RADIO TEST REPORT

For

MODEL NO.:1914
FCC ID: C3K1914
IC ID: 3048A-1914

Test Report No. R-TR623-FCCISED-WLAN-1
Issue Date: June 1,2020

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

Prepared by
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ACCREDITED
TESTING CERT #3472.01

1 Record of Revisions

Revision	Date	Section	Page(s)	Summary of Changes	Author/Revised By:
1.0	06/01/2020	All	All	Version 1.0	Vishwas Narayan

Table of Contents

Test Report Attestation

Microsoft Corporation
Model: 1914
FCC ID: C3K1914
IC ID: 3048A-1914

Applicable Standards

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

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

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

Written By: Vishwas Narayan

RF Test Engineer

Reviewed/ Issued By: Daniel Salinas

RF Compliance Technical Manager

2 Deviations from Standards

None.

3 Facilities and Accreditations

3.1 Test Facility

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

3.2 Accreditations

The lab is established and follows procedures as outlined in IEC/ISO 17025 and A2LA accreditation requirements.
A2LA Accredited Testing Certificate Number: 3472.01
FCC Registration Number: US1141
IC Site Registration Numbers: 3048A-3, 3048A-4

3.3 Test Equipment

The site and related equipment are constructed in conformance with the requirements of ANSI C63.4:2014 and other equivalent applicable standards.
Test site requirements for measurements above 1 GHz are in accordance with ANSI C63.4:2014.
ANSI C63.10:2013 and the appropriate KDB test methods were followed.

4 Measurement Uncertainty

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

Test item	Uncertainty	Unit
Radiated disturbance (9KHz to 1 GHz)	5.99	dB
Radiated disturbance (1 GHz to 40 GHz)	5.12	dB
Conducted Disturbance at Mains Port	3.31	dB
Uncertainty for Conducted Power test	1.277	dB
Uncertainty for Conducted Spurious emission test	2.742	dB
Uncertainty for Bandwidth test	83	kHz
Uncertainty for DC power test	0.05	%
Uncertainty for test site temperature	0.5	ºC
Uncertainty for test site Humidity	3	%
Uncertainty for time	0.189	%

5 Product Description

Company Name:	Microsoft Corporation
Address:	One Microsoft Way
City, State, Zip:	Redmond, WA 98052-6399
Customer Contact:	Kyle Chen
Functional Description of the EUT:	Wireless input device with 802.11 a/g/n 20MHz Accessory and Bluetooth Low Energy radios
Model:	1914
FCC ID:	C3K1914
IC ID:	3048A-1914
Radio under test:	IEEE 802.11 g/n SISO Radio supporting 20 MHz Bandwidth (2.4 GHz- 2.4835 GHz)
Modulation(s):	BPSK, OFDM, and QAM modulation
Antenna Information:	Integral Antenna. **Manufacturer declared Antenna Gain:** Chain A: 1.74dBi
EUT Classification:	DTS
Equipment Design State:	Prototype/Production Equivalent (DV)
Equipment Condition:	Good
Test Sample Details:	**RF Conducted Test Sample** Asset No.: R-623-DV-03, S/N: 09710000705012 **RF Radiated Test Sample** Asset No.: R-623-DV-11, S/N: 09710001225012 Asset No.: R-623-DV-12, S/N: 09710001195012 Asset No.: R-623-DV-01, S/N: 09710001075012

5.1 Test Configurations

Test software “Tera Term V4.102/Tera Term 4.97” and “QA Tool V0.0.1.63” provided by the customer was used to program the EUT to transmit continuously.
All modes of operation were investigated initially with full testing performed on the worst-case modes. This report contains data from the following worst-case modes of operation:
802.11g: 6Mbps
802.11n: 6.5Mbps

5.2 Environmental Conditions

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

5.3 Antenna Requirements

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

5.3.1 Antenna Gain

Antenna Gain	
Frequency Band (MHz)	**Chain A Wi-Fi Antenna Peak Gain (dBi)**
2400 – 2483.5	1.74

5.4 Equipment Modifications

No modifications were made during testing.

5.5 Dates of Testing

Testing was performed from April 20th 2020 to May 21st 2020

5.6 Test Engineers

Test Case	Test Engineers
Radiated	Akshay Landge Nitin Kishore Kumar Nanda Gopal Jeevarathnam Paulami Roy Pooja Akhoury Shiny Yadiki
Conducted	Vishwas Narayan

6 Test Results Summary

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

7 Test Equipment List

Equipment used for Radiated and Conducted Measurements				
Manufacturer	**Description**	**Model #**	**Asset #**	**Calibration Due**
Keysight	Signal Analyzer	N9020B	RF-997	5/5/2020*
Rohde & Schwarz	EMI Test Receiver	ESU40	RF-248	4/5/2021
Rohde & Schwarz	EMI Test Receiver	ESU40	RF-192	4/5/2021
Rohde & Schwarz	Open Switch and Control	OSP130	RF-249	12/11/2020
Rohde & Schwarz	Open Switch and Control	OSP150	RF-250	12/11/2020
Rohde & Schwarz	Open Switch and Control	OSP130	RF-018	12/15/2020
Rohde & Schwarz	Open Switch and Control	OSP150	RF-019	12/15/2020
Rohde & Schwarz	Custom Filter Bank	SFUNIT RX	RF-323	12/5/2020
Rohde & Schwarz	Preamplifier	TS-PR26	RF-199	12/4/2020
Rohde & Schwarz	Power Meter	NRP2	RF-210	4/7/2021
Rohde & Schwarz	Power Sensor	NRP-Z81	RF-283	4/12/2021
Sunol Sciences	Antenna - Broadband	JB6	EMC-640	1/28/2021
ETS-Lindgren	Antenna – Passive Loop	6512	RF-202	2/21/2021
ETS-Lindgren	Antenna - Double-Ridged	3117	RF-139	6/14/2020
ETS-Lindgren	Antenna - Standard Gain	3160-09	EMC-452	11/21/2020
Huber & Suhner	RF Cable	SucoFlex 100	RF-452	12/15/2020
Huber & Suhner	RF Cable	SucoFlex 100	RF-350	12/5/2020
Huber and Suhner	RF-Cable	Cable- SucoFlex 106A	RF-599	12/6/2020
Huber & Suhner	RF Cable	SucoFlex 102A	RF-269	12/3/2020
Micro-Coax	RF Cable	UTI Flex	RF-359	12/15/2020
Micro-Coax	RF Cable	UTI Flex	RF-354	12/6/2020

Micro-Coax	RF Cable	UFB311A-1-0787-50U50U	EMC-351	12/15/2020
MegaPhase	RF Cable	EMC3-N1N1-394	RF-1035	12/26/2020
MegaPhase	RF Cable	EMC3-N1N1-394	RF-1036	12/26/2020
Madge Tech	THP Monitor	PRHTemp2000	EMC-167	8/19/2020
Murata	Cable	MXJA01JA1000	RF-885	4/28/2021
Pasternack	Attenuator	PE7004-6	EMC-951	1/28/2021
Pasternack	Attenuator	PE7087-6	RF-563	4/28/2021
PCE	Climate Meter	PCE-THB 40	EMC-1205	10/21/2020

Equipment used for AC Line Conducted Emissions

Manufacturer	Description	Model #	Asset #	Calibration Due
Rohde & Schwarz	Receiver	ESR3	RF-997	4/5/2021
Teseq	EUT LISN	NNB 51	RF-248	4/5/2021
EMCO	AE LISN	3810/2 LISN	RF-192	4/5/2021
Micro-Coax	RF Cable	CA HFK	RF-249	12/11/2020
ETS-Lindgren	TILE Profile	Ver 7.5.3.5	RF-250	12/11/2020
Fluke	Multimeter	87V	RF-018	12/15/2020
PCE	Environmental Monitor	PCE-THB 40	RF-019	12/15/2020
Chroma	AC Power Source	61602	RF-323	12/5/2020

Manufacturer	Description	Model #	Asset #	Calibration Due
Rohde & Schwarz	EMC 32 Test Software	V10.01.0	N/A	N/A

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

8 Test Site Description

8.1 Radiated Emissions Test Site

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

8.1.1 Radiated Measurements in 9kHz- 30 MHz

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

8.1.2 Radiated Measurements in 30 MHz - 1000 MHz

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

8.1.3 Radiated Measurements above 1GHz

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

8.2 Antenna port conducted measurements

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

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

8.3 Test Setup Diagrams

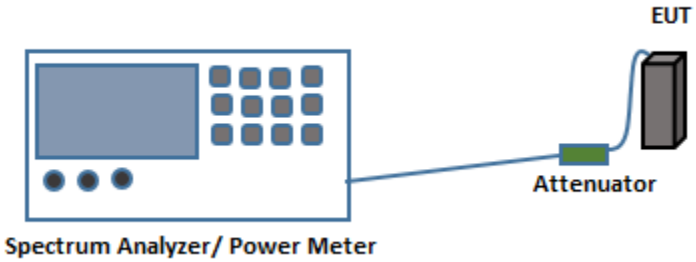


Fig.1. Test Setup for Antenna port conducted measurements

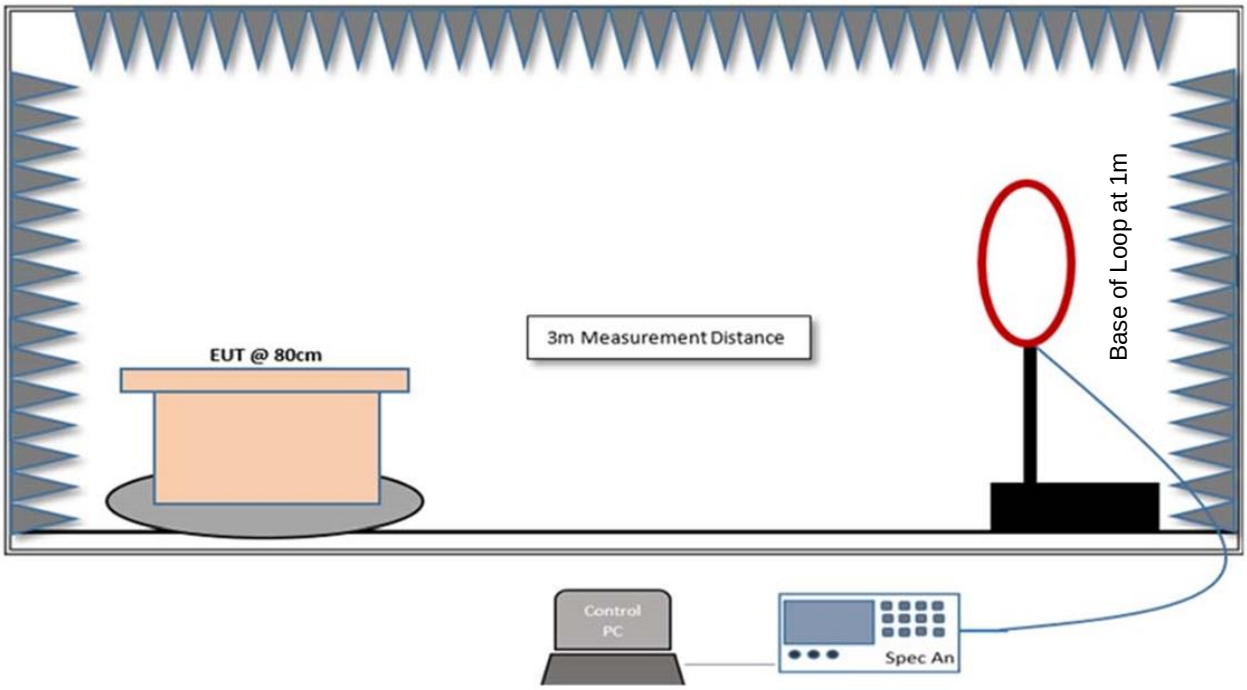


Fig.2. Test Setup for Radiated measurements in 9kHz - 30MHz Range

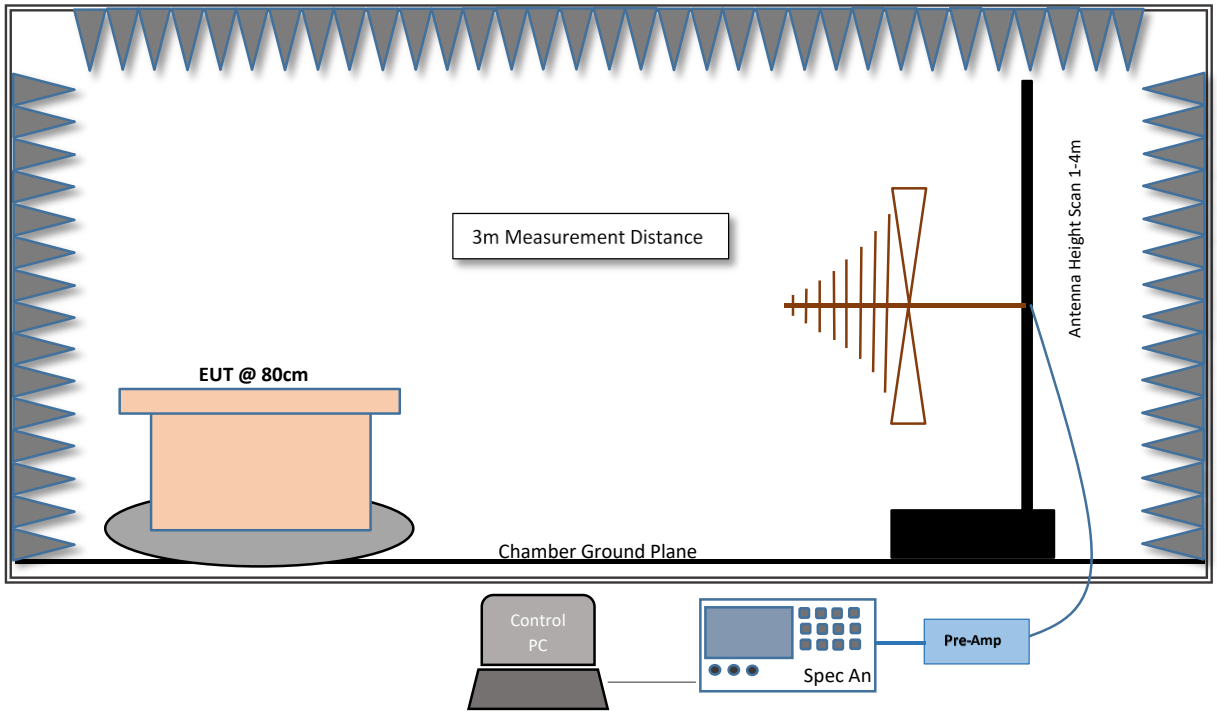


Fig.3. Test Setup for Radiated measurements in 30MHz- 1GHz Range

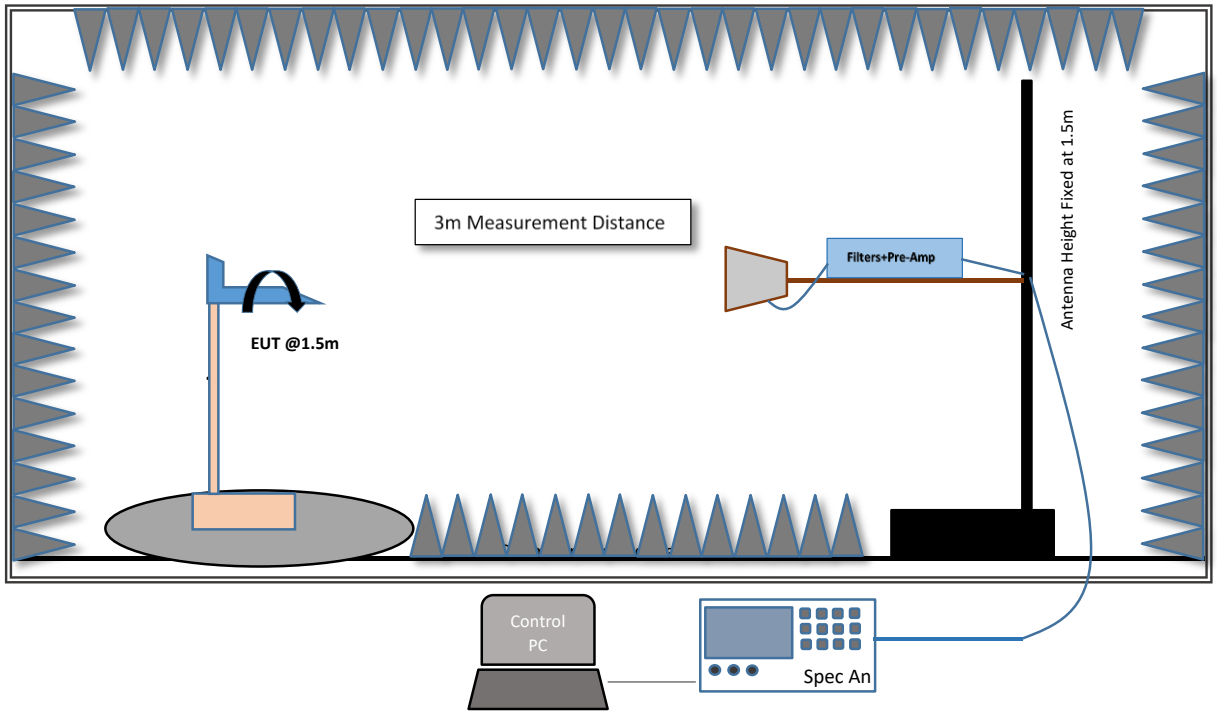


Fig.4. Test Setup for Radiated measurements in 1GHz- 18GHz Range

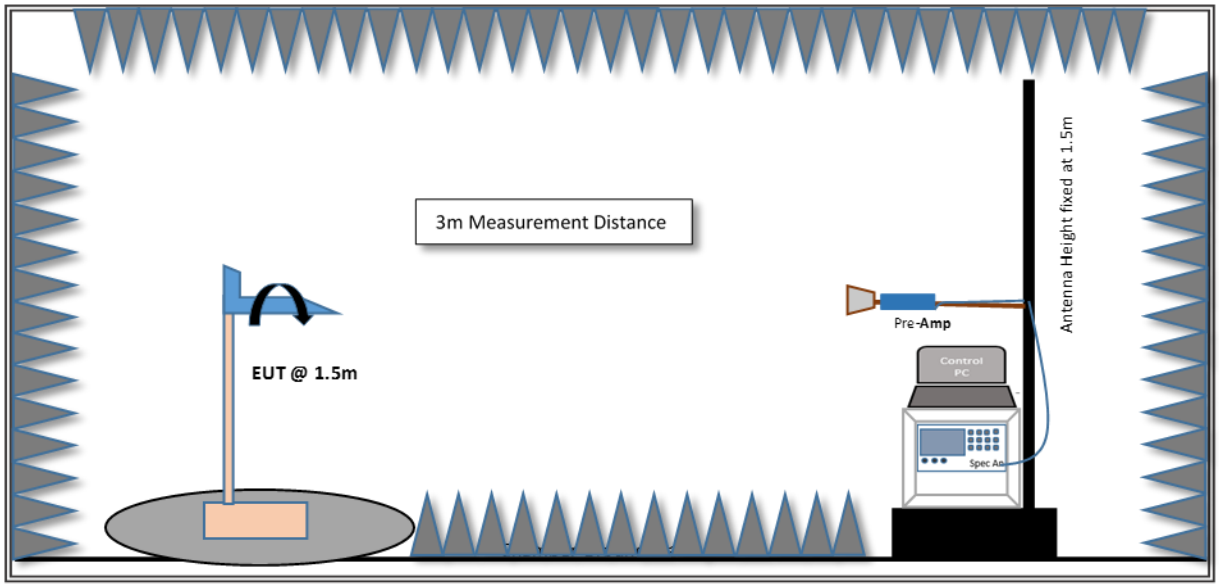


Fig.5. Test Setup for Radiated measurements >18GHz

9 Test Results- Conducted

9.1 Duty Cycle

9.1.1 Test Requirement:

Reporting and measurement purposes only.

9.1.2 Test Method:

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

Spectrum Analyzer Settings:
RBW ≥ Occupied Bandwidth if possible; otherwise, set RBW to the largest available value
VBW ≥ RBW ≥ Signal Period
Detector = Peak
Span = 0 Hz
Sweep points > 100

9.1.3 Limits:

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

9.1.4 Test Results:

Mode	Path A/B	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11g	A	1.386	1.458	95.062	0.220
802.11n	A	1.308	1.368	95.614	0.195

9.1.5 Test Data:

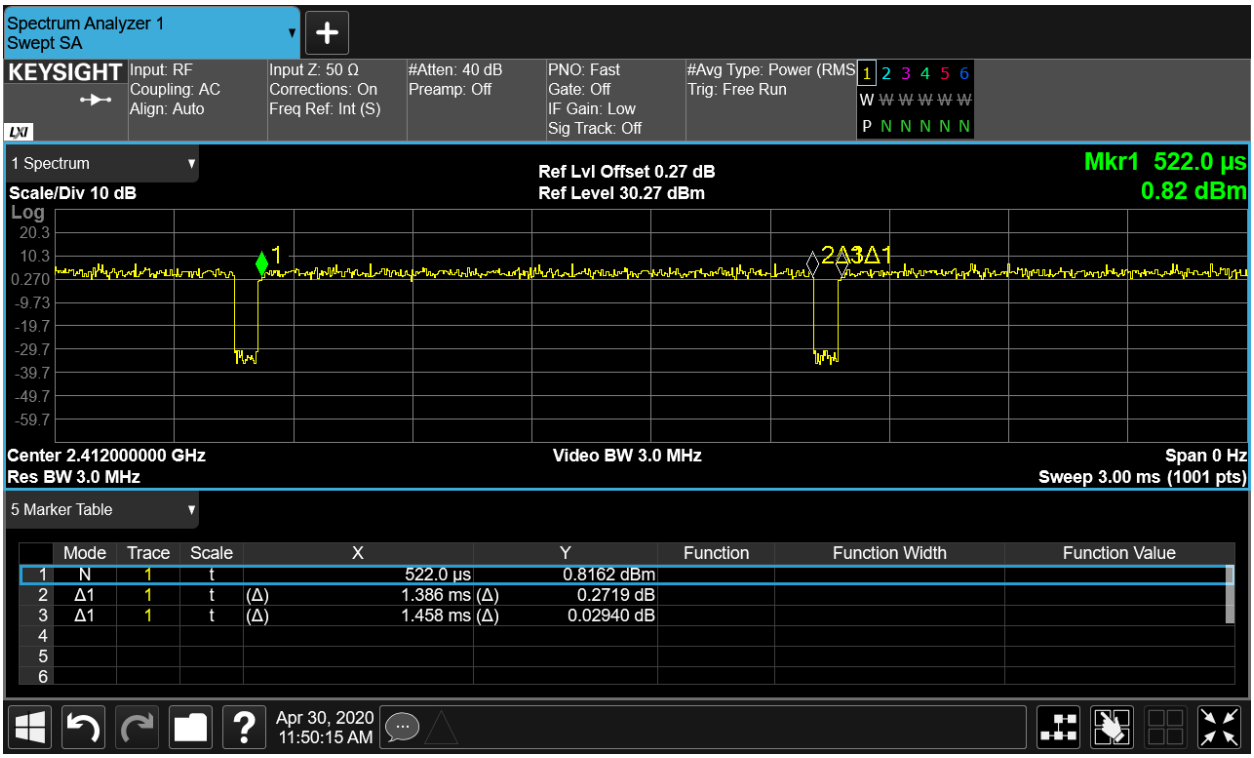


Figure 9-1. Duty Cycle 802.11g- Path A

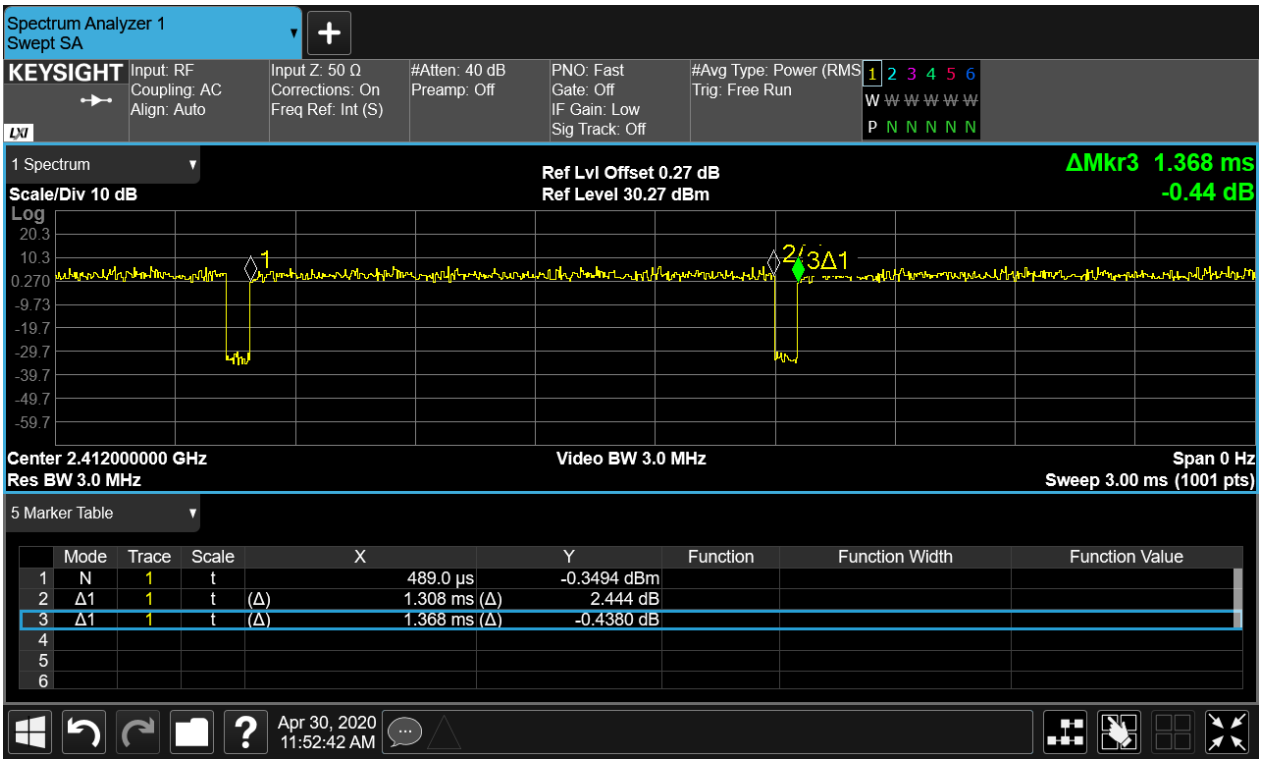


Figure 9-2. Duty Cycle 802.11n -Path A

9.2 DTS Bandwidth

9.2.1 Test Requirement:

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

ISED RSS-247 [5.2]

9.2.2 Test Method:

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

Spectrum Analyzer Settings:
RBW= 100 kHz
VBW≥ 3 × RBW
Detector = Peak
Span = 30MHz
Trace Mode= Max Hold
Sweep time= Auto Couple
The in-built functionality of the Spectrum Analyzer is used to measure the 6-dB bandwidth.

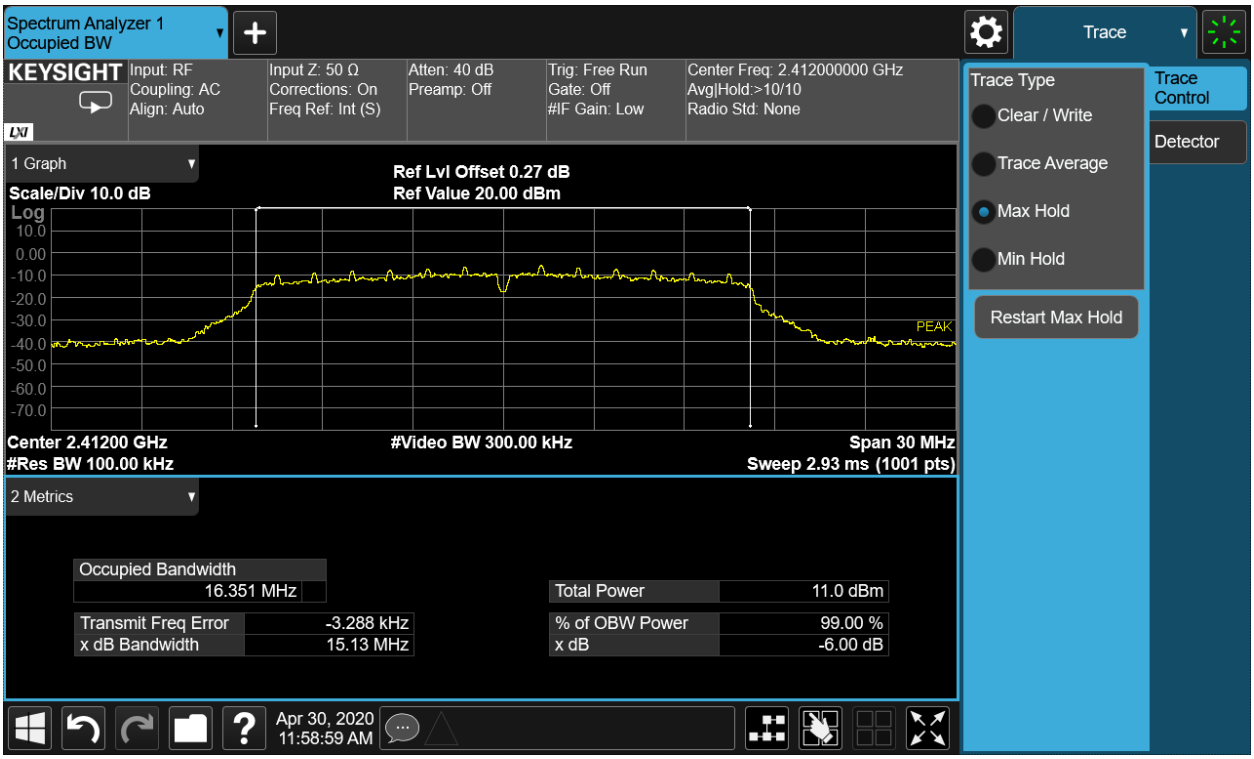
9.2.3 Limits:

The 6-dB bandwidth shall be at least 500 kHz

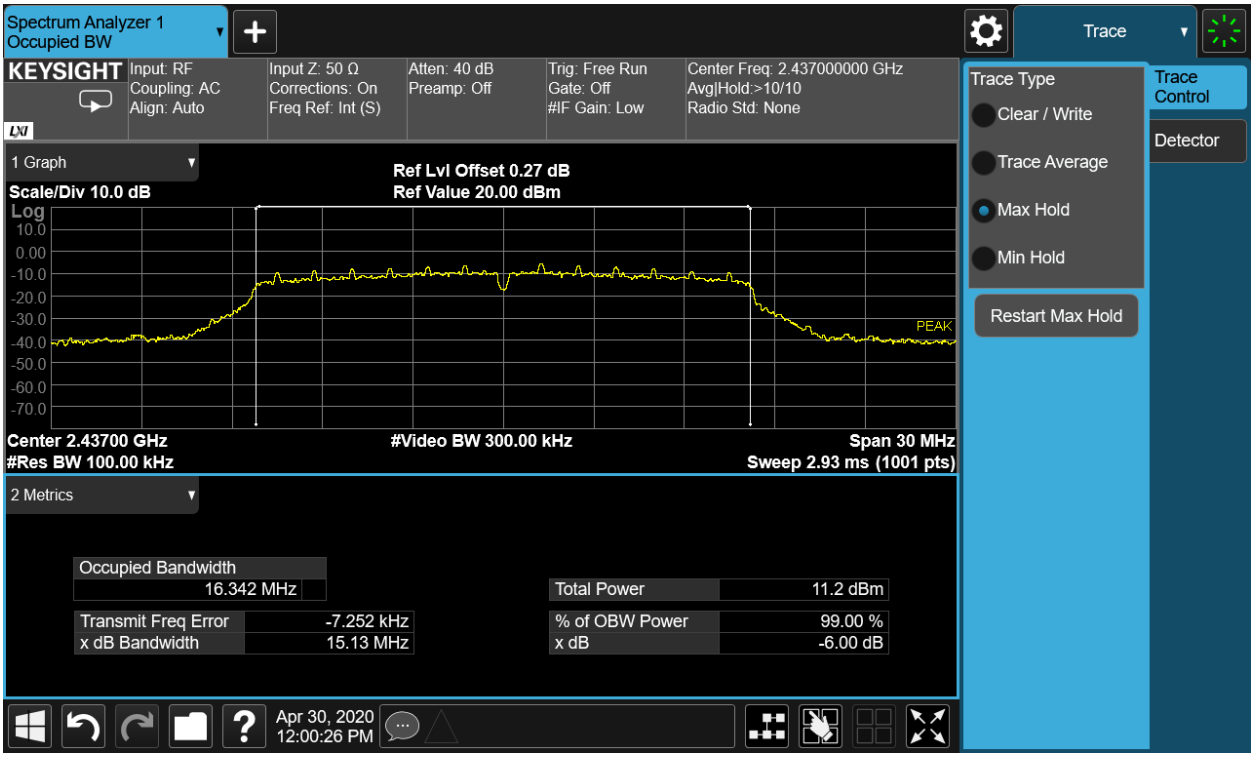
9.2.4 Test Results:

Chain A 802.11g 6-dB Emission Bandwidth				
Channel No.	**Frequency (MHz)**	**6-dB Emission Bandwidth (MHz)**	**Limit (MHz)**	**Result**
1	2412	15.13	≥ 0.5	Pass
6	2437	15.13	≥ 0.5	Pass
11	2462	15.13	≥ 0.5	Pass
Chain A 802.11n 6-dB Emission Bandwidth				
Channel No.	**Frequency (MHz)**	**6-dB Emission Bandwidth (MHz)**	**Limit (MHz)**	**Result**
1	2412	15.13	≥ 0.5	Pass
6	2437	15.13	≥ 0.5	Pass
11	2462	15.13	≥ 0.5	Pass

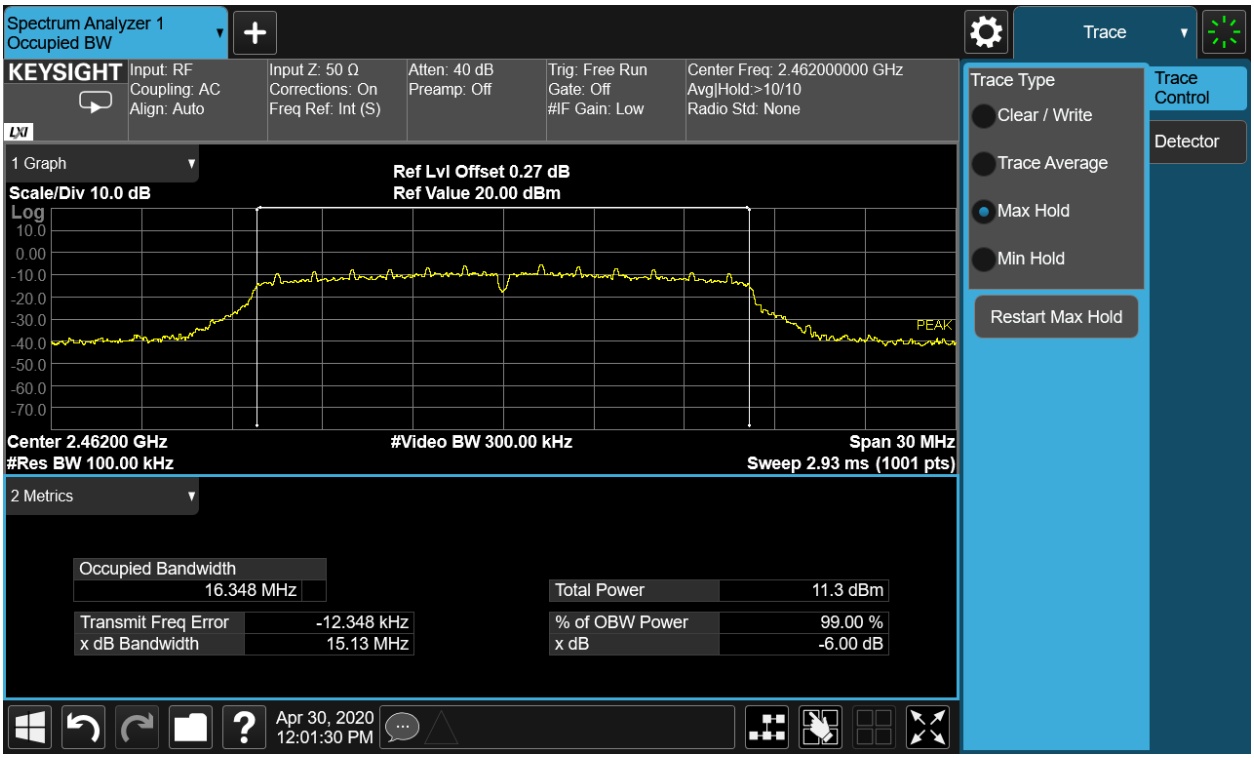
9.2.5 Test Data:



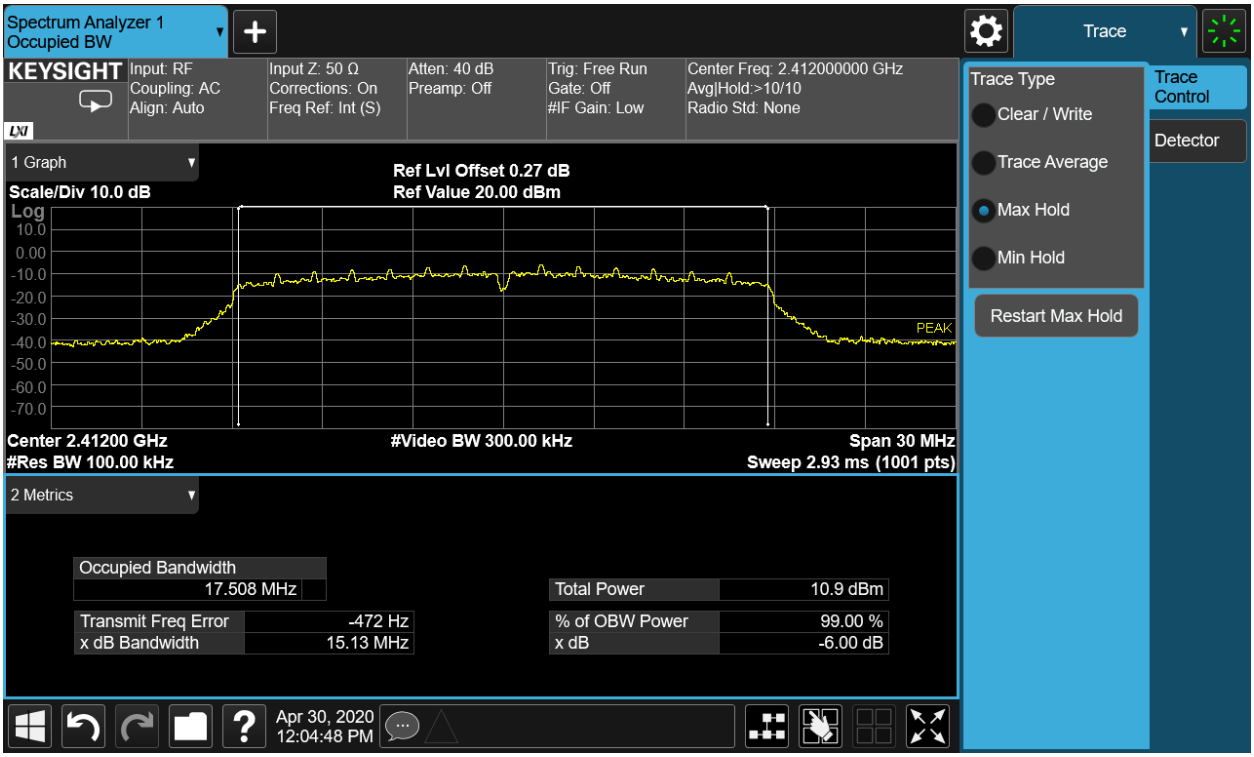
Plot 9-3 Chain A DTS Bandwidth 802.11g mode - Ch.1 (2412 MHz)



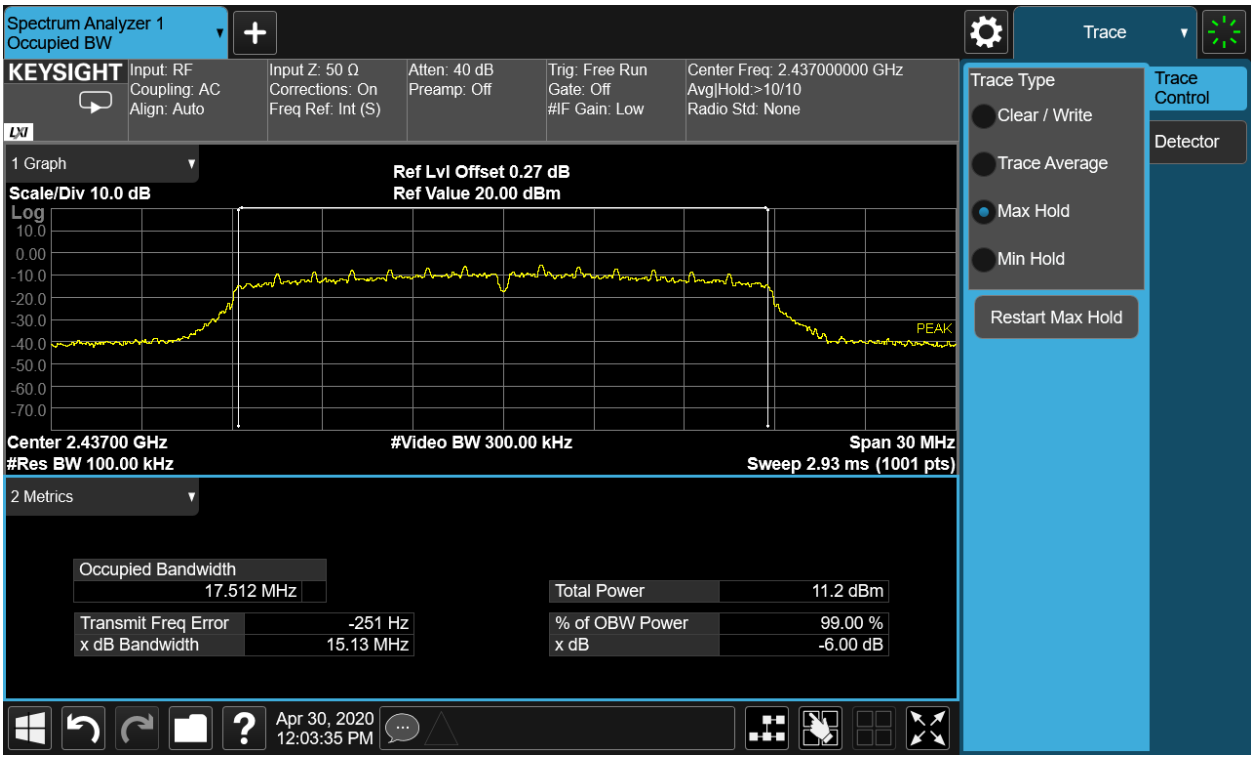
Plot 9-4 Chain A DTS Bandwidth 802.11g mode - Ch.6 (2437 MHz)



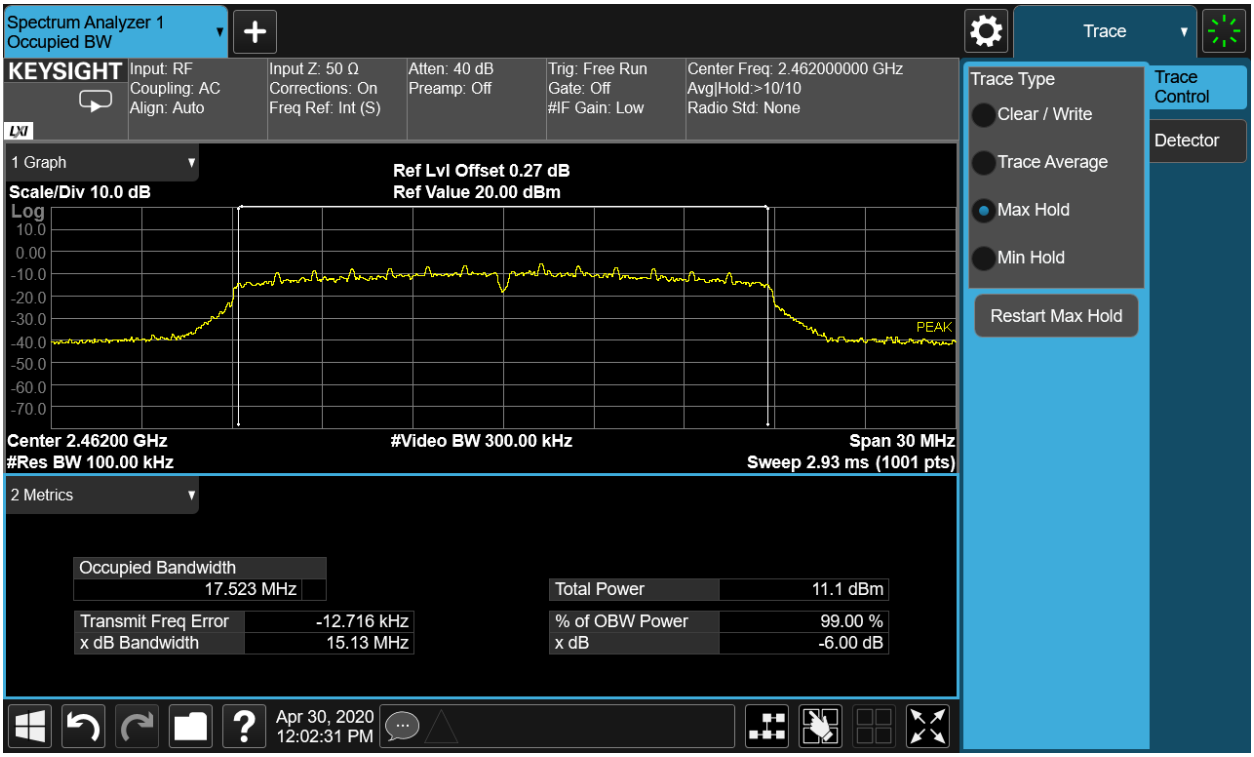
Plot 9-5 Chain A DTS Bandwidth 802.11g mode - Ch.11 (2462 MHz)



Plot 9-6 Chain A DTS Bandwidth 802.11n mode - Ch.1 (2412 MHz)



Plot 9-7 Chain A DTS Bandwidth 802.11n mode - Ch.6 (2437 MHz)



Plot 9-8 Chain A DTS Bandwidth 802.11n mode - Ch.11 (2462 MHz)

9.3 99% Bandwidth

9.3.1 Test Requirement:

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

9.3.2 Test Method:

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

Spectrum Analyzer settings:

Set analyzer center frequency to the nominal EUT channel frequency
Span set to between 1.5 and 5.0 times the DTS bandwidth
RBW to: 1% to 5% of the OBW
VBW ≥ 3 RBW
Detector = Peak
Sweep time = auto couple
Trace mode = max hold
Use the 99% power bandwidth function of the instrument.

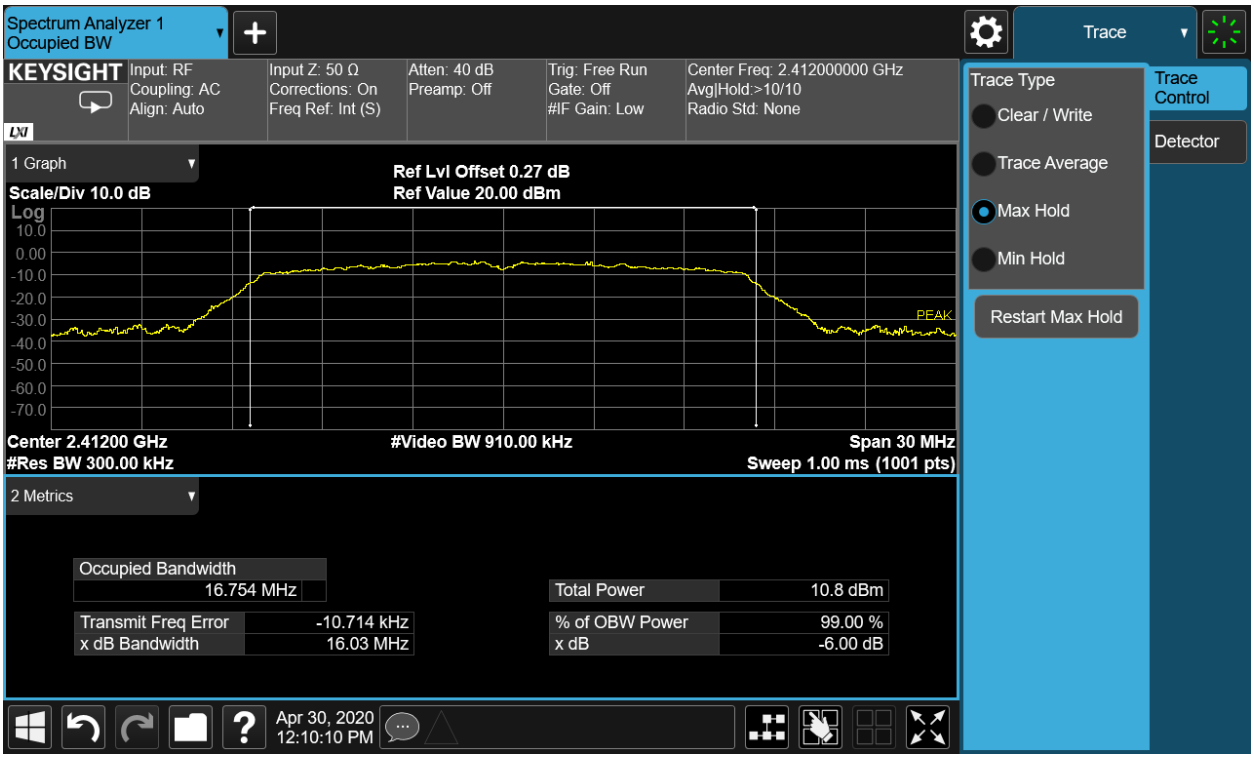
9.3.3 Limit:

Reporting and measurement purposes only.

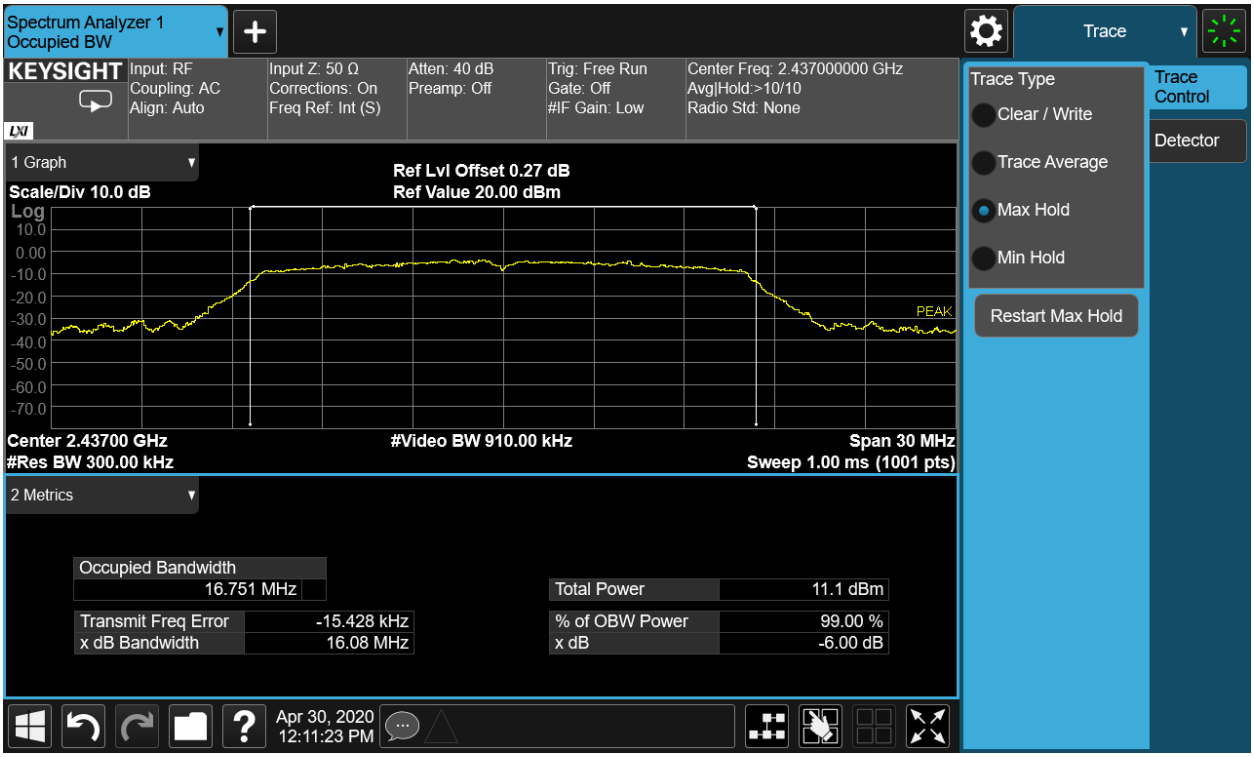
9.3.4 Test Results:

Chain A 802.11g 99% Bandwidth (MHz)		
Channel No.	**Frequency (MHz)**	**99% Bandwidth (MHz)**
1	2412	16.754
6	2437	16.751
11	2462	16.756
Chain A 802.11n 99% Bandwidth (MHz)		
Channel No.	**Frequency (MHz)**	**99% Bandwidth (MHz)**
1	2412	17.633
6	2437	17.66
11	2462	17.647

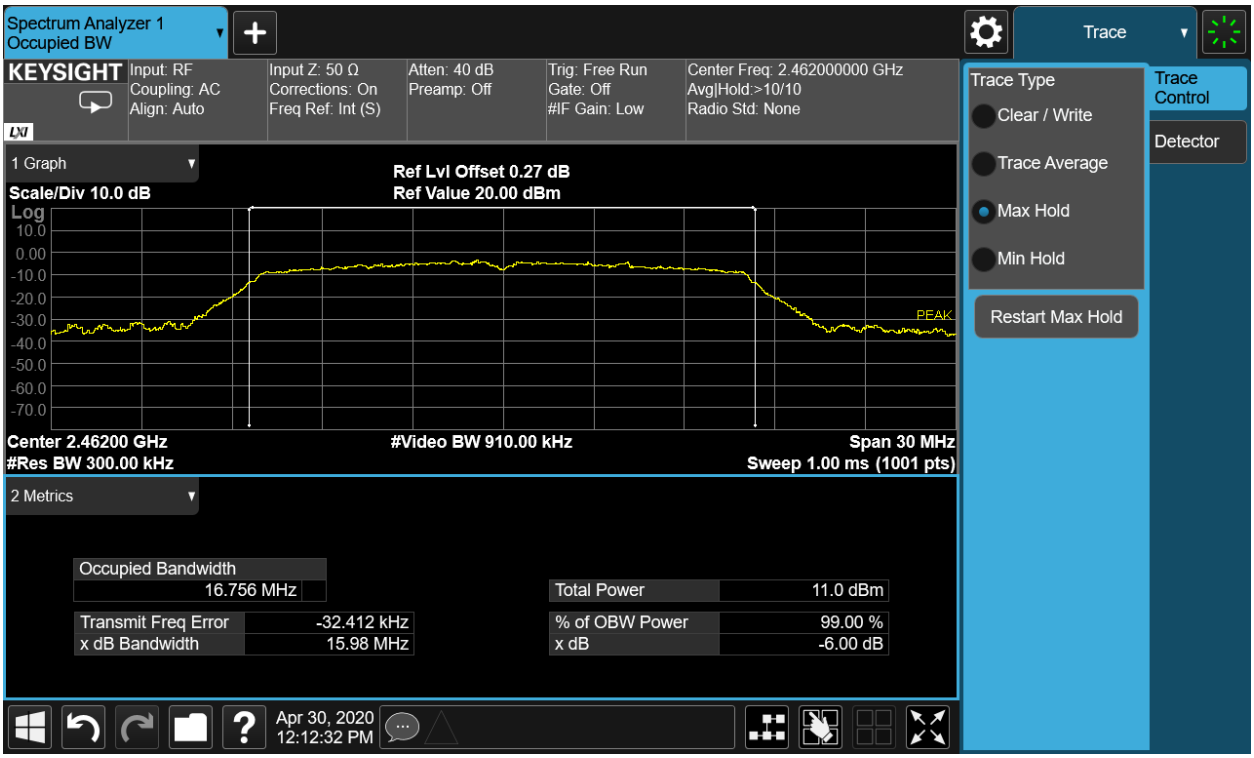
9.3.5 Test Data:



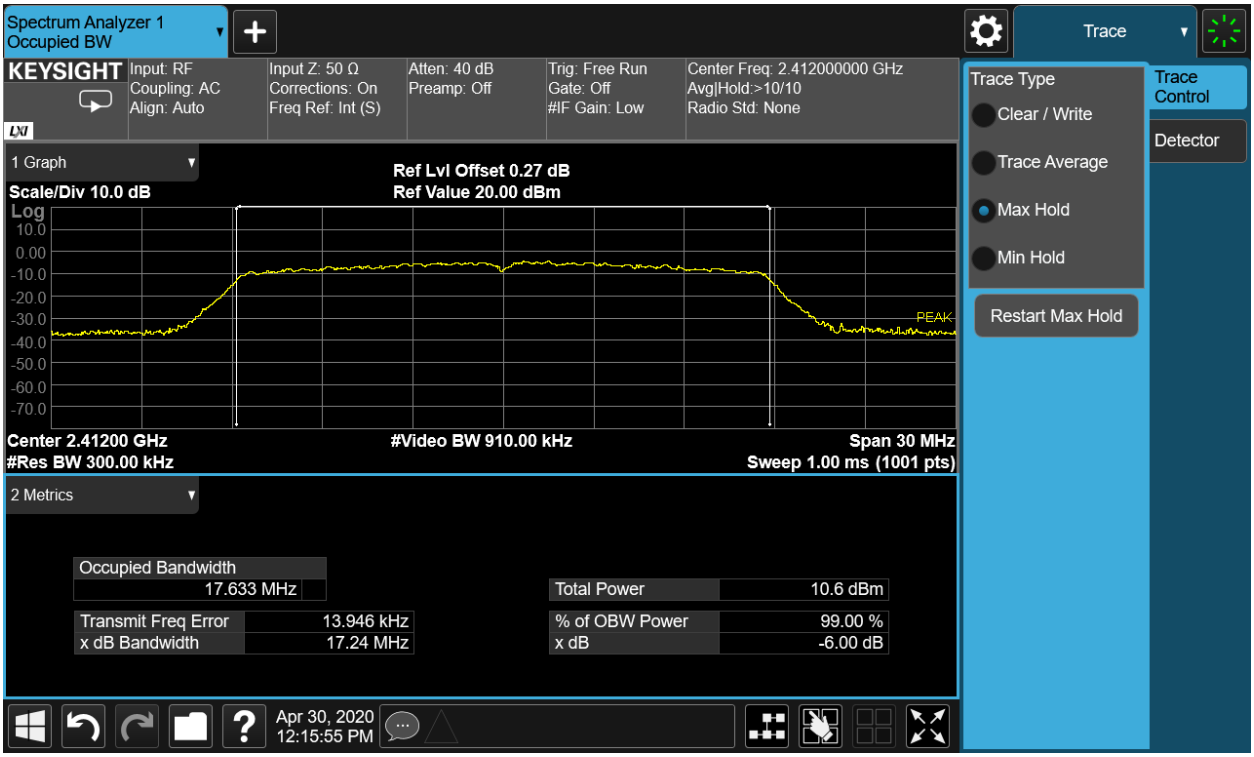
Plot 9-9 Chain A 99% Bandwidth 802.11g - Ch.1 (2412 MHz)



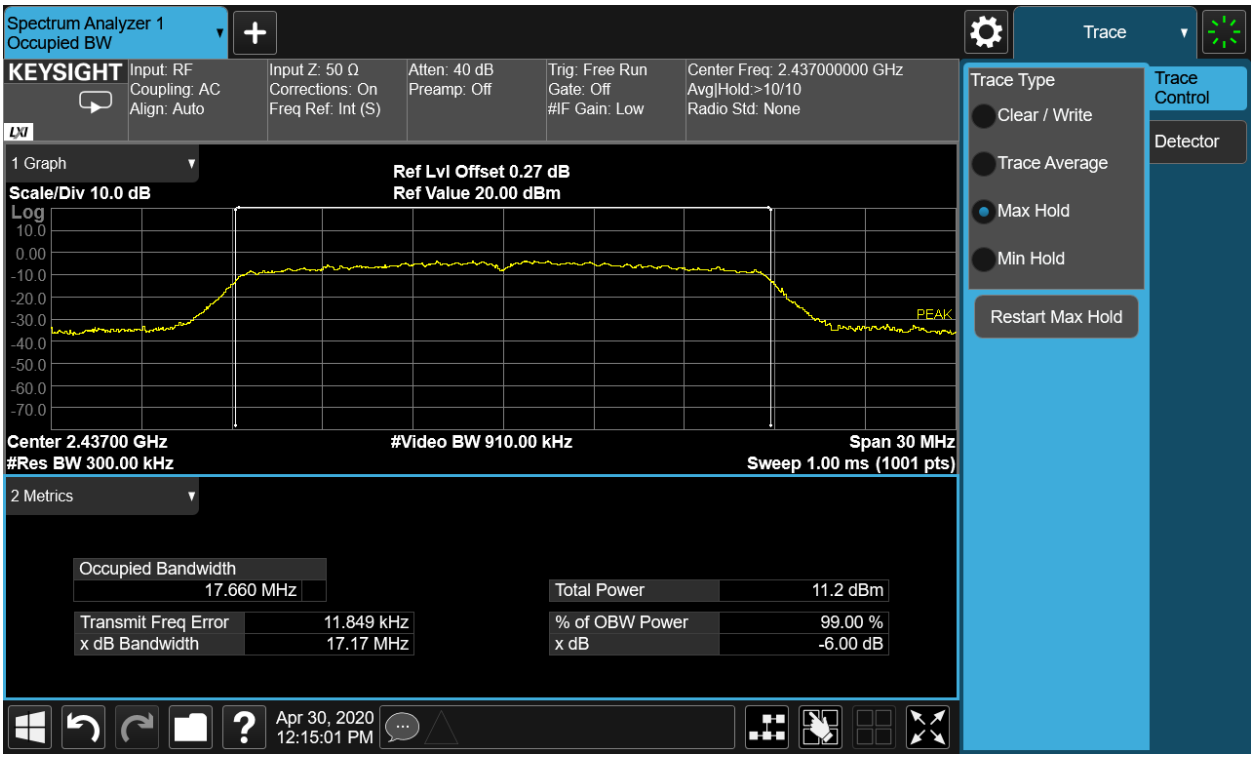
Plot 9-10 Chain A 99% Bandwidth 802.11g - Ch.6 (2437 MHz)



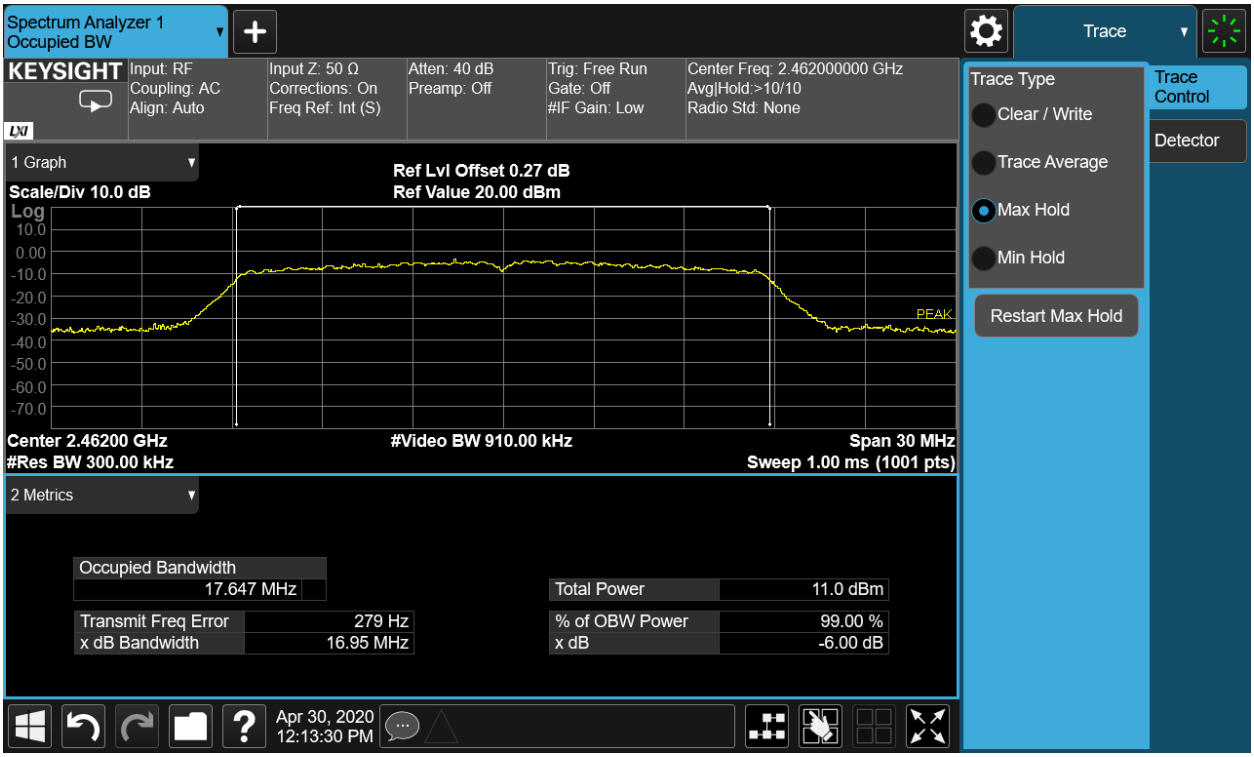
Plot 9-11 Chain A 99% Bandwidth 802.11g - Ch.11 (2462 MHz)



Plot 9-12 Chain A 99% Bandwidth 802.11n - Ch.1 (2412 MHz)



Plot 9-13 Chain A 99% Bandwidth 802.11n - Ch.6 (2437 MHz)



Plot 9-14 Chain A 99% Bandwidth 802.11n - Ch.11 (2462 MHz)

9.4 Output Power

9.4.1 Test Requirement:

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

ISED RSS-247 [5.4]

9.4.2 Test Method:

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

Power Meter Settings:

Peak Power:

The maximum peak conducted output power was measured using a broadband peak RF power meter. The power meter had a video bandwidth that is greater than or equal to the DTS bandwidth and utilized a fast-responding diode detector.

9.4.3 Limits:

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

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

9.4.4 Test Results:

802.11 mode	Freq (MHz)	Path A Conducted Output power (dBm)	Total Peak Cond Power (dBm)	Conducted Limit (dBm)	Margin (dB)	Result
g	2412	14.076	14.076	30.00	-15.92	Pass
g	2437	13.992	13.992	30.00	-16.01	Pass
g	2462	13.594	13.594	30.00	-16.41	Pass
n	2412	14.057	14.057	30.00	-15.94	Pass
n	2437	13.976	13.976	30.00	-16.02	Pass
n	2462	13.954	13.954	30.00	-16.05	Pass

802.11 mode	Frequency (MHz)	Total Peak Conducted Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
g	2412	14.076	1.740	15.816	36.00	-20.18	Pass
g	2437	13.992	1.740	15.732	36.00	-20.27	Pass
g	2462	13.594	1.740	15.334	36.00	-20.67	Pass
n	2412	14.057	1.740	15.797	36.00	-20.20	Pass
n	2437	13.976	1.740	15.716	36.00	-20.28	Pass
n	2462	13.954	1.740	15.694	36.00	-20.31	Pass

9.5 Power Spectral Density

9.5.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (e)
ISED RSS-247 Issue 1 [5.2]

9.5.2 Test Method:

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

Spectrum Analyzer settings:
Set analyzer center frequency to DTS channel center frequency.
Span to 1.5 times the DTS bandwidth
RBW to: 3 kHz ≤ RBW ≤ 100 kHz
VBW ≥ 3 RBW
Detector = Peak
Sweep time = auto couple
Trace mode = max hold
Use the peak marker function to determine the maximum amplitude level within the RBW
If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

9.5.3 Limits:

The maximum permissible power density is 8 dBm/3kHz, however if the antenna gain is >6 dBi, the limit is reduced by the total Directional Antenna Gain –6 dBi.

In this case:

Directional Antenna gain = 1.74 dBi.

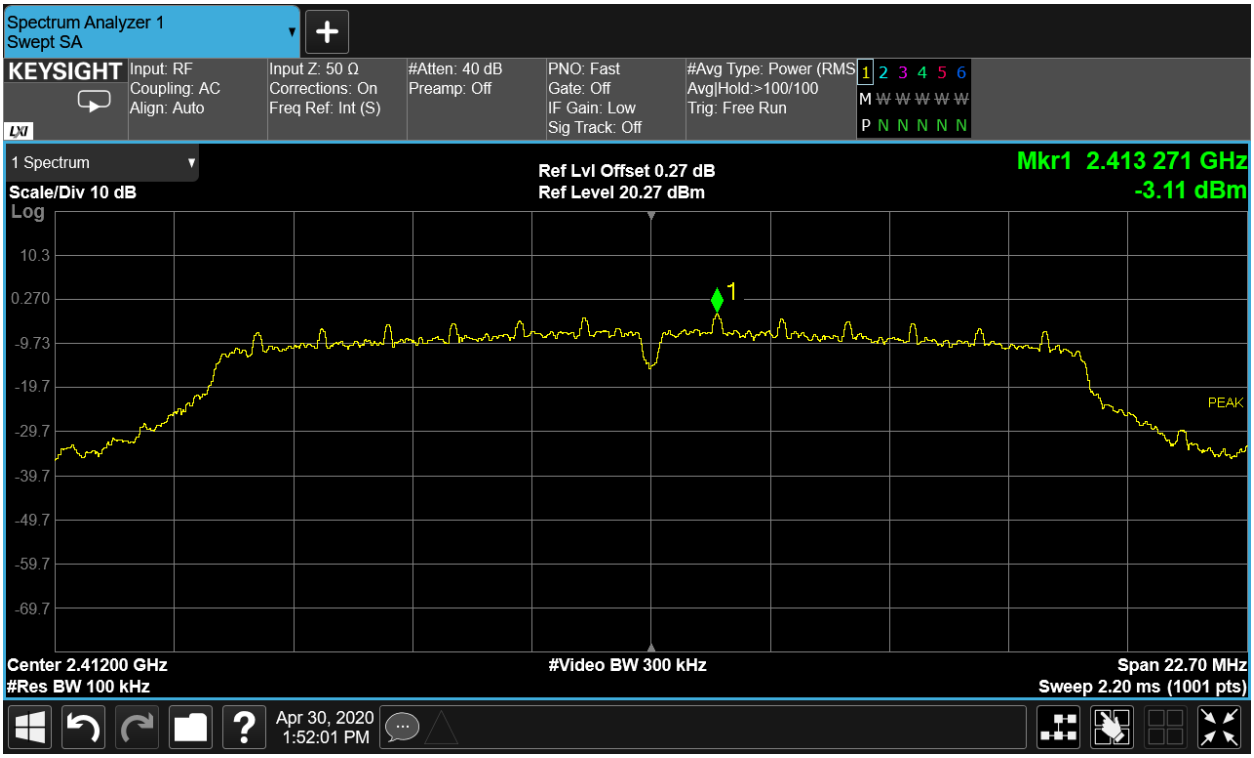
No adjustments to test limits is required here.

9.5.4 Test Results:

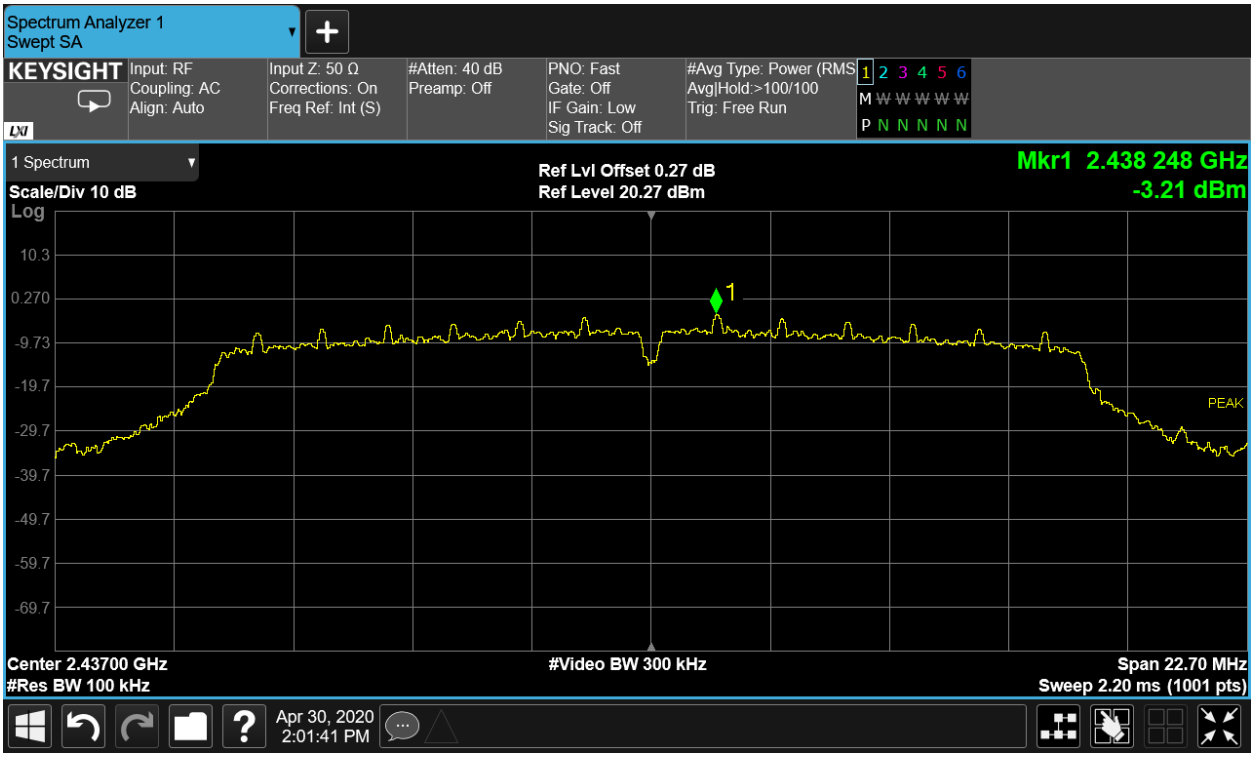
802.11 mode	Frequency (MHz)	Path A Power Spectral Density (dBm/100kHz)	Total Power Spectral Density Limit (dBm/100kHz)	Limit (dBm/3kHz)	Pass/Fail
g	2412	-3.11	-3.11	8.0	Pass
g	2437	-3.21	-3.21	8.0	Pass
g	2462	-3.15	-3.15	8.0	Pass
n	2412	-3.34	-3.34	8.0	Pass
n	2437	-3.51	-3.51	8.0	Pass
n	2462	-3.52	-3.52	8.0	Pass

The test data shows that the EUT passes the requirement using 100kHz RBW setting and hence will meet the requirement for 3kHz BW.

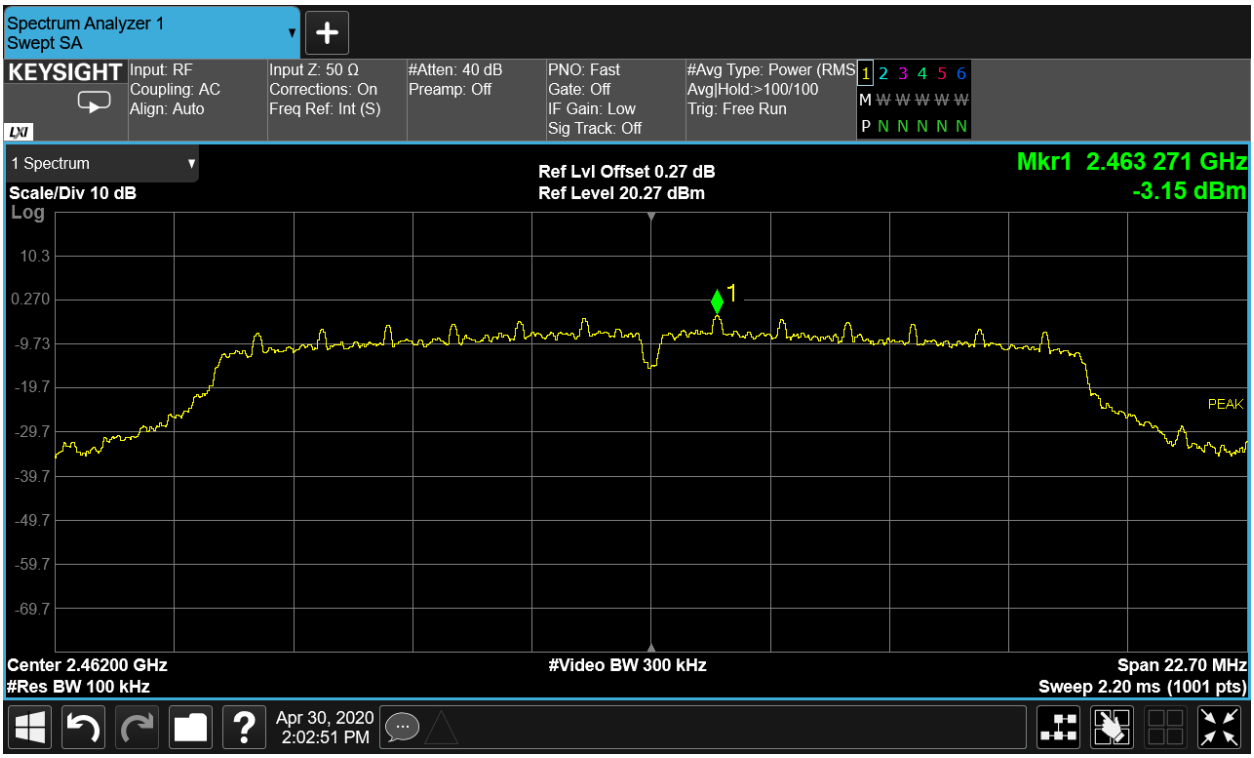
9.5.5 Test Data:



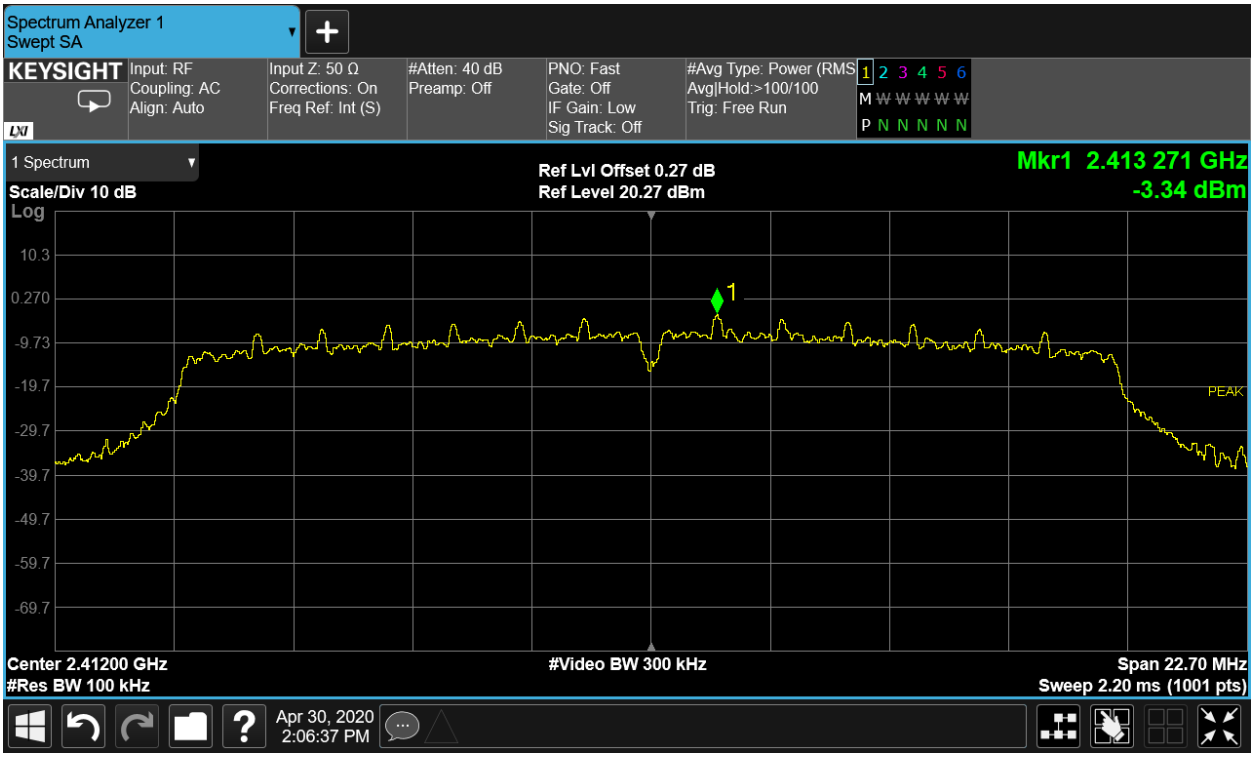
Plot 9-15 Chain A Peak Power Spectral Density 802.11g - Ch.1 (2412 MHz)



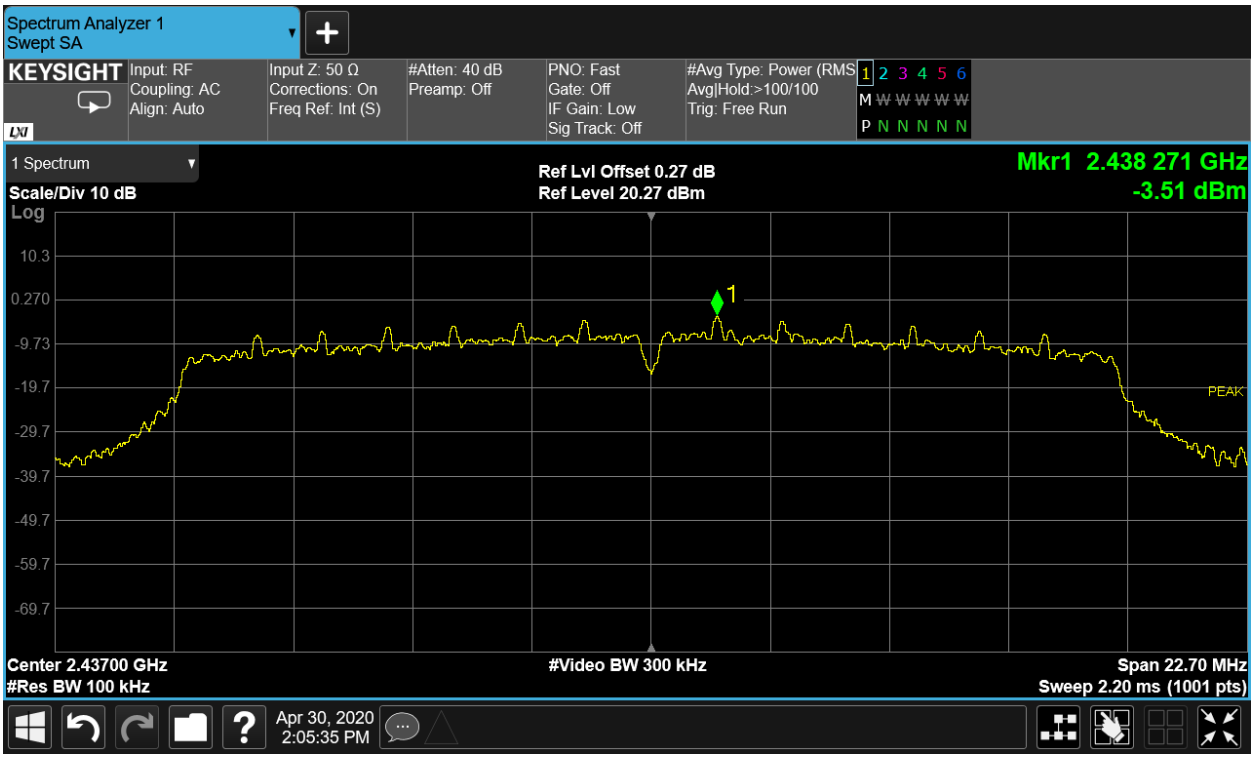
Plot 9-16 Chain A Peak Power Spectral Density 802.11g - Ch.6 (2437 MHz)



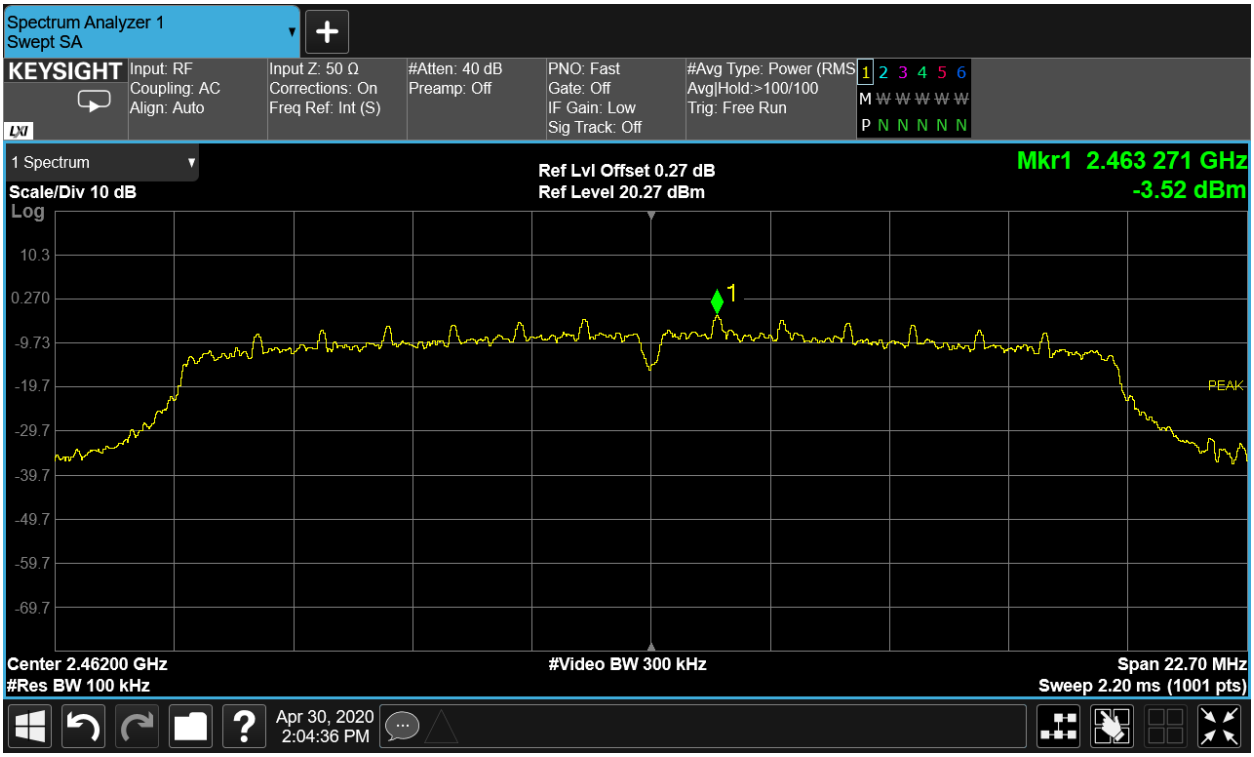
Plot 9-17 Chain A Peak Power Spectral Density 802.11g - Ch.11 (2462 MHz)



Plot 9-18 Chain A Peak Power Spectral Density 802.11n - Ch.1 (2412 MHz)



Plot 9-19 Chain A Peak Power Spectral Density 802.11n - Ch.6 (2437 MHz)



Plot 9-20 Chain A Peak Power Spectral Density 802.11n - Ch.11 (2462 MHz)

9.6 Conducted Spurious Emissions

9.6.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (d)
ISED RSS-247 [5.5]

9.6.2 Test Method:

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

Spectrum Analyzer settings:
Identification of Reference Level:
RBW= 100 kHz
VBW ≥ 3 x RBW
Trace Mode= Peak Detector (Max Hold)
Sweep time= auto couple
Span ≥1.5 times DTS Bandwidth
Peak Marker function to determine the max PSD level.
Conducted Spurious Emissions:
RBW= 1 MHz
VBW≥ 3 x RBW = 3 MHz
Trace Mode= Peak Detector (Max Hold)

Sweep time= auto couple

Span= 30 MHz- 12 GHz; 12 GHz – 25 GHz
Sweep Points= 30000

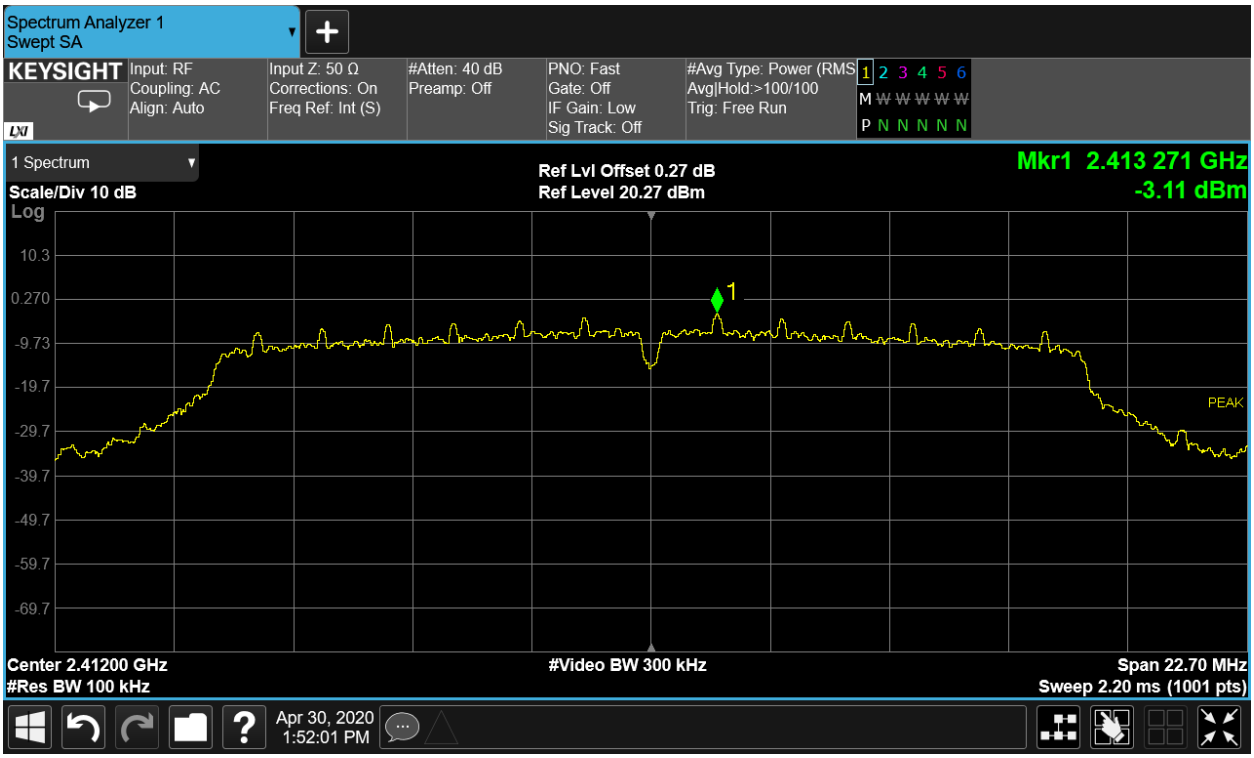
9.6.3 Limits:

All spurious emissions at least 20 dBc.

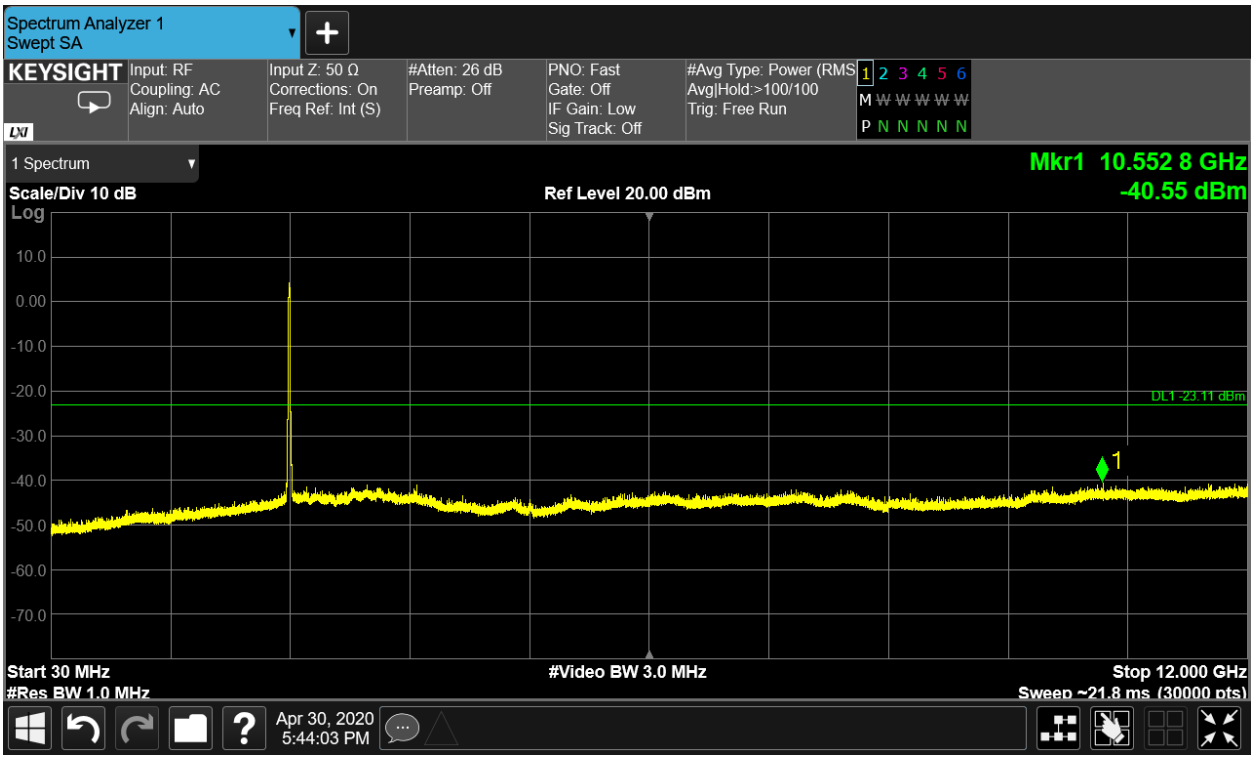
9.6.4 Test Result:

Pass.

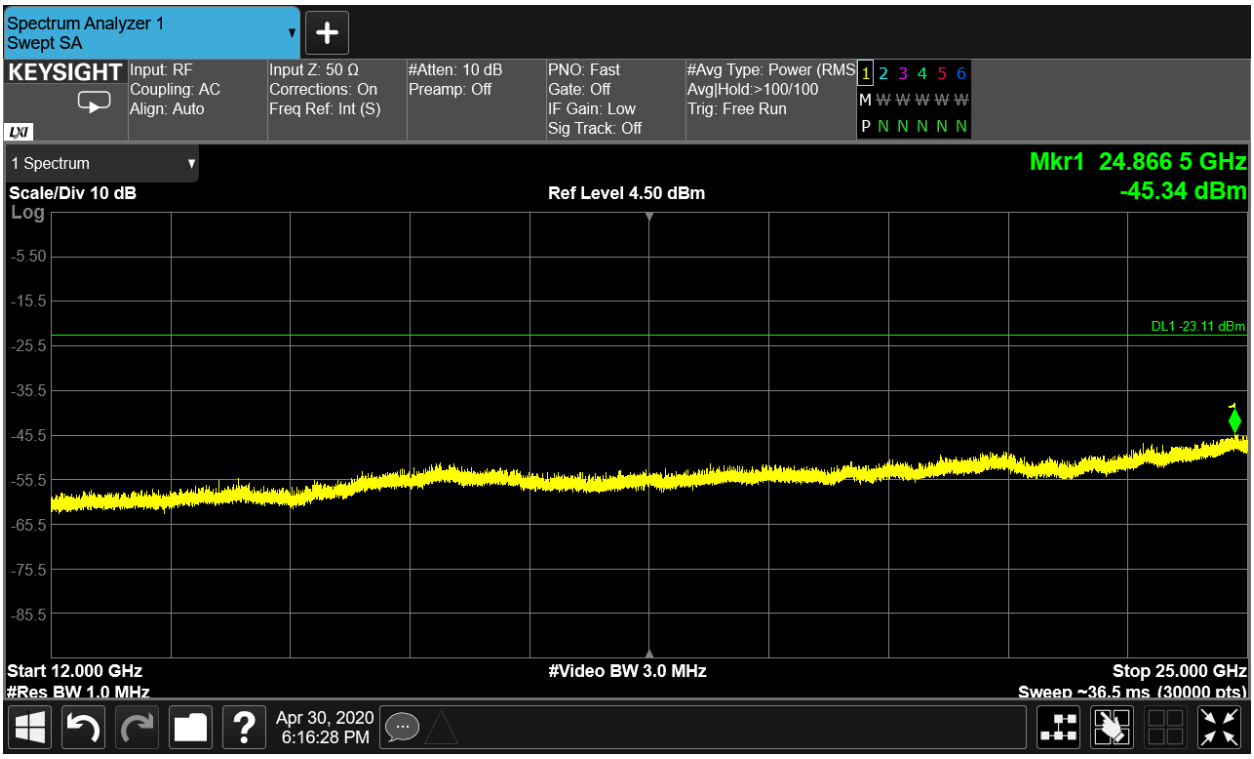
9.6.5 Test Data:



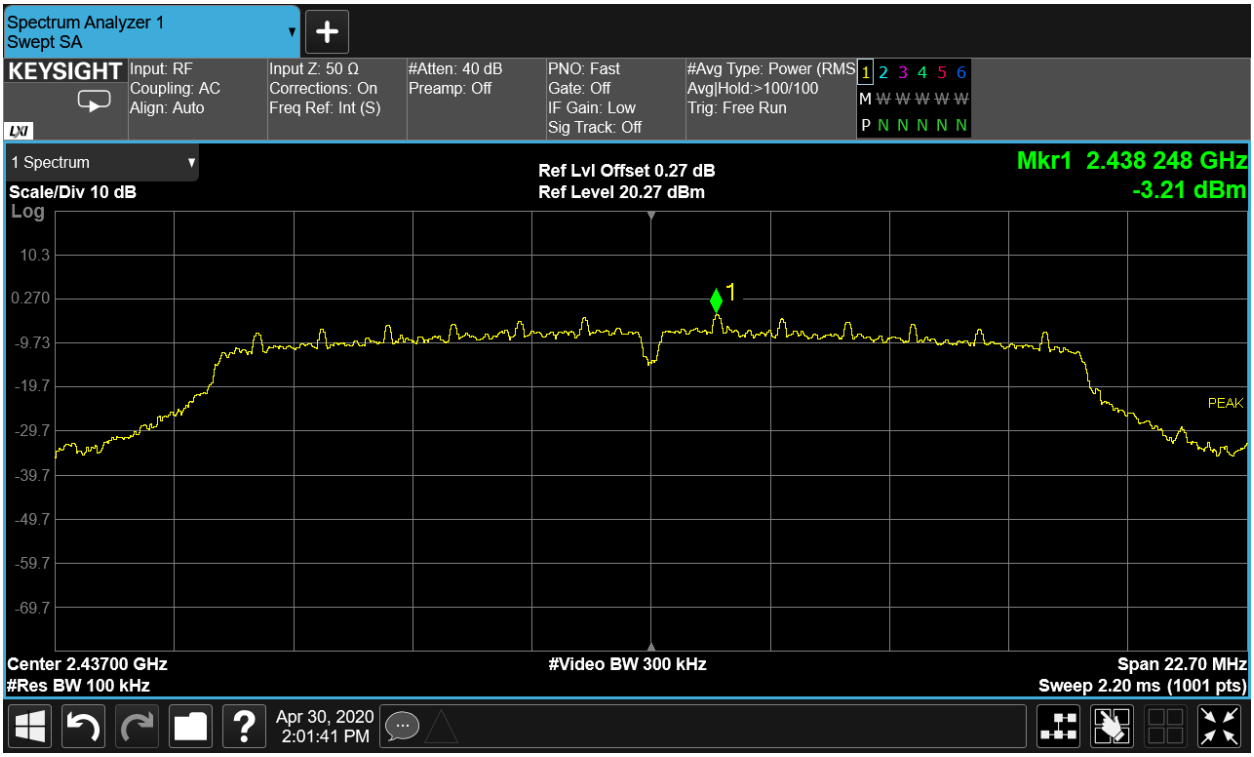
Plot 9-21 Chain A Reference Level 802.11g - Ch.1 (2412 MHz)



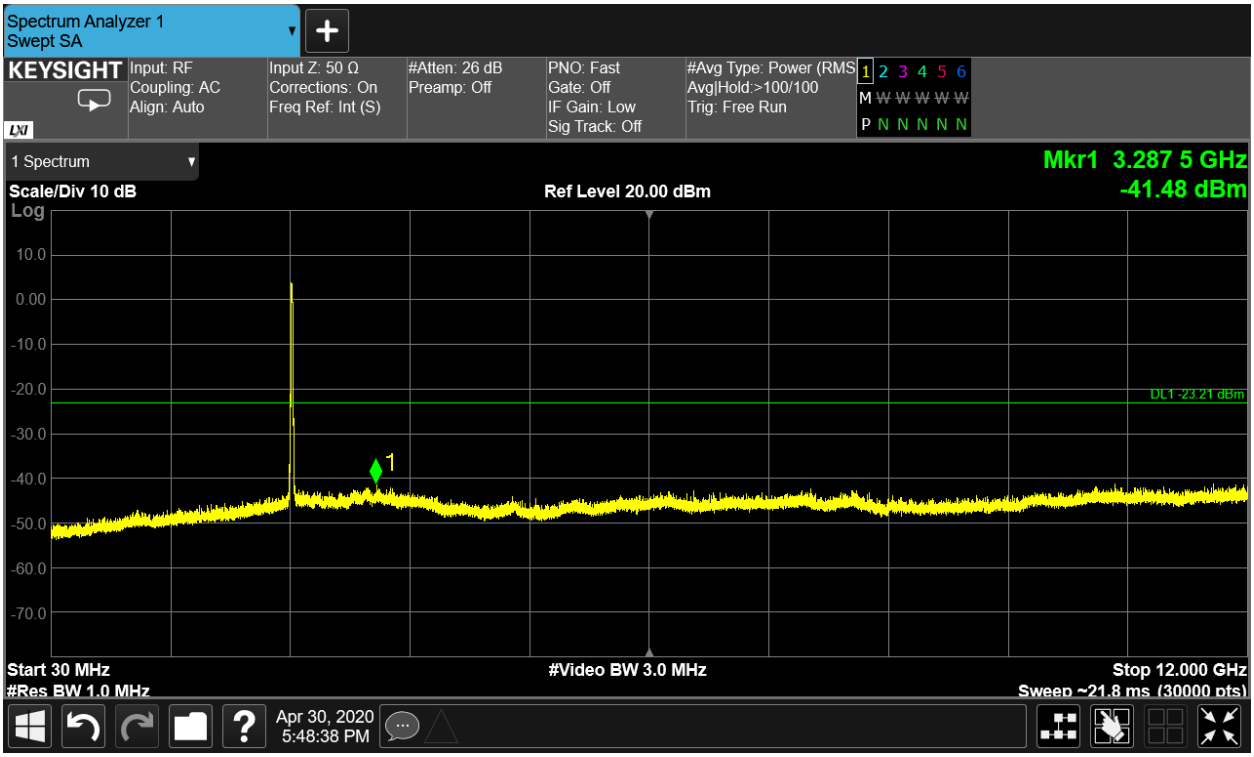
Plot 9-22 Chain A Conducted Spurious Emissions 30 MHz - 12 GHz 802.11g - Ch.1 (2412 MHz)



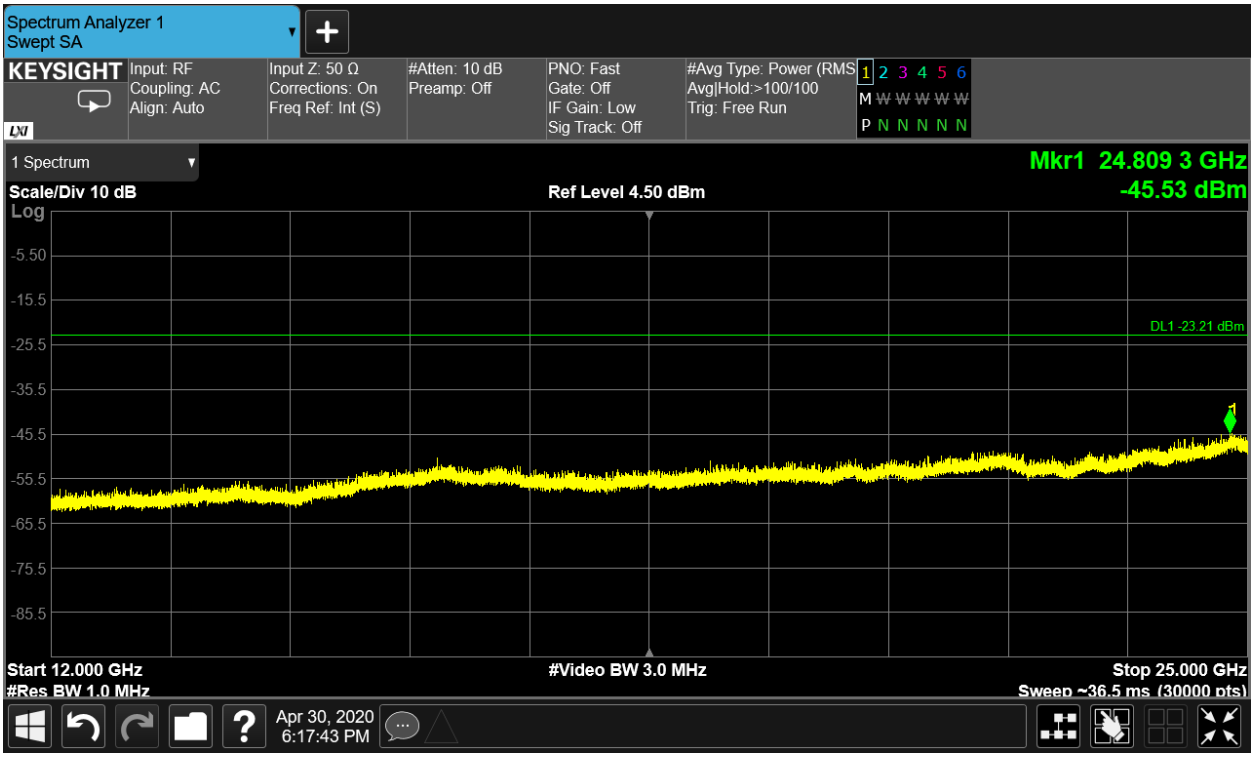
Plot 9-23 Chain A Conducted Spurious Emissions 12 - 25 GHz 802.11g - Ch.1 (2412 MHz)



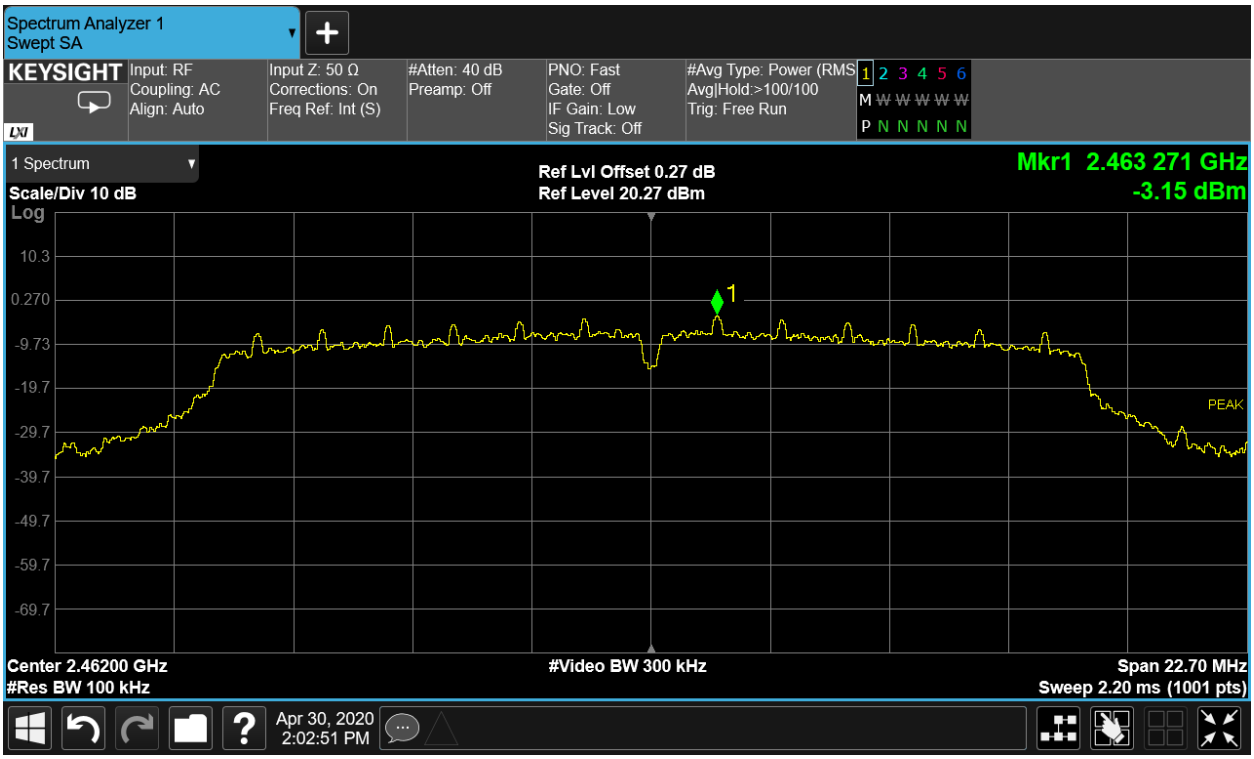
Plot 9-24 Chain A Reference Level 802.11g - Ch.6 (2437 MHz)



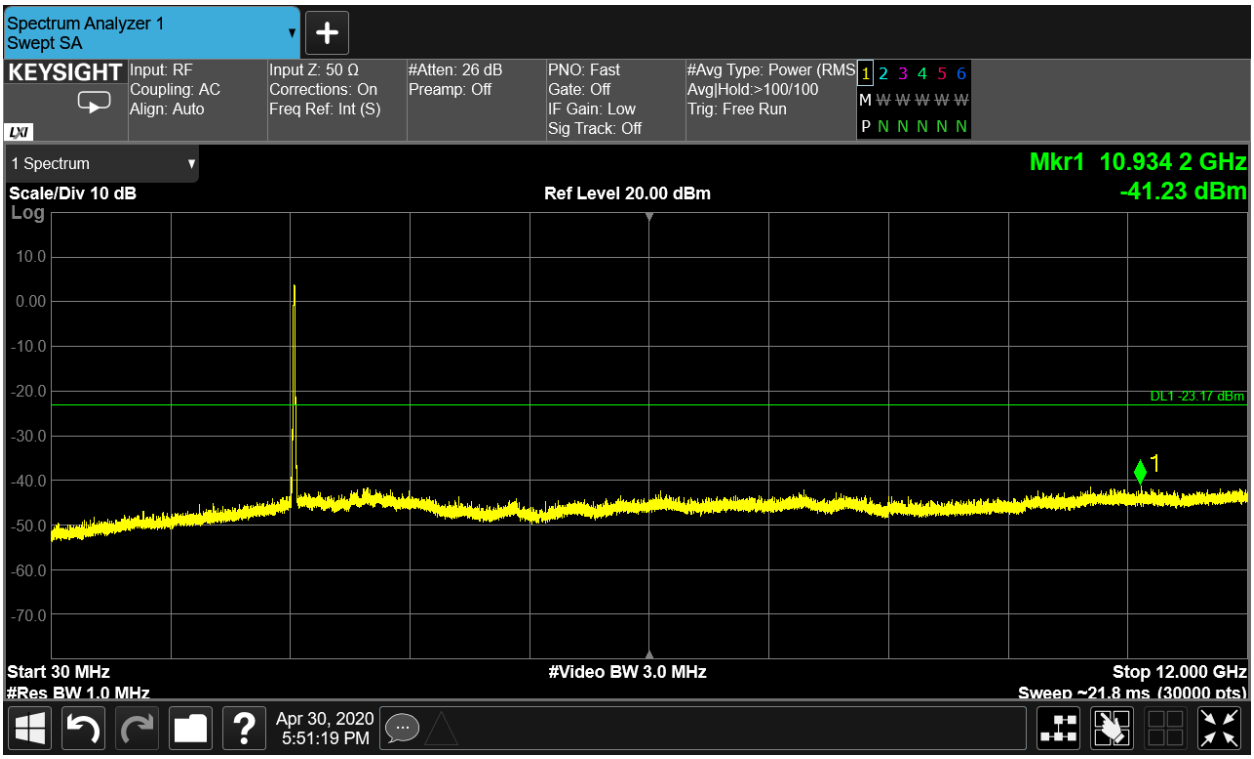
Plot 9-25 Chain A Conducted Spurious Emissions 30 MHz - 12 GHz 802.11g - Ch.6 (2437 MHz)



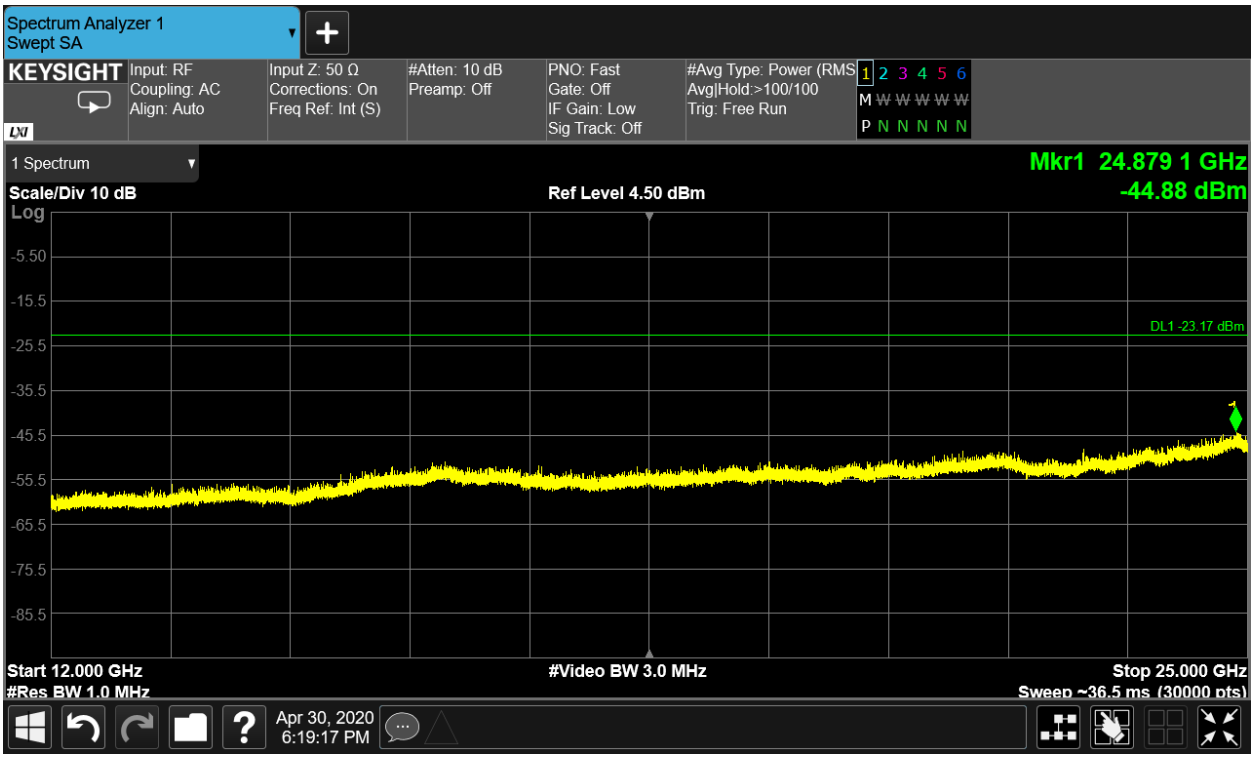
Plot 9-26 Chain A Conducted Spurious Emissions 12 - 25 GHz 802.11g - Ch.6 (2437 MHz)



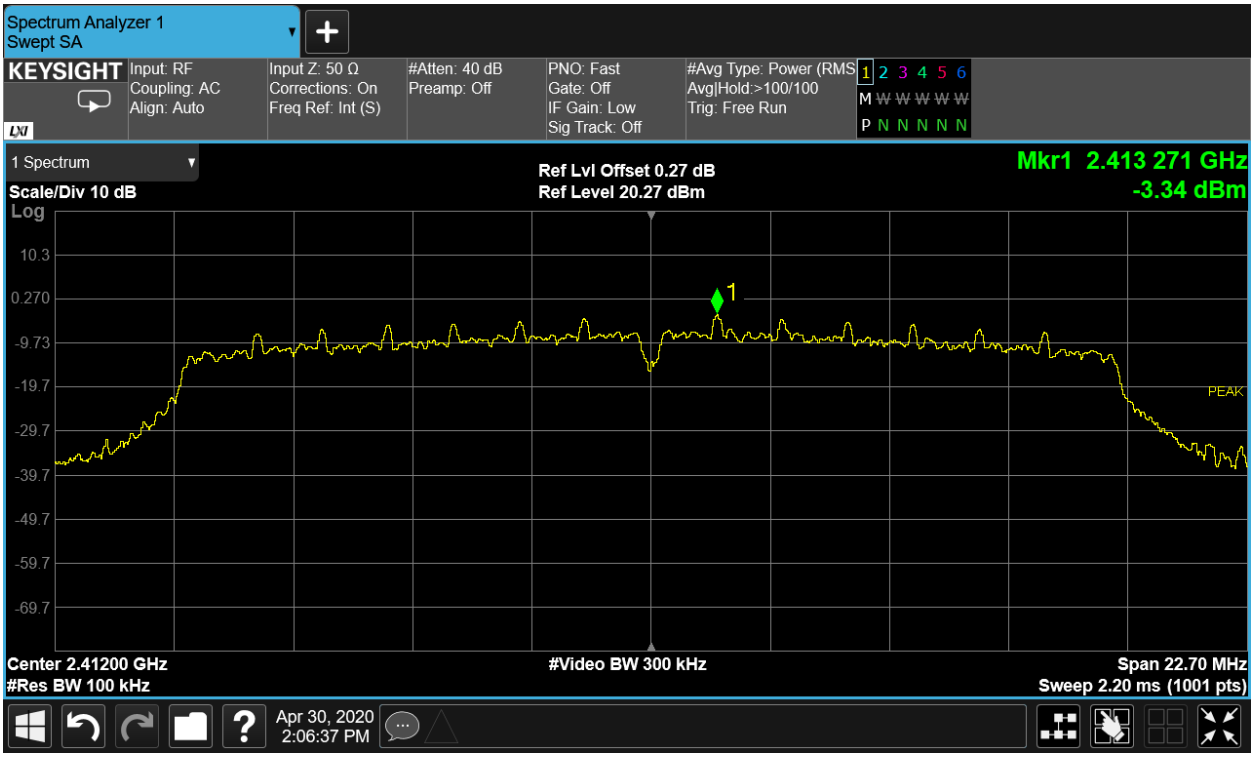
Plot 9-27 Chain A Reference Level 802.11g - Ch.11 (2462 MHz)



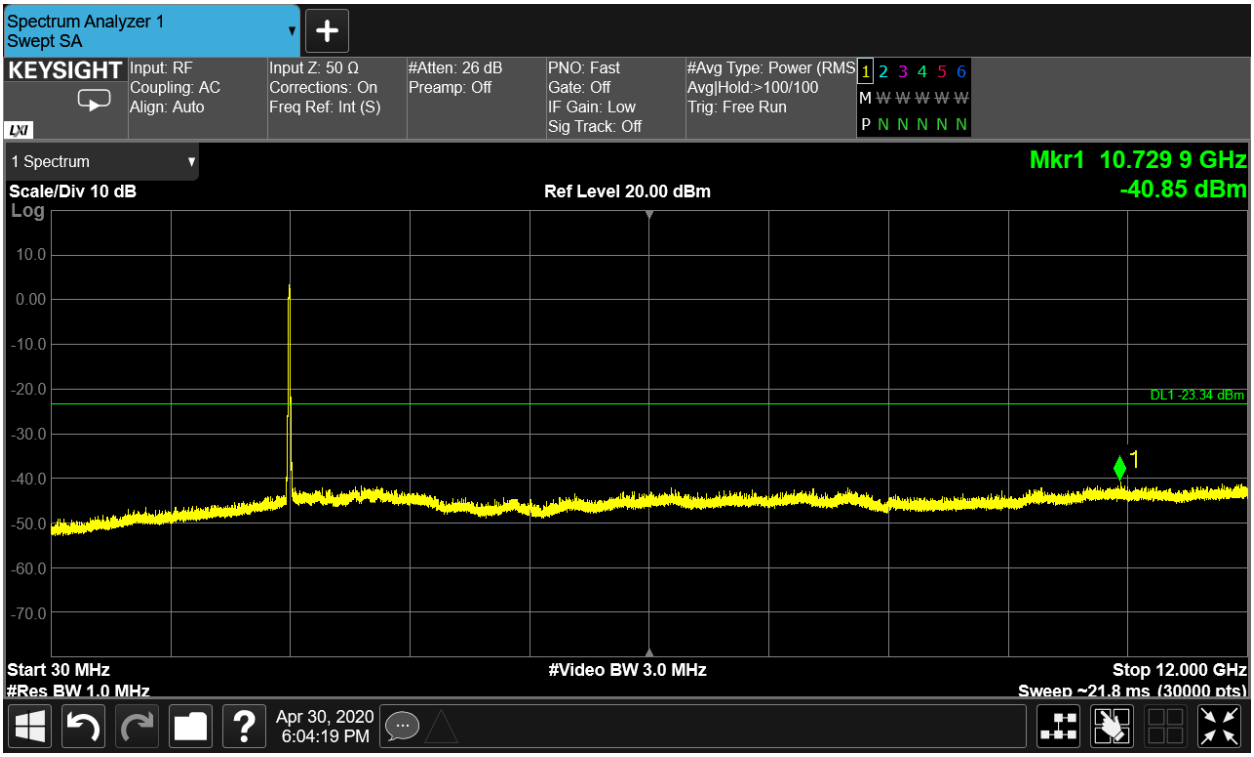
Plot 9-28 Chain A Conducted Spurious Emissions 30 MHz - 12 GHz 802.11g - Ch.11 (2462 MHz)



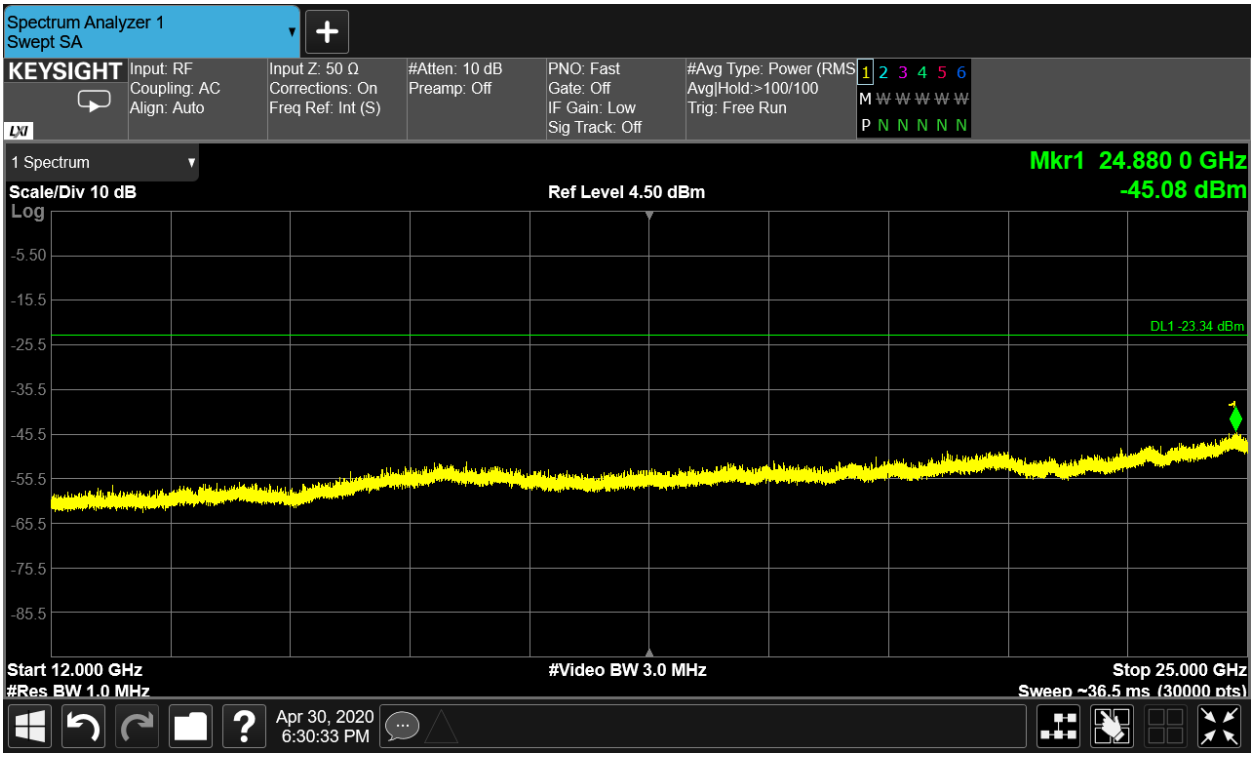
Plot 9-29 Chain A Conducted Spurious Emissions 12 - 25 GHz 802.11g - Ch.11 (2462 MHz)



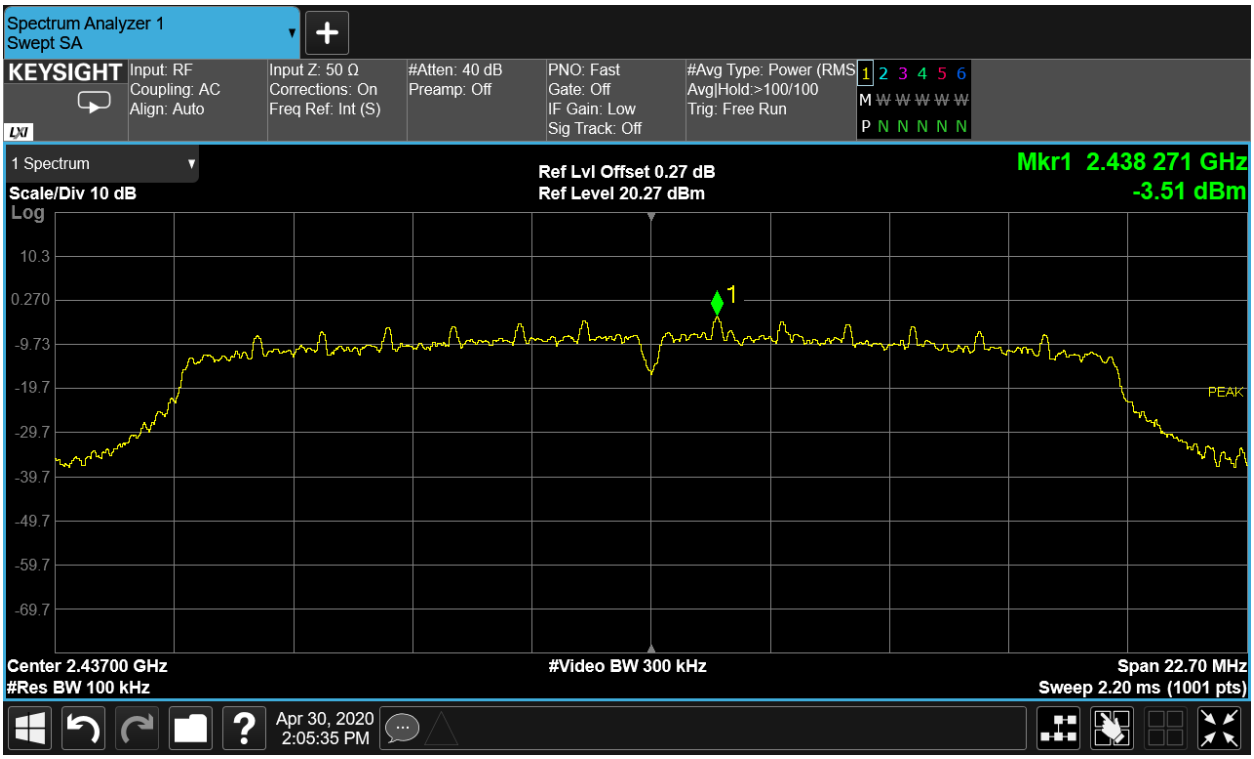
Plot 9-30 Chain A Reference Level 802.11n - Ch.1 (2412 MHz)



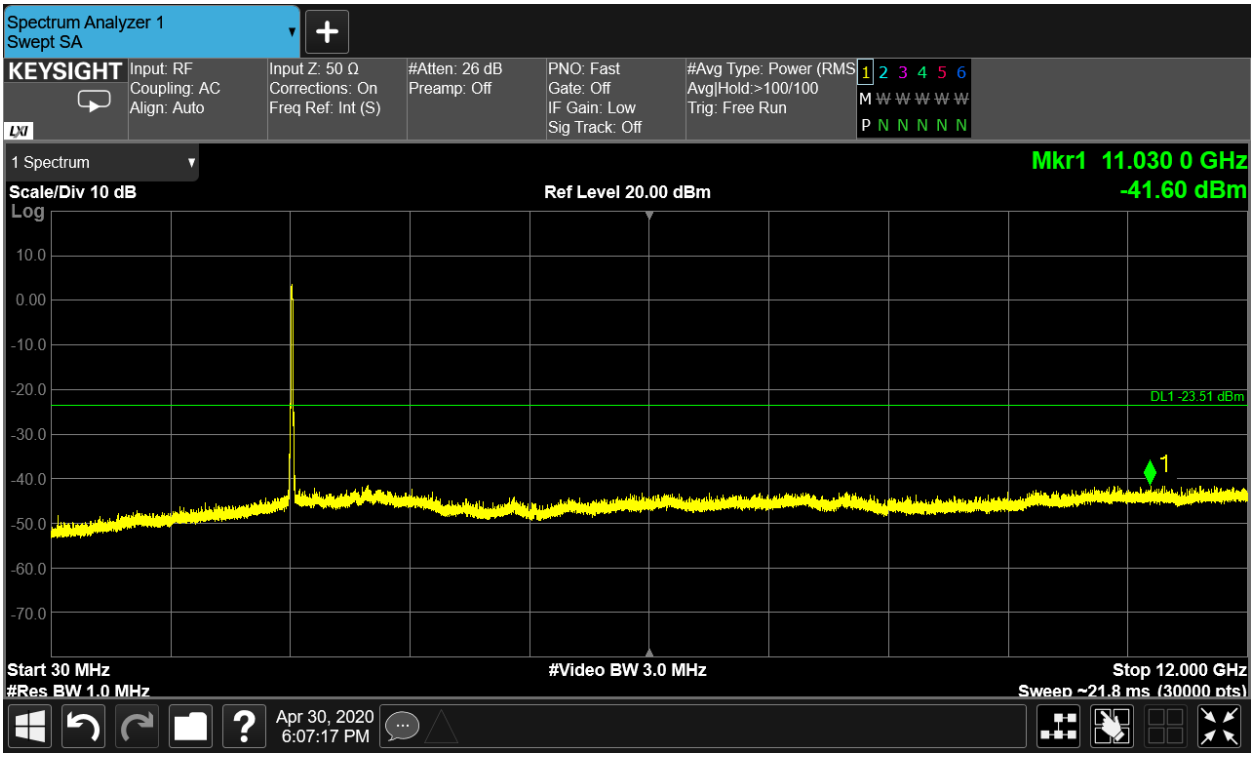
Plot 9-31 Chain A Conducted Spurious Emissions 30 MHz - 12 GHz 802.11n - Ch.1 (2412 MHz)



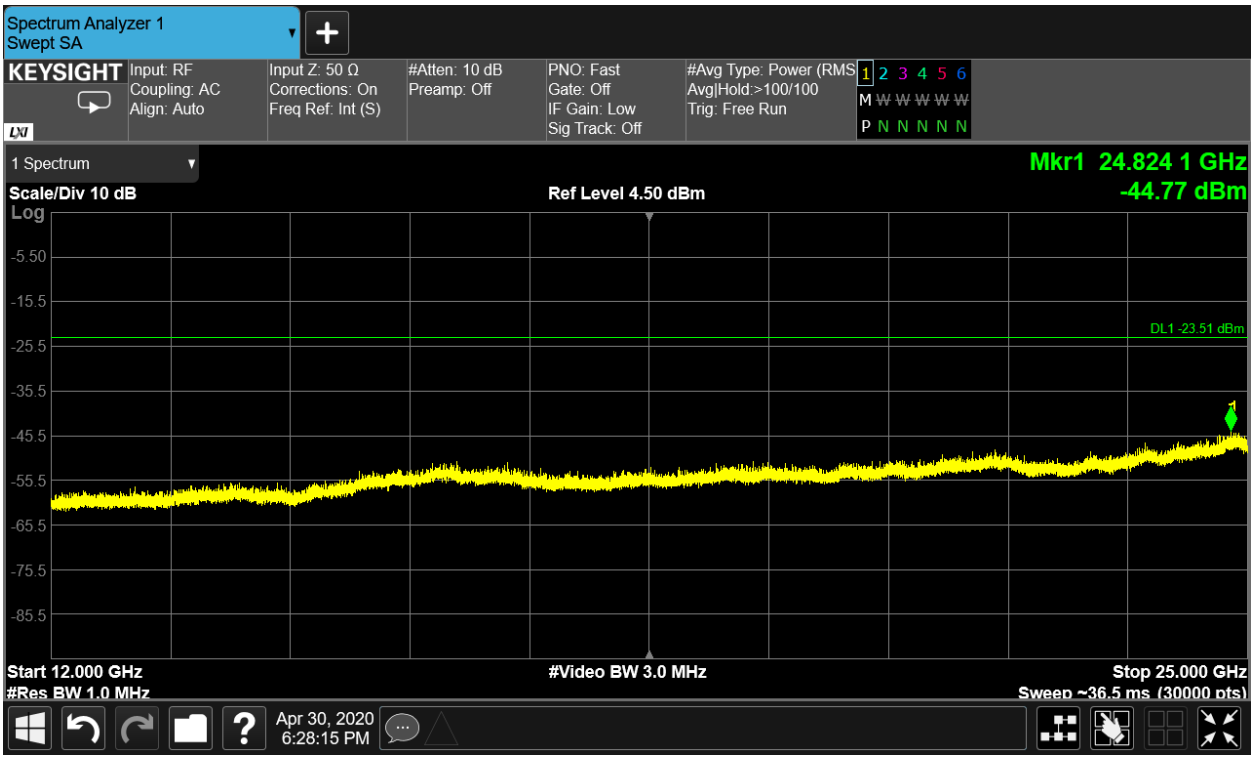
Plot 9-32 Chain A Conducted Spurious Emissions 12 - 25 GHz 802.11n - Ch.1 (2412 MHz)



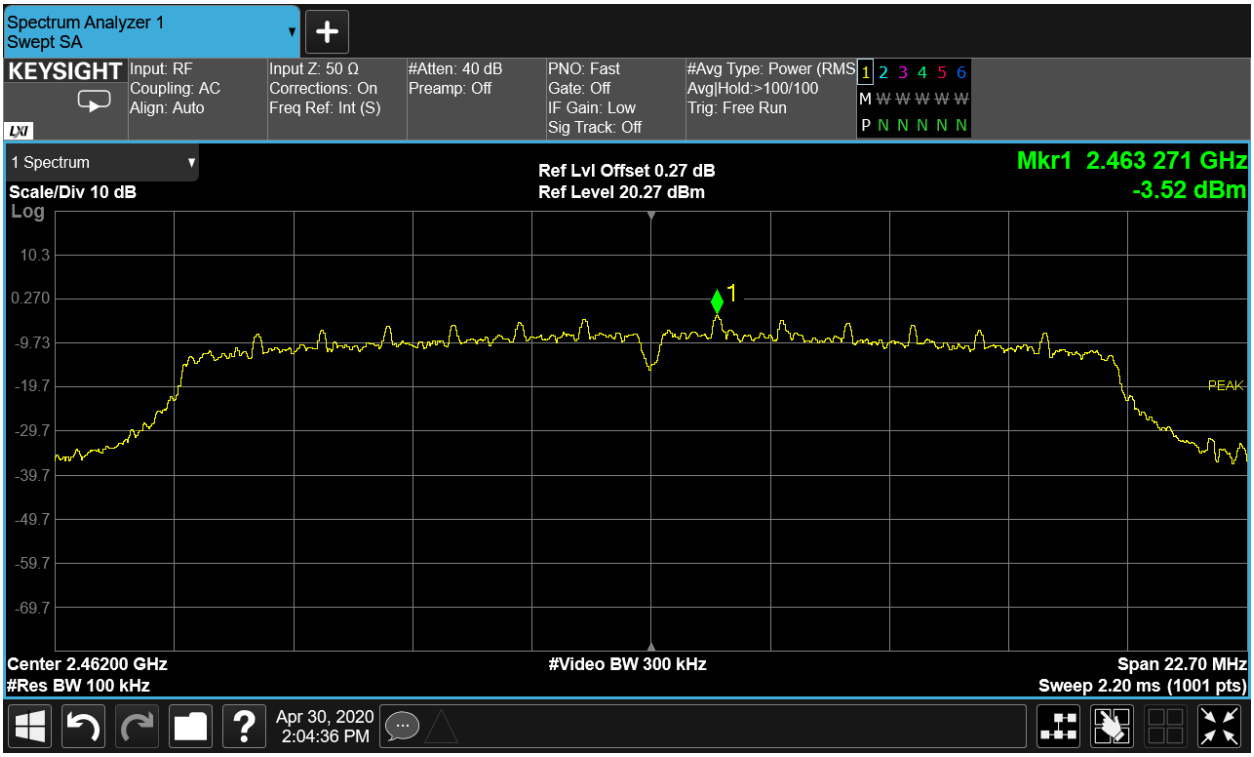
Plot 9-33 Chain A Reference Level 802.11n - Ch.6 (2437 MHz)



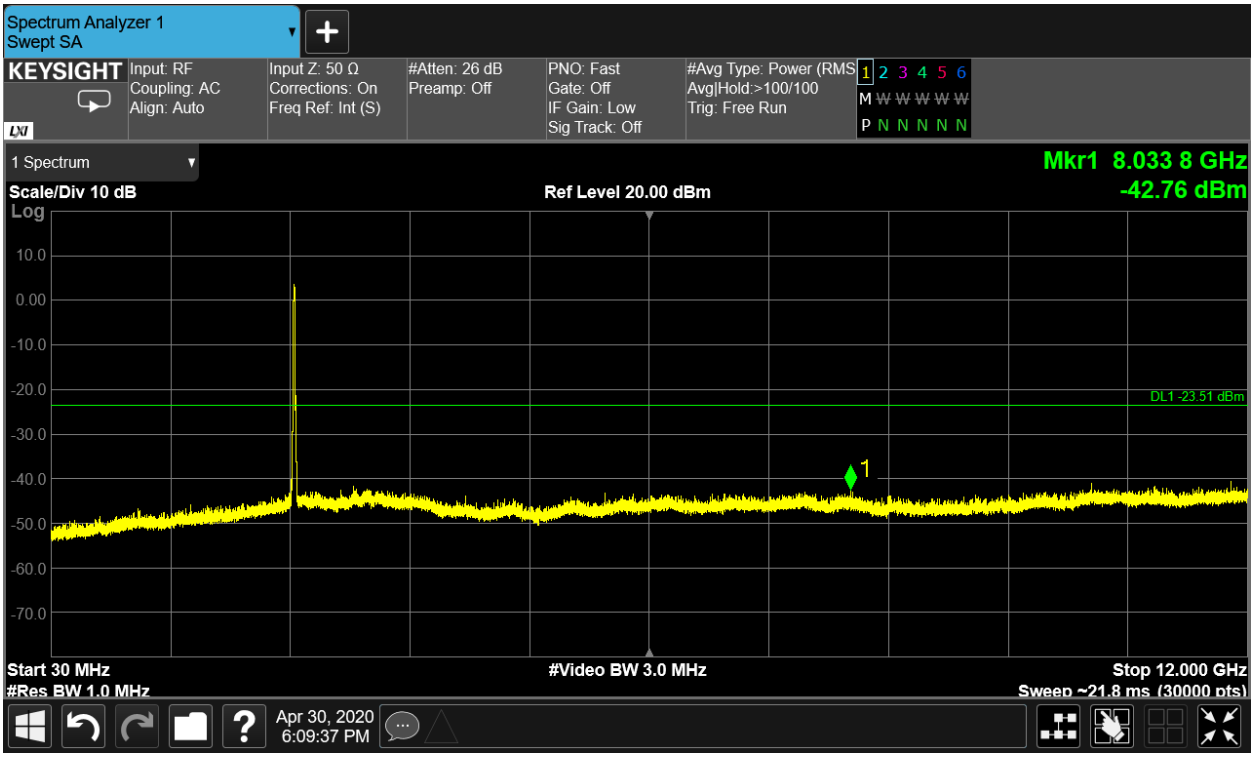
Plot 9-34 Chain A Conducted Spurious Emissions 30 MHz - 12 GHz 802.11n - Ch.6 (2437 MHz)



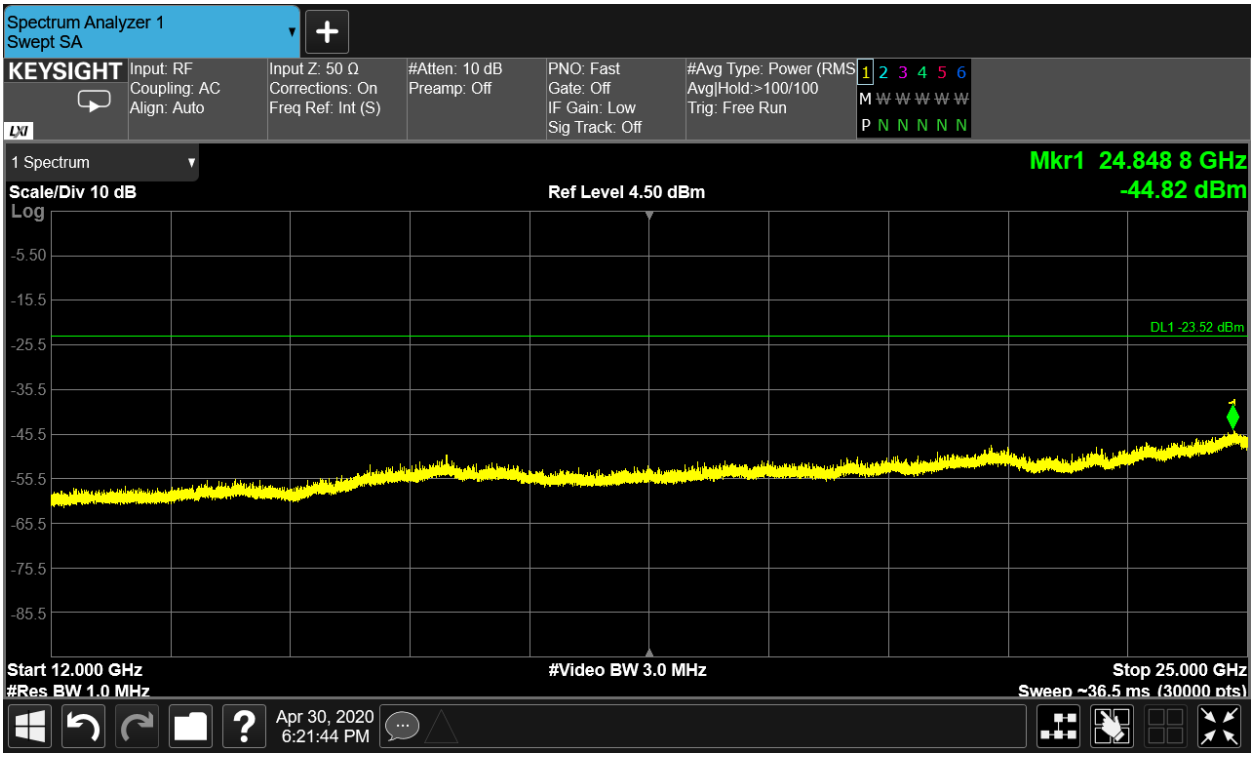
Plot 9-35 Chain A Conducted Spurious Emissions 12 - 25 GHz 802.11n - Ch.6 (2437 MHz)



Plot 9-36 Chain A Reference Level 802.11n - Ch.11 (2462 MHz)



Plot 9-37 Chain A Conducted Spurious Emissions 30 MHz - 12 GHz 802.11n - Ch.11 (2462 MHz)



Plot 9-38 Chain A Conducted Spurious Emissions 12 - 25 GHz 802.11n - Ch.11 (2462 MHz)

9.7 Conducted Band Edge Emissions

9.7.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (d)

ISED RSS-247 [5.5]

9.7.2 Test Method:

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

Spectrum analyzer settings:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation
RBW = 100 kHz
VBW = 300 kHz
Sweep = auto couple
Detector function = Peak
Trace = Max Hold
The trace was allowed to stabilize. The marker was set on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band

edge. The delta marker function was set and the marker-to-peak function moved to the peak of the in-band emission.

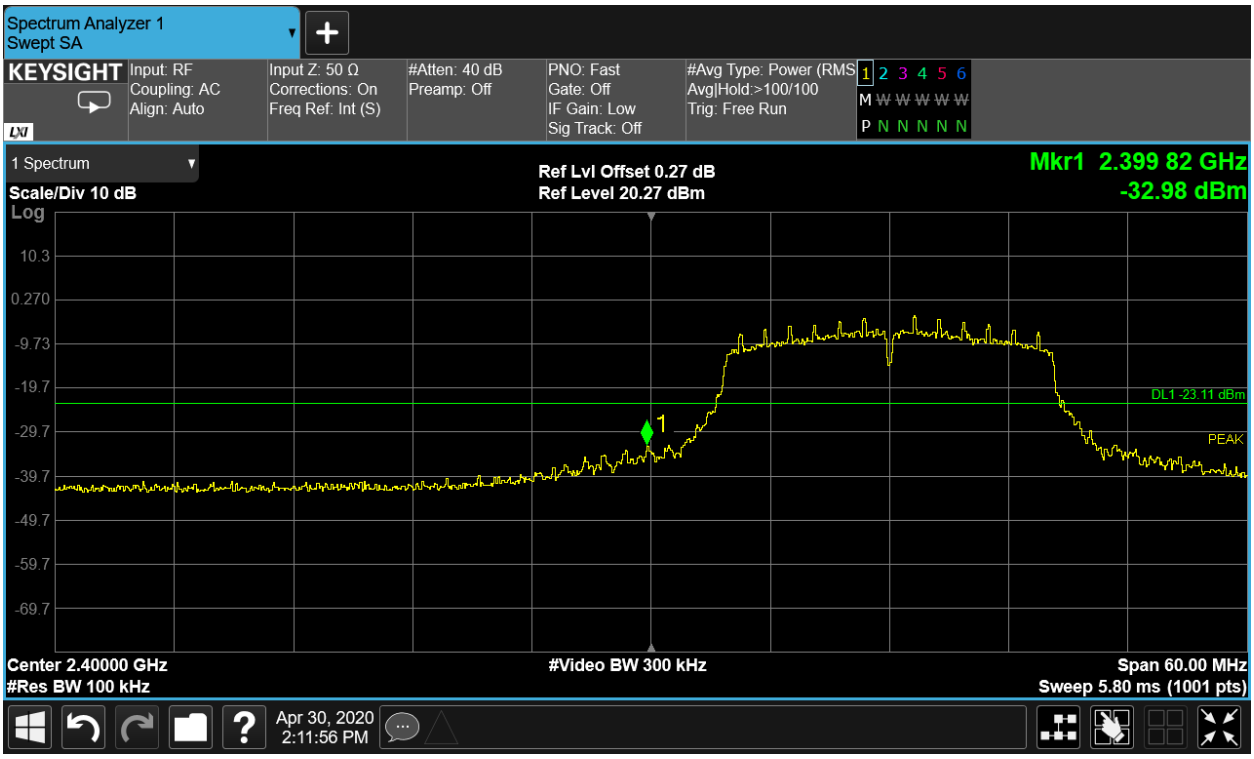
9.7.3 Limits:

All spurious emissions at least 20 dBc.

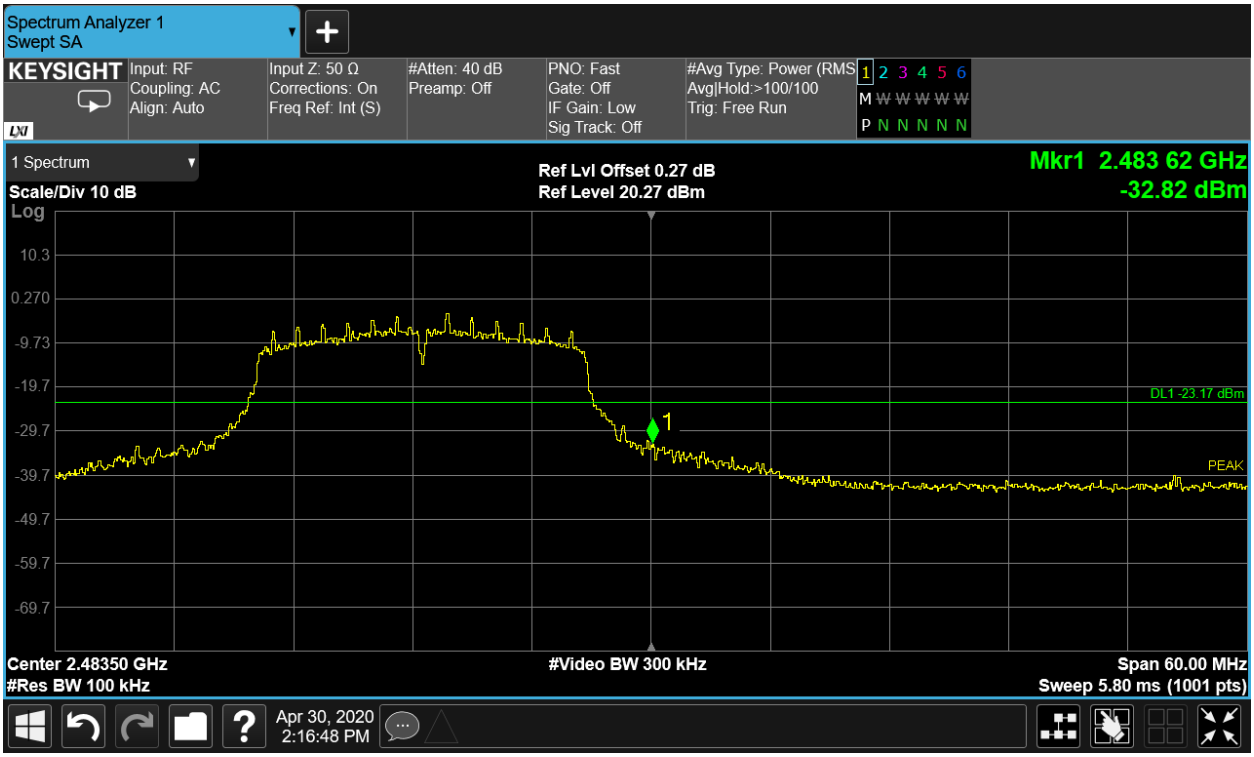
9.7.4 Test Result:

Pass.

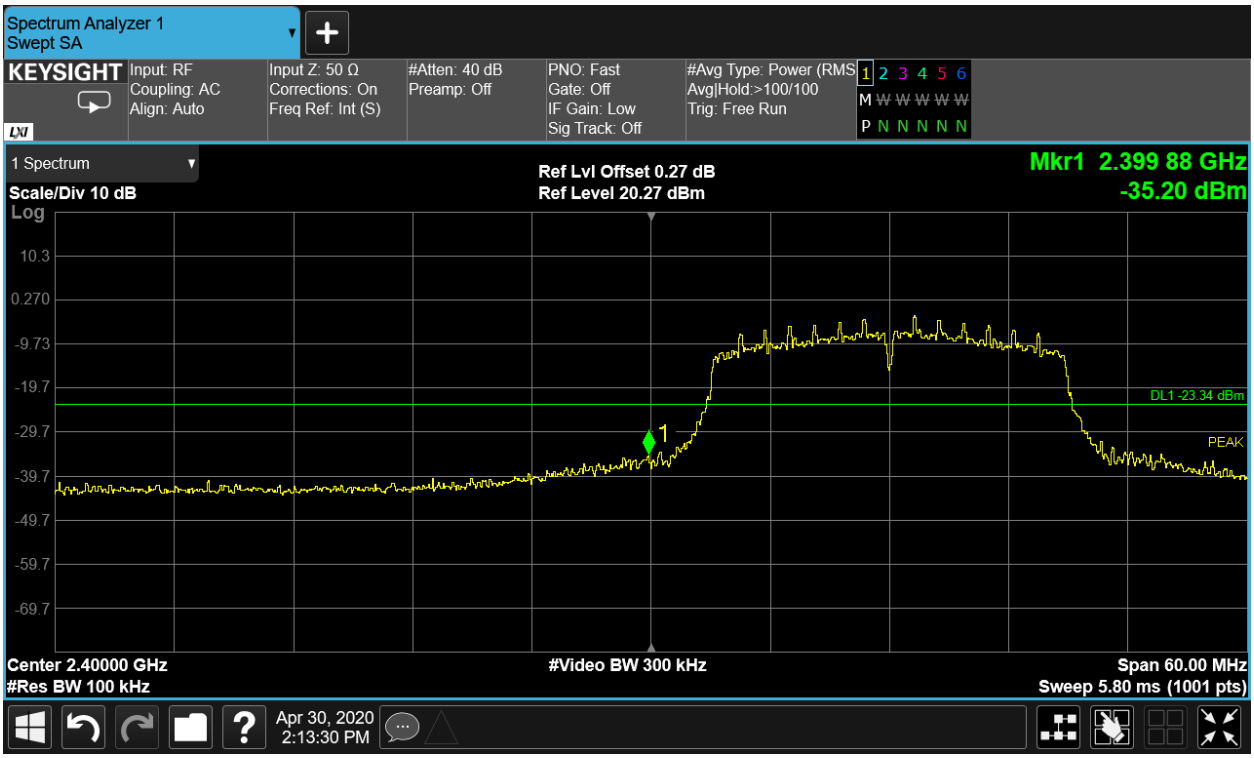
9.7.5 Test Data:



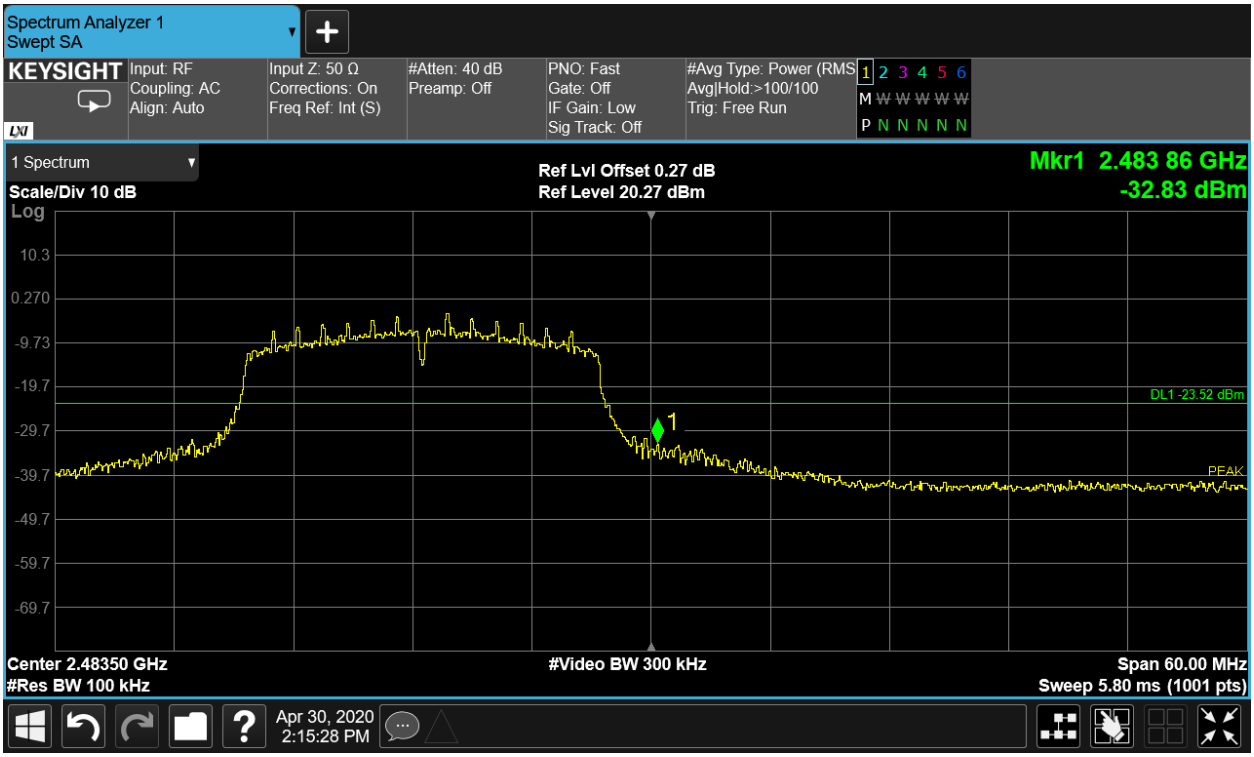
Plot 9-39 Chain A Conducted Band Edge 802.11g - Ch. 1 (2412 MHz)



Plot 9-40 Chain A Conducted Band Edge 802.11g - Ch. 11 (2462 MHz)



Plot 9-41 Chain A Conducted Band Edge 802.11n - Ch. 1 (2412 MHz)



Plot 9-42 Chain A Conducted Band Edge 802.11n - Ch. 11 (2462 MHz)

9.8 Radiated Spurious and Band Edge Emissions

9.8.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (d)
ISED RSS-247 [5.5] and RSS GEN [8.9]

9.8.2 Test Method:

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

Radiated spurious measurements are made from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter. The limit for radiated spurious emissions is per 15.209 and RSS-247 [5.5]. Additionally, emissions found in the restricted bands as listed in 15.205 were tested for compliance per limits in 15.209 and RSS-Gen.

The EUT was tested near the low, middle and high channels of operation in each sub band. Guidelines in ANSI C63.10:2013 were followed with respect to maximizing the emissions.

A pre-amp and a high pass filter were required for this test to provide the measuring system with sufficient sensitivity. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength.

Both horizontal and vertical antenna polarizations were investigated. Worst-case maximized data for both polarizations is shown in this test report.

Radiated Spurious Emissions
Spectrum Analyzer Settings:
30 MHz- 1 GHz:
RBW= 120 kHz
VBW ≥ 3 X RBW
Trace Mode: Peak Detector (Max Hold). Final measurements performed using QP Detector.
Span= 30 MHz- 1 GHz
Sweep time= Auto
Sweep points ≥ 2 x Span/RBW
Above 1 GHz:
RBW= 1 MHz
VBW= 3 MHz
Trace Mode: Peak Detector (Max Hold) and RMS Average Detector (Max Hold)
Span= 1- 18 GHz and 18- 26.5 GHz.
Sweep time= Auto
Sweep points ≥ 2 x Span/RBW

Final Measurements above 1 GHz
Peak Measurements
Spectrum Analyzer Settings:

RBW= 1 MHz
VBW= 3 MHz
Trace Mode: Peak Detector (Max Hold)
Span= wide enough to encompass the emission
Sweep Points ≥ 2 × Span/RBW
Sweep Time = Auto

RMS Average Measurements

Spectrum Analyzer Settings:

RBW= 1 MHz
VBW≥ 3 × RBW
Detector= RMS
Span= wide enough to encompass the emission
Sweep points≥ 2 × Span/RBW
Sweep time = auto
Trace= Average at least 100 traces
Trace Averaging Type= power (RMS)
The duty cycle correction factor is added to the emission level.

Restricted Band-Edge Emissions

Peak Measurements

Spectrum Analyzer Settings:

RBW= 1 MHz
VBW= 3 MHz
Trace Mode: Peak Detector (Max Hold)
Span= 2310 – 2500 MHz
Sweep Points = 401
Sweep Time = Auto

Average Measurements (Reduced Video Bandwidth Method)

Spectrum Analyzer Settings:

RBW= 1 MHz
VBW= 2 kHz
VBW Mode = Linear
Trace Mode: Peak Detector (Max Hold)
Span= 2310 – 2500 MHz
Sweep Points = 401
Sweep Time = Auto
Sweep Count = 200

Sample Calculation:

Field Strength Level: Amplitude (Analyzer level) + AFCL (Antenna Factor and Cable losses) – Amplifier Gain = 50 dBuV + 33 dB – 25 dB = 58dBuV/m

9.8.3 Limits:

Frequency (MHz)	Field Strength (µV/m)	Measurement Distance (meters)	Corrected Field Strength for 3m measurement distance (dBµV/m)
0.009-0.490	2400/F (kHz)	300	48.5- 13.8
0.490-1.705	24000/F (kHz)	30	33.8- 23.0
1.705-30	30	30	29.5
30-88	100	3	40
88-216	150	3	43.5
216-960	200	3	46
960-1000	500	3	54
Above 1000 (Restricted Frequency Bands)	500	3	54 (Average) 74 (Peak)
Note: The limits in CFR 47, Part 15, Subpart C, paragraph 15.209 (a), are identical to those in RSS-GEN Section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377Ω. For example, the measurement frequency X kHz resulted in a level of Y dBµV/m, which is equivalent to Y-51.5 = Z dBµA/m, which has the same margin, W dB, to the corresponding RSS-GEN Table 6 limit as it has to be 15.209(a) limit.			

9.8.4 Test Result:

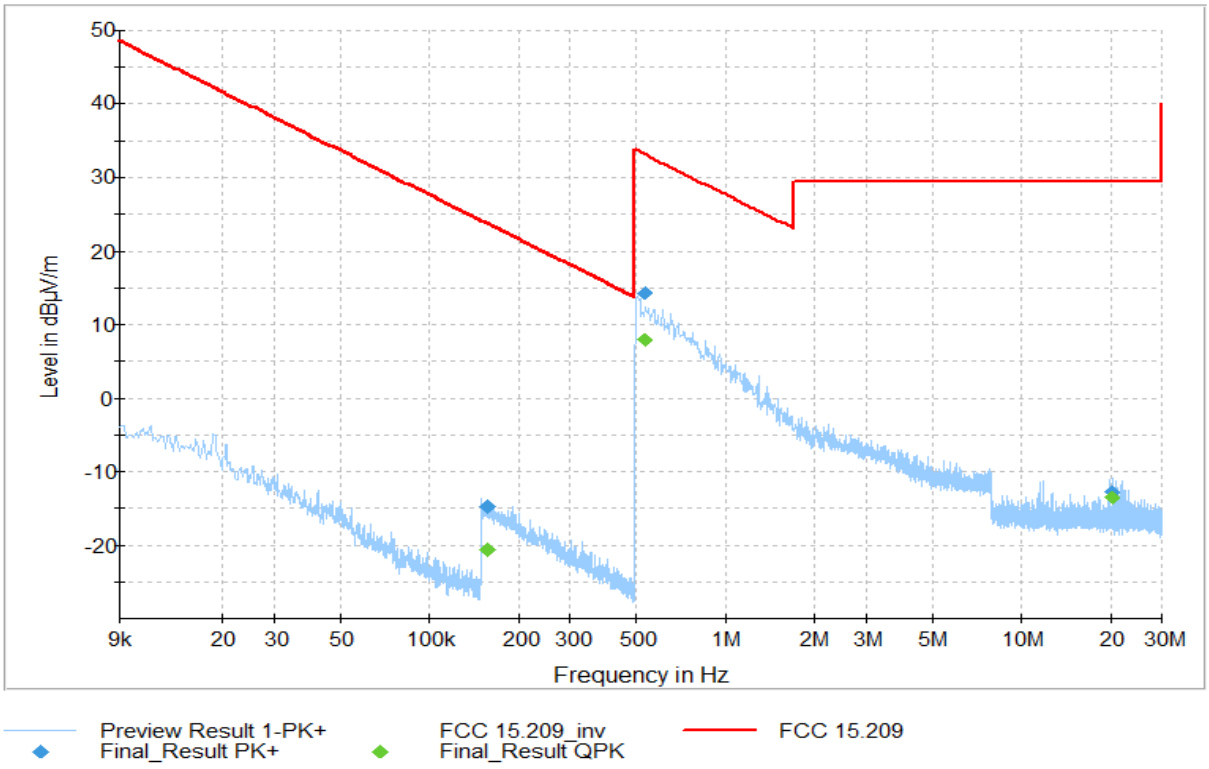
Pass.

9.8.5 Test Data:

9.8.5.1 Emissions in 9 KHz- 30 MHz range

All channels and modes were tested and worst-case results shown here.

RSE 9KHz - 30MHz							
Mode	**Tx Freq (MHz)**	**Spurious Frequency (MHz)**	**Raw Quasi-Peak Amplitude (dBµV/m)**	**System Correction Factor (dB)**	**Corrected Quasi-Peak Field Strength (dBµV/m)**	**Quasi-Peak Limit (dBµV/m)**	**Quasi-Peak Margin (dB)**
802.11g	Tx	0.15882	-2.8	-17.9	-20.7	23.586	-44.286
802.11g	Tx	0.538	-3.8	11.6	7.8	32.989	-25.189
802.11g	Tx	20.26	-8.28	-5.3	-13.58	29.542	-43.122

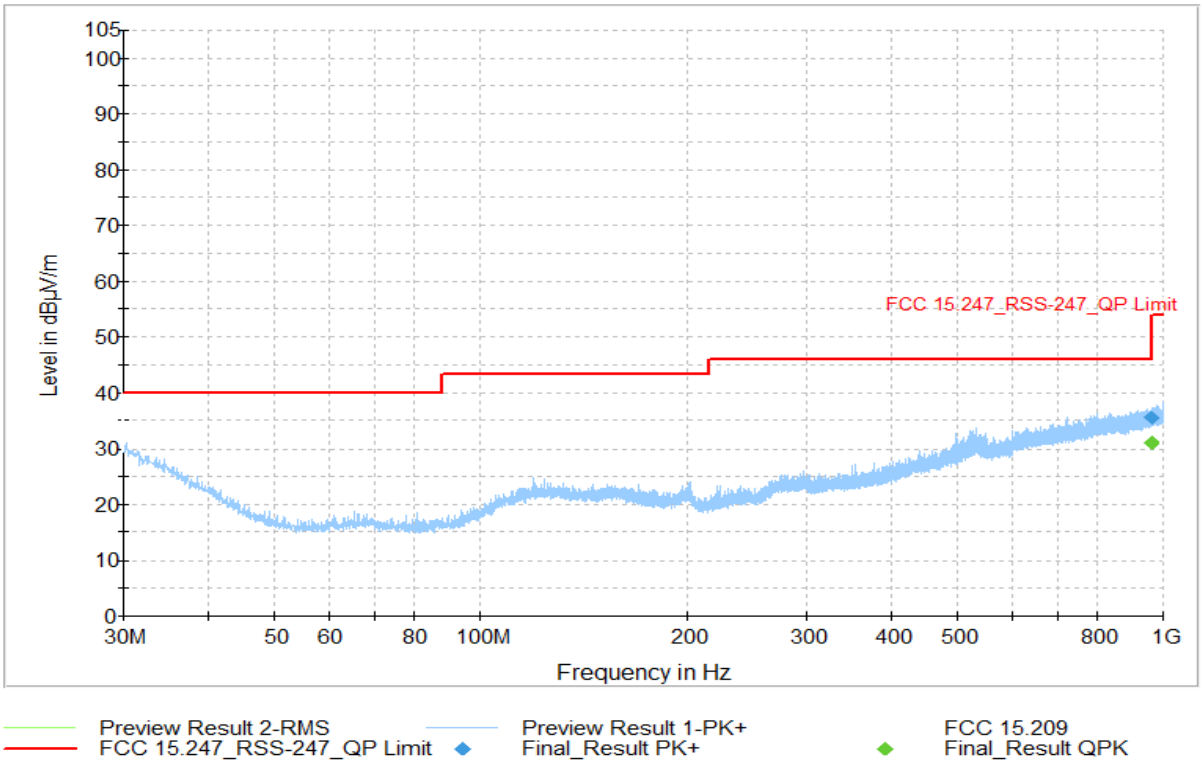


Plot 9-43 Radiated Spurious Emissions 9KHz - 30 MHz 802.11g - Ch. 6 (2437 MHz) – Perpendicular orientation

9.8.5.2 Emissions in 30 MHz- 1 GHz range

All channels and modes were tested, and worst-case results shown here.

RSE 30-1000 MHz							
Mode	**Tx Freq (MHz)**	**Spurious Frequency (MHz)**	**Raw Quasi-Peak Amplitude (dBµV/m)**	**System Correction Factor (dB)**	**Corrected Quasi-Peak Field Strength (dBµV/m)**	**Quasi-Peak Limit (dBµV/m)**	**Quasi-Peak Margin (dB)**
802.11g	Tx	959.78	-0.89	32	31.11	46.02	-14.91

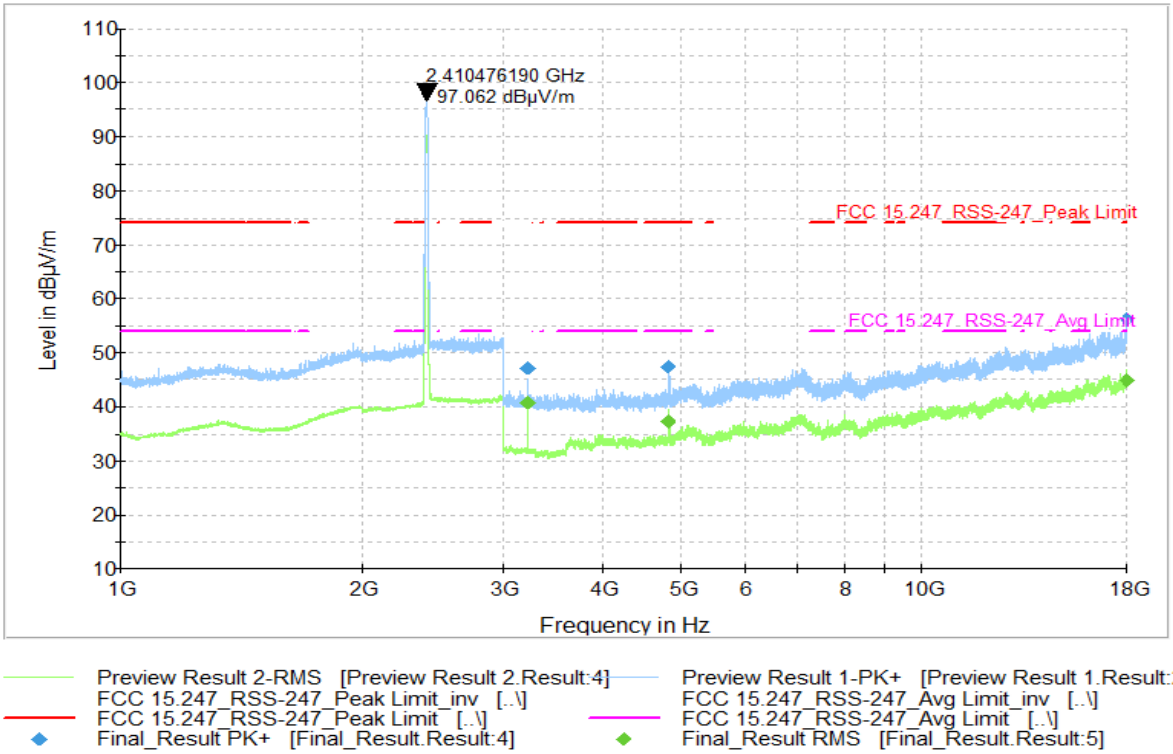


Plot 9-44 Radiated Spurious Emissions 30 – 1000 MHz 802.11g - Ch. 6 (2437 MHz)

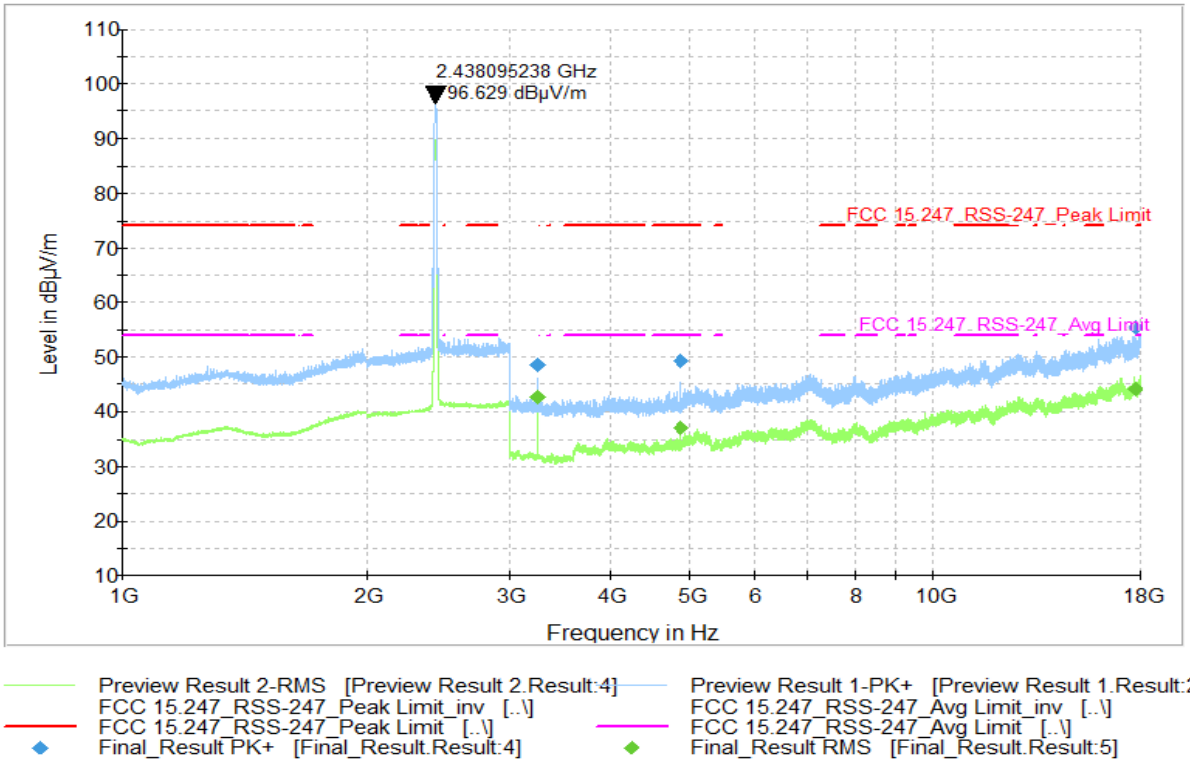
9.8.5.3 Emissions in 1-18 GHz range

802.11g RSE 1 - 18GHz Average Data						
Carrier Frequency (MHz)	**Frequency (MHz)**	**Raw Avg. Amplitude (dBµV)**	**Correction Factor (incl DCF=0dB) (dB)**	**Corrected Avg. Field Strength (dBµV/m)**	**Average Limit (dBµV/m)**	**Margin (dB)**
2412	3216*	33.58	7.2	40.78	54	-13.22
2412	4820	28.19	9.1	37.29	54	-16.71
2412	17980	20.64	24.2	44.84	54	-9.16
2437	3249.4*	35.48	7.1	42.58	54	-11.42
2437	4874.1	28.19	8.8	36.99	54	-17.01
2437	17690.4	20.77	23.3	44.07	54	-9.93
2462	3282.5*	34.32	7.1	41.42	54	-12.58
2462	4923.9	25.85	8.7	34.55	54	-19.45
2462	17875.3	20.62	23.2	43.82	54	-10.18
802.11g RSE 1 – 18GHz Peak Data						
Carrier Frequency (MHz)	**Frequency (MHz)**	**Raw Peak Amplitude (dBµV)**	**Correction Factor (dB)**	**Corrected Peak Field Strength (dBµV/m)**	**Peak Limit (dBµV/m)**	**Margin (dB)**
2412	3216*	40.04	7.2	47.24	74	-26.76
2412	4820	38.36	9	47.36	74	-26.64
2412	17968	32.44	23.8	56.24	74	-17.76
2437	3249.4*	41.63	7.1	48.73	74	-25.27
2437	4874.1	40.64	8.8	49.44	74	-24.56
2437	17700	31.91	23.5	55.41	74	-18.59
2462	3282.9*	40.4	7.1	47.5	74	-26.5
2462	4924.3	38.31	8.7	47.01	74	-26.99
2462	17833.5	32.11	23.2	55.31	74	-18.69

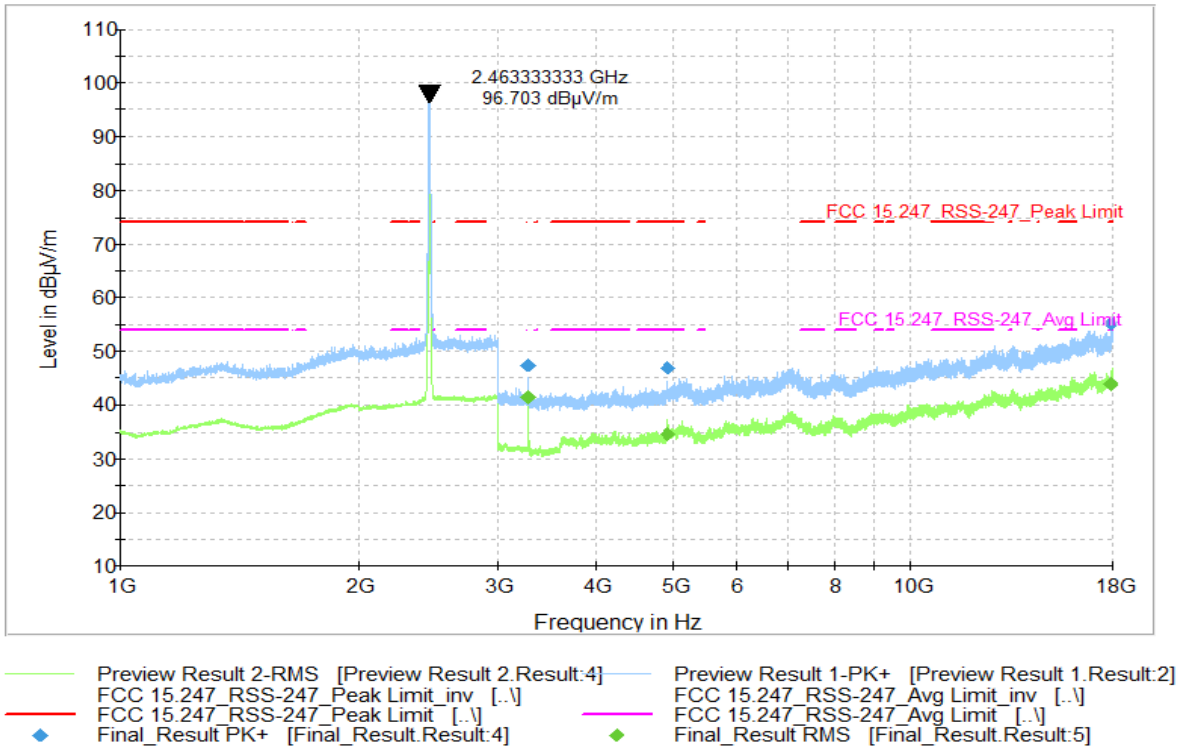
Note: Frequencies with (*) mark do not fall in the restricted frequency band.



Plot 9-45 Radiated Spurious Emission 1-18GHz 802.11g - Ch.1 (2412 MHz)



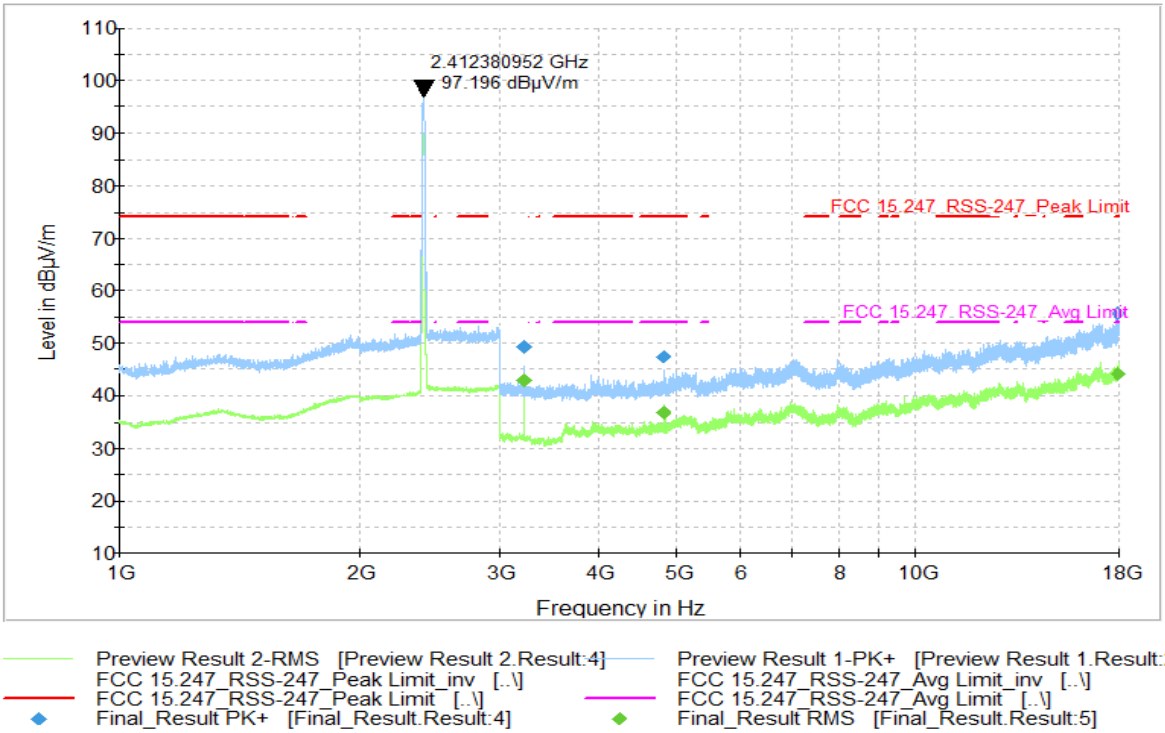
Plot 9-46 Radiated Spurious Emission 1-18GHz 802.11g - Ch.6 (2437 MHz)



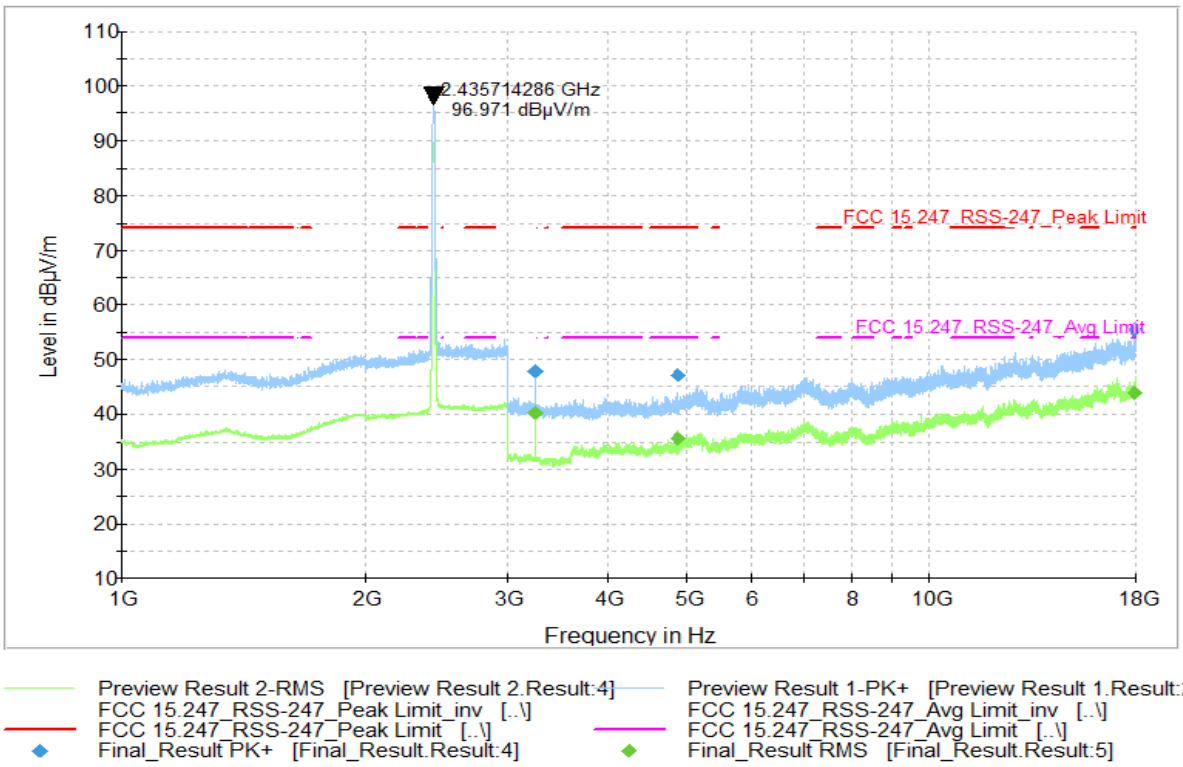
Plot 9-47 Radiated Spurious Emission 1-18GHz 802.11g - Ch.11 (2462 MHz)

802.11n RSE 1 - 18GHz Average Data						
Carrier Frequency (MHz)	**Frequency (MHz)**	**Raw Avg. Amplitude (dBµV)**	**Correction Factor (incl DCF=0dB) (dB)**	**Corrected Avg. Field Strength (dBµV/m)**	**Average Limit (dBµV/m)**	**Margin (dB)**
2412	3215.9*	35.66	7.2	42.86	54	-11.14
2412	4823.9	27.66	9.1	36.76	54	-17.24
2412	17936.2	20.8	23.3	44.1	54	-9.9
2437	3249.4*	33.25	7.1	40.35	54	-13.65
2437	4872.5	26.72	8.8	35.52	54	-18.48
2437	17916.9	20.75	23.2	43.95	54	-10.05
2462	3282.5*	35.42	7.1	42.52	54	-11.48
2462	4923.9	26.29	8.7	34.99	54	-19.01
2462	17989.5	20.56	24.5	45.06	54	-8.94
802.11n RSE 1 – 18GHz Peak Data						
Carrier Frequency (MHz)	**Frequency (MHz)**	**Raw Peak Amplitude (dBµV)**	**Correction Factor (dB)**	**Corrected Peak Field Strength (dBµV/m)**	**Peak Limit (dBµV/m)**	**Margin (dB)**
2412	3216*	42.07	7.2	49.27	74	-24.73
2412	4824.5	38.45	9.1	47.55	74	-26.45
2412	17918.2	32.45	23.2	55.65	74	-18.35
2437	3249.4*	40.84	7.1	47.94	74	-26.06
2437	4874.3	38.45	8.8	47.25	74	-26.75
2437	17903.2	32.51	23.1	55.61	74	-18.39
2462	3282.5*	41.74	7.1	48.84	74	-25.16
2462	4921.1	37.41	8.7	46.11	74	-27.89
2462	17981.3	32.57	24.2	56.77	74	-17.23

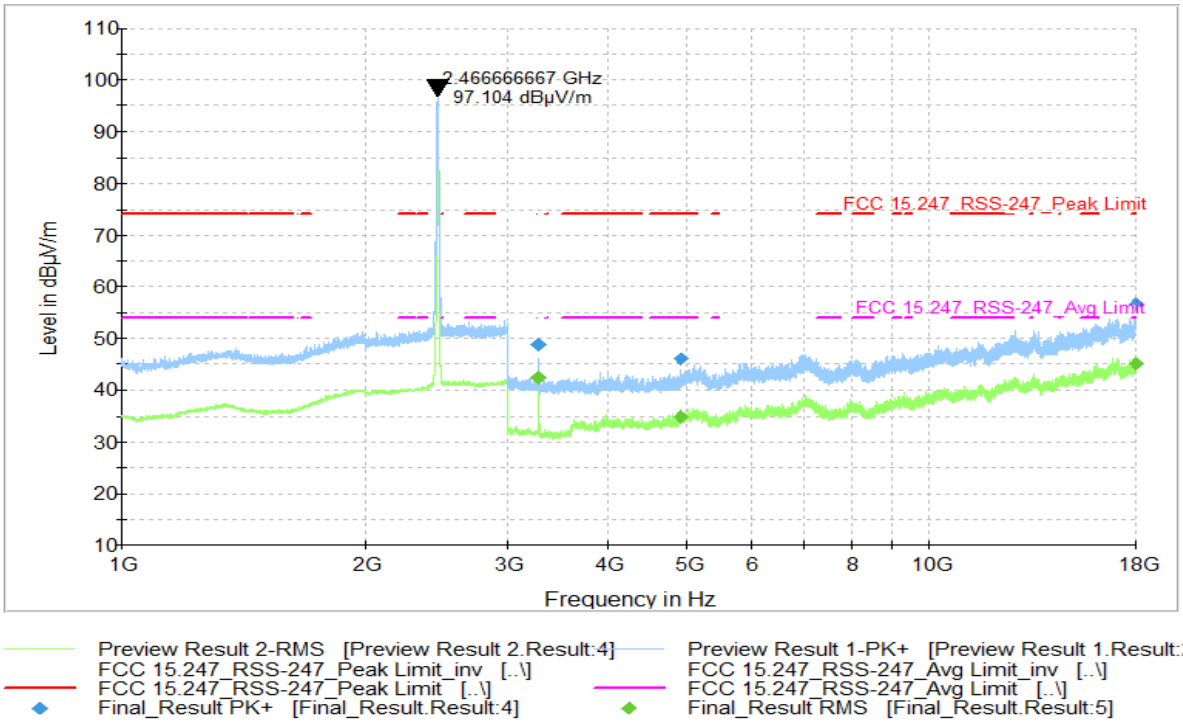
Note: Frequencies with (*) mark do not fall in the restricted frequency band.



Plot 9-48 Radiated Spurious Emission 1-18GHz 802.11n - Ch.1 (2412 MHz)



Plot 9-49 Radiated Spurious Emission 1-18GHz 802.11n - Ch.6 (2437 MHz)

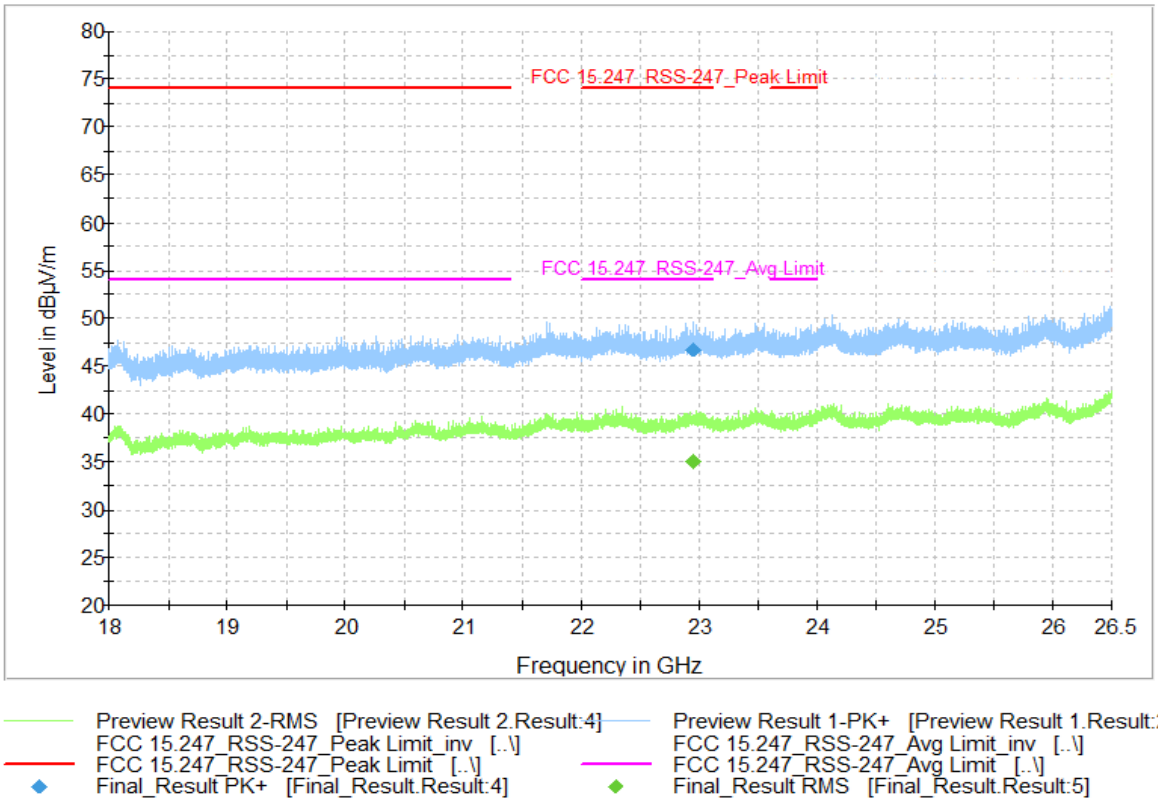


Plot 9-50 Radiated Spurious Emission 1-18GHz 802.11n - Ch.11 (2462 MHz)

9.8.5.4 Emissions in 18-26.5 GHz range

All modes and channels were tested and worst-case data from mid channel of operation shown here. No significant emissions to report above noise floor.

802.11g RSE 18 – 26.5GHz Average Data						
Carrier Frequency (MHz)	**Frequency (MHz)**	**Raw Avg. Amplitude (dBµV)**	**Correction Factor (incl DCF=0dB) (dB)**	**Corrected Avg. Field Strength (dBµV/m)**	**Average Limit (dBµV/m)**	**Margin (dB)**
2437	22952.52	22.95	12.1	35.05	54	-18.95
802.11g RSE 18 – 26.5GHz Peak Data						
Carrier Frequency (MHz)	**Frequency (MHz)**	**Raw Peak Amplitude (dBµV)**	**Correction Factor (dB)**	**Corrected Peak Field Strength (dBµV/m)**	**Peak Limit (dBµV/m)**	**Margin (dB)**
2437	22950.4	34.64	12.1	46.74	74	-27.26

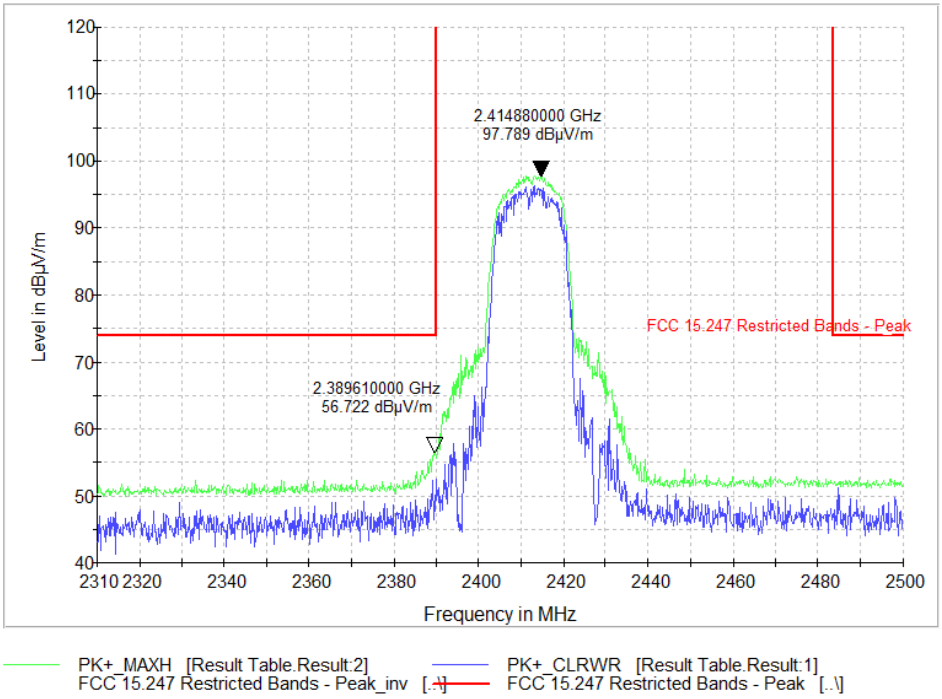


Plot 9-51 Radiated Spurious Emissions 18-26.5GHz 802.11g - Ch.6 (2437 MHz)

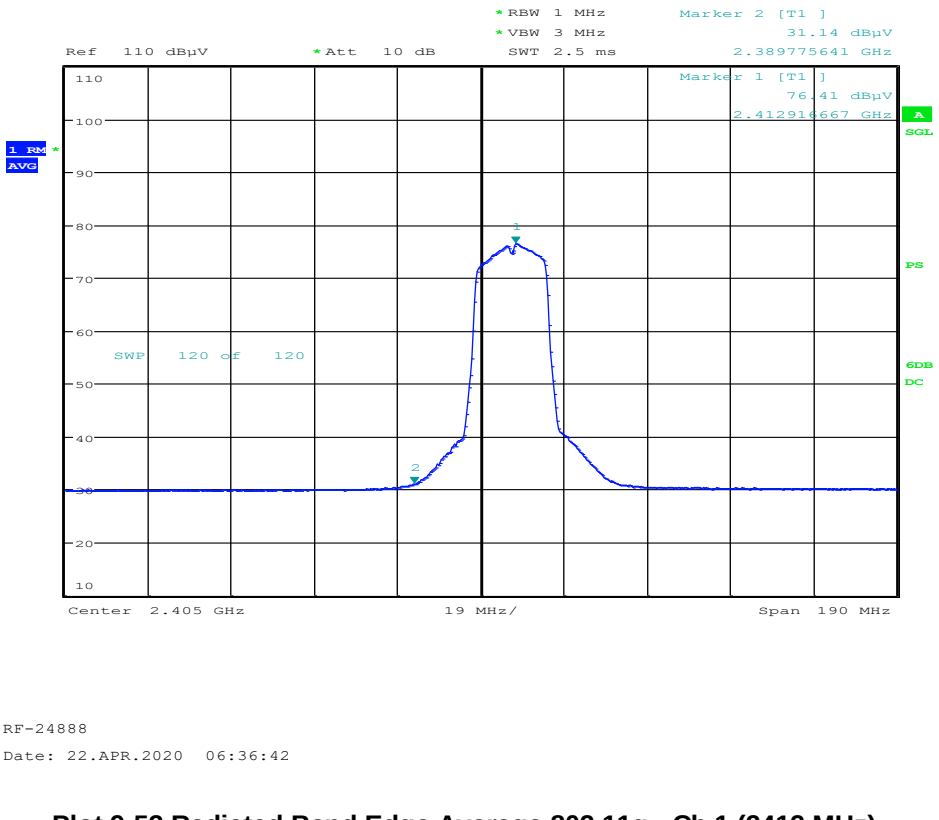
9.8.5.5 Radiated restricted Band-edge emissions

802.11g Band-edge Average Data						
Carrier Frequency (MHz)	**Frequency (MHz)**	**Raw Avg. Amplitude (dBµV)**	**Correction Factor (incl DCF) (dB)**	**Corrected Avg. Field Strength (dBµV/m)**	**Average Limit (dBµV/m)**	**Margin (dB)**
2412	2389.78	31.14	13.49	44.63	54	-9.37
2462	2483.86	28.93	13.99	42.92	54	-11.08
802.11g Band-edge Peak Data						
Carrier Frequency (MHz)	**Frequency (MHz)**	**Raw Peak Amplitude (dBµV)**	**Correction Factor (dB)**	**Corrected Peak Field Strength (dBµV/m)**	**Peak Limit (dBµV/m)**	**Margin (dB)**
2412	2389.61	43.62	13.1	56.72	74	-17.28
2462	2484.23	47.05	13.6	60.65	74	-13.35

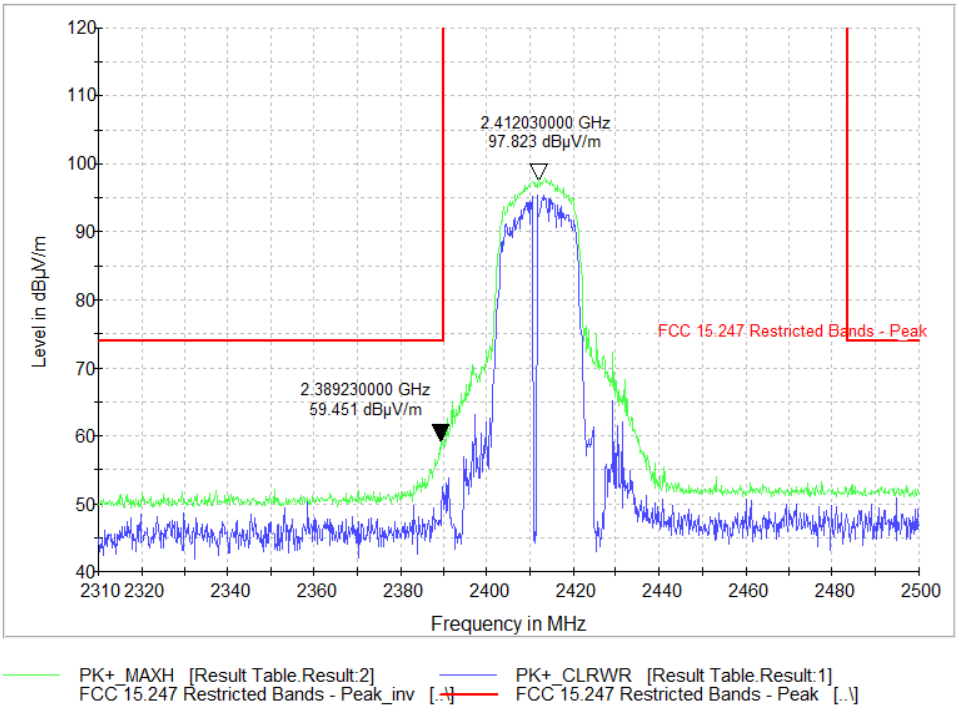
802.11n Band-edge Average Data						
Carrier Frequency (MHz)	**Frequency (MHz)**	**Raw Avg. Amplitude (dBµV)**	**Correction Factor (incl DCF) (dB)**	**Corrected Avg. Field Strength (dBµV/m)**	**Average Limit (dBµV/m)**	**Margin (dB)**
2412	2389.61	31.03	13.76	44.79	54	-9.21
2462	2483.61	31.22	14.26	45.48	54	-8.52
802.11n Band-edge Peak Data						
Carrier Frequency (MHz)	**Frequency (MHz)**	**Raw Peak Amplitude (dBµV)**	**Correction Factor (dB)**	**Corrected Peak Field Strength (dBµV/m)**	**Peak Limit (dBµV/m)**	**Margin (dB)**
2412	2389.23	46.35	13.1	59.45	74	-14.55
2462	2483.66	46.36	13.6	59.96	74	-14.04



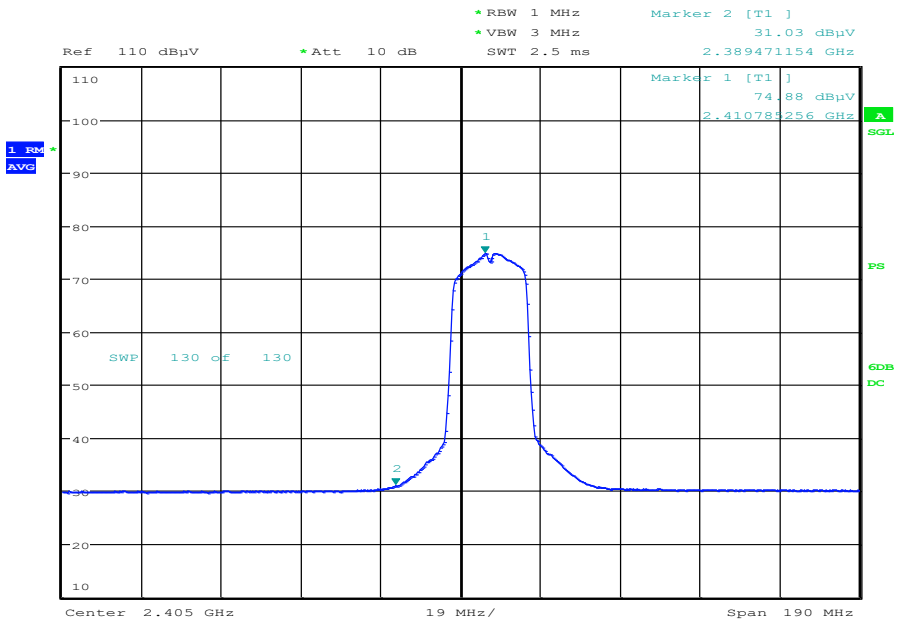
Plot 9-52 Radiated Band Edge Peak 802.11g - Ch.1 (2412 MHz)



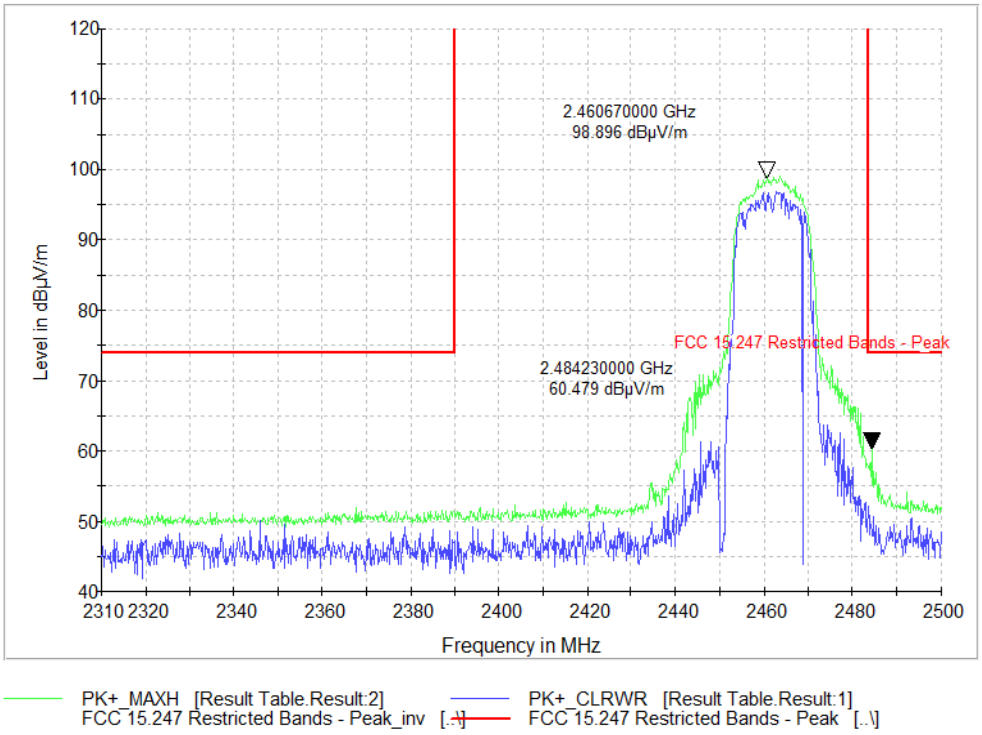
Plot 9-53 Radiated Band Edge Average 802.11g - Ch.1 (2412 MHz)



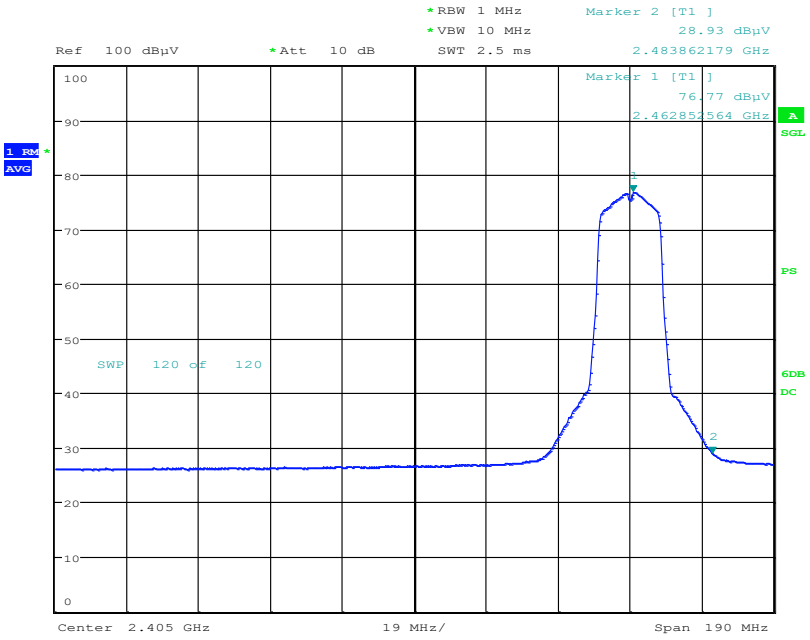
Plot 9-54 Radiated Band Edge Peak 802.11n - Ch.1 (2412 MHz)



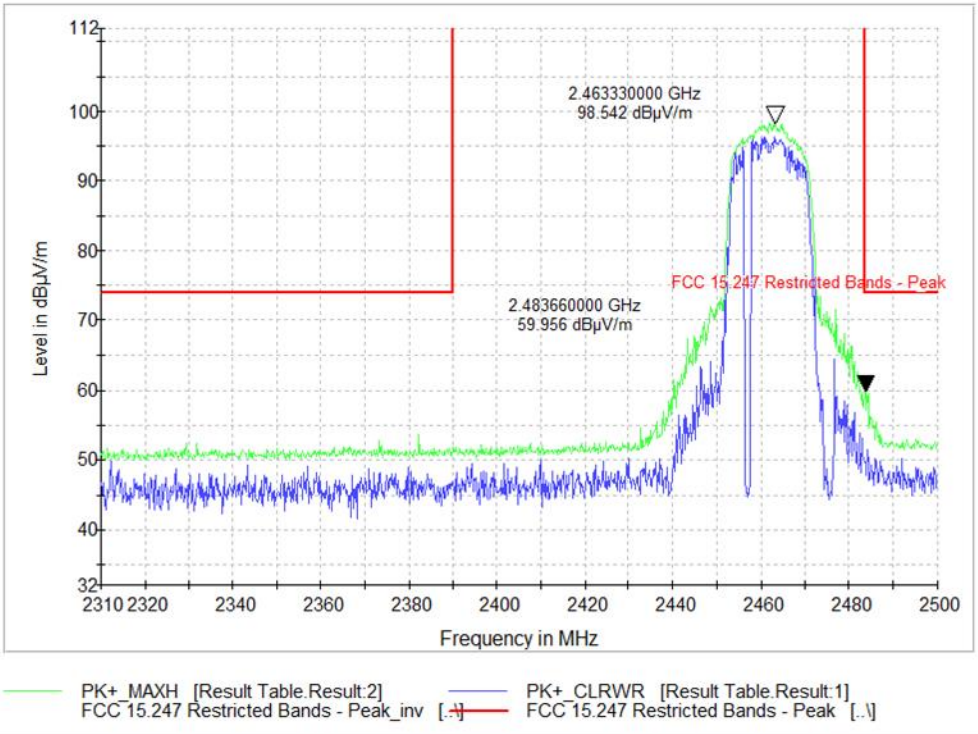
Plot 9-55 Radiated Band Edge Average 802.11n - Ch.1 (2412 MHz)



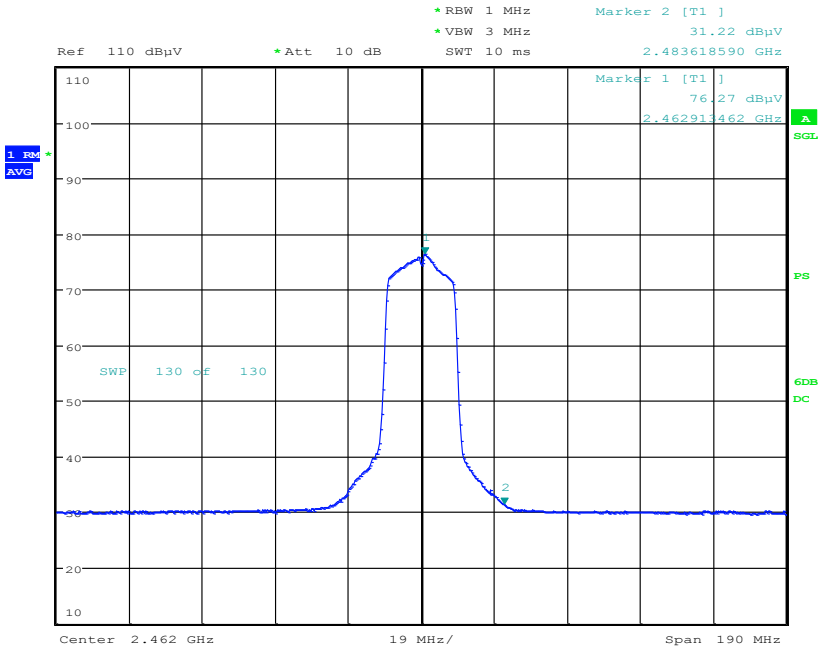
Plot 9-56 Radiated Band Edge Peak 802.11g - Ch.11 (2462 MHz)



Plot 9-57 Radiated Band Edge Average 802.11g - Ch.11 (2462 MHz)



Plot 9-58 Radiated Band Edge Peak 802.11n - Ch.11 (2462 MHz)



Plot 9-59 Radiated Band Edge Average 802.11n - Ch.11 (2462 MHz)

9.9 AC Line Conducted Emissions

9.9.1 Test Requirements

FCC CFR 47 Rule Part 15.207 (a)
Innovation Science and Economic Development Canada RSS-Gen [8.8]

9.9.2 Test Method

Conducted power line measurements are made, unless otherwise specified, over the frequency range from 150 kHz to 30 MHz to determine the unsymmetric radio-noise voltage that is conducted from the EUT power-input terminals that are directly (or indirectly via separate transformer or power supplies) connected to a public power network. Equipment is tested with the power cords that are used under normal operating conditions. These measurements are made using a LISN (Line Impedance Stabilization Network). AC powered peripherals are attached to a second LISN with the 50-ohm measuring port terminated by a 50 ohm resistive load.

The EUT is set to continuously transmit on Ch.6, 802.11g mode at 6dBm power setting.

EMI Receiver Settings:
150 kHz – 30 MHz:
RBW= 9 kHz
VBW ≥ 3 X RBW
Trace Mode: Peak Detector (Max Hold).
Final measurements performed using Quasi-Peak and Average Detectors.
Span= 150 kHz – 30 MHz
Sweep time= Auto

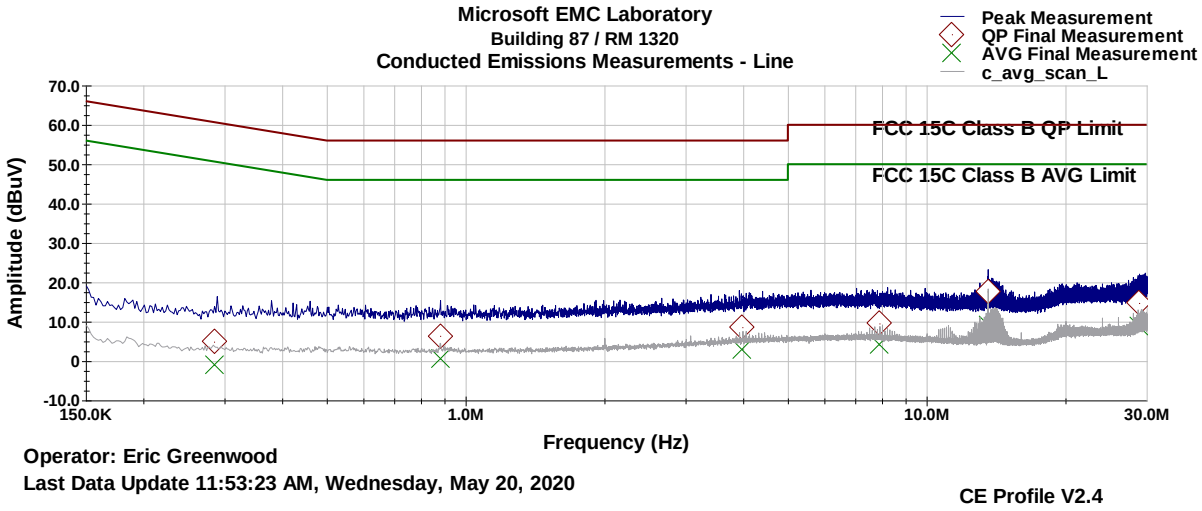
9.9.3 Limit

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

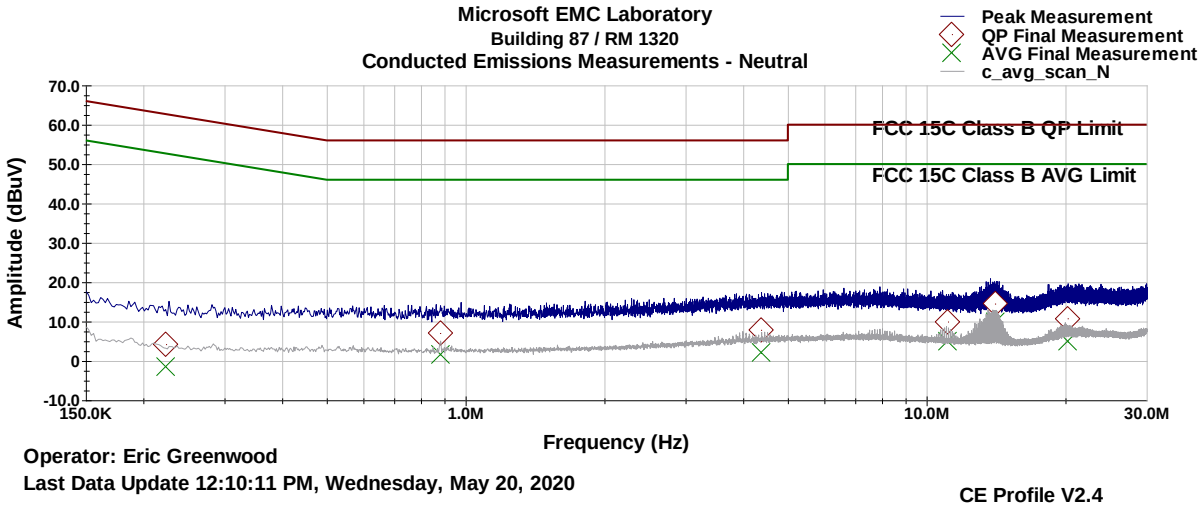
9.9.4 Test Result:

Pass

9.9.5 Test Data:



Plot 9-60 Conducted Emissions Measurements-Line



Plot 9-61 Conducted Emissions Measurements- Neutral

Frequency (MHz)	Line Tested (L or N)	AVG Amplitude (dBµV)	QP Amplitude (dBµV)	AVG Limit (dBµV)	QP Limit (dBµV)	AVG Margin (dB)	QP Margin (dB)
0.285	L	-0.94	4.91	50.68	60.68	-51.62	-55.78
0.880	L	0.62	6.40	46.00	56.00	-45.38	-49.60
3.983	L	3.05	8.60	46.00	56.00	-42.96	-47.40
7.898	L	4.10	9.56	50.00	60.00	-45.90	-50.45
13.564	L	9.04	17.67	50.00	60.00	-40.96	-42.33
28.880	L	8.85	14.76	50.00	60.00	-41.15	-45.25
0.224	N	-1.55	4.24	52.67	62.67	-54.22	-58.43
0.880	N	1.63	7.08	46.00	56.00	-44.37	-48.92
4.373	N	2.03	7.89	46.00	56.00	-43.97	-48.11
11.123	N	4.93	9.98	50.00	60.00	-45.07	-50.02
14.070	N	9.93	14.55	50.00	60.00	-40.07	-45.45
20.225	N	4.88	10.82	50.00	60.00	-45.12	-49.18

End of Report