HCT CO.,LTD.
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
TEL: +82-31-645-6300 FAX: +82-31-645-6401

# FCC REPORT

## FCC Certification

**Applicant Name:**
SAMSUNG Electronics Co.,Ltd.

**Address:**
129, Samsung-ro, Yeongtong-gu, Suwon-si,
Gyeonggi-do, 16677, Rep. of Korea

**Date of Issue:**
November 16, 2017
**Test Site/Location:**
HCT CO., LTD.,
74, Seoicheon-ro 578beon-gil, Majang-myeon,
Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
**Report No.:** HCT-R-1711-F008

| | |
|---|---|
| **FCC ID:** | **A3LSLS-BU10G** |
| **APPLICANT:** | **SAMSUNG Electronics Co., Ltd.** |

**FCC Model(s):** SLS-BU10G

**EUT Type:** 4G LTE Network Extender 2 for Enterprise

**Frequency of Operation:** DL 746 – 756 MHz (Band 13)
DL 2110 – 2180 MHz (Band 66)

**Emission Designator:**

| Mode (MHz) | Frequency (MHz) | Emission Designator | |
|---|---|---|---|
| | | QPSK (G7D) | 16QAM/64QAM (W7D) |
| LTE Band 13 (10) | 751.0 | 8M94G7D | 8M96W7D |
| LTE Band 66 (5) | 2112.5 ~ 2177.5 | 4M44G7D | 4M45W7D |
| LTE Band 66 (10) | 2115.0 ~ 2175.0 | 8M96G7D | 8M97W7D |
| LTE Band 66 (15) | 2117.5 ~ 2172.5 | 13M4G7D | 13M3W7D |
| LTE Band 66 (20) | 2120.0 ~ 2170.0 | 17M9G7D | 17M9W7D |

**TX Output Power :** 500 mW (250 mW * 2 ports)

**FCC Rule Part(s):** FCC CFR 47 Part 2, 27.

**Data of Test:** October 18, 2017 ~ November 16, 2017

Engineering Statement:

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of FCC Part 27 of the FCC Rules under normal use and maintenance.

**Report prepared by : Se Wook Park**
**Engineer of Telecommunication testing center**

**Approved by : Jong Seok Lee**
**Manager of Telecommunication testing center**

# Report Revision

| TEST REPORT NO. | DATE | DESCRIPTION |
|---|---|---|
| HCT-R-1711-F008 | November 16, 2017 | - First Approval Report |
| | | |
| | | |
| | | |

# Result of Test

## CONTENTS

# 1. GENERAL INFORMATION

## 1.1. CLIENT INFORMATION

| | |
|---|---|
| Company | **Samsung Electronics Co., Ltd.** |
| Contact Point | 129, Samsung-ro, Yeongtong-gu, Suwon-si,<br>Gyeonggi-do, 16677, Rep. of Korea |

## 1.2. PRODUCT INFORMATION

| | |
|---|---|
| MODEL | SLS-BU10G |
| EUT TYPE | 4G LTE Network Extender 2 for Enterprise |
| POWER SUPPLY | AC [90 ~ 264] VAC<br>PoE : 48 VDC |
| EMISSION DESIGNATOR | |
| OPERATING FREQUENCY | LTE Band 13: 746 ~ 756 MHz<br>LTE Band 66: 2110 ~ 2180 MHz |
| TX OUTPUT POWER | 500 mW (250 mW * 2 ports) |
| CHANNEL BANDWIDTH | Band 13 : 10 MHz<br>Band 66 : 5 MHz, 10 MHz, 15 MHz, 20 MHz |
| MEASUREMENT STANDARDS | ANSI/TIA-603-D-2010, KDB 971168 D01 v02r02, |
| MODULATION TYPE | QPSK, 16QAM, 64QAM |
| ANTENNA SPECIFICATION | Manufacturer: ETHERTRONICS INC.<br>Antenna type: Internal Antenna<br>Peak Gain: |

| Mode (MHz) | Frequency (MHz) | Emission Designator | |
|---|---|---|---|
| | | QPSK (G7D) | 16QAM/64QAM (W7D) |
| LTE Band 13 (10) | 751.0 | 8M95G7D | 8M96W7D |
| LTE Band 66 (5) | 2112.5 ~ 2177.5 | 4M44G7D | 4M45W7D |
| LTE Band 66 (10) | 2115.0 ~ 2175.0 | 8M96G7D | 8M97W7D |
| LTE Band 66 (15) | 2117.5 ~ 2172.5 | 13M3G7D | 13M4W7D |
| LTE Band 66 (20) | 2120.0 ~ 2170.0 | 17M9G7D | 17M9W7D |

| Frequency [MHz] | Gain [dBi] | |
|---|---|---|
| | Port 4 | Port 5 |
| 746 ~ 756 | 2.0 | 2.0 |
| 2110 ~ 2180 | 4.0 | 4.0 |

# 2. FACILITIES AND ACCREDITATIONS

## 2.1. FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22. Detailed description of test facility was submitted to the Commission and accepted dated July 07, 2015 (Registration Number: 90661).

## 2.2. EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.
Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.
All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

# 3. TEST SPECIFICATIONS

## 3.1. STANDARDS

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 2, Part 27

| SECTION | TEST ITEMS | RESULTS |
|---|---|---|
| §2.1046, §27.50(b), (d) | Conducted Output Power | Compliant |
| §2.1049 | Occupied Bandwidth | Compliant |
| §2.1051, §27.53(c), (f), (h) | Spurious Emissions at Antenna Terminals | Compliant |
| §2.1051, §27.53(c), (h) | Band edge | Compliant |
| §2.1053, §27.53(c), (h) | Spurious Radiated Emissions. | Compliant |
| §2.1055, §27.54 | Frequency Stability | Compliant |

## 3.2. MODE OF OPERATION DURING THE TEST

The EUT is operated in a manner representative of the typical usage of the equipment.

During all testing, system components were manipulated within the confines of typical usage to maximize each emission. All Modulation (QPSK, 16QAM and 64QAM) modes were tested.

The EUT is supported power supply both of the AC/DC Adapter and PoE. Test results are only attached worst cases.

## 3.3. MAXIMUM MEASUREMENTUNCERTAINTY

The value of the measurement uncertainty for the measurement of each parameter.

Coverage factor *k* = 2, Confidence levels of 95 %

| Description | Condition | Uncertainty |
|---|---|---|
| Conducted RF Output Power | - | ± 0.72 dB |
| Occupied Bandwidth | OBW ≤ 20 MHz | ± 52 kHz |
| Spurious Emissions at Antenna Terminals | - | ± 1.08 dB |
| Radiated Spurious Emissions | f ≤ 1 GHz<br>f > 1 GHz | ± 4.80 dB<br>± 6.07 dB |
| Frequency Stability | - | ± 1.22 x $10^{-6}$ |

## 3.4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

| | |
|---|---|
| **Temperature :** | **+ 15 ℃ to + 35 ℃** |
| **Relative humidity:** | **30 % to 60 %** |
| **Air pressure** | **860 mbar to 1 060 mbar** |

# 4. TEST EQUIPMENT

| Manufacturer | Model / Equipment | Calibration Date | Calibration Interval | Serial No. |
|---|---|---|---|---|
| Agilent | N9030A / Signal Analyzer | 11/30/2016 | Annual | MY49431210 |
| Weinschel | 67-30-33 / Fixed Attenuator | 02/09/2017 | Annual | CC7264 |
| Rohde&Schwarz | ATT / 10dB Attenuator | 08/10/2017 | Annual | N/A |
| NANGYEUL CO., LTD. | NY-THR18750 / Temperature and Humidity Chamber | 10/21/2017 | Annual | NY-2009012201A |
| Innco system | MA4000-EP / Antenna Position Tower | N/A | N/A | N/A |
| Innco system | CT0800 / Turn Table | N/A | N/A | N/A |
| Innco system | CO3000 / Controller(Antenna mast) | N/A | N/A | CO3000-4p |
| ETS | 2090 / Controller(Turn table) | N/A | N/A | 1646 |
| Rohde&Schwarz | Loop Antenna | 04/19/2017 | Biennial | 1513-175 |
| Schwarzbeck | VULB 9168 / Hybrid Antenna | 04/06/2017 | Biennial | 760 |
| Schwarzbeck | BBHA 9120D / Horn Antenna | 08/25/2016 | Biennial | 1300 |
| Schwarzbeck | BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz) | 04/25/2017 | Biennial | BBHA9170124 |
| Rohde & Schwarz | FSP / Spectrum Analyzer | 09/06/2017 | Annual | 100688 |
| Rohde & Schwarz | FSV40-N / Spectrum Analyzer | 09/27/2017 | Annual | 101068-SZ |
| Wainwright Instruments | WHKX10-900-1G-15G / Highpass Filter | 07/21/2017 | Annual | 5 |
| Wainwright Instruments | WHK3.0/18G-10EF / Highpass Filter | 06/12/2017 | Annual | 8 |
| CERNEX | CBLU1183540 / Power Amplifier | 01/25/2017 | Annual | 24614 |
| CERNEX | CBL06185030 / Power Amplifier | 01/25/2017 | Annual | 24615 |
| CERNEX | CBL18265035 / Power Amplifier | 01/23/2017 | Annual | 22966 |
| CERNEX | CBL26405040 / Power Amplifier | 06/30/2017 | Annual | 25956 |

# 5. CONDUCTED OUTPUT POWER

**Test Requirements:**

**§ 2.1046 Measurements required: RF power output:**

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8).The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

(b) For single sideband, independent sideband, and single channel, controlled carrier radio telephone transmitters, the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as specified and as applicable in § 2.1046 (b) (1-5). In all tests, the input level of the modulating signal shall be such as to develop rated peak envelope power or carrier power, as appropriate, for the transmitter.

(c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

**§27.50 Power limits and duty cycle.**

(b) The following power and antenna height limits apply to transmitters operating in the 746-758 MHz, 775-788 MHz and 805-806 MHz bands:

(1) Fixed and base stations transmitting a signal in the 757-758 and 775-776 MHz bands must not exceed an effective radiated power (ERP) of 1000 watts and an antenna height of 305 m height above average terrain (HAAT), except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts ERP in accordance with Table 1 of this section.

(2) Fixed and base stations transmitting a signal in the 746-757 MHz and 776-787 MHz bands with an emission bandwidth of 1 MHz or less must not exceed an ERP of 1000 watts and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts ERP in accordance with Table 1 of this section.

(3) Fixed and base stations located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal in the 746-757 MHz and 776-787 MHz bands with an emission bandwidth of 1 MHz or less must not exceed an ERP of 2000 watts and an antenna

height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 2000 watts ERP in accordance with Table 2 of this section.

(4) Fixed and base stations transmitting a signal in the 746-757 MHz and 776-787 MHz bands with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP in accordance with Table 3 of this section.

(5) Fixed and base stations located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal in the 746-757 MHz and 776-787 MHz bands with an emission bandwidth greater than 1 MHz must not exceed an ERP of 2000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 2000 watts/MHz ERP in accordance with Table 4 of this section.

(6) Licensees of fixed or base stations transmitting a signal in the 746-757 MHz and 776-787 MHz bands at an ERP greater than 1000 watts must comply with the provisions set forth in paragraph (b)(8) of this section and §27.55(c).

(7) Licensees seeking to operate a fixed or base station located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal in the 746-757 MHz and 776-787 MHz bands at an ERP greater than 1000 watts must:

(i) Coordinate in advance with all licensees authorized to operate in the 698-758 MHz, 775-788, and 805-806 MHz bands within 120 kilometers (75 miles) of the base or fixed station;

(ii) coordinate in advance with all regional planning committees, as identified in §90.527 of this chapter, with jurisdiction within 120 kilometers (75 miles) of the base or fixed station.

(8) Licensees authorized to transmit in the 746-757 MHz and 776-787 MHz bands and intending to operate a base or fixed station at a power level permitted under the provisions of paragraph (b)(6) of this section must provide advanced notice of such operation to the Commission and to licensees authorized in their area of operation. Licensees who must be notified are all licensees authorized to operate in the 758-775 MHz and 788-805 MHz bands under part 90 of this chapter within 75 km of the base or fixed station and all regional planning committees, as identified in §90.527 of this chapter, with jurisdiction within 75 km of the base or fixed station. Notifications must provide the location and operating parameters of the base or fixed station, including the station's ERP, antenna coordinates, antenna height above ground, and vertical antenna pattern, and such notifications must be provided at least 90 days prior to the commencement of station operation.

(9) Control stations and mobile stations transmitting in the 746-757 MHz, 776-788 MHz, and 805-806 MHz bands and fixed stations transmitting in the 787-788 MHz and 805-806 MHz bands

are limited to 30 watts ERP.

(10) Portable stations (hand-held devices) transmitting in the 746-757 MHz, 776-788 MHz, and 805-806 MHz bands are limited to 3 watts ERP.

(11) For transmissions in the 757-758, 775-776, 787-788, and 805-806 MHz bands, maximum composite transmit power shall be measured over any interval of continuous transmission using instrumentation calibrated in terms of RMS-equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, etc., so as to obtain a true maximum composite measurement for the emission in question over the full bandwidth of the channel.

(12) For transmissions in the 746-757 and 776-787 MHz bands, licensees may employ equipment operating in compliance with either the measurement techniques described in paragraph (b)(11) of this section or a Commission-approved average power technique. In both instances, equipment employed must be authorized in accordance with the provisions of §27.51.

(d) The following power and antenna height requirements apply to stations transmitting in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz and 2180-2200 MHz bands:

(1) The power of each fixed or base station transmitting in the 1995-2000 MHz, 2110-2155 MHz, 2155-2180 MHz or 2180-2200 MHz band and located in any county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, is limited to:

(i) An equivalent isotropically radiated power (EIRP) of 3280 watts when transmitting with an emission bandwidth of 1 MHz or less;

(ii) An EIRP of 3280 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.

(2) The power of each fixed or base station transmitting in the 1995-2000 MHz, the 2110-2155 MHz 2155-2180 MHz band, or 2180-2200 MHz band and situated in any geographic location other than that described in paragraph (d)(1) of this section is limited to:

(i) An equivalent isotropically radiated power (EIRP) of 1640 watts when transmitting with an emission bandwidth of 1 MHz or less;

(ii) An EIRP of 1640 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.

(3) A licensee operating a base or fixed station in the 2110-2155 MHz band utilizing a power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must coordinate such operations in advance with all Government and non-Government satellite entities in the 2025-2110 MHz band. A licensee operating a base or fixed station in the 2110-2180 MHz band utilizing power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must be coordinated in advance with the following licensees authorized to operate within 120 kilometers

(75 miles) of the base or fixed station operating in this band: All Broadband Radio Service (BRS) licensees authorized under this part in the 2155-2160 MHz band and all advanced wireless services (AWS) licensees authorized to operate on adjacent frequency blocks in the 2110-2180 MHz band.

(4) Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz bands are limited to 1 watt EIRP. Fixed stations operating in the 1710-1755 MHz band are limited to a maximum antenna height of 10 meters above ground. Mobile and portable stations operating in these bands must employ a means for limiting power to the minimum necessary for successful communications.

(5) Equipment employed must be authorized in accordance with the provisions of §24.51. Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (d)(6) of this section. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

(6) Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

(7) Fixed, mobile, and portable (hand-held) stations operating in the 2000-2020 MHz band are limited to 2 watts EIRP, except that the total power of any portion of an emission that falls within the 2000-2005 MHz band may not exceed 5 milliwatts. A licensee of AWS-4 authority may enter into private operator-to-operator agreements with all 1995-2000 MHz licensees to operate in 2000-2005 MHz at power levels above 5 milliwatts EIRP; except the total power of the AWS-4 mobile emissions may not exceed 2 watts EIRP.

(8) A licensee operating a base or fixed station in the 2180-2200 MHz band utilizing a power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must be coordinated in advance with all AWS licensees authorized to operate on adjacent frequency blocks in the 2180-2200 MHz band.

(9) Fixed, mobile and portable (hand-held) stations operating in the 1915-1920 MHz band are limited to 300 milliwatts EIRP.

(10) A licensee operating a base or fixed station in the 1995-2000 MHz band utilizing a power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must be coordinated in advance with all PCS G Block licensees authorized to operate on adjacent frequency blocks in the 1990-1995 MHz band within 120 kilometers of the base or fixed station operating in this band.

**Test Procedures:**

According to FCC §2.1046 (a), for transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

1) The radio frequency load attached to the EUT antenna terminal was 50 Ohm. The lost of the cables the test system is calibrated to correct the reading.
2) The spectrum analyzer was set to RMS Detector function and Average mode.
3) The resolution bandwidth of the spectrum analyzer was comparable to the emission bandwidth.
4) The conducted emission level is meaured at each antenna port and then summed mathmatically to determine the total emission level from the device. (500m W = 250mW x 2 Ports)

Note:

The maximum ERP/EIRP for each band are sufficient level to pass the limit.

ERP of Band 13 : Port 4, 5 = 24.20 dBm + 2.0 dBi - 2.15 dB = 24.05 dBm

EIRP of Band 66 : Port 4, 5 = 23.36 dBm + 4.0 dBi = 27.36 dBm

## Test Results:

**700 MHz_LTE 10 MHz**

**Test Data at Output Port 4**

| Frequency (MHz) | Output Power | | | | | |
|---|---|---|---|---|---|---|
| | QPSK | | 16QAM | | 64QAM | |
| | dBm | W | dBm | W | dBm | W |
| 751.00 | 23.73 | 0.236 | 23.77 | 0.238 | 23.79 | 0.239 |

**Test Data at Output Port 5**

| Frequency (MHz) | Output Power | | | | | |
|---|---|---|---|---|---|---|
| | QPSK | | 16QAM | | 64QAM | |
| | dBm | W | dBm | W | dBm | W |
| 751.00 | 24.20 | 0.263 | 23.94 | 0.248 | 23.66 | 0.232 |

**Sum Data of Port 4 and Port 5**

| Frequency (MHz) | Output Power | | |
|---|---|---|---|
| | QPSK | 16QAM | 64QAM |
| | W | W | W |
| 751.00 | 0.499 | 0.486 | 0.471 |

**700 MHz_LTE 10 MHz**

**Plot Data for Output Port 4 (Conducted Output Power)**

(QPSK Middle Channel)


(16QAM Middle Channel)

(64QAM Middle Channel)

**700 MHz_LTE 10 MHz**

**Plot Data for Output Port 5 (Conducted Output Power)**

(QPSK Middle Channel)


(16QAM Middle Channel)

(64QAM Middle Channel)

**AWS 2100_LTE 5 MHz**

**Test Data at Output Port 4**

| Frequency (MHz) | Output Power | | | | | |
|---|---|---|---|---|---|---|
| | QPSK | | 16QAM | | 64QAM | |
| | dBm | W | dBm | W | dBm | W |
| 2112.50 | 22.60 | 0.182 | 22.60 | 0.182 | 22.65 | 0.184 |
| 2145.00 | 22.81 | 0.191 | 22.84 | 0.192 | 22.87 | 0.194 |
| 2177.50 | 22.77 | 0.189 | 22.69 | 0.186 | 22.67 | 0.185 |

**Test Data at Output Port 5**

| Frequency (MHz) | Output Power | | | | | |
|---|---|---|---|---|---|---|
| | QPSK | | 16QAM | | 64QAM | |
| | dBm | W | dBm | W | dBm | W |
| 2112.50 | 22.70 | 0.186 | 22.47 | 0.177 | 22.64 | 0.184 |
| 2145.00 | 22.63 | 0.183 | 22.64 | 0.184 | 22.67 | 0.185 |
| 2177.50 | 22.59 | 0.182 | 22.62 | 0.183 | 22.50 | 0.178 |

**Sum Data of Port 4 and Port 5**

| Frequency (MHz) | Output Power | | |
|---|---|---|---|
| | QPSK | 16QAM | 64QAM |
| | W | W | W |
| 2112.50 | 0.368 | 0.359 | 0.368 |
| 2145.00 | 0.374 | 0.376 | 0.379 |
| 2177.50 | 0.371 | 0.369 | 0.363 |

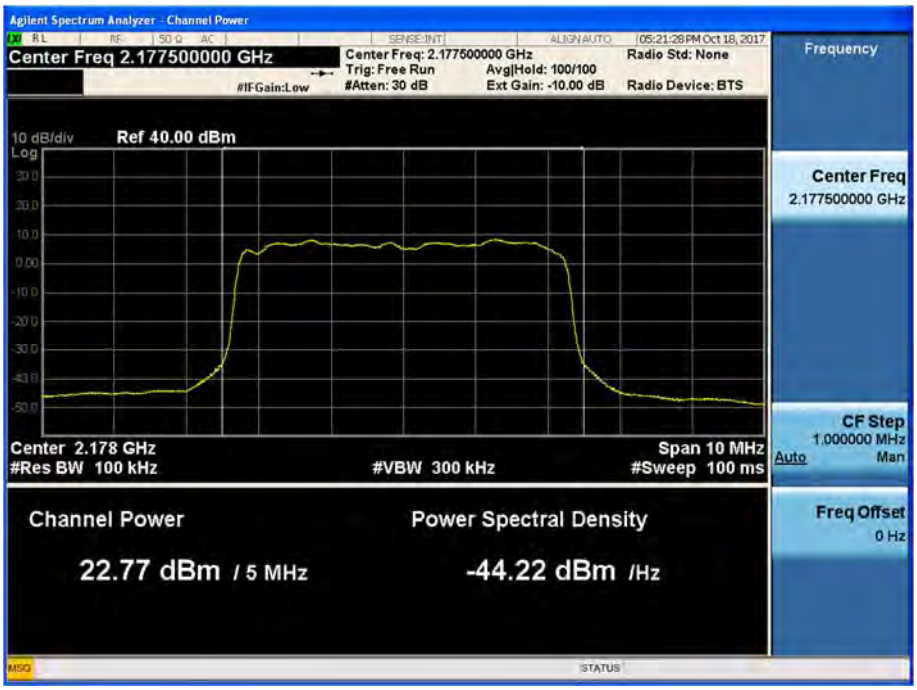
**AWS 2100_LTE 5 MHz**

**Plot Data for Output Port 4 (Conducted Output Power)**

(QPSK Low Channel)


(QPSK Middle Channel)

(QPSK High Channel)




(16QAM Low Channel)

(16QAM Middle Channel)


(16QAM High Channel)

(64QAM Low Channel)

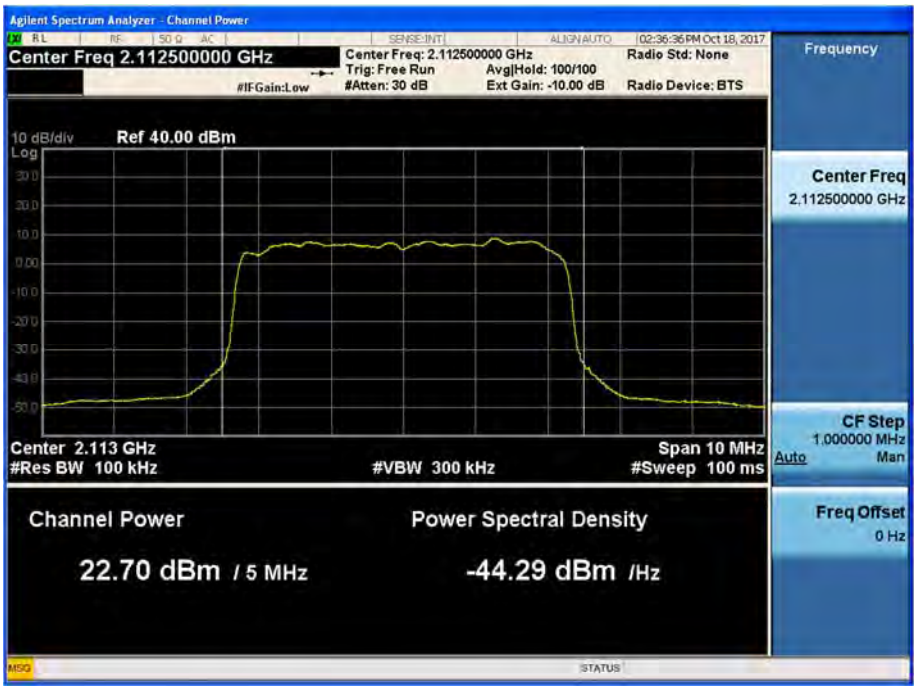

(64QAM Middle Channel)

(64QAM High Channel)

**AWS 2100_LTE 5 MHz**

**Plot Data for Output Port 5 (Conducted Output Power)**

(QPSK Low Channel)




(QPSK Middle Channel)

(QPSK High Channel)


(16QAM Low Channel)

(16QAM Middle Channel)


(16QAM High Channel)

(QPSK Low Channel)


(QPSK Middle Channel)

(QPSK High Channel)

**AWS 2100_LTE 10 MHz**

**Test Data at Output Port 4**

| Frequency (MHz) | Output Power | | | | | |
|---|---|---|---|---|---|---|
| | QPSK | | 16QAM | | 64QAM | |
| | dBm | W | dBm | W | dBm | W |
| 2115.00 | 22.81 | 0.191 | 22.86 | 0.193 | 22.91 | 0.195 |
| 2145.00 | 23.36 | 0.217 | 23.33 | 0.215 | 23.03 | 0.201 |
| 2175.00 | 23.14 | 0.206 | 23.17 | 0.207 | 23.23 | 0.210 |

**Test Data at Output Port 5**

| Frequency (MHz) | Output Power | | | | | |
|---|---|---|---|---|---|---|
| | QPSK | | 16QAM | | 64QAM | |
| | dBm | W | dBm | W | dBm | W |
| 2115.00 | 23.28 | 0.213 | 23.13 | 0.206 | 23.25 | 0.211 |
| 2145.00 | 23.18 | 0.208 | 23.05 | 0.202 | 23.05 | 0.202 |
| 2175.00 | 23.04 | 0.201 | 23.03 | 0.201 | 23.07 | 0.203 |

**Sum Data of Port 4 and Port 5**

| Frequency (MHz) | Output Power | | |
|---|---|---|---|
| | QPSK | 16QAM | 64QAM |
| | W | W | W |
| 2115.00 | 0.404 | 0.399 | 0.406 |
| 2145.00 | 0.425 | 0.417 | 0.403 |
| 2175.00 | 0.407 | 0.408 | 0.413 |

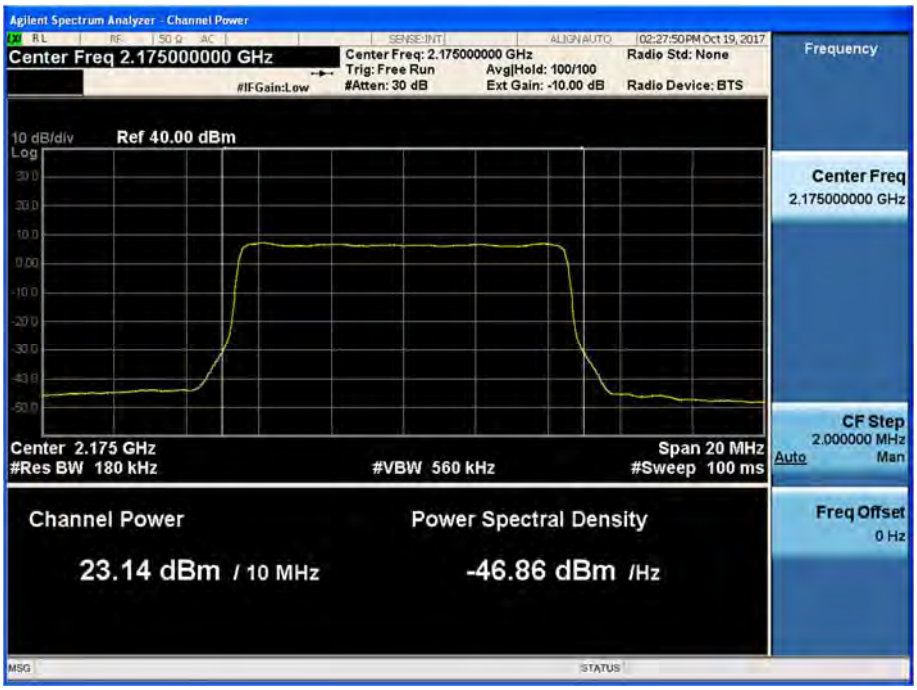
**AWS 2100_LTE 10 MHz**

**Plot Data for Output Port 4 (Conducted Output Power)**

(QPSK Low Channel)

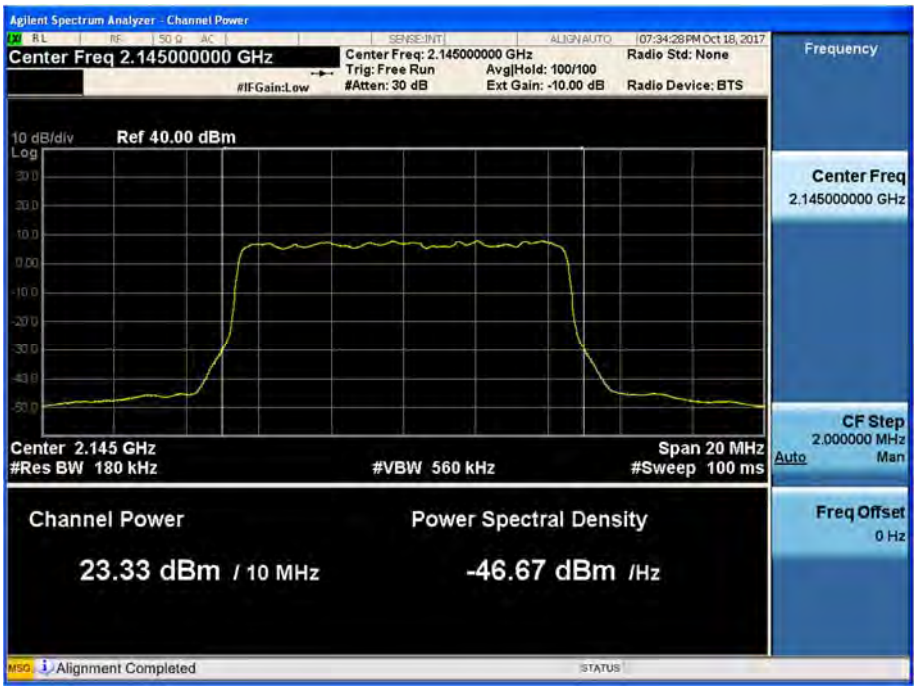

(QPSK Middle Channel)

(QPSK High Channel)




(16QAM Low Channel)

(16QAM Middle Channel)




(16QAM High Channel)

(64QAM Low Channel)


(64QAM Middle Channel)

(64QAM High Channel)

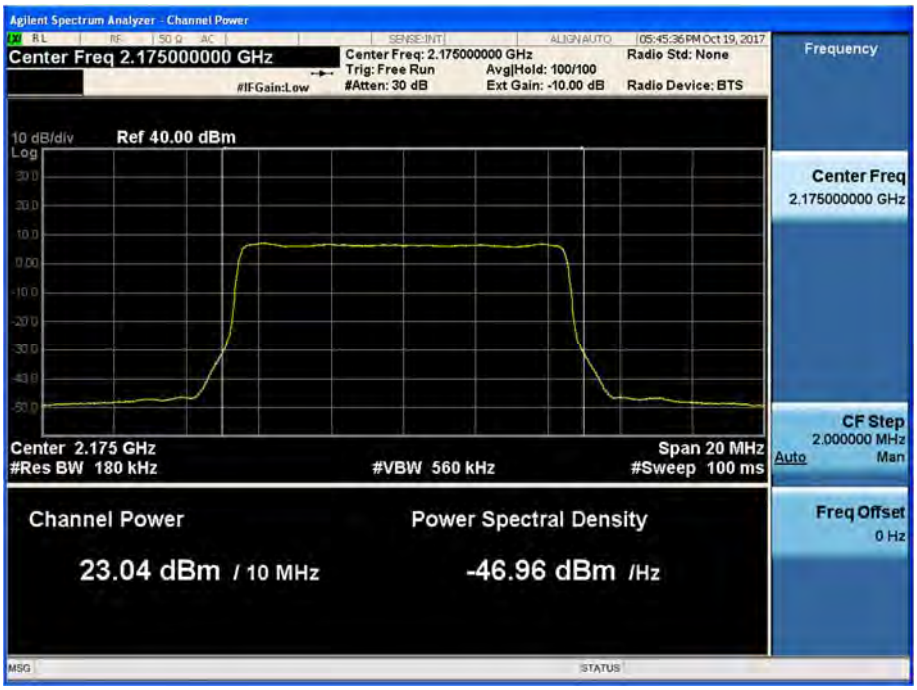
**AWS 2100_LTE 10 MHz**

**Plot Data for Output Port 5 (Conducted Output Power)**

(QPSK Low Channel)


(QPSK Middle Channel)

(QPSK High Channel)




(16QAM Low Channel)

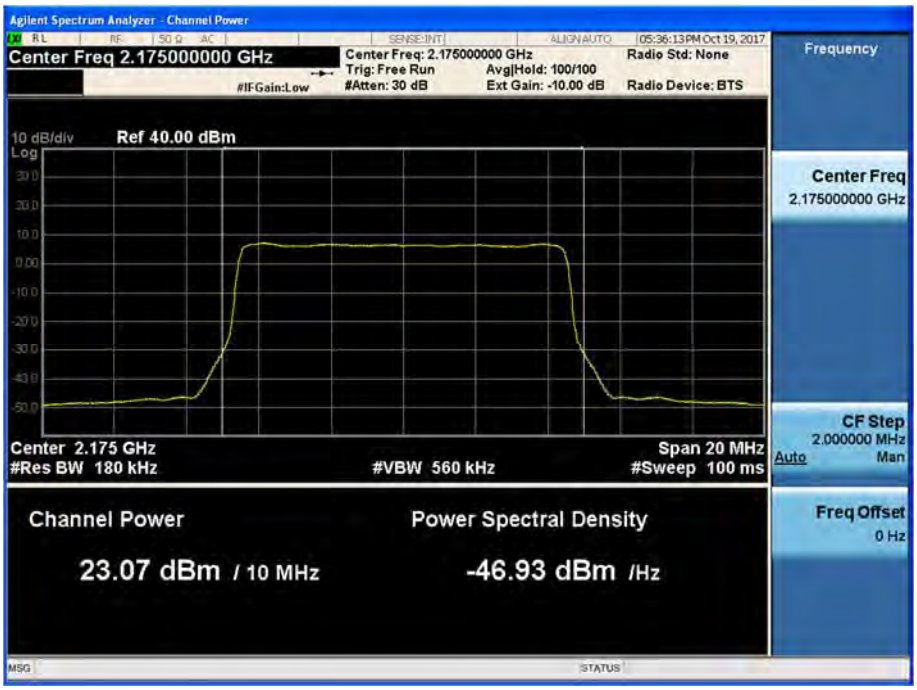
(16QAM Middle Channel)


(16QAM High Channel)

(64QAM Low Channel)


(64QAM Middle Channel)

(64QAM High Channel)



**AWS 2100_LTE 15 MHz**

**Test Data at Output Port 4**

| Frequency (MHz) | Output Power | | | | | |
|---|---|---|---|---|---|---|
| | QPSK | | 16QAM | | 64QAM | |
| | dBm | W | dBm | W | dBm | W |
| 2117.50 | 22.56 | 0.174 | 22.56 | 0.172 | 22.57 | 0.177 |
| 2145.00 | 22.60 | 0.181 | 22.61 | 0.184 | 22.66 | 0.177 |
| 2172.50 | 22.32 | 0.174 | 22.36 | 0.175 | 22.47 | 0.177 |

**Test Data at Output Port 5**

| Frequency (MHz) | Output Power | | | | | |
|---|---|---|---|---|---|---|
| | QPSK | | 16QAM | | 64QAM | |
| | dBm | W | dBm | W | dBm | W |
| 2117.50 | 22.40 | 0.174 | 22.35 | 0.172 | 22.49 | 0.177 |
| 2145.00 | 22.58 | 0.181 | 22.64 | 0.184 | 22.47 | 0.177 |
| 2172.50 | 22.39 | 0.173 | 22.43 | 0.175 | 22.48 | 0.177 |

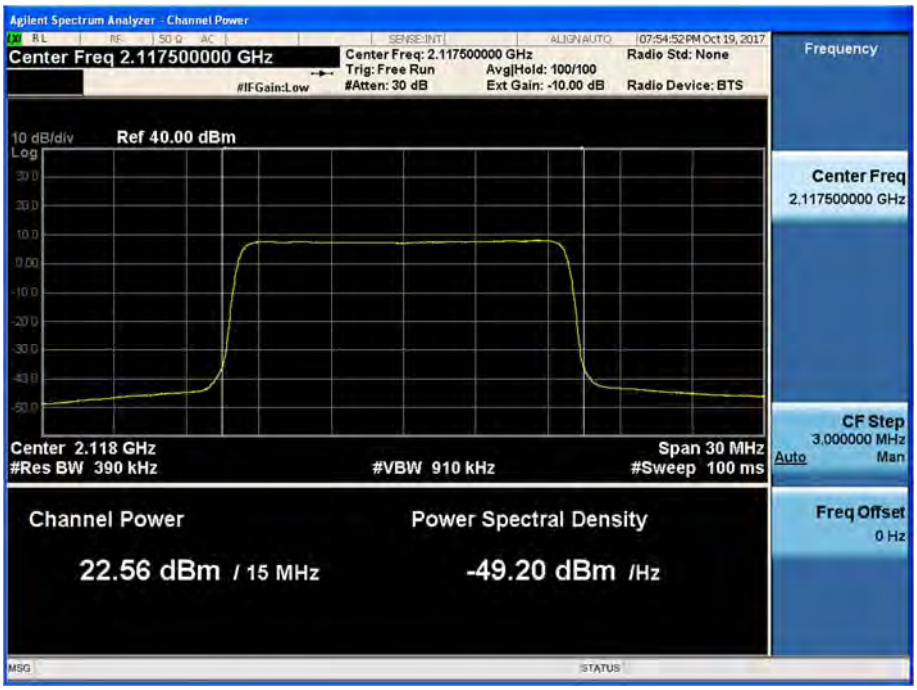
**Sum Data of Port 4 and Port 5**

| Frequency (MHz) | Output Power | | |
|---|---|---|---|
| | QPSK | 16QAM | 64QAM |
| | W | W | W |
| 2117.50 | 0.348 | 0.344 | 0.354 |
| 2145.00 | 0.362 | 0.368 | 0.354 |
| 2172.50 | 0.347 | 0.35 | 0.354 |

**AWS 2100_LTE 15 MHz**

**Plot Data for Output Port 4 (Conducted Output Power)**

(QPSK Low Channel)




(QPSK Middle Channel)

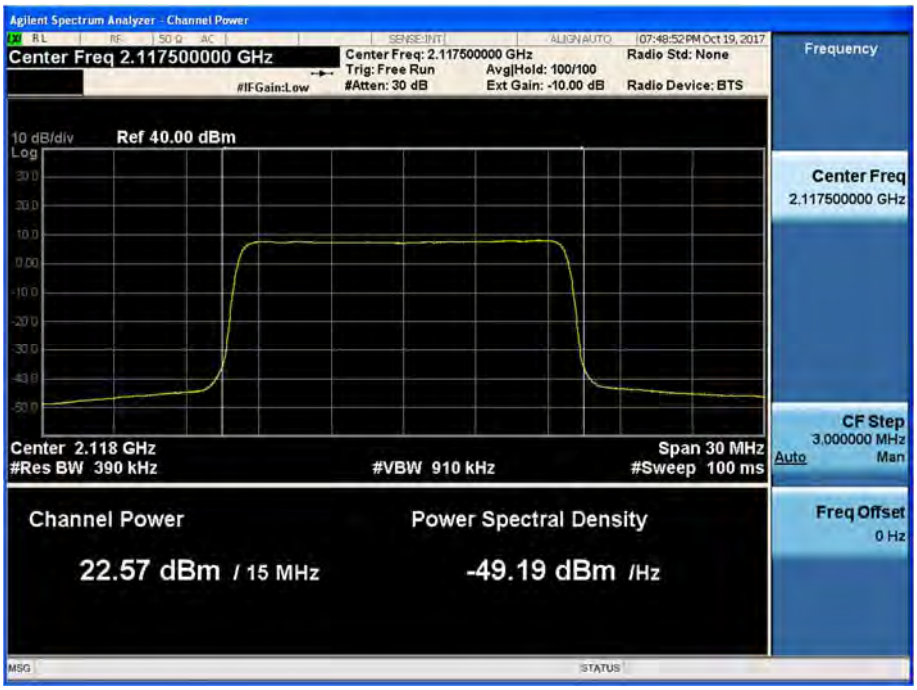
(QPSK High Channel)


(16QAM Low Channel)

(16QAM Middle Channel)

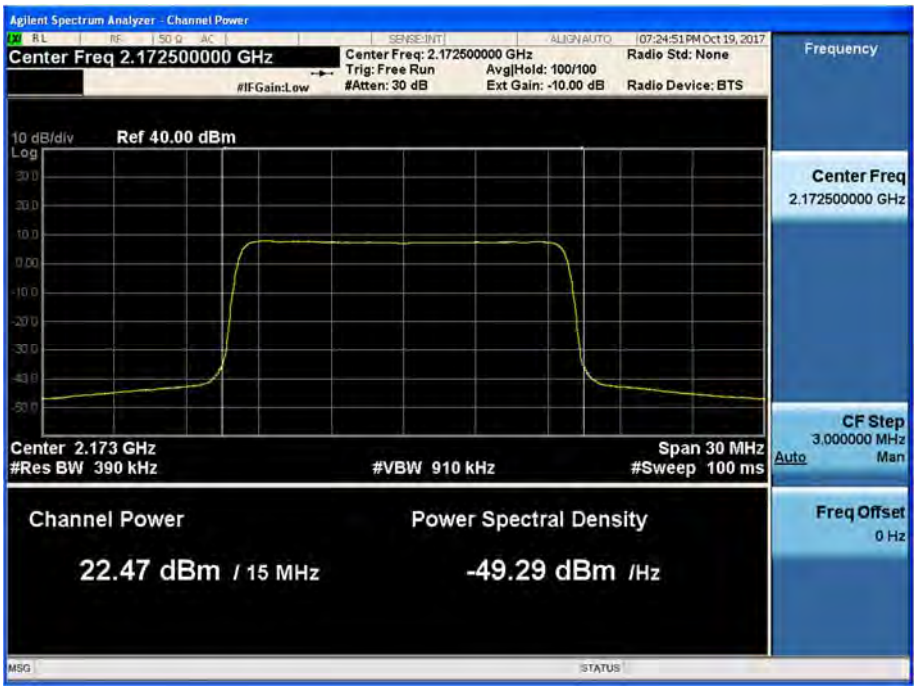

(16QAM High Channel)

(64QAM Low Channel)




(64QAM Middle Channel)

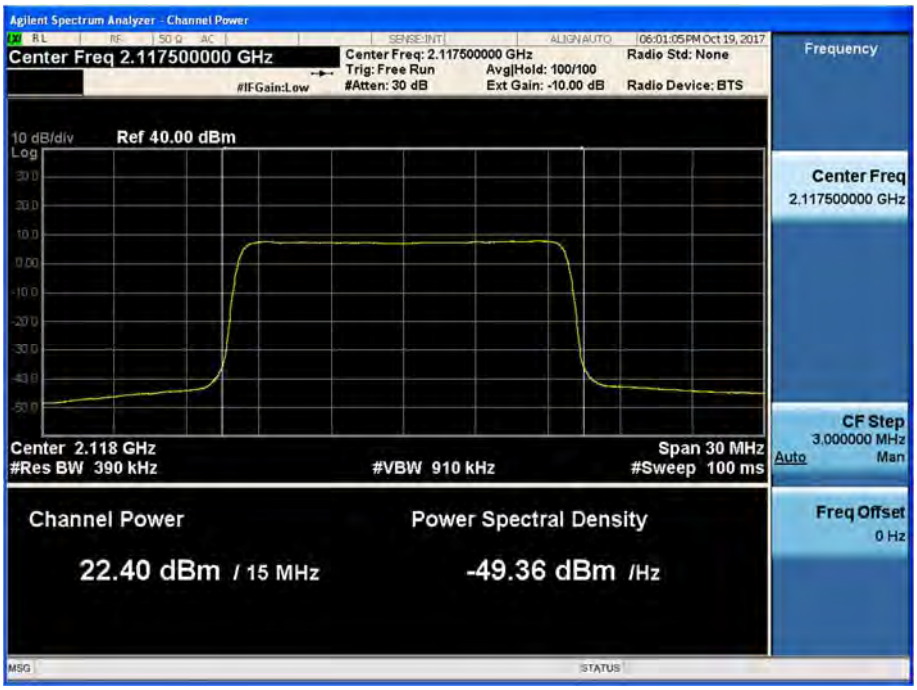
(64QAM High Channel)



**AWS 2100_LTE 15 MHz**

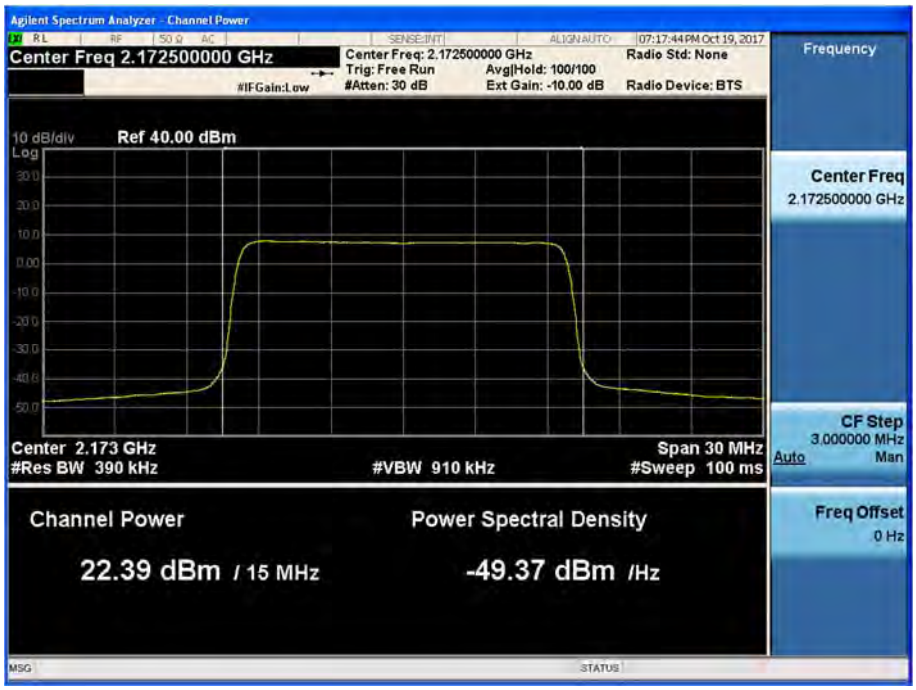
**Plot Data for Output Port 5 (Conducted Output Power)**

(QPSK Low Channel)



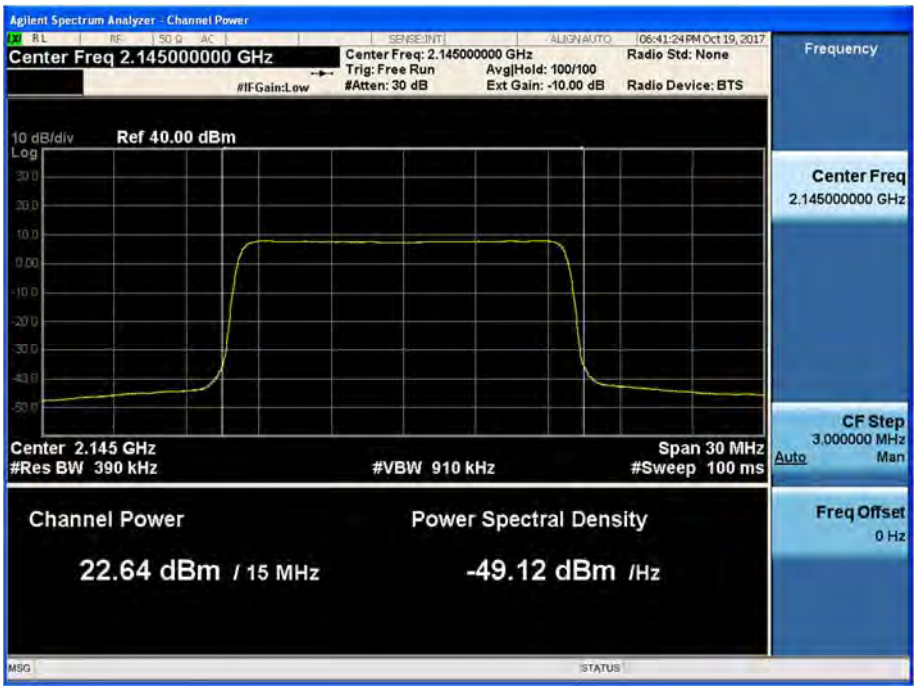

(QPSK Middle Channel)

(QPSK High Channel)




(16QAM Low Channel)

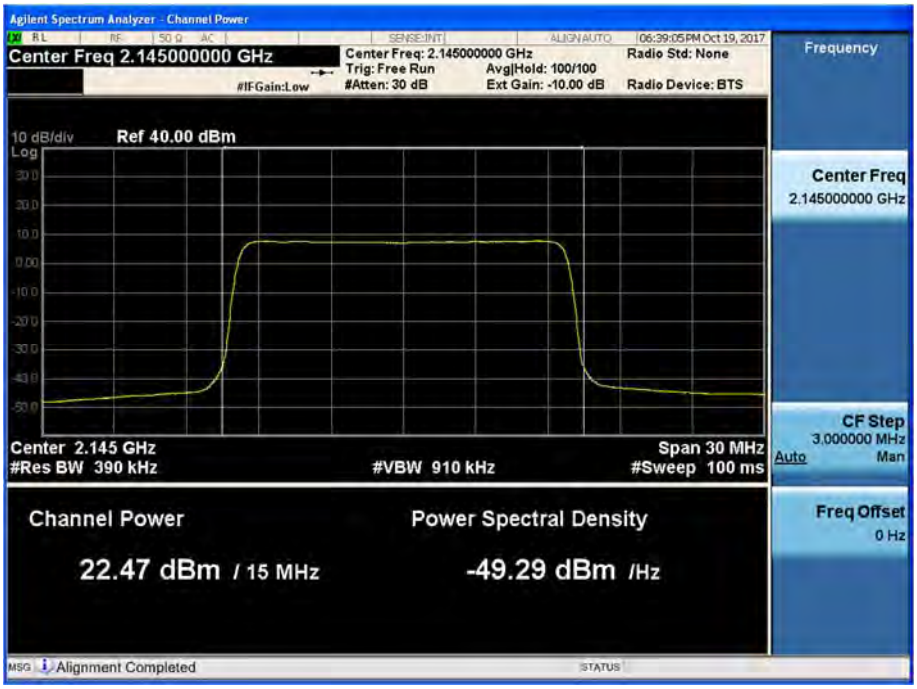
(16QAM Middle Channel)



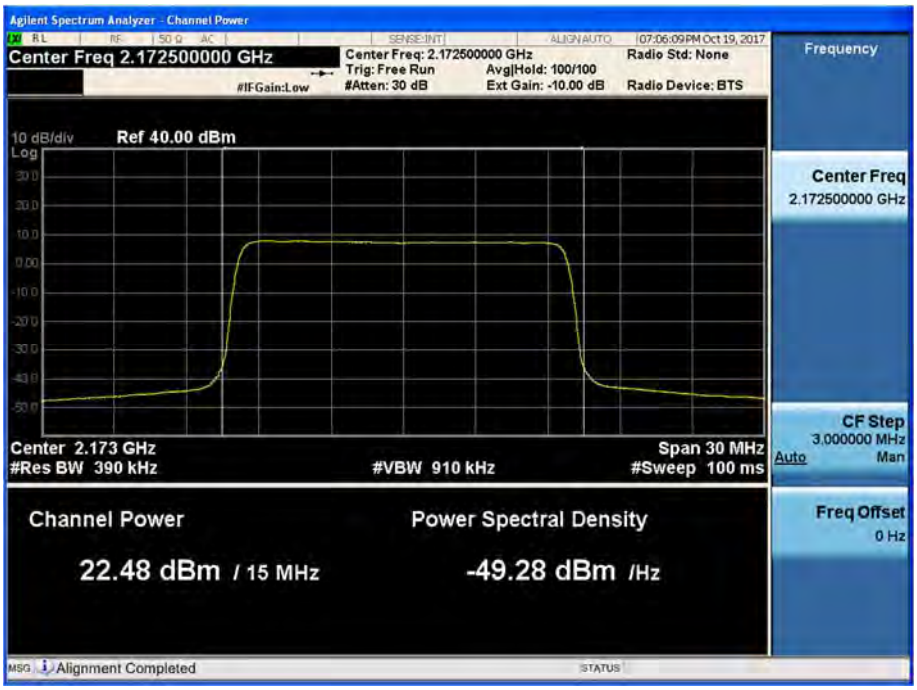

(16QAM High Channel)

(64QAM Low Channel)


(64QAM Middle Channel)



(64QAM High Channel)



**AWS 2100_LTE 20 MHz**

**Test Data at Output Port 4**

| Frequency (MHz) | Output Power | | | | | |
|---|---|---|---|---|---|---|
| | QPSK | | 16QAM | | 64QAM | |
| | dBm | W | dBm | W | dBm | W |
| 2120.00 | 22.70 | 0.174 | 23.13 | 0.172 | 23.17 | 0.177 |
| 2145.00 | 23.30 | 0.181 | 23.36 | 0.184 | 23.21 | 0.177 |
| 2170.00 | 23.00 | 0.174 | 23.03 | 0.175 | 23.13 | 0.177 |

**Test Data at Output Port 5**

| Frequency (MHz) | Output Power | | | | | |
|---|---|---|---|---|---|---|
| | QPSK | | 16QAM | | 64QAM | |
| | dBm | W | dBm | W | dBm | W |
| 2120.00 | 22.94 | 0.197 | 22.96 | 0.198 | 22.98 | 0.199 |
| 2145.00 | 23.10 | 0.204 | 23.12 | 0.205 | 23.13 | 0.206 |
| 2170.00 | 23.02 | 0.200 | 22.86 | 0.193 | 22.76 | 0.189 |

**Sum Data of Port 4 and Port 5**

| Frequency (MHz) | Output Power | | |
|---|---|---|---|
| | QPSK | 16QAM | 64QAM |
| | W | W | W |
| 2120.00 | 0.371 | 0.37 | 0.376 |
| 2145.00 | 0.385 | 0.389 | 0.383 |
| 2170.00 | 0.374 | 0.368 | 0.366 |

**AWS 2100_LTE 20 MHz**

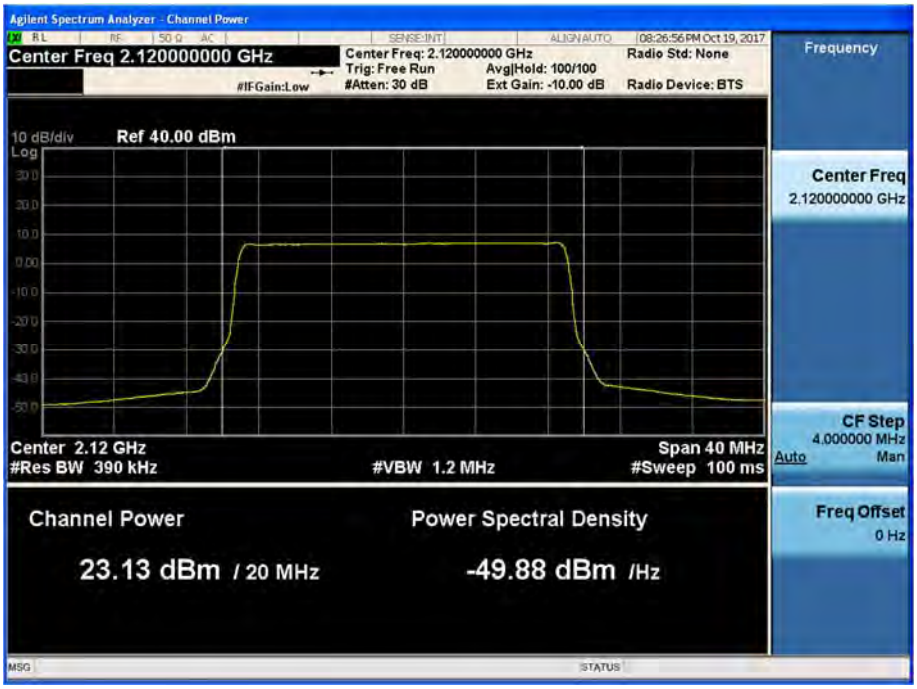
**Plot Data for Output Port 4 (Conducted Output Power)**

(QPSK Low Channel)


(QPSK Middle Channel)

(QPSK High Channel)

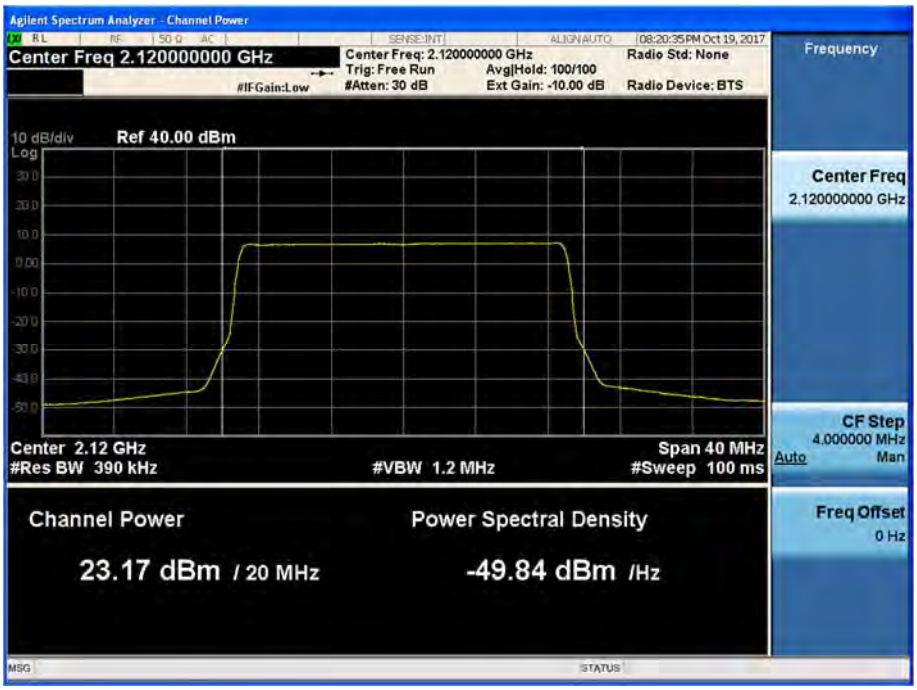

(16QAM Low Channel)



(16QAM Middle Channel)

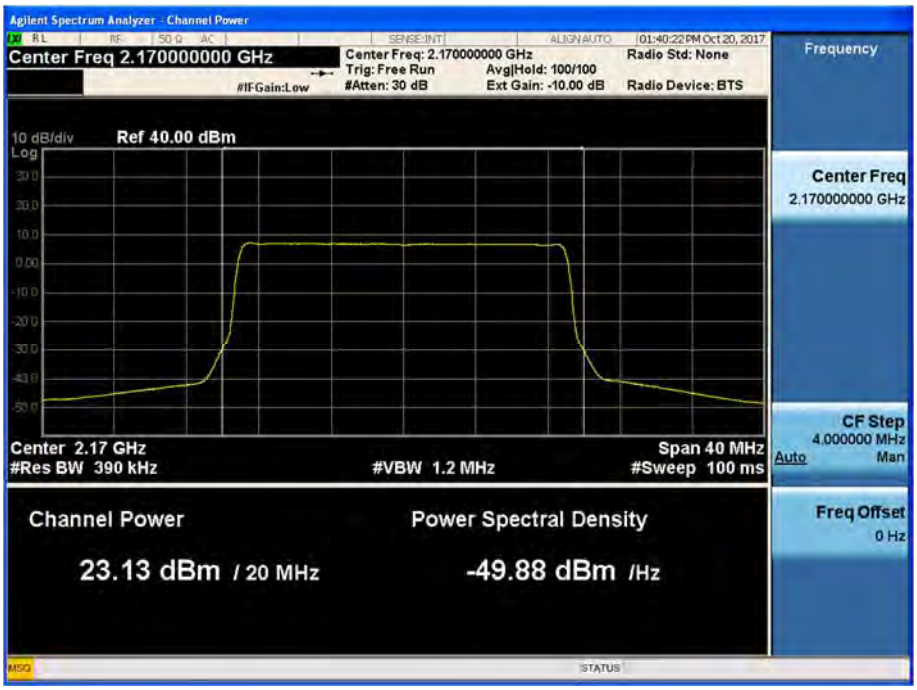

(16QAM High Channel)

(64QAM Low Channel)




(64QAM Middle Channel)

(64QAM High Channel)



**AWS 2100_LTE 20 MHz**

**Plot Data for Output Port 5 (Conducted Output Power)**

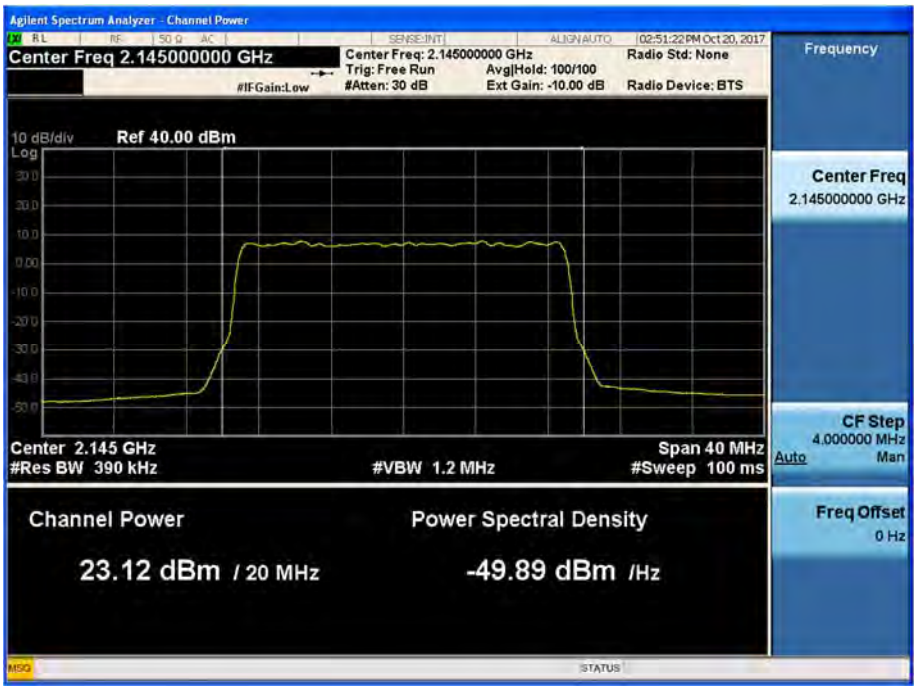
(QPSK Low Channel)


(QPSK Middle Channel)

(QPSK High Channel)


(16QAM Low Channel)

(16QAM Middle Channel)




(16QAM High Channel)

(64QAM Low Channel)


(64QAM Middle Channel)

(64QAM High Channel)

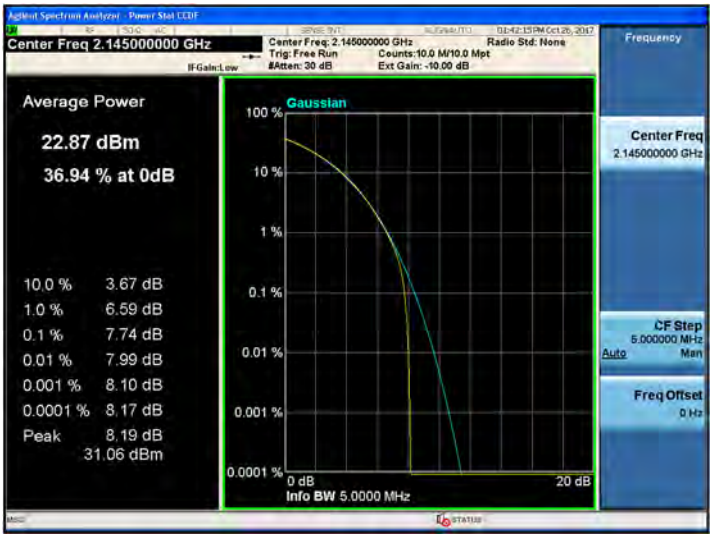
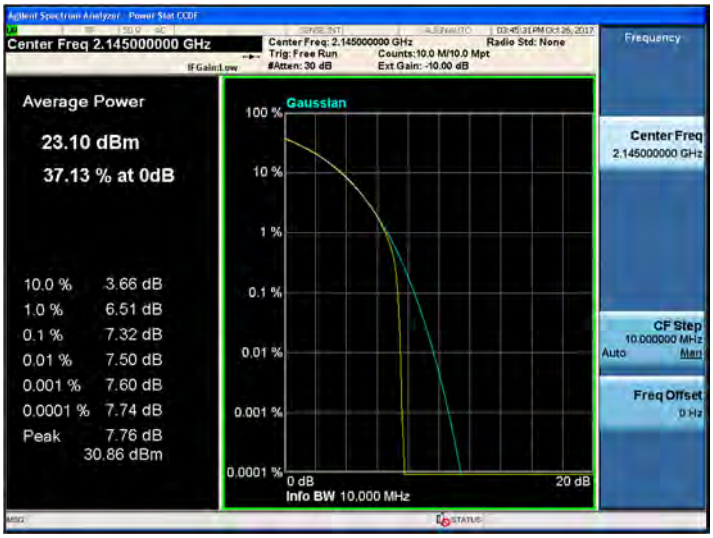
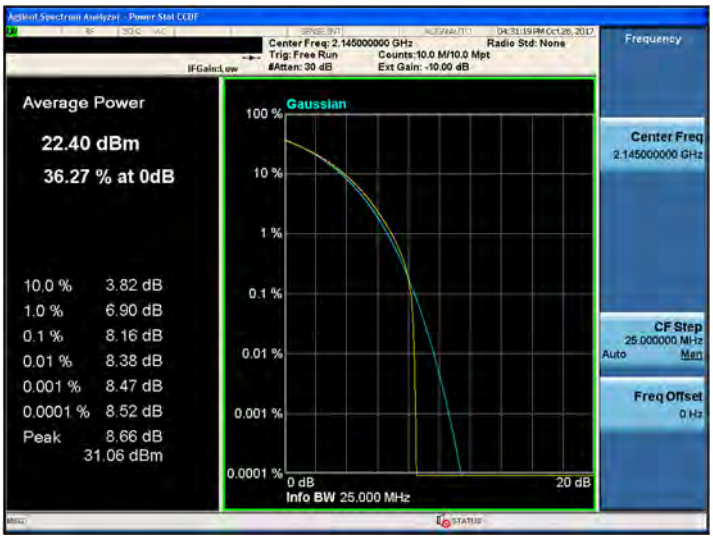
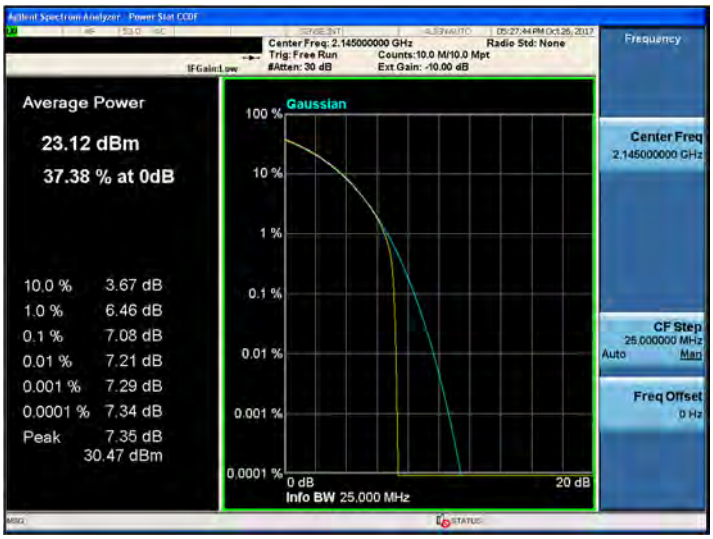
**Peak-to-Average Ratio**

**AWS 2100 Test Data**

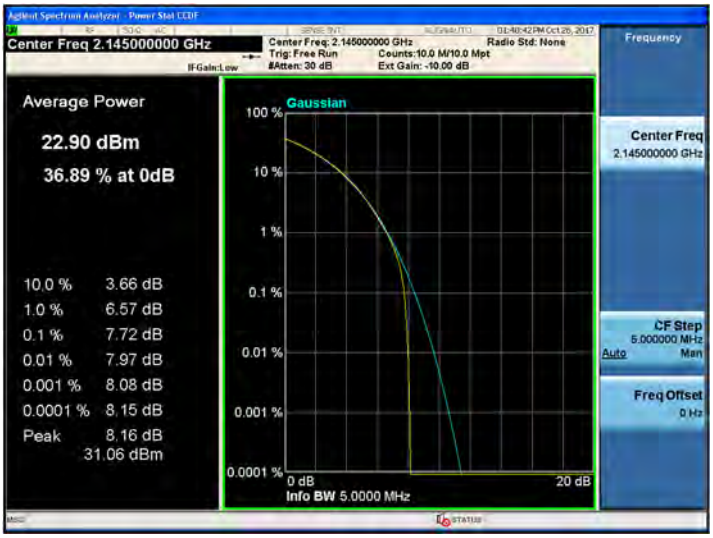
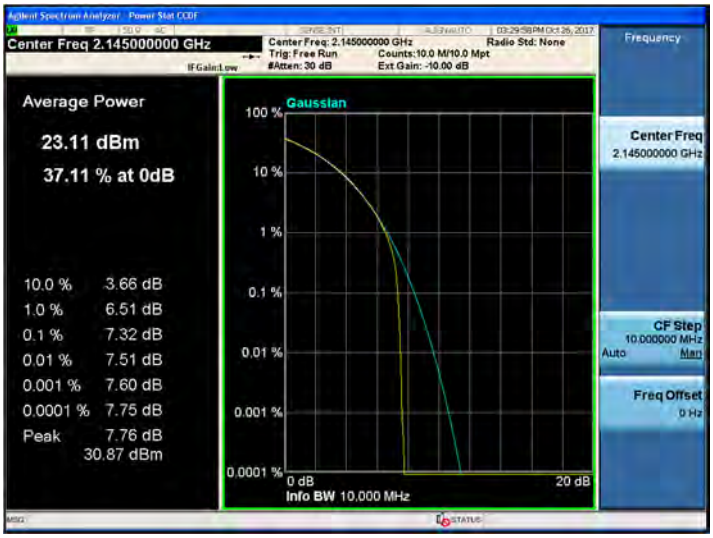
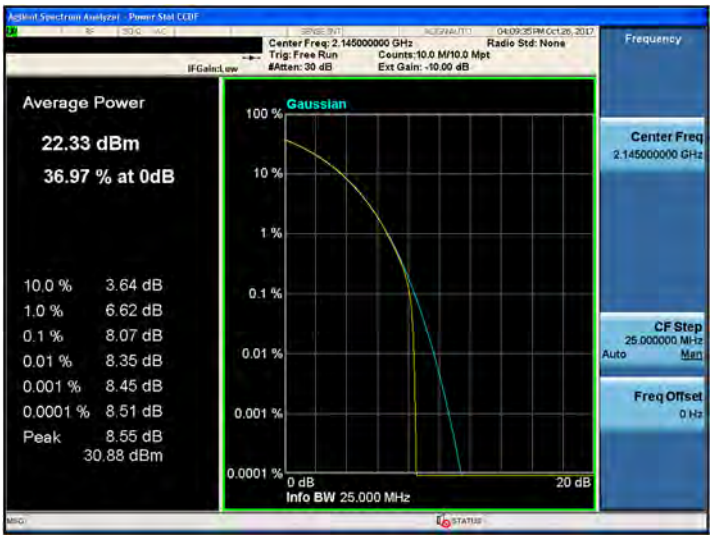
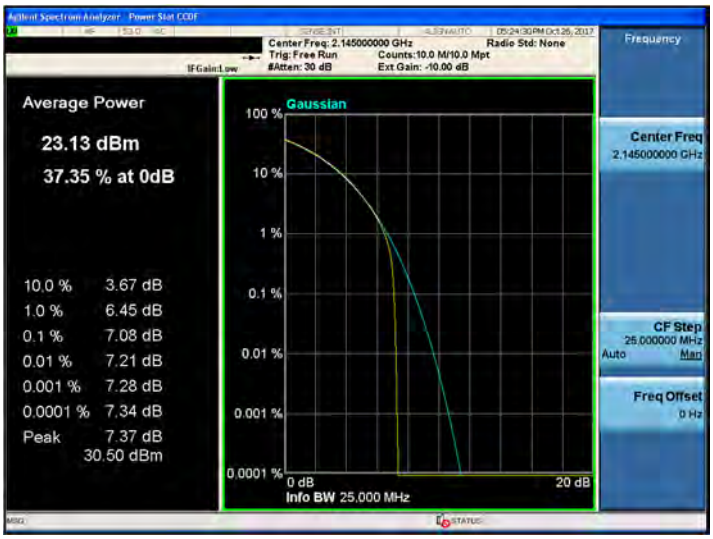
| LTE Bandwidth | Frequency (MHz) | PAR [dB] | | | | | |
|---|---|---|---|---|---|---|---|
| | | QPSK | | 16QAM | | 64QAM | |
| | | Port 4 | Port 5 | Port 4 | Port 5 | Port 4 | Port 5 |
| 5 MHz | 2145.00 | 7.74 | 7.71 | 7.72 | 7.70 | 7.79 | 7.71 |
| 10 MHz | | 7.32 | 7.31 | 7.32 | 7.32 | 7.32 | 7.31 |
| 15 MHz | | 8.16 | 8.05 | 8.07 | 8.05 | 7.82 | 8.05 |
| 20 MHz | | 7.08 | 7.04 | 7.08 | 7.04 | 7.08 | 7.03 |

**AWS 2100 Test Plots for Output Port 4**

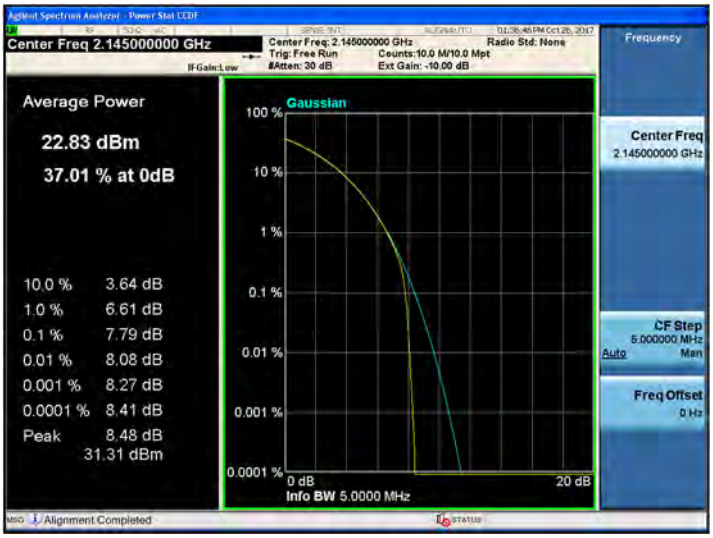
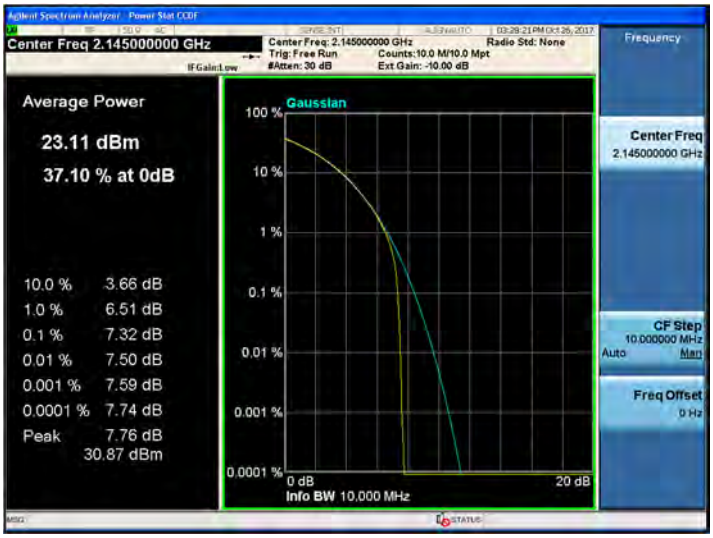
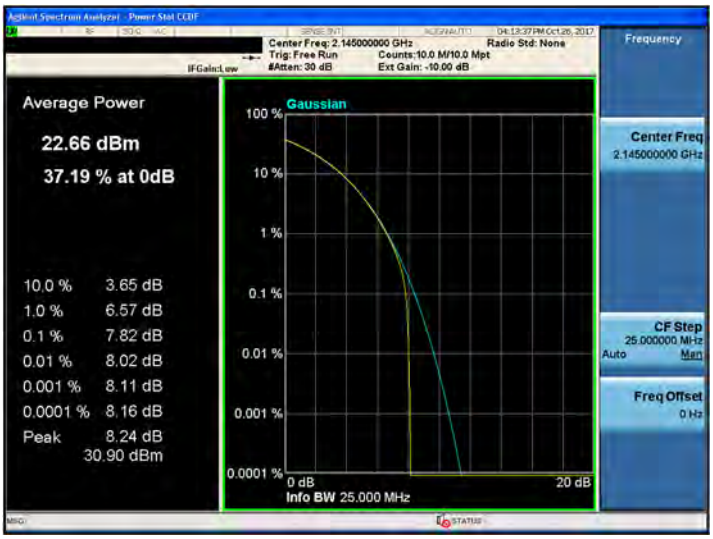
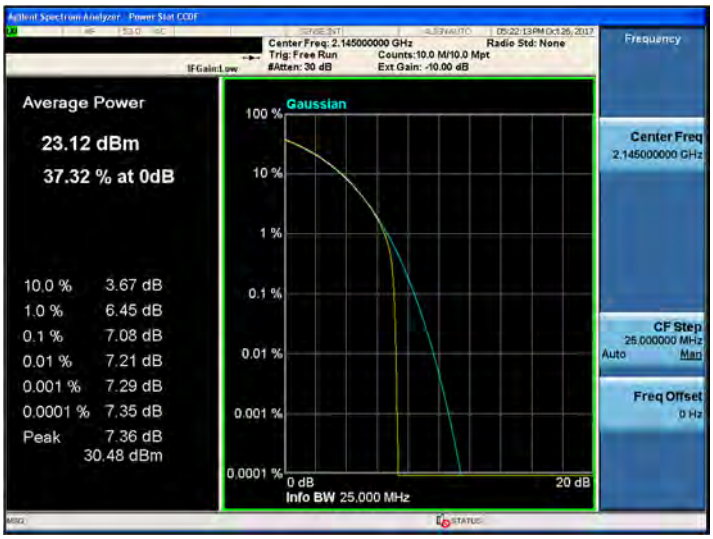
**QPSK Mid Channel**

| LTE_5 MHz Bandwidth | LTE_10 MHz Bandwidth |
|---|---|
|  |  |
| **LTE_15 MHz Bandwidth** | **LTE_20 MHz Bandwidth** |
|  |  |

**16QAM Mid Channel**

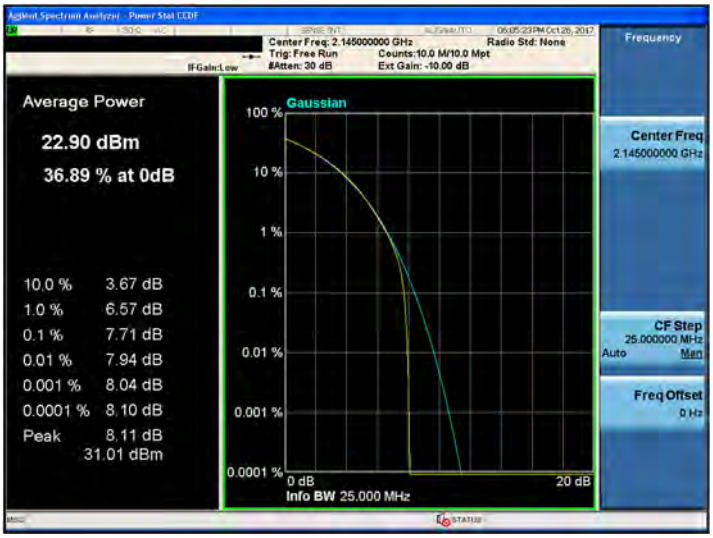
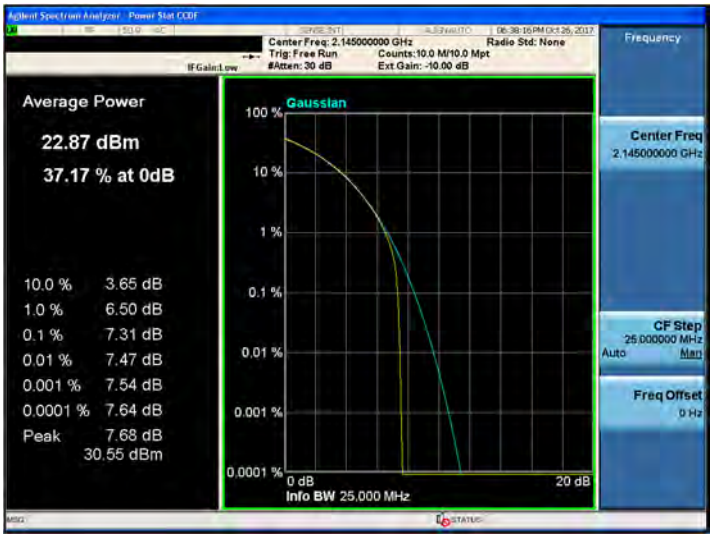
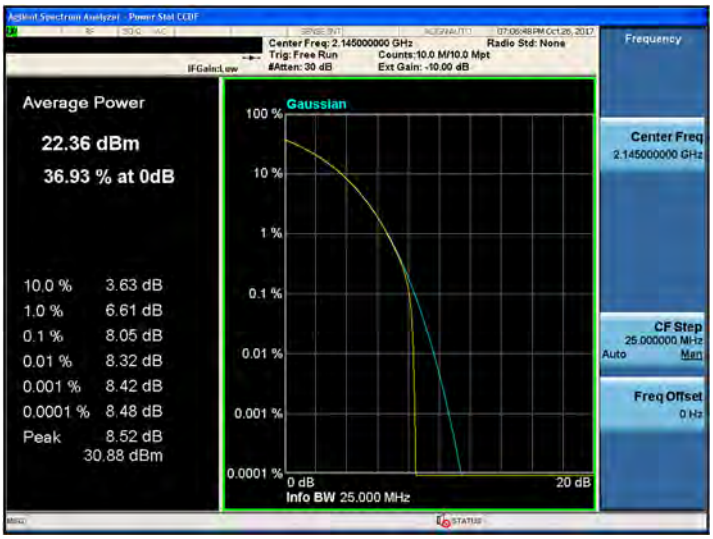
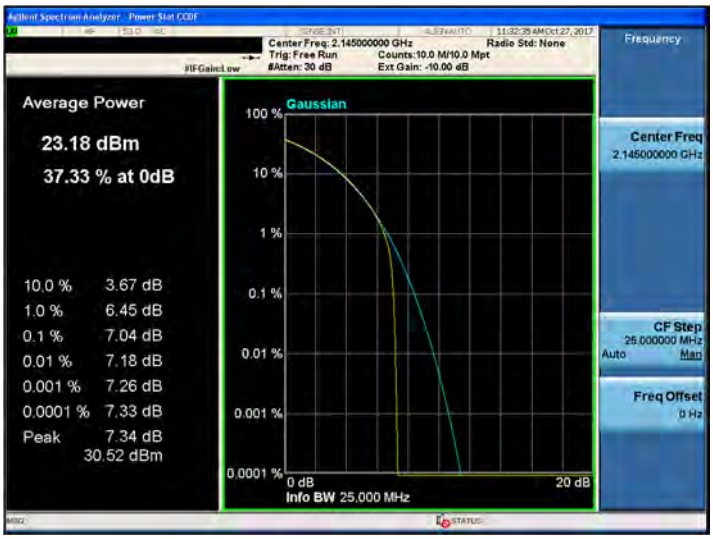
| LTE_5 MHz Bandwidth | LTE_10 MHz Bandwidth |
|---|---|
|  |  |
| **LTE_15 MHz Bandwidth** | **LTE_20 MHz Bandwidth** |
|  |  |

**64QAM Mid Channel**

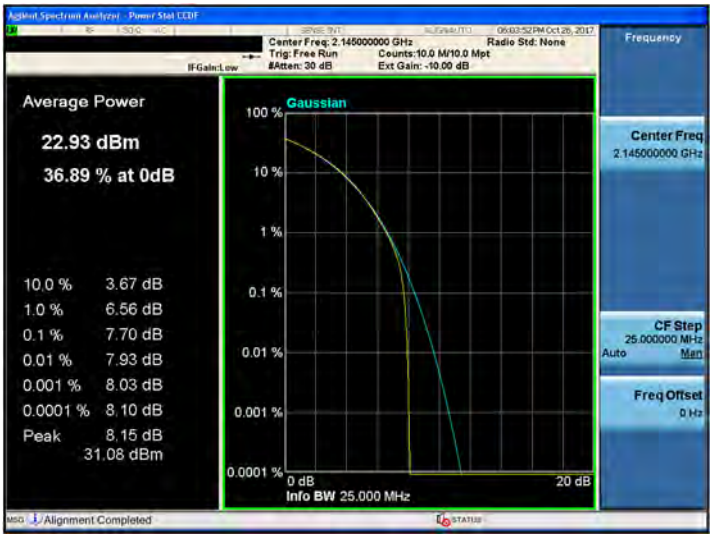
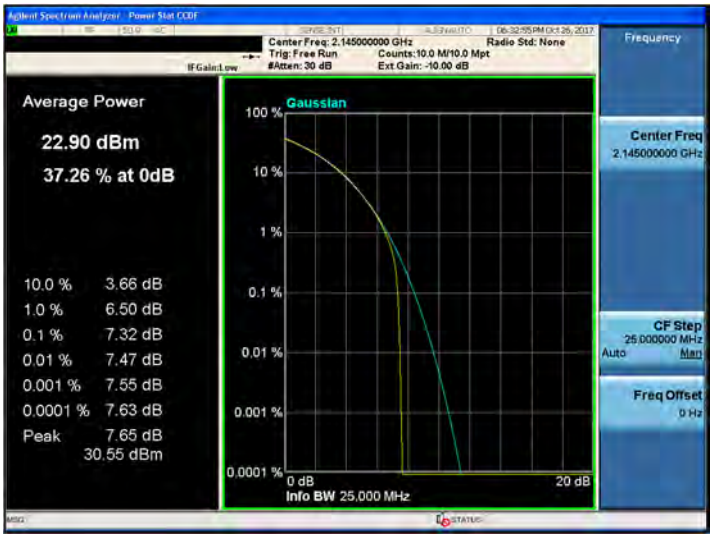
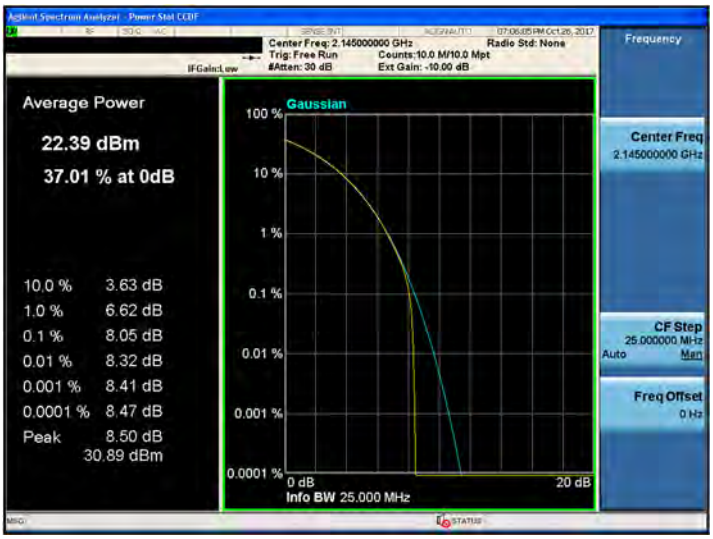
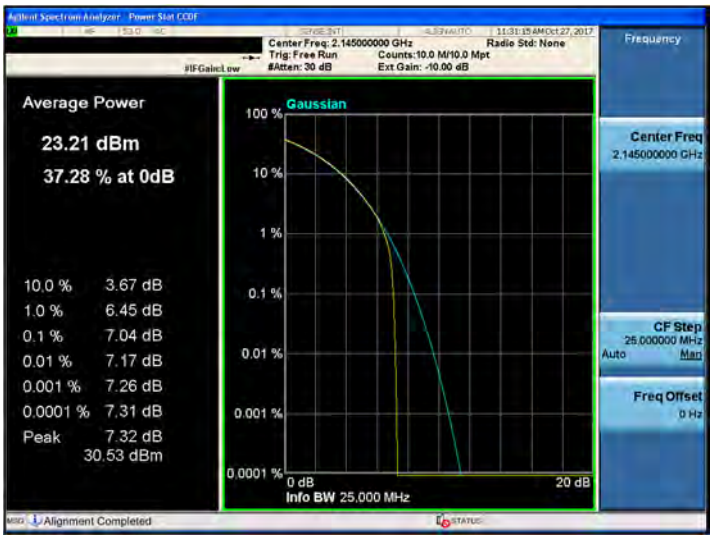
| LTE_5 MHz Bandwidth | LTE_10 MHz Bandwidth |
|---|---|
|  |  |
| **LTE_15 MHz Bandwidth** | **LTE_20 MHz Bandwidth** |
|  |  |

**AWS 2100 Test Plots for Output Port 5**

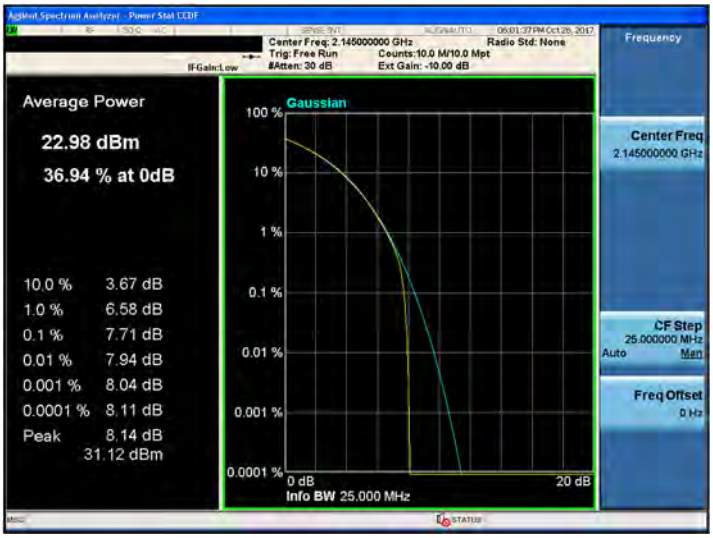
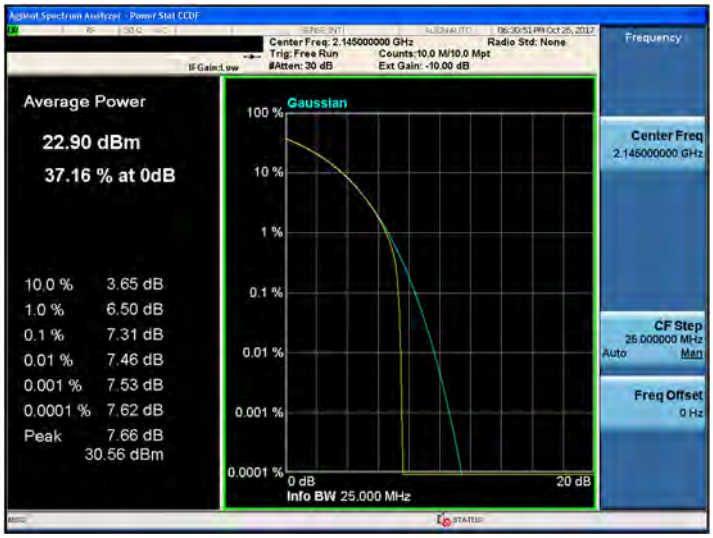
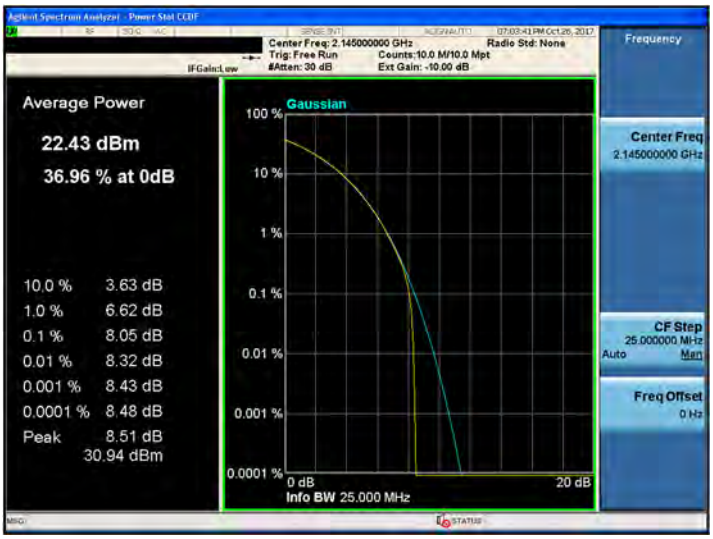
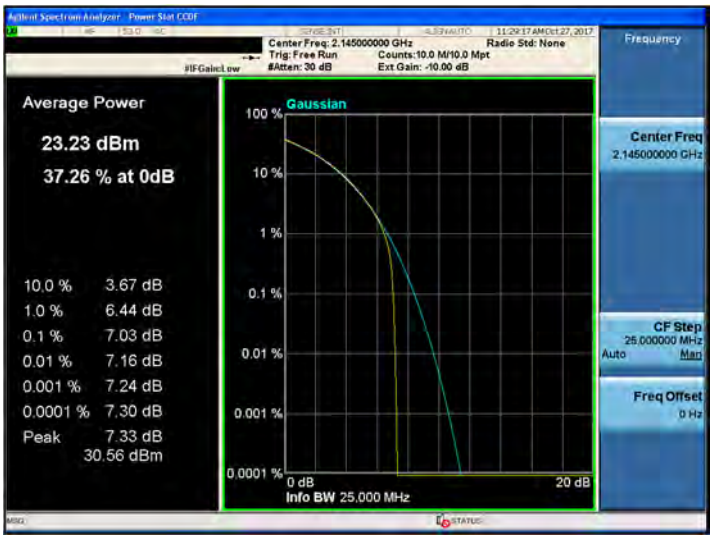
**QPSK Mid Channel**

| LTE_5 MHz Bandwidth | LTE_10 MHz Bandwidth |
|---|---|
|  |  |
| **LTE_15 MHz Bandwidth** | **LTE_20 MHz Bandwidth** |
|  |  |

**16QAM Mid Channel**

| LTE_5 MHz Bandwidth | LTE_10 MHz Bandwidth |
|---|---|
|  |  |
| **LTE_15 MHz Bandwidth** | **LTE_20 MHz Bandwidth** |
|  |  |

**64QAM Mid Channel**

| LTE_5 MHz Bandwidth | LTE_10 MHz Bandwidth |
|---|---|
|  |  |
| **LTE_15 MHz Bandwidth** | **LTE_20 MHz Bandwidth** |
|  |  |

# 6. OCCUPIED BANDWIDTH

**Test Requirements:**

**§ 2.1049 Measurements required: Occupied bandwidth.**

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 under the specified conditions of § 2.1049 (a) through (i) as applicable.

**Test Procedures:**

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation. The EUT was connected to a spectrum analyzer enabled with an occupied bandwidth function via its antenna port. Measurements were performed to determine the occupied bandwidth in accordance with FCC Part 2.1049. The occupied bandwidth was measured from the fundamental emission at the bottom, middle and top channels. The occupied bandwidth was measured using the built in occupied bandwidth function of the spectrum analyzer. It was set to measure the bandwidth where 99% of the signal power was contained. The analyzer automatically configures the measurement bandwidths to make an accurate measurement based on the channel bandwidth and channel spacing of the EUT.

**Test Results:**

**700 MHz_LTE 10 MHz**

**Test Data at Output Port 4**

| Frequency (MHz) | Occupied Bandwidth (MHz) | | |
|---|---|---|---|
| | QPSK | 16QAM | 64QAM |
| 751.00 | 8.9409 | 8.9383 | 8.9460 |

**Test Data at Output Port 5**

| Frequency (MHz) | Occupied Bandwidth (MHz) | | |
|---|---|---|---|
| | QPSK | 16QAM | 64QAM |
| 751.00 | 8.9339 | 8.9596 | 8.9521 |

**AWS 2100_LTE 5 MHz**

**Test Data at Output Port 4**

| Frequency (MHz) | Occupied Bandwidth (MHz) | | |
|---|---|---|---|
| | QPSK | 16QAM | 64QAM |
| 2112.50 | 4.4400 | 4.4528 | 4.4423 |
| 2145.00 | 4.4402 | 4.4459 | 4.4419 |
| 2177.50 | 4.4440 | 4.4381 | 4.4397 |

**Test Data at Output Port 5**

| Frequency (MHz) | Occupied Bandwidth (MHz) | | |
|---|---|---|---|
| | QPSK | 16QAM | 64QAM |
| 2112.50 | 4.4389 | 4.4444 | 4.4430 |
| 2145.00 | 4.4392 | 4.4355 | 4.4436 |
| 2177.50 | 4.4404 | 4.4401 | 4.4353 |

**AWS 2100_LTE 10 MHz**

**Test Data at Output Port 4**

| Frequency (MHz) | Occupied Bandwidth (MHz) | | |
|---|---|---|---|
| | QPSK | 16QAM | 64QAM |
| 2115.00 | 8.9588 | 8.9531 | 8.9569 |
| 2145.00 | 8.9608 | 8.9589 | 8.9529 |
| 2175.00 | 8.9461 | 8.9454 | 8.9403 |

**Test Data at Output Port 5**

| Frequency (MHz) | Occupied Bandwidth (MHz) | | |
|---|---|---|---|
| | QPSK | 16QAM | 64QAM |
| 2115.00 | 8.9328 | 8.9667 | 8.9265 |
| 2145.00 | 8.9550 | 8.9523 | 8.9517 |
| 2175.00 | 8.9398 | 8.9467 | 8.9412 |

**AWS 2100_LTE 15 MHz**

**Test Data at Output Port 4**

| Frequency (MHz) | Occupied Bandwidth (MHz) | | |
|---|---|---|---|
| | QPSK | 16QAM | 64QAM |
| 2117.50 | 13.342 | 13.342 | 13.347 |
| 2145.00 | 13.336 | 13.345 | 13.347 |
| 2172.50 | 13.399 | 13.342 | 13.345 |

**Test Data at Output Port 5**

| Frequency (MHz) | Occupied Bandwidth (MHz) | | |
|---|---|---|---|
| | QPSK | 16QAM | 64QAM |
| 2117.50 | 13.342 | 13.345 | 13.346 |
| 2145.00 | 13.348 | 13.349 | 13.344 |
| 2172.50 | 13.340 | 13.332 | 13.319 |

**AWS 2100_LTE 20 MHz**

**Test Data at Output Port 4**

| Frequency (MHz) | Occupied Bandwidth (MHz) | | |
|---|---|---|---|
| | QPSK | 16QAM | 64QAM |
| 2120.00 | 17.943 | 17.906 | 17.913 |
| 2145.00 | 17.925 | 17.937 | 17.897 |
| 2170.00 | 17.890 | 17.906 | 17.908 |

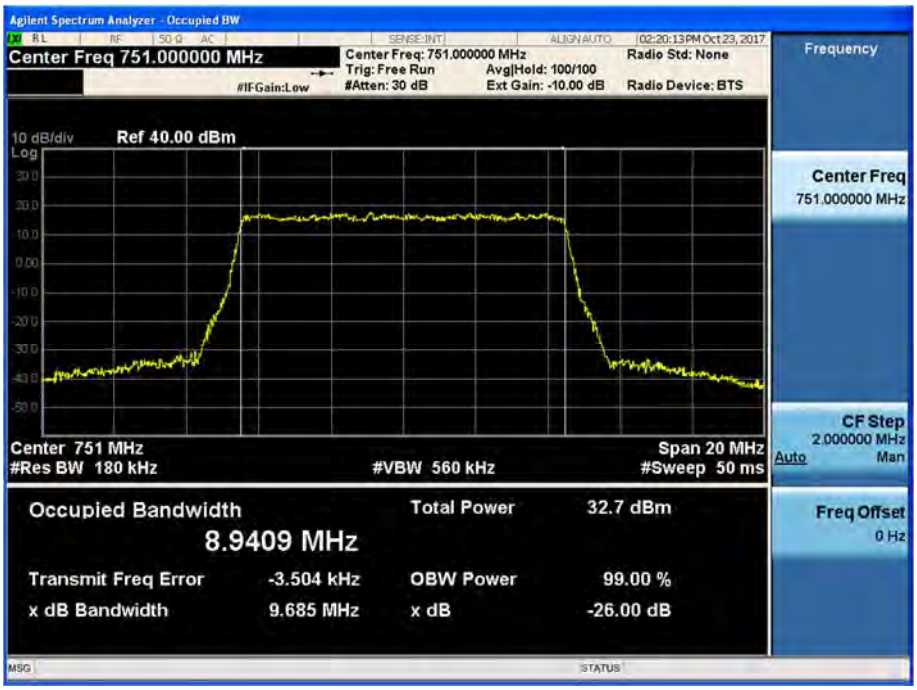
**Test Data at Output Port 5**

| Frequency (MHz) | Occupied Bandwidth (MHz) | | |
|---|---|---|---|
| | QPSK | 16QAM | 64QAM |
| 2120.00 | 17.905 | 17.906 | 17.889 |
| 2145.00 | 17.932 | 17.934 | 17.912 |
| 2170.00 | 17.926 | 17.915 | 17.881 |

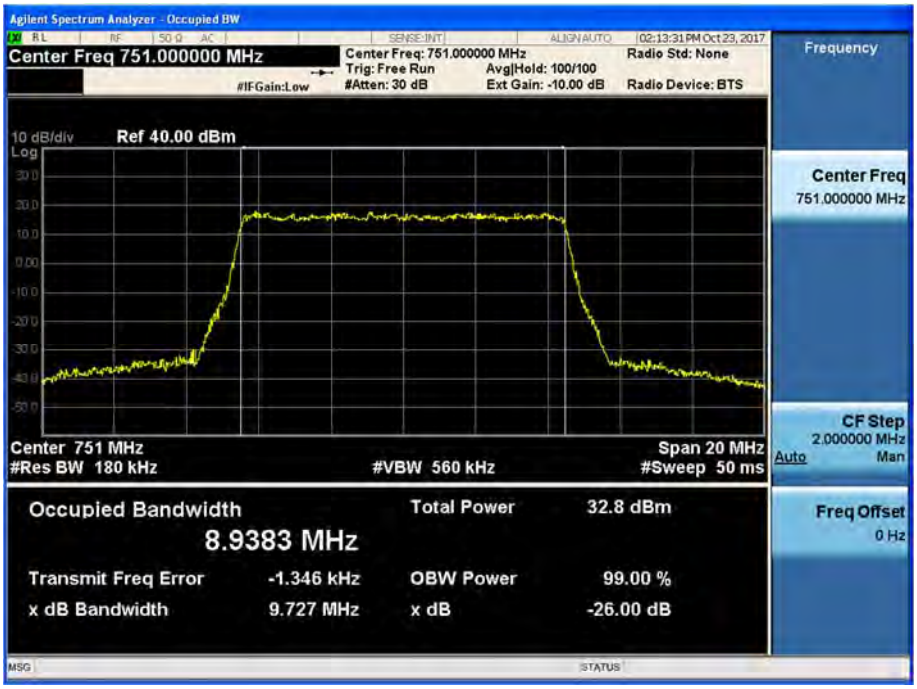
**700 MHz_LTE 10 MHz**

**Test Plot at Output Port 4**

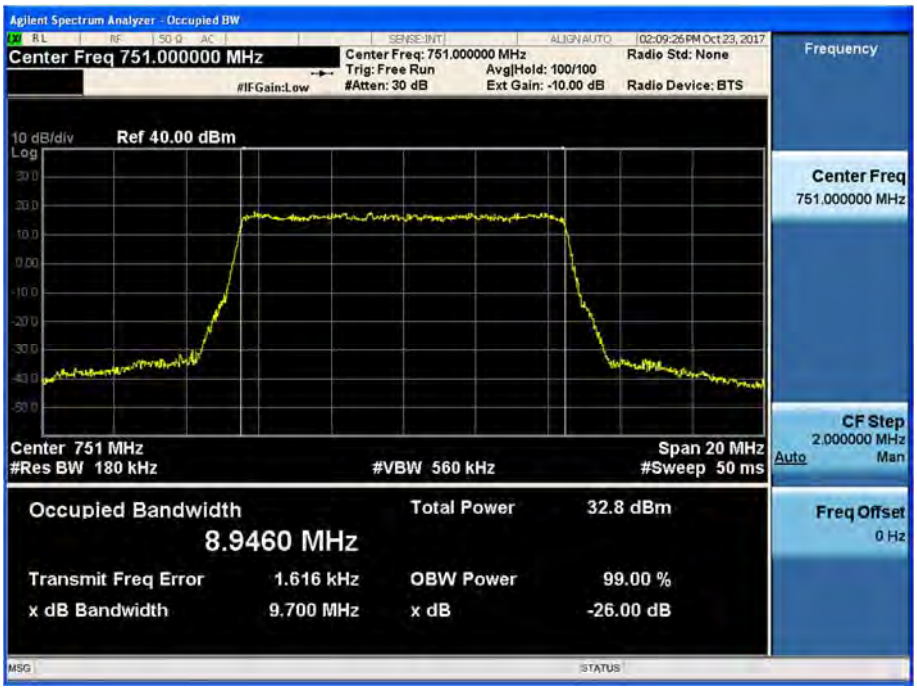
(64QAM Middle Channel)




(16QAM Middle Channel)



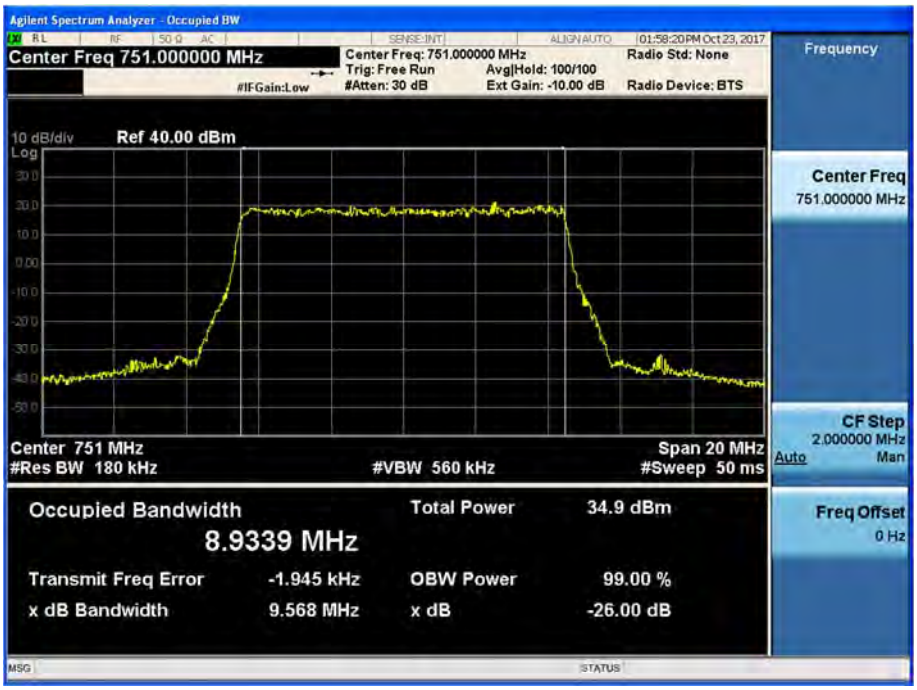
(QPSK Middle Channel)



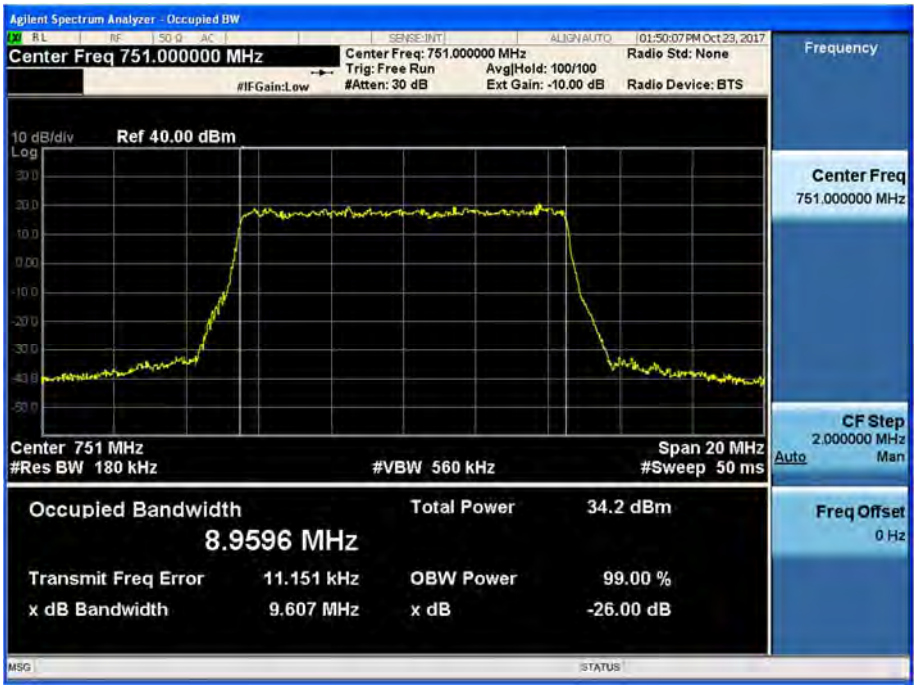
**700 MHz_LTE 10 MHz**

**Test Plot at Output Port 5**

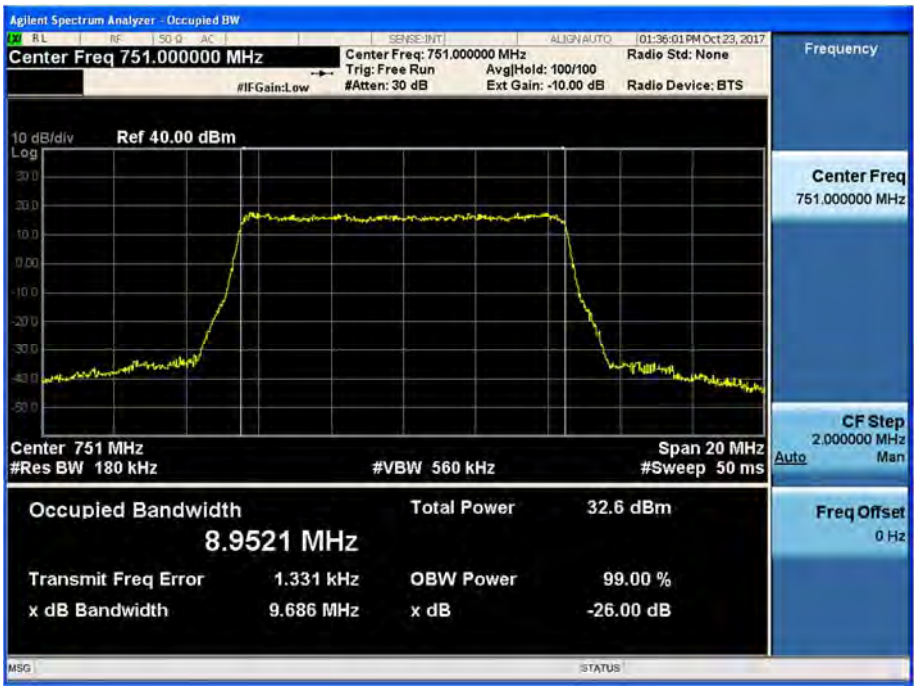
(64QAM Middle Channel)




(16QAM Middle Channel)



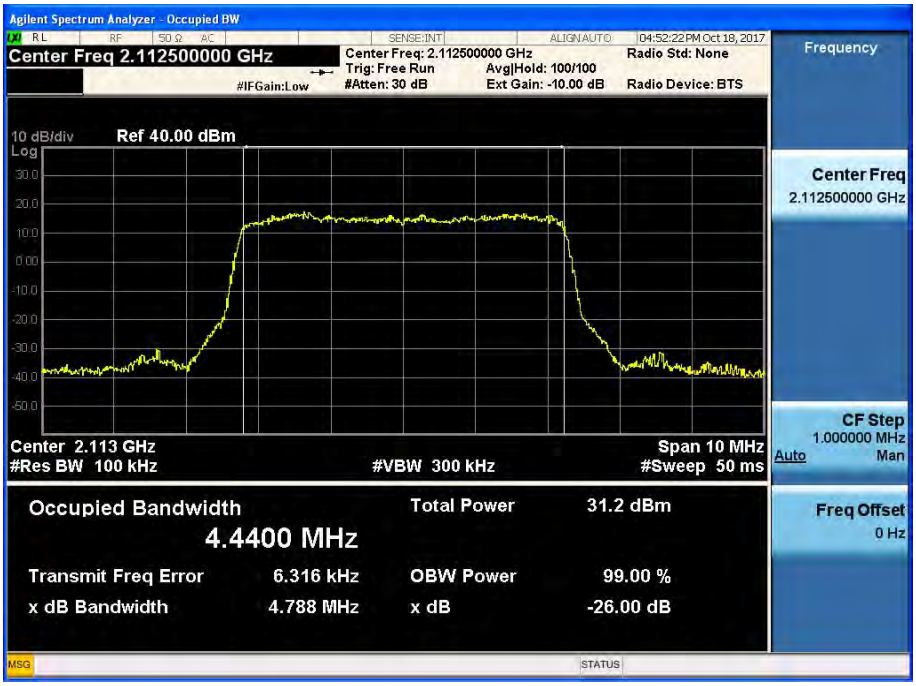
(QPSK Middle Channel)



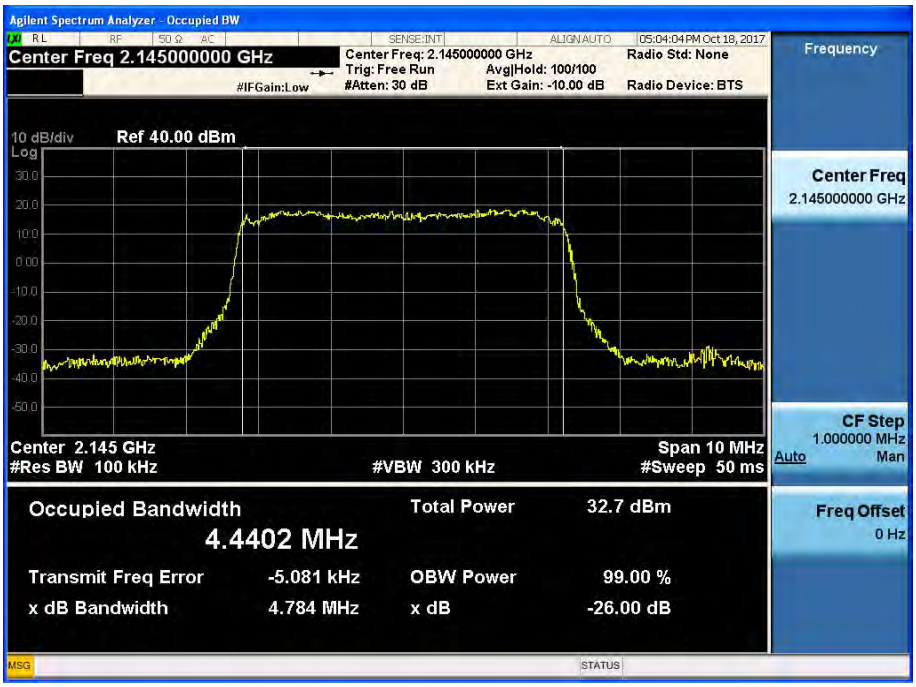
**AWS 2100_LTE 5 MHz**

**Test Plot at Output Port 4**

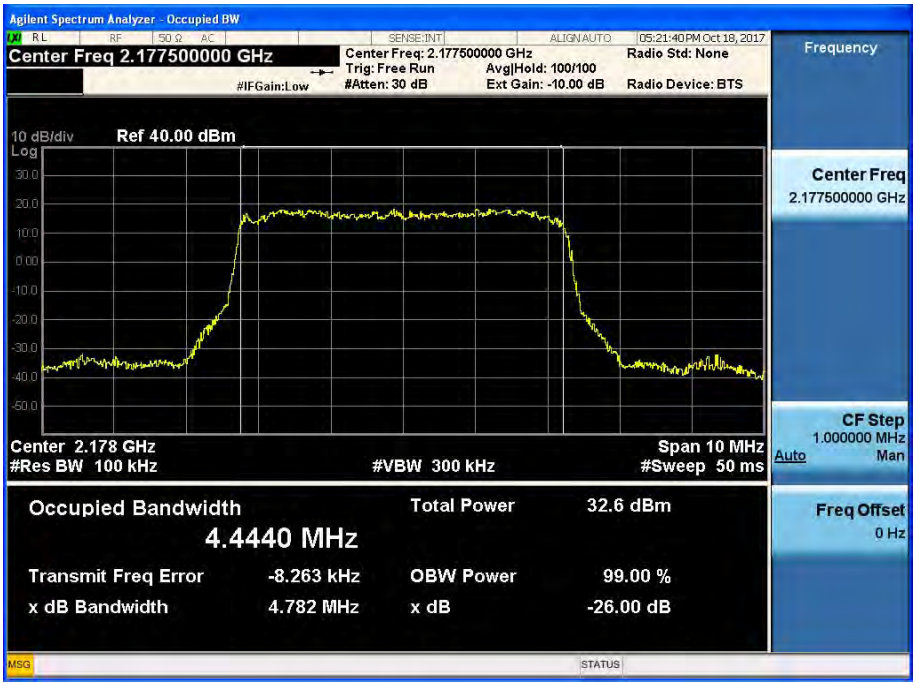
(QPSK Low Channel)



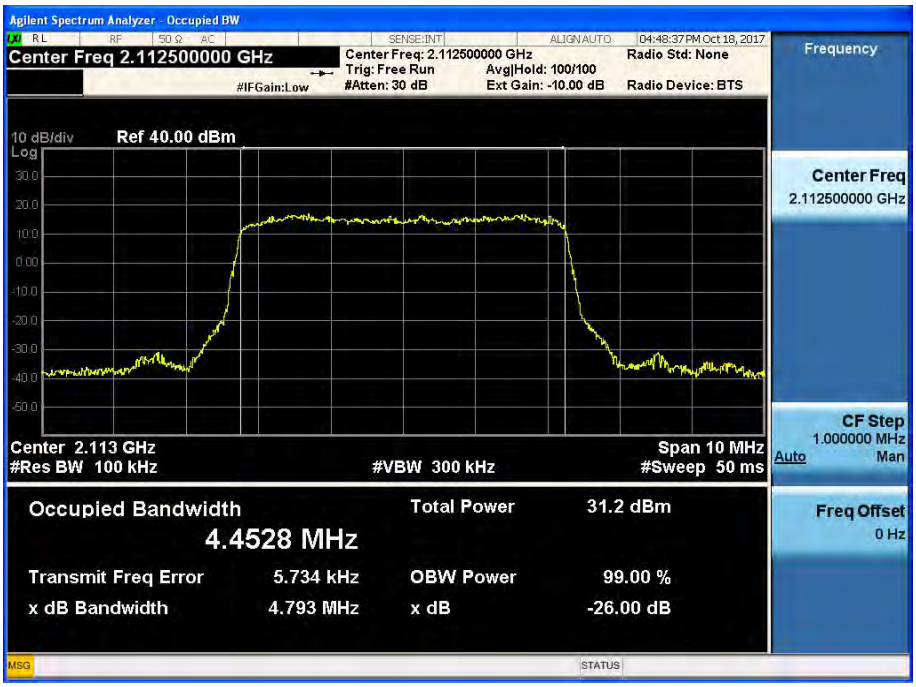

(QPSK Middle Channel)



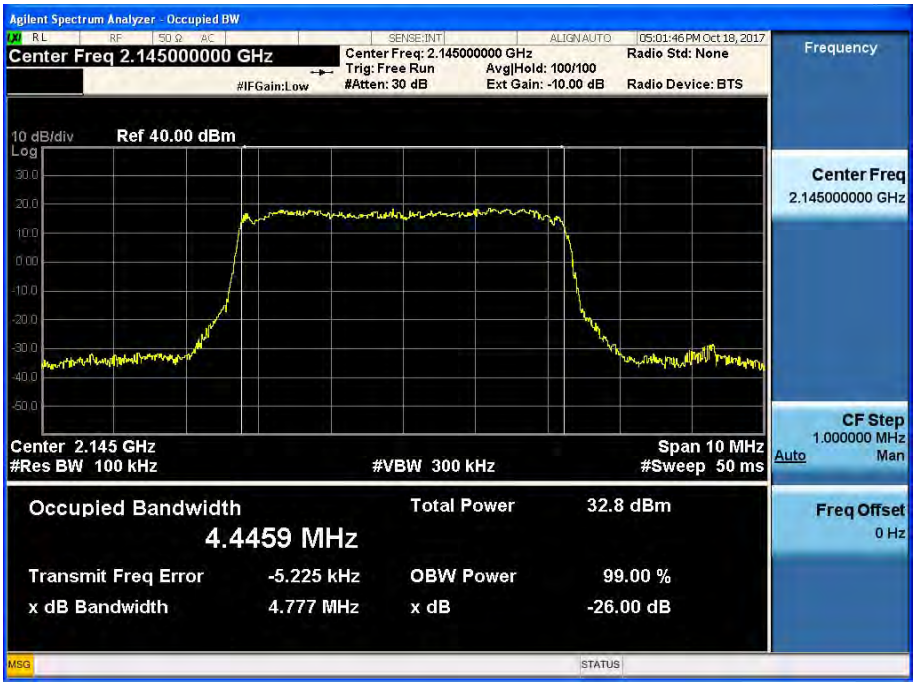
(QPSK High Channel)



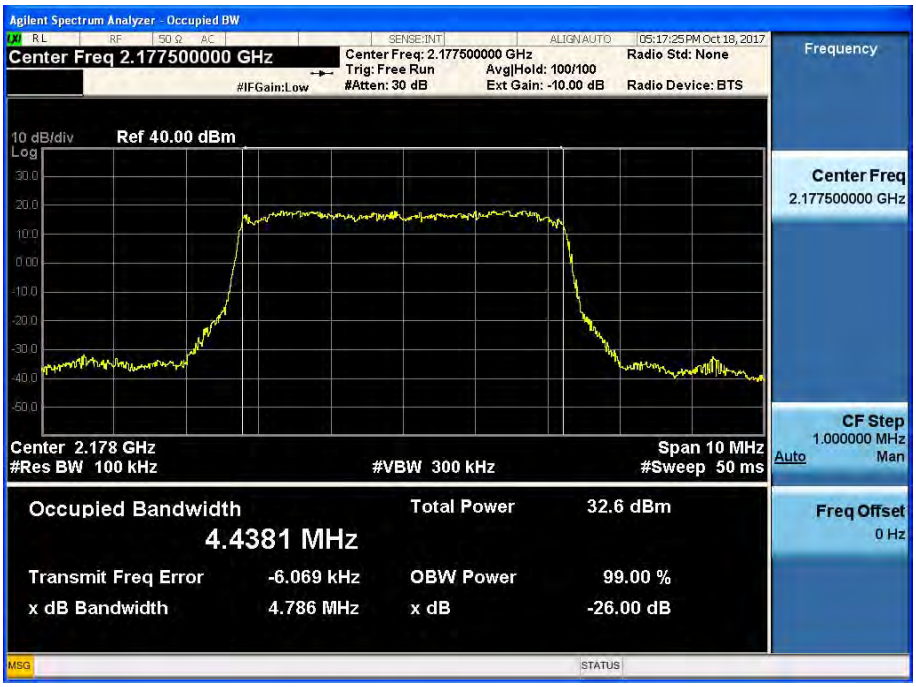

(16QAM Low Channel)



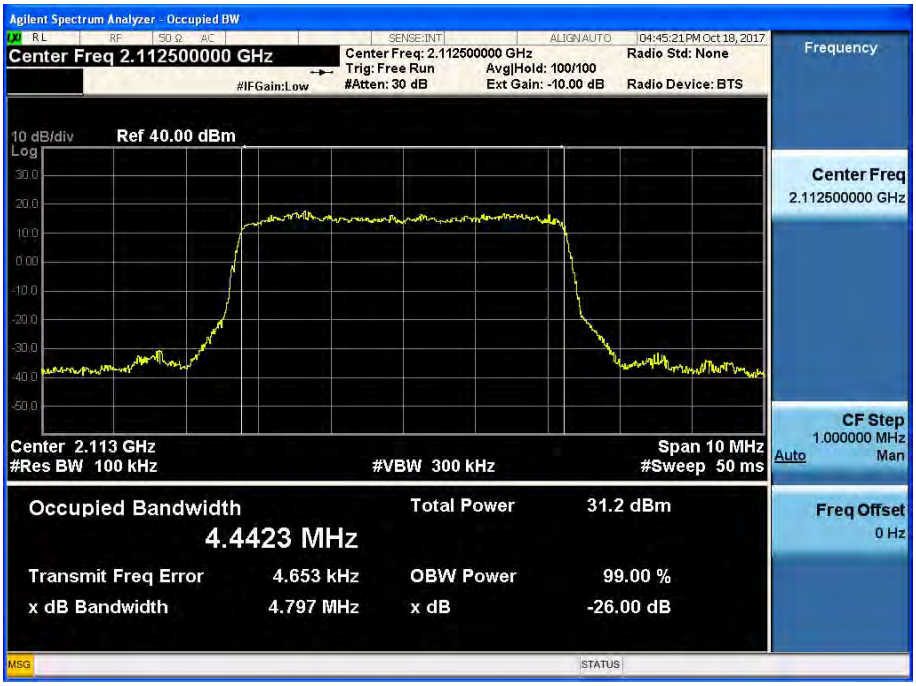
(16QAM Middle Channel)



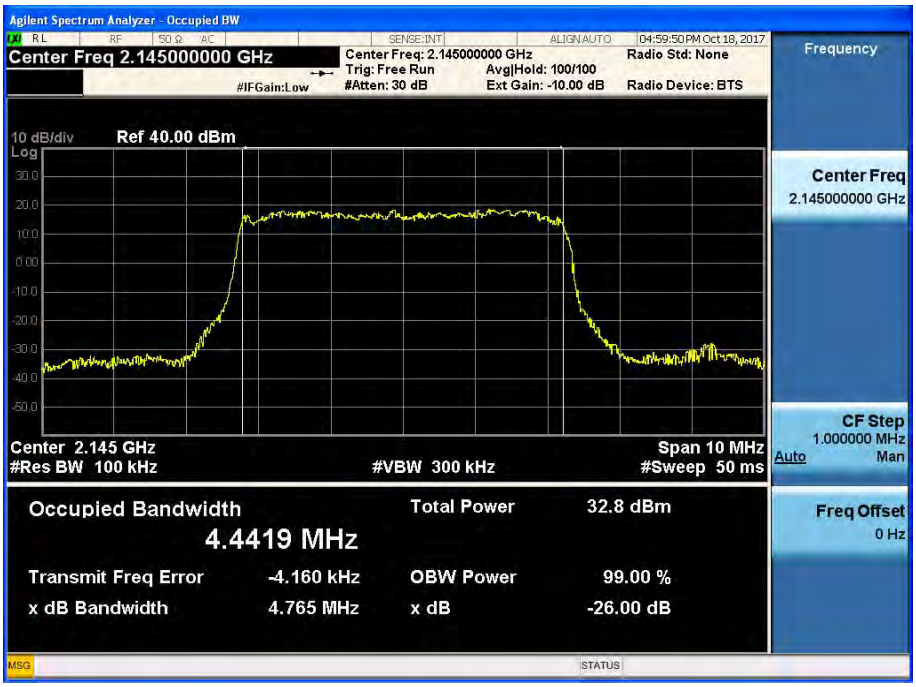

(16QAM High Channel)



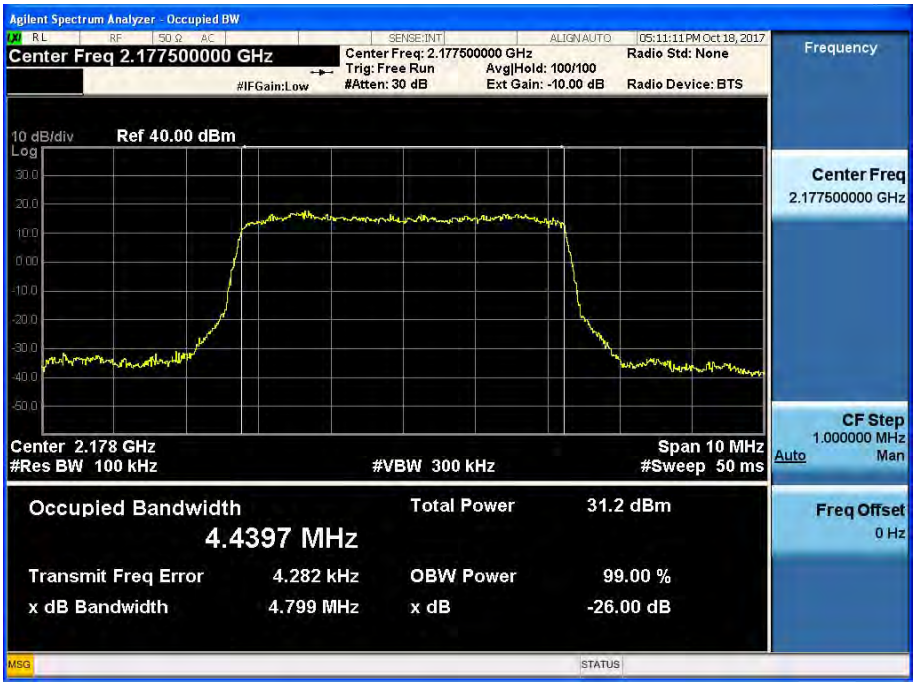
(64QAM Low Channel)




(64QAM Middle Channel)



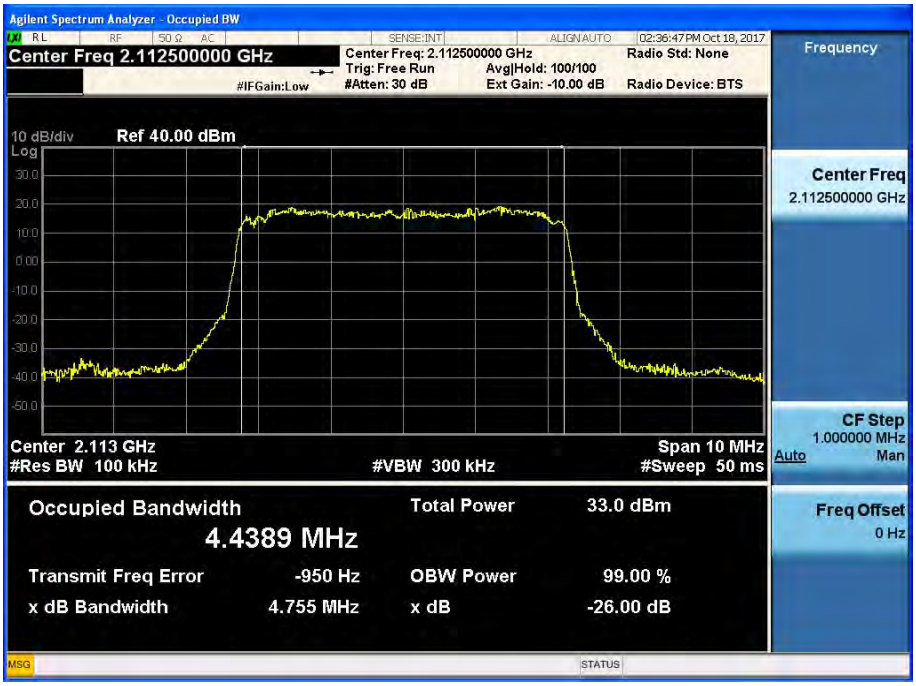
(64QAM High Channel)



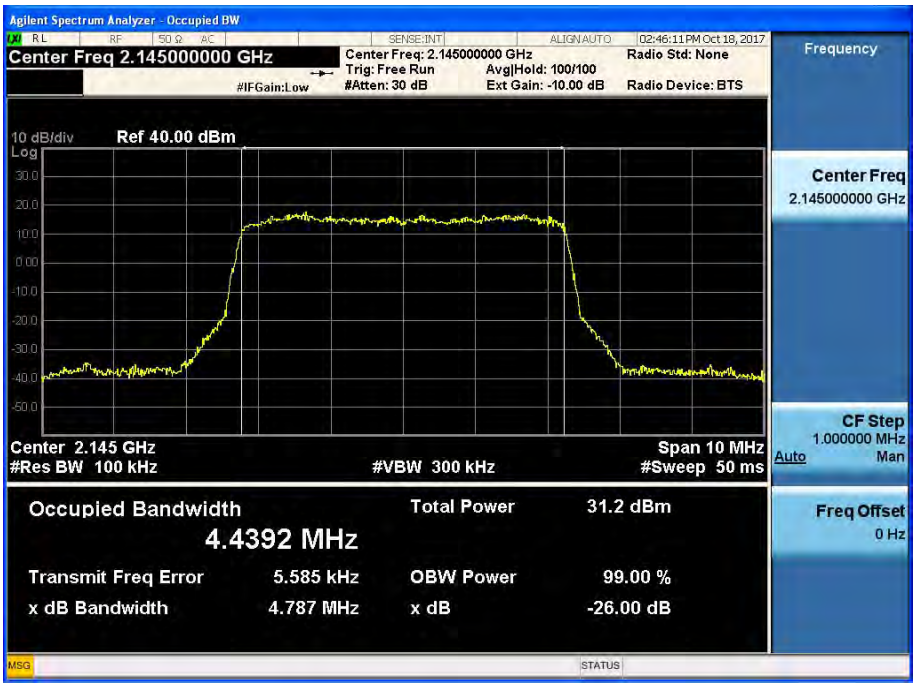
**AWS 2100_LTE 5 MHz**

**Test Plot at Output Port 5**

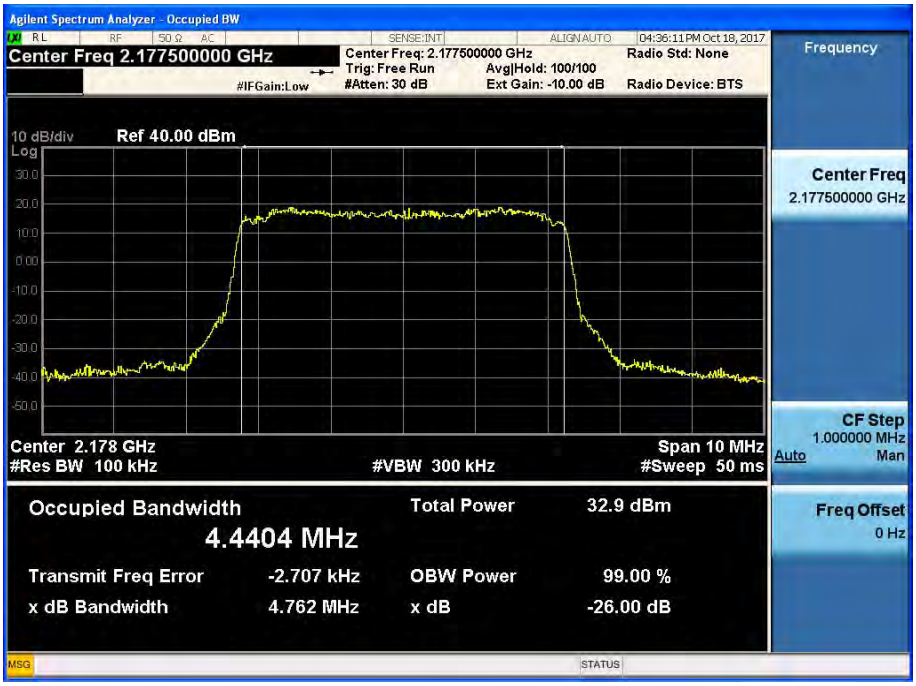
(QPSK Low Channel)



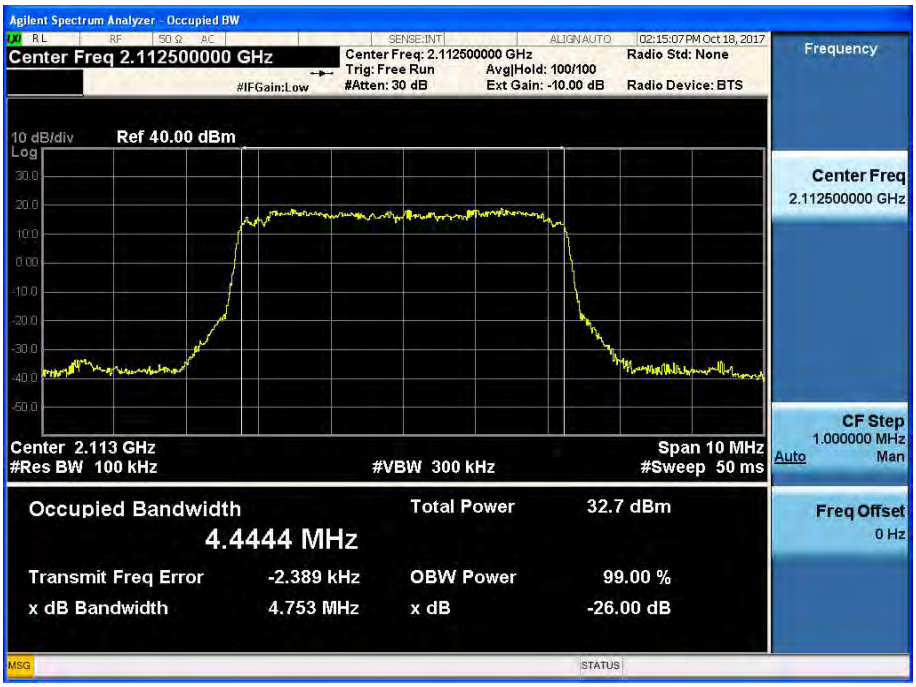

(QPSK Middle Channel)



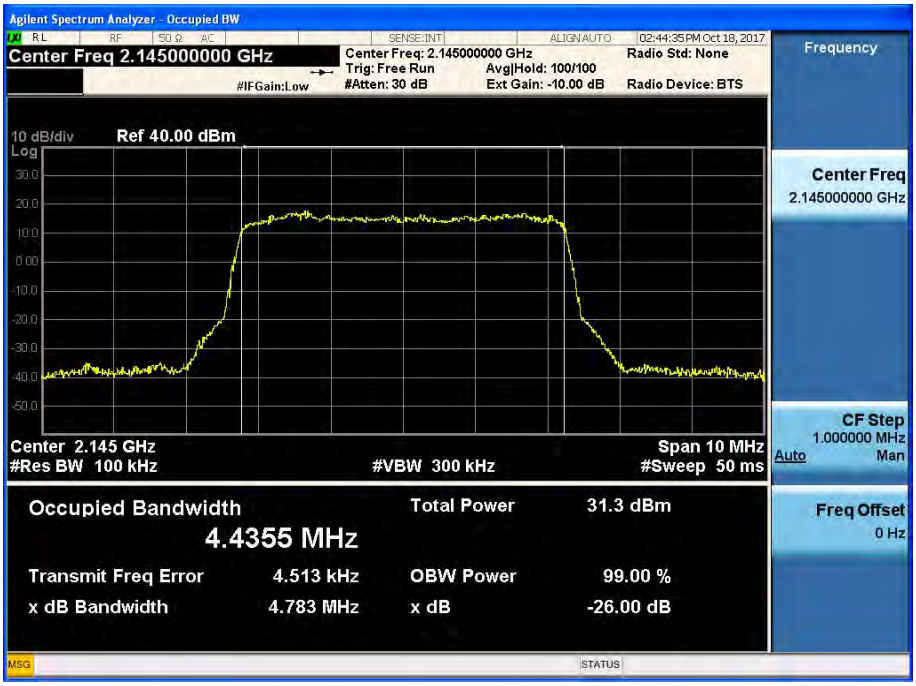
(QPSK High Channel)



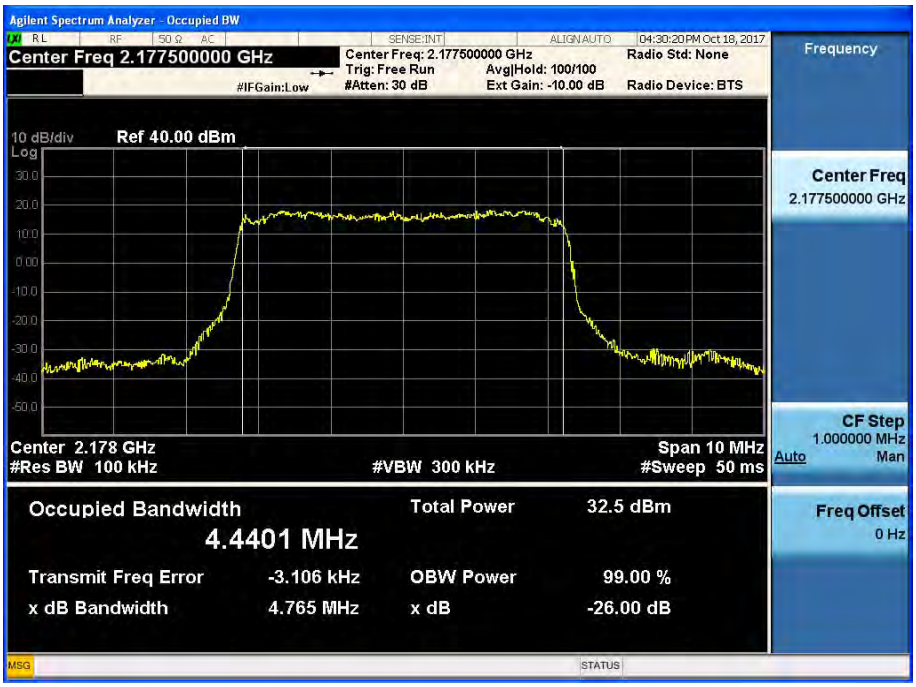

(16QAM Low Channel)



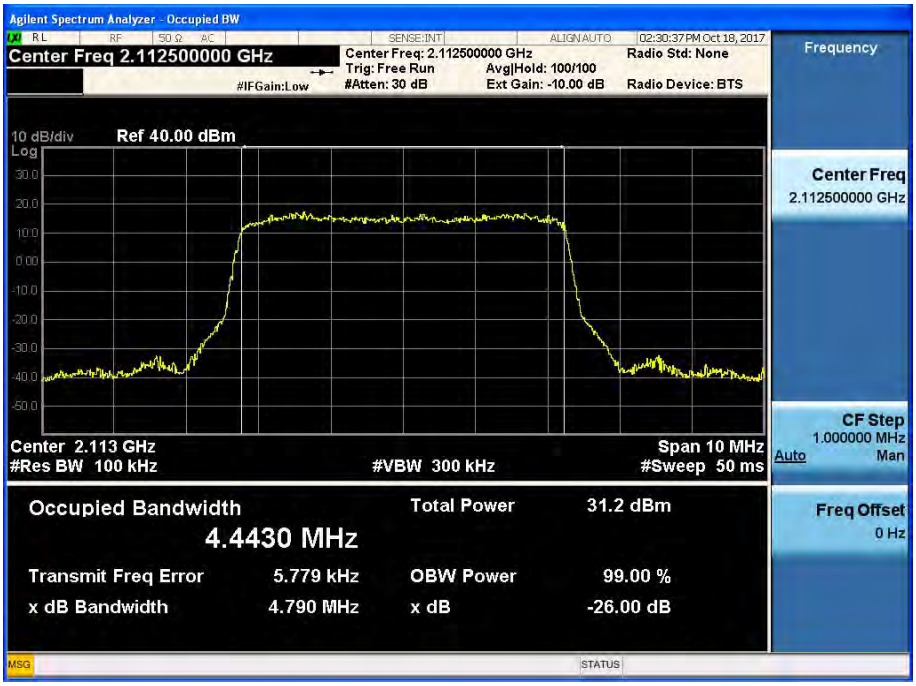
(16QAM Middle Channel)



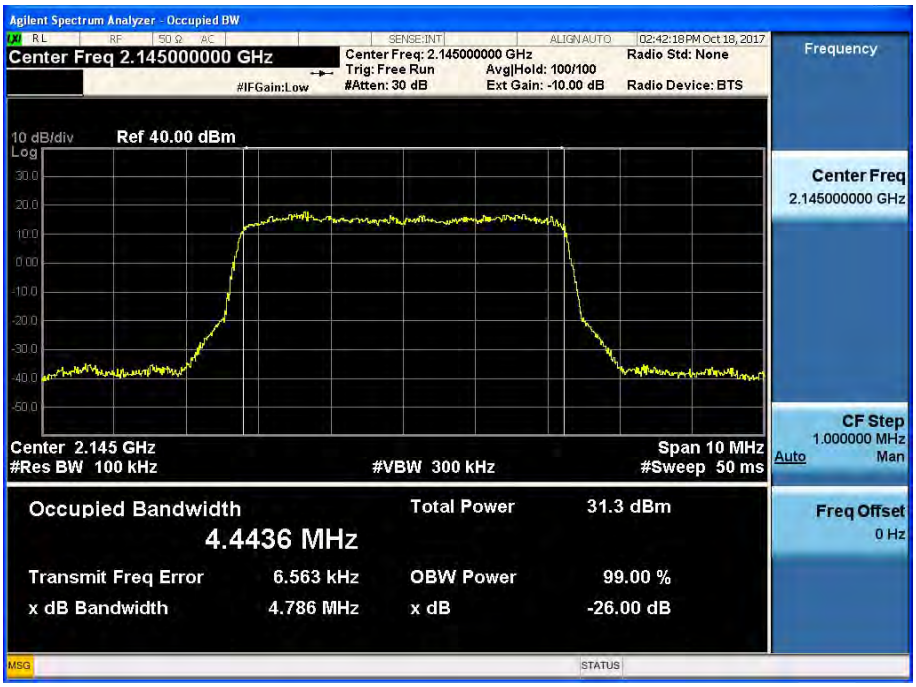

(16QAM High Channel)



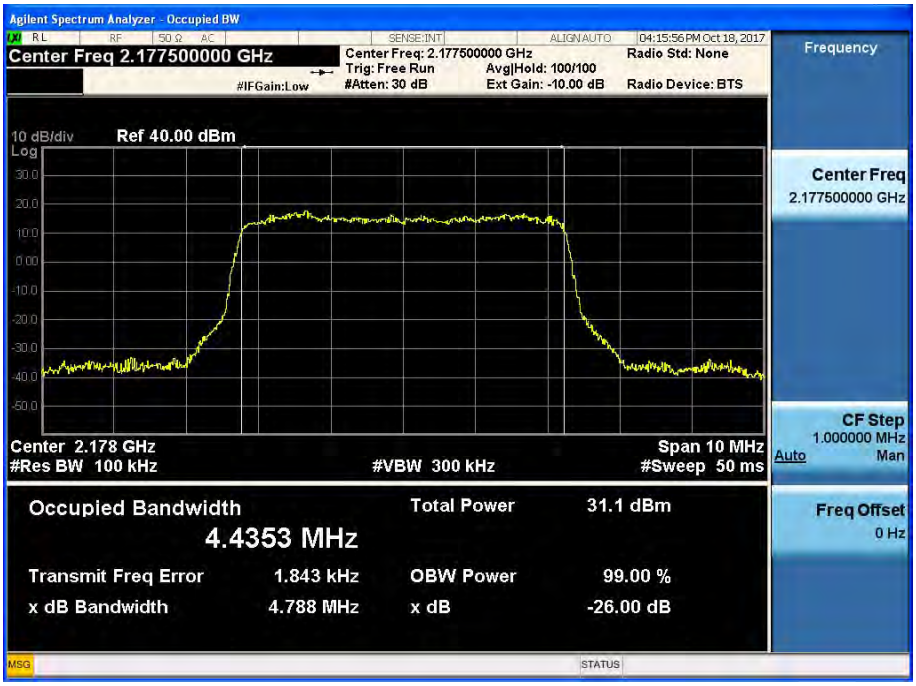
(64QAM Low Channel)




(64QAM Middle Channel)



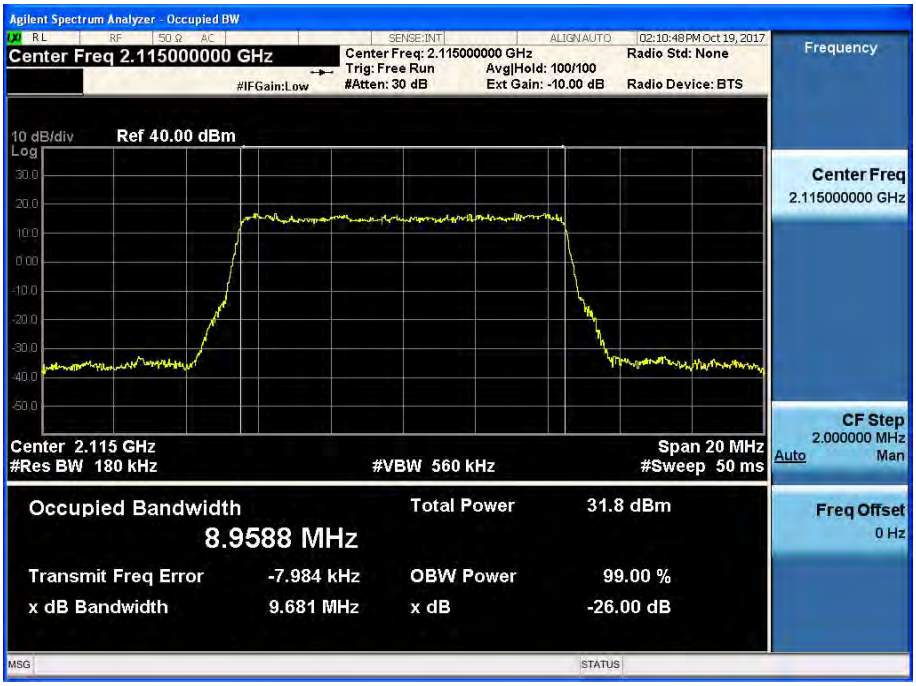
(64QAM High Channel)



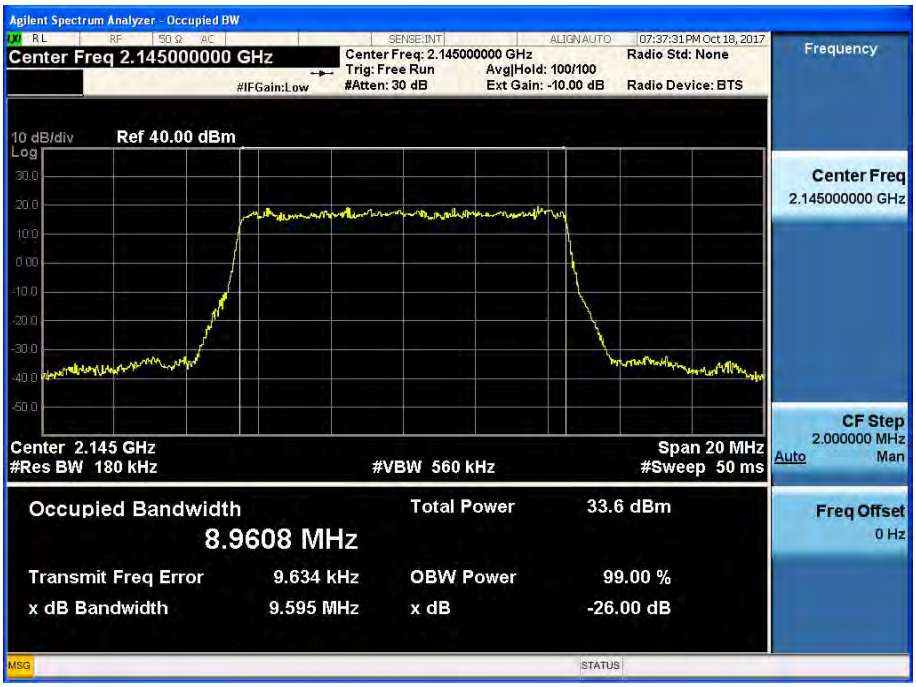
**AWS 2100_LTE 10 MHz**

**Test Plot at Output Port 4**

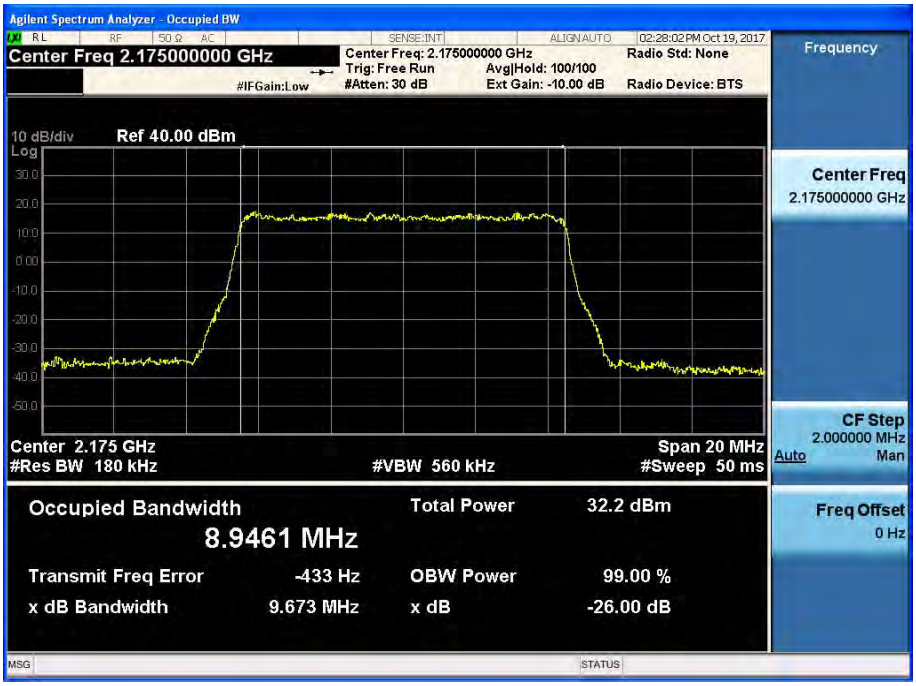
(QPSK Low Channel)



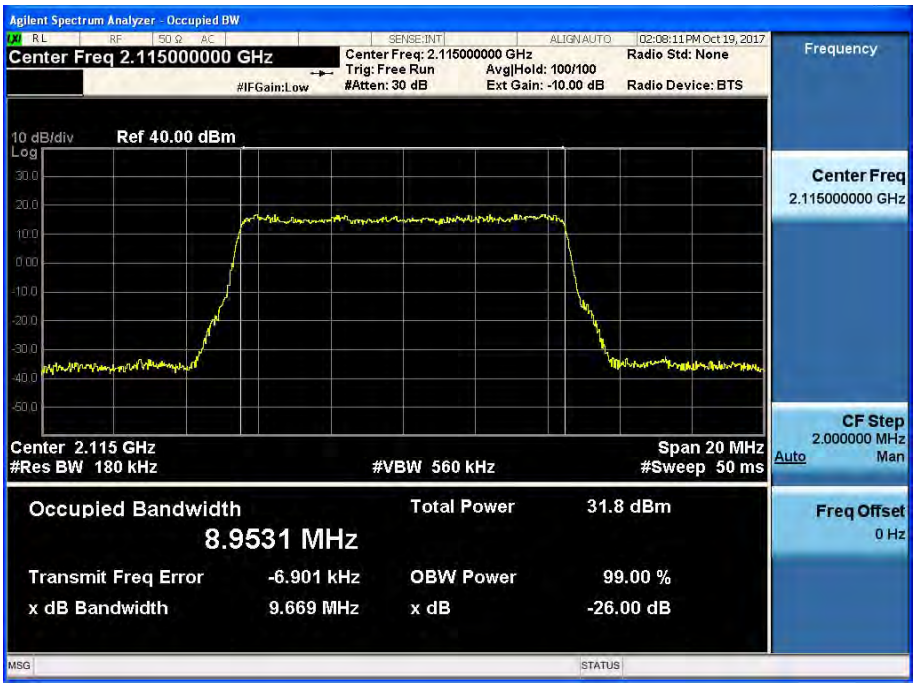

(QPSK Middle Channel)



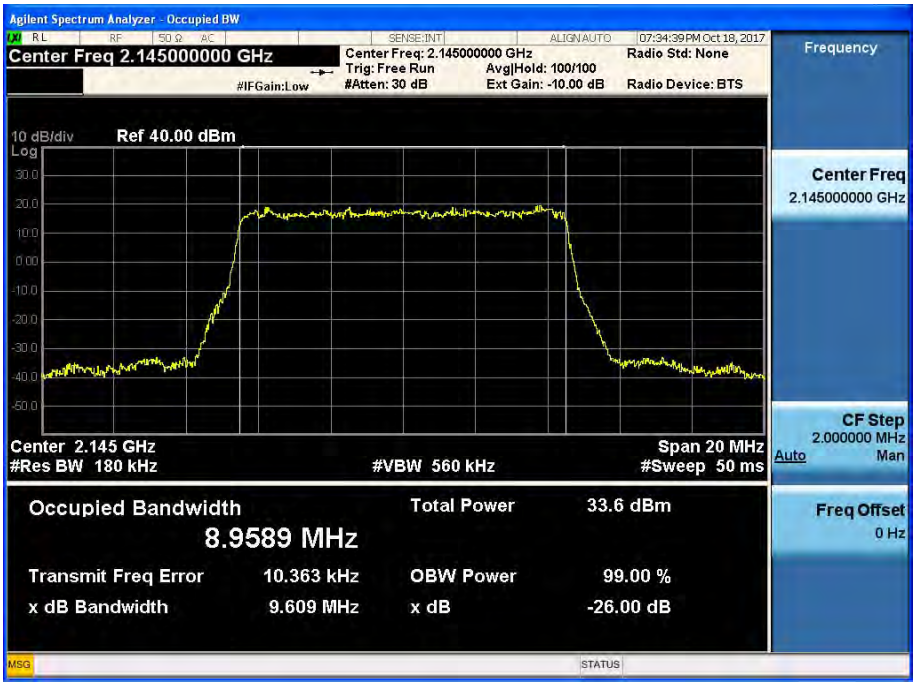
(QPSK High Channel)



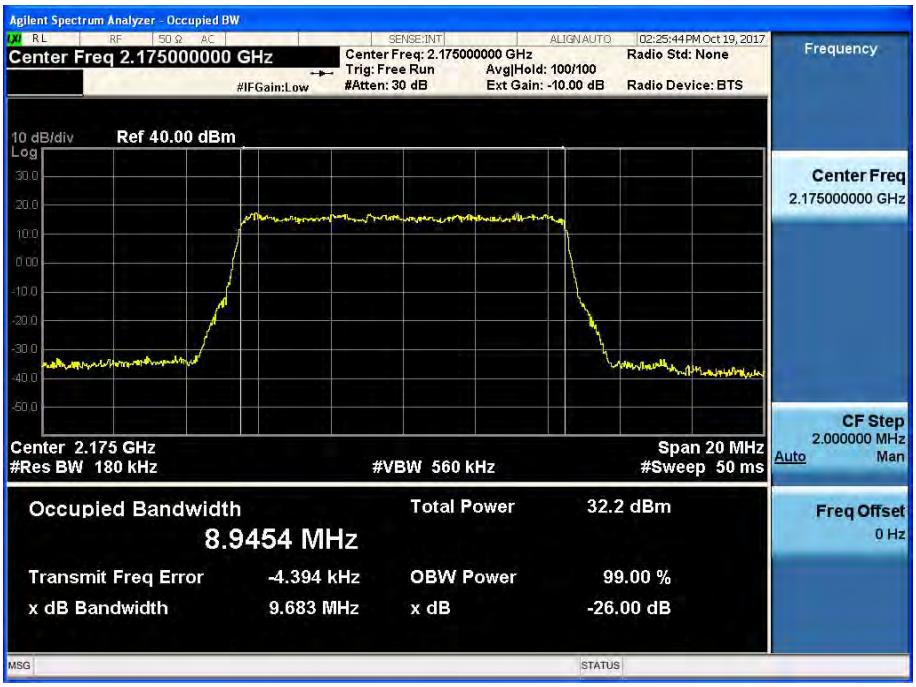

(16QAM Low Channel)



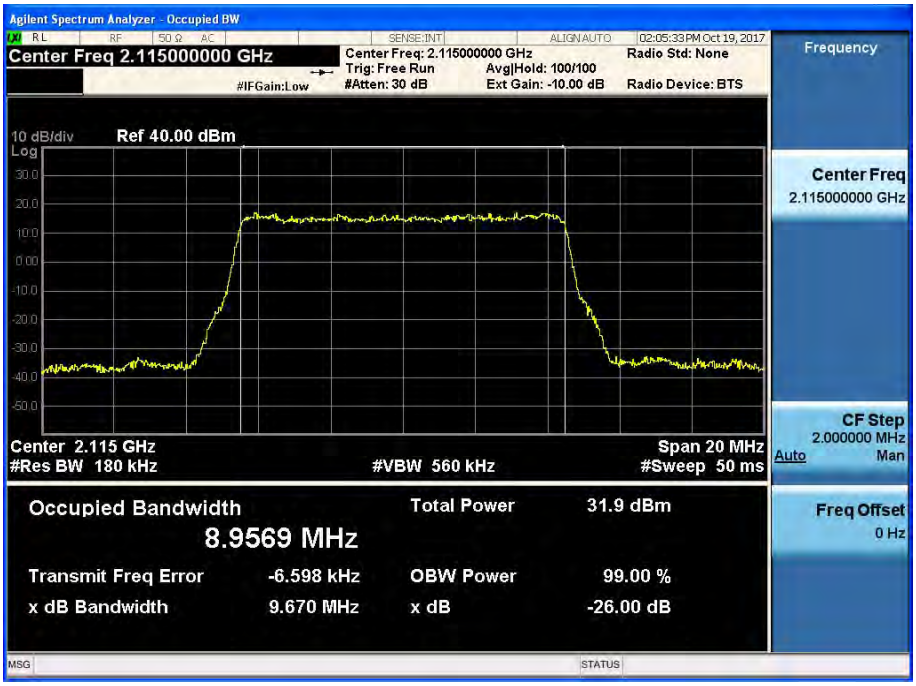
(16QAM Middle Channel)



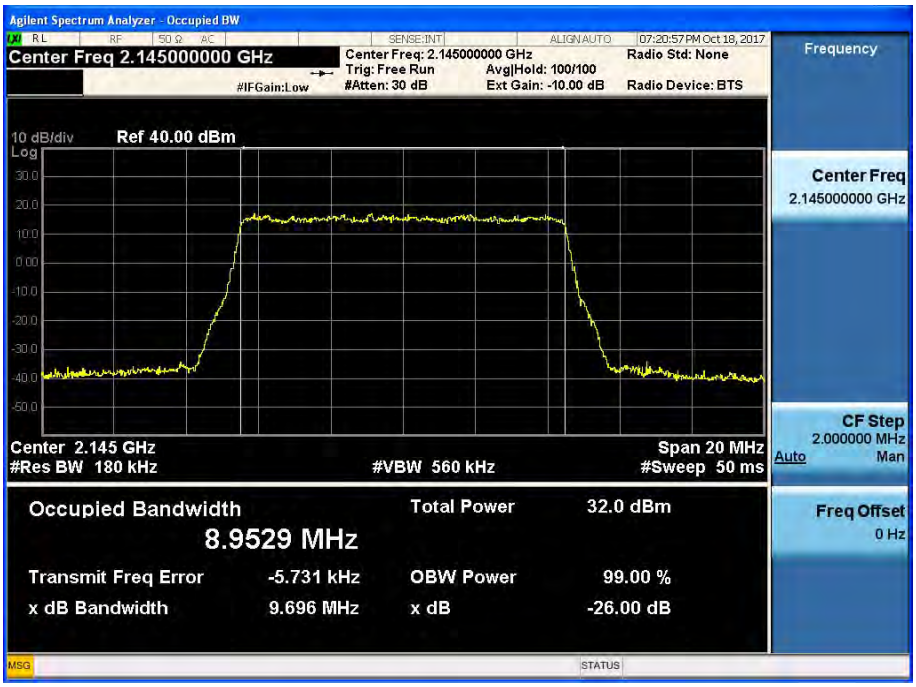

(16QAM High Channel)



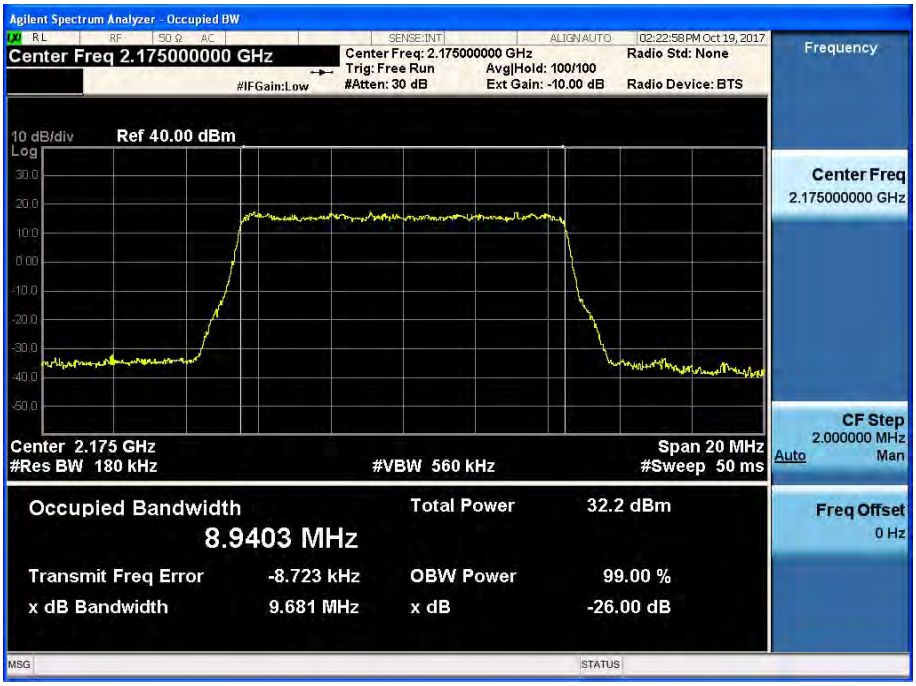
(64QAM Low Channel)




(64QAM Middle Channel)



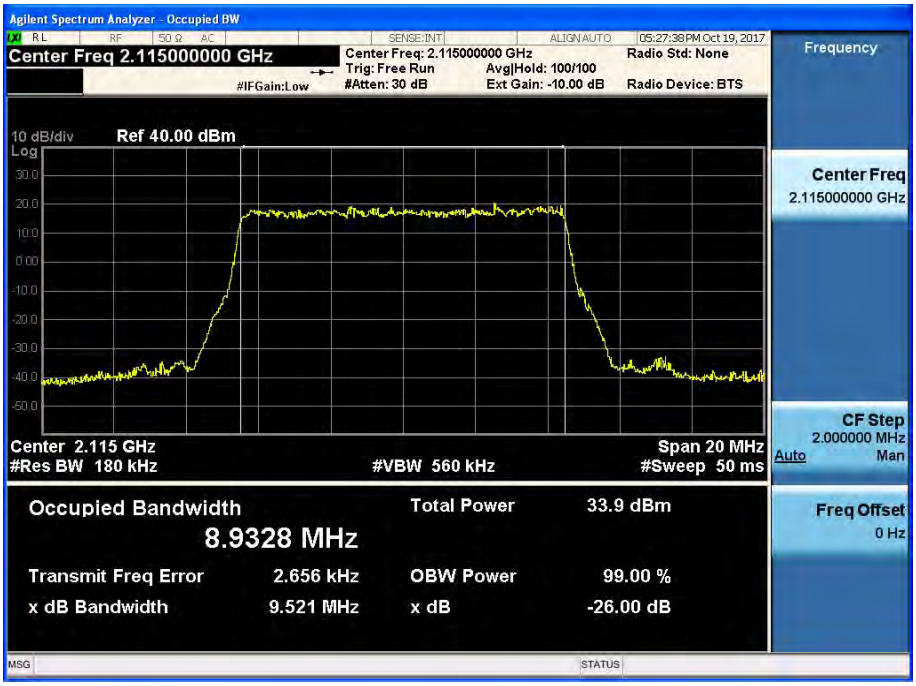
(64QAM High Channel)



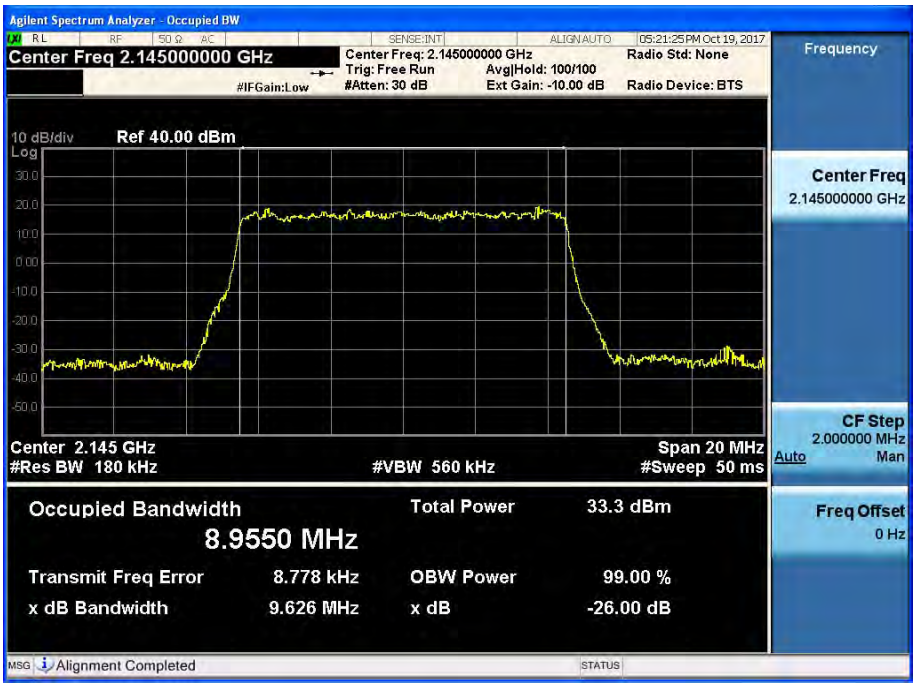
**AWS 2100_LTE 10 MHz**

**Test Plot at Output Port 5**

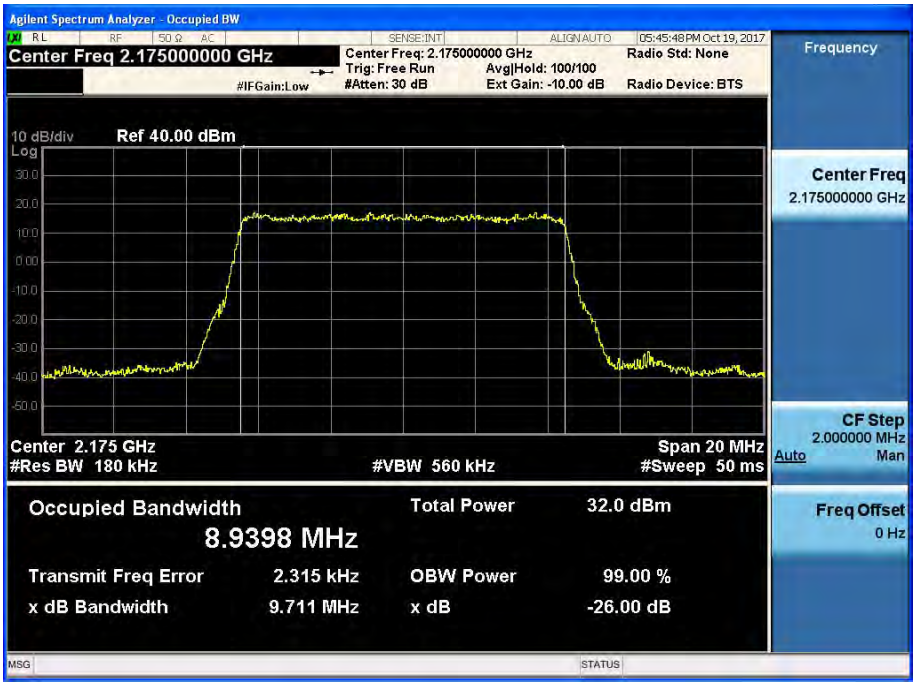
(QPSK Low Channel)



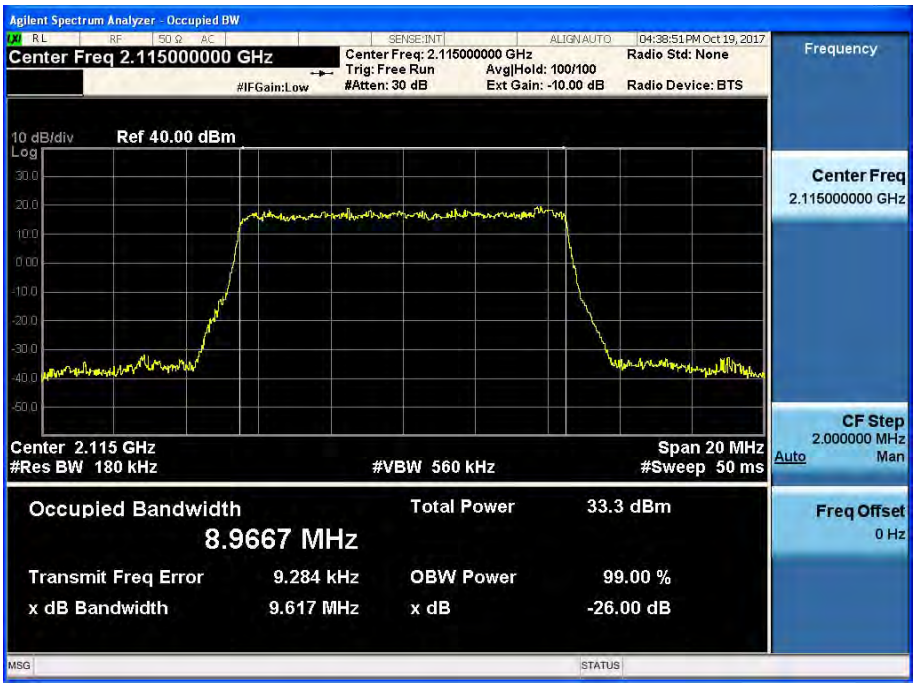

(QPSK Middle Channel)



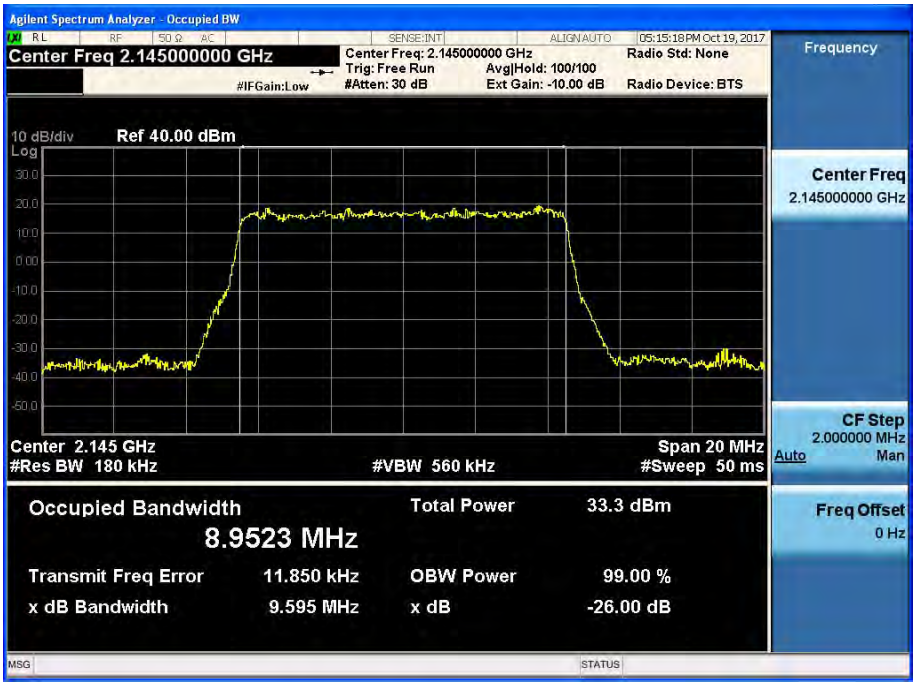
(QPSK High Channel)



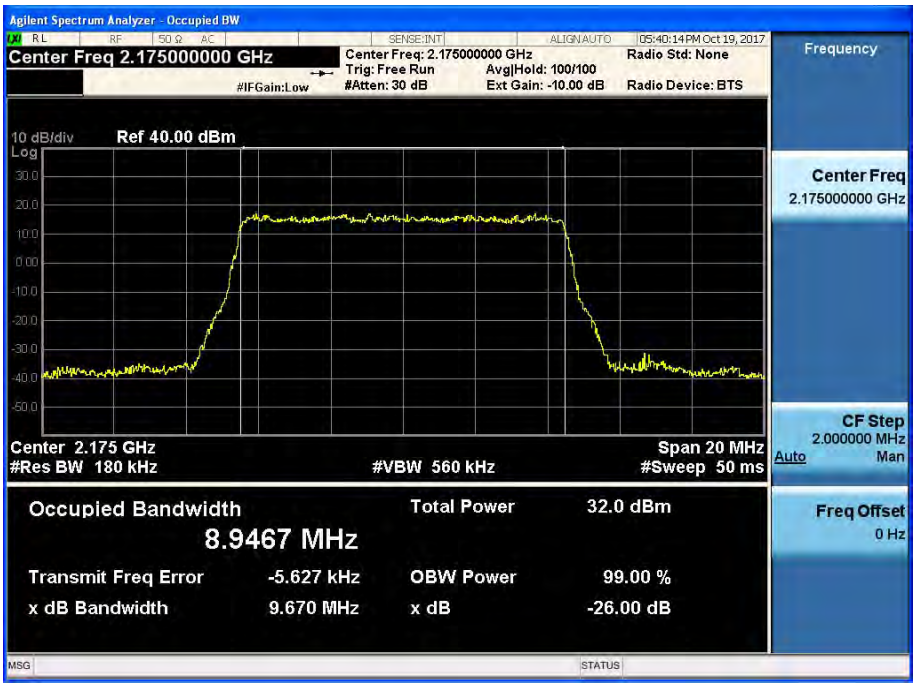

(16QAM Low Channel)



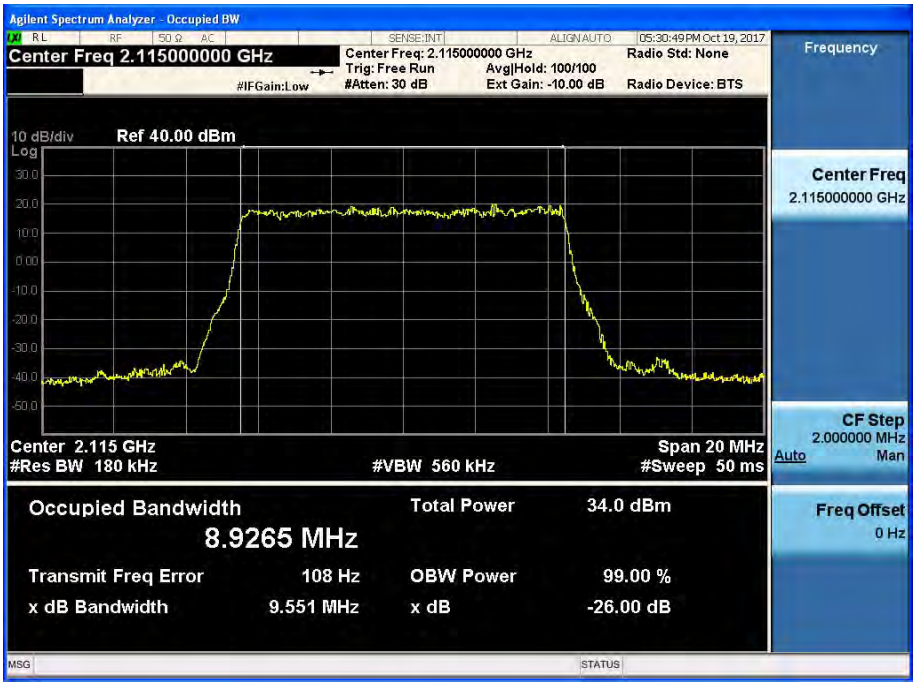
(16QAM Middle Channel)



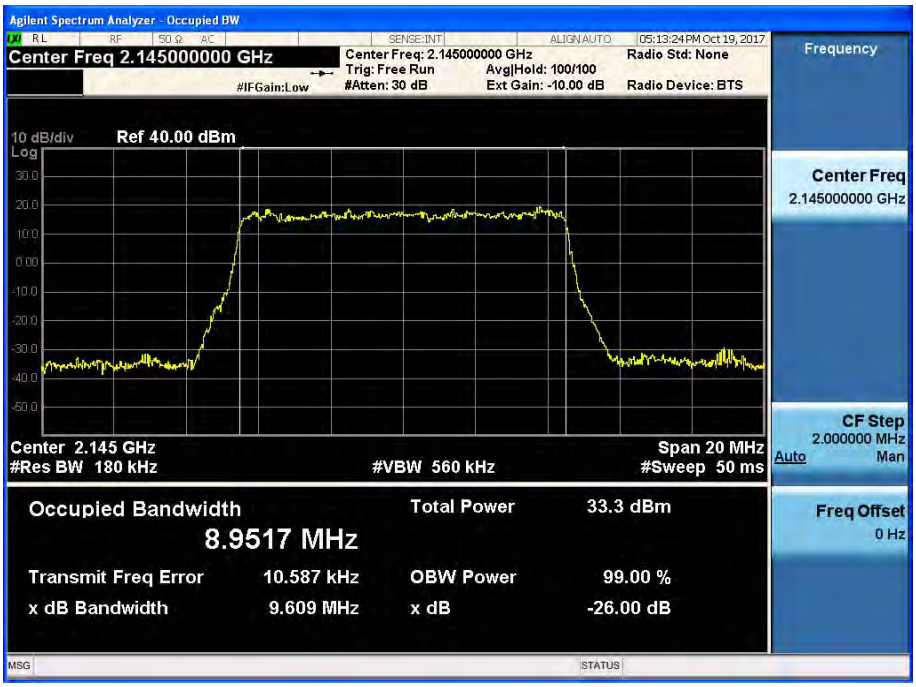

(16QAM High Channel)



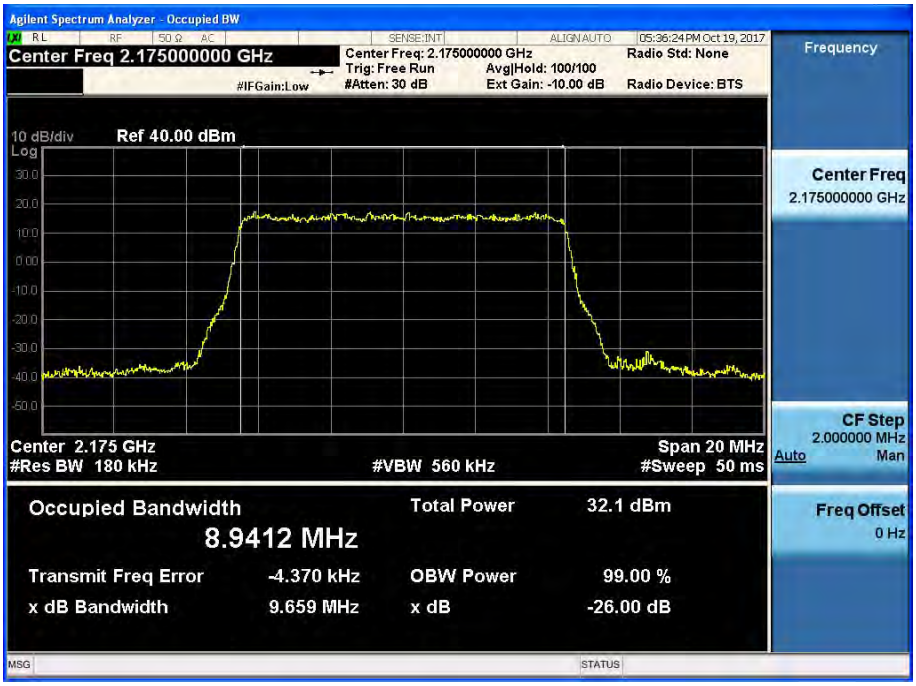
(64QAM Low Channel)




(64QAM Middle Channel)



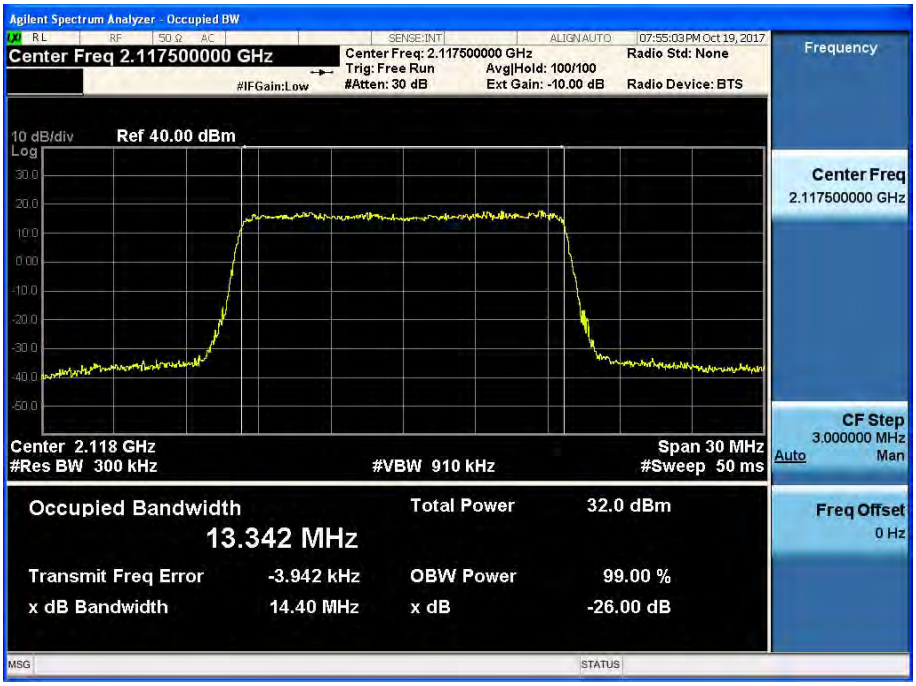
(64QAM High Channel)



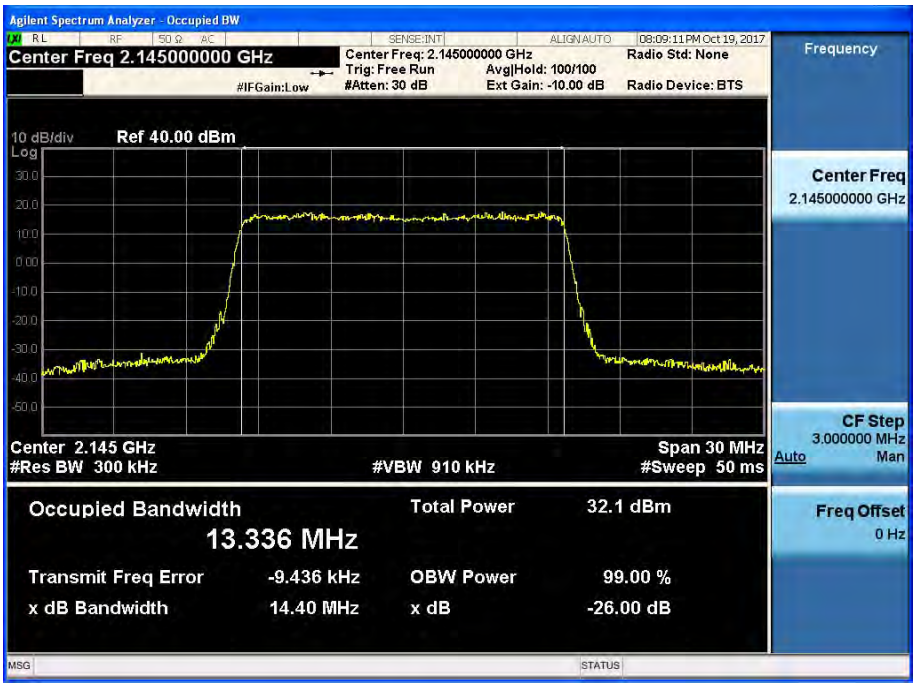
**AWS 2100_LTE 15 MHz**

**Test Plot at Output Port 4**

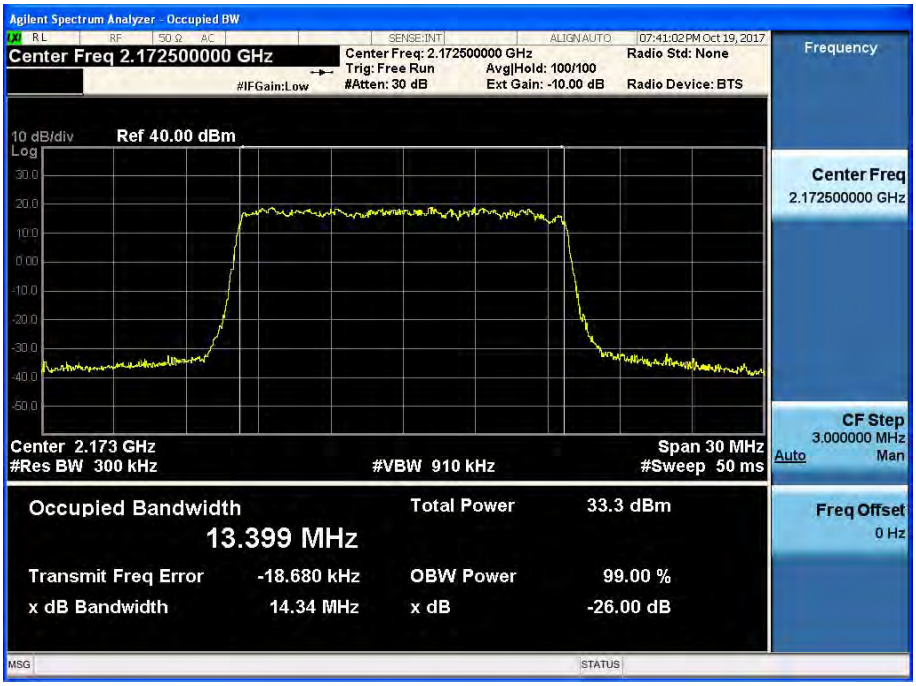
(QPSK Low Channel)



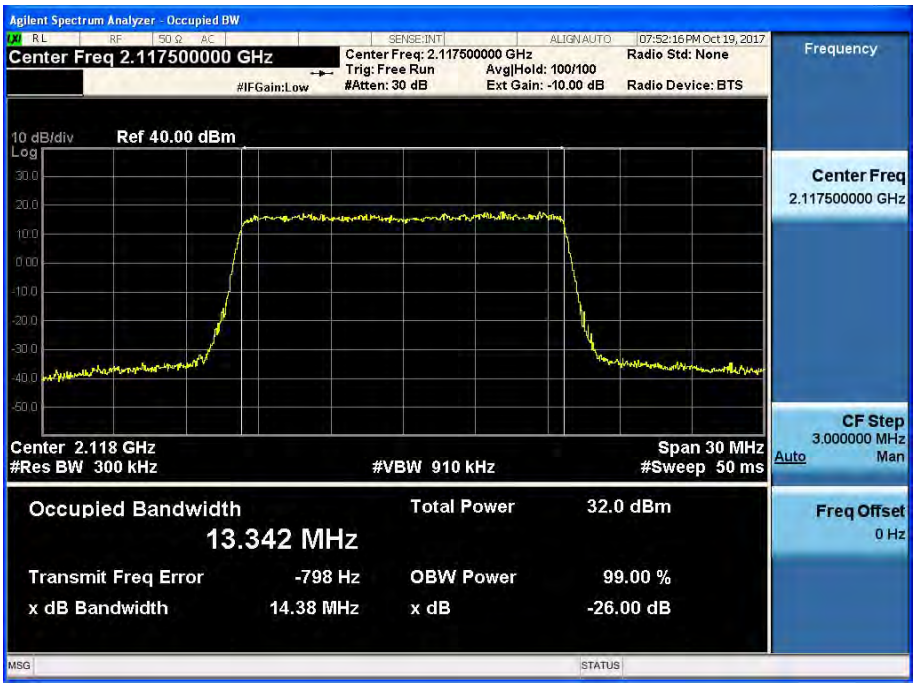

(QPSK Middle Channel)



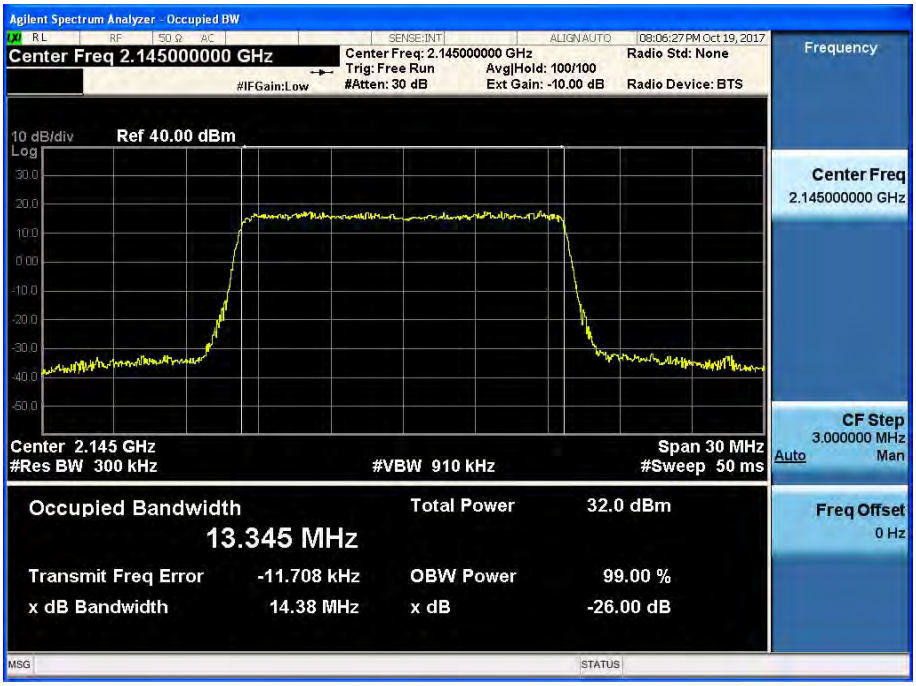
(QPSK High Channel)




(16QAM Low Channel)



(16QAM Middle Channel)




(16QAM High Channel)