



**MOBILE DEVICES BUSINESS**

**PRODUCT SAFETY AND COMPLIANCE**

**EMC LABORATORY**

**EMC TEST REPORT**

**TEST REPORT NUMBER – 25389-1 LTE**

The test results and statements contained herein relate only to the model(s) identified and tested. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical characteristics.

As the responsible EMC Engineer, I hereby declare that the equipment tested as specified in this report conforms to the requirements indicated.

Signature:

A handwritten signature in black ink, reading 'Albert J. Patapack', written over a light beige rectangular background.

Name: Albert J. Patapack

Title: EMC Engineer

Date: June 3, 2013

This report must not be reproduced, except in full, without written approval from this laboratory.



2404

**Table of Contents**

| <u>Description</u>                      | <u>Page</u> |
|-----------------------------------------|-------------|
| Test Report Details                     | 3           |
| Applicable Standards                    | 4           |
| Summary of Testing                      | 4           |
| General and Special Conditions          | 4           |
| Equipment List                          | 5           |
| Measurement Procedures and Data         | 6           |
| Radiated Power                          | 6           |
| Measurement results                     | 7           |
| Occupied Bandwidth                      | 11          |
| Measurement results                     | 12          |
| Band Edge Measurement                   | 26          |
| Measurement results                     | 27          |
| Spurious Emissions at Antenna Terminals | 41          |
| Measurement results                     | 42          |
| Field Strength of Spurious Emissions    | 64          |
| Measurement results                     | 65          |
| Frequency Stability                     | 68          |
| Measurement results                     | 69          |

**Test Report Details**

|                         |                                                                                                                                                                                                                                                                            |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| All Tests Performed By: | ADR Testing Service<br>Location Code: ADR LV<br>Motorola Mobility LLC<br>Product Safety and Compliance Group<br>600 North US Hwy 45<br>Libertyville, IL 60048<br>PH (847) 523-6167 Fax (847) 523-4538<br>FCC Registration Number: 316588<br>Industry Canada Number: 109O-1 |
| Tests Requested By:     | Motorola Mobility LLC<br>600 North US Hwy 45<br>Libertyville, IL 60048                                                                                                                                                                                                     |
| Product Type:           | Cellular Phone                                                                                                                                                                                                                                                             |
| Signaling Capability:   | WCDMA 1700/1900/2100/850/900,<br>GSM 1800/1900/850/900,<br>LTE Band 02/Band4/Band 17, aGPS,<br>Bluetooth Class 2, Version 4.0 LE+EDR,<br>802.11b/802.11g/802.11a/802.11n/802.11ac, NFC                                                                                     |
| FCC ID:                 | IHDT56PA2                                                                                                                                                                                                                                                                  |
| Serial Numbers:         | LXAA1W0033, LXAA1W0024, LXAA1W0028,<br>LXAA1W0009, LXAB140001, LXTU1J0043,<br>LXTU1J0003, LXTU1J0055                                                                                                                                                                       |
| Testing Complete Date:  | April 9 – June 3, 2013                                                                                                                                                                                                                                                     |

**Applicable Standards**

All tests and measurements indicated in this document were performed in accordance with the Code of Federal Regulations Title 47 Part 2, Sub-part J as well as the following parts:

  X   Part 24  
  X   Part 27

Applicable Standards: ANSI 63.4 2003, ANSI/TIA-603-C-2004, RSS-Gen Issue 3, RSS-132 Issue 3, RSS-133 Issue 6, RSS-139 Issue 2.

**Summary of Testing**

| Test # | Test Name                              | Pass/Fail |
|--------|----------------------------------------|-----------|
| 1      | ERP (Effective Radiated Power)         | Pass      |
| 2      | Occupied Bandwidth                     | Pass      |
| 3      | Band Edge                              | Pass      |
| 4      | Spurious Emissions at Antenna Terminal | Pass      |
| 5      | Field Strength of Spurious Emissions   | Pass      |
| 6      | Frequency Stability                    | Pass      |

The margin with respect to the limit is the minimum margin for all modes and bands.

**General and Special Conditions**

This product utilizes an internal battery that is not removable. When applicable, EMC testing was performed with the internal battery fully charged. Where the internal battery could not be used due to the need for a controlled variation of input voltage, an external power supply was utilized.

All testing was done in an indoor controlled environment. The temperature and the relative humidity were maintained within the ANSI C63.4 2003 Standard requirements during the entire duration of testing.

**Equipment List**

| Manufacturer     | Equipment Type                | Model No.   | Serial Number | Calibration Due Date |
|------------------|-------------------------------|-------------|---------------|----------------------|
| Rohde & Schwarz  | Receiver                      | ESIB40      | 100226        | 5/15/2013            |
| Rohde & Schwarz  | Receiver                      | ESIB26      | 838786/010    | 9/24/2013            |
| Hewlett Packard  | EMC Analyzer                  | E7405       | US40240219    | 7/30/2013            |
| Agilent          | MXA Signal Analyzer           | N9020A      | US46470586    | 1/20/2014            |
| Agilent          | Signal Generator              | 83712A      | 3429A00286    | 3/26/2013            |
| Agilent          | Signal Generator              | 83623B      | 3844A00935    | 5/11/2014            |
| ETS-Lindgren     | Horn Antenna                  | 3115        | 6222          | 7/26/2013            |
| A. H. Systems    | Horn Antenna                  | SAS 200/571 | 365           | 9/4/2013             |
| ETS              | Log-Periodic Antenna          | 3148        | 1188          | 9/6/2013             |
| ETS              | Biconical Antenna             | 3110B       | 3369          | 9/5/2013             |
| TDK RF Solutions | Precision Log Periodic        | PLP 3003C   | 130387        | 2/25/2014            |
| Rohde & Schwarz  | Wideband Communication Tester | CMW500      | 126211        | 7/27/2013            |
| Attenuator       | Weinschel                     | AS-6        | 6675          | NCR                  |
| Attenuator       | Weinschel                     | AS-6        | 6677          | NCR                  |
| Thermotron       | Environmental Chamber         | S-4         | 31580         | 11/15/2013           |
| Agilent          | Power Meter                   | E4416A      | GB41293258    | 7/15/2013            |
| Agilent          | Power Sensor                  | E9323A      | US40412067    | 8/29/2013            |
| Rohde & Schwarz  | Amplifier                     | TS-PR18     | 100073        | 9/5/2013             |

Note that the Agilent power meter, the Signal Generator and the MXA signal analyzer are on a two-year calibration cycle. All other equipment is on a one-year calibration cycle. All testing was performed using equipment that was within calibration at the time that the test was performed. No equipment listed in the table above was used after the specified calibration due date. If, during the course of product testing, a piece of equipment went out of calibration, a similar piece of calibrated equipment was substituted. If a substitution was made, that new piece of equipment would be listed in the above table along with the piece that was removed from service.

## Measurement Procedures and Data

### RADIATED POWER

§24.232 (c), §27.50 (c) (10), §27.50 (d) (4)

#### Measurement Procedure

The equipment under test is placed inside the semi-anechoic chamber on a wooden table at the turntable center 3 meters from the receive antenna. The antenna mast is raised and lowered from 1 to 4 meters and the turntable is rotated 360 degrees to obtain a maximum reading on the spectrum analyzer. This is repeated for both horizontal and vertical polarizations of the receive antenna.

The equipment under test is then replaced with a substitution antenna fed by a signal generator. With the signal generator tuned to a particular frequency, the antenna mast is raised and lowered from 1 to 4 meters to obtain the same maximum reading at the spectrum analyzer. The output of the signal generator is then adjusted until a reading identical to that obtained with the actual transmitter is achieved.

The power in dBm of each emission is calculated by correcting the signal generator level for cable loss and gain of the substitution antenna referenced to a dipole. A fully charged battery was used for the supply voltage.

An RMS detector was used for all measurements.

The EUT was tested in all configurations and the highest power level is reported.

The settings of the receiver were as follows:

|                       |       |
|-----------------------|-------|
| Units                 | dBm   |
| Divisions             | 5 dB  |
| Resolution Bandwidth  | 1 MHz |
| Video Bandwidth (AVG) | 3 MHz |
| Sweep Time            | Auto  |

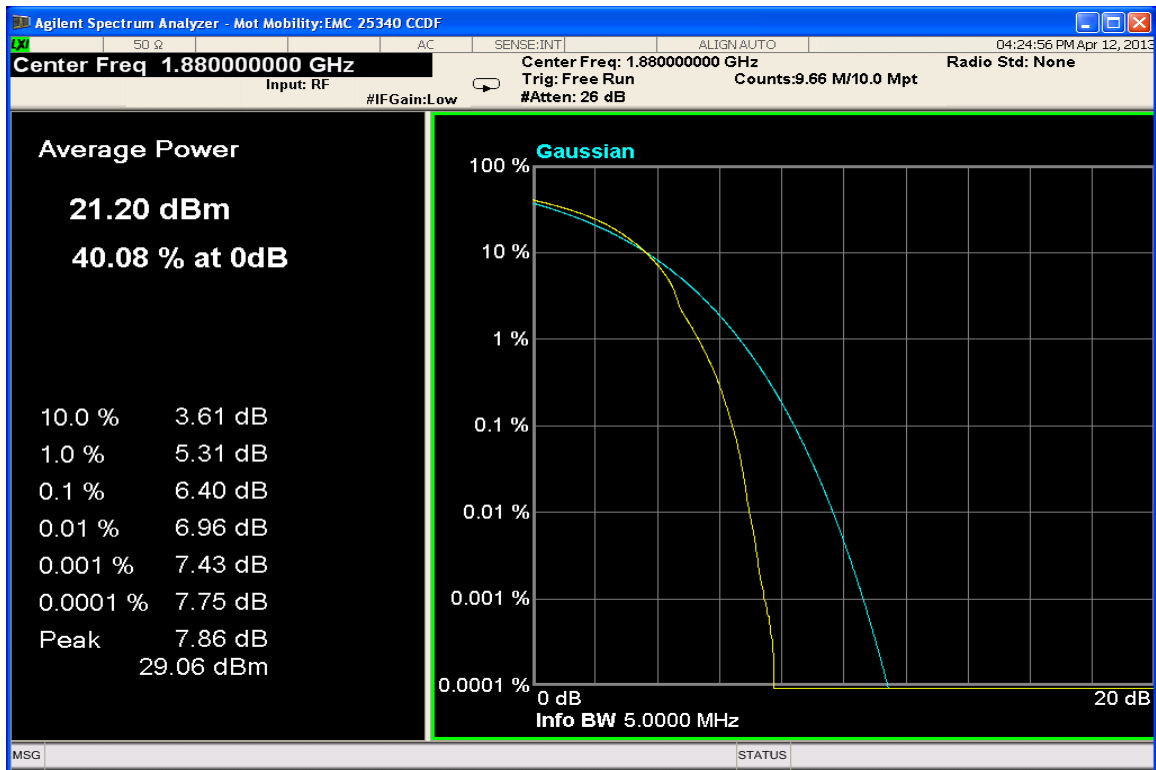
The EUT was tested under all configurations and modulations with the worst cases reported in the plots below.

**Measurement Results**

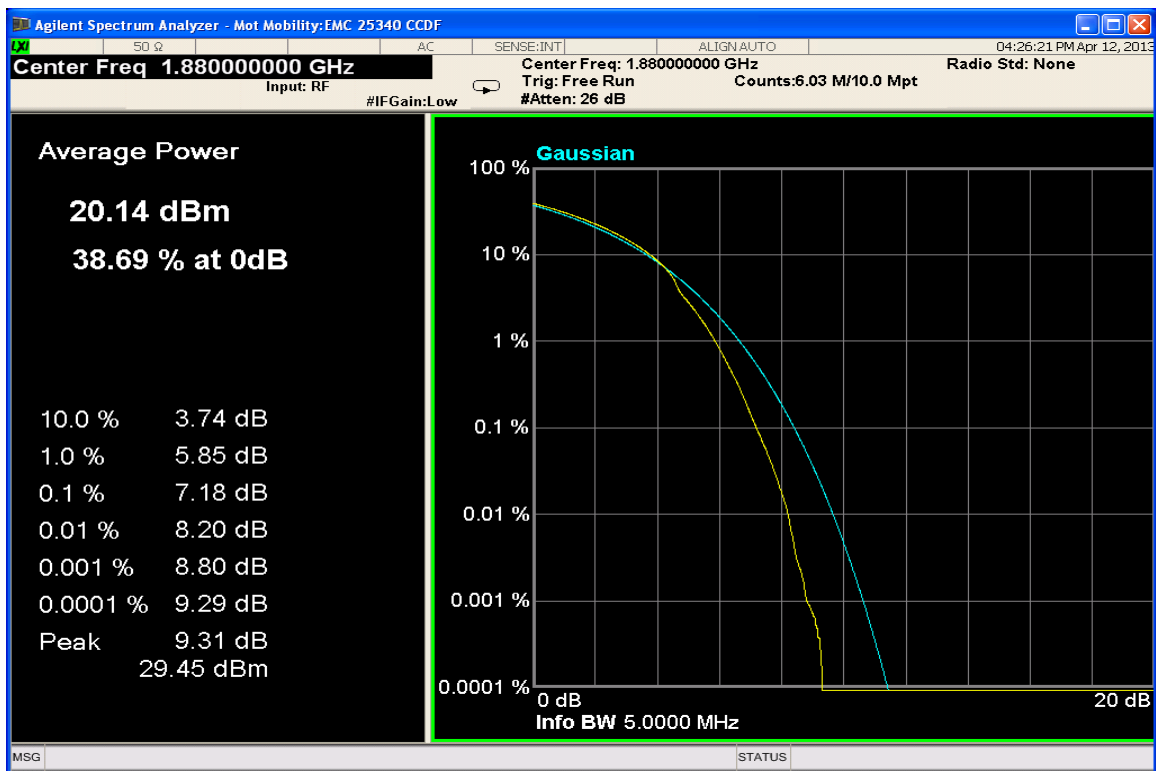
| Band   | BW  | Modulation | RB Size/Offset | EIRP dBm | Limit dBm |
|--------|-----|------------|----------------|----------|-----------|
| Band 2 | 20  | QPSK       | 1/50           | 29.43    | 33.01     |
|        | 15  | QPSK       | 1/37           | 29.42    | 33.01     |
|        | 10  | QPSK       | 1/25           | 29.32    | 33.01     |
|        | 5   | QPSK       | 1/12           | 29.12    | 33.01     |
|        | 3   | QPSK       | 1/7            | 28.82    | 33.01     |
|        | 1.4 | QPSK       | 1/3            | 28.72    | 33.01     |
|        |     |            |                |          |           |
|        | 20  | 16 QAM     | 1/50           | 27.79    | 33.01     |
|        | 15  | 16 QAM     | 1/37           | 27.32    | 33.01     |
|        | 10  | 16 QAM     | 1/25           | 27.42    | 33.01     |
|        | 5   | 16 QAM     | 1/12           | 27.22    | 33.01     |
|        | 3   | 16 QAM     | 1/7            | 27.05    | 33.01     |
|        | 1.4 | 16 QAM     | 1/3            | 27.22    | 33.01     |

| Band   | BW  | Modulation | RB Size/Offset | EIRP dBm | Limit dBm |
|--------|-----|------------|----------------|----------|-----------|
| Band 4 | 20  | QPSK       | 1/50           | 26.90    | 30.00     |
|        | 15  | QPSK       | 1/37           | 26.95    | 30.00     |
|        | 10  | QPSK       | 1/25           | 27.06    | 30.00     |
|        | 5   | QPSK       | 1/12           | 27.41    | 30.00     |
|        | 3   | QPSK       | 1/7            | 27.58    | 30.00     |
|        | 1.4 | QPSK       | 1/3            | 27.61    | 30.00     |
|        |     |            |                |          |           |
|        | 20  | 16 QAM     | 1/50           | 24.56    | 30.00     |
|        | 15  | 16 QAM     | 1/37           | 24.60    | 30.00     |
|        | 10  | 16 QAM     | 1/25           | 24.66    | 30.00     |
|        | 5   | 16 QAM     | 1/12           | 24.98    | 30.00     |
|        | 3   | 16 QAM     | 1/7            | 25.12    | 30.00     |
|        | 1.4 | 16 QAM     | 1/3            | 25.36    | 30.00     |

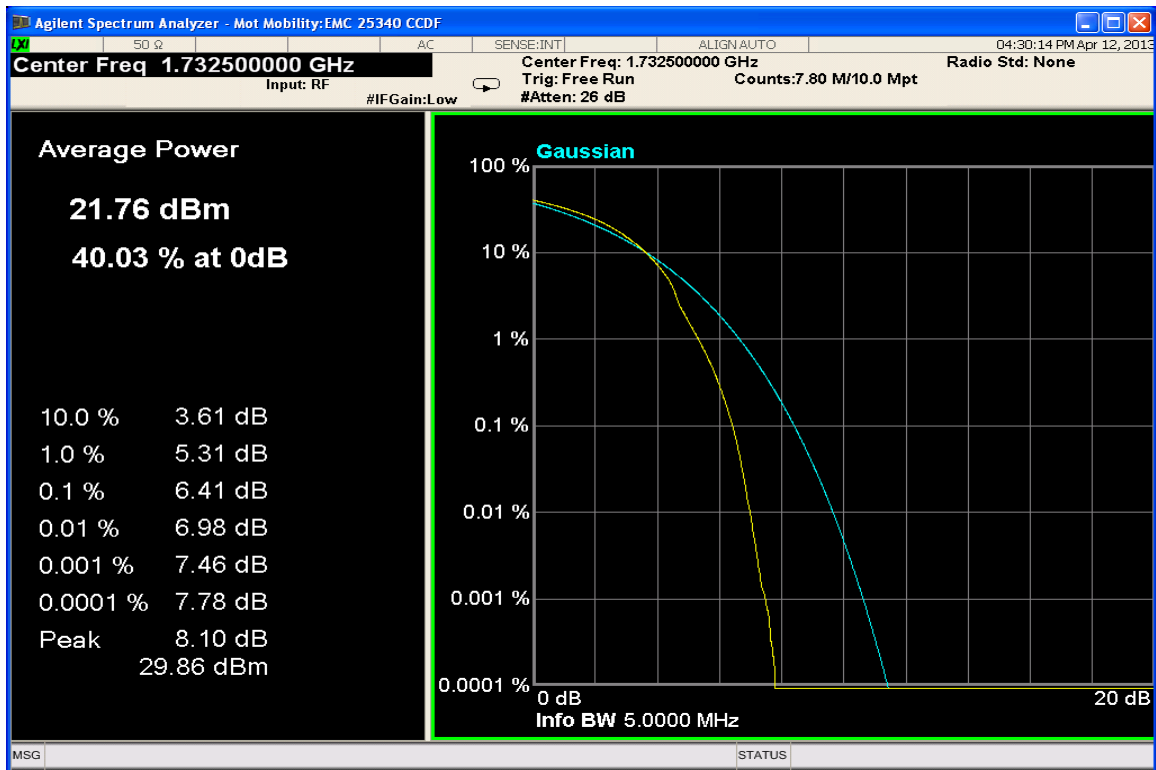
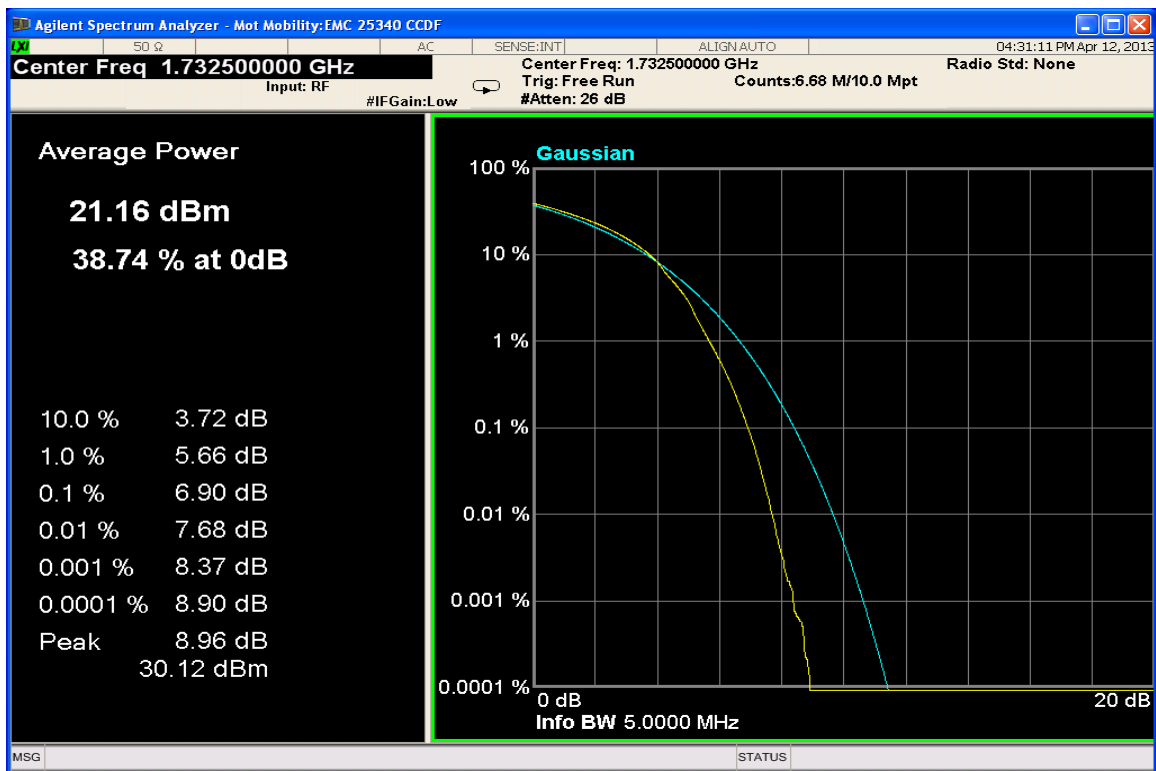
| Band    | BW | Modulation | RB Size/Offset | ERP dBm | Limit dBm |
|---------|----|------------|----------------|---------|-----------|
| Band 17 | 10 | QPSK       | 1/25           | 16.89   | 34.77     |
|         | 5  | QPSK       | 1/12           | 17.05   | 34.77     |
|         |    |            |                |         |           |
|         | 10 | 16 QAM     | 1/25           | 14.87   | 34.77     |
|         | 5  | 16 QAM     | 1/12           | 14.91   | 34.77     |

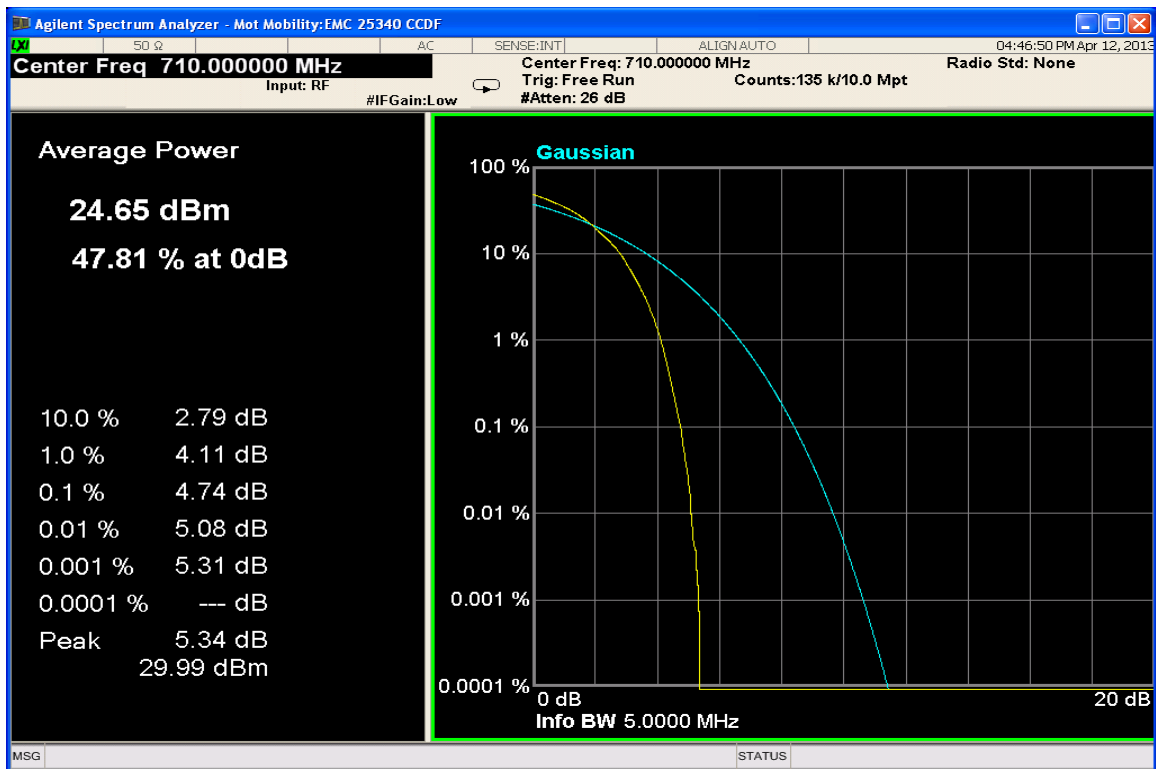


**LTE Band 2 PAR Plot - 20 MHz BW, QPSK RB Size = 100 RB Start 0**



**LTE Band 2 PAR Plot - 20 MHz BW, 16-QAM RB Size = 100 RB Start 0**

**LTE Band 4 PAR Plot - 20 MHz BW, QPSK RB Size = 100 RB Start 0****LTE Band 4 PAR Plot - 20 MHz BW, 16-QAM RB Size = 100 RB Start 0**



**LTE Band 17 PAR Plot - 10 MHz BW, QPSK RB Size = 50 RB Start 0**



**LTE Band 17 PAR Plot - 10 MHz BW, 16-QAM RB Size = 50 RB Start 0**

**OCCUPIED BANDWIDTH**

§ 2.1049

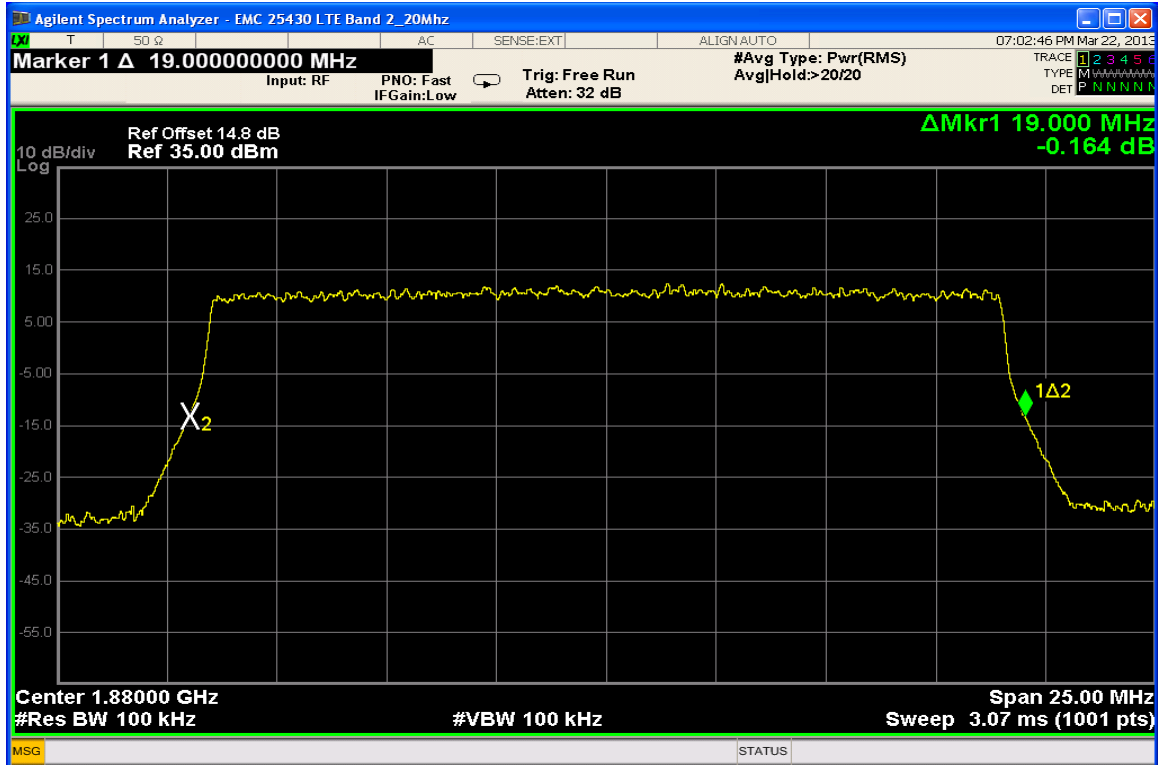
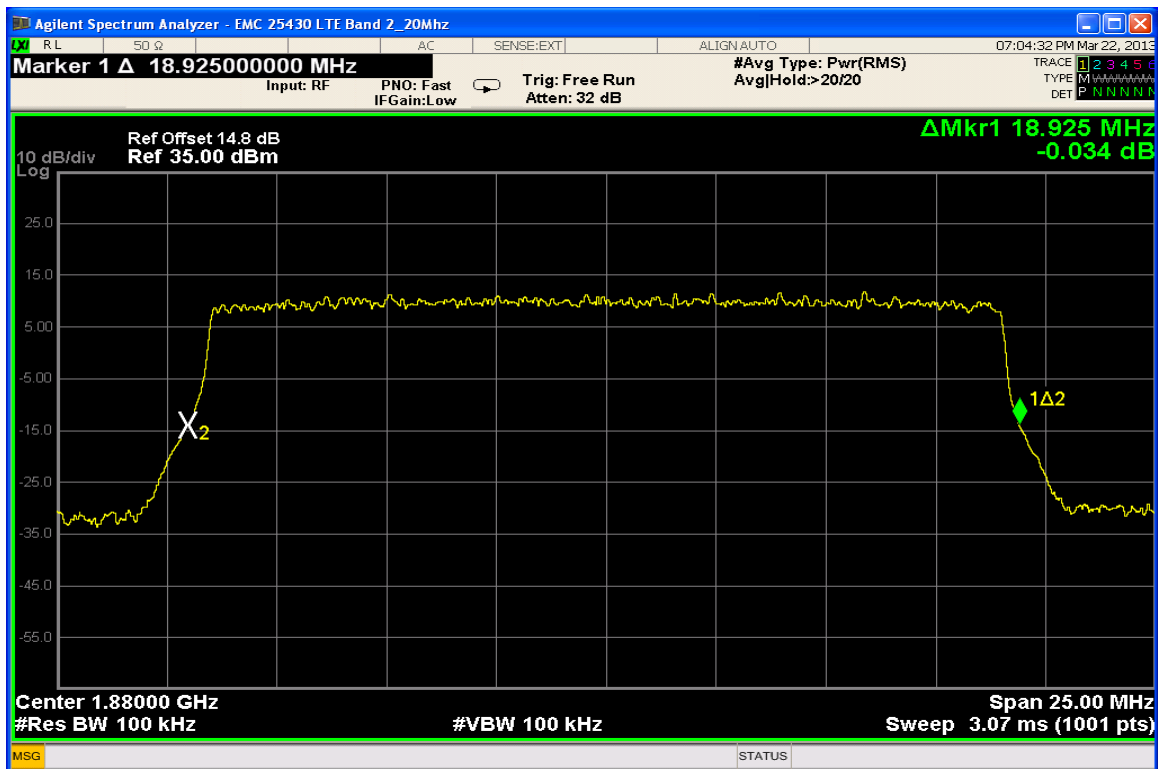
**Measurement Procedure**

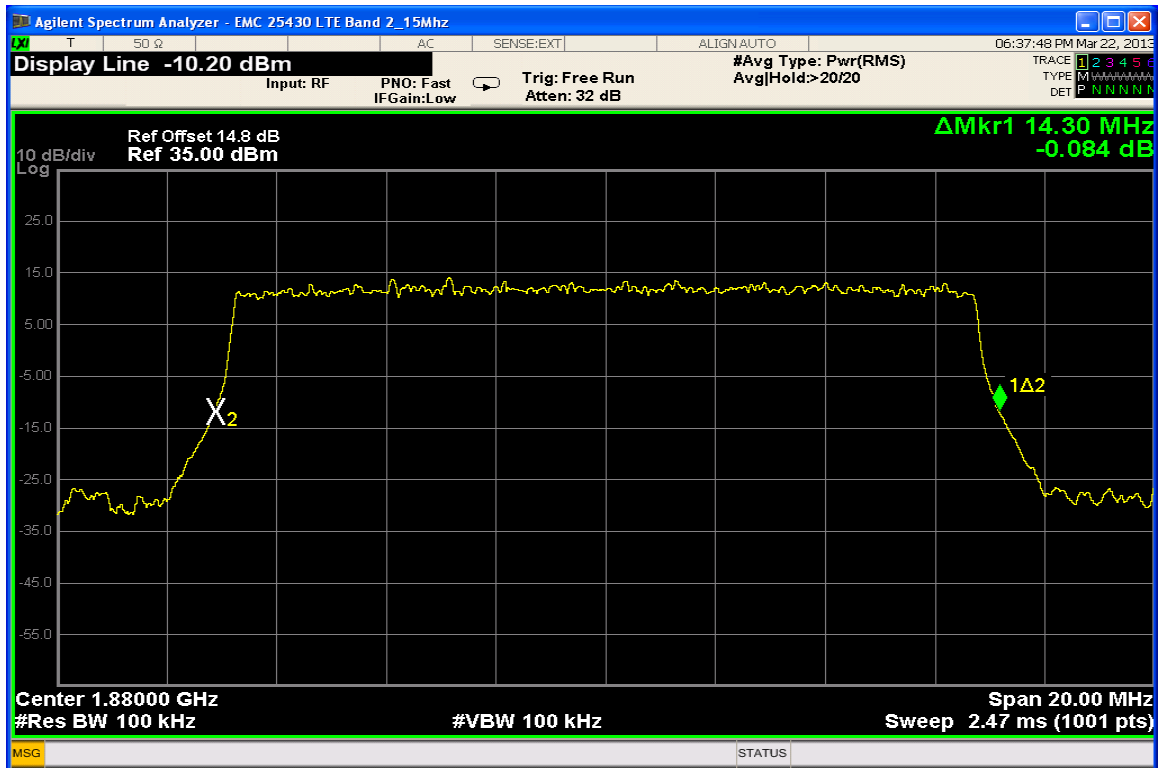
The RF output port of the EUT is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10dB passive attenuator. The amplitude of the spectrum analyzer is corrected for the attenuator and any other applicable losses. The analyzer is set for Peak Detector and each trace is set for Max Hold. The fully charged internal battery was used for the supply voltage.

The EUT was tested under all configurations and modulations.

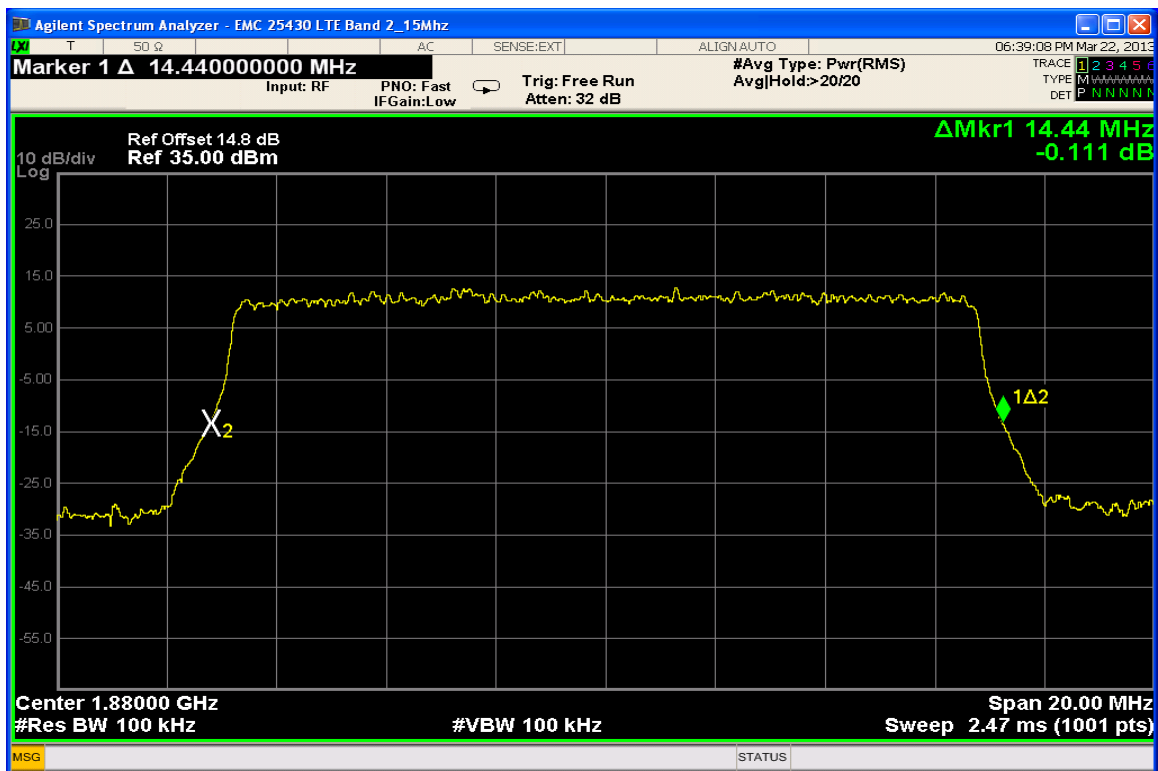
**Measurement Results**

Attached

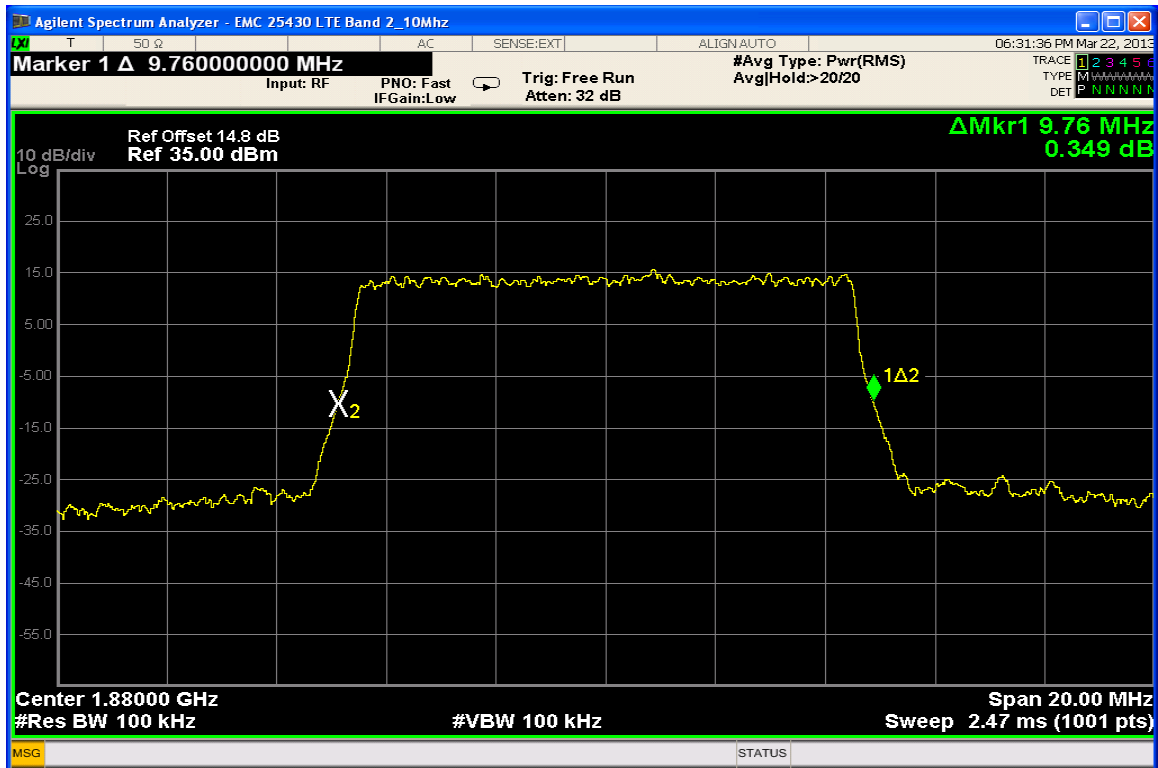
**Measurement Results: LTE Band 2 QPSK & 16-QAM Occupied Bandwidth****Band 2 LTE – 20 MHz BW, QPSK RB Size = 100 RB Start 0****Band 2 LTE – 20 MHz BW, 16-QAM RB Size = 100 RB Start 0**



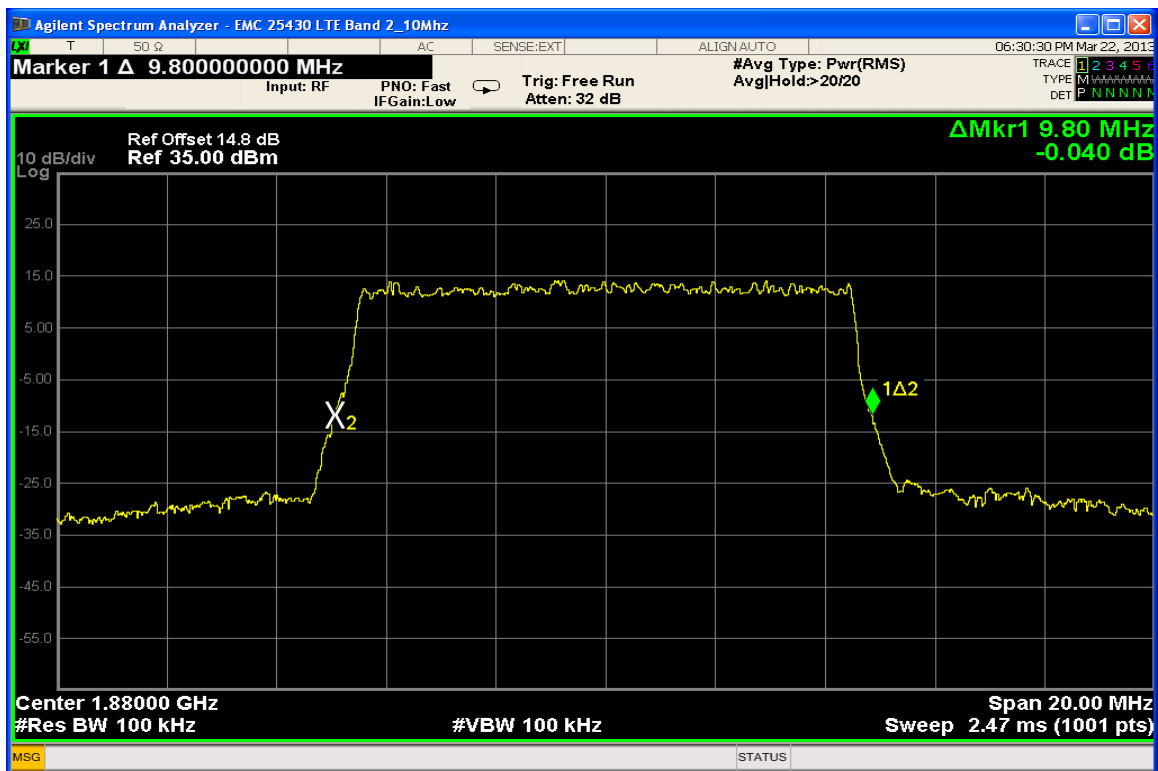
Band 2 LTE – 15 MHz BW, QPSK RB Size = 75 RB Start 0



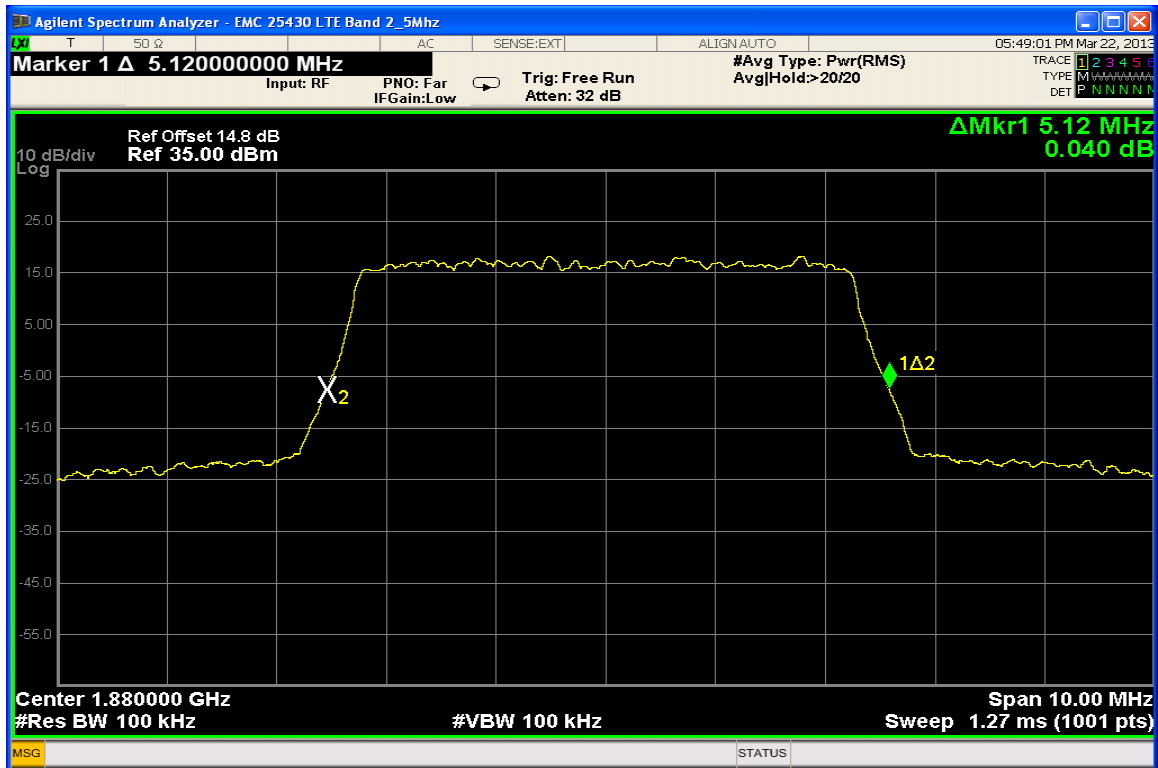
Band 2 LTE – 15 MHz BW, 16QAM RB Size = 75 RB Start 0



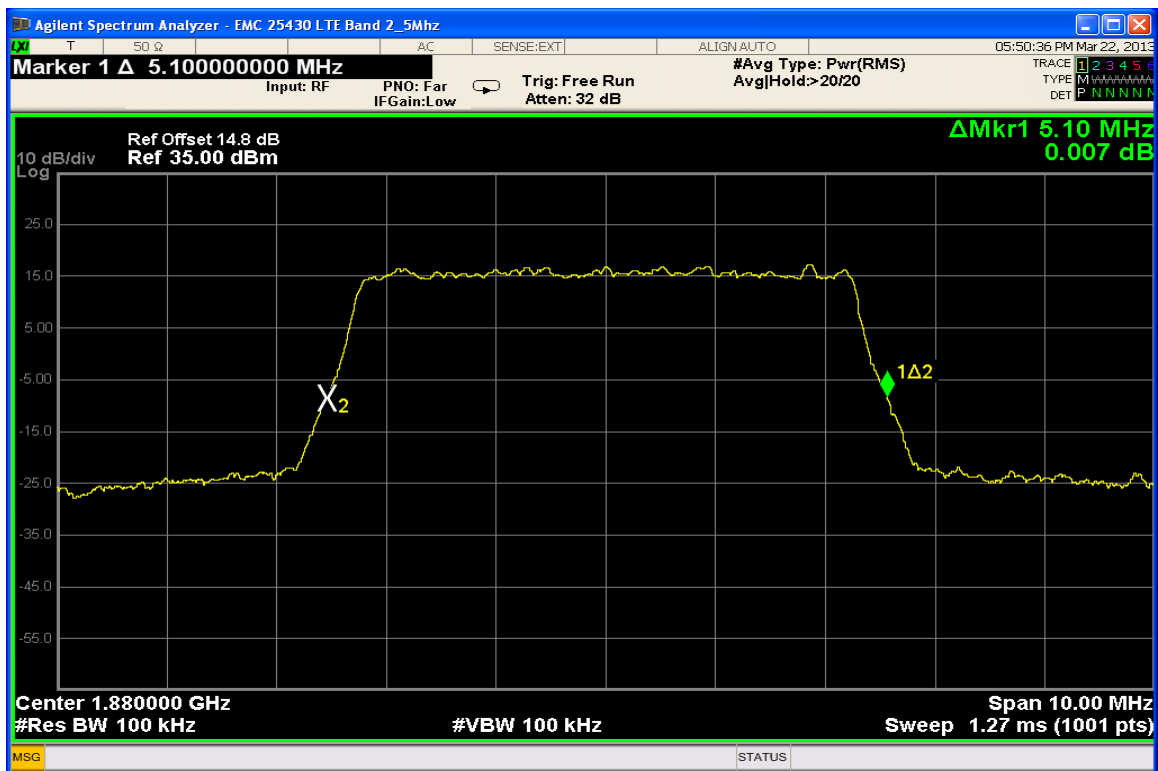
Band 2 LTE – 10 MHz BW, QPSK RB Size = 50 RB Start 0



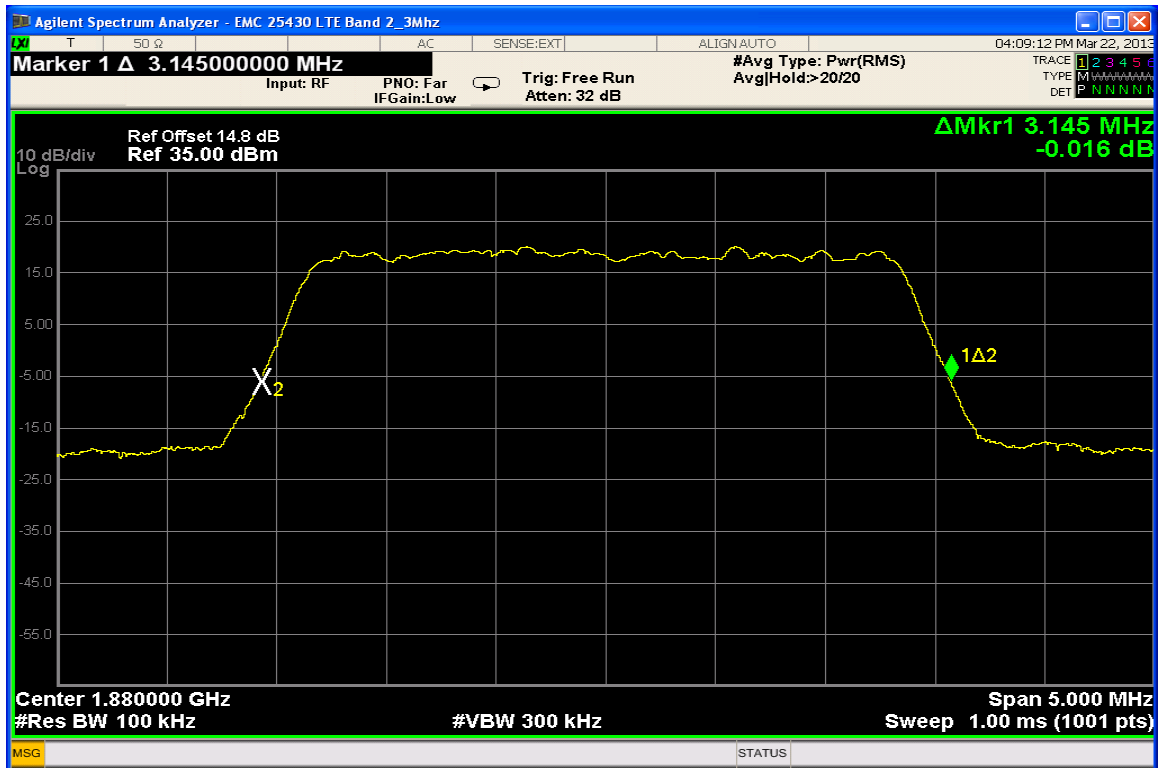
Band 2 LTE – 10 MHz BW, 16QAM RB Size = 50 RB Start 0



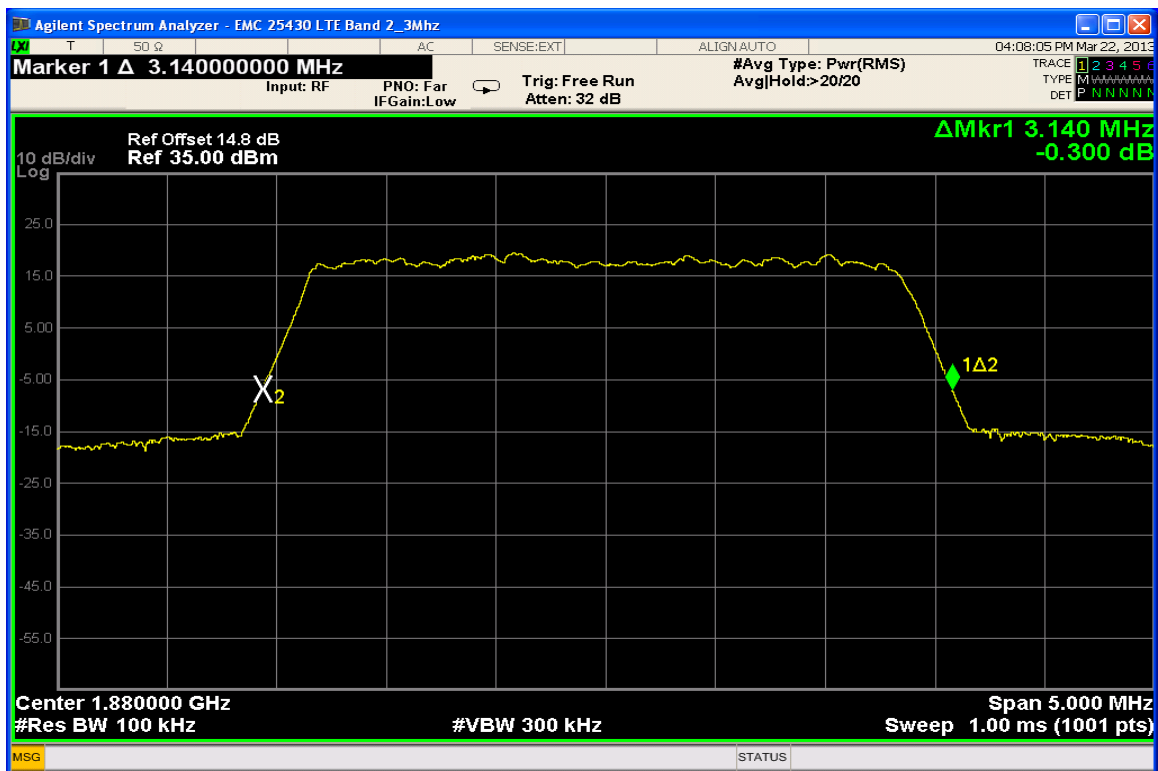
Band 2 LTE – 5 MHz BW, QPSK RB Size = 25 RB Start 0



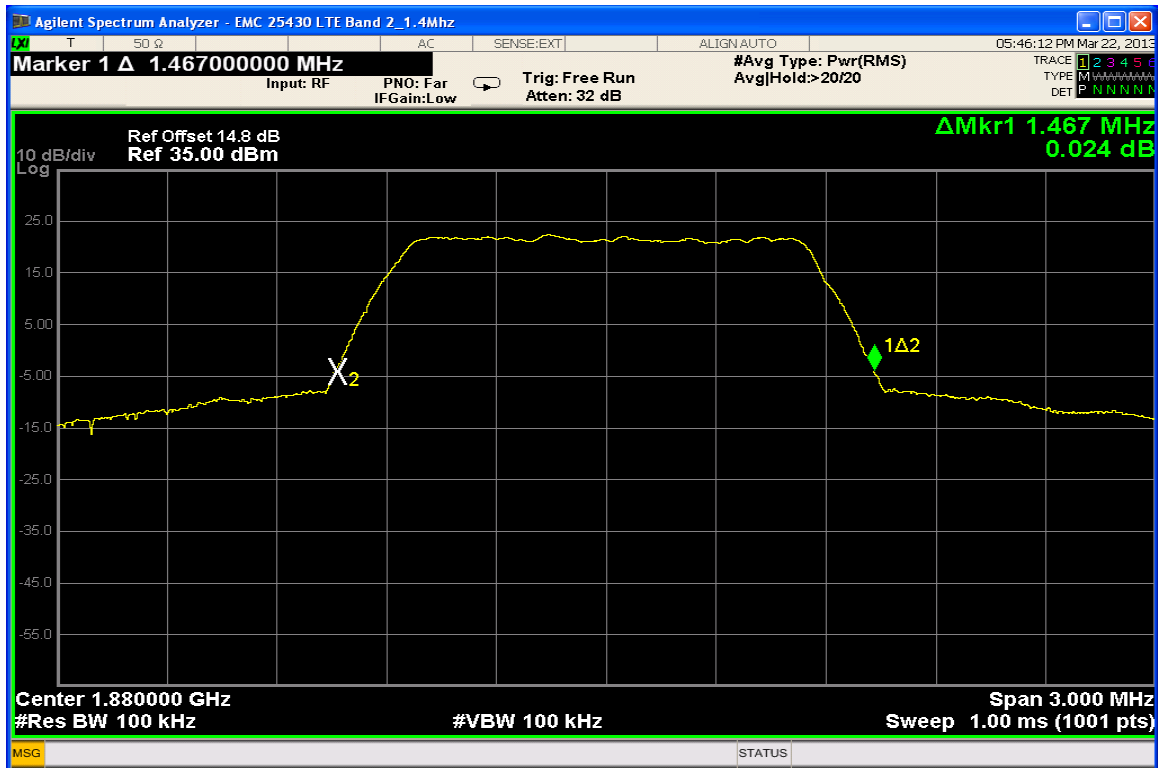
Band 2 LTE – 5 MHz BW, 16QAM RB Size = 25 RB Start 0



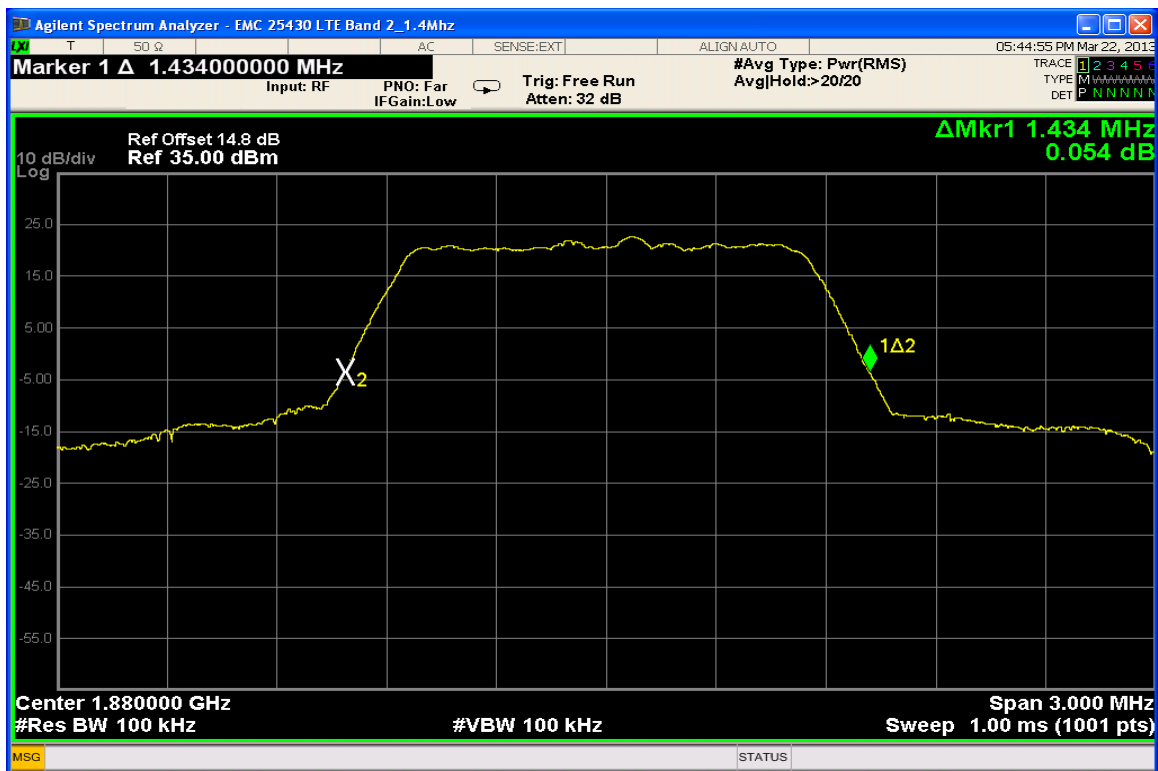
Band 2 LTE – 3 MHz BW, QPSK RB Size = 15 RB Start 0



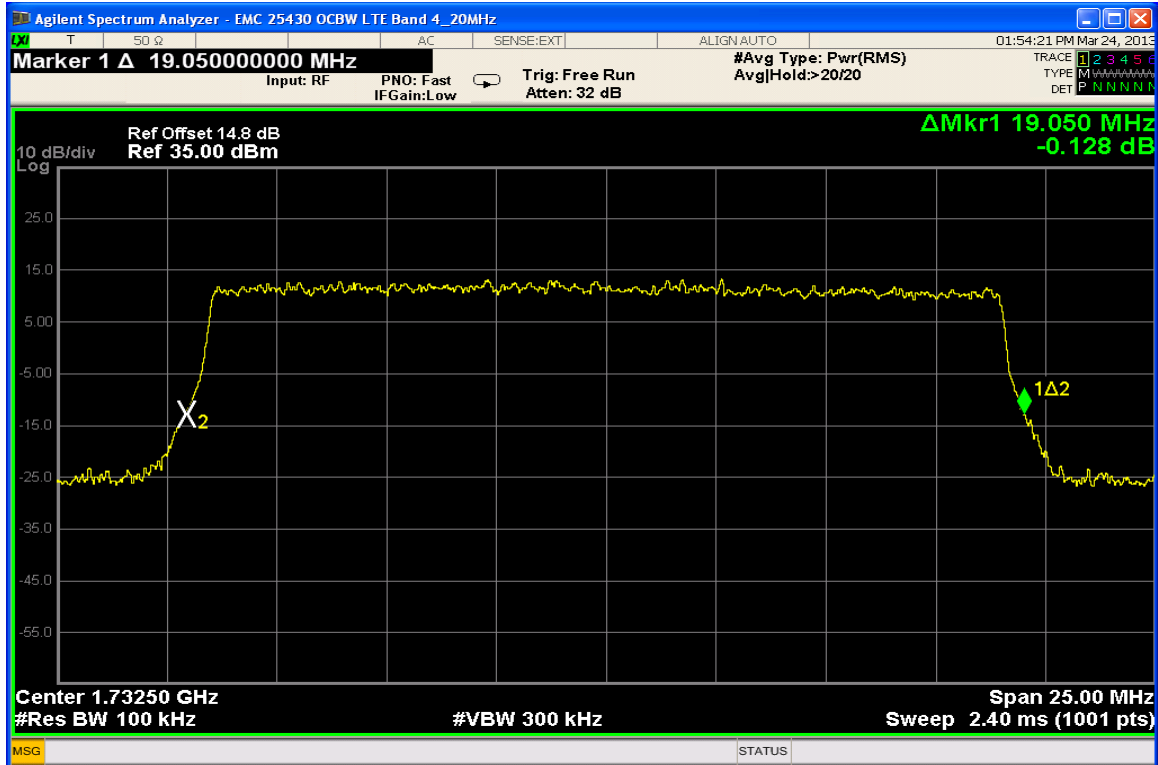
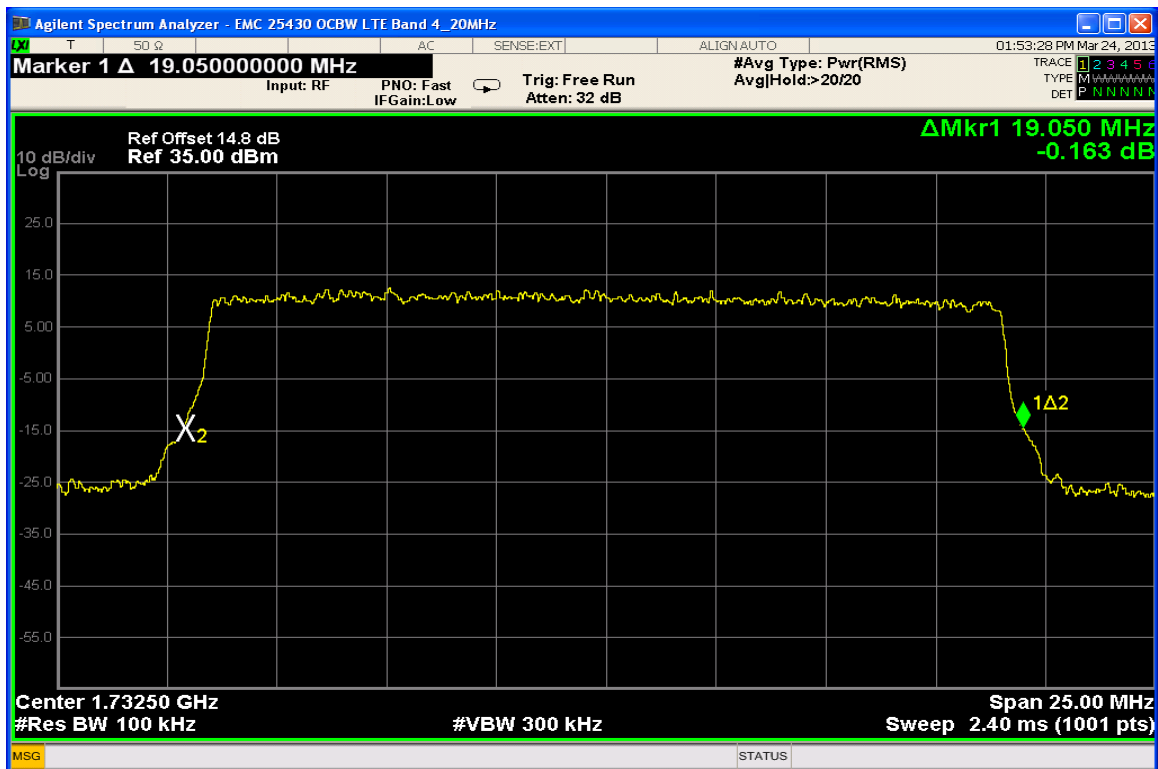
Band 2 LTE – 3 MHz BW, 16QAM RB Size = 15 RB Start 0

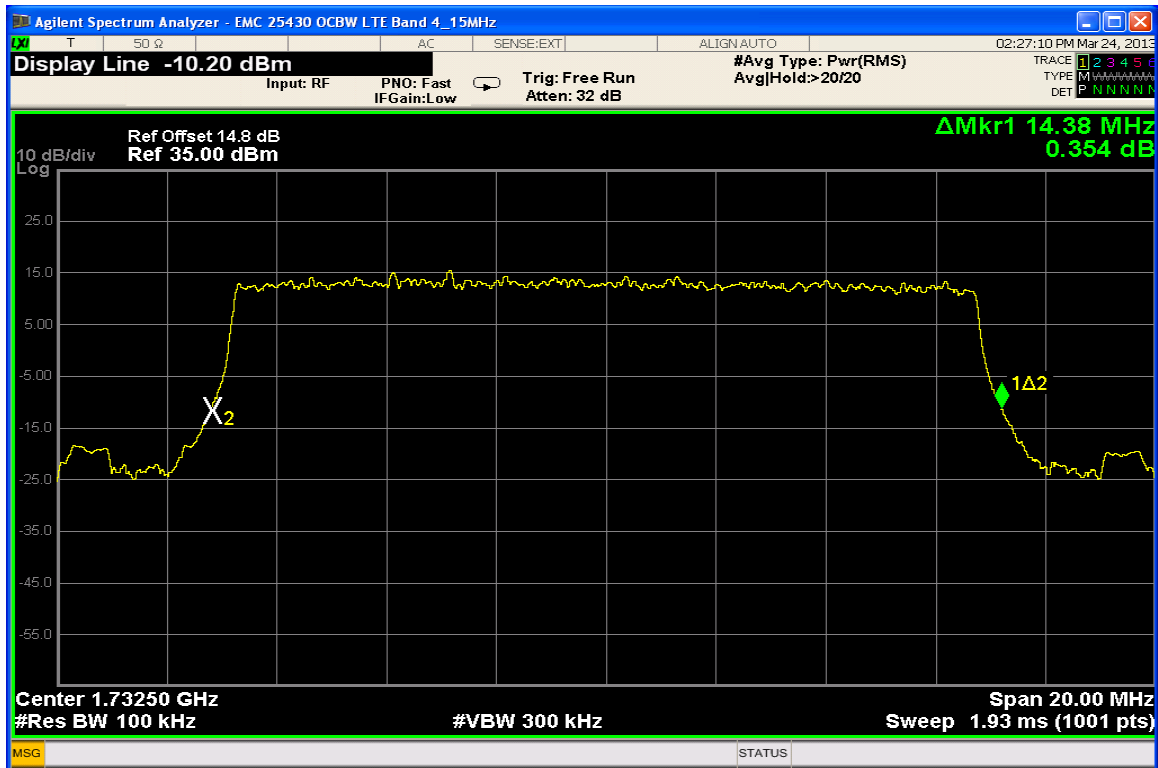


Band 2 LTE – 1.4 MHz BW, QPSK RB Size = 6 RB Start 0

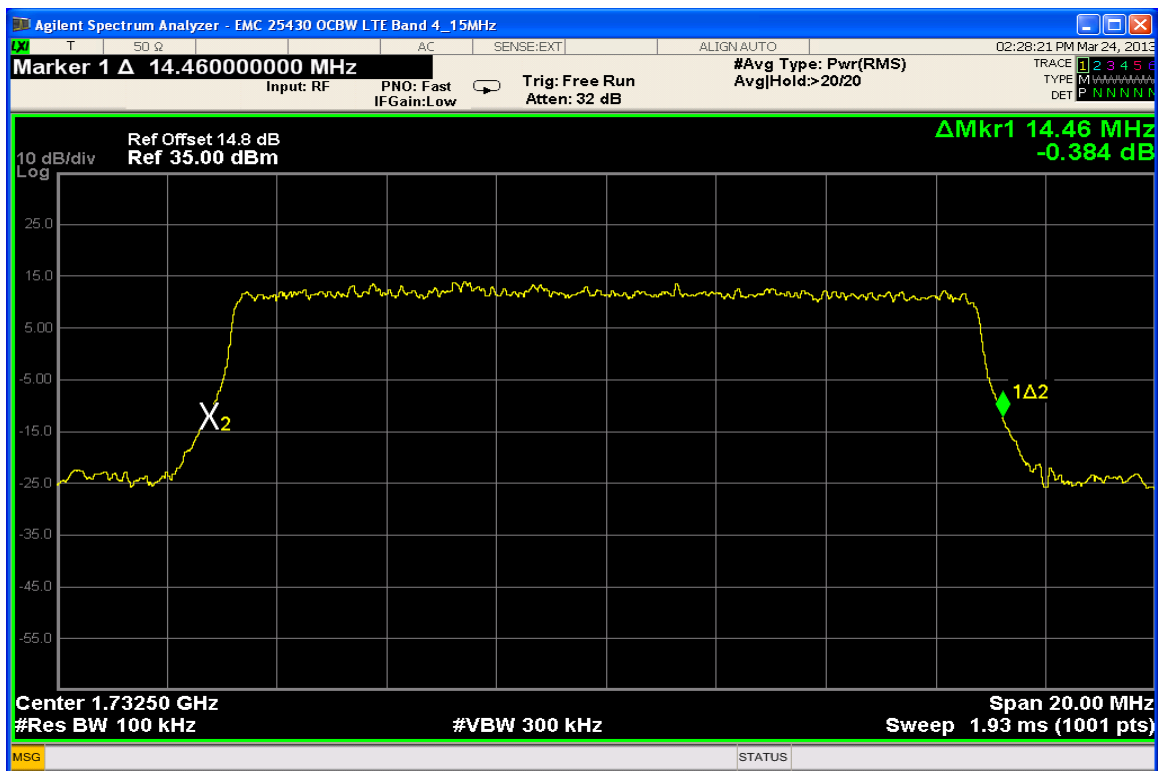


Band 2 LTE – 1.4 MHz BW, 16QAM RB Size = 6 RB Start 0

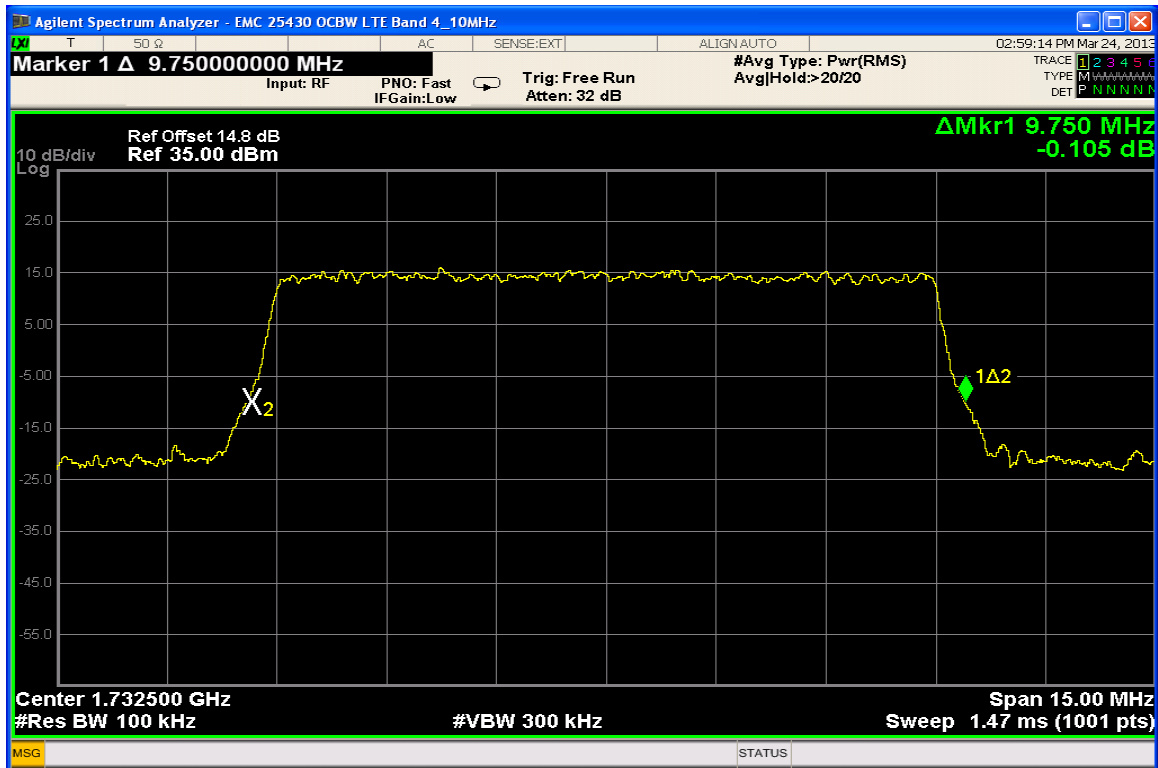
**Measurement Results: LTE Band 4 QPSK & 16-QAM Occupied Bandwidth****Band 4 LTE – 20 MHz BW, QPSK RB Size = 100 RB Start 0****Band 4 LTE – 20 MHz BW, 16-QAM RB Size = 100 RB Start 0**



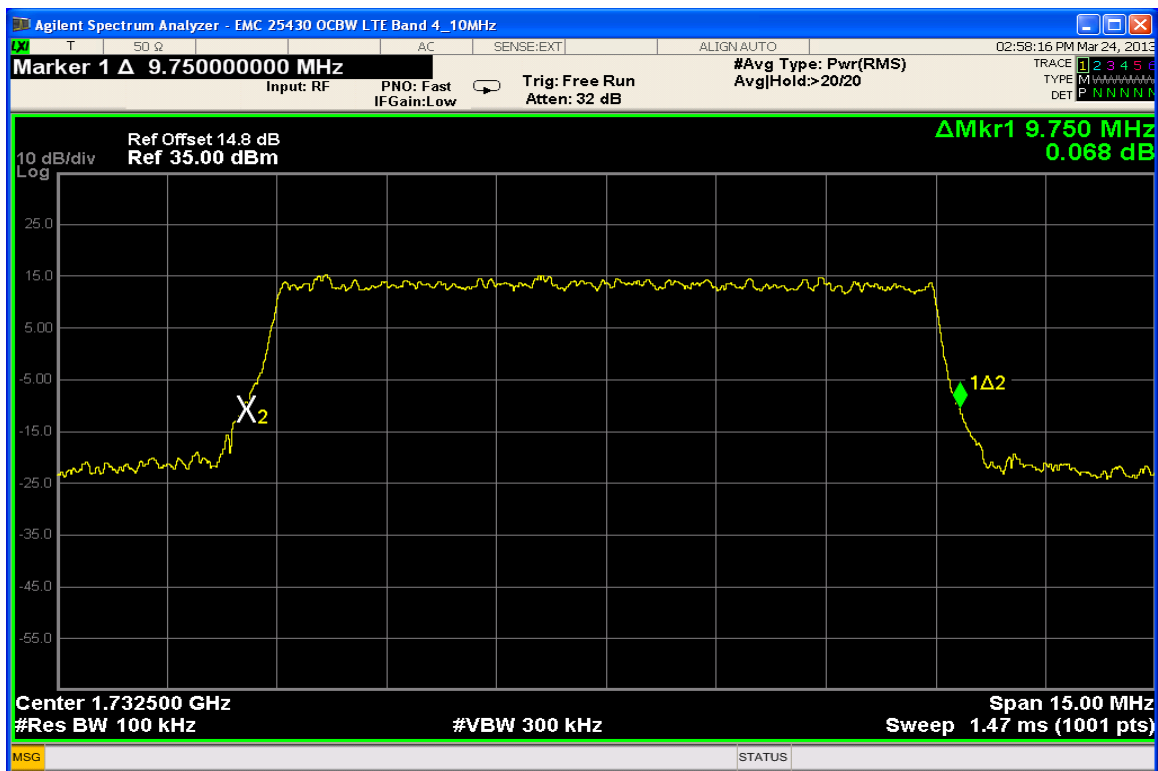
Band 4 LTE – 15 MHz BW, QPSK RB Size = 75 RB Start 0



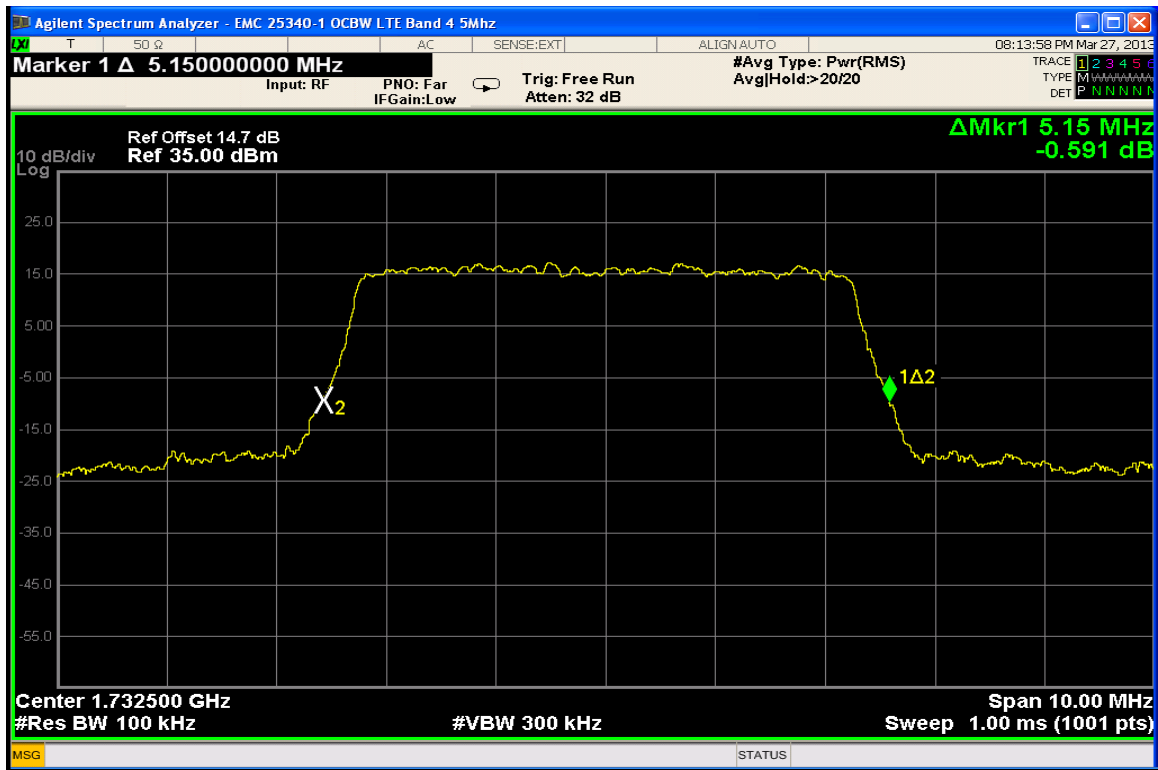
Band 4 LTE – 15 MHz BW, 16QAM RB Size = 75 RB Start 0



Band 4 LTE – 10 MHz BW, QPSK RB Size = 50 RB Start 0



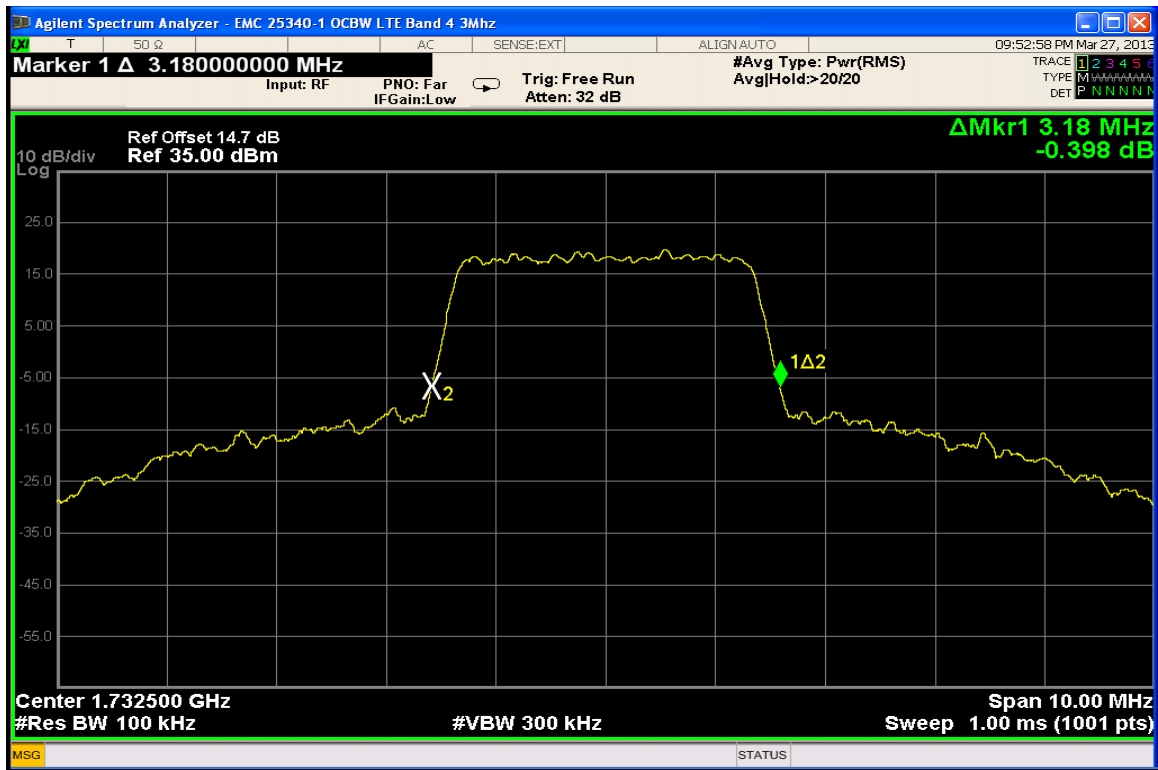
Band 4 LTE – 10 MHz BW, 16QAM RB Size = 50 RB Start 0



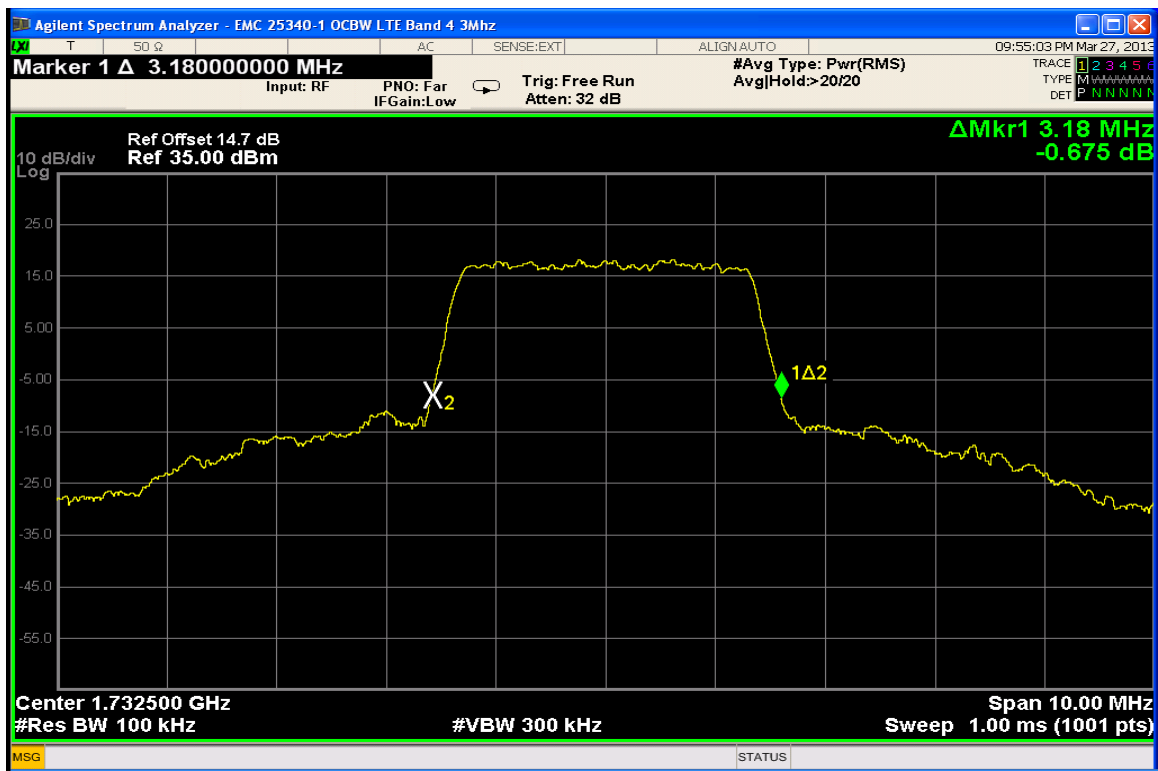
Band 4 LTE – 5 MHz BW, QPSK RB Size = 25 RB Start 0



Band 4 LTE – 5 MHz BW, 16QAM RB Size = 25 RB Start 0



Band 4 LTE – 3 MHz BW, QPSK RB Size = 15 RB Start 0



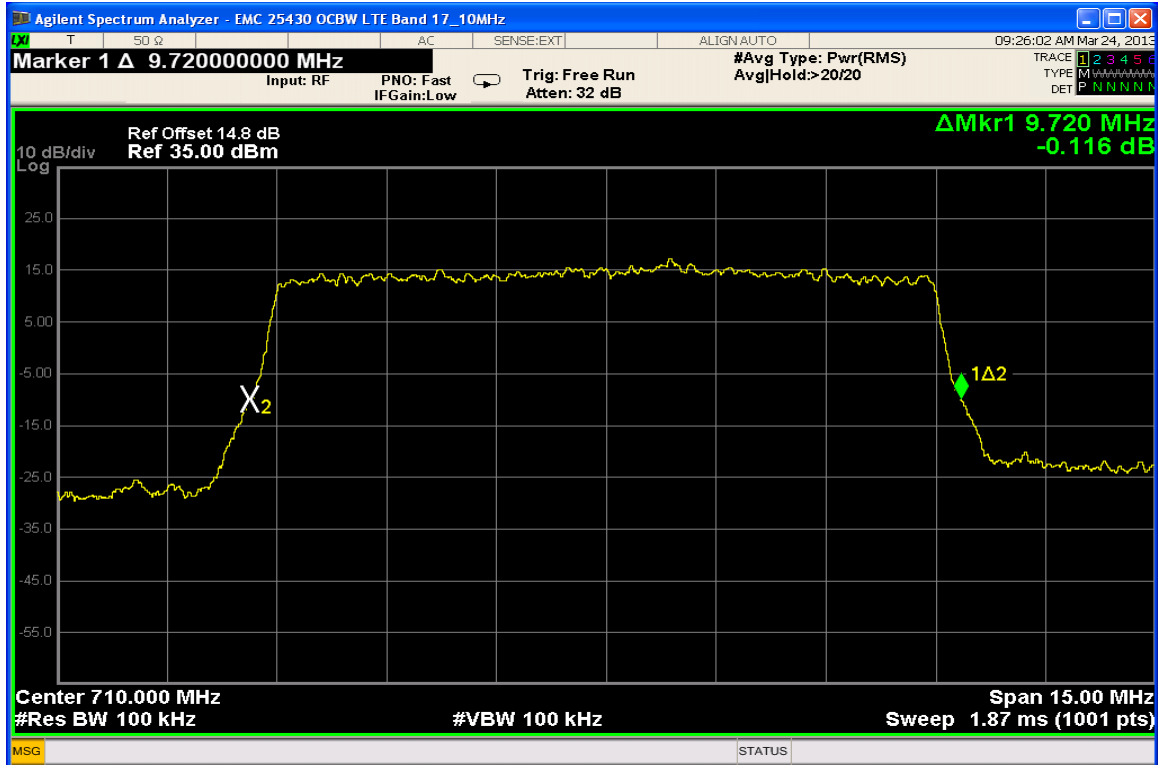
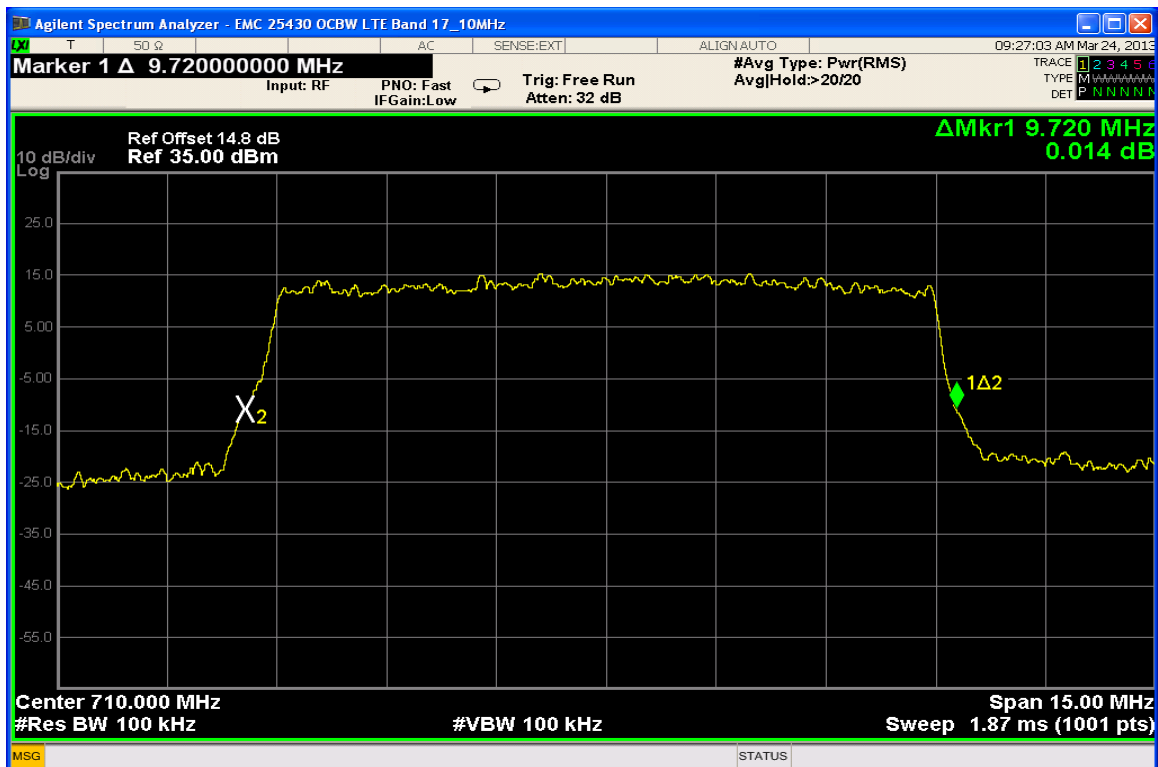
Band 4 LTE – 3 MHz BW, 16QAM RB Size = 15 RB Start 0



Band 4 LTE – 1.4 MHz BW, QPSK RB Size = 6 RB Start 0



Band 4 LTE – 1.4 MHz BW, 16QAM RB Size = 6 RB Start 0

**Measurement Results: LTE Band 17 QPSK & 16-QAM Occupied Bandwidth****Band 17 LTE – 10 MHz BW, QPSK RB Size = 50 RB Start 0****Band 17 LTE – 10 MHz BW, 16QAM RB Size = 50 RB Start 0**



Band 17 LTE – 5 MHz BW, QPSK RB Size = 25 RB Start 0



Band 17 LTE – 5 MHz BW, 16QAM RB Size = 25 RB Start 0

**BAND EDGE MEASUREMENTS**

§24.238 (a), §27.53 (g), §27.53 (h)

**Measurement Procedure**

The RF output port of the EUT is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10dB passive attenuator. The amplitude of the spectrum analyzer is corrected for the attenuator and any other applicable losses. The analyzer is set for Average Detector and each trace is set for Max Hold. The fully charged internal battery was used for the supply voltage.

§24.238 (a) The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.

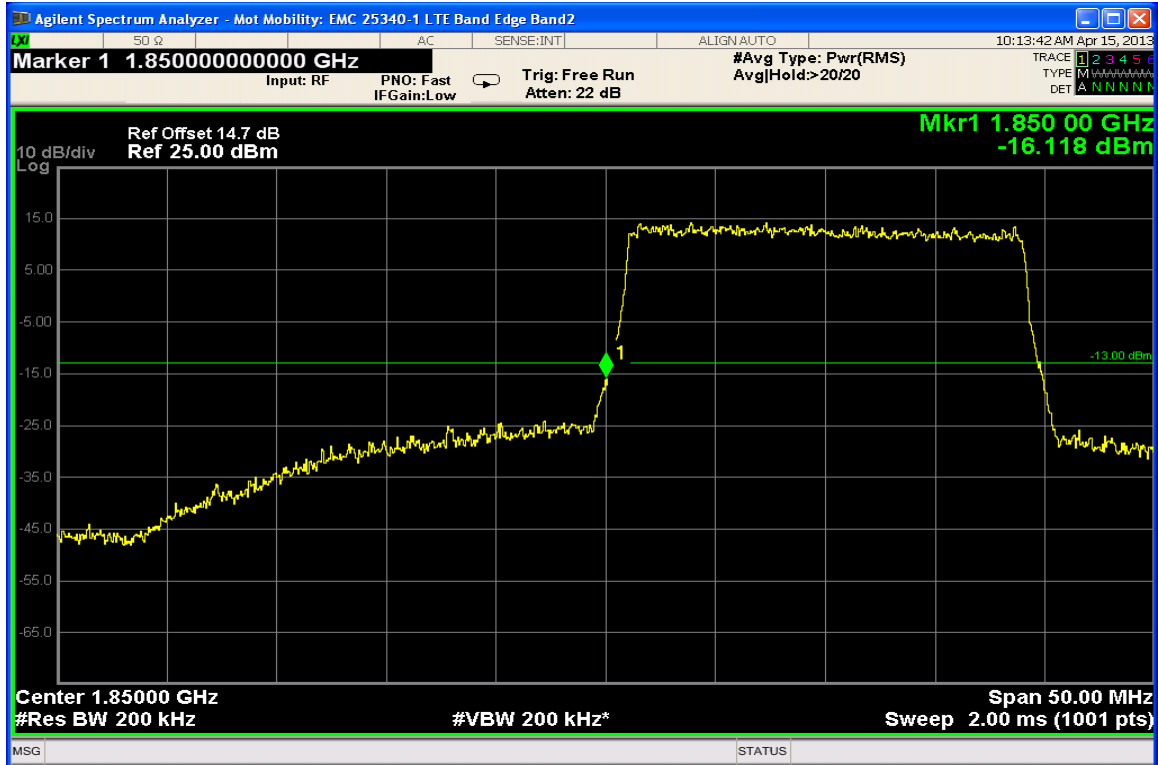
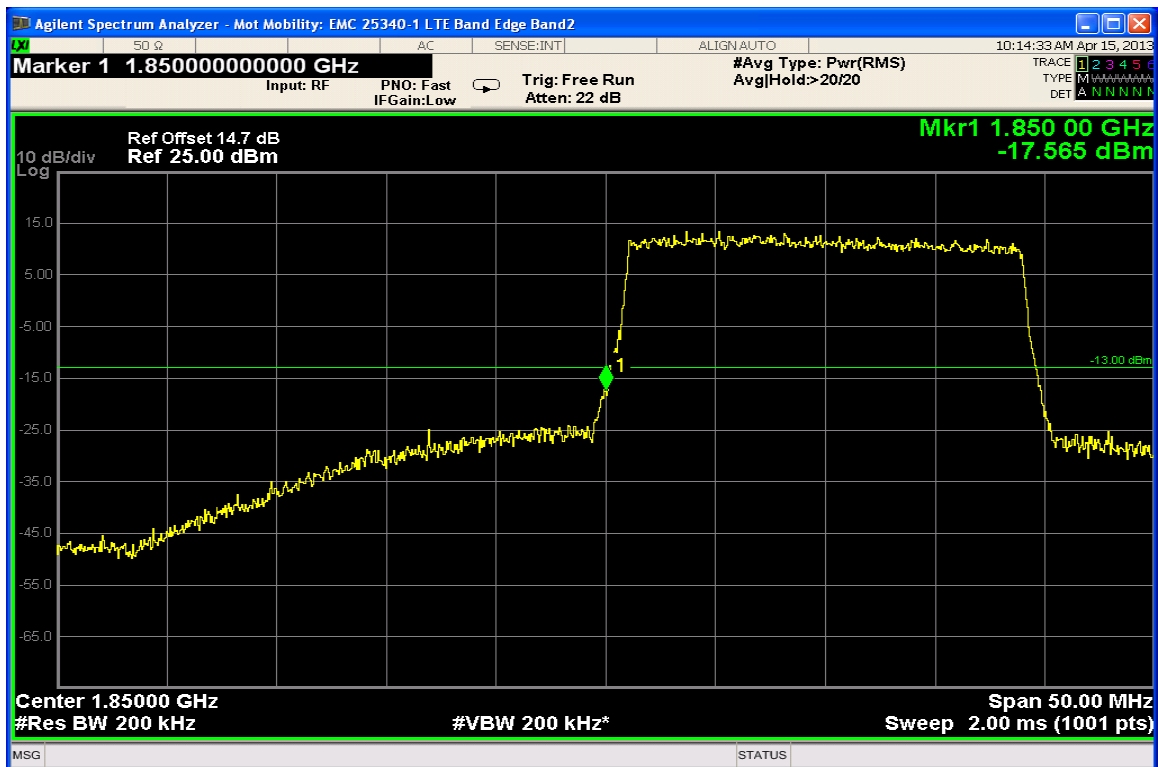
(g) For operations in the 698–746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least  $43 + 10 \log(P)$  dB.

(h) For operations in the 1710–1755 MHz and 2110–2155 MHz bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log_{10}(P)$  dB.

The EUT was tested in the all bandwidths and both modulations in each band and the worst case plots are reported below.

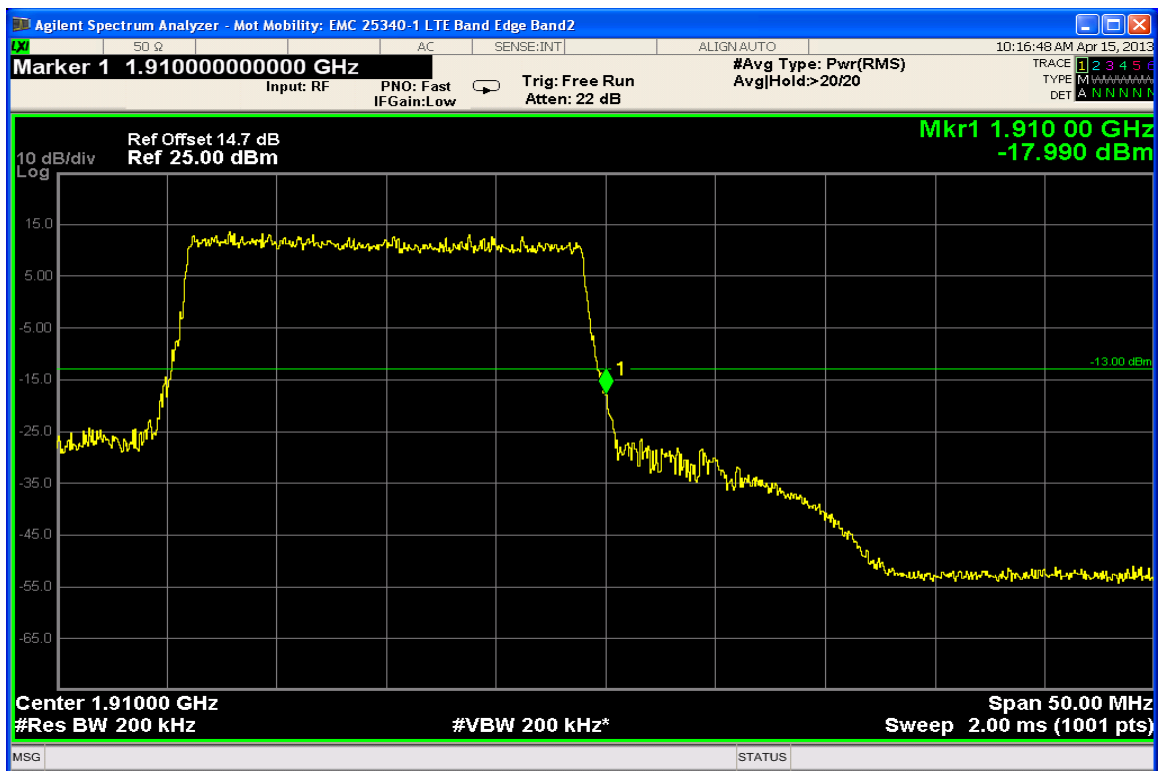
**Measurement Results**

Attached

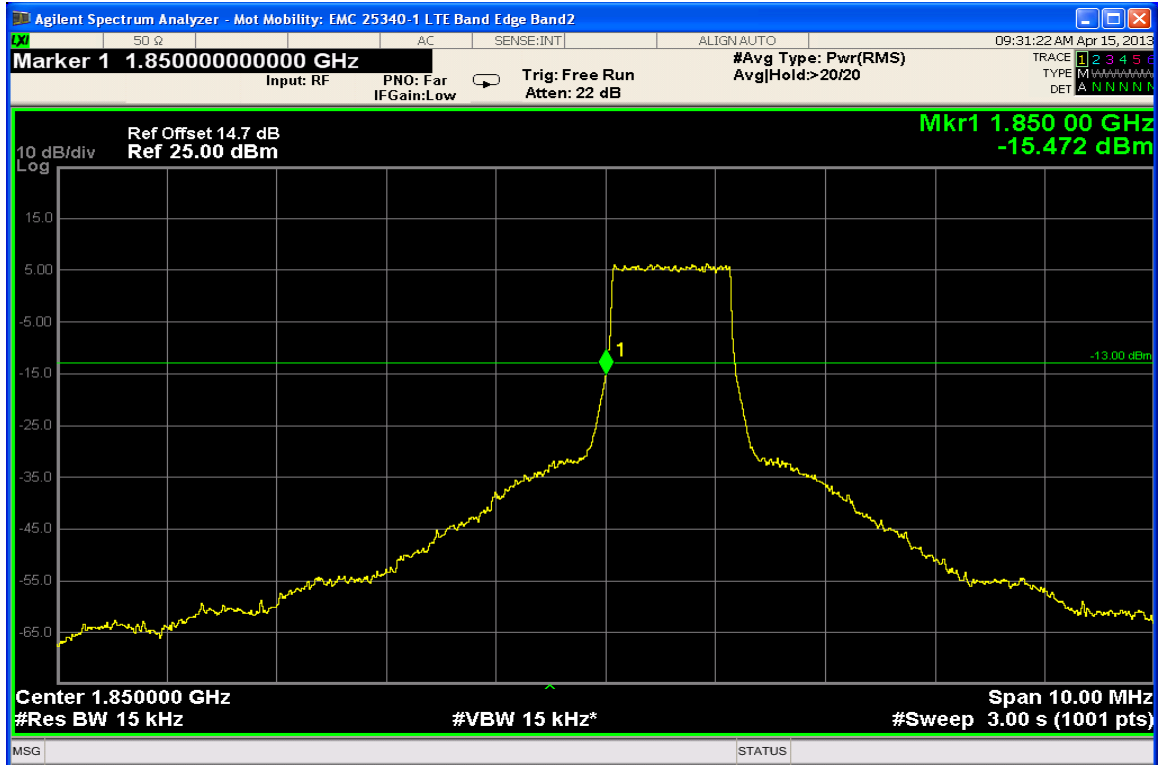
**Measurement Results: Band 2 Low and High Band Edge****Band 2 LTE – 20 MHz BW, QPSK RB Size = 100 RB Start 0****Band 2 LTE – 20 MHz BW, 16-QAM RB Size = 100 RB Start 0**



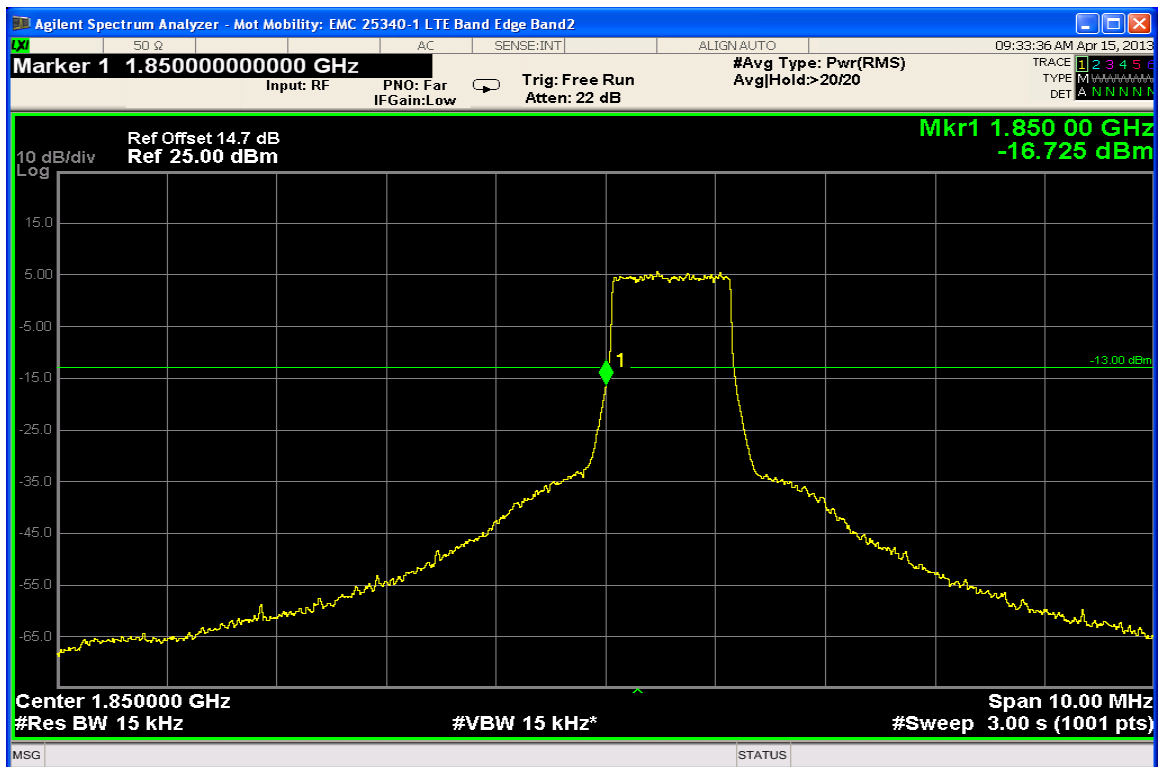
Band 2 LTE – 20 MHz BW, QPSK RB Size = 100 RB Start 0



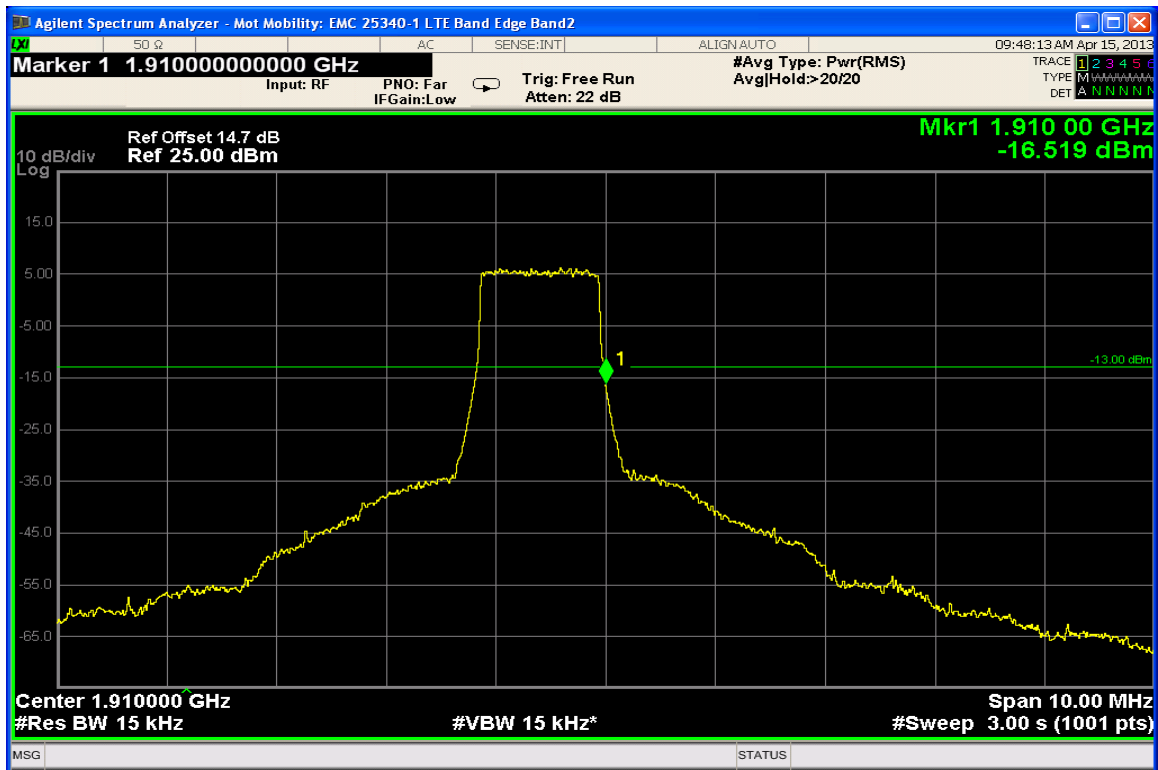
Band 2 LTE – 20 MHz BW, 16-QAM RB Size = 100 RB Start 0



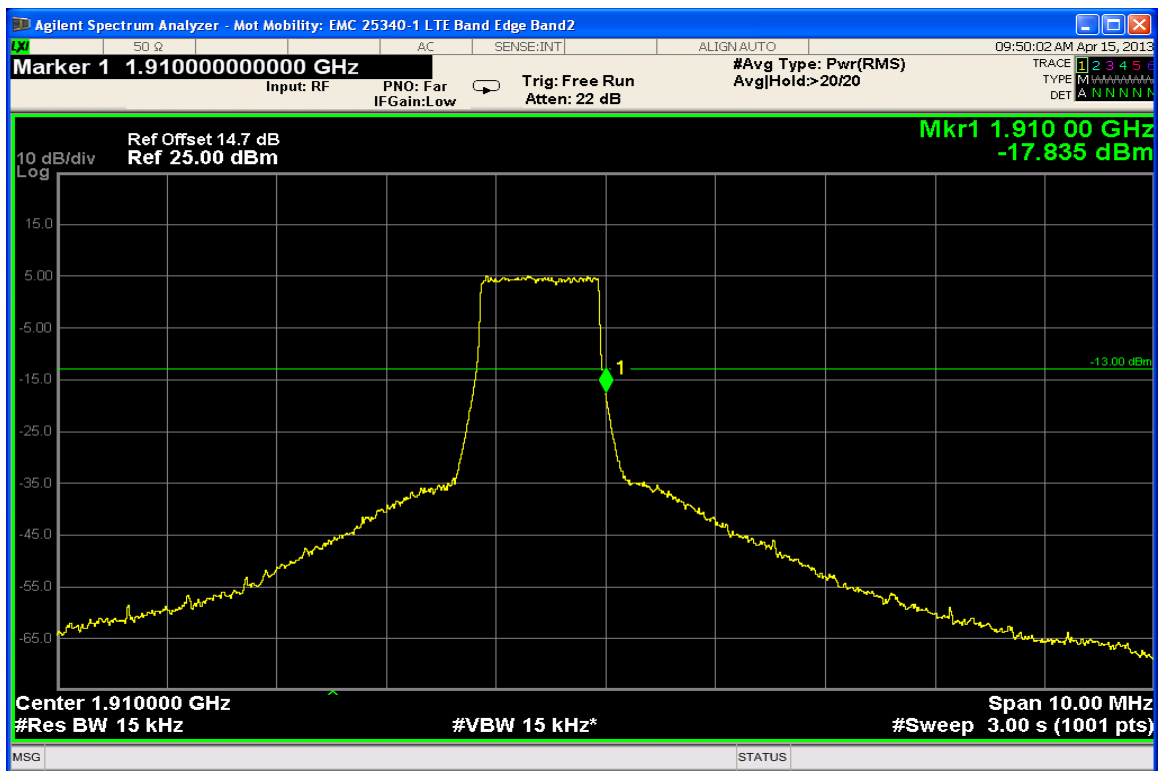
Band 2 LTE – 1.4 MHz BW, QPSK RB Size = 6 RB Start 0



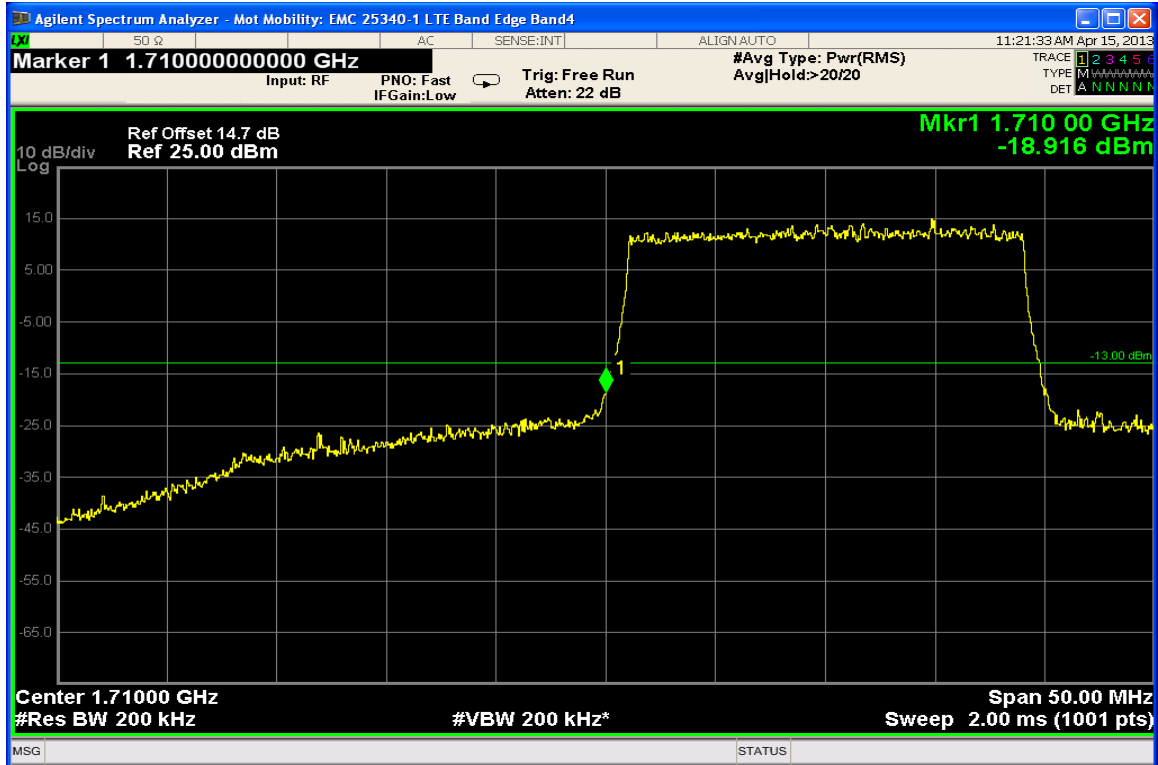
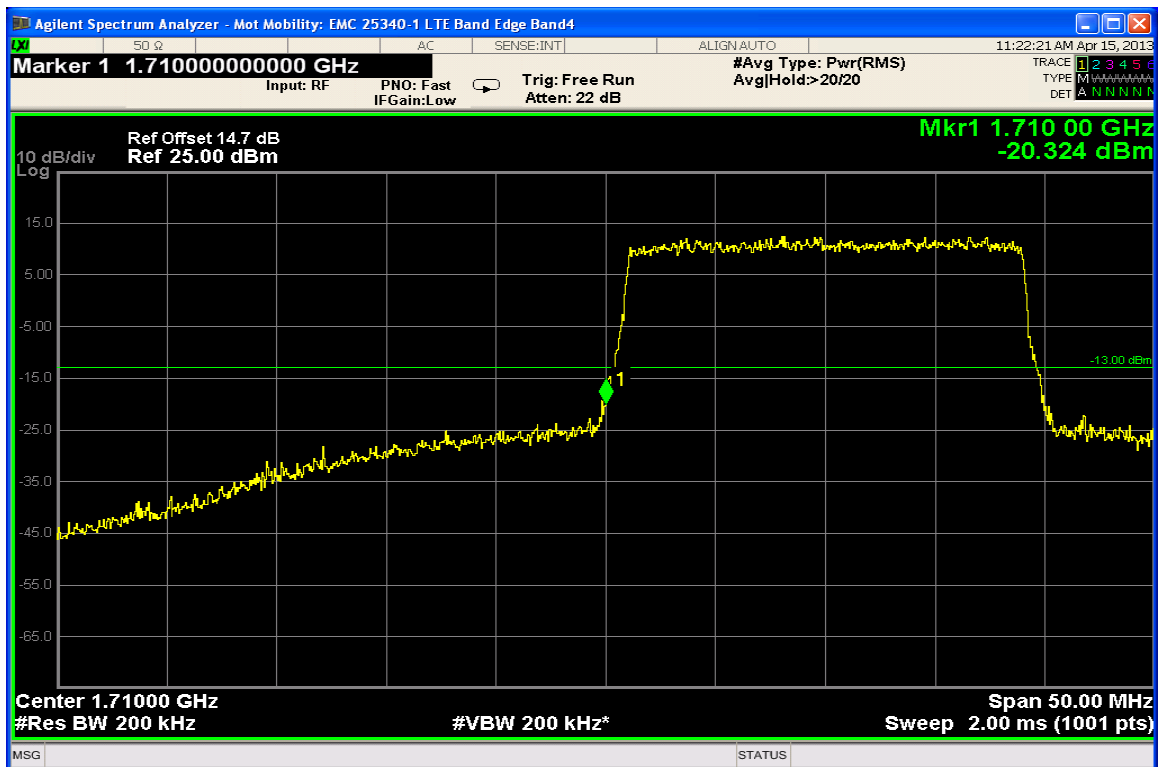
Band 2 LTE – 1.4 MHz BW, 16-QAM RB Size = 6 RB Start 0



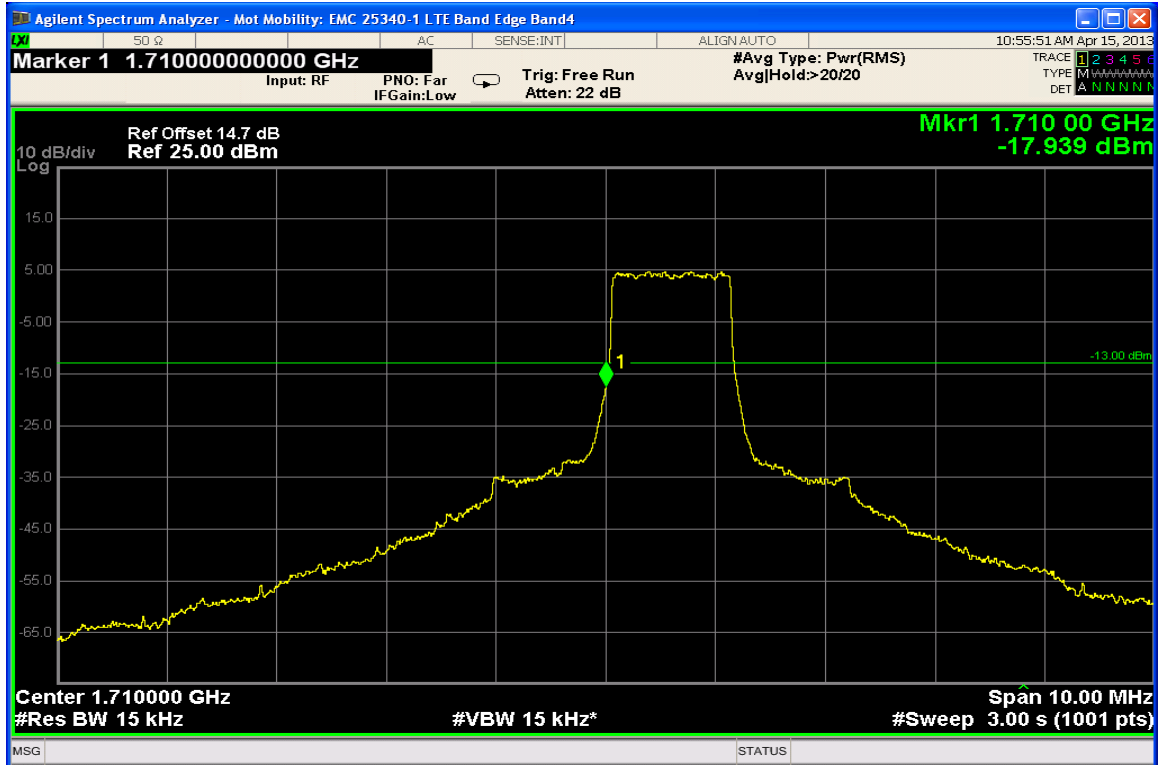
Band 2 LTE – 1.4 MHz BW, QPSK RB Size = 6 RB Start 0



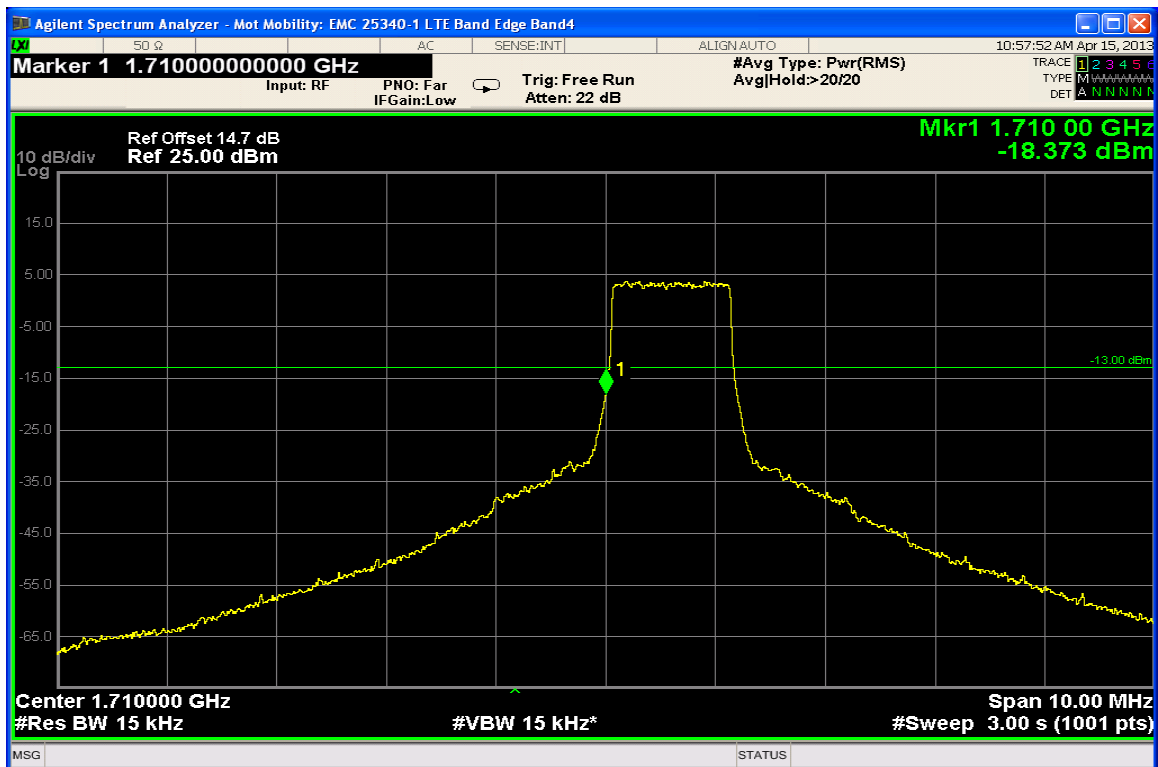
Band 2 LTE – 1.4 MHz BW, 16-QAM RB Size = 6 RB Start 0

**Measurement Results: Band 4 Low and High Band Edge****Band 4 LTE – 20 MHz BW, QPSK RB Size = 100 RB Start 0****Band 4 LTE – 20 MHz BW, 16-QAM RB Size = 100 RB Start 0**

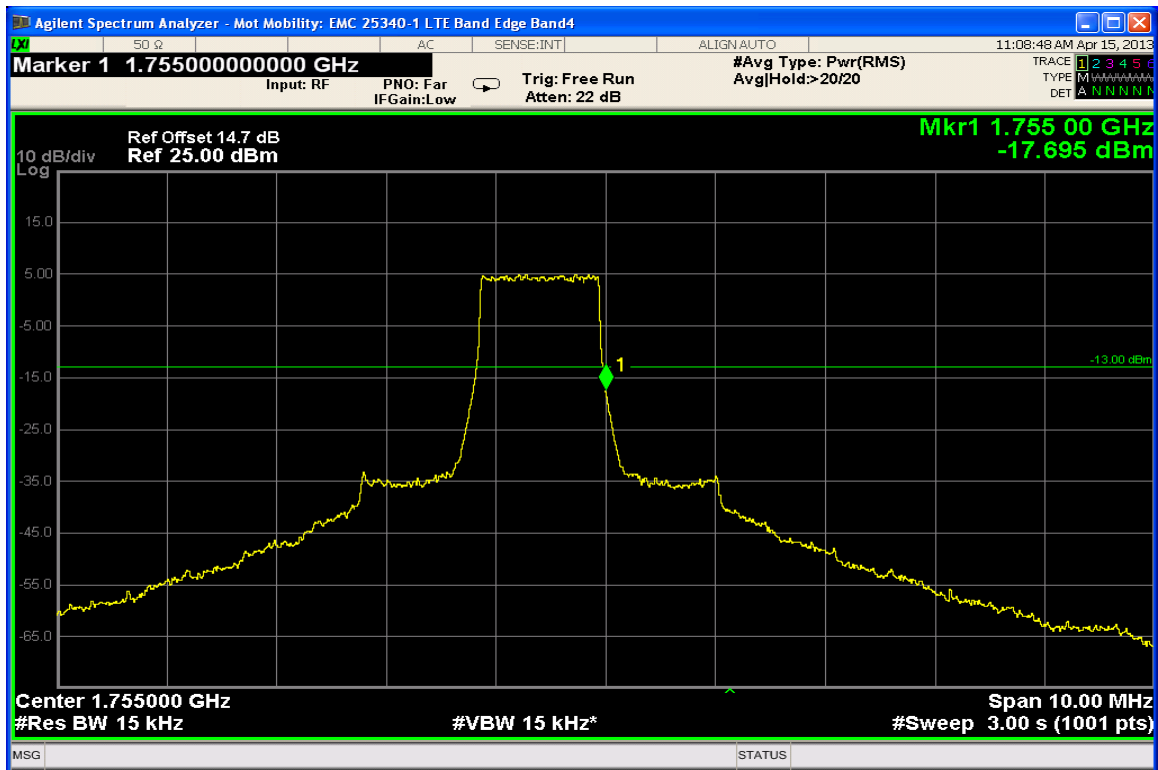
**Band 4 LTE – 20 MHz BW, QPSK RB Size = 100 RB Start 0****Band 4 LTE – 20 MHz BW, 16-QAM RB Size = 100 RB Start 0**



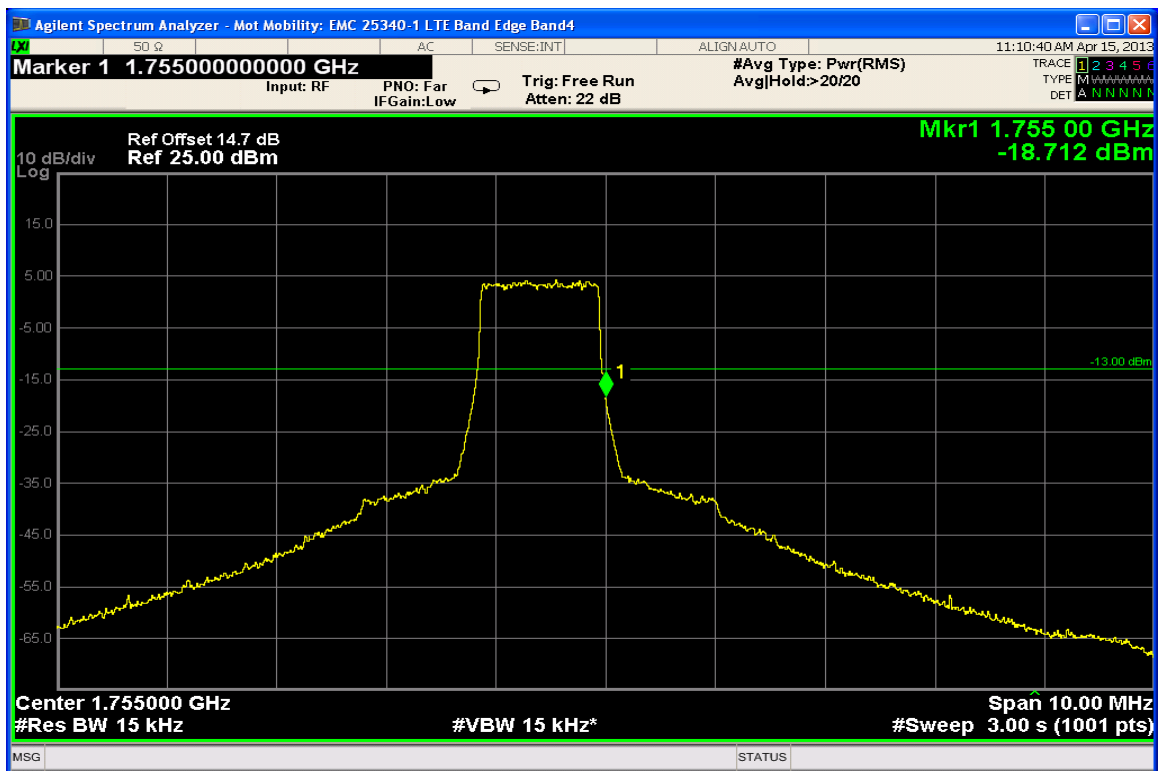
Band 4 LTE – 1.4 MHz BW, QPSK RB Size = 6 RB Start 0



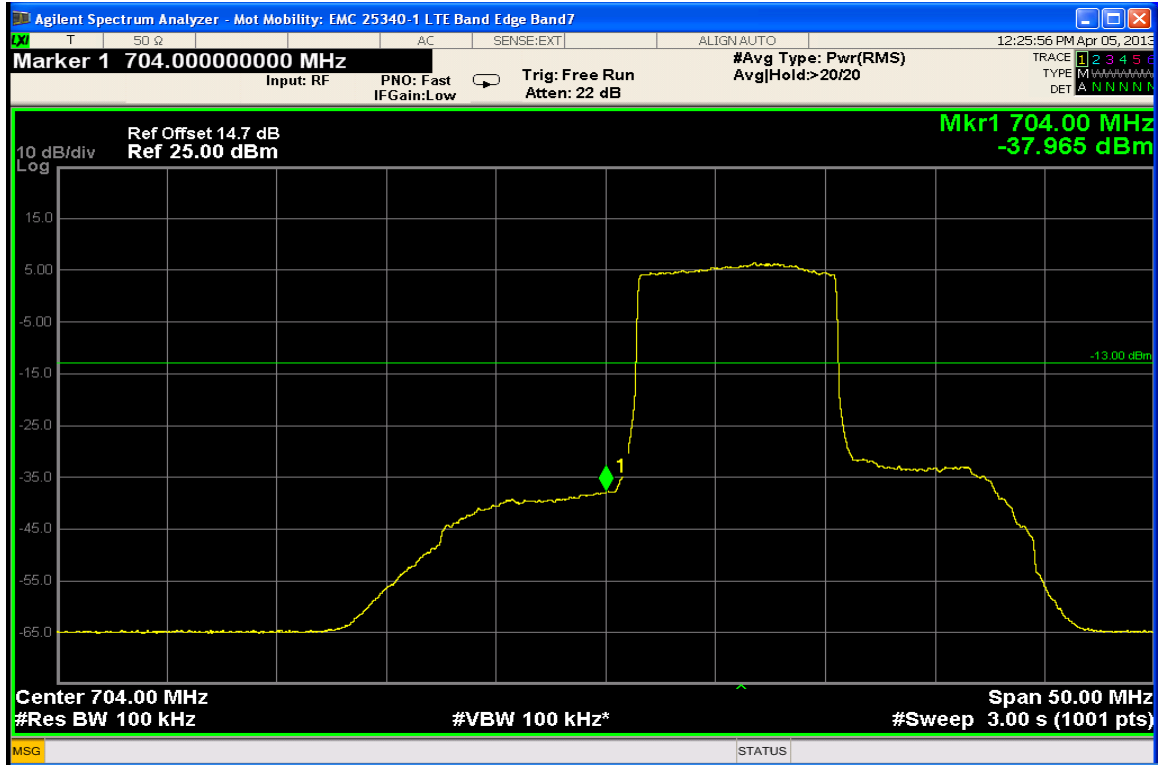
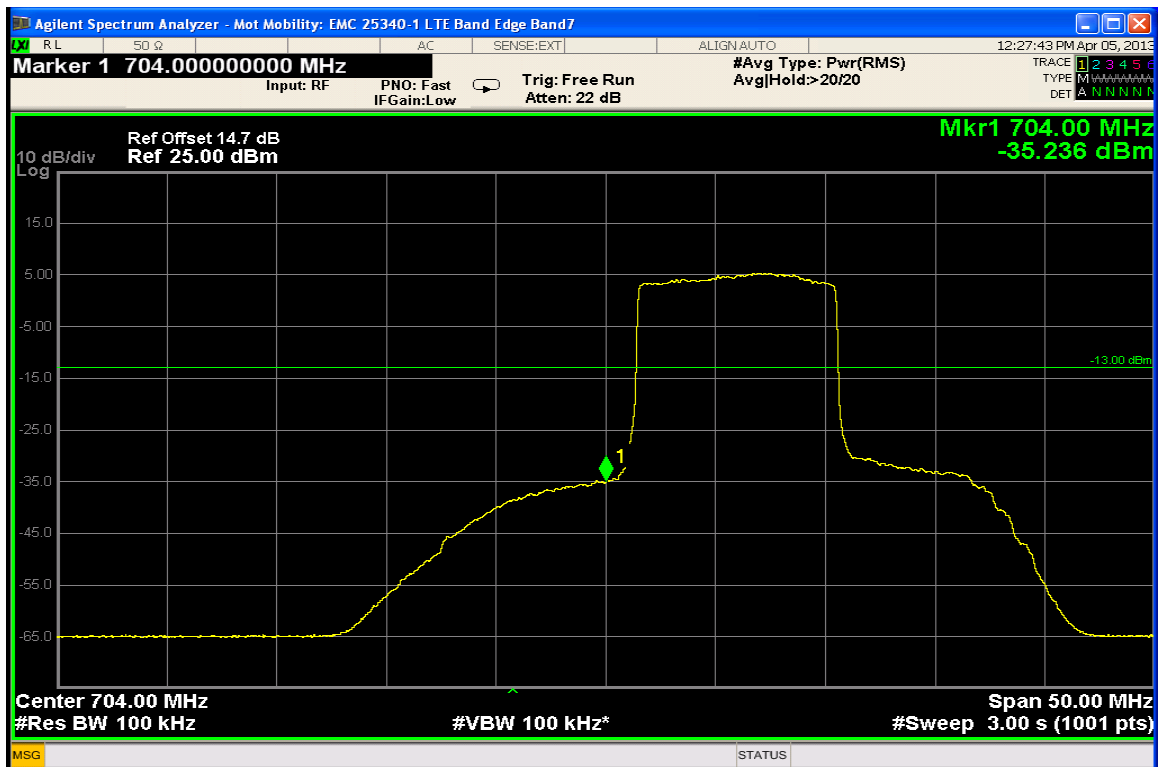
Band 4 LTE – 1.4 MHz BW, 16-QAM RB Size = 6 RB Start 0

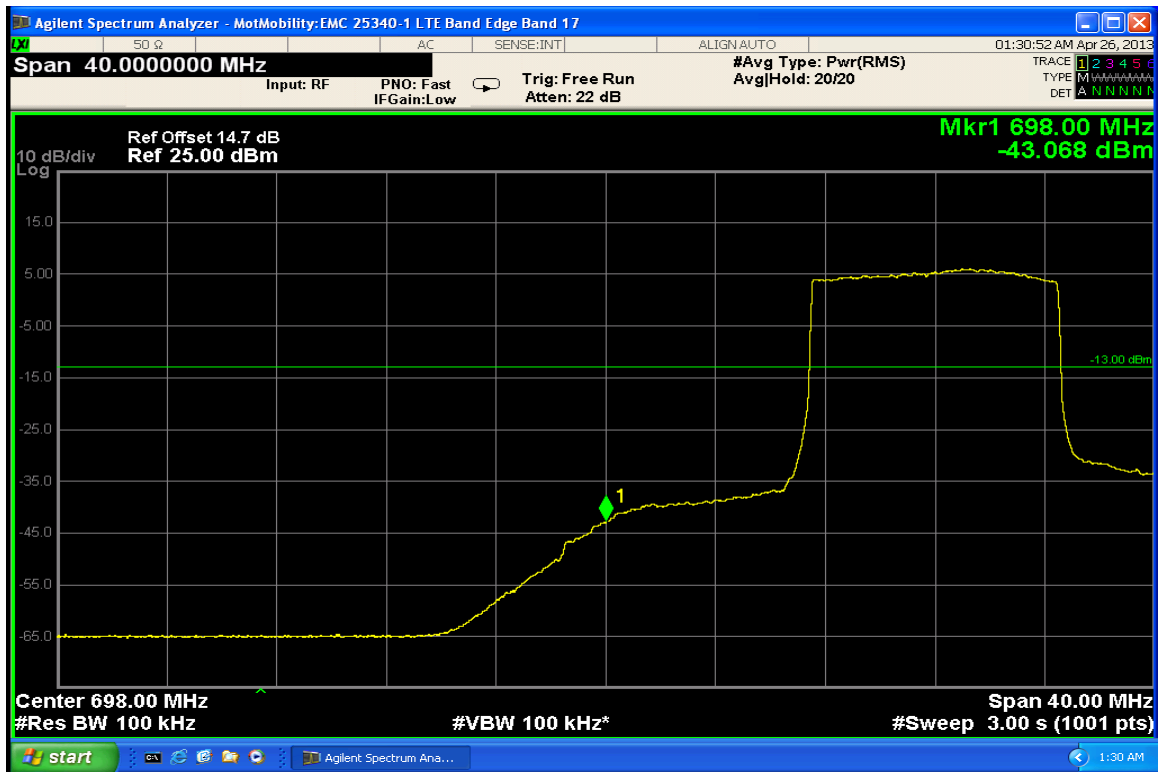


Band 4 LTE – 1.4 MHz BW, QPSK RB Size = 6 RB Start 0

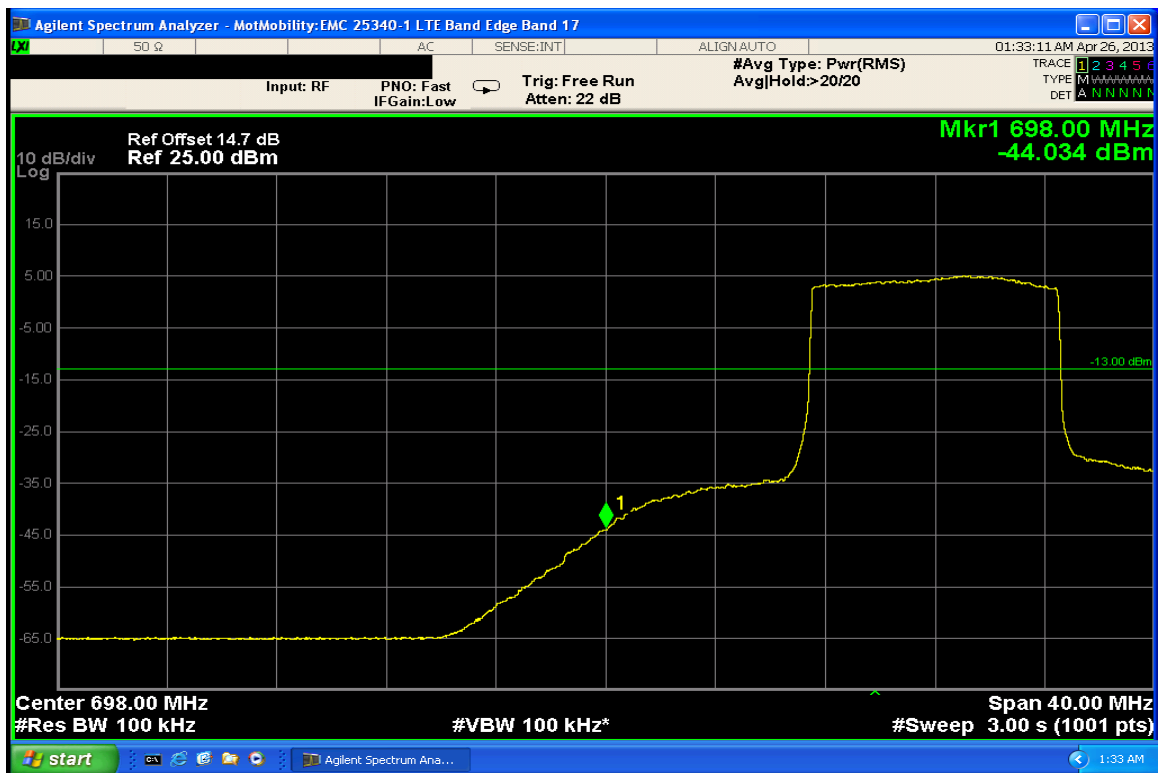


Band 4 LTE – 1.4 MHz BW, 16-QAM RB Size = 6 RB Start 0

**Measurement Results: Band 17 Low and High Band Edge****Band 17 LTE – 10 MHz BW, QPSK RB Size = 50 RB Start 0****Band 17 LTE – 10 MHz BW, 16-QAM RB Size = 50 RB Start 0**



Band 17 LTE – 10 MHz BW, QPSK RB Size = 50 RB Start 0



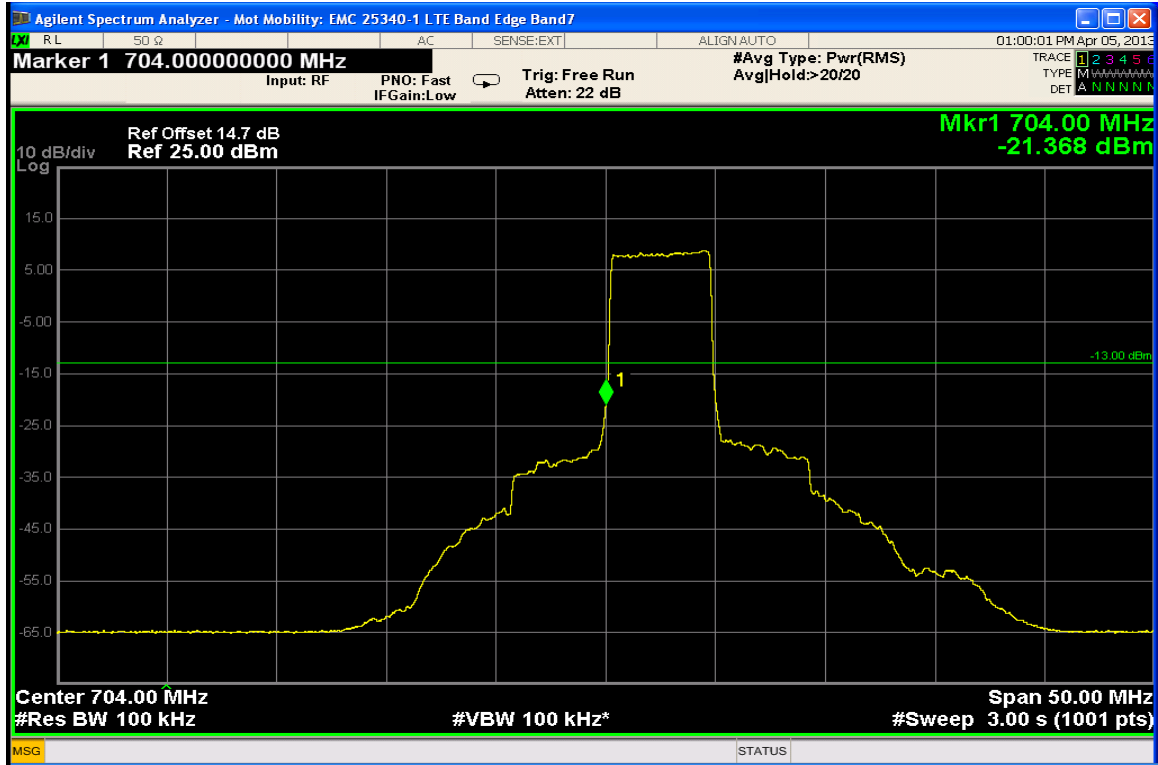
Band 17 LTE – 10 MHz BW, 16-QAM RB Size = 50 RB Start 0



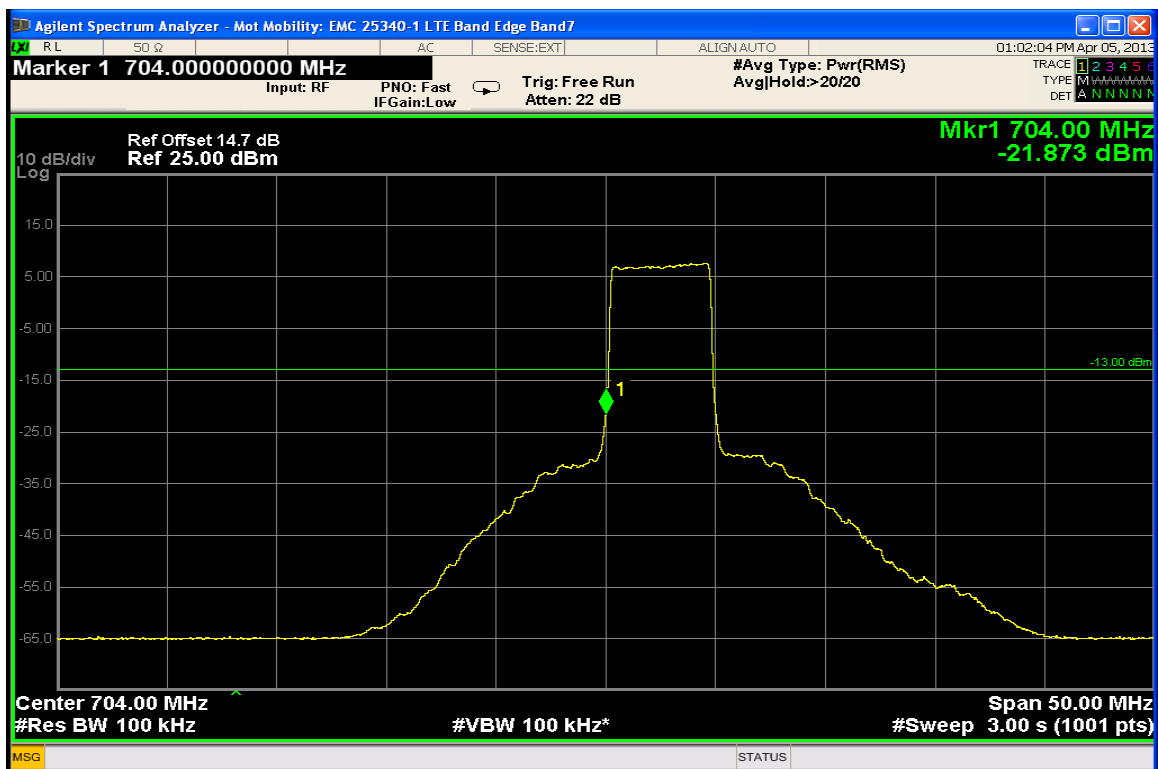
Band 17 LTE – 10 MHz BW, QPSK RB Size = 50 RB Start 0



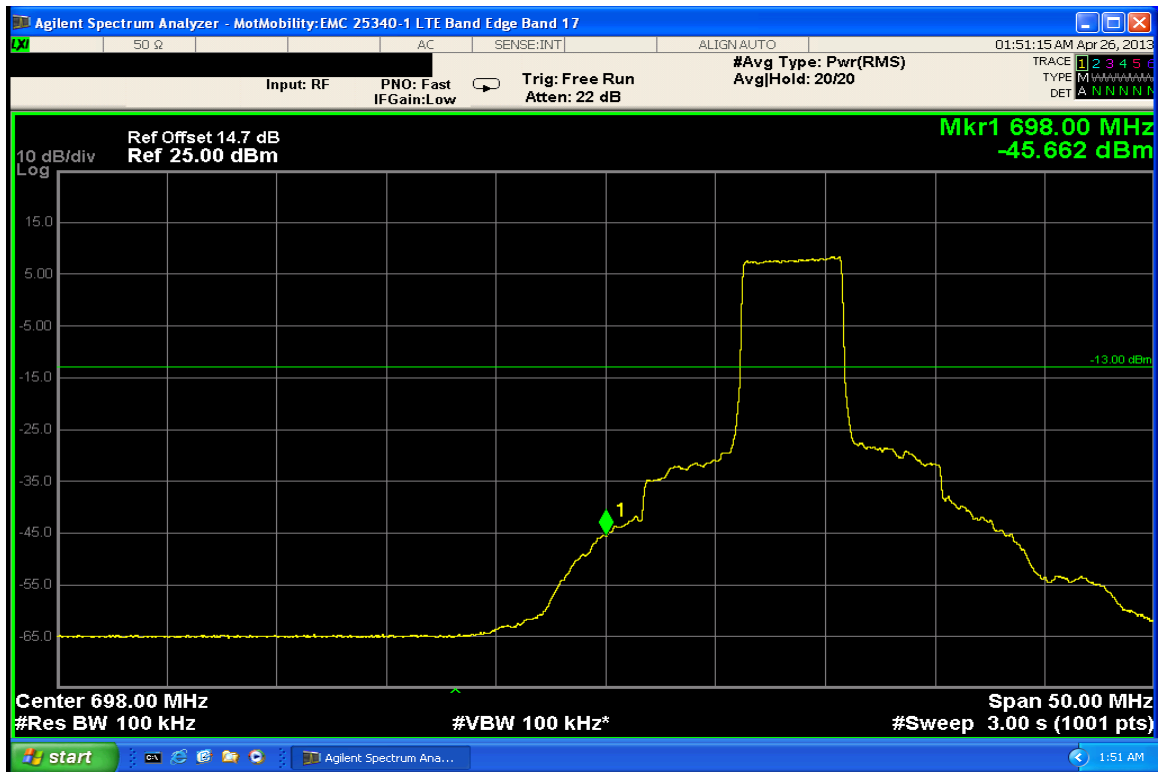
Band 17 LTE – 10 MHz BW, 16-QAM RB Size = 50 RB Start 0



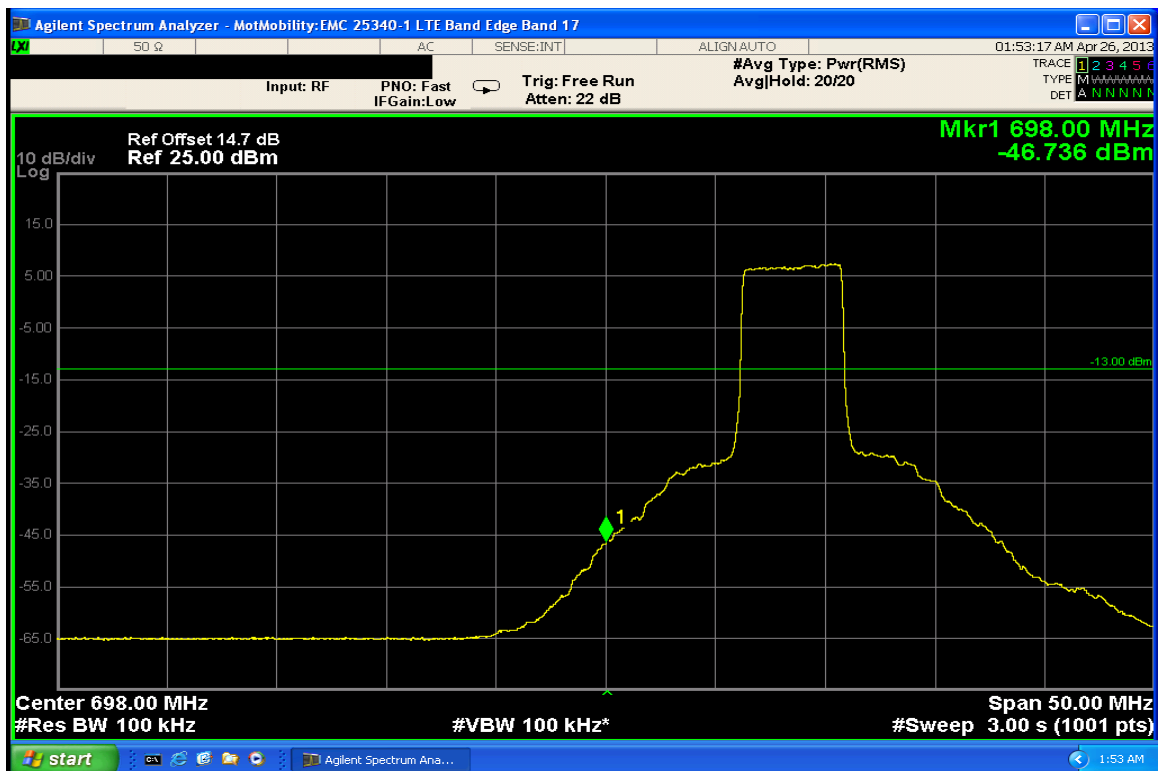
Band 17 LTE – 5 MHz BW, QPSK RB Size = 25 RB Start 0



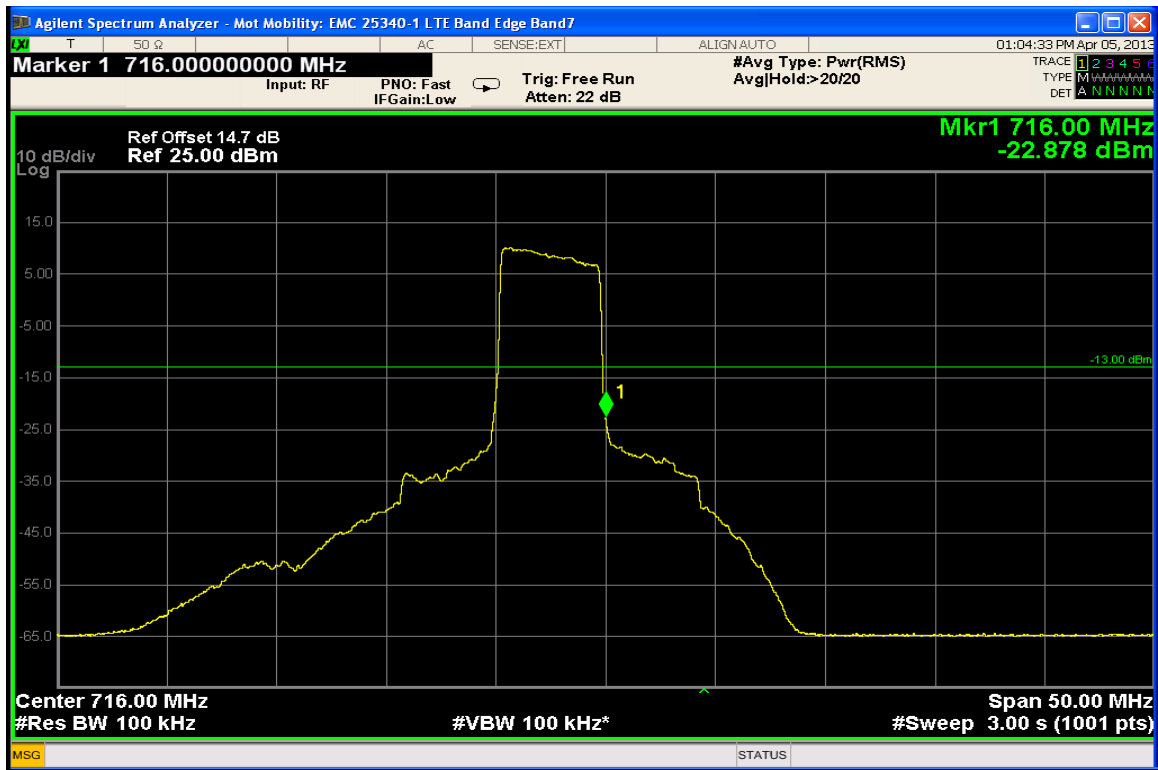
Band 17 LTE – 5 MHz BW, 16-QAM RB Size = 25 RB Start 0



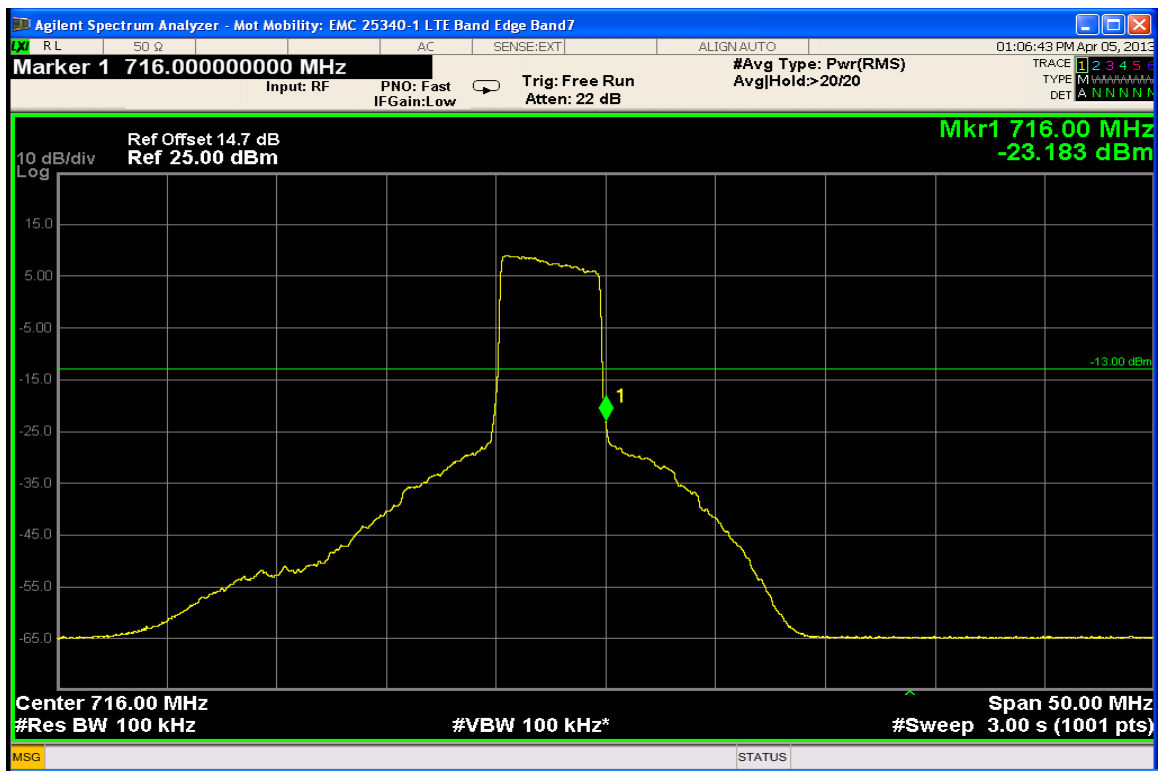
Band 17 LTE – 5 MHz BW, QPSK RB Size = 25 RB Start 0



Band 17 LTE – 5 MHz BW, 16-QAM RB Size = 25 RB Start 0



Band 17 LTE – 5 MHz BW, QPSK RB Size = 25 RB Start 0



Band 17 LTE – 5 MHz BW, 16-QAM RB Size = 25 RB Start 0

**SPURIOUS EMISSIONS AT ANTENNA TERMINALS**

§24.238 (a), §27.53 (g), §27.53 (h)

**Measurement Procedure**

The RF output port of the EUT is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10dB passive attenuator. The fully charged internal battery was used for the supply voltage.

The spectrum was investigated from the lowest frequency signal generated, without going below 9 kHz, up to at least the tenth harmonic of the fundamental or 40 GHz, whichever is lower.

§24.238 (a) The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.

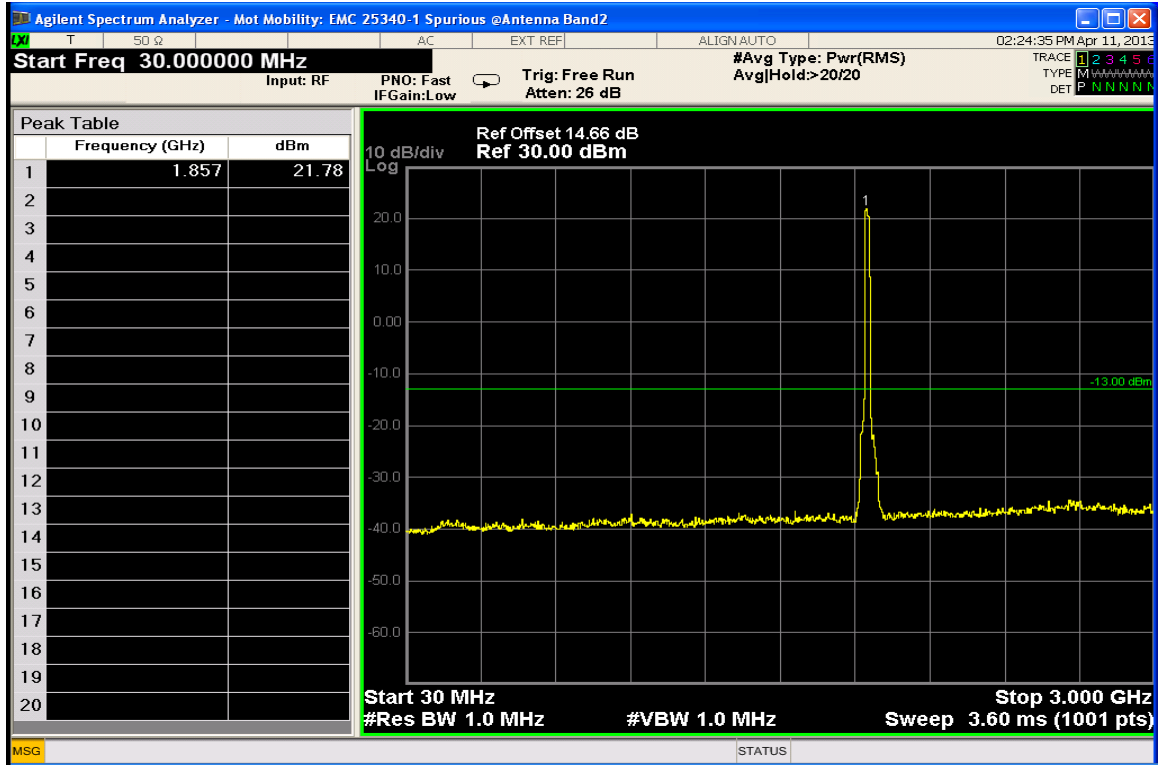
§27.53 (g) For operations in the 698–746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least  $43 + 10 \log(P)$  dB.

§27.53 (h) For operations in the 1710–1755 MHz and 2110–2155 MHz bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log_{10}(P)$  dB.

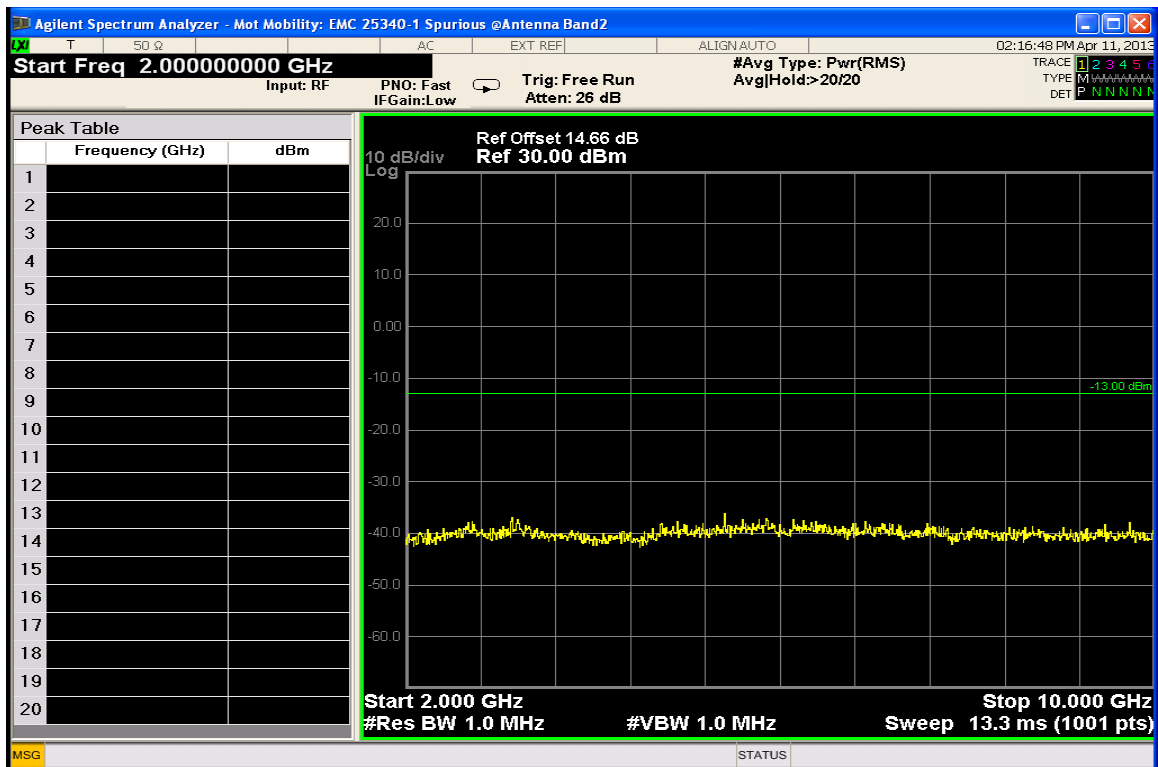
The spectrum analyzer settings were as follows:

|                       |               |
|-----------------------|---------------|
| Units                 | dBm           |
| Divisions             | 10 dB         |
| Detector              | Peak Detector |
| Resolution Bandwidth  | 1MHz          |
| Video Bandwidth (AVG) | Auto          |
| Sweep Time            | Auto          |

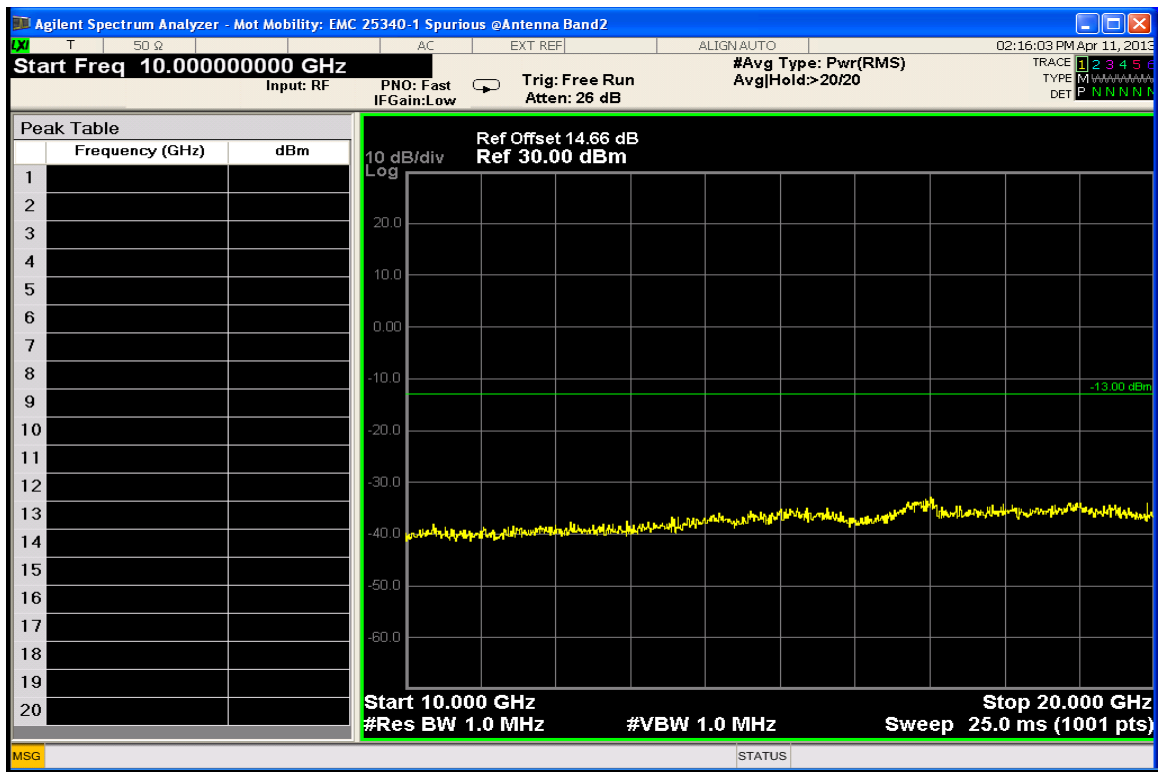
The EUT was tested in the highest bandwidth and both modulations in each band and the plots are reported below.

**Measurement Results: LTE Band 2 QPSK Conducted Spurious Emissions**

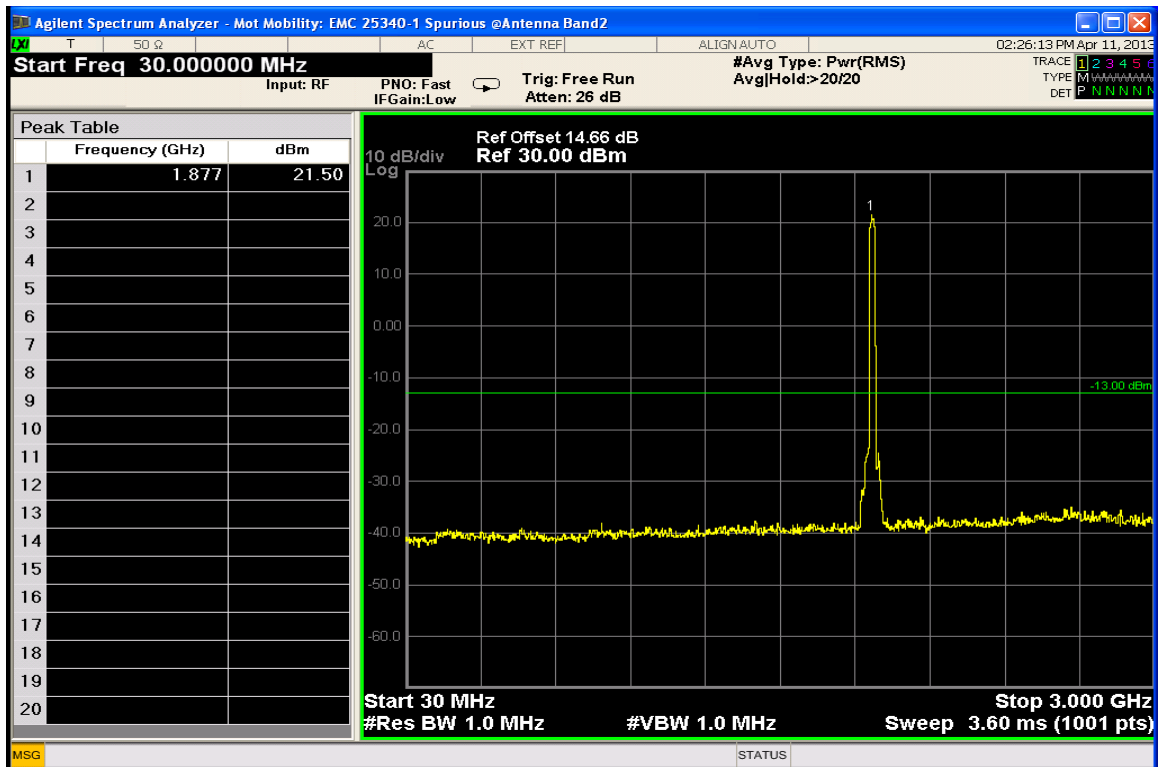
20 MHz BW, QPSK RB Size = 100RB Start 0, Low Channel



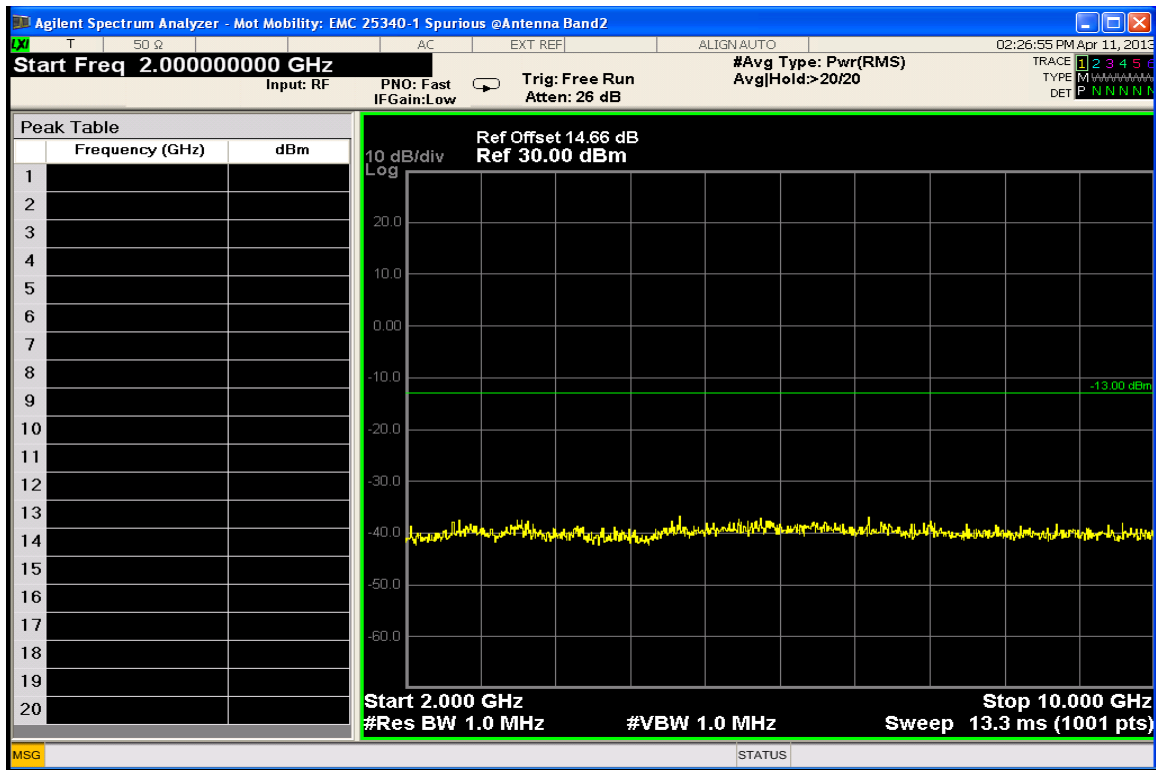
20 MHz BW, QPSK RB Size = 100RB Start 0, Low Channel



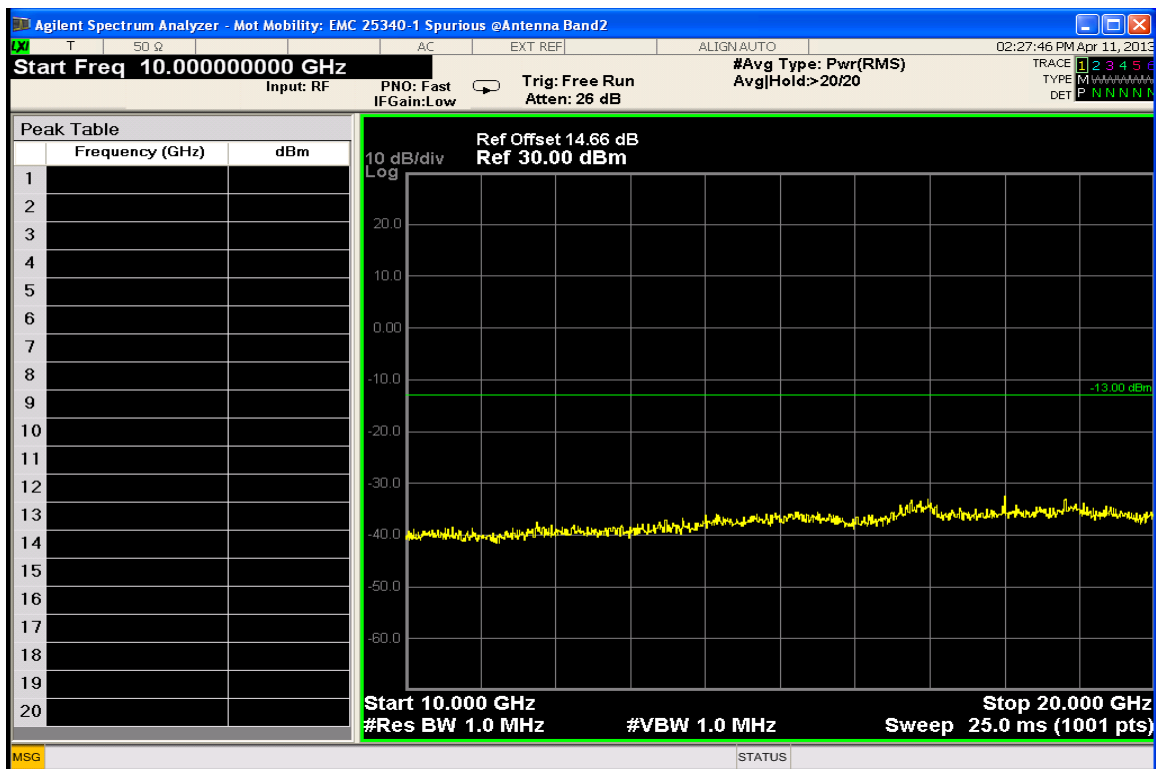
20 MHz BW, QPSK RB Size = 100RB Start 0, Low Channel



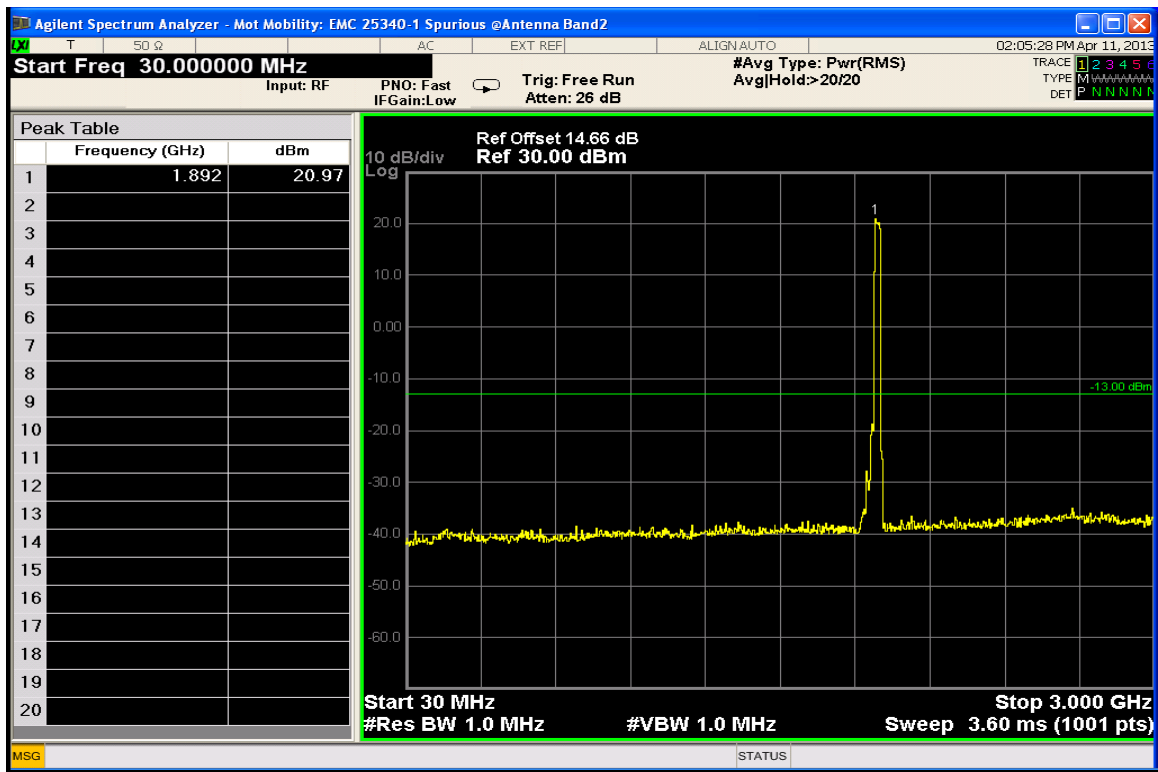
20 MHz BW, QPSK RB Size = 100RB Start 0, Mid Channel



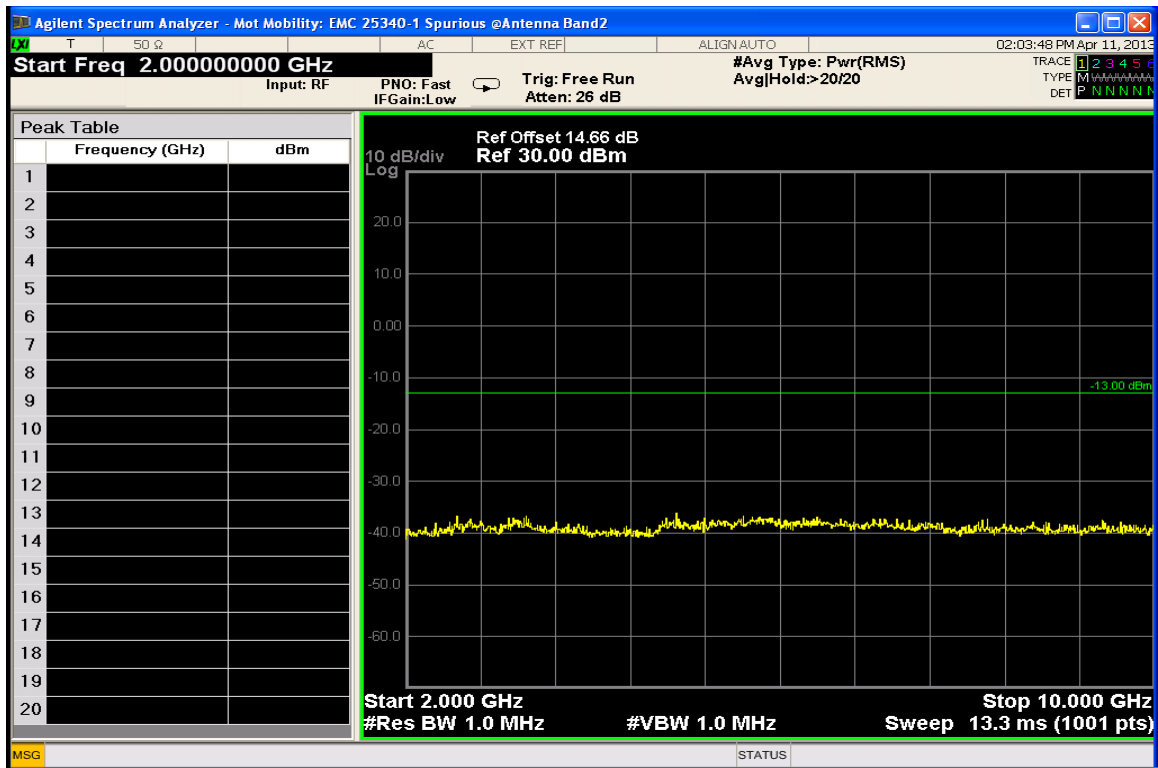
20 MHz BW, QPSK RB Size = 100RB Start 0, Mid Channel



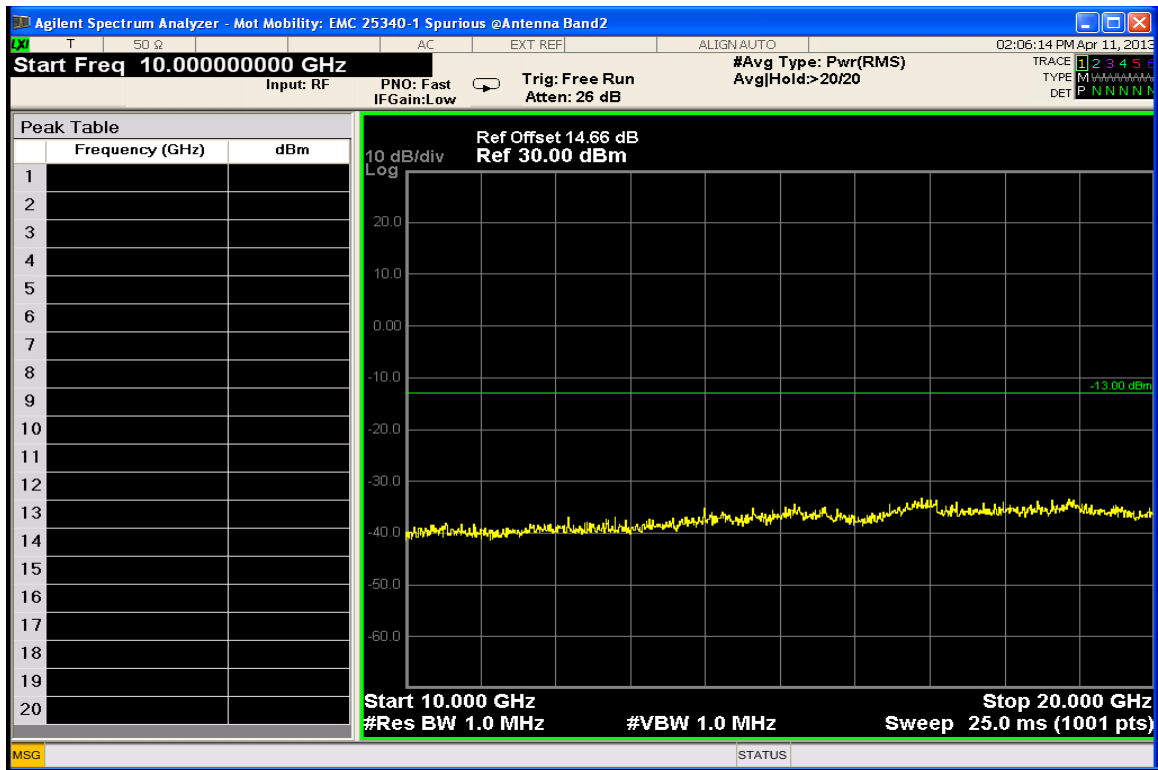
20 MHz BW, QPSK RB Size = 100RB Start 0, Mid Channel



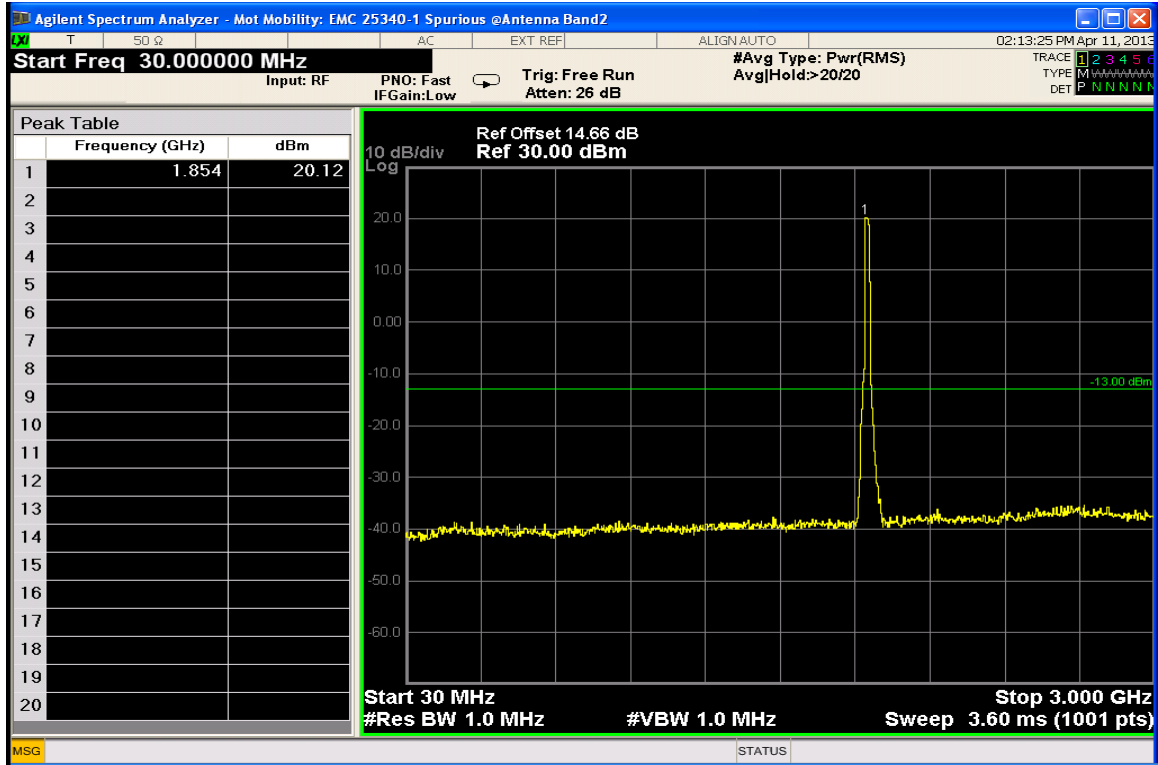
20 MHz BW, QPSK RB Size = 100RB Start 0, High Channel



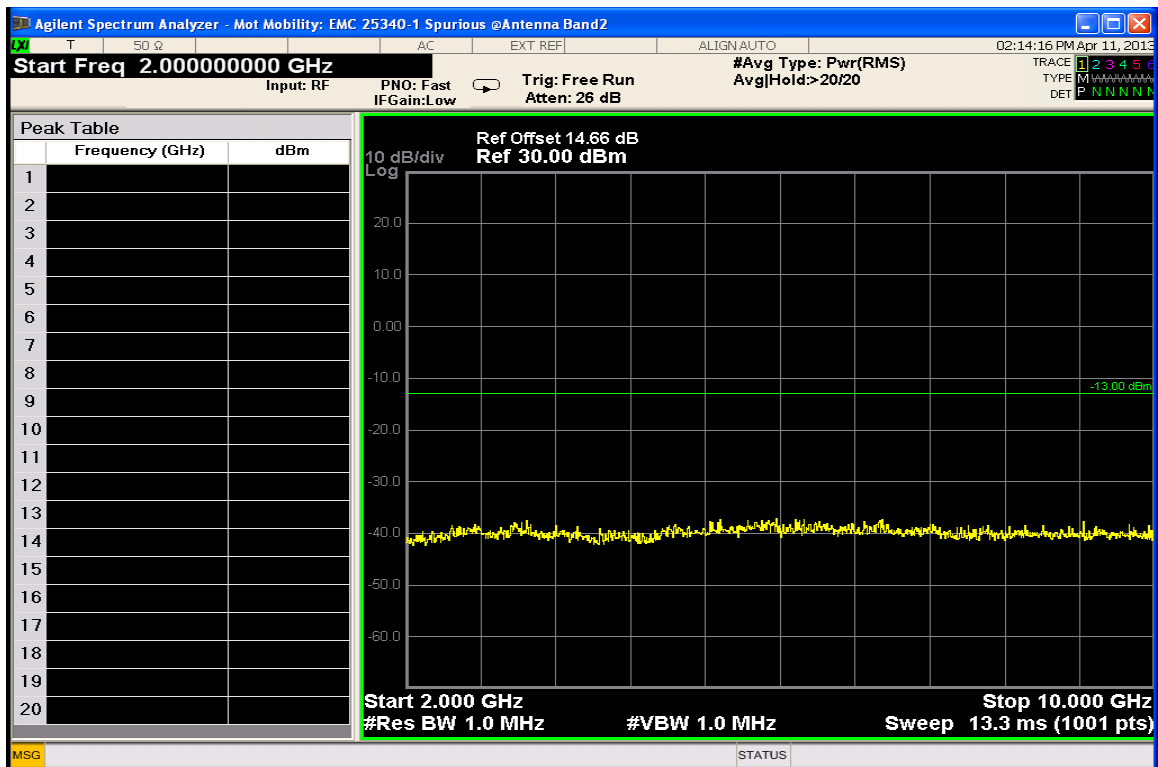
20 MHz BW, QPSK RB Size = 100RB Start 0, High Channel



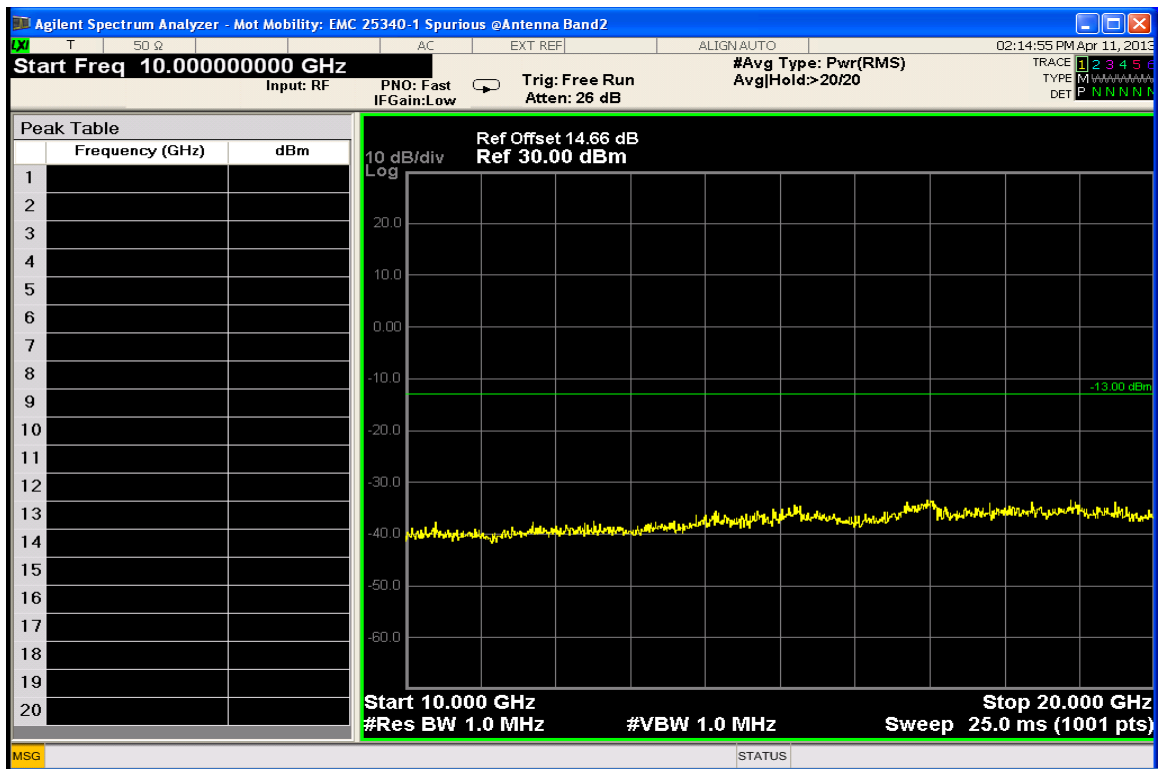
20 MHz BW, QPSK RB Size = 100RB Start 0, High Channel

**Measurement Results: LTE Band 2 16-QAM Conducted Spurious Emissions**

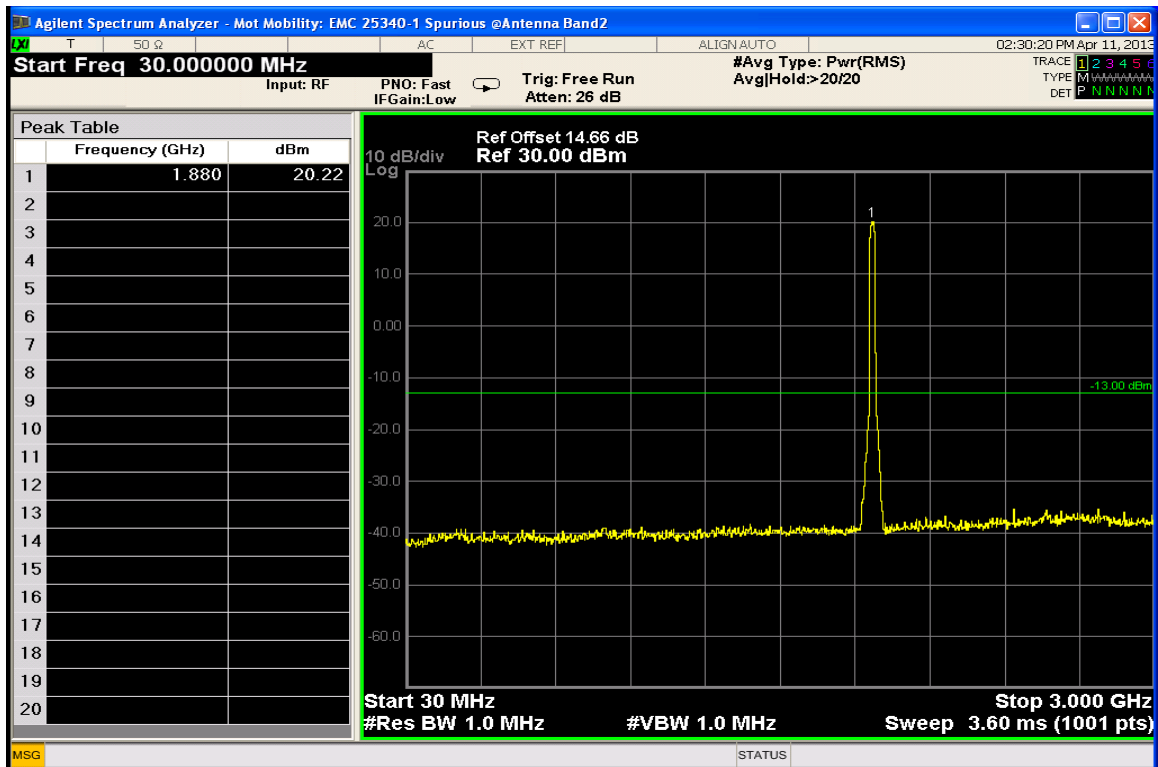
20 MHz BW, 16-QAM RB Size = 100RB Start 0, Low Channel



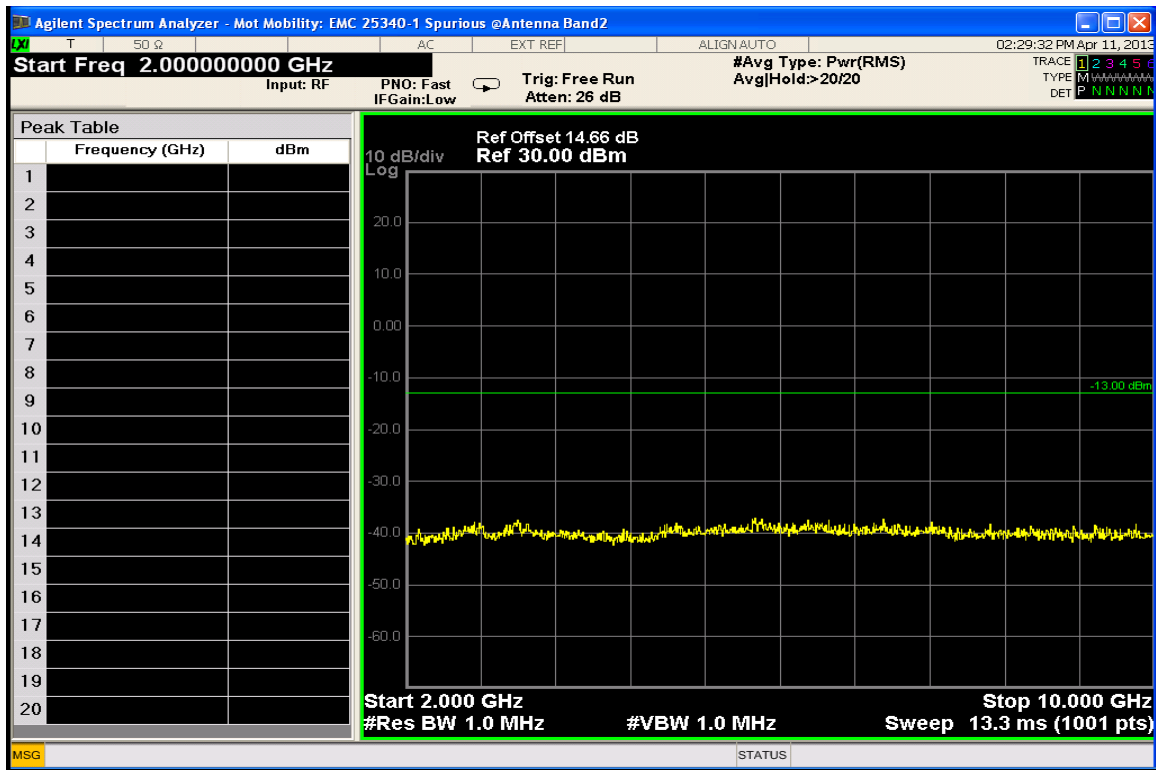
20 MHz BW, 16-QAM RB Size = 100RB Start 0, Low Channel



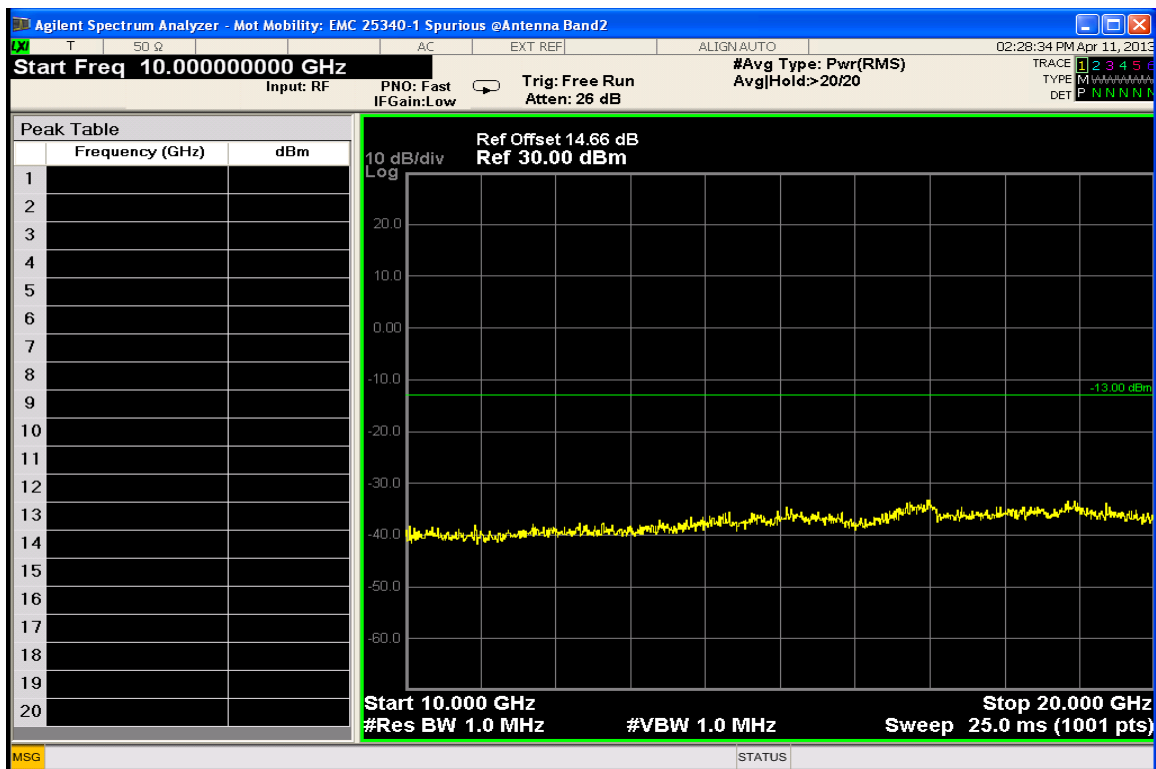
20 MHz BW, 16-QAM RB Size = 100RB Start 0, Low Channel



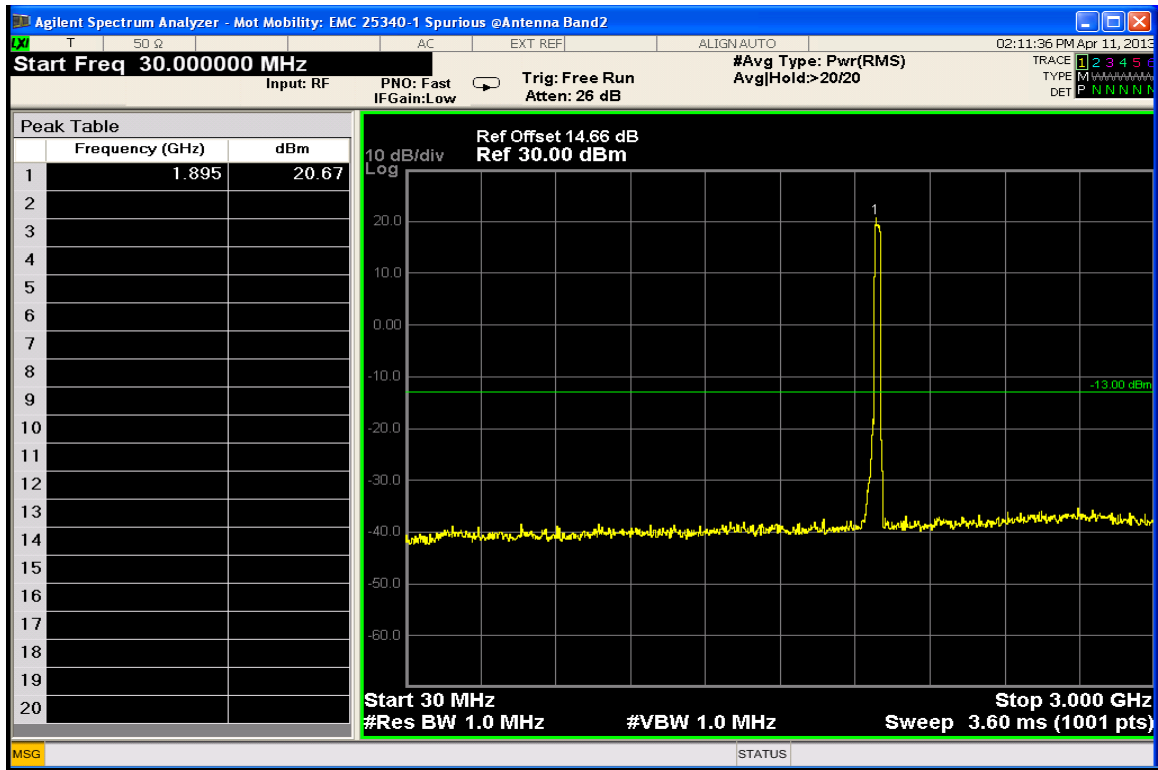
20 MHz BW, 16-QAM RB Size = 100RB Start 0, Mid Channel



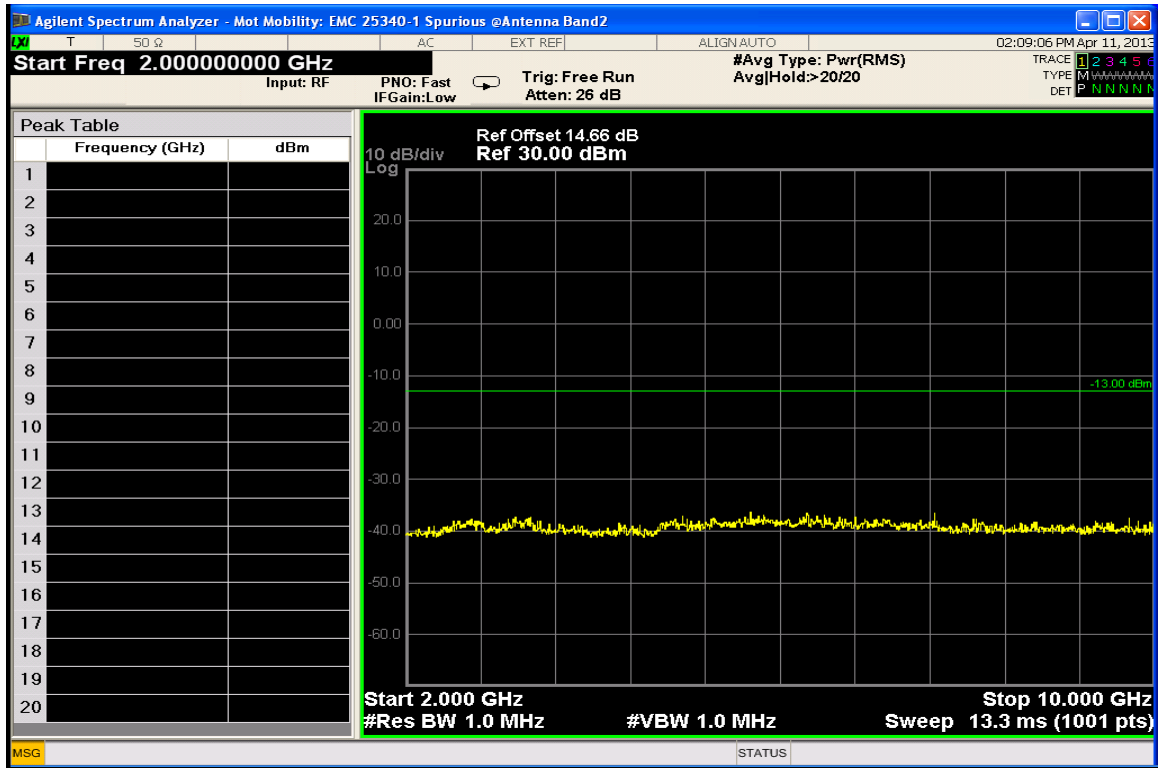
20 MHz BW, 16-QAM RB Size = 100RB Start 0, Mid Channel



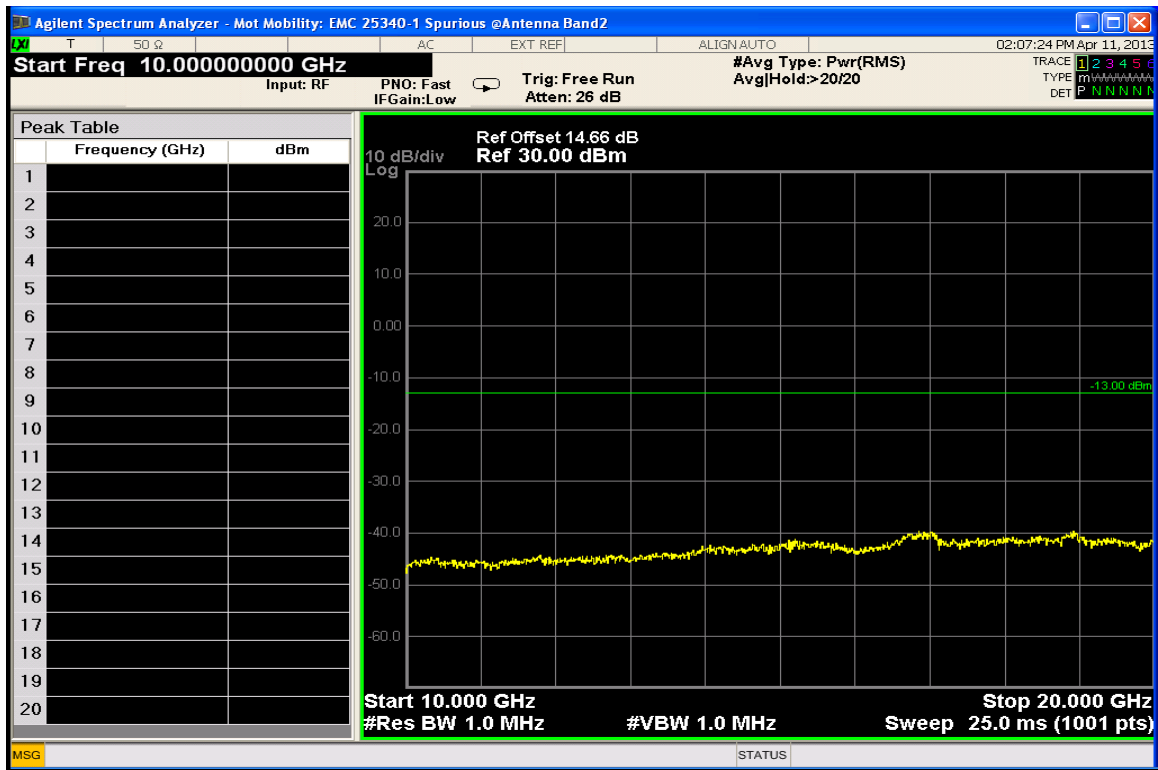
20 MHz BW, 16-QAM RB Size = 100RB Start 0, Mid Channel



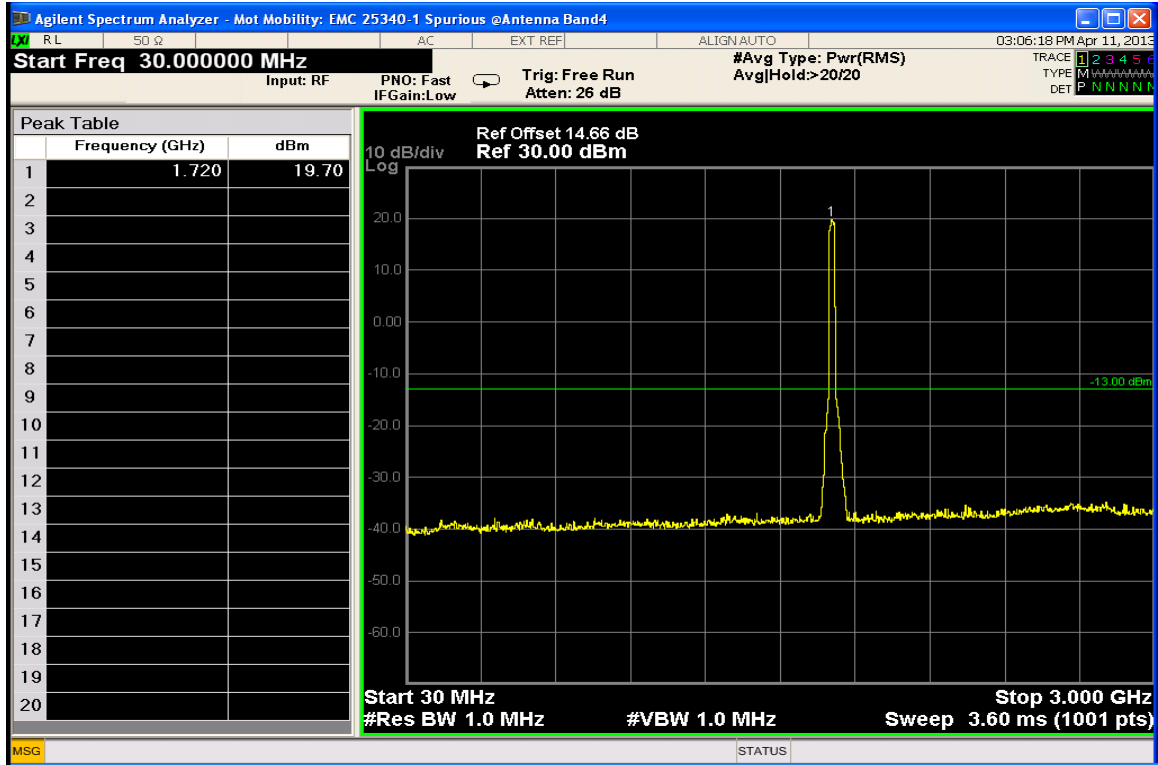
20 MHz BW, 16-QAM RB Size = 100RB Start 0, High Channel



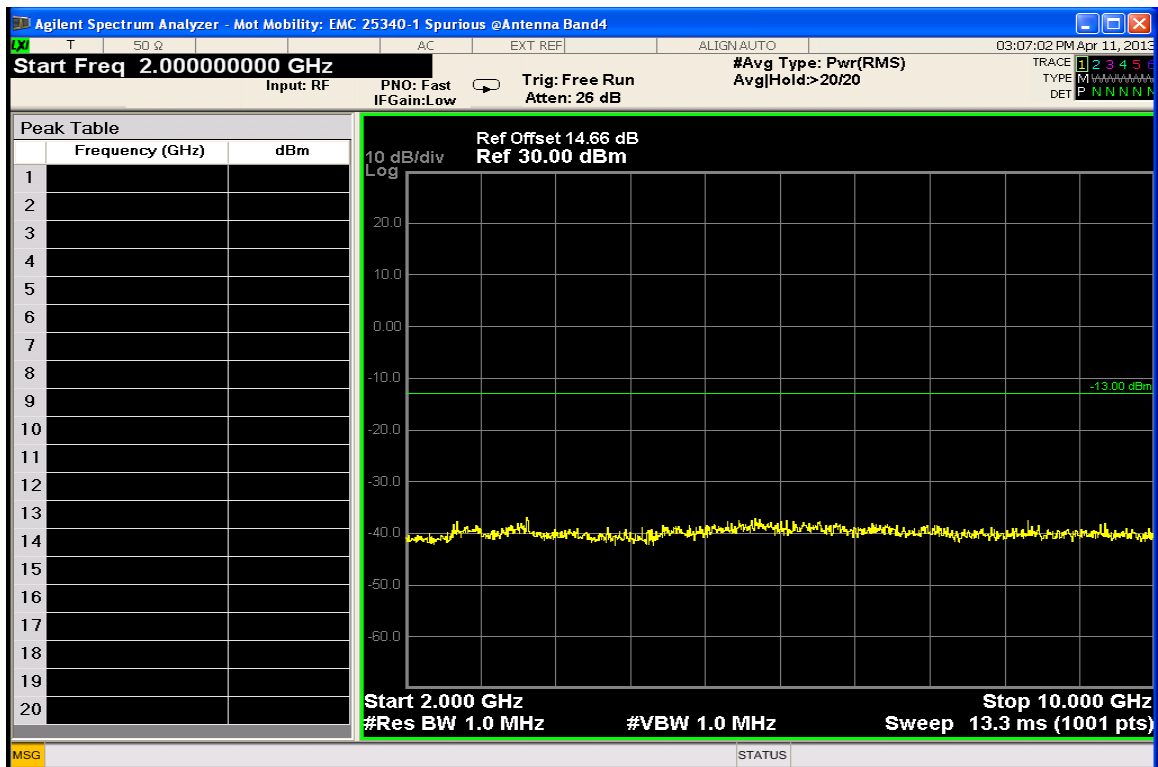
20 MHz BW, 16-QAM RB Size = 100RB Start 0, High Channel



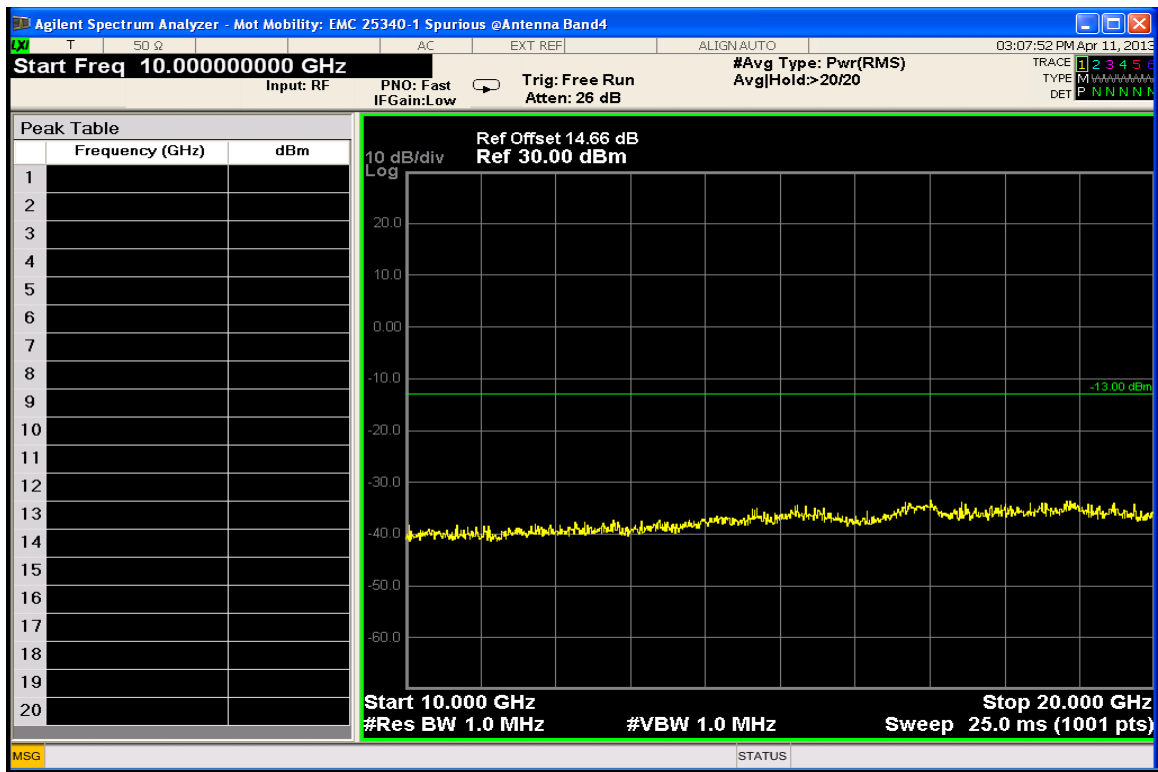
20 MHz BW, 16-QAM RB Size = 100RB Start 0, High Channel

**Measurement Results: LTE Band 4 QPSK Conducted Spurious Emissions**

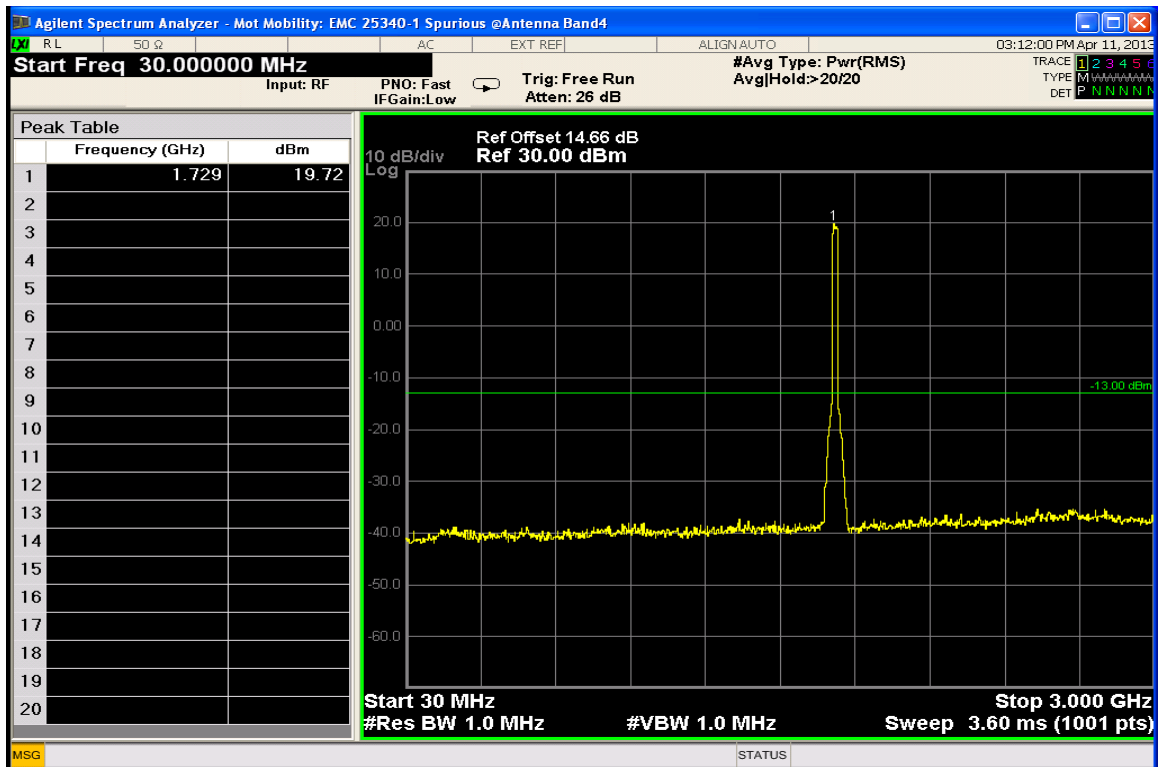
20 MHz BW, QPSK RB Size = 100RB Start 0, Low Channel



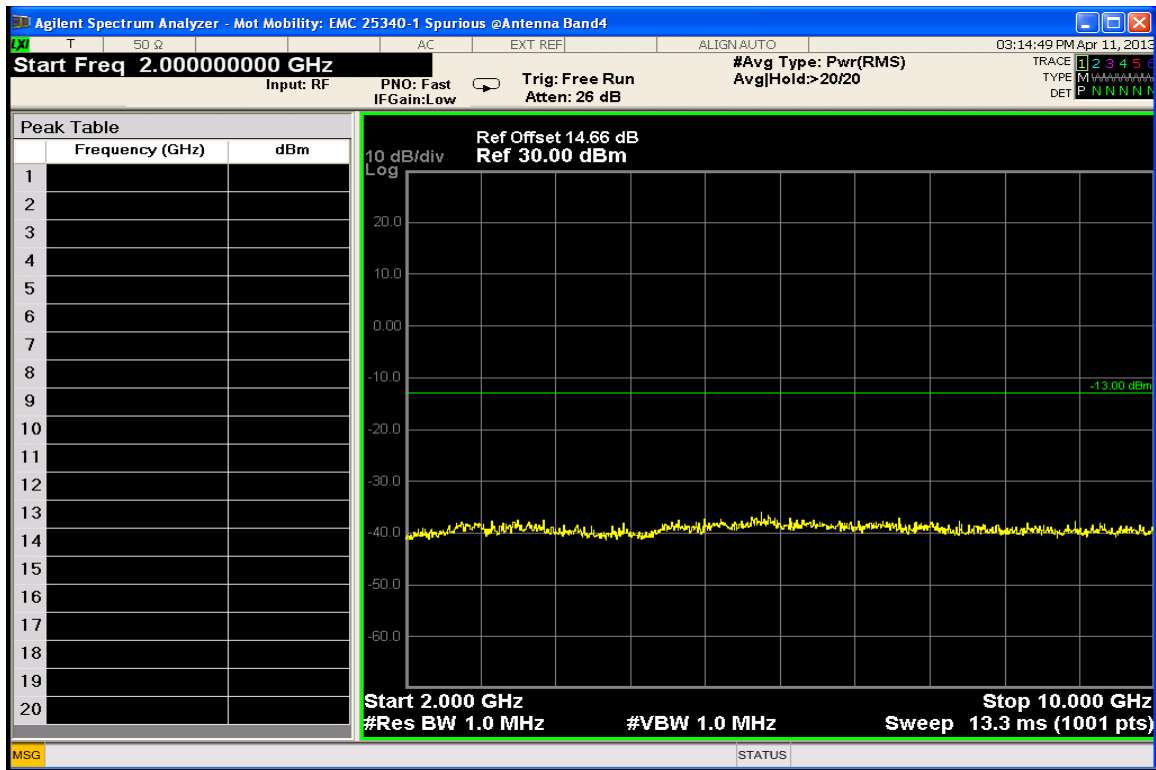
20 MHz BW, QPSK RB Size = 100RB Start 0, Low Channel



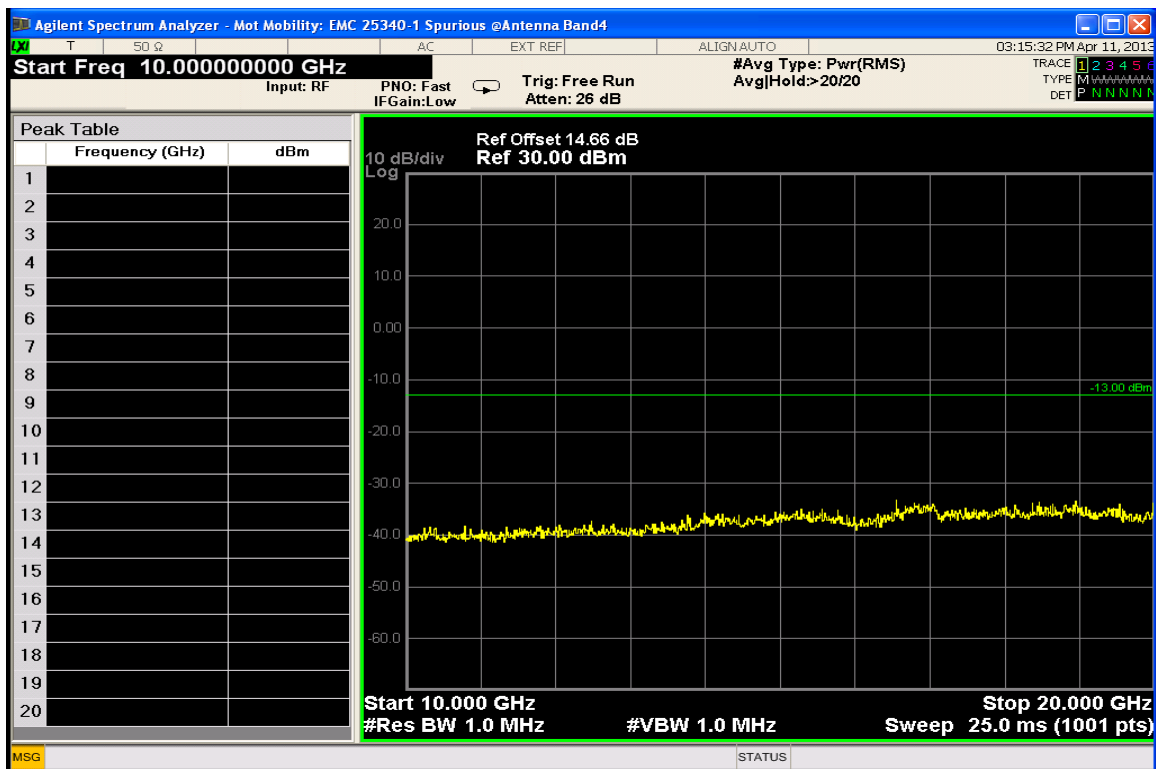
20 MHz BW, QPSK RB Size = 100RB Start 0, Low Channel



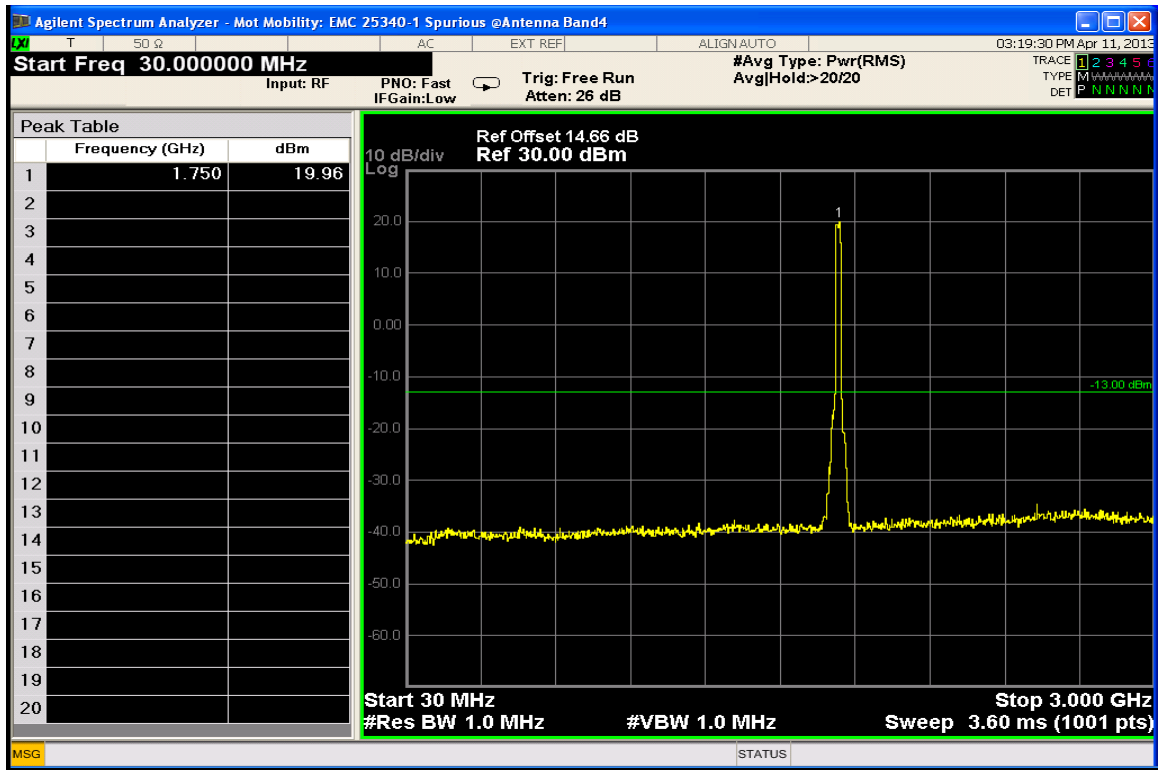
20 MHz BW, QPSK RB Size = 100RB Start 0, Mid Channel



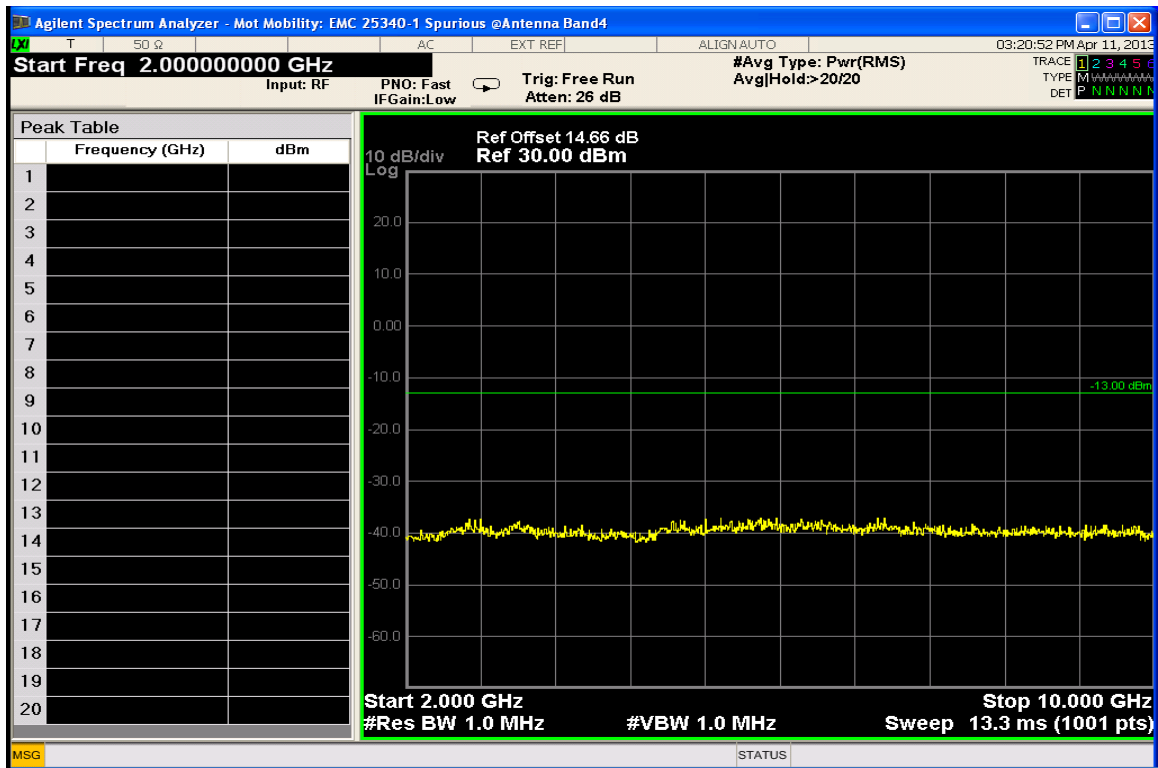
20 MHz BW, QPSK RB Size = 100RB Start 0, Mid Channel



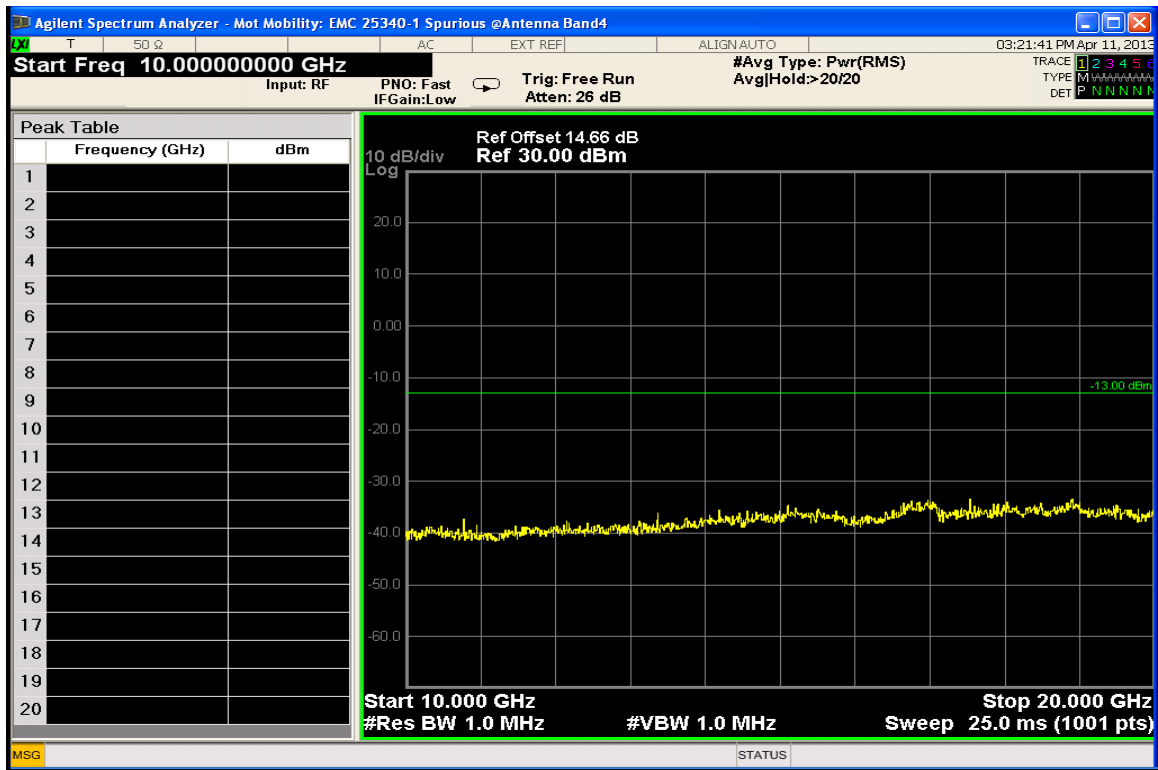
20 MHz BW, QPSK RB Size = 100RB Start 0, Mid Channel



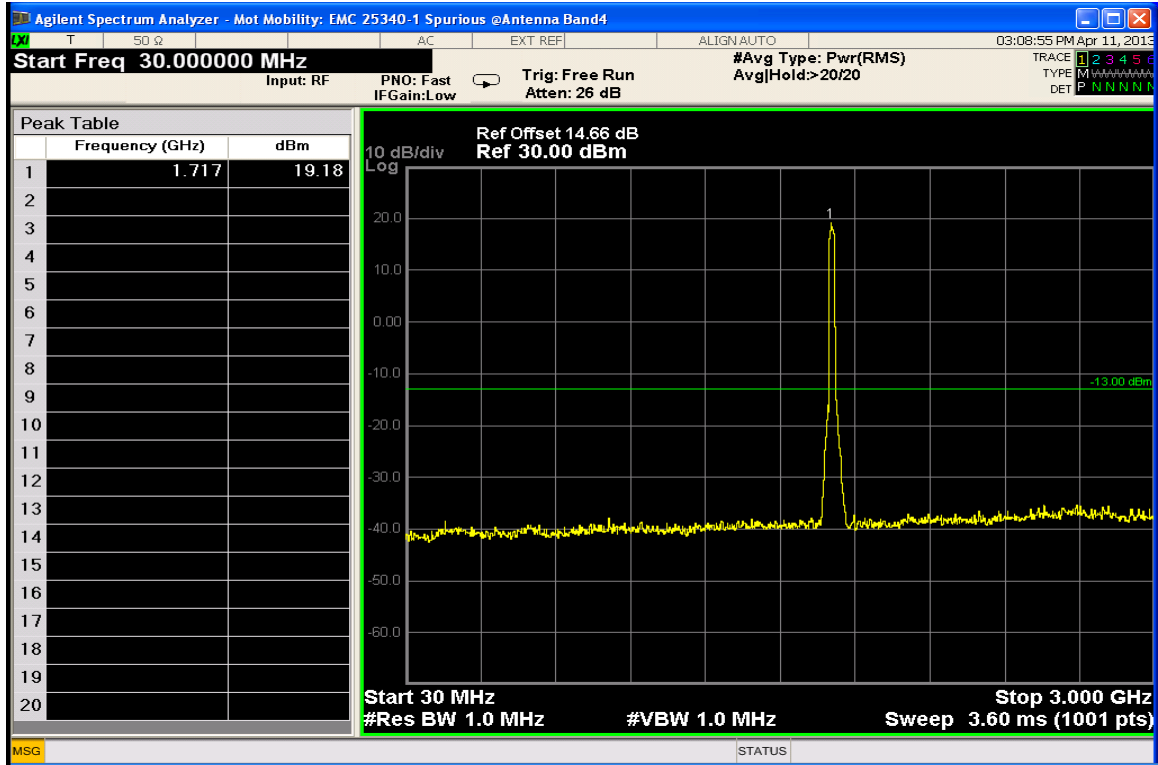
20 MHz BW, QPSK RB Size = 100RB Start 0, High Channel



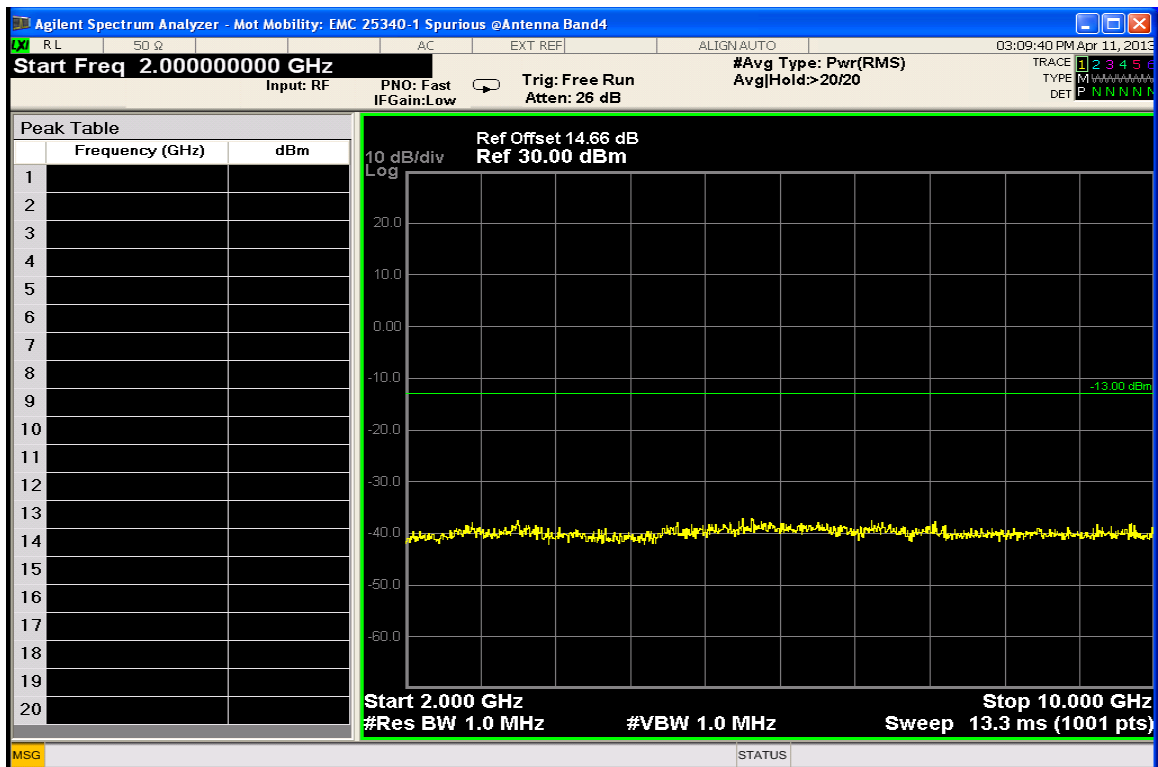
20 MHz BW, QPSK RB Size = 100RB Start 0, High Channel



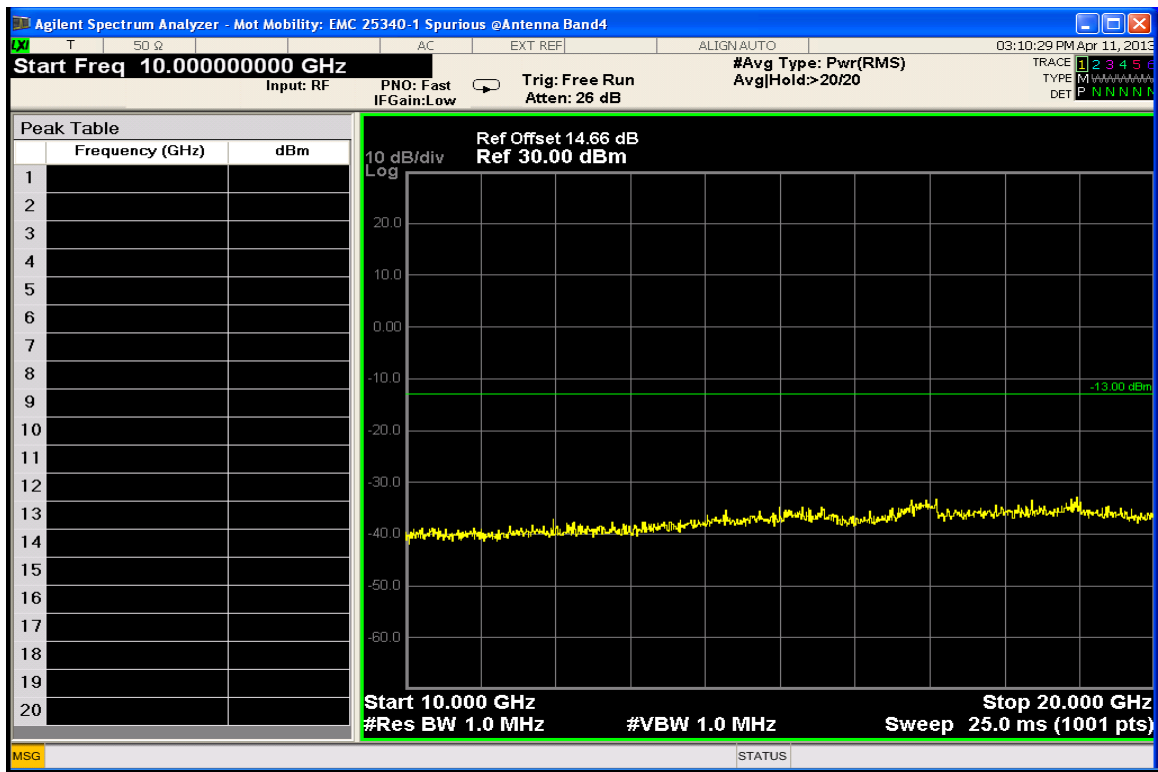
20 MHz BW, QPSK RB Size = 100RB Start 0, High Channel

**Measurement Results: LTE Band 4 16-QAM Conducted Spurious Emissions**

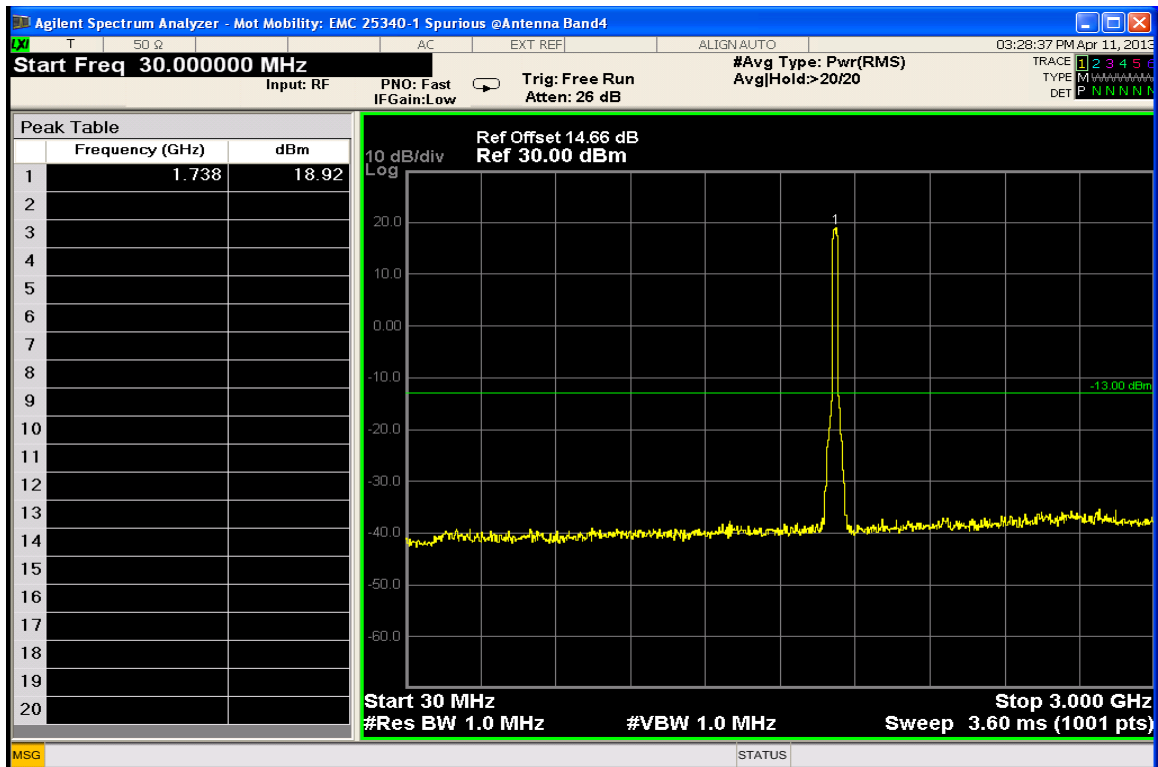
20 MHz BW, 16-QAM RB Size = 100RB Start 0, Low Channel



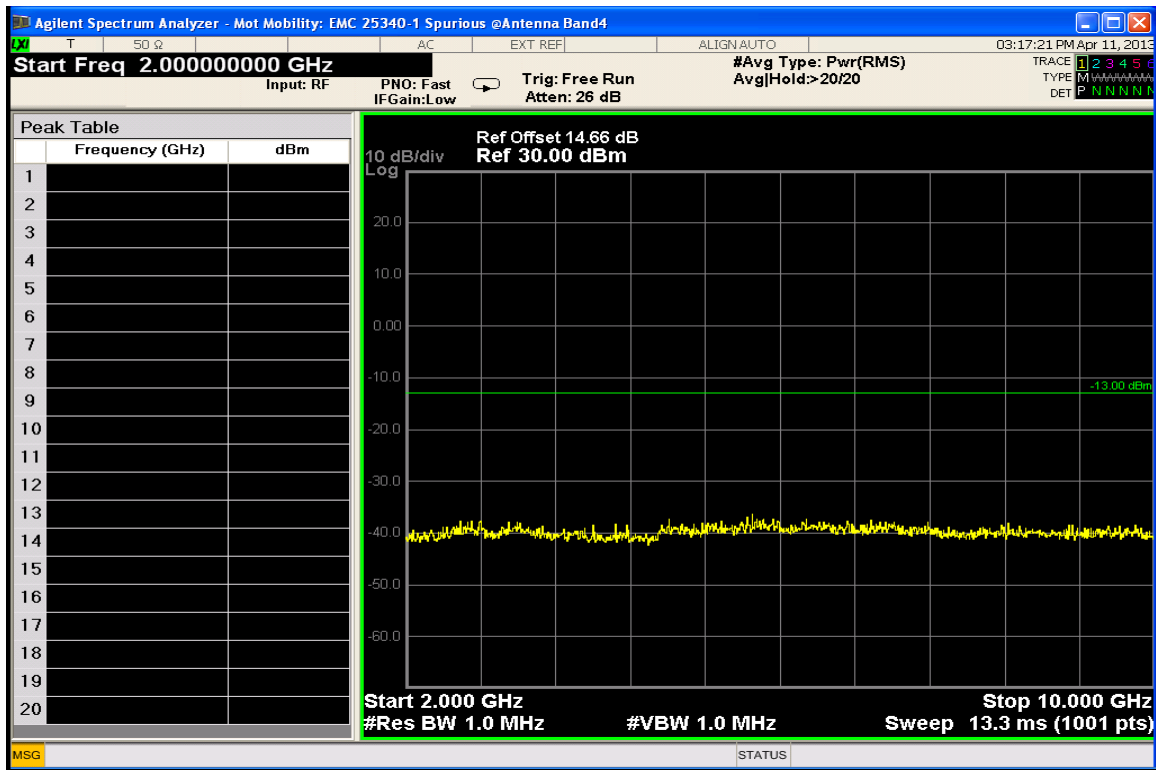
20 MHz BW, 16-QAM RB Size = 100RB Start 0, Low Channel



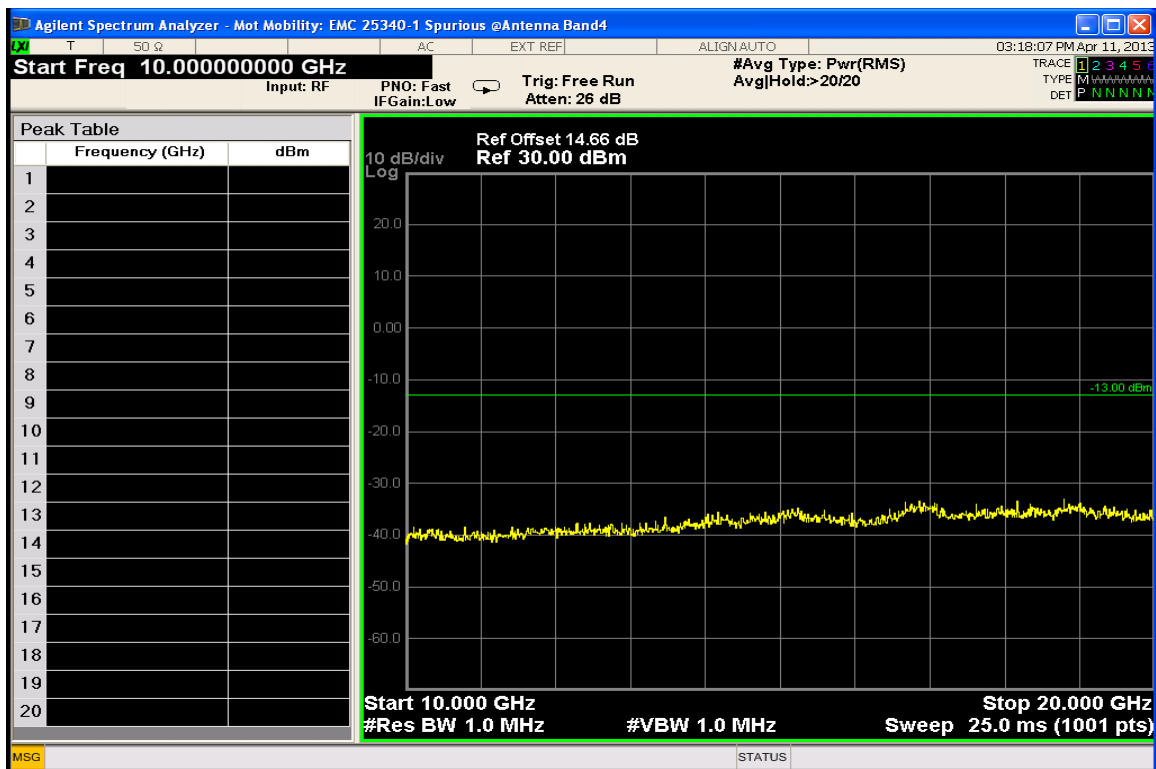
20 MHz BW, 16-QAM RB Size = 100RB Start 0, Low Channel



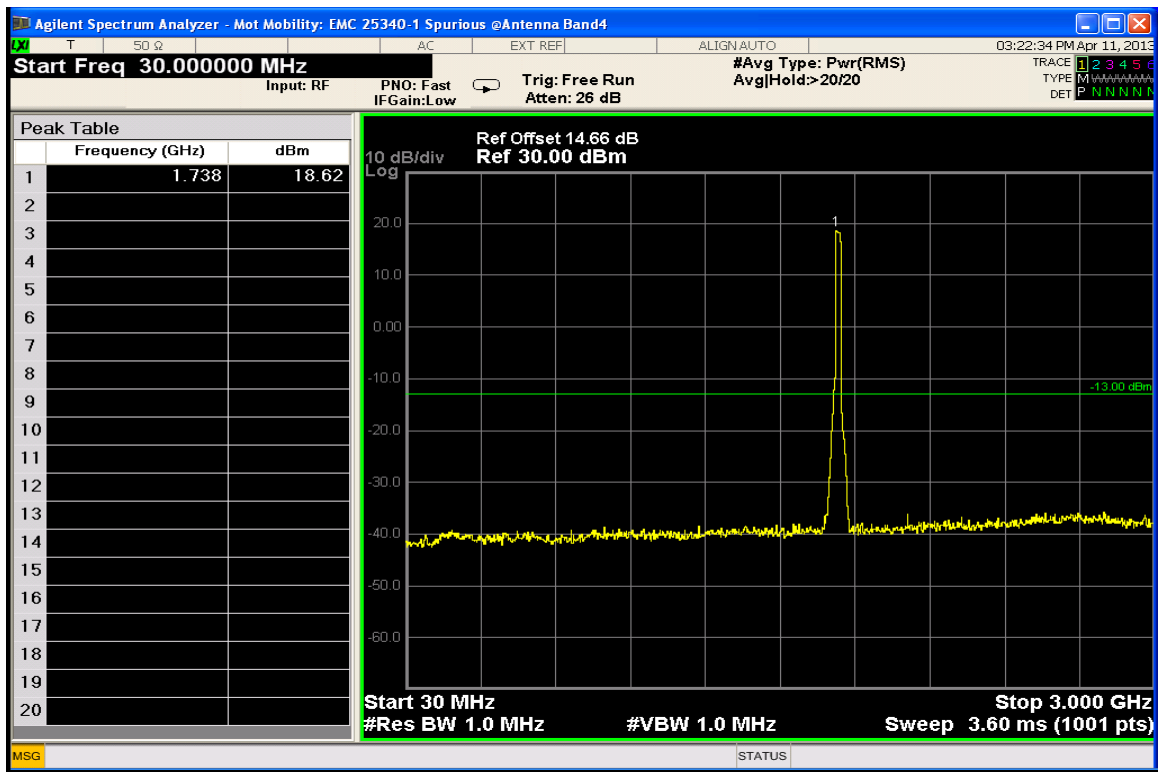
20 MHz BW, 16-QAM RB Size = 100RB Start 0, Mid Channel



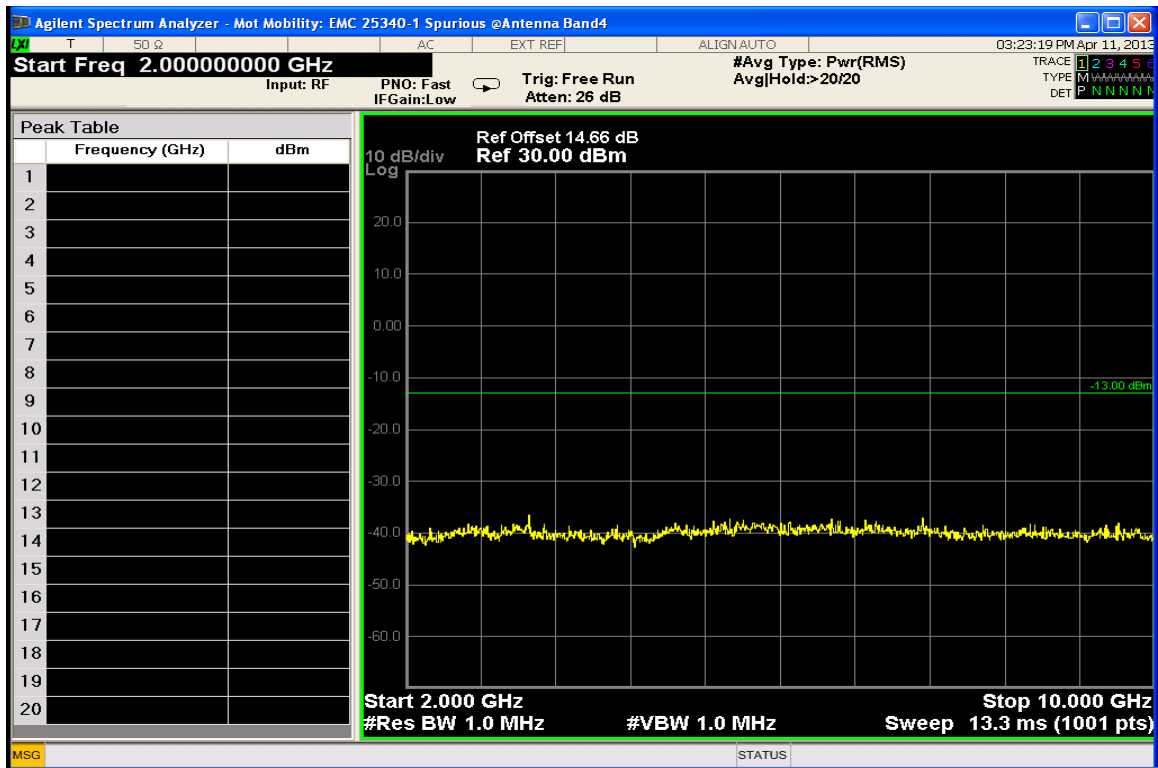
20 MHz BW, 16-QAM RB Size = 100RB Start 0, Mid Channel



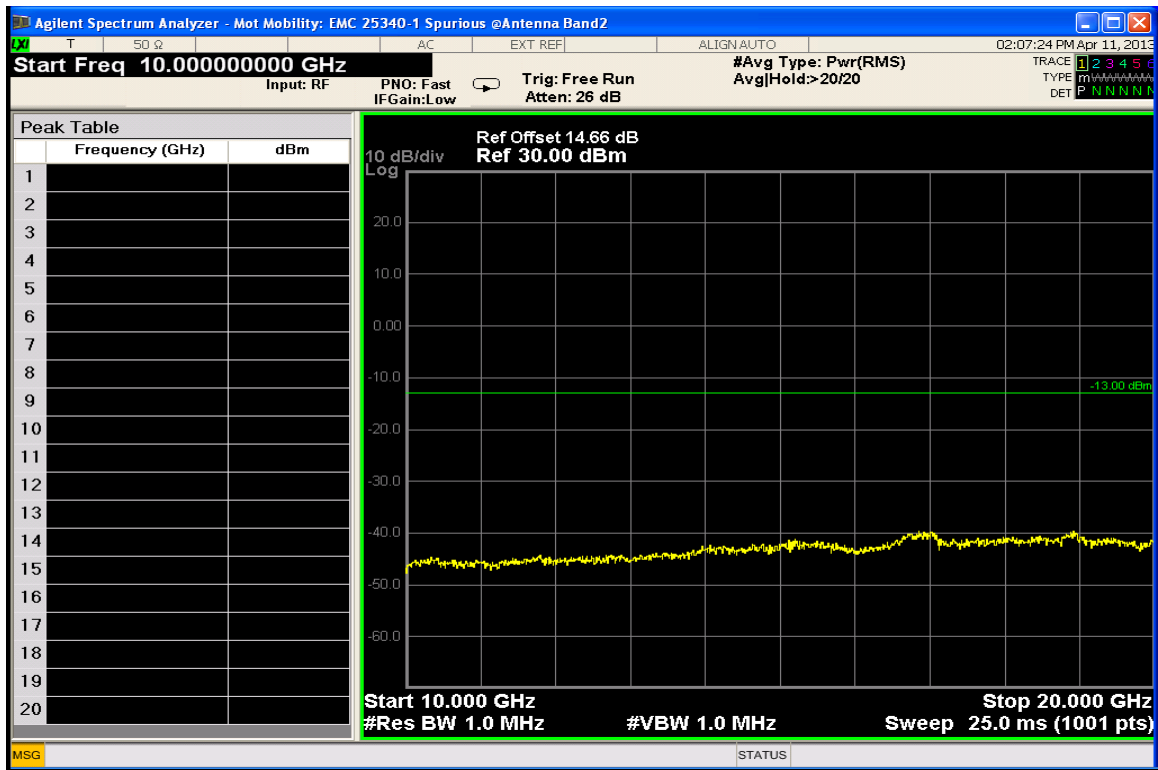
20 MHz BW, 16-QAM RB Size = 100RB Start 0, Mid Channel



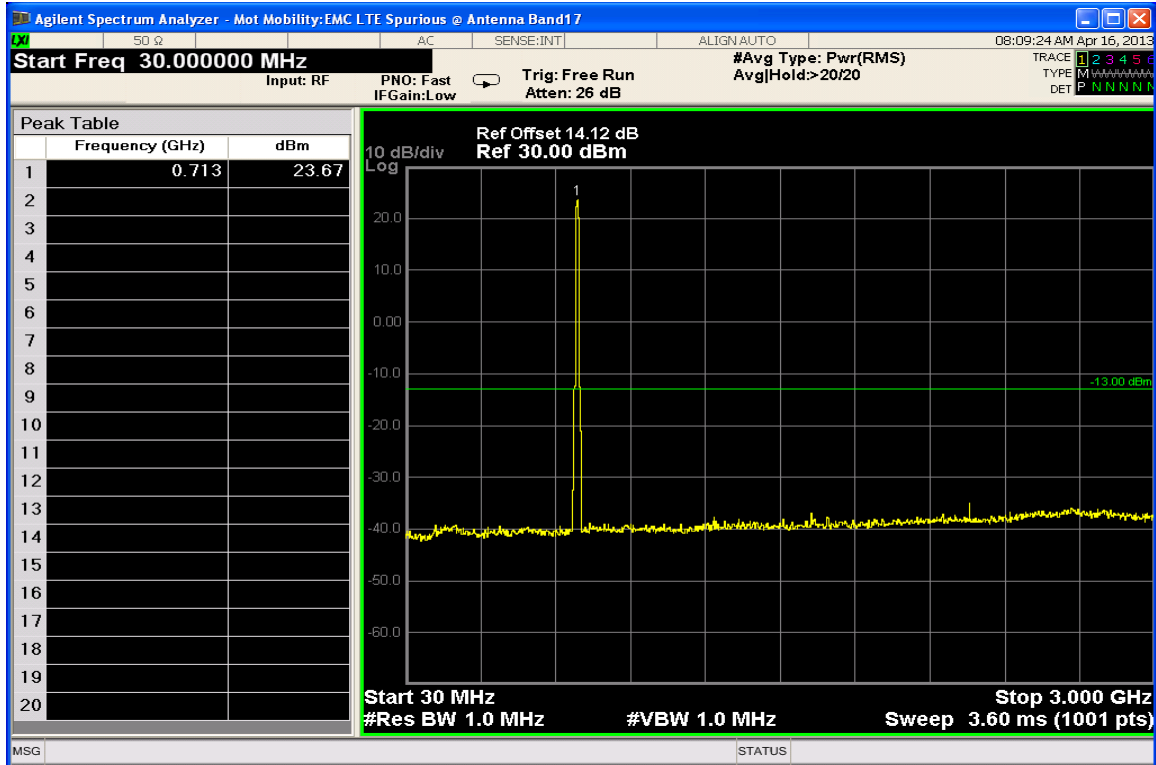
20 MHz BW, 16-QAM RB Size = 100RB Start 0, High Channel



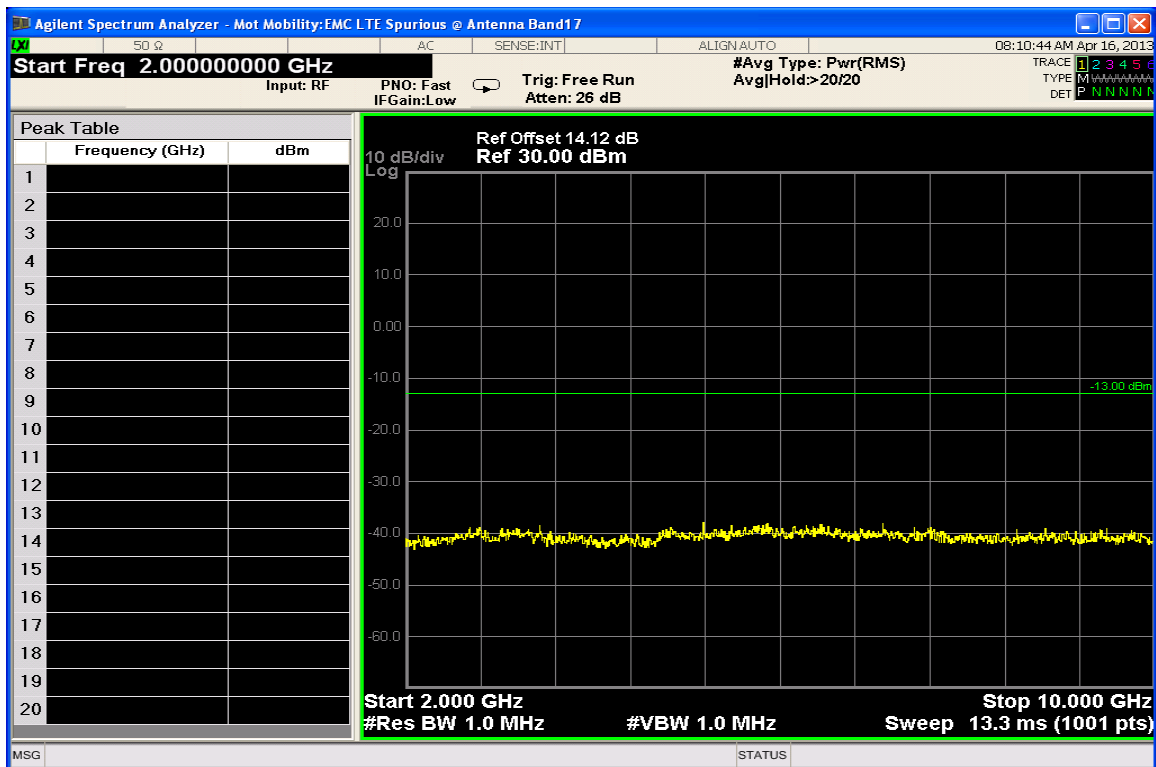
20 MHz BW, 16-QAM RB Size = 100RB Start 0, High Channel



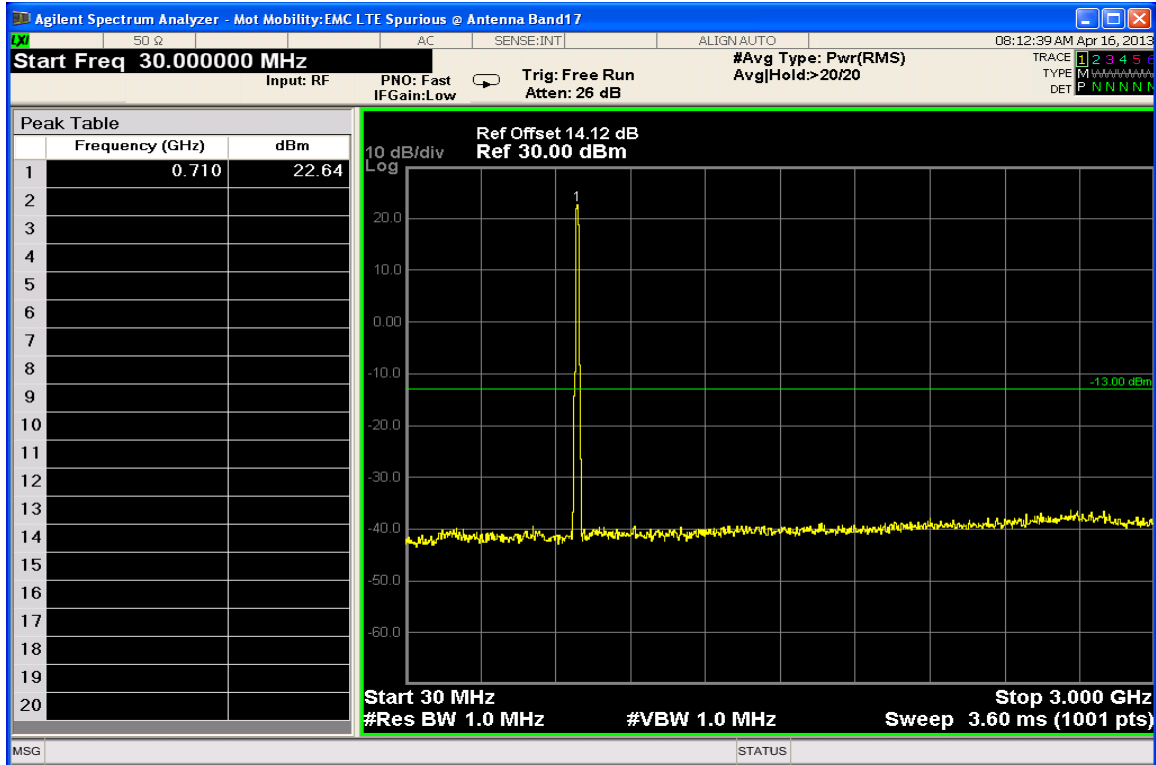
20 MHz BW, 16-QAM RB Size = 100RB Start 0, High Channel

**Measurement Results: LTE Band 17 QPSK Conducted Spurious Emissions**

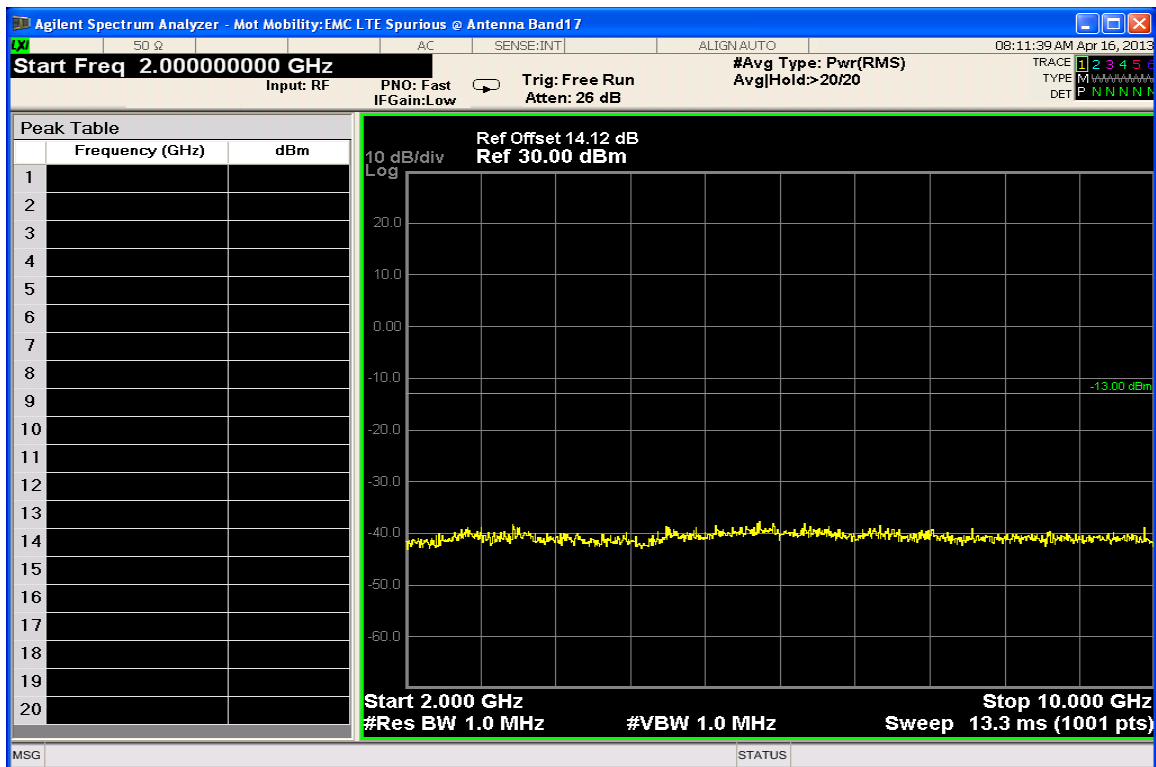
10 MHz BW, QPSK RB Size = 50RB Start 0, Low Channel



10 MHz BW, QPSK RB Size = 50RB Start 0, Low Channel

**Measurement Results: LTE Band 17 16-QAM Conducted Spurious Emissions**

10 MHz BW, 16-QAM RB Size = 50RB Start 0, Low Channel



10 MHz BW, 16-QAM RB Size = 50RB Start 0, Low Channel

**FIELD STRENGTH OF SPURIOUS EMISSIONS**

§24.238 (a), §27.53 (g), §27.53 (h)

**Measurement Procedure**

The EUT is placed inside the semi-anechoic chamber on a wooden table at the turntable center. For each spurious frequency, the antenna mast is raised and lowered from 1 to 4 meters and the turntable is rotated 360 degrees to obtain a maximum reading on the spectrum analyzer. This is repeated for both horizontal and vertical polarizations of the receive antenna.

The EUT is then replaced with a substitution antenna fed by a signal generator. With the signal generator tuned to a particular spurious frequency, the antenna mast is raised and lowered from 1 to 4 meters to obtain a maximum reading at the spectrum analyzer. The output of the signal generator is then adjusted until a reading identical to that obtained with the actual transmitter is achieved.

The power in dBm of each spurious emission is calculated by correcting the signal generator level for cable loss and gain of the substitution antenna referenced to a dipole. A fully charged battery was used for the supply voltage. Testing was performed in three orthogonal planes where the X plane is with the EUT orientated vertically, the Y plane is with the EUT orientated on its side and the Z plane with the EUT laying flat on the table.

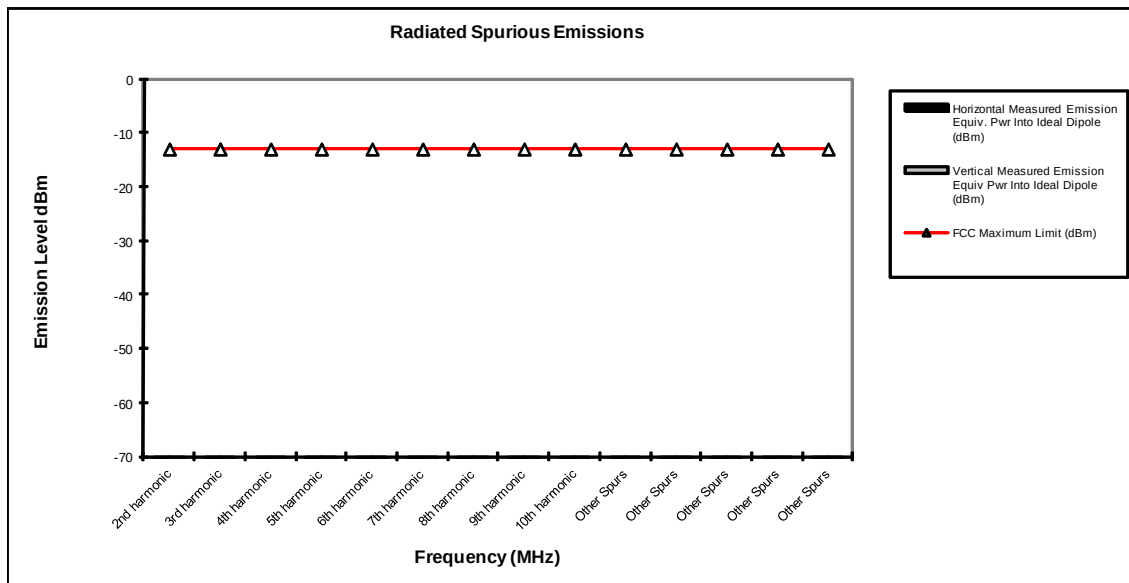
The settings of the receiver were as follows:

|                       |               |
|-----------------------|---------------|
| Units                 | dBm           |
| Divisions             | 5 dB          |
| Detector              | Peak Detector |
| Resolution Bandwidth  | 1 MHz         |
| Video Bandwidth (AVG) | 3 MHz         |
| Sweep Time            | Auto          |

The EUT was tested under all configurations and modulations in the largest BW available in multiple RB configurations. The worst cases data is reported in the plots below.

**Measurement Results****Band: LTE Band 2 and Band 4****Modulation: QPSK and 16QAM****Channel: All Channels**

| Frequency (MHz) | FCC Maximum Limit (dBm) | Horizontal Measured Emission<br>Equiv. Pwr Into Ideal Dipole (dBm) | Vertical Measured Emission<br>Equiv Pwr Into Ideal Dipole (dBm) |
|-----------------|-------------------------|--------------------------------------------------------------------|-----------------------------------------------------------------|
| 2nd harmonic    | -13                     | *                                                                  | *                                                               |
| 3rd harmonic    | -13                     | *                                                                  | *                                                               |
| 4th harmonic    | -13                     | *                                                                  | *                                                               |
| 5th harmonic    | -13                     | *                                                                  | *                                                               |
| 6th harmonic    | -13                     | *                                                                  | *                                                               |
| 7th harmonic    | -13                     | *                                                                  | *                                                               |
| 8th harmonic    | -13                     | *                                                                  | *                                                               |
| 9th harmonic    | -13                     | *                                                                  | *                                                               |
| 10th harmonic   | -13                     | *                                                                  | *                                                               |
| Other Spurs     | -13                     | *                                                                  | *                                                               |
| Other Spurs     | -13                     | *                                                                  | *                                                               |
| Other Spurs     | -13                     | *                                                                  | *                                                               |
| Other Spurs     | -13                     | *                                                                  | *                                                               |
| Other Spurs     | -13                     | *                                                                  | *                                                               |

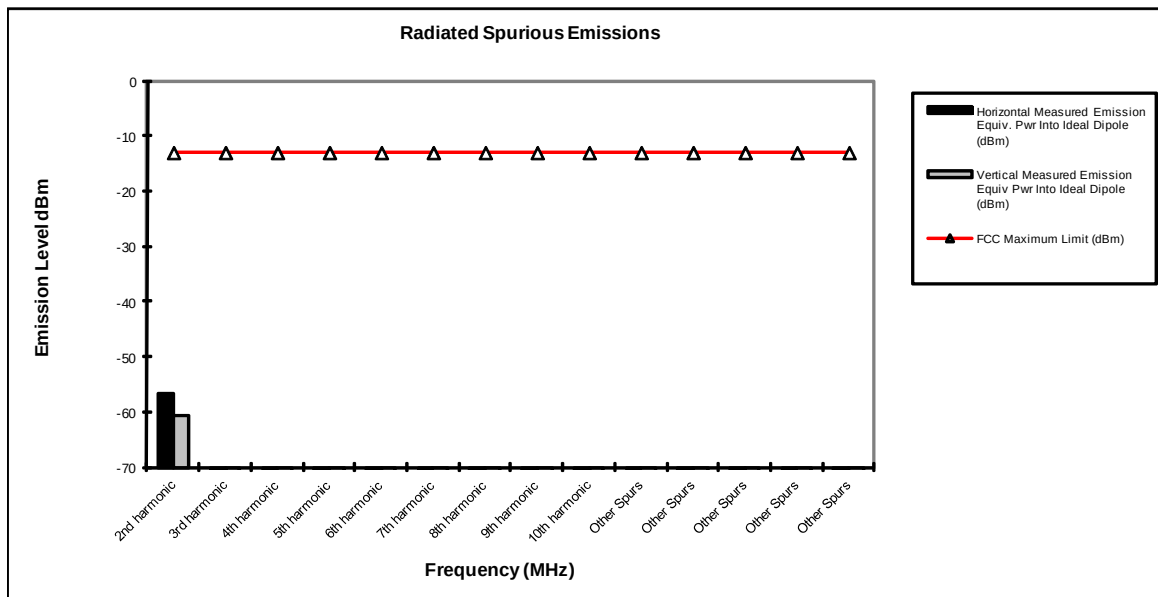
**Notes:**

1. \* Indicates the spurious emission could not be detected due to noise limitations or ambients or the emissions are lower than -33 dBm.
2. Each emission reported reflects the highest absolute level at the specific harmonic for the low, mid, and high channels at maximum power.
3. The Spectrum was investigated from 30 MHz to the tenth harmonic of the fundamental.

The margin with respect to the limit is the minimum margin for all modes and bands.

**Band: LTE Band 17****Modulation: QPSK.****Channel: All Channels**

| Frequency (MHz) | FCC Maximum Limit (dBm) | Horizontal Measured Emission<br>Equiv. Pwr Into Ideal Dipole (dBm) | Vertical Measured Emission<br>Equiv Pwr Into Ideal Dipole (dBm) |
|-----------------|-------------------------|--------------------------------------------------------------------|-----------------------------------------------------------------|
| 2nd harmonic    | -13                     | -56.7                                                              | -60.6                                                           |
| 3rd harmonic    | -13                     | *                                                                  | *                                                               |
| 4th harmonic    | -13                     | *                                                                  | *                                                               |
| 5th harmonic    | -13                     | *                                                                  | *                                                               |
| 6th harmonic    | -13                     | *                                                                  | *                                                               |
| 7th harmonic    | -13                     | *                                                                  | *                                                               |
| 8th harmonic    | -13                     | *                                                                  | *                                                               |
| 9th harmonic    | -13                     | *                                                                  | *                                                               |
| 10th harmonic   | -13                     | *                                                                  | *                                                               |
| Other Spurs     | -13                     | *                                                                  | *                                                               |
| Other Spurs     | -13                     | *                                                                  | *                                                               |
| Other Spurs     | -13                     | *                                                                  | *                                                               |
| Other Spurs     | -13                     | *                                                                  | *                                                               |
| Other Spurs     | -13                     | *                                                                  | *                                                               |



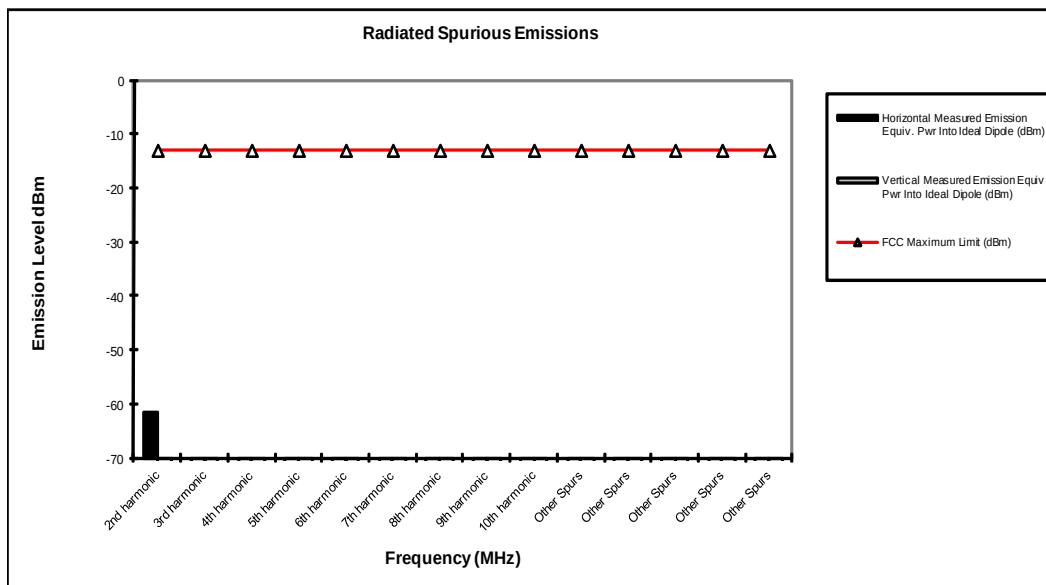
Notes:

- \* Indicates the spurious emission could not be detected due to noise limitations or ambients or the emissions are lower than -33 dBm.
- Each emission reported reflects the highest absolute level at the specific harmonic for the low, mid, and high channels at maximum power.

The margin with respect to the limit is the minimum margin for all modes and bands.

**Band: LTE Band 17****Modulation: 16-QAM.****Channel: All Channels**

| Frequency (MHz) | FCC Maximum Limit (dBm) | Horizontal Measured Emission Equiv. Pwr Into Ideal Dipole (dBm) | Vertical Measured Emission Equiv Pwr Into Ideal Dipole (dBm) |
|-----------------|-------------------------|-----------------------------------------------------------------|--------------------------------------------------------------|
| 2nd harmonic    | -13                     | -61.5                                                           | *                                                            |
| 3rd harmonic    | -13                     | *                                                               | *                                                            |
| 4th harmonic    | -13                     | *                                                               | *                                                            |
| 5th harmonic    | -13                     | *                                                               | *                                                            |
| 6th harmonic    | -13                     | *                                                               | *                                                            |
| 7th harmonic    | -13                     | *                                                               | *                                                            |
| 8th harmonic    | -13                     | *                                                               | *                                                            |
| 9th harmonic    | -13                     | *                                                               | *                                                            |
| 10th harmonic   | -13                     | *                                                               | *                                                            |
| Other Spurs     | -13                     | *                                                               | *                                                            |
| Other Spurs     | -13                     | *                                                               | *                                                            |
| Other Spurs     | -13                     | *                                                               | *                                                            |
| Other Spurs     | -13                     | *                                                               | *                                                            |
| Other Spurs     | -13                     | *                                                               | *                                                            |

**Notes:**

1. \* Indicates the spurious emission could not be detected due to noise limitations or ambients or the emissions are lower than -33 dBm.
2. Each emission reported reflects the highest absolute level at the specific harmonic for the low, mid, and high channels at maximum power.
3. The Spectrum was investigated from 30 MHz to the tenth harmonic of the fundamental.

The margin with respect to the limit is the minimum margin for all modes and bands.

**FREQUENCY STABILITY**

§Part 2.1055 (a), §Part 2.1055 (d), §Part 24.235, §Part 27.54

**Measurement Procedure**

The EUT is placed in an environmental chamber. The antenna port of the EUT is directly coupled to the input of the measurement equipment through a specialized RF connector. A power supply is attached as the primary voltage supply.

Frequency measurements are made at the extremes of the temperature range -30° C to +60° C and at intervals of 10° C with the primary supply voltage set to the nominal battery operating voltage. A period of time sufficient to stabilize all components of the equipment is allowed at each frequency measurement. The maximum variation of frequency is measured.

At room temperature, the primary supply voltage is reduced to the battery operating endpoint of the equipment under test. The maximum variation of frequency is measured. A power supply was used for the input supply voltage.

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

The EUT was tested in the highest bandwidth and both modulations in each band and the plots are reported below.

# Measurement Results

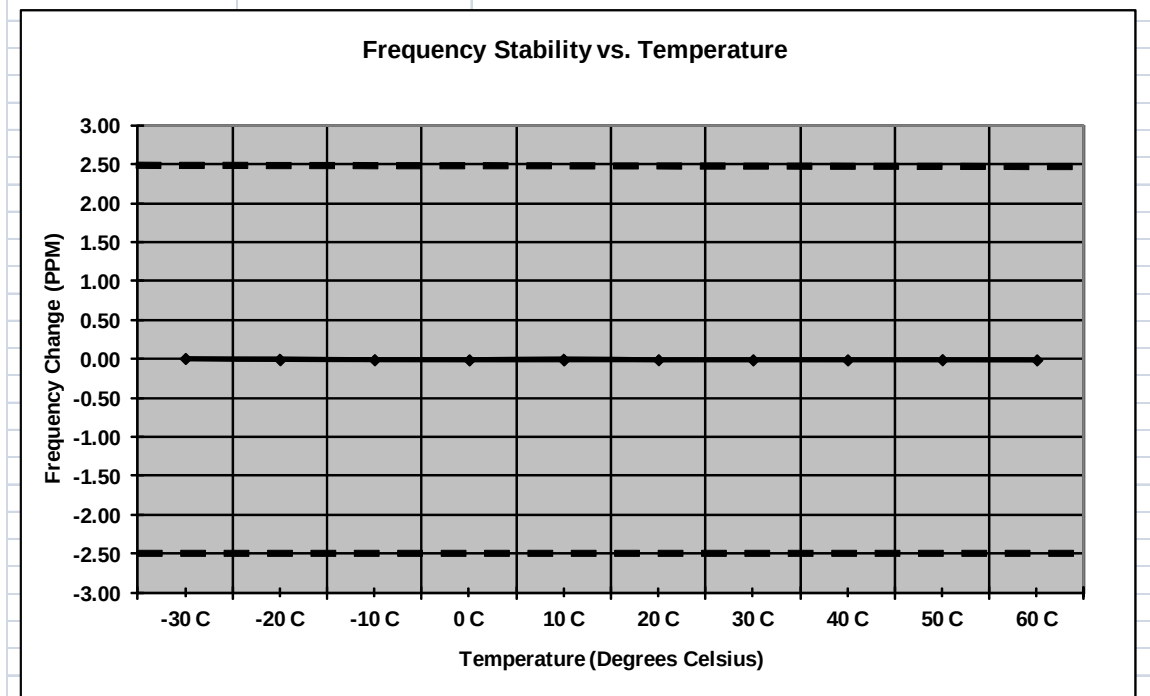
## Modulation: LTE Band 2 QPSK 20 MHz BW

Mode: LTE Band 2-20 MHz      Operating Frequency: 1860 MHz

Channel: 18700      Deviation Limit (PPM): 2.5 ppm

100 RB QPSK

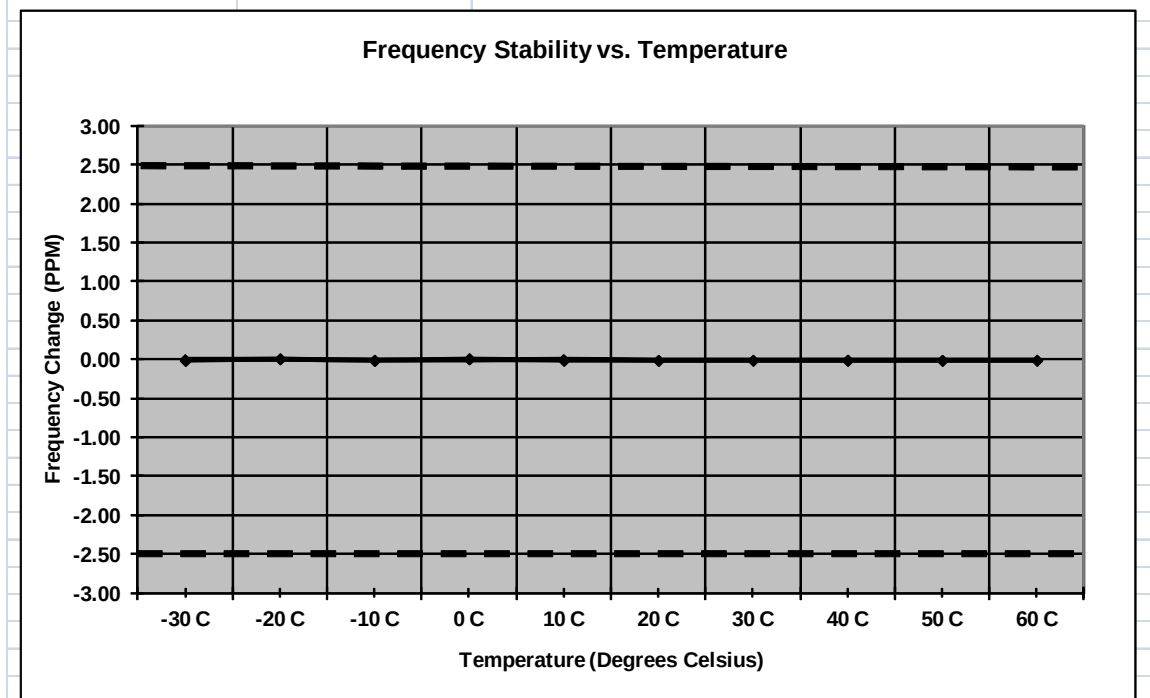
| Temperature | Frequency Error | Frequency Error | Voltage          | Voltage |
|-------------|-----------------|-----------------|------------------|---------|
| C           | Hz              | (PPM)           | (%)              | (VDC)   |
| -30 C       | 16.42           | 0.009           | 100%             | 3.80    |
| -20 C       | -15.52          | -0.008          | 100%             | 3.80    |
| -10 C       | -15.25          | -0.008          | 100%             | 3.80    |
| 0 C         | -19.15          | -0.010          | 100%             | 3.80    |
| 10 C        | -18.17          | -0.010          | 100%             | 3.80    |
| 20 C        | -15.76          | -0.008          | 100%             | 3.80    |
| 30 C        | -17.92          | -0.010          | 100%             | 3.80    |
| 40 C        | -18.68          | -0.010          | 100%             | 3.80    |
| 50 C        | -14.42          | -0.008          | 100%             | 3.80    |
| 60 C        | -18.83          | -0.010          | 100%             | 3.80    |
| 20 C        | -17.12          | -0.009          | Battery Endpoint | 3.20    |



**Modulation: LTE Band 2 16-QAM 20MHz BW**

Mode: LTE Band 2-20 MHz      Operating Frequency: 1860 MHz  
 Channel: 18700      Deviation Limit (PPM): 2.5 ppm  
 100 RB 16 QAM

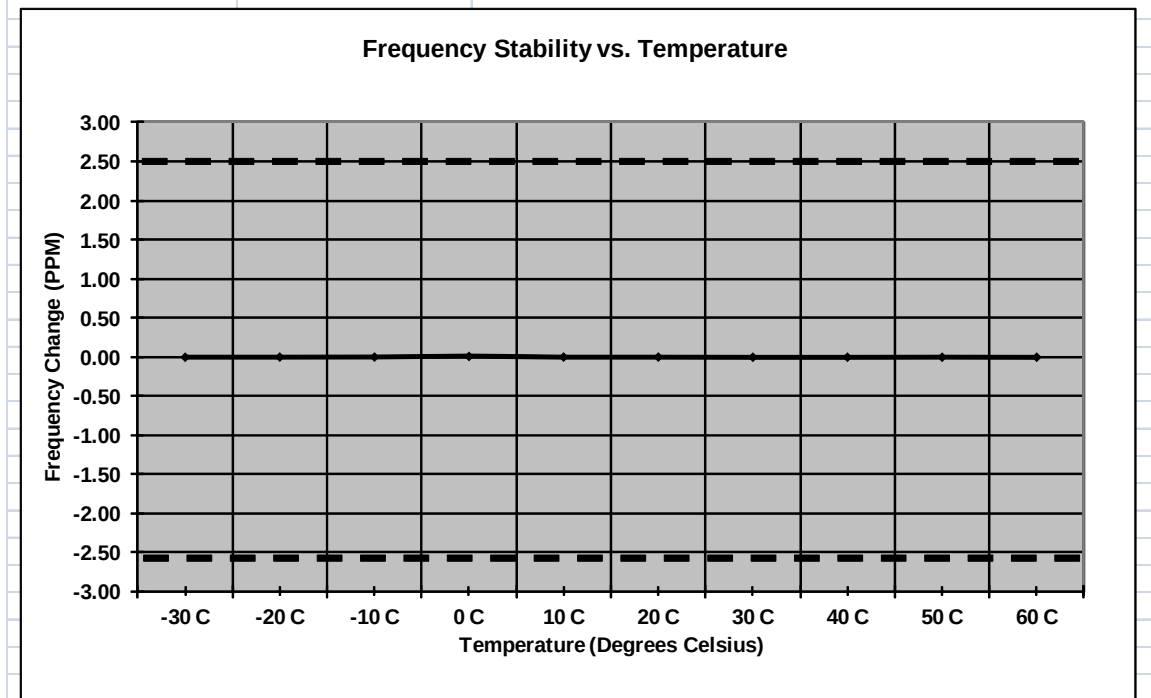
| Temperature | Frequency Error | Frequency Error | Voltage          | Voltage |
|-------------|-----------------|-----------------|------------------|---------|
| C           | Hz              | (PPM)           | (%)              | (VDC)   |
| -30 C       | -21.24          | -0.011          | 100%             | 3.80    |
| -20 C       | 17.41           | 0.009           | 100%             | 3.80    |
| -10 C       | -20.50          | -0.011          | 100%             | 3.80    |
| 0 C         | 17.12           | 0.009           | 100%             | 3.80    |
| 10 C        | -18.54          | -0.010          | 100%             | 3.80    |
| 20 C        | -20.54          | -0.011          | 100%             | 3.80    |
| 30 C        | -19.21          | -0.010          | 100%             | 3.80    |
| 40 C        | -17.47          | -0.009          | 100%             | 3.80    |
| 50 C        | -20.84          | -0.011          | 100%             | 3.80    |
| 60 C        | -17.87          | -0.010          | 100%             | 3.80    |
| 20 C        | -20.37          | -0.011          | Battery Endpoint | 3.20    |



**Modulation: LTE Band 4 QPSK 20 MHz BW**

Mode: LTE Band 4-20 MHz      Operating Frequency: 1720 MHz  
 Channel: 20050      Deviation Limit (PPM): 2.5 ppm  
 100 RB QPSK

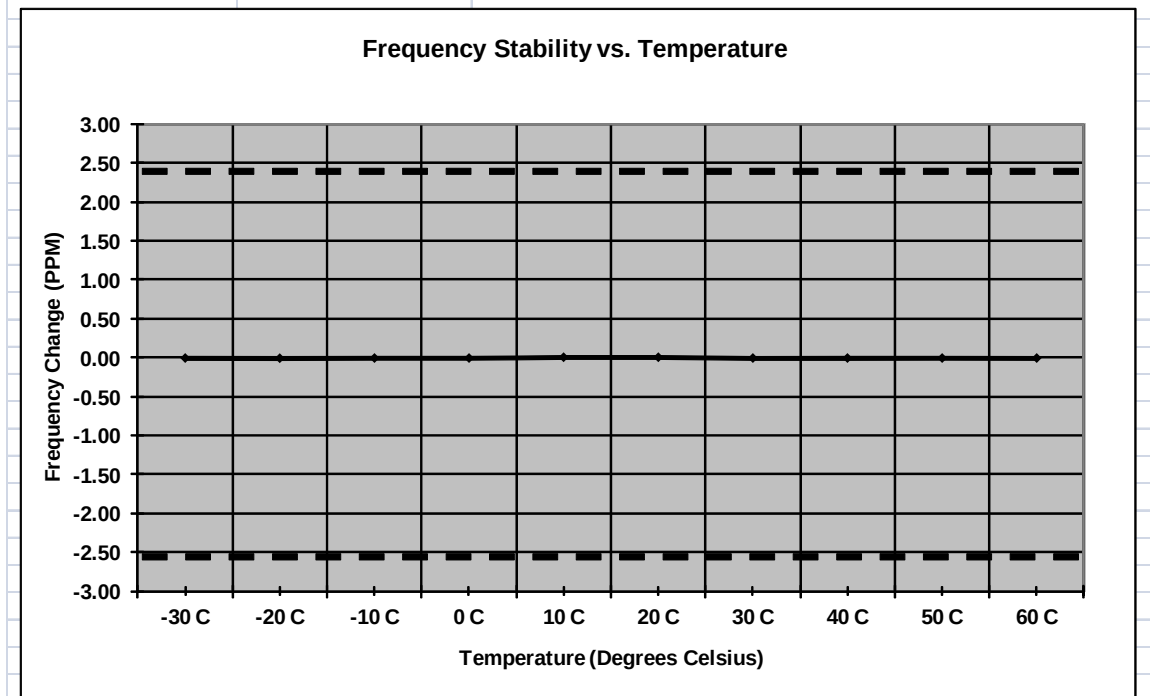
| Temperature | Frequency Error | Frequency Error | Voltage          | Voltage |
|-------------|-----------------|-----------------|------------------|---------|
| C           | Hz              | (PPM)           | (%)              | (VDC)   |
| -30 C       | -8.40           | -0.005          | 100%             | 3.80    |
| -20 C       | -7.51           | -0.004          | 100%             | 3.80    |
| -10 C       | -6.44           | -0.004          | 100%             | 3.80    |
| 0 C         | 8.04            | 0.005           | 100%             | 3.80    |
| 10 C        | -7.58           | -0.004          | 100%             | 3.80    |
| 20 C        | -7.55           | -0.004          | 100%             | 3.80    |
| 30 C        | -9.47           | -0.006          | 100%             | 3.80    |
| 40 C        | -10.31          | -0.006          | 100%             | 3.80    |
| 50 C        | -8.28           | -0.005          | 100%             | 3.80    |
| 60 C        | -9.86           | -0.006          | 100%             | 3.80    |
| 20 C        | -10.43          | -0.006          | Battery Endpoint | 3.20    |



**Modulation: LTE Band 4 16-QAM 20 MHz BW**

**Mode:** LTE Band 4-20 MHz      **Operating Frequency:** 1720 MHz  
**Channel:** 20050      **Deviation Limit (PPM):** 2.5 ppm  
 100 RB 16 QAM

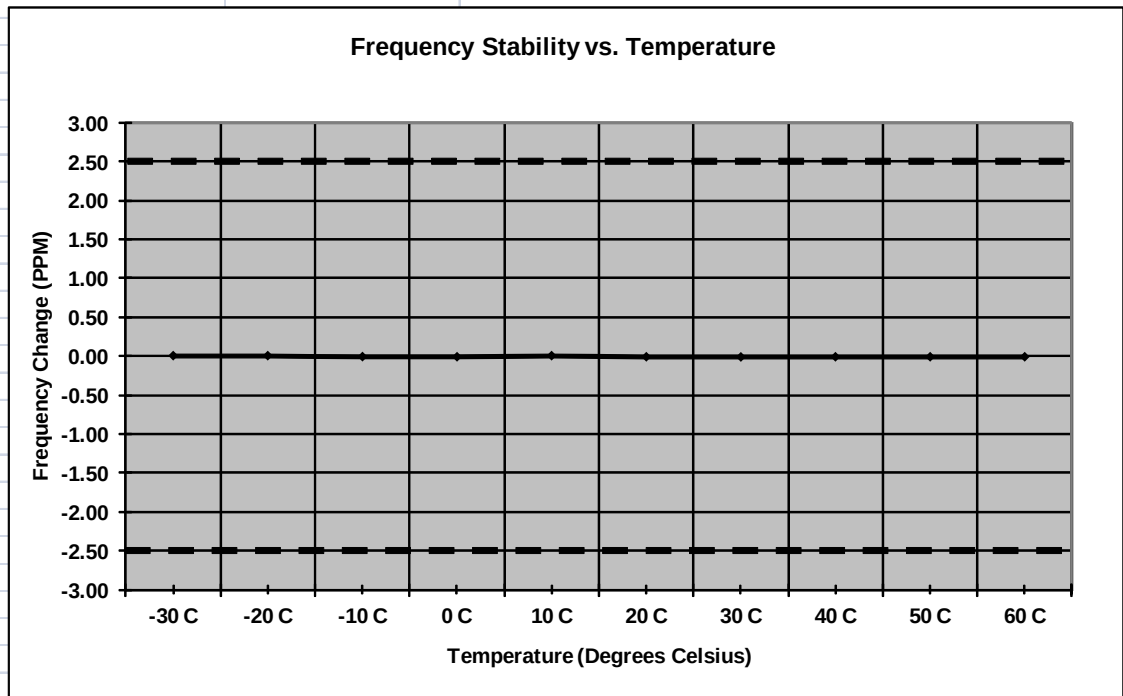
| Temperature | Frequency Error | Frequency Error | Voltage          | Voltage |
|-------------|-----------------|-----------------|------------------|---------|
| C           | Hz              | (PPM)           | (%)              | (VDC)   |
| -30 C       | -8.77           | -0.005          | 100%             | 3.80    |
| -20 C       | -11.49          | -0.007          | 100%             | 3.80    |
| -10 C       | -7.77           | -0.005          | 100%             | 3.80    |
| 0 C         | -7.60           | -0.004          | 100%             | 3.80    |
| 10 C        | 8.33            | 0.005           | 100%             | 3.80    |
| 20 C        | 8.00            | 0.005           | 100%             | 3.80    |
| 30 C        | -9.34           | -0.005          | 100%             | 3.80    |
| 40 C        | -8.73           | -0.005          | 100%             | 3.80    |
| 50 C        | -7.81           | -0.005          | 100%             | 3.80    |
| 60 C        | -10.19          | -0.006          | 100%             | 3.80    |
| 20 C        | -7.90           | -0.005          | Battery Endpoint | 3.20    |



**Modulation: LTE Band 17 QPSK 10 MHz BW**

Mode: LTE Band 17-10 MHz      Operating Frequency: 710.0 Mhz  
 Channel: 23790      Deviation Limit (PPM): 2.5 ppm  
 50 RB QPSK

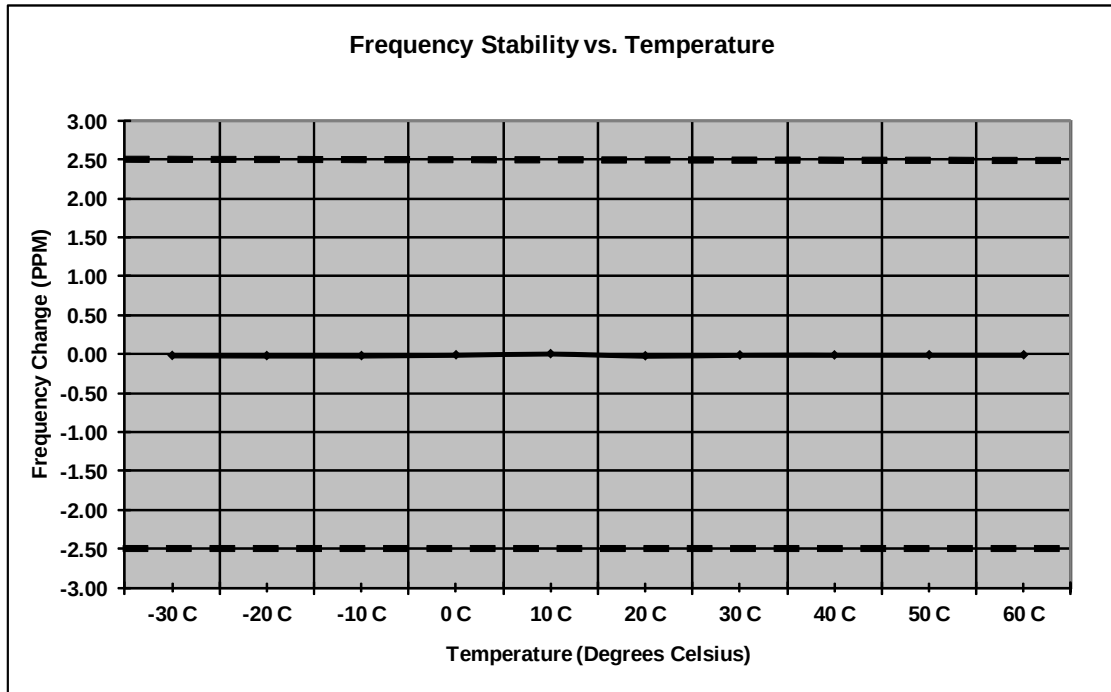
| Temperature | Frequency Error | Frequency Error | Voltage          | Voltage |
|-------------|-----------------|-----------------|------------------|---------|
| C           | Hz              | (PPM)           | (%)              | (VDC)   |
| -30 C       | 4.96            | 0.007           | 100%             | 3.80    |
| -20 C       | 5.06            | 0.007           | 100%             | 3.80    |
| -10 C       | -4.29           | -0.006          | 100%             | 3.80    |
| 0 C         | -4.61           | -0.006          | 100%             | 3.80    |
| 10 C        | 5.54            | 0.008           | 100%             | 3.80    |
| 20 C        | -5.48           | -0.008          | 100%             | 3.80    |
| 30 C        | -6.02           | -0.008          | 100%             | 3.80    |
| 40 C        | -5.19           | -0.007          | 100%             | 3.80    |
| 50 C        | -5.72           | -0.008          | 100%             | 3.80    |
| 60 C        | -5.76           | -0.008          | 100%             | 3.80    |
| 20 C        | -5.38           | -0.008          | Battery Endpoint | 3.42    |



**Modulation: LTE Band 17 16-QAM 10 MHz BW**

**Mode:** LTE Band 17-10 MHz  
**Channel:** 23790  
 50 RB 16 QAM  
**Operating Frequency:** 710.0 Mhz  
**Deviation Limit (PPM):** 2.5 ppm

| Temperature | Frequency Error | Frequency Error | Voltage          | Voltage |
|-------------|-----------------|-----------------|------------------|---------|
| C           | Hz              | (PPM)           | (%)              | (VDC)   |
| -30 C       | -11.40          | -0.016          | 100%             | 3.80    |
| -20 C       | -11.77          | -0.017          | 100%             | 3.80    |
| -10 C       | -11.82          | -0.017          | 100%             | 3.80    |
| 0 C         | -5.38           | -0.008          | 100%             | 3.80    |
| 10 C        | 5.16            | 0.007           | 100%             | 3.80    |
| 20 C        | -13.10          | -0.018          | 100%             | 3.80    |
| 30 C        | -5.81           | -0.008          | 100%             | 3.80    |
| 40 C        | -6.24           | -0.009          | 100%             | 3.80    |
| 50 C        | -5.62           | -0.008          | 100%             | 3.80    |
| 60 C        | -5.14           | -0.007          | 100%             | 3.80    |
| 20 C        | -12.82          | -0.018          | Battery Endpoint | 3.42    |



**End of Test Report**