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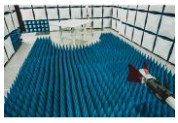

MEASUREMENT REPORT
FCC PART 15.407 / ISED RSS-247 UNII 802.11a/n/ac

Applicant Name:
Apple Inc.
One Apple Park Way
Cupertino, CA 95014
United States

Date of Testing:
05/01/2019-08/07/2019
Test Site/Location:
PCTEST Lab. Morgan Hill, CA, USA
Test Report Serial No.:
1C1901280003-09.BCG

FCC ID:	**BCGA2200**
IC:	**579C-A2200**
APPLICANT:	**Apple Inc.**

Application Type:	Certification
Model/HVIN:	A2200
EUT Type:	Tablet Device
Frequency Range:	5180 – 5825MHz
FCC Classification:	Unlicensed National Information Infrastructure (UNII)
FCC Rule Part(s):	Part 15 Subpart E (15.407)
ISED Specification:	RSS-247 Issue 2
Test Procedure(s):	ANSI C63.10-2013, KDB 789033 D02 v02r01, 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 v02r01. 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.

Randy Ortanez
President

ACCREDITED
TESTING CERT#2041.02

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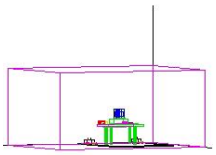

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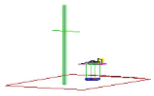

UNII Band	Channel Bandwidth (MHz)	Tx Frequency (MHz)	SISO				CDD/SDM					
			Core 0		Core 1		Core 0		Core 1		Combined	
			Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)
1	20	5180 - 5240	44.668	16.50	42.170	16.25	44.668	16.50	42.170	16.25	86.896	19.39
2A		5260 - 5320	50.119	17.00	47.315	16.75	50.119	17.00	47.315	16.75	97.275	19.88
2C		5500 - 5720	56.234	17.50	53.088	17.25	56.234	17.50	53.088	17.25	109.396	20.39
3		5745 - 5825	42.170	16.25	44.668	16.50	42.170	16.25	44.361	16.47	86.099	19.35
1	40	5190 - 5230	43.152	16.35	41.687	16.20	43.652	16.40	42.170	16.25	85.901	19.34
2A		5270 - 5310	50.119	17.00	46.238	16.65	49.888	16.98	47.098	16.73	97.051	19.87
2C		5510 - 5710	56.234	17.50	53.088	17.25	55.976	17.48	53.088	17.25	107.895	20.33
3		5755 - 5795	42.170	16.25	44.668	16.50	42.073	16.24	44.668	16.50	86.298	19.36
1	80	5210	19.953	13.00	19.724	12.95	14.060	11.48	14.125	11.50	28.184	14.50
2A		5290	19.953	13.00	19.953	13.00	15.740	11.97	15.346	11.86	31.117	14.93
2C		5530 - 5690	55.335	17.43	53.088	17.25	56.234	17.50	52.723	17.22	108.893	20.37
3		5775	41.210	16.15	43.652	16.40	39.174	15.93	39.174	15.93	78.343	18.94

FCC EUT Overview

UNII Band	Channel Bandwidth (MHz)	Tx Frequency (MHz)	SISO				CDD/SDM					
			Core 0		Core 1		Core 0		Core 1		Combined	
			Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)
1	20	5180 - 5240	31.623	15.00	31.623	15.00	15.849	12.00	15.849	12.00	31.696	15.01
2A		5260 - 5320	50.119	17.00	47.315	16.75	50.119	17.00	47.315	16.75	97.275	19.88
2C		5500 - 5720	56.234	17.50	53.088	17.25	56.234	17.50	53.088	17.25	109.396	20.39
3		5745 - 5825	42.170	16.25	44.668	16.50	42.170	16.25	44.361	16.47	86.099	19.35
1	40	5190 - 5230	43.152	16.35	41.687	16.20	25.119	14.00	25.061	13.99	50.234	17.01
2A		5270 - 5310	50.119	17.00	46.238	16.65	49.888	16.98	47.098	16.73	97.051	19.87
2C		5510 - 5710	56.234	17.50	53.088	17.25	55.976	17.48	53.088	17.25	107.895	20.33
3		5755 - 5795	42.170	16.25	44.668	16.50	42.073	16.24	44.668	16.50	86.298	19.36
1	80	5210	19.953	13.00	19.724	12.95	14.060	11.48	14.125	11.50	28.184	14.50
2A		5290	19.953	13.00	19.953	13.00	15.740	11.97	15.346	11.86	31.117	14.93
2C		5530 - 5690	55.335	17.43	53.088	17.25	56.234	17.50	52.723	17.22	108.893	20.37
3		5775	41.210	16.15	43.652	16.40	39.174	15.93	39.174	15.93	78.343	18.94

ISED EUT Overview

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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 18855 Adams Court, Morgan Hill, CA 95037. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014 and KDB 414788 D01 v01.

1.3 Test Facility / Accreditations

Measurements were performed at PCTEST Engineering Lab located in Morgan Hill, CA 95037, U.S.A.

- PCTEST is an ISO 17025-2005 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.02 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 **Apple Tablet Device FCC ID: BCGA2200**. The test data contained in this report pertains only to the emissions due to the EUT's UNII transmitter.

Test Device Serial No.: F9FYL01SMLWN, F9FYL01RMLWN

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/ac 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	5580	157	5785
:	:	:	:	:	:	:	:
48	5240	64	5320	144	5720	165	5825

Table 2-1. 802.11a / 802.11n / 802.11ac (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	110	5550	159	5795
				:	:		
				142	5710		

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

Band 1		Band 2A		Band 2C		Band 3	
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
42	5210	58	5290	106	5530	155	5775
				:	:		
				138	5690		

Table 2-3. 802.11ac (80MHz BW) Frequency / Channel Operations

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Notes:

1. 5GHz NII operation is possible in 20MHz, and 40MHz, and 80MHz 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 KDB 789033 D02 v02r01 and ANSI C63.10-2013. 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:

Measured Duty Cycles				
802.11 Mode/Band		Duty Cycle [%]		
		CORE 0	CORE 1	CDD/SDM
5GHz	a	98.6	98.6	98.6
	n (HT20)	98.8	98.7	98.9
	n (HT40)	97.4	97.7	97.7
	ac (HT80)	95.0	95.0	95.0

Table 2-4. Measured Duty Cycles

2. WF1 is correlating to Core 0 and WF2 is correlating to Core 1.
3. The device employs MIMO technology. Below are the possible configurations.

WiFi Configurations		SISO		CDD		SDM		STBC	
		CORE 0	CORE 1	CORE 0	CORE 1	CORE 0	CORE 1	CORE 0	CORE 1
5GHz	11a	✓	✓	✓	✓	×	×	×	×
	11n (20MHz)	✓	✓	✓	✓	✓	✓	✓	✓
	11n (40MHz)	✓	✓	✓	✓	✓	✓	✓	✓
	11ac (80MHz)	✓	✓	✓	✓	✓	✓	✓	✓

Table 2-5. Frequency / Channel Operations

✓= Support ; × = NOT Support
SISO = Single Input Single Output
CDD = Cyclic Delay Diversity - 2Tx Function
SDM = Spatial Diversity Multiplexing – MIMO Function
STBC = Space-Time Block Coding

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, 78/86.7 (n – 20MHz)

13.5/15, 27/30, 40.5/45, 54/60, 81/90, 108/120, 121.5/135, 135/150 (n – 40MHz BW)

29.3/32.5, 58.5/65, 87.8/97.5, 117/130, 175.5/195, 234/260, 263.3/292.5, 292.5/325, 351/390, 390/433.3 (ac – 80MHz BW)
13/14.4, 26.28.9, 39/43.3, 52/57.8, 78/86.7, 104/115.6, 117/130, 130/144.4MBps (MIMO n/ac – 20MHz) 156/173Mbps (MIMO ac – 20MHz)
27/30, 54/60, 81/90, 108/120, 162/180, 216/240, 243,270, 270/300Mbps (MIMO n/ac – 40MHz) 324/360, 360/400Mbps (MIMO ac – 40MHz)
58.5/65, 117/130, 175.5/195, 234/260, 351/390, 468/520, 526.5/585, 585/650, 702/780, 780/866.7Mbps (MIMO ac – 80MHz)

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4. This device supports simultaneous transmission operation, which allows for two SISO channels to operate independent of one another in the 2.4GHz and 5GHz bands simultaneously on each antenna, which was single antenna transmitting both Bluetooth 2.4GHz and WIFI 5GHz. The following tables show the worst case configurations determined during testing. The data for these configurations is contained in this test report.

Worst Case Configuration: CORE 0 transmitting both Bluetooth 2.4GHz mode and WIFI 5GHz mode

Description	2.4 GHz Emission	5 GHz Emission
Antenna	0	0
Channel	78	36
Operating Frequency (MHz)	2480	5180
Data Rate (Mbps)	GFSK/1Mbps	MCS0
Mode	Bluetooth	UNII

Table 2-6. Worst Case Simultaneous Transmission Config

2.3 Antenna Description

Following antenna was used for the testing.

Frequency [GHz]	Antenna Gain (dBi)	
	Core 0	Core 1
5.150 - 5.250	1.27	2.64
5.260 - 5.350	2.24	2.77
5.470 - 5.725	3.39	3.17
5.745 - 5.850	3.54	3.21

Table 2-7. Highest Antenna Gain

2.4 Test Support Equipment

1	Apple MacBook	Model:	A1398	S/N:	C2QKP008F6F3
	w/AC/DC Adapter	Model:	A1435	S/N:	N/A
2	Apple USB Cable	Model:	Kanzi	S/N:	32530F
3	USB Lightning Cable	Model:	N/A	S/N:	N/A
	w/ AC Adapter	Model:	A1401	S/N:	N/A
4	Apple Pencil	Model:	A1603	S/N:	G64TG0FEGWTJ
5	DC Power Supply	Model:	KPS3010D	S/N:	N/A

Table 2-8. Test Support Equipment Used

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2.5 Test Configuration

The EUT was tested per the guidance of KDB 789033 D02 v02r01. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing. See Sections 7.8 for AC line conducted emissions test setups, 7.6 for radiated emissions test setups, and 7.2, 7.3, 7.4, and 7.5 for antenna port conducted emissions test setups.

There are two vendors of the WiFi/Bluetooth radio modules, variant 1 and variant 2. Both radio modules have the same mechanical outline, same on-board antenna matching circuit, identical antenna structure, and are built and tested to conform to the same specifications and to operate within the same tolerances. The worst case configuration was found between the two variants. The EUT was also investigated with and without charger.

The emissions below 1GHz and above 18GHz were tested with the highest transmitting power channel and the worst case configuration.

The EUT was manipulated through three orthogonal planes of X-orientation (flatbed), Y-orientation (landscape), and Z-orientation (portrait) during the testing. Only the worst case emissions were reported in this test report.

For AC line conducted and radiated test below 1GHz, following configuration were investigated and worst case was reported.

- EUT powered by AC/DC adaptor via USB cable with wire charger
- EUT powered by host PC via USB cable with wire charger

802.11n HT20/40 and acVHT80 2TX CDD mode test data provided in this report covers 802.11n HT20/40 and 802.11acVHT80 STBC mode

802.11ac VHT20 and VHT40 mode are different from 802.11n HT20 and HT40 only in control messages and have the same power settings.

Throughout the report, Antenna WF1 is correlating to Core 0 and WF2 is correlating to Core 1.

2.6 Software and Firmware

The test was conducted with firmware version 17A522 installed on the EUT.

2.7 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 v02r01 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 7m x 3.66m x 2.7m shielded enclosure. The shielded enclosure is manufactured by AP Americas. The shielding effectiveness of the shielded room is in accordance with MIL-Std-285 or NSA 65-6. 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 EPCOS 2X60A Power Line Filter (100dB Attenuation, 14kHz-18GHz) and the two EPCOs 2X48A filters (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 7.1. Automated test software was used to perform the AC line conducted emissions testing. Automated measurement software utilized is Rohde & Schwarz EMC32, Version 10.35.04.

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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.

Per KDB 414788, radiated emission test sites other than open-field test sites (e.g., shielded anechoic chambers), may be employed for emission measurements below 30MHz if characterized so that the measurements correspond to those obtained at an open-field test site. To determine test site equivalency, a reference sample transmitting at 149kHz was measured on an open field test site (asphalt with no ground plane) and then measured in the 3m semi-anechoic chamber. A calibrated 60cm loop antenna was rotated about its vertical axis while the reference device was rotated through the X, Y and Z axis in order to capture the worst case level. A maximum deviation of 2.77dB at 149kHz was measured when comparing the 3 meter semi-anechoic chamber to the open field site.

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 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.

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014. Additionally, radiated emissions below 30MHz are also validated on an Open Area Test Site to assert correlation with the chamber measurements per the requirements of KDB 474788 D01.

3.4 Environmental Conditions

The temperature is controlled within range of 15ºC to 35ºC. 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 U_{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	1.29
Line Conducted Disturbance	2.48
Radiated Disturbance (<1GHz)	4.15
Radiated Disturbance (>1GHz)	4.70
Radiated Disturbance (>18GHz)	5.01

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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
Agilent Technologies	N9030A	3Hz-44GHz PXA Signal Analyzer	3/13/2019	Annual	3/13/2020	MY49430244
Anritsu	ML2496A	Power Meter	10/22/2018	Annual	10/22/2019	184005
Anritsu	MA2411B	Pulse Power Sensor	10/22/2018	Annual	10/22/2019	1726261
Anritsu	MA2411B	Pulse Power Sensor	10/22/2018	Annual	10/22/2019	1726262
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	9/10/2018	Annual	9/10/2019	T058701-03
COM-POWER	LIN-120A	LISN	3/13/2019	Annual	3/13/2020	241297
Rohde & Schwarz	ESW26	EMI Test Receiver	5/21/2019	Annual	5/21/2020	101299
Rohde & Schwarz	ESW44	EMI Test Receiver	11/20/2018	Annual	11/20/2019	101570
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	9/5/2018	Annual	9/5/2019	100050
ETS-Lindgren	118490	Pre-Amplifier (30MHz - 6GHz)	8/31/2018	Annual	8/31/2019	213236
ETS-Lindgren	3142E	BiConiLog Antenna (30MHz - 6GHz)	12/11/2018	Annual	12/11/2019	224569
Rohde & Schwarz	TC-TA18	Cross Polarized Vivaldi Antenna (400MHz-18GHz)	11/21/2018	Annual	11/21/2019	101057
Rohde & Schwarz	TC-TA18	Cross Polarized Vivaldi Antenna (400MHz-18GHz)	12/7/2018	Annual	12/7/2019	101063
Rohde & Schwarz	HFH2-Z2	Loop Antenna	3/21/2019	Annual	3/21/2020	100519

Table 6-1. Annual Test Equipment Calibration Schedule

Note:

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.

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7.0 TEST RESULTS

7.1 Summary

Company Name: Apple Inc.
FCC ID: BCGA2200
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 [6.7]	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	Section7.5
15.407(h)	RSS-247 [6.3]	Dynamic Frequency Selection	See DFS Test Report	RADIATED	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])		PASS	Section 7.6
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 7.6, **Error! Reference source not found.**
15.407	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 (RSS-Gen [8.8]) limits	LINE CONDUCTED	PASS	Section 7.8

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 4.6.
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 1.3.0.

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7.2 26dB Bandwidth Measurement – 802.11a/n/ac

RSS-Gen [6.7]

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 v02r01, 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 v02r01 – 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

All antenna configs were investigated and only the worst case is reported.

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SISO CORE 0-26 dB Bandwidth Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured 26dB Bandwidth [MHz]
5180	36	n (20MHz)	6.5/7.2 (MCS0)	21.26
5200	40	n (20MHz)	6.5/7.2 (MCS0)	21.34
5240	48	n (20MHz)	6.5/7.2 (MCS0)	21.51
5190	38	n (40MHz)	13.5/15 (MCS0)	39.68
5230	46	n (40MHz)	13.5/15 (MCS0)	39.63
5210	42	ac (80MHz)	29.3/32.5 (MCS0)	81.78
5260	52	n (20MHz)	6.5/7.2 (MCS0)	21.24
5280	56	n (20MHz)	6.5/7.2 (MCS0)	21.40
5320	64	n (20MHz)	6.5/7.2 (MCS0)	21.48
5270	54	n (40MHz)	13.5/15 (MCS0)	39.72
5310	62	n (40MHz)	13.5/15 (MCS0)	39.65
5290	58	ac (80MHz)	29.3/32.5 (MCS0)	81.20
5500	100	n (20MHz)	6.5/7.2 (MCS0)	21.37
5580	116	n (20MHz)	6.5/7.2 (MCS0)	21.31
5720	144	n (20MHz)	6.5/7.2 (MCS0)	21.52
5510	102	n (40MHz)	13.5/15 (MCS0)	39.52
5550	110	n (40MHz)	13.5/15 (MCS0)	39.72
5710	142	n (40MHz)	13.5/15 (MCS0)	39.96
5530	106	ac (80MHz)	29.3/32.5 (MCS0)	80.92
5690	138	ac (80MHz)	29.3/32.5 (MCS0)	81.23

Table 7-2. Conducted Bandwidth Measurements SISO CORE 0

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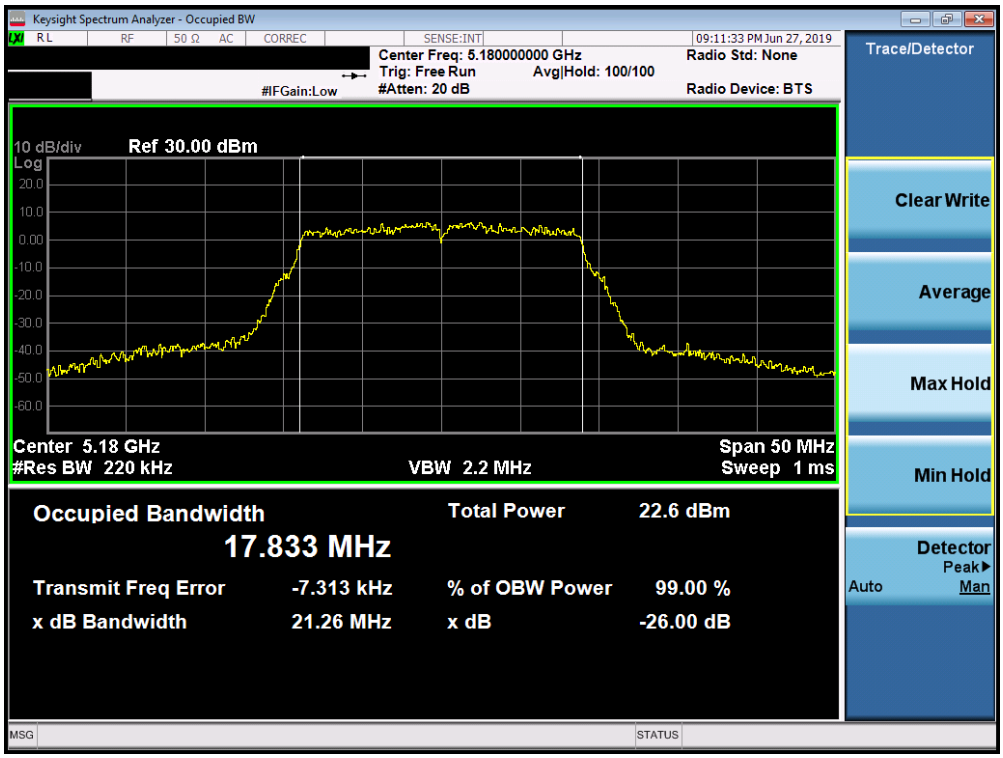
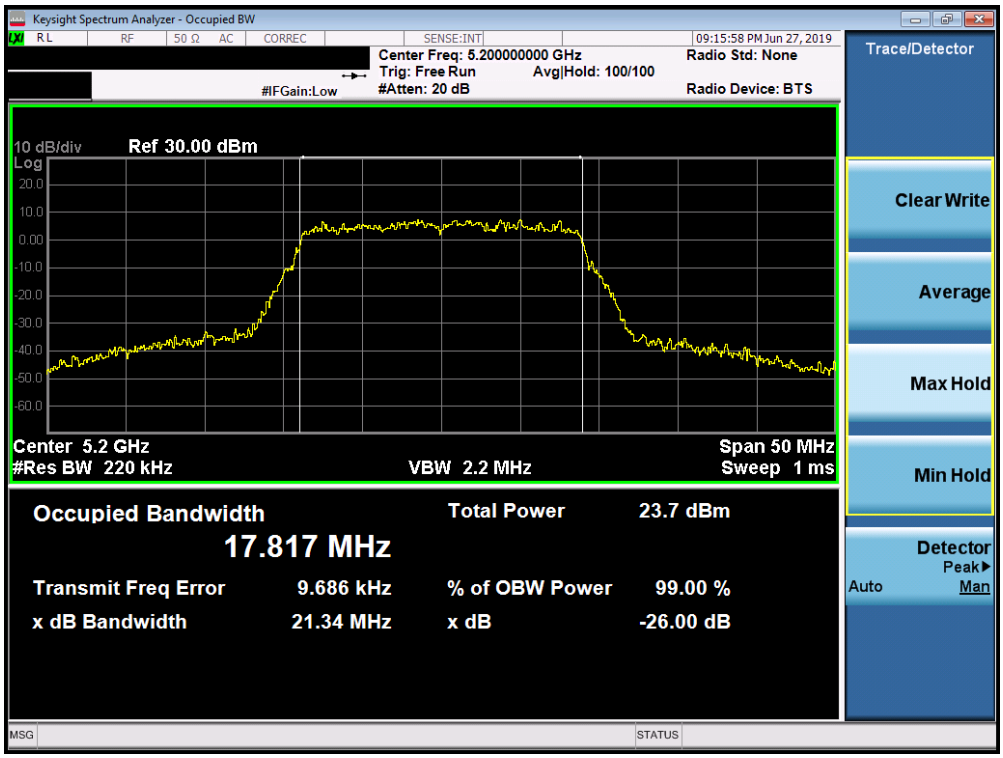


Plot 7-1. 26dB Bandwidth Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 1) – Ch. 36)



Plot 7-2. 26dB Bandwidth Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 1) – Ch. 40)

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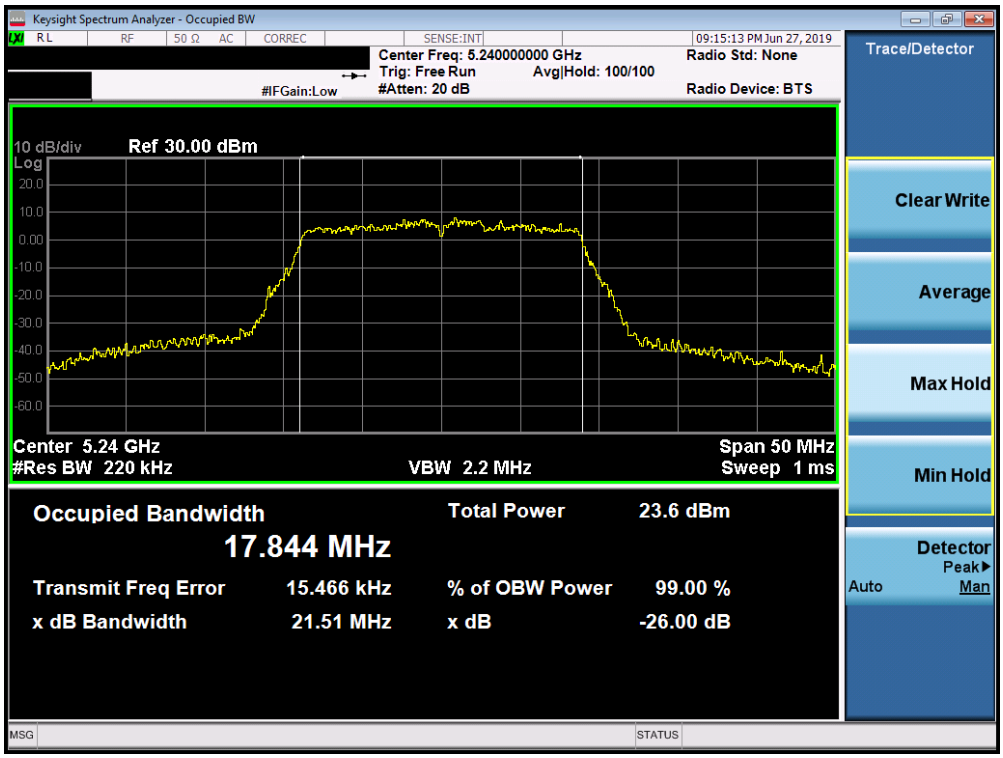
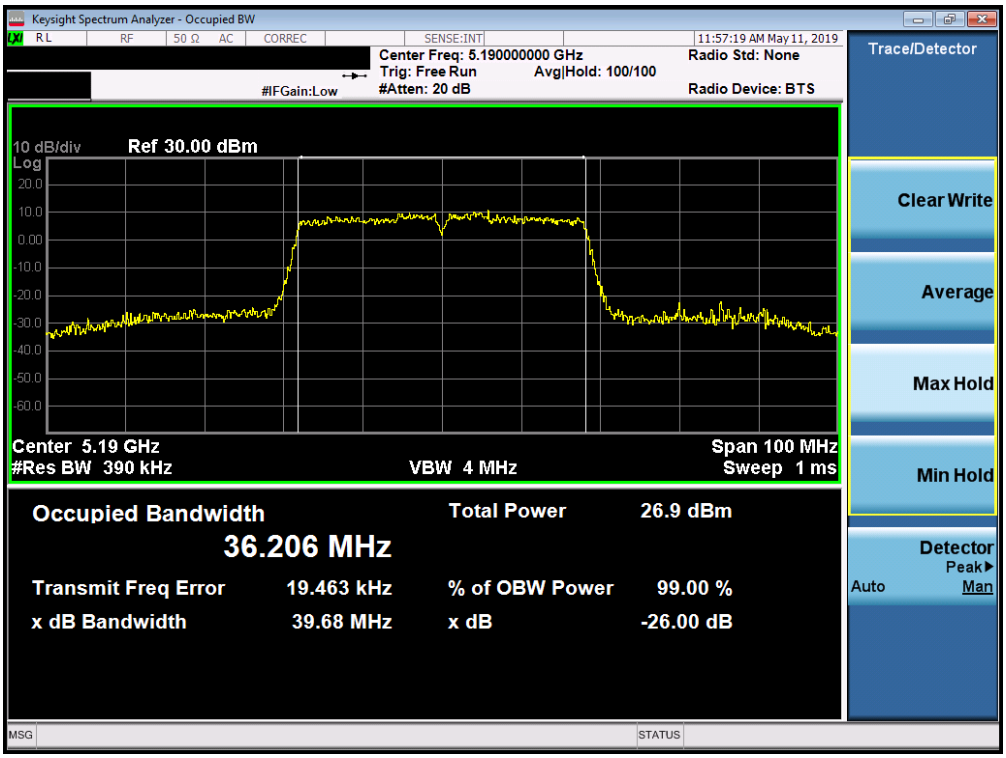


Plot 7-3. 26dB Bandwidth Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 1) – Ch. 48)



Plot 7-4. 26dB Bandwidth Plot SISO CORE 0 (40MHz BW 802.11n (UNII Band 1) – Ch. 38)

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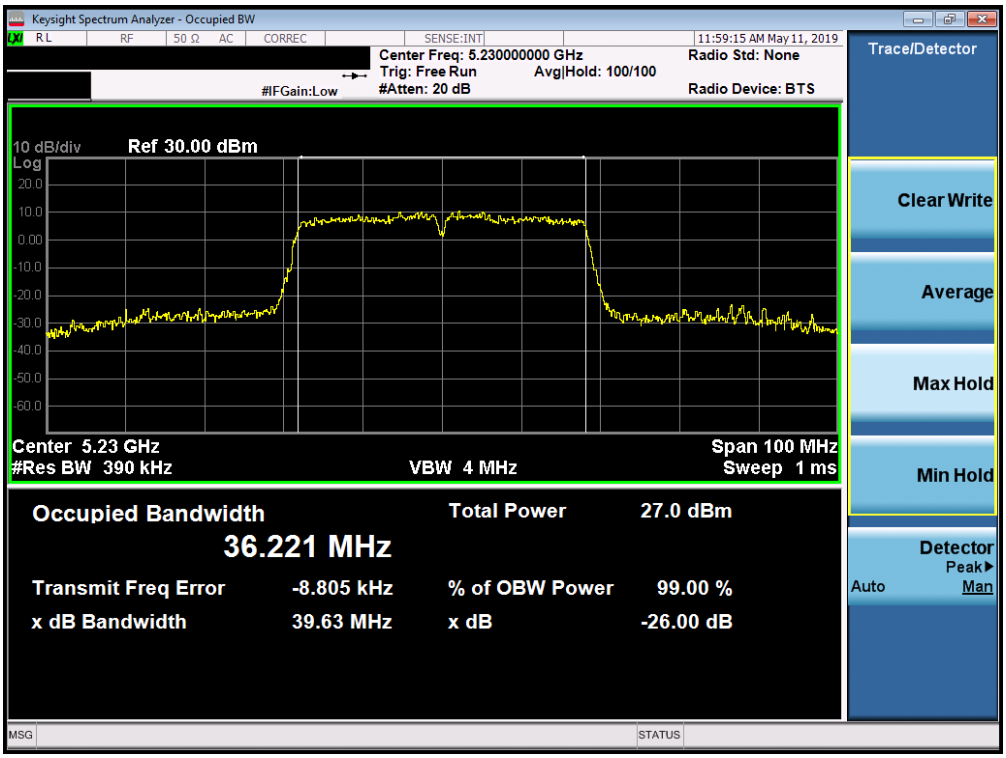
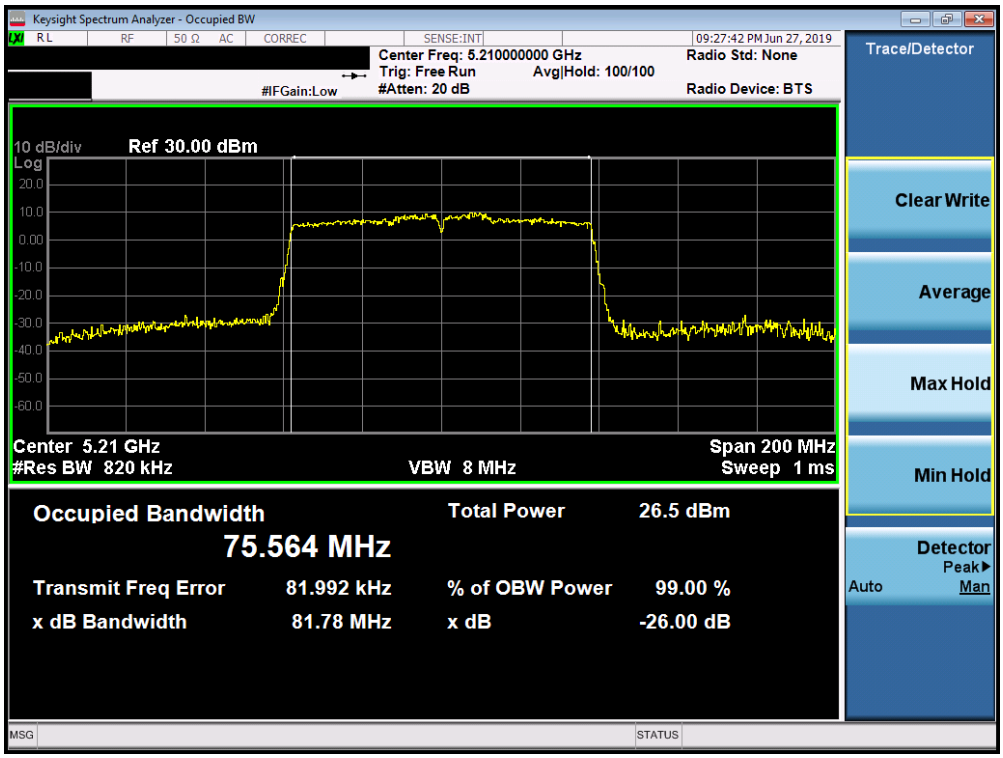


Plot 7-5. 26dB Bandwidth Plot SISO CORE 0 (40MHz BW 802.11n (UNII Band 1) – Ch. 46)



Plot 7-6. 26dB Bandwidth Plot SISO CORE 0 (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)

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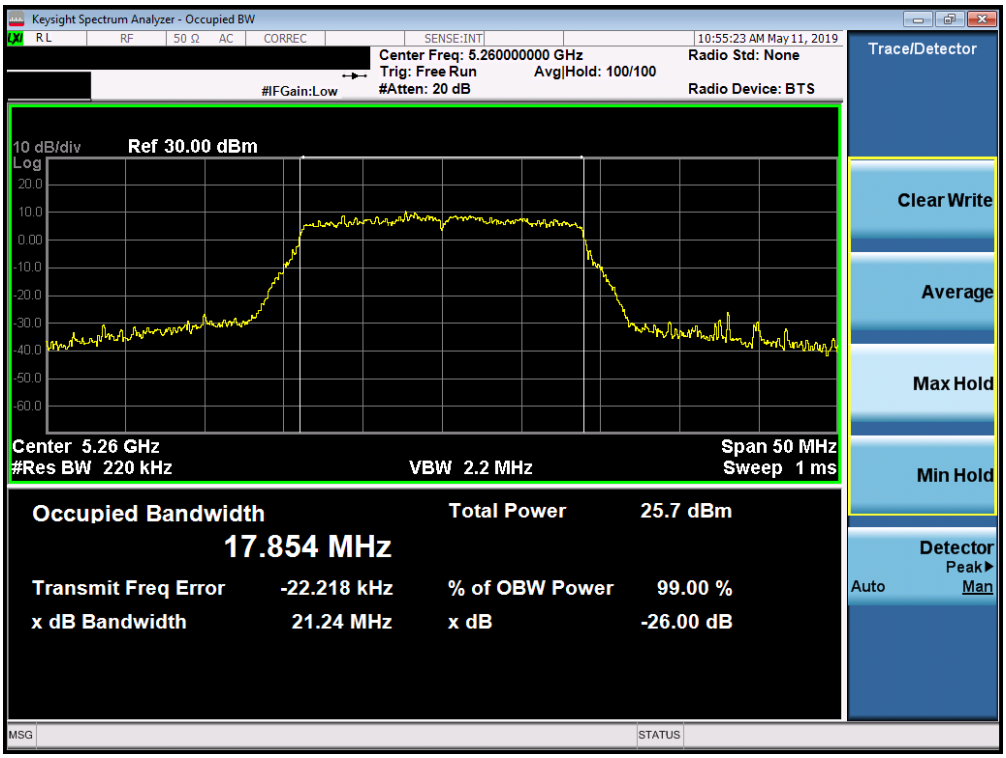
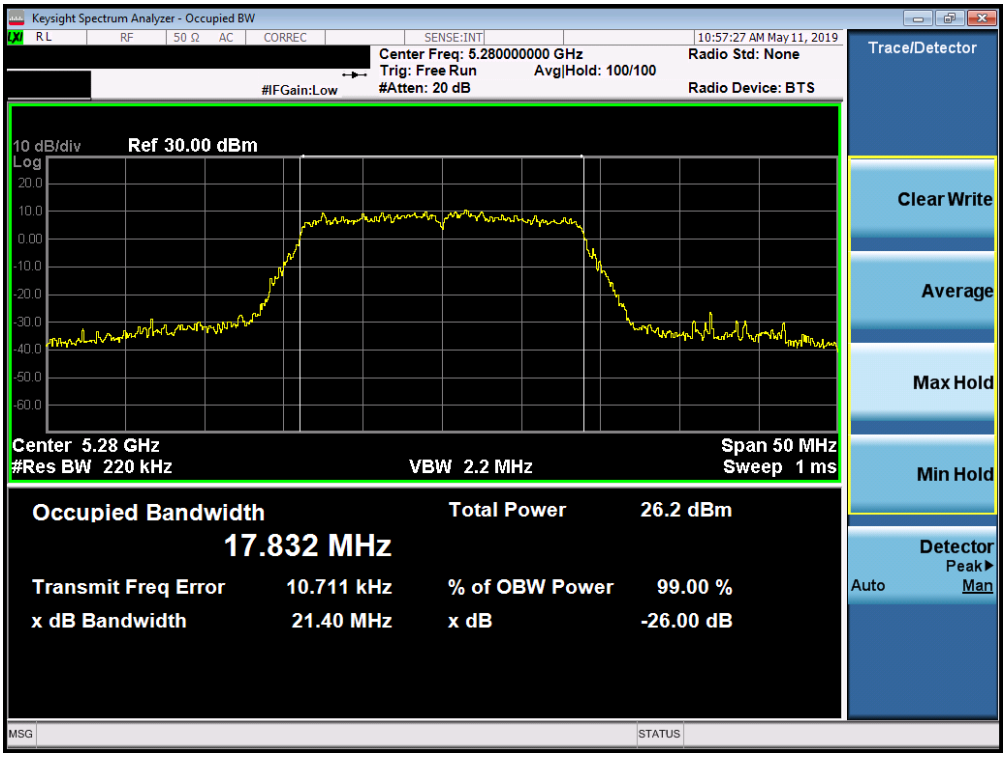


Plot 7-7. 26dB Bandwidth Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 2A) – Ch. 52)



Plot 7-8. 26dB Bandwidth Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)

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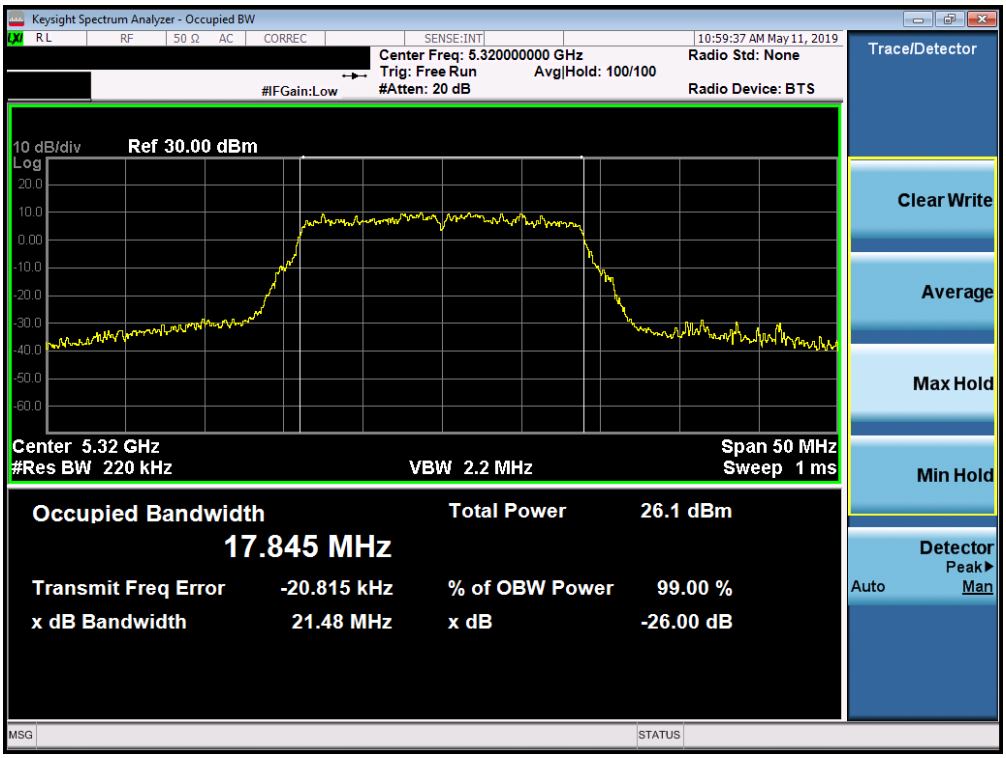
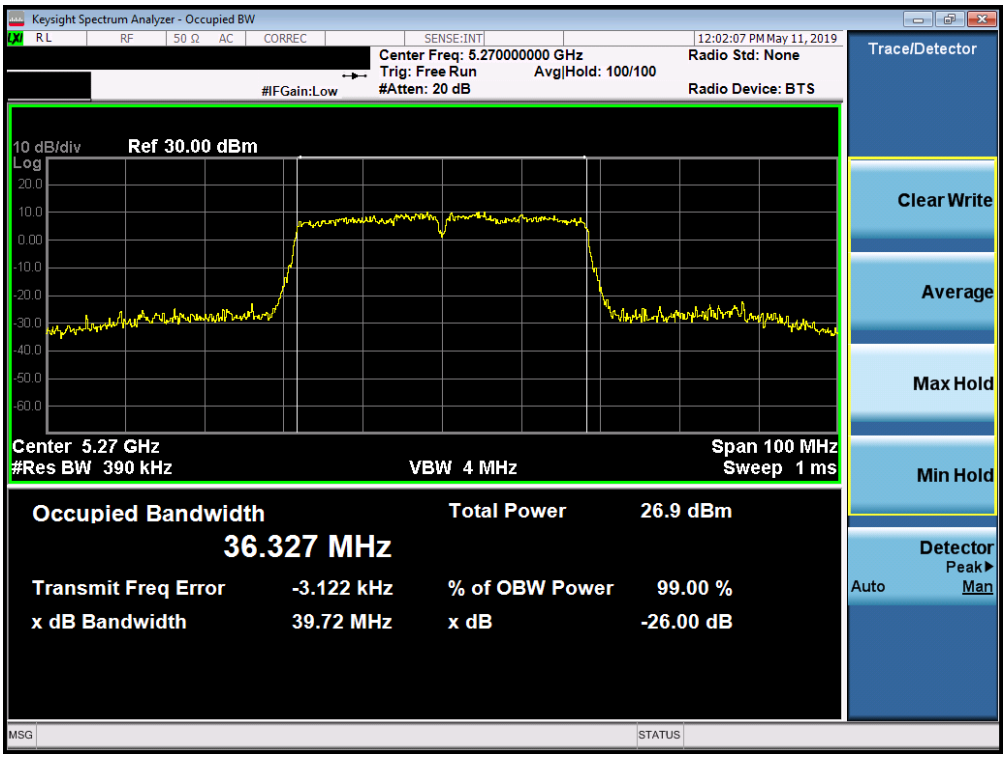


Plot 7-9. 26dB Bandwidth Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 2A) – Ch. 64)



Plot 7-10. 26dB Bandwidth Plot SISO CORE 0 (40MHz BW 802.11n (UNII Band 2A) – Ch. 54)

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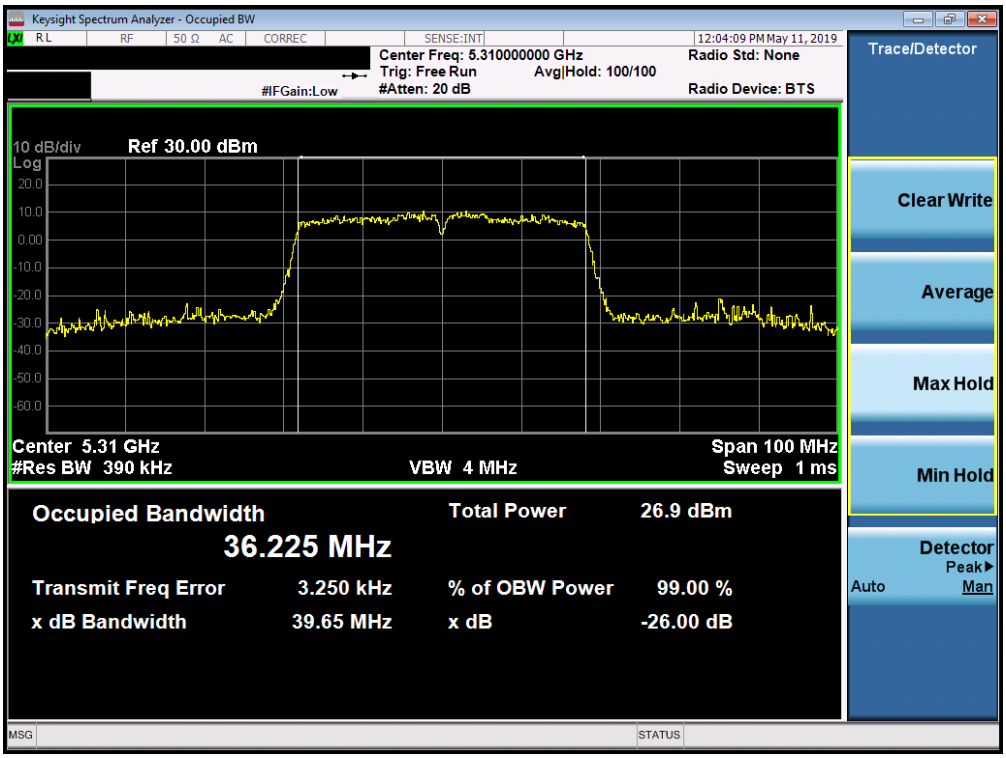
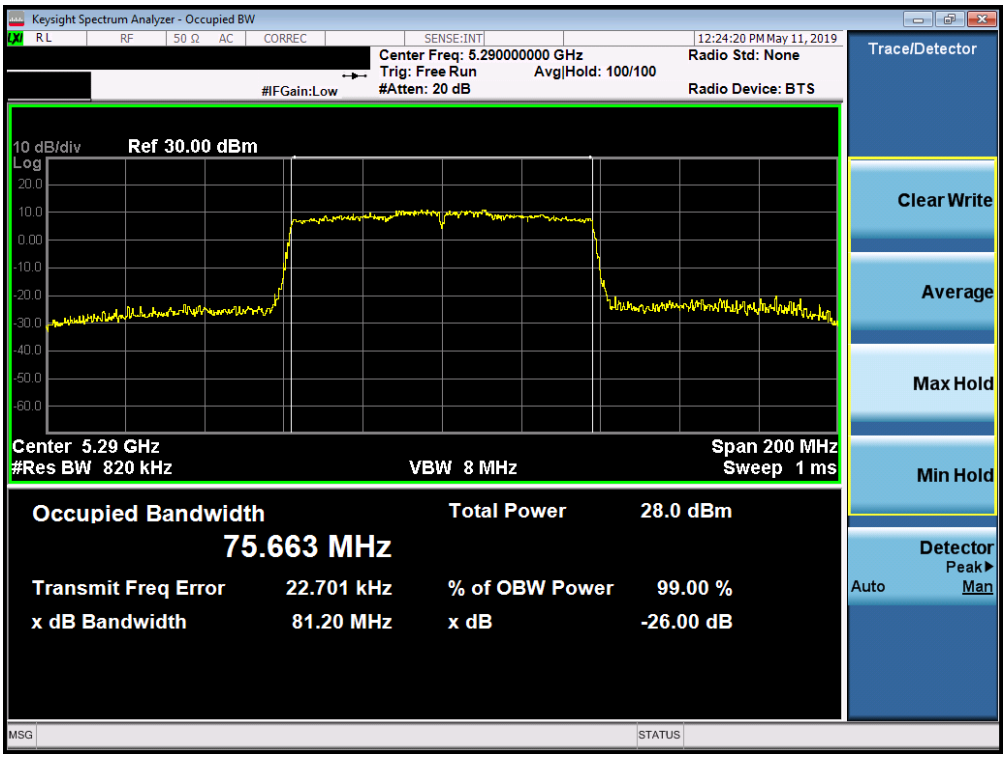


Plot 7-11. 26dB Bandwidth Plot SISO CORE 0 (40MHz BW 802.11n (UNII Band 2A) – Ch. 62)



Plot 7-12. 26dB Bandwidth Plot SISO CORE 0 (80MHz BW 802.11ac (UNII Band 2A) – Ch. 58)

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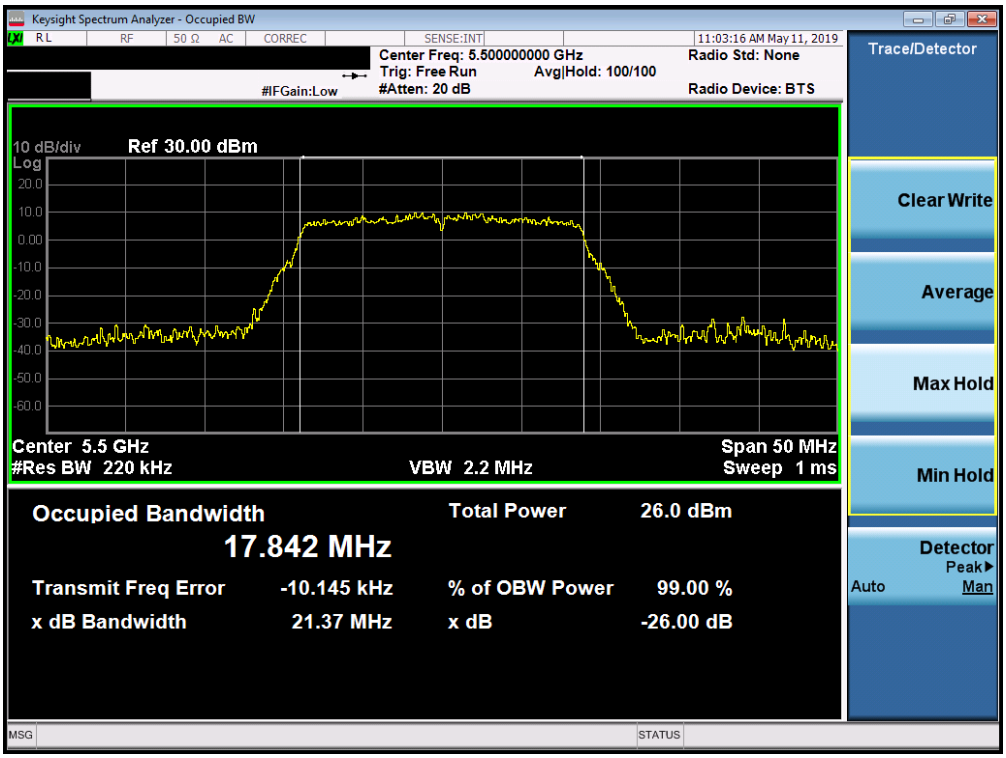
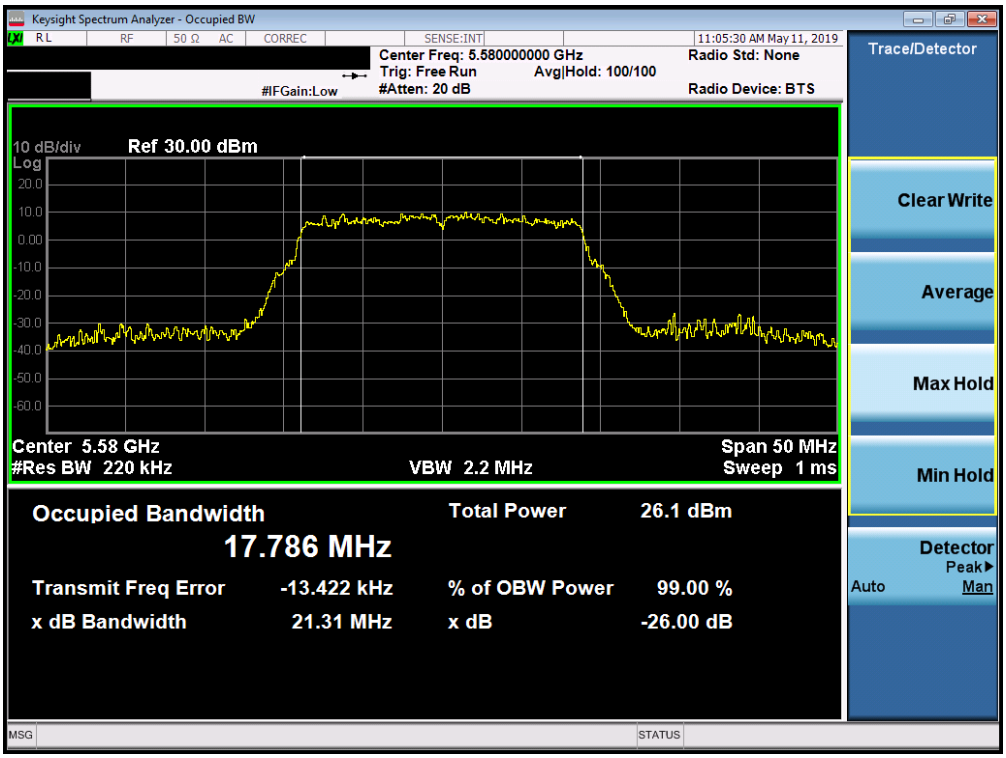


Plot 7-13. 26dB Bandwidth Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 2C) – Ch. 100)



Plot 7-14. 26dB Bandwidth Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 2C) – Ch. 116)

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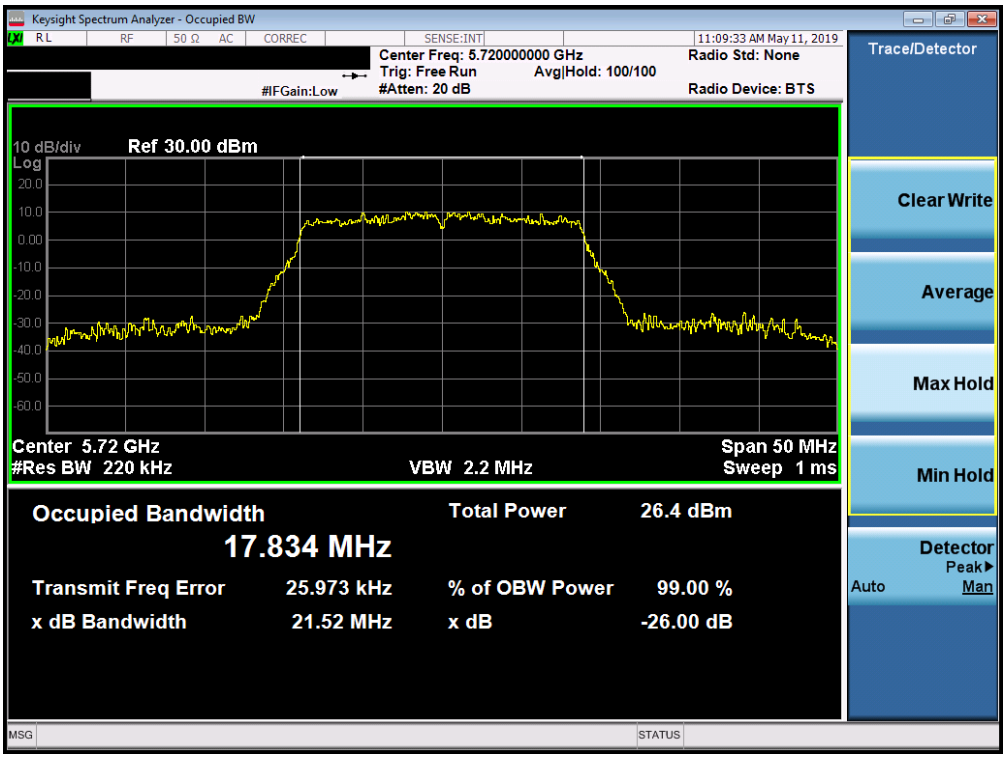
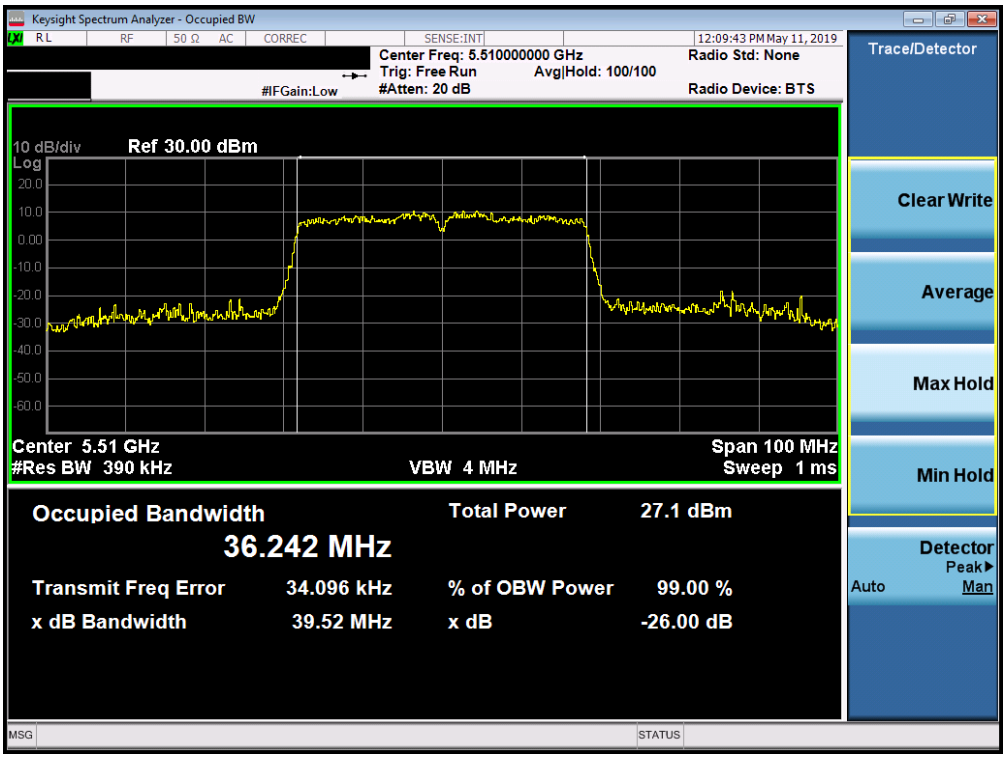


Plot 7-15. 26dB Bandwidth Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 2C) – Ch. 144)



Plot 7-16. 26dB Bandwidth Plot SISO CORE 0 (40MHz BW 802.11n (UNII Band 2C) – Ch. 102)

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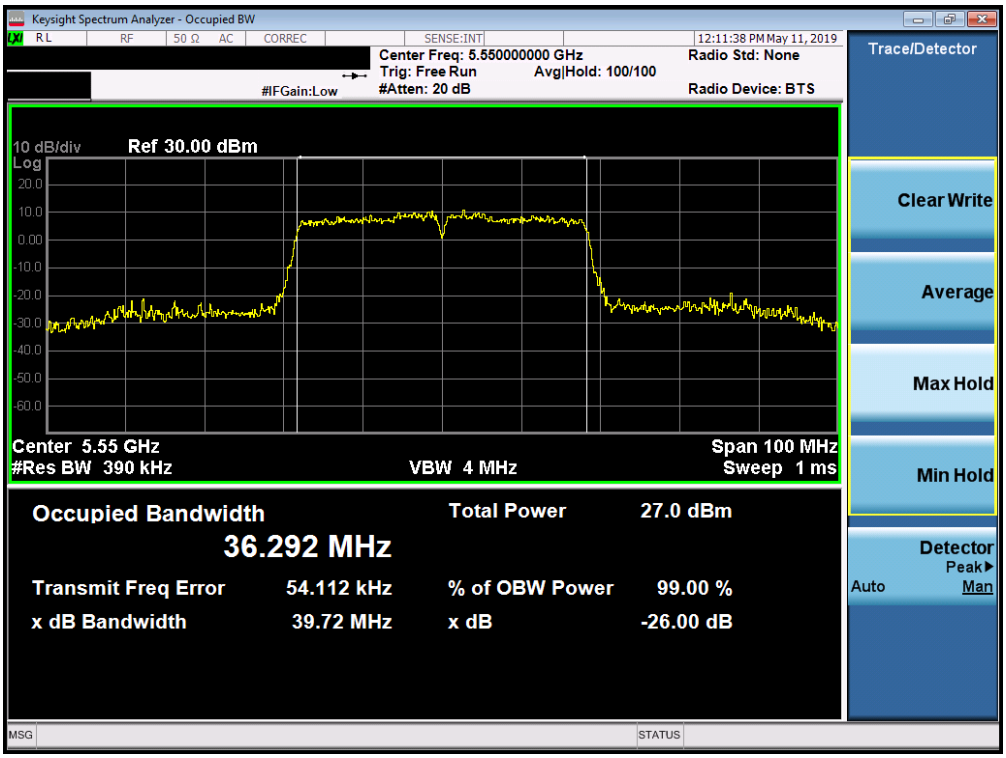
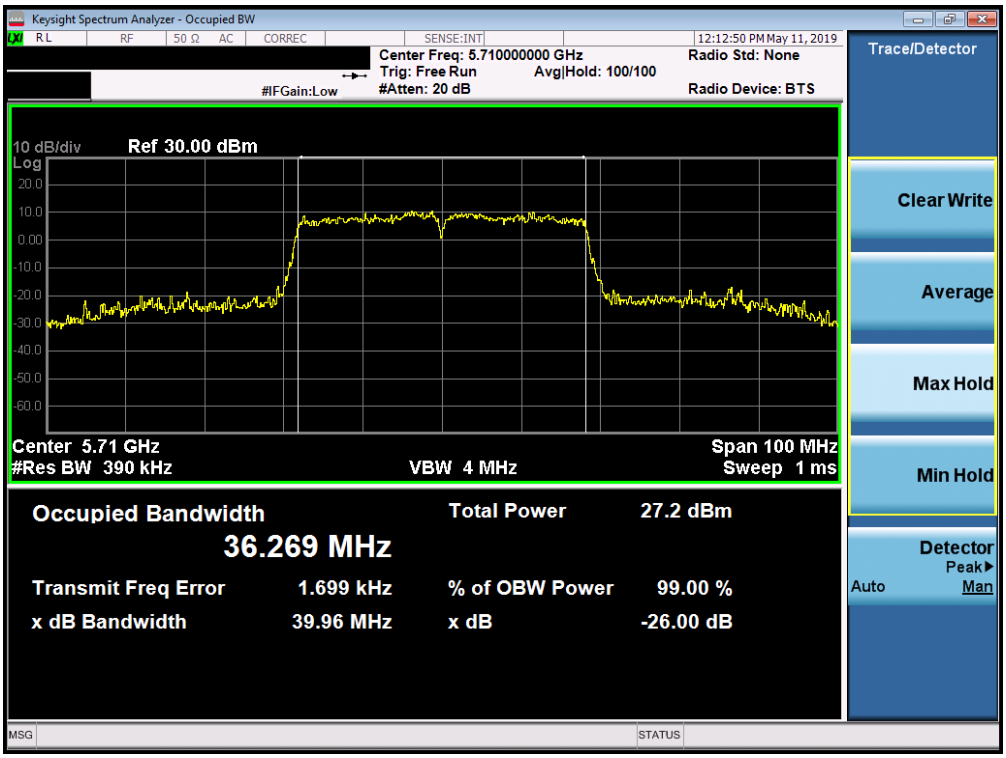


Plot 7-17. 26dB Bandwidth Plot SISO CORE 0 (40MHz BW 802.11n (UNII Band 2C) – Ch. 110)



Plot 7-18. 26dB Bandwidth Plot SISO CORE 0 (40MHz BW 802.11n (UNII Band 2C) – Ch. 142)

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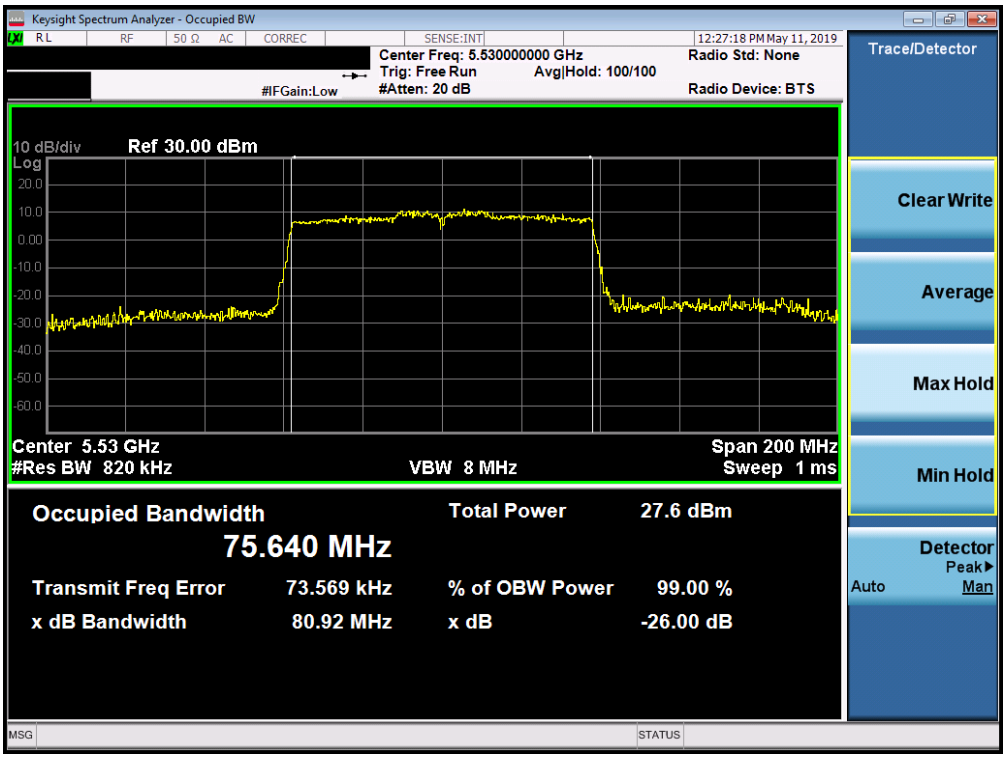
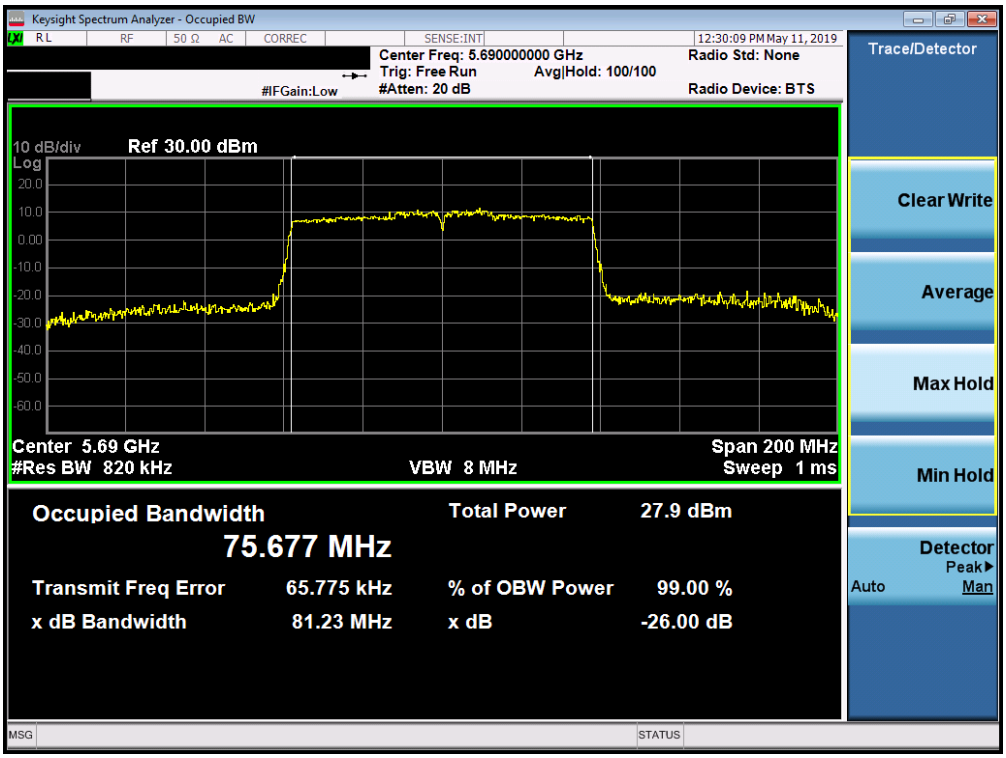


Plot 7-19. 26dB Bandwidth Plot SISO CORE 0 (80MHz BW 802.11ac (UNII Band 2C) – Ch. 106)



Plot 7-20. 26dB Bandwidth Plot SISO CORE 0 (80MHz BW 802.11ac (UNII Band 2C) – Ch. 138)

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SISO CORE 1-26dB Bandwidth Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured 26dB Bandwidth [MHz]
5180	36	n (20MHz)	6.5/7.2 (MCS0)	21.29
5200	40	n (20MHz)	6.5/7.2 (MCS0)	21.21
5240	48	n (20MHz)	6.5/7.2 (MCS0)	21.36
5190	38	n (40MHz)	13.5/15 (MCS0)	39.48
5230	46	n (40MHz)	13.5/15 (MCS0)	39.75
5210	42	ac (80MHz)	29.3/32.5 (MCS0)	80.79
5260	52	n (20MHz)	6.5/7.2 (MCS0)	21.24
5280	56	n (20MHz)	6.5/7.2 (MCS0)	21.25
5320	64	n (20MHz)	6.5/7.2 (MCS0)	21.33
5270	54	n (40MHz)	13.5/15 (MCS0)	39.68
5310	62	n (40MHz)	13.5/15 (MCS0)	39.41
5290	58	ac (80MHz)	29.3/32.5 (MCS0)	81.60
5500	100	n (20MHz)	6.5/7.2 (MCS0)	21.24
5580	116	n (20MHz)	6.5/7.2 (MCS0)	21.54
5720	144	n (20MHz)	6.5/7.2 (MCS0)	21.51
5510	102	n (40MHz)	13.5/15 (MCS0)	39.38
5550	110	n (40MHz)	13.5/15 (MCS0)	39.61
5710	142	n (40MHz)	13.5/15 (MCS0)	39.88
5530	106	ac (80MHz)	29.3/32.5 (MCS0)	80.56
5690	138	ac (80MHz)	29.3/32.5 (MCS0)	80.85

Table 7-3. Conducted Bandwidth Measurements SISO CORE 1

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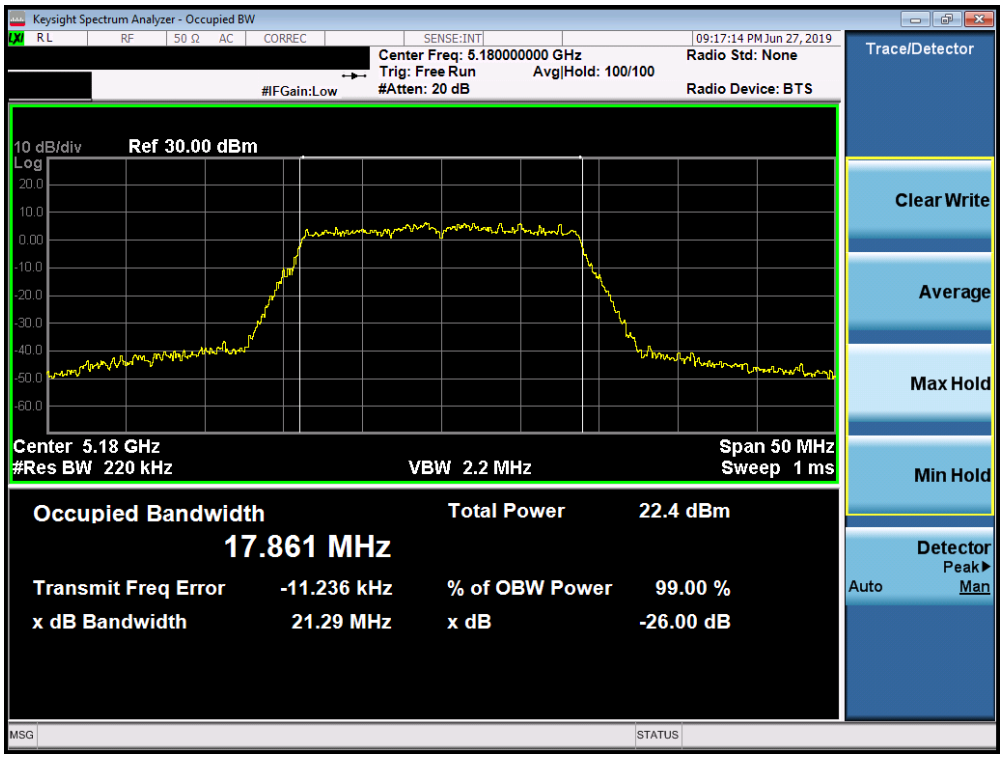
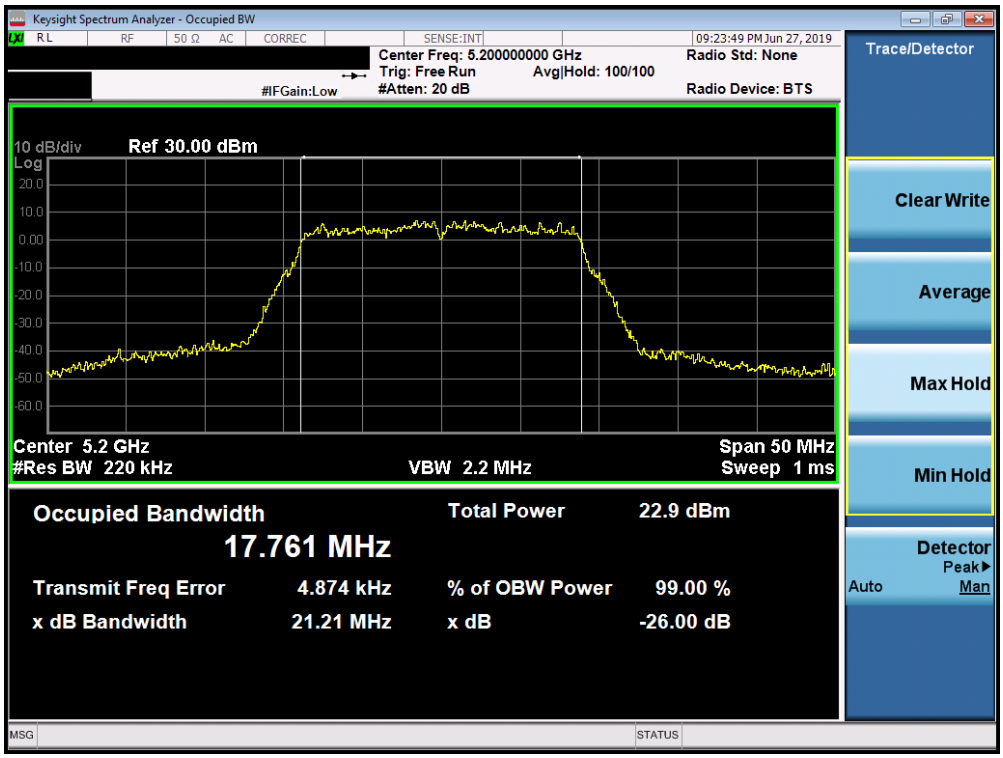


Plot 7-21. 26dB Bandwidth Plot SISO CORE 1 (20MHz BW 802.11n (UNII Band 1) – Ch. 36)



Plot 7-22. 26dB Bandwidth Plot SISO CORE 1 (20MHz BW 802.11n (UNII Band 1) – Ch. 40)

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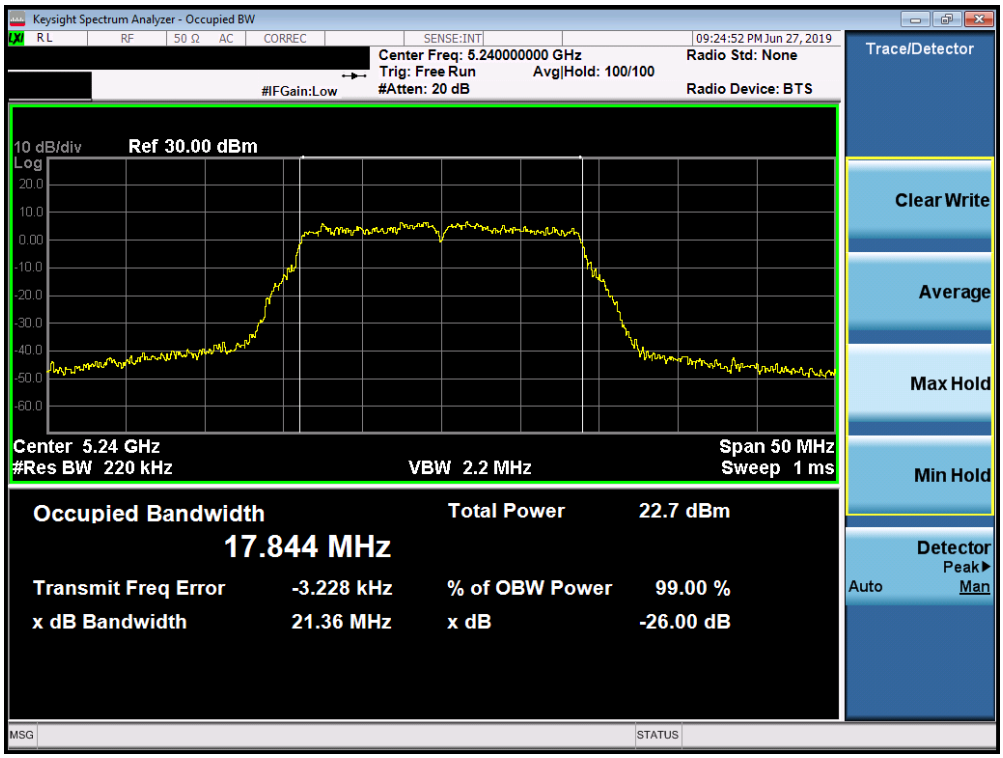
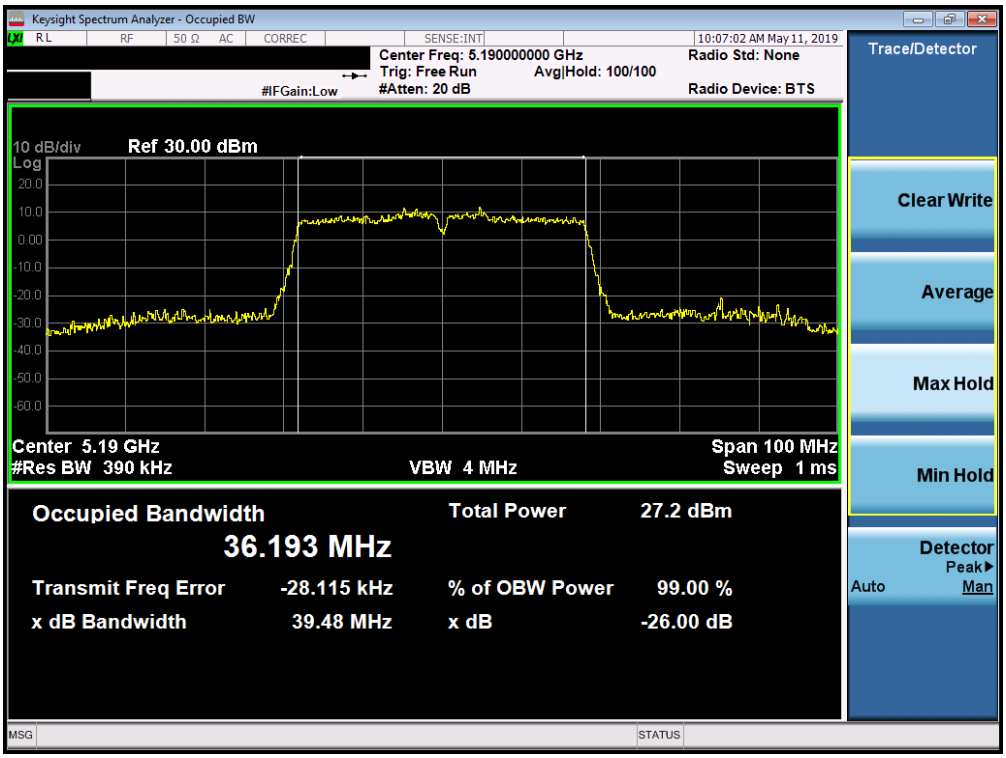


Plot 7-23. 26dB Bandwidth Plot SISO CORE 1 (20MHz BW 802.11n (UNII Band 1) – Ch. 48)



Plot 7-24. 26dB Bandwidth Plot SISO CORE 1 (40MHz BW 802.11n (UNII Band 1) – Ch. 38)

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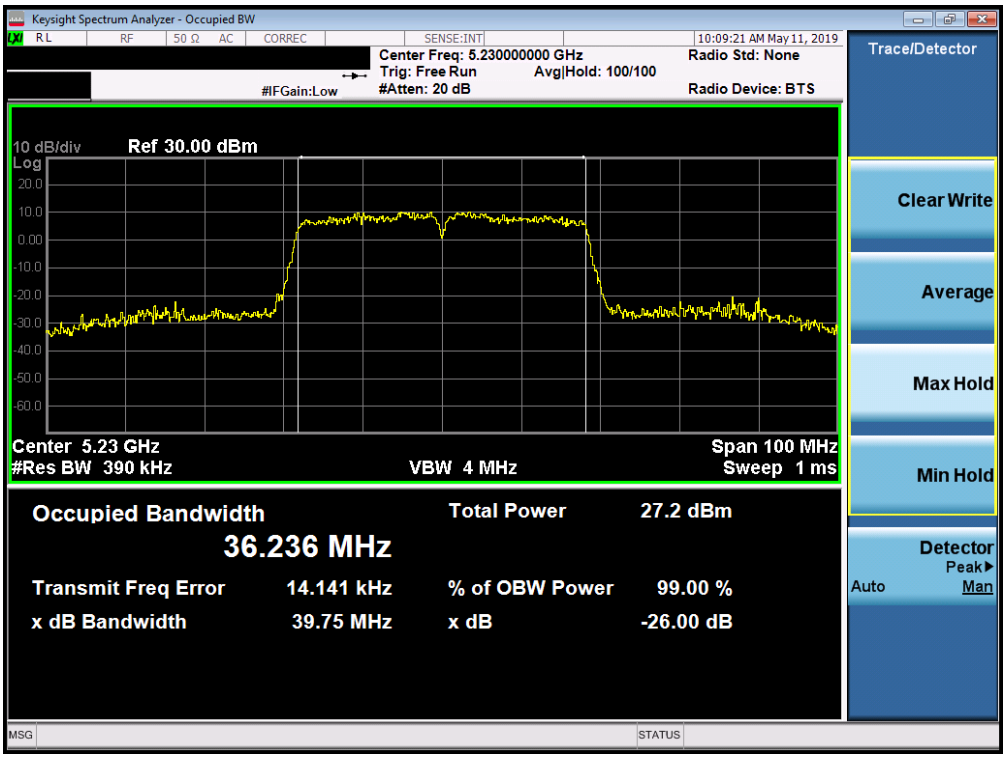
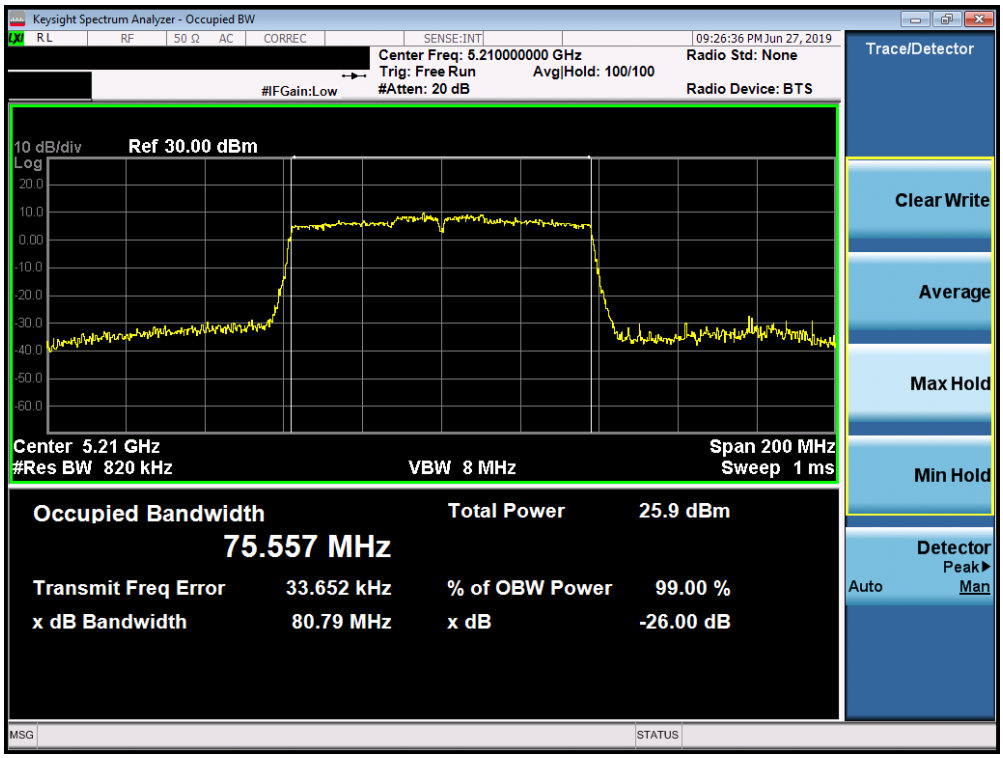


Plot 7-25. 26dB Bandwidth Plot SISO CORE 1 (40MHz BW 802.11n (UNII Band 1) – Ch. 46)



Plot 7-26. 26dB Bandwidth Plot SISO CORE 1 (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)

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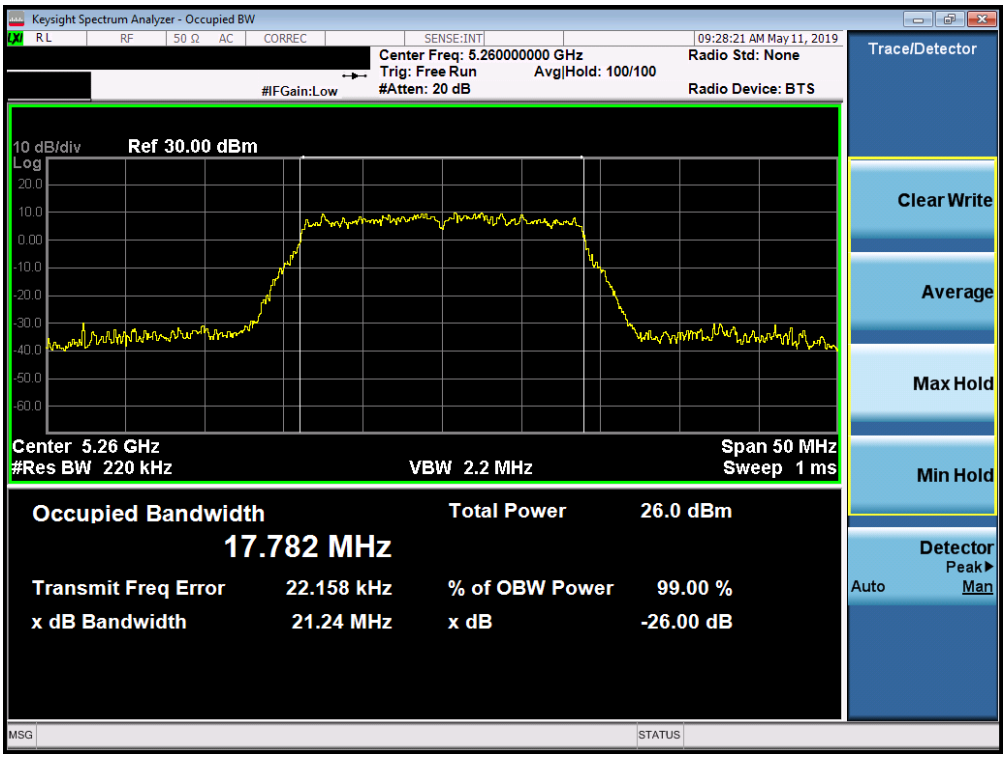
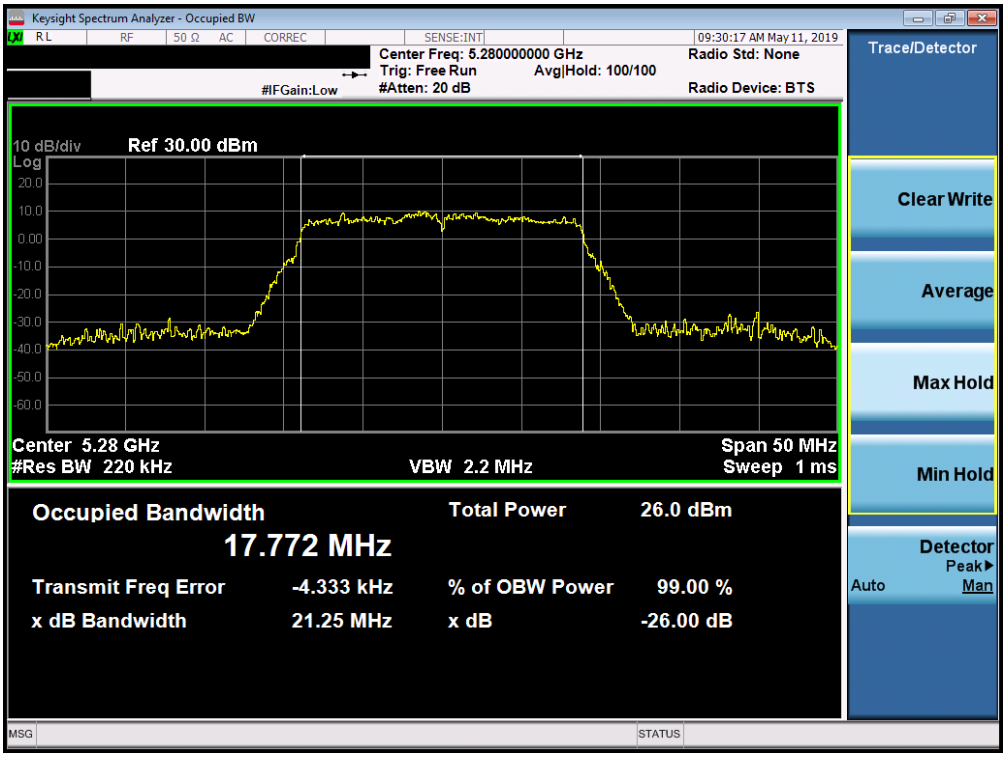


Plot 7-27. 26dB Bandwidth Plot SISO CORE 1 (20MHz BW 802.11n (UNII Band 2A) – Ch. 52)



Plot 7-28. 26dB Bandwidth Plot SISO CORE 1 (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)

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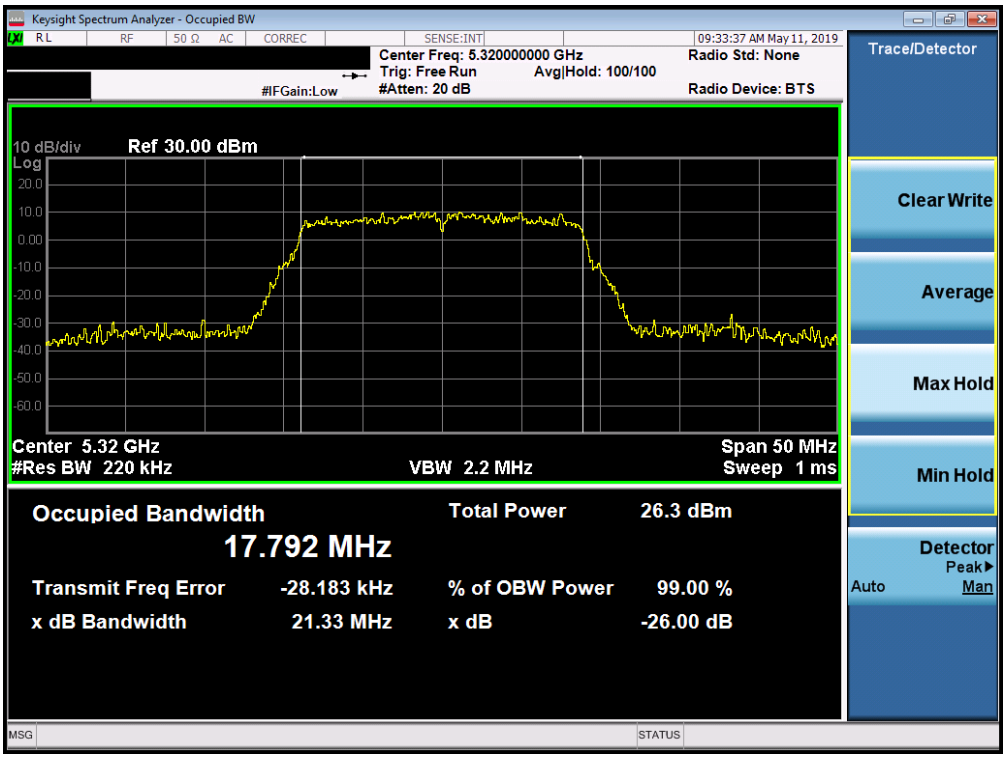
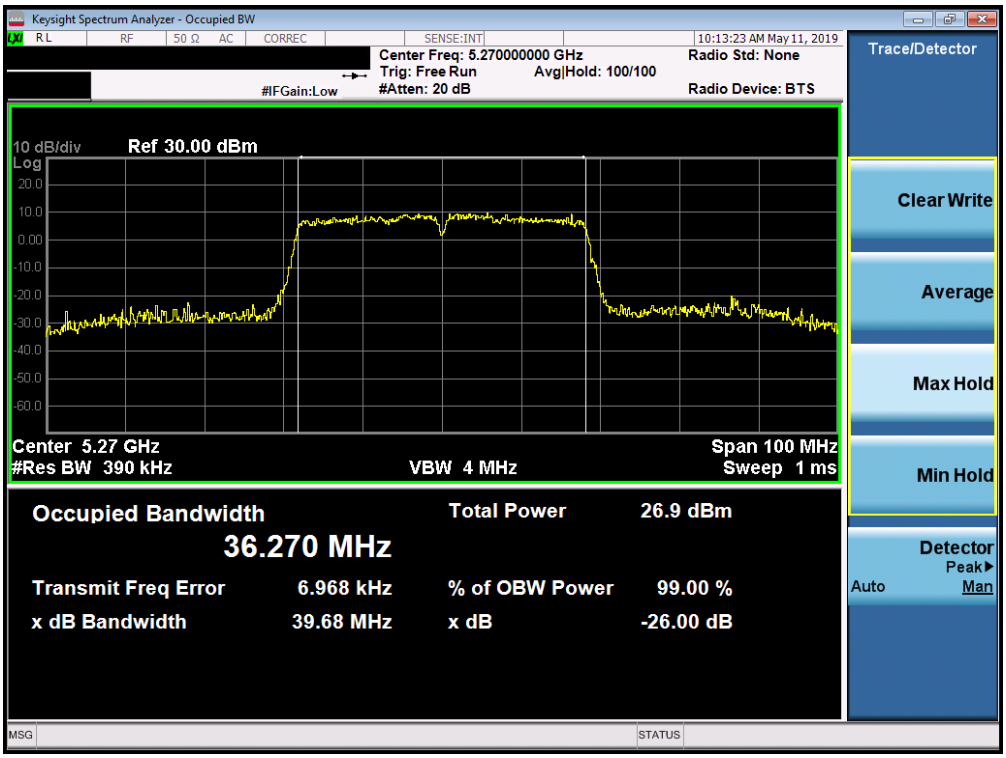


Plot 7-29. 26dB Bandwidth Plot SISO CORE 1 (20MHz BW 802.11n (UNII Band 2A) – Ch. 64)



Plot 7-30. 26dB Bandwidth Plot SISO CORE 1 (40MHz BW 802.11n (UNII Band 2A) – Ch. 54)

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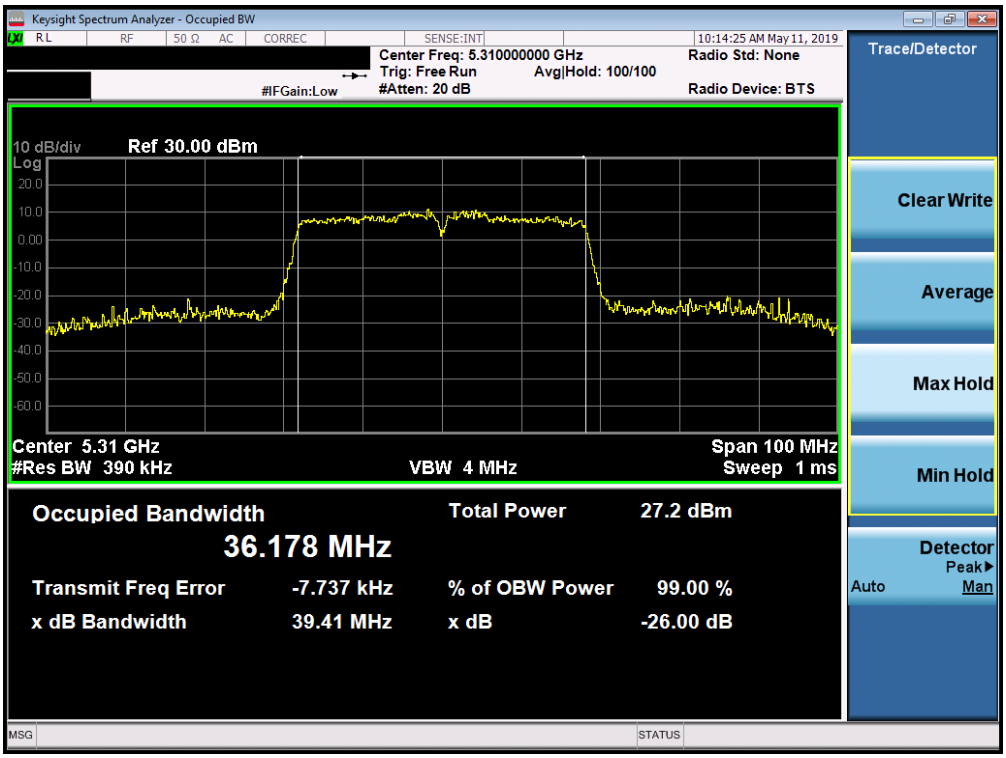
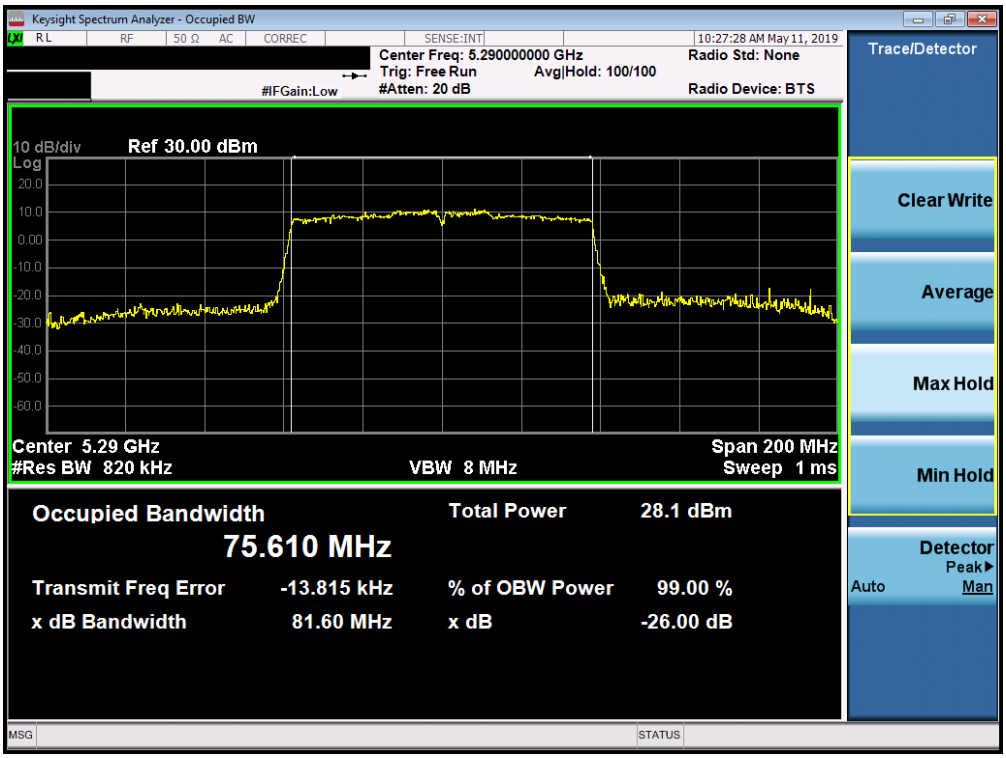


Plot 7-31. 26dB Bandwidth Plot SISO CORE 1 (40MHz BW 802.11n (UNII Band 2A) – Ch. 62)



Plot 7-32. 26dB Bandwidth Plot SISO CORE 1 (80MHz BW 802.11ac (UNII Band 2A) – Ch. 58)

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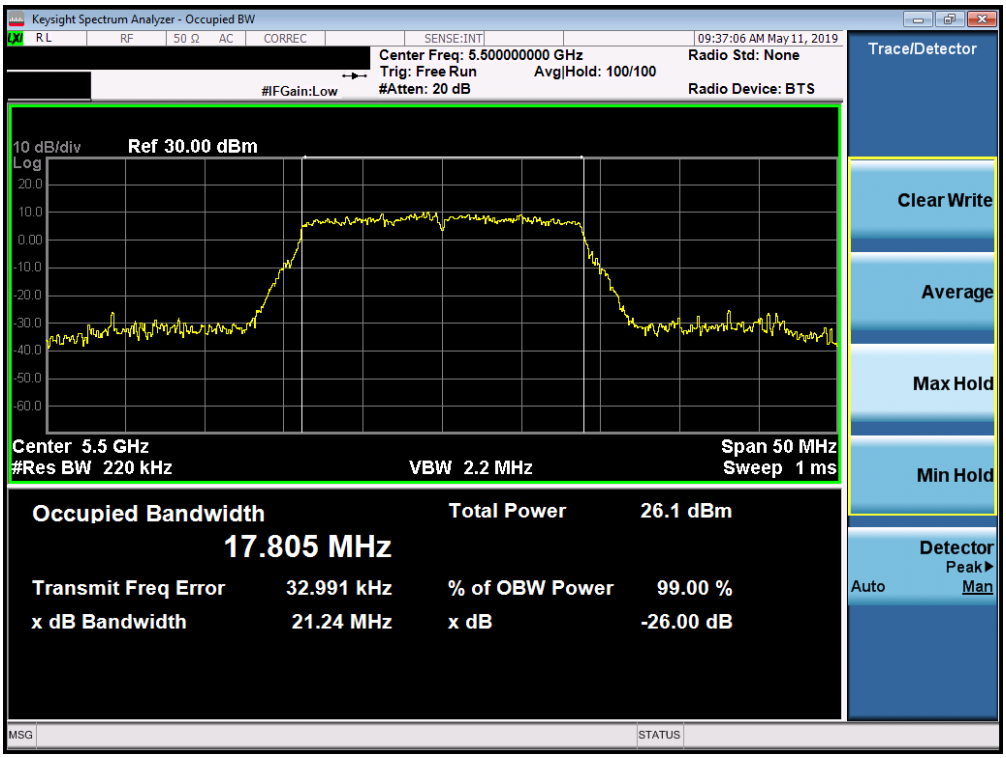
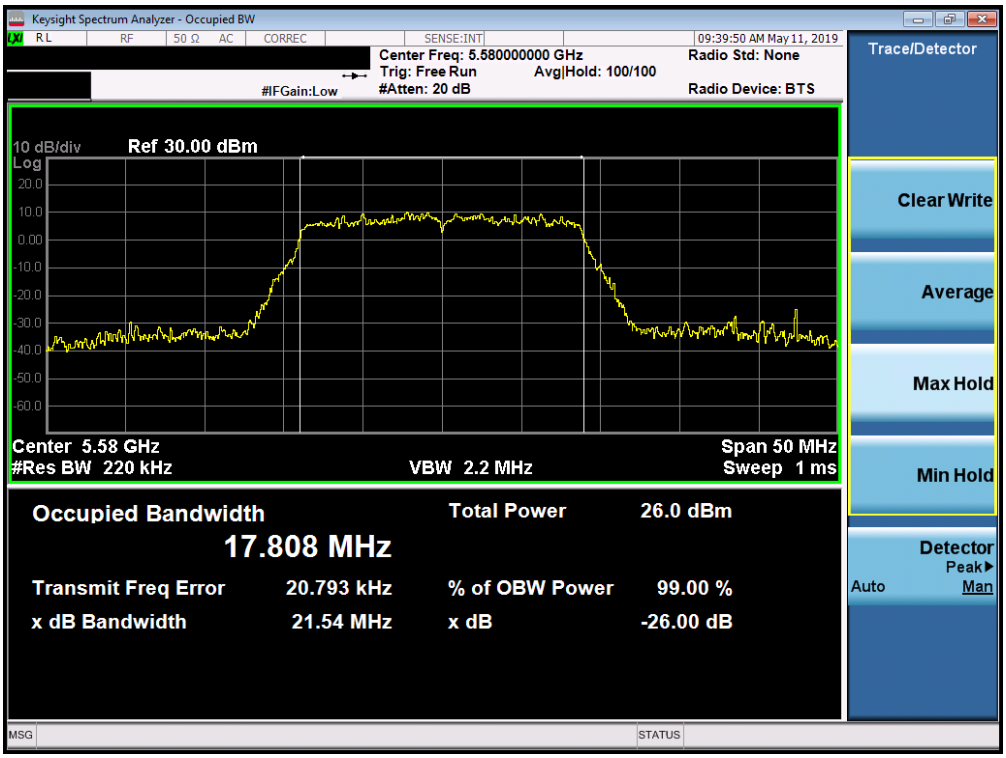


Plot 7-33. 26dB Bandwidth Plot SISO CORE 1 (20MHz BW 802.11n (UNII Band 2C) – Ch. 100)



Plot 7-34. 26dB Bandwidth Plot SISO CORE 1 (20MHz BW 802.11n (UNII Band 2C) – Ch. 116)

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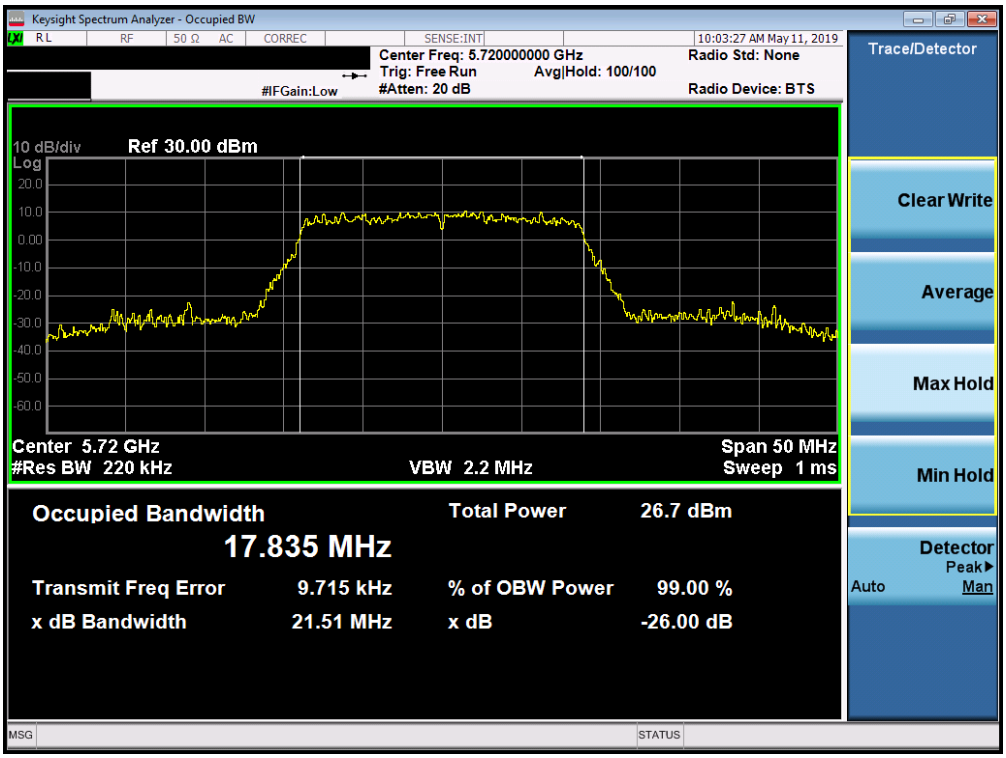
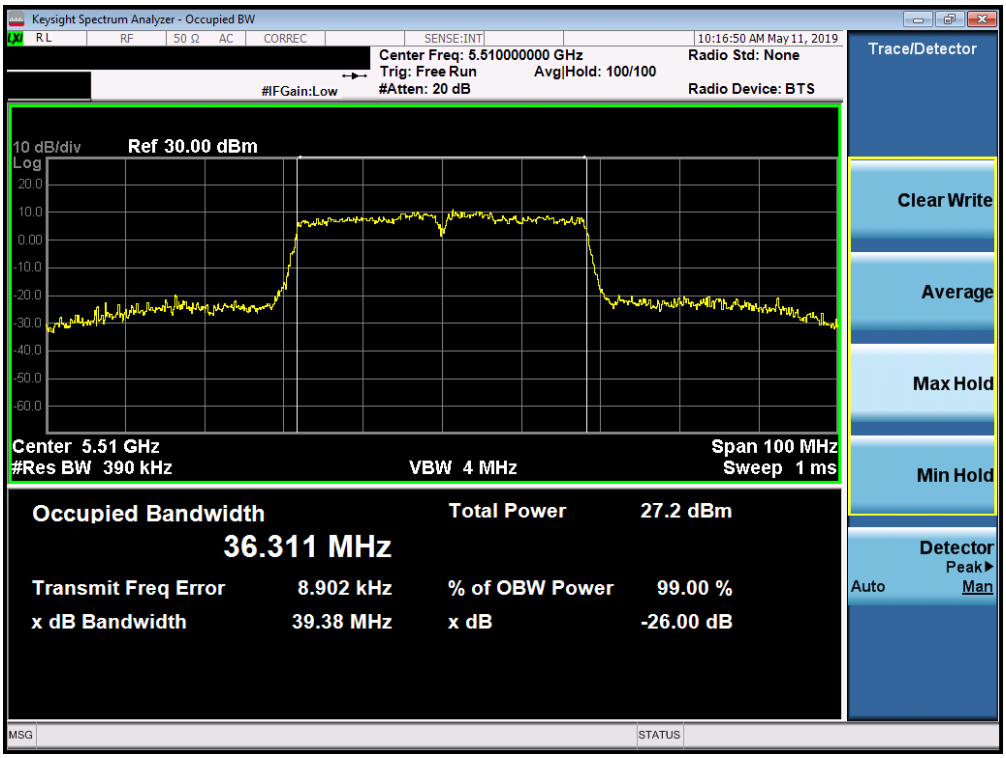


Plot 7-35. 26dB Bandwidth Plot SISO CORE 1 (20MHz BW 802.11n (UNII Band 2C) – Ch. 144)



Plot 7-36. 26dB Bandwidth Plot SISO CORE 1 (40MHz BW 802.11n (UNII Band 2C) – Ch. 102)

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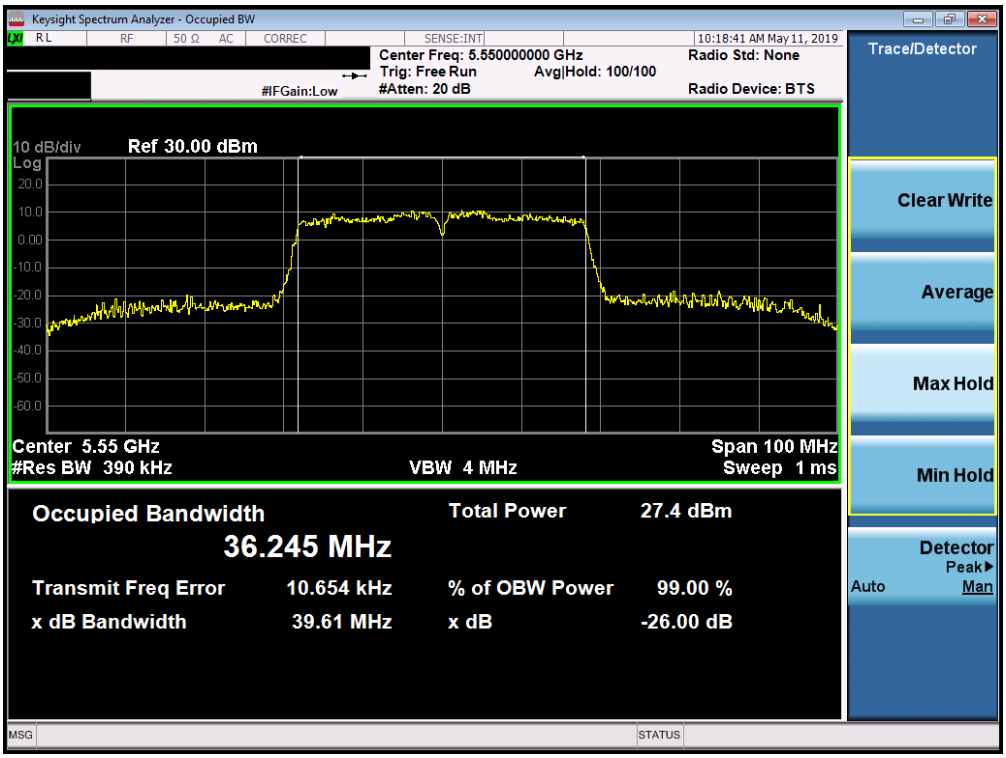
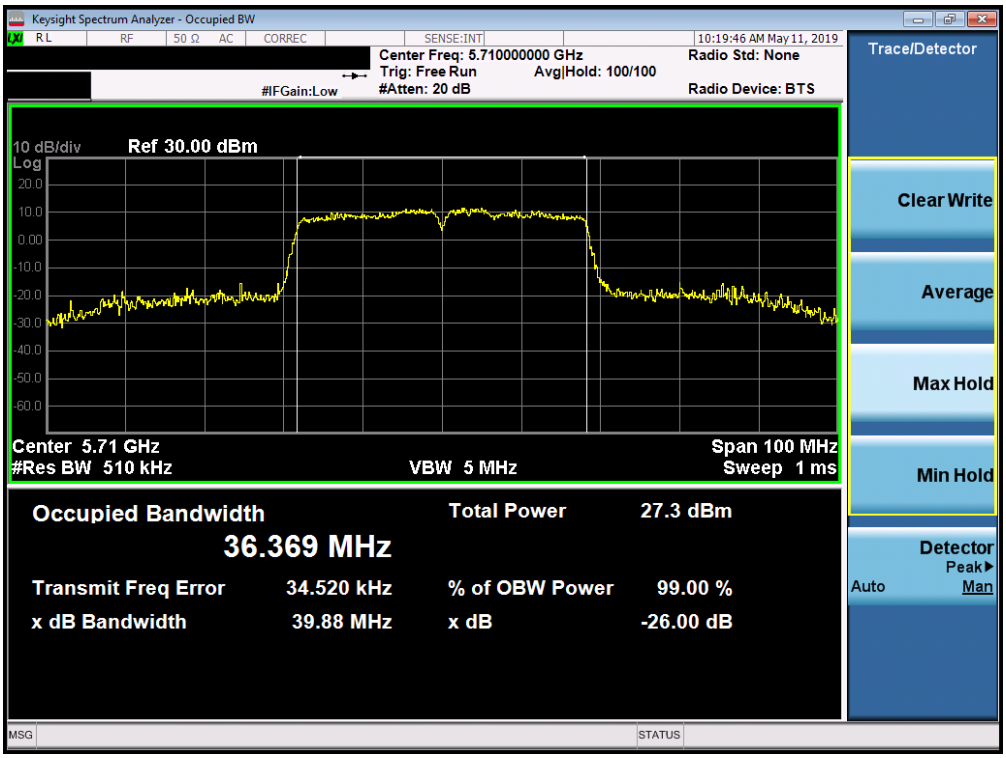


Plot 7-37. 26dB Bandwidth Plot SISO CORE 1 (40MHz BW 802.11n (UNII Band 2C) – Ch. 110)



Plot 7-38. 26dB Bandwidth Plot SISO CORE 1 (40MHz BW 802.11n (UNII Band 2C) – Ch. 142)

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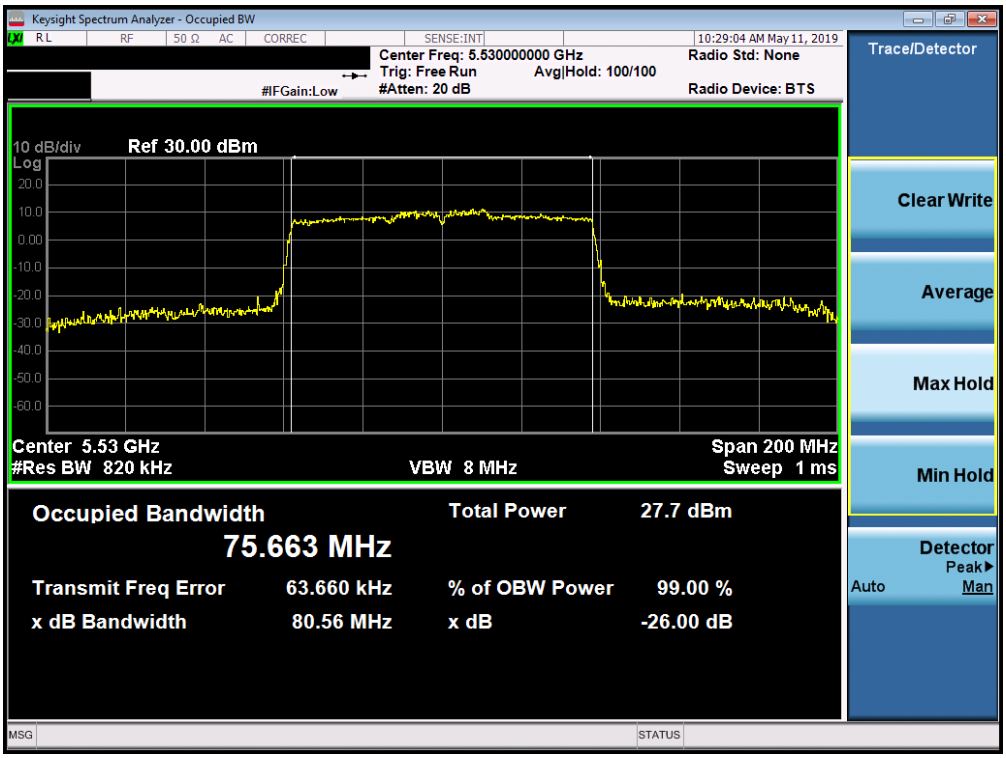
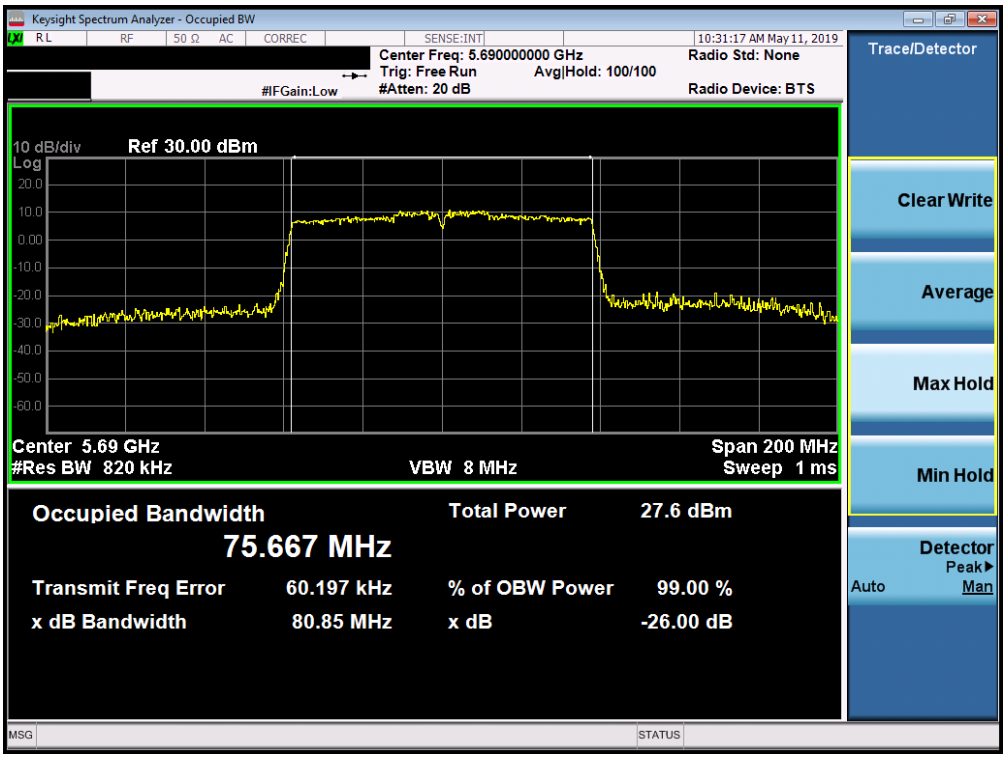


Plot 7-39. 26dB Bandwidth Plot SISO CORE 1 (80MHz BW 802.11ac (UNII Band 2C) – Ch. 106)



Plot 7-40. 26dB Bandwidth Plot SISO CORE 1 (80MHz BW 802.11ac (UNII Band 2C) – Ch. 138)

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7.3 6dB Bandwidth Measurement – 802.11a/n/ac

§15.407 (e); RSS-Gen [6.7]

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 v02r01, 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 v02r01 – 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

All antenna configs were investigated and only the worst case is reported.

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SISO CORE 0-6dB Bandwidth Measurements

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured 6dB Bandwidth [MHz]
Band 3	5745	149	n (20MHz)	6.5/7.2 (MCS0)	17.07
	5785	157	n (20MHz)	6.5/7.2 (MCS0)	17.09
	5825	165	n (20MHz)	6.5/7.2 (MCS0)	17.55
	5755	151	n (40MHz)	13.5/15 (MCS0)	35.48
	5795	159	n (40MHz)	13.5/15 (MCS0)	35.81
	5775	155	ac (80MHz)	29.3/32.5 (MCS0)	75.63

Table 7-4. Conducted Bandwidth Measurements SISO CORE 0

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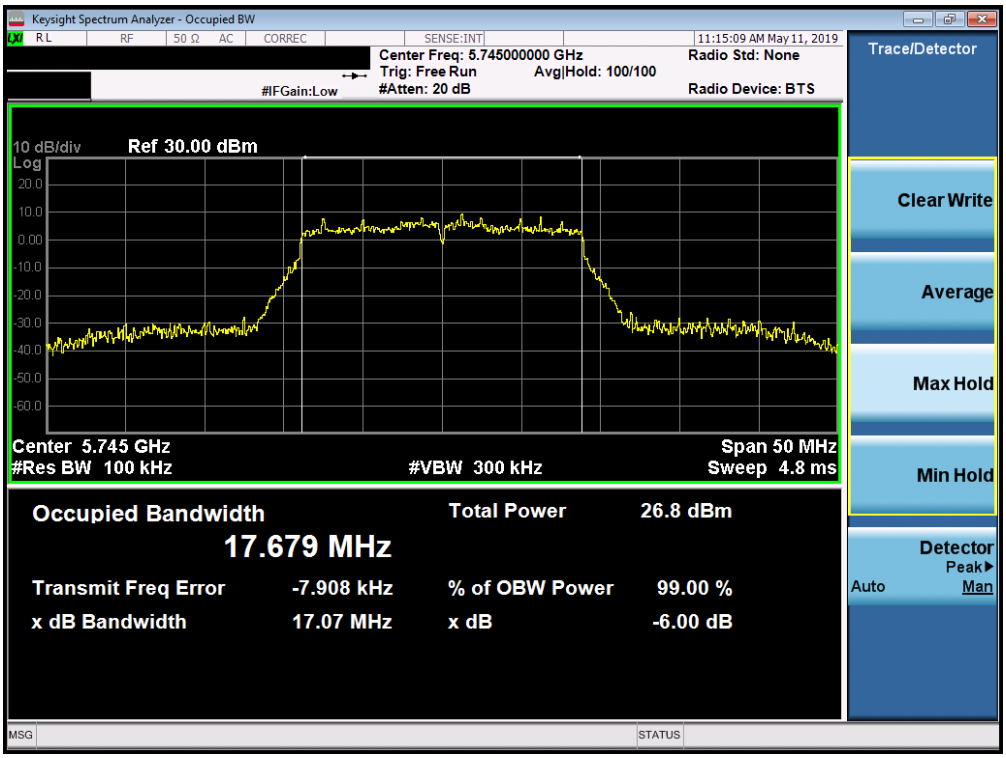
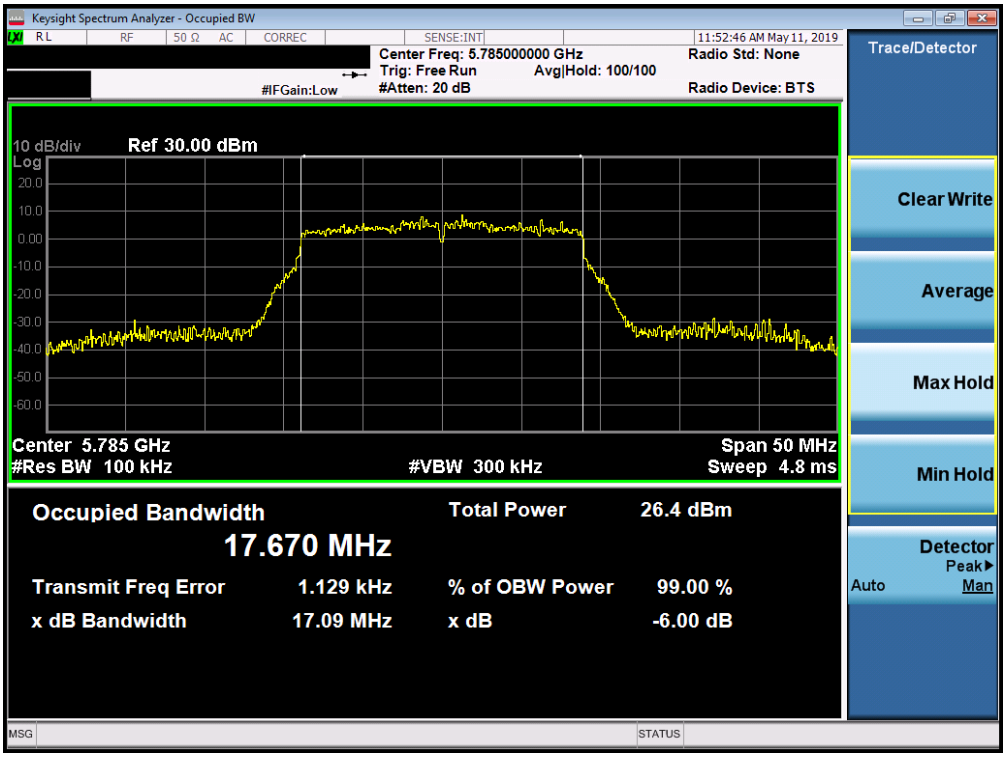


Plot 7-41. 6dB Bandwidth Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 3) – Ch. 149)



Plot 7-42. 6dB Bandwidth Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 3) – Ch. 157)

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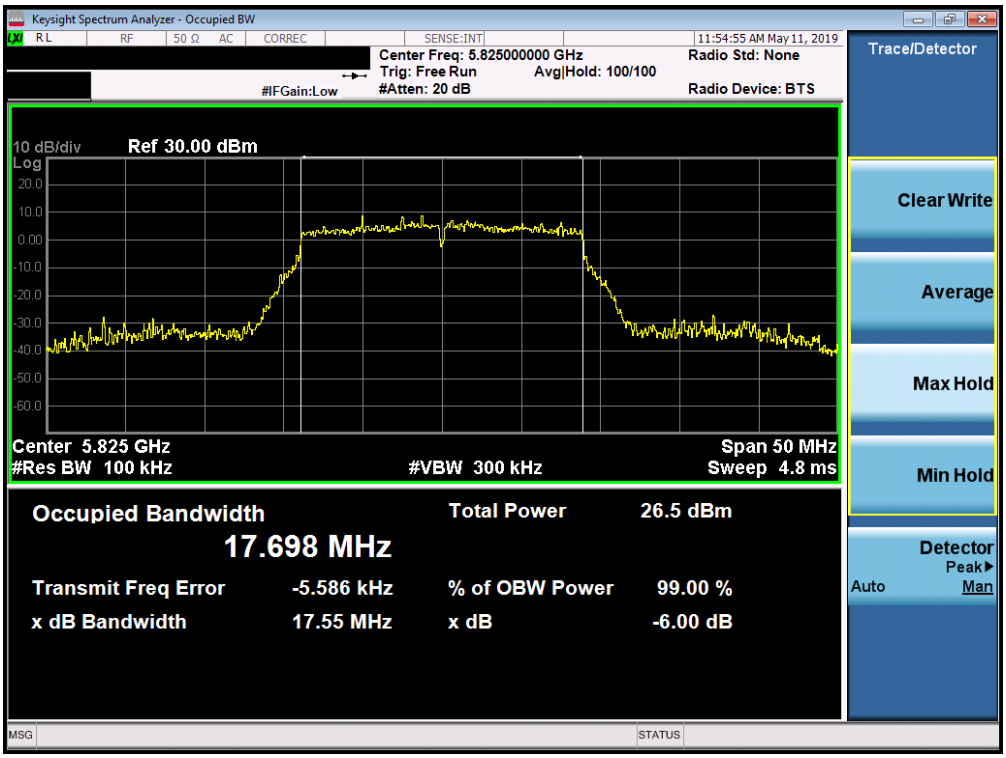

Plot 7-43. 6dB Bandwidth Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 3) – Ch. 165)

Plot 7-44. 6dB Bandwidth Plot SISO CORE 0 (40MHz BW 802.11n (UNII Band 3) – Ch. 151)

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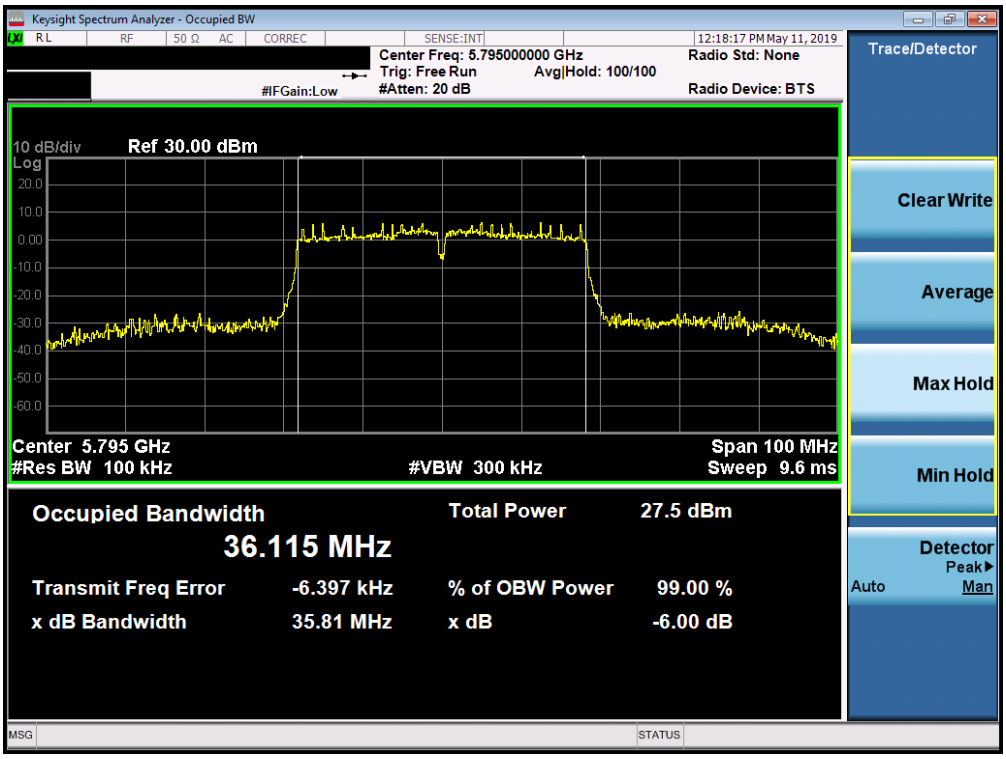
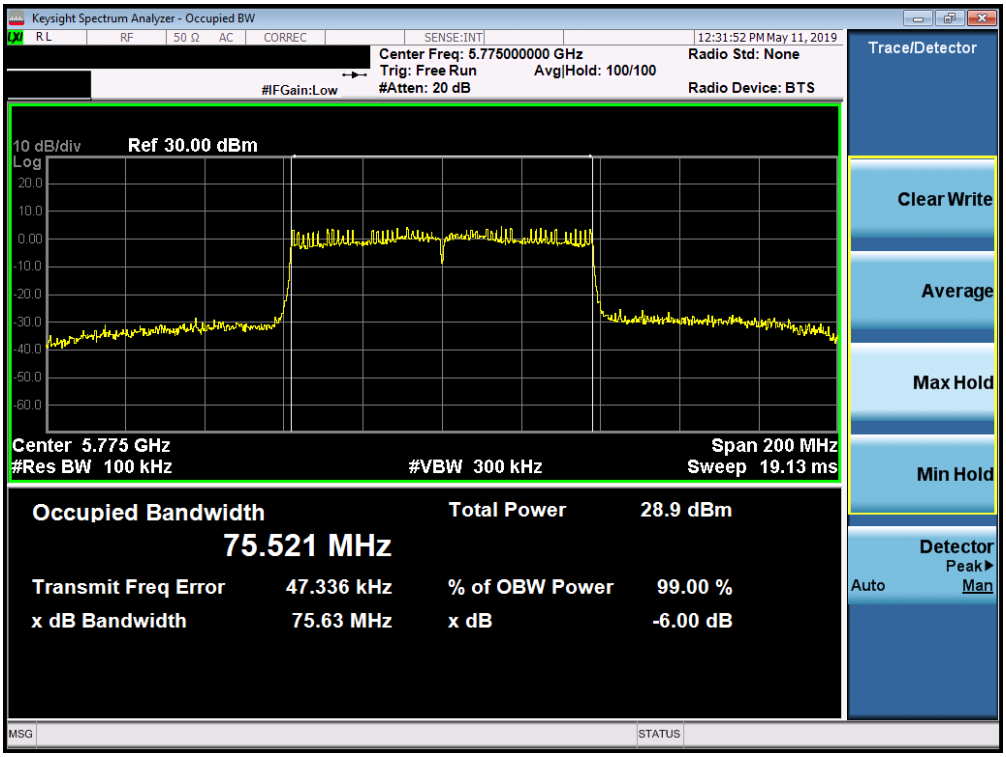


Plot 7-45. 6dB Bandwidth Plot SISO CORE 0 (40MHz BW 802.11n (UNII Band 3) – Ch. 159)



Plot 7-46. 6dB Bandwidth Plot SISO CORE 0 (80MHz BW 802.11ac (UNII Band 3) – Ch. 155)

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SISO CORE 1-6dB Bandwidth Measurements

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured 6dB Bandwidth [MHz]
Band 3	5745	149	n (20MHz)	6.5/7.2 (MCS0)	16.62
	5785	157	n (20MHz)	6.5/7.2 (MCS0)	17.52
	5825	165	n (20MHz)	6.5/7.2 (MCS0)	17.27
	5755	151	n (40MHz)	13.5/15 (MCS0)	35.50
	5795	159	n (40MHz)	13.5/15 (MCS0)	35.54
	5775	155	ac (80MHz)	29.3/32.5 (MCS0)	75.59

Table 7-5. Conducted Bandwidth Measurements SISO CORE 1

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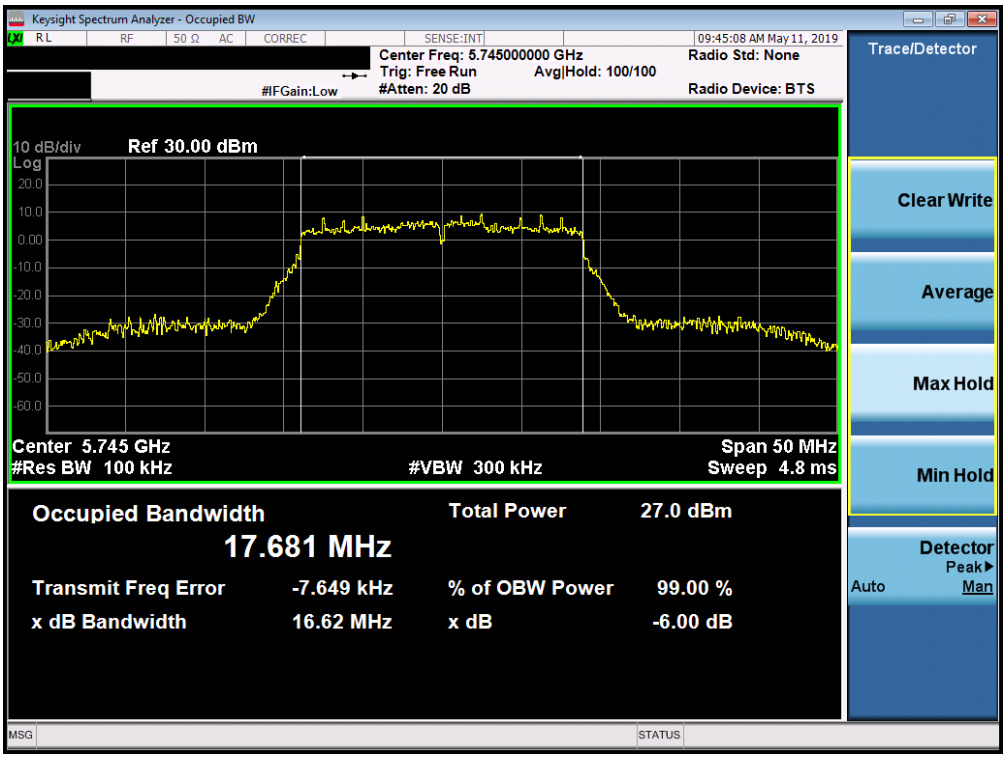
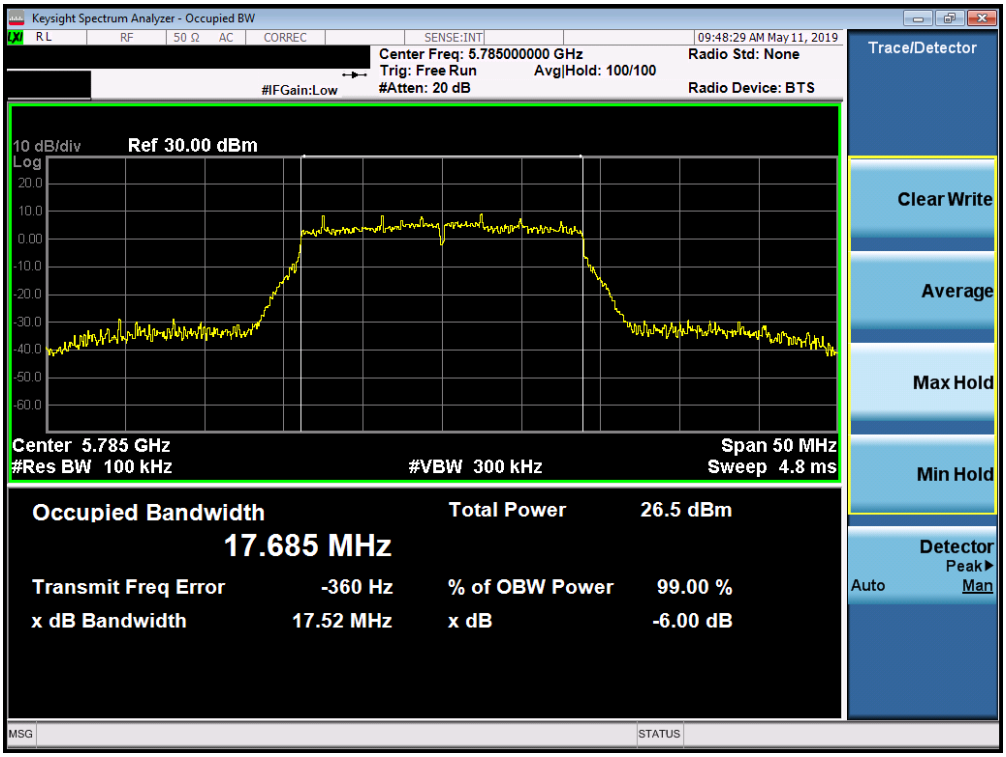


Plot 7-47. 6dB Bandwidth Plot SISO CORE 1 (20MHz BW 802.11n (UNII Band 3) – Ch. 149)



Plot 7-48. 6dB Bandwidth Plot SISO CORE 1 (20MHz BW 802.11n (UNII Band 3) – Ch. 157)

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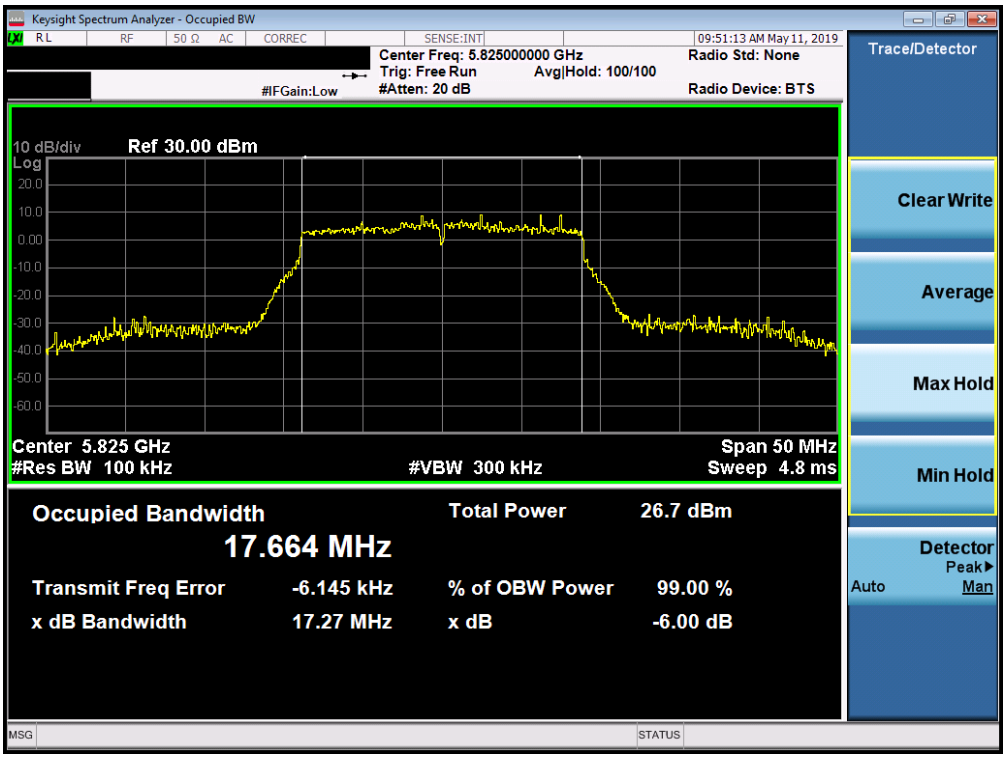
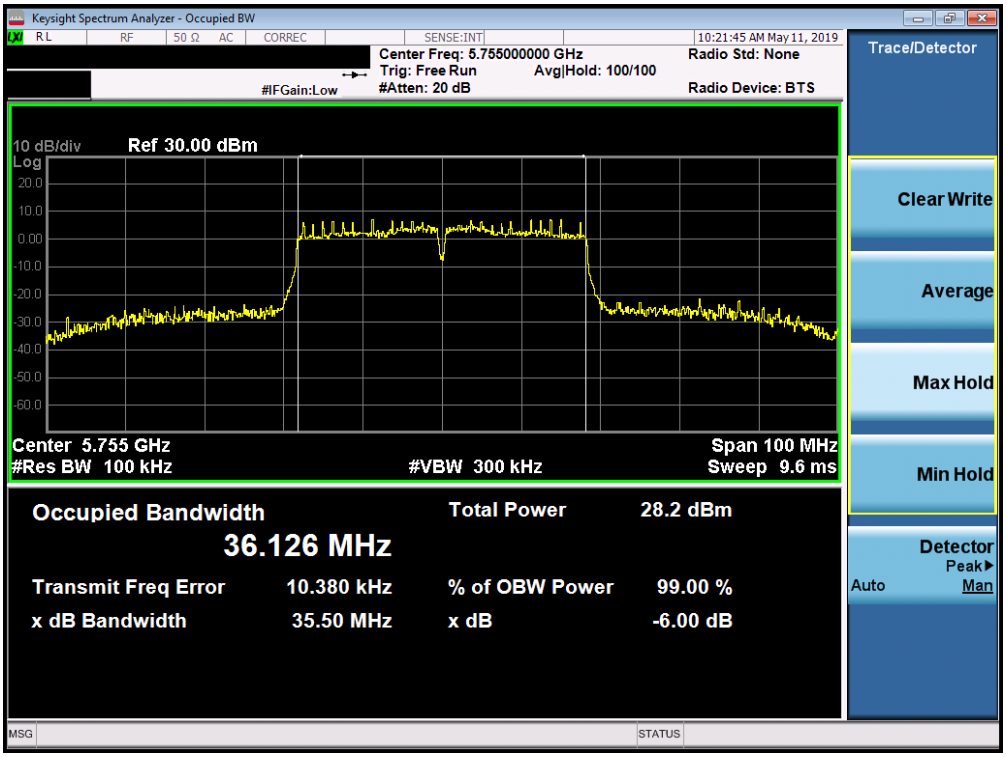


Plot 7-49. 6dB Bandwidth Plot SISO CORE 1 (20MHz BW 802.11n (UNII Band 3) – Ch. 165)



Plot 7-50. 6dB Bandwidth Plot SISO CORE 1 (40MHz BW 802.11n (UNII Band 3) – Ch. 151)

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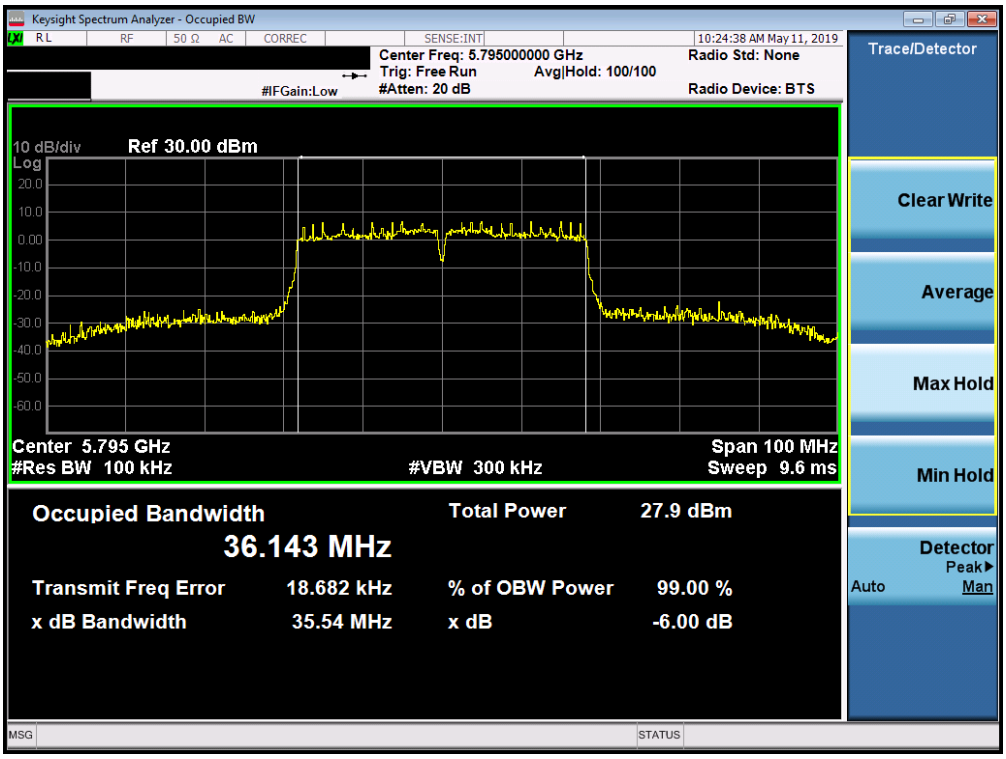
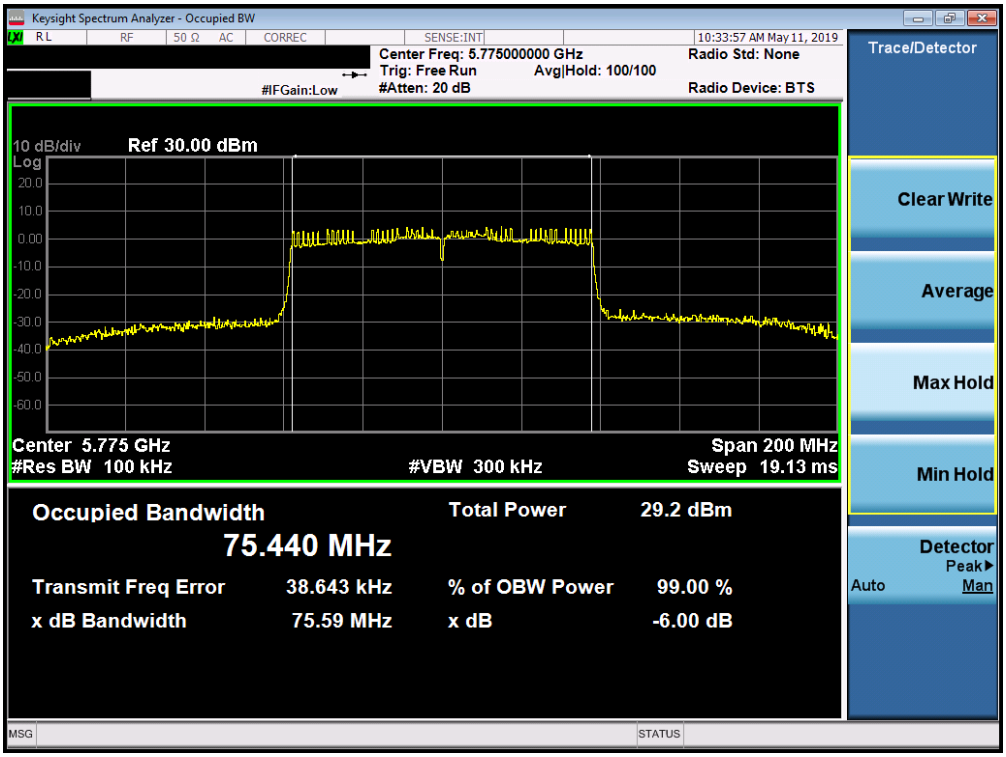


Plot 7-51. 6dB Bandwidth Plot SISO CORE 1 (40MHz BW 802.11n (UNII Band 3) – Ch. 159)



Plot 7-52. 6dB Bandwidth Plot SISO CORE 1 (80MHz BW 802.11ac (UNII Band 3) – Ch. 155)

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7.4 UNII Output Power Measurement – 802.11a/n/ac

§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 v02r01, and at the appropriate frequencies.

In the 5.15 – 5.25GHz band, the maximum permissible conducted output power is 250mW (23.98dBm). The maximum e.i.r.p. shall not exceed the lesser of 200 mW or 10 + 10 log10B, dBm.

In the 5.25 – 5.35GHz band, the maximum permissible conducted output power is the lesser of 250mW (23.98dBm) or 11 dBm + 10log$_{10}$(26dB BW) = 11 dBm + 10log$_{10}$(21.24) = 24.27dBm. The maximum e.i.r.p. shall not exceed the lesser of 1.0 W or 17 + 10 log10B, dBm.

In the 5.47 – 5.725GHz band, the maximum permissible conducted output power is the lesser of 250mW (23.98dBm) or 11 dBm + 10log$_{10}$(26dB BW) = 11 dBm + 10log$_{10}$(21.31) = 24.29dBm. The maximum e.i.r.p. shall not exceed the lesser of 1.0 W or 17 + 10 log10B, dBm.

In the 5.725 – 5.850GHz band, the maximum permissible conducted output power is 1W (30dBm). The maximum e.i.r.p. is 36 dBm.

Test Procedure Used

ANSI C63.10-2013 – Section 12.3.3.2 Method PM-G
KDB 789033 D02 v02r01 – Section E)3)b) Method PM-G
ANSI C63.10-2013 – Section 14.2 Measure-and-Sum Technique
KDB 662911 v02r01 – Section E)1) Measure-and-Sum Technique

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

Per RSS-247 Section 6.2.3, transmission on channels which overlap the 5600-5650 MHz is prohibited. This device operates under these frequencies only under the control of a certified master device and does not support active scanning on these channels. This device does not transmit any beacons or initiate any transmissions in UNII Bands 2A or 2C.

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FCC SISO CORE-0 Conducted Output Power Measurements

Freq [MHz]	Channel	Detector	IEEE Transmission Mode		Conducted Power Limit [dBm]	Conducted Power Margin [dB]
			802.11a	802.11n		
5180	36	AVG	16.00	15.98	23.98	-7.98
5200	40	AVG	16.43	16.44	23.98	-7.54
5220	44	AVG	16.46	16.39	23.98	-7.52
5240	48	AVG	16.40	16.50	23.98	-7.48
5260	52	AVG	17.00	17.00	23.98	-6.98
5280	56	AVG	17.00	17.00	23.98	-6.98
5300	60	AVG	17.00	16.89	23.98	-6.98
5320	64	AVG	16.00	15.94	23.98	-7.98
5500	100	AVG	15.00	14.85	23.98	-8.98
5520	104	AVG	17.50	17.45	23.98	-6.48
5680	136	AVG	17.34	17.38	23.98	-6.60
5700	140	AVG	14.92	14.90	23.98	-9.06
5720	144	AVG	17.26	17.33	23.98	-6.65
5745	149	AVG	16.25	16.16	30.00	-13.75
5785	157	AVG	16.21	16.20	30.00	-13.79
5825	165	AVG	16.17	16.25	30.00	-13.75

Table 7-6. FCC SISO CORE 0 20MHz BW (UNII) Maximum Conducted Output Power

Freq [MHz]	Channel	Detector	IEEE Transmission Mode	Conducted Power Limit [dBm]	Conducted Power Margin [dB]
			802.11n		
5190	38	AVG	14.00	23.98	-9.98
5230	46	AVG	16.35	23.98	-7.63
5270	54	AVG	17.00	23.98	-6.98
5310	62	AVG	14.48	23.98	-9.50
5510	102	AVG	14.00	23.98	-9.98
5550	110	AVG	17.32	23.98	-6.66
5630	126	AVG	17.37	23.98	-6.61
5670	134	AVG	15.47	23.98	-8.51
5710	142	AVG	17.50	23.98	-6.48
5755	151	AVG	16.25	30.00	-13.75
5795	159	AVG	16.25	30.00	-13.75

Table 7-7. FCC SISO CORE 0 40MHz BW (UNII) Maximum Conducted Output Power

Freq [MHz]	Channel	Detector	IEEE Transmission Mode	Conducted Power Limit [dBm]	Conducted Power Margin [dB]
			802.11ac		
5210	42	AVG	13.00	23.98	-10.98
5290	58	AVG	13.00	23.98	-10.98
5530	106	AVG	14.00	23.98	-9.98
5610	122	AVG	17.00	23.98	-6.98
5690	138	AVG	17.43	23.98	-6.55
5775	155	AVG	16.15	30.00	-13.85

Table 7-8. FCC SISO CORE 0 80MHz BW (UNII) Maximum Conducted Output Power

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ISED SISO CORE-0 Conducted Output Power Measurements

Freq [MHz]	Channel	Detector	IEEE Transmission Mode		Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
			802.11a	802.11n						
5180	36	AVG	14.97	14.92	23.98	-9.01	1.27	16.24	23.01	-6.77
5200	40	AVG	15.00	15.00	23.98	-8.98	1.27	16.27	23.01	-6.74
5220	44	AVG	14.90	15.00	23.98	-8.98	1.27	16.27	23.01	-6.74
5240	48	AVG	14.96	14.92	23.98	-9.02	1.27	16.23	23.01	-6.78
5260	52	AVG	17.00	17.00	23.98	-6.98	2.24	19.24	30.00	-10.76
5280	56	AVG	17.00	17.00	23.98	-6.98	2.24	19.24	30.00	-10.76
5300	60	AVG	17.00	16.89	23.98	-6.98	2.24	19.24	30.00	-10.76
5320	64	AVG	16.00	15.94	23.98	-7.98	2.24	18.24	30.00	-11.76
5500	100	AVG	15.00	14.85	23.98	-8.98	3.39	18.39	30.00	-11.61
5520	104	AVG	17.50	17.45	23.98	-6.48	3.39	20.89	30.00	-9.11
5580	116	AVG	17.50	17.50	23.98	-6.48	3.39	20.89	30.00	-9.11
5680	136	AVG	17.34	17.38	23.98	-6.60	3.39	20.77	30.00	-9.23
5700	140	AVG	14.92	14.90	23.98	-9.06	3.39	18.31	30.00	-11.69
5720	144	AVG	17.26	17.33	23.98	-6.65	3.39	20.72	30.00	-9.28
5745	149	AVG	16.25	16.16	30.00	-13.75	3.54	19.79	30.00	-10.21
5785	157	AVG	16.21	16.20	30.00	-13.79	3.54	19.75	30.00	-10.25
5825	165	AVG	16.17	16.25	30.00	-13.75	3.54	19.79	30.00	-10.21

Table 7-9. ISED SISO CORE 0 20MHz BW (UNII) Maximum Conducted Output Power

Freq [MHz]	Channel	Detector	IEEE Transmission Mode	Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
			802.11n						
5190	38	AVG	14.00	23.98	-9.98	1.27	15.27	23.01	-7.74
5230	46	AVG	16.35	23.98	-7.63	1.27	17.62	23.01	-5.39
5270	54	AVG	17.00	23.98	-6.98	2.24	19.24	30.00	-10.76
5310	62	AVG	14.48	23.98	-9.50	2.24	16.72	30.00	-13.28
5510	102	AVG	14.00	23.98	-9.98	3.39	17.39	30.00	-12.61
5550	110	AVG	17.32	23.98	-6.66	3.39	20.71	30.00	-9.29
5630	126	AVG	17.37	23.98	-6.61	3.39	20.76	30.00	-9.24
5670	134	AVG	15.47	23.98	-8.51	3.39	18.86	30.00	-11.14
5710	142	AVG	17.50	23.98	-6.48	3.39	20.89	30.00	-9.11
5755	151	AVG	16.25	30.00	-13.75	3.54	19.79	30.00	-10.21
5795	159	AVG	16.25	30.00	-13.75	3.54	19.79	30.00	-10.21

Table 7-10. ISED SISO CORE 0 40MHz BW (UNII) Maximum Conducted Output Power

Freq [MHz]	Channel	Detector	IEEE Transmission Mode	Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
			802.11ac						
5210	42	AVG	13.00	23.98	-10.98	1.27	14.27	23.01	-8.74
5290	58	AVG	13.00	23.98	-10.98	2.24	15.24	30.00	-14.76
5530	106	AVG	14.00	23.98	-9.98	3.39	17.39	30.00	-12.61
5610	122	AVG	17.00	23.98	-6.98	3.39	20.39	30.00	-9.61
5690	138	AVG	17.43	23.98	-6.55	3.39	20.82	30.00	-9.18
5775	155	AVG	16.15	30.00	-13.85	3.54	19.69	30.00	-10.31

Table 7-11. ISED SISO CORE 0 80MHz BW (UNII) Maximum Conducted Output Power

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FCC SISO CORE-1 Conducted Output Power Measurements

Freq [MHz]	Channel	Detector	IEEE Transmission Mode		Conducted Power Limit [dBm]	Conducted Power Margin [dB]
			802.11a	802.11n		
5180	36	AVG	15.92	16.00	23.98	-7.98
5200	40	AVG	16.25	16.25	23.98	-7.73
5220	44	AVG	16.25	16.25	23.98	-7.73
5240	48	AVG	16.25	16.25	23.98	-7.73
5260	52	AVG	16.70	16.65	23.98	-7.28
5280	56	AVG	16.71	16.70	23.98	-7.27
5300	60	AVG	16.75	16.65	23.98	-7.23
5320	64	AVG	15.89	15.93	23.98	-8.05
5500	100	AVG	14.88	15.00	23.98	-8.98
5520	104	AVG	17.25	17.20	23.98	-6.73
5580	116	AVG	17.25	17.21	23.98	-6.73
5680	136	AVG	17.23	17.20	23.98	-6.75
5700	140	AVG	15.00	14.96	23.98	-8.98
5720	144	AVG	17.20	17.21	23.98	-6.77
5745	149	AVG	16.50	16.41	30.00	-13.50
5785	157	AVG	16.47	16.26	30.00	-13.53
5825	165	AVG	16.43	16.41	30.00	-13.57

Table 7-12. FCC SISO CORE 1 20MHz BW (UNII) Maximum Conducted Output Power

Freq [MHz]	Channel	Detector	IEEE Transmission Mode	Conducted Power Limit [dBm]	Conducted Power Margin [dB]
			802.11n		
5190	38	AVG	13.95	23.98	-10.03
5230	46	AVG	16.20	23.98	-7.78
5270	54	AVG	16.65	23.98	-7.33
5310	62	AVG	14.40	23.98	-9.58
5510	102	AVG	13.89	23.98	-10.09
5550	110	AVG	17.17	23.98	-6.81
5630	126	AVG	17.23	23.98	-6.75
5670	134	AVG	15.43	23.98	-8.55
5710	142	AVG	17.25	23.98	-6.73
5755	151	AVG	16.50	30.00	-13.50
5795	159	AVG	16.50	30.00	-13.50

Table 7-13. FCC SISO CORE 1 40MHz BW (UNII) Maximum Conducted Output Power

Freq [MHz]	Channel	Detector	IEEE Transmission Mode	Conducted Power Limit [dBm]	Conducted Power Margin [dB]
			802.11ac		
5210	42	AVG	12.95	23.98	-11.03
5290	58	AVG	13.00	23.98	-10.98
5530	106	AVG	14.00	23.98	-9.98
5610	122	AVG	17.00	23.98	-6.98
5690	138	AVG	17.25	23.98	-6.73
5775	155	AVG	16.40	30.00	-13.60

Table 7-14. FCC SISO CORE 1 80MHz BW (UNII) Maximum Conducted Output Power

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ISED SISO CORE-1 Conducted Output Power Measurements

Freq [MHz]	Channel	Detector	IEEE Transmission Mode		Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
			802.11a	802.11n						
5180	36	AVG	15.00	15.00	23.98	-8.98	2.64	17.64	23.01	-5.37
5200	40	AVG	14.91	15.00	23.98	-8.98	2.64	17.64	23.01	-5.37
5220	44	AVG	14.99	15.00	23.98	-8.98	2.64	17.64	23.01	-5.37
5240	48	AVG	14.93	15.00	23.98	-8.98	2.64	17.64	23.01	-5.37
5260	52	AVG	16.70	16.65	23.98	-7.28	2.77	19.47	30.00	-10.53
5280	56	AVG	16.71	16.70	23.98	-7.27	2.77	19.48	30.00	-10.52
5300	60	AVG	16.75	16.65	23.98	-7.23	2.77	19.52	30.00	-10.48
5320	64	AVG	15.89	15.93	23.98	-8.05	2.77	18.70	30.00	-11.30
5500	100	AVG	14.88	15.00	23.98	-8.98	3.17	18.17	30.00	-11.83
5520	104	AVG	17.25	17.20	23.98	-6.73	3.17	20.42	30.00	-9.58
5580	116	AVG	17.25	17.21	23.98	-6.73	3.17	20.42	30.00	-9.58
5680	136	AVG	17.23	17.20	23.98	-6.75	3.17	20.40	30.00	-9.60
5700	140	AVG	15.00	14.96	23.98	-8.98	3.17	18.17	30.00	-11.83
5720	144	AVG	17.20	17.21	23.98	-6.77	3.17	20.38	30.00	-9.62
5745	149	AVG	16.50	16.41	30.00	-13.50	3.21	19.71	30.00	-10.29
5785	157	AVG	16.47	16.26	30.00	-13.53	3.21	19.68	30.00	-10.32
5825	165	AVG	16.43	16.41	30.00	-13.57	3.21	19.64	30.00	-10.36

Table 7-15. ISED SISO CORE 1 20MHz BW (UNII) Maximum Conducted Output Power

Freq [MHz]	Channel	Detector	IEEE Transmission Mode	Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
			802.11n						
5190	38	AVG	13.95	23.98	-10.03	2.64	16.59	23.01	-6.42
5230	46	AVG	16.20	23.98	-7.78	2.64	18.84	23.01	-4.17
5270	54	AVG	16.65	23.98	-7.33	2.77	19.42	30.00	-10.58
5310	62	AVG	14.40	23.98	-9.58	2.77	17.17	30.00	-12.83
5510	102	AVG	13.89	23.98	-10.09	3.17	17.06	30.00	-12.94
5550	110	AVG	17.17	23.98	-6.81	3.17	20.34	30.00	-9.66
5630	126	AVG	17.23	23.98	-6.75	3.17	20.40	30.00	-9.60
5670	134	AVG	15.43	23.98	-8.55	3.17	18.60	30.00	-11.40
5710	142	AVG	17.25	23.98	-6.73	3.17	20.42	30.00	-9.58
5755	151	AVG	16.50	30.00	-13.50	3.21	19.71	30.00	-10.29
5795	159	AVG	16.50	30.00	-13.50	3.21	19.71	30.00	-10.29

Table 7-16. ISED SISO CORE 1 40MHz BW (UNII) Maximum Conducted Output Power

Freq [MHz]	Channel	Detector	IEEE Transmission Mode	Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
			802.11ac						
5210	42	AVG	12.95	23.98	-11.03	2.64	15.59	23.01	-7.42
5290	58	AVG	13.00	23.98	-10.98	2.77	15.77	30.00	-14.23
5530	106	AVG	14.00	23.98	-9.98	3.17	17.17	30.00	-12.83
5610	122	AVG	17.00	23.98	-6.98	3.17	20.17	30.00	-9.83
5690	138	AVG	17.25	23.98	-6.73	3.17	20.42	30.00	-9.58
5775	155	AVG	16.40	30.00	-13.60	3.21	19.61	30.00	-10.39

Table 7-17. ISED SISO CORE 1 80MHz BW (UNII) Maximum Conducted Output Power

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FCC CDD/SDM Maximum Conducted Output Power Measurements

Freq [MHz]	Channel	Detector	Conducted Power [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]
			Core 0	Core 1	Summed			
5180	36	AVG	15.00	14.95	17.99	23.98	-5.99	4.99
5200	40	AVG	16.50	16.25	19.39	23.98	-4.59	4.99
5220	44	AVG	16.48	16.19	19.35	23.98	-4.63	4.99
5240	48	AVG	16.50	16.15	19.34	23.98	-4.64	4.99
5260	52	AVG	16.50	16.50	19.51	23.98	-4.47	5.52
5280	56	AVG	16.50	16.50	19.51	23.98	-4.47	5.52
5300	60	AVG	16.48	16.49	19.50	23.98	-4.48	5.52
5320	64	AVG	14.35	14.50	17.44	23.98	-6.54	5.52
5500	100	AVG	14.50	14.27	17.40	23.69	-6.29	6.29
5520	104	AVG	15.50	15.46	18.49	23.69	-5.20	6.29
5580	116	AVG	15.45	15.50	18.49	23.69	-5.20	6.29
5680	136	AVG	15.50	15.41	18.47	23.69	-5.22	6.29
5700	140	AVG	13.49	13.50	16.51	23.69	-7.18	6.29
5720	144	AVG	15.50	15.40	18.46	23.69	-5.23	6.29
5745	149	AVG	16.15	16.47	19.32	29.61	-10.29	6.39
5785	157	AVG	16.25	16.19	19.23	29.61	-10.38	6.39
5825	165	AVG	16.18	16.28	19.24	29.61	-10.37	6.39

Table 7-18. FCC CDD 20MHz BW 802.11a (UNII) Maximum Conducted Output Power

Freq [MHz]	Channel	Detector	Mode	Conducted Power [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]
				Core 0	Core 1	Summed			
5180	36	AVG	CDD	14.88	14.94	17.92	23.98	-6.06	4.99
5200	40	AVG	CDD	16.46	16.05	19.27	23.98	-4.71	4.99
5220	44	AVG	CDD	16.50	16.23	19.38	23.98	-4.60	4.99
5240	48	AVG	CDD	16.50	16.14	19.33	23.98	-4.65	4.99
5260	52	AVG	SDM	17.00	16.73	19.88	23.98	-4.10	2.51
5280	56	AVG	SDM	16.99	16.75	19.88	23.98	-4.10	2.51
5300	60	AVG	SDM	16.99	16.75	19.88	23.98	-4.10	2.51
5320	64	AVG	CDD	14.46	14.50	17.49	23.98	-6.49	5.52
5500	100	AVG	CDD	14.48	14.50	17.50	23.69	-6.19	6.29
5520	104	AVG	SDM	17.50	17.16	20.34	23.98	-3.64	3.28
5580	116	AVG	SDM	17.50	17.21	20.37	23.98	-3.61	3.28
5680	136	AVG	SDM	17.33	17.20	20.28	23.98	-3.70	3.28
5700	140	AVG	CDD	13.38	13.50	16.45	23.69	-7.24	6.29
5720	144	AVG	SDM	17.50	17.25	20.39	23.98	-3.59	3.28
5745	149	AVG	CDD	16.16	16.44	19.31	29.61	-10.30	6.39
5785	157	AVG	CDD	16.12	16.44	19.29	29.61	-10.32	6.39
5825	165	AVG	CDD	16.25	16.42	19.35	29.61	-10.26	6.39

Table 7-19. FCC CDD/SDM 20MHz BW 802.11n (UNII) Maximum Conducted Output Power

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Freq [MHz]	Channel	Detector	Conducted Power [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]
			Core 0	Core 1	Summed			
5190	38	AVG	12.50	12.40	15.46	23.98	-8.52	4.99
5230	46	AVG	16.40	16.25	19.34	23.98	-4.64	4.99
5270	54	AVG	16.98	16.73	19.87	23.98	-4.11	5.52
5310	62	AVG	13.50	13.50	16.51	23.98	-7.47	5.52
5510	102	AVG	12.83	12.97	15.91	23.69	-7.78	6.29
5550	110	AVG	17.48	17.16	20.33	23.69	-3.36	6.29
5630	126	AVG	17.36	17.25	20.32	23.69	-3.37	6.29
5670	134	AVG	13.98	14.00	17.00	23.69	-6.69	6.29
5710	142	AVG	17.41	17.23	20.33	23.69	-3.36	6.29
5755	151	AVG	16.20	16.50	19.36	29.61	-10.25	6.39
5795	159	AVG	16.24	16.44	19.35	29.61	-10.26	6.39

Table 7-20. FCC CDD 40MHz BW 802.11n (UNII) Maximum Conducted Output Power

Freq [MHz]	Channel	Detector	Conducted Power [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]
			Core 0	Core 1	Summed			
5210	42	AVG	11.48	11.50	14.50	23.98	-9.48	4.99
5290	58	AVG	11.97	11.86	14.93	23.98	-9.05	5.52
5530	106	AVG	13.00	13.00	16.01	23.69	-7.68	6.29
5610	122	AVG	16.90	17.00	19.96	23.69	-3.73	6.29
5690	138	AVG	17.50	17.22	20.37	23.69	-3.32	6.29
5775	155	AVG	15.93	15.93	18.94	29.61	-10.67	6.39

Table 7-21. FCC CDD 80MHz BW 802.11ac (UNII) Maximum Conducted Output Power

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ISED CDD/SDM Maximum Conducted Output Power Measurements

Freq [MHz]	Channel	Detector	Conducted Power [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
			Core 0	Core 1	Summed						
5180	36	AVG	12.00	11.87	14.95	-	-	4.99	19.94	23.01	-3.07
5200	40	AVG	11.95	11.95	14.96	-	-	4.99	19.95	23.01	-3.06
5220	44	AVG	11.90	11.90	14.91	-	-	4.99	19.90	23.01	-3.11
5240	48	AVG	11.93	11.88	14.92	-	-	4.99	19.91	23.01	-3.10
5260	52	AVG	16.50	16.50	19.51	23.98	-4.47	5.52	25.03	30.00	-4.97
5280	56	AVG	16.50	16.50	19.51	23.98	-4.47	5.52	25.03	30.00	-4.97
5300	60	AVG	16.48	16.49	19.50	23.98	-4.48	5.52	25.02	30.00	-4.98
5320	64	AVG	14.35	14.50	17.44	23.98	-6.54	5.52	22.96	30.00	-7.04
5500	100	AVG	14.50	14.27	17.40	23.98	-6.58	6.29	23.69	30.00	-6.31
5520	104	AVG	15.48	15.46	18.48	23.98	-5.50	6.29	24.77	30.00	-5.23
5580	116	AVG	15.45	15.50	18.49	23.98	-5.49	6.29	24.78	30.00	-5.22
5680	136	AVG	15.50	15.41	18.47	23.98	-5.51	6.29	24.76	30.00	-5.24
5700	140	AVG	13.49	13.50	16.51	23.98	-7.47	6.29	22.80	30.00	-7.20
5720	144	AVG	15.50	15.40	18.46	23.98	-5.52	6.29	24.75	30.00	-5.25
5745	149	AVG	16.15	16.47	19.32	29.61	-10.29	6.39	25.71	-	-
5785	157	AVG	16.25	16.19	19.23	29.61	-10.38	6.39	25.62	-	-
5825	165	AVG	16.18	16.28	19.24	29.61	-10.37	6.39	25.63	-	-

Table 7-22. ISED CDD 20MHz BW 802.11a (UNII) Maximum Conducted Output Power

Freq [MHz]	Channel	Detector	Mode	Conducted Power [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
				Core 0	Core 1	Summed						
5180	36	AVG	CDD	11.98	11.92	14.96	-	-	4.99	19.95	23.01	-3.06
5200	40	AVG	CDD	12.00	12.00	15.01	-	-	4.99	20.00	23.01	-3.01
5220	44	AVG	CDD	12.00	11.92	14.97	-	-	4.99	19.96	23.01	-3.05
5240	48	AVG	CDD	12.00	11.93	14.98	-	-	4.99	19.97	23.01	-3.04
5260	52	AVG	SDM	17.00	16.73	19.88	23.98	-4.10	2.51	22.39	30.00	-7.61
5280	56	AVG	SDM	16.99	16.75	19.88	23.98	-4.10	2.51	22.39	30.00	-7.61
5300	60	AVG	SDM	16.99	16.75	19.88	23.98	-4.10	2.51	22.39	30.00	-7.61
5320	64	AVG	CDD	14.46	14.50	17.49	23.98	-6.49	5.52	23.01	30.00	-6.99
5500	100	AVG	CDD	14.48	14.50	17.50	23.98	-6.48	6.29	23.79	30.00	-6.21
5520	104	AVG	SDM	17.50	17.16	20.34	23.98	-3.64	3.28	23.62	30.00	-6.38
5580	116	AVG	SDM	17.50	17.21	20.37	23.98	-3.61	3.28	23.65	30.00	-6.35
5680	136	AVG	SDM	17.33	17.20	20.28	23.98	-3.70	3.28	23.56	30.00	-6.44
5700	140	AVG	CDD	13.38	13.50	16.45	23.98	-7.53	6.29	22.74	30.00	-7.26
5720	144	AVG	SDM	17.50	17.25	20.39	23.98	-3.59	3.28	23.67	30.00	-6.33
5745	149	AVG	CDD	16.16	16.44	19.31	29.61	-10.30	6.39	25.70	-	-
5785	157	AVG	CDD	16.12	16.44	19.29	29.61	-10.32	6.39	25.68	-	-
5825	165	AVG	CDD	16.25	16.42	19.35	29.61	-10.26	6.39	25.74	-	-

Table 7-23. ISED CDD/SDM 20MHz BW 802.11n (UNII) Maximum Conducted Output Power

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Freq [MHz]	Channel	Detector	Conducted Power [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
			Core 0	Core 1	Summed						
5190	38	AVG	12.50	12.40	15.46	-	-	4.99	20.45	23.01	-2.56
5230	46	AVG	14.00	13.99	17.01	-	-	4.99	22.00	23.01	-1.01
5270	54	AVG	16.98	16.73	19.87	23.98	-4.11	5.52	25.39	30.00	-4.61
5310	62	AVG	13.50	13.50	16.51	23.98	-7.47	5.52	22.03	30.00	-7.97
5510	102	AVG	12.83	12.97	15.91	23.98	-8.07	6.29	22.20	30.00	-7.80
5550	110	AVG	17.48	17.16	20.33	23.98	-3.65	6.29	26.62	30.00	-3.38
5670	134	AVG	13.98	14.00	17.00	23.98	-6.98	6.29	23.29	30.00	-6.71
5710	142	AVG	17.41	17.23	20.33	23.98	-3.65	6.29	26.62	30.00	-3.38
5755	151	AVG	16.20	16.50	19.36	29.61	-10.25	6.39	25.75	-	-
5795	159	AVG	16.24	16.44	19.35	29.61	-10.26	6.39	25.74	-	-

Table 7-24. ISED CDD 40MHz BW 802.11n (UNII) Maximum Conducted Output Power

Freq [MHz]	Channel	Detector	Conducted Power [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
			Core 0	Core 1	Summed						
5210	42	AVG	11.48	11.50	14.50	-	-	4.99	19.49	23.01	-3.52
5290	58	AVG	11.97	11.86	14.93	23.98	-9.05	5.52	20.45	30.00	-9.55
5530	106	AVG	13.00	13.00	16.01	23.98	-7.97	6.29	22.30	30.00	-7.70
5610	122	AVG	16.90	17.00	19.96	23.98	-4.02	6.29	26.25	30.00	-3.75
5690	138	AVG	17.50	17.22	20.37	23.98	-3.61	6.29	26.66	30.00	-3.34
5775	155	AVG	15.93	15.93	18.94	29.61	-10.67	6.39	25.33	-	-

Table 7-25. ISED CDD 80MHz BW 802.11ac (UNII) Maximum Conducted Output Power

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Note:

Per ANSI C63.10-2013 and KDB 662911 v02r01 Section E)1), the conducted powers at Core 0 and Core 1 were first measured separately during CDD/SDM transmission as shown in the section above. The measured values were then summed in linear power units then converted back to dBm.

Per ANSI C63.10-2013 Section 14.4.3, the directional gain is calculated using the following formula, where G_N is the gain of the nth antenna and N_{ANT}, the total number of antennas used.

For *correlated* unequal antenna gain

$$\text{Directional gain} = 10 \log[(10^{G_1/20} + 10^{G_2/20} + \ldots + 10^{G_N/20})^2 / N_{ANT}] \text{ dBi}$$

For *completely uncorrelated* unequal antenna gain

$$\text{Directional gain} = 10 \log[(10^{G_1/10} + 10^{G_2/10} + \ldots + 10^{G_N/10}) / N_{ANT}] \text{ dBi}$$

Sample CDD/SDM Calculation:

At 5180MHz in 802.11n (20MHz BW) mode, the average conducted output power was measured to be 14.88 dBm for CORE 0 and 14.94 dBm for CORE 1.

Core 0 + Core 1 = CDD/SDM

(14.88 dBm + 14.94 dBm) = (30.76 mW + 31.19 mW) = 61.95 mW = 17.92 dBm

Sample e.i.r.p. Calculation:

At 5180MHz in 802.11n (20MHz BW) mode, the average CDD/SDM conducted power was calculated to be 17.92 dBm with directional gain of 4.99 dBi.

e.i.r.p. (dBm) = Conducted Power (dBm) + Ant gain (dBi)

14.01 dBm + 6.17 dBi = 20.18 dBm

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7.5 Maximum Power Spectral Density – 802.11a/n/ac

§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 v02r01, and at the appropriate frequencies. Method SA-1, as defined in ANSI C63.10-2013 and KDB 789033 D02 v02r01, 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 v02r01 – Section F
ANSI C63.10-2013 – Section 14.3.2.2 Measure-and-Sum Technique
KDB 662911 v02r01 – Section E)2) Measure-and-Sum Technique

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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SISO CORE-0 Power Spectral Density Measurements

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Power Density [dBm/MHz]	Max Power Density [dBm/MHz]	Margin [dB]
Band 1	5180	36	n (20MHz)	6.5/7.2 (MCS0)	5.78	11.0	-5.22
	5200	40	n (20MHz)	6.5/7.2 (MCS0)	6.97	11.0	-4.03
	5240	48	n (20MHz)	6.5/7.2 (MCS0)	6.85	11.0	-4.15
	5190	38	n (40MHz)	13.5/15 (MCS0)	6.68	11.0	-4.32
	5230	46	n (40MHz)	13.5/15 (MCS0)	6.67	11.0	-4.33
	5210	42	ac (80MHz)	29.3/32.5 (MCS0)	-3.58	11.0	-14.58
Band 2A	5260	52	n (20MHz)	6.5/7.2 (MCS0)	8.46	11.0	-2.54
	5280	56	n (20MHz)	6.5/7.2 (MCS0)	8.79	11.0	-2.21
	5320	64	n (20MHz)	6.5/7.2 (MCS0)	8.98	11.0	-2.02
	5270	54	n (40MHz)	13.5/15 (MCS0)	6.64	11.0	-4.36
	5310	62	n (40MHz)	13.5/15 (MCS0)	6.84	11.0	-4.16
	5290	58	ac (80MHz)	29.3/32.5 (MCS0)	3.89	11.0	-7.11
Band 2C	5500	100	n (20MHz)	6.5/7.2 (MCS0)	9.08	11.0	-1.92
	5580	116	n (20MHz)	6.5/7.2 (MCS0)	9.03	11.0	-1.97
	5720	144	n (20MHz)	6.5/7.2 (MCS0)	9.02	11.0	-1.98
	5510	102	n (40MHz)	13.5/15 (MCS0)	7.15	11.0	-3.85
	5550	110	n (40MHz)	13.5/15 (MCS0)	6.92	11.0	-4.08
	5710	142	n (40MHz)	13.5/15 (MCS0)	7.09	11.0	-3.91
	5530	106	ac (80MHz)	29.3/32.5 (MCS0)	3.74	11.0	-7.26
	5690	138	ac (80MHz)	29.3/32.5 (MCS0)	4.09	11.0	-6.91

Table 7-26. Bands 1, 2A, 2C Conducted Power Spectral Density Measurements SISO CORE 0

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Power Density [dBm/MHz]	Antenna Gain [dBi]	e.i.r.p. Power Density [dBm/MHz]	ISED Max e.i.r.p. Power Density [dBm/MHz]	Margin [dB]
Band 1	5180	36	n (20MHz)	6.5/7.2 (MCS0)	3.89	1.27	5.16	10.0	-4.84
	5200	40	n (20MHz)	6.5/7.2 (MCS0)	3.90	1.27	5.17	10.0	-4.83
	5240	48	n (20MHz)	6.5/7.2 (MCS0)	3.70	1.27	4.97	10.0	-5.03
	5190	38	n (40MHz)	13.5/15 (MCS0)	6.68	1.27	7.95	10.0	-2.05
	5230	46	n (40MHz)	13.5/15 (MCS0)	6.67	1.27	7.94	10.0	-2.06
	5210	42	ac (80MHz)	29.3/32.5 (MCS0)	-3.58	1.27	-2.31	10.0	-12.31

Table 7-27. Band 1 e.i.r.p. Conducted Power Spectral Density Measurements (ISED) SISO CORE 0

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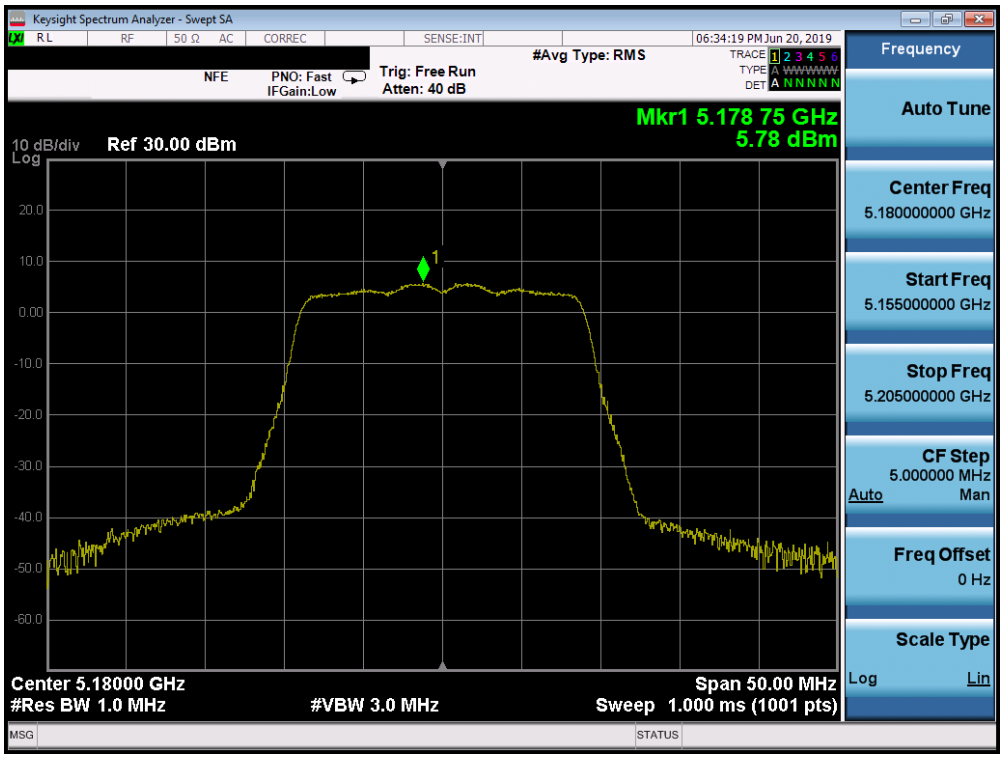
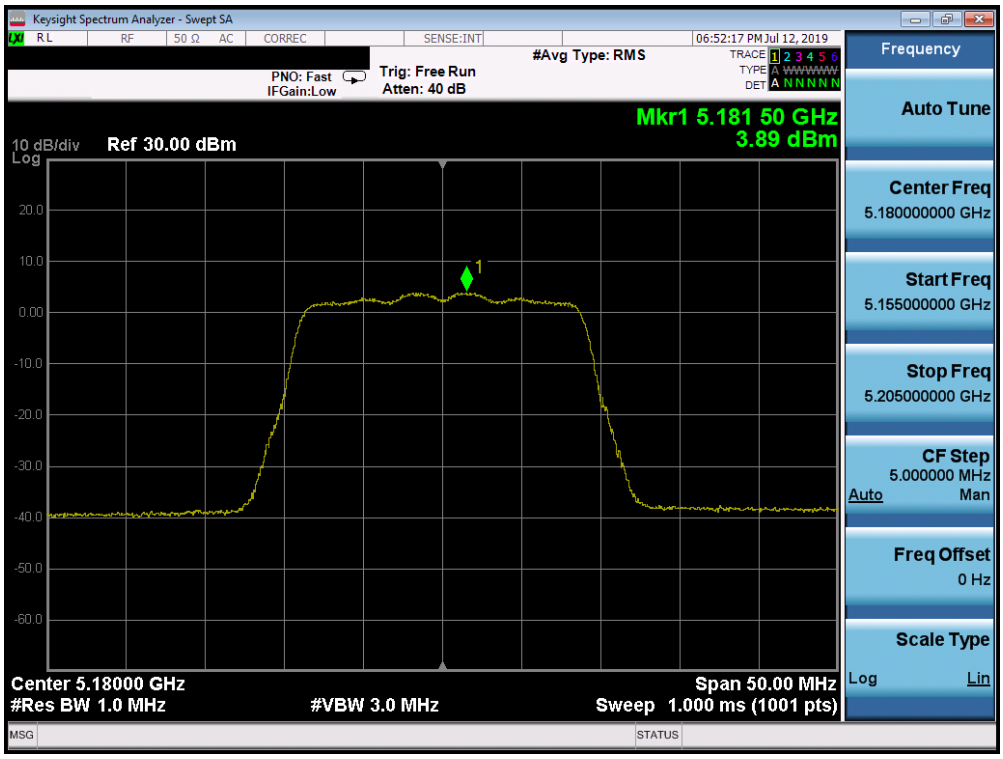


Plot 7-53. Power Spectral Density Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 1) – Ch. 36)



Plot 7-54. Power Spectral Density Plot ISED SISO CORE 0 (20MHz BW 802.11n (UNII Band 1) – Ch. 36)

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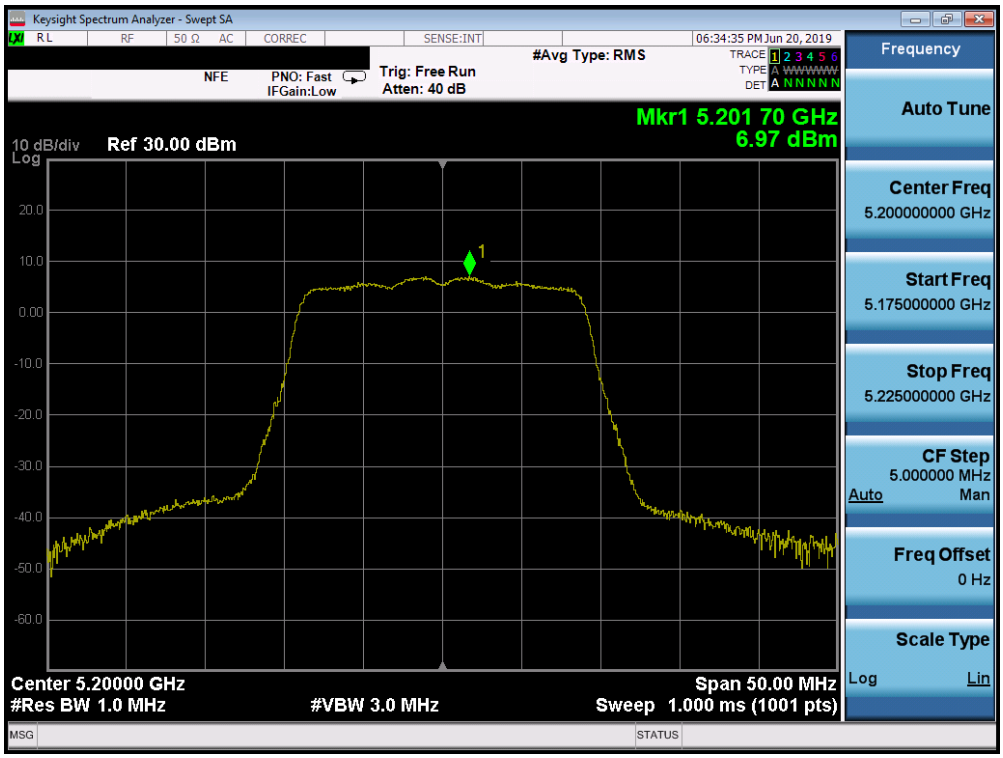
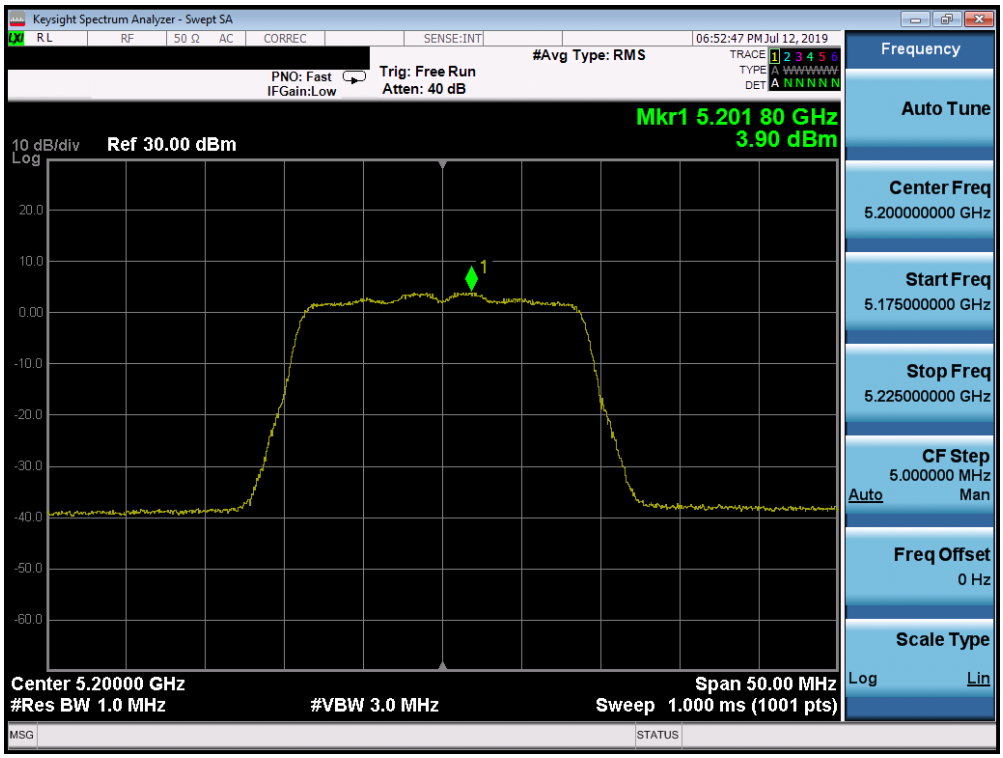


Plot 7-55. Power Spectral Density Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 1) – Ch. 40)



Plot 7-56. Power Spectral Density Plot ISED SISO CORE 0 (20MHz BW 802.11n (UNII Band 1) – Ch. 40)

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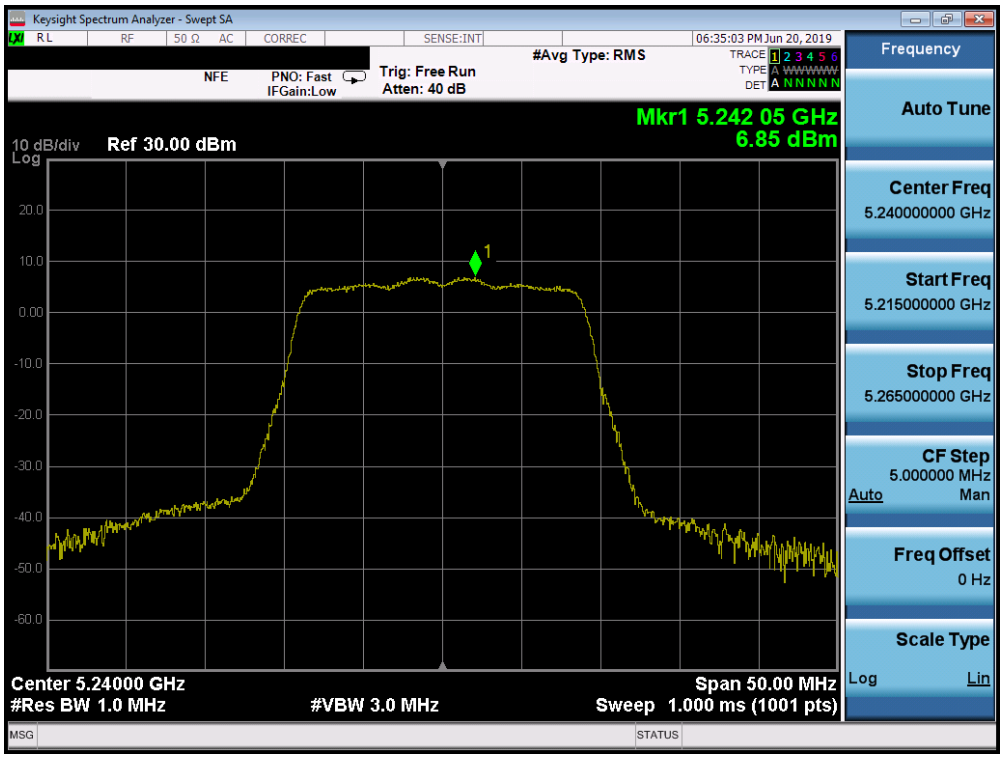
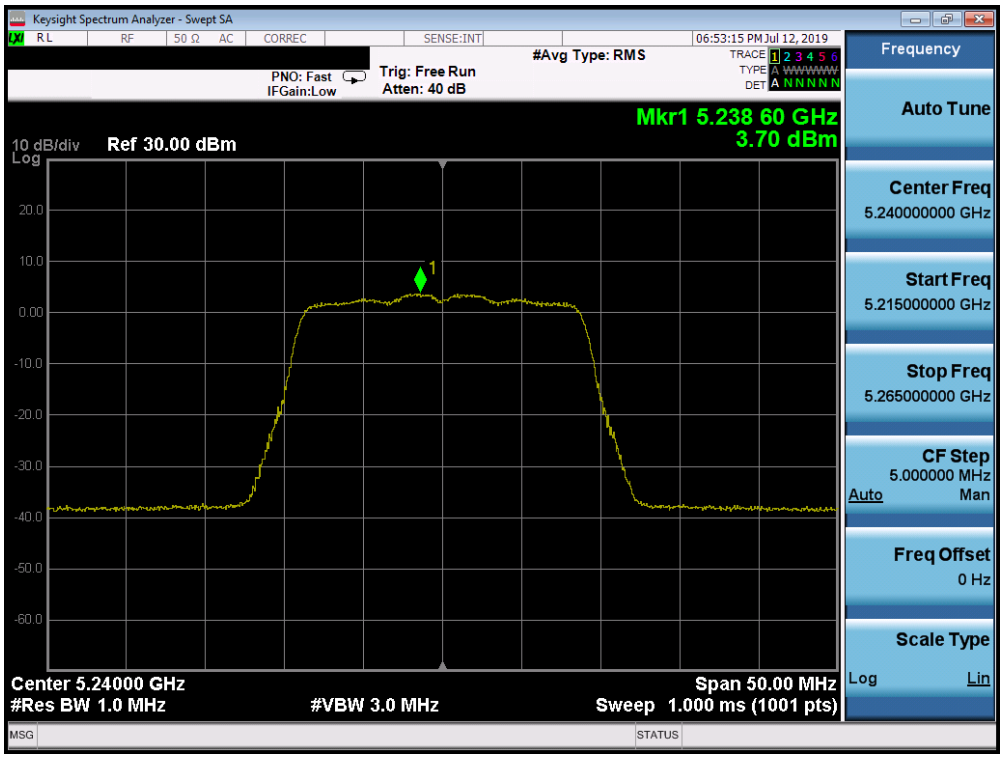


Plot 7-57. Power Spectral Density Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 1) – Ch. 48)



Plot 7-58. Power Spectral Density Plot ISED SISO CORE 0 (20MHz BW 802.11n (UNII Band 1) – Ch. 48)

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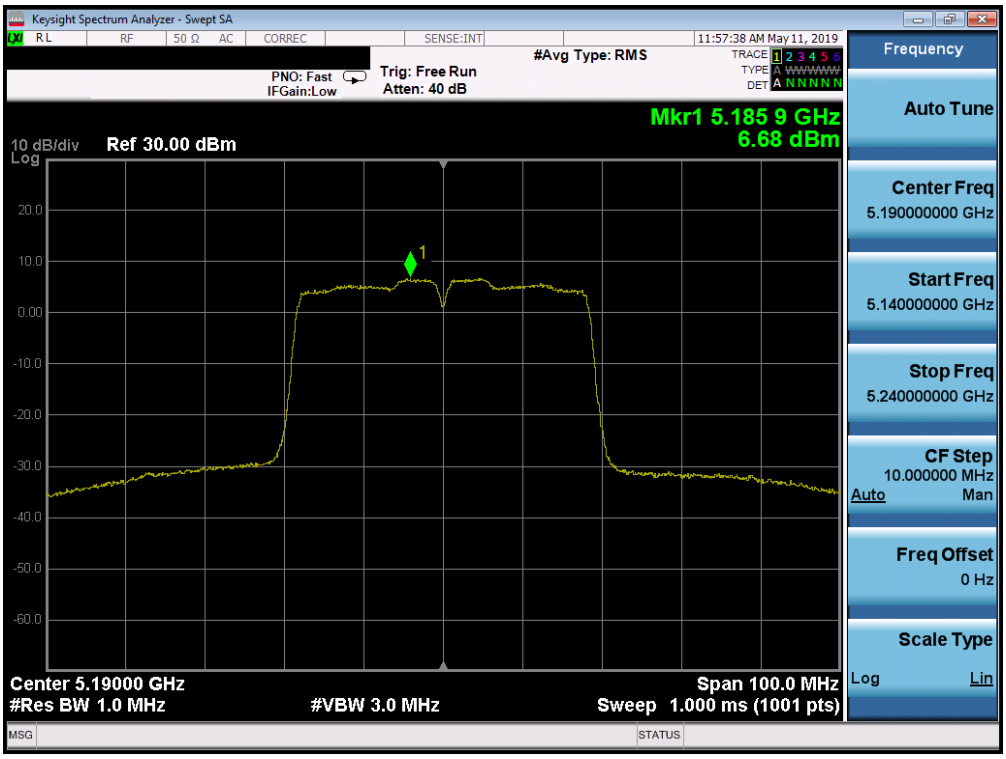
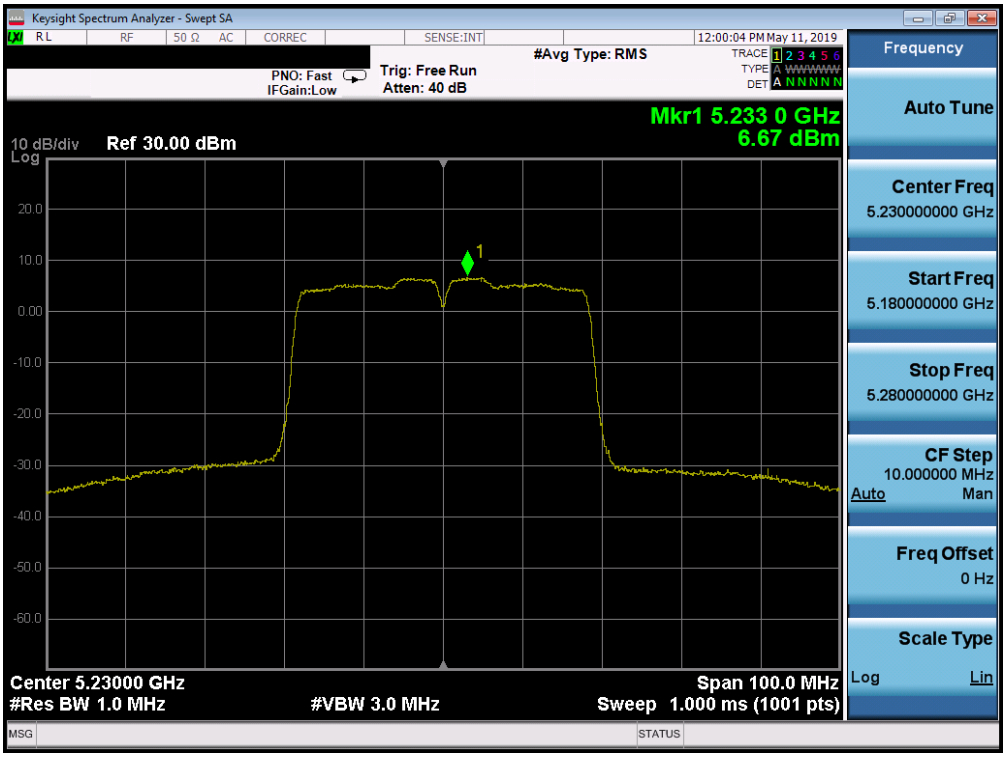


Plot 7-59. Power Spectral Density Plot SISO CORE 0 (40MHz BW 802.11n (UNII Band 1) – Ch. 38)



Plot 7-60. Power Spectral Density Plot SISO CORE 0 (40MHz BW 802.11n (UNII Band 1) – Ch. 46)

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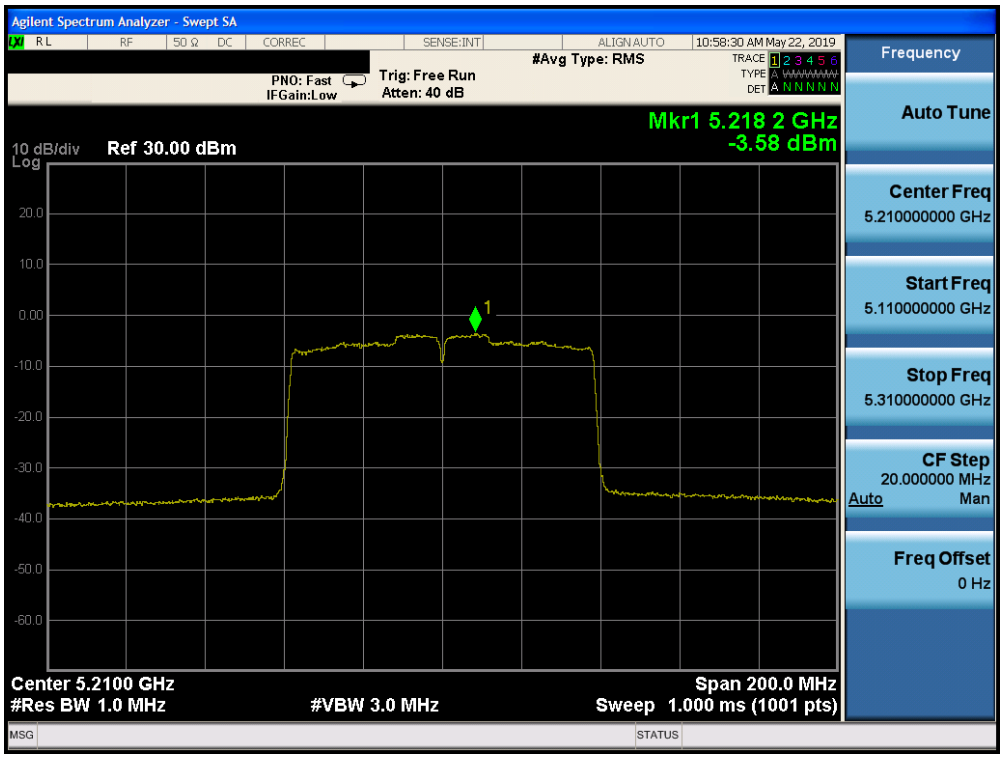
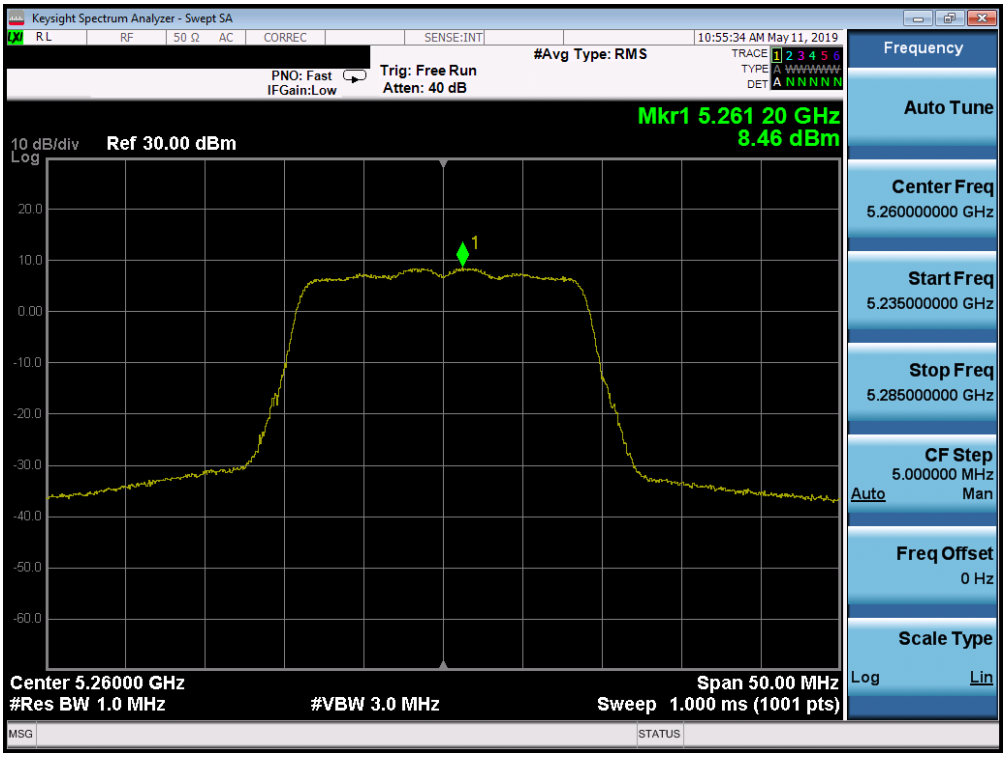


Plot 7-61. Power Spectral Density Plot SISO CORE 0 (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)



Plot 7-62. Power Spectral Density Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 2A) – Ch. 52)

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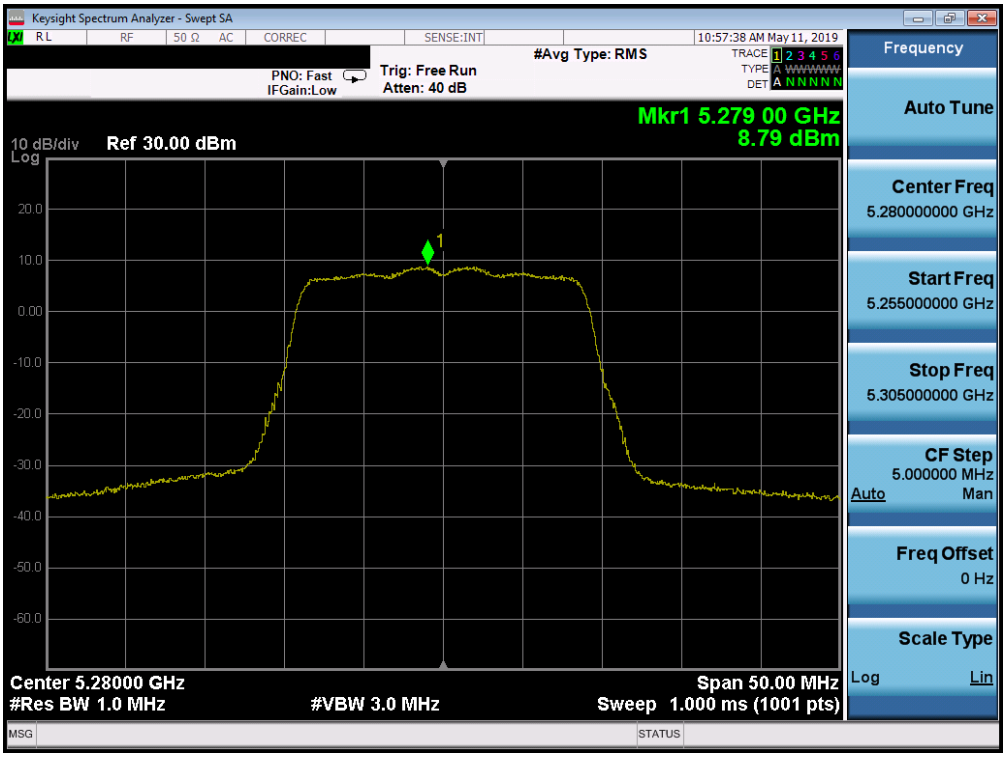
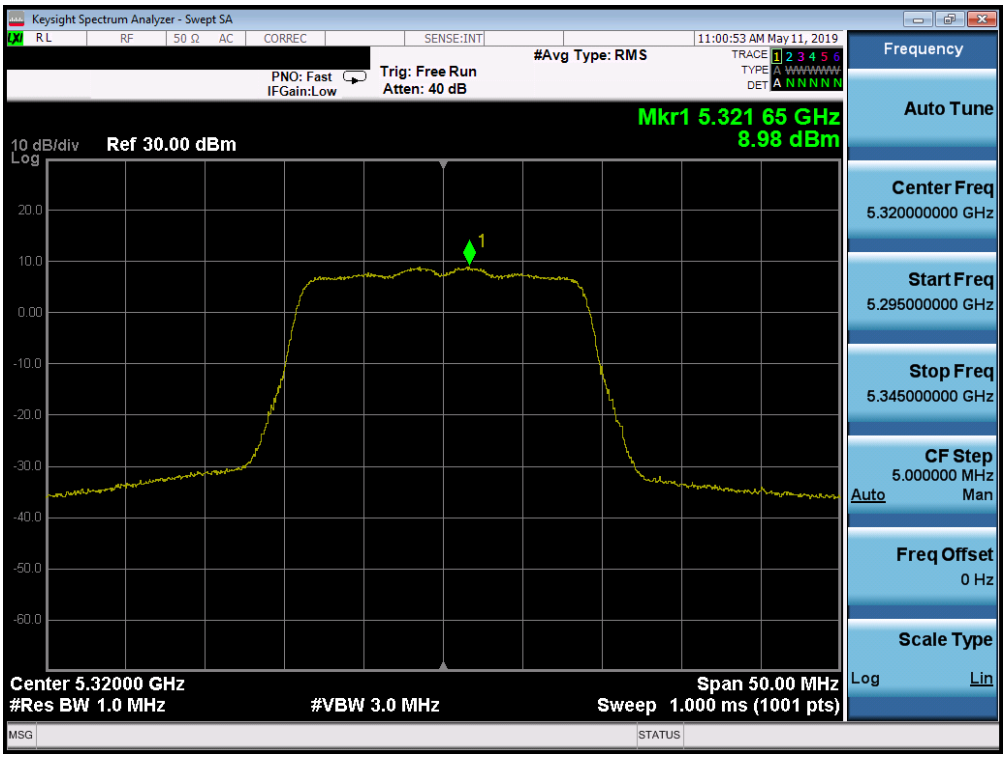


Plot 7-63. Power Spectral Density Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)



Plot 7-64. Power Spectral Density Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 2A) – Ch. 64)

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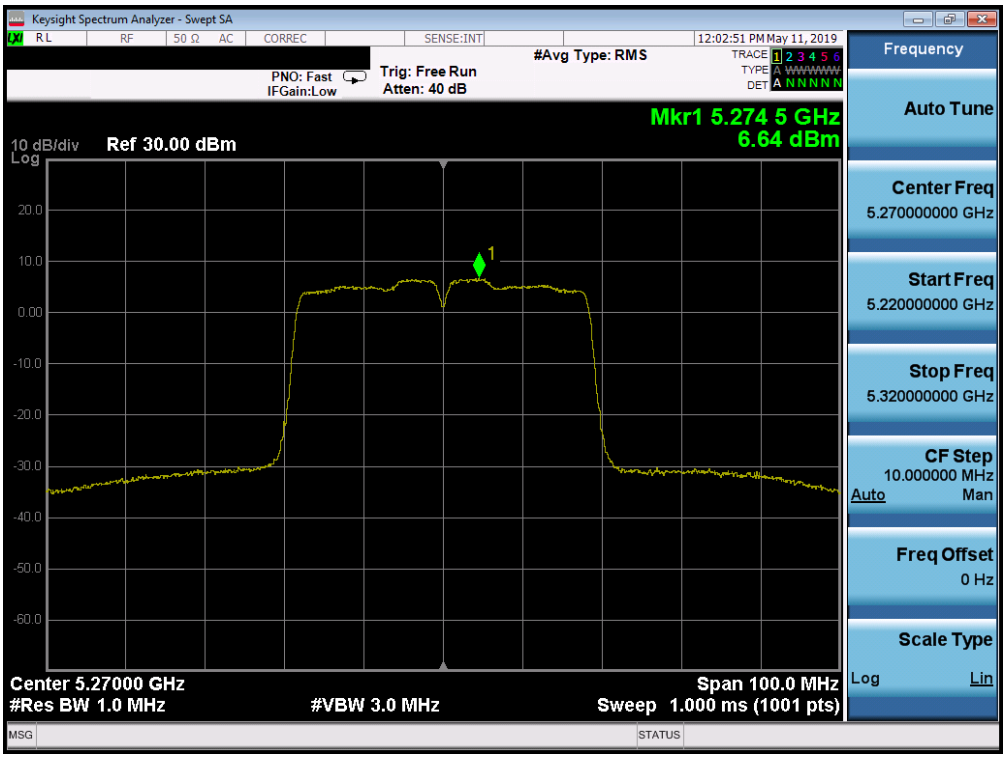
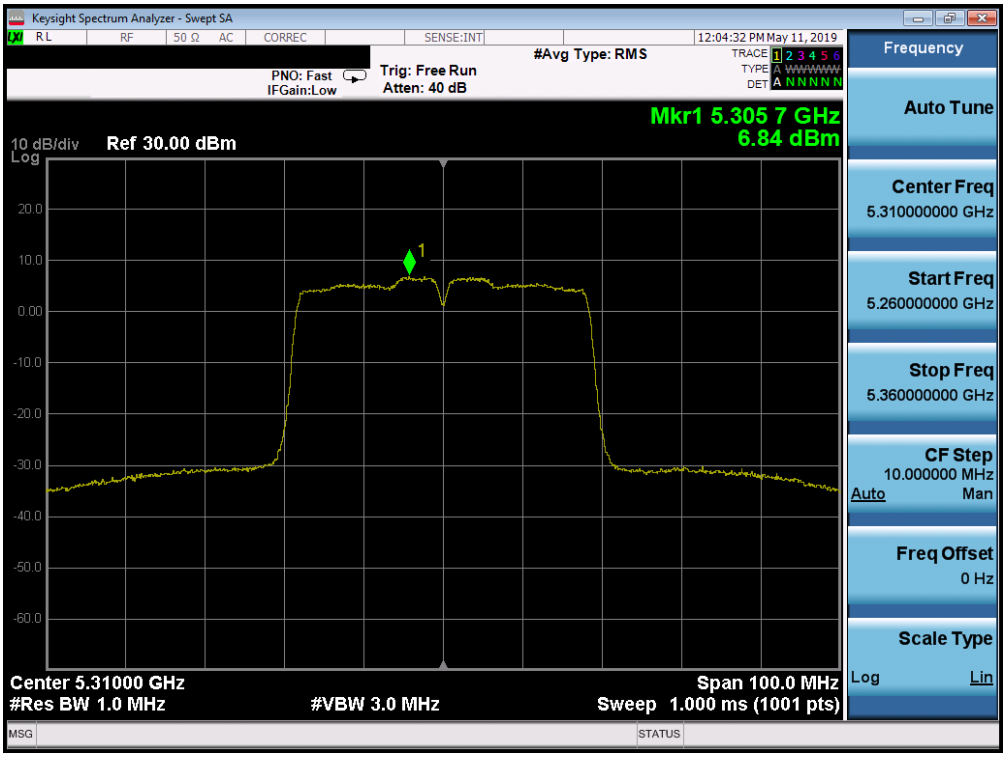


Plot 7-65. Power Spectral Density Plot SISO CORE 0 (40MHz BW 802.11n (UNII Band 2A) – Ch. 54)



Plot 7-66. Power Spectral Density Plot SISO CORE 0 (40MHz BW 802.11n (UNII Band 2A) – Ch. 62)

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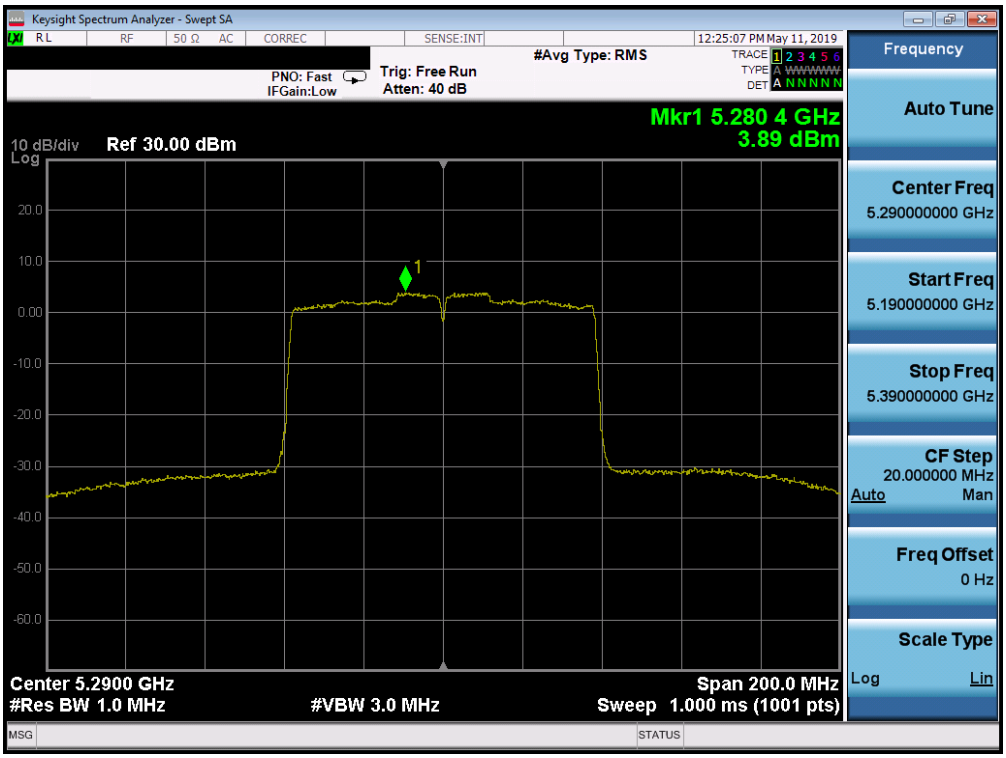
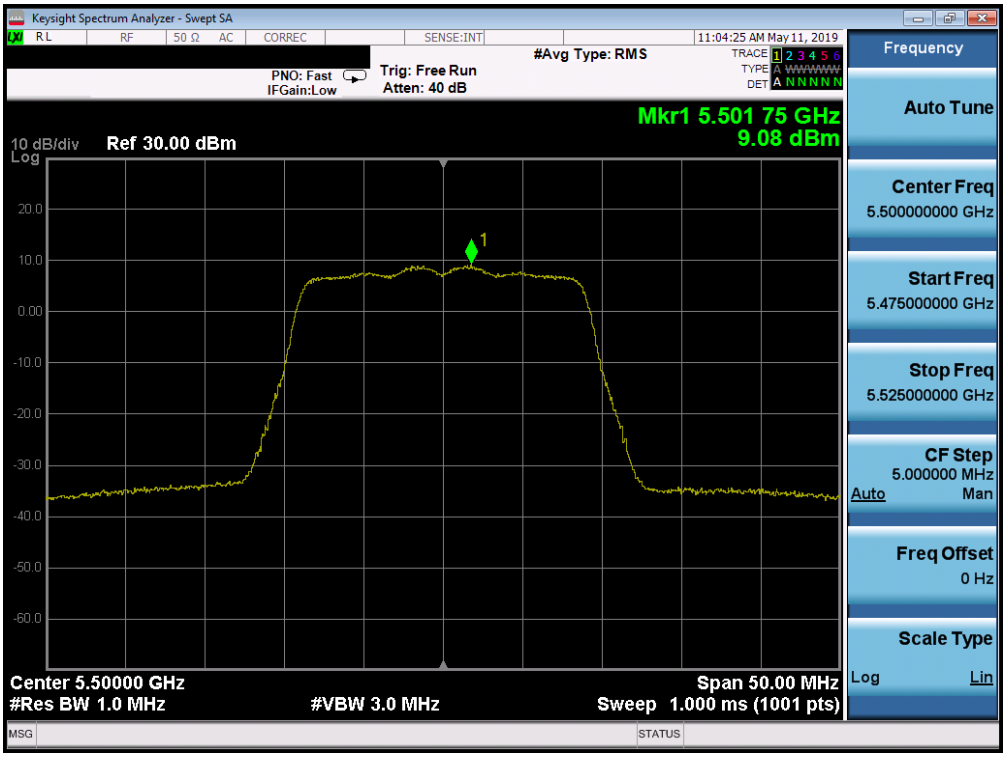


Plot 7-67. Power Spectral Density Plot SISO CORE 0 (80MHz BW 802.11ac (UNII Band 2A) – Ch. 58)



Plot 7-68. Power Spectral Density Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 2C) – Ch. 100)

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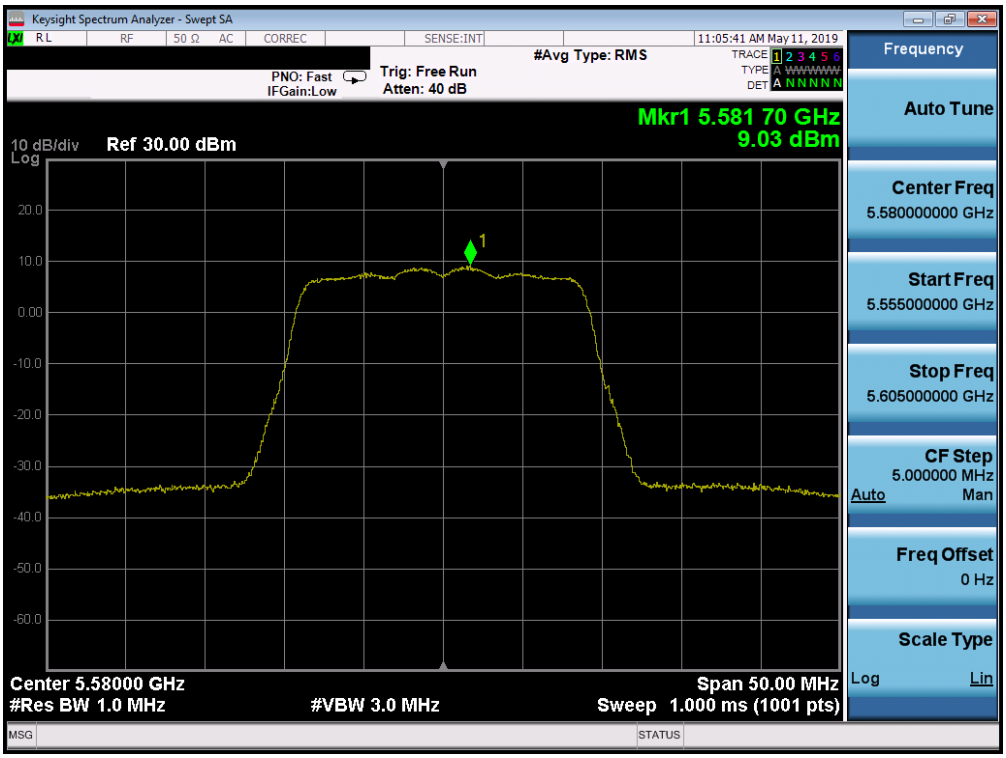
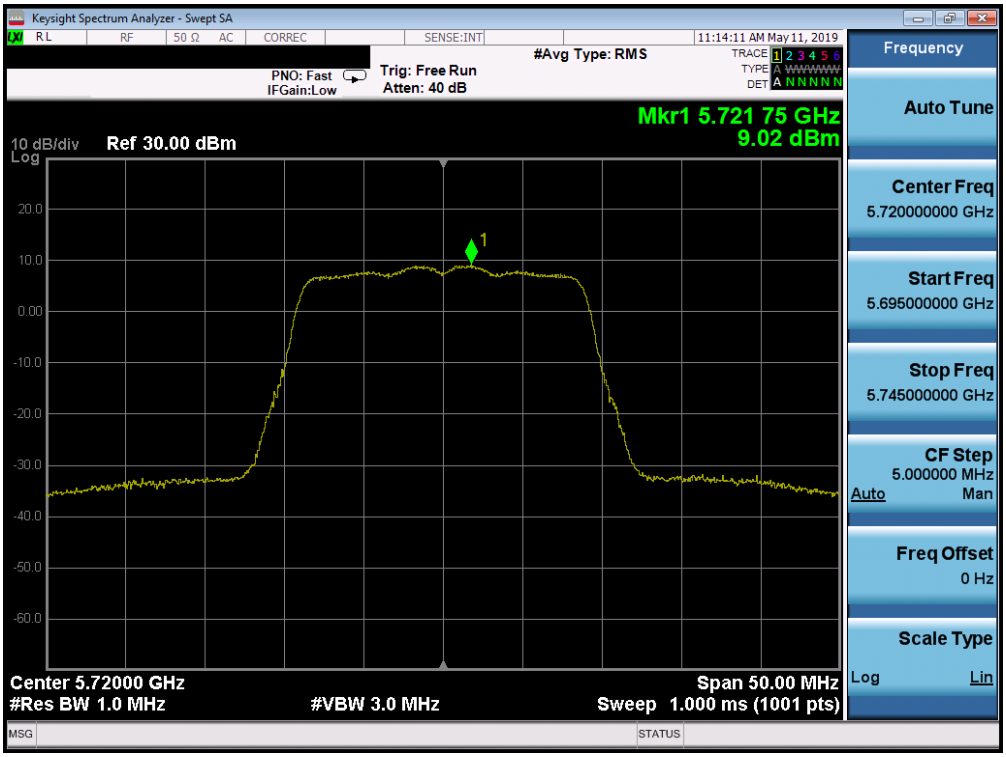


Plot 7-69. Power Spectral Density Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 2C) – Ch. 116)



Plot 7-70. Power Spectral Density Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 2C) – Ch. 144)

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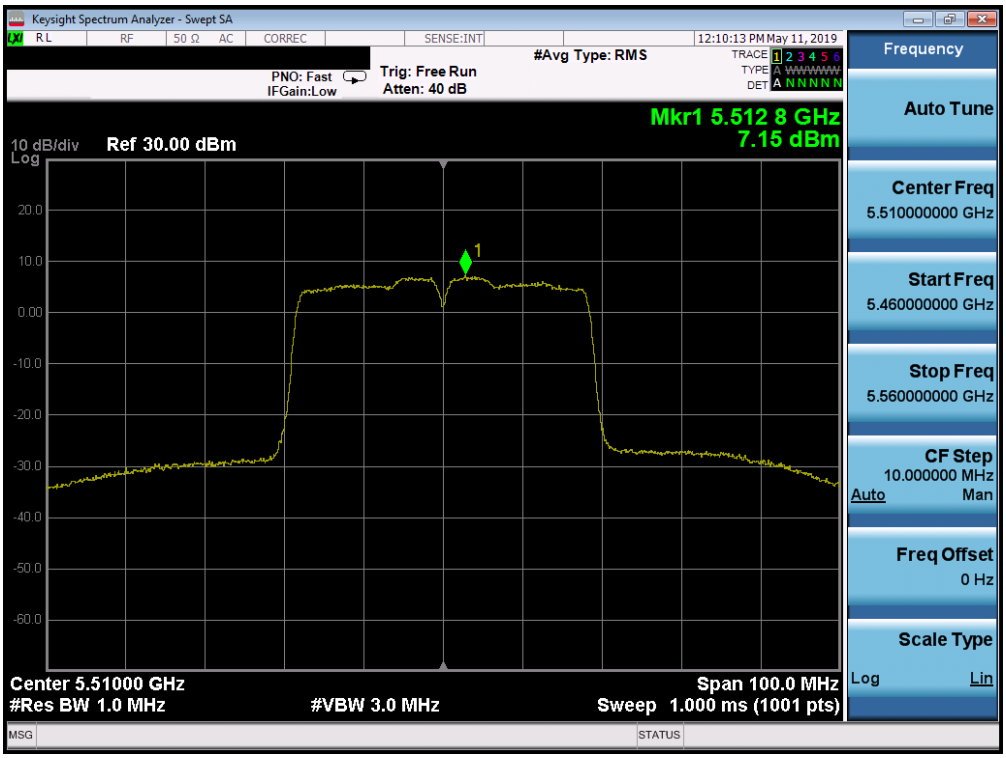
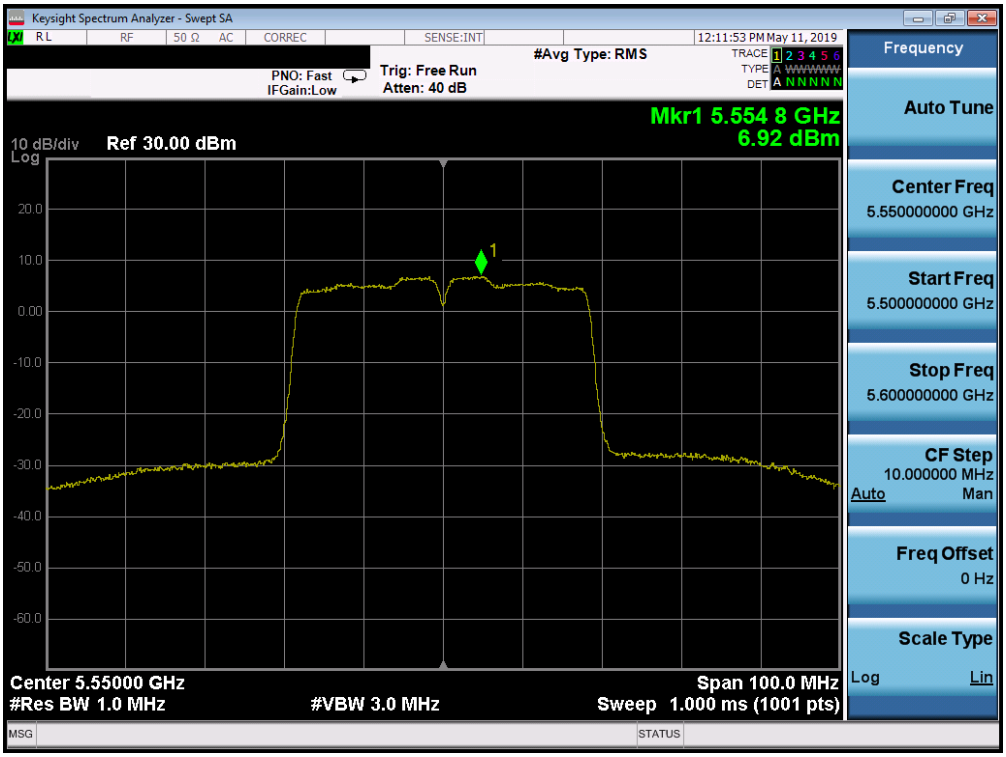


Plot 7-71. Power Spectral Density Plot SISO CORE 0 (40MHz BW 802.11n (UNII Band 2C) – Ch. 102)



Plot 7-72. Power Spectral Density Plot SISO CORE 0 (40MHz BW 802.11n (UNII Band 2C) – Ch. 110)

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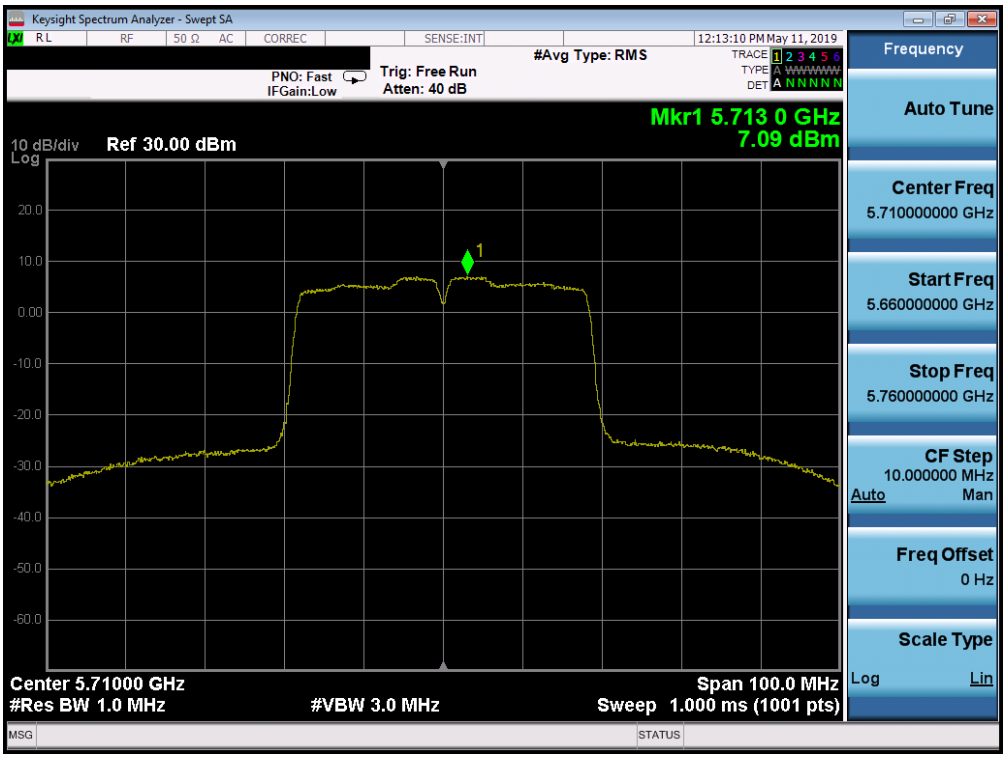
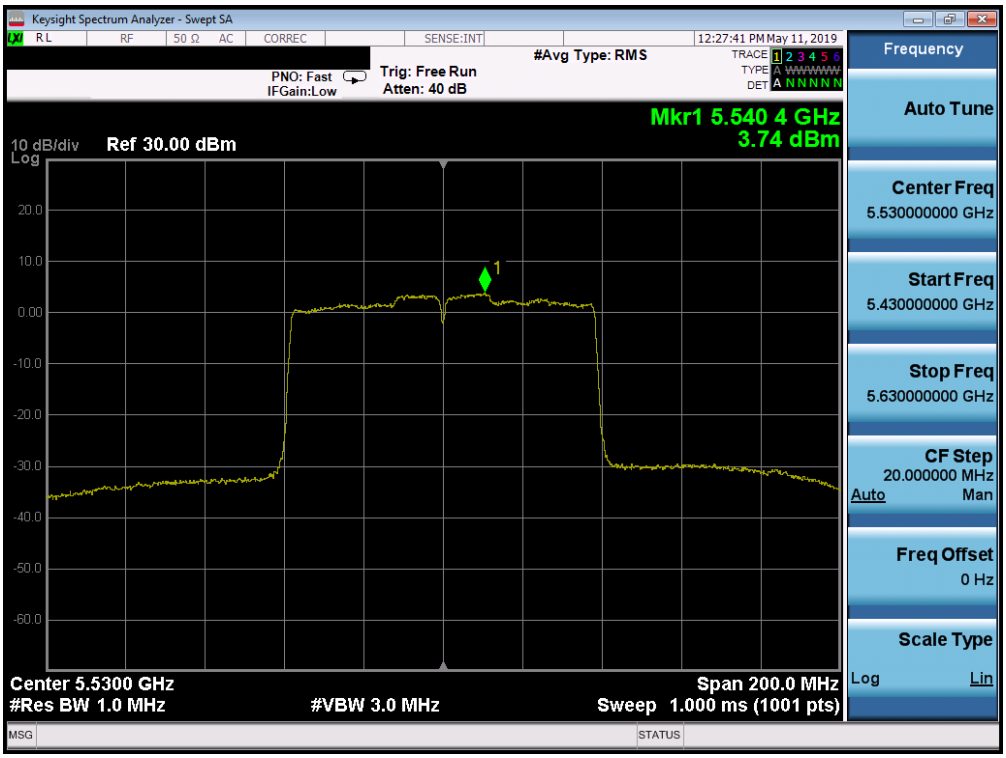


Plot 7-73. Power Spectral Density Plot SISO CORE 0 (40MHz BW 802.11n (UNII Band 2C) – Ch. 142)



Plot 7-74. Power Spectral Density Plot SISO CORE 0 (80MHz BW 802.11ac (UNII Band 2C) – Ch. 106)

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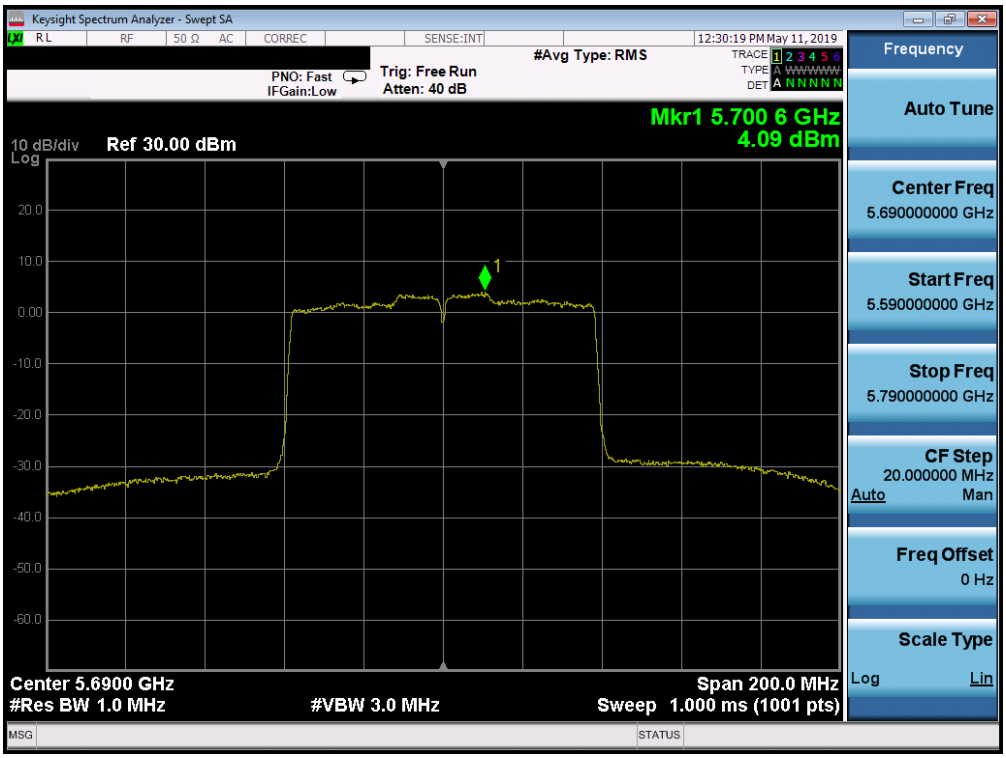

Plot 7-75. Power Spectral Density Plot SISO CORE 0 (80MHz BW 802.11ac (UNII Band 2C) – Ch. 138)

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	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Power Density [dBm/500kHz]	Max Permissible Power Density [dBm/500kHz]	Margin [dB]
Band 3	5745	149	n (20MHz)	6.5/7.2 (MCS0)	6.36	30.0	-23.64
	5785	157	n (20MHz)	6.5/7.2 (MCS0)	6.22	30.0	-23.78
	5825	165	n (20MHz)	6.5/7.2 (MCS0)	6.46	30.0	-23.54
	5755	151	n (40MHz)	13.5/15 (MCS0)	3.98	30.0	-26.02
	5795	159	n (40MHz)	13.5/15 (MCS0)	3.68	30.0	-26.32
	5775	155	ac (80MHz)	29.3/32.5 (MCS0)	1.15	30.0	-28.85

Table 7-28. Band 3 Conducted Power Spectral Density Measurements SISO CORE 0

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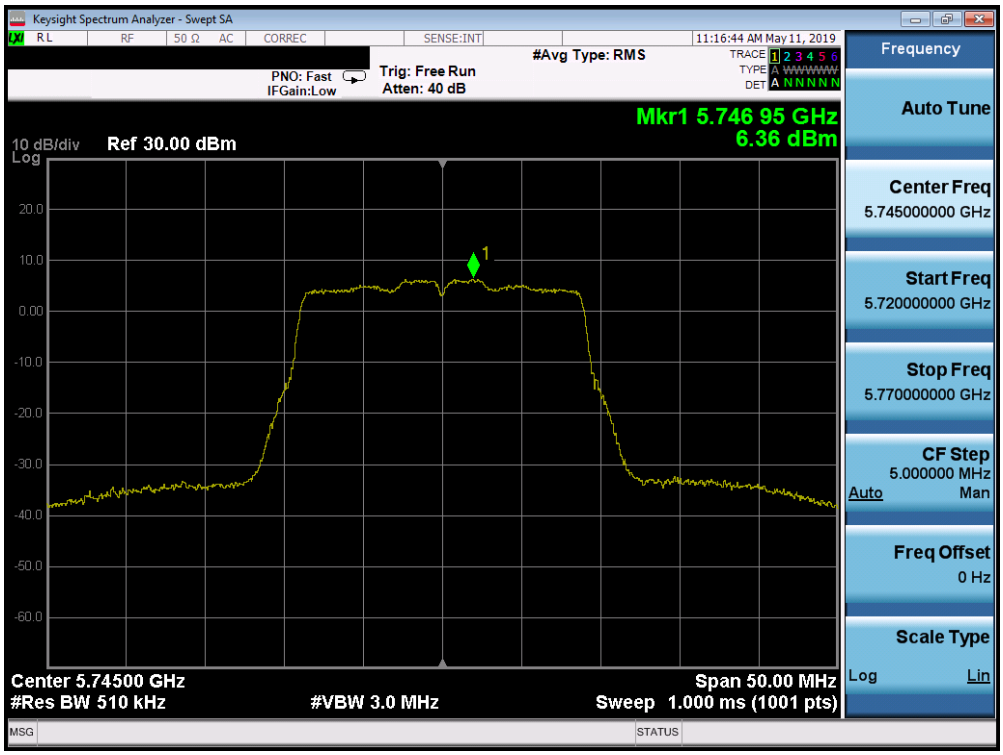
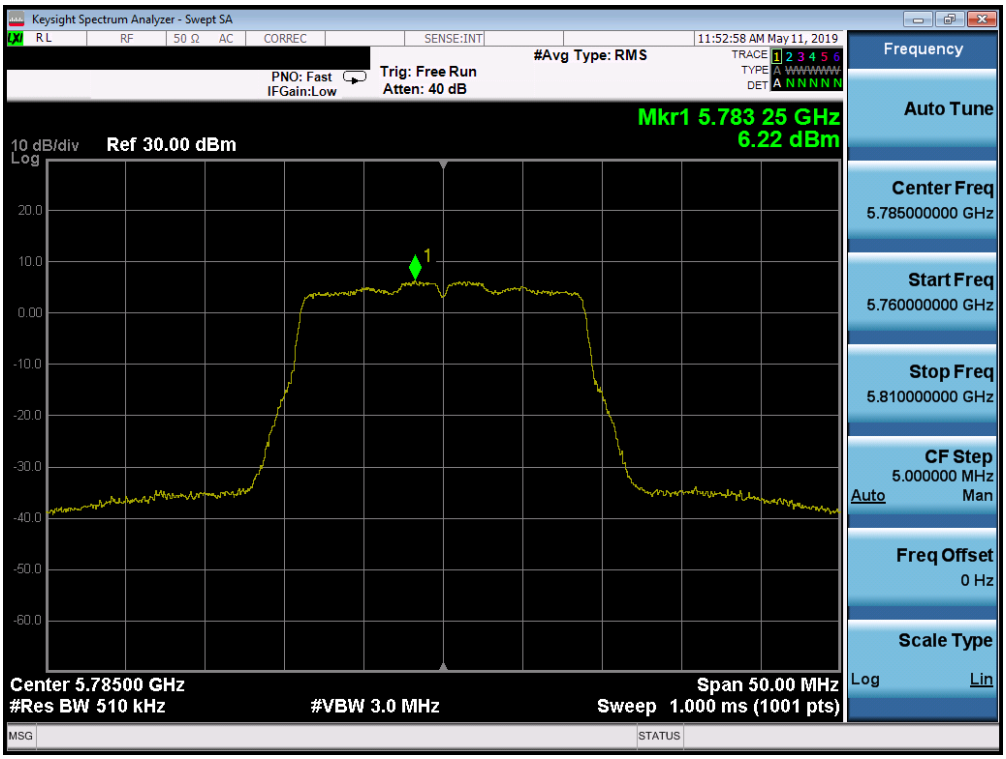


Plot 7-76. Power Spectral Density Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 3) – Ch. 149)



Plot 7-77. Power Spectral Density Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 3) – Ch. 157)

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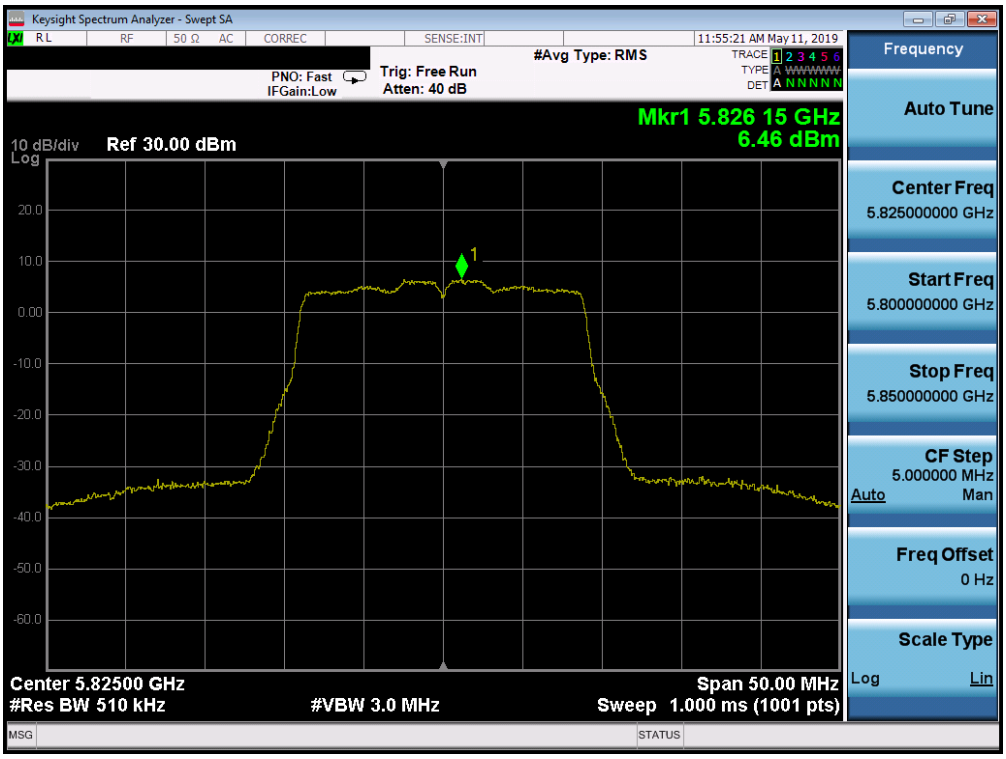
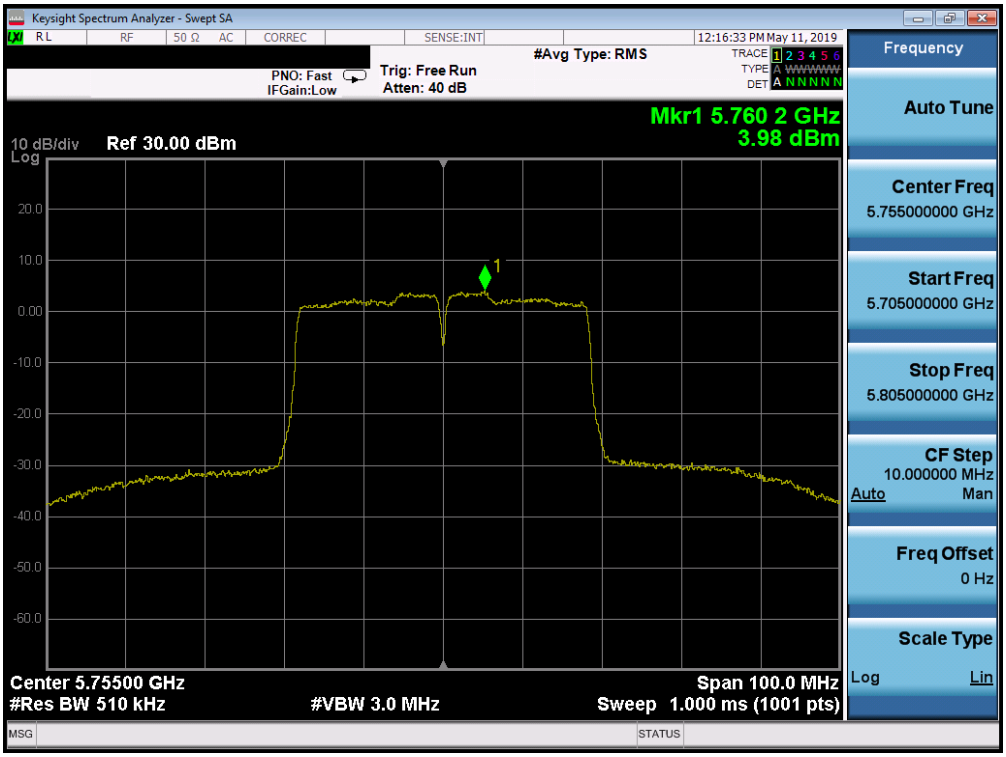


Plot 7-78. Power Spectral Density Plot SISO CORE 0 (20MHz BW 802.11n (UNII Band 3) – Ch. 165)



Plot 7-79. Power Spectral Density Plot SISO CORE 0 (40MHz BW 802.11n (UNII Band 3) – Ch. 151)

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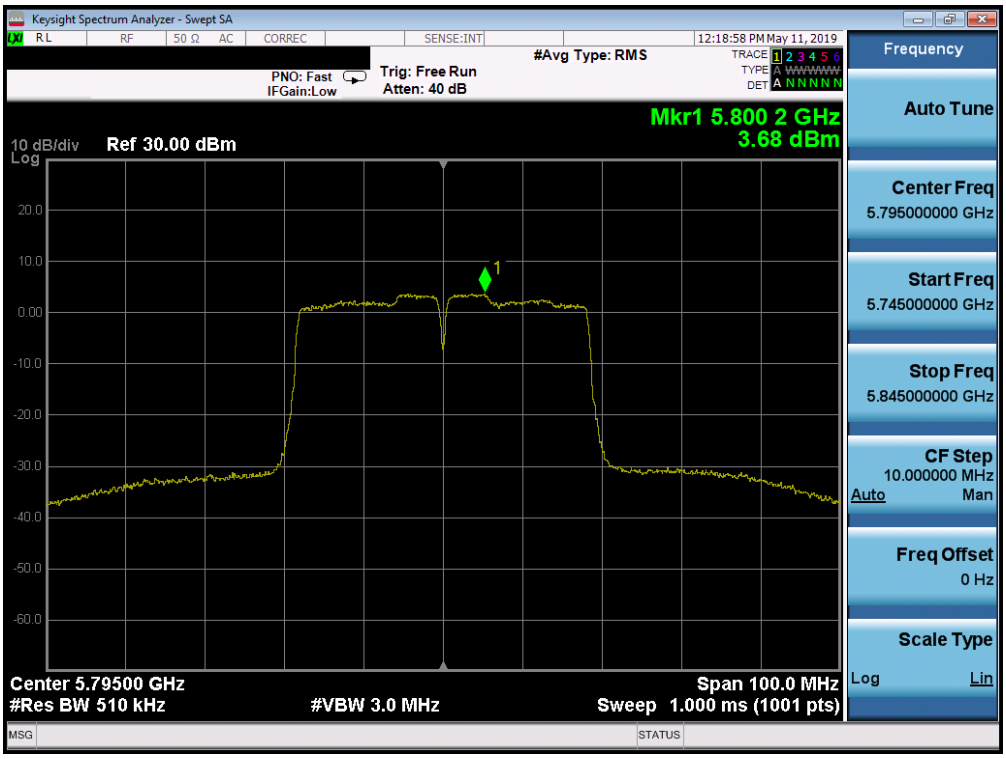
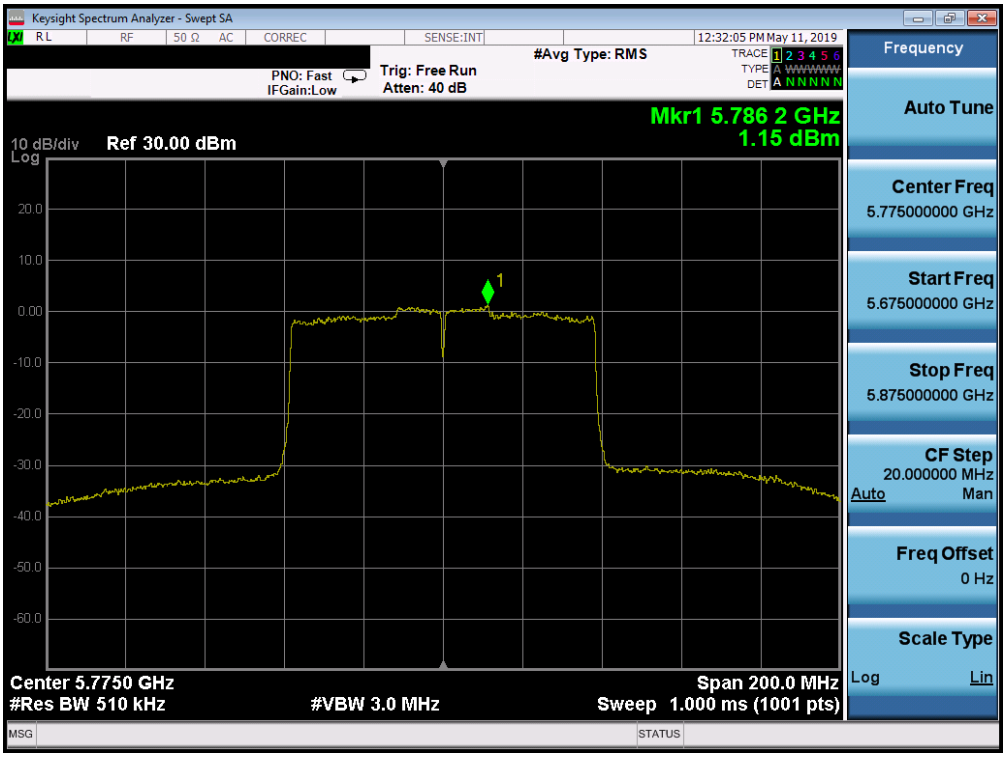


Plot 7-80. Power Spectral Density Plot SISO CORE 0 (40MHz BW 802.11n (UNII Band 3) – Ch. 159)



Plot 7-81. Power Spectral Density Plot SISO CORE 0 (80MHz BW 802.11ac (UNII Band 3) – Ch. 155)

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SISO CORE-1 Power Spectral Density Measurements

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Power Density [dBm/MHz]	Max Power Density [dBm/MHz]	Margin [dB]
Band 1	5180	36	n (20MHz)	6.5/7.2 (MCS0)	5.37	11.0	-5.63
	5200	40	n (20MHz)	6.5/7.2 (MCS0)	6.52	11.0	-4.48
	5240	48	n (20MHz)	6.5/7.2 (MCS0)	6.48	11.0	-4.52
	5190	38	n (40MHz)	13.5/15 (MCS0)	-1.55	11.0	-12.55
	5230	46	n (40MHz)	13.5/15 (MCS0)	1.91	11.0	-9.09
	5210	42	ac (80MHz)	29.3/32.5 (MCS0)	2.49	11.0	-8.51
Band 2A	5260	52	n (20MHz)	6.5/7.2 (MCS0)	9.00	11.0	-2.00
	5280	56	n (20MHz)	6.5/7.2 (MCS0)	8.83	11.0	-2.17
	5320	64	n (20MHz)	6.5/7.2 (MCS0)	9.14	11.0	-1.86
	5270	54	n (40MHz)	13.5/15 (MCS0)	6.62	11.0	-4.38
	5310	62	n (40MHz)	13.5/15 (MCS0)	6.80	11.0	-4.20
	5290	58	ac (80MHz)	29.3/32.5 (MCS0)	4.24	11.0	-6.76
Band 2C	5500	100	n (20MHz)	6.5/7.2 (MCS0)	9.18	11.0	-1.82
	5580	116	n (20MHz)	6.5/7.2 (MCS0)	8.95	11.0	-2.05
	5720	144	n (20MHz)	6.5/7.2 (MCS0)	9.32	11.0	-1.68
	5510	102	n (40MHz)	13.5/15 (MCS0)	7.13	11.0	-3.87
	5550	110	n (40MHz)	13.5/15 (MCS0)	7.07	11.0	-3.93
	5710	142	n (40MHz)	13.5/15 (MCS0)	7.26	11.0	-3.74
	5530	106	ac (80MHz)	29.3/32.5 (MCS0)	3.84	11.0	-7.16
	5690	138	ac (80MHz)	29.3/32.5 (MCS0)	3.78	11.0	-7.22

Table 7-29. Conducted Power Spectral Density Measurements SISO CORE 1

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Power Density [dBm/MHz]	Antenna Gain [dBi]	e.i.r.p. Power Density [dBm/MHz]	ISED Max e.i.r.p. Power Density [dBm/MHz]	Margin [dB]
Band 1	5180	36	n (20MHz)	6.5/7.2 (MCS0)	3.53	2.64	6.17	10.0	-3.83
	5200	40	n (20MHz)	6.5/7.2 (MCS0)	3.44	2.64	6.08	10.0	-3.92
	5240	48	n (20MHz)	6.5/7.2 (MCS0)	3.25	2.64	5.89	10.0	-4.11
	5190	38	n (40MHz)	13.5/15 (MCS0)	-1.55	2.64	1.09	10.0	-8.91
	5230	46	n (40MHz)	13.5/15 (MCS0)	1.91	2.64	4.55	10.0	-5.45
	5210	42	ac (80MHz)	29.3/32.5 (MCS0)	2.49	2.64	5.13	10.0	-4.87

Table 7-30. Band 1 e.i.r.p. Conducted Power Spectral Density Measurements (ISED) SISO CORE 1

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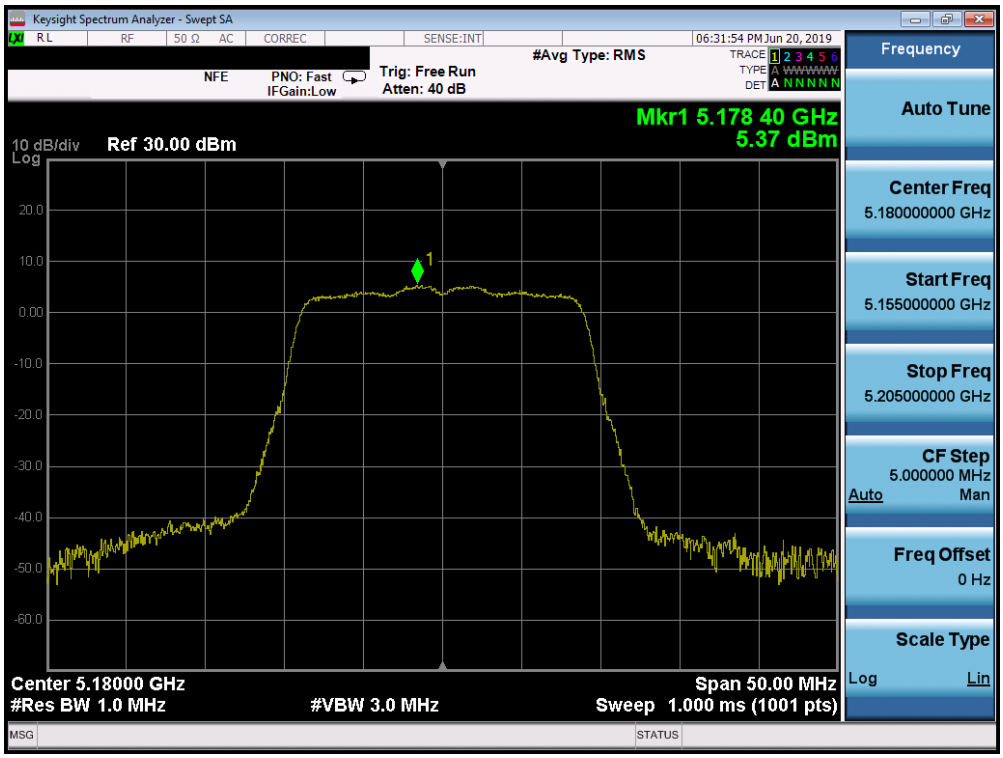
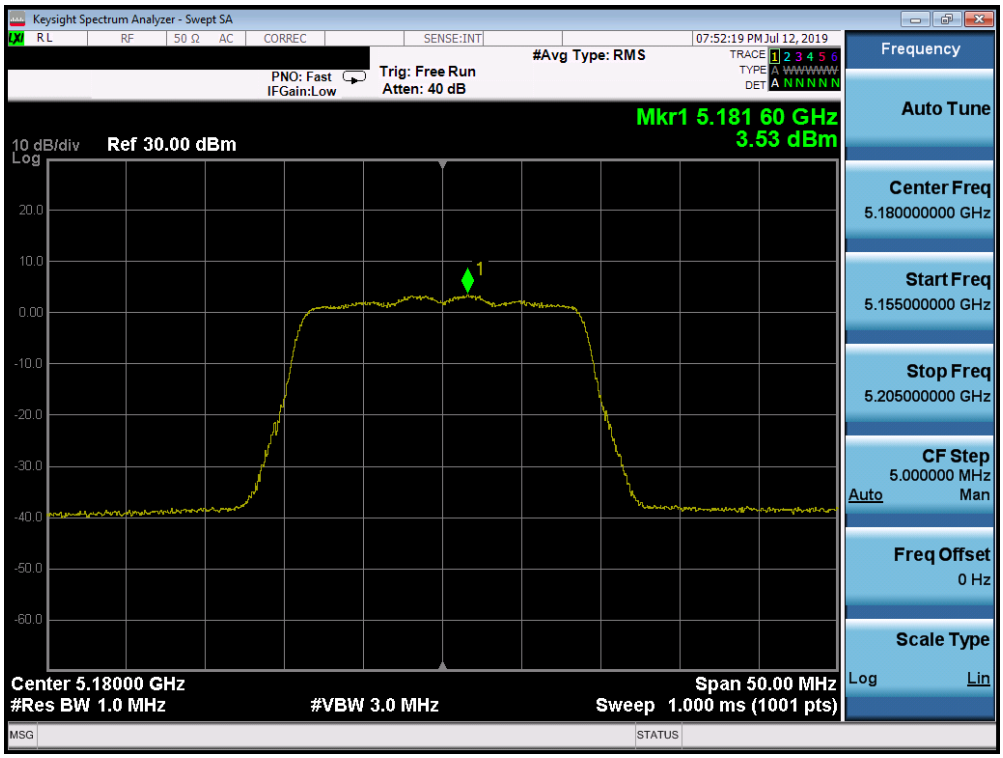


Plot 7-82. Power Spectral Density Plot SISO CORE 1 (20MHz BW 802.11n (UNII Band 1) – Ch. 36)



Plot 7-83. Power Spectral Density Plot ISED SISO CORE 1 (20MHz BW 802.11n (UNII Band 1) – Ch. 36)

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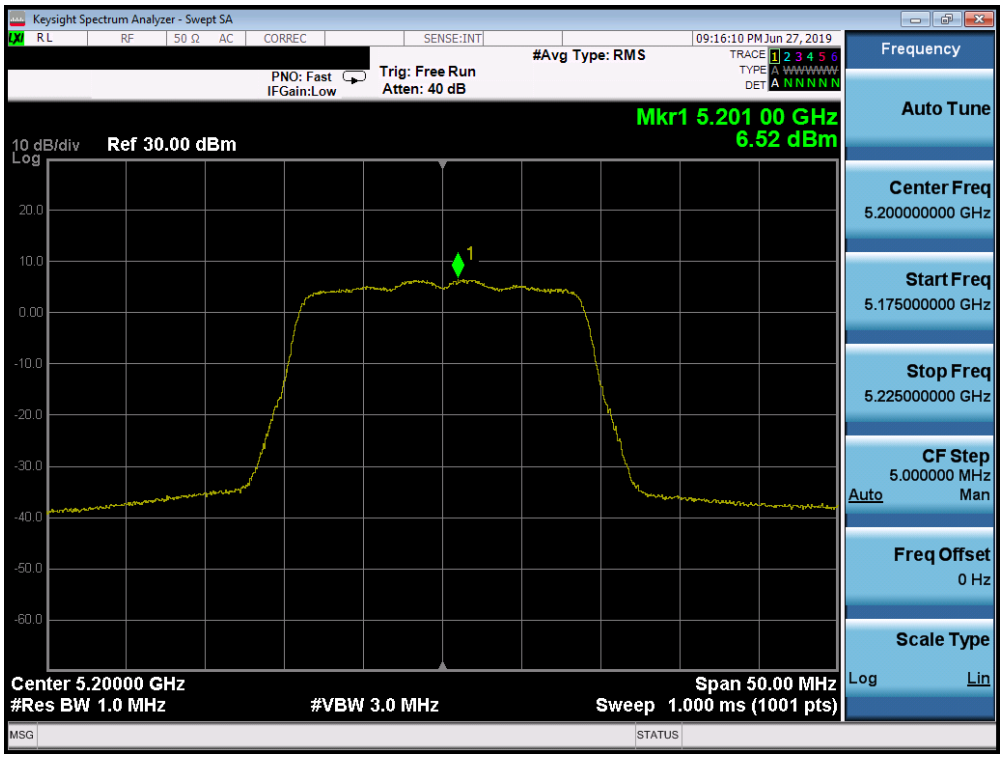
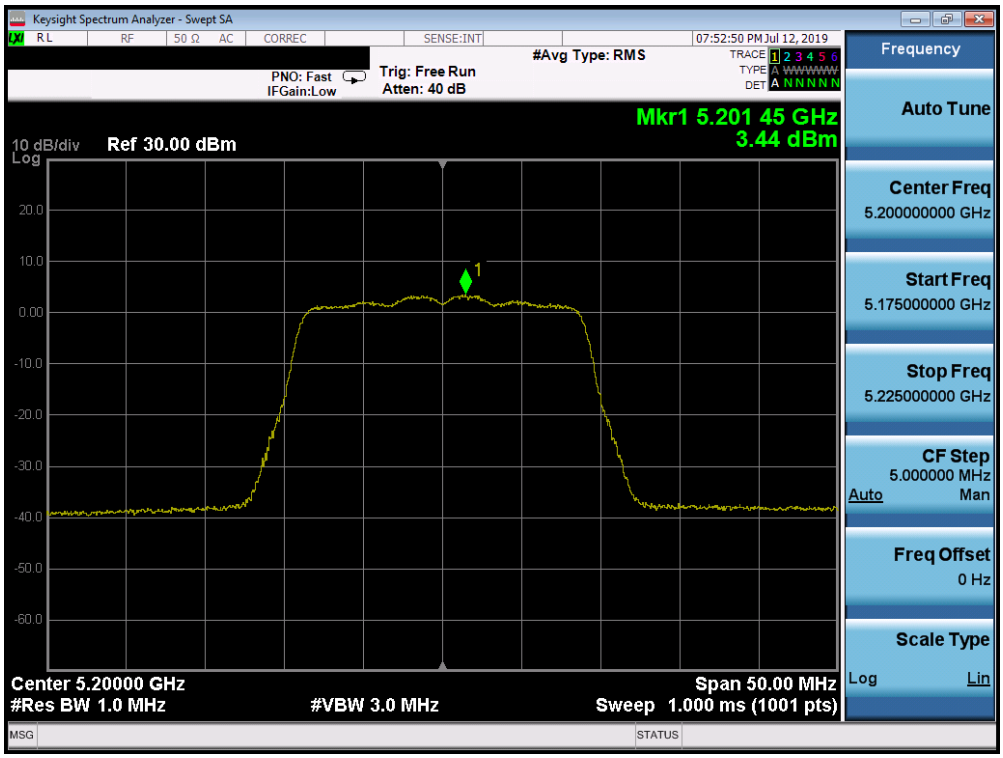


Plot 7-84. Power Spectral Density Plot SISO CORE 1 (20MHz BW 802.11n (UNII Band 1) – Ch. 40)



Plot 7-85. Power Spectral Density Plot ISED SISO CORE 1 (20MHz BW 802.11n (UNII Band 1) – Ch. 40)

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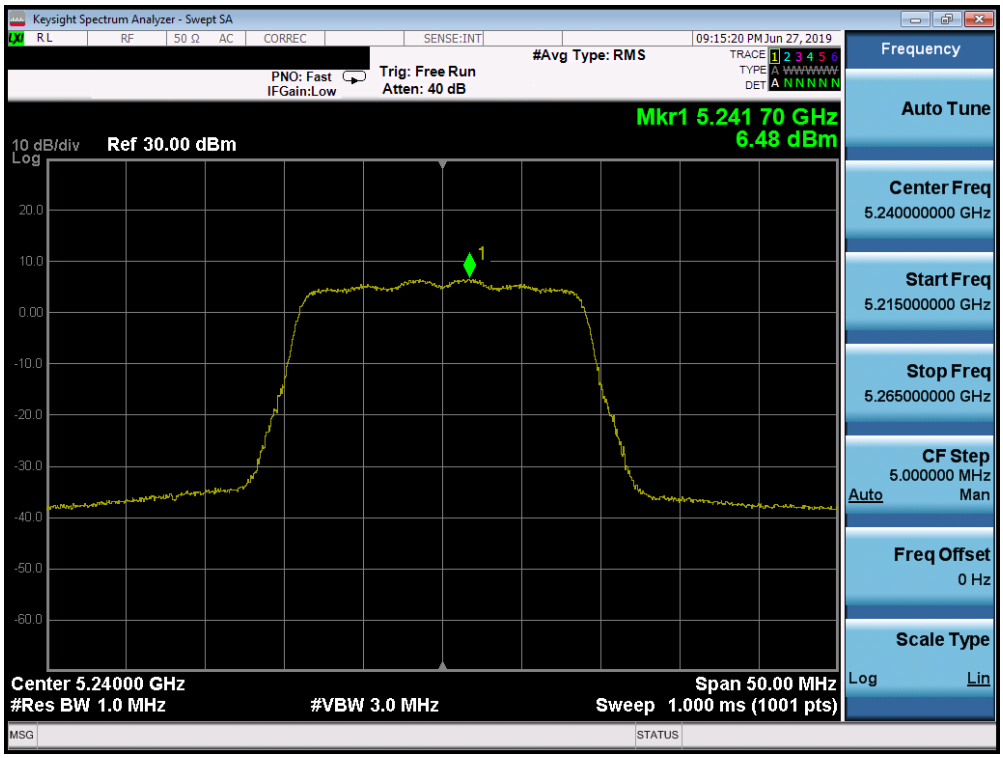
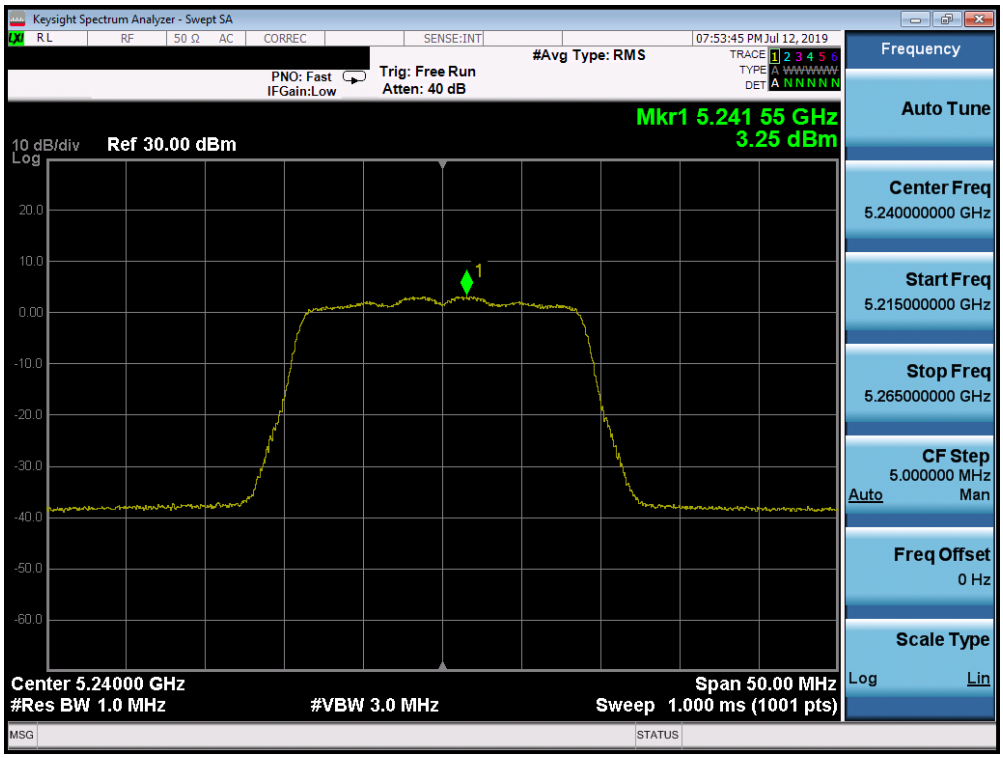


Plot 7-86. Power Spectral Density Plot SISO CORE 1 (20MHz BW 802.11n (UNII Band 1) – Ch. 48)



Plot 7-87. Power Spectral Density Plot ISED SISO CORE 1 (20MHz BW 802.11n (UNII Band 1) – Ch. 48)

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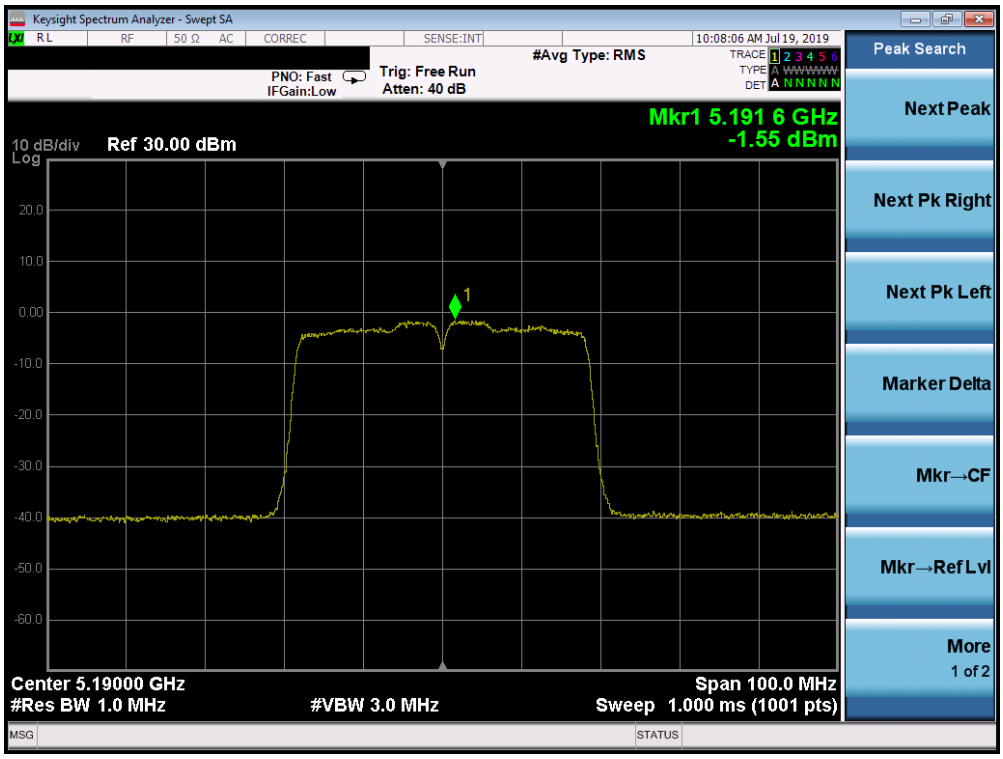
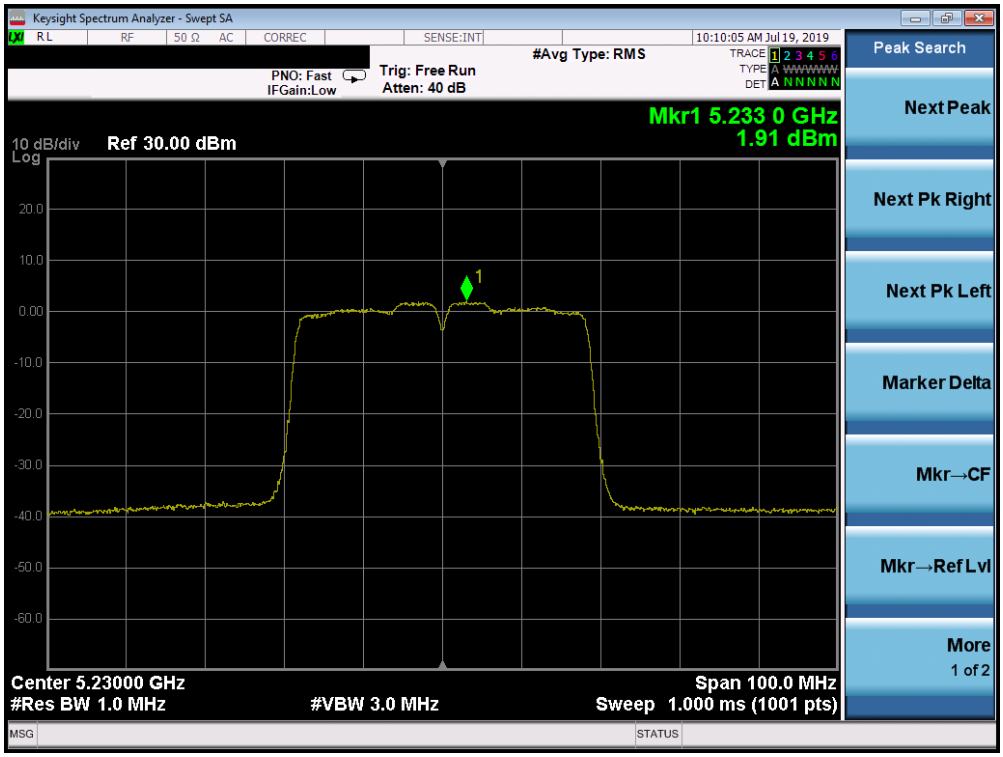


Plot 7-88. Power Spectral Density Plot SISO CORE 1 (40MHz BW 802.11n (UNII Band 1) – Ch. 38)



Plot 7-89. Power Spectral Density Plot SISO CORE 1 (40MHz BW 802.11n (UNII Band 1) – Ch. 46)

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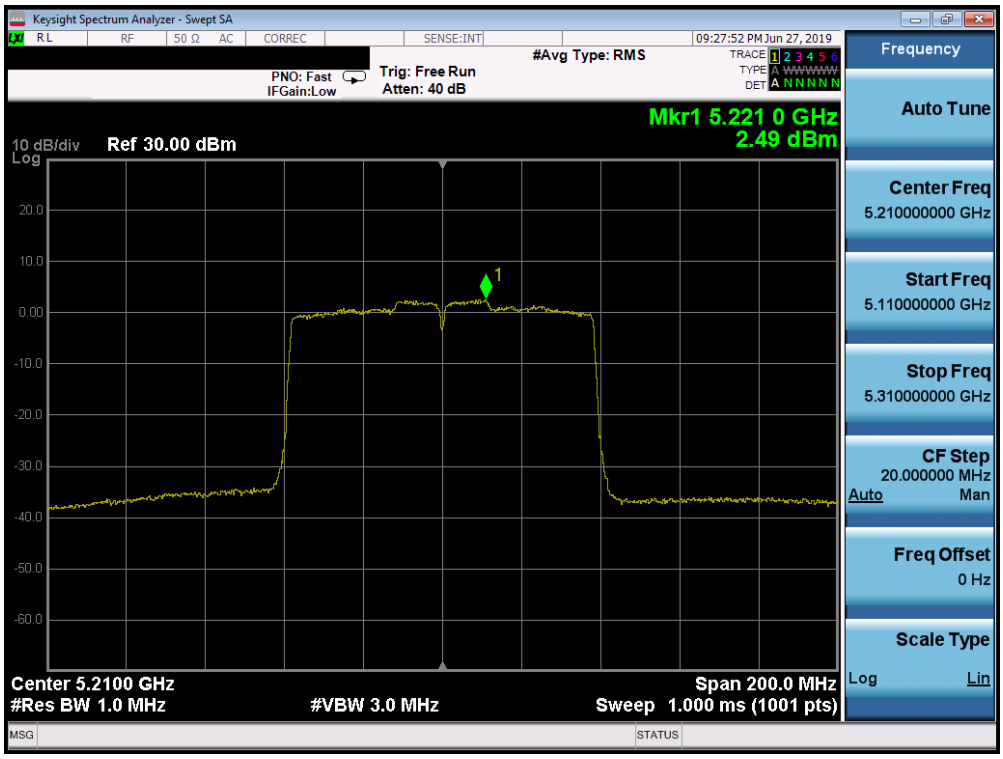
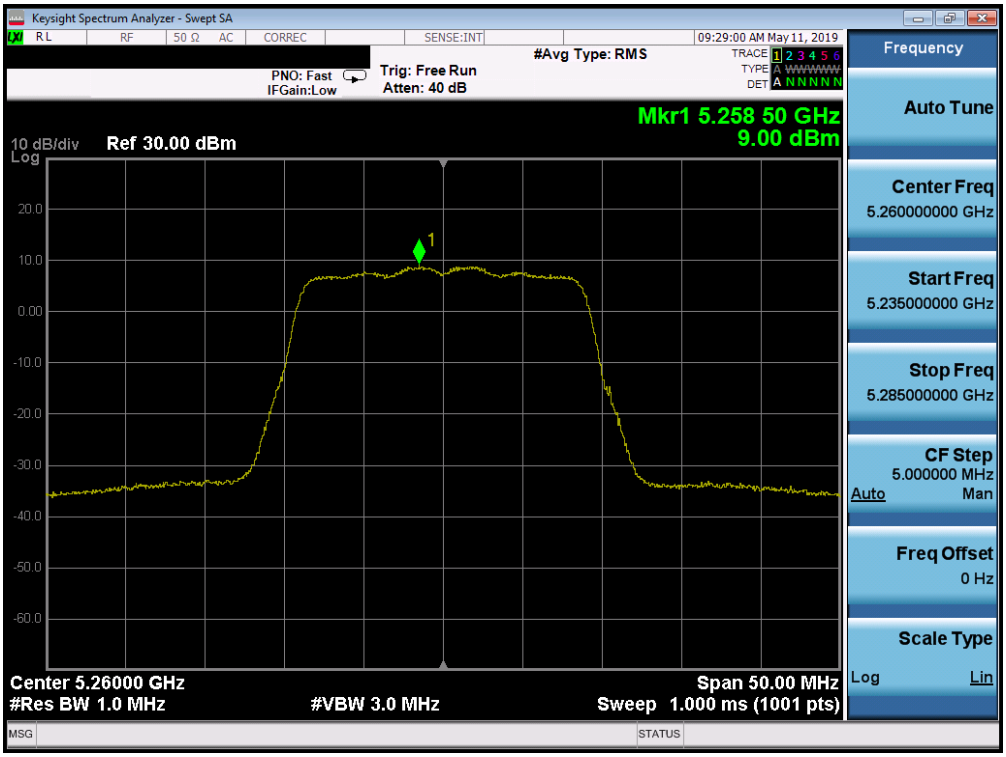


Plot 7-90. Power Spectral Density Plot SISO CORE 1 (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)



Plot 7-91. Power Spectral Density Plot SISO CORE 1 (20MHz BW 802.11n (UNII Band 2A) – Ch. 52)

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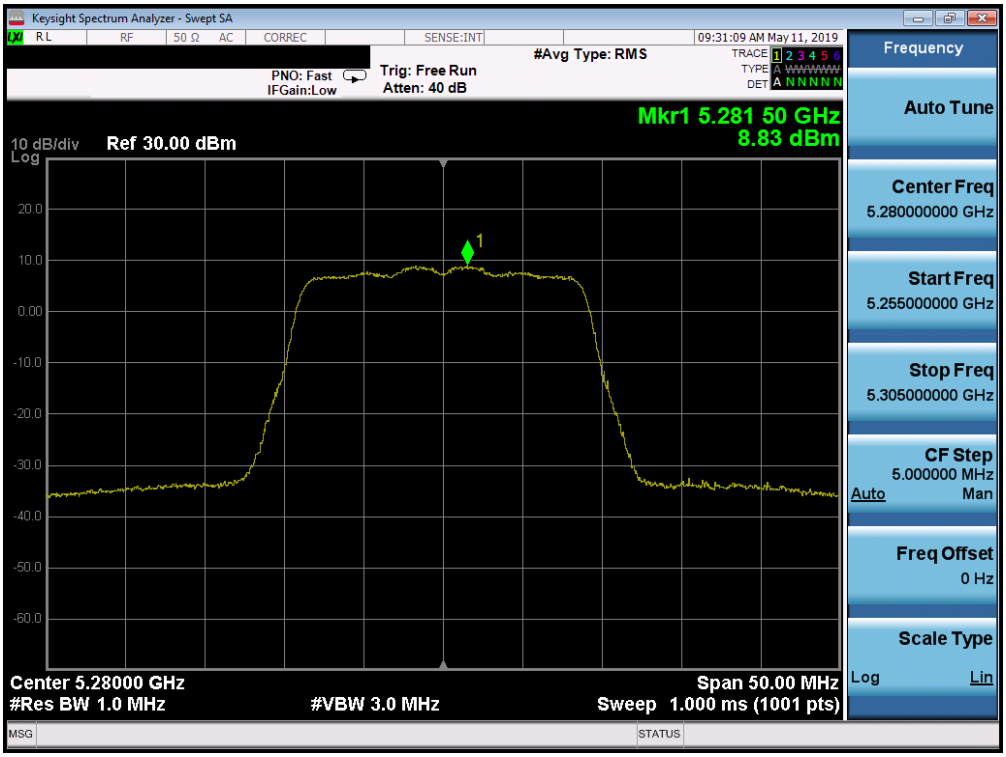
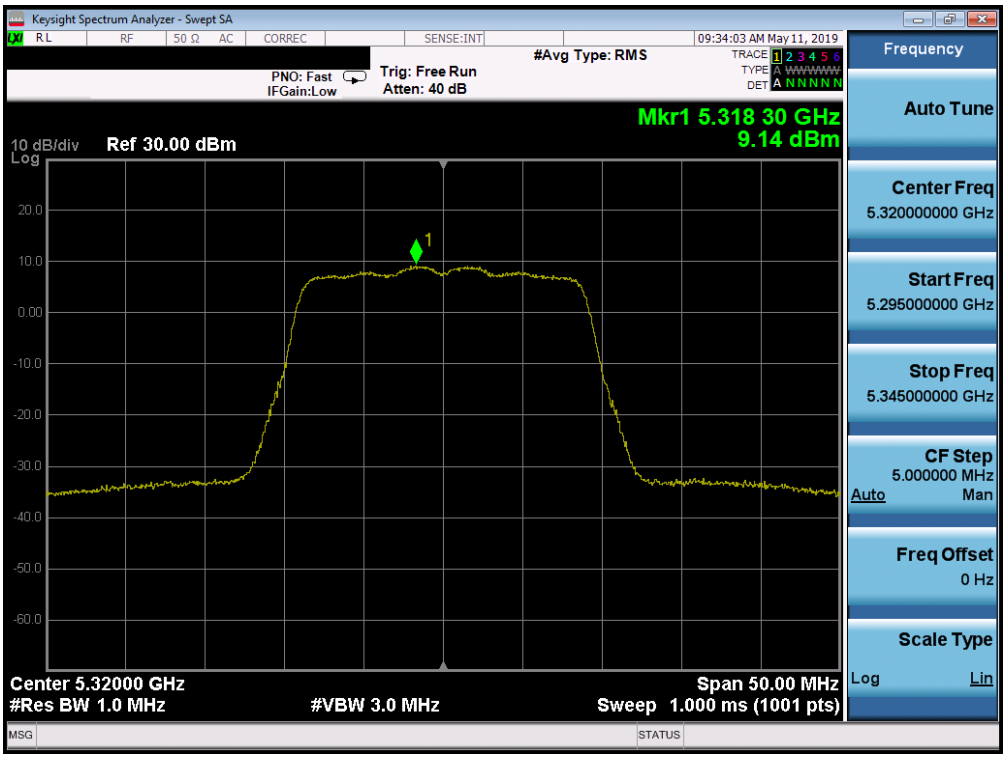


Plot 7-92. Power Spectral Density Plot SISO CORE 1 (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)



Plot 7-93. Power Spectral Density Plot SISO CORE 1 (20MHz BW 802.11n (UNII Band 2A) – Ch. 64)

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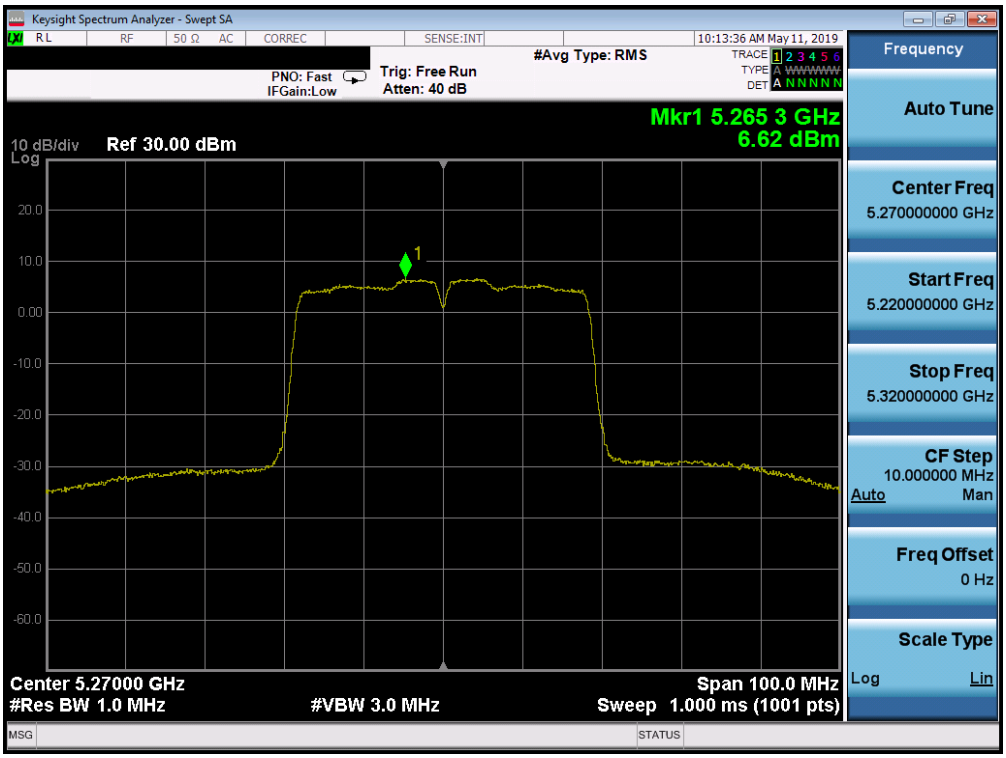
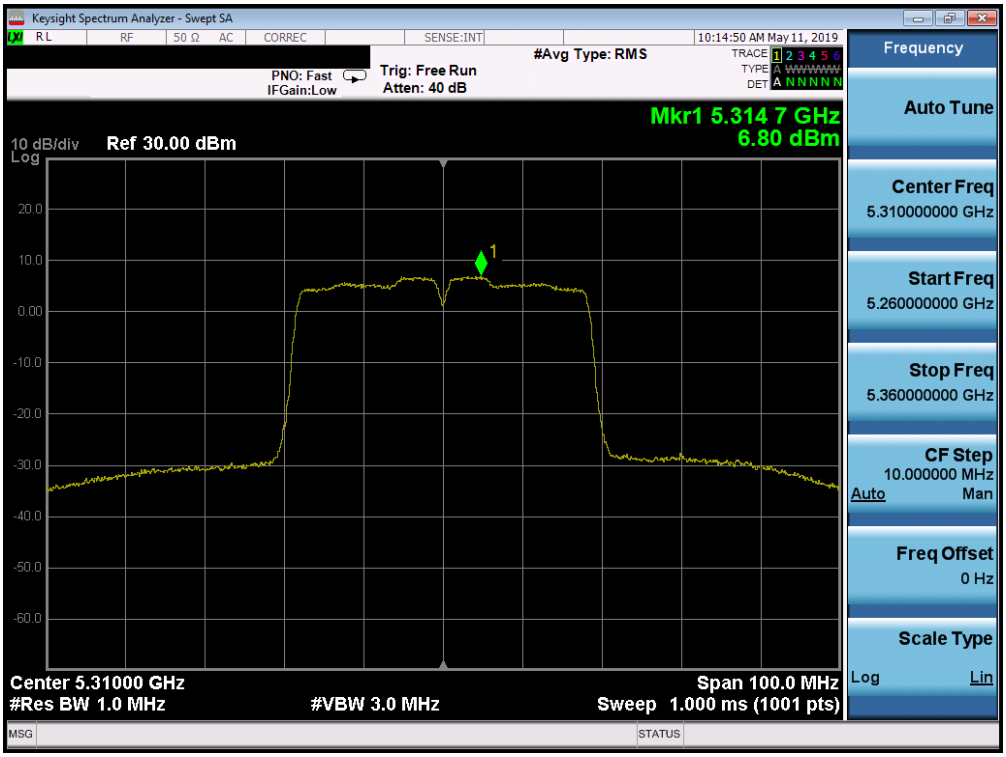


Plot 7-94. Power Spectral Density Plot SISO CORE 1 (40MHz BW 802.11n (UNII Band 2A) – Ch. 54)



Plot 7-95. Power Spectral Density Plot SISO CORE 1 (40MHz BW 802.11n (UNII Band 2A) – Ch. 62)

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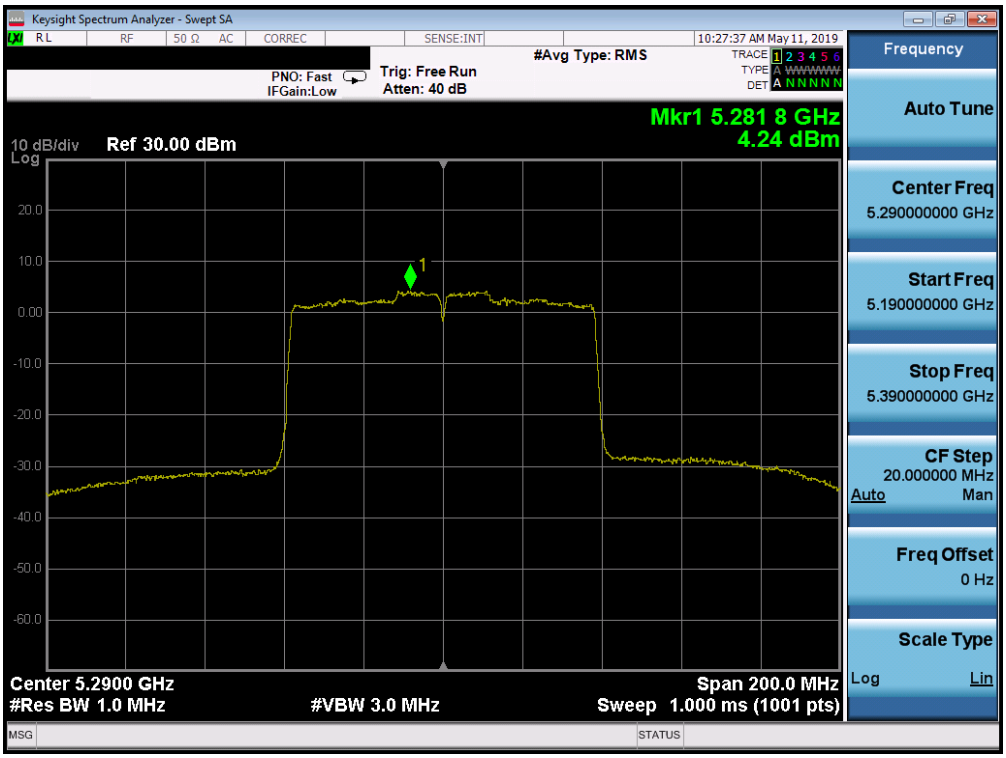
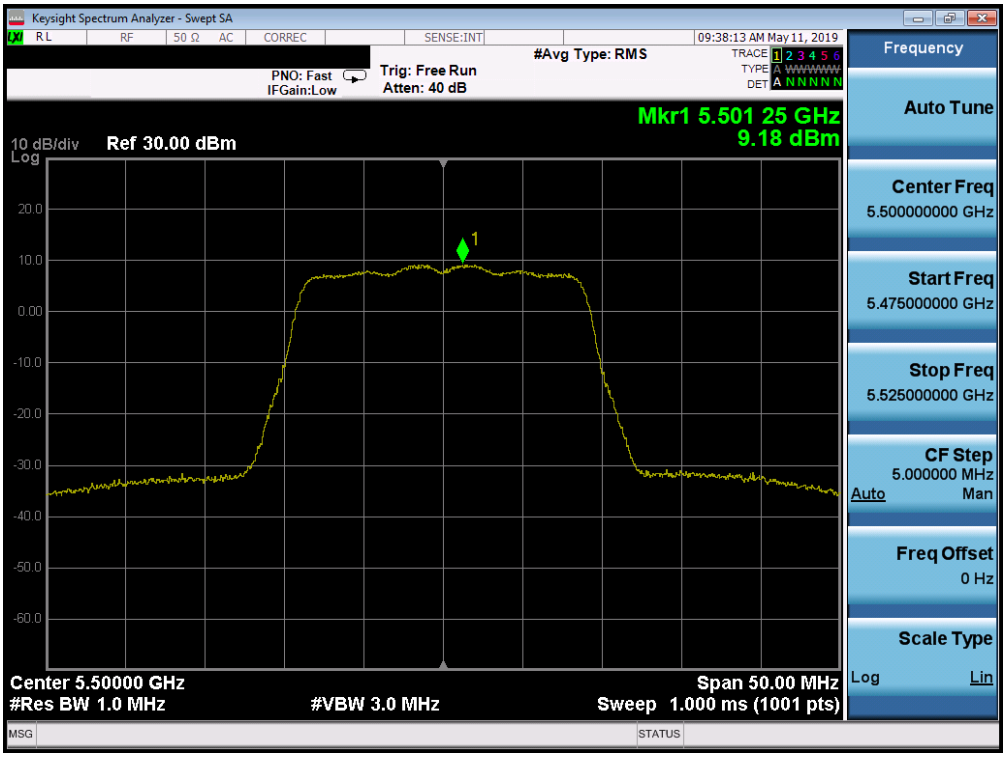


Plot 7-96. Power Spectral Density Plot SISO CORE 1 (80MHz BW 802.11ac (UNII Band 2A) – Ch. 58)



Plot 7-97. Power Spectral Density Plot SISO CORE 1 (20MHz BW 802.11n (UNII Band 2C) – Ch. 100)

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