



ISRAEL TESTING LABORATORIES  
Global Certifications You Can Trust



**DATE: 27 January 2020**

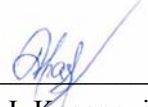
**I.T.L. (PRODUCT TESTING) LTD.**  
**FCC Radio Test Report**  
**For**

**Corning Optical Communication Wireless**  
**Equipment under test:**

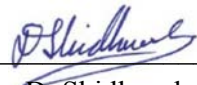
**Building Wireless System (BWS) v1.0**

**Low Power Radio (LPR)**  
**(WCS Section 2350-2360MHz Band)**

Tested by:

  
I. Kaganovich

Approved by:

  
D. Shidlowsky

This report must not be reproduced, except in full, without the written  
permission of I.T.L. (Product Testing) Ltd.

This report relates only to items tested.



ISRAEL TESTING LABORATORIES  
Global Certifications You Can Trust



# **Measurement/Technical Report for**

## **Corning Optical Communication Wireless**

### **Building Wireless System (BWS) v1.0**

**FCC ID: OJF1LFR**

This report concerns:

Original Grant: X

Class II change:

Class I change:

Equipment type:

B21 – Part 20 Industrial Booster (CMRS)

Limits used:

47CFR Parts 2, 27

Measurement procedure used is KDB 935210 D05 v01r03 April 2019 and  
ANSI IEEE C63.26-2015

Substitution Method used as in ANSI TIA-603-E-2016

Application for Certification  
prepared by:

R. Pinchuck  
ITL (Product Testing) Ltd.  
1 Bat Sheva St.  
Lod 7120101  
Israel  
e-mail [rpinchuck@itl.co.il](mailto:rpinchuck@itl.co.il)

Applicant for this device:  
(different from "prepared by")

Isaac Nissan  
Corning Optical Communication Wireless  
8253 1<sup>st</sup> Street  
Vienna, VA 22812  
U.S.A.  
Tel: +1-703 855-1773  
E-mail: [NissanI@corning.com](mailto:NissanI@corning.com)



## TABLE OF CONTENTS

|           |                                                                |           |
|-----------|----------------------------------------------------------------|-----------|
| <b>1.</b> | <b>GENERAL INFORMATION</b>                                     | <b>5</b>  |
| 1.1       | Administrative Information                                     | 5         |
| 1.2       | List of Accreditations                                         | 6         |
| 1.3       | Product Description                                            | 7         |
| 1.4       | Test Methodology                                               | 7         |
| 1.5       | Test Facility                                                  | 7         |
| 1.6       | Measurement Uncertainty                                        | 7         |
| <b>2.</b> | <b>SYSTEM TEST CONFIGURATION</b>                               | <b>8</b>  |
| 2.1       | Justification                                                  | 8         |
| 2.2       | EUT Exercise Software                                          | 8         |
| 2.3       | Special Accessories                                            | 8         |
| 2.4       | Equipment Modifications                                        | 8         |
| 2.5       | Configuration of Tested System                                 | 10        |
| <b>3.</b> | <b>TEST SET-UP PHOTOS</b>                                      | <b>12</b> |
| <b>4.</b> | <b>PEAK OUTPUT POWER &amp; BOOSTER GAIN</b>                    | <b>15</b> |
| 4.1       | Test Specification                                             | 15        |
| 4.2       | Test Procedure                                                 | 15        |
| 4.3       | Test Limit                                                     | 15        |
| 4.4       | Test Results                                                   | 15        |
| 4.5       | Test Equipment Used; Peak Output Power                         | 22        |
| <b>5.</b> | <b>AVERAGE POWER SPECTRAL DENSITY</b>                          | <b>23</b> |
| 5.1       | Test Specification                                             | 23        |
| 5.2       | Test Procedure                                                 | 23        |
| 5.3       | Test Limit                                                     | 23        |
| 5.4       | Test Results                                                   | 23        |
| 5.5       | Test Equipment Used; Average Power Spectral Density            | 31        |
| <b>6.</b> | <b>PEAK TO AVERAGE POWER RATIO</b>                             | <b>32</b> |
| 6.1       | Test Specification                                             | 32        |
| 6.2       | Test Procedure                                                 | 32        |
| 6.3       | Test Limit                                                     | 32        |
| 6.4       | Test Results                                                   | 32        |
| 6.5       | Test Equipment Used; 0.1% PAPR                                 | 36        |
| <b>7.</b> | <b>OCCUPIED BANDWIDTH</b>                                      | <b>37</b> |
| 7.1       | Test Specification                                             | 37        |
| 7.2       | Test Procedure                                                 | 37        |
| 7.3       | Test Limit                                                     | 37        |
| 7.4       | Test Results                                                   | 37        |
| 7.5       | Test Equipment Used; Occupied Bandwidth                        | 41        |
| <b>8.</b> | <b>SPURIOUS EMISSIONS AT ANTENNA TERMINALS</b>                 | <b>42</b> |
| 8.1       | Test Specification                                             | 42        |
| 8.2       | Test Procedure                                                 | 42        |
| 8.3       | Test Limit                                                     | 42        |
| 8.4       | Test Results                                                   | 42        |
| 8.5       | Test Equipment Used; Out of Band Emission at Antenna Terminals | 55        |
| <b>9.</b> | <b>BAND EDGE SPECTRUM</b>                                      | <b>56</b> |
| 9.1       | Test Specification                                             | 56        |
| 9.2       | Test Procedure                                                 | 56        |
| 9.3       | Test Limit                                                     | 56        |
| 9.4       | Test Results                                                   | 56        |
| 9.5       | Test Equipment Used; Band Edge Spectrum                        | 60        |



|            |                                                                                       |           |
|------------|---------------------------------------------------------------------------------------|-----------|
| <b>10.</b> | <b>SPURIOUS EMISSIONS (RADIATED)</b>                                                  | <b>61</b> |
| 10.1       | Test Specification .....                                                              | 61        |
| 10.2       | Test Procedure .....                                                                  | 61        |
| 10.3       | Test Limit.....                                                                       | 62        |
| 10.4       | Test Results .....                                                                    | 62        |
| 10.5       | Test Instrumentation Used, Radiated Measurements .....                                | 63        |
| <b>11.</b> | <b>OUT-OF-BAND REJECTION (WCS)</b>                                                    | <b>64</b> |
| 11.1       | Test Specification .....                                                              | 64        |
| 11.2       | Test Procedure .....                                                                  | 64        |
| 11.3       | Test Limit.....                                                                       | 64        |
| 11.4       | Test Results .....                                                                    | 64        |
| 11.5       | Test Equipment Used; Out-of-Band Rejection .....                                      | 65        |
| <b>12.</b> | <b>APPENDIX A - CORRECTION FACTORS</b>                                                | <b>66</b> |
| 12.1       | Correction factors for RF OATS Cable 35m.....                                         | 66        |
| 12.2       | Correction Factors for RF Cable for Anechoic Chamber.....                             | 67        |
| 12.3       | Correction Factors for Active Loop Antenna .....                                      | 68        |
| 12.4       | Correction Factors for Biconical Antenna .....                                        | 69        |
| 12.5       | Correction Factors for Log Periodic Antenna .....                                     | 70        |
| 12.6       | Correction Factors for Double – Ridged Waveguide Horn ANTENNA<br>3 meter range; ..... | 71        |
| 12.7       | Correction Factors for Horn Antenna Model .....                                       | 72        |



# 1. General Information

## 1.1 Administrative Information

|                                |                                                                                   |
|--------------------------------|-----------------------------------------------------------------------------------|
| Manufacturer:                  | Corning Optical Communication<br>Wireless                                         |
| Manufacturer's Address:        | 8253 1 <sup>st</sup> Street<br>Vienna, VA 22182<br>U.S.A.<br>Tel: +1-703-855-1773 |
| Manufacturer's Representative: | Isaac Nissan                                                                      |
| Equipment Under Test (E.U.T):  | Building Wireless System (BWS)<br>v1.0                                            |
| Equipment Model No.:           | Low Power Radio (LPR)                                                             |
| Equipment Serial No.:          | 704A055003                                                                        |
| Date of Receipt of E.U.T:      | October 3, 2019                                                                   |
| Start of Test:                 | October 3, 2019                                                                   |
| End of Test:                   | December 24, 2019                                                                 |
| Test Laboratory Location:      | I.T.L (Product Testing) Ltd.<br>1 Batsheva St,<br>Lod,<br>Israel 7116002          |
| Test Specifications:           | FCC Parts 2, 27                                                                   |



## **1.2 List of Accreditations**

The EMC laboratory of I.T.L. is accredited by/registered with the following bodies:

1. The American Association for Laboratory Accreditation (A2LA) (U.S.A.), Certificate No. 1152.01.
2. The Federal Communications Commission (FCC) (U.S.A.), FCC Designation Number IL1005.
3. The Israel Ministry of the Environment (Israel), Registration No. 1104/01.
4. Department of Innovation, Science and Economic Development (ISED) Canada, CAB identifier: IL1002

I.T.L. Product Testing Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this test report have been determined in accordance with I.T.L.'s terms of accreditation unless stated otherwise in the report.

### 1.3 **Product Description**

Corning's BWS™ platform 1.0 is the first fully-digital, end-to-end in-building cellular solution, for medium size venues.

Corning's Low Power Radio (LPR) units are the end-point antennas connected by optical cable to the BWS system Digital Router Unit (DRU) (distribution/routing of RF samples via CPRI stream), and to the system Power Supply Unit (PSU) for power.

LPR is the first release of Corning's fully-digital radio remote unit, providing plug-and-play, cost-effective processing, minimizing power loss and noise.

### 1.4 **Test Methodology**

Both conducted and radiated testing were performed according to the procedures in KDB 935210 D05 v01r03 April 2019 and ANSI/TIA-603-E-2016. Radiated testing was performed at an antenna to EUT distance of 3 meters.

### 1.5 **Test Facility**

Both conducted and radiated emissions tests were performed at I.T.L.'s testing facility in Lod, Israel. I.T.L.'s EMC Laboratory is accredited by A2LA, certificate No. 1152.01 and its FCC Designation Number is IL1005.

### 1.6 **Measurement Uncertainty**

#### **Conducted Emission**

Conducted Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4)  
0.15 – 30 MHz:

Expanded Uncertainty (95% Confidence, K=2):  
± 3.44 dB

#### **Radiated Emission**

Radiated Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4) for open site:

30-1000MHz:

Expanded Uncertainty (95% Confidence, K=2):  
± 4.96 dB

1 GHz to 6 GHz

Expanded Uncertainty (95% Confidence, K=2):  
±5.19 dB

>6 GHz

Expanded Uncertainty (95% Confidence, K=2):  
±5.51 dB

## 2. System Test Configuration

### 2.1 Justification

- 2.1.1 The test setup was configured to closely resemble the standard installation.
- 2.1.2 The EUT consists of the LPR (Low-Power Remote Module) which is connected with the head-end ICRAN equipment (BBU and DRU) using fiber optic cable.
- 2.1.3 The RF source signals are represented in the setup by BBU unit.
- 2.1.4 An “Exercise” SW on the computer was used to enable/disable transmission of the EUT, while the EUT output was connected to the spectrum analyzer.
- 2.1.5 The system was tested under maximum gain conditions.
- 2.1.6 Only peak power testing was done on the both ports, all other testing was performed 1 port (see customer declaration on following page regarding the identical ports).
- 2.1.7 Testing was performed on the following configuration:

| Frequency Range (MHz) |               |            |
|-----------------------|---------------|------------|
| Service/Band          | Downlink (DL) | Technology |
| WCS                   | 2350-2360     | LTE        |

### 2.2 EUT Exercise Software

vHCM SW ver. 1.0 used for commands delivery. These commands are used to enable/disable the EUT transmission.

EUT Embedded SW versions are:

DRU ver dru\_d719\_10\_25

LPR ver LPR\_D803\_01.63

### 2.3 Special Accessories

No special accessories were needed in order to achieve compliance.

### 2.4 Equipment Modifications

No modifications were needed in order to achieve compliance.



# CORNING

## Declaration

Date: December 25, 2019

RE: Corning Optical Communication Wireless

P/N: LPR-3C-2A2P2W-10

FCC ID: OJF1LPR

I hereby declare that the MIMO stream 1 and MIMO stream 2 of the LPR-3C-2A2P2W-10 have the identical RF chain including antenna gain of 2dBi.

Authorized Signature:

Printed Name:

Isaac Nissan

## 2.5 Configuration of Tested System

|                                                                  |                                     |
|------------------------------------------------------------------|-------------------------------------|
| Product Name                                                     | Building Wireless System (BWS) v1.0 |
| Model Name                                                       | Low Power Radio (LPR)               |
| Working voltage                                                  | 100-240VAC/ 48VDC                   |
| Mode of operation                                                | Industrial Booster for WCS band     |
| Modulations                                                      | 64QAM, 16QAM, QPSK                  |
| Assigned Frequency Range                                         | 2345.0MHz-2360.0MHz                 |
| Operating Frequency Range                                        | 2350.0MHz -2360.0MHz                |
| Transmit power                                                   | ~15.0 dBm                           |
| Antenna Gain                                                     | 2dBi                                |
| DATA rate                                                        | N/A                                 |
| Modulation BW                                                    | 5MHz, 10.0MHz                       |
| DC Voltage and DC current applied to the final amplifying device | 36-60VDC, (nominal voltage 48V)/ 2A |

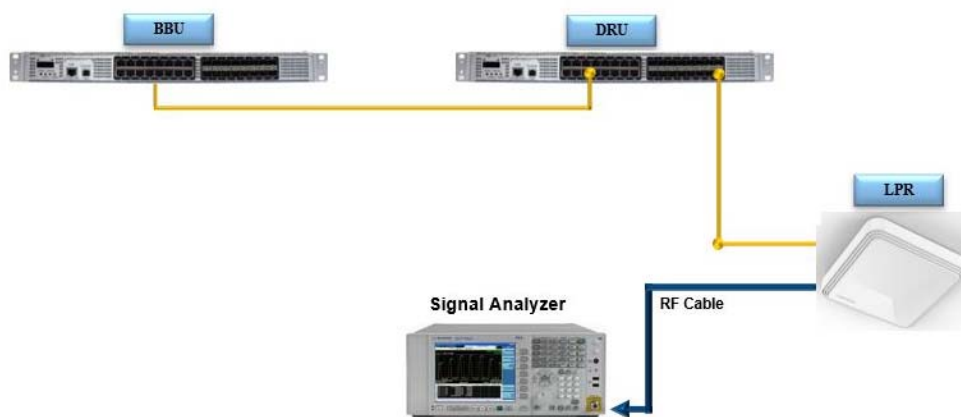
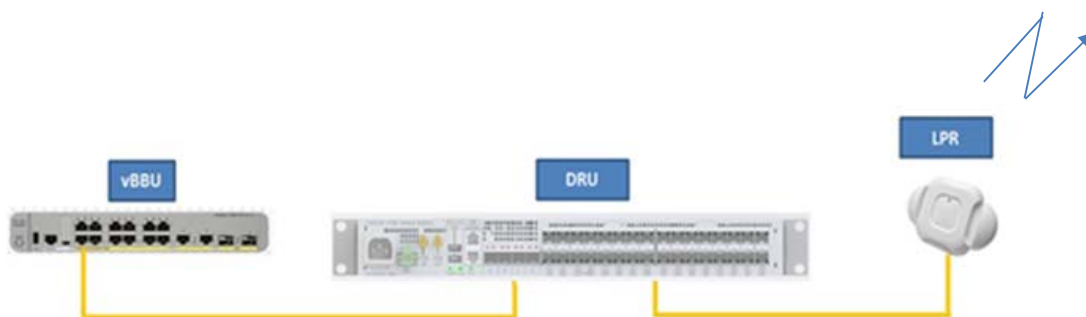


Figure 1. Test Set-Up – Conducted



**Figure 2. Test Set-Up - Radiated**

### 3. Test Set-Up Photos



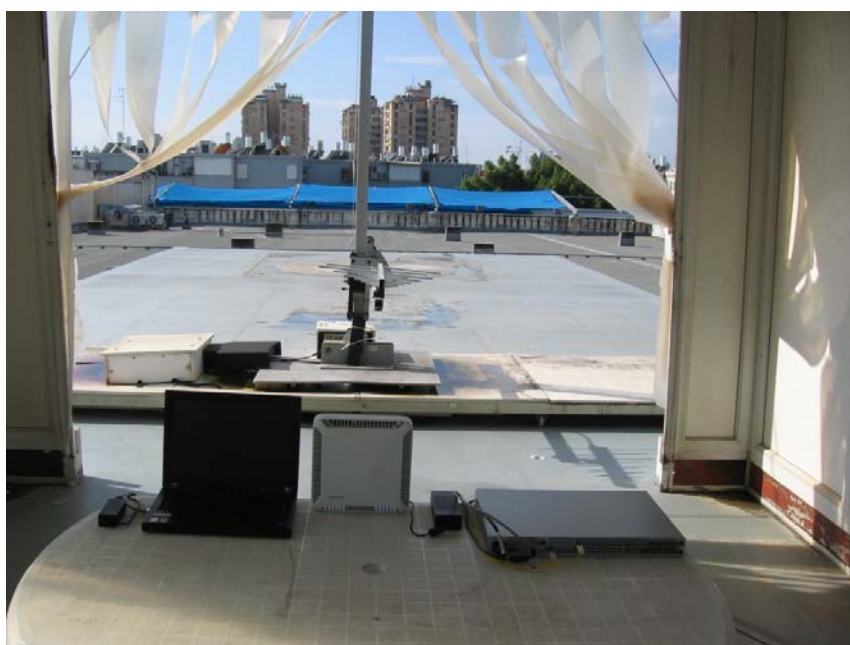
Figure 3. Conducted Test Set-Up



Figure 4. Radiated Emission Test, 0.009-30MHz



**Figure 5. Radiated Emission Test, 30-200MHz**



**Figure 6. Radiated Emission Test, 200-1000MHz**



**Figure 7. Radiated Emission Test, 1-18GHz**



**Figure 8. Radiated Emission Test, 18-26.5GHz**

## 4. Peak Output Power & Booster Gain

### 4.1 Test Specification

FCC Part 27, Subpart C, Section 27.50(a)(ii)

### 4.2 Test Procedure

(Temperature (22°C)/Humidity (40%RH))

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an appropriate coaxial cable. Special attention was taken to prevent Spectrum Analyzer RF input overload.

### 4.3 Test Limit

Peak Power Output must not exceed 2000 Watts (63dBm).

### 4.4 Test Results

| Modulation | Operation Frequency | Port1 Reading | Port1 Reading | Port2 Reading | Port2 Reading | EIRP* | Limit | Margin |
|------------|---------------------|---------------|---------------|---------------|---------------|-------|-------|--------|
|            | (MHz)               | (dBm)         | (Watts)       | (dBm)         | (Watts)       | (dBm) | (dBm) | (dB)   |
| QPSK       | 2352.5              | 16.9          | 0.049         | 16.9          | 0.049         | 21.91 | 63.0  | -41.09 |
|            | 2355.0              | 16.9          | 0.049         | 16.9          | 0.049         | 21.91 | 63.0  | -41.09 |
|            | 2357.5              | 17            | 0.050         | 17            | 0.050         | 22.01 | 63.0  | -40.99 |
| 16QAM      | 2352.5              | 16.8          | 0.048         | 16.9          | 0.049         | 21.86 | 63.0  | -41.14 |
|            | 2355.0              | 16.9          | 0.049         | 16.9          | 0.049         | 21.91 | 63.0  | -41.09 |
|            | 2357.5              | 17            | 0.050         | 17            | 0.050         | 22.01 | 63.0  | -40.99 |
| 64QAM      | 2352.5              | 17.3          | 0.054         | 16.9          | 0.049         | 22.11 | 63.0  | -40.89 |
|            | 2355.0              | 17.3          | 0.054         | 16.8          | 0.048         | 22.07 | 63.0  | -40.93 |
|            | 2357.5              | 17.5          | 0.056         | 17            | 0.050         | 22.27 | 63.0  | -40.73 |

Figure 9 Peak Output Power, 5MHz BW

| Modulation | Operation Frequency | Port1 Reading | Port1 Reading | Port2 Reading | Port2 Reading | EIRP* | Limit | Margin |
|------------|---------------------|---------------|---------------|---------------|---------------|-------|-------|--------|
|            | (MHz)               | (dBm)         | (Watts)       | (dBm)         | (Watts)       | (dBm) | (dBm) | (dB)   |
| QPSK       | 2355.0              | 16.9          | 0.049         | 16.9          | 0.049         | 21.91 | 63.0  | -41.09 |
| 16QAM      | 2355.0              | 16.9          | 0.049         | 16.9          | 0.049         | 21.91 |       | -41.09 |
| 64QAM      | 2355.0              | 17.3          | 0.054         | 16.9          | 0.049         | 22.11 |       | -40.89 |

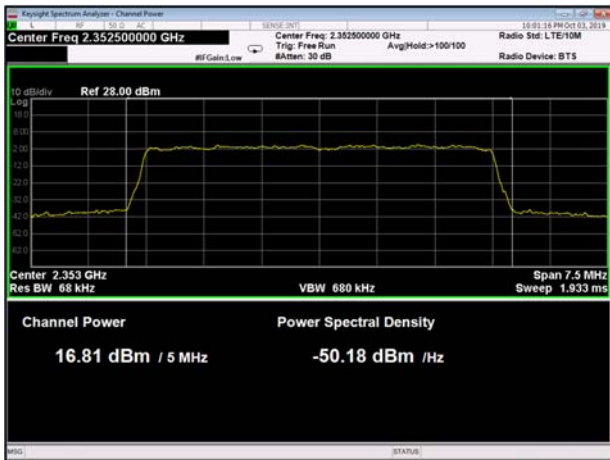
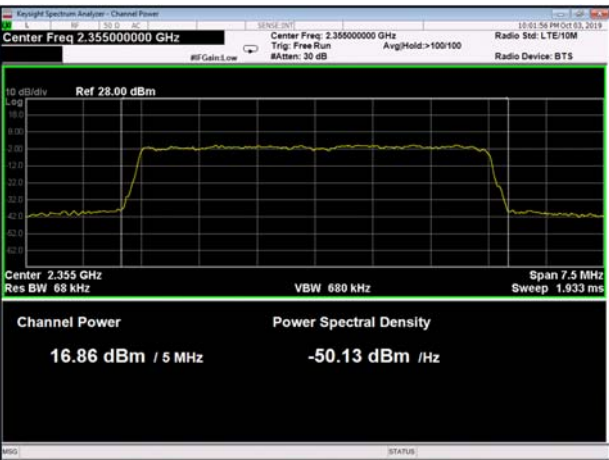
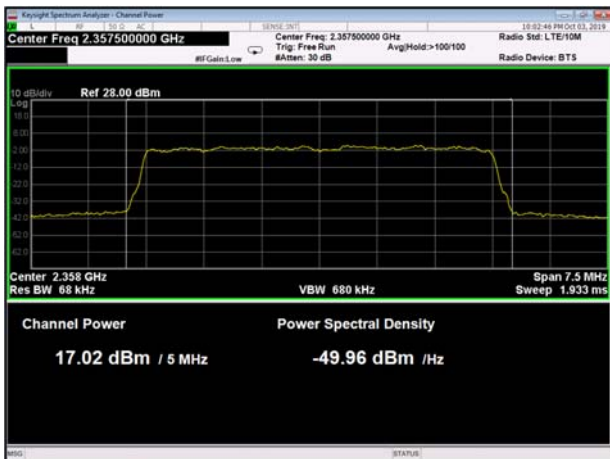
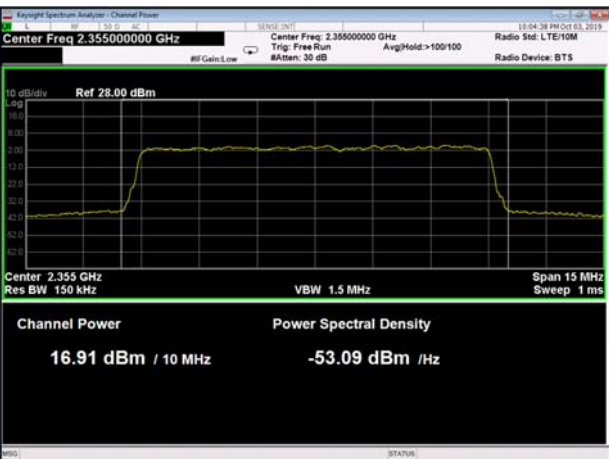
Figure 10 Peak Output Power, 10MHz BW

\*Note – EIRP was calculated by adding both Port readings in W, then converting to dBm and adding the antenna gain.

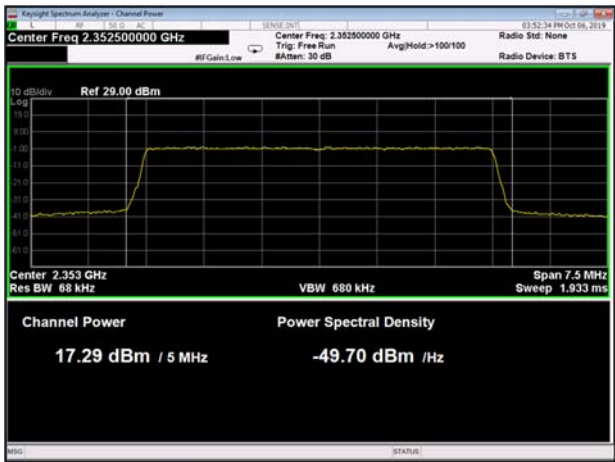
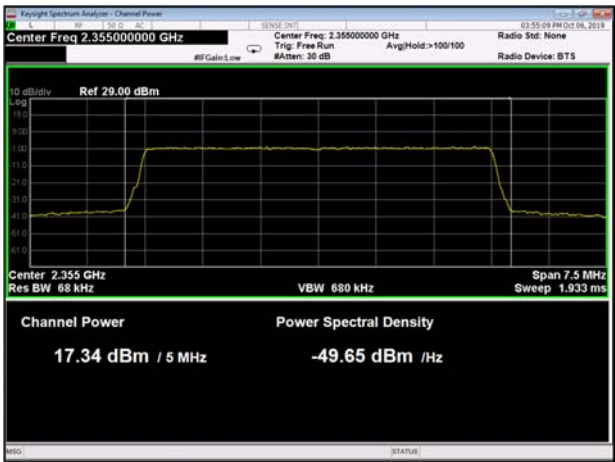
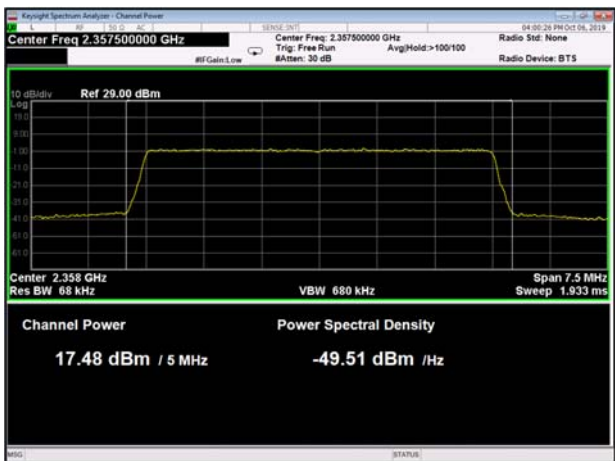
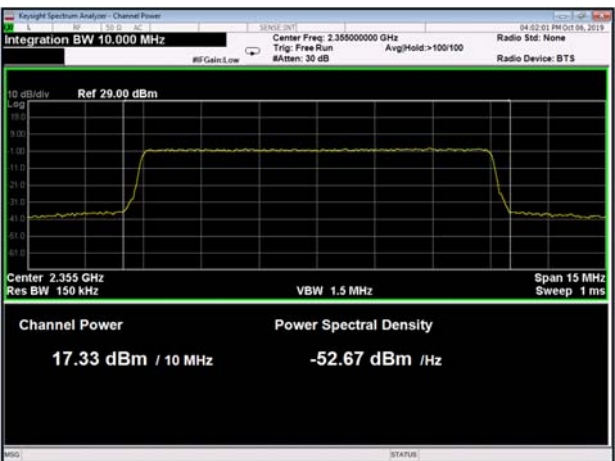
JUDGEMENT: Passed by 40.73 dB

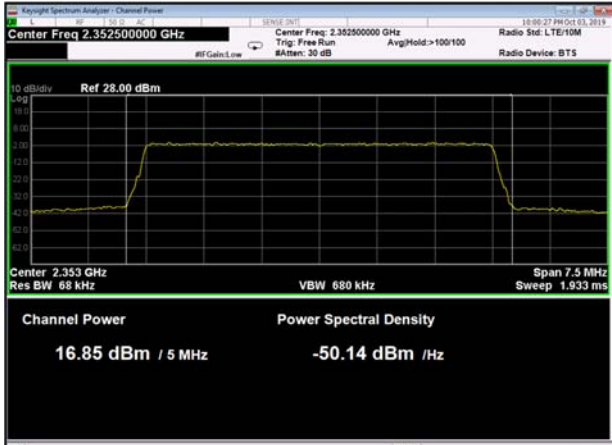
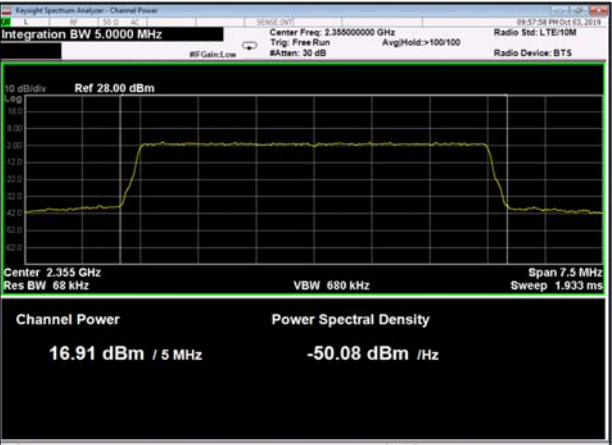
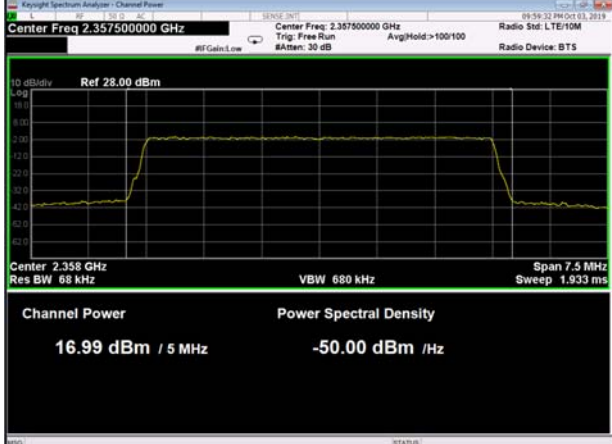
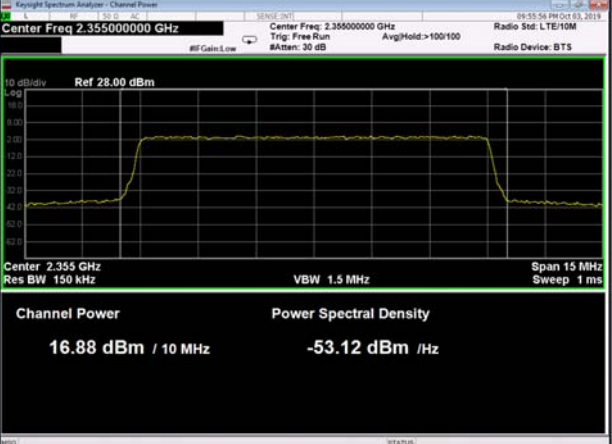
See additional information in Figure 11 to Figure 34.

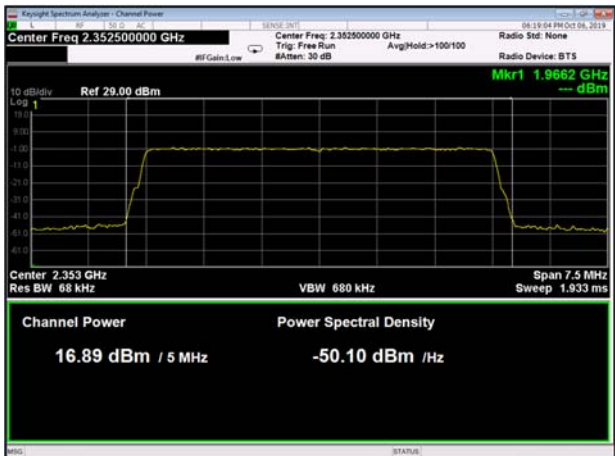
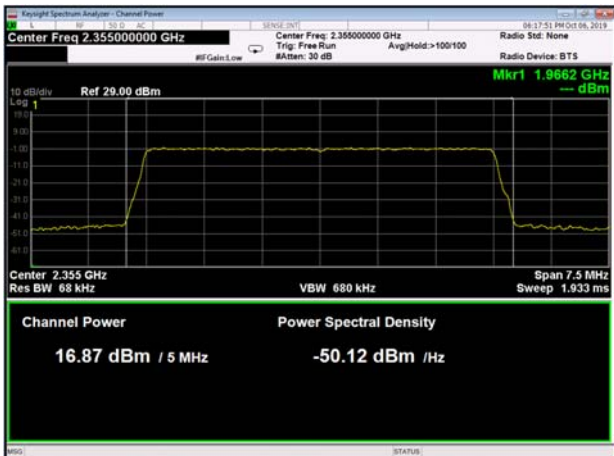
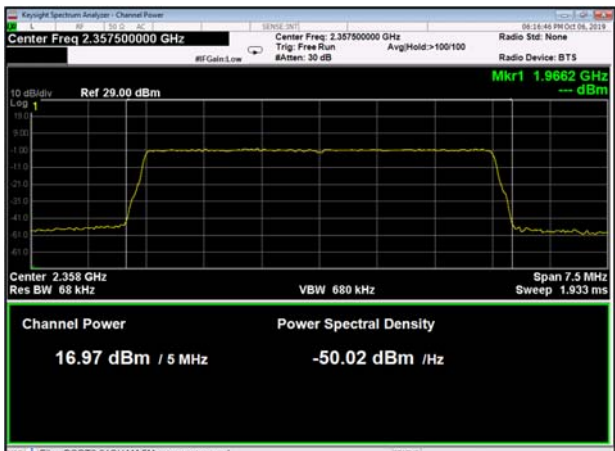
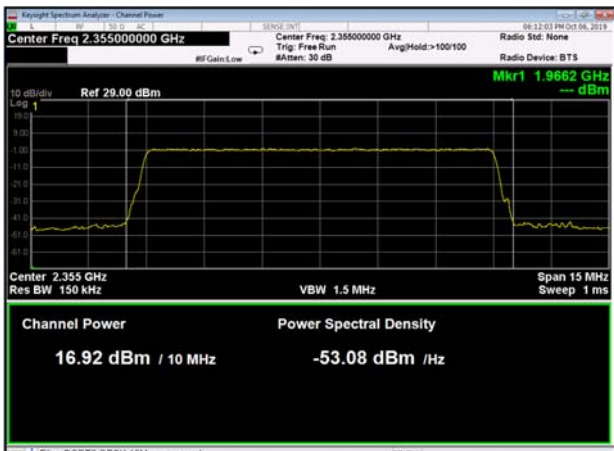


|                                                                                    |                                                                                     |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Antenna PORT                                                                       | 1                                                                                   |
| Modulation                                                                         | 16QAM                                                                               |
|   |   |
| Figure 11 5MHz BW, 2352.5MHz                                                       | Figure 12 5MHz BW, 2355MHz                                                          |
|  |  |
| Figure 13 5MHz BW, 2357.5MHz                                                       | Figure 14 10MHz BW, 2355MHz                                                         |



|                                                                                    |                                                                                     |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Antenna PORT                                                                       | 1                                                                                   |
| Modulation                                                                         | 64QAM                                                                               |
|   |   |
| Figure 15 5MHz BW, 2352.5MHz                                                       | Figure 16 5MHz BW, 2355MHz                                                          |
|  |  |
| Figure 17 5MHz BW, 2357.5MHz                                                       | Figure 18 10MHz BW, 2355MHZ                                                         |

|                                                                                                                        |                                                                                                                        |
|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| Antenna PORT                                                                                                           | 1                                                                                                                      |
| Modulation                                                                                                             | QPSK                                                                                                                   |
|  <p>Figure 19 5MHz BW, 2352.5MHz</p>  |  <p>Figure 20 5MHz BW, 2355MHz</p>   |
|  <p>Figure 21 5MHz BW, 2357.5MHz</p> |  <p>Figure 22 10MHz BW, 2355MHz</p> |

|                                                                                    |                                                                                     |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Antenna PORT                                                                       | 2                                                                                   |
| Modulation                                                                         | 16QAM                                                                               |
|   |   |
| Figure 23 5MHz BW, 2352.5MHz                                                       | Figure 24 5MHz BW, 2355MHz                                                          |
|  |  |
| Figure 25 5MHz BW, 2357.5MHz                                                       | Figure 26 10MHz BW, 2355MHz                                                         |



Antenna PORT

2

Modulation

64QAM

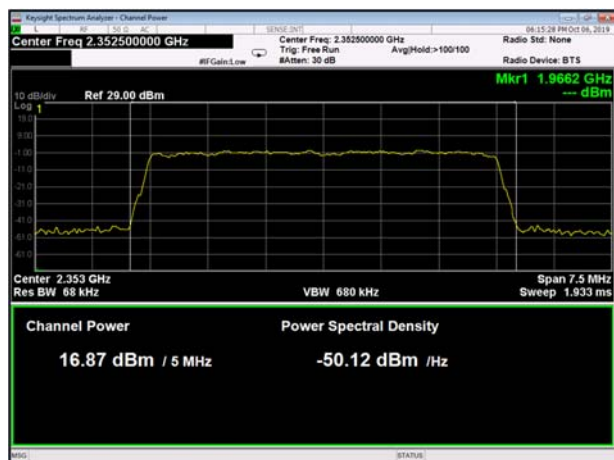


Figure 27 5MHz BW, 2352.5MHz

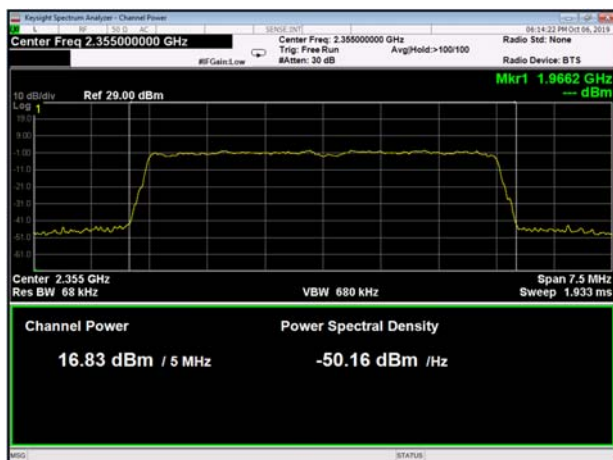


Figure 28 5MHz BW, 2355MHz

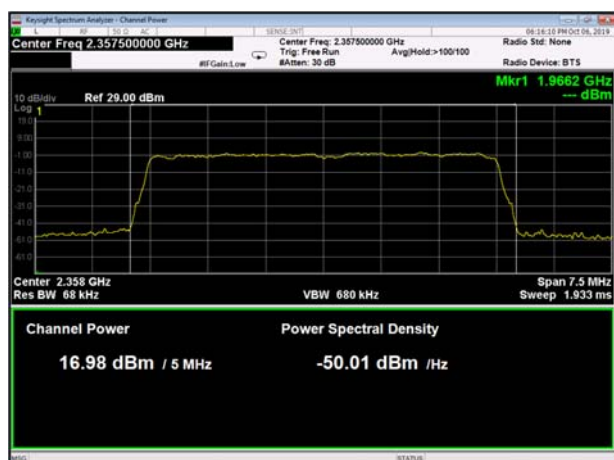


Figure 29 5MHz BW, 2357.5MHz

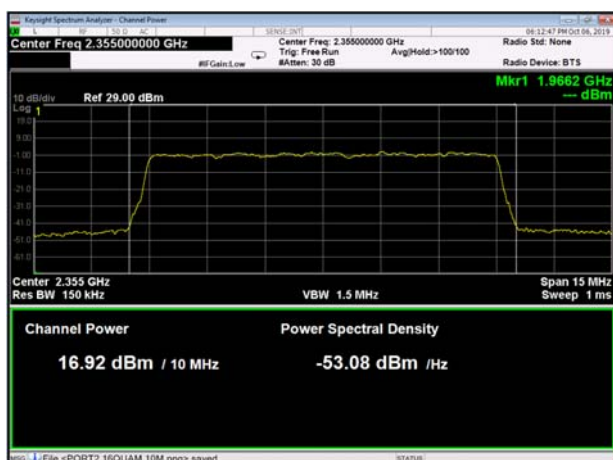
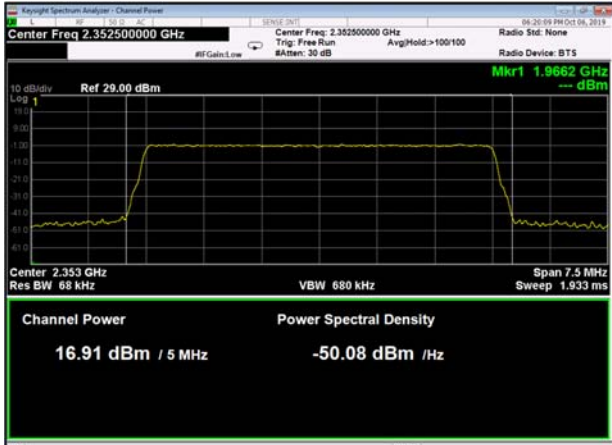
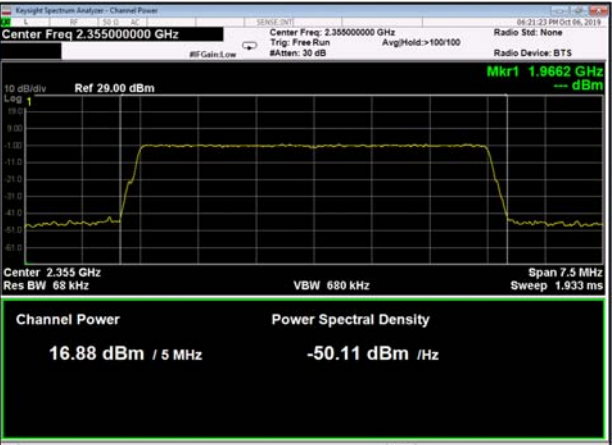
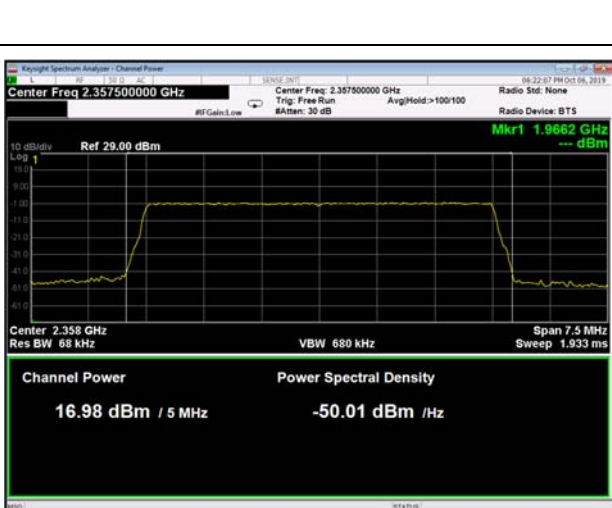
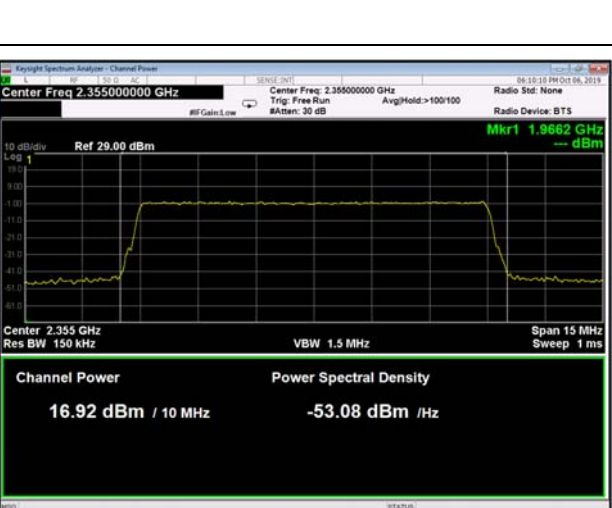


Figure 30 10MHz BW, 2355MHz

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Antenna PORT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Modulation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | QPSK                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|  <p>Center Freq 2.352500000 GHz<br/>Center Freq: 2.352500000 GHz<br/>Trig: Free Run<br/>#Att: 30 dB<br/>AvgHold: &gt;100/100<br/>Radio Std: None<br/>Radio Device: BTS</p> <p>10 dB/div Ref 29.00 dBm<br/>Mkr1 1.9662 GHz --- dBm</p> <p>Center 2.353 GHz<br/>Res BW 68 kHz<br/>VBW 680 kHz<br/>Span 7.5 MHz<br/>Sweep 1.933 ms</p> <p>Channel Power 16.91 dBm / 5 MHz<br/>Power Spectral Density -50.08 dBm / Hz</p>  |  <p>Center Freq 2.355000000 GHz<br/>Center Freq: 2.355000000 GHz<br/>Trig: Free Run<br/>#Att: 30 dB<br/>AvgHold: &gt;100/100<br/>Radio Std: None<br/>Radio Device: BTS</p> <p>10 dB/div Ref 29.00 dBm<br/>Mkr1 1.9662 GHz --- dBm</p> <p>Center 2.355 GHz<br/>Res BW 68 kHz<br/>VBW 680 kHz<br/>Span 7.5 MHz<br/>Sweep 1.933 ms</p> <p>Channel Power 16.88 dBm / 5 MHz<br/>Power Spectral Density -50.11 dBm / Hz</p> |
| Figure 31 5MHz BW, 2352.5MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Figure 32 5MHz BW, 2355MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|  <p>Center Freq 2.357500000 GHz<br/>Center Freq: 2.357500000 GHz<br/>Trig: Free Run<br/>#Att: 30 dB<br/>AvgHold: &gt;100/100<br/>Radio Std: None<br/>Radio Device: BTS</p> <p>10 dB/div Ref 29.00 dBm<br/>Mkr1 1.9662 GHz --- dBm</p> <p>Center 2.358 GHz<br/>Res BW 68 kHz<br/>VBW 680 kHz<br/>Span 7.5 MHz<br/>Sweep 1.933 ms</p> <p>Channel Power 16.98 dBm / 5 MHz<br/>Power Spectral Density -50.01 dBm / Hz</p> |  <p>Center Freq 2.355000000 GHz<br/>Center Freq: 2.355000000 GHz<br/>Trig: Free Run<br/>#Att: 30 dB<br/>AvgHold: &gt;100/100<br/>Radio Std: None<br/>Radio Device: BTS</p> <p>10 dB/div Ref 29.00 dBm<br/>Mkr1 1.9662 GHz --- dBm</p> <p>Center 2.355 GHz<br/>Res BW 150 kHz<br/>VBW 1.5 MHz<br/>Span 15 MHz<br/>Sweep 1 ms</p> <p>Channel Power 16.92 dBm / 10 MHz<br/>Power Spectral Density -53.08 dBm / Hz</p>   |
| Figure 33 5MHz BW, 2357.5MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Figure 34 10MHz BW, 2355MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |



#### 4.5 Test Equipment Used; Peak Output Power

| Instrument              | Manufacturer | Model    | Serial Number      | Calibration           |                       |
|-------------------------|--------------|----------|--------------------|-----------------------|-----------------------|
|                         |              |          |                    | Last Calibration Date | Next Calibration Date |
| Spectrum Analyzer       | Agilent      | N9010A   | MY52220686         | November 28, 2018     | November 28, 2020     |
| Vector Signal Generator | VIAVI        | MTS 5800 | WMNK00716<br>90263 | July 1, 2018          | July 1, 2021          |

Figure 35 Test Equipment Used

## 5. Average Power Spectral Density

### 5.1 Test Specification

FCC, Part 27, Subpart C, Section 27.50(a)(1)(A)

### 5.2 Test Procedure

(Temperature (22°C)/ Humidity (40%RH))

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (loss=31.7 dB). The E.U.T. RF output was modulated. Special attention was taken to prevent Spectrum Analyzer RF input overload. The Spectrum Analyzer was set to 1MHz RBW. The output power level was measured at each modulation.

In the next step RBW was set to 5MHz, power output level was measured at each modulation and compared to the limit.

### 5.3 Test Limit

Average PSD in any 1 MHz must not exceed 400 Watts (56dBm) and in any 5MHz, must not exceed 2000 Watts (63dBm).

### 5.4 Test Results

| Band | Modulation | Operation Frequency | Reading | Antenna Gain | EIRP  | Limit | Margin |
|------|------------|---------------------|---------|--------------|-------|-------|--------|
|      |            | (MHz)               | (dBm)   | (dBi)        | (dBm) | (dBm) | (dB)   |
| WCS  | QPSK       | 2352.5              | 11.1    | 2.0          | 13.1  | 56.0  | -42.9  |
|      |            | 2355.0              | 11.1    |              | 13.1  |       | -42.9  |
|      |            | 2357.5              | 11.5    |              | 13.5  |       | -42.5  |
|      | 16QAM      | 2352.5              | 9.7     |              | 11.7  |       | -44.3  |
|      |            | 2355.0              | 10.3    |              | 12.3  |       | -43.7  |
|      |            | 2357.5              | 11.9    |              | 13.9  |       | -42.1  |
|      | 64QAM      | 2352.5              | 11.0    |              | 13.0  |       | -43.0  |
|      |            | 2355.0              | 11.6    |              | 13.6  |       | -42.4  |
|      |            | 2357.5              | 11.6    |              | 13.6  |       | -42.4  |

Figure 36 1 MHz - Average Power Spectral Density, 5MHz OBW

| Band | Modulation | Operation Frequency | Reading | Antenna Gain | EIRP  | Limit | Margin |
|------|------------|---------------------|---------|--------------|-------|-------|--------|
|      |            | (MHz)               | (dBm)   | (dBi)        | (dBm) | (dBm) | (dB)   |
| WCS  | 64QAM      | 2355.0              | 8.2     | 2.0          | 10.2  | 56.0  | -45.8  |
|      | 16QAM      | 2355.0              | 8.4     |              | 10.4  |       | -45.6  |
|      | QPSK       | 2355.0              | 8.7     |              | 10.7  |       | -45.3  |

Figure 37 1 MHz - Average Power Spectral Density, 10MHz OBW

| Band | Modulation | Operation Frequency | Reading | Antenna Gain | EIRP  | Limit | Margin |
|------|------------|---------------------|---------|--------------|-------|-------|--------|
|      |            | (MHz)               | (dBm)   | (dBi)        | (dBm) | (dBm) | (dB)   |
| WCS  | QPSK       | 2352.5              | 16.4    | 2.0          | 18.4  | 63.0  | -44.6  |
|      |            | 2355.0              | 17.0    |              | 19.0  |       | -44    |
|      |            | 2357.5              | 17.6    |              | 19.6  |       | -43.4  |
|      | 16QAM      | 2352.5              | 16.4    |              | 18.4  |       | -44.6  |
|      |            | 2355.0              | 17.0    |              | 19.0  |       | -44    |
|      |            | 2357.5              | 17.4    |              | 19.4  |       | -43.6  |
|      | 64QAM      | 2352.5              | 17.4    |              | 19.4  |       | -43.6  |
|      |            | 2355.0              | 16.7    |              | 18.7  |       | -44.3  |
|      |            | 2357.5              | 17.2    |              | 19.2  |       | -43.8  |

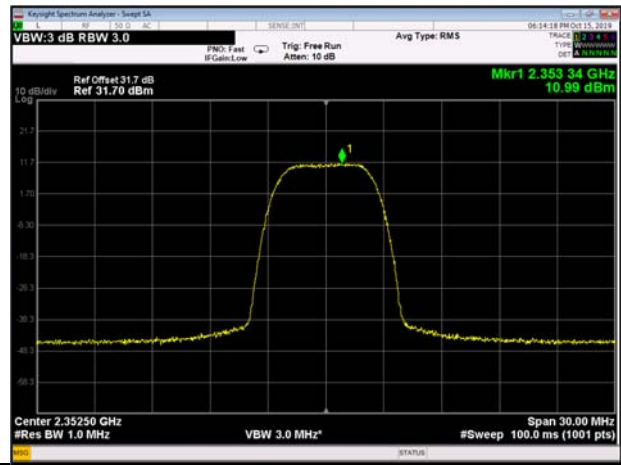
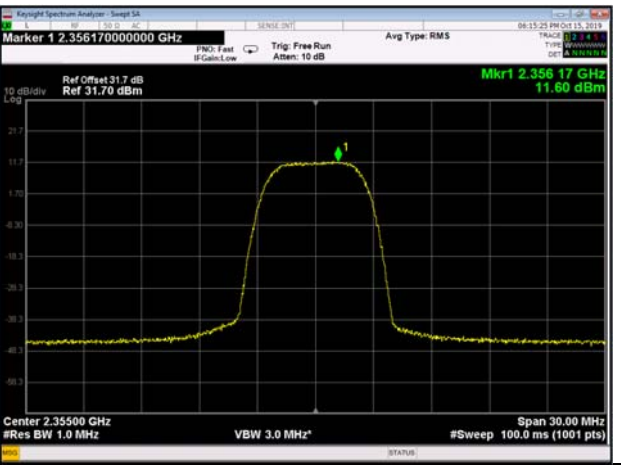
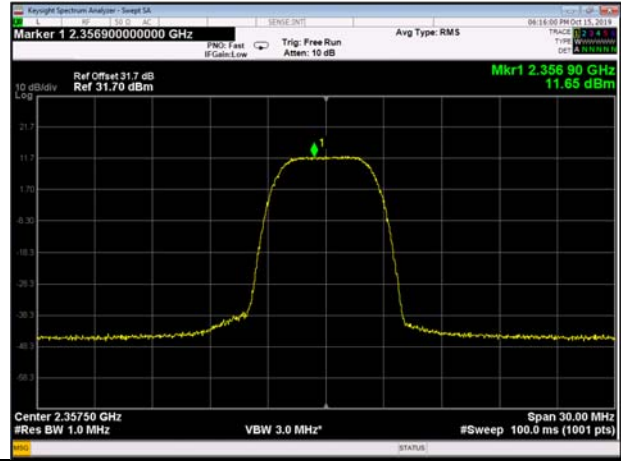
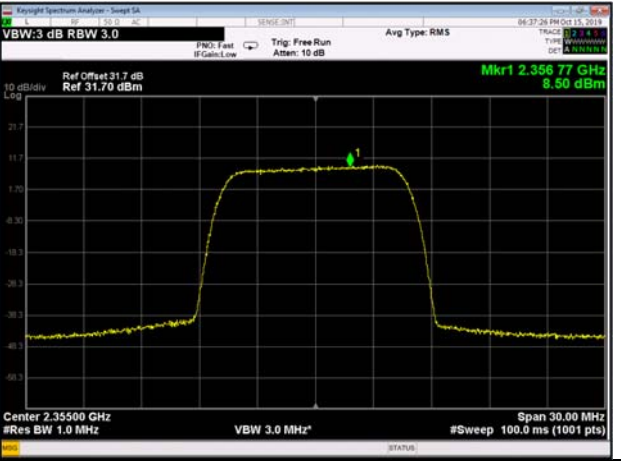
Figure 38 5 MHz - Average Power Spectral Density, 5MHz OBW

| Band | Modulation | Operation Frequency | Reading | Antenna Gain | EIRP  | Limit | Margin |
|------|------------|---------------------|---------|--------------|-------|-------|--------|
|      |            | (MHz)               | (dBm)   | (dBi)        | (dBm) | (dBm) | (dB)   |
| WCS  | 64QAM      | 2355.0              | 14.8    | 2.0          | 16.8  | 63.0  | -46.2  |
|      | 16QAM      | 2355.0              | 14.1    |              | 16.1  |       | -46.9  |
|      | QPSK       | 2355.0              | 15.0    |              | 17.0  |       | -46.0  |

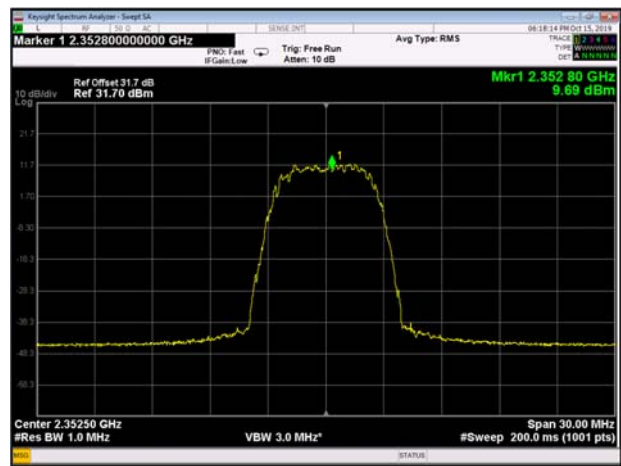
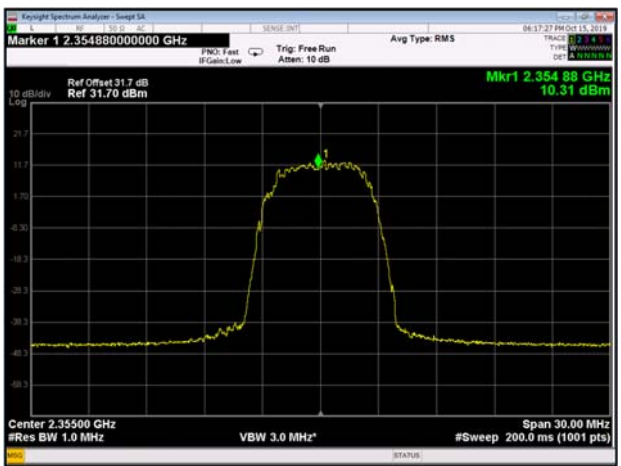
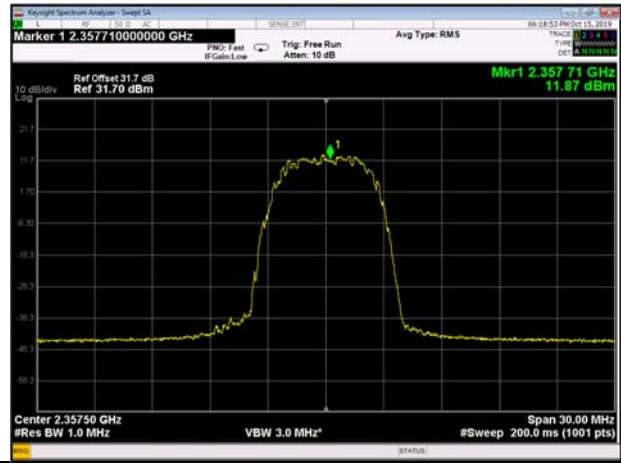
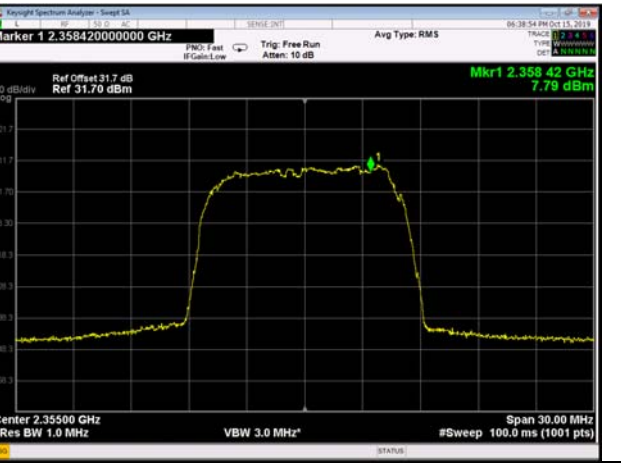
Figure 39 5 MHz - Average Power Spectral Density, 10MHz OBW

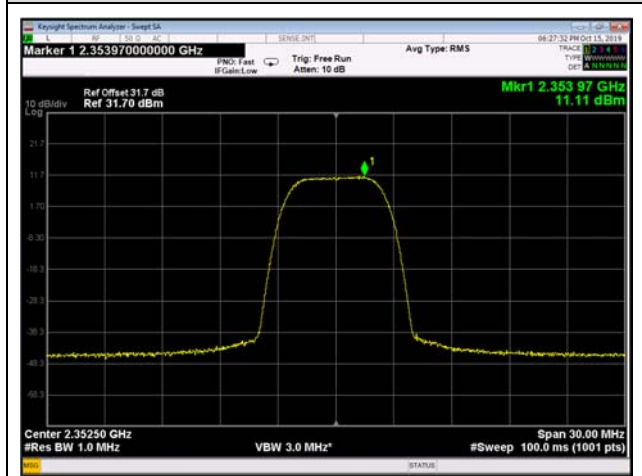
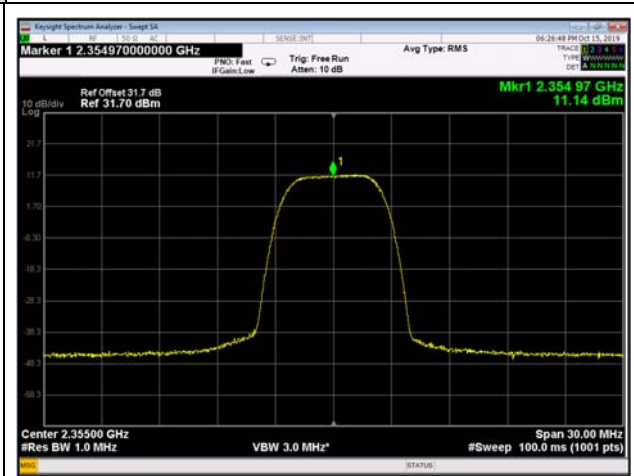
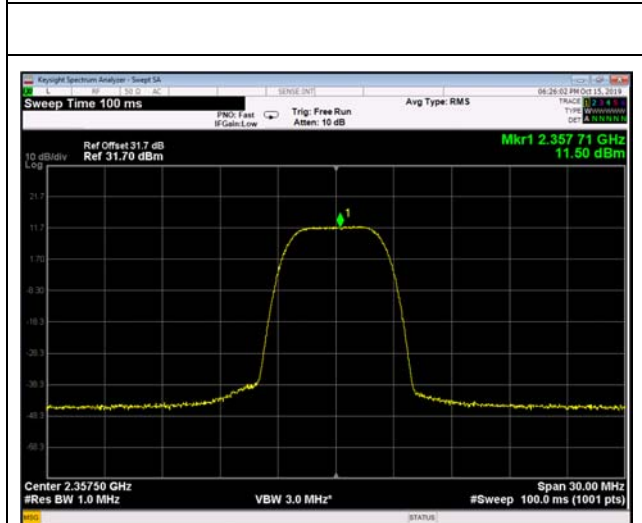
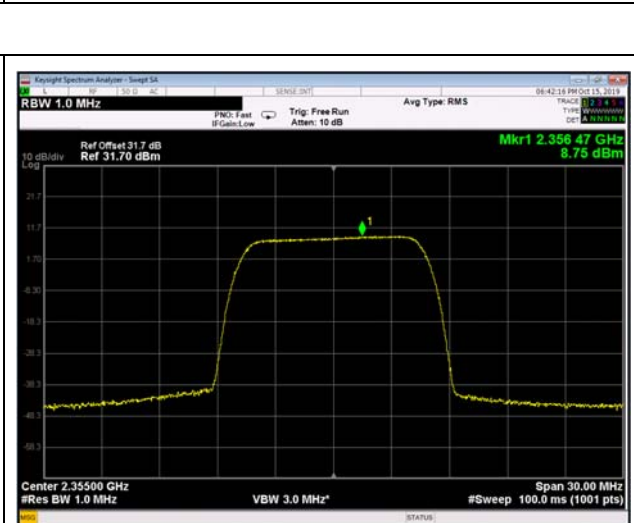
JUDGEMENT: Passed by 42.1 dB

See additional information in Figure 40 to Figure 63.

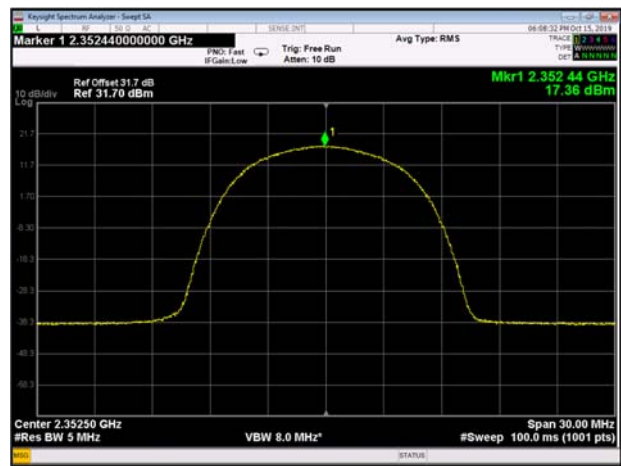
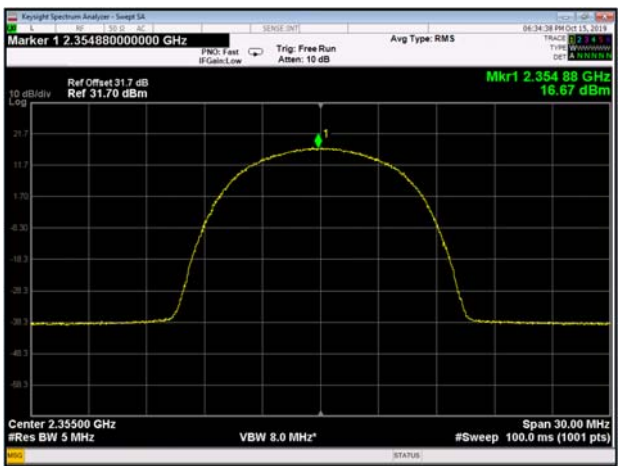
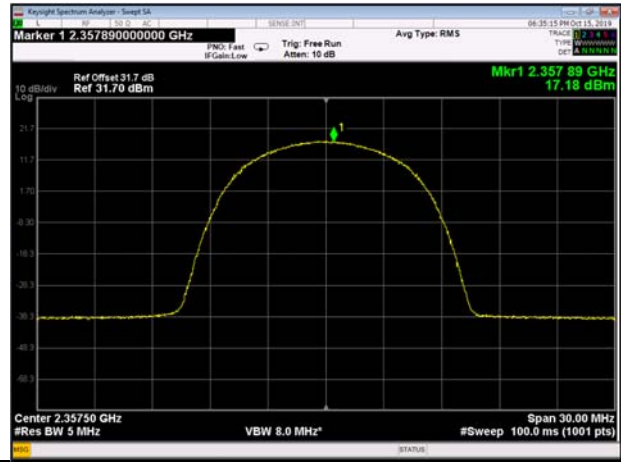
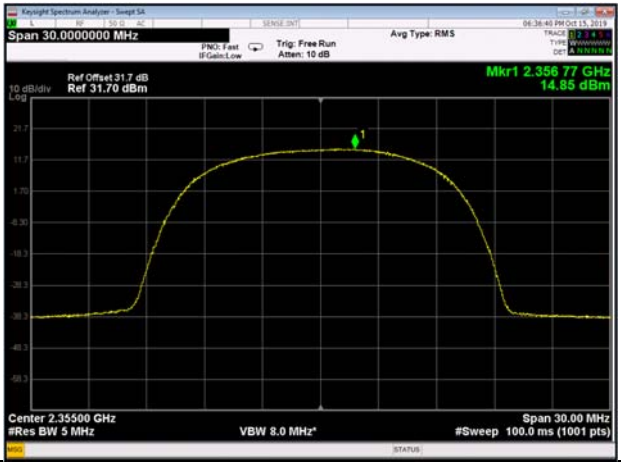
|                                                                                    |                                                                                     |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| RBW                                                                                | 1MHz                                                                                |
| Antenna Port                                                                       | 1                                                                                   |
| Modulation                                                                         | 64QAM                                                                               |
|   |   |
| Figure 40 5MHz BW, 2352.5MHz                                                       | Figure 41 5MHz BW, 2355MHz                                                          |
|  |  |
| Figure 42 5MHz BW, 2357.5MHz                                                       | Figure 43 10MHz BW, 2355MHz                                                         |

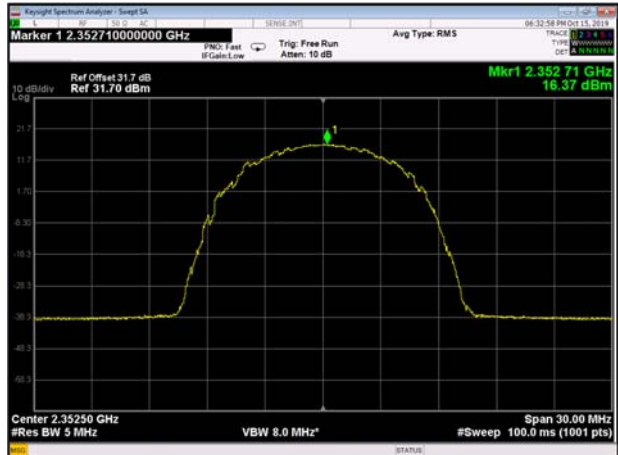
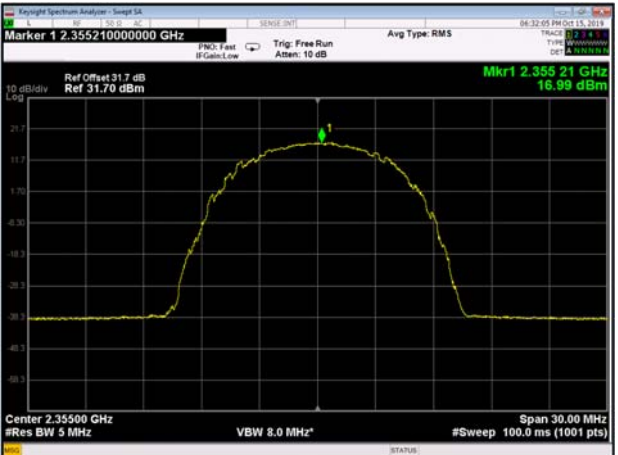
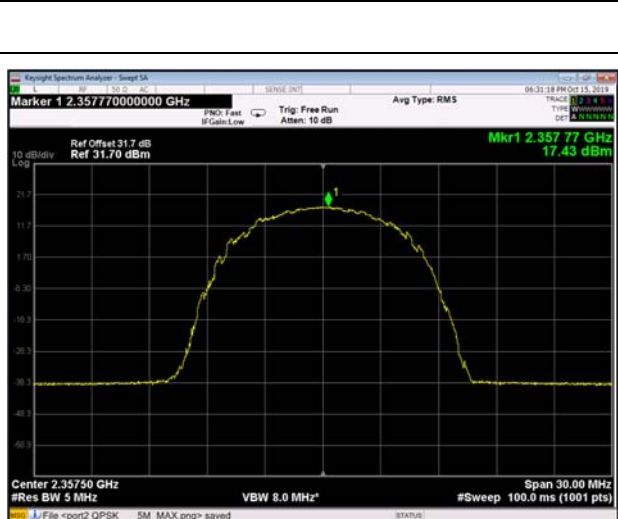
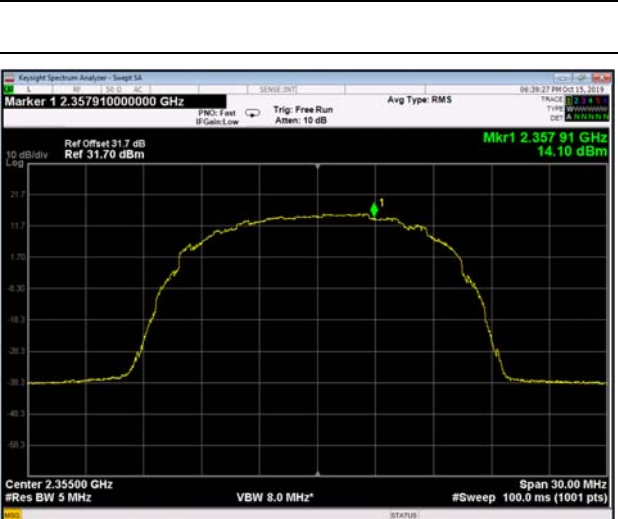


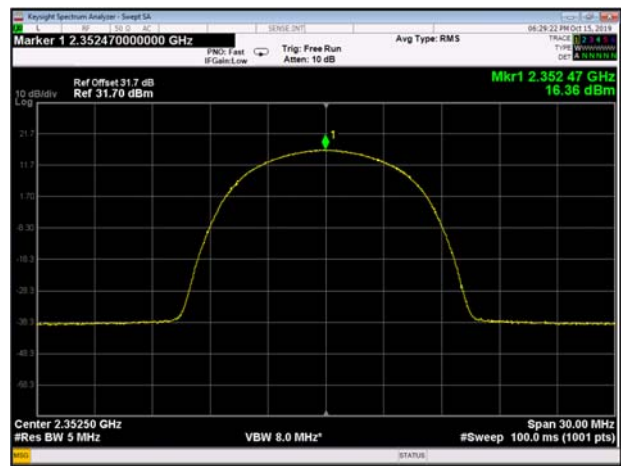
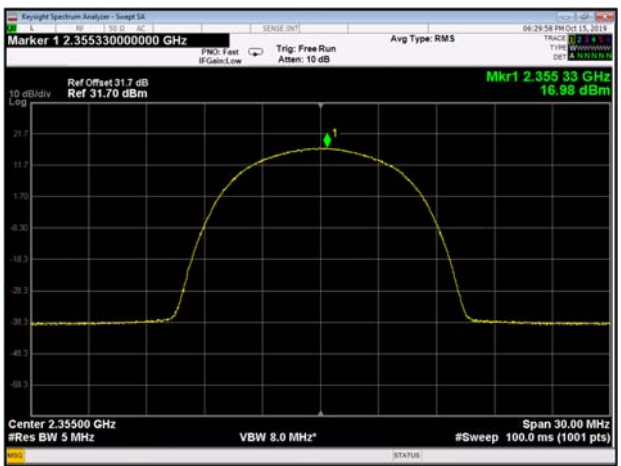
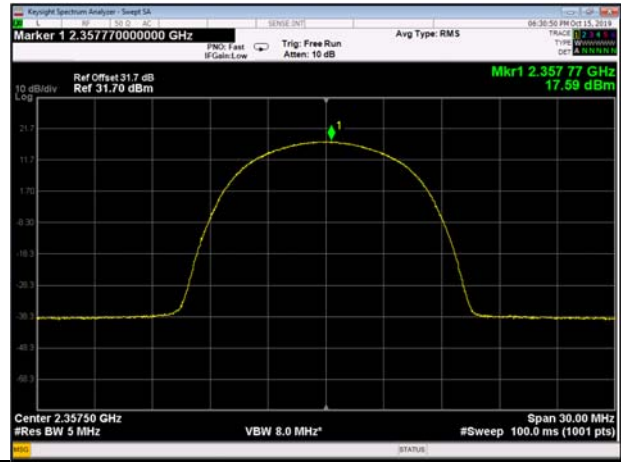
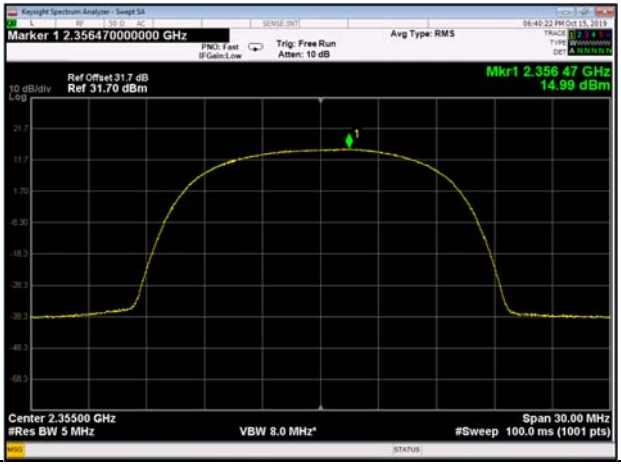
|                                                                                    |                                                                                     |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| RBW                                                                                | 1MHz                                                                                |
| Antenna Port                                                                       | 1                                                                                   |
| Modulation                                                                         | 16QAM                                                                               |
|   |   |
| Figure 44 5MHz BW, 2352.5MHz                                                       | Figure 45 5MHz BW, 2355MHz                                                          |
|  |  |
| Figure 46 5MHz BW, 2357.5MHz                                                       | Figure 47 10MHz BW, 2355MHz                                                         |

|                                                                                    |                                                                                     |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| RBW                                                                                | 1MHz                                                                                |
| Antenna Port                                                                       | 1                                                                                   |
| Modulation                                                                         | QPSK                                                                                |
|   |   |
| Figure 48 5MHz BW, 2352.5MHz                                                       | Figure 49 5MHz BW, 2355MHz                                                          |
|  |  |
| Figure 50 5MHz BW, 2357.5MHz                                                       | Figure 51 10MHz BW, 2355MHz                                                         |



|                                                                                    |                                                                                     |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| RBW                                                                                | 5MHz                                                                                |
| Antenna Port                                                                       | 1                                                                                   |
| Modulation                                                                         | 64QAM                                                                               |
|   |   |
| Figure 52 5MHz BW, 2352.5MHz                                                       | Figure 53 5MHz BW, 2355MHz                                                          |
|  |  |
| Figure 54 5MHz BW, 2357.5MHz                                                       | Figure 55 10MHz BW, 2355MHz                                                         |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RBW                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 5MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Antenna Port                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Modulation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 16QAM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|  <p>             KeySight Spectrum Analyzer - Swept SA<br/>             Marker 1 2.352710000000 GHz<br/>             Ref Offset 31.7 dB<br/>             Ref 31.70 dBm<br/>             Mkr1 2.352 71 GHz<br/>             16.37 dBm<br/>             Center 2.35250 GHz<br/>             #Res BW 5 MHz<br/>             VBW 8.0 MHz*<br/>             Span 30.00 MHz<br/>             #Sweep 100.0 ms (1001 pts)           </p>  |  <p>             KeySight Spectrum Analyzer - Swept SA<br/>             Marker 1 2.355210000000 GHz<br/>             Ref Offset 31.7 dB<br/>             Ref 31.70 dBm<br/>             Mkr1 2.355 21 GHz<br/>             16.99 dBm<br/>             Center 2.35500 GHz<br/>             #Res BW 5 MHz<br/>             VBW 8.0 MHz*<br/>             Span 30.00 MHz<br/>             #Sweep 100.0 ms (1001 pts)           </p>  |
| Figure 56 5MHz BW, 2352.5MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Figure 57 5MHz BW, 2355MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|  <p>             KeySight Spectrum Analyzer - Swept SA<br/>             Marker 1 2.357710000000 GHz<br/>             Ref Offset 31.7 dB<br/>             Ref 31.70 dBm<br/>             Mkr1 2.357 77 GHz<br/>             17.43 dBm<br/>             Center 2.35790 GHz<br/>             #Res BW 5 MHz<br/>             VBW 8.0 MHz*<br/>             Span 30.00 MHz<br/>             #Sweep 100.0 ms (1001 pts)           </p> |  <p>             KeySight Spectrum Analyzer - Swept SA<br/>             Marker 1 2.357910000000 GHz<br/>             Ref Offset 31.7 dB<br/>             Ref 31.70 dBm<br/>             Mkr1 2.357 91 GHz<br/>             14.10 dBm<br/>             Center 2.35500 GHz<br/>             #Res BW 5 MHz<br/>             VBW 8.0 MHz*<br/>             Span 30.00 MHz<br/>             #Sweep 100.0 ms (1001 pts)           </p> |
| Figure 58 5MHz BW, 2357.5MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Figure 59 10MHz BW, 2355MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

|                                                                                    |                                                                                     |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| RBW                                                                                | 5MHz                                                                                |
| Antenna Port                                                                       | 1                                                                                   |
| Modulation                                                                         | QPSK                                                                                |
|   |   |
| Figure 60 5MHz BW, 2352.5MHz                                                       | Figure 61 5MHz BW, 2355MHz                                                          |
|  |  |
| Figure 62 5MHz BW, 2357.5MHz                                                       | Figure 63 10MHz BW, 2355MHz                                                         |



### 5.5 Test Equipment Used; Average Power Spectral Density

| Instrument              | Manufacturer | Model      | Serial Number      | Calibration           |                       |
|-------------------------|--------------|------------|--------------------|-----------------------|-----------------------|
|                         |              |            |                    | Last Calibration Date | Next Calibration Date |
| Spectrum Analyzer       | Agilent      | N9010A     | MY52220686         | November 28, 2018     | November 28, 2020     |
| Vector Signal Generator | VIAVI        | MTS 5800   | WMNK00716<br>90263 | July 1, 2018          | July 1, 2021          |
| Attenuator<br>10dB      | Bird         | 8304-N10DB | -                  | December 24, 2018     | December 31, 2019     |
| Attenuator<br>20dB      | Bird         | 8304-N20DB | -                  | December 24, 2018     | December 31, 2019     |

Figure 64 Test Equipment Used

## 6. Peak to Average Power Ratio

### 6.1 Test Specification

FCC Part 27.50(a)(1)(B)

### 6.2 Test Procedure

(Temperature (22°C)/ Humidity (40%RH))

The method used is detailed in FCC KDB 971168 D03 v01

Measurements was using CCDF function for each modulation.

### 6.3 Test Limit

The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB.

### 6.4 Test Results

| Band | Modulation | Operation Frequency | 0.1% PAPR | Limit | Margin |
|------|------------|---------------------|-----------|-------|--------|
|      |            | (MHz)               | (dBm)     | (dBm) | (dB)   |
| WCS  | QPSK       | 2352.5              | 8.3       | 13.0  | 4.7    |
|      |            | 2355.0              | 8.4       |       | 4.6    |
|      |            | 2357.5              | 8.4       |       | 4.6    |
|      | 16QAM      | 2352.5              | 8.3       |       | 4.7    |
|      |            | 2355.0              | 8.3       |       | 4.7    |
|      |            | 2357.5              | 8.4       |       | 4.6    |
|      | 64QAM      | 2352.5              | 8.3       |       | 4.7    |
|      |            | 2355.0              | 8.3       |       | 4.7    |
|      |            | 2357.5              | 8.3       |       | 4.7    |

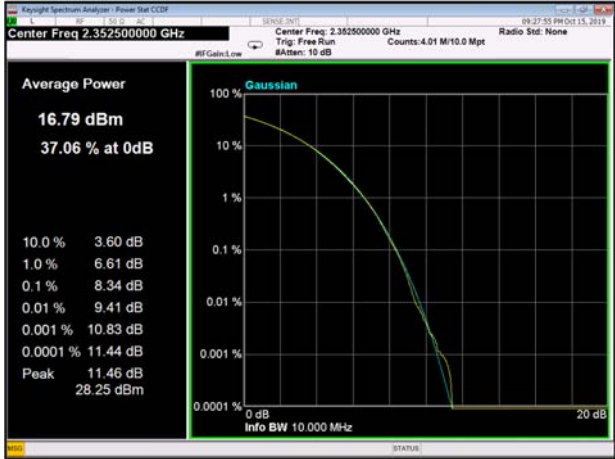
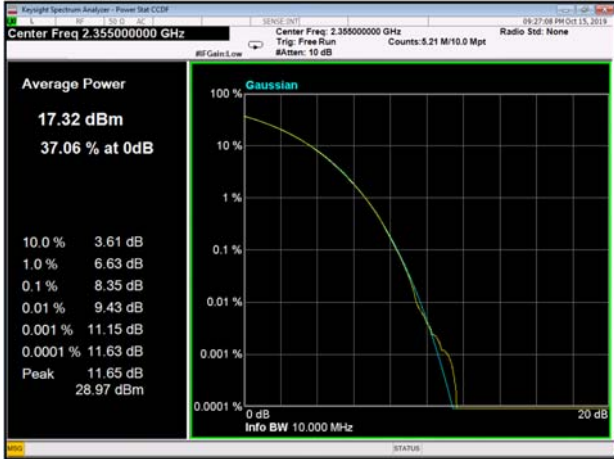
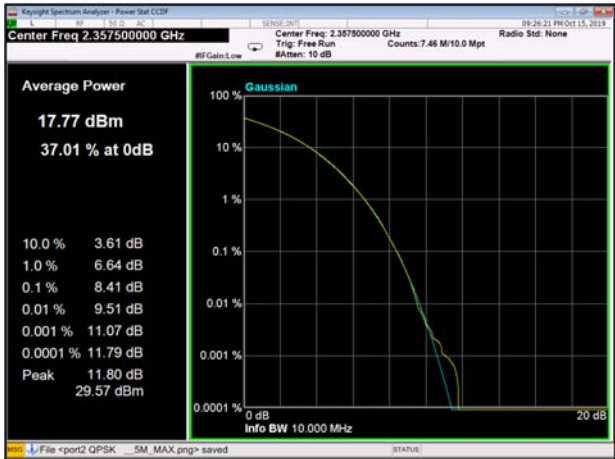
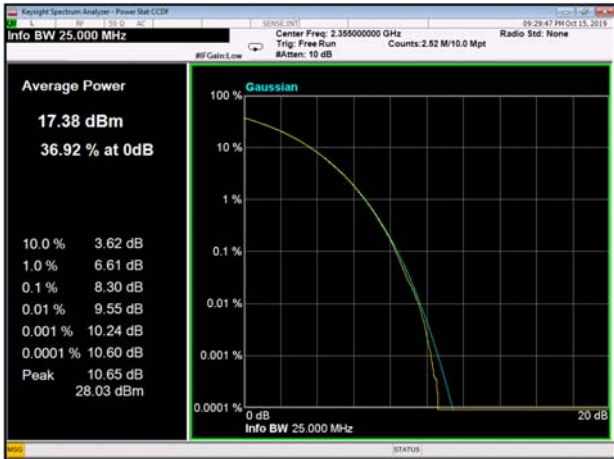
Table 1 Test Results Peak to Average Power Ratio, 5MHz BW

| Band | Modulation | Operation Frequency | 0.1% PAPR | Limit | Margin |
|------|------------|---------------------|-----------|-------|--------|
|      |            | (MHz)               | (dBm)     | (dBm) | (dB)   |
| WCS  | QPSK       | 2355.0              | 8.4       | 13.0  | 4.6    |
|      | 16QAM      | 2355.0              | 8.3       |       | 4.7    |
|      | 64QAM      | 2355.0              | 8.4       |       | 4.6    |

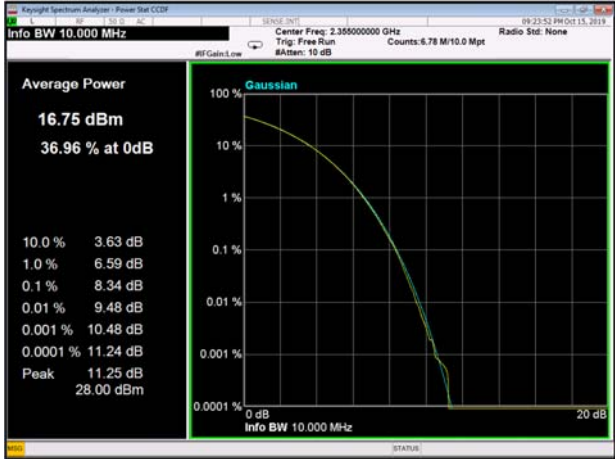
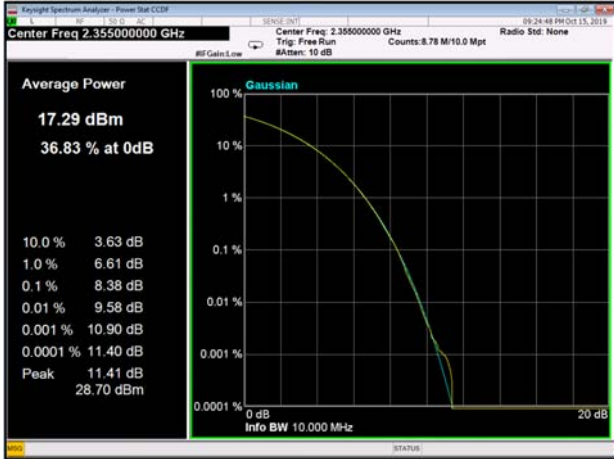
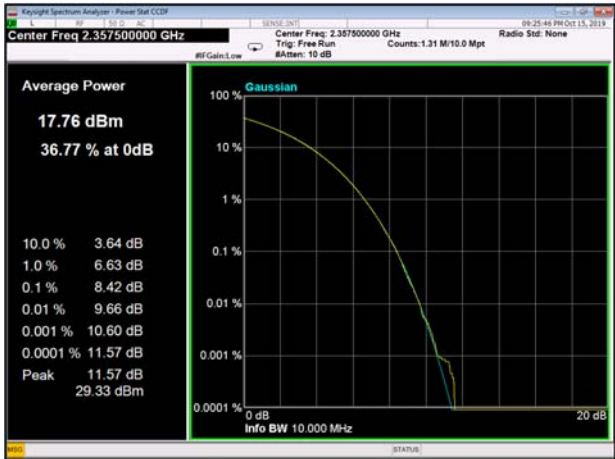
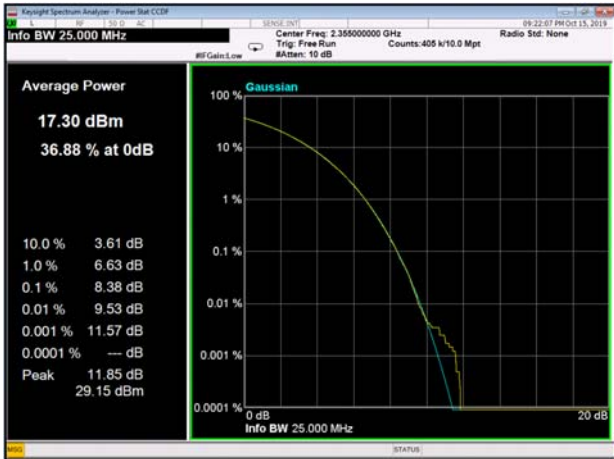
Table 2 Test Results Peak to Average Power Ratio, 10MHz BW

JUDGEMENT: Passed

For additional information see Figure 65 to Figure 76.

|                                                                                    |                                                                                     |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| RBW                                                                                | 5MHz                                                                                |
| Antenna Port                                                                       | 1                                                                                   |
| Modulation                                                                         | 16QAM                                                                               |
|   |   |
| Figure 65 5MHz BW, 2352.5MHz                                                       | Figure 66 5MHz BW, 2355MHz                                                          |
|  |  |
| Figure 67 5MHz BW, 2357.5MHz                                                       | Figure 68 10MHz BW, 2355MHZ                                                         |

|                              |                             |
|------------------------------|-----------------------------|
| RBW                          | 5MHz                        |
| Antenna Port                 | 1                           |
| Modulation                   | 64QAM                       |
|                              |                             |
| Figure 69 5MHz BW, 2352.5MHz | Figure 70 5MHz BW, 2355MHz  |
|                              |                             |
| Figure 71 5MHz BW, 2357.5MHz | Figure 72 10MHz BW, 2355MHz |

|                                                                                    |                                                                                     |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| RBW                                                                                | 5MHz                                                                                |
| Antenna Port                                                                       | 1                                                                                   |
| Modulation                                                                         | QPSK                                                                                |
|   |   |
| Figure 73 5MHz BW, 2352.5MHz                                                       | Figure 74 5MHz BW, 2355MHz                                                          |
|  |  |
| Figure 75 5MHz BW, 2357.5MHz                                                       | Figure 76 10MHz BW, 2355MHz                                                         |



**6.5 Test Equipment Used; 0.1% PAPR**

| Instrument              | Manufacturer | Model    | Serial Number  | Calibration           |                       |
|-------------------------|--------------|----------|----------------|-----------------------|-----------------------|
|                         |              |          |                | Last Calibration Date | Next Calibration Date |
| Spectrum Analyzer       | Agilent      | N9010A   | MY52220686     | November 28, 2018     | November 28, 2020     |
| Vector Signal Generator | VIAVI        | MTS 5800 | WMNK0071690263 | July 1, 2018          | July 1, 2021          |

**Figure 77 Test Equipment Used**

## 7. Occupied Bandwidth

### 7.1 Test Specification

FCC Part 2, Section 1049

### 7.2 Test Procedure

(Temperature (22°C)/ Humidity (40%RH))

The E.U.T. was set to the applicable test frequency with modulation. The E.U.T. antenna terminal was connected to the spectrum analyzer through appropriate coaxial cable. The OBW function (99%) was used for this evaluation. RBW was set to 100 kHz.

Occupied bandwidth measured was repeated for each modulation.

### 7.3 Test Limit

N/A

### 7.4 Test Results

| Modulation | Operating Frequency [MHz] | Reading [MHz] |
|------------|---------------------------|---------------|
| QPSK       | 2352.5                    | 4.5           |
|            | 2355.0                    | 4.5           |
|            | 2357.5                    | 4.5           |
| 16QAM      | 2352.5                    | 4.5           |
|            | 2355.0                    | 4.5           |
|            | 2357.5                    | 4.5           |
| 64QAM      | 2352.5                    | 4.5           |
|            | 2355.0                    | 4.5           |
|            | 2357.5                    | 4.5           |

Figure 78 Occupied Bandwidth WCS, 5MHz OBW

| Modulation | Operating Frequency [MHz] | Reading [MHz] |
|------------|---------------------------|---------------|
| QPSK       | 2355                      | 9.0           |
| 16QAM      | 2355                      | 9.0           |
| 64QAM      | 2355                      | 9.0           |

Figure 79 Occupied Bandwidth WCS, 10MHz OBW

JUDGEMENT: Passed

See additional information in *Figure 80* to *Figure 91*.



Antenna Port

1

Modulation

16QAM

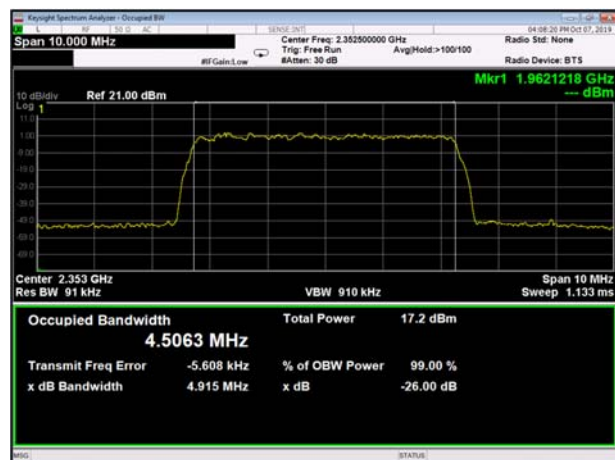


Figure 80 5MHz BW, 2352.5MHz

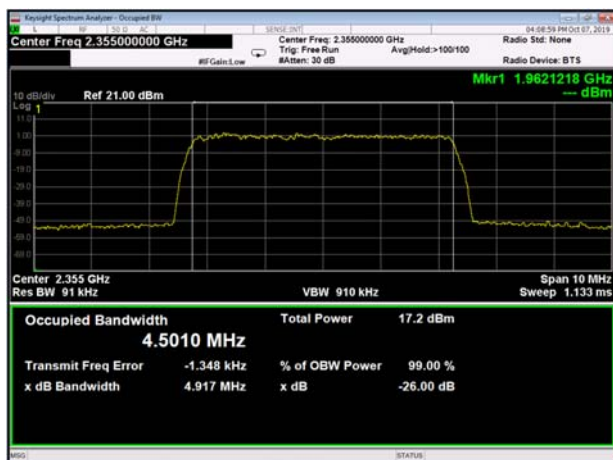


Figure 81 5MHz BW, 2355MHz

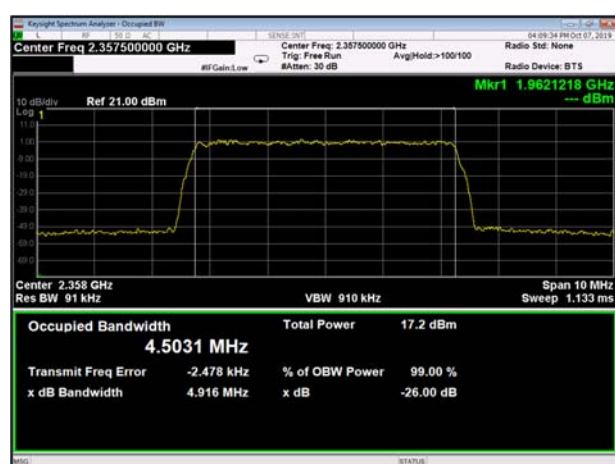


Figure 82 5MHz BW, 2357.5MHz

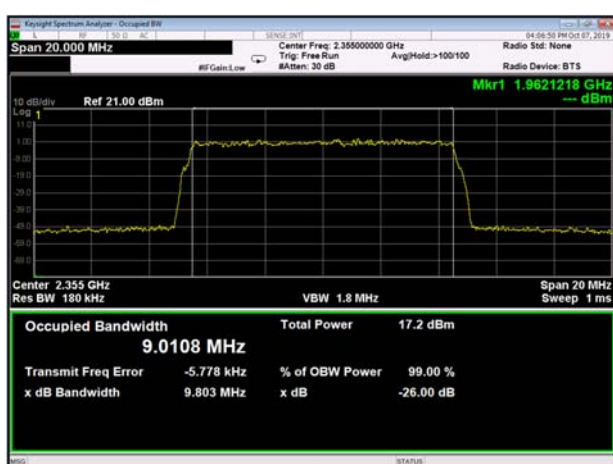
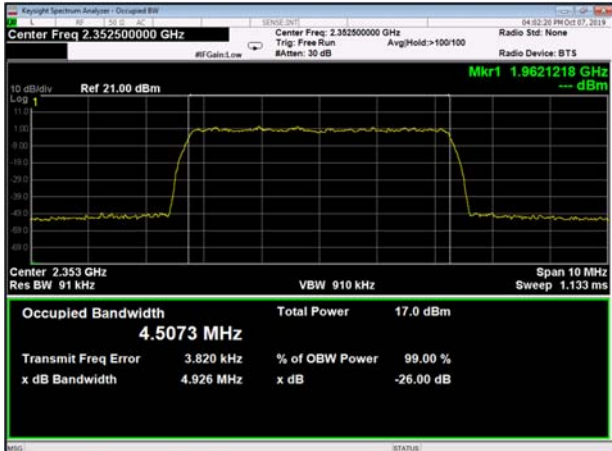
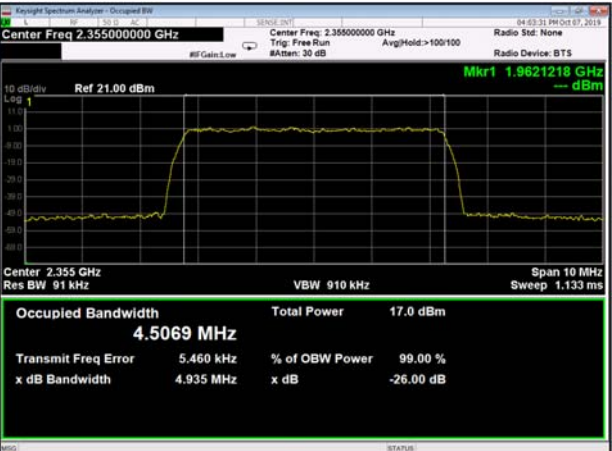
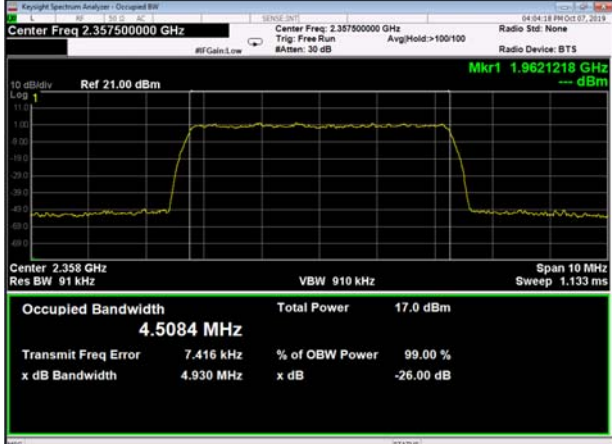
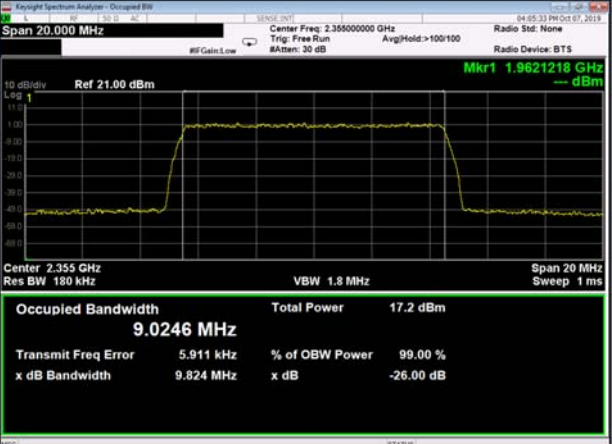


Figure 83 10MHz BW, 2355MHz

|                                                                                                                                      |                                                                                                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Antenna Port                                                                                                                         | 1                                                                                                                                     |
| Modulation                                                                                                                           | 64QAM                                                                                                                                 |
| <p>Center Freq: 2.352500000 GHz<br/>Res BW: 91 kHz<br/>Span: 10 MHz<br/>Occupied Bandwidth: 4.5292 MHz<br/>Total Power: 17.3 dBm</p> | <p>Center Freq: 2.355000000 GHz<br/>Res BW: 91 kHz<br/>Span: 10 MHz<br/>Occupied Bandwidth: 4.5316 MHz<br/>Total Power: 17.1 dBm</p>  |
| Figure 84 5MHz BW, 2352.5MHz                                                                                                         | Figure 85 5MHz BW, 2355MHz                                                                                                            |
| <p>Center Freq: 2.357500000 GHz<br/>Res BW: 91 kHz<br/>Span: 10 MHz<br/>Occupied Bandwidth: 4.5319 MHz<br/>Total Power: 17.1 dBm</p> | <p>Center Freq: 2.355000000 GHz<br/>Res BW: 180 kHz<br/>Span: 20 MHz<br/>Occupied Bandwidth: 9.0230 MHz<br/>Total Power: 17.2 dBm</p> |
| Figure 86 5MHz BW, 2357.5MHz                                                                                                         | Figure 87 10MHz BW, 2355MHz                                                                                                           |

|                                                                                    |                                                                                     |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| <p>Antenna Port</p>                                                                | <p>1</p>                                                                            |
| <p>Modulation</p>                                                                  | <p>QPSK</p>                                                                         |
|   |   |
| <p>Figure 88 5MHz BW, 2352.5MHz</p>                                                | <p>Figure 89 5MHz BW, 2355MHz</p>                                                   |
|  |  |
| <p>Figure 90 5MHz BW, 2357.5MHz</p>                                                | <p>Figure 91 10MHz BW, 2355MHz</p>                                                  |



### 7.5 Test Equipment Used; Occupied Bandwidth

| Instrument              | Manufacturer | Model    | Serial Number  | Calibration           |                       |
|-------------------------|--------------|----------|----------------|-----------------------|-----------------------|
|                         |              |          |                | Last Calibration Date | Next Calibration Date |
| Spectrum Analyzer       | Agilent      | N9010A   | MY52220686     | November 28, 2018     | November 28, 2020     |
| Vector Signal Generator | VIAVI        | MTS 5800 | WMNK0071690263 | July 1, 2018          | July 1, 2021          |

Figure 92 Test Equipment Used