



## DATA REFERENCE REPORT PART 24

**Applicant Name:**

Apple Inc.  
One Apple Park Way  
Cupertino, CA 95014  
United States

**Date of Testing:**

12/23/2020 - 03/05/2021

**Test Site/Location:**

PCTEST Lab. Morgan Hill, CA, USA

**Test Report Serial No.:**

1C2101020003-04.BCG

**FCC ID:**

**BCGA2459**

**Applicant Name:**

**Apple Inc.**

**Reference Model:**

A2301

**Variant Model:**

A2459, A2460

**EUT Type:**

Tablet Device

**FCC Classification:**

PCS Licensed Transmitter (PCB)

**FCC Rule Part:**

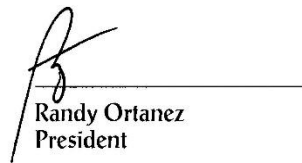
24

**Test Procedure(s):**

ANSI C63.26-2015, TIA-603-E-2016, KDB 971168 D01 v03r01

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in §2.947. Test results reported herein relate only to the item(s) tested.


I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.



Randy Ortanez  
President




CERT #2041.02

|  |  |  |
|--|--|--|
| <b>FCC ID:</b> BCGA2459                        |  <b>PART 24 DATA REFERENCE REPORT</b> | <b>Approved by:</b><br>Quality Manager |
| <b>Test Report S/N:</b><br>1C2101020003-04.BCG | <b>Test Dates:</b><br>12/23/2020 - 03/05/2021  | <b>EUT Type:</b><br>Tablet Device      |
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## 1.0 INTRODUCTION

### 1.1 Scope

Per manufacturer declaration, there are two tablet device models, A2301 and A2459(A2460), with high degree of similarity, reference model FCC ID: BCGA2301 and variant model **FCC ID: BCGA2459**. The reference model supports mmWave operations, while the variant model has the mmWave components/antennas removed. Both models share the same material, form factor, circuit design, and components, including antennas and their locations. The reference and variant models use the same power tables and have same tune-up tolerances.

Per FCC approved Data Referencing Test Plan, testing was done fully on the reference model FCC ID: BCGA2301, while radiated spot-check verification has been performed on variant model **FCC ID: BCGA2459**. Additionally, due to Antenna 4a location being close to the depopulated mmWave components, full radiated testing has been done for all supported technologies on Antenna 4a. Spot-check measurements were conducted, all measurements were investigated and found to be within acceptable tolerance.

| Equipment Class | Reference Model FCC ID | Reference Report    | Report Title           |
|-----------------|------------------------|---------------------|------------------------|
| PCE             | BCGA2301               | 1C2101020002-03.BCG | RF Part 24 Test Report |

**Table 1-1. Reference Model Details**


Reference model FCC ID: BCGA2301 test report has been included in Appendix A

### 1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST. facility located at 18855 Adams Court, Morgan Hill, CA 95037. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014 and KDB 414788 D01 v01r01.

### 1.3 Test Facility / Accreditations

- PCTEST is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.02 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISSED Standards (RSS).
- PCTEST facility is a registered (22831) test laboratory with the site description on file with ISSED.

|  |  |                                      |  |
|--|--|--------------------------------------|--|
| FCC ID: BCGA2459                               |  <b>PCTEST</b><br>Proud to be part of element | <b>PART 24 DATA REFERENCE REPORT</b> | <b>Approved by:</b><br>Quality Manager |
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## 2.0 PRODUCT INFORMATION

### 2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Tablet Device FCC ID:BCGA2459**. The test data contained in this report pertains only to the emissions due to the EUT's licensed transmitters that operate under the provisions of Part 24.

**Test Device Serial No.:** H1931W7GTV, TM6JQGGX3H

### 2.2 Device Capabilities

This device contains the following capabilities:

850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, 5G NR (FR1), 802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII, Bluetooth (1x, EDR, LE1M, LE2M, HDR4, HDR8), WPT


This device supports BT Beamforming

This device supports simultaneous transmission operations, which allows for multiple transmitters to transmit simultaneously on the same antenna. The table below shows all configurations possible.

| Antenna | Simultaneous Tx Config | WLAN            | Bluetooth                | GSM / WCDMA | LTE / FR1 NR |           |                 | UNII             |
|---------|------------------------|-----------------|--------------------------|-------------|--------------|-----------|-----------------|------------------|
|         |                        | 802.11 b/g/n/ax | BDR, EDR, HDR4/8, LE1/2M | Mid Band    | Mid Band     | High Band | Ultra High Band | 802.11 a/n/ac/ax |
| 2a      | Config 1               | ✓               | ✗                        | ✗           | ✗            | ✗         | ✓               | ✗                |
| 2a      | Config 2               | ✗               | ✓                        | ✗           | ✗            | ✗         | ✓               | ✗                |
| 4a      | Config 3               | ✓               | ✗                        | ✗           | ✗            | ✗         | ✓               | ✗                |
| 4a      | Config 4               | ✗               | ✓                        | ✗           | ✗            | ✗         | ✓               | ✗                |
| 4b      | Config 5               | ✗               | ✗                        | ✓           | ✗            | ✗         | ✗               | ✓                |
| 4b      | Config 6               | ✗               | ✗                        | ✗           | ✓            | ✗         | ✗               | ✓                |
| 4b      | Config 7               | ✗               | ✗                        | ✗           | ✗            | ✓         | ✗               | ✓                |

**Table 2-1. Simultaneous Transmission Configurations**

✓ = Support; ✗ = Not Support

|  |  |                                   |  |
|--|--|-----------------------------------|--|
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## 2.3 Antenna Description

Following antenna gains provided by manufacturer were used for the testing.


| Band           | Antenna Gain (dBi) |           |            |            |
|----------------|--------------------|-----------|------------|------------|
|                | Antenna 3          | Antenna 1 | Antenna 4b | Antenna 2b |
| GPRS1900       | 1.4                | -0.1      | -3.9       | -4.5       |
| EDGE1900       |                    |           |            |            |
| WCDMA1900      |                    |           |            |            |
| LTE Band 2/25  |                    |           |            |            |
| NR Band n2/n25 |                    |           |            |            |

**Table 2-2. Highest Antenna Gain**

## 2.4 Test Support Equipment

|   |                   |        |          |      |              |
|---|-------------------|--------|----------|------|--------------|
| 1 | Apple MacBook Pro | Model: | A2141    | S/N: | C02DV7VKMD6T |
|   | w/AC/DC Adapter   | Model: | A2166    | S/N: | N/A          |
| 2 | Apple USB-C Cable | Model: | Chimp    | S/N: | 420A57       |
|   |                   |        |          |      |              |
| 3 | USB-C Cable       | Model: | A146     | S/N: | N/A          |
|   | w/ AC Adapter     | Model: | A2305    | S/N: | N/A          |
| 4 | Apple Pencil      | Model: | N/A      | S/N: | GQXYGSXBJKM9 |
|   |                   |        |          |      |              |
| 5 | DC Power Supply   | Model: | KPS3010D | S/N: | N/A          |

**Table 2-3. Test Support Equipment**

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2459                        |  <b>PART 24 DATA REFERENCE REPORT</b> |                            | Approved by:<br>Quality Manager |
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## 2.5 Test Configuration

The EUT was tested per the guidance of ANSI C63.26 2015, TIA-603-E-2016 and KDB 971168 D01 v03r01. See Section 7.0 of this test report for a description of the radiated emissions tests.

For emissions from 1GHz – 18GHz, low, mid, and high channels were tested with highest power and worst case configuration. The emissions below 1GHz and above 18GHz were tested with the highest transmitting power and the worst case channel.

The EUT was manipulated through three orthogonal planes of X-orientation (flatbed), Y-orientation (landscape), and Z-orientation (portrait) during the testing. Only the worst case emissions were reported in this test report.

Per FCC Approved Data Referencing Test Plan, spot-check measurements have been conducted and reported. Spot-check Test Plan can be referred to below Table 2-4.

| Technology  | Test Case                   | FCC ID: BCGA2459                                   |         |
|---|-----------------------------|--|---------|
|   |                             | Mode   | Channel |
| GSM, WCDMA, LTE, FR1<br>Single Carrier & IntraBand ULCA | Radiated Spurious Emissions | Antenna 3<br>LTE Band 5, 2, 7<br>Max BW, 1RB, QPSK | M       |

**Table 2-4. FCC Approved Spot-Check Test Plan**


Output powers were measured and confirmed to be consistent between Reference and Variant models prior to testing.

## 2.6 Software and Firmware

The test was conducted with firmware version 18E20700y installed on the EUT.

## 2.7 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and no modifications were made during testing.

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
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## 3.0 DESCRIPTION OF TESTS

### 3.1 Measurement Procedure

The measurement procedures described in the document titled "Land Mobile FM or PM – Communications Equipment – Measurements and Performance Standards" (ANSI C63.26-2015/TIA-603-E-2016) and "Procedures for Compliance Measurement of the Fundamental Emission Power of Licensed Wideband (> 1 MHz) Digital Transmission Systems" (KDB 971168 D01 v03r01) were used in the measurement of the EUT.

### 3.2 Radiated Spurious Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. For measurements below 1GHz, the absorbers are removed. A raised turntable is used for radiated measurement. The turn table is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm tall test table made of Styrodur is placed on top of the turn table. A Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

The equipment under test was transmitting while connected to its integral antenna and is placed on a turntable 3 meters from the receive antenna. The receive antenna height is adjusted between 1 and 4 meter height, the turntable is rotated through 360 degrees, and the EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer.

For radiated spurious emissions measurements and calculations, conversion method is used per the formulas in KDB 971168 Section 5.8.4. Field Strength (EIRP) is calculated using the following formulas:

$$E_{[dB\mu V/m]} = \text{Measured amplitude level}_{[dBm]} + 107 + \text{Cable Loss}_{[dB]} + \text{Antenna Factor}_{[dB/m]}$$

And


$$\text{EIRP}_{[dBm]} = E_{[dB\mu V/m]} + 20\log D - 104.8;$$

Where D is the measurement distance in meters.

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014.

Per KDB 414788 D01 v01r01, radiated emission test sites other than open-field test sites (e.g., shielded anechoic chambers), may be employed for emission measurements below 30MHz if characterized so that the measurements correspond to those obtained at an open-field test site. To determine test site equivalency, a reference sample transmitting at 149kHz was measured on an open field test site (asphalt with no ground plane) and then measured in the 3m semi-anechoic chamber. A calibrated 60cm loop antenna was used while the reference device was rotated through the X, Y and Z axis in order to capture the worst case level. A maximum deviation of 2.77dB at 149kHz was measured when comparing the 3 meter semi-anechoic chamber to the open field site.


Radiated spurious emission levels are investigated with the receive antenna horizontally and vertically polarized per ANSI C63.26-2015 and TIA-603-E-2016.

|  |   |                                      |  |
|--|---|--------------------------------------|--|
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## 4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.23-2012. All measurement uncertainty values are shown with a coverage factor of  $k = 2$  to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the  $U_{\text{CISPR}}$  measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

| Contribution                      | Expanded Uncertainty ( $\pm$ dB) |
|-----------------------------------|----------------------------------|
| Radiated Disturbance (<30MHz)     | 4.06                             |
| Radiated Disturbance (30MHz-1GHz) | 4.30                             |
| Radiated Disturbance (1-18GHz)    | 4.78                             |
| Radiated Disturbance (>18GHz)     | 4.79                             |

|   |  |                                 |
|---|--|---------------------------------|
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## 5.0 TEST EQUIPMENT CALIBRATION DATA


Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

| Manufacturer         | Model       | Description                                    | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|----------------------|-------------|--|------------|--------------|------------|---------------|
| Agilent Technologies | N9030A      | PXA Signal Analyzer (3Hz - 26.5 GHz)           | 7/24/2020  | Annual       | 7/24/2021  | MY55330128    |
| Keysight Technology  | N9040B      | UXA Signal Analyzer                            | 12/19/2020 | Annual       | 12/19/2021 | MY57212015    |
| Keysight Technology  | E7515B      | UXM 5G Wireless Test Platform                  | 11/14/2020 | Annual       | 11/14/2021 | MY60192562    |
| ATM                  | 180-442A-KF | 20dB Nominal Gain Horn Antenna                 | 8/11/2020  | Annual       | 8/11/2021  | T058701-01    |
| ESPEC                | SU-241      | Tabletop Temperature Chamber                   | 9/28/2020  | Annual       | 9/28/2021  | 92009574      |
| ETS-Lindgren         | 3142E       | BiConiLog Antenna (30MHz - 6GHz)               | 9/15/2020  | Annual       | 9/15/2021  | 208204        |
| ETS-Lindgren         | 3117        | Double Ridged Guide Antenna (1-18 GHz)         | 4/21/2020  | Annual       | 4/21/2021  | 205956        |
| Rohde & Schwarz      | TS-PR8      | Pre-Amplifier (30MHz - 8GHz)                   | 7/15/2020  | Annual       | 7/15/2021  | 102356        |
| Rohde & Schwarz      | TS-PR18     | Pre-Amplifier (1GHz - 18GHz)                   | 12/3/2020  | Annual       | 12/3/2021  | 101648        |
| Rohde & Schwarz      | ESW26       | EMI Test Receiver                              | 6/8/2020   | Annual       | 6/8/2021   | 101299        |
| Rohde & Schwarz      | ESW44       | EMI Test Receiver                              | 8/6/2020   | Annual       | 8/6/2021   | 101668        |
| Rohde & Schwarz      | CMW500      | Wideband Radio Communication Tester            | 10/13/2020 | Annual       | 10/13/2021 | 161616        |
| Rohde & Schwarz      | CMW500      | Wideband Radio Communication Tester            | 4/16/2020  | Annual       | 4/16/2021  | 166869        |
| Rohde & Schwarz      | TS-PR1840   | Pre-Amplifier (18GHz - 40GHz)                  | 4/23/2020  | Annual       | 4/23/2021  | 100052        |
| Rohde & Schwarz      | TC-TA18     | Cross Polarized Vivaldi Antenna (400MHz-18GHz) | 10/2/2020  | Annual       | 10/2/2021  | 101063        |
| Rohde & Schwarz      | HFH2-Z2     | Loop Antenna                                   | 3/12/2020  | Annual       | 3/12/2021  | 100546        |

**Table 5-1. Test Equipment**

### Notes:

1. For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.


|   |  |                            |                                 |
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## 6.0 SAMPLE CALCULATIONS

### Spurious Radiated Emission

#### **Example: Spurious emission at 3700.40 MHz**

The receive spectrum analyzer reading at 3 meters with the EUT on the turntable was  $-81.0$  dBm. The gain of the substituted antenna is  $8.1$  dBi. The signal generator connected to the substituted antenna terminals is adjusted to produce a reading of  $-81.0$  dBm on the spectrum analyzer. The loss of the cable between the signal generator and the terminals of the substituted antenna is  $2.0$  dB at  $3700.40$  MHz. So  $6.1$  dB is added to the signal generator reading of  $-30.9$  dBm yielding  $-24.80$  dBm. The fundamental EIRP was  $25.50$  dBm so this harmonic was  $25.50$  dBm  $- (-24.80) = 50.3$  dBc.

|   |  |                            |                                 |
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## 7.0 TEST RESULTS (SPOT-CHECK DATA)


### 7.1 Summary

Company Name: Apple Inc.  
 FCC ID: BCGA2459  
 FCC Classification: PCS Licensed Transmitter (PCB)  
 Mode(s): GSM/GPRS/EDGE/WCDMA/LTE/NR

| Technology | Test Configurations         |            |                 |         |                             | Reference Model  | Variant Model    | Delta        |
|------------|-----------------------------|------------|-----------------|---------|-----------------------------|------------------|------------------|--------------|
|            | Test Description            | Modulation | BW / RB Config  | Channel | Measurement Frequency [MHz] | FCC ID: BCGA2301 | FCC ID: BCGA2459 |              |
|            |                             |            |                 |         |                             | Average [dBm]    | Average [dBm]    | Average [dB] |
| LTE Band 2 | Radiated Spurious Emissions | QPSK       | 20MHz / 1/50 RB | M       | 5647.5                      | -58.51           | -57.81           | 0.70         |

**Table 7-1. Worst Case Spot-check Results**

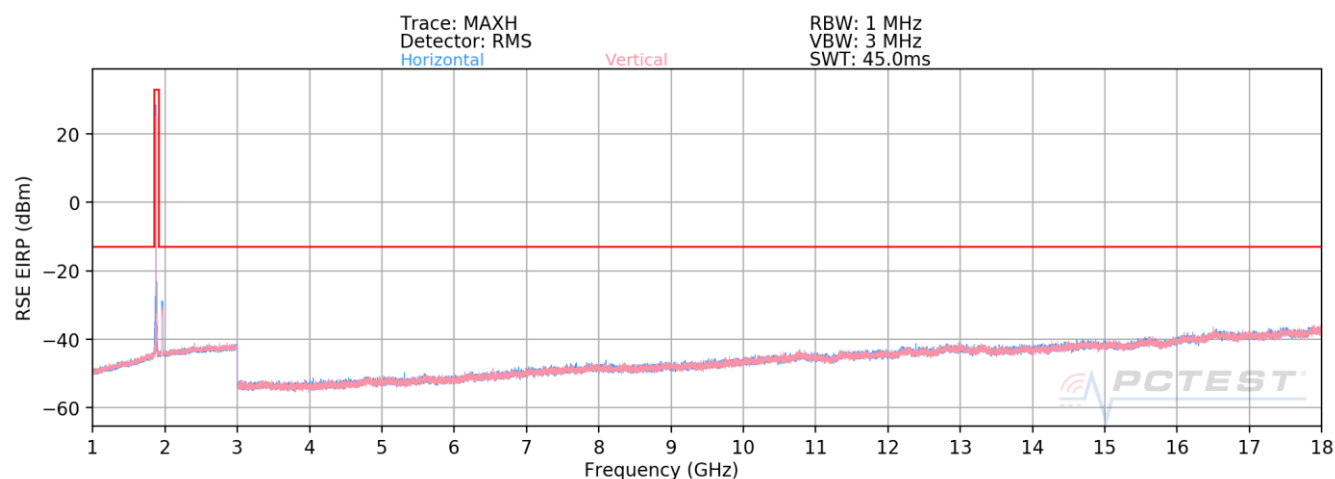
Spot-checks were conducted, all measurements were investigated and found to be within acceptable tolerance in accordance with FCC Approved Data Referencing Test Plan.

|   |   |                                      |                                 |
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## 7.2 Radiated Spurious Emissions

### §2.1053, 24.238(a)

#### LTE Band 2



**Plot 7-1. Radiated Spurious Emission above 1GHz (LTE Band 2)**

|                  |        |
|------------------|--------|
| Bandwidth (MHz): | 20     |
| Frequency (MHz): | 1882.5 |
| RB / Offset:     | 1 / 50 |


| Frequency [MHz] | Ant. Pol. [H/V] | Antenna Height [cm] | Turntable Azimuth [degree] | Analyzer Level [dBm] | AFCL [dB/m] | Field Strength [dBμV/m] | EIRP Spurious Emission Level [dBm] | Limit [dBm] | Margin [dB] |
|-----------------|-----------------|---------------------|----------------------------|----------------------|-------------|-------------------------|------------------------------------|-------------|-------------|
| 3765.0          | H               | -                   | -                          | -80.69               | 7.01        | 33.32                   | -61.94                             | -13.00      | -48.94      |
| 5647.5          | H               | 109                 | 204                        | -79.31               | 9.75        | 37.44                   | -57.81                             | -13.00      | -44.81      |
| 7530.0          | H               | -                   | -                          | -82.33               | 10.81       | 35.48                   | -59.78                             | -13.00      | -46.78      |
| 9412.5          | H               | -                   | -                          | -83.64               | 12.97       | 36.33                   | -58.93                             | -13.00      | -45.93      |
| 11295.0         | H               | -                   | -                          | -84.56               | 15.81       | 38.25                   | -57.01                             | -13.00      | -44.01      |

**Table 7-2. Radiated Spurious Data (LTE Band 2 – Mid Channel)**

|   |  |                                      |                                 |
|---|--|--------------------------------------|---------------------------------|
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## 8.0 CONCLUSION

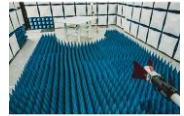
The spot-check data measured for variant model **FCC ID: BCGA2459** is in tolerance with reference model FCC ID: BCGA2301 per FCC Approved Data Referencing Test Plan.

|  |  |  |
|--|--|--|
| <b>FCC ID:</b> BCGA2459                        |  <b>PART 24 DATA REFERENCE REPORT</b> | <b>Approved by:</b><br>Quality Manager |
| <b>Test Report S/N:</b><br>1C2101020003-04.BCG | <b>Test Dates:</b><br>12/23/2020 - 03/05/2021  | <b>EUT Type:</b><br>Tablet Device      |
|  |  | Page 13 of 14                          |

## 9.0 APPENDIX A: REFERENCE MODEL TEST REPORT

Attached is the test report (1C2101020002-03.BCG) from reference model FCC ID: BCGA2301, which includes referenced data results.

|  |  |  |
|--|--|--|
| <b>FCC ID:</b> BCGA2459                        |  <b>PART 24 DATA REFERENCE REPORT</b> | <b>Approved by:</b><br>Quality Manager |
| <b>Test Report S/N:</b><br>1C2101020003-04.BCG | <b>Test Dates:</b><br>12/23/2020 - 03/05/2021  | <b>EUT Type:</b><br>Tablet Device      |
|  |  | Page 14 of 14                          |



## PART 24 MEASUREMENT REPORT

**Applicant Name:**

Apple Inc.  
One Apple Park Way  
Cupertino, CA 95014  
United States

**Date of Testing:**

12/23/2020 - 03/05/2021

**Test Site/Location:**

PCTEST Lab. Morgan Hill, CA, USA

**Test Report Serial No.:**

1C2101020002-03.BCG

**FCC ID:**

**BCGA2301**

**Applicant Name:**

**Apple Inc.**

**Application Type:**

Certification

**Model:**

A2301

**EUT Type:**

Tablet Device

**FCC Classification:**

PCS Licensed Transmitter (PCB)

**FCC Rule Part:**


24


**Test Procedure(s):**

ANSI C63.26-2015, TIA-603-E-2016, KDB 971168 D01  
v03r01

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in §2.947. Test results reported herein relate only to the item(s) tested.


I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

  
Randy Ortanez  
President

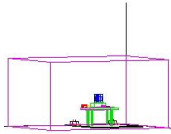
|  |   |  |
|--|---|--|
| <b>FCC ID:</b> BCGA2301                        |  <b>PART 24 MEASUREMENT REPORT</b> | <b>Approved by:</b><br>Quality Manager |
| <b>Test Report S/N:</b><br>1C2101020002-03.BCG | <b>Test Dates:</b><br>12/23/2020 - 03/05/2021   | <b>EUT Type:</b><br>Tablet Device      |
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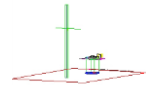
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|--|---|-----------------------------------|--|
| <b>FCC ID:</b> BCGA2301                        |  <b>PCTEST</b><br><small>Proud to be part of element</small> | <b>PART 24 MEASUREMENT REPORT</b> | <b>Approved by:</b><br>Quality Manager |
| <b>Test Report S/N:</b><br>1C2101020002-03.BCG | <b>Test Dates:</b><br>12/23/2020 - 03/05/2021   | <b>EUT Type:</b><br>Tablet Device | Page 2 of 196                          |






## PART 24 MEASUREMENT REPORT



| Mode          | Bandwidth | Modulation      | Tx Frequency Range [MHz] | OBW [MHz] | PAR at 0.1% [dB] | EIRP           |                  | Emission Designator |
|---------------|-----------|-----------------|--------------------------|-----------|------------------|----------------|------------------|---------------------|
|               |           |                 |                          |           |                  | Max. Power [W] | Max. Power [dBm] |                     |
| GSM/GPRS 1900 | 250 kHz   | GMSK            | 1850.2 - 1909.8          | 0.2435    | 0.33             | 1.629          | 32.12            | 243KGXW             |
| EDGE 1900     |           | 8-PSK           | 1850.2 - 1909.8          | 0.2390    | 5.21             | 0.513          | 27.10            | 239KG7W             |
| WCDMA 1900    | 5 MHz     | Spread Spectrum | 1852.4 - 1907.6          | 4.1628    | 2.87             | 0.513          | 27.10            | 4M16F9W             |
| LTE Band 2    | 20 MHz    | QPSK            | 1860 - 1900              | 18.0240   | 4.92             | 0.513          | 27.10            | 18M0G7W             |
|               |           | 16QAM           | 1861 - 1900              | 17.9930   | 5.77             | 0.471          | 26.73            | 18M0D7W             |
|               |           | 64QAM           | 1862 - 1900              | 17.9760   | 6.70             | 0.416          | 26.19            | 18M0D7W             |
|               |           | 256QAM          | 1863 - 1900              | 18.0340   | 6.79             | 0.180          | 22.55            | 18M0D7W             |
|               | 15 MHz    | QPSK            | 1857.5 - 1902.5          | 13.5210   | 4.88             | 0.513          | 27.10            | 13M5G7W             |
|               |           | 16QAM           | 1857.5 - 1902.5          | 13.5170   | 5.70             | 0.455          | 26.58            | 13M5D7W             |
|               |           | 64QAM           | 1857.5 - 1902.5          | 13.5340   | 6.73             | 0.402          | 26.04            | 13M5D7W             |
|               |           | 256QAM          | 1857.5 - 1902.5          | 13.5090   | 6.80             | 0.195          | 22.90            | 13M5D7W             |
|               | 10 MHz    | QPSK            | 1855 - 1905              | 9.0119    | 5.04             | 0.513          | 27.10            | 9M01G7W             |
|               |           | 16QAM           | 1856 - 1905              | 9.0219    | 5.95             | 0.449          | 26.52            | 9M02D7W             |
|               |           | 64QAM           | 1857 - 1905              | 9.0020    | 6.63             | 0.398          | 26.00            | 9M00D7W             |
|               |           | 256QAM          | 1858 - 1905              | 8.9986    | 6.71             | 0.192          | 22.84            | 9M00D7W             |
|               | 5 MHz     | QPSK            | 1858 - 1905              | 4.5312    | 5.45             | 0.513          | 27.10            | 4M53G7W             |
|               |           | 16QAM           | 1858 - 1905              | 4.5239    | 5.89             | 0.463          | 26.66            | 4M52D7W             |
|               |           | 64QAM           | 1858 - 1905              | 4.5230    | 6.71             | 0.409          | 26.12            | 4M52D7W             |
|               |           | 256QAM          | 1858 - 1905              | 4.5286    | 6.78             | 0.179          | 22.52            | 4M53D7W             |
|               | 3 MHz     | QPSK            | 1851.5 - 1908.5          | 2.7121    | 5.39             | 0.513          | 27.10            | 2M71G7W             |
|               |           | 16QAM           | 1851.5 - 1908.5          | 2.7010    | 5.85             | 0.450          | 26.53            | 2M70D7W             |
|               |           | 64QAM           | 1851.5 - 1908.5          | 2.7040    | 6.73             | 0.394          | 25.96            | 2M70D7W             |
|               |           | 256QAM          | 1851.5 - 1908.5          | 2.7150    | 6.78             | 0.194          | 22.88            | 2M72D7W             |
|               | 1.4 MHz   | QPSK            | 1850.7 - 1909.3          | 1.0985    | 4.82             | 0.513          | 27.10            | 1M10G7W             |
|               |           | 16QAM           | 1850.7 - 1909.3          | 1.1008    | 5.81             | 0.453          | 26.56            | 1M10D7W             |
|               |           | 64QAM           | 1850.7 - 1909.3          | 1.0898    | 7.57             | 0.398          | 26.00            | 1M09D7W             |
|               |           | 256QAM          | 1850.7 - 1909.3          | 1.0957    | 6.91             | 0.178          | 22.51            | 1M10D7W             |
| LTE Band 25   | 20 MHz    | QPSK            | 1860 - 1905              | 18.0240   | 5.00             | 0.513          | 27.10            | 18M0G7W             |
|               |           | 16QAM           | 1860 - 1905              | 17.9930   | 5.97             | 0.473          | 26.75            | 18M0D7W             |
|               |           | 64QAM           | 1860 - 1905              | 17.9760   | 6.67             | 0.401          | 26.03            | 18M0D7W             |
|               |           | 256QAM          | 1860 - 1905              | 18.0340   | 6.66             | 0.176          | 22.46            | 18M0D7W             |
|               | 15 MHz    | QPSK            | 1857.5 - 1907.5          | 13.5210   | 4.87             | 0.513          | 27.10            | 13M5G7W             |
|               |           | 16QAM           | 1857.5 - 1907.5          | 13.5170   | 5.85             | 0.431          | 26.34            | 13M5D7W             |
|               |           | 64QAM           | 1857.5 - 1907.5          | 13.5340   | 6.72             | 0.368          | 25.66            | 13M5D7W             |
|               |           | 256QAM          | 1857.5 - 1907.5          | 13.5090   | 6.67             | 0.178          | 22.50            | 13M5D7W             |
|               | 10 MHz    | QPSK            | 1855 - 1910              | 9.0119    | 4.92             | 0.513          | 27.10            | 9M01G7W             |
|               |           | 16QAM           | 1855 - 1910              | 9.0219    | 5.73             | 0.453          | 26.56            | 9M02D7W             |
|               |           | 64QAM           | 1855 - 1910              | 9.0020    | 6.59             | 0.352          | 25.47            | 9M00D7W             |
|               |           | 256QAM          | 1855 - 1910              | 8.9986    | 6.64             | 0.186          | 22.70            | 9M00D7W             |
|               | 5 MHz     | QPSK            | 1852.5 - 1912.5          | 4.5312    | 5.44             | 0.513          | 27.10            | 4M53G7W             |
|               |           | 16QAM           | 1852.5 - 1912.5          | 4.5239    | 5.67             | 0.416          | 26.19            | 4M52D7W             |
|               |           | 64QAM           | 1852.5 - 1912.5          | 4.5230    | 6.65             | 0.390          | 25.91            | 4M52D7W             |
|               |           | 256QAM          | 1852.5 - 1912.5          | 4.5286    | 6.68             | 0.176          | 22.46            | 4M53D7W             |
|               | 3 MHz     | QPSK            | 1851.5 - 1913.5          | 2.7121    | 5.10             | 0.513          | 27.10            | 2M71G7W             |
|               |           | 16QAM           | 1851.5 - 1913.5          | 2.7010    | 5.84             | 0.369          | 25.67            | 2M70D7W             |
|               |           | 64QAM           | 1851.5 - 1913.5          | 2.7040    | 6.76             | 0.367          | 25.85            | 2M70D7W             |
|               |           | 256QAM          | 1851.5 - 1913.5          | 2.7150    | 6.64             | 0.181          | 22.58            | 2M72D7W             |
|               | 1.4 MHz   | QPSK            | 1850.7 - 1914.3          | 1.0985    | 4.76             | 0.513          | 27.10            | 1M10G7W             |
|               |           | 16QAM           | 1850.7 - 1914.3          | 1.1008    | 5.77             | 0.405          | 26.07            | 1M10D7W             |
|               |           | 64QAM           | 1850.7 - 1914.3          | 1.0898    | 6.84             | 0.356          | 25.52            | 1M09D7W             |
|               |           | 256QAM          | 1850.7 - 1914.3          | 1.0957    | 6.75             | 0.173          | 22.38            | 1M10D7W             |
| NR Band n2    | 20 MHz    | $\pi/2$ BPSK    | 1860 - 1900              | 17.9950   | 3.95             | 0.500          | 26.99            | 18M0G7W             |
|               |           | QPSK            | 1860 - 1900              | 19.0330   | 5.27             | 0.513          | 27.10            | 19M0D7W             |
|               |           | 16QAM           | 1860 - 1900              | 19.0750   | 6.16             | 0.423          | 26.26            | 19M1D7W             |
|               |           | 64QAM           | 1860 - 1900              | 19.0330   | 6.49             | 0.276          | 24.41            | 19M0D7W             |
|               | 15 MHz    | 256QAM          | 1860 - 1900              | 18.9830   | 6.77             | 0.196          | 22.93            | 19M0D7W             |
|               |           | $\pi/2$ BPSK    | 1857.5 - 1902.5          | 13.5150   | 4.05             | 0.501          | 27.00            | 13M5G7W             |
|               |           | QPSK            | 1857.5 - 1902.5          | 14.2180   | 5.30             | 0.513          | 27.10            | 14M2G7W             |
|               |           | 16QAM           | 1857.5 - 1902.5          | 14.2160   | 6.27             | 0.434          | 26.37            | 14M2D7W             |
|               |           | 64QAM           | 1857.5 - 1902.5          | 14.2200   | 6.55             | 0.288          | 24.59            | 14M2D7W             |
|               | 10 MHz    | 256QAM          | 1857.5 - 1902.5          | 14.1630   | 6.74             | 0.184          | 22.65            | 14M2D7W             |
|               |           | $\pi/2$ BPSK    | 1855 - 1905              | 8.9782    | 4.08             | 0.500          | 26.99            | 8M98G7W             |
|               |           | QPSK            | 1855 - 1905              | 9.3238    | 5.56             | 0.512          | 27.09            | 9M32G7W             |
|               |           | 16QAM           | 1855 - 1905              | 9.3209    | 6.37             | 0.441          | 26.44            | 9M32D7W             |
|               | 5 MHz     | 64QAM           | 1855 - 1905              | 9.3595    | 6.58             | 0.238          | 24.74            | 9M36D7W             |
|               |           | 256QAM          | 1855 - 1905              | 9.3691    | 6.80             | 0.173          | 22.38            | 9M37D7W             |
|               |           | $\pi/2$ BPSK    | 1852.5 - 1902.5          | 4.5237    | 3.82             | 0.513          | 27.10            | 4M52G7W             |
|               |           | QPSK            | 1852.5 - 1902.5          | 4.4924    | 5.15             | 0.500          | 26.99            | 4M49G7W             |
|               | 1.4 MHz   | 16QAM           | 1852.5 - 1902.5          | 4.5226    | 6.14             | 0.419          | 26.22            | 4M52D7W             |
|               |           | 64QAM           | 1852.5 - 1902.5          | 4.5077    | 6.44             | 0.277          | 24.42            | 4M51D7W             |
|               |           | 256QAM          | 1852.5 - 1902.5          | 4.5029    | 7.14             | 0.175          | 22.42            | 4M50D7W             |
| NR Band n25   | 20 MHz    | $\pi/2$ BPSK    | 1860 - 1905              | 17.9950   | 3.85             | 0.505          | 27.03            | 18M0G7W             |
|               |           | QPSK            | 1860 - 1905              | 19.0330   | 5.23             | 0.513          | 27.10            | 19M0D7W             |
|               |           | 16QAM           | 1860 - 1905              | 19.0750   | 6.12             | 0.432          | 26.35            | 19M1D7W             |
|               |           | 64QAM           | 1860 - 1905              | 19.0330   | 6.46             | 0.302          | 24.80            | 19M0D7W             |
|               | 15 MHz    | 256QAM          | 1860 - 1905              | 18.9830   | 6.61             | 0.199          | 22.98            | 19M0D7W             |
|               |           | $\pi/2$ BPSK    | 1857.5 - 1907.5          | 13.5150   | 4.02             | 0.508          | 27.06            | 13M5G7W             |
|               |           | QPSK            | 1857.5 - 1907.5          | 14.2180   | 5.29             | 0.513          | 27.10            | 14M2G7W             |
|               |           | 16QAM           | 1857.5 - 1907.5          | 14.2160   | 6.21             | 0.411          | 26.14            | 14M2D7W             |
|               | 10 MHz    | 64QAM           | 1857.5 - 1907.5          | 14.2200   | 6.49             | 0.292          | 24.66            | 14M2D7W             |
|               |           | 256QAM          | 1857.5 - 1907.5          | 14.1630   | 6.85             | 0.192          | 22.83            | 14M2D7W             |
|               |           | $\pi/2$ BPSK    | 1855 - 1910              | 8.9782    | 4.10             | 0.511          | 27.08            | 8M98G7W             |
|               |           | QPSK            | 1855 - 1910              | 9.3238    | 5.51             | 0.513          | 27.10            | 9M32G7W             |
|               | 5 MHz     | 16QAM           | 1855 - 1910              | 9.3209    | 6.29             | 0.422          | 26.25            | 9M32D7W             |
|               |           | 64QAM           | 1855 - 1910              | 9.3595    | 6.43             | 0.285          | 24.55            | 9M36D7W             |
|               |           | 256QAM          | 1855 - 1910              | 9.3691    | 6.73             | 0.183          | 22.62            | 9M37D7W             |
|               |           | $\pi/2$ BPSK    | 1852.5 - 1912.5          | 4.5237    | 3.78             | 0.511          | 27.08            | 4M52G7W             |
|               | 1.4 MHz   | QPSK            | 1852.5 - 1912.5          | 4.4924    | 5.11             | 0.513          | 27.10            | 4M49G7W             |
|               |           | 16QAM           | 1852.5 - 1912.5          | 4.5226    | 6.16             | 0.441          | 26.44            | 4M52D7W             |
|               |           | 64QAM           | 1852.5 - 1912.5          | 4.5077    | 6.37             | 0.290          | 24.63            | 4M51D7W             |
|               |           | 256QAM          | 1852.5 - 1912.5          | 4.5029    | 7.11             | 0.193          | 22.86            | 4M50D7W             |

### EUT Overview

|   |   |                            |                                 |
|---|---|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        |  <b>PART 24 MEASUREMENT REPORT</b> |                            | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021  | EUT Type:<br>Tablet Device | Page 3 of 196                   |

## 1.0 INTRODUCTION

### 1.1 Scope


Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada.

### 1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST facility located at 18855 Adams Court, Morgan Hill, CA 95037. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014 and KDB 414788 D01 v01r01.

### 1.3 Test Facility / Accreditations

- PCTEST is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.02 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISSED Standards (RSS).
- PCTEST facility is a registered (22831) test laboratory with the site description on file with ISSED.

|   |   |                            |                                 |
|---|---|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        |  <b>PART 24 MEASUREMENT REPORT</b> |                            | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021  | EUT Type:<br>Tablet Device | Page 4 of 196                   |

## 2.0 PRODUCT INFORMATION

### 2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Tablet Device FCC ID:BCGA2301**. The test data contained in this report pertains only to the emissions due to the EUT's licensed transmitters that operate under the provisions of Part 24.

**Test Device Serial No.:** NQ73CFK6VJ, LGXMHP6X6Y

### 2.2 Device Capabilities

This device contains the following capabilities:

850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, 5G NR (FR1/FR2), 802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII, Bluetooth (1x, EDR, LE1M, LE2M, HDR4, HDR8), WPT

This device supports BT Beamforming

This device supports simultaneous transmission operations, which allows for multiple transmitters to transmit simultaneously on the same antenna. The table below shows all configurations possible.


| Antenna | Simultaneous Tx Config | WLAN            | Bluetooth                | GSM / WCDMA | LTE / FR1 NR |           |                 | UNII             |
|---------|------------------------|-----------------|--------------------------|-------------|--------------|-----------|-----------------|------------------|
|         |                        | 802.11 b/g/n/ax | BDR, EDR, HDR4/8, LE1/2M | Mid Band    | Mid Band     | High Band | Ultra High Band | 802.11 a/n/ac/ax |
| 2a      | Config 1               | ✓               | ✗                        | ✗           | ✗            | ✗         | ✓               | ✗                |
| 2a      | Config 2               | ✗               | ✓                        | ✗           | ✗            | ✗         | ✓               | ✗                |
| 4a      | Config 3               | ✓               | ✗                        | ✗           | ✗            | ✗         | ✓               | ✗                |
| 4a      | Config 4               | ✗               | ✓                        | ✗           | ✗            | ✗         | ✓               | ✗                |
| 4b      | Config 5               | ✗               | ✗                        | ✓           | ✗            | ✗         | ✗               | ✓                |
| 4b      | Config 6               | ✗               | ✗                        | ✗           | ✓            | ✗         | ✗               | ✓                |
| 4b      | Config 7               | ✗               | ✗                        | ✗           | ✗            | ✓         | ✗               | ✓                |

**Table 2-1. Simultaneous Transmission Configurations**

✓ = Support; ✗ = Not Support

**Note:**

All the above simultaneous transmission configurations have been tested and the worst case configuration was found to be config 6 and reported in UNII (OFDMA) and Part 27a test reports.

|   |   |                            |                                 |
|---|---|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        |  <b>PART 24 MEASUREMENT REPORT</b> |                            | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021  | EUT Type:<br>Tablet Device | Page 5 of 196                   |

## 2.3 Antenna Description

Following antenna gains provided by manufacturer were used for the testing.

| Band           | Antenna Gain (dBi) |           |            |            |
|----------------|--------------------|-----------|------------|------------|
|                | Antenna 3          | Antenna 1 | Antenna 4b | Antenna 2b |
| GPRS1900       | 1.4                | -0.1      | -3.9       | -4.5       |
| EDGE1900       |                    |           |            |            |
| WCDMA1900      |                    |           |            |            |
| LTE Band 2/25  |                    |           |            |            |
| NR Band n2/n25 |                    |           |            |            |

**Table 2-2. Highest Antenna Gain**

## 2.4 Test Support Equipment

|   |                   |        |          |      |              |
|---|-------------------|--------|----------|------|--------------|
| 1 | Apple MacBook Pro | Model: | A2141    | S/N: | C02DV7VKMD6T |
|   | w/AC/DC Adapter   | Model: | A2166    | S/N: | N/A          |
| 2 | Apple USB-C Cable | Model: | Chimp    | S/N: | 420A57       |
| 3 | USB-C Cable       | Model: | A146     | S/N: | N/A          |
|   | w/ AC Adapter     | Model: | A2305    | S/N: | N/A          |
| 4 | Apple Pencil      | Model: | N/A      | S/N: | GQXYGSXBJKM9 |
| 5 | DC Power Supply   | Model: | KPS3010D | S/N: | N/A          |


**Table 2-3. Test Support Equipment**

## 2.5 Test Configuration

The EUT was tested per the guidance of ANSI C63.26 2015, TIA-603-E-2016 and KDB 971168 D01 v03r01. See Section 7.0 of this test report for a description of the radiated and antenna port conducted emissions tests.

For emissions from 1GHz – 18GHz, low, mid, and high channels were tested with highest power and worst case configuration. The emissions below 1GHz and above 18GHz were tested with the highest transmitting power and the worst case channel.

The EUT was manipulated through three orthogonal planes of X-orientation (flatbed), Y-orientation (landscape), and Z-orientation (portrait) during the testing. Only the worst case emissions were reported in this test report.


|  |   |                                   |  |
|--|---|-----------------------------------|--|
| FCC ID: BCGA2301                               |  <b>PCTEST</b><br><small>Proud to be part of element</small> | <b>PART 24 MEASUREMENT REPORT</b> | <b>Approved by:</b><br>Quality Manager |
| <b>Test Report S/N:</b><br>1C2101020002-03.BCG | <b>Test Dates:</b><br>12/23/2020 - 03/05/2021   | <b>EUT Type:</b><br>Tablet Device | Page 6 of 196                          |

## 2.6 Software and Firmware

The test was conducted with firmware version 18E20700y installed on the EUT.

## 2.7 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and no modifications were made during testing.

|  |   |                                   |  |
|--|---|-----------------------------------|--|
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## 3.0 DESCRIPTION OF TESTS

### 3.1 Measurement Procedure

The measurement procedures described in the document titled "Land Mobile FM or PM – Communications Equipment – Measurements and Performance Standards" (ANSI C63.26-2015/TIA-603-E-2016) and "Procedures for Compliance Measurement of the Fundamental Emission Power of Licensed Wideband (> 1 MHz) Digital Transmission Systems" (KDB 971168 D01 v03r01) were used in the measurement of the EUT.

### 3.2 Radiated Spurious Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. For measurements below 1GHz, the absorbers are removed. A raised turntable is used for radiated measurement. The turn table is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm tall test table made of Styrodur is placed on top of the turn table. A Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

The equipment under test was transmitting while connected to its integral antenna and is placed on a turntable 3 meters from the receive antenna. The receive antenna height is adjusted between 1 and 4 meter height, the turntable is rotated through 360 degrees, and the EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer.

For radiated spurious emissions measurements and calculations, conversion method is used per the formulas in KDB 971168 Section 5.8.4. Field Strength (EIRP) is calculated using the following formulas:

$$E_{[dB\mu V/m]} = \text{Measured amplitude level}_{[dBm]} + 107 + \text{Cable Loss}_{[dB]} + \text{Antenna Factor}_{[dB/m]}$$

And


$$\text{EIRP}_{[dBm]} = E_{[dB\mu V/m]} + 20\log D - 104.8;$$

Where D is the measurement distance in meters.

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014.

Per KDB 414788 D01 v01r01, radiated emission test sites other than open-field test sites (e.g., shielded anechoic chambers), may be employed for emission measurements below 30MHz if characterized so that the measurements correspond to those obtained at an open-field test site. To determine test site equivalency, a reference sample transmitting at 149kHz was measured on an open field test site (asphalt with no ground plane) and then measured in the 3m semi-anechoic chamber. A calibrated 60cm loop antenna was used while the reference device was rotated through the X, Y and Z axis in order to capture the worst case level. A maximum deviation of 2.77dB at 149kHz was measured when comparing the 3 meter semi-anechoic chamber to the open field site.


Radiated spurious emission levels are investigated with the receive antenna horizontally and vertically polarized per ANSI C63.26-2015 and TIA-603-E-2016.

|  |  |                                   |  |
|--|--|-----------------------------------|--|
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## 4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.23-2012. All measurement uncertainty values are shown with a coverage factor of  $k = 2$  to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the  $U_{\text{CISPR}}$  measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

| Contribution                      | Expanded Uncertainty ( $\pm$ dB) |
|-----------------------------------|----------------------------------|
| Conducted Bench Top Measurements  | 1.65                             |
| Radiated Disturbance (<30MHz)     | 4.06                             |
| Radiated Disturbance (30MHz-1GHz) | 4.30                             |
| Radiated Disturbance (1-18GHz)    | 4.78                             |
| Radiated Disturbance (>18GHz)     | 4.79                             |

|   |   |                                 |
|---|---|---------------------------------|
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## 5.0 TEST EQUIPMENT CALIBRATION DATA


Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

| Manufacturer         | Model       | Description                                    | Cal Date   | Cal Interval | Cal Due    | Serial Number |
|----------------------|-------------|--|------------|--------------|------------|---------------|
| Agilent Technologies | N9030A      | PXA Signal Analyzer (3Hz - 26.5 GHz)           | 7/24/2020  | Annual       | 7/24/2021  | MY55330128    |
| Keysight Technology  | N9040B      | UXA Signal Analyzer                            | 12/19/2020 | Annual       | 12/19/2021 | MY57212015    |
| Keysight Technology  | E7515B      | UXM 5G Wireless Test Platform                  | 11/14/2020 | Annual       | 11/14/2021 | MY60192562    |
| ATM                  | 180-442A-KF | 20dB Nominal Gain Horn Antenna                 | 8/11/2020  | Annual       | 8/11/2021  | T058701-01    |
| ESPEC                | SU-241      | Tabletop Temperature Chamber                   | 9/28/2020  | Annual       | 9/28/2021  | 92009574      |
| ETS-Lindgren         | 3142E       | BiConiLog Antenna (30MHz - 6GHz)               | 9/15/2020  | Annual       | 9/15/2021  | 208204        |
| ETS-Lindgren         | 3117        | Double Ridged Guide Antenna (1-18 GHz)         | 4/21/2020  | Annual       | 4/21/2021  | 205956        |
| Rohde & Schwarz      | TS-PR8      | Pre-Amplifier (30MHz - 8GHz)                   | 7/15/2020  | Annual       | 7/15/2021  | 102356        |
| Rohde & Schwarz      | TS-PR18     | Pre-Amplifier (1GHz - 18GHz)                   | 12/3/2020  | Annual       | 12/3/2021  | 101648        |
| Rohde & Schwarz      | ESW26       | EMI Test Receiver                              | 6/8/2020   | Annual       | 6/8/2021   | 101299        |
| Rohde & Schwarz      | ESW44       | EMI Test Receiver                              | 8/6/2020   | Annual       | 8/6/2021   | 101668        |
| Rohde & Schwarz      | CMW500      | Wideband Radio Communication Tester            | 10/13/2020 | Annual       | 10/13/2021 | 161616        |
| Rohde & Schwarz      | CMW500      | Wideband Radio Communication Tester            | 4/16/2020  | Annual       | 4/16/2021  | 166869        |
| Rohde & Schwarz      | TS-PR1840   | Pre-Amplifier (18GHz - 40GHz)                  | 4/23/2020  | Annual       | 4/23/2021  | 100052        |
| Rohde & Schwarz      | TC-TA18     | Cross Polarized Vivaldi Antenna (400MHz-18GHz) | 10/2/2020  | Annual       | 10/2/2021  | 101063        |
| Rohde & Schwarz      | HFH2-Z2     | Loop Antenna                                   | 3/12/2020  | Annual       | 3/12/2021  | 100546        |

**Table 5-1. Test Equipment**

### Notes:

1. For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

|  |  |                                   |  |
|--|--|-----------------------------------|--|
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## 6.0 SAMPLE CALCULATIONS

### GSM Emission Designator

#### **Emission Designator = 250KGXW**

GSM BW = 250 kHz

G = Phase Modulation

X = Cases not otherwise covered

W = Combination (Audio/Data)

### EDGE Emission Designator

#### **Emission Designator = 250KG7W**

EDGE BW = 250 kHz

G = Phase Modulation

7 = Quantized/Digital Info

W = Combination (Audio/Data)

### WCDMA Emission Designator

#### **Emission Designator = 4M16F9W**

WCDMA BW = 4.16 MHz

F = Frequency Modulation

9 = Composite Digital Info

W = Combination (Audio/Data)

### $\pi/2$ BPSK / QPSK Modulation

#### **Emission Designator = 8M62G7W**

BW = 8.62 MHz

G = Phase Modulation

7 = Quantized/Digital Info

W = Combination of Any

### QAM Modulation

#### **Emission Designator = 8M45D7W**

BW = 8.45 MHz

D = Amplitude/Angle Modulated


7 = Quantized/Digital Info

W = Combination of Any

### Spurious Radiated Emission

#### **Example: Spurious emission at 3700.40 MHz**

The receive spectrum analyzer reading at 3 meters with the EUT on the turntable was  $-81.0$  dBm. The gain of the substituted antenna is 8.1 dBi. The signal generator connected to the substituted antenna terminals is adjusted to produce a reading of  $-81.0$  dBm on the spectrum analyzer. The loss of the cable between the signal generator and the terminals of the substituted antenna is 2.0 dB at 3700.40 MHz. So 6.1 dB is added to the signal generator reading of  $-30.9$  dBm yielding  $-24.80$  dBm. The fundamental EIRP was 25.50 dBm so this harmonic was  $25.50$  dBm  $- (-24.80) = 50.3$  dBc.

|  |   |                                   |  |
|--|---|-----------------------------------|--|
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## 7.0 TEST RESULTS

### 7.1 Summary


Company Name: Apple Inc.  
 FCC ID: BCGA2301  
 FCC Classification: PCS Licensed Transmitter (PCB)  
 Mode(s): GSM/GPRS/EDGE/WCDMA/LTE/NR

| Test Condition | Test Description   | FCC Part Section(s) | Test Limit  | Test Result | Reference              |
|----------------|--|---------------------|---|-------------|------------------------|
| CONDUCTED      | Occupied Bandwidth   | 2.1049              | N/A   | N/A         | Section 7.2            |
|                | Conducted Band Edge / Spurious Emissions                       | 2.1051, 24.238(a)   | $> 43 + 10\log_{10}(P[\text{Watts}])$ at Band Edge and for all out-of-band emissions  | PASS        | Sections 7.3, 7.4      |
|                | Peak-Average Ratio   | 24.232(d)           | $< 13$ dB   | PASS        | Section 7.5            |
|                | Transmitter Conducted Output Power                             | 2.1046              | N/A   | N/A         | See RF Exposure Report |
|                | Frequency Stability  | 2.1055, 24.235      | The lowest and highest channel of this band have been tested and is determined to remain operating in-band over the temperature and voltage range as tested | PASS        | Section 7.8            |
|                | Effective Radiated Power / Equivalent Isotropic Radiated Power | 24.232(c)           | $< 2$ Watts max. EIRP   | PASS        | Section 7.6            |
| RADIATED       | Radiated Spurious Emissions                                    | 2.1053, 24.238(a)   | $> 43 + 10\log_{10}(P[\text{Watts}])$ for all out-of-band emissions   | PASS        | Section 7.7            |

**Table 7-1. Summary of Test Results**

#### Notes:

- 1) All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
- 2) The analyzer plots were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables, directional couplers, and attenuators used as part of the system to maintain a link between the call box and the EUT at all frequencies of interest.
- 3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables, attenuators, and couplers.
- 4) All conducted emissions measurements are performed with automated test software to capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST 2G/3G Automation Version 4.5 and LTE Automation Version 5.3.

|   |   |                            |                                 |
|---|---|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        |  <b>PART 24 MEASUREMENT REPORT</b> |                            | Approved by:<br>Quality Manager |
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## 7.2 Occupied Bandwidth

### \$2.1049

#### Test Overview

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. All modes of operation were investigated and the worst case configuration results are reported in this section. All ports were tested and only the worst case data were reported.

#### Test Procedure Used

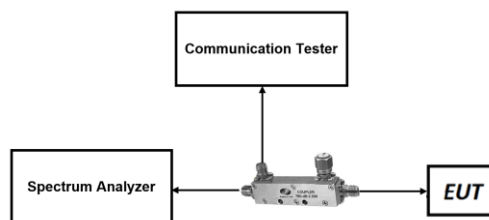
KDB 971168 D01 v03r01 – Section 4.2

#### Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth and the 26dB bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% of the expected OBW
3. VBW  $\geq 3 \times$  RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7

#### Test Setup


The EUT and measurement equipment were set up as shown in the diagram below.



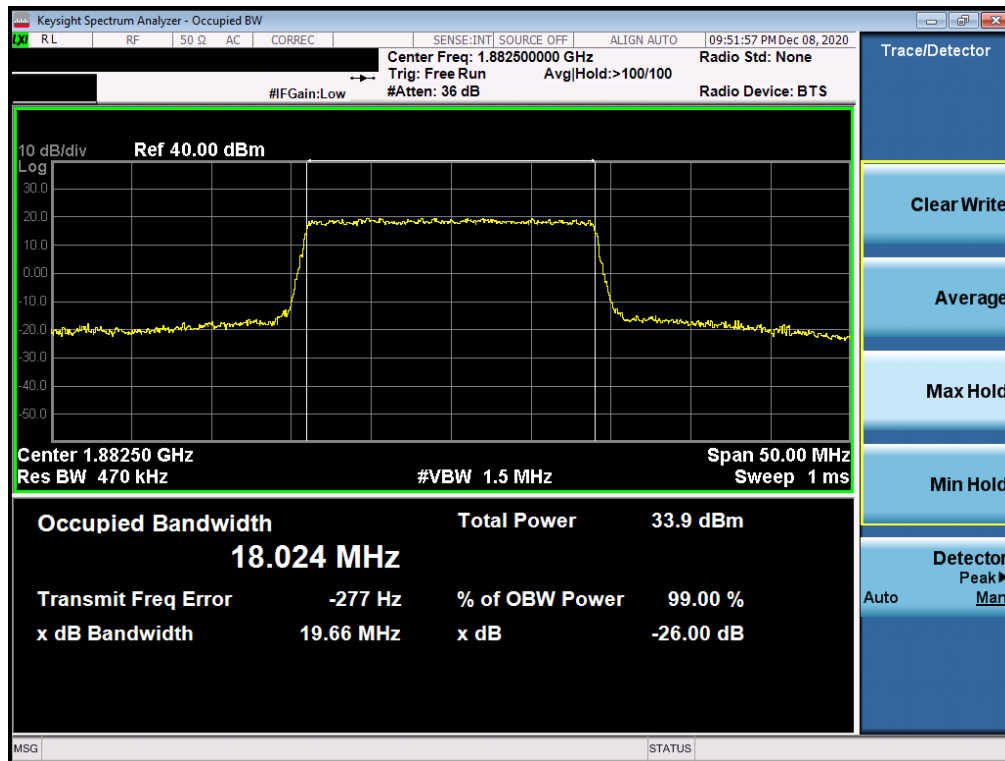
**Figure 7-1. Test Instrument & Measurement Setup**

#### Test Notes

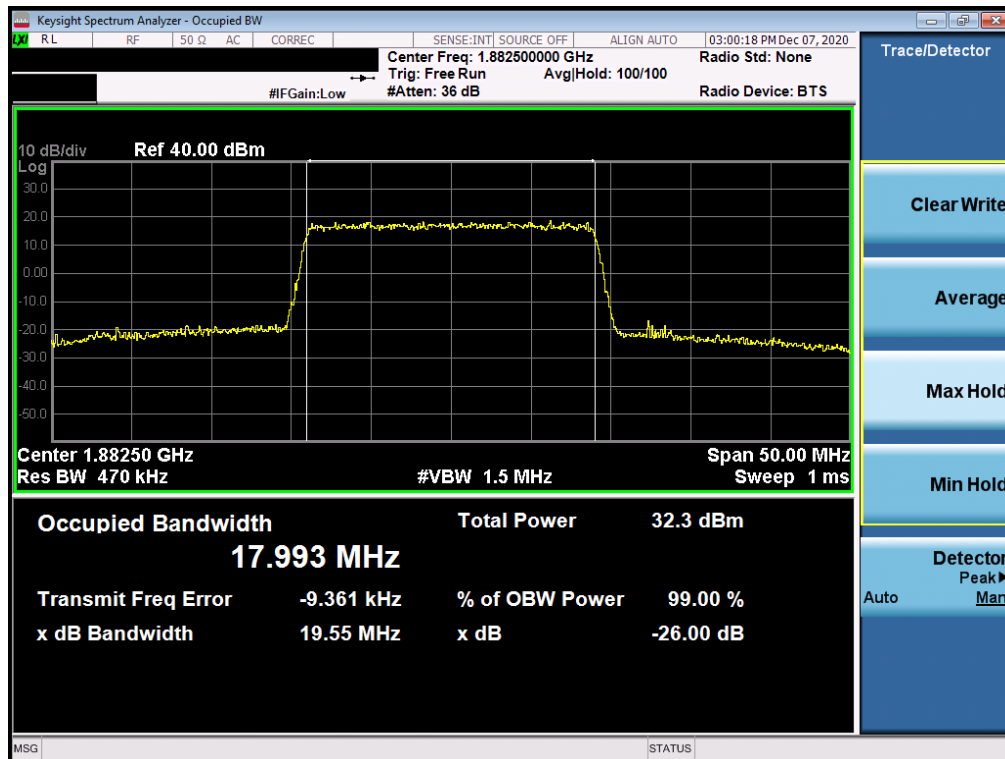
None.

|   |   |                            |                                 |
|---|---|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        |  <b>PART 24 MEASUREMENT REPORT</b> |                            | Approved by:<br>Quality Manager |
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## LTE Band 25/2

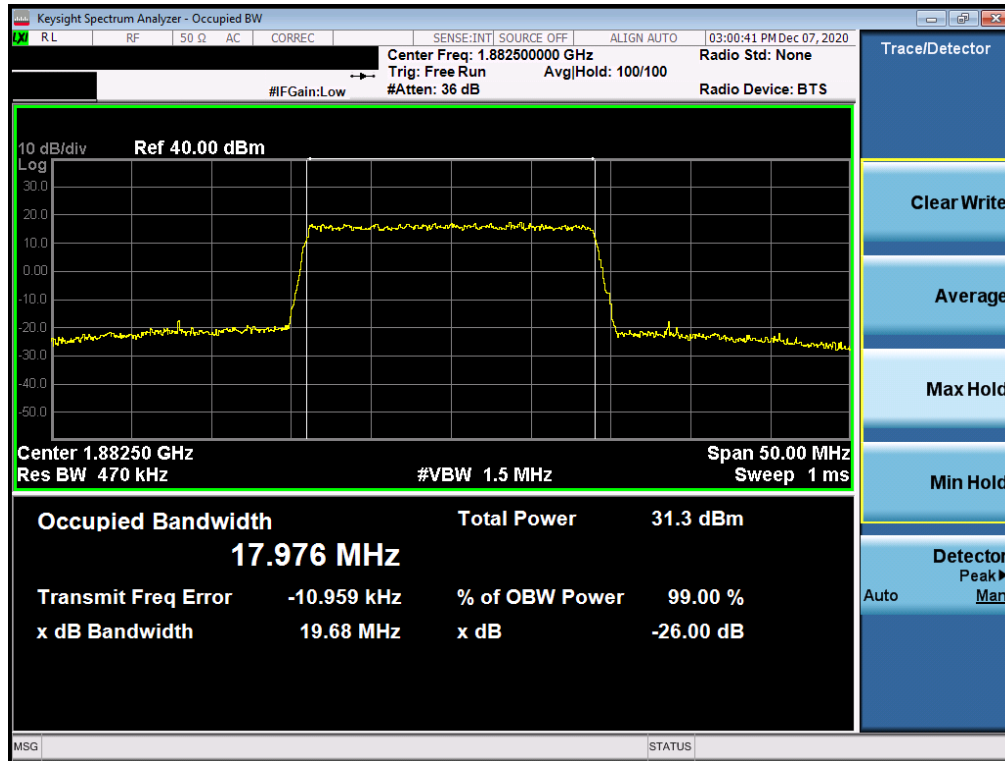


Plot 7-1. Occupied Bandwidth Plot (LTE Band 25/2 - 20MHz QPSK - Full RB Configuration)

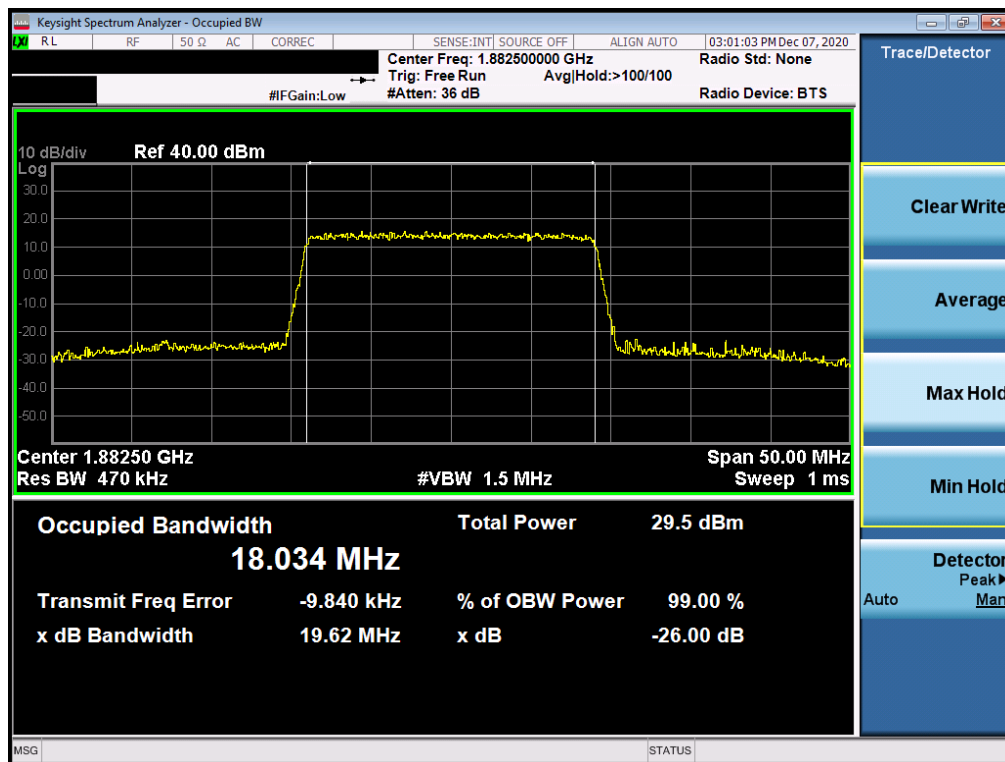


Plot 7-2. Occupied Bandwidth Plot (LTE Band 25/2 - 20MHz 16-QAM - Full RB Configuration)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
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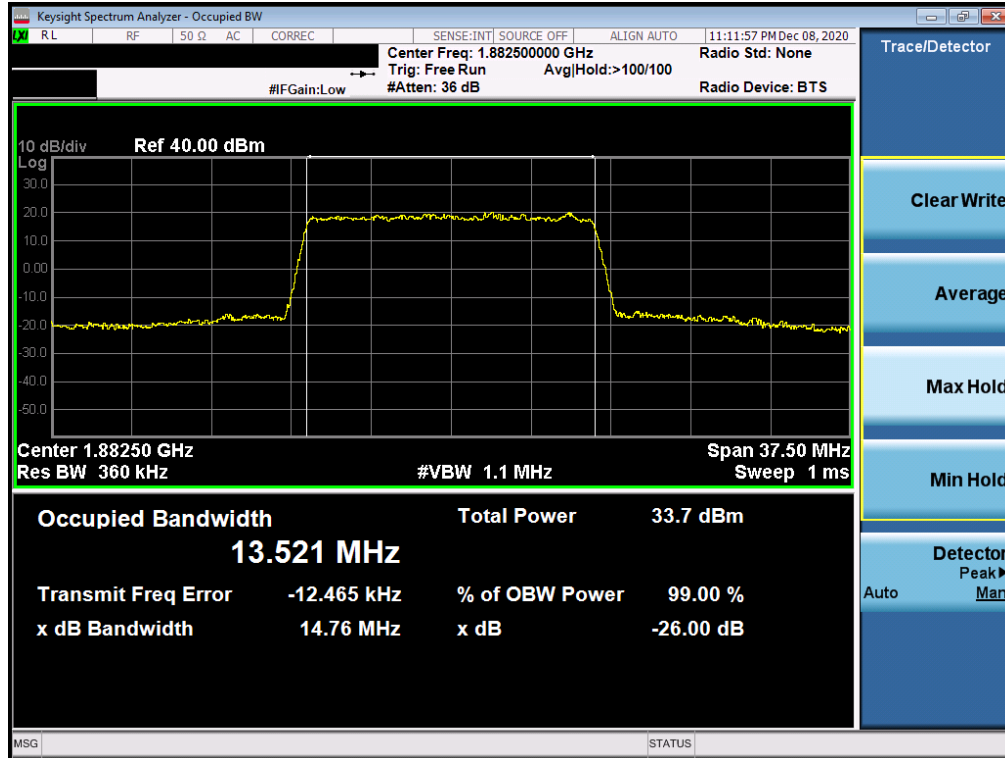


Plot 7-3. Occupied Bandwidth Plot (LTE Band 25/2 - 20MHz 64-QAM - Full RB Configuration)

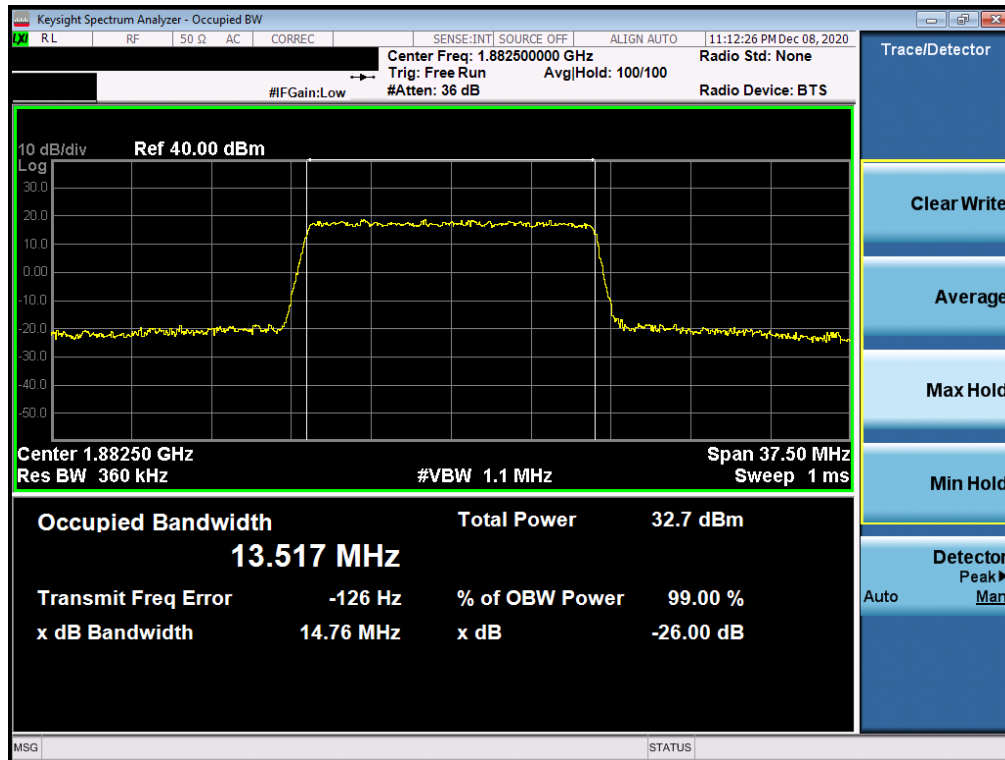


Plot 7-4. Occupied Bandwidth Plot (LTE Band 25/2 - 20MHz 256-QAM - Full RB Configuration)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 15 of 196                  |

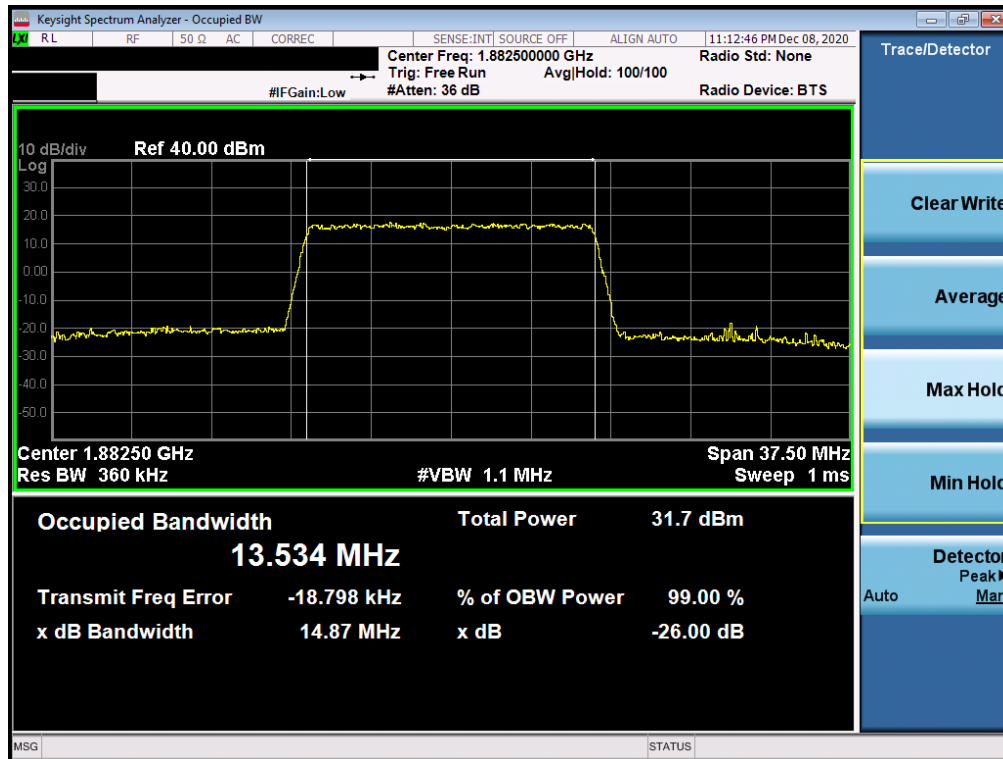


Plot 7-5. Occupied Bandwidth Plot (LTE Band 25/2 - 15MHz QPSK - Full RB Configuration)

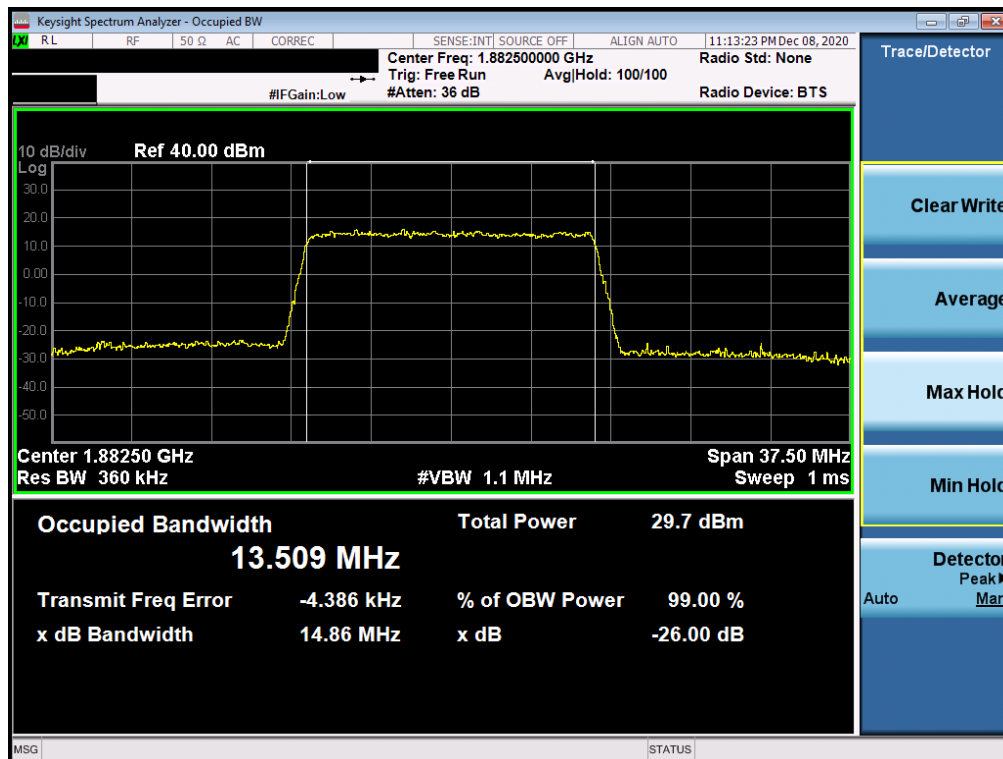


Plot 7-6. Occupied Bandwidth Plot (LTE Band 25/2 - 15MHz 16-QAM - Full RB Configuration)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
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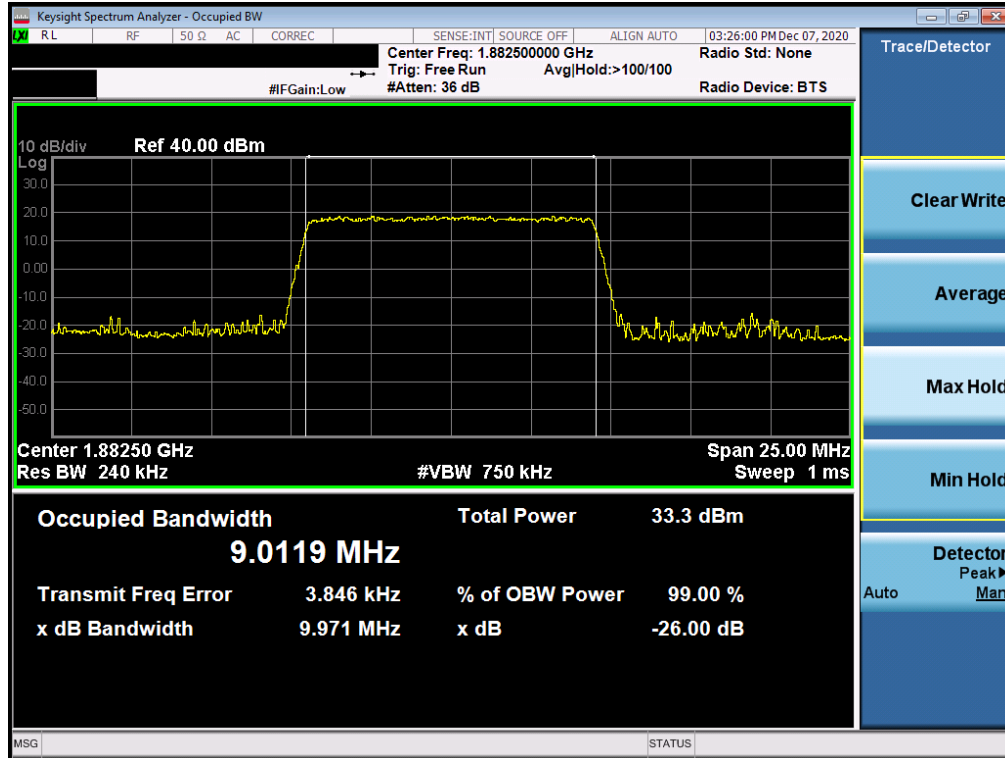


Plot 7-7. Occupied Bandwidth Plot (LTE Band 25/2 - 15MHz 64-QAM - Full RB Configuration)



Plot 7-8. Occupied Bandwidth Plot (LTE Band 25/2 - 15MHz 256-QAM - Full RB Configuration)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
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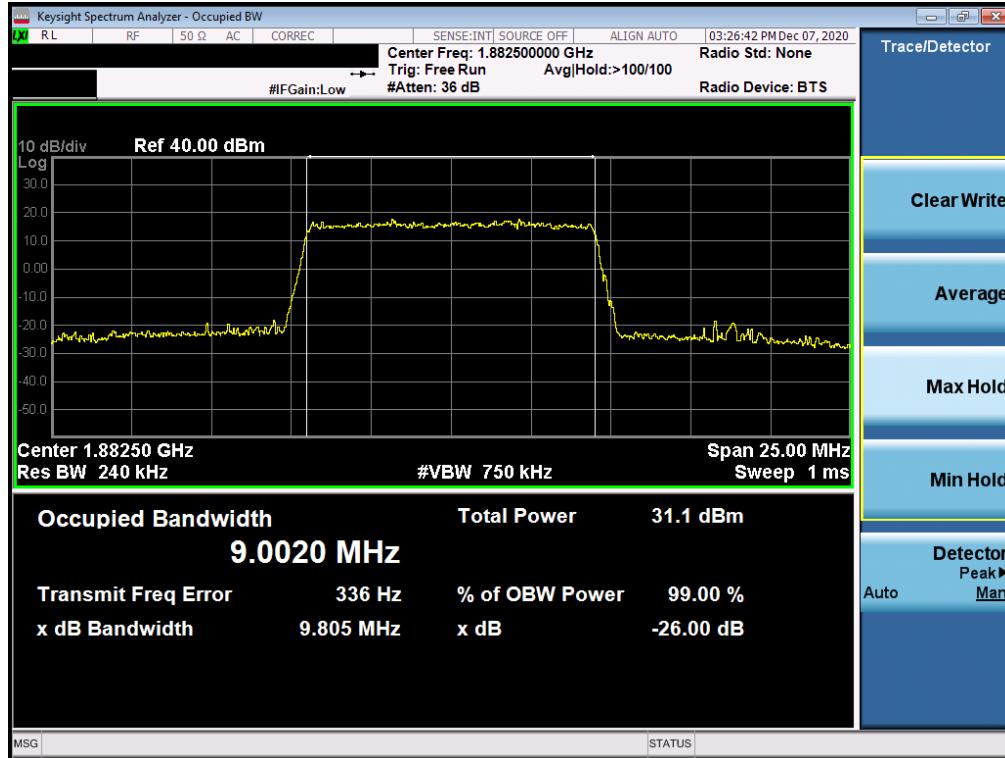
Plot 7-9. Occupied Bandwidth Plot (LTE Band 25/2 - 10MHz QPSK - Full RB Configuration)



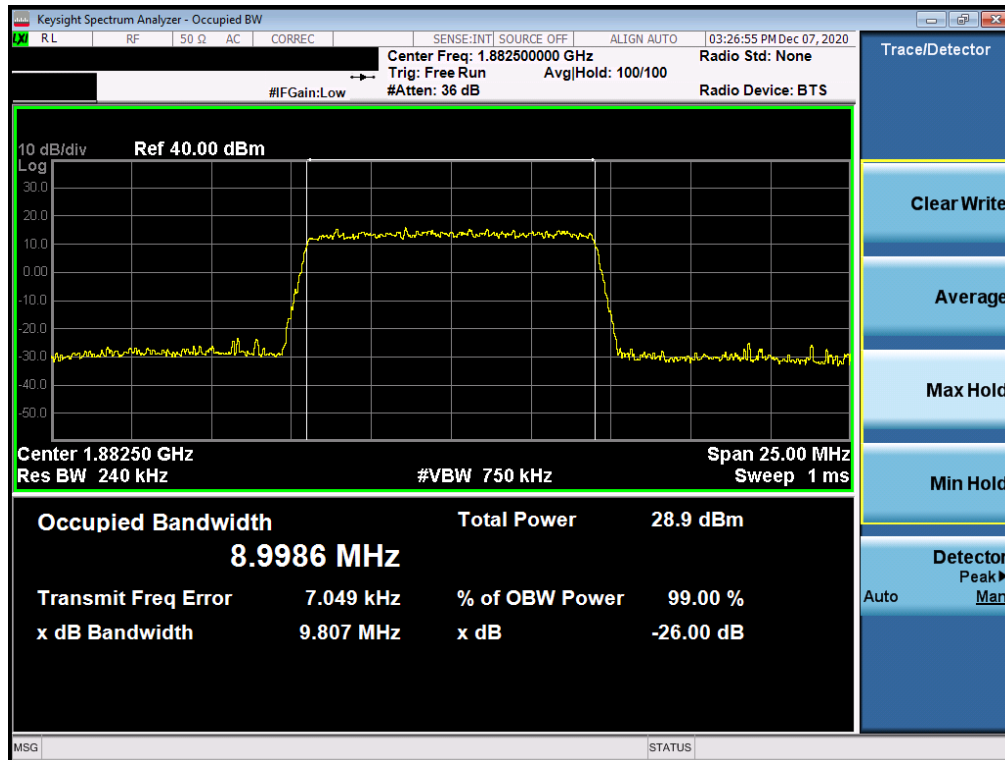
Plot 7-10. Occupied Bandwidth Plot (LTE Band 25/2 - 10MHz 16-QAM - Full RB Configuration)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
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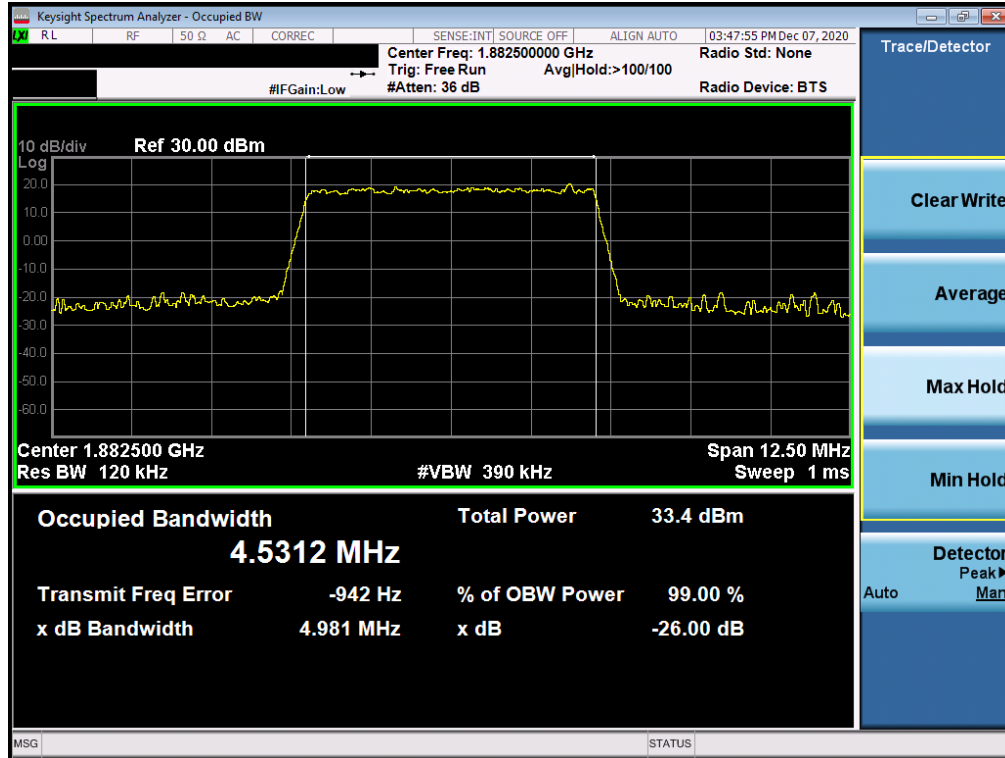


Plot 7-11. Occupied Bandwidth Plot (LTE Band 25/2 - 10MHz 64-QAM - Full RB Configuration)

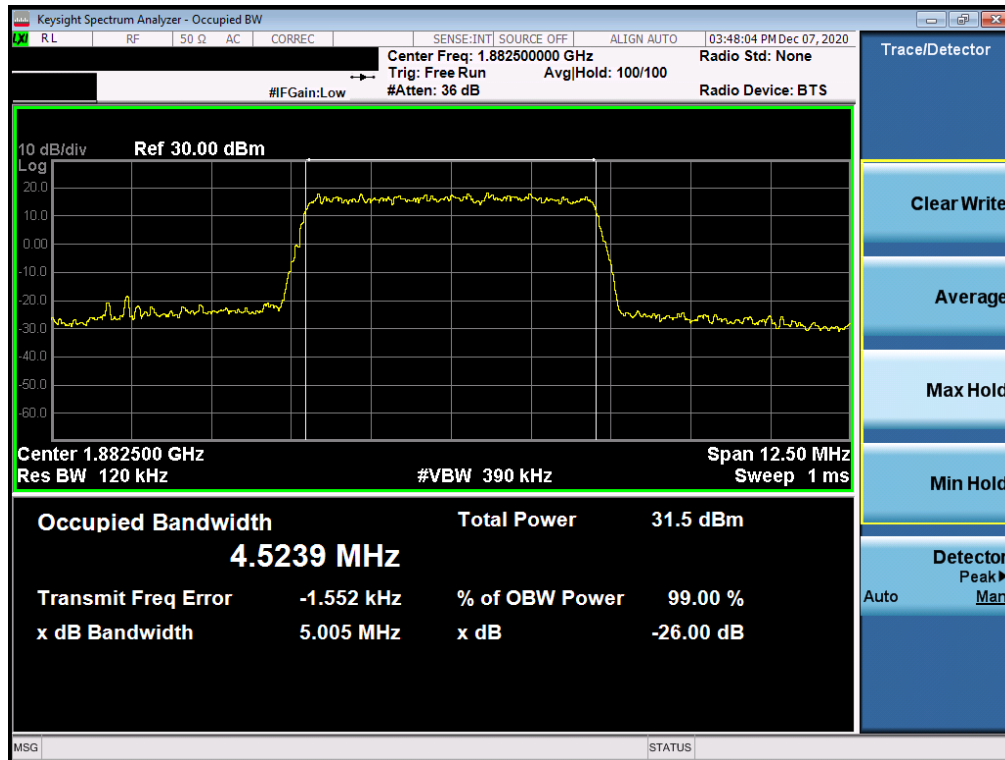


Plot 7-12. Occupied Bandwidth Plot (LTE Band 25/2 - 10MHz 256-QAM - Full RB Configuration)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 19 of 196                  |

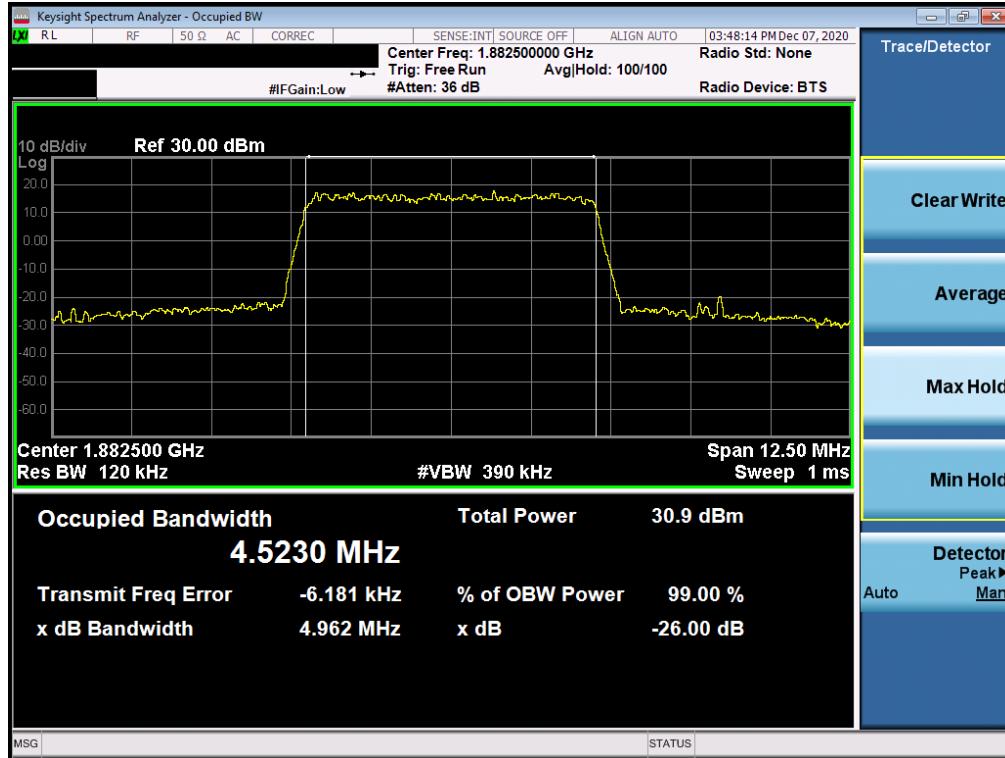


Plot 7-13. Occupied Bandwidth Plot (LTE Band 25/2 - 5MHz QPSK - Full RB Configuration)

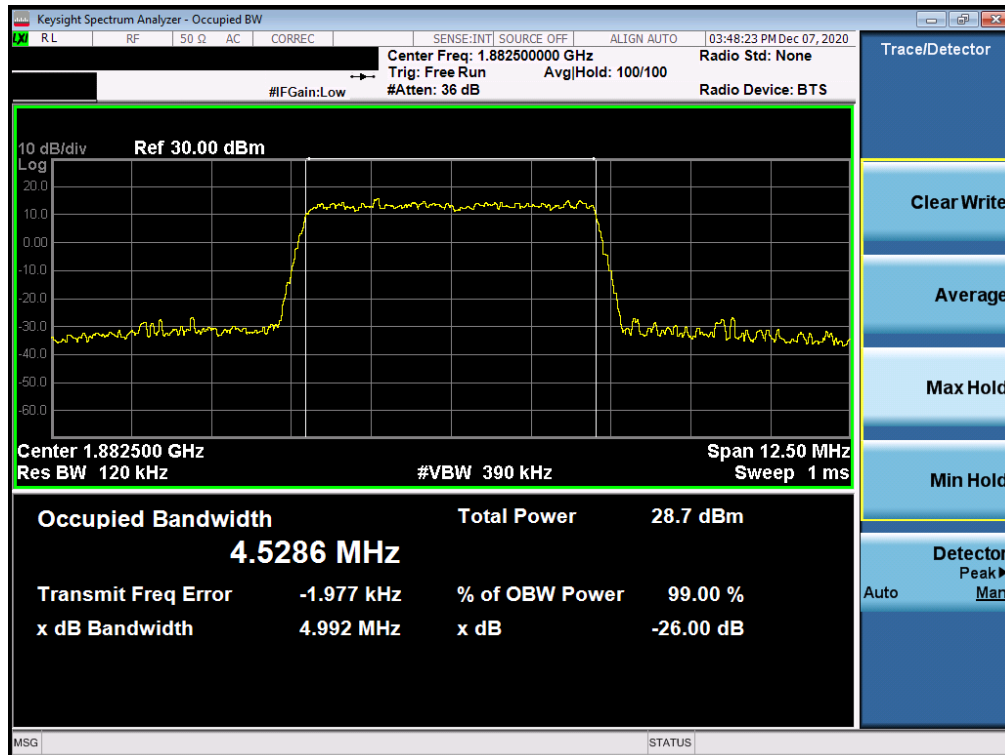


Plot 7-14. Occupied Bandwidth Plot (LTE Band 25/2 - 5MHz 16-QAM - Full RB Configuration)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
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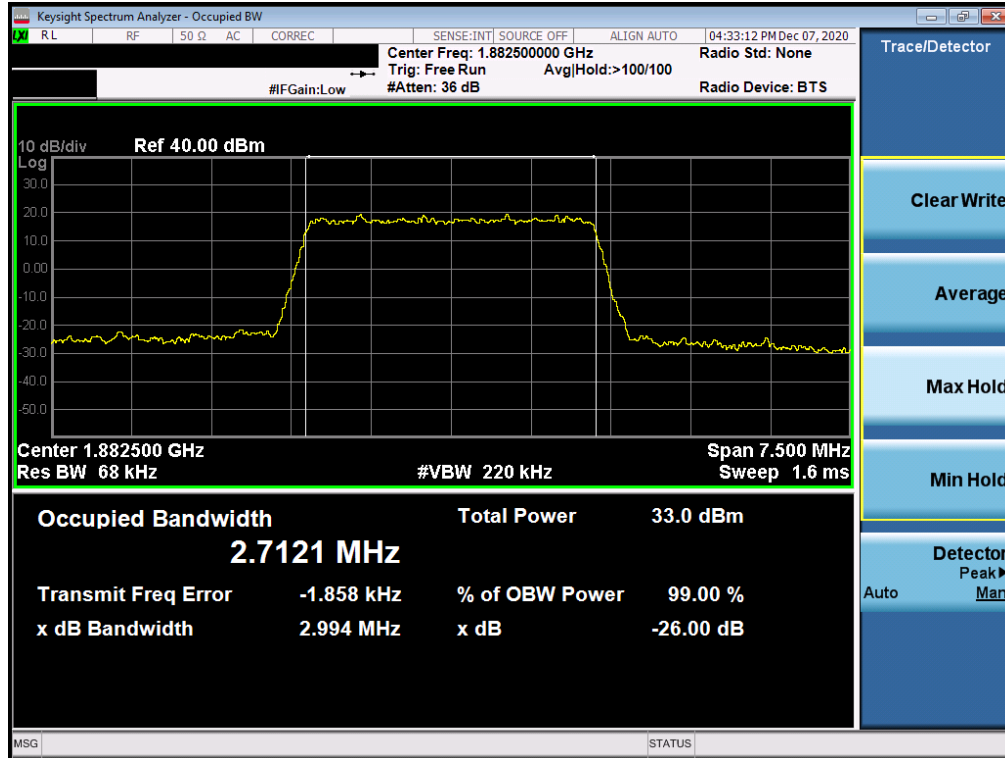


Plot 7-15. Occupied Bandwidth Plot (LTE Band 25/2 - 5MHz 64-QAM - Full RB Configuration)

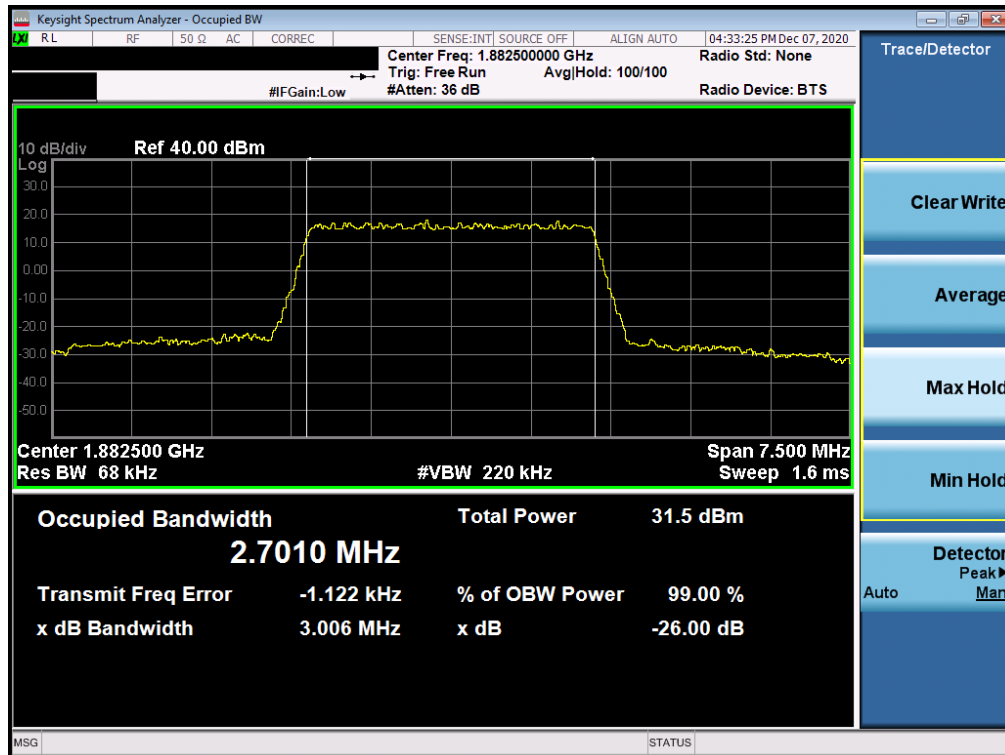


Plot 7-16. Occupied Bandwidth Plot (LTE Band 25/2 - 5MHz 256-QAM - Full RB Configuration)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 21 of 196                  |

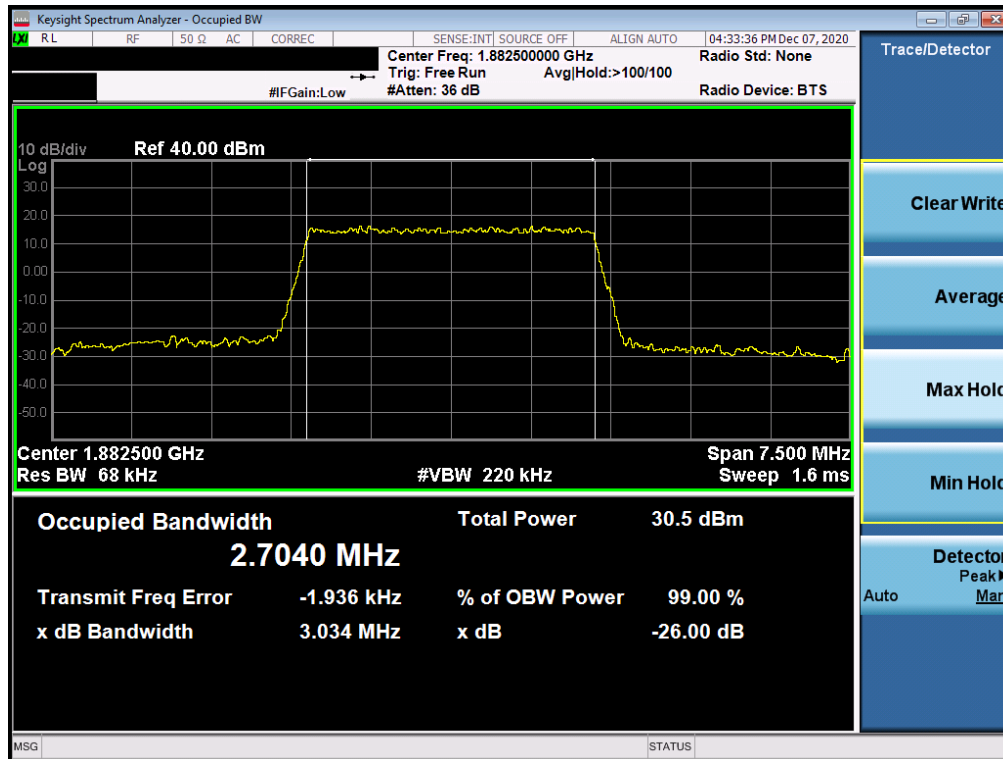


Plot 7-17. Occupied Bandwidth Plot (LTE Band 25/2 - 3MHz QPSK - Full RB Configuration)

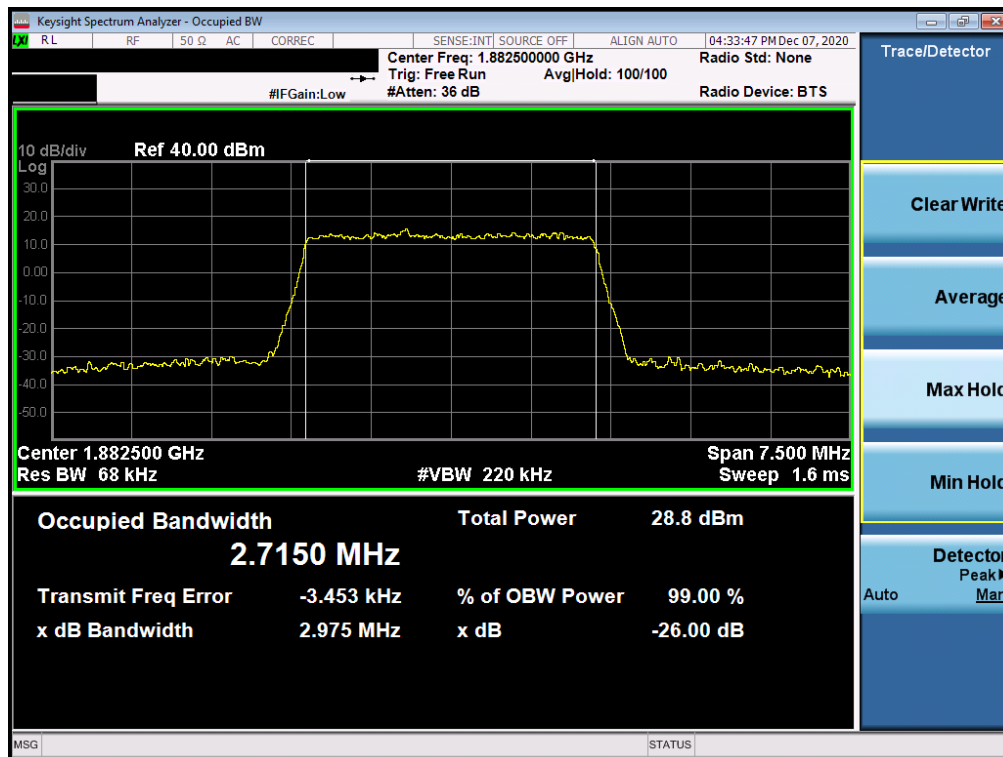


Plot 7-18. Occupied Bandwidth Plot (LTE Band 25/2 - 3MHz 16-QAM - Full RB Configuration)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 22 of 196                  |



Plot 7-19. Occupied Bandwidth Plot (LTE Band 25/2 - 3MHz 64-QAM - Full RB Configuration)

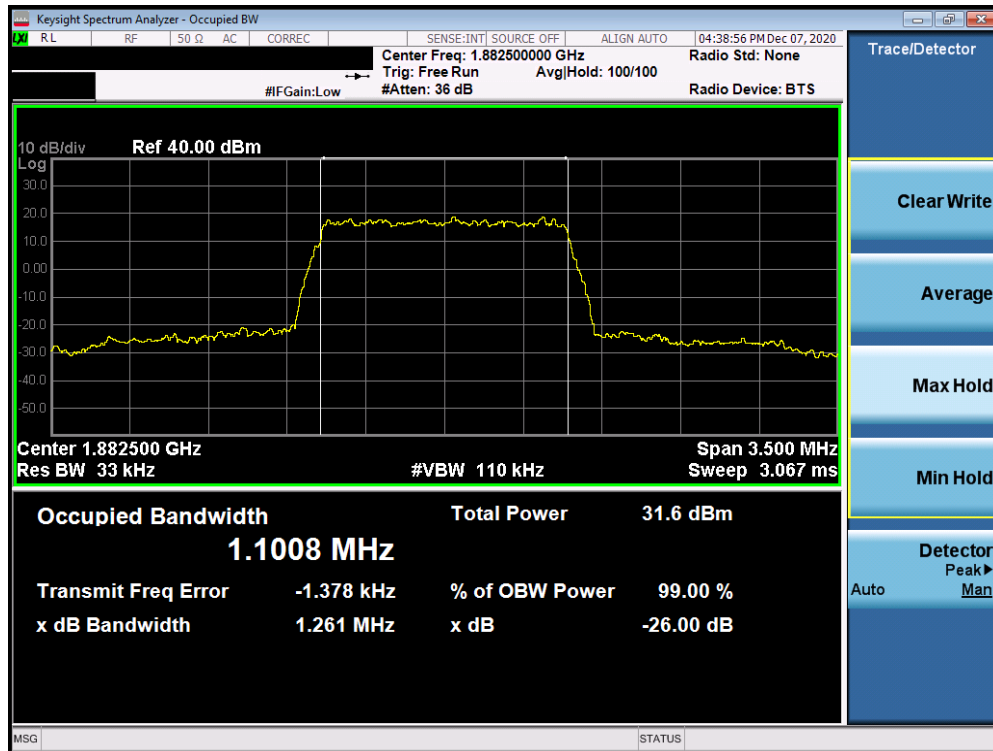


Plot 7-20. Occupied Bandwidth Plot (LTE Band 25/2 - 3MHz 256-QAM - Full RB Configuration)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 23 of 196                  |

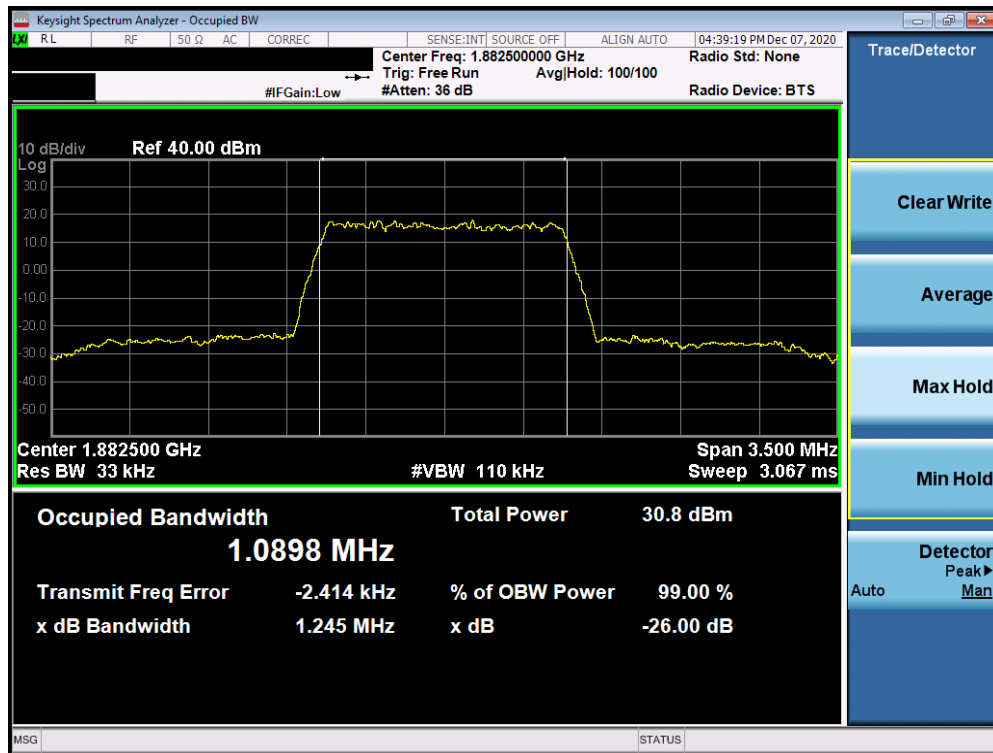


Plot 7-21. Occupied Bandwidth Plot (LTE Band 25/2 - 1.4MHz QPSK - Full RB Configuration)

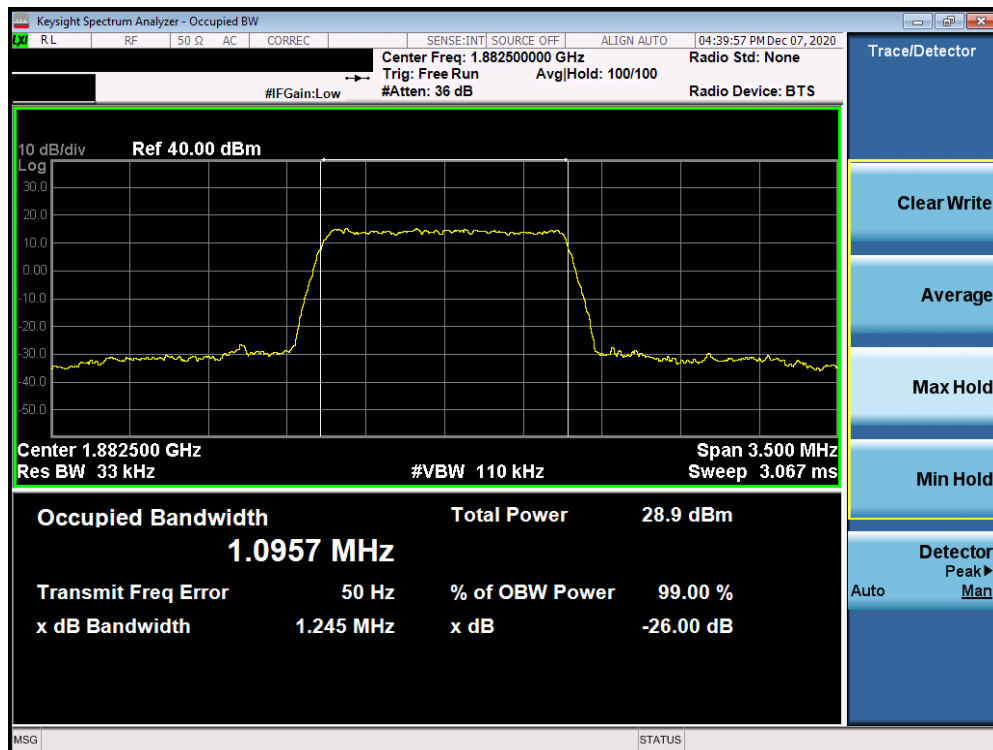


Plot 7-22. Occupied Bandwidth Plot (LTE Band 25/2 - 1.4MHz 16-QAM - Full RB Configuration)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 24 of 196                  |



Plot 7-23. Occupied Bandwidth Plot (LTE Band 25/2 - 1.4MHz 64-QAM - Full RB Configuration)

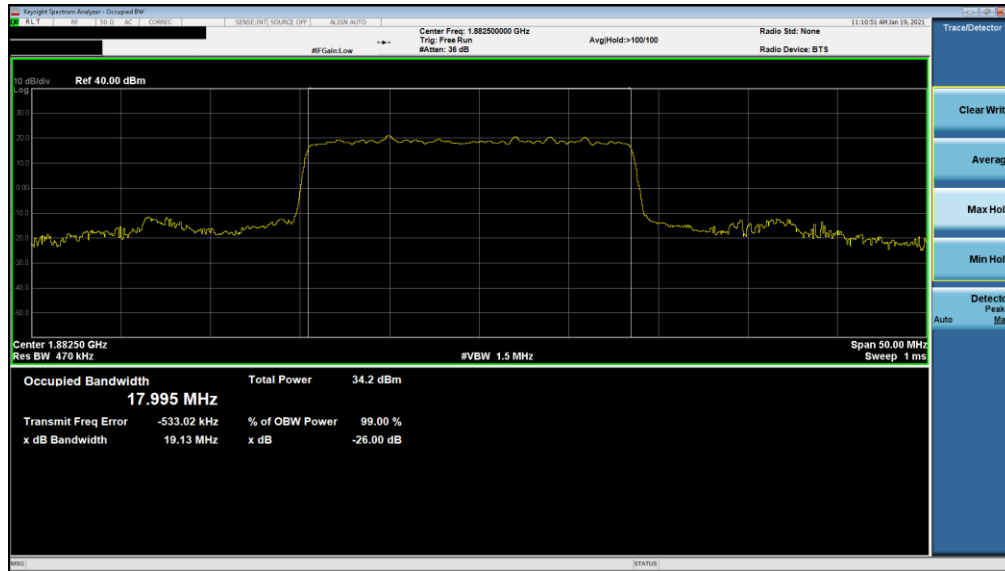


Plot 7-24. Occupied Bandwidth Plot (LTE Band 25/2 - 1.4MHz 256-QAM - Full RB Configuration)

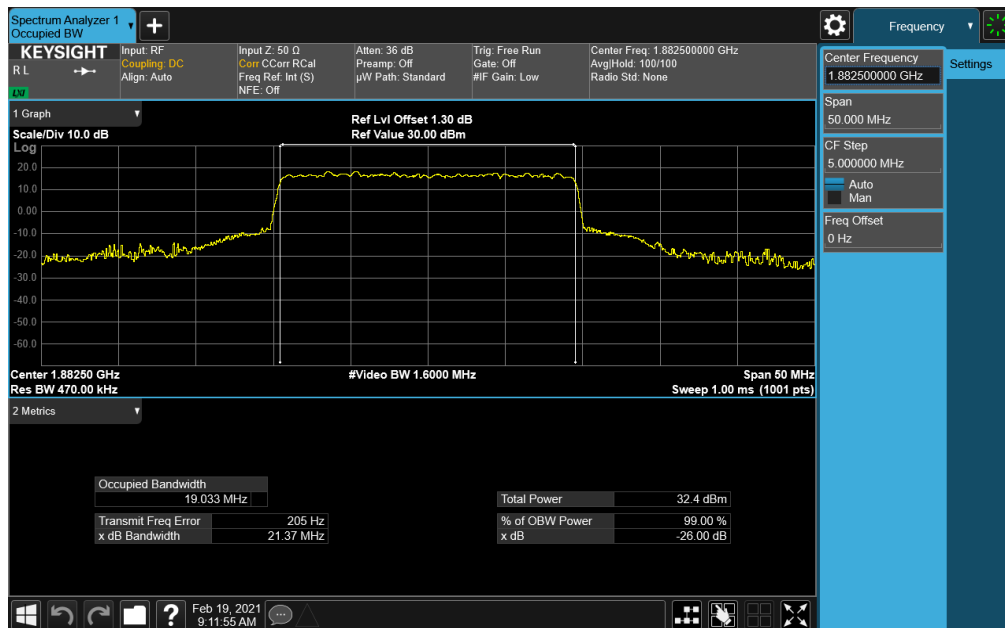
|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 25 of 196                  |



## NR Band n25/n2



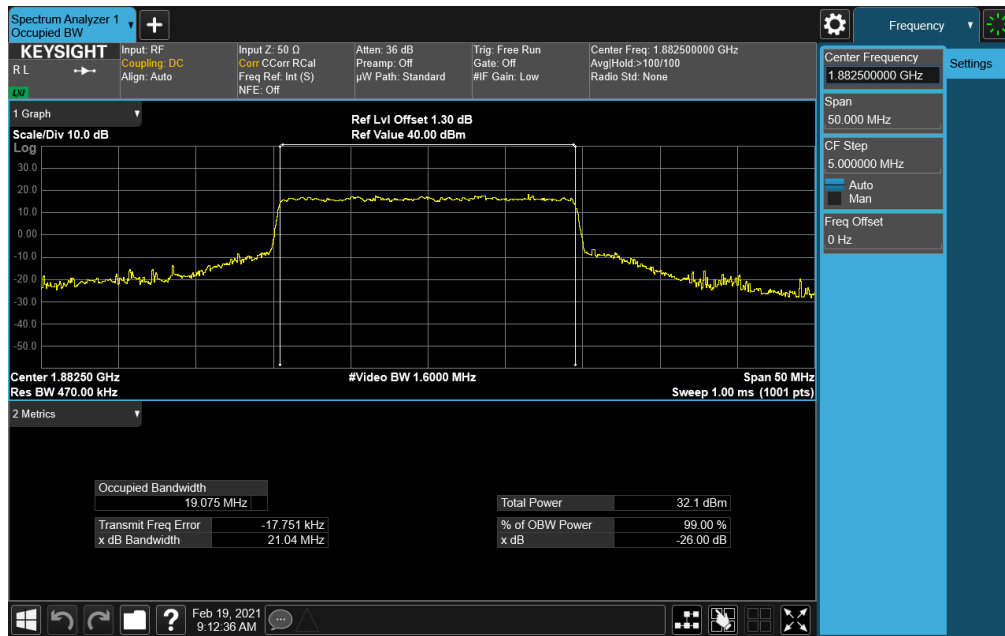
Plot 7-25. Occupied Bandwidth Plot (NR Band n25/n2 - 20.0MHz DFT-s-OFDM  $\pi/2$  BPSK - Full RB)



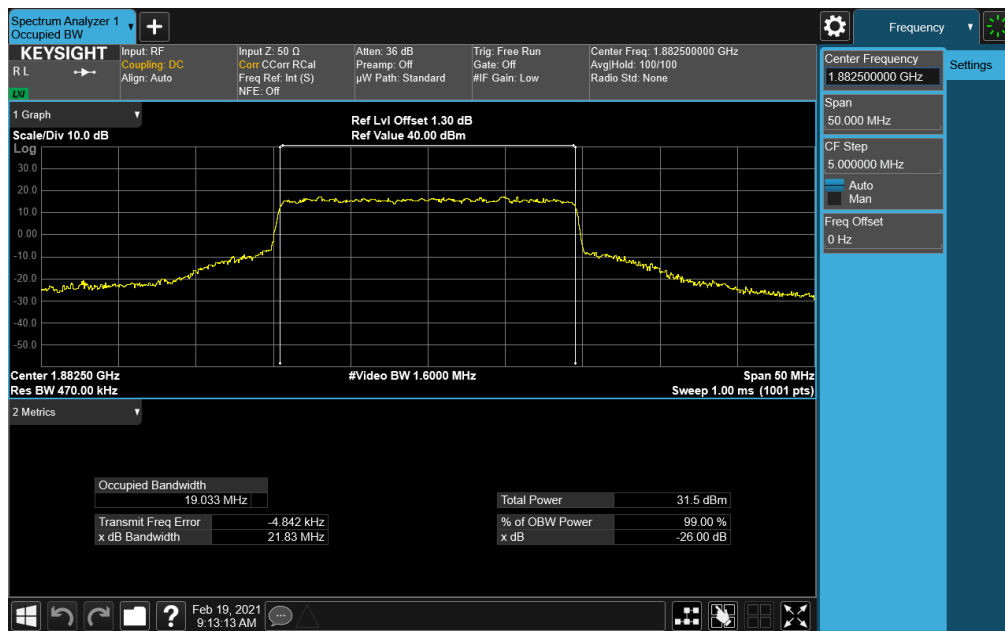
Plot 7-26. Occupied Bandwidth Plot (NR Band n25/n2 - 20.0MHz CP-OFDM QPSK - Full RB)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 26 of 196                  |



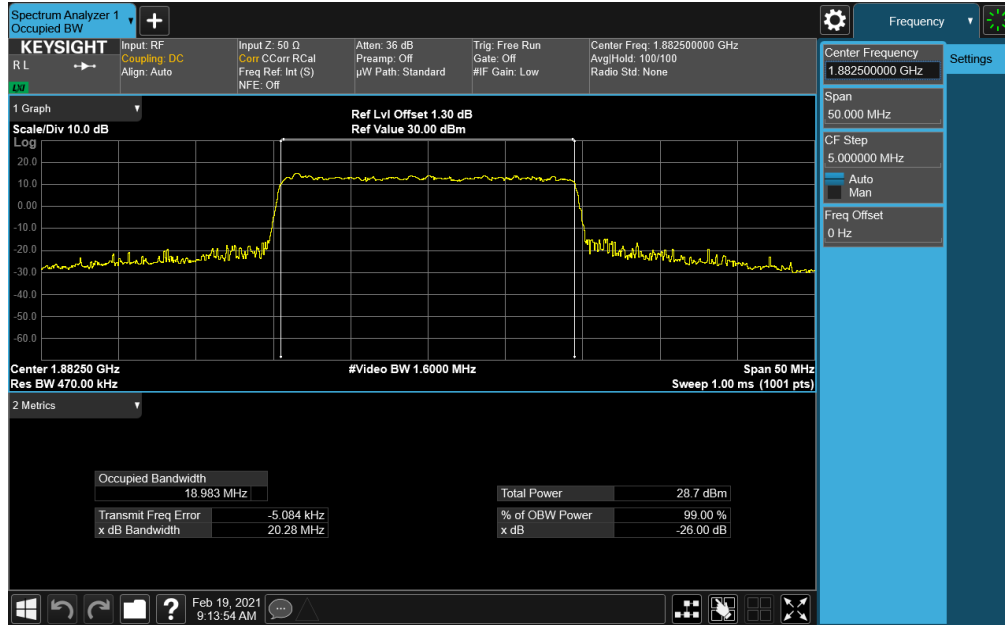


Plot 7-27. Occupied Bandwidth Plot (NR Band n25/n2 - 20.0MHz CP-OFDM 16QAM - Full RB)

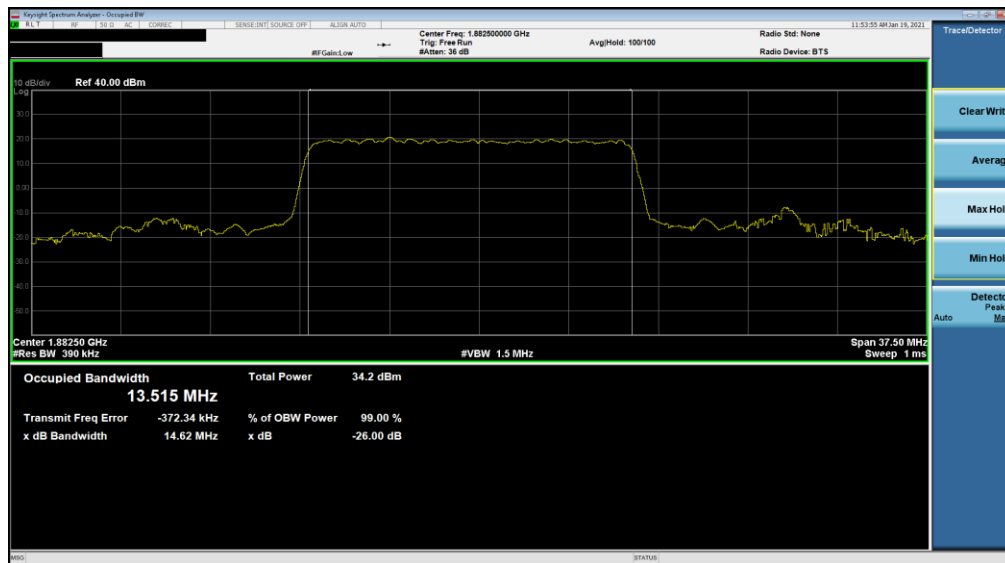


Plot 7-28. Occupied Bandwidth Plot (NR Band n25/n2 - 20.0MHz CP-OFDM 64QAM - Full RB)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 27 of 196                  |

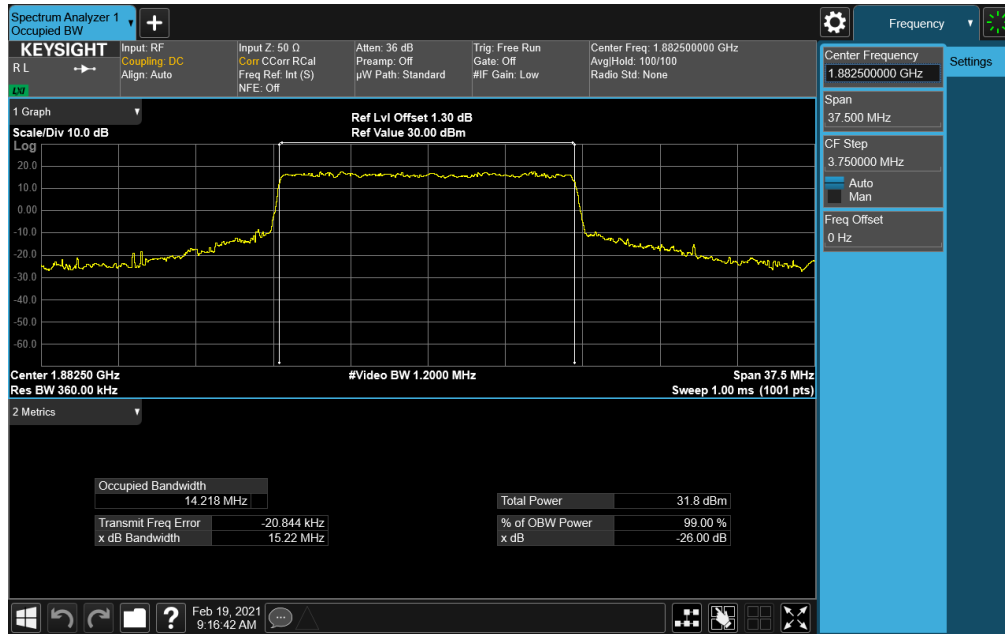


Plot 7-29. Occupied Bandwidth Plot (NR Band n25/n2 - 20.0MHz CP-OFDM 256QAM - Full RB)

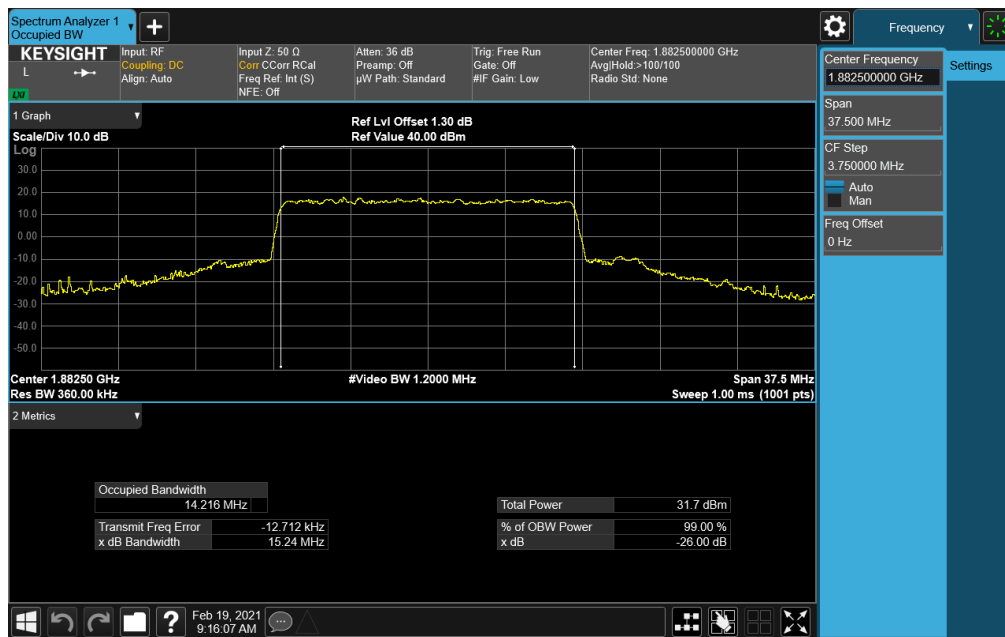


Plot 7-30. Occupied Bandwidth Plot (NR Band n25/n2 - 15.0MHz DFT-s-OFDM  $\pi/2$  BPSK - Full RB)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 28 of 196                  |

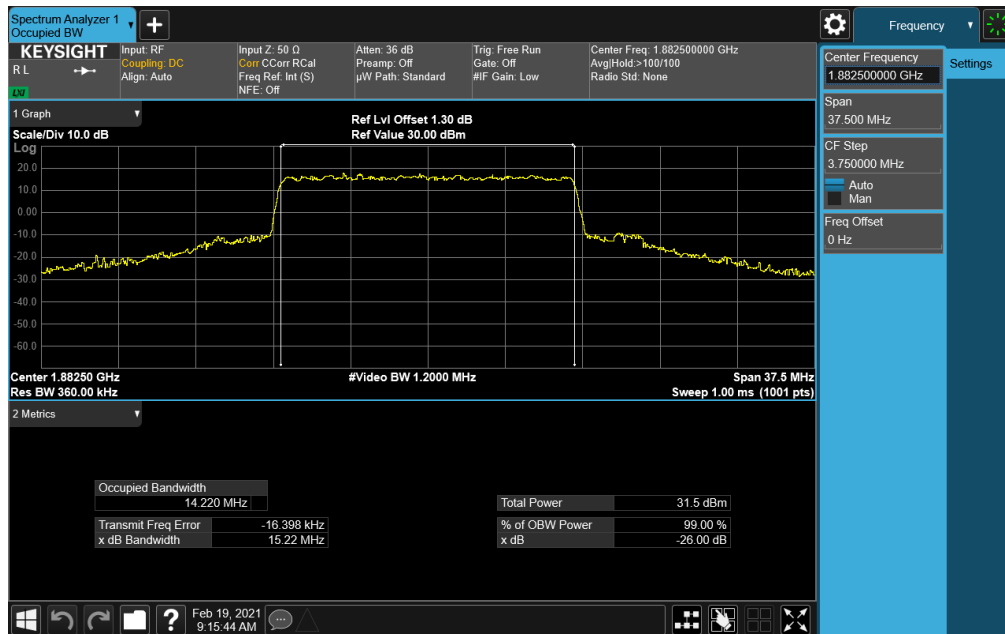


Plot 7-31. Occupied Bandwidth Plot (NR Band n25/n2 - 15.0MHz CP-OFDM QPSK - Full RB)

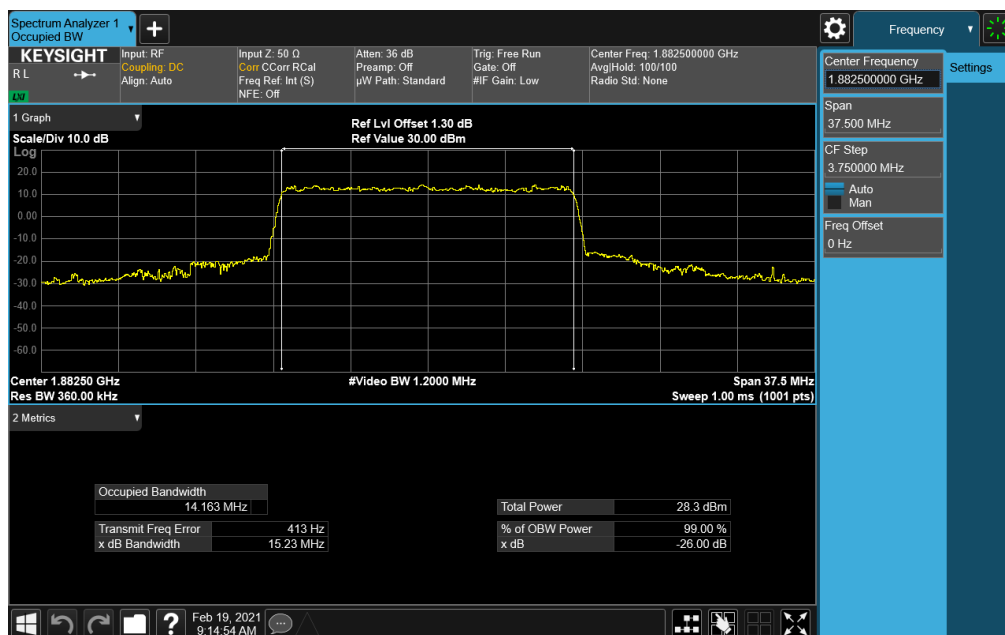


Plot 7-32. Occupied Bandwidth Plot (NR Band n25/n2 - 15.0MHz CP-OFDM 16QAM - Full RB)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 29 of 196                  |

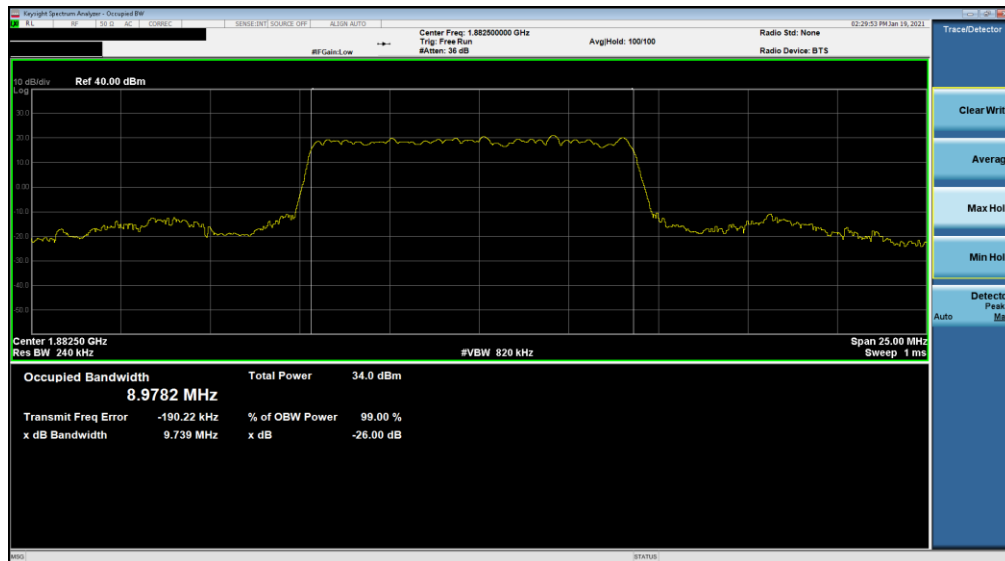


Plot 7-33. Occupied Bandwidth Plot (NR Band n25/n2 - 15.0MHz CP-OFDM 64QAM - Full RB)

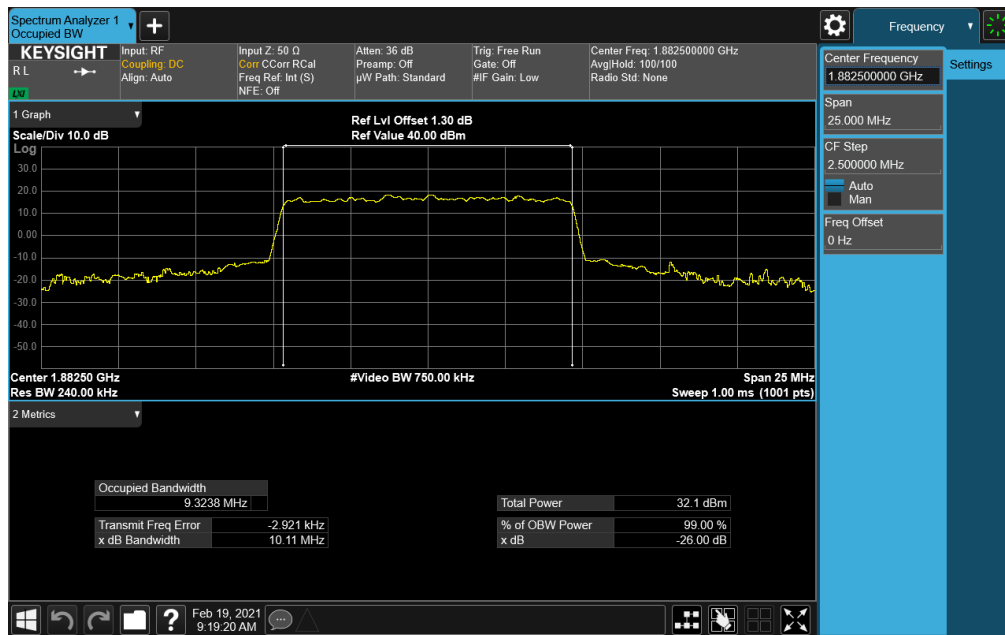


Plot 7-34. Occupied Bandwidth Plot (NR Band n25/n2 - 15.0MHz CP-OFDM 256QAM - Full RB)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 30 of 196                  |

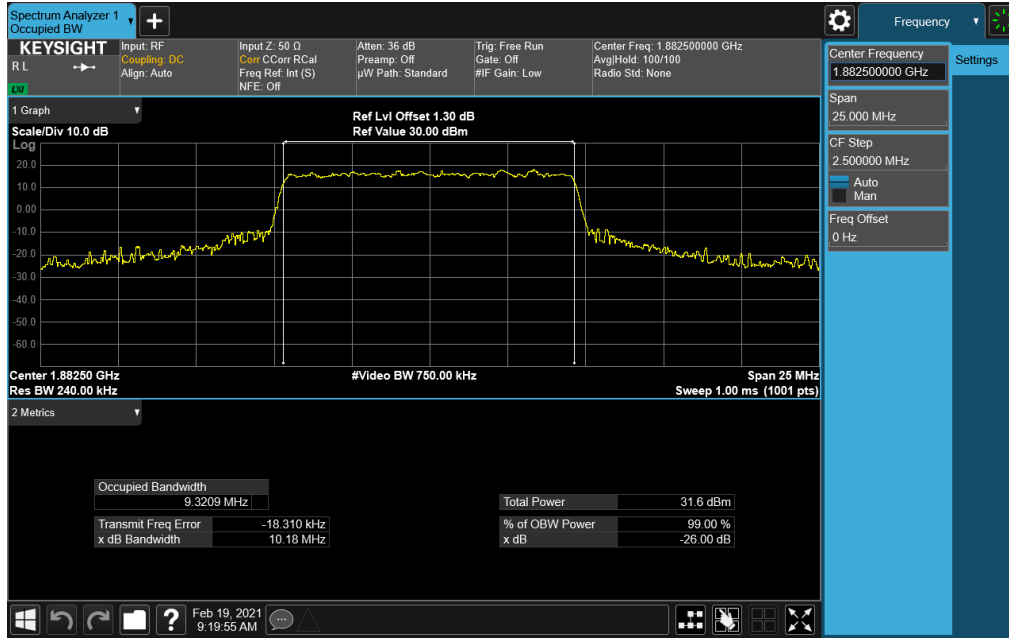


Plot 7-35. Occupied Bandwidth Plot (NR Band n25/n2 - 10.0MHz DFT-s-OFDM  $\pi/2$  BPSK - Full RB)

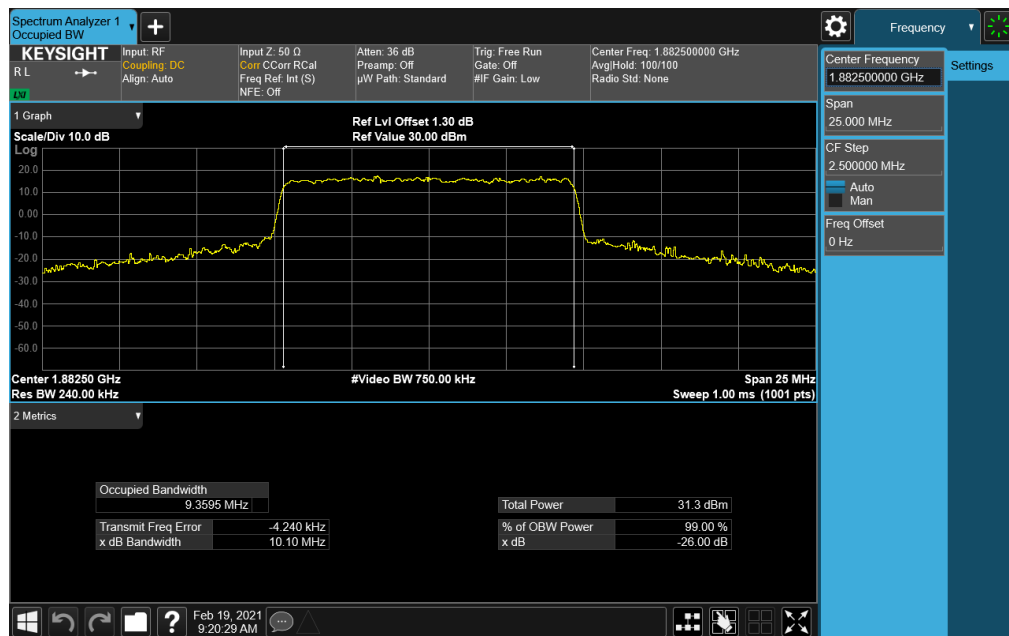


Plot 7-36. Occupied Bandwidth Plot (NR Band n25/n2 - 10.0MHz DFT-s-OFDM QPSK - Full RB)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 31 of 196                  |

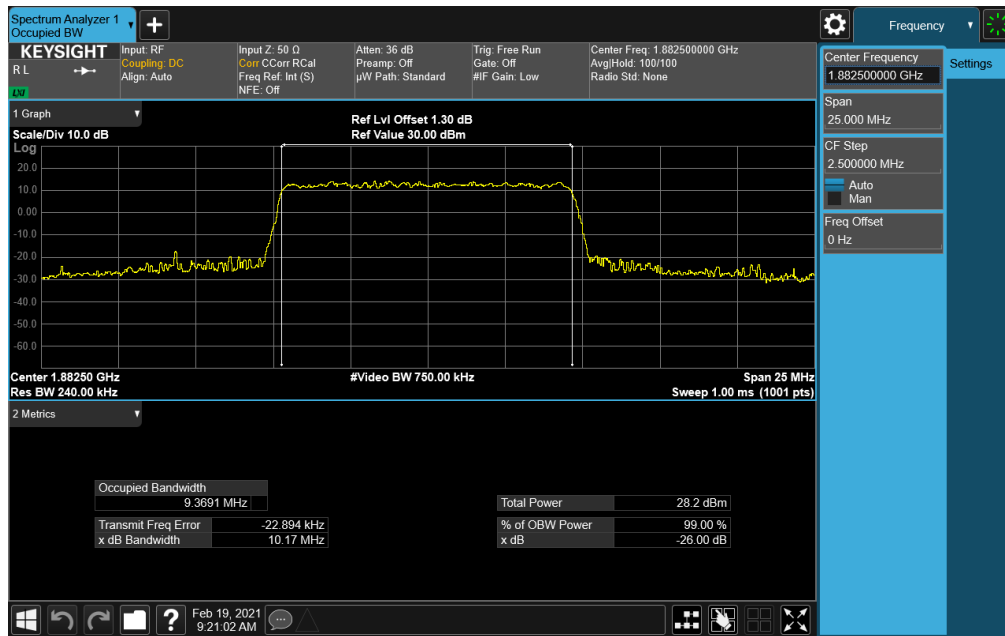


Plot 7-37. Occupied Bandwidth Plot (NR Band n25/n2 - 10.0MHz DFT-s-OFDM 16QAM - Full RB)

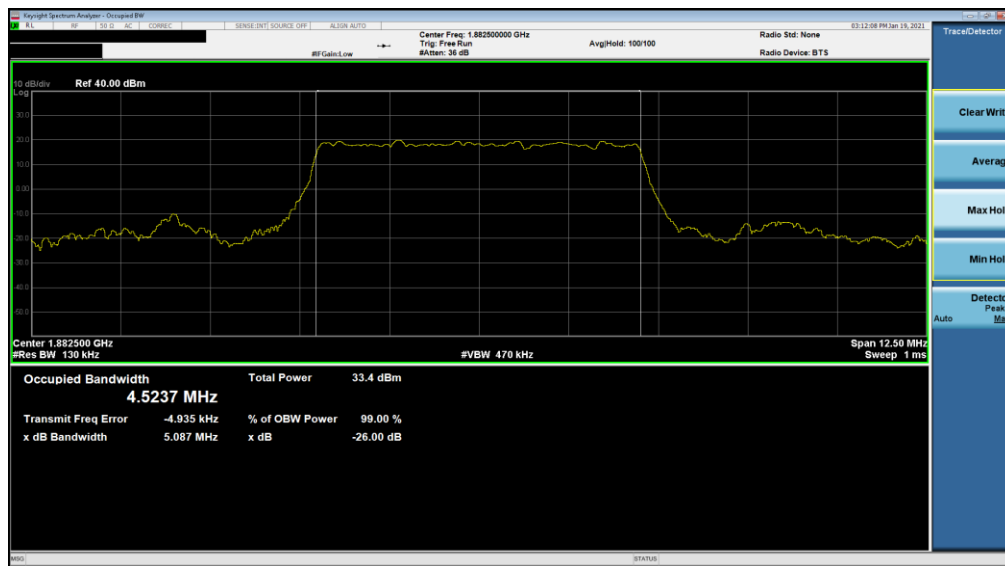


Plot 7-38. Occupied Bandwidth Plot (NR Band n25/n2 - 10.0MHz DFT-s-OFDM 64QAM - Full RB)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 32 of 196                  |

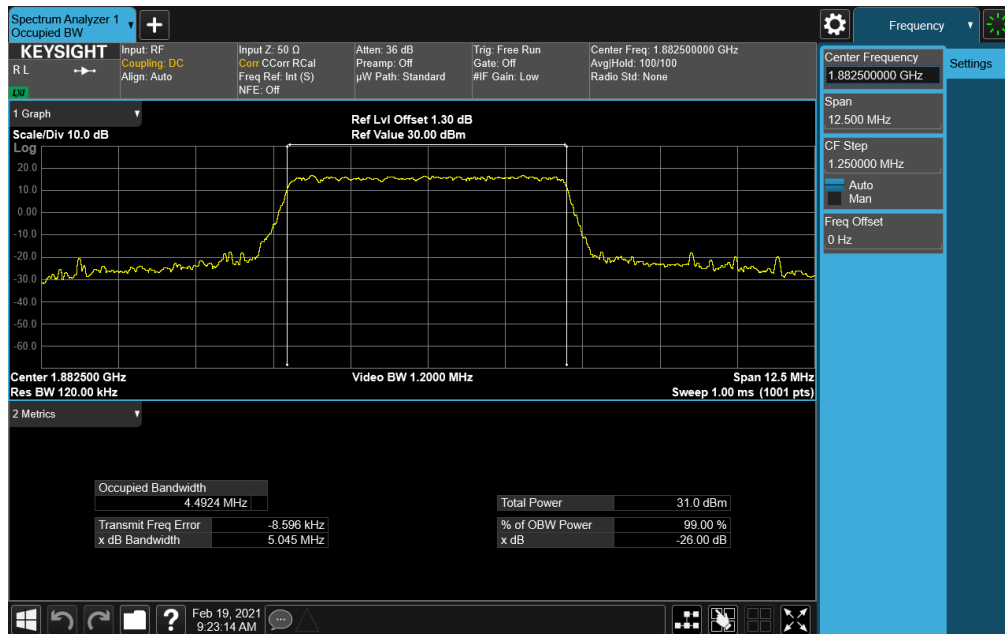


Plot 7-39. Occupied Bandwidth Plot (NR Band n25/n2 - 10.0MHz DFT-s-OFDM 256QAM - Full RB)

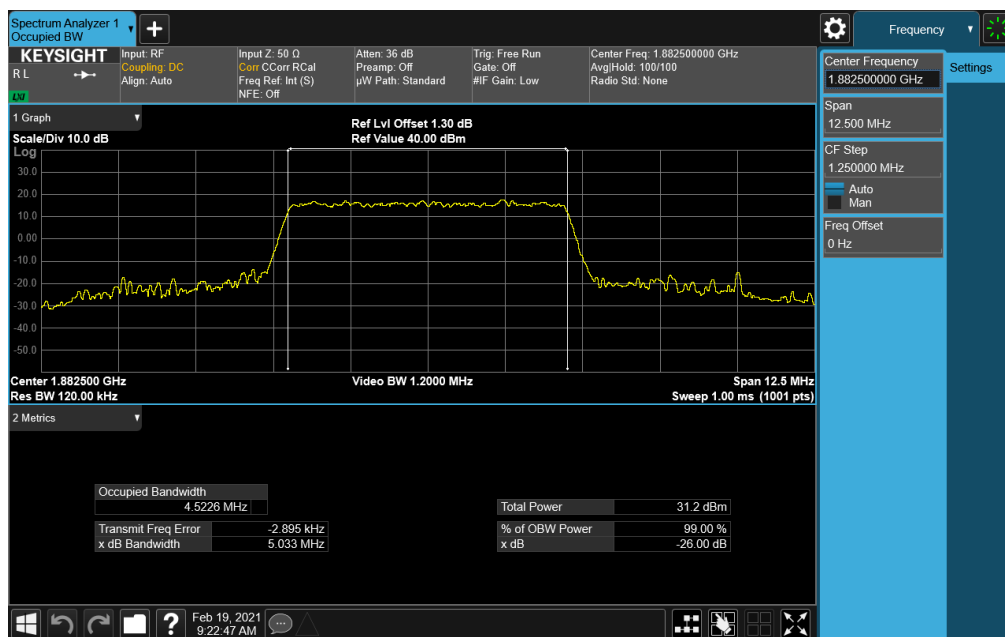


Plot 7-40. Occupied Bandwidth Plot (NR Band n25/n2 - 5.0MHz DFT-s-OFDM  $\pi/2$  BPSK - Full RB)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 33 of 196                  |



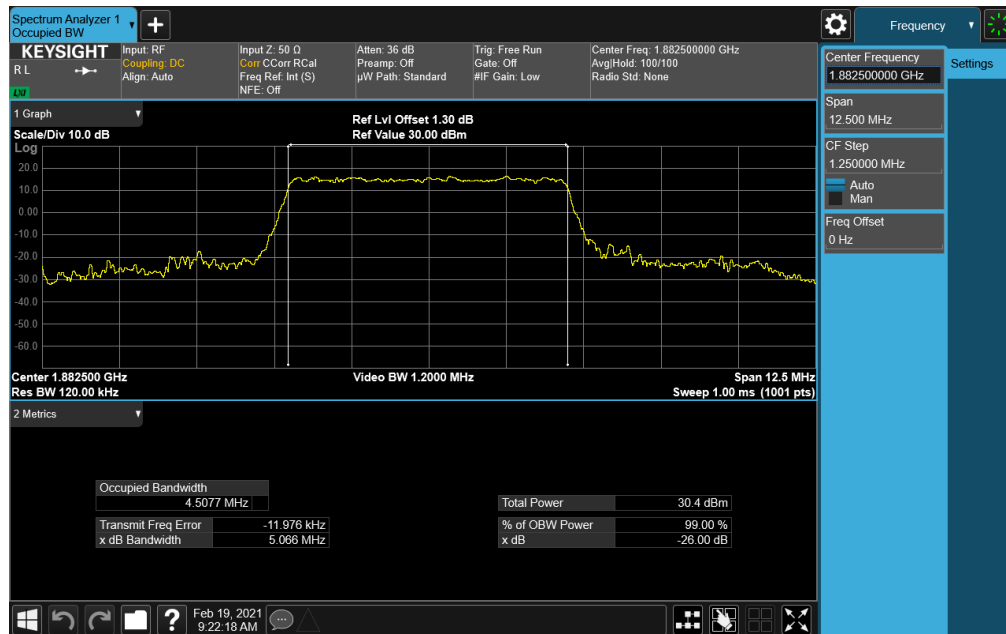
Plot 7-41. Occupied Bandwidth Plot (NR Band n25/n2 - 5.0MHz CP-OFDM QPSK - Full RB)



Plot 7-42. Occupied Bandwidth Plot (NR Band n25/n2 - 5.0MHz CP-OFDM 16QAM - Full RB)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 34 of 196                  |





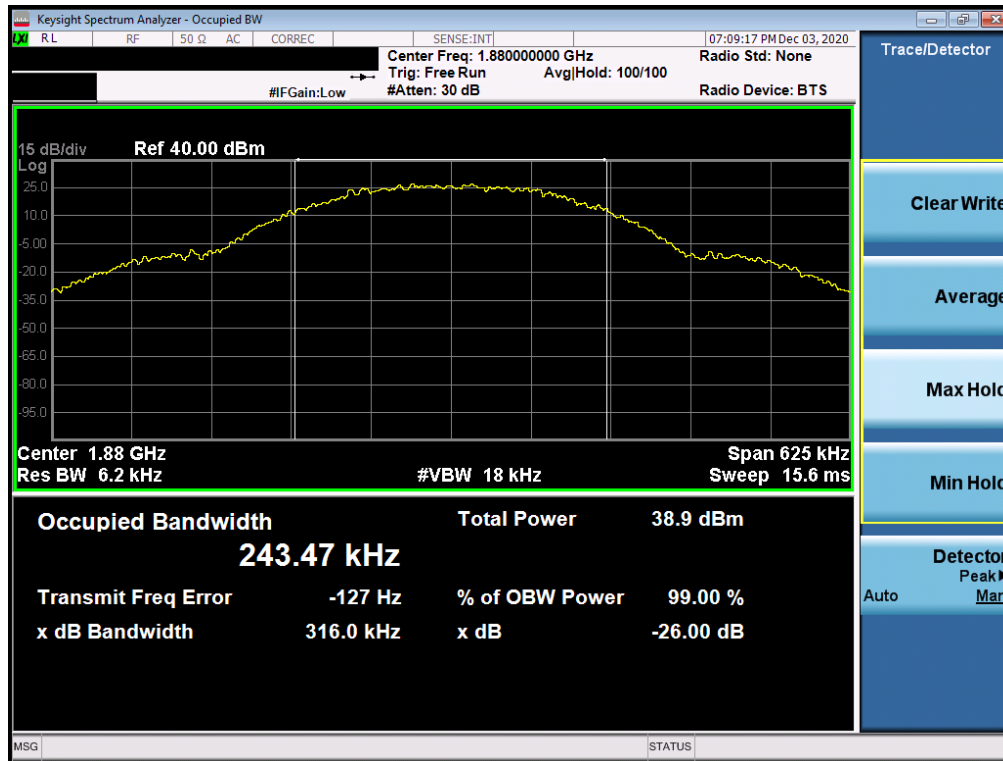
Plot 7-43. Occupied Bandwidth Plot (NR Band n25/n2 - 5.0MHz CP-OFDM 64QAM - Full RB)



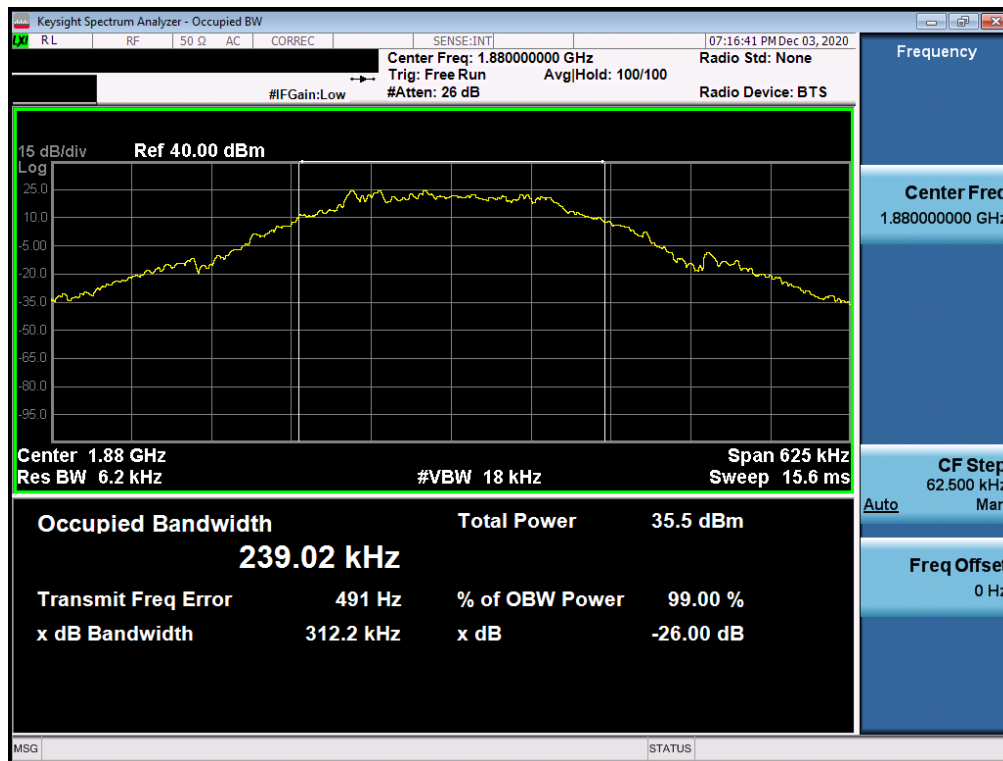
Plot 7-44. Occupied Bandwidth Plot (NR Band n2 - 5.0MHz CP-OFDM 256QAM - Full RB)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 35 of 196                  |

## GSM/GPRS PCS



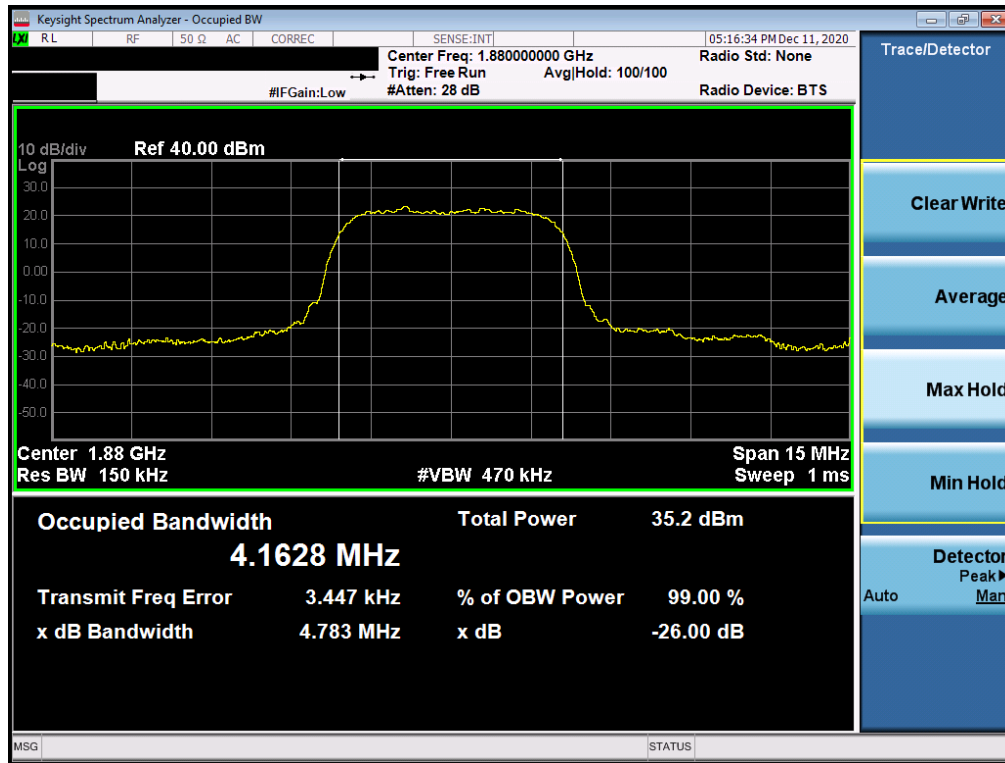
Plot 7-45. Occupied Bandwidth Plot (GPRS, Ch. 661)



Plot 7-46. Occupied Bandwidth Plot (EDGE, Ch. 661)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 36 of 196                  |

## WCDMA PCS



Plot 7-47. Occupied Bandwidth Plot (WCDMA, Ch. 9400)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 37 of 196                  |

## 7.3 Spurious and Harmonic Emissions at Antenna Terminal

### §2.1051, §24.238(a)

#### Test Overview

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10<sup>th</sup> harmonic. All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section. All ports were tested and only the worst case data were reported.

***The minimum permissible attenuation level of any spurious emission is  $43 + 10 \log_{10}(P_{\text{Watts}})$ , where  $P$  is the transmitter power in Watts.***

#### Test Procedure Used

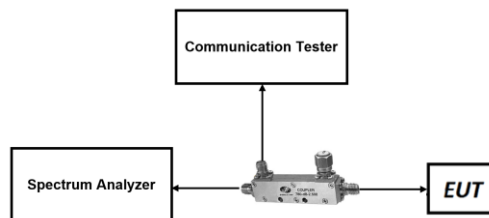
KDB 971168 D01 v03r01 – Section 6.0

#### Test Settings


1. Start frequency was set to 30MHz and stop frequency was set to 20GHz (separated into at least two plots per channel)
2. Detector = RMS
3. Trace mode = trace average for continuous emissions, max hold for pulse emissions
4. Sweep time = auto couple
5. The trace was allowed to stabilize
6. Please see test notes below for RBW and VBW settings

#### Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.




**Figure 7-2. Test Instrument & Measurement Setup**

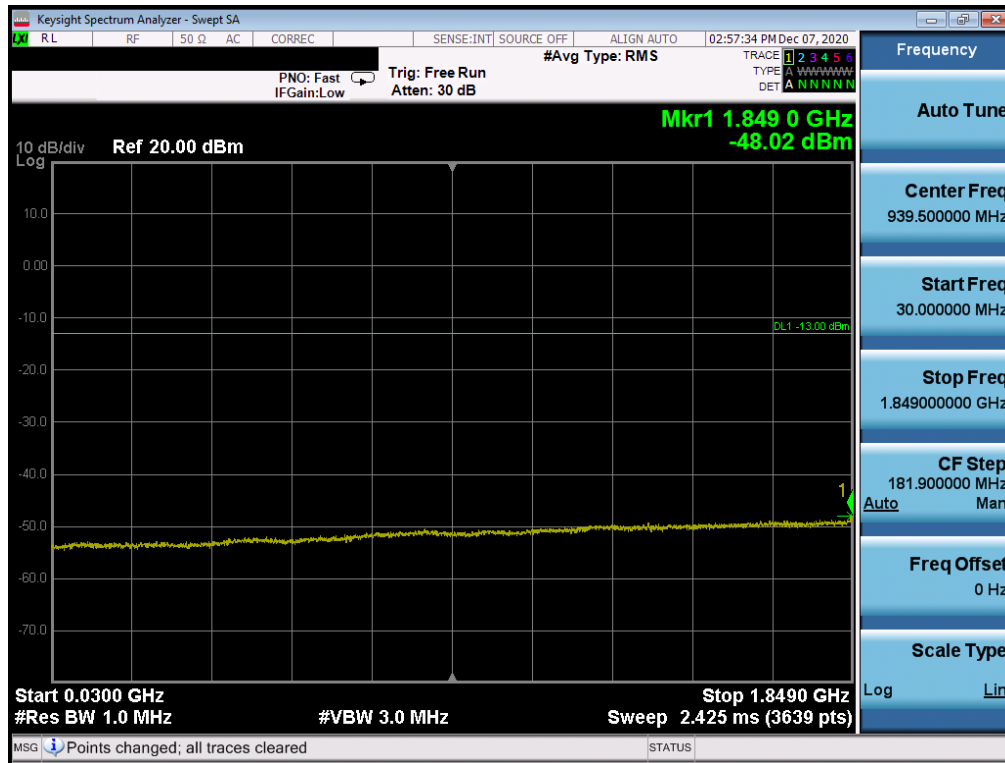
|   |   |                            |                                 |
|---|---|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        |  <b>PART 24 MEASUREMENT REPORT</b> |                            | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021  | EUT Type:<br>Tablet Device | Page 38 of 196                  |

## Test Notes

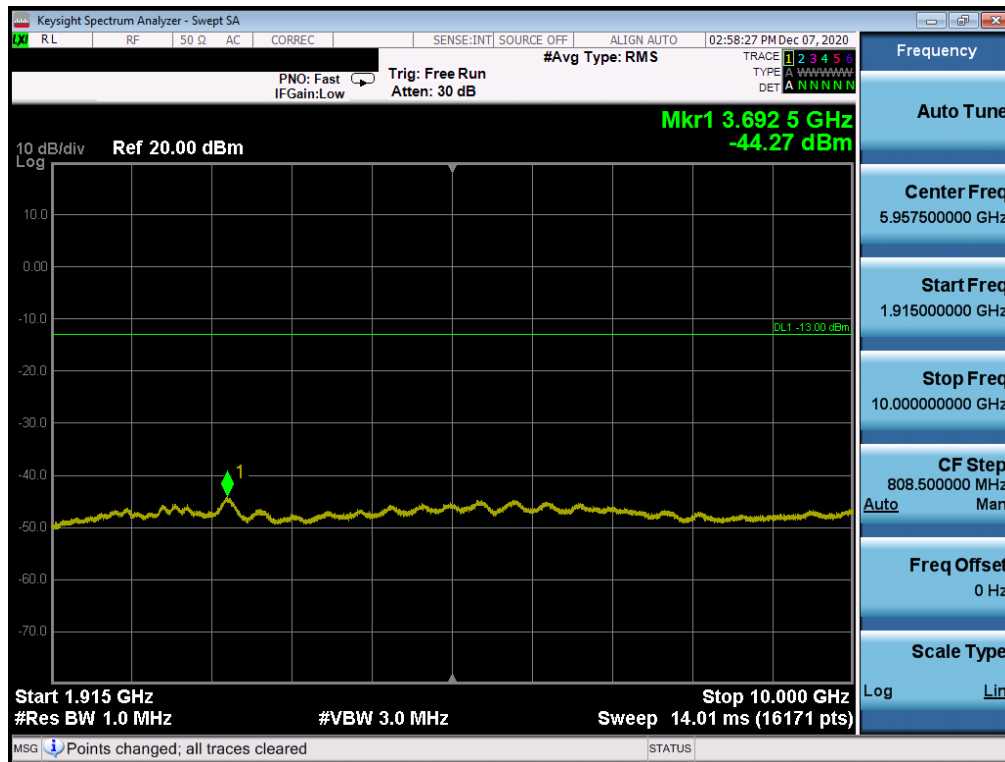
1. Per Part 24, compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth 100 kHz or greater for measurements below 1GHz. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.
2. For NR operation, all subcarrier spacings (SCS) and transmission schemes (e.g. CP-OFDM and DFT-s-OFDM) were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

|  |   |                                   |  |
|--|---|-----------------------------------|--|
| <b>FCC ID:</b> BCGA2301                        |  <b>PART 24 MEASUREMENT REPORT</b> |                                   | <b>Approved by:</b><br>Quality Manager |
| <b>Test Report S/N:</b><br>1C2101020002-03.BCG | <b>Test Dates:</b><br>12/23/2020 - 03/05/2021   | <b>EUT Type:</b><br>Tablet Device | Page 39 of 196                         |

## LTE Band 25/2

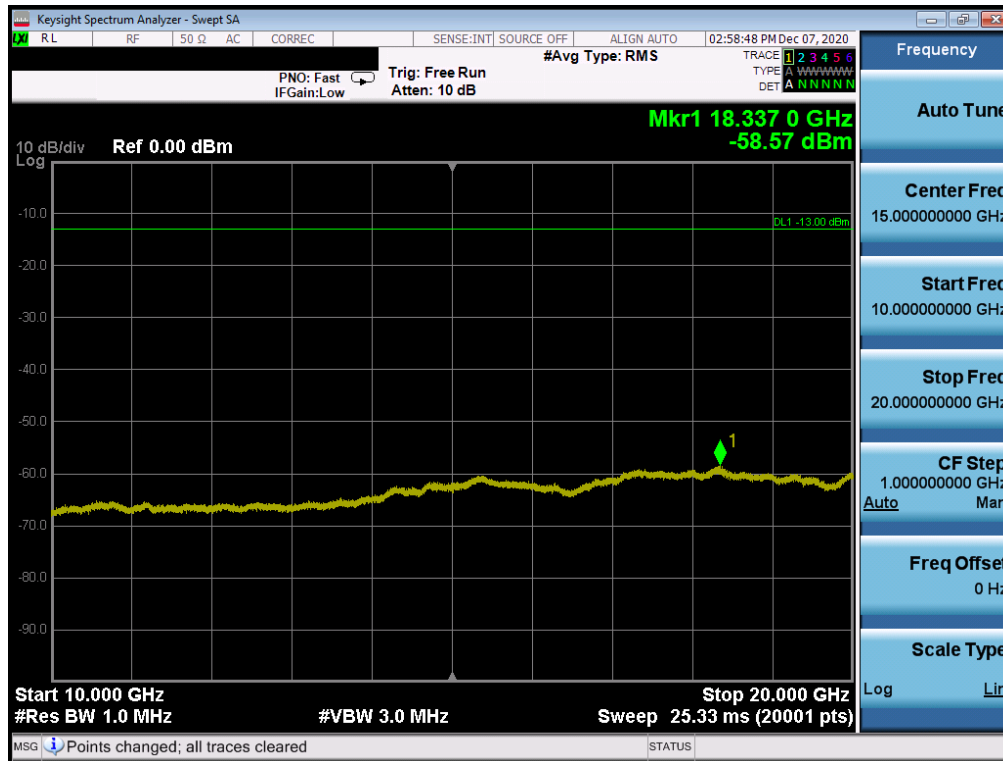


Plot 7-48. CSE (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

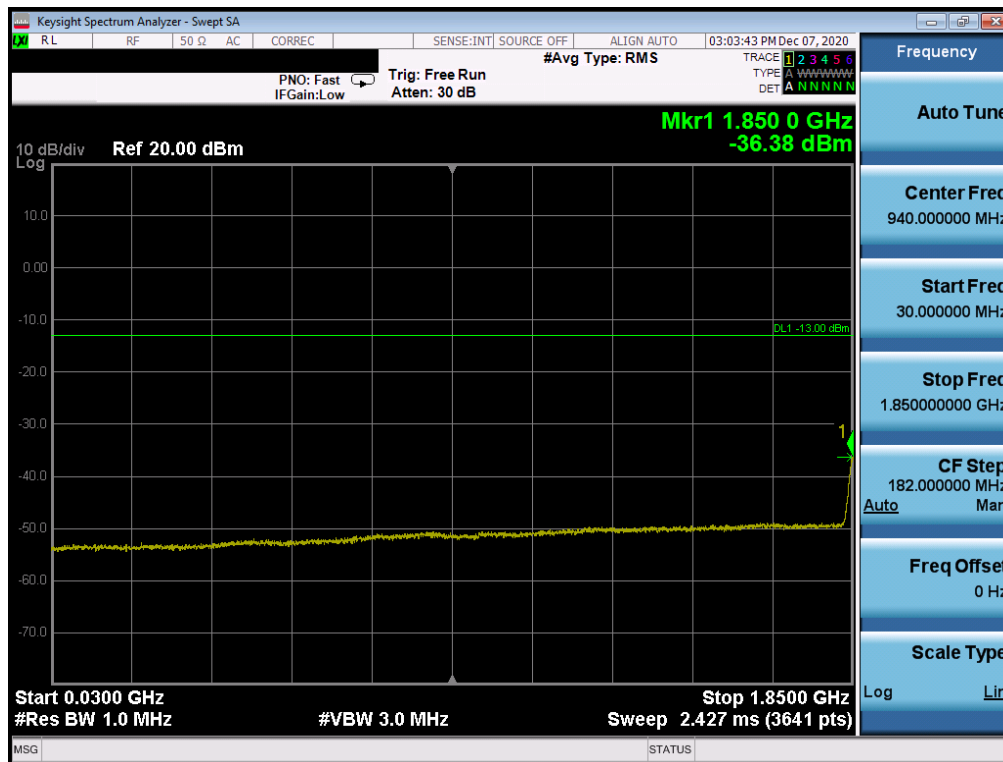


Plot 7-49. CSE (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 40 of 196                  |

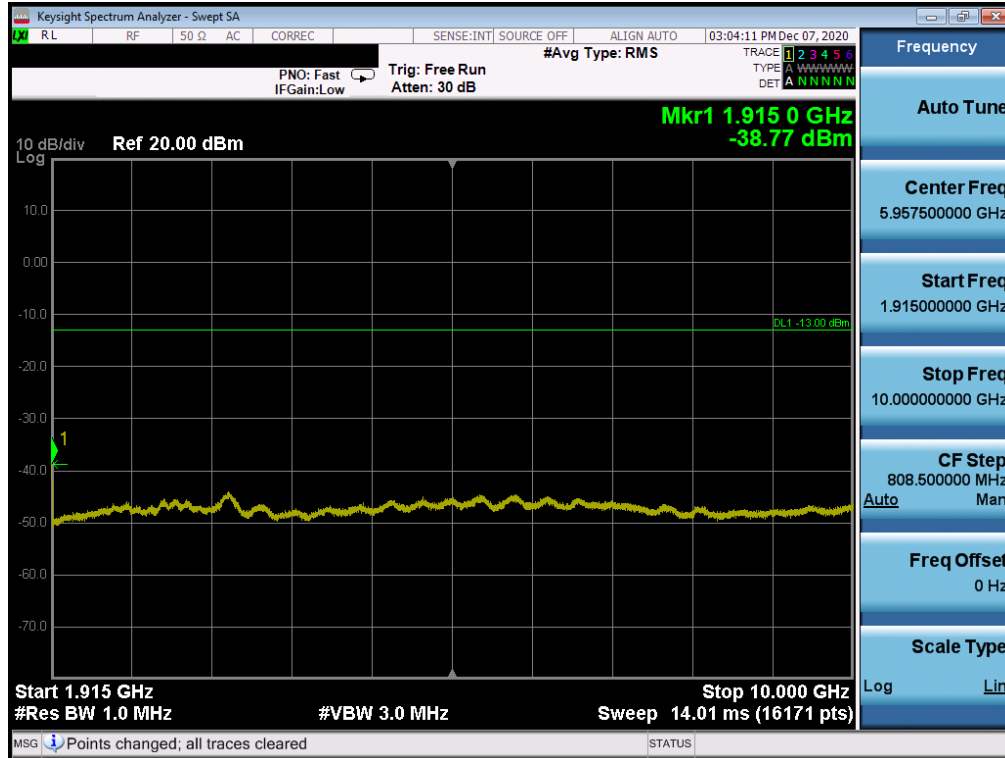


Plot 7-50. CSE (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

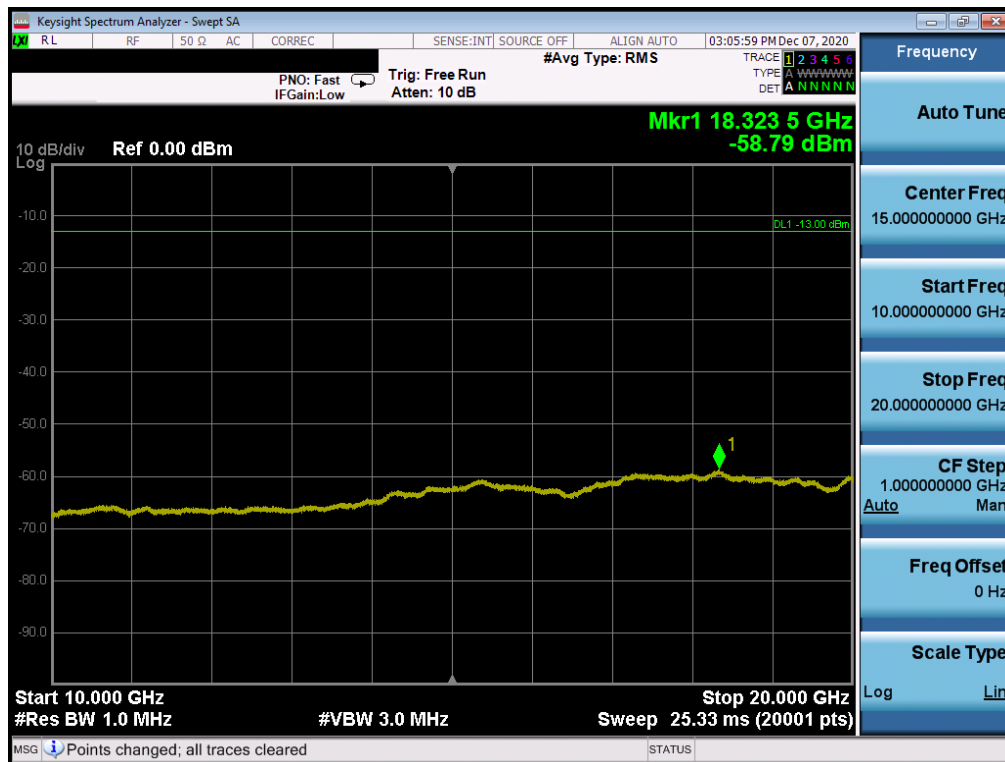


Plot 7-51. CSE (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 41 of 196                  |



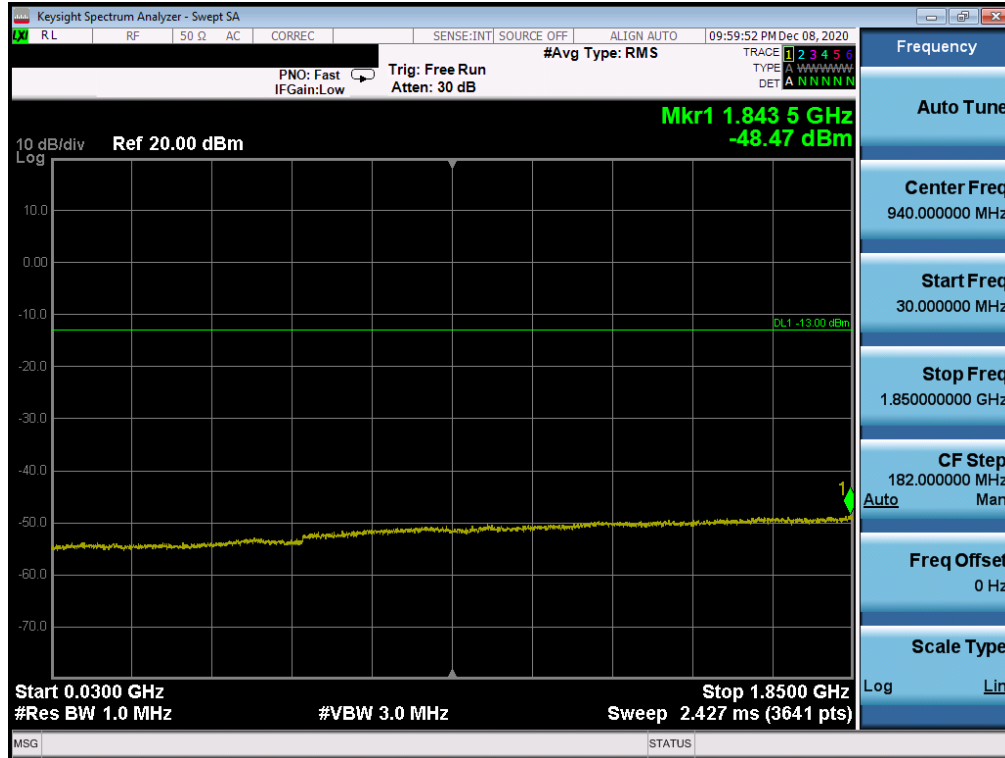
Plot 7-52. CSE (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)



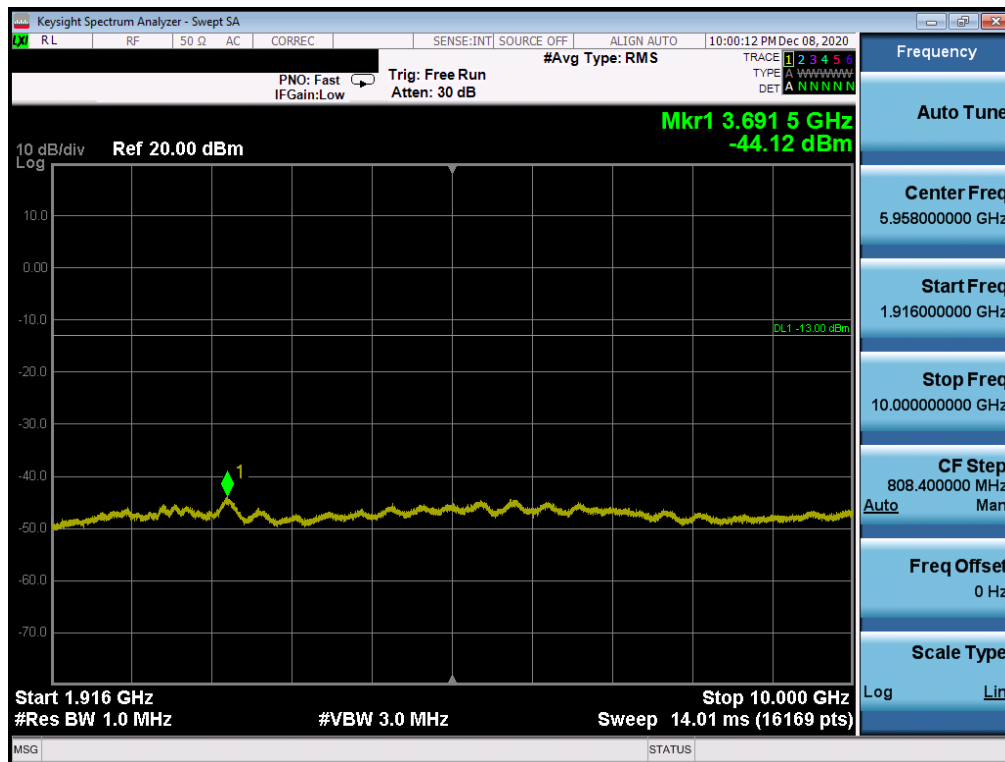
Plot 7-53. CSE (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 42 of 196                  |



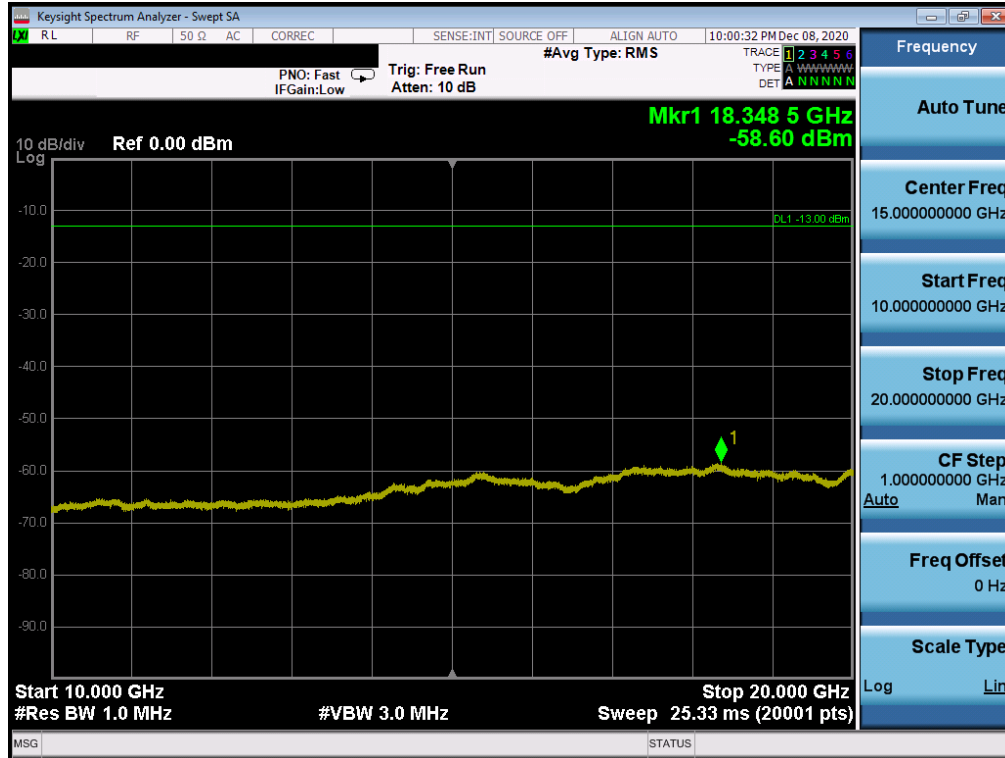


Plot 7-54. CSE (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



Plot 7-55. CSE (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

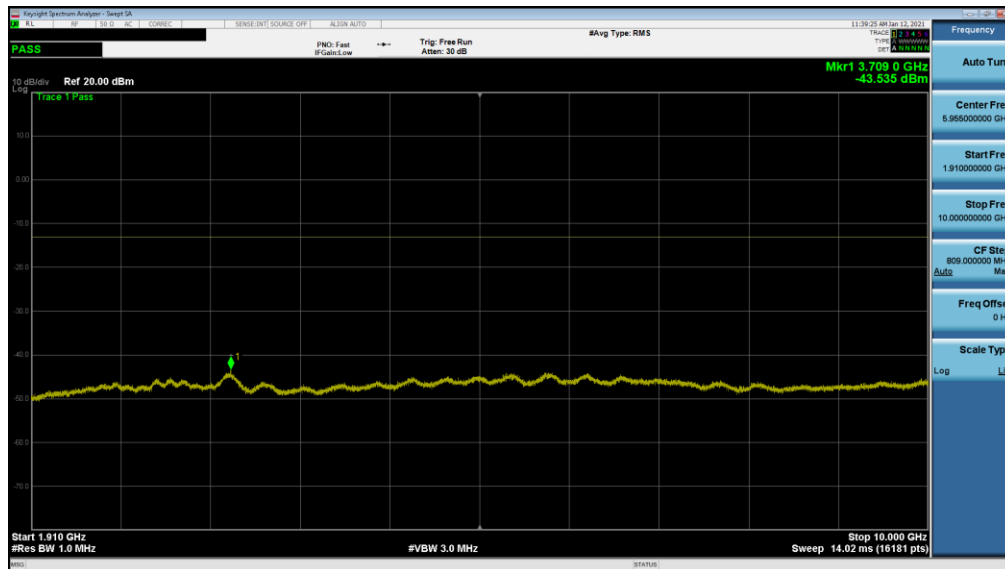
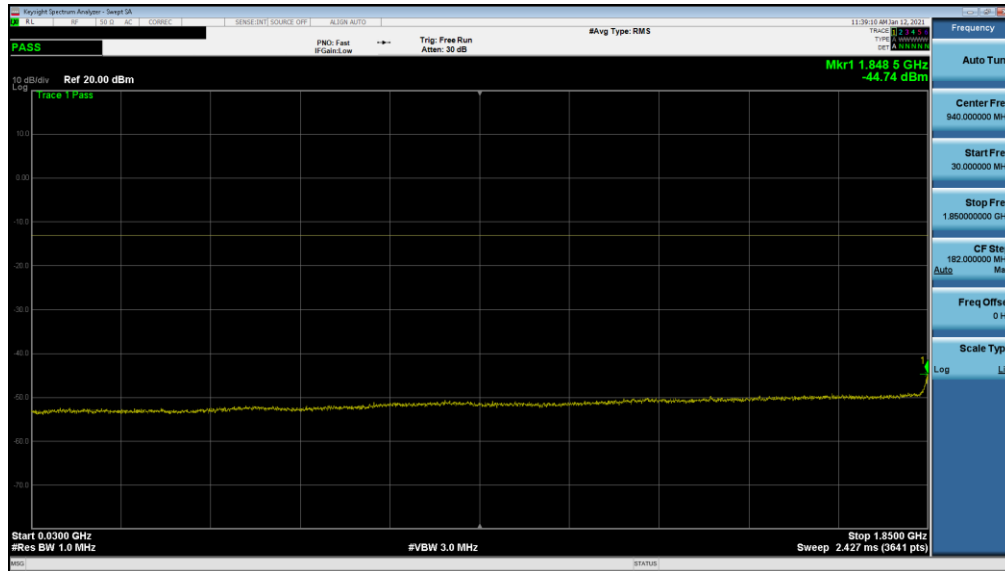
|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 43 of 196                  |



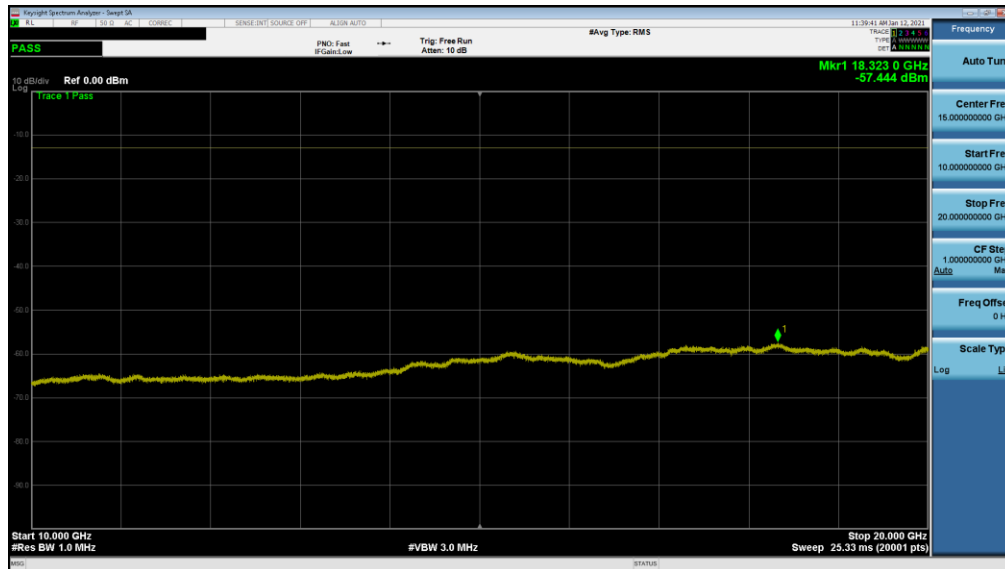
Plot 7-56. CSE (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 44 of 196                  |

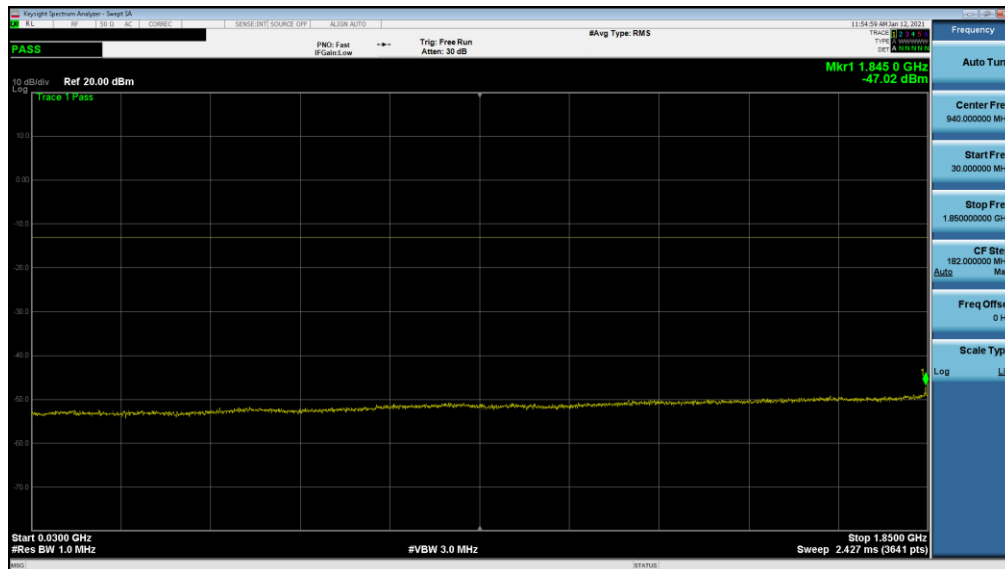
## NR Band n25/2



|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 45 of 196                  |

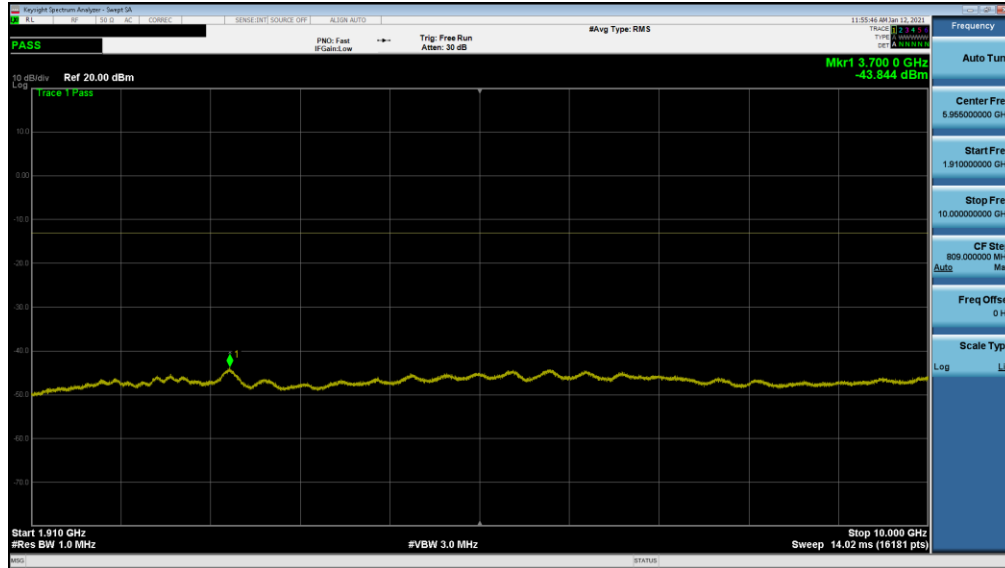


Plot 7-59. CSE (NR Band n25/2 - 15.0MHz DFT-s-OFDM QPSK - RB Size 1, RB Offset 0 - Low Channel)

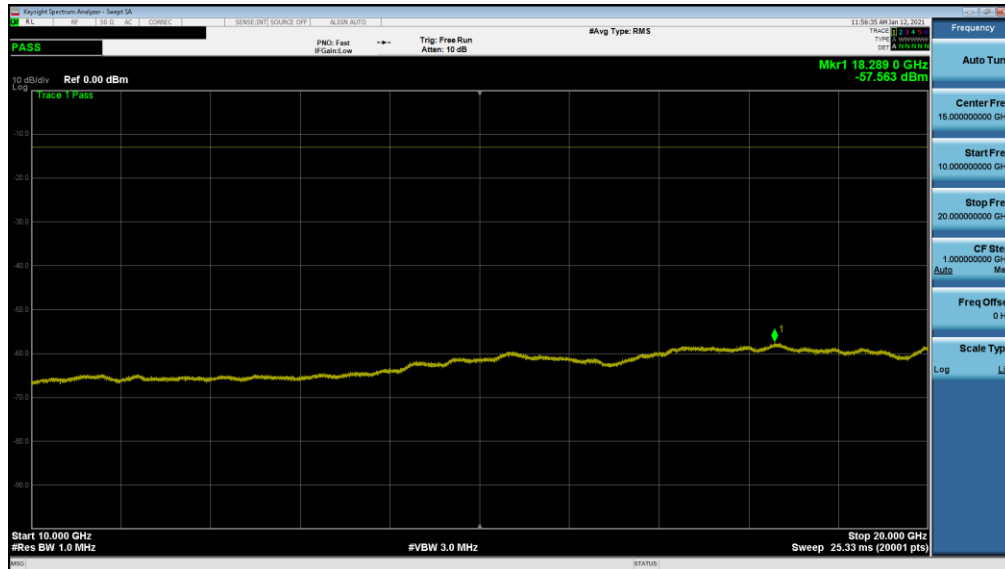


Plot 7-60. CSE (NR Band n25/2 - 15.0MHz DFT-s-OFDM QPSK - RB Size 1, RB Offset 0 - Mid Channel)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 46 of 196                  |

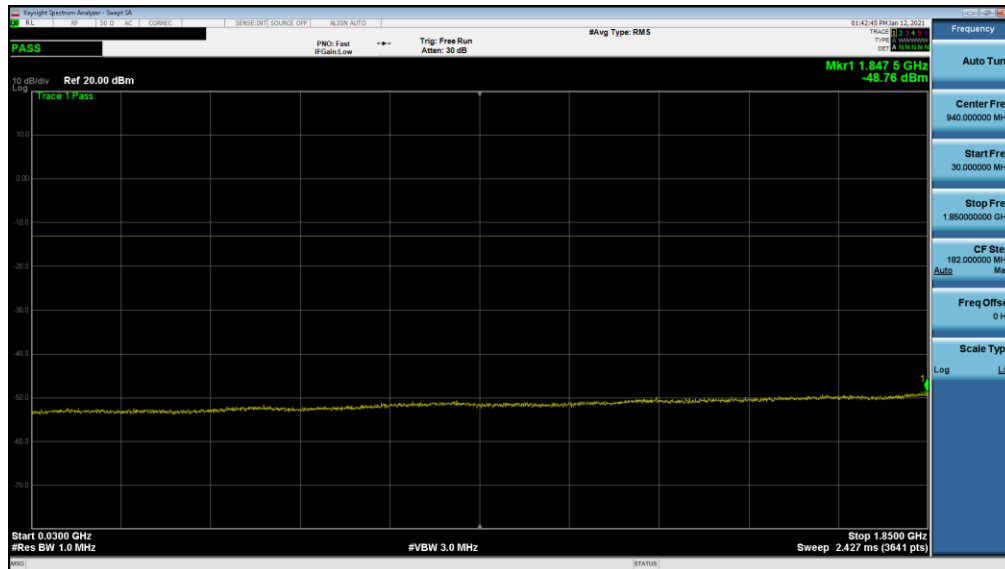


Plot 7-61. CSE (NR Band n25/2 - 15.0MHz DFT-s-OFDM QPSK - RB Size 1, RB Offset 0 - Mid Channel)

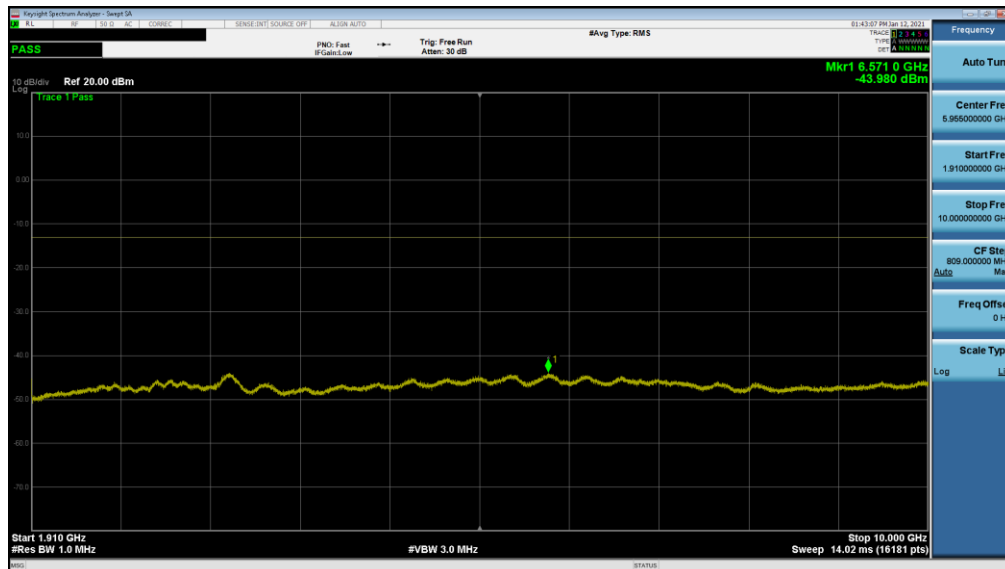


Plot 7-62. CSE (NR Band n25/2 - 15.0MHz DFT-s-OFDM QPSK - RB Size 1, RB Offset 0 - Mid Channel)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 47 of 196                  |

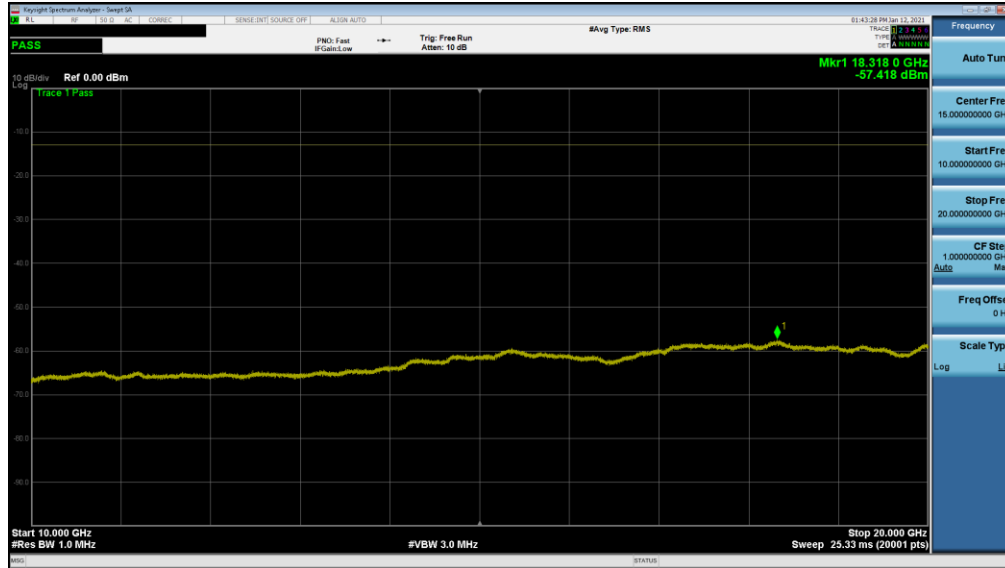


Plot 7-63. CSE (NR Band n25/2 - 15.0MHz DFT-s-OFDM QPSK - RB Size 1, RB Offset 0 - High Channel)



Plot 7-64. CSE (NR Band n25/2 - 15.0MHz DFT-s-OFDM QPSK - RB Size 1, RB Offset 0 - High Channel)

|   |  |                            |                                 |
|---|--|----------------------------|---------------------------------|
| FCC ID: BCGA2301                        | <b>PCTEST</b><br>Proud to be part of element | PART 24 MEASUREMENT REPORT | Approved by:<br>Quality Manager |
| Test Report S/N:<br>1C2101020002-03.BCG | Test Dates:<br>12/23/2020 - 03/05/2021       | EUT Type:<br>Tablet Device | Page 48 of 196                  |



Plot 7-65. CSE (NR Band n25/2 - 15.0MHz DFT-s-OFDM QPSK - RB Size 1, RB Offset 0 - High Channel)

|  |   |                                   |  |
|--|---|-----------------------------------|--|
| FCC ID: BCGA2301                               | <b>PCTEST</b><br>Proud to be part of element  | <b>PART 24 MEASUREMENT REPORT</b> | <b>Approved by:</b><br>Quality Manager |
| <b>Test Report S/N:</b><br>1C2101020002-03.BCG | <b>Test Dates:</b><br>12/23/2020 - 03/05/2021 | <b>EUT Type:</b><br>Tablet Device | Page 49 of 196                         |