

Report on the FCC and IC Testing of: Apple Inc. Model: A1993

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: BCGA1993

IC: 579C-A1993



Product Service

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Document Number: 75942779-12 | Issue: 02

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NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Matthew Russell	RF Team Leader	Authorised Signatory	08 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
Mehadi Choudhury	Test Engineer	Testing	08 October 2018
Graeme Lawler	Test Engineer	Testing	08 October 2018
Tony Hubbard	Test Engineer	Testing	08 October 2018
Mohammed Malik	Assistant Engineer	Testing	08 October 2018
Sharif Sendagire	Shift Technician	Testing	08 October 2018
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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	03 October 2018
2	Second Issue – FCCID and IC ID updated	08 October 2018

Table 1

1.2 Introduction

Applicant	Apple Inc.
Manufacturer	Apple Inc.
Model Number(s)	A1993
Serial Number(s)	C07WR00KK2T5, C07WT003K2V0 and C07WT00HK2V0
Hardware Version(s)	EVT
Software Version(s)	18B2034
Number of Samples Tested	3
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	0540058293
Date	18-May-2018
Date of Receipt of EUT	12-July-2018 and 20-June-2018
Start of Test	27-July-2018
Finish of Test	07-Sep-2018
Name of Engineer(s)	Mehadi Choudhury, Graeme Lawler, Tony Hubbard Mohammed Malik, Sharif Sendagire and 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, 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: Main						
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
Configuration and Mode: Aux						
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 desktop computer, with Bluetooth, Bluetooth Low Energy and 802.11 b/g/n/ac capabilities in the 2.4GHz and 5GHz bands.

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: C07WT00HK2V0			
0	As supplied by the customer	Not Applicable	Not Applicable
Serial Number: C07WR00KK2T5			
0	As supplied by the customer	Not Applicable	Not Applicable
Serial Number: C07WT003K2V0			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3



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: Main		
Maximum Conducted Output Power	Mehadi Choudhury and Philip Harrison	UKAS
Power Spectral Density	Mehadi Choudhury and Philip Harrison	UKAS
Emission Bandwidth	Mehadi Choudhury and Philip Harrison	UKAS
Authorised Band Edges	Graeme Lawler, Tony Hubbard Mohammed Malik and Sharif Sendagire	UKAS
Restricted Band Edges		UKAS
Spurious Radiated Emissions		UKAS
Configuration and Mode: Aux		
Maximum Conducted Output Power	Mehadi Choudhury and Philip Harrison	UKAS
Power Spectral Density	Mehadi Choudhury and Philip Harrison	UKAS
Emission Bandwidth	Mehadi Choudhury and Philip Harrison	UKAS
Authorised Band Edges	Graeme Lawler, Tony Hubbard Mohammed Malik and Sharif Sendagire	UKAS
Restricted Band Edges		UKAS
Spurious Radiated Emissions		UKAS

Table 4

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

A1993, S/N: C07WR00KK2T5 - Modification State 0
A1993, S/N: C07WT003K2V0 - Modification State 0

2.1.3 Date of Test

27-July-2018 to 10-September -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 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 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.

2.1.5 Environmental Conditions

Ambient Temperature	23.4 - 28.7 °C
Relative Humidity	43.1 - 62.3 %



2.1.6 Test Results

Main - 1 Mbps, b (SISO)

Testing was performed on the Data Rate with the highest conducted output power. This Data Rate was 1 Mbps.

	2412 MHz	2437 MHz	2462 MHz
Conducted Power Core 0 (dBm)	19.9	24.0	17.7
Antenna Directional Gain (dBi)	5.0	5.0	5.0
15.407 Conducted Power Limit (dBm)	30.0	30.0	30.0
RSS-247 EIRP Limit (dBm)	36.0	36.0	36.0
EIRP Power (dBm)	24.9	29.0	22.7

Table 5

The antenna gain did not exceed 6 dBi and hence the conducted output power limit was not 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.



Main - 6 Mbps, g (SISO)

Testing was performed on the Data Rate with the highest conducted output power. This Data Rate was 6 Mbps.

	2412 MHz	2437 MHz	2462 MHz
Conducted Power Core 0 (dBm)	17.4	23.4	16.2
Antenna Directional Gain (dBi)	5.0	5.0	5.0
15.407 Conducted Power Limit (dBm)	30.0	30.0	30.0
RSS-247 EIRP Limit (dBm)	36.0	36.0	36.0
EIRP Power (dBm)	22.4	28.4	21.2

Table 6

The antenna gain did not exceed 6 dBi and hence the conducted output power limit was not 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 DTSSs 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.



Main - MCS0, HT20 (SISO)

Testing was performed on the Data Rate with the highest conducted output power. This Data Rate was MCS0.

	2412 MHz	2437 MHz	2462 MHz
Conducted Power Core 0 (dBm)	17.4	23.9	16.4
Antenna Directional Gain (dBi)	5.0	5.0	5.0
15.247 Conducted Power Limit (dBm)	30.0	30.0	30.0
RSS-247 EIRP Limit (dBm)	36.0	36.0	36.0
EIRP Power (dBm)	22.4	28.9	21.4

Table 7

The antenna gain did not exceed 6 dBi and hence the conducted output power limit was not 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 DTSSs 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.



Main - MCS0, HT20 (2 Tx TXBF)

Testing was performed on the Data Rate with the highest conducted output power. This Data Rate was MCS0.

	2412 MHz	2437 MHz	2462 MHz
Conducted Power – Core 0 (dBm)	14.57	23.53	16.17
Conducted Power – Core 2 (dBm)	14.46	23.25	16.32
Antenna Directional Gain (dBi)	5.96	5.96	5.96
15.247 Conducted Power Limit (dBm)	30.00	30.00	30.00
Total Conducted Power (dBm)	17.53	26.40	19.26
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	23.49	32.36	25.22

Table 8

The Directional Gain for the above transmit beamforming mode was calculated in accordance with KDB 662911 D01 in accordance with F)2)d)(i). The directional gain did not exceed 6 dBi and hence the conducted output power limit was not 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 DTSSs 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.



Main - 1 Mbps (CDD) and b (MIMO) 3Tx

Testing was performed on the Data Rate with the highest conducted output power. This Data Rate was 1 Mbps.

	2412 MHz	2437 MHz	2462 MHz
Conducted Power Core 0 (dBm)	19.4	23.8	17.3
Conducted Power Core 1 (dBm)	19.4	23.7	17.3
Conducted Power Core 2 (dBm)	19.4	23.9	17.5
Antenna Directional Gain (dBi)	5.0	5.0	5.0
15.407 Conducted Power Limit (dBm)	30.0	30.0	30.0
Total Conducted Power (dBm)	24.2	28.6	22.1
RSS-247 EIRP Limit (dBm)	36.0	36.0	36.0
EIRP Power (dBm)	29.2	33.6	27.1

Table 9

For the CDD results above the Directional Gain was calculated in accordance with KDB 662911 D01 clause F)2)f(i) using worst-case individual gain and an array gain of zero. The directional gain did not exceed 6 dBi and hence the conducted output power limit was not 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.



Main - 1 Mbps (CDD) and b (MIMO) 2Tx

Testing was performed on the Data Rate with the highest conducted output power. This Data Rate was 1 Mbps.

	2412 MHz	2437 MHz	2462 MHz
Conducted Power Core 0 (dBm)	19.5	23.9	17.4
Conducted Power Core 2 (dBm)	19.5	23.9	17.5
Antenna Directional Gain (dBi)	5.0	5.0	5.0
15.247 Conducted Power Limit (dBm)	30.0	30.0	30.0
Total Conducted Power (dBm)	22.5	26.9	20.5
RSS-247 EIRP Limit (dBm)	36.0	36.0	36.0
EIRP Power (dBm)	27.5	31.9	25.5

Table 10

For the CDD results above the Directional Gain was calculated in accordance with KDB 662911 D01 clause F)2)f(i) using worst-case individual gain and an array gain of zero. The directional gain did not exceed 6 dBi and hence the conducted output power limit was not 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 DTSSs 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.



Main - MCS0 and HT20 (CDD) 2Tx

Testing was performed on the Data Rate with the highest conducted output power. This Data Rate was MCS0.

	2412 MHz	2437 MHz	2462 MHz
Conducted Power Core 0 (dBm)	14.30	23.90	16.50
Conducted Power Core 2 (dBm)	14.30	23.70	16.50
Total Conducted Power (dBm)	17.31	26.81	19.51
Antenna Directional Gain (dBi)	5.0	5.0	5.0
15.247 Conducted Power Limit (dBm)	30	30	30
Margin (dB)	12.69	3.19	10.49
RSS-247 EIRP Limit (dBm)	36.0	36.0	36.0
EIRP Power (dBm)	22.31	31.81	24.51

Table 11

For the CDD results above the Directional Gain was calculated in accordance with KDB 662911 D01 clause F)2)f(i) using worst-case individual gain and an array gain of zero. The directional gain did not exceed 6 dBi and hence the conducted output power limit was not 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 DTSSs 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.



Main - MCS0 and HT20 (CDD) 3Tx

Testing was performed on the Data Rate with the highest conducted output power. This Data Rate was MCS0.

	2412 MHz	2437 MHz	2462 MHz
Conducted Power Core 0 (dBm)	14.4	23.8	16.4
Conducted Power Core 1 (dBm)	14.2	23.8	16.5
Conducted Power Core 2 (dBm)	14.3	23.8	16.3
Total Conducted Power (dBm)	19.1	28.6	21.2
Antenna Directional Gain (dBi)	5.0	5.0	5.0
15.247 Conducted Power Limit (dBm)	30.0	30.0	30.0
Margin (dB)	10.9	1.4	8.8
RSS-247 EIRP Limit (dBm)	36.0	36.0	36.0
EIRP Power (dBm)	24.1	33.6	26.2

Table 12

For the CDD results above the Directional Gain was calculated in accordance with KDB 662911 D01 clause F)2)f)(i) using worst-case individual gain and an array gain of zero. The directional gain did not exceed 6 dBi and hence the conducted output power limit was not 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.



Main - MCS0, HT20 (3 Tx and TXBF)

Testing was performed on the Data Rate with the highest conducted output power. This Data Rate was MCS0.

	2412 MHz	2437 MHz	2462 MHz
Conducted Power Core 0 (dBm)	14.26	23.59	16.49
Conducted Power Core 1 (dBm)	14.38	23.39	16.59
Conducted Power Core 2 (dBm)	14.25	23.48	16.49
Total Conducted Power (dBm)	19.07	28.26	21.29
Antenna Directional Gain (dBi)	6.84	6.84	6.84
15.247 Conducted Power Limit (dBm)	30.00	30.00	30.00
Margin (dB)	10.93	1.74	8.71
RSS-247 EIRP Limit (dBm)	36.00	36.00	36.00
EIRP Power (dBm)	25.91	35.10	28.14

Table 13

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.

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 DTSSs 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.



Aux - b (SISO)

Testing was performed on the Data Rate with the highest conducted output power. This Data Rate was 1 Mbps.

	2412 MHz	2437 MHz	2462 MHz
Conducted Power Aux Core (dBm)	19.7	23.7	18.0
Antenna Directional Gain (dBi)	5.0	5.0	5.0
15.247 Conducted Power Limit (dBm)	30.0	30.0	30.0
Margin (dB)	10.3	6.3	12.0
RSS-247 EIRP Limit (dBm)	36.0	36.0	36.0
EIRP Power (dBm)	24.7	28.7	23.0

Table 14

The antenna gain did not exceed 6 dBi and hence the conducted output power limit was not 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.



Aux - g (SISO)

Testing was performed on the Data Rate with the highest conducted output power. This Data Rate was 6 Mbps.

	2412 MHz	2437 MHz	2462 MHz
Conducted Power Aux Core (dBm)	14.0	21.7	13.9
Antenna Directional Gain (dBi)	5.0	5.0	5.0
15.407 Conducted Power Limit (dBm)	30.0	30.0	30.0
Margin	16.0	8.30	16.10
RSS-247 EIRP Limit (dBm)	36.0	36.0	36.0
EIRP Power (dBm)	19.0	26.7	18.9

Table 15

The antenna gain did not exceed 6 dBi and hence the conducted output power limit was not 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.



Aux - HT20 (SISO)

Testing was performed on the Data Rate with the highest conducted output power. This Data Rate was MCS0.

	2412 MHz	2437 MHz	2462 MHz
Conducted Power Aux Core (dBm)	13.9	21.6	13.8
Antenna Directional Gain (dBi)	5.0	5.0	5.0
15.407 Conducted Power Limit (dBm)	30.0	30.0	30.0
Margin (dB)	16.1	8.4	16.2
RSS-247 EIRP Limit (dBm)	36.0	36.0	36.0
EIRP Power (dBm)	18.9	26.6	18.8

Table 16

The antenna gain did not exceed 6 dBi and hence the conducted output power limit was not 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
Mains Voltage Monitor	TUV SUD Product Service	MVM1	1378	12	17-Apr-2019
Cable (3m, SMA(m) - SMA(m))	Reynolds	262-0248-3000	2402	12	19-Sep-2018
Hygrometer	Rotronic	I-1000	2891	12	30-Aug-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	20-Oct-2018
RadiPower Pulse Wireless Power Meter	DARE!! Instruments	RPR3006W	4438	12	10-Oct-2018
EXA	Keysight Technologies	N9010B	4969	12	21-Dec-2018
Directional Coupler	Hewlett Packard	11692D	451	12	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
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	2-Oct-2018
'3.5mm' - '3.5mm' RF Cable (2m)	Rhophase	3PS-1803-2000-3PS	3702	12	9-Feb-2019
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-2018
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3983	12	29-Sep-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	6-Mar-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	5-Feb-2019
Power splitter - 4 port	Mini-Circuits	ZN4PD1-63-S+	4744	12	14-Sep-2018

Table 17

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

A1993, S/N: C07WR00KK2T5 - Modification State 0
A1993, S/N: C07WT003K2V0 - Modification State 0

2.2.3 Date of Test

30-July-2018 to 31-July-2018 and 06-September-2018

2.2.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.10.2. or 11.10.5.

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.

2.2.5 Environmental Conditions

Ambient Temperature 23.4 - 24.4 °C
Relative Humidity 48.3 - 62.3 %

2.2.6 Test Results

Main - 1 Mbps, b (SISO)

Data Rate:1 Mbps

Antenna Port	Power Spectral Density (dBm)		
	2412 MHz	2437 MHz	2462 MHz
Conducted PSD Core 0 (dBm/10kHz)	-6.30	-1.72	-8.07

Table 18 - Power Spectral Density

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



Main - 6 Mbps, g (SISO)

Data Rate:6 Mbps

Antenna Port	Power Spectral Density (dBm)		
	2412 MHz	2437 MHz	2462 MHz
Conducted PSD Core 0 (dBm/10kHz)	-10.70	-3.68	-11.35

Table 19 - Power Spectral Density

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

Main - MCS0 and HT20 (SISO)

Data Rate:MCS0

Antenna Port	Power Spectral Density (dBm)		
	2412 MHz	2437 MHz	2462 MHz
Conducted PSD Core 0 (dBm/10kHz)	-10.35	-3.97	-11.45

Table 20 - Power Spectral Density

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



Main - MCS0, HT20 (2 Tx TXBF)

Antenna Port	2412 MHz	2437 MHz	2462 MHz
Conducted PSD Core 0 (dBm/30kHz)	-9.47	-0.31	-7.49
Conducted PSD Core 2 (dBm/30kHz)	-9.38	-0.28	-7.25
Duty Cycle Correction (dB)	0.68	0.68	0.68
0.68	-5.73	3.40	-3.68

Table 21

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.

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

Main - 1 Mbps (CDD)and b (MIMO) 3Tx

Data Rate:1 Mbps

Antenna Port	Power Spectral Density (dBm)		
	2412 MHz	2437 MHz	2462 MHz
Conducted Total PSD (dBm/10kHz)	-2.30	2.52	-3.62
Conducted PSD Core 0 (dBm/10kHz)	-6.33	-2.45	-8.23
Conducted PSD Core 1 (dBm/10kHz)	-7.55	-2.12	-8.62
Conducted PSD Core 2 (dBm/10kHz)	-7.43	-2.20	-8.32

Table 22 - Power Spectral Density

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



Main - 1 Mbps (CDD) and b (MIMO) 2Tx

Data Rate: 1 Mbps

Antenna Port	Power Spectral Density (dBm)		
	2412 MHz	2437 MHz	2462 MHz
Conducted Total PSD (dBm/10kHz)	-3.47	0.94	-4.94
Conducted PSD Core 0 (dBm/10kHz)	-6.70	-2.02	-8.14
Conducted PSD Core 2 (dBm/10kHz)	-6.27	-2.12	-7.77

Table 23 - Power Spectral Density

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

Main - MCS0 and HT20 (CDD) 2Tx

Data Rate: MCS0

Antenna Port	Power Spectral Density (dBm)		
	2412 MHz	2437 MHz	2462 MHz
Conducted Total PSD (dBm/10kHz)	-8.65	0.45	-6.45
Conducted PSD Core 0 (dBm/10kHz)	-13.41	-4.26	-11.36
Conducted PSD Core 2 (dBm/10kHz)	-13.31	-4.46	-11.12

Table 24 - Power Spectral Density

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



Main - MCS0 and HT20 (CDD) 3Tx

Data Rate: MCS0

Antenna Port	Power Spectral Density (dBm)		
	2412 MHz	2437 MHz	2462 MHz
Conducted Total PSD (dBm/10kHz)	-8.65	0.45	-6.45
Conducted PSD Core 0 (dBm/10kHz)	-13.41	-4.26	-11.36
Conducted PSD Core 1 (dBm/10kHz)	-13.54	-4.26	-11.20
Conducted PSD Core 2 (dBm/10kHz)	-13.31	-4.46	-11.21

Table 25 - Power Spectral Density

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 AVGPSSD-2.

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



Main - MCS0, HT20 (3 Tx and TXBF)

Antenna Port	2412 MHz	2437 MHz	2462 MHz
Conducted PSD Core 0 (dBm/30kHz)	-9.37	0.10	-7.33
Conducted PSD Core 1 (dBm/30kHz)	-9.40	-0.57	-7.81
Conducted PSD Core 2 (dBm/30kHz)	-9.51	0.33	-7.62
Duty Cycle Correction (dB)	0.68	0.68	0.68
Conducted Total PSD Result (dBm/30kHz)	-3.98	5.42	-2.13

Table 26

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 AVGPSD-2.

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

Aux - b (SISO)

Data Rate:1 Mbps

Antenna Port	Power Spectral Density (dBm)		
	2412 MHz	2437 MHz	2462 MHz
Conducted PSD Aux (dBm/10kHz)	-6.30	-2.06	-7.58

Table 27 - Power Spectral Density

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



Aux - g (SISO)

Data Rate:6 Mbps

Antenna Port	Power Spectral Density (dBm)		
	2412 MHz	2437 MHz	2462 MHz
Conducted PSD Aux (dBm/10kHz)	-14.43	-7.23	-14.28

Table 28 - Power Spectral Density

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

Aux - HT20 (SISO)

Data Rate:MCS0

Antenna Port	Power Spectral Density (dBm)		
	2412 MHz	2437 MHz	2462 MHz
Conducted PSD Aux (dBm/10kHz)	-14.61	-7.51	-17.78

Table 29 - Power Spectral Density

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
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	20-Oct-2018
Mains Voltage Monitor	TUV SUD Product Service	MVM1	1378	12	17-Apr-2019
Cable (3m, SMA(m) - SMA(m))	Reynolds	262-0248-3000	2402	12	19-Sep-2018
Hygrometer	Rotronic	A1	2138	12	21-Feb-2019
Termination (50ohm, 1W)	Suhner	50ohm 1W	3080	12	18-Jul-2019
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	-	O/P Mon
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	20-Oct-2018
2 metre SMA Cable	IW Microwave	3PS-1806LC-788-3PS	4829	12	24-Jan-2018
EXA	Keysight Technologies	N9010B	4969	12	21-Dec-2018
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
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	2-Oct-2018
'3.5mm' - '3.5mm' RF Cable (2m)	Rhophase	3PS-1803-2000-3PS	3702	12	9-Feb-2019
DC - 12.4 GHz 10 dB Attenuator	Suhner	6810.17.A	3965	12	18-Jul-2019
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	6-Mar-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	5-Feb-2019
Power splitter - 4 port	Mini-Circuits	ZN4PD1-63-S+	4744	12	14-Sep-2018

Table 30

O/P Mon – Output Monitored using calibrated equipment



Product Service

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

A1993, S/N: C07WR00KK2T5 - Modification State 0
A1993, S/N: C07WT003K2V0 - Modification State 0

2.3.3 Date of Test

31-July-2018 to 07-Sep-2018

2.3.4 Test Method

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

2.3.5 Environmental Conditions

Ambient Temperature	24.4 °C to 22.2 °C
Relative Humidity	48.3 % to 39.5 %



2.3.6 Test Results

Main - 1 Mbps, b (SISO)

Data Rate: 1 Mbps

Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2412	8.545	10.333
2437	8.070	11.303
2462	8.081	10.332

Table 31

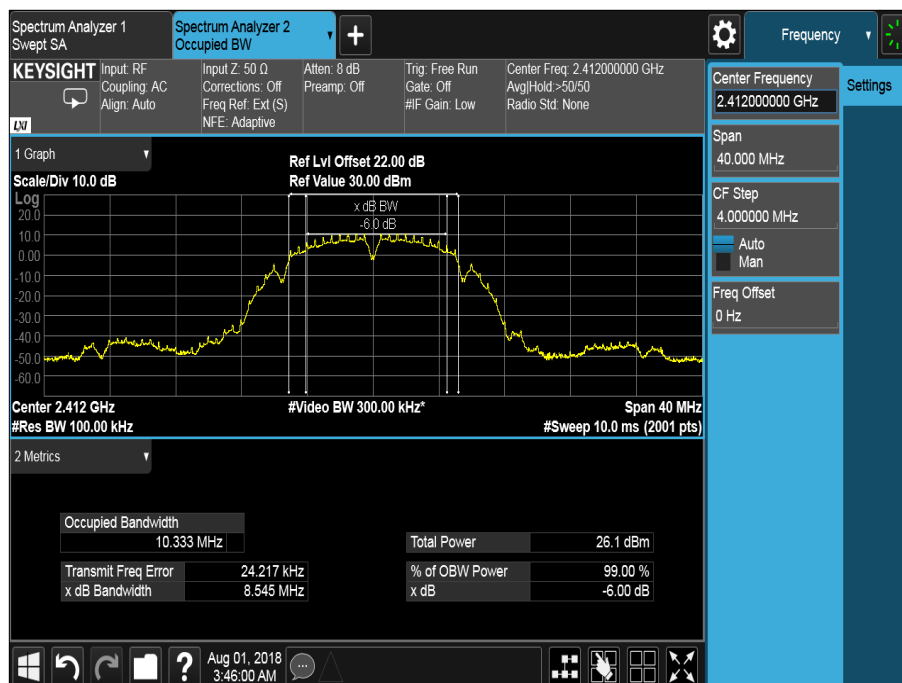


Figure 1 - 2412 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth

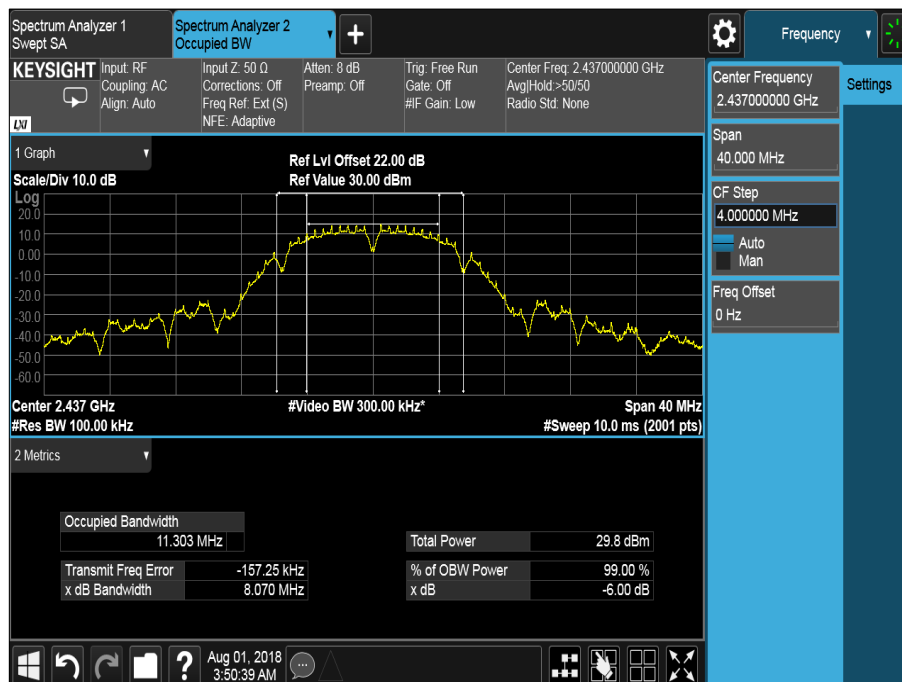


Figure 2 - 2437 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth

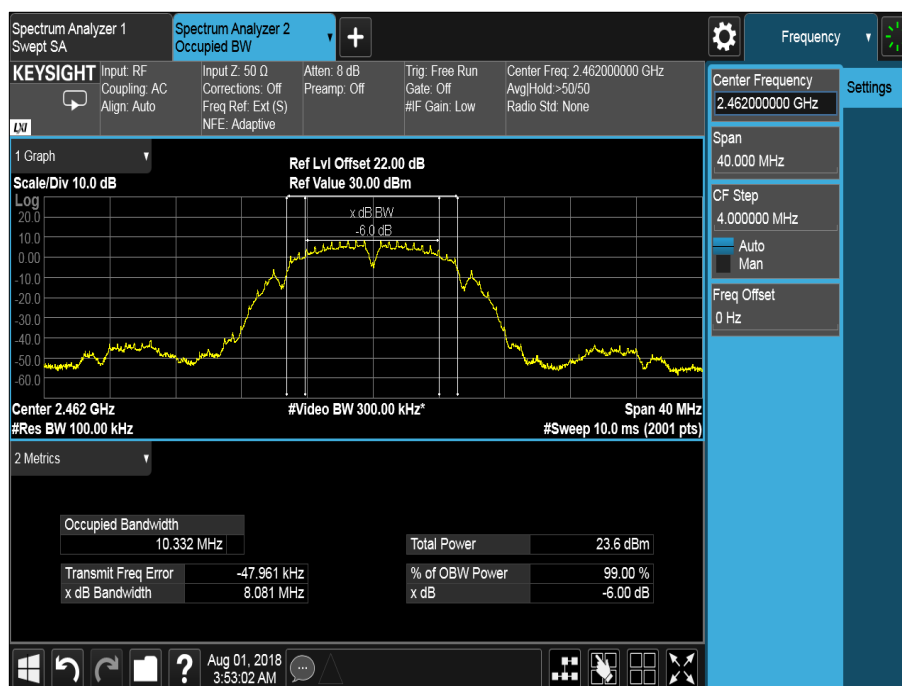


Figure 3 - 2462 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth

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.



Main - 6 Mbps, g (SISO)

Data Rate: 6 Mbps

Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2412	15.110	16.325
2437	15.060	16.438
2462	15.080	16.299

Table 32

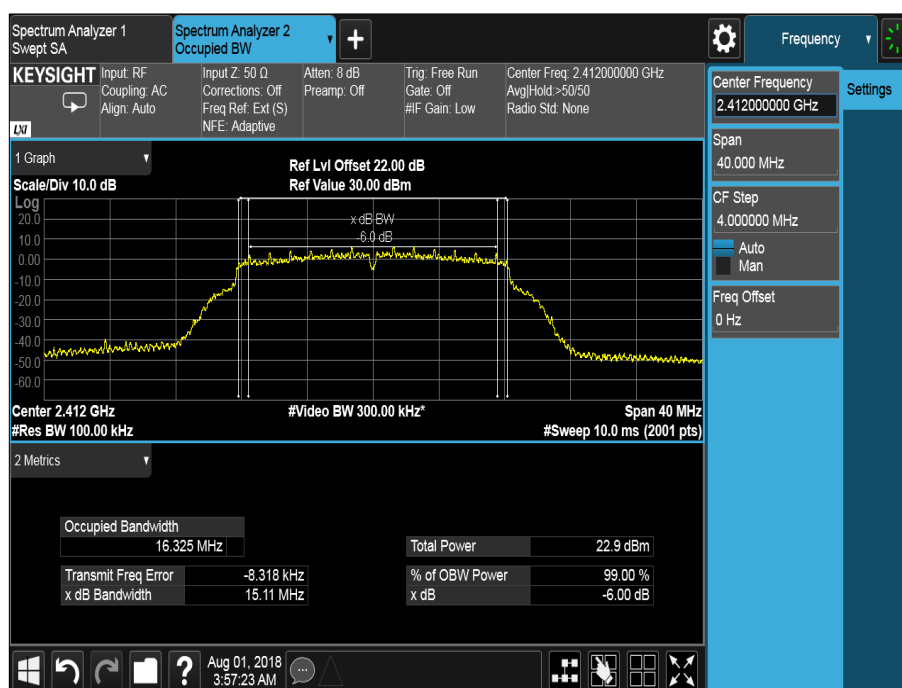


Figure 4 - 2412 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth



Figure 5 - 2437 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth

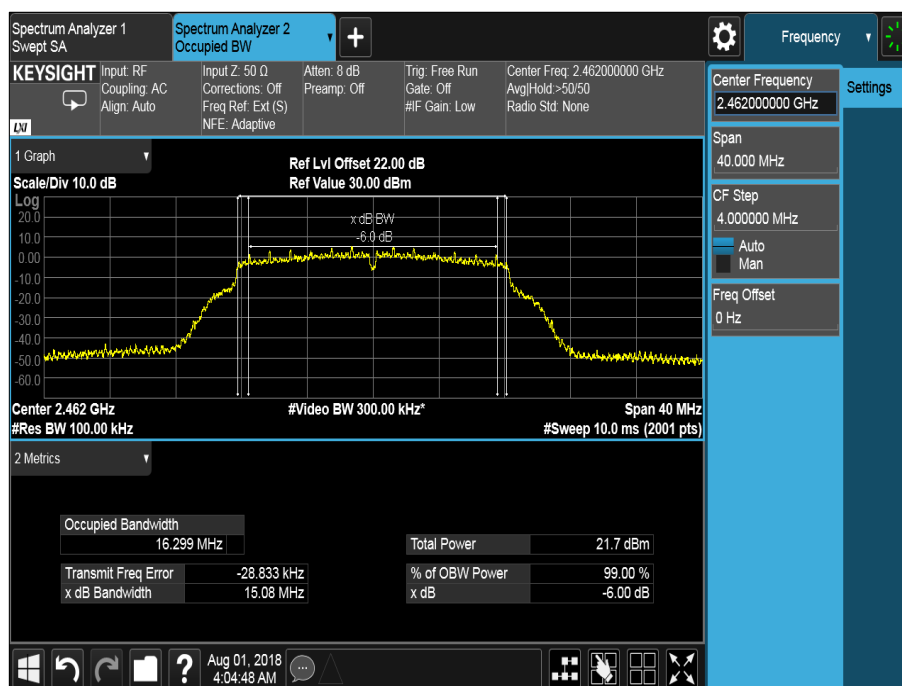


Figure 6 - 2462 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth

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.



Main - MCS0 and HT20 (SISO)

Data Rate: MCS0

Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2412	15.080	17.514
2437	15.020	17.609
2462	15.040	17.488

Table 33

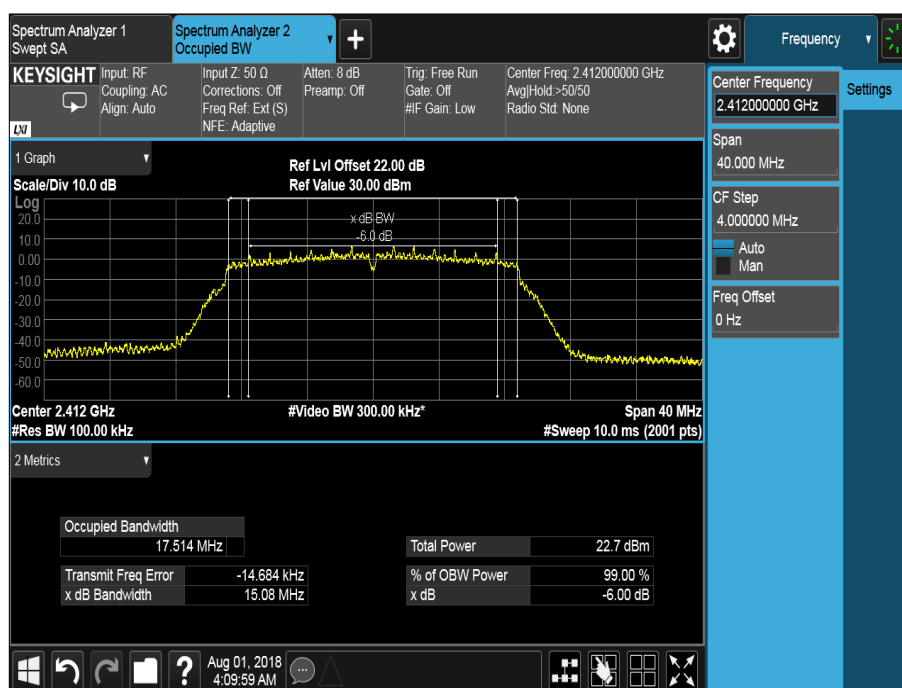


Figure 7 - 2412 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth

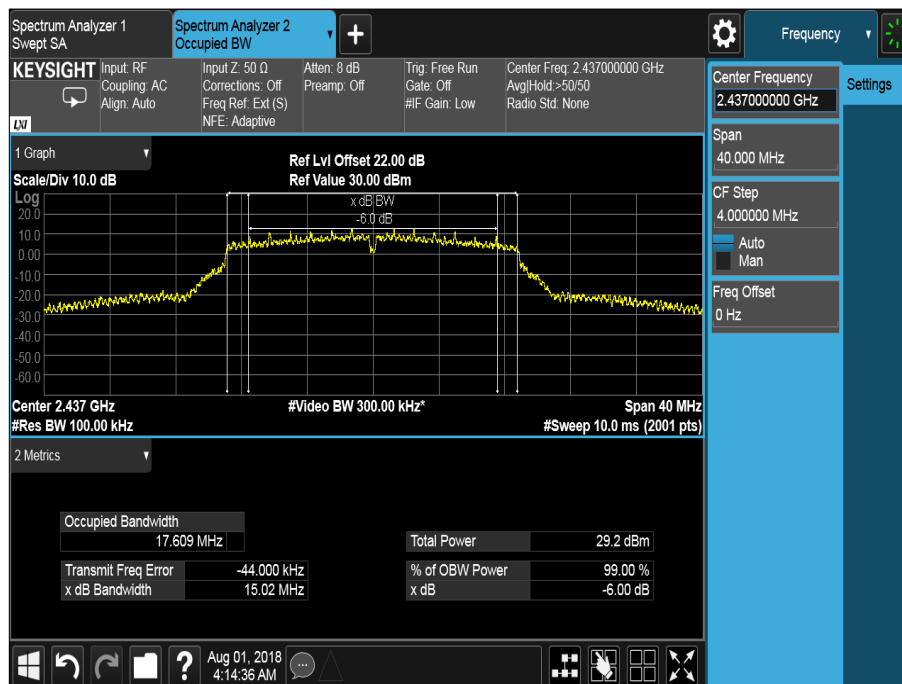


Figure 8 - 2437 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth

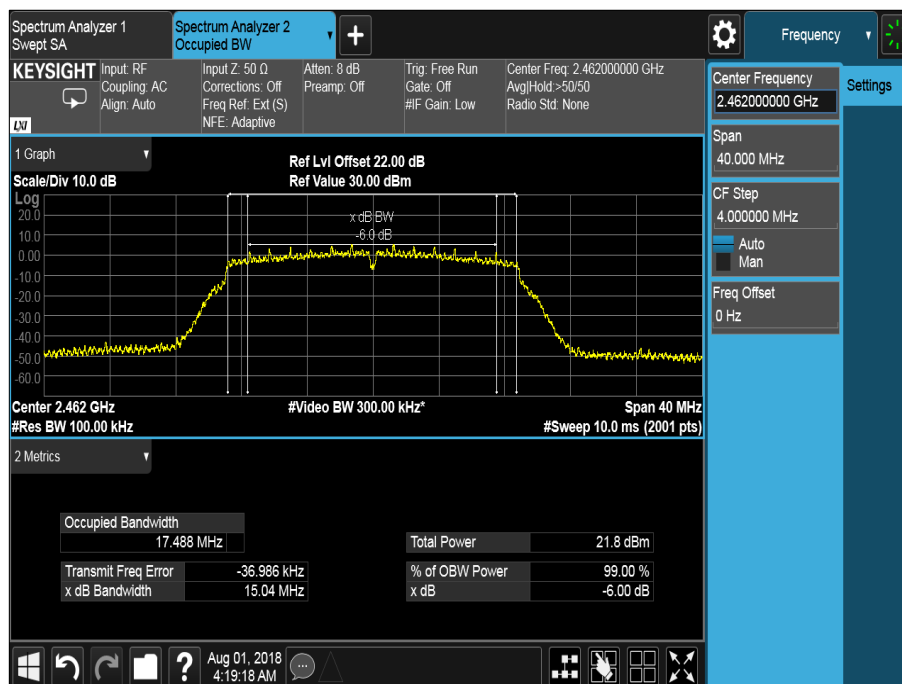


Figure 9 - 2462 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth

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.



Main - MCS0, HT20 (2 Tx TXBF)

Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2412	15.18	17.518
2437	15.18	17.777
2462	15.18	17.521

Table 34

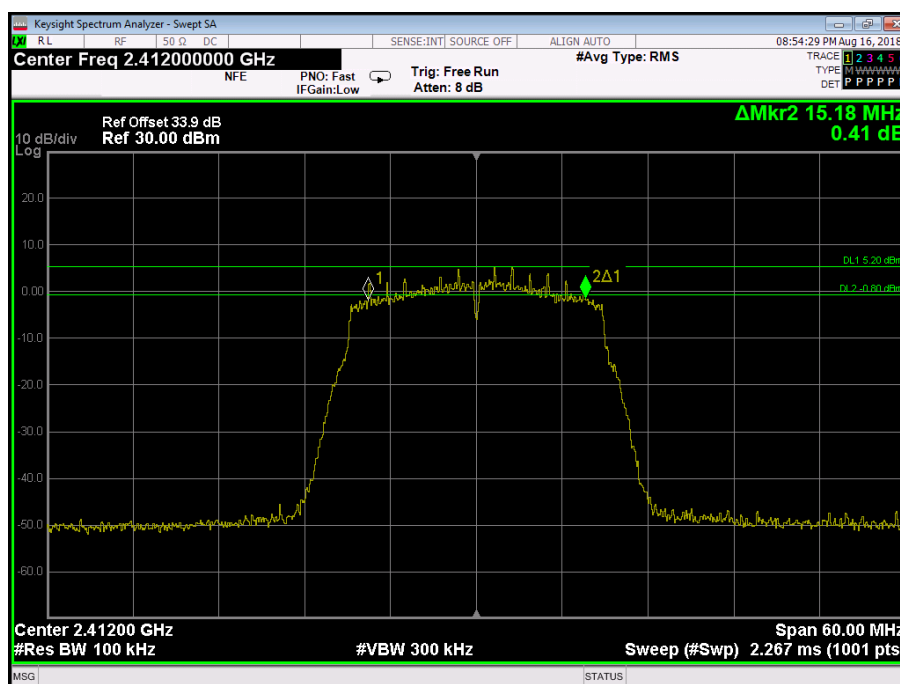


Figure 10 - 2412 MHz – 6 dB Bandwidth

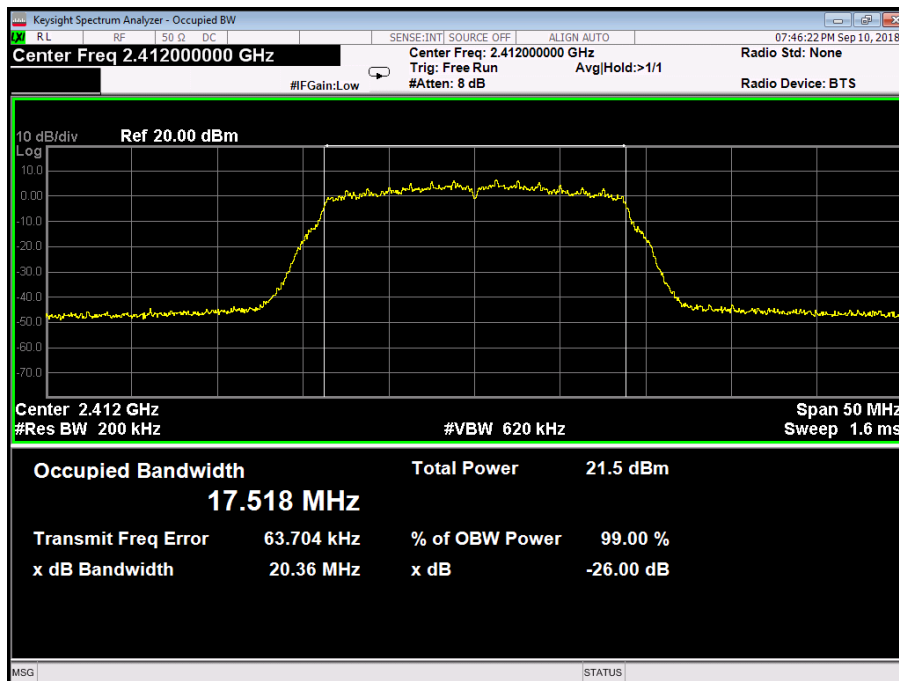


Figure 11 - 2412 MHz – 99% Occupied Bandwidth

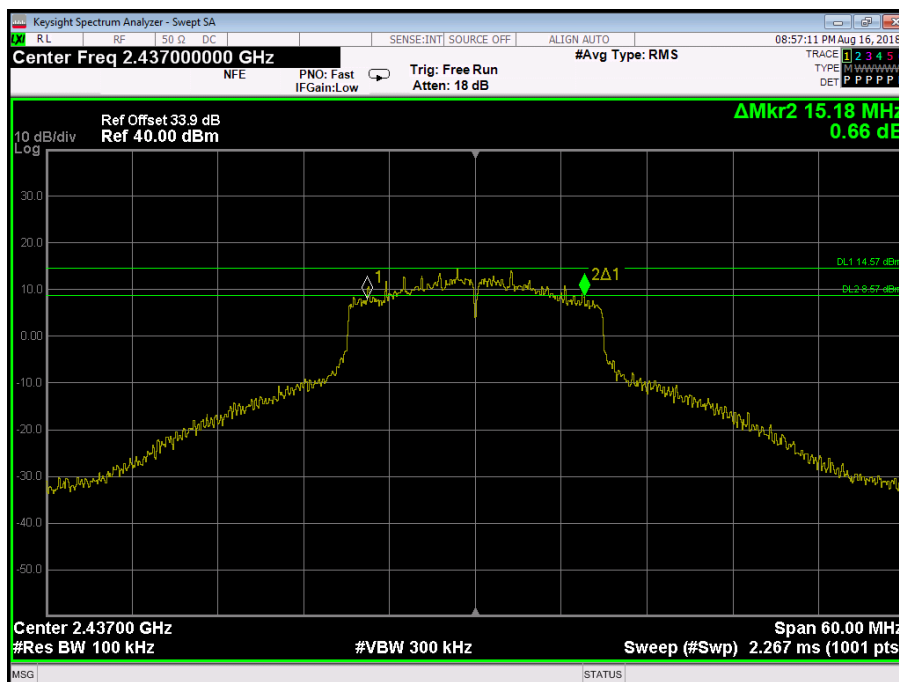


Figure 12 - 2437 MHz – 6 dB Bandwidth

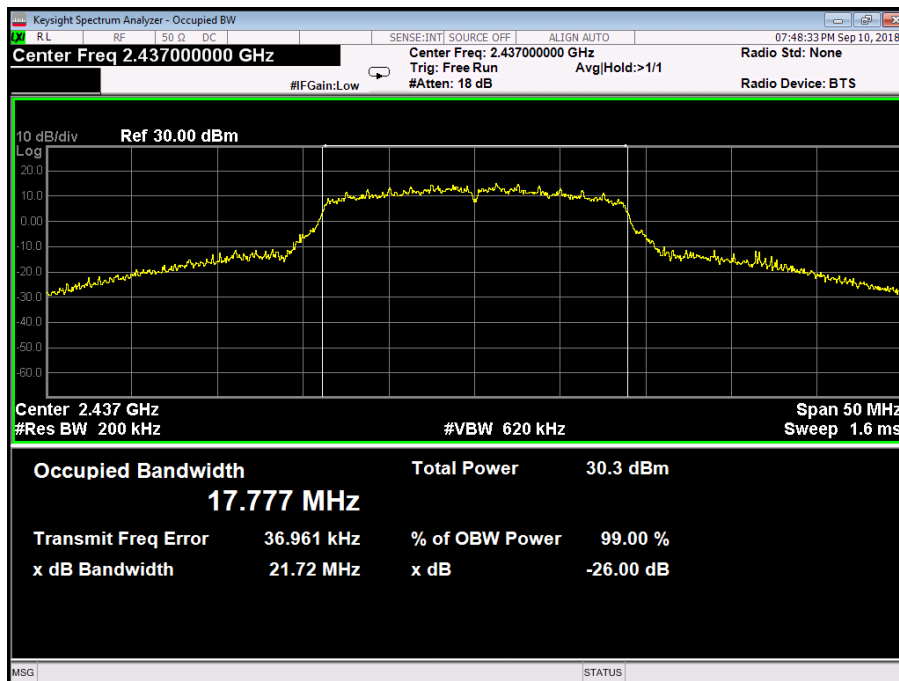


Figure 13 - 2437 MHz – 99% Occupied Bandwidth

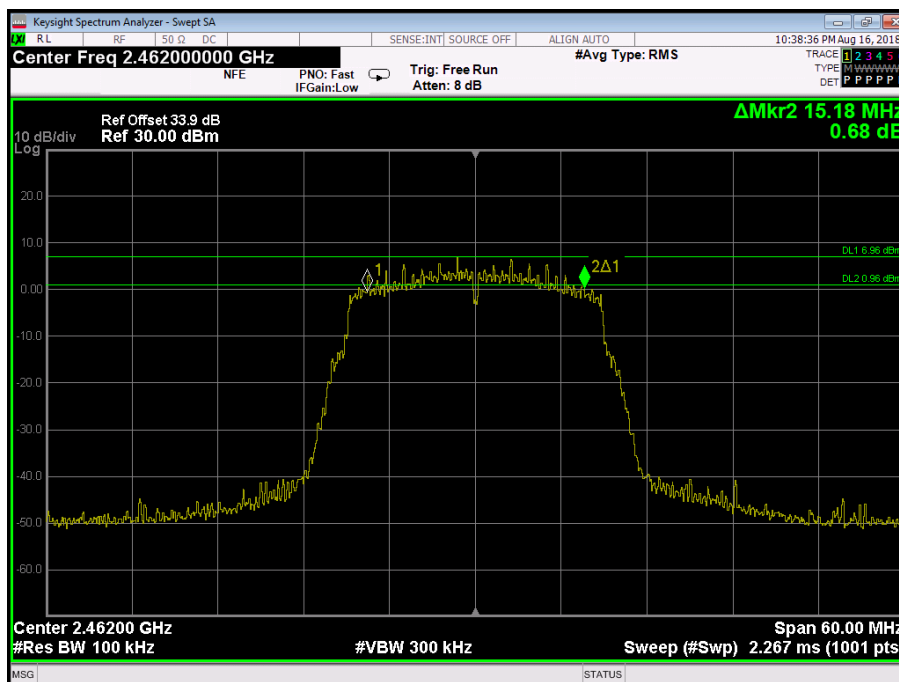


Figure 14 - 2462 MHz – 6 dB Bandwidth

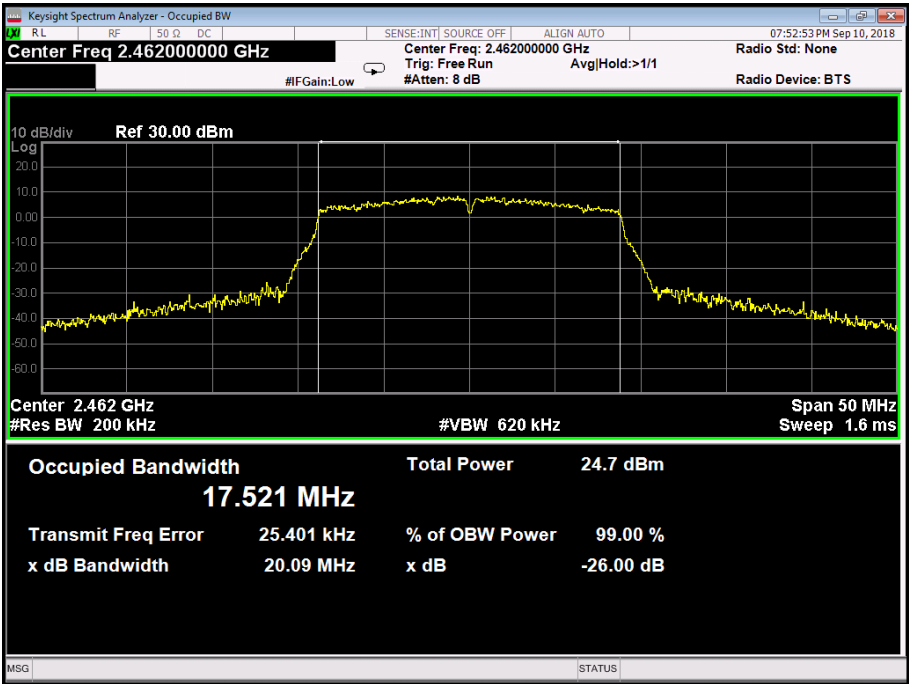


Figure 15 - 2462 MHz – 99% Occupied Bandwidth

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.



Main - MCS0, HT20 (3 Tx TXBF)

Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2412	15.24	17.549
2437	15.54	17.711
2462	15.24	17.536

Table 35

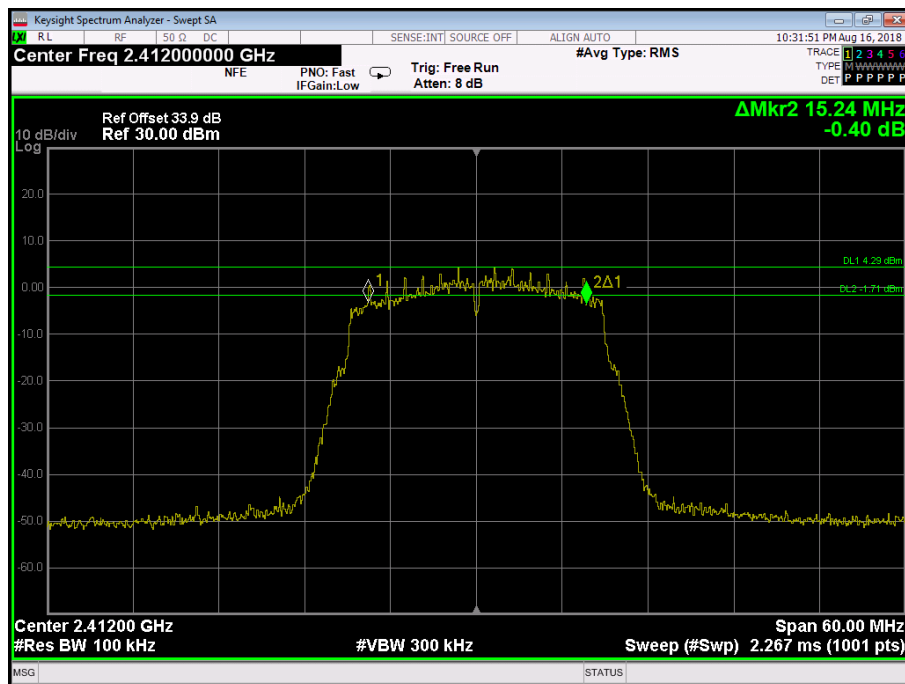


Figure 16 - 2412 MHz – 6 dB Bandwidth

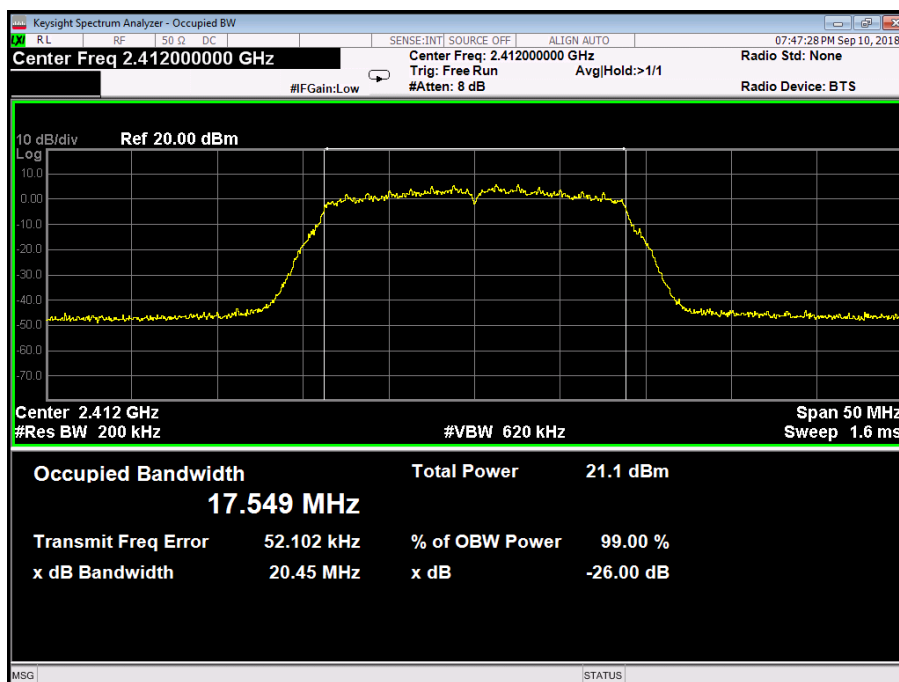


Figure 17 - 2412 MHz – 99% Occupied Bandwidth

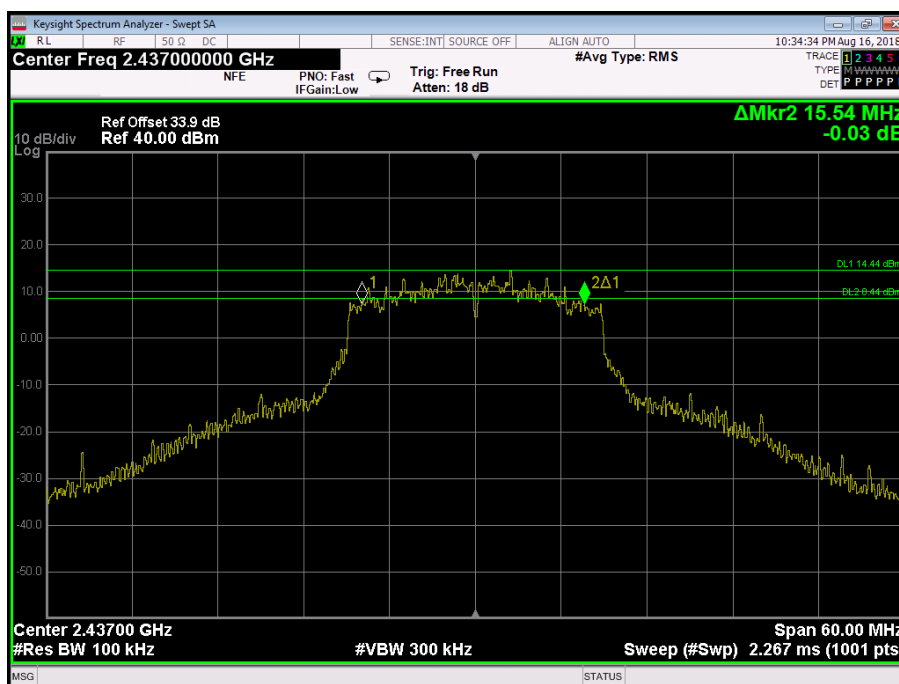


Figure 18 - 2437 MHz – 6 dB Bandwidth

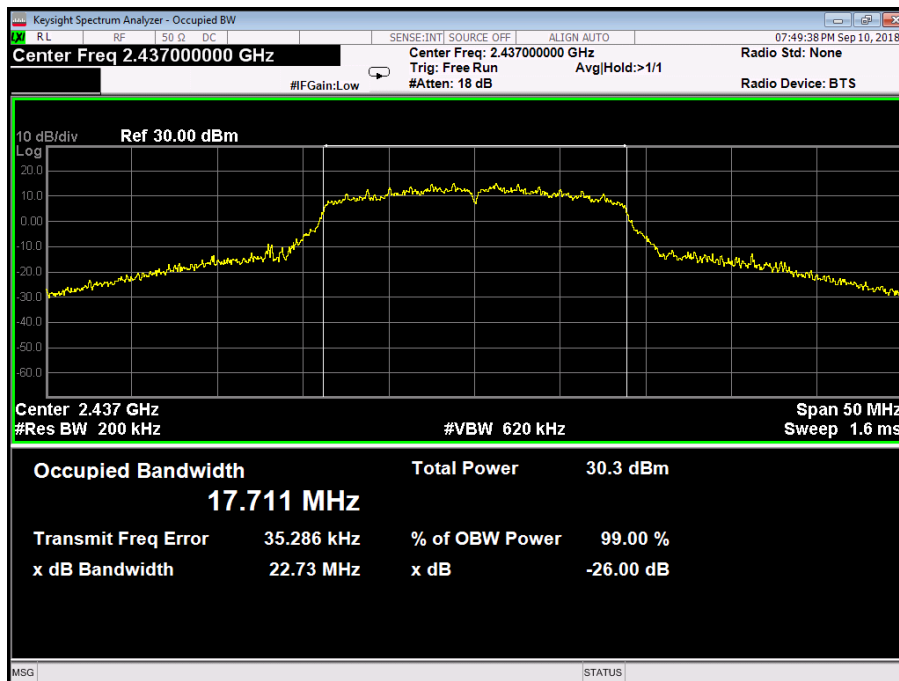


Figure 19 - 2437 MHz – 99% Occupied Bandwidth

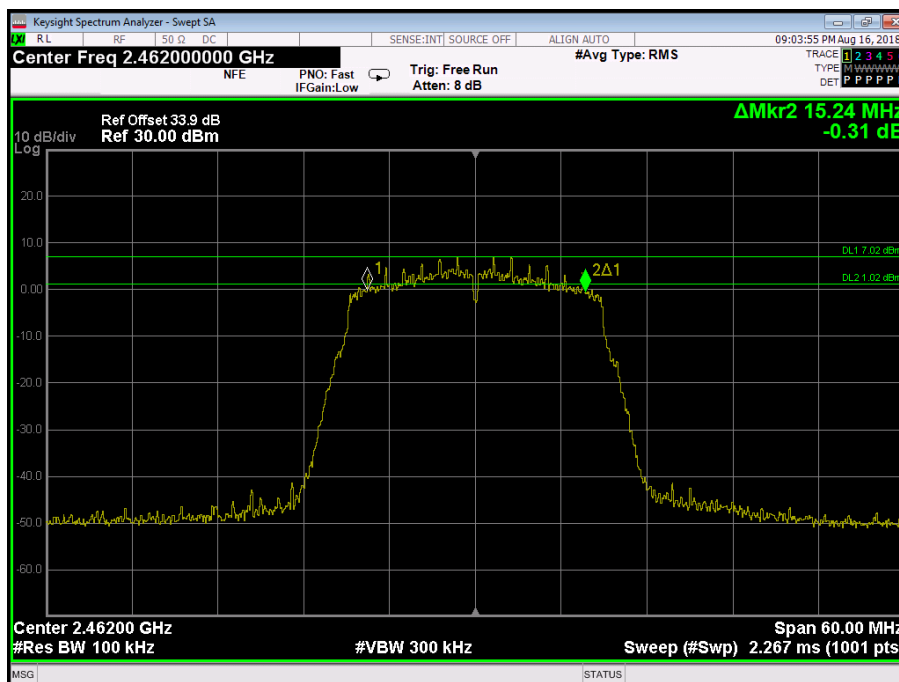


Figure 20 - 2462 MHz – 6 dB Bandwidth



Product Service

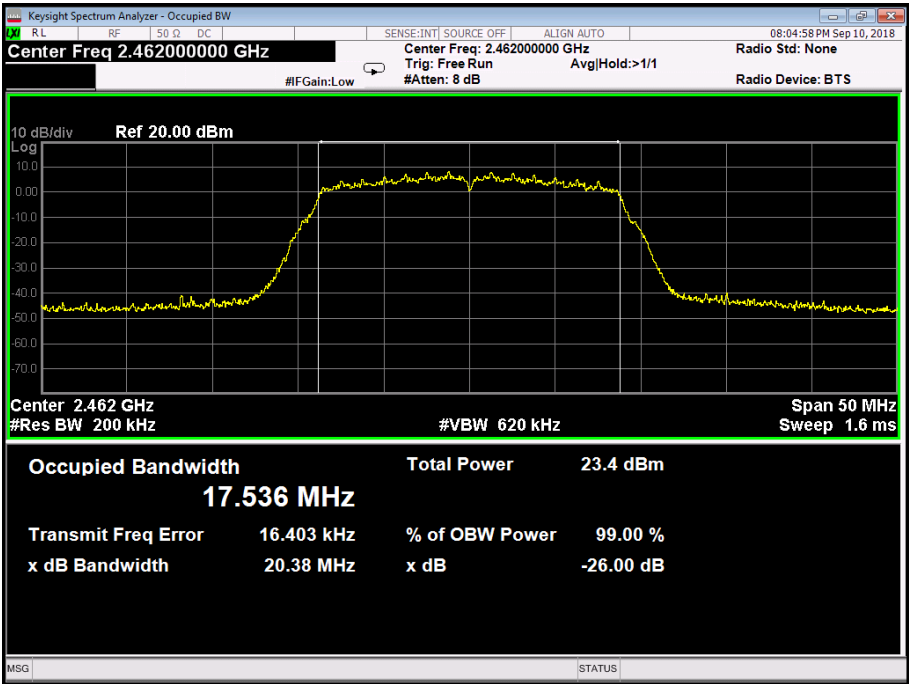


Figure 21 - 2462 MHz – 99% Occupied Bandwidth

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.



Product Service

Aux - b (SISO)

Data Rate: 1 Mbps

Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2412	8.542	10.555
2437	8.080	11.710
2462	8.557	10.832

Table 36

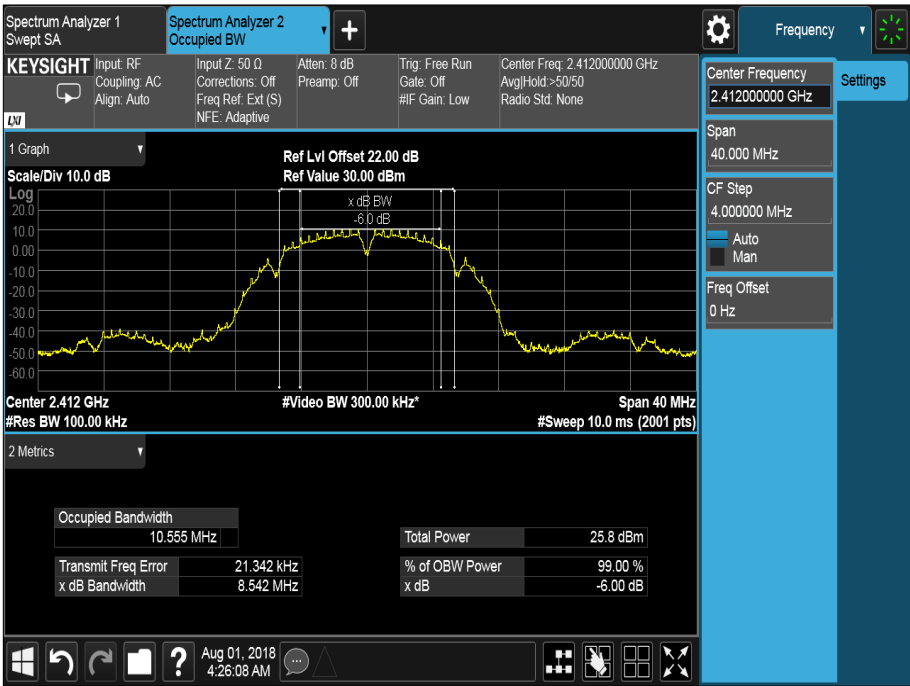


Figure 22 - 2412 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth

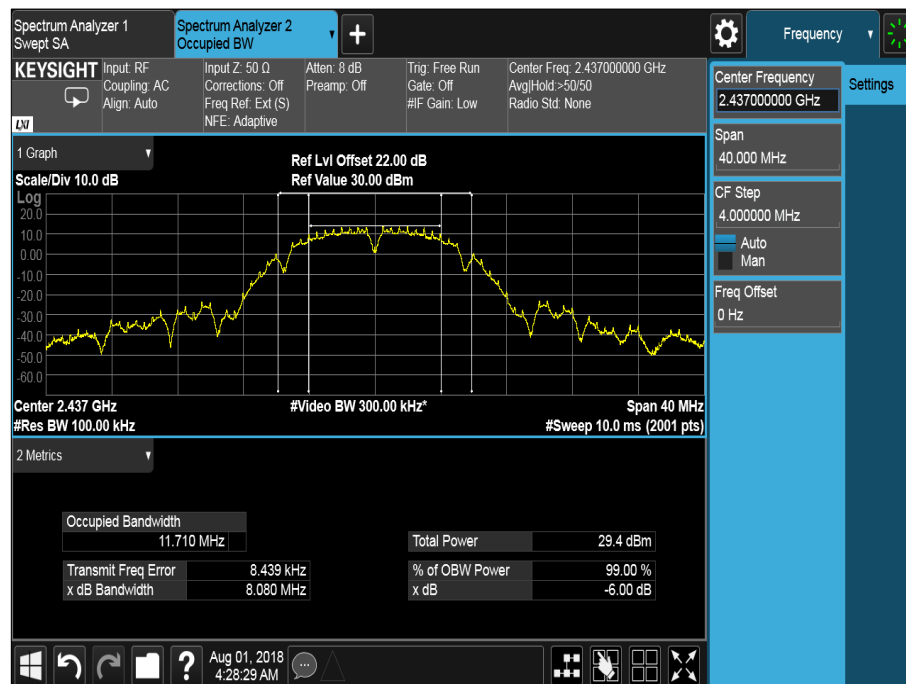


Figure 23 - 2437 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth

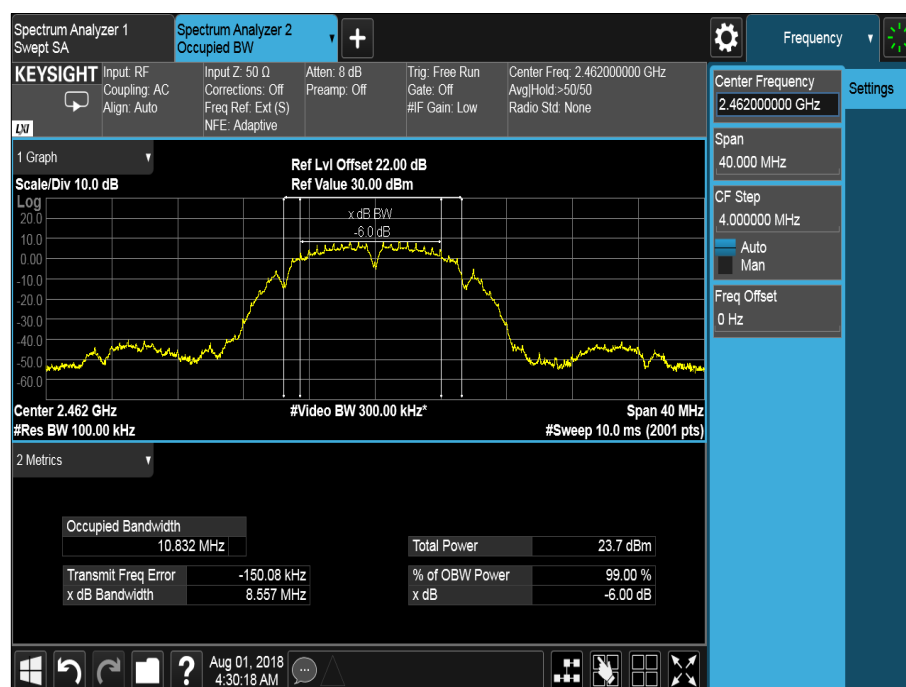


Figure 24 - 2462 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth

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.



Aux - g (SISO)

Data Rate: 6 Mbps

Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2412	15.42	16.455
2437	16.34	16.541
2462	16.37	16.471

Table 37

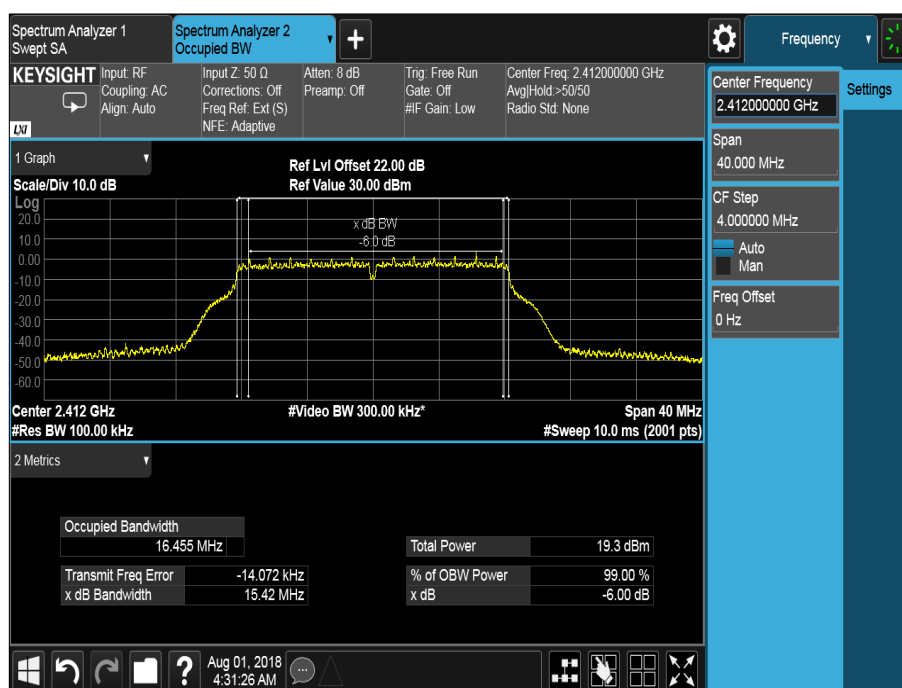


Figure 25 - 2412 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth

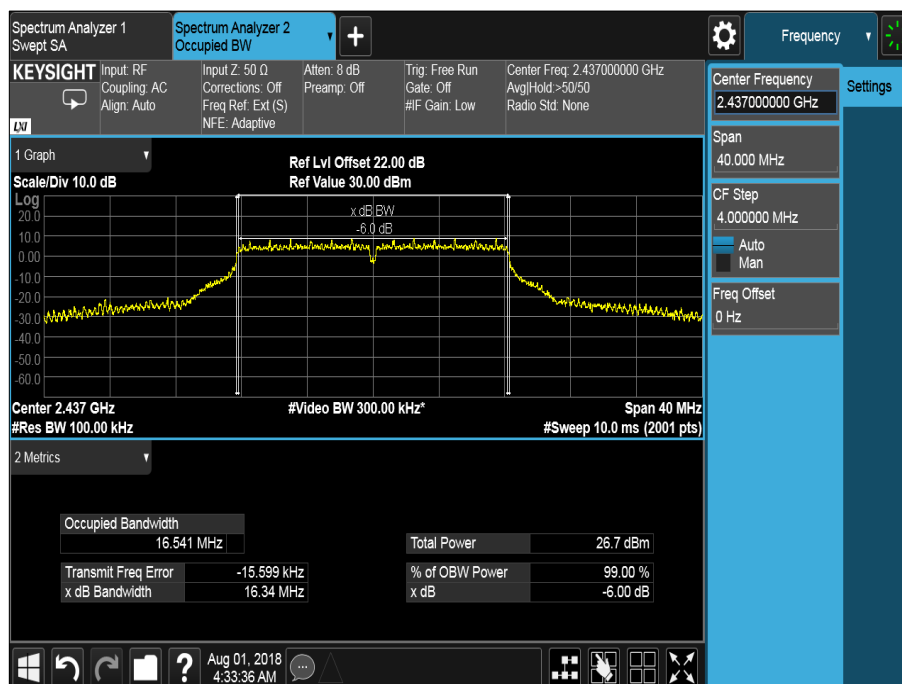


Figure 26 - 2437 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth

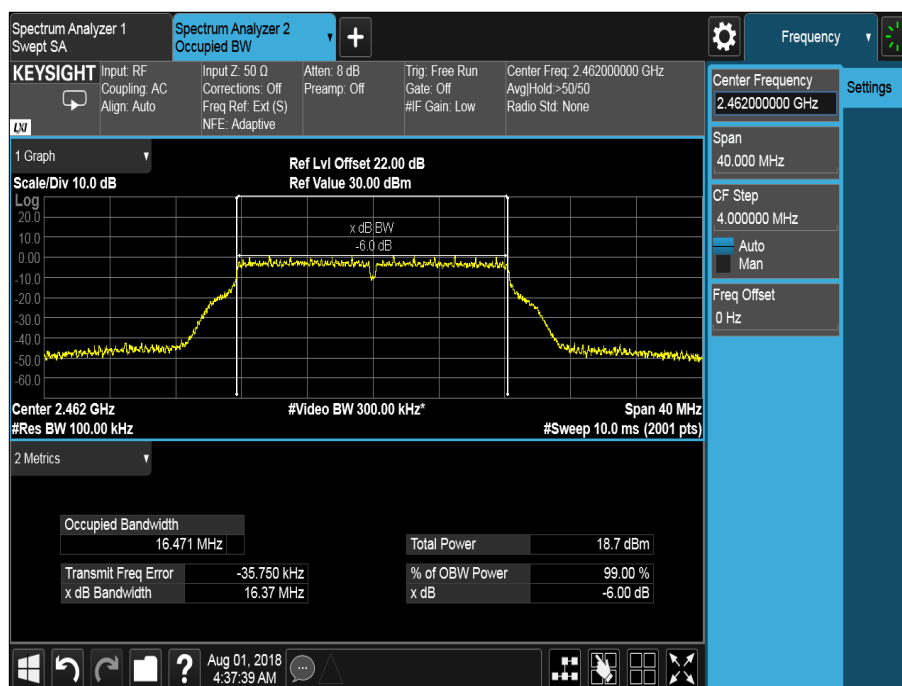


Figure 27 - 2462 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth

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.



Aux - HT20 (SISO)

Data Rate: MCS0

Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2412	17.59	17.674
2437	17.59	17.758
2462	17.60	17.684

Table 38

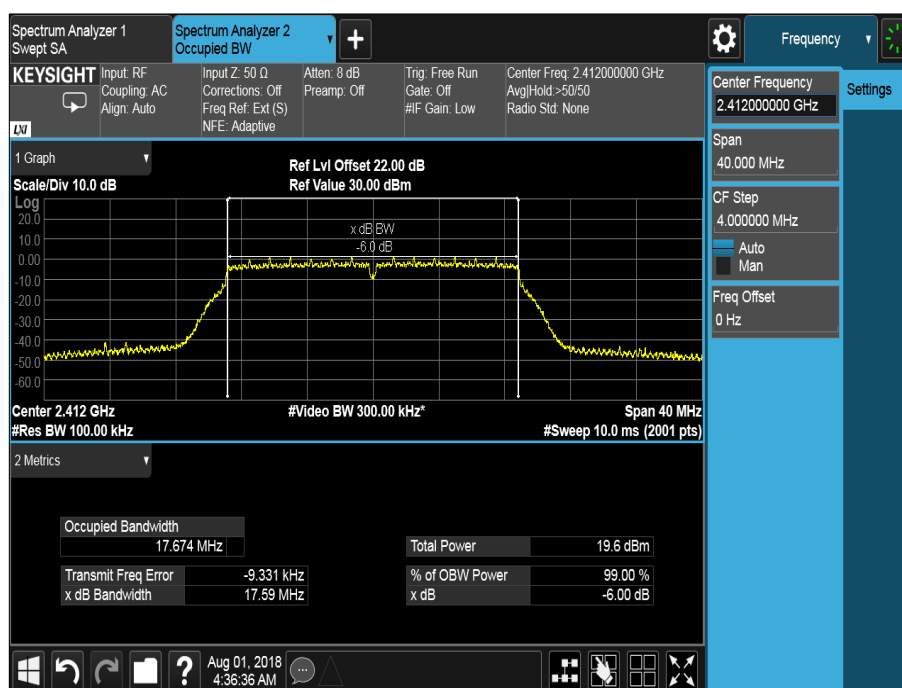


Figure 28 - 2412 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth

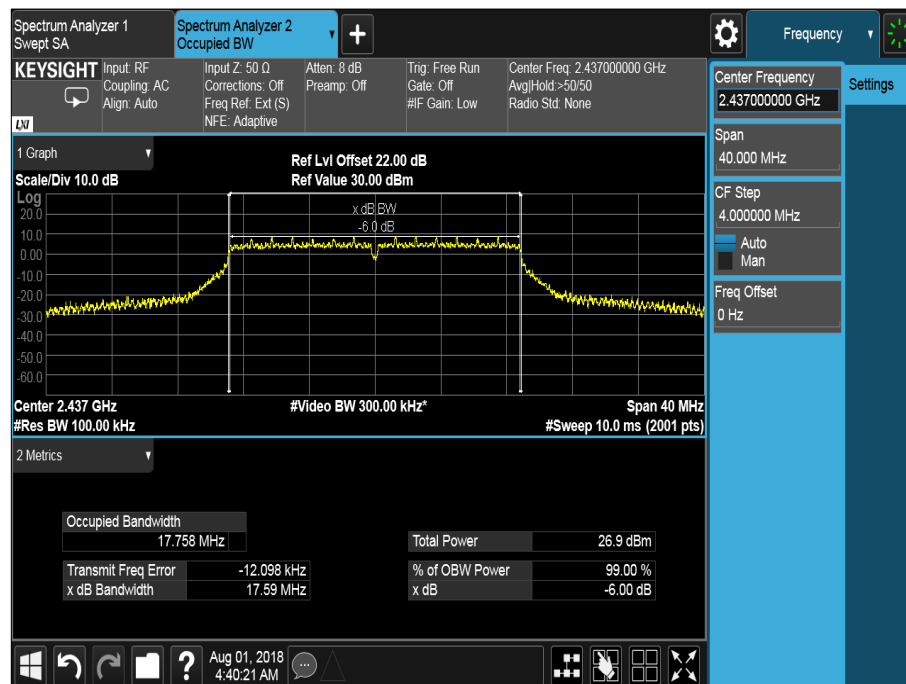


Figure 29 - 2437 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth

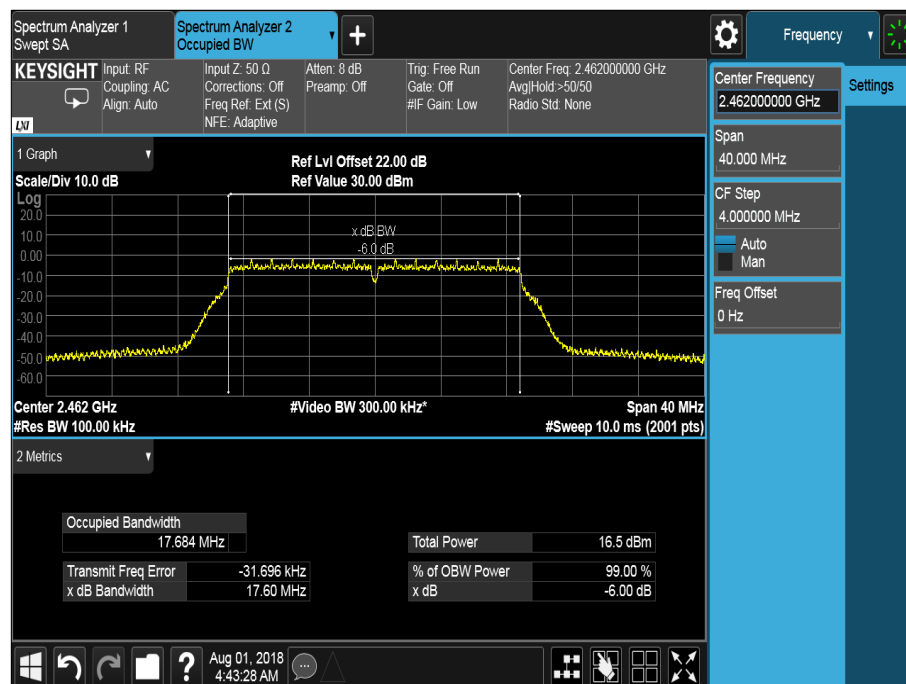


Figure 30 - 2462 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth

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 and RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
20dB/2W Attenuator	Narda	4772-20	462	-	O/P Mon
Mains Voltage Monitor	TUV SUD Product Service	MVM1	1378	12	17-Apr-2019
Cable(3m, SMA(m) - SMA(m))	Reynolds	262-0248-3000	2402	12	19-Sep-2018
Hygrometer	Rotronic	I-1000	2891	12	30-Aug-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	20-Oct-2018
EXA	Keysight Technologies	N9010B	4969	12	21-Dec-2018
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
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	2-Oct-2018
'3.5mm' - '3.5mm' RF Cable (2m)	Rhophase	3PS-1803-2000-3PS	3702	12	9-Feb-2019
DC - 12.4 GHz 10 dB Attenuator	Suhner	6810.17.A	3965	12	18-Jul-2019
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	6-Mar-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	5-Feb-2019
Power splitter - 4 port	Mini-Circuits	ZN4PD1-63-S+	4744	12	14-Sep-2018

Table 39

O/P Mon – Output Monitored using calibrated equipment



Product Service

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

A1993, S/N: C07WT00HK2V0 - Modification State 0

2.4.3 Date of Test

09-August-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.

2.4.6 Environmental Conditions

Ambient Temperature	19.0 - 23.0 °C
Relative Humidity	48.0 - 61.5 %



2.4.7 Test Results

Main - (SISO)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
802.11b	1 Mbps	2412	2400.0	-53.60

Table 40

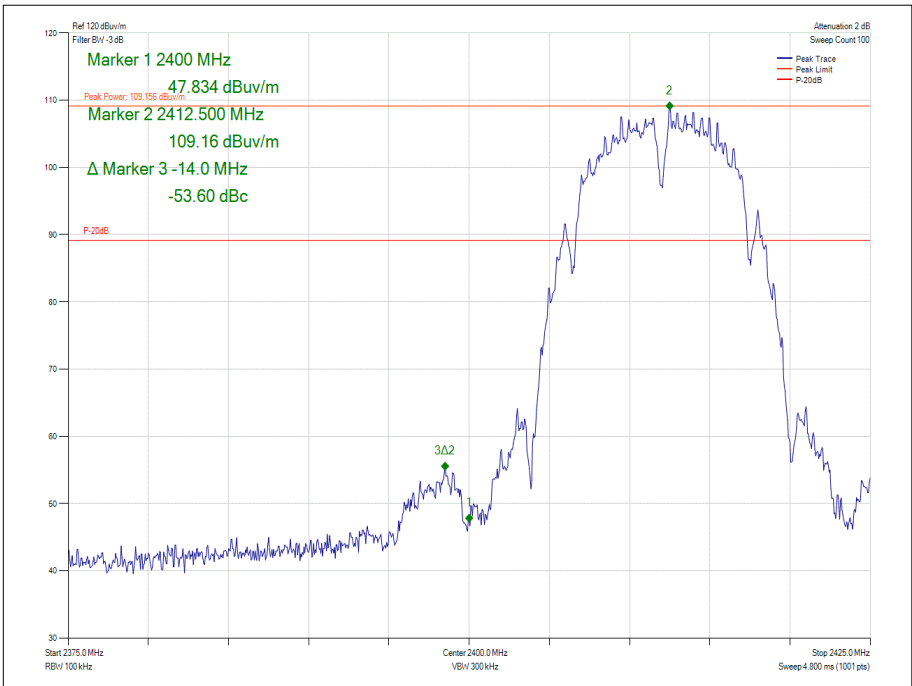


Figure 31 - 2412 MHz - Measured Frequency 2400.0 MHz



Main - (SISO)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
802.11g	6 Mbps	2412	2400.0	-48.05

Table 41

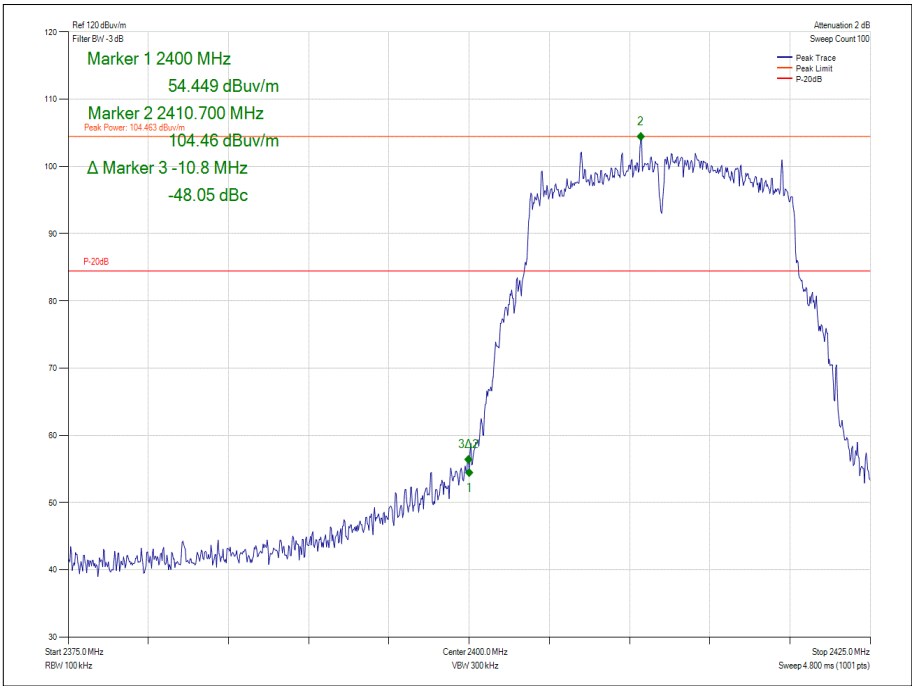


Figure 32 - 2412 MHz - Measured Frequency 2400.0 MHz



Main - (SISO)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
802.11n	MCS0	2412	2400.0	-47.50

Table 42

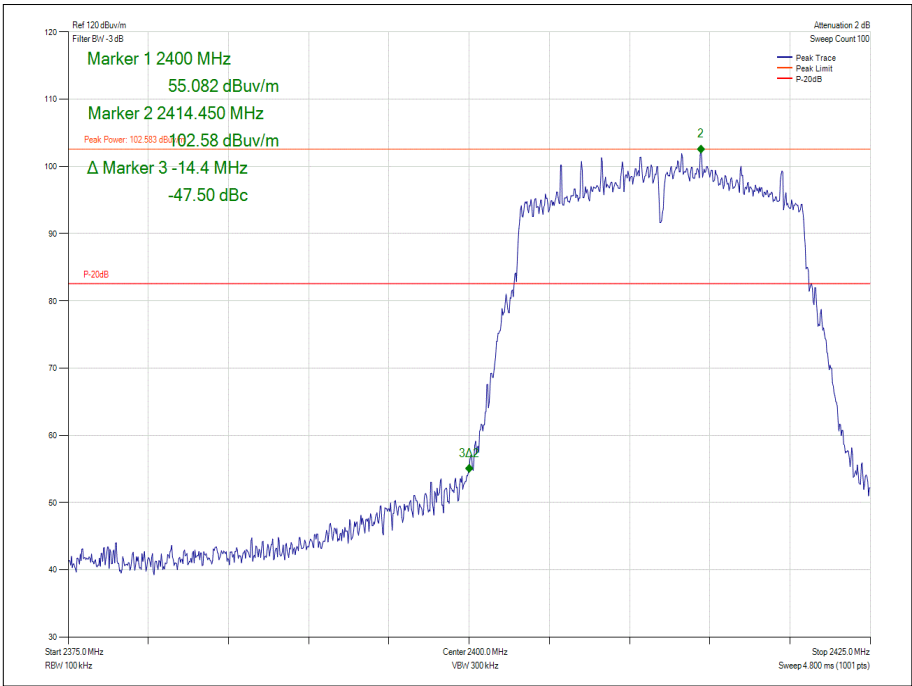


Figure 33 - 2412 MHz - Measured Frequency 2400.0 MHz



Main - (MIMO 2 Tx, TXBF)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
802.11n	MCS0	2412	2400.0	-53.21

Table 43

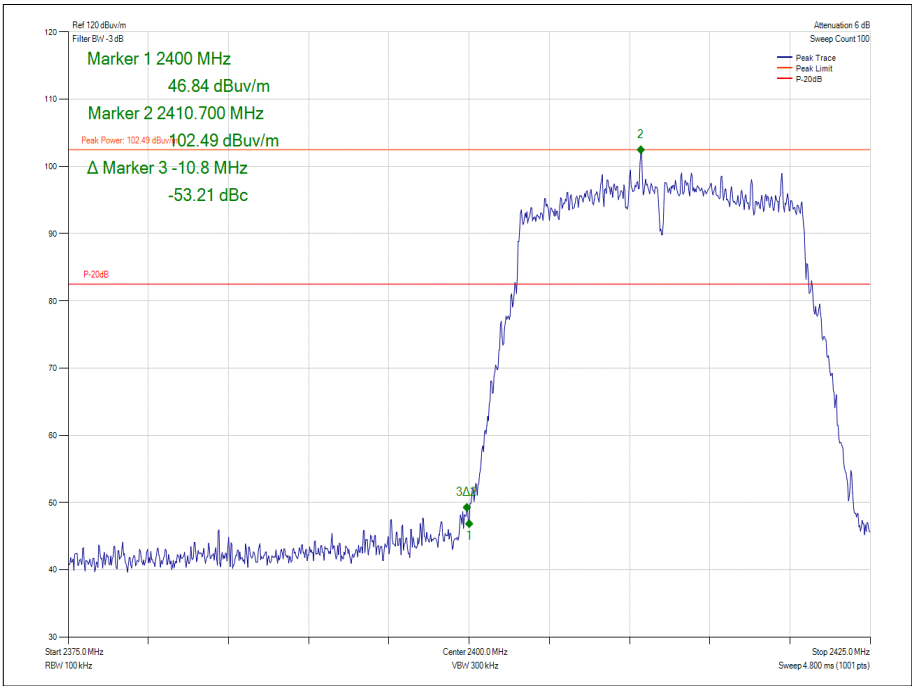


Figure 34 - 2412 MHz - Measured Frequency 2400.0 MHz



Main - (MIMO 3Tx, CDD)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
802.11b	1 Mbps	2412	2400.0	-53.64

Table 44

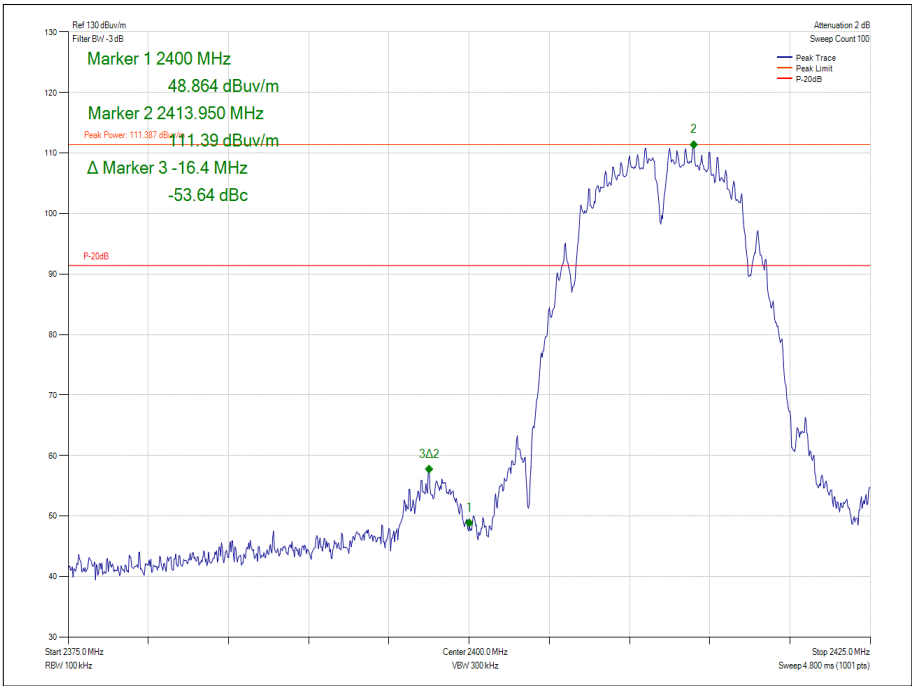


Figure 35 - 2412 MHz - Measured Frequency 2400.0 MHz



Main – (MIMO 2Tx, CDD)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
802.11b	1 Mbps	2412	2400.0	-60.37

Table 45

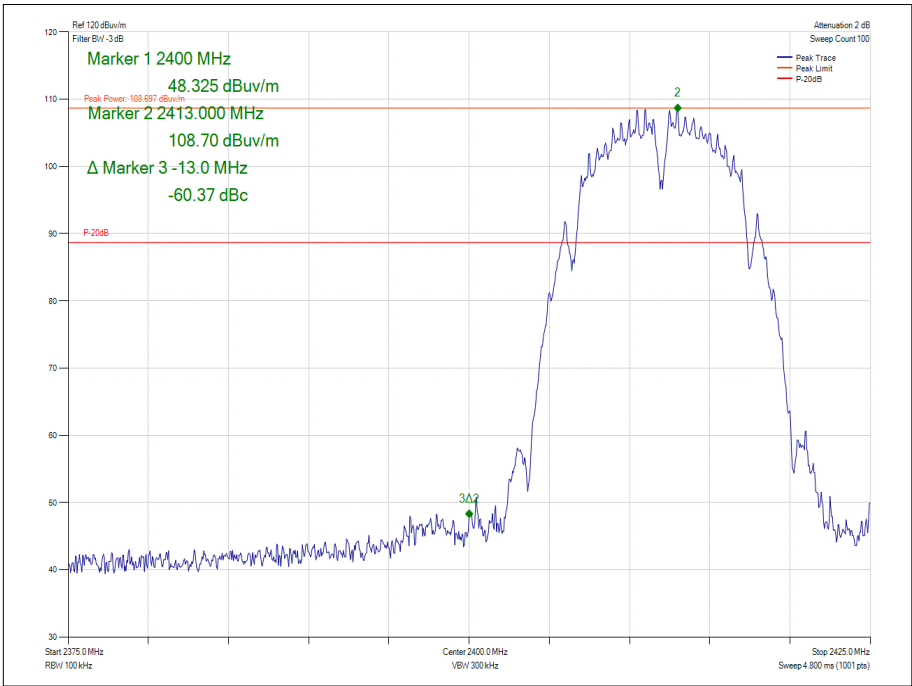


Figure 36 - 2412 MHz - Measured Frequency 2400.0 MHz



Main - (MIMO 2Tx, CDD)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
802.11n	MCS0	2412	2400.0	-52.33

Table 46

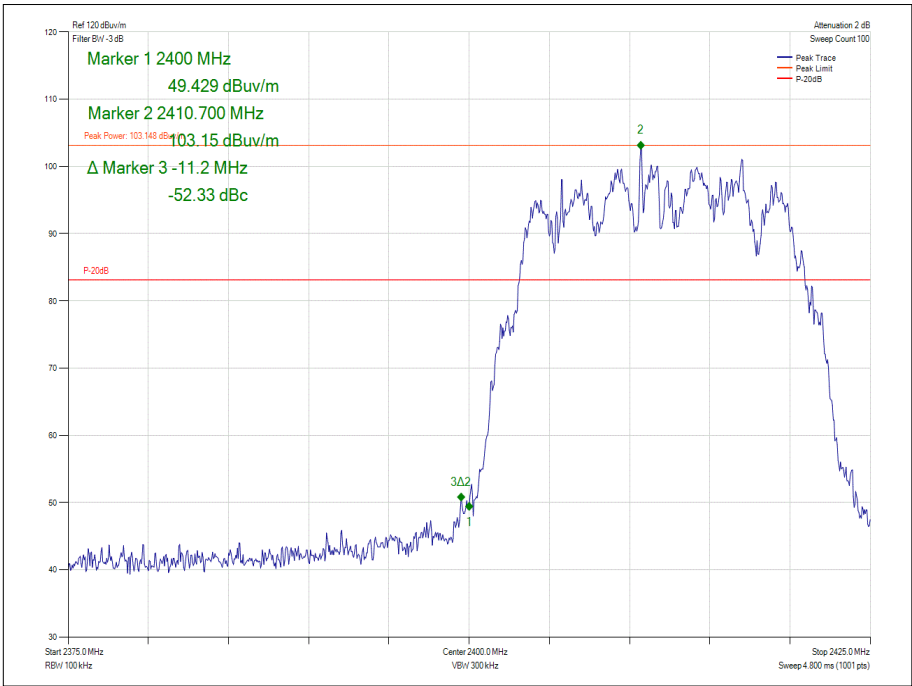


Figure 37 - 2412 MHz - Measured Frequency 2400.0 MHz



Main - (MIMO 3Tx, CDD)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
802.11n	MCS0	2412	2400.0	-54.74

Table 47

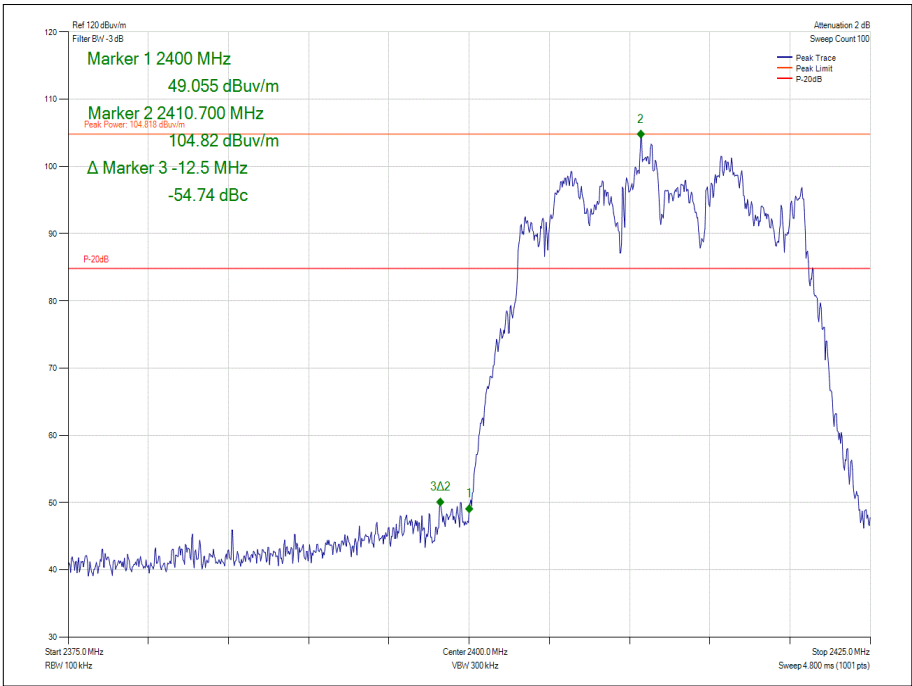


Figure 38 - 2412 MHz - Measured Frequency 2400.0 MHz



Main - (MIMO 3Tx, TXBF)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
802.11n	MCS0	2412	2400.0	-53.51

Table 48

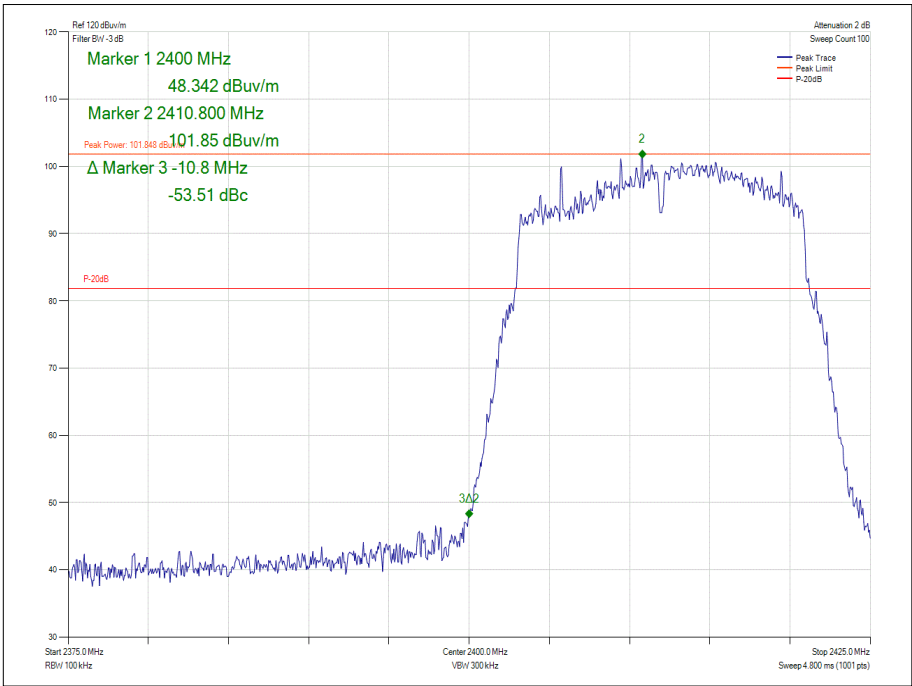


Figure 39 - 2412 MHz - Measured Frequency 2400.0 MHz



Aux - (SISO)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
802.11b	1 Mbps	2412	2400.0	-57.13

Table 49

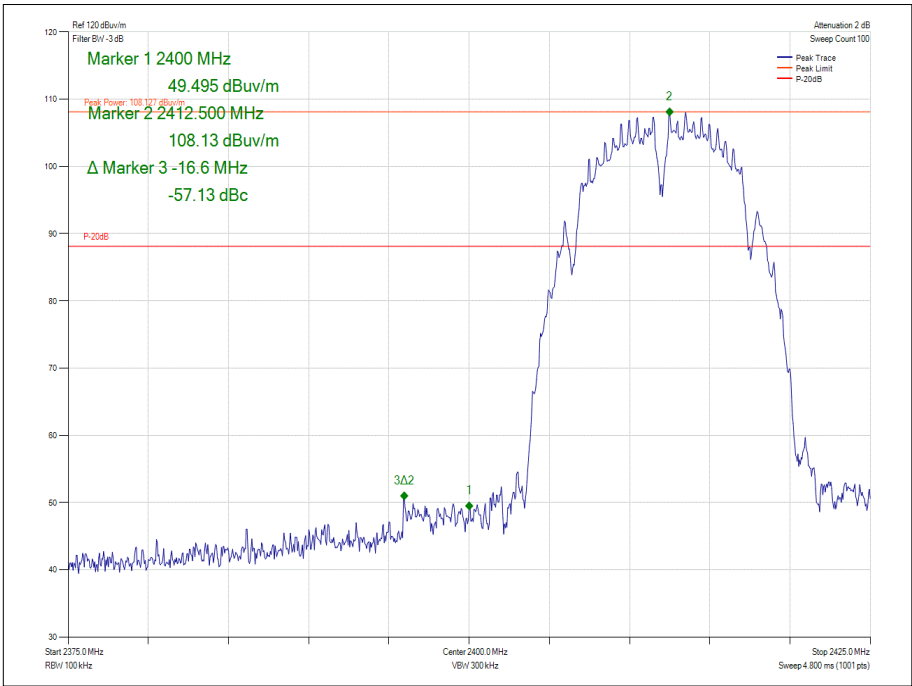


Figure 40 - 2412 MHz - Measured Frequency 2400.0 MHz



Aux - (SISO)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
802.11g	6 Mbps	2412	2400.0	-45.34

Table 50

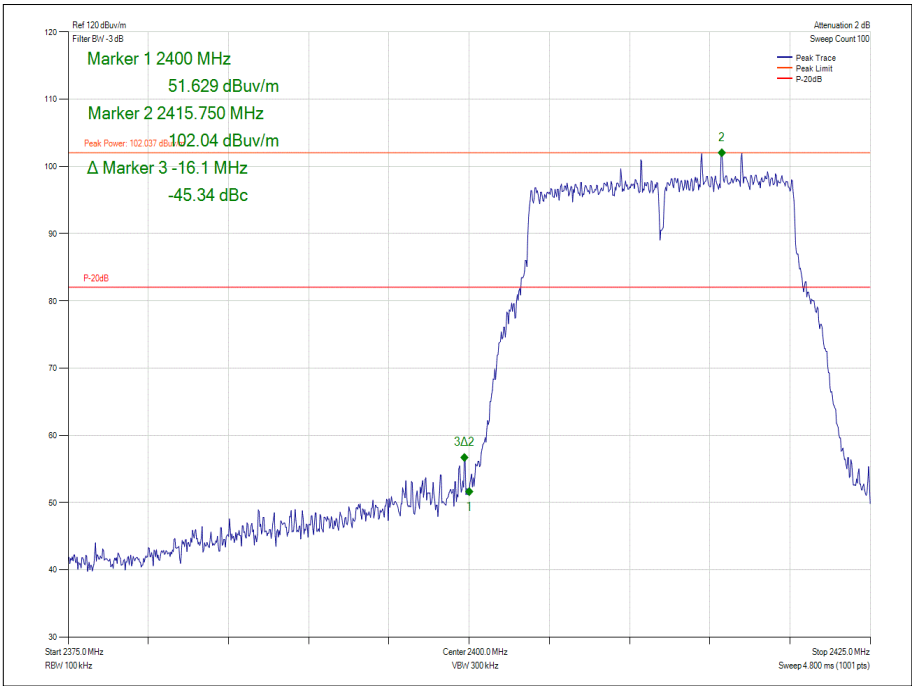


Figure 41 - 2412 MHz - Measured Frequency 2400.0 MHz



Aux (SISO)

Mode	Data Rate/MCS	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
802.11n	MCS0	2412	2400.0	-44.10

Table 51

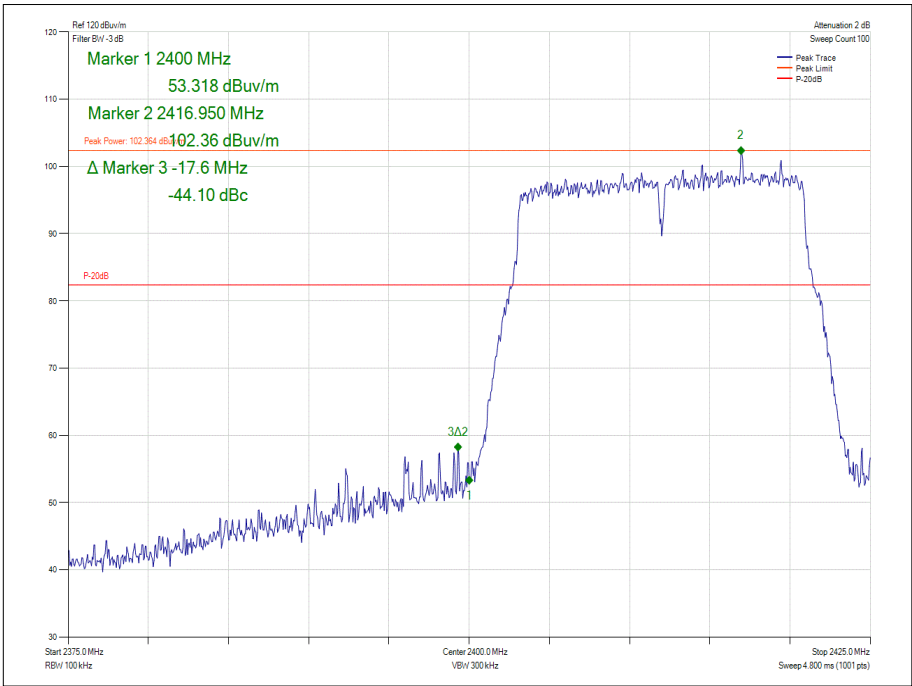


Figure 42 - 2412 MHz - Measured Frequency 2400.0 MHz

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
10dB/1W SMA Attenuator dc - 18GHz	Sealectro	60-674-1010-89	3	12	31-Aug-2018
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Nov-2018
1 Metre SMA Cable	Rhophase	3PS-1801A-1000-3PS	4099	12	19-Sep-2018
Cable (Rx, Nm-Nm, 7m)	Scott Cables	SLU18-NMNM-07.00M	4498	-	O/P Mon
Cable (Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4526	6	31-Aug-2018
EMI Receiver	Keysight Technologies	N9038A MXE	4628	12	4-Jul-2019
EMI Receiver	Keysight Technologies	N9038A MXE	4629	12	13-Sep-2018
Mast Controller	Maturo GmbH	NCD	4810	-	TU
Tilt Antenna Mast	Maturo GmbH	TAM 4.0-P	4811	-	TU
9m N type RF cable	Rosenberger	2303-0 9.0m PNm PNm	4827	6	4-Jan-2019
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	12-Feb-2019
Hygrometer	Rotronic	HP21	4989	12	26-Apr-2019

Table 52

TU – Traceability Unscheduled

O/P Mon – Output Monitored