	MIMO(2TX 1-2)	1	/	15	15	/
		2~10	/	20	20	/
		11	/	17.5	17.5	/
	SISO(1TX 0)	1	15	/	/	/
		2~10	20	/	/	/
		11	17.5	/	/	/
	SISO(1TX 01)	1	/	15	/	/
		2~10	/	20	/	/
		11	/	17.5	/	/
	SISO(1TX 02)	1	/	/	15	/
		2~10	/	/	20	/
		11	/	/	17.5	/
N(HT40)	MIMO(3TX 0-1-2)	3	14	14	14	/
		4	14	14	14	/
		5	17	17	17	/

		6	17.5	17.5	17.5	/
		7	17.5	17.5	17.5	/
		8	16	16	16	/
		9	15.5	15.5	15.5	/
	MIMO(2TX 0-1)	3	14	14	/	/
		4	14	14	/	/
		5	17	17	/	/
		6	17.5	17.5	/	/
		7	17.5	17.5	/	/
		8	16	16	/	/
		9	15.5	15.5	/	/
	MIMO(2TX 0-2)	3	14	/	14	/
		4	14	/	14	/
		5	17	/	17	/
		6	17.5	/	17.5	/
		7	17.5	/	17.5	/
		8	16	/	16	/
		9	15.5	/	15.5	/
	MIMO(2TX 1-2)	3	/	14	14	/
		4	/	14	14	/
		5	/	17	17	/
		6	/	17.5	17.5	/
		7	/	17.5	17.5	/
		8	/	16	16	/
		9	/	15.5	15.5	/
	SISO(1TX 0)	3	14	/	/	/
		4	14	/	/	/
		5	17	/	/	/
		6	17.5	/	/	/
		7	17.5	/	/	/
		8	16	/	/	/
		9	15.5	/	/	/
	SISO(1TX 01)	3	/	14	/	/
		4	/	14	/	/
		5	/	17	/	/
		6	/	17.5	/	/
		7	/	17.5	/	/
		8	/	16	/	/
		9	/	15.5	/	/

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	SISO(1TX 02)	3	/	/	14	/
		4	/	/	14	/
		5	/	/	17	/
		6	/	/	17.5	/
		7	/	/	17.5	/
		8	/	/	16	/
		9	/	/	15.5	/

5. Test Summary

The product was tested in accordance with the following specifications.

All testing has been performed according to below product classification:

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.247 (a)(2)	DTS (6 dB&20 dB) CHANNEL BANDWIDTH	Compliance
§15.247(b)(3)	Conducted Maximum Output Power	Compliance
§15.247(e)	Power Spectral Density	Compliance
§15.247(d)	Band-Edge & Unwanted Emissions into Non-Restricted Frequency Bands	Compliance
§15.207 (a),	AC Power Line Conducted Emissions	Compliance
§15.205, §15.209, §15.247(d)	Radiated Spurious Emissions & Unwanted Emissions into Restricted Frequency Bands	Compliance

Measurement Uncertainty

Emissions		
Test Item	Description	Uncertainty
Band Edge and Radiated Spurious Emissions	Confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2 (for EUTs < 0.5m X 0.5m X 0.5m)	+5.6dB/-4.5dB
-	-	-

6. Measurements, Examination And Derived Results

6.1 Antenna Requirement

Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- Antenna must be permanently attached to the unit.
- Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

The EUT has three attached Dipole antennas for 2.4GHz WIFI and four attached PIFA internal antennas for 5GHz WIFI.

FCC KDB 662911 D01 Multiple Transmitter Output V02r01

For CDD transmissions, directional gain is calculated as

Directional Gain = GANT + Array Gain, where Array Gain is as follows.

For power spectral density (PSD) measurements on all devices.

Array Gain = $10 \log(NANT/NSS)$ (NANT = 1)

For power measurements on IEEE802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for NANT ≤ 4.

The EUT supports CDD mode, for Power and PSD, the directional gain is following F2) f) i)

The directional gain "DG" is calculated as following table.

Mode	Antenna (White) (dBi)	Antenna (Blue) (dBi)	Antenna (Black) (dBi)	Antenna (Gray) (dBi)	DG For Power (dBi)	DG For PSD (dBi)	Power Limit Reduction	PSD Limit Reduction
2.4GHz	3.5	3.5	3.5	/	3.5	8.27	0	2.27
5G	4.5	4.5	4.5	4.5	4.5	10.52	0	4.52

Power Limit Reduction= $DG(\text{Power}) - 6\text{dBi}$, (min=0)

PSD Limit Reduction= $DG(\text{Power}) - 6\text{dBi}$, (min=0)

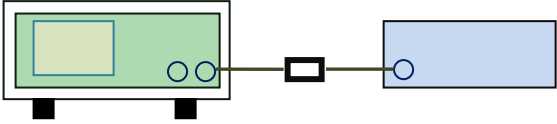
DG: Directional Gain

The antenna meets up with the ANTENNA REQUIREMENT.

Result: Compliance.

6.2 DTS (6 dB&20 dB) Channel Bandwidth

Temperature	24°C
Relative Humidity	57%
Atmospheric Pressure	1007mbar
Test date :	November 11 and December 11 , 2017
Tested By :	Aaron Liang

Spec	Item	Requirement	Applicable
§ 15.247(a)(2)	a)	6dB BW $\geq$ 500kHz;	☒
RSS Gen(4.6.1)	b)	99% BW: For FCC reference only; required by IC.	☒
Test Setup	 Spectrum Analyzer EUT		
Test Procedure	558074 D01 DTS MEAS Guidance v04, 8.1 DTS bandwidth <u>6dB bandwidth</u> - Set RBW = 100 kHz. - Set the video bandwidth (VBW) $\geq 3 \times$ RBW. - Detector = Peak. - Trace mode = max hold. - Sweep = auto couple. - Allow the trace to stabilize. - Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. <u>20dB bandwidth</u> C63.10 Occupied Bandwidth (OBW=20dB bandwidth) - Set RBW = 1%-5% OBW. - Set the video bandwidth (VBW) $\geq 3 \times$ RBW. - Set the span range between 2 times and 5 times of the OBW. - Sweep time=Auto, Detector=PK, Trace=Max hold. - Once the reference level is established, the equipment is conditioned with typical modulating signals to produce the worst-		

	case (i.e., the widest) bandwidth. Unless otherwise specified for an unlicensed wireless device, measure the bandwidth at the 20 dB levels with respect to the reference level.
Remark	
Result	☒ Pass ☐ Fail

Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

6dB Bandwidth measurement result

Type	Test mode	CH	Freq (MHz)	Result (MHz)			Limit (MHz)	Result
				Antenna (White)	Antenna (Blue)	Antenna (Black)		
6dB BW	802.11b	Low	2412	6.865	7.342	6.741	≥ 0.5	Pass
		Mid	2437	7.112	7.242	7.572	≥ 0.5	Pass
		High	2462	6.917	6.780	6.730	≥ 0.5	Pass
	802.11g	1	2412	16.35	19.45	16.36	≥ 0.5	Pass
		2	2417	17.59	16.43	16.40	≥ 0.5	Pass
		3	2422	16.36	16.41	16.42	≥ 0.5	Pass
		6	2437	16.35	16.40	16.37	≥ 0.5	Pass
		9	2452	16.40	16.39	19.65	≥ 0.5	Pass
		10	2457	16.33	16.42	16.44	≥ 0.5	Pass
		11	2462	15.72	16.38	16.37	≥ 0.5	Pass
	802.11n (20M)	1	2412	17.56	17.63	17.60	≥ 0.5	Pass
		2	2417	16.37	17.61	17.59	≥ 0.5	Pass
		6	2437	17.59	17.60	17.62	≥ 0.5	Pass
		11	2462	17.54	17.55	17.60	≥ 0.5	Pass
	802.11n (40M)	3	2422	35.68	35.43	35.70	≥ 0.5	Pass
		4	2427	36.29	35.73	36.07	≥ 0.5	Pass
		5	2432	37.00	36.36	36.31	≥ 0.5	Pass
		6	2437	36.28	35.72	36.33	≥ 0.5	Pass
		7	2442	36.38	35.46	36.24	≥ 0.5	Pass
		8	2447	35.99	35.72	36.30	≥ 0.5	Pass
		9	2452	36.05	35.68	36.02	≥ 0.5	Pass

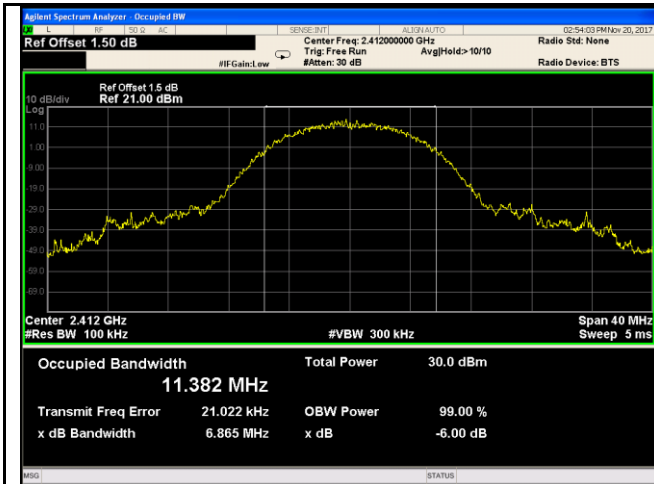
20 dB Bandwidth measurement result

Type	Test mode	CH	Freq (MHz)	Result (MHz)			Result
				Antenna (White)	Antenna (Blue)	Antenna (Black)	
20dB BW	802.11b	Low	2412	13.18	13.18	13.18	Pass
		Mid	2437	13.31	13.25	13.34	Pass
		High	2462	13.13	13.20	13.15	Pass
	802.11g	1	2412	18.90	19.47	19.23	Pass
		2	2417	20.25	20.06	19.22	Pass
		3	2422	20.42	20.44	20.41	Pass
		6	2437	20.36	21.49	19.24	Pass
		9	2452	19.21	19.73	19.21	Pass
		10	2457	19.31	19.57	19.43	Pass
		11	2462	20.61	21.53	19.08	Pass
	802.11n (20M)	1	2412	20.18	19.97	19.86	Pass
		2	2417	19.91	20.14	19.95	Pass
		6	2437	20.84	20.05	20.22	Pass
		11	2462	20.03	20.25	20.21	Pass
	802.11n (40M)	3	2422	41.46	41.60	41.48	Pass
		4	2427	42.94	41.09	41.20	Pass
		5	2432	40.23	40.62	40.97	Pass
		6	2437	40.47	41.24	41.20	Pass
		7	2442	40.52	41.67	41.44	Pass
		8	2447	41.01	41.30	41.94	Pass
		9	2452	41.85	40.58	40.53	Pass

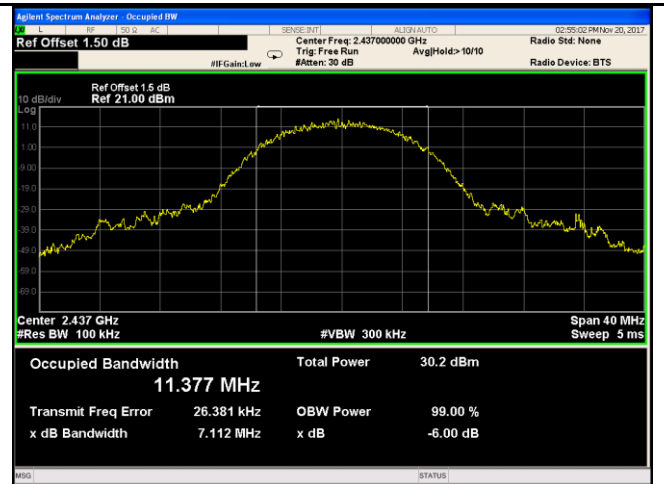
Test Plots

6dB Bandwidth measurement result

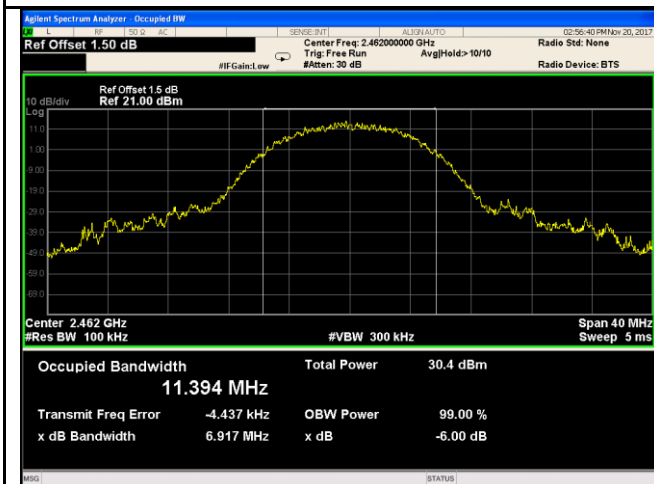
Antenna (White):



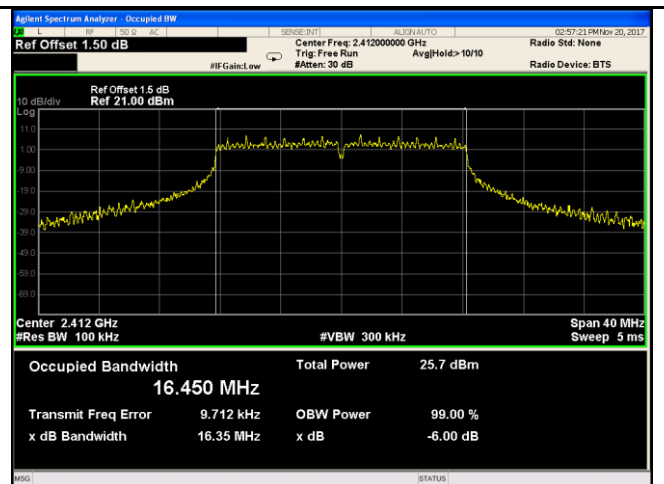
802.11b 6dB Bandwidth - Low CH 2412



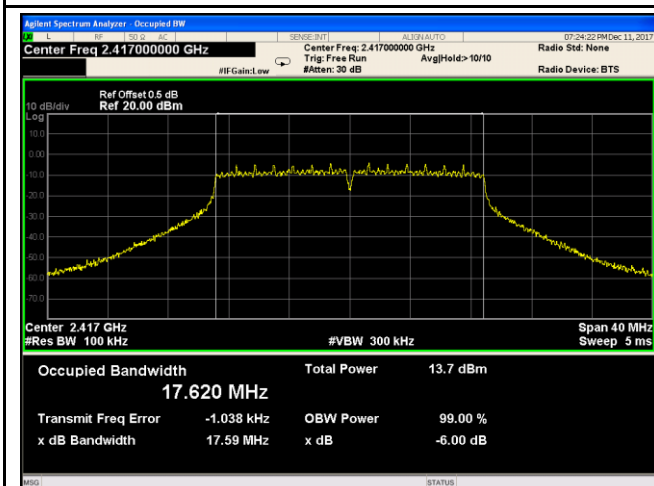
802.11b 6dB Bandwidth - Mid CH 2437



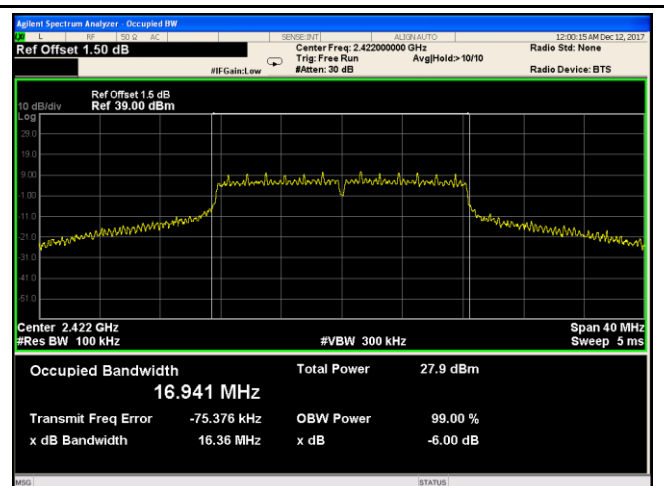
802.11b 6dB Bandwidth - High CH 2462



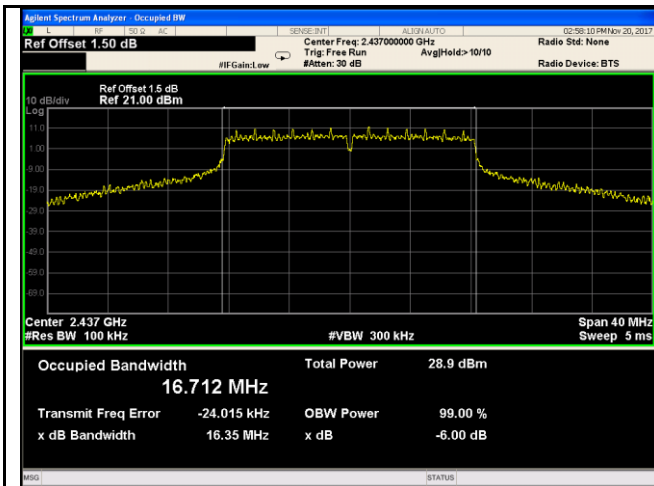
802.11g 6dB Bandwidth - 1 CH 2412



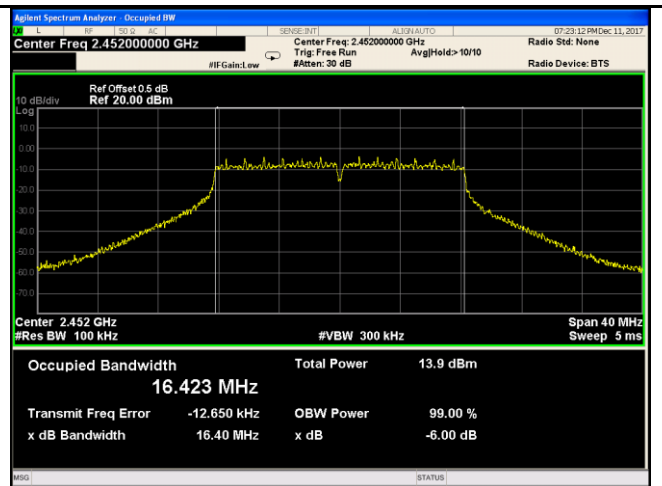
802.11g 6dB Bandwidth - 2 CH 2417



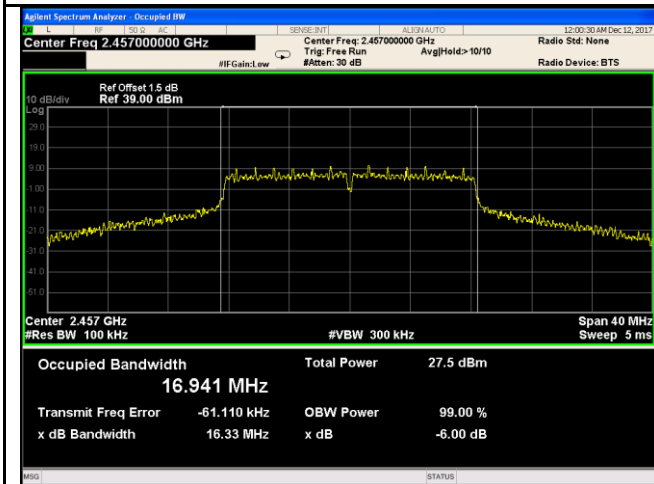
802.11g 6dB Bandwidth - 3 CH 2422



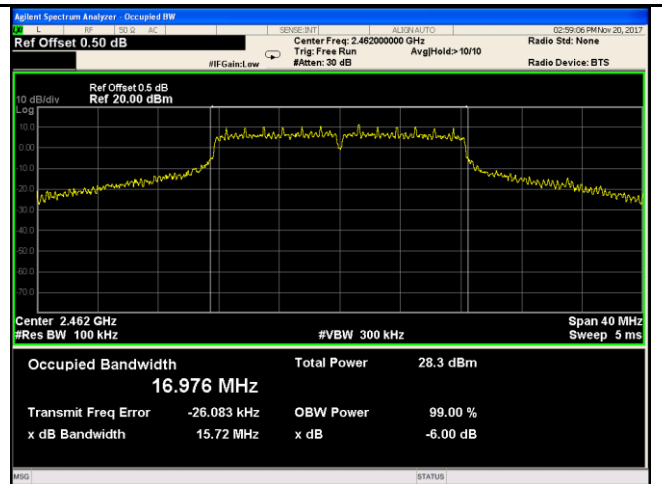
802.11g 6dB Bandwidth - 6 CH 2437



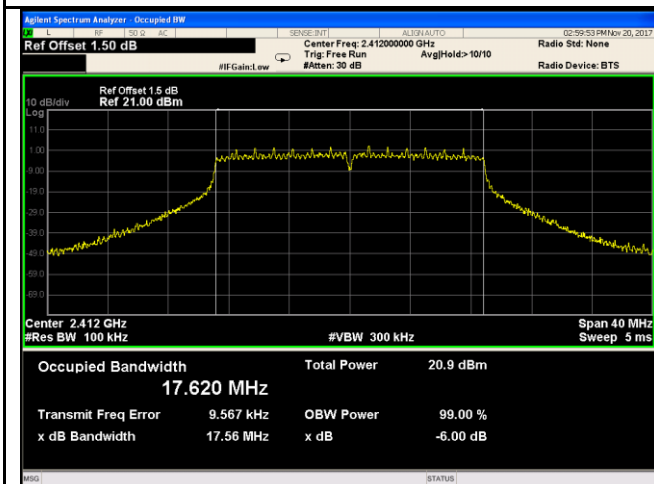
802.11g 6dB Bandwidth - 9 CH 2452



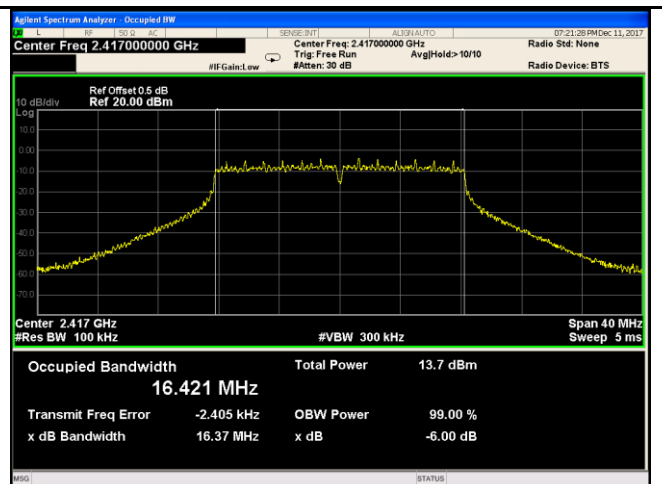
802.11g 6dB Bandwidth - 10 CH 2457



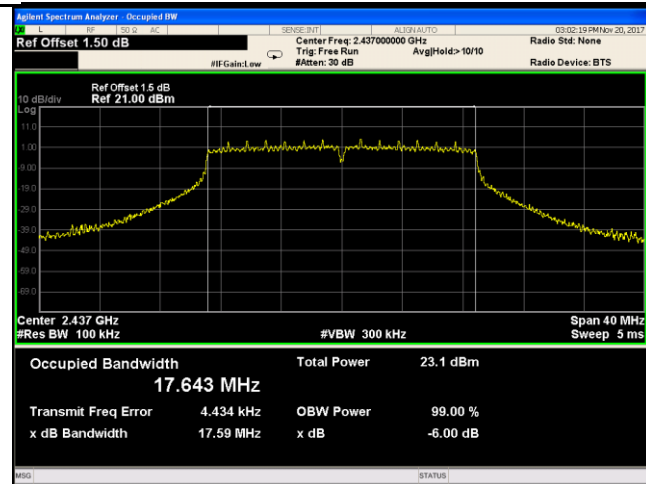
802.11g 6dB Bandwidth - 11 CH 2462



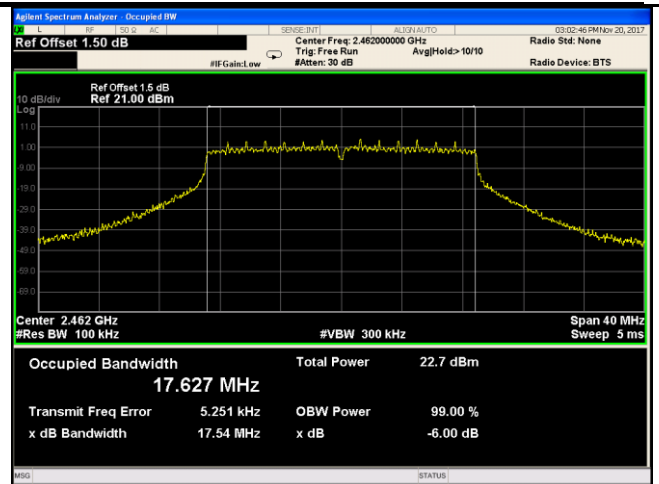
802.11n20 6dB Bandwidth - 1 CH 2412



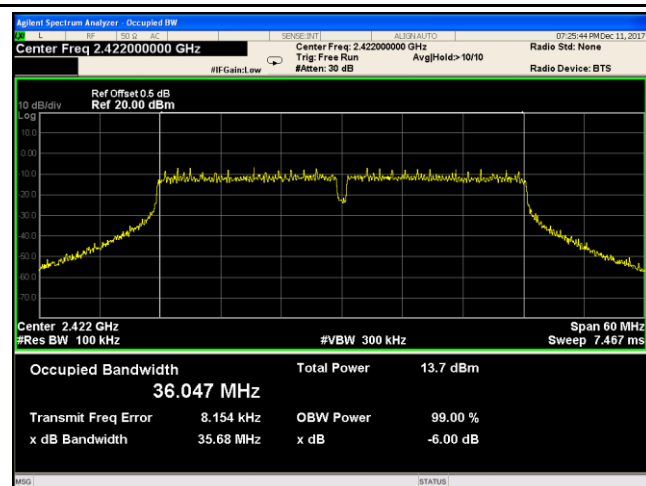
802.11n20 6dB Bandwidth - 2 CH 2417



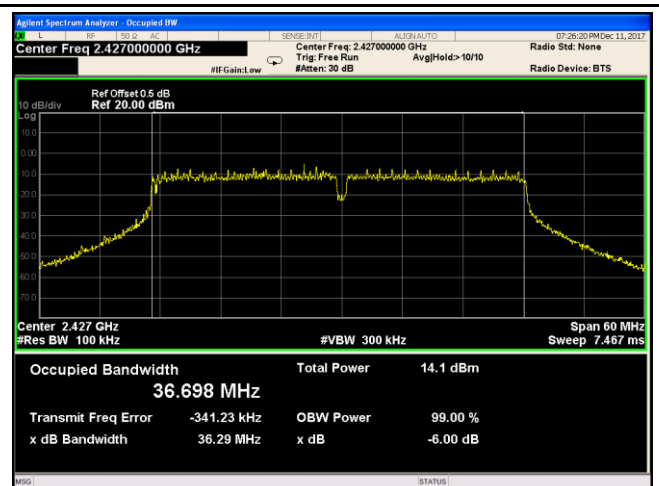
802.11n20 6dB Bandwidth - 6 CH 2437



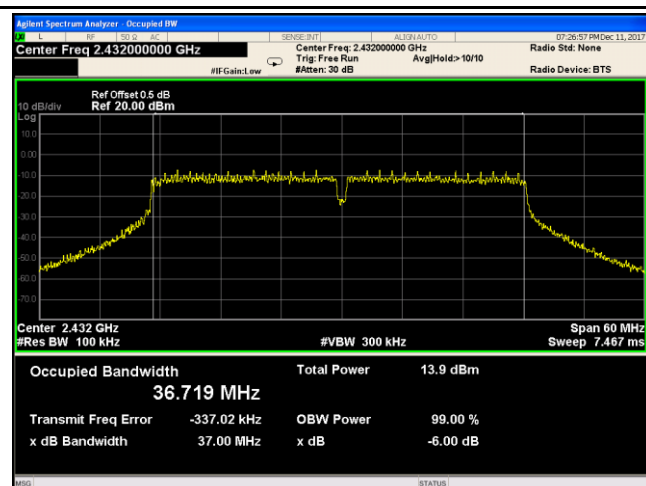
802.11n20 6dB Bandwidth - 11 CH 2462



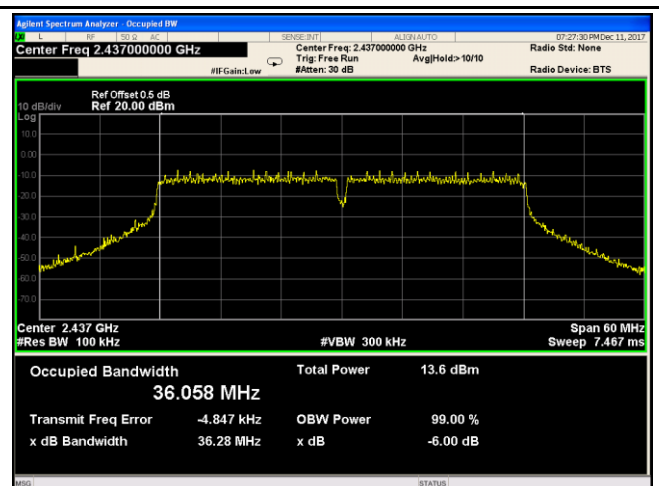
802.11n40 6dB Bandwidth - 3 CH 2422



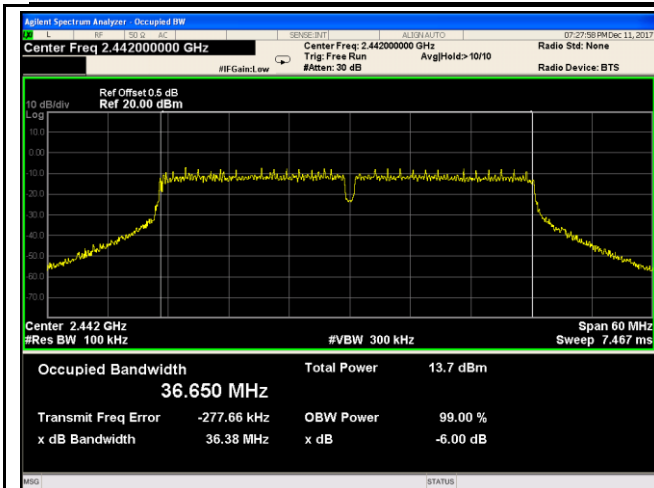
802.11n40 6dB Bandwidth - 4 CH 2427



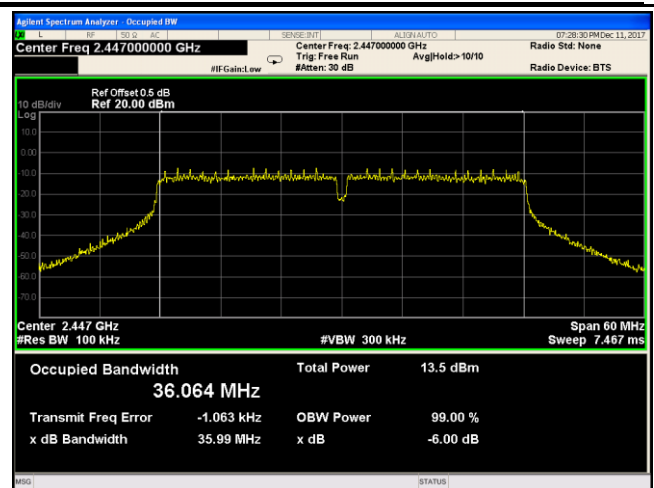
802.11n40 6dB Bandwidth - 5 CH 2432



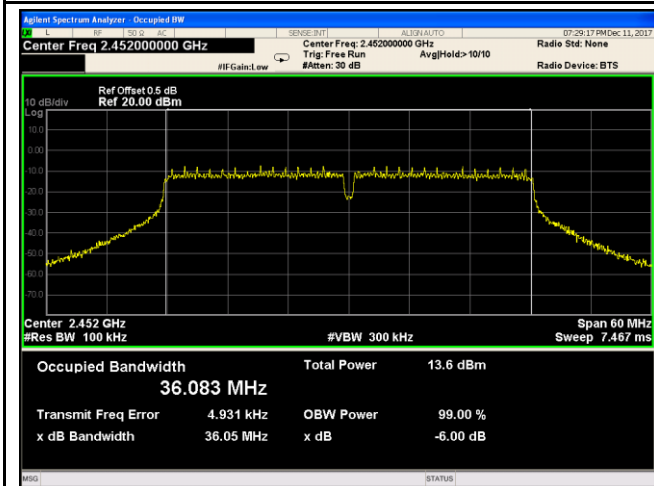
802.11n40 6dB Bandwidth - 6 CH 2437



802.11n40 6dB Bandwidth - 7 CH 2442

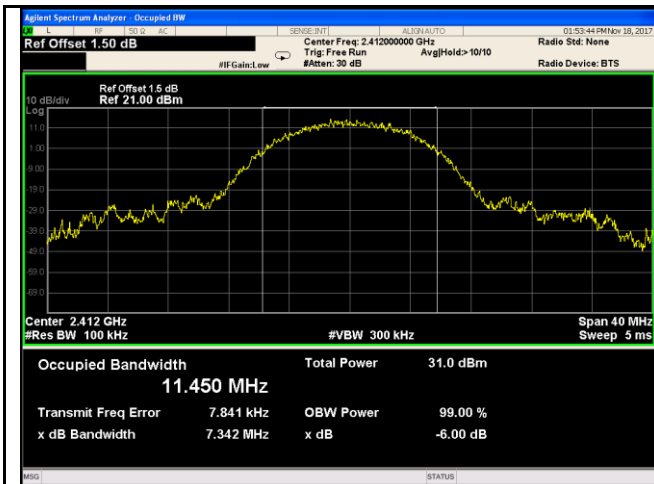


802.11n40 6dB Bandwidth - 8 CH 2447

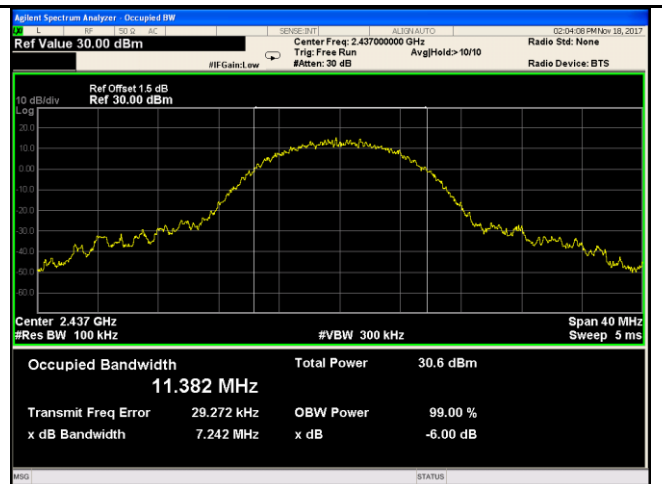


802.11n40 6dB Bandwidth - 9 CH 2452

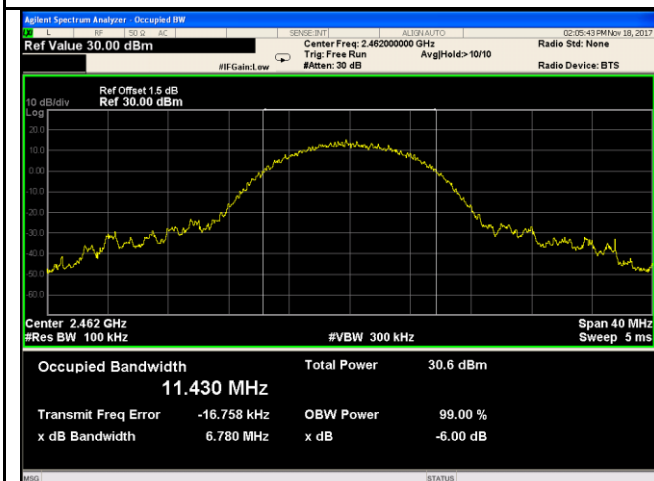
Antenna (Blue):



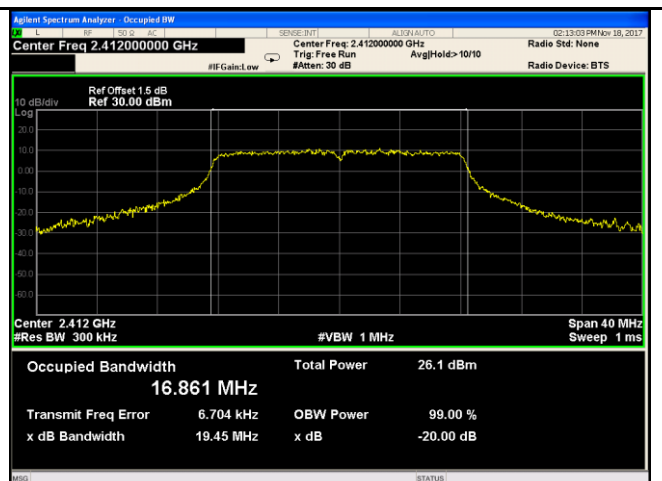
802.11b 6dB Bandwidth - Low CH 2412



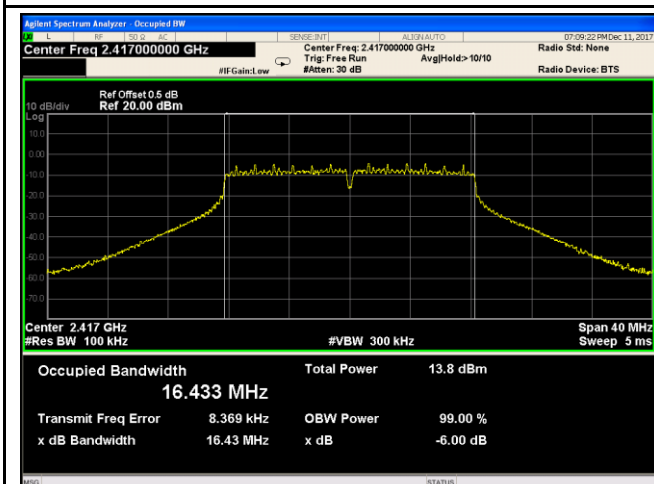
802.11b 6dB Bandwidth - Mid CH 2437



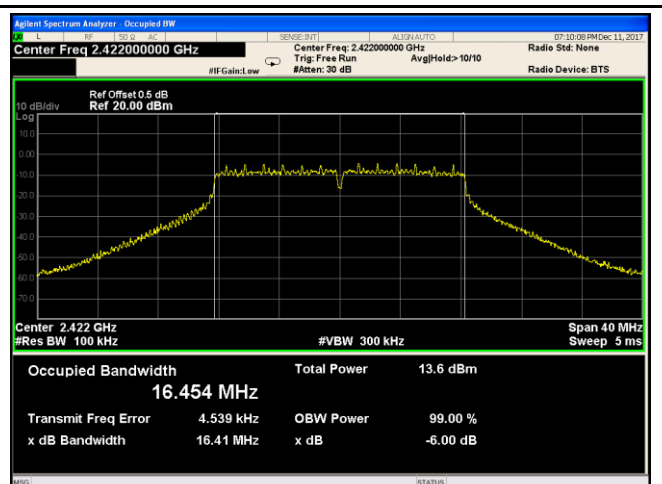
802.11b 6dB Bandwidth - High CH 2462



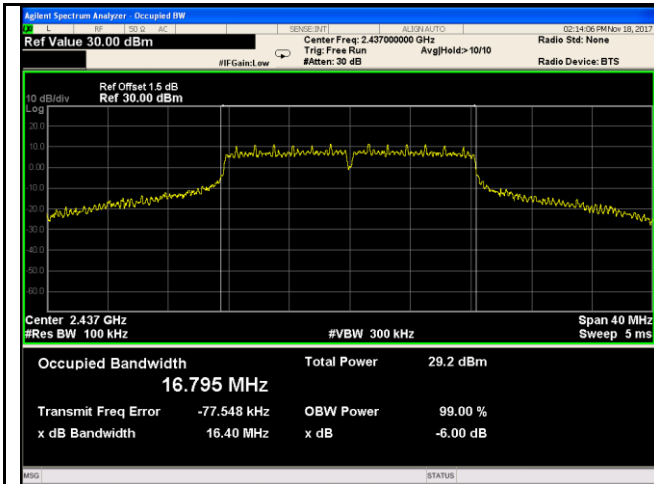
802.11g 6dB Bandwidth - 1 CH 2412



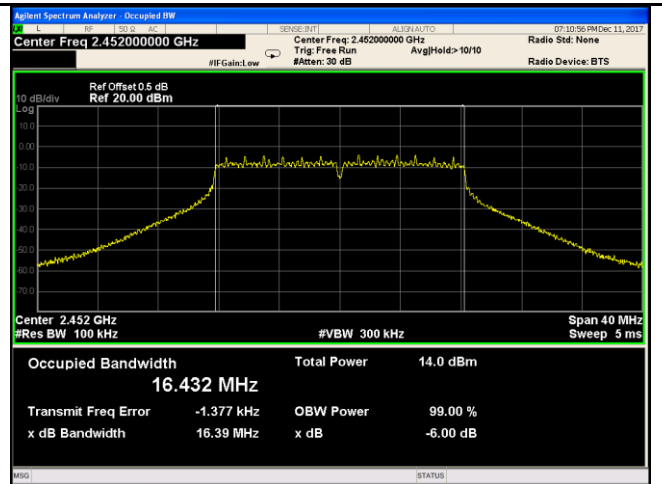
802.11g 6dB Bandwidth - 2 CH 2417



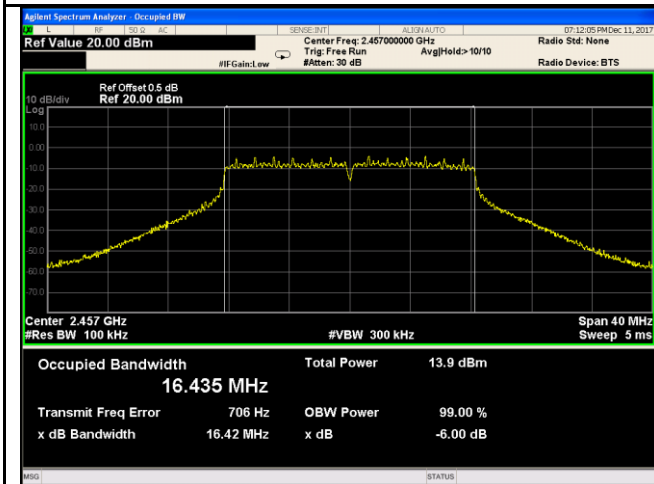
802.11g 6dB Bandwidth - 3 CH 2422



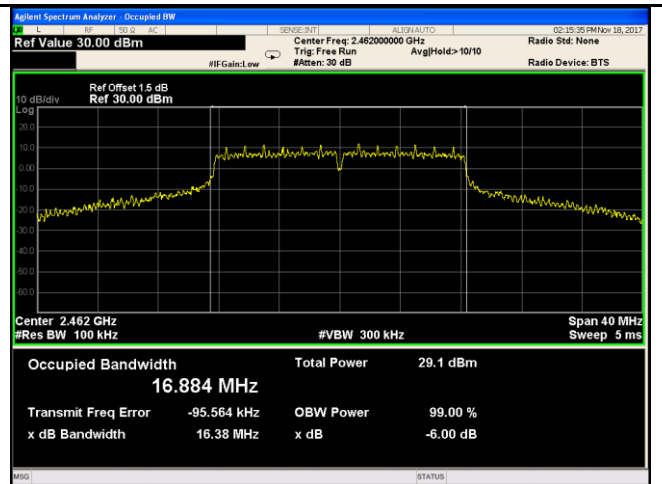
802.11g 6dB Bandwidth - 6 CH 2437



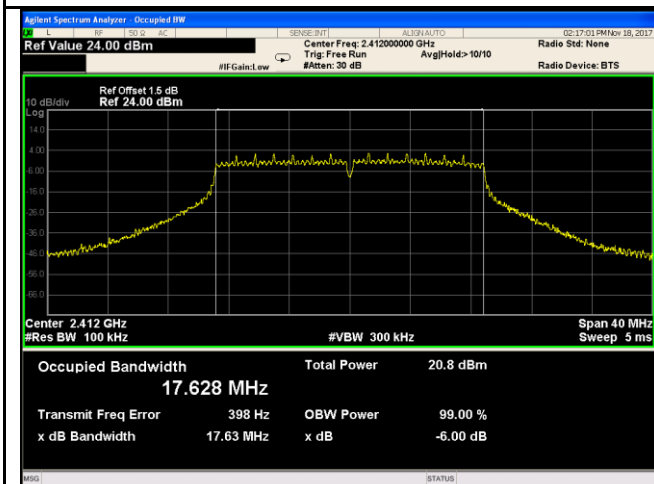
802.11g 6dB Bandwidth - 9 CH 2452



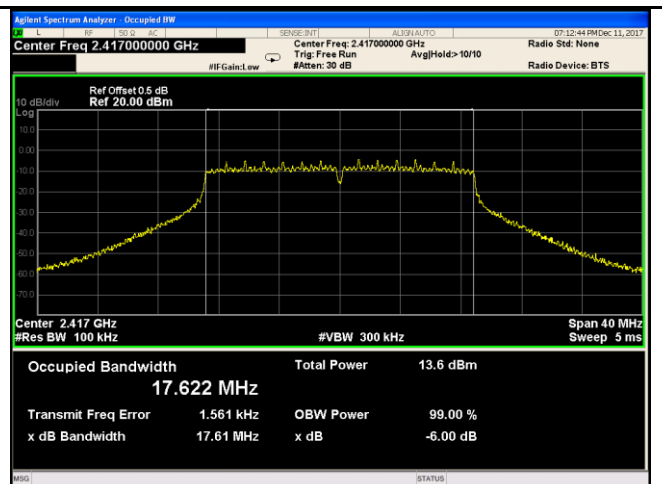
802.11g 6dB Bandwidth - 10 CH 2457



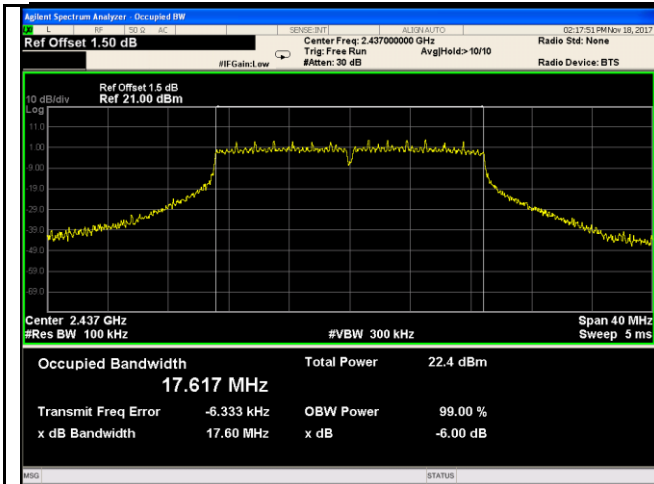
802.11g 6dB Bandwidth - 11 CH 2462



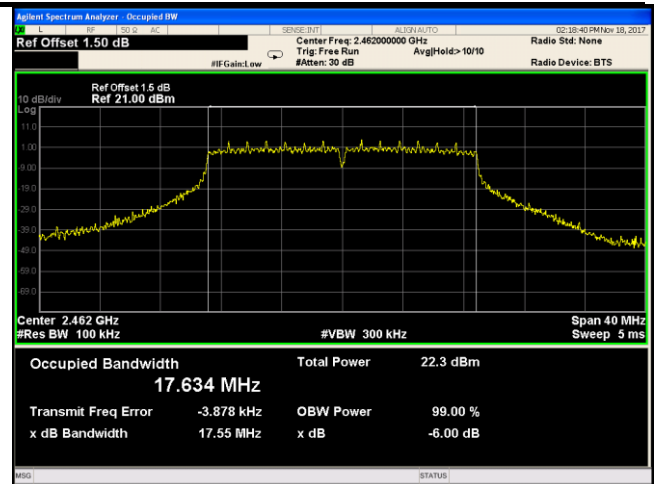
802.11n20 6dB Bandwidth - 1 CH 2412



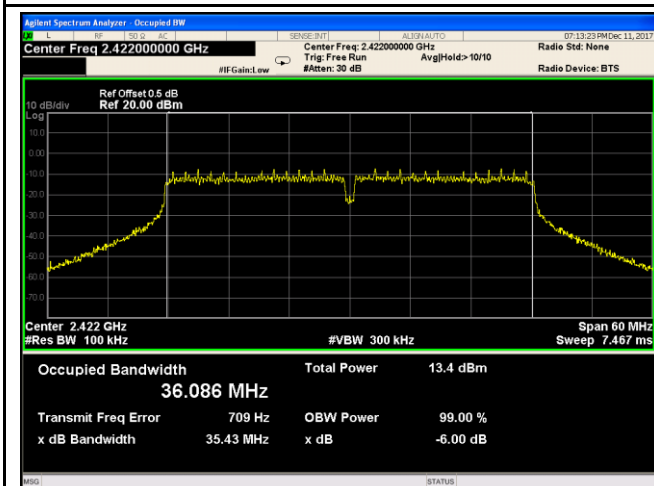
802.11n20 6dB Bandwidth - 2 CH 2417



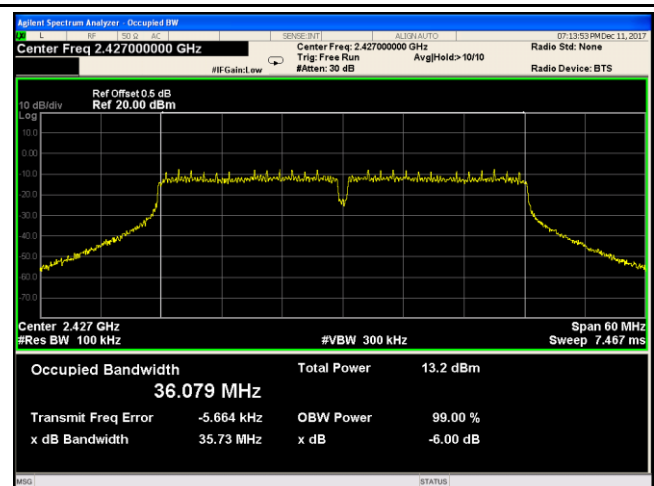
802.11n20 6dB Bandwidth - 6 CH 2437



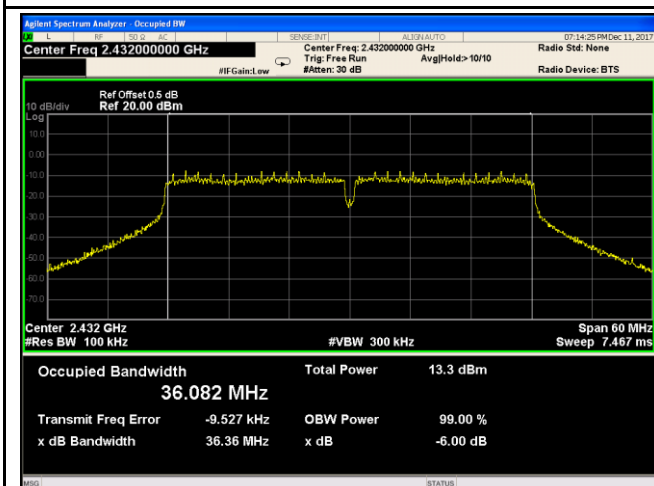
802.11n20 6dB Bandwidth - 11 CH 2462



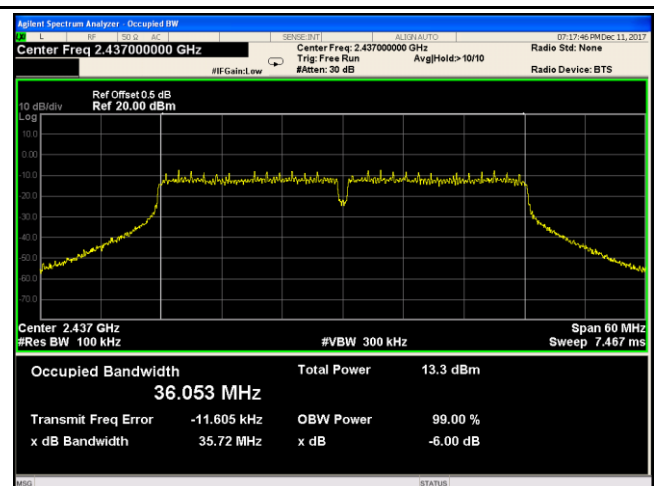
802.11n40 6dB Bandwidth - 3 CH 2422



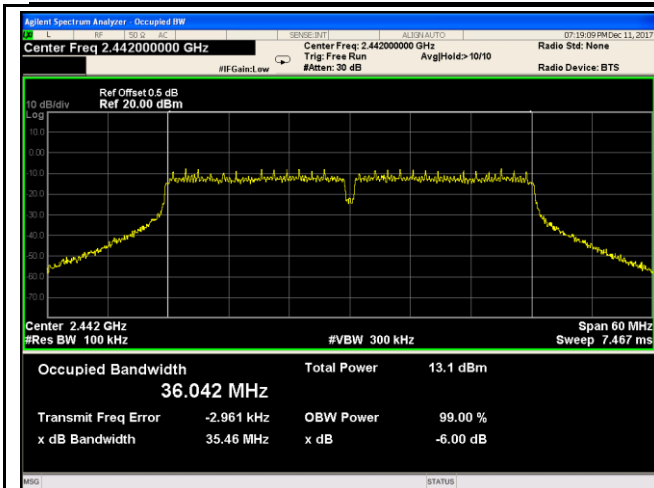
802.11n40 6dB Bandwidth - 4 CH 2427



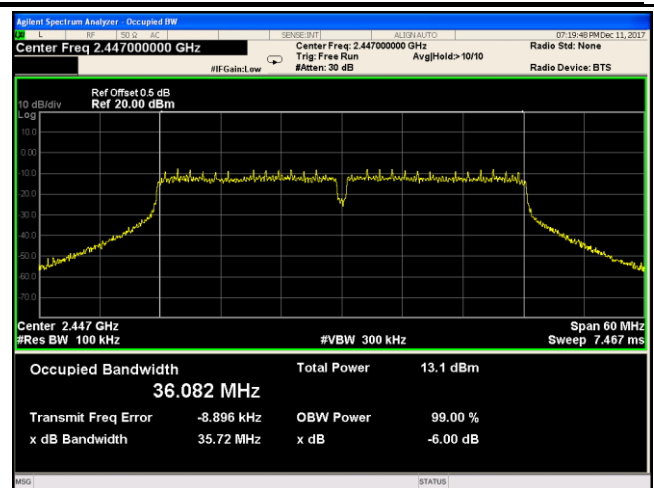
802.11n40 6dB Bandwidth - 5 CH 2432



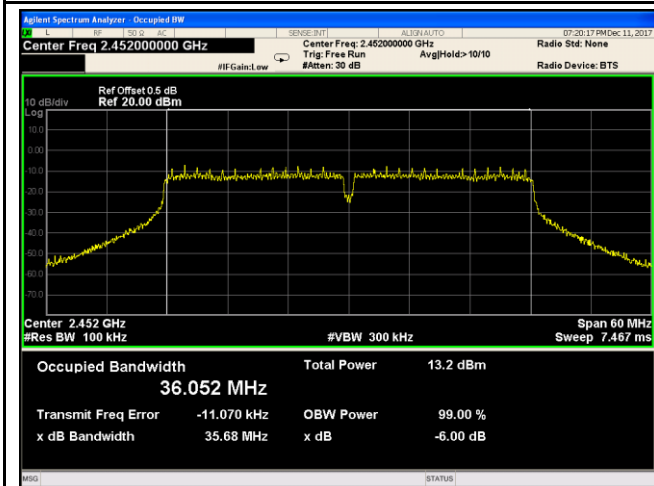
802.11n40 6dB Bandwidth - 6 CH 2437



802.11n40 6dB Bandwidth - 7 CH 2442

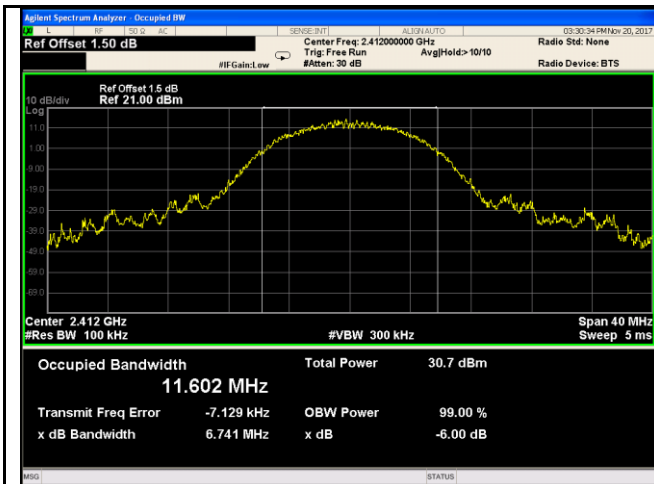


802.11n40 6dB Bandwidth - 8 CH 2447

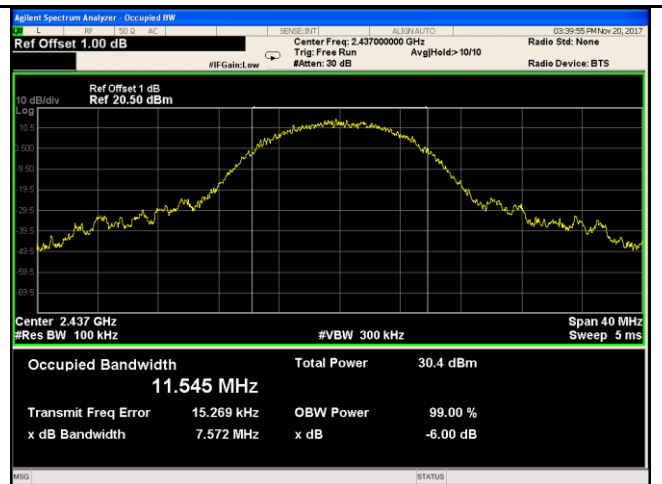


802.11n40 6dB Bandwidth - 9 CH 2452

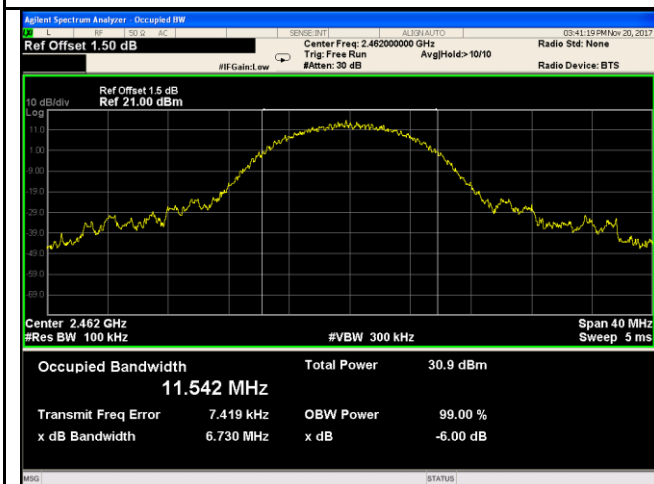
Antenna (Black):



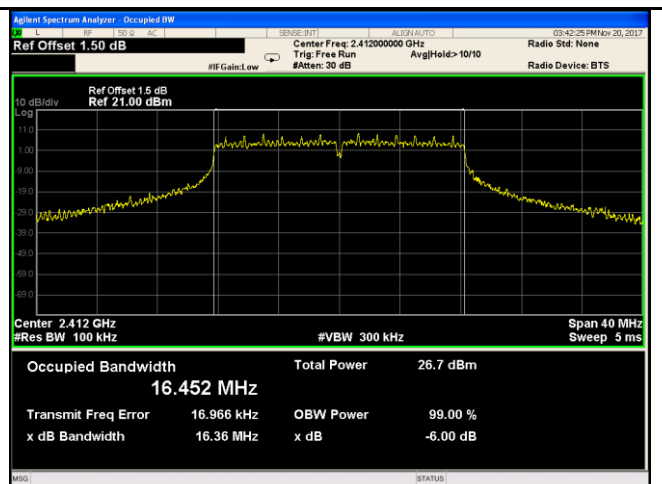
802.11b 6dB Bandwidth - Low CH 2412



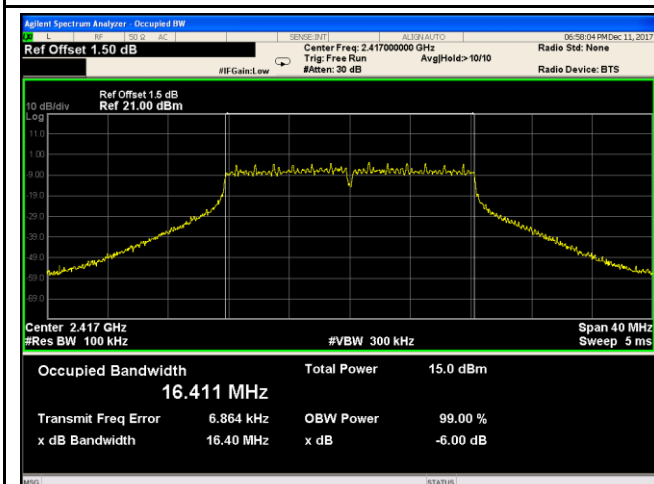
802.11b 6dB Bandwidth - Mid CH 2437



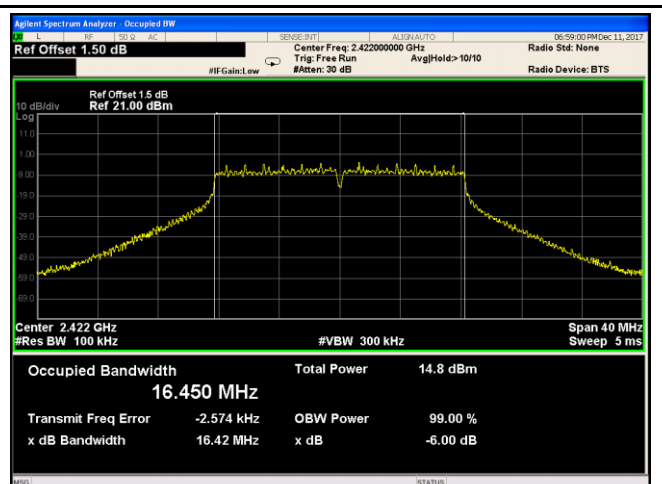
802.11b 6dB Bandwidth - High CH 2462



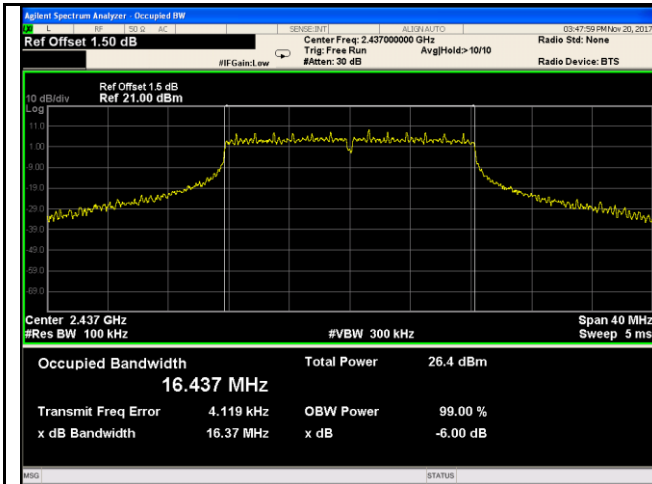
802.11g 6dB Bandwidth - 1 CH 2412



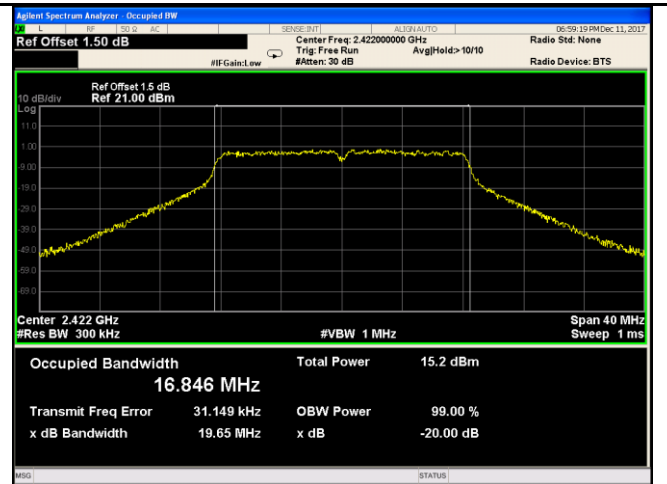
802.11g 6dB Bandwidth - 2 CH 2417



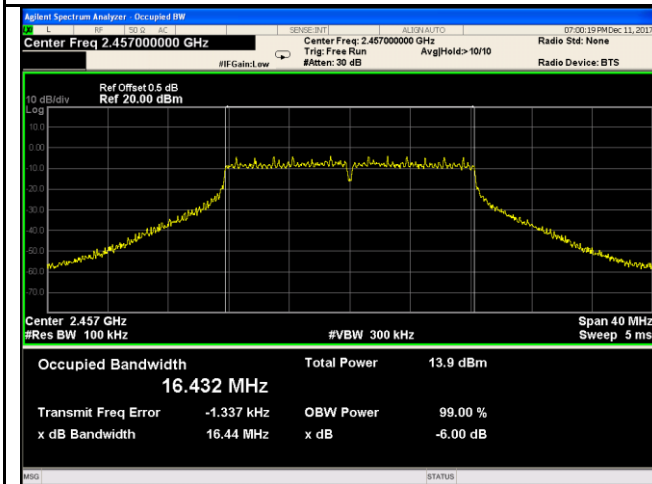
802.11g 6dB Bandwidth - 3 CH 2422



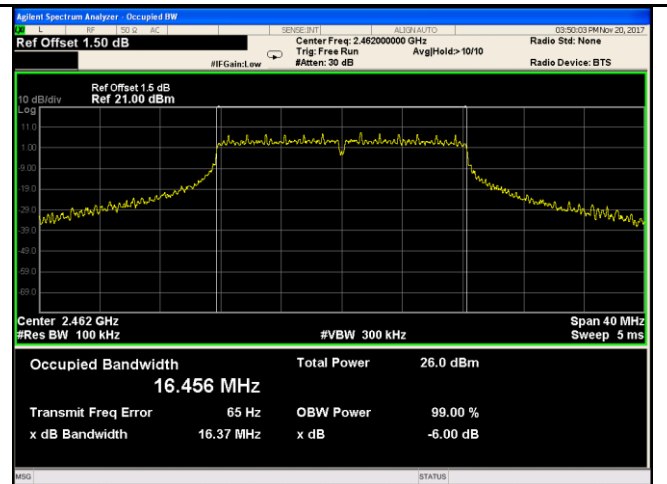
802.11g 6dB Bandwidth - 6 CH 2437



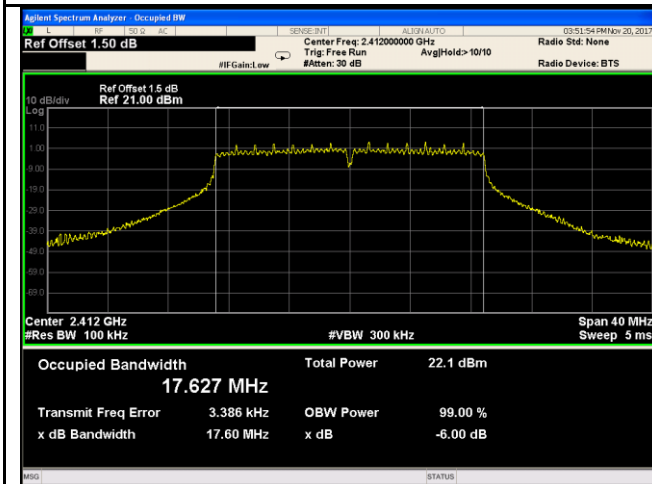
802.11g 6dB Bandwidth - 9 CH 2452



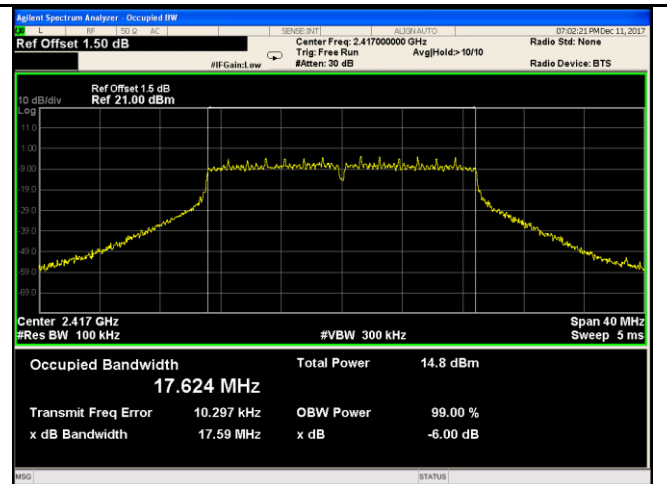
802.11g 6dB Bandwidth - 10 CH 2457



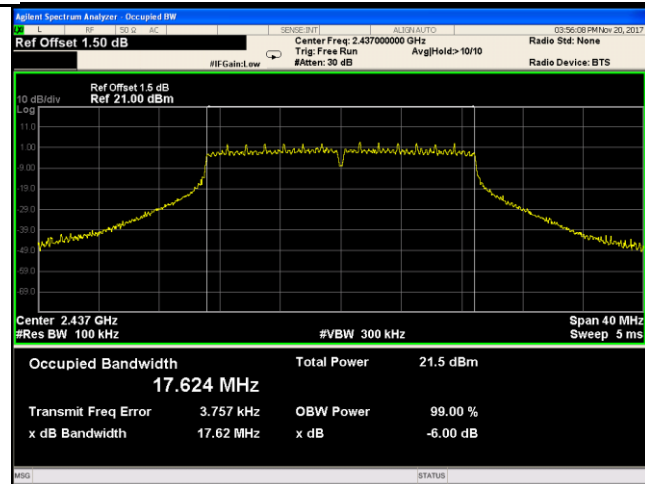
802.11g 6dB Bandwidth - 11 CH 2462



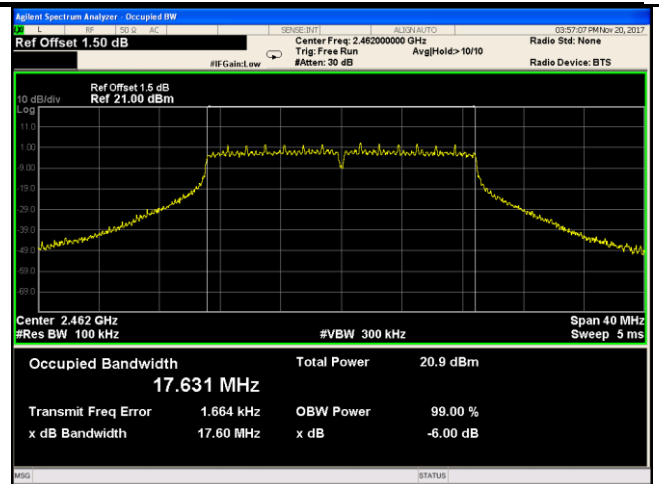
802.11n20 6dB Bandwidth - 1 CH 2412



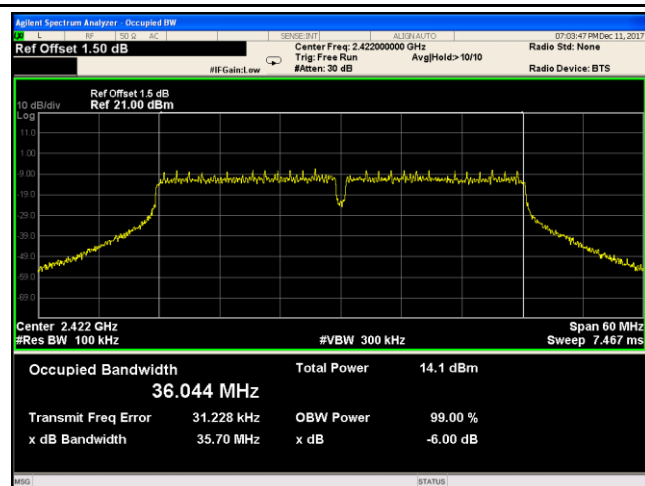
802.11n20 6dB Bandwidth - 2 CH 2417



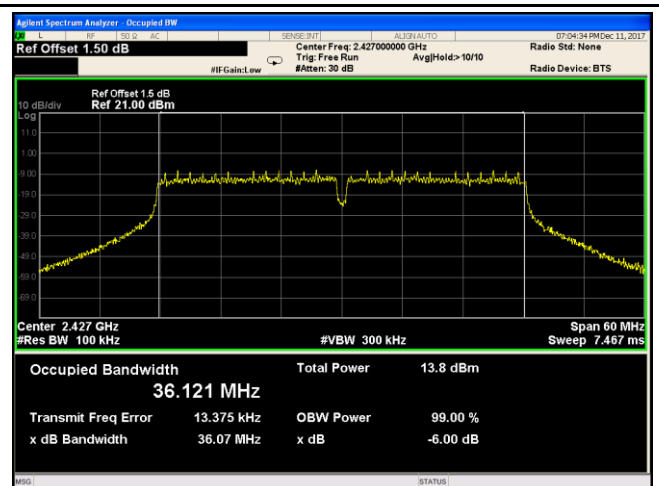
802.11n20 6dB Bandwidth - 6 CH 2437



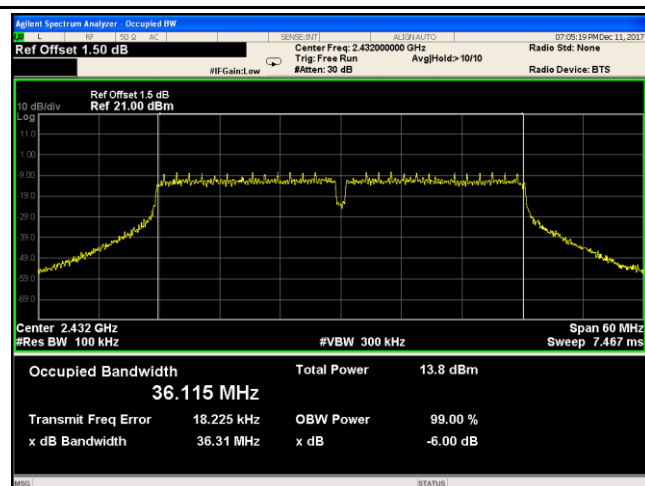
802.11n20 6dB Bandwidth - 11 CH 2462



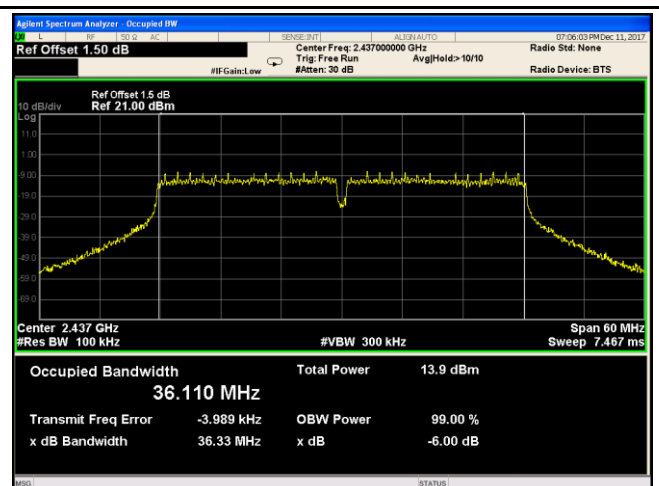
802.11n40 6dB Bandwidth - 3 CH 2422



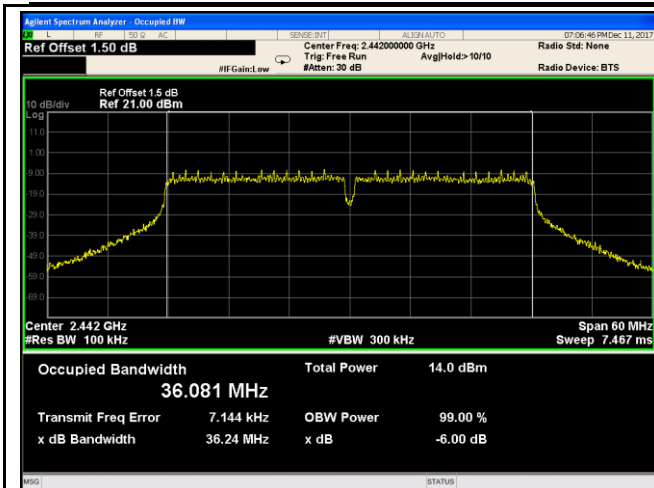
802.11n40 6dB Bandwidth - 4 CH 2427



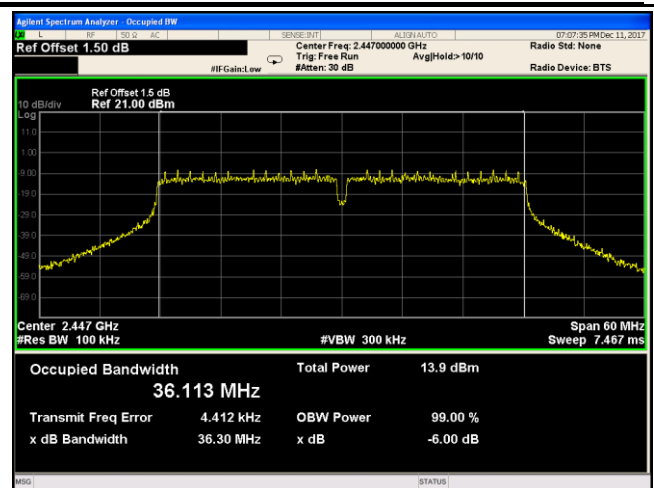
802.11n40 6dB Bandwidth -5 CH 2432



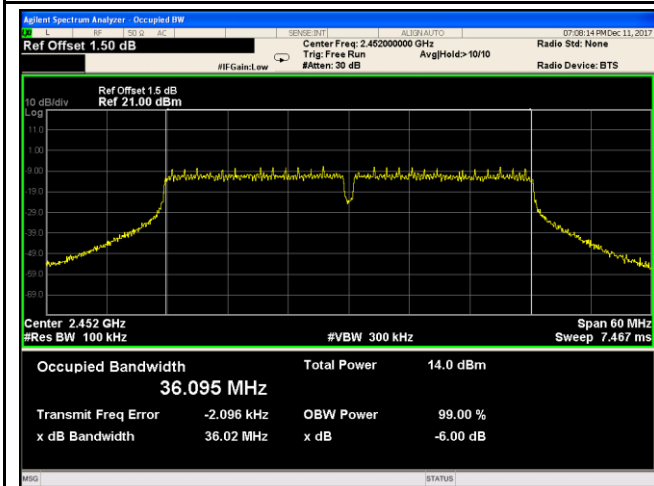
802.11n40 6dB Bandwidth - 6 CH 2437



802.11n40 6dB Bandwidth - 7 CH 2442



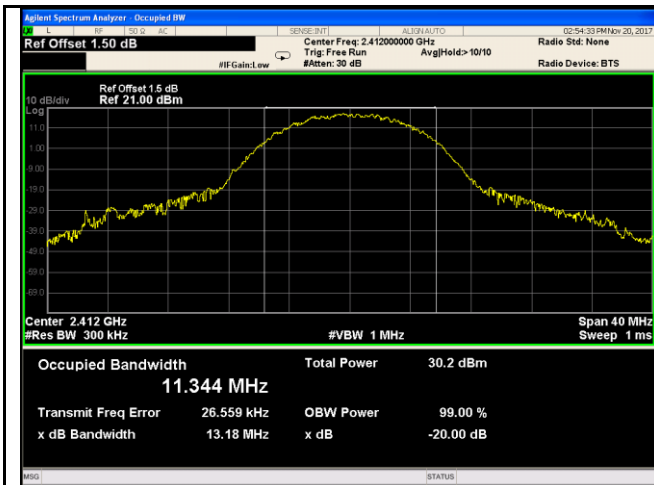
802.11n40 6dB Bandwidth - 8 CH 2447



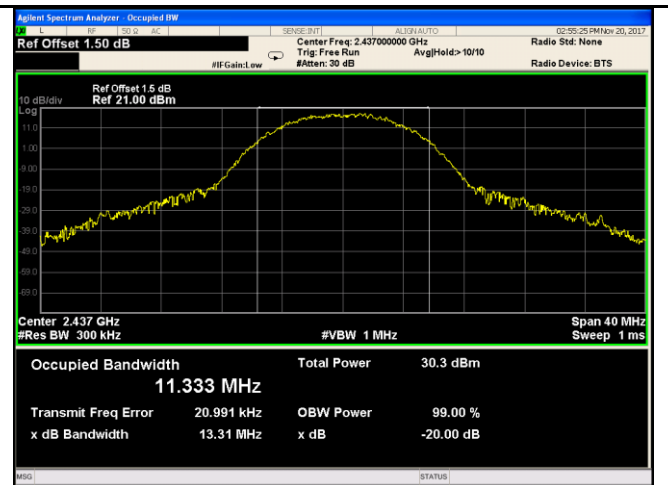
802.11n40 6dB Bandwidth - 9 CH 2452

20 dB Bandwidth measurement result:

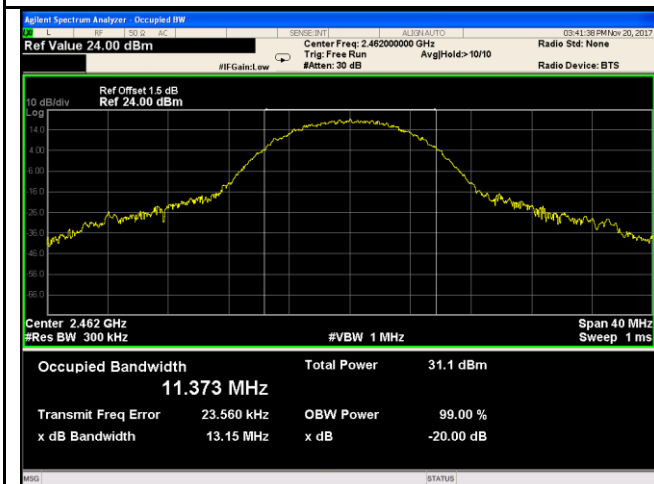
Antenna (White):



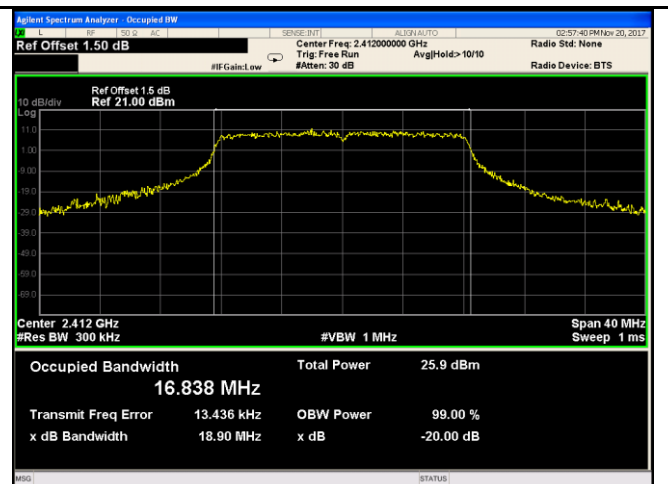
802.11b 20dB Bandwidth - Low CH 2412



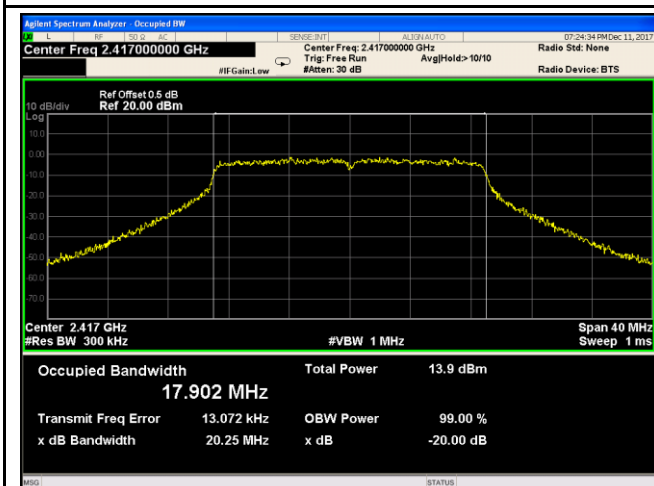
802.11b 20dB Bandwidth - Mid CH 2437



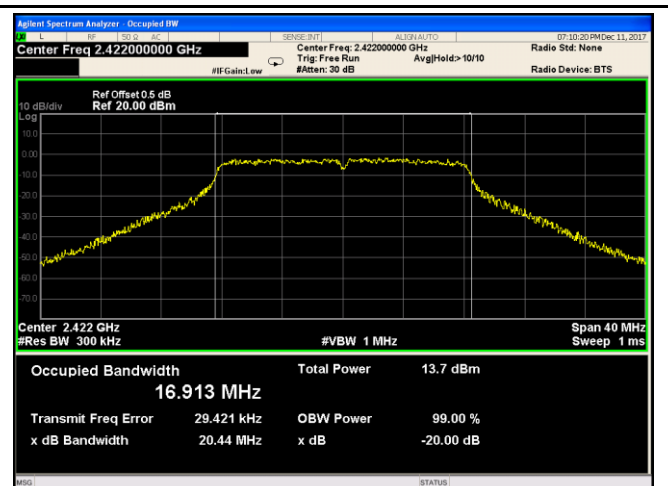
802.11b 20dB Bandwidth - High CH 2462



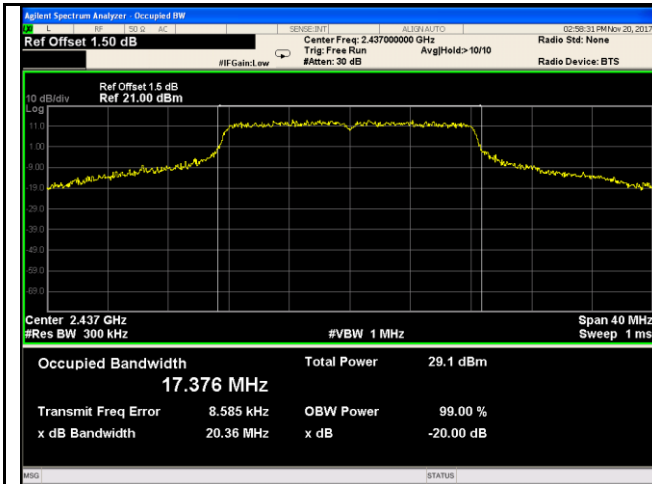
802.11g 20dB Bandwidth - 1 CH 2412



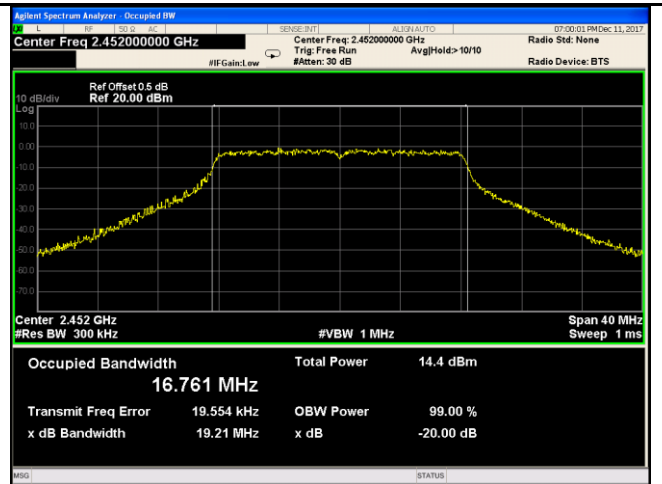
802.11g 20dB Bandwidth - 2 CH 2417



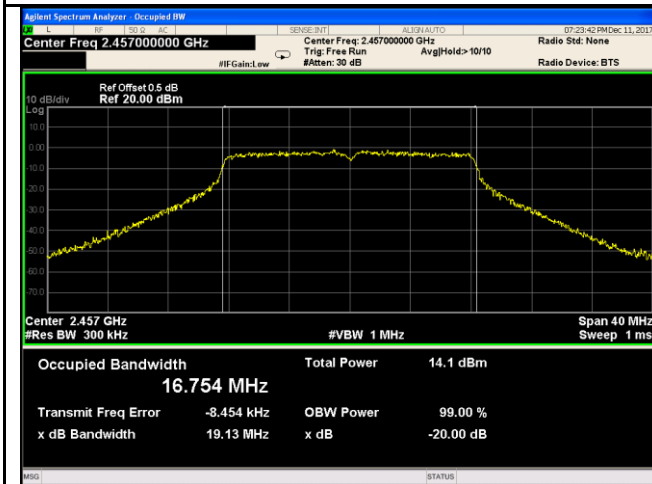
802.11g 20dB Bandwidth - 3 CH 2422



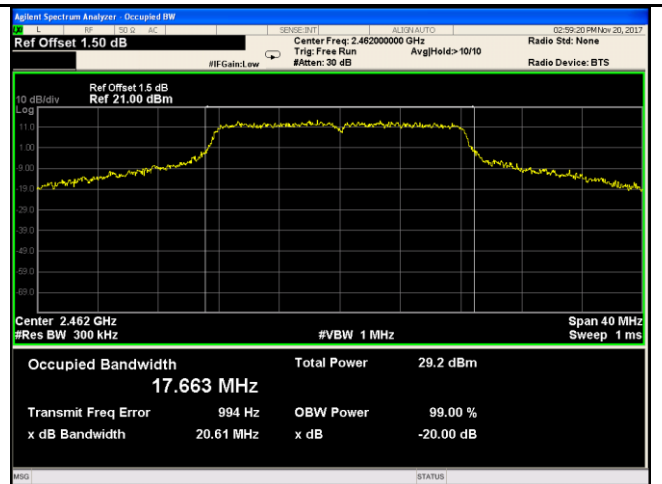
802.11g 20dB Bandwidth - 6 CH 2437



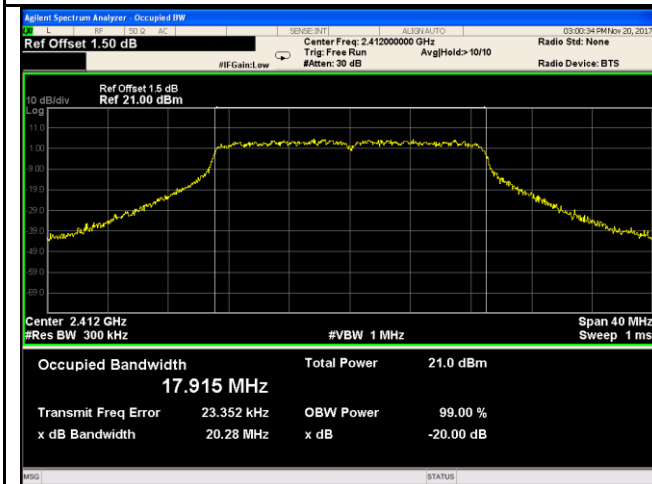
802.11g 20dB Bandwidth - 9 CH 2452



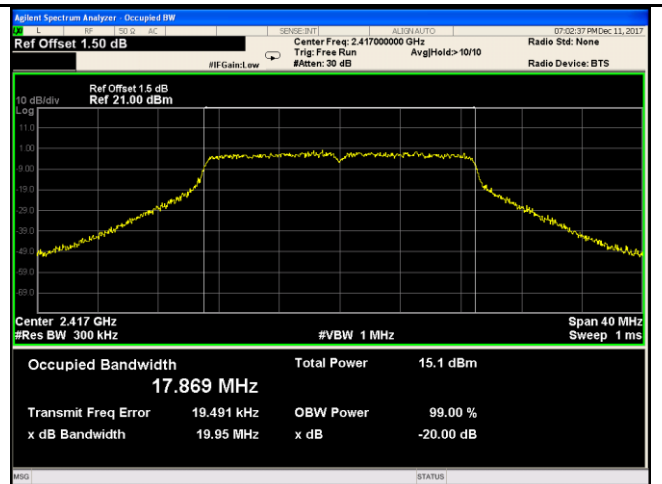
802.11g 20dB Bandwidth - 10 CH 2457



802.11g 20dB Bandwidth - 11 CH 2462



802.11n20 20dB Bandwidth - 1 CH 2412



802.11n20 20dB Bandwidth - 2 CH 2417