

Report on the FCC and IC Testing of: Apple Inc. Model: A1932

In accordance with FCC 47 CFR Part 15C and
Industry Canada RSS-247 and Industry Canada
RSS-GEN

Prepared for: Apple Inc.
One Apple Park Way
Cupertino, California 95014, USA

FCC ID: BCGA1932 IC: 579C-A1932



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Document Number: 75942371-12 | Issue: 01

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NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Matthew Russell	RF Team Leader	Authorised Signatory	18 October 2018

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 15C and Industry Canada RSS-247 and Industry Canada RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Graeme Lawler	Test Engineer	Testing	18 October 2018
Tony Hubbard	Test Engineer	Testing	18 October 2018
Cristian Onaca	Engineer	Testing	18 October 2018
Sharif Sendagire	Shift Engineer	Testing	18 October 2018
Phillip Harrison	Senior Engineer	Testing	18 October 2018
Nandhini Mathivanan	Engineer	Testing	18 October 2018

FCC Accreditation

90987 Octagon House, Fareham Test Laboratory

Industry Canada Accreditation

IC2932B-1 Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15C: 2017, Industry Canada RSS-247: Issue 2 (2017-02) and Industry Canada RSS-GEN: Issue 5 (2018-04).



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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	18 October 2018

Table 1

1.2 Introduction

Applicant	Apple Inc.
Manufacturer	Apple Inc.
Model Number(s)	A1932
Serial Number(s)	C02X5003L3J0, C02X5003L3J3, C02X5003JL8Y & C02X5004L3FP
Hardware Version(s)	EVT2
Software Version(s)	18B2034
Number of Samples Tested	4
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2017 Industry Canada RSS-247: Issue 2 (2017-02) Industry Canada RSS-GEN: Issue 5 (2018-04)
Order Number	0540166213
Date	06-April-2018
First Date of Receipt of EUT	23-August 2018
Start of Test	07-September-2018
Finish of Test	17-October-2018
Name of Engineer(s)	Sharif Sendagire, Graeme Lawler, Tony Hubbard, Cristian Onaca, Nandhini Mathivanan, Phillip Harrison
Related Document(s)	ANSI C63.10 (2013) KDB 662911 D01 v02r01



1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C, Industry Canada RSS-247 and Industry Canada RSS-GEN is shown below.

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	Part 15C	RSS-247	RSS-GEN			
Configuration and Mode: 802.11 b/g/n						
2.1	15.247 (b)(3)	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 KDB 662911 D01 v02r01
2.2	15.247 (e)	5.2	-	Power Spectral Density	Pass	ANSI C63.10 KDB 662911 D01 v02r01
2.3	15.247 (a)(2)	5.2	6.7	Emission Bandwidth	Pass	ANSI C63.10
2.4	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10
2.5	15.205	-	8.10	Restricted Band Edges	Pass	ANSI C63.10
2.6	15.247 (d), 15.205	5.5	6.13	Spurious Radiated Emissions	Pass	ANSI C63.10

Table 2

1.4 Product Information

1.4.1 Technical Description

The Equipment Under Test (EUT) was a Laptop computer, with Bluetooth, Bluetooth Low Energy and 802.11 b/g/n/ac capabilities in the 2.4GHz and 5GHz bands.

1.4.2 Details of Antenna Assembly

Frequency (MHz)	Peak Gain (dBi)	Conducted Cable Loss (dB)
2400 – 2480 (Core0)	2.3	1.00
2400 – 2480 (Core1)	3.9	1.00

Table 3

1.5 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.6 EUT Modification Record

The table below details modifications made to the EUT during the test programme. The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
Serial Number: C02X5003L3J0			
0	As supplied by the customer	Not Applicable	Not Applicable
Serial Number: C02X5003L3J3			
0	As supplied by the customer	Not Applicable	Not Applicable
1	Maximum conducted output power and PSD tests repeated at reduced powers.	Not Applicable	15 October 2018
Serial Number: C02X5003JL8Y			
0	As supplied by the customer	Not Applicable	Not Applicable
Serial Number: C02X5004L3FP			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 4

1.7 Test Location

TÜV SÜD Product Service conducted the following tests at our Fareham Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: 802.11 b/g/n		
Maximum Conducted Output Power	Philip Harrison	UKAS
Power Spectral Density	Philip Harrison	UKAS
Emission Bandwidth	Philip Harrison	UKAS
Authorised Band Edges	Sharifu Sendagire, Graeme Lawler, Tony Hubbard, Cristian Onaca, Nandhini Mathivanan	UKAS
Restricted Band Edges		UKAS
Spurious Radiated Emissions		UKAS

Table 5

Office Address:

Octagon House
Concorde Way
Segensworth North
Fareham
Hampshire
PO15 5RL
United Kingdom

2 Test Details

2.1 Maximum Conducted Output Power

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (b)
Industry Canada RSS-247, 5.4
Industry Canada RSS-GEN, 6.12

2.1.2 Equipment Under Test and Modification State

A1932, S/N: C02X5003L3J3 - Modification State 0
A1932, S/N: C02X5003L3J3 - Modification State 1
A1932, S/N: C02X5003JL8Y - Modification State 0

2.1.3 Date of Test

26-September-2018 to 17-October-2018

2.1.4 Test Method

The test was performed in accordance with ANSI C63.10 clause 11.9.2.3.2 Method AVGPM-G

The conducted output power was verified as being the same from each transmit chain, but the antenna gains were not identical, therefore the modes reported for SISO operation are those giving the highest EIRP and/or lowest conducted limit based on the antenna giving highest total directional gain.

MIMO output port summing was performed in accordance with KDB 662911 D01. Cyclic delay diversity (CDD) modes had the output chains summed using clause F)2)f)(i) with an array gain of 0 dB (802.11 devices with ≤ 4 antennas). Transmit beamforming (TxBF) modes were summed as per F)2)d)(i).

2.1.5 Environmental Conditions

Ambient Temperature	21 to 24°C
Relative Humidity	36 to 68%

2.1.6 Test Results

802.11b / 1 Mbps / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Antenna Directional Gain (dBi)	3.90	3.90	3.90
15.407 Conducted Power Limit (dBm)	30.00	30.00	30.00
RSS-247 Conducted Power Limit (dBm)	30.00	30.00	30.00
Conducted Power (dBm)	19.20	19.96	12.86
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	23.10	23.86	16.76

Table 6

802.11b / 1 Mbps / MIMO CDD / Cores 0+1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Conducted Power Core 0 (dBm)	18.27	19.89	12.35
Conducted Power Core 1 (dBm)	18.24	19.66	12.43
Antenna Directional Gain (dBi)	3.90	3.90	3.90
15.407 Conducted Power Limit (dBm)	30.00	30.00	30.00
RSS-247 Conducted Power Limit (dBm)	30.00	30.00	30.00
Total Conducted Power (dBm)	21.27	22.79	15.40
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	25.17	26.69	19.30

Table 7

802.11g / 6 Mbps / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Antenna Directional Gain (dBi)	3.90	3.90	3.90
15.407 Conducted Power Limit (dBm)	30.00	30.00	30.00
RSS-247 Conducted Power Limit (dBm)	30.00	30.00	30.00
Conducted Power (dBm)	13.79	19.88	1.17
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	17.69	23.78	5.07

Table 8

802.11n / HT20 MCS0 / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Antenna Directional Gain (dBi)	3.90	3.90	3.90
15.407 Conducted Power Limit (dBm)	30.00	30.00	30.00
RSS-247 Conducted Power Limit (dBm)	30.00	30.00	30.00
Conducted Power (dBm)	13.65	19.95	1.40
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	17.55	23.85	5.30

Table 9

802.11n / HT20 MCS0 / MIMO CDD / Cores 0+1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Conducted Power Core 0 (dBm)	13.69	19.58	-2.17
Conducted Power Core 1 (dBm)	13.69	19.72	-2.32
Antenna Directional Gain (dBi)	3.90	3.90	3.90
15.407 Conducted Power Limit (dBm)	30.00	30.00	30.00
RSS-247 Conducted Power Limit (dBm)	30.00	30.00	30.00
Total Conducted Power (dBm)	16.70	22.66	0.77
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	20.60	26.56	4.67

Table 10

802.11n / HT20 MCS0 / MIMO TxBF / Cores 0+1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Conducted Power Core 0 (dBm)	13.24	19.69	-3.07
Conducted Power Core 1 (dBm)	13.27	19.55	-3.01
Antenna Directional Gain (dBi)	6.15	6.15	6.15
15.407 Conducted Power Limit (dBm)	29.85	29.85	29.85
RSS-247 Conducted Power Limit (dBm)	30.00	30.00	30.00
Total Conducted Power (dBm)	16.27	22.63	-0.03
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	22.41	28.78	6.12

Table 11

Remarks

In cases where the directional gain exceeded 6 dBi the conducted output power limit was reduced in accordance with 15.247(b)(4).

FCC 47 CFR Part 15, Limit Clause 15.247 (b)(3)

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

Industry Canada RSS-247, Limit Clause 5.4 (b)

For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e) of the specification.

2.1.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
20dB/2W Attenuator	Narda	4772-20	462	-	O/P Mon
Hygrometer	Rotronic	I-1000	2891	12	18-Sept-2019
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Directional Coupler	Hewlett Packard	11692D	451	-	O/P Mon
Attenuator (20dB, 2W)	Pasternack	PE7004-20	2943	12	18-Jul-2019
Attenuator (20dB, 150W)	Narda	769-20	3367	12	17-Jul-2019
Attenuator (10dB, 150W)	Narda	769-10	3368	12	17-Jul-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	09-Oct-2018
DC - 12.4 GHz 10 dB Attenuator	Suhner	6810.17.A	3965	12	18-Jul-2019
P-Series Power Meter	Agilent Technologies;	N1911A	3981	12	29-Sep-2019
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies;	N1921A	3983	12	29-Sep-2019
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4742	12	29-Sep-2019
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4743	12	29-Sep-2019
Power splitter - 4 port	Mini-Circuits	ZN4PD1-63-S+	4744	12	29-Sep-2019
EMI Receiver	Keysight Technologies;	N9038A MXE	4628	12	4-July-2019

Table 12

All test equipment was in calibration at the time of use.
O/P Mon – Output Monitored using calibrated equipment



2.2 Power Spectral Density

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (e)
Industry Canada RSS-247, Clause 5.2
Industry Canada RSS-GEN, Clause 6.12

2.2.2 Equipment Under Test and Modification State

A1932, S/N: C02X5003L3J3 - Modification State 0
A1932, S/N: C02X5003L3J3 - Modification State 1
A1932, S/N: C02X5003JL8Y - Modification State 0

2.2.3 Date of Test

26-September-2018 to 17-October-2018

2.2.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.10.3, 11.10.5 or 11.10.7.

The output power was verified as being the same from each transmit chain, but the antenna gains were not identical. Therefore the modes reported here for SISO or 2x2 MIMO operation are those giving the highest EIRP and/or lowest conducted limit based on the combination of antennas giving highest total directional gain.

MIMO output port summing was performed in accordance with KDB 662911 D01. Cyclic delay diversity (CDD) modes had the output chains summed using clause F)2)f)(ii) Transmit beamforming (TxBF) modes were summed as per F)2)d)(i).

2.2.5 Environmental Conditions

Ambient Temperature	21 to 24°C
Relative Humidity	36 to 68%

2.2.6 Test Results

802.11b / 1 Mbps / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Raw Conducted PSD (dBm/30kHz)	-2.34	-1.53	-8.93
Duty Cycle Correction (dB)	N/A SA-1	N/A SA-1	N/A SA-1
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-2.34	-1.53	-8.93

Table 13

802.11b / 1 Mbps / MIMO CDD / Cores 0+1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Conducted PSD Core 0 (dBm/30kHz)	-3.34	-1.82	-9.51
Conducted PSD Core 1 (dBm/30kHz)	-3.58	-1.43	-9.42
Duty Cycle Correction (dB)	N/A SA-1	N/A SA-1	N/A SA-1
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-0.45	1.39	-6.45

Table 14

802.11g / 6 Mbps / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Raw Conducted PSD (dBm/30kHz)	-10.42	-4.18	-22.99
Duty Cycle Correction (dB)	N/A SA-1	N/A SA-1	N/A SA-1
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-10.42	-4.18	-22.99

Table 15

802.11n / HT20 MCS0 / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Raw Conducted PSD (dBm/30kHz)	-10.22	-4.21	-23.32
Duty Cycle Correction (dB)	N/A SA-1	N/A SA-1	N/A SA-1
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-10.22	-4.21	-23.32

Table 16

802.11n / HT20 MCS0 / MIMO CDD / Cores 0+1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Conducted PSD Core 0 (dBm/30kHz)	-9.78	-4.73	-26.69
Conducted PSD Core 1 (dBm/30kHz)	-10.64	-4.62	-26.92
Duty Cycle Correction (dB)	N/A SA-1	N/A SA-1	N/A SA-1
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-7.18	-1.67	-23.79

Table 17

802.11n / HT20 MCS0 / MIMO TxBF / Cores 0+1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
Conducted PSD Core 0 (dBm/30kHz)	-4.73	1.12	-21.68
Conducted PSD Core 1 (dBm/30kHz)	-5.49	2.46	-20.55
Duty Cycle Correction (dB)	N/A SA-3	N/A SA-3	N/A SA-3
15.247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/3kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-2.08	4.85	-18.07

Table 18

FCC 47 CFR Part 15, Limit Clause 15.247 (e)

The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Industry Canada RSS-247, Limit Clause 5.2(b)

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission

2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
20dB/2W Attenuator	Narda	4772-20	462	-	O/P Mon
Hygrometer	Rotronic	I-1000	2891	12	18-Sept-2019
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Directional Coupler	Hewlett Packard	11692D	451	-	O/P Mon
Attenuator (20dB, 2W)	Pasternack	PE7004-20	2943	12	18-Jul-2019
Attenuator (20dB, 150W)	Narda	769-20	3367	12	17-Jul-2019
Attenuator (10dB, 150W)	Narda	769-10	3368	12	17-Jul-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	09-Oct-2018
DC - 12.4 GHz 10 dB Attenuator	Suhner	6810.17.A	3965	12	18-Jul-2019
PXA Signal Analyser	Keysight Technologies;	N9030A	4653	12	05-Feb-2019
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4742	12	29-Sep-2019
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4743	12	29-Sep-2019
Power splitter - 4 port	Mini-Circuits	ZN4PD1-63-S+	4744	12	29-Sep-2019
EMI Receiver	Keysight Technologies;	N9038A MXE	4628	12	4-July-2019

Table 19

All test equipment was in calibration at the time of use.
O/P Mon – Output Monitored using calibrated equipment



2.3 Emission Bandwidth

2.3.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(2)
Industry Canada RSS-247, 5.2
Industry Canada RSS-GEN, 6.6

2.3.2 Equipment Under Test and Modification State

A1932, S/N: C02X5003L3J3 - Modification State 0
A1932, S/N: C02X5003JL8Y - Modification State 0

2.3.3 Date of Test

15-October-2018 to 17-October-2018

2.3.4 Test Method

This test was performed in accordance with ANSI C63.10, 11.8.1 and RSS-Gen, clause 6.7

2.3.5 Environmental Conditions

Ambient Temperature	21 to 24°C
Relative Humidity	36 to 68%

2.3.6 Test Results

802.11b / 1 Mbps / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	8.640	8.160	8.160
99% Bandwidth (MHz)	10.410	10.809	10.430

Table 20

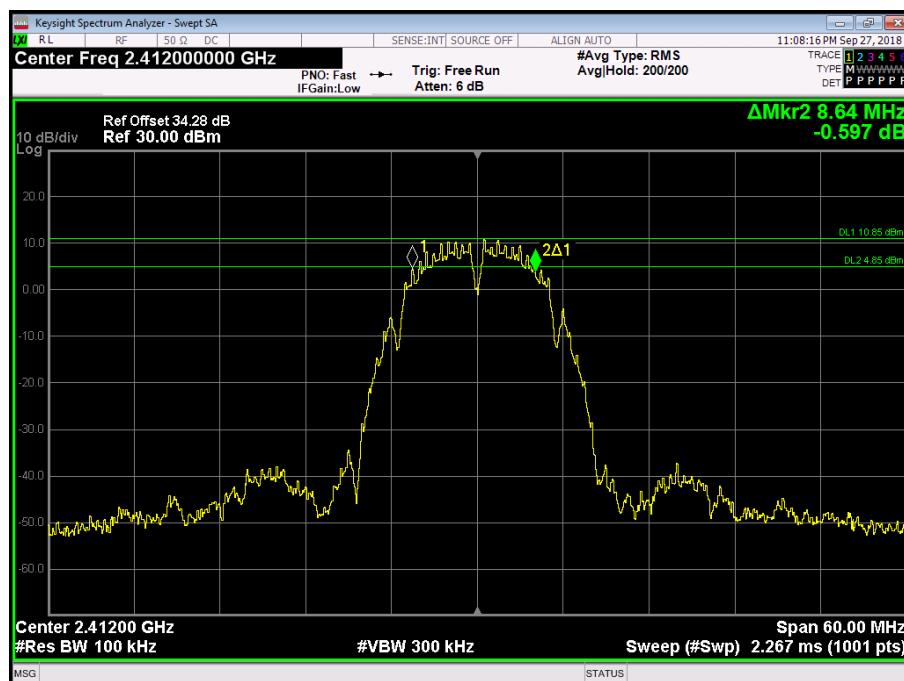


Figure 1 - 2412 MHz - 6 dB DTS Bandwidth

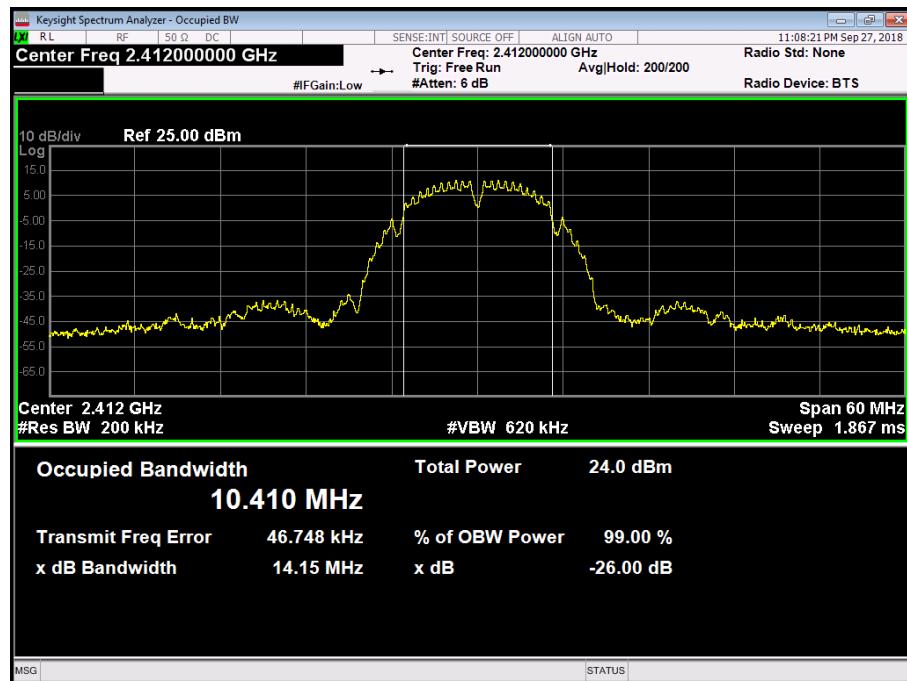


Figure 2 - 2412 MHz - 99% Occupied Bandwidth

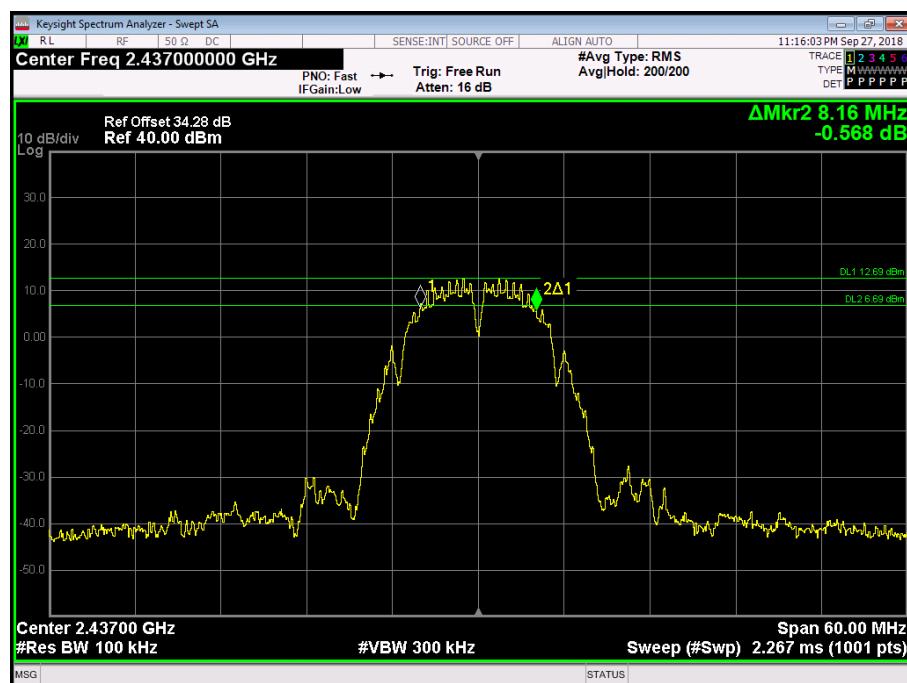


Figure 3 - 2437 MHz - 6 dB DTS Bandwidth

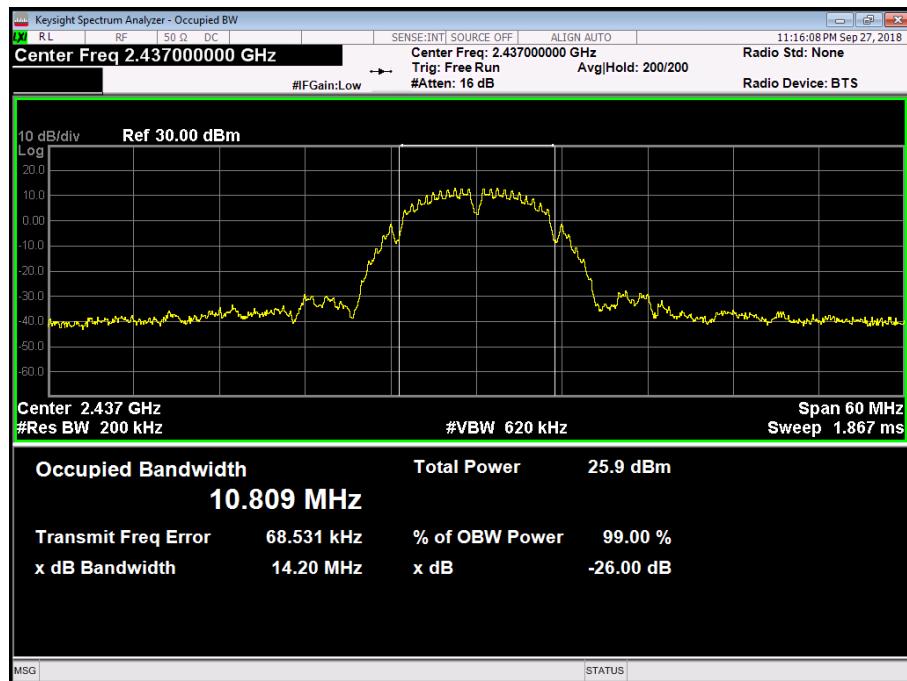


Figure 4 - 2437 MHz - 99% Occupied Bandwidth

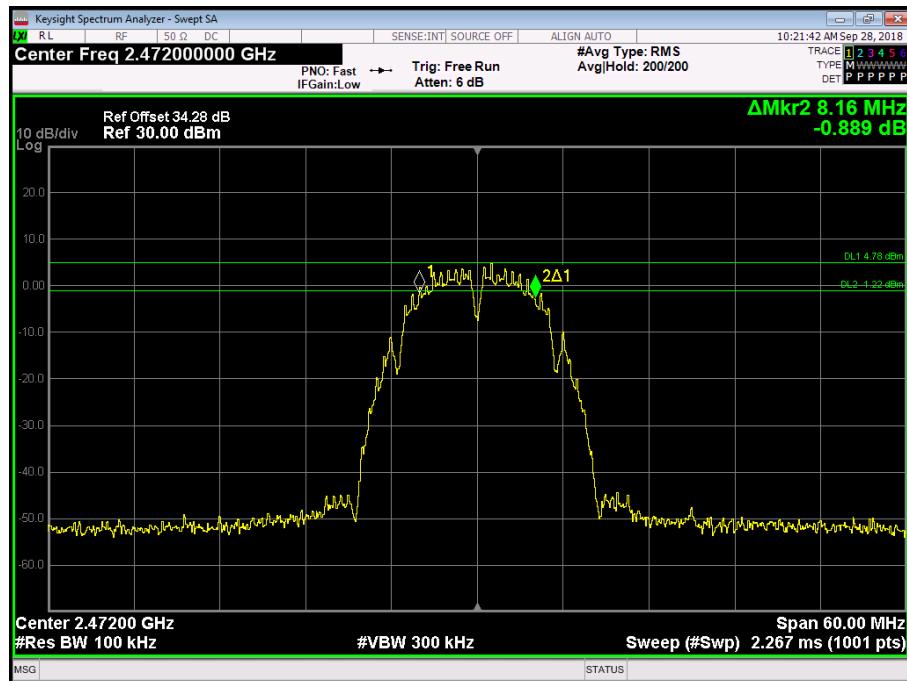


Figure 5 - 2472 MHz - 6 dB DTS Bandwidth

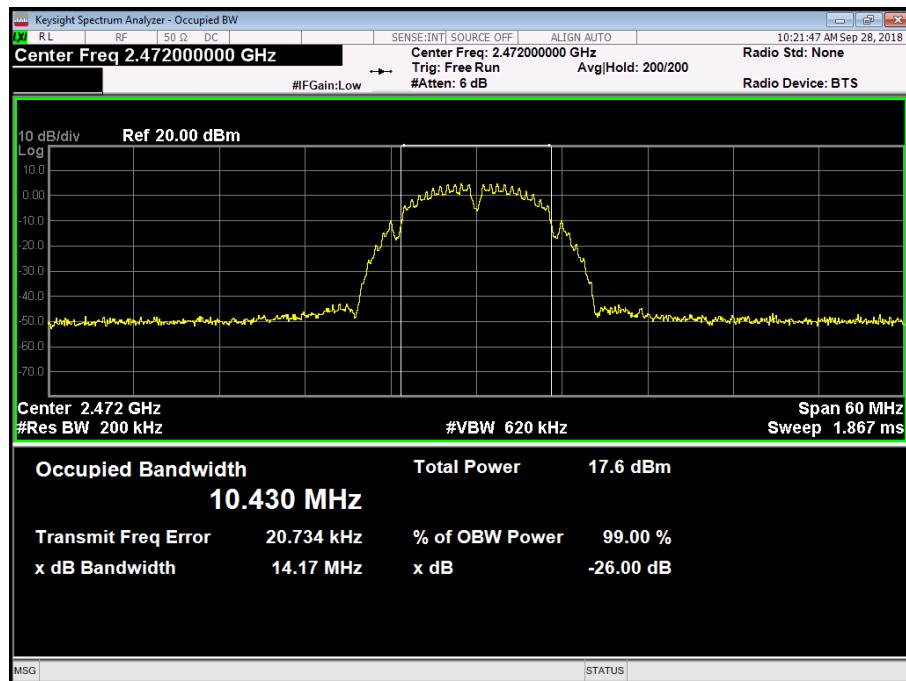


Figure 6 - 2472 MHz - 99% Occupied Bandwidth

802.11b / 1 Mbps / MIMO CDD / Cores 0+1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	8.160	7.680	8.160
99% Bandwidth (MHz)	10.455	10.633	10.435

Table 21

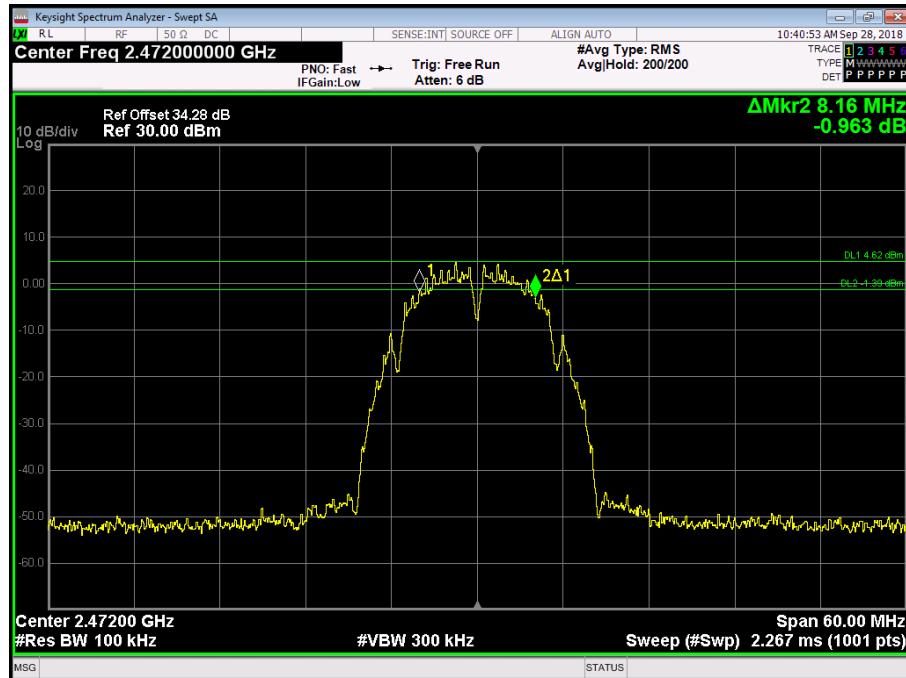


Figure 7 - 2412 MHz - 6 dB DTS Bandwidth

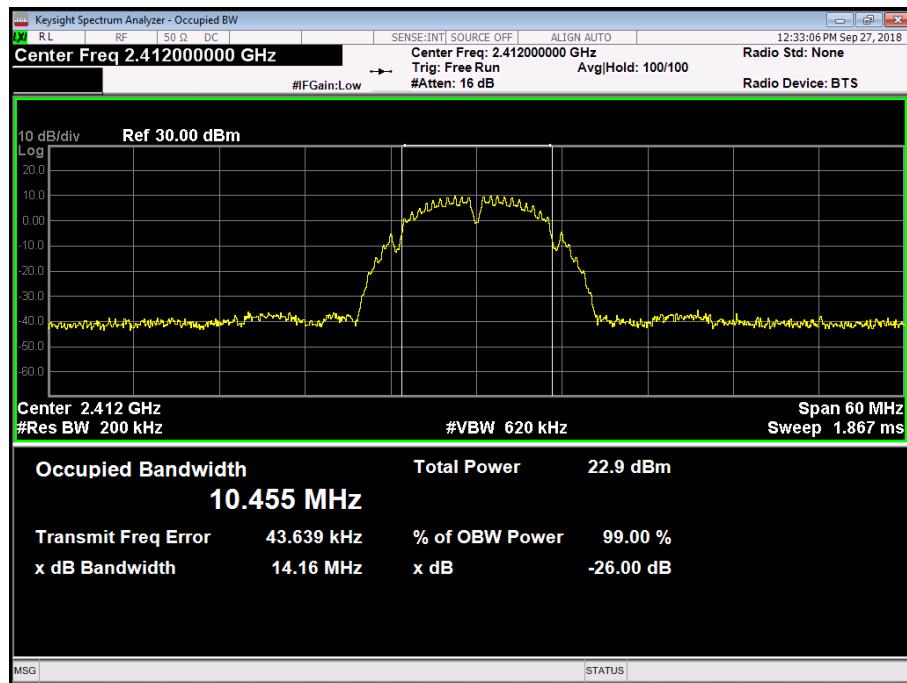


Figure 8 - 2412 MHz - 99% Occupied Bandwidth

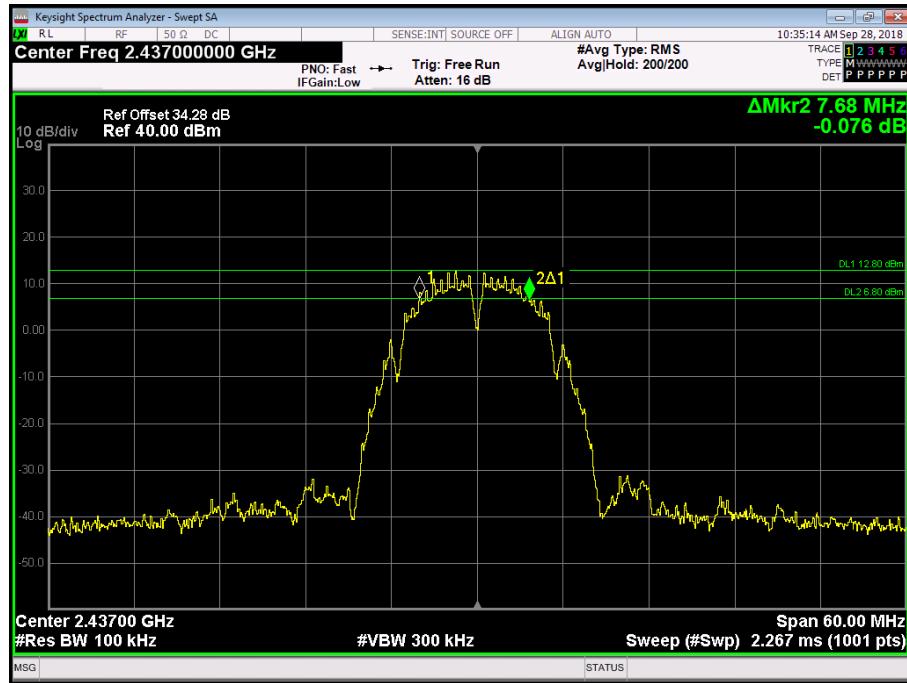


Figure 9 - 2437 MHz - 6 dB DTS Bandwidth

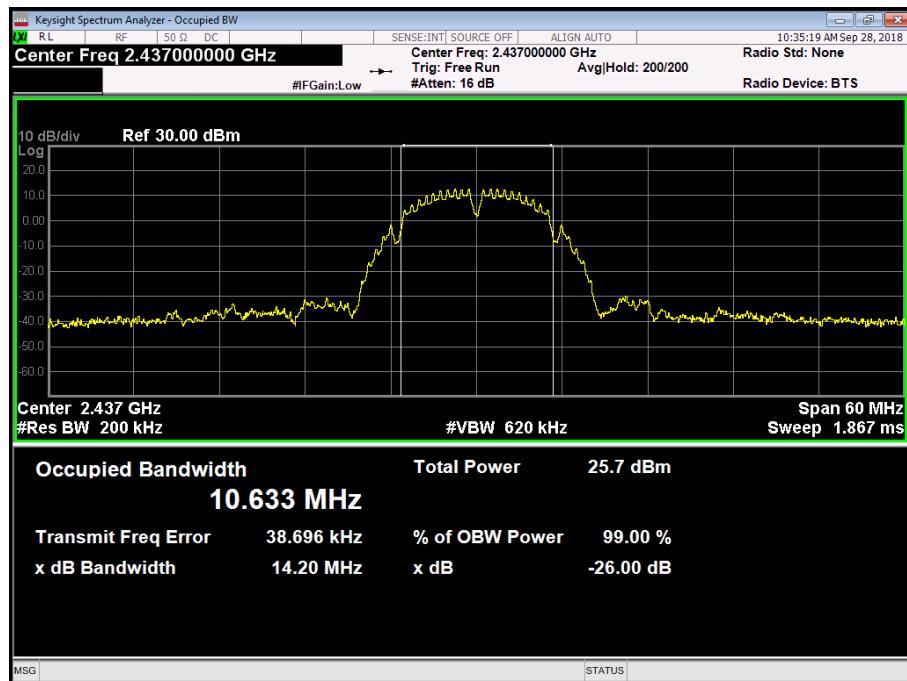


Figure 10 - 2437 MHz - 99% Occupied Bandwidth

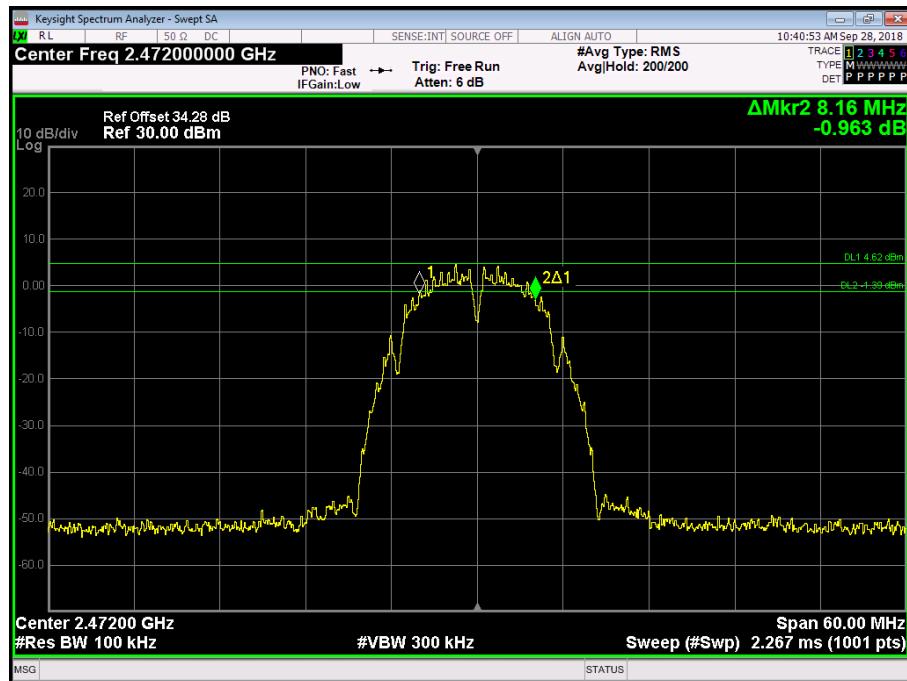


Figure 11 - 2472 MHz - 6 dB DTS Bandwidth

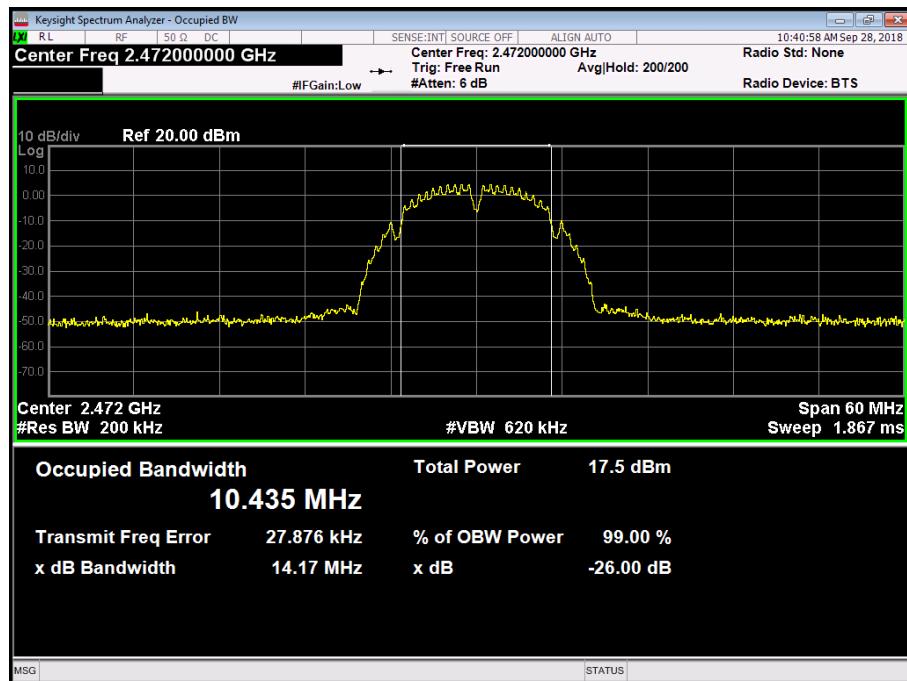


Figure 12 - 2472 MHz - 99% Occupied Bandwidth

802.11g / 6 Mbps / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	16.440	16.380	16.440
99% Bandwidth (MHz)	16.515	16.636	16.551

Table 22

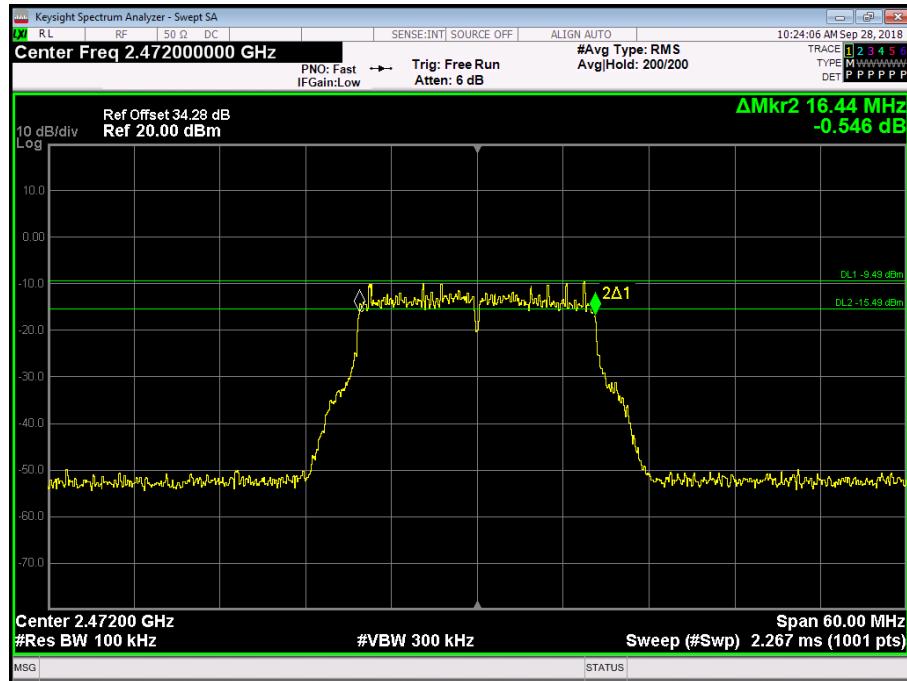


Figure 13 - 2412 MHz - 6 dB DTS Bandwidth

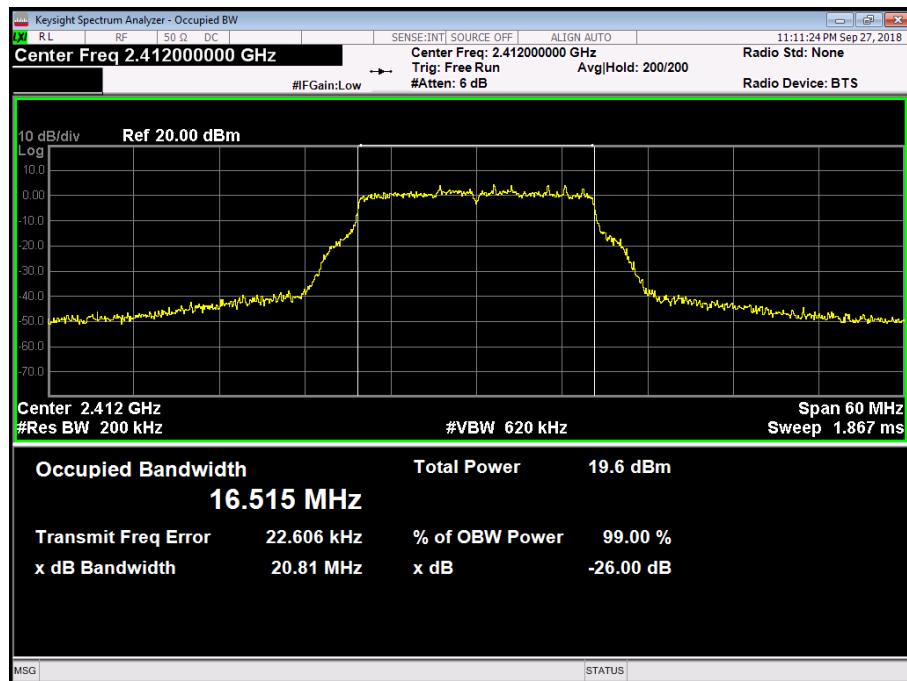


Figure 14 - 2412 MHz - 99% Occupied Bandwidth

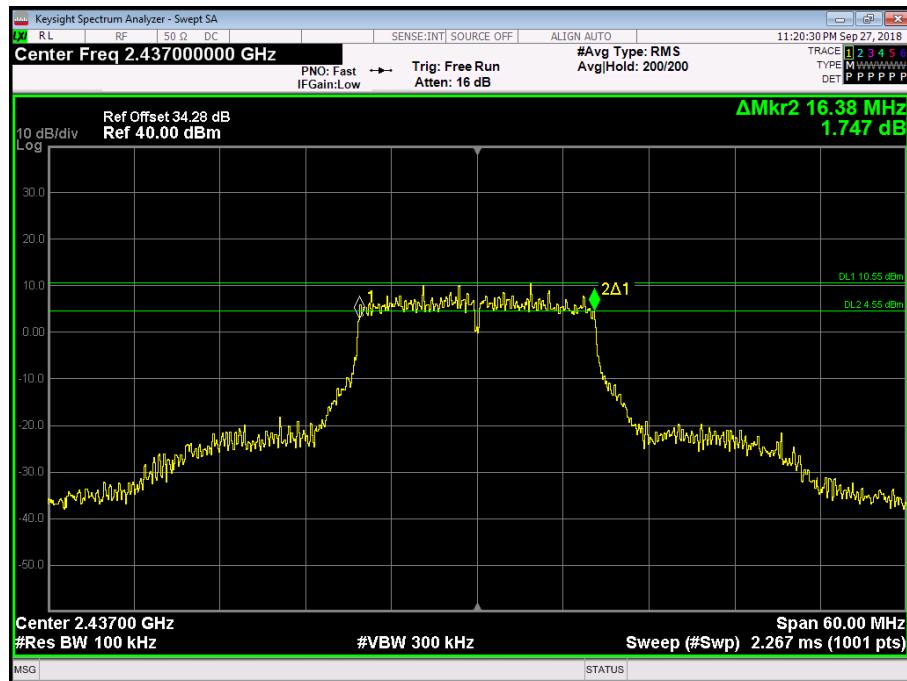


Figure 15 - 2437 MHz - 6 dB DTS Bandwidth

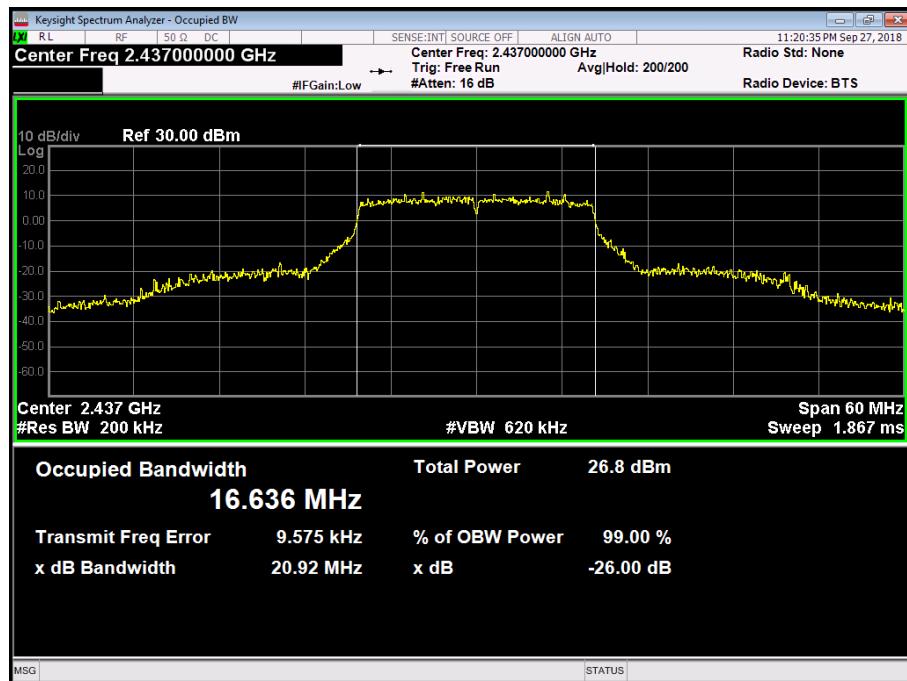


Figure 16 - 2437 MHz - 99% Occupied Bandwidth

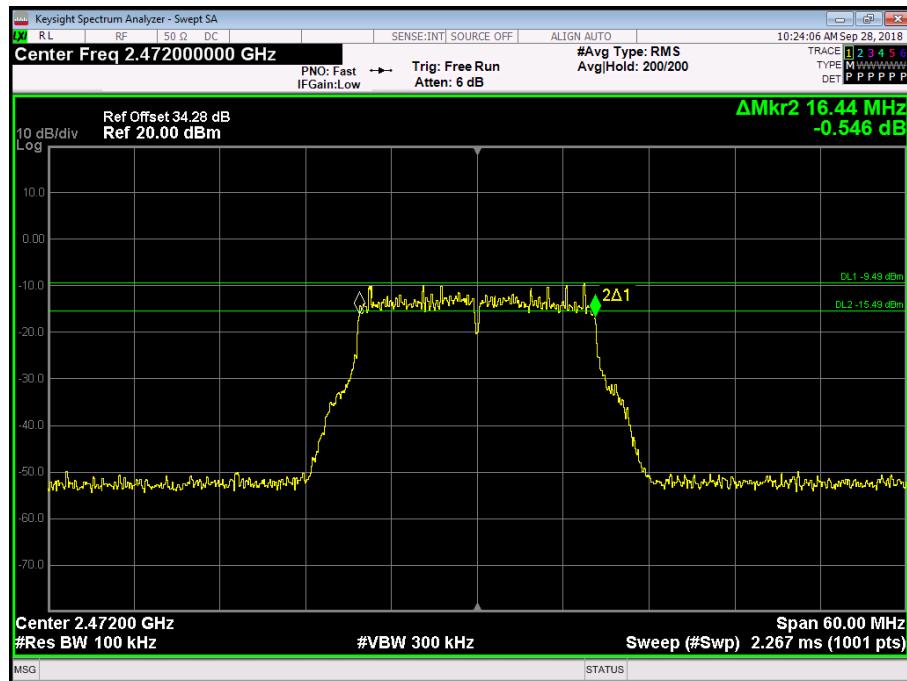


Figure 17 - 2472 MHz - 6 dB DTS Bandwidth

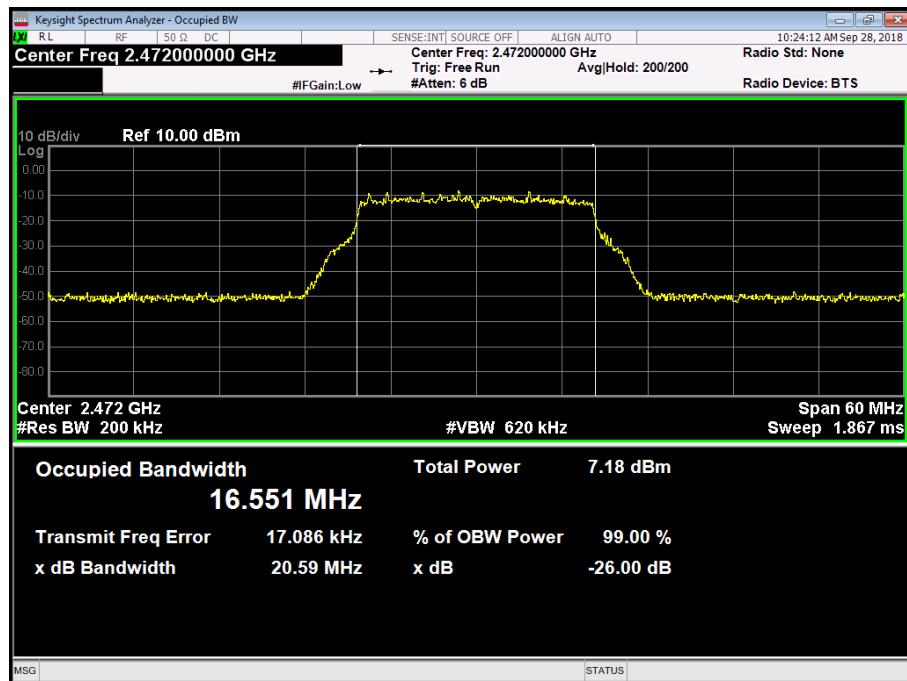


Figure 18 - 2472 MHz - 99% Occupied Bandwidth

802.11n / HT20 MCS0 / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	17.700	17.640	17.700
99% Bandwidth (MHz)	17.696	17.843	17.703

Table 23

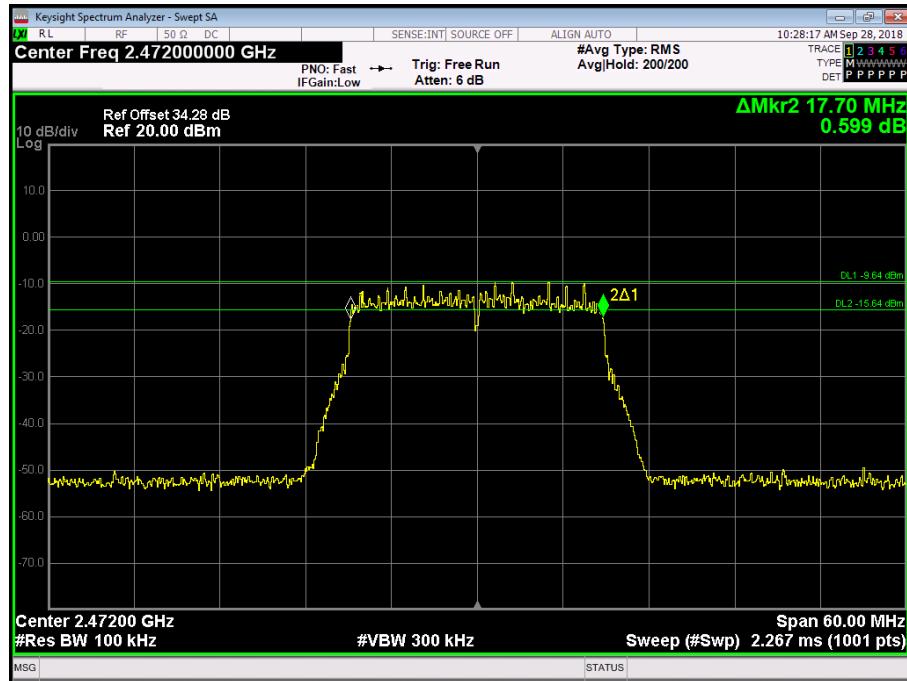


Figure 19 - 2412 MHz - 6 dB DTS Bandwidth

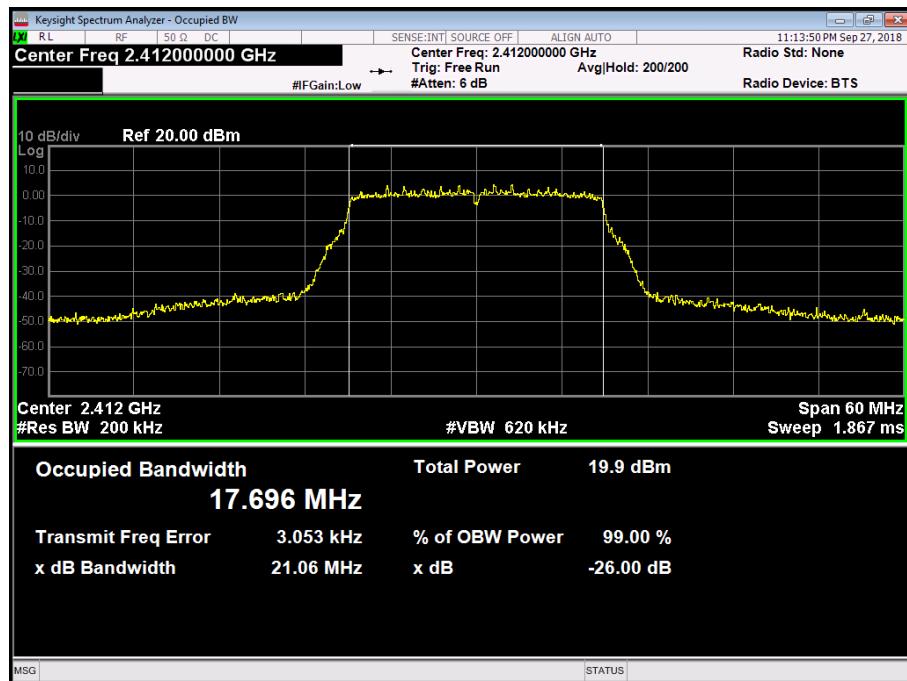


Figure 20 - 2412 MHz - 99% Occupied Bandwidth

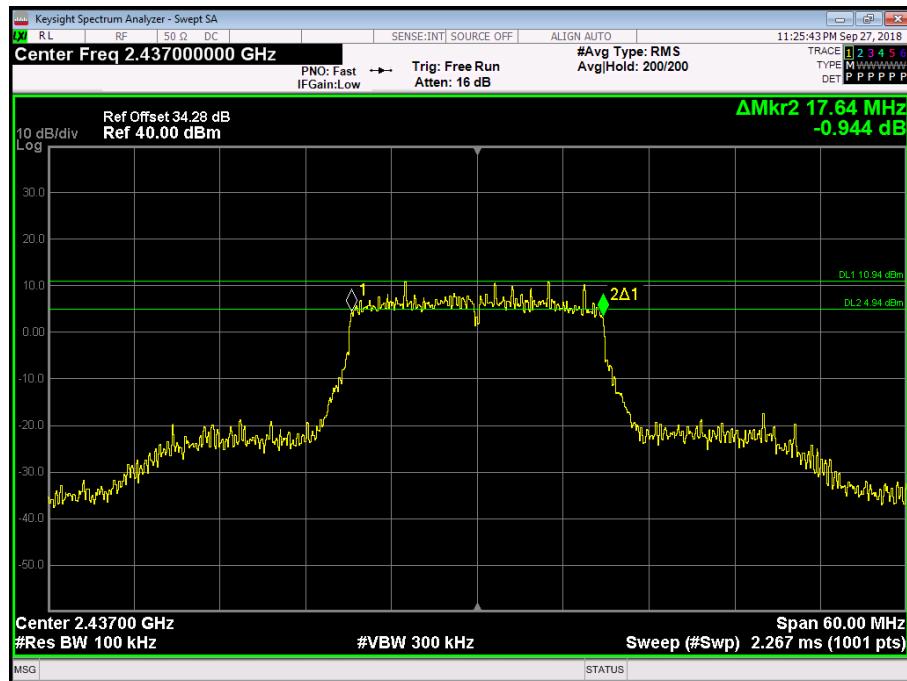


Figure 21 - 2437 MHz - 6 dB DTS Bandwidth

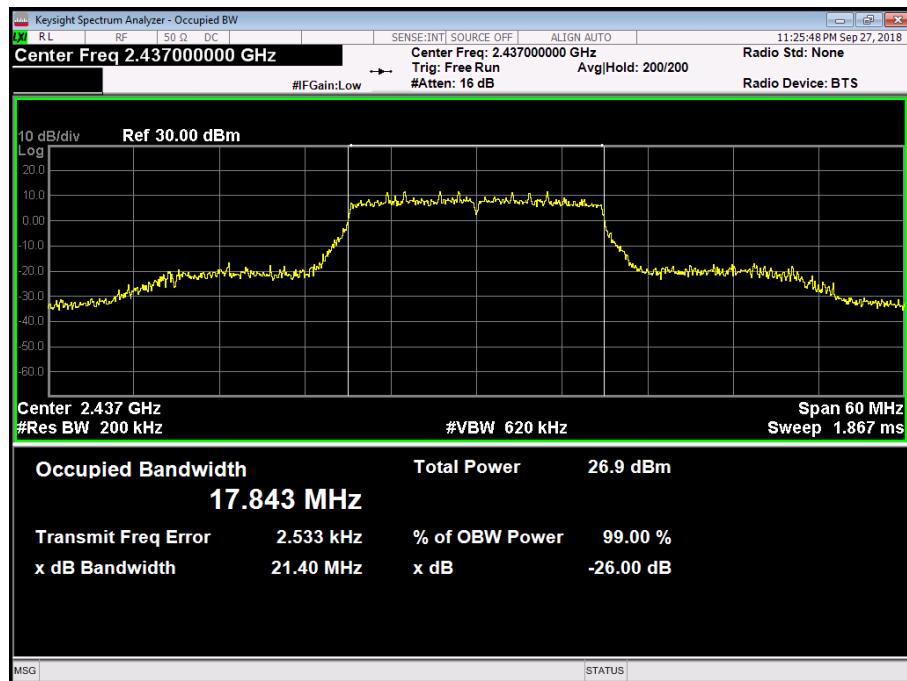


Figure 22 - 2437 MHz - 99% Occupied Bandwidth

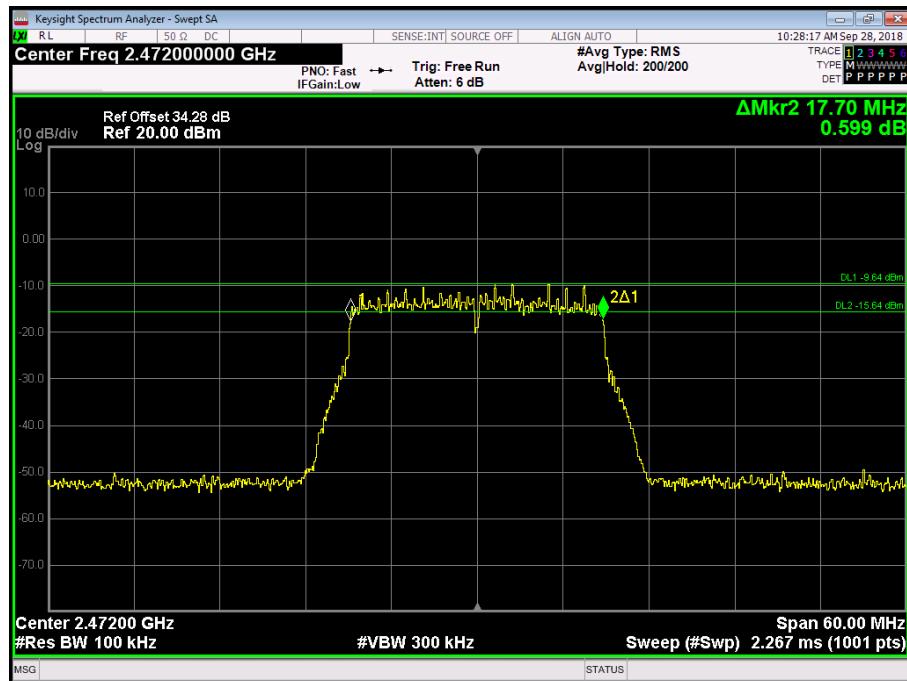


Figure 23 - 2472 MHz - 6 dB DTS Bandwidth

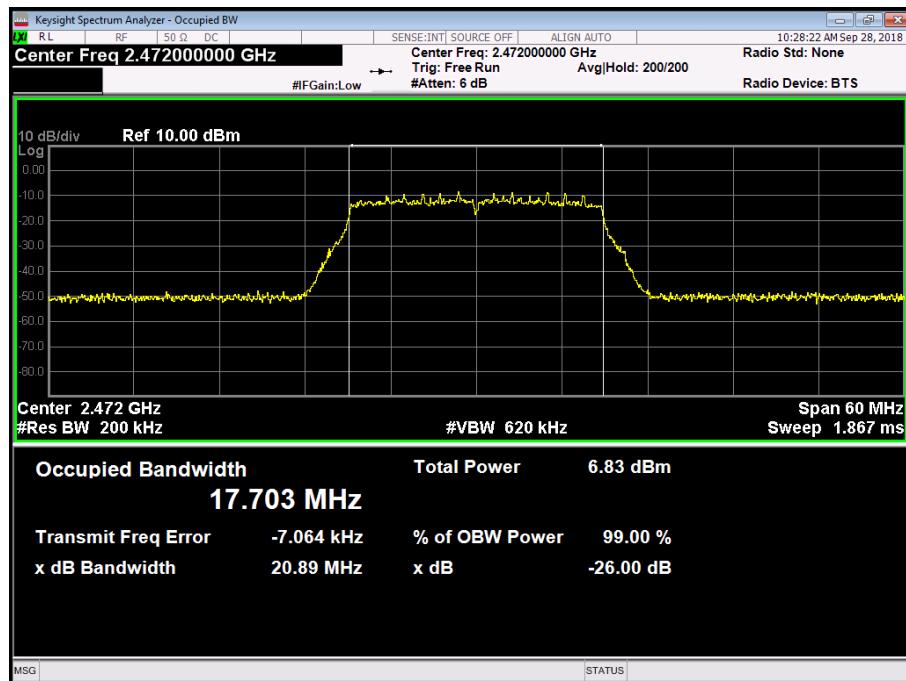


Figure 24 - 2472 MHz - 99% Occupied Bandwidth

802.11n / HT20 MCS0 / MIMO CDD / Cores 0+1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	17.640	16.080	17.640
99% Bandwidth (MHz)	17.786	17.776	17.811

Table 24

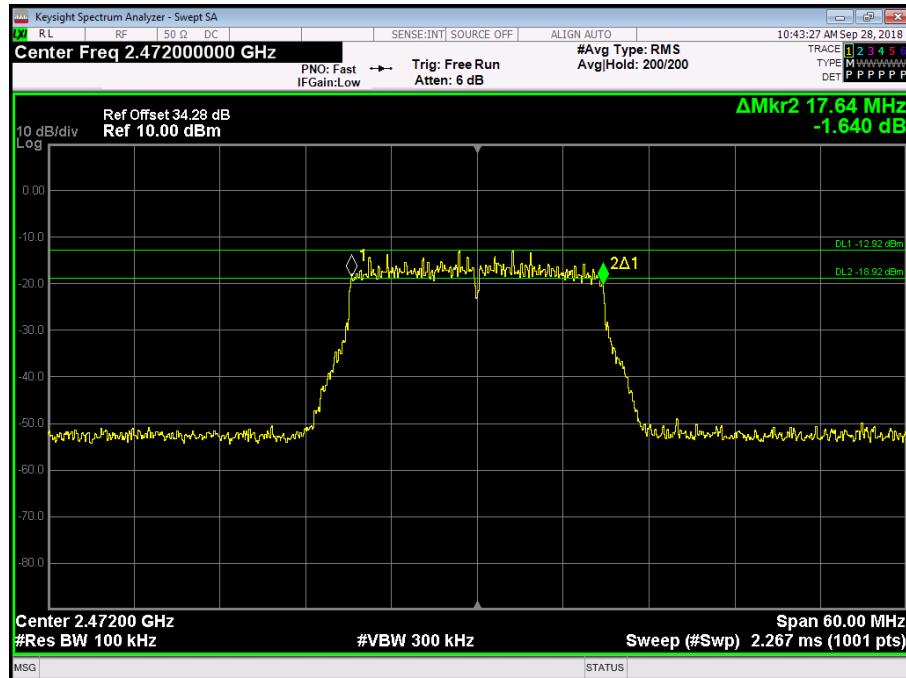


Figure 25 - 2412 MHz - 6 dB DTS Bandwidth

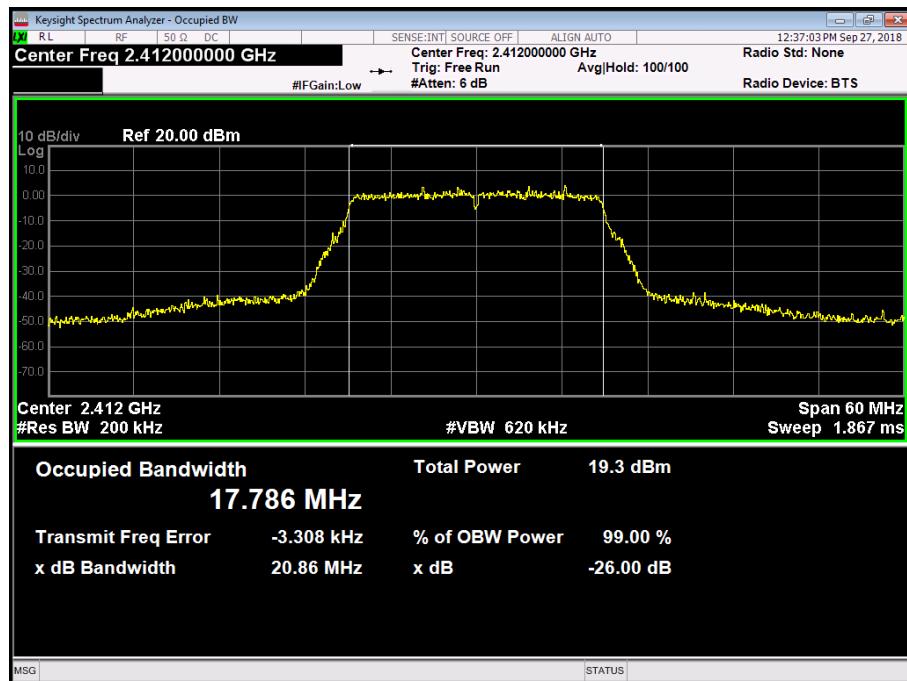


Figure 26 - 2412 MHz - 99% Occupied Bandwidth



Figure 27 - 2437 MHz - 6 dB DTS Bandwidth

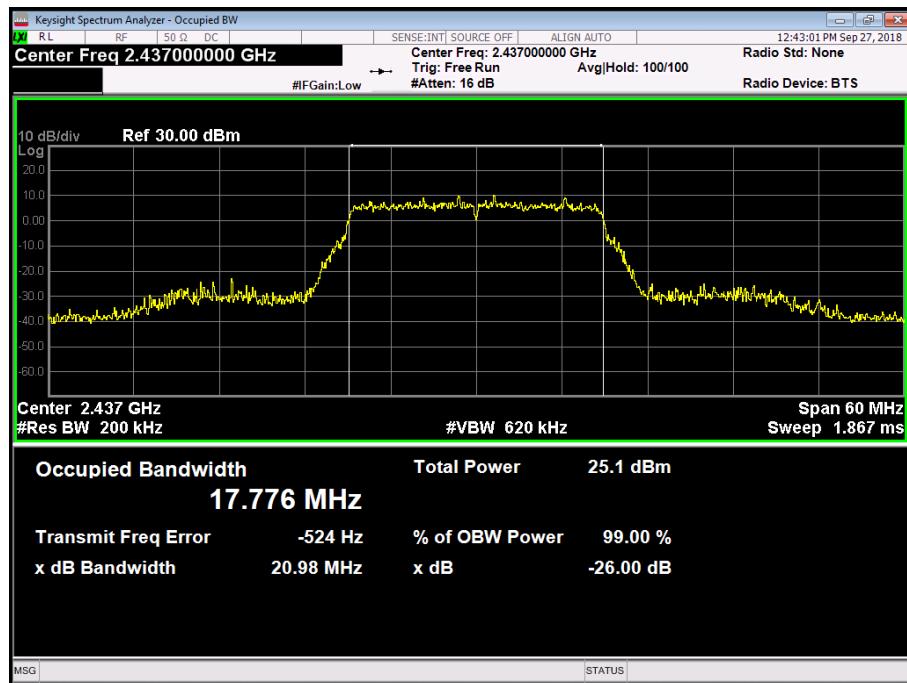


Figure 28 - 2437 MHz - 99% Occupied Bandwidth

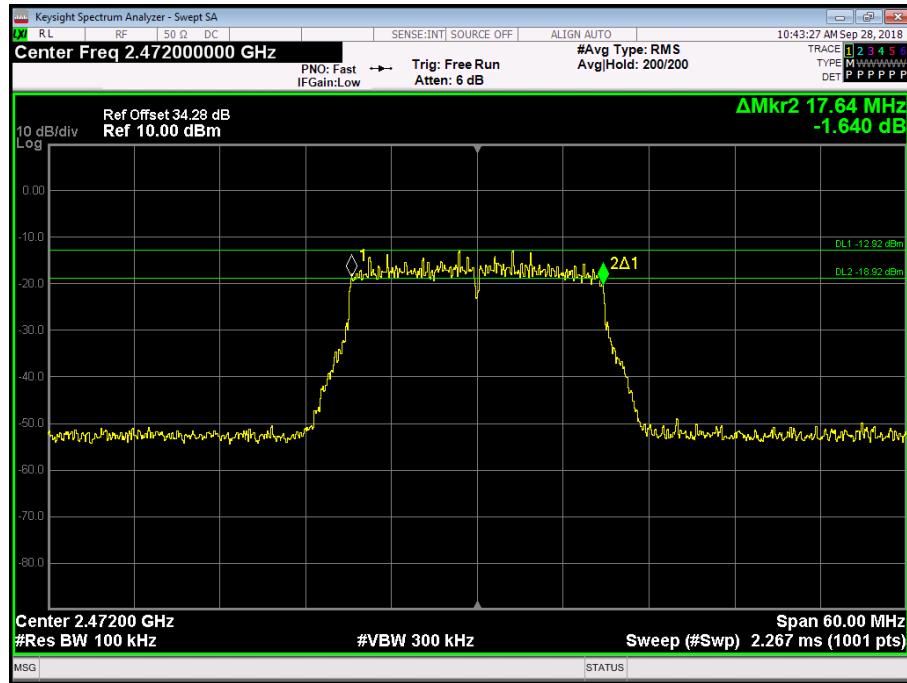


Figure 29 - 2472 MHz - 6 dB DTS Bandwidth

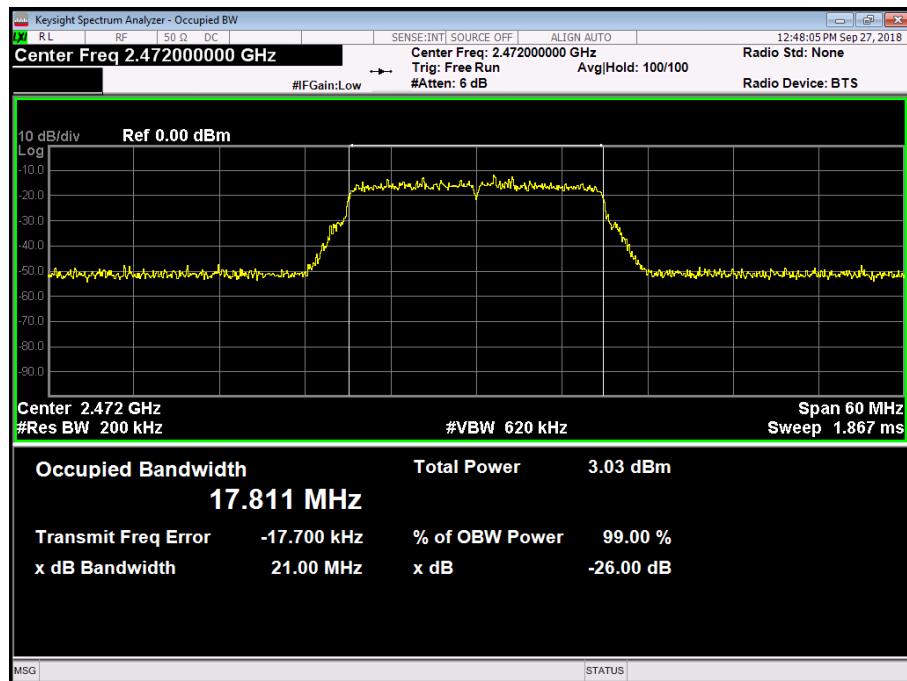


Figure 30 - 2472 MHz - 99% Occupied Bandwidth

802.11n / HT20 MCS0 / MIMO TxBF / Cores 0+1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	17.640	16.380	17.700
99% Bandwidth (MHz)	17.790	17.746	17.727

Table 25

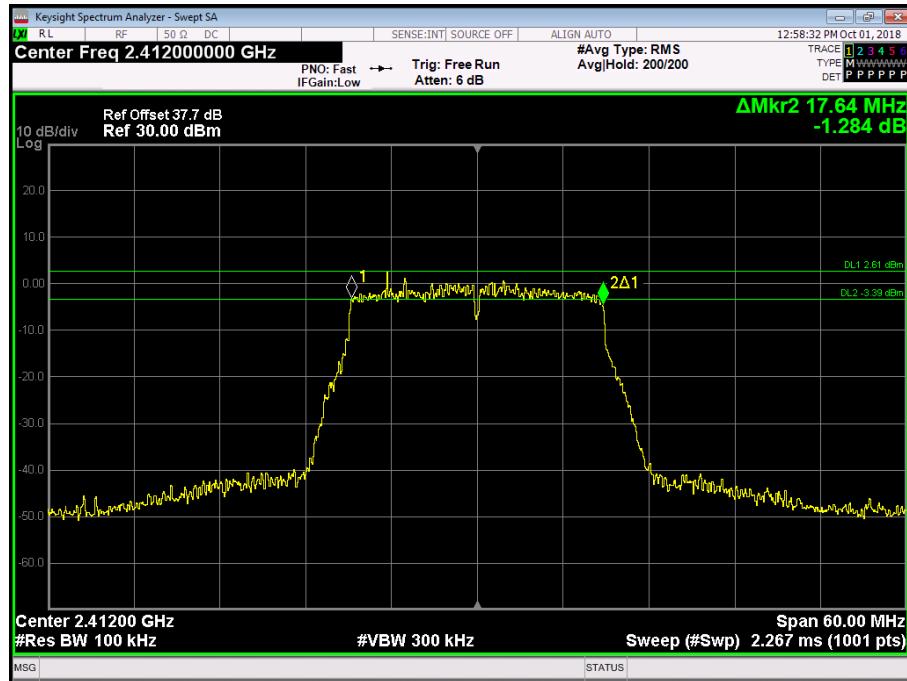


Figure 31 - 2412 MHz - 6 dB DTS Bandwidth

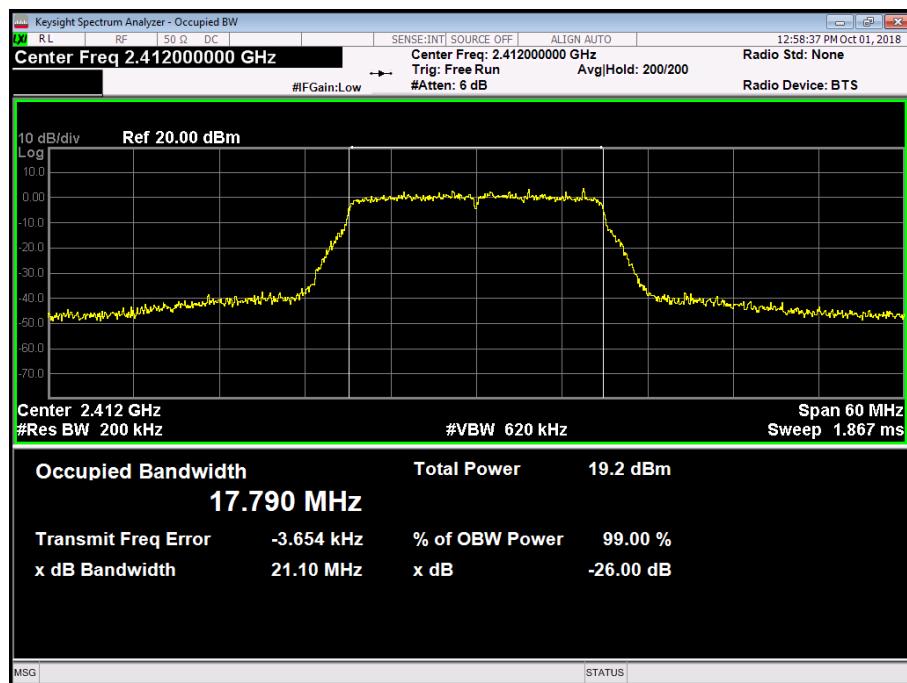


Figure 32 - 2412 MHz - 99% Occupied Bandwidth

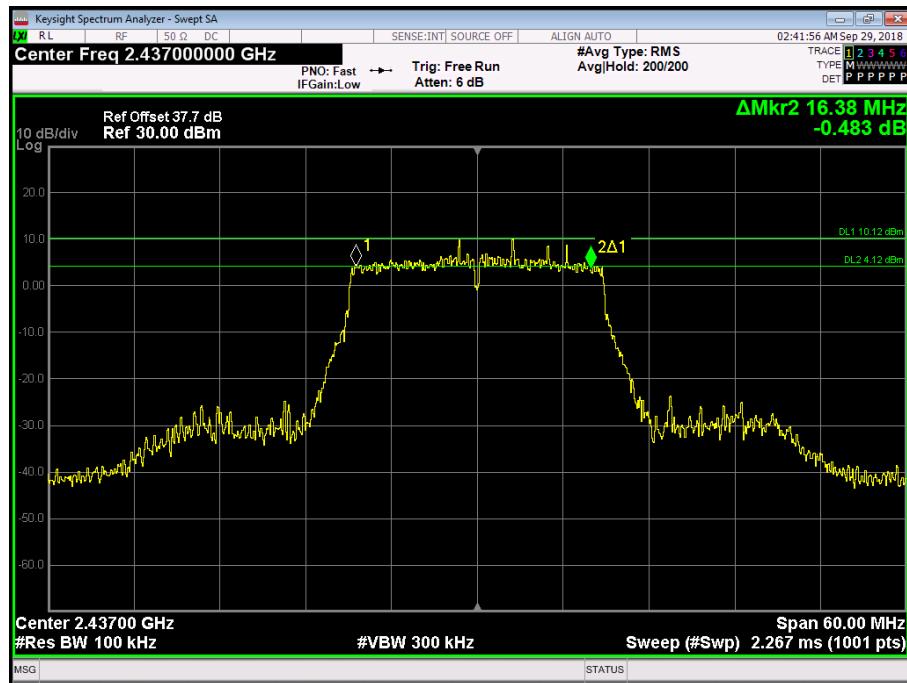


Figure 33 - 2437 MHz - 6 dB DTS Bandwidth

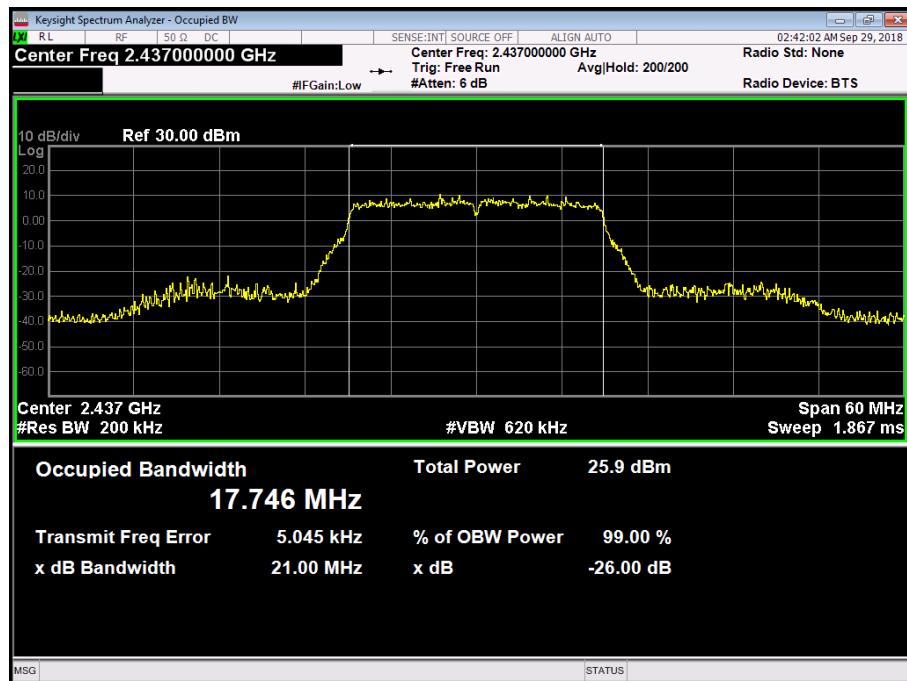


Figure 34 - 2437 MHz - 99% Occupied Bandwidth



Figure 35 - 2472 MHz - 6 dB DTS Bandwidth

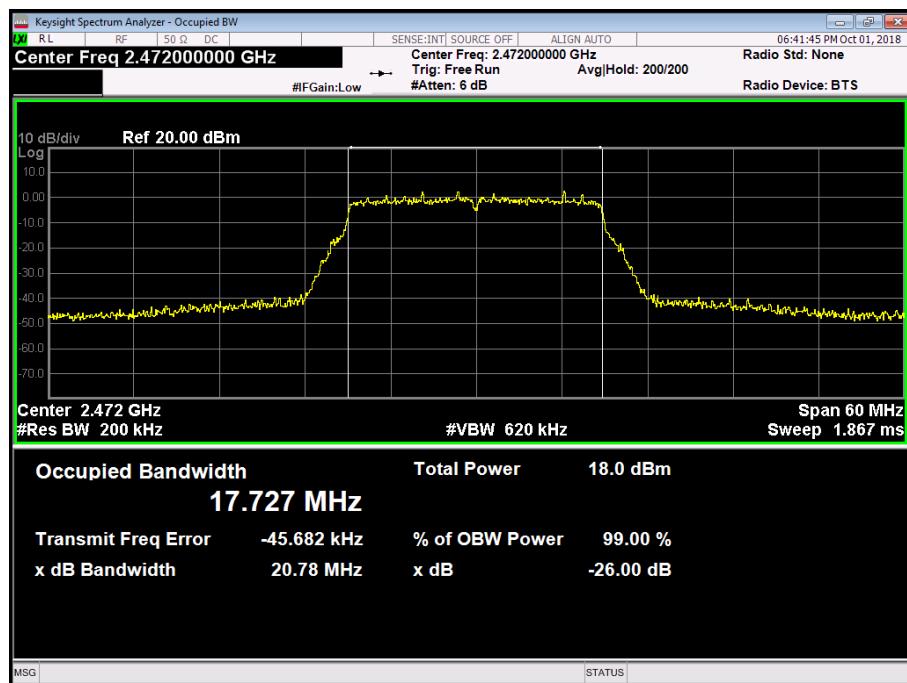


Figure 36 - 2472 MHz - 99% Occupied Bandwidth

802.11b / 1 Mbps / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	8.160	7.680	8.640
99% Bandwidth (MHz)	10.385	10.416	10.431

Table 26

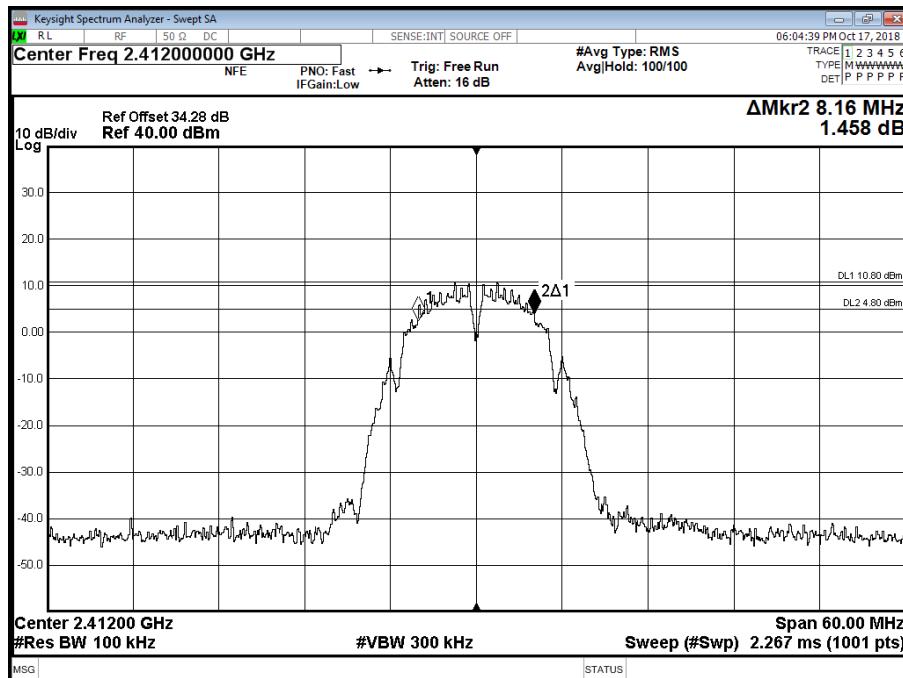


Figure 37 - 2412 MHz - 6 dB DTS Bandwidth

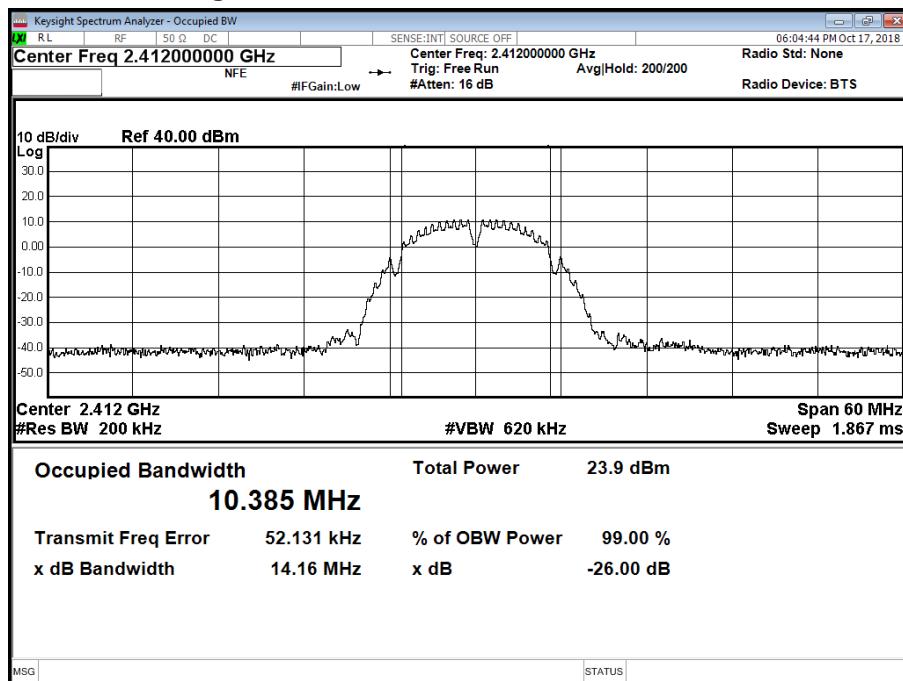


Figure 38 - 2412 MHz - 99% Occupied Bandwidth

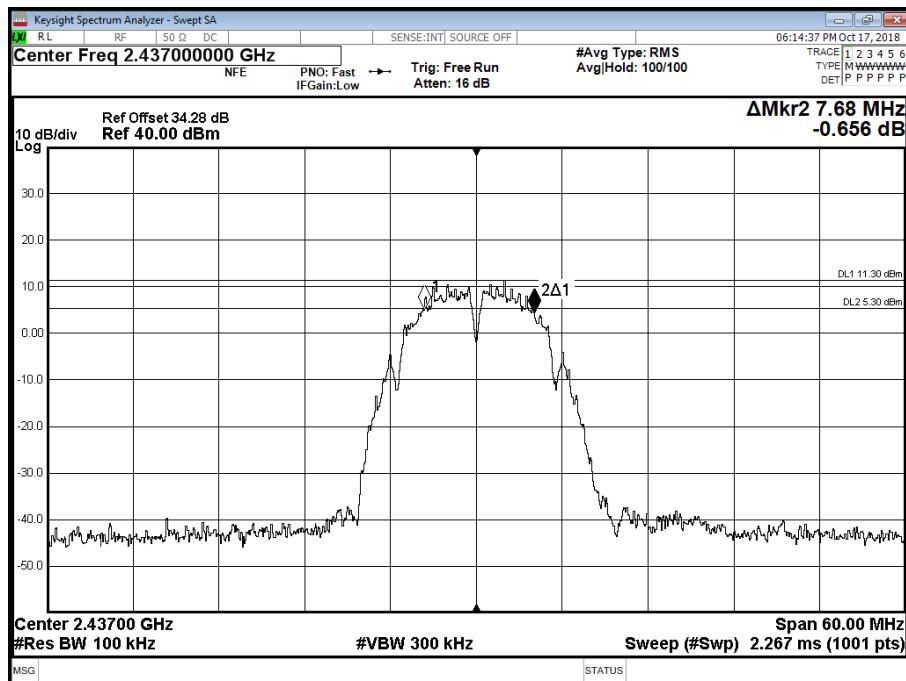


Figure 39 - 2437 MHz - 6 dB DTS Bandwidth

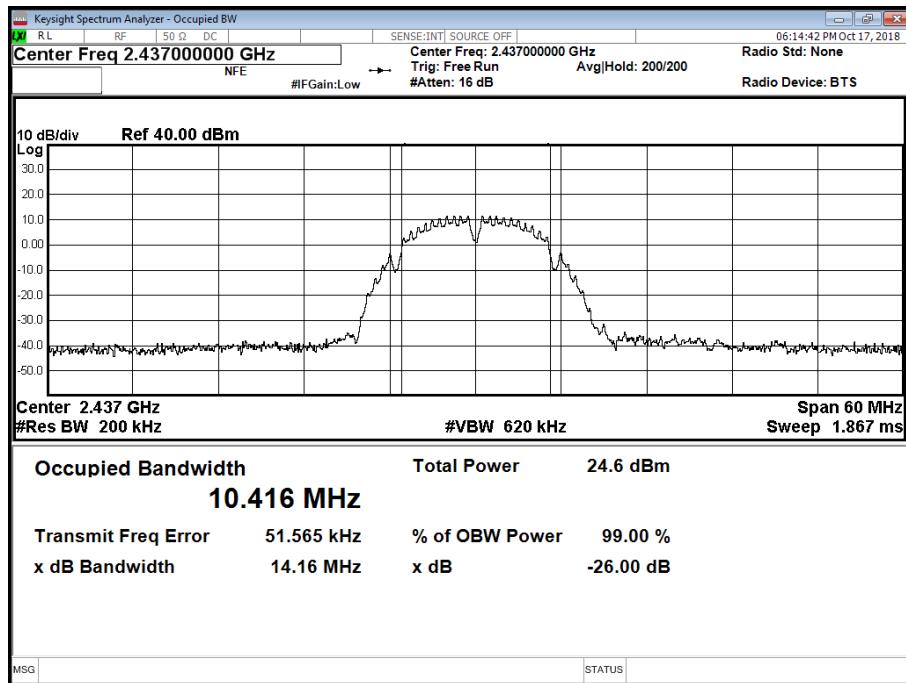


Figure 40 - 2437 MHz - 99% Occupied Bandwidth

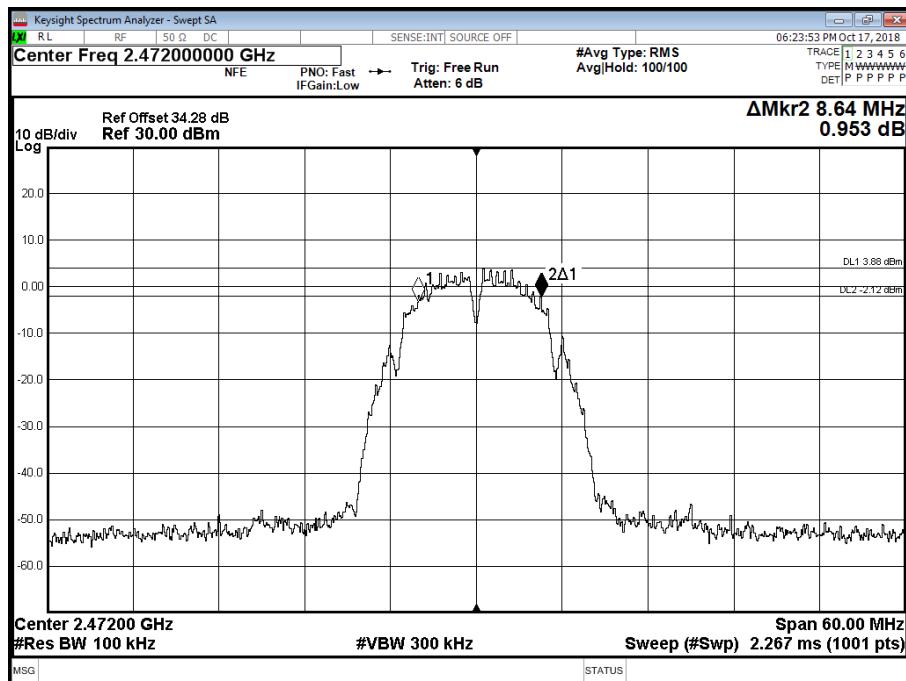


Figure 41 - 2472 MHz - 6 dB DTS Bandwidth

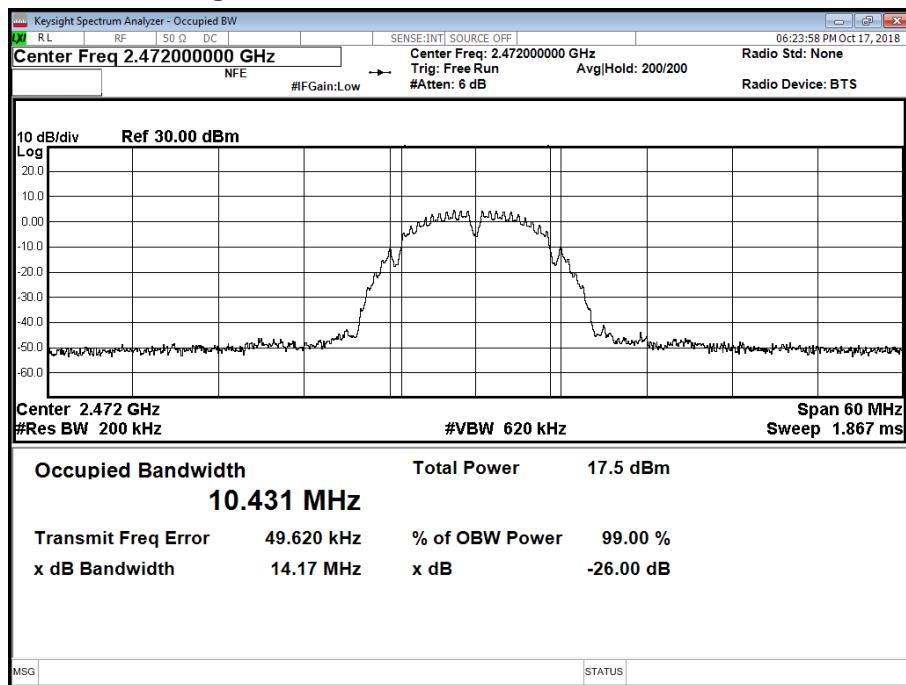


Figure 42 - 2472 MHz - 99% Occupied Bandwidth

802.11b / 1 Mbps / MIMO CDD / Cores 0+1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	8.160	7.740	7.680
99% Bandwidth (MHz)	10.368	10.444	10.417

Table 27

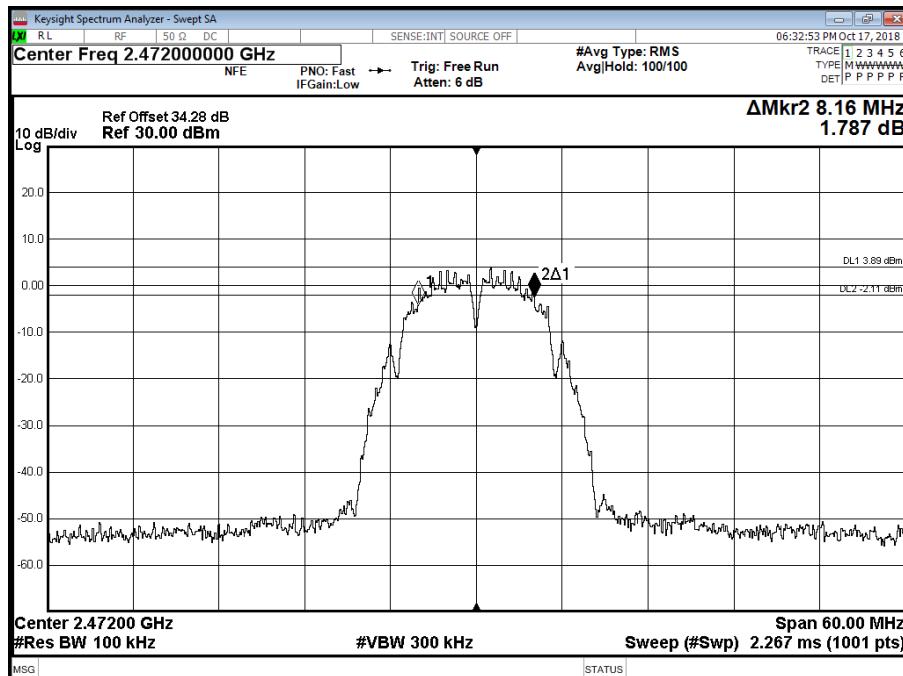


Figure 43 - 2412 MHz - 6 dB DTS Bandwidth

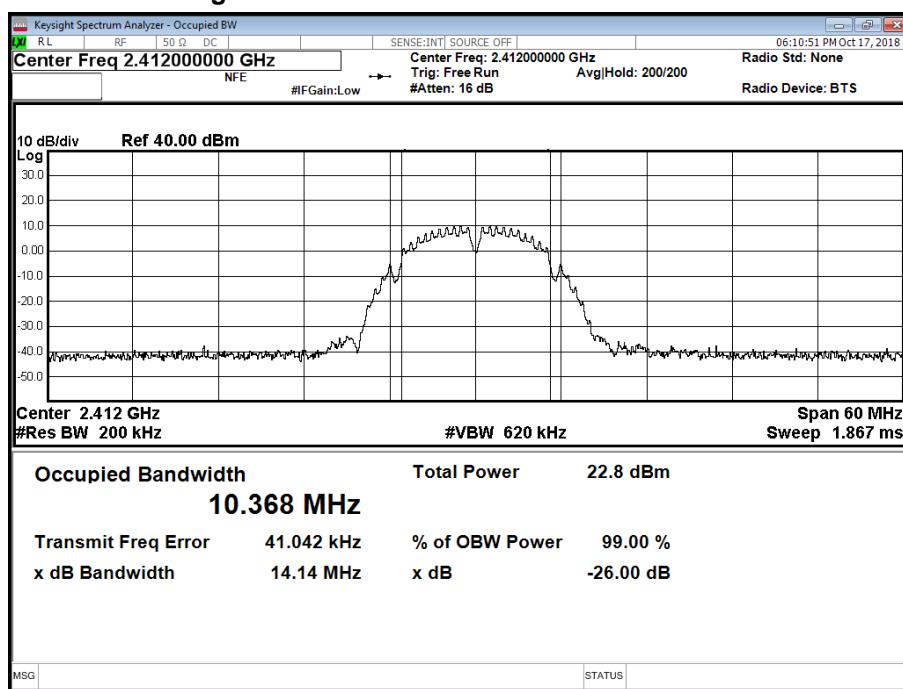


Figure 44 - 2412 MHz - 99% Occupied Bandwidth

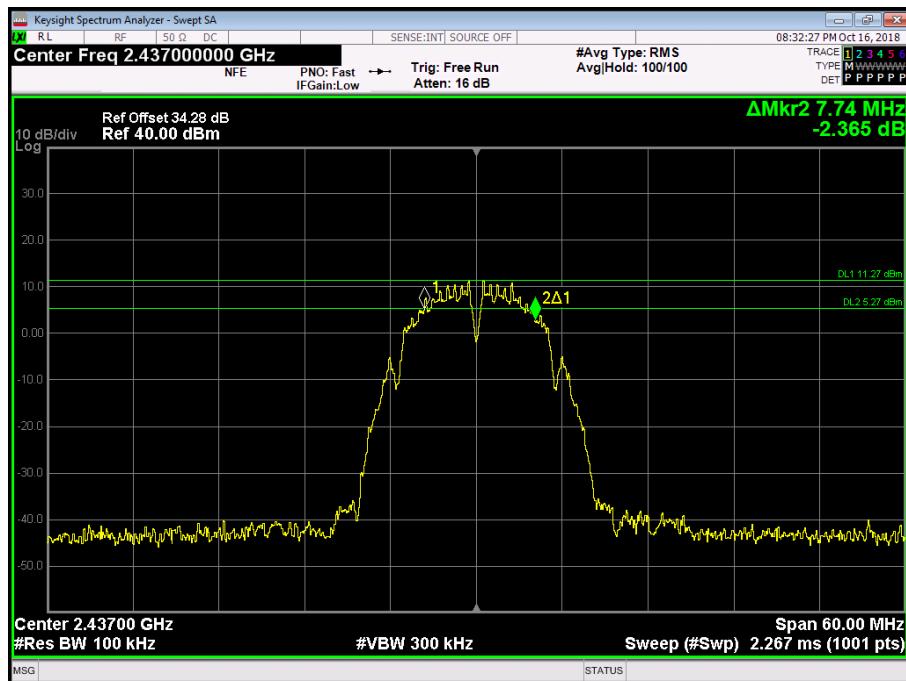


Figure 45 - 2437 MHz - 6 dB DTS Bandwidth

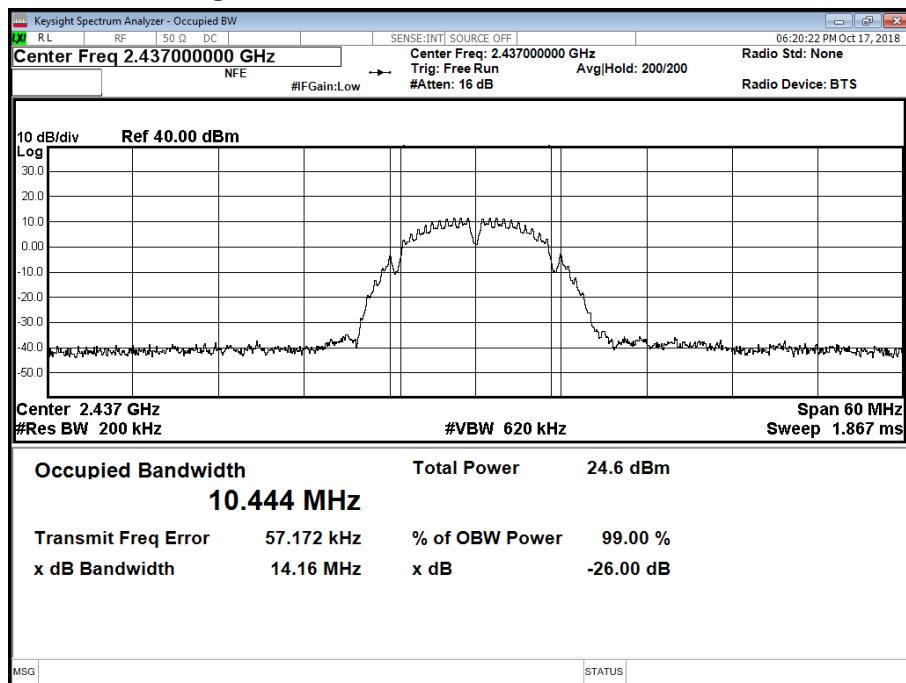


Figure 46 - 2437 MHz - 99% Occupied Bandwidth

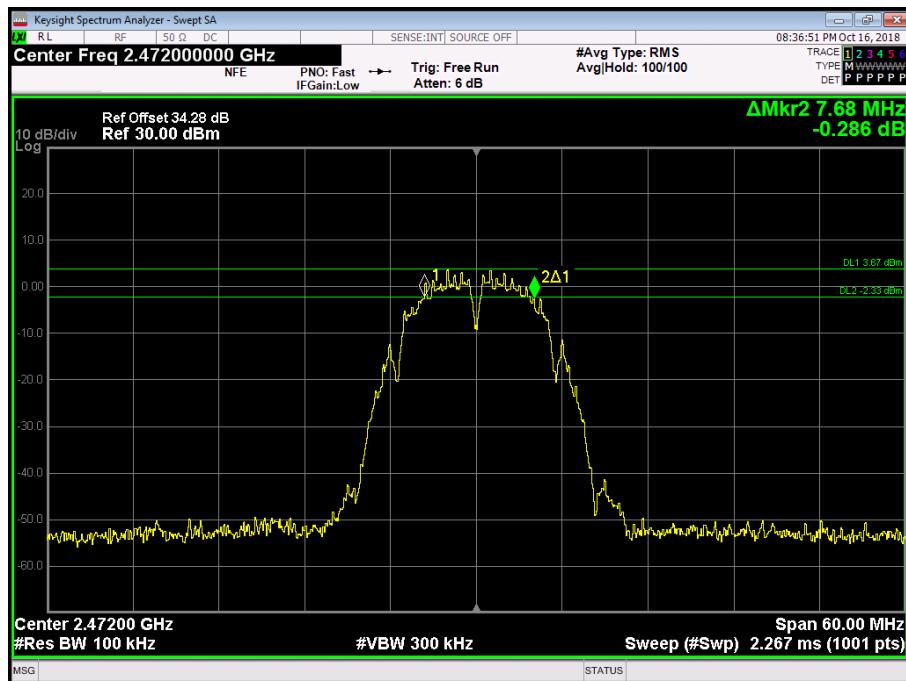


Figure 47 - 2472 MHz - 6 dB DTS Bandwidth

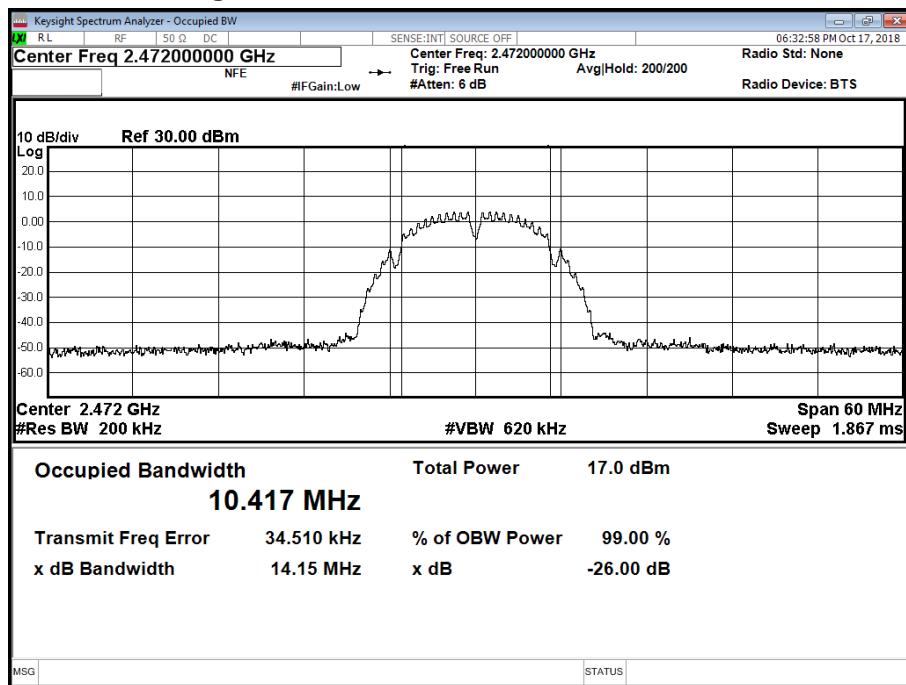


Figure 48 - 2472 MHz - 99% Occupied Bandwidth

802.11g / 6 Mbps / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	16.080	16.440	16.440
99% Bandwidth (MHz)	16.545	16.539	16.557

Table 28

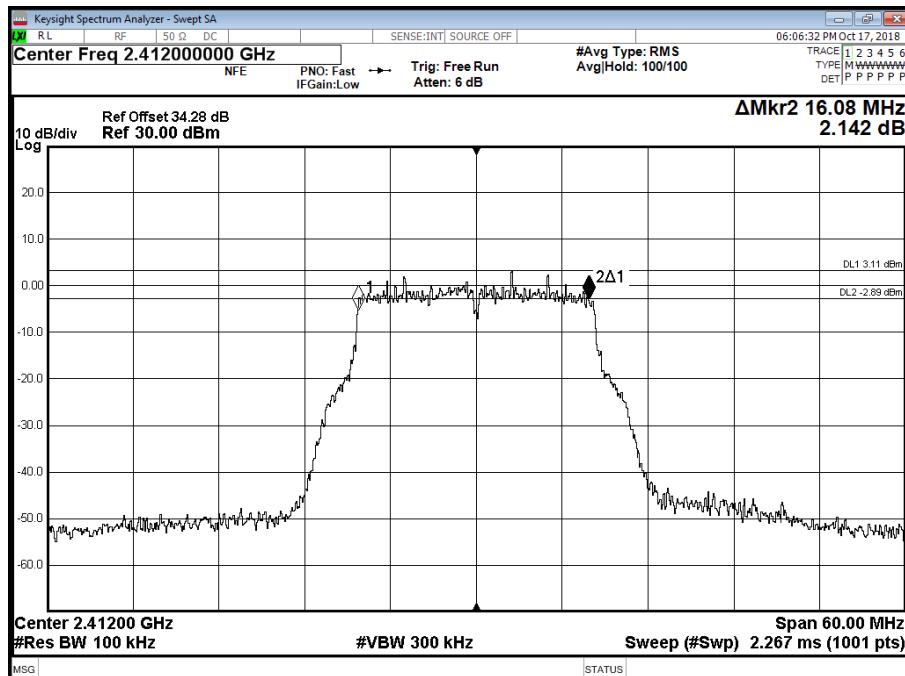


Figure 49 - 2412 MHz - 6 dB DTS Bandwidth

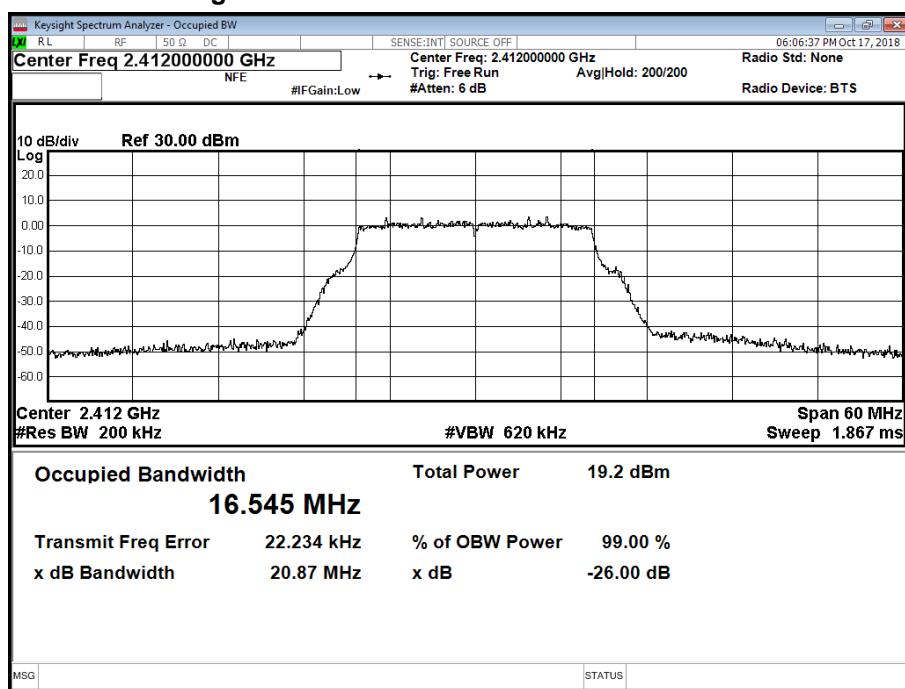


Figure 50 - 2412 MHz - 99% Occupied Bandwidth

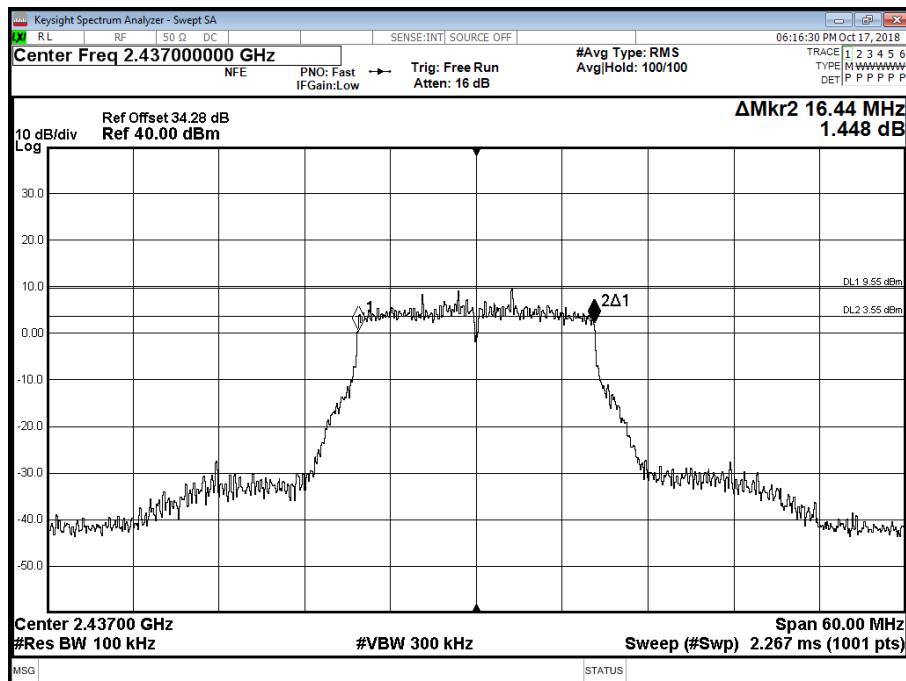


Figure 51 - 2437 MHz - 6 dB DTS Bandwidth

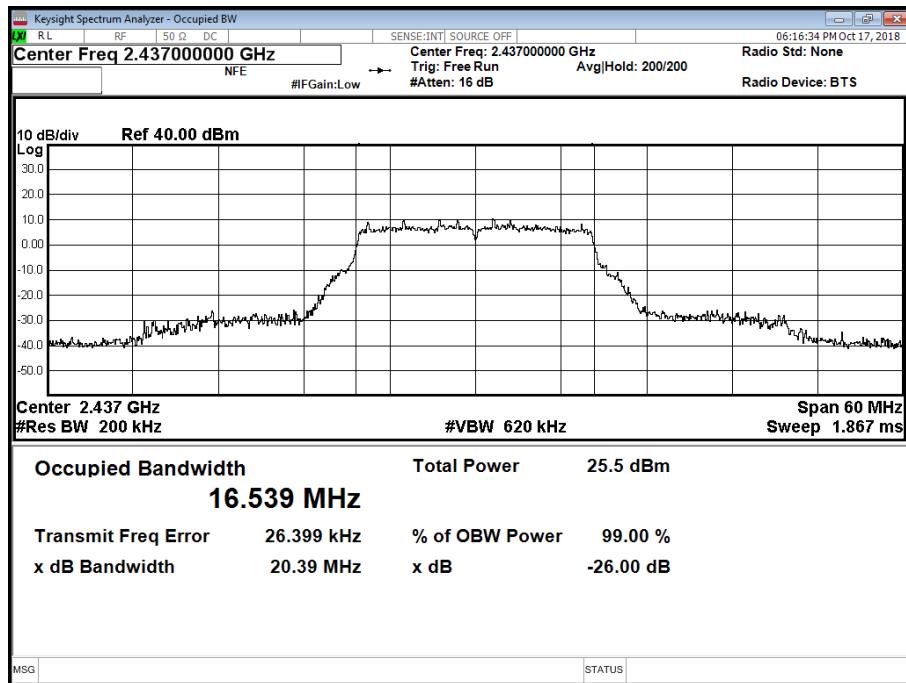


Figure 52 - 2437 MHz - 99% Occupied Bandwidth

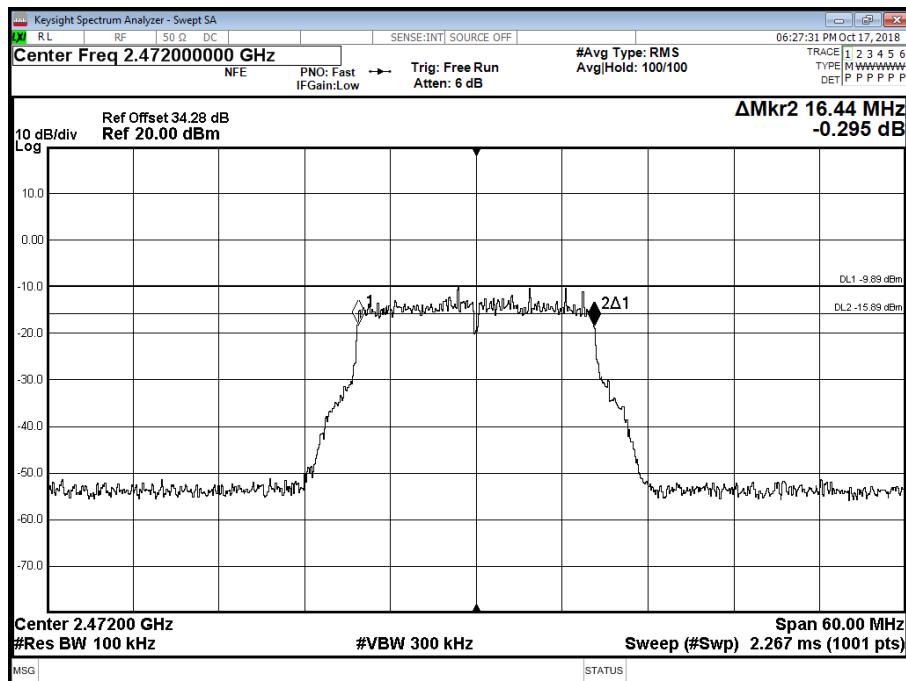


Figure 53 - 2472 MHz - 6 dB DTS Bandwidth

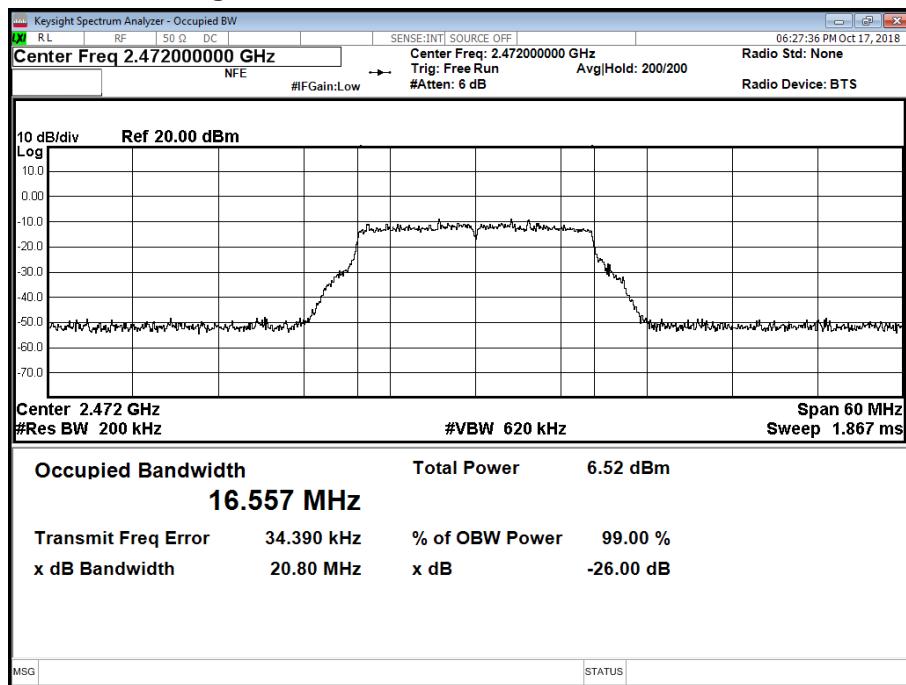


Figure 54 - 2472 MHz - 99% Occupied Bandwidth

802.11n / HT20 MCS0 / SISO / Core 1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	17.640	17.700	17.700
99% Bandwidth (MHz)	17.714	17.743	17.733

Table 29

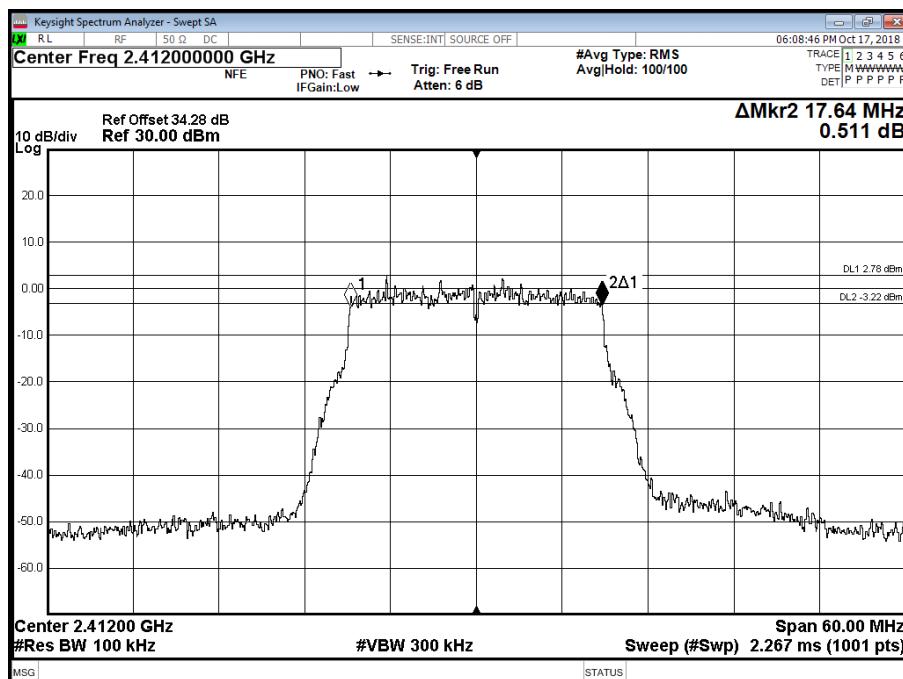


Figure 55 - 2412 MHz - 6 dB DTS Bandwidth

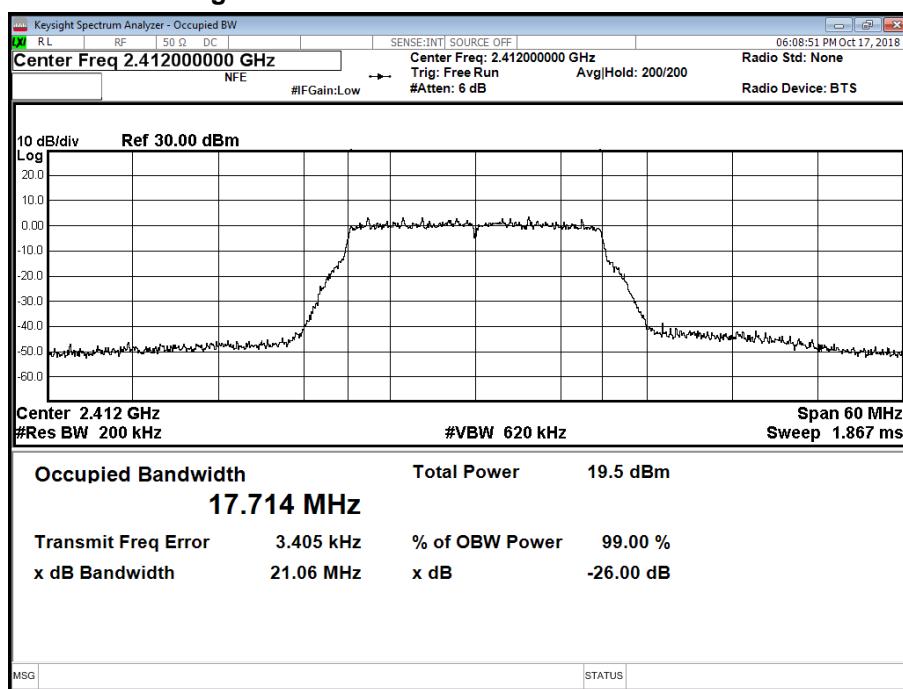


Figure 56 - 2412 MHz - 99% Occupied Bandwidth

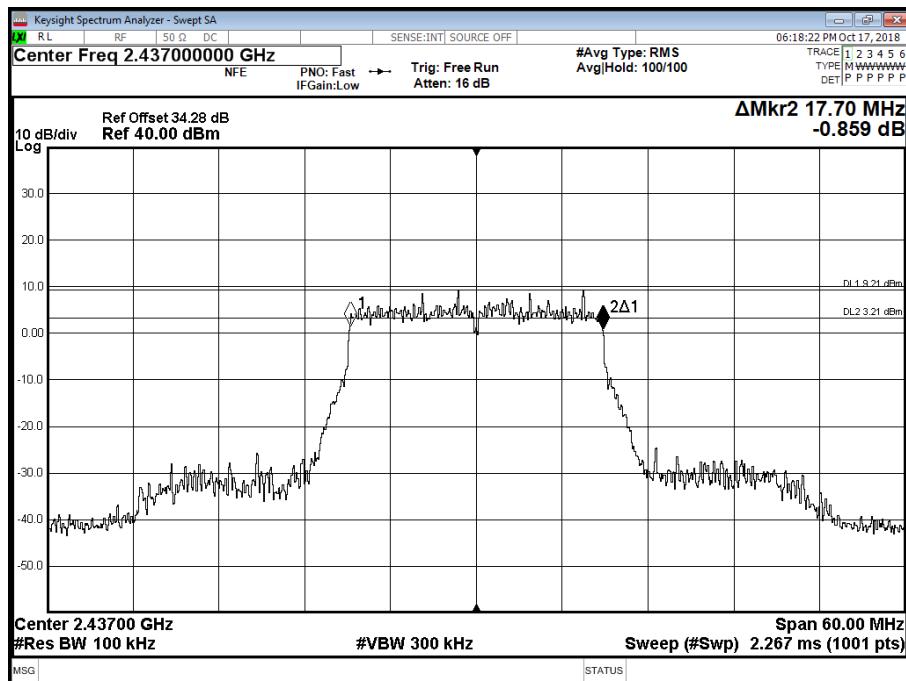


Figure 57 - 2437 MHz - 6 dB DTS Bandwidth

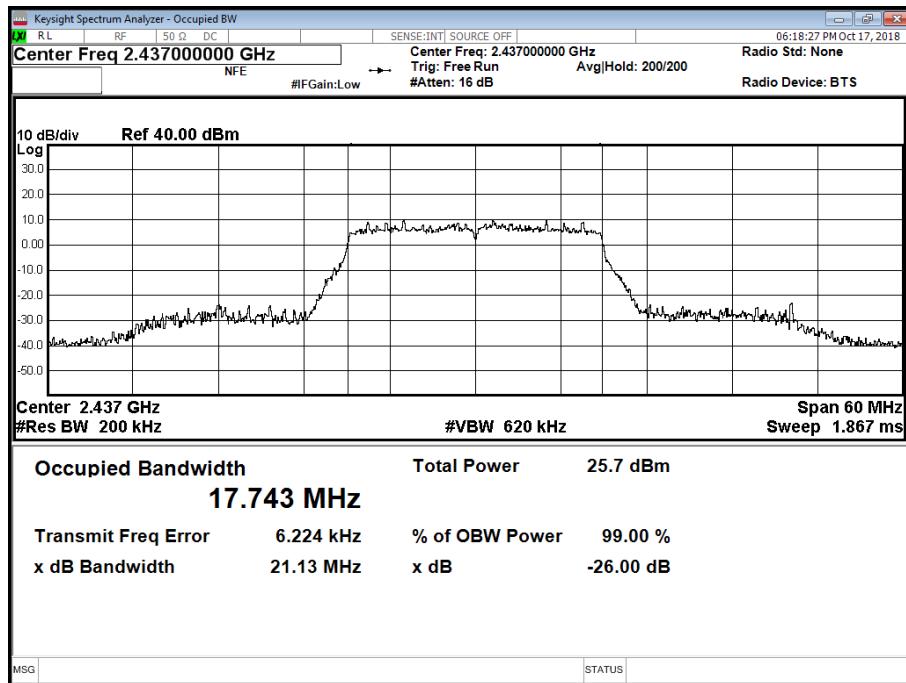


Figure 58 - 2437 MHz - 99% Occupied Bandwidth

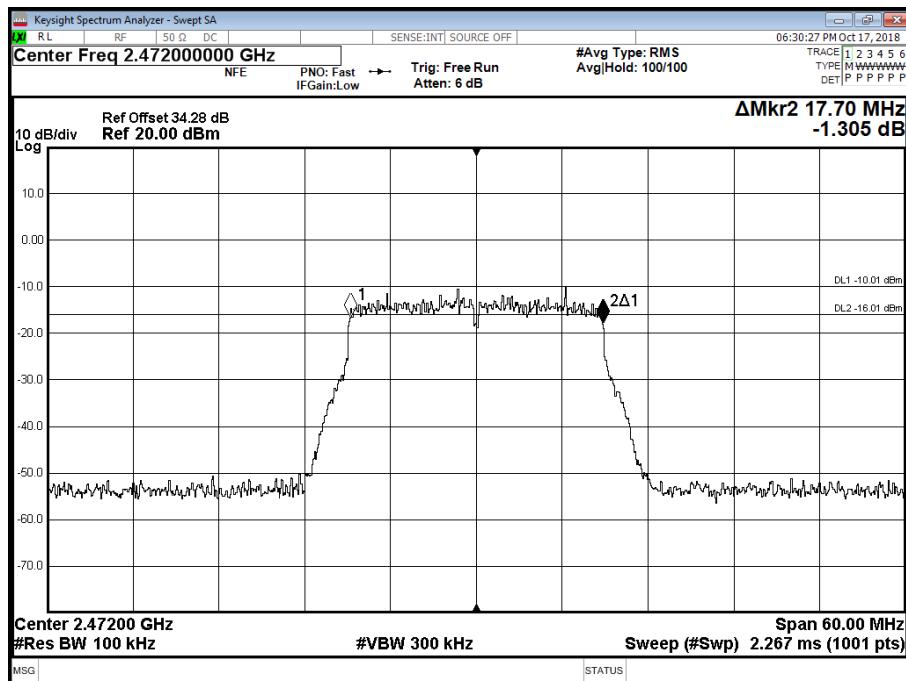


Figure 59 - 2472 MHz - 6 dB DTS Bandwidth

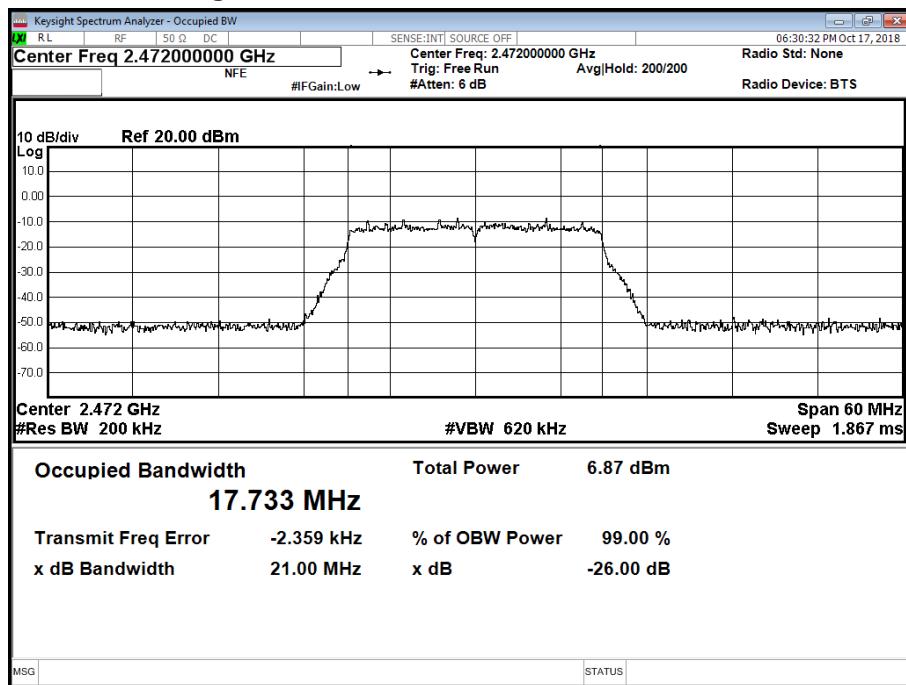


Figure 60 - 2472 MHz - 99% Occupied Bandwidth

802.11n / HT20 MCS0 / MIMO CDD / Cores 0+1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	17.640	17.640	17.400
99% Bandwidth (MHz)	17.779	17.770	17.785

Table 30

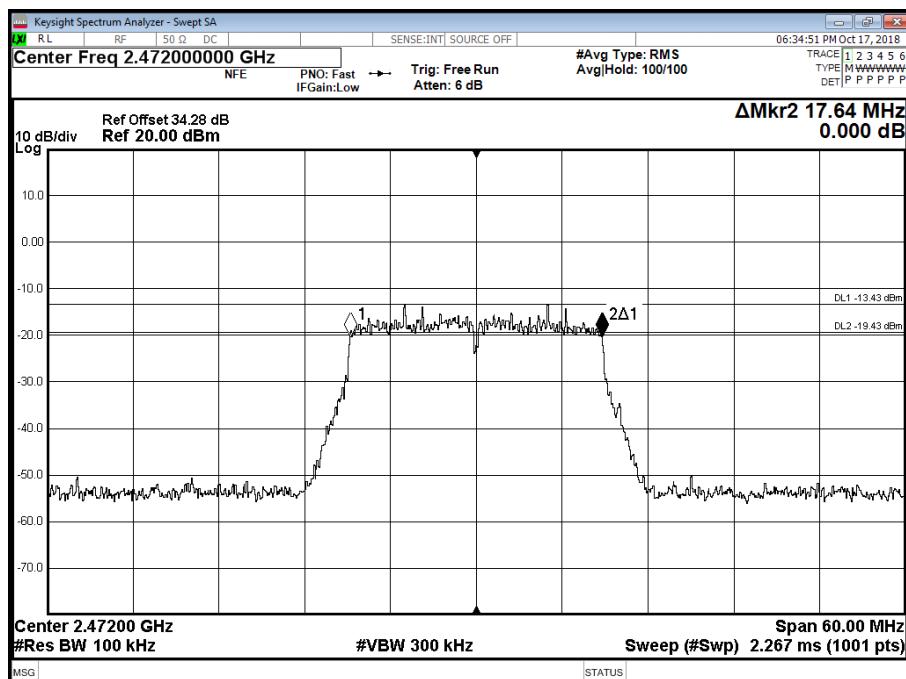


Figure 61 - 2412 MHz - 6 dB DTS Bandwidth

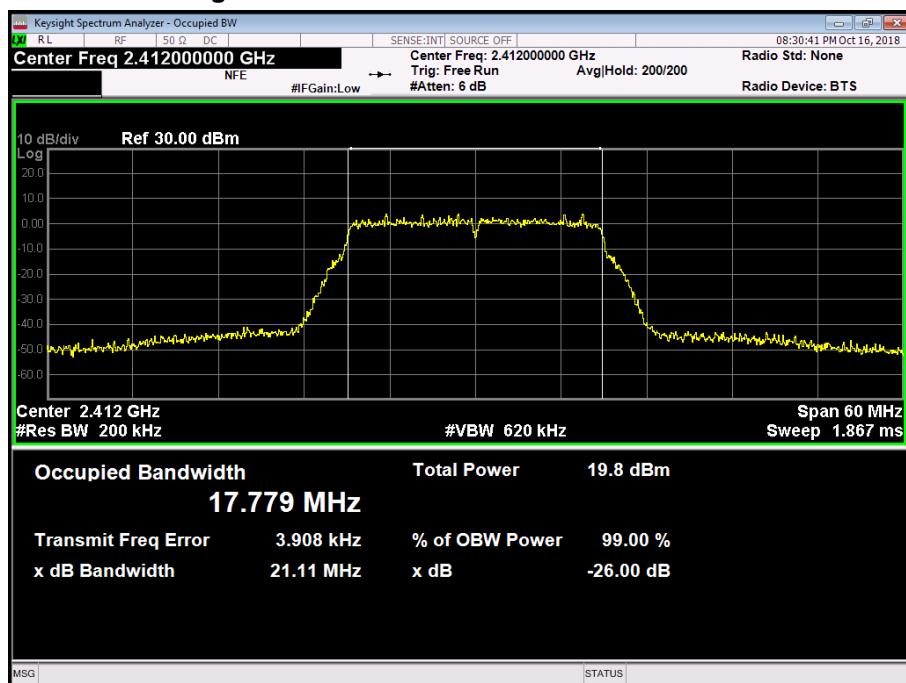


Figure 62 - 2412 MHz - 99% Occupied Bandwidth



Figure 63 - 2437 MHz - 6 dB DTS Bandwidth

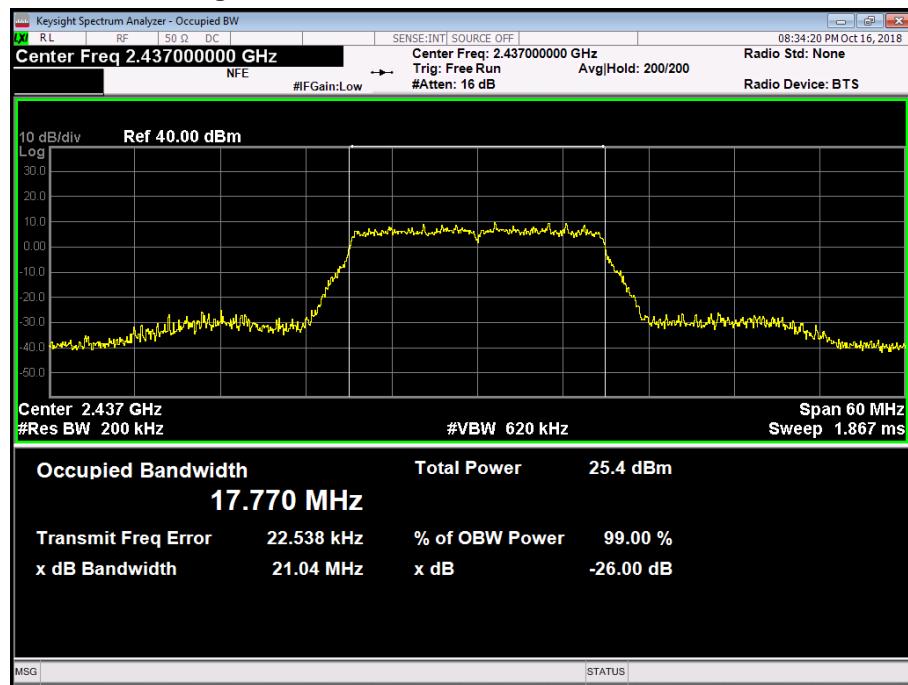


Figure 64 - 2437 MHz - 99% Occupied Bandwidth

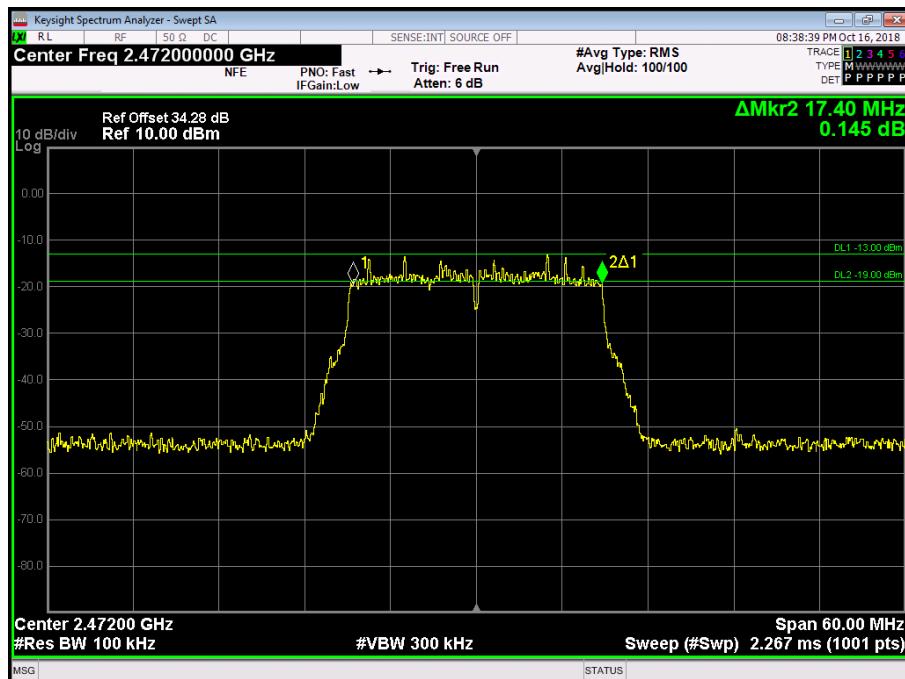


Figure 65 - 2472 MHz - 6 dB DTS Bandwidth

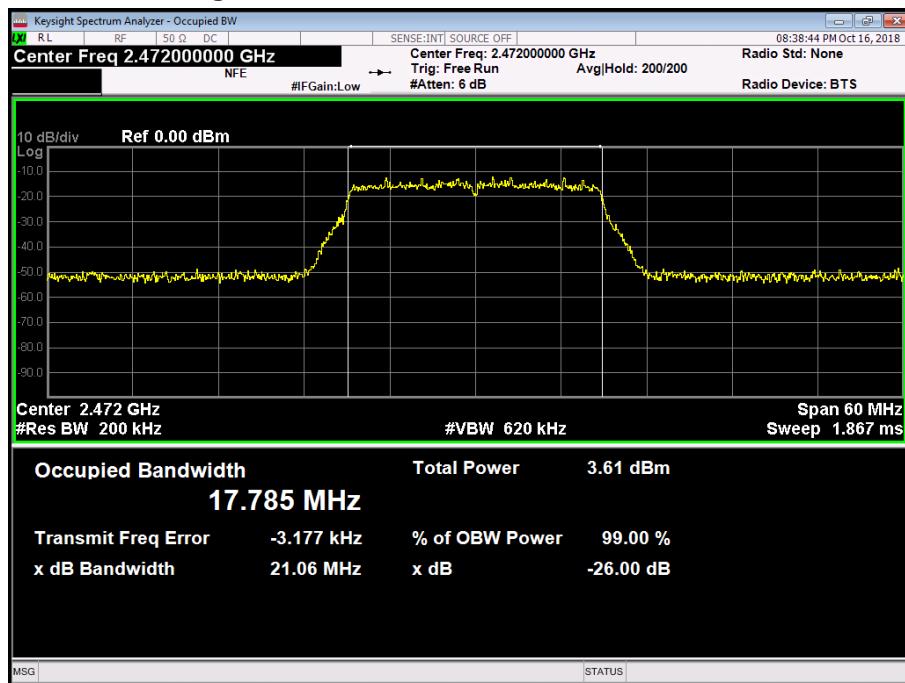


Figure 66 - 2472 MHz - 99% Occupied Bandwidth

802.11n / HT20 MCS0 / MIMO TxBF / Cores 0+1

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2437	2472
6 dB Bandwidth (MHz)	17.640	16.680	16.800
99% Bandwidth (MHz)	17.782	17.779	17.850

Table 31

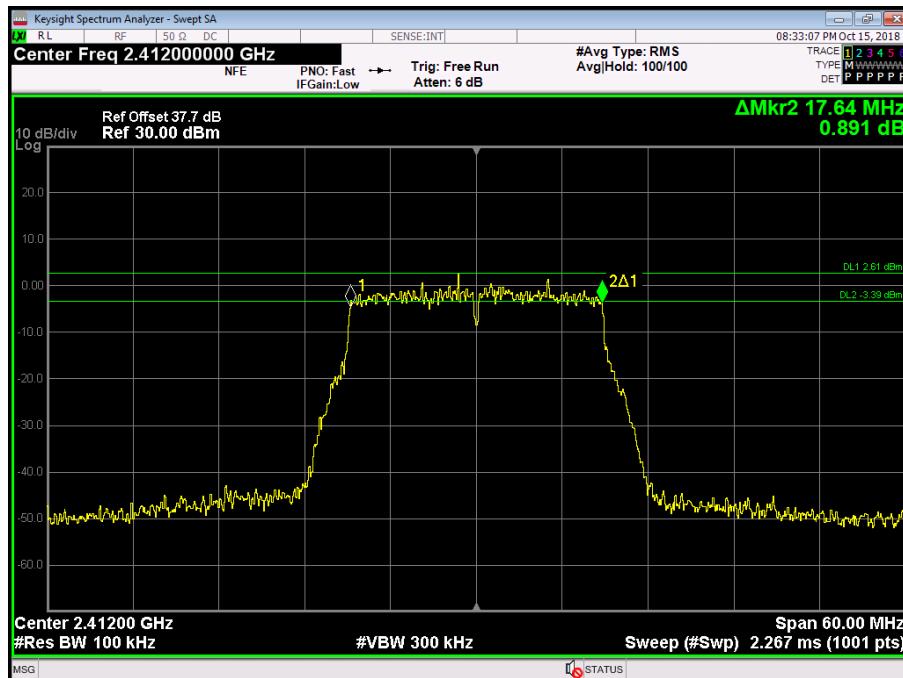


Figure 67 - 2412 MHz - 6 dB DTS Bandwidth

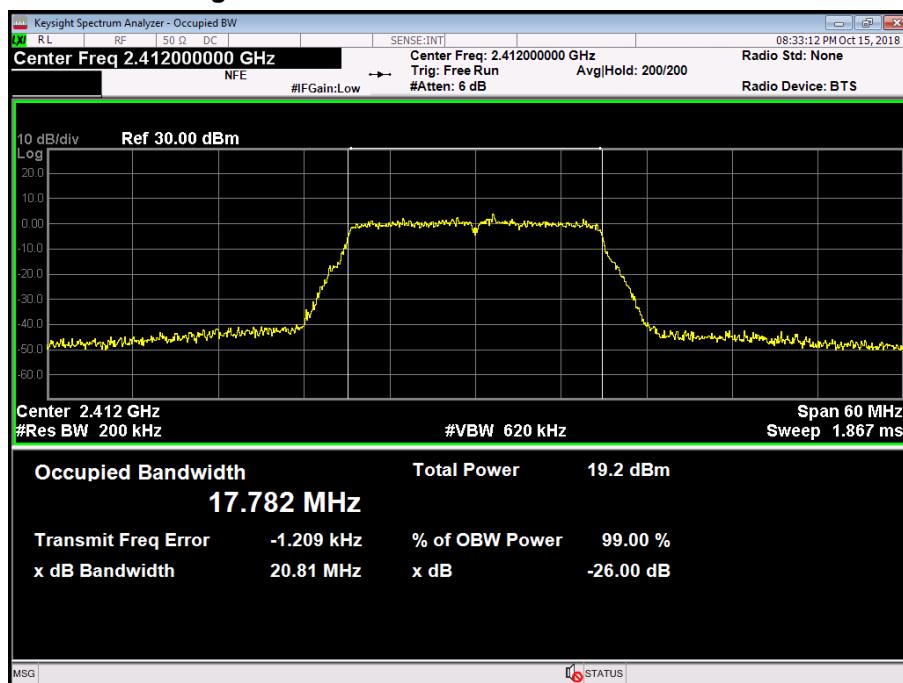


Figure 68 - 2412 MHz - 99% Occupied Bandwidth



Figure 69 - 2437 MHz - 6 dB DTS Bandwidth

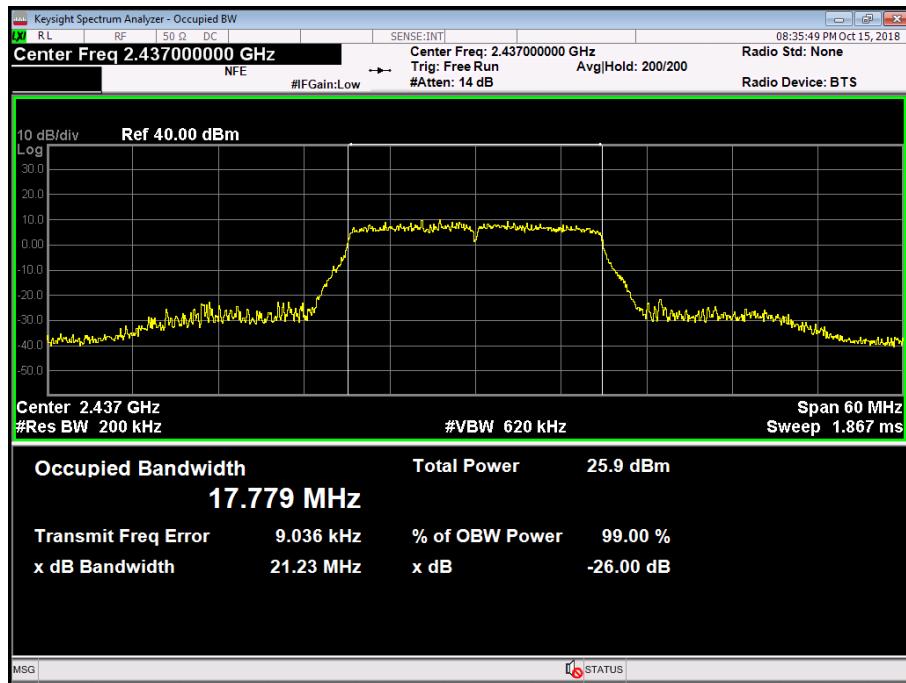


Figure 70 - 2437 MHz - 99% Occupied Bandwidth

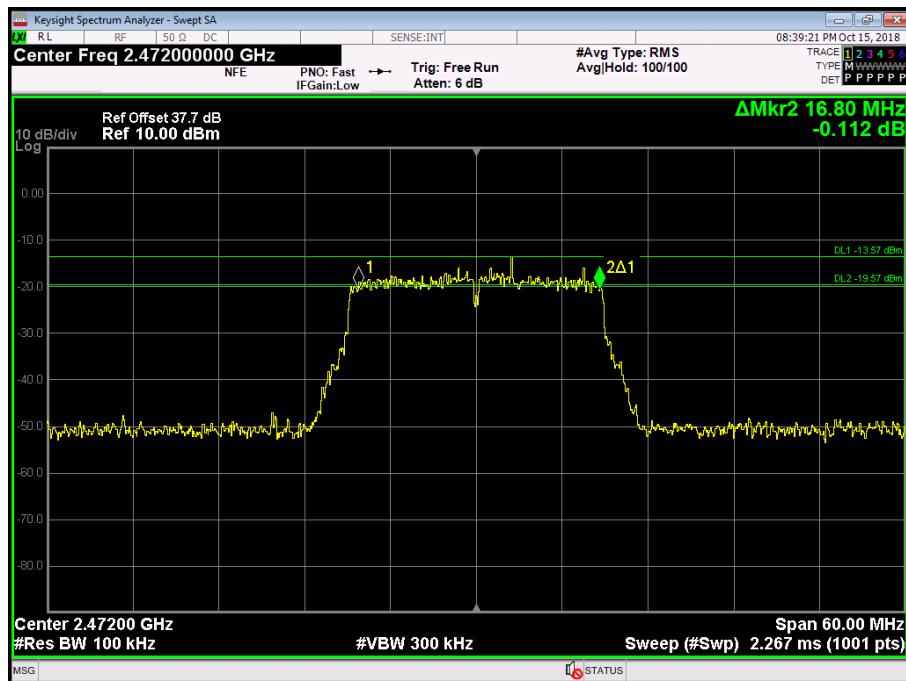


Figure 71 - 2472 MHz - 6 dB DTS Bandwidth

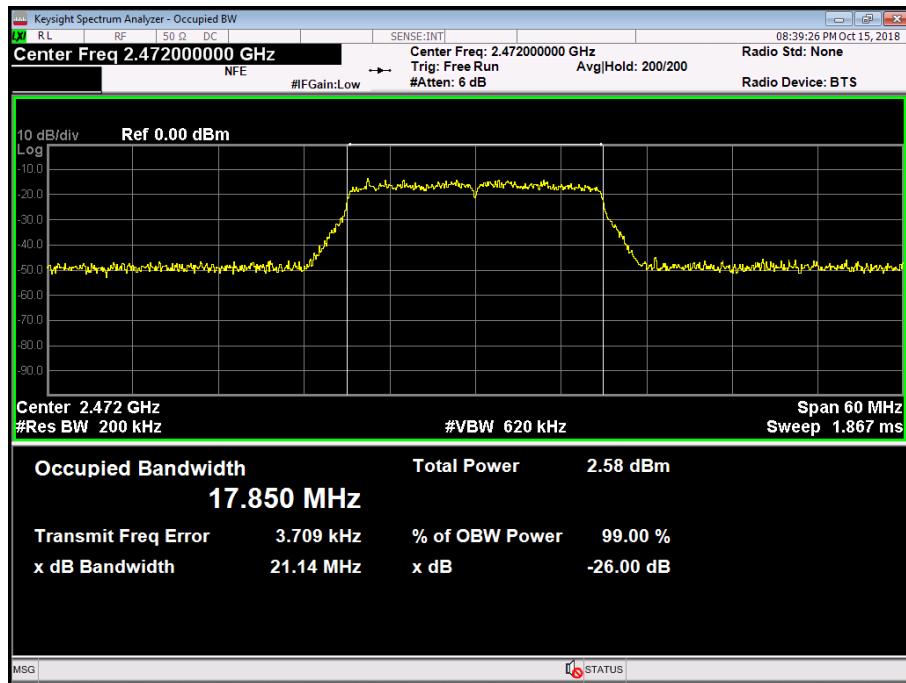


Figure 72 - 2472 MHz - 99% Occupied Bandwidth

FCC 47 CFR Part 15, Limit Clause 15.247(a)(2) and Industry Canada RSS-247, Clause 5.2(a)

The minimum 6 dB Bandwidth shall be at least 500 kHz.

2.3.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
20dB/2W Attenuator	Narda	4772-20	462	-	O/P Mon
Hygrometer	Rotronic	I-1000	2891	12	18-Sept-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	09-Oct-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Directional Coupler	Hewlett Packard	11692D	451	-	O/P Mon
Attenuator (20dB, 2W)	Pasternack	PE7004-20	2943	12	18-Jul-2019
Attenuator (20dB, 150W)	Narda	769-20	3367	12	17-Jul-2019
Attenuator (10dB, 150W)	Narda	769-10	3368	12	17-Jul-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
Attenuator (10 dB)	Suhner	6810.17.A	3965	12	18-Jul-2019
PXA Signal Analyser	Keysight Technologies;	N9030A	4653	12	05-Feb-2019
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4742	12	29-Sep-2019
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4743	12	29-Sep-2019
Power splitter - 4 port	Mini-Circuits	ZN4PD1-63-S+	4744	12	29-Sep-2019
EMI Receiver	Keysight Technologies;	N9038A MXE	4628	12	04-July-2019

Table 32

O/P Mon – Output Monitored using calibrated equipment

2.4 Authorised Band Edges

2.4.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d)
Industry Canada RSS-247 Clause 5.5

2.4.2 Equipment Under Test and Modification State

A1932, S/N: C02X5003L3J0 - Modification State 0

2.4.3 Date of Test

26-August-2018 to 11-Sept-2018

2.4.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.10.4.

2.4.5 Reported Measurements

Authorised band edge measurements were performed with the device operating in SISO, MIMO and TxBF, across the various modes supported by the device.

The measurements displayed within this report, have been limited to those modes which have been shown to be worst case. Further measurements are held on file by TÜV SÜD, and are available if required.

Note: 2483.5 MHz is both an Authorised Band edge and Restricted Band Edge. Of the two limits, the Restricted Band Edge is the most stringent and therefore demonstrates compliance with the 20 dBc Authorised Band Edge requirement.

2.4.6 Environmental Conditions

Ambient Temperature	20.0 - 23.6 °C
Relative Humidity	36.3 - 60.2 %

2.4.7 Test Results

SISO

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
802.11b	1 Mbps	2412	2400.0	-43.62

Table 33

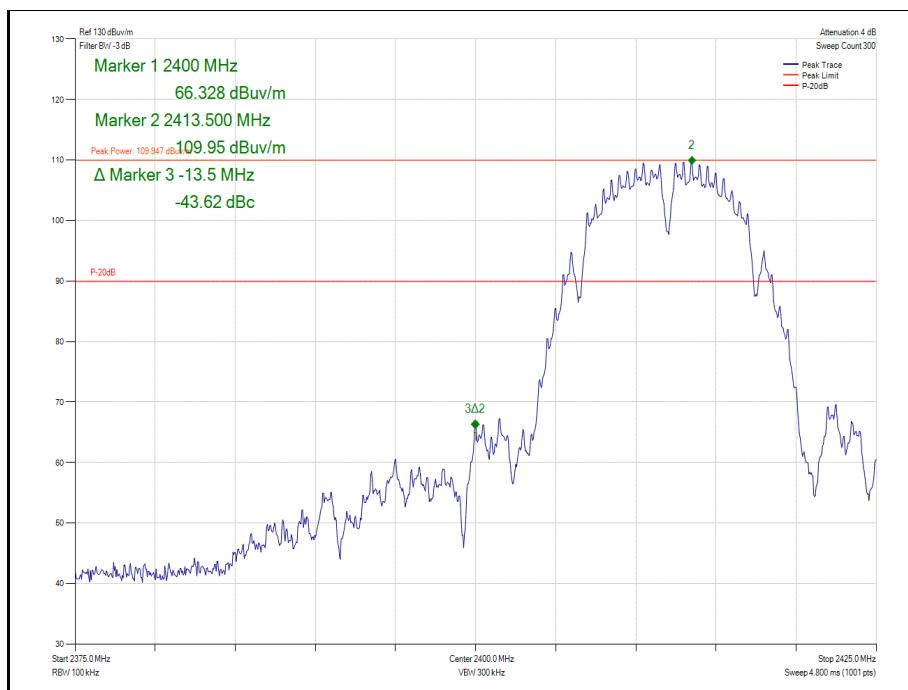


Figure 73 - 2412 MHz - Measured Frequency 2400.0 MHz

SISO

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
802.11g	6 Mbps	2412	2400.0	-36.08

Table 34

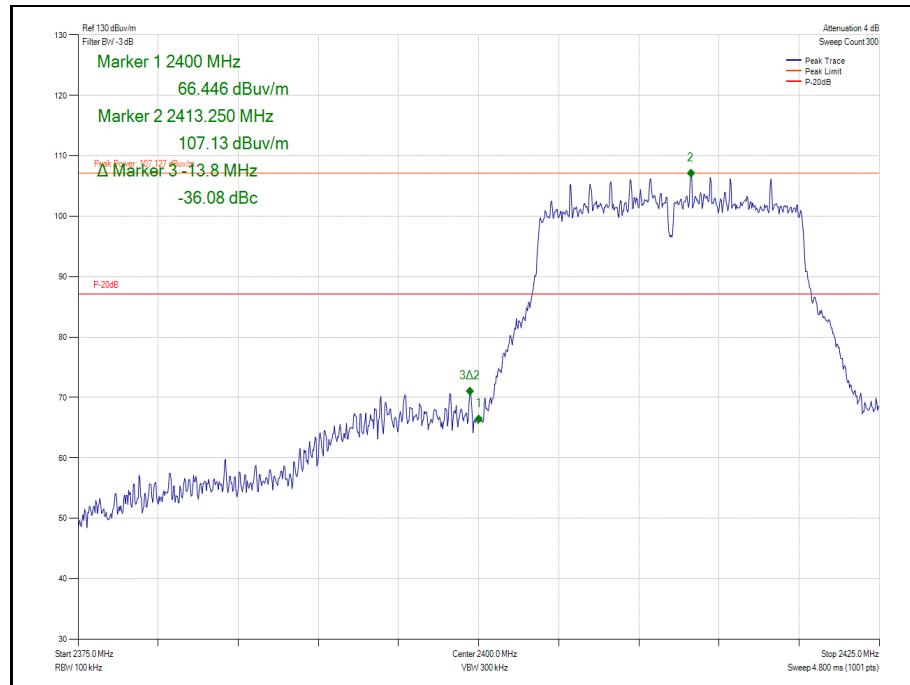


Figure 74 - 2412 MHz - Measured Frequency 2400.0 MHz

SISO

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
802.11n	MCS0	2412	2400.0	-34.75

Table 35

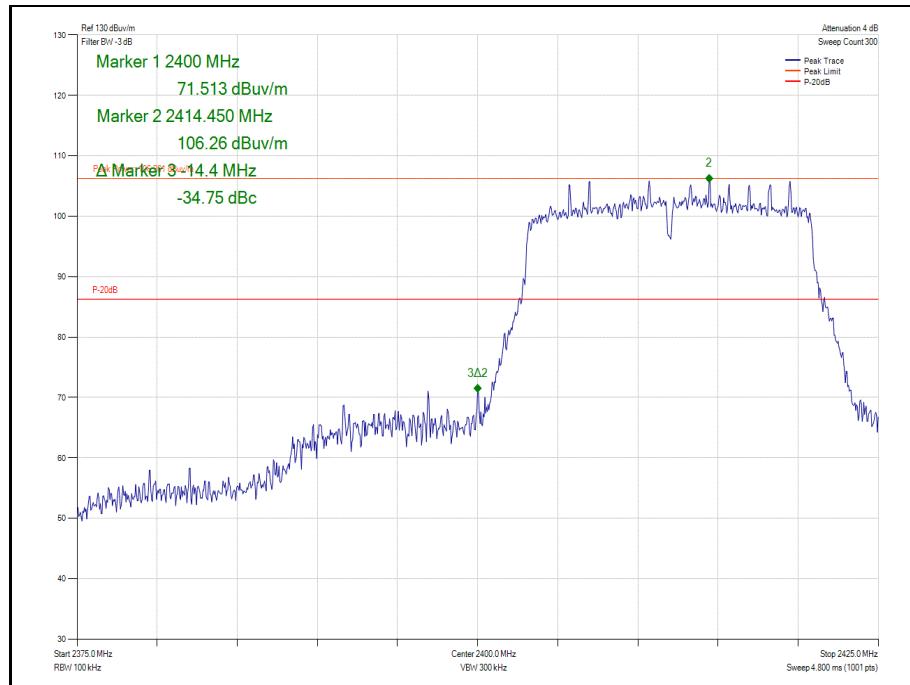


Figure 75 - 2412 MHz - Measured Frequency 2400.0 MHz

MIMO 2 Tx, TXBF

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
802.11n	MCS0	2412	2400.0	-45.78

Table 36

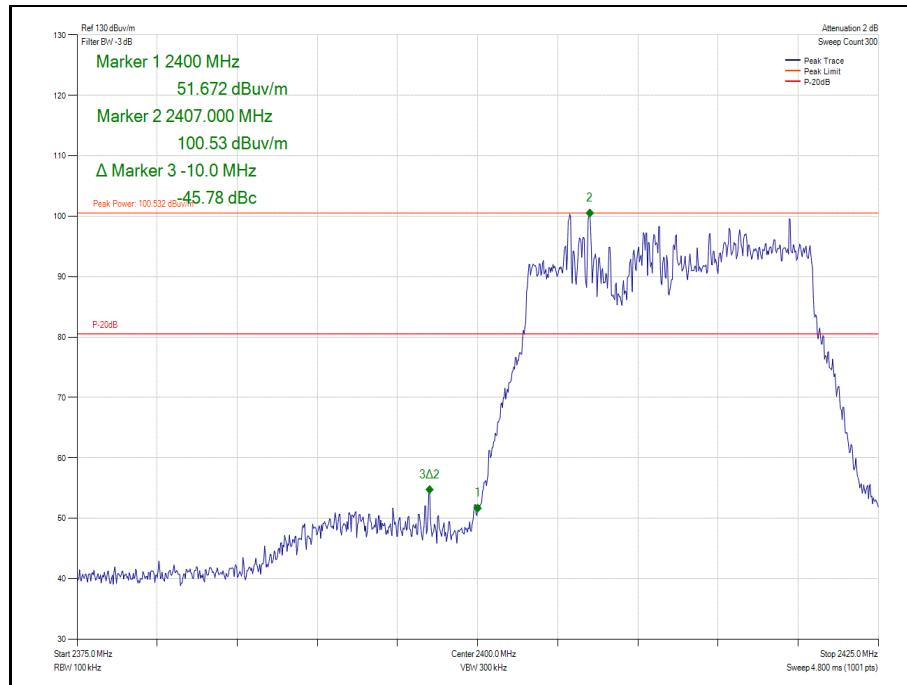


Figure 76 - 2412 MHz - Measured Frequency 2400.0 MHz

MIMO 2Tx

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
802.11b	1 Mbps	2412	2400.0	-40.65

Table 37

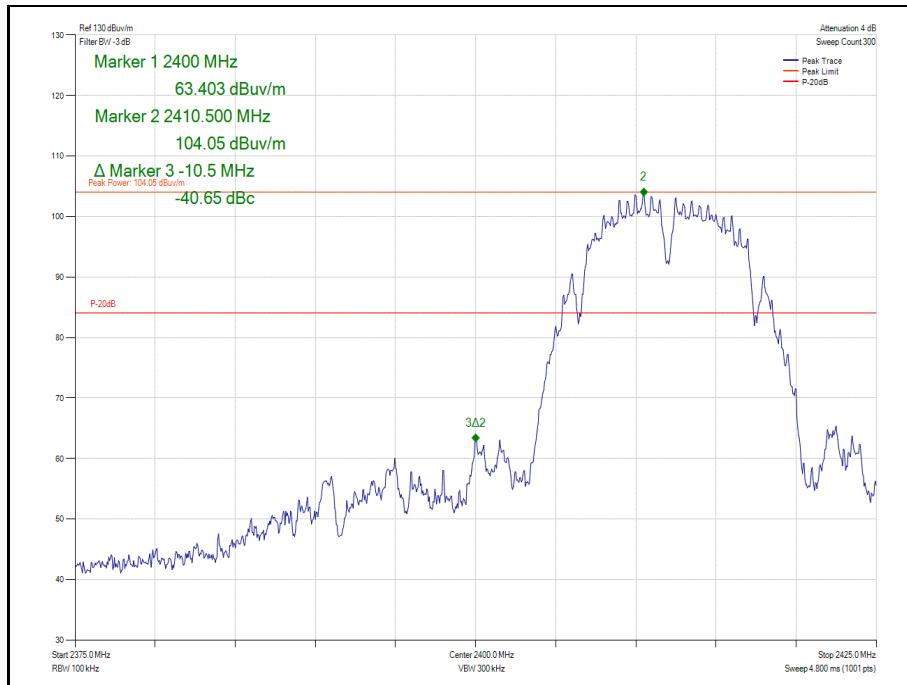


Figure 77 - 2412 MHz - Measured Frequency 2400.0 MHz

MIMO 2Tx

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
802.11n	MCS0	2412	2400.0	-41.93

Table 38

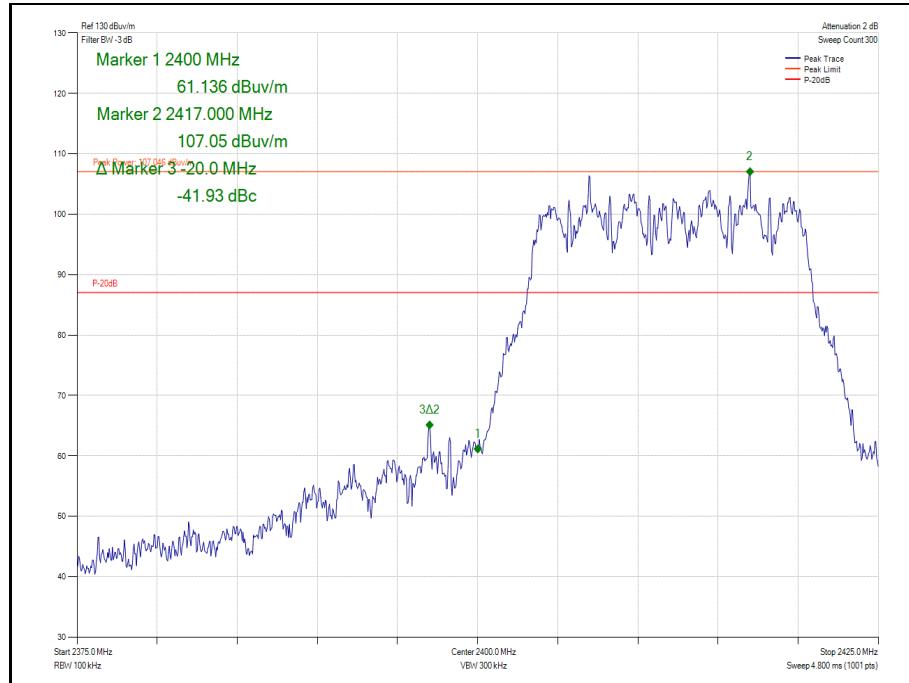


Figure 78 - 2412 MHz - Measured Frequency 2400.0 MHz

FCC 47 CFR Part 15, Limit Clause 15.247 (d)

20 dB below the fundamental measured in a 100 kHz bandwidth using a peak detector. If the transmitter complies with the conducted power limits, based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB below the fundamental instead of 20 dB.

Industry Canada RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

2.4.8 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Hygrometer	Rotronic	HP21	4989	12	26-April-2019
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	12-Feb-2019
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Tilt Antenna Mast	Maturo GmbH	TAM 4.0-P	4811	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Nov-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	09-Oct-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Cable	Rosenberger	LU7-071-1000	5104	6	05-Oct-2019
Cable	Rosenberger	LU7-071-2000	4528	-	O/P Mon
Cable	Rosenberger	2303-0 9.0m PNm PNm	4827	12	04-Jan-2019
EMI Receiver	Keysight Technologies	N9038A MXE	4628	12	04-July-2019

Table 39

TU – Traceability Unscheduled
O/P Mon – Output Monitored

2.5 Restricted Band Edges

2.5.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.205
Industry Canada RSS-GEN 8.10

2.5.2 Equipment Under Test and Modification State

A1932, S/N: C02X5003L3J0 - Modification State 0

2.5.3 Date of Test

26-August-2018 to 11-September-2018

2.5.4 Test Method

Testing was performed in accordance with ANSI C63.10, clause 6.10.5 and 11.12.1.

The following conversion can be applied to convert from dB μ V/m to μ V/m:
 $10^{\frac{1}{2}}(\text{Field Strength in dB}\mu\text{V/m}/20)$.

2.5.5 Reported Measurements

Restricted band edge measurements were performed with the device operating in SISO, MIMO and TxBF, across the various modes supported by the device.

The measurements displayed within this report, have been limited to those modes which have been shown to be worst case. Further measurements are held on file by TÜV SÜD, and are available if required

2.5.6 Environmental Conditions

Ambient Temperature 20 - 23.6 °C
Relative Humidity 36.3 - 60.2 %

2.5.7 Test Results

SISO

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dB μ V/m)	Average Level (dB μ V/m)
802.11b	1 Mbps	2462	2483.5	64.8	51.03
802.11b	1 Mbps	2412	2390.0	59.24	51.55

Table 40

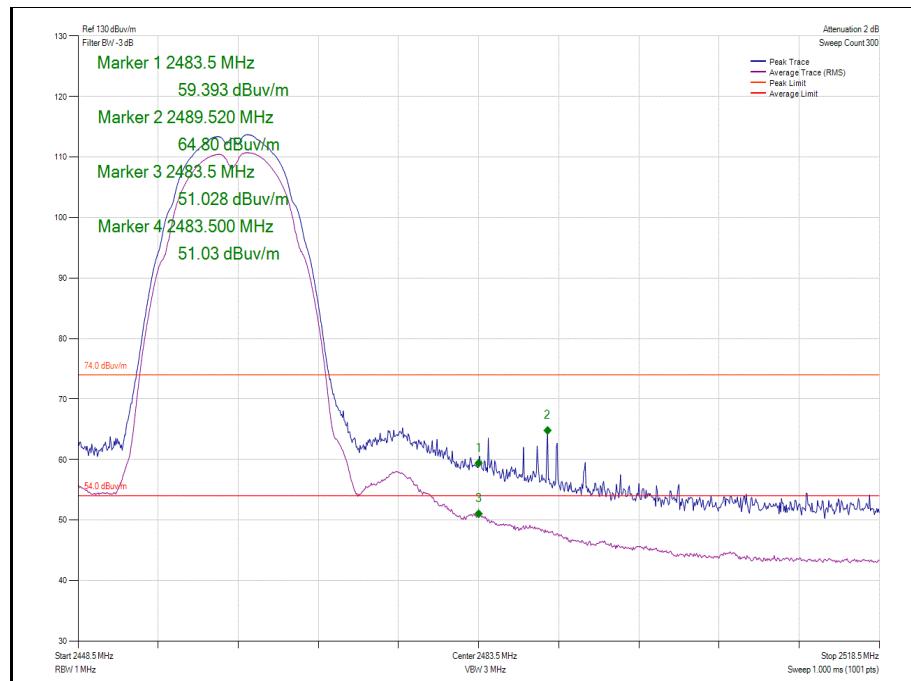


Figure 79 - 2462 MHz - Measured Frequency 2483.5 MHz

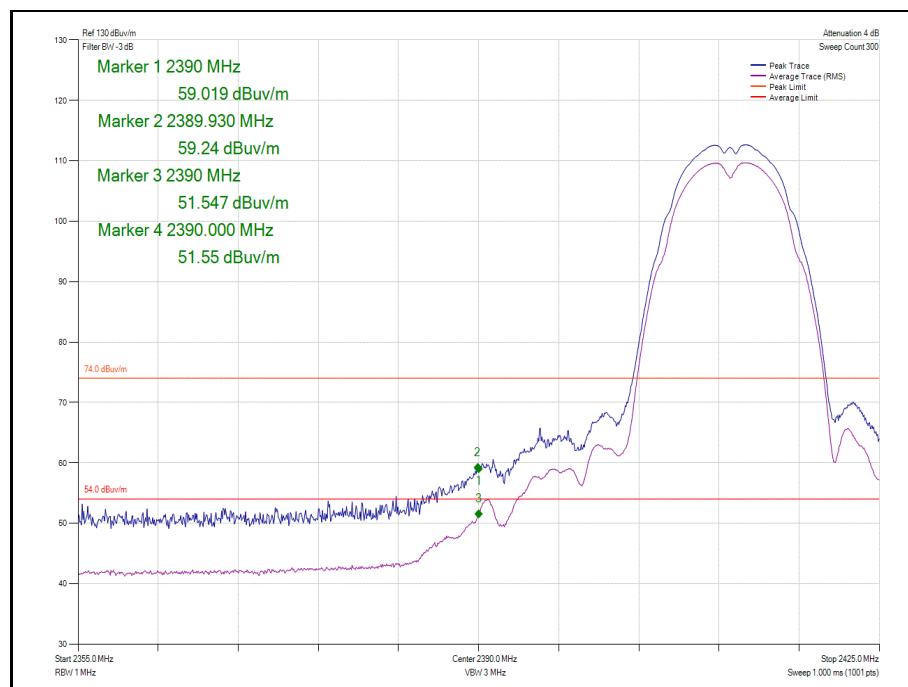


Table 41 Figure 80 - 2412 MHz - Measured Frequency 2390.0 MHz

SISO

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dB μ V/m)	Average Level (dB μ V/m)
802.11b	1 Mbps	2467	2483.5	67.28	51.06
802.11b	1 Mbps	2472	2483.5	60.2	51.09

Table 42

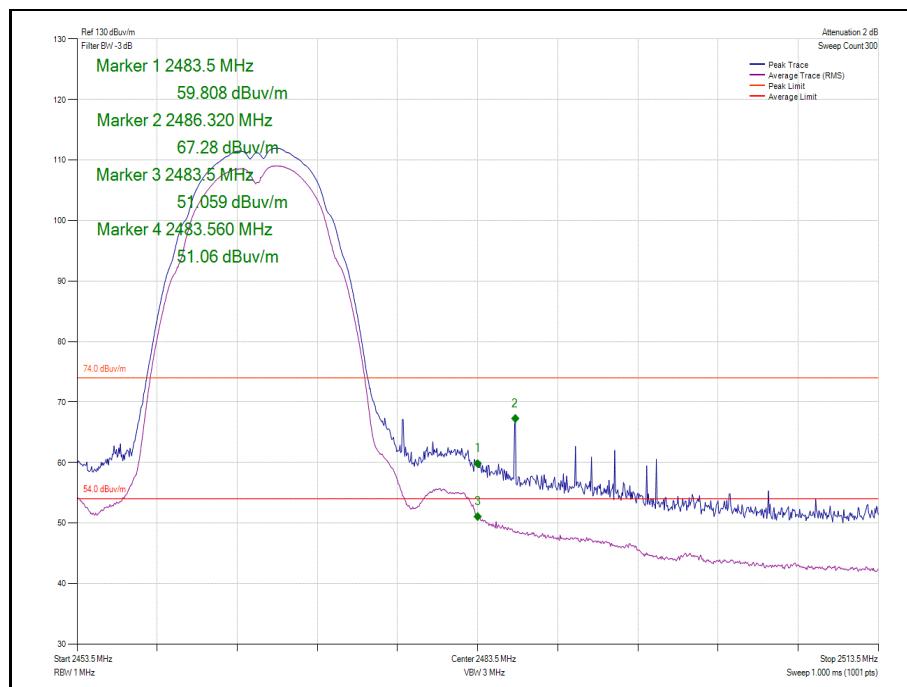


Figure 81 - 2467 MHz - Measured Frequency 2483.5 MHz

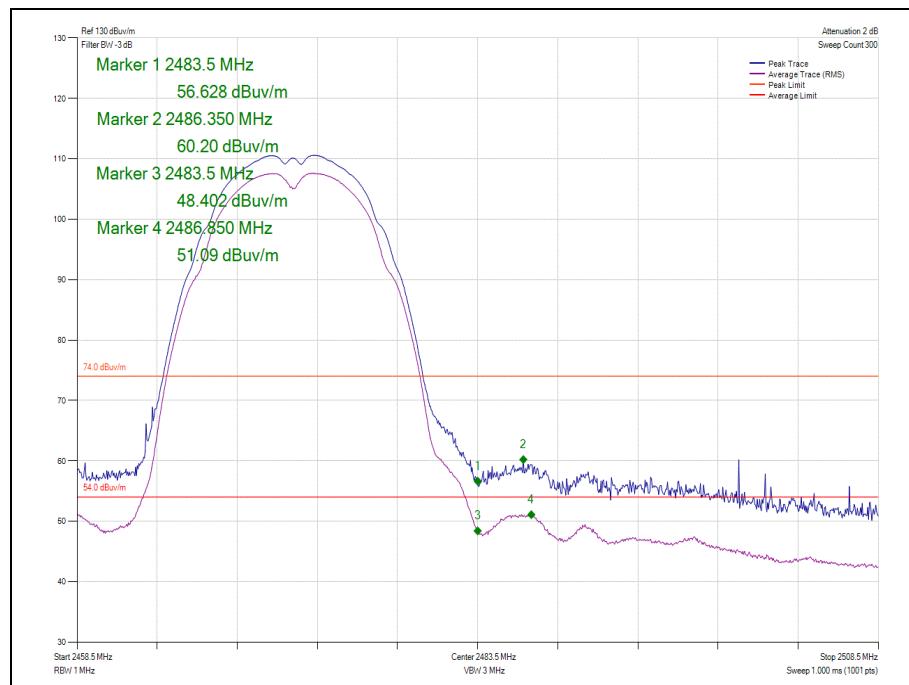


Figure 82 - 2472 MHz - Measured Frequency 2483.5 MHz

(SISO)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dB μ V/m)	Average Level (dB μ V/m)
802.11g	6 Mbps	2462	2483.5	61.36	51.12
802.11g	6 Mbps	2412	2390.0	64.73	50.58

Table 43

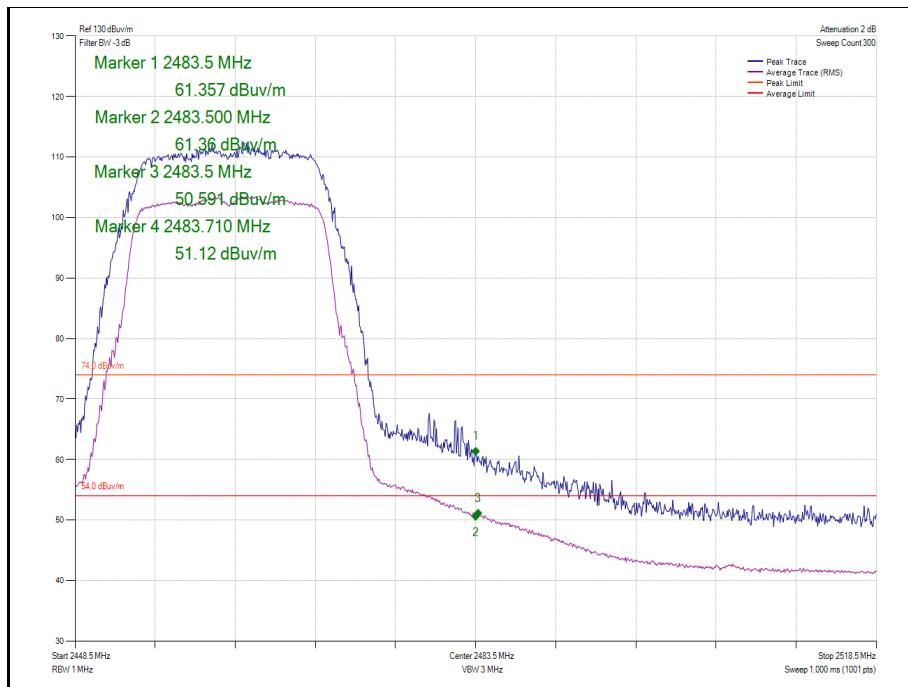


Figure 83 - 2462 MHz - Measured Frequency 2483.5 MHz

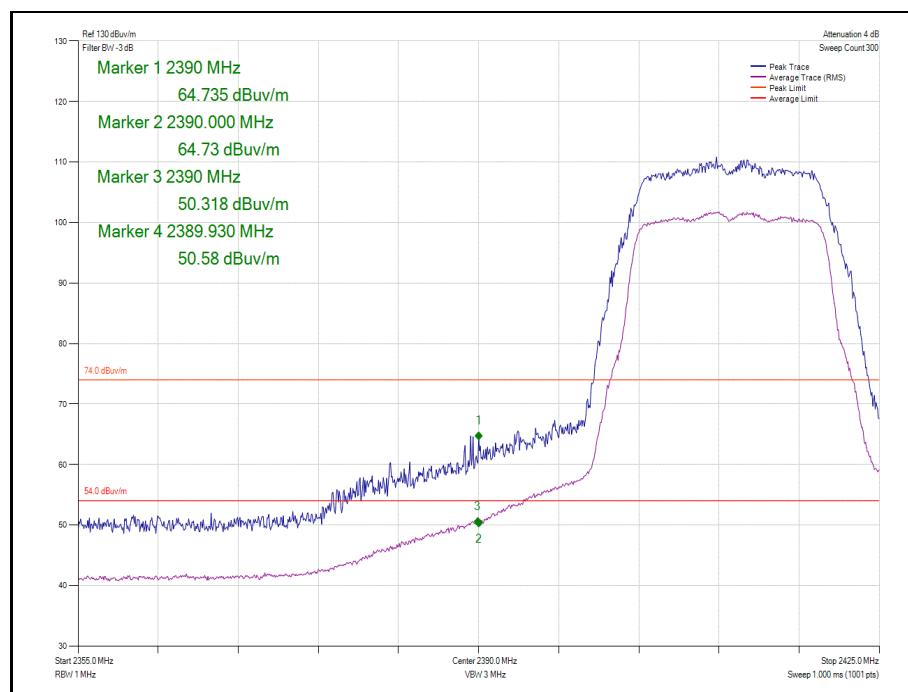


Figure 84 - 2412 MHz - Measured Frequency 2390.0 MHz

(SISO)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dB μ V/m)	Average Level (dB μ V/m)
802.11g	6 Mbps	2467	2483.5	65.75	50.85
802.11g	6 Mbps	2472	2483.5	65.49	51.20

Table 44

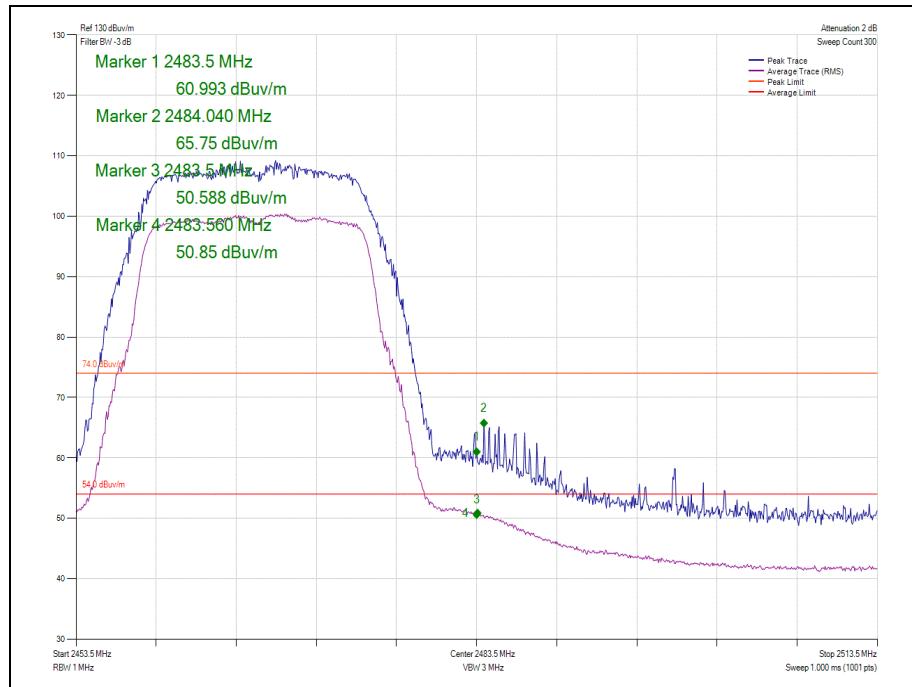


Figure 85 - 2467 MHz - Measured Frequency 2483.5 MHz

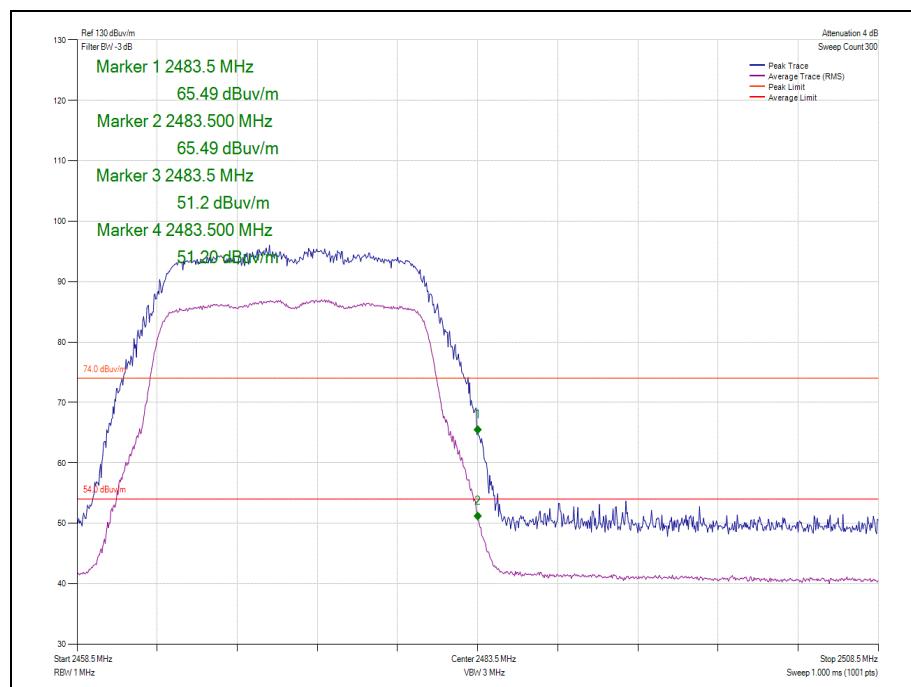


Figure 86 - 2472 MHz - Measured Frequency 2483.5 MHz

(SISO)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dB μ V/m)	Average Level (dB μ V/m)
802.11n	MCS0	2462	2483.5	67.58	50.83
802.11n	MCS0	2412	2390.0	66.81	51.60

Table 45

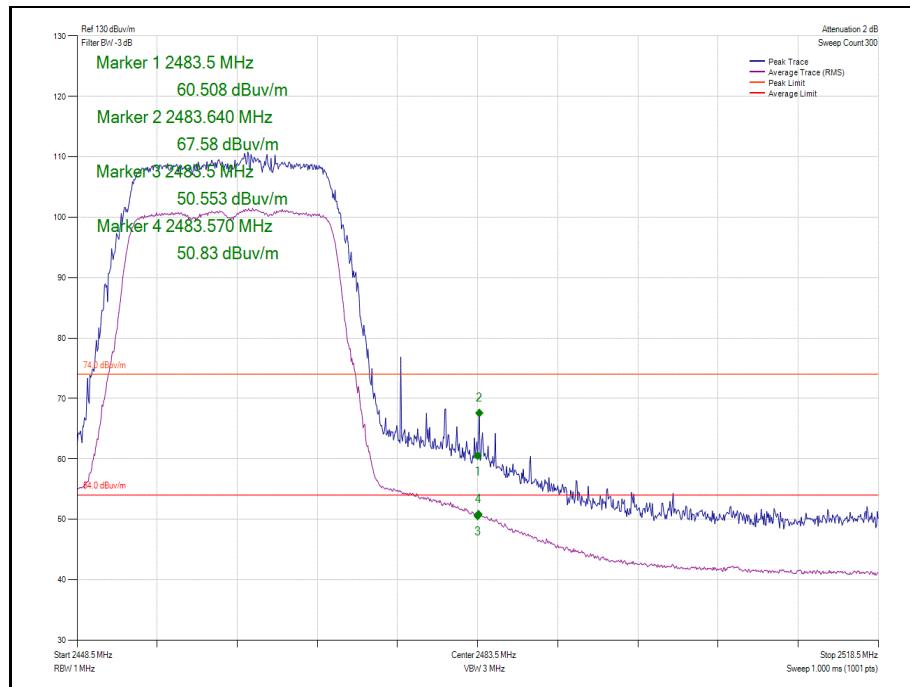


Figure 87 - 2462 MHz - Measured Frequency 2483.5 MHz

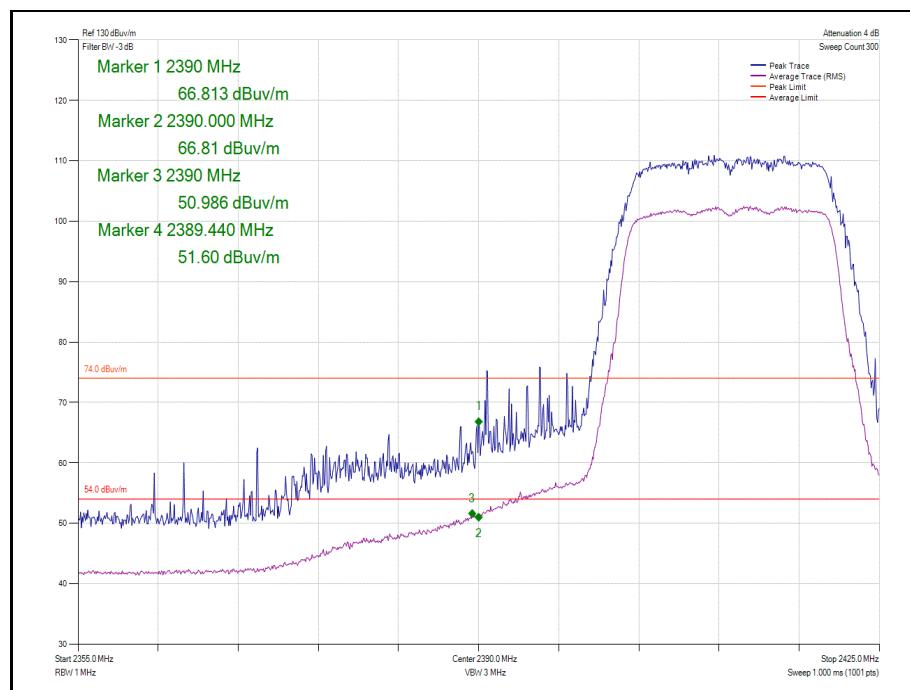


Figure 88 - 2412 MHz - Measured Frequency 2390.0 MHz

Main (SISO)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dB μ V/m)	Average Level (dB μ V/m)
802.11n	MCS0	2467	2483.5	66.58	51.42
802.11n	MCS0	2472	2483.5	66.8	51.51

Table 46

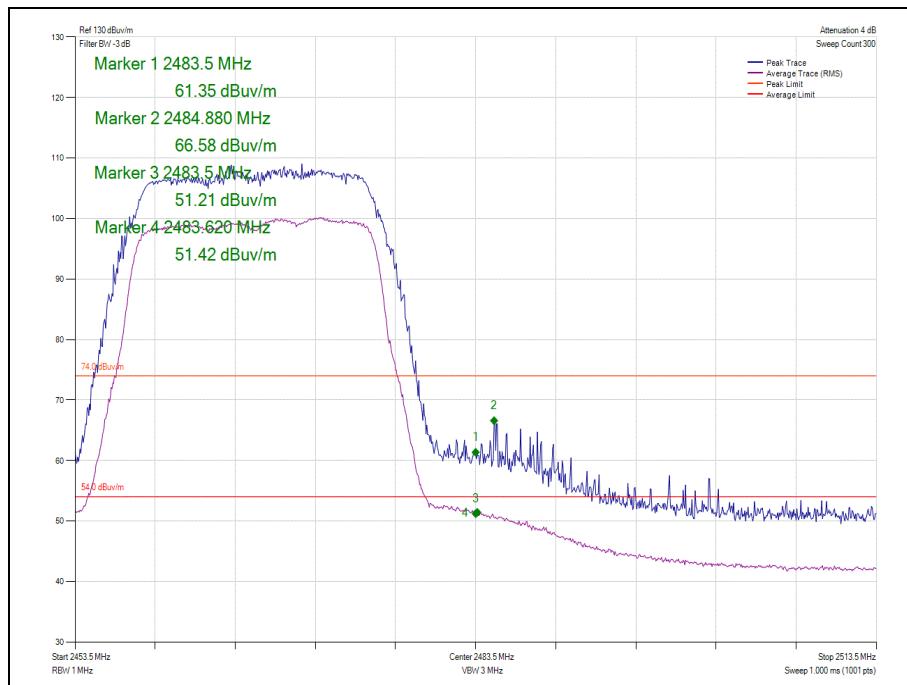


Figure 89 - 2467 MHz - Measured Frequency 2483.5 MHz

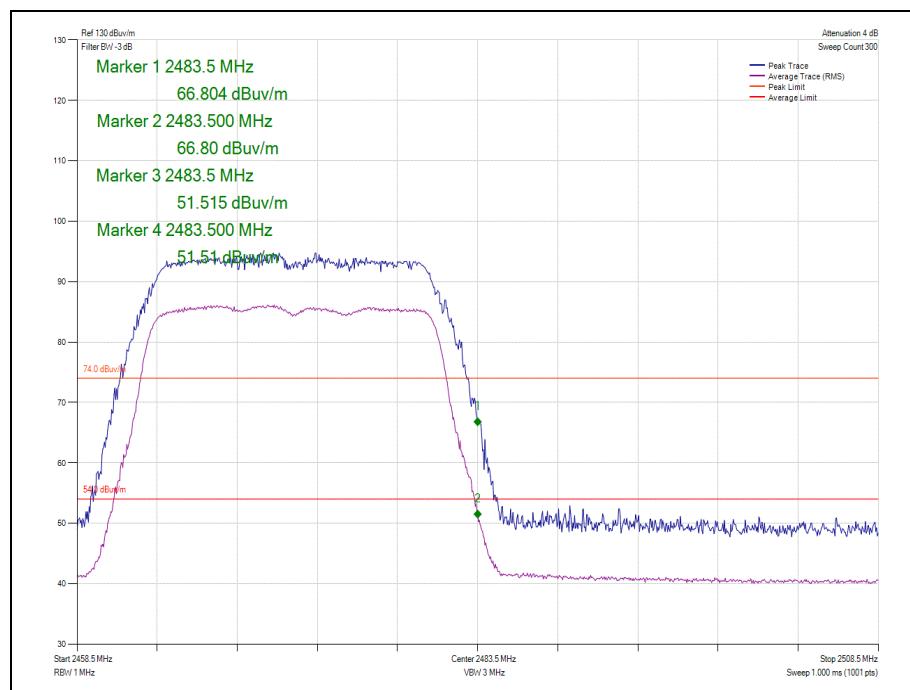


Figure 90 - 2472 MHz - Measured Frequency 2483.5 MHz

(MIMO 2 Tx, TXBF)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dB μ V/m)	Average Level (dB μ V/m)
802.11n	MCS0	2462	2483.5	66.08	51.38
802.11n	MCS0	2412	2390.0	62.0	47.65

Table 47

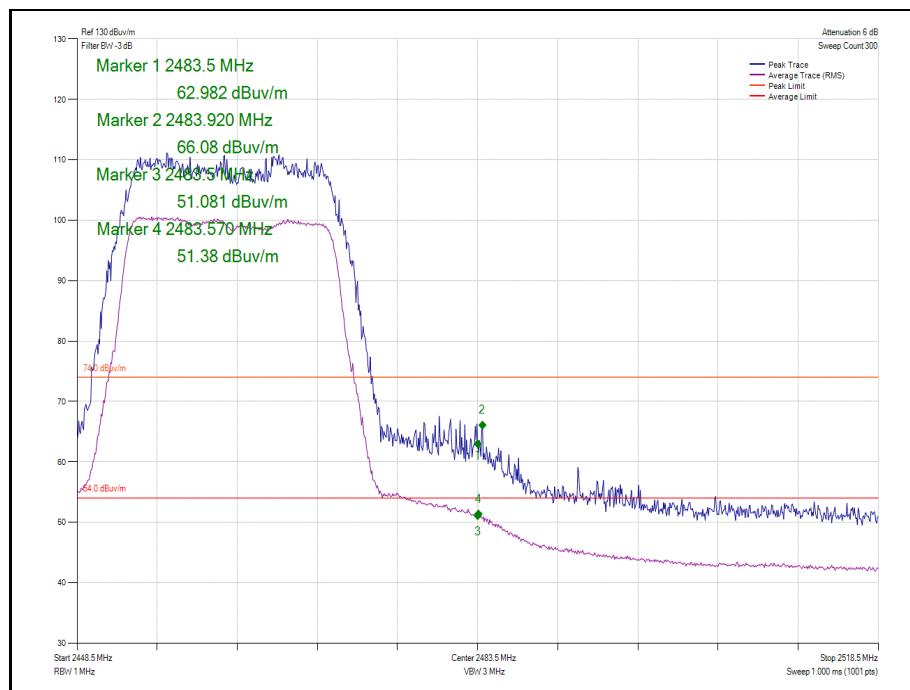


Figure 91 - 2462 MHz - Measured Frequency 2483.5 MHz

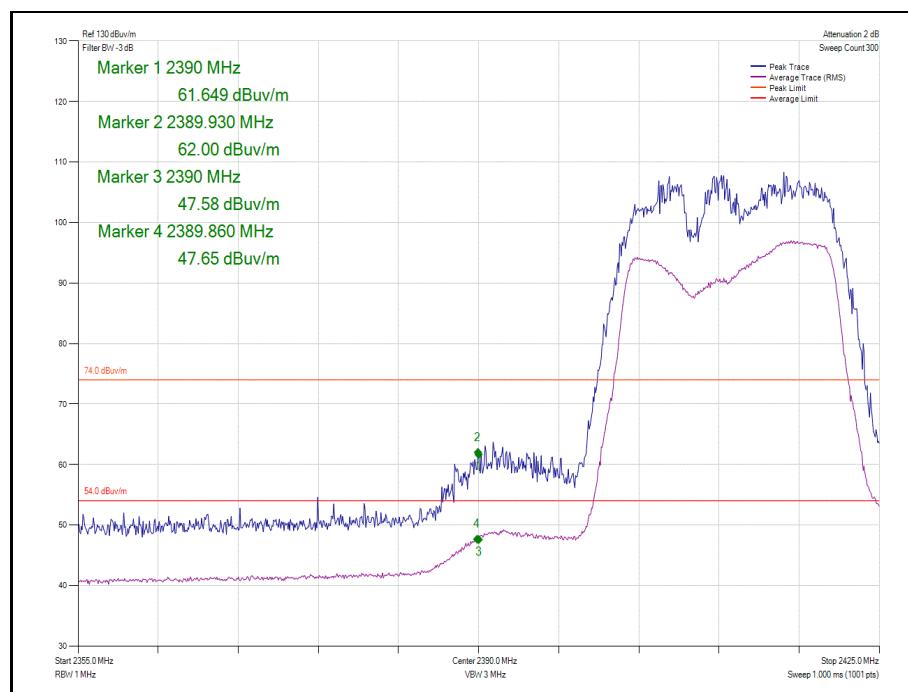


Figure 92 - 2412 MHz - Measured Frequency 2390.0 MHz

(MIMO 2 Tx, TXBF)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dB μ V/m)	Average Level (dB μ V/m)
802.11n	MCS0	2467	2483.5	64.69	51.23
802.11n	MCS0	2472	2483.5	68.22	51.17

Table 48

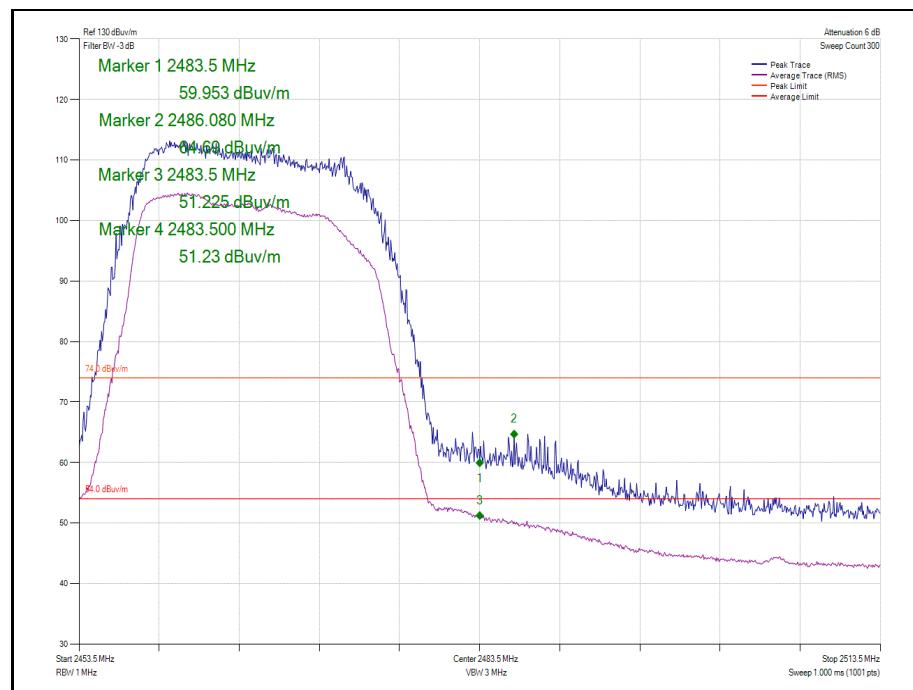


Figure 93 - 2467 MHz - Measured Frequency 2483.5 MHz

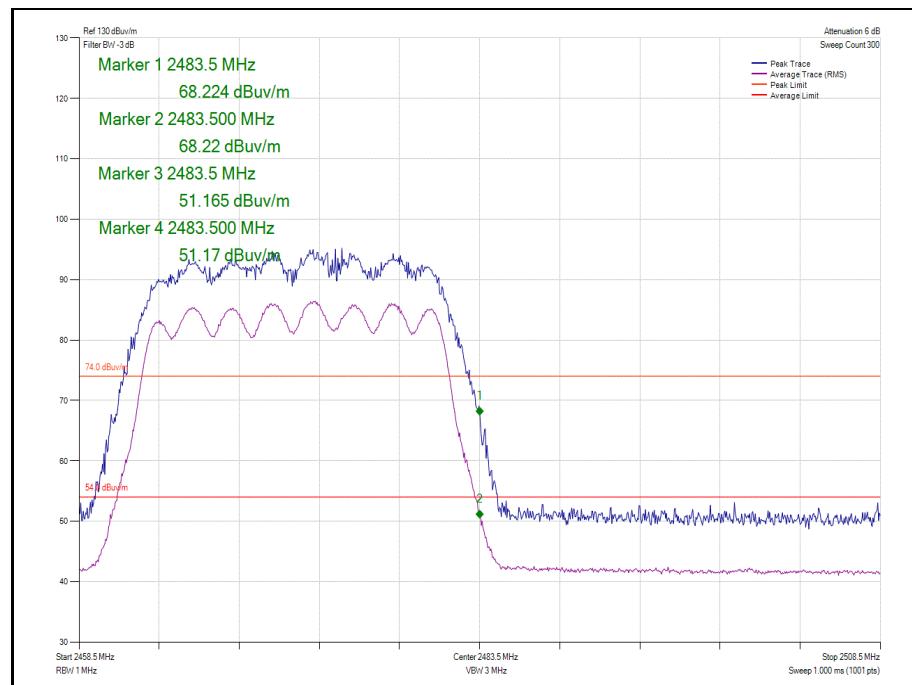


Figure 94 - 2472 MHz - Measured Frequency 2483.5 MHz

(MIMO 2Tx)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dB μ V/m)	Average Level (dB μ V/m)
802.11b	1 Mbps	2462	2483.5	67.24	51.20
802.11b	1 Mbps	2412	2390.0	59.62	49.48

Table 49

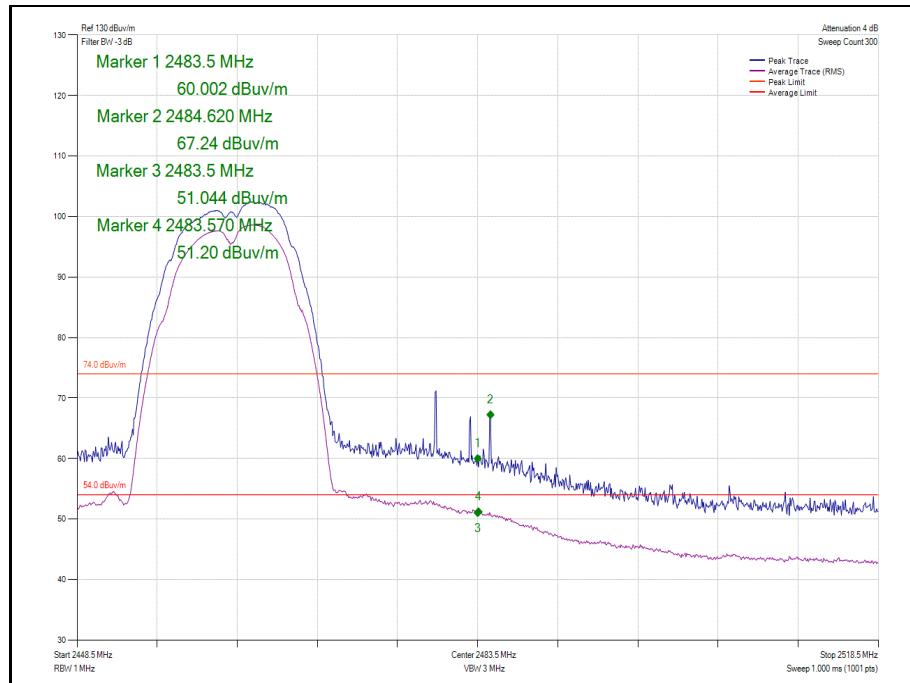


Figure 95 - 2462 MHz - Measured Frequency 2483.5 MHz

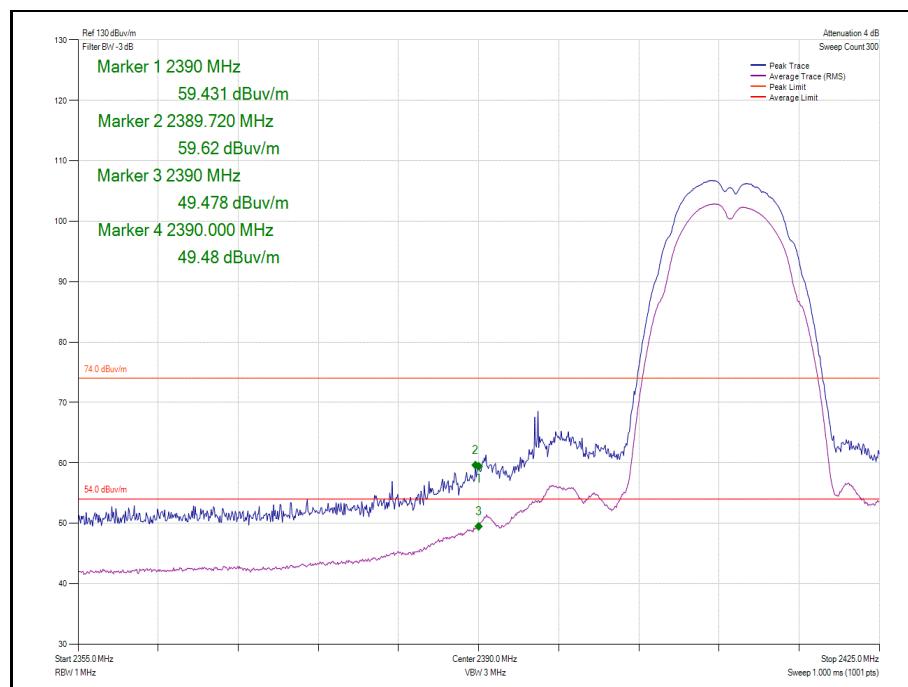


Figure 96 - 2412 MHz - Measured Frequency 2390.0 MHz

(MIMO 2Tx)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dB μ V/m)	Average Level (dB μ V/m)
802.11b	1 Mbps	2467	2483.5	62.22	50.98
802.11b	1 Mbps	2472	2483.5	58.96	47.16

Table 50

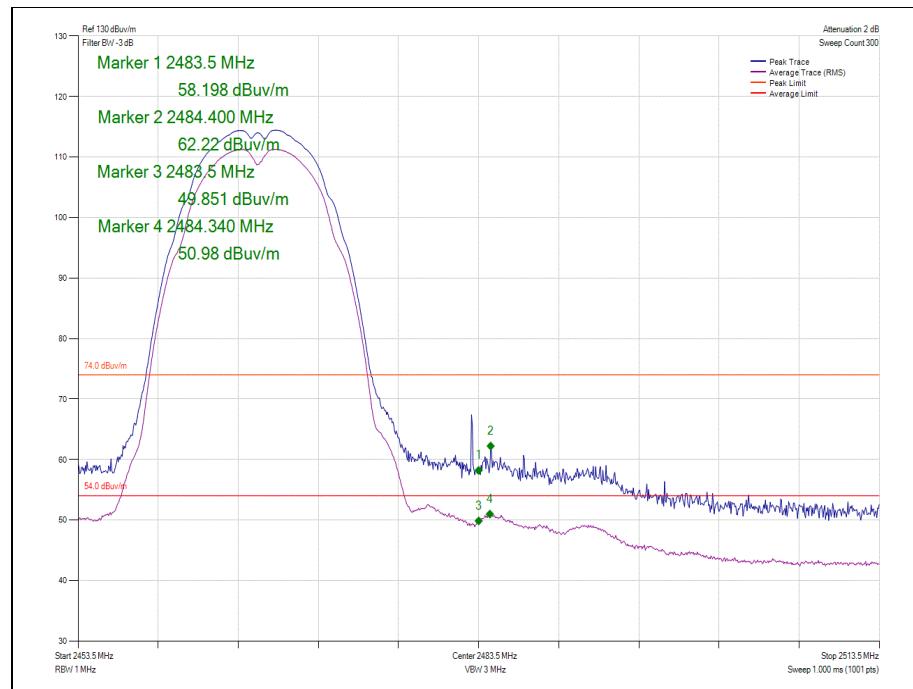


Figure 97 - 2467 MHz - Measured Frequency 2483.5 MHz

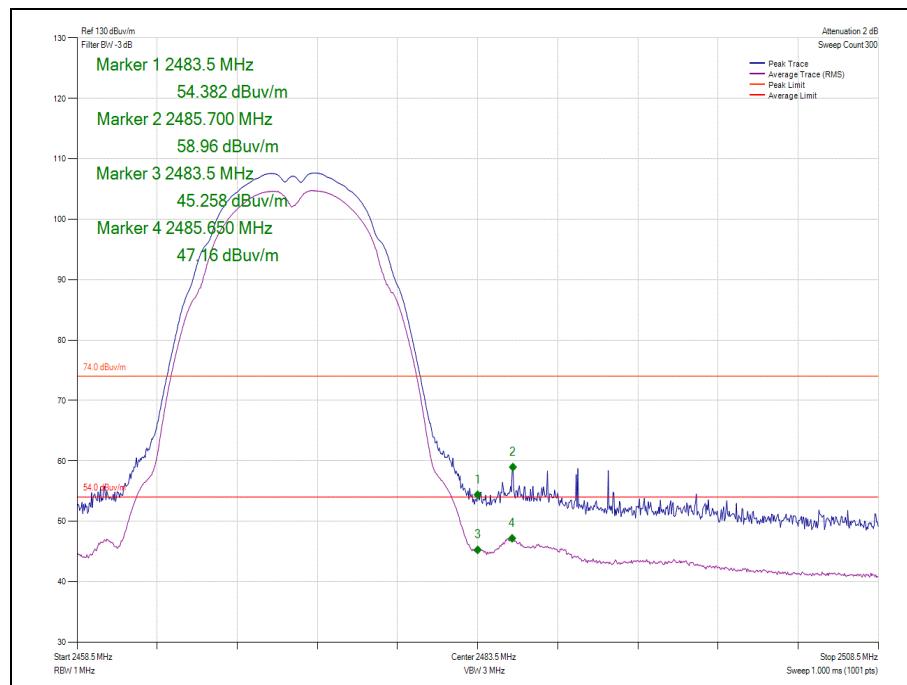


Figure 98 - 2472 MHz - Measured Frequency 2483.5 MHz

(MIMO 2Tx)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dB μ V/m)	Average Level (dB μ V/m)
802.11n	MCS0	2462	2483.5	64.05	51.57
802.11n	MCS0	2412	2390.0	64.47	51.25

Table 51

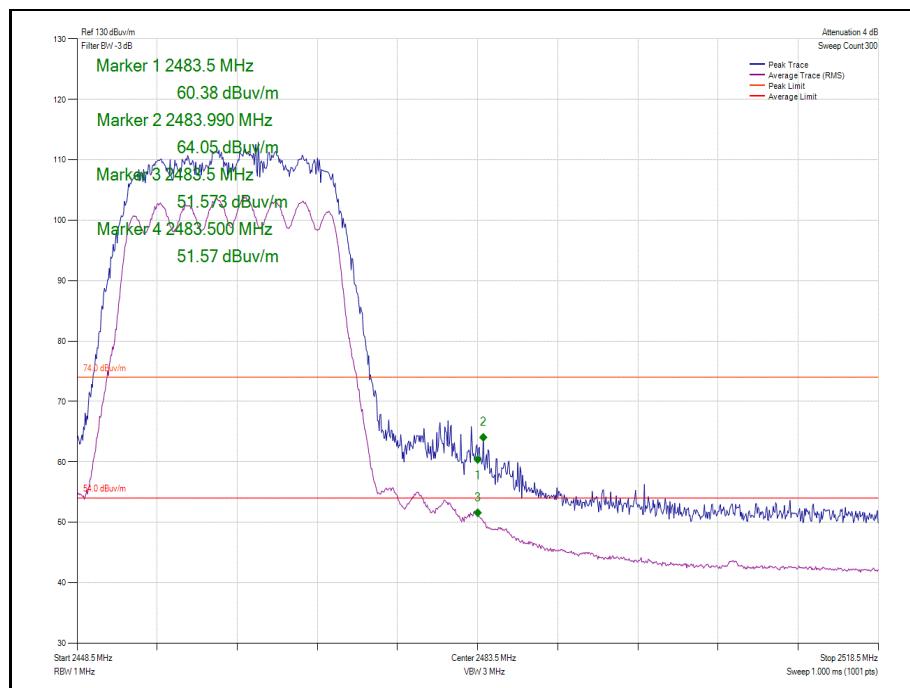


Figure 99 - 2462 MHz - Measured Frequency 2483.5 MHz

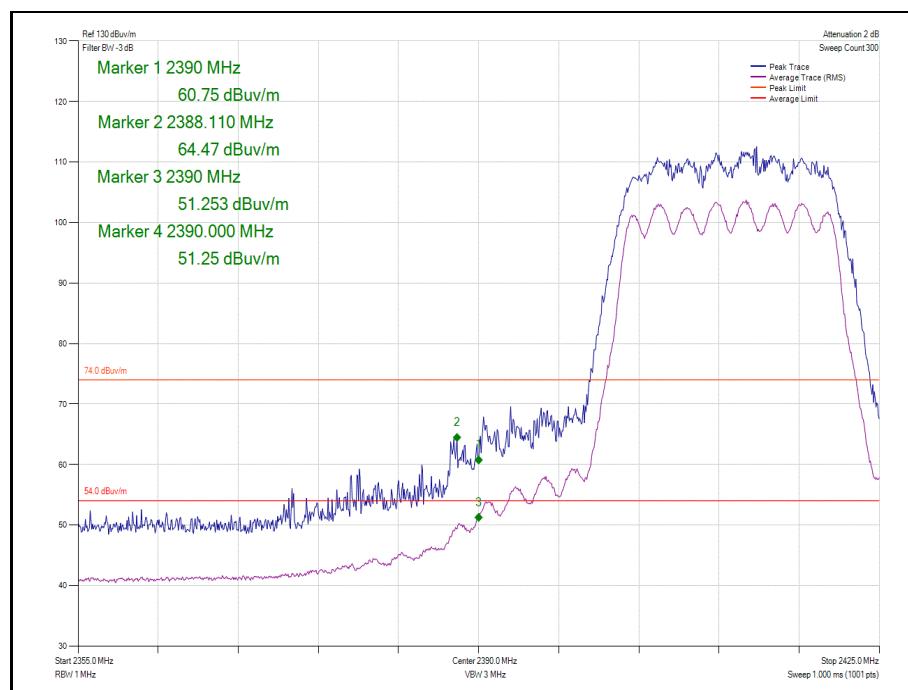


Figure 100 - 2412 MHz - Measured Frequency 2390.0 MHz

(MIMO 2Tx)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dB μ V/m)	Average Level (dB μ V/m)
802.11n	MCS0	2467	2483.5	63.84	49.40
802.11n	MCS0	2472	2483.5	66.76	51.27

Table 52

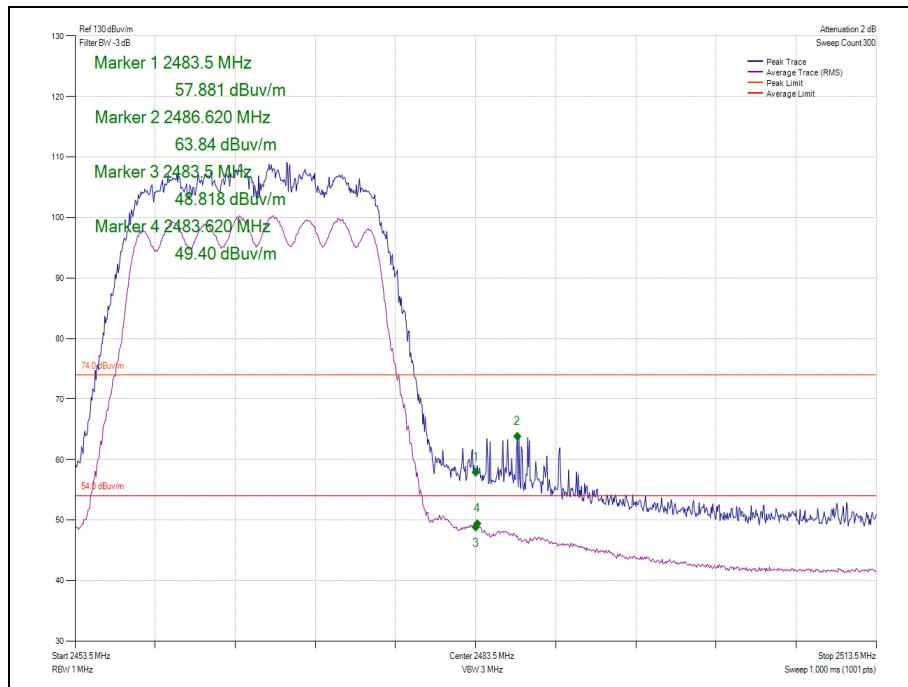


Figure 101 - 2467 MHz - Measured Frequency 2483.5 MHz

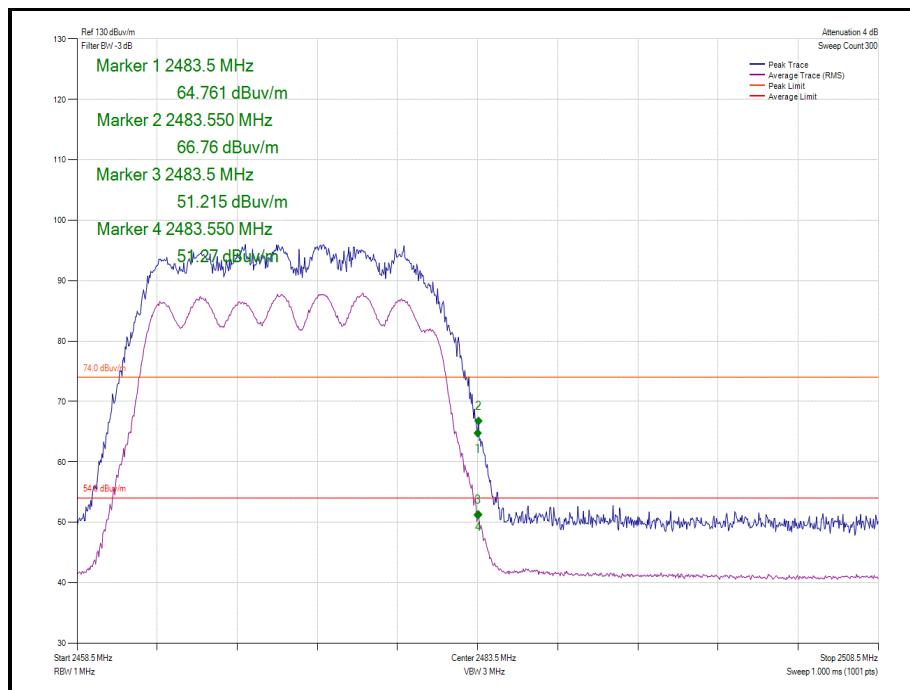


Figure 102 - 2472 MHz - Measured Frequency 2483.5 MHz

FCC 47 CFR Part 15, Limit Clause 15.209

Frequency (MHz)	Field Strength (μ V/m at 3 m)
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

Table 53

Industry Canada RSS-GEN, Limit Clause 8.9

Frequency (MHz)	Field Strength (μ V/m at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960*	500

Table 54

*Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

2.5.8 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Hygrometer	Rotronic	HP21	4989	12	26-April-2019
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	12-Feb-2019
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Tilt Antenna Mast	Maturo GmbH	TAM 4.0-P	4811	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Nov-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	09-Oct-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Cable	Rosenberger	LU7-071-1000	5104	6	05-Oct-2019
Cable	Rosenberger	LU7-071-2000	4528	-	O/P Mon
Cable	Rosenberger	2303-0 9.0m PNm PNm	4827	12	04-Jan-2019
EMI Receiver	Keysight Technologies	N9038A MXE	4628	12	04-July-2019

Table 55

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment

2.6 Spurious Radiated Emissions

2.6.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d) & 15.205
Industry Canada RSS-247 Clause 5.5
Industry Canada RSS-GEN Clause 6.13

2.6.2 Equipment Under Test and Modification State

A1932, S/N: C02X5003L3J0 - Modification State 0
A1932, S/N: C02X5004L3FP - Modification State 0

2.6.3 Date of Test

09-September-2018 to 05-October 2018

2.6.4 Test Method

Testing was performed in accordance with ANSI C63.10 clause 6.3, 6.5 and 6.6.

In the 30MHz to 1GHz range pre scans were only performed on mid channel (2441 MHz) and any emissions identified then measured on bottom (2402 MHz) and top (2480 MHz).

The plots shown are the characterization of the EUT. The limits on the plots represent the most stringent case for restricted bands, (54/74 dB μ V/m @ 3m and 64/84 dB μ V/m @ 1m) when compared to 20 dBc outside restricted bands. The limits shown have been used as a threshold to determine where further measurements are necessary. Where results are within 10 dB of the limits shown on the plots, further investigation was carried out and reported in results tables.

The following conversion can be applied to convert from dB μ V/m to μ V/m:
 $10^{\frac{1}{2}}(\text{Field Strength in dB}\mu\text{V/m}/20)$.

2.6.5 Reported Measurements

Spurious Radiated Emissions measurements were performed, with the device operating in MIMO 2TX during tests on the Main Radio, as this was defined as worst case.

The measurements displayed within this report, have been limited to the mode which was shown to be worst case.

Further measurements are held on file by TÜV SÜD, and are available if required

Pre-scans were performed on two separate samples, C02X5003L3J0 and C02X5004L3FP.

The plots shown with this report are limited to C02X5003L3J0, however any final emissions identified were performed on both samples and are detailed in table 50 to 53 below.

2.6.6 Environmental Conditions

Ambient Temperature 20 - 23.6 °C
Relative Humidity 36.3 - 60.2 %

2.6.7 Test Results

MIMO 2Tx, 802.11b

Frequency (GHz)	Result (dB μ V/m)		Limit (dB μ V/m)		Margin (dB)	
	Peak	Average	Peak	Average	Peak	Average
4.824	-	49.81	74.0	54.0	-	4.19

Table 56 – 2412 MHz - 1 GHz to 26 GHz – Radiated

No other emissions were detected within 10 dB of the limit

Frequency (MHz)	QP Level (dB μ V/m)	QP Limit (dB μ V/m)	QP Margin (dB)	Angle(Deg)	Height(m)	Polarity
*						

Table 57 – 2442 MHz - 30 MHz to 1 GHz – Radiated

*No emissions were detected within 10 dB of the limit

Frequency (GHz)	Result (dB μ V/m)		Limit (dB μ V/m)		Margin (dB)	
	Peak	Average	Peak	Average	Peak	Average
4.883	-	50.04	74.0	54.0	-	3.96

Table 58 – 2442 MHz – 1 GHz to 26 GHz – Radiated

No other emissions were detected within 10 dB of the limit

Frequency (GHz)	Result (dB μ V/m)		Limit (dB μ V/m)		Margin (dB)	
	Peak	Average	Peak	Average	Peak	Average
4.943	-	46.71	74.0	54.0	-	7.29

Table 59 - 2472 MHz - 1 GHz to 26 GHz – Radiated

No other emissions were detected within 10 dB of the limit

MIMO 2Tx, 802.11b

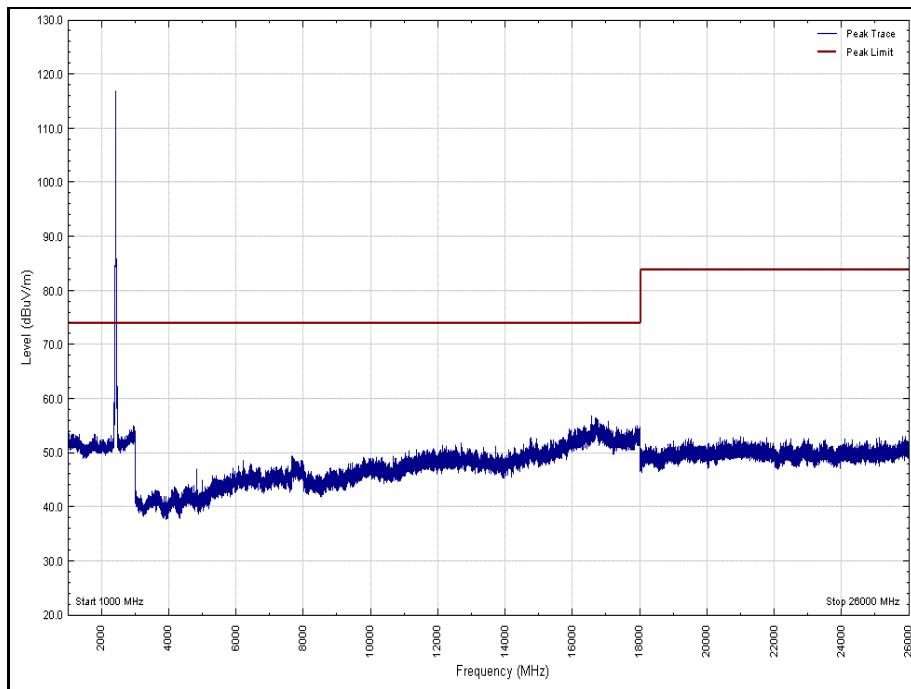


Figure 103 - 2412 MHz - 1 GHz to 26 GHz (Peak)
Polarity: Horizontal

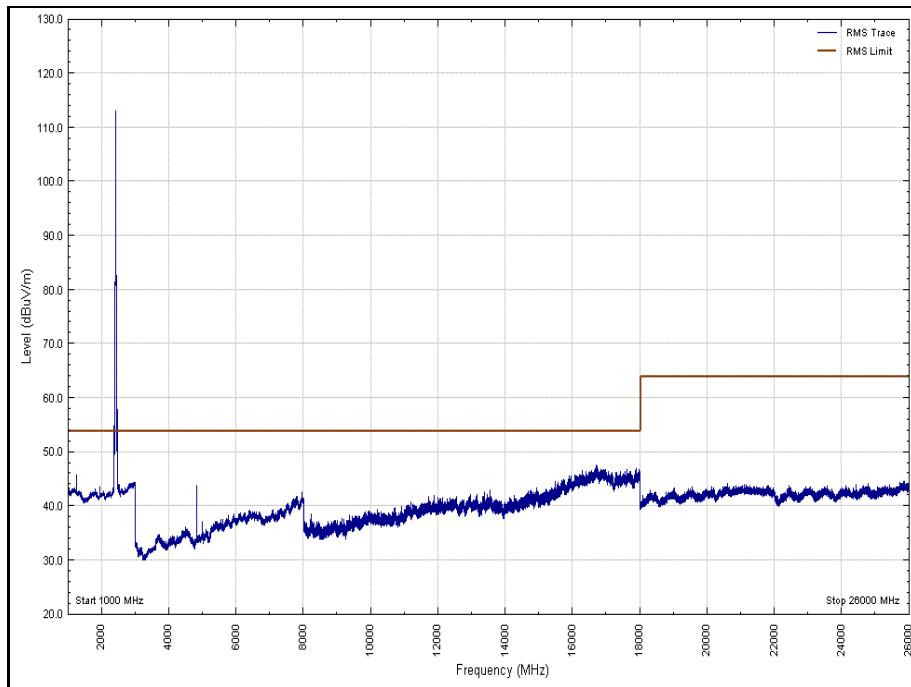


Figure 104 - 2412 MHz - 1 GHz to 26 GHz (Average)
Polarity: Horizontal

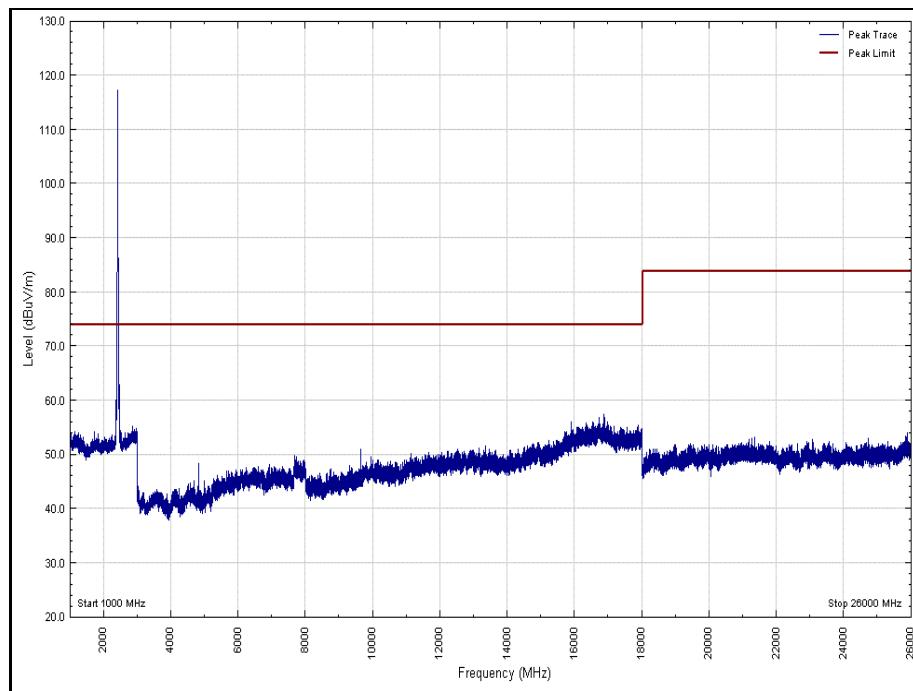


Figure 105 - 2412 MHz - 1 GHz to 26 GHz (Peak)
Polarity: Vertical

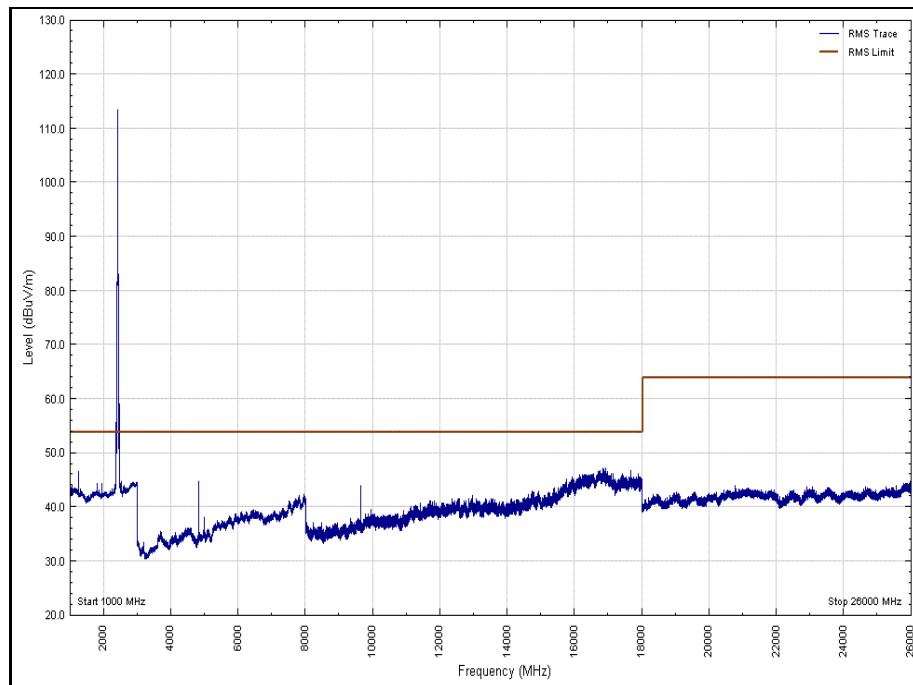
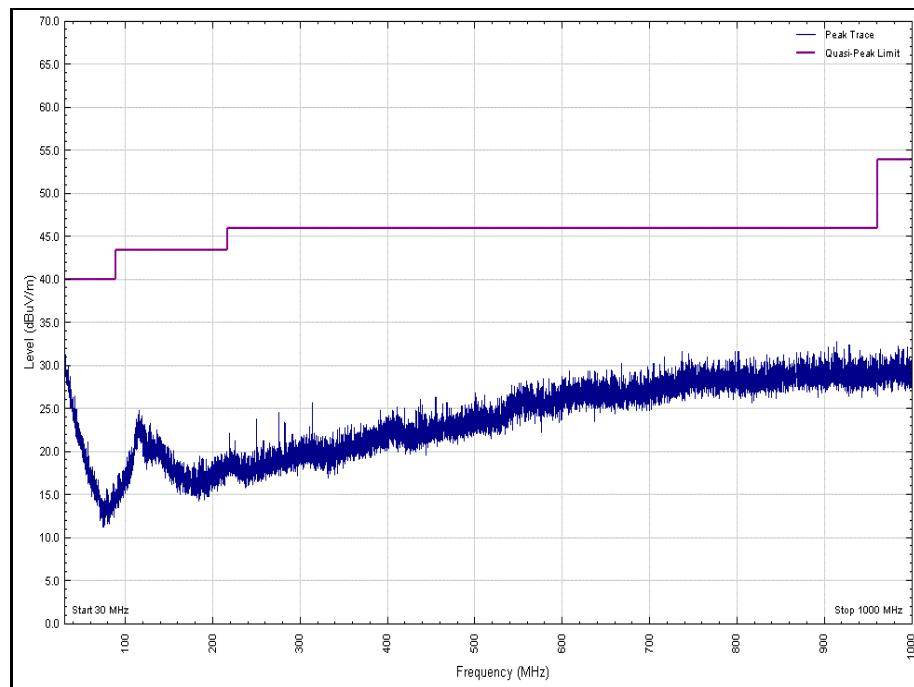
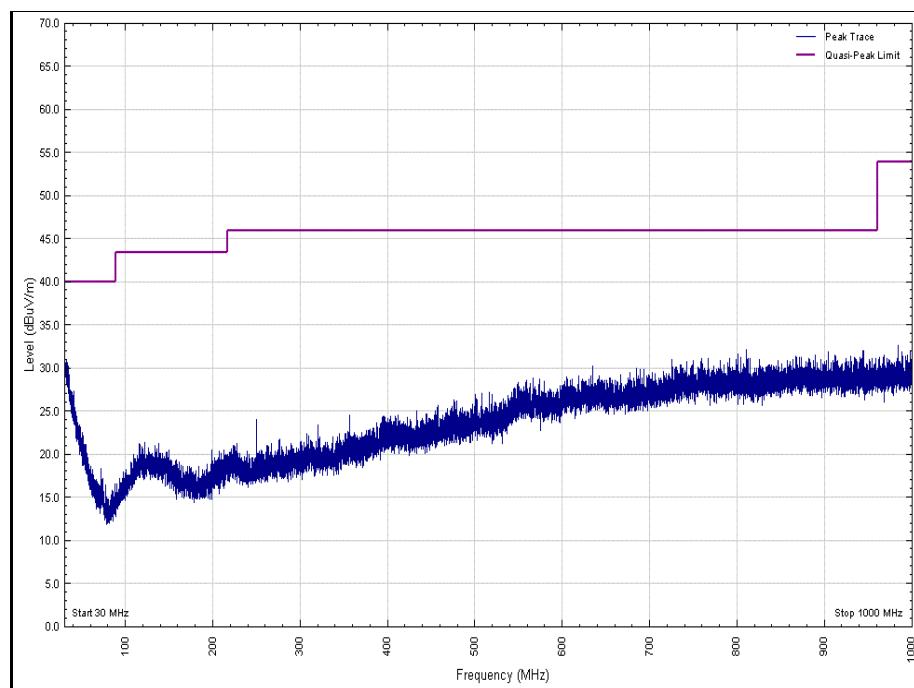


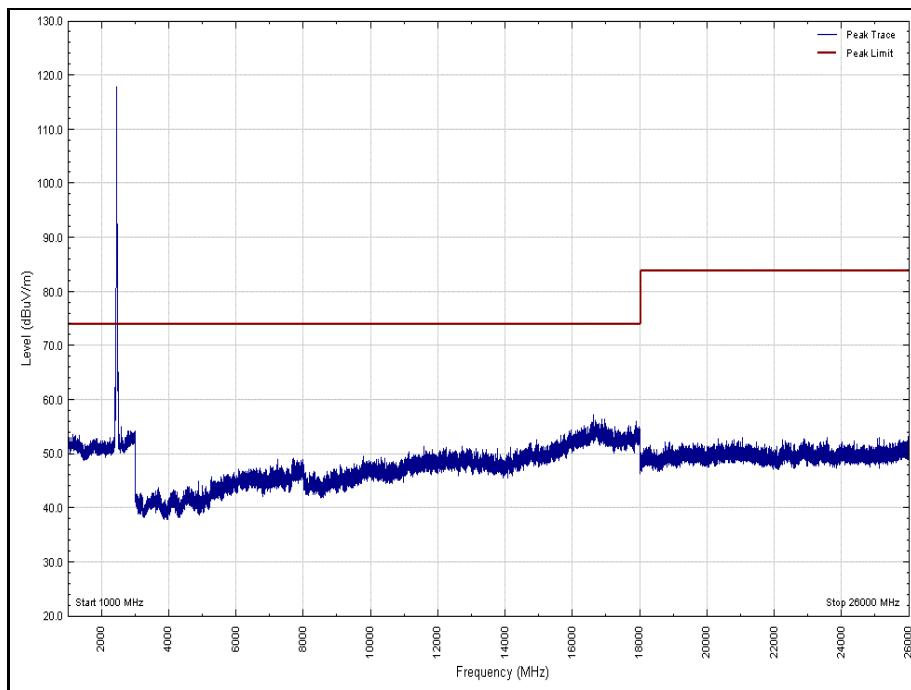
Figure 106 - 2412 MHz - 1 GHz to 26 GHz (Average)
Polarity: Vertical



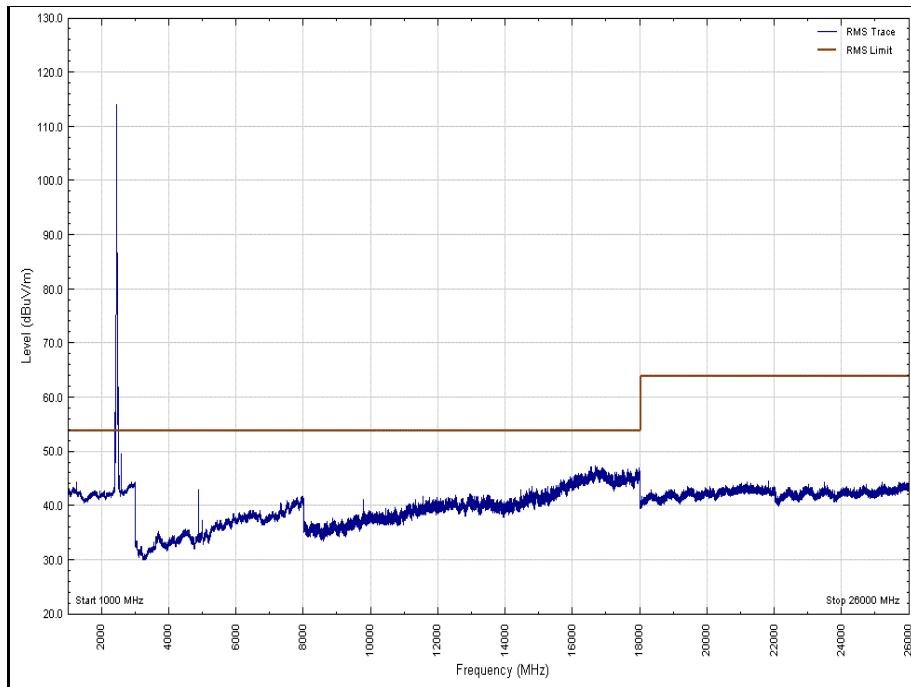
**Figure 107 - 2442 MHz - 30 MHz to 1 GHz
Polarity: Horizontal**



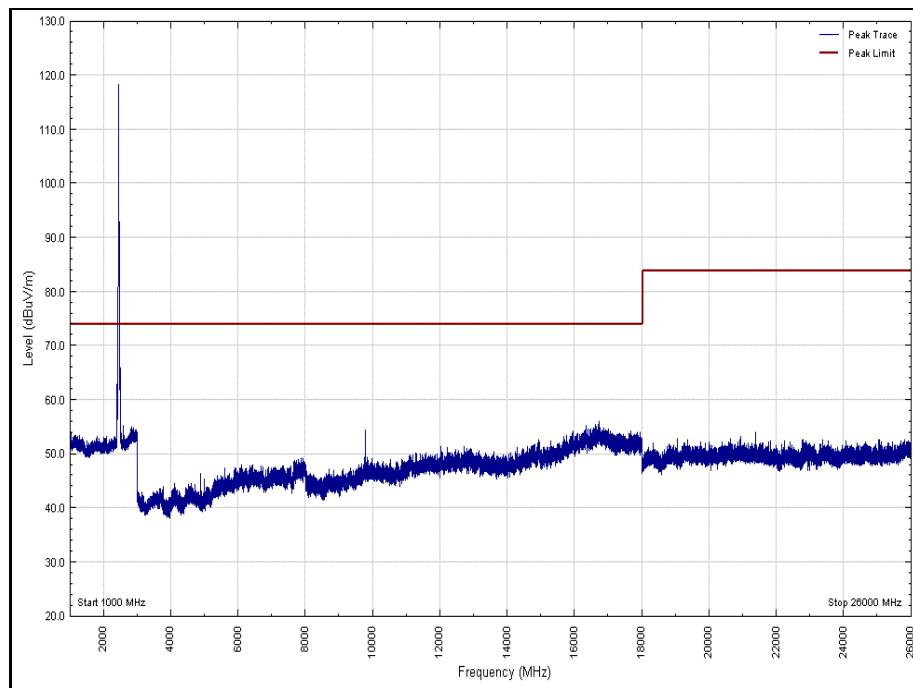
**Figure 108 - 2442 MHz - 30 MHz to 1 GHz
Polarity: Vertical**



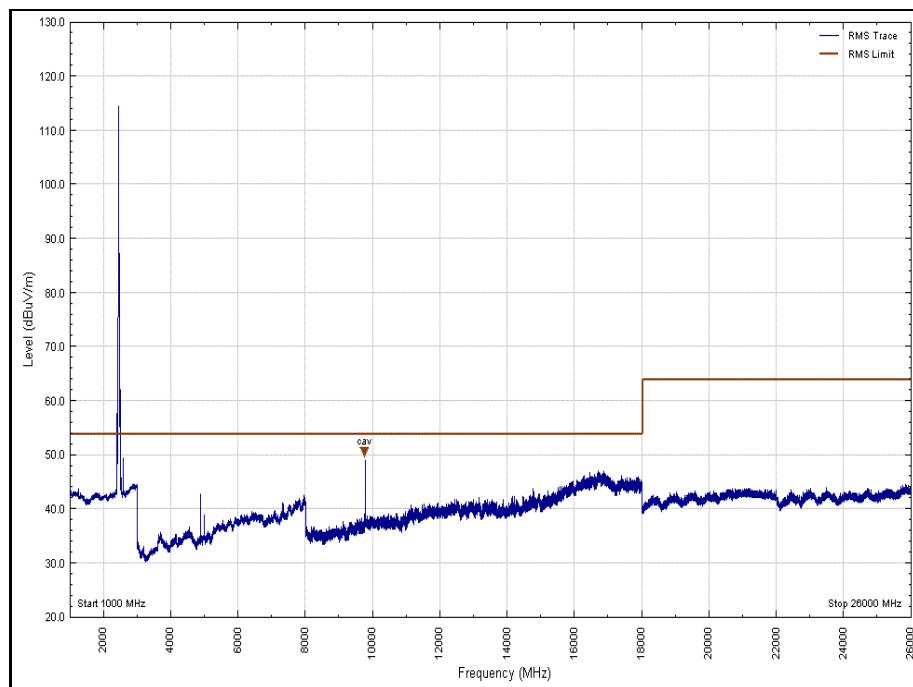
**Figure 109 - 2442 MHz - 1 GHz to 26 GHz
Polarity: Horizontal (Peak)**



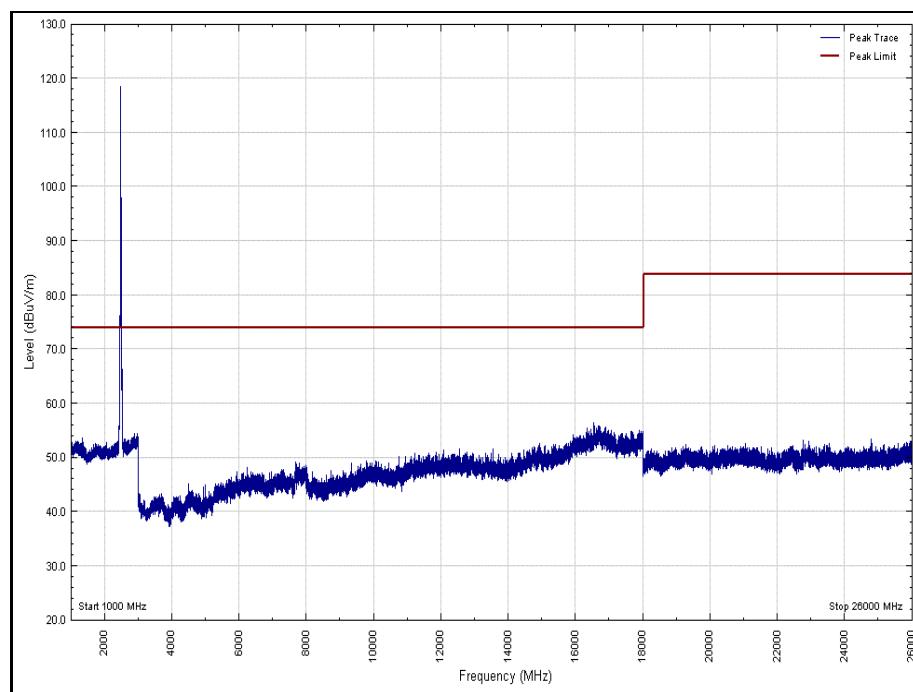
**Figure 110 - 2442 MHz - 1 GHz to 26 GHz
Polarity: Horizontal (Average)**



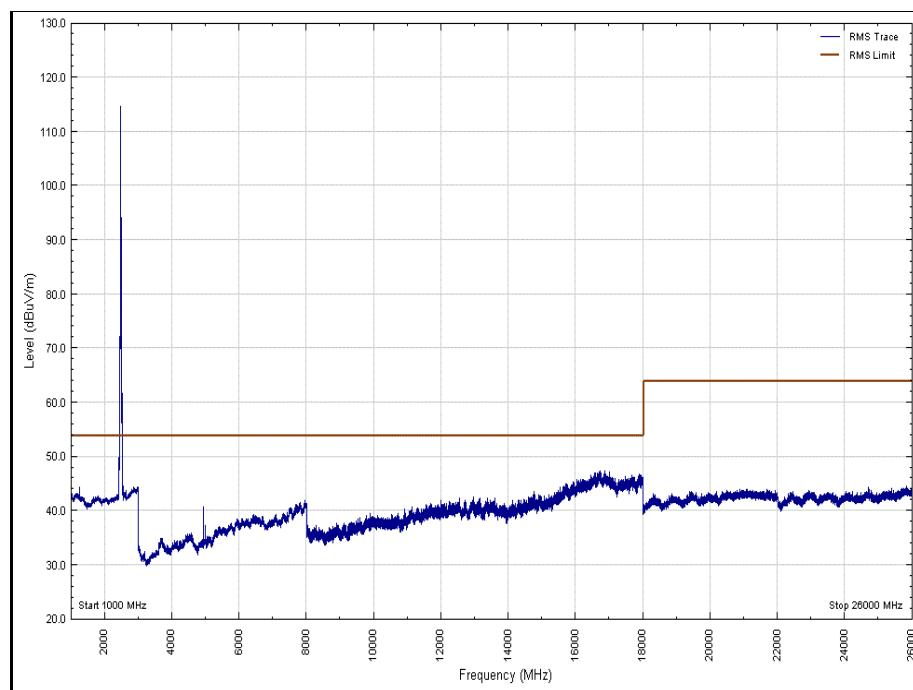
**Figure 111 - 2442 MHz - 1 GHz to 26 GHz
Polarity: Vertical (Peak)**



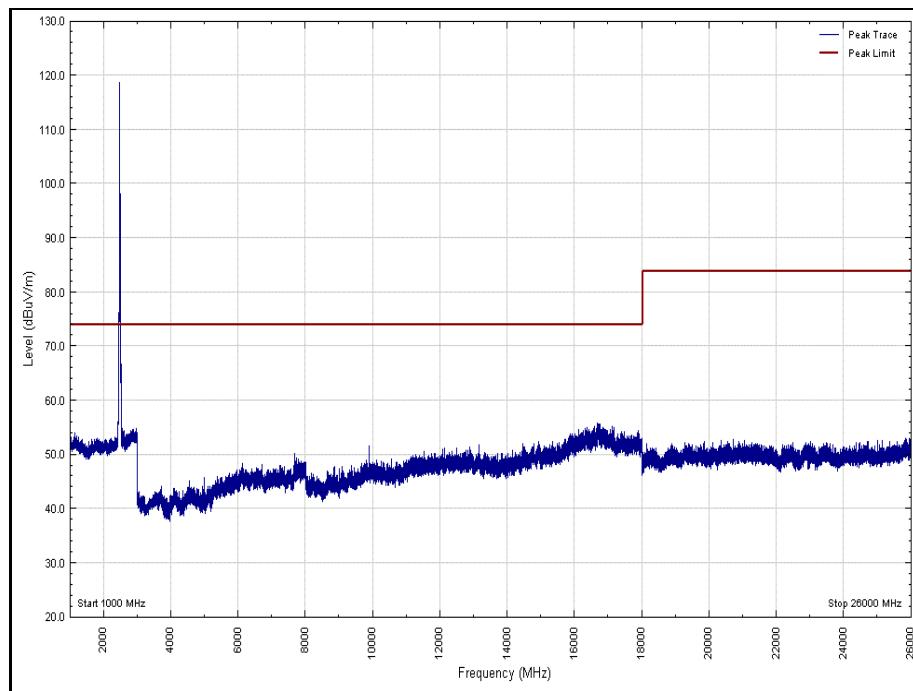
**Figure 112 - 2442 MHz - 1 GHz to 26 GHz
Polarity: Vertical (Average)**



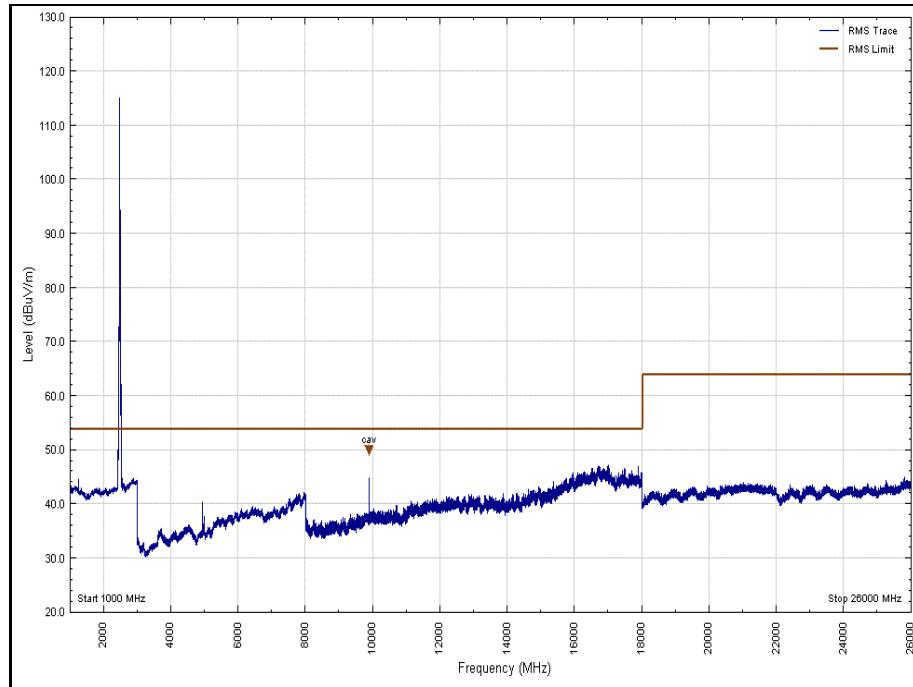
**Figure 113 - 2472 MHz 1 GHz to 26 GHz
Polarity: Horizontal (Peak)**



**Figure 114 - 2472 MHz - 1 GHz to 26 GHz
Polarity: Horizontal (Average)**



**Figure 115 - 2472 MHz 1 GHz to 26 GHz
Polarity: Vertical (Peak)**



**Figure 116 - 2472 MHz - 1 GHz to 26 GHz
Polarity: Vertical (Average)**

FCC 47 CFR Part 15, Limit Clause 15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in 15.209(a)

Industry Canada RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

2.6.8 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	White Gold	WG022	190	12	24-Nov-2018
Pre-Amplifier	Agilent	8494B	-	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	26-April-2019
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	12-Feb-2019
Antenna (Bilog)	Schaffner	CBL6143	287	24	15-May-2020
Dual Power Supply Unit	Thurlby	PL320	288	-	TU
Filter (High Pass)	Lorch	SHP7-7000-SR	566	12	10-May-2019
Pre-Amplifier	Phase One	PS04-0086	1533	12	12-Jan-2019
18GHz - 40GHz Pre-Amplifier	Phase One	PS04-0087	1534	12	02-Feb-2019
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Antenna (Bilog)	Chase	CBL6143	2904	24	08-Aug-2019
Cable (N-N, 8m)	Rhophase	NPS-2302-8000-NPS	3248	-	O/P Mon
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Nov-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	09-Oct-2018
1501A 4.0M Km Km Cable	Rhophase	KPS-1501A-4000-KPS	4301	12	19-Feb-2019
1GHz to 8GHz Low Noise Amplifier	Wright Technologies	APS04-0085	4365	12	18-Oct-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Cable	Rosenberger	LU7-071-1000	5104	12	05-Oct-2019
Cable	Rosenberger	LU7-071-2000	4528	-	O/P Mon
Cable	Rosenberger	2303-0 9.0m PNm PNm	4827	12	04-Jan-2019
EMI Receiver	Keysight Technologies	N9038A MXE	4628	12	04-July-2019
Double Ridged Waveguide Horn Antenna	ETS-Lindgren	3117	4722	12	01-Mar-2019

Mast Controller	Maturo GmbH	NCD	4810	-	TU
Tilt Antenna Mast	Maturo GmbH	TAM 4.0-P	4811	-	TU
Hygrometer	Rotronic	HP21	4989	12	26-Apr-2019
Cable (26.5GHz	Rosenberger	LU7-133-5000	5019	-	O/P Mon
Cable (40GHz	Rosenberger	LU1-001-2000	5020	-	O/P Mon

Table 60

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment

3 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Test Name	Measurement Uncertainty
Maximum Conducted Output Power	± 3.2 dB
Power Spectral Density	± 3.2 dB
Emission Bandwidth	± 358.561 kHz
Authorised Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Restricted Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Spurious Radiated Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB

Table 61