

Report on the FCC and IC Testing of: Apple Inc, Model: A2141

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

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

FCC ID: BCGA2141

IC: 579C-A2141

COMMERCIAL-IN-CONFIDENCE

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SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Simon Bennett	Manager (Innovation & Service Dev)	Authorised Signatory	24 October 2019

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD 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 ISED RSS-247 and ISED RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	TESTING
Testing	Phillip Harrison	24 October 2019	
Testing	Malik Mohammad	24 October 2019	
Testing	Cristian Onaca	24 October 2019	
Testing	Faisal Malyar	24 October 2019	
Testing	Ahmad Javid	24 October 2019	
Testing	Jay Balendrarajah	24 October 2019	

FCC Accreditation

90987 Octagon House, Fareham Test Laboratory

Industry Canada Accreditation

IC12669A 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: 2018, ISED RSS-247: Issue 2 (2017-02) and ISED RSS-GEN: Issue 5 A1 (2019-03) for the tests detailed in section 1.3.



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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	24 October 2019

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2141
Serial Number(s)	C02YT00GL51N & C02YT007L513
Hardware Version(s)	Rev1.0
Software Version(s)	19A497 and 19A507
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2018 ISED RSS-247: Issue 2 (2017-02) ISED RSS-GEN: Issue 5 A1 (2019-03)
Start of Test	28 June 2019
Finish of Test	26 September 2019
Name of Engineer(s)	Malik Mohammad, Cristian Onaca, Jay Balendrarajah, Ahmad Javid, Faisal Malyar, Philip 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, ISED RSS-247 and ISED 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) and 15.205	5.5	6.13	Spurious Radiated Emissions	Pass	ANSI C63.10

Table 2

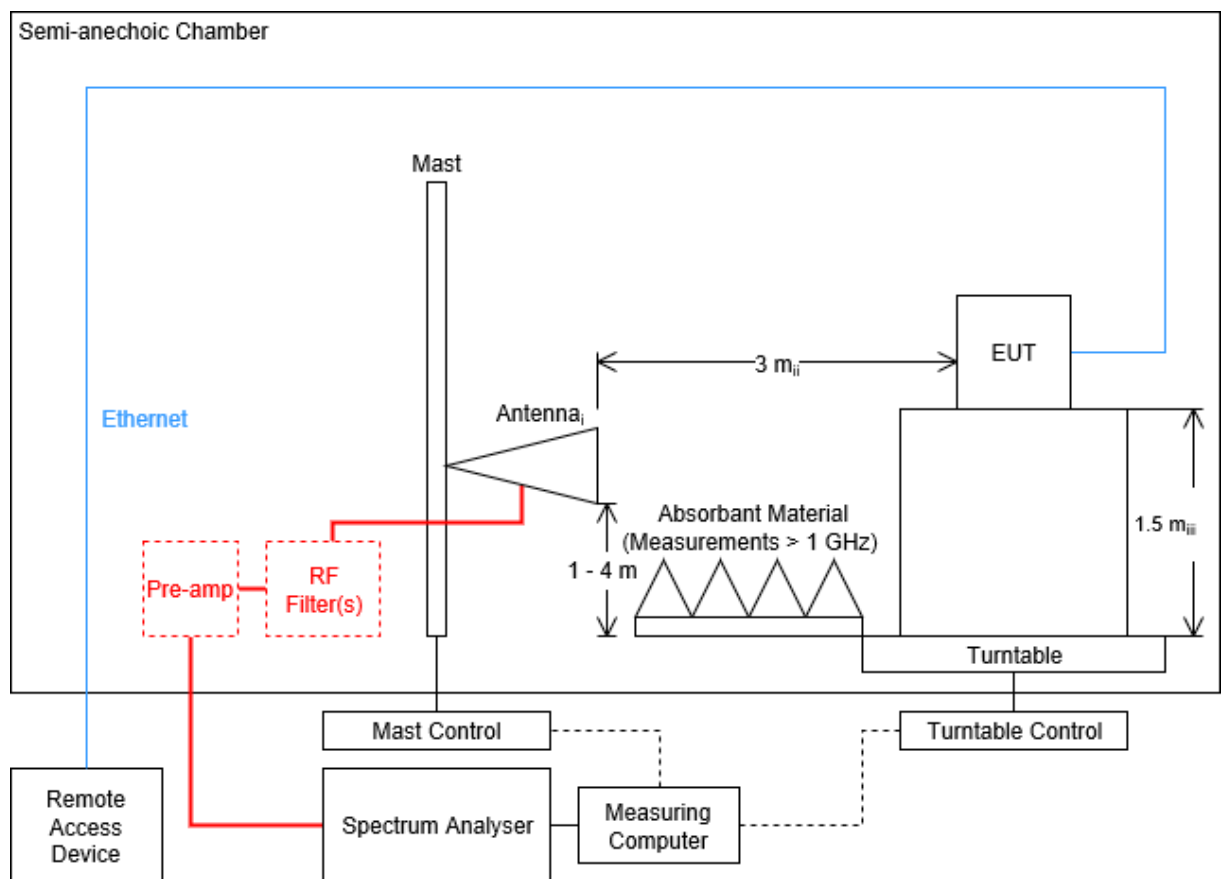
1.4 Product Information

1.4.1 Technical Description

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

The EUT featured an IEEE 802.11 main WLAN radio with up to 3x3 MIMO operation (cores 0, 1 & 2), a Bluetooth radio (sharing the 2nd antenna with main core 1), and an Auxiliary IEEE 802.11 SISO radio (sharing the 3rd antenna with main core 2).

1.4.2 Radiated Test Setup Diagram(s)



- i Antenna is boresighted for measurements > 1 GHz.
- ii Distance from antenna to EUT is 1 m for measurements > 18 GHz.
- iii Height of EUT above the ground plane is 0.8 m for measurements < 1 GHz.

Figure 1 – Radiated Emissions Setup Diagram



1.4.3 EUT Configuration and Rationale for Radiated Spurious Emissions

The EUT was powered and charging from 120V, 60Hz via its USB type C power adaptor.

The spare USB type C port on the device, was connected (via a Belkin F2CU040 USB-C to Ethernet adapter) to another Laptop computer located outside the test chamber which was used to remotely control the unit.

A set of wired Ear Pods were connected to the EUT

1.4.4 Test Modes

The EUT's main radio supports SISO, 2x2 MIMO and 3x3 MIMO. The Auxiliary radio supports only SISO modes. Main and Aux radios are limited to transmitting only one-at-a-time in the 2.4 GHz band (the other only operating simultaneously in the 5 GHz bands). Hence no conformity tests apply for both radios simultaneously transmitting in the 2.4 GHz band. Both radios support 802.11b, g and n modes with a 20 MHz channel bandwidth.

The EUT uses different output powers per core dependent on how many cores are used. The EUT also uses different power tables for Cyclic Delay Diversity (CDD), Space Division Multiplexing (SDM), and transmit beamforming (TxBF) modes. It uses the same conducted power across all cores in any given mode, but due to the different antenna gains the radiated powers per core differs.

After preliminary investigations were performed, the EUT was therefore tested in the following worst-case modes:

- Main SISO Modes (Core 0):
 - 802.11b
 - 802.11g
 - 802.11n HT20
- Main 2x2 MIMO Modes (Cores 0+2):
 - 802.11b – CDD
 - 802.11g – CDD
 - 802.11n HT20 – CDD, SDM and TxBF
- Main 3x3 MIMO Modes (Cores 0+1+2):
 - 802.11b – CDD
 - 802.11g – CDD
 - 802.11n HT20 – CDD, SDM and TxBF
- AUX Modes (SISO only on Core 0):
 - 802.11b
 - 802.11g
 - 802.11n HT20



1.4.5 Antenna Gain Table

Core 0

Frequency (MHz)	Peak Gain (dBi)	Conducted Cable Loss (dB)
2400 - 2480	2.4	1.0

Table 3

Core 1

Frequency (MHz)	Peak Gain (dBi)	Conducted Cable Loss (dB)
2400 - 2480	1.4	1.0

Table 4

Core 2 / Aux

Frequency (MHz)	Peak Gain (dBi)	Conducted Cable Loss (dB)
2400 - 2480	1.5	1.0

Table 5



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: C02YT00GL51N			
0	As supplied by the customer	Not Applicable	Not Applicable
Serial Number: C02YT007L513			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 6

1.7 Test Location

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

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: 802.11 b/g/n/ac		
Maximum Conducted Output Power	Philip Harrison	UKAS
Power Spectral Density	Philip Harrison	UKAS
Emission Bandwidth	Philip Harrison	UKAS
Authorised Band Edges	Malik Mohammad, Cristian Onaca, Jay Balendrarajah, Ahmad Javid, Faisal Malyar	UKAS
Restricted Band Edges	Malik Mohammad, Cristian Onaca, Jay Balendrarajah, Ahmad Javid, Faisal Malyar	UKAS
Spurious Radiated Emissions	Malik Mohammad, Cristian Onaca, Jay Balendrarajah, Ahmad Javid, Faisal Malyar	UKAS

Table 7

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)
ISED RSS-247, Clause 5.4
ISED RSS-GEN, Clause 6.12

2.1.2 Equipment Under Test and Modification State

A2141, S/N: C02YT007L513 - Modification State 0

2.1.3 Date of Test

15 August 2019 to 26 September 2019

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 output power was verified as being the same from each transmit core, but the antenna gains were not identical, therefore the modes reported 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:

- For the CDD results the Directional Gain was calculated in accordance with clause F)2)f)(ii) using the calculations from F)2)f)(i) with worst-case individual gain and an array gain of zero.
- For SDM modes Directional Gain was calculated in accordance with clause F)2)d)(ii).
- For transmit beamforming (TxBF) mode it was calculated in accordance with clause F)2)d)(i).

2.1.5 Environmental Conditions

Ambient Temperature	19 - 26°C
Relative Humidity	39 - 67%



2.1.6 Test Results

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Antenna Directional Gain (dBi)	2.40	2.40	2.40
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)	16.85	16.77	13.72
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	19.25	19.17	16.12

Table 8 - 802.11b / 1 Mbps / SISO / Core 0

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Conducted Power Core 0 (dBm)	16.72	16.88	11.89
Conducted Power Core 2 (dBm)	16.79	16.69	11.93
Antenna Directional Gain (dBi)	2.40	2.40	2.40
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)	19.76	19.79	14.92
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	22.16	22.19	17.32

Table 9 - 802.11b / 1 Mbps / MIMO CDD / Cores 0+2

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Conducted Power Core 0 (dBm)	16.73	16.76	11.34
Conducted Power Core 1 (dBm)	16.70	16.85	11.39
Conducted Power Core 2 (dBm)	16.68	16.81	11.45
Antenna Directional Gain (dBi)	2.40	2.40	2.40
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)	21.48	21.58	16.17
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	23.88	23.98	18.57

Table 10 - 802.11b / 1 Mbps / MIMO CDD / Cores 0+1+2



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Antenna Directional Gain (dBi)	1.50	1.50	1.50
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)	16.71	16.85	14.66
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	18.21	18.35	16.16

Table 11 - 802.11b / 1 Mbps / Aux Core

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Antenna Directional Gain (dBi)	2.40	2.40	2.40
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)	16.80	16.67	3.74
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	19.20	19.07	6.14

Table 12 - 802.11g / 6 Mbps / SISO / Core 0

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Conducted Power Core 0 (dBm)	14.80	16.88	3.73
Conducted Power Core 2 (dBm)	14.75	16.67	3.99
Antenna Directional Gain (dBi)	2.40	2.40	2.40
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)	17.78	19.79	6.87
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	20.18	22.19	9.27

Table 13 - 802.11g / 6 Mbps / MIMO CDD / Cores 0+2



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Conducted Power Core 0 (dBm)	13.70	16.80	11.47
Conducted Power Core 1 (dBm)	13.75	16.78	11.37
Conducted Power Core 2 (dBm)	13.92	16.93	11.27
Antenna Directional Gain (dBi)	2.40	2.40	2.40
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)	18.56	21.61	16.14
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	20.96	24.01	18.54

Table 14 - 802.11g / 6 Mbps / MIMO CDD / Cores 0+1+2

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Antenna Directional Gain (dBi)	1.50	1.50	1.50
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)	14.94	16.89	5.19
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	16.44	18.39	6.69

Table 15 - 802.11g / 6 Mbps / Aux Core

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Antenna Directional Gain (dBi)	2.40	2.40	2.40
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)	16.86	16.92	3.98
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	19.26	19.31	6.38

Table 16 - 802.11n / HT20 MCS0 / SISO / Core 0



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Conducted Power Core 0 (dBm)	14.98	16.75	3.77
Conducted Power Core 2 (dBm)	14.94	16.68	3.79
Antenna Directional Gain (dBi)	2.40	2.40	2.40
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)	17.97	19.73	6.79
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	20.37	22.13	9.19

Table 17 - 802.11n / HT20 MCS0 / MIMO CDD / Cores 0+2

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Conducted Power Core 0 (dBm)	14.78	16.74	3.85
Conducted Power Core 2 (dBm)	14.96	16.85	3.91
Antenna Directional Gain (dBi)	1.97	1.97	1.97
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)	17.88	19.81	6.89
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	19.85	21.78	8.87

Table 18 - 802.11n / HT20 MCS8 / MIMO SDM / Cores 0+2

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Conducted Power Core 0 (dBm)	14.39	16.81	2.94
Conducted Power Core 2 (dBm)	14.44	16.96	2.06
Antenna Directional Gain (dBi)	4.97	4.97	4.97
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)	17.43	19.90	5.53
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	22.40	24.87	10.51

Table 19 - 802.11n / HT20 MCS0 / MIMO TxBF / Cores 0+2



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Conducted Power Core 0 (dBm)	13.84	17.02	2.83
Conducted Power Core 1 (dBm)	13.80	16.90	2.99
Conducted Power Core 2 (dBm)	13.98	16.90	2.75
Antenna Directional Gain (dBi)	2.40	2.40	2.40
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)	18.65	21.71	7.63
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	21.05	24.11	10.03

Table 20 - 802.11n / HT20 MCS0 / MIMO CDD / Cores 0+1+2

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Conducted Power Core 0 (dBm)	13.66	16.79	3.91
Conducted Power Core 1 (dBm)	13.82	16.78	3.96
Conducted Power Core 2 (dBm)	13.88	16.97	4.05
Antenna Directional Gain (dBi)	1.79	1.79	1.79
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)	18.56	21.62	8.75
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	20.35	23.41	10.54

Table 21 - 802.11n / HT20 MCS16 / MIMO SDM / Cores 0+1+2



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Conducted Power Core 0 (dBm)	13.85	18.99	4.47
Conducted Power Core 1 (dBm)	13.81	16.70	4.56
Conducted Power Core 2 (dBm)	13.73	16.85	4.89
Antenna Directional Gain (dBi)	6.55	6.55	6.55
15.407 Conducted Power Limit (dBm)	29.45	29.45	29.45
RSS-247 Conducted Power Limit (dBm)	30.00	30.00	30.00
Total Conducted Power (dBm)	18.57	22.41	9.41
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	25.12	28.96	15.96

Table 22 - 802.11n / HT20 MCS0 / MIMO TxBF / Cores 0+1+2

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Antenna Directional Gain (dBi)	1.50	1.50	1.50
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)	14.76	16.84	5.02
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	16.26	18.34	6.52

Table 23 - 802.11n / HT20 MCS0 / Aux Core

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.

ISED 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.

The antenna directional gain was calculated in accordance with KDB 662911 D01 and is given in the result table above. For TxBF correlated output mode the directional gain was calculated in accordance with clause F)2)d)(i). Since the directional gain exceeds 6 dBi for this mode the 15.247 conducted output power limit is reduced in accordance with 15.247(b)(4). The RSS-247 conducted limit is not adjusted but the EIRP limit yields a smaller margin so is also given in the table above for this mode.



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
Hygropalm Temperature and Humidity Meter	Rotronic	HP21	4410	12	13-Jun-2020
Hygrometer	Rotronic	I-1000	2891	12	02-Oct-2020
True RMS Multimeter	Fluke	179	4007	12	30-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
USB Power Sensor	Boonton	RTP5006	5184	12	12-Dec-2019
AC Programmable PSU	iTech	IT7324	5227	-	O/P Mon
Power Splitter, 4 way	Mini-Circuits	ZN4PD1-63-S+	5235	-	O/P Mon
Power Splitter, 4 way	Mini-Circuits	ZN4PD1-63-S+	5236	-	O/P Mon
Power Splitter, 2 way	Mini-Circuits	ZN2PD2-63-S+	5238	-	O/P Mon
Power splitter, 2 port	Mini-Circuits	ZN2PD-63-S+	4742	-	O/P Mon
Attenuator 10dB 2W	Telegartner	J01156A0031	N/A	-	O/P Mon
Attenuator 10dB 2W	Telegartner	J01156A0031	N/A	-	O/P Mon
Attenuator 10dB 2W	Telegartner	J01156A0031	N/A	-	O/P Mon
Attenuator 10dB 2W	Telegartner	J01156A0031	N/A	-	O/P Mon

Table 24

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)
ISED RSS-247, Clause 5.2
ISED RSS-GEN, Clause 6.12

2.2.2 Equipment Under Test and Modification State

A2141, S/N: C02YT007L513 - Modification State 0

2.2.3 Date of Test

15 August 2019 to 26 September 2019

2.2.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.10.3 (AVG PSD-1), 11.10.5 (AVG PSD-2) or 11.10.7 (AVG PSD-3).

Where the EUT duty cycle was < 98 % and repeatable within 2%, the spectrum analyser was set to trace (power) averaging and a duty cycle correction was added as calculated in the result tables below (Method AVG PSD-2). Where the duty cycle was ≥ 98 % the spectrum analyser was set to trace (power) averaging and no duty cycle correction made (Method AVG PSD-1). In all other cases the spectrum analyser trace was set to max hold (Method AVG PSD-3).

The output power was verified as being the same from each transmit core (within negligible tolerances), 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:

- For the CDD results the Directional Gain was calculated in accordance with the equation given in clause F)2)f)(ii) summed for a single spatial stream.
- For SDM modes Directional Gain was calculated in accordance with clause F)2)d)(ii).
- For transmit beamforming (TxBF) mode it was calculated in accordance with clause F)2)d)(i).

2.2.5 Environmental Conditions

Ambient Temperature	19 – 26 °C
Relative Humidity	39 – 67 %



2.2.6 Test Results

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Raw Conducted PSD (dBm/30kHz)	-4.37	-4.67	-7.87
Duty Cycle Correction (dB)	N/A SA-1	N/A SA-1	N/A SA-1
15.247 Conducted PSD Limit (dBm/30kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/30kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-4.37	-4.67	-7.87

Table 25 - 802.11b / 1 Mbps / SISO / Core 0

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Conducted PSD Core 0 (dBm/30kHz)	-4.62	-4.51	-9.45
Conducted PSD Core 2 (dBm/30kHz)	-4.76	-4.79	-9.51
Duty Cycle Correction (dB)	N/A SA-1	N/A SA-1	N/A SA-1
15.247 Conducted PSD Limit (dBm/30kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/30kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	-1.68	-1.64	-6.47

Table 26 - 802.11b / 1 Mbps / MIMO CDD / Cores 0+2

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Conducted PSD Core 0 (dBm/30kHz)	-4.80	-4.75	-9.87
Conducted PSD Core 1 (dBm/30kHz)	-4.73	-4.24	-10.14
Conducted PSD Core 2 (dBm/30kHz)	-4.66	-4.58	-10.32
Duty Cycle Correction (dB)	0.13	N/A SA-1	N/A SA-1
15.247 Conducted PSD Limit (dBm/30kHz)	8.00	8.00	8.00
RSS-247 Conducted PSD Limit (dBm/30kHz)	8.00	8.00	8.00
Conducted PSD Result (dBm/30kHz)	0.17	0.25	-5.34

Table 27 - 802.11b / 1 Mbps / MIMO CDD / Cores 0+1+2



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Raw Conducted PSD (dBm/30kHz)	-4.66	-4.46	-6.99
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)	-4.66	-4.46	-6.99

Table 28 - 802.11b / 1 Mbps / Aux Core

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Raw Conducted PSD (dBm/30kHz)	-5.70	-6.52	-19.28
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)	-5.70	-6.52	-19.28

Table 29 - 802.11g / 6 Mbps / SISO / Core 0

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Conducted PSD Core 0 (dBm/30kHz)	-8.38	-5.84	-18.66
Conducted PSD Core 2 (dBm/30kHz)	-7.83	-5.93	-18.40
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)	-5.09	-2.88	-15.52

Table 30 - 802.11g / 6 Mbps / MIMO CDD / Cores 0+2

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Conducted PSD Core 0 (dBm/30kHz)	-9.01	-6.10	-11.08
Conducted PSD Core 1 (dBm/30kHz)	-8.68	-5.70	-11.70
Conducted PSD Core 2 (dBm/30kHz)	-8.27	-5.25	-11.69
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)	-3.87	-0.90	-6.71

Table 31 - 802.11g / 6 Mbps / MIMO CDD / Cores 0+1+2



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Raw Conducted PSD (dBm/30kHz)	-9.05	-6.72	-19.89
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)	-9.05	-6.72	-19.89

Table 32 - 802.11g / 6 Mbps / Aux Core

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Raw Conducted PSD (dBm/30kHz)	-6.38	-5.60	-18.86
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)	-6.38	-5.60	-18.86

Table 33 - 802.11n / HT20 MCS0 / SISO / Core 0

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Conducted PSD Core 0 (dBm/30kHz)	-8.43	-6.12	-19.47
Conducted PSD Core 2 (dBm/30kHz)	-8.10	-6.77	-19.73
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)	-5.25	-3.42	-16.59

Table 34 - 802.11n / HT20 MCS0 / MIMO CDD / Cores 0+2

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Conducted PSD Core 0 (dBm/30kHz)	-8.29	-6.40	-19.05
Conducted PSD Core 2 (dBm/30kHz)	-8.07	-5.74	-19.26
Duty Cycle Correction (dB)	0.10	0.10	0.10
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)	-5.06	-2.95	-16.04

Table 35 - 802.11n / HT20 MCS8 / MIMO SDM / Cores 0+2



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Conducted PSD Core 0 (dBm/30kHz)	-4.12	-1.05	-21.16
Conducted PSD Core 2 (dBm/30kHz)	-3.60	-0.55	-23.24
Duty Cycle Correction (dB)	N/A SA-3	N/A SA-3	0.81
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)	-0.84	2.22	-18.26

Table 36 - 802.11n / HT20 MCS0 / MIMO TxBF / Cores 0+2

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Conducted PSD Core 0 (dBm/30kHz)	-9.65	-6.93	-20.26
Conducted PSD Core 1 (dBm/30kHz)	-9.39	-6.40	-20.27
Conducted PSD Core 2 (dBm/30kHz)	-9.63	-6.30	-20.56
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)	-4.78	-1.76	-15.59

Table 37 - 802.11n / HT20 MCS0 / MIMO CDD / Cores 0+1+2

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Conducted PSD Core 0 (dBm/30kHz)	-9.36	-5.98	-19.26
Conducted PSD Core 1 (dBm/30kHz)	-9.42	-5.19	-18.94
Conducted PSD Core 2 (dBm/30kHz)	-9.02	-5.96	-18.26
Duty Cycle Correction (dB)	0.15	0.14	0.15
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)	-4.35	-0.79	-13.88

Table 38 - 802.11n / HT20 MCS16 / MIMO SDM / Cores 0+1+2



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Conducted PSD Core 0 (dBm/30kHz)	-2.16	0.91	-11.77
Conducted PSD Core 1 (dBm/30kHz)	-3.74	-1.57	-14.04
Conducted PSD Core 2 (dBm/30kHz)	-5.14	0.49	-13.40
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)	1.26	4.84	-8.19

Table 39 - 802.11n / HT20 MCS0 / MIMO TxBF / Cores 0+1+2

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
Raw Conducted PSD (dBm/30kHz)	-8.80	-7.17	-19.40
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)	-8.80	-7.17	-19.40

Table 40 - 802.11n / HT20 MCS0 / Aux Core

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.

ISED 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

For TxBF modes the average rather than peak PSD was measured. The duty cycle of the TxBF modes was < 98 %. Therefore a duty cycle correction was applied to the raw results of the individual cores to give the final result above in accordance with ANSI C63.10 AVGPDS-2.



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
Hygropalm Temperature and Humidity Meter	Rotronic	HP21	4410	12	13-Jun-2020
Hygrometer	Rotronic	I-1000	2891	12	02-Oct-2020
True RMS Multimeter	Fluke	179	4007	12	30-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
USB Power Sensor	Boonton	RTP5006	5184	12	12-Dec-2019
AC Programmable PSU	iTech	IT7324	5227	-	O/P Mon
Power Splitter, 4 way	Mini-Circuits	ZN4PD1-63-S+	5235	-	O/P Mon
Power Splitter, 4 way	Mini-Circuits	ZN4PD1-63-S+	5236	-	O/P Mon
Power Splitter, 2 way	Mini-Circuits	ZN2PD2-63-S+	5238	-	O/P Mon
Power splitter, 2 port	Mini-Circuits	ZN2PD-63-S+	4742	-	O/P Mon
Attenuator 10dB 2W	Telegartner	J01156A0031	N/A	-	O/P Mon
Attenuator 10dB 2W	Telegartner	J01156A0031	N/A	-	O/P Mon
Attenuator 10dB 2W	Telegartner	J01156A0031	N/A	-	O/P Mon
Attenuator 10dB 2W	Telegartner	J01156A0031	N/A	-	O/P Mon

Table 41

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)
ISED RSS-247, Clause 5.2
ISED RSS-GEN, Clause 6.6

2.3.2 Equipment Under Test and Modification State

A2141, S/N: C02YT007L513 - Modification State 0

2.3.3 Date of Test

15 August 2019 to 17 September 2019

2.3.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.8.2

For modes of operation using multiple cores, measurements were made on each core but only the worst case results are reported. Worst case was considered as the narrowest results for 6 dB bandwidth and the widest result for 26 dB bandwidth and 99% occupied bandwidth.

2.3.5 Environmental Conditions

Ambient Temperature	19 to 26°C
Relative Humidity	39 to 67%



2.3.6 Test Results

Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
6 dB Bandwidth (MHz)	8.160	8.160	7.740
99% Bandwidth (MHz)	10.364	10.406	10.457

Table 42 - 802.11b / 1 Mbps / SISO / Core 0

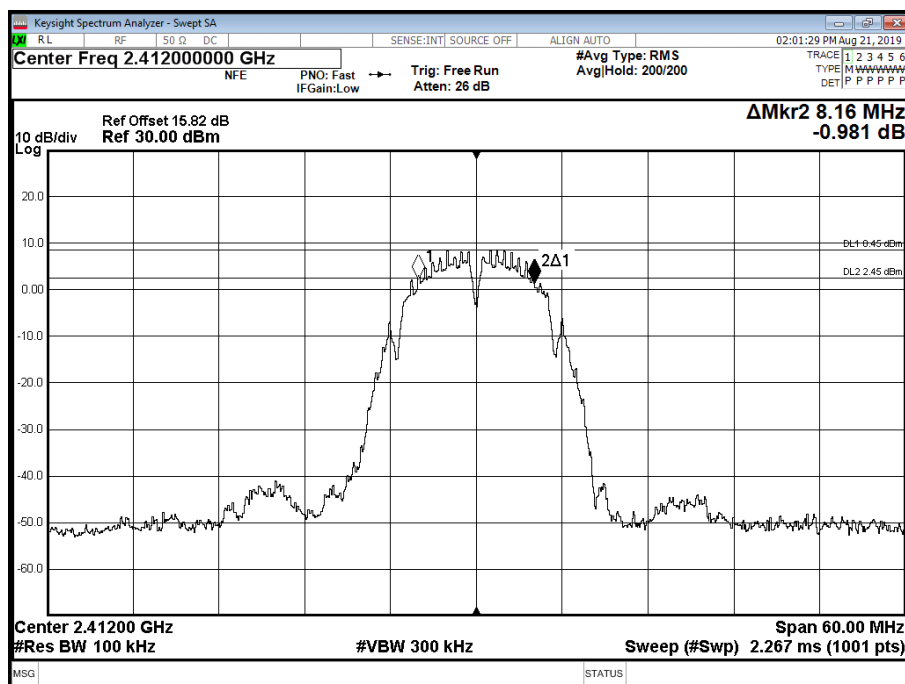


Figure 2 - 2412 MHz - 6 dB DTS Bandwidth

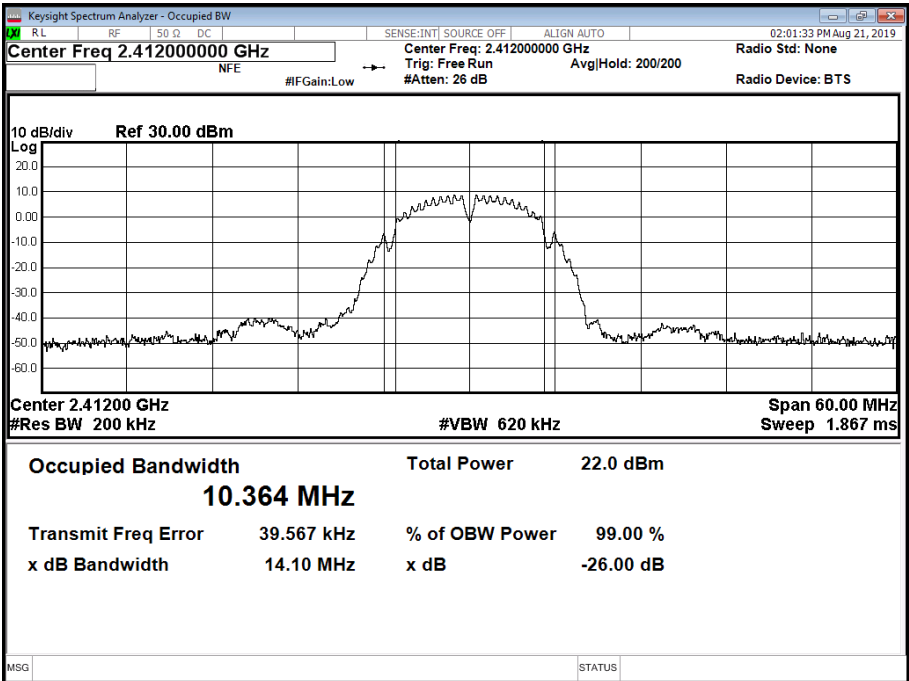


Figure 3 - 2412 MHz - 99% Occupied Bandwidth

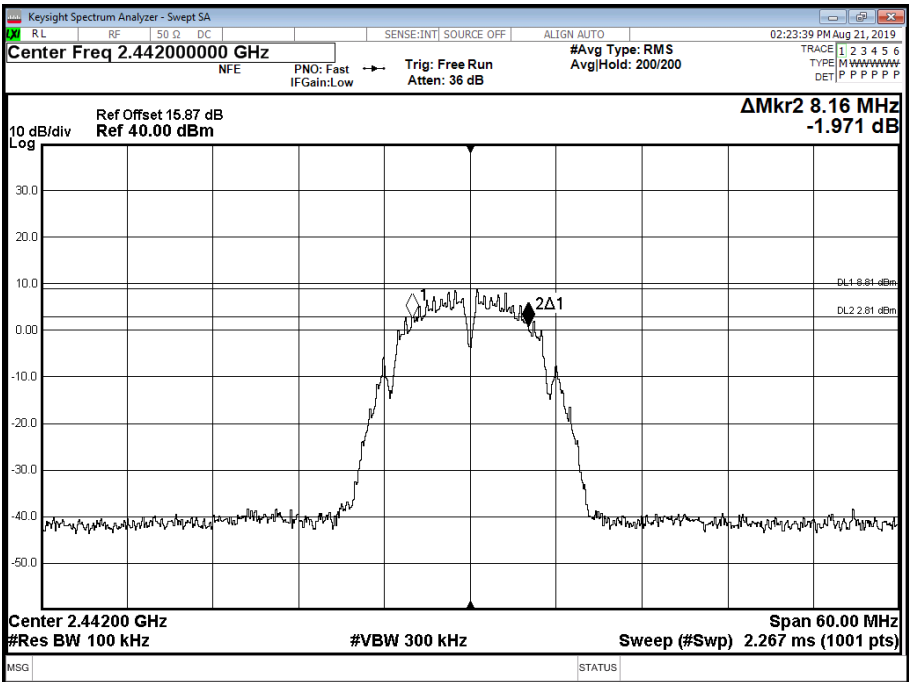


Figure 4 - 2442 MHz - 6 dB DTS Bandwidth

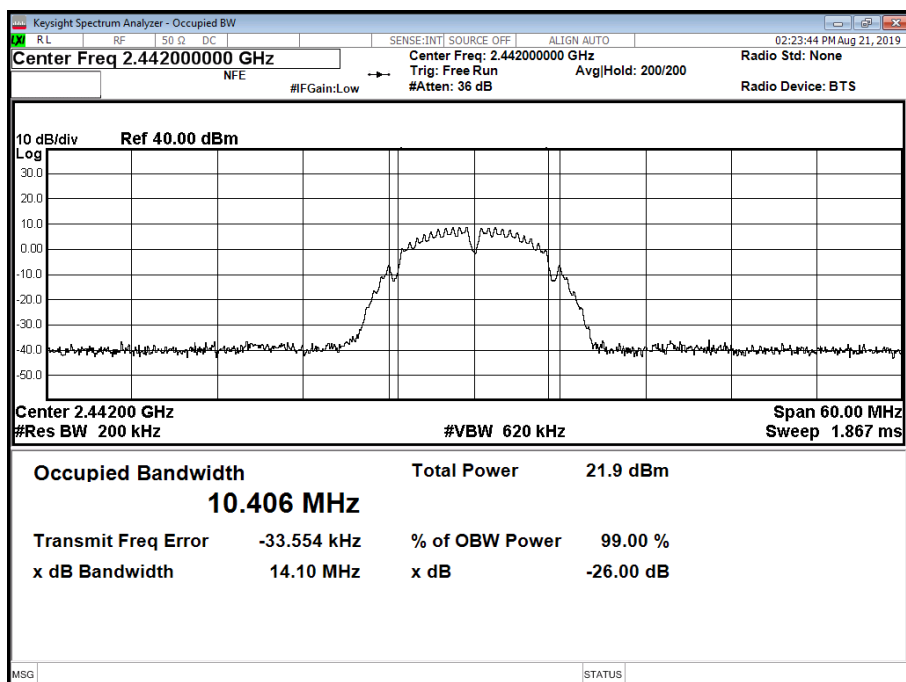


Figure 5 - 2442 MHz - 99% Occupied Bandwidth

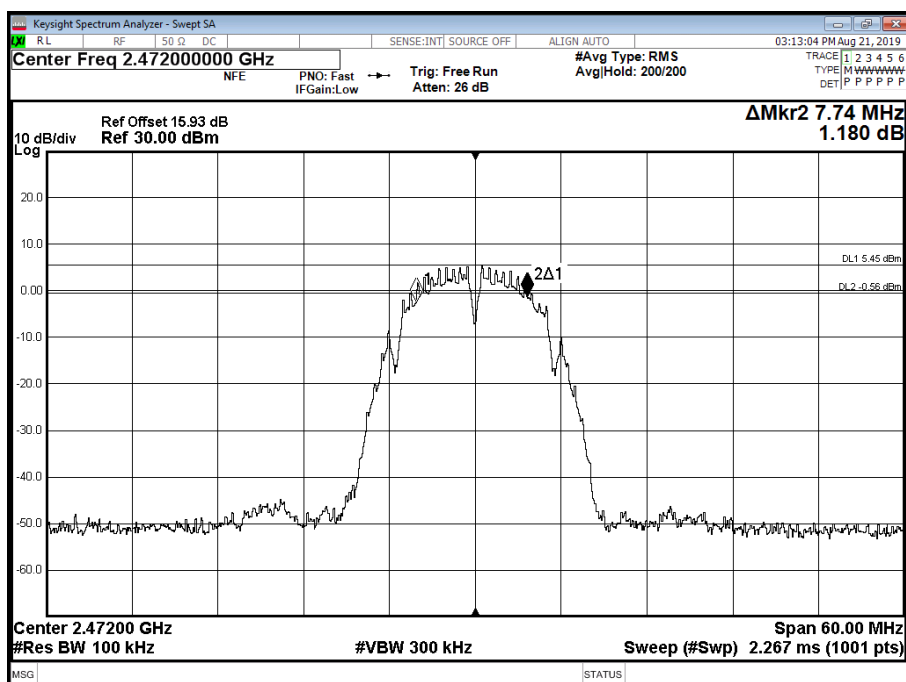


Figure 6 - 2472 MHz - 6 dB DTS Bandwidth

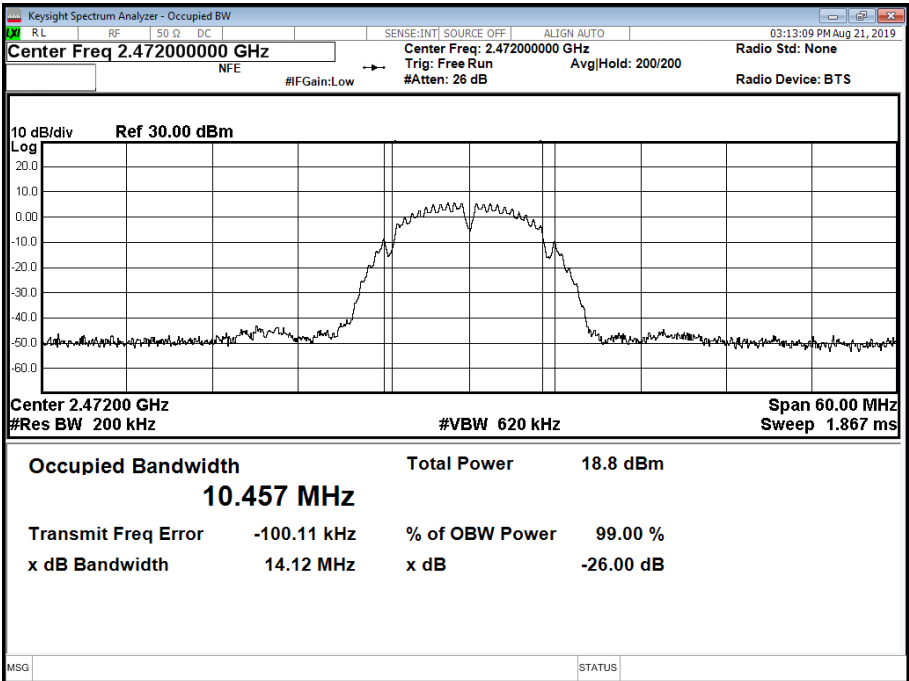


Figure 7 - 2472 MHz - 99% Occupied Bandwidth

Table 43 - 802.11b / 1 Mbps / MIMO CDD / Cores 0+2

Figure 8 - 2412 MHz - 6 dB DTS Bandwidth

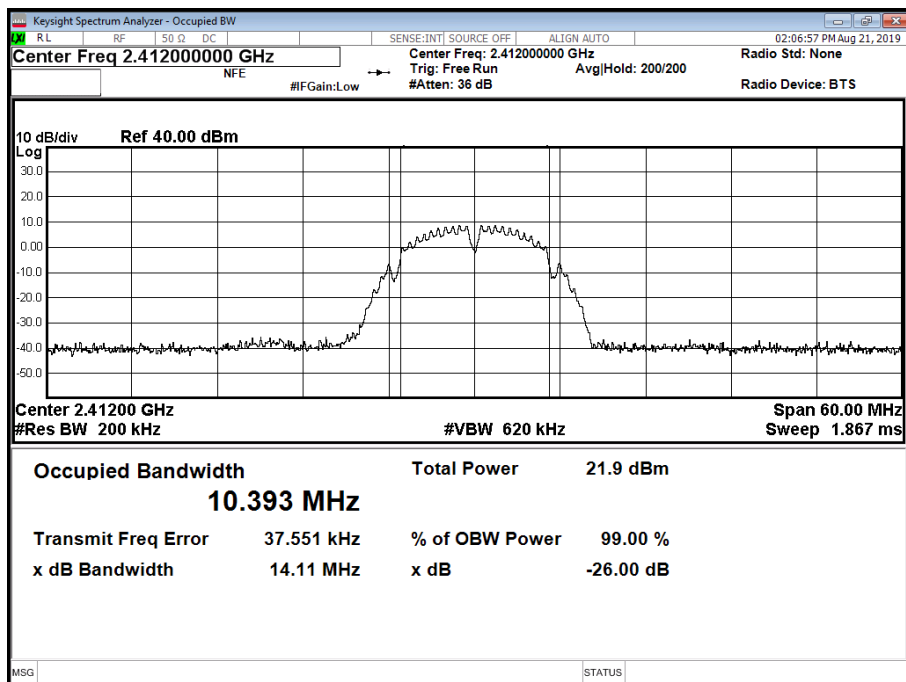


Figure 9 - 2412 MHz - 99% Occupied Bandwidth

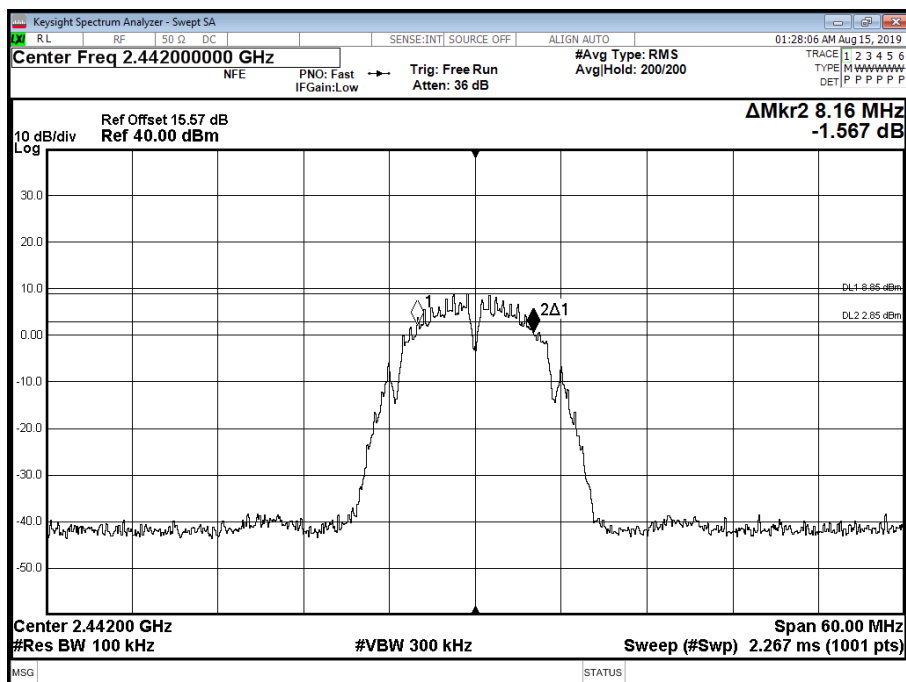


Figure 10 - 2442 MHz - 6 dB DTS Bandwidth

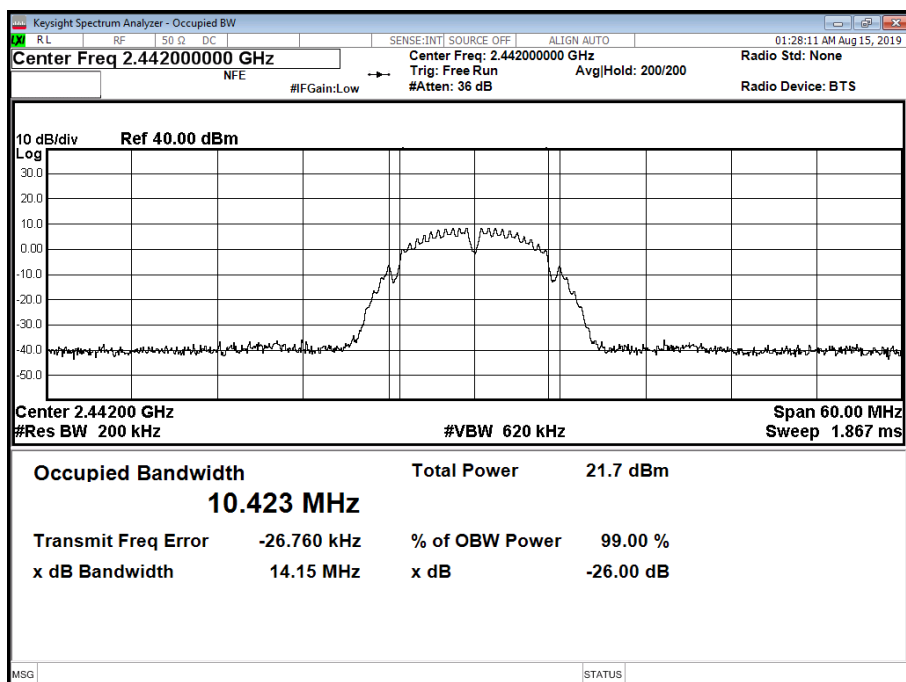


Figure 11 - 2442 MHz - 99% Occupied Bandwidth

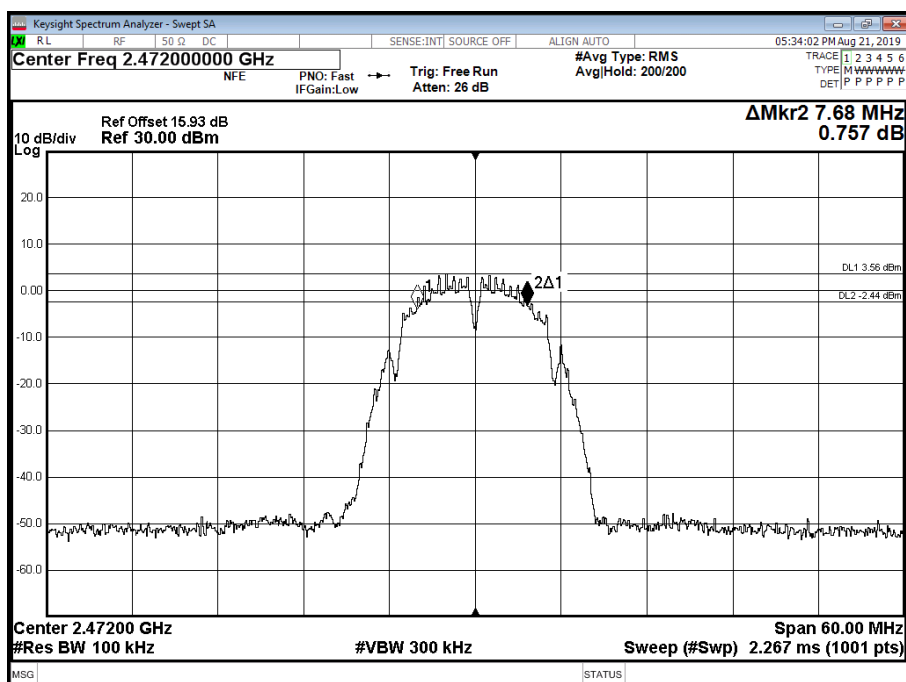


Figure 12 - 2472 MHz - 6 dB DTS Bandwidth

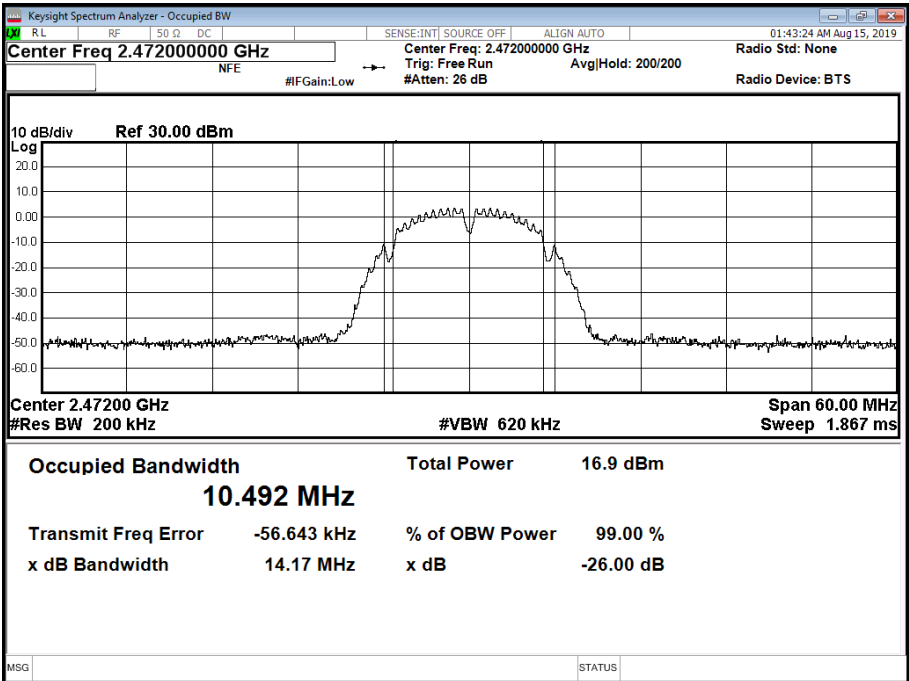


Figure 13 - 2472 MHz - 99% Occupied Bandwidth



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
6 dB Bandwidth (MHz)	7.680	8.160	8.220
99% Bandwidth (MHz)	10.380	10.432	10.504

Table 44 - 802.11b / 1 Mbps / MIMO CDD / Cores 0+1+2

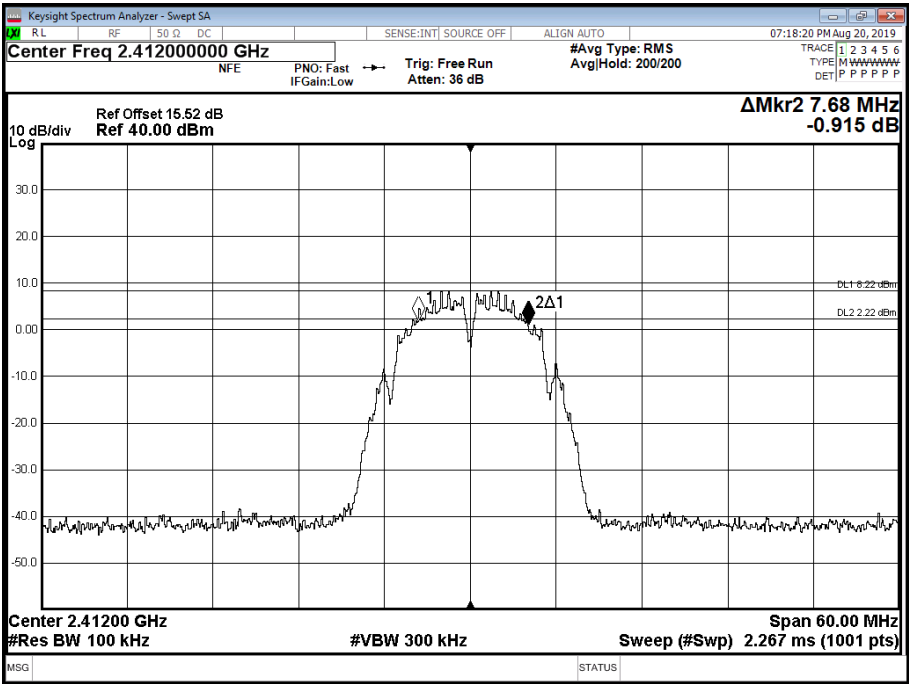


Figure 14 - 2412 MHz - 6 dB DTS Bandwidth

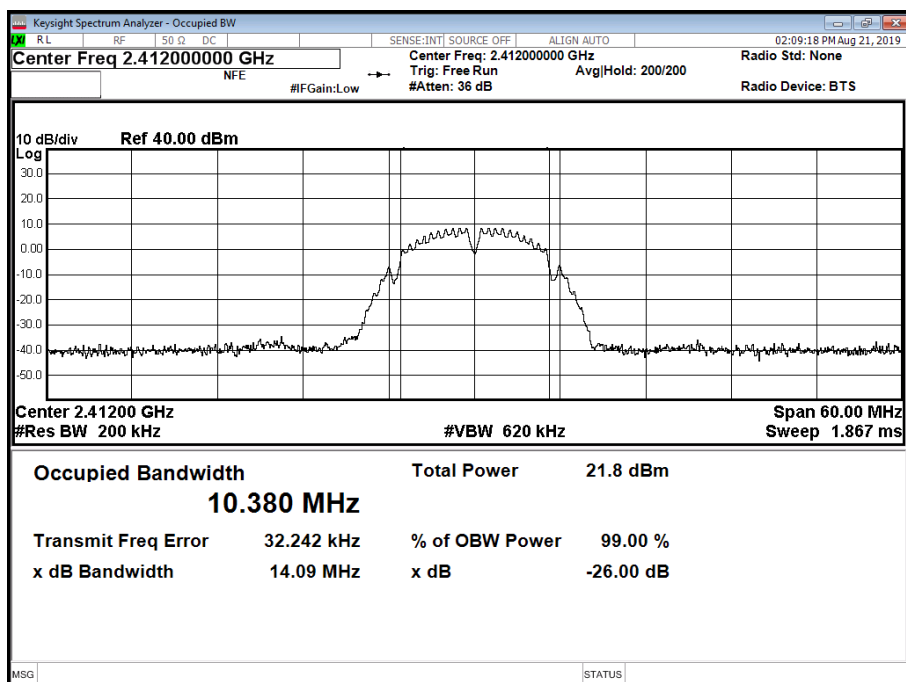


Figure 15 - 2412 MHz - 99% Occupied Bandwidth

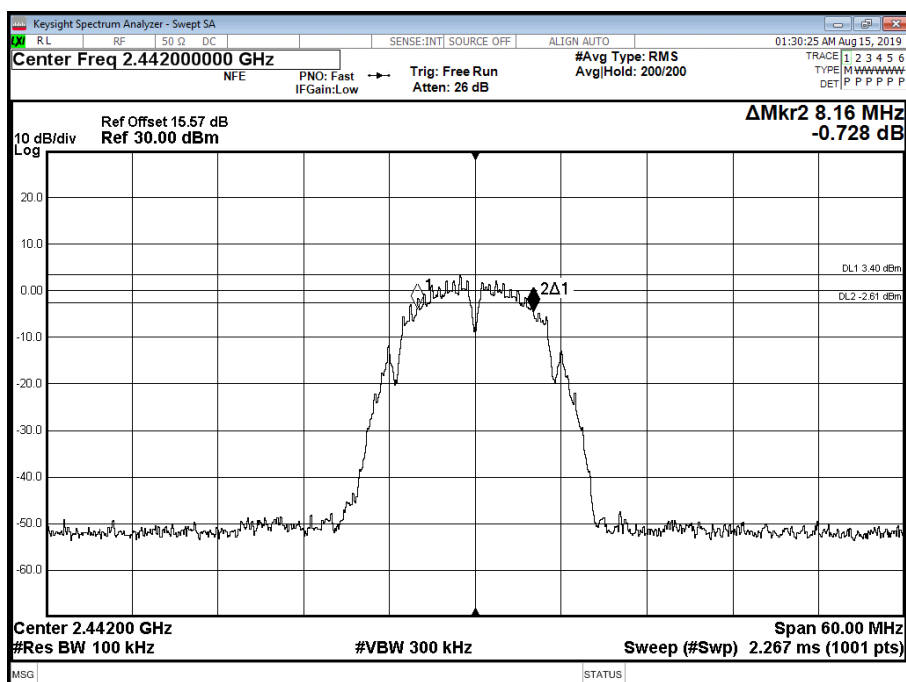


Figure 16 - 2442 MHz - 6 dB DTS Bandwidth

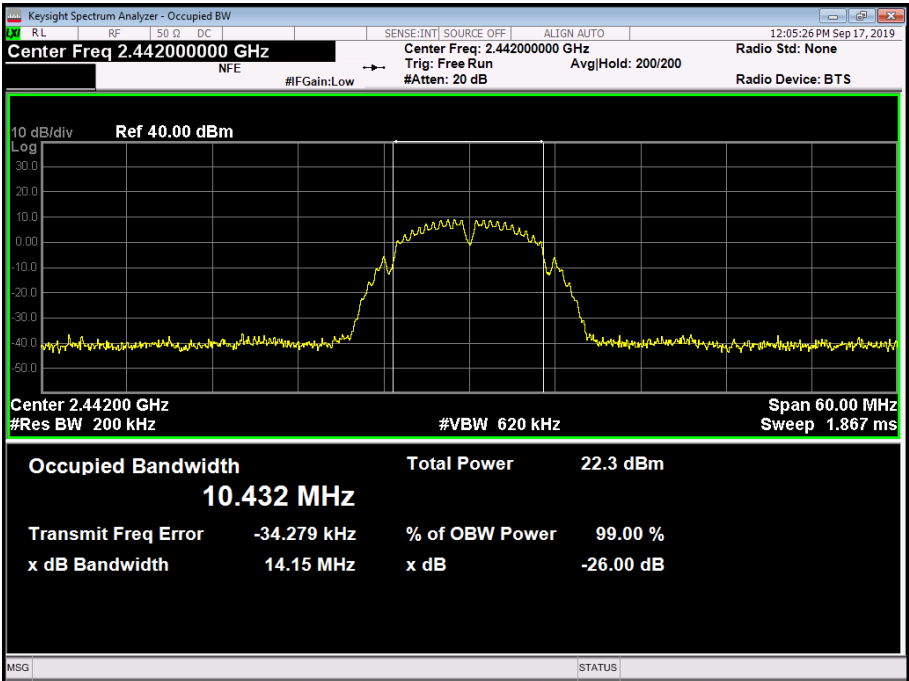


Figure 17 - 2442 MHz - 99% Occupied Bandwidth

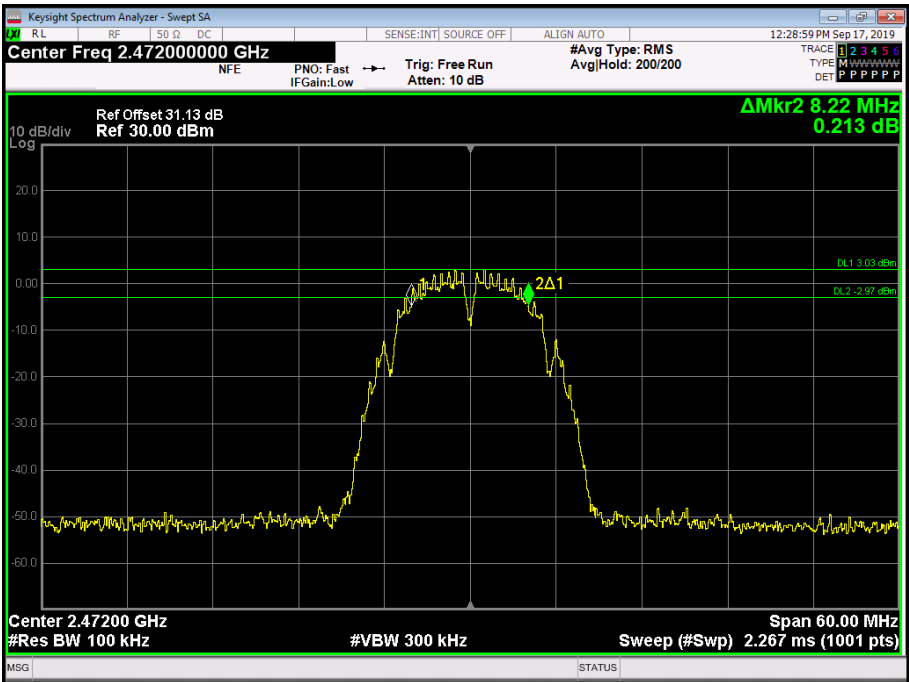


Figure 18 - 2472 MHz - 6 dB DTS Bandwidth

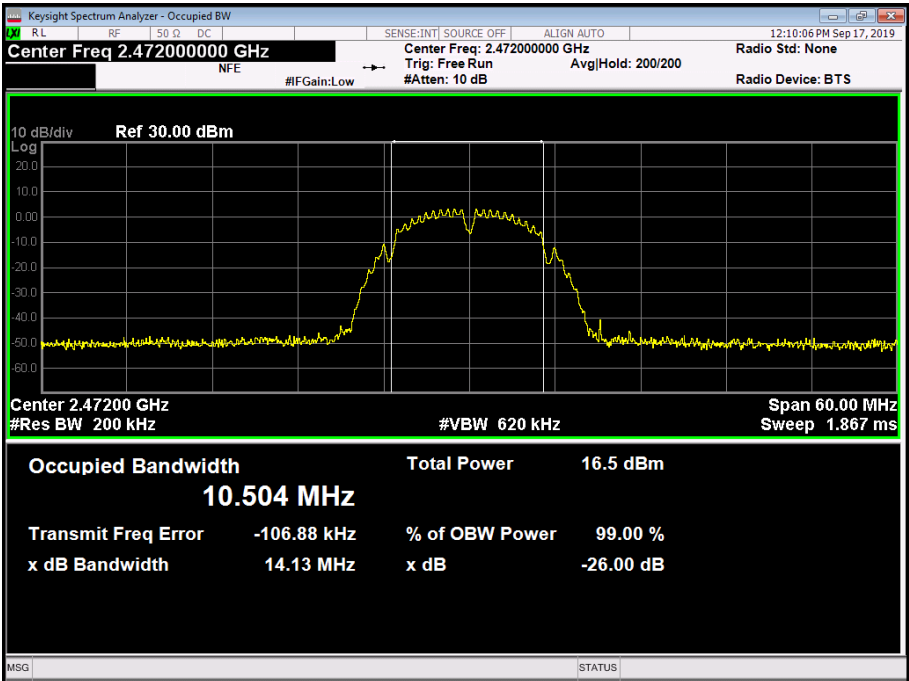


Figure 19 - 2472 MHz - 99% Occupied Bandwidth



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
6 dB Bandwidth (MHz)	8.700	8.160	8.640
99% Bandwidth (MHz)	10.652	10.842	10.946

Table 45 - 802.11b / 1 Mbps / Aux Core

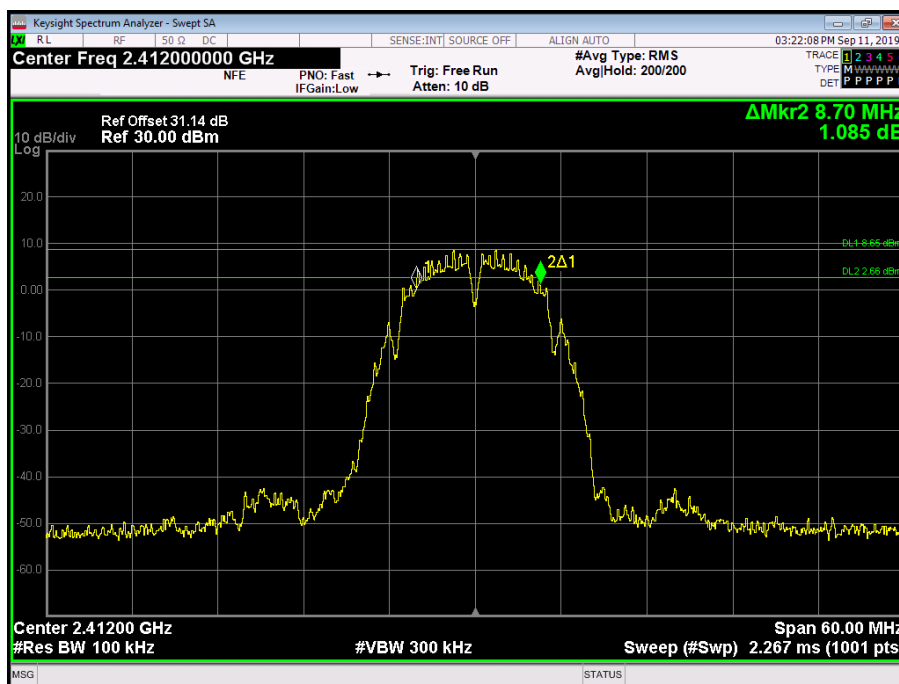


Figure 20 - 2412 MHz - 6 dB DTS Bandwidth

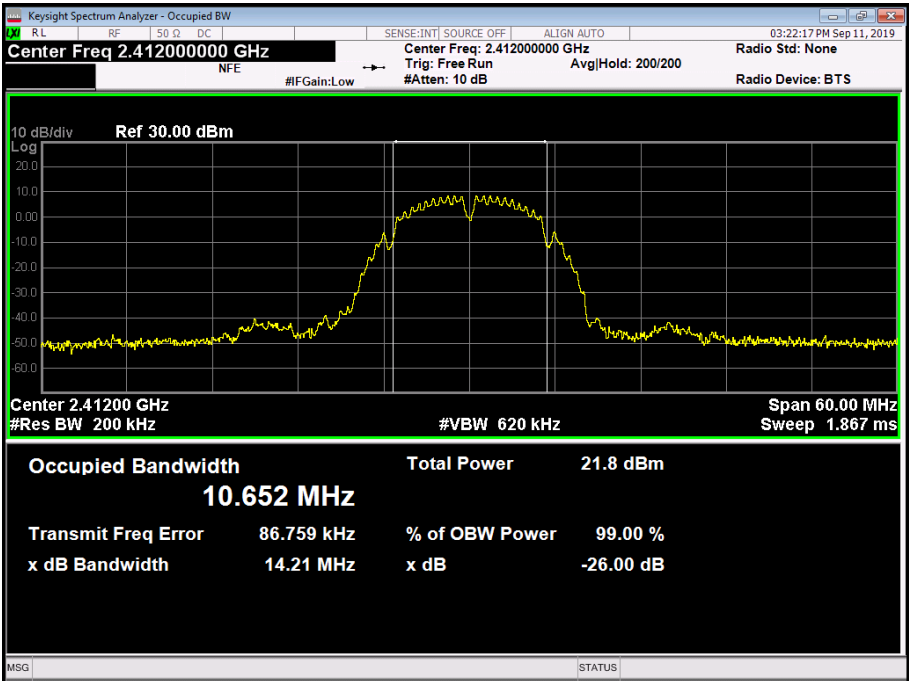


Figure 21 - 2412 MHz - 99% Occupied Bandwidth

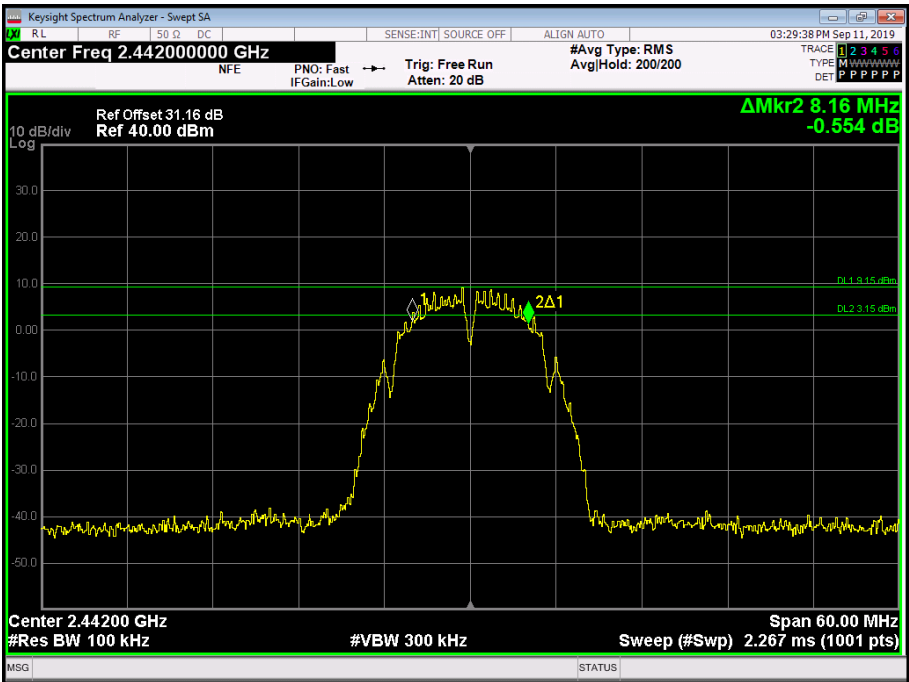


Figure 22 - 2442 MHz - 6 dB DTS Bandwidth

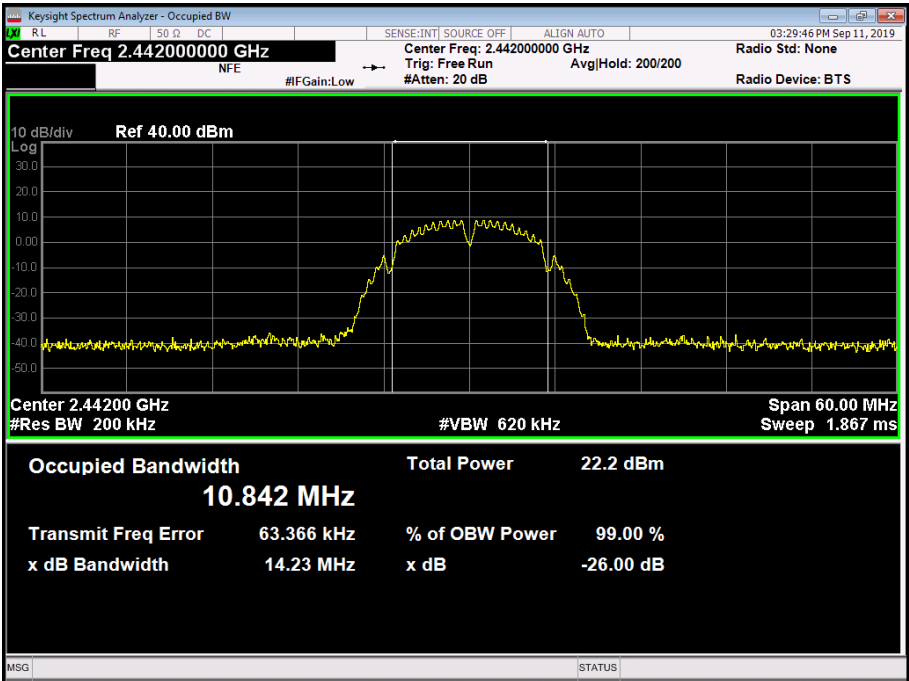


Figure 23 - 2442 MHz - 99% Occupied Bandwidth

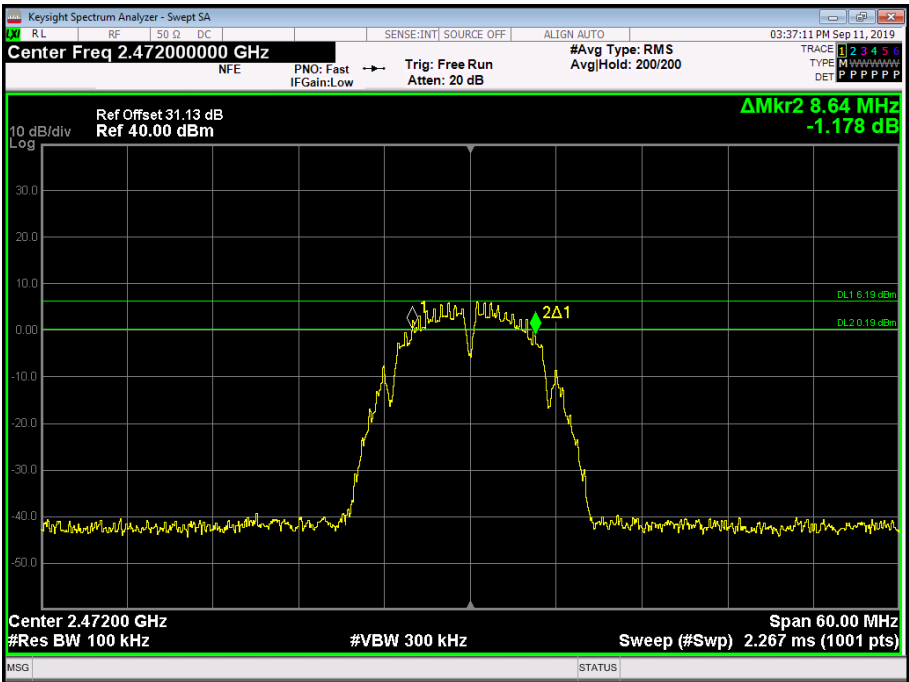


Figure 24 - 2472 MHz - 6 dB DTS Bandwidth

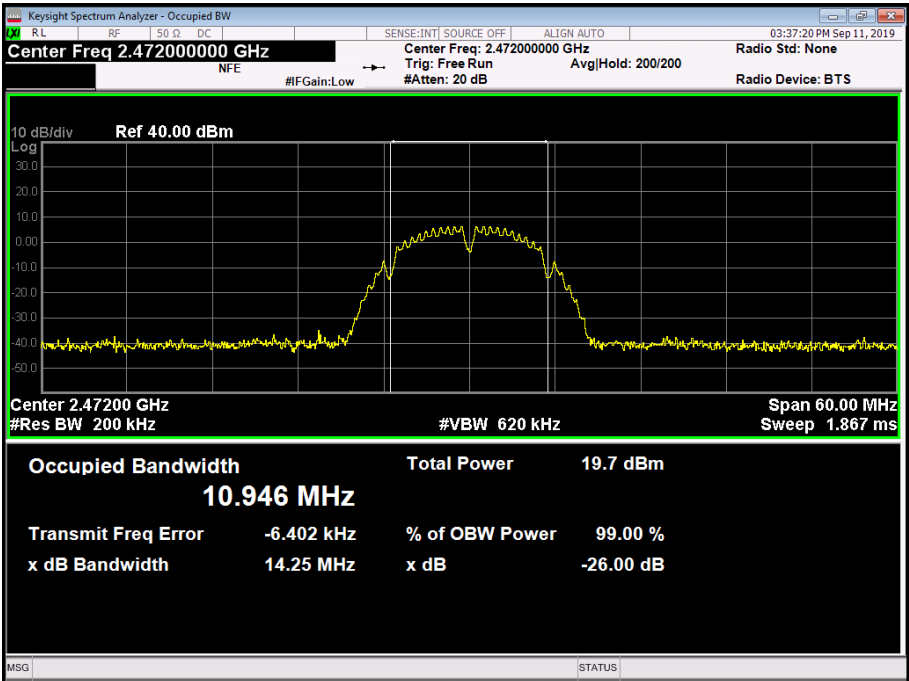


Figure 25 - 2472 MHz - 99% Occupied Bandwidth



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
6 dB Bandwidth (MHz)	15.180	11.400	15.180
99% Bandwidth (MHz)	16.404	16.411	16.365

Table 46 - 802.11g / 6 Mbps / SISO / Core 0

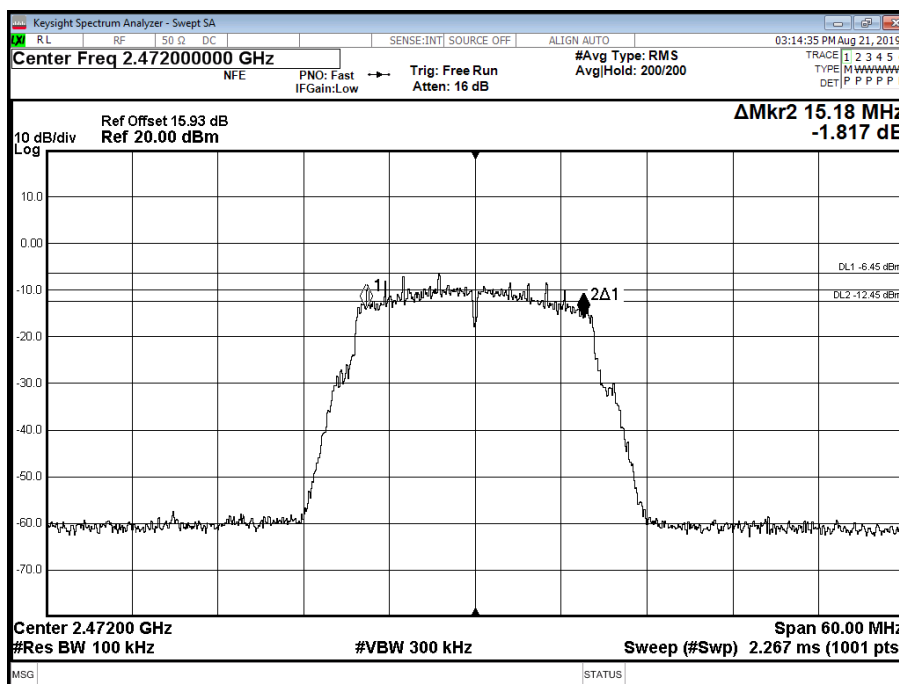


Figure 26 - 2412 MHz - 6 dB DTS Bandwidth

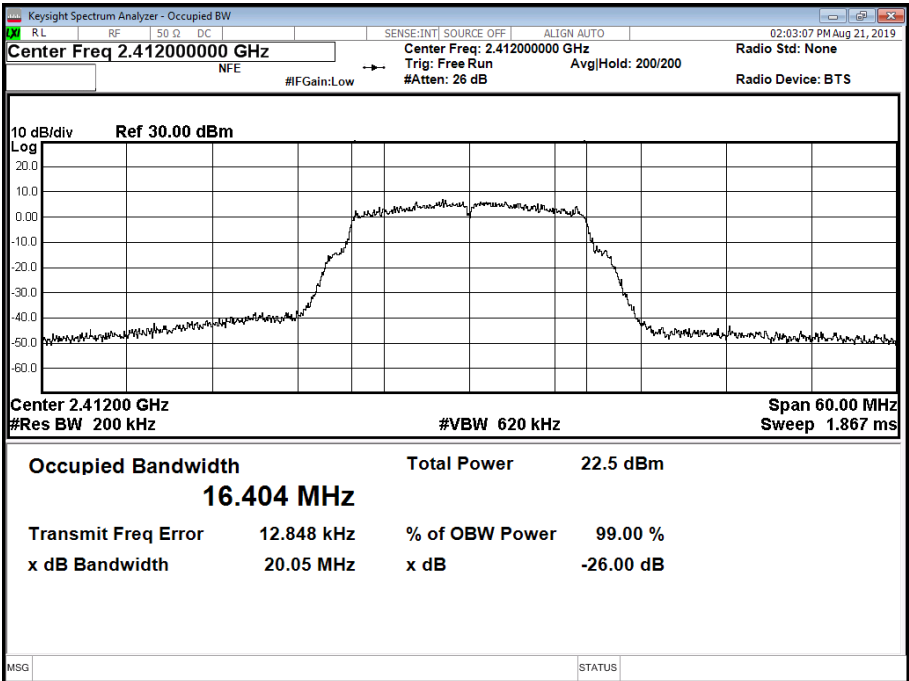


Figure 27 - 2412 MHz - 99% Occupied Bandwidth

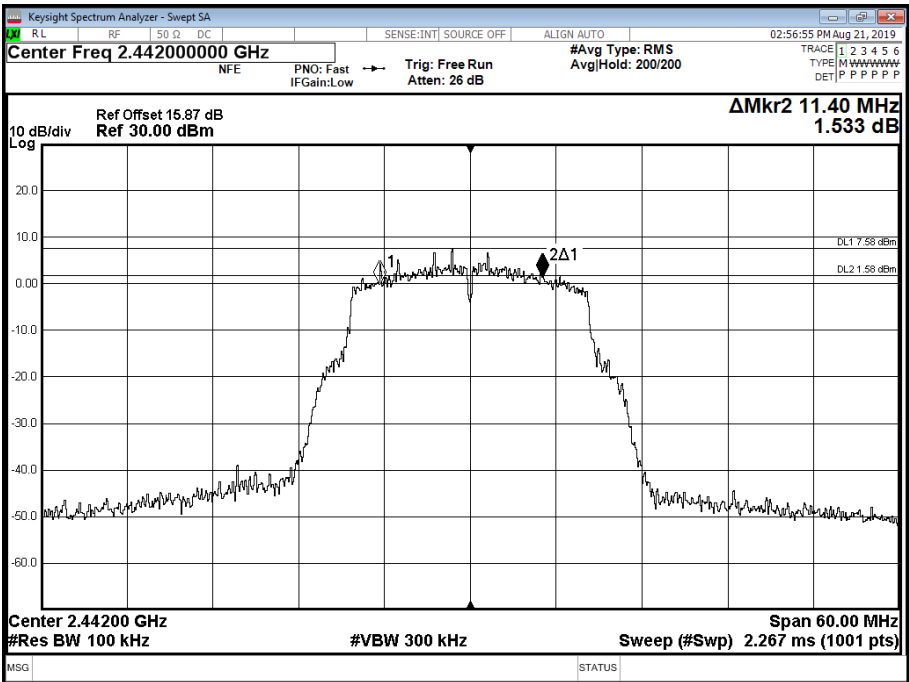


Figure 28 - 2442 MHz - 6 dB DTS Bandwidth

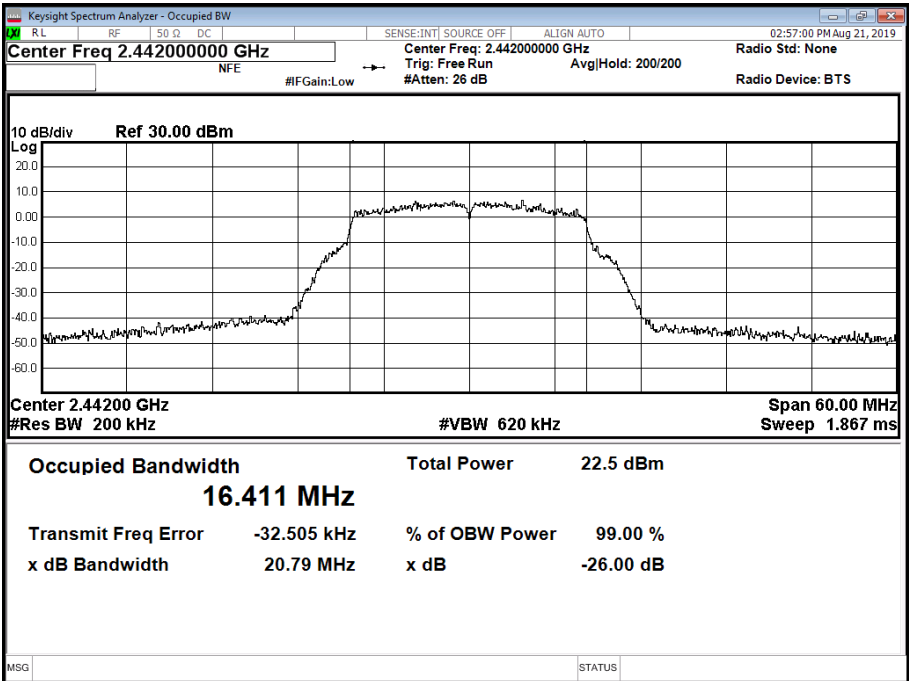


Figure 29 - 2442 MHz - 99% Occupied Bandwidth

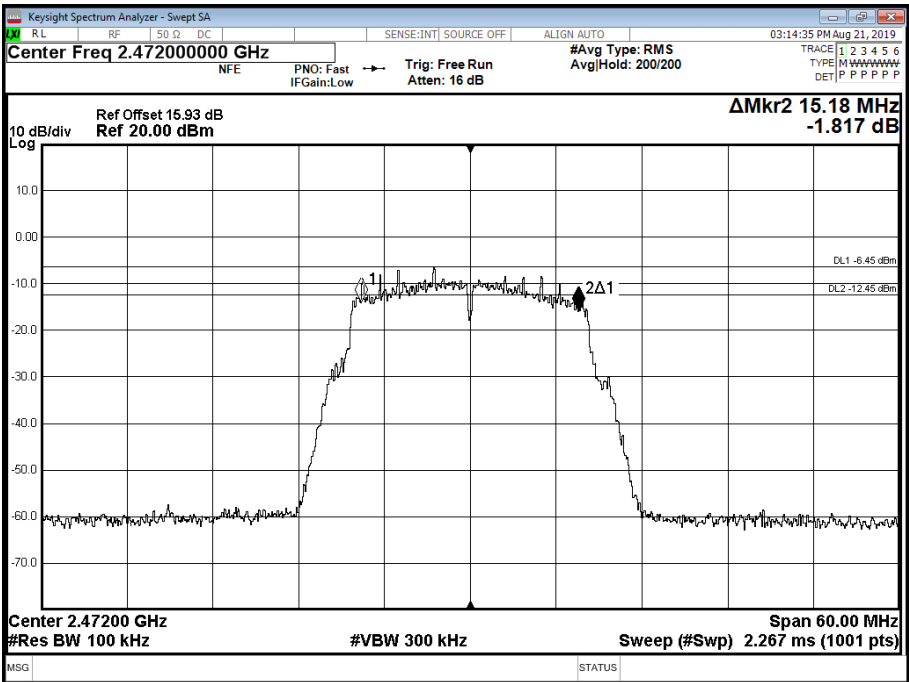


Figure 30 - 2472 MHz - 6 dB DTS Bandwidth

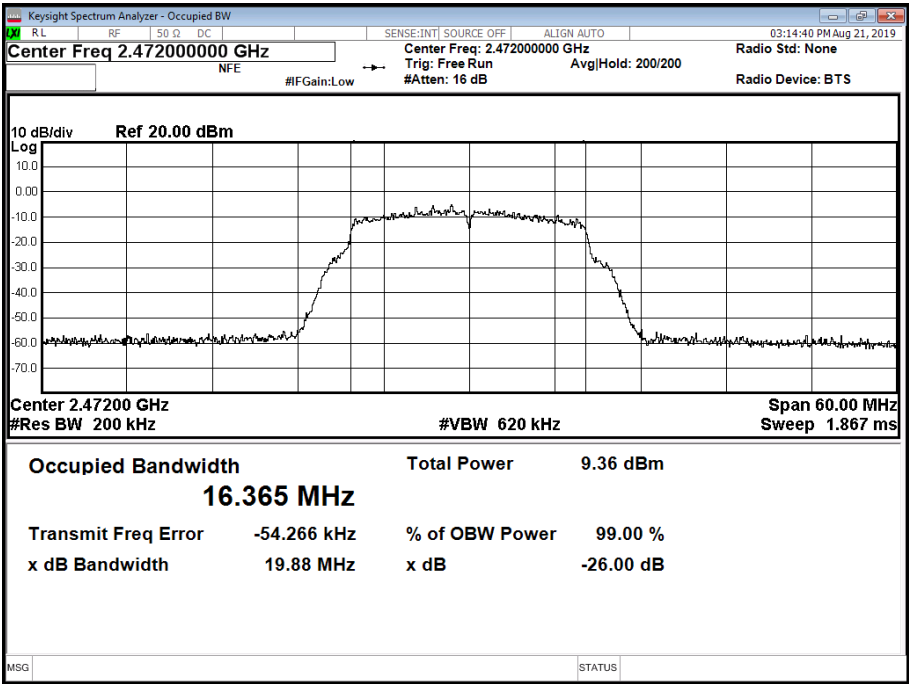


Figure 31 - 2472 MHz - 99% Occupied Bandwidth

Table 47 - 802.11g / 6 Mbps / MIMO CDD / Cores 0+2

Figure 32 - 2412 MHz - 6 dB DTS Bandwidth

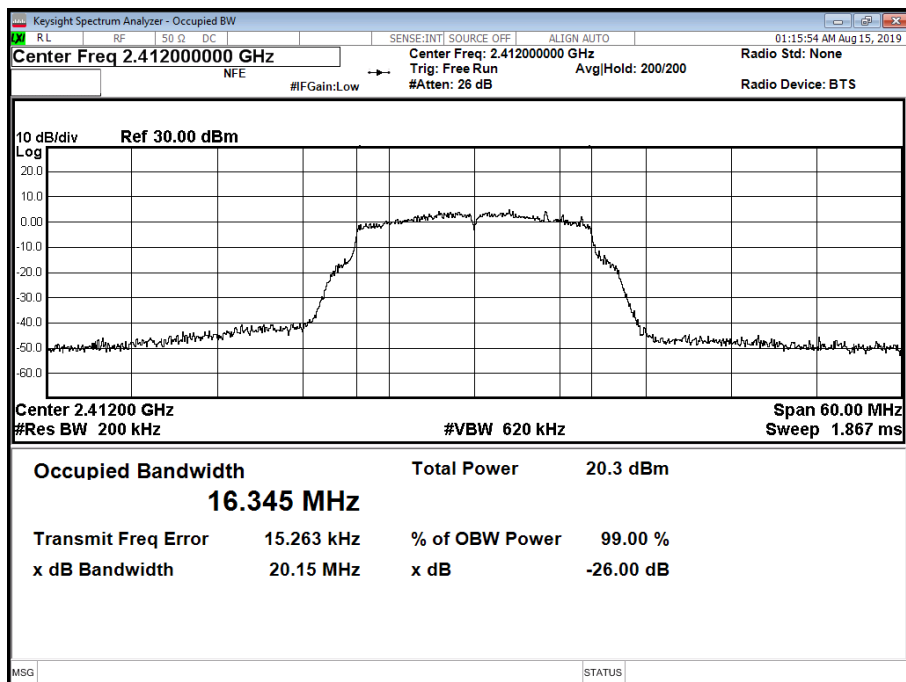


Figure 33 - 2412 MHz - 99% Occupied Bandwidth

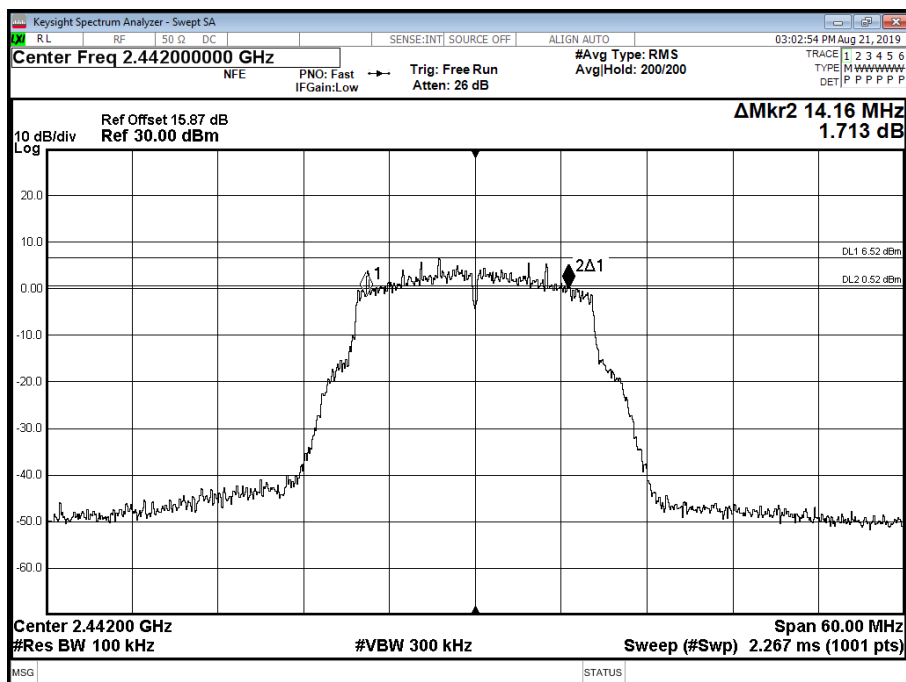


Figure 34 - 2442 MHz - 6 dB DTS Bandwidth

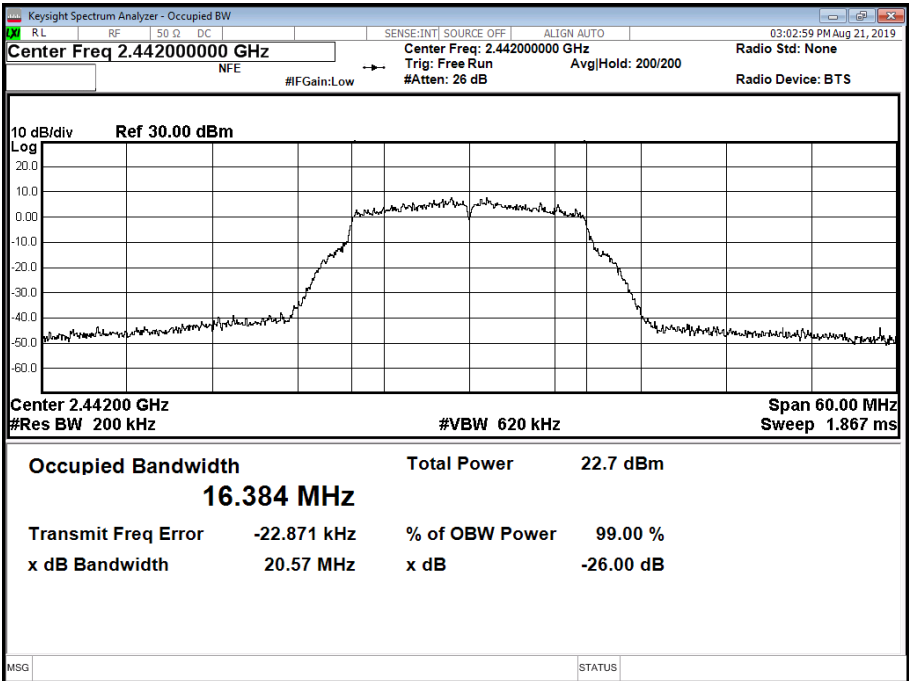


Figure 35 - 2442 MHz - 99% Occupied Bandwidth

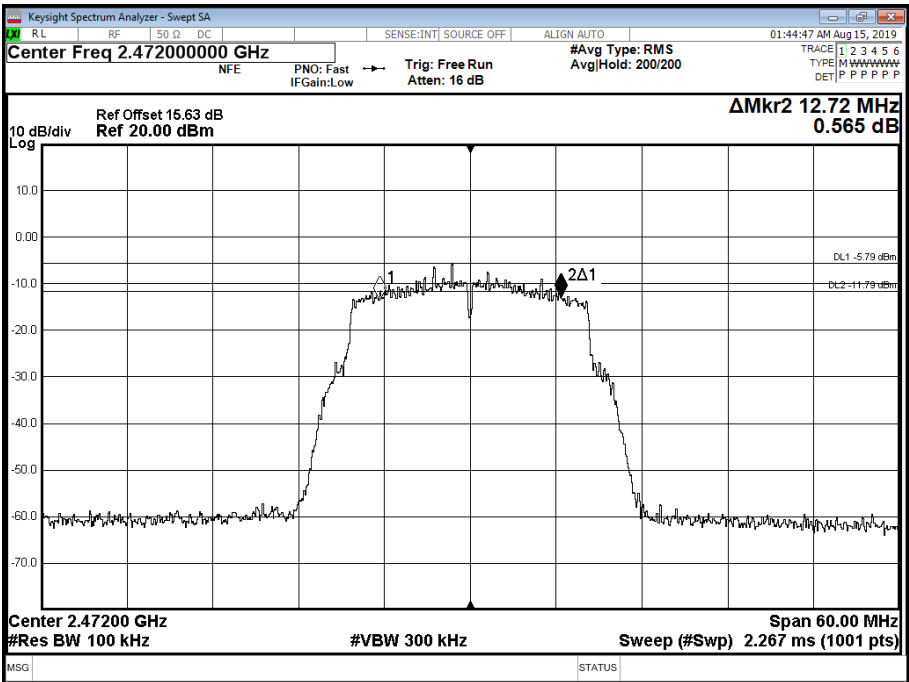


Figure 36 - 2472 MHz - 6 dB DTS Bandwidth

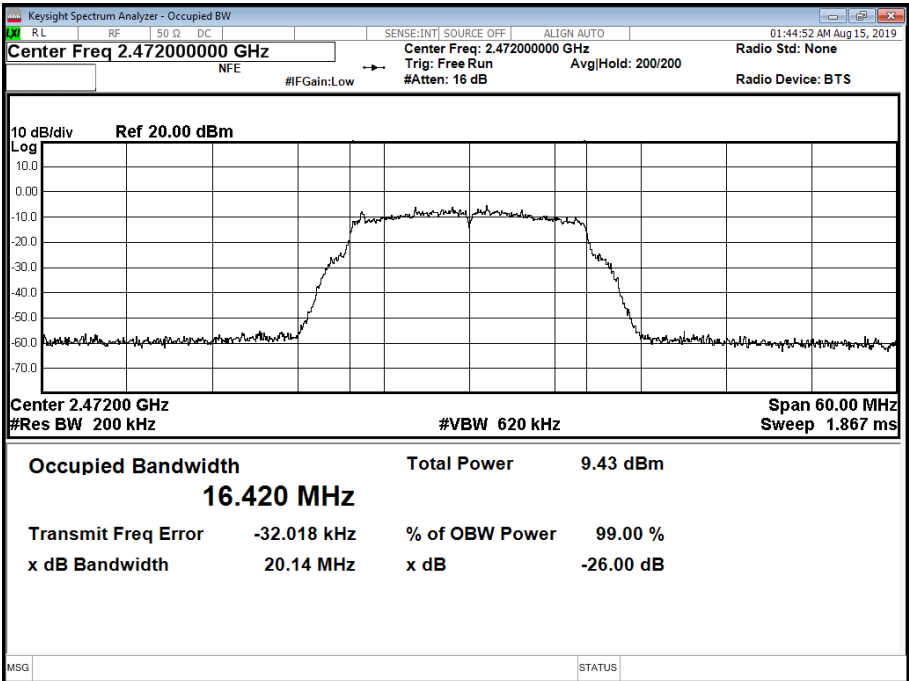


Figure 37 - 2472 MHz - 99% Occupied Bandwidth

Table 48 - 802.11g / 6 Mbps / MIMO CDD / Cores 0+1+2

Figure 38 - 2412 MHz - 6 dB DTS Bandwidth

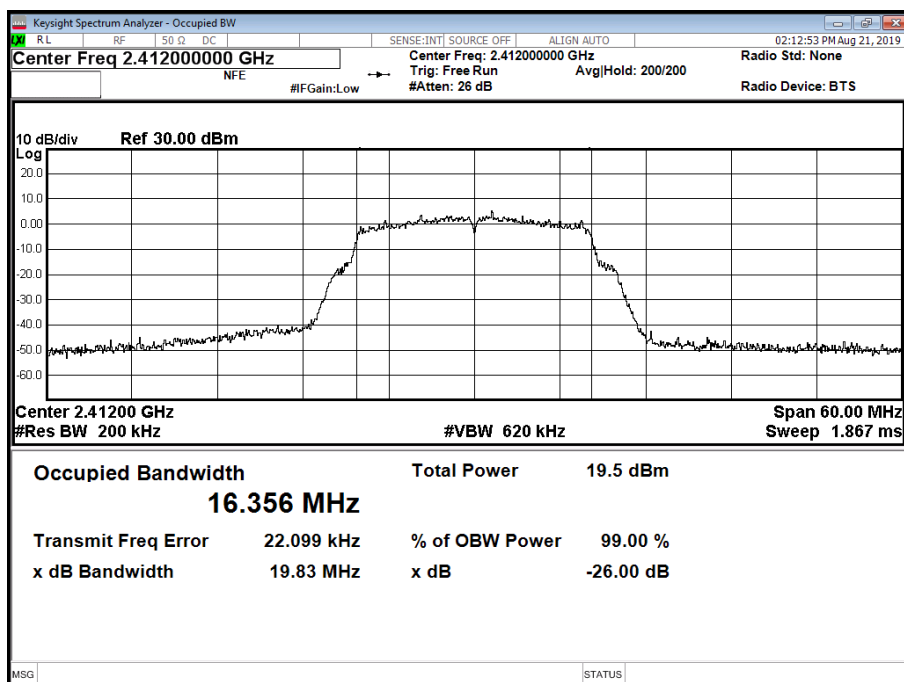


Figure 39 - 2412 MHz - 99% Occupied Bandwidth

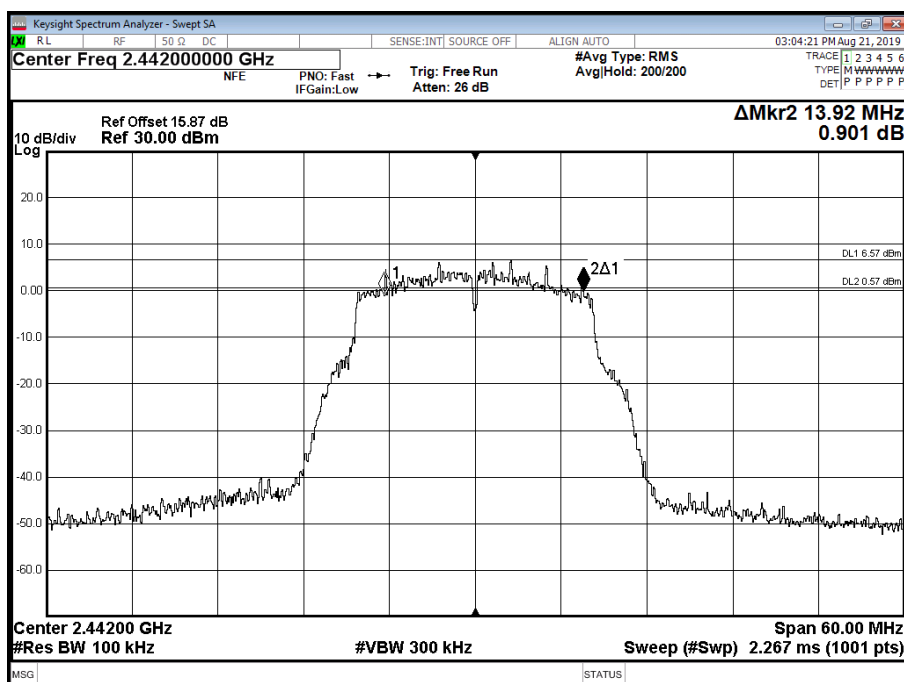


Figure 40 - 2442 MHz - 6 dB DTS Bandwidth

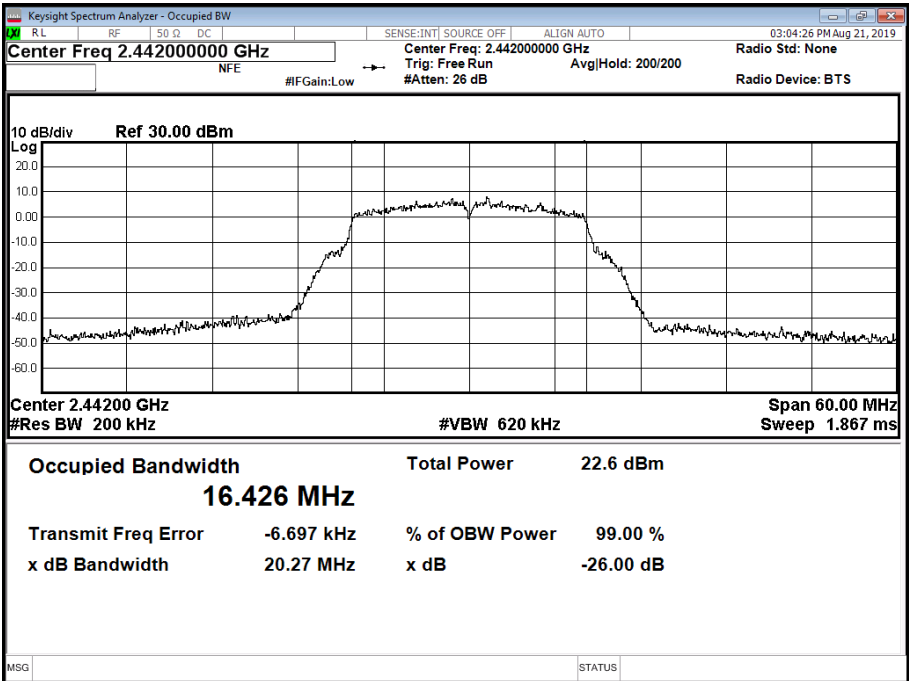


Figure 41 - 2442 MHz - 99% Occupied Bandwidth

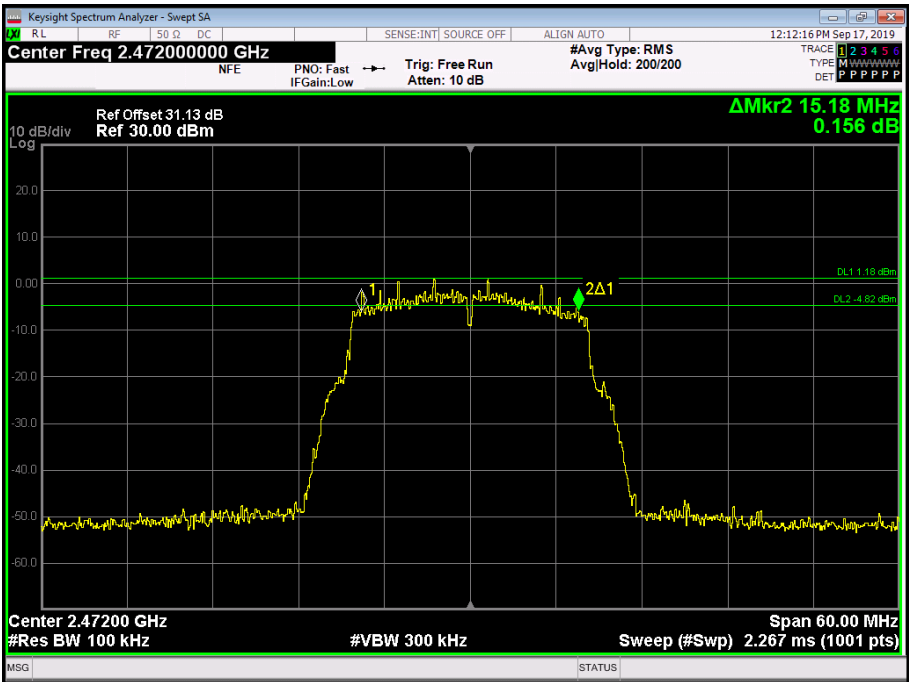


Figure 42 - 2472 MHz - 6 dB DTS Bandwidth

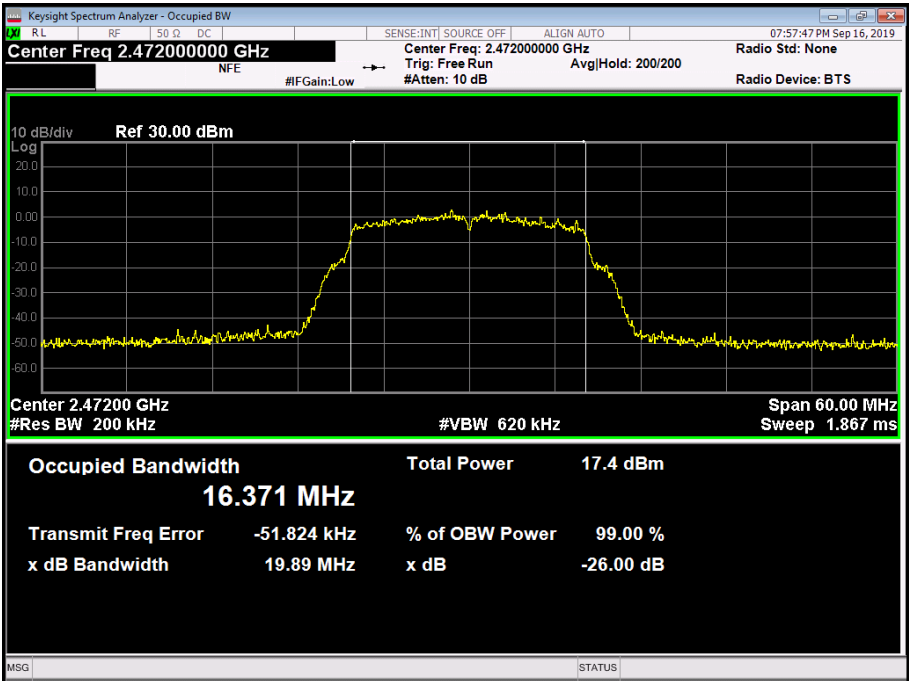


Figure 43 - 2472 MHz - 99% Occupied Bandwidth



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
6 dB Bandwidth (MHz)	16.500	16.440	16.440
99% Bandwidth (MHz)	16.559	16.627	16.651

Table 49 - 802.11g / 6 Mbps / Aux Core

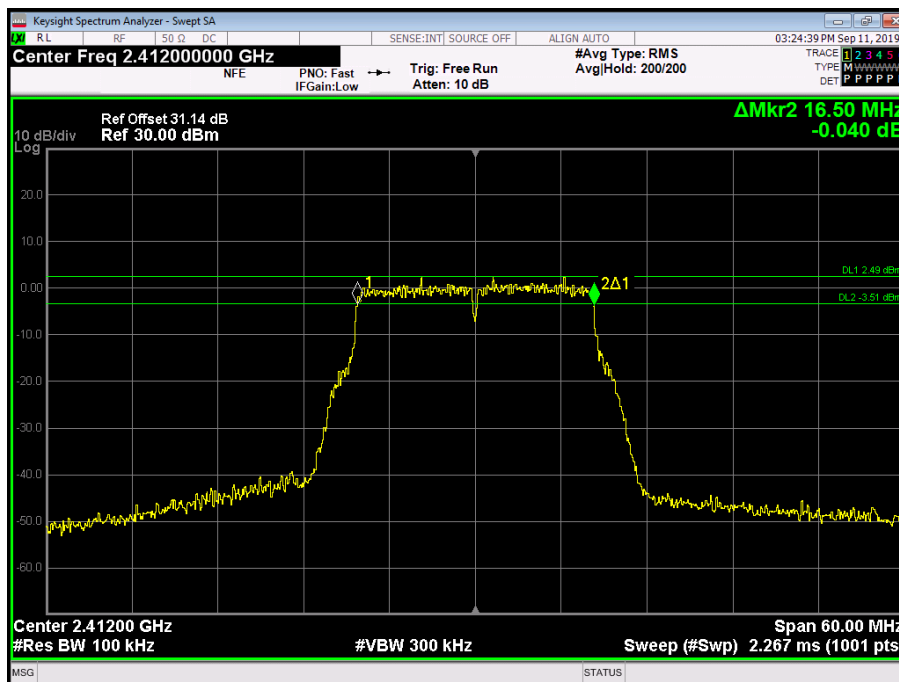


Figure 44 - 2412 MHz - 6 dB DTS Bandwidth

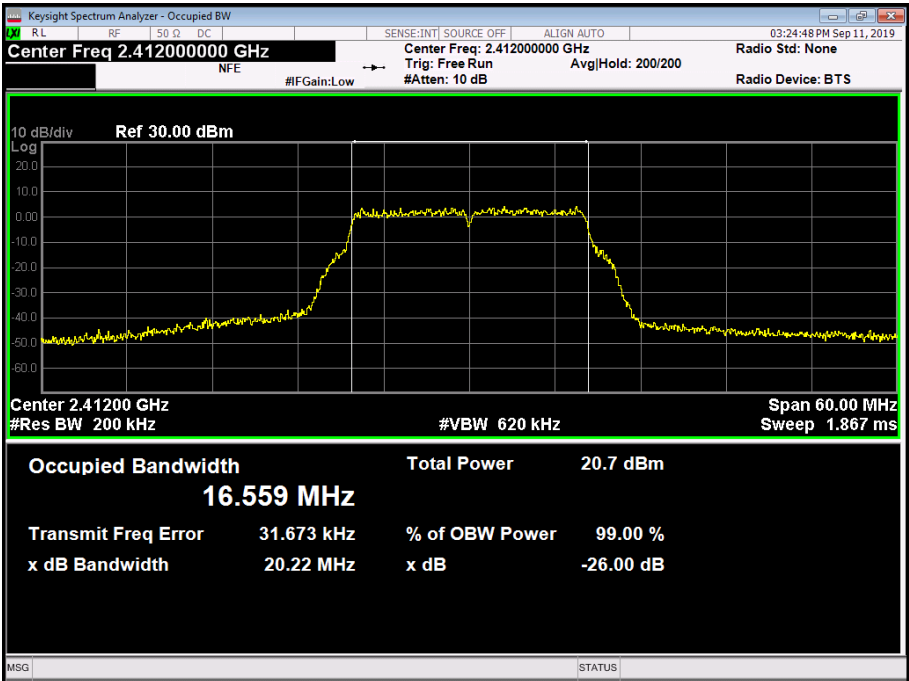


Figure 45 - 2412 MHz - 99% Occupied Bandwidth

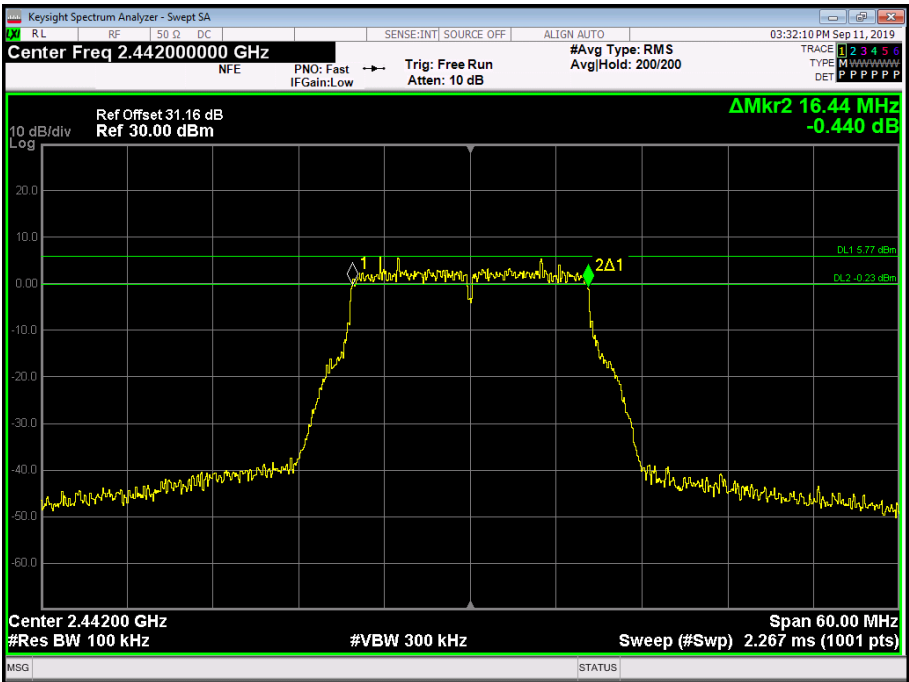


Figure 46 - 2442 MHz - 6 dB DTS Bandwidth

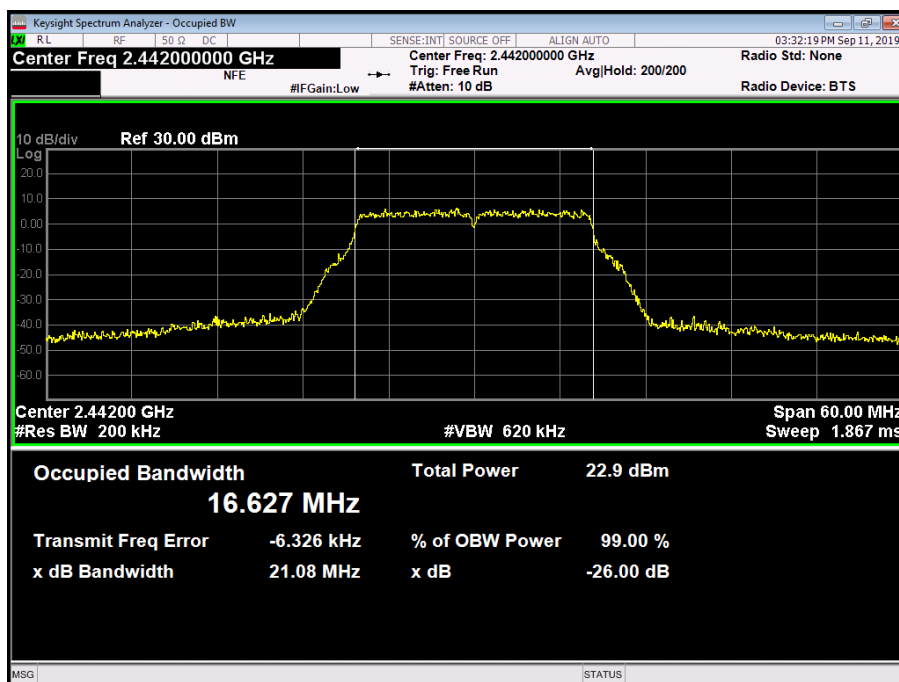


Figure 47 - 2442 MHz - 99% Occupied Bandwidth

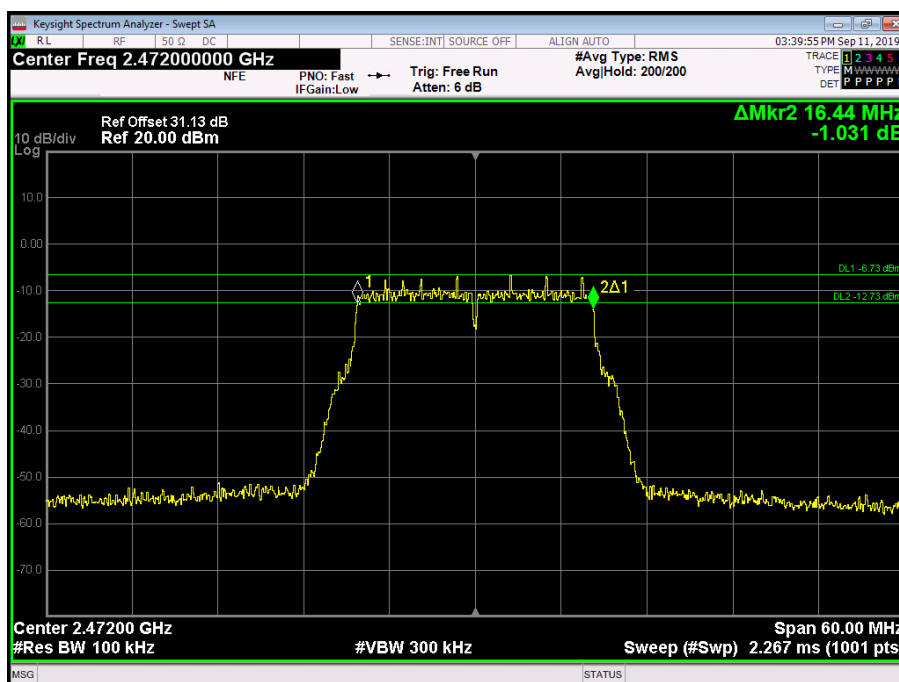


Figure 48 - 2472 MHz - 6 dB DTS Bandwidth

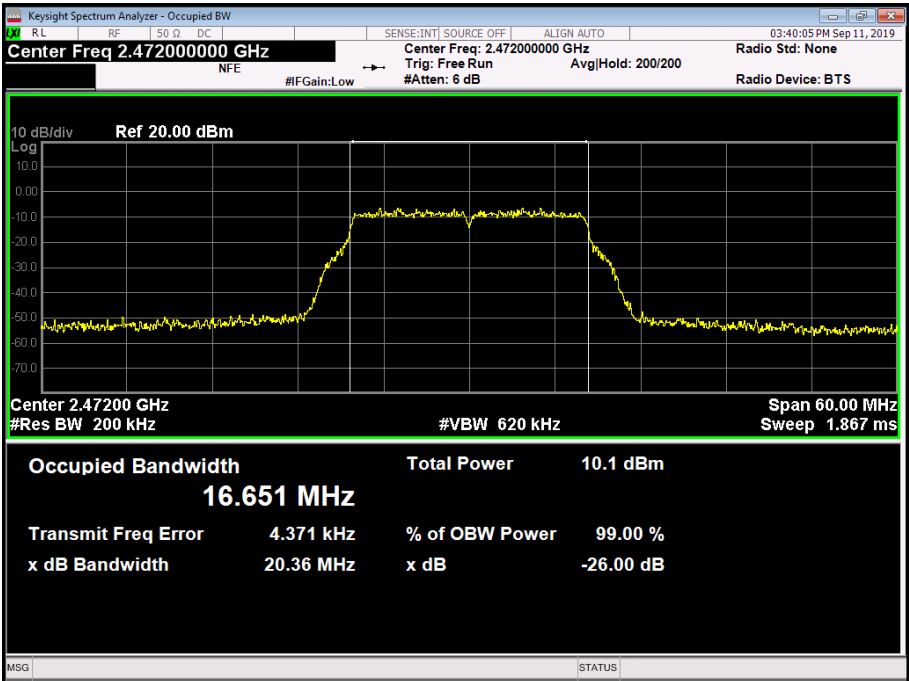


Figure 49 - 2472 MHz - 99% Occupied Bandwidth



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
6 dB Bandwidth (MHz)	13.980	15.120	15.240
99% Bandwidth (MHz)	17.511	17.532	17.536

Table 50 - 802.11n / HT20 MCS0 / SISO / Core 0

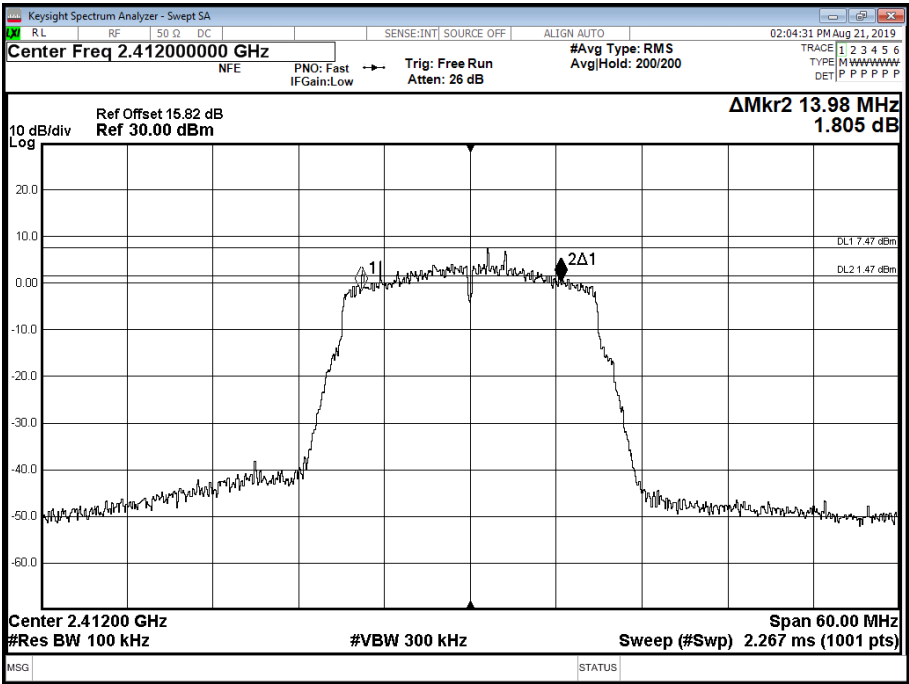


Figure 50 - 2412 MHz - 6 dB DTS Bandwidth

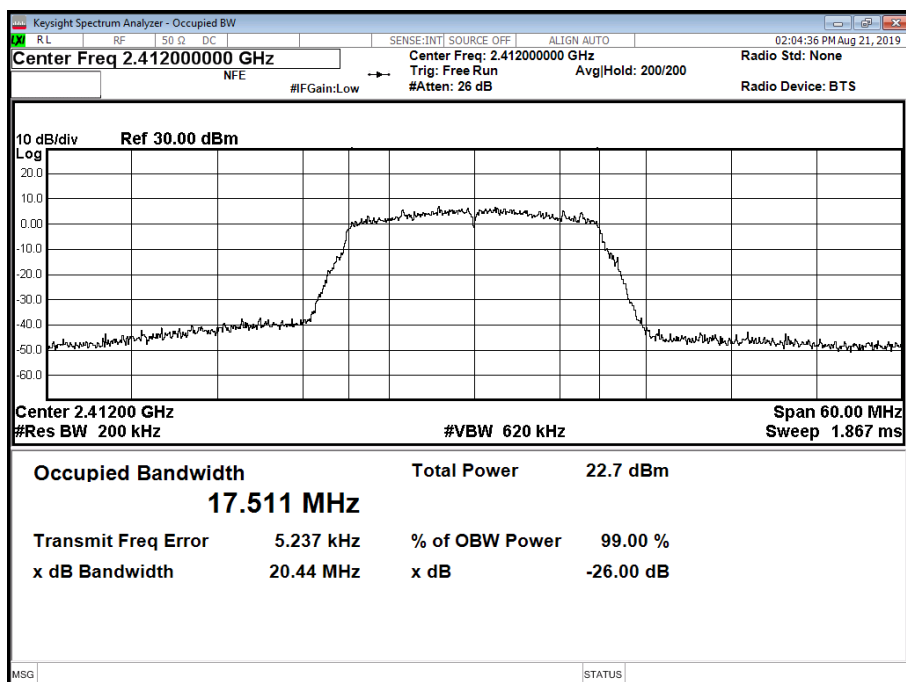


Figure 51 - 2412 MHz - 99% Occupied Bandwidth

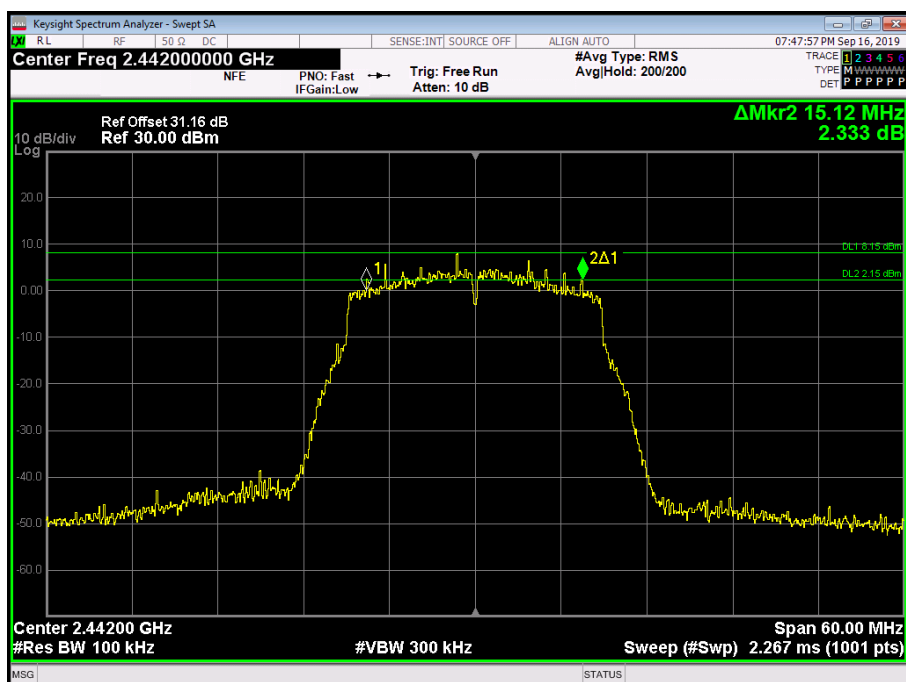


Figure 52 - 2442 MHz - 6 dB DTS Bandwidth

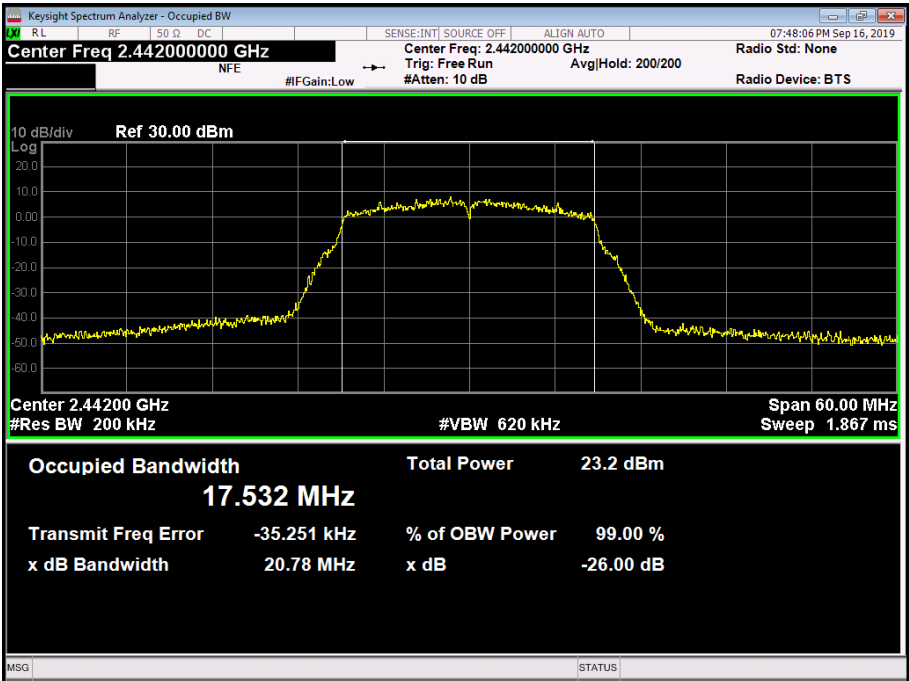


Figure 53 - 2442 MHz - 99% Occupied Bandwidth

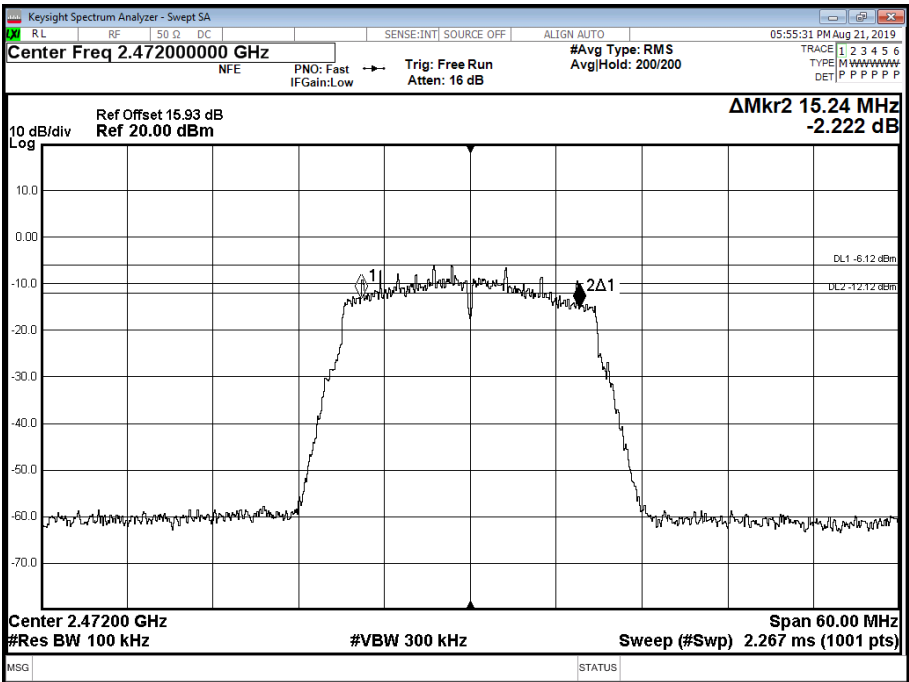


Figure 54 - 2472 MHz - 6 dB DTS Bandwidth

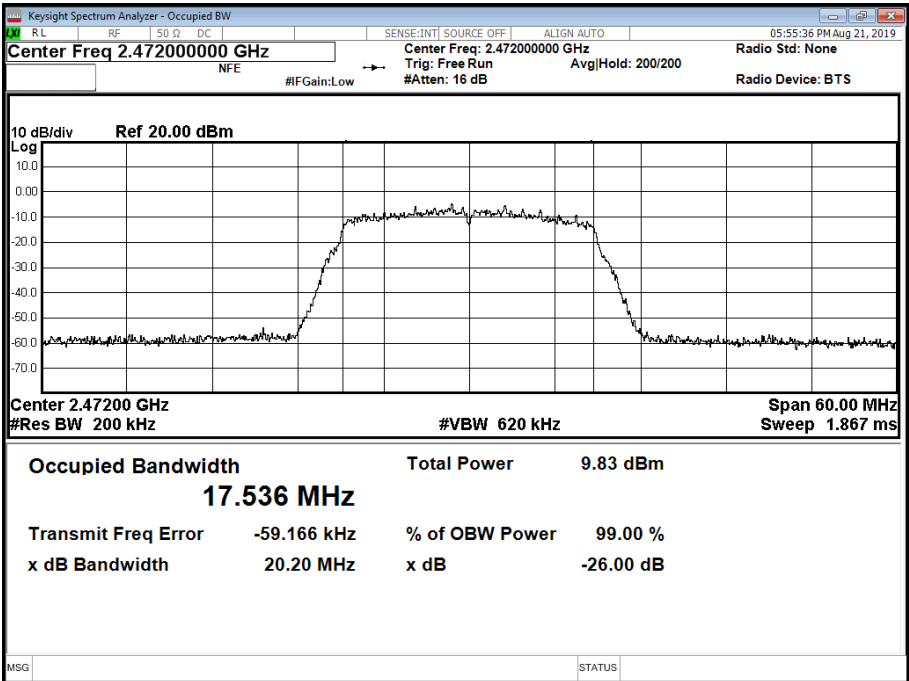


Figure 55 - 2472 MHz - 99% Occupied Bandwidth



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
6 dB Bandwidth (MHz)	15.180	15.240	15.240
99% Bandwidth (MHz)	17.511	17.563	17.573

Table 51 - 802.11n / HT20 MCS0 / MIMO CDD / Cores 0+2

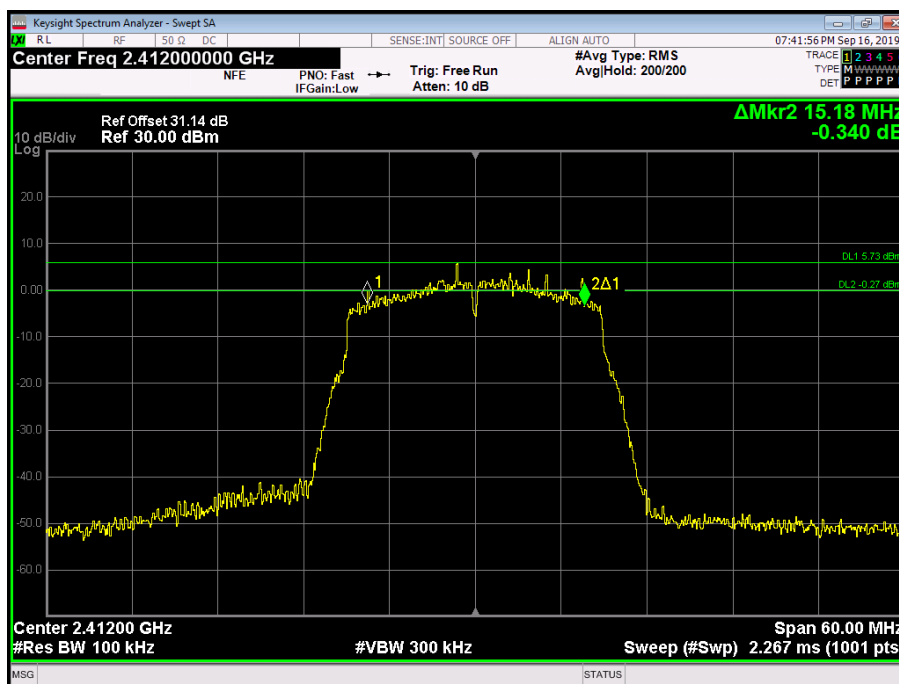


Figure 56 - 2412 MHz - 6 dB DTS Bandwidth

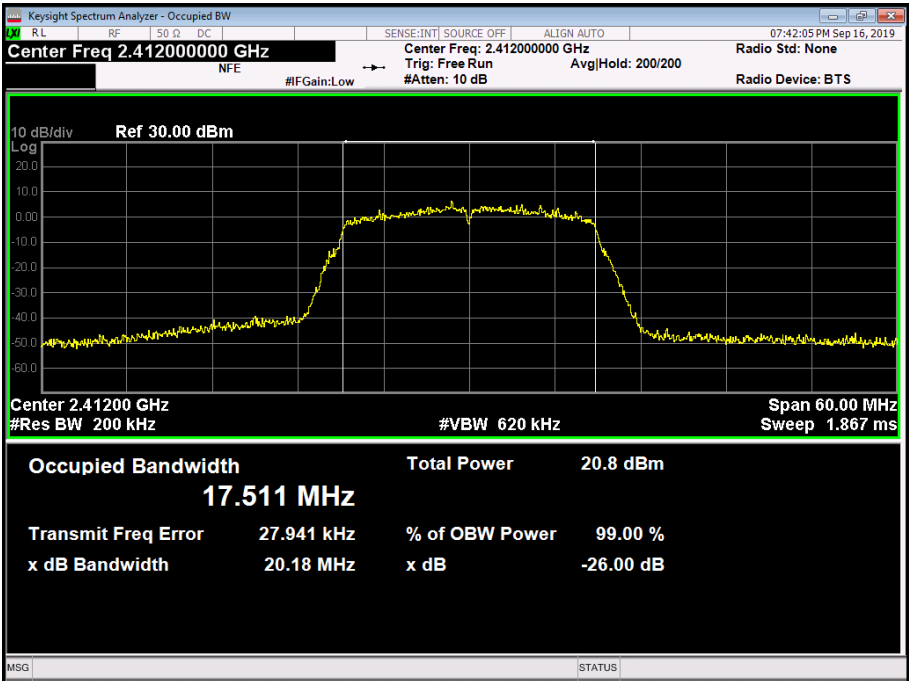


Figure 57 - 2412 MHz - 99% Occupied Bandwidth

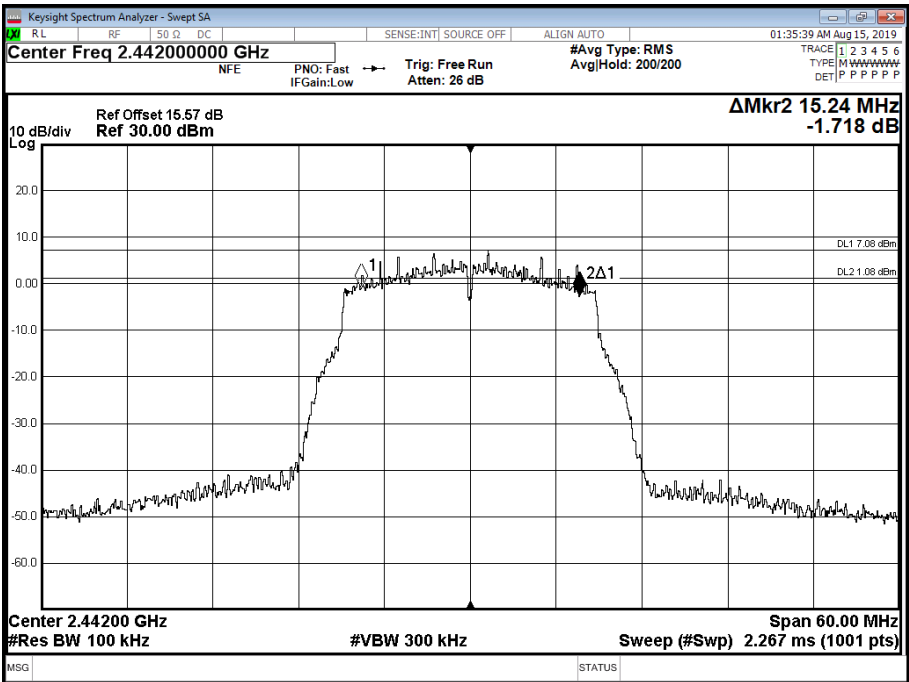


Figure 58 - 2442 MHz - 6 dB DTS Bandwidth

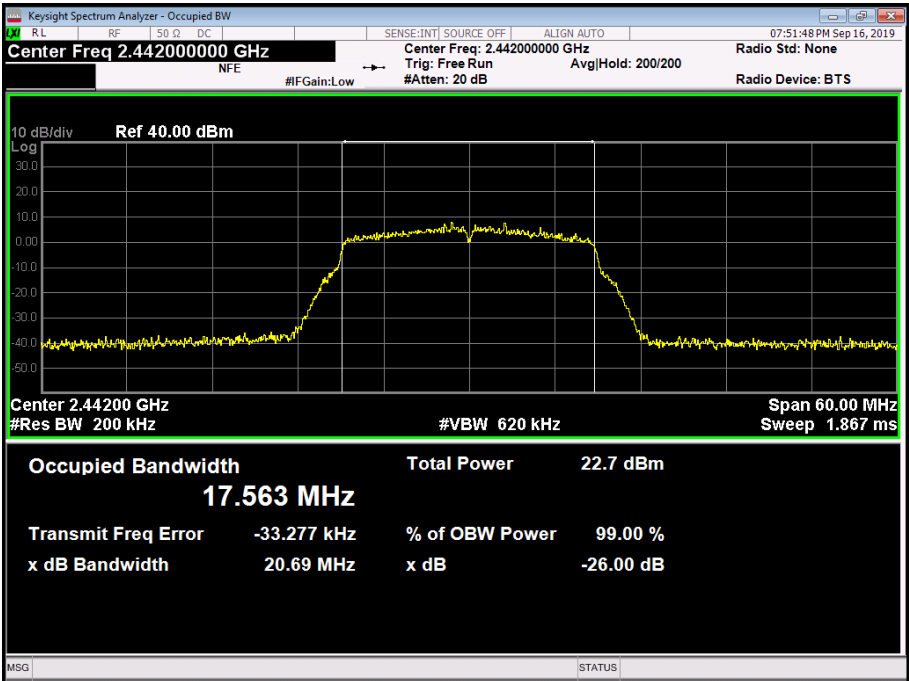


Figure 59 - 2442 MHz - 99% Occupied Bandwidth

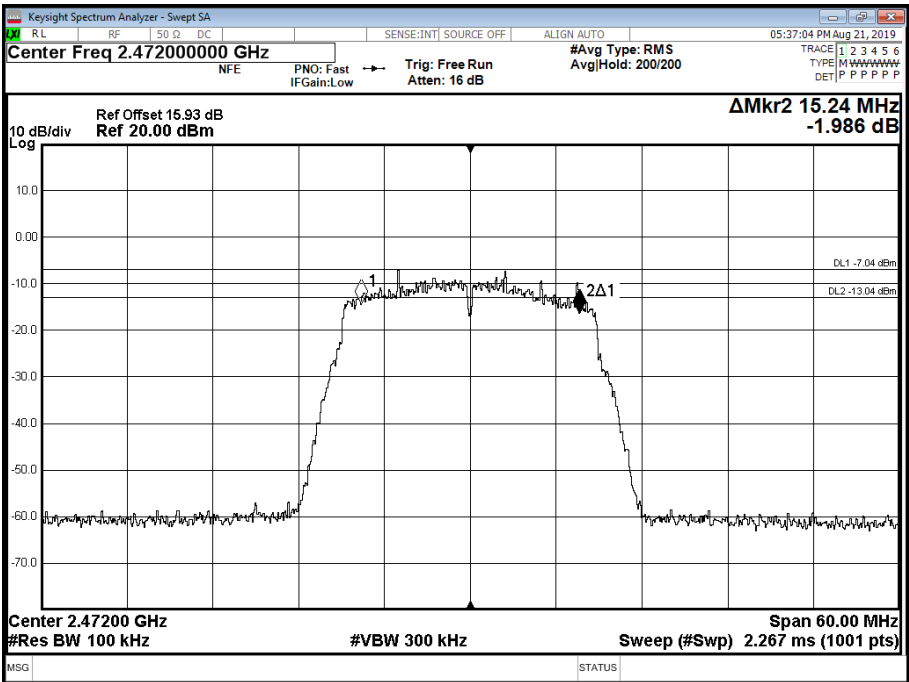


Figure 60 - 2472 MHz - 6 dB DTS Bandwidth

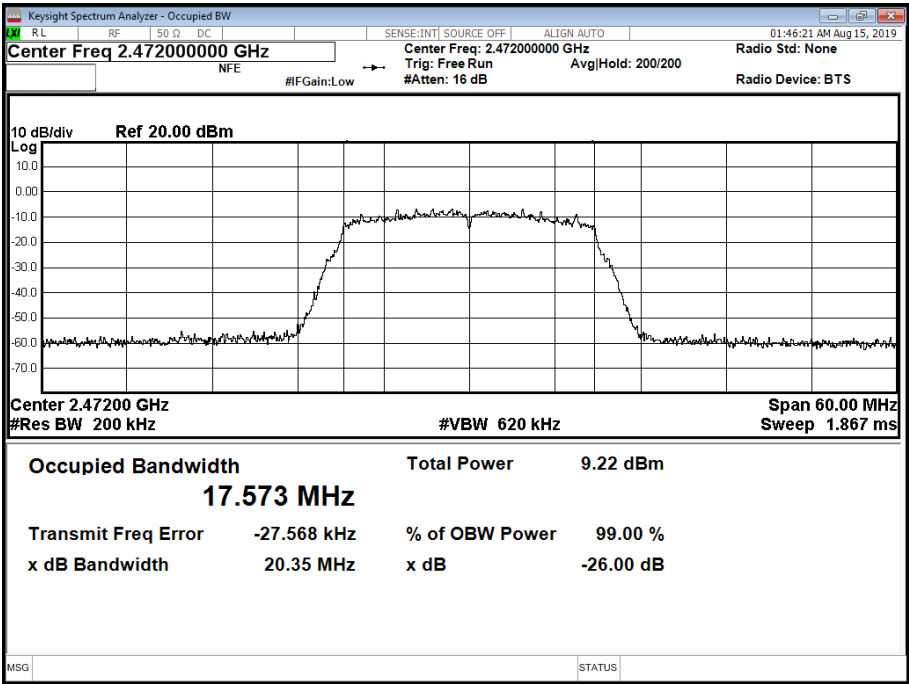


Figure 61 - 2472 MHz - 99% Occupied Bandwidth



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
6 dB Bandwidth (MHz)	13.920	15.180	15.180
99% Bandwidth (MHz)	17.508	17.553	17.557

Table 52 - 802.11n / HT20 MCS8 / MIMO SDM / Cores 0+2

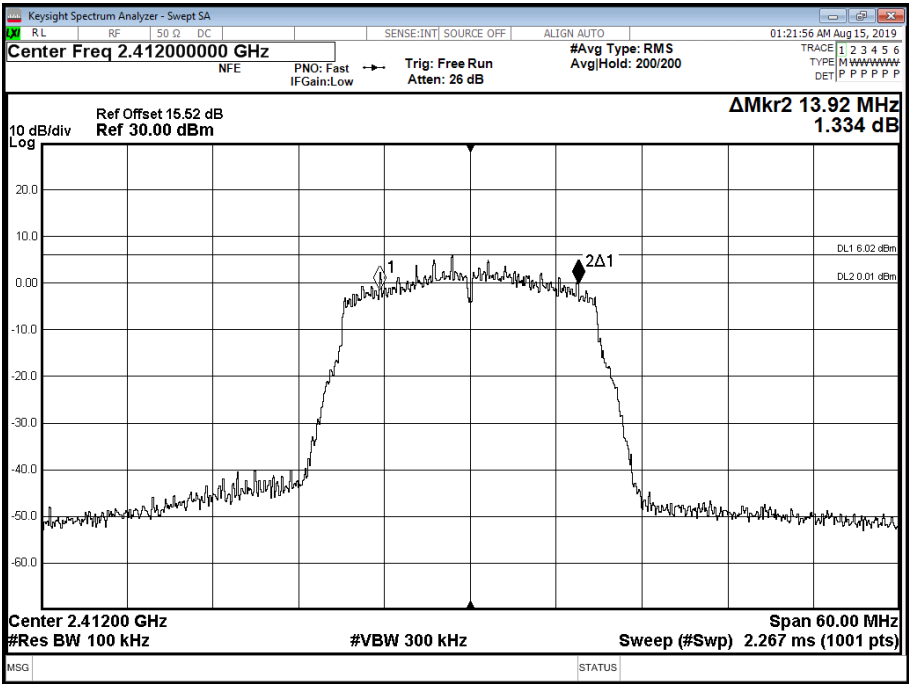


Figure 62 - 2412 MHz - 6 dB DTS Bandwidth

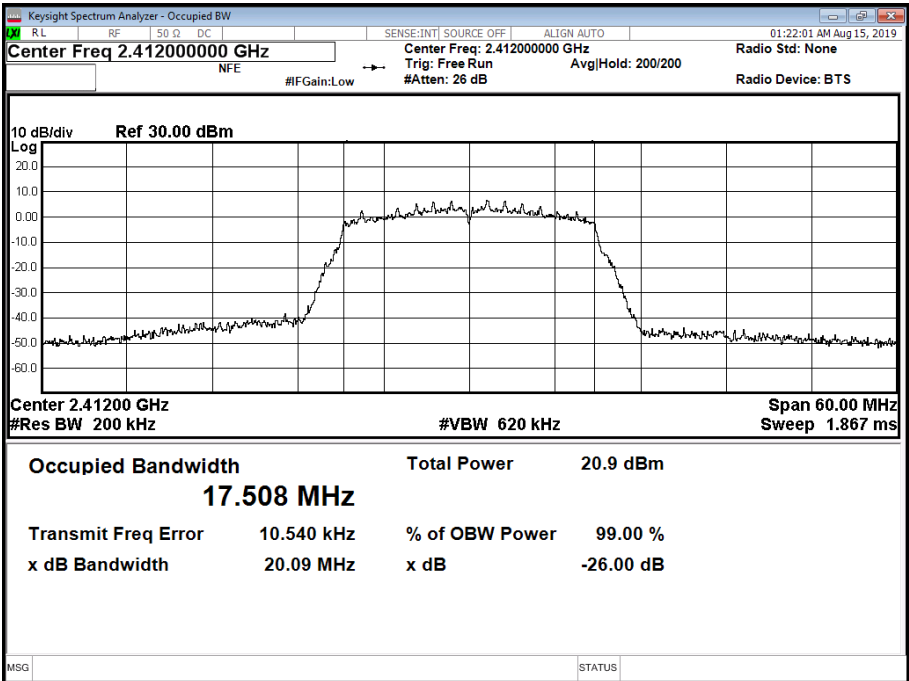


Figure 63 - 2412 MHz - 99% Occupied Bandwidth

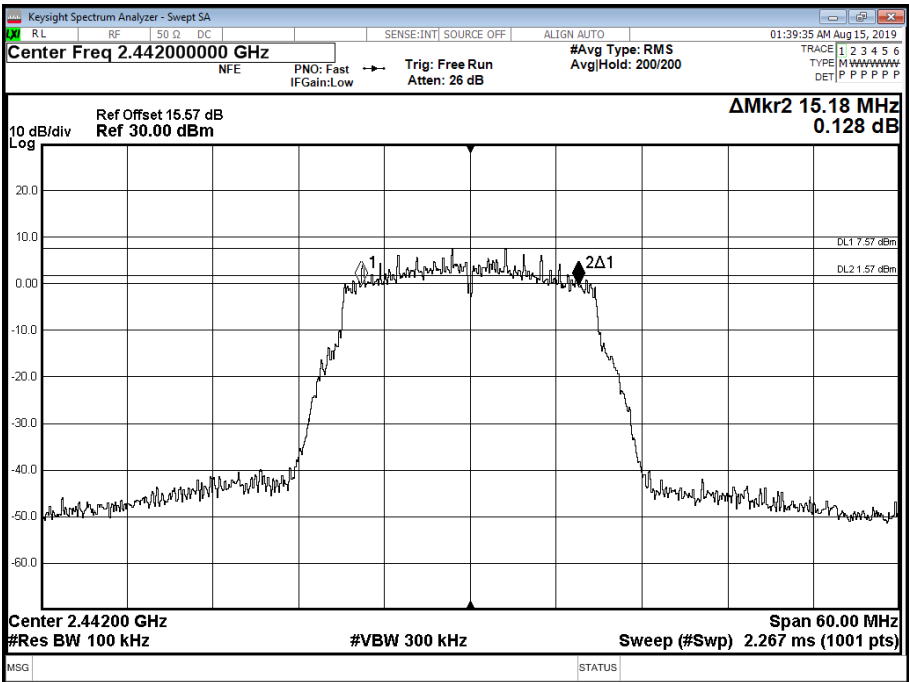


Figure 64 - 2442 MHz - 6 dB DTS Bandwidth

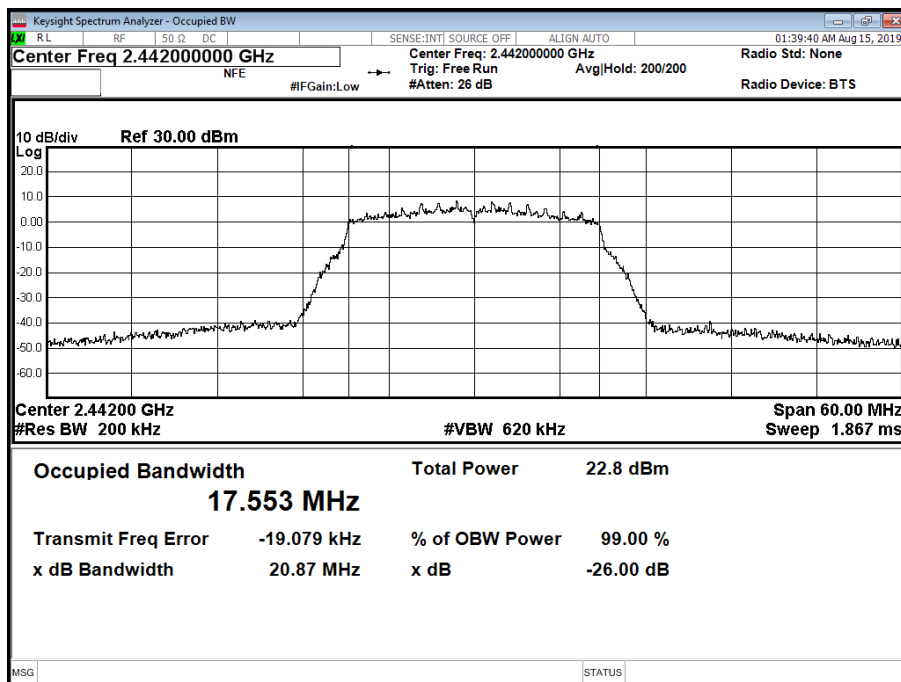


Figure 65 - 2442 MHz - 99% Occupied Bandwidth

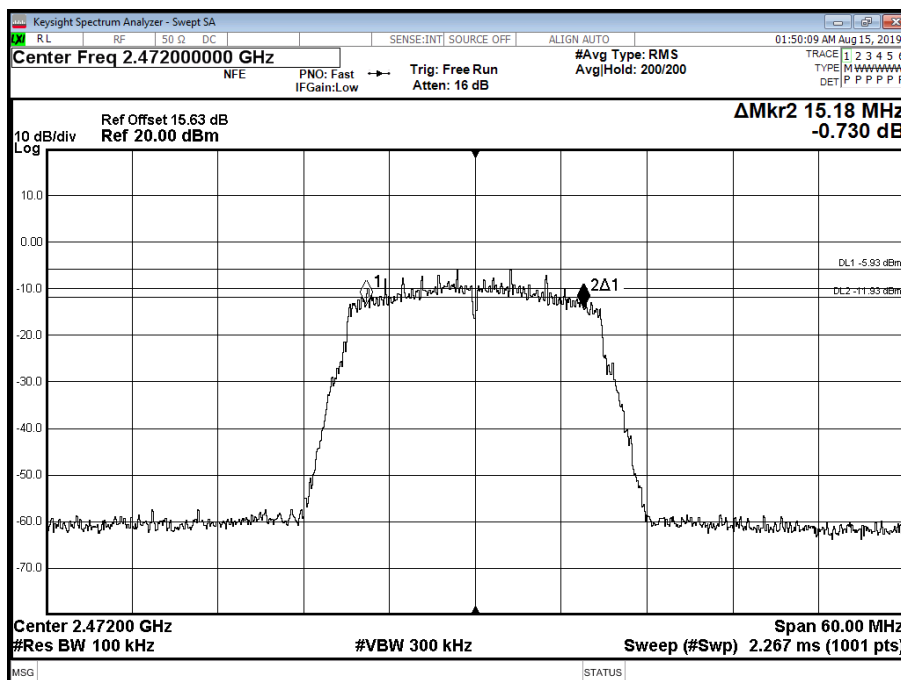


Figure 66 - 2472 MHz - 6 dB DTS Bandwidth

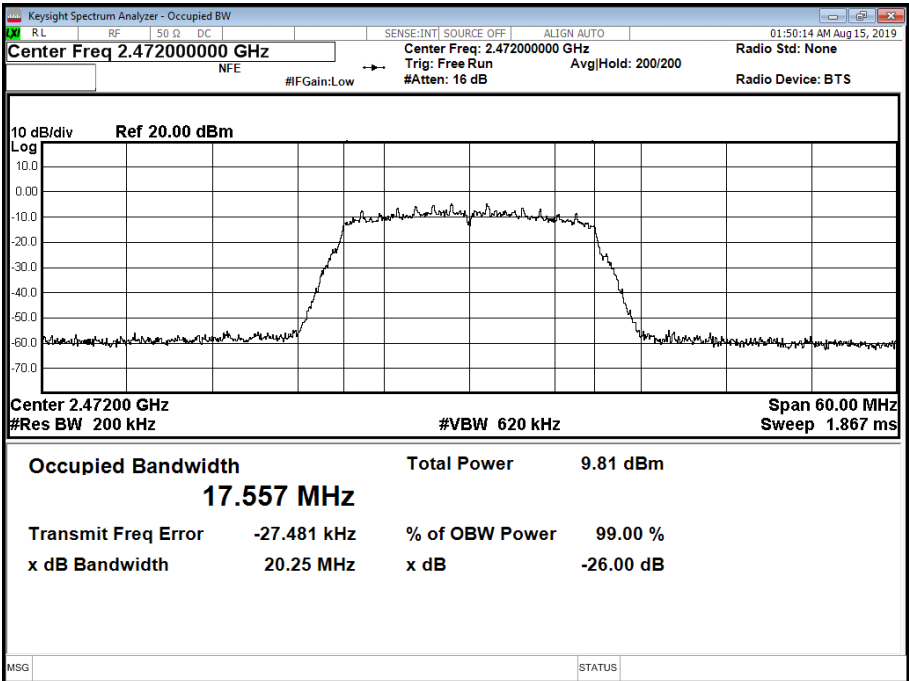


Figure 67 - 2472 MHz - 99% Occupied Bandwidth



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
6 dB Bandwidth (MHz)	10.020	12.060	15.240
99% Bandwidth (MHz)	17.540	17.570	17.558

Table 53 - 802.11n / HT20 MCS0 / MIMO TxBF / Cores 0+2

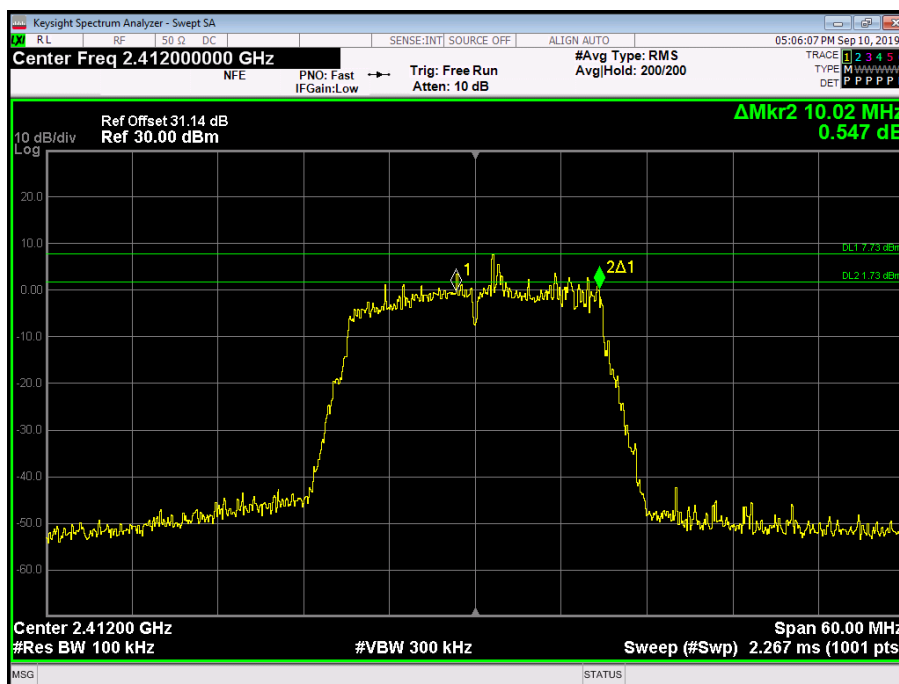


Figure 68 - 2412 MHz - 6 dB DTS Bandwidth

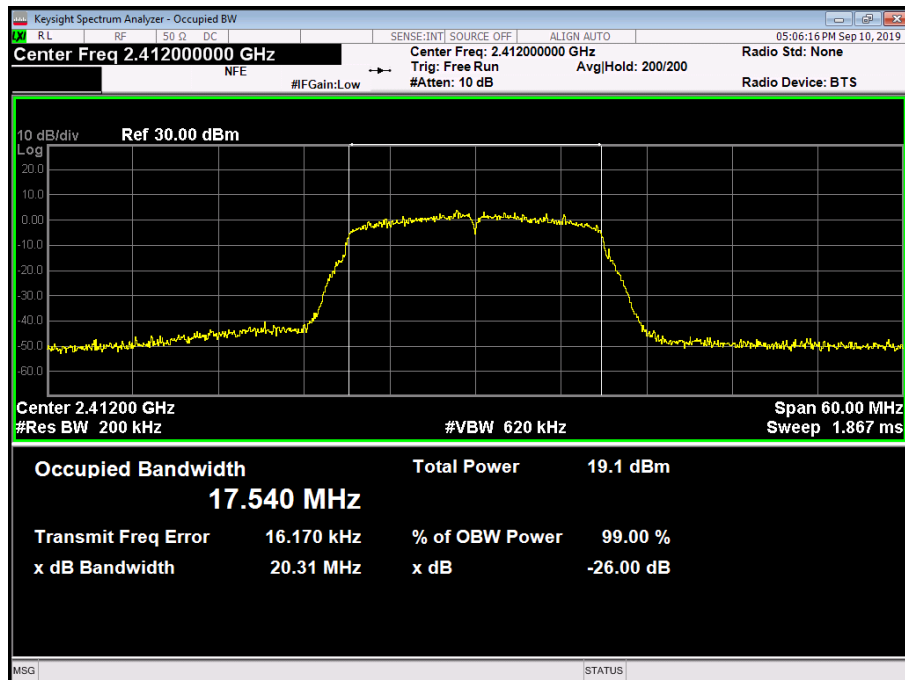


Figure 69 - 2412 MHz - 99% Occupied Bandwidth



Figure 70 - 2442 MHz - 6 dB DTS Bandwidth

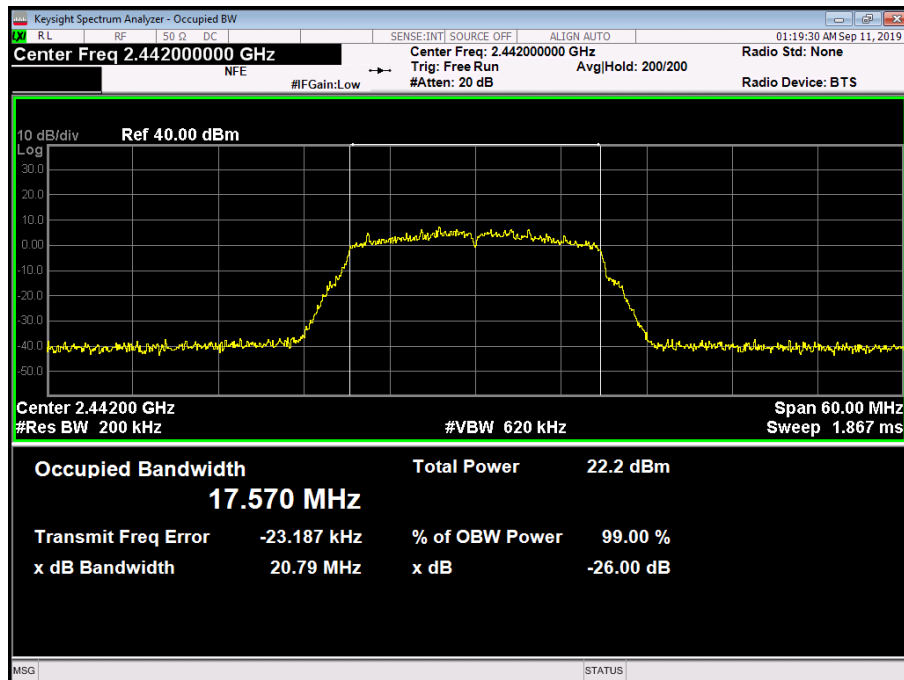


Figure 71 - 2442 MHz - 99% Occupied Bandwidth

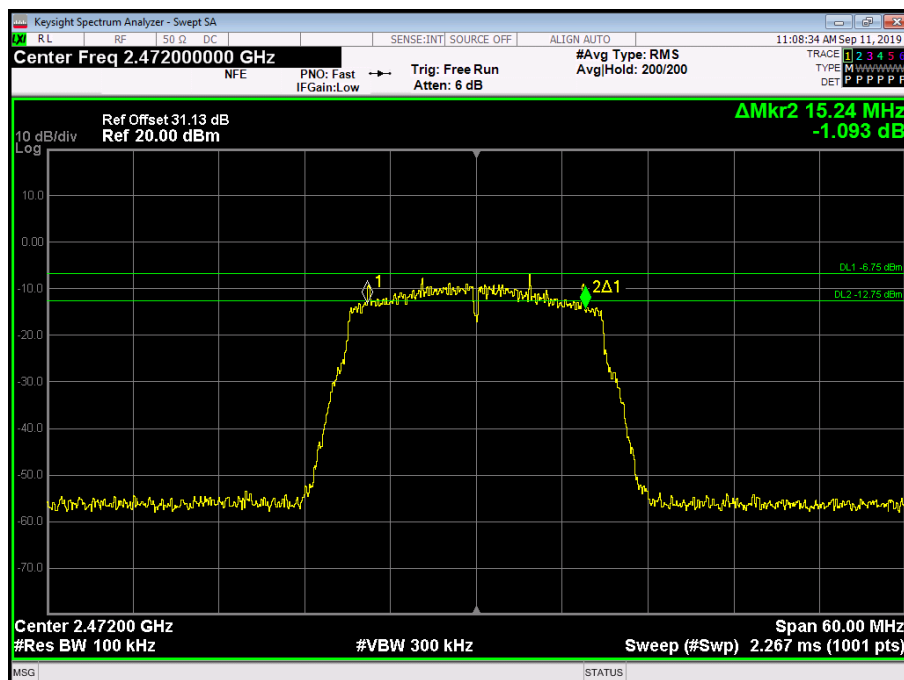


Figure 72 - 2472 MHz - 6 dB DTS Bandwidth

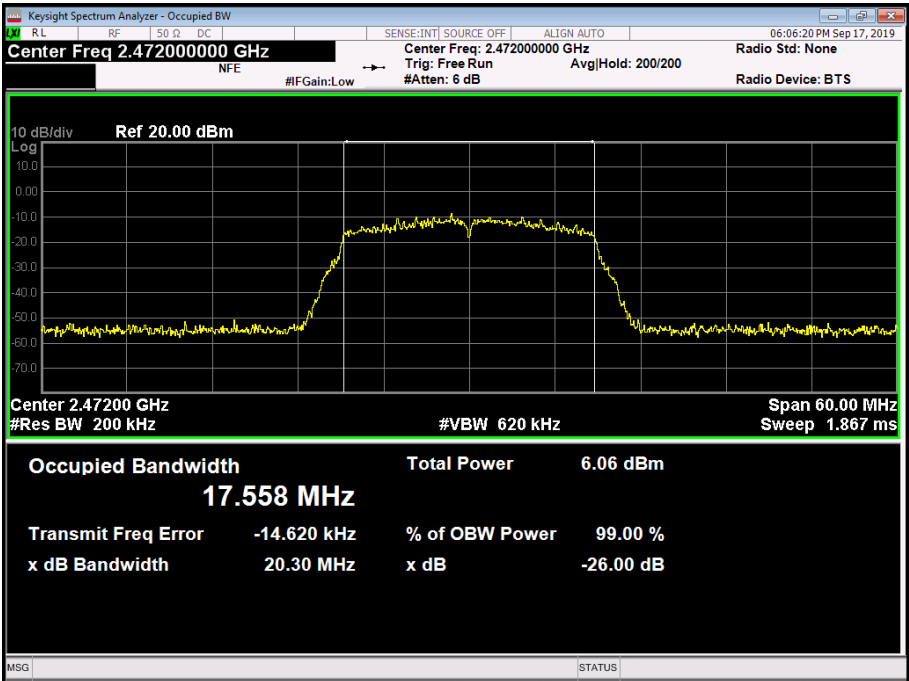


Figure 73 - 2472 MHz - 99% Occupied Bandwidth



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
6 dB Bandwidth (MHz)	13.860	13.980	15.120
99% Bandwidth (MHz)	17.497	17.564	17.536

Table 54 - 802.11n / HT20 MCS0 / MIMO CDD / Cores 0+1+2

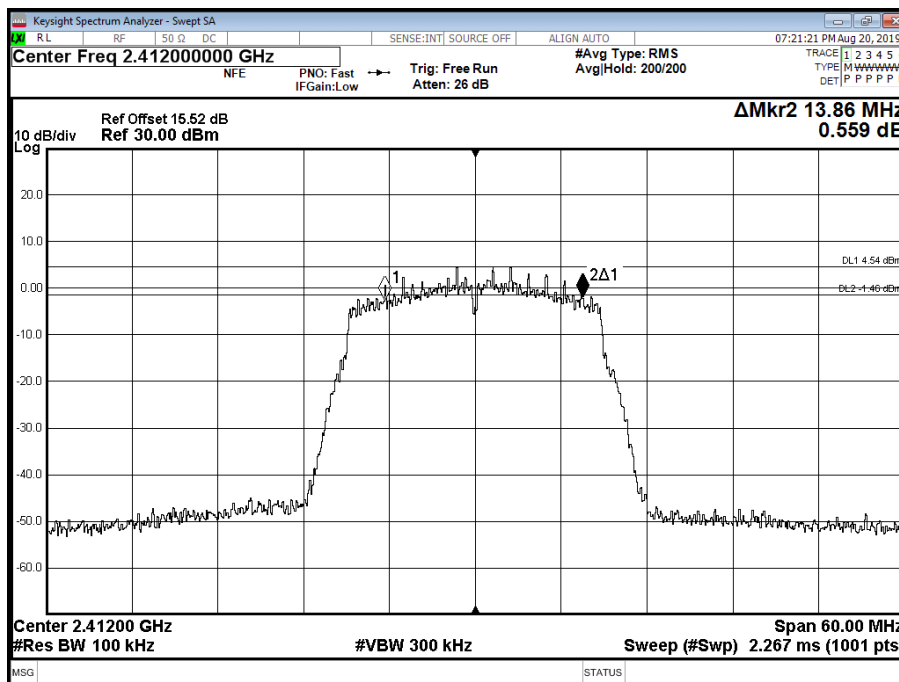


Figure 74 - 2412 MHz - 6 dB DTS Bandwidth

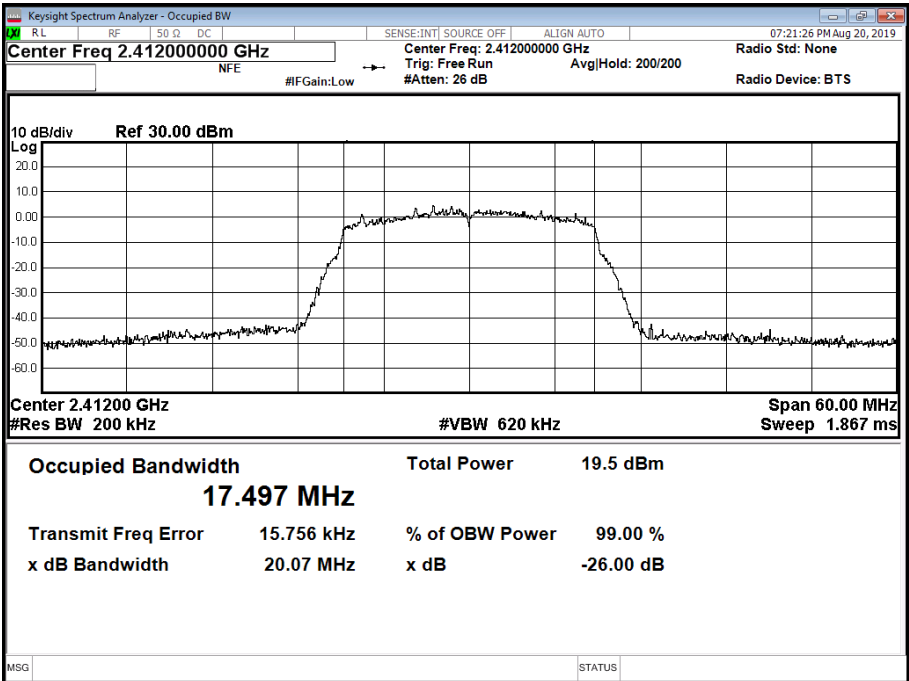


Figure 75 - 2412 MHz - 99% Occupied Bandwidth

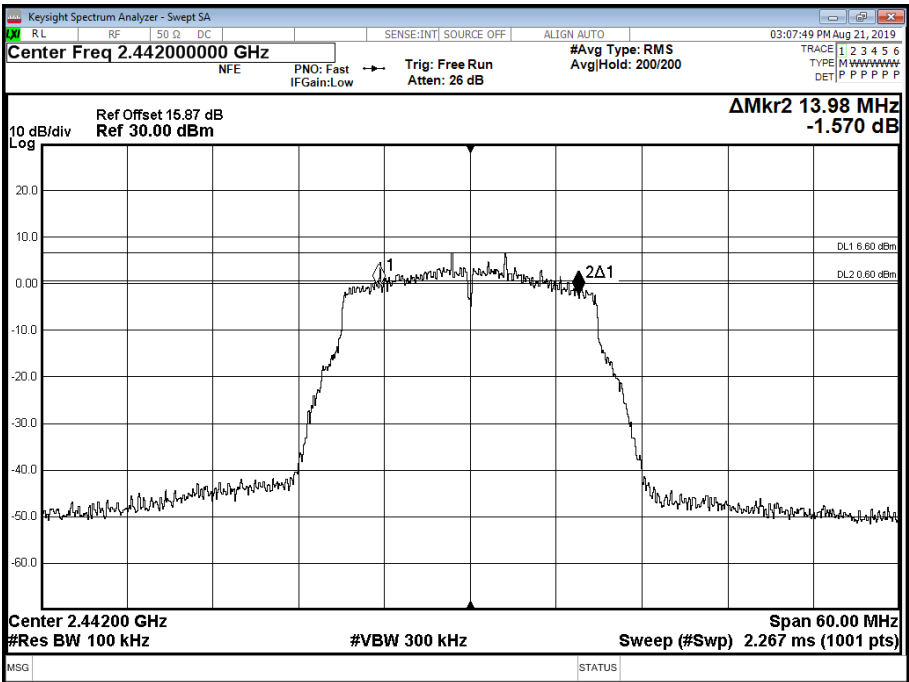


Figure 76 - 2442 MHz - 6 dB DTS Bandwidth

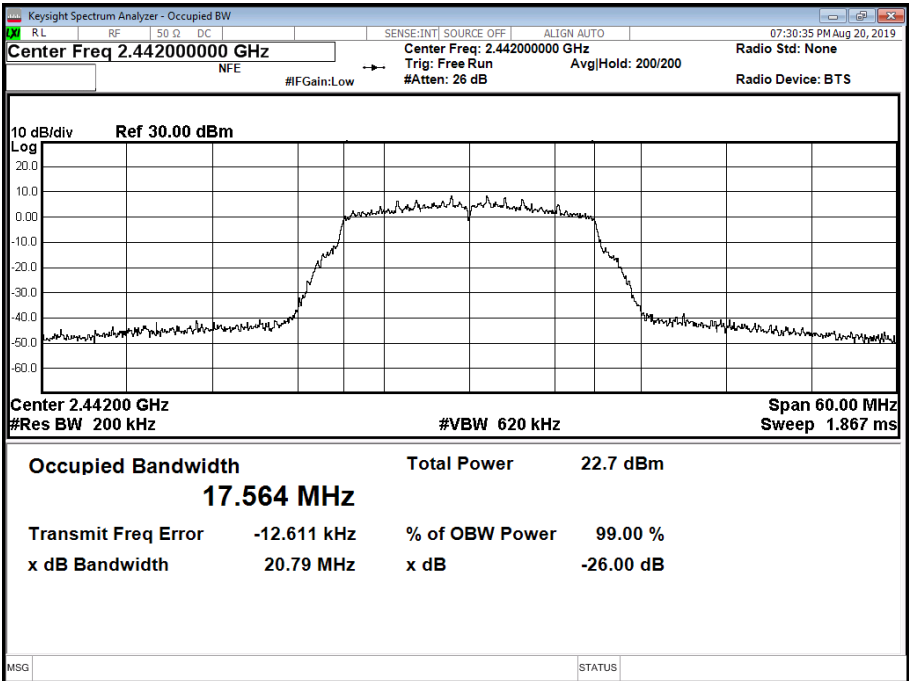


Figure 77 - 2442 MHz - 99% Occupied Bandwidth

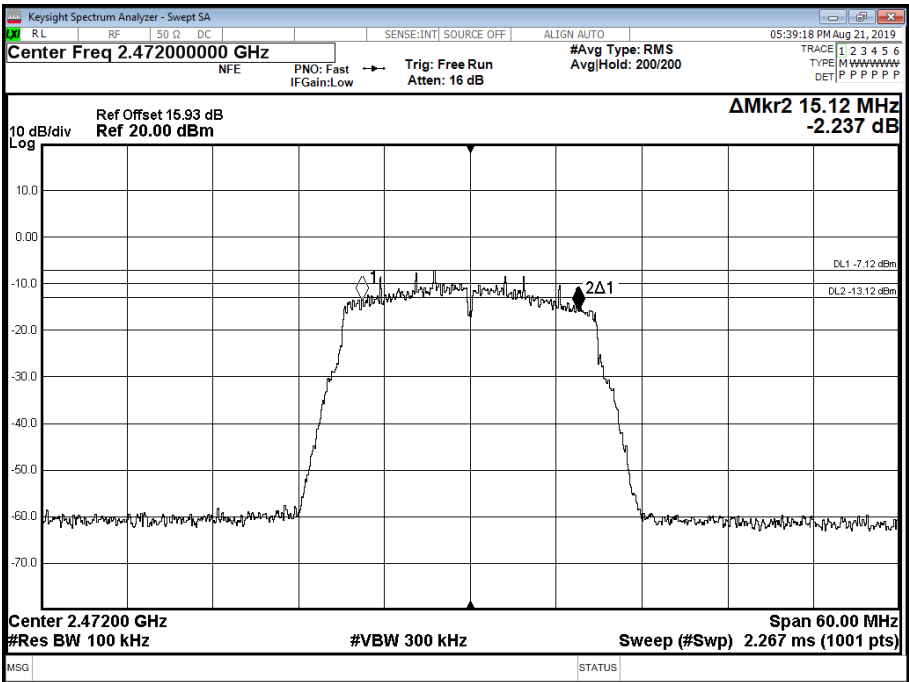


Figure 78 - 2472 MHz - 6 dB DTS Bandwidth

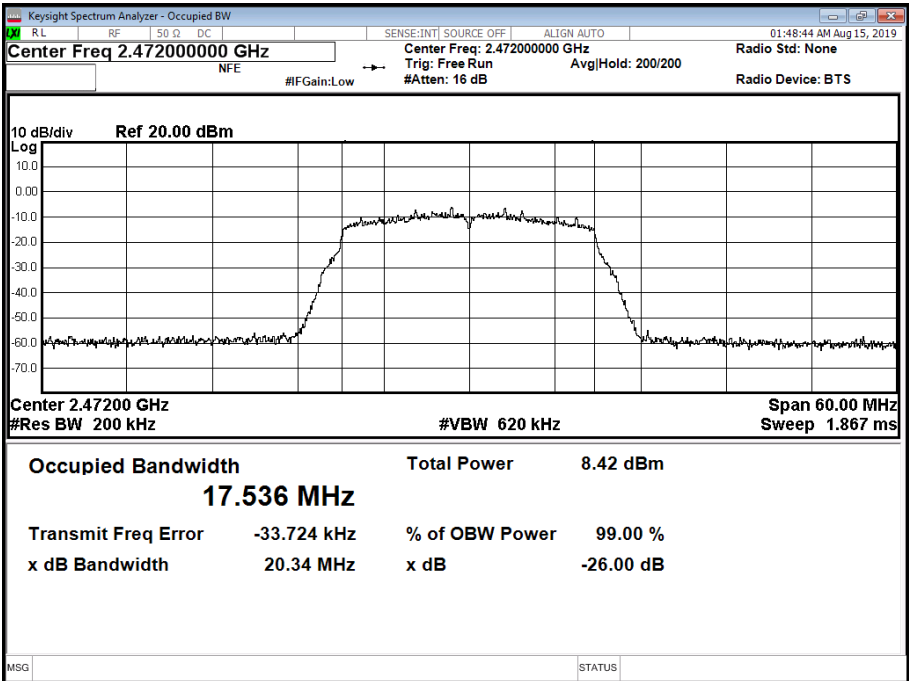


Figure 79 - 2472 MHz - 99% Occupied Bandwidth



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
6 dB Bandwidth (MHz)	15.180	15.240	15.180
99% Bandwidth (MHz)	17.503	17.570	17.553

Table 55 - 802.11n / HT20 MCS16 / MIMO SDM / Cores 0+1+2

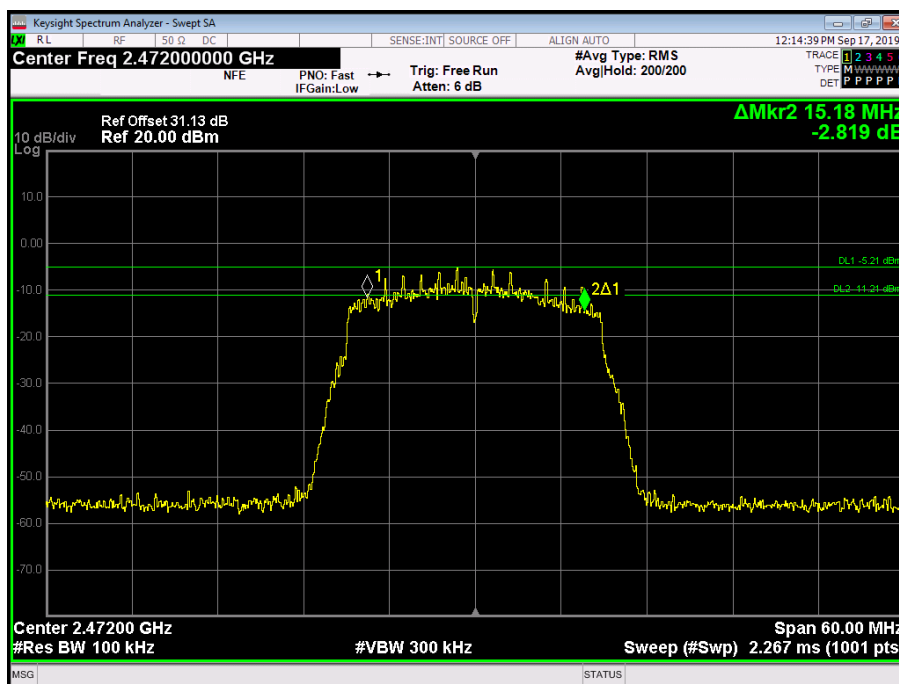


Figure 80 - 2412 MHz - 6 dB DTS Bandwidth

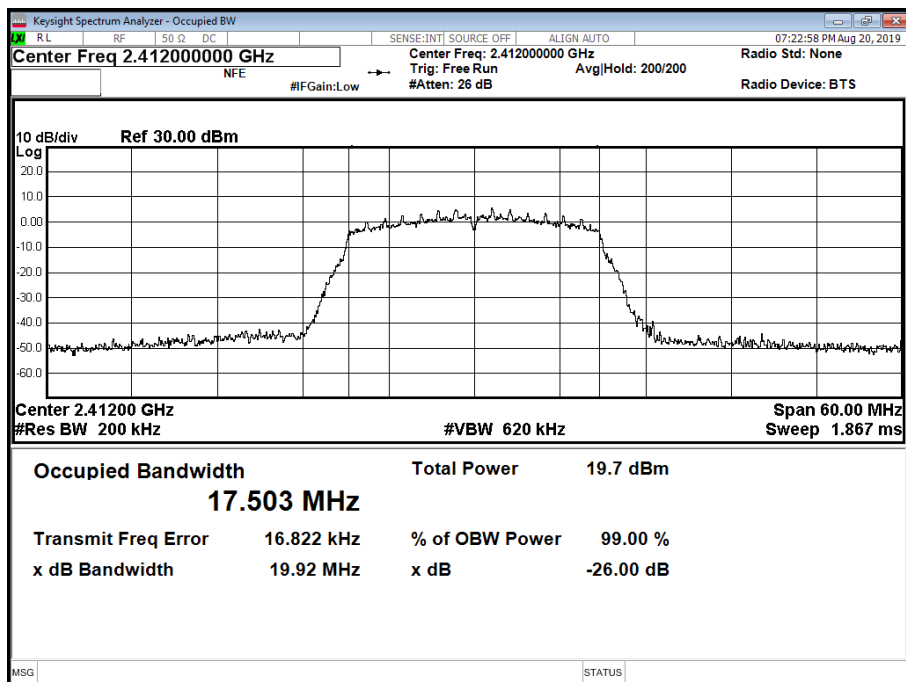


Figure 81 - 2412 MHz - 99% Occupied Bandwidth

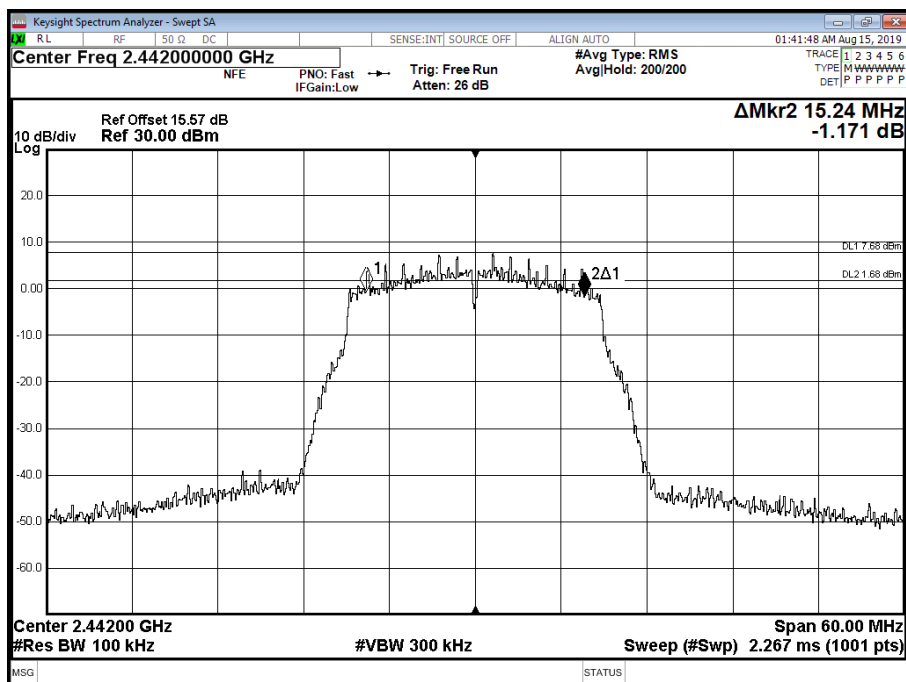


Figure 82 - 2442 MHz - 6 dB DTS Bandwidth

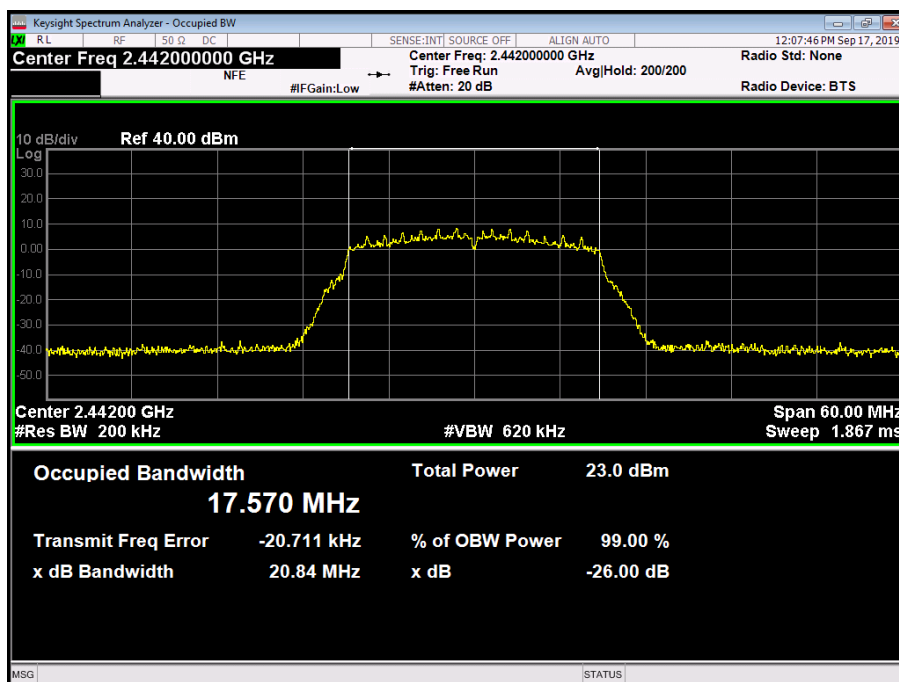


Figure 83 - 2442 MHz - 99% Occupied Bandwidth

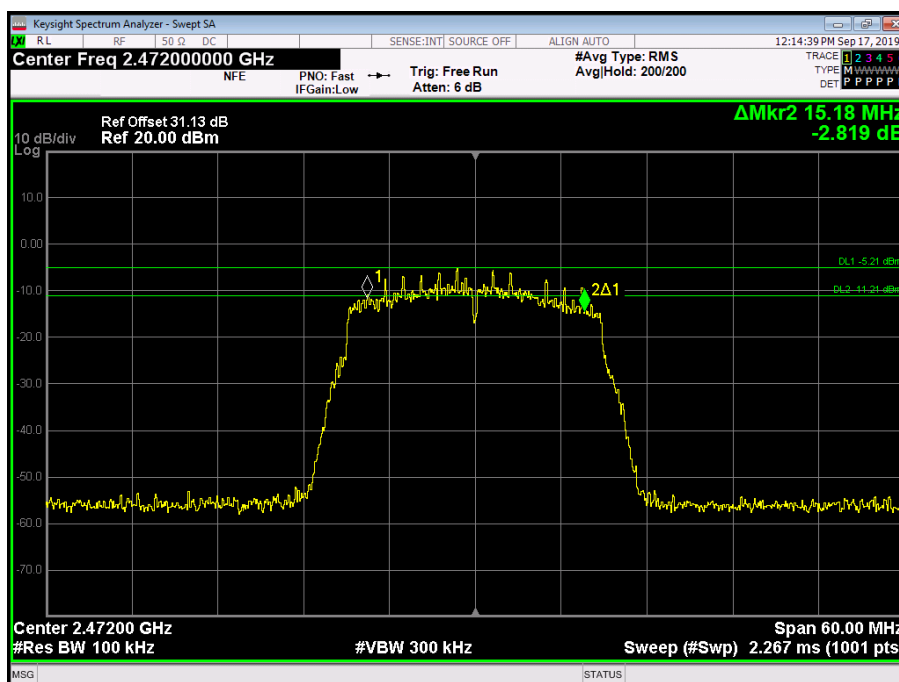


Figure 84 - 2472 MHz - 6 dB DTS Bandwidth

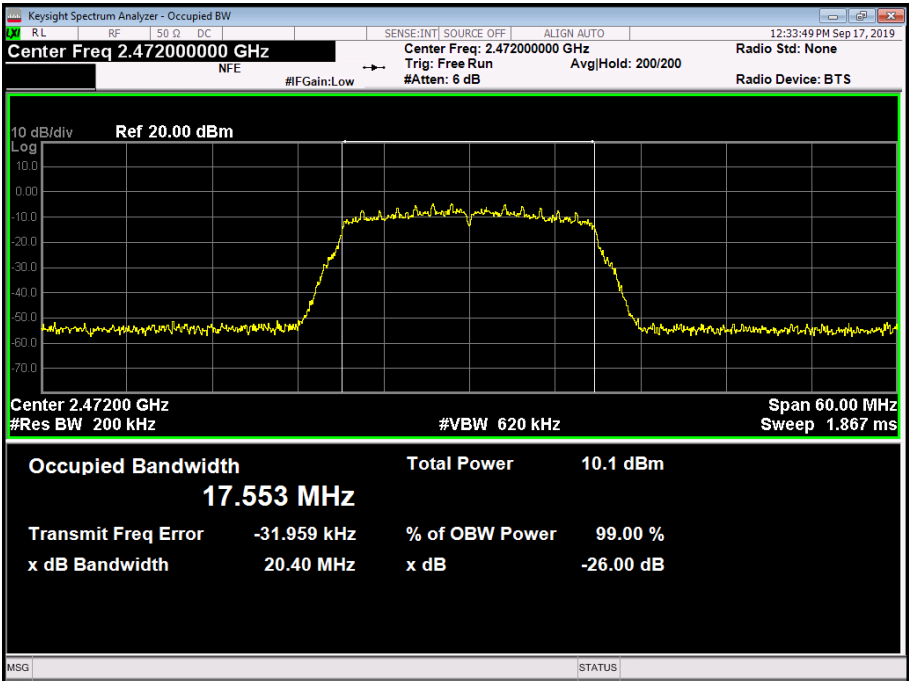


Figure 85 - 2472 MHz - 99% Occupied Bandwidth



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
6 dB Bandwidth (MHz)	13.860	14.280	13.140
99% Bandwidth (MHz)	17.516	17.582	17.561

Table 56 - 802.11n / HT20 MCS0 / MIMO Tx BF / Cores 0+1+2

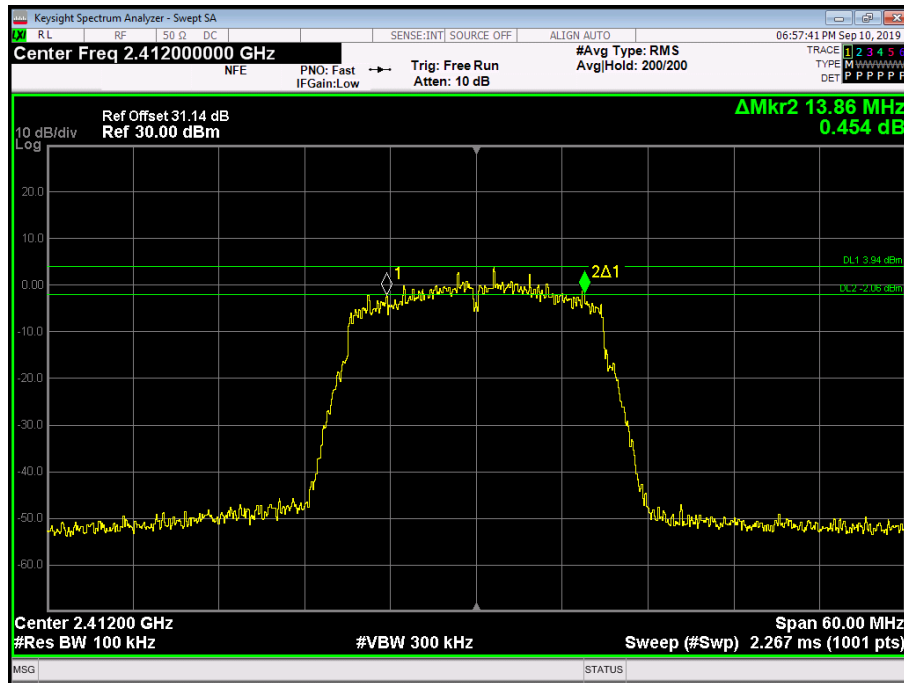


Figure 86 - 2412 MHz - 6 dB DTS Bandwidth

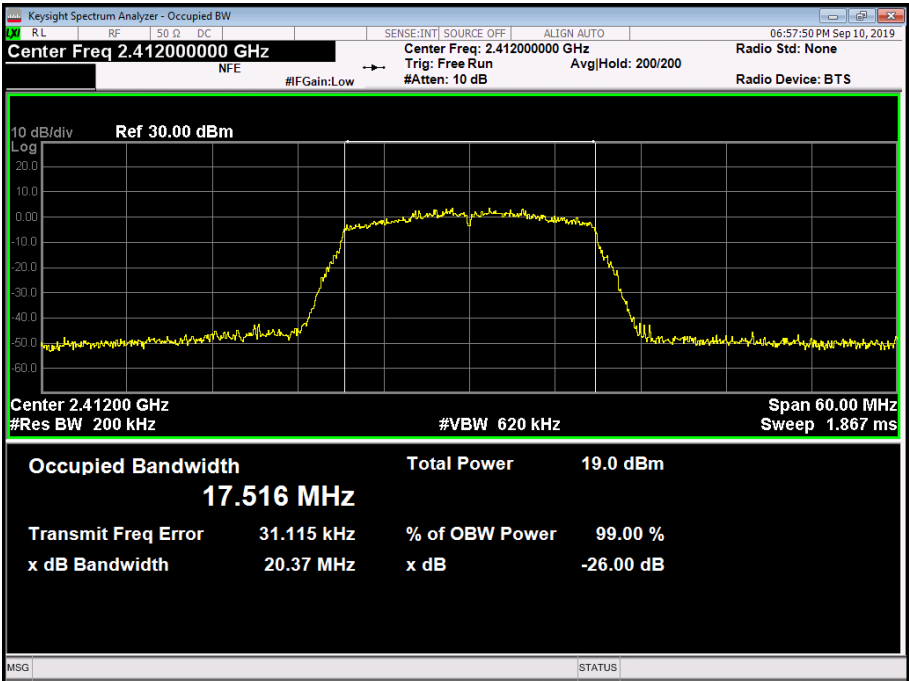


Figure 87 - 2412 MHz - 99% Occupied Bandwidth

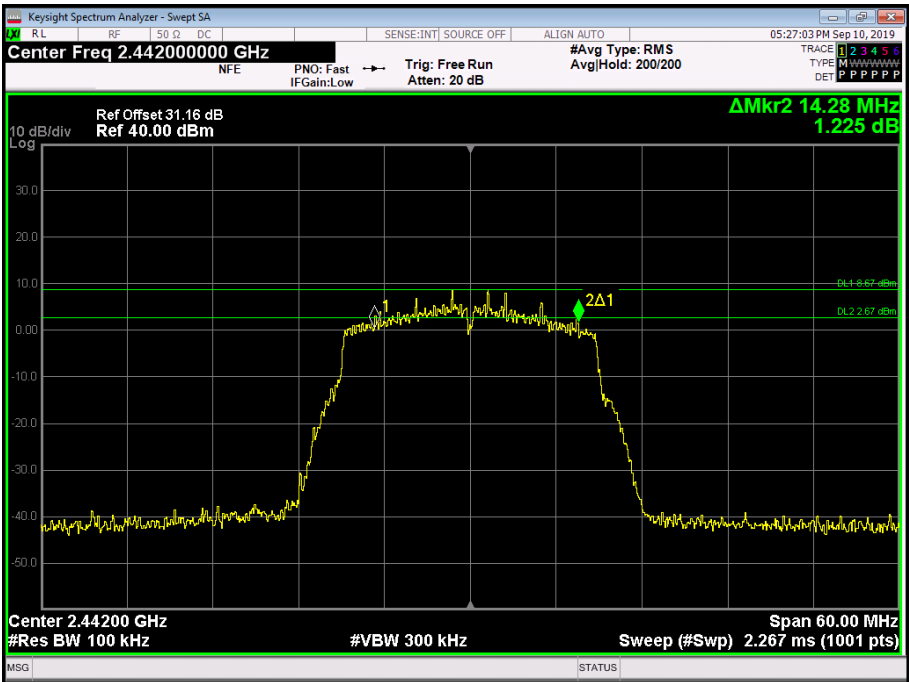


Figure 88 - 2442 MHz - 6 dB DTS Bandwidth

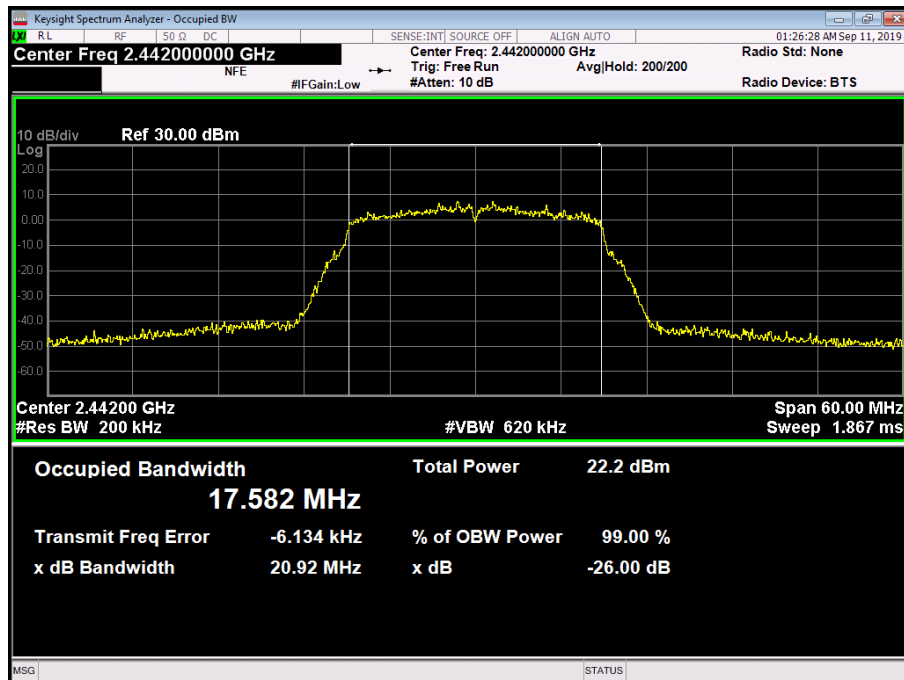


Figure 89 - 2442 MHz - 99% Occupied Bandwidth

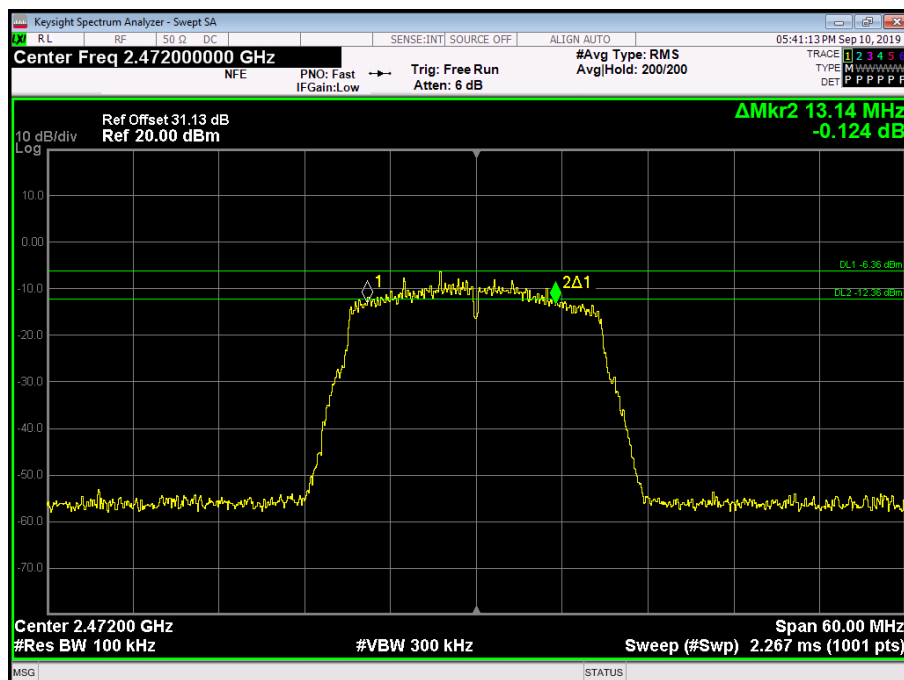


Figure 90 - 2472 MHz - 6 dB DTS Bandwidth

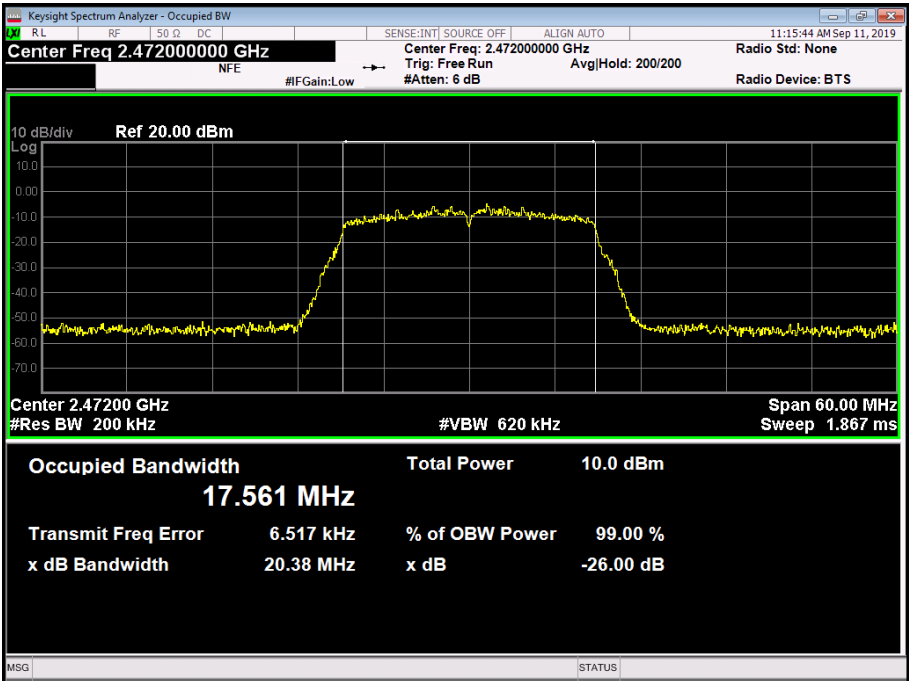


Figure 91 - 2472 MHz - 99% Occupied Bandwidth



Channel	Bottom	Middle	Top
Frequency (MHz)	2412	2442	2472
6 dB Bandwidth (MHz)	17.640	17.700	17.700
99% Bandwidth (MHz)	17.763	17.832	17.815

Table 57 - 802.11n / HT20 MCS0 / Aux Core

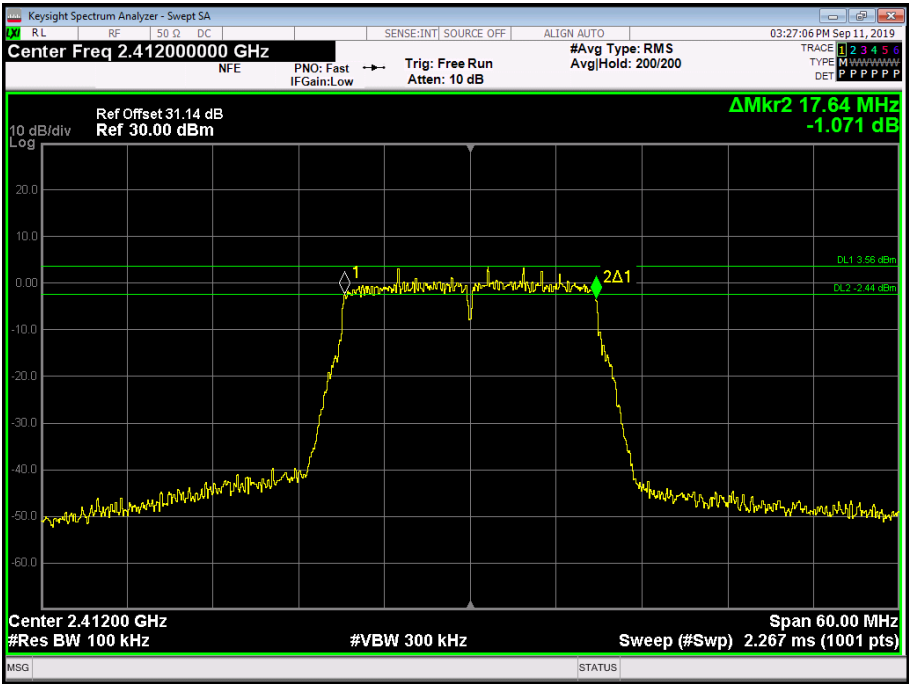


Figure 92 - 2412 MHz - 6 dB DTS Bandwidth

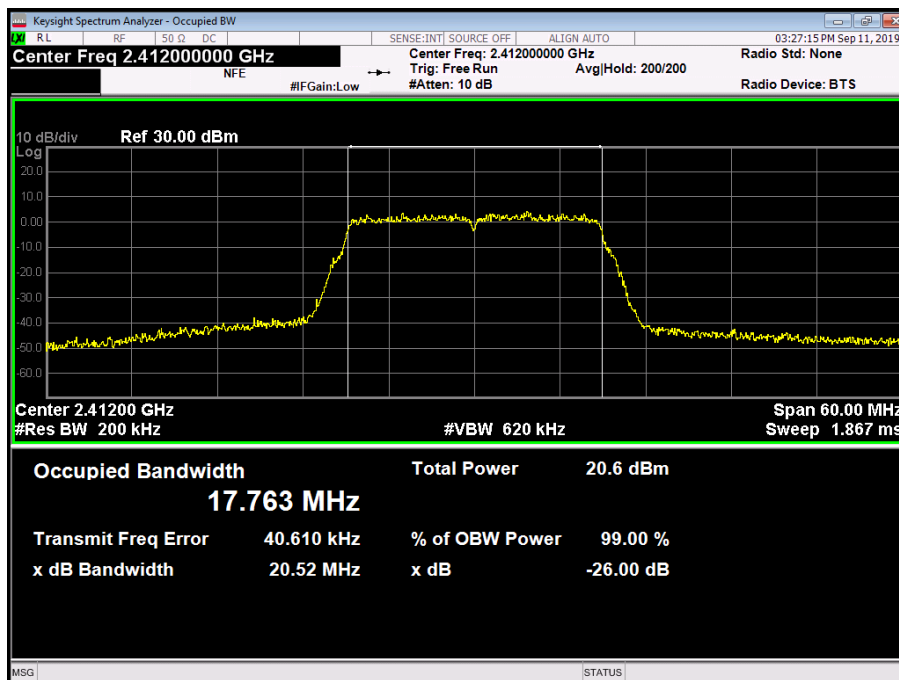


Figure 93 - 2412 MHz - 99% Occupied Bandwidth

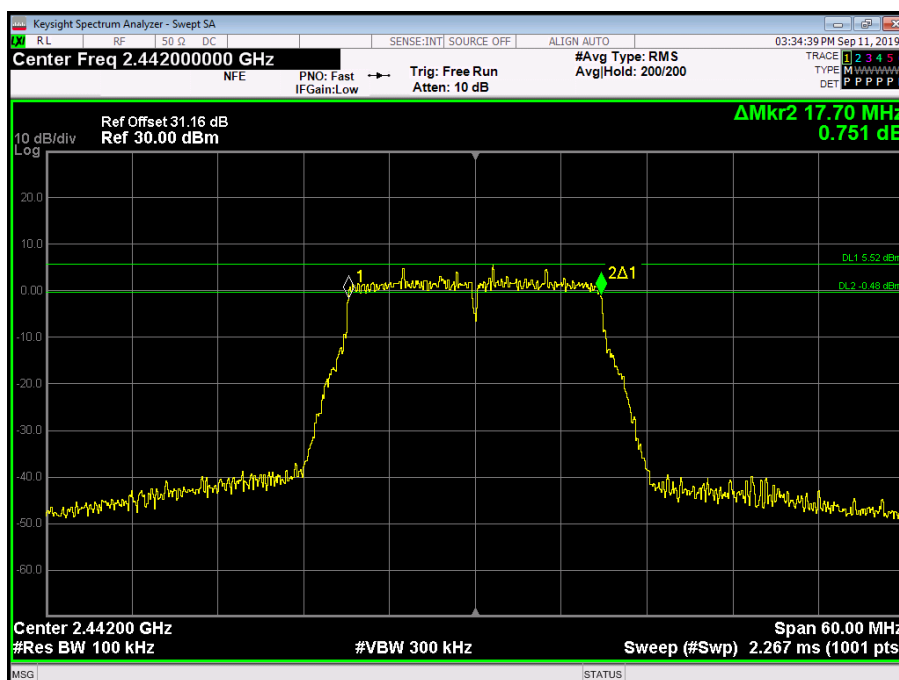


Figure 94 - 2442 MHz - 6 dB DTS Bandwidth

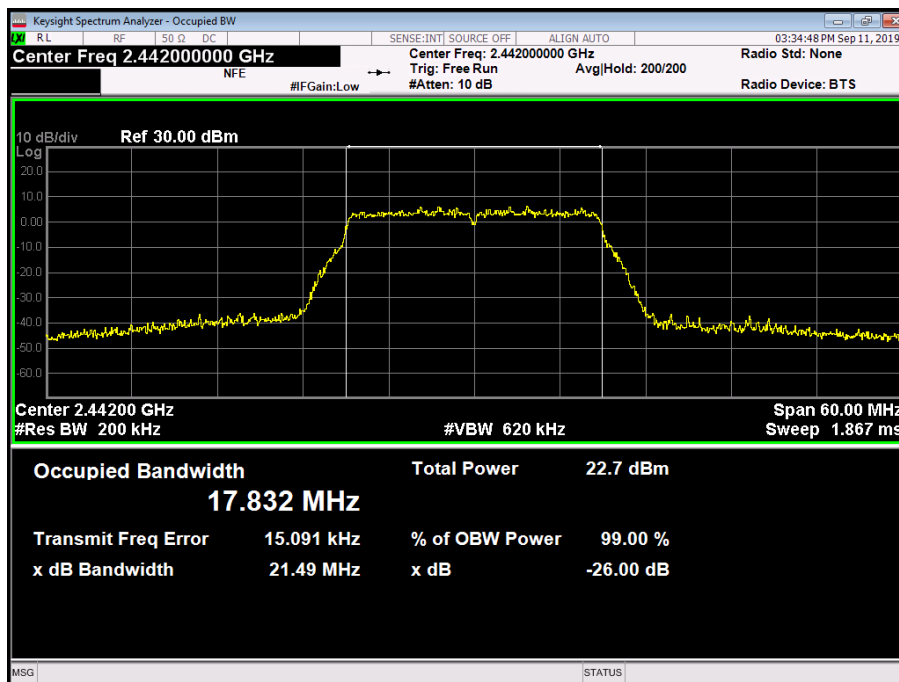


Figure 95 - 2442 MHz - 99% Occupied Bandwidth

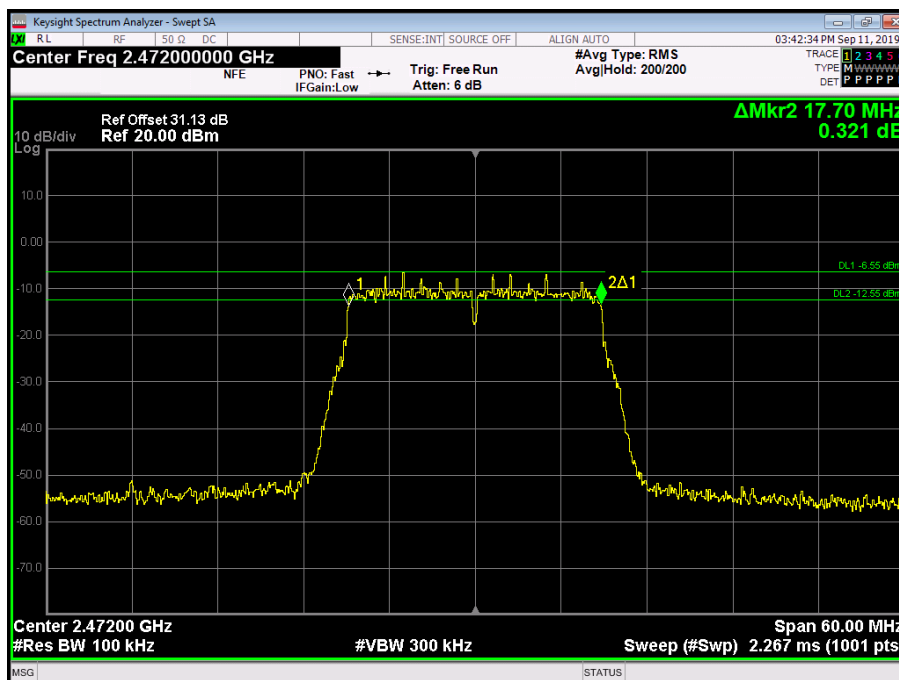


Figure 96 - 2472 MHz - 6 dB DTS Bandwidth

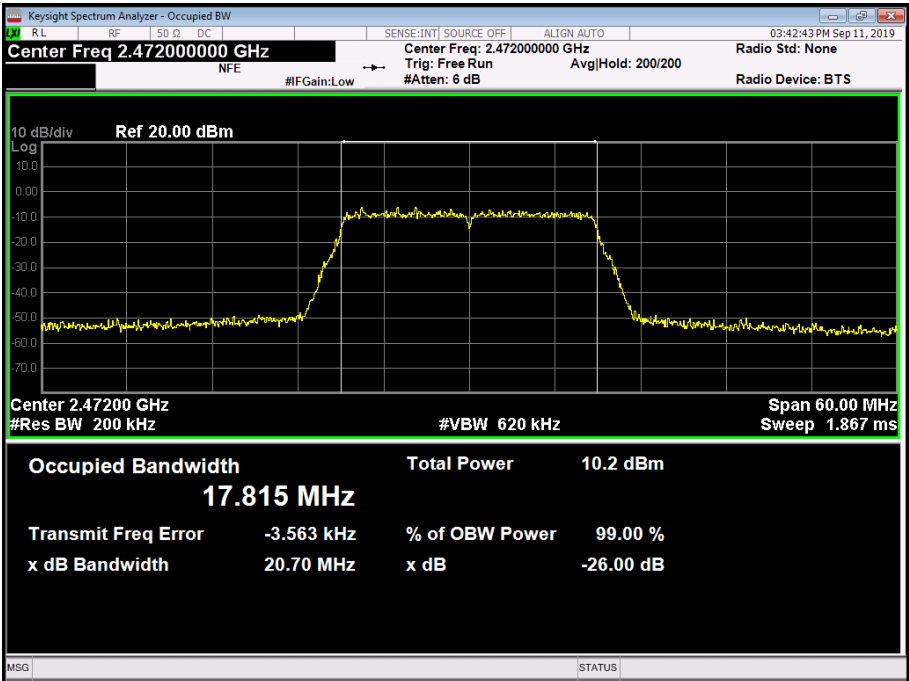


Figure 97 - 2472 MHz - 99% Occupied Bandwidth

FCC 47 CFR Part 15, Limit Clause 15.247(a)(2) and ISEDC 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
Hygropalm Temperature and Humidity Meter	Rotronic	HP21	4410	12	13-Jun-2020
Hygrometer	Rotronic	I-1000	2891	12	02-Oct-2020
True RMS Multimeter	Fluke	179	4007	12	30-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
USB Power Sensor	Boonton	RTP5006	5184	12	12-Dec-2019
AC Programmable PSU	iTech	IT7324	5227	-	O/P Mon
Power Splitter, 4 way	Mini-Circuits	ZN4PD1-63-S+	5235	-	O/P Mon
Power Splitter, 4 way	Mini-Circuits	ZN4PD1-63-S+	5236	-	O/P Mon
Power Splitter, 2 way	Mini-Circuits	ZN2PD2-63-S+	5238	-	O/P Mon
Power splitter, 2 port	Mini-Circuits	ZN2PD-63-S+	4742	-	O/P Mon
Attenuator 10dB 2W	Telegartner	J01156A0031	N/A	-	O/P Mon
Attenuator 10dB 2W	Telegartner	J01156A0031	N/A	-	O/P Mon
Attenuator 10dB 2W	Telegartner	J01156A0031	N/A	-	O/P Mon
Attenuator 10dB 2W	Telegartner	J01156A0031	N/A	-	O/P Mon

Table 58

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)
ISED RSS-247, Clause 5.5

2.4.2 Equipment Under Test and Modification State

A2141, S/N: C02YT00GL51N - Modification State 0

2.4.3 Date of Test

28 June 2019 to 30 July 2019

2.4.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.10.4. Authorised band edge measurements were performed, with the device operating in SISO and MIMO configurations, across the various modes supported by the device.

Since compliance with the power limits in section 2.1 was shown by RMS averaging across all symbols in the signaling alphabet, a 30 dBc limit rather than 20 dBc limit was applied in accordance with FCC 47 CFR Part 15.247 paragraph (d) and RSS-247 section 5.5.

The measurements displayed within this report, have in some cases 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.

2.4.5 Environmental Conditions

Ambient Temperature 21.0 - 23.0 °C
Relative Humidity 45.0 - 62.7 %

2.4.6 Test Results

AUX (SISO)

Mode	Data Rate	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
802.11b	1 Mbps	2412	2398.50	-45.61
802.11g	6 Mbps	2412	2399.15	-39.91
802.11n	MCS0	2412	2398.25	-39.69

Table 59