



RADIO TEST REPORT

For

MODEL NO.:1855

FCC ID: C3K1855

IC ID: 3048A-1855

Test Report No. R-TR516-FCCISED-WLAN-3

Issue Date: July 15, 2019

FCC CFR47 Part 15 Subpart C
Innovation, Science and Economic Development
Canada RSS-247 Issue 2

Prepared by

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TESTING CERT #3472.01

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Test Report Attestation

Microsoft Corporation
Model: 1855
FCC ID: C3K1855
IC ID: 3048A-1855

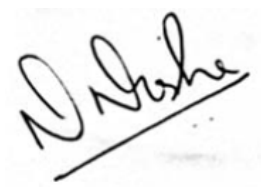
Applicable Standards

Specification	Test Result
FCC 47CFR Rule Parts 15.207, 15.209, 15.247	Pass
Innovation, Science and Economic Development Canada RSS-247 Issue 2, RSS-GEN Issue 5	Pass

Microsoft EMC Laboratory attests that the product model identified in this report has been tested to and meets the requirements identified in the above standards. The test results in this report solely pertains to the specific sample tested, under the conditions and operating modes as provided by the customer.

This report shall not be used to claim product certification, approval, or endorsement by A2LA or any agency of any Government. Reproduction, duplication or publication of extracts from this test report is prohibited and requires prior written approval of Microsoft EMC Laboratory.

This report replaces previously issued report number R-TR516-FCCISED-WLAN-2 issued July 2nd, 2019.



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Reviewed/ Issued By:

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2 Deviations from Standards

None.

3 Facilities and Accreditations

3.1 Test Facility

All test facilities used to collect the test data are located at Microsoft EMC Laboratory,
 17760 NE 67th Ct,
 Redmond WA, 98052, USA

3.2 Accreditations

The lab is established and follows procedures as outlined in IEC/ISO 17025 and A2LA accreditation requirements.

A2LA Accredited Testing Certificate Number: 3472.01

FCC Registration Number: US1141

IC Site Registration Numbers: 3048A-3, 3048A-4

3.3 Test Equipment

The site and related equipment are constructed in conformance with the requirements of ANSI C63.4:2014 and other equivalent applicable standards.

Test site requirements for measurements above 1 GHz are in accordance with ANSI C63.4:2014.

ANSI C63.10:2013 and the appropriate KDB test methods were followed.

4 Measurement Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the product, as specified in ETSI TR 100 028. This represents an expanded uncertainty expressed at 95% confidence level using a coverage factor $k=2$. These levels are for reference only and not included to determine product compliance.

Expanded uncertainty calculations are available upon request.

Test item	Uncertainty	Unit
Radiated disturbance (30 MHz to 1 GHz)	5.99	dB
Radiated disturbance (1 GHz to 18 GHz)	5.12	dB
Radiated disturbance (18-26.5 GHz)	4.86	dB
Conducted Disturbance at Mains Port	3.31	dB
Uncertainty for Conducted Power test	1.277	dB
Uncertainty for Conducted Spurious emission test	2.742	dB
Uncertainty for Bandwidth test	83	kHz
Uncertainty for DC power test	0.05	%
Uncertainty for test site temperature	0.5	°C
Uncertainty for test site Humidity	3	%
Uncertainty for time	0.189	%

5 Product Description

Company Name:	Microsoft Corporation
Address:	One Microsoft Way
City, State, Zip:	Redmond, WA 98052-6399
Customer Contact:	Chaitrali Limaye
Functional Description of the EUT:	Radio transceiver device with IEEE 802.11a/b/g/n/ac MIMO radio supporting 20/40/80MHz bandwidths, Bluetooth 5.0.
Model:	1855
FCC ID:	C3K1855
IC ID:	3048A-1855
Radio under test:	IEEE 802.11 b/g/n MIMO Radio supporting 20 and 40MHz Bandwidth (2.4 GHz- 2.4835 GHz)
Modulation(s):	CCK, BPSK, OFDM, and QAM modulation
Antenna Information:	Integral Antenna. Manufacturer declared Antenna Gain: Chain 0: 3.3dBi Chain 1: 2.7dBi
EUT Classification:	DTS
Equipment Design State:	Prototype/Production Equivalent (EV3)
Equipment Condition:	Good
Test Sample Details:	RF Conducted Test Sample- S/N- A24964030091844A RF Radiated Test Sample- S/N- 900218190956, 900054391556

5.1 Test Configurations

Test software “QRCT4” (V 4.0.00113) was used to program the EUT to transmit continuously. All modes of operation were investigated initially with full testing performed on the worst-case modes. This report contains data from the following worst-case modes of operation:

802.11b: 1Mbps

802.11g: 6Mbps

802.11n: MCS0

All radiated testing reported was performed with the USB charging cord connected as these results were worst case.

5.2 Environmental Conditions

Ambient air temperature of the test site was within the range of 10 °C to 40 °C (50 °F to 104 °F) unless the EUT specified testing over a different temperature range. Humidity levels were in the range of 10% to 90% relative humidity. Testing conditions were within tolerance, and any deviations required from the EUT are reported.

5.3 Antenna Requirements

The antennas are permanently attached and there are no provisions for connection to an external antenna.

5.3.1 Antenna Gain

Antenna Gain			
Frequency Band (MHz)	Wi-Fi Chain 0 Antenna Peak Gain (dBi)	Wi-Fi Chain 1 Antenna Peak Gain (dBi)	Total Antenna Gain (dBi)
2400 – 2483.5	3.3	2.7	3.01 (Uncorrelated)
2400 – 2483.5	3.3	2.7	6.02 (Correlated)

Simultaneous transmission on both transmit chains was observed to be the worst-case mode of operation for all test cases. Since OFDM transmit signals in CSD modes are correlated only over small bandwidths, and not over the entire signal bandwidth, the combined in-band gain for total power is considered as uncorrelated and calculated using the following formula as specified in KDB 662911 D01 Multiple Transmitter Output v02r01:

$$\text{Uncorrelated Directional gain} = 10\log [(10^{G1/10} + 10^{G2/10} + \dots + 10^{GN/10})/N_{ANT}] \text{dBi}$$

In the case that G1 =3.3dBi, G2=2.7dBi:

$$\text{Uncorrelated Directional gain} = 10\log [(10^{3.3/10} + 10^{2.7/10})/2] = 3.01\text{dBi}$$

Since OFDM transmit signals in CSD modes are correlated over small bandwidths, the total gain will influence PSD measurements. The combined gain for PSD is considered to be correlated and calculated using the following formula as specified in KDB 662911 D01 Multiple Transmitter Output v02r01:

$$\text{Correlated Directional gain} = 10\log [(10^{G1/20} + 10^{G2/20} + \dots + 10^{GN/20})^2/N_{ANT}] \text{ dBi}$$

In the case that G1 =3.3dBi, G2=2.7dBi:

$$\text{Correlated Directional gain} = 10\log [(10^{3.3/20} + 10^{2.7/20})^2/2] = 6.02\text{dBi}$$

5.4 Equipment Modifications

No modifications were made during testing.

5.5 Dates of Testing

Testing was performed from March 28th to May 30th, 2019.

6 Test Results Summary

Test Description	FCC CFR 47/ ISED Rule Part	Limit	Test Result
Duty Cycle	Reporting & Measurements	Reporting & Measurements Purposes only	N/A
6dB Bandwidth	15.247 (a)(2) RSS-247 [5.2]	$\geq 500\text{kHz}$	Pass
Occupied Bandwidth	Reporting & Measurements	Reporting & Measurements Purposes only	N/A
Output Power	15.247 (b)(3) RSS-247 [5.4]	$\leq 1 \text{ Watt}$	Pass
Equivalent Isotropic Radiated Power	RSS-247 [5.4]	$\leq 4 \text{ Watt}$	Pass
Power Spectral Density	15.247 (e) RSS-247 [5.2]	$\leq 8\text{dBm}/3\text{kHz}$	Pass
Conducted Band Edge/Spurious Emissions	15.247 (d) RSS-247 [5.5]	At least 20dBc	Pass
Radiated Spurious Emissions/ Restricted Band Emissions	15.205, 15.209 RSS-247 [5.5] RSS-Gen [8.9]	FCC CFR 47 15.209 limits RSS-Gen [8.9]	Pass
AC Power Line Conducted Emissions	15.207 RSS-Gen [8.8]	FCC CFR 47 15.207 limits RSS-Gen [8.8]	Pass

7 Test Equipment List

Equipment used for Radiated and Conducted Measurements				
Manufacturer	Description	Model #	Asset #	Calibration Due
Rohde & Schwarz	EMI Test Receiver	ESU40	RF-192	4/10/2020
Rohde & Schwarz	EMI Test Receiver	ESU40	RF-248	4/11/2020
Rohde & Schwarz	EMI Test Receiver	ESU40	RF-229	4/10/2020
Keysight	Spectrum Analyzer	N9010A	EMC-1213	11/8/2019
Agilent	Spectrum Analyzer	N9030A	EMC-607	2/10/2020
Agilent	Spectrum Analyzer	N9030A	EMC-061	4/23/2020
Sunol Sciences	Antenna - Broadband Hybrid	JB6	EMC-639	8/17/2019
ETS-Lindgren	Antenna	3117-PA	EMC-858	10/8/2019
ETS-Lindgren	Antenna	3117-PA	RF-139	6/1/2019
ETS-Lindgren	Antenna – Standard Gain	3160-09	RF-179	7/30/2019
ETS-Lindgren	Antenna – Standard Gain	3160-10	EMC-602	6/5/2019
Rohde & Schwarz	Custom Filter Bank+PreAmp	SFUNIT RX	RF-322	12/4/2019
Rohde & Schwarz	Custom Filter Bank+PreAmp	SFUNIT RX	RF-323	11/29/2019
Rohde & Schwarz	Pre-Amp	TS-PR26	RF-199	11/29/2019
Rohde & Schwarz	Switch and Control Unit	OSP130	RF-569	7/23/2019
Rohde & Schwarz	Switch and Control Unit	OSP130	RF-018	12/4/2019
Rohde & Schwarz	Switch and Control Unit	OSP130	RF-249	11/29/2019
Rohde & Schwarz	Switch and Control Unit	OSP150	RF-019	12/4/2019
Rohde & Schwarz	Switch and Control Unit	OSP150	RF-250	11/29/2019
Murata	RF Cable	MXJA01JA1000	RF-828	N/A

Manufacturer	Description	Model #	Asset #	Calibration Due
Digi-Key	RF Cable	MXFR01JA1000	RF-847	N/A
Micro-Coax	RF Cable	UTI Flex	RF-359	N/A
Micro-Coax	RF Cable	UTI Flex	RF-354	N/A
Huber & Suhner	RF Cable	SucoFlex 100	RF-452	N/A
Huber & Suhner	RF Cable	SucoFlex 100	RF-350	N/A
Huber & Suhner	RF Cable	SucoFlex 102A	RF-269	N/A
PCE	Climate Meter	PCE-THB 40	EMC-1207	9/28/2019
PCE	Climate Meter	PCE-THB 40	EMC-1206	9/28/2019
Madge Tech	THP Monitor	PRHT Temp 2000	EMC-170	10/18/2019
Micro-Coax	RF Cable	UTI Flex	RF-647	N/A
Micro-Coax	RF Cable	UTI Flex	RF-646	N/A
Micro-Coax	RF Cable	UFA210A-Q-2755-3005GU	EMC-648	N/A
Micro-Coax	RF Cable	UFA0311-1-0787-50U50U	EMC-351	N/A
Micro-Coax	RF Cable	UFB311A-0-2756-5005G0	EMC-865	N/A
Micro-Coax	RF Cable	UFA210A-0-0787-300300	RF-297	N/A
Teledyne	RF Cable	57500	EMC-1025	N/A
Micro-Coax	RF Cable	UFC142A	RF-274	N/A
Pasternack	Attenuator	PE7004-6	EMC-950	8/17/2019
MCL	Attenuator	BHBW-S6-2W263+	RF-710	N/A
Pasternack	Attenuator	PE7087-6	RF-801	N/A
Rohde & Schwarz	Software	EMC-32 V10.01.00	RF-464	N/A

Equipment used for Line Conducted Emissions Measurement				
Manufacturer	Description	Model #	Asset #	Calibration Due
Rohde & Schwarz	EMI Test Receiver	ESU	RF-604	12/26/2019
Teseq	EUT LISN	NNB 51	EMC-057	6/7/2019
Micro-Coax	RF Cable	UFA210A-1-1800-50U50U	EMC-367	N/A
ETS-Lindgren	TILE SW	Version 7.2.5.7	EMC-985	N/A
PCE	THP Monitor	PCE THB 40	EMC-1208	9/28/2019
Fluke	Multimeter	87V	EMC-650	7/30/2019
Chroma	AC Power source	61602	EMC-055	N/A

Note: Items with Calibration Due data marked as N/A are characterized before test, where applicable.

8 Test Site Description

8.1 Radiated Emissions Test Site

Radiated measurements are performed in a 3m semi-anechoic chamber, which meets NSA requirements for the frequency range of 30MHz to 1000MHz. For measurements above 1 GHz, absorbers are placed on the ground plane between the receiving antenna and the EUT to meet Site VSWR requirements in accordance with ANSI C63.4:2014.

8.1.1 Radiated Measurements in 9kHz- 30 MHz

The EUT is positioned on a turntable at a height of 80cm using a non-conducting table. A loop antenna is positioned at 3m from the EUT periphery at 1m height from the ground. The turntable is rotated 360 degrees to determine the highest emissions. This is repeated for three orientations of the measurement antenna- parallel, perpendicular and ground-parallel. All possible orientations of the EUT were investigated for emissions and the flat orientation was identified as the worst-case configuration.

8.1.2 Radiated Measurements in 30 MHz - 1000 MHz

The EUT is positioned on a turntable at a height of 80cm using a non-conducting table. A linearly polarized broadband antenna is positioned at 3m from the EUT periphery. The turntable is rotated 360 degrees and the antenna height varied from 1m to 4m to determine the highest emissions. This is repeated for both horizontal and vertical polarizations of the measurement antenna. All possible orientations of the EUT were investigated for emissions and the vertical standing mode was identified as the worst-case configuration.

8.1.3 Radiated Measurements above 1GHz

The EUT is positioned on a Turntable at a height of 1.5m. A linearly polarized antenna is positioned at 3m from the EUT periphery. Guidelines in ANSI C63.10:2013 were followed with respect to maximizing the emissions. The measurement antenna is set at a fixed 1.5m height while the turntable is rotated 360 degrees and the EUT elevation angle is varied from 0 to 150 degrees to determine the highest emissions. This is repeated for both horizontal and vertical polarizations of the measurement antenna. Measurements above 18GHz were performed at a 3m distance.

8.2 Antenna port conducted measurements

All antenna port conducted measurements were performed on a bench-top setup consisting of a spectrum analyzer, power meter (as necessary), splitters/combiners (as necessary), attenuators, and pre-characterized RF cables.

The correction factors between the EUT and the spectrum analyzer were added internally in the analyzer settings, where applicable. The plots displayed take these correction factors into account.

8.3 Test Setup Diagrams

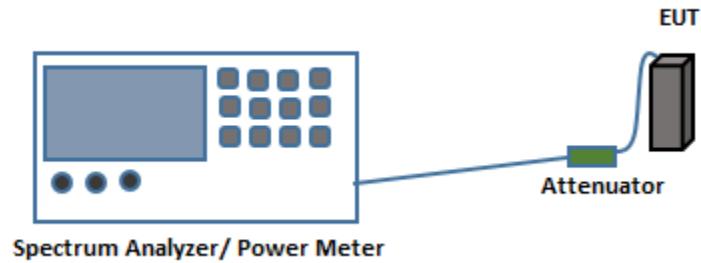


Figure 1. Test Setup for Antenna port conducted measurements

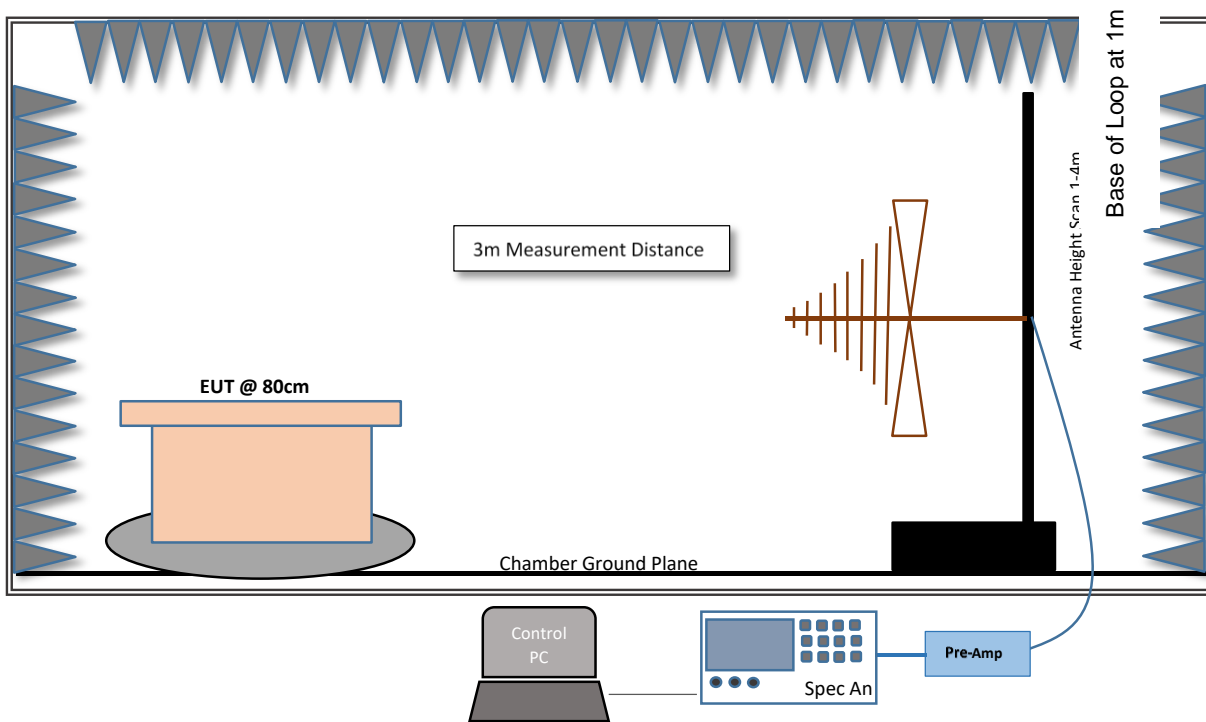


Figure 2. Test Setup for Radiated measurements in 30MHz- 1GHz Range

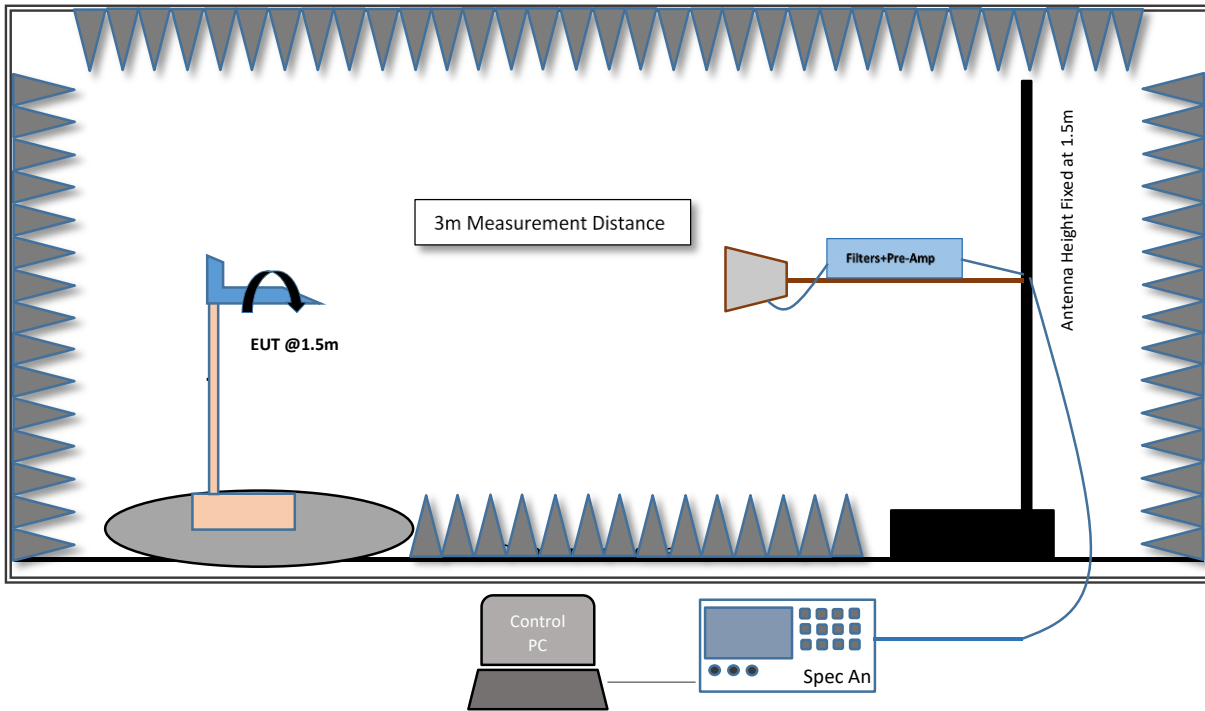


Figure 3. Test Setup for Radiated measurements in 1GHz- 18GHz Range

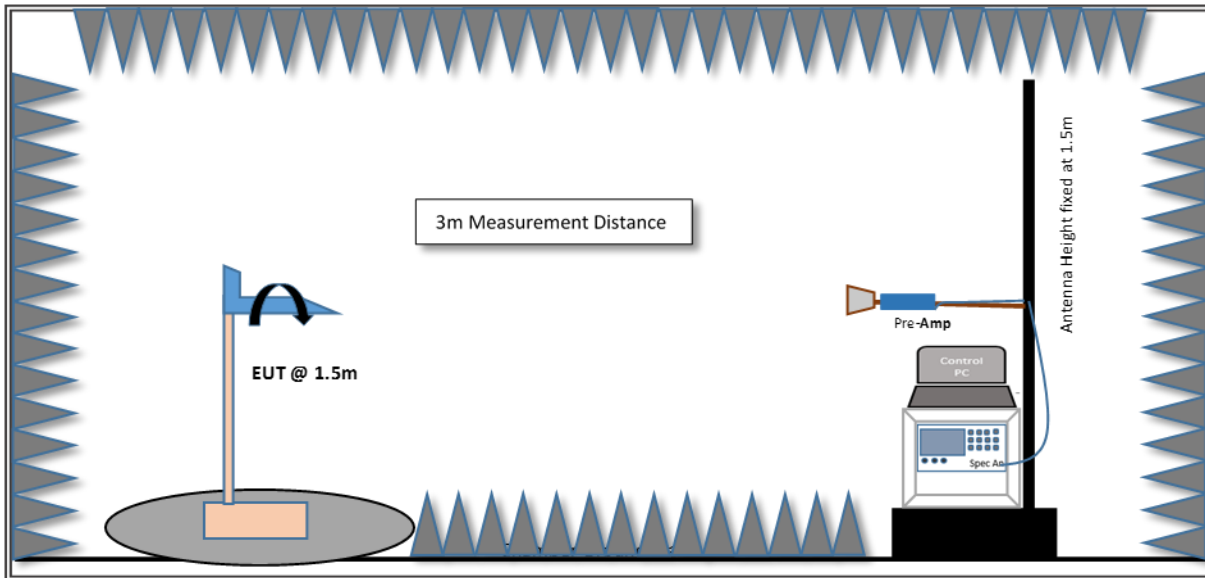


Figure 4. Test Setup for Radiated measurements >18GHz

9 Test Results- Conducted

9.1 Duty Cycle

9.1.1 Test Requirement:

Reporting and measurement purposes only.

9.1.2 Test Method:

Measurements were performed according to the procedure defined in ANSI C63.10: 2013.

Spectrum Analyzer Settings:

RBW \geq Occupied Bandwidth if possible; otherwise, set RBW to the largest available value

VBW \geq RBW \geq Signal Period

Detector = Peak

Span = 0 Hz

Sweep points > 100

9.1.3 Sample Calculation:

Duty Cycle % = $[(T_{on}) / (T_{on} + T_{off})] * 100$

e.g. $[8.60/8.67] = 0.9919 * 100 = 99.19\%$

If duty cycle >98% then the correction factor is 0, else the correction factor is calculated as follows.

Duty Cycle Correction Factor = $10 \log^*(1/DC) = 10 \log (1/0.92) = 0.362\text{dB}$

9.1.4 Limits:

Reporting and measurement purposes only. Duty Cycles > 98% are considered to have a Duty Cycle Correction Factor = 0dB.

9.1.5 Test Results:

Mode	Chain 0/1	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11b	0	8.595	8.670	99.135	0.000
802.11b	1	8.579	8.645	99.237	0.000
802.11g	0	1.585	1.635	96.942	0.135
802.11g	1	1.589	1.640	96.890	0.137
802.11n20	0	1.485	1.535	96.743	0.144
802.11n20	1	1.474	1.525	96.656	0.148
802.11n40	0	0.735	0.795	92.453	0.341
802.11n40	1	0.729	0.795	91.698	0.376

9.1.6 Test Data:

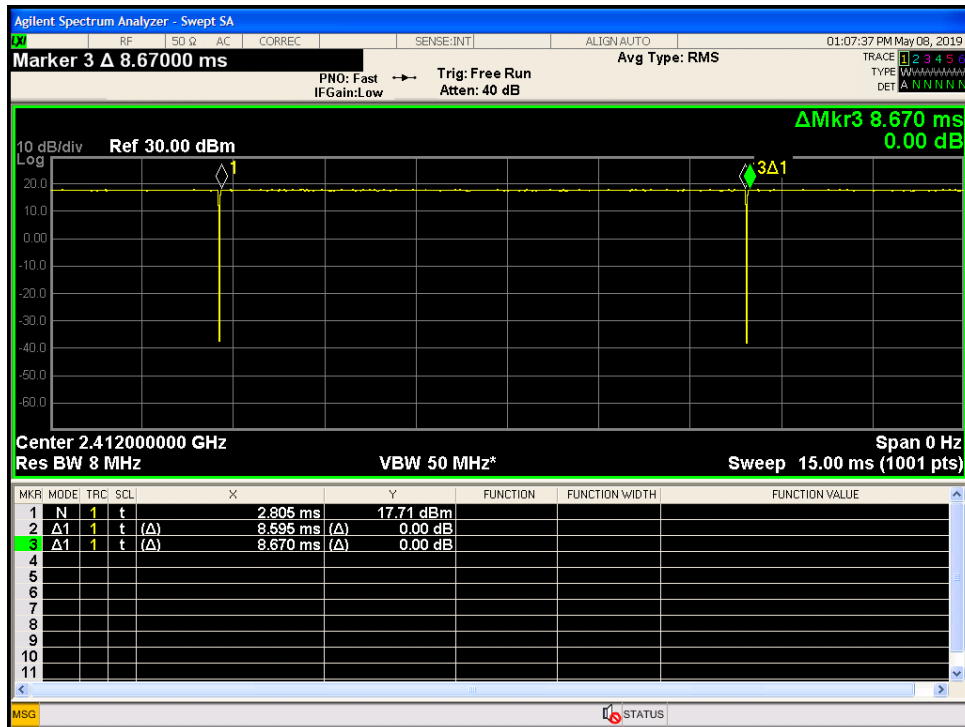


Figure 9-1 Duty Cycle 802.11b -Chain 0

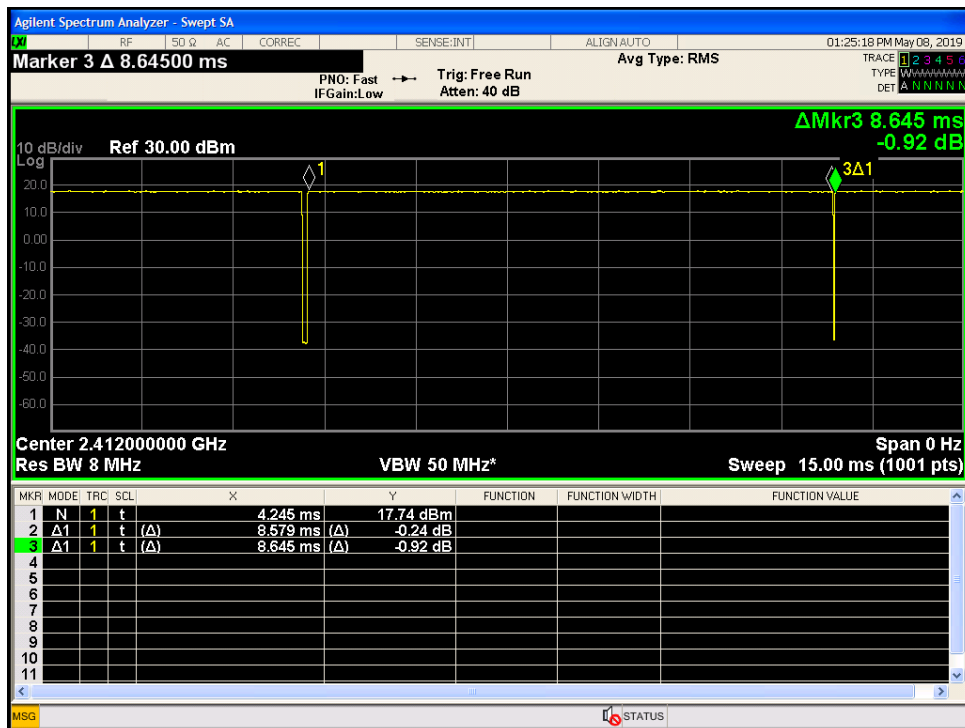


Figure 9-2 Duty Cycle 802.11b -Chain 1

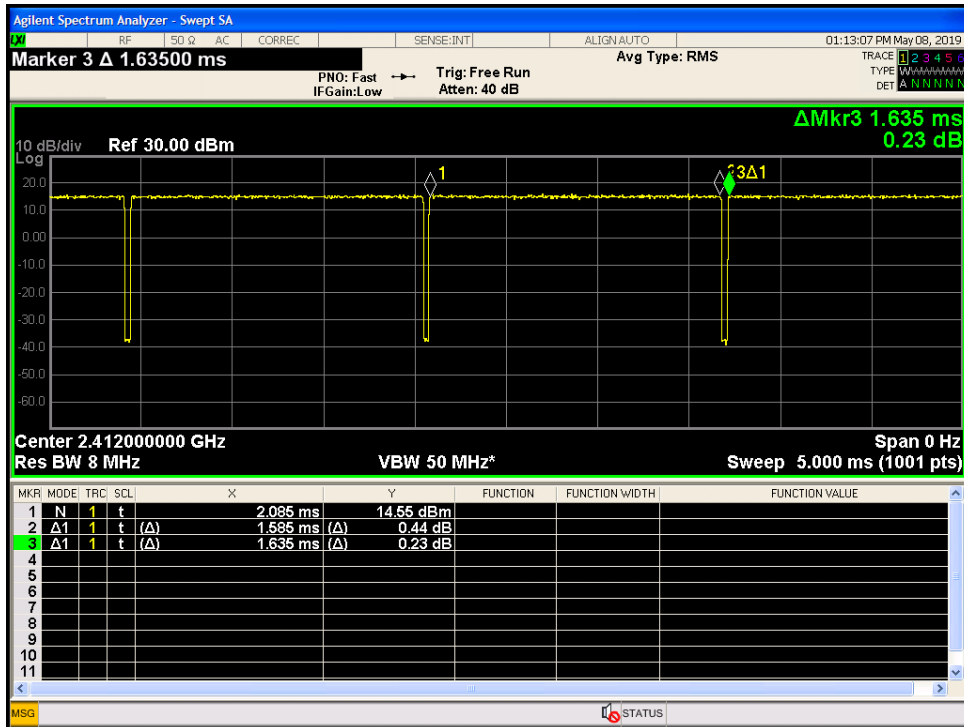


Figure 9-3 Duty Cycle 802.11g -Chain 0

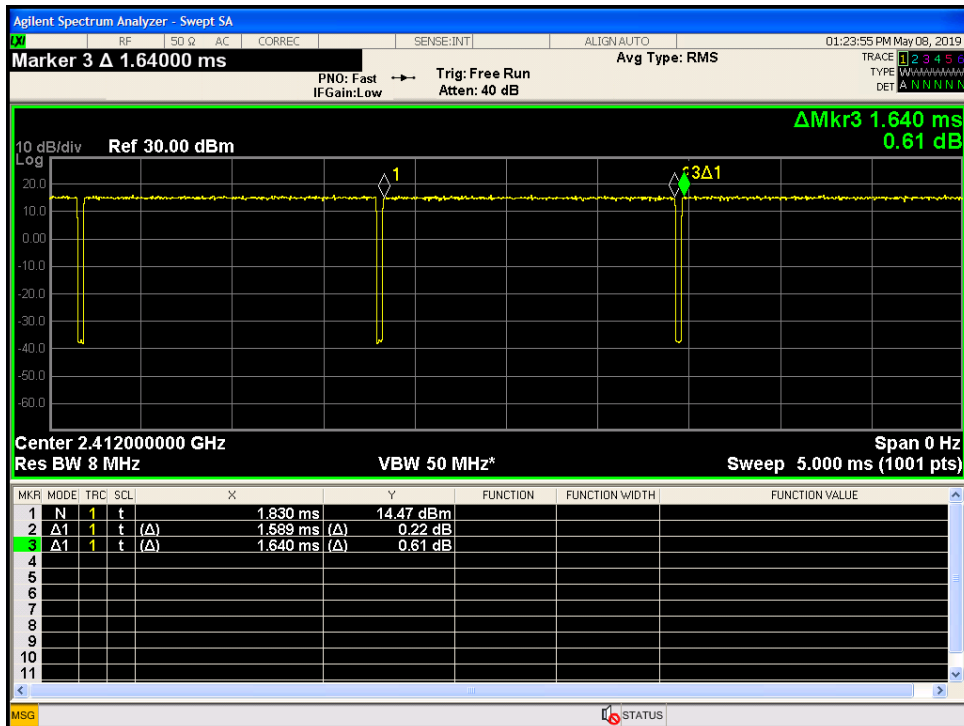


Figure 9-4 Duty Cycle 802.11g -Chain 1

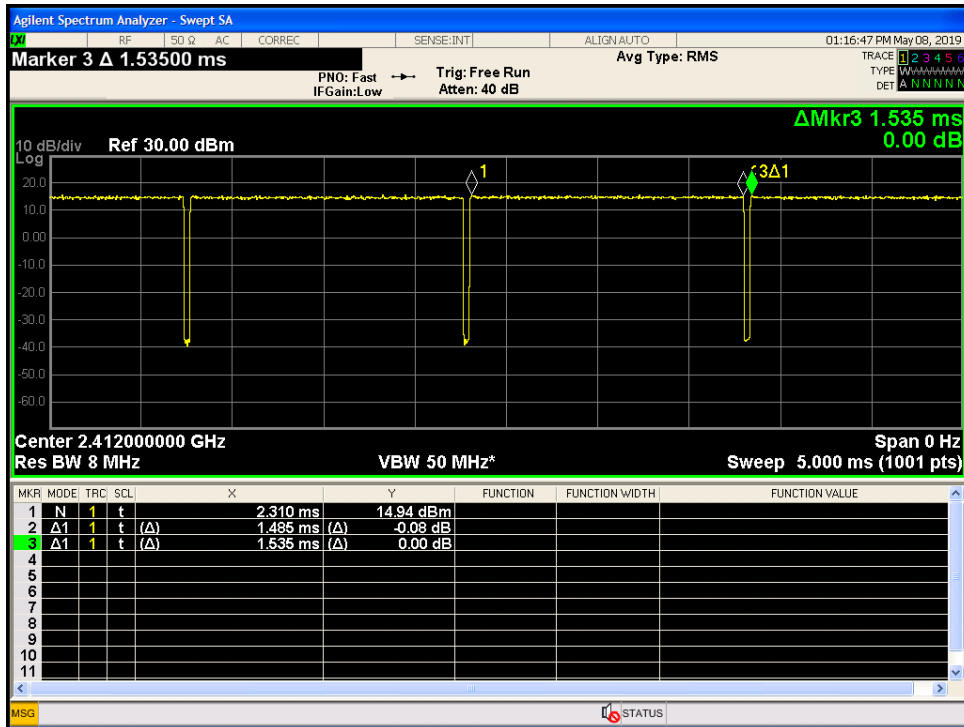


Figure 9-5 Duty Cycle 802.11n20 -Chain 0

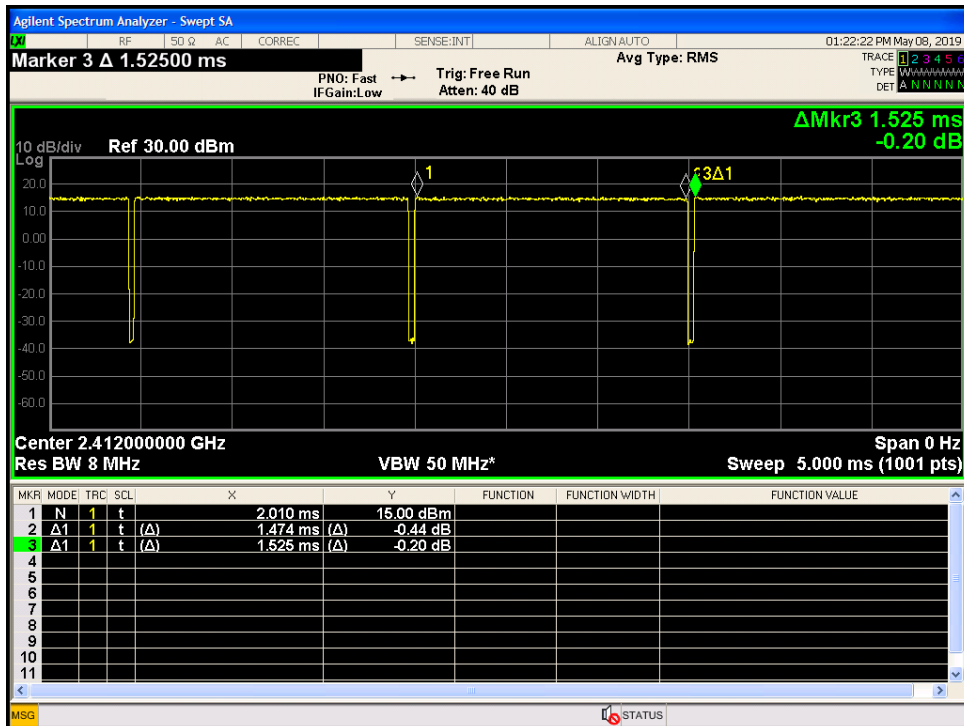


Figure 9-6 Duty Cycle 802.11n20 -Chain 1

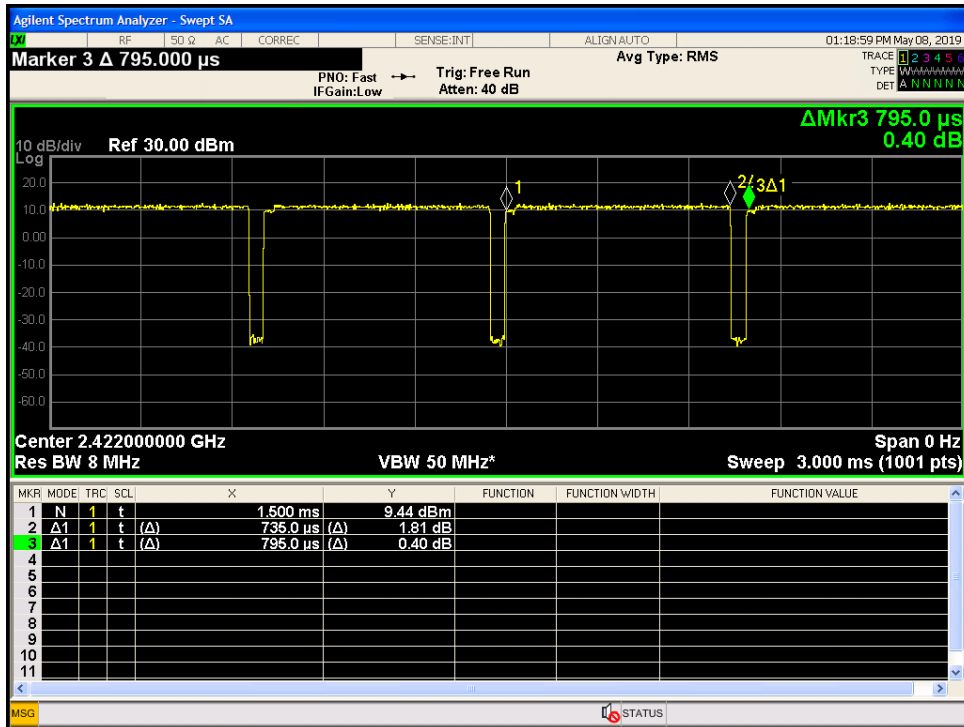


Figure 9-7 Duty Cycle 802.11n40 -Chain 0

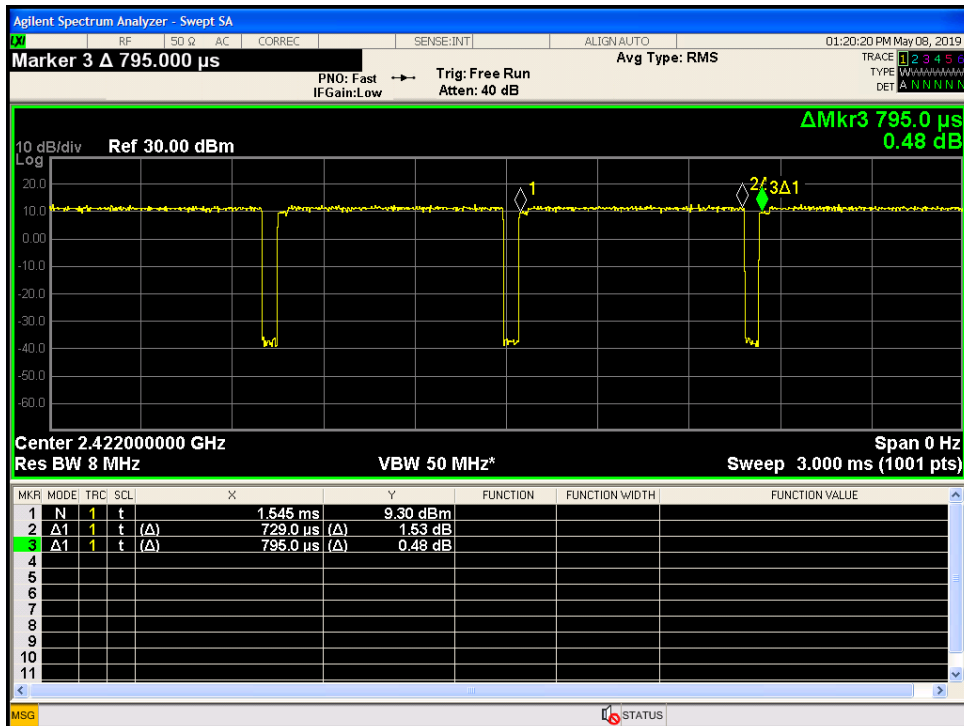


Figure 9-8 Duty Cycle 802.11n40 -Chain 1

9.2 DTS Bandwidth

9.2.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (a)(2)

ISED RSS-247 [5.2]

9.2.2 Test Method:

Measurements were performed according to the procedure defined in KDB 558074- Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 V05 and ANSI C63.10: 2013.

Spectrum Analyzer Settings:

RBW= 100 kHz

VBW \geq 3 \times RBW

Detector = Peak

Span = 30MHz

Trace Mode= Max Hold

Sweep time= Auto Couple

The in-built functionality of the Spectrum Analyzer is used to measure the 6-dB bandwidth.

Sample Calculation:

Corrected Amplitude: Amplitude (Analyzer level) + CL (Cable losses) = -25 dBm + 5 dB = -20dBm.

9.2.3 Limits:

The 6-dB bandwidth shall be at least 500 kHz

9.2.4 Test Results:

Chain 0 802.11b 6-dB Emission Bandwidth				
Channel No.	Frequency (MHz)	6-dB Emission Bandwidth (MHz)	Limit (MHz)	Result
1	2412	9.04	≥ 0.5	Pass
6	2437	8.60	≥ 0.5	Pass
11	2457	8.60	≥ 0.5	Pass
12	2462	9.05	≥ 0.5	Pass
13	2467	9.08	≥ 0.5	Pass
Chain 0 802.11g 6-dB Emission Bandwidth				
Channel No.	Frequency (MHz)	6-dB Emission Bandwidth (MHz)	Limit (MHz)	Result
1	2412	16.41	≥ 0.5	Pass
6	2437	16.40	≥ 0.5	Pass
11	2457	16.37	≥ 0.5	Pass
12	2462	16.43	≥ 0.5	Pass
13	2467	16.38	≥ 0.5	Pass
Chain 0 802.11n20 6-dB Emission Bandwidth				
Channel No.	Frequency (MHz)	6-dB Emission Bandwidth (MHz)	Limit (MHz)	Result
1	2412	17.61	≥ 0.5	Pass
6	2437	17.63	≥ 0.5	Pass
11	2462	17.63	≥ 0.5	Pass
12	2467	17.62	≥ 0.5	Pass
13	2472	17.64	≥ 0.5	Pass
Chain 0 802.11n40 6-dB Emission Bandwidth				
Channel No.	Frequency (MHz)	6-dB Emission Bandwidth (MHz)	Limit (MHz)	Result
3	2422	36.40	≥ 0.5	Pass
7	2442	36.39	≥ 0.5	Pass
9	2452	36.39	≥ 0.5	Pass
10	2457	36.40	≥ 0.5	Pass
11	2462	36.36	≥ 0.5	Pass

Chain 1 802.11b 6-dB Emission Bandwidth				
Channel No.	Frequency (MHz)	6-dB Emission Bandwidth (MHz)	Limit (MHz)	Result
1	2412	8.58	≥ 0.5	Pass
6	2437	8.55	≥ 0.5	Pass
11	2462	9.02	≥ 0.5	Pass
12	2467	8.57	≥ 0.5	Pass
13	2472	8.59	≥ 0.5	Pass
Chain 1 802.11g 6-dB Emission Bandwidth				
Channel No.	Frequency (MHz)	6-dB Emission Bandwidth (MHz)	Limit (MHz)	Result
1	2412	16.43	≥ 0.5	Pass
6	2437	16.40	≥ 0.5	Pass
11	2462	16.40	≥ 0.5	Pass
12	2467	16.43	≥ 0.5	Pass
13	2472	16.36	≥ 0.5	Pass
Chain 1 802.11n20 6-dB Emission Bandwidth				
Channel No.	Frequency (MHz)	6-dB Emission Bandwidth (MHz)	Limit (MHz)	Result
1	2412	17.63	≥ 0.5	Pass
6	2437	17.61	≥ 0.5	Pass
11	2462	17.62	≥ 0.5	Pass
12	2467	17.61	≥ 0.5	Pass
13	2472	17.57	≥ 0.5	Pass
Chain 1 802.11n40 6-dB Emission Bandwidth				
Channel No.	Frequency (MHz)	6-dB Emission Bandwidth (MHz)	Limit (MHz)	Result
3	2422	36.34	≥ 0.5	Pass
7	2442	36.14	≥ 0.5	Pass
9	2452	35.81	≥ 0.5	Pass
10	2457	36.19	≥ 0.5	Pass
11	2462	35.96	≥ 0.5	Pass

9.2.5 Test Data:

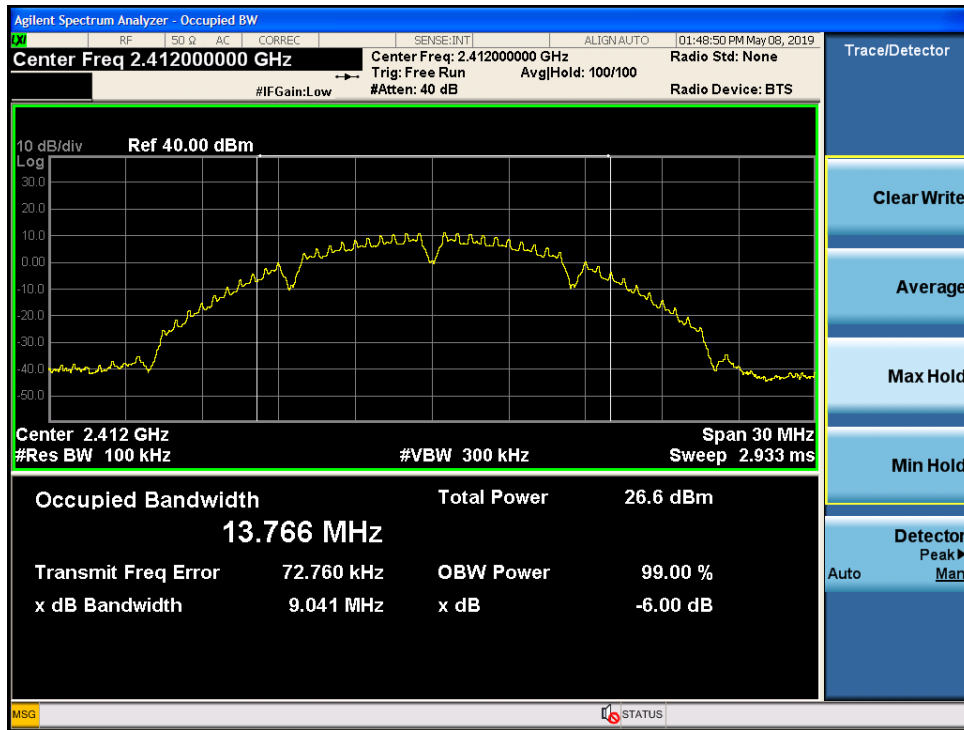


Figure 9-9 Chain 0 DTS Bandwidth 802.11b mode - Ch.1

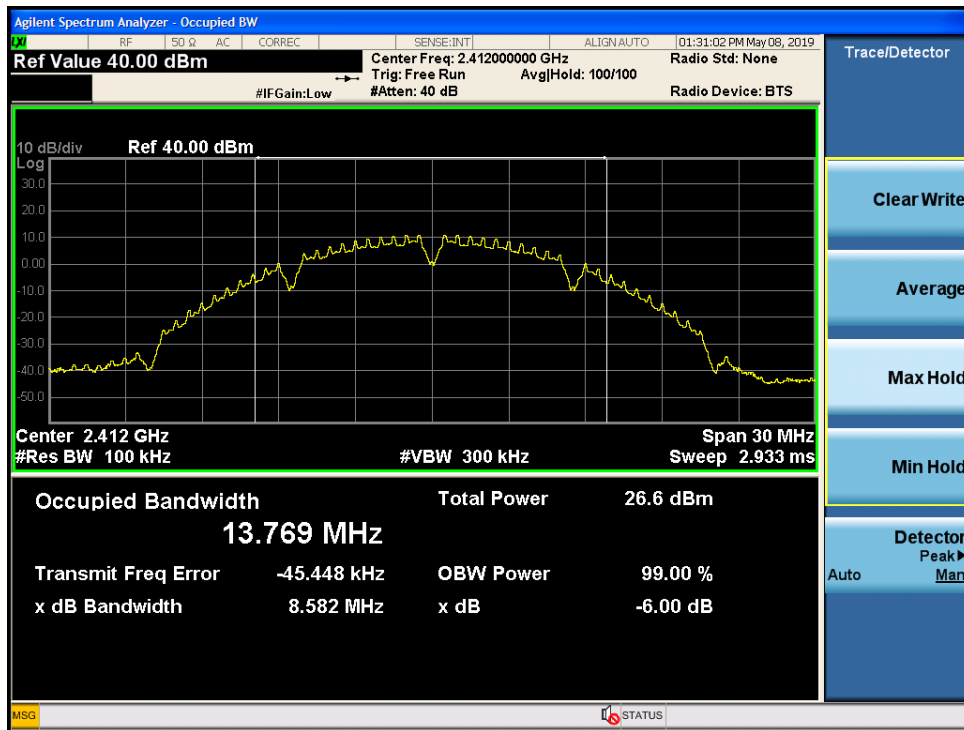


Figure 9-10 Chain 1 DTS Bandwidth 802.11b mode - Ch.1

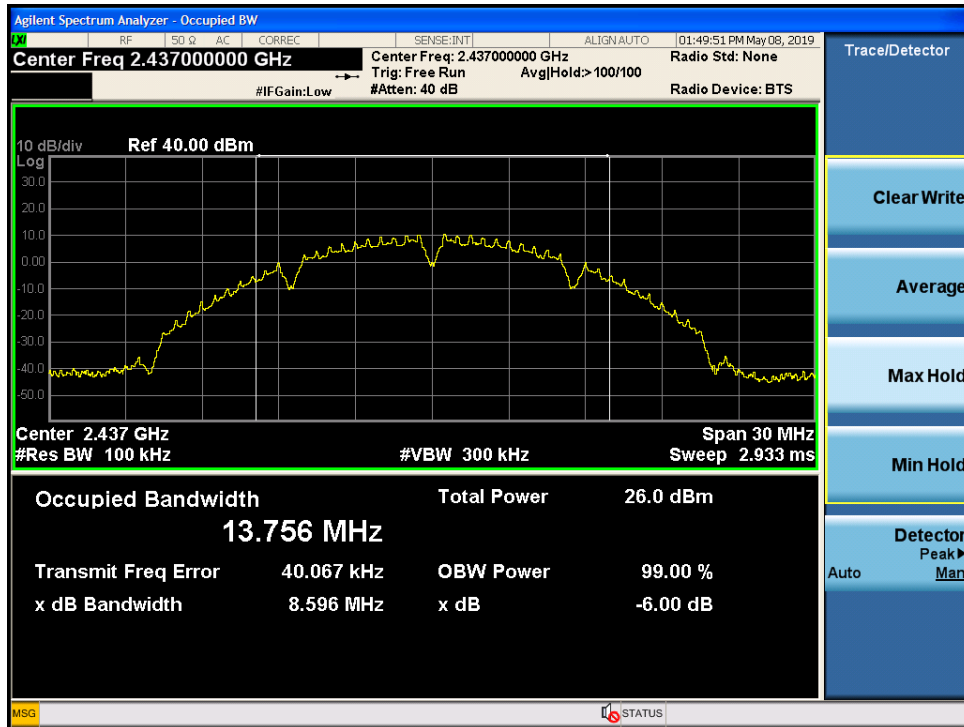


Figure 9-11 Chain 0 DTS Bandwidth 802.11b mode - Ch.6

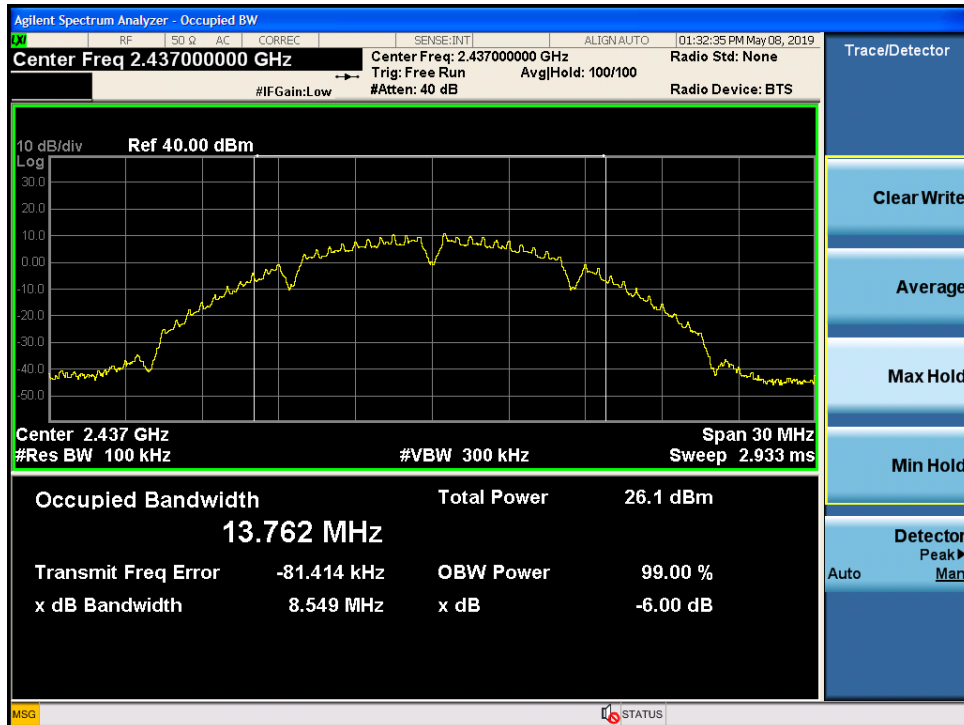


Figure 9-12 Chain 1 DTS Bandwidth 802.11b mode - Ch.6

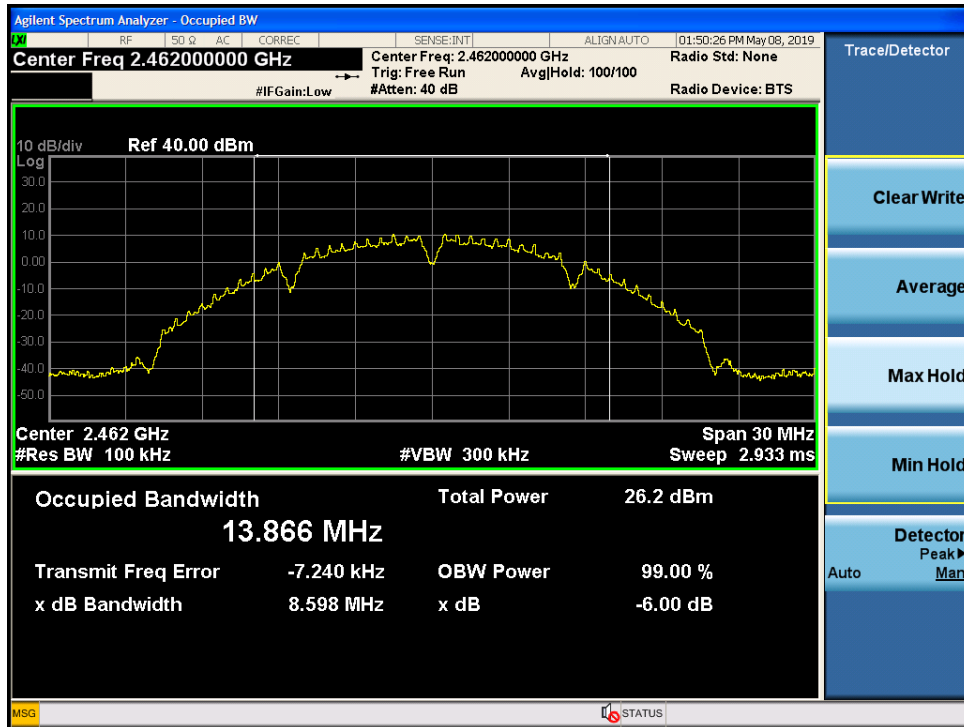


Figure 9-13 Chain 0 DTS Bandwidth 802.11b mode - Ch.11

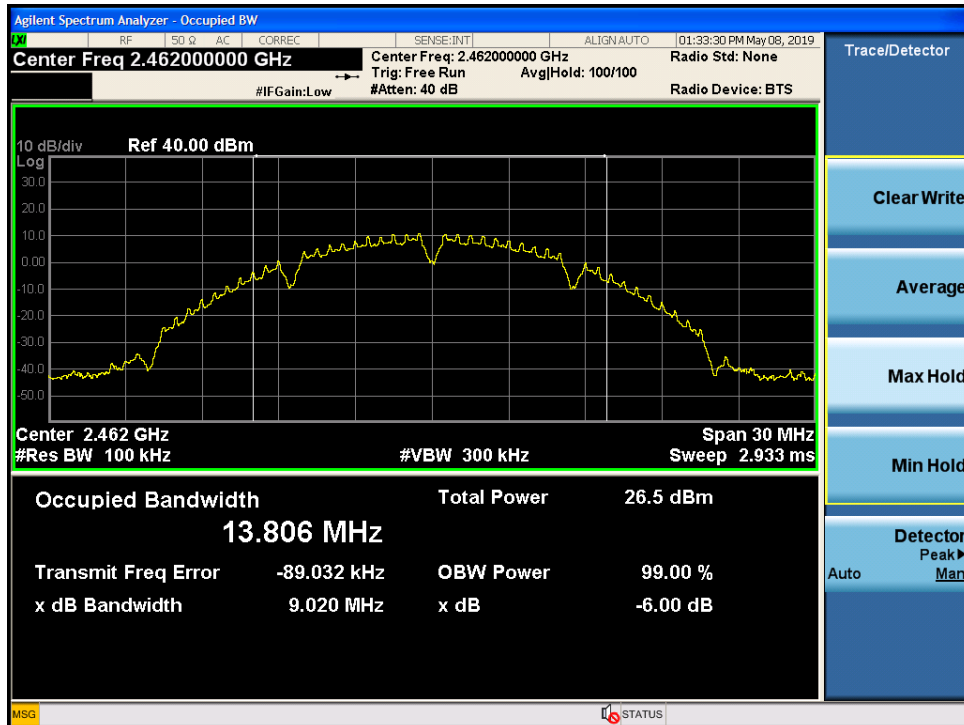


Figure 9-14 Chain 1 DTS Bandwidth 802.11b mode - Ch.11

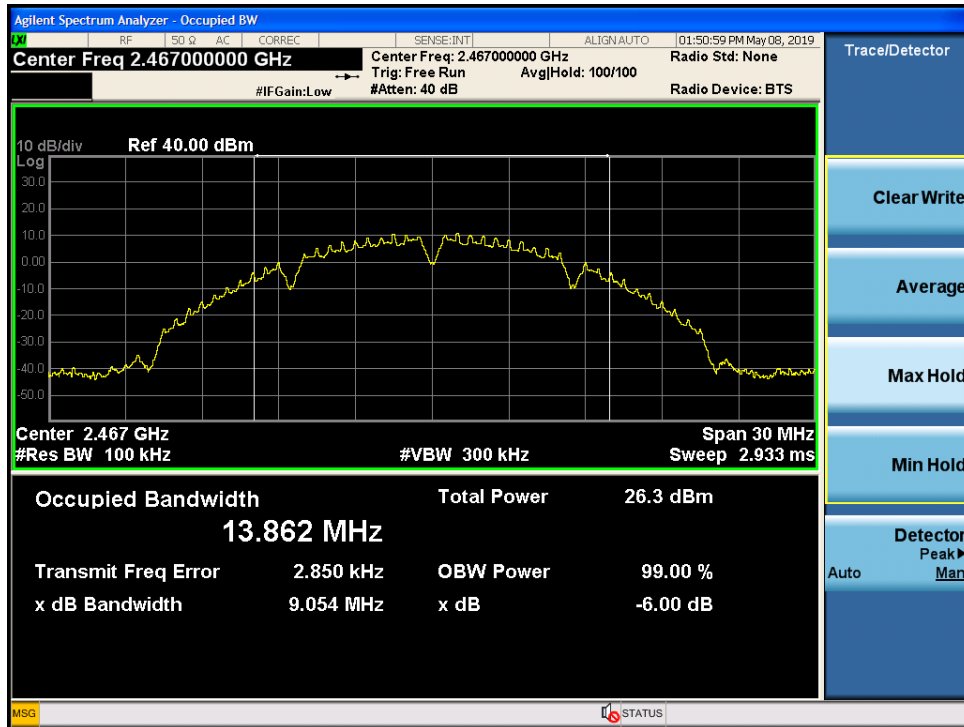


Figure 9-15 Chain 0 DTS Bandwidth 802.11b mode - Ch.12

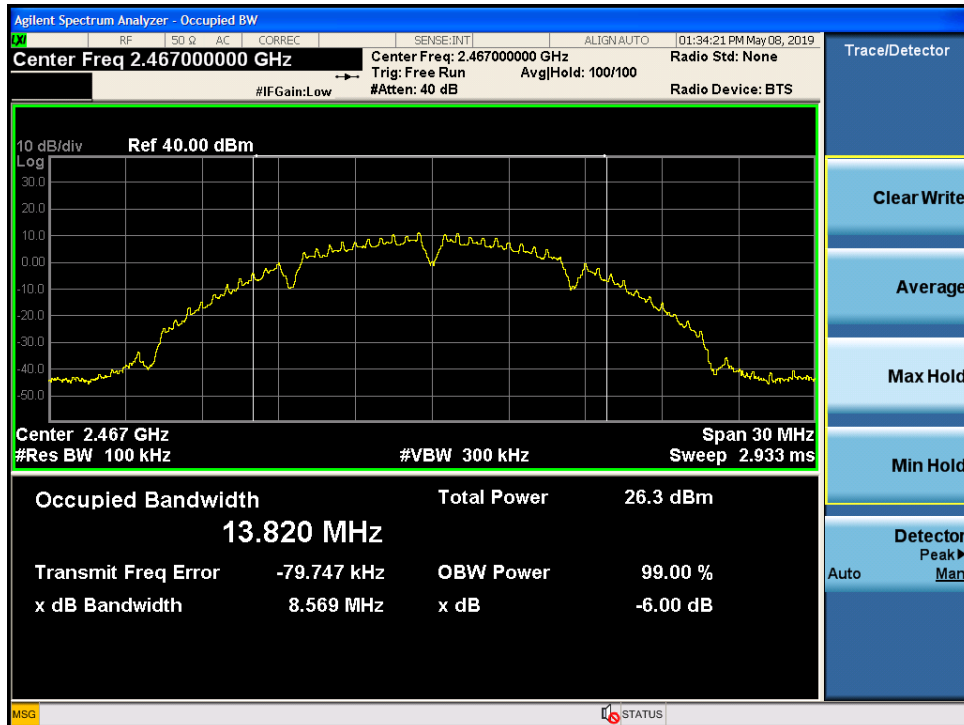


Figure 9-16 Chain 1 DTS Bandwidth 802.11b mode - Ch.12

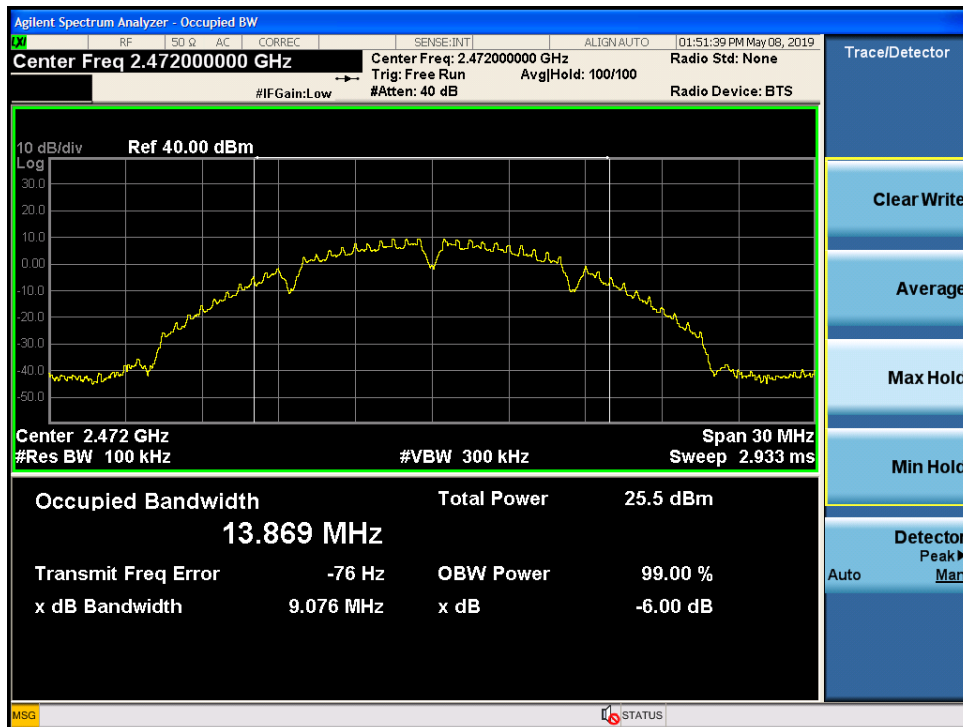


Figure 9-17 Chain 0 DTS Bandwidth 802.11b mode - Ch.13

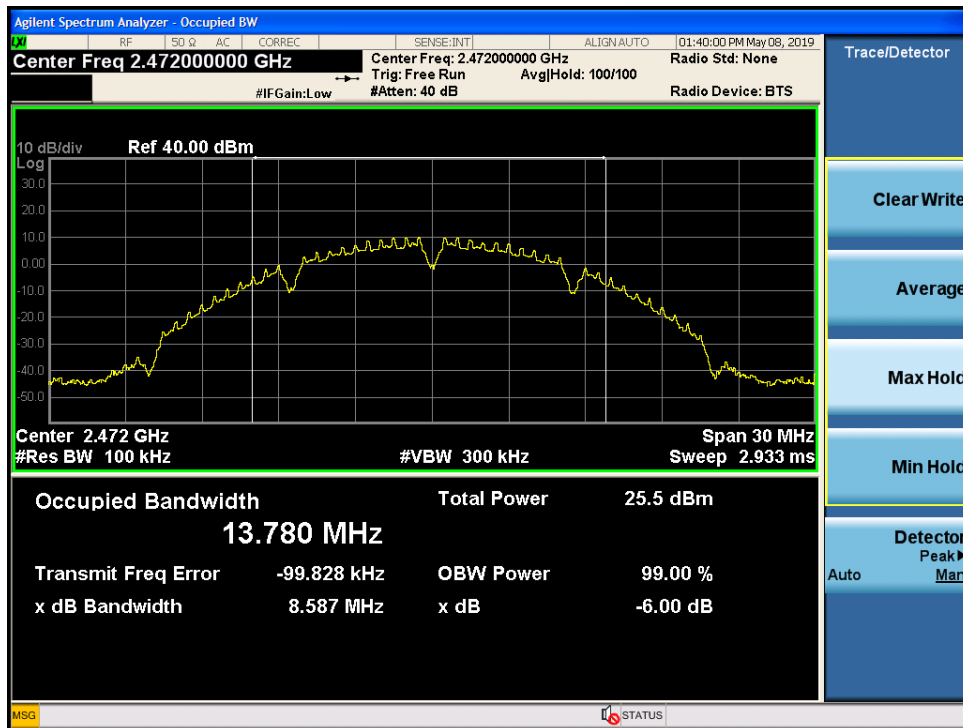


Figure 9-18 Chain 1 DTS Bandwidth 802.11b mode - Ch.13

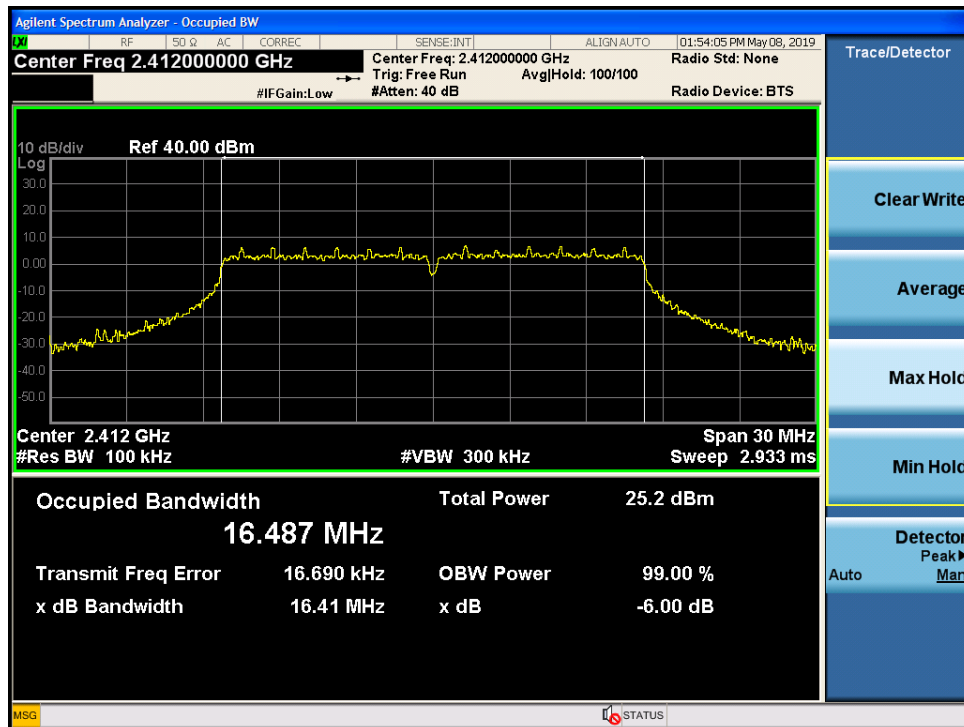


Figure 9-19 Chain 0 DTS Bandwidth 802.11g mode - Ch.1

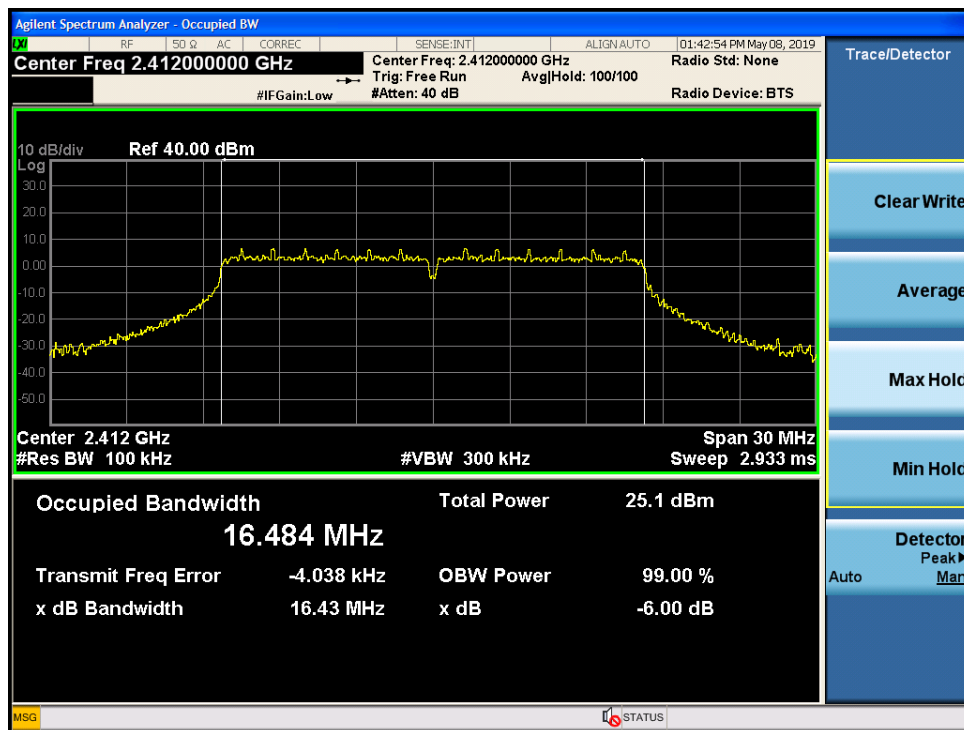


Figure 9-20 Chain 1 DTS Bandwidth 802.11g mode - Ch.1

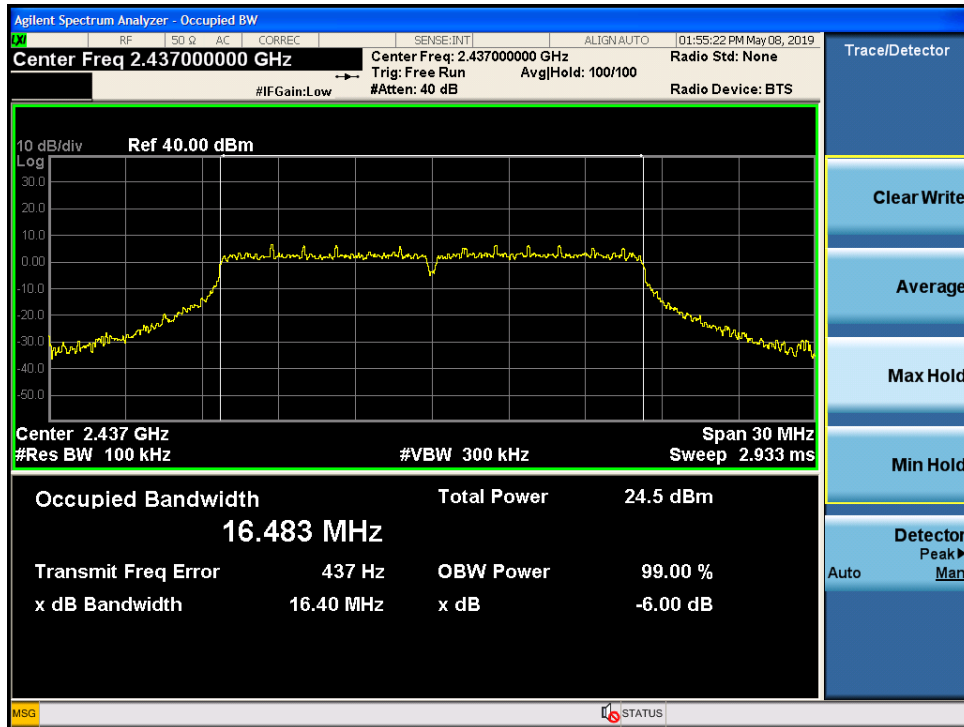


Figure 9-21 Chain 0 DTS Bandwidth 802.11g mode - Ch.6

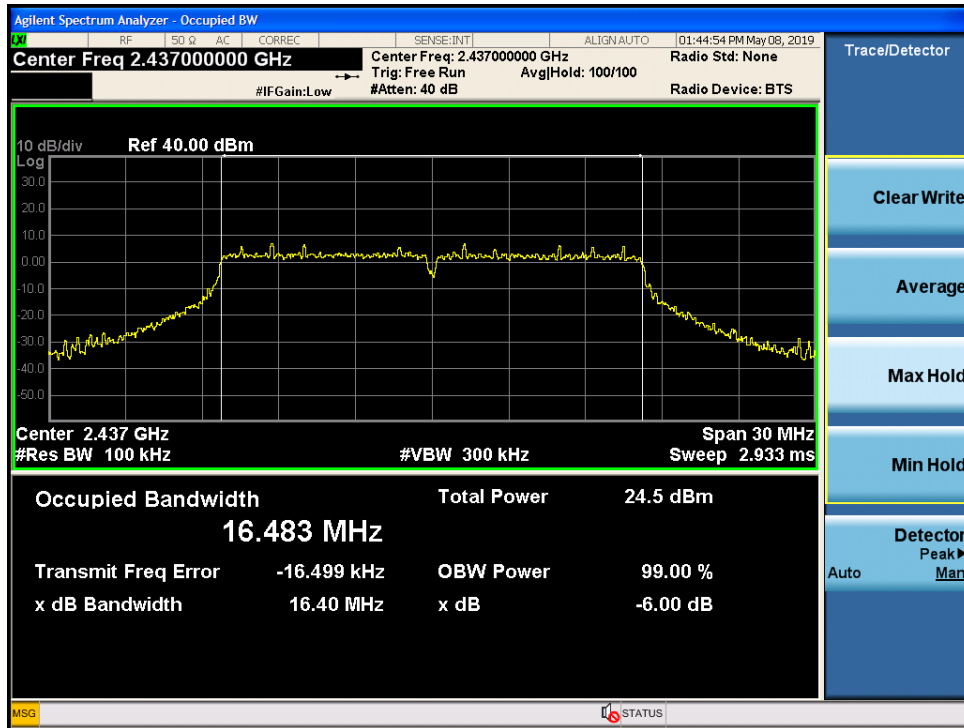


Figure 9-22 Chain 1 DTS Bandwidth 802.11g mode - Ch.6

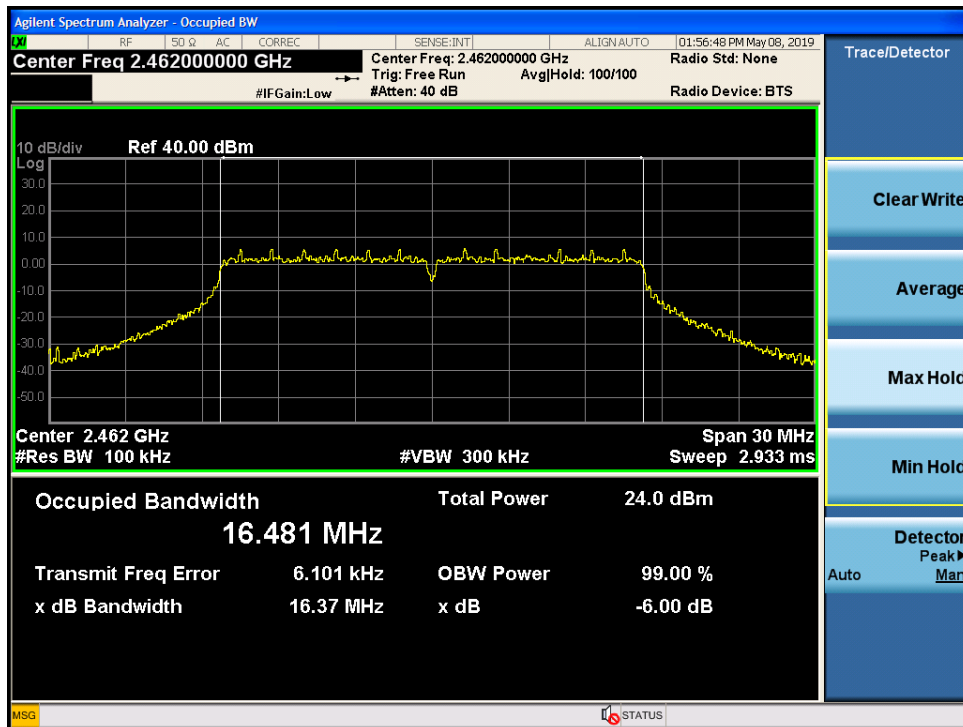


Figure 9-23 Chain 0 DTS Bandwidth 802.11g mode - Ch.11

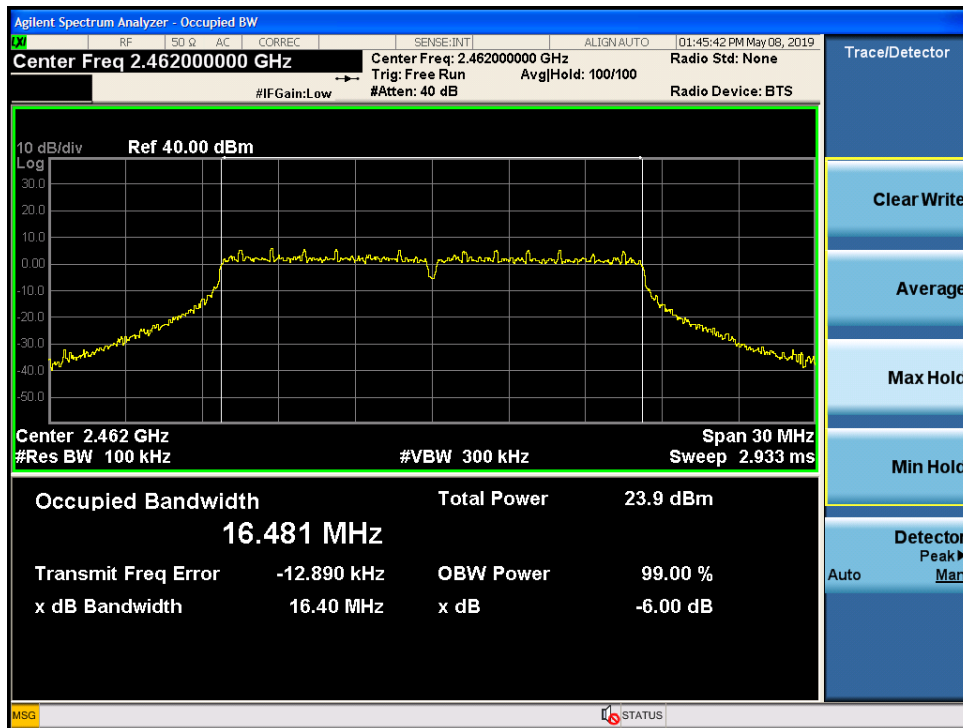


Figure 9-24 Chain 1 DTS Bandwidth 802.11g mode - Ch.11

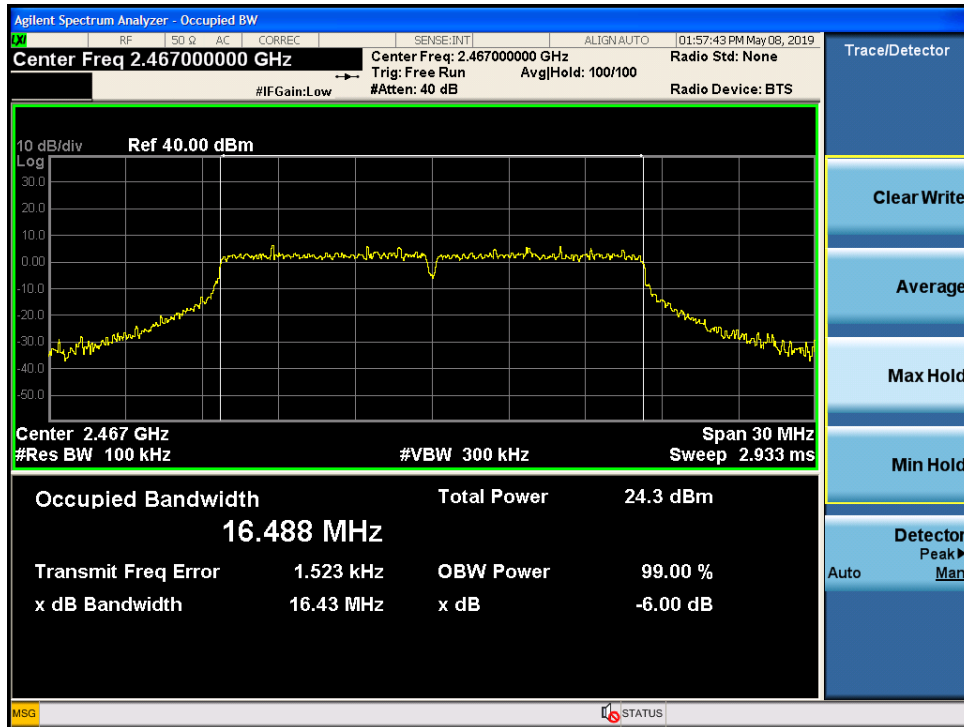


Figure 9-25 Chain 0 DTS Bandwidth 802.11g mode - Ch.12

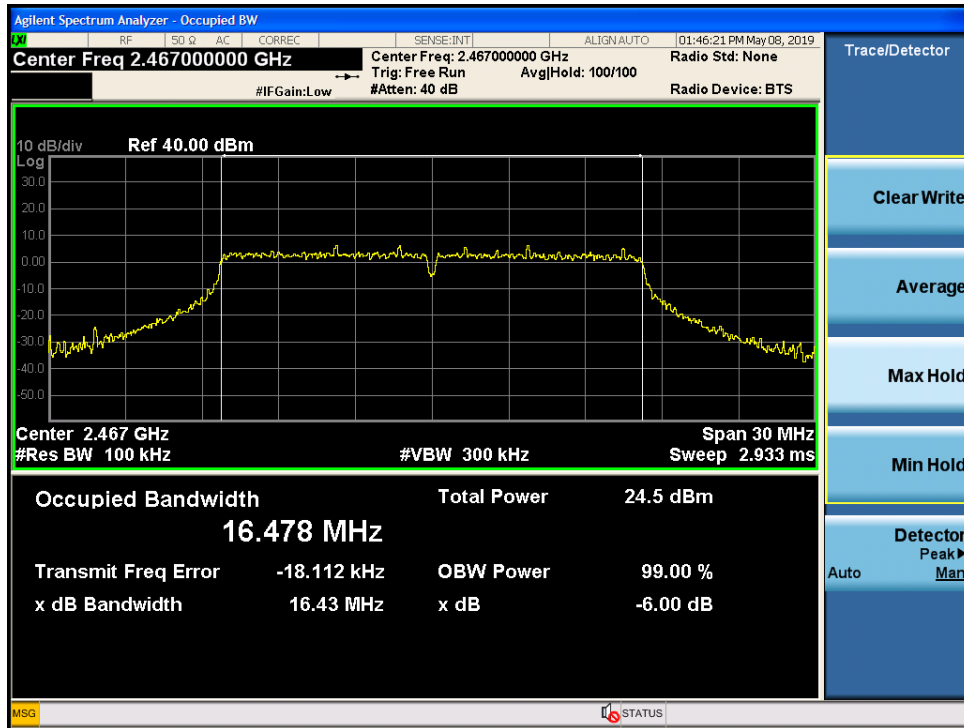


Figure 9-26 Chain 1 DTS Bandwidth 802.11g mode - Ch.12

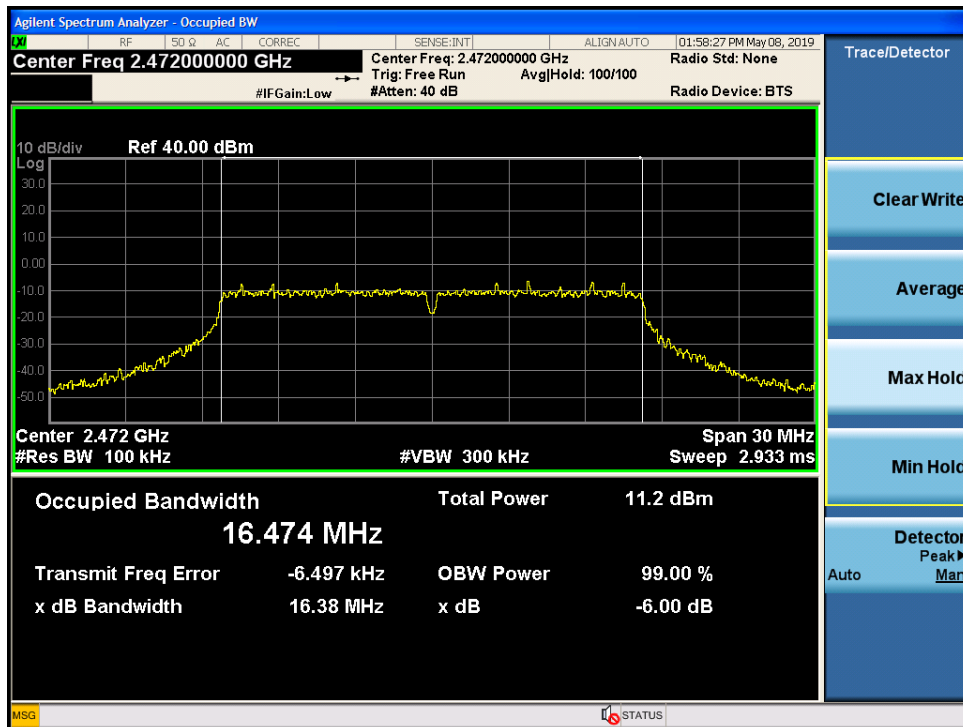


Figure 9-27 Chain 0 DTS Bandwidth 802.11g mode - Ch.13

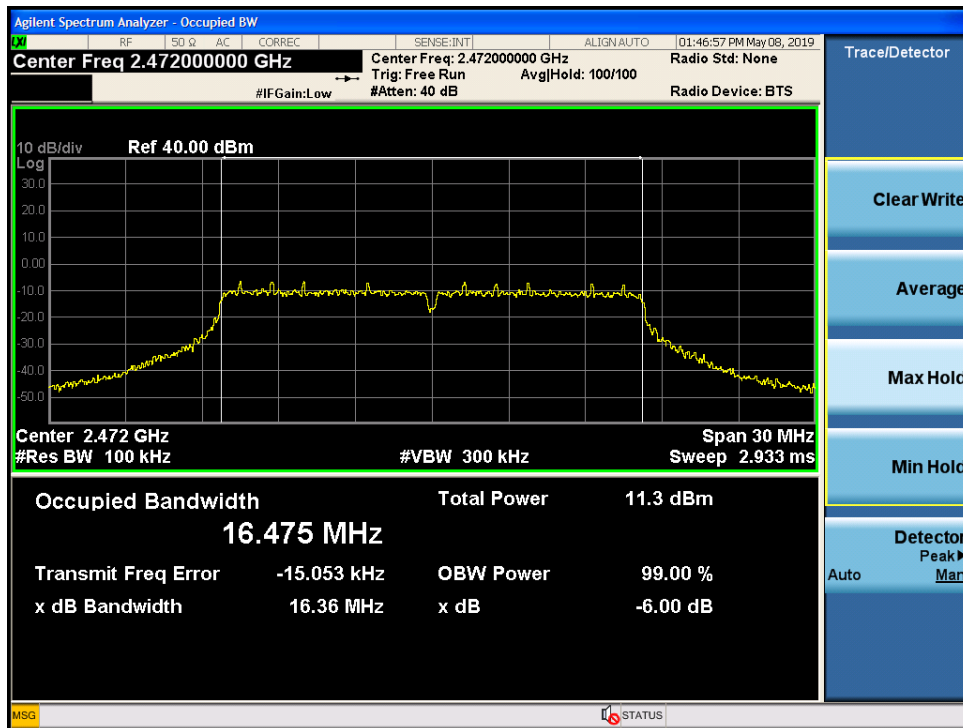


Figure 9-28 Chain 1 DTS Bandwidth 802.11g mode - Ch.13

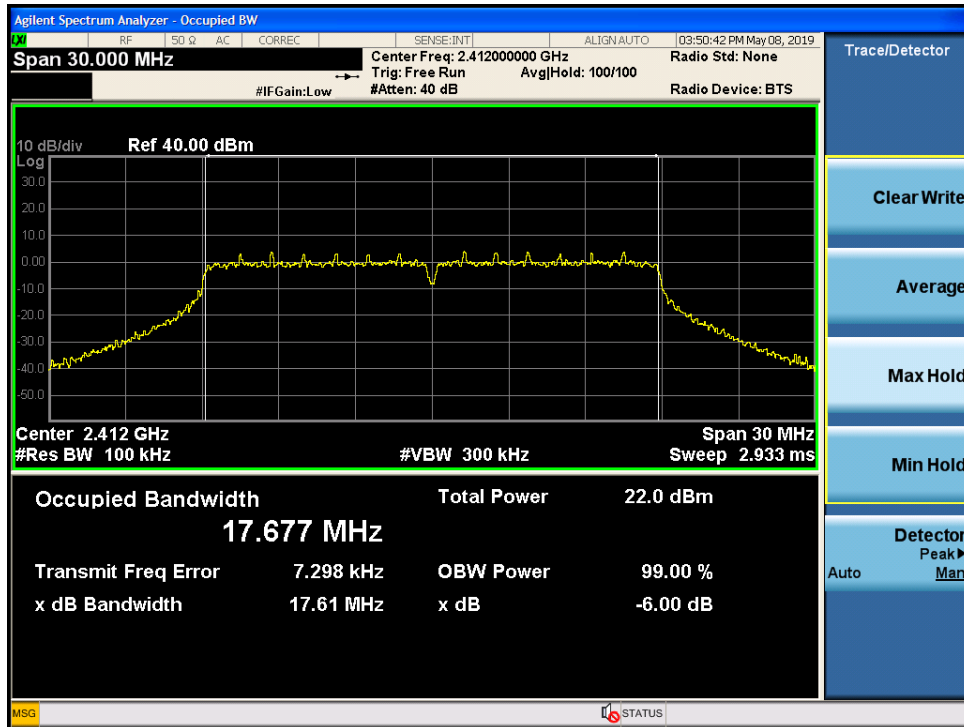


Figure 9-29 Chain 0 DTS Bandwidth 802.11n20 mode - Ch.1

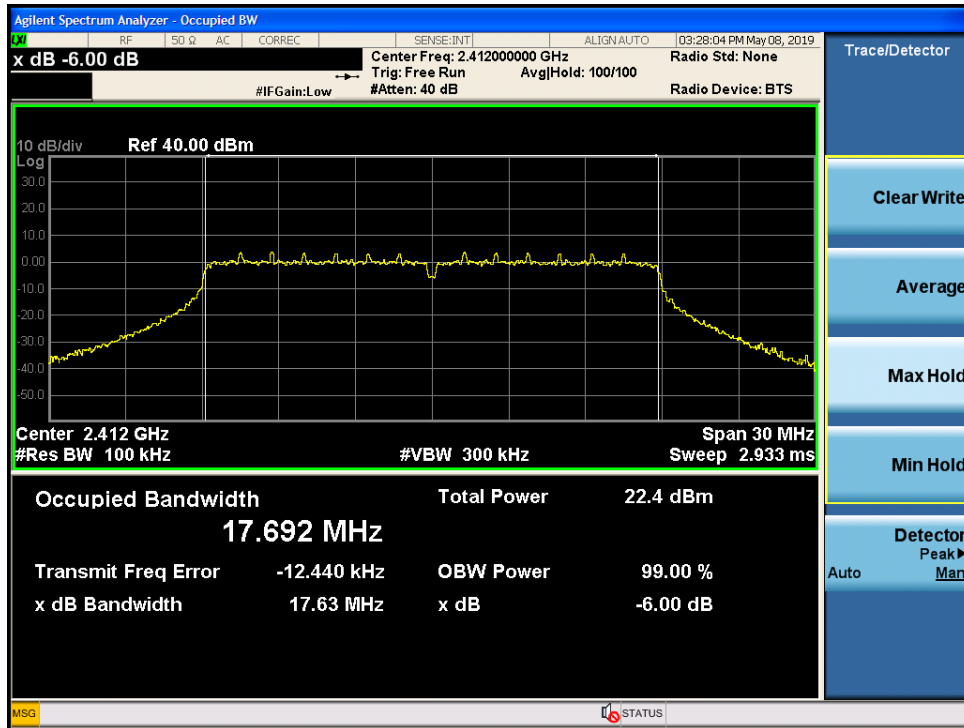


Figure 9-30 Chain 1 DTS Bandwidth 802.11n20 mode - Ch.1

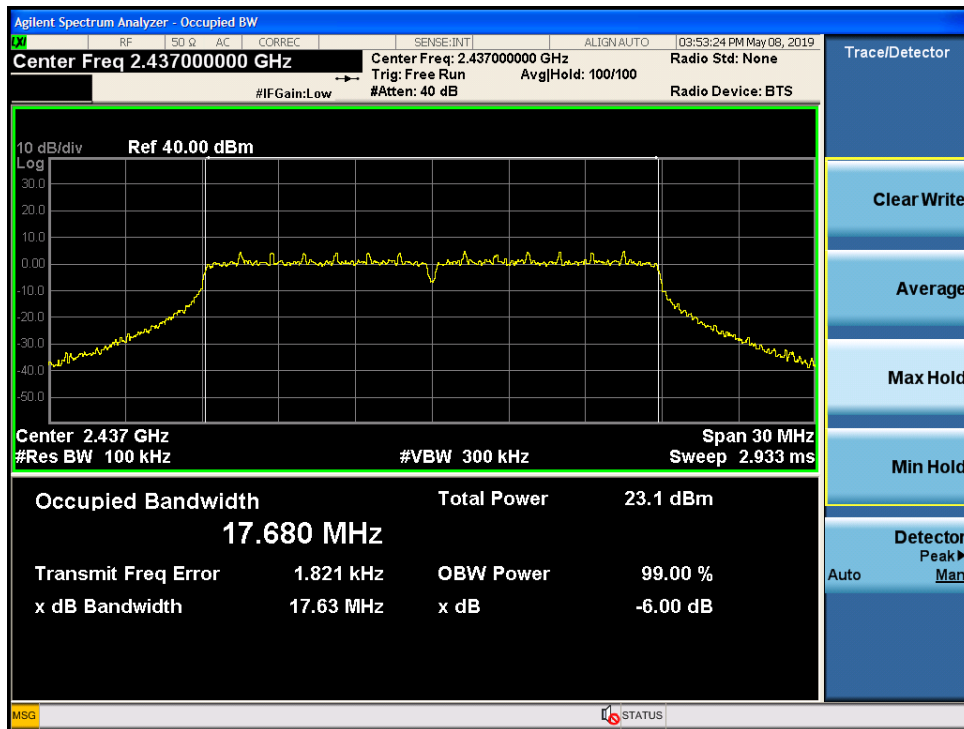


Figure 9-31 Chain 0 DTS Bandwidth 802.11n20 mode - Ch.6

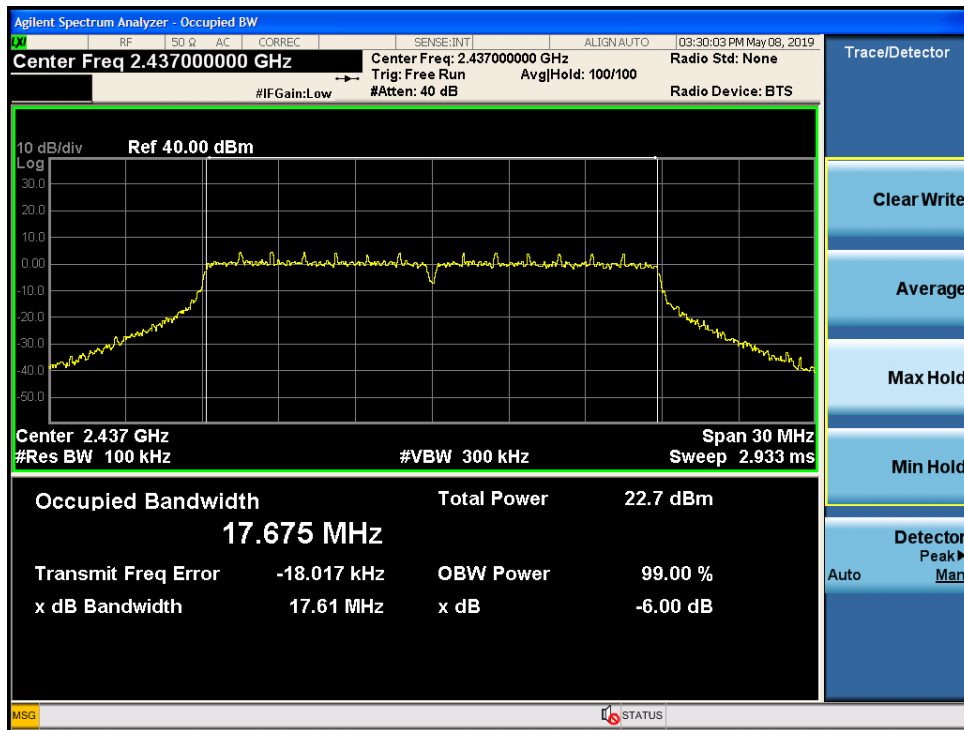


Figure 9-32 Chain 1 DTS Bandwidth 802.11n20 mode - Ch.6

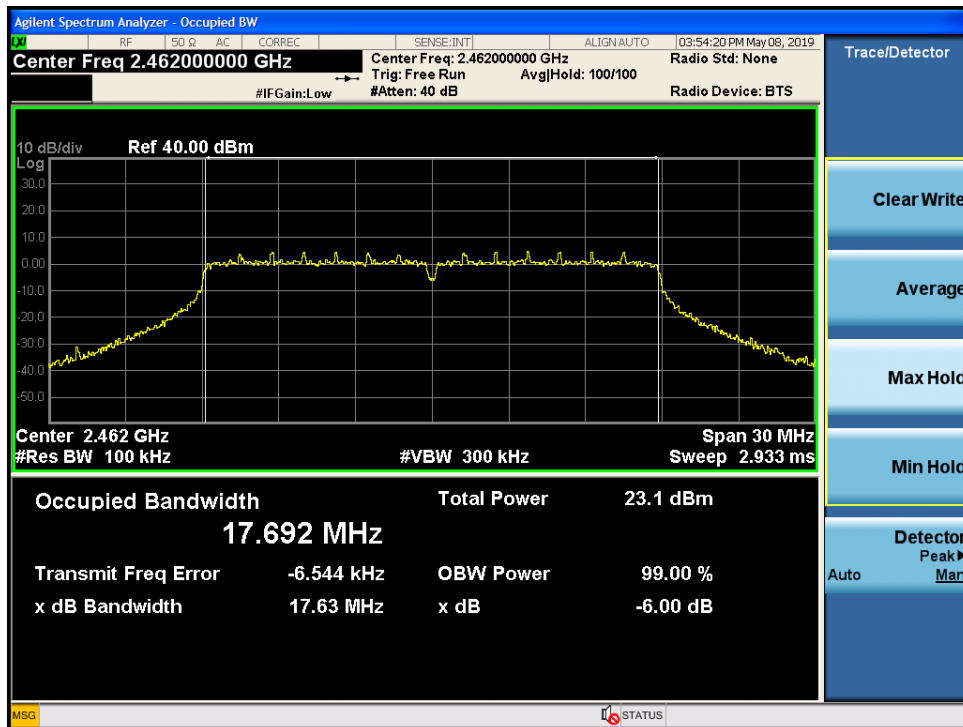


Figure 9-33 Chain 0 DTS Bandwidth 802.11n20 mode - Ch.11

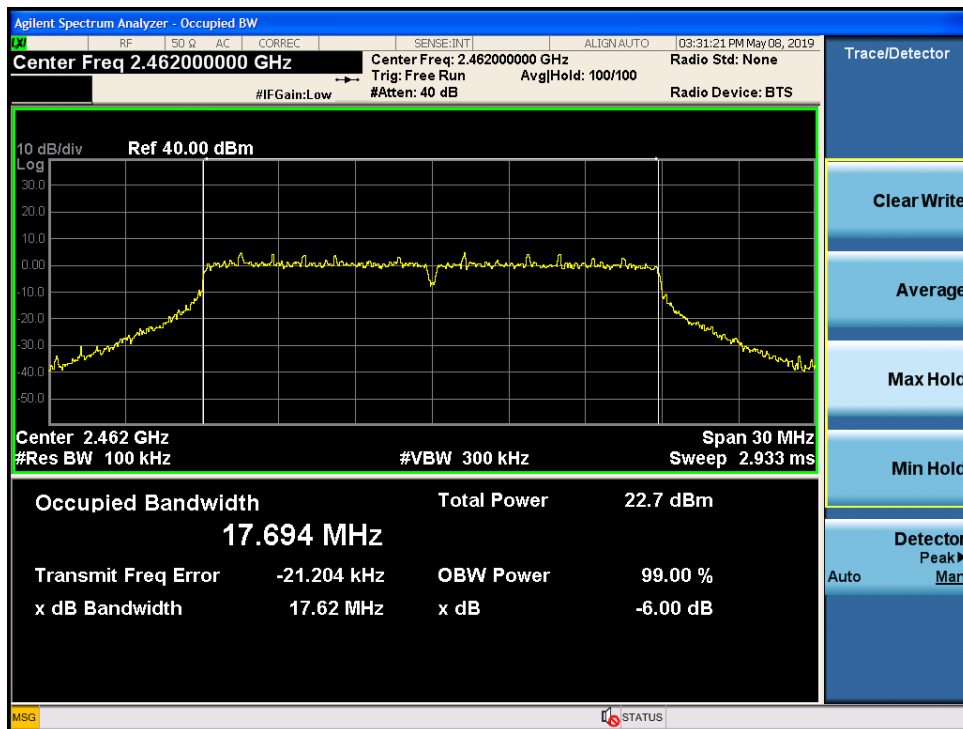


Figure 9-34 Chain 1 DTS Bandwidth 802.11n20 mode - Ch.11

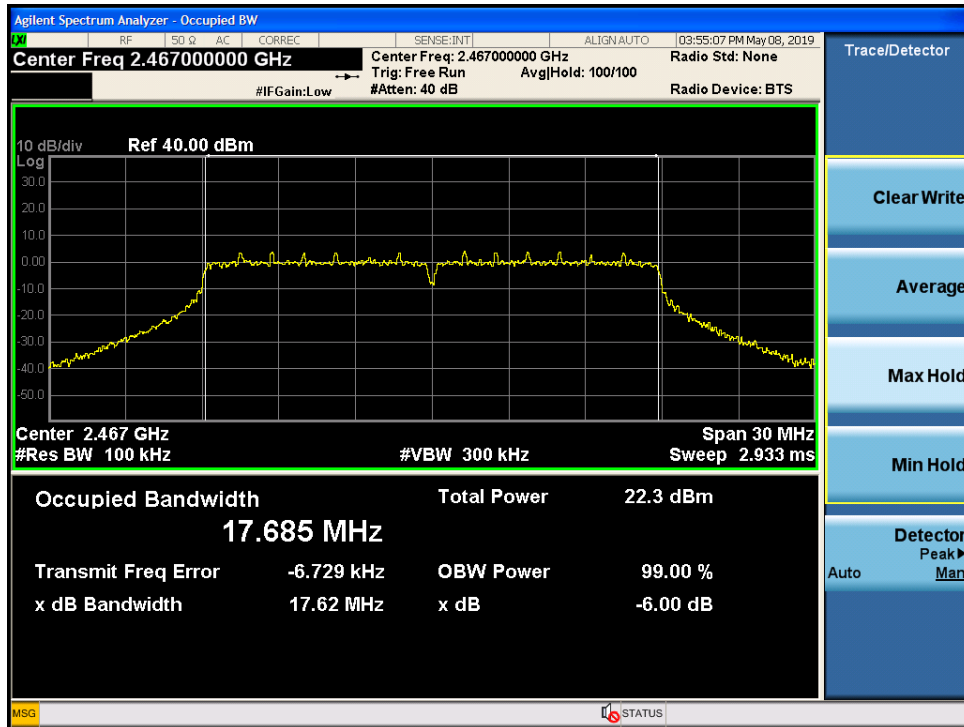


Figure 9-35 Chain 0 DTS Bandwidth 802.11n20 mode - Ch.12

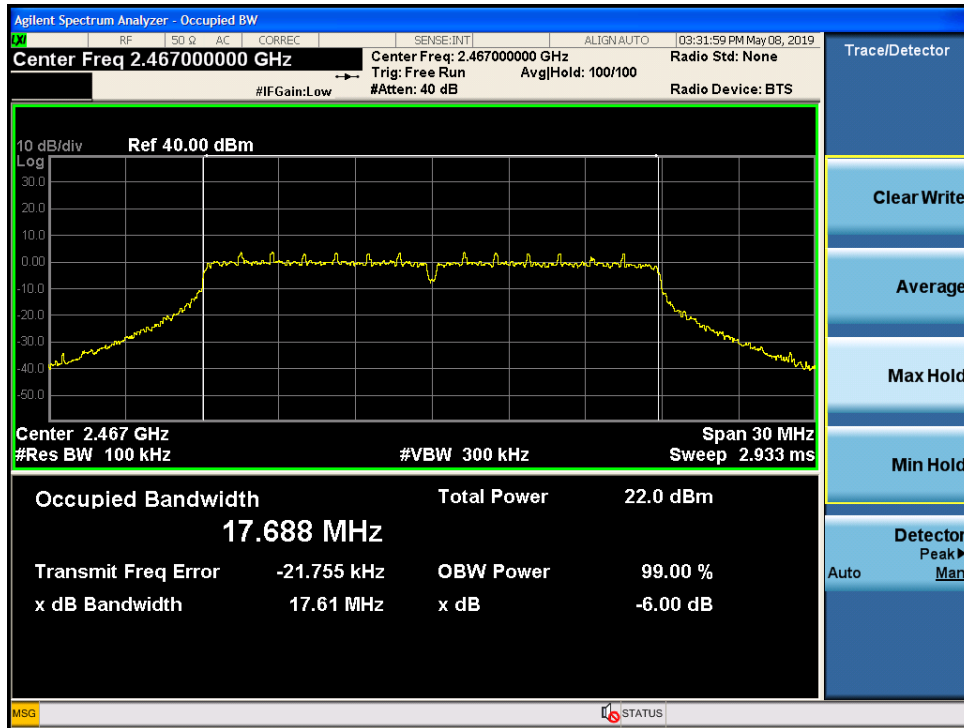


Figure 9-36 Chain 1 DTS Bandwidth 802.11n20 mode - Ch.12

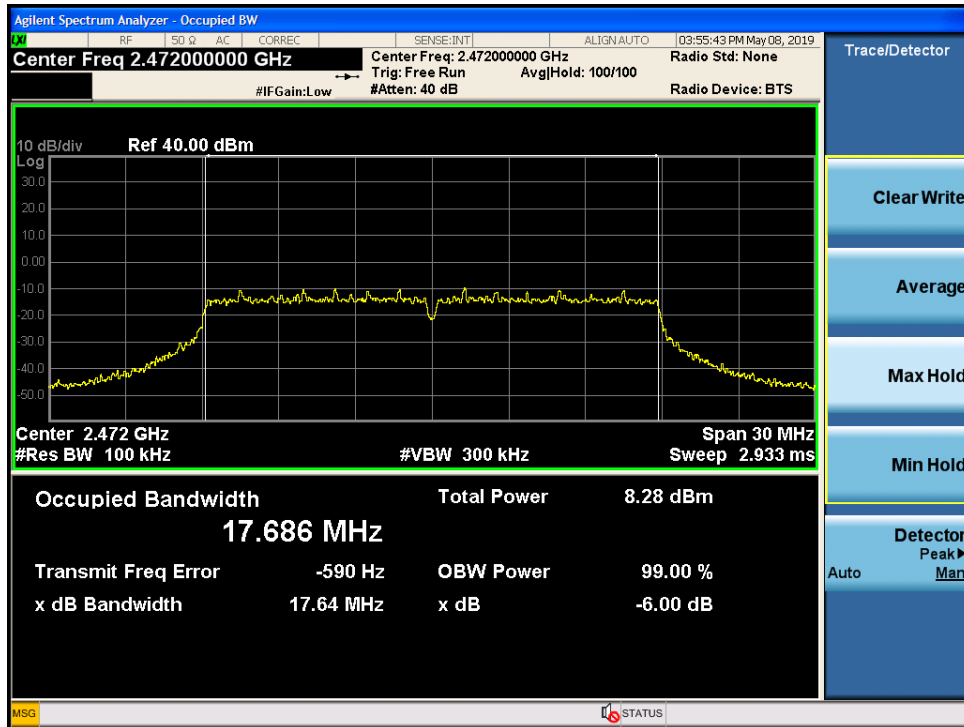


Figure 9-37 Chain 0 DTS Bandwidth 802.11n20 mode - Ch.13

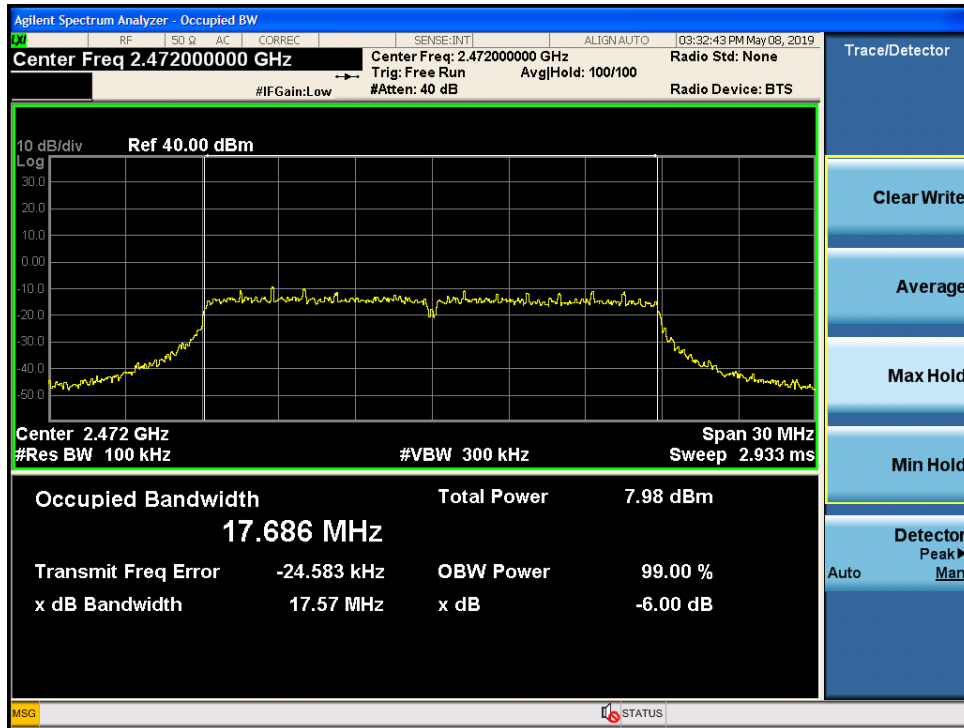


Figure 9-38 Chain 1 DTS Bandwidth 802.11n20 mode - Ch.13

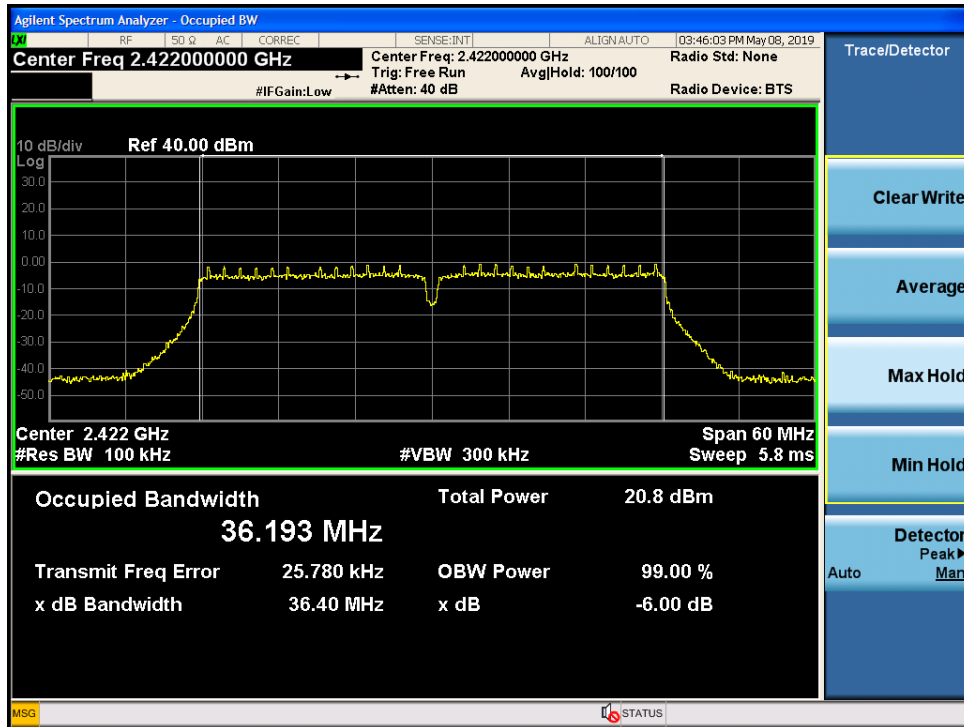


Figure 9-39 Chain 0 DTS Bandwidth 802.11n40 mode - Ch.3

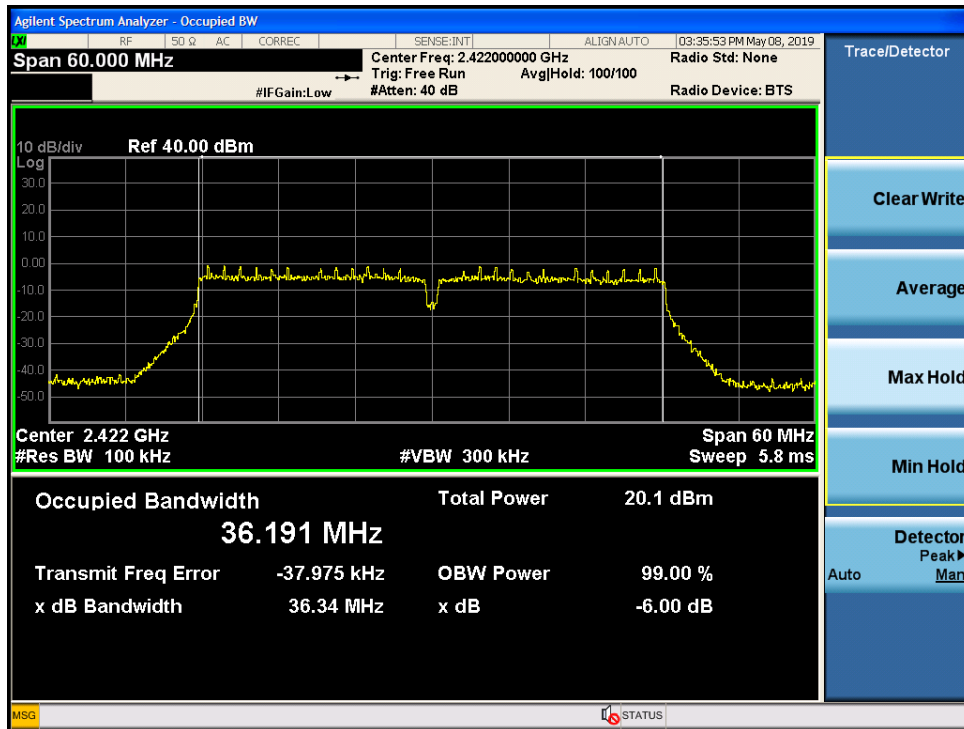


Figure 9-40 Chain 1 DTS Bandwidth 802.11n40 mode - Ch.3

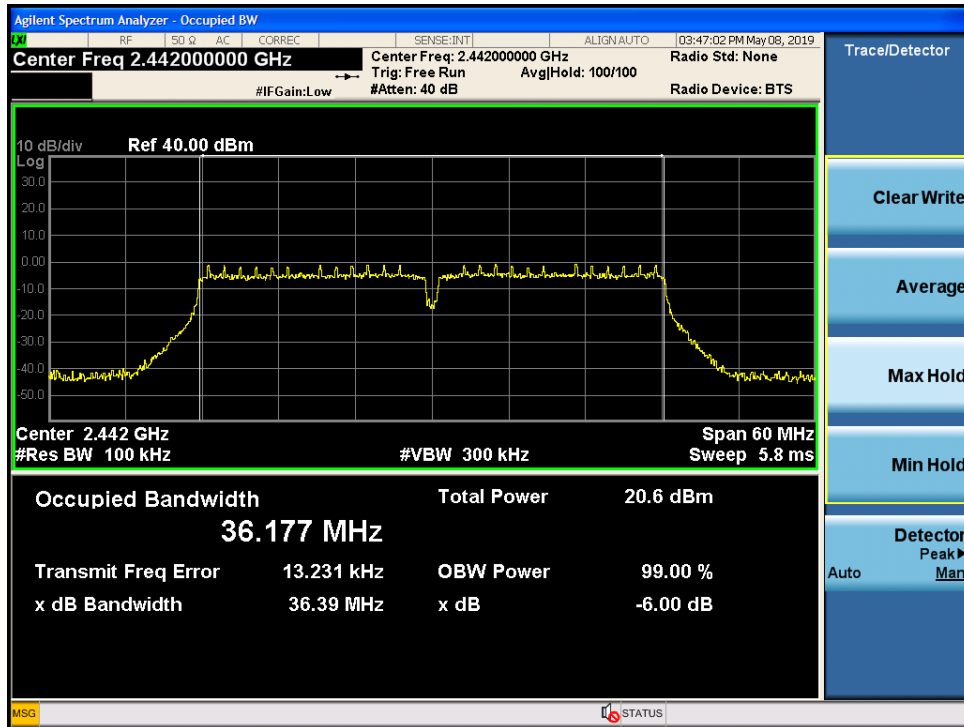


Figure 9-41 Chain 0 DTS Bandwidth 802.11n40 mode - Ch.7

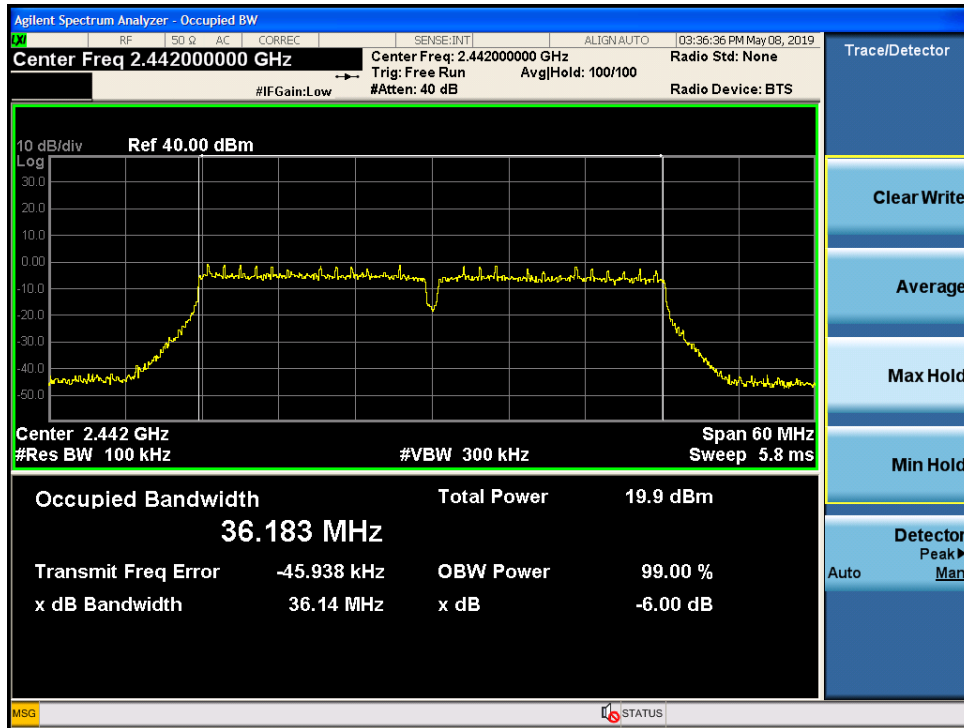


Figure 9-42 Chain 1 DTS Bandwidth 802.11n40 mode - Ch.7

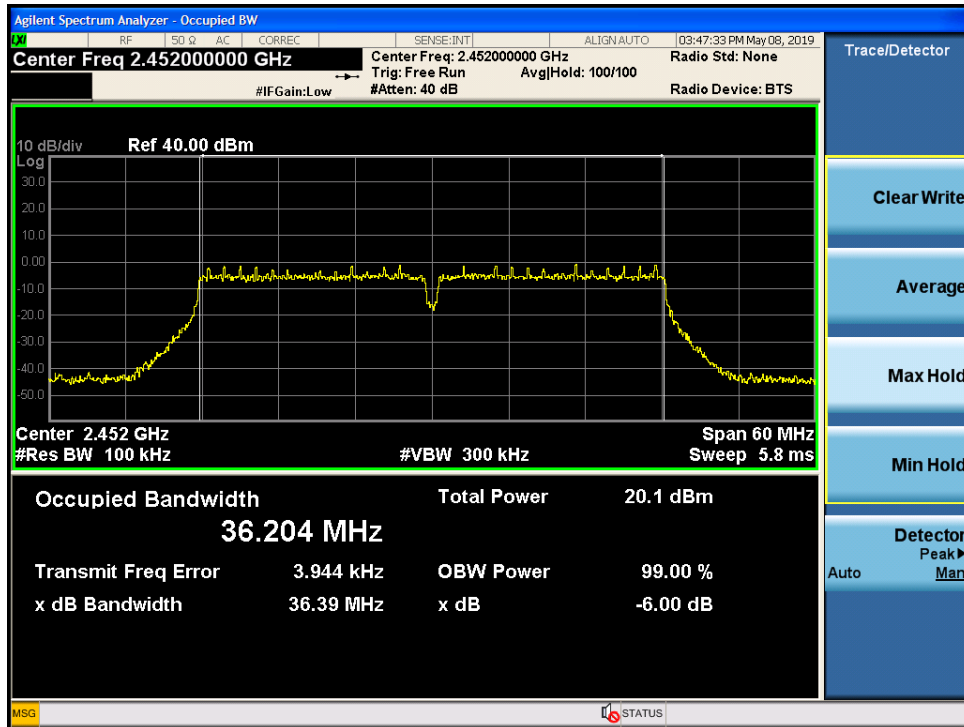


Figure 9-43 Chain 0 DTS Bandwidth 802.11n40 mode - Ch.9

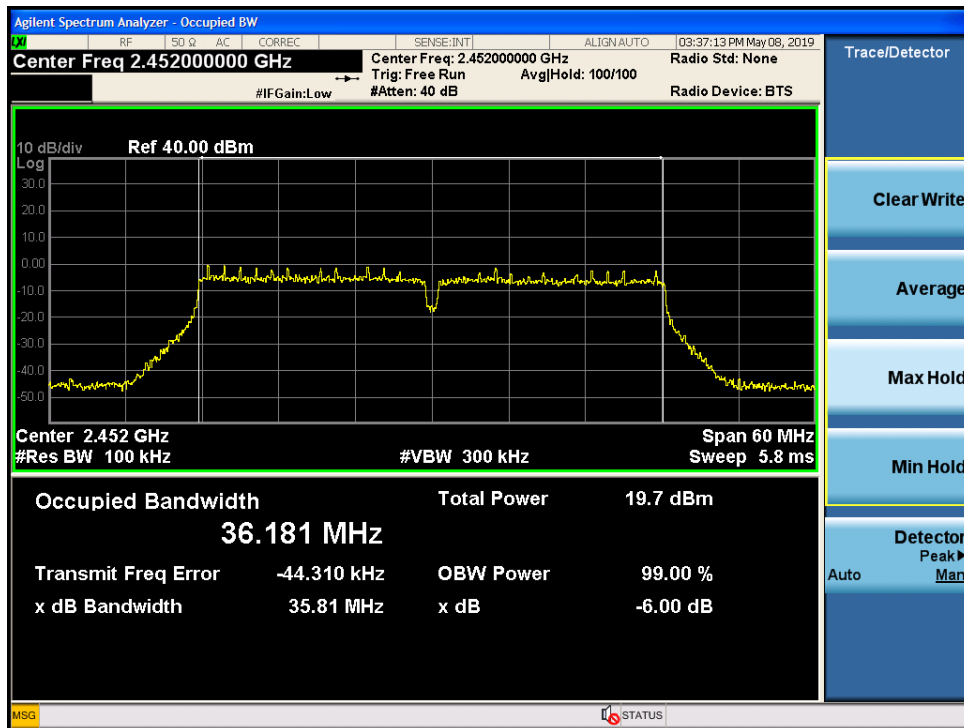


Figure 9-44 Chain 1 DTS Bandwidth 802.11n40 mode - Ch.9

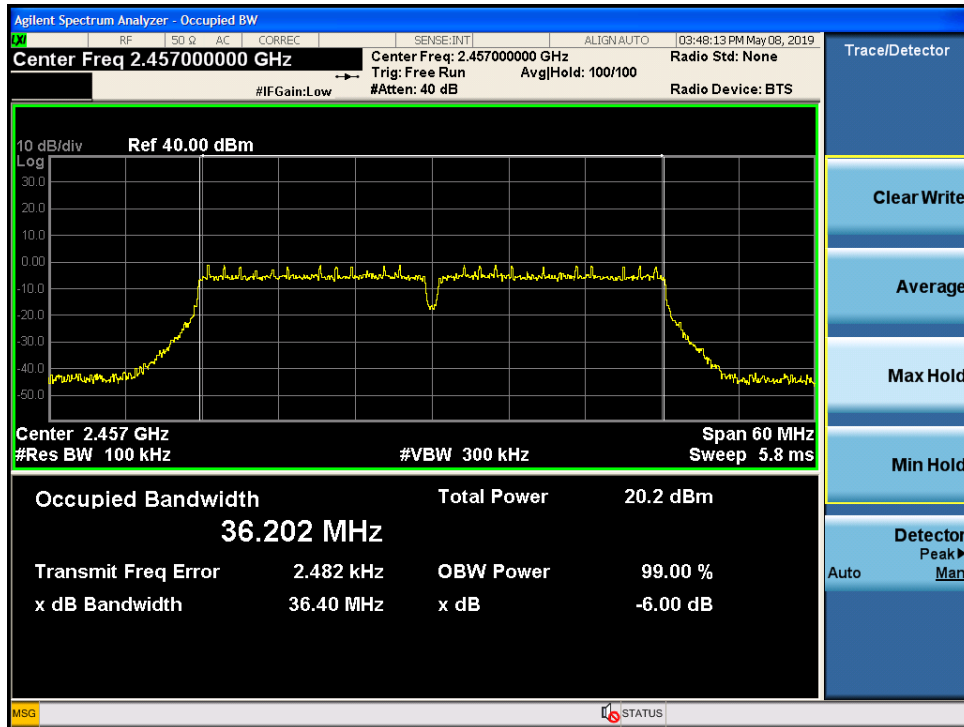


Figure 9-45 Chain 0 DTS Bandwidth 802.11n40 mode - Ch.10

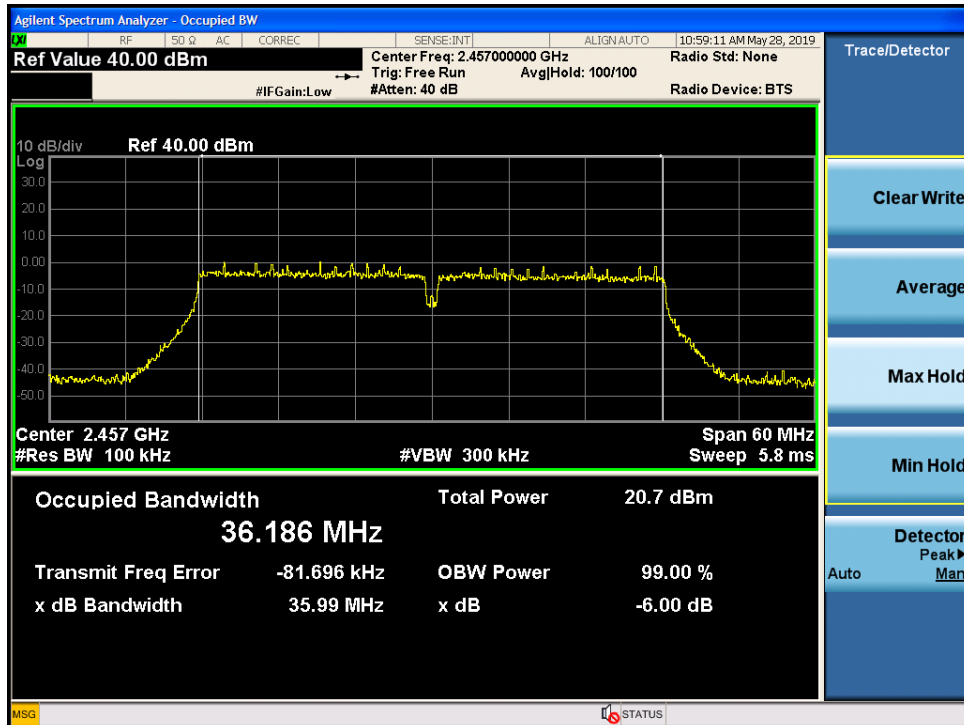


Figure 9-46 Chain 1 DTS Bandwidth 802.11n40 mode - Ch.10

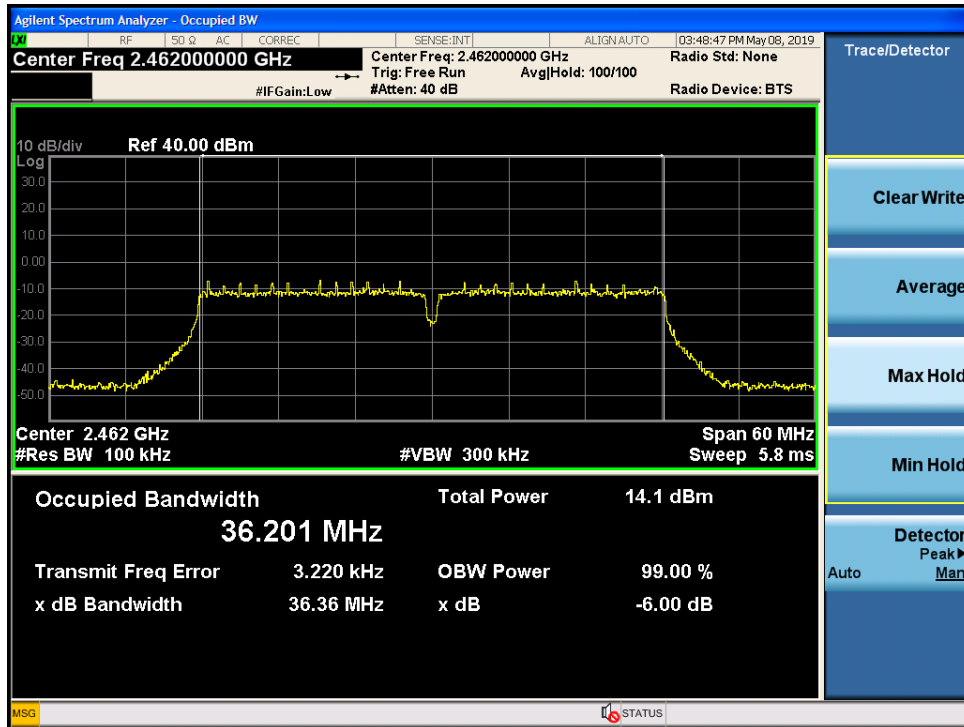


Figure 9-47 Chain 0 DTS Bandwidth 802.11n40 mode - Ch.11

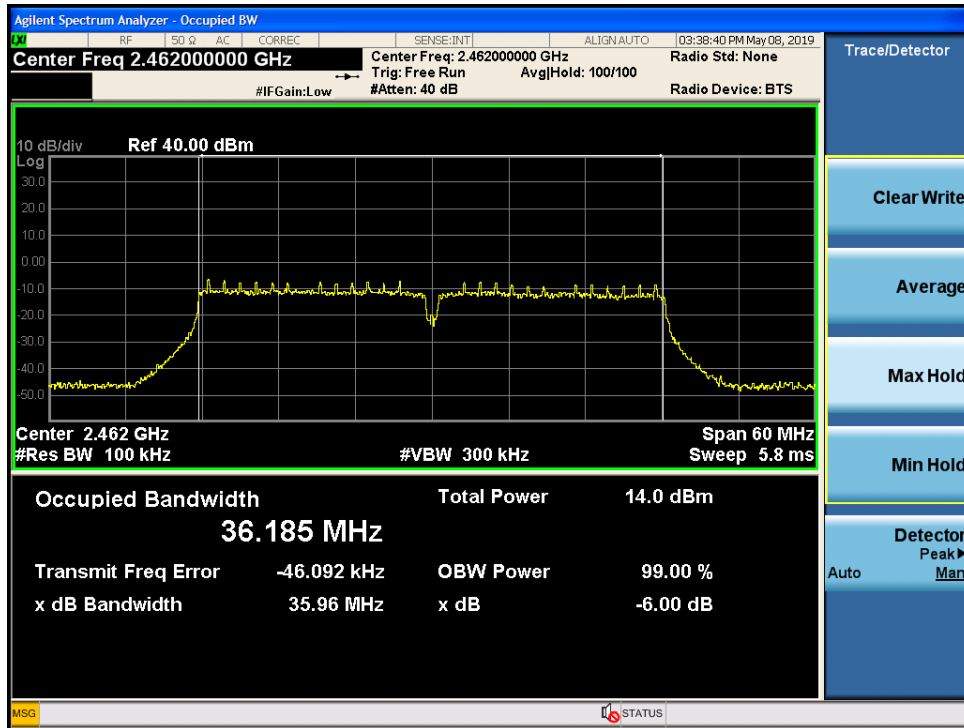


Figure 9-48 Chain 1 DTS Bandwidth 802.11n40 mode - Ch.11

9.3 99% Bandwidth

9.3.1 Test Requirement:

The 99% Occupied Channel Bandwidth is the bandwidth that contains 99 % of the power of the signal. This test is performed for reporting and measurement purposes only.

9.3.2 Test Method:

Measurements were performed according to the procedure defined in ANSI C63.10:2013.

Spectrum Analyzer settings:

Set analyzer center frequency to the nominal EUT channel frequency

Span set to between 1.5 and 5.0 times the DTS bandwidth

RBW to: 1% to 5% of the OBW

VBW \geq 3 RBW

Detector = Peak

Sweep time = auto couple

Trace mode = max hold

Use the 99% power bandwidth function of the instrument.

Sample Calculations:

Corrected Amplitude: Amplitude (Analyzer level) + CL (Cable losses) = -25 dBm + 5 dB = -20dBm.

9.3.3 Limit:

Reporting and measurement purposes only.

9.3.4 Test Results:

Chain 0 802.11b 99% Bandwidth (MHz)		
Channel No.	Frequency (MHz)	99% Bandwidth (MHz)
1	2412	13.79
6	2437	13.82
11	2462	13.84
12	2467	13.84
13	2472	13.85
Chain 0 802.11g 99% Bandwidth (MHz)		
Channel No.	Frequency (MHz)	99% Bandwidth (MHz)
1	2412	16.82
6	2437	16.90
11	2462	16.86
12	2467	16.88
13	2472	16.81
Chain 0 802.11n 99% Bandwidth (MHz)		
Channel No.	Frequency (MHz)	99% Bandwidth (MHz)
1	2412	18.02
6	2437	18.03
11	2462	18.02
12	2467	17.99
13	2472	18.04
Chain 0 802.11n 99% Bandwidth (MHz)		
Channel No.	Frequency (MHz)	99% Bandwidth (MHz)
3	2422	36.62
7	2442	36.53
9	2452	36.54
10	2457	36.61
11	2462	36.62

Chain 1 802.11b 99% Bandwidth (MHz)		
Channel No.	Frequency (MHz)	99% Bandwidth (MHz)
1	2412	13.80
6	2437	13.81
11	2462	13.80
12	2467	13.81
13	2472	13.78
Chain 1 802.11g 99% Bandwidth (MHz)		
Channel No.	Frequency (MHz)	99% Bandwidth (MHz)
1	2412	16.89
6	2437	16.95
11	2462	16.94
12	2467	16.93
13	2472	16.85
Chain 1 802.11n 99% Bandwidth (MHz)		
Channel No.	Frequency (MHz)	99% Bandwidth (MHz)
1	2412	18.04
6	2437	18.02
11	2462	18.01
12	2467	18.01
13	2472	18.01
Chain 1 802.11n 99% Bandwidth (MHz)		
Channel No.	Frequency (MHz)	99% Bandwidth (MHz)
3	2422	36.59
7	2442	36.59
9	2452	36.57
10	2457	36.59
11	2462	36.63

9.3.5 Test Data:

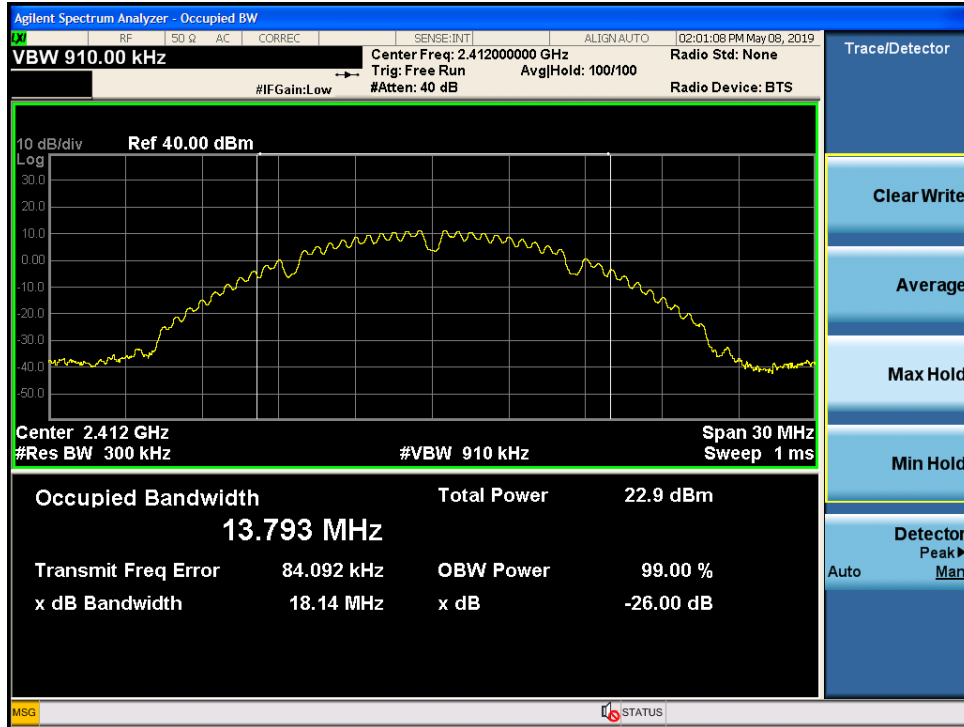


Figure 9-49 Chain 0 99% Bandwidth 802.11b - Ch.1



Figure 9-50 Chain 1 99% Bandwidth 802.11b - Ch.1

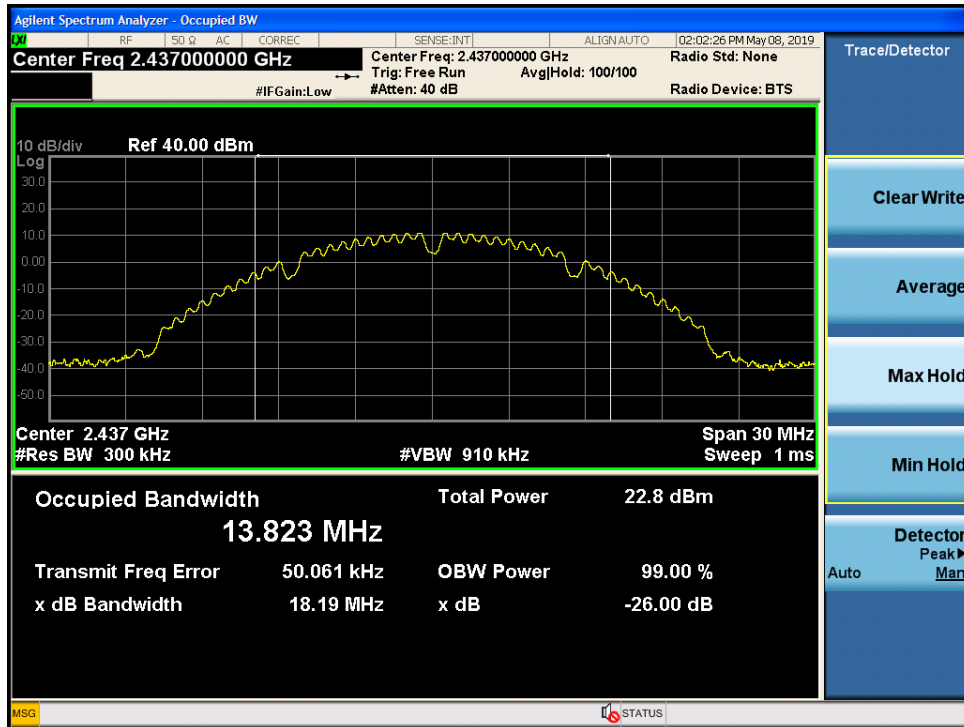


Figure 9-51 Chain 0 99% Bandwidth 802.11b - Ch.6

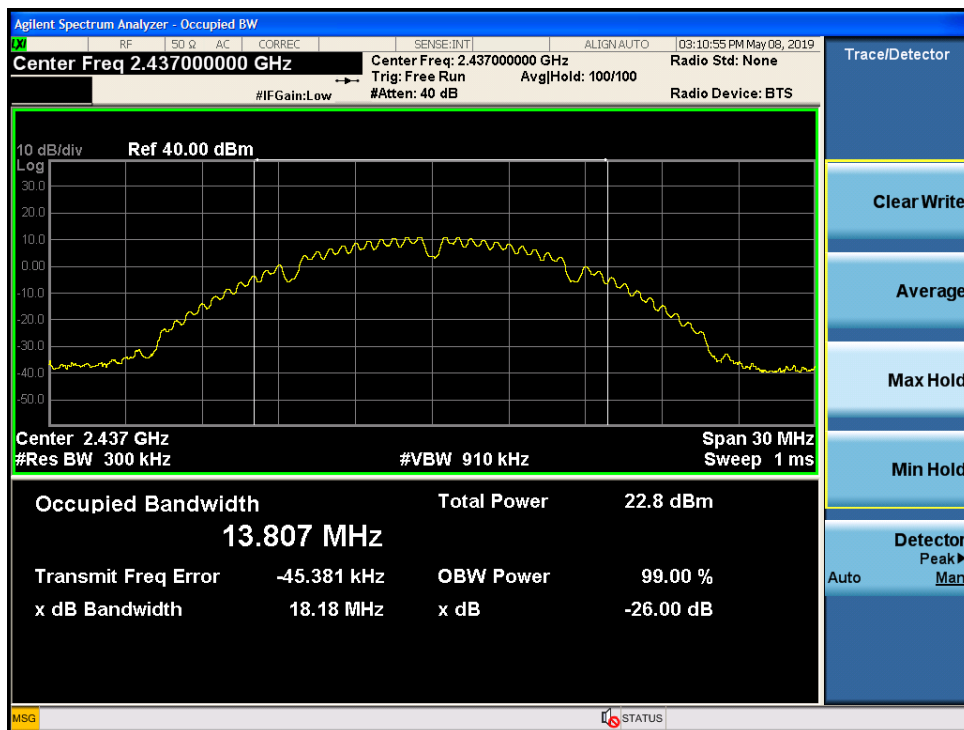


Figure 9-52 Chain 1 99% Bandwidth 802.11b - Ch.6

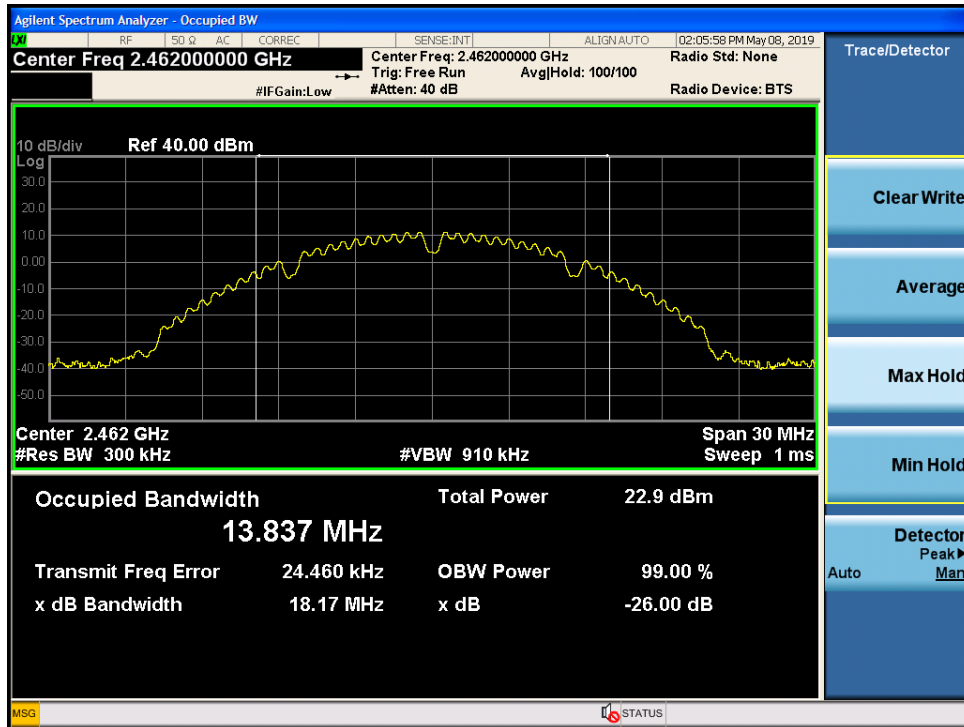


Figure 9-53 Chain 0 99% Bandwidth 802.11b - Ch.11



Figure 9-54 Chain 1 99% Bandwidth 802.11b - Ch.11

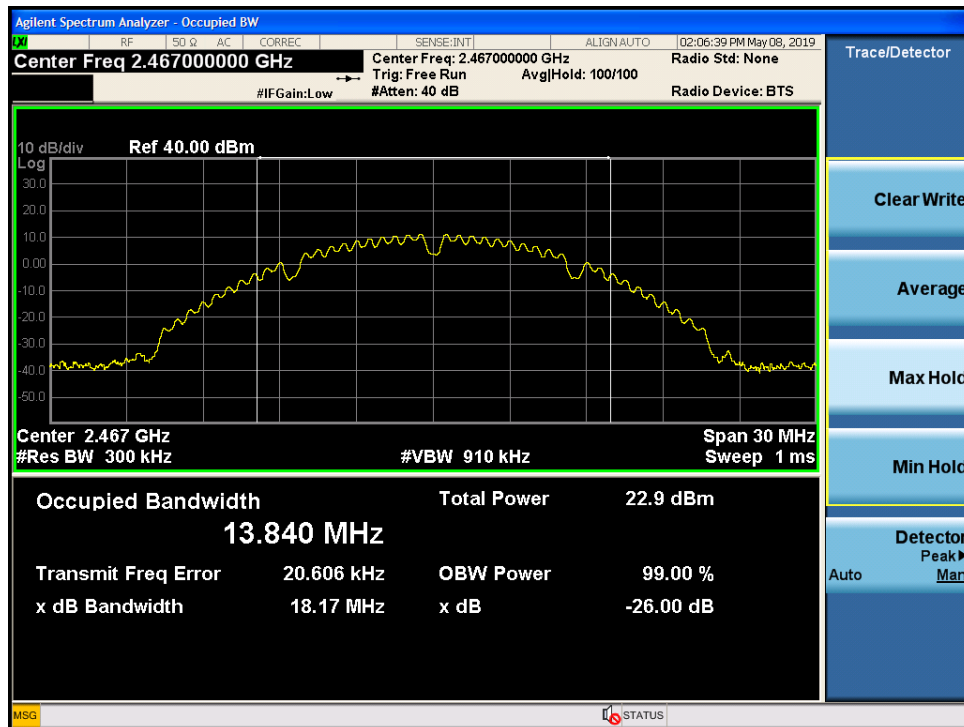


Figure 9-55 Chain 0 99% Bandwidth 802.11b - Ch.12



Figure 9-56 Chain 1 99% Bandwidth 802.11b - Ch.12

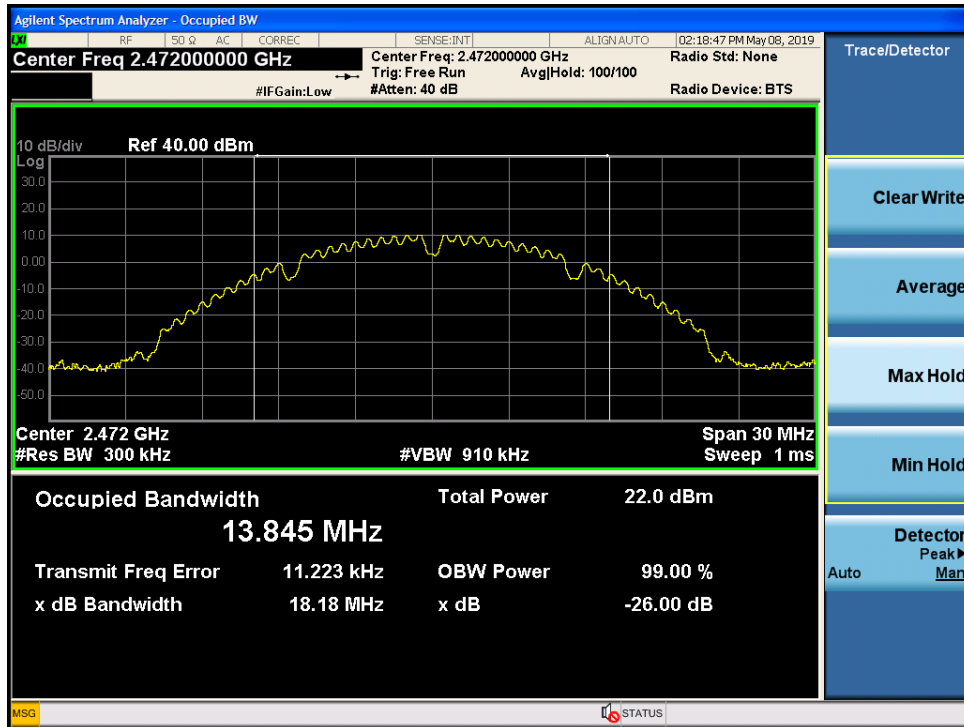


Figure 9-57 Chain 0 99% Bandwidth 802.11b - Ch.13



Figure 9-58 Chain 1 99% Bandwidth 802.11b - Ch.13

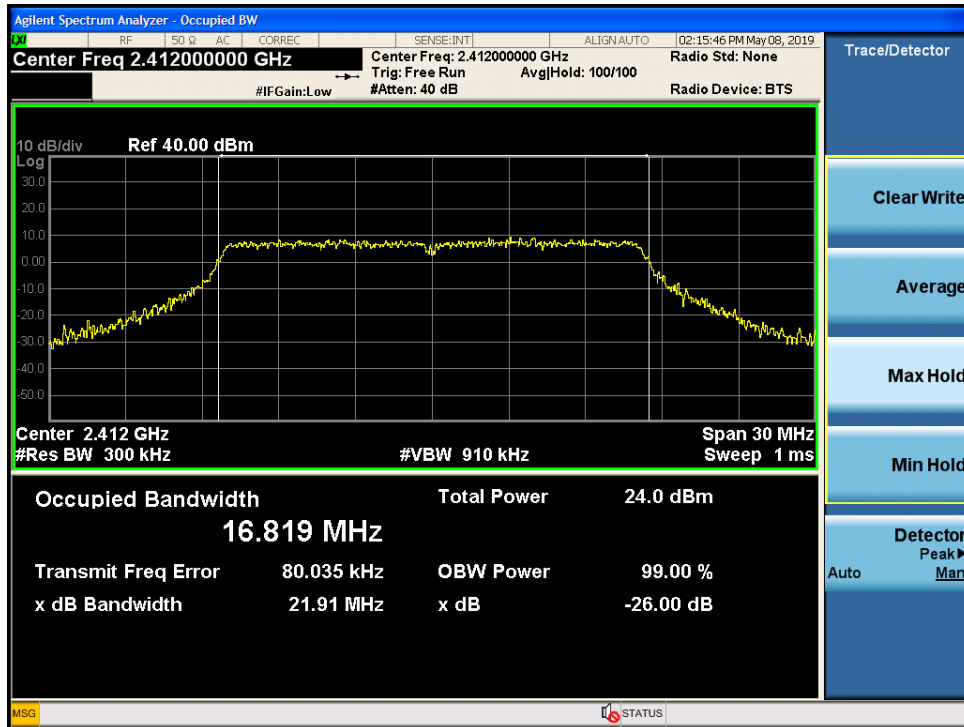


Figure 9-59 Chain 0 99% Bandwidth 802.11g - Ch.1



Figure 9-60 Chain 1 99% Bandwidth 802.11g - Ch.1

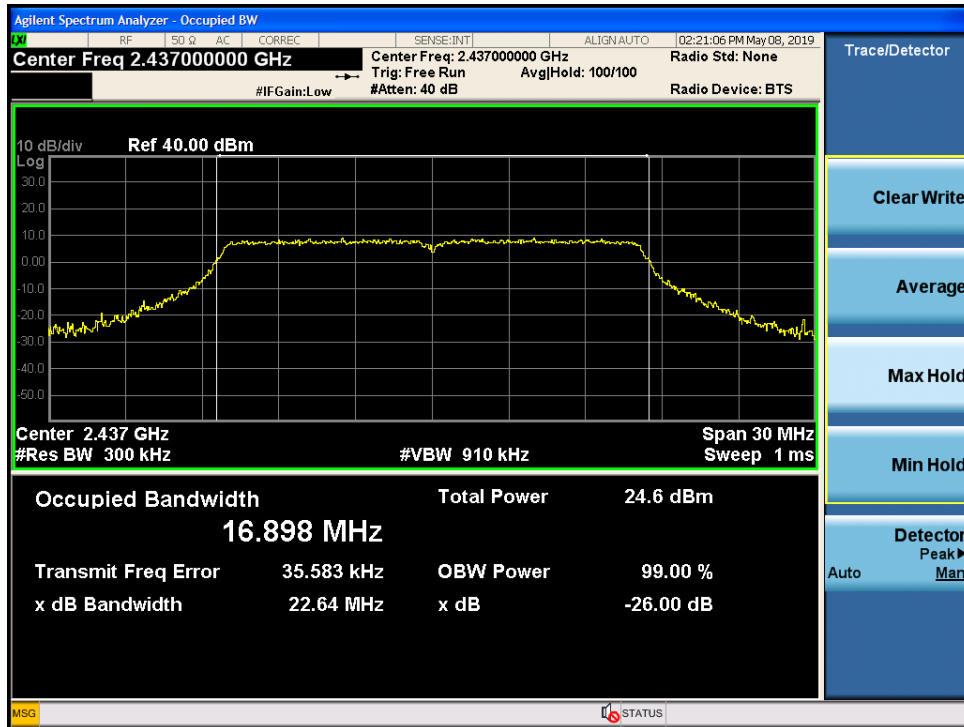


Figure 9-61 Chain 0 99% Bandwidth 802.11g - Ch.6

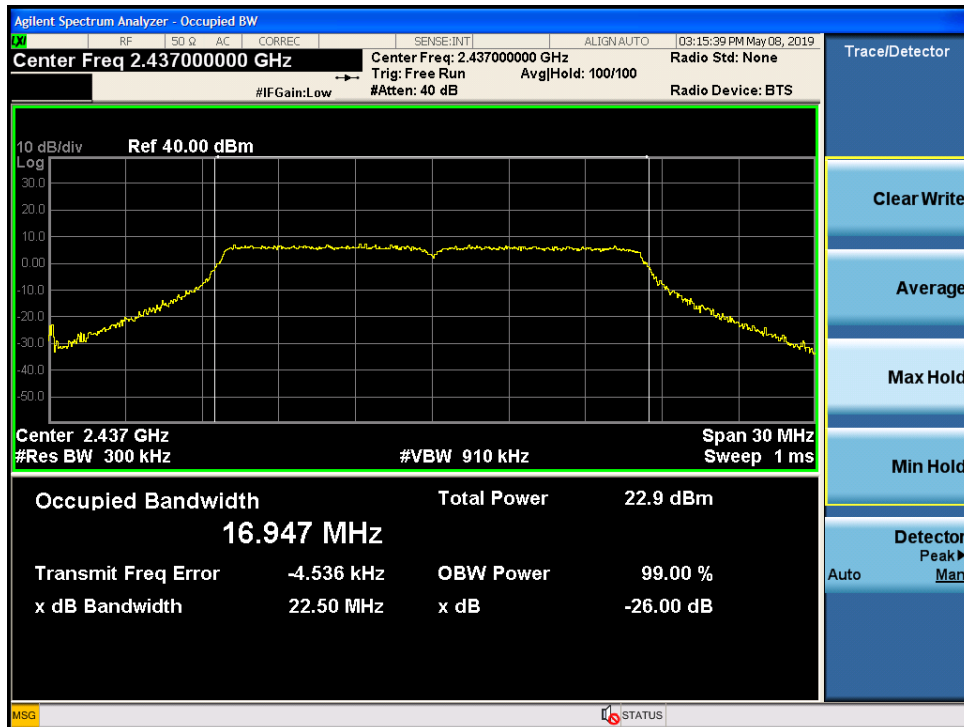


Figure 9-62 Chain 1 99% Bandwidth 802.11g - Ch.6

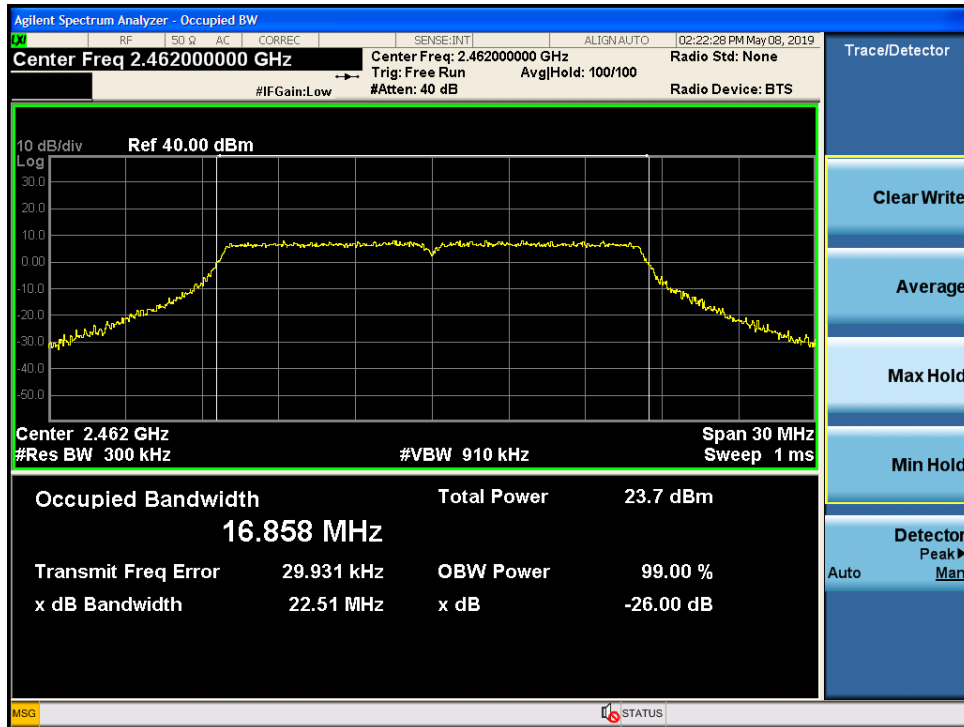


Figure 9-63 Chain 0 99% Bandwidth 802.11g- Ch.11

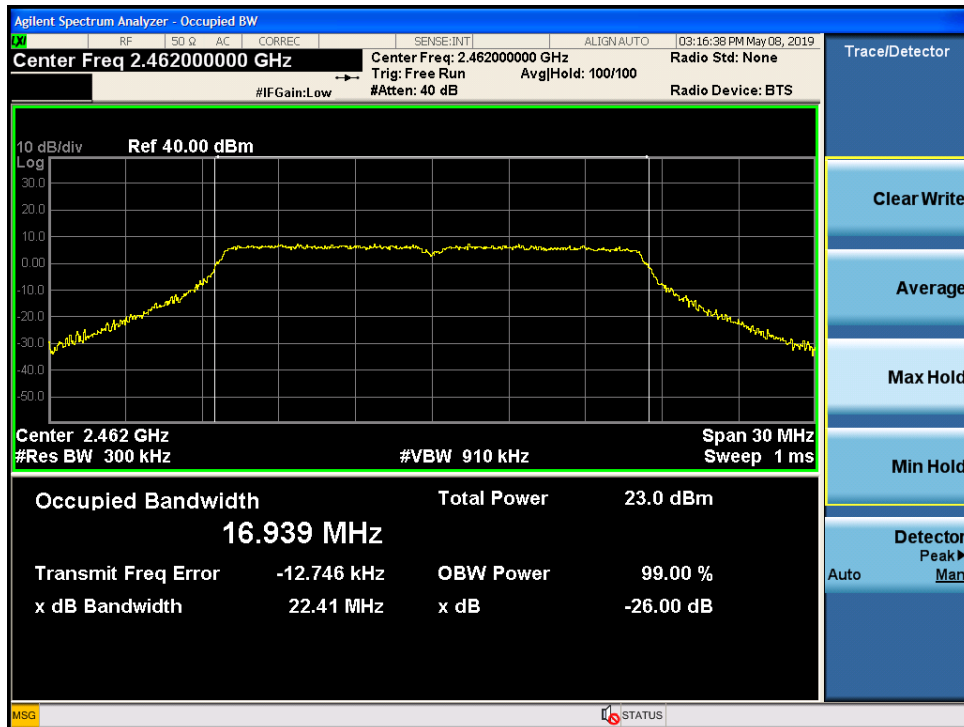


Figure 9-64 Chain 1 99% Bandwidth 802.11g- Ch.11

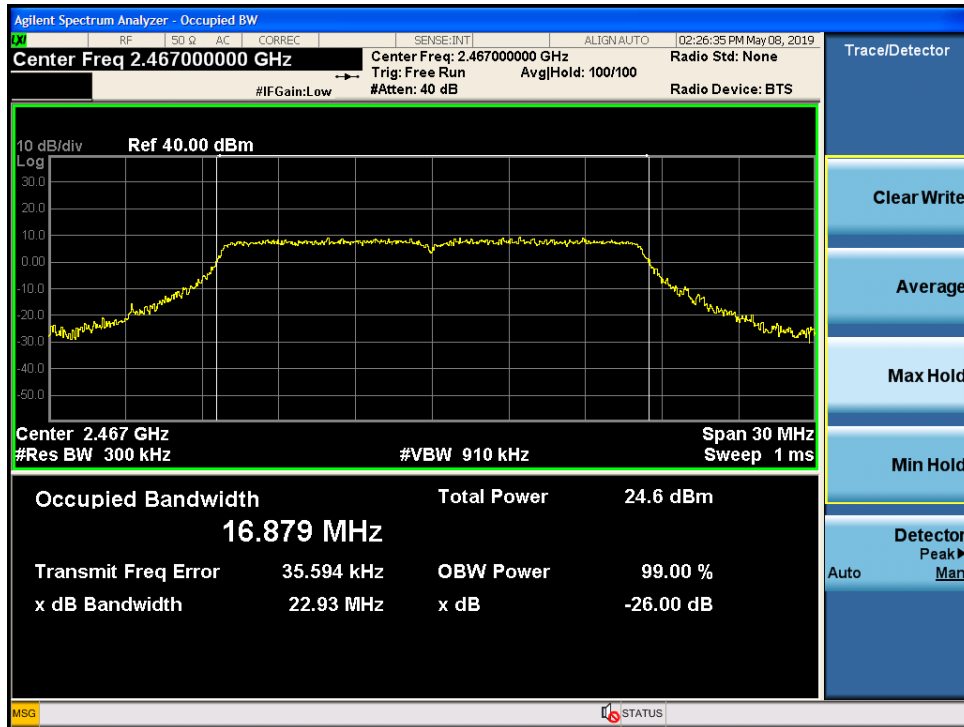


Figure 9-65 Chain 0 99% Bandwidth 802.11g- Ch.12

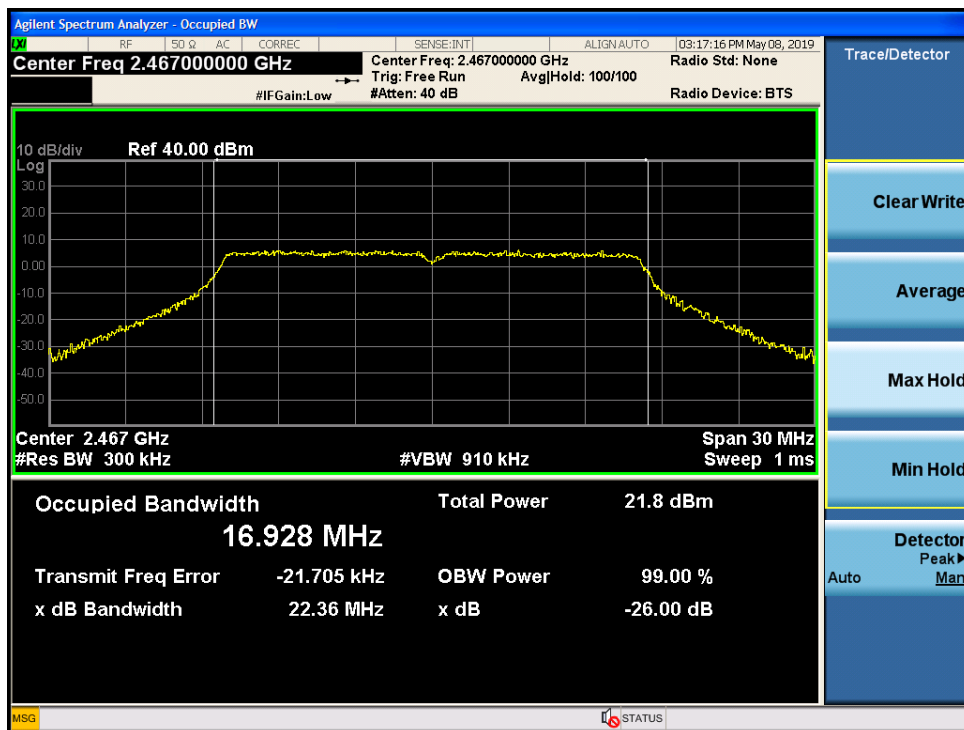


Figure 9-66 Chain 1 99% Bandwidth 802.11g- Ch.12

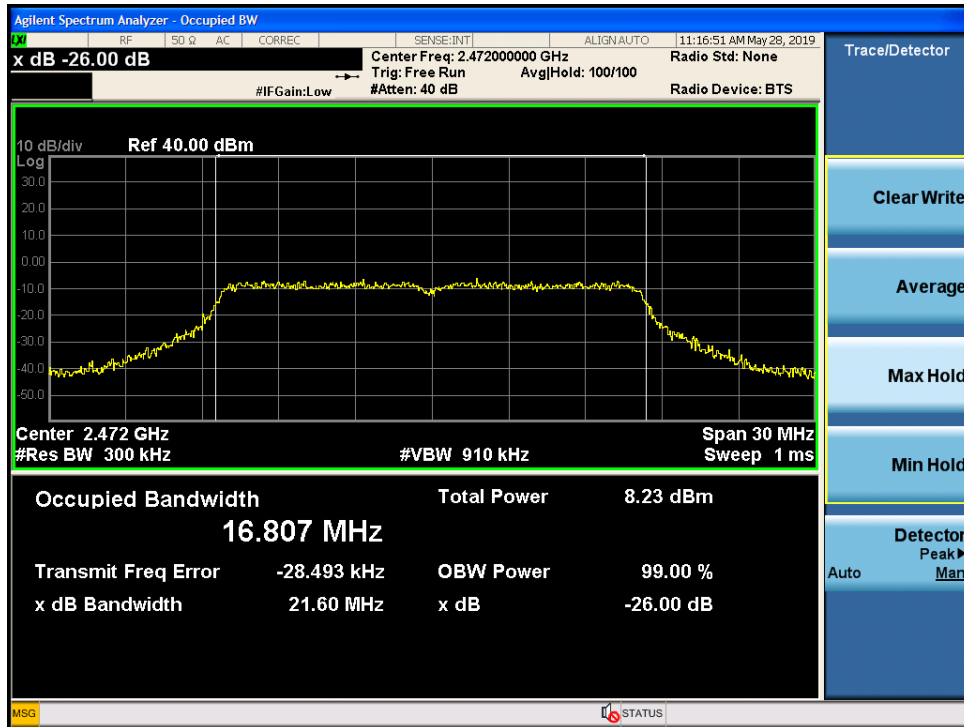


Figure 9-67 Chain 0 99% Bandwidth 802.11g - Ch.13

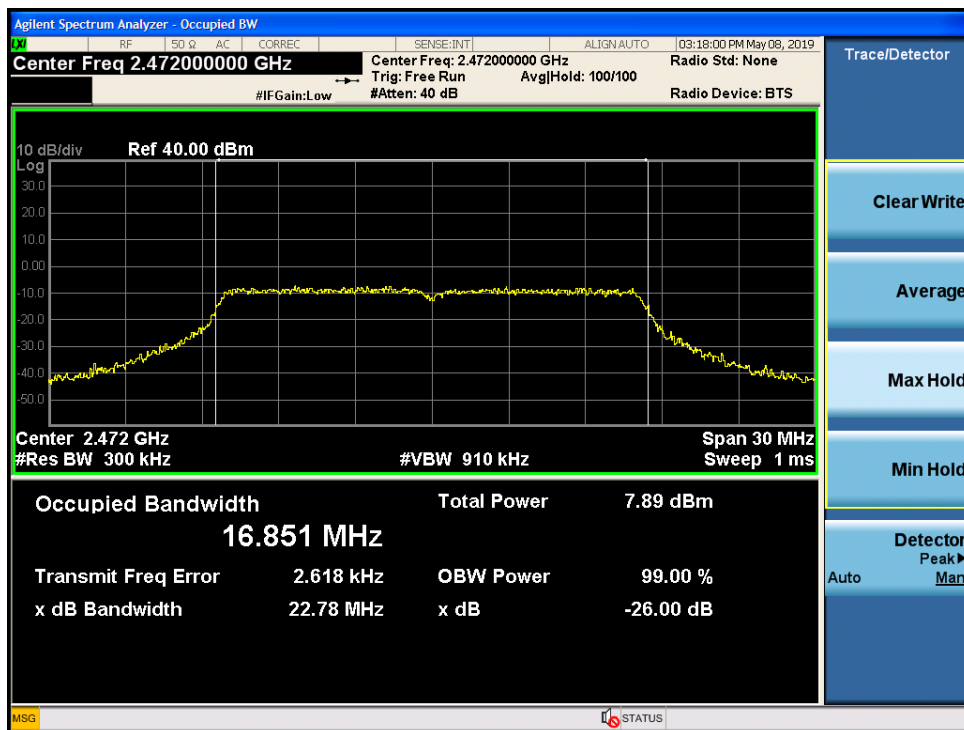


Figure 9-68 Chain 1 99% Bandwidth 802.11g - Ch.13

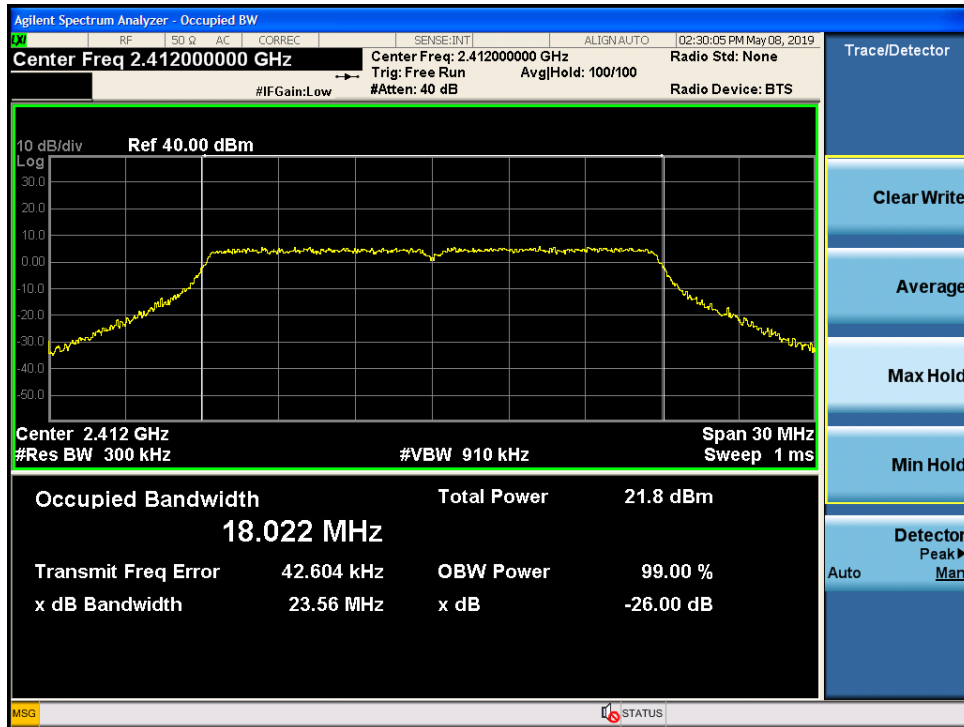


Figure 9-69 Chain 0 99% Bandwidth 802.11g - Ch.1

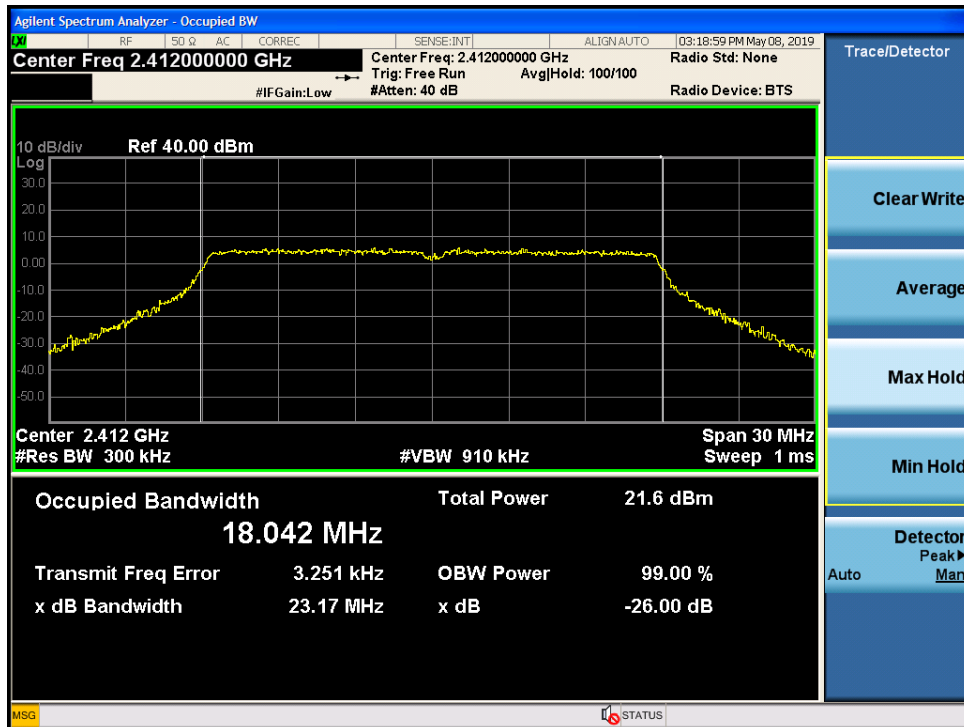


Figure 9-70 Chain 1 99% Bandwidth 802.11n20 - Ch.1

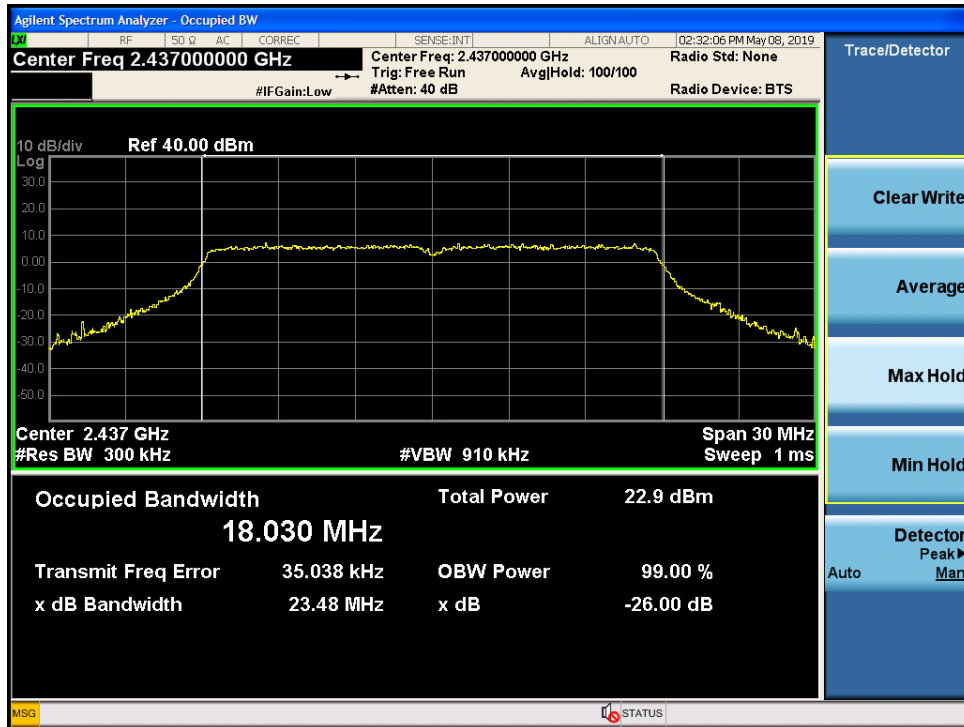


Figure 9-71 Chain 0 99% Bandwidth 802.11n20 - Ch.6

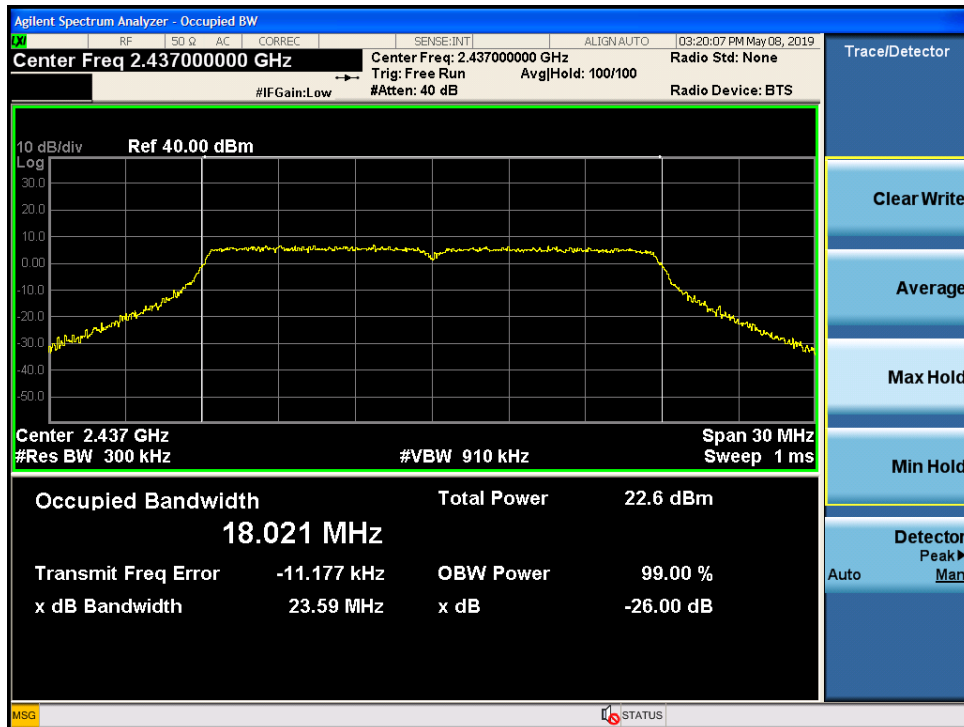


Figure 9-72 Chain 1 99% Bandwidth 802.11n20 - Ch.6

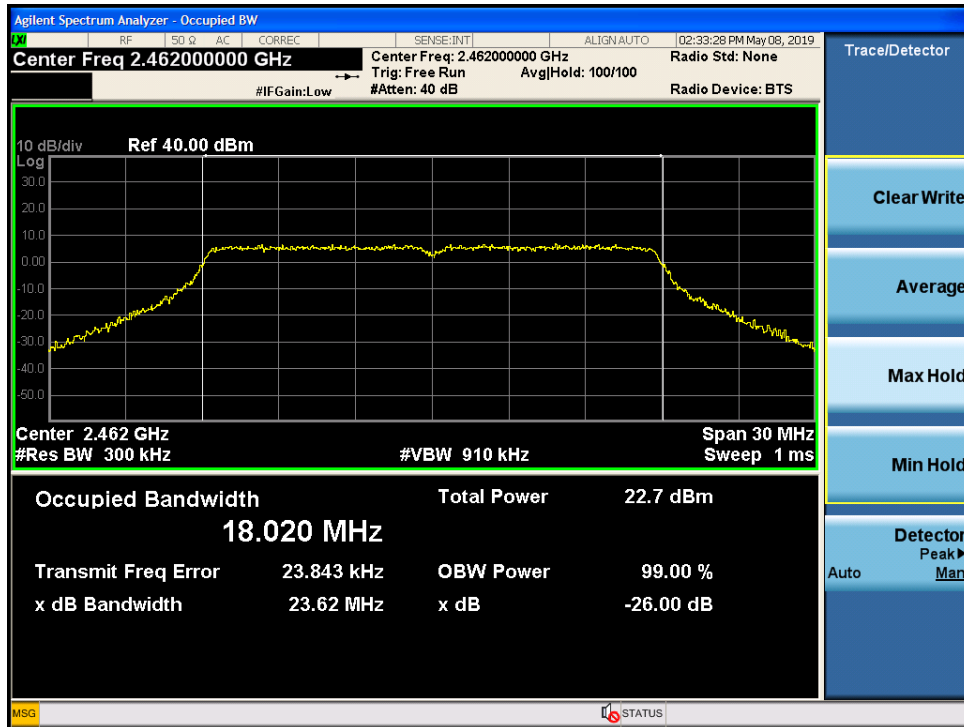


Figure 9-73 Chain 0 99% Bandwidth 802.11n20 - Ch.11

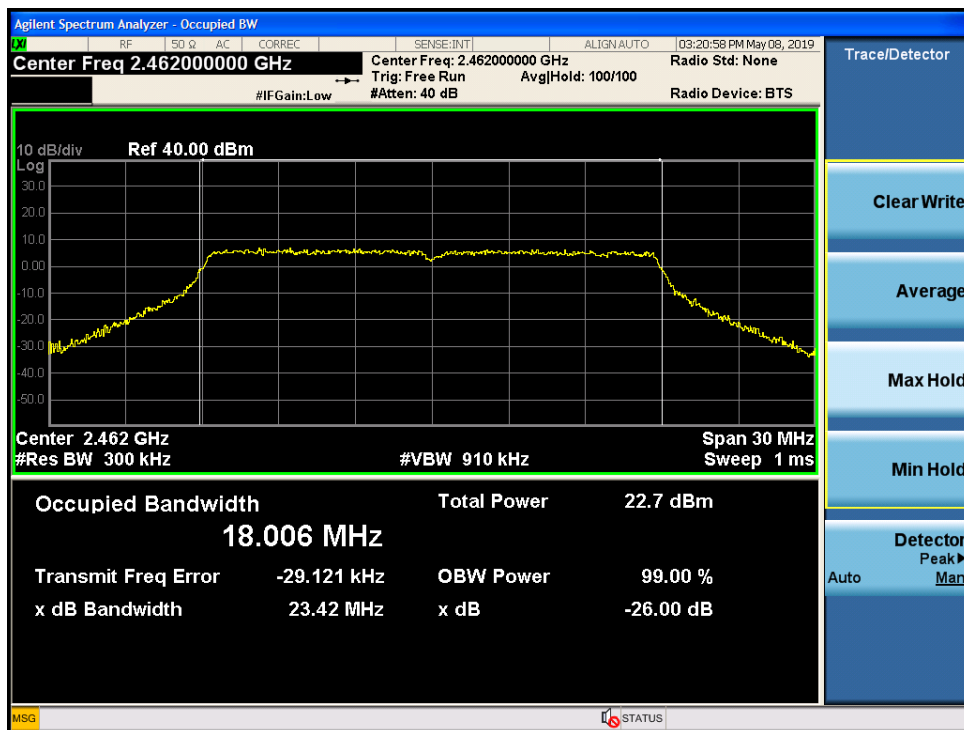


Figure 9-74 Chain 1 99% Bandwidth 802.11n20 - Ch.11

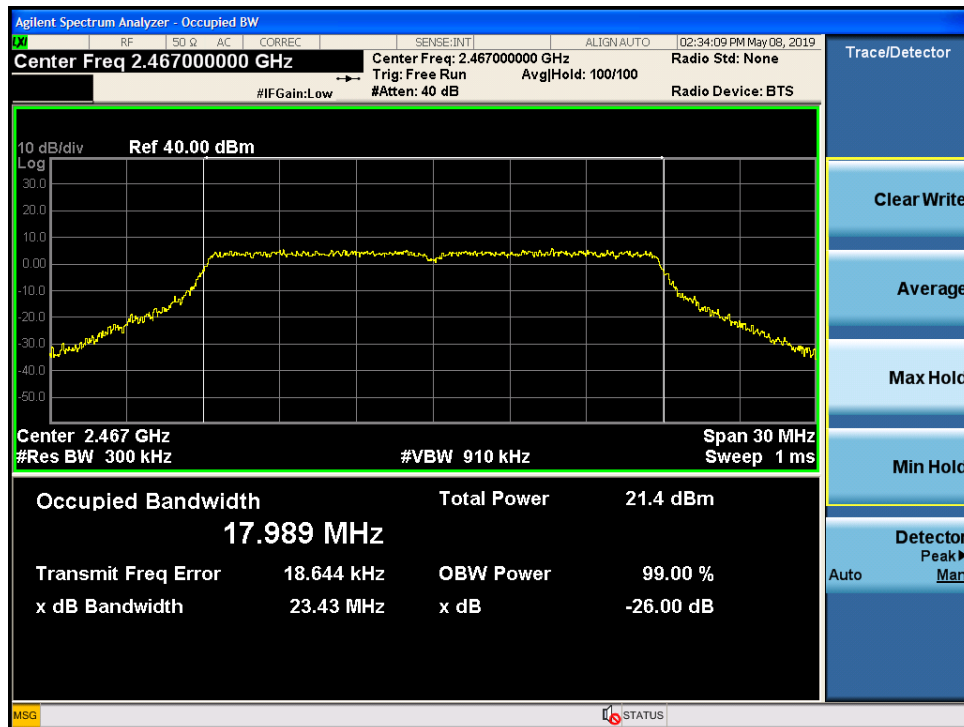


Figure 9-75 Chain 0 99% Bandwidth 802.11n20 - Ch.12

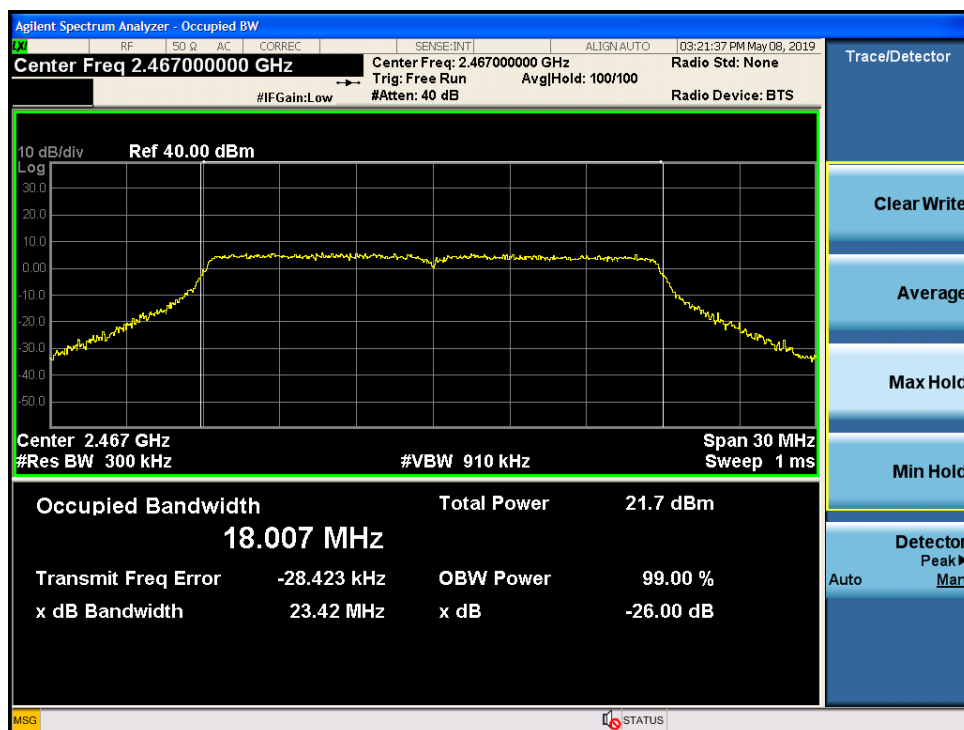


Figure 9-76 Chain 1 99% Bandwidth 802.11n20 - Ch.12

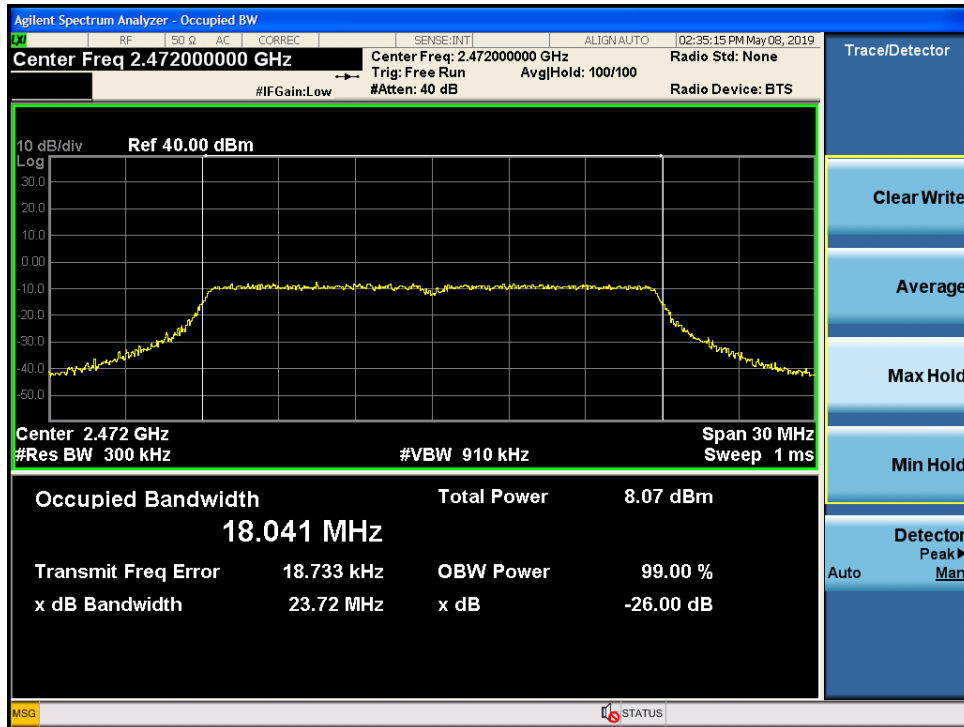


Figure 9-77 Chain 0 99% Bandwidth 802.11n20 - Ch.13

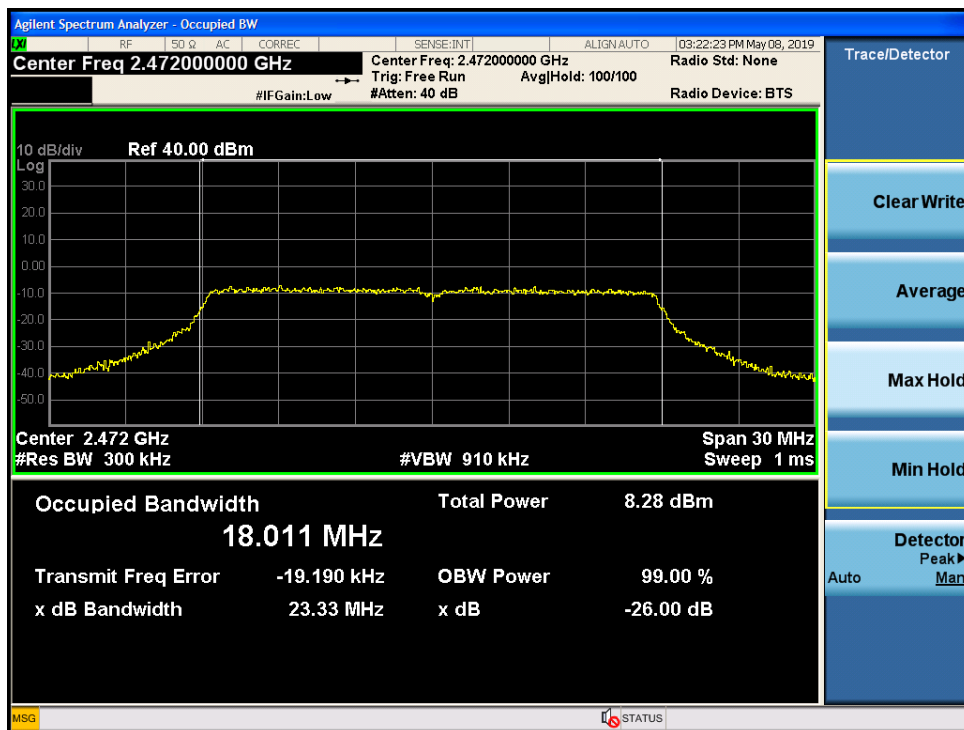


Figure 9-78 Chain 1 99% Bandwidth 802.11n20 - Ch.13

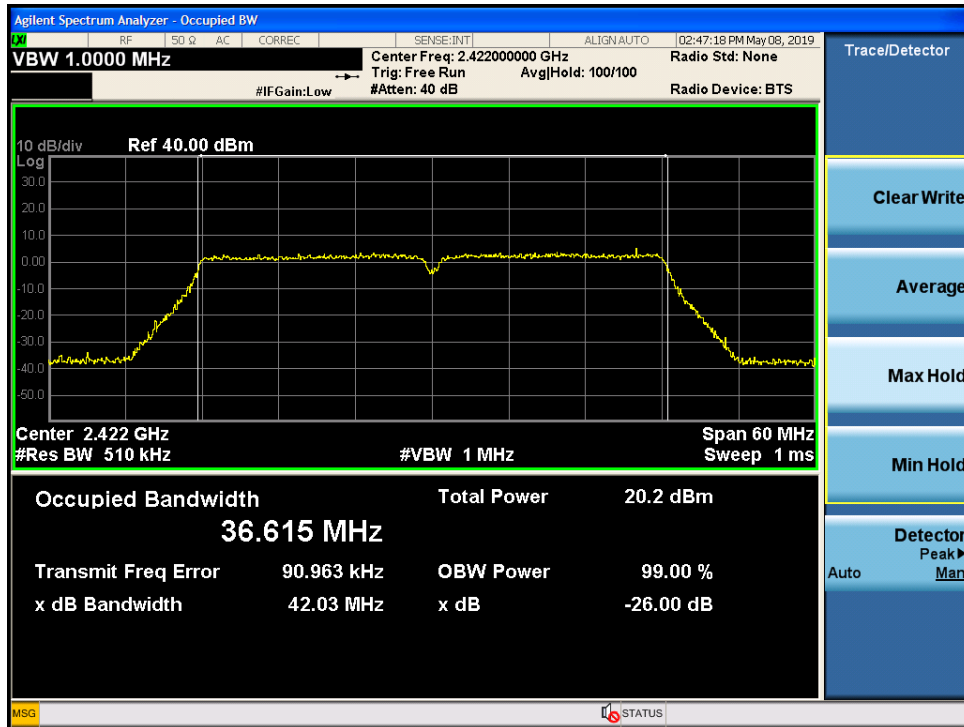


Figure 9-79 Chain 0 99% Bandwidth 802.11n40 - Ch.3

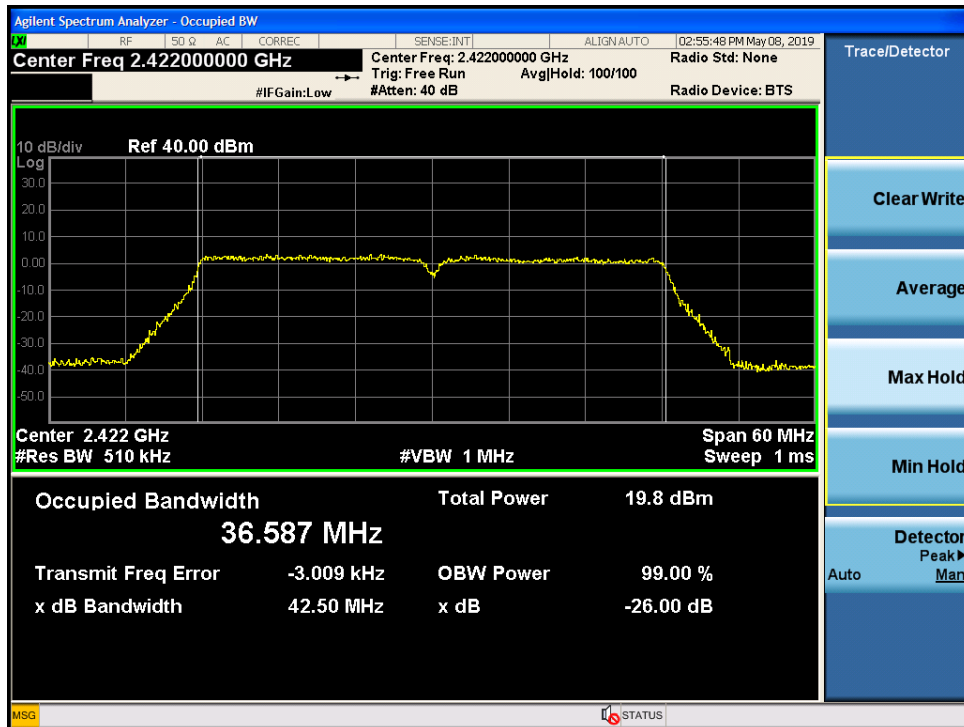


Figure 9-80 Chain 1 99% Bandwidth 802.11n40 - Ch.3

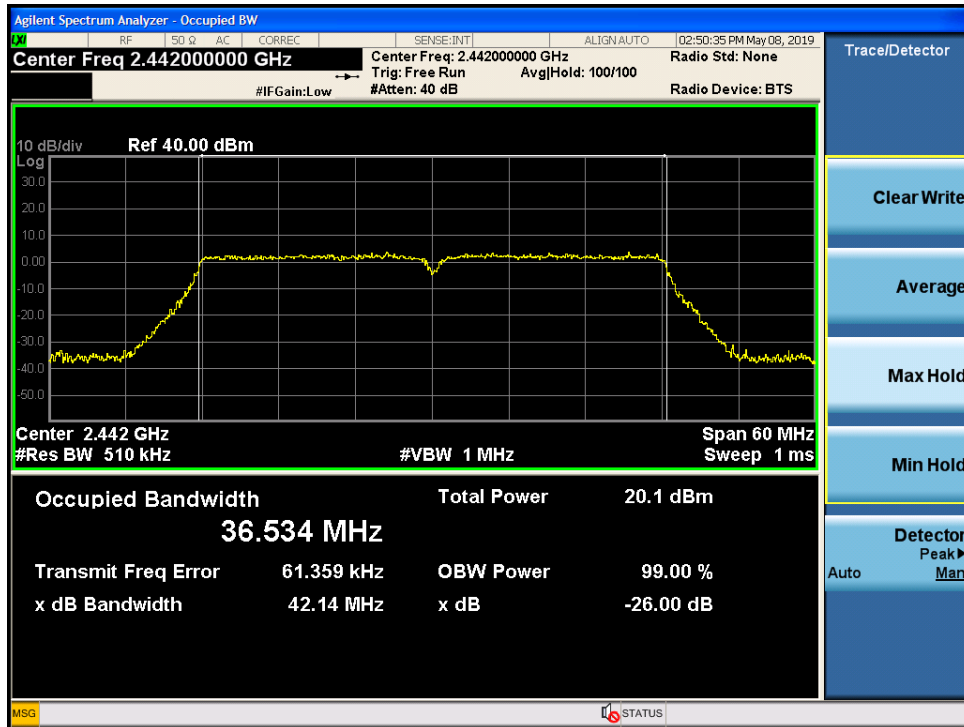


Figure 9-81 Chain 0 99% Bandwidth 802.11n40 - Ch.7

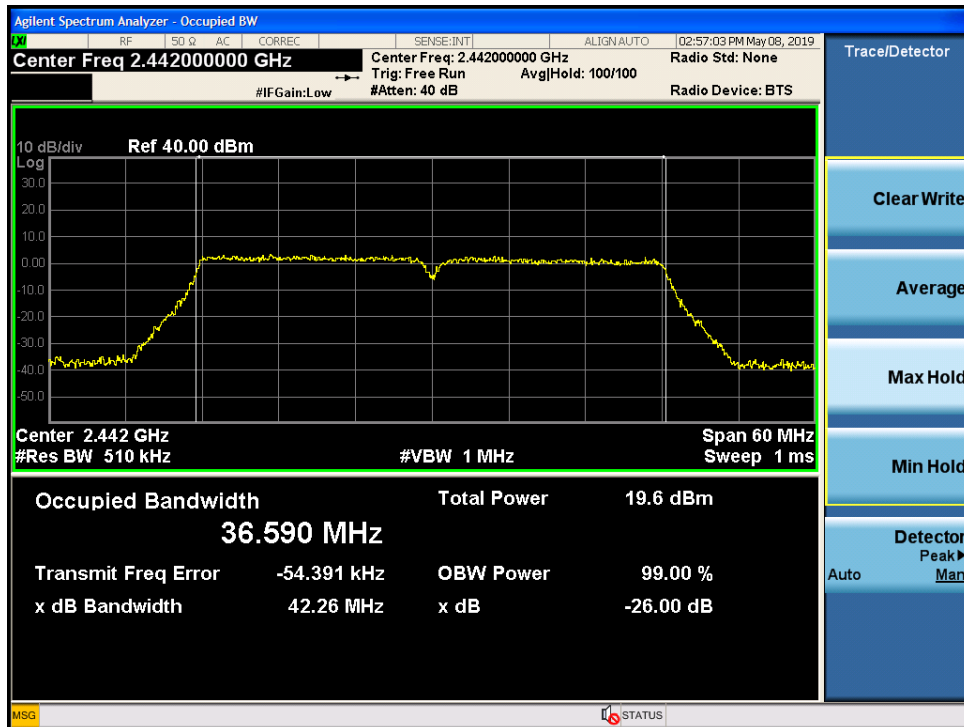


Figure 9-82 Chain 1 99% Bandwidth 802.11n40 - Ch.7

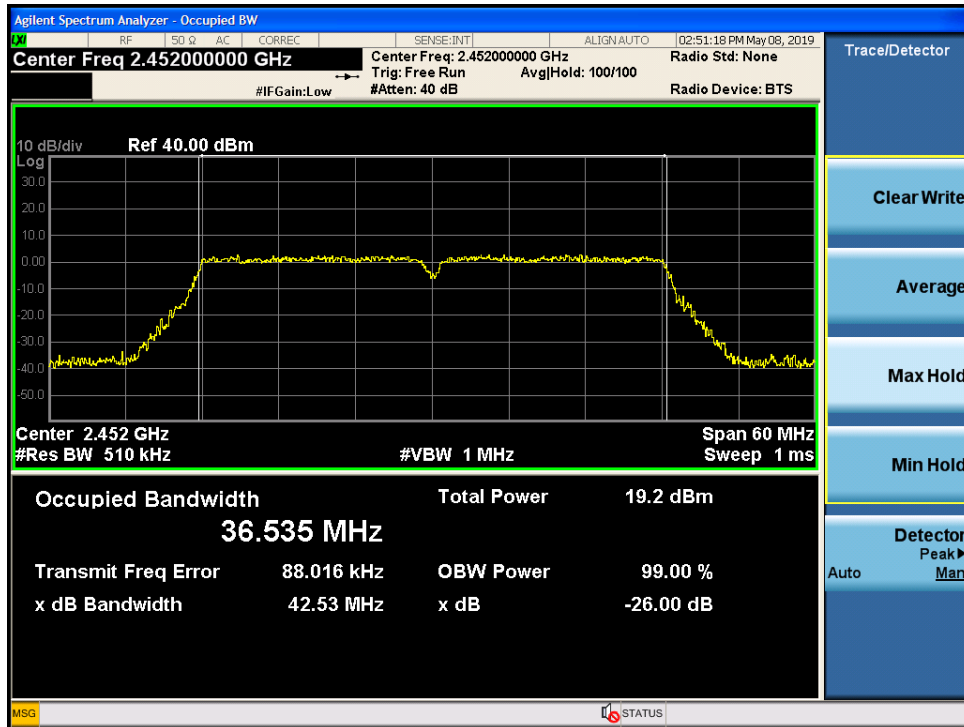


Figure 9-83 Chain 0 99% Bandwidth 802.11n40 - Ch.9

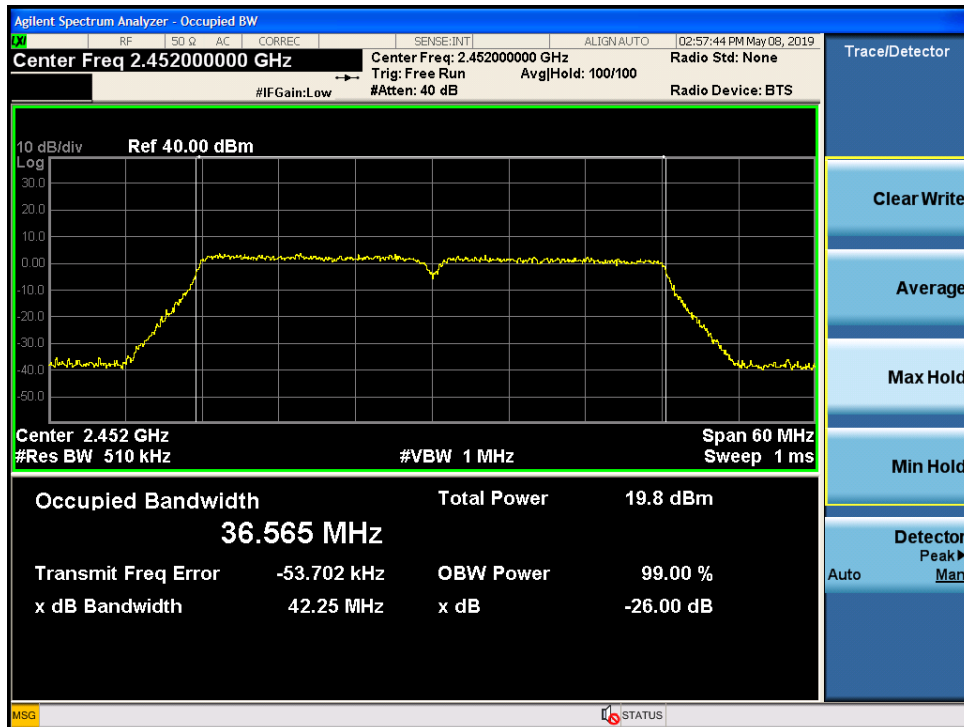


Figure 9-84 Chain 1 99% Bandwidth 802.11n40 - Ch.9

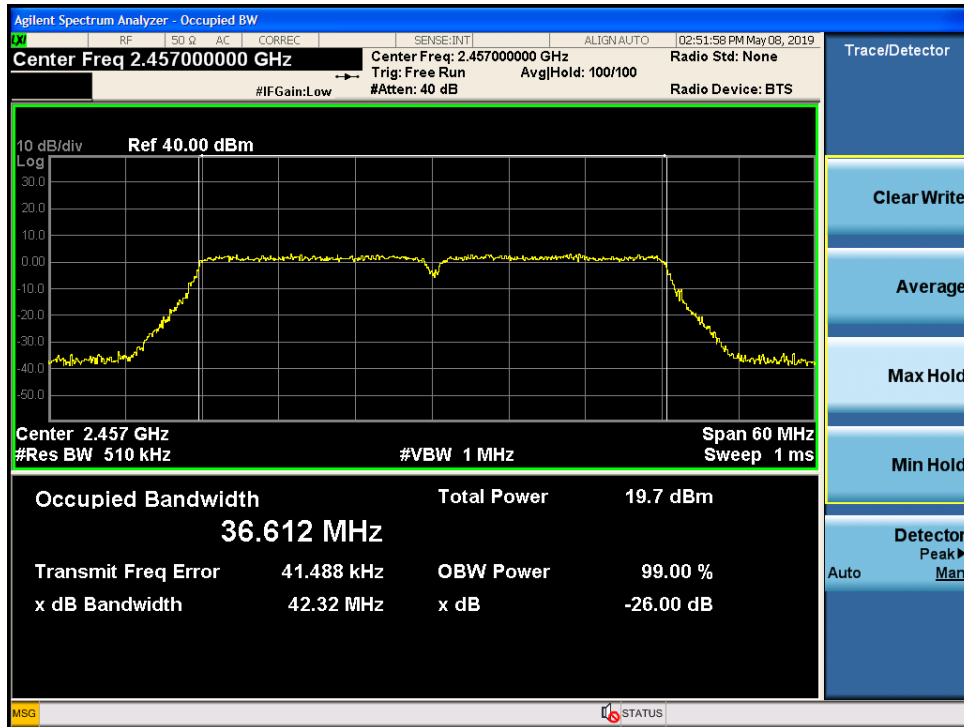


Figure 9-85 Chain 0 99% Bandwidth 802.11n40 - Ch.10

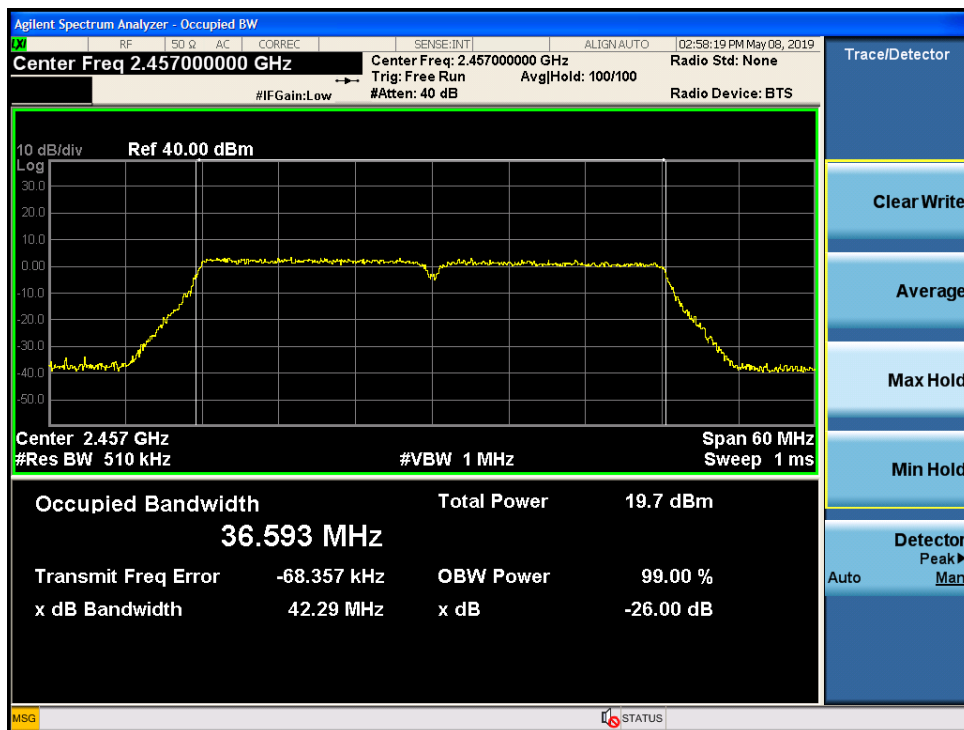


Figure 9-86 Chain 1 99% Bandwidth 802.11n40 - Ch.10

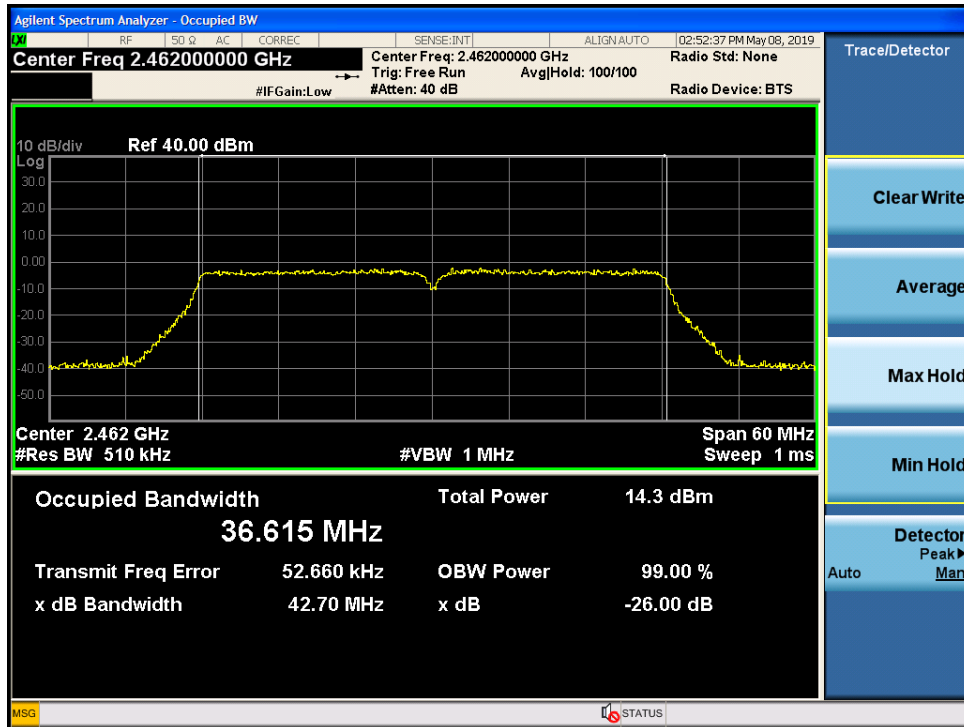


Figure 9-87 Chain 0 99% Bandwidth 802.11n40 - Ch.11

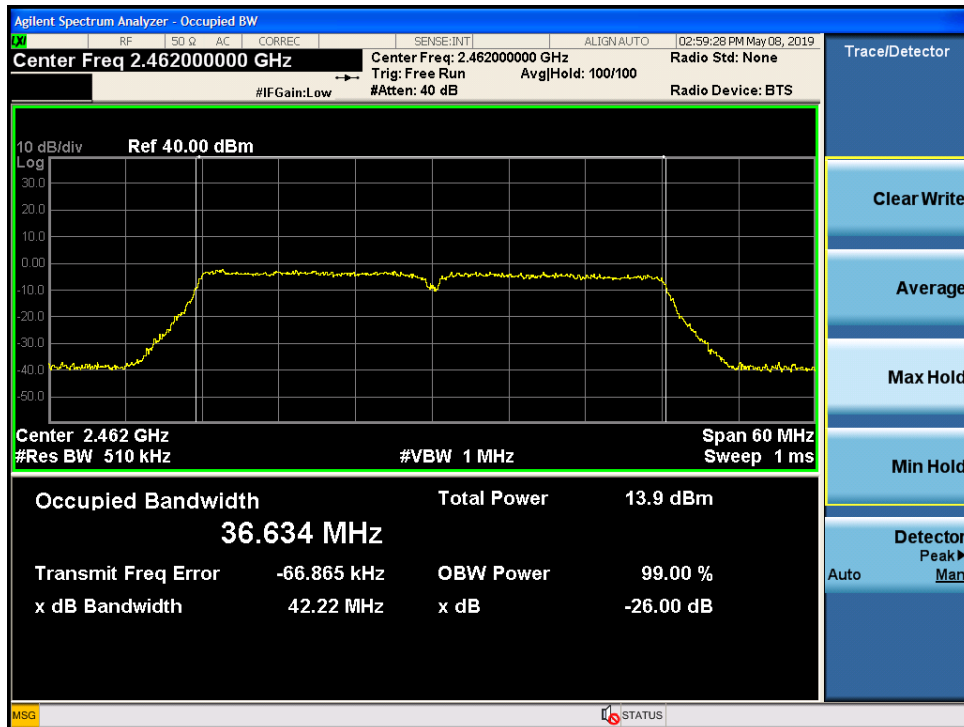


Figure 9-88 Chain 1 99% Bandwidth 802.11n40 - Ch.11

9.4 Output Power

9.4.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (b)(3)

ISED RSS-247 [5.4]

9.4.2 Test Method:

Measurements were performed according to the procedure defined in KDB 558074- Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 V05 and ANSI C63.10: 2013.

9.4.3 Sample Calculation:

For MIMO, the total average power is calculated as follows,

$$\text{Total Average Power} = [10 \cdot \text{LOG} ((10^{\text{Power}_{(\text{Chain } 0)}/10}) + 10^{\text{Power}_{(\text{Chain } 1)}/10})] + \text{DCF}$$

For e.g.

$$\text{Total Power} = [10 \cdot \text{LOG} (10^{(17.54/10)} + 10^{(17.36/10)})] + \text{DCF} = (20.46 + 0.14) = 20.6 \text{ dBm}$$

9.4.4 Limits:

15.247: The maximum permissible peak output power is 30 dBm (1 W)

RSS-247: The maximum peak conducted output power shall not exceed 30dBm (1 W) and the maximum radiated output power shall not exceed 36dBm (4 W) EIRP.

9.4.5 Test Results:

802.11 mode	Frequency (MHz)	Chain 0 Conducted Output power (dBm)	Chain 1 Conducted Output Power (dBm)	Total Average Cond Power (dBm)	Conducted Limit (dBm)	Margin (dB)	Result
b	2412	17.22	17.21	20.23	30.00	-12.76	Pass
b	2437	17.37	17.21	20.30	30.00	-12.69	Pass
b	2462	17.35	17.33	20.35	30.00	-12.64	Pass
b	2467	17.49	17.3	20.41	30.00	-12.58	Pass
b	2472	17.46	17.29	20.39	30.00	-12.60	Pass
g	2412	17.24	17.19	20.36	30.00	-12.63	Pass
g	2437	17.41	17.16	20.43	30.00	-12.56	Pass
g	2462	16.90	16.75	19.97	30.00	-13.02	Pass
g	2467	14.95	15.79	18.54	30.00	-14.45	Pass
g	2472	5.64	5.21	8.58	30.00	-24.41	Pass
n20	2412	14.79	14.63	17.87	30.00	-15.12	Pass
n20	2417	17.39	17.13	20.42	30.00	-12.57	Pass
n20	2462	15.85	15.8	18.98	30.00	-14.01	Pass
n20	2467	13.53	13.70	16.77	30.00	-16.22	Pass
n20	2472	0.84	-0.37	3.44	30.00	-29.55	Pass
n40	2422	12.74	12.51	16.01	30.00	-16.98	Pass
n40	2442	14.87	14.68	18.16	30.00	-14.83	Pass
n40	2452	13.83	13.58	17.09	30.00	-15.90	Pass
n40	2457	13.41	13.04	16.61	30.00	-16.37	Pass
n40	2462	6.48	6.05	9.66	30.00	-23.33	Pass

802.11 mode	Frequency (MHz)	Total Average Conducted Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
b	2412	20.23	3.01	23.24	36.00	-12.76	Pass
b	2437	20.30	3.01	23.31	36.00	-12.69	Pass
b	2462	20.35	3.01	23.36	36.00	-12.64	Pass
b	2467	20.41	3.01	23.42	36.00	-12.58	Pass
b	2472	20.39	3.01	23.40	36.00	-12.60	Pass
g	2412	20.36	3.01	23.37	36.00	-12.63	Pass
g	2437	20.43	3.01	23.44	36.00	-12.56	Pass
g	2462	19.97	3.01	22.98	36.00	-13.02	Pass
g	2467	18.54	3.01	21.55	36.00	-14.45	Pass
g	2472	8.58	3.01	11.59	36.00	-24.41	Pass
n20	2412	17.87	3.01	20.88	36.00	-15.12	Pass
n20	2417	20.42	3.01	23.43	36.00	-12.57	Pass
n20	2462	18.98	3.01	21.99	36.00	-14.01	Pass
n20	2467	16.77	3.01	19.78	36.00	-16.22	Pass
n20	2472	3.44	3.01	6.45	36.00	-29.55	Pass
n40	2422	16.01	3.01	19.02	36.00	-16.98	Pass
n40	2442	18.16	3.01	21.17	36.00	-14.83	Pass
n40	2452	17.09	3.01	20.10	36.00	-15.90	Pass
n40	2457	16.62	3.01	19.63	36.00	-16.37	Pass
n40	2462	9.66	3.01	12.67	36.00	-23.33	Pass

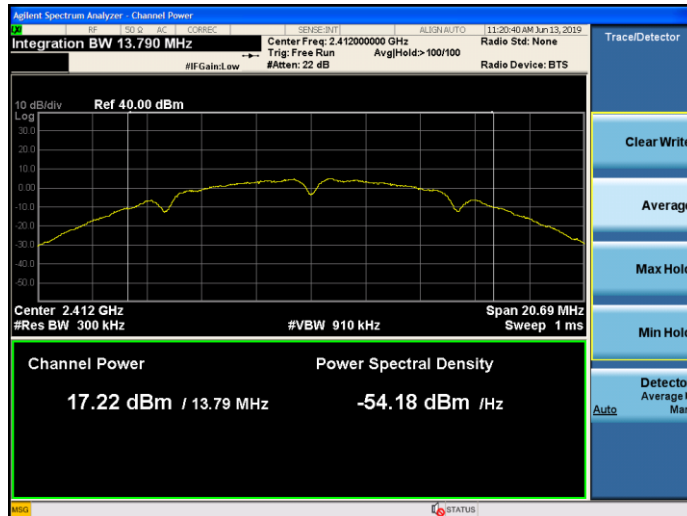


Figure 9-89 Chain 0 Average Power 802.11b - Ch.1

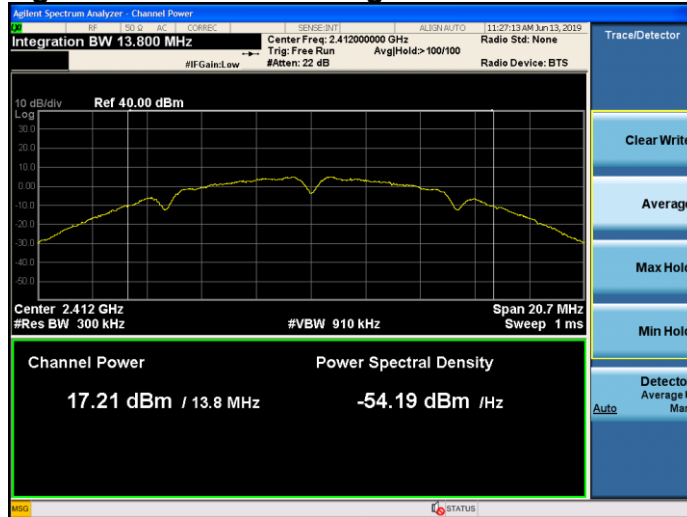


Figure 9-90 Chain 1 Average Power 802.11b - Ch.1

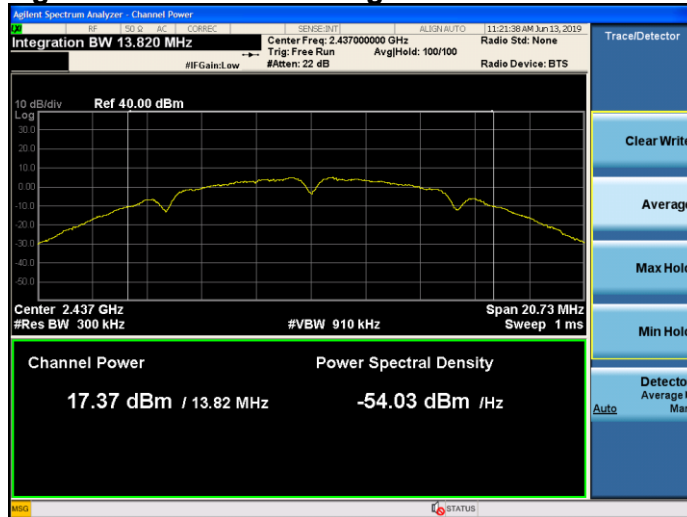


Figure 9-91 Chain 0 Average Power 802.11b - Ch.6

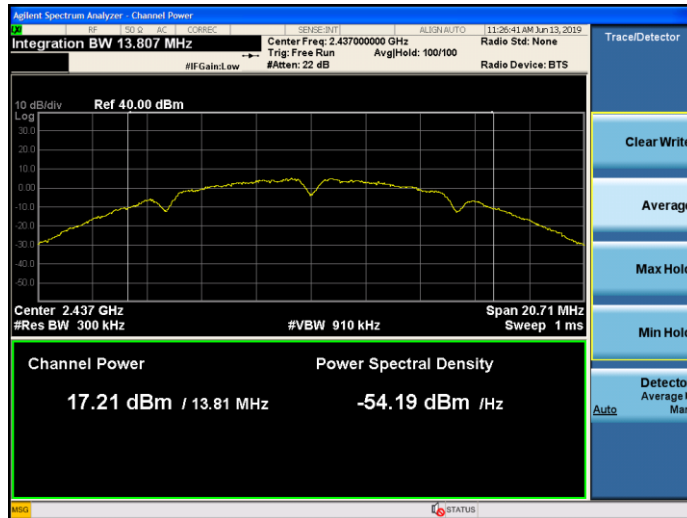


Figure 9-92 Chain 1 Average Power 802.11b - Ch.6



Figure 9-93 Chain 0 Average Power 802.11b - Ch.11



Figure 9-94 Chain 1 Average Power 802.11b - Ch.11



Figure 9-95 Chain 0 Average Power 802.11b - Ch.12

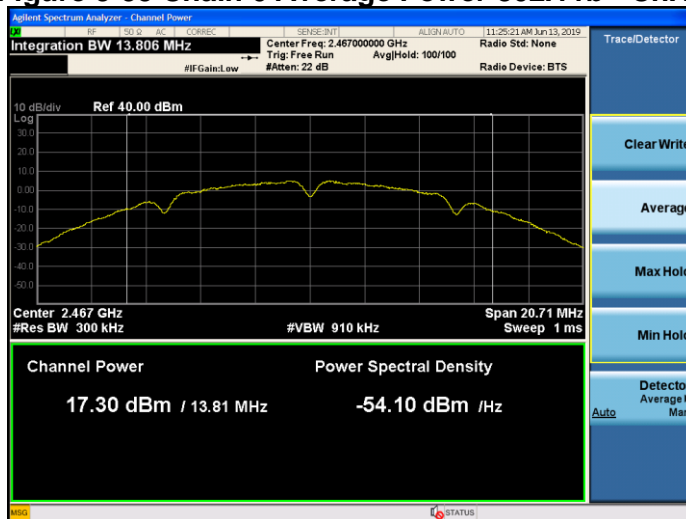


Figure 9-96 Chain 1 Average Power 802.11b - Ch.12



Figure 9-97 Chain 0 Average Power 802.11b - Ch.13

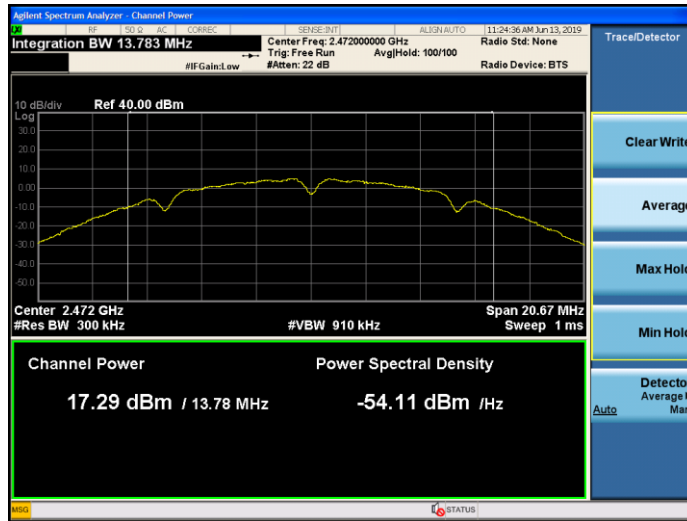


Figure 9-98 Chain 1 Average Power 802.11b - Ch.13

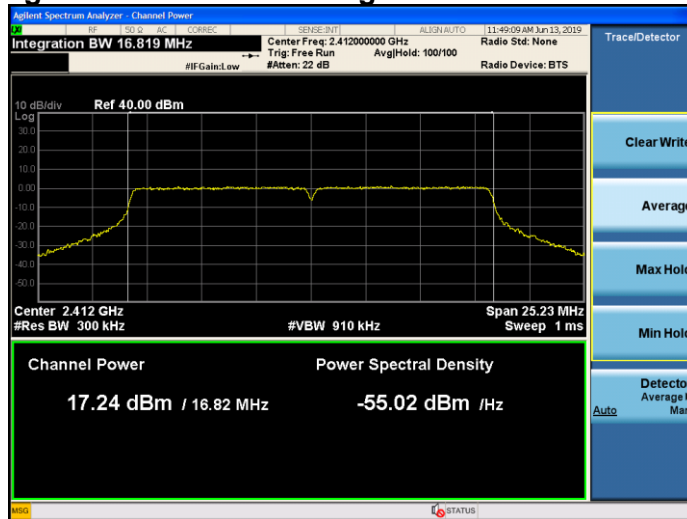


Figure 9-99 Chain 0 Average Power 802.11g - Ch.1

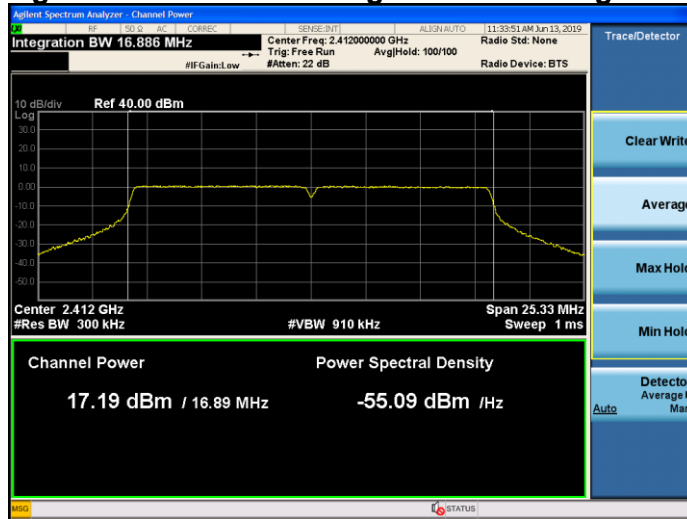


Figure 9-100 Chain 1 Average Power 802.11g - Ch.1

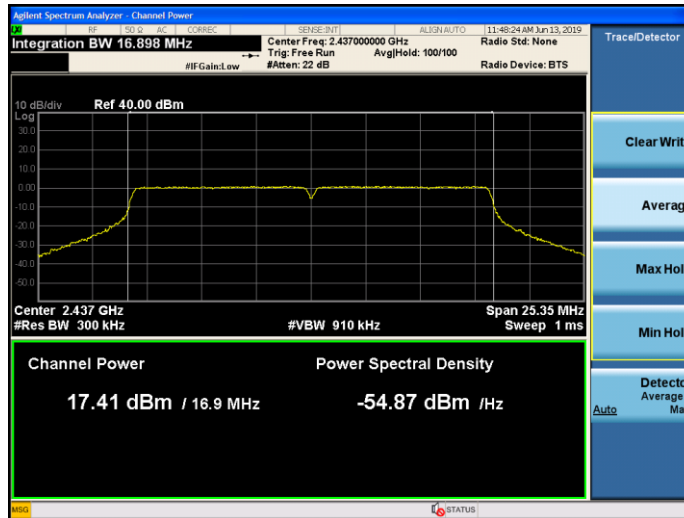


Figure 9-101 Chain 0 Average Power 802.11g - Ch.6

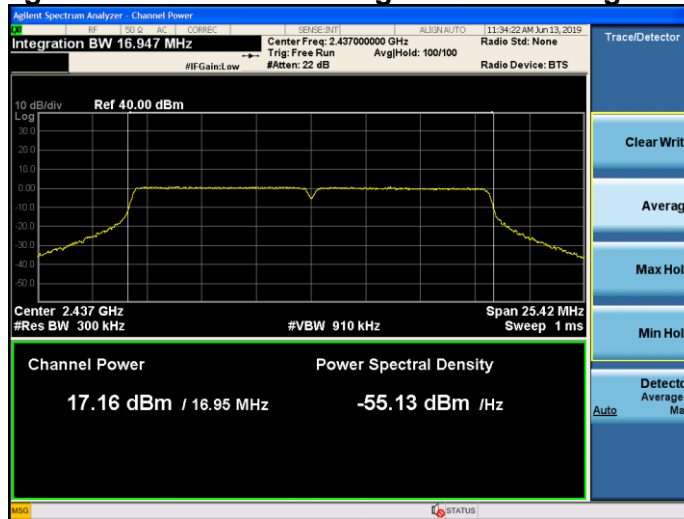


Figure 9-102 Chain 1 Average Power 802.11g - Ch.6

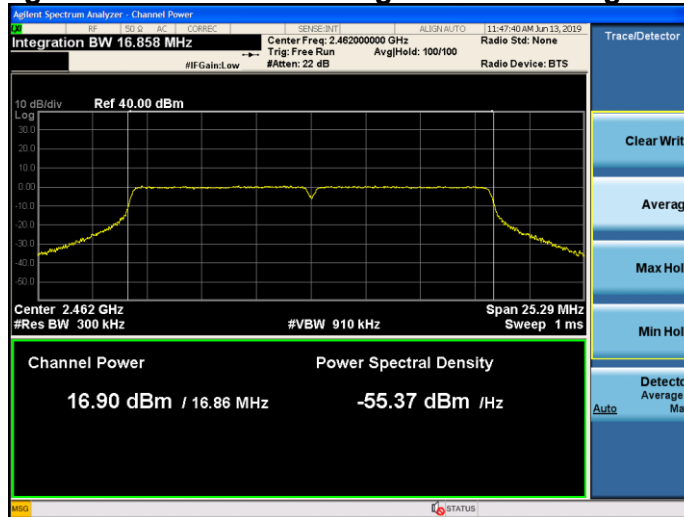


Figure 9-103 Chain 0 Average Power 802.11g- Ch.11