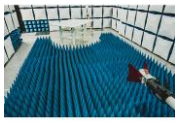
PCTEST
18855 Adams Court, Morgan Hill, CA 95037 USA
Tel. 410.290.6652 / Fax 410.290.6654
http://www.pctest.com



# DATA REFERENCE REPORT
## PART 96

**Applicant Name:**
Apple Inc.
One Apple Park Way
Cupertino, CA 95014
United States

**Date of Testing:**
12/15/2020 - 03/03/2021
**Test Site/Location:**
PCTEST Lab. Morgan Hill, CA, USA
**Test Report Serial No.:**
1C2101020006-09.BCG

| | |
|---|---|
| **FCC ID:** | **BCGA2461** |
| **Applicant Name:** | **Apple Inc.** |

| | |
|---|---|
| **Reference Model:** | A2379 |
| **Variant Model:** | A2461, A2462 |
| **EUT Type:** | Tablet Device |
| **FCC Classification:** | PCS Licensed Transmitter (PCB) |
| **FCC Rule Part:** | 96 |
| **Test Procedure(s):** | ANSI C63.26-2015, TIA-603-E-2016, KDB 971168 D01 v03r01, KDB 940660 D01 v02, WINNF-TS-0122 V1.0.2 |

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

Authorized Test Lab

ACCREDITED
CERT #2041.02

# TABLE OF CONTENTS

# 1.0 INTRODUCTION

## 1.1 Scope

Per manufacturer declaration, there are two tablet device models, A2379 and A2461(A2462), with high degree of similarity, reference model FCC ID: BCGA2379 and variant model **FCC ID: BCGA2461**. 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: BCGA2379, while radiated spot-check verification has been performed on variant model **FCC ID: BCGA2461**. 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 |
|---|---|---|---|
| CBE | BCGA2379 | 1C2101020005-08.BCG | RF Part 96 Test Report |

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

Reference model FCC ID: BCGA2379 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 ISED Standards (RSS).

- PCTEST facility is a registered (22831) test laboratory with the site description on file with ISED.

# 2.0 PRODUCT INFORMATION

## 2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Tablet Device FCC ID:BCGA2461**. 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 96.

**Test Device Serial No.:** JP76RWY2XR, XW3JN32D9W

## 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

LTE Band 48 supports NS10 for Antenna 3, Antenna 1, Antenna 4a, and Antenna 2a.

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

## 2.3 Antenna Description

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

| Band | Antenna Gain (dBi) | | | |
|---|---|---|---|---|
| | Antenna 3 | Antenna 1 | Antenna 4a | Antenna 2a |
| LTE Band 48 | 1.2 | 3.5 | 2.1 | 0.3 |

**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 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, Antenna 4a radiated testing and 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: BCGA2461 | |
|---|---|---|---|
| | | Mode | Channel |
| **GSM, WCDMA, LTE, FR1 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.

# 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

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

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.

# 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 $U_{CISPR}$ measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

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

# 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.

# 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.

# 7.0 TEST RESULTS (ANTENNA 4A)

## 7.1 Summary

Company Name: Apple Inc.

FCC ID: BCGA2461

FCC Classification: Citizens Band End User Devices (CBE)

Mode(s): LTE/ULCA

| FCC Part Section(s) | Test Description | Test Limit | Test Condition | Test Result | Reference |
|---|---|---|---|---|---|
| 2.1053<br>96.41(e) | Undesirable Emissions | -40 dBm/MHz | RADIATED | 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) Below 1GHz and Above 18GHz Radiated Spurious Emissions have been investigated and no significant emissions were found.

## 7.2 Radiated Spurious Emissions

**§2.1053 §96.41(e)**

### Test Overview

Radiated spurious emissions measurements are performed using the field strength conversion method described in KDB 971168 with the EUT transmitting into an integral antenna. Measurements on signals operating below 1GHz are performed using horizontally and vertically polarized broadband hybrid antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed while the EUT is operating at maximum power and at the appropriate frequencies.

### Test Procedures Used

KDB 971168 D01 v03r01 – Section 5.8

ANSI C63.26-2015

TIA-603-E-2016 – Section 2.2.12

### Test Settings

1. RBW = 100kHz for emissions below 1GHz and 1MHz for emissions above 1GHz
2. VBW ≥ 3 x RBW
3. Span = 1.5 times the OBW
4. No. of sweep points ≥ 2 x span / RBW
5. Detector = RMS
6. Trace mode = Max Hold (In cases where the level is within 2dB of the limit, the final measurement is taken using triggering/gating and trace averaging.)
7. The trace was allowed to stabilize

## Test Setup

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

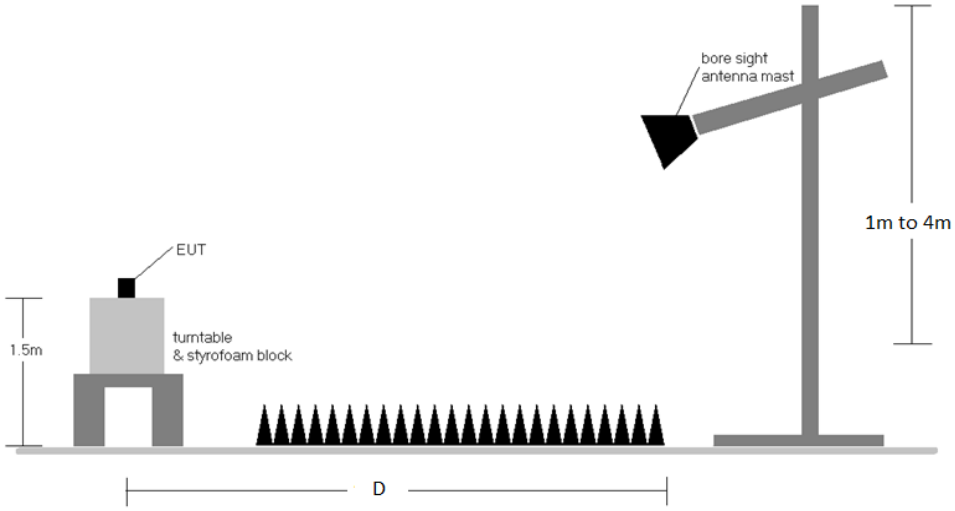



**Figure 7-1. Test Instrument & Measurement Setup**

## Test Notes

1) Field strengths are calculated using the Measurement quantity conversions in KDB 971168 Section 5.8.4.
   a. E(dBµV/m) = Measured amplitude level (dBm) + 107 + Cable Loss (dB) + Antenna Factor (dB/m)
   b. EIRP (dBm) = E(dBµV/m) + 20logD – 104.8; where D is the measurement distance in meters.

2) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below. 1RB config was found and reported as a worst case RB size.

3) This unit was tested with its standard battery.

4) The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter. The worst-case emissions are reported.

5) Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.

6) The "-" shown in the following RSE tables are used to denote a noise floor measurement.

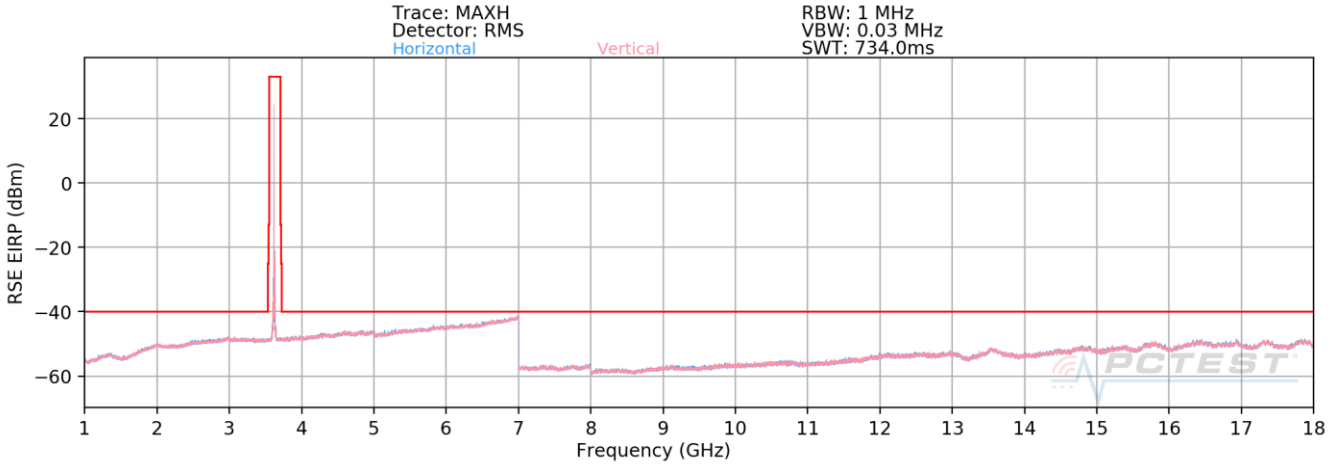
7) Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.

8) For LTE Band 48 pre-scans 1-18GHz, the RBW is set to 1MHz and VBW to 30kHz. For final measurements above 1GHz, the RBW is set to 1MHz and VBW to 3MHz when measuring with an RMS detector and max hold trace.

9) Uplink carrier aggregation intra-band radiated spurious emissions measurements were evaluated for the two contiguous channels using various combinations of RB size, RB offset, modulation, and channel bandwidth. The worst case (highest) emissions were found while operating with QPSK modulation with both carriers set to transmit using 1RB.

## Antenna 4a Radiated Spurious Emissions Measurements

## LTE Band 48




**Plot 7-1. Radiated Spurious Plot 1 - 18GHz (Band 48)**

| | |
|---|---|
| **Bandwidth (MHz):** | 20 |
| **Frequency (MHz):** | 3560.0 |
| **Modulatiuon Signal:** | QPSK |
| **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] |
|---|---|---|---|---|---|---|---|---|---|
| 7120.0 | H | - | - | -72.33 | 8.91 | 43.58 | -51.68 | -40.00 | -11.68 |
| 10680.0 | H | 173 | 217 | -74.18 | 14.48 | 47.30 | -47.95 | -40.00 | -7.95 |
| 14240.0 | H | - | - | -75.25 | 18.27 | 50.02 | -45.24 | -40.00 | -5.24 |

**Table 7-2. Radiated Spurious Data (Band 48 – Low Channel)**

| | |
|---|---|
| **Bandwidth (MHz):** | 20 |
| **Frequency (MHz):** | 3625.0 |
| **Modulatiuon Signal:** | QPSK |
| **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] |
|---|---|---|---|---|---|---|---|---|---|
| 7250.0 | H | 127 | 128 | -71.45 | 8.68 | 44.23 | -51.03 | -40.00 | -11.03 |
| 10875.0 | H | - | - | -75.45 | 15.18 | 46.73 | -48.53 | -40.00 | -8.53 |
| 14500.0 | H | - | - | -75.27 | 19.52 | 51.25 | -44.01 | -40.00 | -4.01 |

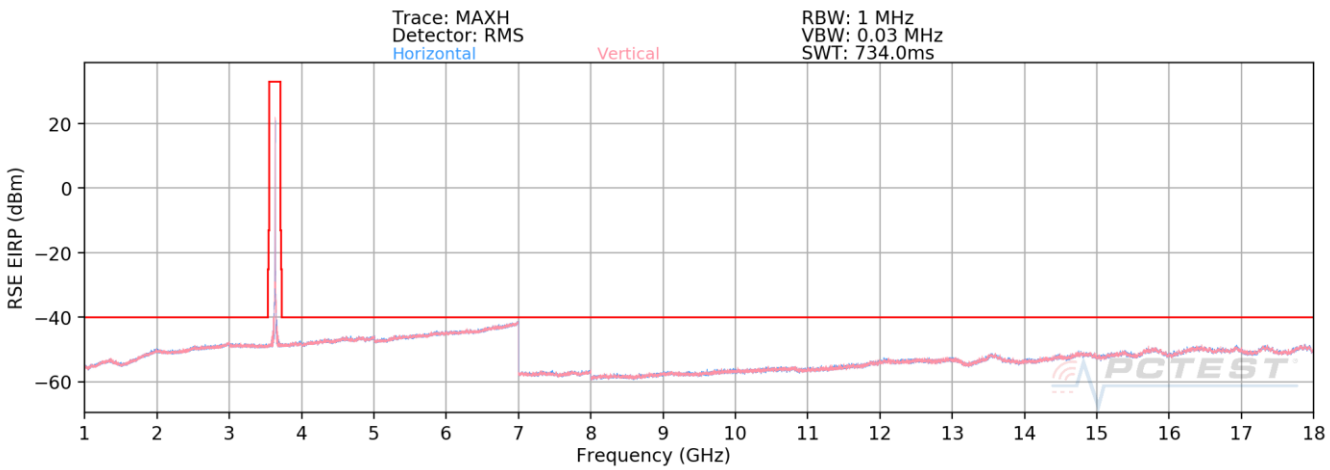
**Table 7-3. Radiated Spurious Data (Band 48 – Mid Channel)**

| | |
|---|---|
| **Bandwidth (MHz):** | 20 |
| **Frequency (MHz):** | 3690.0 |
| **Modulatiuon Signal:** | QPSK |
| **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] |
|---|---|---|---|---|---|---|---|---|---|
| 7380.00 | H | 237 | 182 | -72.32 | 9.26 | 43.94 | -51.32 | -40.00 | -11.32 |
| 11070.00 | H | - | - | -75.17 | 15.28 | 47.11 | -48.15 | -40.00 | -8.15 |
| 14760.00 | H | - | - | -76.00 | 19.84 | 50.84 | -44.42 | -40.00 | -4.42 |

**Table 7-4. Radiated Spurious Data (Band 48 – High Channel)**

## ULCA - LTE Band 48




**Plot 7-2. Radiated Spurious Plot 1 - 18GHz (ULCA Band 48)**

| | |
|---|---|
| **PCC Bandwidth (MHz):** | 20 |
| **PCC Frequency (MHz):** | 3560.0 |
| **PCC RB / Offset:** | 1 / 99 |
| **SCC Bandwidth (MHz):** | 20 |
| **SCC Frequency (MHz):** | 3579.8 |
| **SCC RB / Offset:** | 1 / 0 |

| 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7140.0 | H | - | - | -73.20 | 8.91 | 42.71 | -52.55 | -40.00 | -12.55 |
| 10710.0 | H | - | - | -75.39 | 14.48 | 46.09 | -49.16 | -40.00 | -9.16 |
| 14280.0 | H | - | - | -75.71 | 18.27 | 49.56 | -45.70 | -40.00 | -5.70 |

**Table 7-5. Radiated Spurious Data (ULCA Band 48 – Low Channel)**

| | |
|---|---|
| **PCC Bandwidth (MHz):** | 20 |
| **PCC Frequency (MHz):** | 3625.0 |
| **PCC RB / Offset:** | 1 / 99 |
| **SCC Bandwidth (MHz):** | 20 |
| **SCC Frequency (MHz):** | 3644.8 |
| **SCC RB / Offset:** | 1 / 0 |

| 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7270.0 | H | - | - | -72.93 | 8.68 | 42.75 | -52.51 | -40.00 | -12.51 |
| 10905.0 | H | - | - | -75.48 | 15.18 | 46.70 | -48.56 | -40.00 | -8.56 |
| 14540.0 | H | - | - | -75.60 | 19.52 | 50.92 | -44.34 | -40.00 | -4.34 |

**Table 7-6. Radiated Spurious Data (ULCA Band 48 – Mid Channel)**

| | |
|---|---|
| **PCC Bandwidth (MHz):** | 20 |
| **PCC Frequency (MHz):** | 3690.0 |
| **PCC RB / Offset:** | 1 / 0 |
| **SCC Bandwidth (MHz):** | 20 |
| **SCC Frequency (MHz):** | 3670.2 |
| **SCC RB / Offset:** | 1 / 99 |

| 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7400.0 | H | - | - | -73.61 | 9.26 | 42.65 | -52.61 | -40.00 | -12.61 |
| 11100.0 | H | - | - | -75.40 | 15.28 | 46.88 | -48.38 | -40.00 | -8.38 |
| 14800.0 | H | - | - | -76.89 | 19.84 | 49.95 | -45.31 | -40.00 | -5.31 |

**Table 7-7. Radiated Spurious Data (ULCA Band 48 – High Channel)**

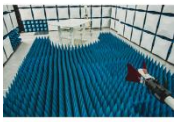
# 8.0 CONCLUSION

Antenna 4a radiated testing has been fully conducted for variant model **FCC ID: BCGA2461** and results were found in compliance with all of the End User Device requirements of Part 96 of the FCC Rules for LTE operation only.

# 9.0 APPENDIX A: REFERENCE MODEL TEST REPORT

Attached is the test report (1C2101020005-08.BCG) from reference model FCC ID: BCGA2379, which includes referenced data results.

PCTEST
18855 Adams Court, Morgan Hill, CA 95037 USA
Tel. 410.290.6652 / Fax 410.290.6654
http://www.pctest.com



# MEASUREMENT REPORT
## Part 96 LTE

**Applicant Name:**
Apple Inc.
One Apple Park Way
Cupertino, CA 95014
United States

**Date of Testing:**
12/15/2020-03/03/2021
**Test Site/Location:**
PCTEST Morgan Hill, CA, USA
**Test Report Serial No.:**
1C2101020005-08.BCG

| | |
|---|---|
| **FCC ID:** | **BCGA2379** |
| **APPLICANT:** | **Apple Inc.** |

| | |
|---|---|
| **Application Type:** | Certification |
| **Model:** | A2379 |
| **EUT Type:** | Tablet Device |
| **FCC Classification:** | Citizens Band End User Devices (CBE) |
| **FCC Rule Part(s):** | 96 |
| **Test Procedure(s):** | ANSI C63.26-2015, TIA-603-E-2016, KDB 971168 D01 v03r01, KDB 940660 D01 v02, WINNF-TS-0122 V1.0.2 |

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.

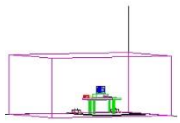
I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking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

Randy Ortanez
President

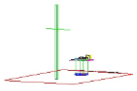
OnGo Authorized Test Lab

ilac-MRA A2LA ACCREDITED CERT #2041.02

# TABLE OF CONTENTS



# MEASUREMENT REPORT
## FCC Part 96



| Mode | Bandwidth | Modulation | Tx Frequency Range [MHz] | OBW [MHz] | EIRP | | Emission Designator |
|---|---|---|---|---|---|---|---|
| | | | | | Max. Power [W] | Max. Power [dBm] | |
| LTE Band 48 | 20 MHz | QPSK | 3560.0 - 3690.0 | 18.0340 | 0.158 | 22.00 | 18M0G7W |
| | | 16QAM | 3560.0 - 3690.0 | 17.9650 | 0.156 | 21.93 | 18M0D7W |
| | | 64QAM | 3560.0 - 3690.0 | 17.9310 | 0.157 | 21.97 | 17M9D7W |
| | | 256QAM | 3560.0 - 3690.0 | 18.0010 | 0.151 | 21.78 | 18M0D7W |
| | 15 MHz | QPSK | 3557.5 - 3692.5 | 13.5560 | 0.158 | 22.00 | 13M6G7W |
| | | 16QAM | 3557.5 - 3692.5 | 13.5300 | 0.154 | 21.87 | 13M5D7W |
| | | 64QAM | 3557.5 - 3692.5 | 13.4780 | 0.154 | 21.88 | 13M5D7W |
| | | 256QAM | 3557.5 - 3692.5 | 13.5200 | 0.150 | 21.77 | 13M5D7W |
| | 10 MHz | QPSK | 3555.0 - 3695.0 | 9.0317 | 0.158 | 22.00 | 9M03G7W |
| | | 16QAM | 3555.0 - 3695.0 | 8.9915 | 0.153 | 21.85 | 8M99D7W |
| | | 64QAM | 3555.0 - 3695.0 | 9.0077 | 0.158 | 21.98 | 9M01D7W |
| | | 256QAM | 3555.0 - 3695.0 | 9.0562 | 0.149 | 21.73 | 9M06D7W |
| | 5 MHz | QPSK | 3552.5 - 3697.5 | 4.5308 | 0.158 | 22.00 | 4M53G7W |
| | | 16QAM | 3552.5 - 3697.5 | 4.5201 | 0.156 | 21.92 | 4M52D7W |
| | | 64QAM | 3552.5 - 3697.5 | 4.5291 | 0.156 | 21.94 | 4M53D7W |
| | | 256QAM | 3552.5 - 3697.5 | 4.5106 | 0.149 | 21.72 | 4M51D7W |
| LTE ULCA Band 48 | 20+20 MHz | QPSK | 3570.0 - 3680.0 | 37.6480 | 0.158 | 22.00 | 37M6G7W |
| | | 16QAM | 3570.0 - 3680.0 | 37.5890 | 0.134 | 21.27 | 37M6D7W |
| | | 64QAM | 3570.0 - 3680.0 | 37.5510 | 0.134 | 21.26 | 37M6D7W |
| | | 256QAM | 3570.0 - 3680.0 | 37.5130 | 0.133 | 21.23 | 37M5D7W |
| | 20+15 MHz | QPSK | 3567.5 - 3682.5 | 32.7820 | 0.158 | 22.00 | 32M8G7W |
| | | 16QAM | 3567.5 - 3682.5 | 32.7390 | 0.141 | 21.50 | 32M7D7W |
| | | 64QAM | 3567.5 - 3682.5 | 32.7320 | 0.141 | 21.48 | 32M7D7W |
| | | 256QAM | 3567.5 - 3682.5 | 32.6710 | 0.144 | 21.57 | 32M7D7W |
| | 20+10 MHz | QPSK | 3565.0 - 3685.0 | 27.8710 | 0.158 | 22.00 | 27M9G7W |
| | | 16QAM | 3565.0 - 3685.0 | 27.8630 | 0.142 | 21.52 | 27M9D7W |
| | | 64QAM | 3565.0 - 3685.0 | 27.8140 | 0.140 | 21.47 | 27M8D7W |
| | | 256QAM | 3565.0 - 3685.0 | 27.8230 | 0.141 | 21.50 | 27M8D7W |
| | 20+5 MHz | QPSK | 3562.5 - 3687.5 | 23.0120 | 0.158 | 22.00 | 23M0G7W |
| | | 16QAM | 3562.5 - 3687.5 | 22.9820 | 0.136 | 21.33 | 23M0D7W |
| | | 64QAM | 3562.5 - 3687.5 | 23.0430 | 0.136 | 21.34 | 23M0D7W |
| | | 256QAM | 3562.5 - 3687.5 | 22.9950 | 0.137 | 21.37 | 23M0D7W |

**EUT Overview**

# 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.

## 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

**Measurements were performed at PCTEST located in Morgan Hill, CA 95037, U.S.A.**

- PCTEST is a CBRS Alliance (OnGo) Approved Test Lab
- PCTEST is a WInnForum Approved Test Lab
- PCTEST is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.02 for CBRS Alliance Certification Test Plan and WInnForum Conformance and Performance Test Technical Standard.
- 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 ISED Standards (RSS).
- PCTEST facility is a registered (22831) test laboratory with the site description on file with ISED.

# 2.0 PRODUCT INFORMATION

## 2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Tablet Device FCC ID: BCGA2379**. The test data contained in this report pertains only to the emissions due to the EUT's LTE Band 48 operation in the CBRS band. Per FCC Part 96, this device is evaluated under Citizens Band End User Devices (CBE).

**Test Device Serial No.:** DLXDL0110RXG, H4MTX492NT, NN63X069PP, DLXDL0110RXG

## 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.

LTE Band 48 supports NS10 for Antenna 3, Antenna 1, Antenna 4a, and Antenna 2a.

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, LE1M/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 7 and reported in UNII 802.11ax (OFDMA) and FCC part 27b test reports.

## 2.3 Antenna Description

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

| Band | Antenna Gain (dBi) | | | |
|---|---|---|---|---|
| | Antenna 3 | Antenna 1 | Antenna 4a | Antenna 2a |
| LTE Band 48 | 1.2 | 3.5 | 2.1 | 0.3 |

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

## 2.4 Test Support Equipment

| | | | | | |
|---|---|---|---|---|---|
| 1 | Apple MacBook | 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/DC 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 |
| 6 | LTE Access Point | Model: | Q710 | S/N: | 991929000125 |
| 7 | Dell Laptop (Local SAS - WINNForum Test Harness) | Model: | A2217 | S/N: | C39Z600ANXM2 |

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

## 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.

## 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.

# 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

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

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 and TIA-603-E-2016.

# 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 $U_{CISPR}$ measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

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

# 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 | 3Hz-44GHz PXA Signal Analyzer | 3/4/2020 | Annual | 3/4/2021 | MY49430244 |
| Keysight Technology | N9040B | UXA Signal Analyzer | 12/19/2020 | Annual | 12/19/2021 | MY57212015 |
| 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 | FSV40 | Signal Analyzer (10Hz-40GHz) | 3/2/2020 | Annual | 3/2/2021 | 101619 |
| 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 | 9/24/2020 | Annual | 9/24/2021 | 151888 |
| 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 List**

**Notes:**

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.

# 6.0 SAMPLE CALCULATIONS

## Emission Designator

### QPSK Modulation

**Emission Designator = 8M62G7W**

LTE BW = 8.62 MHz
G = Phase Modulation
7 = Quantized/Digital Info
W = Combination of Any

### QAM Modulation

**Emission Designator = 8M45D7W**

LTE BW = 8.45 MHz
D = Amplitude/Angle Modulated
7 = Quantized/Digital Info
W = Combination of Any

## Spurious Radiated Emission – LTE Band

**Example: Middle Channel LTE Mode 2nd Harmonic (7250 MHz)**

The average 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 analzyer. The loss of the cable between the signal generator and the terminals of the substituted antenna is 2.0 dB at 1564 MHz. So 6.1 dB is added to the signal generator reading of –30.9 dBm yielding –24.80 dBm. The fundamental EIRP was 25.501 dBm so this harmonic was 25.501 dBm – (-24.80).

# 7.0 TEST RESULTS

## 7.1 Summary

Company Name: Apple Inc.

FCC ID: BCGA2379

FCC Classification: Citizens Band End User Devices (CBE)

Mode(s): LTE/ULCA

| FCC Part Section(s) | Test Description | Test Limit | Test Condition | Test Result | Reference |
|---|---|---|---|---|---|
| 2.1049 | Occupied Bandwidth | N/A | CONDUCTED | N/A | Section 7.2 |
| 2.1051<br>96.41(e)(ii) | Out of Band Emissions | -13 dBm/MHz at frequencies within 0-B MHz of channel edge (where B is the bandwidth of the assigned channel)<br><br>-25 dBm/MHz at frequencies greater than B MHz above and below channel edge<br><br>-40 dBm/MHz at frequencies below 3530 MHz and above 3720 MHz | | PASS | Section 7.3, 7.4 |
| 2.1046 | Transmitter Conducted Output Power | N/A | | N/A | See RF Exposure Report |
| 2.1046 | Additional Maximum Power Reduction (A-MPR) | N/A | | N/A | Section 7.5 |
| 96.41(b) | Equivalent Isotropic Radiated Power (EIRP) | 23 dBm/10MHz | | PASS | Section 7.6 |
| 2.1053<br>96.41(e) | Undesirable Emissions | -40 dBm/MHz | RADIATED | PASS | Section 7.7 |
| 2.1055 | Frequency Stability | Fundamental emissions stay within authorized frequency block over the temperature and voltage range as tested | CONDUCTED | PASS | Section 7.8 |
| 96.47 | End User Device Additional Requirements (CBSD Protocol) | End User Devices may operate only if they can positively receive and decode an authorization signal transmitted by a CBSD, including the frequencies and power limits for their operation.<br><br>An End User Device must discontinue operations, change frequencies, or change its operational power level within 10 seconds of receiving instructions from its associated CBSD. | | PASS | Section 7.9 |

**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) For conducted spurious emissions, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST "LTE Automation," Version 5.3.

## 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 ≥ 3 x 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

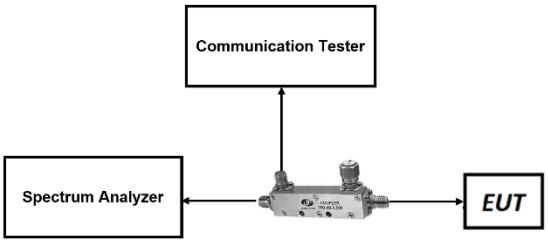
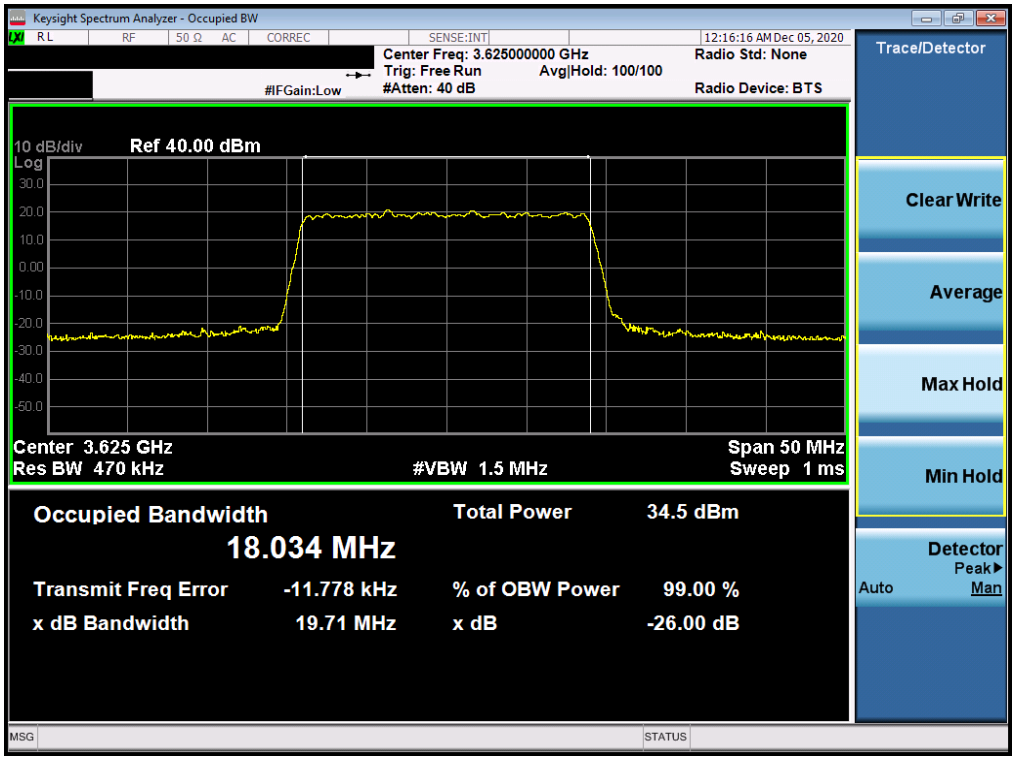



**Figure 7-1. Test Instrument & Measurement Setup**

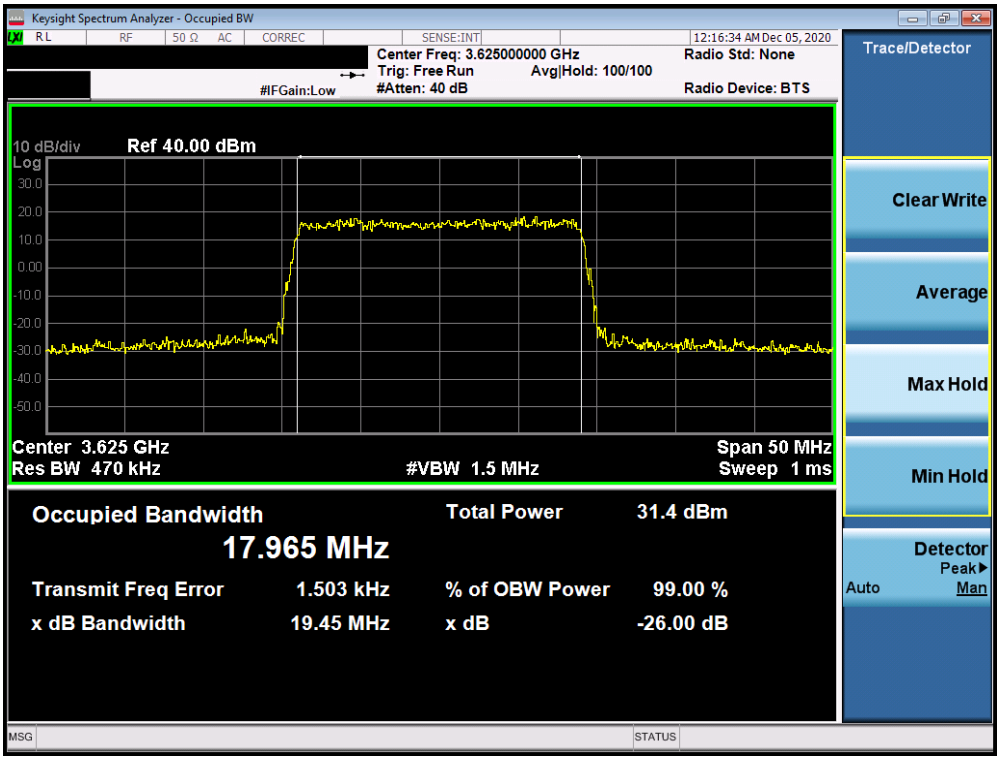
### Test Notes

None.

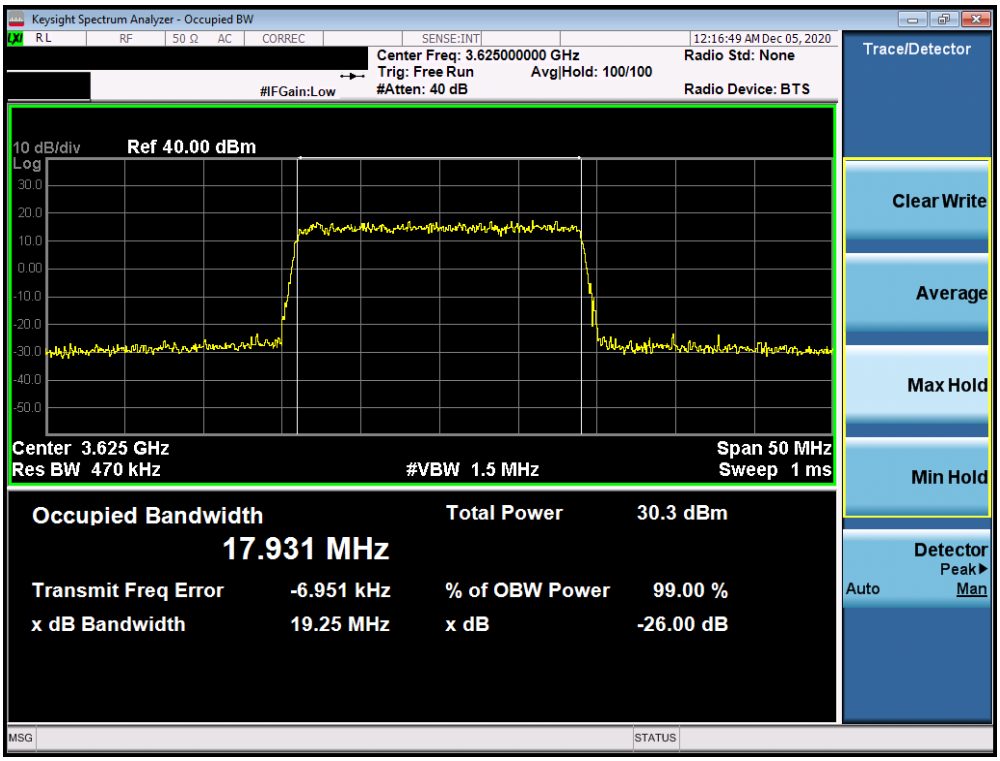
## LTE Band 48



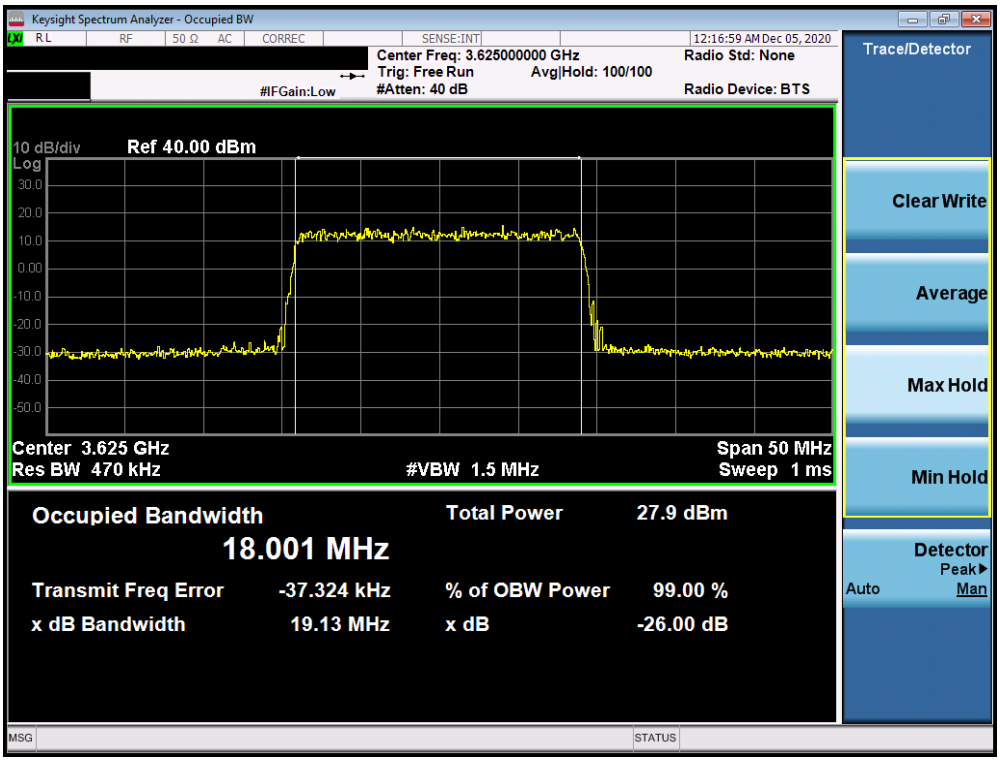

**Plot 7-1. Occupied Bandwidth Plot (LTE Band 48 - 20MHz QPSK - Full RB Configuration)**



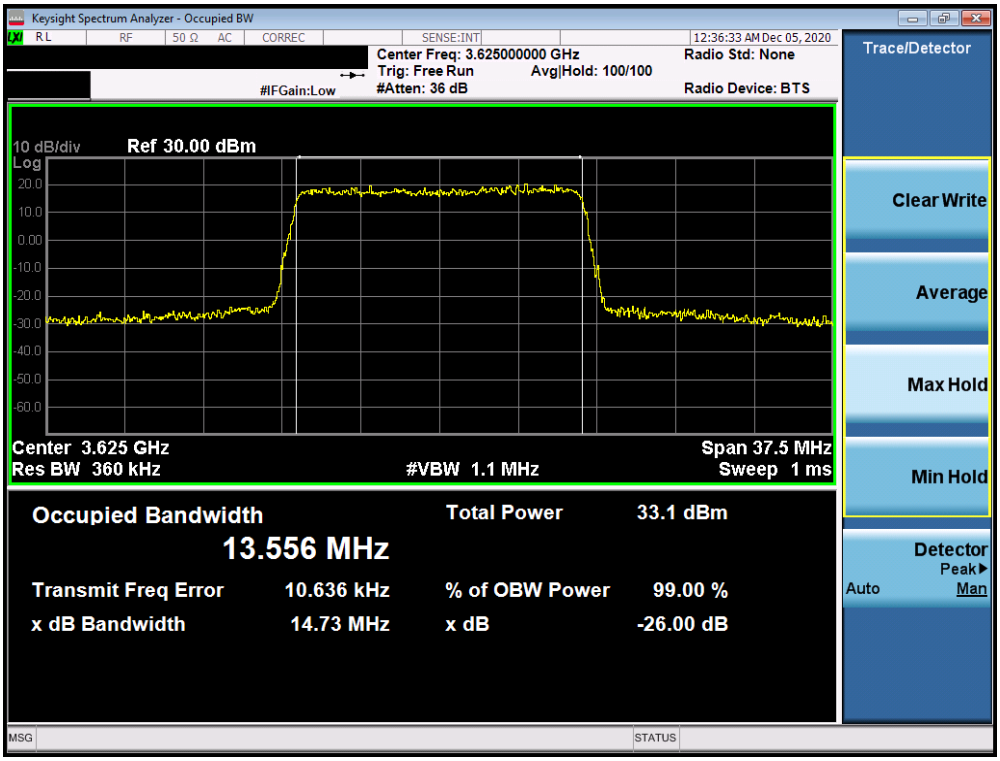

**Plot 7-2. Occupied Bandwidth Plot (LTE Band 48 - 20MHz 16-QAM - Full RB Configuration)**



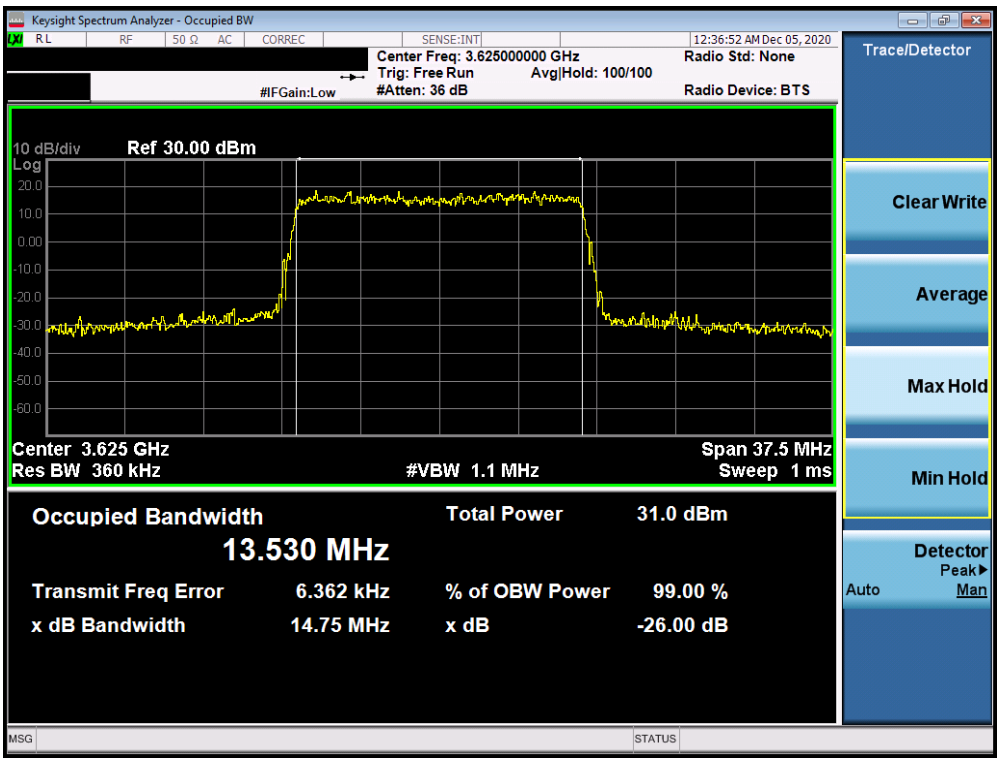

**Plot 7-3. Occupied Bandwidth Plot (LTE Band 48 - 20MHz 64-QAM - Full RB Configuration)**



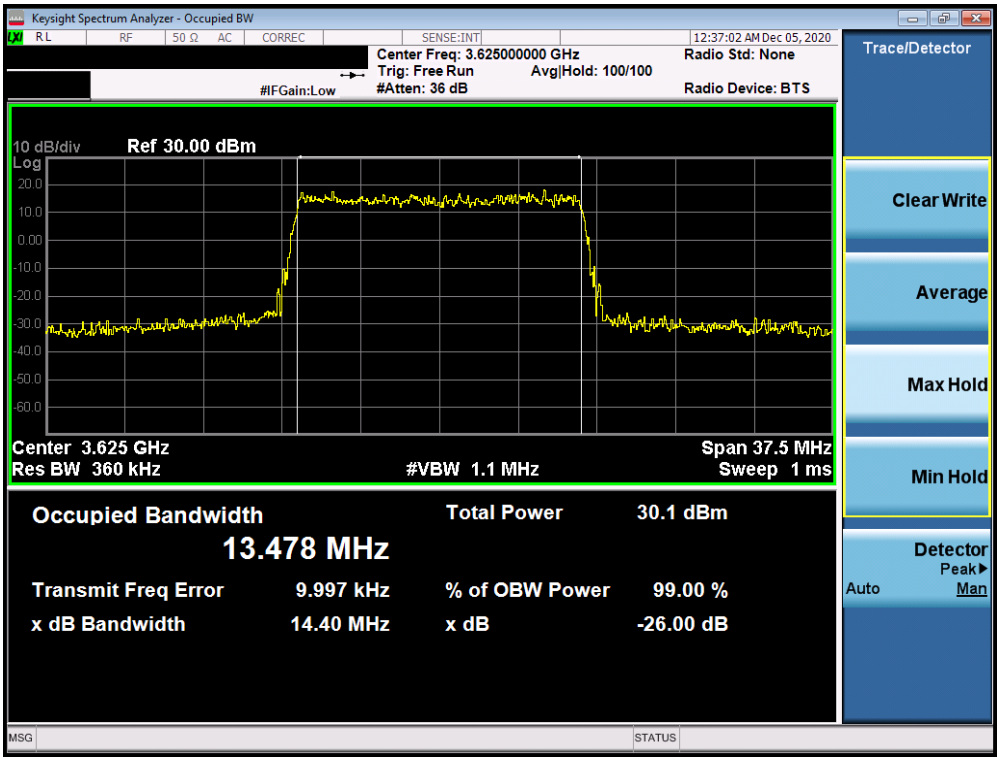

**Plot 7-4. Occupied Bandwidth Plot (LTE Band 48 - 20MHz 256-QAM - Full RB Configuration)**



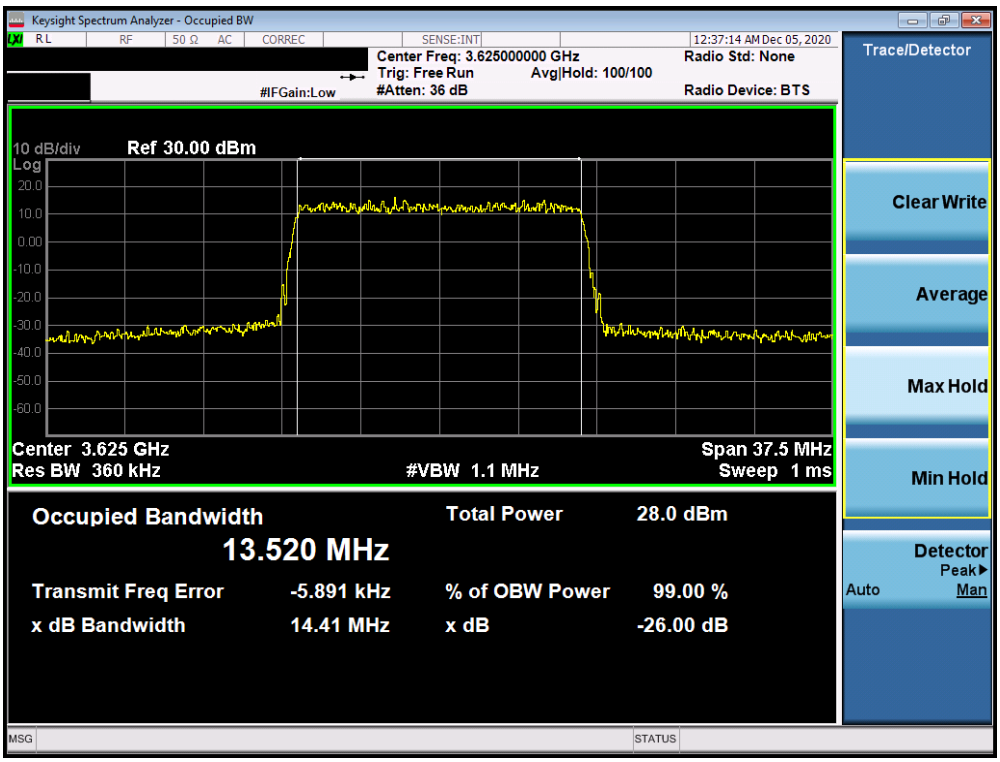

**Plot 7-5. Occupied Bandwidth Plot (LTE Band 48 - 15MHz QPSK - Full RB Configuration)**



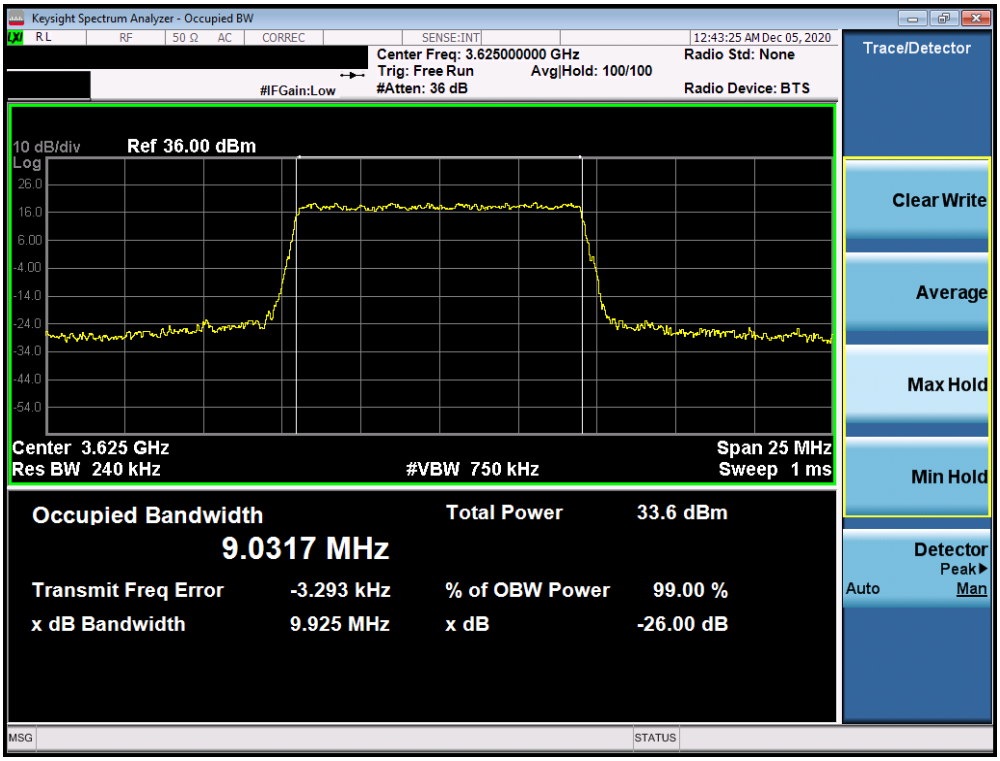

**Plot 7-6. Occupied Bandwidth Plot (LTE Band 48 - 15MHz 16-QAM - Full RB Configuration)**



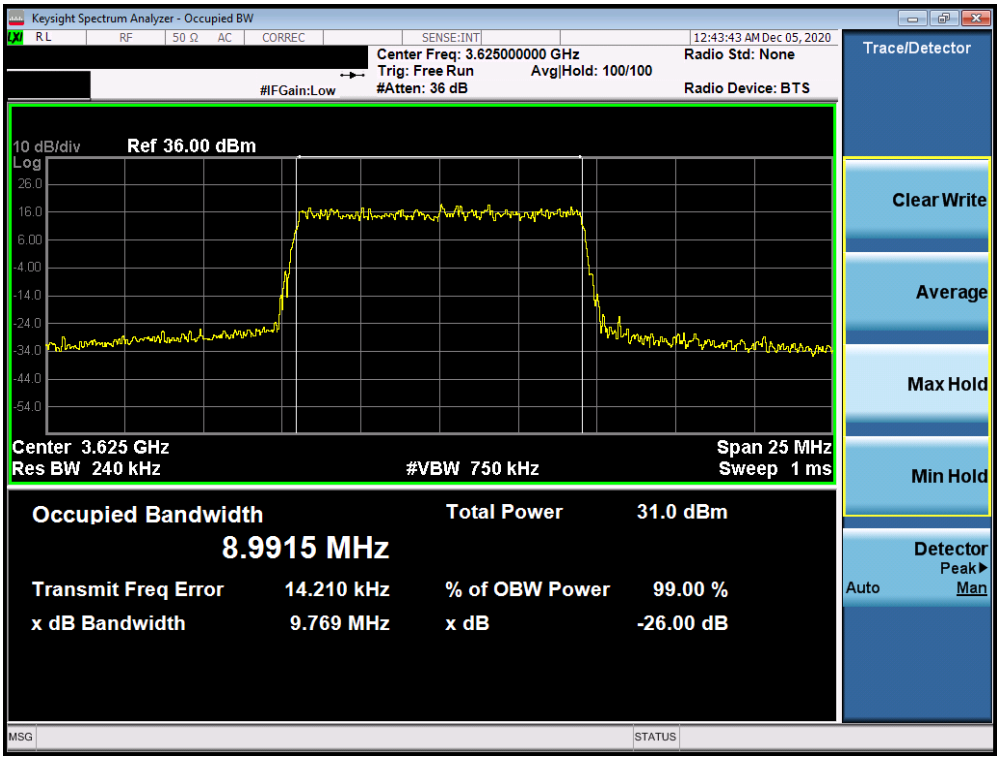

**Plot 7-7. Occupied Bandwidth Plot (LTE Band 48 - 15MHz 64-QAM - Full RB Configuration)**



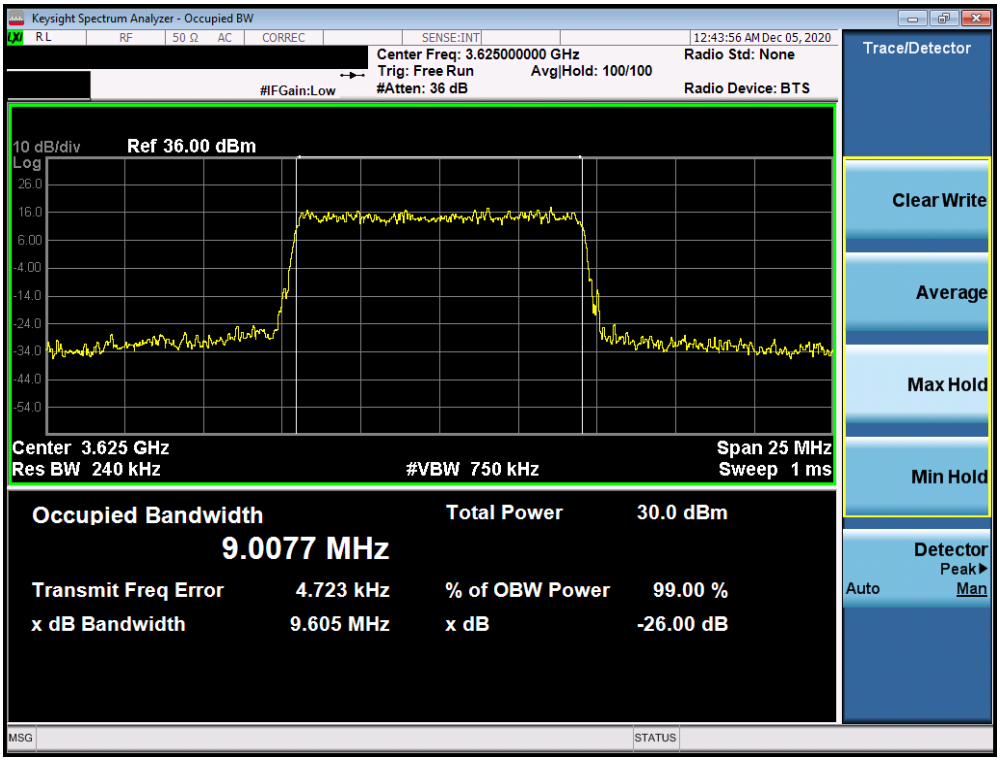

**Plot 7-8. Occupied Bandwidth Plot (LTE Band 48 - 15MHz 256-QAM - Full RB Configuration)**



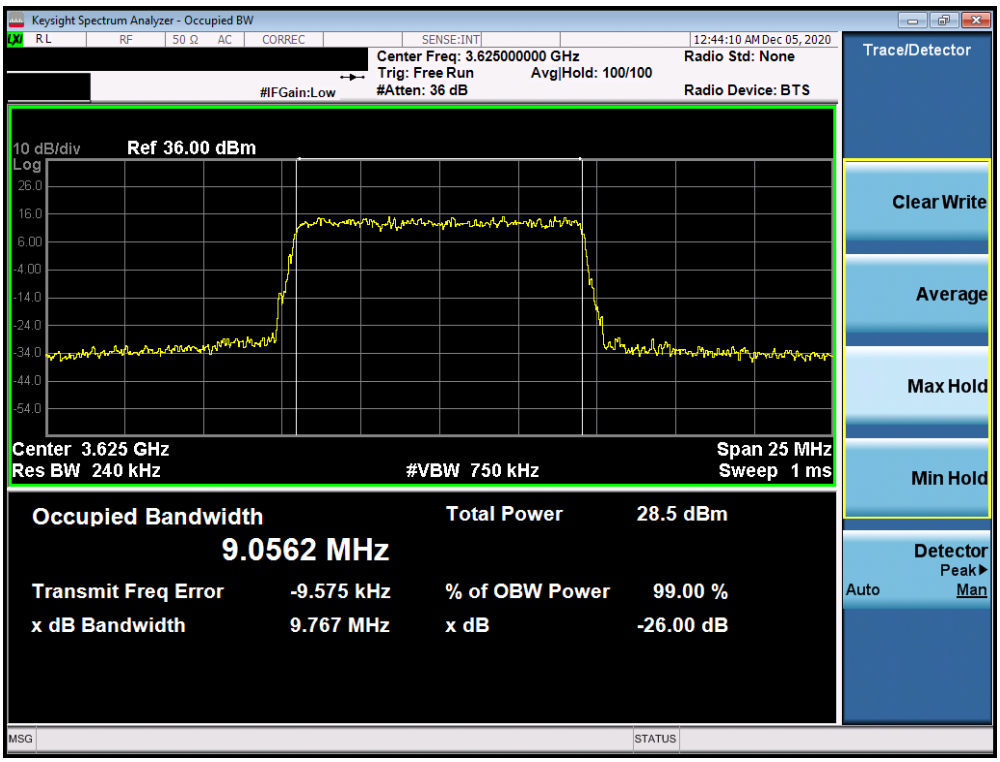

**Plot 7-9. Occupied Bandwidth Plot (LTE Band 48 - 10MHz QPSK - Full RB Configuration)**



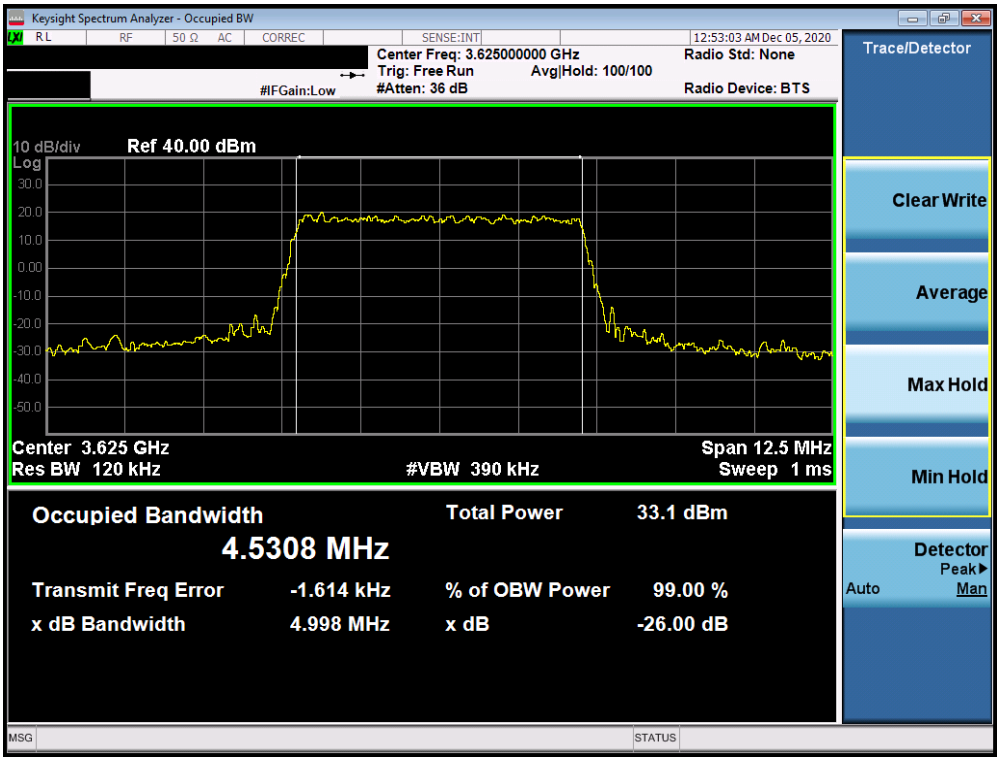

**Plot 7-10. Occupied Bandwidth Plot (LTE Band 48 - 10MHz 16-QAM - Full RB Configuration)**



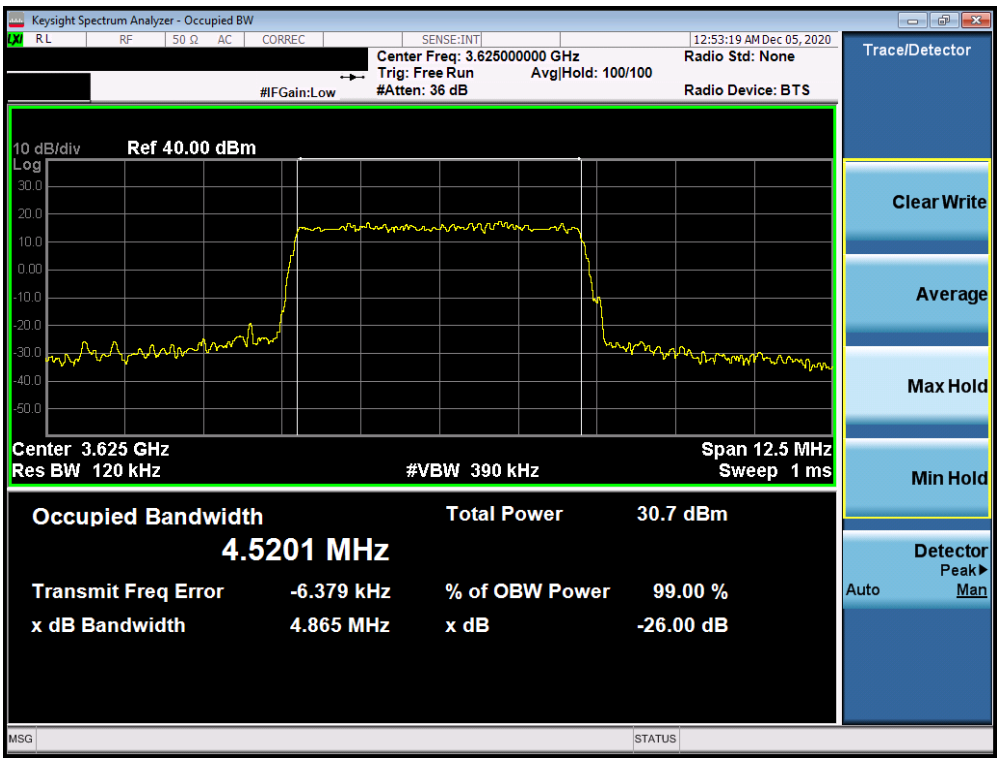

**Plot 7-11. Occupied Bandwidth Plot (LTE Band 48 - 10MHz 64-QAM - Full RB Configuration)**



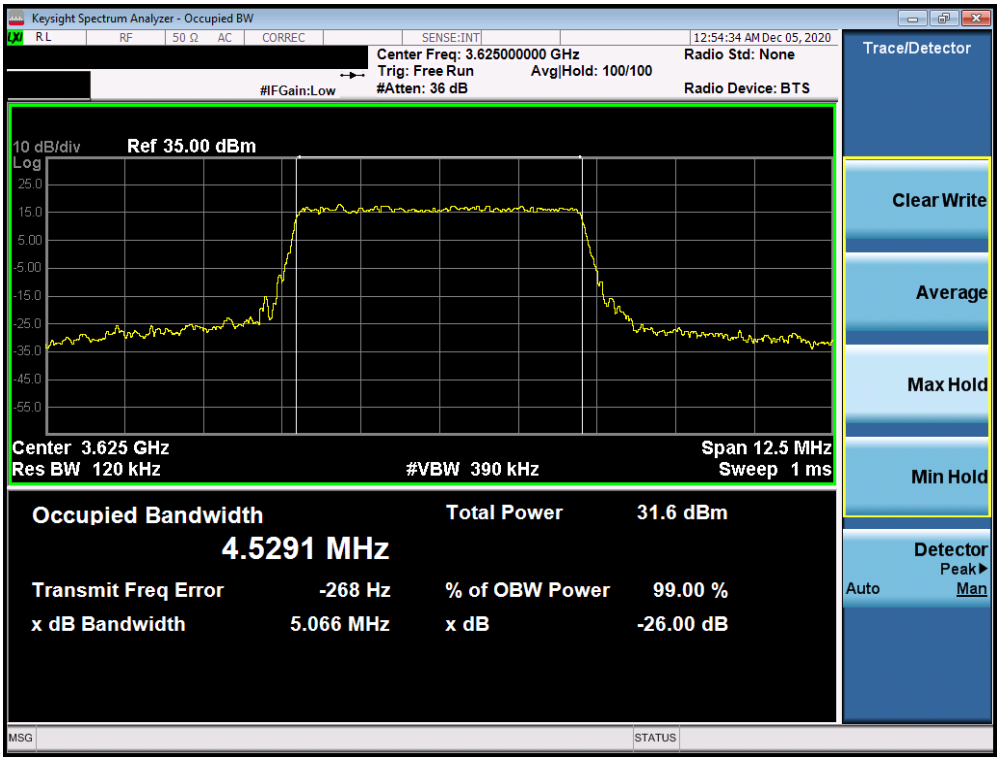

**Plot 7-12. Occupied Bandwidth Plot (LTE Band 48 - 10MHz 256-QAM - Full RB Configuration)**



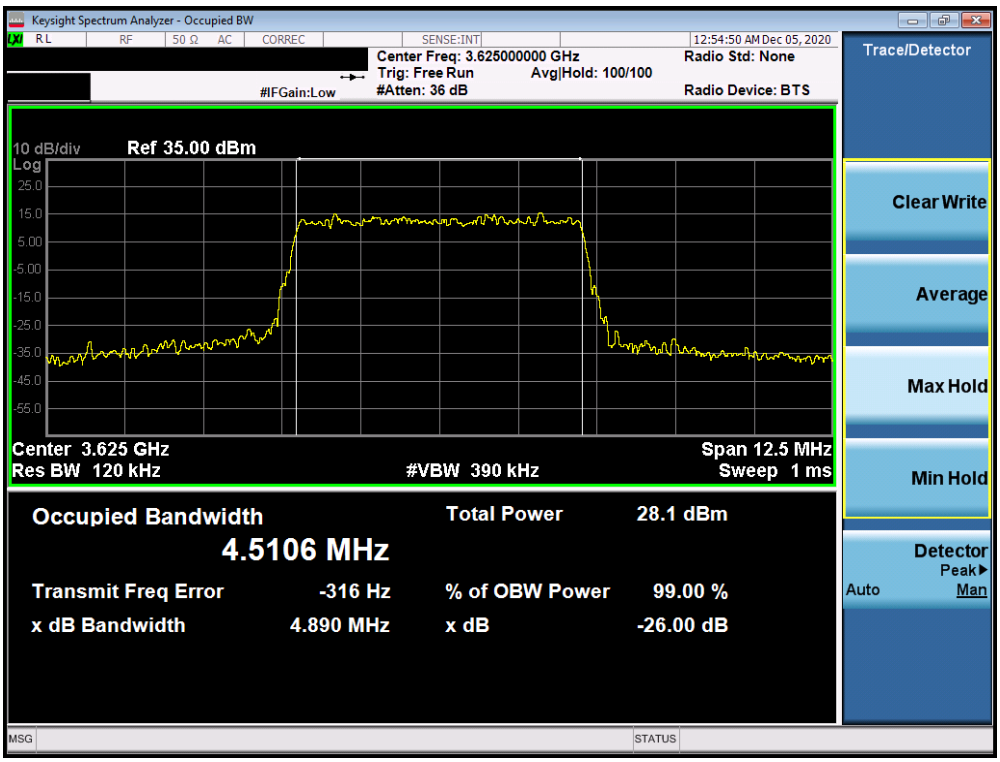

**Plot 7-13. Occupied Bandwidth Plot (LTE Band 48 - 5MHz QPSK - Full RB Configuration)**




**Plot 7-14. Occupied Bandwidth Plot (LTE Band 48 - 5MHz 16-QAM - Full RB Configuration)**

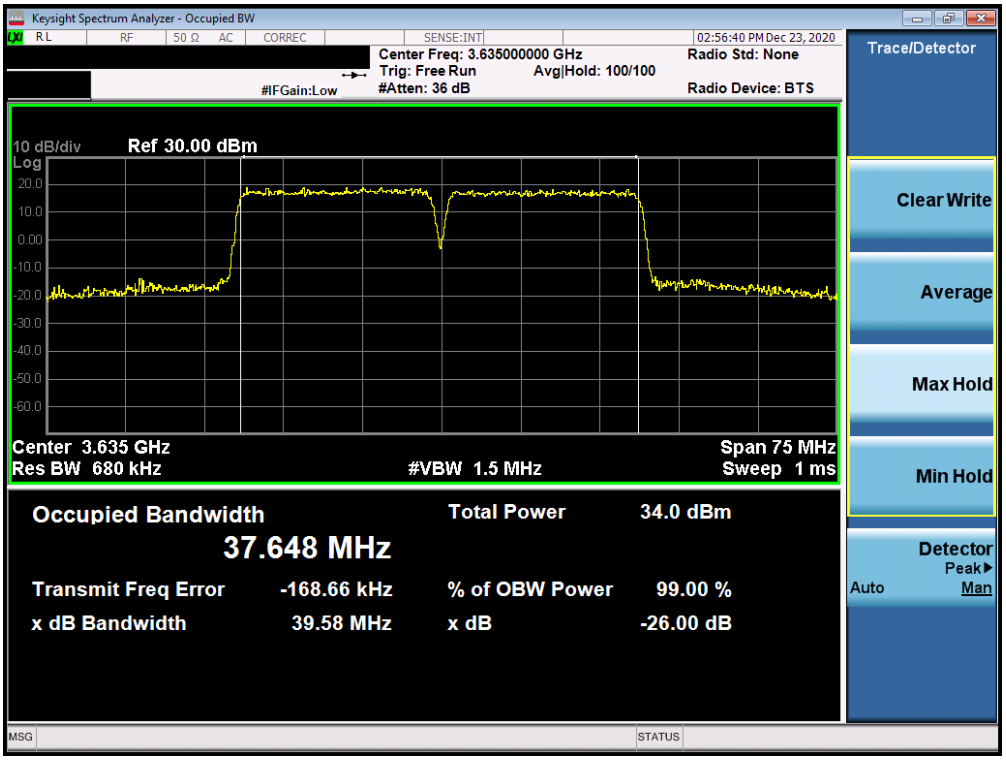



**Plot 7-15. Occupied Bandwidth Plot (LTE Band 48 - 5MHz 64-QAM - Full RB Configuration)**

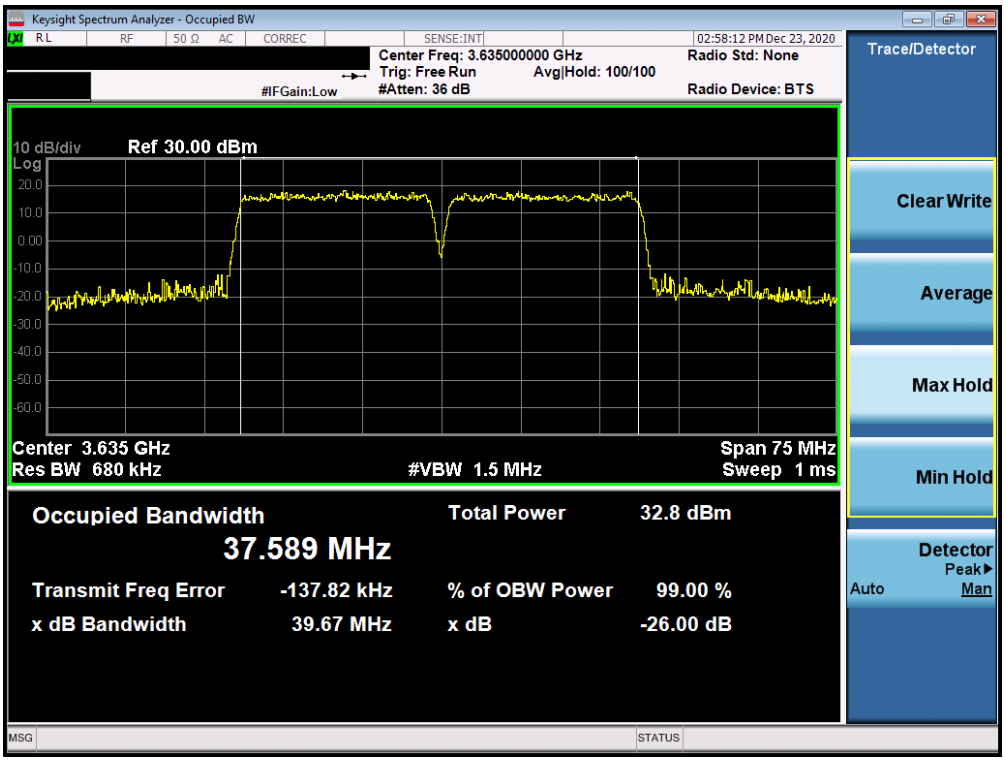



**Plot 7-16. Occupied Bandwidth Plot (LTE Band 48 - 5MHz 256-QAM - Full RB Configuration)**

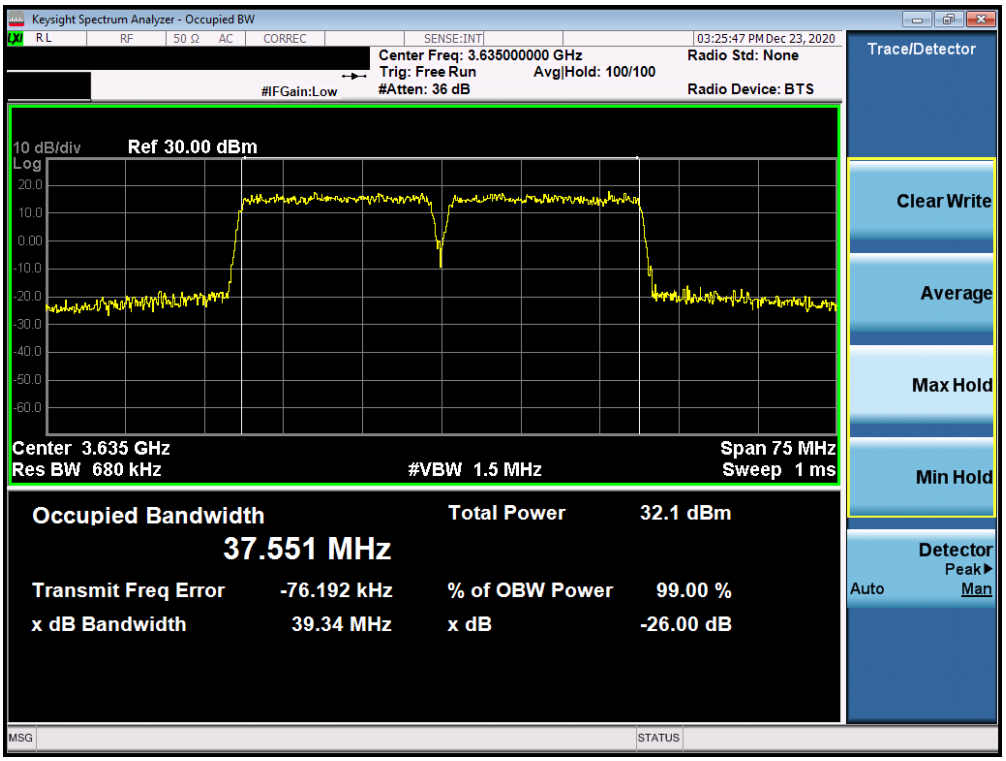
## ULCA - LTE Band 48



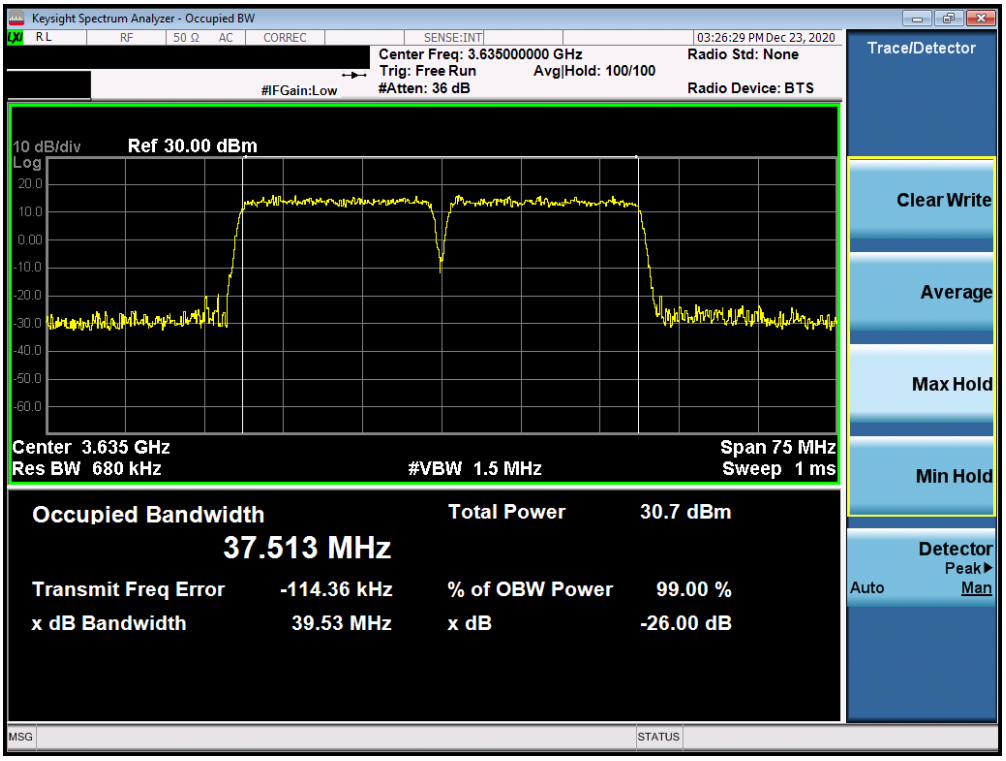

**Plot 7-17. Occupied Bandwidth Plot (ULCA LTE Band 48 – 20+20MHz QPSK - Full RB Configuration)**



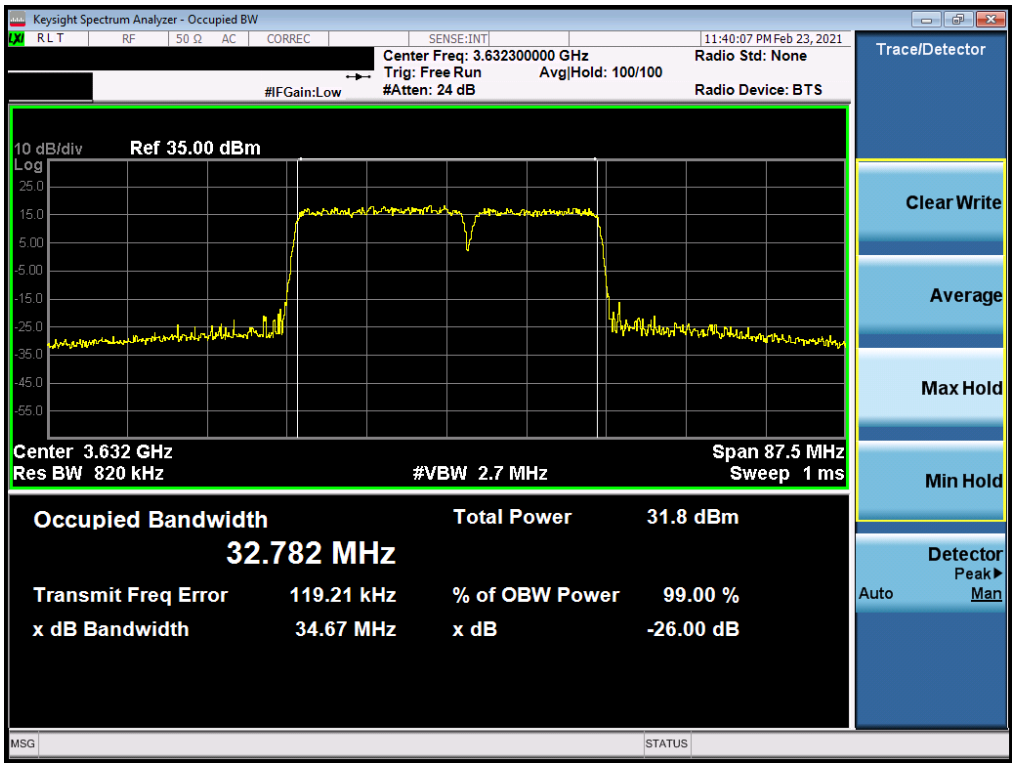

**Plot 7-18. Occupied Bandwidth Plot (ULCA LTE Band 48 – 20+20MHz 16-QAM - Full RB Configuration)**



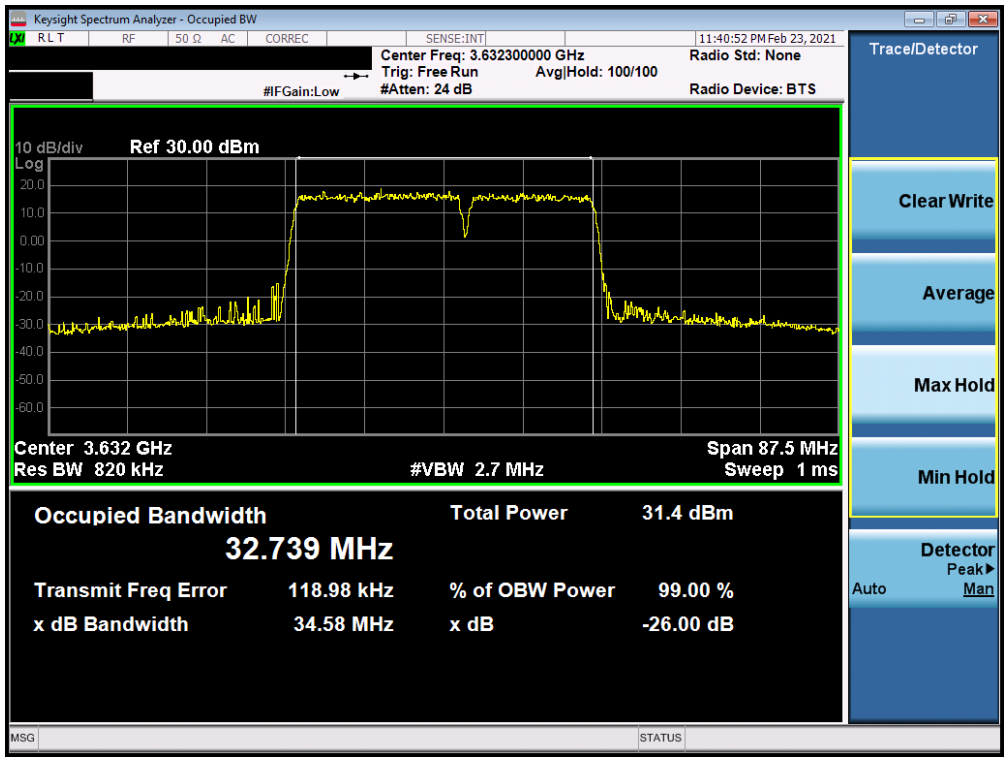

**Plot 7-19. Occupied Bandwidth Plot (ULCA LTE Band 48 – 20+20MHz 64-QAM - Full RB Configuration)**



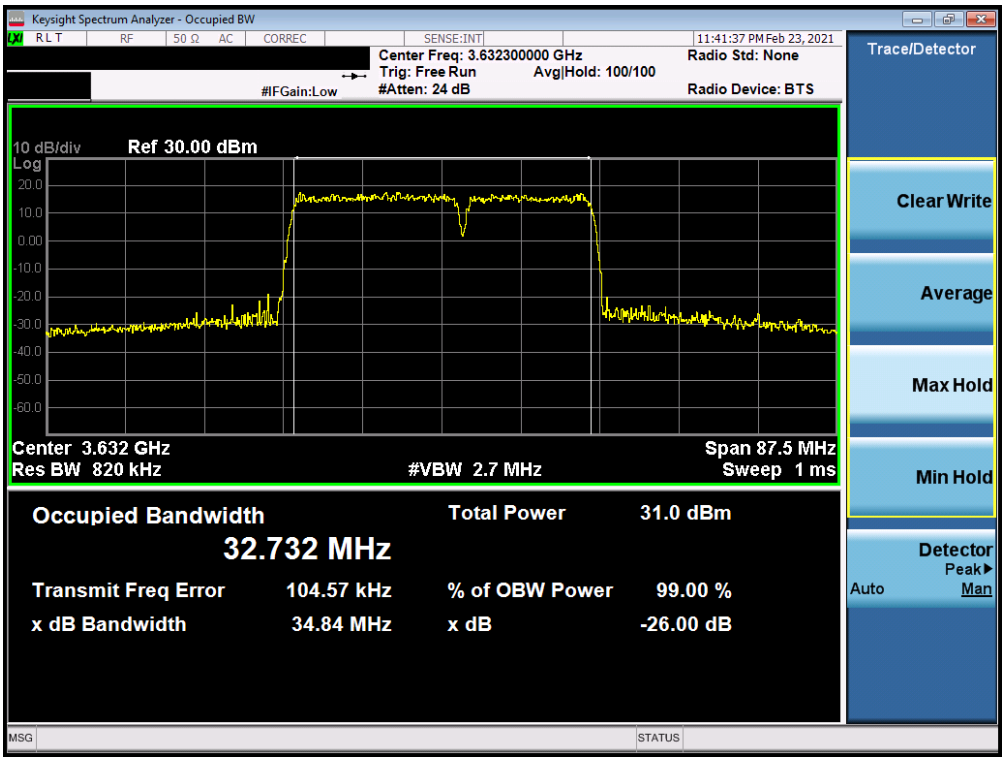

**Plot 7-20. Occupied Bandwidth Plot (ULCA LTE Band 48 – 20+20MHz 256-QAM - Full RB Configuration)**



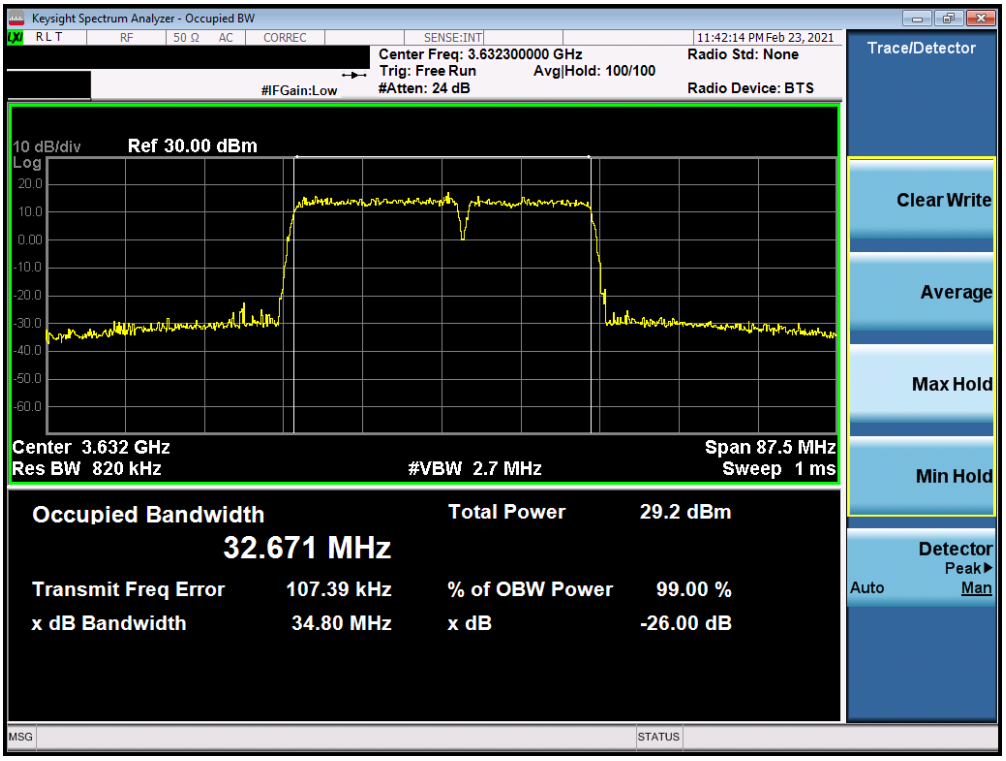

**Plot 7-21. Occupied Bandwidth Plot (ULCA LTE Band 48 – 20+15MHz QPSK - Full RB Configuration)**



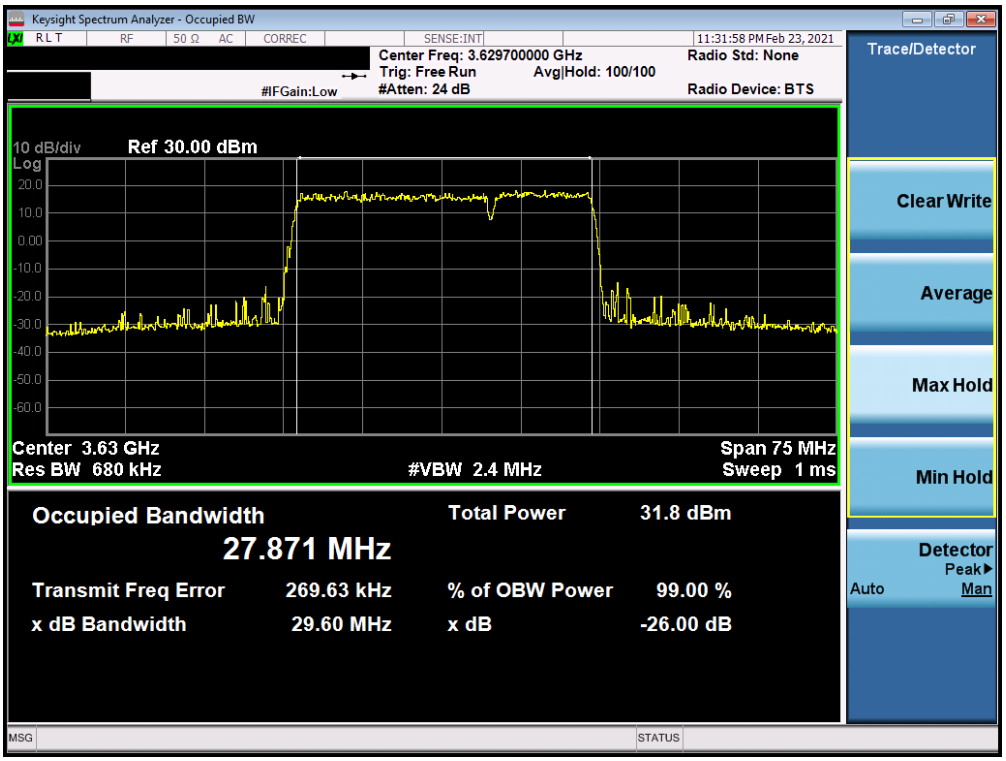

**Plot 7-22. Occupied Bandwidth Plot (ULCA LTE Band 48 – 20+15MHz 16-QAM - Full RB Configuration)**



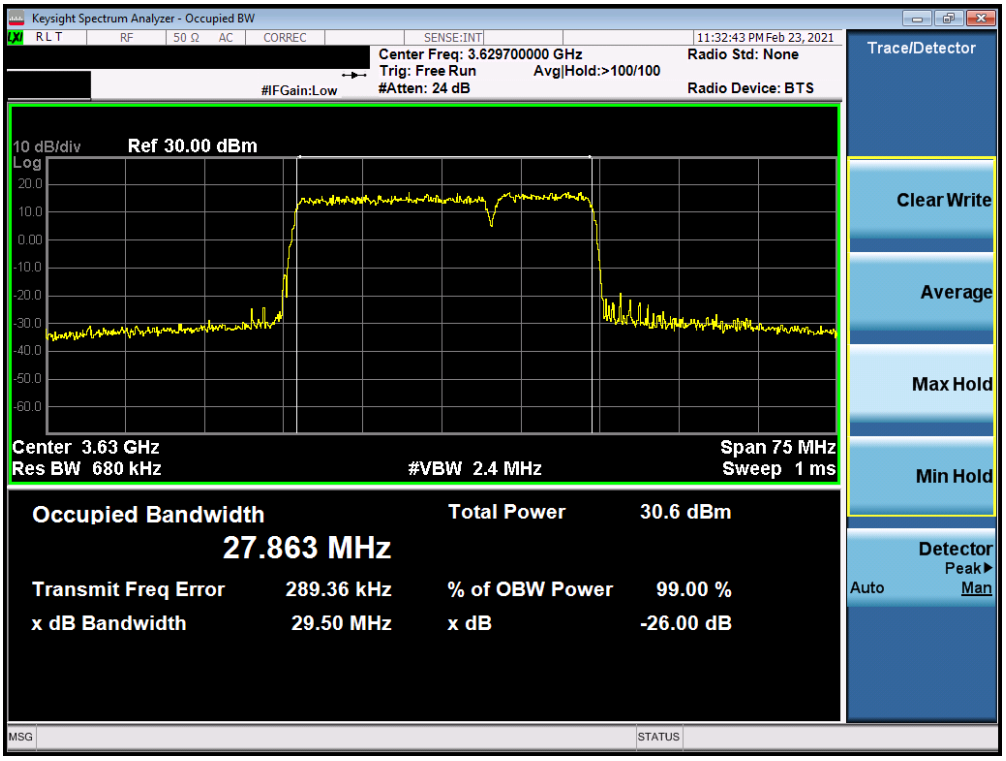

**Plot 7-23. Occupied Bandwidth Plot (ULCA LTE Band 48 – 20+15MHz 64-QAM - Full RB Configuration)**



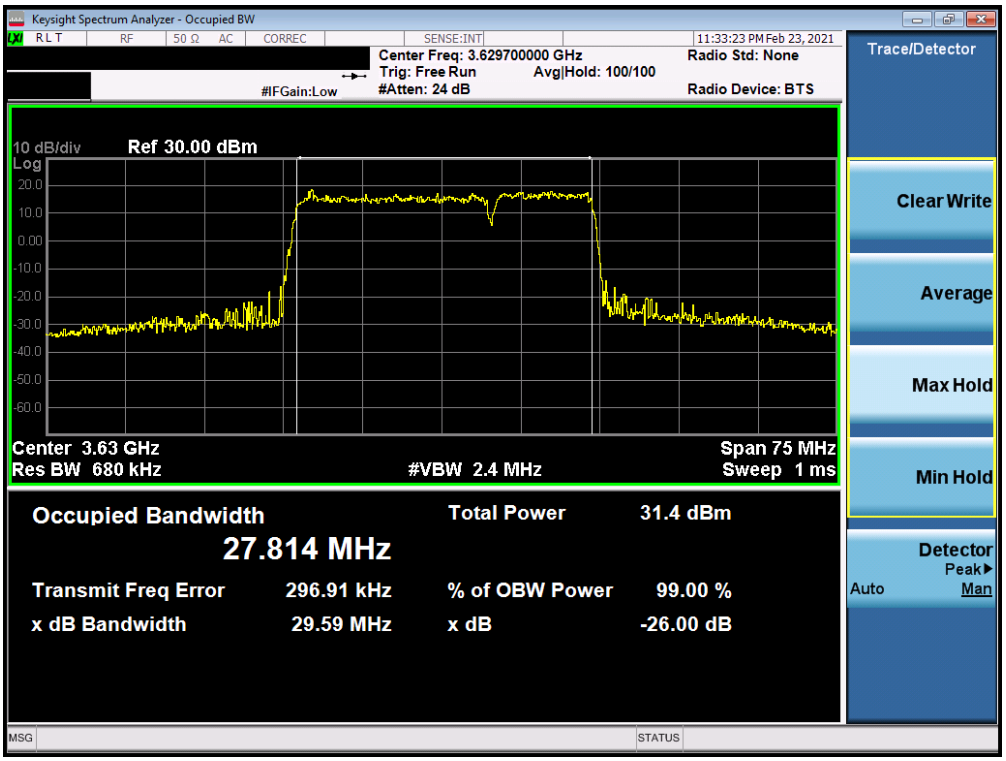

**Plot 7-24. Occupied Bandwidth Plot (ULCA LTE Band 48 – 20+15MHz 256-QAM - Full RB Configuration)**



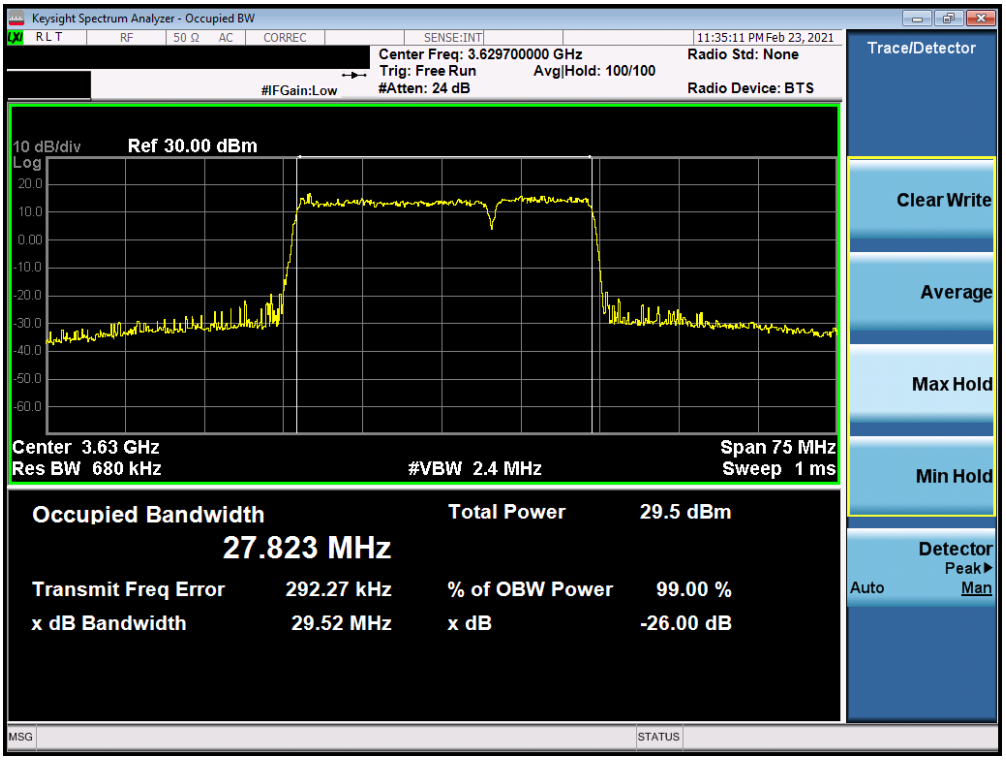

**Plot 7-25. Occupied Bandwidth Plot (ULCA LTE Band 48 – 20+10MHz QPSK - Full RB Configuration)**



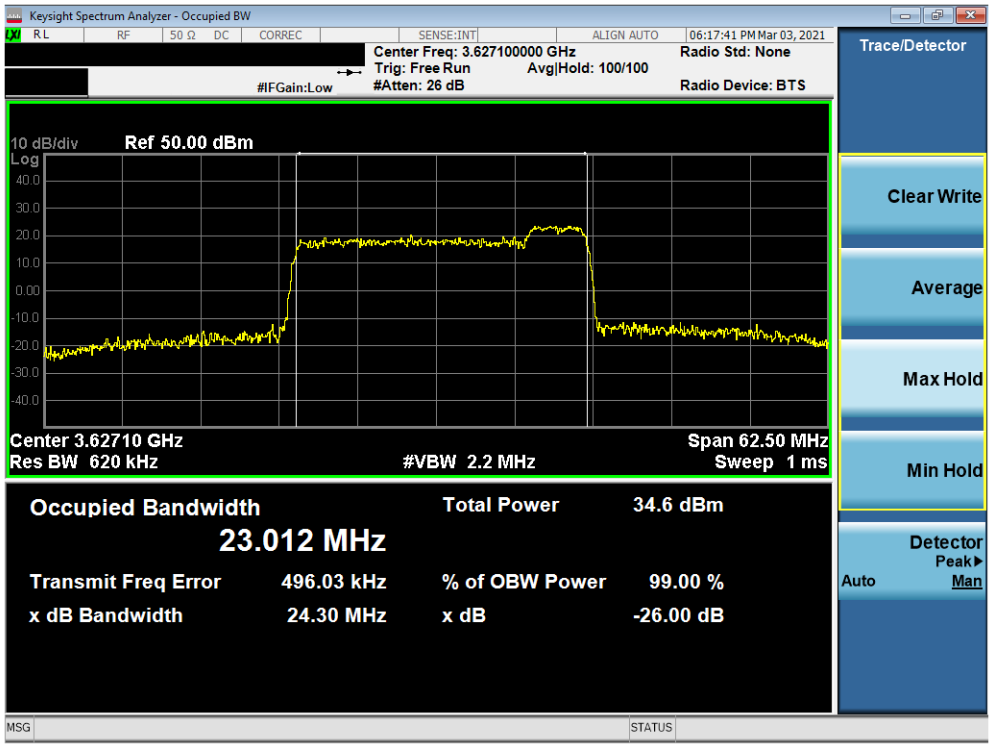

**Plot 7-26. Occupied Bandwidth Plot (ULCA LTE Band 48 – 20+10MHz 16-QAM - Full RB Configuration)**



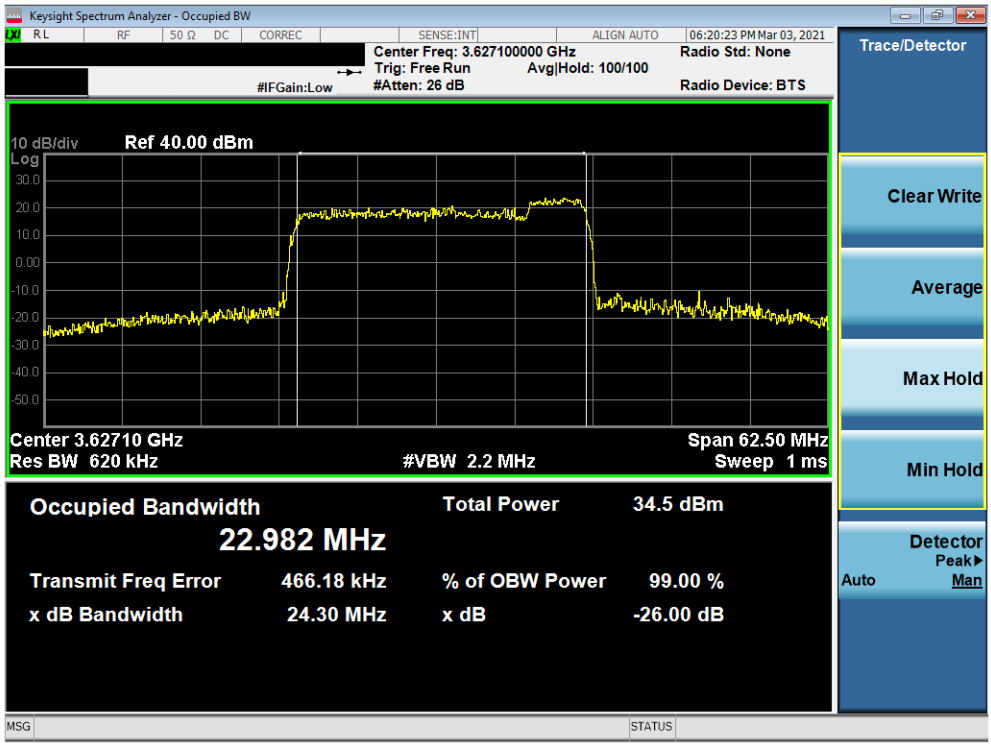

**Plot 7-27. Occupied Bandwidth Plot (ULCA LTE Band 48 – 20+10MHz 64-QAM - Full RB Configuration)**



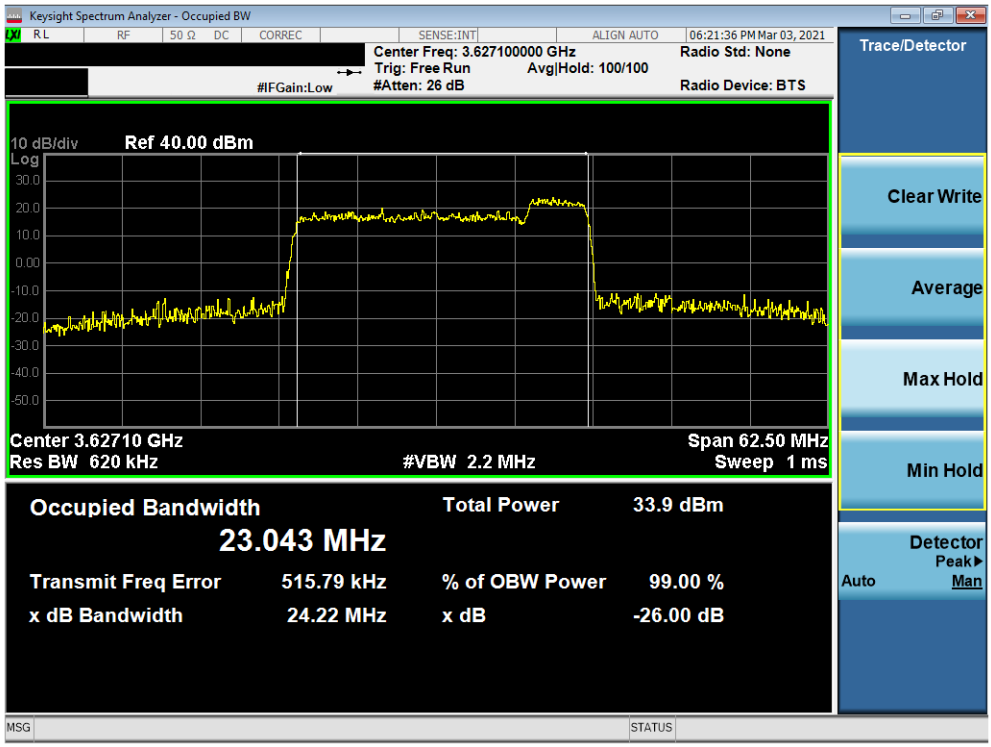

**Plot 7-28. Occupied Bandwidth Plot (ULCA LTE Band 48 – 20+10MHz 256-QAM - Full RB Configuration)**



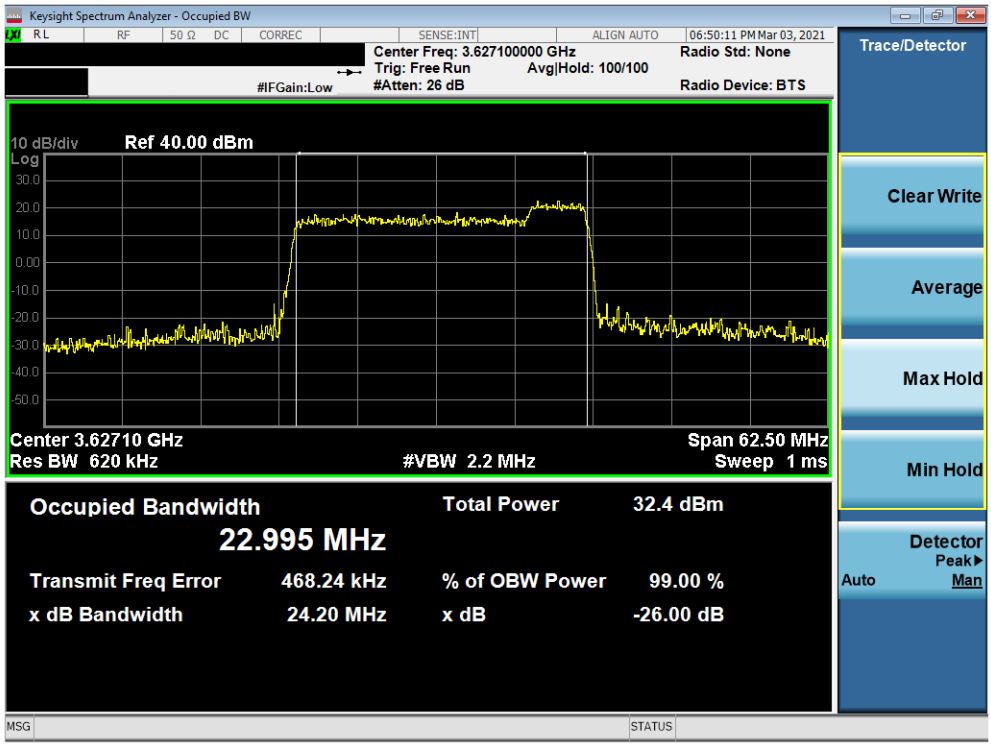

**Plot 7-29. Occupied Bandwidth Plot (ULCA LTE Band 48 – 20+5MHz QPSK - Full RB Configuration)**




**Plot 7-30. Occupied Bandwidth Plot (ULCA LTE Band 48 – 20+5MHz 16-QAM - Full RB Configuration)**




**Plot 7-31. Occupied Bandwidth Plot (ULCA LTE Band 48 – 20+5MHz 64-QAM - Full RB Configuration)**




**Plot 7-32. Occupied Bandwidth Plot (ULCA LTE Band 48 – 20+5MHz 256-QAM - Full RB Configuration)**

## 7.3 Spurious and Harmonic Emissions at Antenna Terminal

**§2.1051 §96.41(e)**

### 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 10th 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 its maximum duty cycle, 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 conducted power of any emissions below 3530 MHz or above 3720 MHz shall not exceed -40 dBm/Mhz.***

### 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 at least 10 * the fundamental frequency (separated into at least two plots per channel)
2. Detector = RMS
3. Trace mode = Max Hold
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.

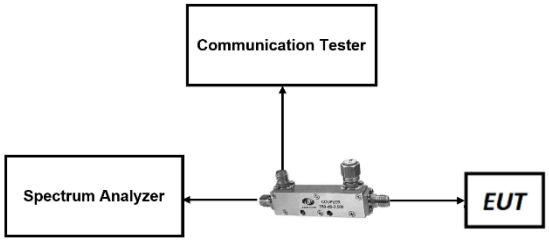
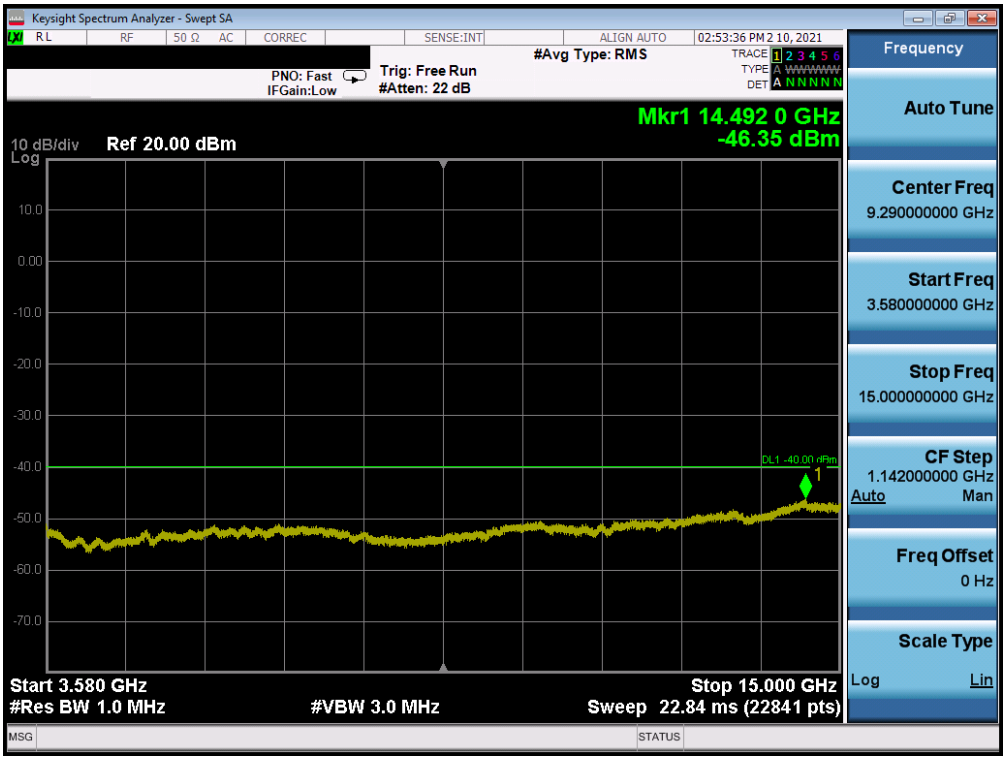



**Figure 7-2. Test Instrument & Measurement Setup**

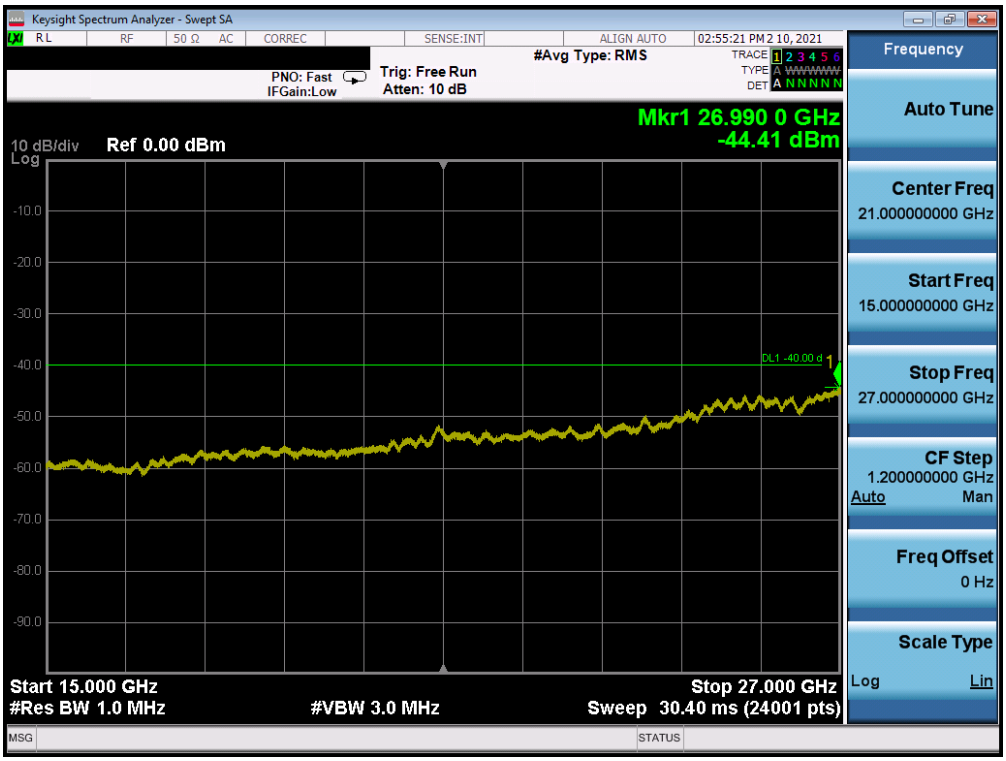
### Test Notes

1. Compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater for frequencies less than 1 GHz and 1 MHz or greater for frequencies greater than 1 GHz. 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. Uplink carrier aggregation conducted spurious emissions measurements were evaluated for the two contiguous channels using various combinations of RB size, RB offset, modulation, and channel bandwidth. The worst case (highest) powers were found while operating with QPSK modulation with both carriers set to transmit using 1RB.
3. Uplink carrier aggregation inter-band emission was investigated and found to not be the worst case


**Plot 7-33. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)**

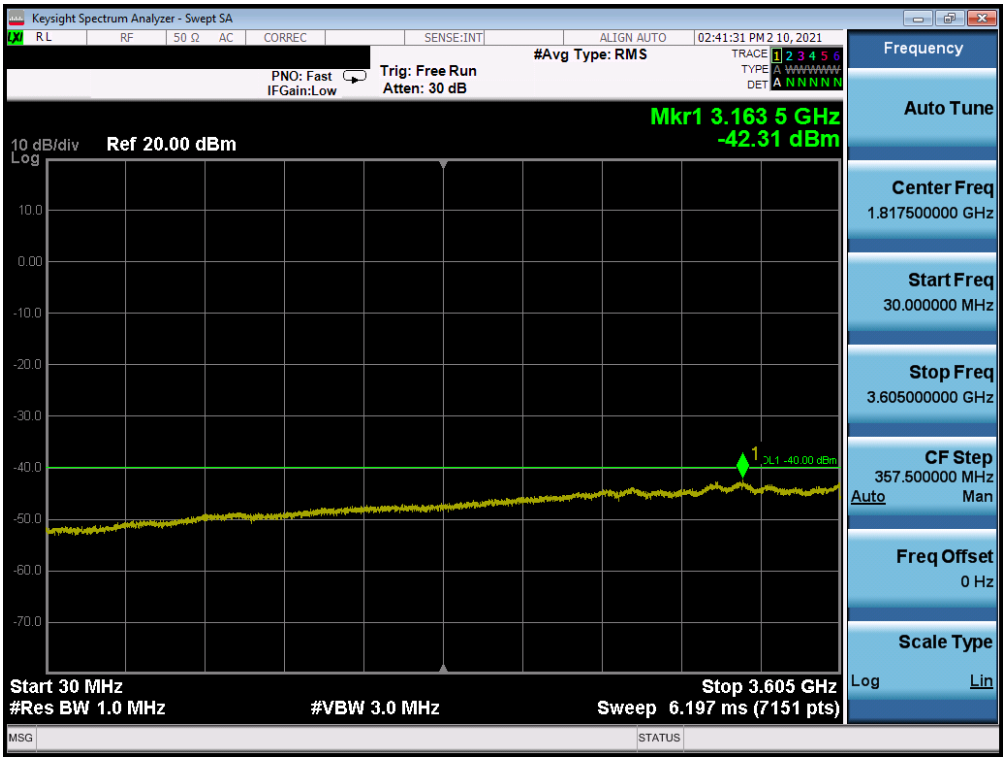



**Plot 7-34. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)**



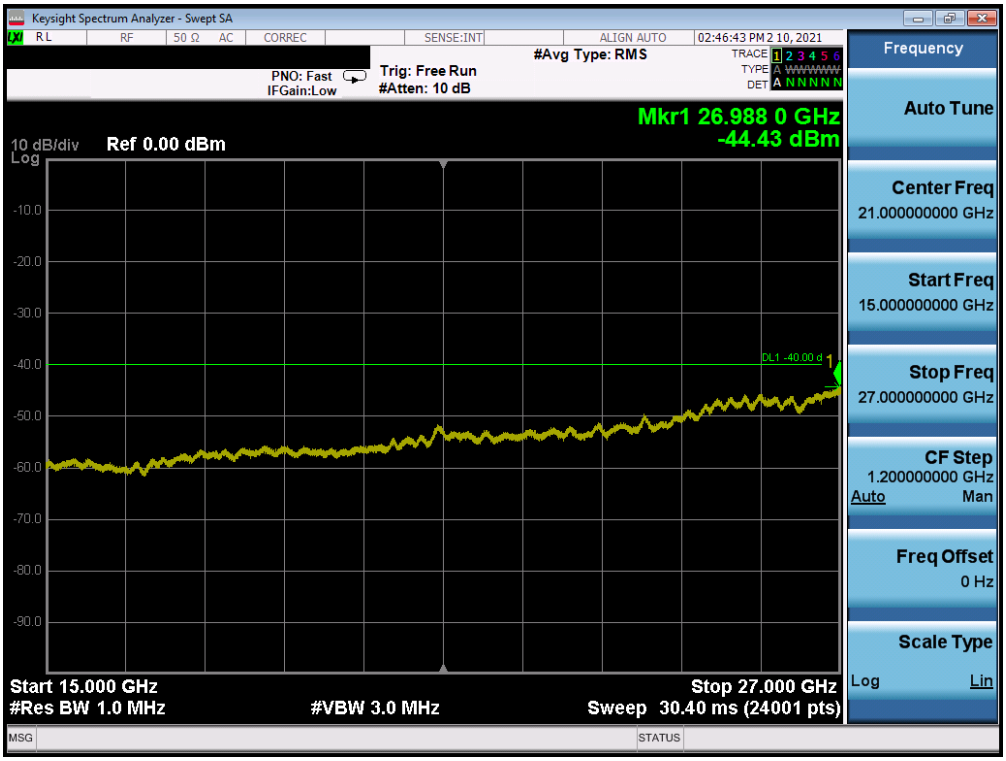

**Plot 7-35. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)**


**Plot 7-36. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)**



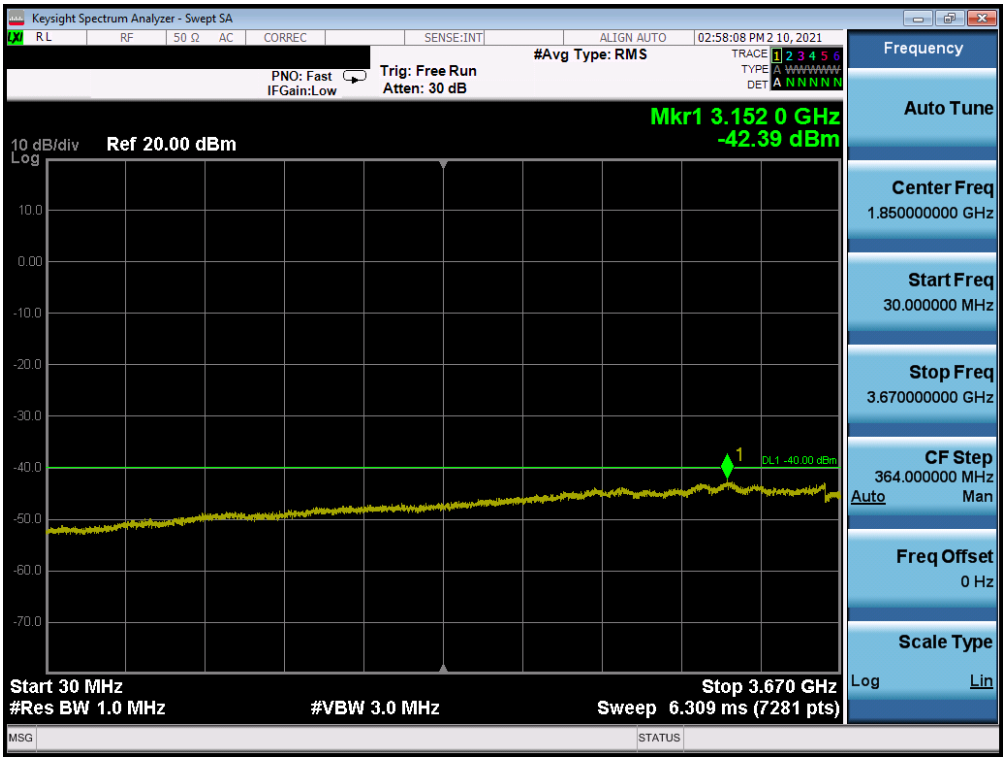

**Plot 7-37. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)**


**Plot 7-38. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)**

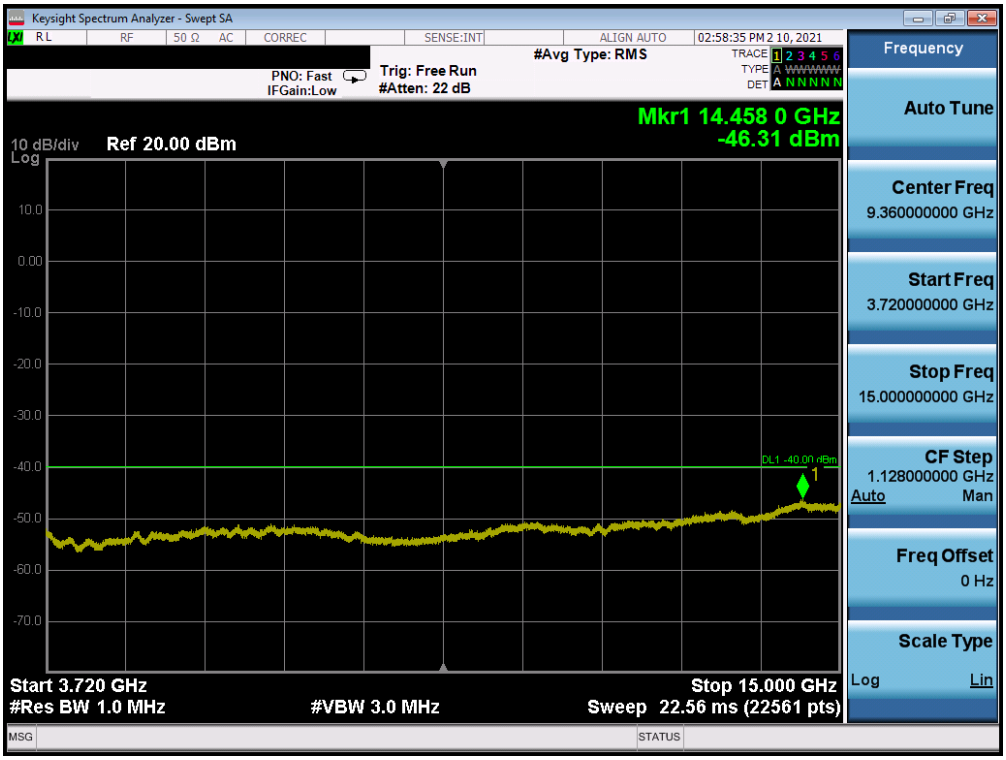



**Plot 7-39. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)**

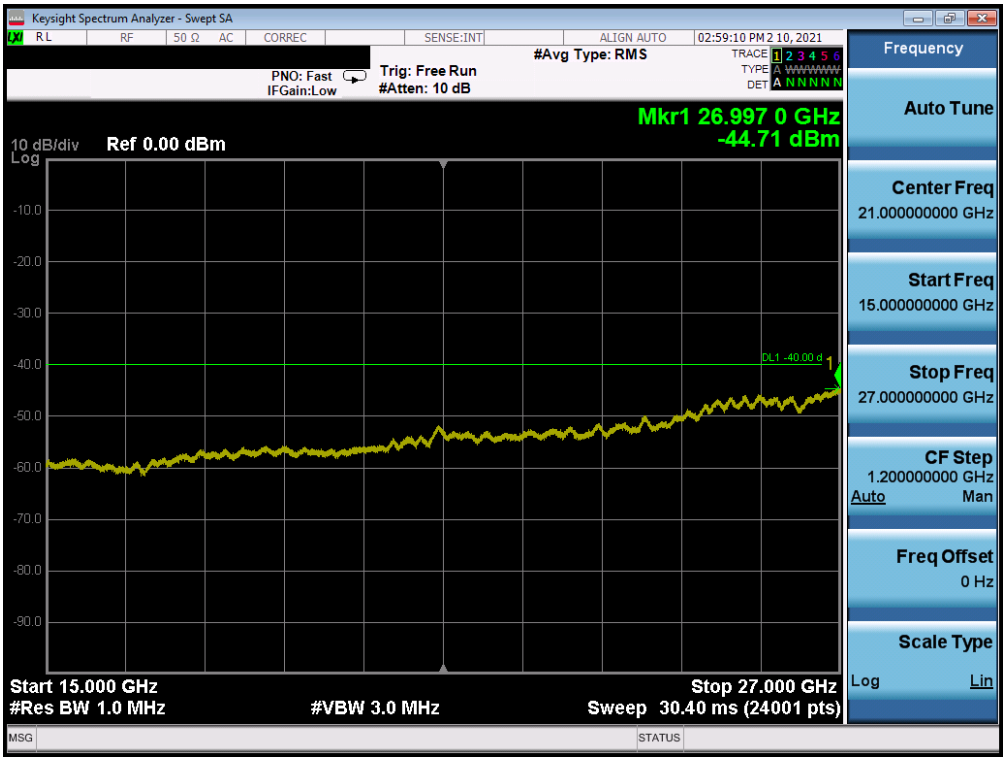

**Plot 7-40. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)**




**Plot 7-41. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)**

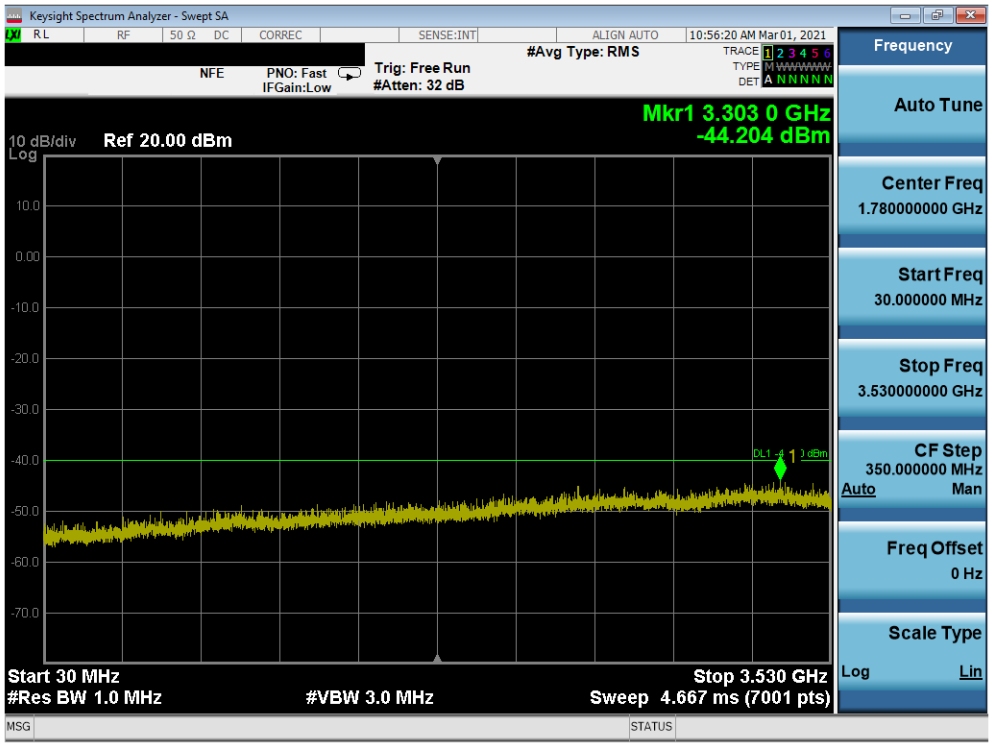



**Plot 7-42. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)**

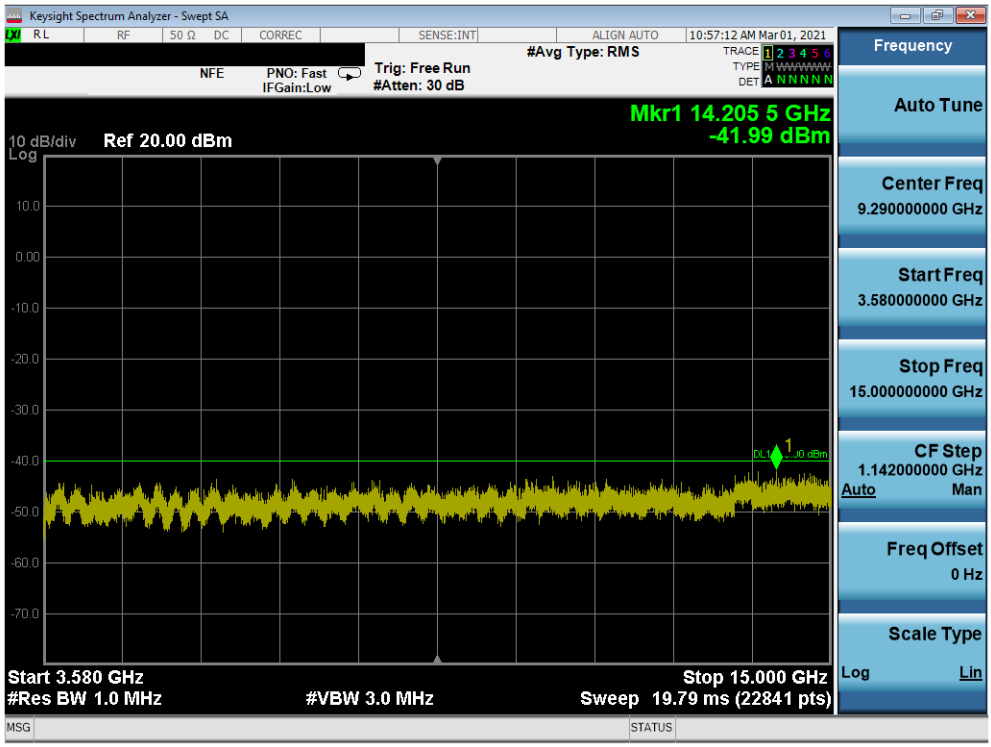



**Plot 7-43. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)**

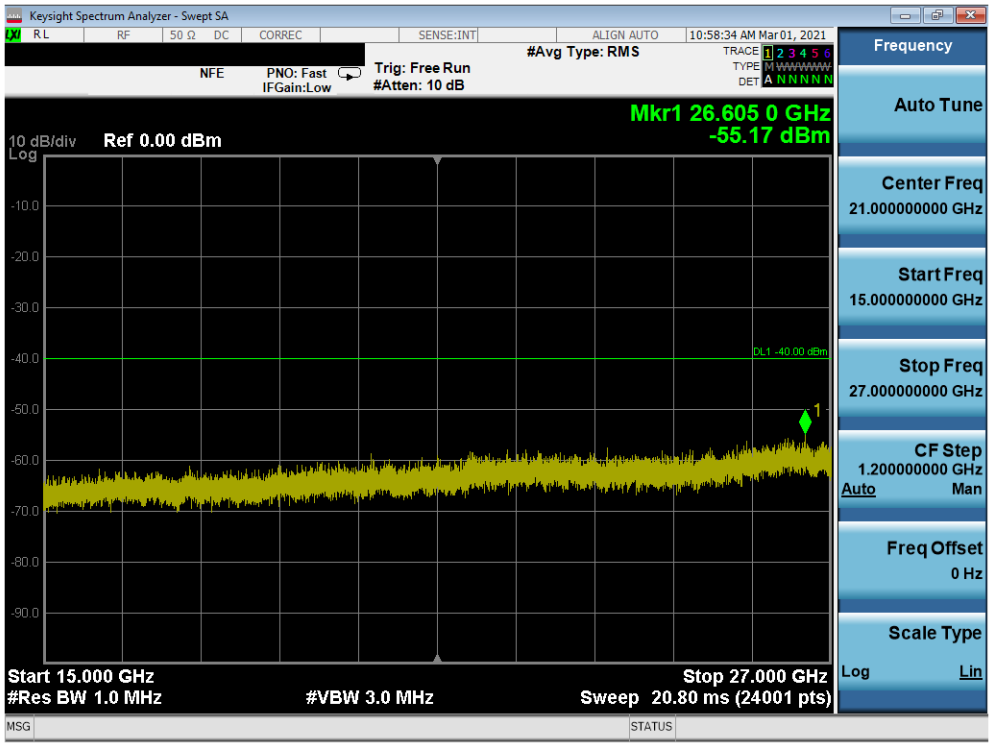

**Plot 7-44. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)**



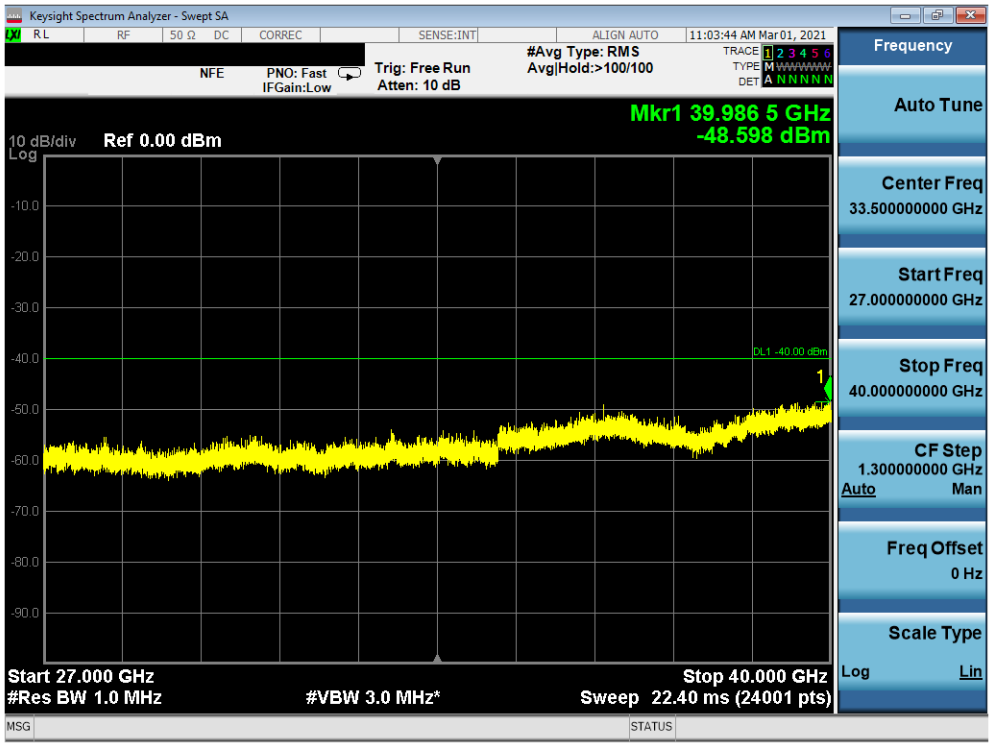

**Plot 7-45. Conducted Spurious Plot (ULCA LTE Band 48 – 20+20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)**



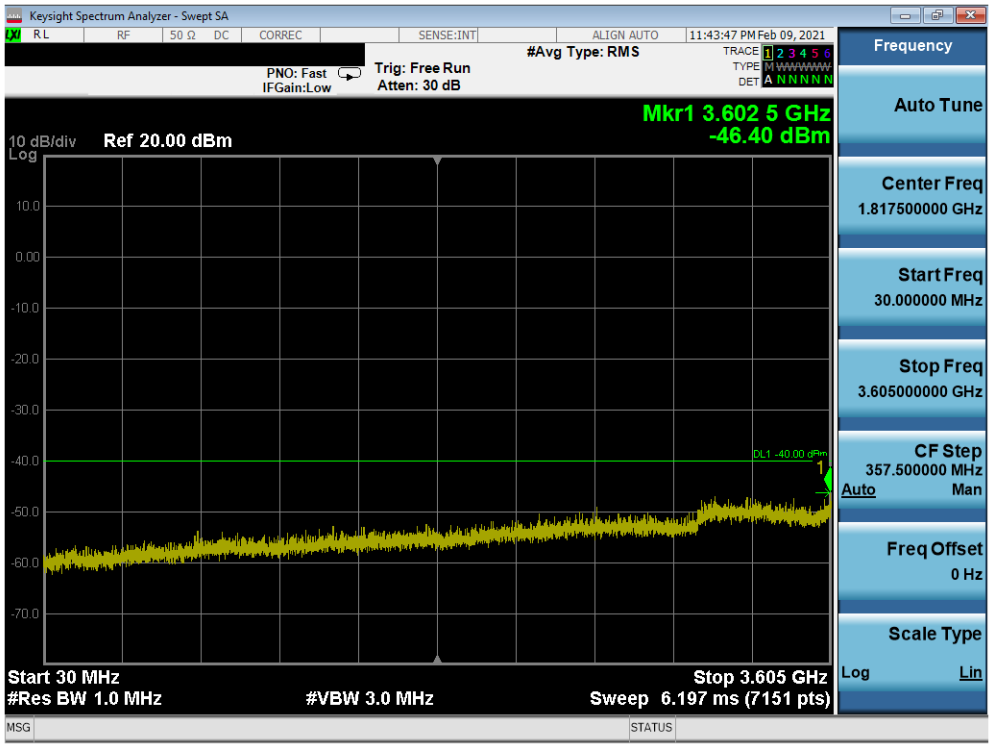

**Plot 7-46. Conducted Spurious Plot (ULCA LTE Band 48 – 20+20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)**



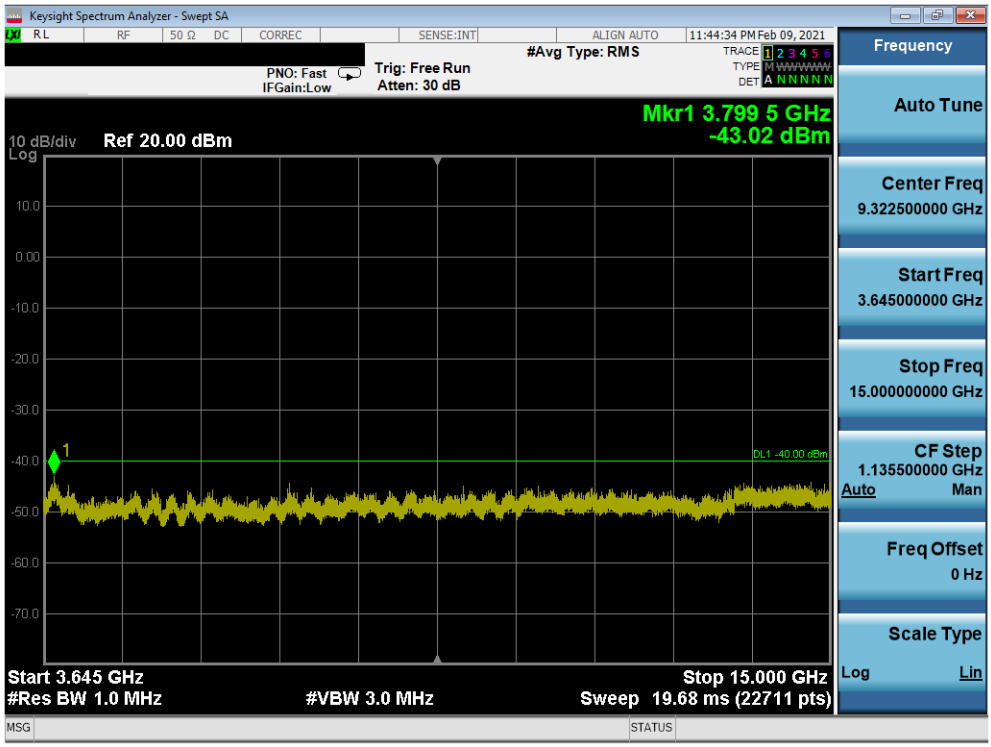

**Plot 7-47. Conducted Spurious Plot (ULCA LTE Band 48 – 20+20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)**



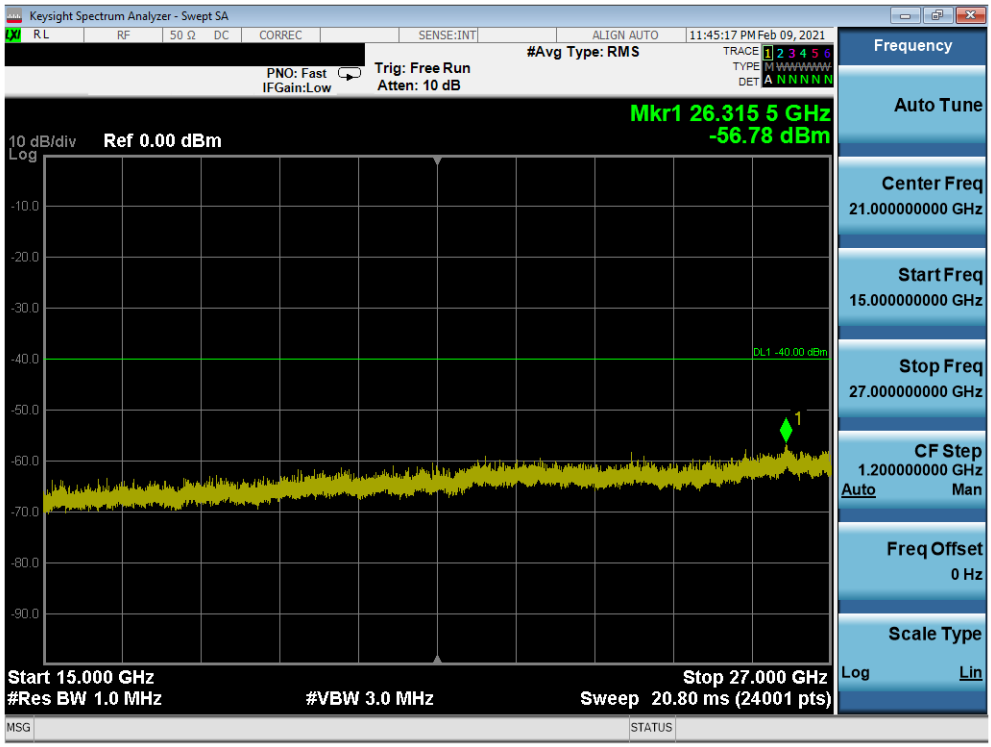

**Plot 7-48. Conducted Spurious Plot (ULCA LTE Band 48 – 20+20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)**



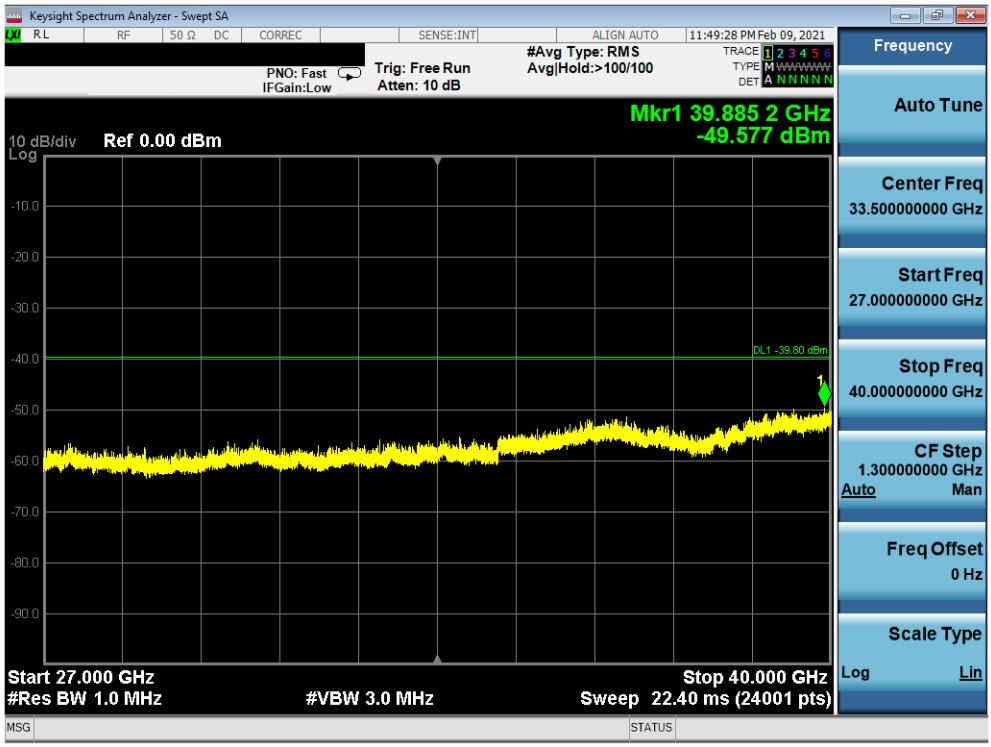

**Plot 7-49. Conducted Spurious Plot (ULCA LTE Band 48 – 20+20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)**



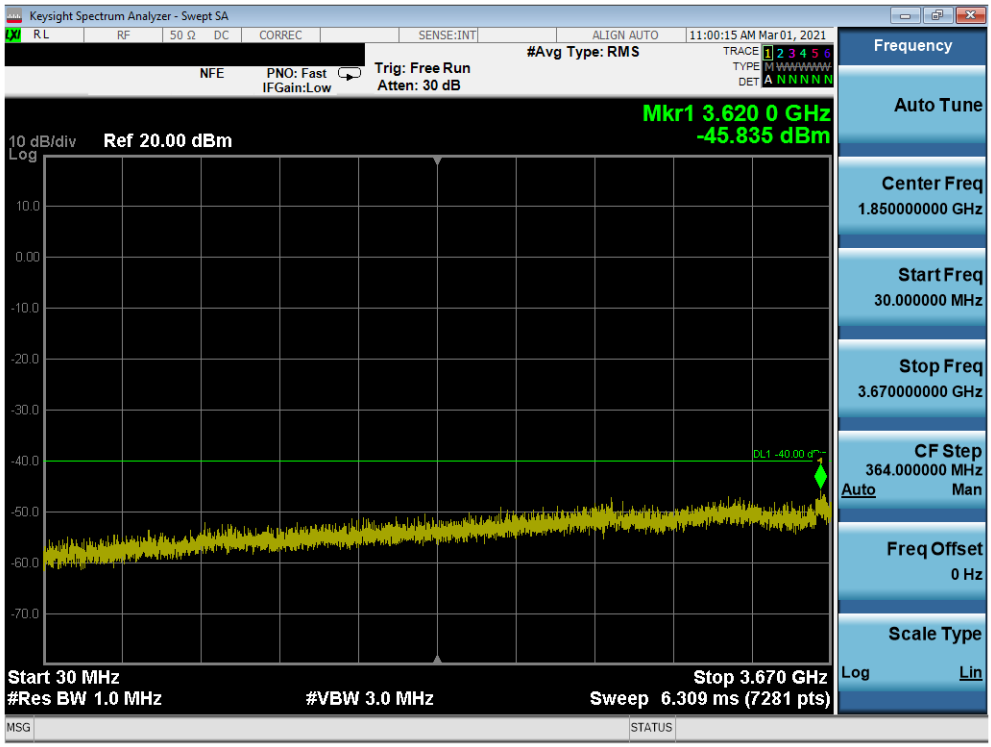

**Plot 7-50. Conducted Spurious Plot (ULCA LTE Band 48 – 20+20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)**



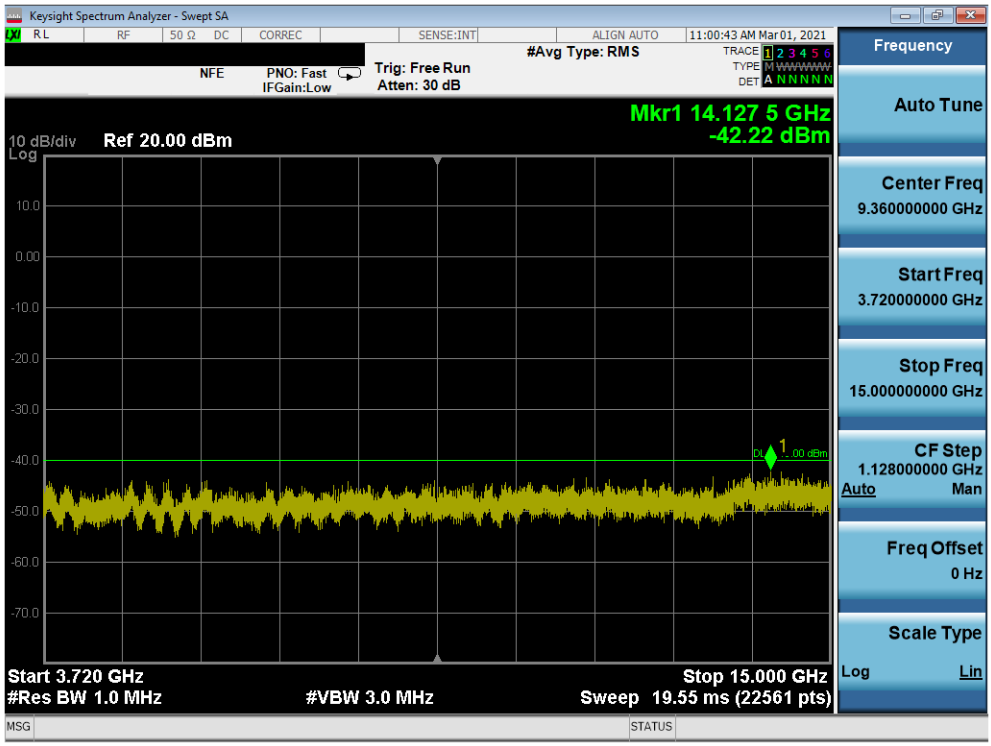

**Plot 7-51. Conducted Spurious Plot (ULCA LTE Band 48 – 20+20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)**



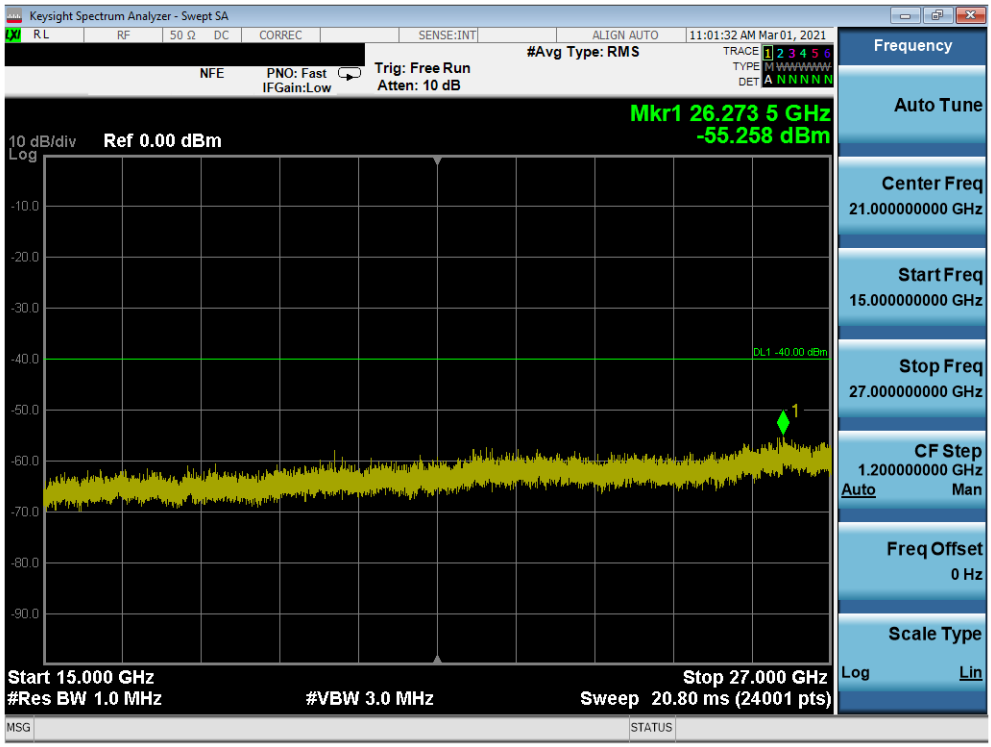

**Plot 7-52. Conducted Spurious Plot (ULCA LTE Band 48 – 20+20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)**



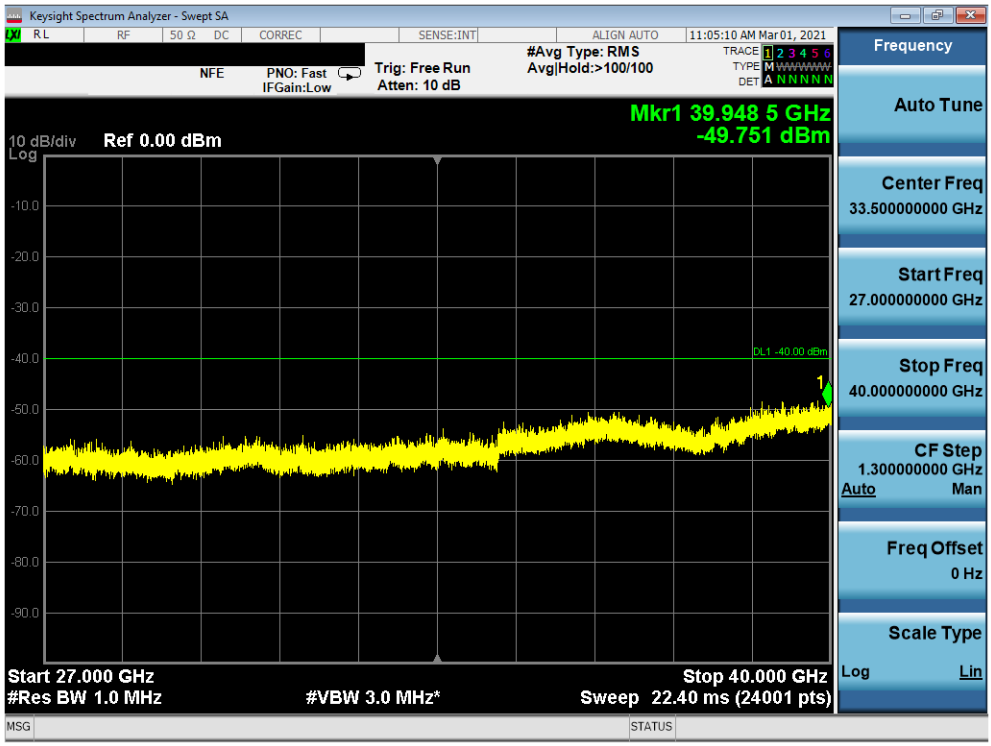

**Plot 7-53. Conducted Spurious Plot (ULCA LTE Band 48 – 20+20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)**




**Plot 7-54. Conducted Spurious Plot (ULCA LTE Band 48 – 20+20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)**




**Plot 7-55. Conducted Spurious Plot (ULCA LTE Band 48 – 20+20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)**




**Plot 7-56. Conducted Spurious Plot (ULCA LTE Band 48 – 20+20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)**

## 7.4 Band Edge Emissions at Antenna Terminal

**§2.1051 §96.41(e)(ii)**

### Test Overview

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 its maximum duty cycle, 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.

***The conducted power of any emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed −13 dBm/MHz within 0 to B MHz (where B is the bandwidth in MHz of the assigned channel or multiple contiguous channels of the End User Device) above the upper CBSD-assigned channel edge and within 0 to B MHz below the lower CBSD-assigned channel edge. At all frequencies greater than B MHz above the upper CBSD assigned channel edge and less than B MHz below the lower CBSD-assigned channel edge, the conducted power of any end user device emission shall not exceed −25 dBm/MHz. The conducted power of emissions below 3530 MHz or above 3720 MHz shall not exceed −40dBm/MHz.***

### Test Procedure Used

KDB 971168 D01 v03r01 – Section 6.0

### Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW ≥ 1% of the emission bandwidth
4. VBW ≥ 3 x RBW
5. Detector = RMS
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = trace average
8. Sweep time = auto couple
9. The trace was allowed to stabilize

### Test Setup

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

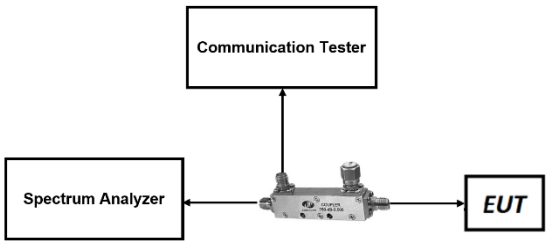
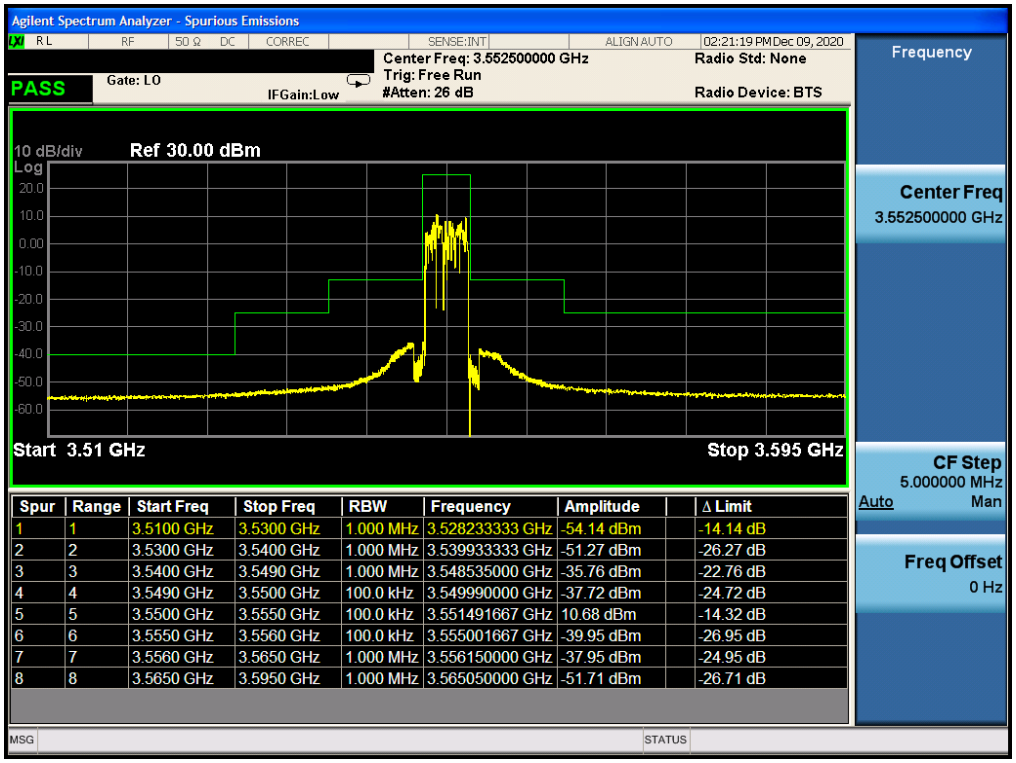



**Figure 7-3. Test Instrument & Measurement Setup**

### Test Notes

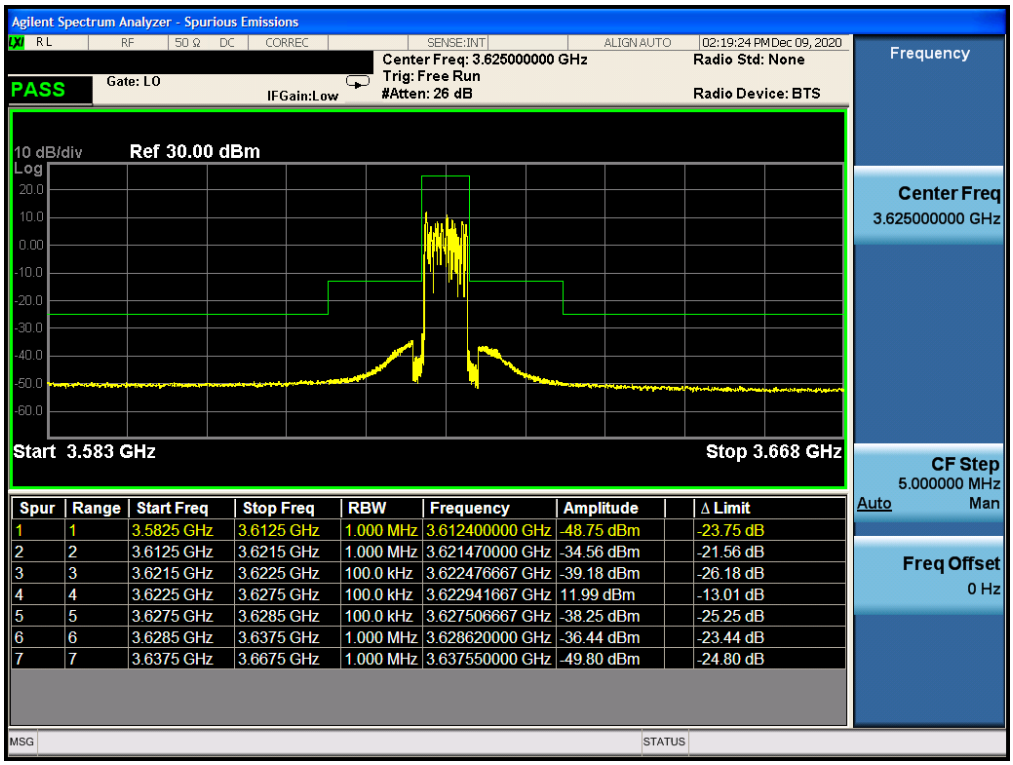
None.

## LTE Band 48



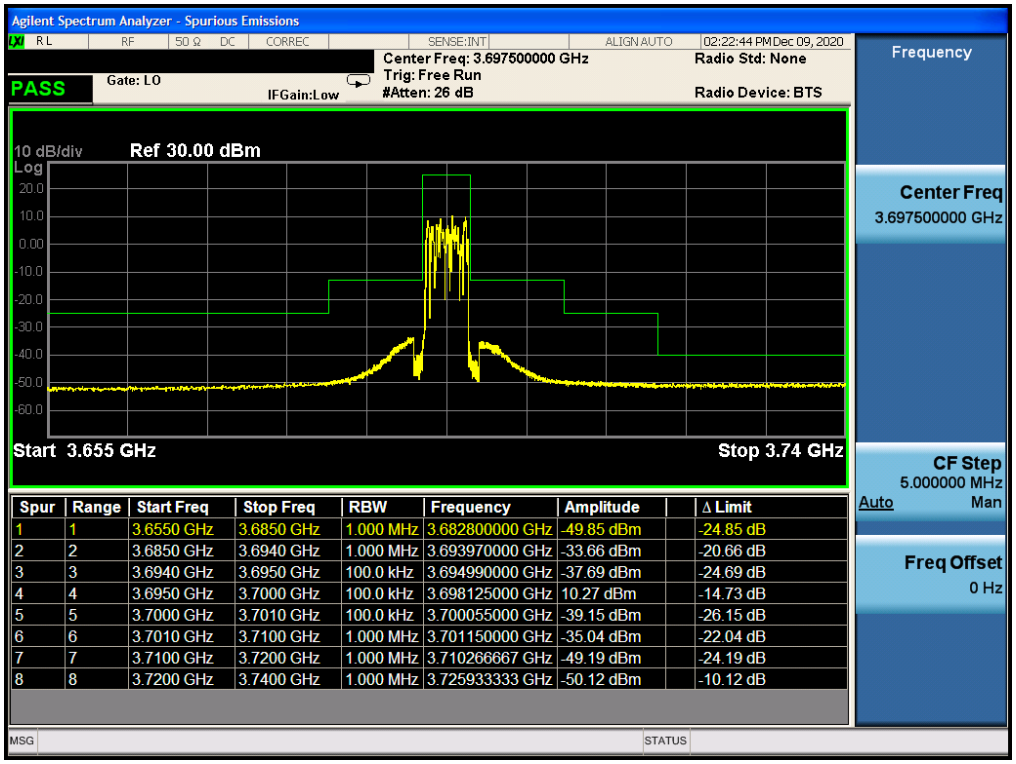

| Spur | Range | Start Freq | Stop Freq | RBW | Frequency | Amplitude | Δ Limit |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3.5100 GHz | 3.5300 GHz | 1.000 MHz | 3.528233333 GHz | -54.14 dBm | -14.14 dB |
| 2 | 2 | 3.5300 GHz | 3.5400 GHz | 1.000 MHz | 3.539933333 GHz | -51.27 dBm | -26.27 dB |
| 3 | 3 | 3.5400 GHz | 3.5490 GHz | 1.000 MHz | 3.548535000 GHz | -35.76 dBm | -22.76 dB |
| 4 | 4 | 3.5490 GHz | 3.5500 GHz | 100.0 kHz | 3.549990000 GHz | -37.72 dBm | -24.72 dB |
| 5 | 5 | 3.5500 GHz | 3.5550 GHz | 100.0 kHz | 3.551491667 GHz | 10.68 dBm | -14.32 dB |
| 6 | 6 | 3.5550 GHz | 3.5560 GHz | 100.0 kHz | 3.555001667 GHz | -39.95 dBm | -26.95 dB |
| 7 | 7 | 3.5560 GHz | 3.5650 GHz | 1.000 MHz | 3.556150000 GHz | -37.95 dBm | -24.95 dB |
| 8 | 8 | 3.5650 GHz | 3.5950 GHz | 1.000 MHz | 3.565050000 GHz | -51.71 dBm | -26.71 dB |

**Plot 7-57. Lower ACP Plot (LTE Band 48 - 5MHz QPSK)**



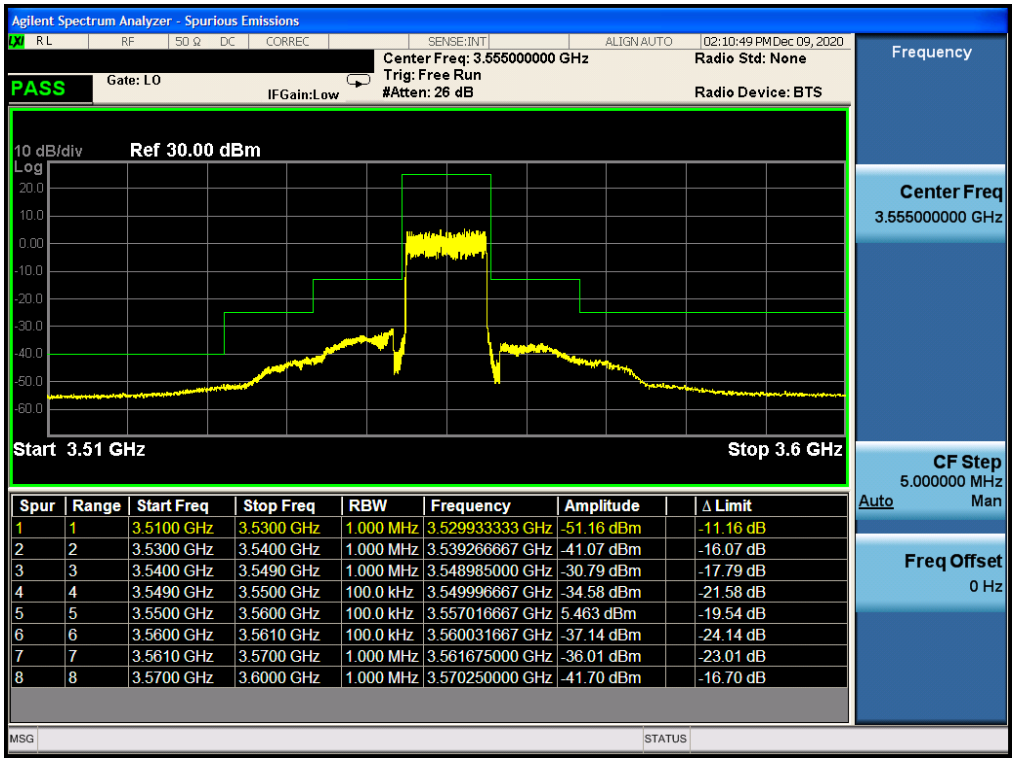

| Spur | Range | Start Freq | Stop Freq | RBW | Frequency | Amplitude | Δ Limit |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3.5825 GHz | 3.6125 GHz | 1.000 MHz | 3.612400000 GHz | -48.75 dBm | -23.75 dB |
| 2 | 2 | 3.6125 GHz | 3.6215 GHz | 1.000 MHz | 3.621470000 GHz | -34.56 dBm | -21.56 dB |
| 3 | 3 | 3.6215 GHz | 3.6225 GHz | 100.0 kHz | 3.622476667 GHz | -39.18 dBm | -26.18 dB |
| 4 | 4 | 3.6225 GHz | 3.6275 GHz | 100.0 kHz | 3.622941667 GHz | 11.99 dBm | -13.01 dB |
| 5 | 5 | 3.6275 GHz | 3.6285 GHz | 100.0 kHz | 3.627506667 GHz | -38.25 dBm | -25.25 dB |
| 6 | 6 | 3.6285 GHz | 3.6375 GHz | 1.000 MHz | 3.628620000 GHz | -36.44 dBm | -23.44 dB |
| 7 | 7 | 3.6375 GHz | 3.6675 GHz | 1.000 MHz | 3.637550000 GHz | -49.80 dBm | -24.80 dB |

**Plot 7-58. Mid ACP Plot (LTE Band 48 - 5MHz QPSK)**



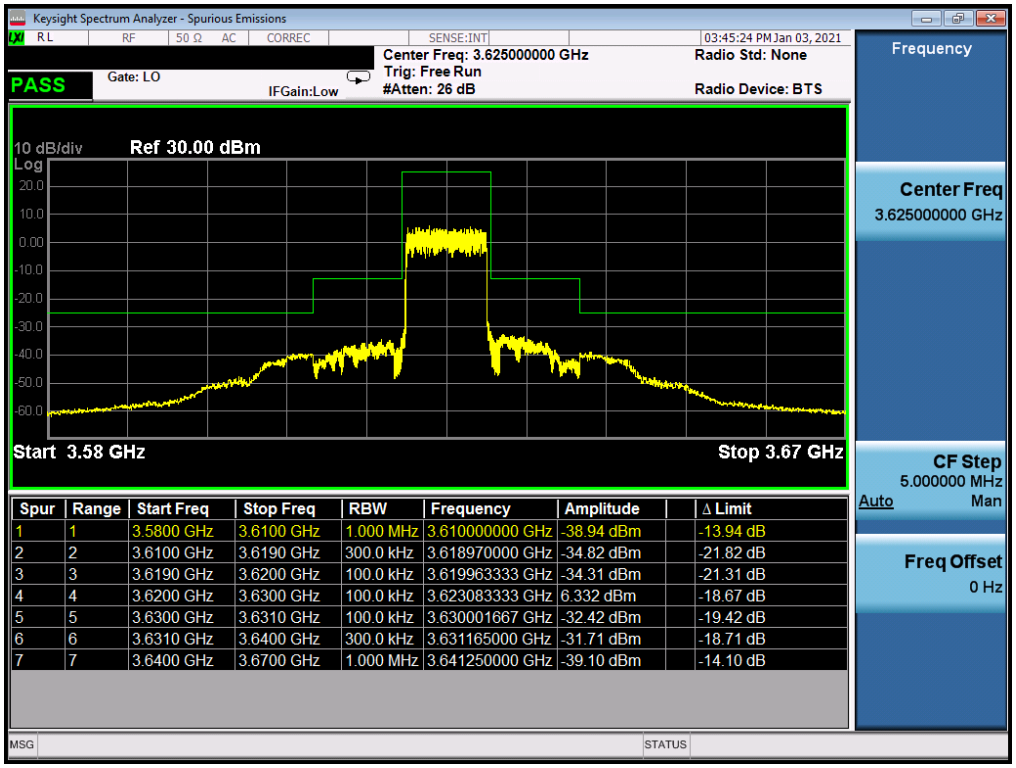

| Spur | Range | Start Freq | Stop Freq | RBW | Frequency | Amplitude | Δ Limit |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3.6550 GHz | 3.6850 GHz | 1.000 MHz | 3.682800000 GHz | -49.85 dBm | -24.85 dB |
| 2 | 2 | 3.6850 GHz | 3.6940 GHz | 1.000 MHz | 3.693970000 GHz | -33.66 dBm | -20.66 dB |
| 3 | 3 | 3.6940 GHz | 3.6950 GHz | 100.0 kHz | 3.694990000 GHz | -37.69 dBm | -24.69 dB |
| 4 | 4 | 3.6950 GHz | 3.7000 GHz | 100.0 kHz | 3.698125000 GHz | 10.27 dBm | -14.73 dB |
| 5 | 5 | 3.7000 GHz | 3.7010 GHz | 100.0 kHz | 3.700055000 GHz | -39.15 dBm | -26.15 dB |
| 6 | 6 | 3.7010 GHz | 3.7100 GHz | 1.000 MHz | 3.701150000 GHz | -35.04 dBm | -22.04 dB |
| 7 | 7 | 3.7100 GHz | 3.7200 GHz | 1.000 MHz | 3.710266667 GHz | -49.19 dBm | -24.19 dB |
| 8 | 8 | 3.7200 GHz | 3.7400 GHz | 1.000 MHz | 3.725933333 GHz | -50.12 dBm | -10.12 dB |

**Plot 7-59. Upper ACP Plot (LTE Band 48 - 5MHz QPSK)**



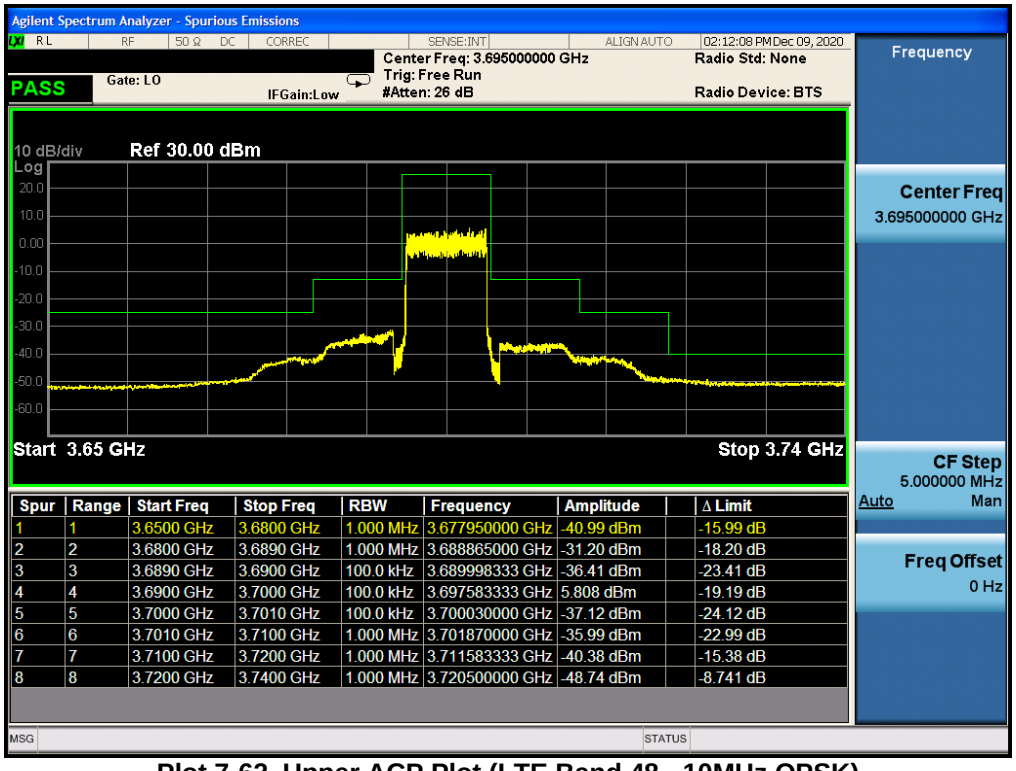

| Spur | Range | Start Freq | Stop Freq | RBW | Frequency | Amplitude | Δ Limit |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3.5100 GHz | 3.5300 GHz | 1.000 MHz | 3.529933333 GHz | -51.16 dBm | -11.16 dB |
| 2 | 2 | 3.5300 GHz | 3.5400 GHz | 1.000 MHz | 3.539266667 GHz | -41.07 dBm | -16.07 dB |
| 3 | 3 | 3.5400 GHz | 3.5490 GHz | 1.000 MHz | 3.548985000 GHz | -30.79 dBm | -17.79 dB |
| 4 | 4 | 3.5490 GHz | 3.5500 GHz | 100.0 kHz | 3.549996667 GHz | -34.58 dBm | -21.58 dB |
| 5 | 5 | 3.5500 GHz | 3.5600 GHz | 100.0 kHz | 3.557016667 GHz | 5.463 dBm | -19.54 dB |
| 6 | 6 | 3.5600 GHz | 3.5610 GHz | 100.0 kHz | 3.560031667 GHz | -37.14 dBm | -24.14 dB |
| 7 | 7 | 3.5610 GHz | 3.5700 GHz | 1.000 MHz | 3.561675000 GHz | -36.01 dBm | -23.01 dB |
| 8 | 8 | 3.5700 GHz | 3.6000 GHz | 1.000 MHz | 3.570250000 GHz | -41.70 dBm | -16.70 dB |

**Plot 7-60. Lower ACP Plot (LTE Band 48 - 10MHz QPSK)**



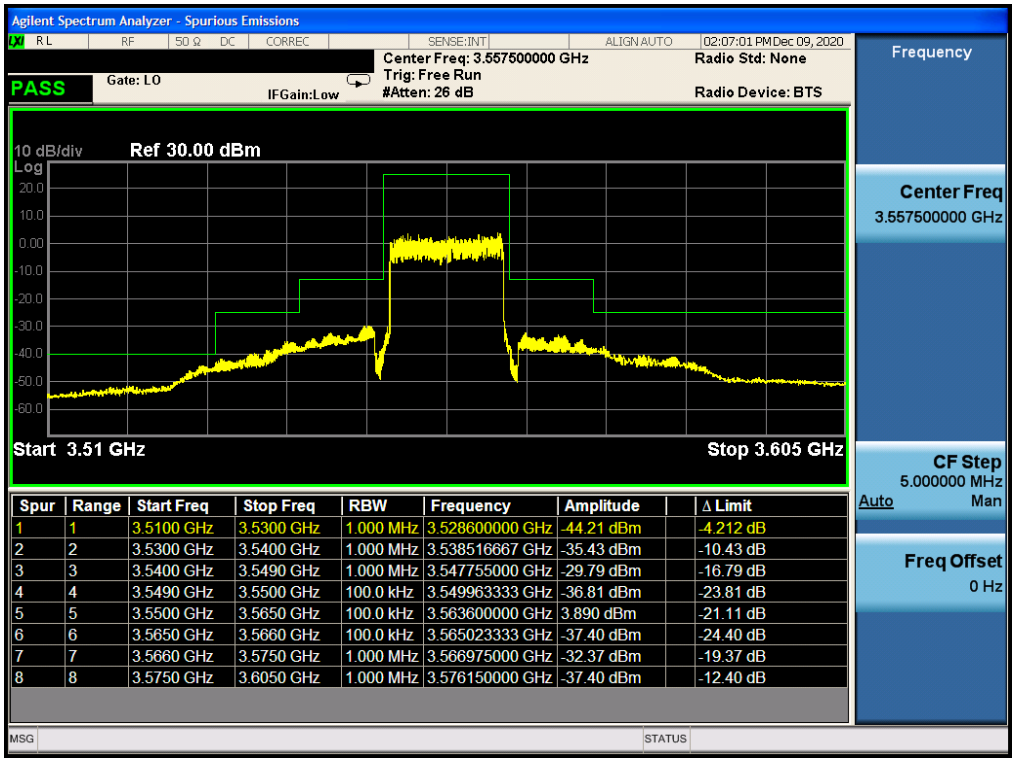

| Spur | Range | Start Freq | Stop Freq | RBW | Frequency | Amplitude | Δ Limit |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3.5800 GHz | 3.6100 GHz | 1.000 MHz | 3.610000000 GHz | -38.94 dBm | -13.94 dB |
| 2 | 2 | 3.6100 GHz | 3.6190 GHz | 300.0 kHz | 3.618970000 GHz | -34.82 dBm | -21.82 dB |
| 3 | 3 | 3.6190 GHz | 3.6200 GHz | 100.0 kHz | 3.619963333 GHz | -34.31 dBm | -21.31 dB |
| 4 | 4 | 3.6200 GHz | 3.6300 GHz | 100.0 kHz | 3.623083333 GHz | 6.332 dBm | -18.67 dB |
| 5 | 5 | 3.6300 GHz | 3.6310 GHz | 100.0 kHz | 3.630001667 GHz | -32.42 dBm | -19.42 dB |
| 6 | 6 | 3.6310 GHz | 3.6400 GHz | 300.0 kHz | 3.631165000 GHz | -31.71 dBm | -18.71 dB |
| 7 | 7 | 3.6400 GHz | 3.6700 GHz | 1.000 MHz | 3.641250000 GHz | -39.10 dBm | -14.10 dB |

**Plot 7-61. Mid ACP Plot (LTE Band 48 - 10MHz QPSK)**



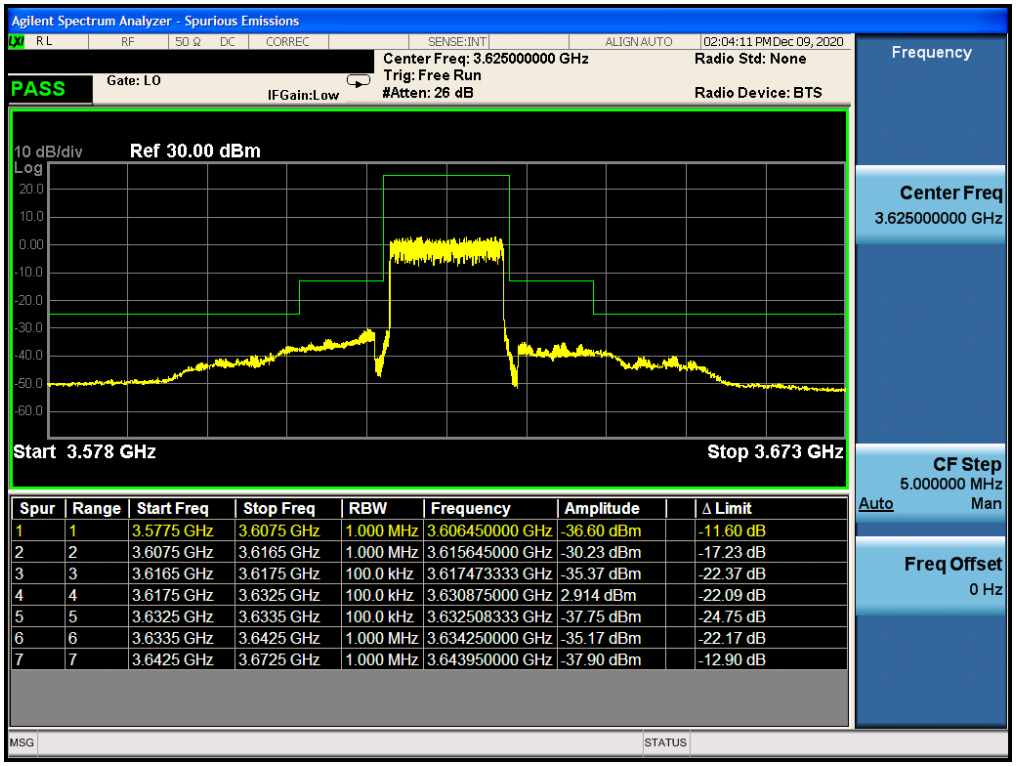

| Spur | Range | Start Freq | Stop Freq | RBW | Frequency | Amplitude | Δ Limit |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3.6500 GHz | 3.6800 GHz | 1.000 MHz | 3.677950000 GHz | -40.99 dBm | -15.99 dB |
| 2 | 2 | 3.6800 GHz | 3.6890 GHz | 1.000 MHz | 3.688865000 GHz | -31.20 dBm | -18.20 dB |
| 3 | 3 | 3.6890 GHz | 3.6900 GHz | 100.0 kHz | 3.689998333 GHz | -36.41 dBm | -23.41 dB |
| 4 | 4 | 3.6900 GHz | 3.7000 GHz | 100.0 kHz | 3.697583333 GHz | 5.808 dBm | -19.19 dB |
| 5 | 5 | 3.7000 GHz | 3.7010 GHz | 100.0 kHz | 3.700030000 GHz | -37.12 dBm | -24.12 dB |
| 6 | 6 | 3.7010 GHz | 3.7100 GHz | 1.000 MHz | 3.701870000 GHz | -35.99 dBm | -22.99 dB |
| 7 | 7 | 3.7100 GHz | 3.7200 GHz | 1.000 MHz | 3.711583333 GHz | -40.38 dBm | -15.38 dB |
| 8 | 8 | 3.7200 GHz | 3.7400 GHz | 1.000 MHz | 3.720500000 GHz | -48.74 dBm | -8.741 dB |

**Plot 7-62. Upper ACP Plot (LTE Band 48 - 10MHz QPSK)**



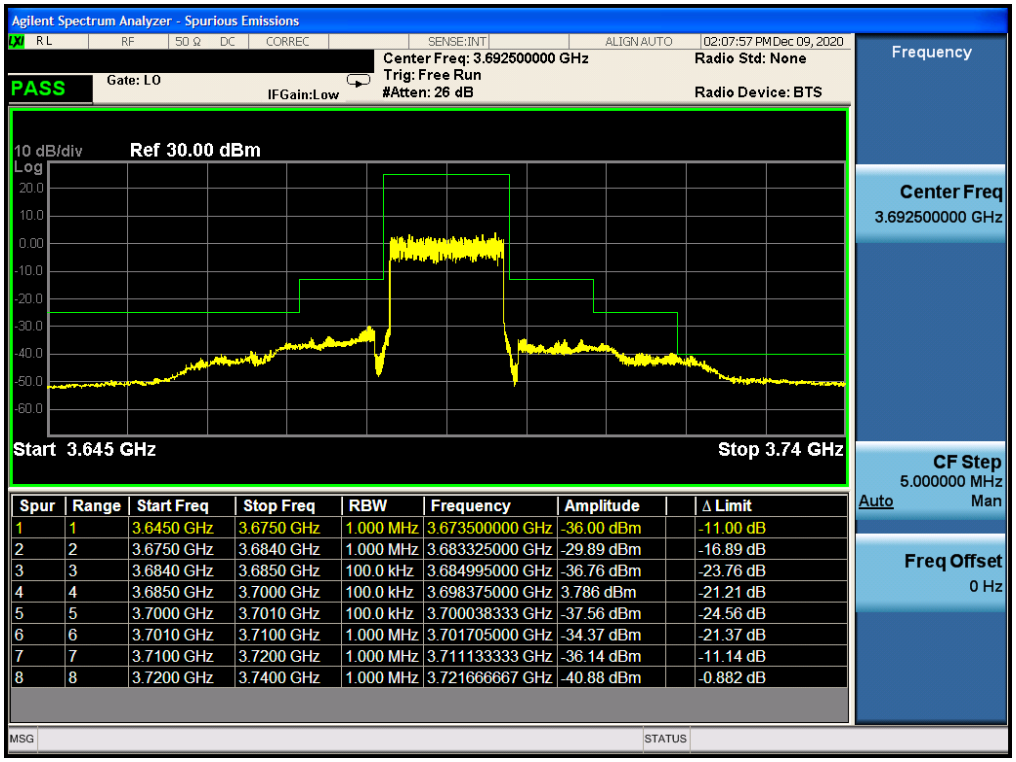

| Spur | Range | Start Freq | Stop Freq | RBW | Frequency | Amplitude | Δ Limit |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3.5100 GHz | 3.5300 GHz | 1.000 MHz | 3.528600000 GHz | -44.21 dBm | -4.212 dB |
| 2 | 2 | 3.5300 GHz | 3.5400 GHz | 1.000 MHz | 3.538516667 GHz | -35.43 dBm | -10.43 dB |
| 3 | 3 | 3.5400 GHz | 3.5490 GHz | 1.000 MHz | 3.547755000 GHz | -29.79 dBm | -16.79 dB |
| 4 | 4 | 3.5490 GHz | 3.5500 GHz | 100.0 kHz | 3.549963333 GHz | -36.81 dBm | -23.81 dB |
| 5 | 5 | 3.5500 GHz | 3.5650 GHz | 100.0 kHz | 3.563600000 GHz | 3.890 dBm | -21.11 dB |
| 6 | 6 | 3.5650 GHz | 3.5660 GHz | 100.0 kHz | 3.565023333 GHz | -37.40 dBm | -24.40 dB |
| 7 | 7 | 3.5660 GHz | 3.5750 GHz | 1.000 MHz | 3.566975000 GHz | -32.37 dBm | -19.37 dB |
| 8 | 8 | 3.5750 GHz | 3.6050 GHz | 1.000 MHz | 3.576150000 GHz | -37.40 dBm | -12.40 dB |

**Plot 7-63. Lower ACP Plot (LTE Band 48 - 15MHz QPSK)**



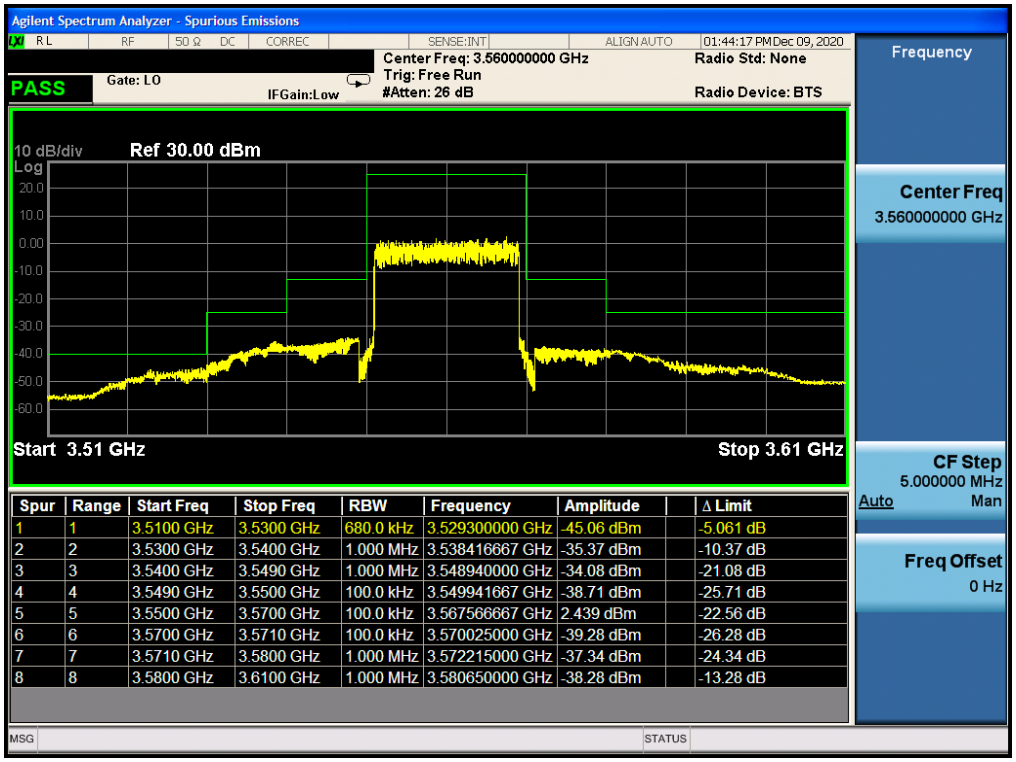

| Spur | Range | Start Freq | Stop Freq | RBW | Frequency | Amplitude | Δ Limit |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3.5775 GHz | 3.6075 GHz | 1.000 MHz | 3.606450000 GHz | -36.60 dBm | -11.60 dB |
| 2 | 2 | 3.6075 GHz | 3.6165 GHz | 1.000 MHz | 3.615645000 GHz | -30.23 dBm | -17.23 dB |
| 3 | 3 | 3.6165 GHz | 3.6175 GHz | 100.0 kHz | 3.617473333 GHz | -35.37 dBm | -22.37 dB |
| 4 | 4 | 3.6175 GHz | 3.6325 GHz | 100.0 kHz | 3.630875000 GHz | 2.914 dBm | -22.09 dB |
| 5 | 5 | 3.6325 GHz | 3.6335 GHz | 100.0 kHz | 3.632508333 GHz | -37.75 dBm | -24.75 dB |
| 6 | 6 | 3.6335 GHz | 3.6425 GHz | 1.000 MHz | 3.634250000 GHz | -35.17 dBm | -22.17 dB |
| 7 | 7 | 3.6425 GHz | 3.6725 GHz | 1.000 MHz | 3.643950000 GHz | -37.90 dBm | -12.90 dB |

**Plot 7-64. Mid ACP Plot (LTE Band 48 - 15MHz QPSK)**



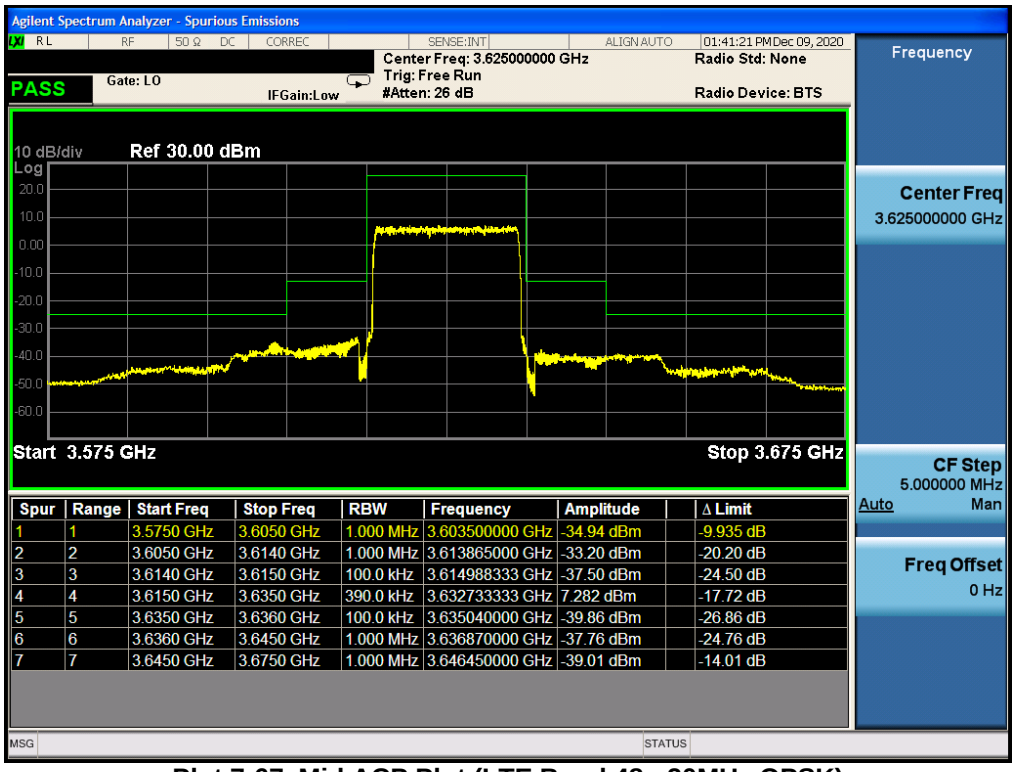

| Spur | Range | Start Freq | Stop Freq | RBW | Frequency | Amplitude | Δ Limit |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3.6450 GHz | 3.6750 GHz | 1.000 MHz | 3.673500000 GHz | -36.00 dBm | -11.00 dB |
| 2 | 2 | 3.6750 GHz | 3.6840 GHz | 1.000 MHz | 3.683325000 GHz | -29.89 dBm | -16.89 dB |
| 3 | 3 | 3.6840 GHz | 3.6850 GHz | 100.0 kHz | 3.684995000 GHz | -36.76 dBm | -23.76 dB |
| 4 | 4 | 3.6850 GHz | 3.7000 GHz | 100.0 kHz | 3.698375000 GHz | 3.786 dBm | -21.21 dB |
| 5 | 5 | 3.7000 GHz | 3.7010 GHz | 100.0 kHz | 3.700038333 GHz | -37.56 dBm | -24.56 dB |
| 6 | 6 | 3.7010 GHz | 3.7100 GHz | 1.000 MHz | 3.701705000 GHz | -34.37 dBm | -21.37 dB |
| 7 | 7 | 3.7100 GHz | 3.7200 GHz | 1.000 MHz | 3.711133333 GHz | -36.14 dBm | -11.14 dB |
| 8 | 8 | 3.7200 GHz | 3.7400 GHz | 1.000 MHz | 3.721666667 GHz | -40.88 dBm | -0.882 dB |

**Plot 7-65. Upper ACP Plot (LTE Band 48 - 15MHz QPSK)**



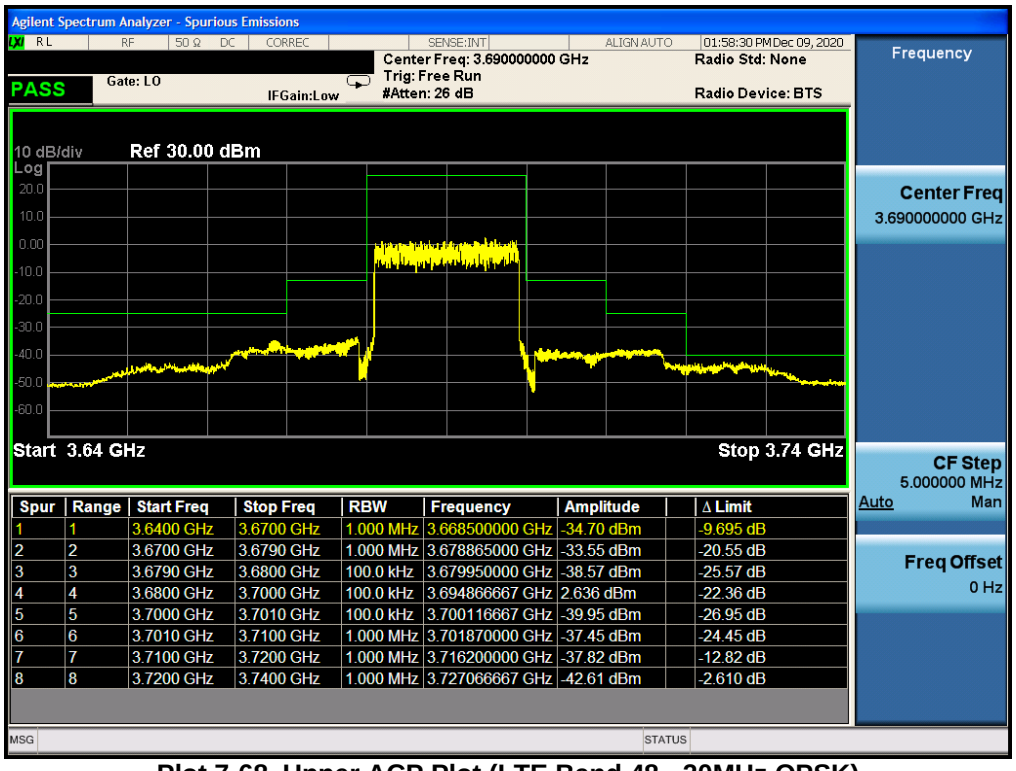

| Spur | Range | Start Freq | Stop Freq | RBW | Frequency | Amplitude | Δ Limit |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3.5100 GHz | 3.5300 GHz | 680.0 kHz | 3.529300000 GHz | -45.06 dBm | -5.061 dB |
| 2 | 2 | 3.5300 GHz | 3.5400 GHz | 1.000 MHz | 3.538416667 GHz | -35.37 dBm | -10.37 dB |
| 3 | 3 | 3.5400 GHz | 3.5490 GHz | 1.000 MHz | 3.548940000 GHz | -34.08 dBm | -21.08 dB |
| 4 | 4 | 3.5490 GHz | 3.5500 GHz | 100.0 kHz | 3.549941667 GHz | -38.71 dBm | -25.71 dB |
| 5 | 5 | 3.5500 GHz | 3.5700 GHz | 100.0 kHz | 3.567566667 GHz | 2.439 dBm | -22.56 dB |
| 6 | 6 | 3.5700 GHz | 3.5710 GHz | 100.0 kHz | 3.570025000 GHz | -39.28 dBm | -26.28 dB |
| 7 | 7 | 3.5710 GHz | 3.5800 GHz | 1.000 MHz | 3.572215000 GHz | -37.34 dBm | -24.34 dB |
| 8 | 8 | 3.5800 GHz | 3.6100 GHz | 1.000 MHz | 3.580650000 GHz | -38.28 dBm | -13.28 dB |

**Plot 7-66. Lower ACP Plot (LTE Band 48 - 20MHz QPSK)**




| Spur | Range | Start Freq | Stop Freq | RBW | Frequency | Amplitude | Δ Limit |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3.5750 GHz | 3.6050 GHz | 1.000 MHz | 3.603500000 GHz | -34.94 dBm | -9.935 dB |
| 2 | 2 | 3.6050 GHz | 3.6140 GHz | 1.000 MHz | 3.613865000 GHz | -33.20 dBm | -20.20 dB |
| 3 | 3 | 3.6140 GHz | 3.6150 GHz | 100.0 kHz | 3.614988333 GHz | -37.50 dBm | -24.50 dB |
| 4 | 4 | 3.6150 GHz | 3.6350 GHz | 390.0 kHz | 3.632733333 GHz | 7.282 dBm | -17.72 dB |
| 5 | 5 | 3.6350 GHz | 3.6360 GHz | 100.0 kHz | 3.635040000 GHz | -39.86 dBm | -26.86 dB |
| 6 | 6 | 3.6360 GHz | 3.6450 GHz | 1.000 MHz | 3.636870000 GHz | -37.76 dBm | -24.76 dB |
| 7 | 7 | 3.6450 GHz | 3.6750 GHz | 1.000 MHz | 3.646450000 GHz | -39.01 dBm | -14.01 dB |

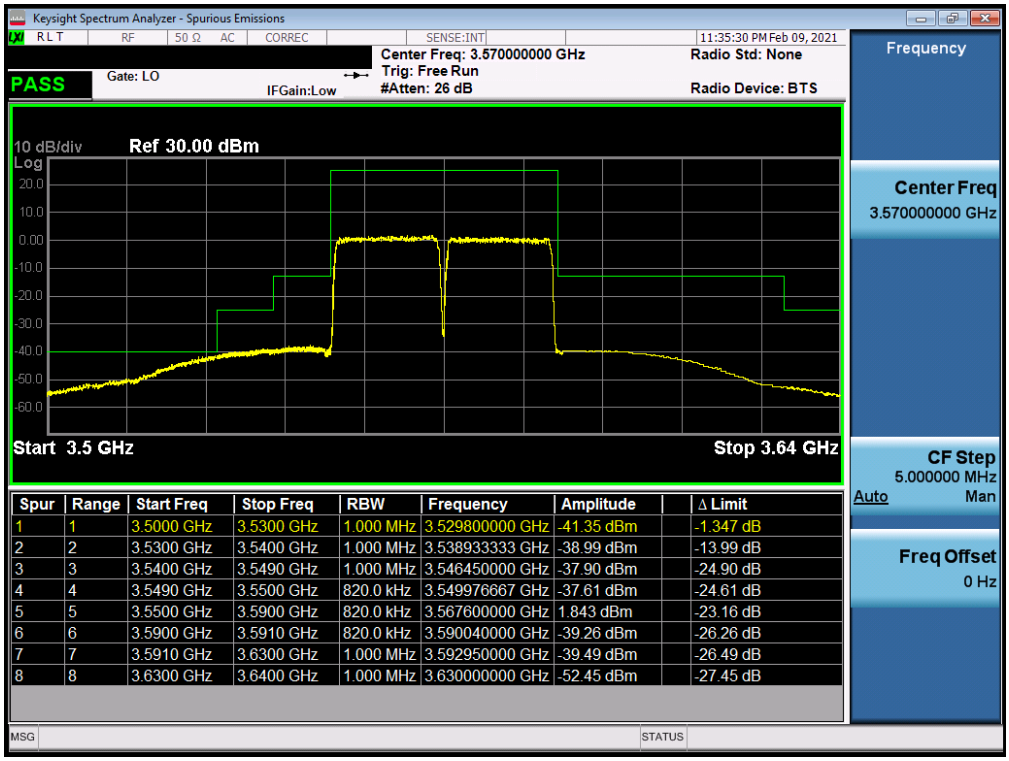
**Plot 7-67. Mid ACP Plot (LTE Band 48 - 20MHz QPSK)**




| Spur | Range | Start Freq | Stop Freq | RBW | Frequency | Amplitude | Δ Limit |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3.6400 GHz | 3.6700 GHz | 1.000 MHz | 3.668500000 GHz | -34.70 dBm | -9.695 dB |
| 2 | 2 | 3.6700 GHz | 3.6790 GHz | 1.000 MHz | 3.678865000 GHz | -33.55 dBm | -20.55 dB |
| 3 | 3 | 3.6790 GHz | 3.6800 GHz | 100.0 kHz | 3.679950000 GHz | -38.57 dBm | -25.57 dB |
| 4 | 4 | 3.6800 GHz | 3.7000 GHz | 100.0 kHz | 3.694866667 GHz | 2.636 dBm | -22.36 dB |
| 5 | 5 | 3.7000 GHz | 3.7010 GHz | 100.0 kHz | 3.700116667 GHz | -39.95 dBm | -26.95 dB |
| 6 | 6 | 3.7010 GHz | 3.7100 GHz | 1.000 MHz | 3.701870000 GHz | -37.45 dBm | -24.45 dB |
| 7 | 7 | 3.7100 GHz | 3.7200 GHz | 1.000 MHz | 3.716200000 GHz | -37.82 dBm | -12.82 dB |
| 8 | 8 | 3.7200 GHz | 3.7400 GHz | 1.000 MHz | 3.727066667 GHz | -42.61 dBm | -2.610 dB |

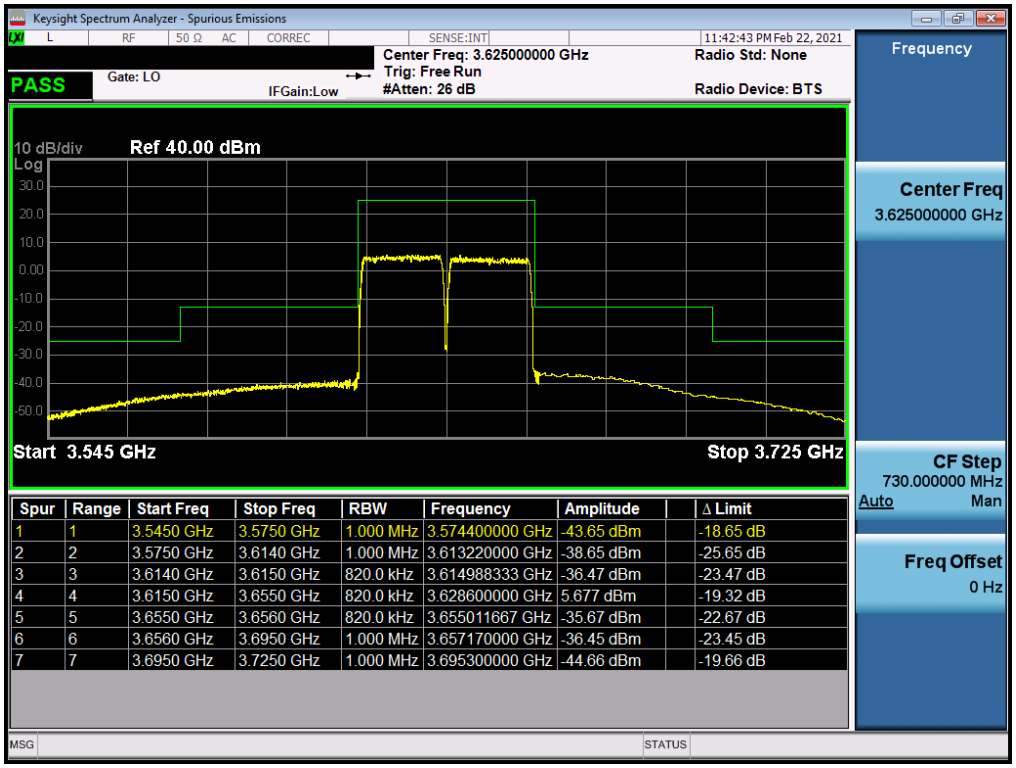
**Plot 7-68. Upper ACP Plot (LTE Band 48 - 20MHz QPSK)**

## ULCA - LTE Band 48



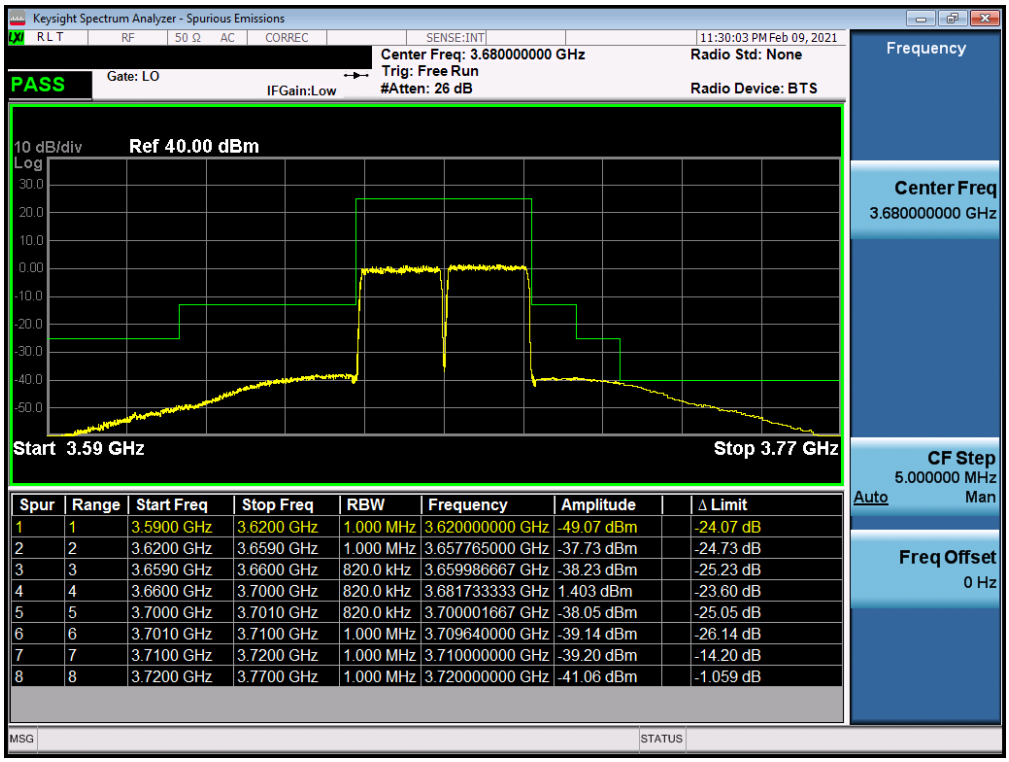

| Spur | Range | Start Freq | Stop Freq | RBW | Frequency | Amplitude | Δ Limit |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3.5000 GHz | 3.5300 GHz | 1.000 MHz | 3.529800000 GHz | -41.35 dBm | -1.347 dB |
| 2 | 2 | 3.5300 GHz | 3.5400 GHz | 1.000 MHz | 3.538933333 GHz | -38.99 dBm | -13.99 dB |
| 3 | 3 | 3.5400 GHz | 3.5490 GHz | 1.000 MHz | 3.546450000 GHz | -37.90 dBm | -24.90 dB |
| 4 | 4 | 3.5490 GHz | 3.5500 GHz | 820.0 kHz | 3.549976667 GHz | -37.61 dBm | -24.61 dB |
| 5 | 5 | 3.5500 GHz | 3.5900 GHz | 820.0 kHz | 3.567600000 GHz | 1.843 dBm | -23.16 dB |
| 6 | 6 | 3.5900 GHz | 3.5910 GHz | 820.0 kHz | 3.590040000 GHz | -39.26 dBm | -26.26 dB |
| 7 | 7 | 3.5910 GHz | 3.6300 GHz | 1.000 MHz | 3.592950000 GHz | -39.49 dBm | -26.49 dB |
| 8 | 8 | 3.6300 GHz | 3.6400 GHz | 1.000 MHz | 3.630000000 GHz | -52.45 dBm | -27.45 dB |

**Plot 7-69. Lower ACP Plot (ULCA LTE Band 48 – 20+20MHz QPSK)**




| Spur | Range | Start Freq | Stop Freq | RBW | Frequency | Amplitude | Δ Limit |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3.5450 GHz | 3.5750 GHz | 1.000 MHz | 3.574400000 GHz | -43.65 dBm | -18.65 dB |
| 2 | 2 | 3.5750 GHz | 3.6140 GHz | 1.000 MHz | 3.613220000 GHz | -38.65 dBm | -25.65 dB |
| 3 | 3 | 3.6140 GHz | 3.6150 GHz | 820.0 kHz | 3.614988333 GHz | -36.47 dBm | -23.47 dB |
| 4 | 4 | 3.6150 GHz | 3.6550 GHz | 820.0 kHz | 3.628600000 GHz | 5.677 dBm | -19.32 dB |
| 5 | 5 | 3.6550 GHz | 3.6560 GHz | 820.0 kHz | 3.655011667 GHz | -35.67 dBm | -22.67 dB |
| 6 | 6 | 3.6560 GHz | 3.6950 GHz | 1.000 MHz | 3.657170000 GHz | -36.45 dBm | -23.45 dB |
| 7 | 7 | 3.6950 GHz | 3.7250 GHz | 1.000 MHz | 3.695300000 GHz | -44.66 dBm | -19.66 dB |

**Plot 7-70. Mid ACP Plot (ULCA LTE Band 48 – 20+20MHz QPSK)**




| Spur | Range | Start Freq | Stop Freq | RBW | Frequency | Amplitude | Δ Limit |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3.5900 GHz | 3.6200 GHz | 1.000 MHz | 3.620000000 GHz | -49.07 dBm | -24.07 dB |
| 2 | 2 | 3.6200 GHz | 3.6590 GHz | 1.000 MHz | 3.657765000 GHz | -37.73 dBm | -24.73 dB |
| 3 | 3 | 3.6590 GHz | 3.6600 GHz | 820.0 kHz | 3.659986667 GHz | -38.23 dBm | -25.23 dB |
| 4 | 4 | 3.6600 GHz | 3.7000 GHz | 820.0 kHz | 3.681733333 GHz | 1.403 dBm | -23.60 dB |
| 5 | 5 | 3.7000 GHz | 3.7010 GHz | 820.0 kHz | 3.700001667 GHz | -38.05 dBm | -25.05 dB |
| 6 | 6 | 3.7010 GHz | 3.7100 GHz | 1.000 MHz | 3.709640000 GHz | -39.14 dBm | -26.14 dB |
| 7 | 7 | 3.7100 GHz | 3.7200 GHz | 1.000 MHz | 3.710000000 GHz | -39.20 dBm | -14.20 dB |
| 8 | 8 | 3.7200 GHz | 3.7700 GHz | 1.000 MHz | 3.720000000 GHz | -41.06 dBm | -1.059 dB |

**Plot 7-71. Upper ACP Plot (ULCA LTE Band 48 – 20+20MHz QPSK)**

## 7.5 Additional Maximum Power Reduction (A-MPR)

**§2.1046**

### Test Overview

A-MPR is implemented in this device per the A-MPR specification in 3GPP TS 36.101. The conducted powers are shown herein to cover the different A-MPR levels specified in the standard. Conducted power measurements are performed to measure the average output power of the EUT. The averaging is to be performed only over duration of active transmissions at maximum output power level. The average measurements do not include averaging over periods when the transmitter is quiescent or when operating at reduced power level. All ports were tested and only the worst case data were reported.

### Test Procedure Used

KDB 971168 D01 v03

### Test Setup

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

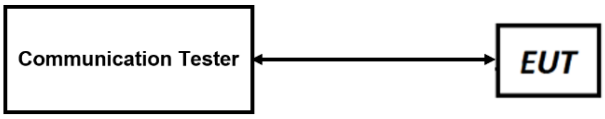



**Figure 7-4. Conducted Power Measurement Setup**

### Test Notes

1. A-MPR was only applied for test purposes to the 2CC case since the 1CC case was compliant for all testing at max power.
2. A-MPR was verified to comply with the "CA_NS_10" specification in the 3GPP TS 36.101 standard by setting the MCC to a U.S. code and the MNC to a U.S. carrier supporting LTE B48 operation.

| Test Case | NS | MCC | MNC | Channel BW [MHz] | PCC Channel Frequency [MHz] | SCC Channel Frequency [MHz] | Modulation | PCC RB Size | PCC RB Offset | SCC RB Size | SCC RB Offset | MPR [dB] | Maximum Target Output Power [dBm] | A-MPR [dB] | A-MPR Measured Power [dBm] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01 | 310 | 910 | 20 + 20 | 3560 | 3579.8 | QPSK | 100 | 0 | 100 | 0 | 0 | 20.80 | ≤11 | 16.56 |
| | | | | | | | 16-QAM | 100 | 0 | 100 | 0 | ≤1 | 19.80 | | 16.52 |
| | | | | | | | 64-QAM | 100 | 0 | 100 | 0 | ≤2 | 18.80 | | 16.64 |
| | | | | | | | 256-QAM | 100 | 0 | 100 | 0 | ≤3 | 17.80 | | 16.70 |
| 2 | | | | 20 + 20 | 3560 | 3579.8 | QPSK | 1 | 99 | 1 | 0 | 0 | 20.80 | ≤11 | 20.48 |
| | | | | | | | 16-QAM | 1 | 99 | 1 | 0 | ≤1 | 19.80 | | 20.73 |
| | | | | | | | 64-QAM | 1 | 99 | 1 | 0 | ≤2 | 18.80 | | 20.74 |
| | | | | | | | 256-QAM | 1 | 99 | 1 | 0 | ≤3 | 17.80 | | 20.67 |
| 3 | | | | 20 + 20 | 3605.1 | 3624.9 | QPSK | 100 | 0 | 100 | 0 | 0 | 20.80 | ≤4.5 | 20.56 |
| | | | | | | | 16-QAM | 100 | 0 | 100 | 0 | ≤1 | 19.80 | | 20.60 |
| | | | | | | | 64-QAM | 100 | 0 | 100 | 0 | ≤2 | 18.80 | | 20.58 |
| | | | | | | | 256-QAM | 100 | 0 | 100 | 0 | ≤3 | 17.80 | | 20.55 |
| 4 | | | | 20 + 20 | 3605.1 | 3624.9 | QPSK | 1 | 99 | 1 | 0 | 0 | 20.80 | ≤4.5 | 20.43 |
| | | | | | | | 16-QAM | 1 | 99 | 1 | 0 | ≤1 | 19.80 | | 20.58 |
| | | | | | | | 64-QAM | 1 | 99 | 1 | 0 | ≤2 | 18.80 | | 20.79 |
| | | | | | | | 256-QAM | 1 | 99 | 1 | 0 | ≤3 | 17.80 | | 20.80 |
| 5 | | | | 20 + 20 | 3667.1 | 3689.9 | QPSK | 100 | 0 | 100 | 0 | 0 | 20.80 | ≤11 | 16.53 |
| | | | | | | | 16-QAM | 100 | 0 | 100 | 0 | ≤1 | 19.80 | | 16.52 |
| | | | | | | | 64-QAM | 100 | 0 | 100 | 0 | ≤2 | 18.80 | | 16.58 |
| | | | | | | | 256-QAM | 100 | 0 | 100 | 0 | ≤3 | 17.80 | | 16.56 |
| 6 | | | | 20 + 20 | 3667.1 | 3689.9 | QPSK | 1 | 99 | 1 | 0 | 0 | 20.80 | ≤11 | 20.40 |
| | | | | | | | 16-QAM | 1 | 99 | 1 | 0 | ≤1 | 19.80 | | 20.59 |
| | | | | | | | 64-QAM | 1 | 99 | 1 | 0 | ≤2 | 18.80 | | 20.78 |
| | | | | | | | 256-QAM | 1 | 99 | 1 | 0 | ≤3 | 17.80 | | 20.67 |

**Table 7-2. A-MPR Conducted Power Measurements**

## 7.6 Radiated Power (EIRP)

**§96.41(b)**

### Test Overview

Equivalent Isotropic Radiated Power (EIRP) measurements are calculated by adding highest antenna gain to maximum measured conducted output power. All measurements are performed as RMS average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

### Test Procedures Used

KDB 971168 D01 v03r01 – Section 5.2.1

ANSI C63.26-2015

### Test Settings

The relevant equation for determining the EIRP from the conducted RF output power measured is:

EIRP = PMeas – LC + GT

Where:

EIRP = Equivalent Isotropic Radiated Power (expressed in the same units as PMeas, typically dBW or dBm)

PMeas = measured transmitter output power or PSD, in dBW or dBm

LC = signal attenuation in the connecting cable between the transmitter and antenna in dB

GT = gain of the transmitting antenna, in dBi (EIRP)

### Test Setup

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

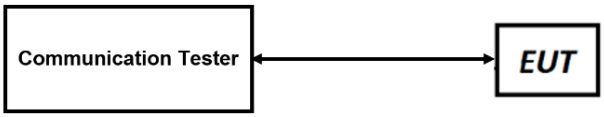



**Figure 7-5. EIRP Measurement Setup**

## Test Notes

1) The worst case emissions are reported with the modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below.

2) This unit was tested with its standard battery.

3) The Level (dBm) readings in the table were taken with a correction table loaded into the base station simulator. The correction table was used to account for the signal attenuation in the connecting cable between the transmitter and antenna.

4) The worst case EIRP shown in this section is found with LTE operating only using 1RB. As such, the EIRP/10MHz and full channel EIRP values will be identical since 1RB is fully contained within all available channel bandwidths for LTE Band 48 (i.e. 5, 10, 15, 20MHz).

5) Uplink carrier aggregation for LTE B48 is only supported in this EUT while operating in Power Class 3.

6) For ULCA, conducted power measurements were evaluated for the two contiguous channels using various combinations of RB size, RB offset, modulation, and channel bandwidth. Channel bandwidth data is shown in the tables below based only on the channel bandwidths that were supported in this device.

## Antenna 3

| Bandwidth | Mod. | Frequency [MHz] | Ant. Gain [dBi] | RB Size/Offset | Conducted Power [dBm] | EIRP [dBm/10MHz] | EIRP [Watts/10MHz] | EIRP Limit [dBm/10MHz] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|
| 20 MHz | QPSK | 3560.0 | 1.20 | 1 / 0 | 20.80 | **22.00** | **0.158** | 23.00 | -1.00 |
| | | 3625.0 | 1.20 | 1 / 0 | 20.77 | 21.97 | 0.157 | 23.00 | -1.03 |
| | | 3690.0 | 1.20 | 1 / 0 | 20.73 | 21.93 | 0.156 | 23.00 | -1.07 |
| | 16-QAM | 3625.0 | 1.20 | 1 / 50 | 20.51 | **21.71** | 0.148 | 23.00 | -1.29 |
| | 64-QAM | 3625.0 | 1.20 | 1 / 0 | 20.54 | **21.74** | 0.149 | 23.00 | -1.26 |
| | 256-QAM | 3560.0 | 1.20 | 1 / 50 | 20.12 | **21.32** | **0.136** | 23.00 | -1.68 |
| 15 MHz | QPSK | 3557.5 | 1.20 | 1 / 0 | 20.76 | **21.96** | **0.157** | 23.00 | -1.04 |
| | | 3625.0 | 1.20 | 1 / 74 | 20.74 | 21.94 | 0.156 | 23.00 | -1.06 |
| | | 3692.5 | 1.20 | 1 / 74 | 20.71 | 21.91 | 0.155 | 23.00 | -1.09 |
| | 16-QAM | 3625.0 | 1.20 | 1 / 37 | 20.54 | **21.74** | 0.149 | 23.00 | -1.26 |
| | 64-QAM | 3625.0 | 1.20 | 1 / 0 | 20.52 | **21.72** | 0.149 | 23.00 | -1.28 |
| | 256-QAM | 3557.5 | 1.20 | 1 / 0 | 20.24 | **21.44** | **0.139** | 23.00 | -1.56 |
| 10 MHz | QPSK | 3555.0 | 1.20 | 1 / 49 | 20.73 | 21.93 | 0.156 | 23.00 | -1.07 |
| | | 3625.0 | 1.20 | 1 / 0 | 20.66 | 21.86 | 0.153 | 23.00 | -1.14 |
| | | 3695.0 | 1.20 | 1 / 0 | 20.75 | **21.95** | **0.157** | 23.00 | -1.05 |
| | 16-QAM | 3555.0 | 1.20 | 1 / 25 | 20.61 | **21.81** | 0.152 | 23.00 | -1.19 |
| | 64-QAM | 3625.0 | 1.20 | 1 / 0 | 20.53 | **21.73** | 0.149 | 23.00 | -1.27 |
| | 256-QAM | 3555.0 | 1.20 | 1 / 49 | 20.29 | **21.49** | **0.141** | 23.00 | -1.51 |
| 5 MHz | QPSK | 3552.5 | 1.20 | 1 / 24 | 20.77 | **21.97** | **0.157** | 23.00 | -1.03 |
| | | 3625.0 | 1.20 | 1 / 0 | 20.73 | 21.93 | 0.156 | 23.00 | -1.07 |
| | | 3697.5 | 1.20 | 1 / 12 | 20.67 | 21.87 | 0.154 | 23.00 | -1.13 |
| | 16-QAM | 3552.5 | 1.20 | 1 / 12 | 20.56 | **21.76** | 0.150 | 23.00 | -1.24 |
| | 64-QAM | 3625.0 | 1.20 | 1 / 0 | 20.74 | **21.94** | 0.156 | 23.00 | -1.06 |
| | 256-QAM | 3625.0 | 1.20 | 1 / 12 | 20.18 | **21.38** | **0.137** | 23.00 | -1.62 |

**Table 7-3. EIRP Data (Band 48)**

| Power State | Band | Bandwidth (PCC + SCC) | PCC | | | | | SCC | | | | | ULCA Conducted Power [dBm] | Ant. Gain [dBi] | EIRP [dBm/10MHz] | EIRP [Watts/10MHz] | EIRP Limit [dBm/10MHz] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Modulation | UL Channel | UL Frequency [MHz] | UL # RB | UL RB Offset | Modulation | UL Channel | UL Frequency [MHz] | UL # RB | UL RB Offset | | | | | | |
| Max | LTE B48 | 20MHz + 20MHz | QPSK | 55340 | 3560.0 | 1 | 99 | QPSK | 55538 | 3579.8 | 1 | 0 | 20.18 | 1.20 | 21.38 | 0.137 | 23.00 | -1.62 |
| | | | | 55990 | 3625.0 | 1 | 99 | | 56188 | 3644.8 | 1 | 0 | 20.17 | 1.20 | 21.37 | 0.137 | 23.00 | -1.63 |
| | | | | 56640 | 3690.0 | 1 | 0 | | 56442 | 3670.2 | 1 | 99 | 20.80 | 1.20 | 22.00 | 0.158 | 23.00 | -1.00 |
| | | | QPSK | 55990 | 3625.0 | 100 | 0 | QPSK | 56188 | 3644.8 | 100 | 0 | 19.79 | 1.20 | 20.99 | 0.126 | 23.00 | -2.01 |
| | | | 16-QAM | 55990 | 3625.0 | 100 | 0 | 16-QAM | 56188 | 3644.8 | 100 | 0 | 19.76 | 1.20 | 20.96 | 0.125 | 23.00 | -2.04 |
| | | | 64-QAM | 55990 | 3625.0 | 100 | 0 | 64-QAM | 56188 | 3644.8 | 100 | 0 | 19.83 | 1.20 | 21.03 | 0.127 | 23.00 | -1.97 |
| | | | 256-QAM | 55990 | 3625.0 | 100 | 0 | 256-QAM | 56188 | 3644.8 | 100 | 0 | 19.83 | 1.20 | 21.03 | 0.127 | 23.00 | -1.97 |
| Max | LTE B48 | 20MHz + 15MHz | QPSK | 55340 | 3560.0 | 1 | 99 | QPSK | 55511 | 3577.1 | 1 | 0 | 20.33 | 1.20 | 21.53 | 0.142 | 23.00 | -1.47 |
| | | | | 55990 | 3625.0 | 1 | 99 | | 56161 | 3642.1 | 1 | 0 | 20.79 | 1.20 | 21.99 | 0.158 | 23.00 | -1.01 |
| | | | | 56640 | 3690.0 | 1 | 0 | | 56811 | 3707.1 | 1 | 99 | 20.30 | 1.20 | 21.50 | 0.141 | 23.00 | -1.50 |
| | | | QPSK | 55990 | 3625.0 | 100 | 0 | QPSK | 56161 | 3642.1 | 100 | 0 | 19.66 | 1.20 | 20.86 | 0.122 | 23.00 | -2.14 |
| | | | 16-QAM | 55990 | 3625.0 | 100 | 0 | 16-QAM | 56161 | 3642.1 | 100 | 0 | 19.63 | 1.20 | 20.83 | 0.121 | 23.00 | -2.17 |
| | | | 64-QAM | 55990 | 3625.0 | 100 | 0 | 64-QAM | 56161 | 3642.1 | 100 | 0 | 19.63 | 1.20 | 20.83 | 0.121 | 23.00 | -2.17 |
| | | | 256-QAM | 55990 | 3625.0 | 100 | 0 | 256-QAM | 56161 | 3642.1 | 100 | 0 | 19.61 | 1.20 | 20.81 | 0.121 | 23.00 | -2.19 |
| Max | LTE B48 | 20MHz + 10MHz | QPSK | 55340 | 3560.0 | 1 | 99 | QPSK | 55484 | 3574.4 | 1 | 0 | 20.34 | 1.20 | 21.54 | 0.143 | 23.00 | -1.46 |
| | | | | 55990 | 3625.0 | 1 | 99 | | 56134 | 3639.4 | 1 | 0 | 20.68 | 1.20 | 21.88 | 0.154 | 23.00 | -1.12 |
| | | | | 56640 | 3690.0 | 1 | 0 | | 56784 | 3704.4 | 1 | 99 | 20.26 | 1.20 | 21.46 | 0.140 | 23.00 | -1.54 |
| | | | QPSK | 55990 | 3625.0 | 100 | 0 | QPSK | 56134 | 3639.4 | 100 | 0 | 19.85 | 1.20 | 21.05 | 0.127 | 23.00 | -1.95 |
| | | | 16-QAM | 55990 | 3625.0 | 100 | 0 | 16-QAM | 56134 | 3639.4 | 100 | 0 | 19.84 | 1.20 | 21.04 | 0.127 | 23.00 | -1.96 |
| | | | 64-QAM | 55990 | 3625.0 | 100 | 0 | 64-QAM | 56134 | 3639.4 | 100 | 0 | 19.92 | 1.20 | 21.12 | 0.129 | 23.00 | -1.88 |
| | | | 256-QAM | 55990 | 3625.0 | 100 | 0 | 256-QAM | 56134 | 3639.4 | 100 | 0 | 19.92 | 1.20 | 21.12 | 0.129 | 23.00 | -1.88 |
| Max | LTE B48 | 20MHz + 5MHz | QPSK | 55340 | 3560.0 | 1 | 99 | QPSK | 55457 | 3571.7 | 1 | 0 | 20.76 | 1.20 | 21.96 | 0.157 | 23.00 | -1.04 |
| | | | | 55990 | 3625.0 | 1 | 99 | | 56107 | 3636.7 | 1 | 0 | 20.23 | 1.20 | 21.43 | 0.139 | 23.00 | -1.57 |
| | | | | 56640 | 3690.0 | 1 | 0 | | 56757 | 3701.7 | 1 | 99 | 20.37 | 1.20 | 21.57 | 0.144 | 23.00 | -1.43 |
| | | | QPSK | 55990 | 3625.0 | 100 | 0 | QPSK | 56107 | 3636.7 | 100 | 0 | 19.85 | 1.20 | 21.05 | 0.127 | 23.00 | -1.95 |
| | | | 16-QAM | 55990 | 3625.0 | 100 | 0 | 16-QAM | 56107 | 3636.7 | 100 | 0 | 19.82 | 1.20 | 21.02 | 0.126 | 23.00 | -1.98 |
| | | | 64-QAM | 55990 | 3625.0 | 100 | 0 | 64-QAM | 56107 | 3636.7 | 100 | 0 | 19.88 | 1.20 | 21.08 | 0.128 | 23.00 | -1.92 |
| | | | 256-QAM | 55990 | 3625.0 | 100 | 0 | 256-QAM | 56107 | 3636.7 | 100 | 0 | 19.87 | 1.20 | 21.07 | 0.128 | 23.00 | -1.93 |

**Table 7-4. EIRP Data (ULCA LTE B48)**

## Antenna 1

| Bandwidth | Mod. | Frequency [MHz] | Ant. Gain [dBi] | RB Size/Offset | Conducted Power [dBm] | EIRP [dBm/10MHz] | EIRP [Watts/10MHz] | EIRP Limit [dBm/10MHz] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|
| 20 MHz | QPSK | 3560.0 | 3.50 | 1 / 99 | 18.38 | 21.88 | 0.154 | 23.00 | -1.12 |
| | | 3625.0 | 3.50 | 1 / 50 | 18.40 | 21.90 | 0.155 | 23.00 | -1.10 |
| | | 3690.0 | 3.50 | 1 / 99 | 18.50 | **22.00** | **0.158** | 23.00 | -1.00 |
| | 16-QAM | 3560.0 | 3.50 | 1 / 99 | 18.24 | **21.74** | 0.149 | 23.00 | -1.26 |
| | 64-QAM | 3690.0 | 3.50 | 1 / 0 | 18.37 | **21.87** | 0.154 | 23.00 | -1.13 |
| | 256-QAM | 3690.0 | 3.50 | 1 / 50 | 18.28 | **21.78** | **0.151** | 23.00 | -1.22 |
| 15 MHz | QPSK | 3557.5 | 3.50 | 1 / 0 | 18.45 | 21.95 | 0.157 | 23.00 | -1.05 |
| | | 3625.0 | 3.50 | 1 / 74 | 18.49 | 21.99 | 0.158 | 23.00 | -1.01 |
| | | 3692.5 | 3.50 | 1 / 74 | 18.50 | **22.00** | **0.158** | 23.00 | -1.00 |
| | 16-QAM | 3625.0 | 3.50 | 1 / 37 | 18.29 | **21.79** | 0.151 | 23.00 | -1.21 |
| | 64-QAM | 3625.0 | 3.50 | 1 / 74 | 18.16 | **21.66** | 0.147 | 23.00 | -1.34 |
| | 256-QAM | 3557.5 | 3.50 | 1 / 0 | 18.04 | **21.54** | **0.143** | 23.00 | -1.46 |
| 10 MHz | QPSK | 3555.0 | 3.50 | 1 / 49 | 18.48 | 21.98 | 0.158 | 23.00 | -1.02 |
| | | 3625.0 | 3.50 | 1 / 49 | 18.48 | 21.98 | 0.158 | 23.00 | -1.02 |
| | | 3695.0 | 3.50 | 1 / 49 | 18.50 | **22.00** | **0.158** | 23.00 | -1.00 |
| | 16-QAM | 3555.0 | 3.50 | 1 / 0 | 18.35 | **21.85** | 0.153 | 23.00 | -1.15 |
| | 64-QAM | 3625.0 | 3.50 | 1 / 25 | 18.48 | **21.98** | 0.158 | 23.00 | -1.02 |
| | 256-QAM | 3695.0 | 3.50 | 1 / 0 | 18.23 | **21.73** | **0.149** | 23.00 | -1.27 |
| 5 MHz | QPSK | 3552.5 | 3.50 | 1 / 0 | 18.50 | **22.00** | **0.158** | 23.00 | -1.00 |
| | | 3625.0 | 3.50 | 1 / 24 | 18.45 | 21.95 | 0.157 | 23.00 | -1.05 |
| | | 3697.5 | 3.50 | 1 / 12 | 18.48 | 21.98 | 0.158 | 23.00 | -1.02 |
| | 16-QAM | 3552.5 | 3.50 | 1 / 24 | 18.28 | **21.78** | 0.151 | 23.00 | -1.22 |
| | 64-QAM | 3552.5 | 3.50 | 1 / 12 | 18.14 | **21.64** | 0.146 | 23.00 | -1.36 |
| | 256-QAM | 3697.5 | 3.50 | 1 / 24 | 18.09 | **21.59** | **0.144** | 23.00 | -1.41 |

**Table 7-5. EIRP Data (Band 48)**

| Power State | Band | Bandwidth (PCC + SCC) | PCC | | | | | SCC | | | | | ULCA Conducted Power [dBm] | Ant. Gain [dBi] | EIRP [dBm/10MHz] | EIRP [Watts/10MHz] | EIRP Limit [dBm/10MHz] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Modulation | UL Channel | UL Frequency [MHz] | UL # RB | UL RB Offset | Modulation | UL Channel | UL Frequency [MHz] | UL # RB | UL RB Offset | | | | | | |
| Max | LTE B48 | 20MHz + 20MHz | QPSK | 55340 | 3560.0 | 1 | 99 | QPSK | 55538 | 3579.8 | 1 | 0 | 18.50 | 3.50 | 22.00 | 0.158 | 23.00 | -1.00 |
| | | | | 55990 | 3625.0 | 1 | 99 | | 56188 | 3644.8 | 1 | 0 | 18.35 | 3.50 | 21.85 | 0.153 | 23.00 | -1.15 |
| | | | | 56640 | 3690.0 | 1 | 0 | | 56442 | 3670.2 | 1 | 99 | 18.22 | 3.50 | 21.72 | 0.149 | 23.00 | -1.28 |
| | | | QPSK | 55990 | 3625.0 | 100 | 0 | QPSK | 56188 | 3644.8 | 100 | 0 | 17.76 | 3.50 | 21.26 | 0.134 | 23.00 | -1.74 |
| | | | 16-QAM | 55990 | 3625.0 | 100 | 0 | 16-QAM | 56188 | 3644.8 | 100 | 0 | 17.68 | 3.50 | 21.18 | 0.131 | 23.00 | -1.82 |
| | | | 64-QAM | 55990 | 3625.0 | 100 | 0 | 64-QAM | 56188 | 3644.8 | 100 | 0 | 17.71 | 3.50 | 21.21 | 0.132 | 23.00 | -1.79 |
| | | | 256-QAM | 55990 | 3625.0 | 100 | 0 | 256-QAM | 56188 | 3644.8 | 100 | 0 | 17.64 | 3.50 | 21.14 | 0.130 | 23.00 | -1.86 |
| Max | LTE B48 | 20MHz + 15MHz | QPSK | 55340 | 3560.0 | 1 | 99 | QPSK | 55511 | 3577.1 | 1 | 0 | 18.33 | 3.50 | 21.83 | 0.152 | 23.00 | -1.17 |
| | | | | 55990 | 3625.0 | 1 | 99 | | 56161 | 3642.1 | 1 | 0 | 18.45 | 3.50 | 21.95 | 0.157 | 23.00 | -1.05 |
| | | | | 56640 | 3690.0 | 1 | 0 | | 56811 | 3707.1 | 1 | 99 | 18.35 | 3.50 | 21.85 | 0.153 | 23.00 | -1.15 |
| | | | QPSK | 55990 | 3625.0 | 100 | 0 | QPSK | 56161 | 3642.1 | 100 | 0 | 18.00 | 3.50 | 21.50 | 0.141 | 23.00 | -1.50 |
| | | | 16-QAM | 55990 | 3625.0 | 100 | 0 | 16-QAM | 56161 | 3642.1 | 100 | 0 | 18.00 | 3.50 | 21.50 | 0.141 | 23.00 | -1.50 |
| | | | 64-QAM | 55990 | 3625.0 | 100 | 0 | 64-QAM | 56161 | 3642.1 | 100 | 0 | 17.98 | 3.50 | 21.48 | 0.141 | 23.00 | -1.52 |
| | | | 256-QAM | 55990 | 3625.0 | 100 | 0 | 256-QAM | 56161 | 3642.1 | 100 | 0 | 18.07 | 3.50 | 21.57 | 0.144 | 23.00 | -1.43 |
| Max | LTE B48 | 20MHz + 10MHz | QPSK | 55340 | 3560.0 | 1 | 99 | QPSK | 55484 | 3574.4 | 1 | 0 | 18.40 | 3.50 | 21.90 | 0.155 | 23.00 | -1.10 |
| | | | | 55990 | 3625.0 | 1 | 99 | | 56134 | 3639.4 | 1 | 0 | 18.29 | 3.50 | 21.79 | 0.151 | 23.00 | -1.21 |
| | | | | 56640 | 3690.0 | 1 | 0 | | 56784 | 3704.4 | 1 | 99 | 18.50 | 3.50 | 22.00 | 0.158 | 23.00 | -1.00 |
| | | | QPSK | 55990 | 3625.0 | 100 | 0 | QPSK | 56134 | 3639.4 | 100 | 0 | 18.00 | 3.50 | 21.50 | 0.141 | 23.00 | -1.50 |
| | | | 16-QAM | 55990 | 3625.0 | 100 | 0 | 16-QAM | 56134 | 3639.4 | 100 | 0 | 18.02 | 3.50 | 21.52 | 0.142 | 23.00 | -1.48 |
| | | | 64-QAM | 55990 | 3625.0 | 100 | 0 | 64-QAM | 56134 | 3639.4 | 100 | 0 | 17.97 | 3.50 | 21.47 | 0.140 | 23.00 | -1.53 |
| | | | 256-QAM | 55990 | 3625.0 | 100 | 0 | 256-QAM | 56134 | 3639.4 | 100 | 0 | 18.00 | 3.50 | 21.50 | 0.141 | 23.00 | -1.50 |
| Max | LTE B48 | 20MHz + 5MHz | QPSK | 55340 | 3560.0 | 1 | 99 | QPSK | 55457 | 3571.7 | 1 | 0 | 18.42 | 3.50 | 21.92 | 0.156 | 23.00 | -1.08 |
| | | | | 55990 | 3625.0 | 1 | 99 | | 56107 | 3636.7 | 1 | 0 | 18.39 | 3.50 | 21.89 | 0.155 | 23.00 | -1.11 |
| | | | | 56640 | 3690.0 | 1 | 0 | | 56757 | 3701.7 | 1 | 99 | 18.29 | 3.50 | 21.79 | 0.151 | 23.00 | -1.21 |
| | | | QPSK | 55990 | 3625.0 | 100 | 0 | QPSK | 56107 | 3636.7 | 100 | 0 | 17.88 | 3.50 | 21.38 | 0.137 | 23.00 | -1.62 |
| | | | 16-QAM | 55990 | 3625.0 | 100 | 0 | 16-QAM | 56107 | 3636.7 | 100 | 0 | 17.83 | 3.50 | 21.33 | 0.136 | 23.00 | -1.67 |
| | | | 64-QAM | 55990 | 3625.0 | 100 | 0 | 64-QAM | 56107 | 3636.7 | 100 | 0 | 17.83 | 3.50 | 21.33 | 0.136 | 23.00 | -1.67 |
| | | | 256-QAM | 55990 | 3625.0 | 100 | 0 | 256-QAM | 56107 | 3636.7 | 100 | 0 | 17.87 | 3.50 | 21.37 | 0.137 | 23.00 | -1.63 |

**Table 7-6. EIRP Data (ULCA LTE B48)**

## Antenna 4a

| Bandwidth | Mod. | Frequency [MHz] | Ant. Gain [dBi] | RB Size/Offset | Conducted Power [dBm] | EIRP [dBm/10MHz] | EIRP [Watts/10MHz] | EIRP Limit [dBm/10MHz] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|
| 20 MHz | QPSK | 3560.0 | 2.10 | 1 / 0 | 19.90 | **22.00** | **0.158** | 23.00 | -1.00 |
| | | 3625.0 | 2.10 | 1 / 99 | 19.89 | 21.99 | 0.158 | 23.00 | -1.01 |
| | | 3690.0 | 2.10 | 1 / 0 | 19.84 | 21.94 | 0.156 | 23.00 | -1.06 |
| | 16-QAM | 3560.0 | 2.10 | 1 / 50 | 19.83 | **21.93** | 0.156 | 23.00 | -1.07 |
| | 64-QAM | 3560.0 | 2.10 | 1 / 99 | 19.87 | **21.97** | 0.157 | 23.00 | -1.03 |
| | 256-QAM | 3690.0 | 2.10 | 1 / 50 | 19.57 | **21.67** | **0.147** | 23.00 | -1.33 |
| 15 MHz | QPSK | 3557.5 | 2.10 | 1 / 74 | 19.90 | **22.00** | **0.158** | 23.00 | -1.00 |
| | | 3625.0 | 2.10 | 1 / 74 | 19.89 | 21.99 | 0.158 | 23.00 | -1.01 |
| | | 3692.5 | 2.10 | 1 / 0 | 19.82 | 21.92 | 0.156 | 23.00 | -1.08 |
| | 16-QAM | 3625.0 | 2.10 | 1 / 0 | 19.77 | **21.87** | 0.154 | 23.00 | -1.13 |
| | 64-QAM | 3625.0 | 2.10 | 1 / 37 | 19.78 | **21.88** | 0.154 | 23.00 | -1.12 |
| | 256-QAM | 3625.0 | 2.10 | 1 / 74 | 19.67 | **21.77** | **0.150** | 23.00 | -1.23 |
| 10 MHz | QPSK | 3555.0 | 2.10 | 1 / 49 | 19.90 | **22.00** | **0.158** | 23.00 | -1.00 |
| | | 3625.0 | 2.10 | 1 / 0 | 19.79 | 21.89 | 0.155 | 23.00 | -1.11 |
| | | 3695.0 | 2.10 | 1 / 0 | 19.76 | 21.86 | 0.153 | 23.00 | -1.14 |
| | 16-QAM | 3555.0 | 2.10 | 1 / 25 | 19.75 | **21.85** | 0.153 | 23.00 | -1.15 |
| | 64-QAM | 3555.0 | 2.10 | 1 / 0 | 19.80 | **21.90** | 0.155 | 23.00 | -1.10 |
| | 256-QAM | 3695.0 | 2.10 | 1 / 49 | 19.59 | **21.69** | **0.148** | 23.00 | -1.31 |
| 5 MHz | QPSK | 3552.5 | 2.10 | 1 / 0 | 19.90 | **22.00** | **0.158** | 23.00 | -1.00 |
| | | 3625.0 | 2.10 | 1 / 12 | 19.87 | 21.97 | 0.157 | 23.00 | -1.03 |
| | | 3697.5 | 2.10 | 1 / 0 | 19.77 | 21.87 | 0.154 | 23.00 | -1.13 |
| | 16-QAM | 3552.5 | 2.10 | 1 / 12 | 19.82 | **21.92** | 0.156 | 23.00 | -1.08 |
| | 64-QAM | 3552.5 | 2.10 | 1 / 0 | 19.79 | **21.89** | 0.155 | 23.00 | -1.11 |
| | 256-QAM | 3625.0 | 2.10 | 1 / 12 | 19.62 | **21.72** | **0.149** | 23.00 | -1.28 |

**Table 7-7. EIRP Data (Band 48)**

| Power State | Band | Bandwidth (PCC + SCC) | PCC | | | | | SCC | | | | | ULCA Conducted Power [dBm] | Ant. Gain [dBi] | EIRP [dBm/10MHz] | EIRP [Watts/10MHz] | EIRP Limit [dBm/10MHz] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Modulation | UL Channel | UL Frequency [MHz] | UL # RB | UL RB Offset | Modulation | UL Channel | UL Frequency [MHz] | UL # RB | UL RB Offset | | | | | | |
| Max | LTE B48 | 20MHz + 20MHz | QPSK | 55340 | 3560.0 | 1 | 99 | QPSK | 55538 | 3579.8 | 1 | 0 | 19.43 | 2.10 | 21.53 | 0.142 | 23.00 | -1.47 |
| | | | | 55990 | 3625.0 | 1 | 99 | | 56188 | 3644.8 | 1 | 0 | 19.90 | 2.10 | 22.00 | 0.158 | 23.00 | -1.00 |
| | | | | 56640 | 3690.0 | 1 | 0 | | 56442 | 3670.2 | 1 | 99 | 19.82 | 2.10 | 21.92 | 0.156 | 23.00 | -1.08 |
| | | | QPSK | 55990 | 3625.0 | 100 | 0 | QPSK | 56188 | 3644.8 | 100 | 0 | 19.12 | 2.10 | 21.22 | 0.132 | 23.00 | -1.78 |
| | | | 16-QAM | 55990 | 3625.0 | 100 | 0 | 16-QAM | 56188 | 3644.8 | 100 | 0 | 19.17 | 2.10 | 21.27 | 0.134 | 23.00 | -1.73 |
| | | | 64-QAM | 55990 | 3625.0 | 100 | 0 | 64-QAM | 56188 | 3644.8 | 100 | 0 | 19.16 | 2.10 | 21.26 | 0.134 | 23.00 | -1.74 |
| | | | 256-QAM | 55990 | 3625.0 | 100 | 0 | 256-QAM | 56188 | 3644.8 | 100 | 0 | 19.13 | 2.10 | 21.23 | 0.133 | 23.00 | -1.77 |
| Max | LTE B48 | 20MHz + 15MHz | QPSK | 55340 | 3560.0 | 1 | 99 | QPSK | 55511 | 3577.1 | 1 | 0 | 19.62 | 2.10 | 21.72 | 0.149 | 23.00 | -1.28 |
| | | | | 55990 | 3625.0 | 1 | 99 | | 56161 | 3642.1 | 1 | 0 | 19.38 | 2.10 | 21.48 | 0.141 | 23.00 | -1.52 |
| | | | | 56640 | 3690.0 | 1 | 0 | | 56811 | 3707.1 | 1 | 99 | 19.90 | 2.10 | 22.00 | 0.158 | 23.00 | -1.00 |
| | | | QPSK | 55990 | 3625.0 | 100 | 0 | QPSK | 56161 | 3642.1 | 100 | 0 | 18.81 | 2.10 | 20.91 | 0.123 | 23.00 | -2.09 |
| | | | 16-QAM | 55990 | 3625.0 | 100 | 0 | 16-QAM | 56161 | 3642.1 | 100 | 0 | 18.85 | 2.10 | 20.95 | 0.124 | 23.00 | -2.05 |
| | | | 64-QAM | 55990 | 3625.0 | 100 | 0 | 64-QAM | 56161 | 3642.1 | 100 | 0 | 18.87 | 2.10 | 20.97 | 0.125 | 23.00 | -2.03 |
| | | | 256-QAM | 55990 | 3625.0 | 100 | 0 | 256-QAM | 56161 | 3642.1 | 100 | 0 | 18.88 | 2.10 | 20.98 | 0.125 | 23.00 | -2.02 |
| Max | LTE B48 | 20MHz + 10MHz | QPSK | 55340 | 3560.0 | 1 | 99 | QPSK | 55484 | 3574.4 | 1 | 0 | 19.83 | 2.10 | 21.93 | 0.156 | 23.00 | -1.07 |
| | | | | 55990 | 3625.0 | 1 | 99 | | 56134 | 3639.4 | 1 | 0 | 19.35 | 2.10 | 21.45 | 0.140 | 23.00 | -1.55 |
| | | | | 56640 | 3690.0 | 1 | 0 | | 56784 | 3704.4 | 1 | 99 | 19.38 | 2.10 | 21.48 | 0.141 | 23.00 | -1.52 |
| | | | QPSK | 55990 | 3625.0 | 100 | 0 | QPSK | 56134 | 3639.4 | 100 | 0 | 19.05 | 2.10 | 21.15 | 0.130 | 23.00 | -1.85 |
| | | | 16-QAM | 55990 | 3625.0 | 100 | 0 | 16-QAM | 56134 | 3639.4 | 100 | 0 | 18.85 | 2.10 | 20.95 | 0.124 | 23.00 | -2.05 |
| | | | 64-QAM | 55990 | 3625.0 | 100 | 0 | 64-QAM | 56134 | 3639.4 | 100 | 0 | 18.85 | 2.10 | 20.95 | 0.124 | 23.00 | -2.05 |
| | | | 256-QAM | 55990 | 3625.0 | 100 | 0 | 256-QAM | 56134 | 3639.4 | 100 | 0 | 18.86 | 2.10 | 20.96 | 0.125 | 23.00 | -2.04 |
| Max | LTE B48 | 20MHz + 5MHz | QPSK | 55340 | 3560.0 | 1 | 99 | QPSK | 55457 | 3571.7 | 1 | 0 | 19.56 | 2.10 | 21.66 | 0.147 | 23.00 | -1.34 |
| | | | | 55990 | 3625.0 | 1 | 99 | | 56107 | 3636.7 | 1 | 0 | 19.79 | 2.10 | 21.89 | 0.155 | 23.00 | -1.11 |
| | | | | 56640 | 3690.0 | 1 | 0 | | 56757 | 3701.7 | 1 | 99 | 19.64 | 2.10 | 21.74 | 0.149 | 23.00 | -1.26 |
| | | | QPSK | 55990 | 3625.0 | 100 | 0 | QPSK | 56107 | 3636.7 | 100 | 0 | 19.20 | 2.10 | 21.30 | 0.135 | 23.00 | -1.70 |
| | | | 16-QAM | 55990 | 3625.0 | 100 | 0 | 16-QAM | 56107 | 3636.7 | 100 | 0 | 19.20 | 2.10 | 21.30 | 0.135 | 23.00 | -1.70 |
| | | | 64-QAM | 55990 | 3625.0 | 100 | 0 | 64-QAM | 56107 | 3636.7 | 100 | 0 | 19.24 | 2.10 | 21.34 | 0.136 | 23.00 | -1.66 |
| | | | 256-QAM | 55990 | 3625.0 | 100 | 0 | 256-QAM | 56107 | 3636.7 | 100 | 0 | 19.16 | 2.10 | 21.26 | 0.134 | 23.00 | -1.74 |

**Table 7-8. EIRP Data (ULCA LTE B48)**

## Antenna 2a

| Bandwidth | Mod. | Frequency [MHz] | Ant. Gain [dBi] | RB Size/Offset | Conducted Power [dBm] | EIRP [dBm/10MHz] | EIRP [Watts/10MHz] | EIRP Limit [dBm/10MHz] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|
| 20 MHz | QPSK | 3560.0 | 0.30 | 1 / 0 | 20.70 | **21.00** | **0.126** | 23.00 | -2.00 |
| | | 3625.0 | 0.30 | 1 / 0 | 20.66 | 20.96 | 0.125 | 23.00 | -2.04 |
| | | 3690.0 | 0.30 | 1 / 0 | 20.43 | 20.73 | 0.118 | 23.00 | -2.27 |
| | 16-QAM | 3560.0 | 0.30 | 1 / 99 | 20.45 | **20.75** | 0.119 | 23.00 | -2.25 |
| | 64-QAM | 3560.0 | 0.30 | 1 / 50 | 20.57 | **20.87** | 0.122 | 23.00 | -2.13 |
| | 256-QAM | 3625.0 | 0.30 | 1 / 0 | 20.36 | **20.66** | **0.116** | 23.00 | -2.34 |
| 15 MHz | QPSK | 3557.5 | 0.30 | 1 / 37 | 20.70 | **21.00** | **0.126** | 23.00 | -2.00 |
| | | 3625.0 | 0.30 | 1 / 37 | 20.56 | 20.86 | 0.122 | 23.00 | -2.14 |
| | | 3692.5 | 0.30 | 1 / 74 | 20.43 | 20.73 | 0.118 | 23.00 | -2.27 |
| | 16-QAM | 3625.0 | 0.30 | 1 / 74 | 20.39 | **20.69** | 0.117 | 23.00 | -2.31 |
| | 64-QAM | 3625.0 | 0.30 | 1 / 0 | 20.61 | **20.91** | 0.123 | 23.00 | -2.09 |
| | 256-QAM | 3557.5 | 0.30 | 1 / 37 | 20.21 | **20.51** | **0.112** | 23.00 | -2.49 |
| 10 MHz | QPSK | 3555.0 | 0.30 | 1 / 0 | 20.66 | 20.96 | 0.125 | 23.00 | -2.04 |
| | | 3625.0 | 0.30 | 1 / 0 | 20.70 | **21.00** | **0.126** | 23.00 | -2.00 |
| | | 3695.0 | 0.30 | 1 / 25 | 20.41 | 20.71 | 0.118 | 23.00 | -2.29 |
| | 16-QAM | 3555.0 | 0.30 | 1 / 0 | 20.70 | **21.00** | **0.126** | 23.00 | -2.00 |
| | 64-QAM | 3555.0 | 0.30 | 1 / 0 | 20.59 | **20.89** | 0.123 | 23.00 | -2.11 |
| | 256-QAM | 3625.0 | 0.30 | 1 / 0 | 20.34 | **20.64** | **0.116** | 23.00 | -2.36 |
| 5 MHz | QPSK | 3552.5 | 0.30 | 1 / 24 | 20.68 | 20.98 | 0.125 | 23.00 | -2.02 |
| | | 3625.0 | 0.30 | 1 / 0 | 20.63 | 20.93 | 0.124 | 23.00 | -2.07 |
| | | 3697.5 | 0.30 | 1 / 24 | 20.70 | **21.00** | **0.126** | 23.00 | -2.00 |
| | 16-QAM | 3552.5 | 0.30 | 1 / 0 | 20.65 | **20.95** | 0.124 | 23.00 | -2.05 |
| | 64-QAM | 3552.5 | 0.30 | 1 / 24 | 20.67 | **20.97** | 0.125 | 23.00 | -2.03 |
| | 256-QAM | 3625.0 | 0.30 | 1 / 0 | 20.46 | **20.76** | **0.119** | 23.00 | -2.24 |

**Table 7-9. EIRP Data (Band 48)**

| Power State | Band | Bandwidth (PCC + SCC) | PCC | | | | | SCC | | | | | ULCA Conducted Power [dBm] | Ant. Gain [dBi] | EIRP [dBm/10MHz] | EIRP [Watts/10MHz] | EIRP Limit [dBm/10MHz] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Modulation | UL Channel | UL Frequency [MHz] | UL # RB | UL RB Offset | Modulation | UL Channel | UL Frequency [MHz] | UL # RB | UL RB Offset | | | | | | |
| Max | LTE B48 | 20MHz + 20MHz | QPSK | 55340 | 3560.0 | 1 | 99 | QPSK | 55538 | 3579.8 | 1 | 0 | 21.70 | 0.30 | 22.00 | 0.158 | 23.00 | -1.00 |
| | | | | 55990 | 3625.0 | 1 | 99 | | 56188 | 3644.8 | 1 | 0 | 21.59 | 0.30 | 21.89 | 0.155 | 23.00 | -1.11 |
| | | | | 56640 | 3690.0 | 1 | 0 | | 56442 | 3670.2 | 1 | 99 | 21.42 | 0.30 | 21.72 | 0.149 | 23.00 | -1.28 |
| | | | QPSK | 55990 | 3625.0 | 100 | 0 | QPSK | 56188 | 3644.8 | 100 | 0 | 20.74 | 0.30 | 21.04 | 0.127 | 23.00 | -1.96 |
| | | | 16-QAM | 55990 | 3625.0 | 100 | 0 | 16-QAM | 56188 | 3644.8 | 100 | 0 | 20.75 | 0.30 | 21.05 | 0.127 | 23.00 | -1.95 |
| | | | 64-QAM | 55990 | 3625.0 | 100 | 0 | 64-QAM | 56188 | 3644.8 | 100 | 0 | 20.76 | 0.30 | 21.06 | 0.128 | 23.00 | -1.94 |
| | | | 256-QAM | 55990 | 3625.0 | 100 | 0 | 256-QAM | 56188 | 3644.8 | 100 | 0 | 20.59 | 0.30 | 20.89 | 0.123 | 23.00 | -2.11 |
| Max | LTE B48 | 20MHz + 15MHz | QPSK | 55340 | 3560.0 | 1 | 99 | QPSK | 55511 | 3577.1 | 1 | 0 | 21.58 | 0.30 | 21.88 | 0.154 | 23.00 | -1.12 |
| | | | | 55990 | 3625.0 | 1 | 99 | | 56161 | 3642.1 | 1 | 0 | 21.47 | 0.30 | 21.77 | 0.150 | 23.00 | -1.23 |
| | | | | 56640 | 3690.0 | 1 | 0 | | 56811 | 3707.1 | 1 | 99 | 21.67 | 0.30 | 21.97 | 0.157 | 23.00 | -1.03 |
| | | | QPSK | 55990 | 3625.0 | 100 | 0 | QPSK | 56161 | 3642.1 | 100 | 0 | 20.84 | 0.30 | 21.14 | 0.130 | 23.00 | -1.86 |
| | | | 16-QAM | 55990 | 3625.0 | 100 | 0 | 16-QAM | 56161 | 3642.1 | 100 | 0 | 20.81 | 0.30 | 21.11 | 0.129 | 23.00 | -1.89 |
| | | | 64-QAM | 55990 | 3625.0 | 100 | 0 | 64-QAM | 56161 | 3642.1 | 100 | 0 | 20.83 | 0.30 | 21.13 | 0.130 | 23.00 | -1.87 |
| | | | 256-QAM | 55990 | 3625.0 | 100 | 0 | 256-QAM | 56161 | 3642.1 | 100 | 0 | 20.82 | 0.30 | 21.12 | 0.129 | 23.00 | -1.88 |
| Max | LTE B48 | 20MHz + 10MHz | QPSK | 55340 | 3560.0 | 1 | 99 | QPSK | 55484 | 3574.4 | 1 | 0 | 21.68 | 0.30 | 21.98 | 0.158 | 23.00 | -1.02 |
| | | | | 55990 | 3625.0 | 1 | 99 | | 56134 | 3639.4 | 1 | 0 | 21.65 | 0.30 | 21.95 | 0.157 | 23.00 | -1.05 |
| | | | | 56640 | 3690.0 | 1 | 0 | | 56784 | 3704.4 | 1 | 99 | 21.47 | 0.30 | 21.77 | 0.150 | 23.00 | -1.23 |
| | | | QPSK | 55990 | 3625.0 | 100 | 0 | QPSK | 56134 | 3639.4 | 100 | 0 | 20.71 | 0.30 | 21.01 | 0.126 | 23.00 | -1.99 |
| | | | 16-QAM | 55990 | 3625.0 | 100 | 0 | 16-QAM | 56134 | 3639.4 | 100 | 0 | 20.80 | 0.30 | 21.10 | 0.129 | 23.00 | -1.90 |
| | | | 64-QAM | 55990 | 3625.0 | 100 | 0 | 64-QAM | 56134 | 3639.4 | 100 | 0 | 20.86 | 0.30 | 21.16 | 0.131 | 23.00 | -1.84 |
| | | | 256-QAM | 55990 | 3625.0 | 100 | 0 | 256-QAM | 56134 | 3639.4 | 100 | 0 | 20.78 | 0.30 | 21.08 | 0.128 | 23.00 | -1.92 |
| Max | LTE B48 | 20MHz + 5MHz | QPSK | 55340 | 3560.0 | 1 | 99 | QPSK | 55457 | 3571.7 | 1 | 0 | 21.35 | 0.30 | 21.65 | 0.146 | 23.00 | -1.35 |
| | | | | 55990 | 3625.0 | 1 | 99 | | 56107 | 3636.7 | 1 | 0 | 21.70 | 0.30 | 22.00 | 0.158 | 23.00 | -1.00 |
| | | | | 56640 | 3690.0 | 1 | 0 | | 56757 | 3701.7 | 1 | 99 | 21.59 | 0.30 | 21.89 | 0.155 | 23.00 | -1.11 |
| | | | QPSK | 55990 | 3625.0 | 100 | 0 | QPSK | 56107 | 3636.7 | 100 | 0 | 20.93 | 0.30 | 21.23 | 0.133 | 23.00 | -1.77 |
| | | | 16-QAM | 55990 | 3625.0 | 100 | 0 | 16-QAM | 56107 | 3636.7 | 100 | 0 | 20.79 | 0.30 | 21.09 | 0.129 | 23.00 | -1.91 |
| | | | 64-QAM | 55990 | 3625.0 | 100 | 0 | 64-QAM | 56107 | 3636.7 | 100 | 0 | 20.77 | 0.30 | 21.07 | 0.128 | 23.00 | -1.93 |
| | | | 256-QAM | 55990 | 3625.0 | 100 | 0 | 256-QAM | 56107 | 3636.7 | 100 | 0 | 20.79 | 0.30 | 21.09 | 0.129 | 23.00 | -1.91 |

**Table 7-10. EIRP Data (ULCA LTE B48)**

## 7.7 Radiated Spurious Emissions

**§2.1053 §96.41(e)**

### Test Overview

Radiated spurious emissions measurements are performed using the field strength conversion method described in KDB 971168 with the EUT transmitting into an integral antenna. Measurements on signals operating below 1GHz are performed using horizontally and vertically polarized tuned dipole antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed as peak measurements while the EUT is operating at maximum power, and at the appropriate frequencies.

### Test Procedures Used

KDB 971168 D01 v03r01 – Section 5.8

ANSI C63.26-2015

TIA-603-E-2016 – Section 2.2.12

### Test Settings

1. RBW = 100kHz for emissions below 1GHz and 1MHz for emissions above 1GHz
2. VBW ≥ 3 x RBW
3. Span = 1.5 times the OBW
4. No. of sweep points ≥ 2 x span / RBW
5. Detector = RMS
6. Trace mode = Max Hold (In cases where the level is within 2dB of the limit, the final measurement is taken using triggering/gating and trace averaging.)
7. The trace was allowed to stabilize

## Test Setup

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

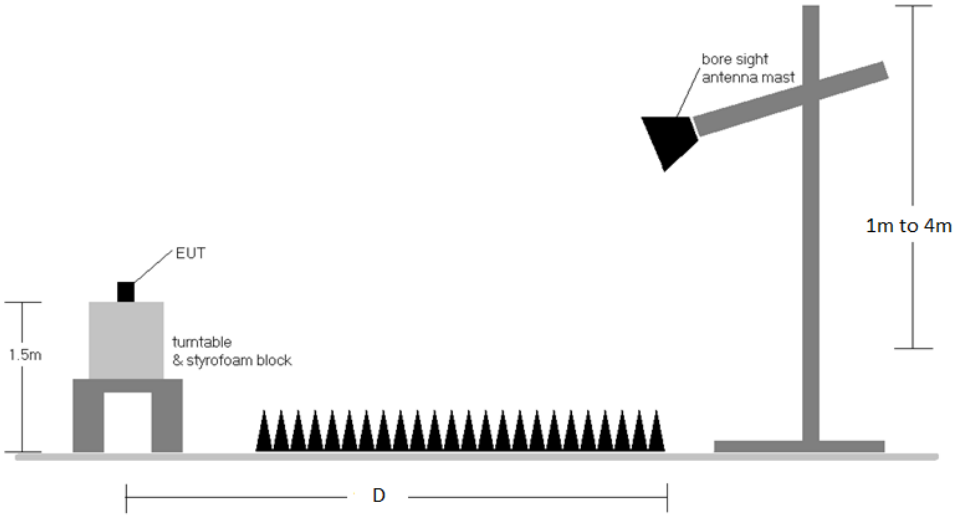



**Figure 7-6. Test Instrument & Measurement Setup**

## Test Notes

1) Field strengths are calculated using the Measurement quantity conversions in KDB 971168 Section 5.8.4.
   a. E(dBµV/m) = Measured amplitude level (dBm) + 107 + Cable Loss (dB) + Antenna Factor (dB/m)
   b. EIRP (dBm) = E(dBµV/m) + 20logD – 104.8; where D is the measurement distance in meters.

2) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below. 1RB config was found and reported as a worst case RB size.

3) This unit was tested with its standard battery.

4) The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter. The worst-case emissions are reported.

5) Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.

6) The "-" shown in the following RSE tables are used to denote a noise floor measurement.

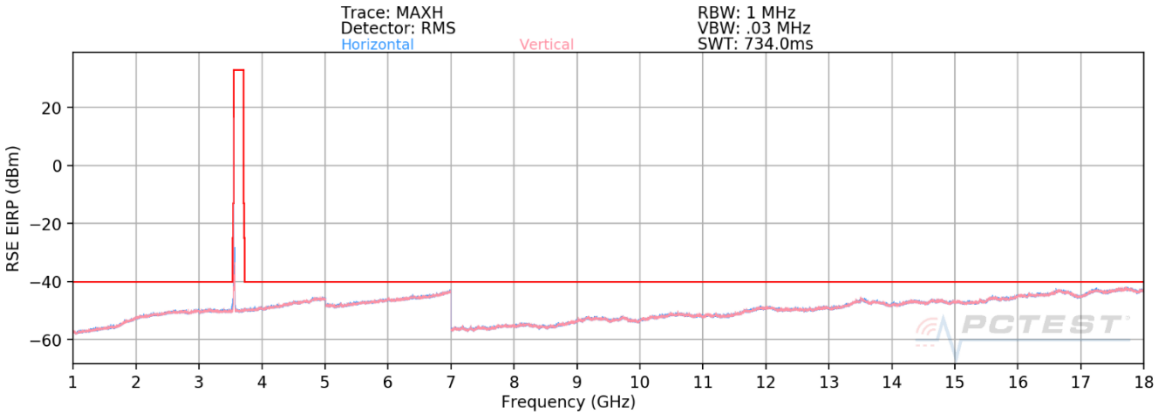
7) Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.

8) For LTE Band 48 pre-scans 1-18GHz, the RBW is set to 1MHz and VBW to 30kHz. For final measurements above 1GHz, the RBW is set to 1MHz and VBW to 3MHz when measuring with an RMS detector and max hold trace.

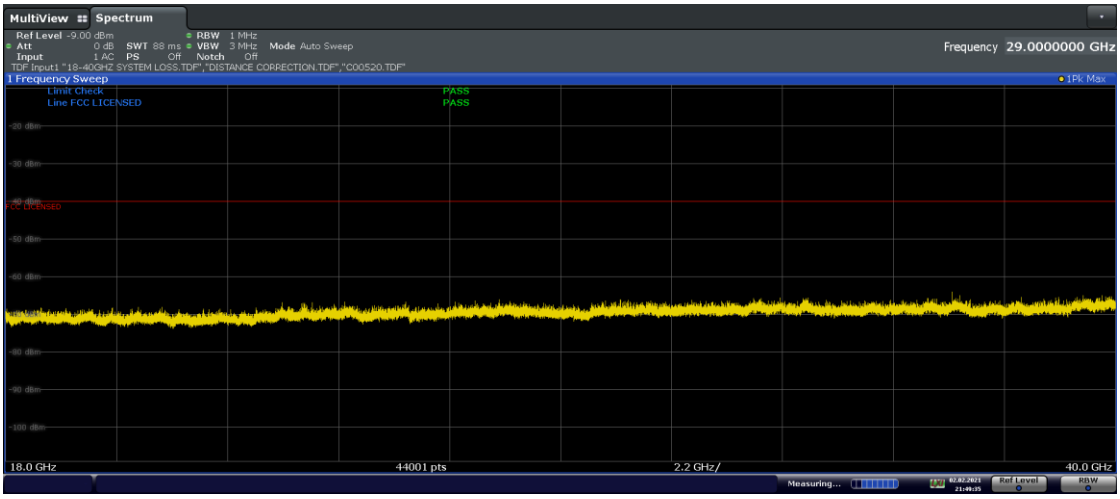
9) Uplink carrier aggregation intra-band radiated spurious emissions measurements were evaluated for the two contiguous channels using various combinations of RB size, RB offset, modulation, and channel bandwidth. The worst case (highest) emissions were found while operating with QPSK modulation with both carriers set to transmit using 1RB.

## 7.7.1 Antenna 3 Radiated Spurious Emissions Measurements

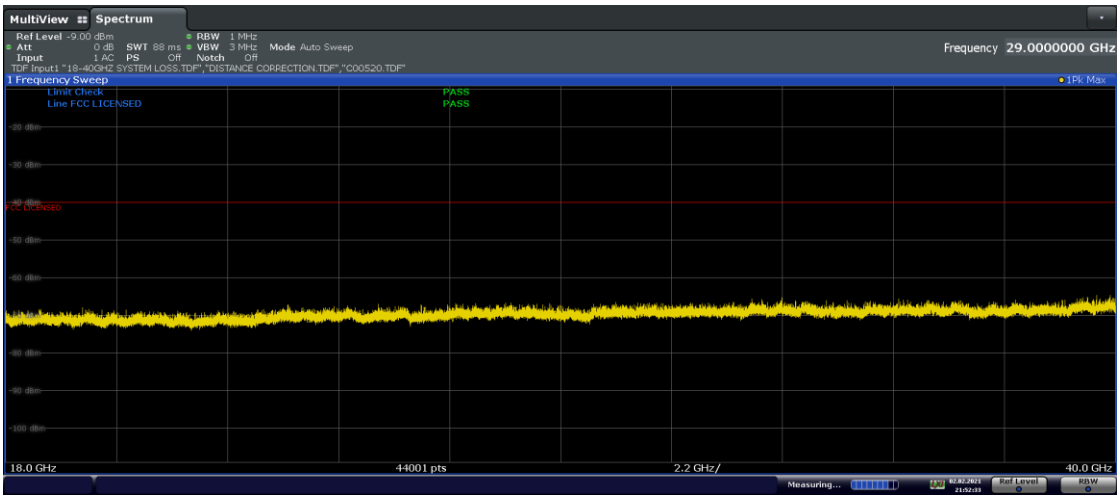
## LTE Band 48




**Plot 7-72. Radiated Spurious Plot 1 - 18GHz (Band 48)**




**Plot 7-73. Radiated Spurious Plot 18 - 40GHz (Band 48 – Ant. Pol H)**




**Plot 7-74. Radiated Spurious Plot 18 - 40GHz (Band 48 – Ant. Pol V)**

| | |
|---|---|
| **Bandwidth (MHz):** | 20 |
| **Frequency (MHz):** | 3560 |
| **Modulation Signal:** | QPSK |
| **RB Config (Size / 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7120.0 | H | - | - | -72.87 | 10.69 | 44.82 | -50.44 | -40.00 | -10.44 |
| 10680.0 | H | - | - | -74.32 | 15.75 | 48.43 | -46.83 | -40.00 | -6.83 |
| 14240.0 | H | - | - | -75.91 | 20.22 | 51.31 | -43.95 | -40.00 | -3.95 |

**Table 7-11. Radiated Spurious Data (Band 48 – Low Channel)**

| | |
|---|---|
| **Bandwidth (MHz):** | 20 |
| **Frequency (MHz):** | 3625 |
| **Modulation Signal:** | QPSK |
| **RB Config (Size / 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7250.0 | H | - | - | -72.19 | 10.60 | 45.41 | -49.85 | -40.00 | -9.85 |
| 10875.0 | H | - | - | -74.20 | 15.53 | 48.33 | -46.93 | -40.00 | -6.93 |
| 14500.0 | H | - | - | -75.82 | 20.13 | 51.31 | -43.95 | -40.00 | -3.95 |

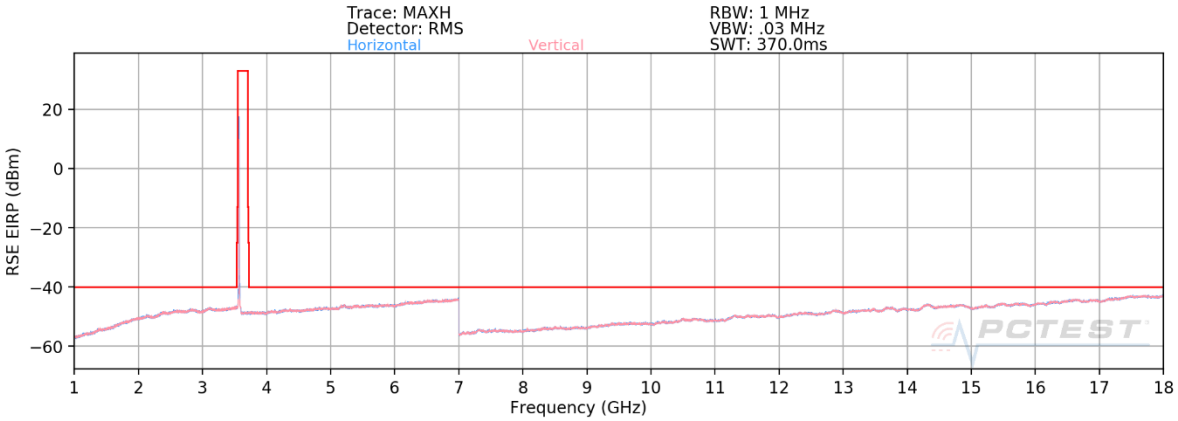
**Table 7-12. Radiated Spurious Data (Band 48 – Mid Channel)**

| | |
|---|---|
| **Bandwidth (MHz):** | 20 |
| **Frequency (MHz):** | 3690 |
| **Modulation Signal:** | QPSK |
| **RB Config (Size / Offset):** | 1 / 50 |

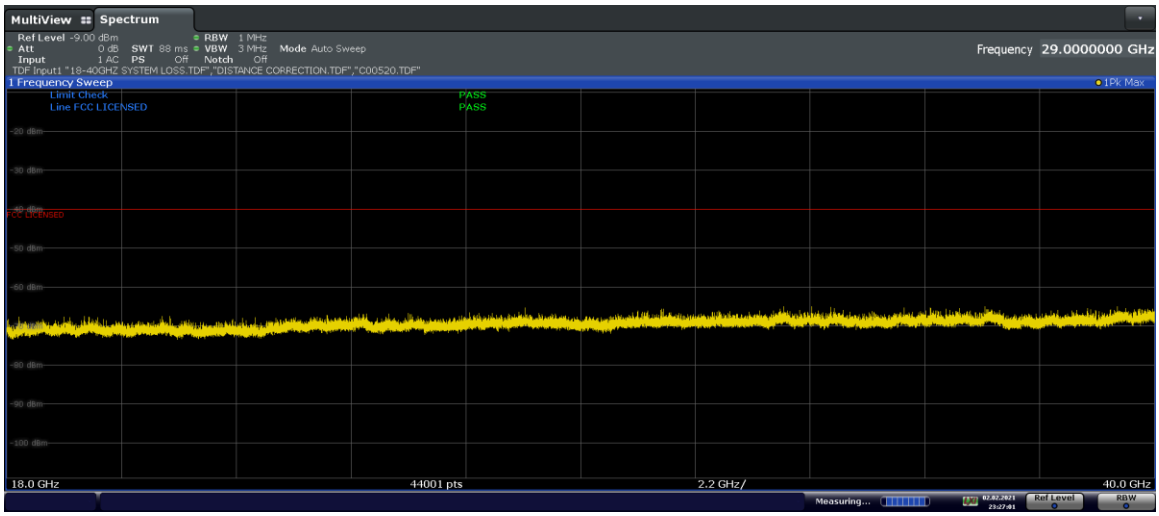
| Frequency [MHz] | Ant. Pol. [H/V] | Antenna Height [cm] | Turntable Azimuth [degree] | Analyzer Level [dBm] | AFCL [dB/m] | Field Strength [dBµV/m] | EIRP Spurious Emission Level [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|
| 7380.00 | H | - | - | -72.43 | 10.84 | 45.41 | -49.84 | -40.00 | -9.84 |
| 11070.00 | H | - | - | -74.80 | 15.80 | 48.00 | -47.25 | -40.00 | -7.25 |
| 14760.00 | H | - | - | -75.46 | 20.43 | 51.97 | -43.28 | -40.00 | -3.28 |

**Table 7-13. Radiated Spurious Data (Band 48 – High Channel)**

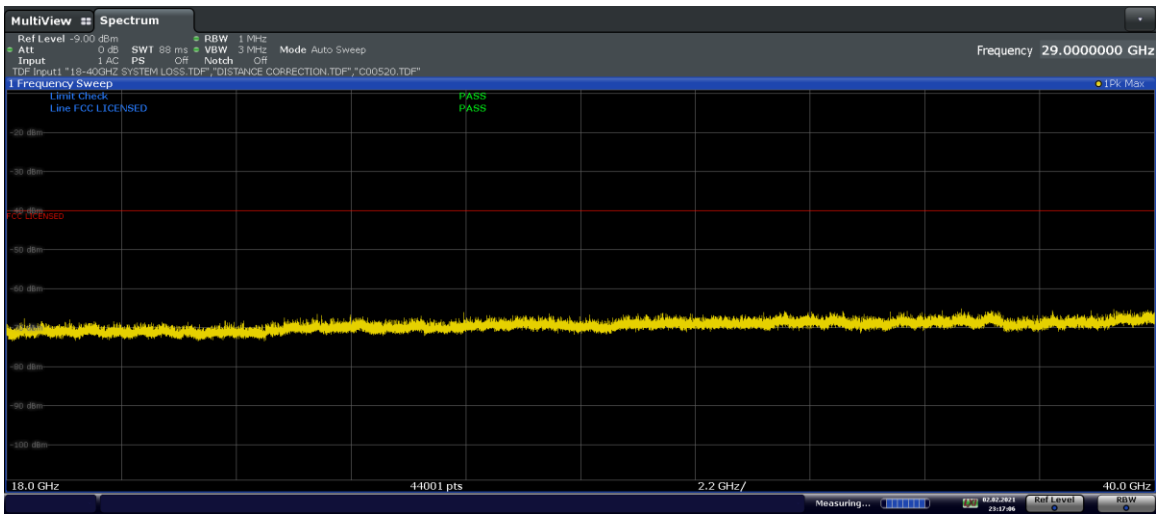
## ULCA - LTE Band 48




**Plot 7-75. Radiated Spurious Plot 1 - 18GHz (ULCA Band 48)**




**Plot 7-76. Radiated Spurious Plot 18 - 40GHz (ULCA Band 48 – Ant. Pol H)**




**Plot 7-77. Radiated Spurious Plot 18 - 40GHz (ULCA Band 48 – Ant. Pol V)**

| | |
|---|---|
| **PCC Bandwidth (MHz):** | 20 |
| **PCC Frequency (MHz):** | 3560 |
| **PCC RB (Size / Offset):** | 1/99 |
| **SCC Bandwidth (MHz):** | 20 |
| **SCC Frequency (MHz):** | 3579.8 |
| **SCC RB (Size / Offset):** | 1/0 |

| 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7120.0 | H | 236 | 262 | -70.58 | 10.69 | 47.11 | -48.15 | -40.00 | -8.15 |
| 10680.0 | H | - | - | -75.38 | 15.75 | 47.37 | -47.89 | -40.00 | -7.89 |
| 14240.0 | H | - | - | -76.17 | 20.22 | 51.05 | -44.21 | -40.00 | -4.21 |

**Table 7-14. Radiated Spurious Data (ULCA Band 48 – Low Channel)**

| | |
|---|---|
| **PCC Bandwidth (MHz):** | 20 |
| **PCC Frequency (MHz):** | 3625 |
| **PCC RB (Size / Offset):** | 1/99 |
| **SCC Bandwidth (MHz):** | 20 |
| **SCC Frequency (MHz):** | 3644.8 |
| **SCC RB (Size / Offset):** | 1/0 |

| 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7250.0 | H | - | - | -72.48 | 10.60 | 45.12 | -50.14 | -40.00 | -10.14 |
| 10875.0 | H | - | - | -75.69 | 15.53 | 46.84 | -48.42 | -40.00 | -8.42 |
| 14500.0 | H | - | - | -76.11 | 20.13 | 51.02 | -44.24 | -40.00 | -4.24 |

**Table 7-15. Radiated Spurious Data (ULCA Band 48 – Mid Channel)**

| | |
|---|---|
| **PCC Bandwidth (MHz):** | 20 |
| **PCC Frequency (MHz):** | 3690 |
| **PCC RB (Size / Offset):** | 1/0 |
| **SCC Bandwidth (MHz):** | 20 |
| **SCC Frequency (MHz):** | 3670.2 |
| **SCC RB (Size / Offset):** | 1/99 |

| 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7380.00 | H | - | - | -71.98 | 10.84 | 45.86 | -49.39 | -40.00 | -9.39 |
| 11070.00 | H | - | - | -75.20 | 15.80 | 47.60 | -47.65 | -40.00 | -7.65 |
| 14760.00 | H | - | - | -76.77 | 20.43 | 50.66 | -44.59 | -40.00 | -4.59 |

**Table 7-16. Radiated Spurious Data (ULCA Band 48 – High Channel)**

## 7.7.2 Antenna 1 Radiated Spurious Emissions Measurements

## LTE Band 48

| | |
|---|---|
| **Bandwidth (MHz):** | 20 |
| **Frequency (MHz):** | 3560 |
| **Modulation Signal:** | QPSK |
| **RB Config (Size / 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7120.0 | H | - | - | -72.61 | 10.69 | 45.08 | -50.18 | -40.00 | -10.18 |
| 10680.0 | H | - | - | -75.44 | 15.75 | 47.31 | -47.95 | -40.00 | -7.95 |
| 14240.0 | H | - | - | -76.22 | 20.22 | 51.00 | -44.26 | -40.00 | -4.26 |

**Table 7-17. Radiated Spurious Data (Band 48 – Low Channel)**

| | |
|---|---|
| **Bandwidth (MHz):** | 20 |
| **Frequency (MHz):** | 3625 |
| **Modulation Signal:** | QPSK |
| **RB Config (Size / 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7250.0 | H | - | - | -72.65 | 10.60 | 44.95 | -50.31 | -40.00 | -10.31 |
| 10875.0 | H | - | - | -75.02 | 15.53 | 47.51 | -47.75 | -40.00 | -7.75 |
| 14500.0 | H | - | - | -75.89 | 20.13 | 51.24 | -44.02 | -40.00 | -4.02 |

**Table 7-18. Radiated Spurious Data (Band 48 – Mid Channel)**

| | |
|---|---|
| **Bandwidth (MHz):** | 20 |
| **Frequency (MHz):** | 3690 |
| **Modulation Signal:** | QPSK |
| **RB Config (Size / 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7380.00 | H | - | - | -72.98 | 10.84 | 44.86 | -50.39 | -40.00 | -10.39 |
| 11070.00 | H | - | - | -75.53 | 15.80 | 47.27 | -47.98 | -40.00 | -7.98 |
| 14760.00 | H | - | - | -76.01 | 20.43 | 51.42 | -43.83 | -40.00 | -3.83 |

**Table 7-19. Radiated Spurious Data (Band 48 – High Channel)**

## ULCA LTE Band 48

| | |
|---|---|
| **PCC Bandwidth (MHz):** | 20 |
| **PCC Frequency (MHz):** | 3560 |
| **PCC RB (Size / Offset):** | 1/99 |
| **SCC Bandwidth (MHz):** | 20 |
| **SCC Frequency (MHz):** | 3579.8 |
| **SCC RB (Size / Offset):** | 1/0 |

| 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7120.0 | H | - | - | -72.47 | 10.69 | 45.22 | -50.04 | -40.00 | -10.04 |
| 10680.0 | H | - | - | -75.77 | 15.75 | 46.98 | -48.28 | -40.00 | -8.28 |
| 14240.0 | H | - | - | -76.19 | 20.22 | 51.03 | -44.23 | -40.00 | -4.23 |

**Table 7-20. Radiated Spurious Data (ULCA Band 48 – Low Channel)**

| | |
|---|---|
| **PCC Bandwidth (MHz):** | 20 |
| **PCC Frequency (MHz):** | 3625 |
| **PCC RB (Size / Offset):** | 1/99 |
| **SCC Bandwidth (MHz):** | 20 |
| **SCC Frequency (MHz):** | 3644.8 |
| **SCC RB (Size / Offset):** | 1/0 |

| 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7250.0 | H | - | - | -72.05 | 10.60 | 45.55 | -49.71 | -40.00 | -9.71 |
| 10875.0 | H | - | - | -75.11 | 15.53 | 47.42 | -47.84 | -40.00 | -7.84 |
| 14500.0 | H | - | - | -75.94 | 20.13 | 51.19 | -44.07 | -40.00 | -4.07 |

**Table 7-21. Radiated Spurious Data (ULCA Band 48 – Mid Channel)**

| | |
|---|---|
| **PCC Bandwidth (MHz):** | 20 |
| **PCC Frequency (MHz):** | 3690 |
| **PCC RB (Size / Offset):** | 1/0 |
| **SCC Bandwidth (MHz):** | 20 |
| **SCC Frequency (MHz):** | 3670.2 |
| **SCC RB (Size / Offset):** | 1/99 |

| 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7380.00 | H | - | - | -71.77 | 10.84 | 46.07 | -49.18 | -40.00 | -9.18 |
| 11070.00 | H | - | - | -75.20 | 15.80 | 47.60 | -47.65 | -40.00 | -7.65 |
| 14760.00 | H | - | - | -75.89 | 20.43 | 51.54 | -43.71 | -40.00 | -3.71 |

**Table 7-22. Radiated Spurious Data (ULCA Band 48 – High Channel)**

## 7.7.3 Antenna 4a Radiated Spurious Emissions Measurements

## LTE Band 48

| | |
|---|---|
| **Bandwidth (MHz):** | 20 |
| **Frequency (MHz):** | 3560 |
| **Modulation Signal:** | QPSK |
| **RB Config (Size / 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7120.0 | H | - | - | -72.12 | 10.69 | 45.57 | -49.69 | -40.00 | -9.69 |
| 10680.0 | H | - | - | -74.38 | 15.75 | 48.37 | -46.89 | -40.00 | -6.89 |
| 14240.0 | H | - | - | -75.41 | 20.22 | 51.81 | -43.45 | -40.00 | -3.45 |

**Table 7-23. Radiated Spurious Data (Band 48 – Low Channel)**

| | |
|---|---|
| **Bandwidth (MHz):** | 20 |
| **Frequency (MHz):** | 3625 |
| **Modulation Signal:** | QPSK |
| **RB Config (Size / 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7250.0 | H | - | - | -72.64 | 10.60 | 44.96 | -50.30 | -40.00 | -10.30 |
| 10875.0 | H | - | - | -75.21 | 15.53 | 47.32 | -47.94 | -40.00 | -7.94 |
| 14500.0 | H | - | - | -76.08 | 20.13 | 51.05 | -44.21 | -40.00 | -4.21 |

**Table 7-24. Radiated Spurious Data (Band 48 – Mid Channel)**

| | |
|---|---|
| **Bandwidth (MHz):** | 20 |
| **Frequency (MHz):** | 3690 |
| **Modulation Signal:** | QPSK |
| **RB Config (Size / 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7380.00 | H | - | - | -72.10 | 10.84 | 45.74 | -49.51 | -40.00 | -9.51 |
| 11070.00 | H | - | - | -74.77 | 15.80 | 48.03 | -47.22 | -40.00 | -7.22 |
| 14760.00 | H | - | - | -75.35 | 20.43 | 52.08 | -43.17 | -40.00 | -3.17 |

**Table 7-25. Radiated Spurious Data (Band 48 – High Channel)**

## ULCA LTE Band 48

| | |
|---|---|
| **PCC Bandwidth (MHz):** | 20 |
| **PCC Frequency (MHz):** | 3560 |
| **PCC RB (Size / Offset):** | 1/99 |
| **SCC Bandwidth (MHz):** | 20 |
| **SCC Frequency (MHz):** | 3579.8 |
| **SCC RB (Size / Offset):** | 1/0 |

| 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7120.0 | V | 122 | 216 | -71.32 | 10.69 | 46.37 | -48.89 | -40.00 | -8.89 |
| 10680.0 | V | - | - | -74.72 | 15.75 | 48.03 | -47.23 | -40.00 | -7.23 |
| 14240.0 | V | - | - | -76.01 | 20.22 | 51.21 | -44.05 | -40.00 | -4.05 |

**Table 7-26. Radiated Spurious Data (ULCA Band 48 – Low Channel)**

| | |
|---|---|
| **PCC Bandwidth (MHz):** | 20 |
| **PCC Frequency (MHz):** | 3625 |
| **PCC RB (Size / Offset):** | 1/99 |
| **SCC Bandwidth (MHz):** | 20 |
| **SCC Frequency (MHz):** | 3644.8 |
| **SCC RB (Size / Offset):** | 1/0 |

| 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7250.0 | V | - | - | -72.50 | 10.60 | 45.10 | -50.16 | -40.00 | -10.16 |
| 10875.0 | V | - | - | -74.79 | 15.53 | 47.74 | -47.52 | -40.00 | -7.52 |
| 14500.0 | V | - | - | -76.16 | 20.13 | 50.97 | -44.29 | -40.00 | -4.29 |

**Table 7-27. Radiated Spurious Data (ULCA Band 48 – Mid Channel)**

| | |
|---|---|
| **PCC Bandwidth (MHz):** | 20 |
| **PCC Frequency (MHz):** | 3690 |
| **PCC RB (Size / Offset):** | 1/0 |
| **SCC Bandwidth (MHz):** | 20 |
| **SCC Frequency (MHz):** | 3670.2 |
| **SCC RB (Size / Offset):** | 1/99 |

| 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7380.00 | V | - | - | -71.99 | 10.84 | 45.85 | -49.40 | -40.00 | -9.40 |
| 11070.00 | V | - | - | -75.12 | 15.80 | 47.68 | -47.57 | -40.00 | -7.57 |
| 14760.00 | V | - | - | -75.84 | 20.43 | 51.59 | -43.66 | -40.00 | -3.66 |

**Table 7-28. Radiated Spurious Data (ULCA Band 48 – High Channel)**

## 7.7.4 Antenna 2a Radiated Spurious Emissions Measurements

## LTE Band 48

| | |
|---|---|
| **Bandwidth (MHz):** | 20 |
| **Frequency (MHz):** | 3560 |
| **Modulation Signal:** | QPSK |
| **RB Config (Size / 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7120.0 | H | - | - | -72.02 | 10.69 | 45.67 | -49.59 | -40.00 | -9.59 |
| 10680.0 | H | - | - | -74.75 | 15.75 | 48.00 | -47.26 | -40.00 | -7.26 |
| 14240.0 | H | - | - | -75.22 | 20.22 | 52.00 | -43.26 | -40.00 | -3.26 |

**Table 7-29. Radiated Spurious Data (Band 48 – Low Channel)**

| | |
|---|---|
| **Bandwidth (MHz):** | 20 |
| **Frequency (MHz):** | 3625 |
| **Modulation Signal:** | QPSK |
| **RB Config (Size / 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7250.0 | H | - | - | -72.99 | 10.60 | 44.61 | -50.65 | -40.00 | -10.65 |
| 10875.0 | H | - | - | -74.45 | 15.53 | 48.08 | -47.18 | -40.00 | -7.18 |
| 14500.0 | H | - | - | -75.09 | 20.13 | 52.04 | -43.22 | -40.00 | -3.22 |

**Table 7-30. Radiated Spurious Data (Band 48 – Mid Channel)**

| | |
|---|---|
| **Bandwidth (MHz):** | 20 |
| **Frequency (MHz):** | 3690 |
| **Modulation Signal:** | QPSK |
| **RB Config (Size / 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7380.00 | H | - | - | -72.21 | 10.84 | 45.63 | -49.62 | -40.00 | -9.62 |
| 11070.00 | H | - | - | -74.74 | 15.80 | 48.06 | -47.19 | -40.00 | -7.19 |
| 14760.00 | H | - | - | -75.66 | 20.43 | 51.77 | -43.48 | -40.00 | -3.48 |

**Table 7-31. Radiated Spurious Data (Band 48 – High Channel)**

## ULCA LTE Band 48

| | |
|---|---|
| **PCC Bandwidth (MHz):** | 20 |
| **PCC Frequency (MHz):** | 3560 |
| **PCC RB (Size / Offset):** | 1/99 |
| **SCC Bandwidth (MHz):** | 20 |
| **SCC Frequency (MHz):** | 3579.8 |
| **SCC RB (Size / Offset):** | 1/0 |

| 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7120.0 | V | 273 | 213 | -71.22 | 10.69 | 46.47 | -48.79 | -40.00 | -8.79 |
| 10680.0 | V | - | - | -75.31 | 15.75 | 47.44 | -47.82 | -40.00 | -7.82 |
| 14240.0 | V | - | - | -76.15 | 20.22 | 51.07 | -44.19 | -40.00 | -4.19 |

**Table 7-32. Radiated Spurious Data (ULCA Band 48 – Low Channel)**

| | |
|---|---|
| **PCC Bandwidth (MHz):** | 20 |
| **PCC Frequency (MHz):** | 3625 |
| **PCC RB (Size / Offset):** | 1/99 |
| **SCC Bandwidth (MHz):** | 20 |
| **SCC Frequency (MHz):** | 3644.8 |
| **SCC RB (Size / Offset):** | 1/0 |

| 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7250.0 | V | - | - | -72.95 | 10.60 | 44.65 | -50.61 | -40.00 | -10.61 |
| 10875.0 | V | - | - | -74.46 | 15.53 | 48.07 | -47.19 | -40.00 | -7.19 |
| 14500.0 | V | - | - | -75.81 | 20.13 | 51.32 | -43.94 | -40.00 | -3.94 |

**Table 7-33. Radiated Spurious Data (ULCA Band 48 – Mid Channel)**

| | |
|---|---|
| **PCC Bandwidth (MHz):** | 20 |
| **PCC Frequency (MHz):** | 3690 |
| **PCC RB (Size / Offset):** | 1/0 |
| **SCC Bandwidth (MHz):** | 20 |
| **SCC Frequency (MHz):** | 3670.2 |
| **SCC RB (Size / Offset):** | 1/99 |

| 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] |
|---|---|---|---|---|---|---|---|---|---|
| 7380.00 | V | - | - | -71.89 | 10.84 | 45.95 | -49.30 | -40.00 | -9.30 |
| 11070.00 | V | - | - | -74.97 | 15.80 | 47.83 | -47.42 | -40.00 | -7.42 |
| 14760.00 | V | - | - | -75.33 | 20.43 | 52.10 | -43.15 | -40.00 | -3.15 |

**Table 7-34. Radiated Spurious Data (ULCA Band 48 – High Channel)**

## 7.8 Frequency Stability / Temperature Variation

**§2.1055**

### Test Overview and Limit

Frequency stability testing is performed in accordance with the guidelines of ANSI C63.26-2015, TIA-603-E-2016. The frequency stability of the transmitter is measured by:

a.) **Temperature:** The temperature is varied from -30°C to +50°C in 10°C increments using an environmental chamber.

b.) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

***For Part 96, the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.***

### Test Procedure Used

ANSI C63.26-2015

TIA-603-E-2016

### Test Settings

1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
2. The equipment is turned on in a "standby" condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

### Test Setup

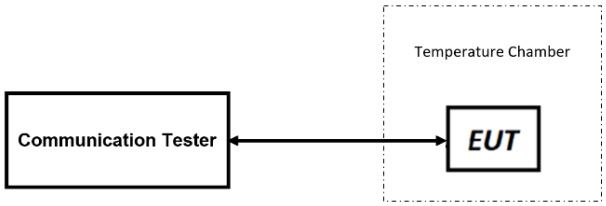



**Figure 7-7. Test Instrument & Measurement Setup**

### Test Notes

All ports were tested and only the worst case data were reported.

## LTE Band 48 Frequency Stability Measurements

**LTE Band 48**

| | |
|---|---|
| Low Ch. Frequency (Hz): | 3,560,000,000 |
| High Ch. Frequency (Hz): | 3,690,000,000 |
| Ref. Voltage (VDC): | 3.80 |

| Voltage (%) | Power (VDC) | Temp (°C) | Low Ch. Frequency (Hz) | High Ch. Frequency (Hz) | Low Ch. Frequency Dev. (Hz) | High Ch. Frequency Dev. (Hz) | Deviation (%) |
|---|---|---|---|---|---|---|---|
| 100 % | 3.80 | - 30 | 3,560,000,005 | 3,690,000,002 | 9 | -4 | -0.0000001 |
| | | - 20 | 3,560,000,009 | 3,690,000,004 | 13 | -2 | 0.0000004 |
| | | - 10 | 3,560,000,004 | 3,689,999,998 | 8 | -8 | -0.0000002 |
| | | 0 | 3,560,000,006 | 3,690,000,005 | 10 | -1 | 0.0000003 |
| | | + 10 | 3,560,000,007 | 3,690,000,002 | 11 | -4 | 0.0000003 |
| | | + 20 (Ref) | 3,559,999,996 | 3,690,000,006 | 0 | 0 | 0.0000000 |
| | | + 30 | 3,560,000,005 | 3,690,000,002 | 9 | -4 | 0.0000003 |
| | | + 40 | 3,560,000,001 | 3,689,999,999 | 5 | -7 | -0.0000002 |
| | | + 50 | 3,559,999,996 | 3,690,000,008 | 0 | 2 | 0.0000001 |
| Battery Endpoint | 3.23 | + 20 | 3,559,999,988 | 3,689,999,985 | -8 | -21 | -0.0000006 |

**Table 7-35. Frequency Stability Data (LTE Band 48)**

**Note:**

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.

## 7.9 End User Device Additional Requirement (CBSD Protocol)

**§96.47**

### Test Overview and Limit

End user device additional requirements (CBSD Protocol) are tested per the test procedures listed below. During testing, the EUT is connected to a certified CBSD (Ruckus FCC ID: S9GQ910US00) as a companion device to show compliance with Part 96.47.

***End User Devices may operate only if they can positively receive and decode an authorization signal transmitted by a CBSD, including the frequencies and power limits for their operation.***

***An End User Device must discontinue operations, change frequencies, or change its operational power level within 10 seconds of receiving instructions from its associated CBSD.***

### Test Procedure Used

KDB 940660 D01 v02, WINNF-TS-0122 V1.0.2.

### Test Setup/Method

The EUT was connected via an RF cable to a certified CBSD and spectrum analyzer. The following procedure is performed by applying WINNF-TS-0122 CBRS CBSD Test Specification.

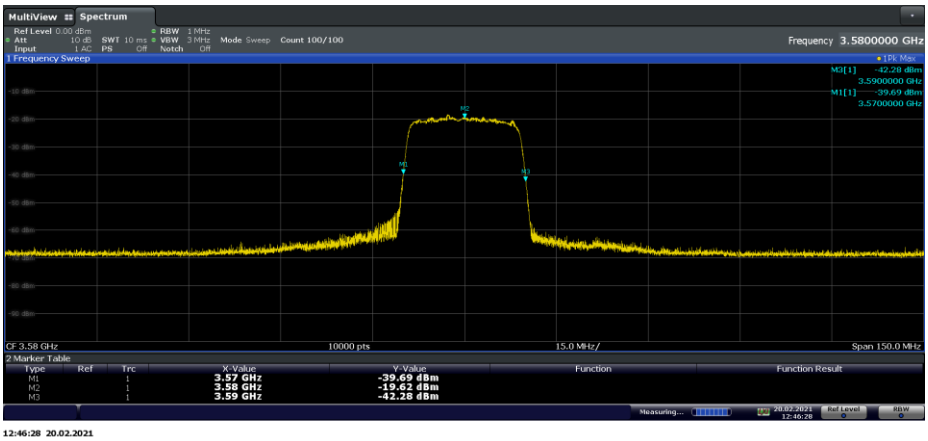
1. Run#1:
    a. Setup WINNF.PT.C.HBT.1 with 3570MHz – 3590MHz.
    b. Enable AP service from Ruckus Cloud management.
    c. Check EUT Tx frequency.
    d. Disable AP service from Ruckus Cloud management and check EUT stop transmission within 10s.
2. Run#2:
    a. Setup WINNF.PT.C.HBT.1 with 3550MHz – 3560MHz.
    b. Enable AP service from Ruckus Cloud management.
    c. Check EUT Tx frequency.
    d. Disable AP service from Ruckus Cloud management and check EUT stop transmission within 10s.

### Test Notes

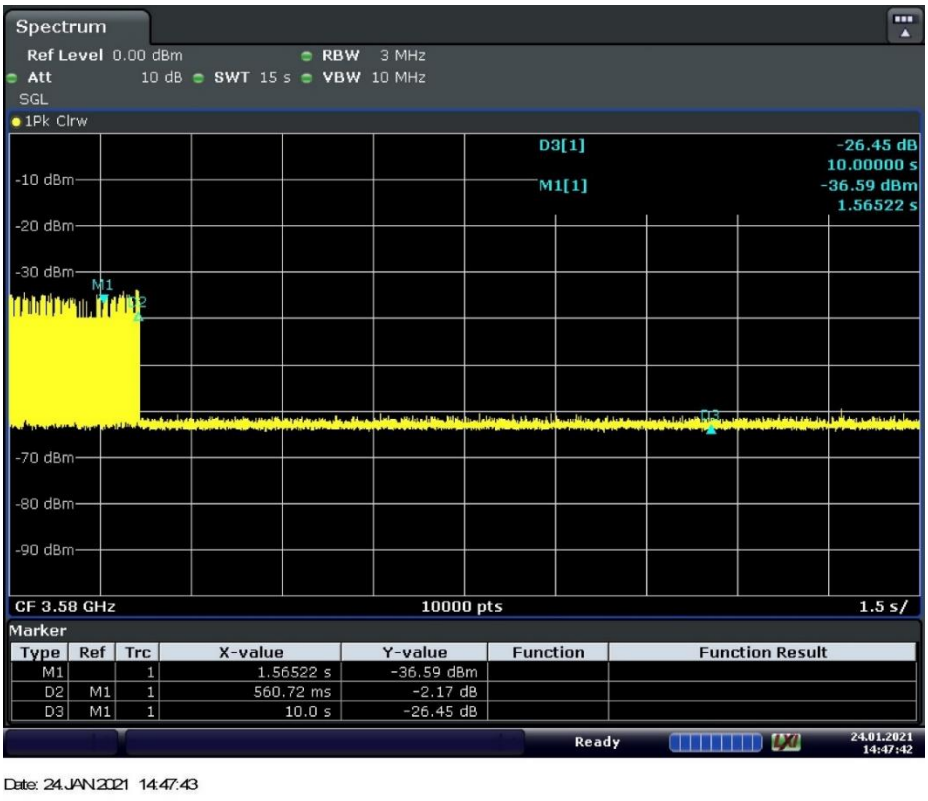
The EUT is an End User Device.

## Run#1:

- Tx Frequency Set: 3570 – 3590MHz
- MaxEIRP Set: 23dBm/MHz




**Plot 7-78. Run#1 End User Device Frequency of Operations**



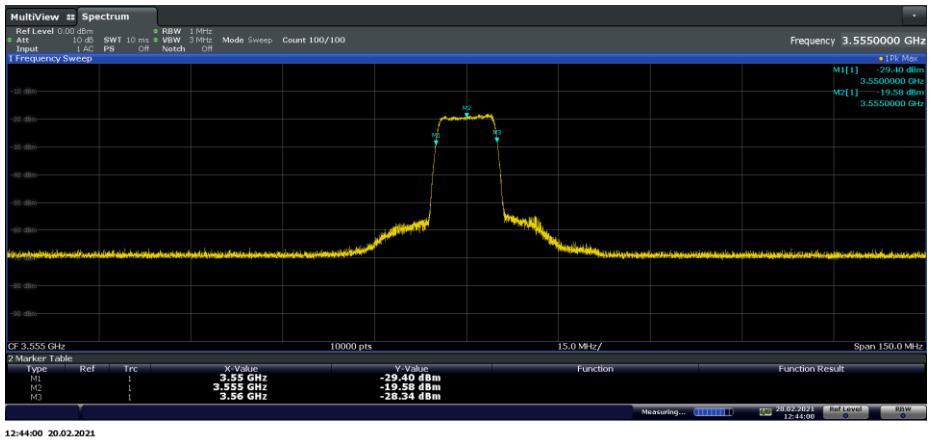

**Plot 7-79. Run#1 End User Device Discontinues Operations within 10s**

## Note:

Marker 1: CBSD sends instructions to discontinue LTE operations.
Marker 2: EUT discontinues operation.
Marker 3: 10 seconds elapsed time from CBSD sending instructions to EUT.

## Run#2:

- Tx Frequency Set: 3550 – 3560MHz
- MaxEIRP Set: 23dBm/MHz




**Plot 7-80. Run#2 End User Device Frequency of Operations**


**Plot 7-81. Run#2 End User Device Discontinues Operations within 10s**

## Note:

Marker 1: CBSD sends instructions to discontinue LTE operations.
Marker 2: EUT discontinues operation.
Marker 3: 10 seconds elapsed time from CBSD sending instructions to EUT.

# 8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Apple Tablet Device FCC ID: BCGA2379** complies with all of the End User Device requirements of Part 96 of the FCC Rules for LTE operation only.