# Report on the FCC and IC Testing of: Frontier Smart Technologies Limited

## Minuet 2 Module (FS5352) and Minuet 2 Voice Reference Platform (FS6626)

## In accordance with FCC 47 CFR Part 15C, ISEDC RSS-247 and ISEDC RSS-GEN (WLAN /BLE)

Prepared for: Frontier Smart Technologies Limited
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Add value.
Inspire trust.

FCC ID: YYX-FS5352 IC: 11458A-FS5352

## COMMERCIAL-IN-CONFIDENCE

Document Number: 75946124-08 | Issue: 01

| SIGNATURE | | | |
|---|---|---|---|
| | | | |
| **NAME** | **JOB TITLE** | **RESPONSIBLE FOR** | **ISSUE DATE** |
| Simon Bennett | Innovations Manager | Authorised Signatory | 17 September 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, ISEDC RSS-247 and ISEDC 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** |
| George Porter | Test Engineer | Testing | |
| Graeme Lawler | Test Engineer | Testing | |
| Connor Lee | Test Engineer | Testing | |
| Nandhini Mathivanan | Test Engineer | Testing | |
| Matthew Dawkins | Test Engineer | Testing | |

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

ISEDC 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: 2018, ISEDC RSS-247: Issue 2 (2017-02) and ISEDC RSS-GEN: Issue 5 Amd 1 (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 | 17 September 2019 |

**Table 1**

## 1.2 Introduction

| | |
|---|---|
| Applicant | Frontier Smart Technologies Limited |
| Manufacturer | Frontier Smart Technologies Limited |
| Model Number(s) | Minuet 2 Module FS5352<br>Minuet 2 Voice Reference Platform FS6626 |
| Serial Number(s) | RAD113219 - Minuet 2 Module (FS5352) FCC Radiated Test Sample<br>RAD113254 - Minuet 2 Module (FS5352) FCC Radiated Test Sample<br>RAD113255 - Minuet 2 Module (FS5352) Conducted Test Sample<br>RAD113239 - Minuet 2 Module (FS5352) Conducted Test Sample |
| Hardware Version(s) | Minuet 2 Module: Rev4<br>Minuet 2 Voice Reference Platform: ES1 |
| Software Version(s) | NS2 |
| Number of Samples Tested | 4 |
| Test Specification/Issue/Date | FCC 47 CFR Part 15C: 2018<br>ISEDC RSS-247: Issue 2 (2017-02)<br>ISEDC RSS-GEN: Issue 5 Amd 1 (2019-03) |
| Order Number<br>Date | FS190532<br>22-May-2019 |
| Date of Receipt of EUT | 11-June-2019, 14-June-2019 and 01-July-2019 |
| Start of Test | 11-June-2019 |
| Finish of Test | 21-July-2019 |
| Name of Engineer(s) | George Porter, Graeme Lawler, Connor Lee, Matthew Dawkins and Nandhini Mathivanan |
| Related Document(s) | ANSI C63.10 (2013)<br>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, ISEDC RSS-247 and ISEDC RSS-GEN is shown below.

| Section | Specification Clause | | | Test Description | Result | Comments/Base Standard |
|---|---|---|---|---|---|---|
| | Part 15C | RSS-247 | RSS-GEN | | | |
| Configuration and Mode: 2.4 GHz WLAN - 802.11b | | | | | | |
| 2.1 | 15.207 | - | 8.8 | AC Power Line Conducted Emissions | Pass | ANSI C63.10 (2013) |
| 2.2 | 15.247 (a)(2) | 5.2 | 6.6 | Emission Bandwidth | Pass | ANSI C63.10 (2013) |
| 2.3 | 15.247 (b) | 5.4 | 6.12 | Maximum Conducted Output Power | Pass | ANSI C63.10 (2013)<br>KDB 662911 D01 v02r01 |
| 2.4 | 15.247 (d) | 5.5 | - | Authorised Band Edges | Pass | ANSI C63.10 (2013) |
| 2.5 | 15.205 | - | 8.10 | Restricted Band Edges | Pass | ANSI C63.10 (2013) |
| 2.6 | 15.247 (d) and 15.205 | 5.5 | 6.13 | Spurious Radiated Emissions | Pass | ANSI C63.10 (2013) |
| 2.7 | 15.247 (e) | 5.2 | 6.12 | Power Spectral Density | Pass | ANSI C63.10 (2013)<br>KDB 662911 D01 v02r01 |
| Configuration and Mode: 2.4 GHz WLAN - 802.11g | | | | | | |
| 2.2 | 15.247 (a)(2) | 5.2 | 6.6 | Emission Bandwidth | Pass | ANSI C63.10 (2013) |
| 2.3 | 15.247 (b) | 5.4 | 6.12 | Maximum Conducted Output Power | Pass | ANSI C63.10 (2013)<br>KDB 662911 D01 v02r01 |
| 2.4 | 15.247 (d) | 5.5 | - | Authorised Band Edges | Pass | ANSI C63.10 (2013) |
| 2.5 | 15.205 | - | 8.10 | Restricted Band Edges | Pass | ANSI C63.10 (2013) |
| 2.6 | 15.247 (e) | 5.2 | 6.12 | Power Spectral Density | Pass | ANSI C63.10 (2013)<br>KDB 662911 D01 v02r01 |

| Section | Specification Clause | | | Test Description | Result | Comments/Base Standard |
|---|---|---|---|---|---|---|
| | Part 15C | RSS-247 | RSS-GEN | | | |
| Configuration and Mode: 2.4 GHz WLAN - 802.11n 20 MHz Bandwidth | | | | | | |
| 2.2 | 15.247 (a)(2) | 5.2 | 6.6 | Emission Bandwidth | Pass | ANSI C63.10 (2013) |
| 2.3 | 15.247 (b) | 5.4 | 6.12 | Maximum Conducted Output Power | Pass | ANSI C63.10 (2013)<br>KDB 662911 D01 v02r01 |
| 2.4 | 15.247 (d) | 5.5 | - | Authorised Band Edges | Pass | ANSI C63.10 (2013) |
| 2.5 | 15.205 | - | 8.10 | Restricted Band Edges | Pass | ANSI C63.10 (2013) |
| 2.6 | 15.247 (d) and 15.205 | 5.5 | 6.13 | Spurious Radiated Emissions | Pass | ANSI C63.10 (2013) |
| 2.7 | 15.247 (e) | 5.2 | 6.12 | Power Spectral Density | Pass | ANSI C63.10 (2013)<br>KDB 662911 D01 v02r01 |
| Configuration and Mode: Bluetooth Low Energy | | | | | | |
| 2.2 | 15.247 (a)(2) | 5.2 | 6.6 | Emission Bandwidth | Pass | ANSI C63.10 (2013) |
| 2.3 | 15.247 (b) | 5.4 | 6.12 | Maximum Conducted Output Power | Pass | ANSI C63.10 (2013)<br>KDB 662911 D01 v02r01 |
| 2.4 | 15.247 (d) | 5.5 | - | Authorised Band Edges | Pass | ANSI C63.10 (2013) |
| 2.5 | 15.205 | - | 8.10 | Restricted Band Edges | Pass | ANSI C63.10 (2013) |
| 2.6 | 15.247 (d) and 15.205 | 5.5 | 6.13 | Spurious Radiated Emissions | Pass | ANSI C63.10 (2013) |
| 2.7 | 15.247 (e) | 5.2 | 6.12 | Power Spectral Density | Pass | ANSI C63.10 (2013)<br>KDB 662911 D01 v02r01 |

**Table 2**

## 1.4 Application Form

### Equipment Description

| | |
|---|---|
| Technical Description:<br>*(Please provide a brief description of the intended use of the equipment)* | Minuet 2 is a module, which when installed in a consumer audio product enables high-quality audio streaming over Wi-Fi, Bluetooth and Ethernet, and can be activated via voice commands. Where appropriate the Minuet 2 module is tested in the Minuet 2 Voice Reference Platform. |
| Manufacturer: | Frontier Smart Technologies Limited |
| Model: | Minuet 2 module (FS5352) |
| Part Number: | Minuet 2 module: HA-FS5352-xxxxxx (where xxxxxxx denotes the customer variant e.g. HA-FS5352-000001) |
| Hardware Version: | Minuet 2 module: Rev4 |
| Software Version: | NS2 |
| FCC ID (if applicable) | YYX-FS5352 |
| IC ID (if applicable) | 11458A-FS5352 |

### Intentional Radiators

| | | | | | | |
|---|---|---|---|---|---|---|
| Technology | Bluetooth | WLAN 2.4GHz | WLAN 5GHz | N/A | N/A | N/A |
| Frequency Band (MHz) | 2400-2483.5 | 2402-2482 | 5150-5350, 5470-5825 | N/A | N/A | N/A |
| Conducted Declared Output Power (dBm) | 6.5 | 16.5 | 16.5 | N/A | N/A | N/A |
| Antenna Gain (dBi) | 2.3 | 2.3 | 2.2(5150-5250MHz) 3.5 (5250-5350 MHz) 4.6 (5470-5725 MHz) 3.1 (5725-5825 MHz) | N/A | N/A | N/A |
| Supported Bandwidth(s) (MHz) | 1, 2 | 20 | 20,40, 80 | N/A | N/A | N/A |
| Modulation Scheme(s) | GFSK, DQPSK, 8-DPSK | BPSK, QPSK, 16-QAM, 64-QAM | BPSK, QPSK, 16-QAM, 64-QAM | N/A | N/A | N/A |
| ITU Emission Designator | 1M00D, 2M00D | 20M00D | 20M00D, 40M00D, 80M00D | N/A | N/A | N/A |
| Bottom Frequency (MHz) | 2400 | 2412 | 5180 | N/A | N/A | N/A |
| Middle Frequency (MHz) | 2441 | 2437 | 5500 | N/A | N/A | N/A |
| Top Frequency (MHz) | 2480 | 2472 | 5825 | N/A | N/A | N/A |

### Un-intentional Radiators

| | |
|---|---|
| Highest frequency generated or used in the device or on which the device operates or tunes | 5825 MHz |
| Lowest frequency generated or used in the device or on which the device operates or tunes | 2402MHz |
| Class A Digital Device (Use in commercial, industrial or business environment) ☑ | |

| |
|---|
| Class B Digital Device (Use in residential environment only) ☑ |

## AC Power Source

| | |
|---|---|
| AC supply frequency: 50 or 60 (Hz) | |
| 100 - 240 V | Max current: 0.8 A |
| Single Phase ☑ Three Phase ☐ | |

## DC Power Source

| |
|---|
| Nominal voltage: 5 V |
| Extreme upper voltage: 5.25 V |
| Extreme lower voltage: 4.75 V |
| Max current: 2 A |

## Battery Power Source

| |
|---|
| Voltage: 11.1 V |
| End-point voltage: 8.1 V *(Point at which the battery will terminate)* |
| Alkaline ☐ Leclanche ☐ Lithium ☐ Nickel Cadmium ☐ Lead Acid* ☐ **(Vehicle regulated)* |
| Other ☑ Please detail: Lithium-ion Polymer |

## Charging

| | |
|---|---|
| Can the EUT transmit whilst being charged | Yes ☑ No ☐ |

## Temperature

| | |
|---|---|
| Minimum temperature: 0 °C | Maximum temperature: 70 °C |

## Antenna Characteristics

| |
|---|
| Antenna connector ☑ State impedance 50 Ohm |
| Temporary antenna connector ☐ State impedance N/A Ohm |
| Integral antenna ☐ Type N/A State Gain N/A dBi |
| External antenna ☑ Type PCB antenna State impedance 50 Ohm |

## Ancillaries (if applicable)

| | |
|---|---|
| Manufacturer: Southstar | Part Number: N12-2128-R0A |
| Model: SW700M（SW750M) | Country of Origin: China |

I hereby declare that the information supplied is correct and complete.

Name: Abdul Wahed Dewan
Position held: Principal RF Engineer
Date: 29/08/2019

## 1.5 Product Information

### 1.5.1 Technical Description

Minuet 2 is a module, which when installed in a consumer audio product enables high-quality audio streaming over Wi-Fi, Bluetooth and Ethernet, and can be activated via voice commands. Where appropriate the Minuet 2 module is tested in the Minuet 2 Voice Reference Platform.

## 1.6 Test Set up Diagrams

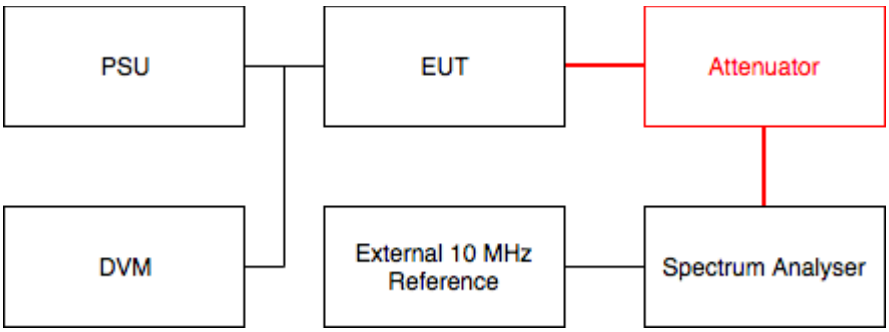


**Figure 1 - Conducted Lab Testing**

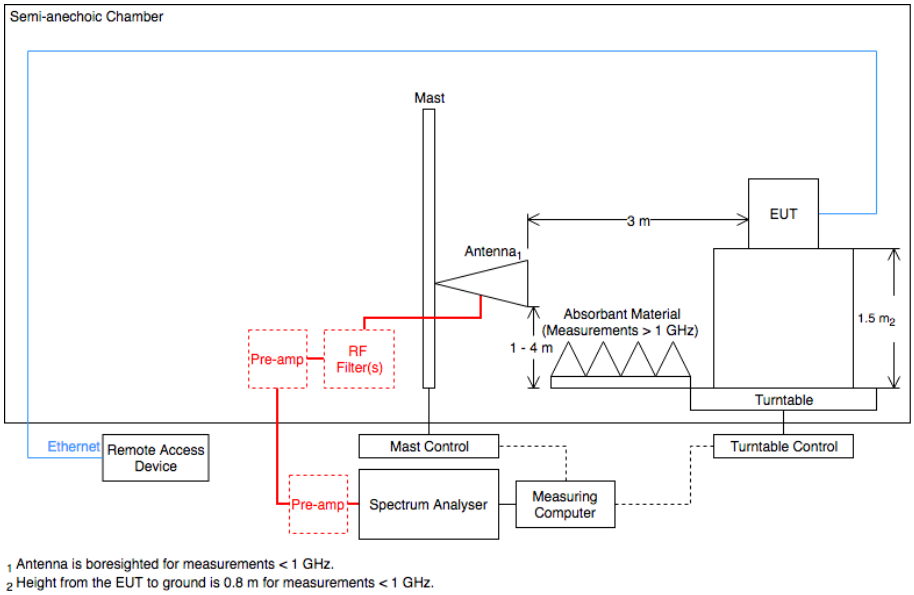


**Figure 2- Radiated Emissions Test Setup Diagram**

## 1.7 Deviations from the Standard

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

## 1.8 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: RAD113255 | | | |
| 0 | As supplied by the customer | Not Applicable | Not Applicable |
| Serial Number: RAD113219 | | | |
| 0 | As supplied by the customer | Not Applicable | Not Applicable |
| Serial Number: RAD113254 | | | |
| 0 | As supplied by the customer | Not Applicable | Not Applicable |
| Serial Number: RAD113239 | | | |
| 0 | As supplied by the customer | Not Applicable | Not Applicable |

**Table 3**

## 1.9 Test Location

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

| Test Name | Name of Engineer(s) | Accreditation |
|---|---|---|
| Configuration and Mode: 2.4 GHz WLAN - 802.11b | | |
| AC Power Line Conducted Emissions | Graeme Lawler | UKAS |
| Emission Bandwidth | George Porter | UKAS |
| Maximum Conducted Output Power | George Porter | UKAS |
| Restricted Band Edges | Connor Lee | UKAS |
| Authorised Band Edges | Connor Lee and Matthew Dawkins | UKAS |
| Spurious Radiated Emissions | Graeme Lawler | UKAS |
| Power Spectral Density | George Porter | UKAS |
| Configuration and Mode: 2.4 GHz WLAN - 802.11g | | |
| Emission Bandwidth | George Porter | UKAS |
| Maximum Conducted Output Power | George Porter | UKAS |
| Restricted Band Edges | Connor Lee | UKAS |
| Authorised Band Edges | Connor Lee and Matthew Dawkins | UKAS |
| Power Spectral Density | George Porter | UKAS |
| Configuration and Mode: 2.4 GHz WLAN - 802.11n 20 MHz Bandwidth | | |
| Emission Bandwidth | George Porter | UKAS |
| Maximum Conducted Output Power | George Porter | UKAS |
| Restricted Band Edges | Connor Lee | UKAS |
| Authorised Band Edges | Connor Lee and Matthew Dawkins | UKAS |
| Spurious Radiated Emissions | Graeme Lawler | UKAS |
| Power Spectral Density | George Porter | UKAS |
| Configuration and Mode: Bluetooth Low Energy | | |
| Restricted Band Edges | Graeme Lawler | UKAS |
| Maximum Conducted Output Power | Nandhini Mathivanan | UKAS |
| Power Spectral Density | Nandhini Mathivanan | UKAS |
| Emission Bandwidth | Nandhini Mathivanan | UKAS |
| Authorised Band Edges | Graeme Lawler | UKAS |
| Spurious Radiated Emissions | Graeme Lawler | UKAS |

**Table 4**

Office Address:

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

# 2 Test Details

## 2.1 AC Power Line Conducted Emissions

### 2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.207
ISEDC RSS-GEN, Clause 8.8

### 2.1.2 Equipment Under Test and Modification State

Minuet 2 Module (FS5352), S/N: RAD113219 - Modification State 0

### 2.1.3 Date of Test

21-July-2019

### 2.1.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.2.

### 2.1.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 17.3 °C |
| Relative Humidity | 76.5 % |

### 2.1.6 Test Results

2.4 GHz WLAN - 802.11b

Applied supply voltage: 120V
Applied supply frequency: 60 Hz

| Frequency (MHz) | QP Level (dBuV) | QP Limit (dBuV) | QP Margin (dBuV) | AV Level (dBuV) | AV Limit (dBuV) | AV Margin (dBuV) |
|---|---|---|---|---|---|---|
| 0.168 | 41.8 | 65.1 | -23.2 | 28.2 | 55.1 | 26.8 |
| 4.907 | 31.1 | 56.0 | -24.9 | 23.2 | 46.0 | 22.8 |

**Table 5 - Live Line Emissions Results**

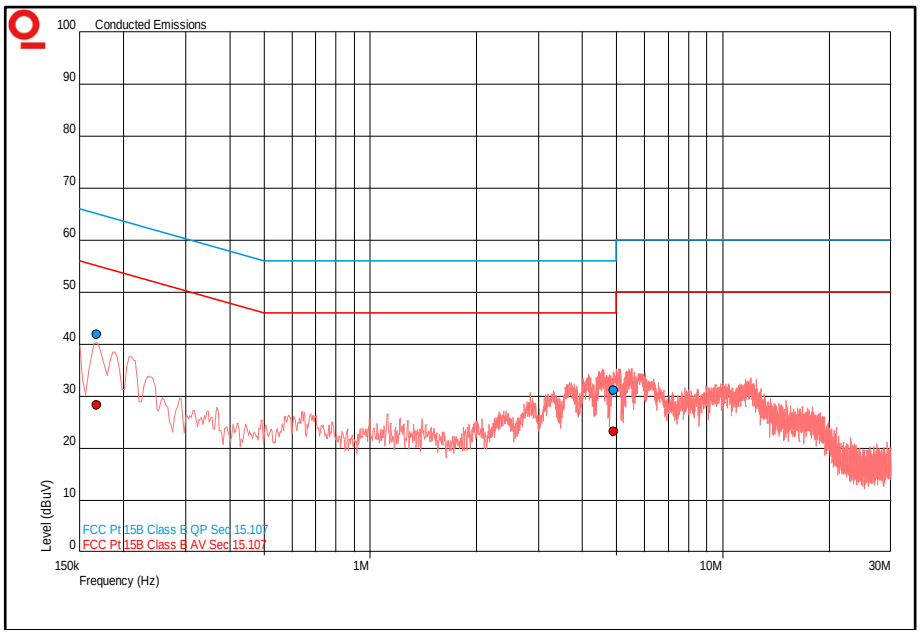


**Figure 3 - Live Line - 150 kHz to 30 MHz**

| Frequency (MHz) | QP Level (dBuV) | QP Limit (dBuV) | QP Margin (dBuV) | AV Level (dBuV) | AV Limit (dBuV) | AV Margin (dBuV) |
|---|---|---|---|---|---|---|
| 0.658 | 32.6 | 56.0 | -23.4 | 24.6 | 46.0 | 21.4 |
| 4.925 | 32.3 | 56.0 | -23.7 | 24.5 | 46.0 | 21.5 |

**Table 6 – Neutral Line Emissions Results**

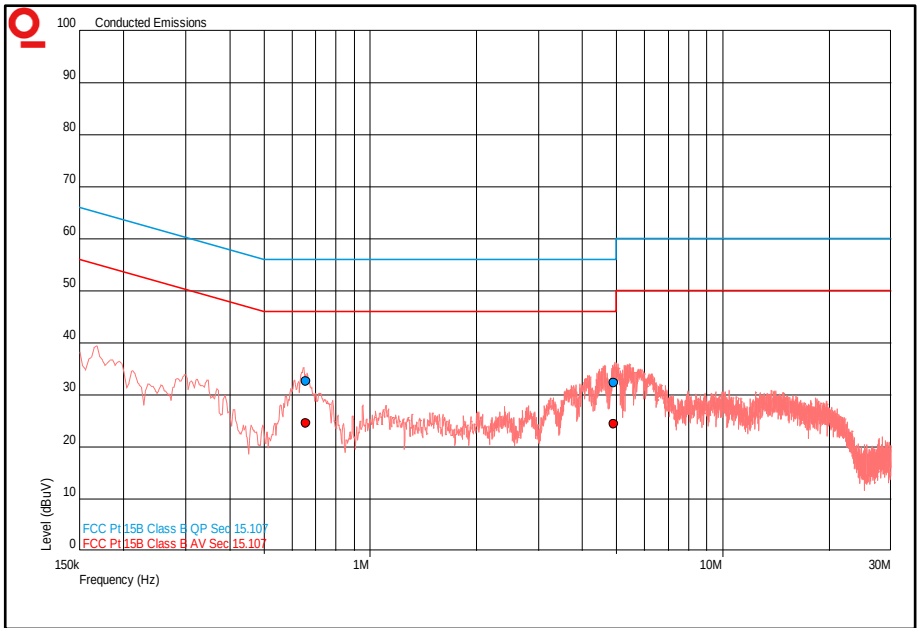


**Figure 4 - Neutral Line - 150 kHz to 30 MHz**

FCC 47 CFR Part 15, Limit Clause 15.207 and ISEDC RSS-GEN Limit Clause 8.8

| Frequency of Emission (MHz) | Conducted Limit (dBµV) | |
|---|---|---|
| | Quasi-Peak | Average |
| 0.15 to 0.5 | 66 to 56* | 56 to 46* |
| 0.5 to 5 | 56 | 46 |
| 5 to 30 | 60 | 50 |

**Table 7**

*Decreases with the logarithm of the frequency.

### 2.1.7 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 |
|---|---|---|---|---|---|
| Transient Limiter | Hewlett Packard | 11947A | 15 | 12 | 26-Jul-2019 |
| LISN | Rohde & Schwarz | ESH3-Z5 | 1390 | 12 | 20-Nov-2019 |
| Screened Room (5) | Rainford | Rainford | 1545 | 36 | 23-Jan-2021 |
| Hygromer | Rotronic | A1 | 2677 | 12 | 20-Feb-2020 |
| Digital Multimeter | Iso-tech | IDM-101 | 2895 | 12 | 04-Oct-2019 |
| EMI Test Receiver | Rohde & Schwarz | ESU40 | 3506 | 12 | 17-Dec-2019 |

**Table 8**

## 2.2 Maximum Conducted Output Power

### 2.2.1 Specification Reference

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

### 2.2.2 Equipment Under Test and Modification State

Minuet 2 Module (FS5352), S/N: RAD113255 - Modification State 0
Minuet 2 Module (FS5352), S/N: RAD113239 - Modification State 0

### 2.2.3 Date of Test

24-June-2019 to 18-July-2019

### 2.2.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 11.9.1.1.

### 2.2.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 21.7 - 22.9 °C |
| Relative Humidity | 48.1 - 65.8 % |

### 2.2.6 Test Results

2.4 GHz WLAN - 802.11b

Testing was performed on the Data Rate with the highest conducted output power. This Data Rate was 2 Mbps.

| Port | Output Power (dBm) | | |
|---|---|---|---|
| | 2412 MHz | 2437 MHz | 2462 MHz |
| 1 | 14.72 | 14.70 | 14.94 |
| 2 | 14.54 | 14.65 | 14.88 |

**Table 9**

2.4 GHz WLAN - 802.11g

Testing was performed on the Data Rate with the highest conducted output power. This Data Rate was 54 Mbps.

| Port | Output Power (dBm) | | |
|---|---|---|---|
| | 2412 MHz | 2437 MHz | 2462 MHz |
| 1 | 14.70 | 14.72 | 14.99 |
| 2 | 14.57 | 14.78 | 14.47 |

**Table 10**

2.4 GHz WLAN - 802.11n 20 MHz Bandwidth

Testing was performed on the Modulation Coding Scheme with the highest conducted output power. This Modulation Coding Scheme was MCS7.

| Port | Output Power (dBm) | | |
|---|---|---|---|
| | 2412 MHz | 2437 MHz | 2462 MHz |
| 1 | 14.80 | 14.81 | 15.13 |
| 2 | 14.80 | 14.93 | 14.47 |
| MIMO – Port 1 + 2 | 17.75 | 17.73 | 17.56 |

**Table 11**

Bluetooth Low Energy

| Frequency (MHz) | Output Power | |
|---|---|---|
| | dBm | mW |
| 2402 | 6.32 | 4.285 |
| 2440 | 6.02 | 3.399 |
| 2480 | 5.56 | 3.597 |

**Table 12**

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.

ISEDC RSS-247, Limit Clause 5.4 (d)

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.

### 2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|
| Dual Power Supply Unit | Hewlett Packard | 6253A | 271 | - | O/P Mon |
| Power Divider | Weinschel | 1506A | 603 | 12 | 23-Apr-2020 |
| Hygrometer | Rotronic | I-1000 | 3220 | 12 | 13-Sep-2019 |
| Network Analyser | Rohde & Schwarz | ZVA 40 | 3548 | 12 | 17-Oct-2019 |
| 1 Metre SMA Cable | Rhophase | 3PS-1801A-1000-3PS | 4101 | - | O/P Mon |
| Calibration Unit | Rohde & Schwarz | ZV-Z54 | 4368 | 12 | 22-Oct-2019 |
| Frequency Standard | Spectracom | SecureSync 1200-0408-0601 | 4393 | 6 | 15-Oct-2019 |
| PXA Signal Analyser | Keysight Technologies | N9030A | 4653 | 12 | 06-Feb-2020 |
| EXA | Keysight Technologies | N9010B | 4968 | 24 | 21-Dec-2019 |
| Cable (18 GHz) | Rosenberger | LU7-071-1000 | 5097 | 12 | 04-Oct-2019 |
| Cable (18GHz SMA 1m) | Rosenberger | LU7-071-1000 | 5164 | 12 | 06-Dec-2019 |
| USB Power Sensor | Boonton | RTP5006 | 5184 | 12 | 12-Dec-2019 |
| Attenuator 10 dB 2W | Telegartner | 01156A0031 | N/S | - | O/P Mon |

**Table 13**

O/P Mon – Output Monitored using calibrated equipment

## 2.3 Power Spectral Density

### 2.3.1 Specification Reference

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

### 2.3.2 Equipment Under Test and Modification State

Minuet 2 Module (FS5352), S/N: RAD113239 - Modification State 0
Minuet 2 Module (FS5352), S/N: RAD113255 - Modification State 0

### 2.3.3 Date of Test

24-June-2019 to 18-July-2019

### 2.3.4 Test Method

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

### 2.3.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 21.7 - 22.9 °C |
| Relative Humidity | 48.1 - 65.8 % |

### 2.3.6 Test Results

2.4 GHz WLAN - 802.11b

Data Rate: 2 Mbps

| Antenna Port | Power Spectral Density (dBm/MHz) | | |
|---|---|---|---|
| | 2412 MHz | 2437 MHz | 2462 MHz |
| 1 | -7.56 | -7.60 | -7.83 |
| 2 | -7.93 | -7.85 | -7.08 |

**Table 14 - Power Spectral Density**

2.4 GHz WLAN - 802.11g

Data Rate: 54 Mbps

| Antenna Port | Power Spectral Density (dBm/MHz) | | |
|---|---|---|---|
| | 2412 MHz | 2437 MHz | 2462 MHz |
| 1 | -8.49 | -7.98 | -8.23 |
| 2 | -8.05 | -7.10 | -9.88 |

**Table 15 - Power Spectral Density**

2.4 GHz WLAN - 802.11n 20 MHz Bandwidth

Modulation Coding Scheme: MCS7

| Antenna Port | Power Spectral Density (dBm/MHz) | | |
|---|---|---|---|
| | 2412 MHz | 2437 MHz | 2462 MHz |
| 1 | -7.48 | -7.80 | -6.78 |
| 2 | -6.96 | -7.21 | -10.98 |
| MIMO – Port 1 + 2 | -7.06 | -7.34 | -7.54 |

**Table 16 - Power Spectral Density**

Bluetooth Low Energy

Modulation/Packet Type: GFSK/DH1

| Frequency (MHz) | Power Spectral Density (dBm/MHz) |
|---|---|
| 2440 | 5.66 |
| 2480 | 5.16 |
| 2402 | 5.94 |

**Table 17 - 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.

ISEDC 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

### 2.3.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|
| Dual Power Supply Unit | Hewlett Packard | 6253A | 271 | - | O/P Mon |
| Power Divider | Weinschel | 1506A | 603 | 12 | 23-Apr-2020 |
| Hygrometer | Rotronic | I-1000 | 3220 | 12 | 13-Sep-2019 |
| Network Analyser | Rohde & Schwarz | ZVA 40 | 3548 | 12 | 17-Oct-2019 |
| 1 Metre SMA Cable | Rhophase | 3PS-1801A-1000-3PS | 4101 | - | O/P Mon |
| Calibration Unit | Rohde & Schwarz | ZV-Z54 | 4368 | 12 | 22-Oct-2019 |
| Frequency Standard | Spectracom | SecureSync 1200-0408-0601 | 4393 | 6 | 15-Oct-2019 |
| RadiPower USB RF power sensor | DARE!! Instruments | RPR3006W | 4466 | 12 | 10-Apr-2020 |
| PXA Signal Analyser | Keysight Technologies | N9030A | 4653 | 12 | 06-Feb-2020 |
| EXA | Keysight Technologies | N9010B | 4968 | 24 | 21-Dec-2019 |
| Cable (18 GHz) | Rosenberger | LU7-071-1000 | 5097 | 12 | 04-Oct-2019 |
| USB Power Sensor | Boonton | RTP5006 | 5184 | 12 | 12-Dec-2019 |
| Attenuator 10 dB 2W | Telegartner | 01156A0031 | N/S | - | O/P Mon |

**Table 18**

O/P Mon – Output Monitored using calibrated equipment

## 2.4 Emission Bandwidth

### 2.4.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(2)
ISEDC RSS-247, Clause 5.2
ISEDC RSS-GEN, Clause 6.7

### 2.4.2 Equipment Under Test and Modification State

Minuet 2 Module (FS5352), S/N: RAD113239 - Modification State 0
Minuet 2 Module (FS5352), S/N: RAD113255 - Modification State 0

### 2.4.3 Date of Test

24-June-2019 to 18-July-2019

### 2.4.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 11.8.1

### 2.4.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 21.7 - 22.9 °C |
| Relative Humidity | 48.1 - 65.8 % |

### 2.4.6 Test Results

2.4 GHz WLAN - 802.11b

Data Rate: 2 Mbps

| Frequency (MHz) | 6 dB Bandwidth (MHz) | 99% Occupied Bandwidth (MHz) |
|---|---|---|
| 2412 | 10.020 | 13.468 |
| 2437 | 10.140 | 13.454 |
| 2462 | 10.080 | 13.417 |

**Table 19 – Antenna Port 1**

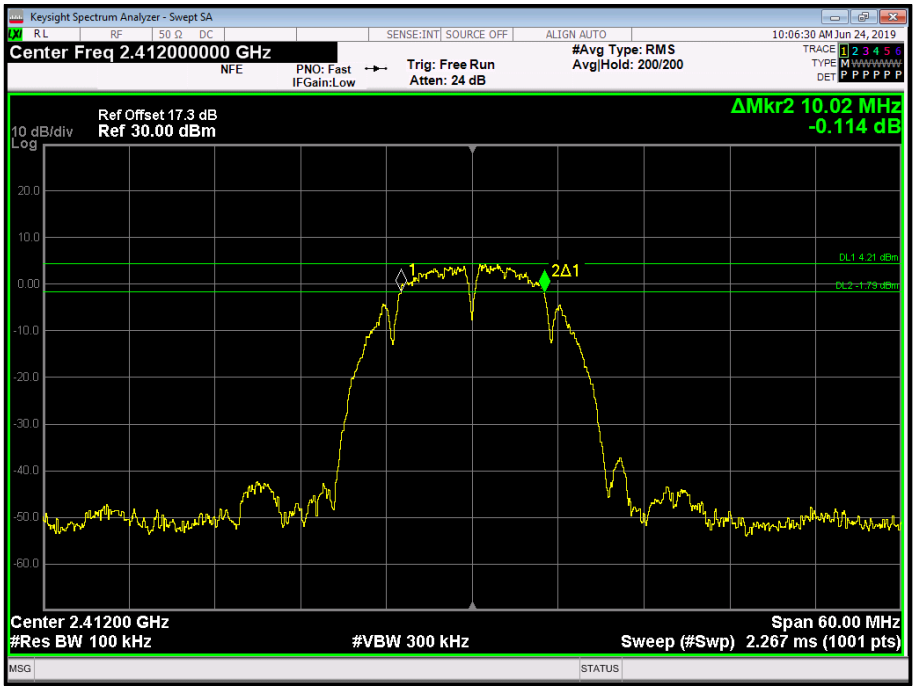


**Figure 5 - 2412 MHz – 6 dB Bandwidth – Antenna Port 1**

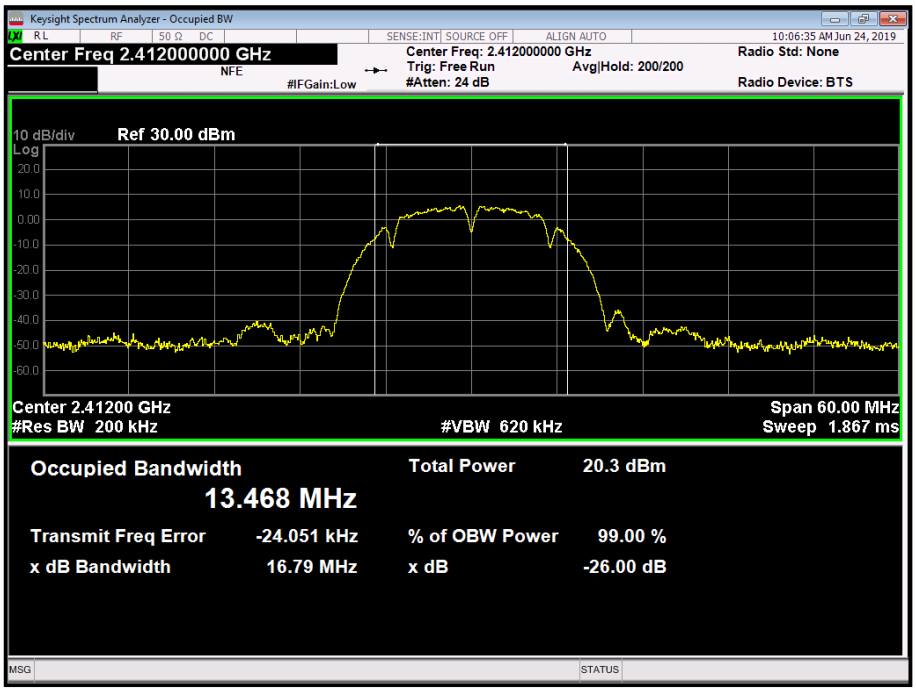


**Figure 6 - 2412 MHz – 99% Occupied Bandwidth – Antenna Port 1**

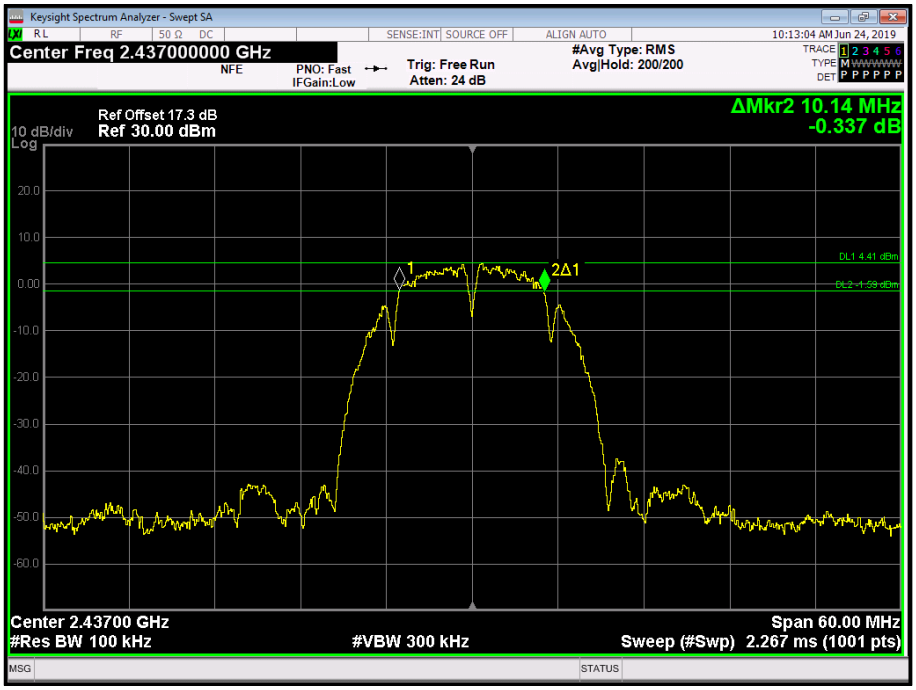


**Figure 7 - 2437 MHz – 6 dB Bandwidth – Antenna Port 1**

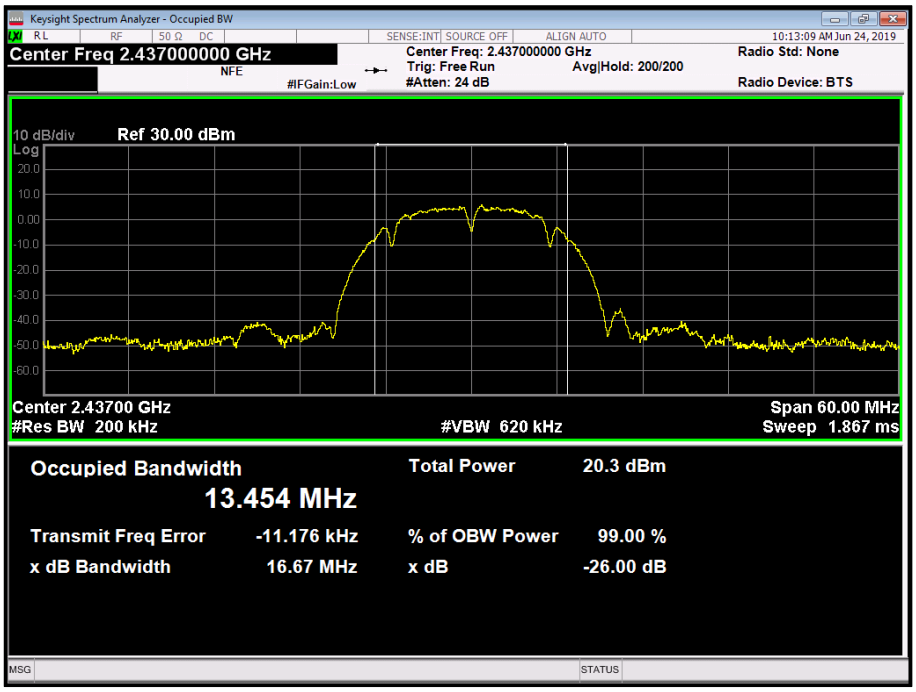


**Figure 8 - 2437 MHz – 99% Occupied Bandwidth – Antenna Port 1**

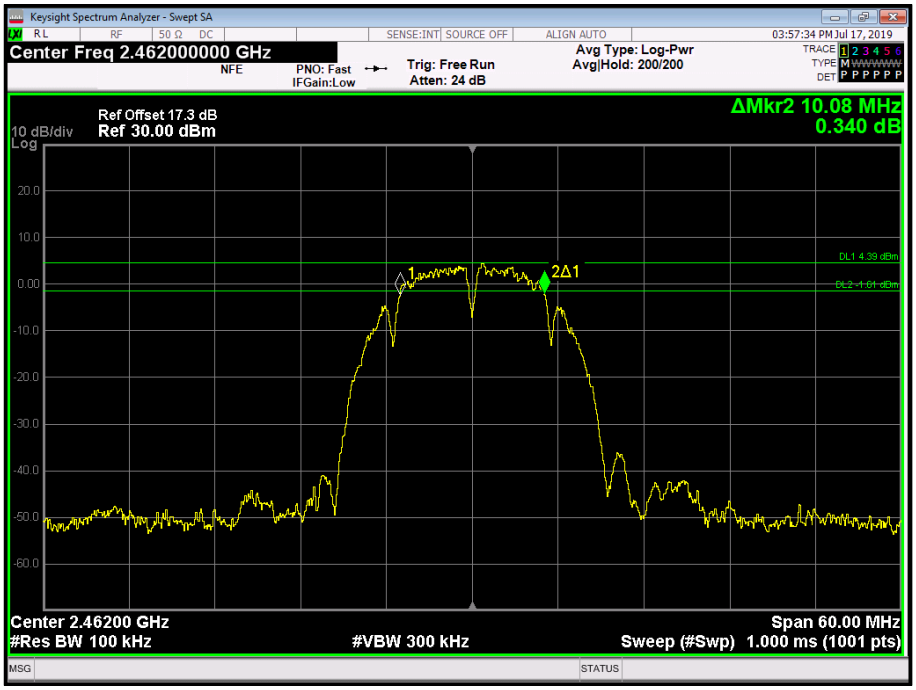


**Figure 9 - 2462 MHz – 6 dB Bandwidth – Antenna Port 1**

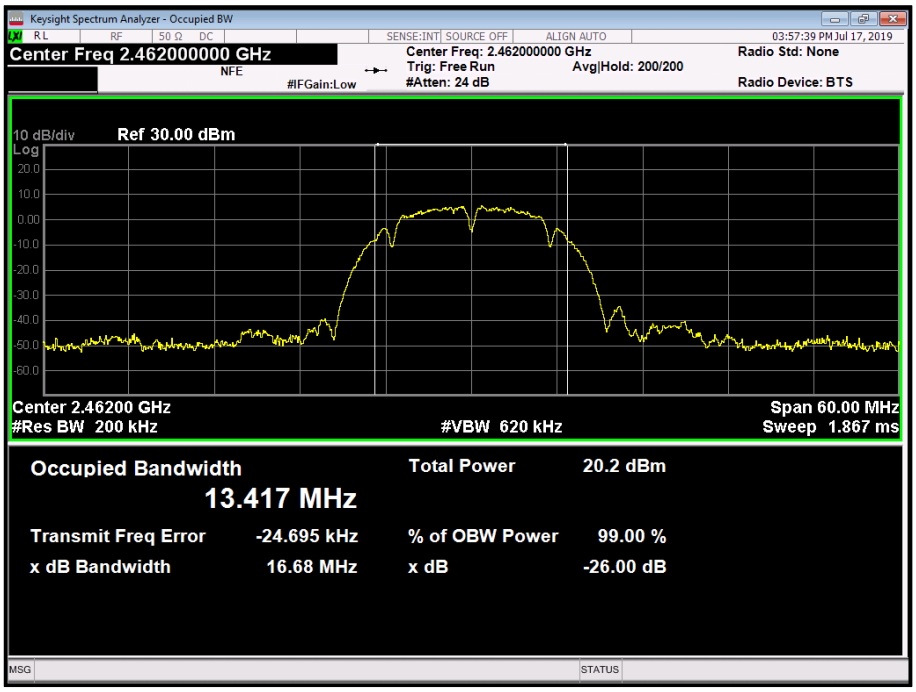


**Figure 10 - 2462 MHz - 99% Occupied Bandwidth – Antenna Port 1**

2.4 GHz WLAN - 802.11b

Data Rate: 2 Mbps

| Frequency (MHz) | 6 dB Bandwidth (MHz) | 99% Occupied Bandwidth (MHz) |
|---|---|---|
| 2412 | 10.020 | 13.456 |
| 2437 | 10.200 | 13.429 |
| 2462 | 9.900 | 13.472 |

**Table 20 – Antenna Port 2**

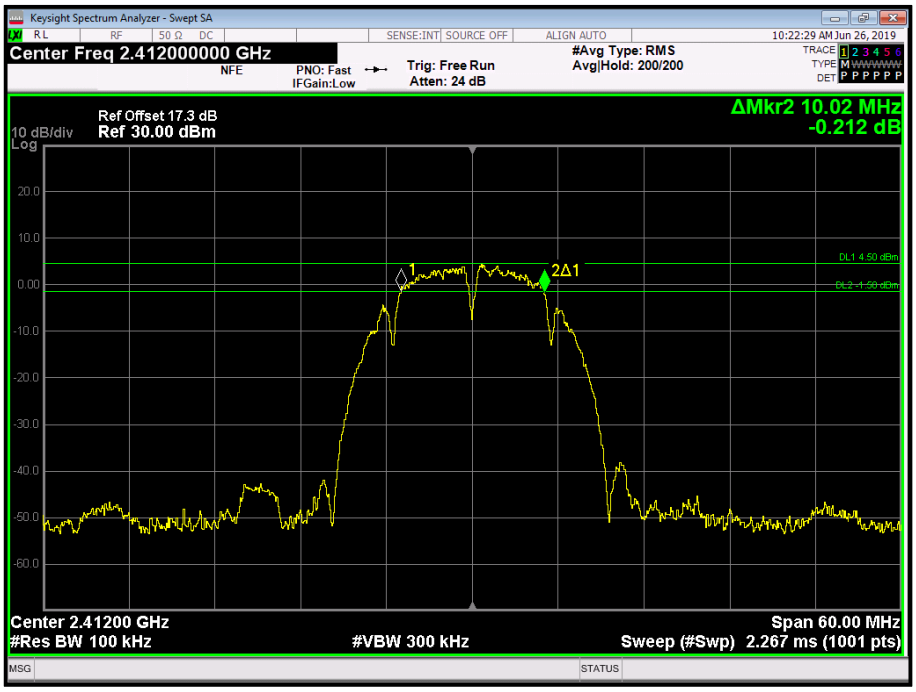


**Figure 11 - 2412 MHz – 6 dB Bandwidth – Antenna Port 2**

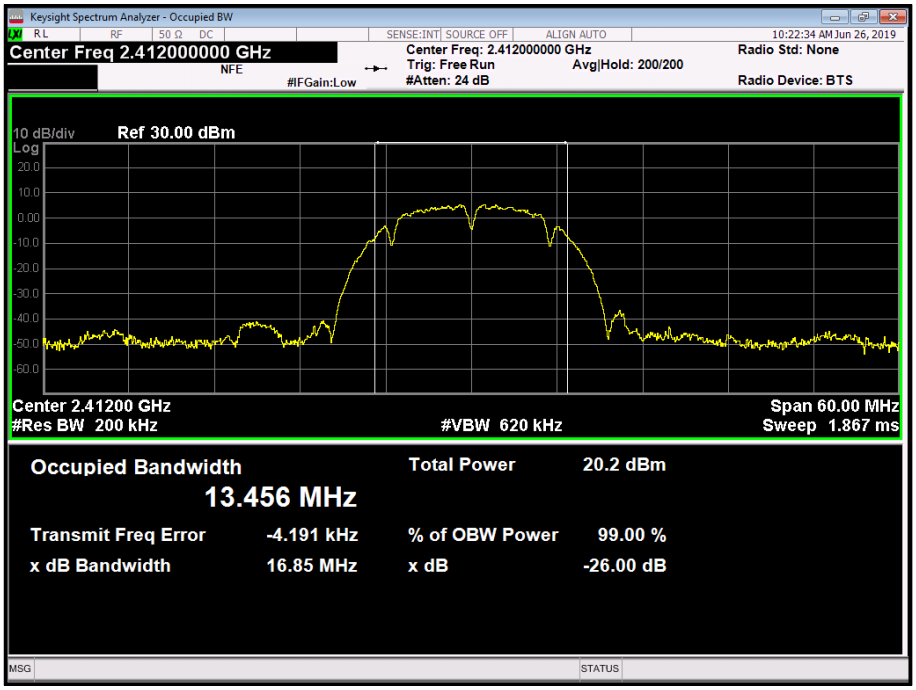


**Figure 12 - 2412 MHz – 99% Occupied Bandwidth - Antenna Port 2**

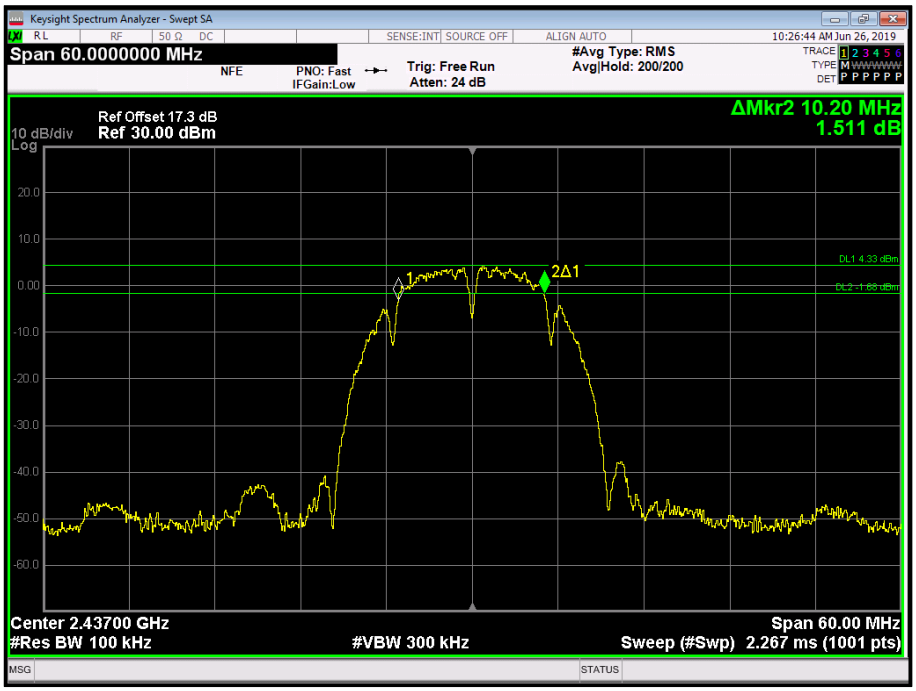


**Figure 13 - 2437 MHz – 6 dB Bandwidth – Antenna Port 2**

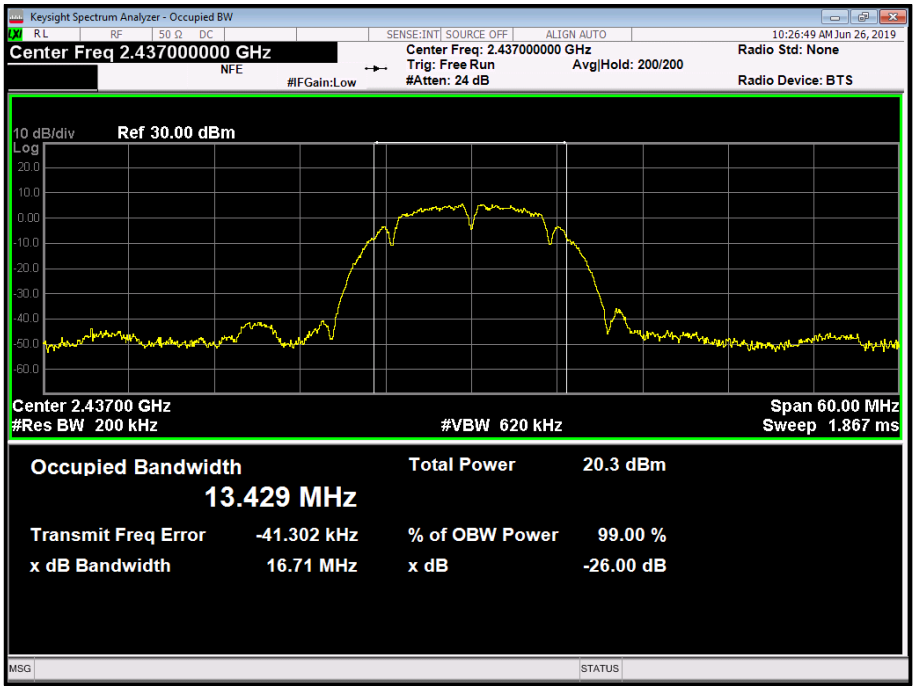


**Figure 14 - 2437 MHz – 99% Occupied Bandwidth – Antenna Port 2**

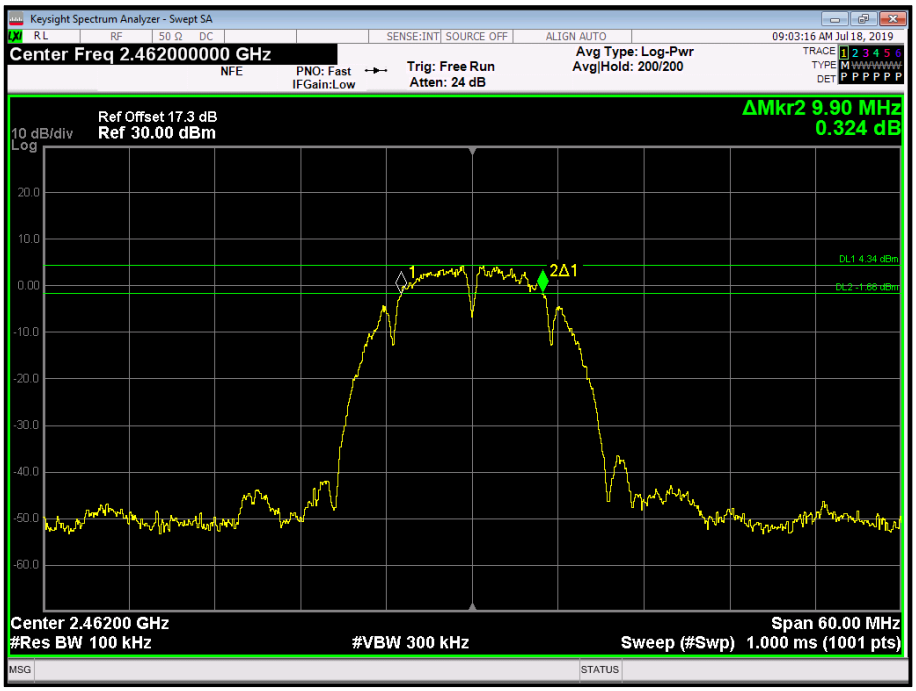


**Figure 15 - 2462 MHz – 6 dB Bandwidth – Antenna Port 2**

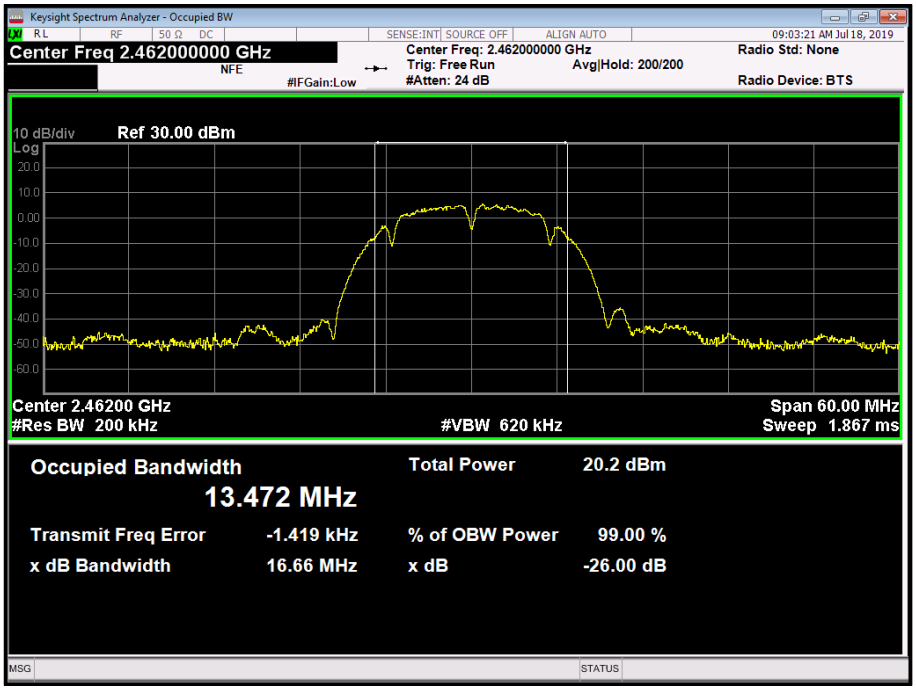


**Figure 16 - 2462 MHz - 99% Occupied Bandwidth – Antenna Port 2**

2.4 GHz WLAN - 802.11g

Data Rate: 54 Mbps

| Frequency (MHz) | 6 dB Bandwidth (MHz) | 99% Occupied Bandwidth (MHz) |
|---|---|---|
| 2412 | 16.560 | 16.507 |
| 2437 | 16.560 | 16.522 |
| 2462 | 16.560 | 16.520 |

**Table 21 – Antenna Port 1**

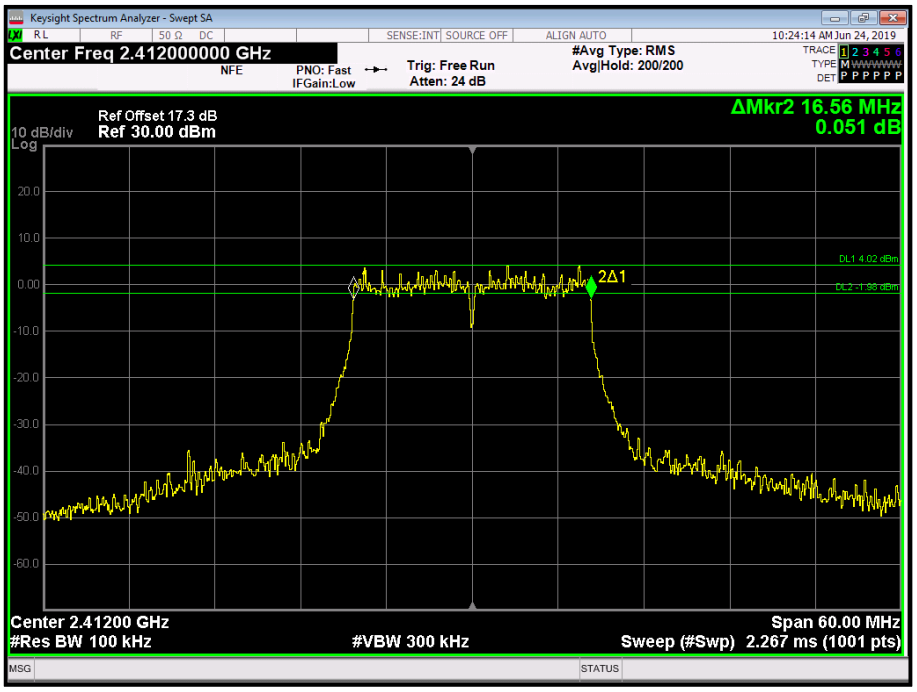


**Figure 17 - 2412 MHz – 6 dB Bandwidth – Antenna Port 1**

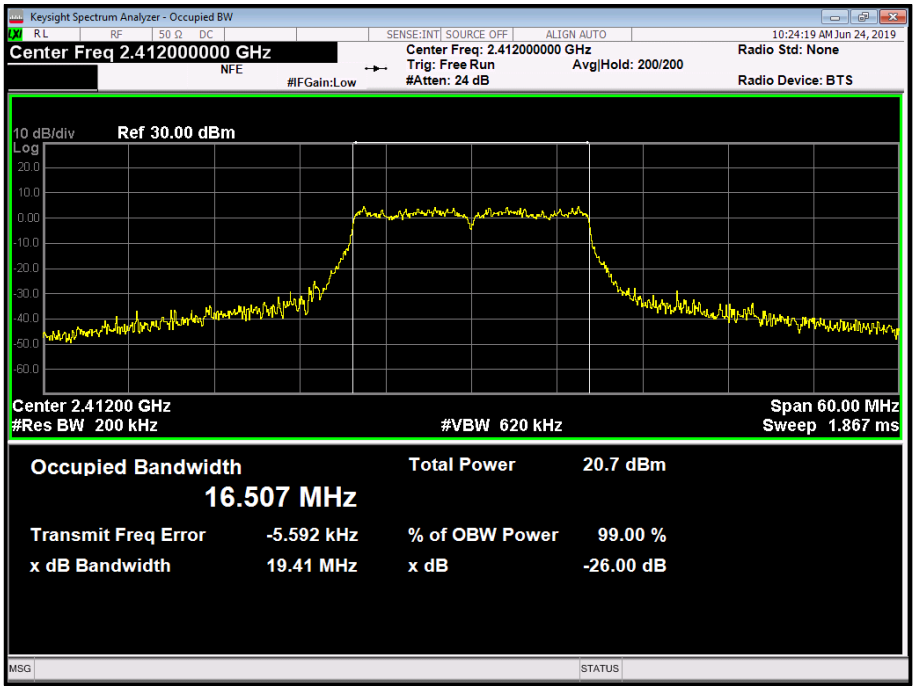


**Figure 18 - 2412 MHz – 99% Occupied Bandwidth – Antenna Port 1**

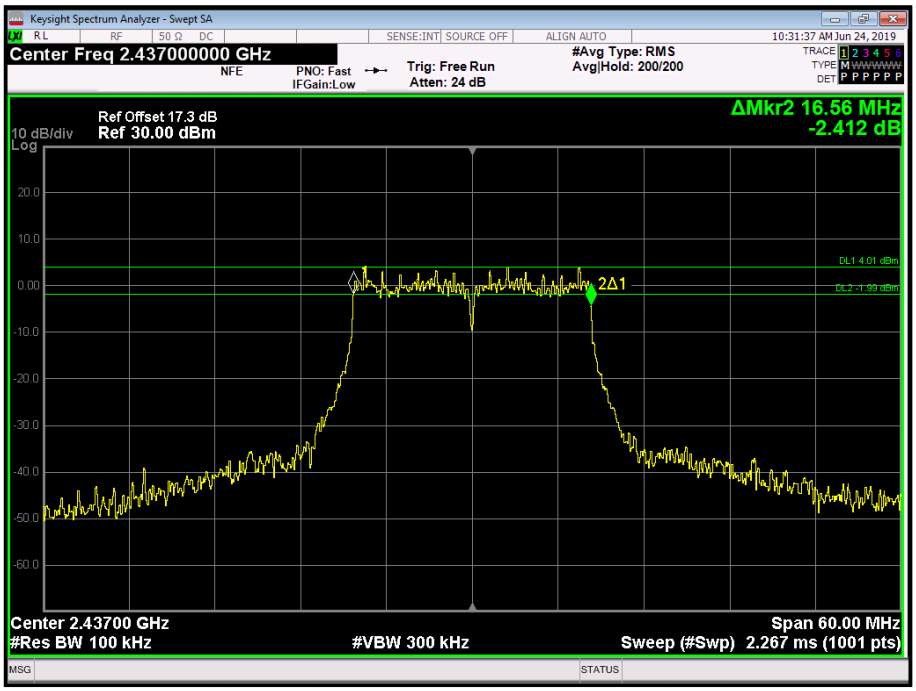


**Figure 19 - 2437 MHz – 6 dB Bandwidth – Antenna Port 1**

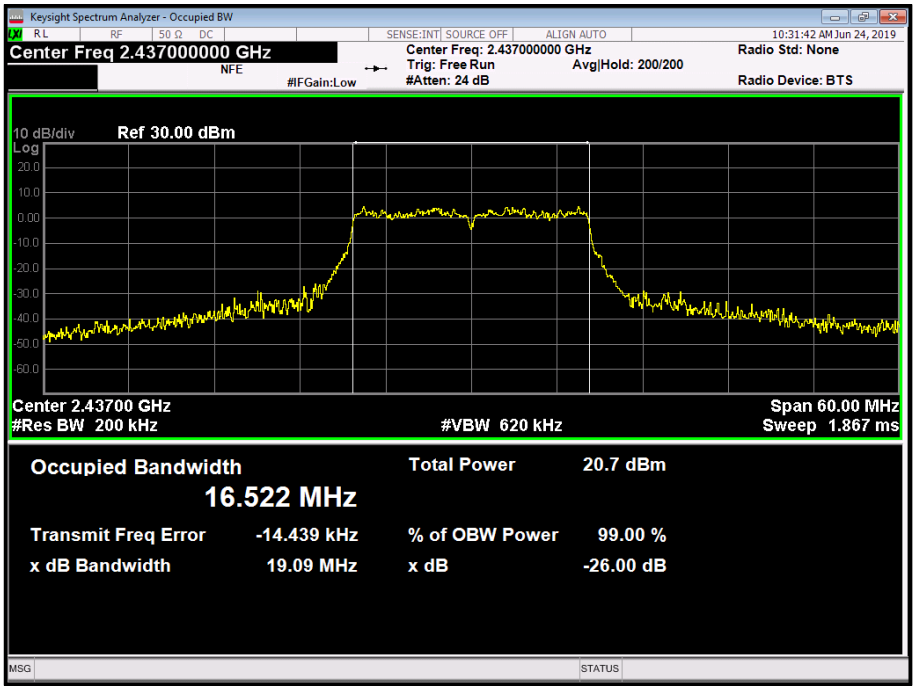


**Figure 20 - 2437 MHz – 99% Occupied Bandwidth – Antenna Port 1**

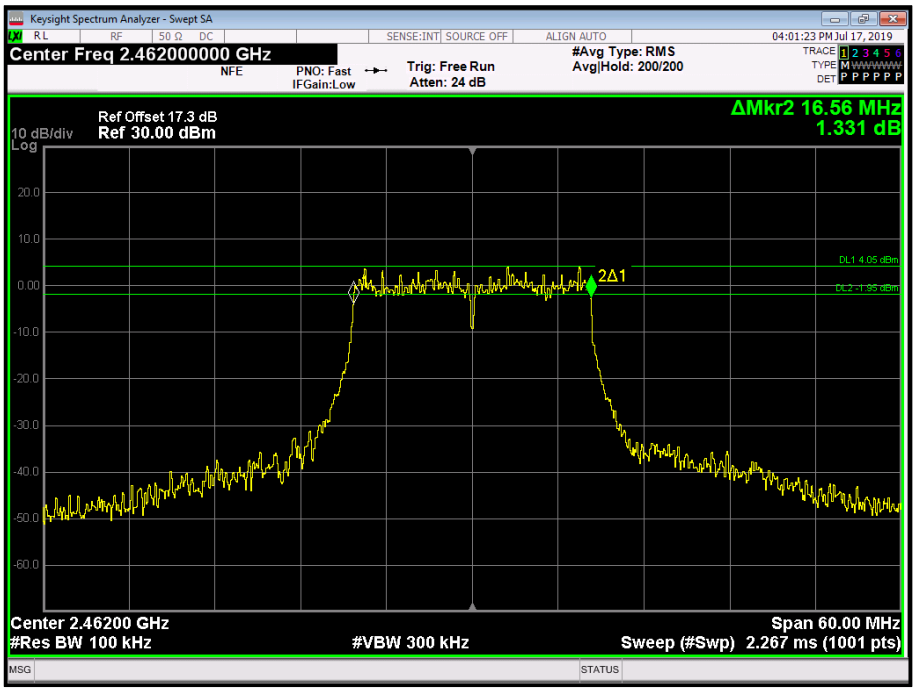


**Figure 21 - 2462 MHz – 6 dB Bandwidth – Antenna Port 1**

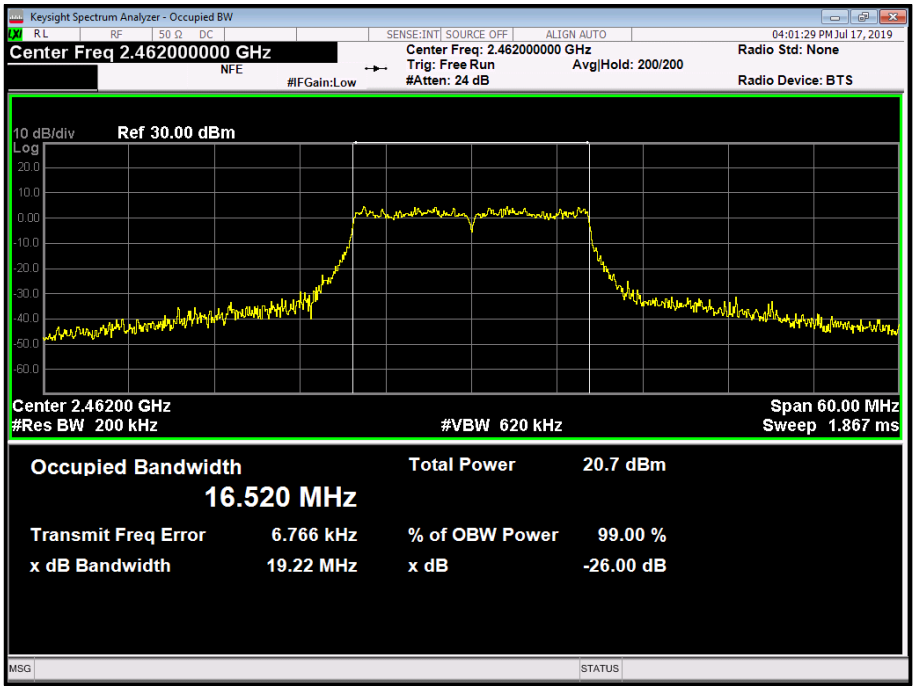


**Figure 22 - 2462 MHz – 99% Occupied Bandwidth – Antenna Port 1**

2.4 GHz WLAN - 802.11g

Data Rate: 54 Mbps

| Frequency (MHz) | 6 dB Bandwidth (MHz) | 99% Occupied Bandwidth (MHz) |
|---|---|---|
| 2412 | 16.500 | 16.534 |
| 2437 | 16.560 | 16.529 |
| 2462 | 17.640 | 17.692 |

**Table 22 – Antenna Port 2**

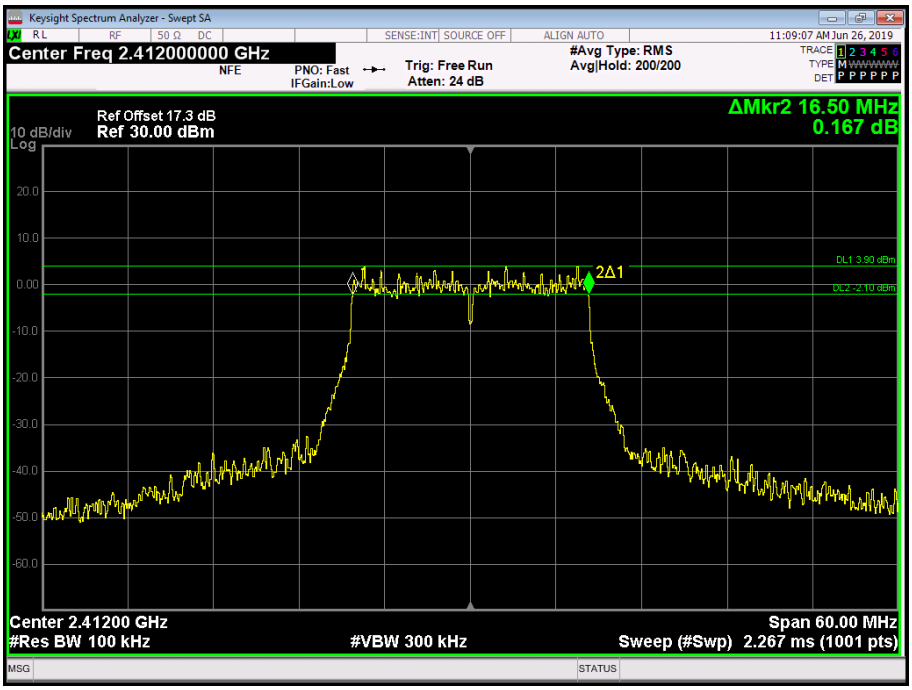


**Figure 23 - 2412 MHz – 6 dB Bandwidth – Antenna Port 2**

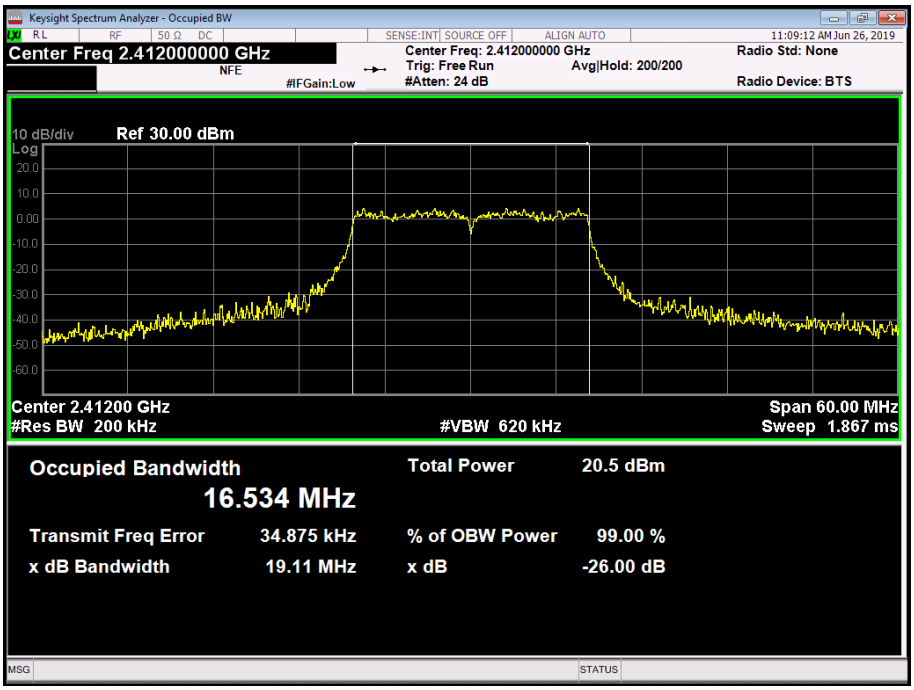


**Figure 24 - 2412 MHz – 99% Occupied Bandwidth – Antenna Port 2**

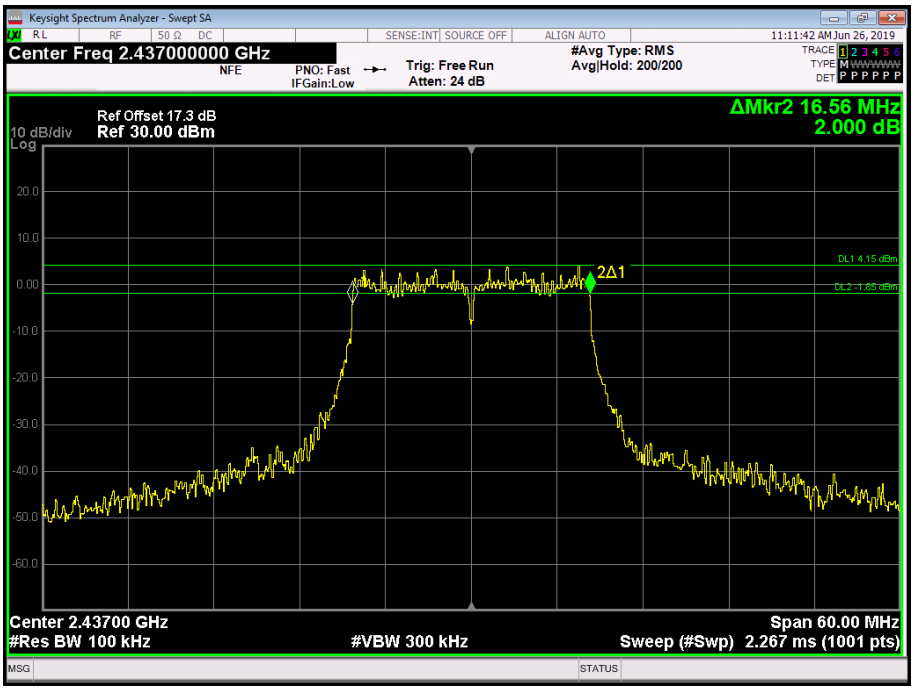


**Figure 25 - 2437 MHz – 6 dB Bandwidth – Antenna Port 2**

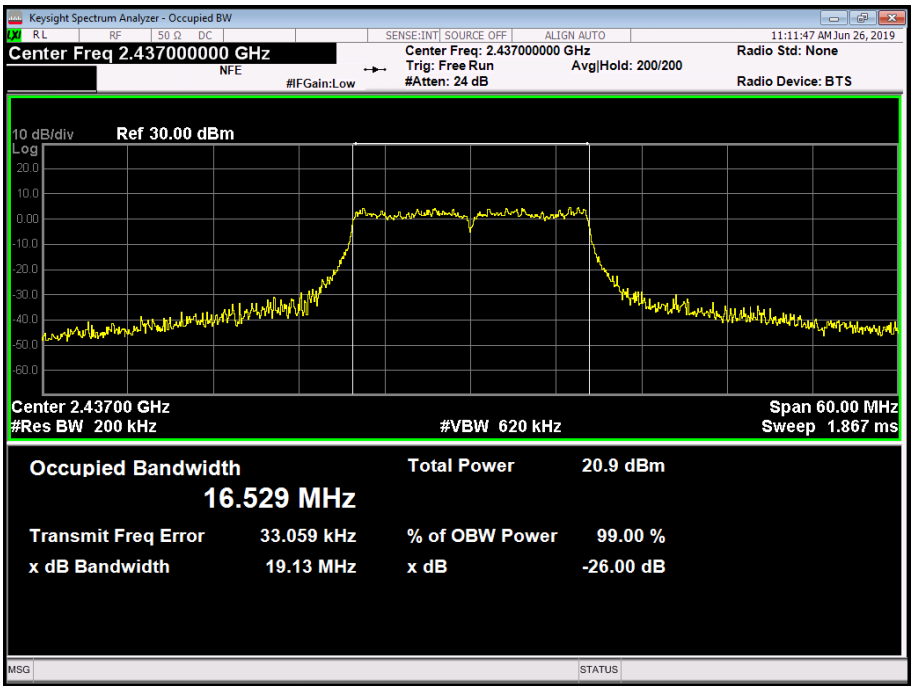


**Figure 26 - 2437 MHz – 99% Occupied Bandwidth – Antenna Port 2**

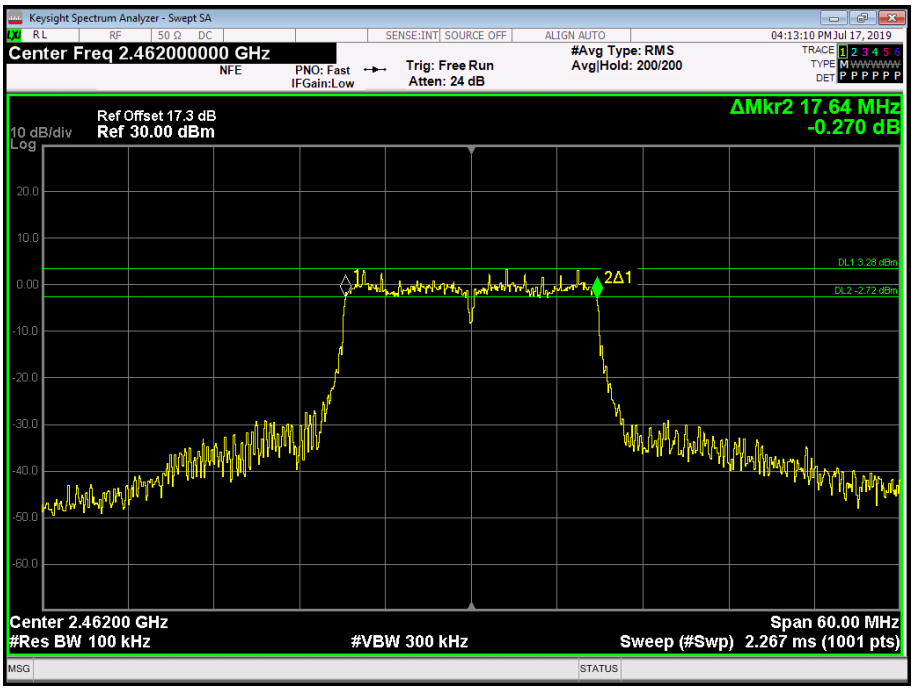


**Figure 27 - 2462 MHz – 6 dB Bandwidth – Antenna Port 2**

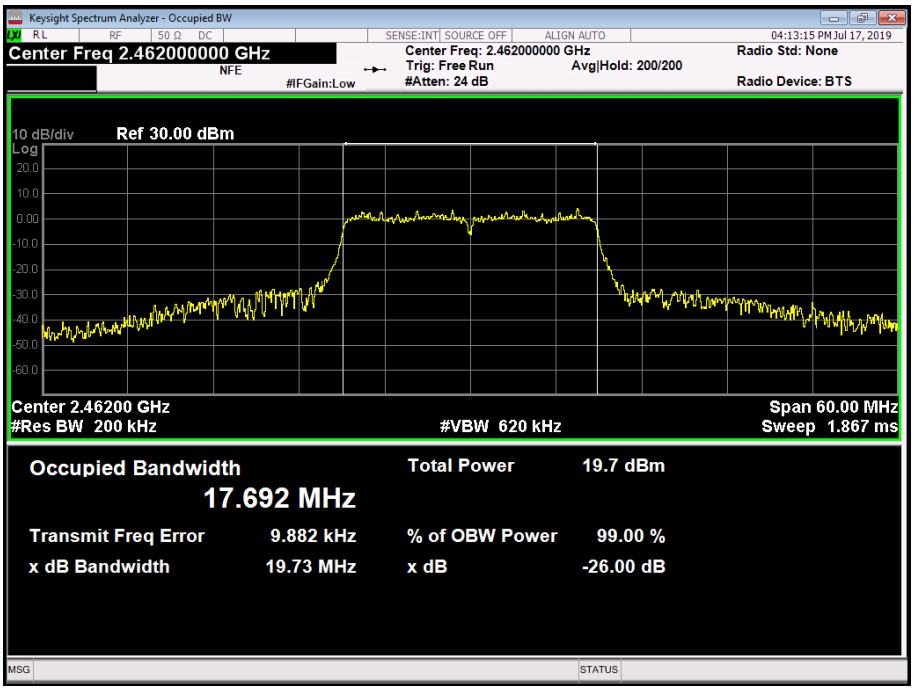


**Figure 28 - 2462 MHz – 99% Occupied Bandwidth – Antenna Port 2**

2.4 GHz WLAN - 802.11n 20 MHz Bandwidth

Modulation Coding Scheme: MCS7

| Frequency (MHz) | 6 dB Bandwidth (MHz) | 99% Occupied Bandwidth (MHz) |
|---|---|---|
| 2412 | 17.760 | 17.681 |
| 2437 | 17.760 | 17.637 |
| 2462 | 17.700 | 17.672 |

**Table 23 – Antenna Port 1**

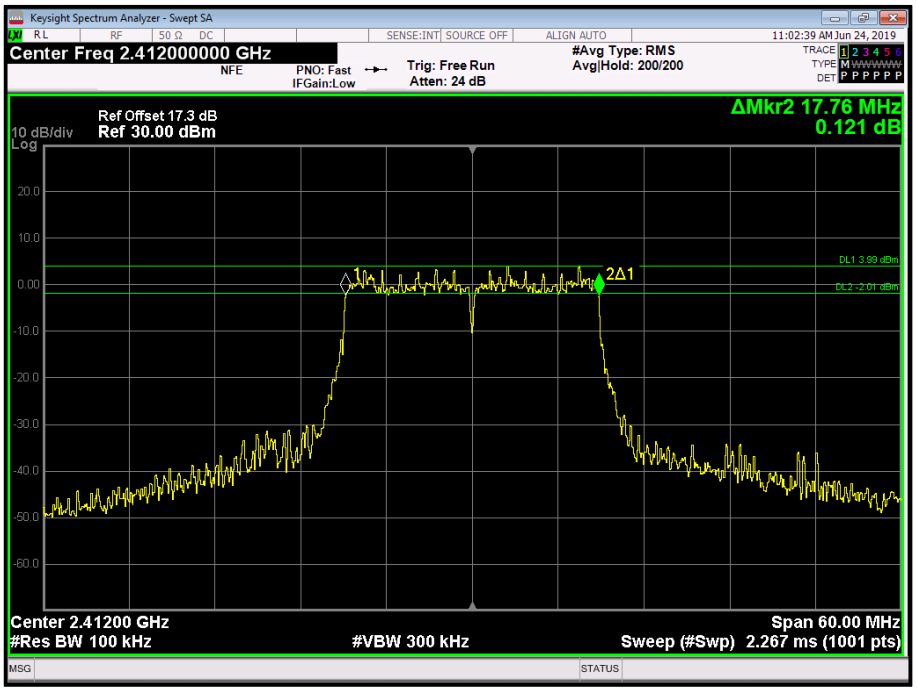


**Figure 29 - 2412 MHz – 6 dB Bandwidth – Antenna Port 1**

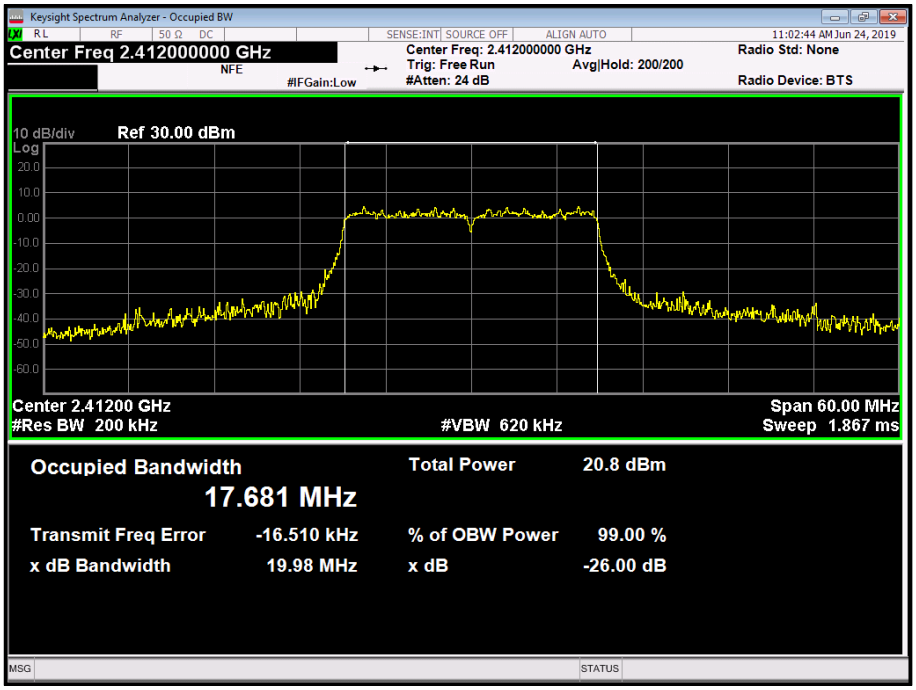


**Figure 30 - 2412 MHz – 99% Occupied Bandwidth – Antenna Port 1**

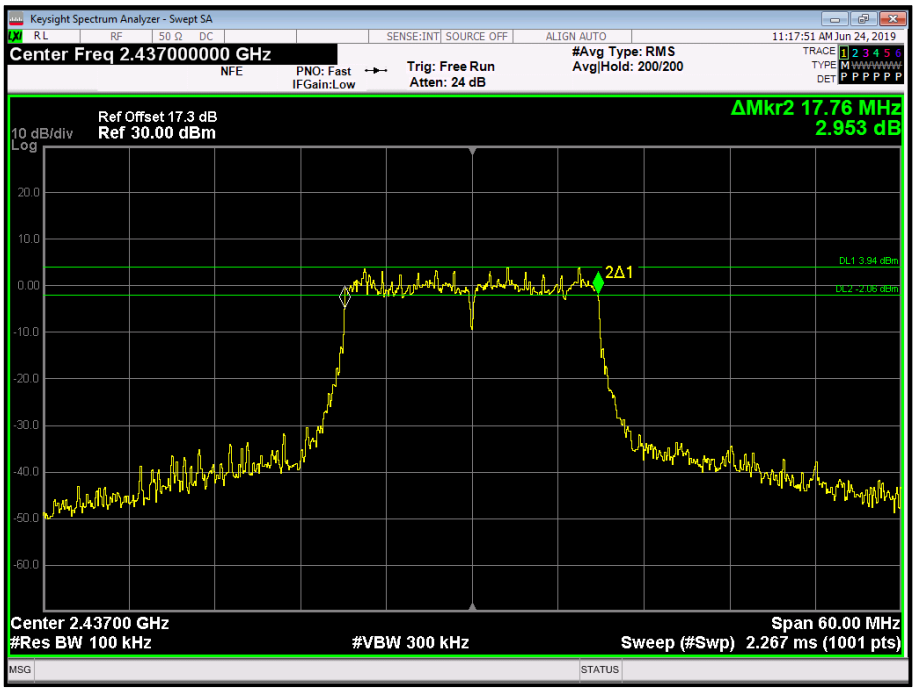


**Figure 31 - 2437 MHz – 6 dB Bandwidth – Antenna Port 1**

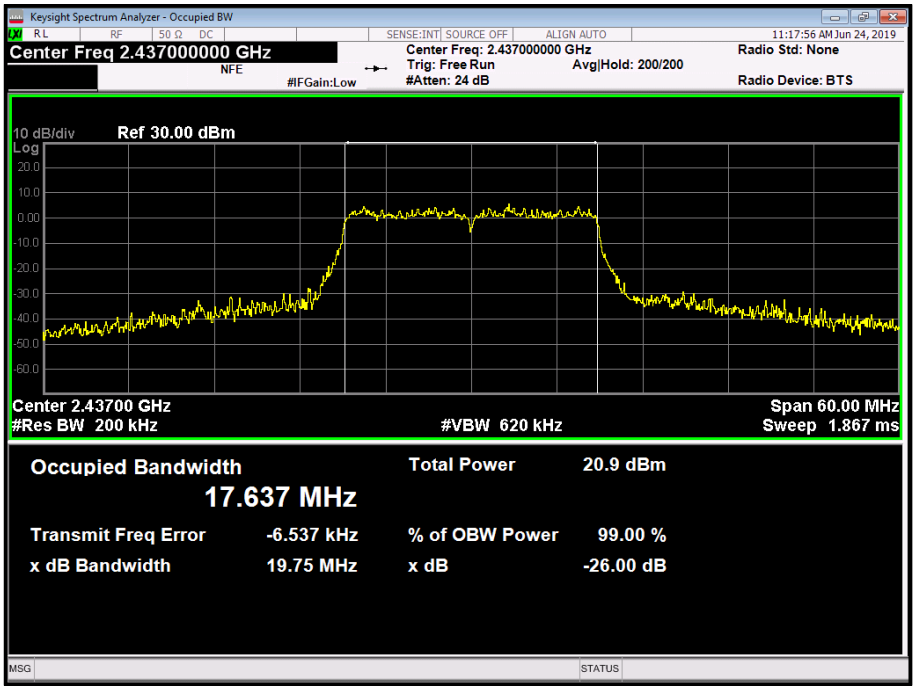


**Figure 32 - 2437 MHz – 99% Occupied Bandwidth – Antenna Port 1**

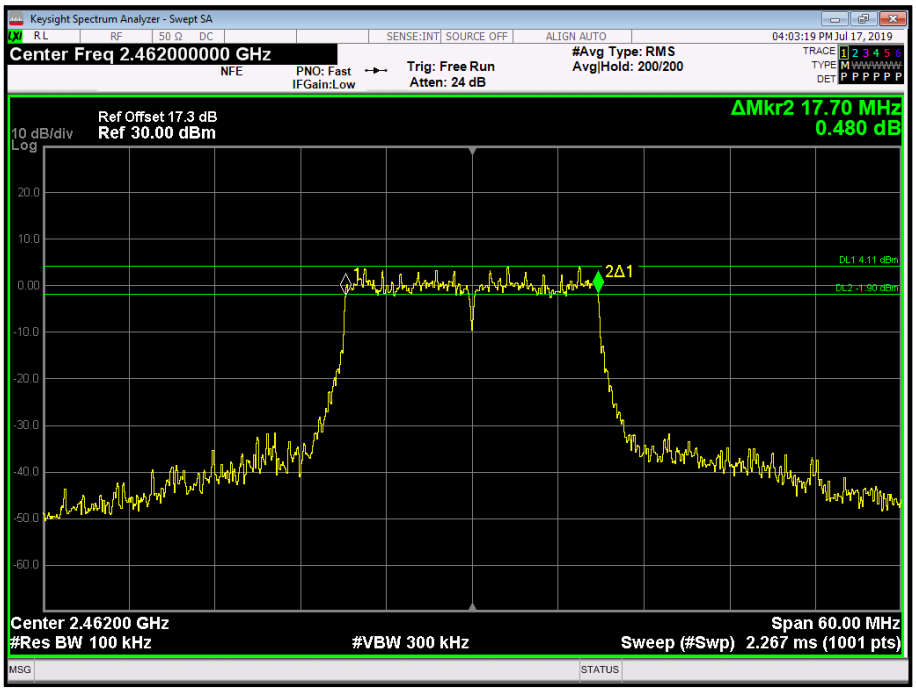


**Figure 33 - 2462 MHz – 6 dB Bandwidth – Antenna Port 1**

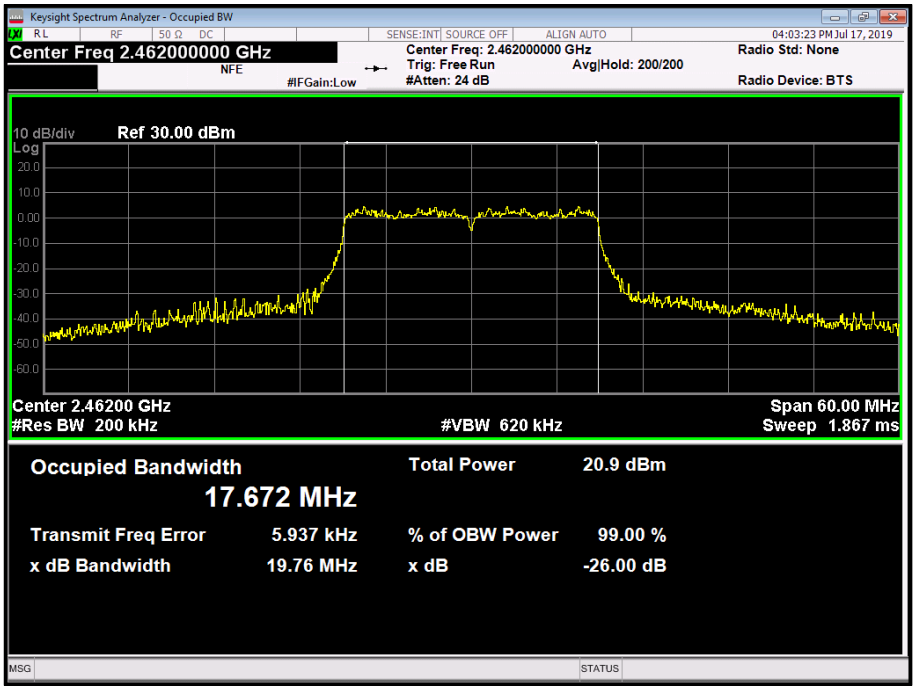


**Figure 34 - 2462 MHz – 99% Occupied Bandwidth – Antenna Port 1**

Modulation Coding Scheme: MCS7

| Frequency (MHz) | 6 dB Bandwidth (MHz) | 99% Occupied Bandwidth (MHz) |
|---|---|---|
| 2412 | 17.760 | 17.684 |
| 2437 | 17.820 | 17.669 |
| 2462 | 17.640 | 17.714 |

**Table 24 – Antenna Port 2**

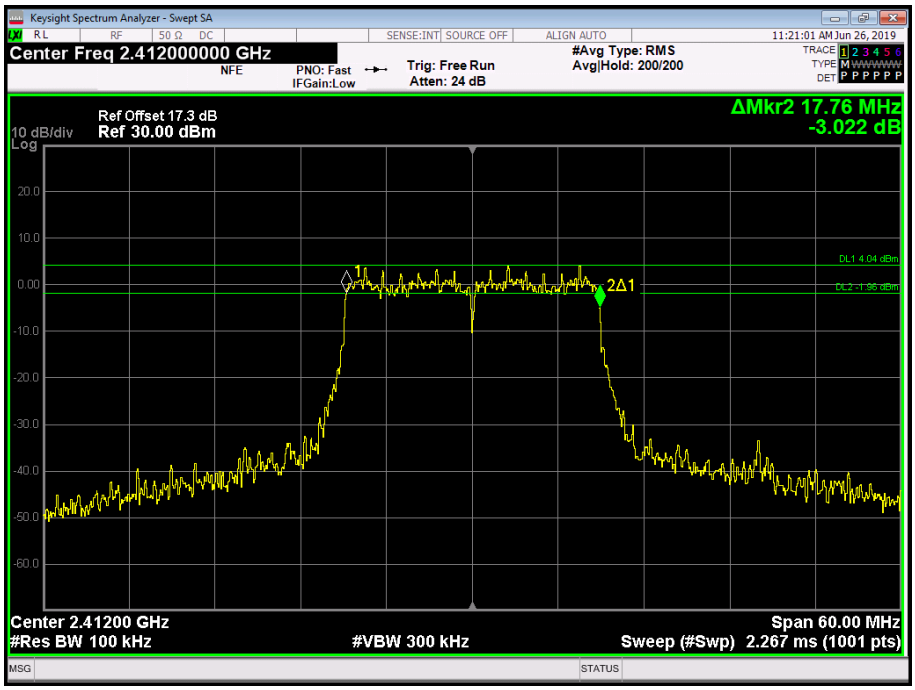


**Figure 35 - 2412 MHz – 6 dB Bandwidth – Antenna Port 2**

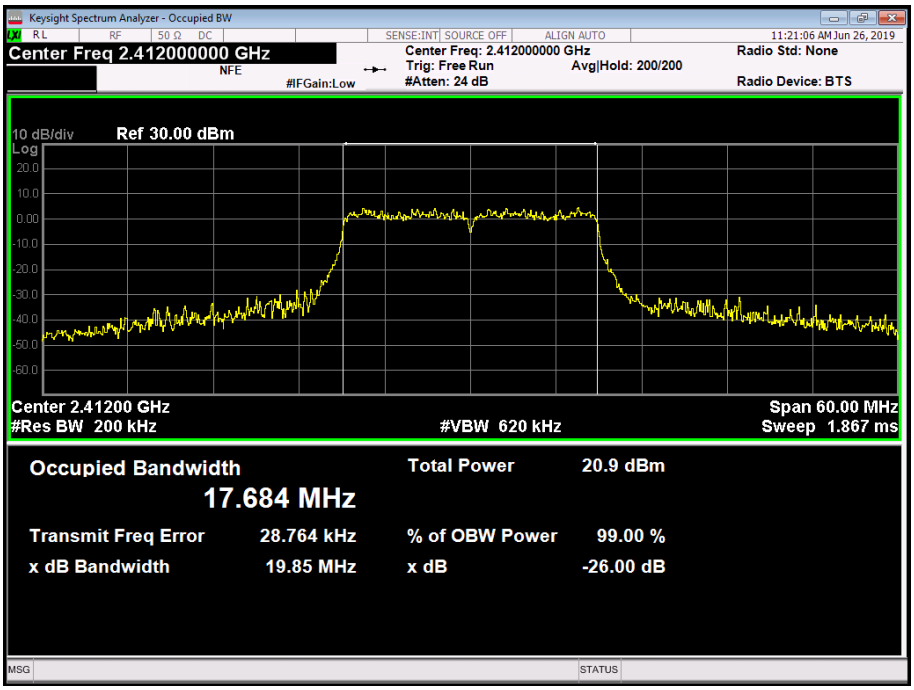


**Figure 36 - 2412 MHz – 99% Occupied Bandwidth – Antenna Port 2**

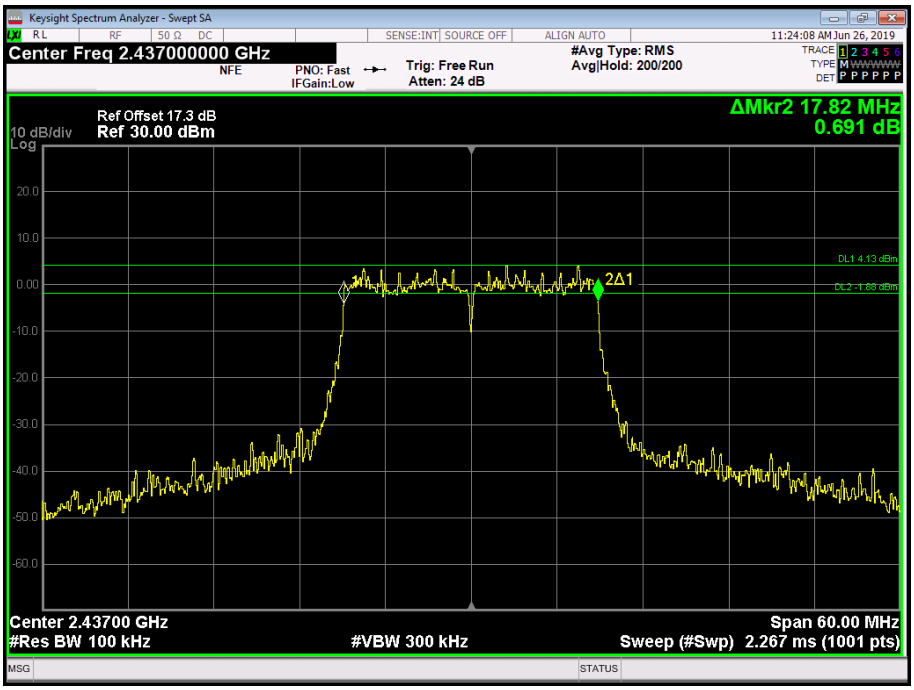


**Figure 37 - 2437 MHz – 6 dB Bandwidth – Antenna Port 2**

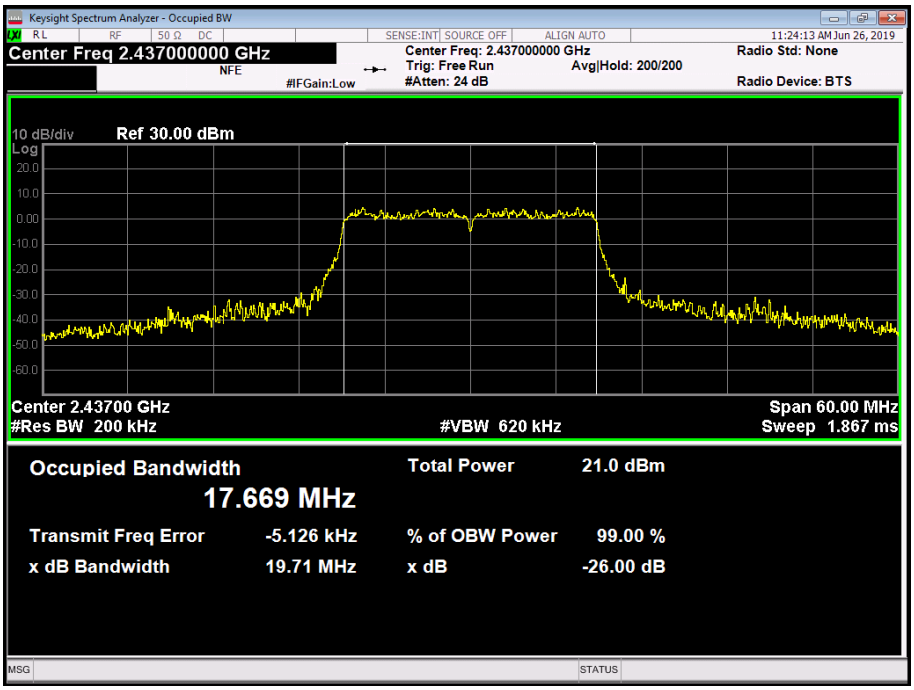


**Figure 38 - 2437 MHz – 99% Occupied Bandwidth – Antenna Port 2**

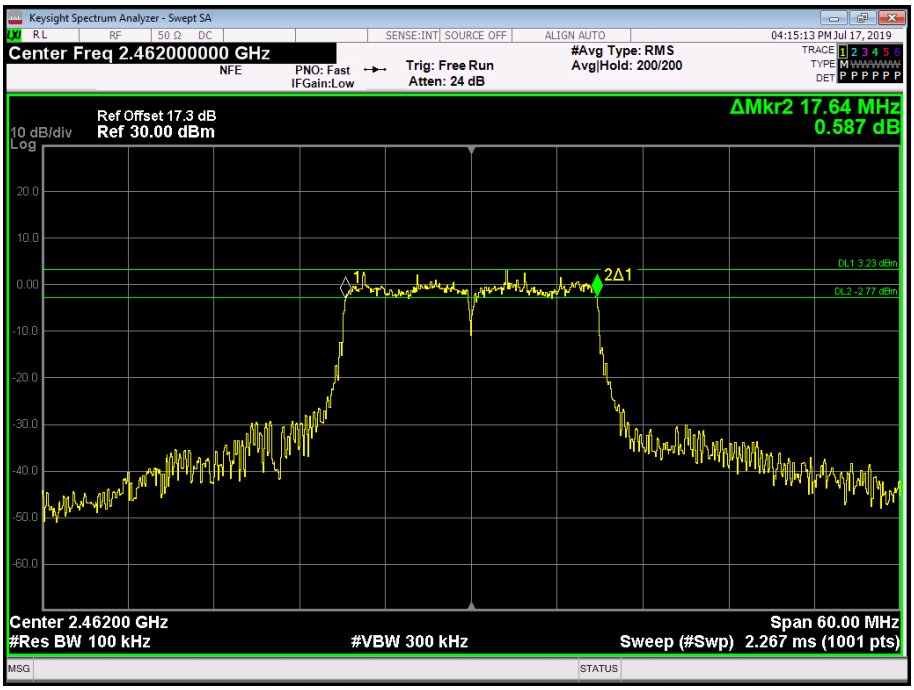


**Figure 39 - 2462 MHz – 6 dB Bandwidth – Antenna Port 2**

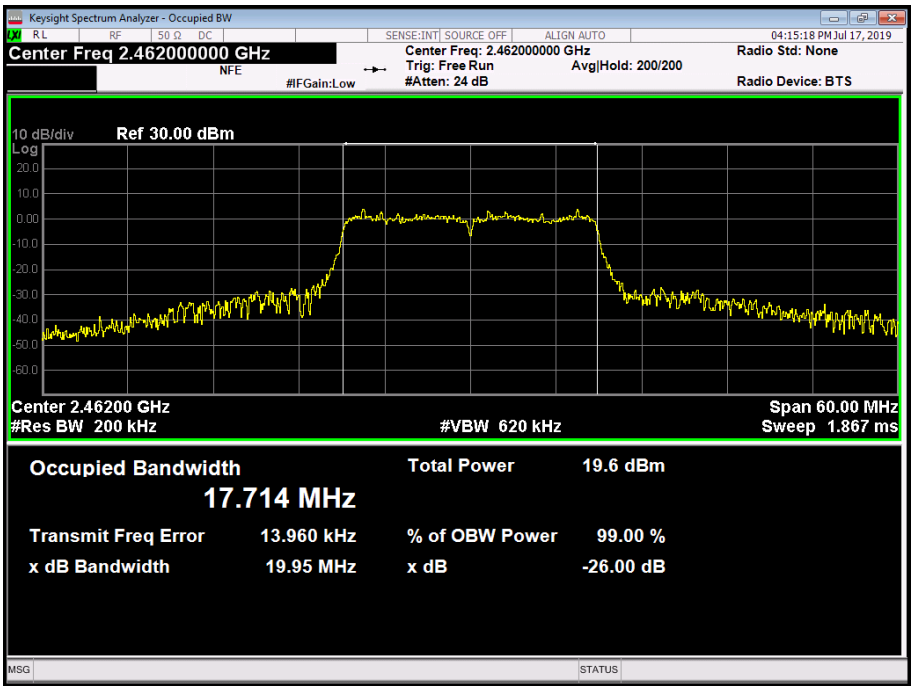


**Figure 40 - 2462 MHz – 99% Occupied Bandwidth – Antenna Port 2**

Modulation Coding Scheme: MCS0 CDD1

| Frequency (MHz) | 6 dB Bandwidth (MHz) | 99% Occupied Bandwidth (MHz) |
|---|---|---|
| 2412 | 17.640 | 17.678 |
| 2437 | 17.640 | 17.718 |
| 2462 | 17.520 | 17.649 |

**Table 25 – Antenna Port 1**

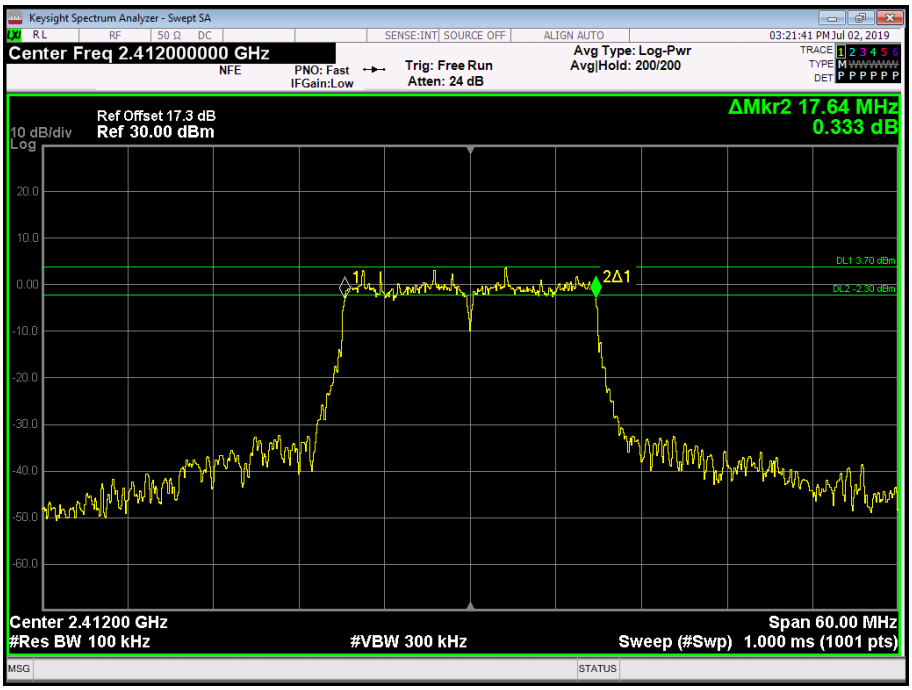


**Figure 41 - 2412 MHz – 6 dB Bandwidth – Antenna Port 1**

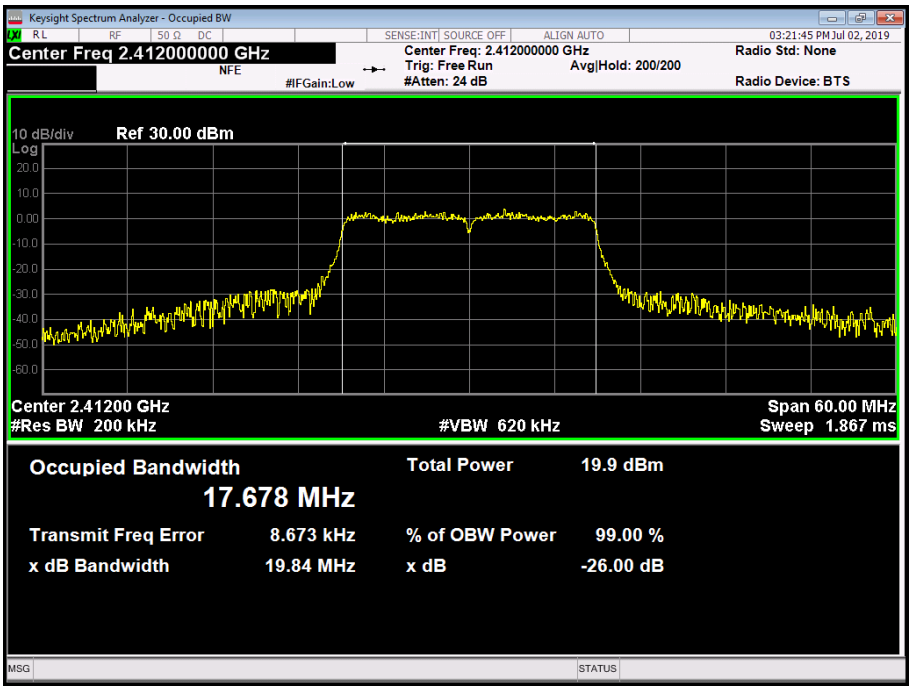


**Figure 42 - 2412 MHz – 99% Occupied Bandwidth – Antenna Port 1**

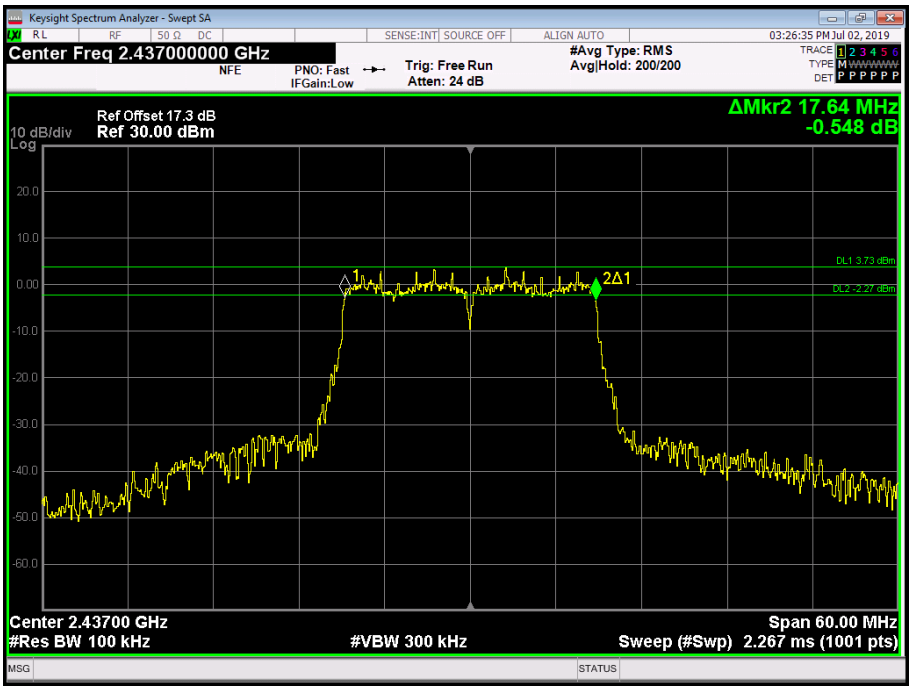


**Figure 43 - 2437 MHz – 6 dB Bandwidth – Antenna Port 1**

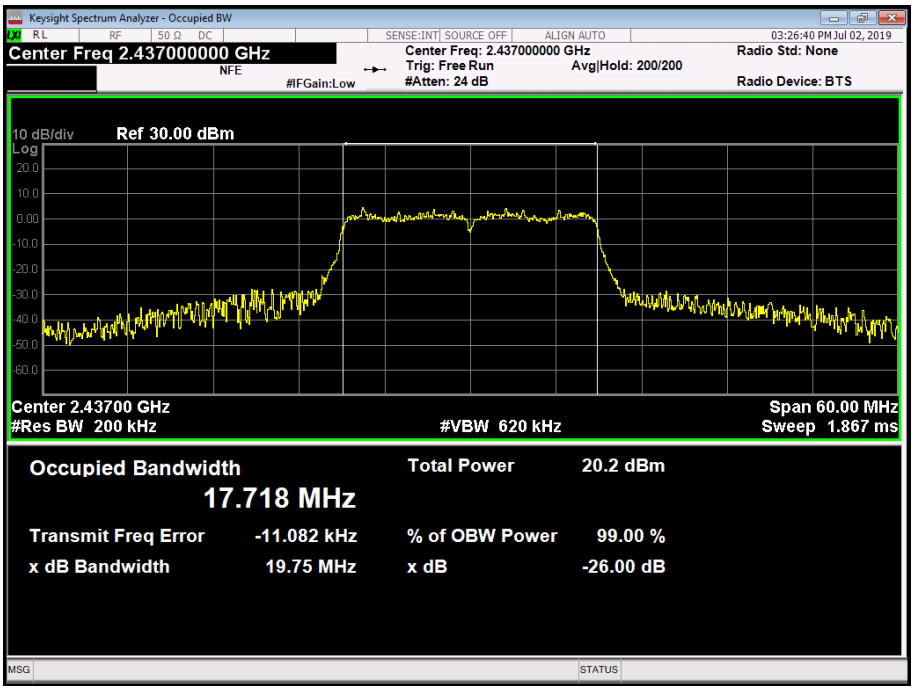


**Figure 44 - 2437 MHz – 99% Occupied Bandwidth – Antenna Port 1**

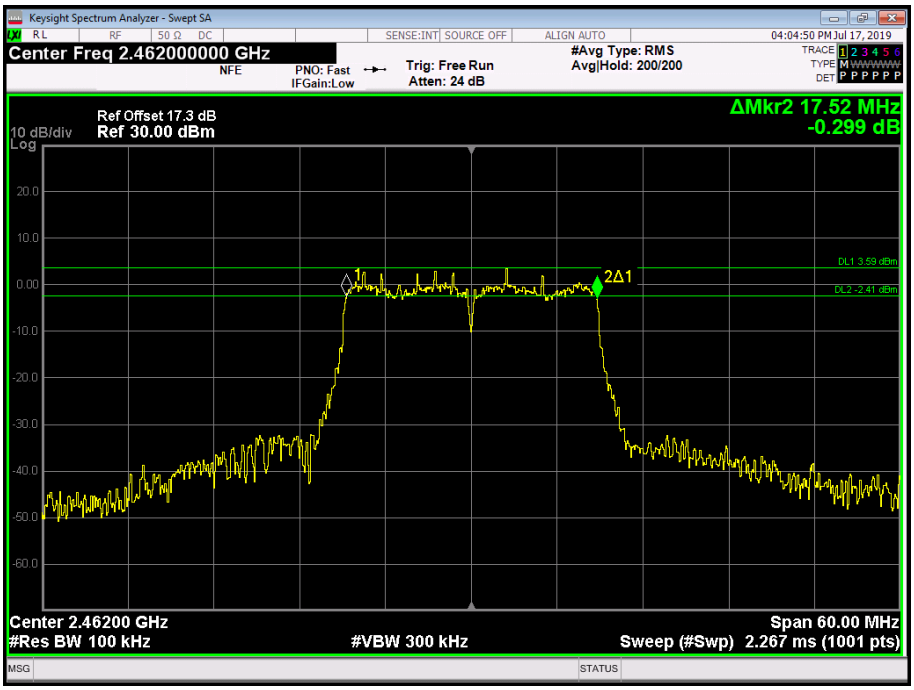


**Figure 45 - 2462 MHz – 6 dB Bandwidth – Antenna Port 1**

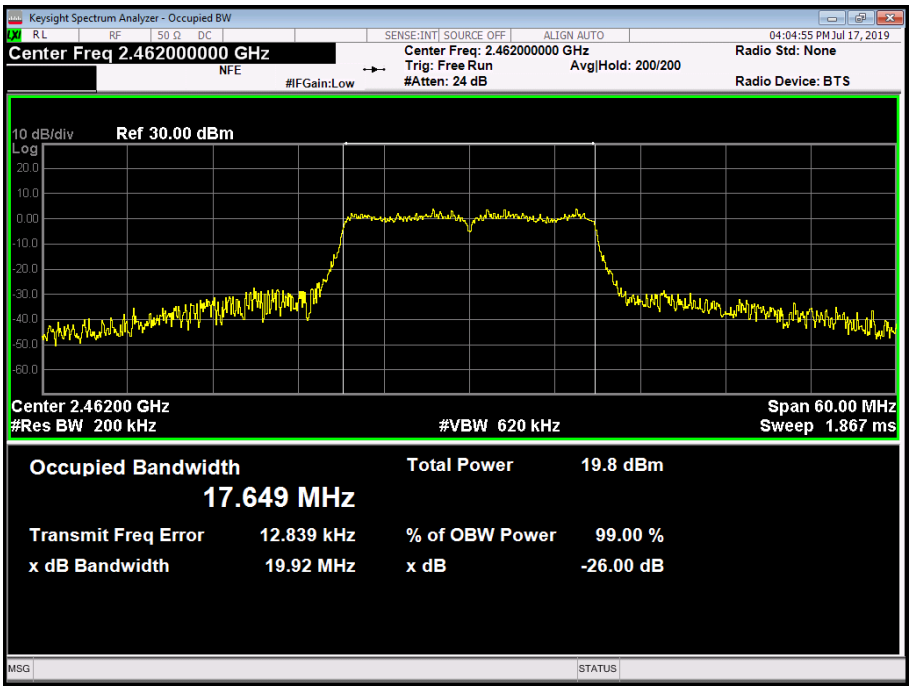


**Figure 46 - 2462 MHz – 99% Occupied Bandwidth – Antenna Port 1**

Modulation Coding Scheme: MCS0 CDD1

| Frequency (MHz) | 6 dB Bandwidth (MHz) | 99% Occupied Bandwidth (MHz) |
|---|---|---|
| 2412 | 17.640 | 17.699 |
| 2437 | 17.520 | 17.694 |
| 2462 | 17.640 | 17.690 |

**Table 26 – Antenna Port 2**

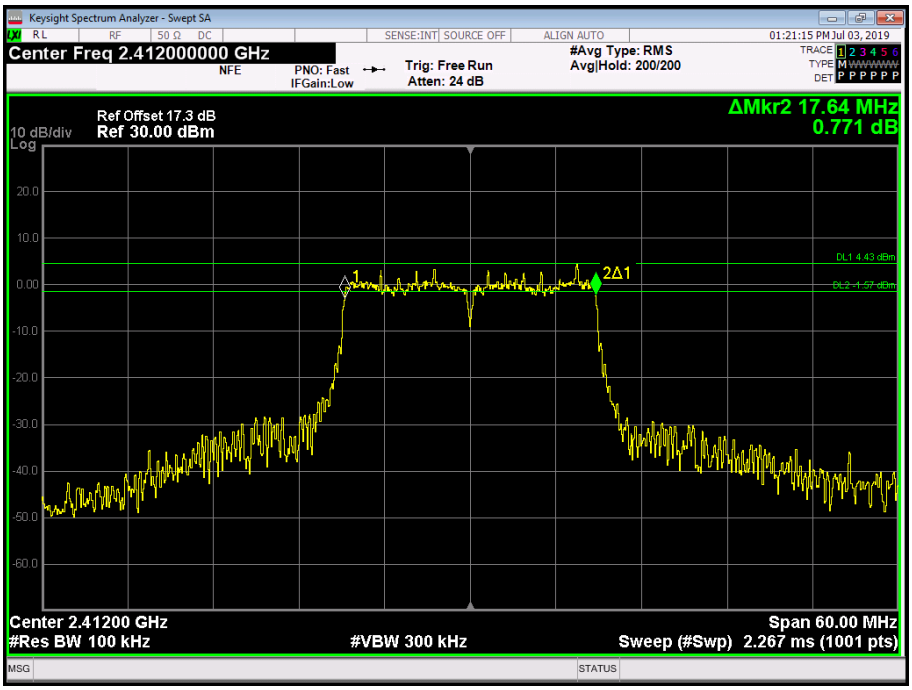


**Figure 47 - 2412 MHz – 6 dB Bandwidth – Antenna Port 2**

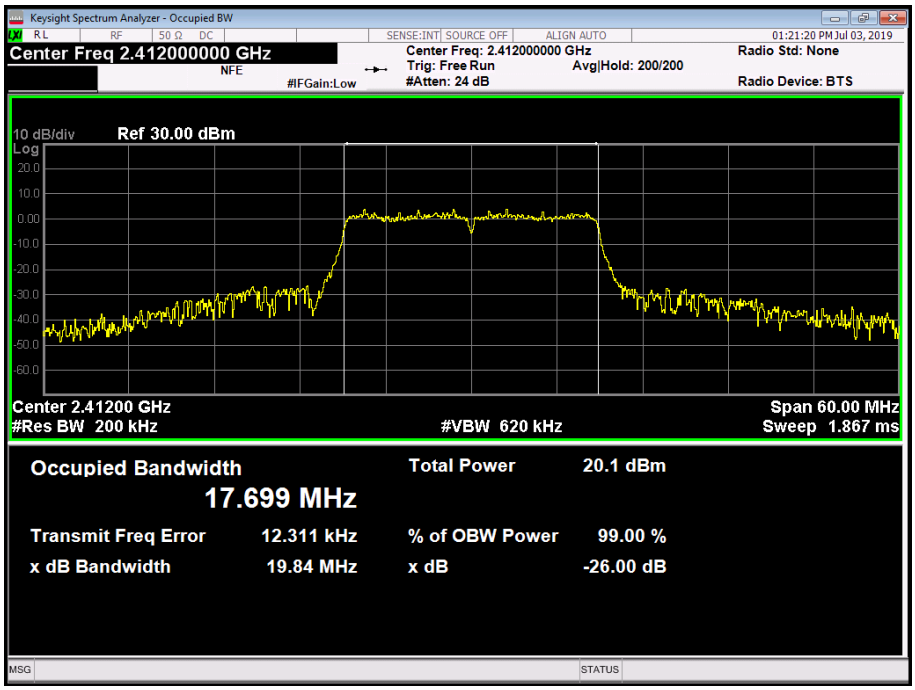


**Figure 48 - 2412 MHz – 99% Occupied Bandwidth – Antenna Port 2**

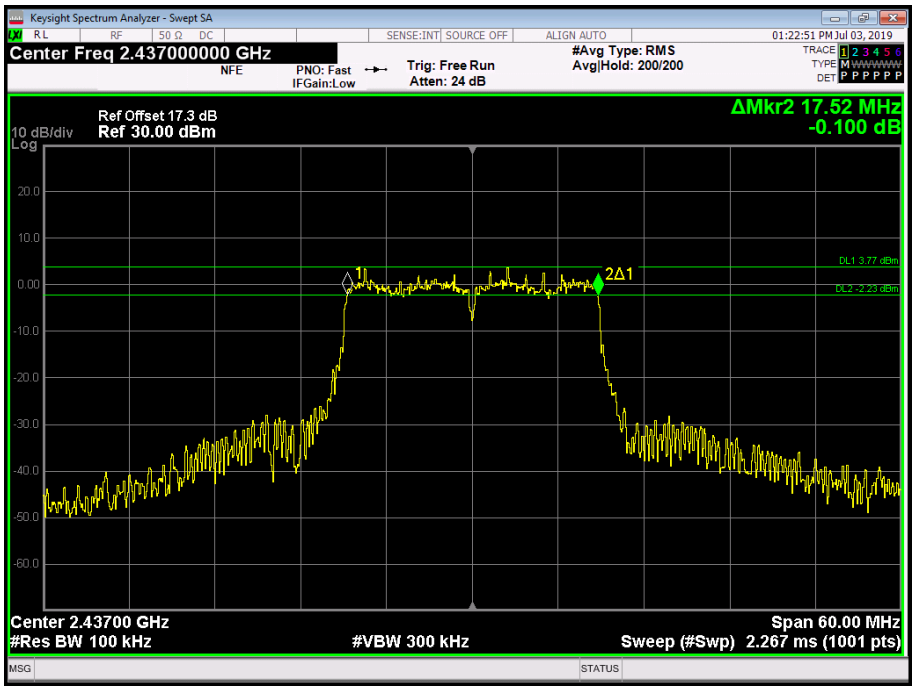


**Figure 49 - 2437 MHz – 6 dB Bandwidth – Antenna Port 2**

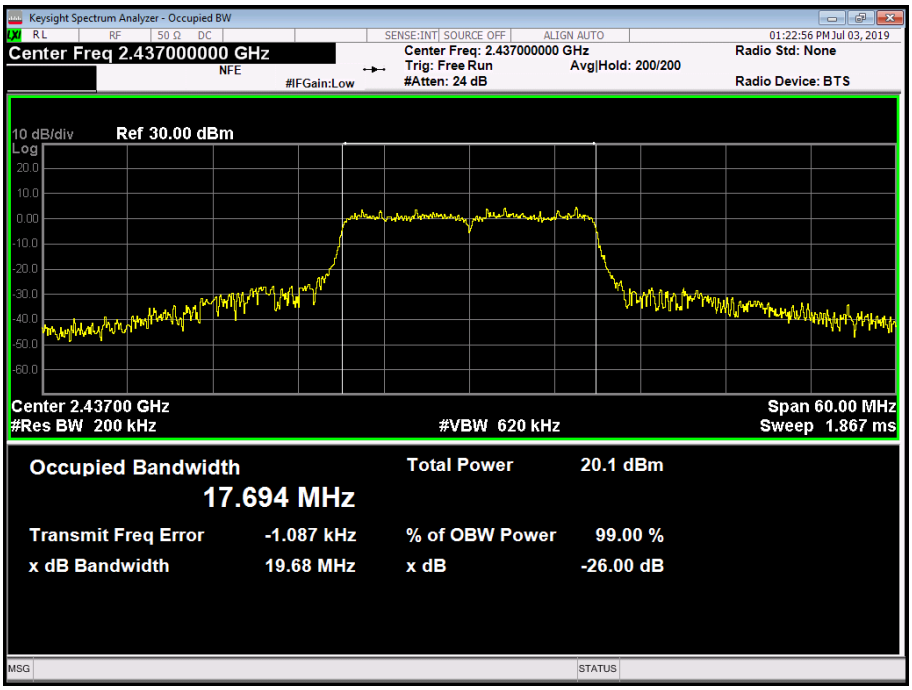


**Figure 50 - 2437 MHz – 99% Occupied Bandwidth – Antenna Port 2**

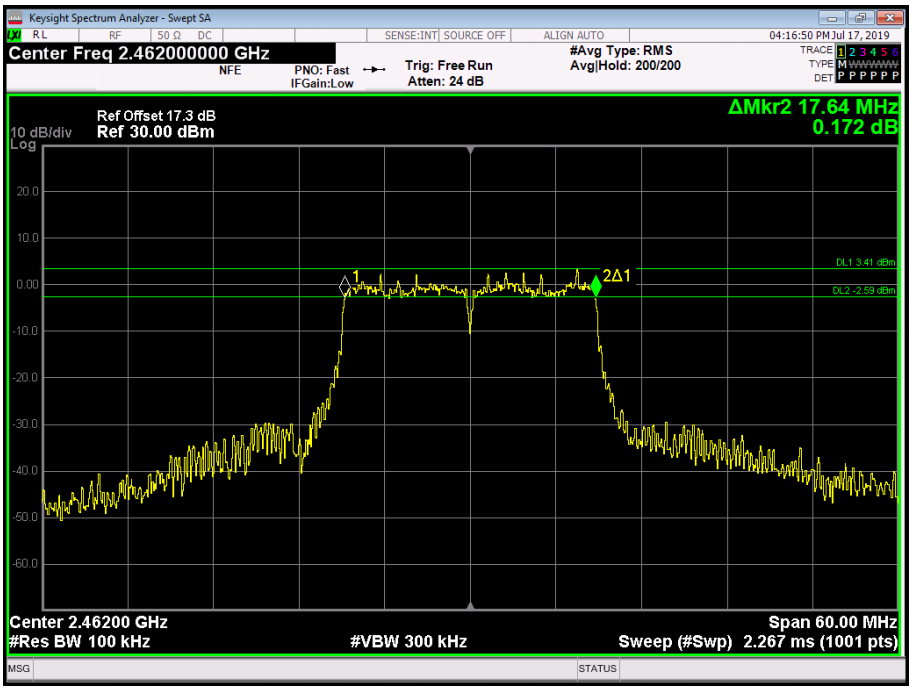


**Figure 51 - 2462 MHz – 6 dB Bandwidth – Antenna Port 2**

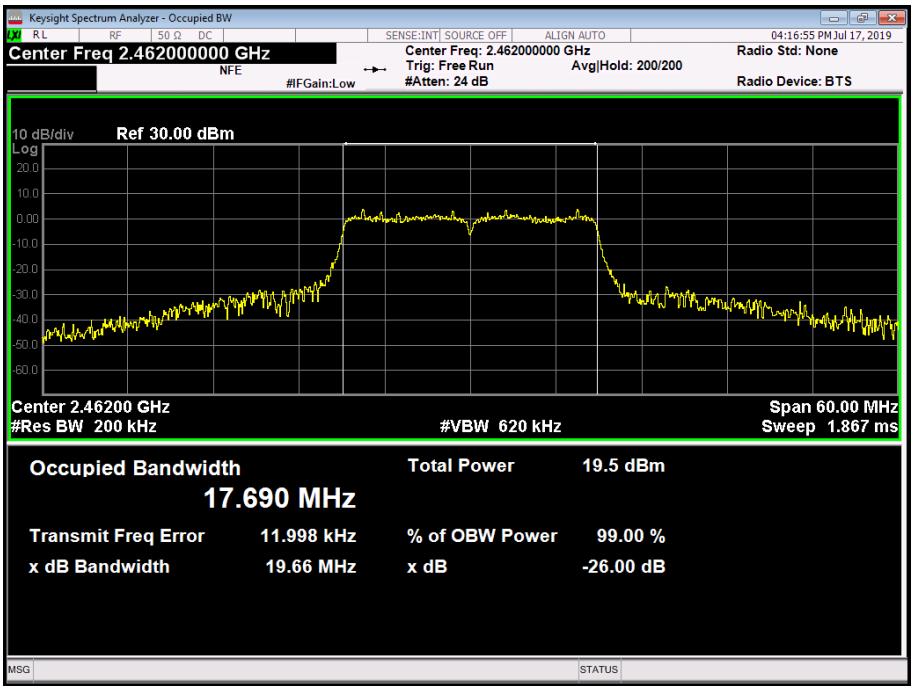


**Figure 52 - 2462 MHz – 99% Occupied Bandwidth – Antenna Port 2**

Bluetooth Low Energy

Modulation/Packet Type: GFSK/DH1

| Frequency (MHz) | 6 dB Bandwidth (MHz) | 99% Occupied Bandwidth (MHz |
|---|---|---|
| 2402 | 0.694800 | 1.045 |
| 2440 | 0.700300 | 1.044 |
| 2480 | 0.702300 | 1.045 |

**Table 27**

**Figure 53 - 2402 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth**

**Figure 54 - 2440 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth**

**Figure 55 - 2480 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth**

<u>FCC 47 CFR Part 15, Limit Clause 15.247(a)(2) and ISEDC RSS-247, Clause 5.2(a)</u>

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

### 2.4.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|
| Dual Power Supply Unit | Hewlett Packard | 6253A | 271 | - | O/P Mon |
| Power Divider | Weinschel | 1506A | 603 | 12 | 23-Apr-2020 |
| Hygrometer | Rotronic | I-1000 | 3220 | 12 | 13-Sep-2019 |
| Network Analyser | Rohde & Schwarz | ZVA 40 | 3548 | 12 | 17-Oct-2019 |
| 1 Metre SMA Cable | Rhophase | 3PS-1801A-1000-3PS | 4101 | - | O/P Mon |
| Calibration Unit | Rohde & Schwarz | ZV-Z54 | 4368 | 12 | 22-Oct-2019 |
| Frequency Standard | Spectracom | SecureSync 1200-0408-0601 | 4393 | 6 | 15-Oct-2019 |
| PXA Signal Analyser | Keysight Technologies | N9030A | 4653 | 12 | 06-Feb-2020 |
| EXA | Keysight Technologies | N9010B | 4968 | 24 | 21-Dec-2019 |
| Cable (18 GHz) | Rosenberger | LU7-071-1000 | 5097 | 12 | 04-Oct-2019 |
| USB Power Sensor | Boonton | RTP5006 | 5184 | 12 | 12-Dec-2019 |
| Attenuator 10 dB 2W | Telegartner | 01156A0031 | N/S | - | O/P Mon |

**Table 28**

O/P Mon – Output Monitored using calibrated equipment

## 2.5 Authorised Band Edges

### 2.5.1 Specification Reference

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

### 2.5.2 Equipment Under Test and Modification State

Minuet 2 Module (FS5352), S/N: RAD113219 - Modification State 0

### 2.5.3 Date of Test

11-June-2019 to 03 July 2019

### 2.5.4 Test Method

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

### 2.5.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 20.4 - 24.4 °C |
| Relative Humidity | 56.8 - 59.9 % |

### 2.5.6 Test Results

2.4 GHz WLAN - 802.11b

| Mode | Data Rate | Frequency (MHz) | Band Edge Frequency (MHz) | Level (dBc) |
|---|---|---|---|---|
| Data Rate with the Highest Power (15 dBm) and Widest Bandwidth | 2 Mbps | 2412 | 2400.0 | -48.81 |
| Data Rate with the Highest Power (15 dBm) and Widest Bandwidth | 2 Mbps | 2462 | 2483.5 | -52.72 |
| Data Rate with the Highest Power (15 dBm) and Widest Bandwidth | 2 Mbps | 2467 | 2483.5 | -49.31 |
| Data Rate with the Highest Power (13 dBm) and Widest Bandwidth | 2 Mbps | 2472 | 2483.5 | -48.54 |

**Table 29 - Authorised Band Edge Results – Antenna Port 1**

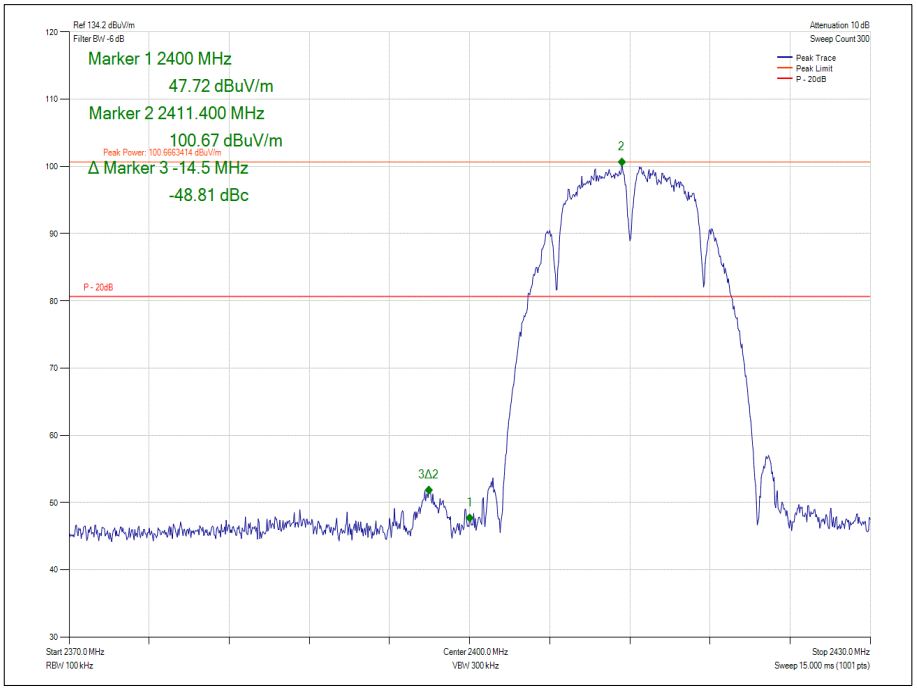


**Figure 56 - Data Rate with the Highest Power and Widest Bandwidth - 2 Mbps 2412 MHz - Band Edge Frequency 2400 MHz – Antenna Port 1**

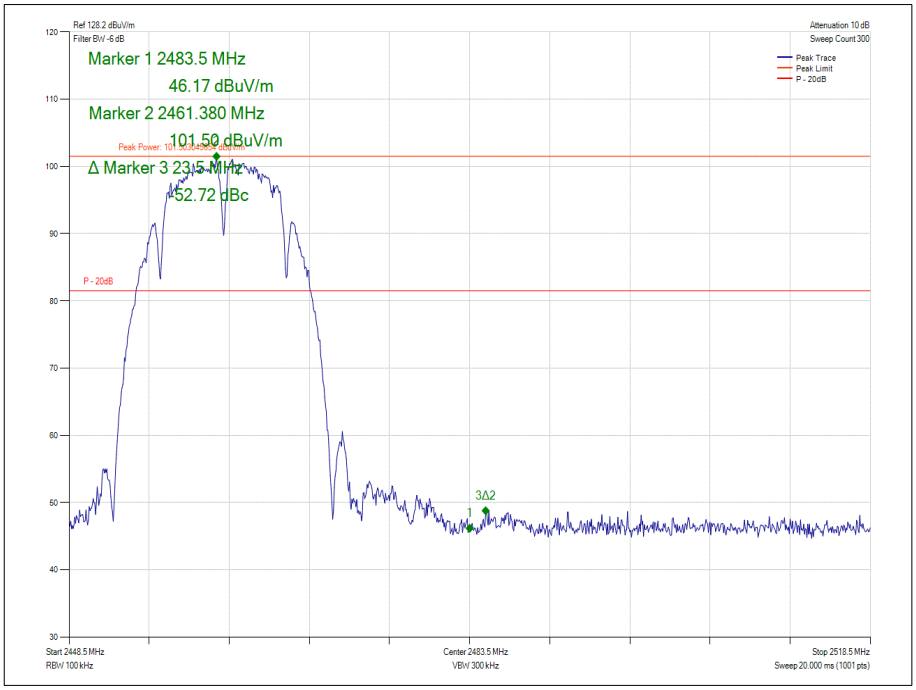


**Figure 57 - Data Rate with the Highest Power and Widest Bandwidth - 2 Mbps 2462 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1**

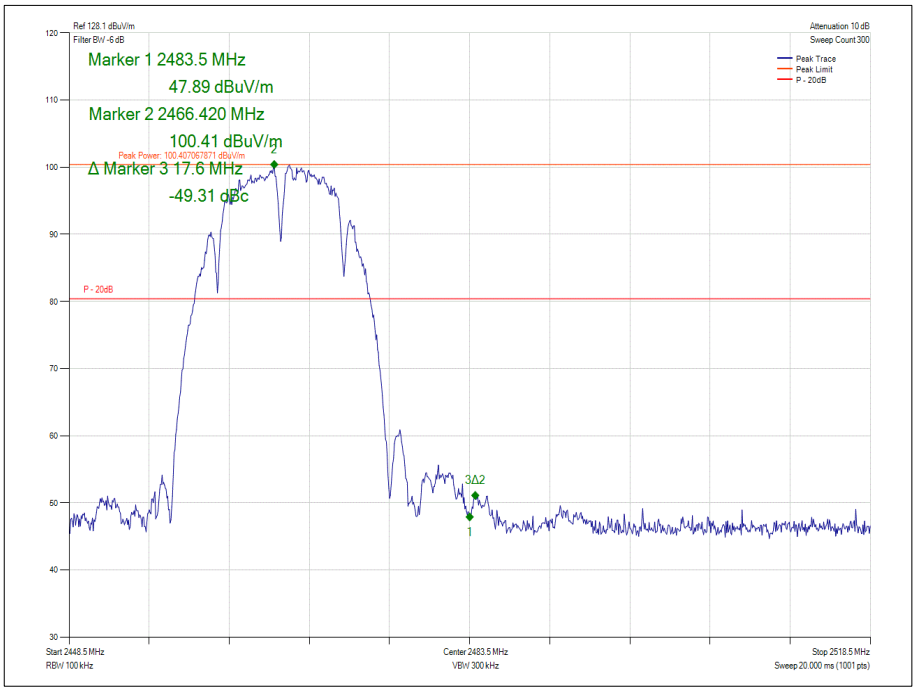


**Figure 58 - Data Rate with the Highest Power and Widest Bandwidth - 2 Mbps 2467 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1**

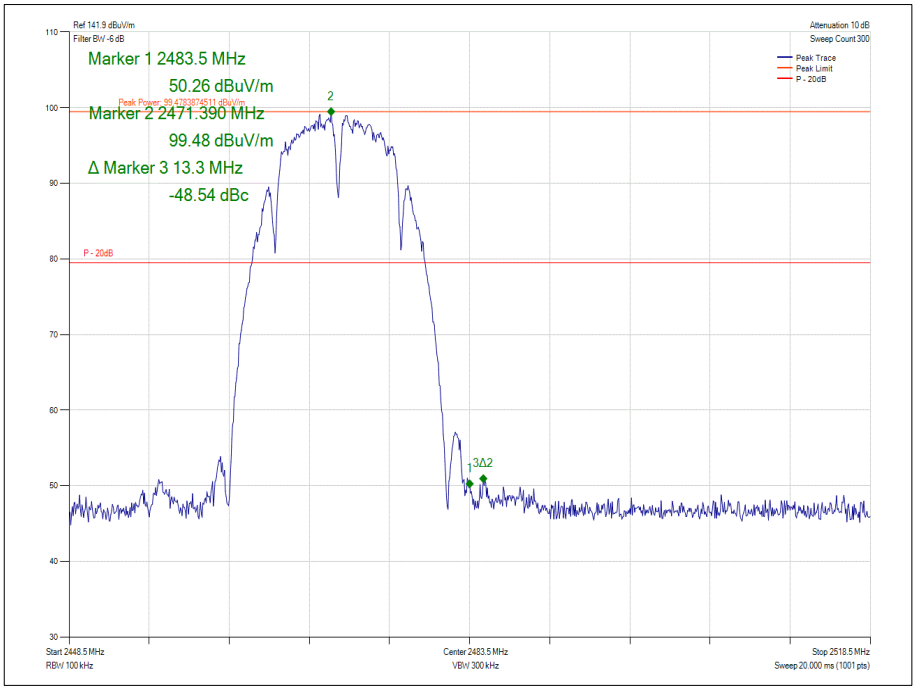


**Figure 59 - Data Rate with the Highest Power and Widest Bandwidth - 2 Mbps 2472 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1**

| Mode | Data Rate | Frequency (MHz) | Band Edge Frequency (MHz) | Level (dBc) |
|---|---|---|---|---|
| Data Rate with the Highest Power (15 dBm) | 2 Mbps | 2412 | 2400.0 | -44.45 |
| Data Rate with the Highest Power (15 dBm) | 2 Mbps | 2462 | 2483.5 | -48.18 |
| Data Rate with the Highest Power (15 dBm) | 2 Mbps | 2467 | 2483.5 | -49.97 |
| Data Rate with the Highest Power (13 dBm) | 2 Mbps | 2472 | 2483.5 | -47.68 |

**Table 30 - Authorised Band Edge Results – Antenna Port 2**

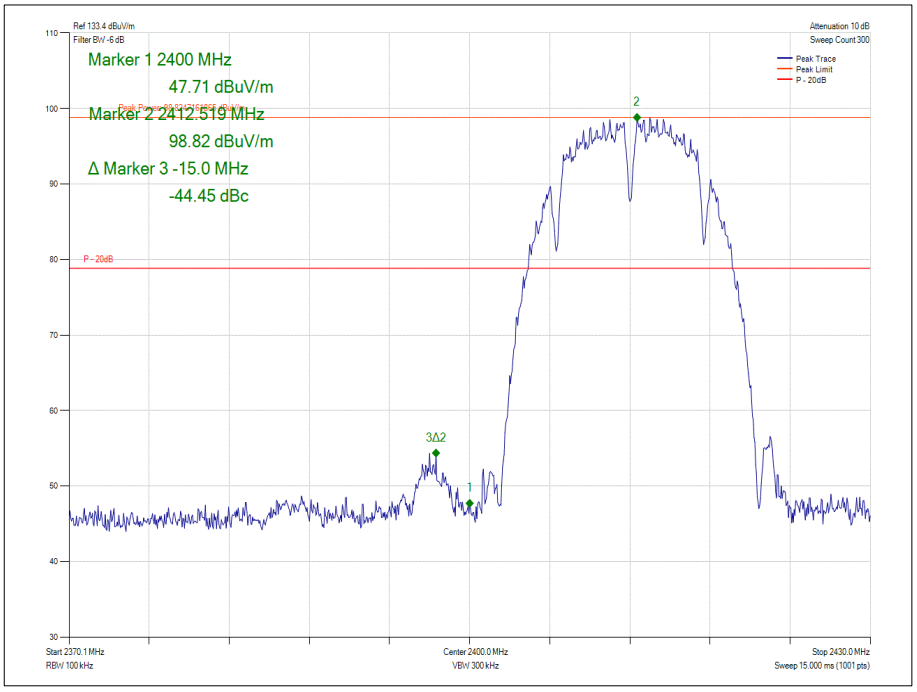


**Figure 60 - Data Rate with the Highest Power - 2 Mbps**
**2412 MHz - Band Edge Frequency 2400 MHz – Antenna Port 2**

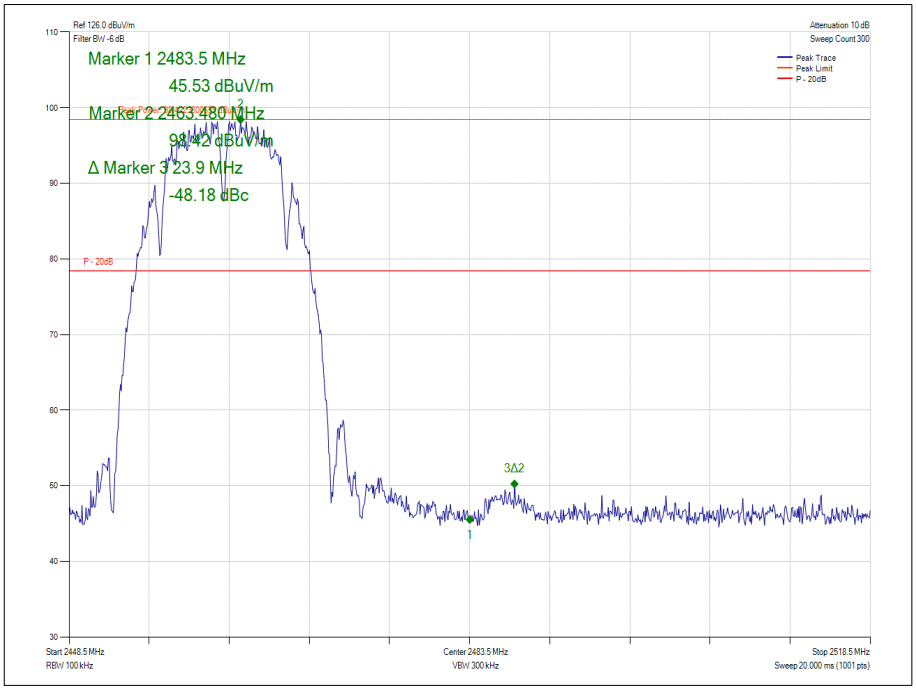


**Figure 61 - Data Rate with the Highest Power - 2 Mbps**
**2462 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

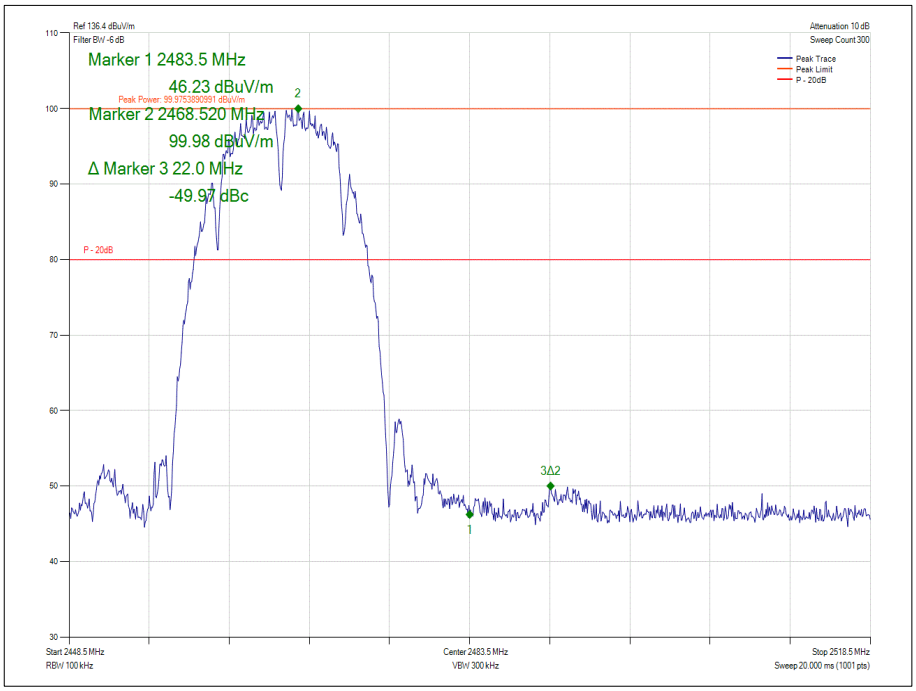


**Figure 62 - Data Rate with the Highest Power - 2 Mbps**
**2467 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

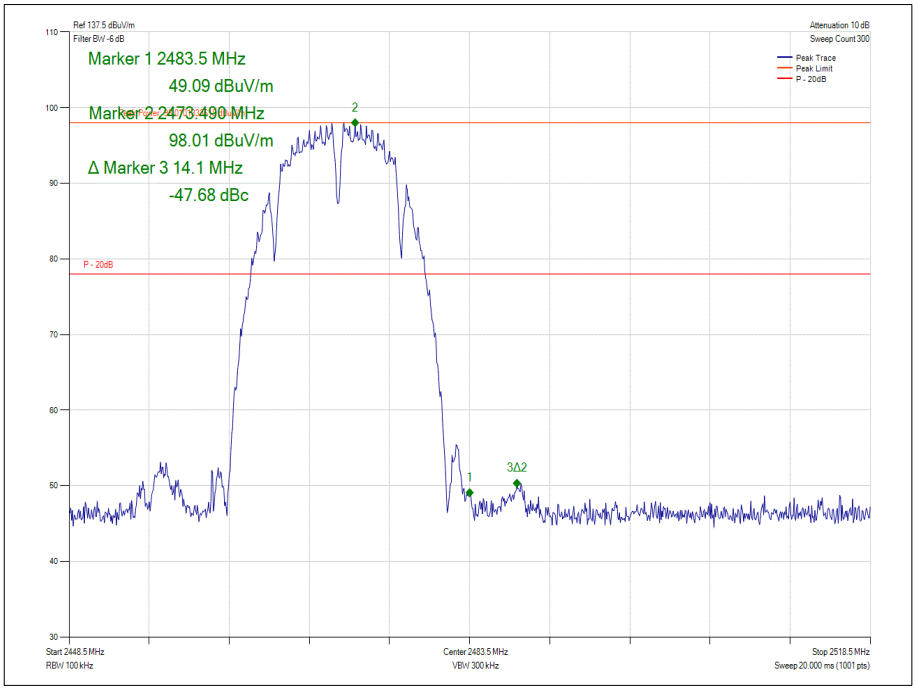


**Figure 63 - Data Rate with the Highest Power - 2 Mbps**
**2472 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

2.4 GHz WLAN - 802.11g

| Mode | Data Rate | Frequency (MHz) | Band Edge Frequency (MHz) | Level (dBc) |
|---|---|---|---|---|
| Data Rate with the Highest Power (13 dBm) | 54 Mbps | 2412 | 2400.0 | -38.97 |
| Data Rate with the Highest Power (13 dBm) | 54 Mbps | 2462 | 2483.5 | -47.30 |
| Data Rate with the Highest Power (11 dBm) | 54 Mbps | 2467 | 2483.5 | -42.57 |
| Data Rate with the Highest Power (7 dBm) | 54 Mbps | 2472 | 2483.5 | -39.60 |
| Data Rate with the Widest Bandwidth | 9 Mbps | 2412 | 2390 | -41.05 |
| Data Rate with the Widest Bandwidth | 9 Mbps | 2462 | 2483.5 | -46.66 |
| Data Rate with the Widest Bandwidth | 9 Mbps | 2467 | 2483.5 | -46.32 |
| Data Rate with the Widest Bandwidth | 9 Mbps | 2472 | 2483.5 | -47.11 |

**Table 31 - Authorised Band Edge Results – Antenna Port 1**

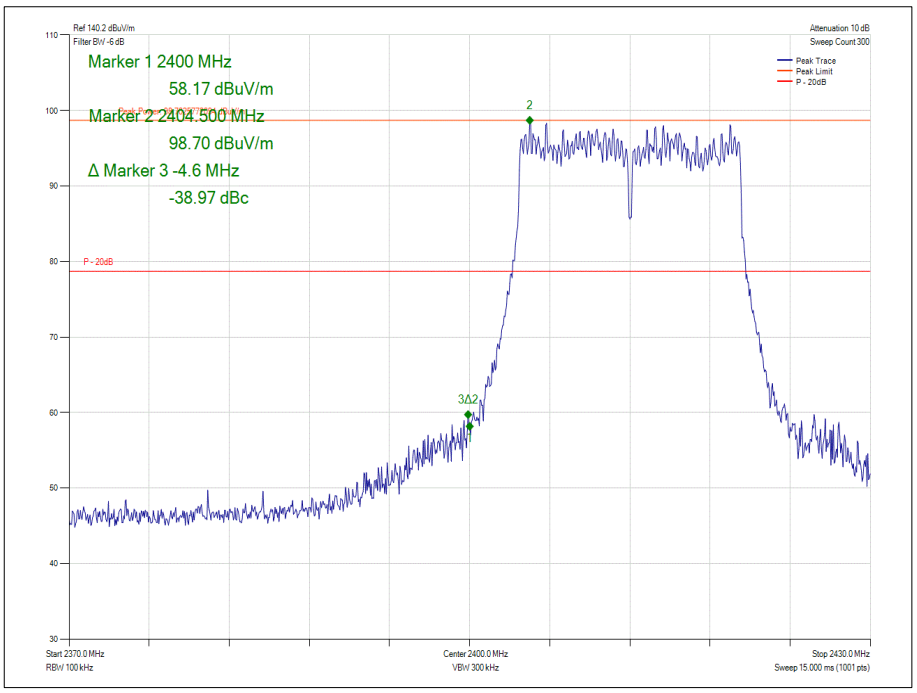


**Figure 64 - Data Rate with the Highest Power - 54 Mbps**
**2412 MHz - Band Edge Frequency 2400 MHz – Antenna Port 1**

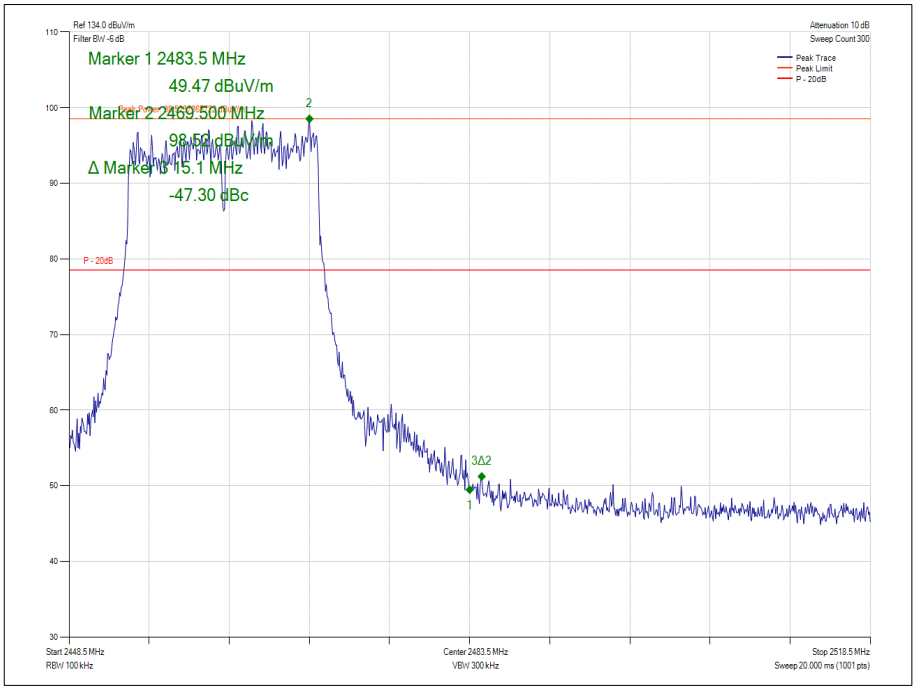


**Figure 65 - Data Rate with the Highest Power - 54 Mbps**
**2462 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1**

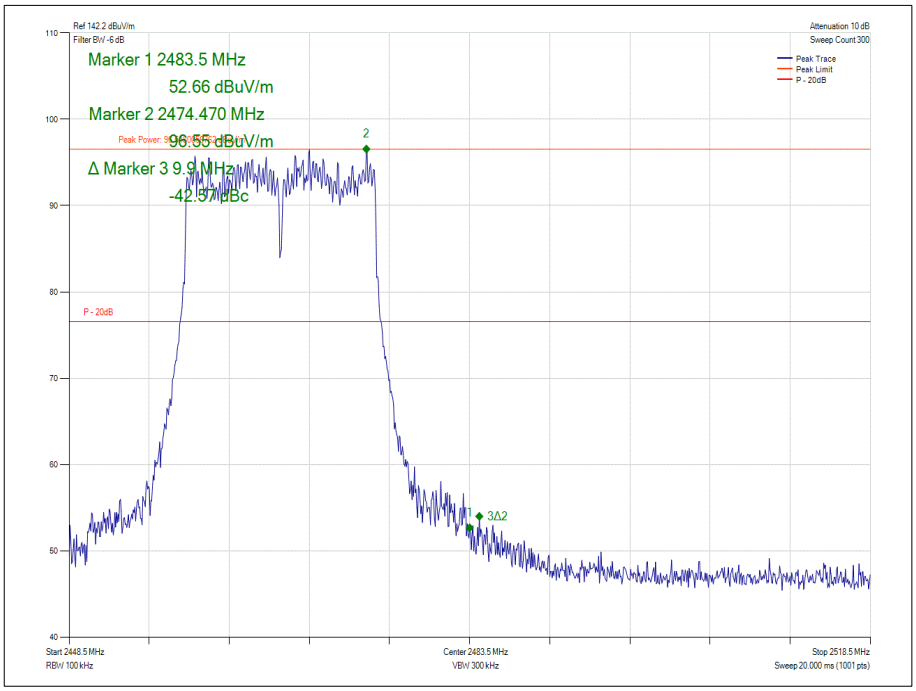


**Figure 66 - Data Rate with the Highest Power - 54 Mbps**
**2467 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1**

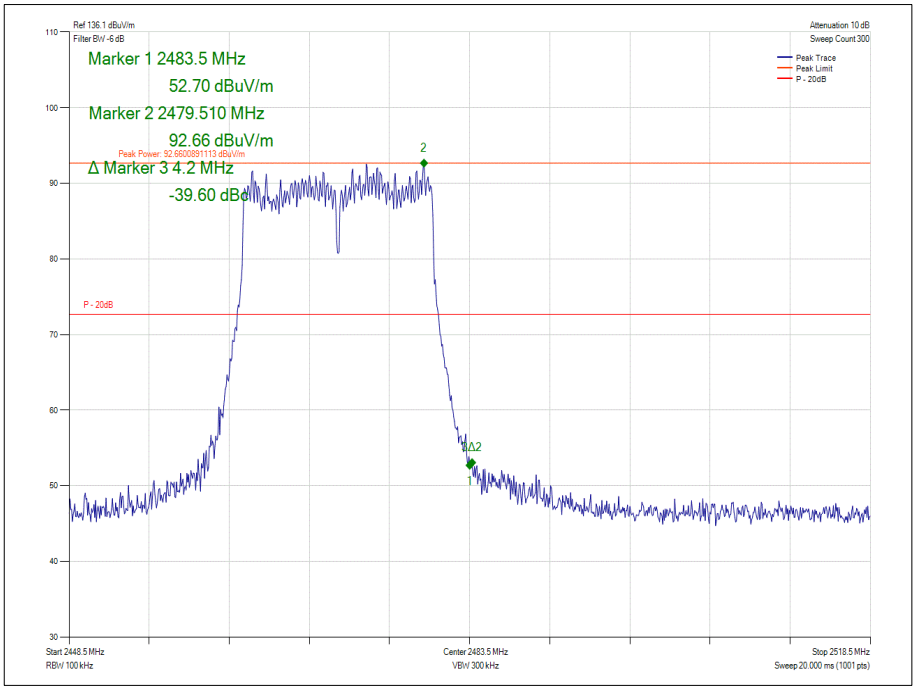


**Figure 67 - Data Rate with the Highest Power - 54 Mbps**
**2472 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1**

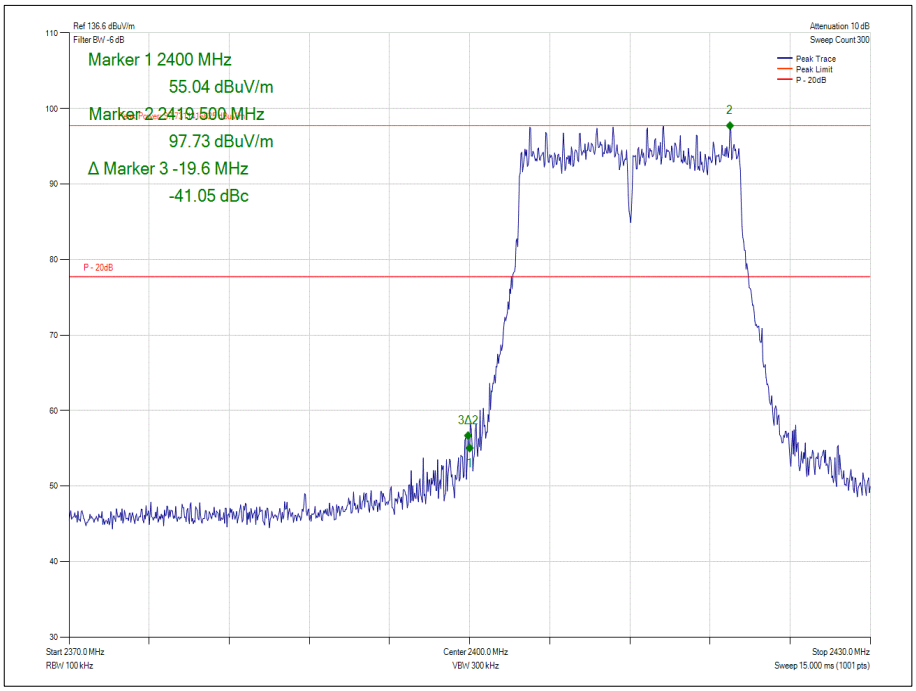


**Figure 68 - Data Rate with the Widest Bandwidth - 9 Mbps**
**2412 MHz - Band Edge Frequency 2400 MHz – Antenna Port 1**

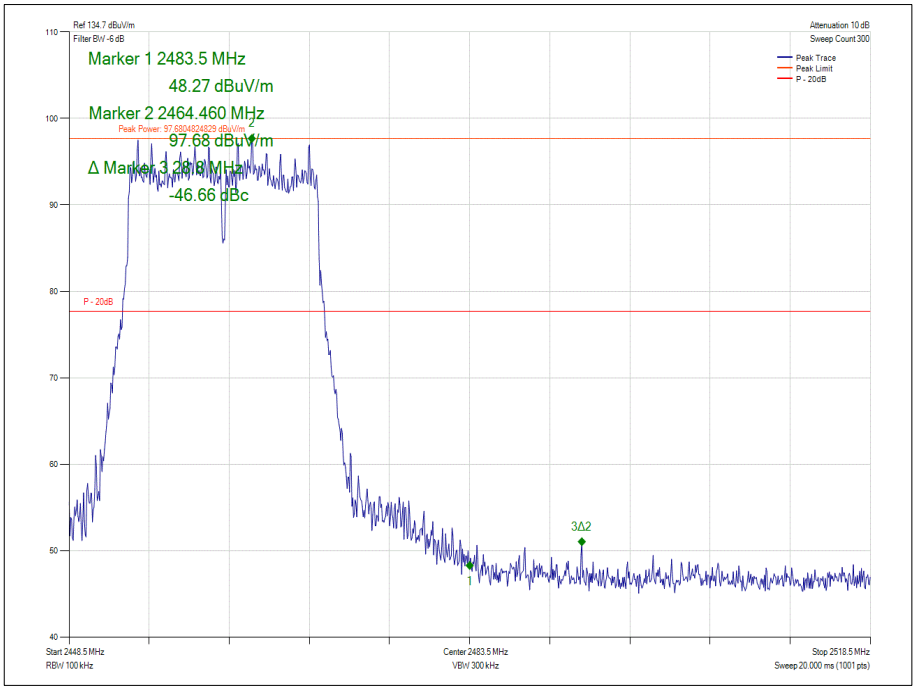


**Figure 69 - Data Rate with the Widest Bandwidth - 9 Mbps**
**2462 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1**

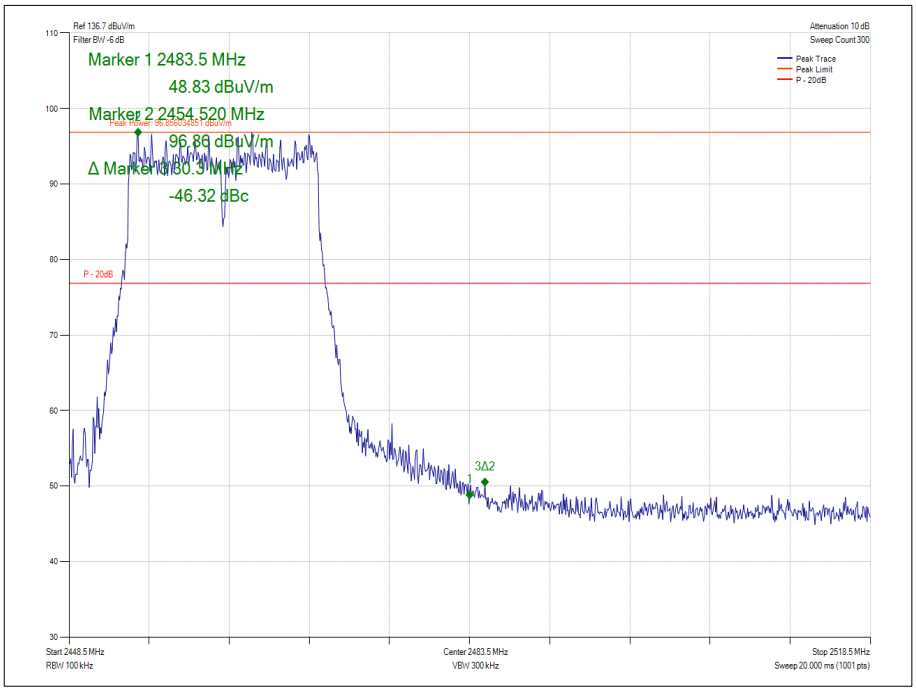


**Figure 70 - Data Rate with the Widest Bandwidth - 9 Mbps**
**2467 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1**

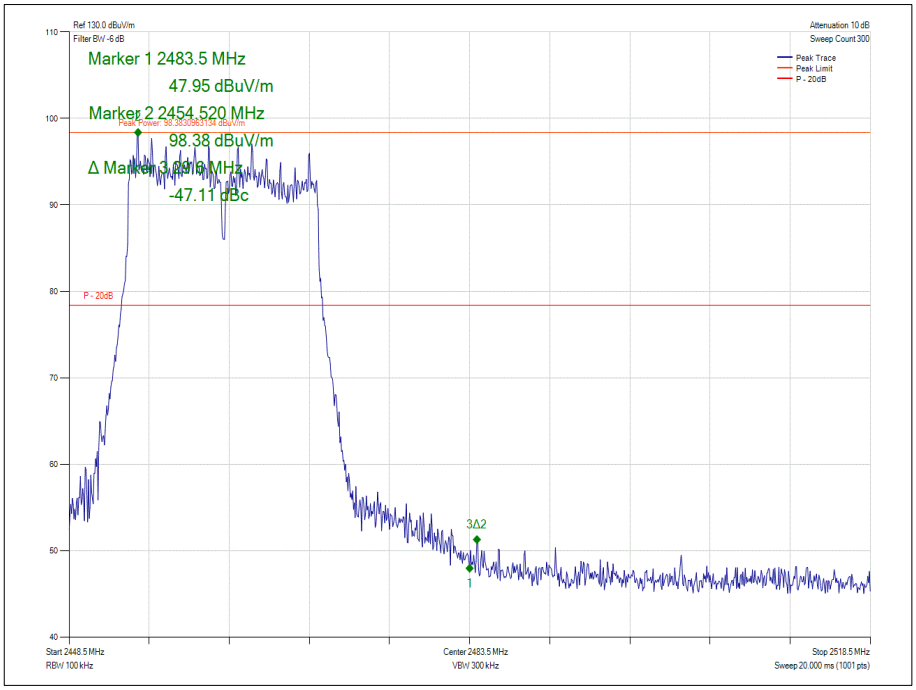


**Figure 71 - Data Rate with the Widest Bandwidth - 9 Mbps**
**2472 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1**

| Mode | Data Rate | Frequency (MHz) | Band Edge Frequency (MHz) | Level (dBc) |
|---|---|---|---|---|
| Data Rate with the Widest Bandwidth | 9 Mbps | 2412 | 2400.0 | -41.00 |
| Data Rate with the Widest Bandwidth | 9 Mbps | 2462 | 2483.5 | -44.32 |
| Data Rate with the Widest Bandwidth | 9 Mbps | 2467 | 2483.5 | -43.16 |
| Data Rate with the Widest Bandwidth | 9 Mbps | 2462 | 2483.5 | -43.11 |
| Data Rate with the Highest Power | 36 Mbps | 2412 | 2400.0 | -39.99 |
| Data Rate with the Highest Power (13 dBm) | 36 Mbps | 2462 | 2483.5 | -44.10 |
| Data Rate with the Highest Power (12 dBm) | 36 Mbps | 2467 | 2483.5 | -42.48 |
| Data Rate with the Highest Power (9 dBm) | 36 Mbps | 2472 | 2483.5 | -39.94 |

**Table 32 - Authorised Band Edge Results – Antenna Port 2**

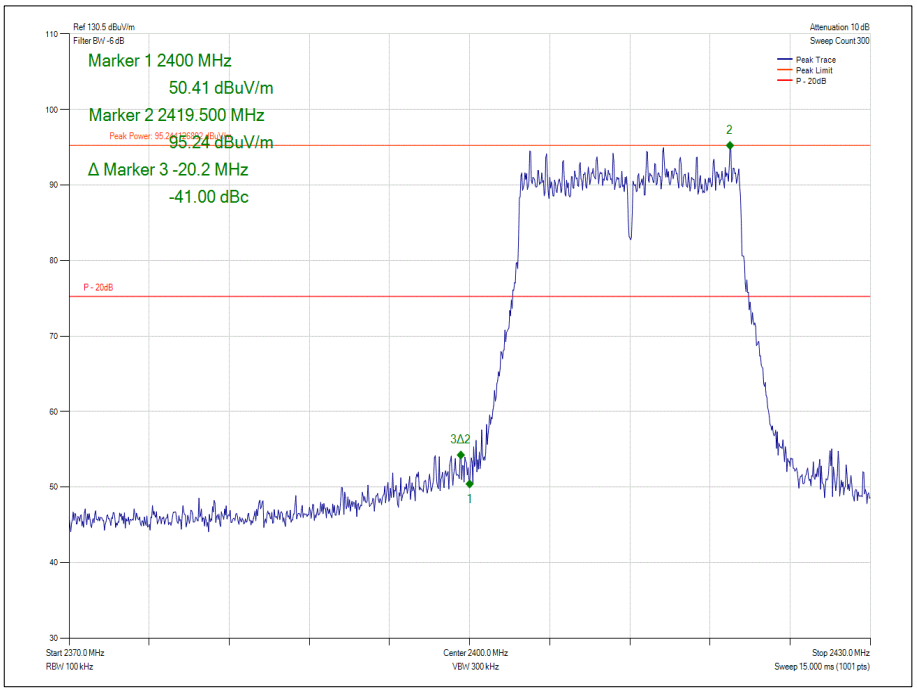


**Figure 72 - Data Rate with the Widest Bandwidth - 9 Mbps**
**2412 MHz - Band Edge Frequency 2400 MHz – Antenna Port 2**

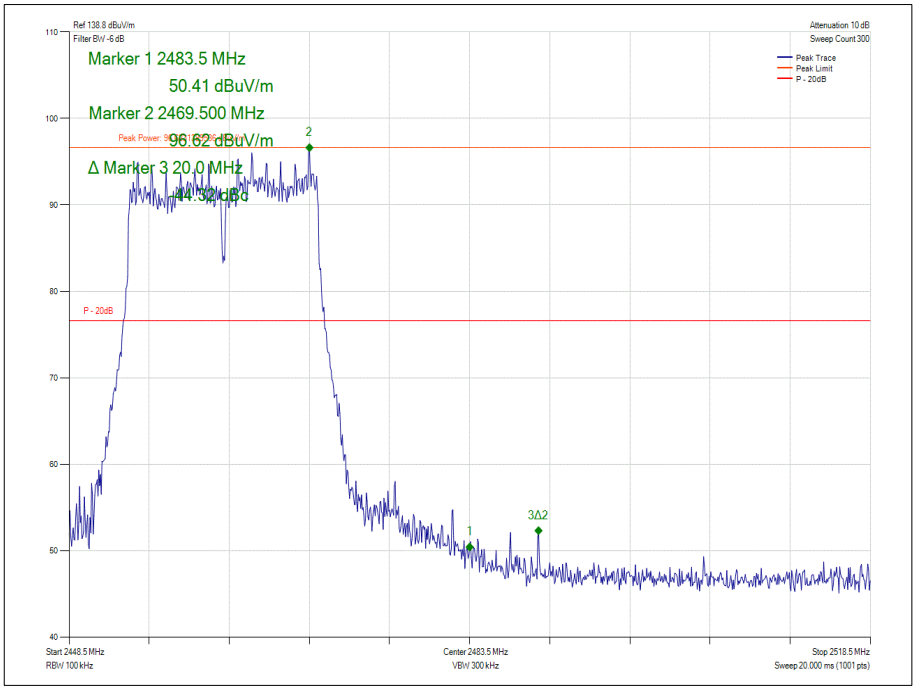


**Figure 73 - Data Rate with the Widest Bandwidth - 9 Mbps**
**2462 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

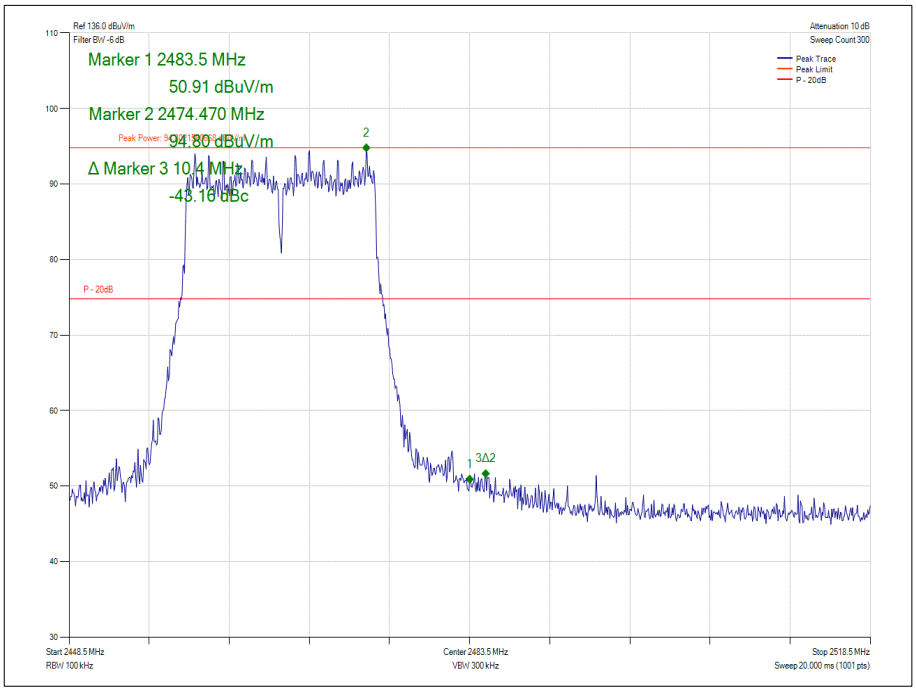


**Figure 74 - Data Rate with the Widest Bandwidth - 9 Mbps**
**2467 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

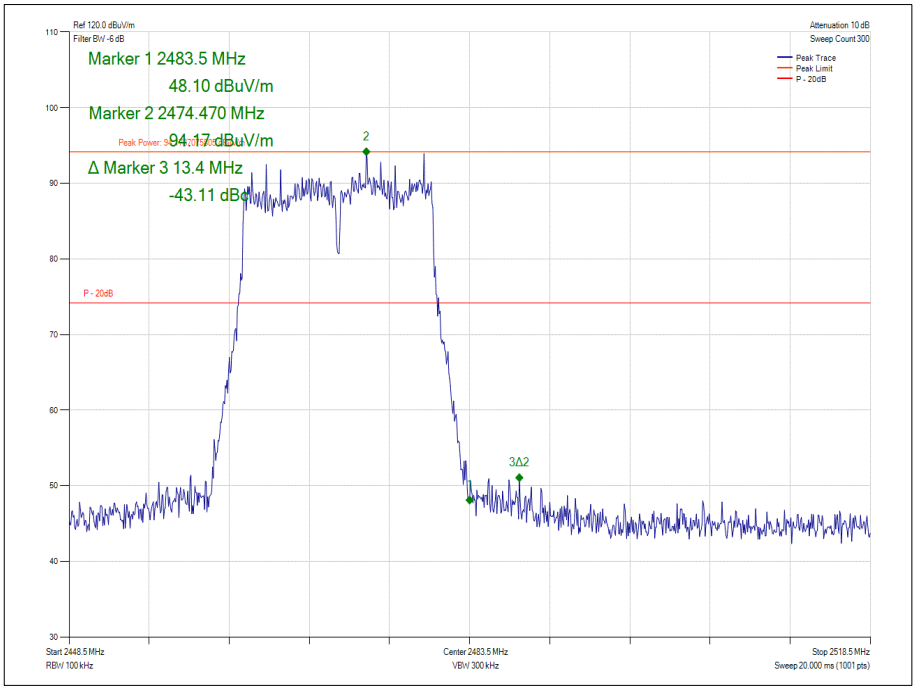


**Figure 75 - Data Rate with the Widest Bandwidth - 9 Mbps**
**2462 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

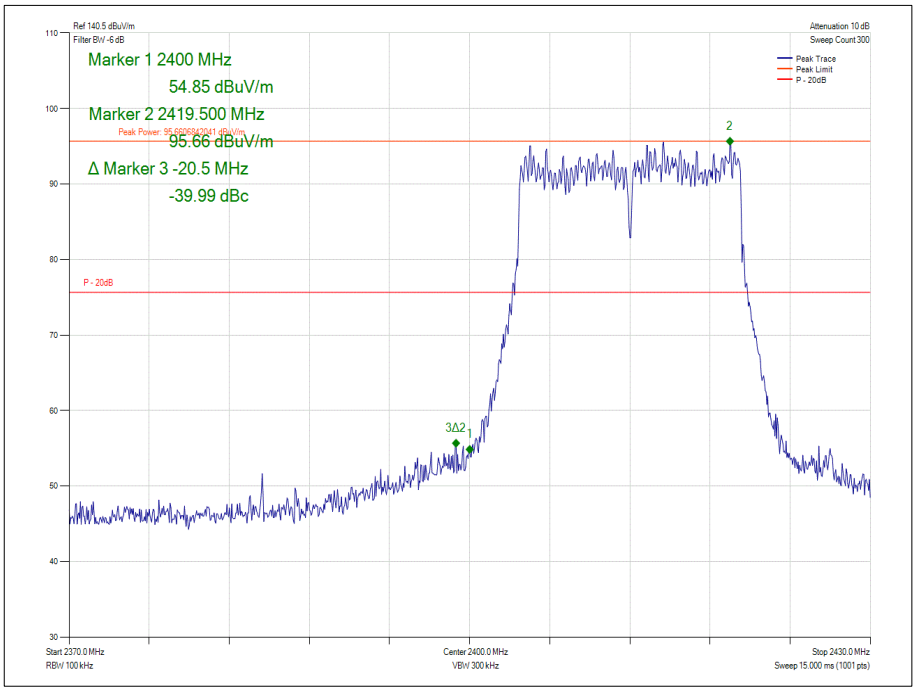


**Figure 76 - Data Rate with the Highest Power - 36 Mbps**
**2412 MHz - Band Edge Frequency 2400 MHz – Antenna Port 2**

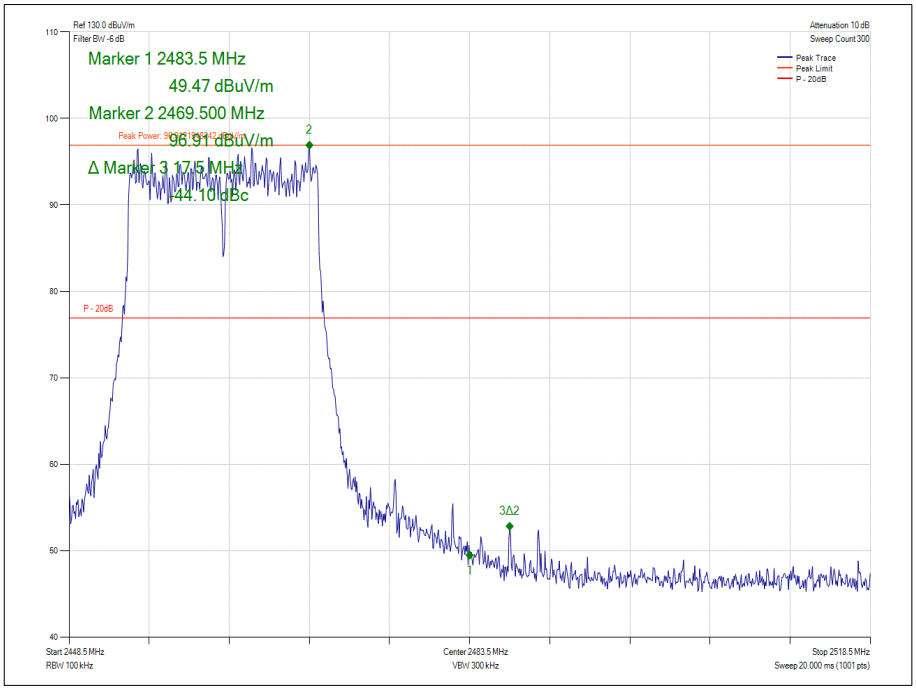


**Figure 77 - Data Rate with the Highest Power - 36 Mbps**
**2462 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

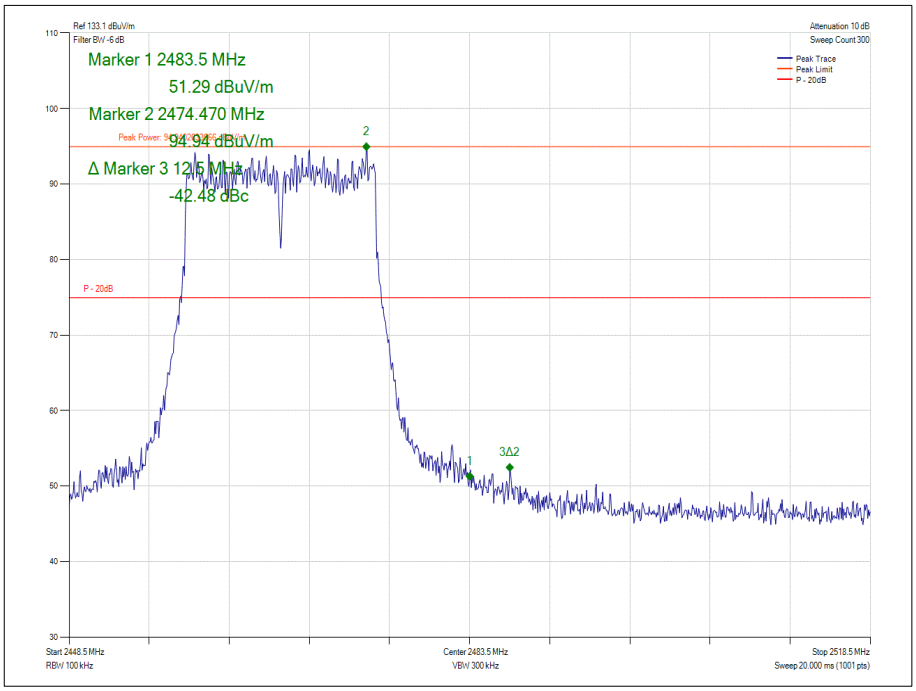


**Figure 78 - Data Rate with the Highest Power - 36 Mbps**
**2467 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

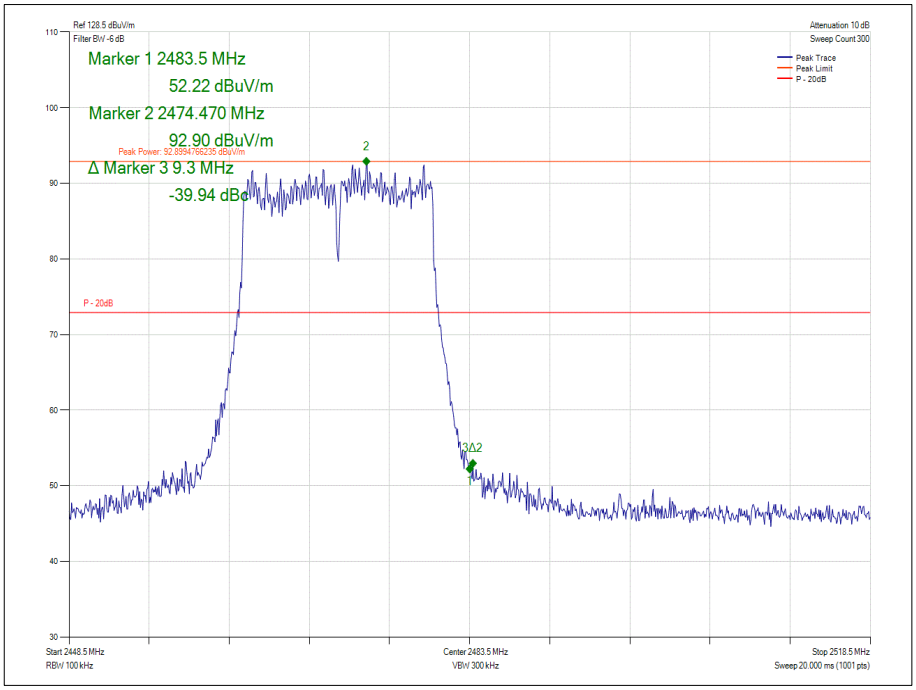


**Figure 79 - Data Rate with the Highest Power - 36 Mbps**
**2472 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

2.4 GHz WLAN - 802.11n 20 MHz Bandwidth

| Mode | MCS | Frequency (MHz) | Band Edge Frequency (MHz) | Level (dBc) |
|---|---|---|---|---|
| MCS with the Highest Power (12 dBm) and Widest Bandwidth | MCS7 | 2412 | 2483.5 | -38.95 |
| MCS with the Highest Power (12 dBm) and Widest Bandwidth | MCS7 | 2462 | 2400.0 | -42.45 |
| MCS with the Highest Power (10 dBm) and Widest Bandwidth | MCS7 | 2467 | 2483.5 | -40.28 |
| MCS with the Highest Power (7 dBm) and Widest Bandwidth | MCS7 | 2472 | 2400.0 | -38.88 |

**Table 33 - Authorised Band Edge Results – Antenna Port 1**

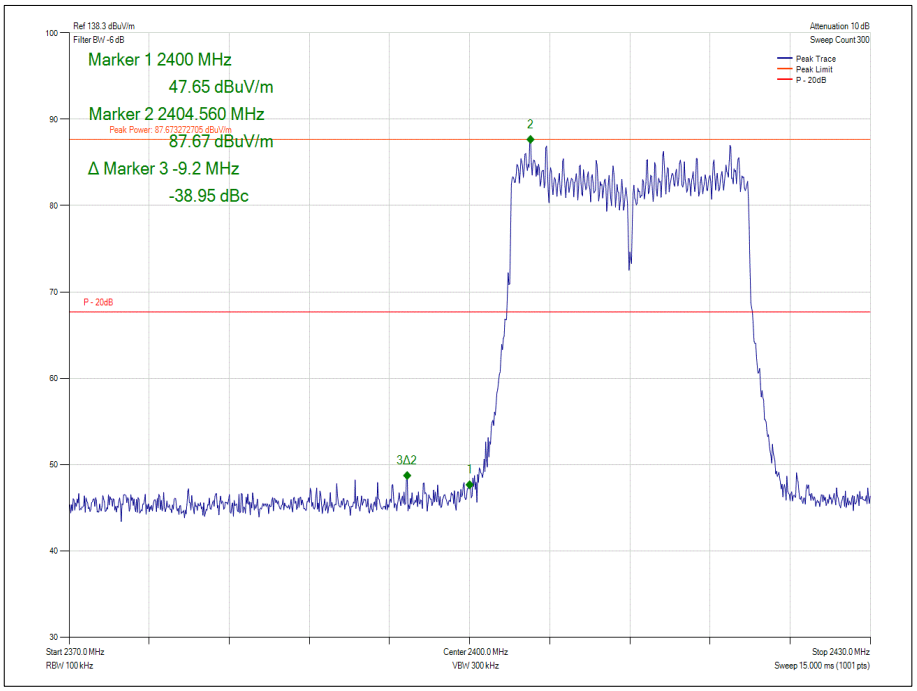


**Figure 80 - MCS with the Highest Power and Widest Bandwidth - MCS7 2412 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1**

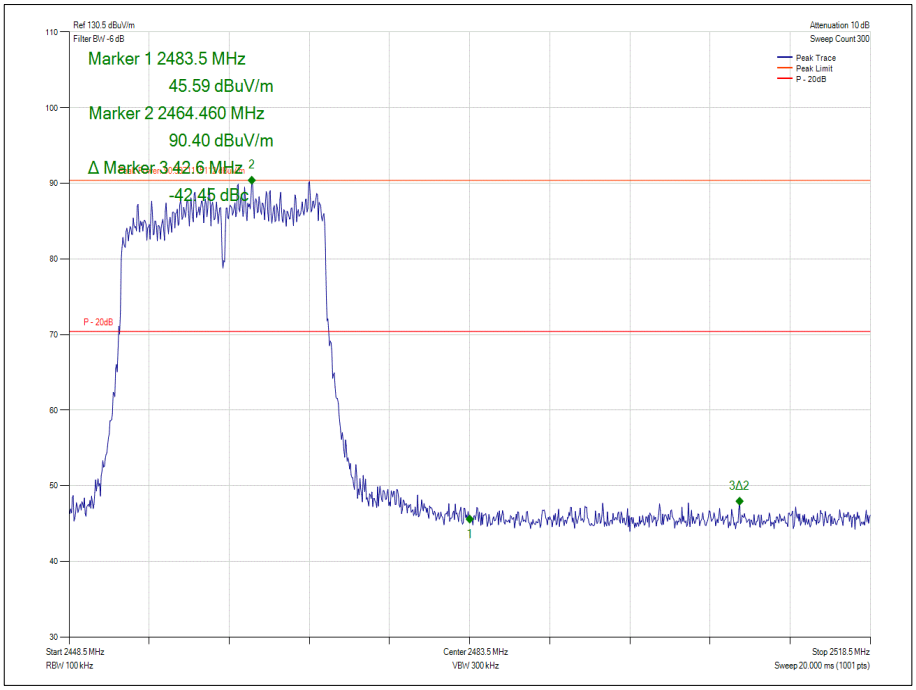


**Figure 81 - MCS with the Highest Power and Widest Bandwidth - MCS7 2462 MHz - Band Edge Frequency 2400 MHz – Antenna Port 1**

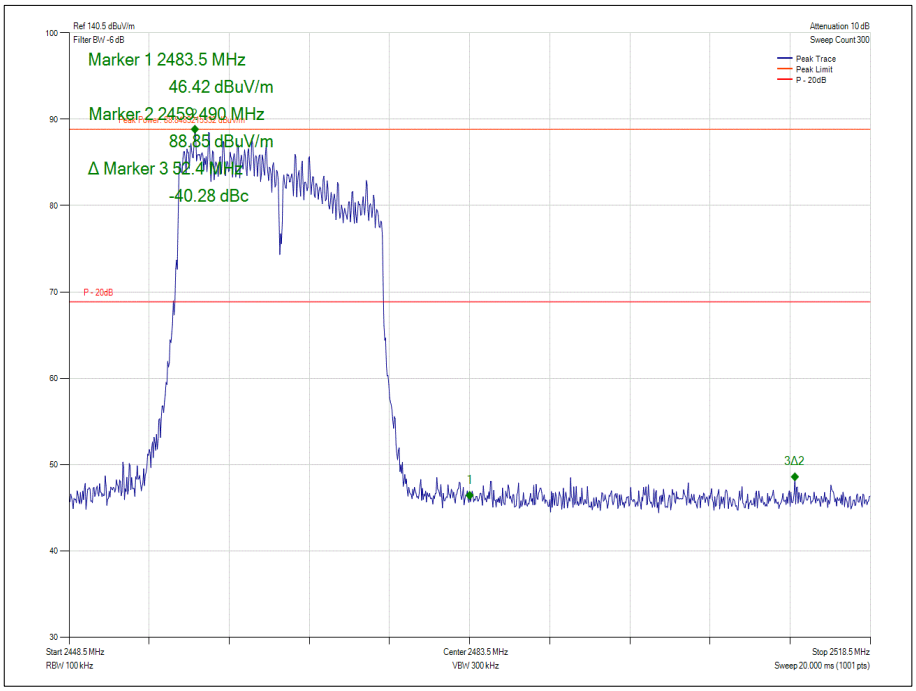


**Figure 82 - MCS with the Highest Power and Widest Bandwidth - MCS7 2467 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1**

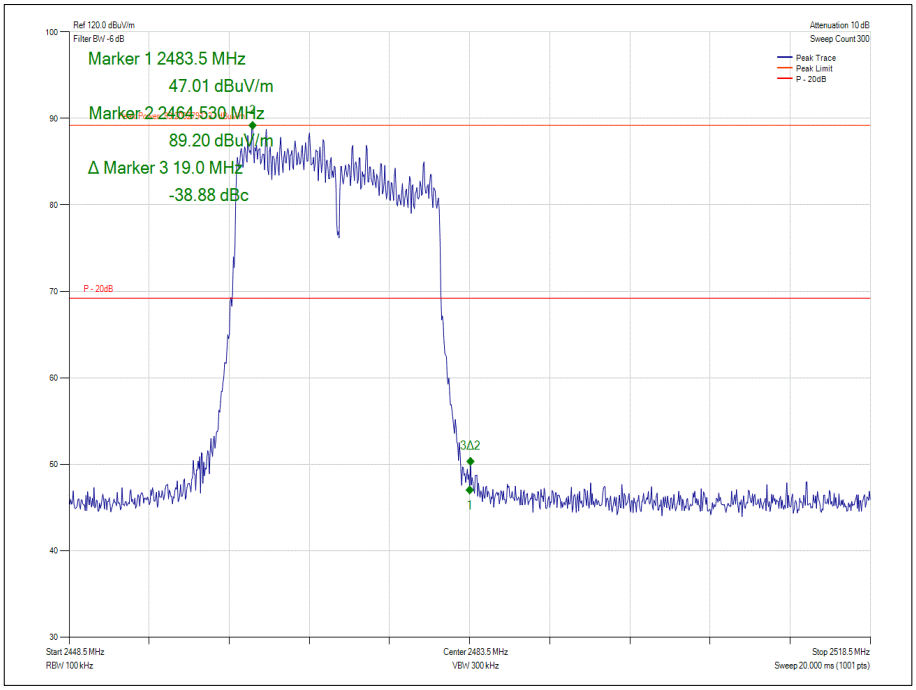


**Figure 83 - MCS with the Highest Power and Widest Bandwidth - MCS7 2472 MHz - Band Edge Frequency 2400 MHz – Antenna Port 1**

| Mode | MCS | Frequency (MHz) | Band Edge Frequency (MHz) | Level (dBc) |
|---|---|---|---|---|
| Data Rate/MCS with the Highest Power (12 dBm) | MCS7 | 2412 | 2400.0 | -38.73 |
| Data Rate/MCS with the Highest Power (12 dBm) | MCS7 | 2462 | 2483.5 | -43.07 |
| Data Rate/MCS with the Highest Power (10 dBm) | MCS7 | 2467 | 2483.5 | -39.94 |
| Data Rate/MCS with the Highest Power (7 dBm) | MCS7 | 2472 | 2483.5 | -36.98 |
| Data Rate/MCS with the Widest Bandwidth | MCS6 | 2412 | 2400.0 | -33.94 |
| Data Rate/MCS with the Widest Bandwidth | MCS6 | 2462 | 2483.5 | -40.70 |
| Data Rate/MCS with the Widest Bandwidth | MCS6 | 2467 | 2483.5 | -40.55 |
| Data Rate/MCS with the Widest Bandwidth | MCS6 | 2472 | 2483.5 | -36.63 |

**Table 34 - Authorised Band Edge Results – Antenna Port 2**

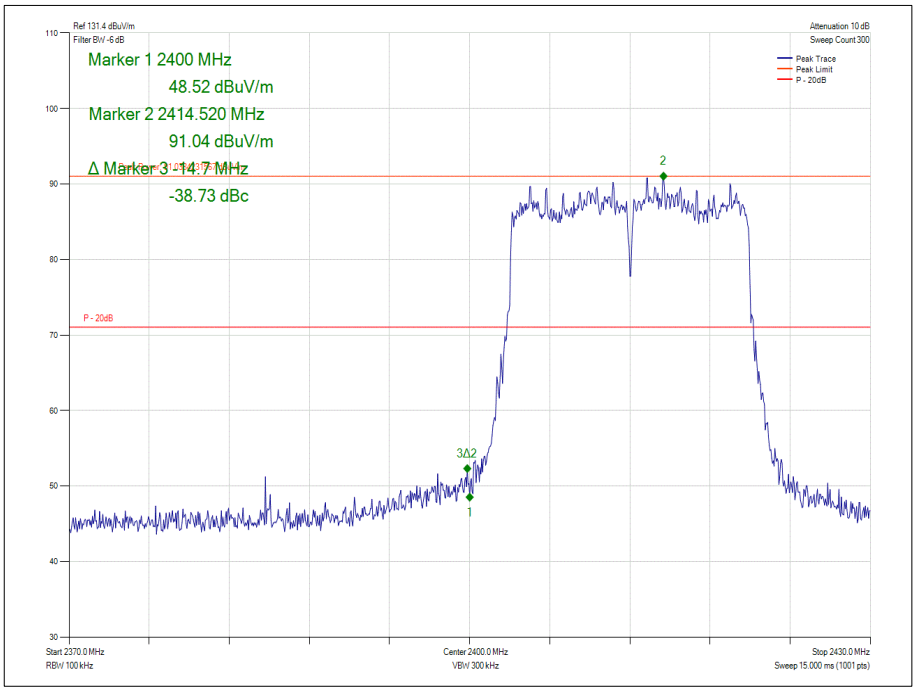


**Figure 84 - MCS with the Highest Power - MCS7**
**2412 MHz - Band Edge Frequency 2400 MHz – Antenna Port 2**

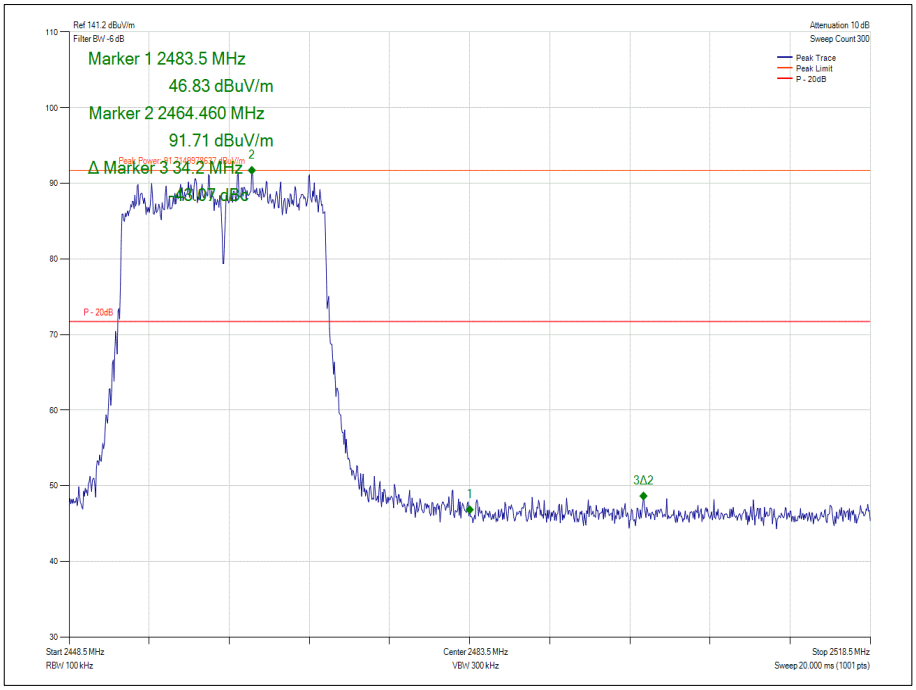


**Figure 85 - MCS with the Highest Power - MCS7**
**2462 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

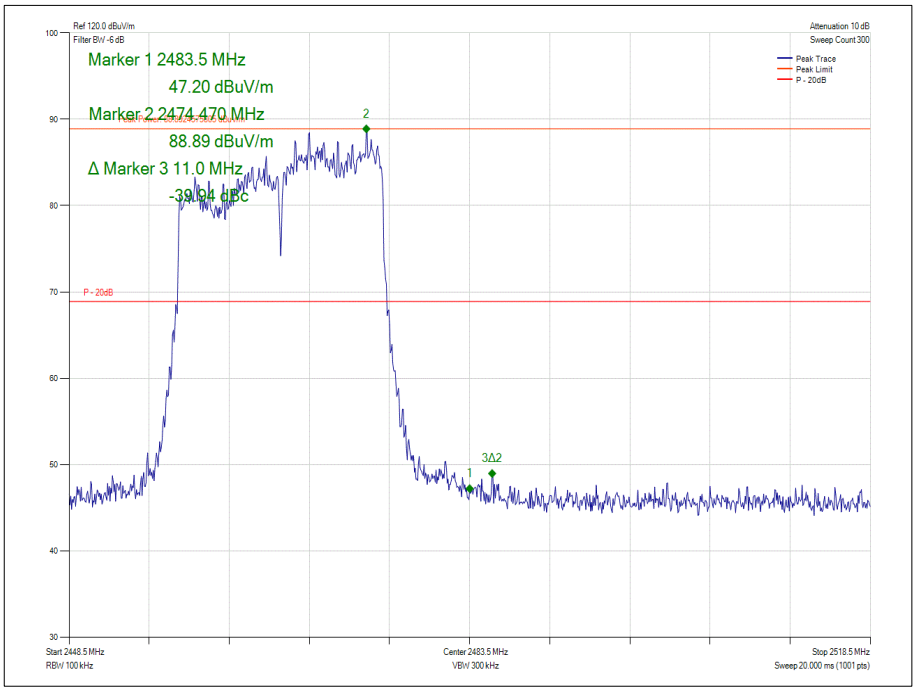


**Figure 86 - MCS with the Highest Power - MCS7**
**2467 MHz - Band Edge Frequency 2483.5 MHz– Antenna Port 2**

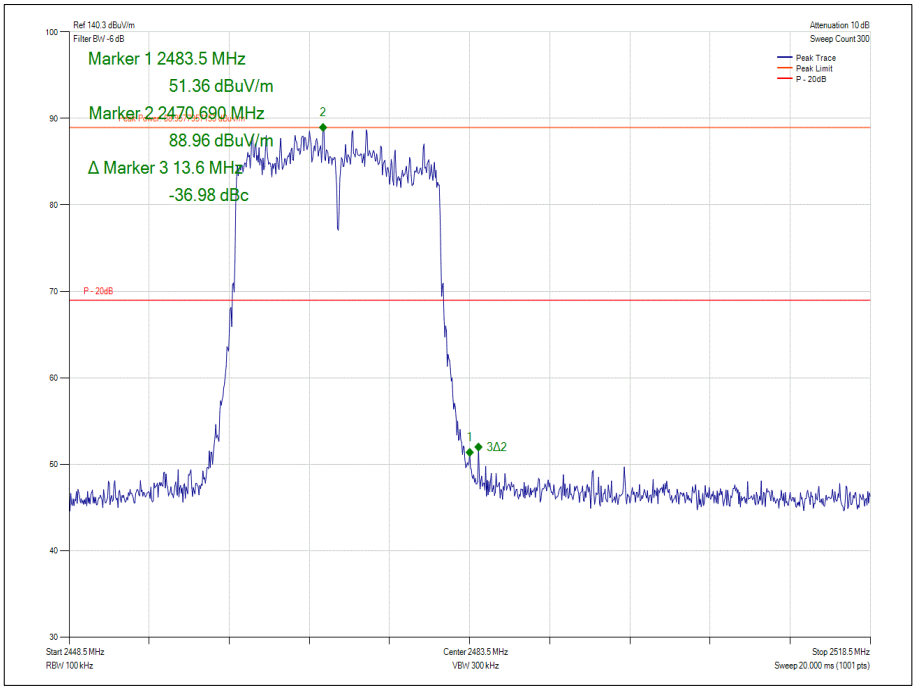


**Figure 87 - MCS with the Highest Power - MCS7**
**2472 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

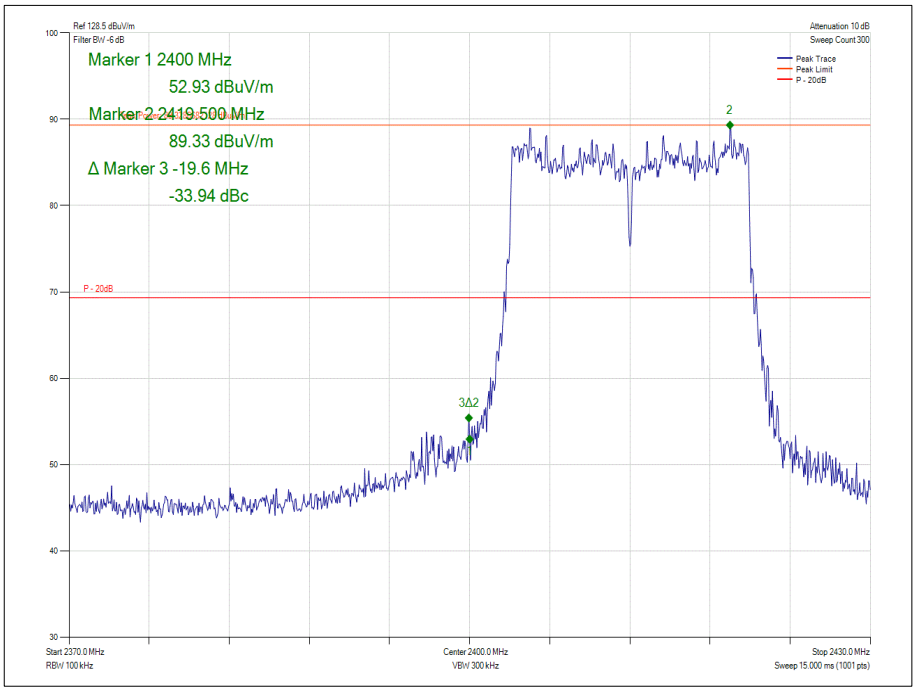


**Figure 88 - MCS with the Widest Bandwidth - MCS6**
**2412 MHz - Band Edge Frequency 2400 MHz – Antenna Port 2**

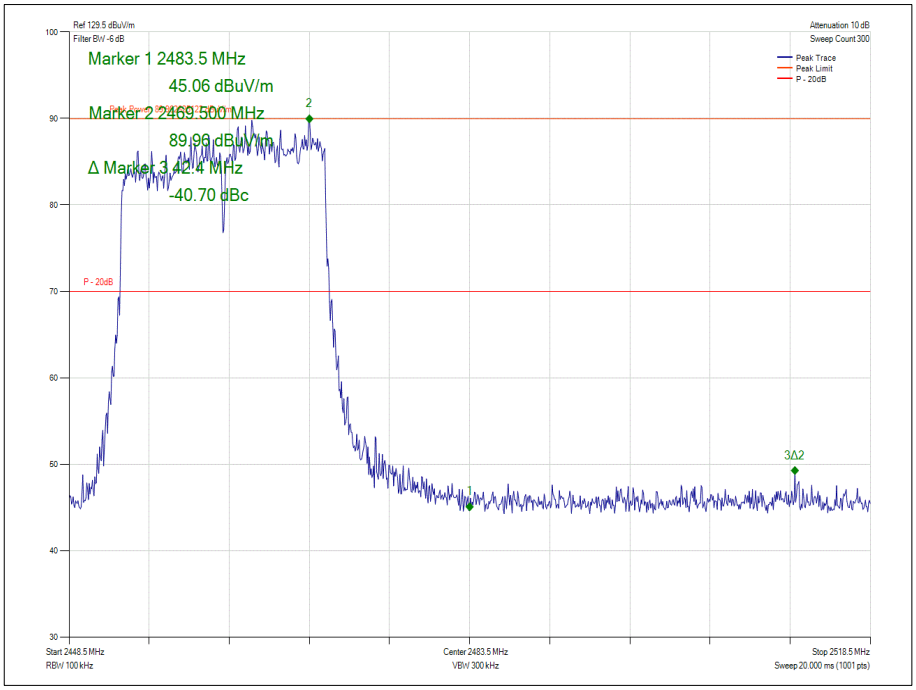


**Figure 89 - MCS with the Widest Bandwidth - MCS6**
**2462 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

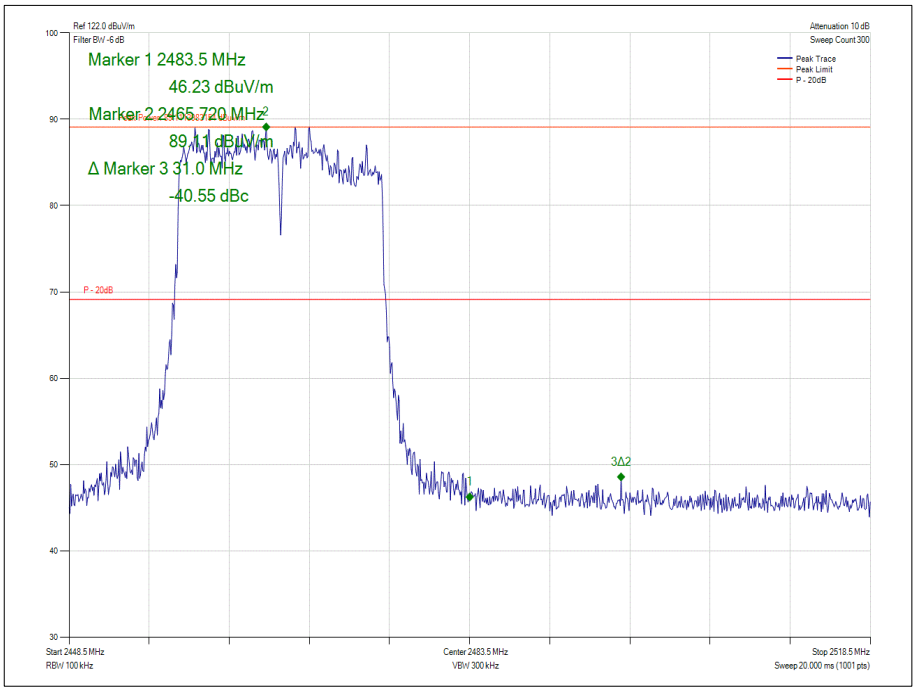


**Figure 90 - MCS with the Widest Bandwidth - MCS6**
**2467 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

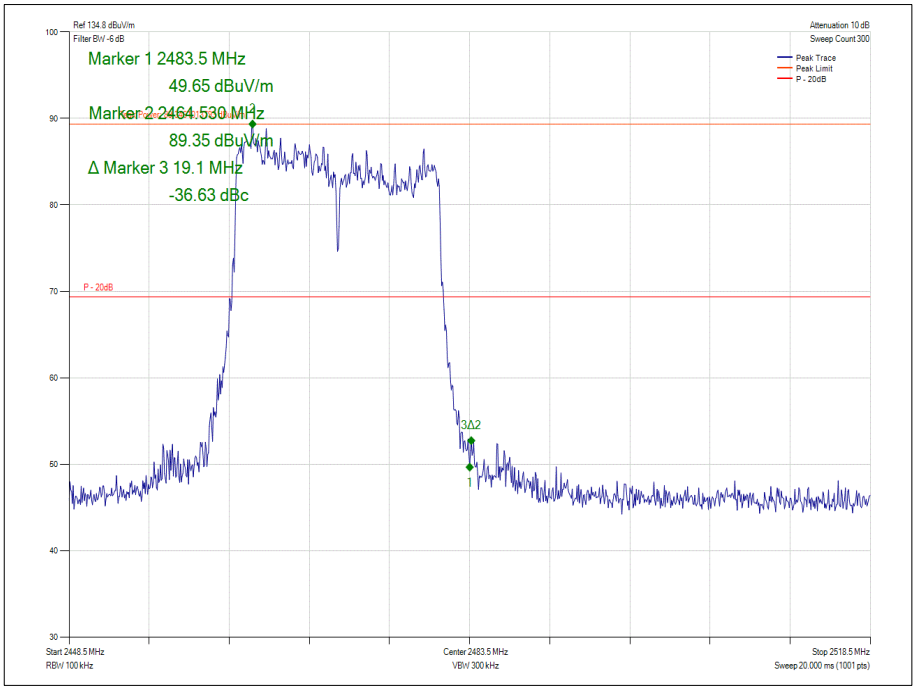


**Figure 91 - MCS with the Widest Bandwidth - MCS6**
**2472 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

| Mode | MCS | Frequency (MHz) | Band Edge Frequency (MHz) | Level (dBc) |
|---|---|---|---|---|
| MCS with the Highest Power and Widest Bandwidth | MCS0 | 2412 | 2400.0 | -36.56 |
| MCS with the Highest Power and Widest Bandwidth | MCS0 | 2462 | 2483.5 | -43.77 |
| MCS with the Highest Power and Widest Bandwidth | MCS0 | 2467 | 2483.5 | -41.68 |
| MCS with the Highest Power and Widest Bandwidth | MCS0 | 2472 | 2483.5 | -38.98 |

**Table 35 - Authorised Band Edge Results – Antenna Port 1+2 MIMO**

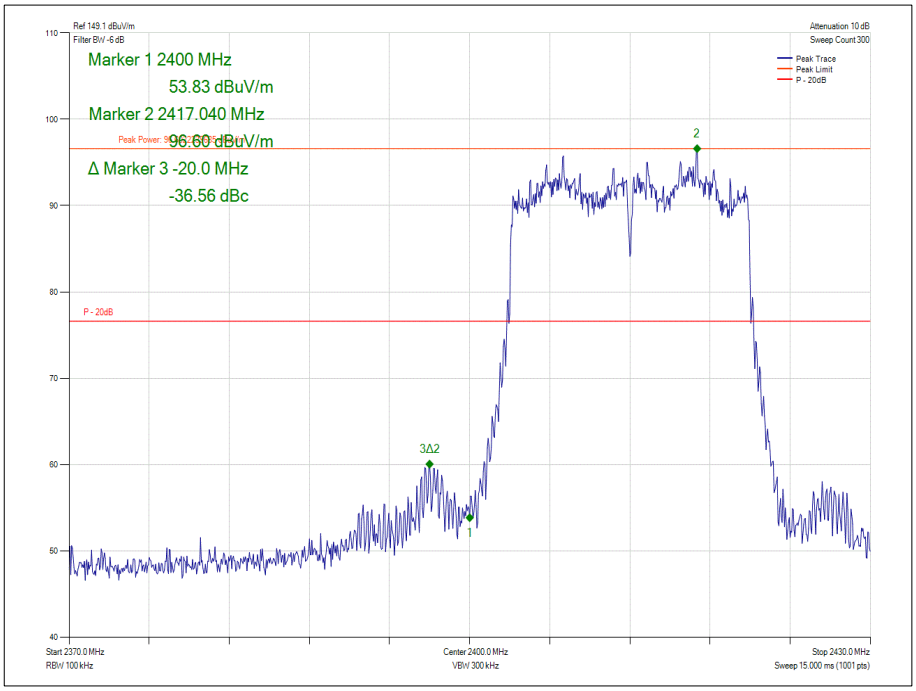


**Figure 92 - MCS with the Highest Power and Widest Bandwidth - MCS0 2412 MHz - Band Edge Frequency 2400 MHz – Antenna Port 1+2 MIMO**

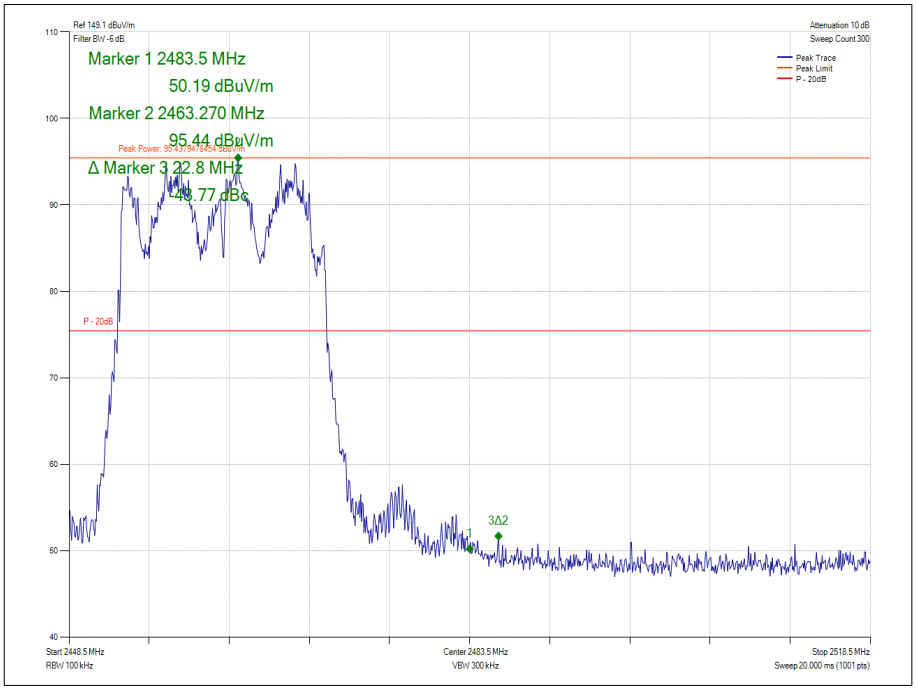


**Figure 93 - MCS with the Highest Power and Widest Bandwidth - MCS0 2462 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1+2 MIMO**

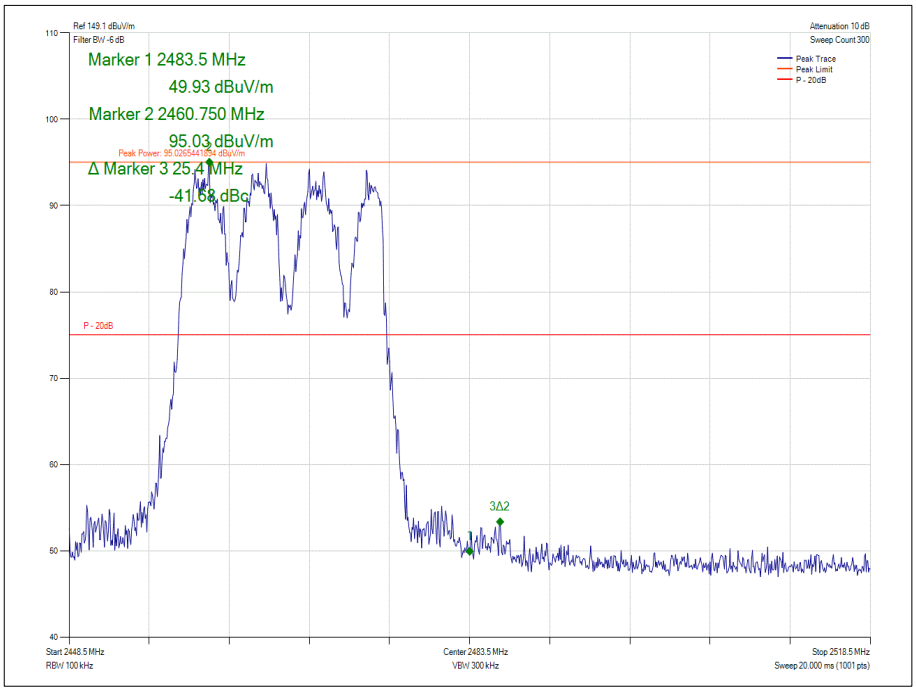


**Figure 94 - MCS with the Highest Power and Widest Bandwidth - MCS0 2467 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1+2 MIMO**

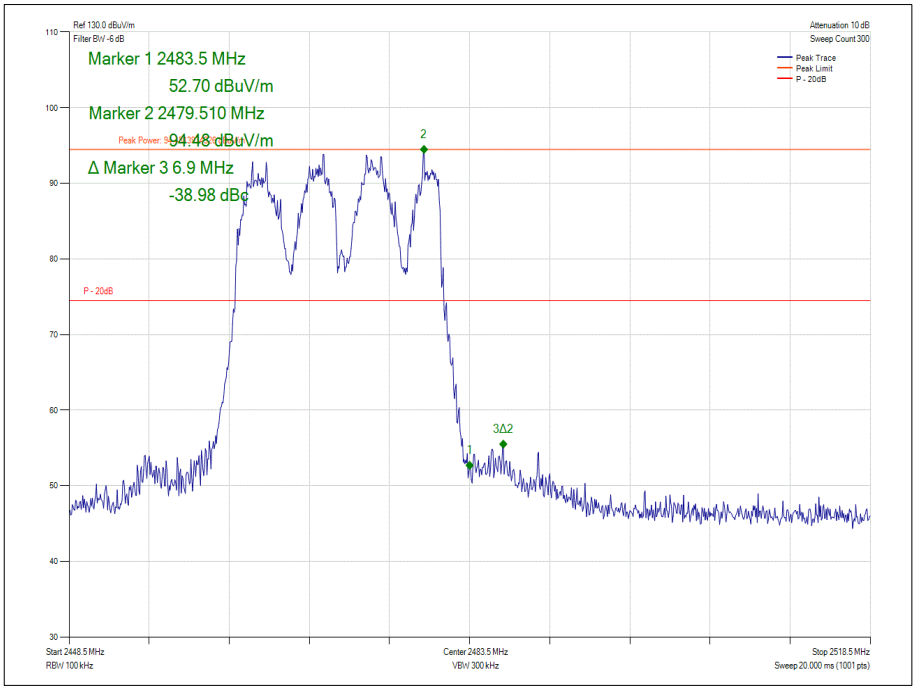


**Figure 95 - MCS with the Highest Power and Widest Bandwidth - MCS0 2472 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1+2 MIMO**

Bluetooth Low Energy

| Modulation/Packet Type | Frequency (MHz) | Band Edge Frequency (MHz) | Level (dBc) |
|---|---|---|---|
| GFSK/DH1 | 2402 | 2400.0 | -56.36 |
| GFSK/DH1 | 2480 | 2483.5 | -56.96 |

**Table 36 - Authorised Band Edge Results**

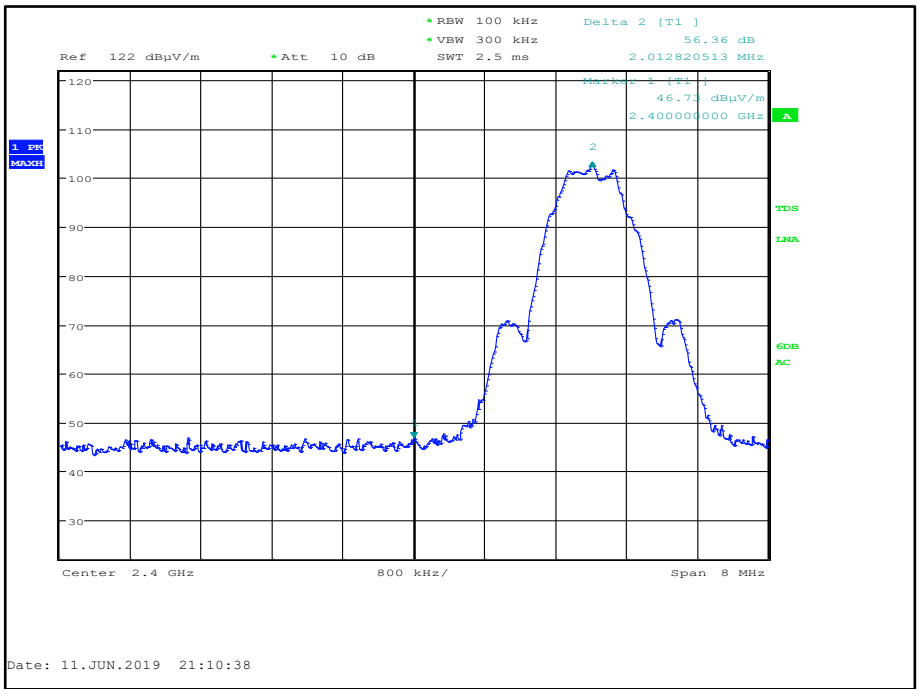


**Figure 96- GFSK/DH1- 2402 MHz - Band Edge Frequency 2400 MHz**

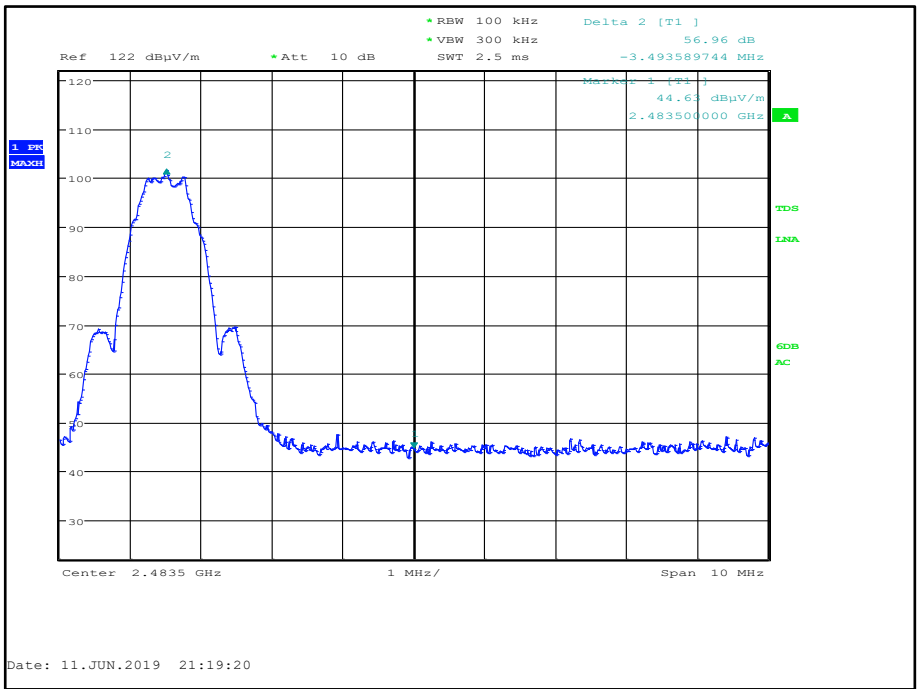


**Figure 97 - GFSK/DH1 – 2480 MHz - Band Edge Frequency 2483.5 MHz**

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.

ISEDC 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.

### 2.5.7 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 |
|---|---|---|---|---|---|
| Screened Room (5) | Rainford | Rainford | 1545 | 36 | 23-Jan-2021 |
| Turntable Controller | Inn-Co GmbH | CO 1000 | 1606 | - | TU |
| Hygromer | Rotronic | A1 | 2677 | 12 | 20-Feb-2020 |
| EMI Test Receiver | Rohde & Schwarz | ESU40 | 3506 | 12 | 17-Dec-2019 |
| Mast Controller | Maturo Gmbh | NCD | 4810 | - | TU |
| Tilt Antenna Mast | Maturo Gmbh | TAM 4.0-P | 4811 | - | TU |
| Double Ridge Broadband Horn Antenna | Schwarzbeck | BBHA 9120 B | 4848 | 12 | 11-Mar-2020 |
| 8m N-Type RF Cable | Teledyne | PR90-088-8MTR | 5093 | 12 | 04-Oct-2019 |
| Cable (18 GHz) | Rosenberger | LU7-071-2000 | 5109 | 12 | 05-Oct-2019 |
| EmX Software | TUV SUD | EmX | 5125 | - | Software |

**Table 37**

TU - Traceability Unscheduled

## 2.6 Restricted Band Edges

### 2.6.1 Specification Reference

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

### 2.6.2 Equipment Under Test and Modification State

Minuet 2 Module (FS5352), S/N: RAD113219 - Modification State 0

### 2.6.3 Date of Test

11-June-2019 to 03-July-2019

### 2.6.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.10.5.

Plots for average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.3. These are shown for information purposes and were used to determine the worst-case measurement point. Final average measurements were then taken in accordance with ANSI C63.10 clause 4.1.4.2.2. to obtain the measurement result recorded in the test results tables.

The following conversion can be applied to convert from dBµV/m to µV/m:
10^(Field Strength in dBµV/m/20).

### 2.6.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 20.4 - 22.4 °C |
| Relative Humidity | 56.8 - 59.9 % |

### 2.6.6 Test Results

2.4 GHz WLAN - 802.11b

| Mode | Data Rate | Frequency (MHz) | Band Edge Frequency (MHz) | Peak Level (dBµV/m) | Average Level (dBµV/m) |
|---|---|---|---|---|---|
| Data Rate with the Highest Power (15 dBm) and Widest Bandwidth | 2 Mbps | 2412 | 2390 | 61.05 | 48.75 |
| Data Rate with the Highest Power (15 dBm) and Widest Bandwidth | 2 Mbps | 2462 | 2483.5 | 60.67 | 48.65 |
| Data Rate with the Highest Power (15 dBm) and Widest Bandwidth | 2 Mbps | 2467 | 2483.5 | 60.22 | 50.89 |
| Data Rate with the Highest Power (13 dBm) and Widest Bandwidth | 2 Mbps | 2472 | 2483.5 | 61.76 | 50.50 |

**Table 38 - Restricted Band Edge Results – Antenna Port 1**

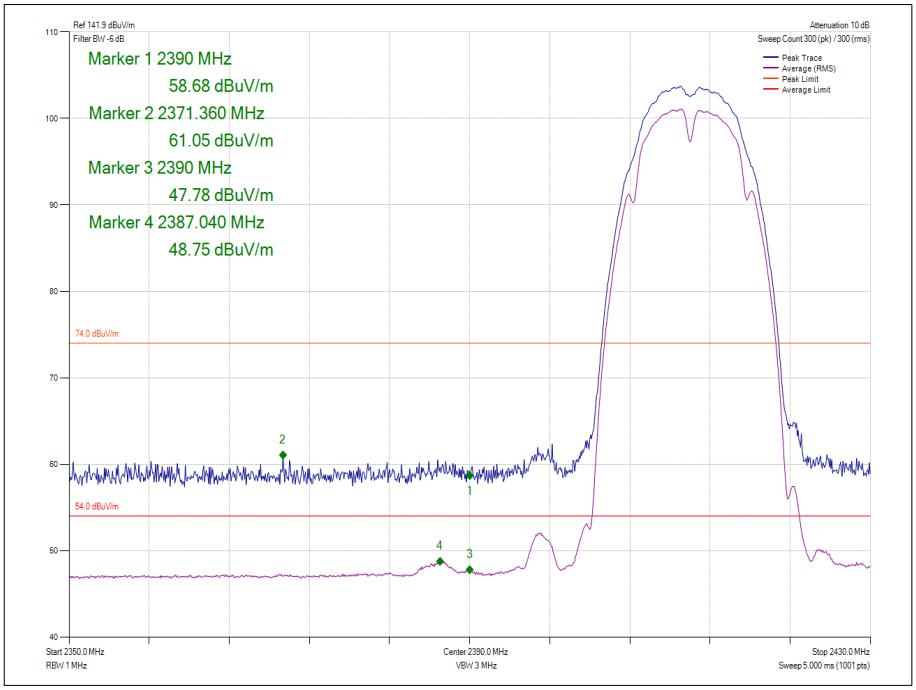


**Figure 98 - Data Rate with the Highest Power and Widest Bandwidth - 2 Mbps 2412 MHz - Band Edge Frequency 2390 MHz – Antenna Port 1**

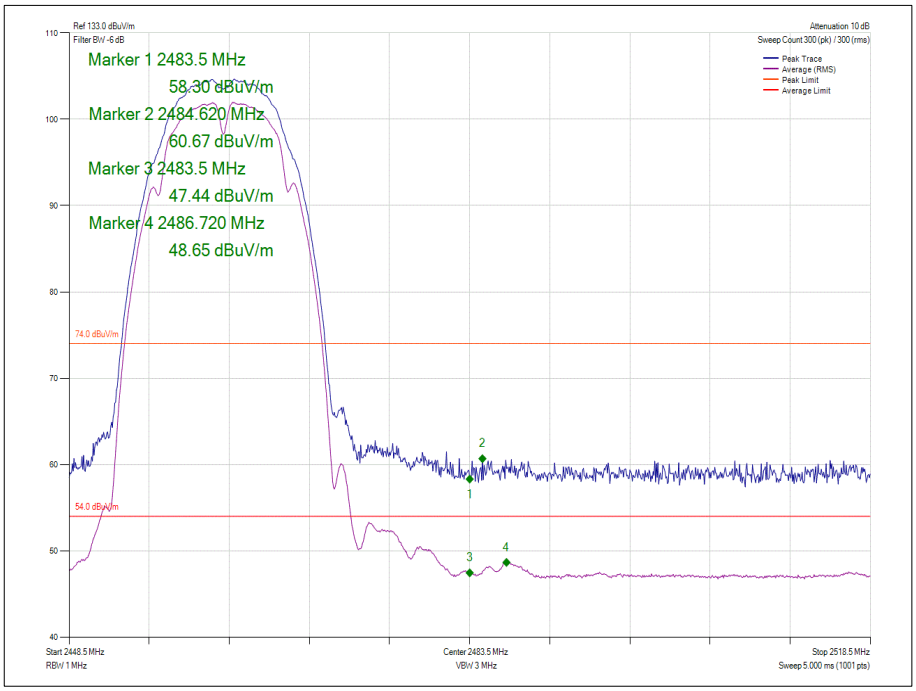


**Figure 99 - Data Rate with the Highest Power and Widest Bandwidth - 2 Mbps 2462 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1**

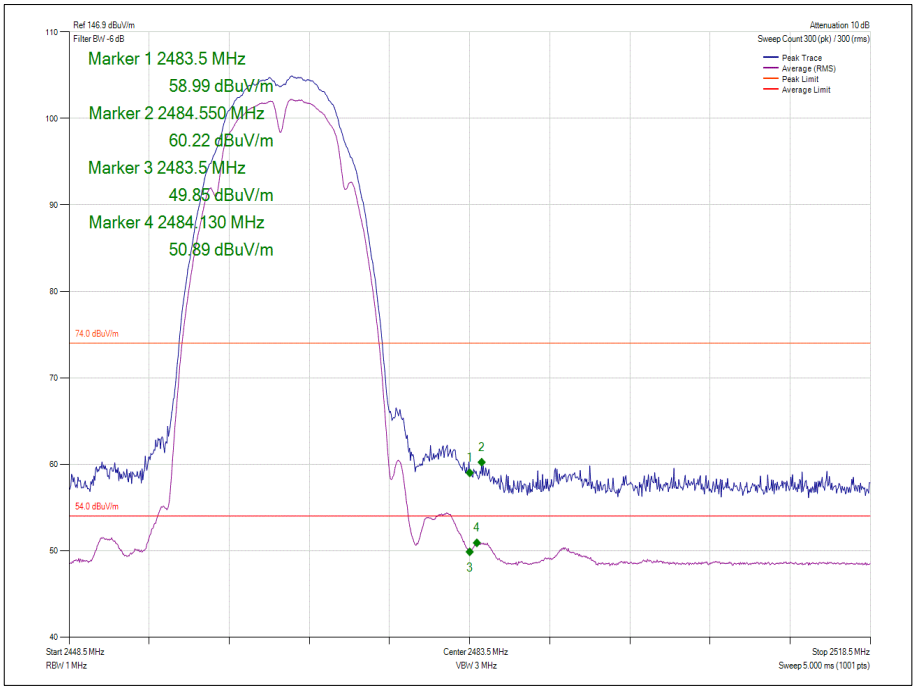


**Figure 100 - Data Rate with the Highest Power and Widest Bandwidth - 2 Mbps 2467 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1**

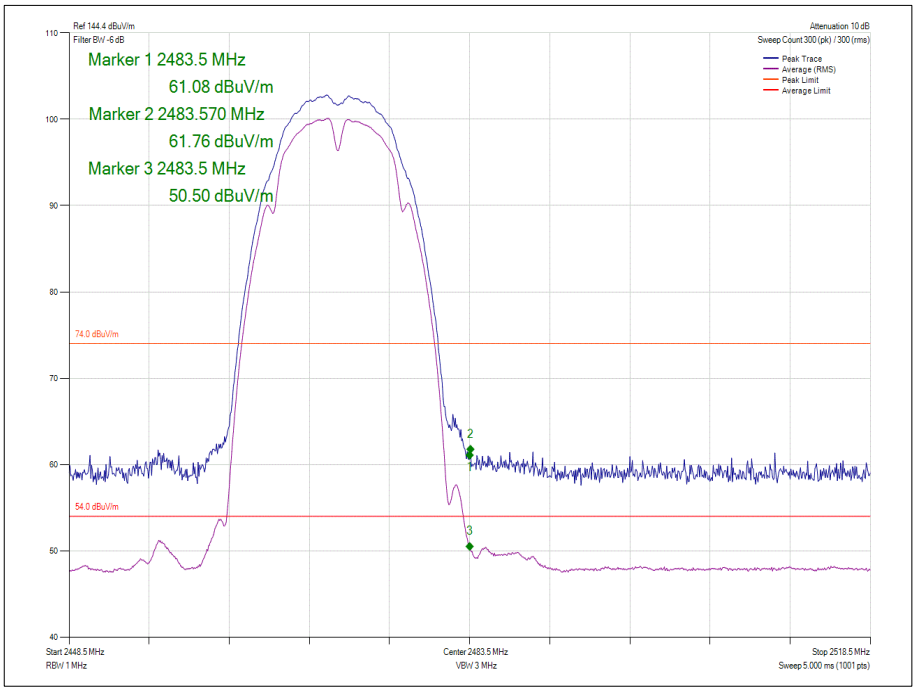


**Figure 101 - Data Rate with the Highest Power and Widest Bandwidth - 2 Mbps 2472 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1**

| Mode | Data Rate | Frequency (MHz) | Band Edge Frequency (MHz) | Peak Level (dBµV/m) | Average Level (dBµV/m) |
|---|---|---|---|---|---|
| Data Rate with the Highest Power (15 dBm) | 1 Mbps | 2412 MHz | 2390 | 58.57 | 48.59 |
| Data Rate with the Highest Power (15 dBm) | 1 Mbps | 2462 MHz | 2483.5 | 59.08 | 49.83 |
| Data Rate with the Highest Power (15 dBm) | 1 Mbps | 2467 MHz | 2483.5 | 59.91 | 49.82 |
| Data Rate with the Highest Power (13 dBm) | 1 Mbps | 2472 MHz | 2483.5 | 59.75 | 50.28 |

**Table 39 - Restricted Band Edge Results – Antenna Port 2**

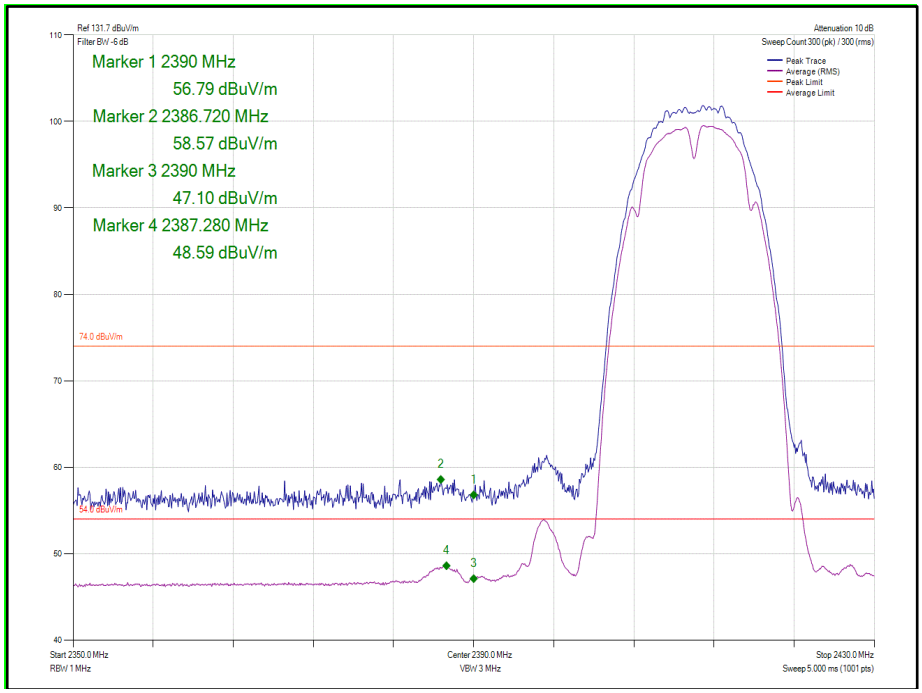


**Figure 102 - Data Rate with the Highest Power - 1 Mbps**
**2412 MHz - Band Edge Frequency 2390 MHz – Antenna Port 2**

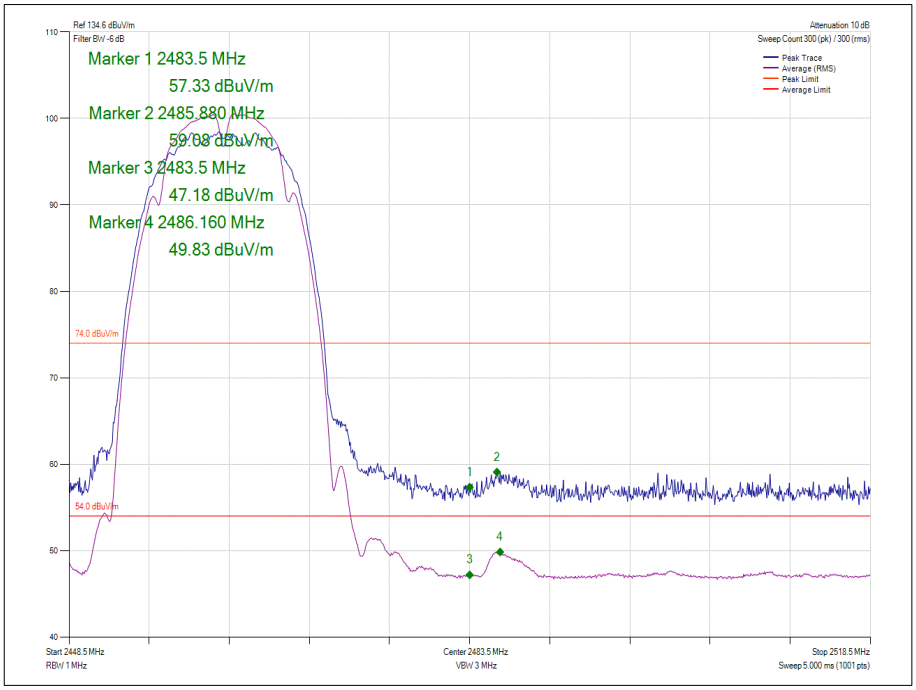


**Figure 103 - Data Rate with the Highest Power - 1 Mbps**
**2462 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

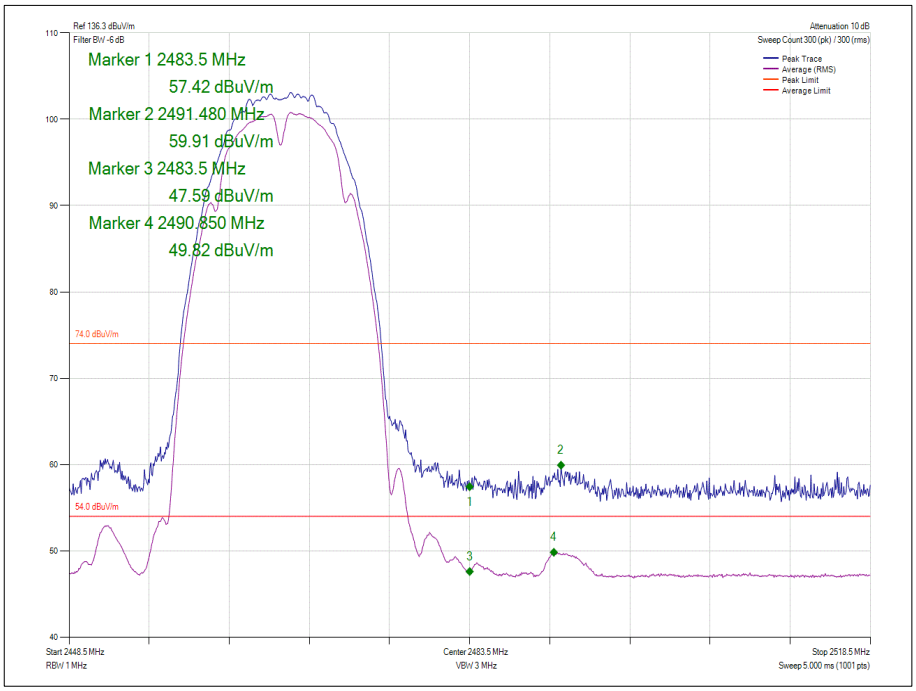


**Figure 104 - Data Rate with the Highest Power - 1 Mbps**
**2467 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

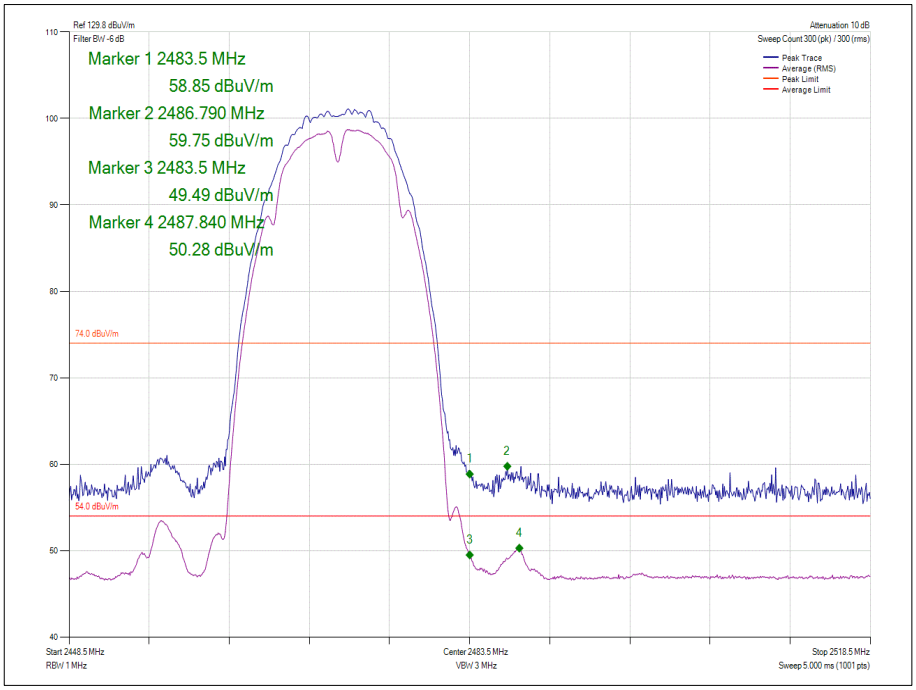


**Figure 105 - Data Rate with the Highest Power - 1 Mbps**
**2472 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

2.4 GHz WLAN - 802.11g

| Mode | Data Rate | Frequency (MHz) | Band Edge Frequency (MHz) | Peak Level (dBµV/m) | Average Level (dBµV/m) |
|---|---|---|---|---|---|
| Data Rate with the Highest Power (13 dBm) | 54 Mbps | 2412 | 2390 | 66.79 | 48.61 |
| Data Rate with the Highest Power (13 dBm) | 54 Mbps | 2462 | 2483.5 | 69.72 | 50.75 |
| Data Rate with the Highest Power (11 dBm) | 54 Mbps | 2467 | 2483.5 | 72.44 | 51.50 |
| Data Rate with the Highest Power (7 dBm) | 54 Mbps | 2472 | 2483.5 | 73.04 | 50.61 |
| Data Rate with the Widest Bandwidth | 9 Mbps | 2412 | 2390 | 63.63 | 47.92 |
| Data Rate with the Widest Bandwidth | 9 Mbps | 2462 | 2483.5 | 65.83 | 49.42 |
| Data Rate with the Widest Bandwidth | 9 Mbps | 2467 | 2483.5 | 67.47 | 50.22 |
| Data Rate with the Widest Bandwidth | 9 Mbps | 2472 | 2483.5 | 65.45 | 50.12 |

**Table 40 - Restricted Band Edge Results – Antenna Port 1**

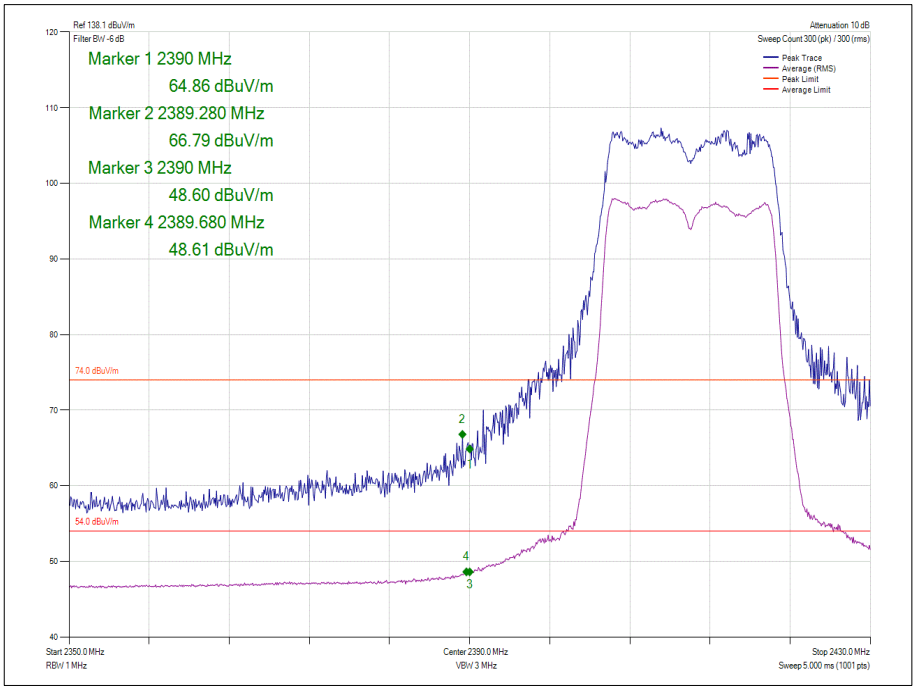


**Figure 106 - Data Rate with the Highest Power - 54 Mbps 2412 MHz - Band Edge Frequency 2390 MHz – Antenna Port 1**

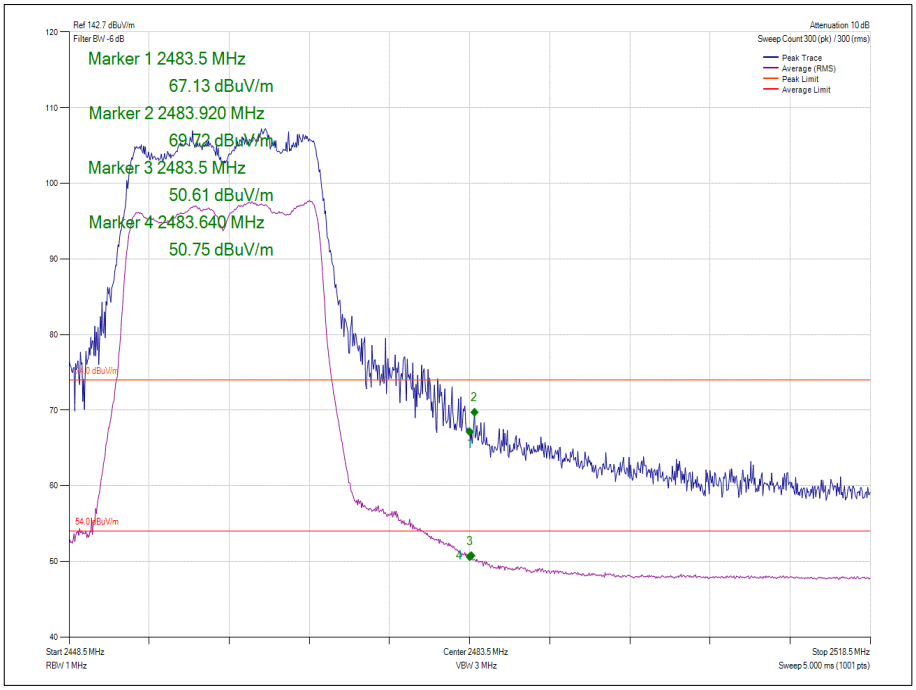


**Figure 107 - Data Rate with the Highest Power - 54 Mbps**
**2462 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1**

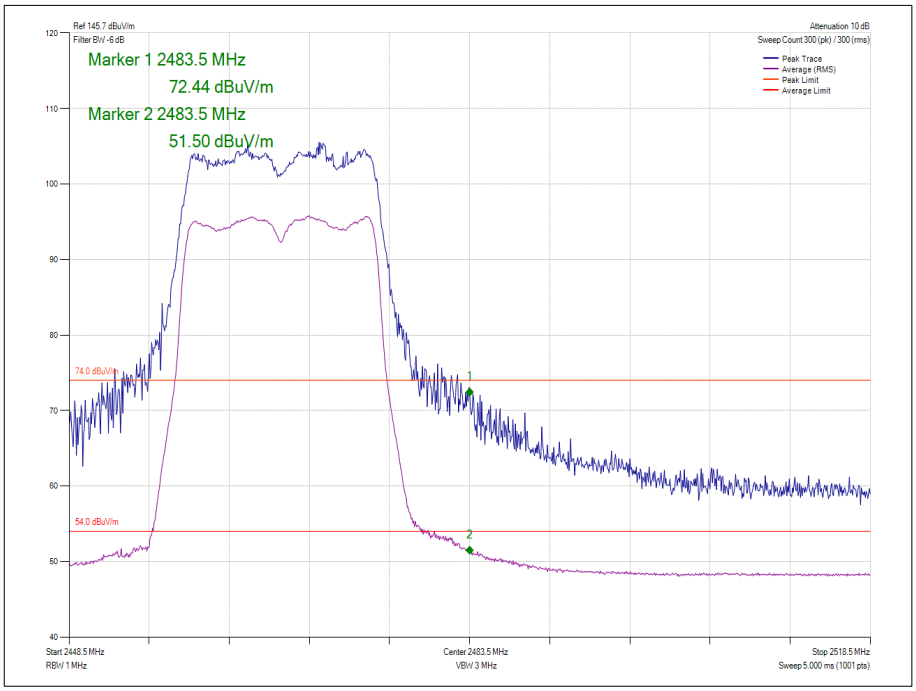


**Figure 108 - Data Rate with the Highest Power - 54 Mbps**
**2467 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1**

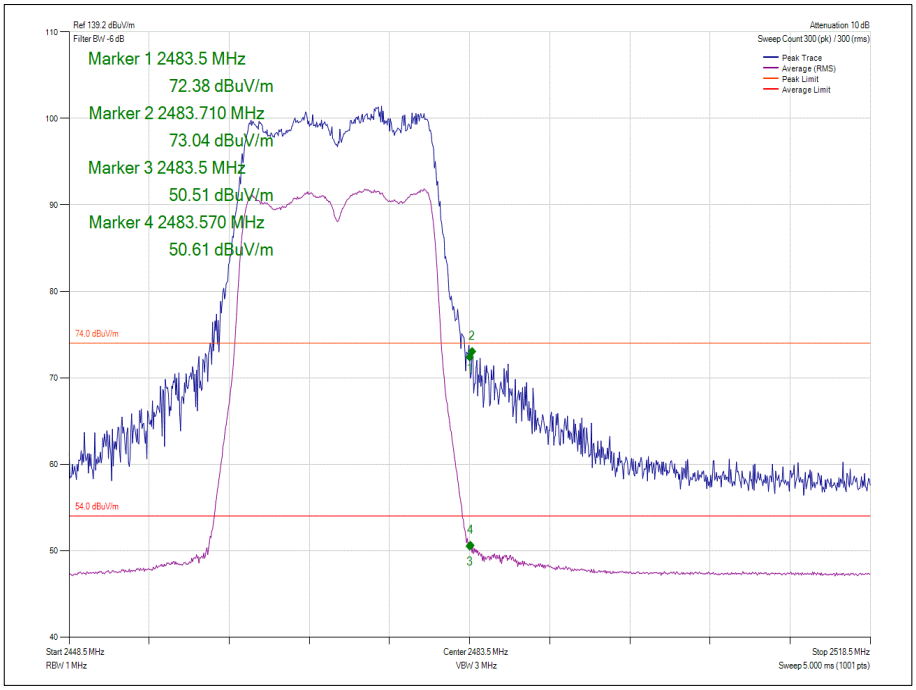


**Figure 109 - Data Rate with the Highest Power - 54 Mbps**
**2472 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1**

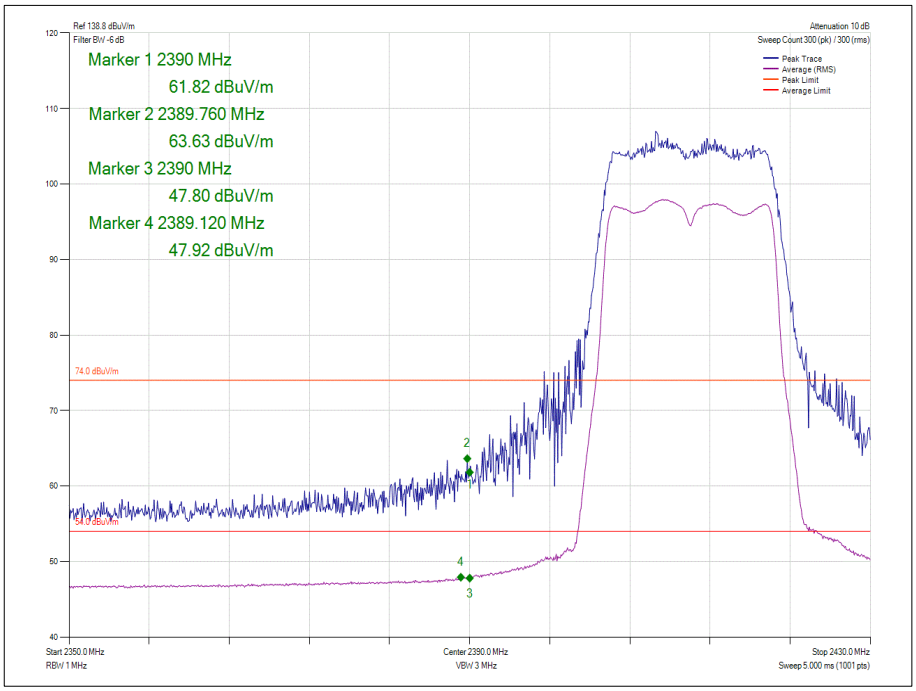


**Figure 110 - Data Rate with the Widest Bandwidth - 9 Mbps**
**2412 MHz - Band Edge Frequency 2390 MHz – Antenna Port 1**

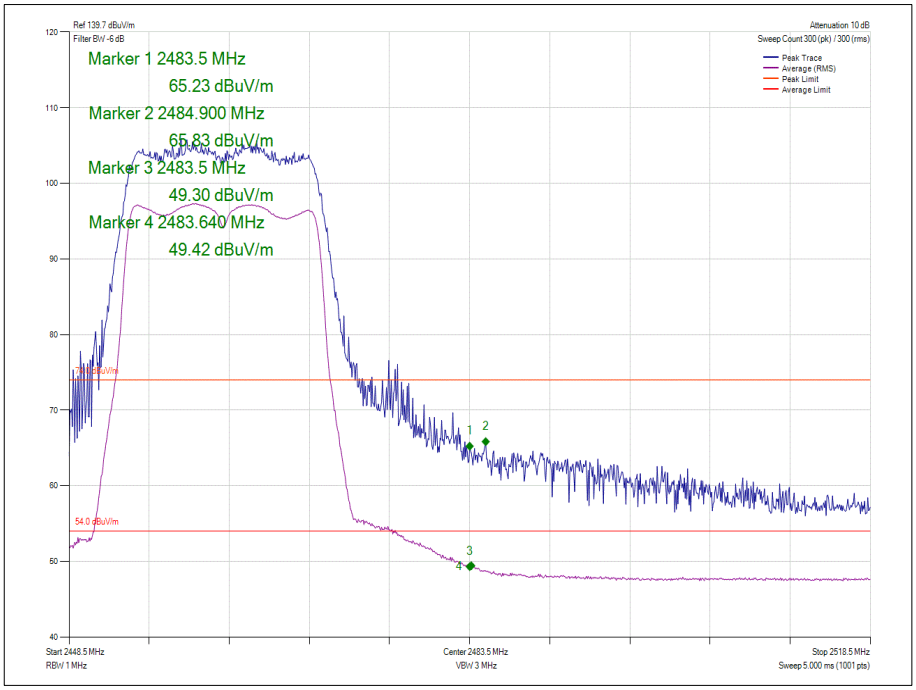


**Figure 111 - Data Rate with the Widest Bandwidth - 9 Mbps**
**2462 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1**

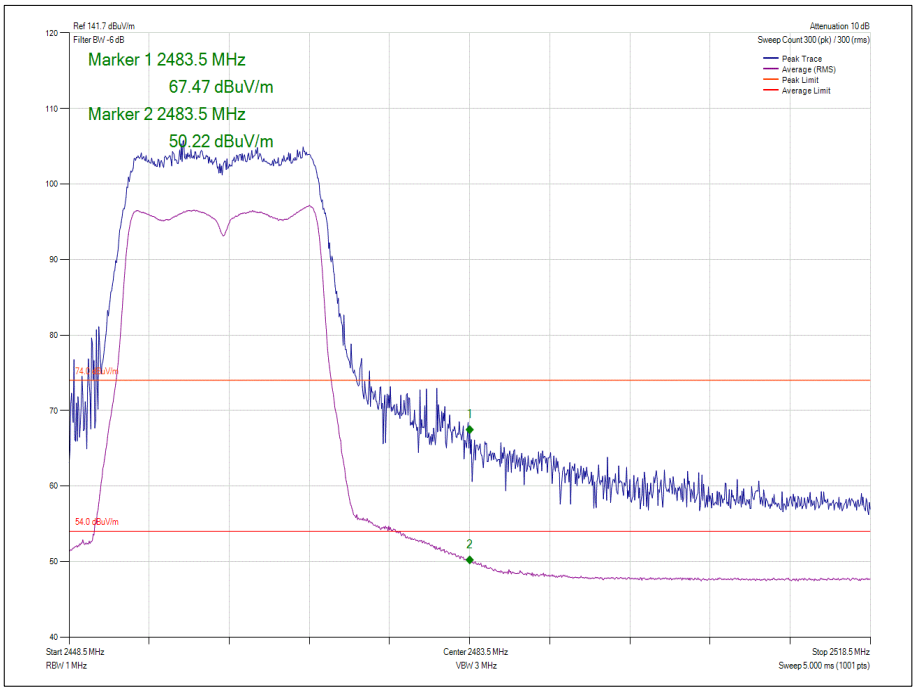


**Figure 112 - Data Rate with the Widest Bandwidth - 9 Mbps**
**2467 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1**

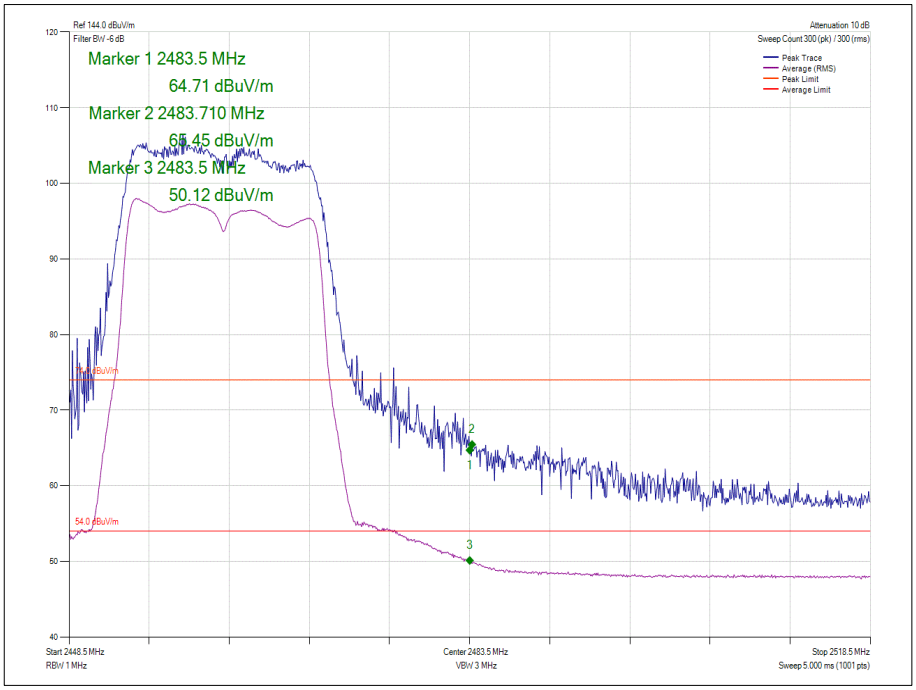


**Figure 113 - Data Rate with the Widest Bandwidth - 9 Mbps**
**2472 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 1**

| Mode | Data Rate | Frequency (MHz) | Band Edge Frequency (MHz) | Peak Level (dBµV/m) | Average Level (dBµV/m) |
|---|---|---|---|---|---|
| Data Rate with the Highest Power (13 dBm) | 36 Mbps | 2412 | 2390 | 63.38 | 48.41 |
| Data Rate with the Highest Power (13 dBm) | 36 Mbps | 2462 | 2483.5 | 68.27 | 50.55 |
| Data Rate with the Highest Power (12 dBm) | 36 Mbps | 2467 | 2483.5 | 70.07 | 51.05 |
| Data Rate with the Highest Power (9 dBm) | 36 Mbps | 2472 | 2483.5 | 71.62 | 51.44 |
| Data Rate with the Widest Bandwidth | 9 Mbps | 2412 | 2390 | 64.75 | 48.29 |
| Data Rate with the Widest Bandwidth | 9 Mbps | 2462 | 2483.5 | 63.48 | 48.94 |
| Data Rate with the Widest Bandwidth | 9 Mbps | 2467 | 2483.5 | 68.29 | 49.80 |
| Data Rate with the Widest Bandwidth | 9 Mbps | 2472 | 2483.5 | 72.74 | 52.12 |

**Table 41 - Restricted Band Edge Results – Antenna Port 2**

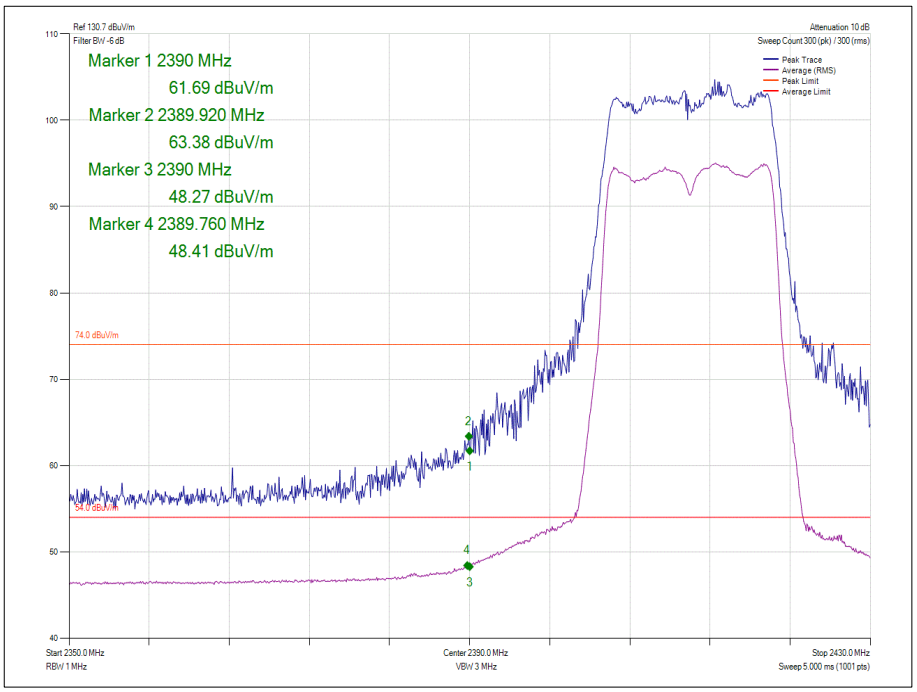


**Figure 114 - Data Rate with the Highest Power - 36 Mbps 2412 MHz - Band Edge Frequency 2390 MHz – Antenna Port 2**

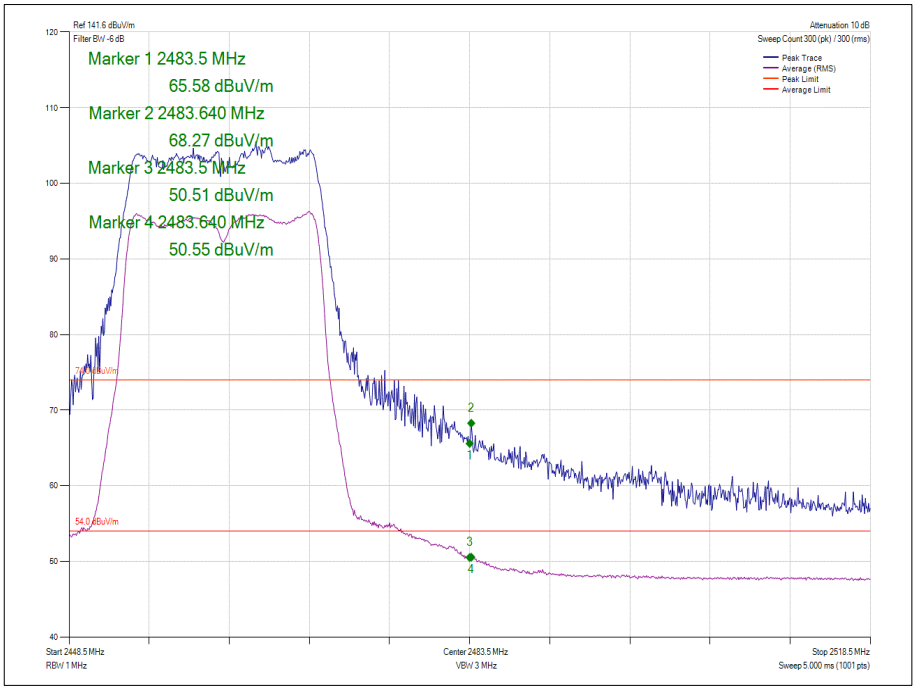


**Figure 115 - Data Rate with the Highest Power - 36 Mbps**
**2462 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

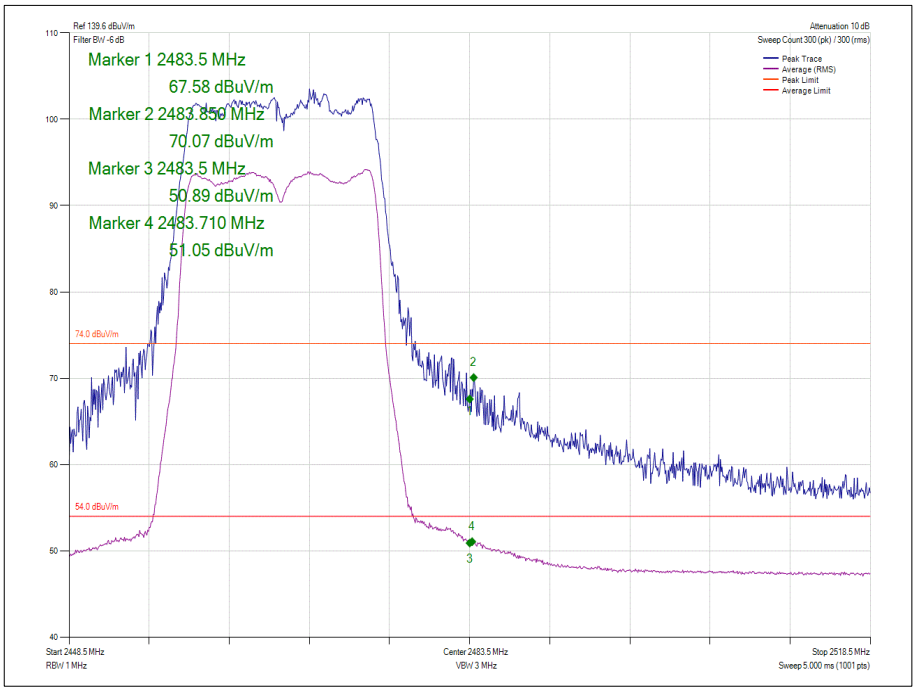


**Figure 116 - Data Rate with the Highest Power - 36 Mbps**
**2467 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

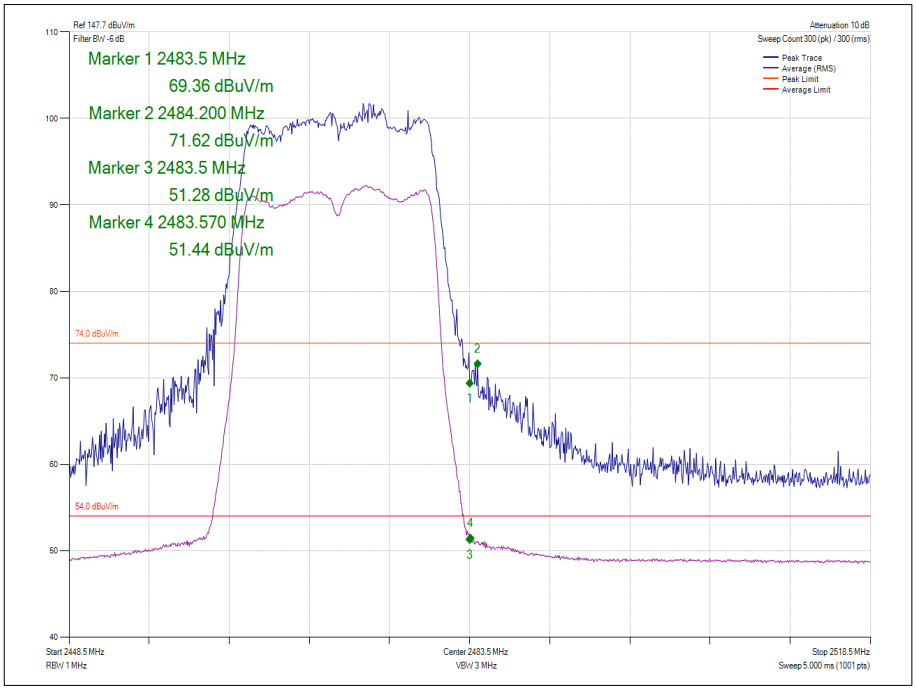


**Figure 117 - Data Rate with the Highest Power - 36 Mbps**
**2472 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

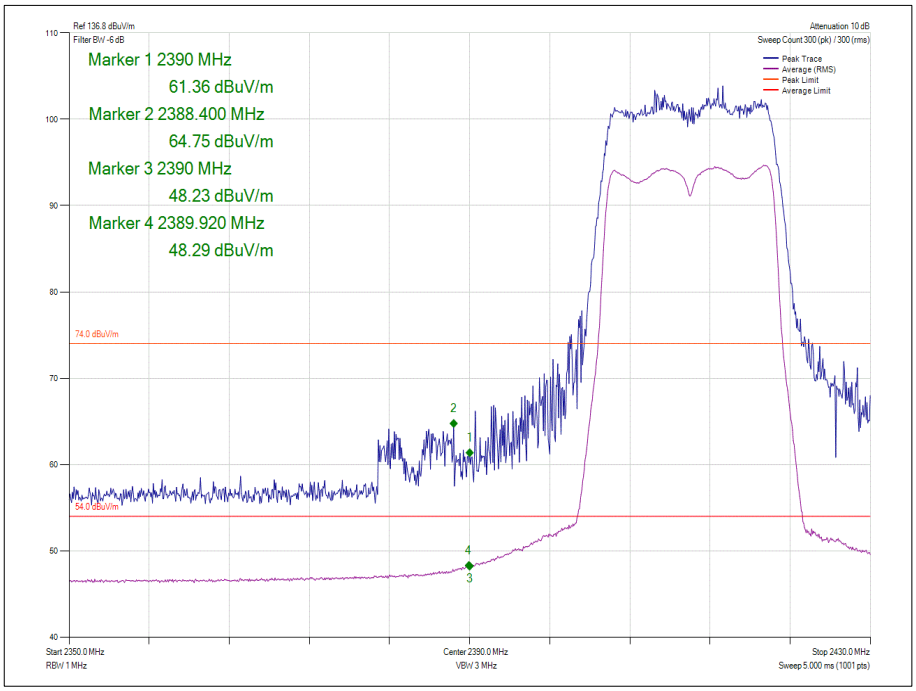


**Figure 118 - Data Rate with the Widest Bandwidth - 9 Mbps**
**2412 MHz - Band Edge Frequency 2390 MHz – Antenna Port 2**

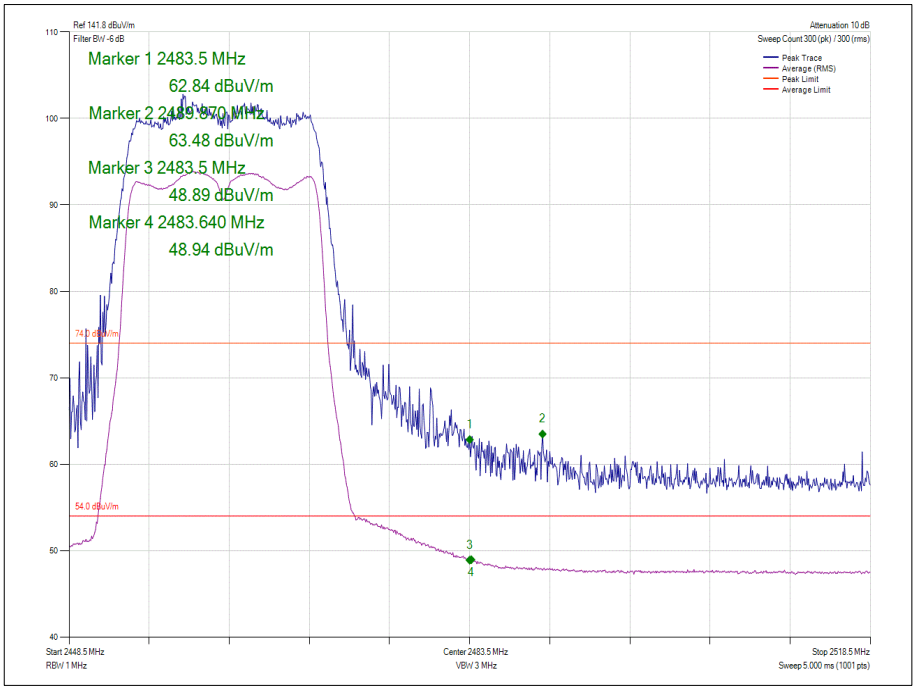


**Figure 119 - Data Rate with the Widest Bandwidth - 9 Mbps**
**2462 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**

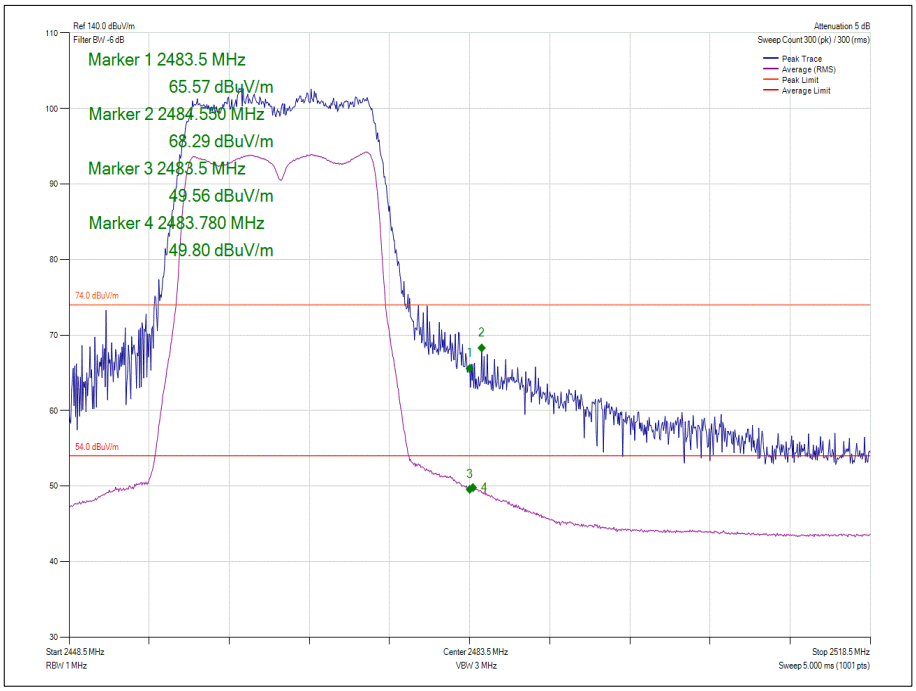


**Figure 120 - Data Rate with the Widest Bandwidth - 9 Mbps**
**2467 MHz - Band Edge Frequency 2483.5 MHz – Antenna Port 2**