



RADIO TEST REPORT

For

MODEL NO. 1703

FCC ID: C3K1703

IC ID: 3048A-1703

Test Report No. R-TR190-FCCIC-UNII-1

Issue Date: 14 September 2015

FCC CFR47 Part 15 Subpart E
Industry Canada RSS-247 Issue 1

Prepared by

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1 Record of Revisions

Revision	Date	Section	Page(s)	Summary of Changes	Author/Revised By:
1.0	09/14/2015	All	All	First Version	Daniel Salinas

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Test Report Attestation

Microsoft Corporation

Model: 1703

FCC ID: C3K1703

IC ID: 3048A-1703

Applicable Standards

Specification	Test Result
FCC CFR47 Rule Parts 15.207, 15.209, 15.407	Pass
Industry Canada RSS-247 Issue 1	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.



Written By: Daniel Salinas
Radio Test Engineer



Reviewed/ Issued By: Sajay Jose
EMC/RF Compliance Lab Manager

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-1, 3048A-2, 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, CISPR 16-1-1 and other equivalent applicable standards. Test site requirements for measurements above 1 GHz are in accordance with ANSI C63.4 2009. ANSI C63.10 2013 and the appropriate KDB test methods were followed.

The calibrations of the measuring instruments, including any accessories that may affect such calibration, are checked frequently to assure their accuracy. Adjustments are made and correction factors applied in accordance with instructions contained in the user manual for the measuring equipment.

4 Measurement Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the product, as specified in CISPR 16-4-2. 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	Value (dB)
Radiated disturbance (30 MHz to 1 GHz)	6.01
Radiated disturbance (1 GHz to 18 GHz)	4.80
Conducted Disturbance at Mains Port	3.30

5 Product Description

Company Name:	Microsoft Corporation
Address:	One Microsoft Way
City, State, Zip:	Redmond, WA 98052-6399
Customer Contact:	Sahithi Kandula
Functional Description of the EUT:	Portable Computing device with 2x2 802.11 a/b/g/n/ac WLAN and BT 4.0 Radios
Model:	1703
FCC ID:	C3K1703
IC ID:	3048A-1703
Radio Description:	802.11a/n/ac with 20MHz, 40MHz and 80MHz Signal Bandwidths
Modulation:	OFDM – BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM
Antenna Type:	Internal
EUT Classification:	UNII
Equipment Design State:	EV3B
Equipment Condition:	Good
Test Sample Details:	SN: 000187552375 - Conducted SN(s): 000130352157, 000133752157- Radiated

5.1 Test Configurations

Test software “WiFi Tool” (V2.7.4 & V2.7.3), provided by the customer, and “Lab Tool” (V2.0.0.77), from the module vendor, were used to program the EUT to transmit continuously and change modes of operation.

This report contains the worst case data from the following modes of test in 20/40/80 MHz signal bandwidths (where applicable).

802.11a: 6Mbps

802.11n: MCS0

802.11ac: MCS0

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 and Gain Information

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

Antenna Gain		
Frequency Band (MHz)	Chain A MIMO Wi-Fi Antenna Peak Gain (dBi)	Chain B Main Antenna Wi-Fi Peak Gain (dBi)
UNII Band 1- 5150 to 5250	6.1	4.5
UNII Band 2a – 5250 to 5350	6.0	5.1
UNII Band 2c – 5470 to 5725	5.7	5.7
UNII Band 3 – 5725 to 5850	5.6	5.6

Simultaneous transmission on both transmit chains was observed to be the worst case mode of operation for all test cases. Since the transmit signals are completely uncorrelated, the combined gain is calculated using the following formula as specified in KDB 662911 D01 Multiple Transmitter Output v02r01:

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

Combined Directional Antenna Gain	
Frequency Band (MHz)	Combined Directional Gain (dBi)
UNII Band 1- 5150 to 5250	5.4
UNII Band 2a – 5250 to 5350	5.6
UNII Band 2c – 5470 to 5725	5.7
UNII Band 3 – 5725 to 5850	5.6

5.4 Equipment Modifications

No modifications were made during testing.

5.5 Dates of Testing

Testing was performed from July, 8th 2015 to September 2nd 2015.

6 Test Results Summary

Test Description	FCC CFR 47/ IC Rule Part	Limit	Test Result
26dB Emission Bandwidth	15.407 (h)(2) RSS-247 [6.2.1]	Reporting and Measurement Purposes	Pass
99% bandwidth	RSS-247 [6.2]	Reporting and Measurement Purposes	Pass
6 dB Bandwidth	15.407 (e) RSS-247 [6.2.4]	> 500kHz	Pass
Output Power	15.407 (a) RSS-247 [6.2]	< 250 mW	Pass
Power Spectral Density	15.407 (a) RSS-247 [6.2]	< 8dBm/3kHz	Pass
Conducted Band Edge/Spurious Emissions	15.2407 (b) RSS-247 [6.2]	< 27dBm/MHz	Pass
Radiated Spurious Emissions/ Restricted Band Emissions	15.407 (b), 15.205, 15.209, RSS-Gen [8.9]	FCC CFR 47 15.209 limits RSS-Gen [8.9]	Pass
AC Power line Conducted Emissions	115.407 (b), 5.207 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	4/14/2016
Rohde & Schwarz	EMI Test Receiver	ESU40	RF-012	4/12/2016
Agilent	Spectrum Analyzer	N9030A	EMC-607	6/16/2016
Rohde & Schwarz	Signal Analyzer	FSV40	RF-195	4/10/2016
Rohde & Schwarz	Signal Analyzer	FSV40	RF-245	4/10/2016
Sunol Sciences	Antenna - Broadband	JB6	EMC-008	3/4/2016
ETS-Lindgren	Antenna	3117	RF-139	4/9/2016
ETS-Lindgren	Antenna	3117	RF-138	5/13/2016
ETS-Lindgren	Antenna - Standard Gain	3160-09	RF-179	4/30/2016
ETS-Lindgren	Antenna - Standard Gain	3160-10	RF-038	4/30/2016
Rohde & Schwarz	Custom Filter Bank+PreAmp	SFUNIT RX	RF-323	3/21/2016
Rohde & Schwarz	Custom Filter Bank	SFUNIT RX	RF-324	3/21/2016
Rohde & Schwarz	Pre-Amp	TS-PR26	RF-042	1/6/2016
Rohde & Schwarz	Pre-Amp	TS-PR40	RF-200	1/6/2016
Rohde & Schwarz	Switch and Control Unit	OSP130	RF-249	1/9/2016
Rohde & Schwarz	Switch and Control Unit	OSP150	RF-250	1/9/2016
Rohde & Schwarz	Switch and Control Unit	OSP130	RF-018	12/18/2015
Rohde & Schwarz	Switch and Control Unit	OSP150	RF-019	12/18/2015

Maturo	Antenna Tower Controller	NCD	RF-002	N/A
Maturo	Device Positioner	TD1.5	RF-003	N/A
Maturo	System Controller	NCD-120	RF-327	N/A
Sunol Sciences	System Controller	SC110V	RF-001	N/A
Madge Tech	THP Monitor	PRH Temp 2000	EMC-681	11/5/2015
Madge Tech	THP Monitor	PRH Temp 2000	EMC-171	N/A
Fluke	Multimeter	87V	EMC-193	4/9/2016
Rohde & Schwarz	Software	EMC-32 V9.15	N/A	N/A
Huber Suhner	RF Cable	102A	RF-272	1/6/2016
Huber Suhner	RF Cable	Sucoflex 102A	RF-269	3/21/2016

Equipment used for Line Conducted Emissions Measurement				
Manufacturer	Description	Model #	Asset #	Calibration Due
Rohde & Schwarz	EMI Test Receiver	ESR 3	EMC-669	11/3/2015
Teseq	LISN	NNB 51	EMC-187	10/11/2015
Teseq	LISN	NNB 51	EMC-642	10/11/2015
Micro-Coax	RF Cable	UFA210A-1-1800-50U50U	EMC-367	8/6/2016
Madge Tech	THP Monitor	PRHTemp2000	EMC-837	6/23/2016
ETS	TILE SW	Ver 7.0	N/A	N/A

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 with a 2.4m X 2.4m configuration are laid out on the ground plane between the Receiving antenna and the EUT in accordance with the requirements of ANSI C63.4:2009.

8.1.1 Radiated Measurements in 30M- 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. The EUT is also rotated about its three orthogonal orientations to investigate emissions.

8.1.2 Radiated Measurements above 1GHz

The EUT is positioned on a Turntable at a height of 150cm using a device positioner. 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 turntable is rotated 360 degrees, the antenna height maintained at 150cm and the device positioner rotated about its horizontal axis 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 distance of 1m.

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 is added internally in the Analyzer settings. The plots displayed accounts for these correction factors.

8.3 Test Setup Diagrams

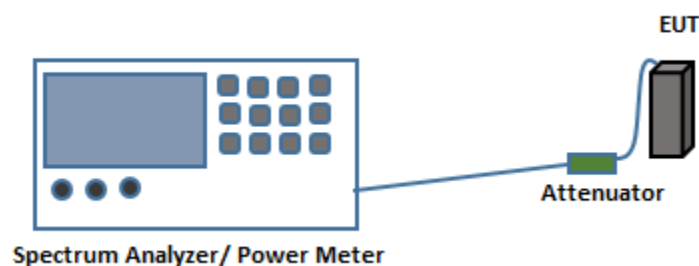


Fig.1. Test Setup for Antenna port conducted measurements

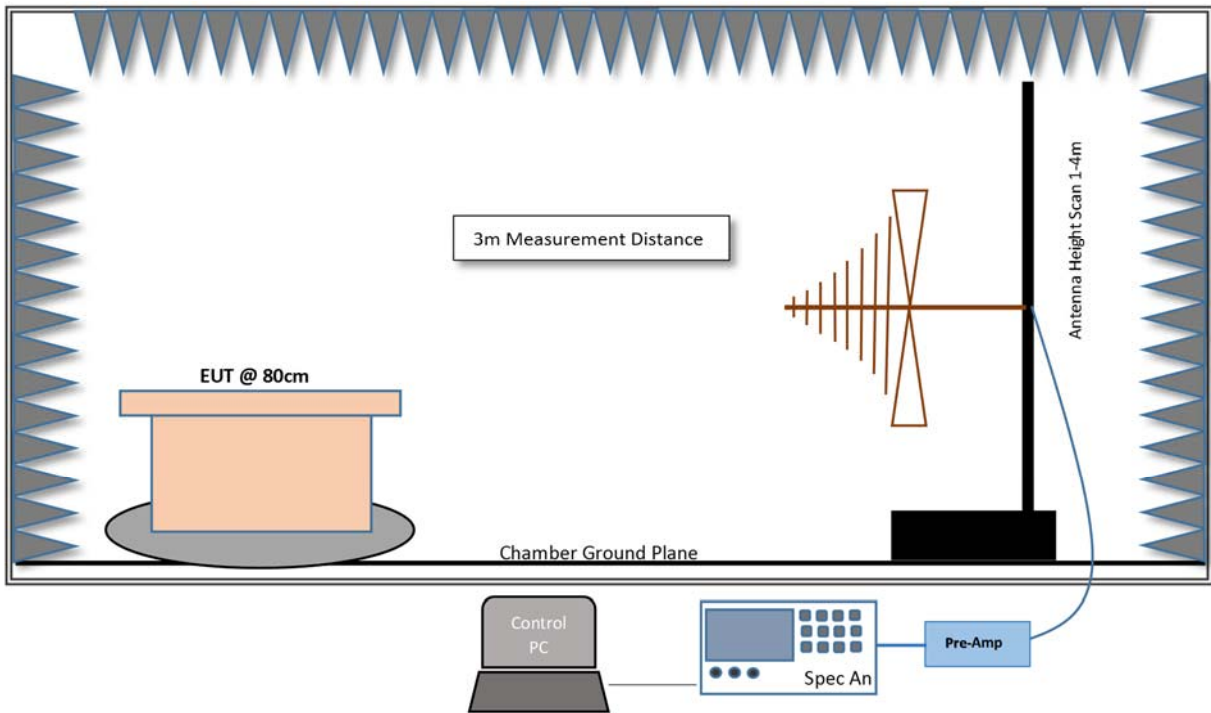


Fig.2. Test Setup for Radiated measurements in 30MHz- 1GHz Range

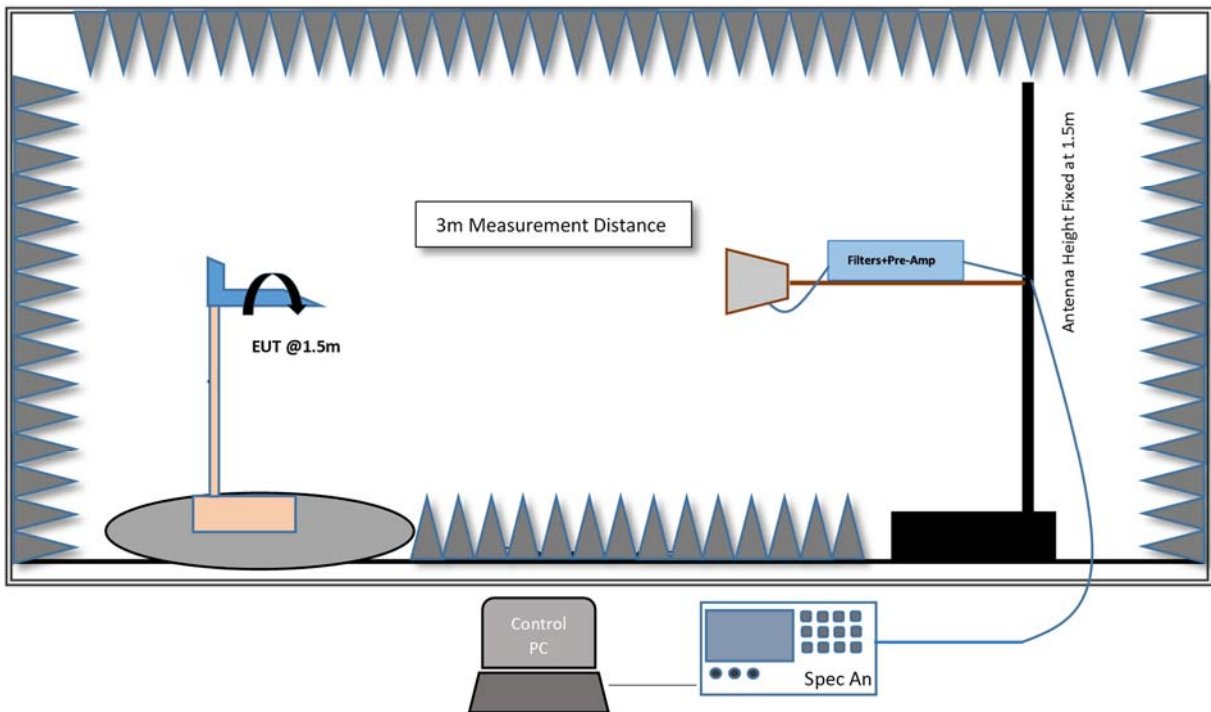


Fig.3. Test Setup for Radiated measurements in 1GHz- 18GHz Range



Fig.4. Test Setup for Radiated measurements >18GHz

9 Test Results- Conducted

9.1 26-dB Emission Bandwidth

9.1.1 Test Requirement:

FCC CFR 47 Rule Part 15.407 (h)(2)

Industry Canada RSS-247 [6.2.1]

9.1.2 Test Method:

Measurements were performed according to the procedures defined in KDB 789033- General UNII Test Procedures New Rules v01 and ANSI C63.10 2013.

Spectrum Analyzer settings:

RBW = approximately 1% of the Emissions Bandwidth

VBW \geq 3xRBW

Trace Mode= Peak Detector (Max Hold)

Sweep time= Auto

The in-built functionality of the Spectrum Analyzer is used to measure the 26-dB emission bandwidth.

9.1.3 Limits:

The 26-dB bandwidth are required for power limits, measurements and reporting purposes

9.1.4 Test Results:

Pass.

9.1.5 Test Data:

9.1.5.1 Chain A 802.11a 26-dB Emission Bandwidth

Chain A 802.11a 26-dB Emission Bandwidth		
Channel No.	Frequency (MHz)	26-dB Emission Bandwidth (MHz)
36	5180	20.30
44	5220	20.49
48	5240	20.54
52	5260	20.04
60	5300	20.42
64	5320	19.68
100	5500	20.81
116	5580	20.75
140	5700	20.05
144	5720	20.87
149	5745	19.59
157	5785	19.88
165	5825	20.89

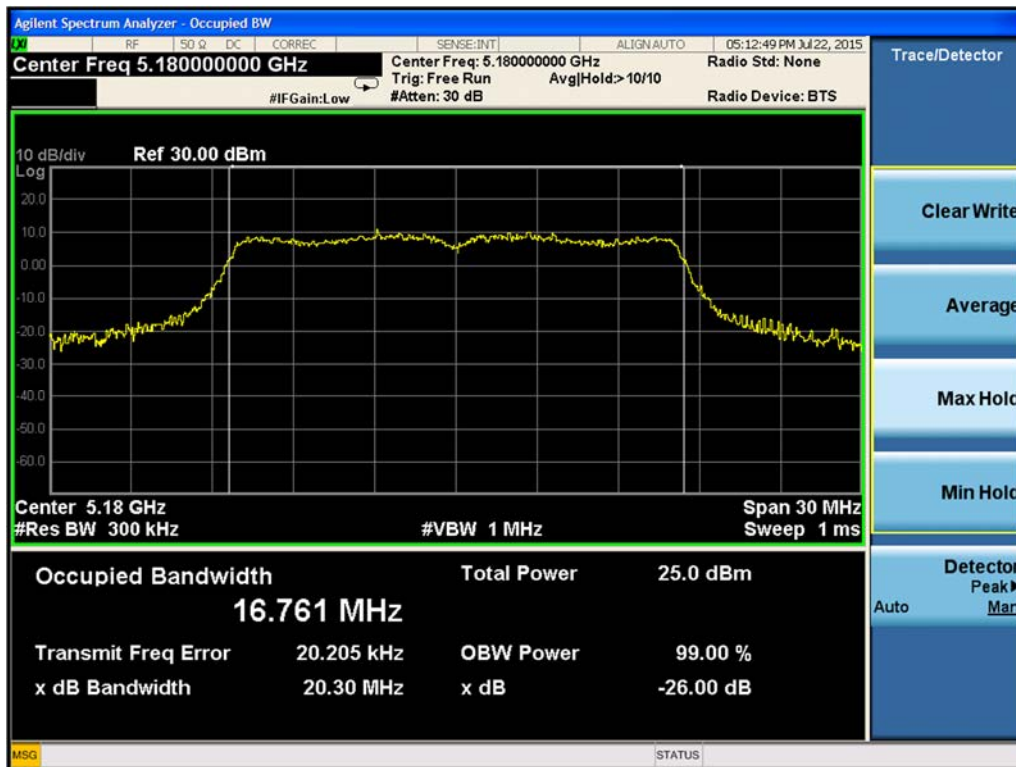


Figure 9-1. 26-dB Emission Bandwidth Chain A 802.11a (Ch. 36)

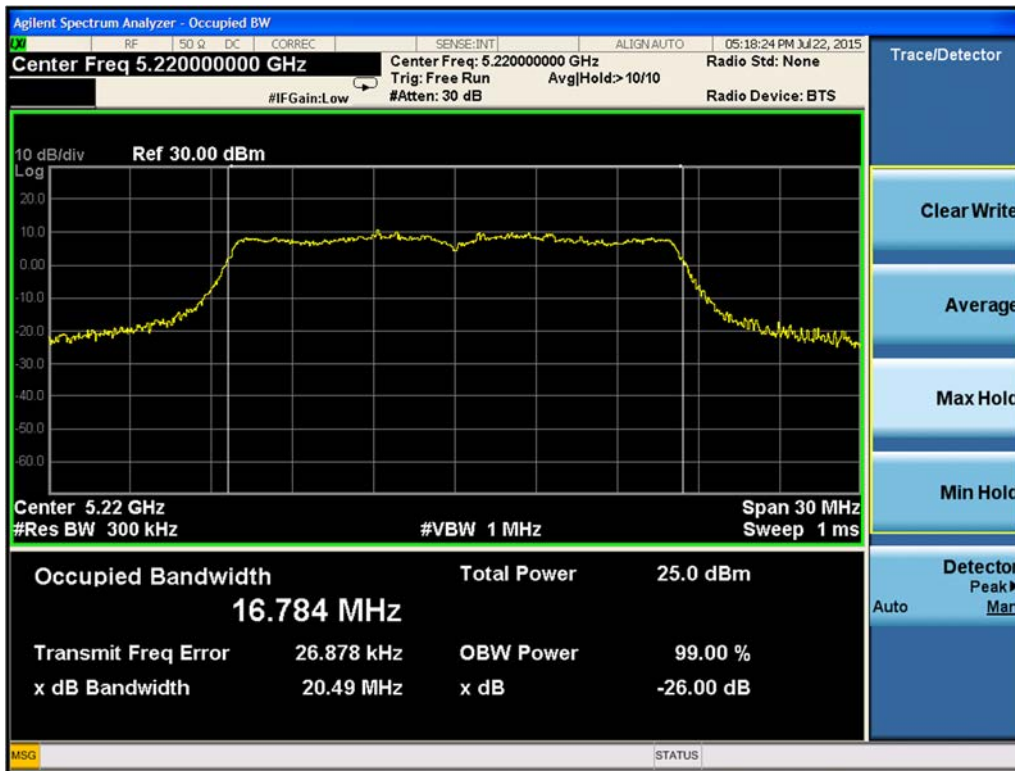


Figure 9-2. 26-dB Emission Bandwidth Chain A 802.11a (Ch. 44)

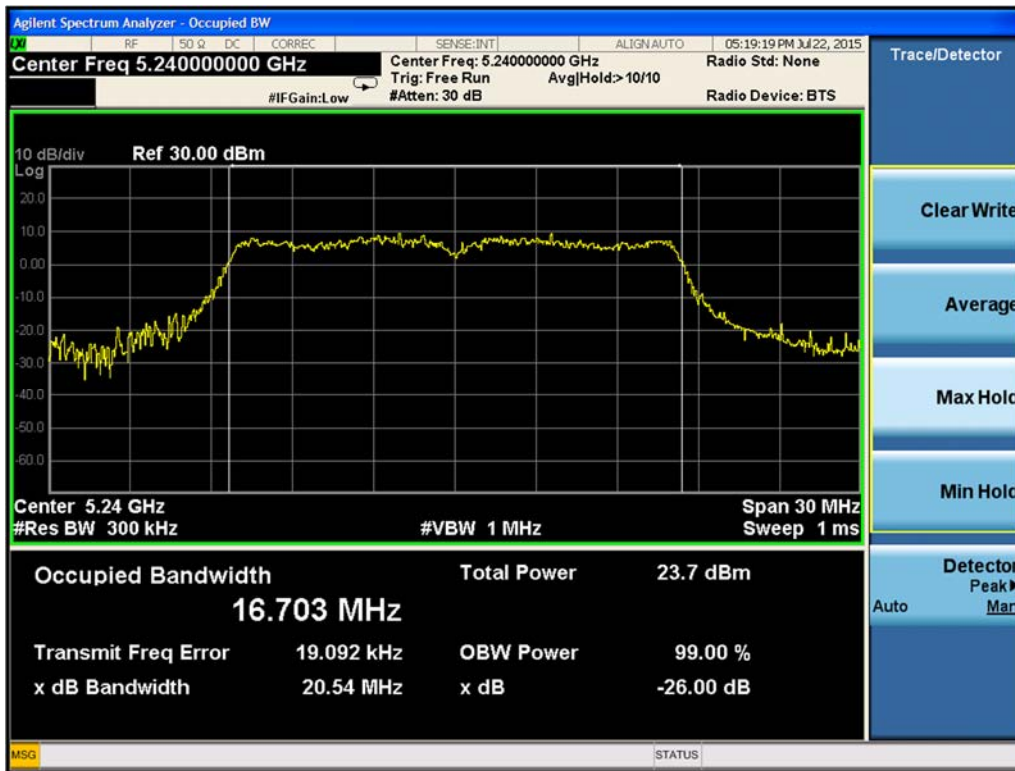


Figure 9-3 26-dB Emission Bandwidth Chain A 802.11a (Ch. 48)

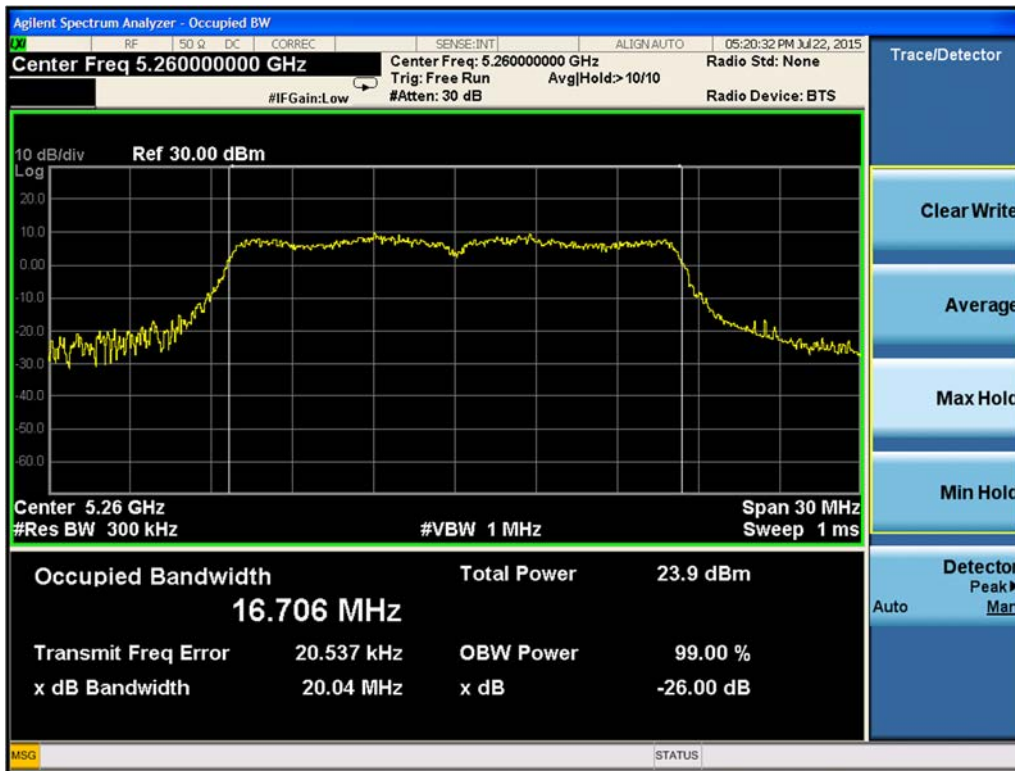


Figure 9-4. 26-dB Emission Bandwidth Chain A 802.11a (Ch. 52)

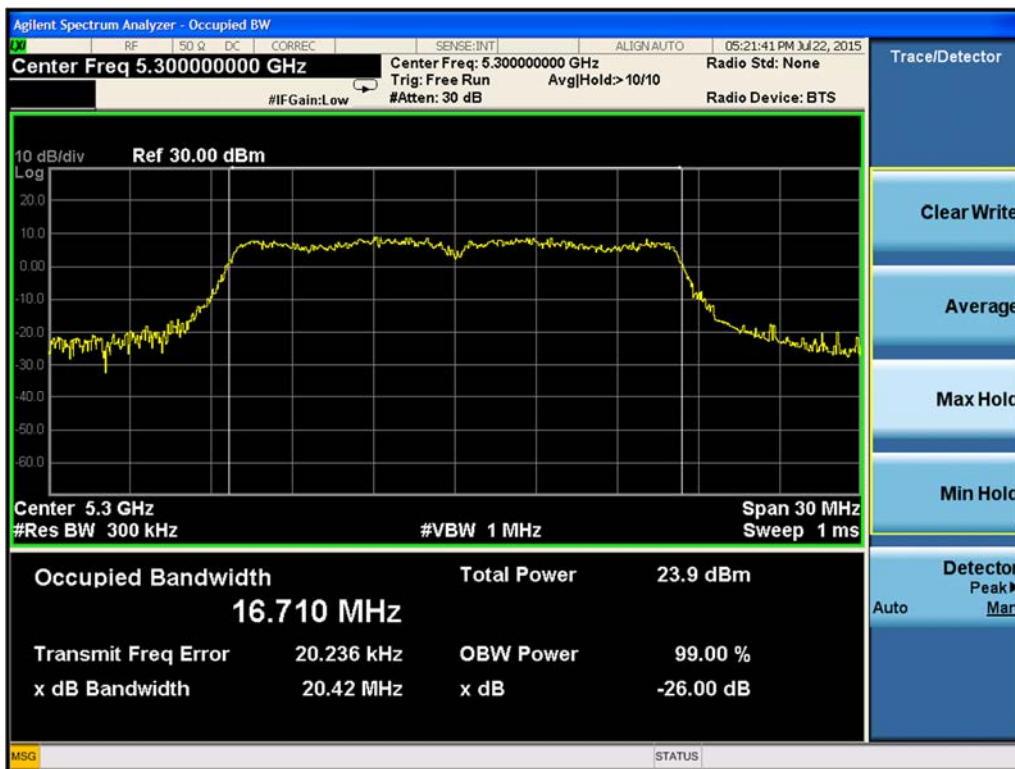


Figure 9-5. 26-dB Emission Bandwidth Chain A 802.11a (Ch. 60)

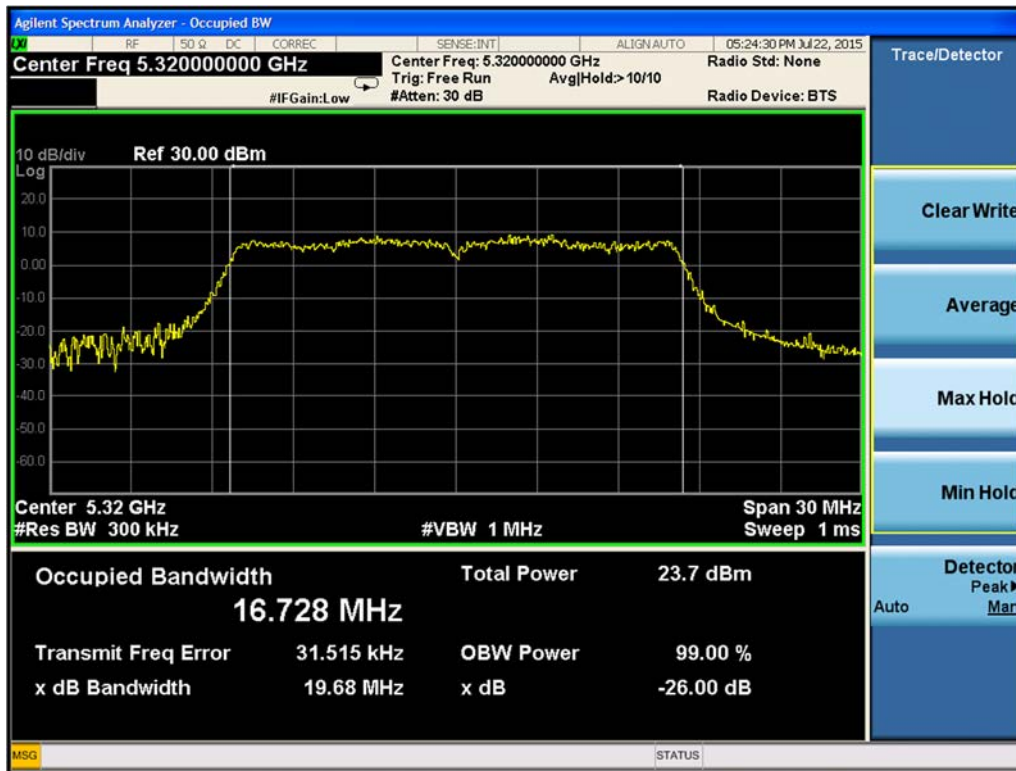


Figure 9-6. 26-dB Emission Bandwidth Chain A 802.11a (Ch. 64)

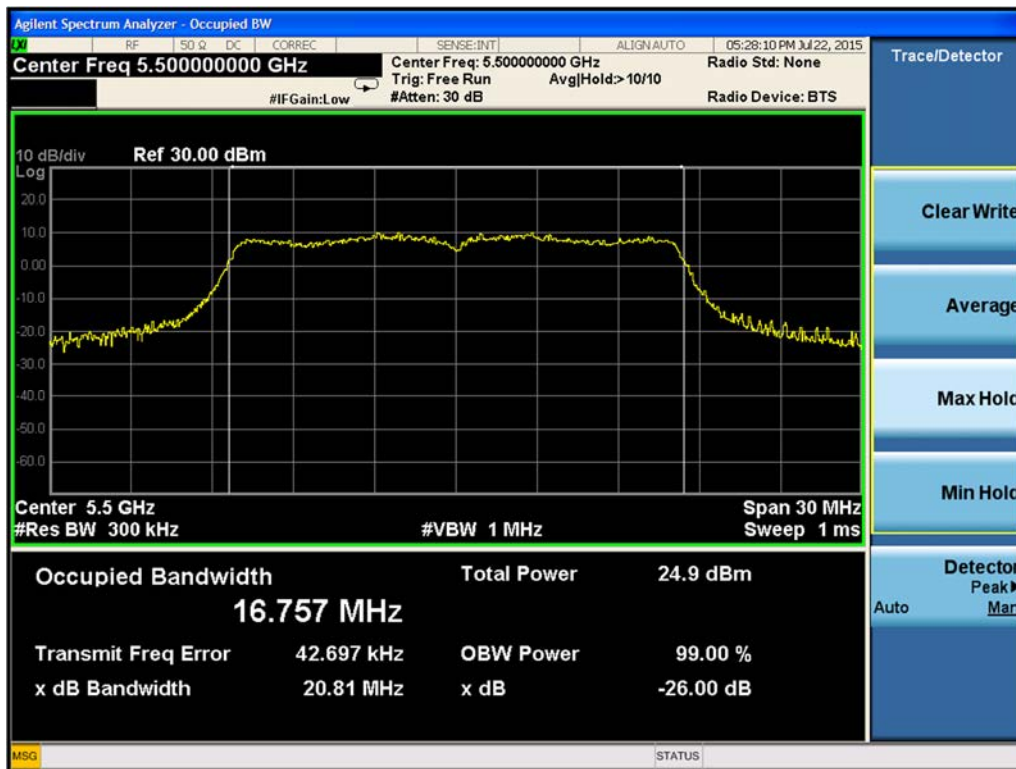


Figure 9-7 . 26-dB Emission Bandwidth Chain A 802.11a (Ch. 100)

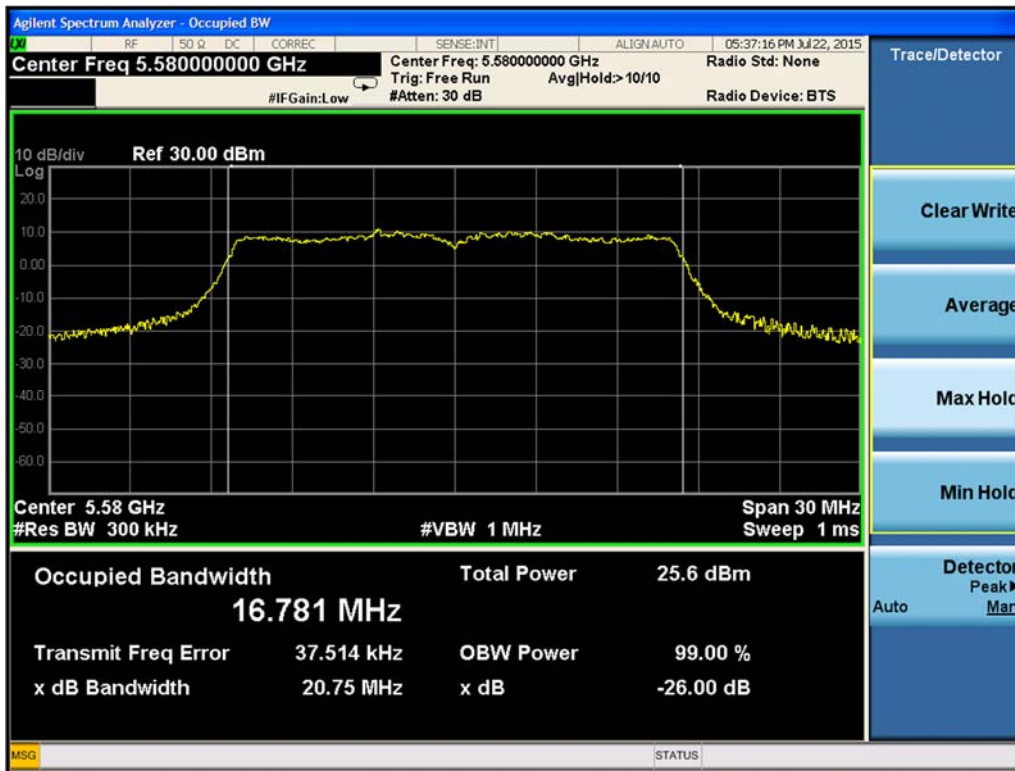


Figure 9-8. 26-dB Emission Bandwidth Chain A 802.11a (Ch. 116)



Figure 9-9. 26-dB Emission Bandwidth Chain A 802.11a (Ch. 140)

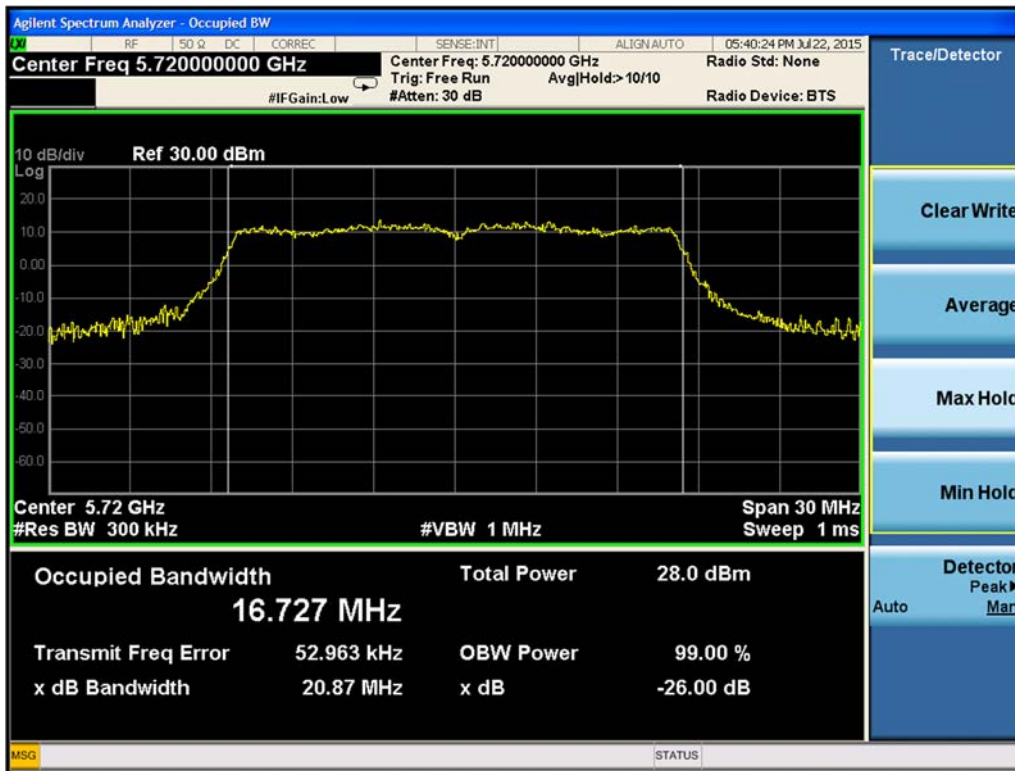


Figure 9-10. 26-dB Emission Bandwidth Chain A 802.11a (Ch. 144)



Figure 9-11. 26-dB Emission Bandwidth Chain A 802.11a (Ch. 149)



Figure 9-12. 26-dB Emission Bandwidth Chain A 802.11a (Ch. 157)



Figure 9-13. 26-dB Emission Bandwidth Chain A 802.11a (Ch. 165)

9.1.5.2 Chain B 802.11a 26-dB Emission Bandwidth

Chain B 802.11a 26-dB Emission Bandwidth		
Channel No.	Frequency (MHz)	26-dB Emission Bandwidth (MHz)
36	5180	22.57
44	5220	23.69
48	5240	21.84
52	5260	20.97
60	5300	20.53
64	5320	20.69
100	5500	20.82
116	5580	21.12
140	5700	20.50
144	5720	21.08
149	5745	20.61
157	5785	20.33
165	5825	21.29

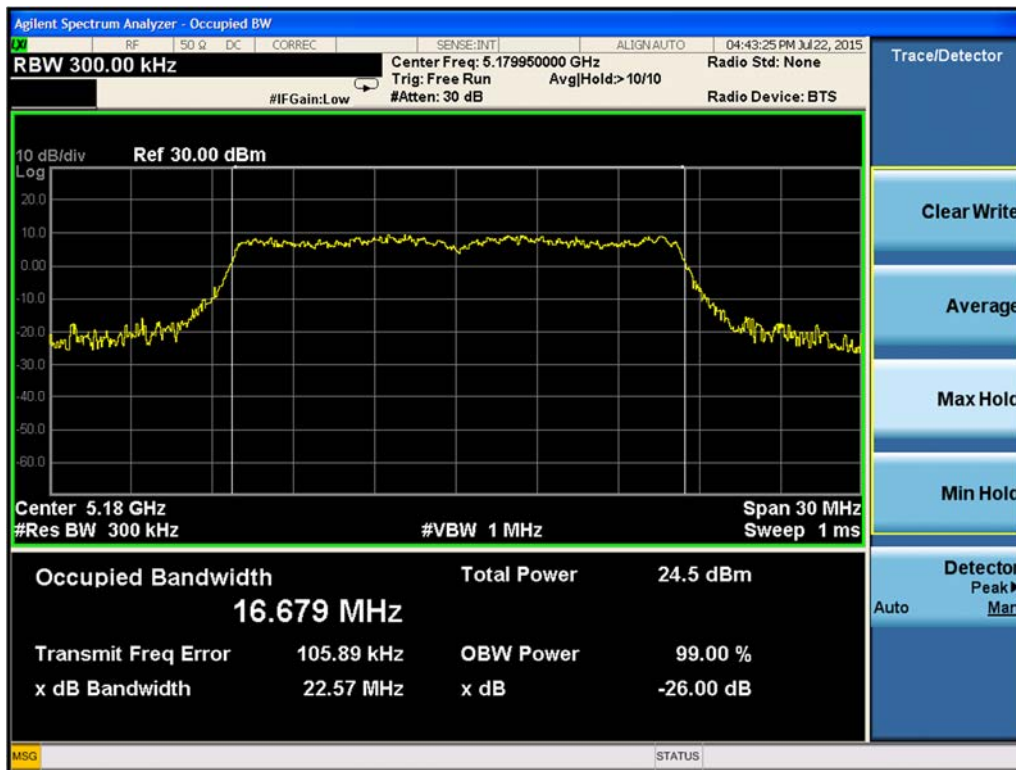


Figure 9-14. 26-dB Emission Bandwidth Chain B 802.11a (Ch. 36)

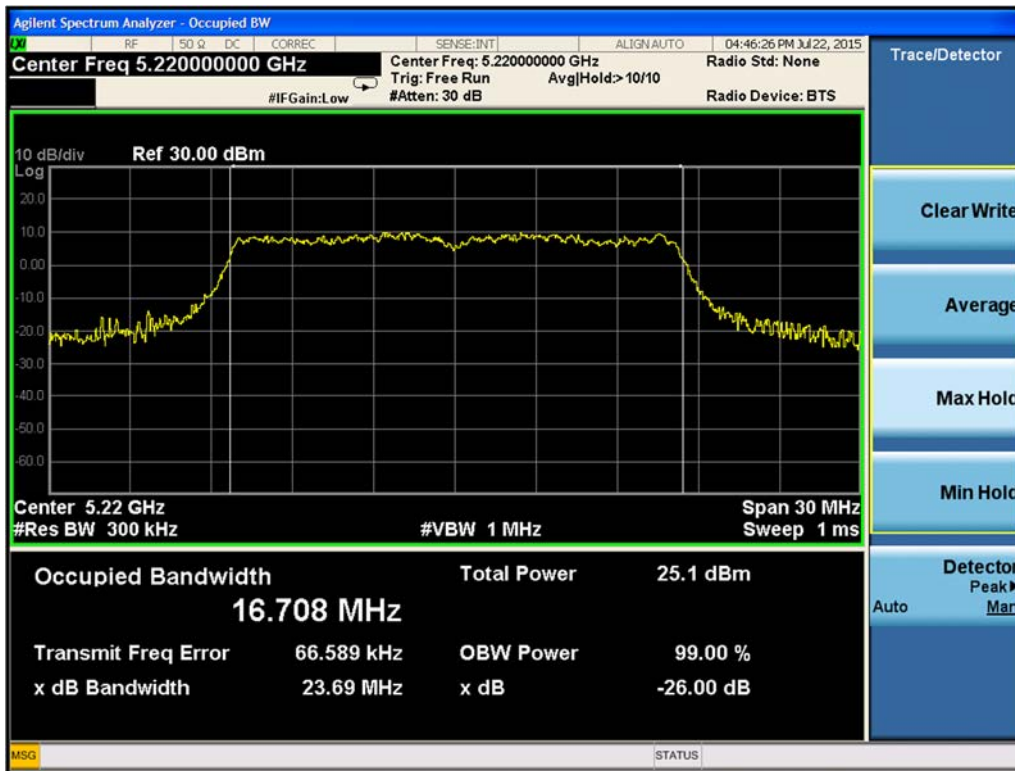


Figure 9-15. 26-dB Emission Bandwidth Chain B 802.11a (Ch. 44)

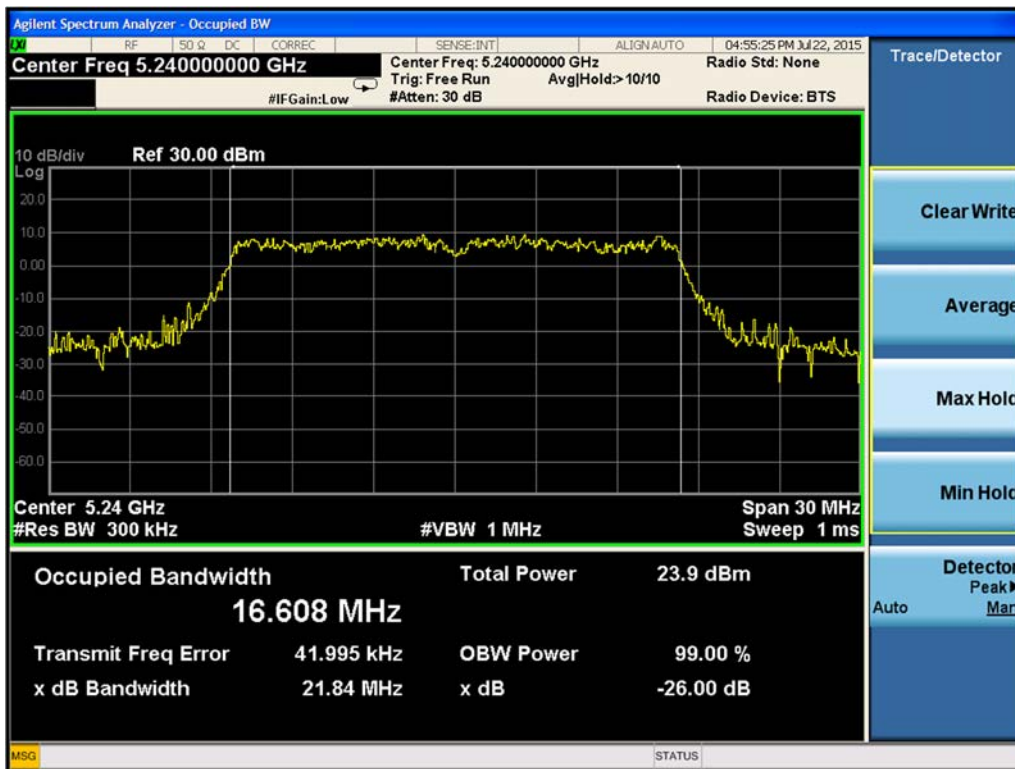


Figure 9-16. 26-dB Emission Bandwidth Chain B 802.11a (Ch. 48)

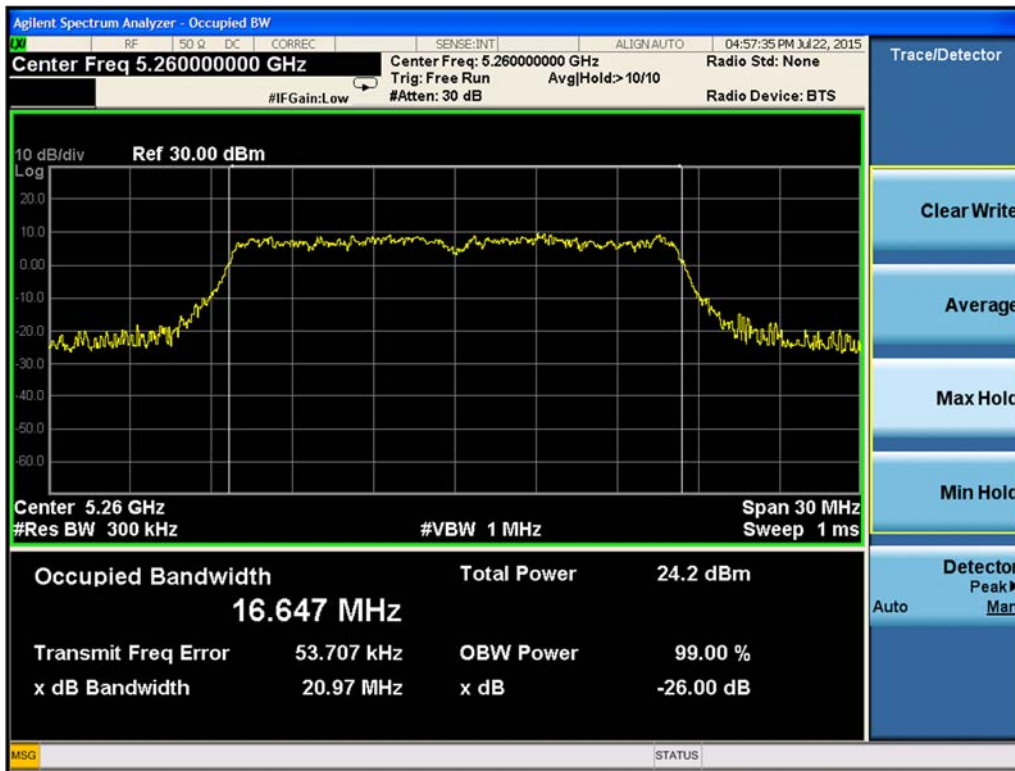


Figure 9-17. 26-dB Emission Bandwidth Chain B 802.11a (Ch. 52)

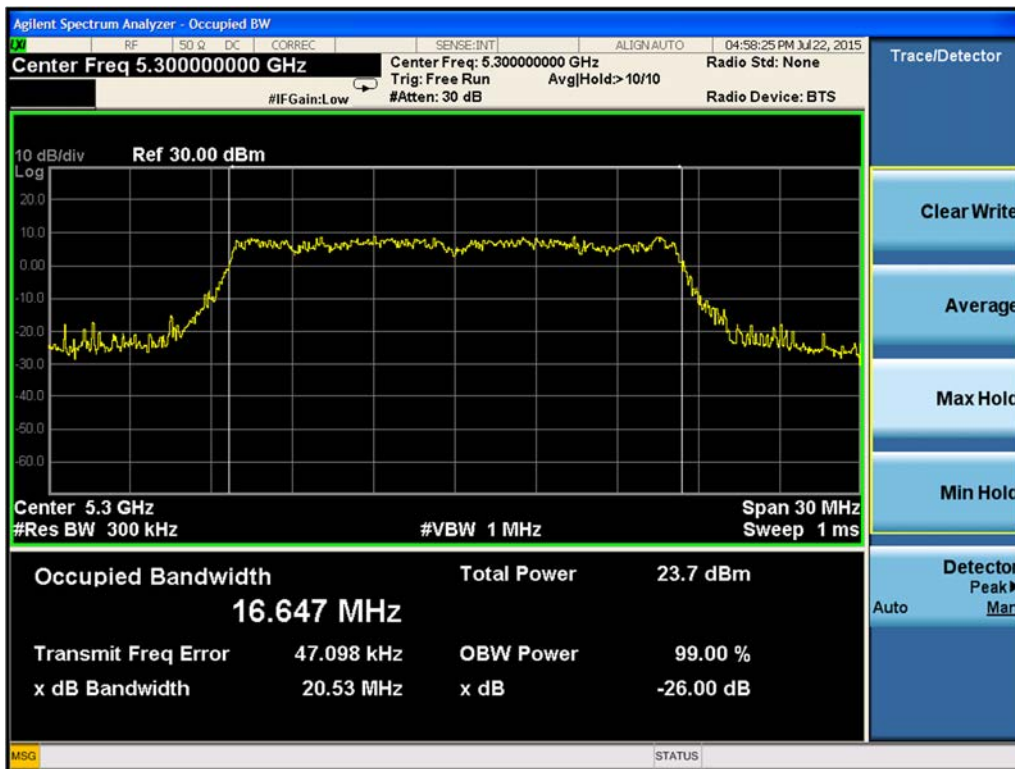


Figure 9-18. 26-dB Emission Bandwidth Chain B 802.11a (Ch. 60)

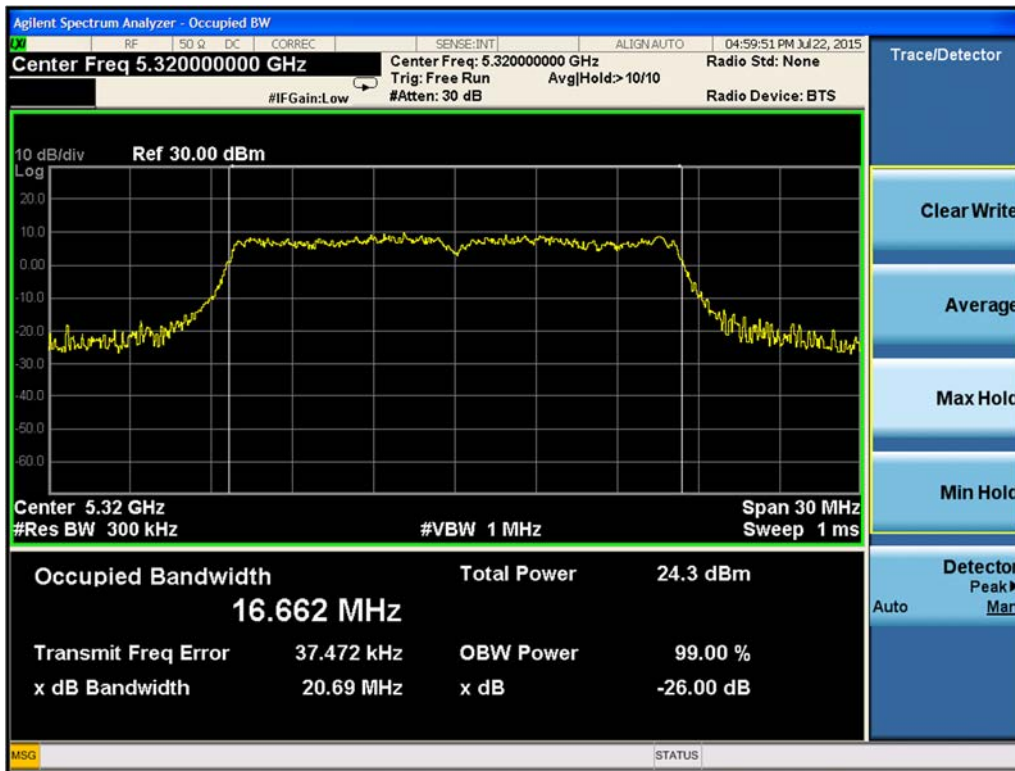


Figure 9-19. 26-dB Emission Bandwidth Chain B 802.11a (Ch. 64)

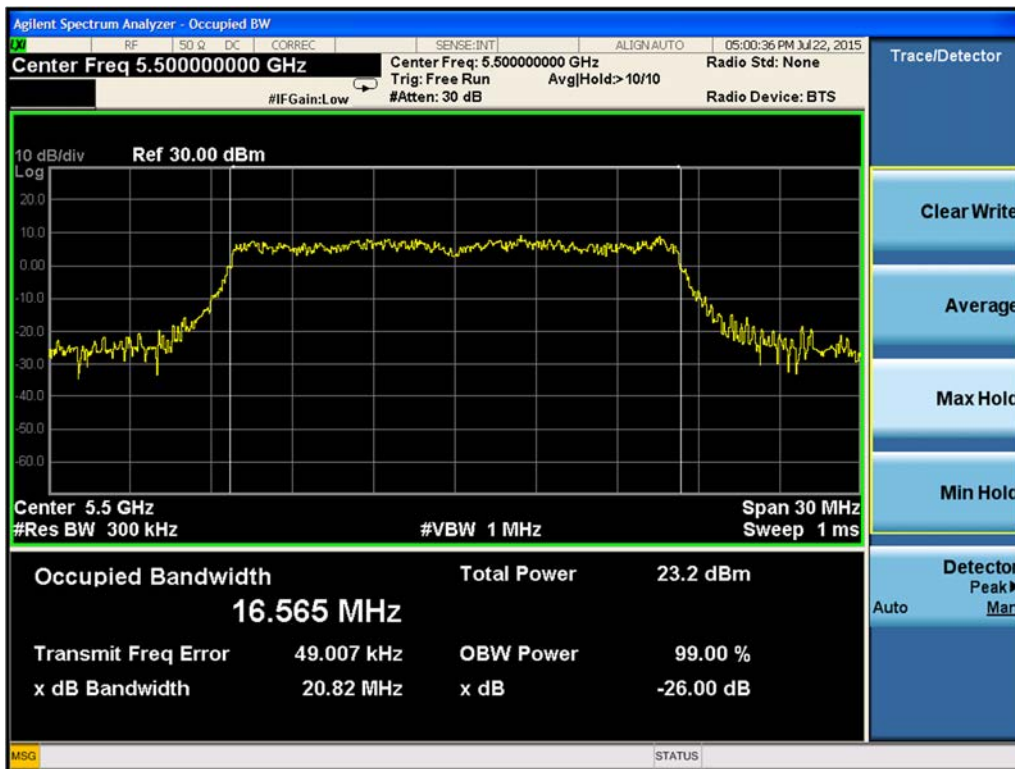


Figure 9-20. 26-dB Emission Bandwidth Chain B 802.11a (Ch. 100)

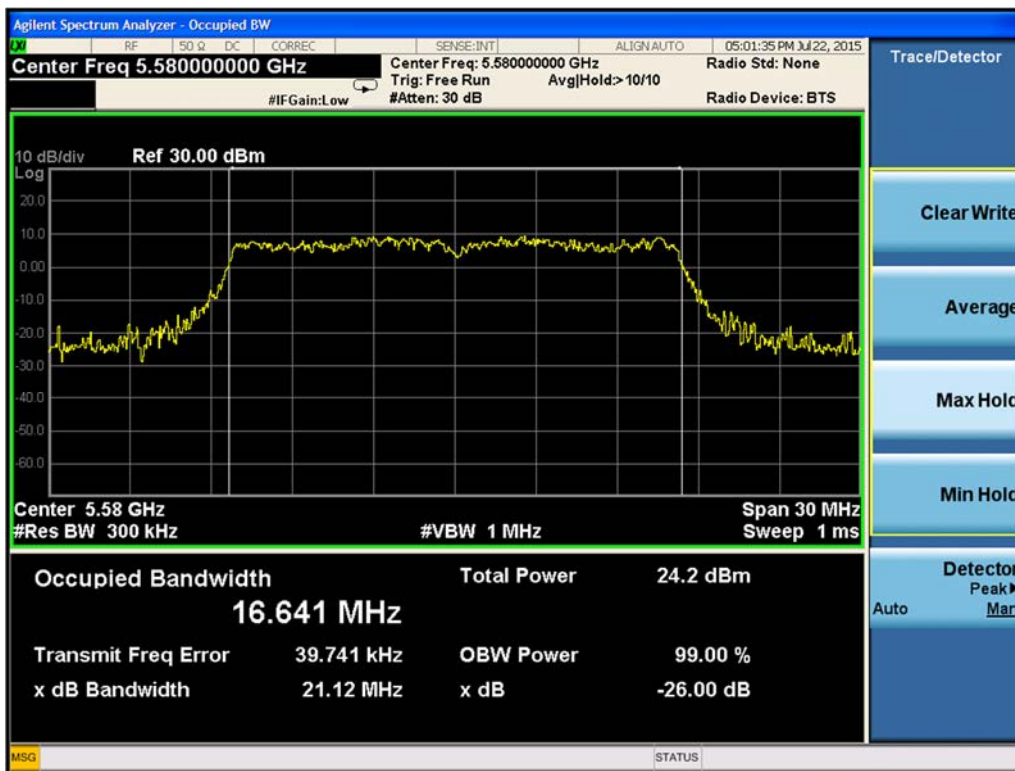


Figure 9-21. 26-dB Emission Bandwidth Chain B 802.11a (Ch. 116)

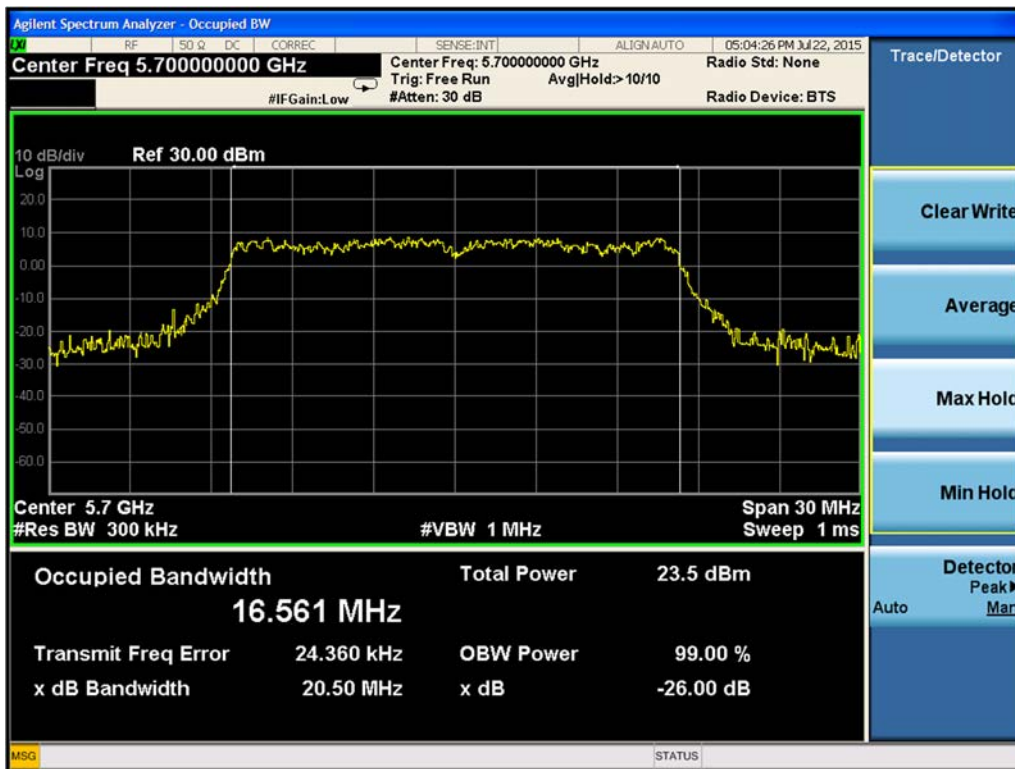


Figure 9-22. 26-dB Emission Bandwidth Chain B 802.11a (Ch. 140)

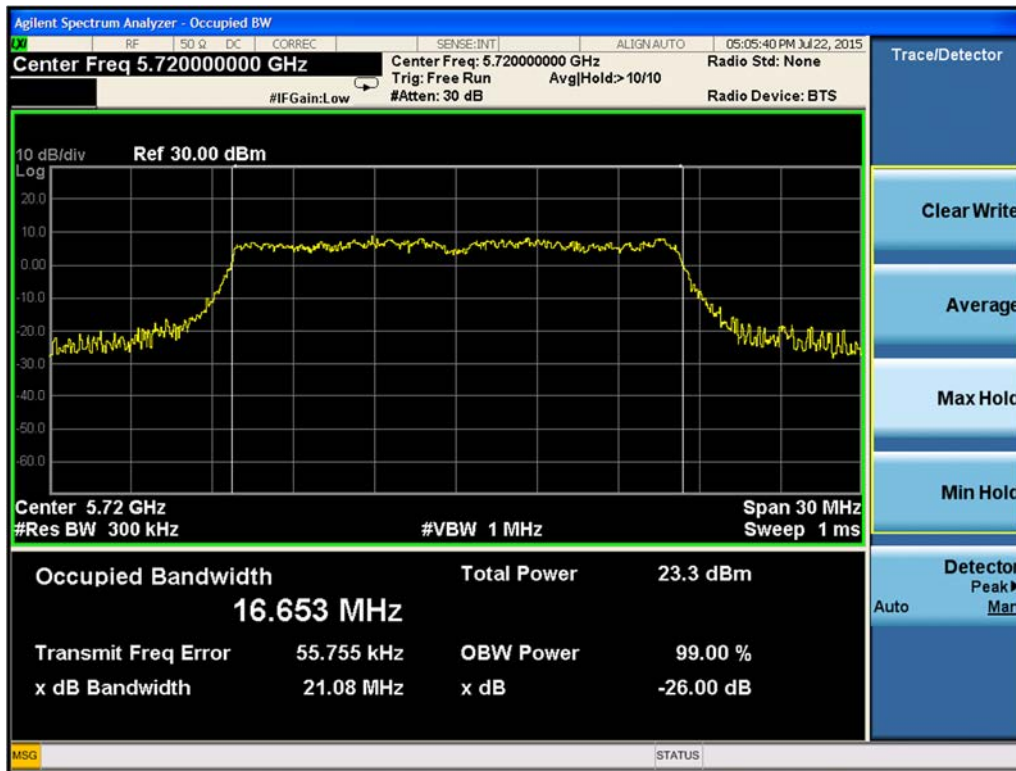


Figure 9-23. 26-dB Emission Bandwidth Chain B 802.11a (Ch. 144)

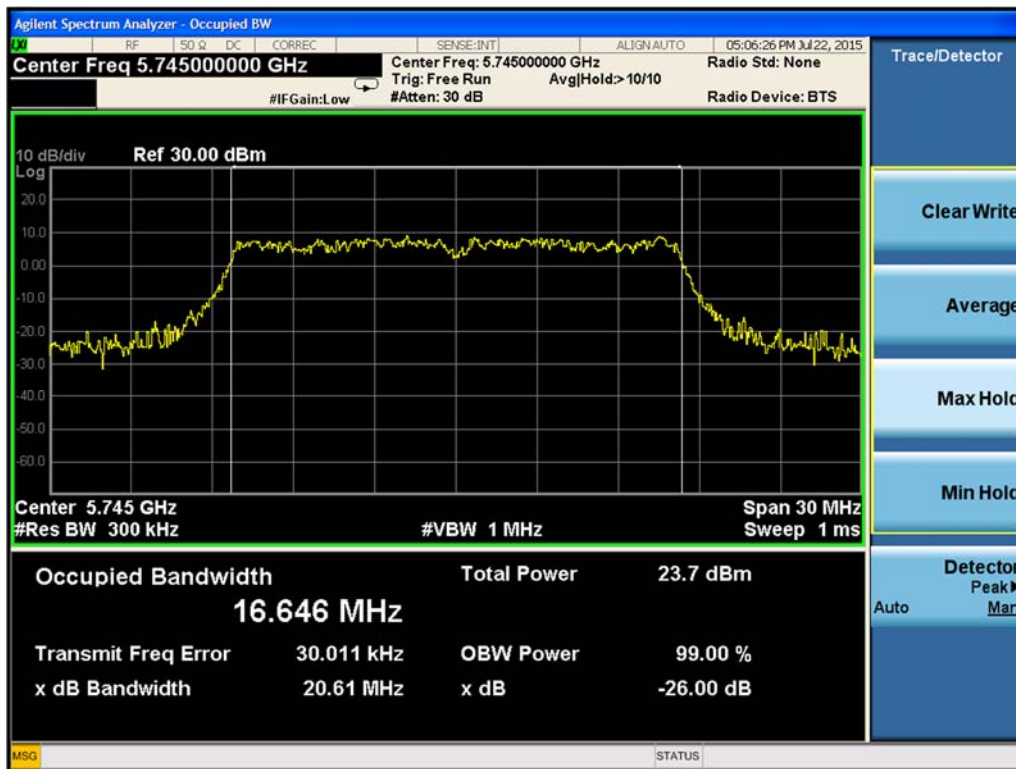


Figure 9-24. 26-dB Emission Bandwidth Chain B 802.11a (Ch. 149)

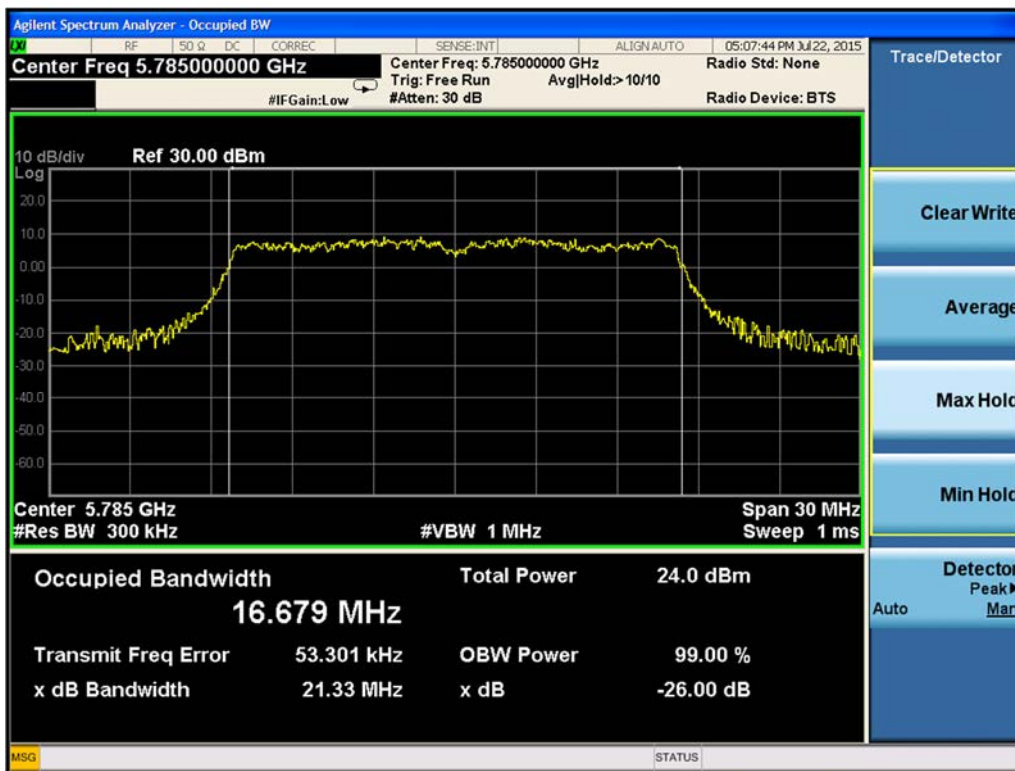


Figure 9-25. 26-dB Emission Bandwidth Chain B 802.11a (Ch. 157)

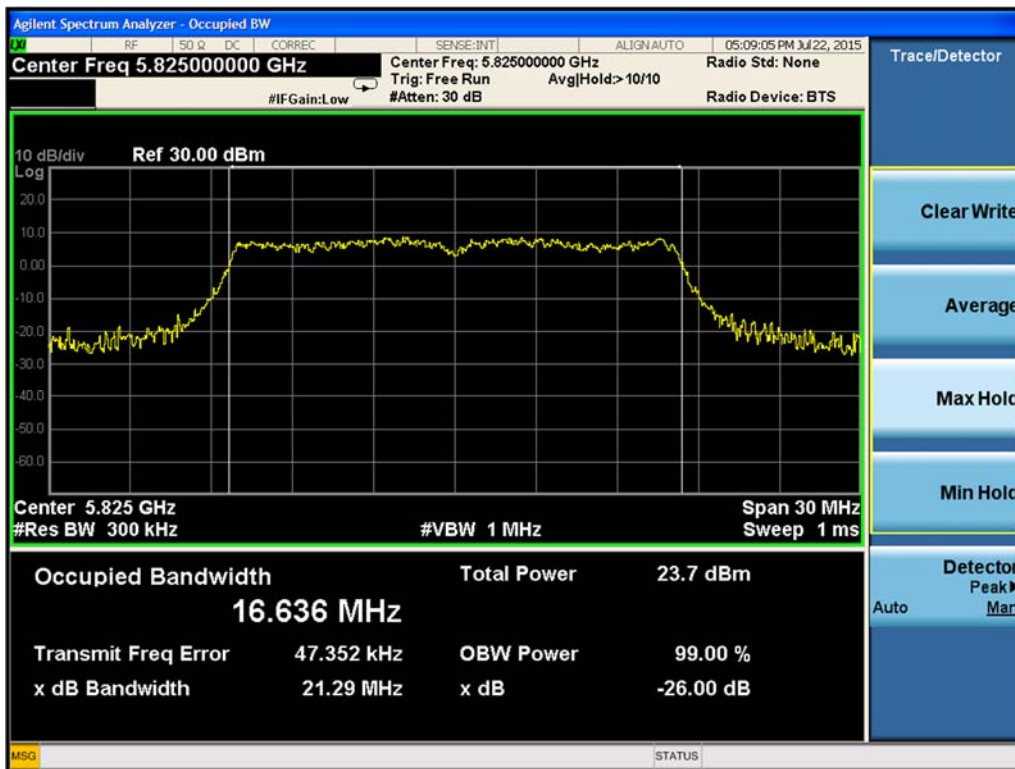


Figure 9-26. 26-dB Emission Bandwidth Chain B 802.11a (Ch. 165)

9.1.5.3 Chain A 802.11n HT20 26-dB Emission Bandwidth

Chain A 802.11n HT20 26-dB Emission Bandwidth		
Channel No.	Frequency (MHz)	26-dB Emission Bandwidth (MHz)
36	5180	20.12
44	5220	20.19
48	5240	20.19
52	5260	20.21
60	5300	20.17
64	5320	20.36
100	5500	20.02
116	5580	20.20
140	5700	19.88
144	5720	20.14
149	5745	20.35
157	5785	20.03
165	5825	20.07

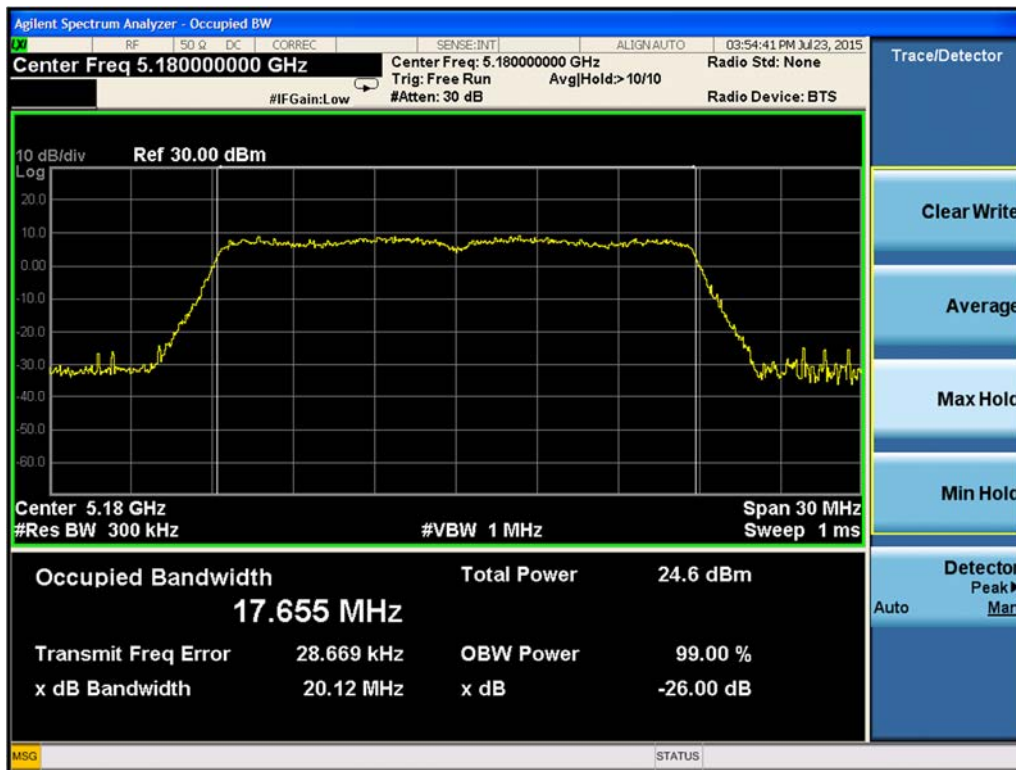


Figure 9-27. 26-dB Emission Bandwidth Chain A 802.11n HT20 (Ch. 36)

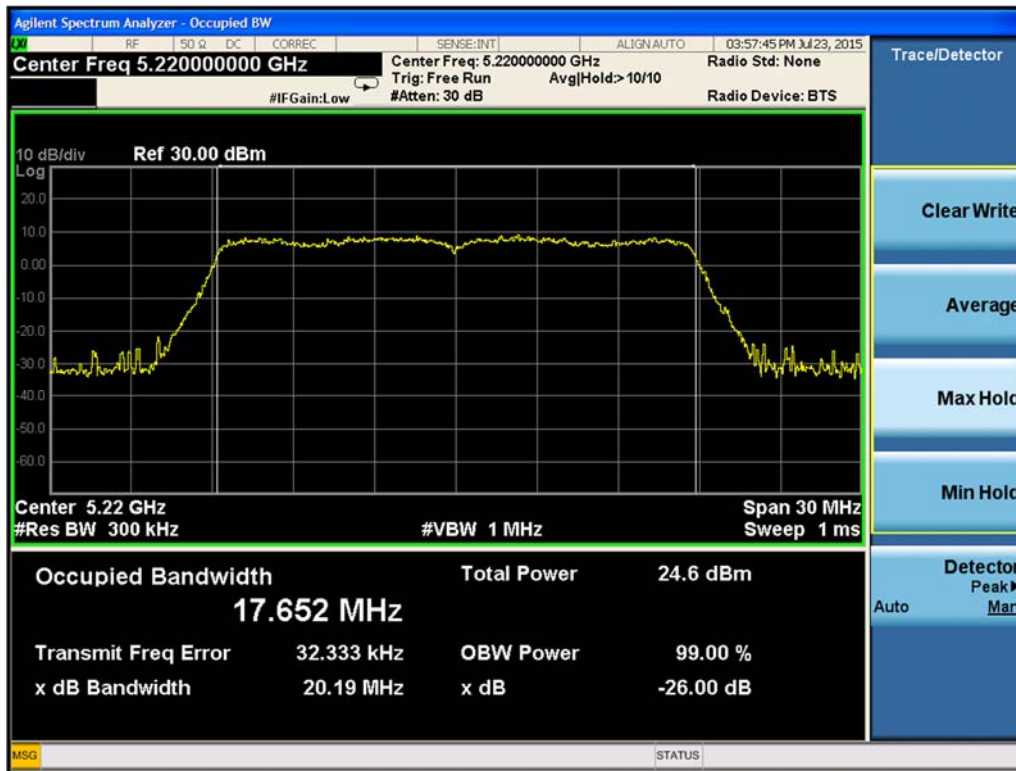


Figure 9-28. 26-dB Emission Bandwidth Chain A 802.11n HT20 (Ch. 44)

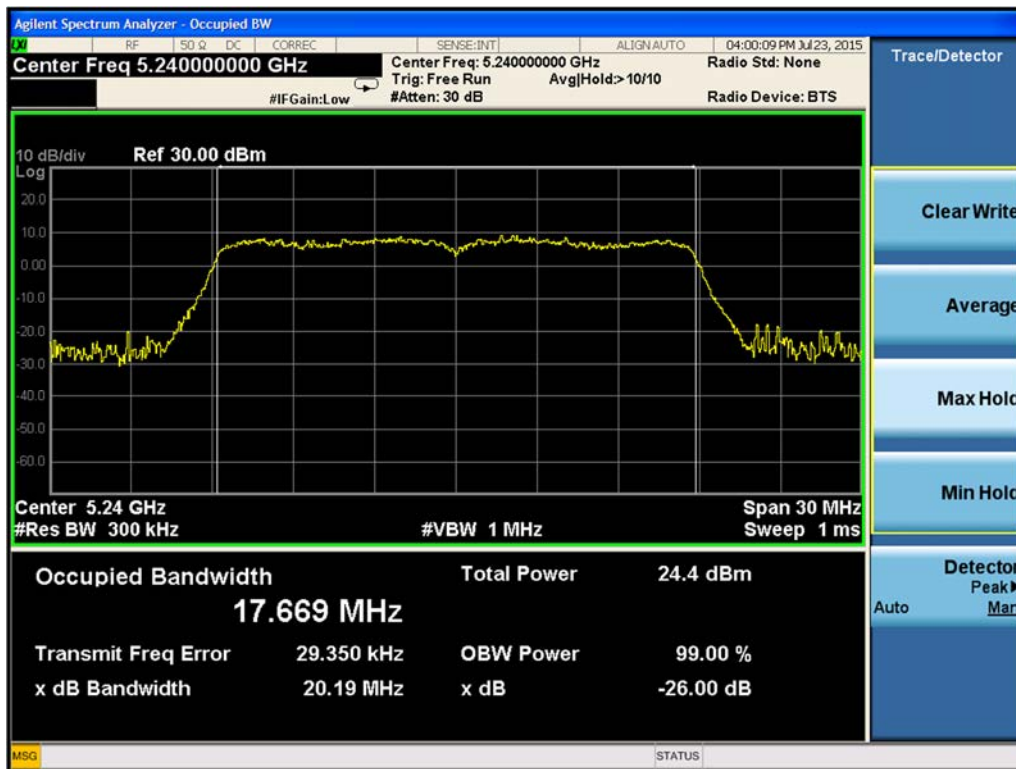


Figure 9-29. 26-dB Emission Bandwidth Chain A 802.11n HT20 (Ch. 48)

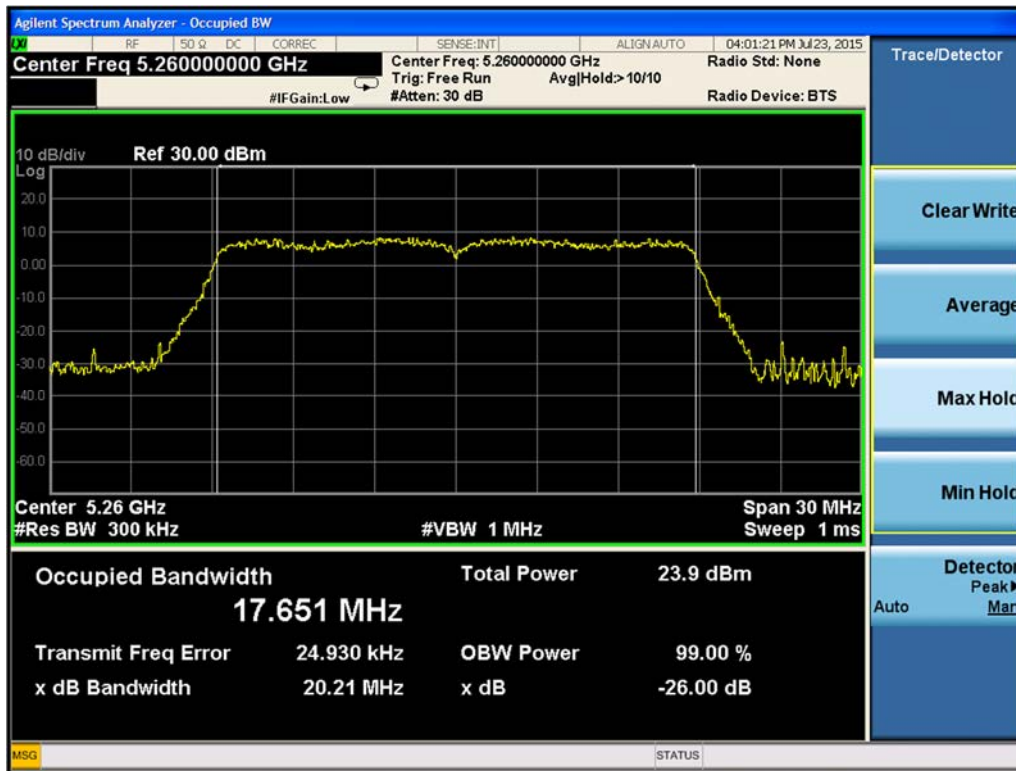


Figure 9-30. 26-dB Emission Bandwidth Chain A 802.11n HT20 (Ch. 52)

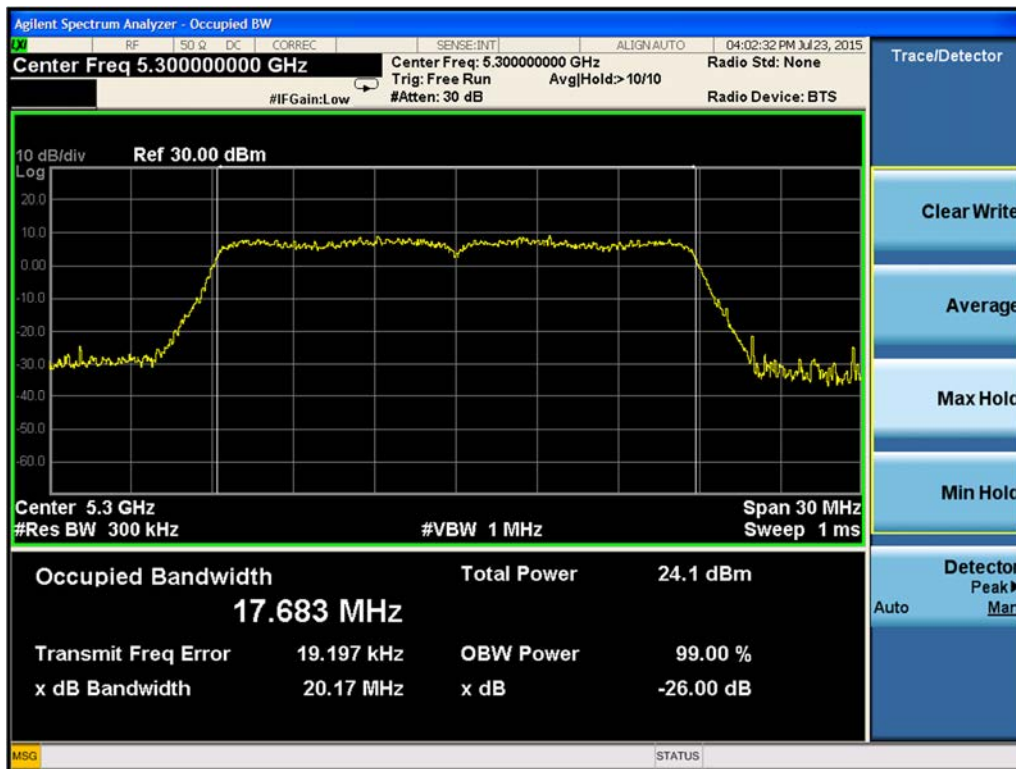


Figure 9-31. 26-dB Emission Bandwidth Chain A 802.11n HT20 (Ch. 60)

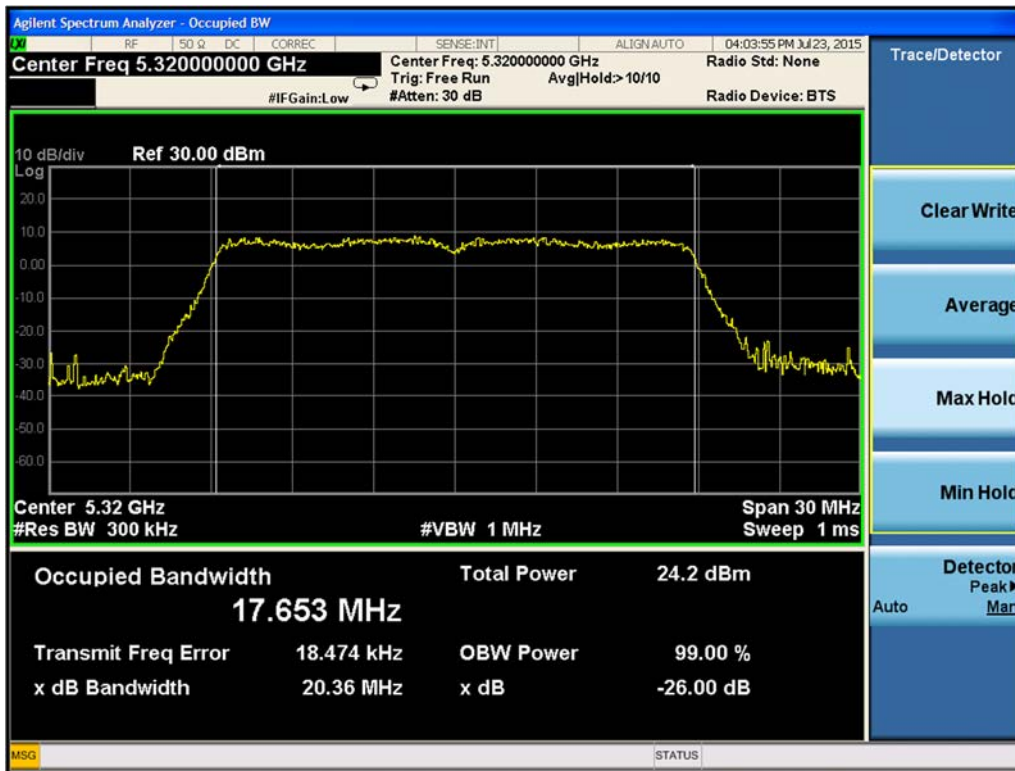


Figure 9-32. 26-dB Emission Bandwidth Chain A 802.11n HT20 (Ch. 64)

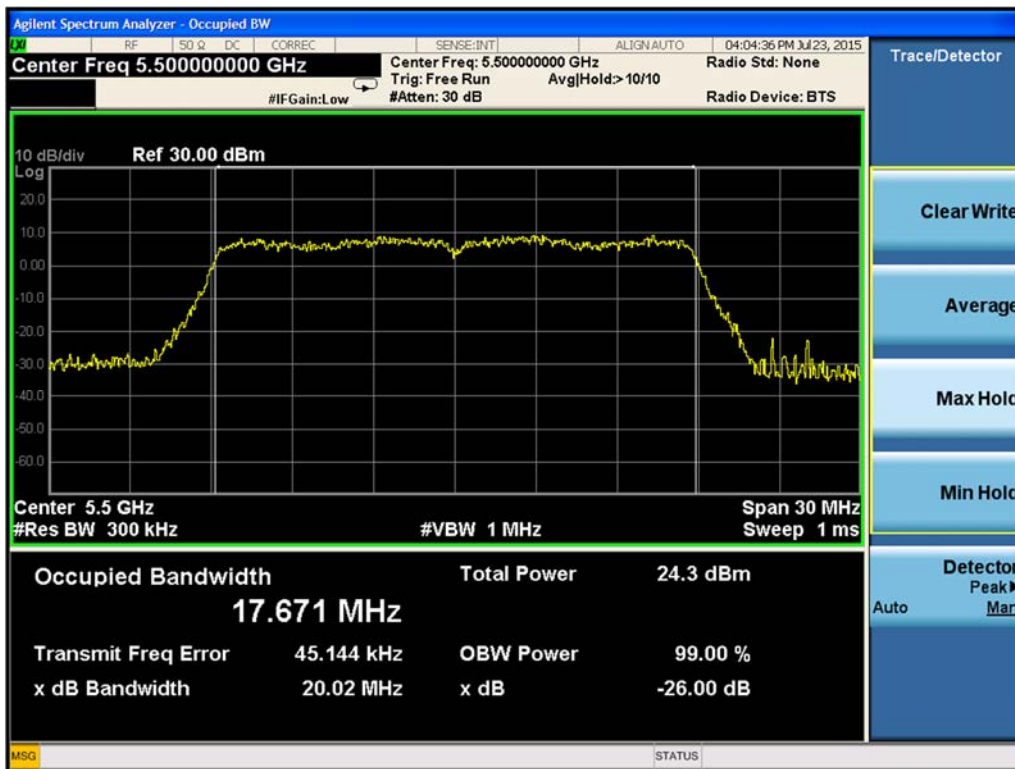


Figure 9-33. 26-dB Emission Bandwidth Chain A 802.11n HT20 (Ch. 100)

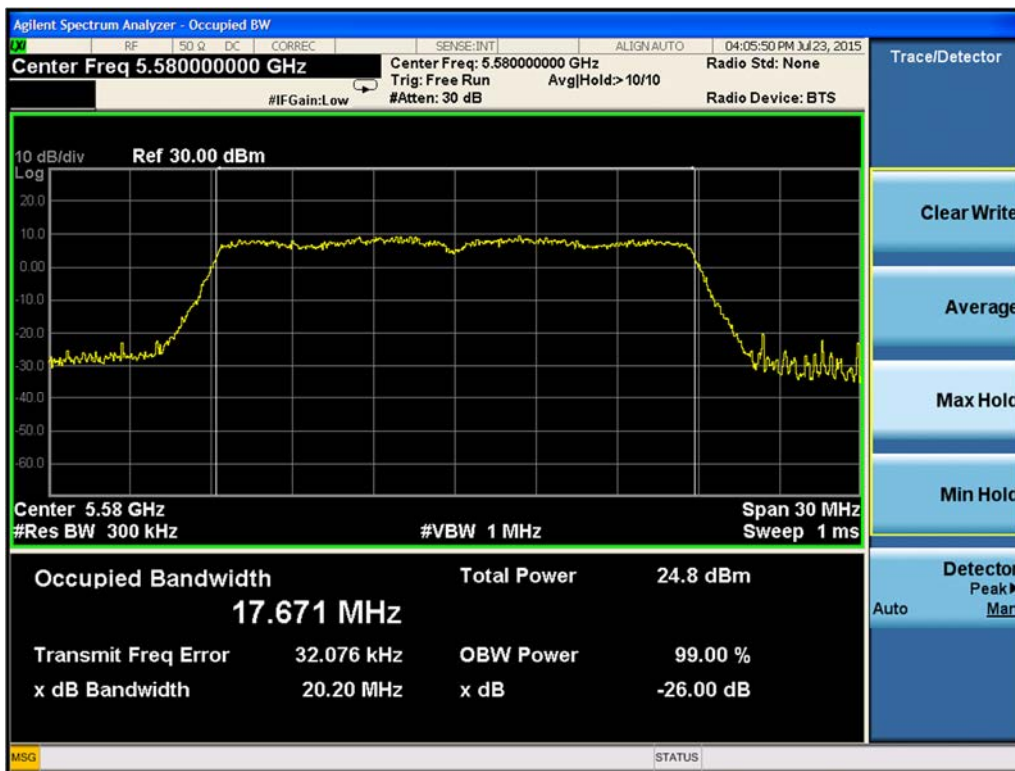


Figure 9-34. 26-dB Emission Bandwidth Chain A 802.11n HT20 (Ch. 116)

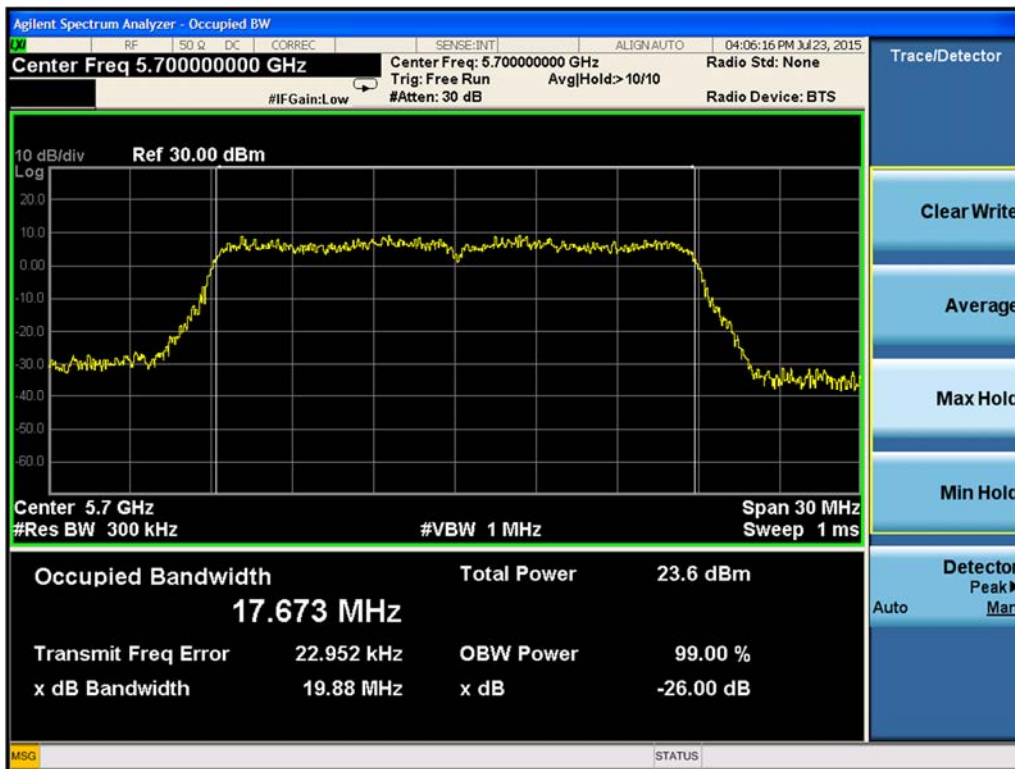


Figure 9-35. 26-dB Emission Bandwidth Chain A 802.11n HT20 (Ch. 140)

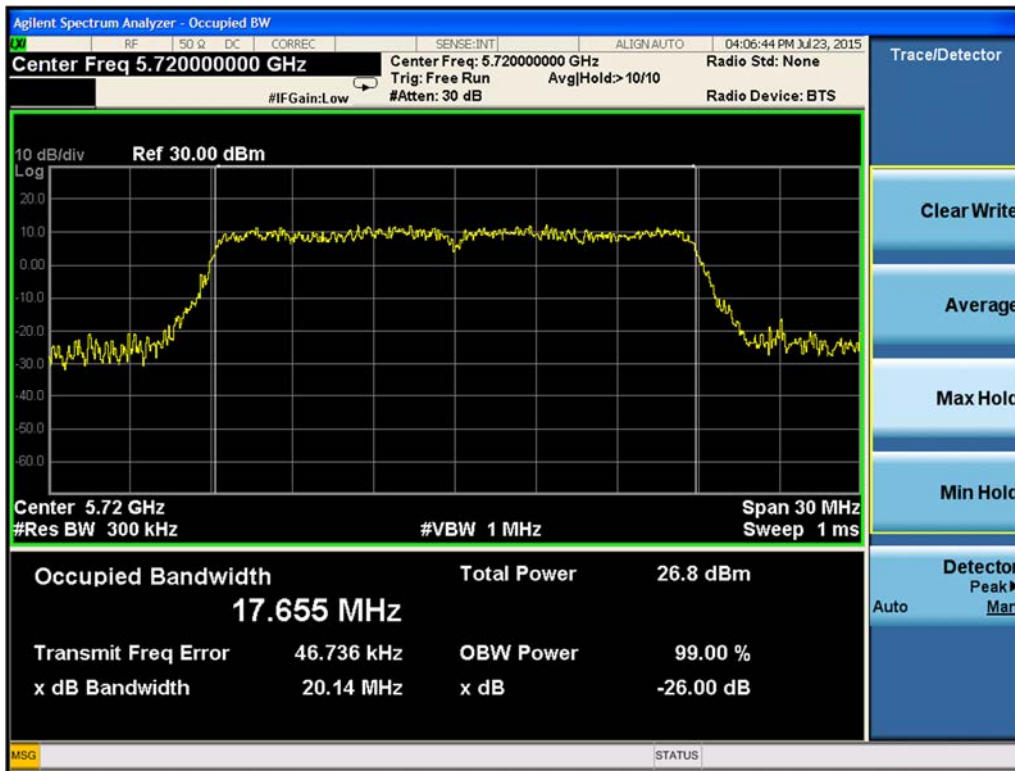


Figure 9-36. 26-dB Emission Bandwidth Chain A 802.11n HT20 (Ch. 144)

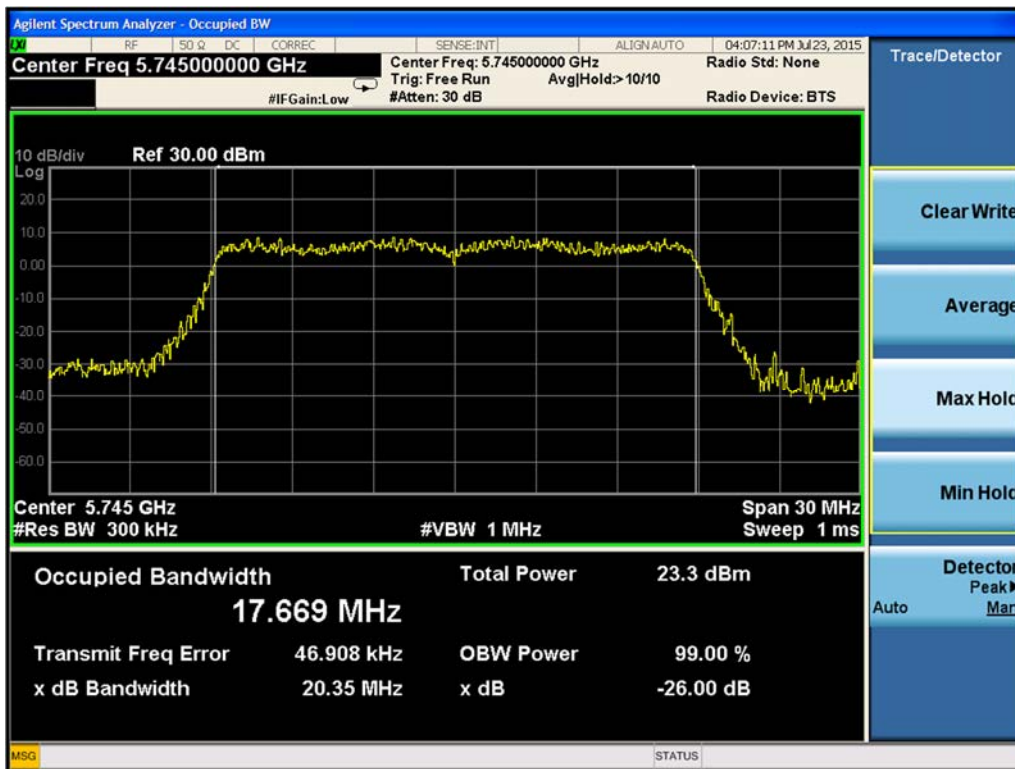


Figure 9-37. 26-dB Emission Bandwidth Chain A 802.11n HT20 (Ch. 149)

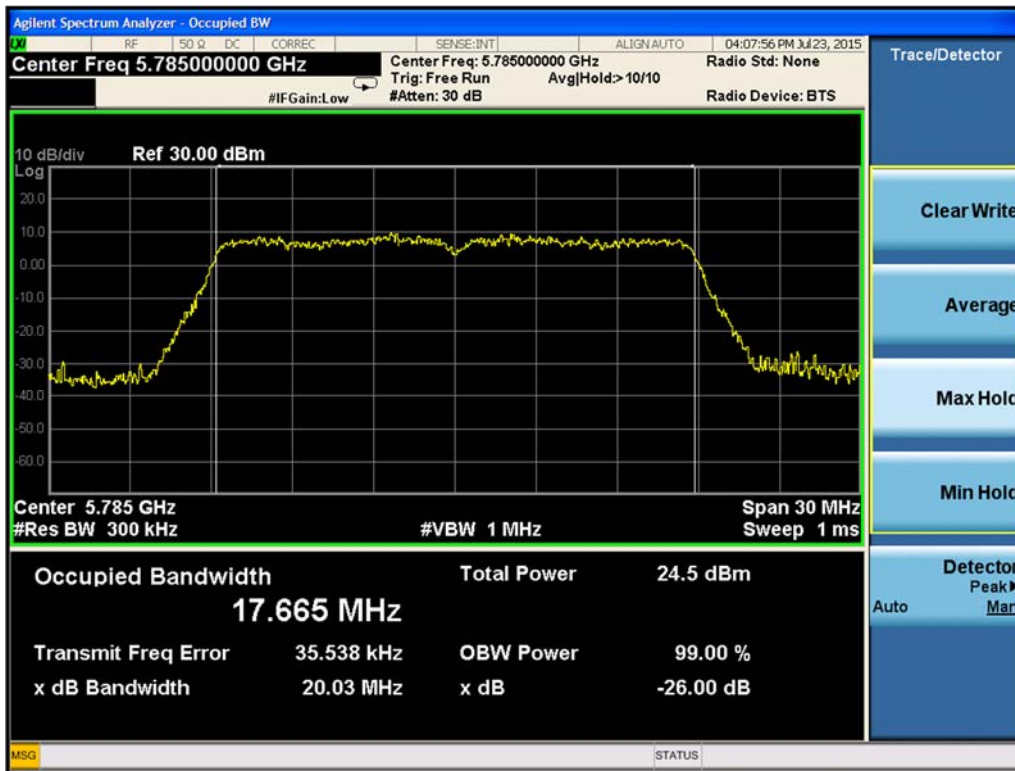


Figure 9-38. 26-dB Emission Bandwidth Chain A 802.11n HT20 (Ch. 157)

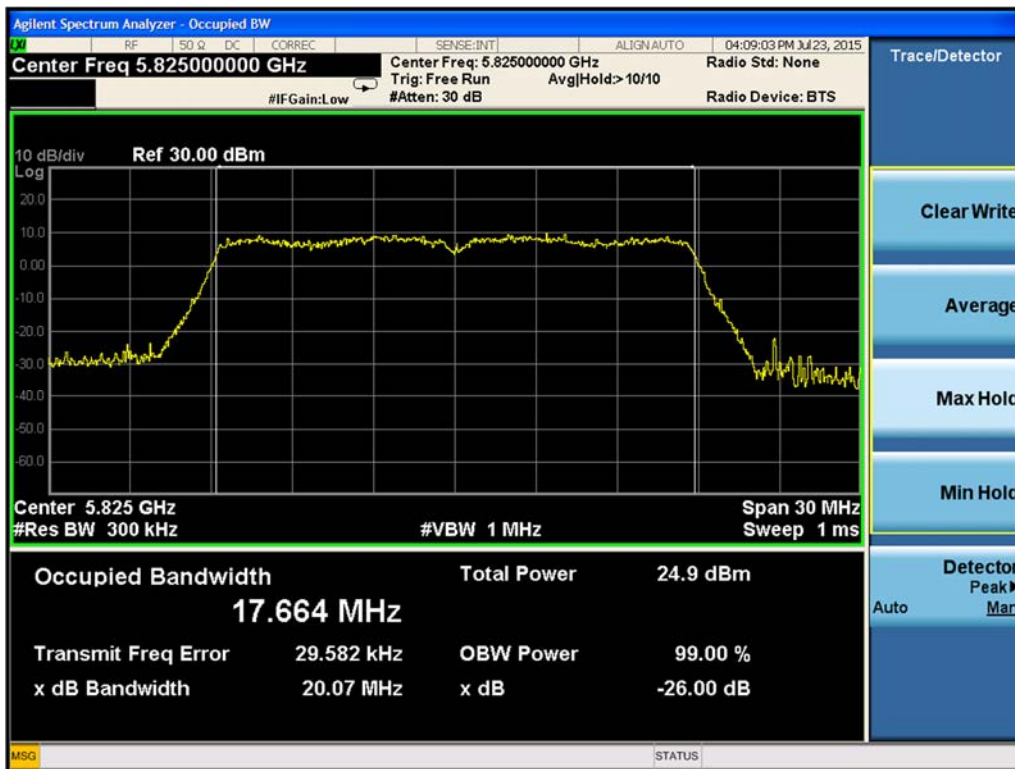


Figure 9-39. 26-dB Emission Bandwidth Chain A 802.11n HT20 (Ch. 165)

9.1.5.4 Chain B 802.11n HT20 26-dB Emission Bandwidth

Chain B 802.11n HT20 26-dB Emission Bandwidth		
Channel No.	Frequency (MHz)	26-dB Emission Bandwidth (MHz)
36	5180	19.94
44	5220	20.18
48	5240	20.06
52	5260	19.99
60	5300	20.17
64	5320	20.03
100	5500	19.78
116	5580	19.98
140	5700	19.96
144	5720	20.17
149	5745	20.03
157	5785	20.22
165	5825	20.13

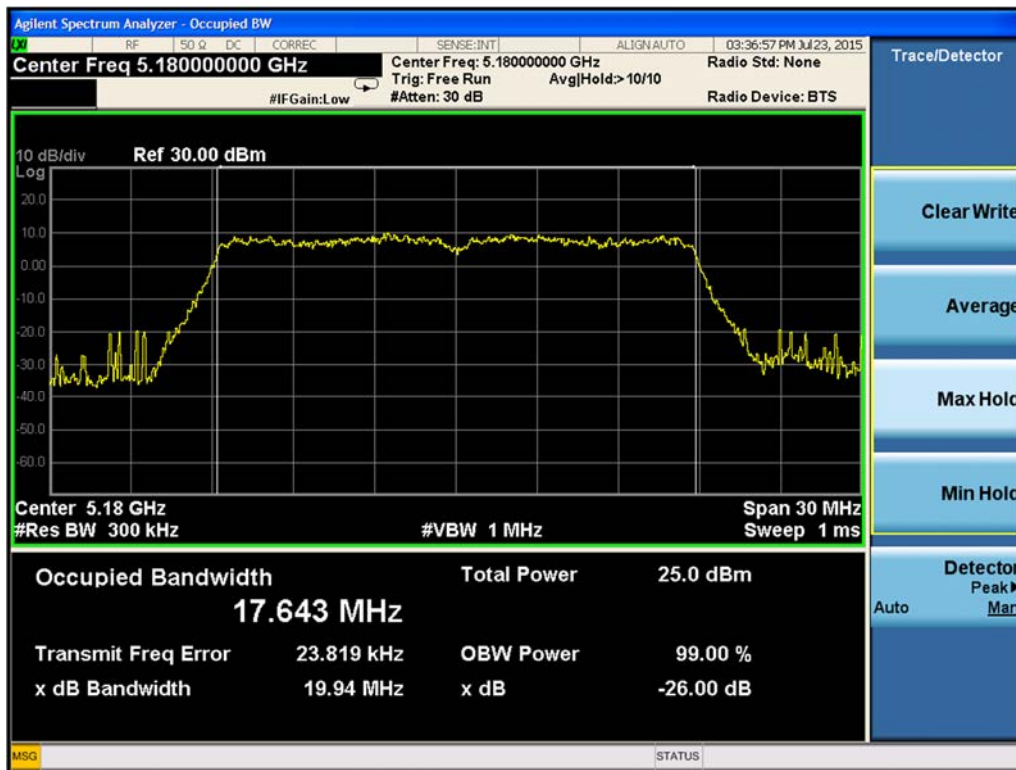


Figure 9-40. 26-dB Emission Bandwidth Chain B 802.11n HT20 (Ch. 36)

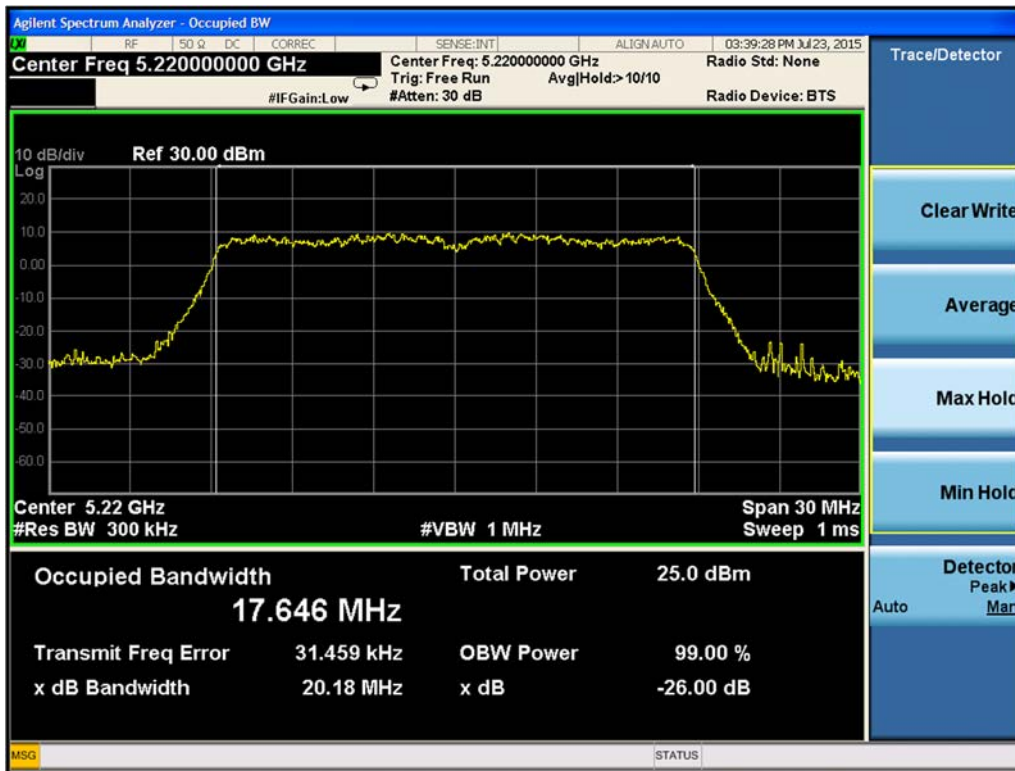


Figure 9-41. 26-dB Emission Bandwidth Chain B 802.11n HT20 (Ch. 44)

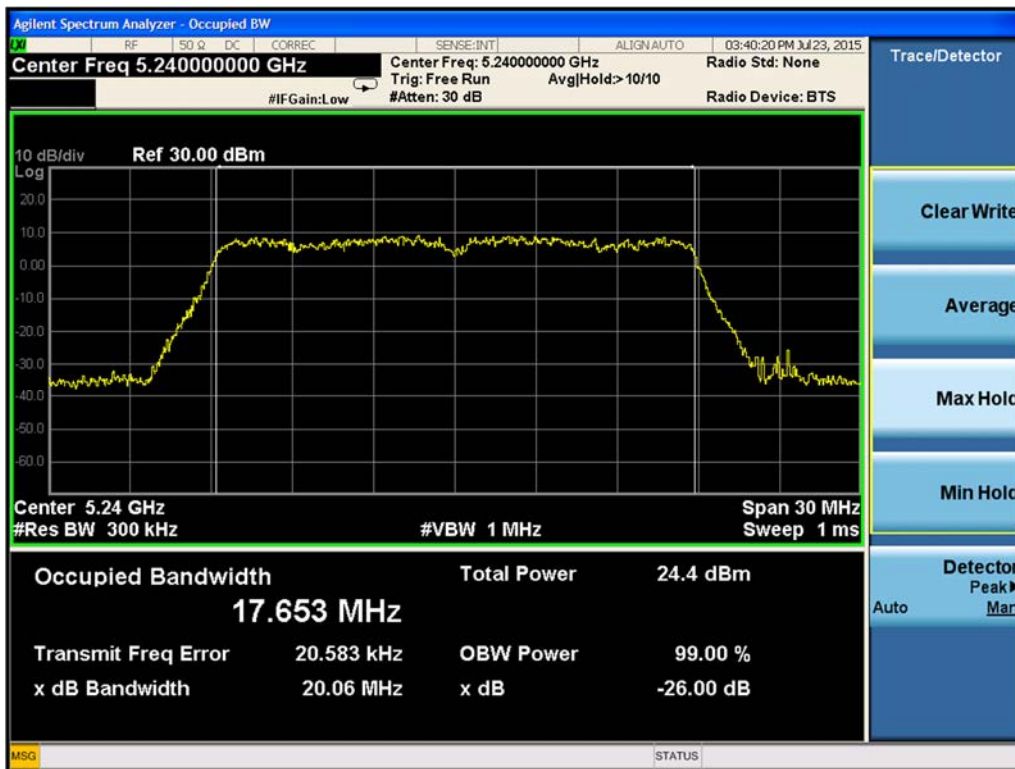


Figure 9-42. 26-dB Emission Bandwidth Chain B 802.11n HT20 (Ch. 48)

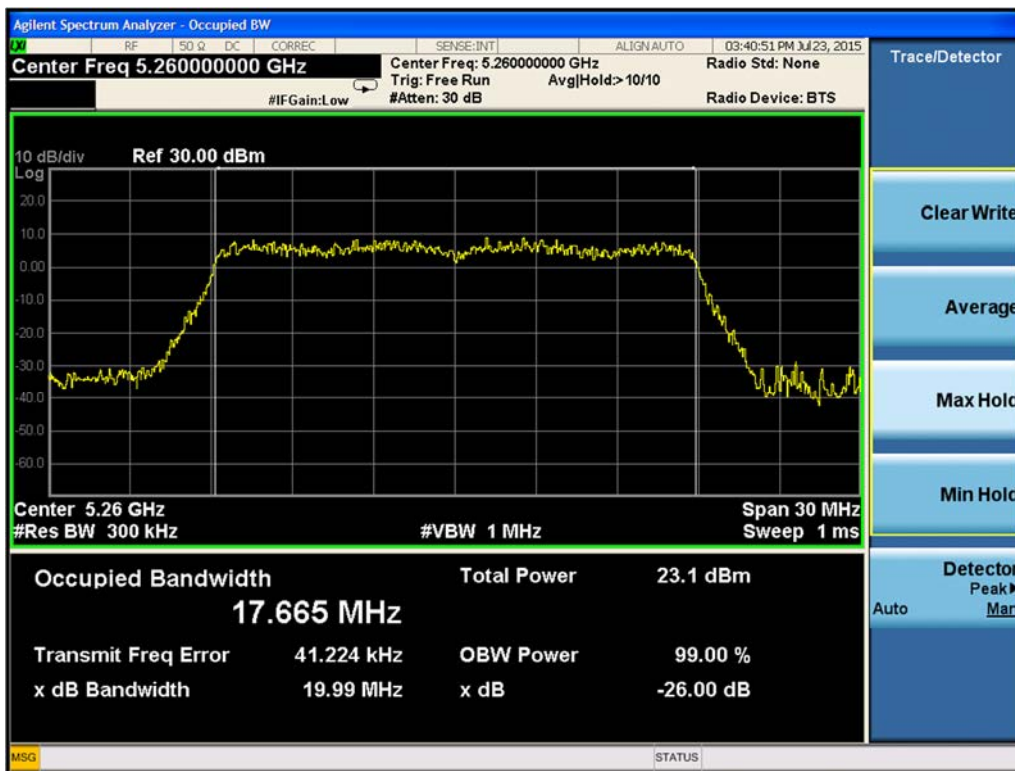


Figure 9-43. 26-dB Emission Bandwidth Chain B 802.11n HT20 (Ch. 52)

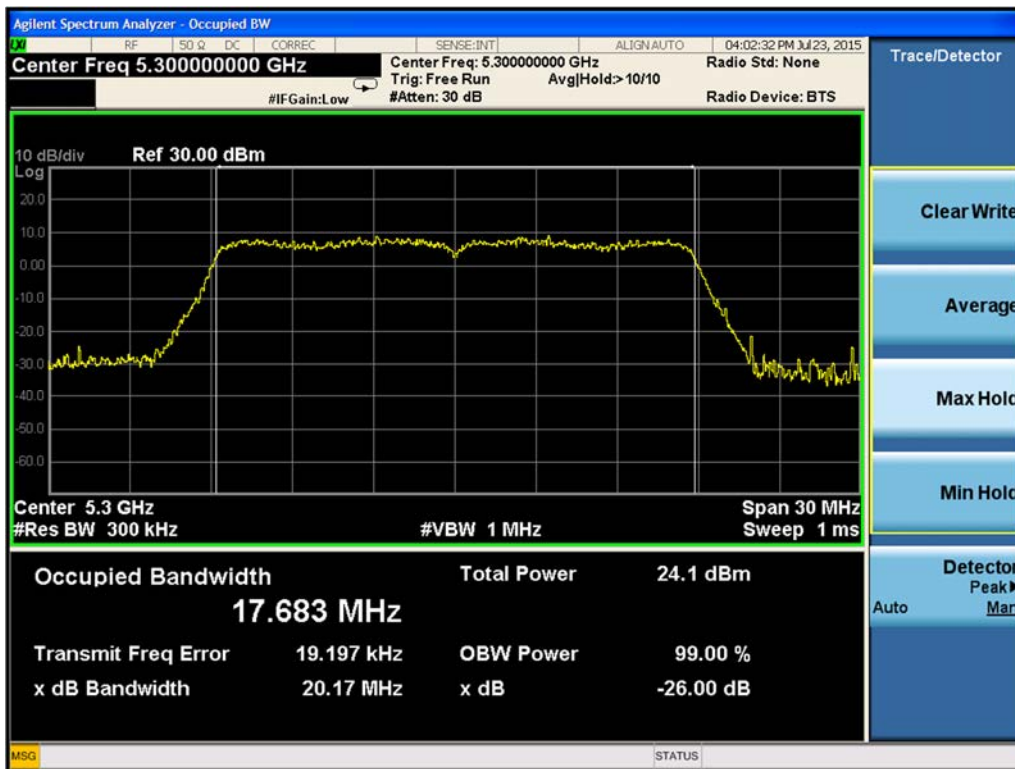


Figure 9-44. 26-dB Emission Bandwidth Chain B 802.11n HT20 (Ch. 60)

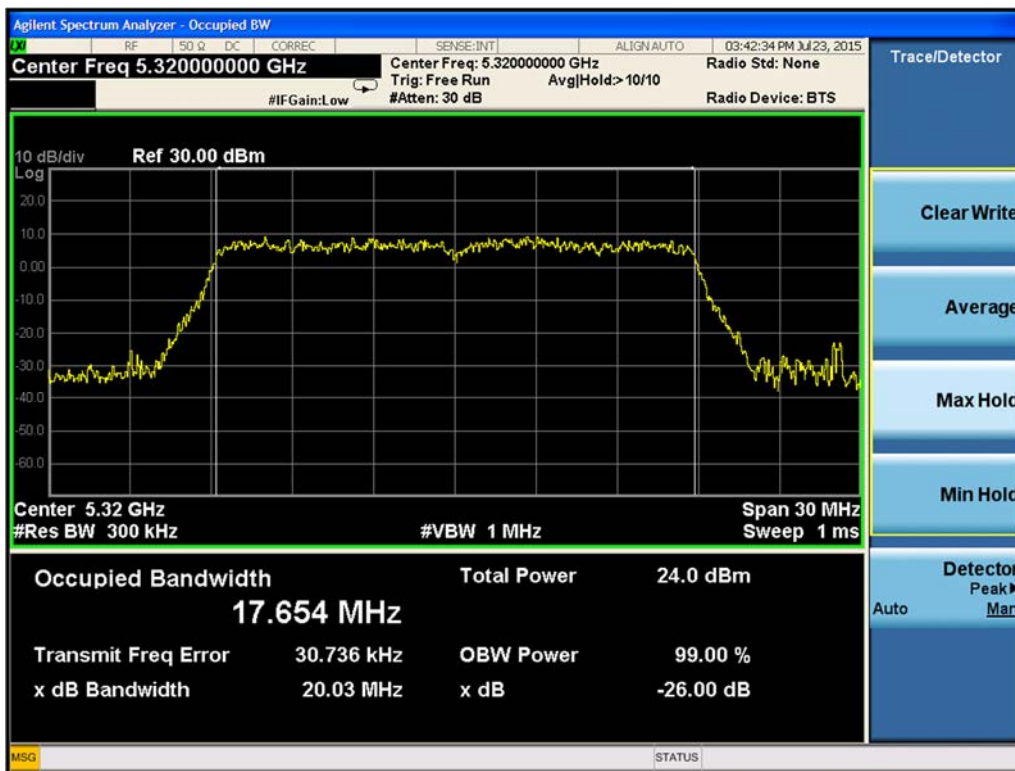


Figure 9-45. 26-dB Emission Bandwidth Chain B 802.11n HT20 (Ch. 64)

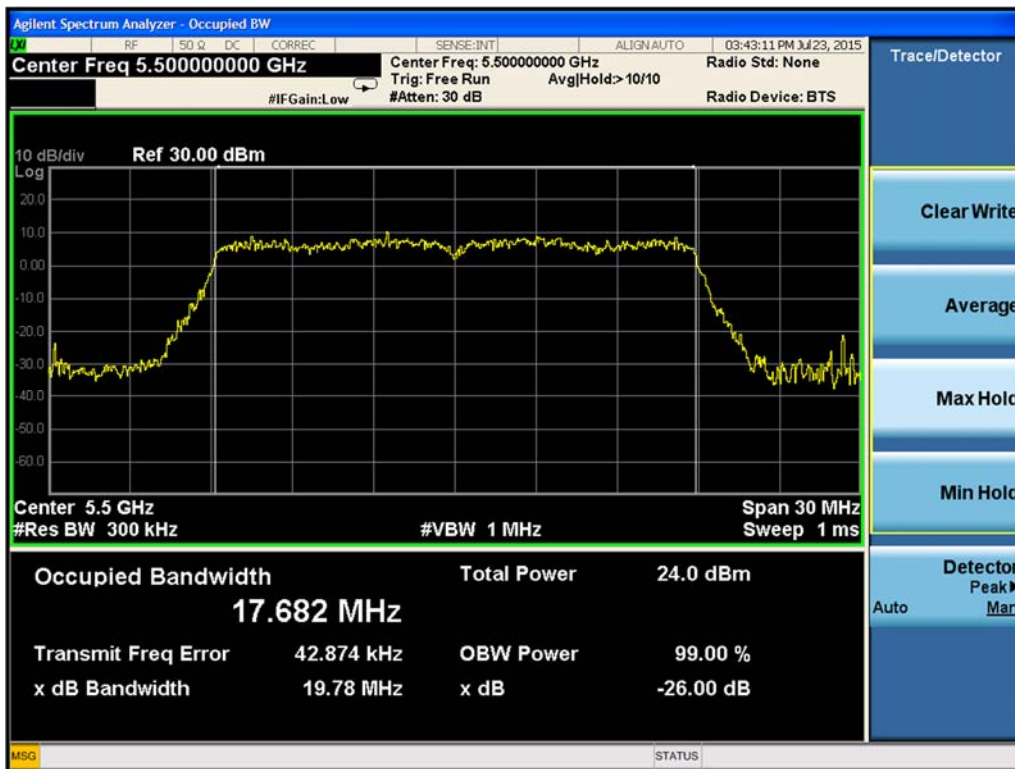


Figure 9-46. 26-dB Emission Bandwidth Chain B 802.11n HT20 (Ch. 100)

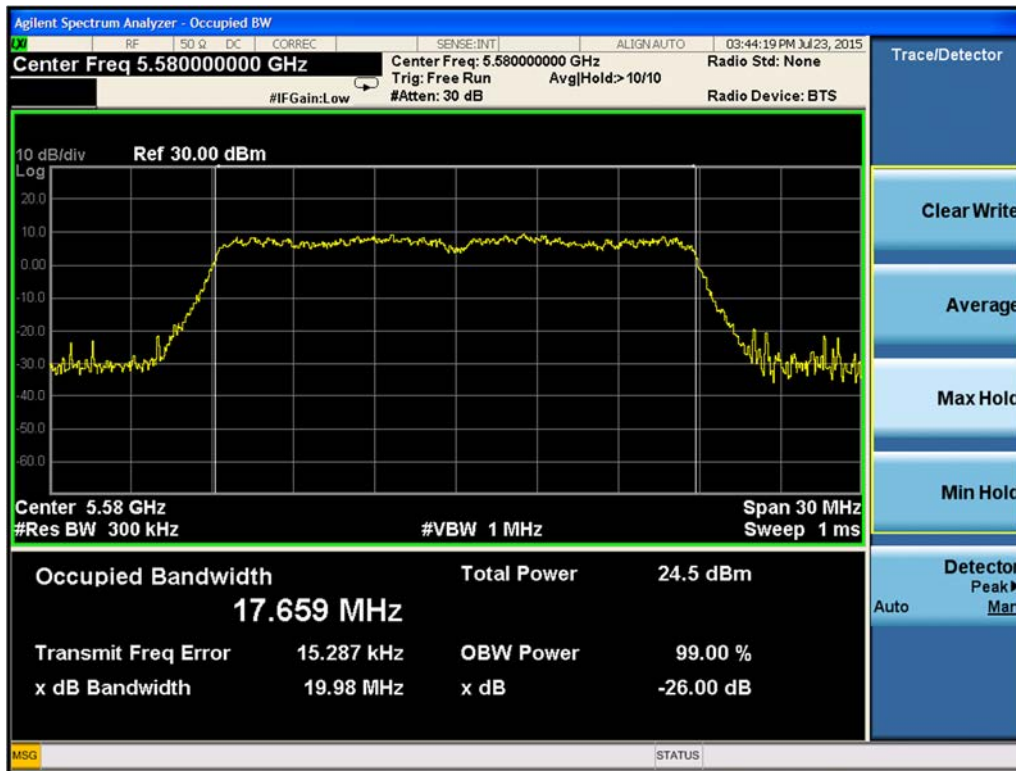


Figure 9-47. 26-dB Emission Bandwidth Chain B 802.11n HT20 (Ch. 116)

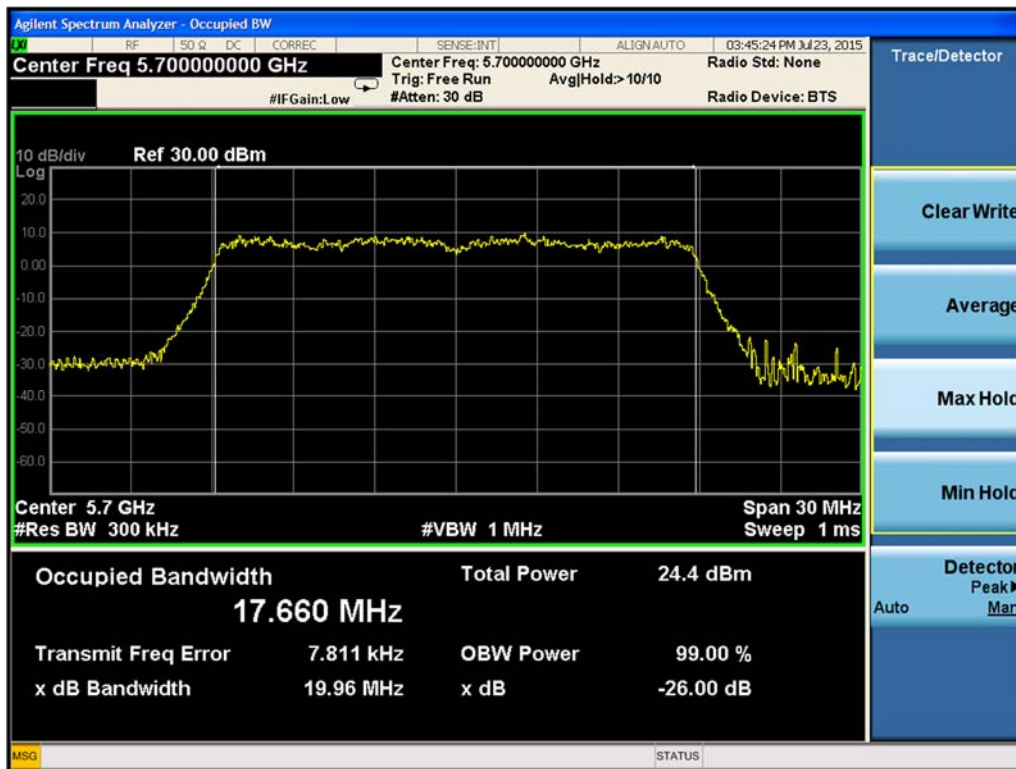


Figure 9-48. 26-dB Emission Bandwidth Chain B 802.11n HT20 (Ch. 140)

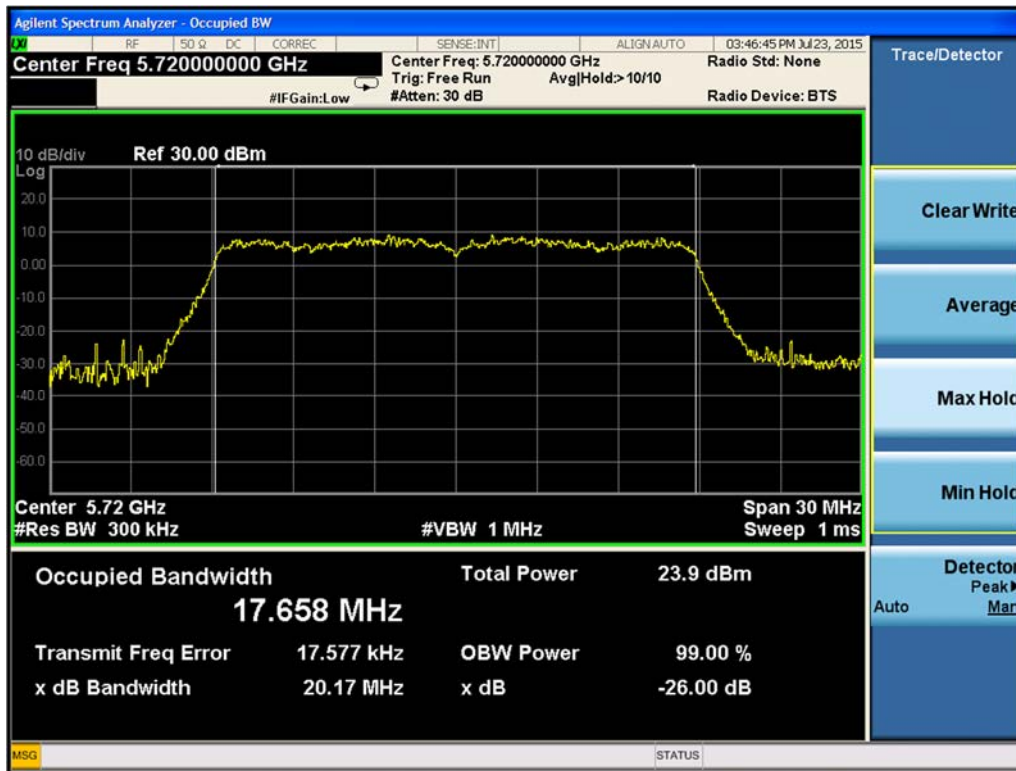


Figure 9-49. 26-dB Emission Bandwidth Chain B 802.11n HT20 (Ch. 144)

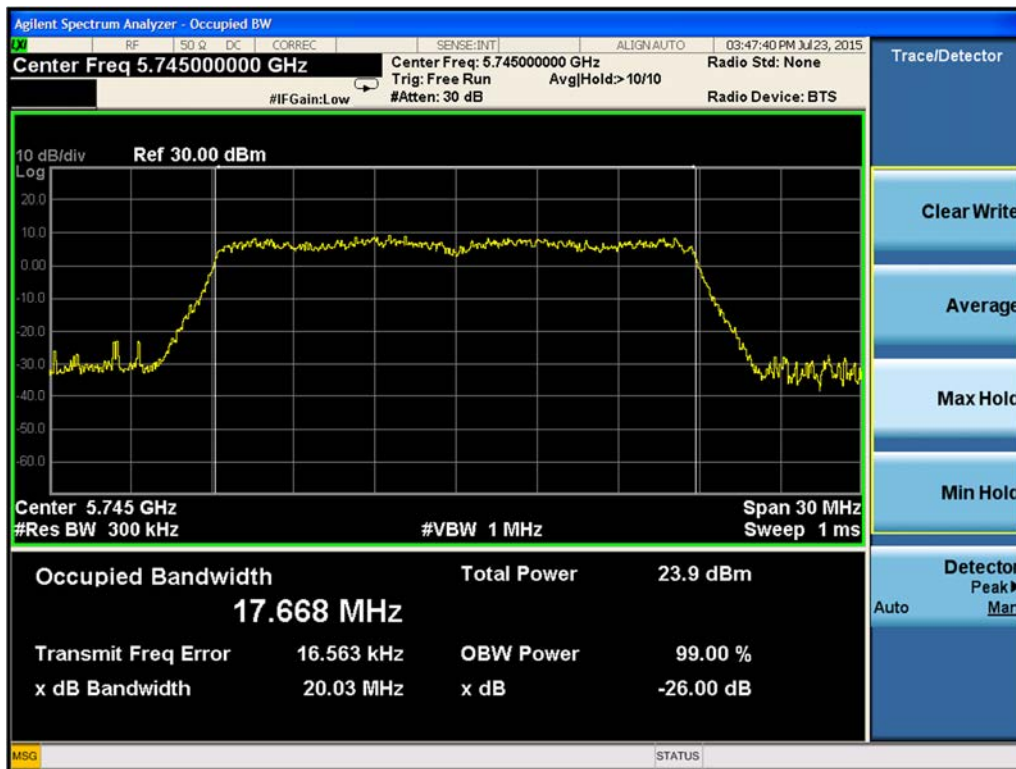


Figure 9-50. 26-dB Emission Bandwidth Chain B 802.11n HT20 (Ch. 149)

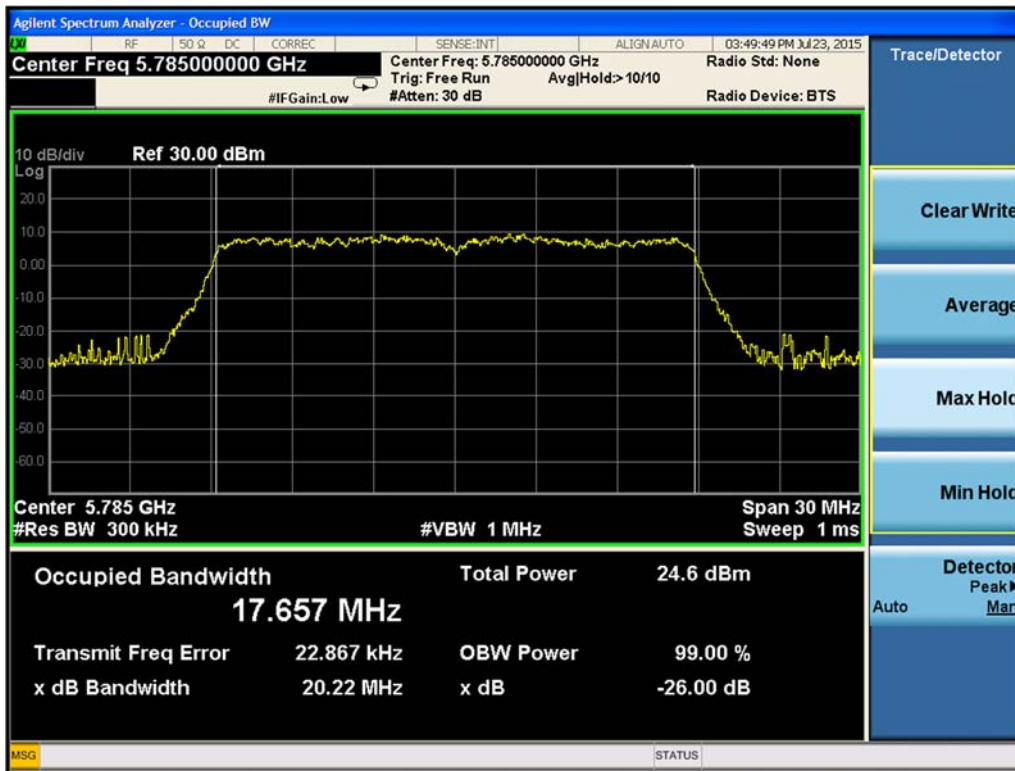


Figure 9-51. 26-dB Emission Bandwidth Chain B 802.11n HT20 (Ch. 157)

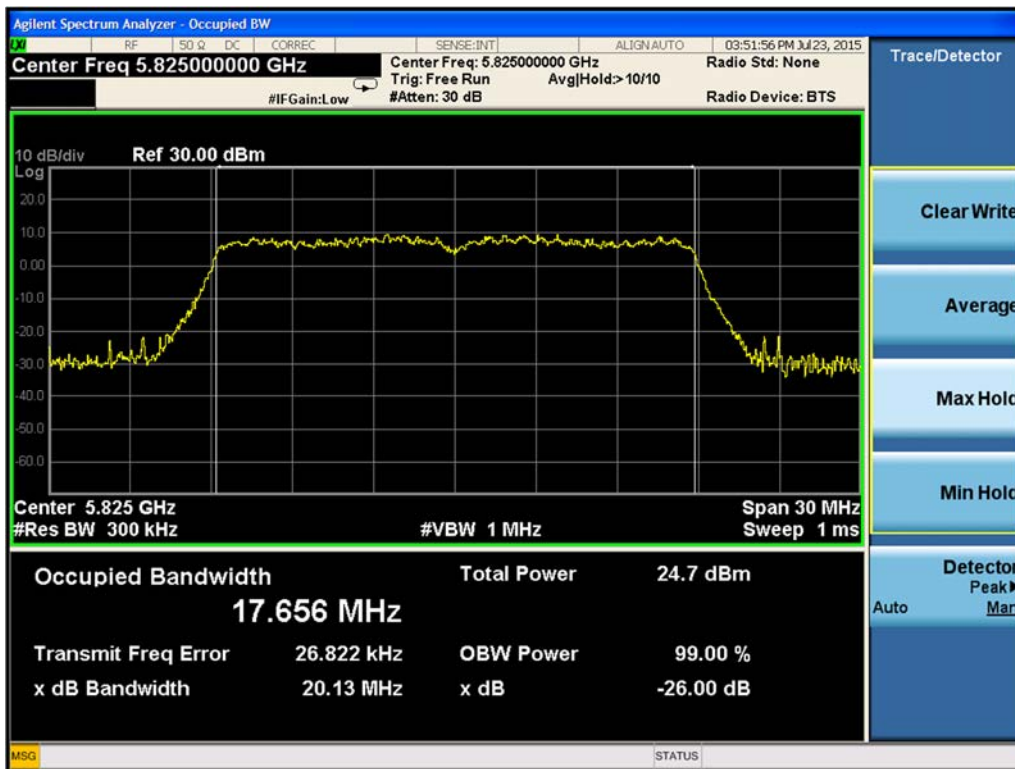


Figure 9-52. 26-dB Emission Bandwidth Chain B 802.11n HT20 (Ch. 165)

9.1.5.5 Chain A 802.11ac VHT20 26-dB Emission Bandwidth

Chain A 802.11ac VHT20 26-dB Emission Bandwidth		
Channel No.	Frequency (MHz)	26-dB Emission Bandwidth (MHz)
36	5180	20.01
44	5220	20.17
48	5240	20.08
52	5260	20.06
60	5300	20.15
64	5320	20.14
100	5500	20.21
116	5580	20.14
140	5700	20.05
144	5720	20.14
149	5745	20.15
157	5785	20.01
165	5825	20.22

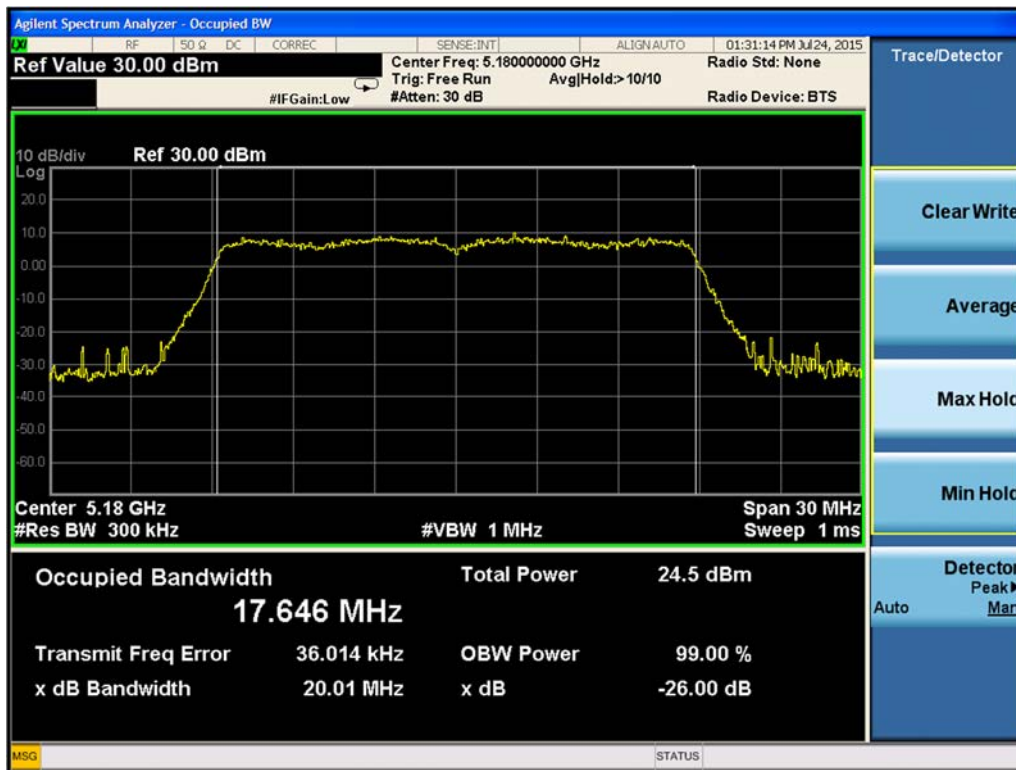


Figure 9-53. 26-dB Emission Bandwidth Chain A 802.11ac VHT20 (Ch. 36)

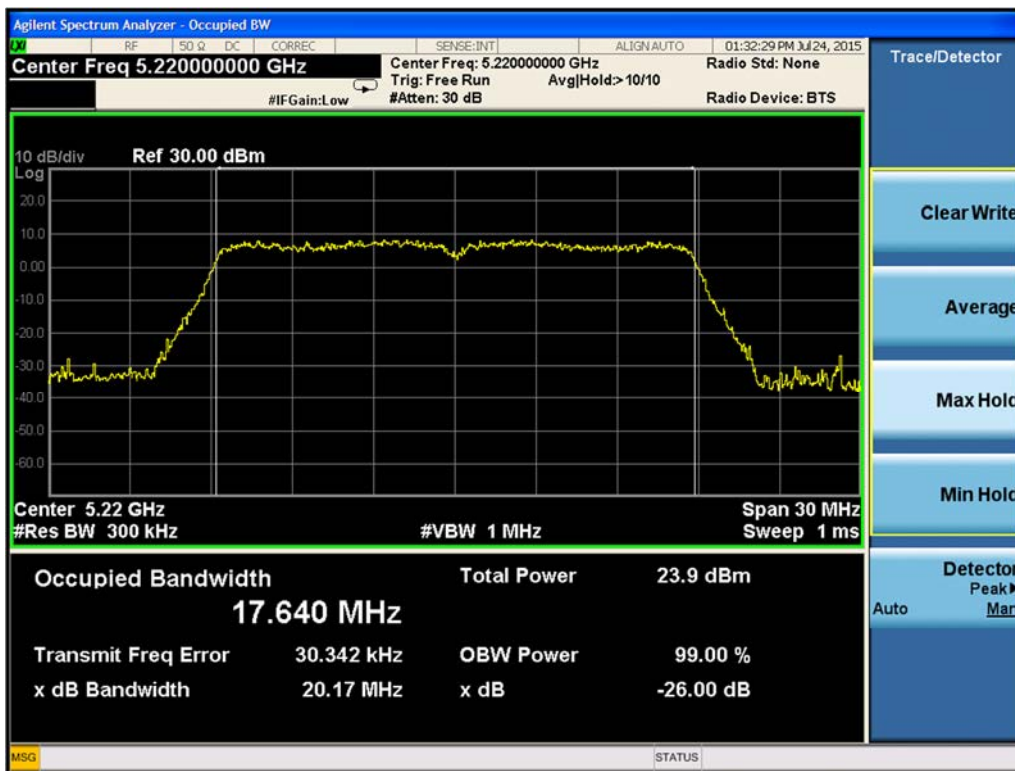


Figure 9-54. 26-dB Emission Bandwidth Chain A 802.11ac VHT20 (Ch. 44)

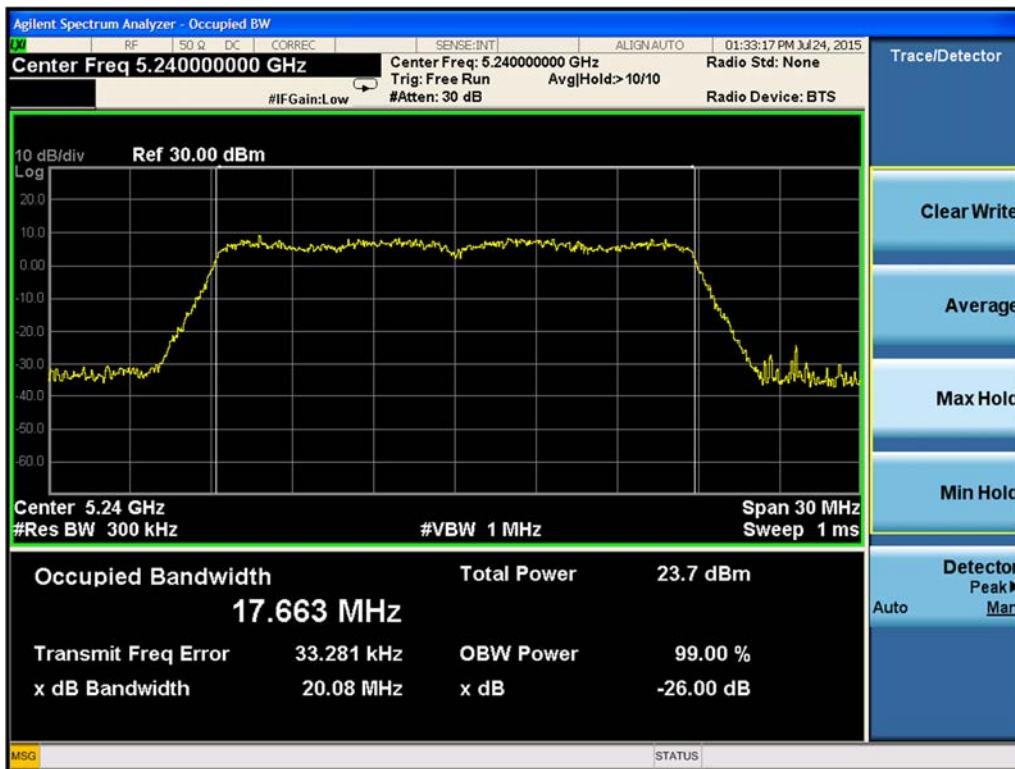


Figure 9-55. 26-dB Emission Bandwidth Chain A 802.11ac VHT20 (Ch. 48)

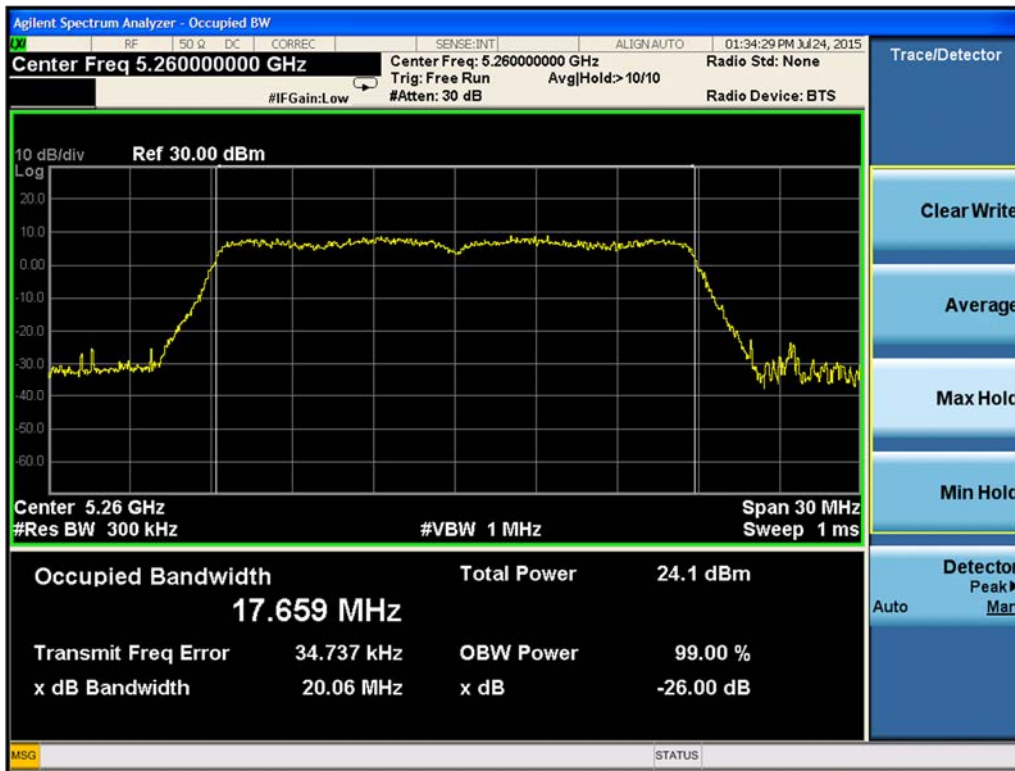


Figure 9-56. 26-dB Emission Bandwidth Chain A 802.11ac VHT20 (Ch. 52)

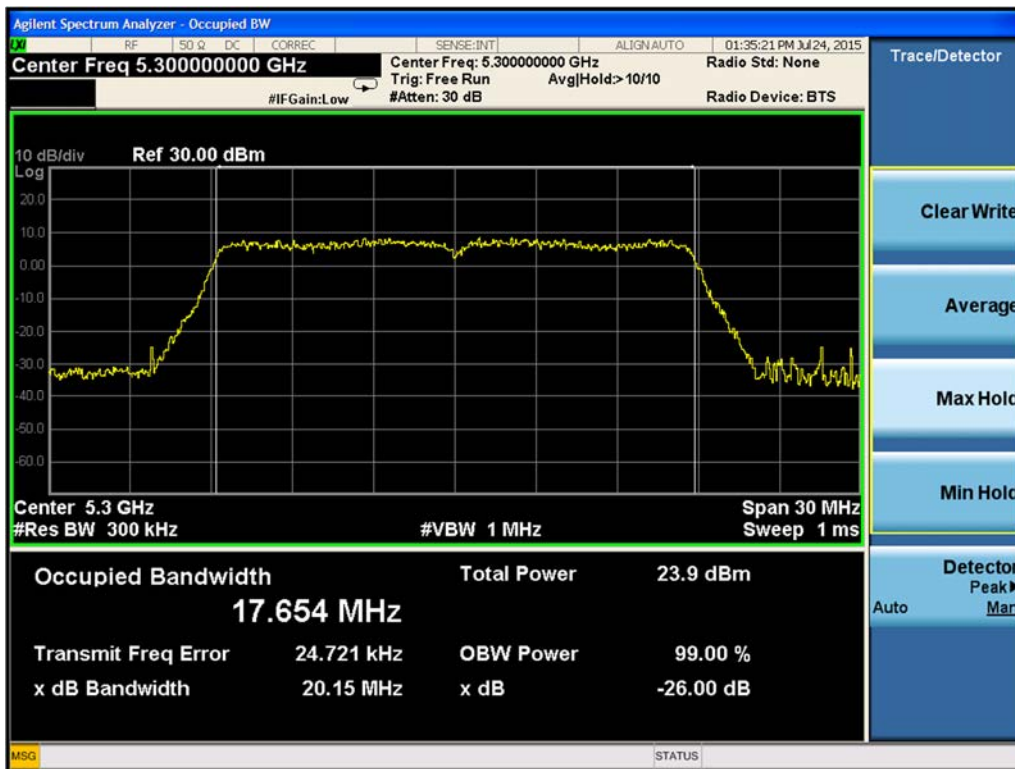


Figure 9-57. 26-dB Emission Bandwidth Chain A 802.11ac VHT20 (Ch. 60)

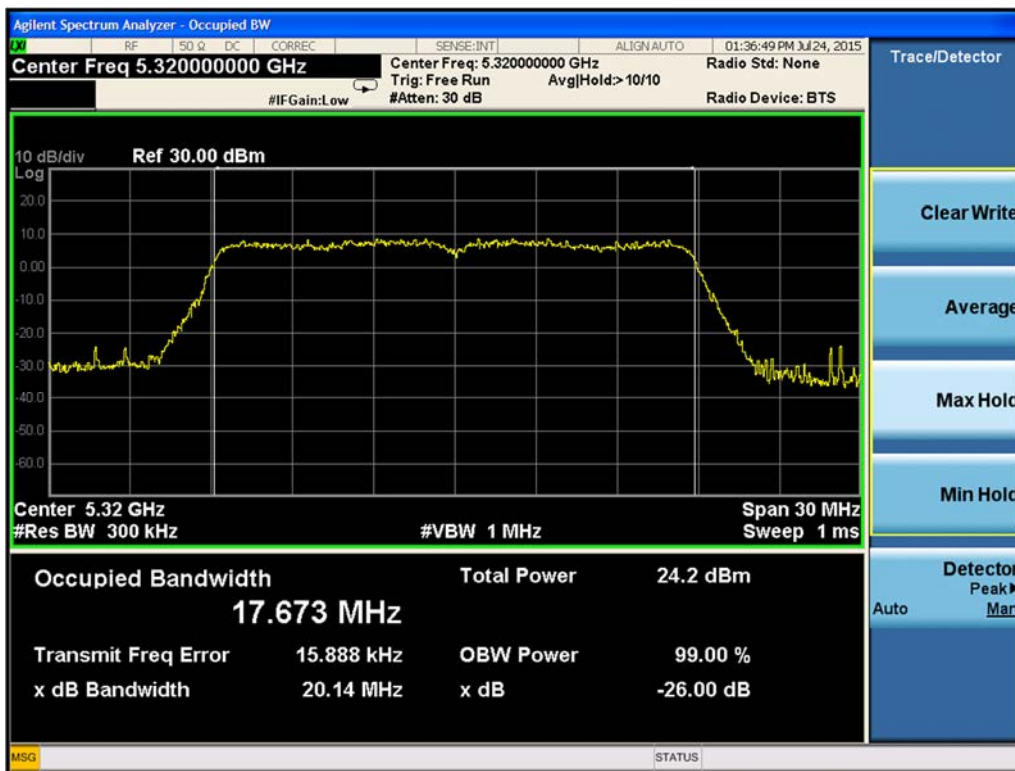


Figure 9-58. 26-dB Emission Bandwidth Chain A 802.11ac VHT20 (Ch. 64)

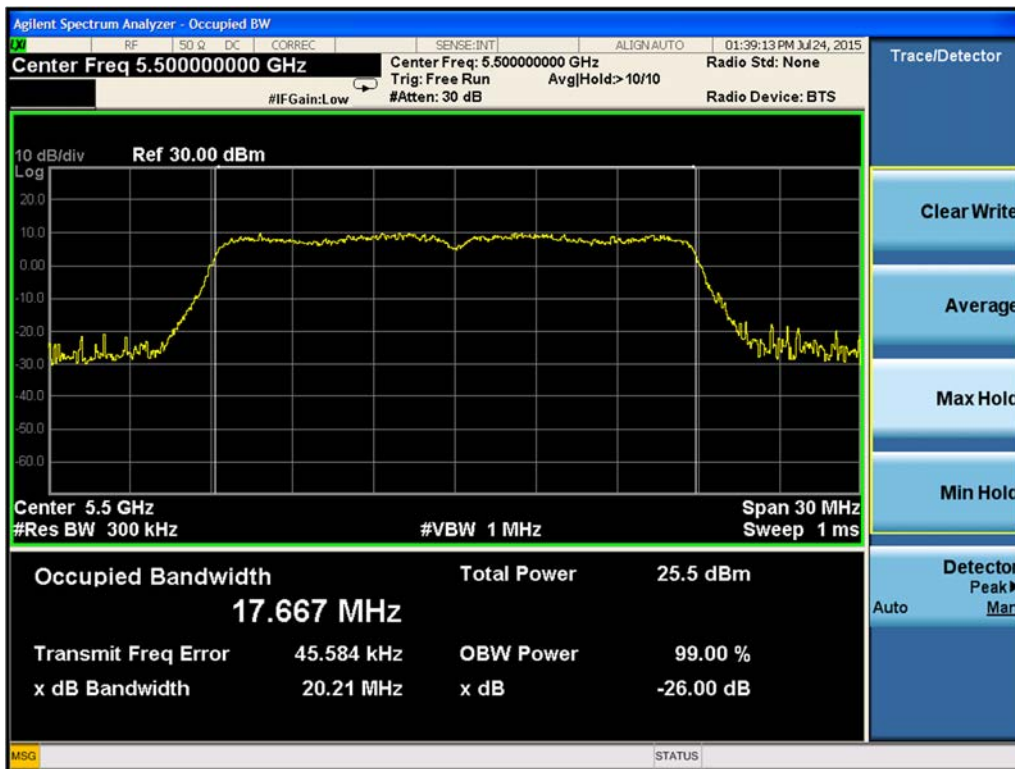


Figure 9-59. 26-dB Emission Bandwidth Chain A 802.11ac VHT20 (Ch. 100)

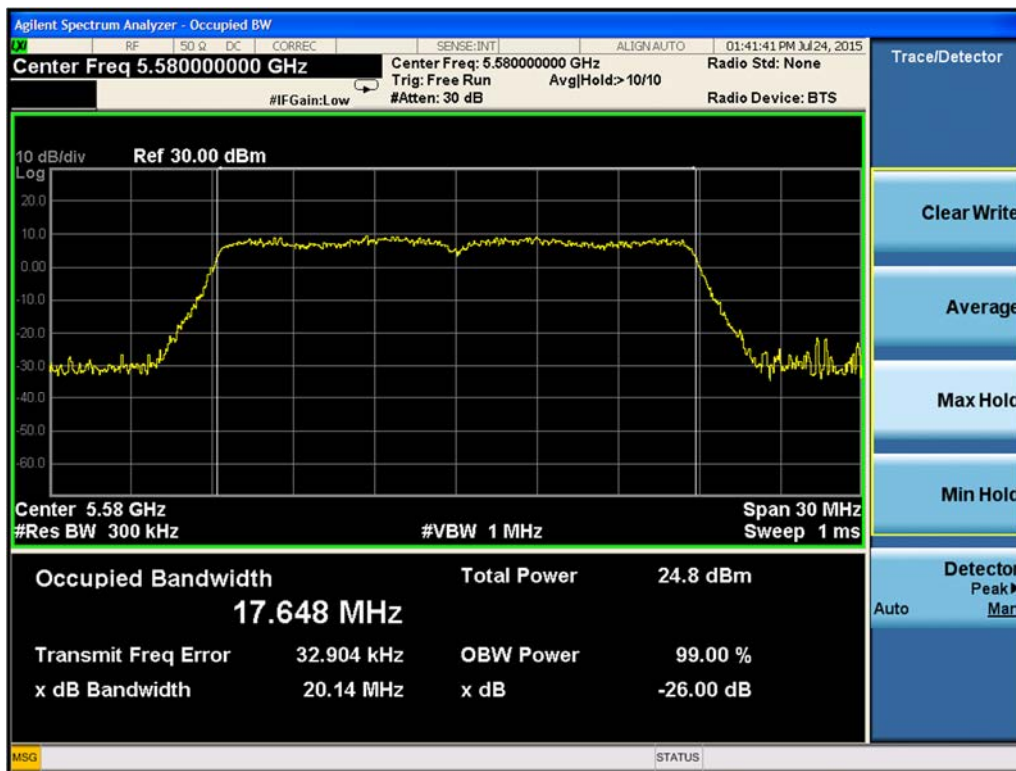


Figure 9-60. 26-dB Emission Bandwidth Chain A 802.11ac VHT20 (Ch. 116)

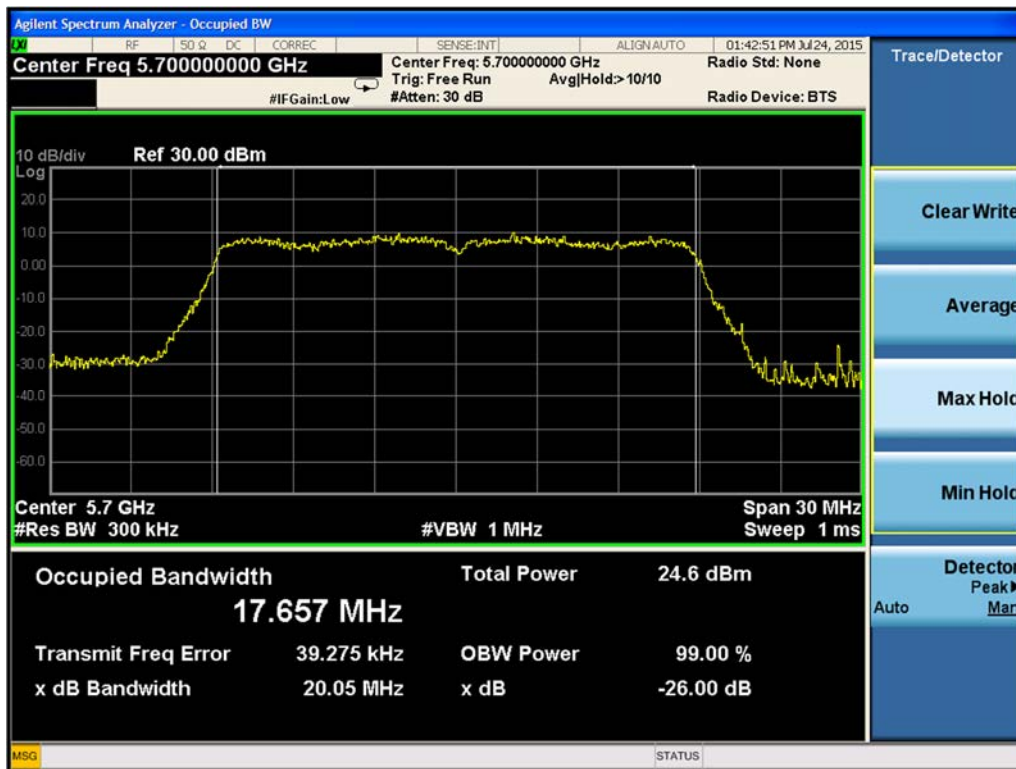


Figure 9-61. 26-dB Emission Bandwidth Chain A 802.11ac VHT20 (Ch. 140)

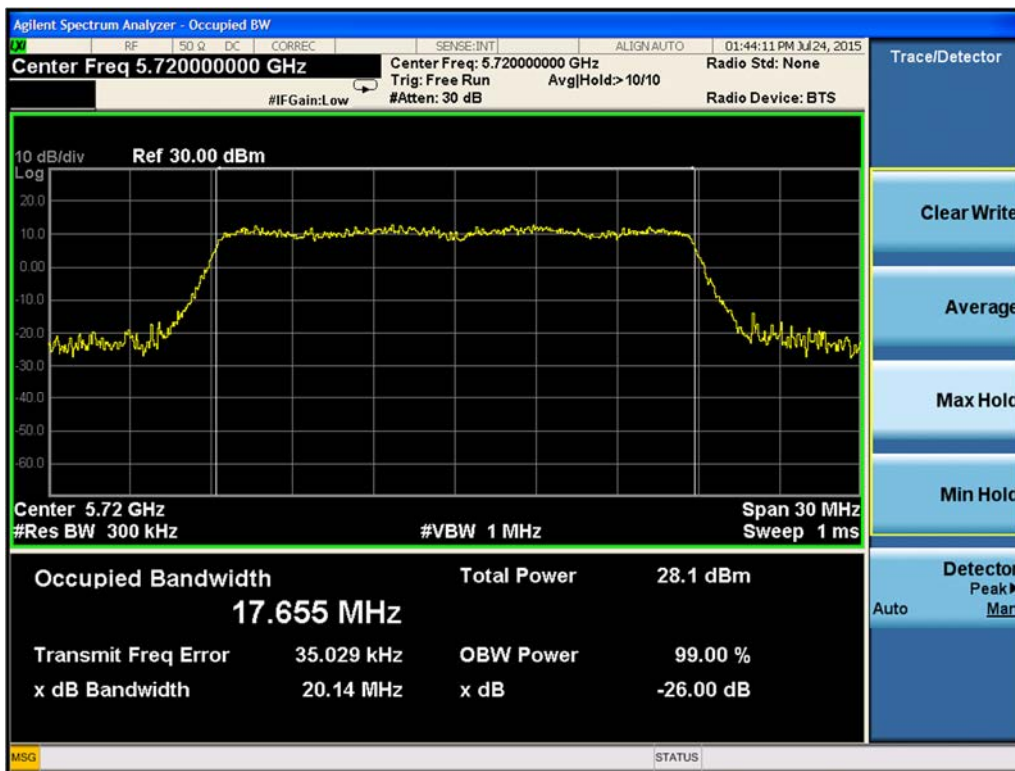


Figure 9-62. 26-dB Emission Bandwidth Chain A 802.11ac VHT20 (Ch. 144)

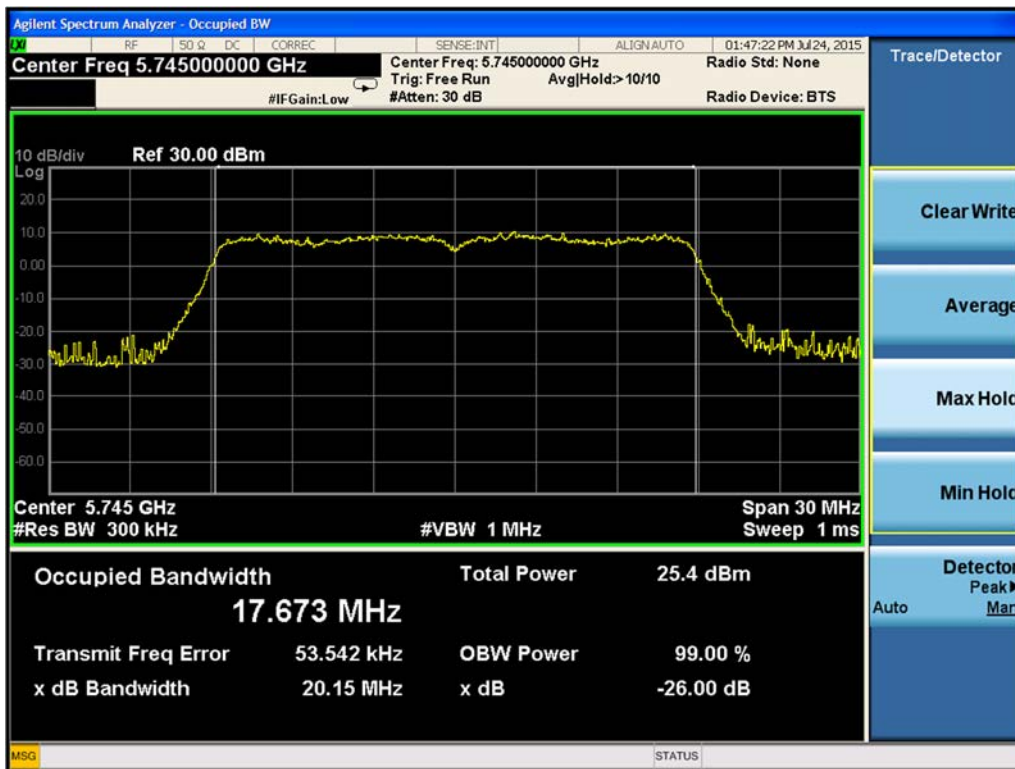


Figure 9-63. 26-dB Emission Bandwidth Chain A 802.11ac VHT20 (Ch. 149)

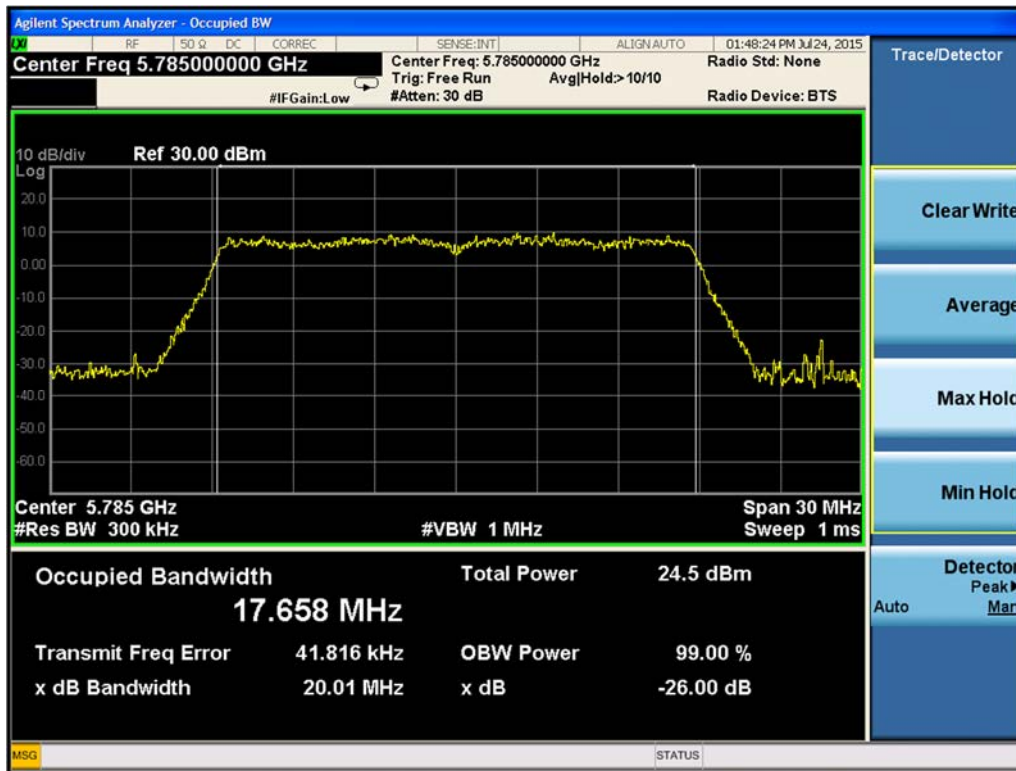


Figure 9-64. 26-dB Emission Bandwidth Chain A 802.11ac VHT20 (Ch. 157)

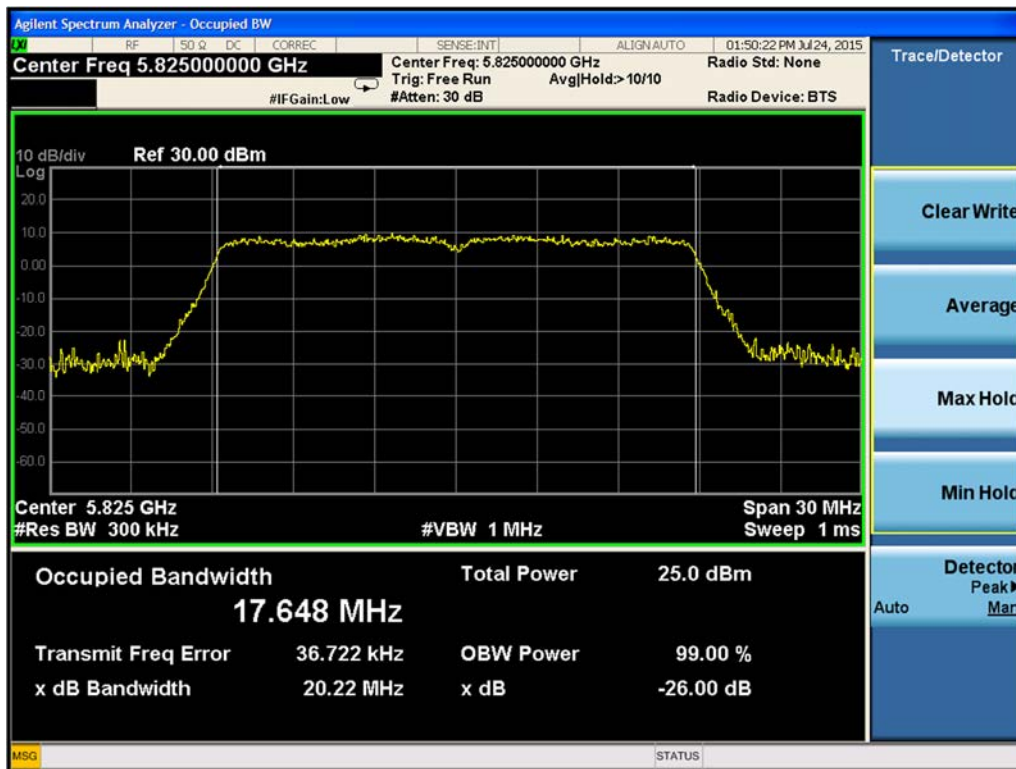


Figure 9-65. 26-dB Emission Bandwidth Chain A 802.11ac VHT20 (Ch. 165)