PCTEST ENGINEERING LABORATORY, INC.
7185 Oakland Mills Road, Columbia, MD 21046 USA
Tel. 410.290.6652 / Fax 410.290.6654
http://www.pctestlab.com

MEASUREMENT REPORT
UNII 802.11a/n

Applicant Name:
LG Electronics MobileComm U.S.A
1000 Sylvan Avenue
Englewood Cliffs, NJ 07632
United States

Date of Testing:
9/5 - 9/21/2017, 2/5-2/21/2018
Test Site/Location:
PCTEST Lab. Columbia, MD, USA
Test Report Serial No.:
1M1802060016-05.ZNF

FCC ID:	**ZNFX212TA**
APPLICANT:	**LG Electronics MobileComm U.S.A**

Application Type:	Certification
Model:	LM-X212TA
Additional Model(s):	LMX212TA, X212TA
EUT Type:	Portable Handset
Frequency Range:	5180 – 5825 MHz
FCC Classification:	Unlicensed National Information Infrastructure (UNII))
FCC Rule Part(s):	Part 15 Subpart E (15.407)
Test Procedure(s):	ANSI C63.10-2013, KDB 789033 D02 v01r04, KDB 648474 D03 v01r04, KDB 662911 D01 v02r01

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013 and KDB 789033 D02 v01r04. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

UNII Band	Channel Bandwidth (MHz)	Tx Frequency (MHz)	Conducted Power	
			Max. Power (mW)	Max. Power (dBm)
1	20	5180 - 5240	61.376	17.88
2A		5260 - 5320	59.293	17.73
2C		5500 - 5700	58.614	17.68
3		5745 - 5825	57.810	17.62
1	40	5190 - 5230	13.062	11.16
2A		5270 - 5310	11.041	10.43
2C		5510 - 5670	10.666	10.28
3		5755 - 5795	10.046	10.02

Randy Ortanez
President

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1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada.

1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility located at 7185 Oakland Mills Road, Columbia, MD 21046. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

1.3 Test Facility / Accreditations

Measurements were performed at PCTEST Engineering Lab located in Columbia, MD 21046, U.S.A.

- PCTEST is an ISO 17025-2005 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).

- PCTEST facility is a registered (22831) test laboratory with the site description on file with ISED.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **LGE Portable Handset FCC ID: ZNFX212TA**. The test data contained in this report pertains only to the emissions due to the EUT's UNII transmitter.

2.2 Device Capabilities

This device contains the following capabilities:

850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, 802.11b/g/n WLAN, 802.11a/n UNII, Bluetooth (1x, EDR, LE)

Band 1		Band 2A		Band 2C		Band 3	
Ch.	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**
36	5180	52	5260	100	5500	149	5745
:	:	:	:	:	:	:	:
42	5210	56	5280	116		157	5785
:	:	:	:	:	:	:	:
48	5240	64	5320	140	5700	165	5825

Table 2-1. 802.11a / 802.11n (20MHz) Frequency / Channel Operations

Band 1		Band 2A		Band 2C		Band 3	
Ch.	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**
38	5190	54	5270	102	5510	151	5755
:	:	:	:	:	:	:	:
46	5230	62	5310		5550		
				:	:		
				134	5670	159	5795

Table 2-2. 802.11n (40MHz BW) Frequency / Channel Operations

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Notes:

1. 5GHz NII operation is possible in 20MHz, and 40MHz channel bandwidths. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz, and detector = peak per the guidance of Section B)2)b) of ANSI C63.10-2013 and KDB 789033 D02 v01r04. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Maximum Achievable Duty Cycles		
802.11 Mode/Band		Duty Cycle [%]
		ANT1
5GHz	a	99.1
	n (HT20)	99.1
	ac (HT20)	98.5

Table 2-3. Measured Duty Cycles

Data Rate(s) Tested: 6, 9, 12, 18, 24, 36, 48, 54Mbps (802.11a)
6.5/7.2, 13/14.4, 19.5/21.7, 26/28.9, 39/43.3, 52/57.8, 58.5/65, 65/72.2 (n – 20MHz)
13.5/15, 27/30, 40.5/45, 54/60, 81/90, 108/120, 121.5/135, 135/150 (n – 40MHz BW)

2.3 Test Configuration

The EUT was tested per the guidance of KDB 789033 D02 v01r04. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing. See Sections 3.2 for AC line conducted emissions test setups, 3.3 for radiated emissions test setups, and 7.2, 7.3, 7.4, and 7.5 for antenna port conducted emissions test setups.

2.4 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

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3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB 789033 D02 v01r04 were used in the measurement of the EUT**.**

Deviation from measurement procedure……..…….....None

3.2 AC Line Conducted Emissions

The line-conducted facility is located inside a 10'x16'x9' shielded enclosure. The shielded enclosure is manufactured by ETS Lindgren RF Enclosures. The shielding effectiveness of the shielded room is in accordance with MIL-Std-285 or NSA 65-5. A 1m x 1.5m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50μH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. The external power line filter is an ETS Lindgren Model LPRX-4X30 (100dB Attenuation, 14kHz-18GHz) and the two EMI/RFI filters are ETS Lindgren Model LRW-2030-S1 (100dB Minimum Insertion Loss, 14kHz – 10GHz). These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply line(s) will be connected to the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference groundplane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The spectrum was scanned from 150kHz to 30MHz with a spectrum analyzer. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 10kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions is used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

Line conducted emissions test results are shown in Section 7.9.

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3.3 Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. An 80cm tall test table made of Styrodur is placed on top of the turn table. For measurements above 1GHz, an additional Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up was placed on top of the 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions.

3.4 Environmental Conditions

The temperature is controlled within range of 15°C to 35°C. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).

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4.0 ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:
"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

- The antennas of the EUT are **permanently attached.**
- There are no provisions for connection to an external antenna.

Conclusion:

The EUT complies with the requirement of §15.203.

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5.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	1.13
Line Conducted Disturbance	3.09
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

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6.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
-	WL40-1	Conducted Cable Set (40GHz)	9/30/2016	Annual	9/30/2017	WL40-1
-	RE1	Radiated Emissions Cable Set (UHF/EHF)	6/21/2017	Annual	6/21/2018	RE1
Agilent	N9038A	MXE EMI Receiver	4/26/2017	Annual	4/26/2018	MY51210133
Anritsu	ML2495A	Power Meter	10/16/2015	Biennial	10/16/2017	941001
Anritsu	MA2411B	Pulse Power Sensor	10/14/2015	Biennial	10/14/2017	846215
Emco	6502	Active Loop Antenna (10k - 30 MHz)	8/9/2016	Biennial	8/9/2018	2936
Emco	3115	Horn Antenna (1-18GHz)	3/10/2016	Biennial	3/10/2018	9704-5182
Emco	3116	Horn Antenna (18 - 40GHz)	3/27/2015	Triennial	3/27/2018	9203-2178
Espec	ESX-2CA	Environmental Chamber	4/11/2017	Annual	4/11/2018	17620
ETS Lindgren	3160-09	18-26.5 GHz Standard Gain Horn	8/23/2016	Biennial	8/23/2018	135427
ETS Lindgren	3160-10	26.5-40 GHz Standard Gain Horn	8/23/2016	Biennial	8/23/2018	130993
ETS Lindgren	3117	1-18 GHz DRG Horn (Medium)	4/26/2016	Biennial	4/26/2018	125518
Huber+Suhner	Sucoflex 102A	40GHz Radiated Cable	10/3/2016	Annual	10/3/2017	251425001
Pasternack	NMLC-1	Line Conducted Emissions Cable (NM)	10/14/2016	Annual	10/14/2017	NMLC-1
PCTEST	-	EMC Switch System	6/21/2017	Annual	6/21/2018	NM1
PCTEST	-	EMC Switch System	6/21/2017	Annual	6/21/2018	NM2
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	7/31/2017	Annual	7/31/2018	100348
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	8/11/2017	Annual	8/11/2018	103200
Rohde & Schwarz	TS-PR40	26.5-40 GHz Pre-Amplifier	5/11/2017	Annual	5/11/2018	100037
Rohde & Schwarz	TS-PR26	18-26.5 GHz Pre-Amplifier	5/11/2017	Annual	5/11/2018	100040
Seekonk	NC-100	Torque Wrench 5/16", 8" lbs	3/2/2016	Biennial	3/2/2018	N/A
Solar Electronics	8012-50-R-24-BNC	Line Impedance Stabilization Network	8/14/2017	Biennial	8/14/2019	310233
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	3/14/2016	Biennial	3/14/2018	A051107

Table 6-1. Annual Test Equipment Calibration Schedule

Notes:

1. For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

2. Equipment with a calibration date of "N/A" shown in this list was not used to make direct calibrated measurements.

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7.0 TEST RESULTS

7.1 Summary

Company Name: LG Electronics MobileComm U.S.A
FCC ID: ZNFX212TA
FCC Classification: Unlicensed National Information Infrastructure (UNII)

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
N/A	RSS-Gen [6.6]	26dB Bandwidth	N/A	CONDUCTED	PASS	Section 7.2
15.407(e)	RSS-Gen [6.6]	6dB Bandwidth	>500kHz(5725-5850MHz)		PASS	Section 7.3
15.407 (a.1.iv), (a.2), (a.3)	RSS-247 [6.2]	Maximum Conducted Output Power	Maximum conducted powers must meet the limits detailed in 15.407 (a) (RSS-247 [6.2])		PASS	Section 7.4
15.407 (a.1.iv), (a.2), (a.3)	RSS-247 [6.2]	Maximum Power Spectral Density	Maximum power spectral density must meet the limits detailed in 15.407 (a) (RSS-247 [6.2])		PASS	Section 7.5
15.407(g)	RSS-Gen [6.11]	Frequency Stability	N/A		PASS	Section 7.6
15.407(h)	RSS-247 [6.3]	Dynamic Frequency Selection	See DFS Test Report		PASS	See DFS Test Report
15.407(b.1), (2), (3), (4)	RSS-247 [6.2]	Undesirable Emissions	Undesirable emissions must meet the limits detailed in 15.407(b) (RSS-247 [6.2])	RADIATED	PASS	Section 7.7
15.205, 15.407(b.1), (4), (5), (6)	RSS-Gen [8.9]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209 (RSS-Gen [8.9])		PASS	Section 7.7, 7.8
15.407	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 (RSS-Gen [8.8]) limits	LINE CONDUCTED	PASS	Section 7.9

Table 7-1. Summary of Test Results

Notes:

1) All channels, modes, and modulations/data rates were investigated among all UNII bands. The test results shown in the following sections represent the worst case emissions.
2) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.
4) For conducted spurious emissions, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST "UNII Automation," Version 4.5.
5) For radiated band edge, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST "Chamber Automation," Version 1.1.5.

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7.2 26dB Bandwidth Measurement – 802.11a/n

RSS-Gen [6.2]

Test Overview and Limit

The bandwidth at 26dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating at its maximum duty cycle, at its maximum power control level, as defined in ANSI C63.10-2013 and KDB 789033 D02 v01r04, and at the appropriate frequencies. The spectrum analyzer's bandwidth measurement function is configured to measure the 26dB bandwidth.

The 26dB bandwidth is used to determine the conducted power limits.

Test Procedure Used

ANSI C63.10-2013 – Section 12.4
KDB 789033 D02 v01r04 – Section C

Test Settings

1. The signal analyzers' automatic bandwidth measurement capability was used to perform the 26dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 26. The automatic bandwidth measurement function also has the capability of simultaneously measuring the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = approximately 1% of the emission bandwidth
3. VBW $\geq$ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

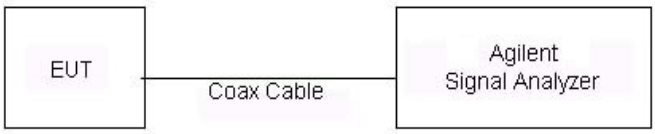

Figure 7-1. Test Instrument & Measurement Setup

Test Notes

None.

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	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured 26dB Bandwidth [MHz]
Band 1	5180	36	a	6	20.68
	5200	40	a	6	27.09
	5240	48	a	6	31.33
	5180	36	n (20MHz)	6.5/7.2 (MCS0)	20.83
	5200	40	n (20MHz)	6.5/7.2 (MCS0)	21.62
	5240	48	n (20MHz)	6.5/7.2 (MCS0)	26.55
	5190	38	n (40MHz)	13.5/15 (MCS0)	43.55
	5230	46	n (40MHz)	13.5/15 (MCS0)	43.33
Band 2A	5260	52	a	6	28.61
	5280	56	a	6	31.41
	5320	64	a	6	20.30
	5260	52	n (20MHz)	6.5/7.2 (MCS0)	27.17
	5280	56	n (20MHz)	6.5/7.2 (MCS0)	24.39
	5320	64	n (20MHz)	6.5/7.2 (MCS0)	20.66
	5270	54	n (40MHz)	13.5/15 (MCS0)	42.46
	5310	62	n (40MHz)	13.5/15 (MCS0)	43.07
Band 2C	5500	100	a	6	20.72
	5580	116	a	6	30.34
	5700	140	a	6	27.45
	5500	100	n (20MHz)	6.5/7.2 (MCS0)	20.71
	5580	116	n (20MHz)	6.5/7.2 (MCS0)	23.68
	5700	140	n (20MHz)	6.5/7.2 (MCS0)	22.13
	5510	102	n (40MHz)	13.5/15 (MCS0)	42.43
	5550	110	n (40MHz)	13.5/15 (MCS0)	42.96
	5670	134	n (40MHz)	13.5/15 (MCS0)	42.11

Table 7-2. Conducted Bandwidth Measurements

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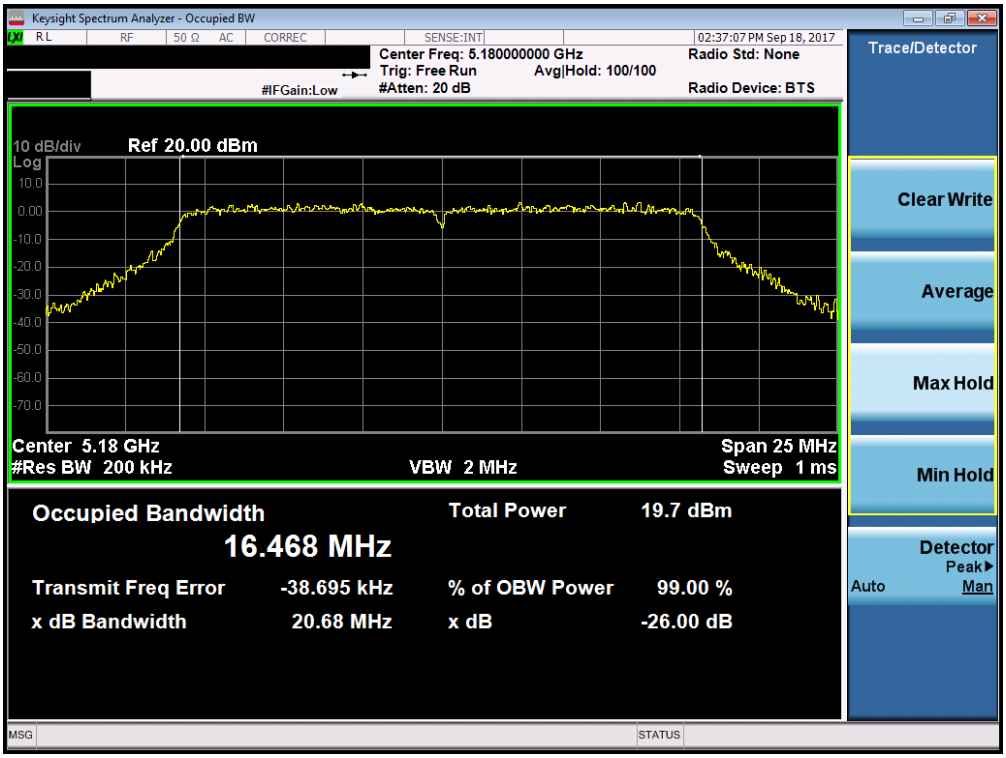
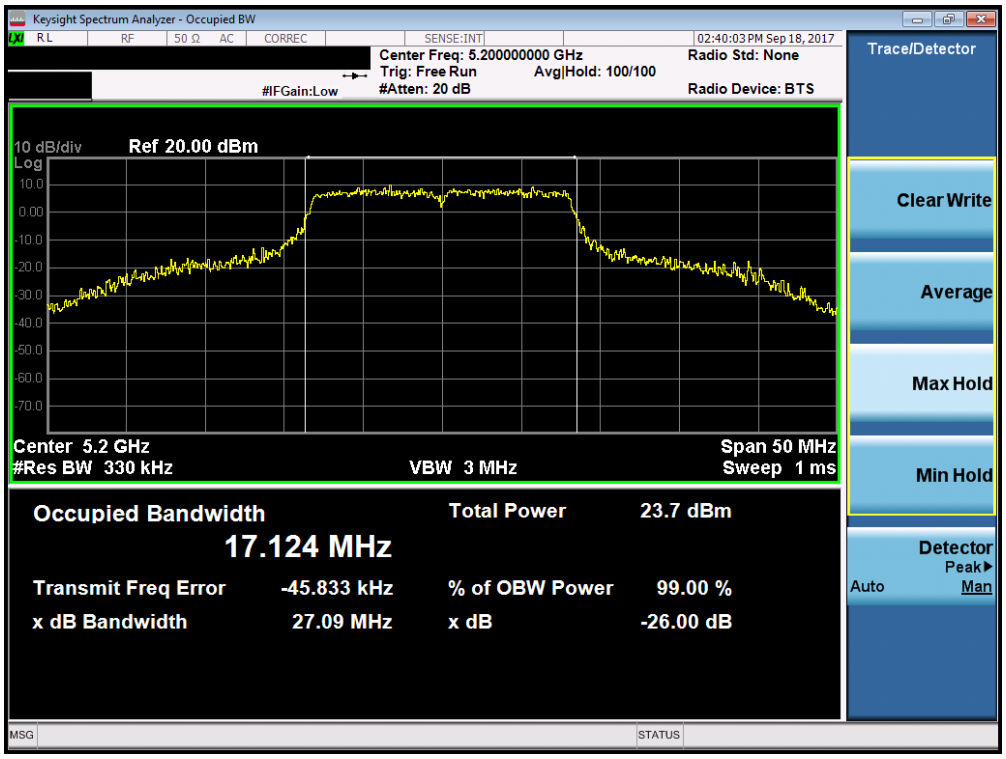


Plot 7-1. 26dB Bandwidth Plot (802.11a (UNII Band 1) – Ch. 36)



Plot 7-2. 26dB Bandwidth Plot (802.11a (UNII Band 1) – Ch. 40)

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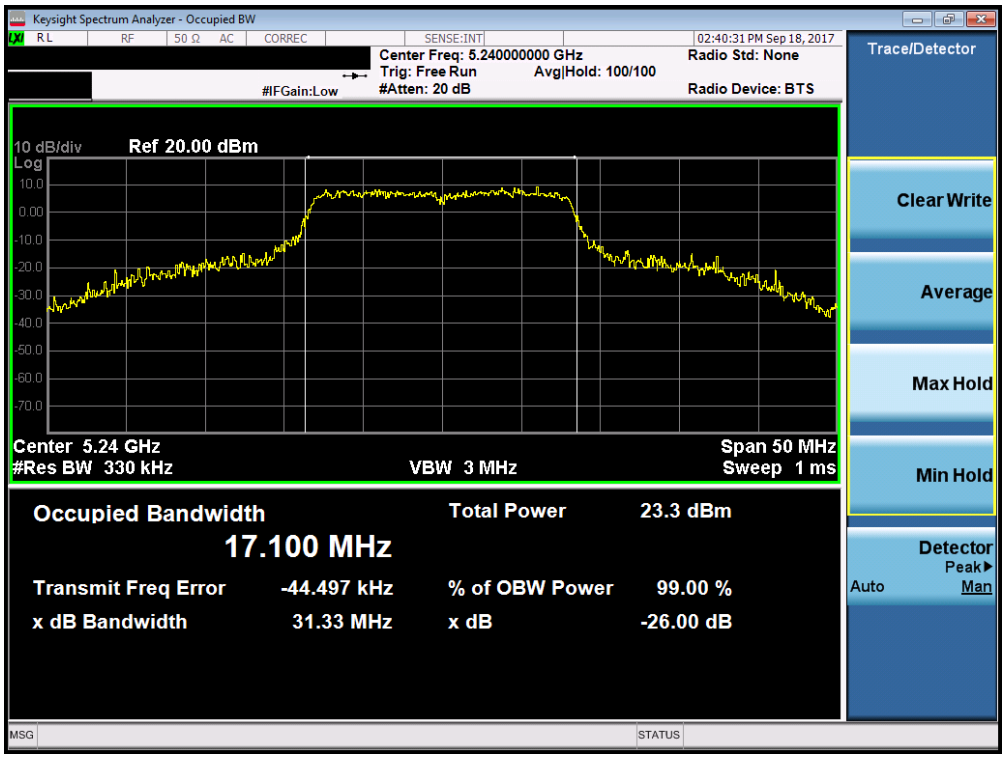
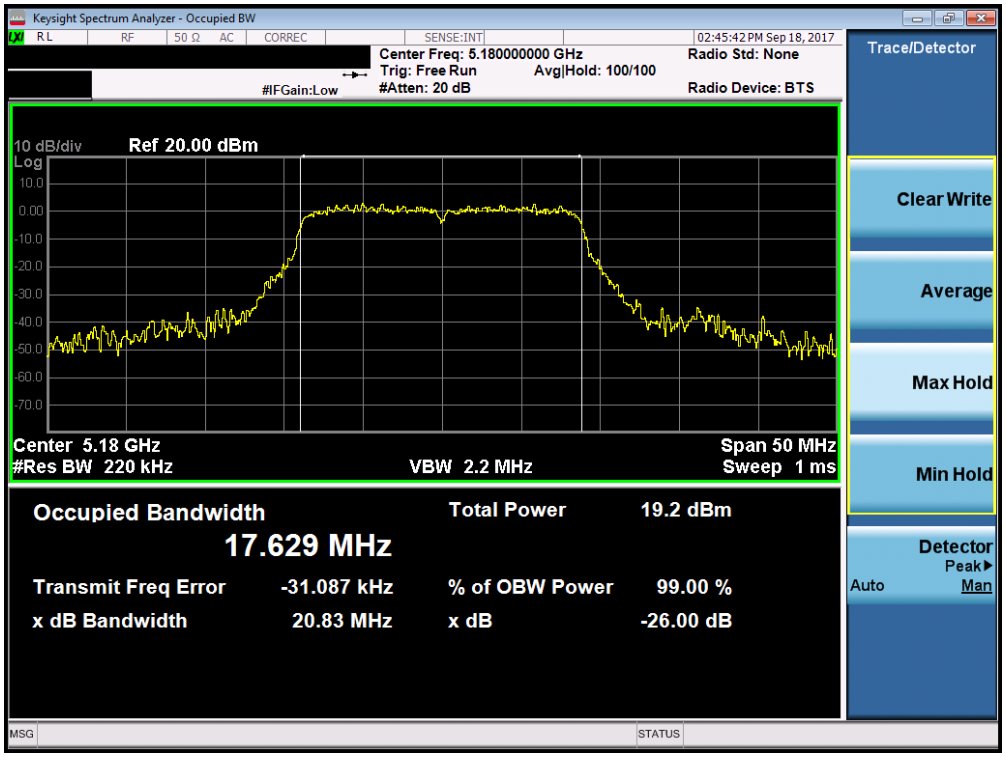


Plot 7-3. 26dB Bandwidth Plot (802.11a (UNII Band 1) – Ch. 48)



Plot 7-4. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 36)

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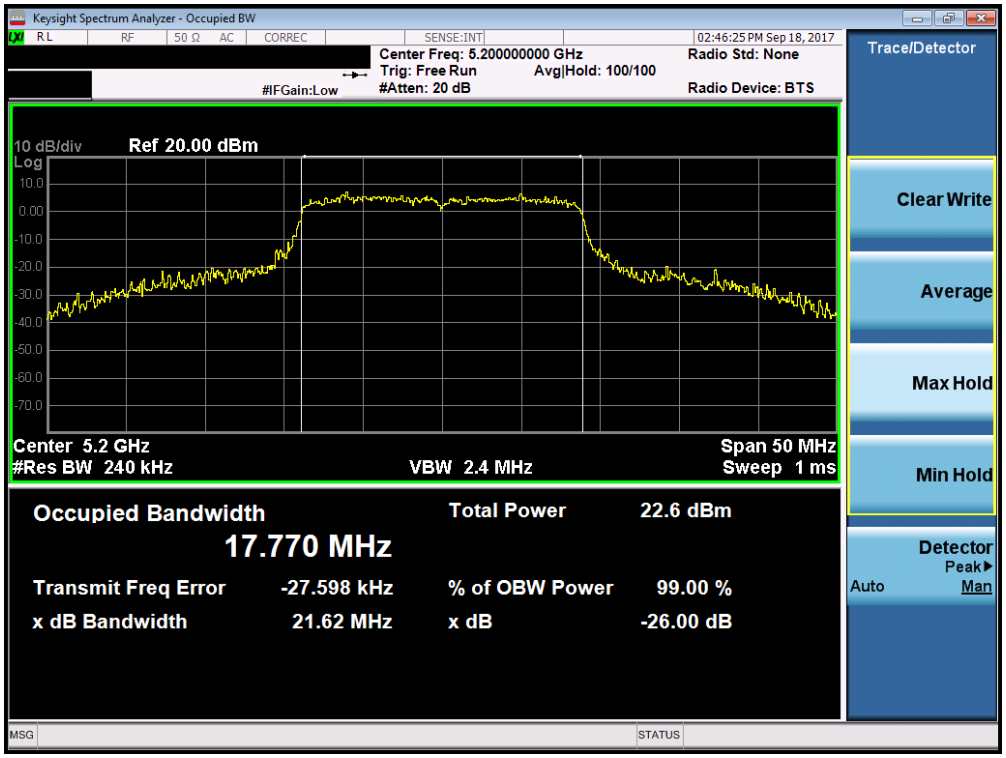
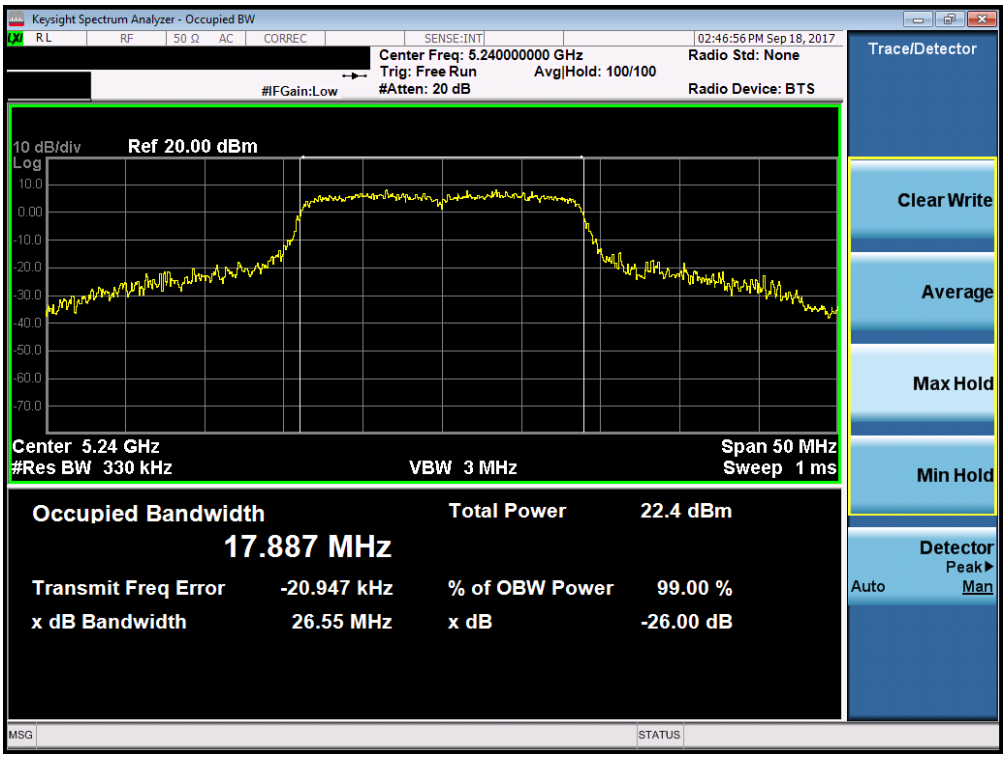


Plot 7-5. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 40)



Plot 7-6. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 48)

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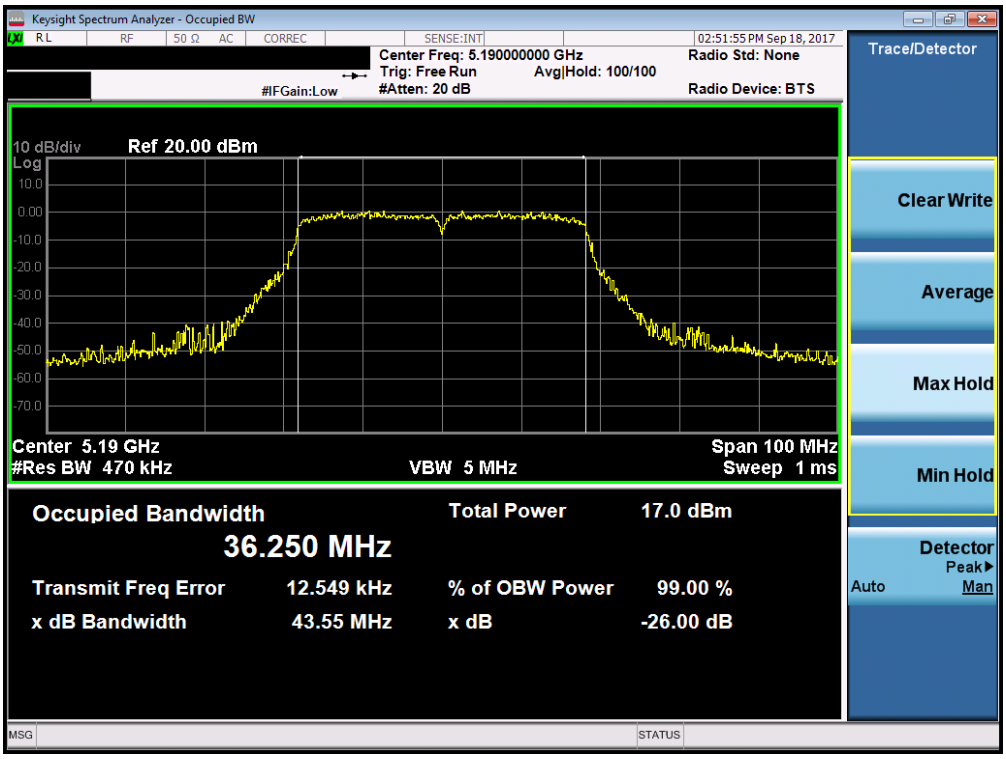
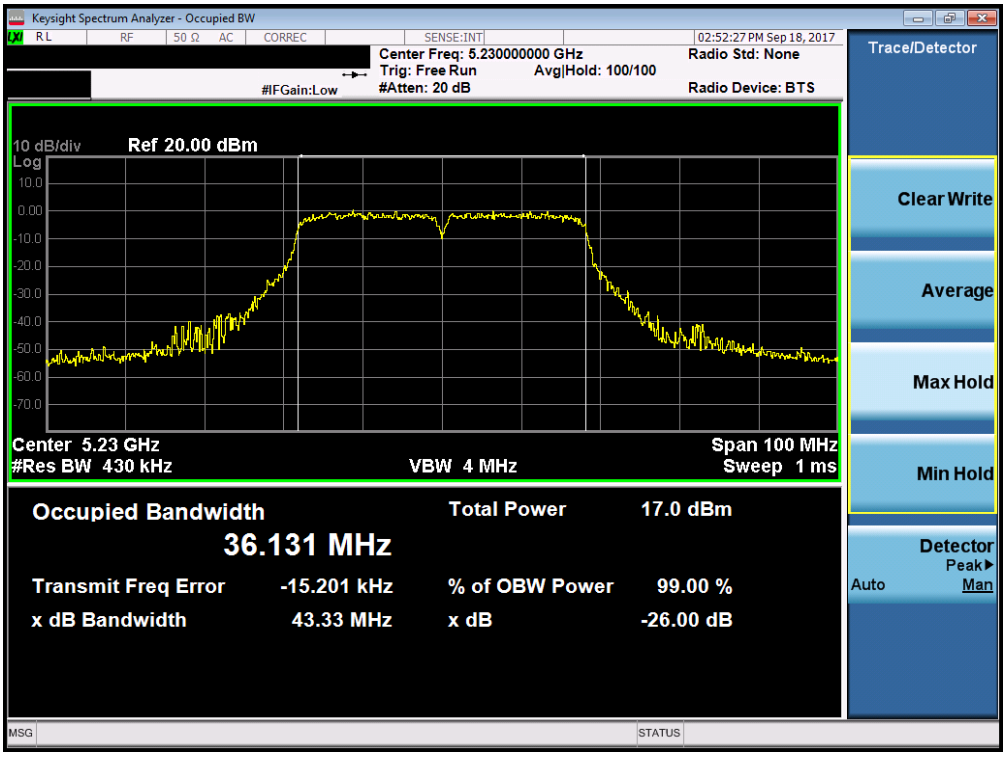


Plot 7-7. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 38)



Plot 7-8. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 46)

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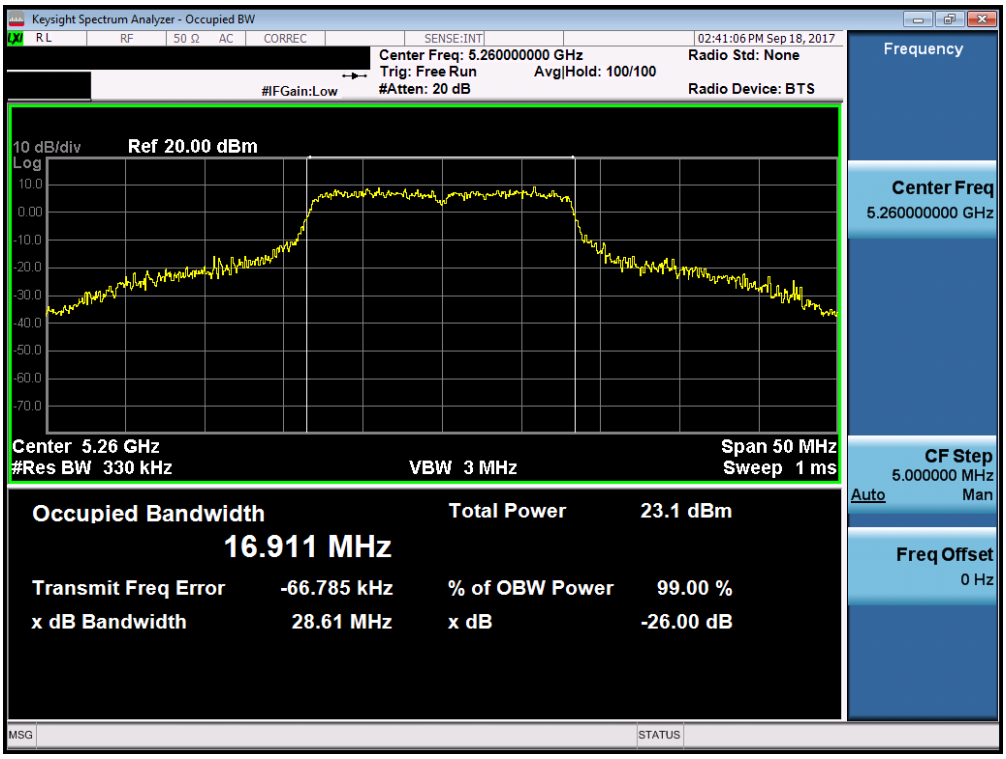
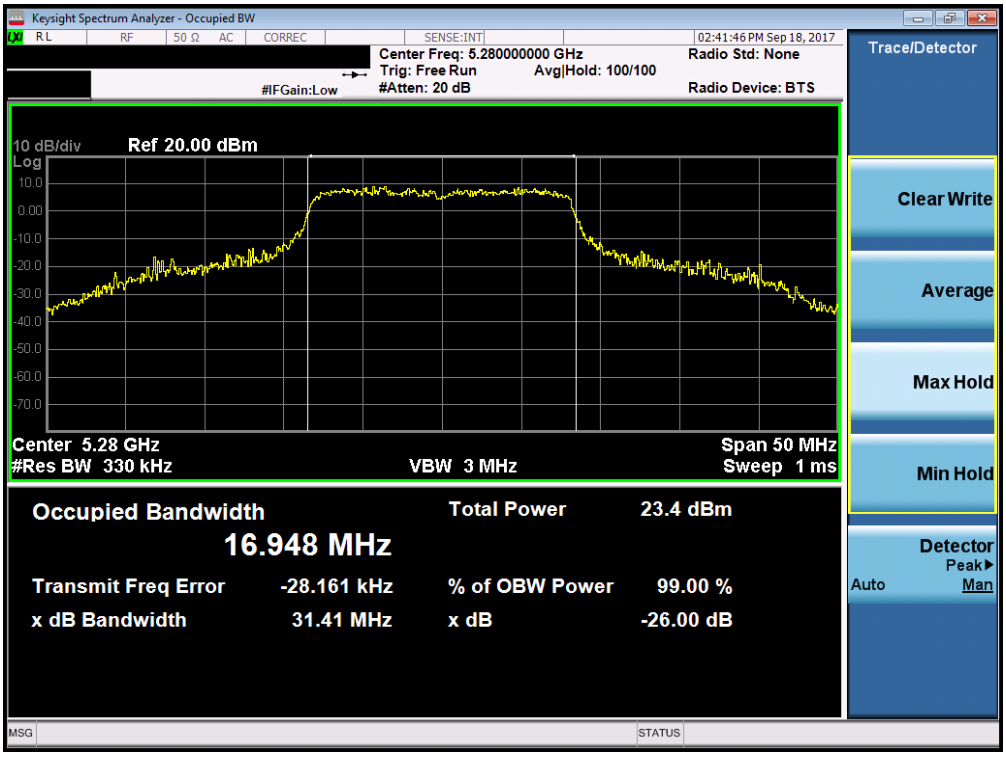


Plot 7-9. 26dB Bandwidth Plot (802.11a (UNII Band 2A) – Ch. 52)



Plot 7-10. 26dB Bandwidth Plot (802.11a (UNII Band 2A) – Ch. 56)

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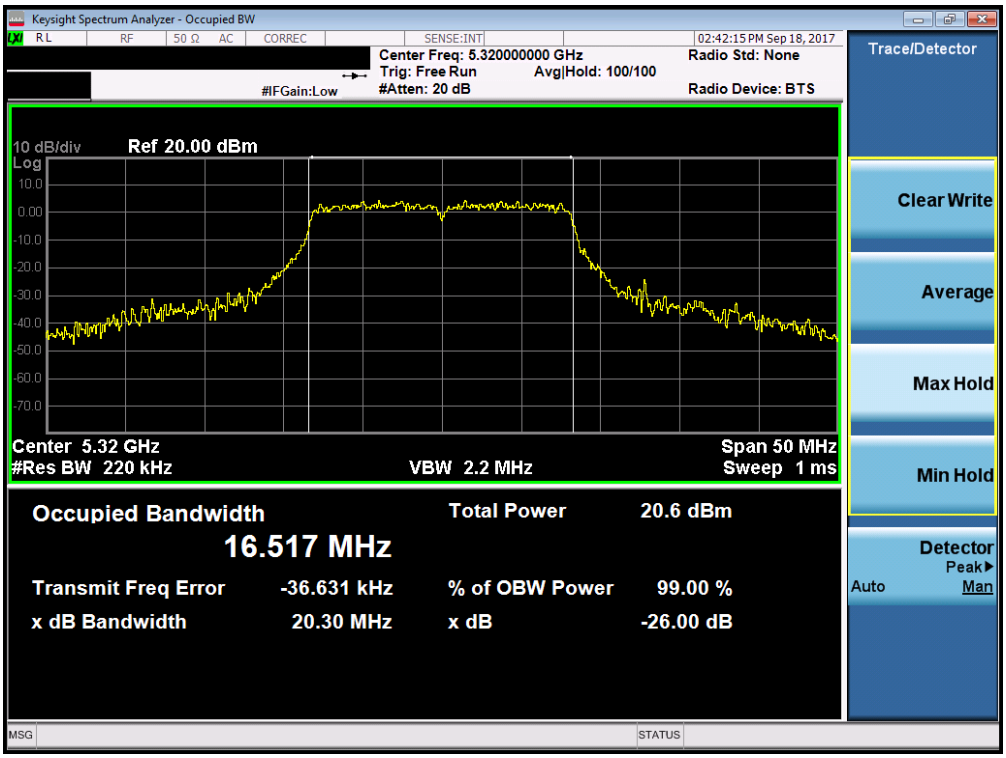
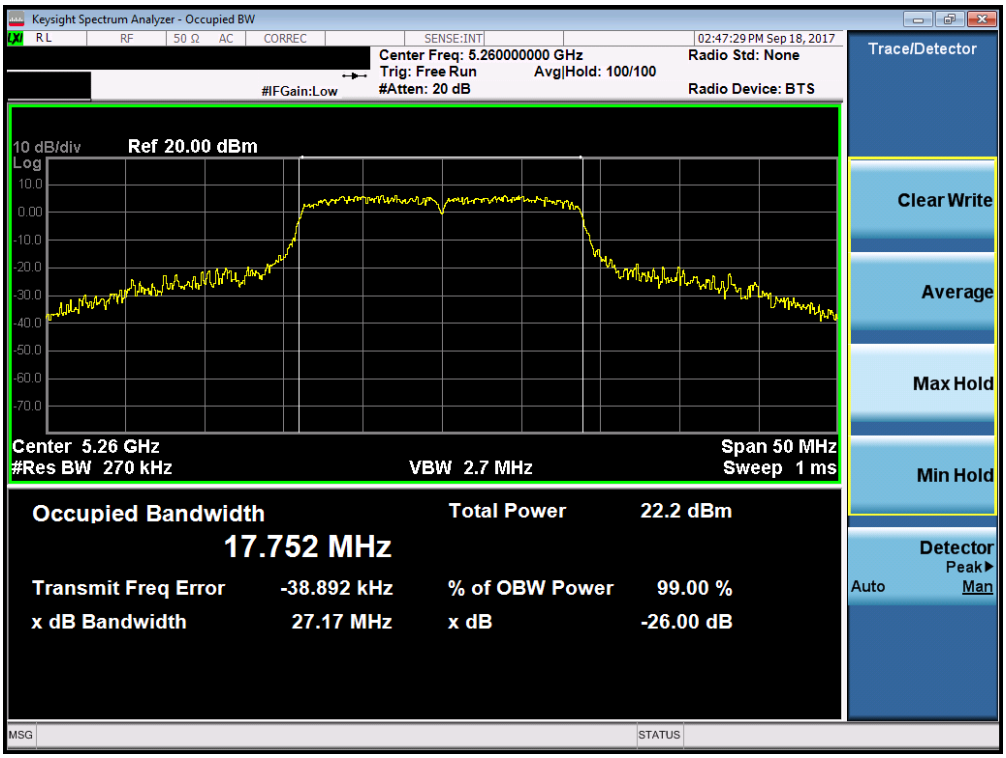


Plot 7-11. 26dB Bandwidth Plot (802.11a (UNII Band 2A) – Ch. 64)



Plot 7-12. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 52)

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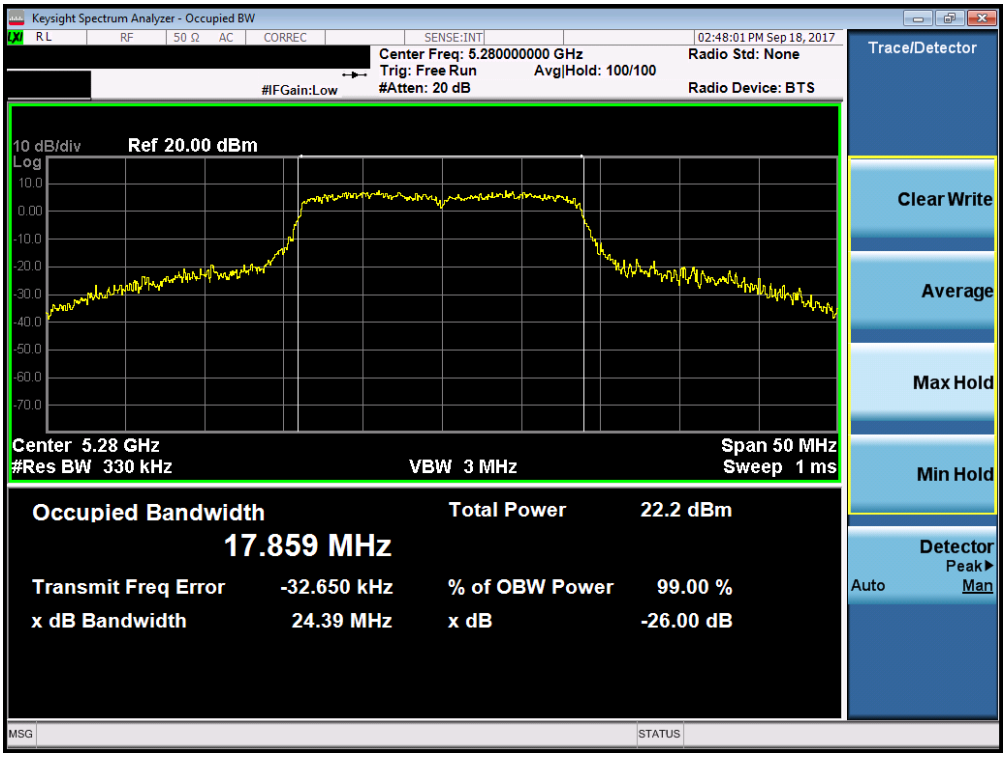
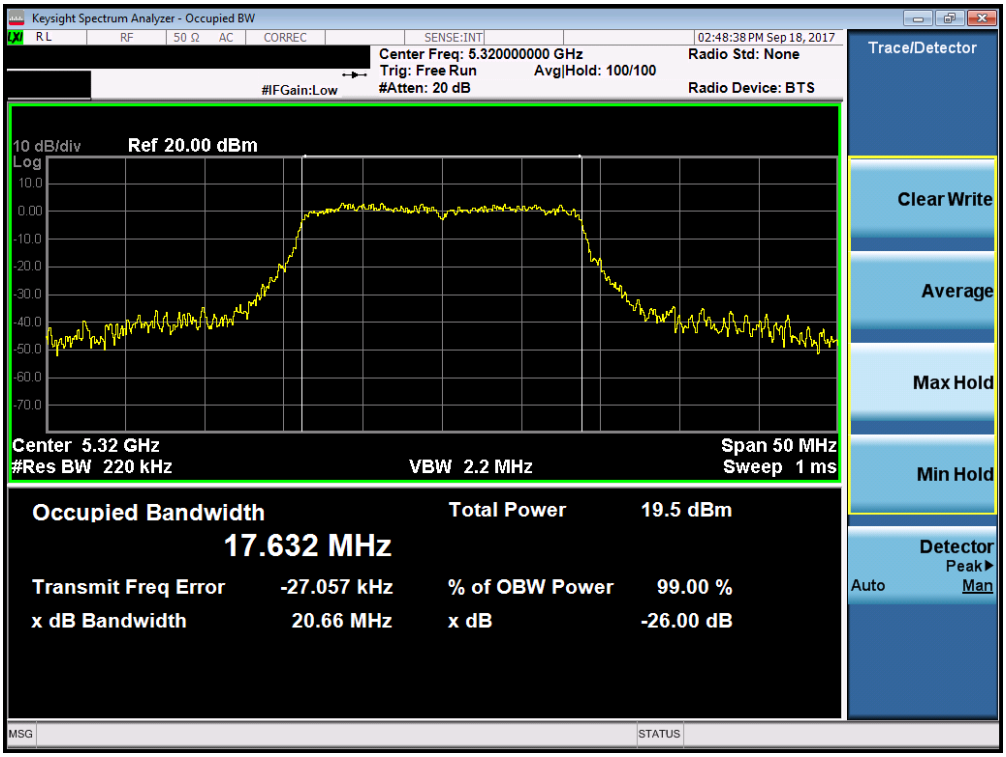


Plot 7-13. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)



Plot 7-14. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 64)

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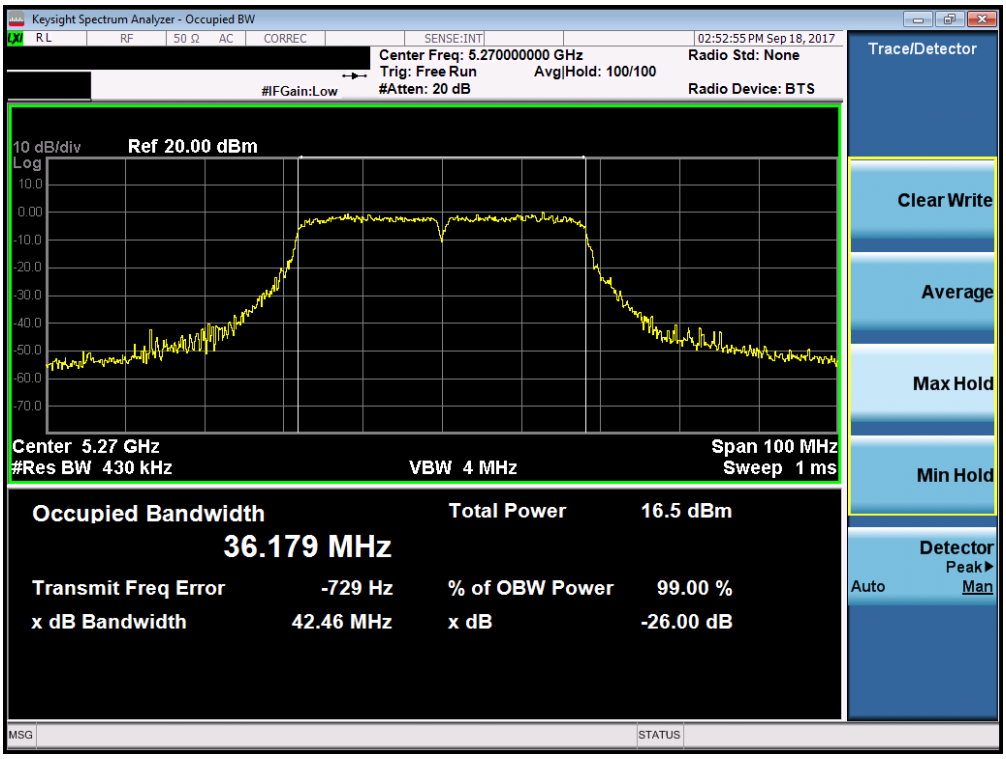
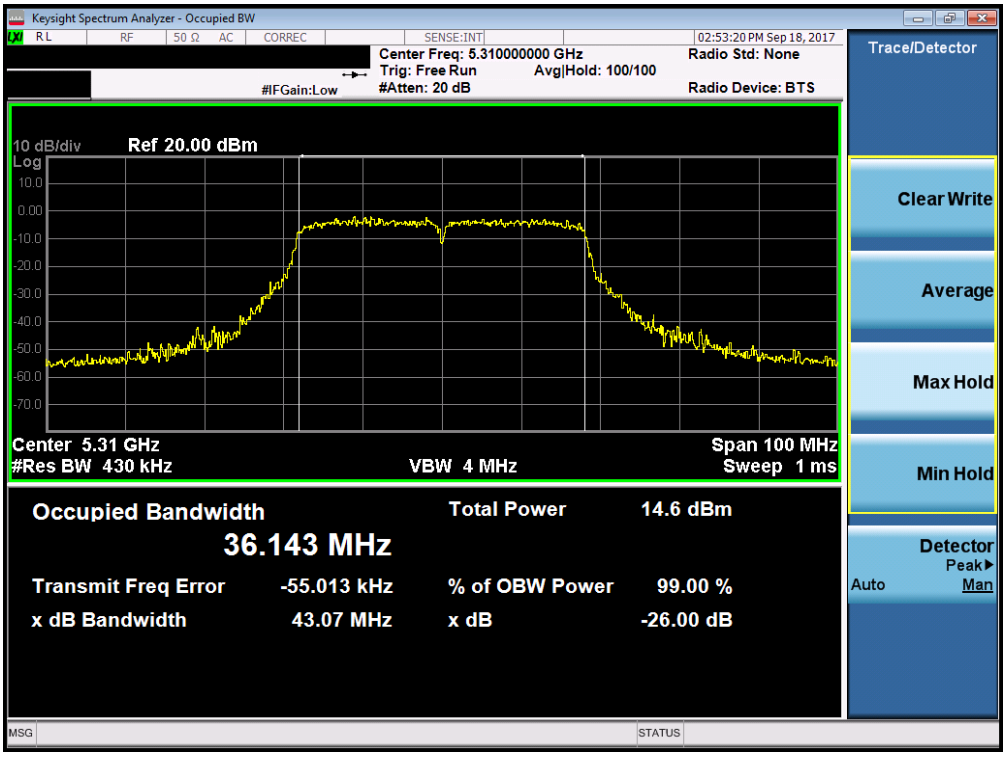


Plot 7-15. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 54)



Plot 7-16. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 62)

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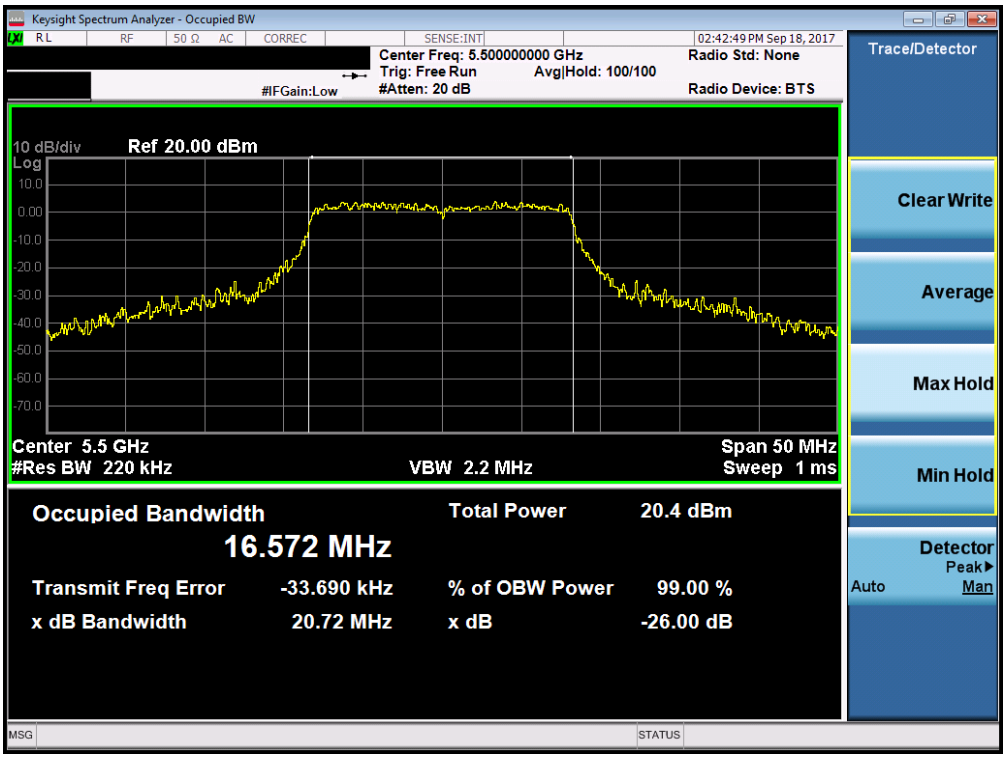

Plot 7-17. 26dB Bandwidth Plot (802.11a (UNII Band 2C) – Ch. 100)

Plot 7-18. 26dB Bandwidth Plot (802.11a (UNII Band 2C) – Ch. 116)

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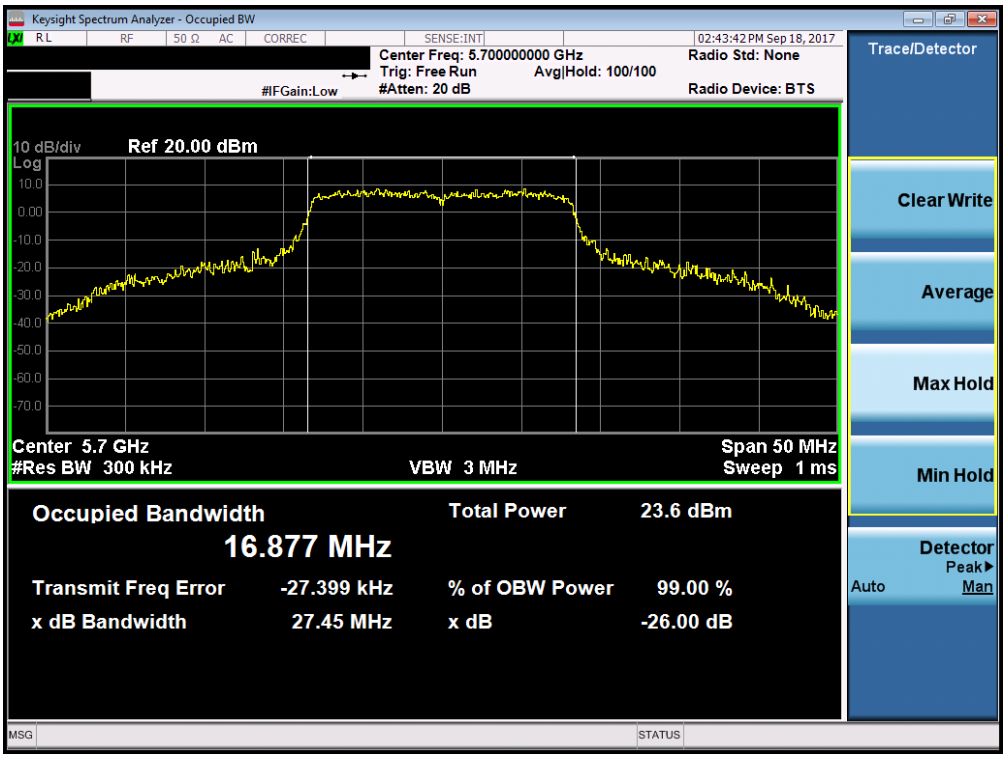
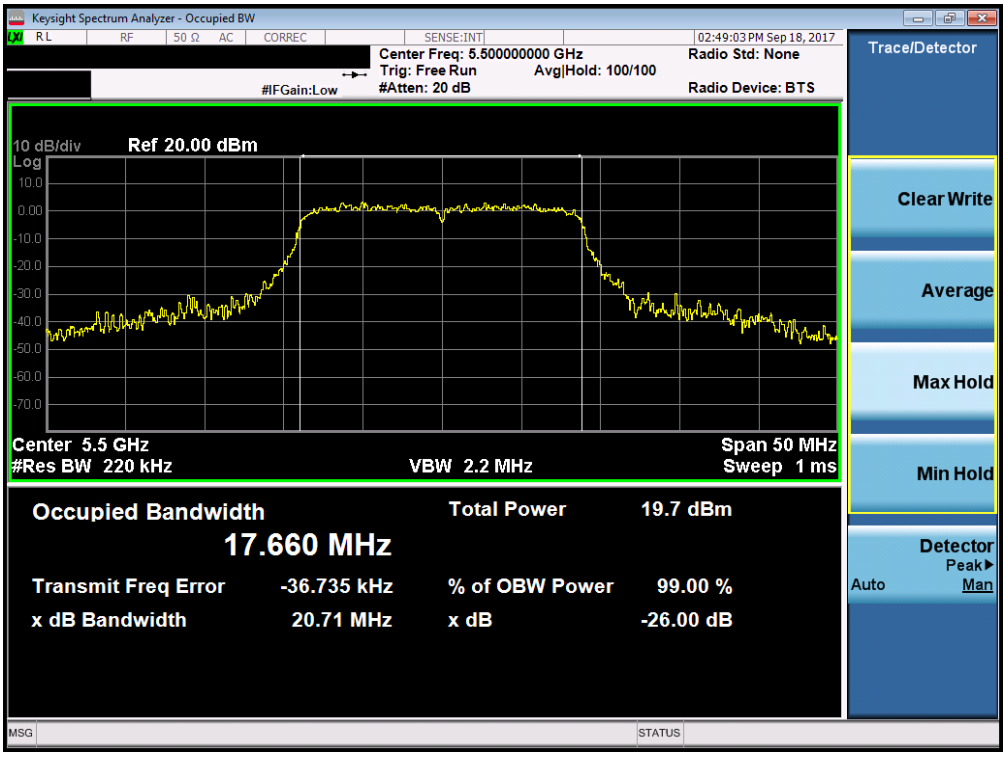


Plot 7-19. 26dB Bandwidth Plot (802.11a (UNII Band 2C) – Ch. 140)



Plot 7-20. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 100)

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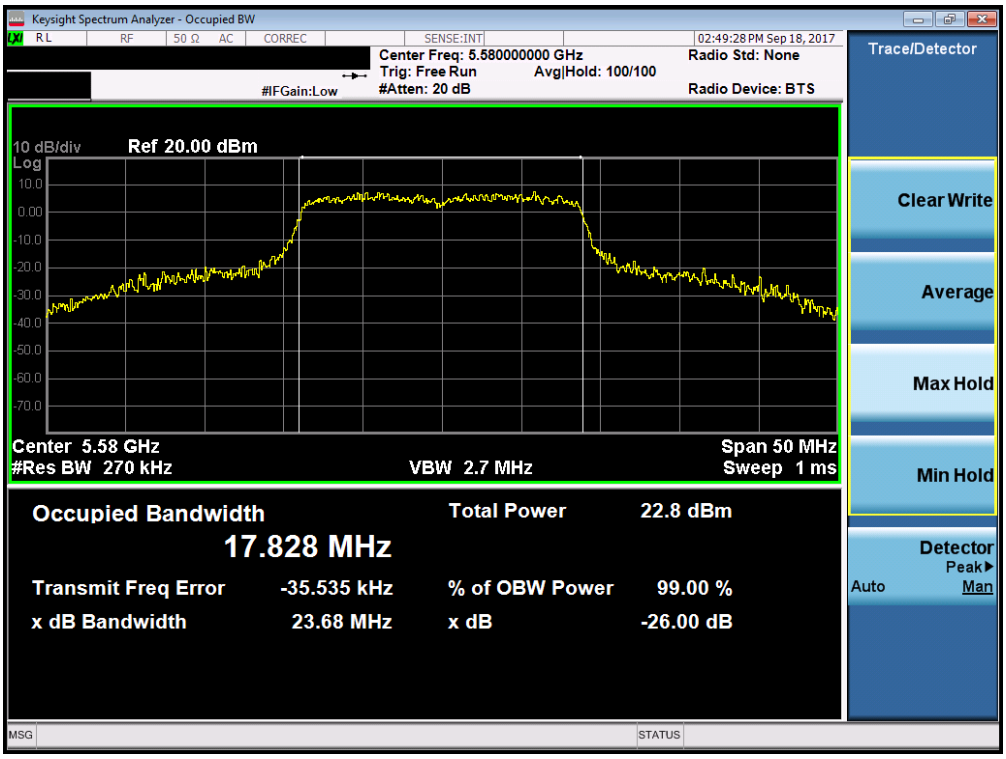
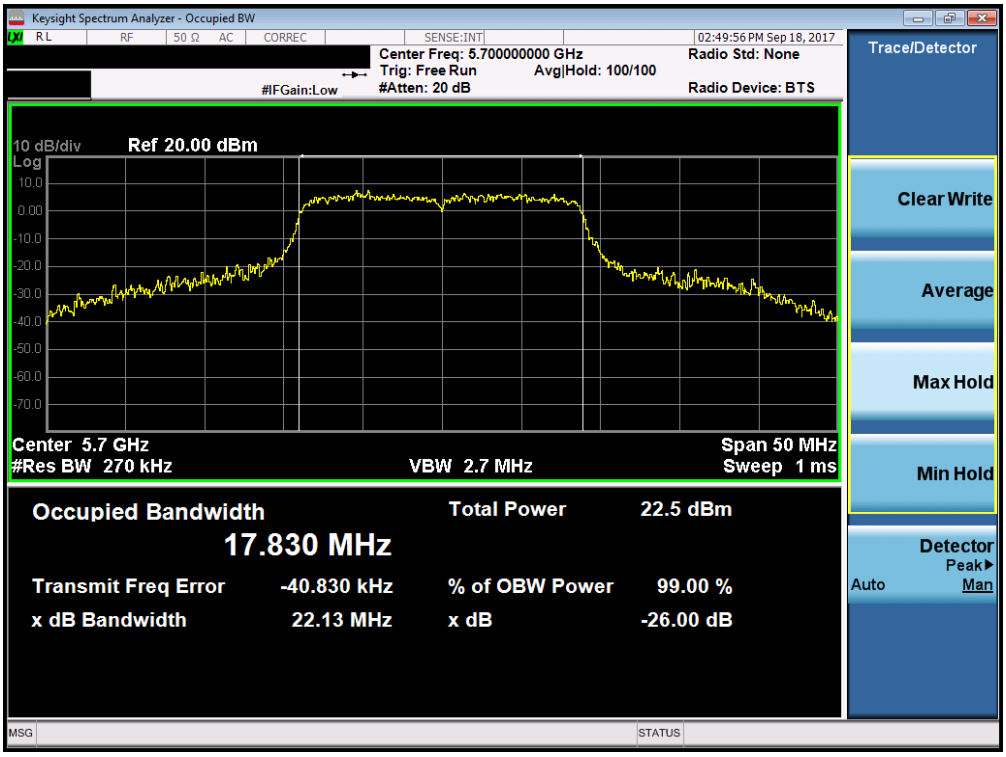


Plot 7-21. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 116)



Plot 7-22. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 140)

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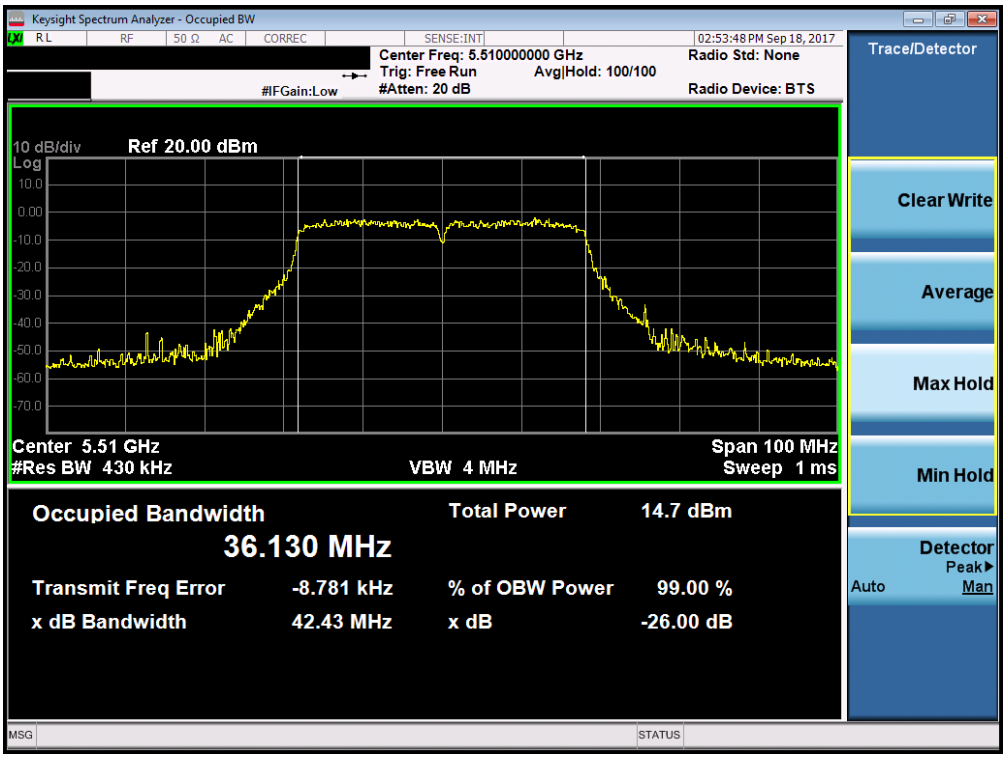
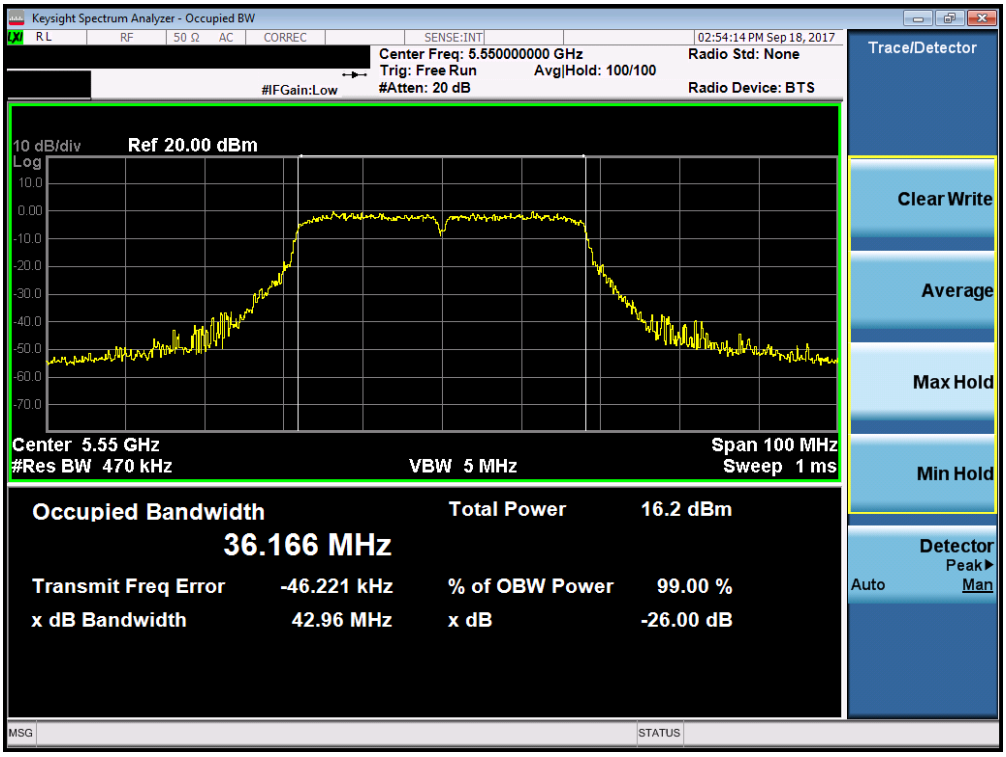


Plot 7-23. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 102)



Plot 7-24. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 110)

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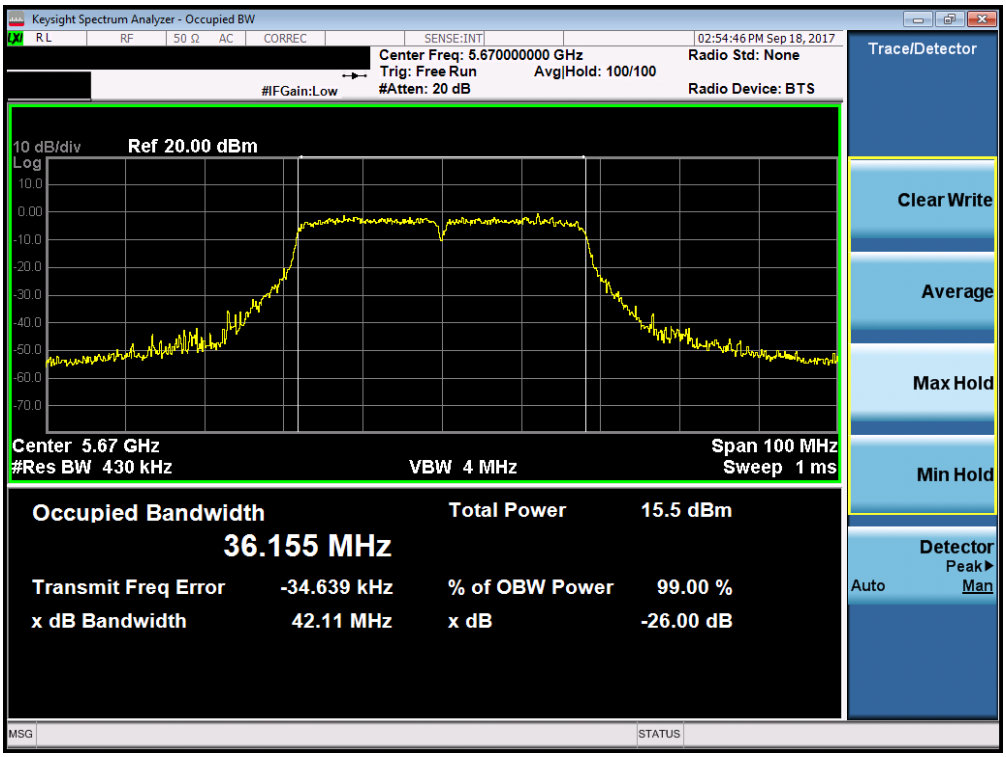

Plot 7-25. 26dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 134)

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7.3 6dB Bandwidth Measurement – 802.11a/n

§15.407 (e); RSS-Gen [6.2]

Test Overview and Limit

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating at its maximum duty cycle, at its maximum power control level, as defined in ANSI C63.10-2013 and KDB 789033 D02 v01r04, and at the appropriate frequencies. The spectrum analyzer's bandwidth measurement function is configured to measure the 6dB bandwidth.

In the 5.725 – *5.850GHz band, the 6dB bandwidth must be ≥ 500 kHz.*

Test Procedure Used

ANSI C63.10-2013 – Section 6.9.2
KDB 789033 D02 v01r04 – Section C

Test Settings

1. The signal analyzers' automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The automatic bandwidth measurement function also has the capability of simultaneously measuring the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 100 kHz
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

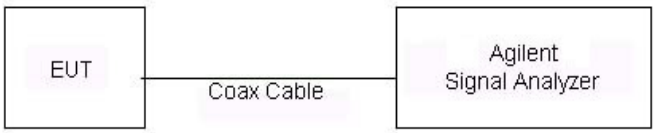

Figure 7-2. Test Instrument & Measurement Setup

Test Notes

None.

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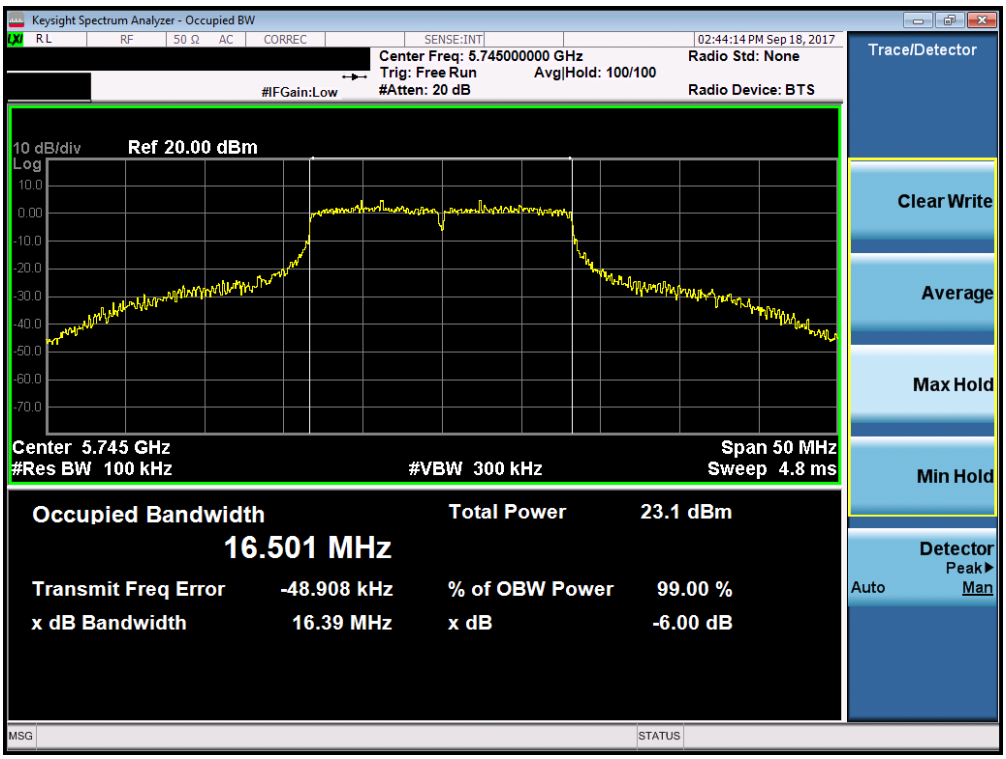
6 dB Bandwidth Measurements

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured 6dB Bandwidth [MHz]
Band 3	5745	149	a	6	16.39
	5785	157	a	6	15.87
	5825	165	a	6	16.36
	5745	149	n (20MHz)	6.5/7.2 (MCS0)	16.73
	5785	157	n (20MHz)	6.5/7.2 (MCS0)	17.21
	5825	165	n (20MHz)	6.5/7.2 (MCS0)	16.90
	5755	151	n (40MHz)	13.5/15 (MCS0)	34.65
	5795	159	n (40MHz)	13.5/15 (MCS0)	34.35

Table 7-3. Conducted Bandwidth Measurements



Plot 7-26. 6dB Bandwidth Plot (802.11a (UNII Band 3) – Ch. 149)

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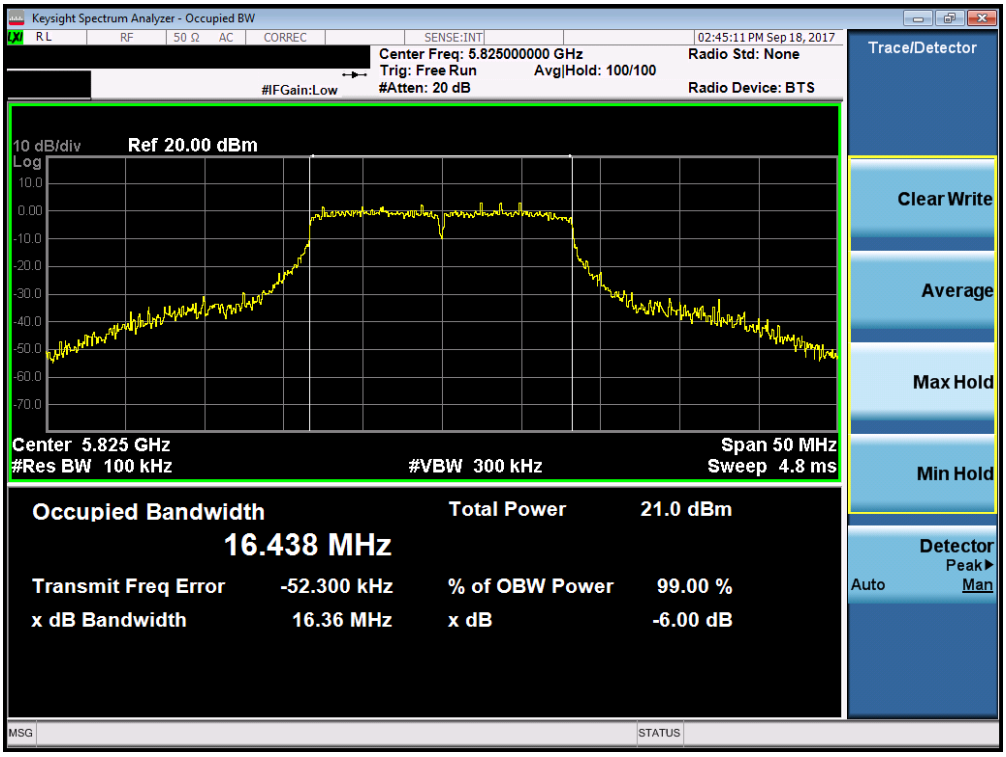
Plot 7-27. 6dB Bandwidth Plot (802.11a (UNII Band 3) – Ch. 157)



Plot 7-28. 6dB Bandwidth Plot (802.11a (UNII Band 3) – Ch. 165)

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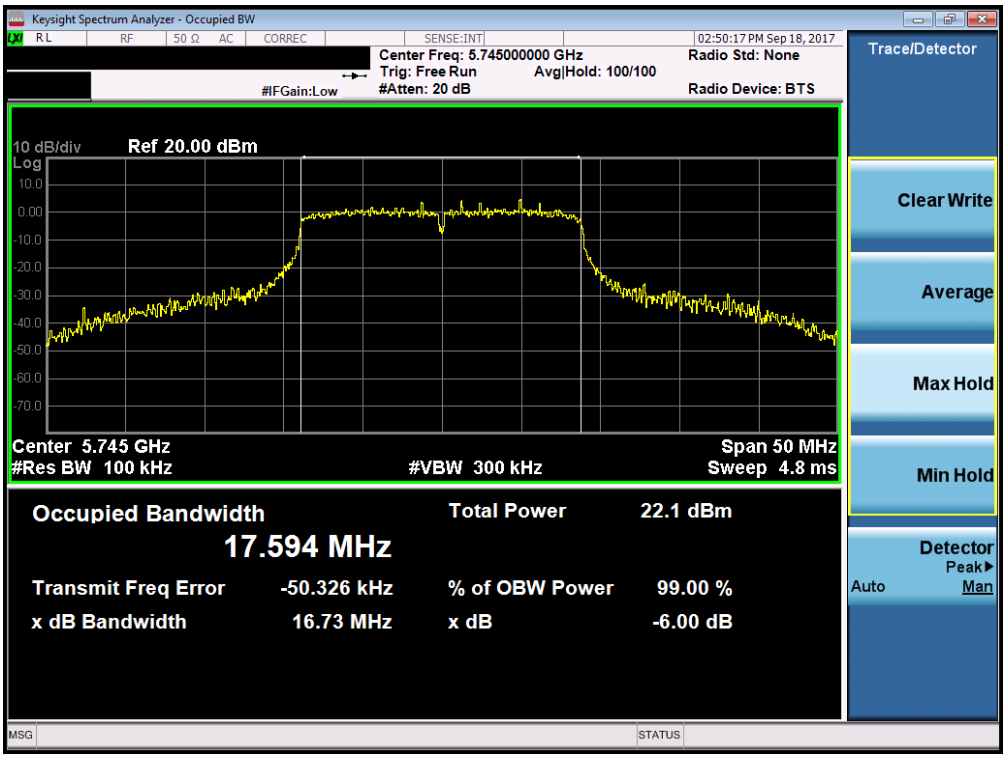
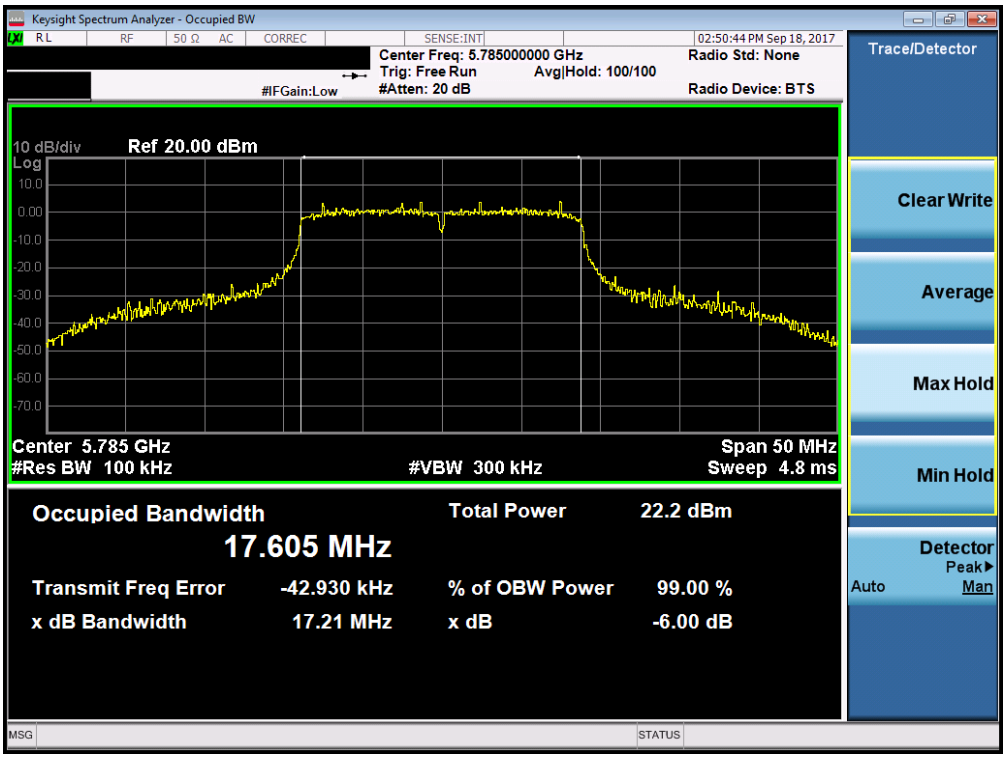


Plot 7-29. 6dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 149)



Plot 7-30. 6dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 157)

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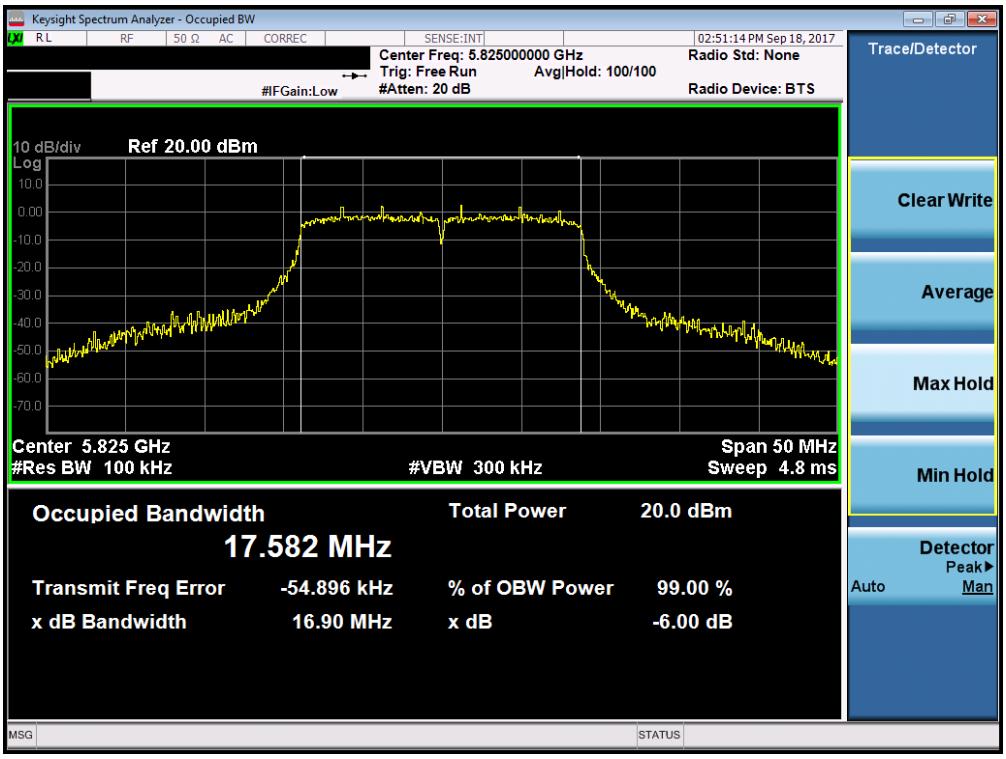
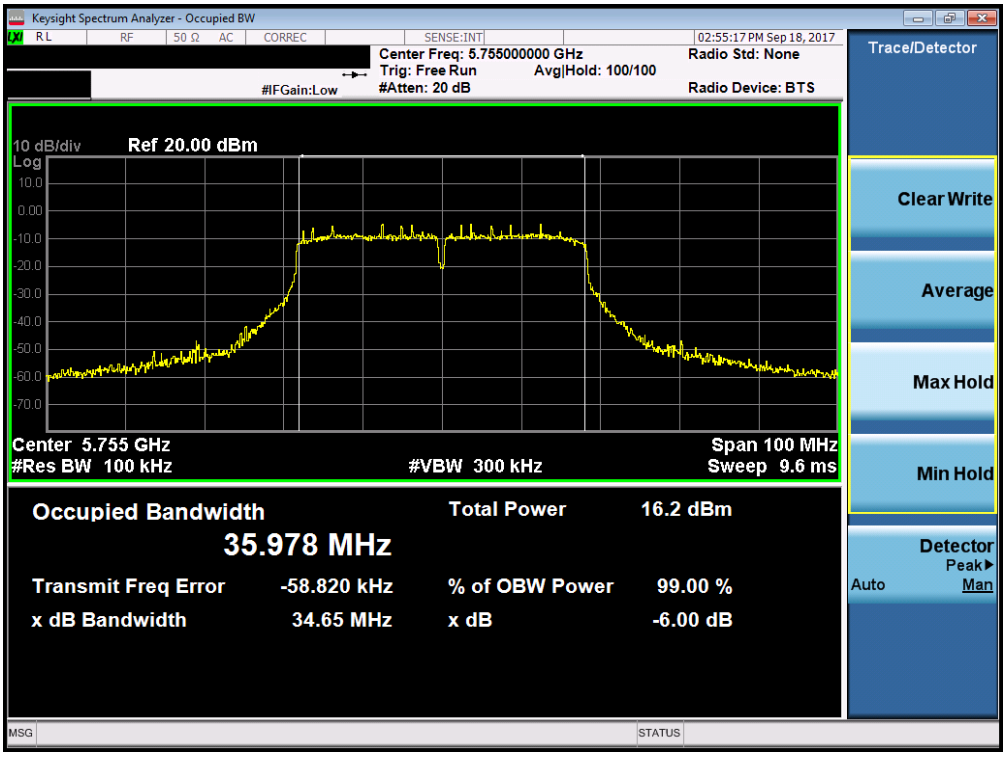


Plot 7-31. 6dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 165)



Plot 7-32. 6dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 3) – Ch. 151)

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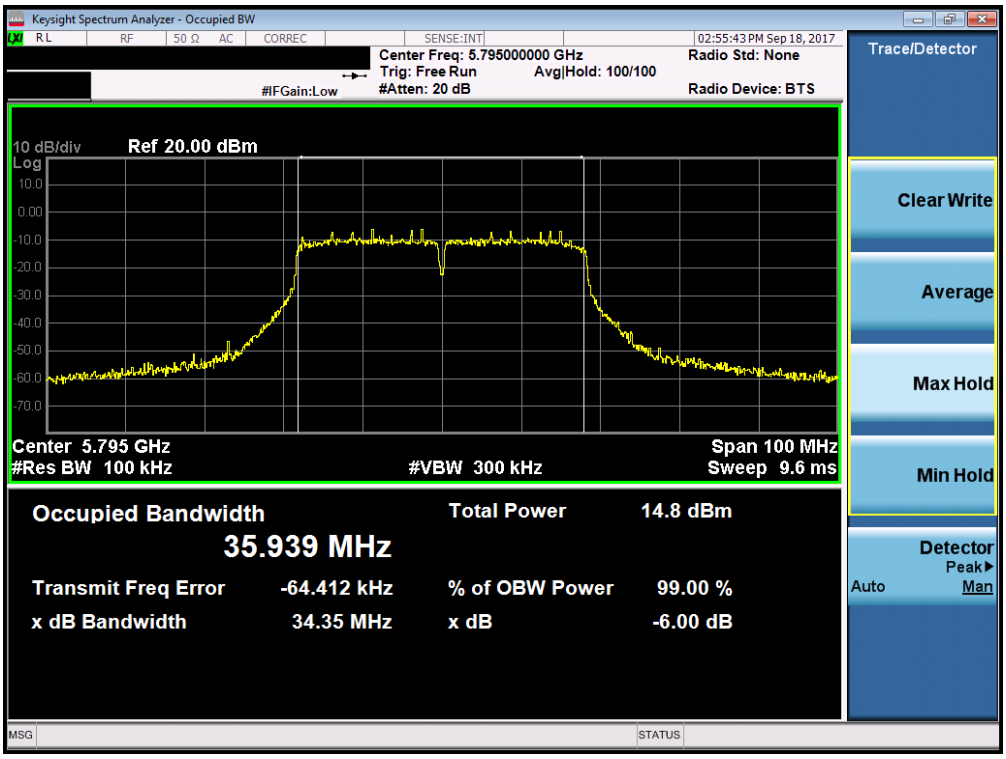

Plot 7-33. 6dB Bandwidth Plot (40MHz BW 802.11n (UNII Band 3) – Ch. 159)

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7.4 UNII Output Power Measurement – 802.11a/n

§15.407(a.1.iv) §15.407(a.2) §15.407(a.3); RSS-247 [6.2]

Test Overview and Limits

A transmitter antenna terminal of the EUT is connected to the input of an RF pulse power sensor. Measurement is made using a broadband average power meter while the EUT is operating at its maximum duty cycle, at its maximum power control level, as defined in ANSI C63.10-2013 and KDB 789033 D02 v01r04, and at the appropriate frequencies.

In the 5.15 – 5.25GHz band, the maximum permissible conducted output power is 250mW (23.98dBm).

In the 5.25 – 5.35GHz band, the maximum permissible conducted output power is the lesser of 250mW (23.98dBm) and 11 dBm + 10log$_{10}$(26dB BW) = 11 dBm + 10log$_{10}$(20.30) = 24.07dBm.

In the 5.47 – 5.725GHz band, the maximum permissible conducted output power is the lesser of 250mW (23.98dBm) and 11 dBm + 10log$_{10}$(26dB BW) = 11 dBm + 10log$_{10}$(20.71) = 24.16dBm.

In the 5.725 – 5.850GHz band, the maximum permissible conducted output power is 1W (30dBm).

Test Procedure Used

ANSI C63.10-2013 – Section 12.3.3.2 Method PM-G
KDB 789033 D02 v01r04 – Section E)3)b) Method PM-G

Test Settings

Average power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter. The trace was averaged over 100 traces to obtain the final measured average power.

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

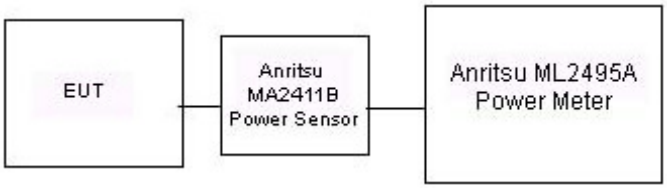

Figure 7-3. Test Instrument & Measurement Setup

Test Notes

None

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Freq [MHz]	Channel	5GHz (20MHz) Conducted Power [dBm]	
		IEEE Transmission Mode	
		802.11a	802.11n
5180	36	14.23	13.50
5200	40	17.88	16.81
5220	44	17.50	16.18
5240	48	17.53	16.76
5260	52	17.73	16.80
5280	56	17.50	16.44
5300	60	17.31	16.38
5320	64	14.40	13.49
5500	100	14.99	13.69
5580	116	17.68	16.80
5660	132	17.35	16.38
5700	140	17.50	16.40
5745	149	17.35	16.26
5785	157	17.62	16.35
5825	165	14.99	13.78

Table 7-4. 20MHz BW (UNII) Maximum Conducted Output Power

Freq [MHz]	5GHz (40MHz) Conducted Power [dBm]
	IEEE Transmission Mode
	802.11n
5190	11.16
5230	11.01
5270	10.43
5310	8.46
5510	8.85
5550	10.28
5670	9.95
5755	10.02
5795	8.56

Table 7-5. 40MHz BW (UNII) Maximum Conducted Output Power

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7.5 Maximum Power Spectral Density – 802.11a/n

§15.407(a.1.iv) §15.407(a.2) §15.407(a.3); RSS-247 [6.2]

Test Overview and Limit

The spectrum analyzer was connected to the antenna terminal while the EUT was operating at its maximum duty cycle, at its maximum power control level, as defined in ANSI C63.10-2013 and KDB 789033 D02 v01r04, and at the appropriate frequencies. Method SA-1, as defined in ANSI C63.10-2013 and KDB 789033 D02 v01r04, was used to measure the power spectral density.

In the 5.15 – 5.25GHz, 5.25 – 5.35GHz, 5.47 – 5.725GHz bands, the maximum permissible power spectral density is 11dBm/MHz.

In the 5.725 – 5.850GHz band, the maximum permissible power spectral density is 30dBm/500kHz.

Test Procedure Used

ANSI C63.10-2013 – Section 12.3.2.2
KDB 789033 D02 v01r04 – Section F

Test Settings

1. Analyzer was set to the center frequency of the UNII channel under investigation
2. Span was set to encompass the entire emission bandwidth of the signal
3. RBW = 1MHz
4. VBW = 3MHz
5. Number of sweep points $\geq$ 2 x (span/RBW)
6. Sweep time = auto
7. Detector = power averaging (RMS)
8. Trigger was set to free run for all modes
9. Trace was averaged over 100 sweeps
10. The peak search function of the spectrum analyzer was used to find the peak of the spectrum.

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

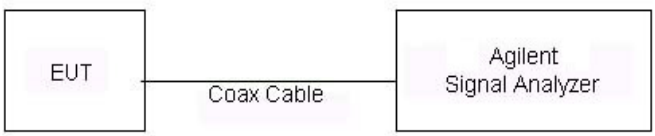

Figure 7-4. Test Instrument & Measurement Setup

Test Notes

None

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	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Power Density [dBm]	Max Power Density [dBm/MHz]	Margin [dB]	ISED Max Power Density [dBm/MHz]	Margin [dB]
Band 1	5180	36	a	6	2.91	11.0	-8.09	10.0	-7.09
	5200	40	a	6	6.48	11.0	-4.52	10.0	-3.52
	5240	48	a	6	6.19	11.0	-4.81	10.0	-3.81
	5180	36	n (20MHz)	6.5/7.2 (MCS0)	1.78	11.0	-9.22	10.0	-8.22
	5200	40	n (20MHz)	6.5/7.2 (MCS0)	5.26	11.0	-5.74	10.0	-4.74
	5240	48	n (20MHz)	6.5/7.2 (MCS0)	5.07	11.0	-5.93	10.0	-4.93
	5190	38	n (40MHz)	13.5/15 (MCS0)	-3.65	11.0	-14.65	10.0	-13.65
	5230	46	n (40MHz)	13.5/15 (MCS0)	-3.59	11.0	-14.59	10.0	-13.59
Band 2A	5260	52	a	6	5.86	11.0	-5.14		
	5280	56	a	6	6.20	11.0	-4.80		
	5320	64	a	6	3.25	11.0	-7.75		
	5260	52	n (20MHz)	6.5/7.2 (MCS0)	4.83	11.0	-6.17		
	5280	56	n (20MHz)	6.5/7.2 (MCS0)	4.97	11.0	-6.03		
	5320	64	n (20MHz)	6.5/7.2 (MCS0)	2.02	11.0	-8.99		
	5270	54	n (40MHz)	13.5/15 (MCS0)	-4.24	11.0	-15.24		
	5310	62	n (40MHz)	13.5/15 (MCS0)	-5.92	11.0	-16.92		
Band 2C	5500	100	a	6	3.43	11.0	-7.58		
	5580	116	a	6	6.45	11.0	-4.55		
	5700	140	a	6	6.45	11.0	-4.55		
	5500	100	n (20MHz)	6.5/7.2 (MCS0)	2.04	11.0	-8.96		
	5580	116	n (20MHz)	6.5/7.2 (MCS0)	5.17	11.0	-5.84		
	5700	140	n (20MHz)	6.5/7.2 (MCS0)	5.20	11.0	-5.80		
	5510	102	n (40MHz)	13.5/15 (MCS0)	-6.03	11.0	-17.03		
	5550	110	n (40MHz)	13.5/15 (MCS0)	-4.69	11.0	-15.69		
	5670	134	n (40MHz)	13.5/15 (MCS0)	-5.16	11.0	-16.16		

Table 7-6. Bands 1, 2A, 2C Conducted Power Spectral Density Measurements

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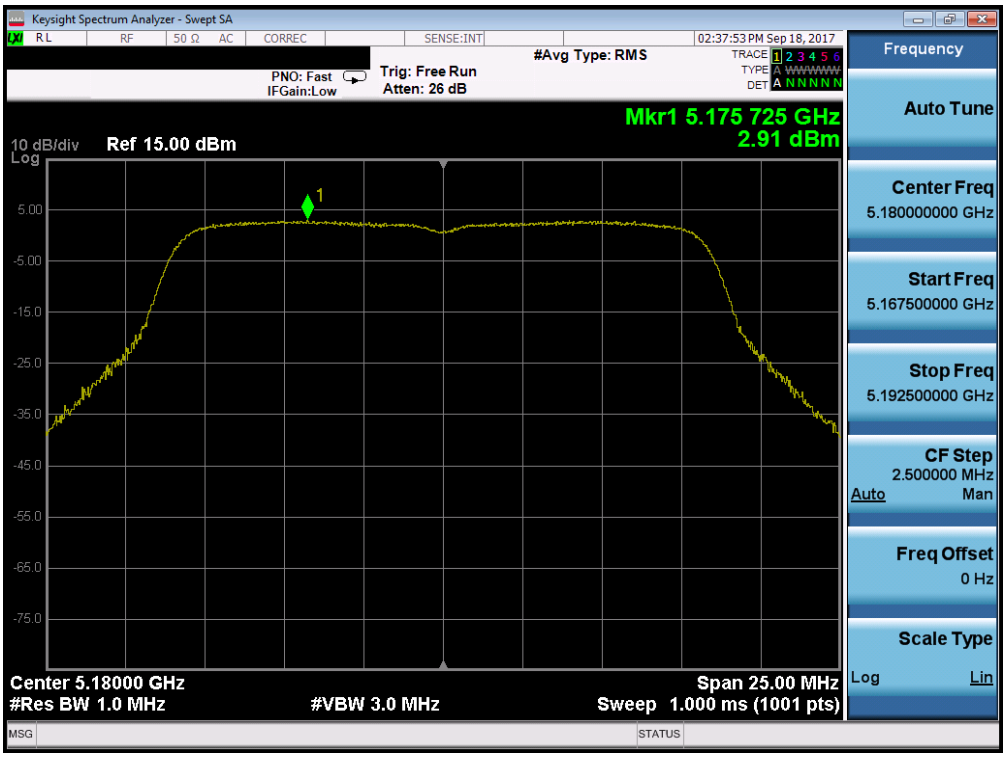
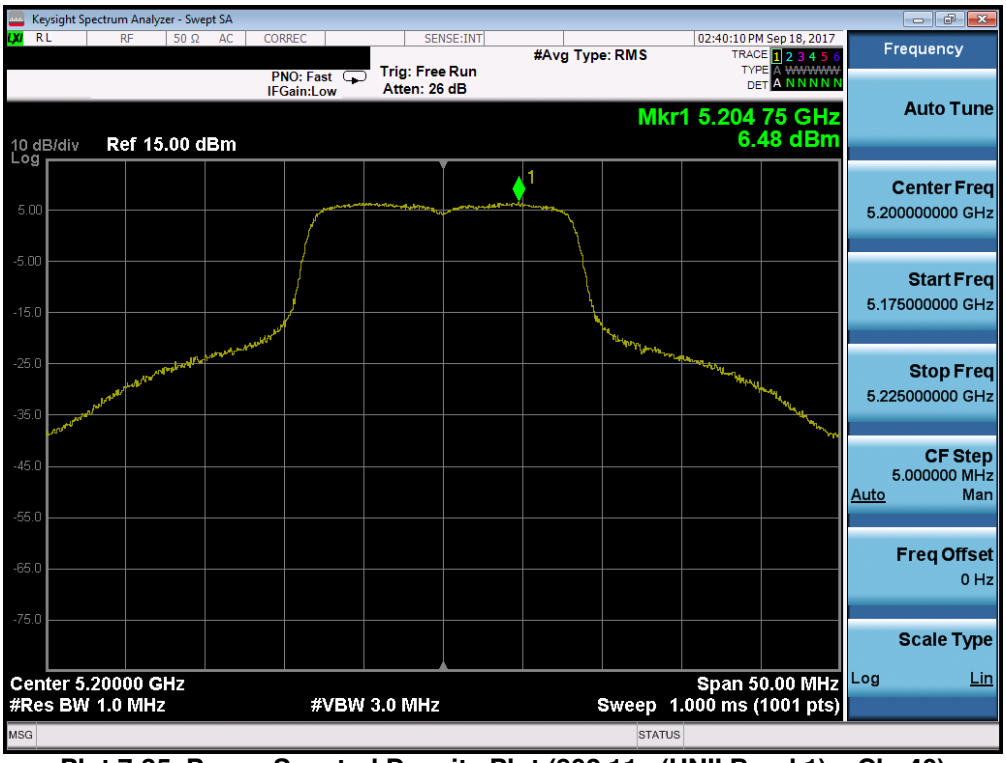


Plot 7-34. Power Spectral Density Plot (802.11a (UNII Band 1) – Ch. 36)



Plot 7-35. Power Spectral Density Plot (802.11a (UNII Band 1) – Ch. 40)

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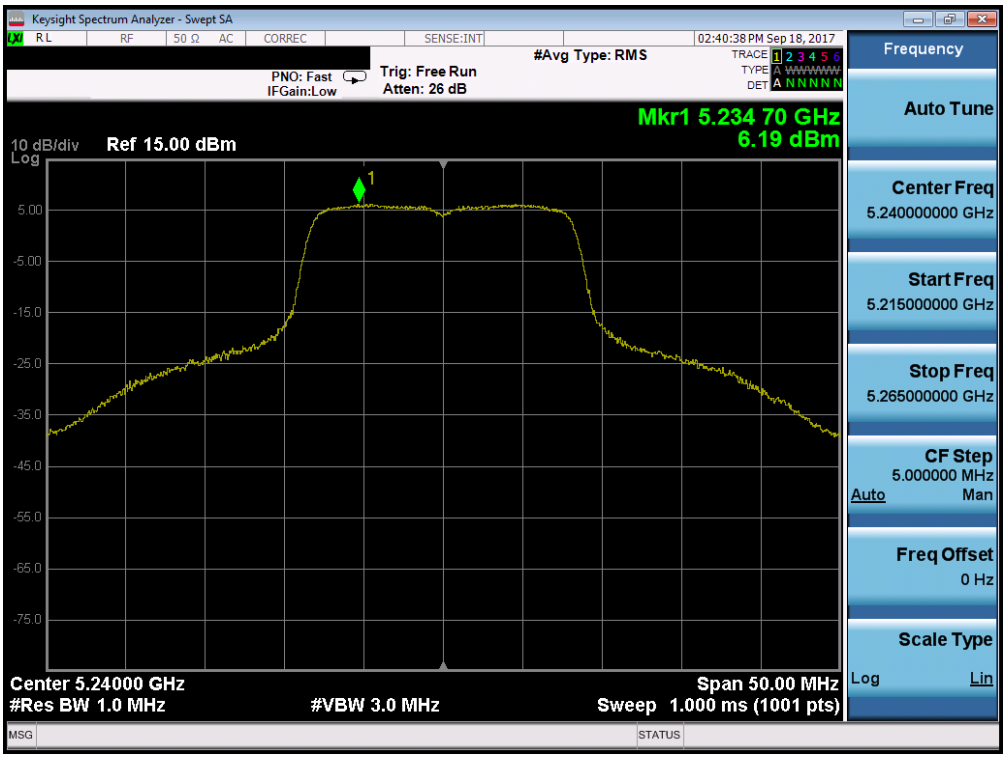
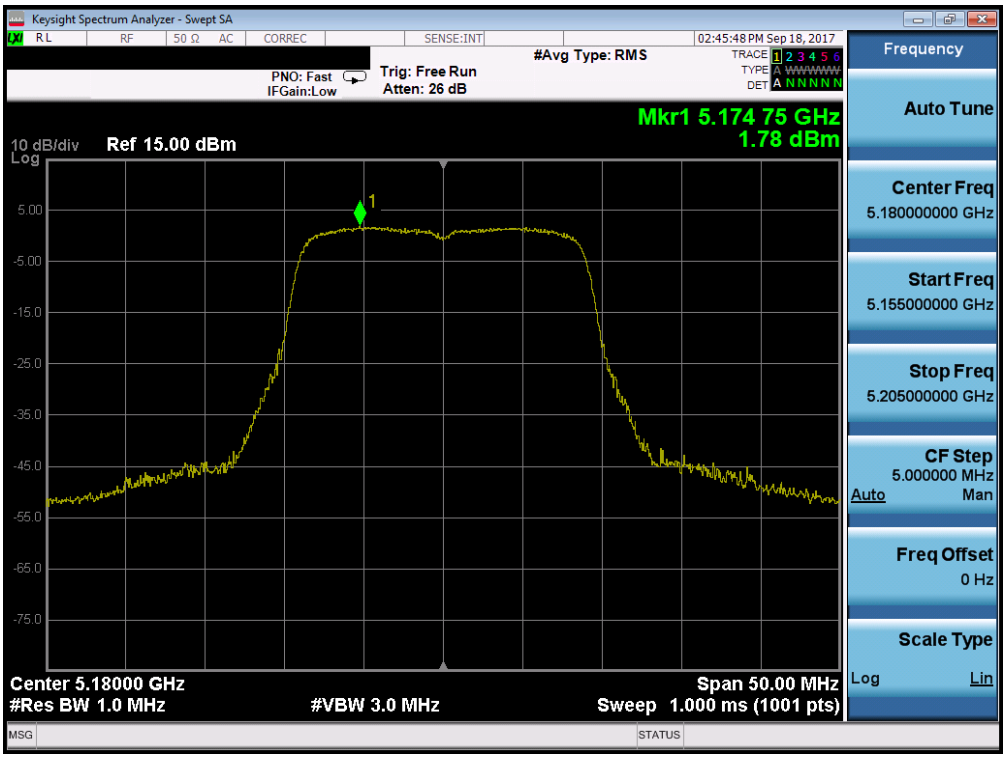


Plot 7-36. Power Spectral Density Plot (802.11a (UNII Band 1) – Ch. 48)



Plot 7-37. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 36)

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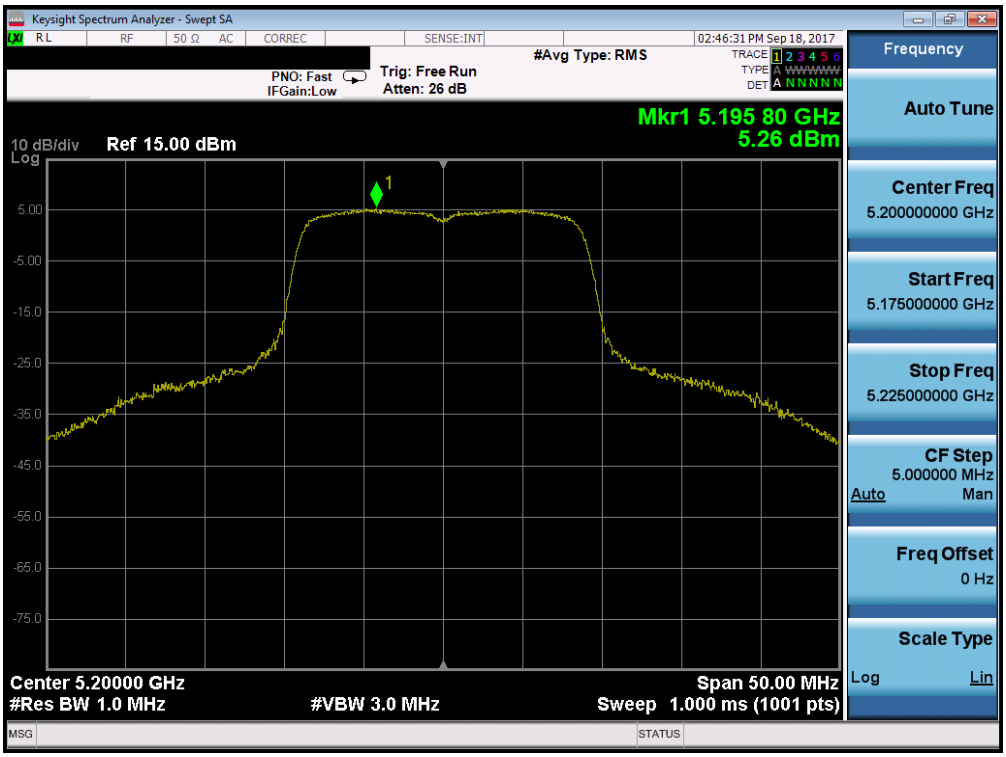
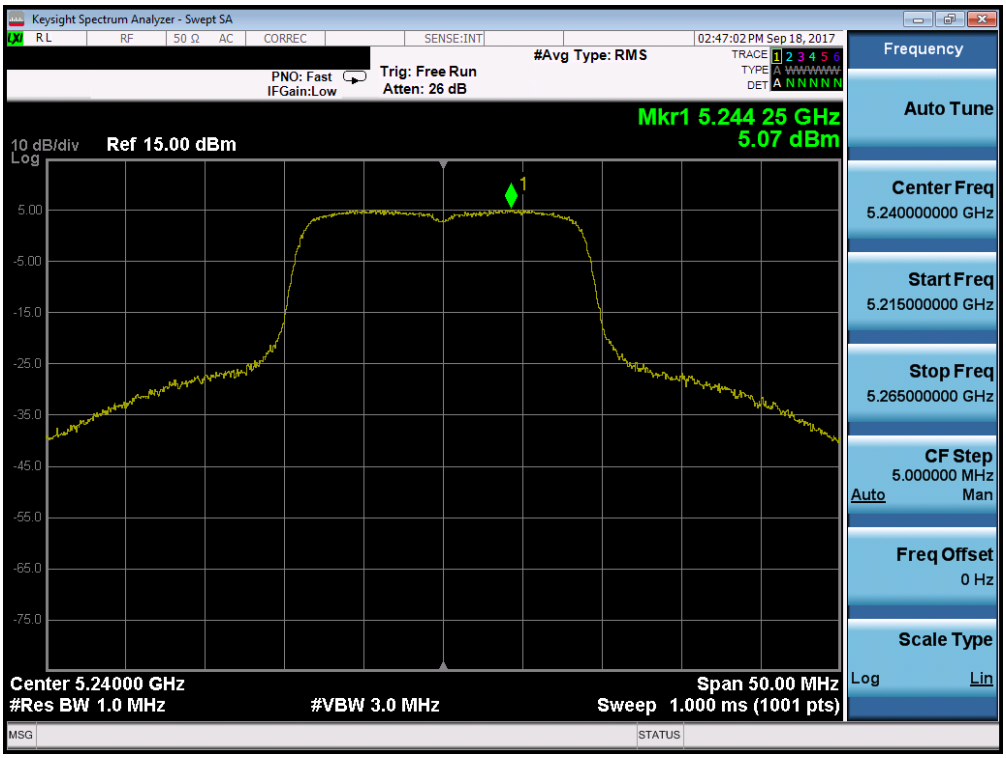


Plot 7-38. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 40)



Plot 7-39. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 48)

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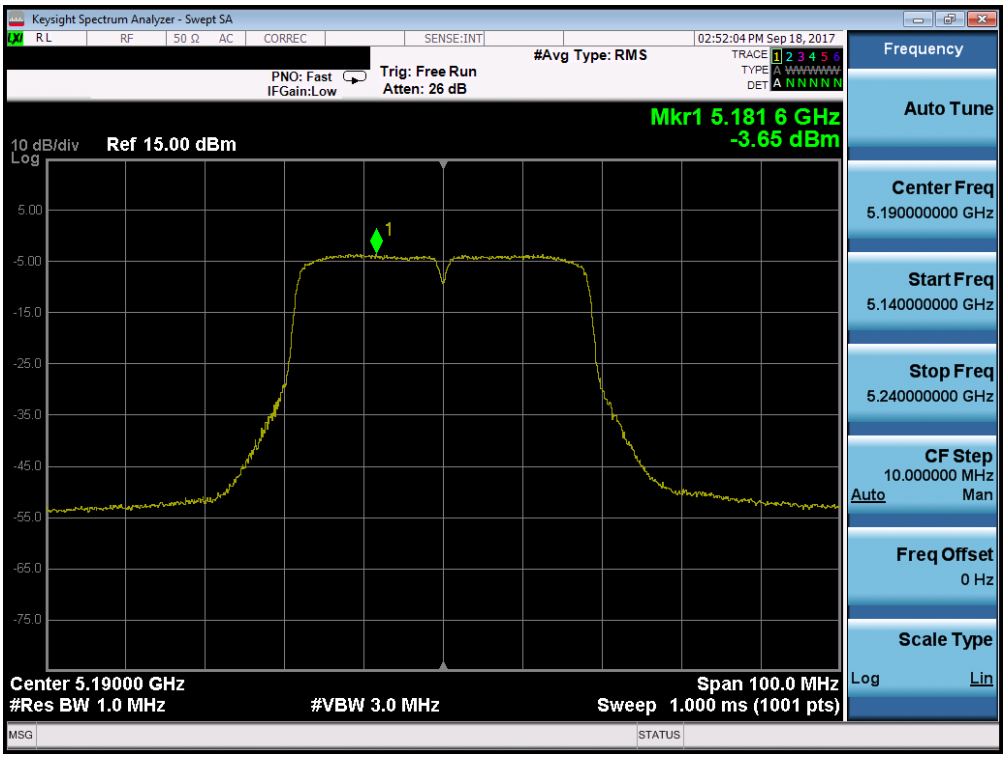
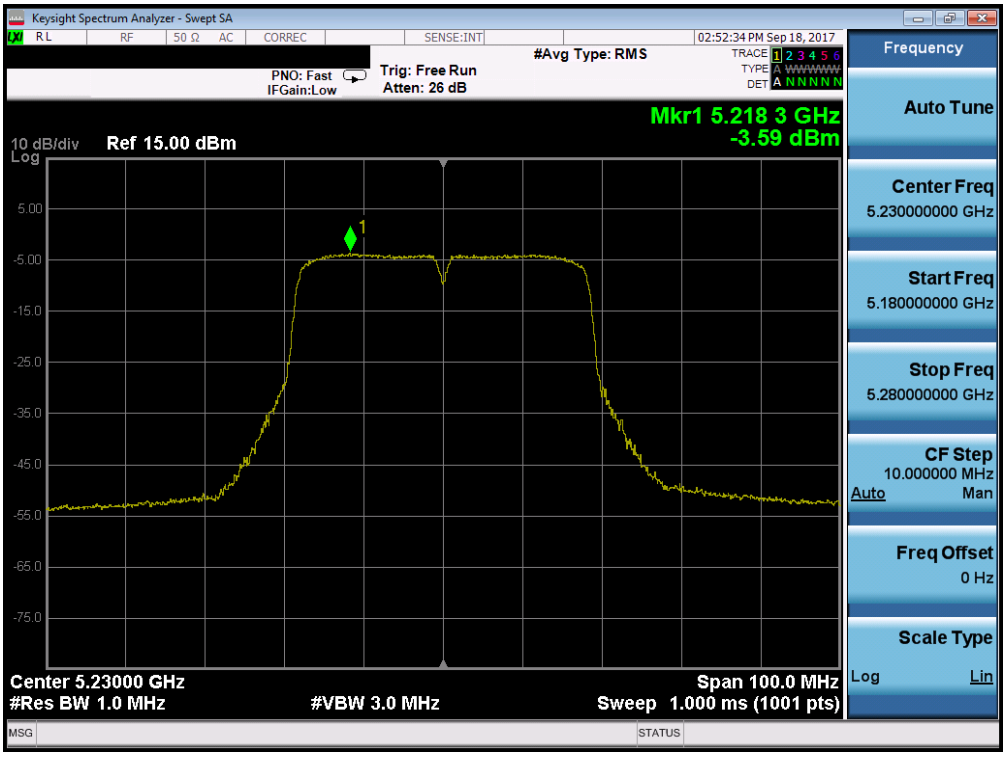


Plot 7-40. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 38)



Plot 7-41. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 1) – Ch. 46)

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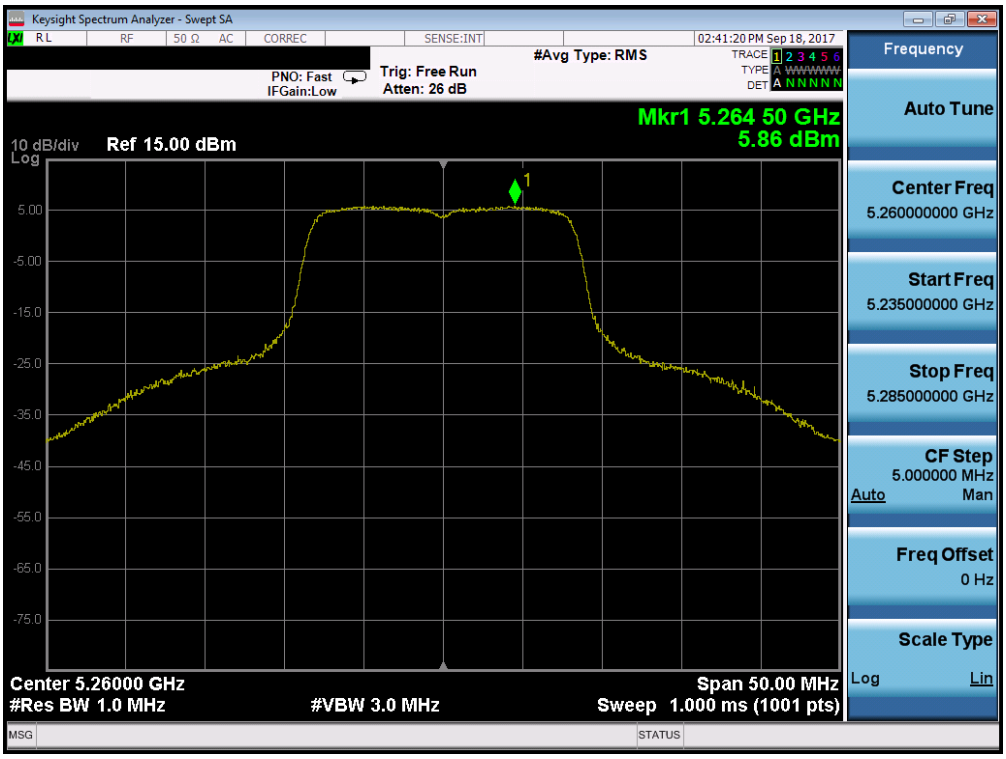
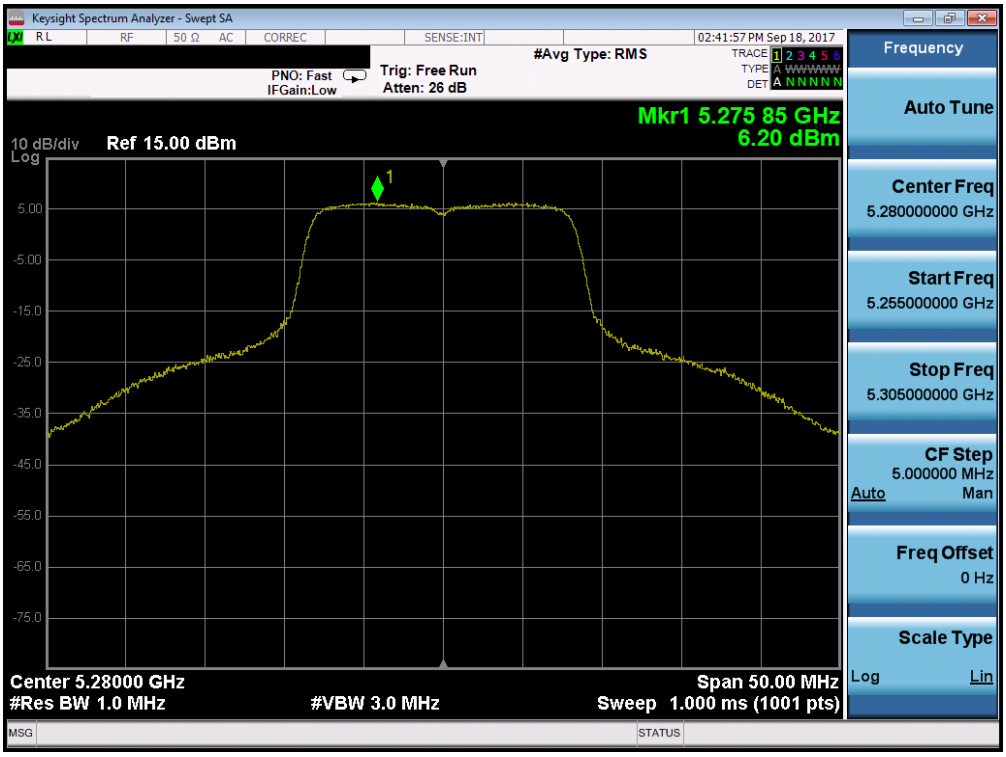


Plot 7-42. Power Spectral Density Plot (802.11a (UNII Band 2A) – Ch. 52)



Plot 7-43. Power Spectral Density Plot (802.11a (UNII Band 2A) – Ch. 56)

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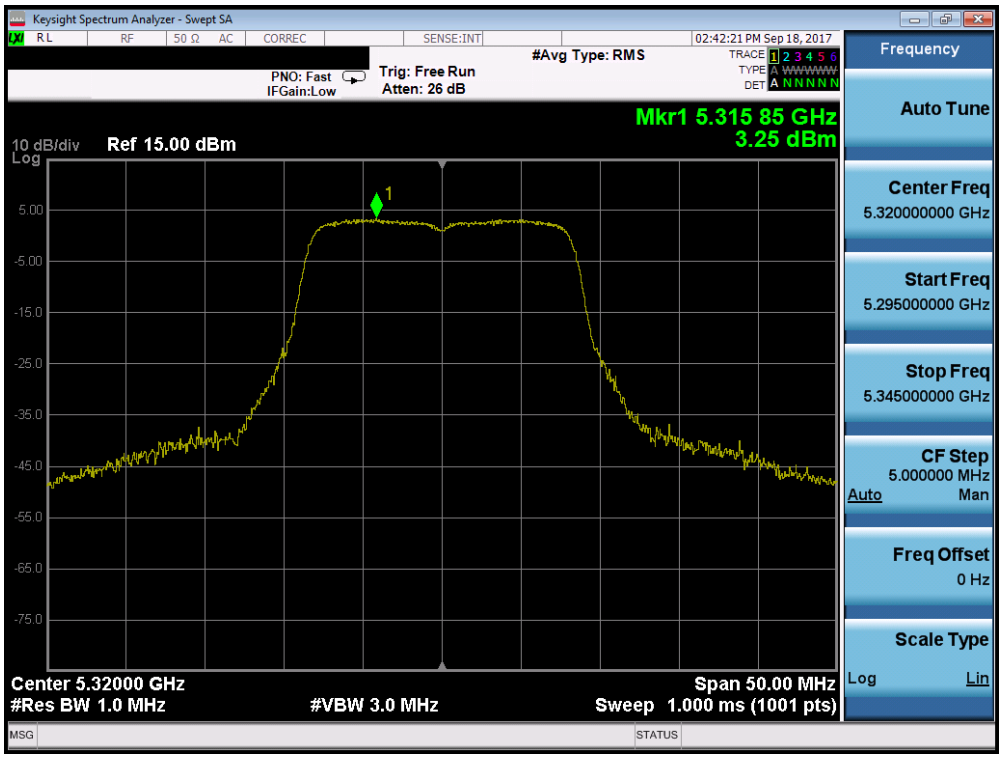
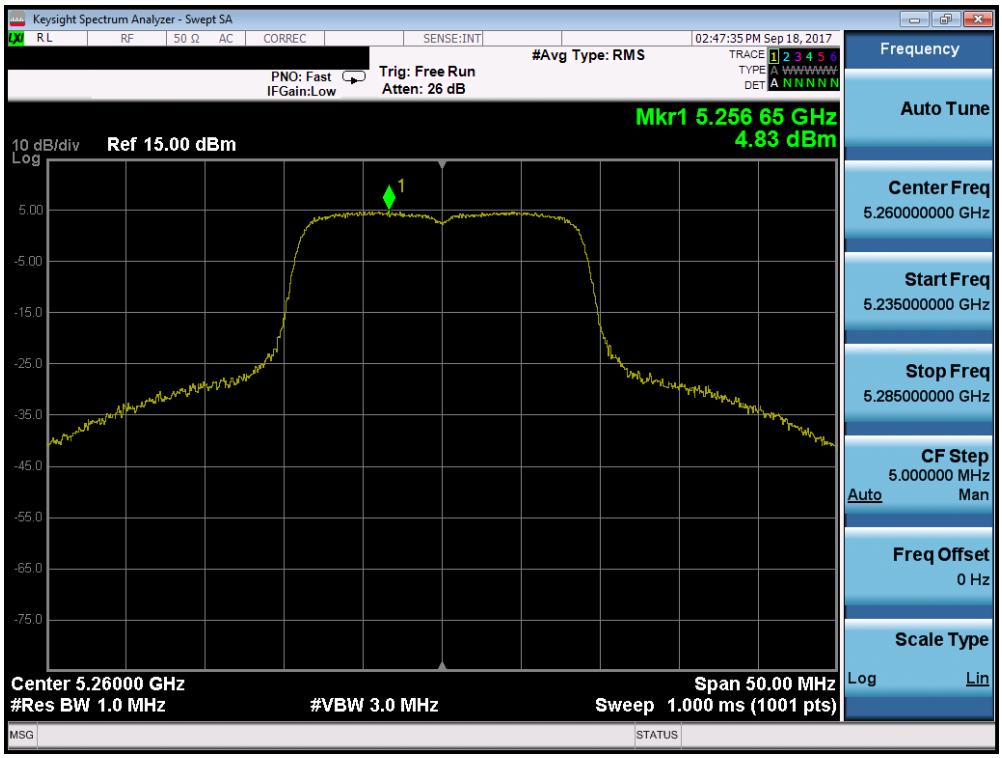


Plot 7-44. Power Spectral Density Plot (802.11a (UNII Band 2A) – Ch. 64)



Plot 7-45. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 52)

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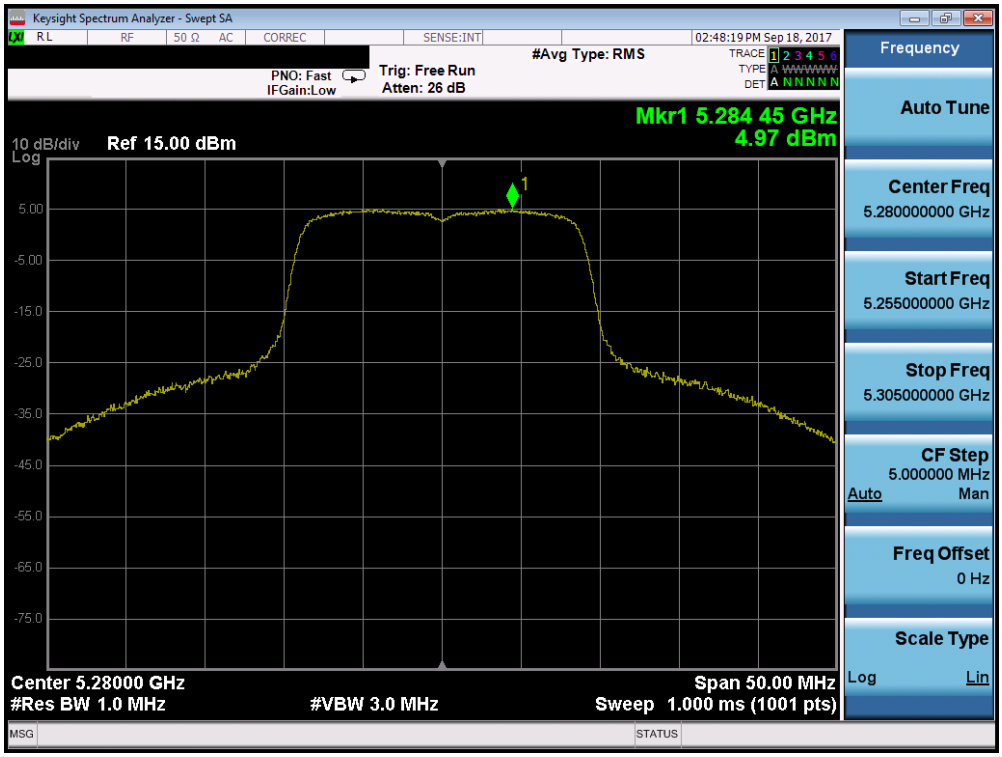
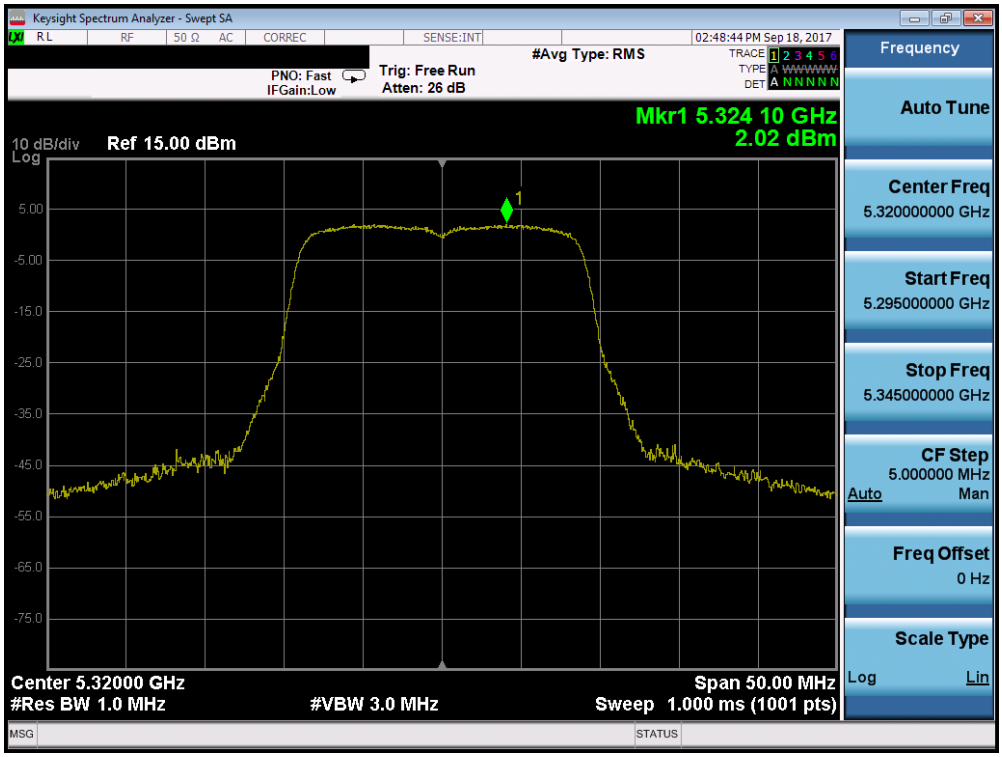


Plot 7-46. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)



Plot 7-47. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 64)

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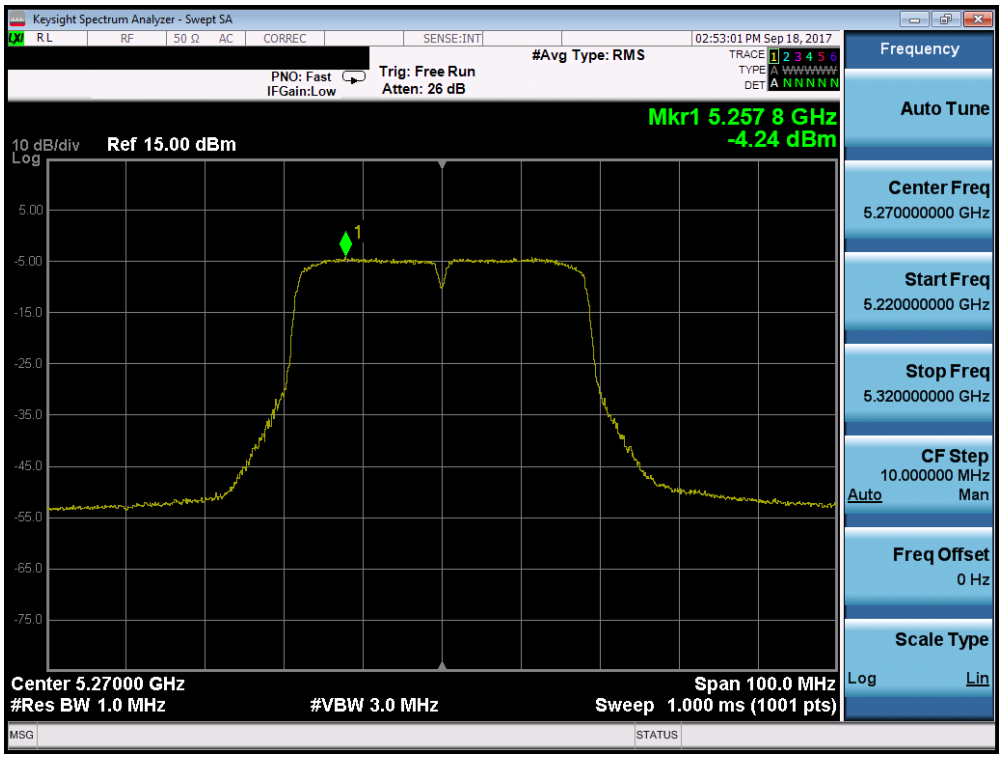
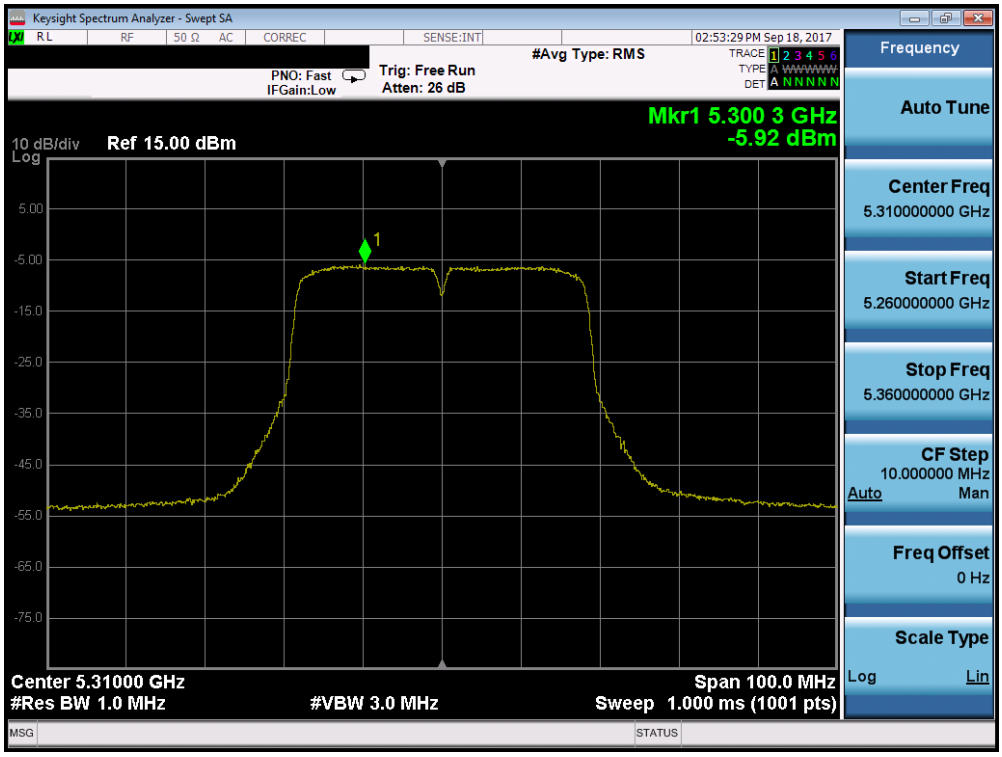


Plot 7-48. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 54)



Plot 7-49. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 2A) – Ch. 62)

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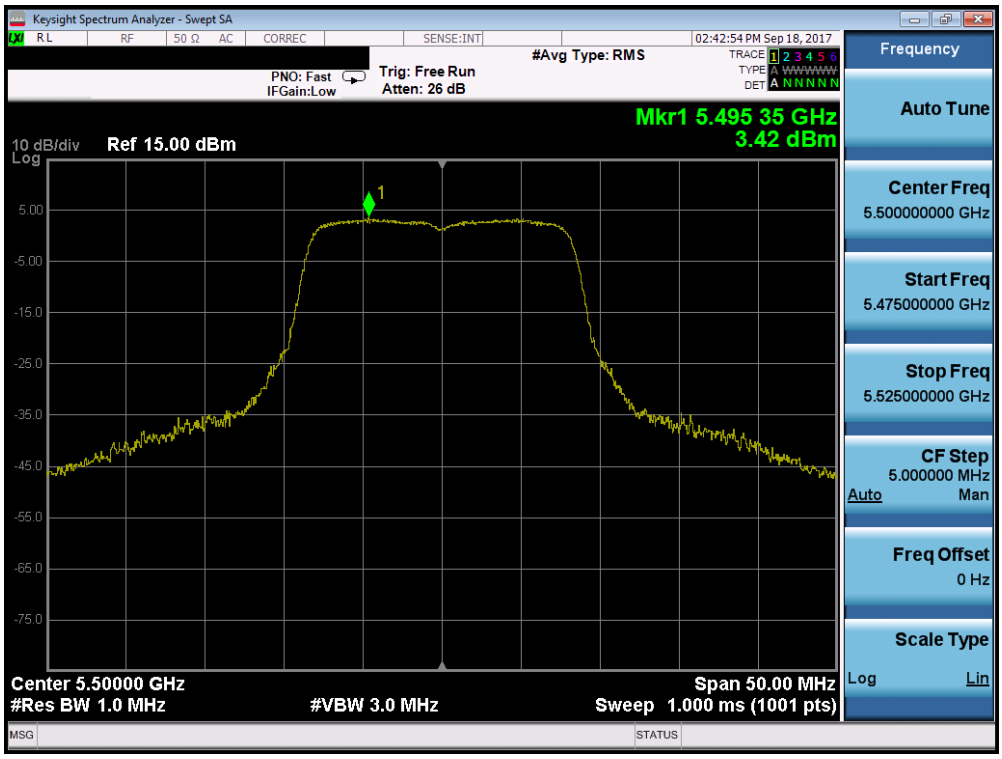
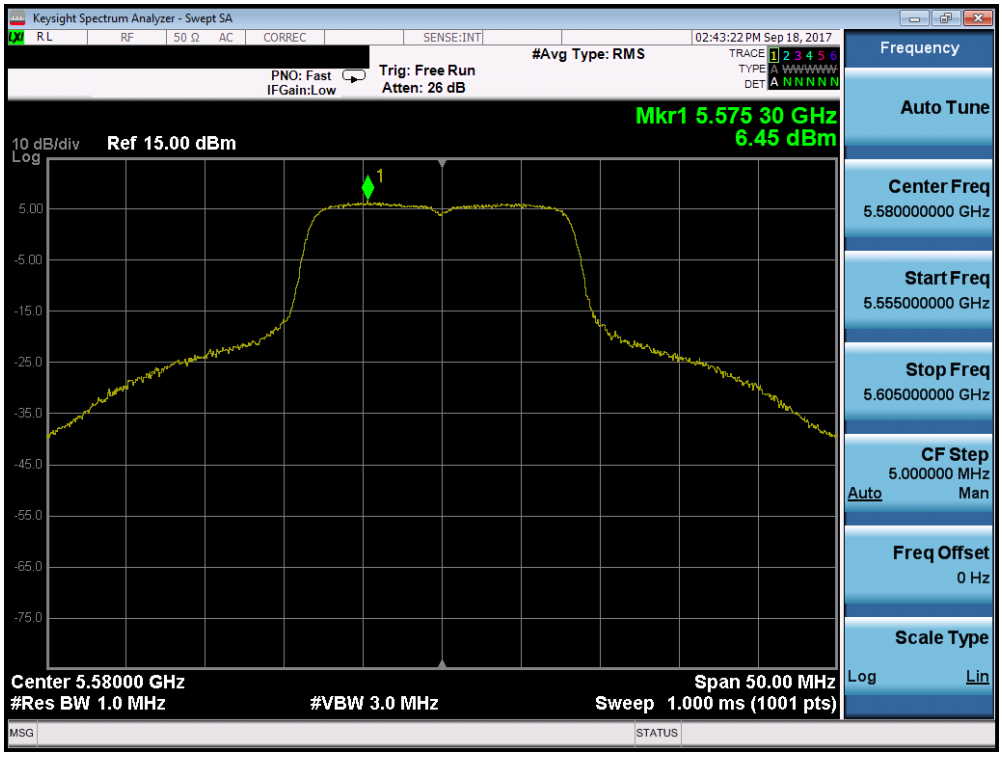


Plot 7-50. Power Spectral Density Plot (802.11a (UNII Band 2C) – Ch. 100)



Plot 7-51. Power Spectral Density Plot (802.11a (UNII Band 2C) – Ch. 116)

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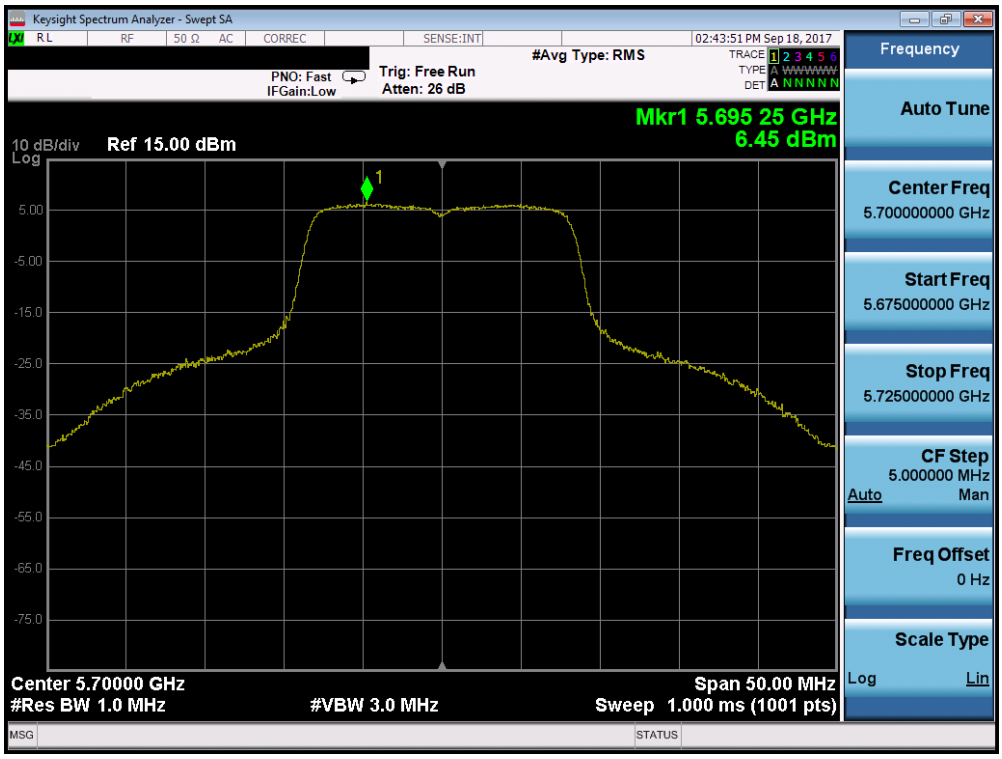
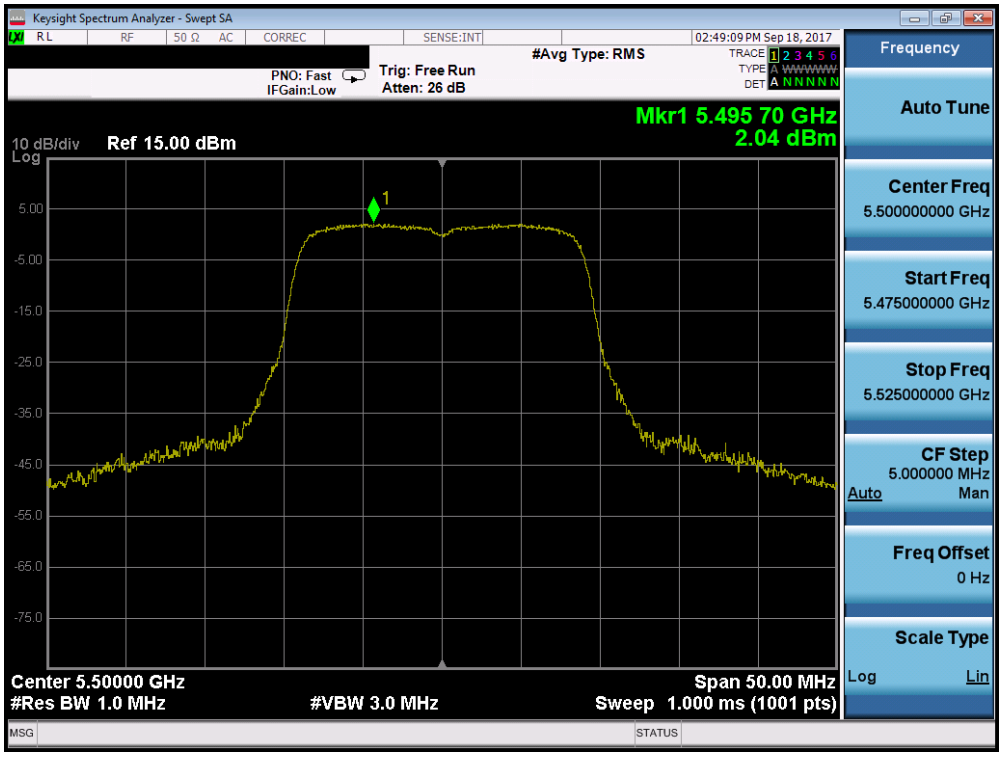


Plot 7-52. Power Spectral Density Plot (802.11a (UNII Band 2C) – Ch. 140



Plot 7-53. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 100)

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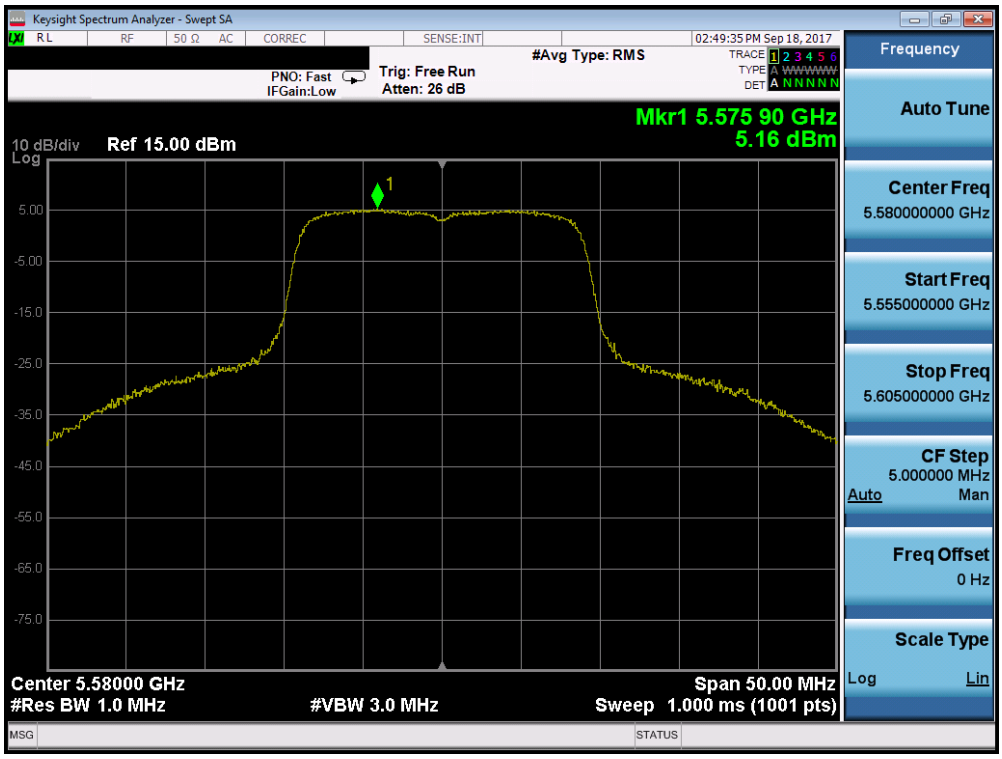
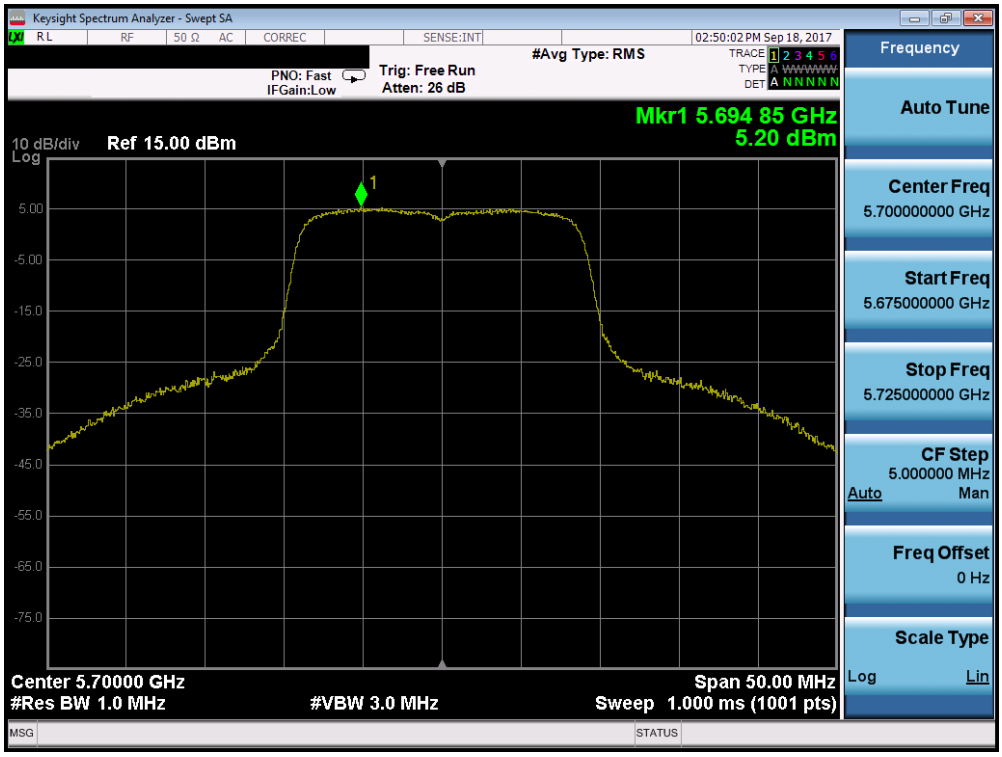


Plot 7-54. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 116)



Plot 7-55. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 140)

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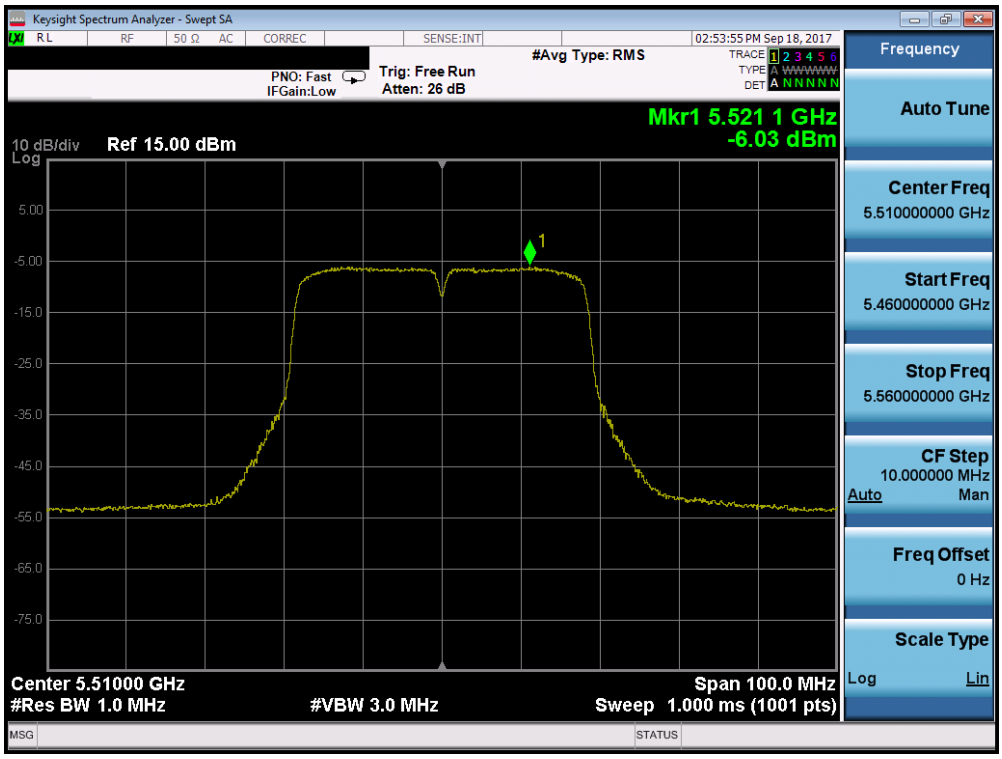
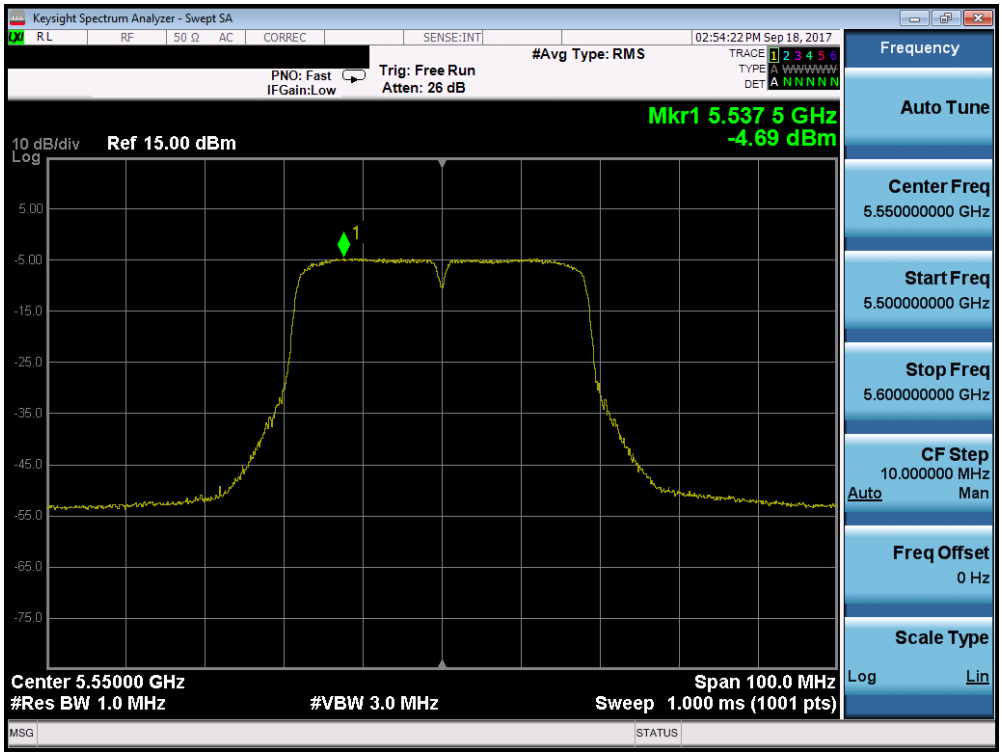


Plot 7-56. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 102)



Plot 7-57. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 110)

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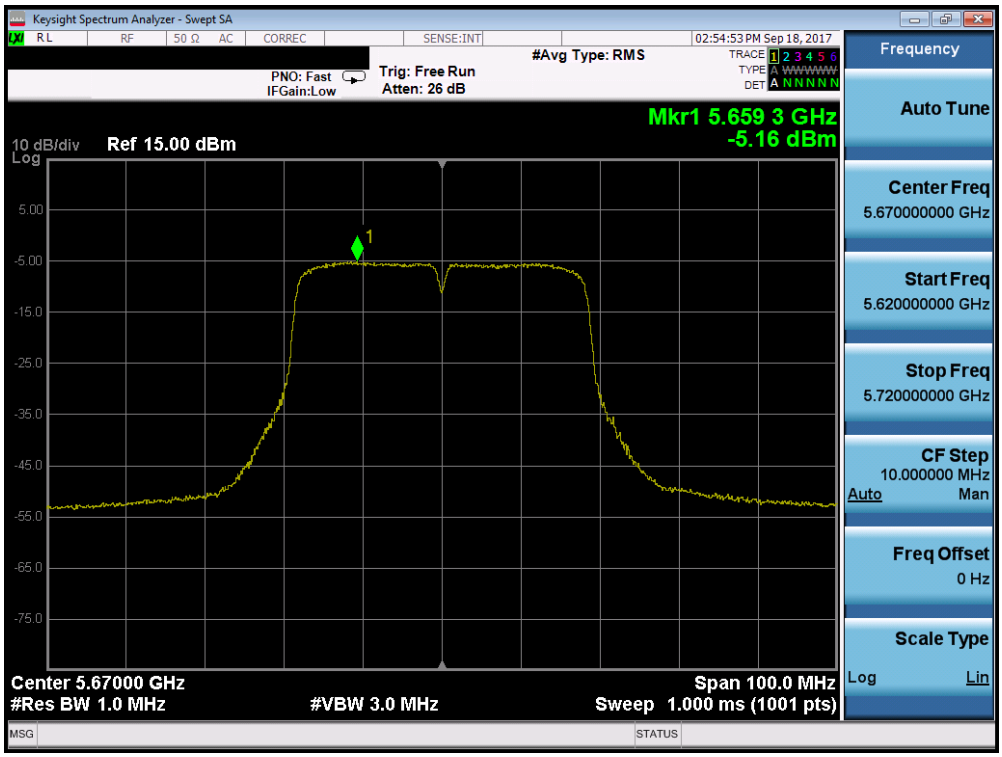

Plot 7-58. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 2C) – Ch. 134)

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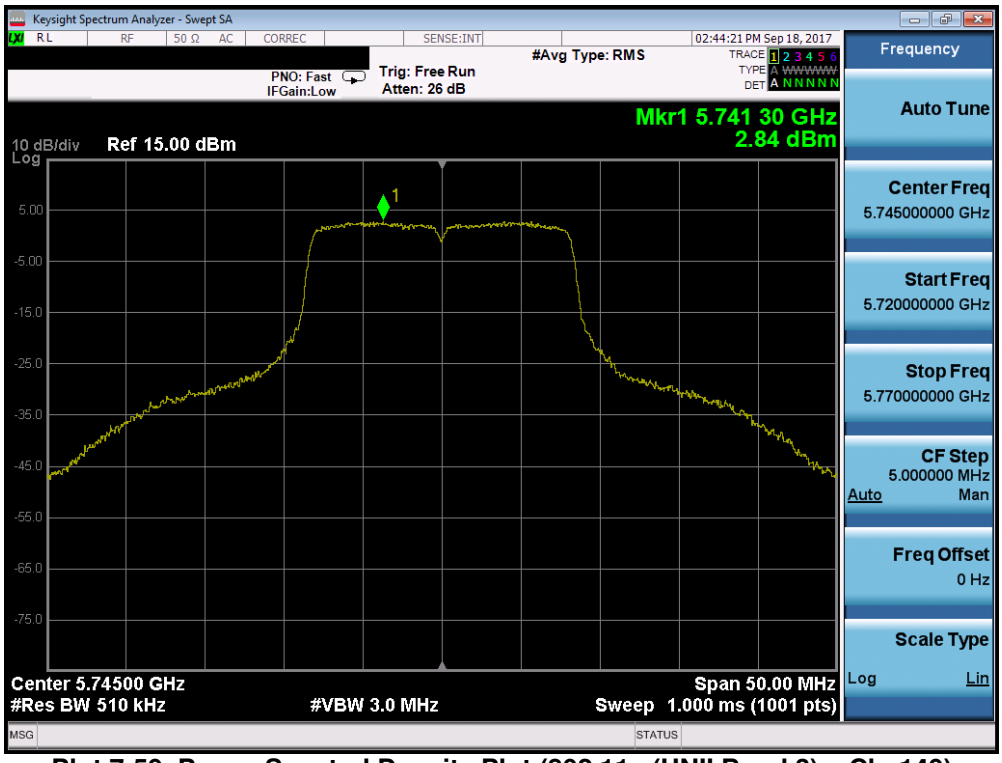
	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Power Density [dBm]	Max Permissible Power Density [dBm/500kHz]	Margin [dB]
Band 3	5745	149	a	6	2.84	30.0	-27.17
	5785	157	a	6	2.90	30.0	-27.10
	5825	165	a	6	0.88	30.0	-29.12
	5745	149	n (20MHz)	6.5/7.2 (MCS0)	1.54	30.0	-28.46
	5785	157	n (20MHz)	6.5/7.2 (MCS0)	1.80	30.0	-28.20
	5825	165	n (20MHz)	6.5/7.2 (MCS0)	-0.61	30.0	-30.61
	5755	151	n (40MHz)	13.5/15 (MCS0)	-7.83	30.0	-37.83
	5795	159	n (40MHz)	13.5/15 (MCS0)	-9.18	30.0	-39.18

Table 7-7. Band 3 Conducted Power Spectral Density Measurements



Plot 7-59. Power Spectral Density Plot (802.11a (UNII Band 3) – Ch. 149)

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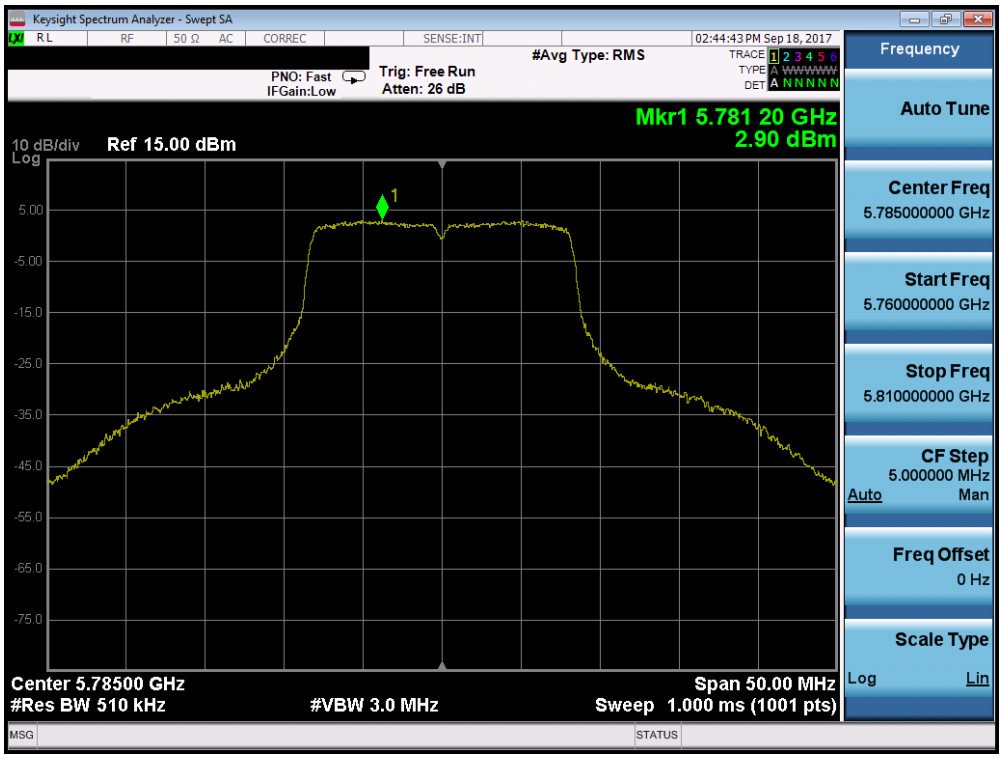
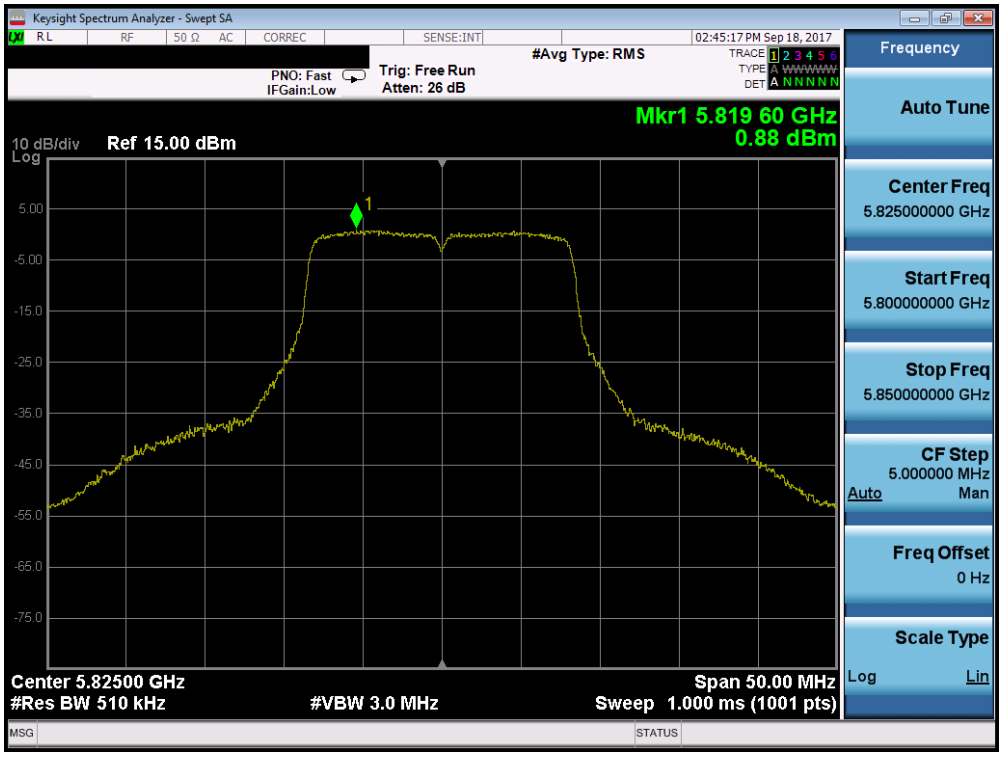


Plot 7-60. Power Spectral Density Plot (802.11a (UNII Band 3) – Ch. 157)



Plot 7-61. Power Spectral Density Plot (802.11a (UNII Band 3) – Ch. 165)

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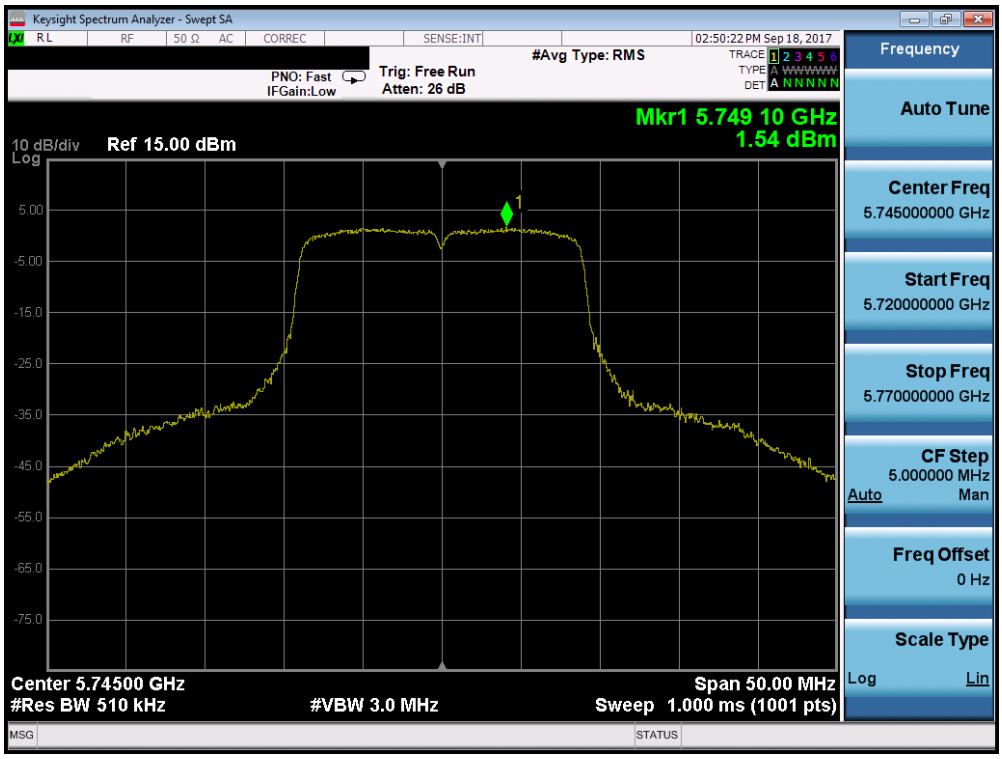
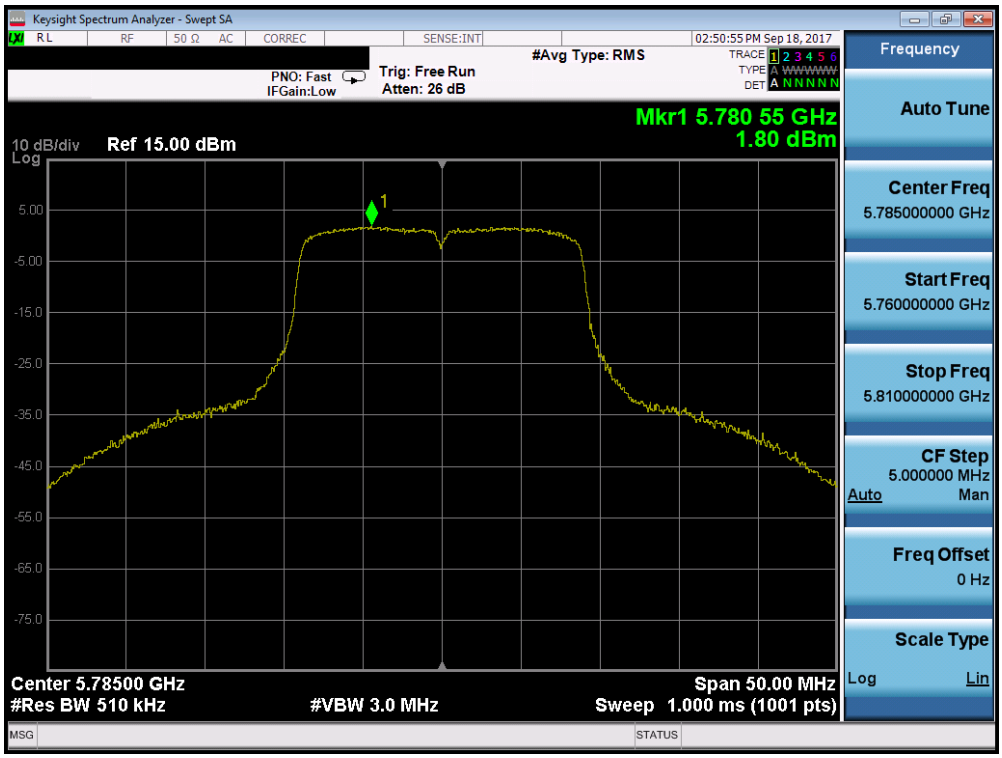


Plot 7-62. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 149)



Plot 7-63. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 157)

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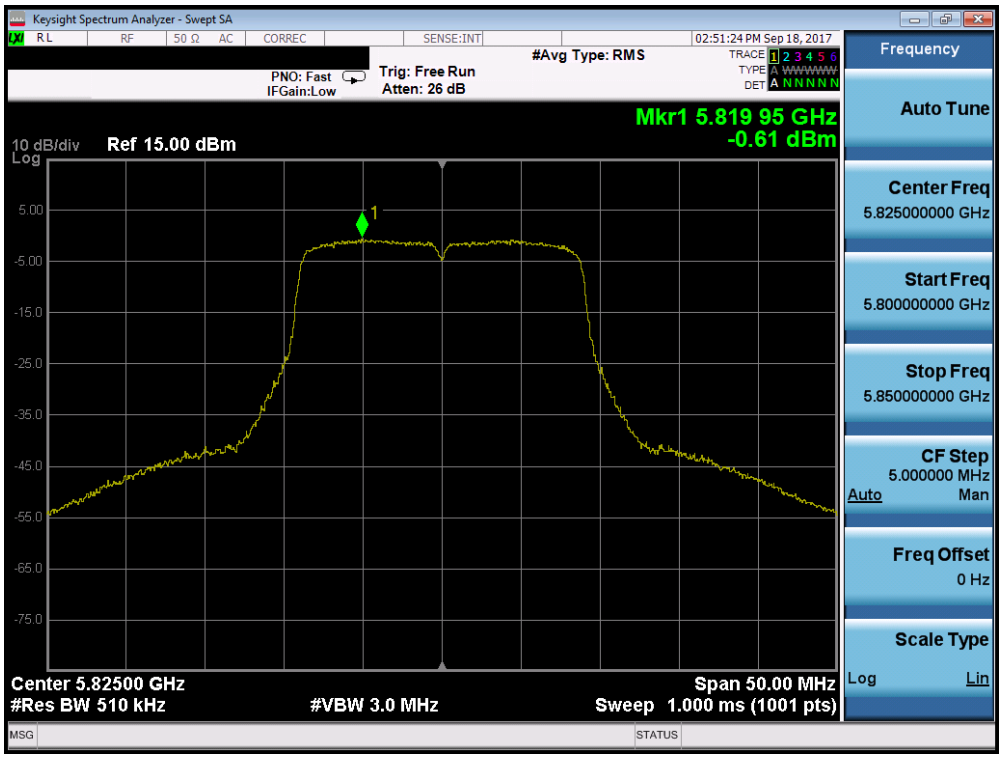
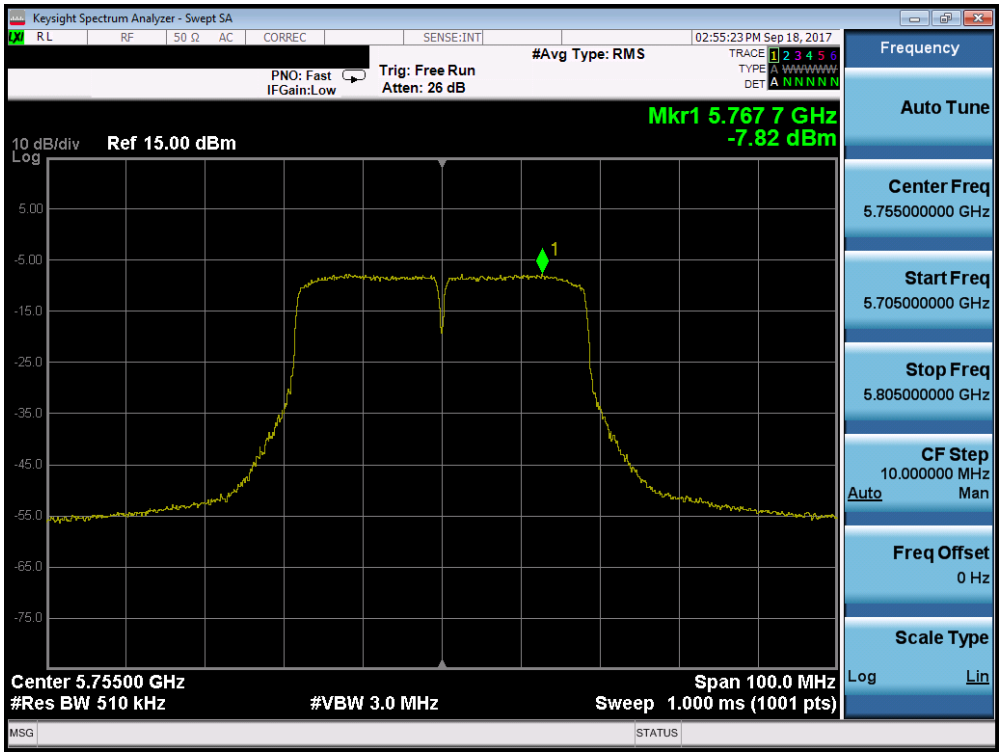


Plot 7-64. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 165)



Plot 7-65. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 3) – Ch. 151)

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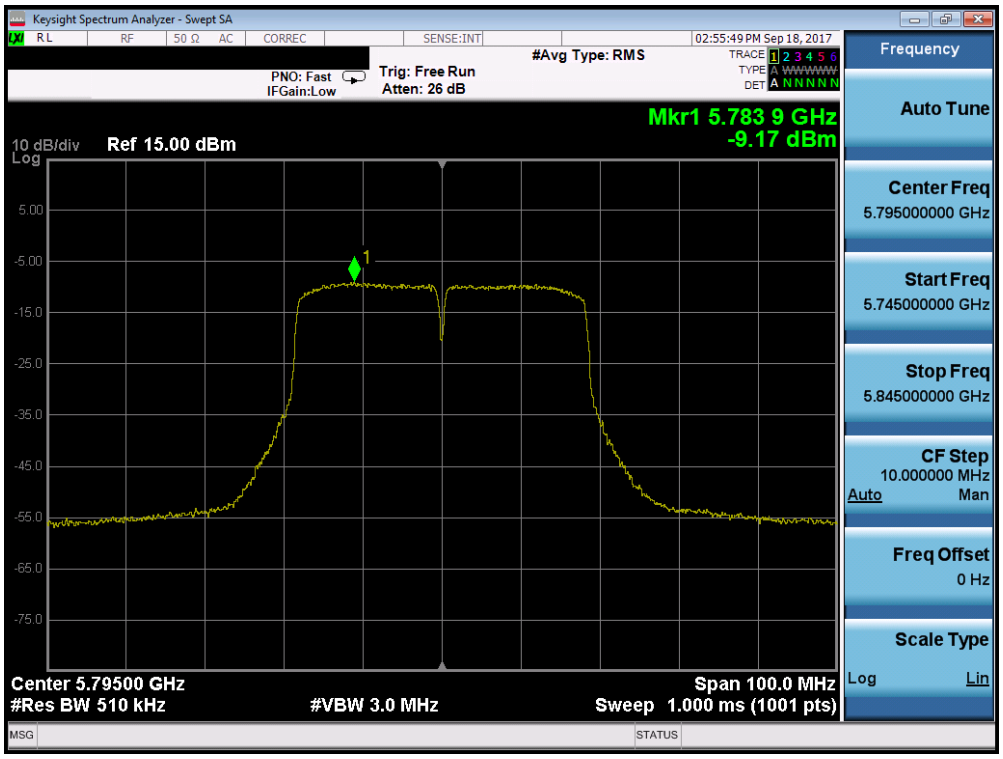

Plot 7-66. Power Spectral Density Plot (40MHz BW 802.11n (UNII Band 3) – Ch. 159)

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7.6 Frequency Stability

§15.407(g); RSS-Gen [6.11]

The EUT was placed inside of an environmental chamber as the temperature in the chamber was varied between -30°C and +50°C. The temperature was incremented by 10° intervals and the unit was allowed to stabilize at each temperature before each measurement. The center frequency of the transmitting channel was evaluated at each temperature and the frequency deviation from the channel's center frequency was recorded. Data for the worst case channel is shown below.

OPERATING FREQUENCY: 5,180,000,000 Hz

CHANNEL: 36

REFERENCE VOLTAGE: 3.85 VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.85	+ 20 (Ref)	5,179,999,945	-55	-0.00000106
100 %		- 30	5,179,999,884	-116	-0.00000224
100 %		- 20	5,179,999,813	-187	-0.00000362
100 %		- 10	5,179,999,971	-29	-0.00000055
100 %		0	5,179,999,851	-149	-0.00000288
100 %		+ 10	5,179,999,861	-139	-0.00000269
100 %		+ 20	5,179,999,867	-133	-0.00000257
100 %		+ 30	5,179,999,816	-184	-0.00000355
100 %		+ 40	5,179,999,944	-56	-0.00000108
100 %		+ 50	5,179,999,917	-83	-0.00000161
BATT. ENDPOINT	3.45	+ 20	5,179,999,912	-88	-0.00000170

Table 7-8. Frequency Stability Measurements for UNII Band 1 (Ch. 36)

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

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Frequency Stability
§15.407(g); RSS-Gen [6.11]

The EUT was placed inside of an environmental chamber as the temperature in the chamber was varied between -30°C and +50°C. The temperature was incremented by 10° intervals and the unit was allowed to stabilize at each temperature before each measurement. The center frequency of the transmitting channel was evaluated at each temperature and the frequency deviation from the channel's center frequency was recorded. Data for the worst case channel is shown below.

OPERATING FREQUENCY: 5,260,000,000 Hz

CHANNEL: 52

REFERENCE VOLTAGE: 3.85 VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.85	+ 20 (Ref)	5,259,999,898	-102	-0.00000195
100 %		- 30	5,259,999,931	-69	-0.00000131
100 %		- 20	5,259,999,899	-101	-0.00000192
100 %		- 10	5,259,999,942	-58	-0.00000110
100 %		0	5,259,999,933	-67	-0.00000127
100 %		+ 10	5,259,999,932	-68	-0.00000130
100 %		+ 20	5,259,999,948	-52	-0.00000100
100 %		+ 30	5,259,999,913	-87	-0.00000166
100 %		+ 40	5,259,999,830	-170	-0.00000323
100 %		+ 50	5,259,999,818	-182	-0.00000345
BATT. ENDPOINT	3.45	+ 20	5,259,999,911	-89	-0.00000169

Table 7-9. Frequency Stability Measurements for UNII Band 2A (Ch. 52)

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

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Frequency Stability
§15.407(g); RSS-Gen [6.11]

The EUT was placed inside of an environmental chamber as the temperature in the chamber was varied between -30°C and +50°C. The temperature was incremented by 10° intervals and the unit was allowed to stabilize at each temperature before each measurement. The center frequency of the transmitting channel was evaluated at each temperature and the frequency deviation from the channel's center frequency was recorded. Data for the worst case channel is shown below.

OPERATING FREQUENCY: 5,500,000,000 Hz

CHANNEL: 100

REFERENCE VOLTAGE: 3.85 VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.85	+ 20 (Ref)	5,499,999,952	-48	-0.00000087
100 %		- 30	5,499,999,975	-25	-0.00000045
100 %		- 20	5,499,999,843	-157	-0.00000286
100 %		- 10	5,499,999,841	-159	-0.00000289
100 %		0	5,499,999,862	-138	-0.00000252
100 %		+ 10	5,499,999,849	-151	-0.00000275
100 %		+ 20	5,499,999,897	-103	-0.00000187
100 %		+ 30	5,499,999,932	-68	-0.00000124
100 %		+ 40	5,499,999,835	-165	-0.00000300
100 %		+ 50	5,499,999,876	-124	-0.00000226
BATT. ENDPOINT	3.45	+ 20	5,499,999,997	-3	-0.00000005

Table 7-10. Frequency Stability Measurements for UNII Band 2C (Ch. 100)

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

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Frequency Stability
§15.407(g); RSS-Gen [6.11]

The EUT was placed inside of an environmental chamber as the temperature in the chamber was varied between -30°C and +50°C. The temperature was incremented by 10° intervals and the unit was allowed to stabilize at each temperature before each measurement. The center frequency of the transmitting channel was evaluated at each temperature and the frequency deviation from the channel's center frequency was recorded. Data for the worst case channel is shown below.

OPERATING FREQUENCY: 5,745,000,000 Hz

CHANNEL: 149

REFERENCE VOLTAGE: 3.85 VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.85	+ 20 (Ref)	5,744,999,807	-193	-0.00000337
100 %		- 30	5,744,999,947	-53	-0.00000092
100 %		- 20	5,744,999,868	-132	-0.00000229
100 %		- 10	5,744,999,936	-64	-0.00000111
100 %		0	5,744,999,873	-127	-0.00000221
100 %		+ 10	5,744,999,820	-180	-0.00000314
100 %		+ 20	5,744,999,917	-83	-0.00000144
100 %		+ 30	5,744,999,917	-83	-0.00000144
100 %		+ 40	5,744,999,951	-49	-0.00000086
100 %		+ 50	5,744,999,925	-75	-0.00000131
BATT. ENDPOINT	3.45	+ 20	5,744,999,884	-116	-0.00000203

Table 7-11. Frequency Stability Measurements for UNII Band 3 (Ch. 149)

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

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7.7 Radiated Spurious Emission Measurements – Above 1GHz

§15.407(b) §15.205 §15.209; RSS-Gen [8.9]

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at its maximum duty cycle, at its maximum power control level, as defined in ANSI C63.10-2013 and KDB 789033 D02 v01r04, and at the appropriate frequencies. All channels, modes (e.g. 802.11a, 802.11n (20MHz BW), 802.11n (40MHz BW), and 802.11ac (80MHz)), and modulations/data rates were investigated among all UNII bands. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

For transmitters operating in the 5.15-5.25 GHz and 5.25-5.35 GHz band: All emissions outside of the 5.15-*5.35 GHz band shall not exceed an EIRP of −27 dBm/MHz.*

For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an EIRP *of −27 dBm/MHz.*

For transmitters operating in the 5.725-5.85 GHz band: *All emissions shall be limited to a level of −27* dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR and Table 6 of RSS-Gen (8.10) must not exceed the limits shown in Table 7-12 per Section 15.209 and RSS-Gen (8.9).

Frequency	Field Strength [μV/m]	Measured Distance [Meters]
Above 960.0 MHz	500	3

Table 7-12. Radiated Limits

Test Procedures Used

ANSI C63.10-2013 – Sections 12.7.7.2, 12.7.6, 12.7.5
KDB 789033 D02 v01r04 – Section G

Test Settings

Average Measurements above 1GHz (Method AD)

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = power average (RMS)
5. Number of measurement points = 1001 (Number of points must be ≥ 2 x span/RBW)
6. Averaging type = power (RMS)
7. Sweep time = auto couple
8. Trace was averaged over 100 sweeps

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Peak Measurements above 1GHz

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Peak Measurements below 1GHz

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. Span was set greater than 1MHz
3. RBW = 120kHz
4. Detector = CISPR quasi-peak
5. Sweep time = auto couple
6. Trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

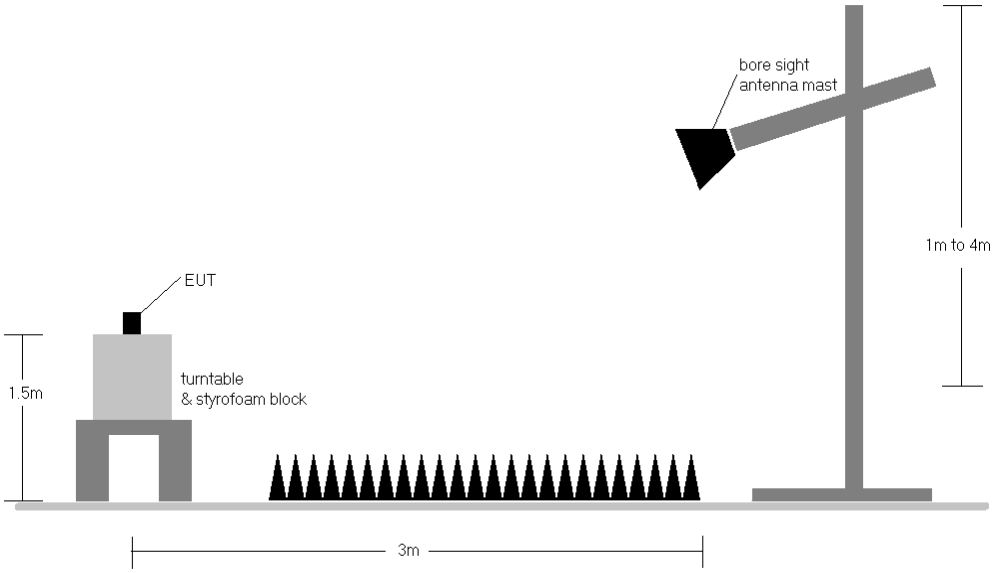

Figure 7-5. Test Instrument & Measurement Setup

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Test Notes

1. All emissions that lie in the restricted bands (denoted by a * next to the frequency) specified in §15.205 and Section 8.10 of RSS-Gen are below the limit shown in Table 7-12.
2. All spurious emissions lying in restricted bands specified in §15.205 and Section 8.10 of RSS-Gen are below the limit shown in Table 7-12. All spurious emissions that do not lie in a restricted band are subject to a peak limit of -27dBm/MHz. At a distance of 3 meters, the field strength limit in dBμV/m can be determined by adding a "conversion" factor of 95.2dB to the EIRP limit of -27dBm/MHz to obtain the limit for out of band spurious emissions of 68.2dBμV/m.
3. The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
4. This unit was tested with its standard battery.
5. The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1GHz. Above 1 GHz, average and peak measurements were taken using linearly polarized horn antennas. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.
6. Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.
7. The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. Any emissions found to be within 20dB of the limit are fully investigated and the results are shown in this section. Rohde & Schwarz EMC32, Version 9.15.00 automated test software was used to perform the Radiated Spurious Emissions Pre-Scan testing.
8. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

Sample Calculations

Determining Spurious Emissions Levels

- Field Strength Level $_{[dB\mu V/m]}$ = Analyzer Level $_{[dBm]}$ + 107 + AFCL $_{[dB/m]}$
- AFCL $_{[dB/m]}$ = Antenna Factor $_{[dB/m]}$ + Cable Loss $_{[dB]}$
- Margin $_{[dB]}$ = Field Strength Level $_{[dB\mu V/m]}$ – Limit $_{[dB\mu V/m]}$

Radiated Band Edge Measurement Offset

- The amplitude offset shown in the radiated restricted band edge plots in Section 7.7 was calculated using the formula:

  Offset (dB) = (Antenna Factor + Cable Loss + Attenuator) – Preamplifier Gain

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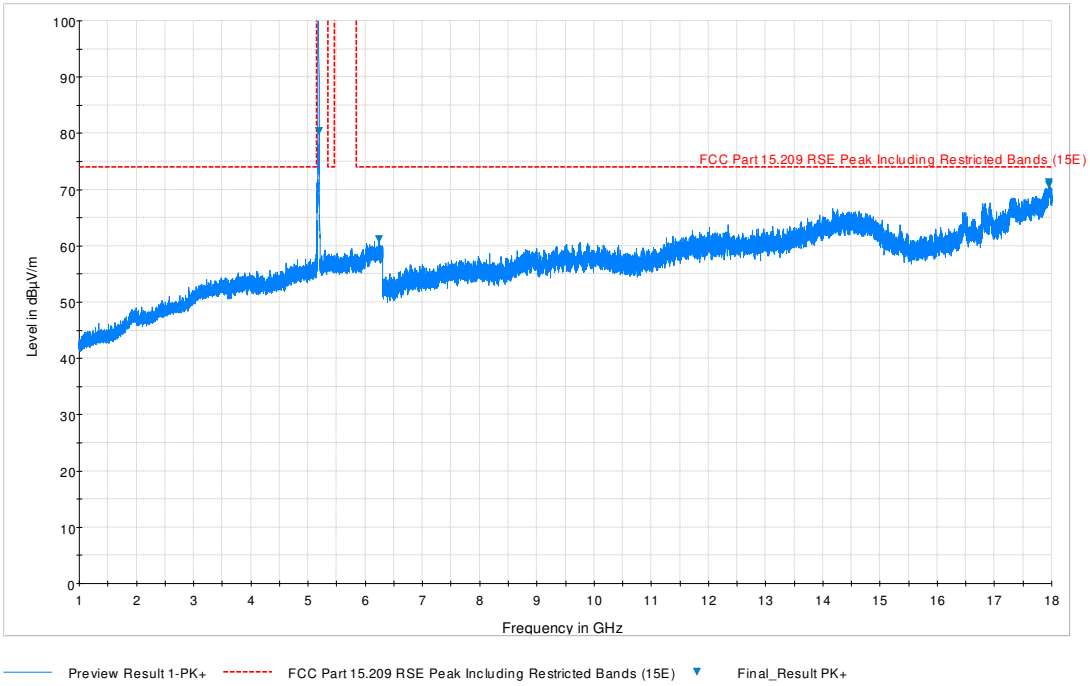
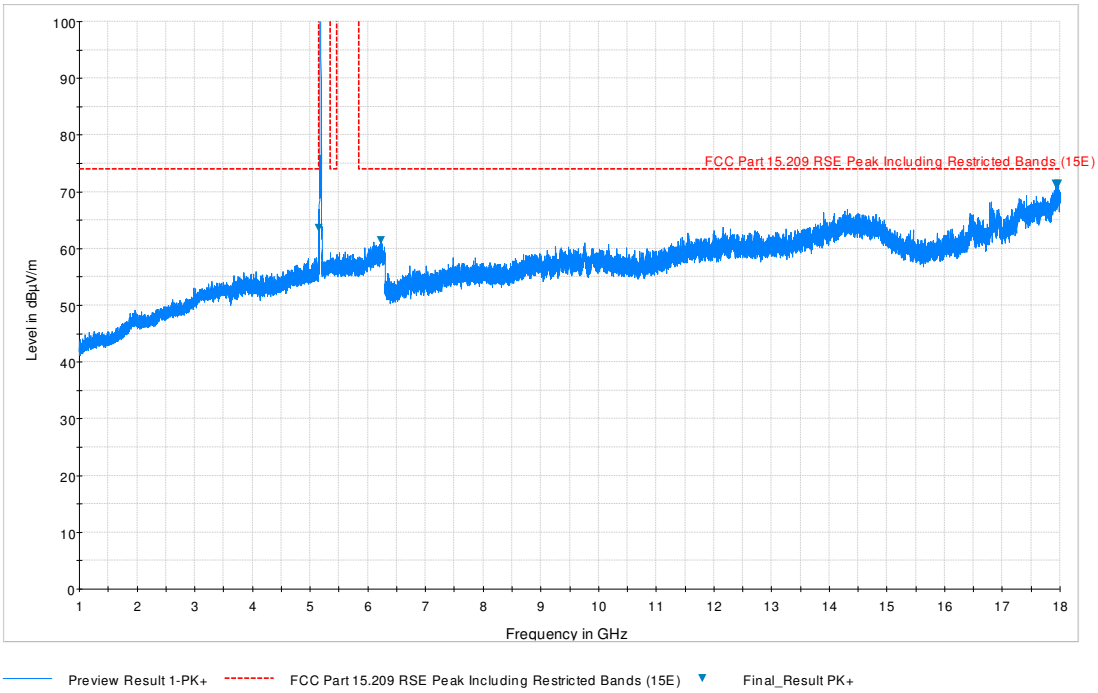
7.7.1 Radiated Spurious Emission Measurements



Plot 7-67. Radiated Spurious Plot above 1GHz (802.11a – U1 Ch. 40, Ant. Pol. H)



Plot 7-68. Radiated Spurious Plot above 1GHz (802.11a – U1 Ch. 40, Ant. Pol. V)

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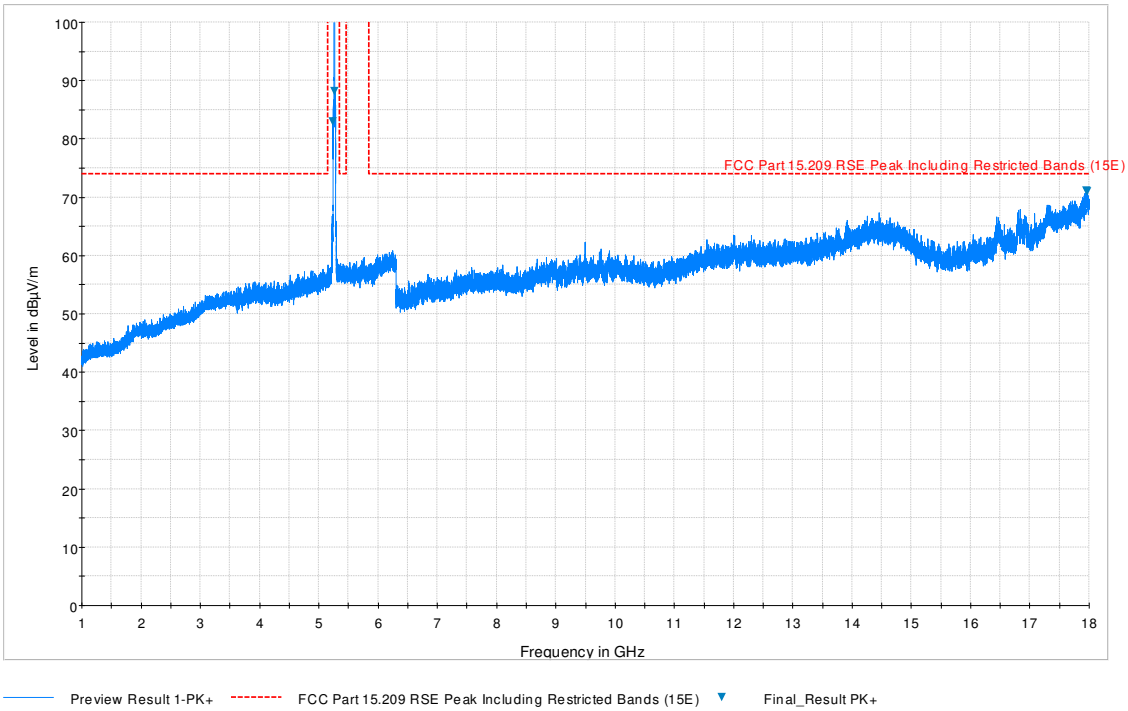
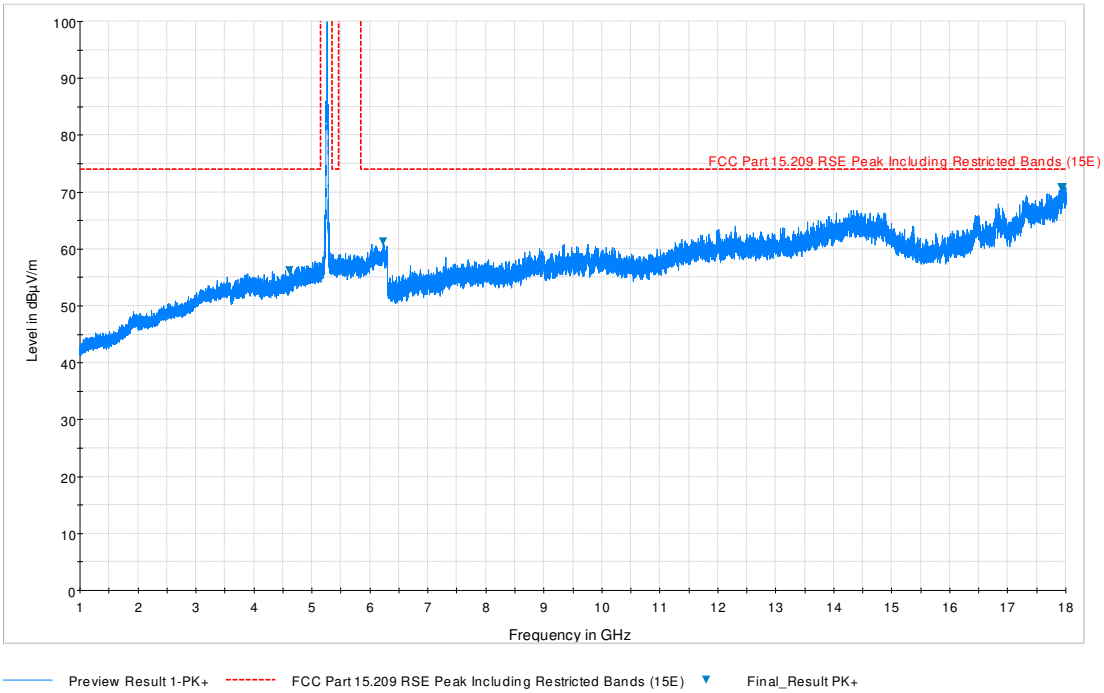


Plot 7-69. Radiated Spurious Plot above 1GHz (802.11a – U2A Ch. 56, Ant. Pol. H)



Plot 7-70. Radiated Spurious Plot above 1GHz (802.11a – U2A Ch. 56, Ant. Pol. V)

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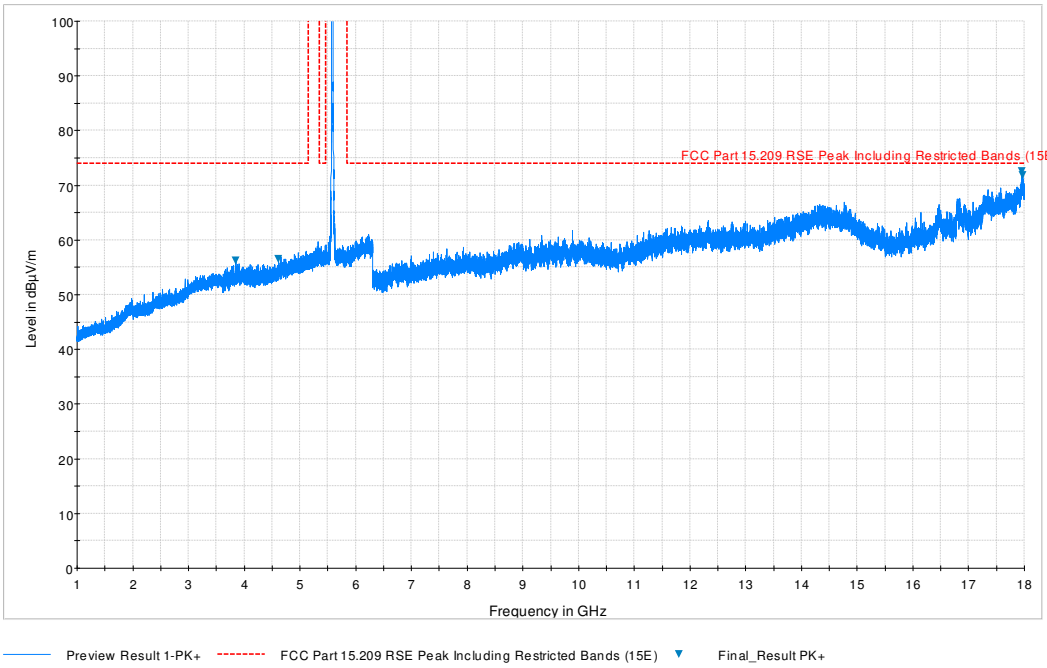
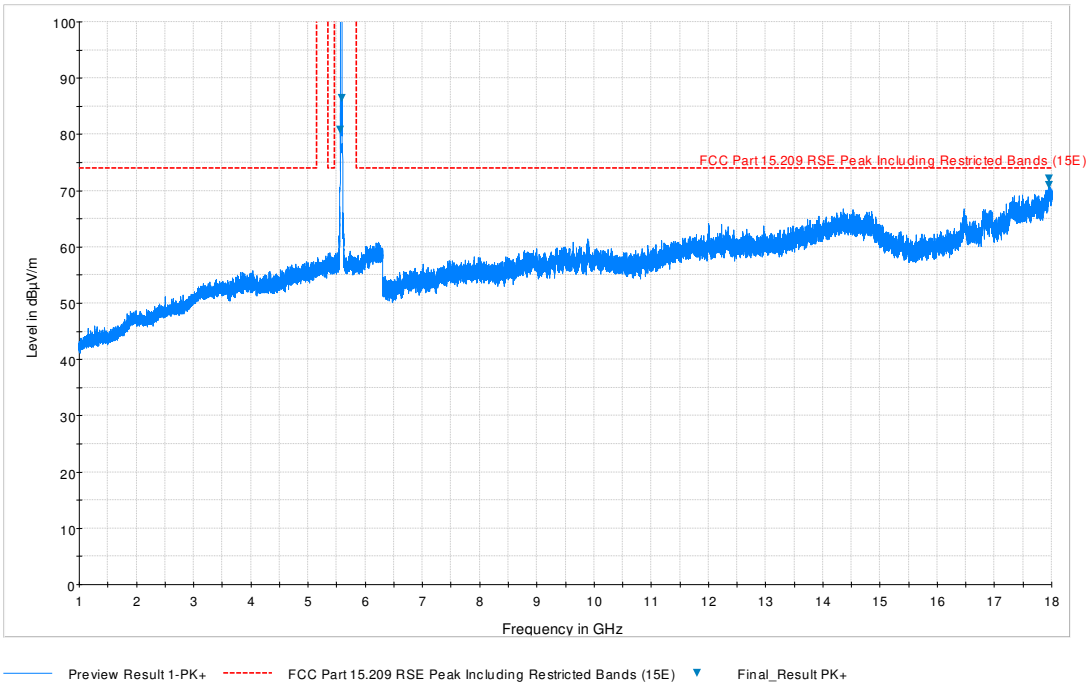


Plot 7-71. Radiated Spurious Plot above 1GHz (802.11a – U2C Ch. 116, Ant. Pol. H)



Plot 7-72. Radiated Spurious Plot above 1GHz (802.11a – U2C Ch. 116, Ant. Pol. V)

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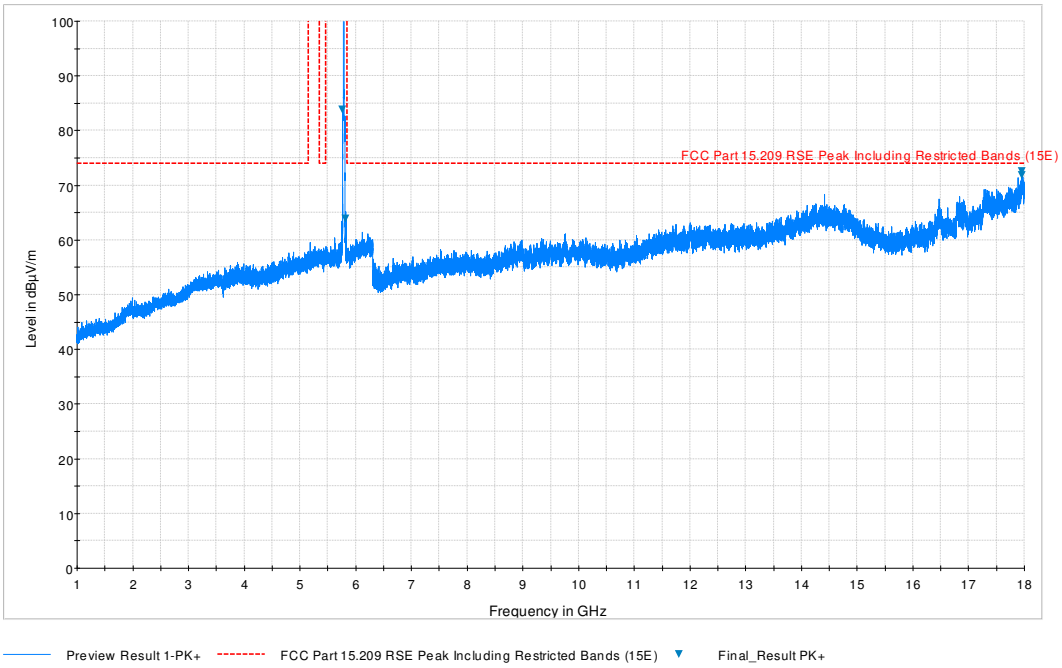
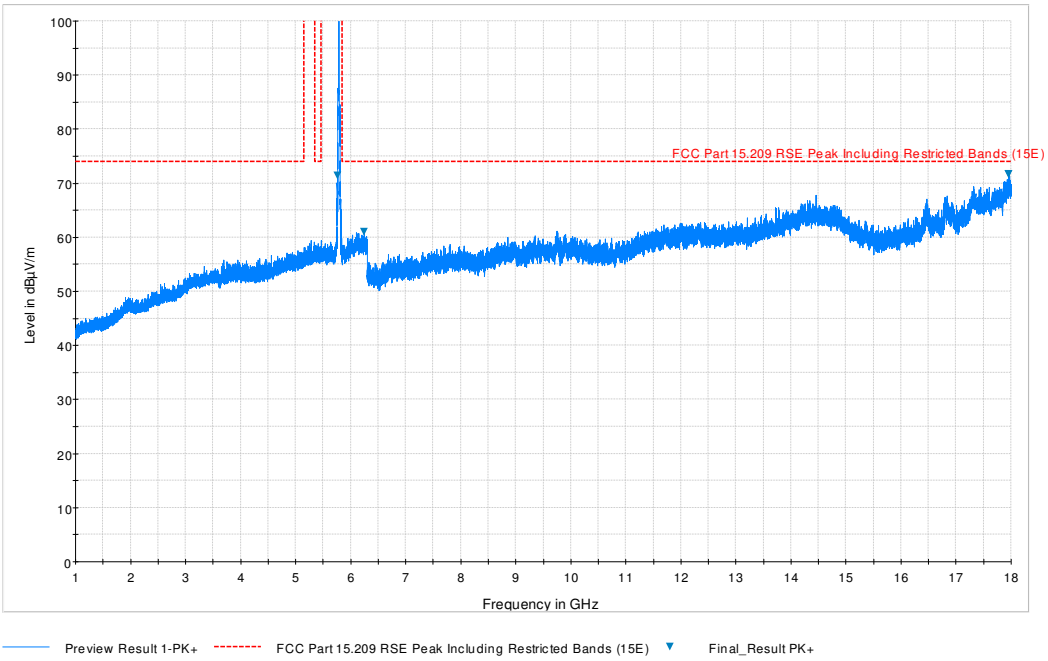


Plot 7-73. Radiated Spurious Plot above 1GHz (802.11a – U3 Ch. 157, Ant. Pol. H)



Plot 7-74. Radiated Spurious Plot above 1GHz (802.11a – U3 Ch. 157, Ant. Pol. V)

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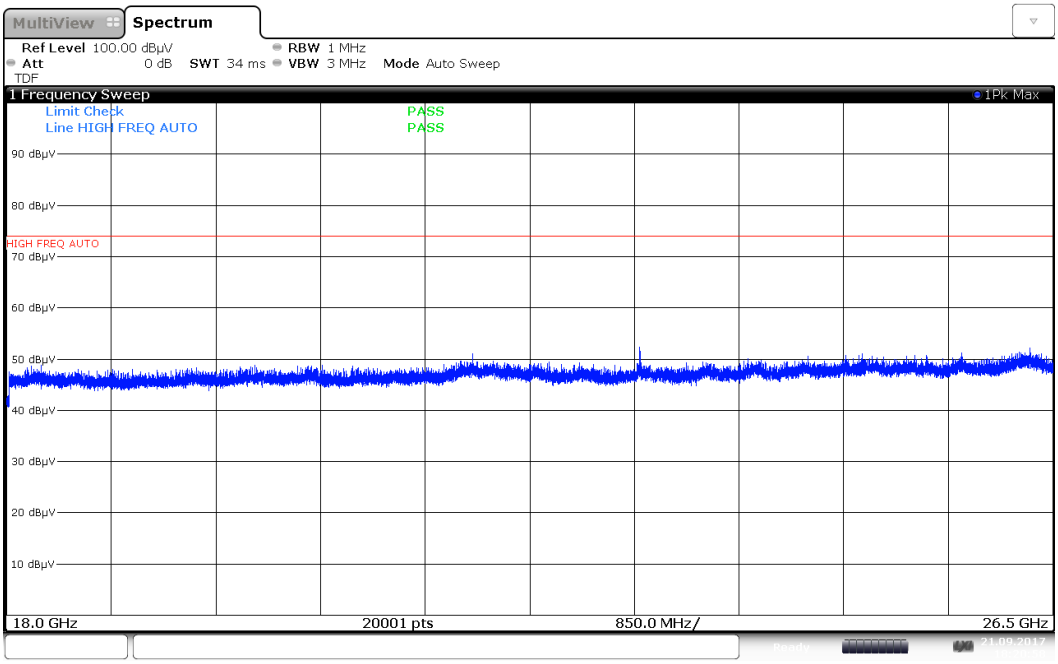
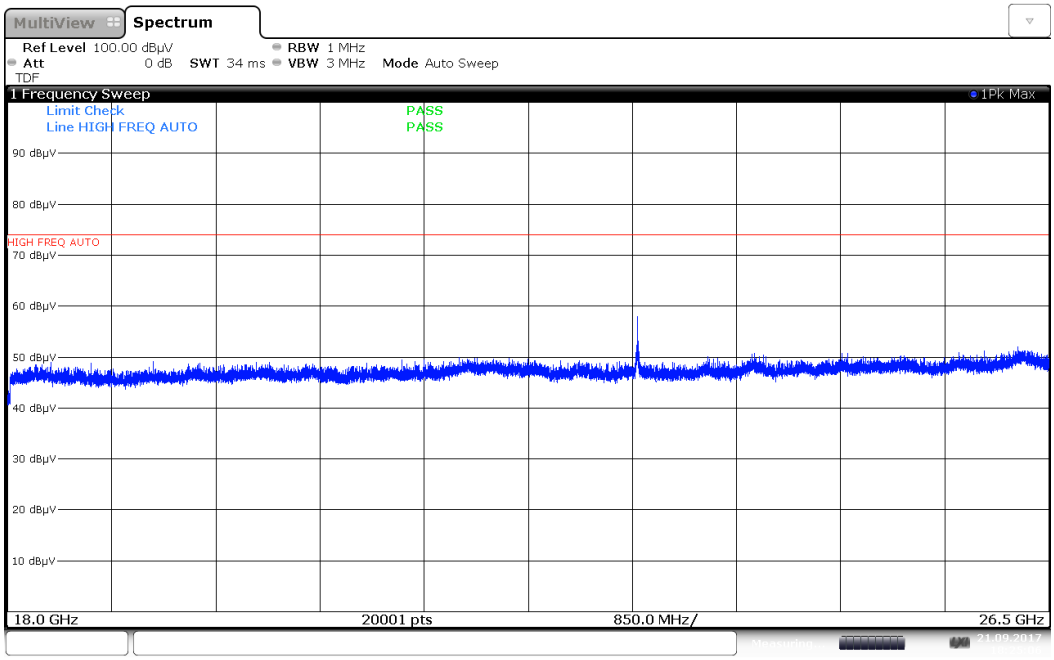
Radiated Spurious Emissions Measurements (Above 18GHz)



18:20:58 21.09.2017

Plot 7-75. Radiated Spurious Plot 18GHz - 26.5GHz (802.11a – Ant. Pol. H)



18:25:06 21.09.2017

Plot 7-76. Radiated Spurious Plot above 18GHz - 26.5GHz (802.11a – Ant. Pol. V)

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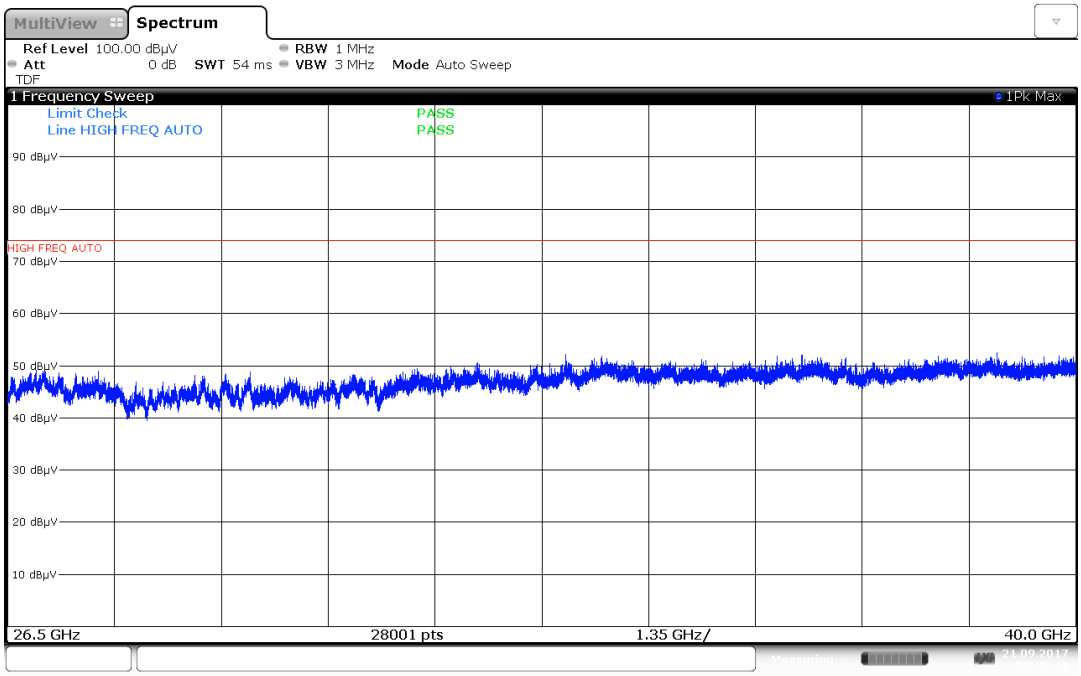
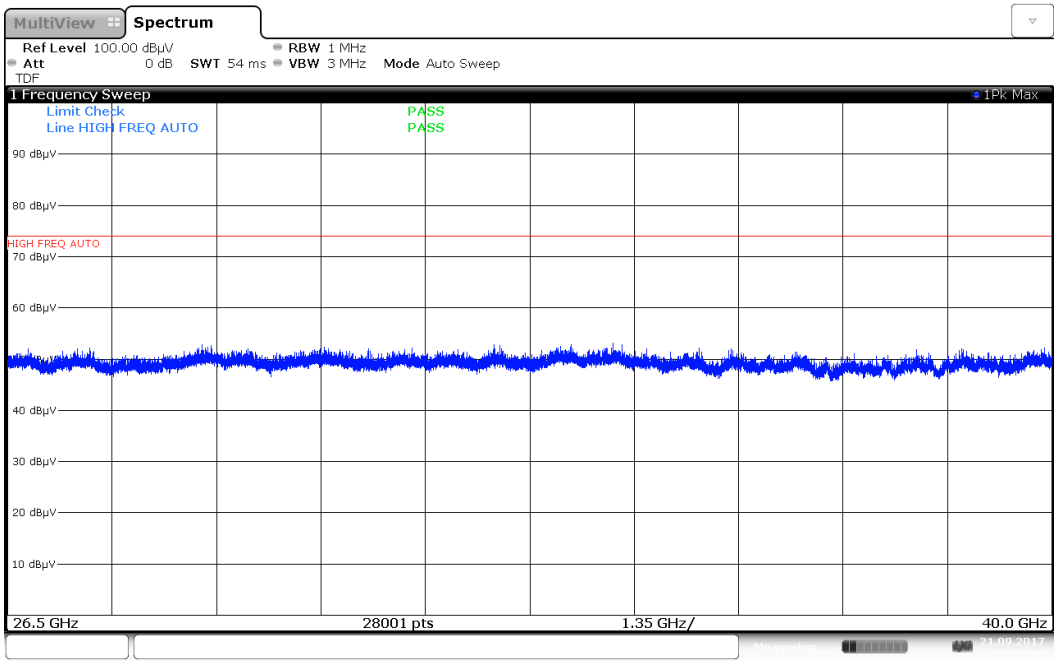
Radiated Spurious Emissions Measurements (Above 18GHz)



20:50:41 21.09.2017

Plot 7-77. Radiated Spurious Plot 26.5GHz - 40GHz (802.11a – Ant. Pol. H)



20:53:46 21.09.2017

Plot 7-78. Radiated Spurious Plot above 26.5GHz - 40GHz (802.11a – Ant. Pol. V)

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Radiated Spurious Emission Measurements

§15.247(d) §15.205 & §15.209; RSS-Gen [8.9]

Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 Meter
Operating Frequency: 5180MHz
Channel: 36

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
	10360.00	Peak	H	100	46	-64.89	12.13	-9.54	44.70	68.20	-23.50
*	15540.00	Average	H	-	-	-81.05	14.49	-9.54	30.90	53.98	-23.08
*	15540.00	Peak	H	-	-	-68.33	14.49	-9.54	43.62	73.98	-30.36
*	20720.00	Average	H	100	155	-61.30	7.94	-9.54	44.10	53.98	-9.88
*	20720.00	Peak	H	100	155	-57.99	7.94	-9.54	47.41	73.98	-26.57
	25900.00	Peak	H	-	-	-63.76	8.46	-9.54	42.16	68.20	-26.04

Table 7-13. Radiated Measurements

Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 Meter
Operating Frequency: 5200MHz
Channel: 40

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
	10400.00	Peak	H	100	28	-70.68	12.12	-9.54	38.90	68.20	-29.30
*	15600.00	Average	H	-	-	-78.89	14.31	-9.54	32.88	53.98	-21.10
*	15600.00	Peak	H	-	-	-69.10	14.31	-9.54	42.67	73.98	-31.31
*	20800.00	Average	H	100	158	-57.20	7.95	-9.54	48.21	53.98	-5.77
*	20800.00	Peak	H	100	158	-54.90	7.95	-9.54	50.51	73.98	-23.47
	26000.00	Peak	H	-	-	-64.35	8.60	-9.54	41.71	68.20	-26.49

Table 7-14. Radiated Measurements

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Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 Meter
Operating Frequency: 5240MHz
Channel: 48

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
	10480.00	Peak	H	100	39	-63.11	12.09	-9.54	46.44	68.20	-21.76
*	15720.00	Average	H	-	-	-80.52	14.02	-9.54	30.96	53.98	-23.02
*	15720.00	Peak	H	-	-	-68.47	14.02	-9.54	43.01	73.98	-30.97
*	20960.00	Average	H	100	156	-56.61	7.91	-9.54	48.76	53.98	-5.22
*	20960.00	Peak	H	100	156	-54.60	7.91	-9.54	50.77	73.98	-23.21
	26200.00	Peak	H	-	-	-64.08	8.62	-9.54	42.00	68.20	-26.20

Table 7-15. Radiated Measurements

Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 Meter
Operating Frequency: 5260MHz
Channel: 52

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
	10520.00	Peak	H	100	35	-64.89	12.16	-9.54	44.73	68.20	-23.47
*	15780.00	Average	H	-	-	-79.37	14.03	-9.54	32.12	53.98	-21.86
*	15780.00	Peak	H	-	-	-67.56	14.03	-9.54	43.93	73.98	-30.05
*	21040.00	Average	H	100	157	-56.33	7.92	-9.54	49.05	53.98	-4.93
*	21040.00	Peak	H	100	157	-54.22	7.92	-9.54	51.16	73.98	-22.82
	26300.00	Peak	H	-	-	-63.10	8.73	-9.54	43.09	68.20	-25.11

Table 7-16. Radiated Measurements

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Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 Meter
Operating Frequency: 5280MHz
Channel: 56

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
	10560.00	Peak	H	100	40	-63.68	12.04	-9.54	45.82	68.20	-22.38
*	15840.00	Average	H	-	-	-79.90	14.25	-9.54	31.80	53.98	-22.18
*	15840.00	Peak	H	-	-	-67.64	14.25	-9.54	44.06	73.98	-29.92
*	21120.00	Average	H	100	155	-56.09	7.96	-9.54	49.33	53.98	-4.65
*	21120.00	Peak	H	100	155	-54.10	7.96	-9.54	51.32	73.98	-22.66
	26400.00	Peak	H	-	-	-64.11	8.94	-9.54	42.29	68.20	-25.91

Table 7-17. Radiated Measurements

Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 Meter
Operating Frequency: 5320MHz
Channel: 64

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	10640.00	Average	H	100	10	-70.44	12.06	-9.54	39.08	53.98	-14.90
*	10640.00	Peak	H	100	10	-64.31	12.06	-9.54	45.21	73.98	-28.77
*	15960.00	Average	H	-	-	-80.31	14.55	-9.54	31.70	53.98	-22.28
*	15960.00	Peak	H	-	-	-68.23	14.55	-9.54	43.78	73.98	-30.20
*	21280.00	Average	H	100	157	-57.88	8.04	-9.54	47.62	53.98	-6.36
*	21280.00	Peak	H	100	157	-53.68	8.04	-9.54	51.82	73.98	-22.16
	26600.00	Peak	H	-	-	-48.17	-8.30	-9.54	40.98	68.20	-27.22

Table 7-18. Radiated Measurements

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Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 Meter
Operating Frequency: 5500MHz
Channel: 100

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11000.00	Average	H	100	40	-73.91	12.87	-9.54	36.42	53.98	-17.56
*	11000.00	Peak	H	100	40	-66.61	12.87	-9.54	43.72	73.98	-30.26
	16500.00	Peak	H	-	-	-68.58	16.61	-9.54	45.49	68.20	-22.71
	22000.00	Peak	H	100	336	-52.83	8.43	-9.54	53.05	68.20	-15.15
	27500.00	Peak	H	-	-	-47.92	-8.80	-9.54	40.74	68.20	-27.46

Table 7-19. Radiated Measurements

Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 Meter
Operating Frequency: 5580MHz
Channel: 116

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11160.00	Average	H	100	31	-70.20	12.64	-9.54	39.90	53.98	-14.08
*	11160.00	Peak	H	100	31	-63.71	12.64	-9.54	46.39	73.98	-27.59
	16740.00	Peak	H	-	-	-80.36	16.21	-9.54	33.31	68.20	-34.89
*	22320.00	Average	H	100	336	-60.02	8.08	-9.54	45.52	53.98	-8.46
*	22320.00	Peak	H	100	336	-52.25	8.08	-9.54	53.29	73.98	-20.69
	27900.00	Peak	H	-	-	-46.41	-9.08	-9.54	41.97	68.20	-26.23

Table 7-20. Radiated Measurements

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Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 Meter
Operating Frequency: 5700MHz
Channel: 140

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11400.00	Average	H	100	117	-72.43	12.47	-9.54	37.50	53.98	-16.48
*	11400.00	Peak	H	100	117	-65.08	12.47	-9.54	44.85	73.98	-29.13
	17100.00	Peak	H	-	-	-68.65	18.06	-9.54	46.87	68.20	-21.33
*	22800.00	Average	H	100	329	-63.59	8.37	-9.54	42.24	53.98	-11.74
*	22800.00	Peak	H	100	329	-54.59	8.37	-9.54	51.24	73.98	-22.74
	28500.00	Peak	H	-	-	-48.04	-8.95	-9.54	40.47	68.20	-27.73

Table 7-21. Radiated Measurements

Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 Meter
Operating Frequency: 5745MHz
Channel: 149

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11490.00	Average	H	100	47	-72.33	12.43	-9.54	37.56	53.98	-16.42
*	11490.00	Peak	H	100	47	-61.28	12.43	-9.54	48.61	73.98	-25.37
	17235.00	Peak	H	-	-	-67.73	18.61	-9.54	48.34	68.20	-19.86
*	22980.00	Average	H	100	366	-61.65	8.16	-9.54	43.97	53.98	-10.01
*	22980.00	Peak	H	100	366	-56.50	8.16	-9.54	49.12	73.98	-24.86
	28725.00	Peak	H	-	-	-46.66	-9.24	-9.54	41.56	68.20	-26.64

Table 7-22. Radiated Measurements

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Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 Meter
Operating Frequency: 5785MHz
Channel: 157

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11570.00	Average	H	100	315	-70.99	12.54	-9.54	39.01	53.98	-14.97
*	11570.00	Peak	H	100	315	-60.11	12.54	-9.54	49.89	73.98	-24.09
	17355.00	Peak	H	-	-	-67.62	18.73	-9.54	48.57	68.20	-19.63
	23140.00	Peak	H	100	23	-51.42	8.37	-9.54	54.41	68.20	-13.79
	28925.00	Peak	H	-	-	-47.99	-9.65	-9.54	39.82	68.20	-28.38

Table 7-23. Radiated Measurements

Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 Meter
Operating Frequency: 5825MHz
Channel: 165

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11650.00	Average	H	100	24	-73.29	12.99	-9.54	37.15	53.98	-16.83
*	11650.00	Peak	H	100	24	-60.36	12.99	-9.54	50.08	73.98	-23.90
	17475.00	Peak	H	-	-	-69.36	19.25	-9.54	47.34	68.20	-20.86
	23300.00	Peak	H	100	357	-53.71	8.50	-9.54	52.24	68.20	-15.96
	29125.00	Peak	H	-	-	-46.89	-9.87	-9.54	40.70	68.20	-27.50

Table 7-24. Radiated Measurements

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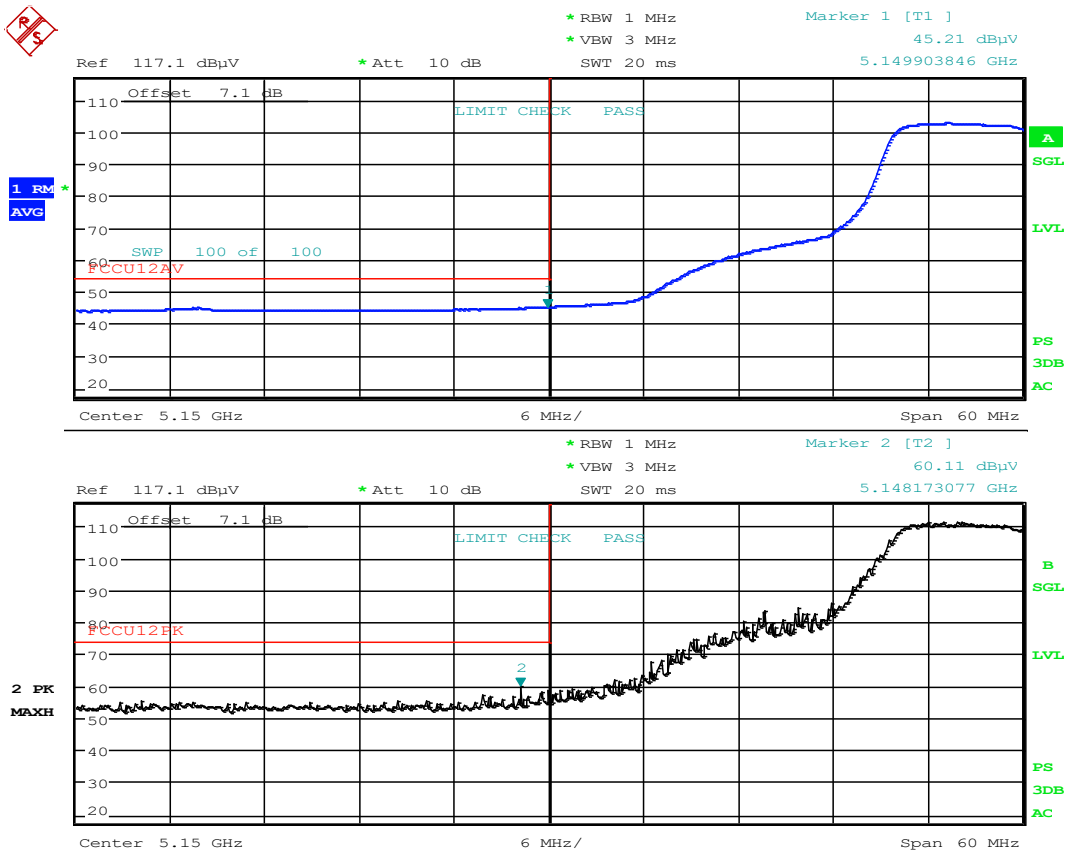
7.7.2 Radiated Band Edge Measurements (20MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209; RSS-Gen [8.9]; RSS-Gen [8.9]

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6 Mbps
Distance of Measurements:	3 Meters
Operating Frequency:	5180MHz
Channel:	36



Date: 12.SEP.2017 20:12:43

Plot 7-79. Radiated Restricted Lower Band Edge Plot (Average & Peak – UNII Band 1)

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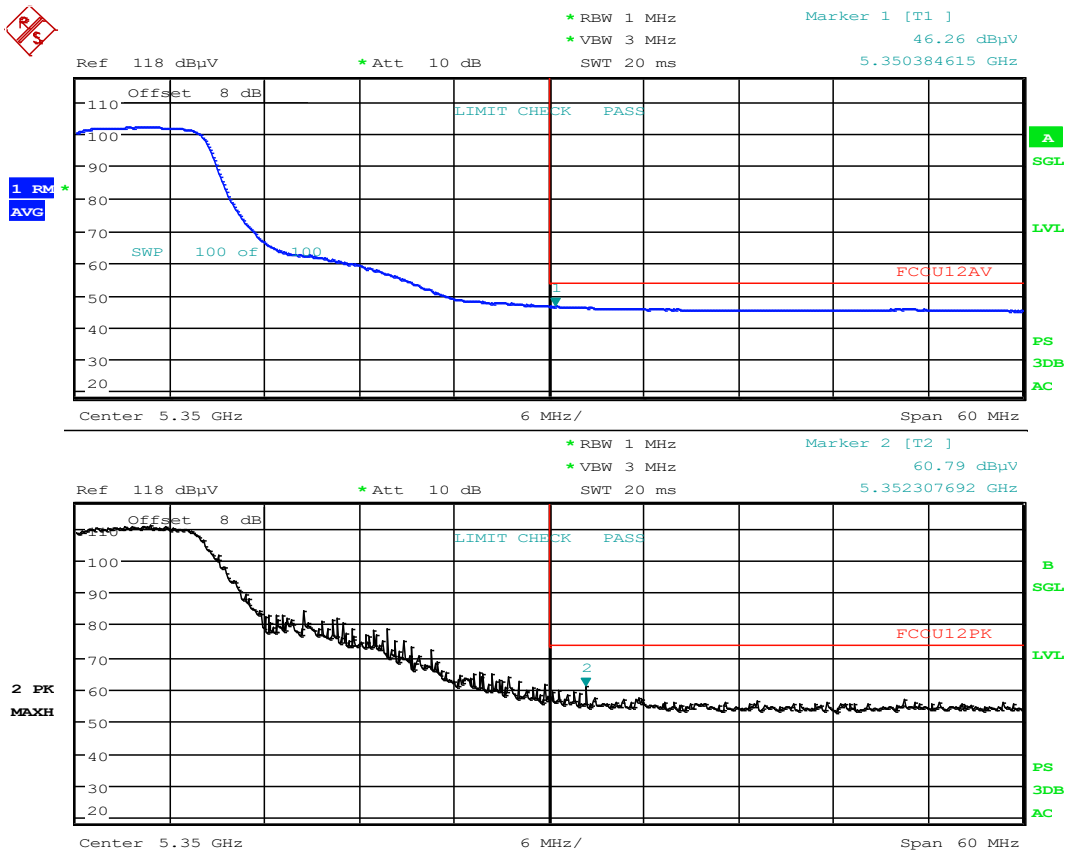
Radiated Band Edge Measurements (20MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209; RSS-Gen [8.9]

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6 Mbps
Distance of Measurements:	3 Meters
Operating Frequency:	5320MHz
Channel:	64



Date: 12.SEP.2017 20:19:46

Plot 7-80. Radiated Restricted Upper Band Edge Plot (Average & Peak – UNII Band 2A)

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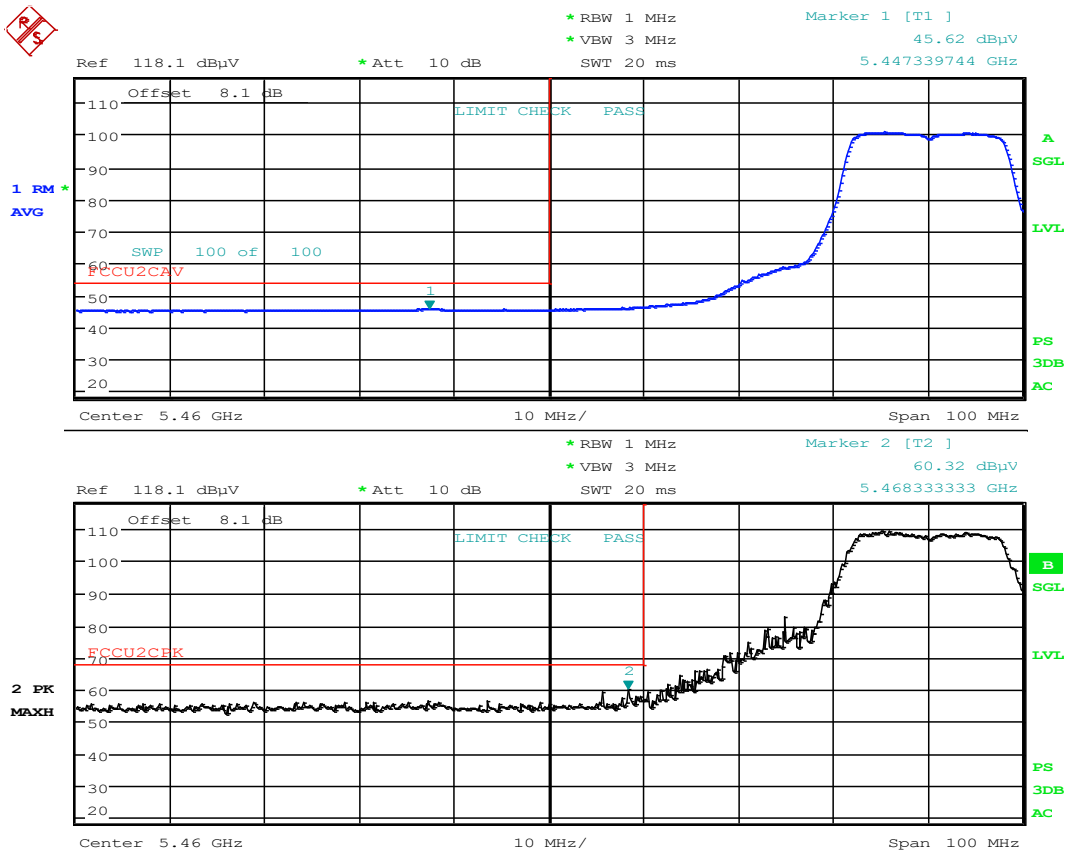
Radiated Band Edge Measurements (20MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209; RSS-Gen [8.9]

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6 Mbps
Distance of Measurements:	3 Meters
Operating Frequency:	5500MHz
Channel:	100



Date: 12.SEP.2017 20:24:16

Plot 7-81. Radiated Restricted Lower Band Edge Plot (Average & Peak – UNII Band 2C)

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