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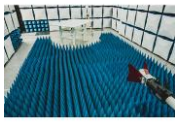

MEASUREMENT REPORT
FCC PART 15.247 / ISED RSS-247 WLAN 802.11b/g/n

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.:
1C1901280003-05.BCG

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

Application Type:	Certification
Model/HVIN:	A2200
EUT Type:	Tablet Device
Frequency Range:	2412 – 2472MHz
FCC Classification:	Digital Transmission System (DTS)
FCC Rule Part(s):	Part 15 Subpart C (15.247)
ISED Specification:	RSS-247 Issue 2
Test Procedure(s):	ANSI C63.10-2013, KDB 558074 D01 v05r02, 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 558074 D01 v05r02. 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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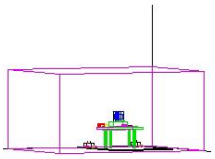
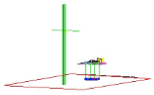


MEASUREMENT REPORT



Mode	Tx Frequency (MHz)	Core 0				Core 1			
		Avg Conducted		Peak Conducted		Avg Conducted		Peak Conducted	
		Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)
802.11b	2412 - 2472	39.811	16.00	90.991	19.59	39.811	16.00	90.573	19.57
802.11g	2412 - 2472	39.446	15.96	248.886	23.96	39.811	16.00	248.313	23.95
802.11n	2412 - 2472	39.811	16.00	255.859	24.08	39.811	16.00	260.615	24.16

EUT Overview SISO

Mode	Tx Frequency (MHz)	Core 0				Core 1				CDD			
		Avg Conducted		Peak Conducted		Avg Conducted		Peak Conducted		Avg Conducted		Peak Conducted	
		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)	Max. Power (mW)	Max. Power (dBm)
802.11g	2412 - 2472	39.719	15.99	243.781	23.87	39.811	16.00	241.546	23.83	79.616	19.01	485.289	26.86
802.11n	2412 - 2472	39.811	16.00	260.016	24.15	39.811	16.00	257.632	24.11	79.616	19.01	516.416	27.13

EUT Overview CDD

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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 WLAN (DTS) 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)

Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
1	2412	8	2447
2	2417	9	2452
3	2422	10	2457
4	2427	11	2462
5	2432	12	2467
6	2437	13	2472
7	2442		

Table 2-1. Frequency/ Channel Operations

Note: 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 6.0 b) of KDB 558074 D01 v05r02 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
2.4GHz	b	100	100	N/A
	g	98.6	98.4	98.4
	n	98.5	98.5	98.5

Table 2-2. Measured Duty Cycles

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The device employs CDD technology. Below are the possible configurations.

WiFi Configurations		SISO		SDM		CDD	
		CORE 0	CORE 1	CORE 0	CORE 1	CORE 0	CORE 1
2.4GHz	11b	✓	✓	×	×	×	×
	11g	✓	✓	✓	✓	✓	✓
	11n	✓	✓	✓	✓	✓	✓

Table 2-3. Frequency / Channel Operations

✓= Support ; × = NOT Support
SISO = Single Input Single Output
SDM = Spatial Diversity Multiplexing – CDD function
CDD = Cyclic Delay Diversity - 2Tx Function

Data Rates Supported: 1Mbps, 2Mbps, 5.5Mbps, 11Mbps (b)
6Mbps, 9Mbps, 12Mbps, 18Mbps, 24Mbps, 36Mbps, 48Mbps, 54Mbps (g)
6.5/7.2Mbps, 13/14.4Mbps, 19.5/21.7Mbps, 26/28.9Mbps, 39/43.3Mbps, 52/57.8Mbps, 58.5/65Mbps, 65/72.2Mbps (n)
13/14.4Mbps, 26/28.9Mbps, 39/43.3Mbps, 52/57.8Mbps, 78/86.7Mbps, 104/115.6Mbps, 117/130Mbps, 130/144.4Mbps (CDD n)

2.3 Antenna Description

Following antenna were used for the testing.

Frequency [GHz]	Antenna Gain (dBi)	
	Core 0	Core 1
2.4	1.91	0.56

Table 2-4. 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 2-5. Test Support Equipment Used

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2.5 Test Configuration

The EUT was tested per the guidance of ANSI C63.10-2013 and KDB 558074 D01 v05r02. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing. See Sections 3.2 for AC line conducted emissions test setups, 3.3 for radiated emissions test setups, and 7.2, 7.3, 7.4, 7.5 and 7.6 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

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

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 558074 D01 v05r02 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 7.9. 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.

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 connections to an external antenna.

Conclusion:

The EUT unit 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: Digital Transmission System (DTS)

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(2)	RSS-247 [5.2]	6dB Bandwidth	> 500kHz	CONDUCTED	PASS	Section 7.2
15.247(b)(3)	RSS-247 [5.4]	Transmitter Output Power	< 1 Watt		PASS	Sections 7.3
15.247(e)	RSS-247 [5.2]	Transmitter Power Spectral Density	< 8dBm / 3kHz Band		PASS	Section 7.4
15.247(d)	RSS-247 [5.5]	Band Edge / Out-of-Band Emissions	≥ 20dBc		PASS	Sections 7.5, 7.6
15.205 15.209	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])	RADIATED	PASS	Sections 7.7, 7.8
15.207	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits (RSS-Gen[8.8])	LINE CONDUCTED	PASS	Section 7.9

Table 7-1. Summary of Test Results

Notes:

1) All modes of operation and data rates were investigated. 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 "WLAN Automation," Version 3.5.
5) For radiated band edge, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST "Chamber Automation," Version 1.3.0.

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7.2 6dB Bandwidth Measurement

§15.247(a.2); RSS-247 [5.2]

Test Overview and Limit

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the transmitter antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated and the worst case configuration results are reported in this section.

The minimum permissible 6dB bandwidth is 500 kHz.

Test Procedure Used

ANSI C63.10-2013 – Section 11.8.2 Option 2
KDB 558074 D01 v05r02 – Section 8.2

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 100kHz
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize

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 6 dB Bandwidth Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]
2412	1	b	1	8.576	0.500
2437	6	b	1	8.628	0.500
2462	11	b	1	8.590	0.500
2412	1	g	6	15.75	0.500
2437	6	g	6	16.10	0.500
2462	11	g	6	16.06	0.500
2412	1	n	6.5/7.2 (MCS0)	16.40	0.500
2437	6	n	6.5/7.2 (MCS0)	17.37	0.500
2462	11	n	6.5/7.2 (MCS0)	17.00	0.500

Table 7-2. Conducted Bandwidth Measurements SISO CORE 0

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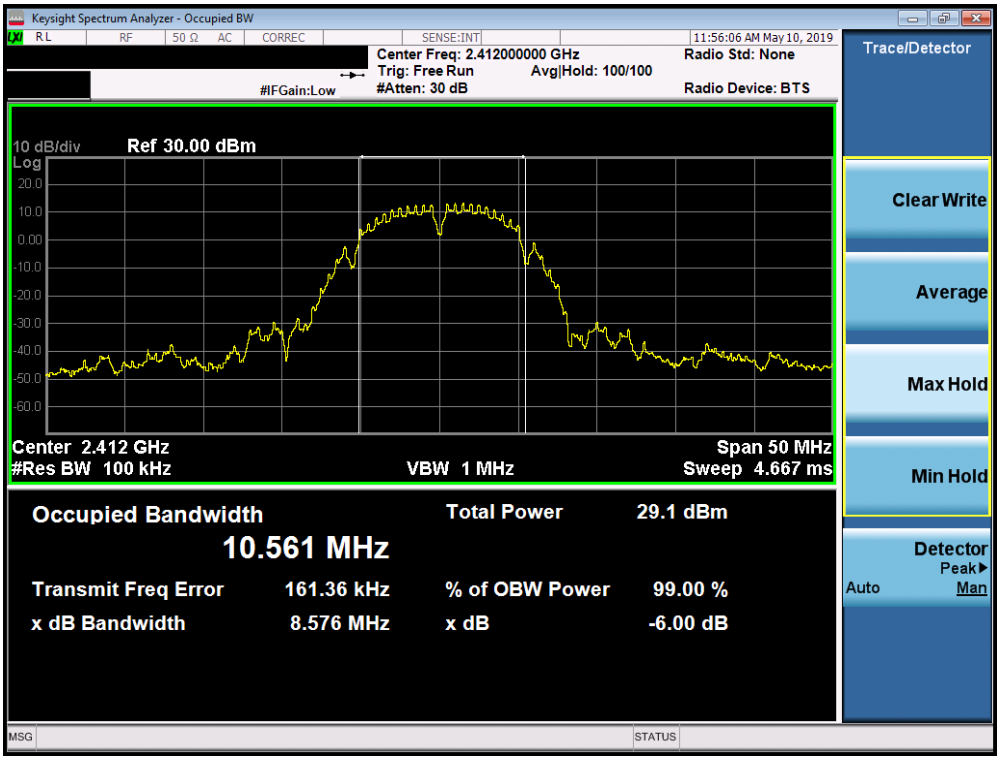
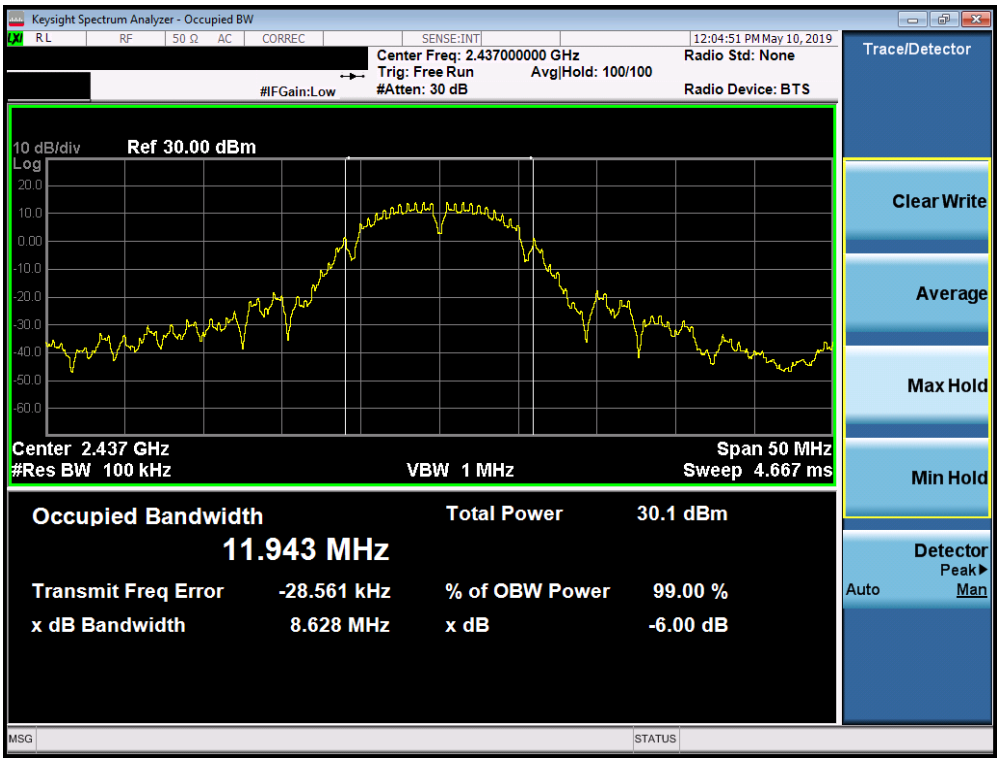


Plot 7-1. 6dB Bandwidth Plot SISO CORE 0 (802.11b – Ch. 1)



Plot 7-2. 6dB Bandwidth Plot SISO CORE 0 (802.11b – Ch. 6)

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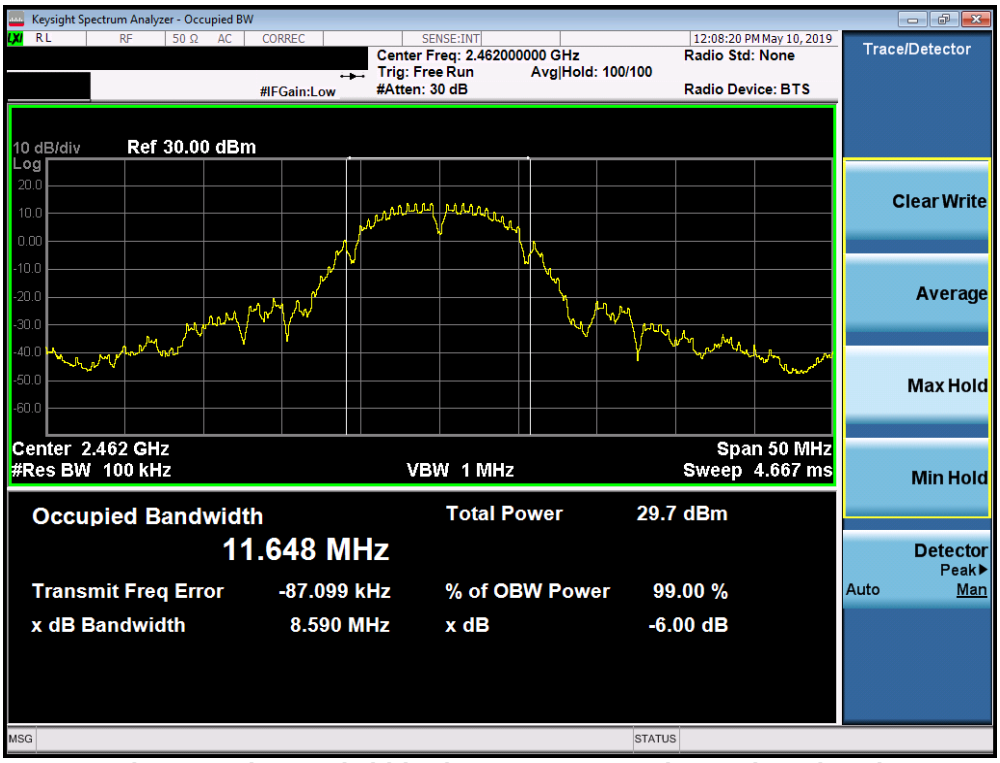
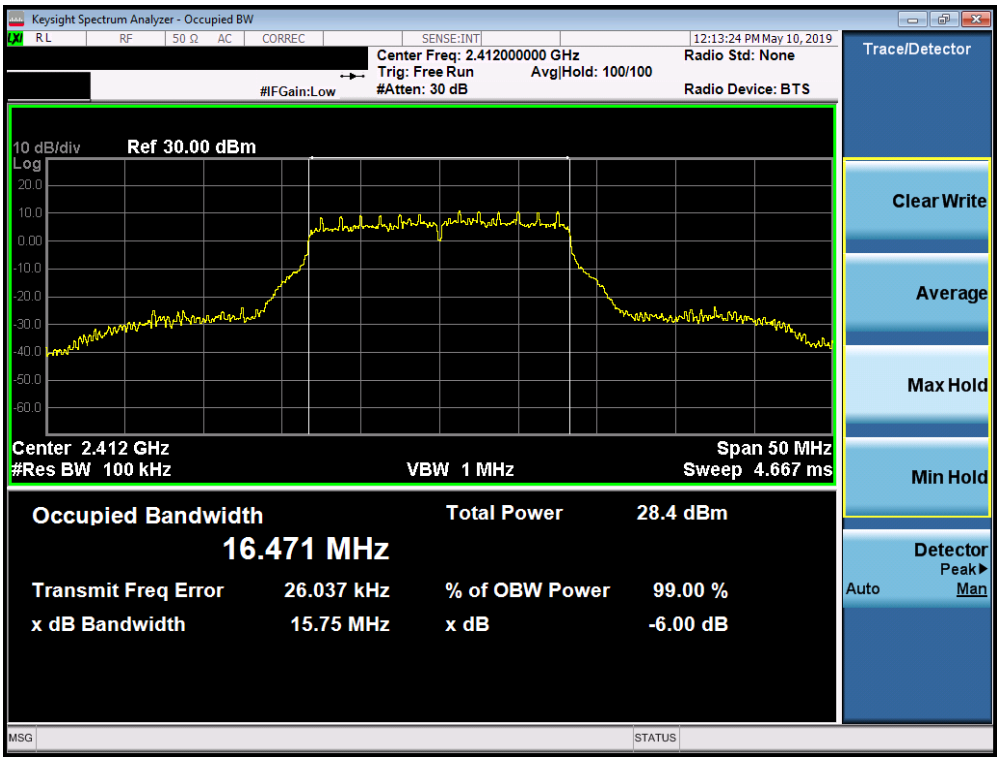


Plot 7-3. 6dB Bandwidth Plot SISO CORE 0 (802.11b – Ch. 11)



Plot 7-4. 6dB Bandwidth Plot SISO CORE 0 (802.11g – Ch. 1)

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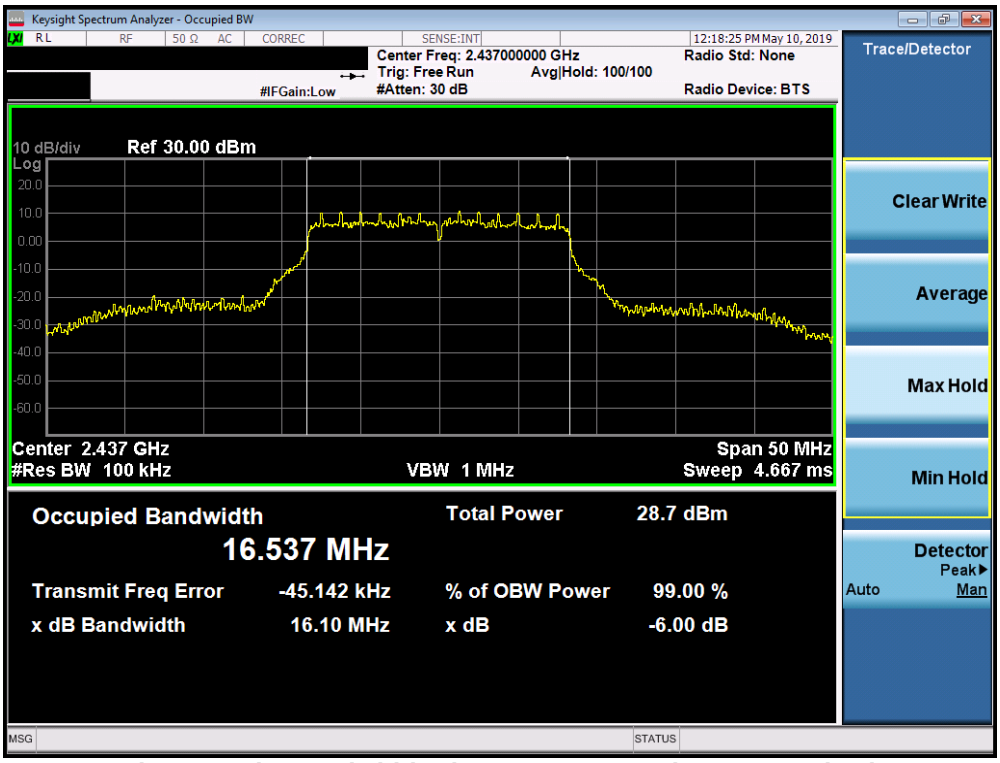
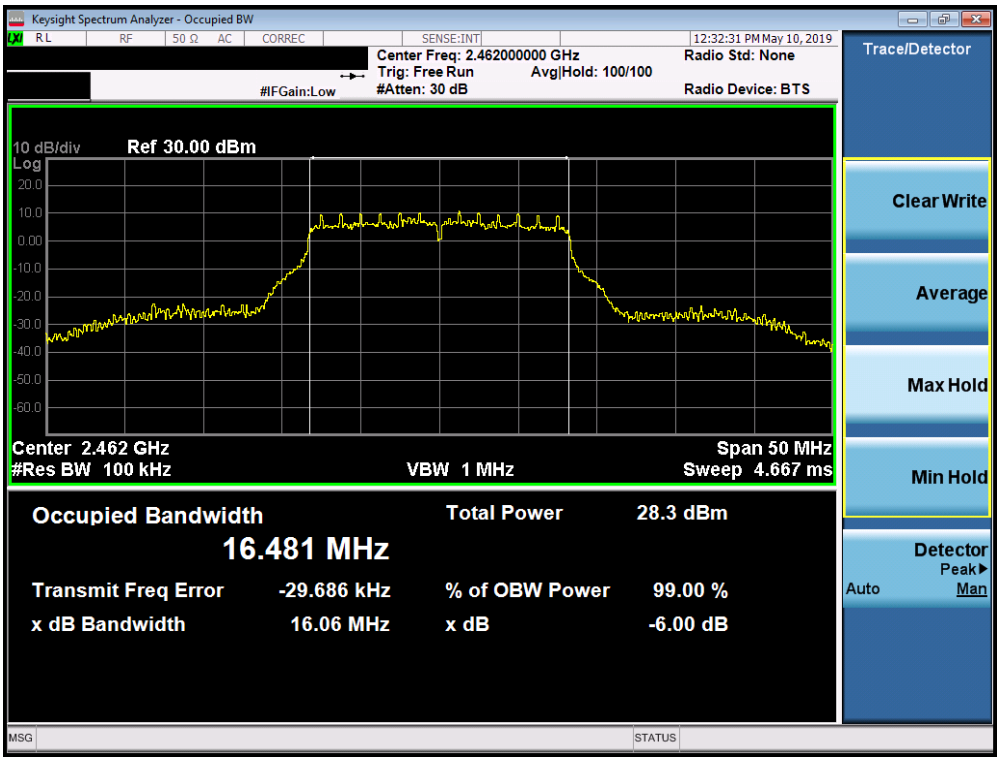


Plot 7-5. 6dB Bandwidth Plot SISO CORE 0 (802.11g – Ch. 6)



Plot 7-6. 6dB Bandwidth Plot SISO CORE 0 (802.11g – Ch. 11)

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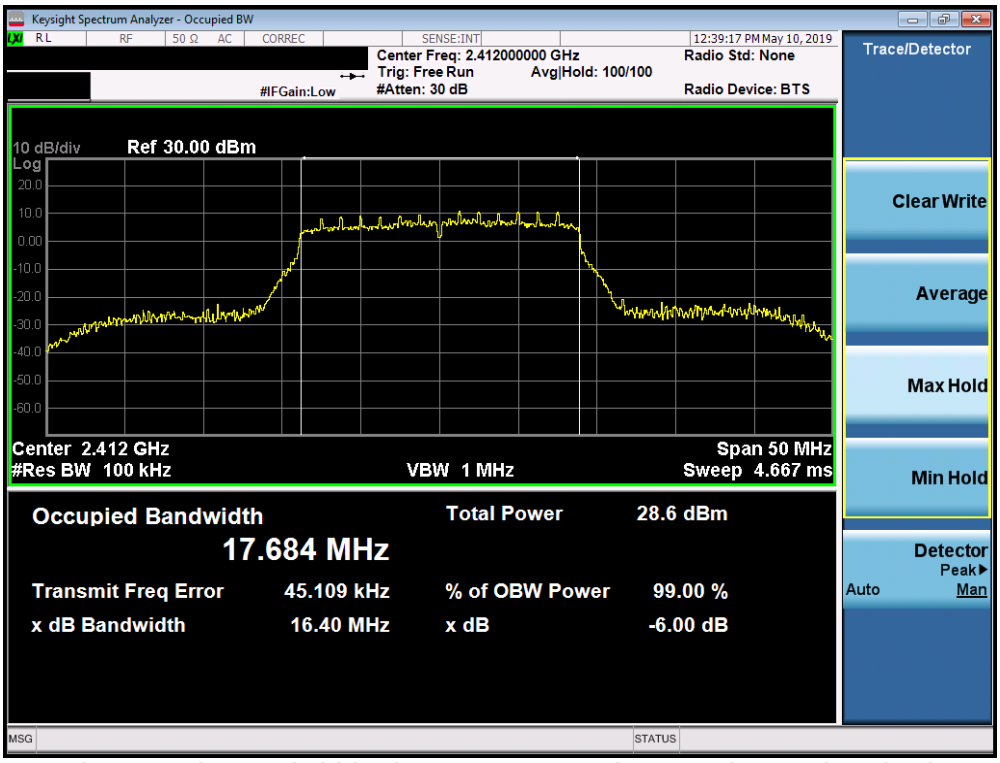
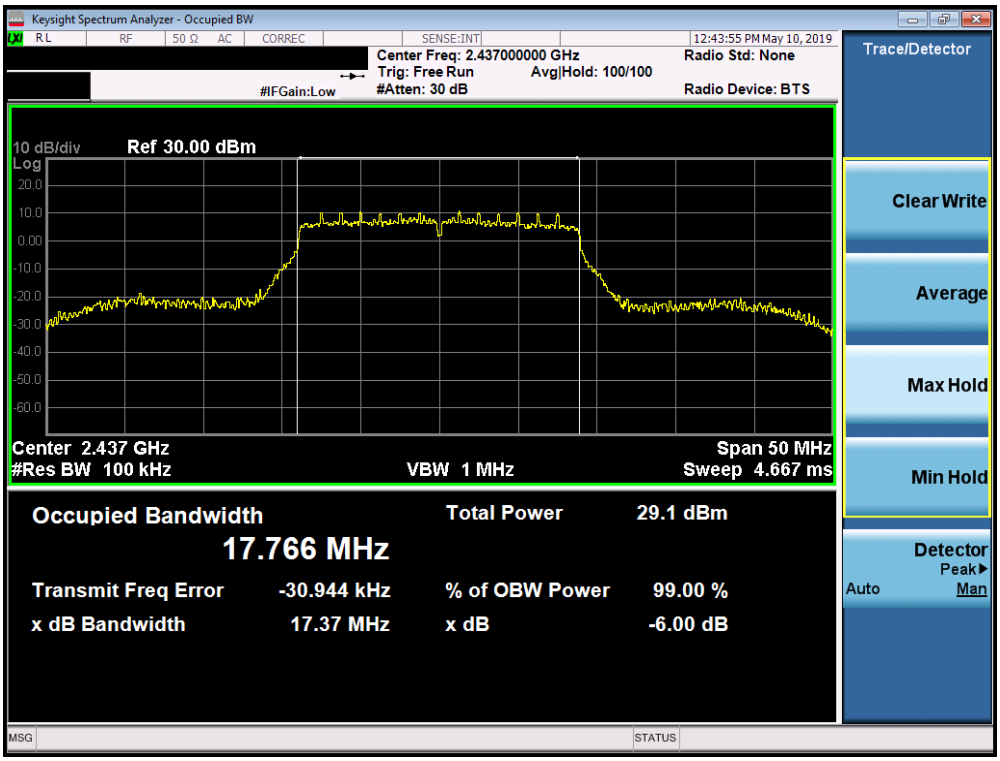


Plot 7-7. 6dB Bandwidth Plot SISO CORE 0 (802.11n (2.4GHz) – Ch. 1)



Plot 7-8. 6dB Bandwidth Plot SISO CORE 0 (802.11n (2.4GHz) – Ch. 6)

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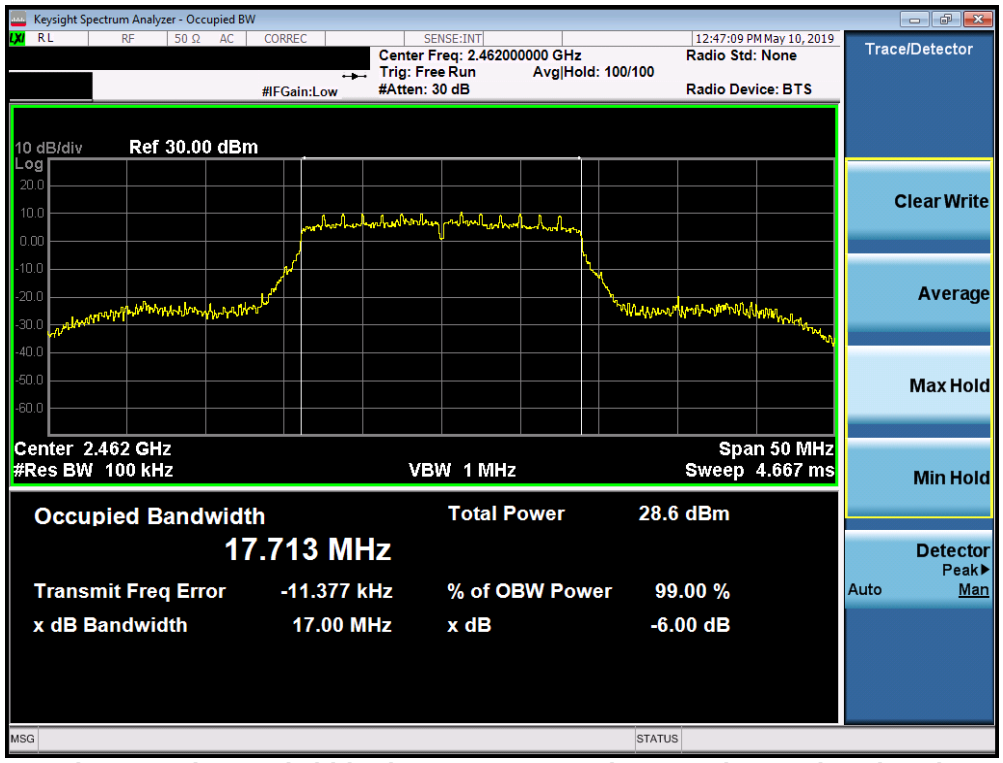

Plot 7-9. 6dB Bandwidth Plot SISO CORE 0 (802.11n (2.4GHz) – Ch. 11)

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SISO Core-1 6 dB Bandwidth Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]
2412	1	b	1	8.597	0.500
2437	6	b	1	8.593	0.500
2462	11	b	1	8.152	0.500
2412	1	g	6	16.05	0.500
2437	6	g	6	15.94	0.500
2462	11	g	6	15.80	0.500
2412	1	n	6.5/7.2 (MCS0)	17.23	0.500
2437	6	n	6.5/7.2 (MCS0)	16.72	0.500
2462	11	n	6.5/7.2 (MCS0)	16.97	0.500

Table 7-3. Conducted Bandwidth Measurements SISO CORE 1

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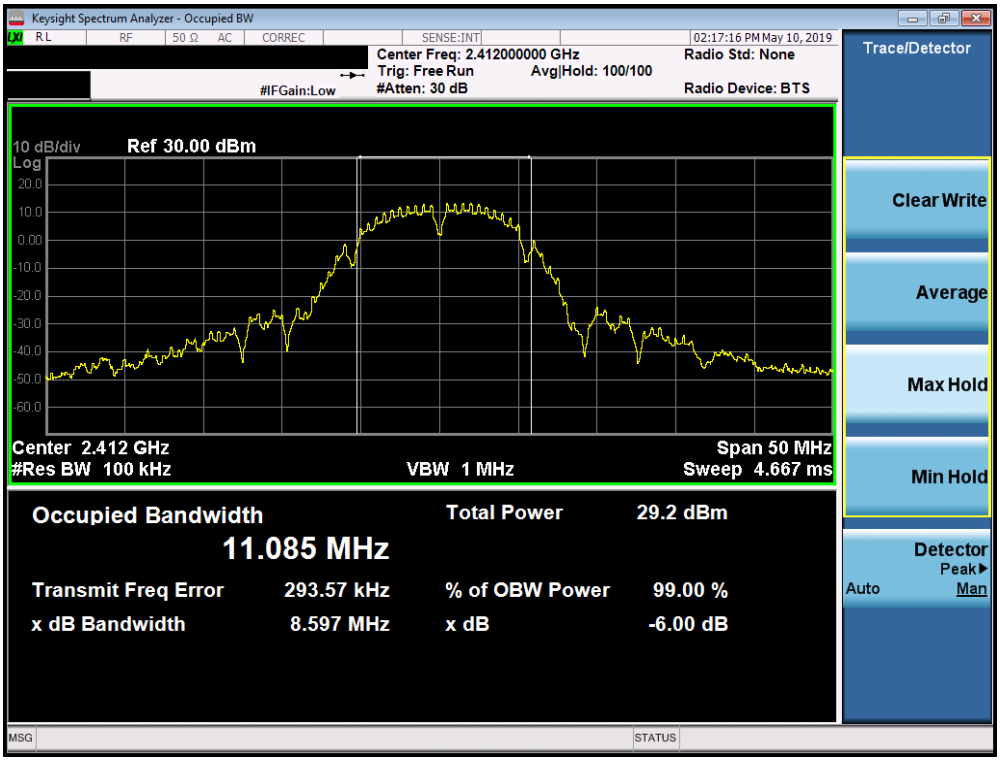
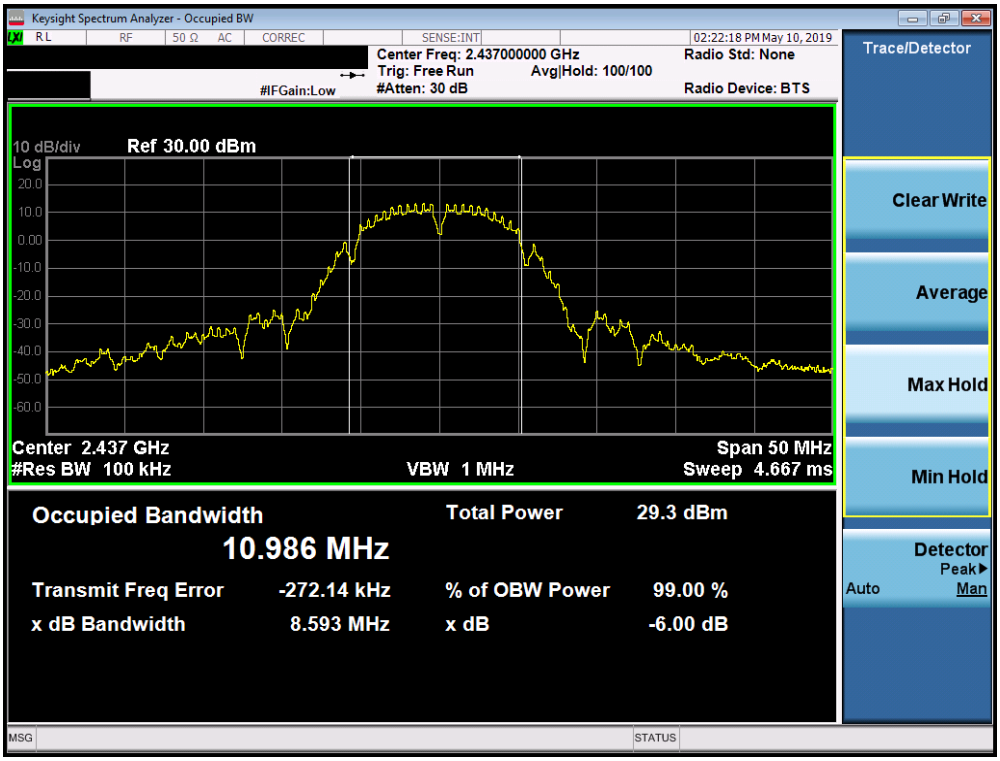


Plot 7-10. 6dB Bandwidth Plot SISO CORE 1 (802.11b – Ch. 1)



Plot 7-11. 6dB Bandwidth Plot SISO CORE 1 (802.11b – Ch. 6)

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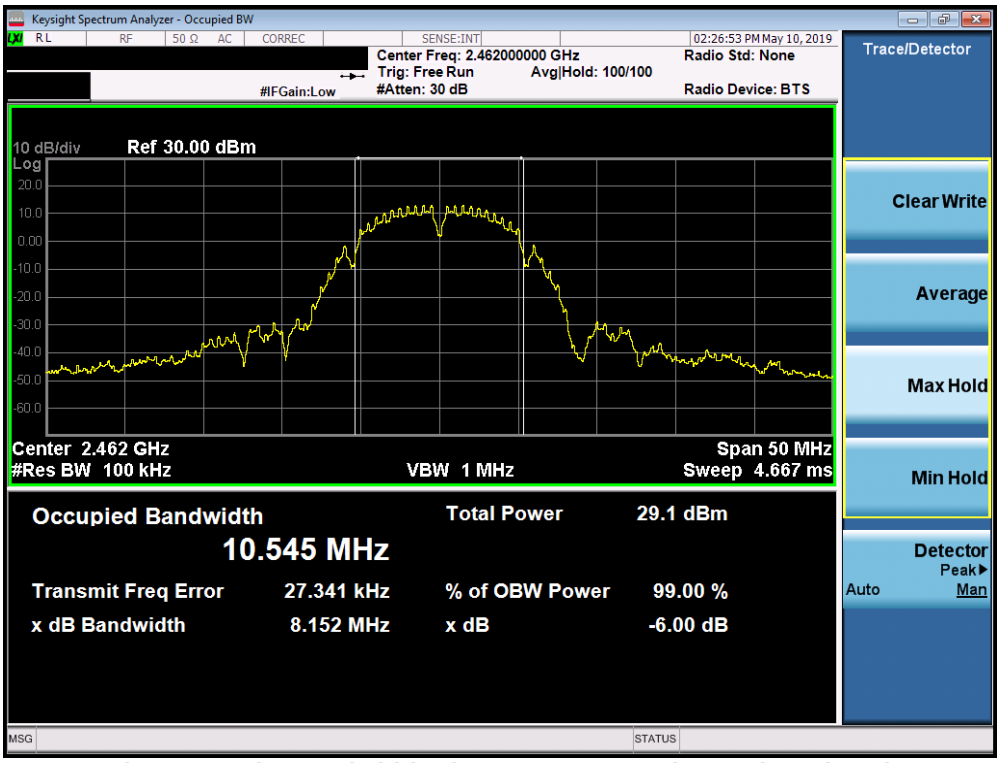
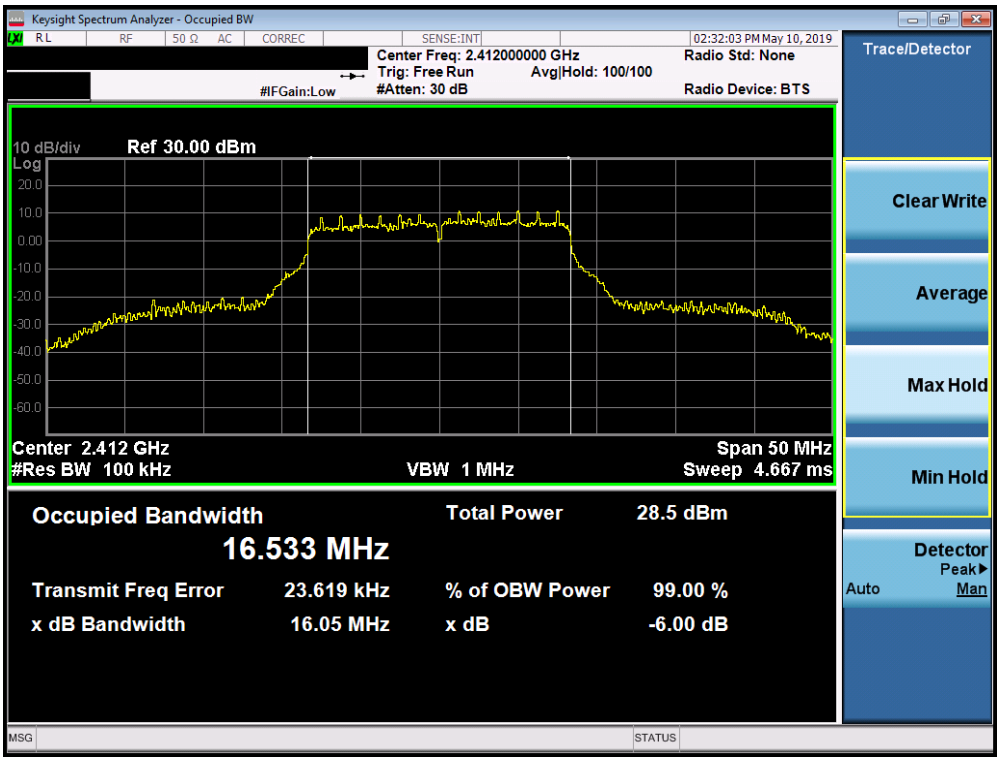


Plot 7-12. 6dB Bandwidth Plot SISO CORE 1 (802.11b – Ch. 11)



Plot 7-13. 6dB Bandwidth Plot SISO CORE 1 (802.11g – Ch. 1)

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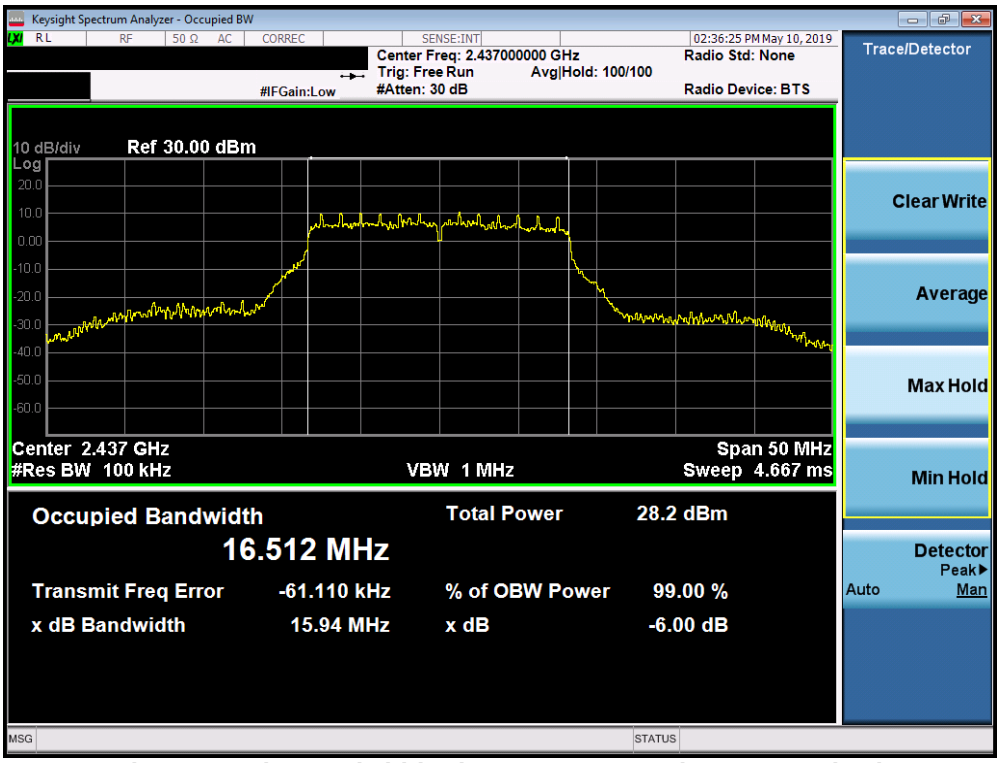
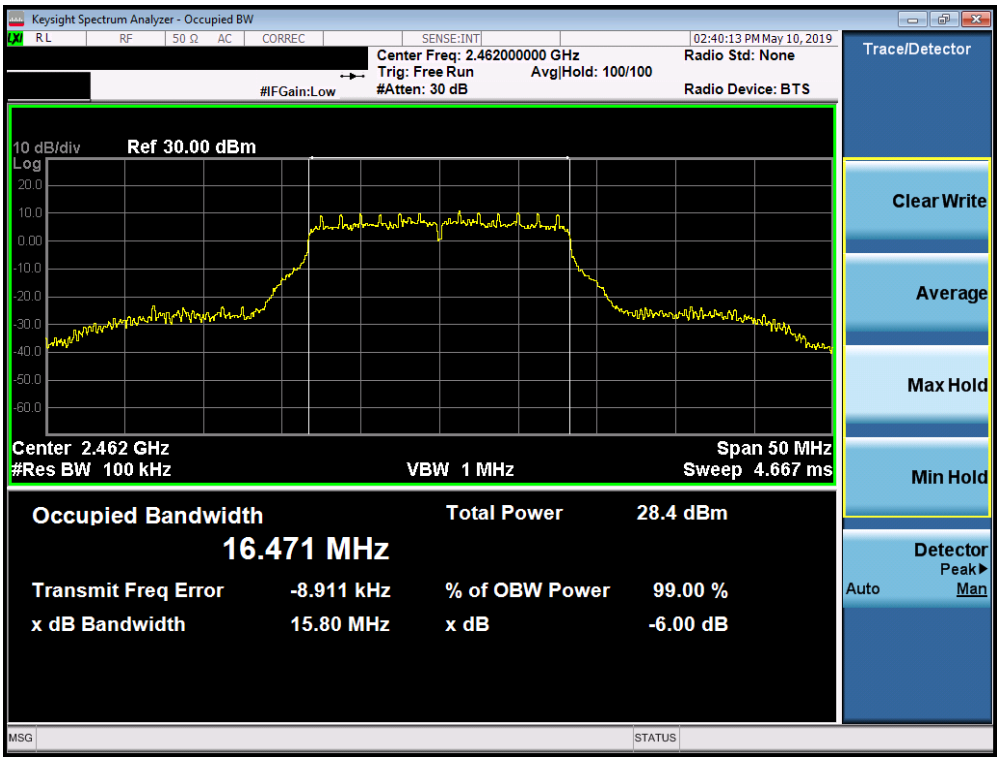


Plot 7-14. 6dB Bandwidth Plot SISO CORE 1 (802.11g – Ch. 6)



Plot 7-15. 6dB Bandwidth Plot SISO CORE 1 (802.11g – Ch. 11)

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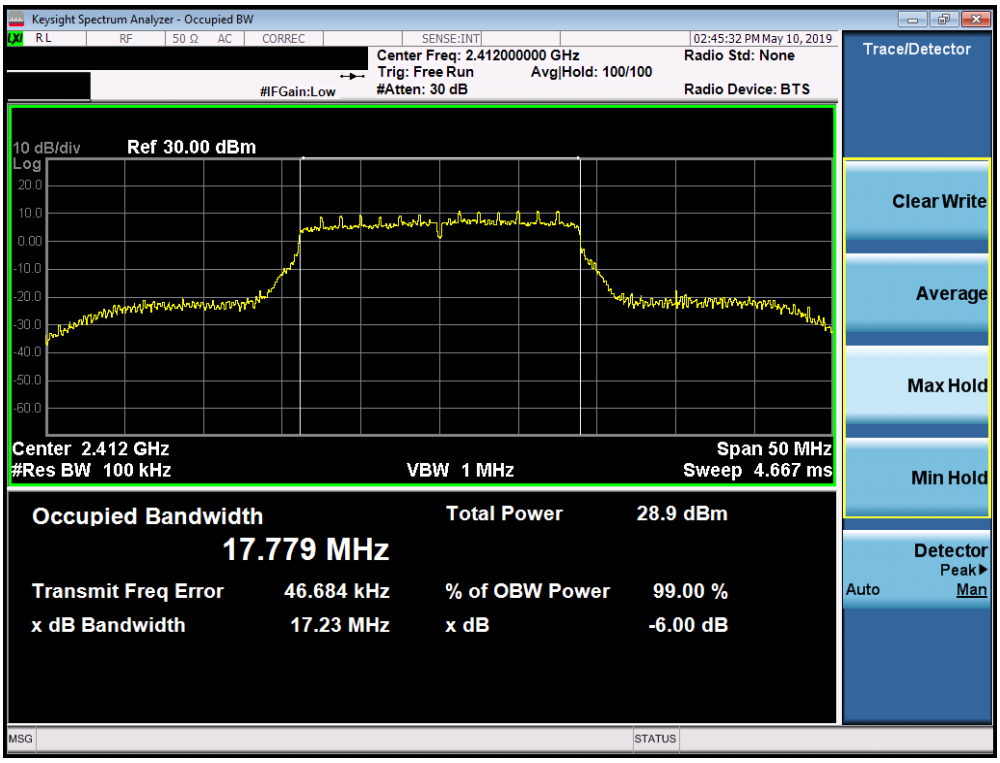
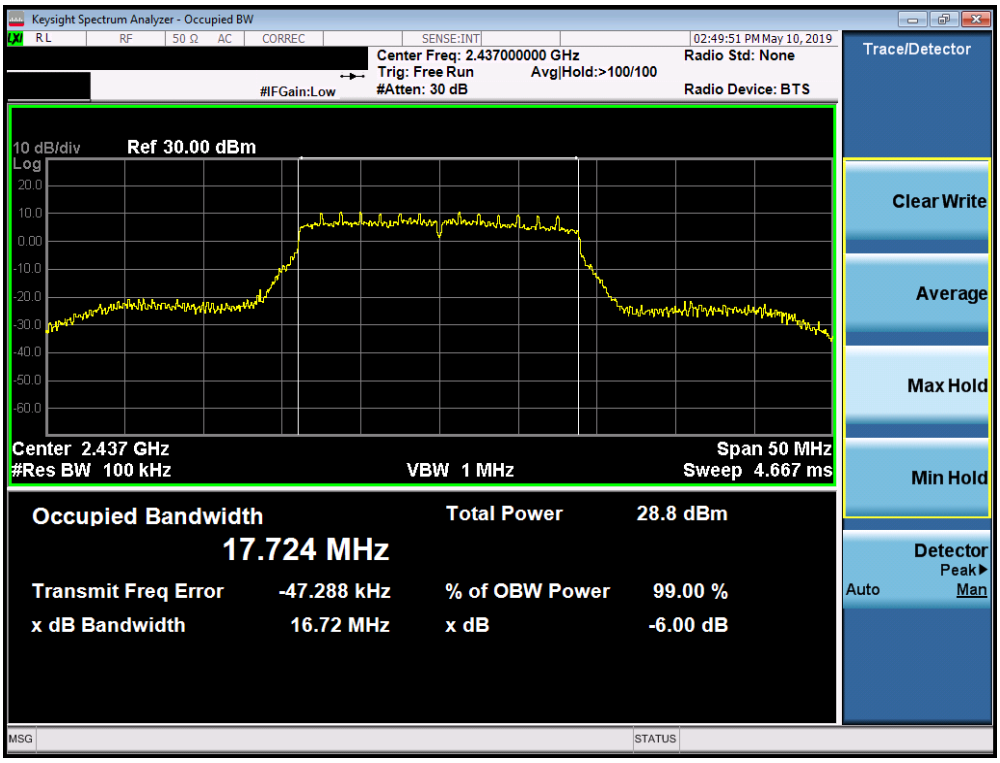


Plot 7-16. 6dB Bandwidth Plot SISO CORE 1 (802.11n (2.4GHz) – Ch. 1)



Plot 7-17. 6dB Bandwidth Plot SISO CORE 1 (802.11n (2.4GHz) – Ch. 6)

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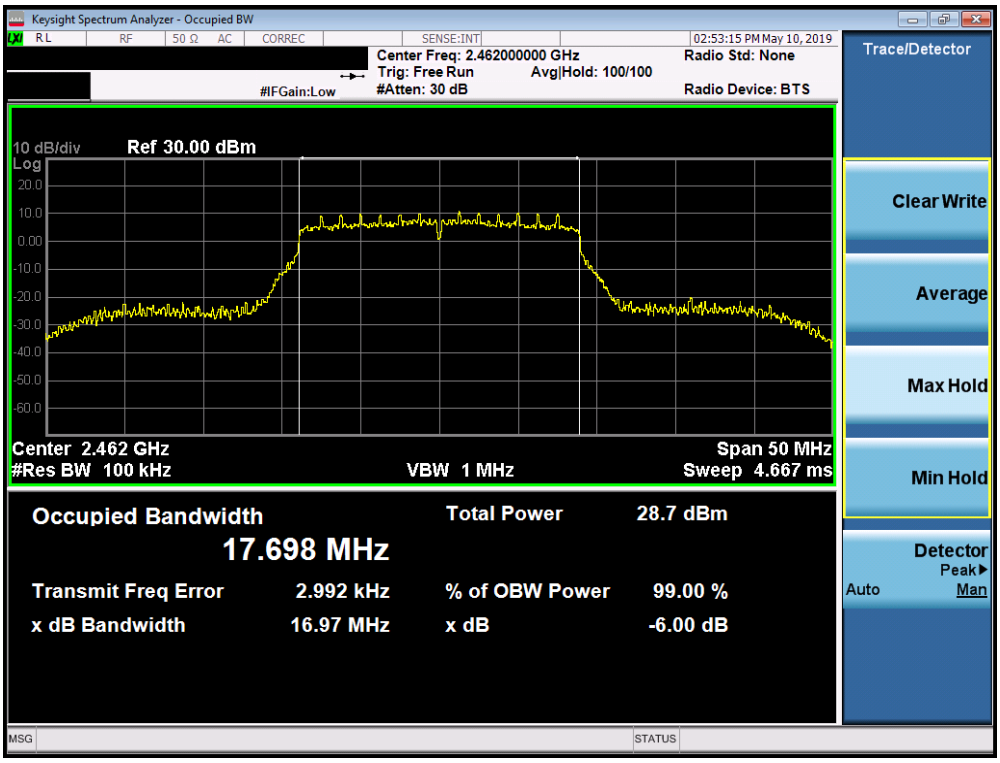

Plot 7-18. 6dB Bandwidth Plot SISO CORE 1 (802.11n (2.4GHz) – Ch. 11)

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7.3 Output Power Measurement

§15.247(b.3); RSS-247 [5.4]

Test Overview and Limits

A transmitter antenna terminal of EUT is connected to the input of an RF power sensor. Measurement is made using a broadband power meter capable of making peak and average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

The maximum permissible conducted output power is 1 Watt.

Test Procedure Used

ANSI C63.10-2013 – Section 11.9.1.3 PKPM1 Peak Power Method
KDB 558074 D01 v05r02 – Section 8.3.1.3 PKPM1 Peak-reading Power Meter Method
ANSI C63.10-2013 – Section 11.9.2.3.2 Method AVGPM-G
KDB 558074 D01 v05r02 – Section 8.3.2.3 Measurement using a Power Meter (PM)
ANSI C63.10-2013 – Section 14.2 Measure-and-Sum Technique
KDB 662911 D01 v02r01 – Section E)1) Measure-and-Sum Technique

Test Settings

Method PKPM1 (Peak Power Measurement)

Peak 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 pulse sensor employs a VBW = 50MHz so this method was only used for signals whose DTS bandwidth was less than or equal to 50MHz.

Method AVGPM-G (Average Power Measurement)

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 diagrams below.

Figure 7-2. Test Instrument & Measurement Setup for Power Meter Measurements

Test Notes

None

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7.3.1 Average Output Power Measurement

§15.247(b.3); RSS-247 [5.4]

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]
			802.11b	802.11g	802.11n						
2412	1	AVG	15.96	15.00	14.98	30.00	-14.04	1.91	17.87	36.02	-18.15
2417	2	AVG	15.99	15.87	15.90	30.00	-14.01	1.91	17.90	36.02	-18.12
2437	6	AVG	16.00	15.94	16.00	30.00	-14.00	1.91	17.91	36.02	-18.11
2457	10	AVG	16.00	15.96	16.00	30.00	-14.00	1.91	17.91	36.02	-18.11
2462	11	AVG	15.98	14.00	14.00	30.00	-14.02	1.91	17.89	36.02	-18.13
2467	12	AVG	16.00	11.94	11.97	30.00	-14.00	1.91	17.91	36.02	-18.11
2472	13	AVG	14.39	1.97	2.00	30.00	-15.61	1.91	16.30	36.02	-19.72

Table 7-4. Average Conducted Output Power Measurements SISO CORE 0

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]
			802.11b	802.11g	802.11n						
2412	1	AVG	15.98	15.00	14.94	30.00	-14.02	0.56	16.54	36.02	-19.48
2417	2	AVG	16.00	16.00	16.00	30.00	-14.00	0.56	16.56	36.02	-19.46
2437	6	AVG	16.00	16.00	16.00	30.00	-14.00	0.56	16.56	36.02	-19.46
2457	10	AVG	16.00	15.95	15.98	30.00	-14.00	0.56	16.56	36.02	-19.46
2462	11	AVG	15.94	13.94	13.96	30.00	-14.06	0.56	16.50	36.02	-19.52
2467	12	AVG	15.98	12.00	11.99	30.00	-14.02	0.56	16.54	36.02	-19.48
2472	13	AVG	14.37	1.93	2.00	30.00	-15.63	0.56	14.93	36.02	-21.09

Table 7-5. Average Conducted Output Power Measurements SISO CORE 1

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						
2412	1	AVG	13.41	13.50	16.47	30.00	-13.53	4.27	20.74	36.02	-15.28
2417	2	AVG	15.85	16.00	18.94	30.00	-11.06	4.27	23.21	36.02	-12.81
2437	6	AVG	15.99	16.00	19.01	30.00	-10.99	4.27	23.28	36.02	-12.74
2457	10	AVG	15.89	15.94	18.93	30.00	-11.07	4.27	23.20	36.02	-12.82
2462	11	AVG	12.98	12.99	16.00	30.00	-14.00	4.27	20.27	36.02	-15.75
2467	12	AVG	10.49	10.44	13.48	30.00	-16.52	4.27	17.75	36.02	-18.27
2472	13	AVG	0.49	0.50	3.51	30.00	-26.49	4.27	7.78	36.02	-28.24

Table 7-6. Average Conducted Output Power Measurements CDD (802.11g)

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						
2412	1	AVG	13.50	13.50	16.51	30.00	-13.49	4.27	20.78	36.02	-15.24
2417	2	AVG	15.80	16.00	18.91	30.00	-11.09	4.27	23.18	36.02	-12.84
2437	6	AVG	16.00	16.00	19.01	30.00	-10.99	4.27	23.28	36.02	-12.74
2457	10	AVG	15.82	16.00	18.92	30.00	-11.08	4.27	23.19	36.02	-12.83
2462	11	AVG	12.99	12.97	15.99	30.00	-14.01	4.27	20.26	36.02	-15.76
2467	12	AVG	10.50	10.50	13.51	30.00	-16.49	4.27	17.78	36.02	-18.24
2472	13	AVG	0.50	0.50	3.51	30.00	-26.49	4.27	7.78	36.02	-28.24

Table 7-7. Average Conducted Output Power Measurements CDD (802.11n)

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7.3.2 Peak Output Power Measurement

§15.247(b.3); RSS-247 [5.4]

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]
			802.11b	802.11g	802.11n						
2412	1	PEAK	19.54	22.90	23.32	30.00	-6.68	1.91	25.23	36.02	-10.79
2417	2	PEAK	19.51	23.45	23.82	30.00	-6.18	1.91	25.73	36.02	-10.29
2437	6	PEAK	19.44	23.72	24.08	30.00	-5.92	1.91	25.99	36.02	-10.03
2457	10	PEAK	19.46	23.96	24.04	30.00	-5.96	1.91	25.95	36.02	-10.07
2462	11	PEAK	19.59	22.35	22.81	30.00	-7.19	1.91	24.72	36.02	-11.30
2467	12	PEAK	19.48	20.14	20.68	30.00	-9.32	1.91	22.59	36.02	-13.43
2472	13	PEAK	17.71	10.43	10.39	30.00	-12.29	1.91	19.62	36.02	-16.40

Table 7-8. Peak Conducted Output Power Measurements SISO CORE 0

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]
			802.11b	802.11g	802.11n						
2412	1	PEAK	19.47	22.93	23.26	30.00	-6.74	0.56	23.82	36.02	-12.20
2417	2	PEAK	19.36	23.92	24.09	30.00	-5.91	0.56	24.65	36.02	-11.37
2437	6	PEAK	19.39	23.95	24.00	30.00	-6.00	0.56	24.56	36.02	-11.46
2457	10	PEAK	19.57	23.65	24.16	30.00	-5.84	0.56	24.72	36.02	-11.30
2462	11	PEAK	19.30	22.29	22.64	30.00	-7.36	0.56	23.20	36.02	-12.82
2467	12	PEAK	19.35	20.11	20.83	30.00	-9.17	0.56	21.39	36.02	-14.63
2472	13	PEAK	17.70	10.14	10.50	30.00	-12.30	0.56	18.26	36.02	-17.76

Table 7-9. Peak Conducted Output Power Measurements SISO CORE 1

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						
2412	1	PEAK	21.25	21.43	24.35	30.00	-5.65	4.27	28.62	36.02	-7.40
2417	2	PEAK	23.55	23.72	26.65	30.00	-3.35	4.27	30.92	36.02	-5.10
2437	6	PEAK	23.87	23.83	26.86	30.00	-3.14	4.27	31.13	36.02	-4.89
2457	10	PEAK	23.67	23.73	26.71	30.00	-3.29	4.27	30.98	36.02	-5.04
2462	11	PEAK	21.21	21.17	24.20	30.00	-5.80	4.27	28.47	36.02	-7.55
2467	12	PEAK	18.64	18.59	21.63	30.00	-8.37	4.27	25.90	36.02	-10.12
2472	13	PEAK	8.61	8.71	11.67	30.00	-18.33	4.27	15.94	36.02	-20.08

Table 7-10. Peak Conducted Output Power Measurements CDD (802.11g)

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						
2412	1	PEAK	22.15	22.26	25.22	30.00	-4.78	4.27	29.49	36.02	-6.53
2417	2	PEAK	23.85	24.11	26.99	30.00	-3.01	4.27	31.26	36.02	-4.76
2437	6	PEAK	24.15	24.09	27.13	30.00	-2.87	4.27	31.40	36.02	-4.62
2457	10	PEAK	23.99	24.06	27.04	30.00	-2.96	4.27	31.31	36.02	-4.71
2462	11	PEAK	21.65	21.75	24.71	30.00	-5.29	4.27	28.98	36.02	-7.04
2467	12	PEAK	19.19	19.44	22.33	30.00	-7.67	4.27	26.60	36.02	-9.42
2472	13	PEAK	9.11	9.19	12.16	30.00	-17.84	4.27	16.43	36.02	-19.59

Table 7-11. Peak Conducted Output Power Measurements CDD (802.11n)

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Note:

Per ANSI C63.10-2013 and KDB 662911 D01 v02r01 Section E)1), the conducted powers at Core 0 and Core 1 were first measured separately during CDD transmission as shown in the section above. The measured values were then summed in linear power units then converted back to dBm.

Sample CDD Calculation:

At 2412MHz the average conducted output power was measured to be 16.00 dBm for Core-0 and 16.00 dBm for Core-1.

Core 0 + Core 1 = CDD

(16.00 dBm + 16.00 dBm) = (39.81 mW + 39.81 mW) = 79.62 mW = 19.01 dBm

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7.4 Power Spectral Density

§15.247(e); RSS-247 [5.2]

Test Overview and Limit

The peak power density is measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated and the worst case configuration results are reported in this section.

The maximum permissible power spectral density is 8 dBm in any 3 kHz band.

Test Procedure Used

ANSI C63.10-2013 – Section 11.10.2 Method PKPSD
KDB 558074 D01 v05r02 – Section 8.4 DTS Maximum Power Spectral Density level in the fundamental emission
ANSI C63.10-2013 – Section 14.3.2.2 Measure-and-Sum Technique
KDB 662911 D01 v02r01 – Section E)2) Measure-and-Sum Technique

Test Settings

1. Analyzer was set to the center frequency of the DTS channel under investigation
2. Span = 1.5 times the DTS channel bandwidth
3. RBW = 3kHz
4. VBW = 1MHz
5. Detector = peak
6. Sweep time = auto couple
7. Trace mode = max hold
8. Trace was allowed to stabilize

Test Setup

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

Figure 7-3. Test Instrument & Measurement Setup

Test Notes

None

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SISO Core-0 Power Spectral Density Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Power Spectral Density [dBm / 3kHz]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]	Pass / Fail
2412	1	b	1	0.06	8.00	-7.94	Pass
2437	6	b	1	1.57	8.00	-6.43	Pass
2462	11	b	1	1.52	8.00	-6.48	Pass
2412	1	g	6	-3.74	8.00	-11.74	Pass
2437	6	g	6	-3.58	8.00	-11.58	Pass
2462	11	g	6	-4.18	8.00	-12.18	Pass
2412	1	n	6.5/7.2 (MCS0)	-3.31	8.00	-11.31	Pass
2437	6	n	6.5/7.2 (MCS0)	-2.72	8.00	-10.72	Pass
2462	11	n	6.5/7.2 (MCS0)	-3.30	8.00	-11.30	Pass

Table 7-12. Conducted Power Density Measurements SISO CORE 0

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Plot 7-19. Power Spectral Density Plot SISO CORE 0 (802.11b – Ch. 1)

Plot 7-20. Power Spectral Density Plot SISO CORE 0 (802.11b – Ch. 6)

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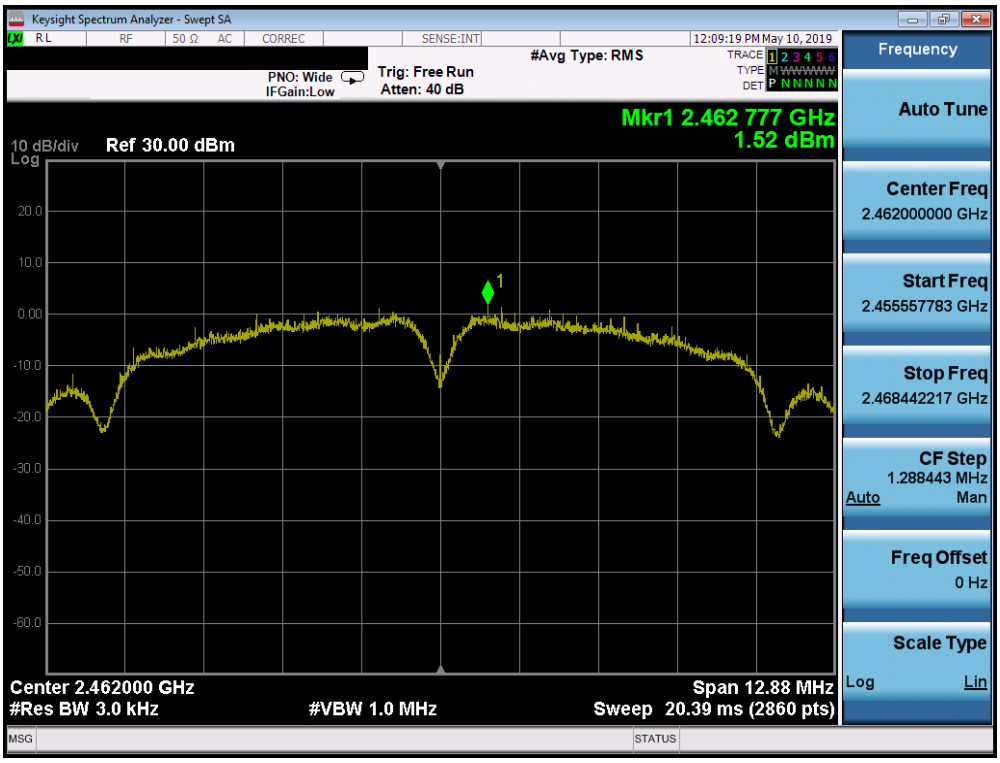
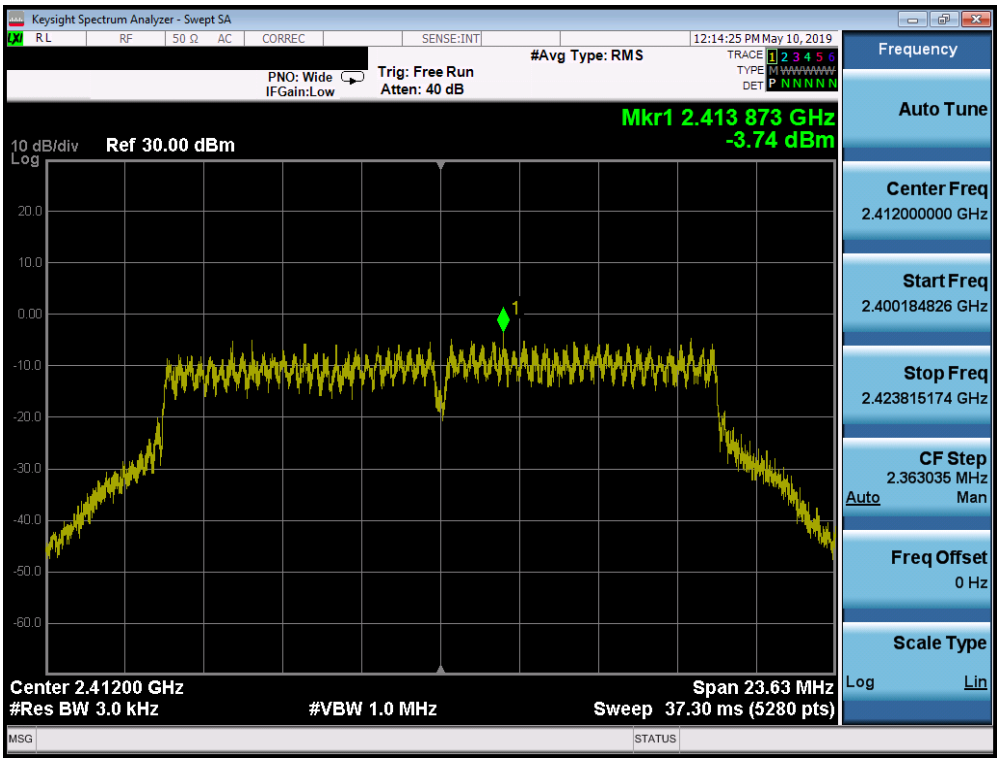


Plot 7-21. Power Spectral Density Plot SISO CORE 0 (802.11b – Ch. 11)



Plot 7-22. Power Spectral Density Plot SISO CORE 0 (802.11g – Ch. 1)

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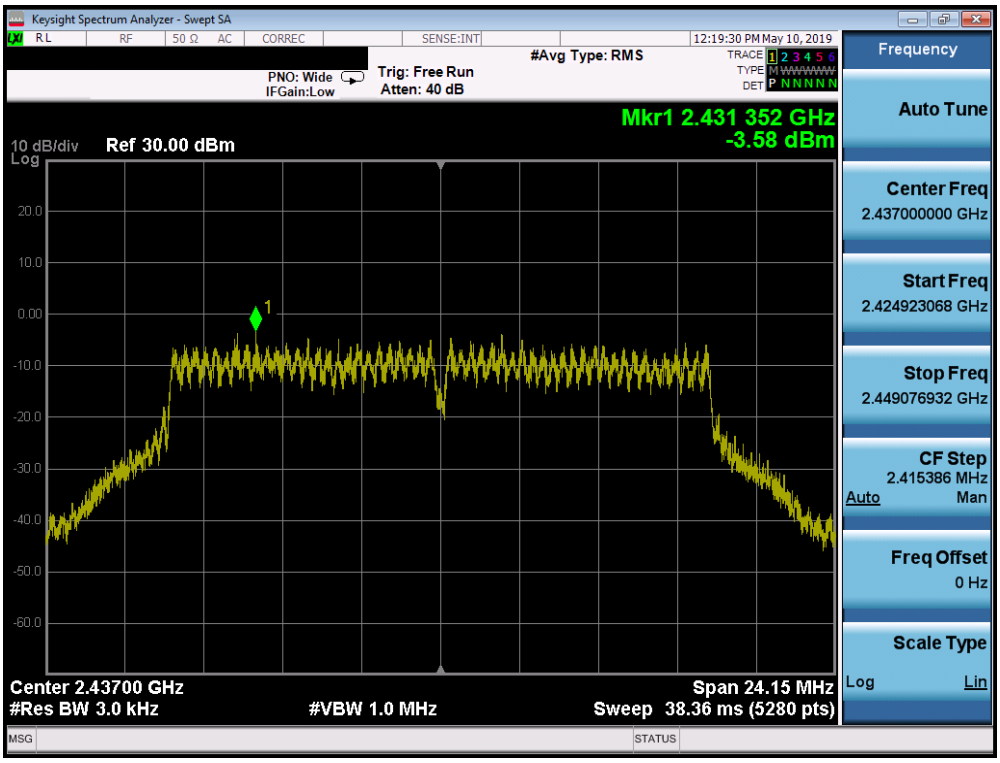
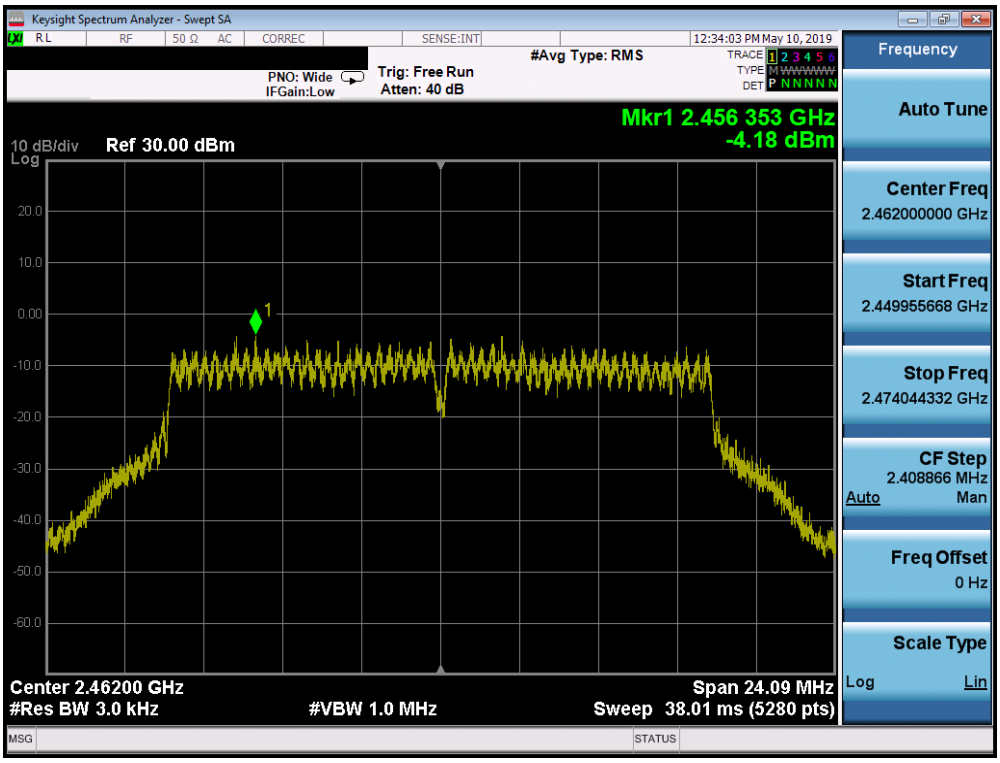


Plot 7-23. Power Spectral Density Plot SISO CORE 0 (802.11g – Ch. 6)



Plot 7-24. Power Spectral Density Plot SISO CORE 0 (802.11g – Ch. 11)

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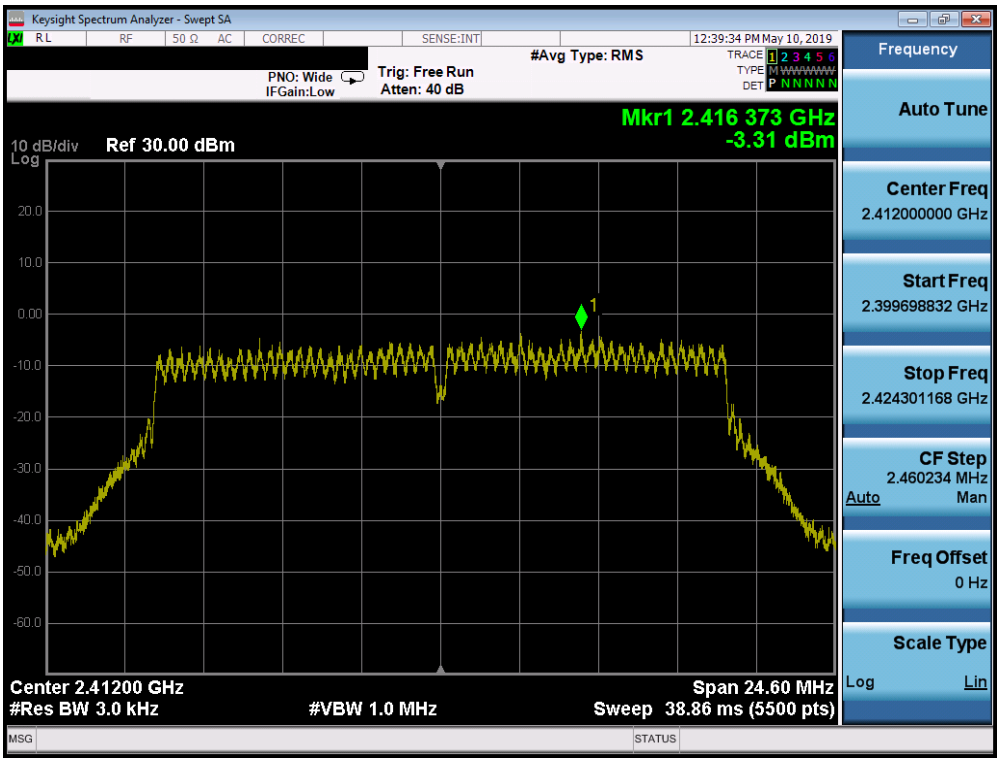
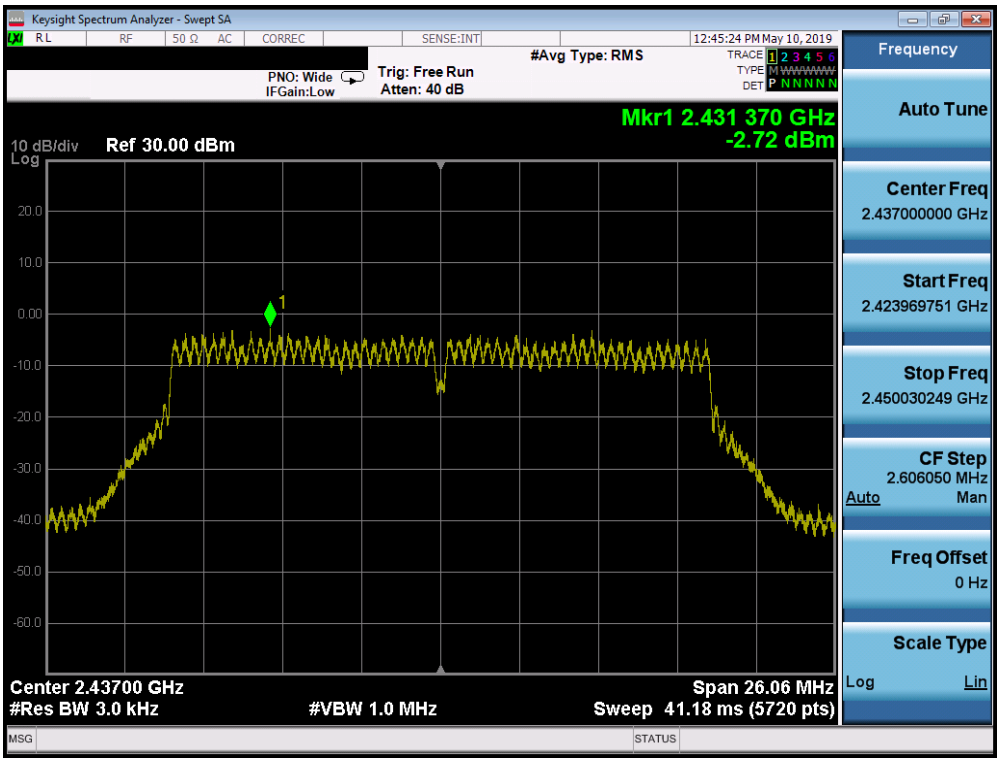


Plot 7-25. Power Spectral Density Plot SISO CORE 0 (802.11n (2.4GHz) – Ch. 1)



Plot 7-26. Power Spectral Density Plot SISO CORE 0 (802.11n (2.4GHz) – Ch. 6)

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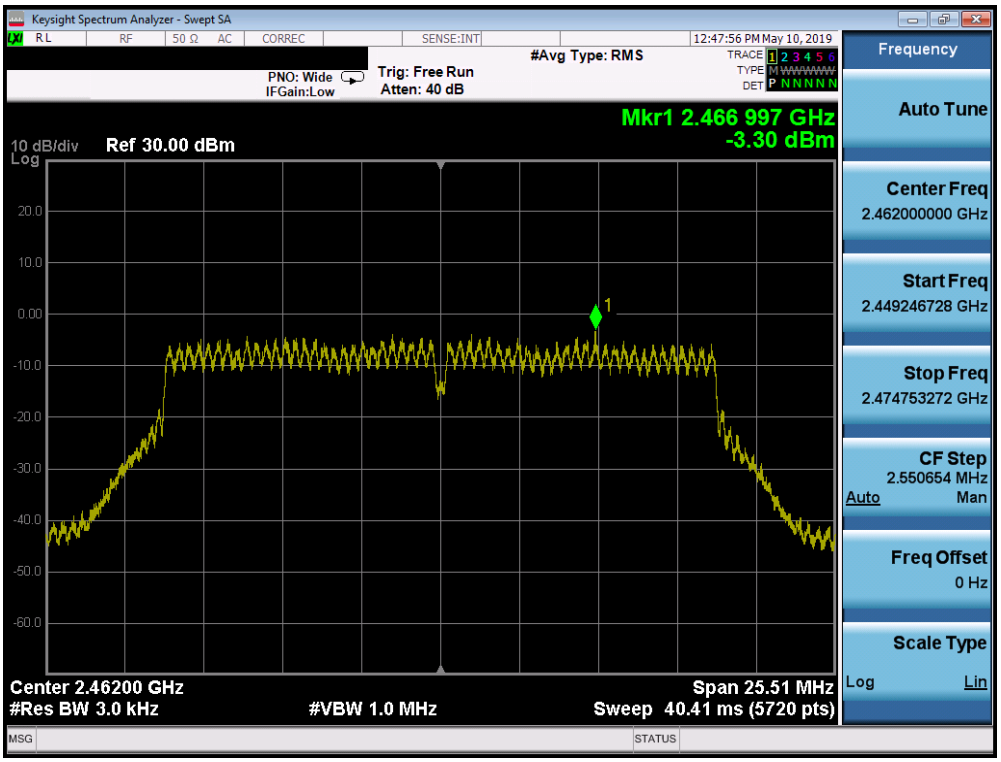

Plot 7-27. Power Spectral Density Plot SISO CORE 0 (802.11n (2.4GHz) – Ch. 11)

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SISO Core-1 Power Spectral Density Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Power Spectral Density [dBm / 3kHz]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]	Pass / Fail
2412	1	b	1	0.91	8.00	-7.09	Pass
2437	6	b	1	0.86	8.00	-7.14	Pass
2462	11	b	1	0.84	8.00	-7.16	Pass
2412	1	g	6	-3.84	8.00	-11.84	Pass
2437	6	g	6	-3.88	8.00	-11.88	Pass
2462	11	g	6	-4.17	8.00	-12.17	Pass
2412	1	n	6.5/7.2 (MCS0)	-1.82	8.00	-9.82	Pass
2437	6	n	6.5/7.2 (MCS0)	-2.94	8.00	-10.94	Pass
2462	11	n	6.5/7.2 (MCS0)	-2.82	8.00	-10.82	Pass

Table 7-13. Conducted Power Density Measurements SISO CORE 1

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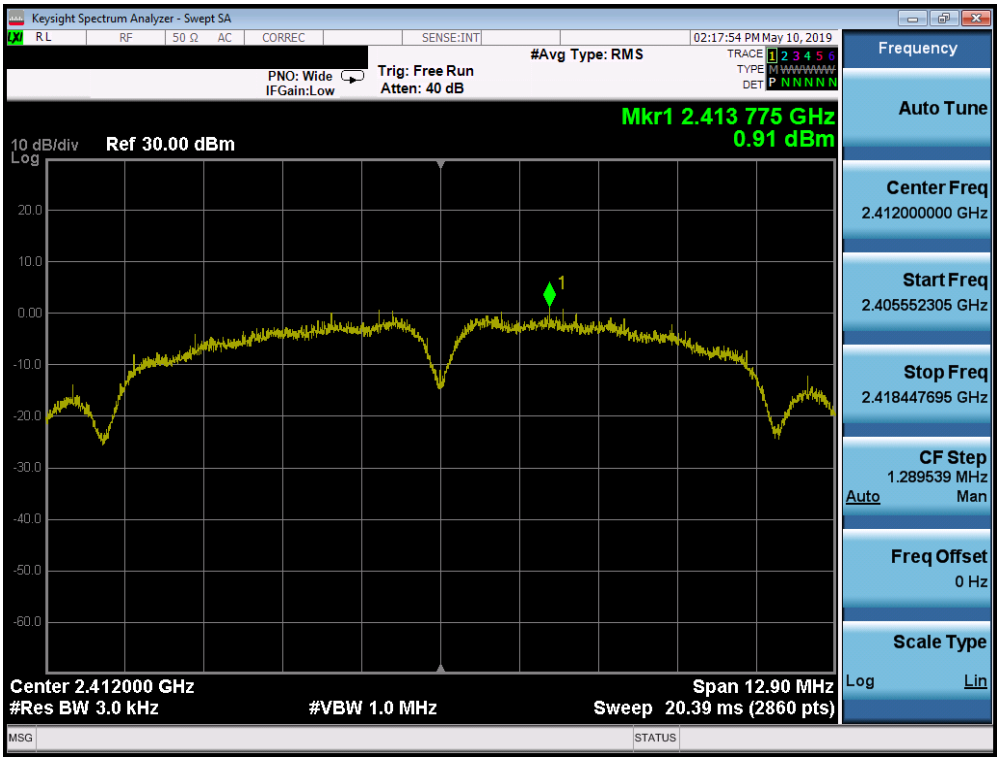
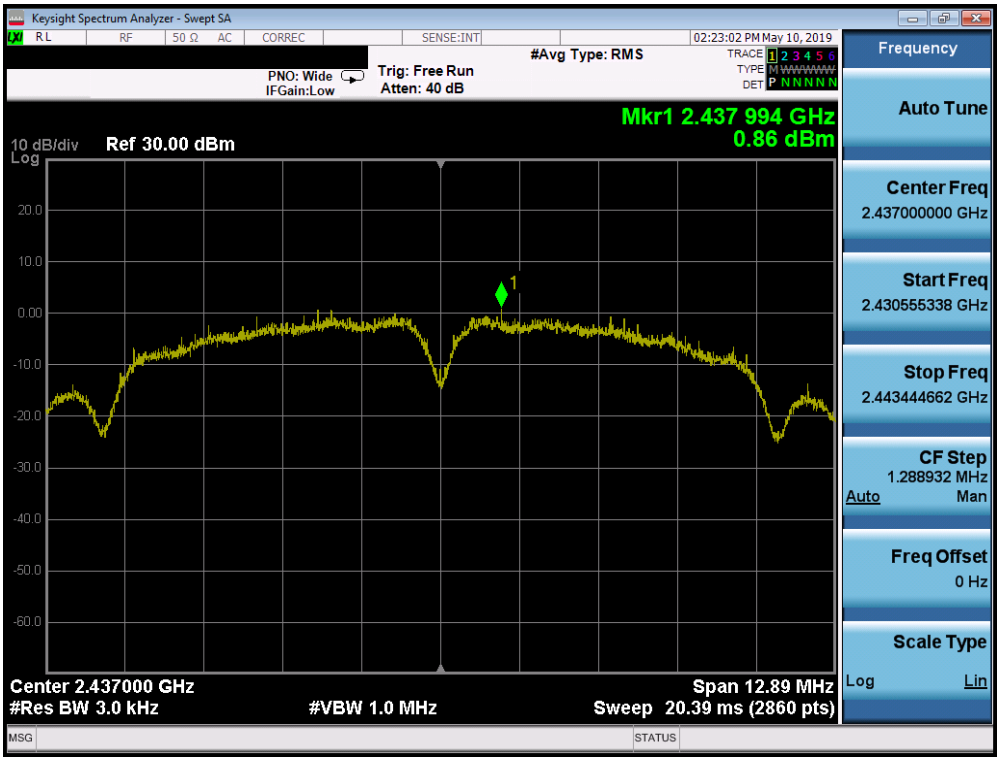


Plot 7-28. Power Spectral Density Plot SISO CORE 1 (802.11b – Ch. 1)



Plot 7-29. Power Spectral Density Plot SISO CORE 1 (802.11b – Ch. 6)

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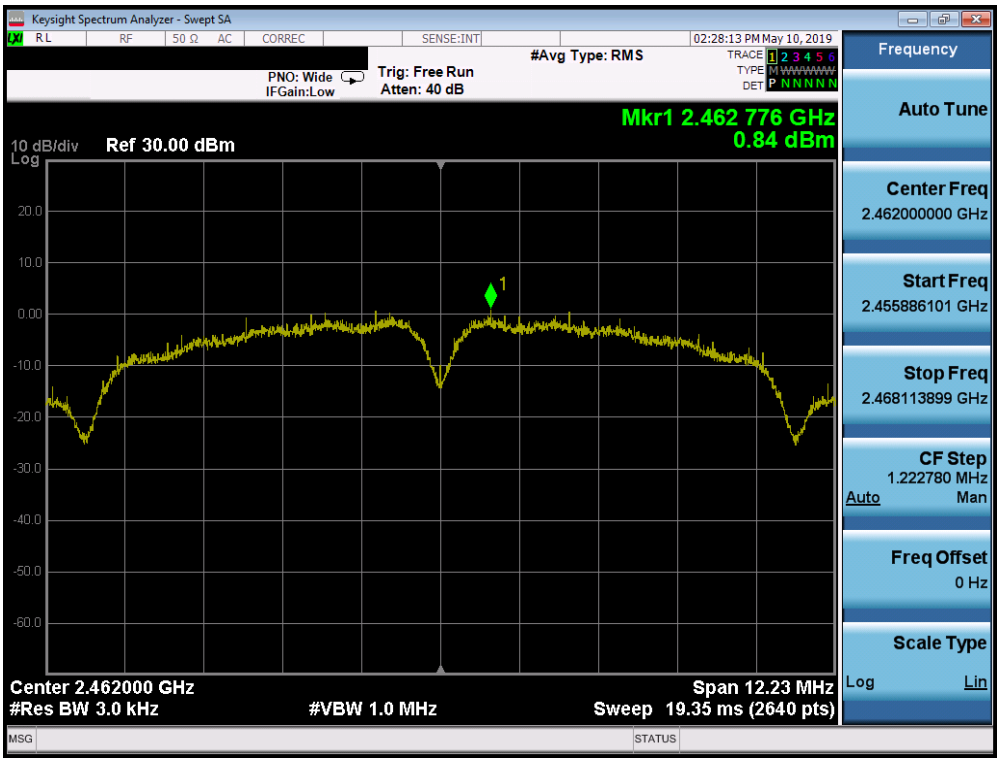
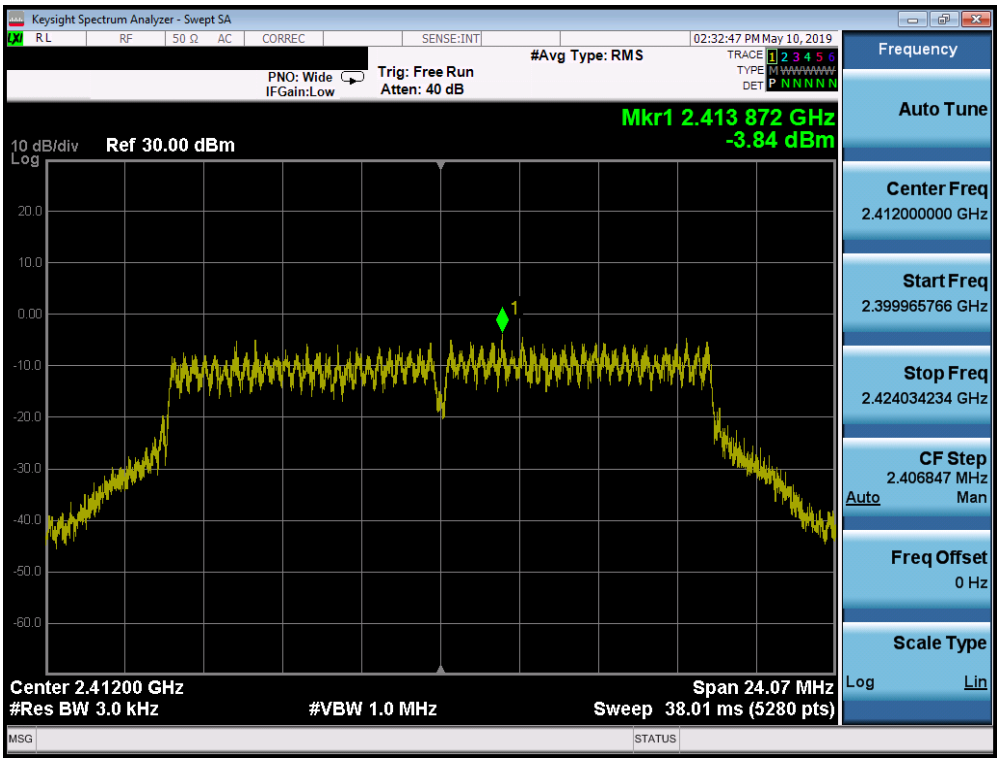


Plot 7-30. Power Spectral Density Plot SISO CORE 1 (802.11b – Ch. 11)



Plot 7-31. Power Spectral Density Plot SISO CORE 1 (802.11g – Ch. 1)

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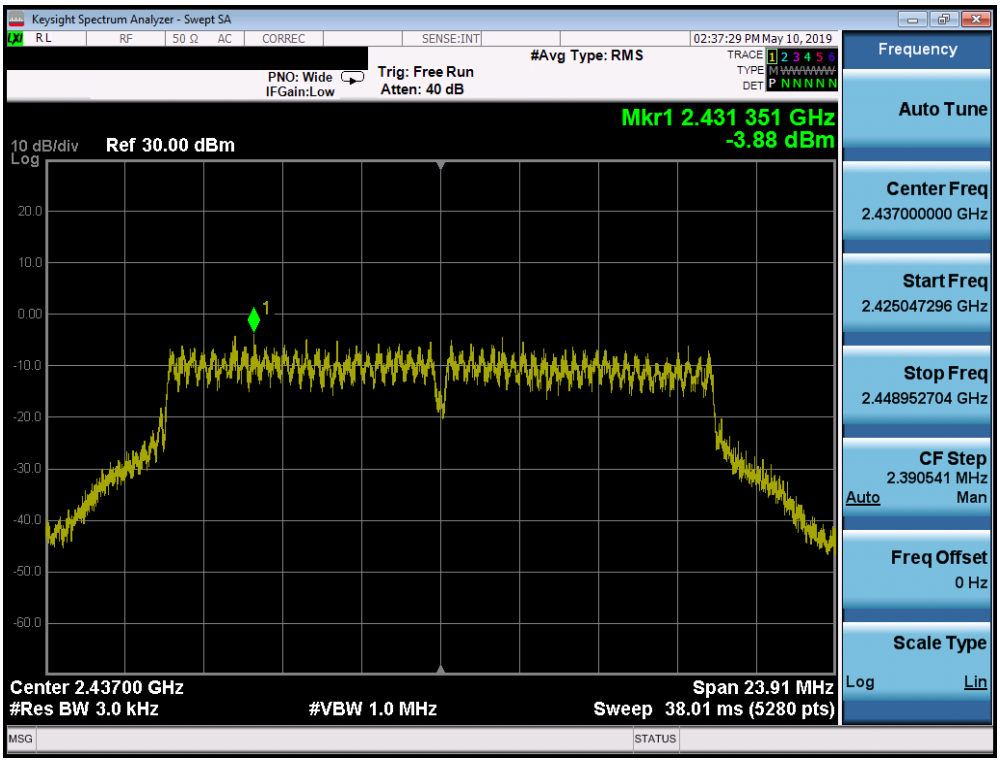
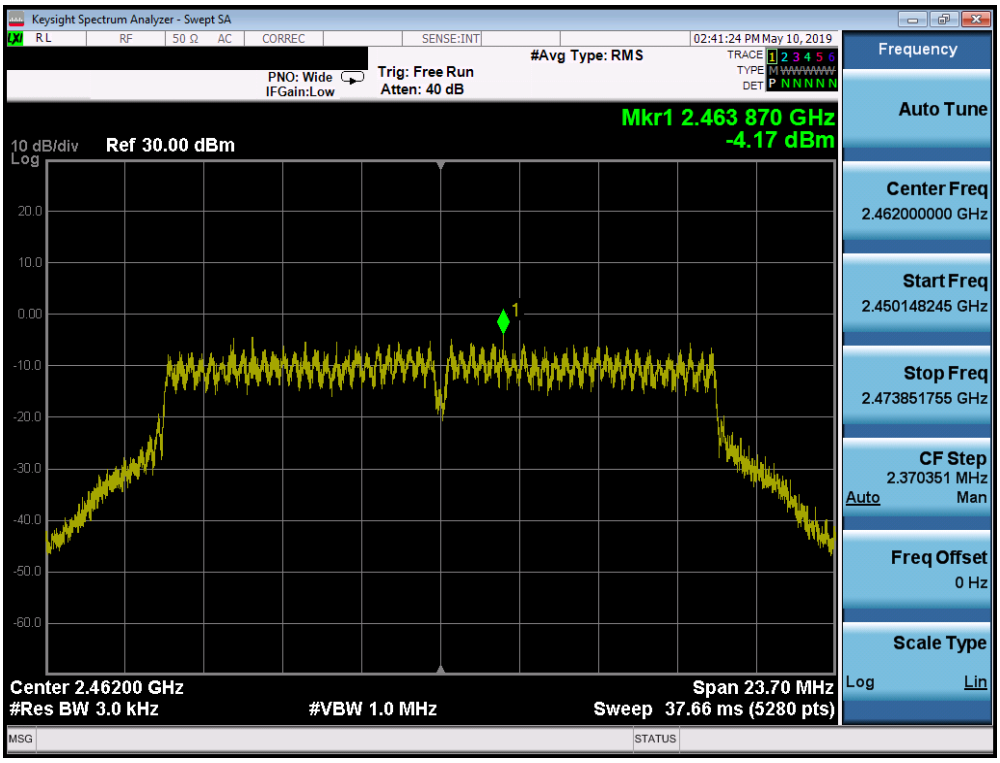


Plot 7-32. Power Spectral Density Plot SISO CORE 1 (802.11g – Ch. 6)



Plot 7-33. Power Spectral Density Plot SISO CORE 1 (802.11g – Ch. 11)

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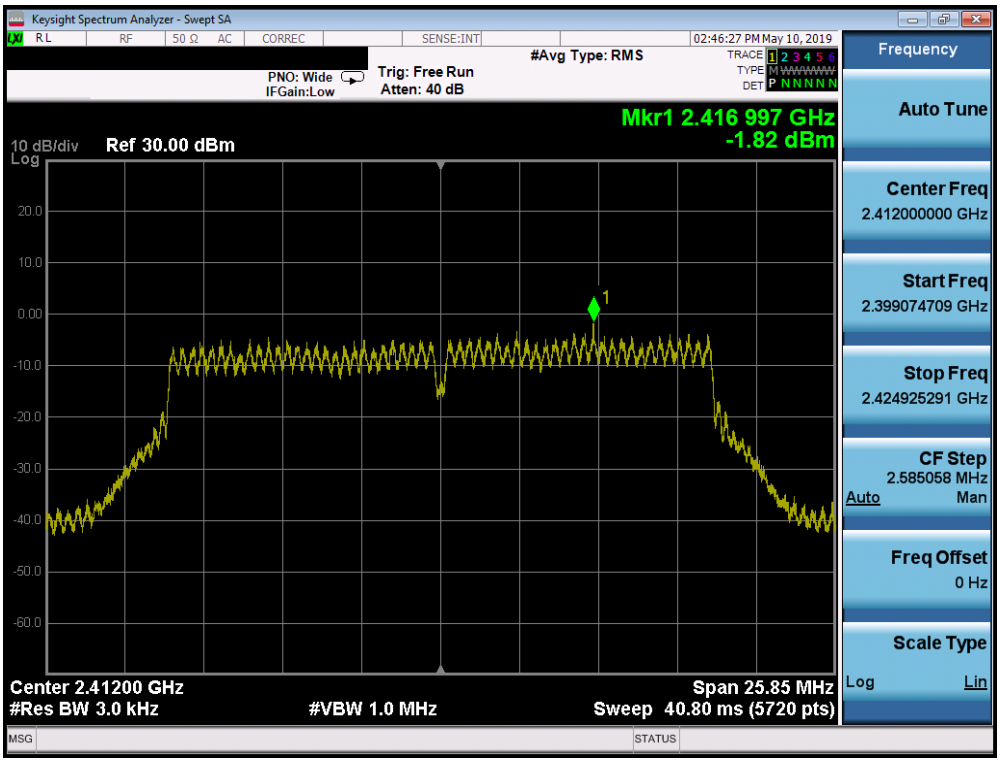
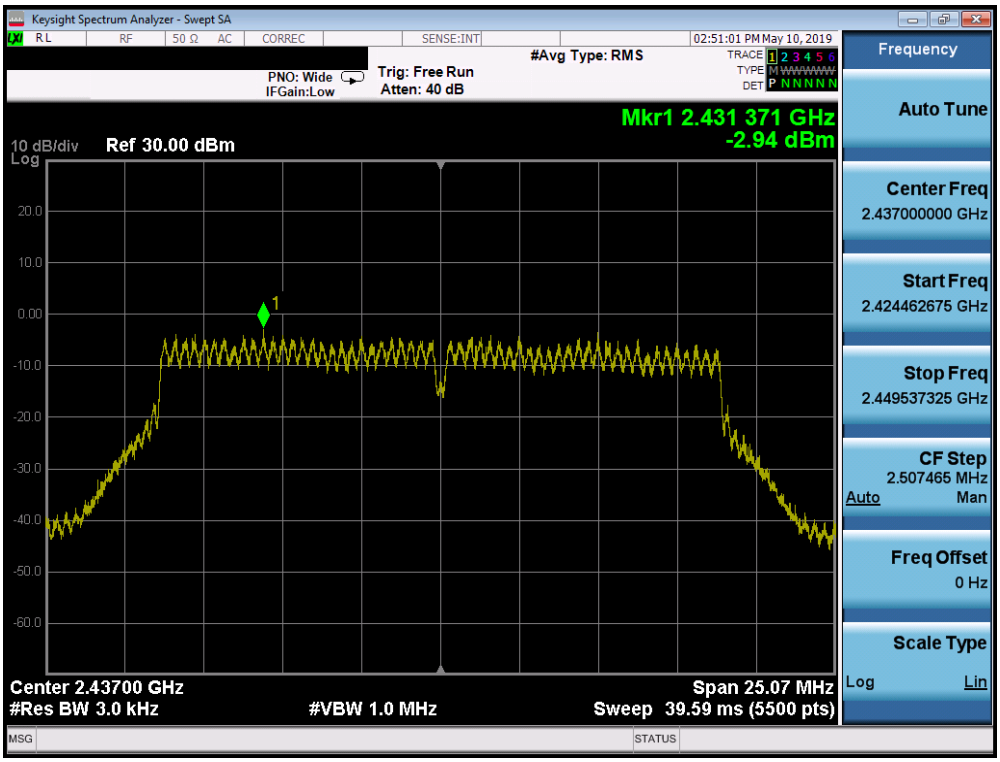


Plot 7-34. Power Spectral Density Plot SISO CORE 1 (802.11n (2.4GHz) – Ch. 1)



Plot 7-35. Power Spectral Density Plot SISO CORE 1 (802.11n (2.4GHz) – Ch. 6)

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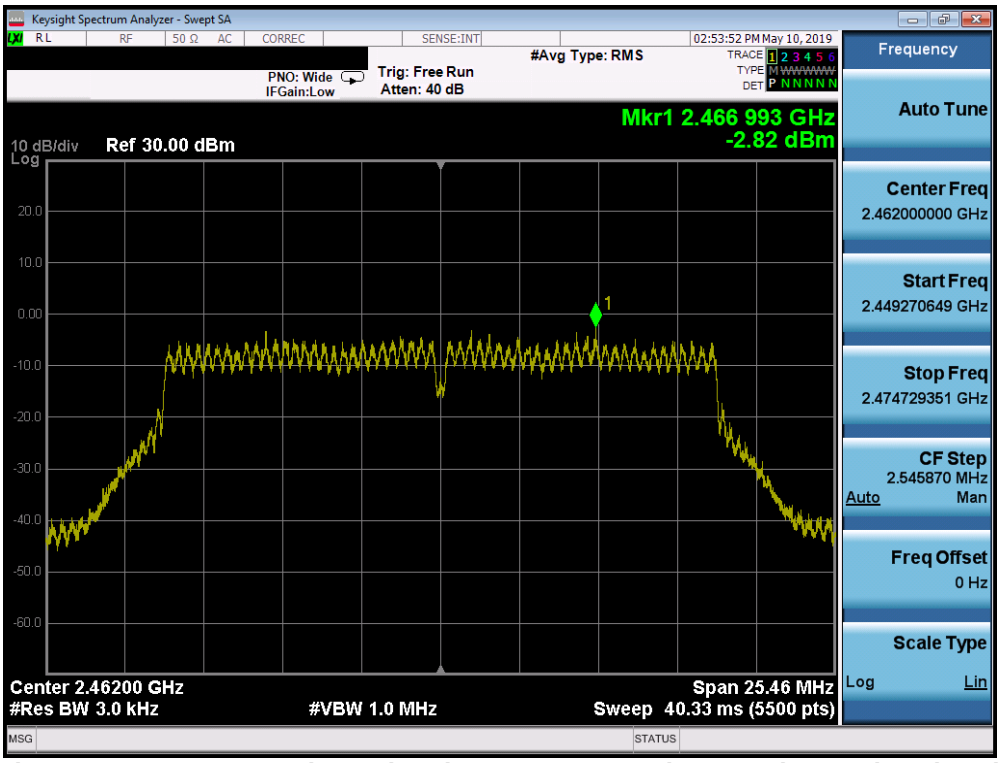

Plot 7-36. Power Spectral Density Plot SISO CORE 1 (802.11n (2.4GHz) – Ch. 11)

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CDD Power Spectral Density Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	CORE 0 Power Spectral Density [dBm / 3kHz]	CORE 1 Power Spectral Density [dBm / 3kHz]	Summed Power Spectral Density [dBm / 3kHz]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]	Pass / Fail
2412	1	g	6	-3.62	-3.98	-0.79	8.00	-8.79	Pass
2437	6	g	6	-3.47	-4.05	-0.74	8.00	-8.74	Pass
2462	11	g	6	-3.89	-3.95	-0.91	8.00	-8.91	Pass
2412	1	n	6.5/7.2 (MCS0)	-1.83	-2.49	0.86	8.00	-7.14	Pass
2437	6	n	6.5/7.2 (MCS0)	-2.95	-2.95	0.06	8.00	-7.94	Pass
2462	11	n	6.5/7.2 (MCS0)	-3.67	-3.36	-0.50	8.00	-8.50	Pass

Table 7-14.CDD Conducted Power Density Measurements

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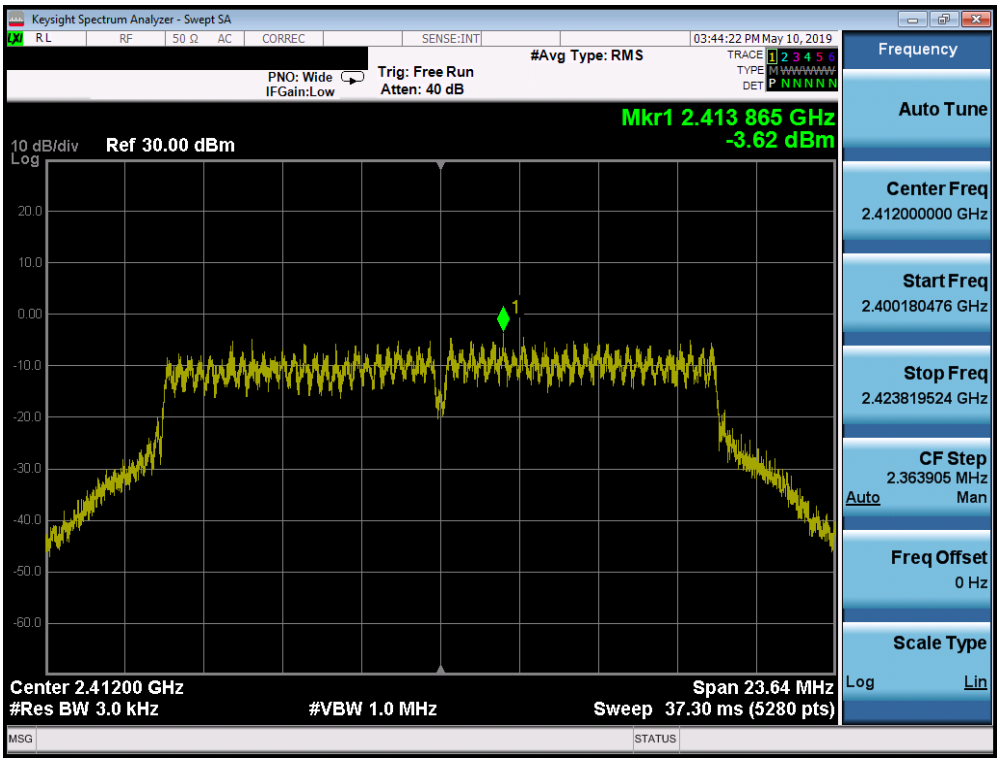
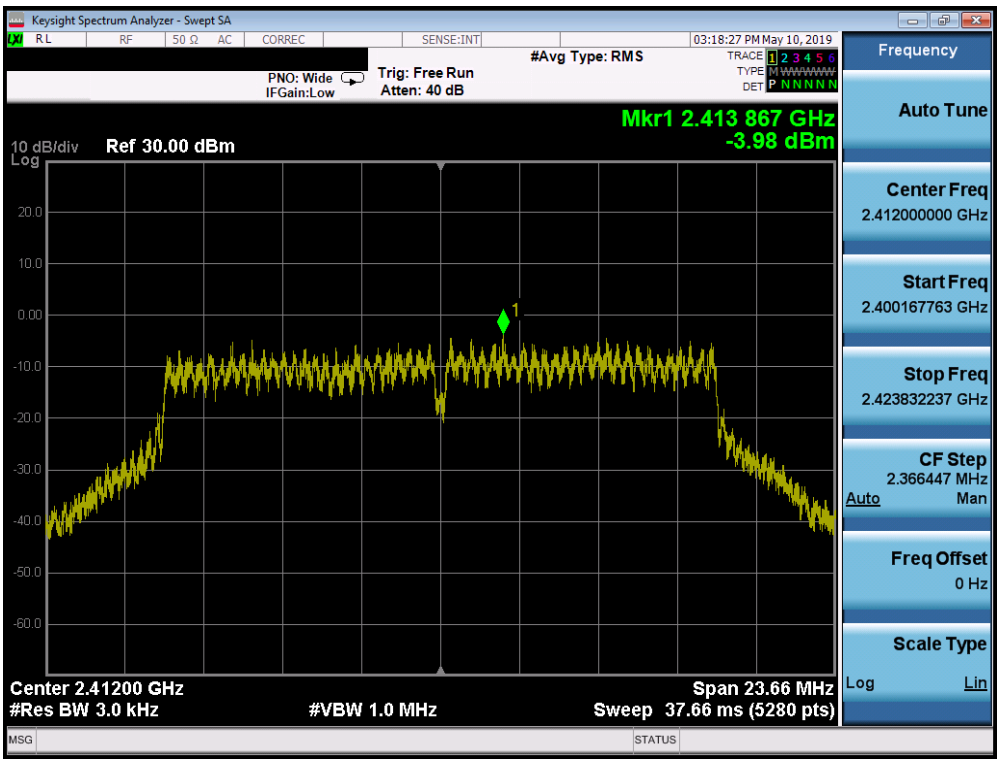


Plot 7-37. Power Spectral Density Plot CDD CORE 0 (802.11g – Ch. 1)



Plot 7-38. Power Spectral Density Plot CDD CORE 1 (802.11g – Ch. 1)

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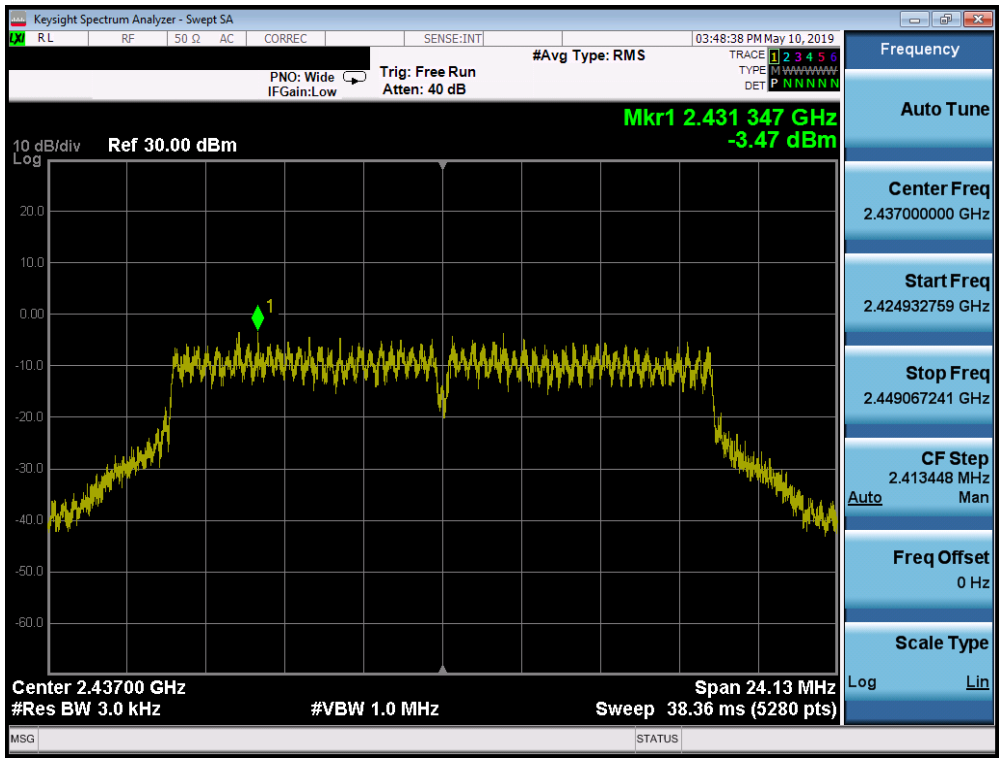
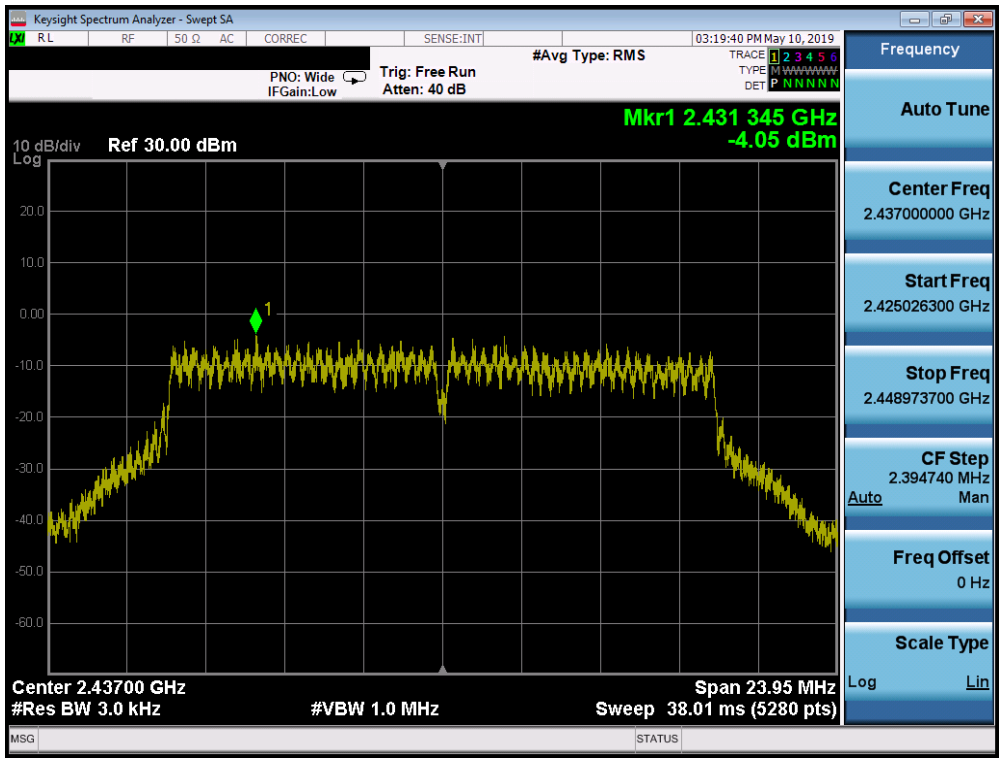


Plot 7-39. Power Spectral Density Plot CDD CORE 0 (802.11g – Ch. 6)



Plot 7-40. Power Spectral Density Plot CDD CORE 1 (802.11g – Ch. 6)

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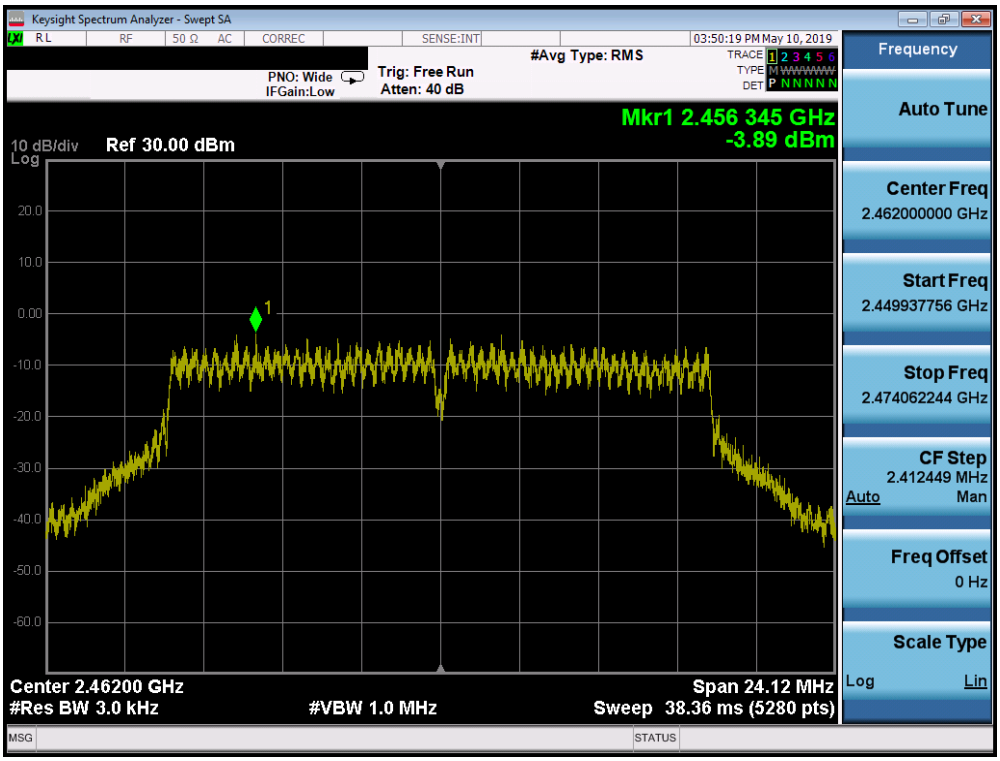
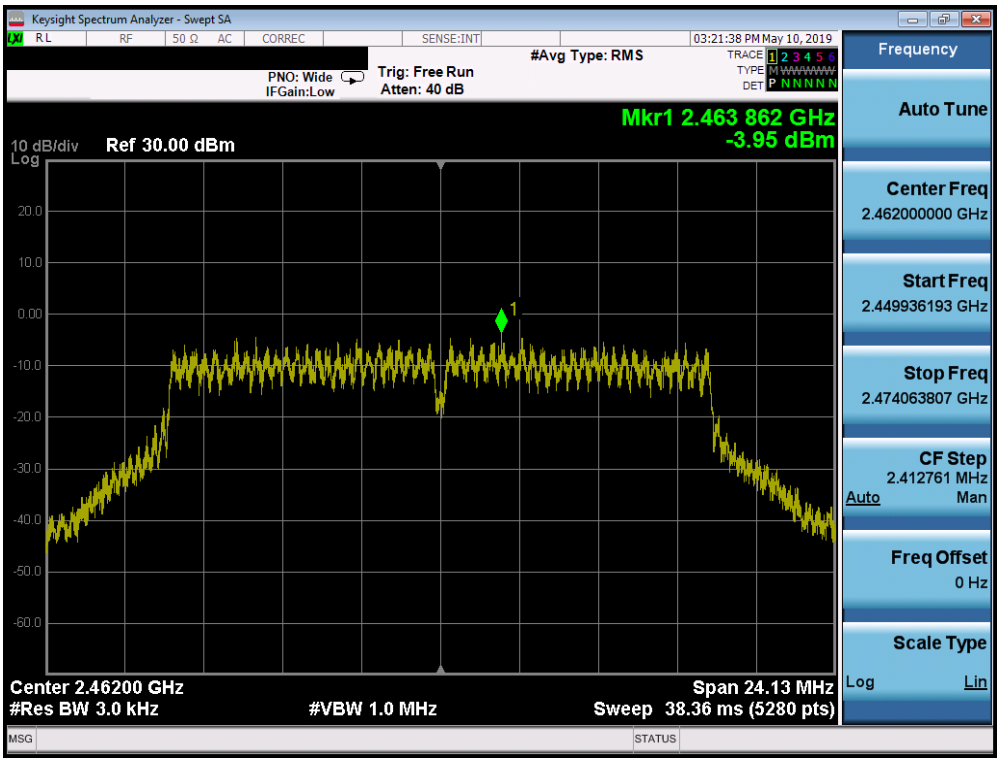


Plot 7-41. Power Spectral Density Plot CDD CORE 0 (802.11g – Ch. 11)



Plot 7-42. Power Spectral Density Plot CDD CORE 1 (802.11g – Ch. 11)

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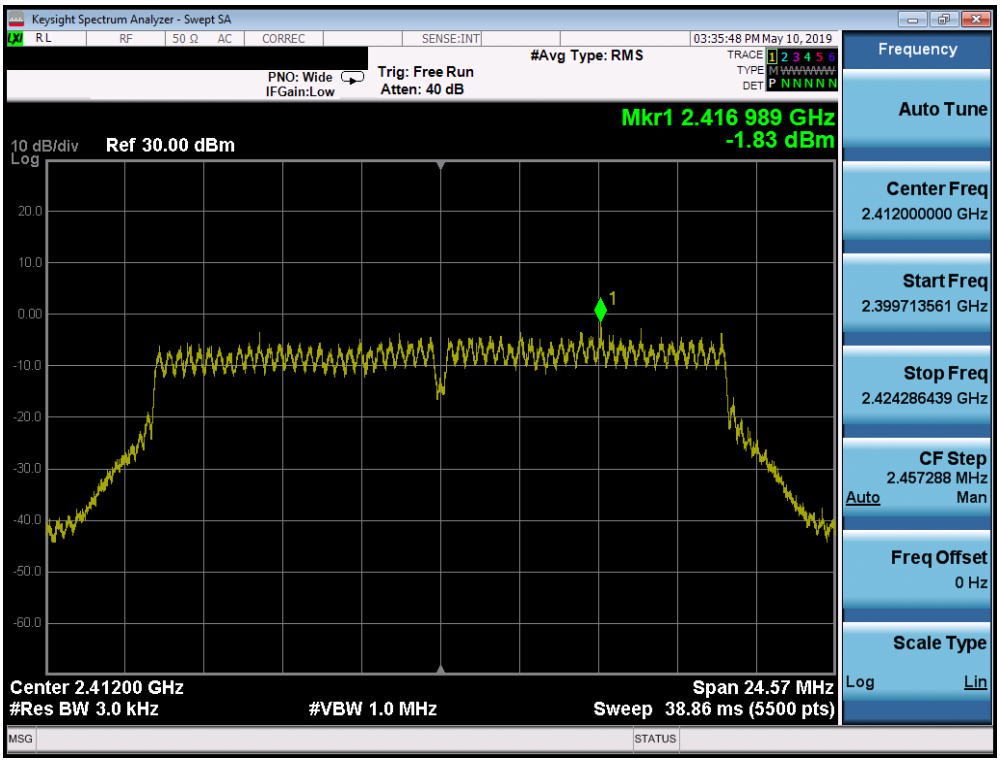
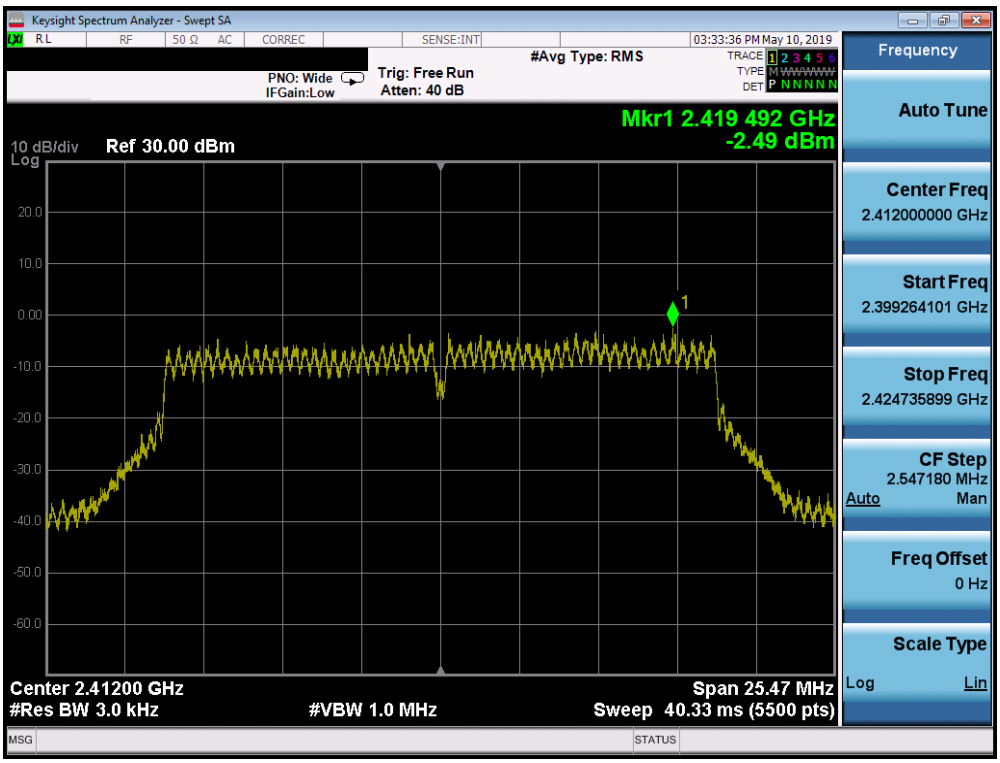


Plot 7-43. Power Spectral Density Plot CDD CORE 0 (802.11n (2.4GHz) – Ch. 1)



Plot 7-44. Power Spectral Density Plot CDD CORE 1 (802.11n (2.4GHz) – Ch. 1)

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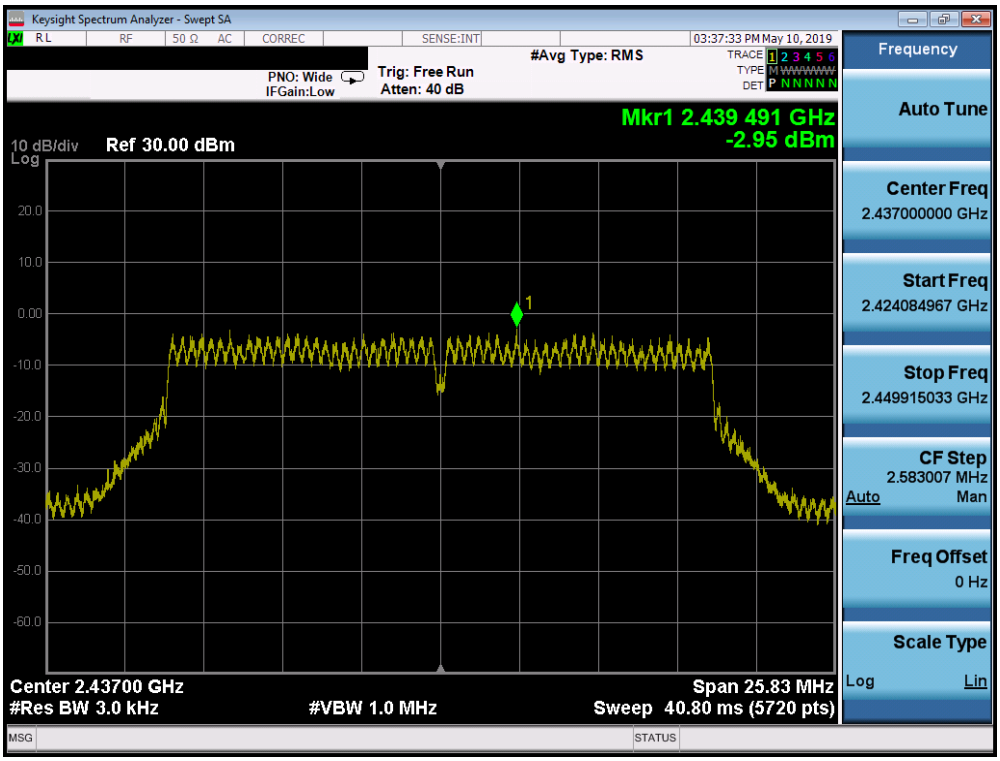
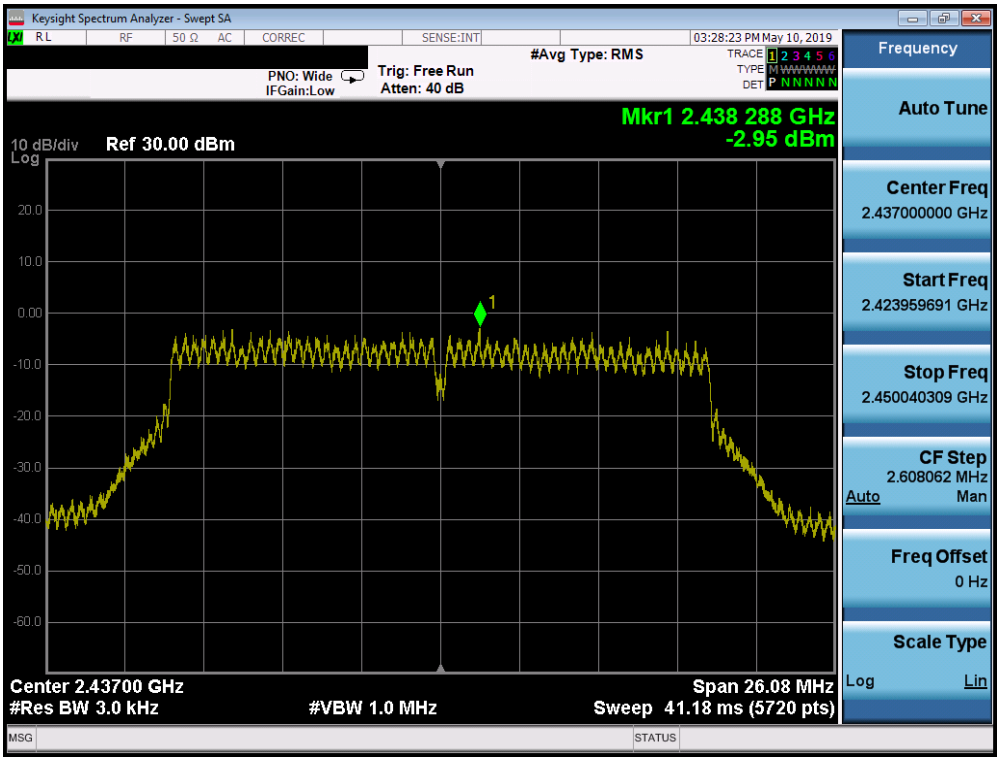


Plot 7-45. Power Spectral Density Plot CDD CORE 0 (802.11n (2.4GHz) – Ch. 6)



Plot 7-46. Power Spectral Density Plot CDD CORE 1 (802.11n (2.4GHz) – Ch. 6)

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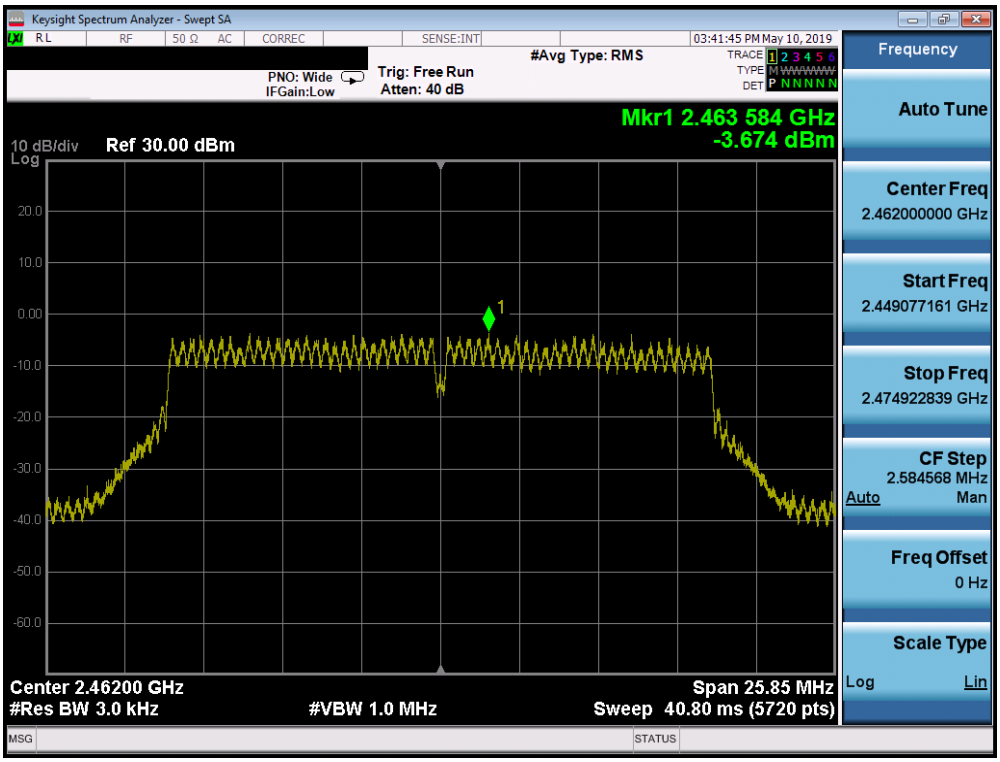
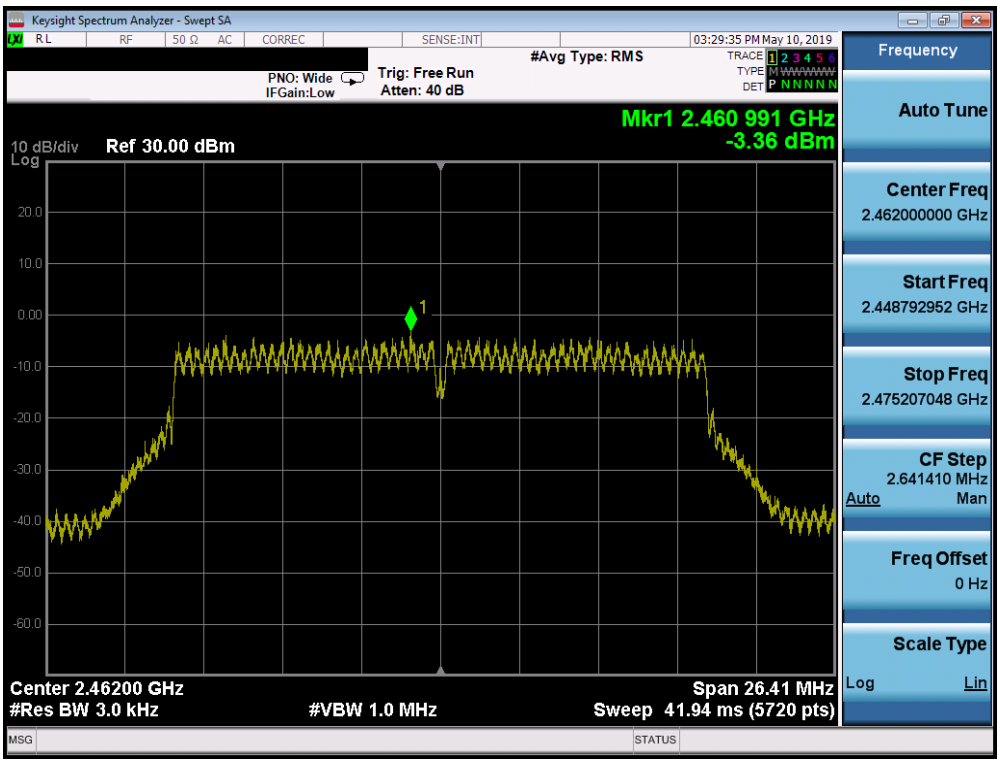


Plot 7-47. Power Spectral Density Plot CDD CORE 0 (802.11n (2.4GHz) – Ch. 11)



Plot 7-48. Power Spectral Density Plot CDD CORE 1 (802.11n (2.4GHz) – Ch. 11)

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Note:

Per ANSI C63.10-2013 Section 14.3.2.2 and KDB 662911 D01 v02r01 Section E)2), the power spectral density at Core 0 and Core 1 were first measured separately as shown in the section above. The measured values were then summed in linear power units then converted back to dBm.

Sample CDD Calculation:

At 2412MHz the average conducted power spectral density was measured to be -1.83 dBm for Core-0 and -2.49 dBm for Core-1.

Core 0 + Core 1 = CDD

(-1.83 dBm + -2.49 dBm) = (0.66 mW + 0.56 mW) = 1.22 mW = 0.86 dBm

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7.5 Conducted Emissions at the Band Edge

§15.247(d); RSS-247 [5.5]

Test Overview and Limit

All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. For the following out of band conducted spurious emissions plots at the band edge, the EUT was set at a data rate of 1Mbps for "b" mode, 6 Mbps for "g" mode, and 6.5/7.2Mbps for "n" mode as these settings produced the worst-case emissions.

The limit for out-of-band spurious emissions at the band edge is 20dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100kHz bandwidth per the PSD procedure (Section 7.4).

Test Procedure Used

ANSI C63.10-2013 – Section 11.11.3
KDB 558074 D01 v05r02 – Section 8.7.2

Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW = 100kHz
4. VBW = 1MHz
5. Detector = Peak
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = max hold
8. Sweep time = auto couple
9. The trace was allowed to stabilize

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

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

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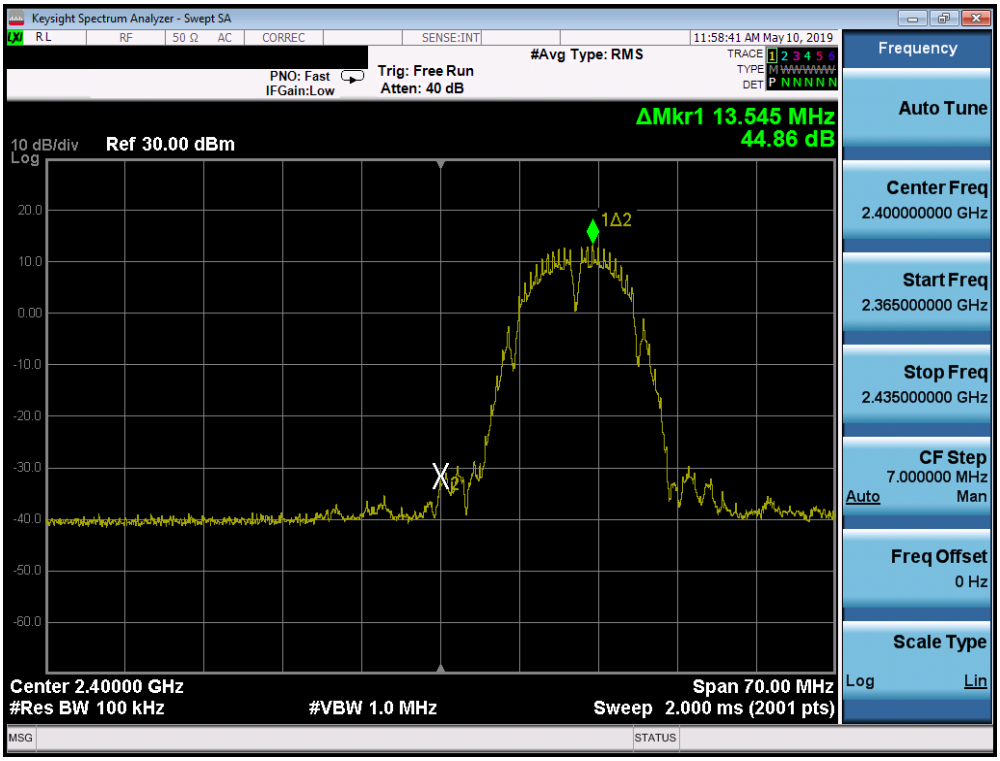
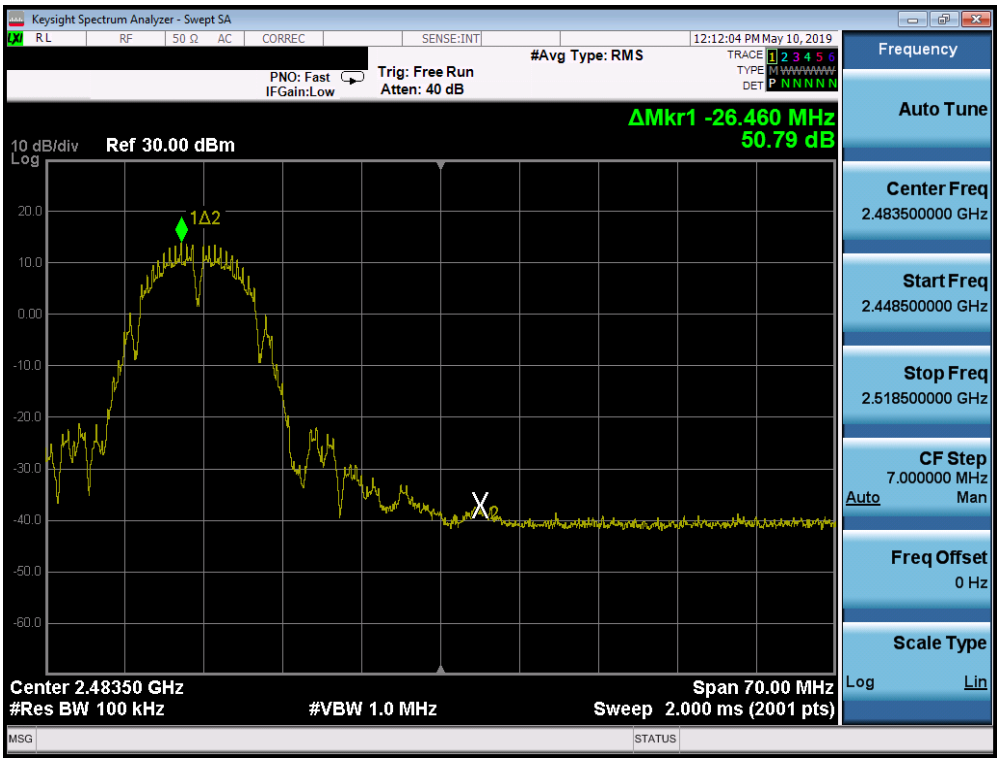
SISO Core-0 Conducted Emissions at the Band Edge



Plot 7-49. Band Edge Plot SISO CORE 0 (802.11b – Ch. 1)



Plot 7-50. Band Edge Plot SISO CORE 0 (802.11b – Ch. 11)

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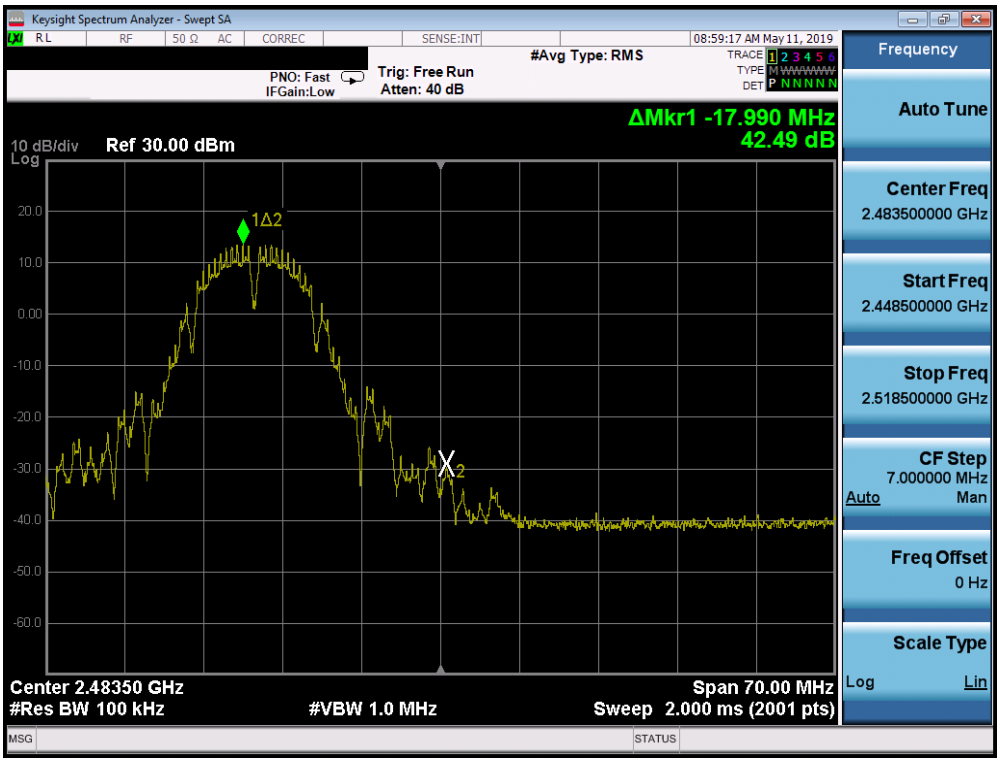
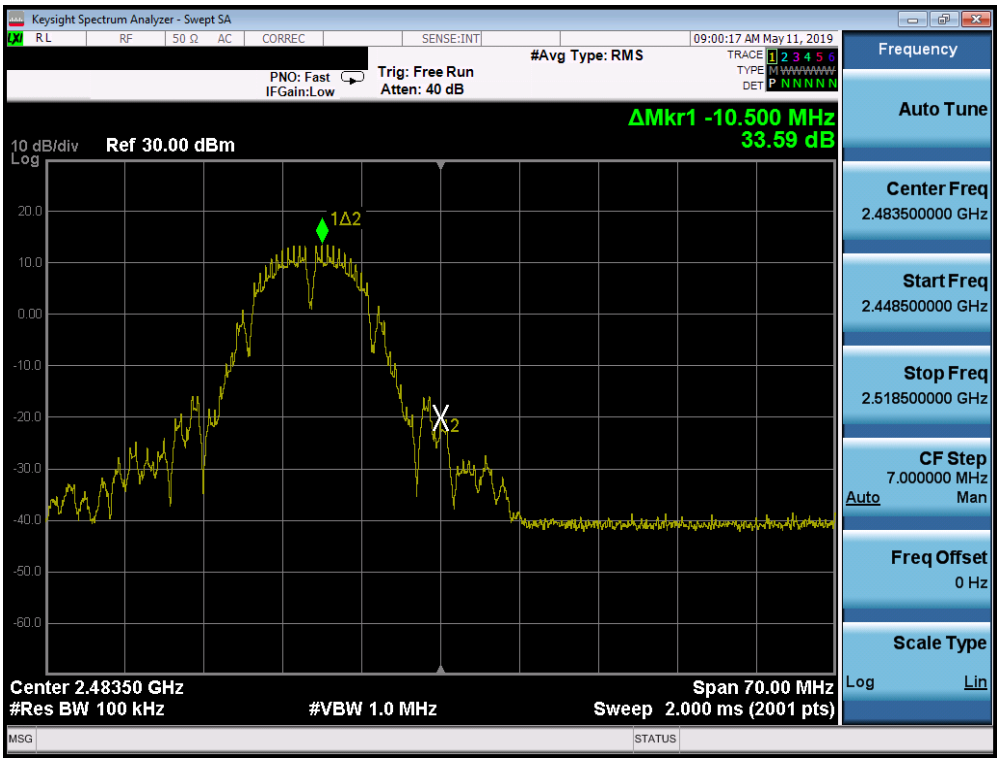


Plot 7-51. Band Edge Plot SISO CORE 0 (802.11b – Ch. 12)



Plot 7-52. Band Edge Plot SISO CORE 0 (802.11b – Ch. 13)

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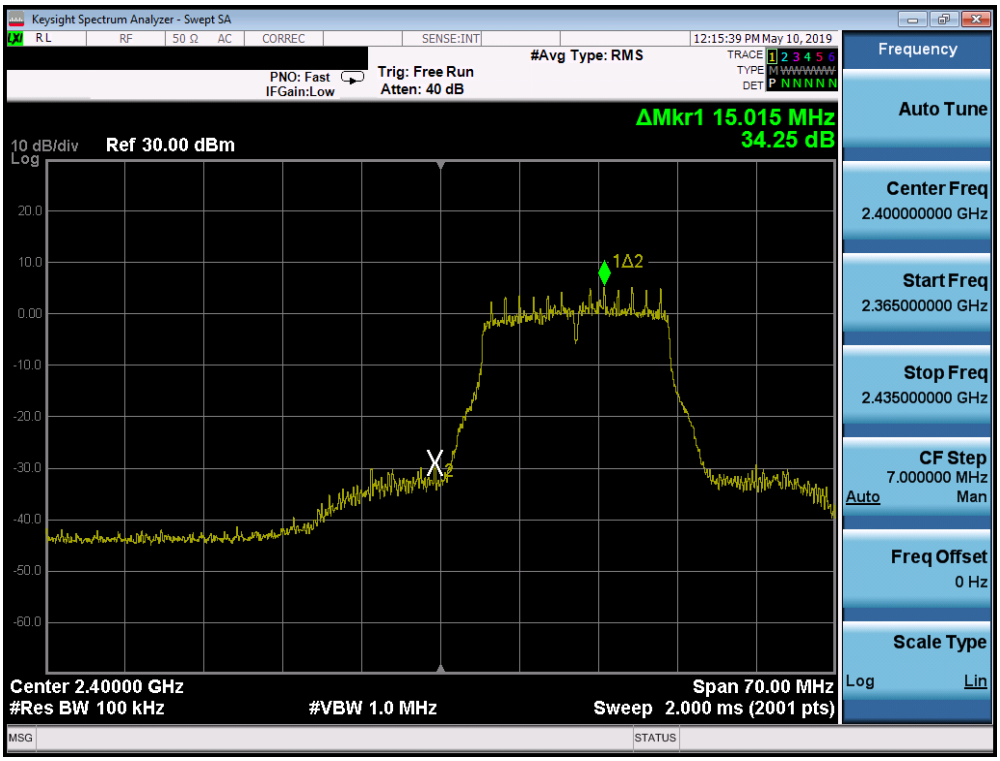
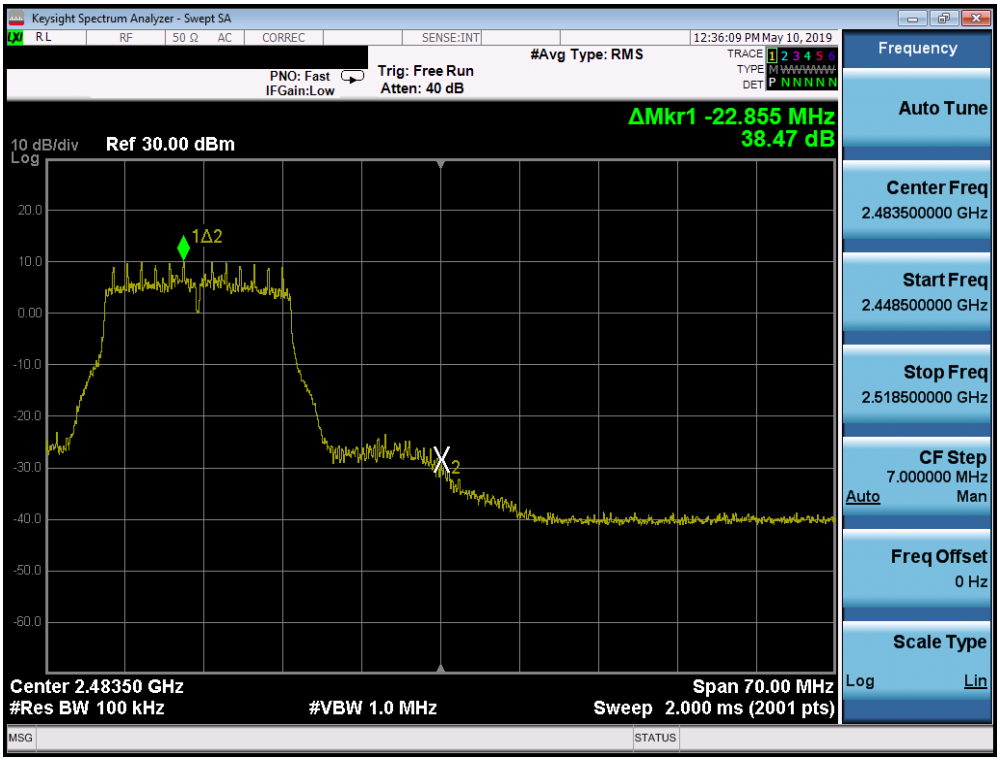


Plot 7-53. Band Edge Plot SISO CORE 0 (802.11g– Ch. 1)



Plot 7-54. Band Edge Plot SISO CORE 0 (802.11g – Ch. 11)

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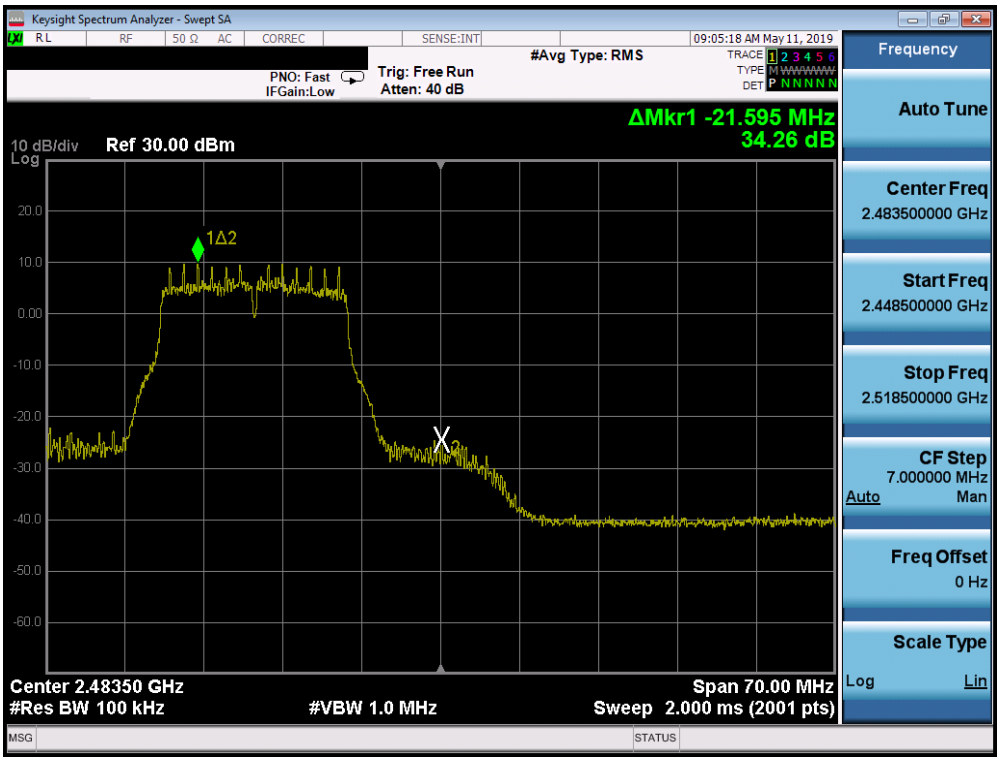
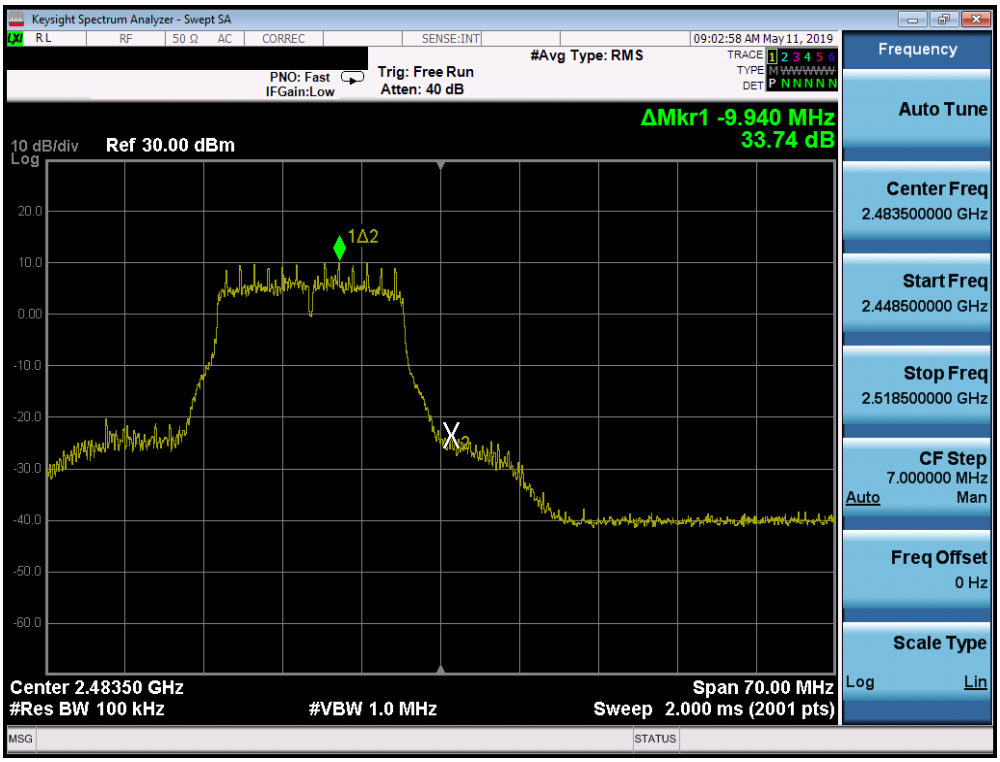


Plot 7-55. Band Edge Plot SISO CORE 0 (802.11g – Ch. 12)



Plot 7-56. Band Edge Plot SISO CORE 0 (802.11g – Ch. 13)

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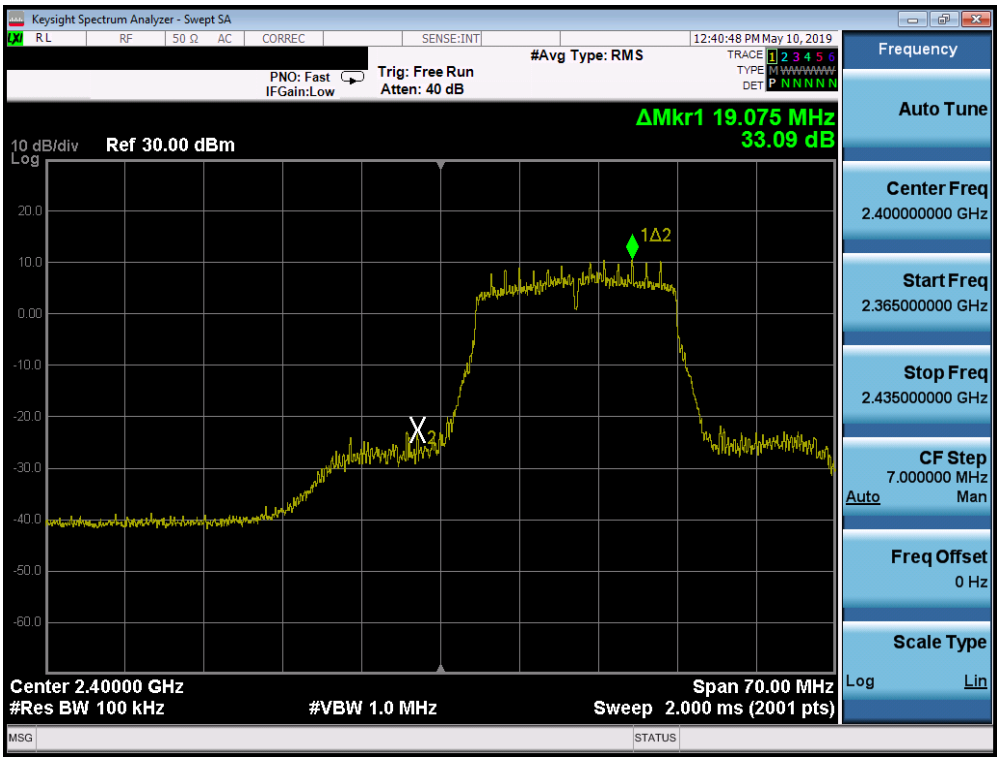
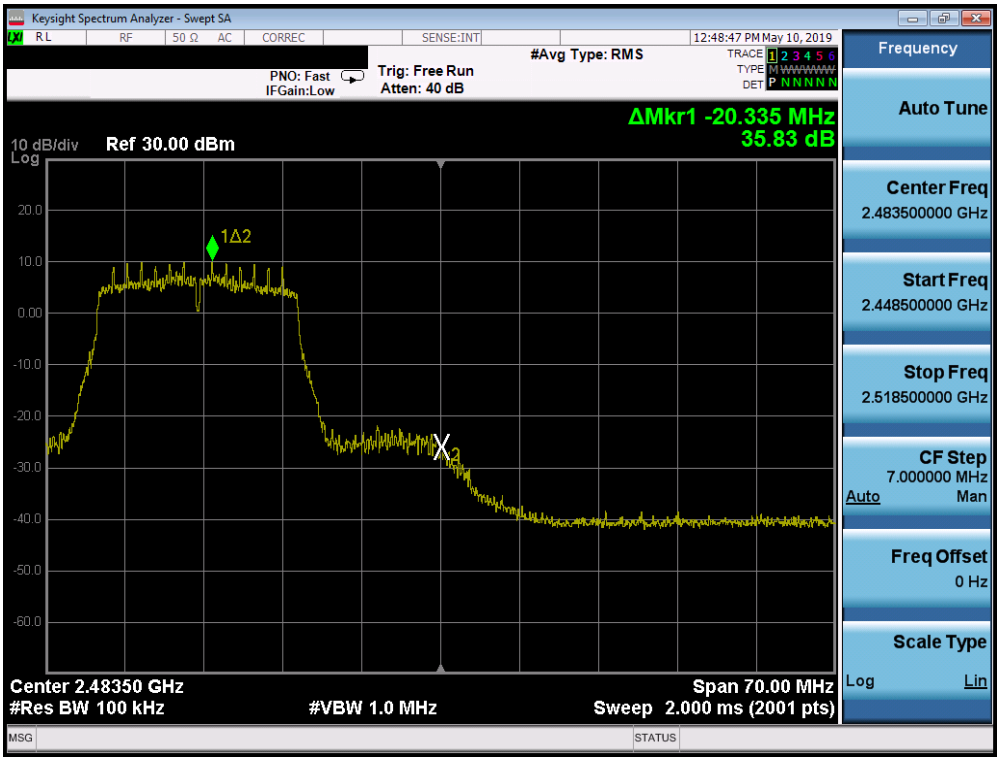


Plot 7-57. Band Edge Plot SISO CORE 0 (802.11n (2.4GHz) – Ch. 1)



Plot 7-58. Band Edge Plot SISO CORE 0 (802.11n (2.4GHz) – Ch. 11)

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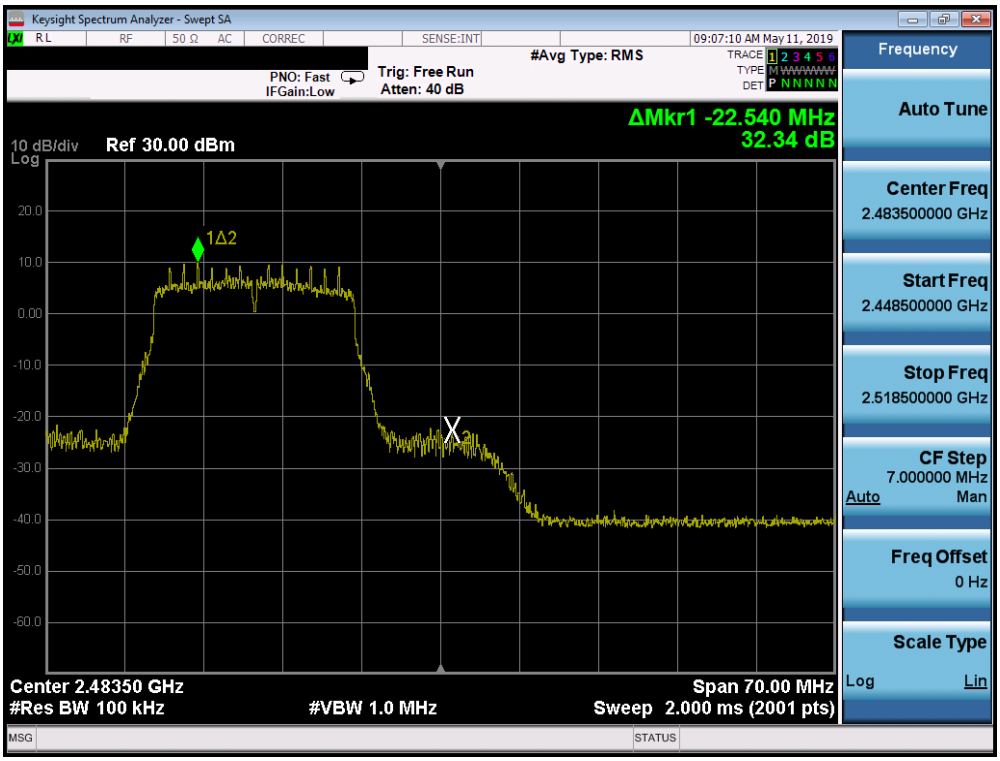
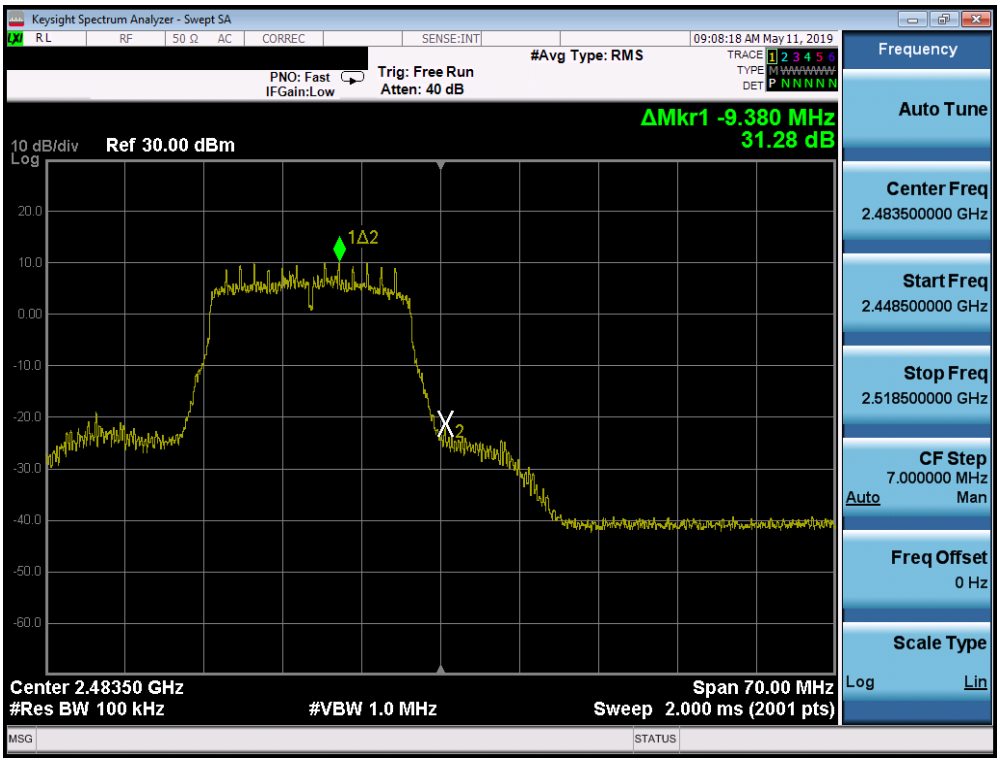


Plot 7-59. Band Edge Plot SISO CORE 0 (802.11n (2.4GHz) – Ch. 12)



Plot 7-60. Band Edge Plot SISO CORE 0 (802.11n (2.4GHz) – Ch. 13)

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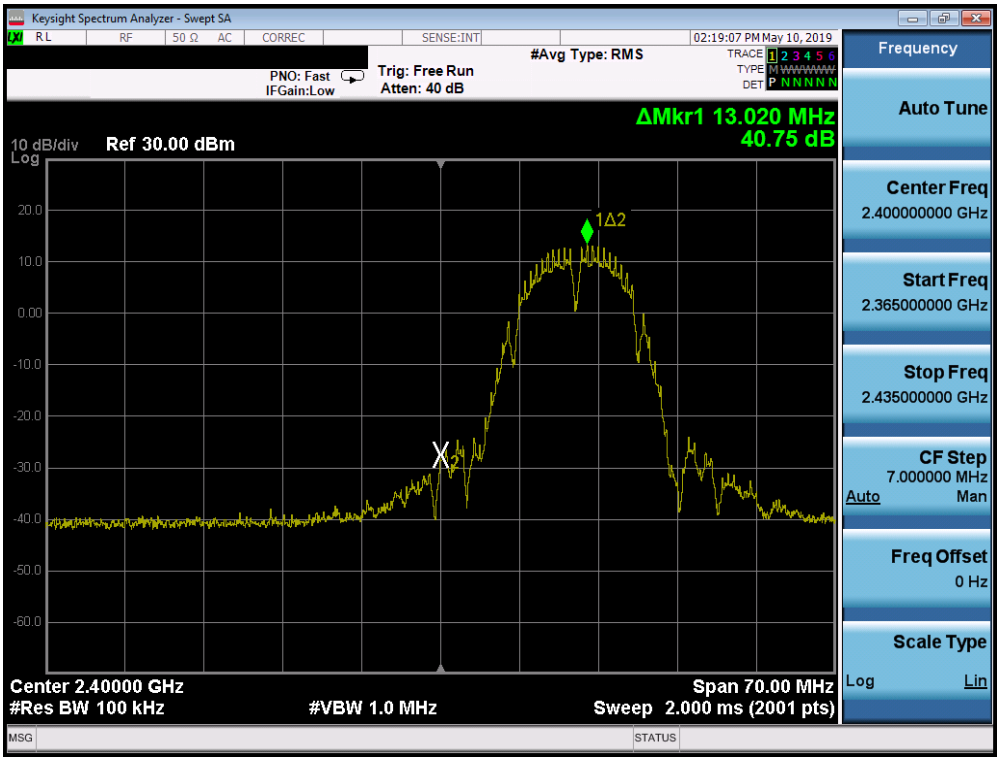
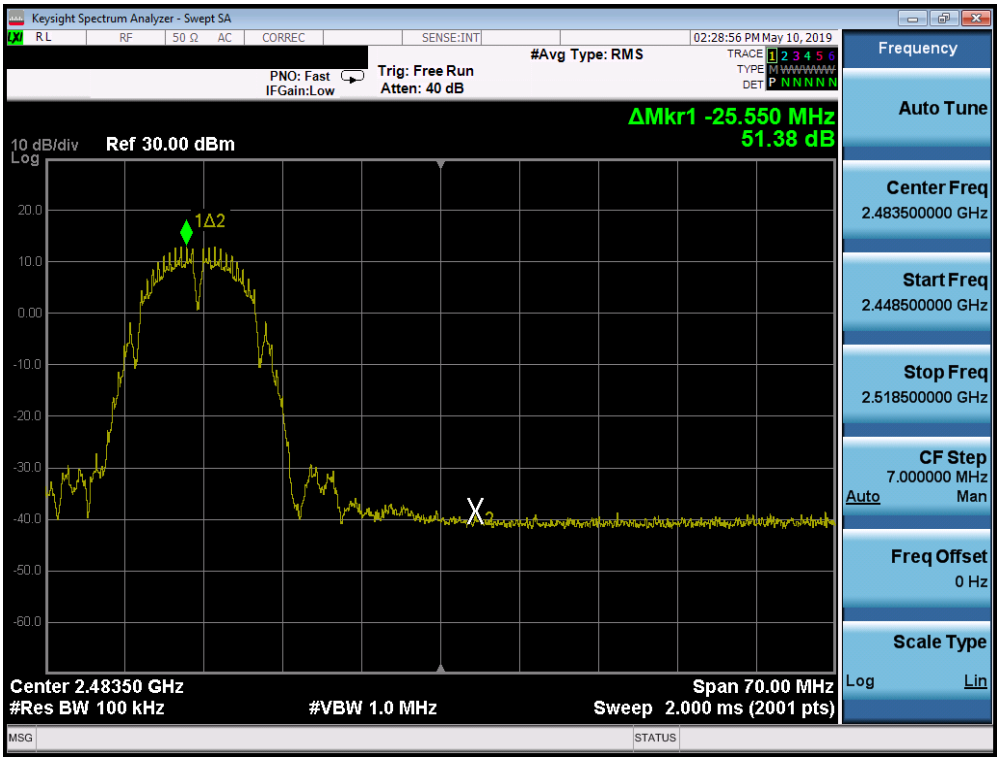
SISO Core-1 Conducted Emissions at the Band Edge



Plot 7-61. Band Edge Plot SISO CORE 1 (802.11b – Ch. 1)



Plot 7-62. Band Edge Plot SISO CORE 1 (802.11b – Ch. 11)

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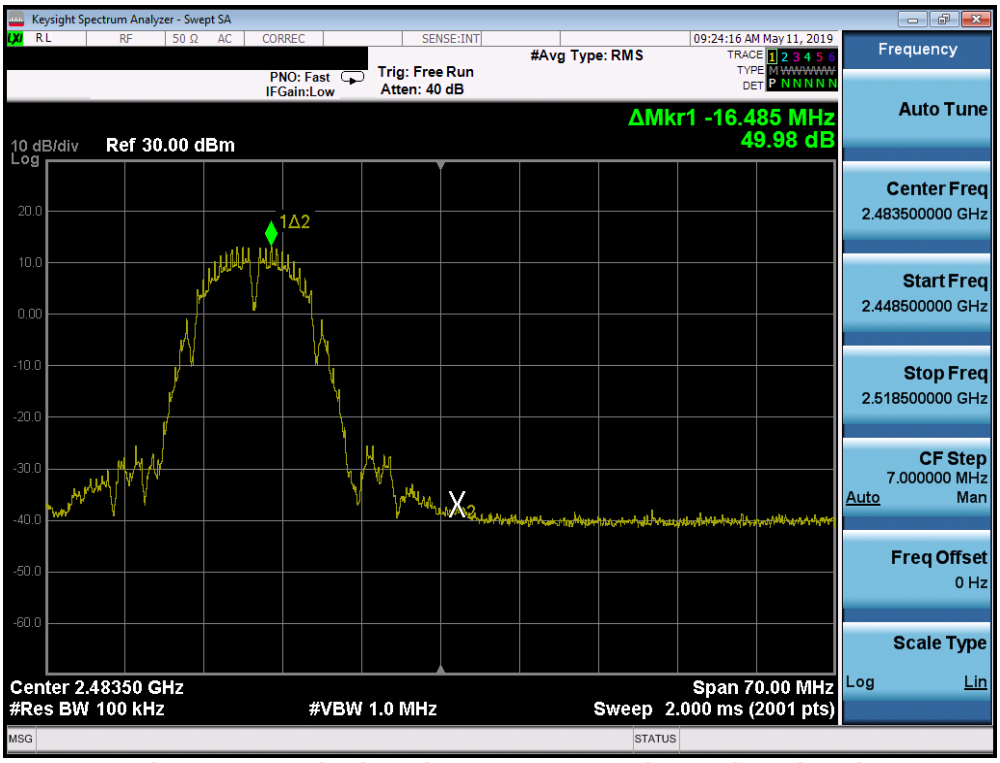
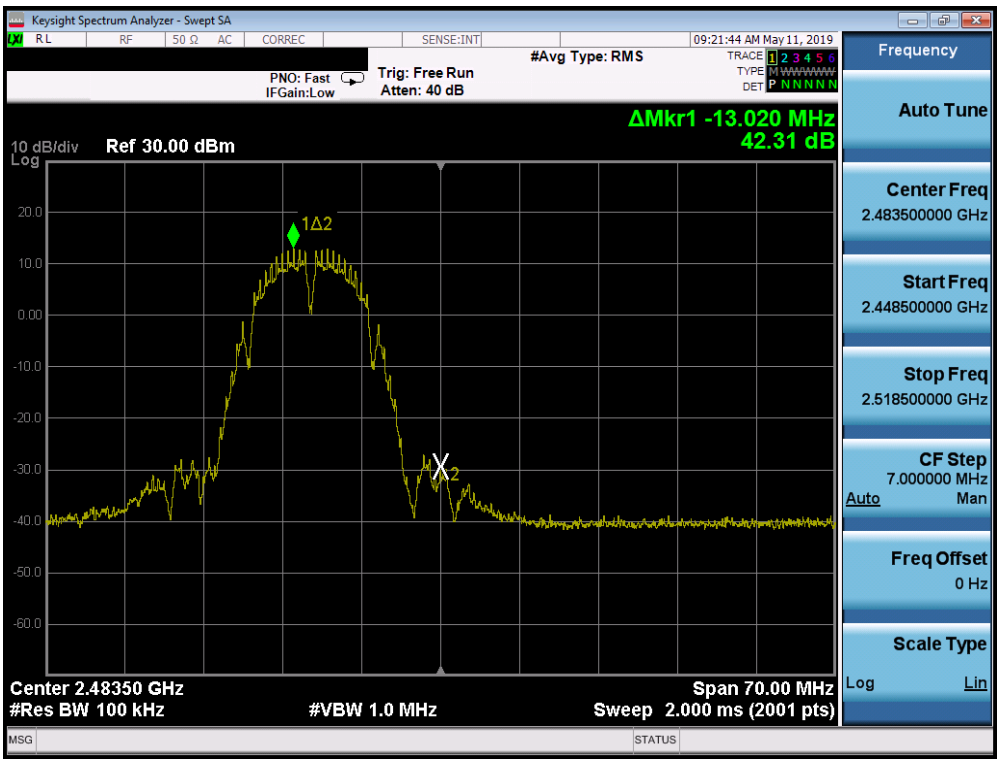


Plot 7-63. Band Edge Plot SISO CORE 1 (802.11b – Ch. 12)



Plot 7-64. Band Edge Plot SISO CORE 1 (802.11b – Ch. 13)

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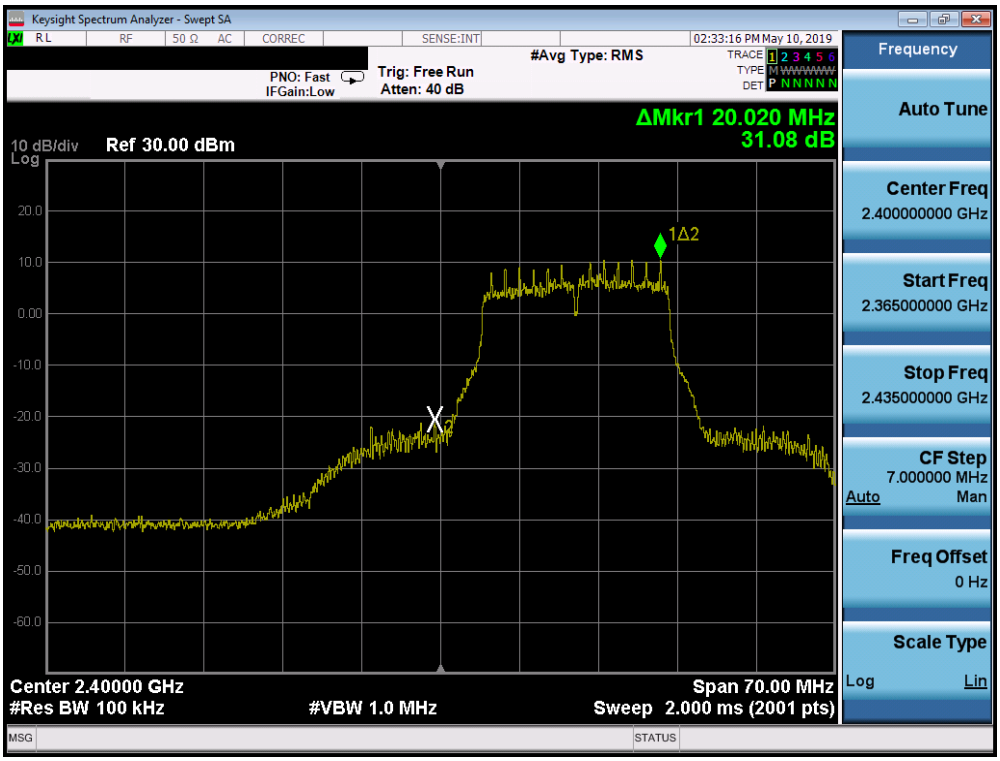
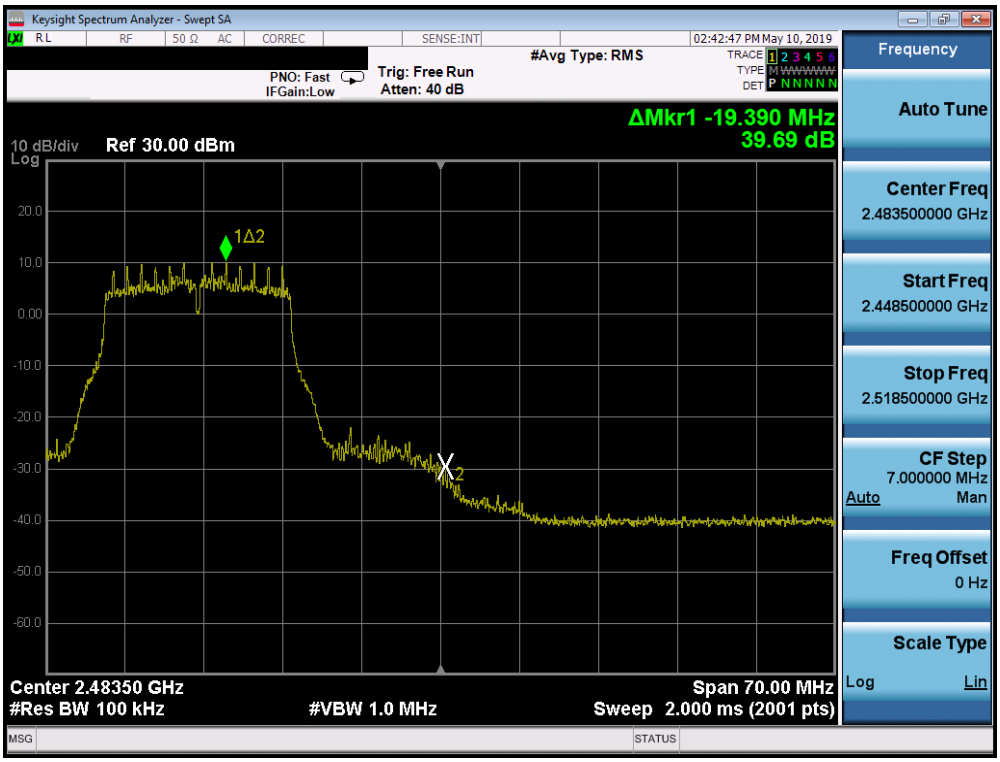


Plot 7-65. Band Edge Plot SISO CORE 1 (802.11g– Ch. 1)



Plot 7-66. Band Edge Plot SISO CORE 1 (802.11g – Ch. 11)

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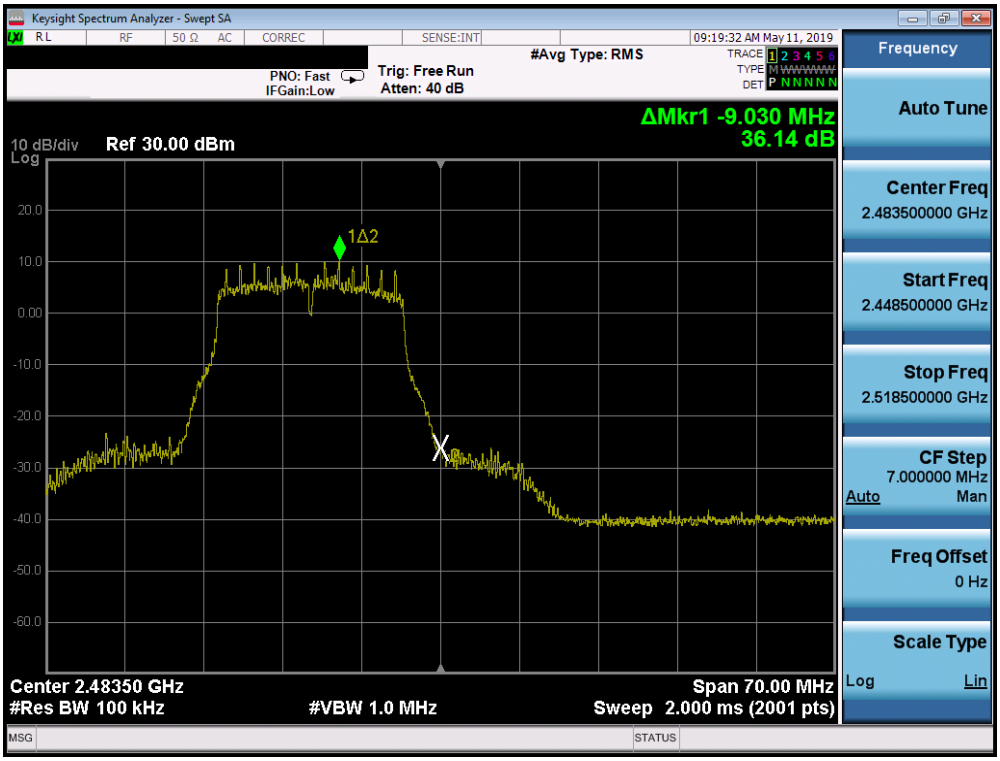
Plot 7-67. Band Edge Plot SISO CORE 1 (802.11g – Ch. 12)



Plot 7-68. Band Edge Plot SISO CORE 1 (802.11g – Ch. 13)

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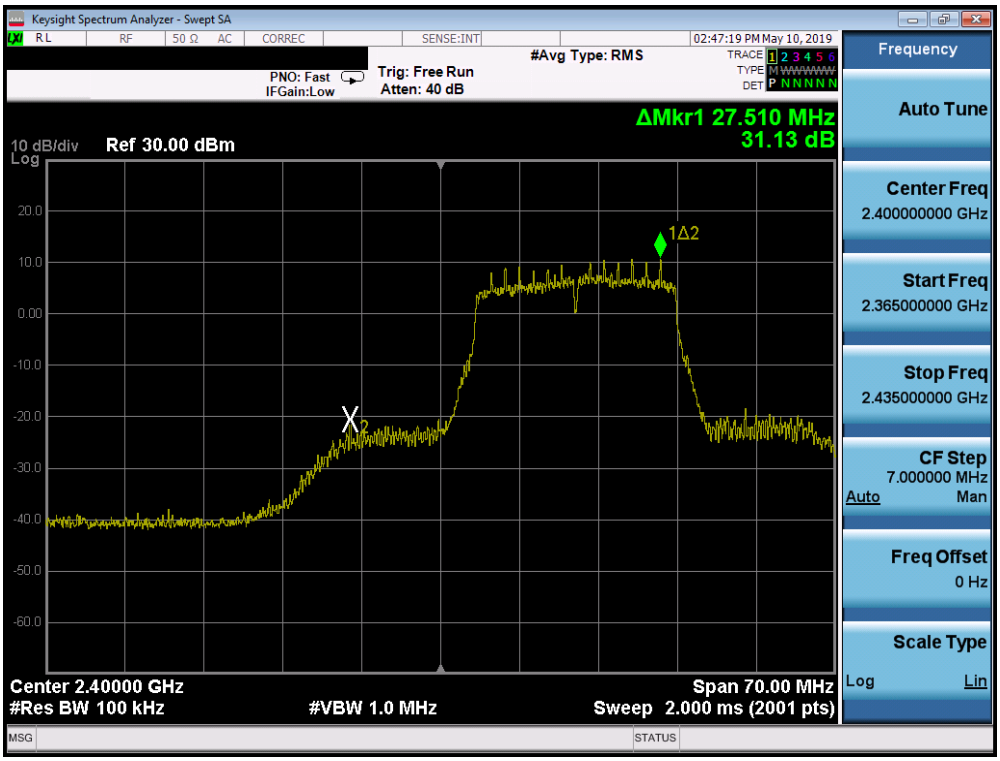
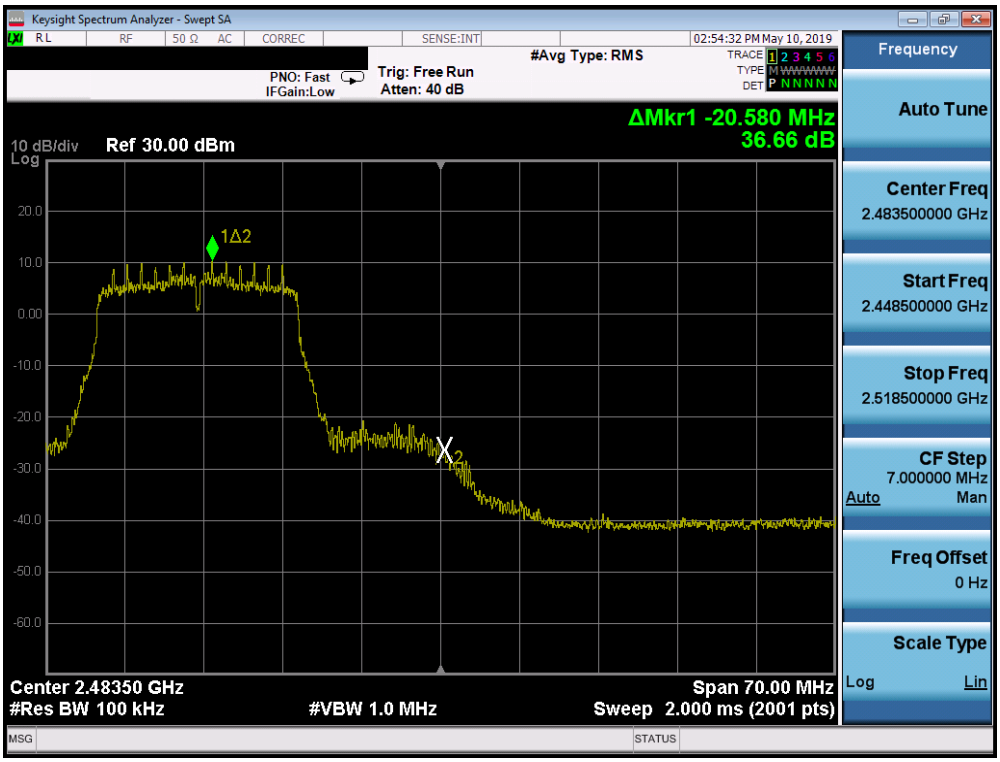


Plot 7-69. Band Edge Plot SISO CORE 1 (802.11n (2.4GHz) – Ch. 1)



Plot 7-70. Band Edge Plot SISO CORE 1 (802.11n (2.4GHz) – Ch. 11)

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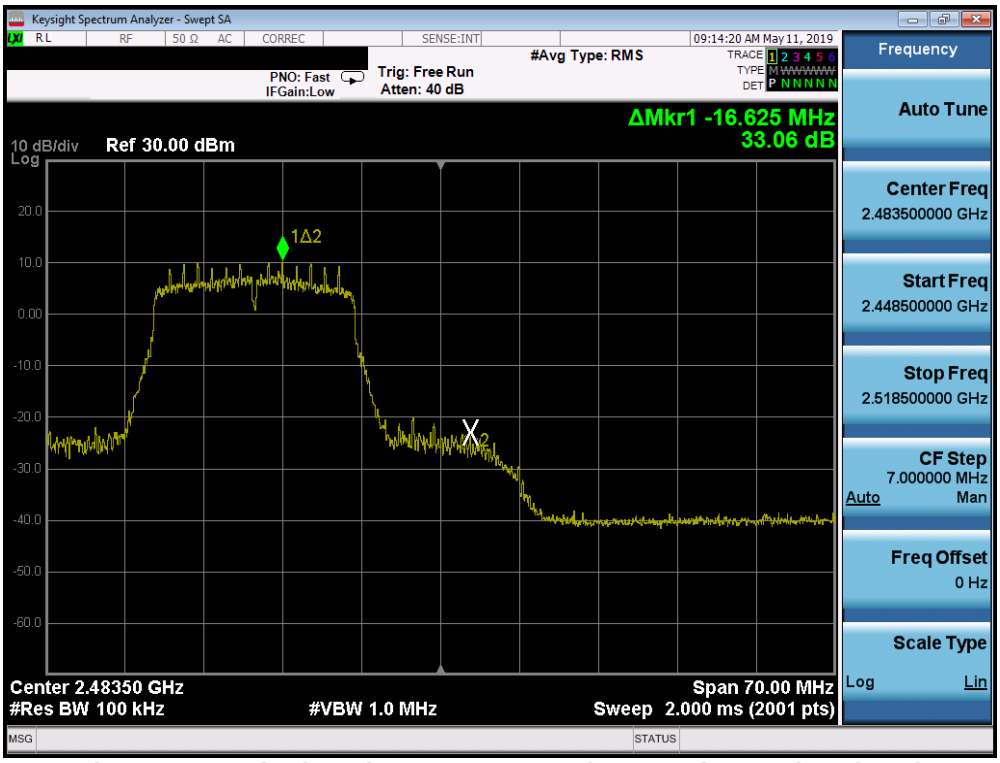
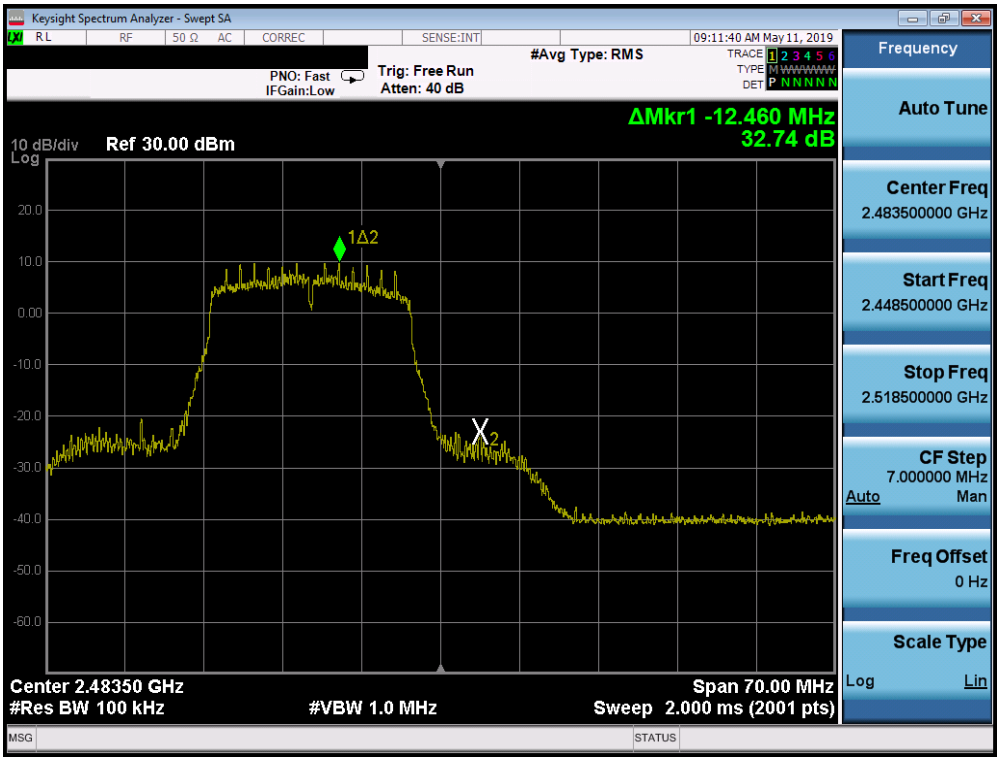


Plot 7-71. Band Edge Plot SISO CORE 1 (802.11n (2.4GHz) – Ch. 12)



Plot 7-72. Band Edge Plot SISO CORE 1 (802.11n (2.4GHz) – Ch. 13)

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7.6 Conducted Spurious Emissions

§15.247(d); RSS-247 [5.5]

Test Overview and Limit

All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. For the following out of band conducted spurious emissions plots, the EUT was investigated in all available data rates for “b”, “g”, and “n” modes. The worst case spurious emissions for the 2.4GHz band were found while transmitting in “b” mode at 1 Mbps and are shown in the plots below.

The limit for out-of-band spurious emissions at the band edge is 20dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100kHz bandwidth per the procedure in Section 11.1 of ANSI C63.10-2013 and KDB 558074 D01 v05r02.

Test Procedure Used

ANSI C63.10-2013 – Section 11.11.3
KDB 558074 D01 v05r02 – Section 8.5
ANSI C63.10-2013 – Section 14.3.3
KDB 662911 D01 v02r01 – Section E)3)b)

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 25GHz (separated into two plots per channel)
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = Peak
5. Trace mode = max hold
6. Sweep time = auto couple
7. The trace was allowed to stabilize

Test Setup

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

Figure 7-5. Test Instrument & Measurement Setup

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Test Notes

1. RBW was set to 1MHz rather than 100kHz in order to increase the measurement speed.

2. The display line shown in the following plots denotes the limit at 20dB below the fundamental emission level measured in a 100kHz bandwidth. However, since the traces in the following plots are measured with a 1MHz RBW, the display line may not necessarily appear to be 20dB below the level of the fundamental in a 1MHz bandwidth.

3. For plots showing conducted spurious emissions near the limit, the frequencies were investigated with a reduced RBW to ensure that no emissions were present.

4. The conducted spurious emissions were measured to relative limits. Therefore, in accordance with ANSI C63.10-2013 and KDB 662911 D01 v02r01 Section E)3)b), it was unnecessary to show compliance through the summation of test results of the individual outputs.

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

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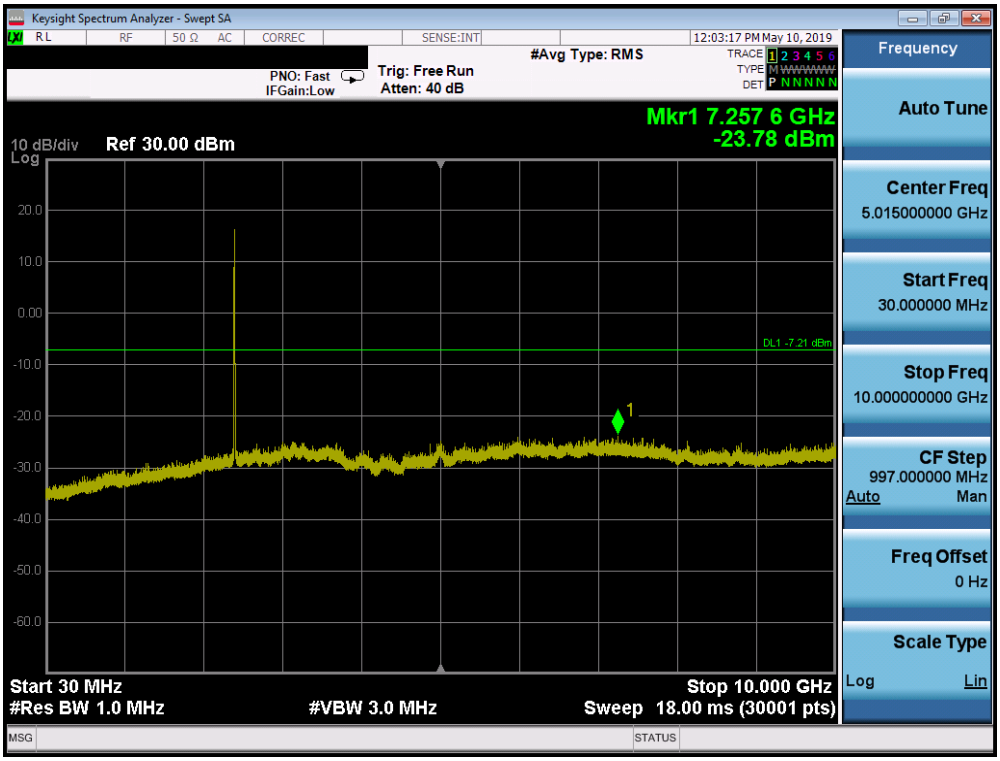
SISO Core-0 Conducted Spurious Emission



Plot 7-73. Conducted Spurious Plot SISO CORE 0 (802.11b – Ch. 1)

Plot 7-74. Conducted Spurious Plot SISO CORE 0 (802.11b – Ch. 1)

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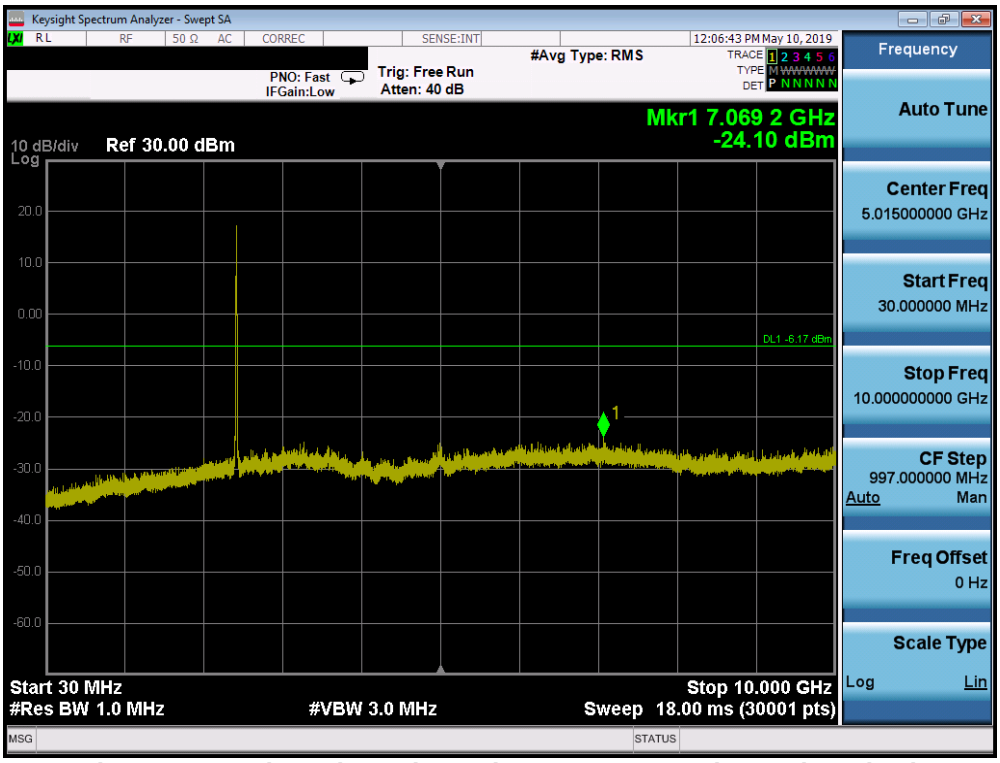

Plot 7-75. Conducted Spurious Plot SISO CORE 0 (802.11b – Ch. 6)

Plot 7-76. Conducted Spurious Plot SISO CORE 0 (802.11b – Ch. 6)

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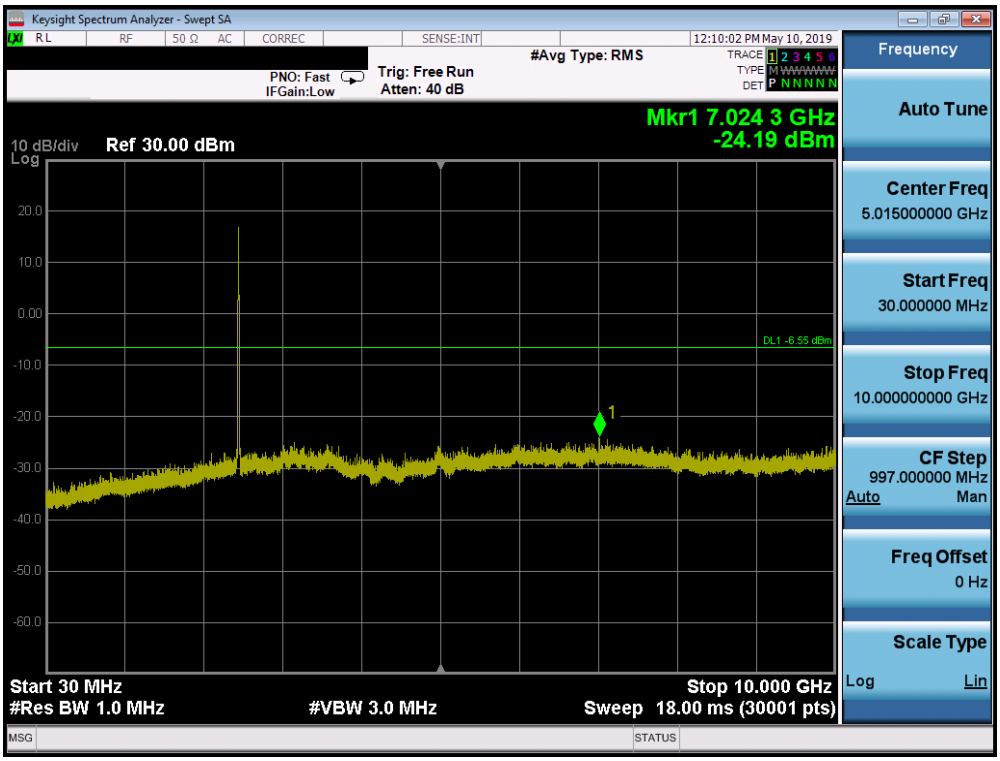

Plot 7-77. Conducted Spurious Plot SISO CORE 0 (802.11b – Ch. 11)

Plot 7-78. Conducted Spurious Plot SISO CORE 0 (802.11b – Ch. 11)

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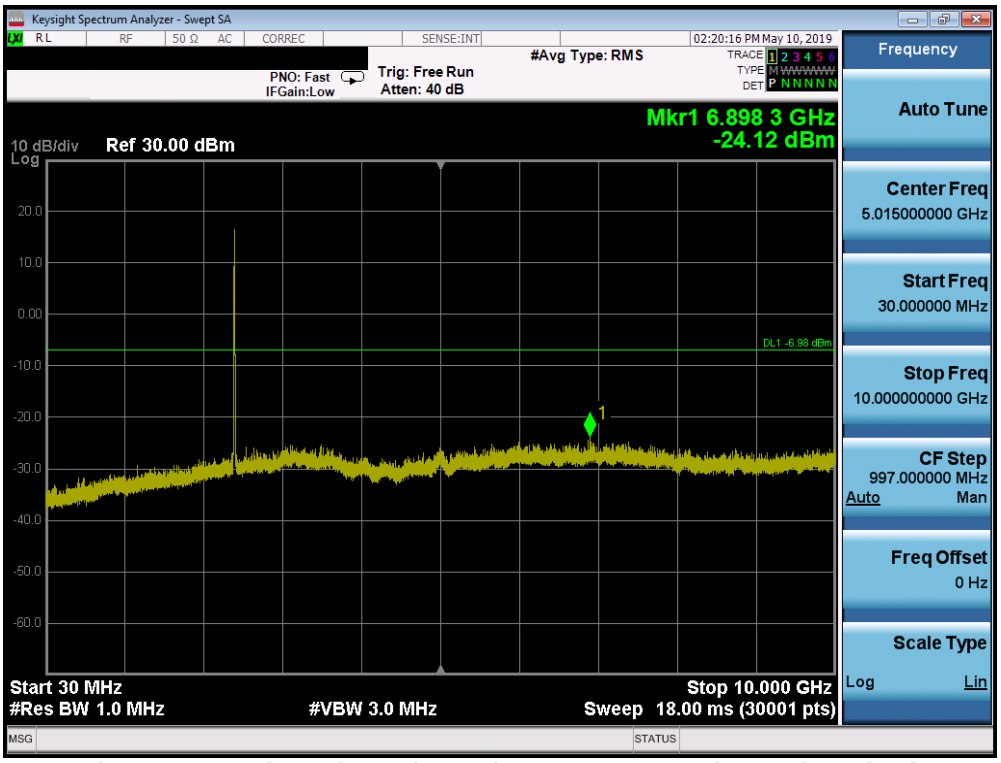
SISO Core-1 Conducted Spurious Emissions



Plot 7-79. Conducted Spurious Plot SISO CORE 1 (802.11b – Ch. 1)

Plot 7-80. Conducted Spurious Plot SISO CORE 1 (802.11b – Ch. 1)

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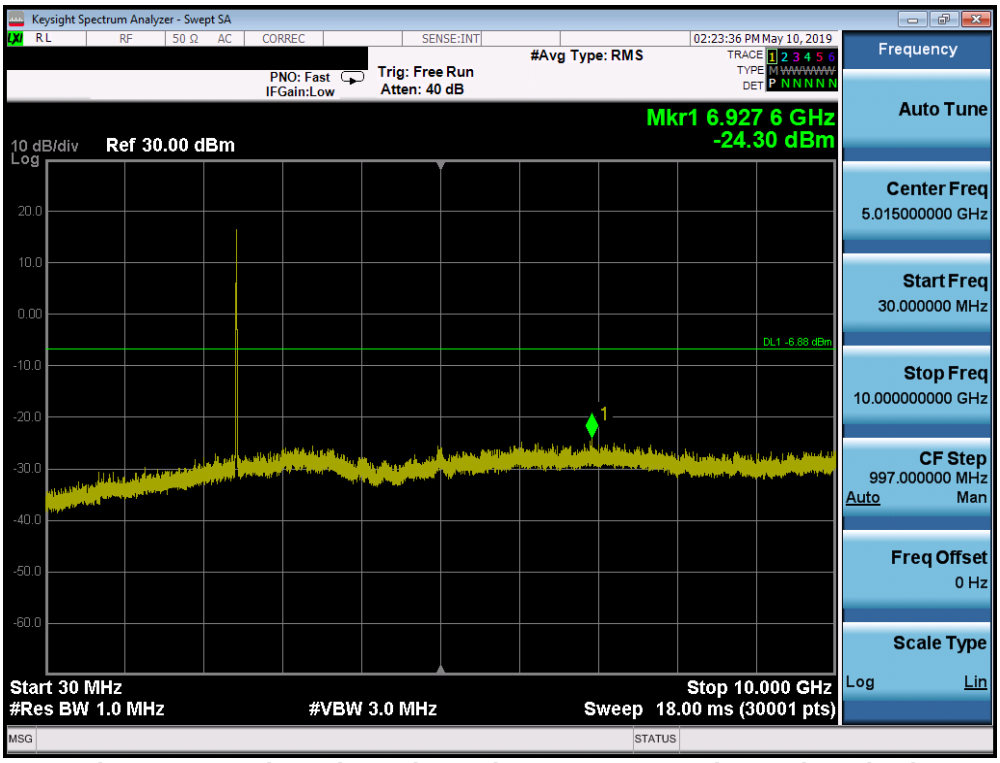

Plot 7-81. Conducted Spurious Plot SISO CORE 1 (802.11b – Ch. 6)

Plot 7-82. Conducted Spurious Plot SISO CORE 1 (802.11b – Ch. 6)

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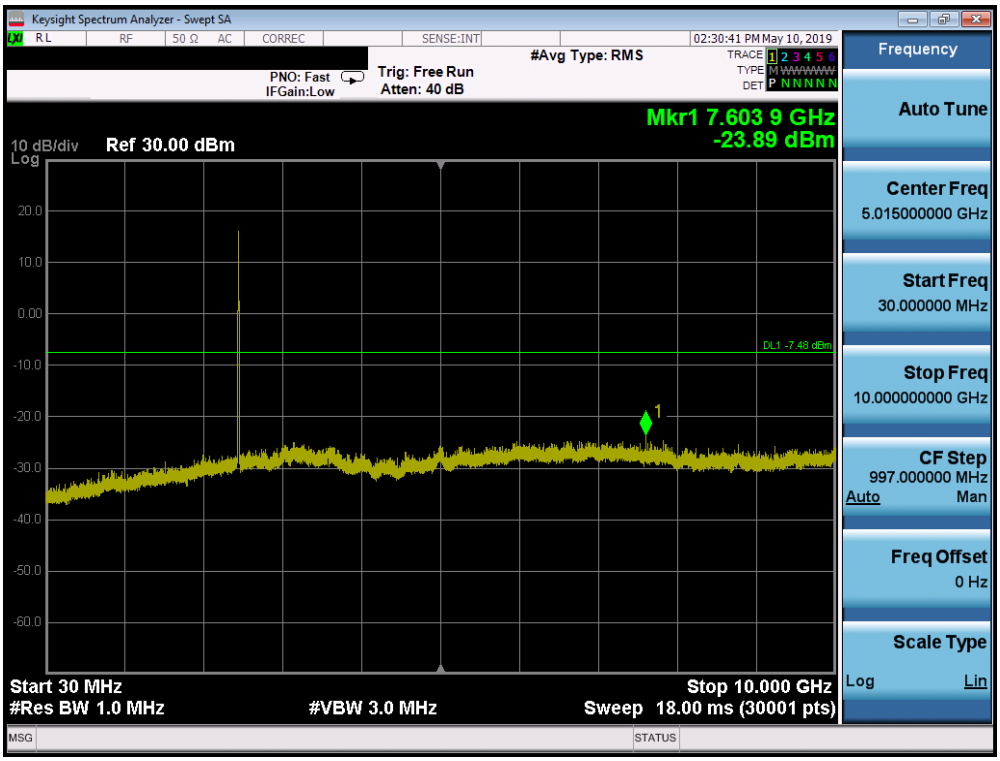

Plot 7-83. Conducted Spurious Plot SISO CORE 1 (802.11b – Ch. 11)

Plot 7-84. Conducted Spurious Plot SISO CORE 1 (802.11b – Ch. 11)

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7.7 Radiated Spurious Emission Measurements – Above 1 GHz

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

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR and Table 7 of RSS-Gen (8.10) must not exceed the limits shown in Table 7-15 per Section 15.209 and RSS-Gen (8.9).

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

Table 7-15. Radiated Limits

Test Procedures Used

ANSI C63.10-2013 – Section 6.6.4.3
KDB 558074 D01 v05r02 – Sections 8.6, 8.7

Test Settings

Average Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = power average (RMS)
5. Number of measurement points = 1001 (Number of points must be $\geq$ 2 x span/RBW)
6. Sweep time = auto
7. Trace (RMS) averaging was performed over at least 100 traces

Peak Field Strength Measurements

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

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Test Setup

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

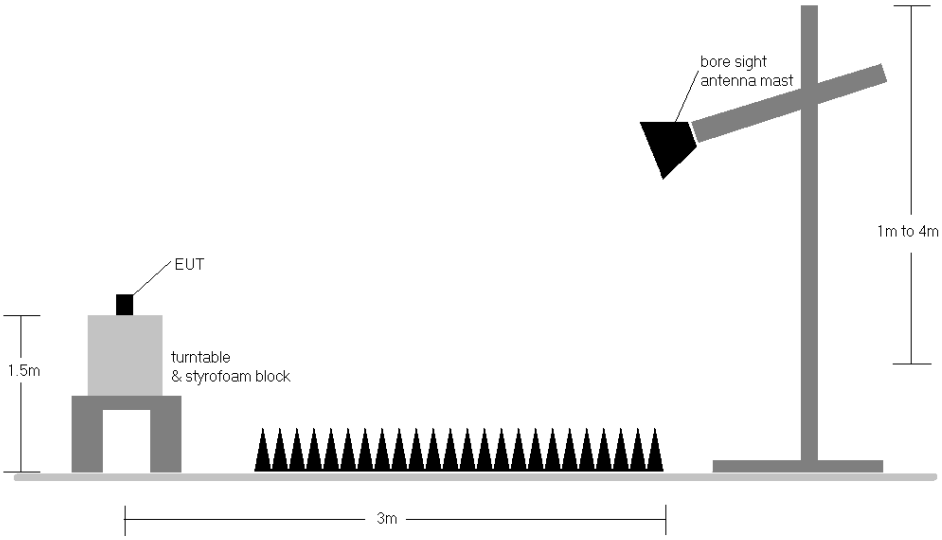

Figure 7-6. Test Instrument & Measurement Setup

Test Notes

1. The optional test procedures for antenna port conducted measurements of unwanted emissions per the guidance of KDB 558074 D01 v05r02 were not used to evaluate this device for compliance to radiated limits. All radiated spurious emissions levels were measured in a radiated test setup.
2. All emissions lying in restricted bands specified in Section 15.205 and Section 8.10 of RSS-Gen are below the limit shown in Table 7-15.
3. The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
4. This unit was tested with its standard battery.
5. The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1GHz. Above 1 GHz, average and peak measurements were taken using linearly polarized horn antennas. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.
6. Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.
7. The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. Any emissions found to be within 20dB of the limit are fully investigated and the results are shown in this section.
8. The "-" shown in the following RSE tables are used to denote a noise floor measurement.
9. All antenna configs were investigated and only the worst case is reported.

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Sample Calculations

Determining Spurious Emissions Levels

- Field Strength Level [dBμV/m] = Analyzer Level [dBm] + 107 + AFCL [dB/m]
- AFCL [dB/m] = Antenna Factor [dB/m] + Cable Loss [dB]
- Margin [dB] = Field Strength Level [dBμV/m] – Limit [dBμV/m]

Radiated Band Edge Measurement Offset

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

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

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