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## Test Report

Prepared for: sci\_Zone, Inc.

Model: LinkStar-STX3-ME

Description: Radio for Low Earth Orbit Communication

Serial Number: 0-2357850

FCC ID: 2ANKS-LINKSTAR-STX3

To

FCC Part 25

Date of Issue: October 18, 2017

On the behalf of the applicant:

sci\_Zone, Inc.  
5108 Alberta Avenue  
Rio Rancho, New Mexico 87144

Attention of:

Andrew Santangelo  
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Project No: p1780007

**Poona Saber**  
**Project Test Engineer**

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## Test Report Revision History

| Revision | Date       | Revised By  | Reason for Revision                                                                                                                    |
|----------|------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------|
| 1.0      | 8/21/2017  | Poona Saber | Original Document                                                                                                                      |
| 2.0      | 10/13/2017 | Poona Saber | Revised the power table and removed the bandwidth correction factor statement from page 7, Revised the Frequency Stability data format |
| 3.0      | 10/17/2017 | Poona Saber | Updated frequency stability versus Voltage<br>Updated test procedure for average power measurement                                     |

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### ILAC / A2LA

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The tests results contained within this test report all fall within our scope of accreditation, unless noted below.

Please refer to <http://www.compliancetesting.com/labscope.html> for current scope of accreditation.

Testing Certificate Number: **2152.01**



FCC OATS Reg. #933597

IC Reg. #2044A-1

**Non-accredited tests contained in this report:**

**N/A**

## Test and Measurement Data

All tests and measurement data shown were performed in accordance with FCC Rules and Regulations, Volume II; Part 2 and the following individual Parts: FCC Part 25 Satellite Communications.

## Standard Test Conditions and Engineering Practices

Except as noted herein, the following conditions and procedures were observed during the testing:

In accordance with ANSI C63.4-2014, section 6.1.9, and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104° F) unless the particular equipment requirements specify testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

| Environmental Conditions |                 |                    |
|--------------------------|-----------------|--------------------|
| Temp<br>(°C)             | Humidity<br>(%) | Pressure<br>(mbar) |
| 26.9 – 28.0              | 25.5 – 28.7     | 966.0 – 970.5      |

Measurement results, unless otherwise noted, are worst case measurement.

### EUT Description

**Model:** LinkStar-STX3-ME

**Description:** LinkStar is a radio designed for use in space that interfaces with the GlobalStar Satellite network

**Firmware:** NA

**Software:** QuickSAT/VMS 4.0

**Serial Number:** 0-2357850

### Additional Information:

The STX 3 is a simplex Satellite transmitter designed to send small packets of user defined data to a network of low earth orbiting (LEO) satellites using the Globalstar simplex satellite network. The received data is then forwarded to a user defined network interface that may be in the form of an FTP host, email account, or HTTP host where the user will interpret the data for further processing.

### EUT Operation during Tests

EUT is placed in “Modulation Mode” using the Manufacturer’s supplied jumper connections which enable the unit to continuously transmit a test packet. The EUT is connected to a DC power supply and is supplied with a measured 3.3 volts. Emission type of the Unit is G1D

**Accessories:** None

**Cables:** None

**Modifications:** None

## Test Result Summary

| Specification   | Test Name                                       | Pass,<br>Fail, N/A | Comments |
|-----------------|-------------------------------------------------|--------------------|----------|
| 25.204          | Power Limits                                    | Pass               |          |
| 25.202(f)       | Emissions Limitations for Mobile Earth Stations | Pass               |          |
| 25.202(f)       | Emissions Mask                                  | Pass               |          |
| 25.216(c)(g)(i) | Emissions Limits for Mobile Earth Stations      | Pass               |          |
| 25.202(d)       | Frequency Tolerance                             | Pass               |          |

## Power Limits

**Engineer:** Poona Saber

**Test Date:** 8/21/2017

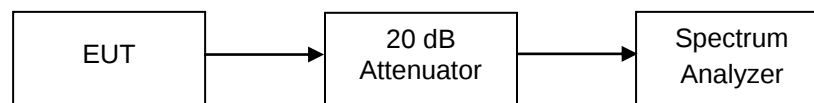
## Test Procedure

The UUT was connected to a Spectrum analyzer through a 20 dB attenuator. Attenuator and cable losses were input into the analyzer as a reference level offset to ensure accurate measurements were obtained. The EIRP is a summation of the conducted power and the antenna gain.

The following setting on spectrum analyzer is used for measuring average power of the fundamental:

- 1- Set span to at least 1.5 times the OBW
- 2- Set RBW = 1-5% of the OBW, not to exceed 1 MHz.
- 3- Set VBW  $\geq 3 \times$  RBW
- 4- Set number of points in sweep  $\geq 2 \times$  span / RBW
- 5- Sweep time = auto-couple
- 6- Detector = RMS (power averaging)
- 8- Trace average at least 100 traces in power averaging (i.e., RMS) mode
- 9- Compute the power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function, with the band limits set equal to the OBW band edges. If the instrument does not have a band power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

## Test Setup



## Transmitter Average Output Power

| Tuned Frequency (MHz) | Conducted Output Power (dBm) | Antenna Gain (dBi) | EIRP Output Power (dBm) | Specification Limit                |
|-----------------------|------------------------------|--------------------|-------------------------|------------------------------------|
| 1611.25               | 18.62                        | 4.25               | 22.87                   | No limit for Mobile Earth Stations |
| 1613.75               | 19.16                        | 4.25               | 23.41                   | No limit for Mobile Earth Stations |
| 1616.25               | 19.43                        | 4.25               | 23.68                   | No limit for Mobile Earth Stations |
| 1618.75               | 19.90                        | 4.25               | 24.15                   | No limit for Mobile Earth Stations |

## Emissions Limitations for Mobile Earth Stations

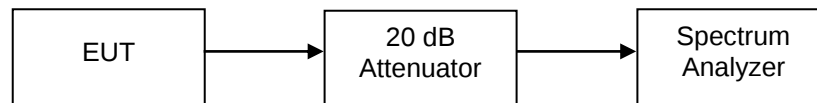
**Engineer:** Poona Saber

**Test Date:** 8/18/2017

### Test Procedure

The EUT was connected directly to a spectrum analyzer and the conducted spurious emissions were measured to ensure that the EUT met the requirements specified. Only the worst-case emission at each frequency was reported. Notch and high pass filters were utilized to ensure that the fundamental power did not force the input of the spectrum analyzer into compressions. These losses in addition to cable losses were input into the analyzer as a reference level offset to ensure accurate measurements were obtained.

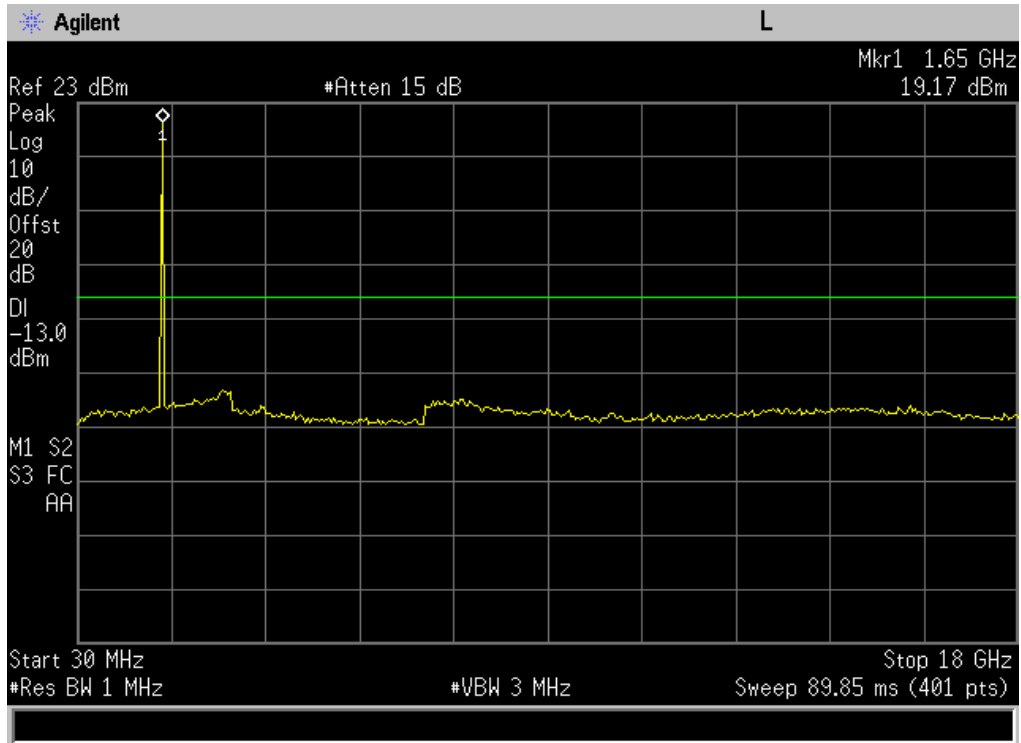
### Test Setup



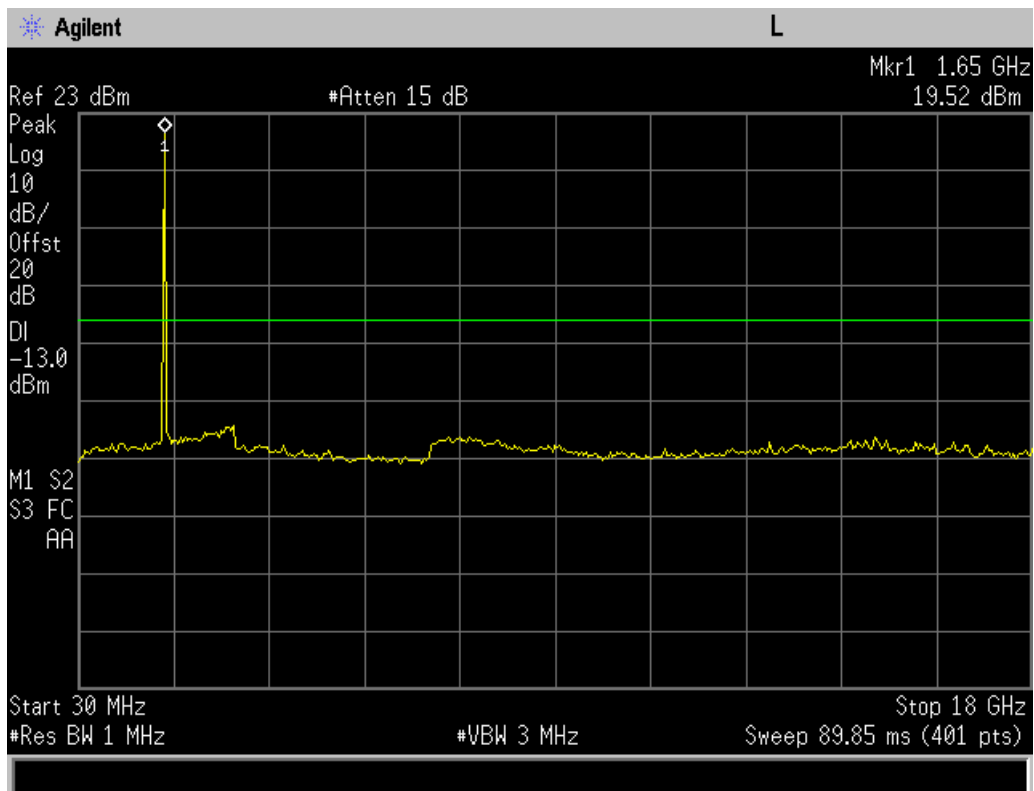
### Emissions Limitations Summary Table

| Tuned Frequency (MHz) | Result | Comments  |
|-----------------------|--------|-----------|
| 1611.25               | Pass   | See Plots |
| 1613.75               | Pass   | See Plots |
| 1616.20               | Pass   | See Plots |
| 1618.75               | Pass   | See Plots |

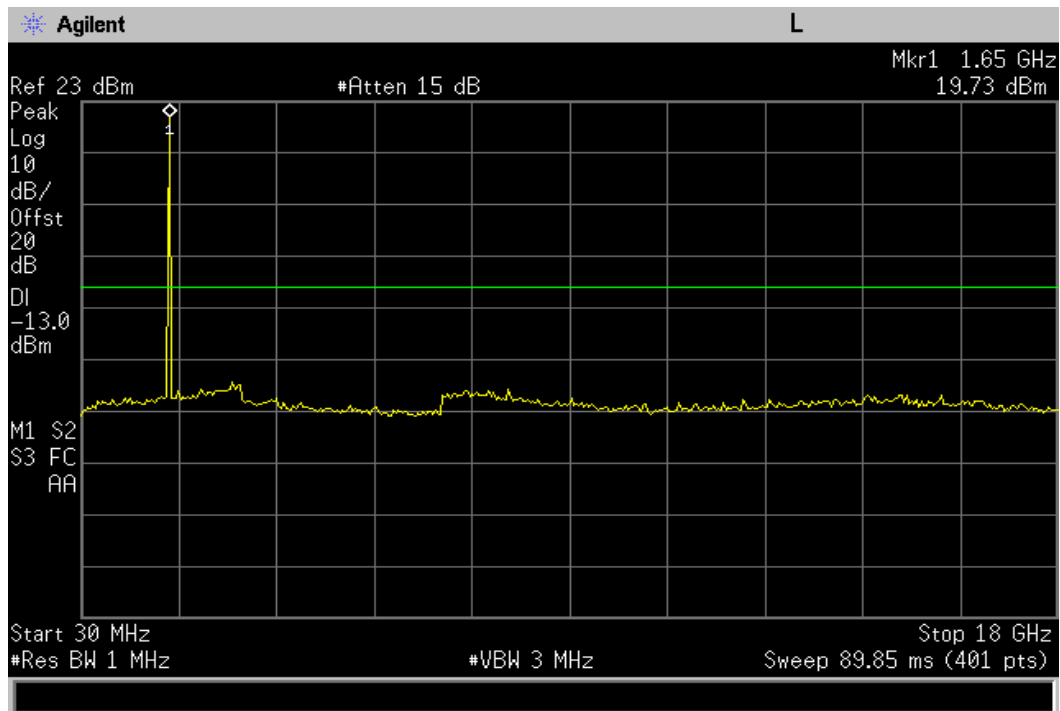
### Emissions Limitations Plot 1611.25 MHz



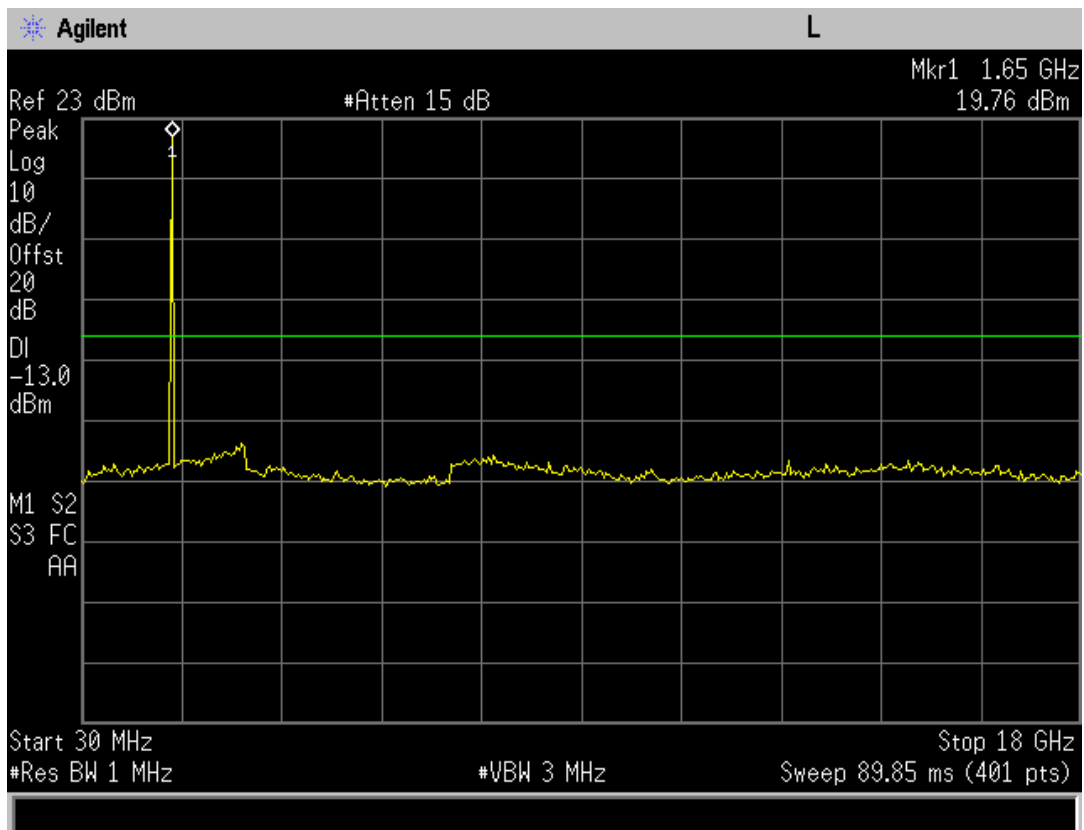
### Emissions Limitations Plot 1613.75 MHz



## Emissions Limitations Plot 1616.25 MHz



## Emissions Limitations Plot 1618.75 MHz



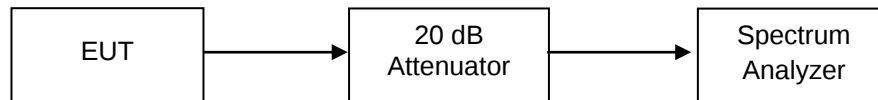
## Occupied Bandwidth

**Engineer:** Poona Saber

**Test Date:** 8/18/2017

### Test Procedure

The EUT was connected directly to a spectrum analyzer. The occupied bandwidth of the modulated output was measured and plotted. Attenuator and cable losses were input into the analyzer as a reference level offset to ensure accurate measurements were obtained.

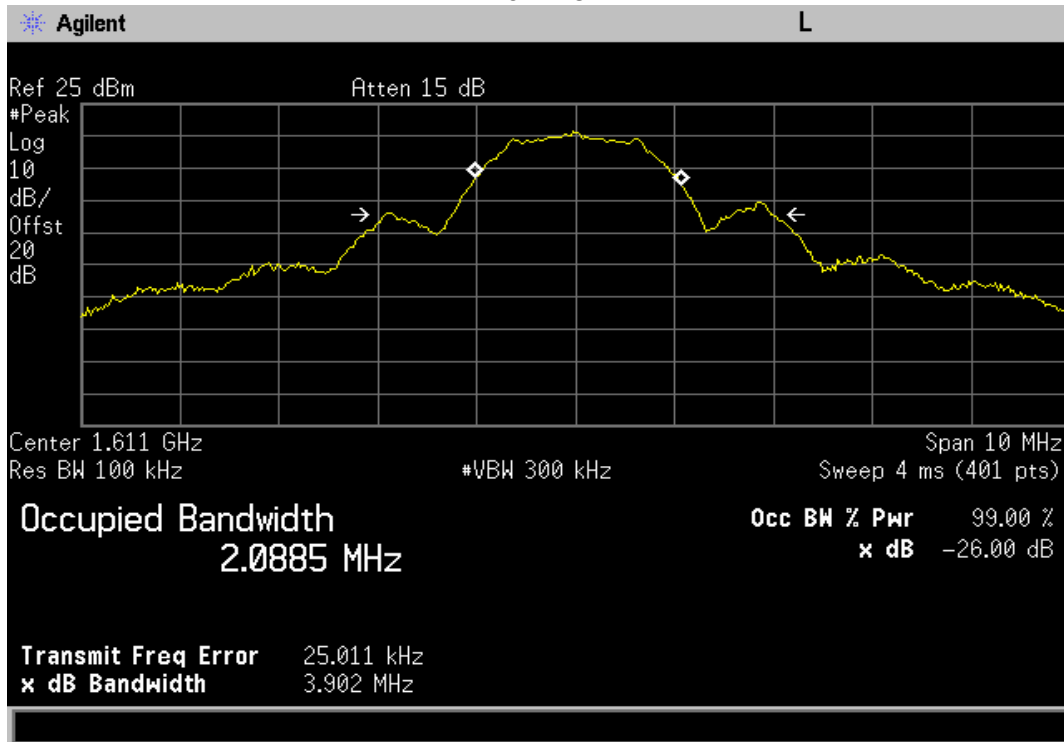


**Note:** There is no requirement for occupied bandwidth in Part 25 for Mobile Earth Stations. However, the emissions masks are based upon the occupied bandwidth. This information is reported for reference only.

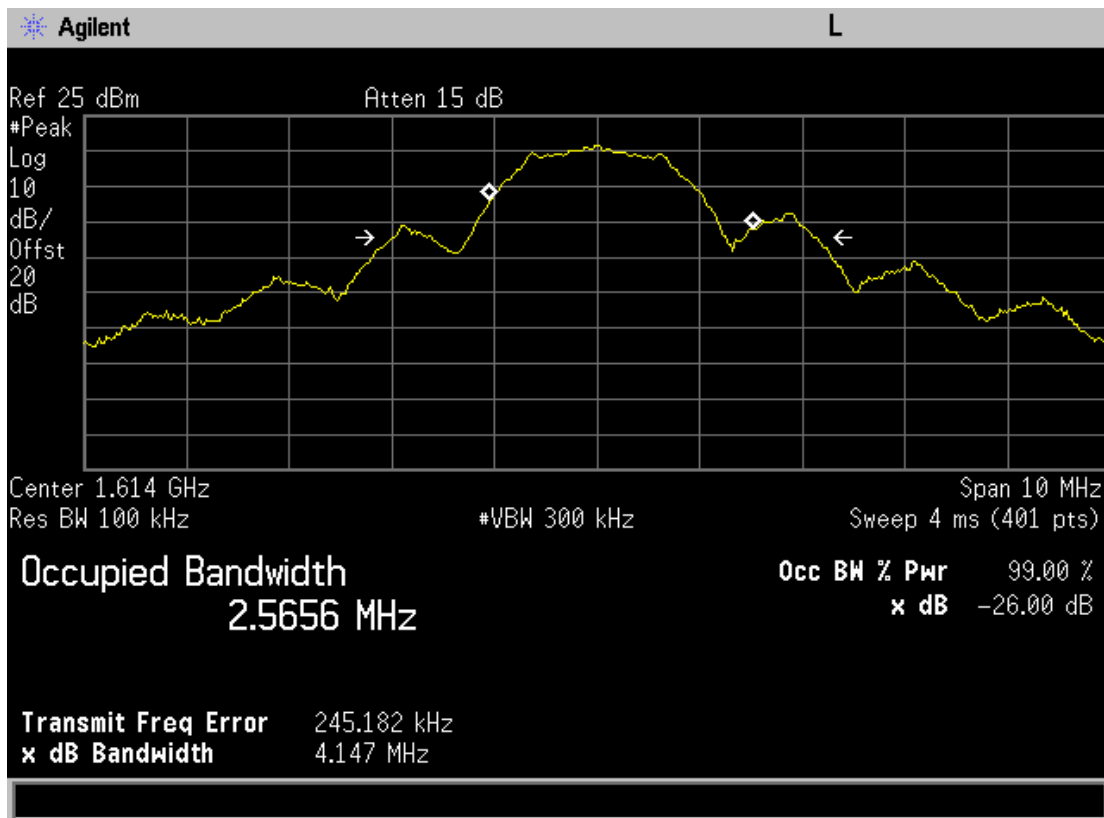
### Test Results

| Frequency (MHz) | Measured Bandwidth (MHz) |
|-----------------|--------------------------|
| 1611.25         | 2.3020                   |
| 1613.75         | 2.3216                   |
| 1616.25         | 2.3277                   |
| 1618.75         | 2.2986                   |

1611.25

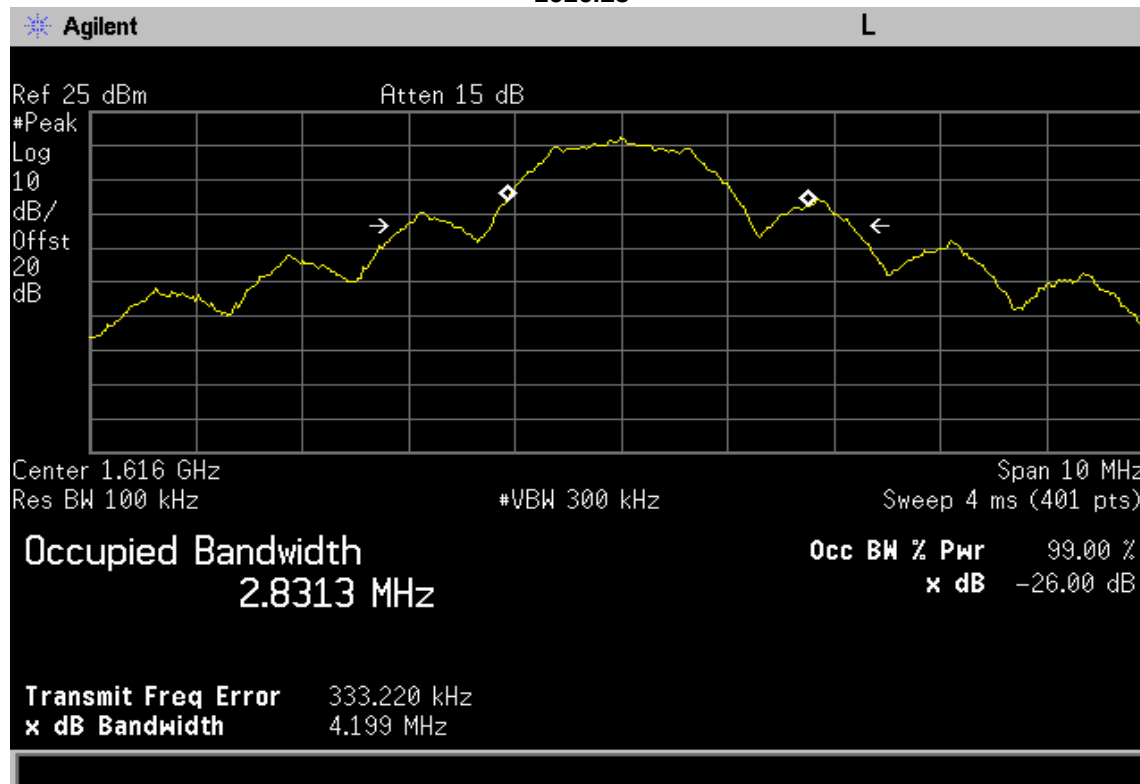


1613.75

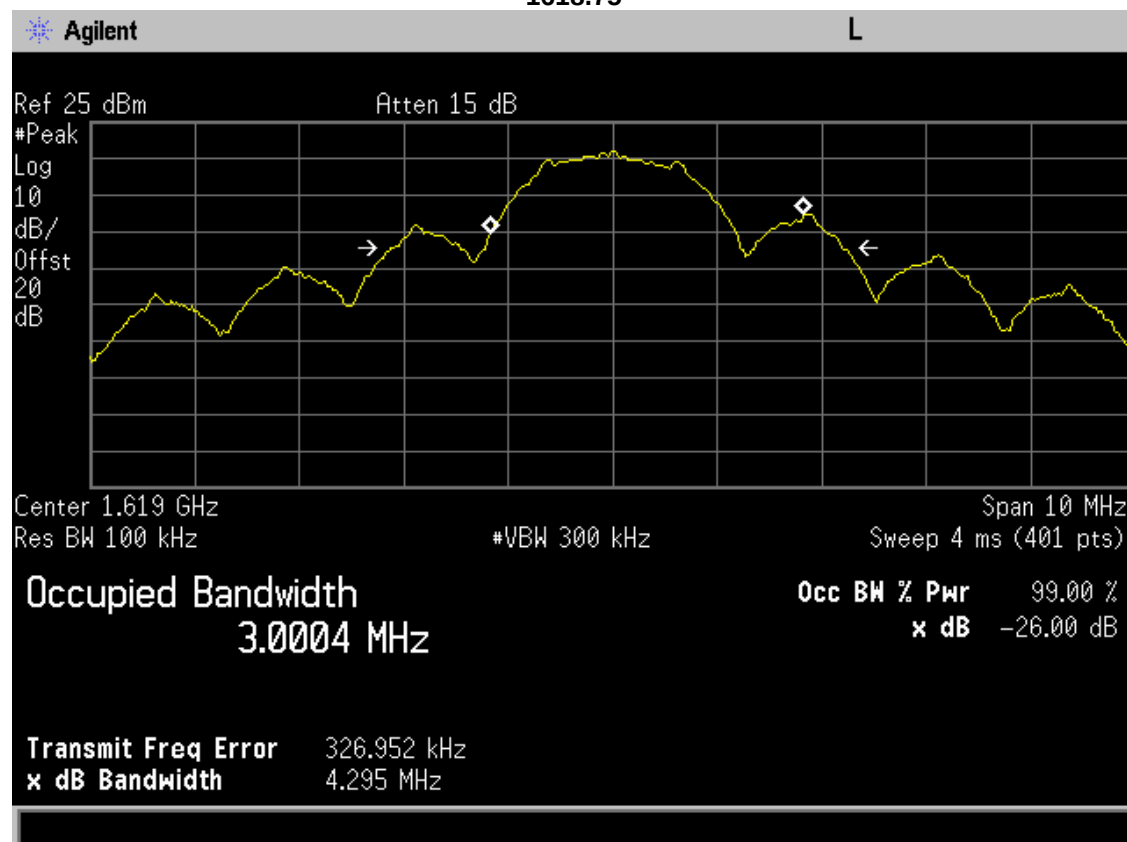




1616.25



1618.75



## Emission Masks

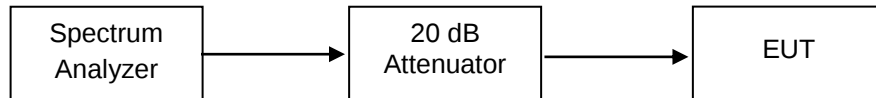
**Engineer:** Poona Saber

**Test Date:** 8/18/2017

## Test Procedure

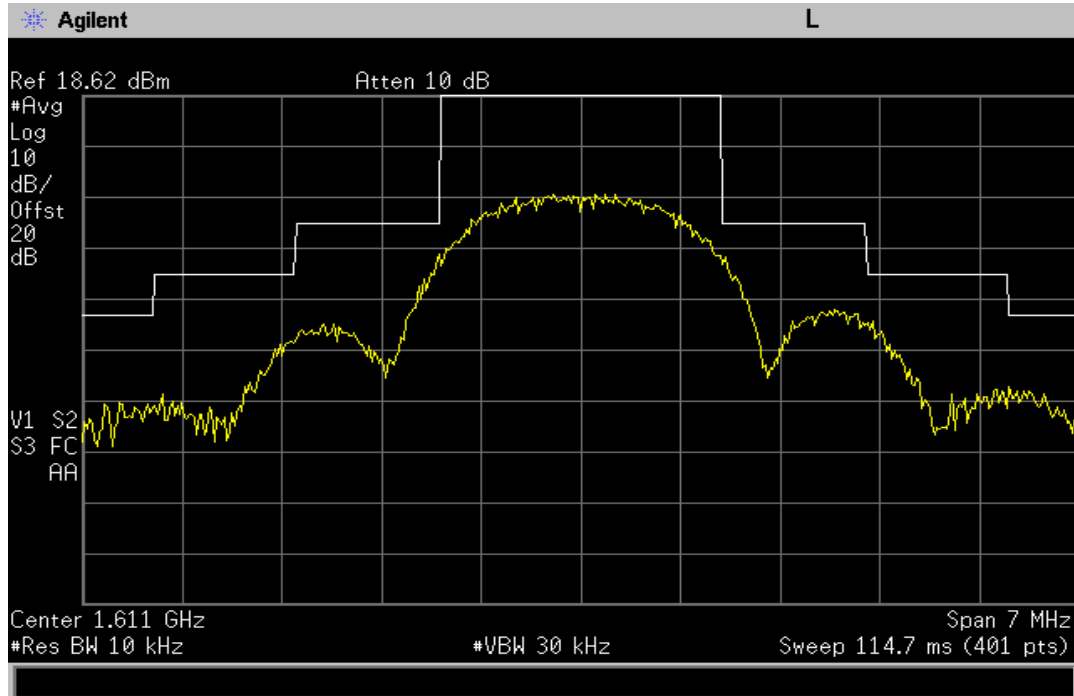
The EUT was connected directly to a spectrum analyzer to verify that the EUT met the requirements for emission mask. Attenuator and cable losses were input into the analyzer as a reference level offset to ensure accurate measurements were obtained.

## Test Setup

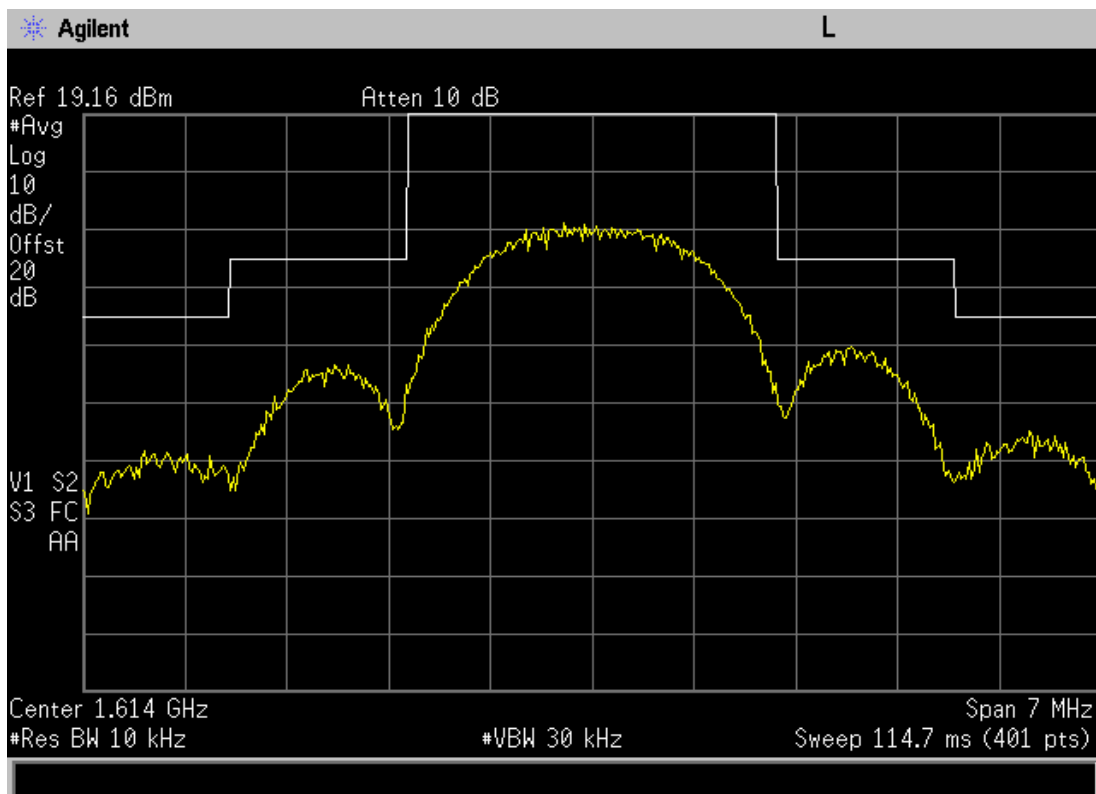


## Emission Mask Plots

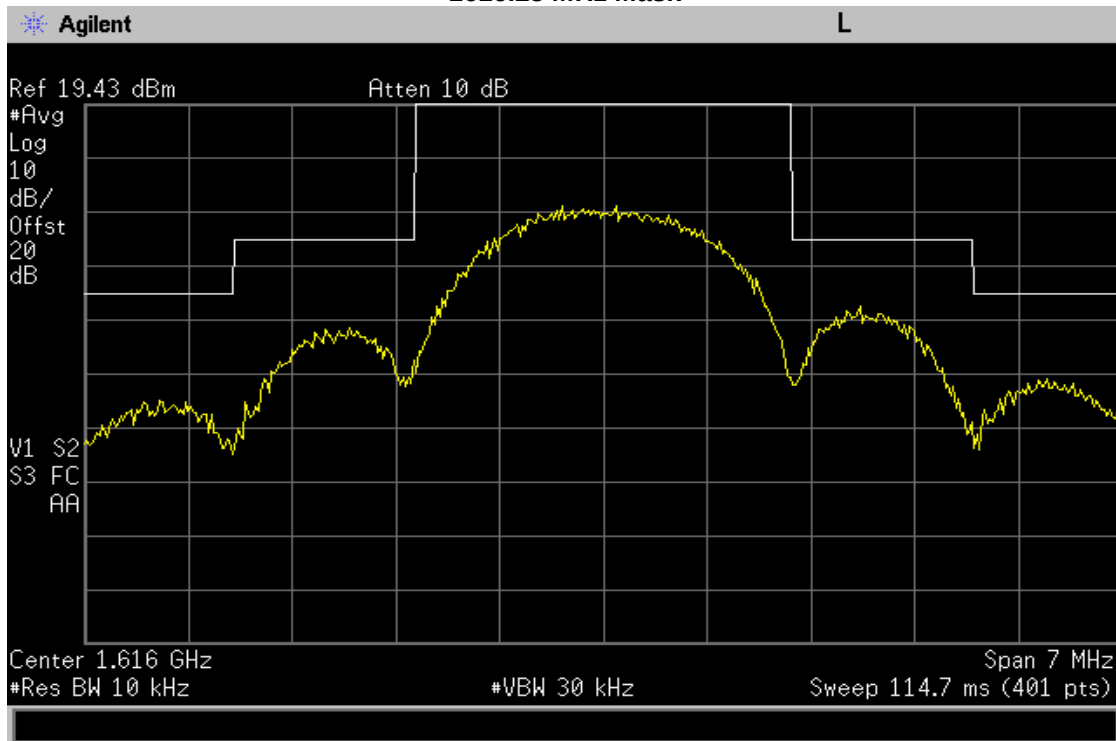
1611.25 MHz Mask



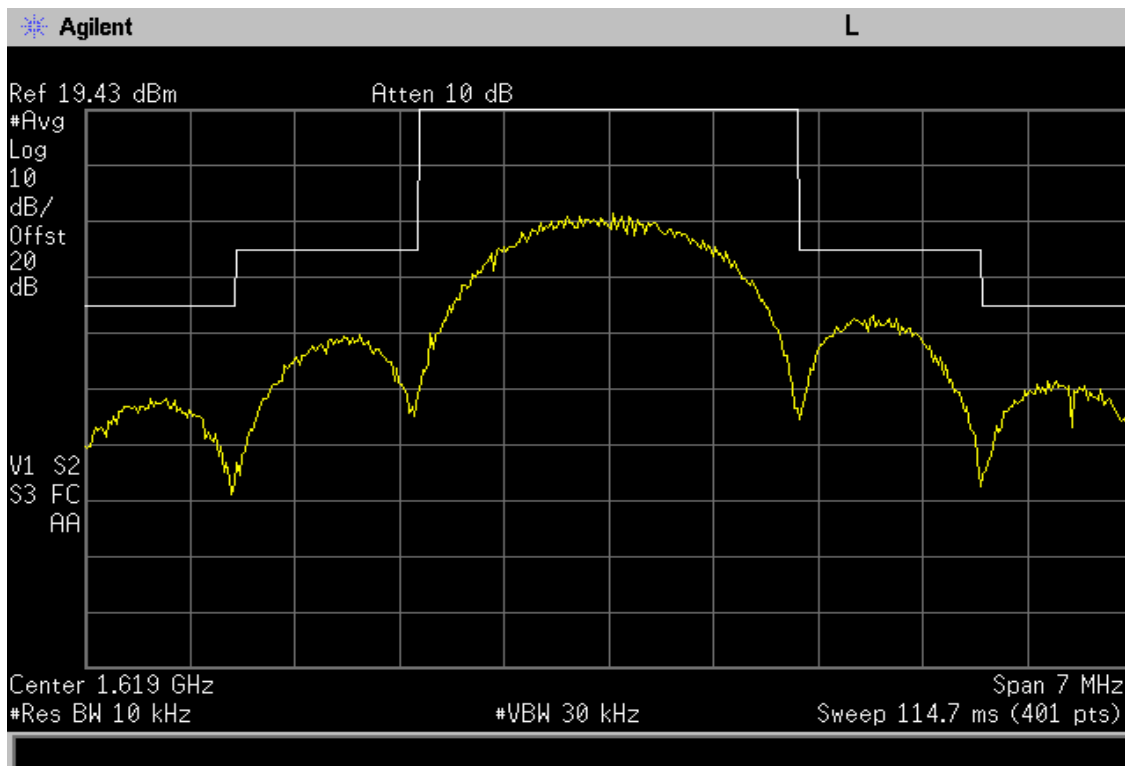
1613.75 MHz Mask



### 1616.25 MHz Mask



### 1618.75 MHz Mask



## Emissions Limits for Mobile Earth Stations

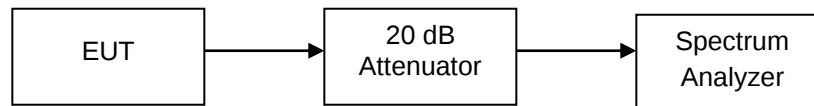
**Engineer:** Poona Saber

**Test Date:** 8/18/2017

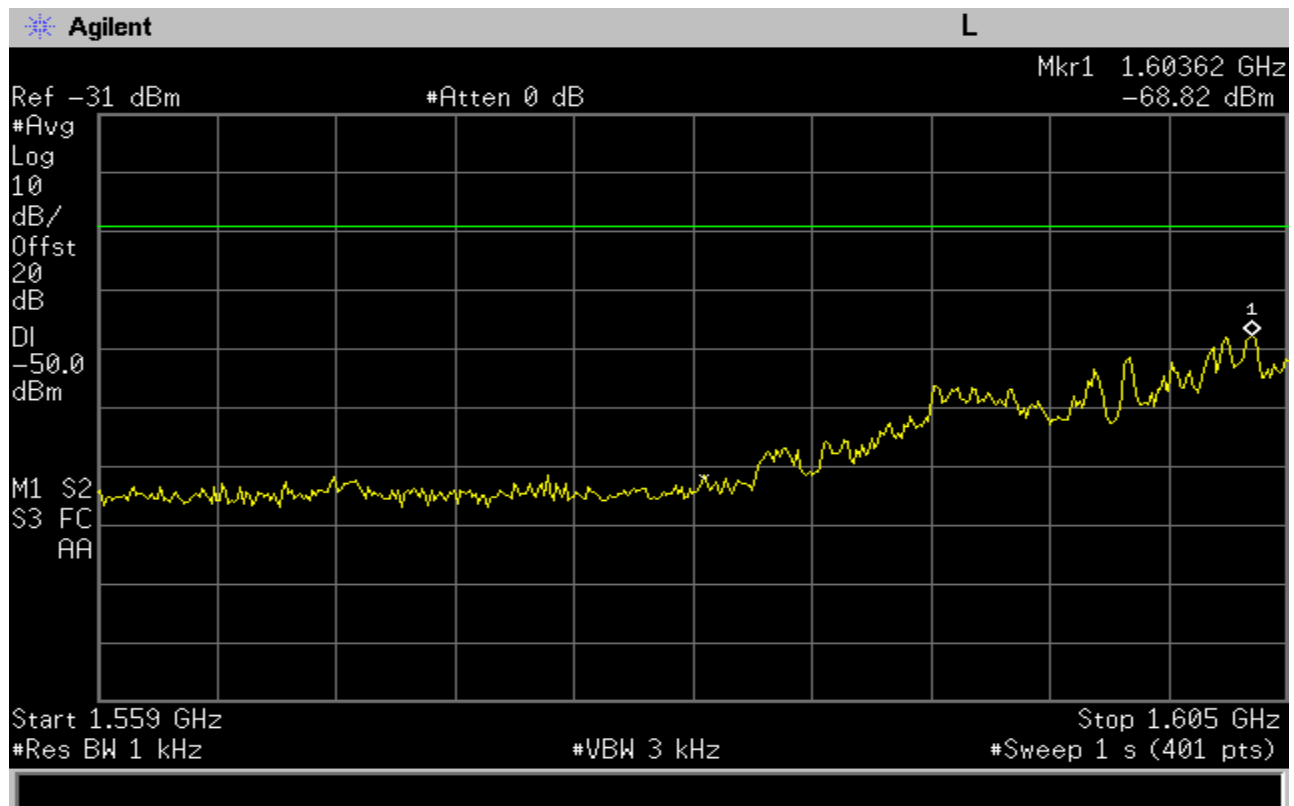
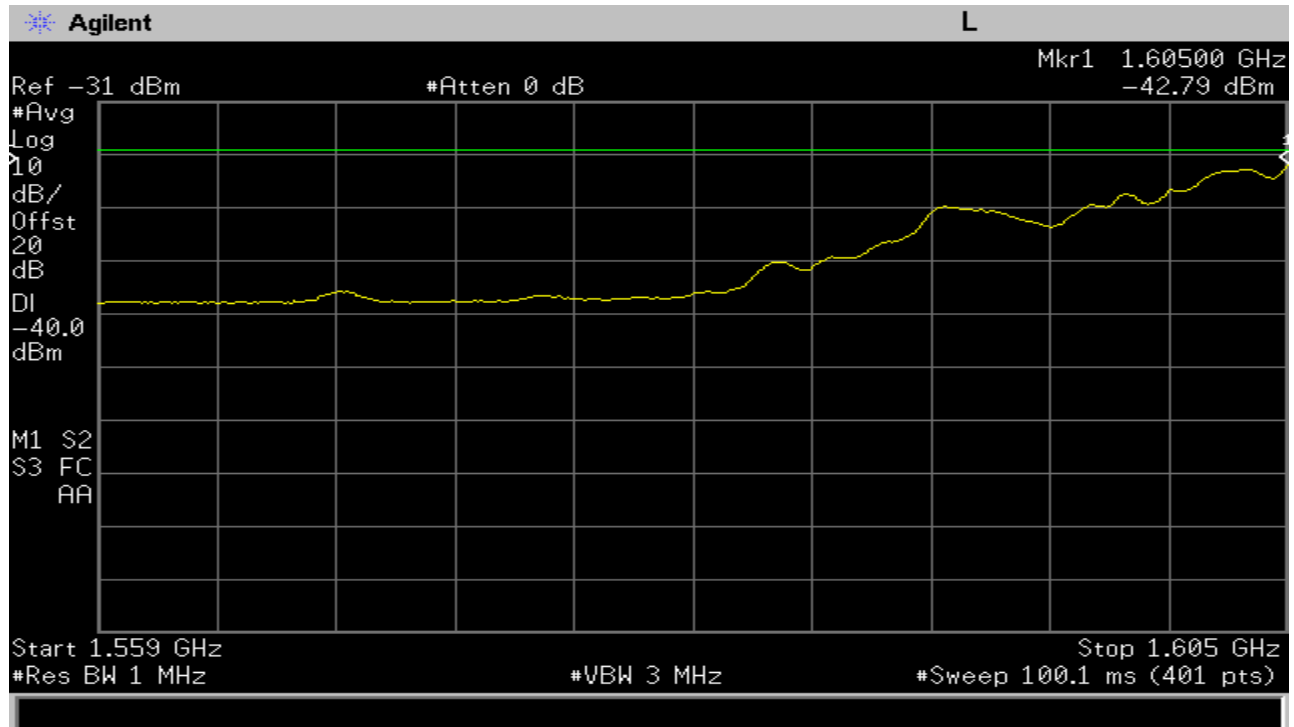
### Test Procedure

The EUT was connected directly to a spectrum analyzer to verify that the EUT met the requirements for emission limits. Attenuator and cable losses were input into the analyzer as a reference level offset to ensure accurate measurements were obtained.

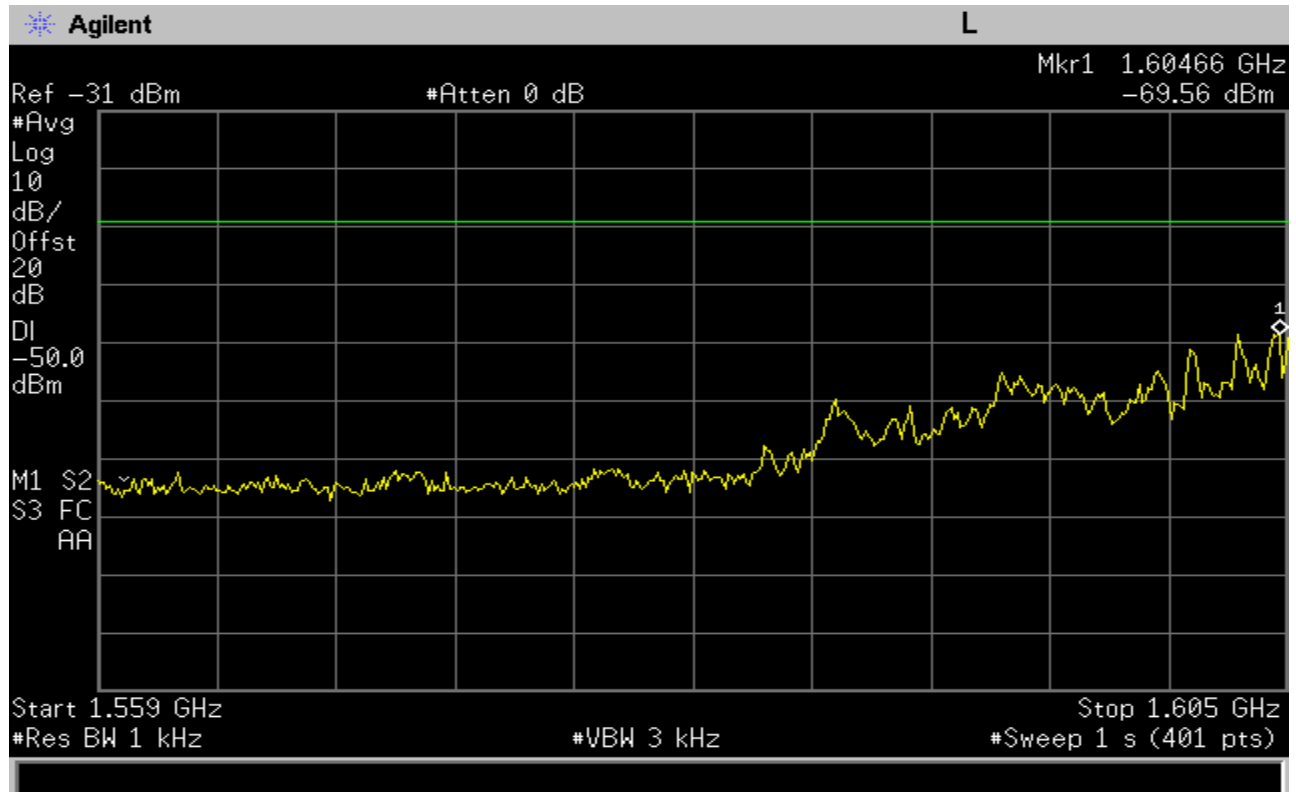
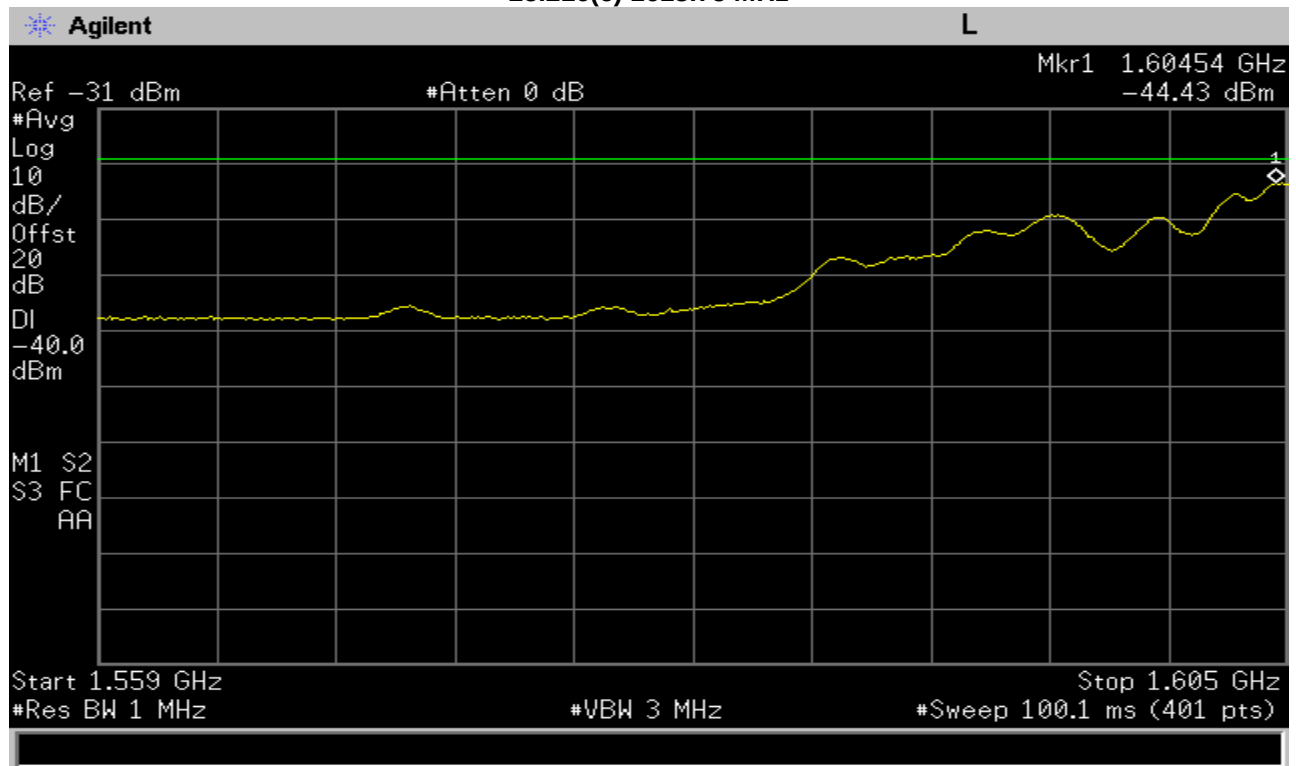
### Test Setup



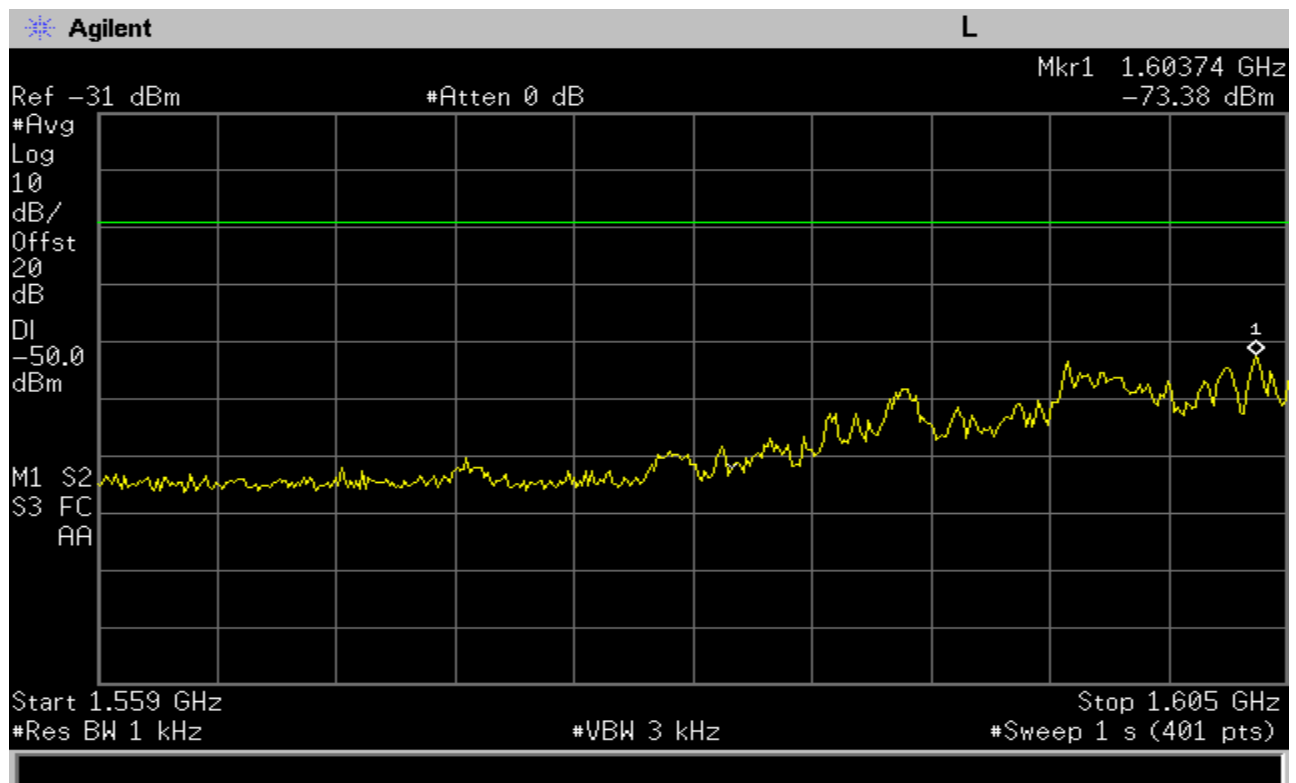
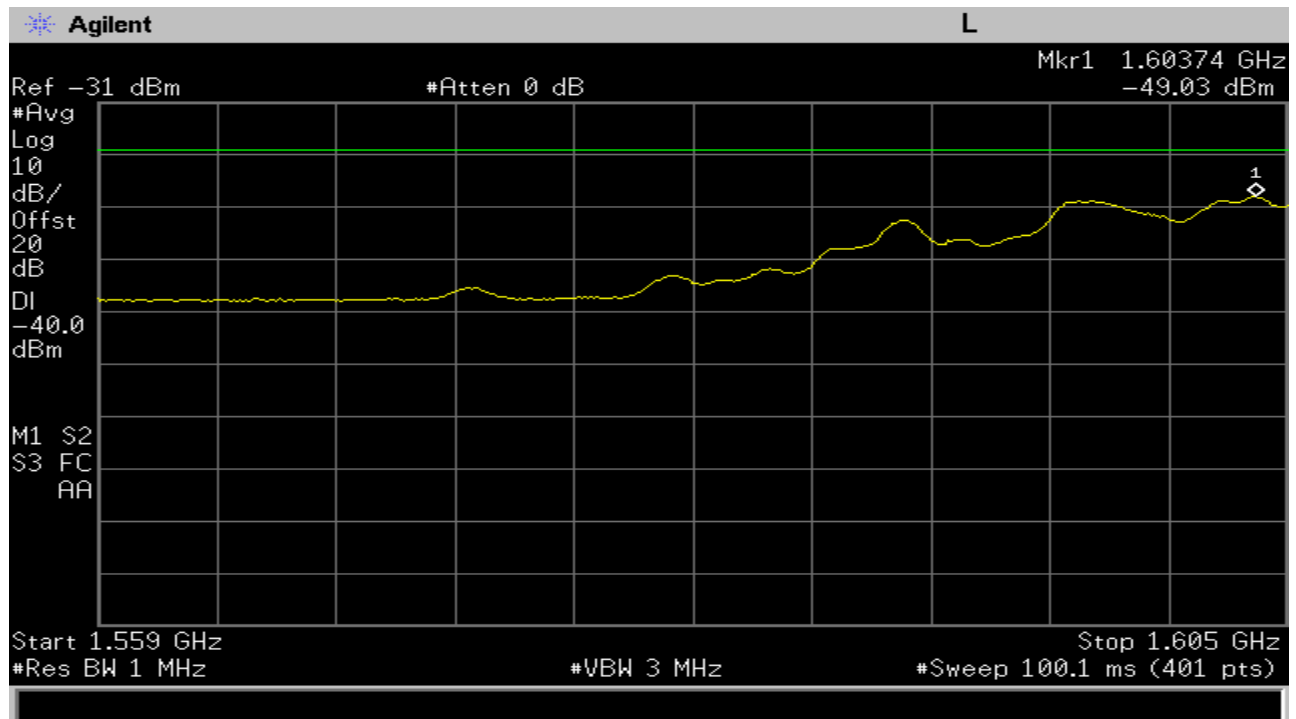
25.216(c) 1611.25 MHz



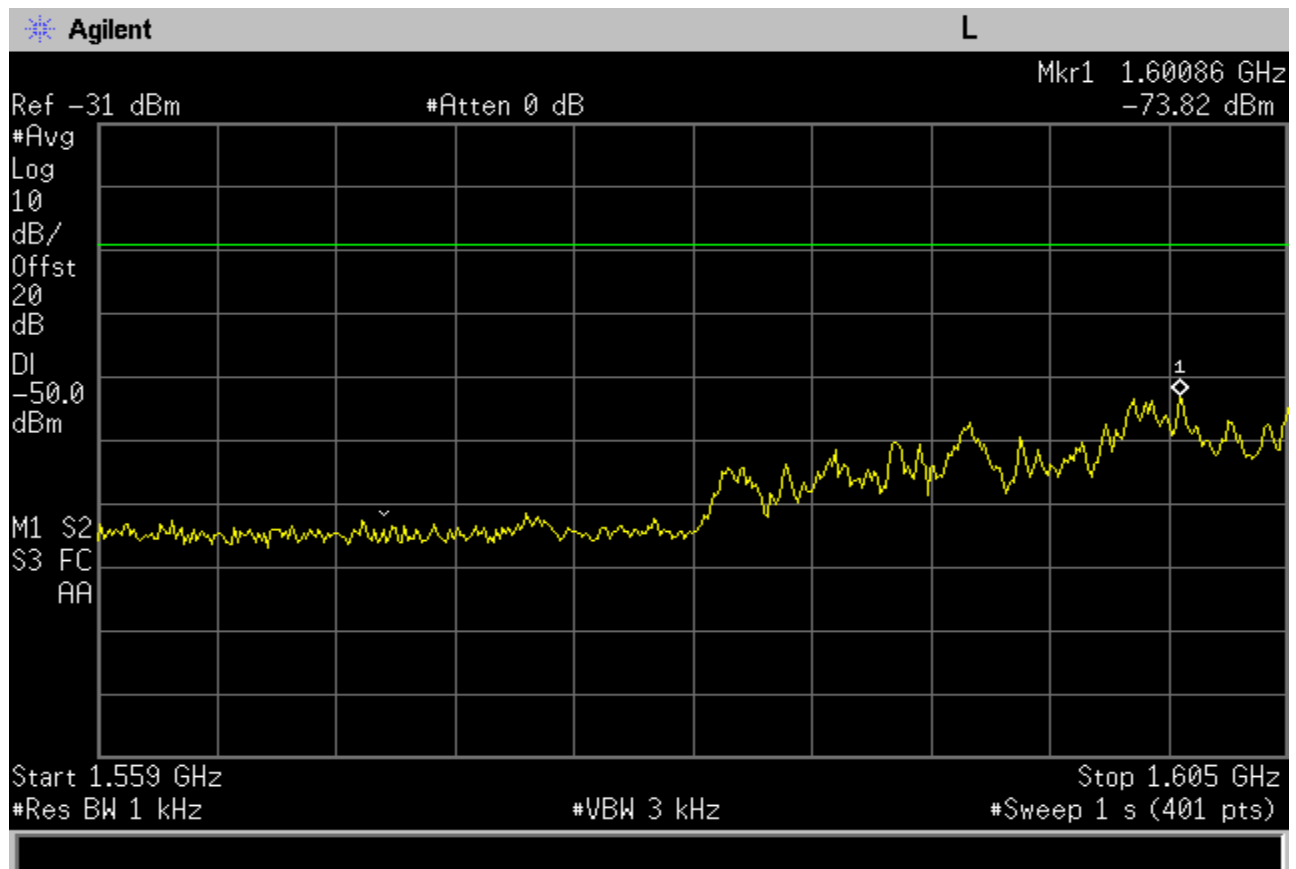
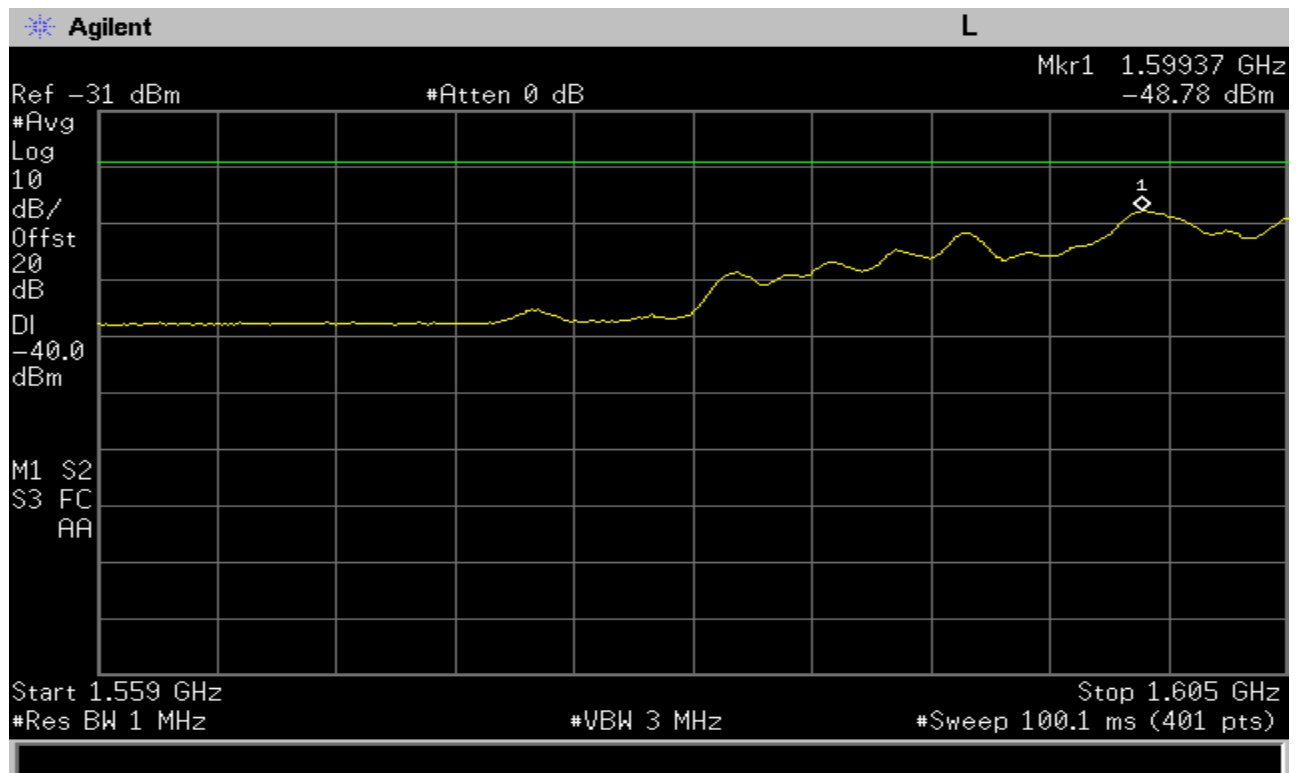
25.216(c) 1613.75 MHz



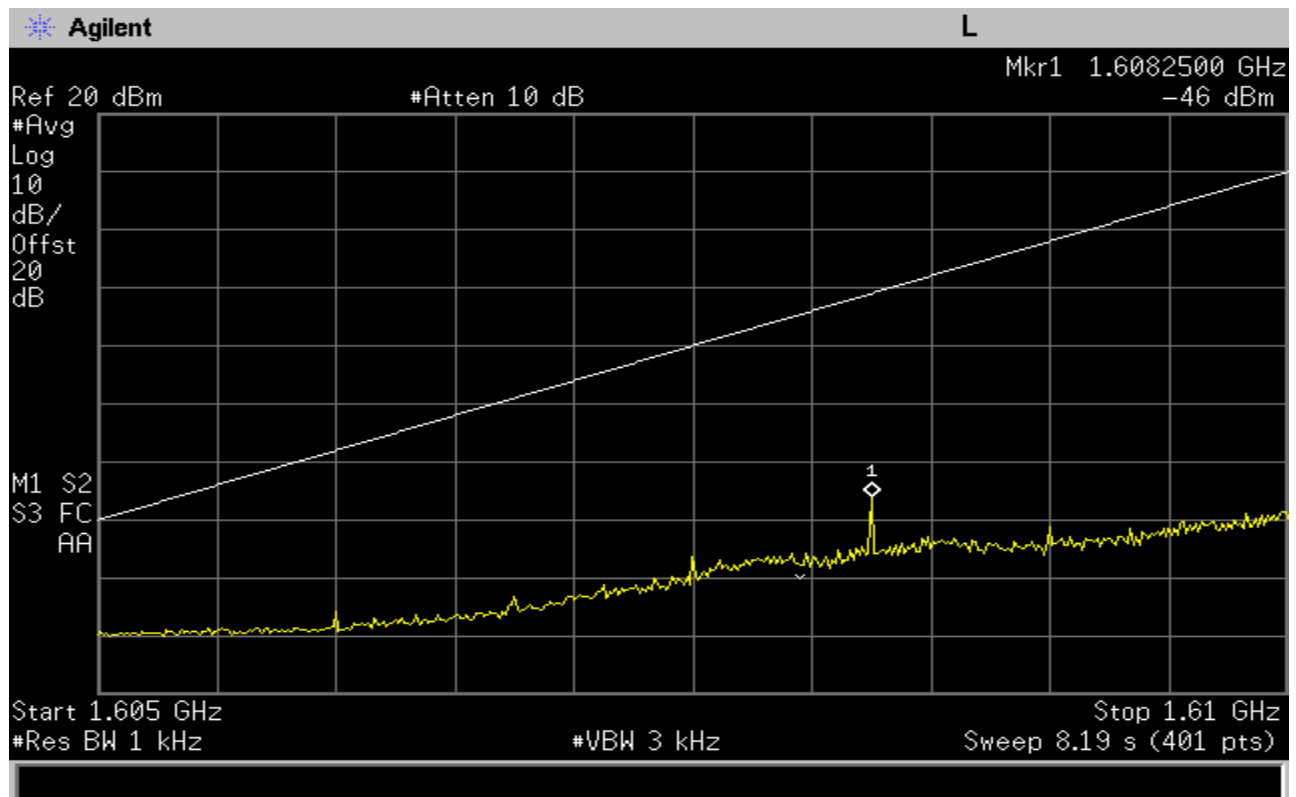
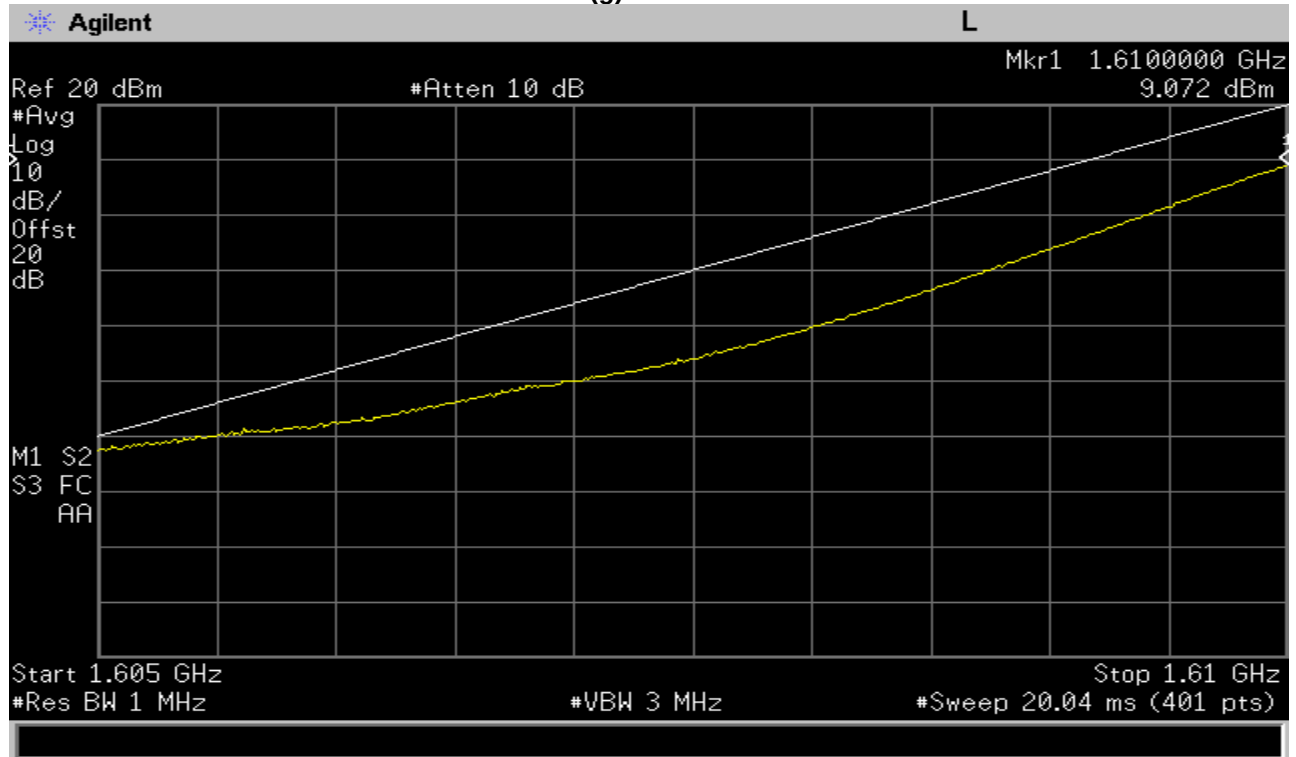
25.216(c) 1616.75 MHz



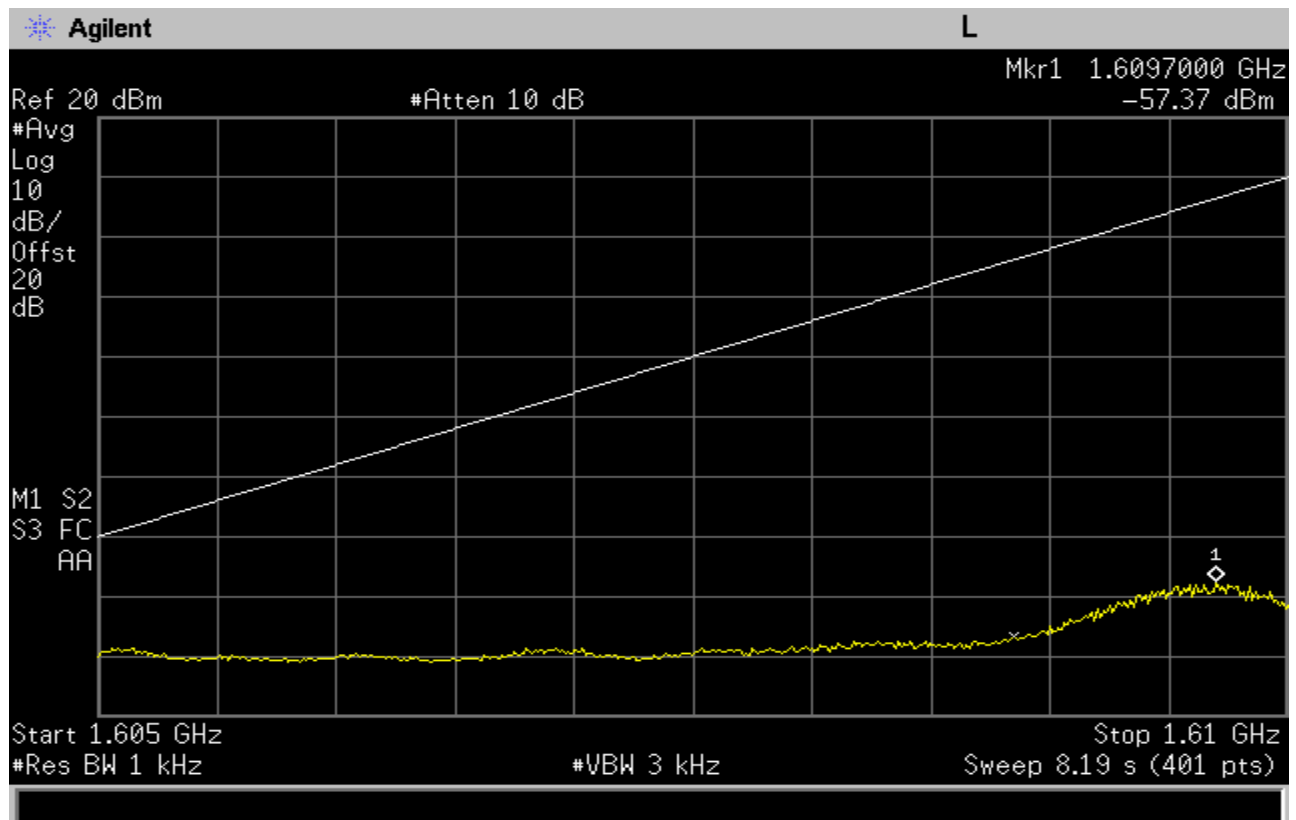
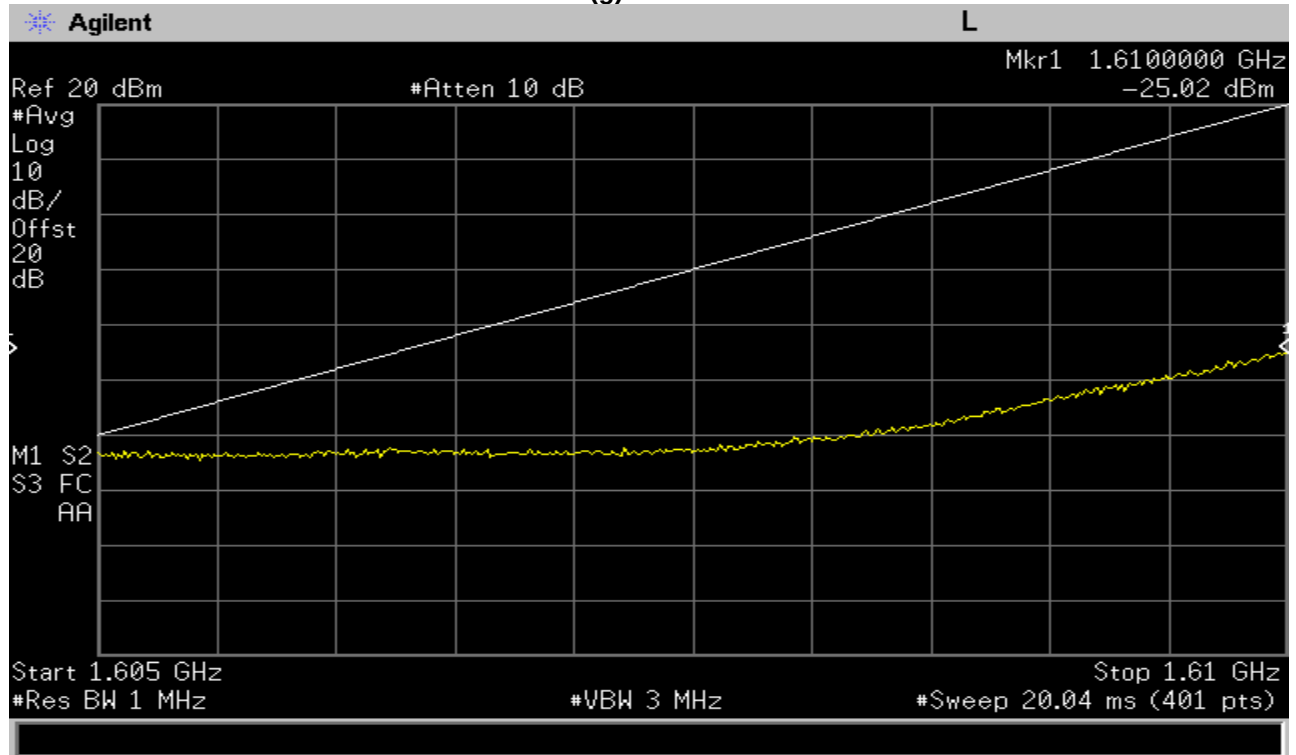
25.216(c) 1618.25 MHz



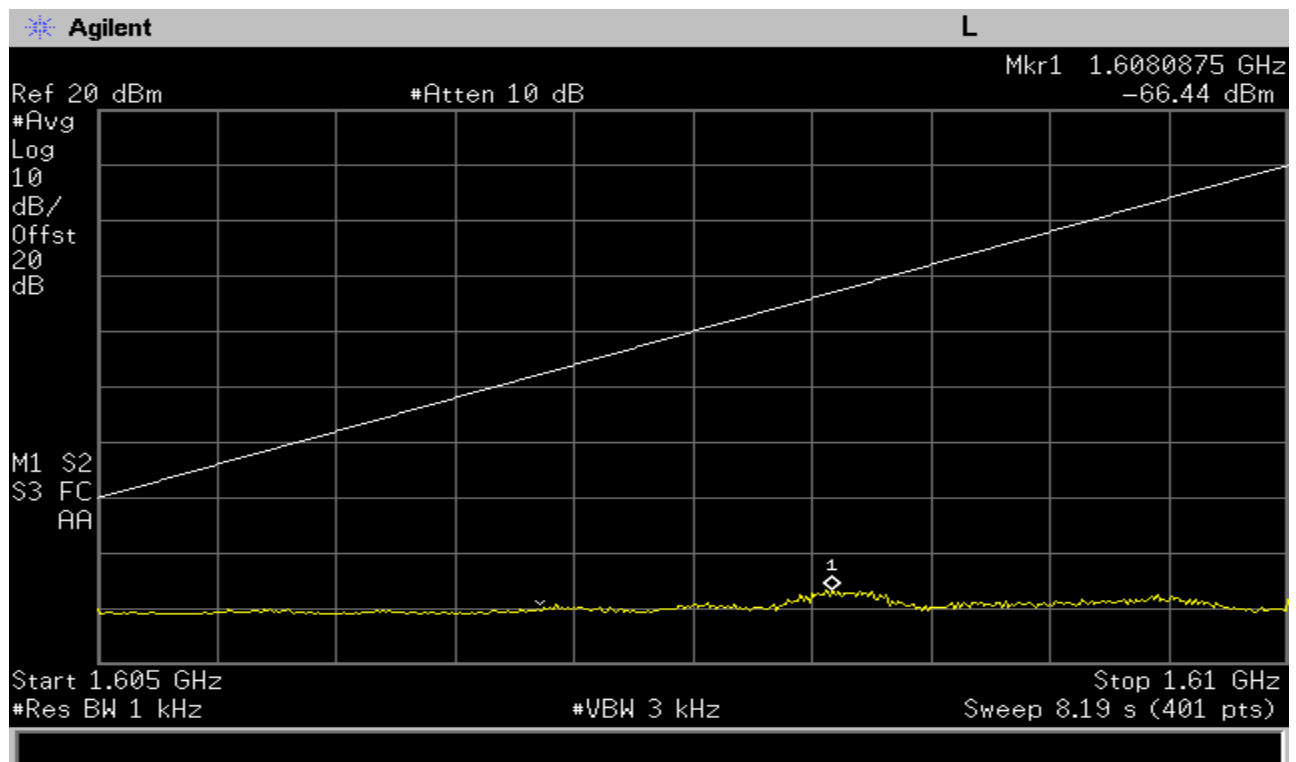
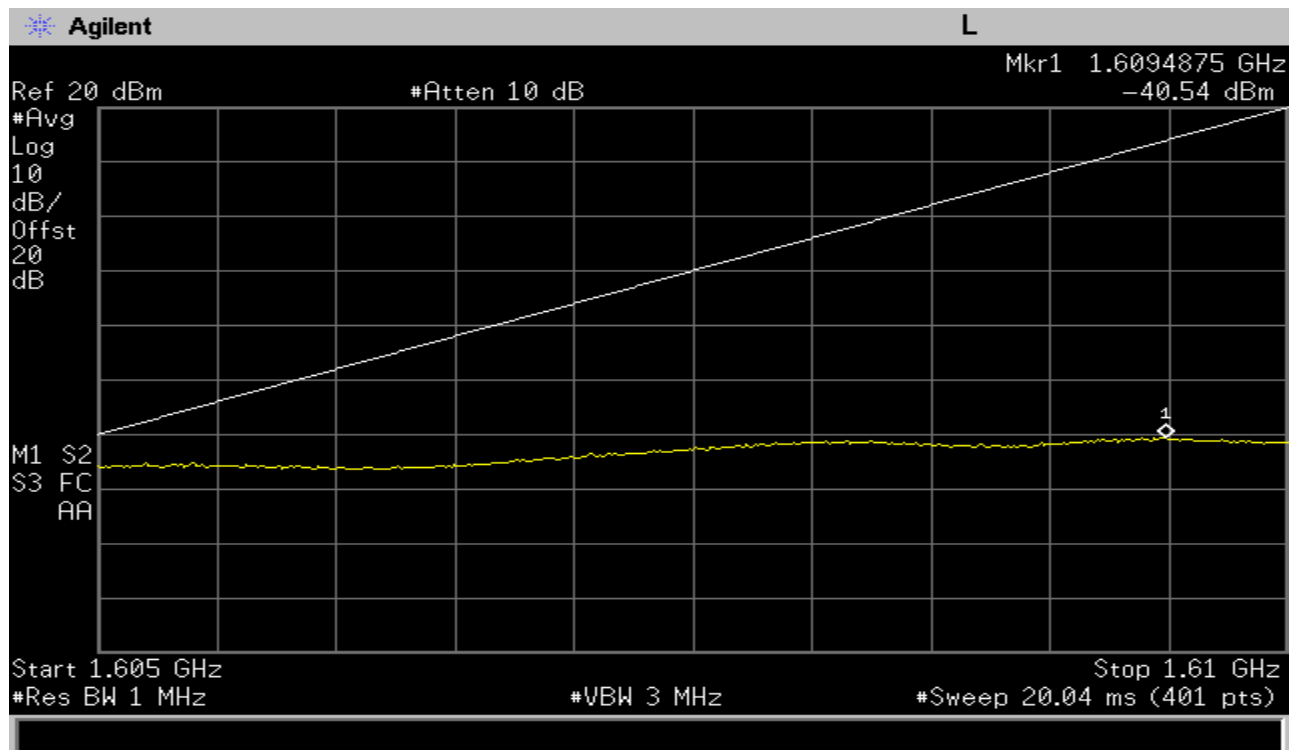
25.216(g) 1611.25 MHz



25.216(g) 1613.75 MHz

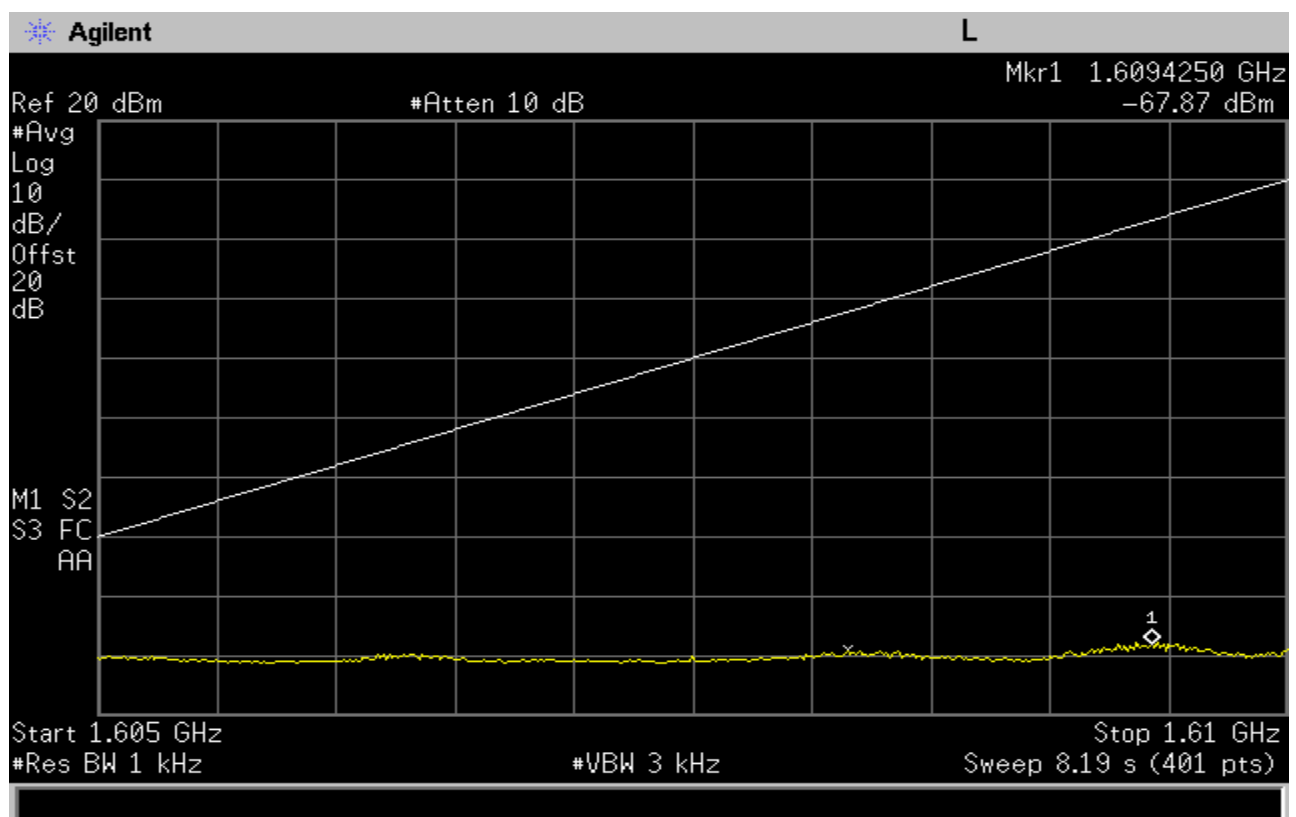
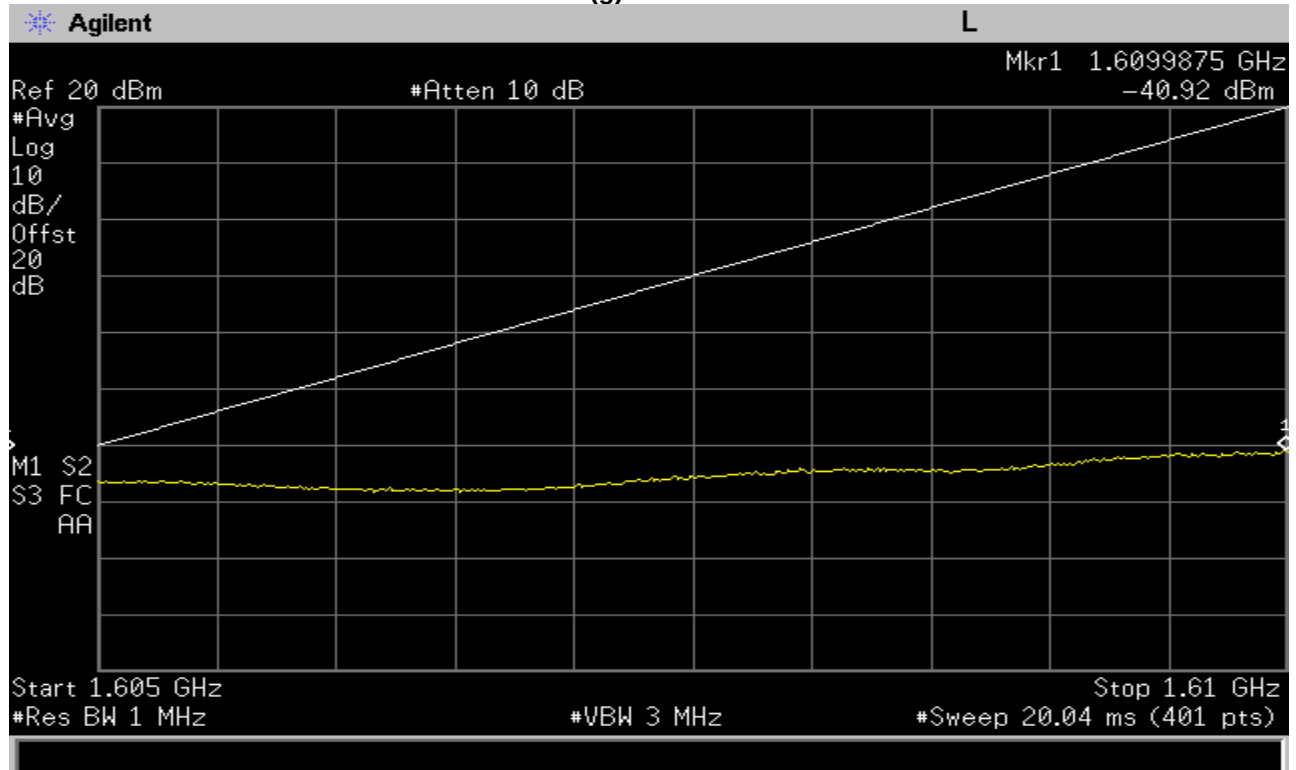


25.216(g) 1616.75 MHz

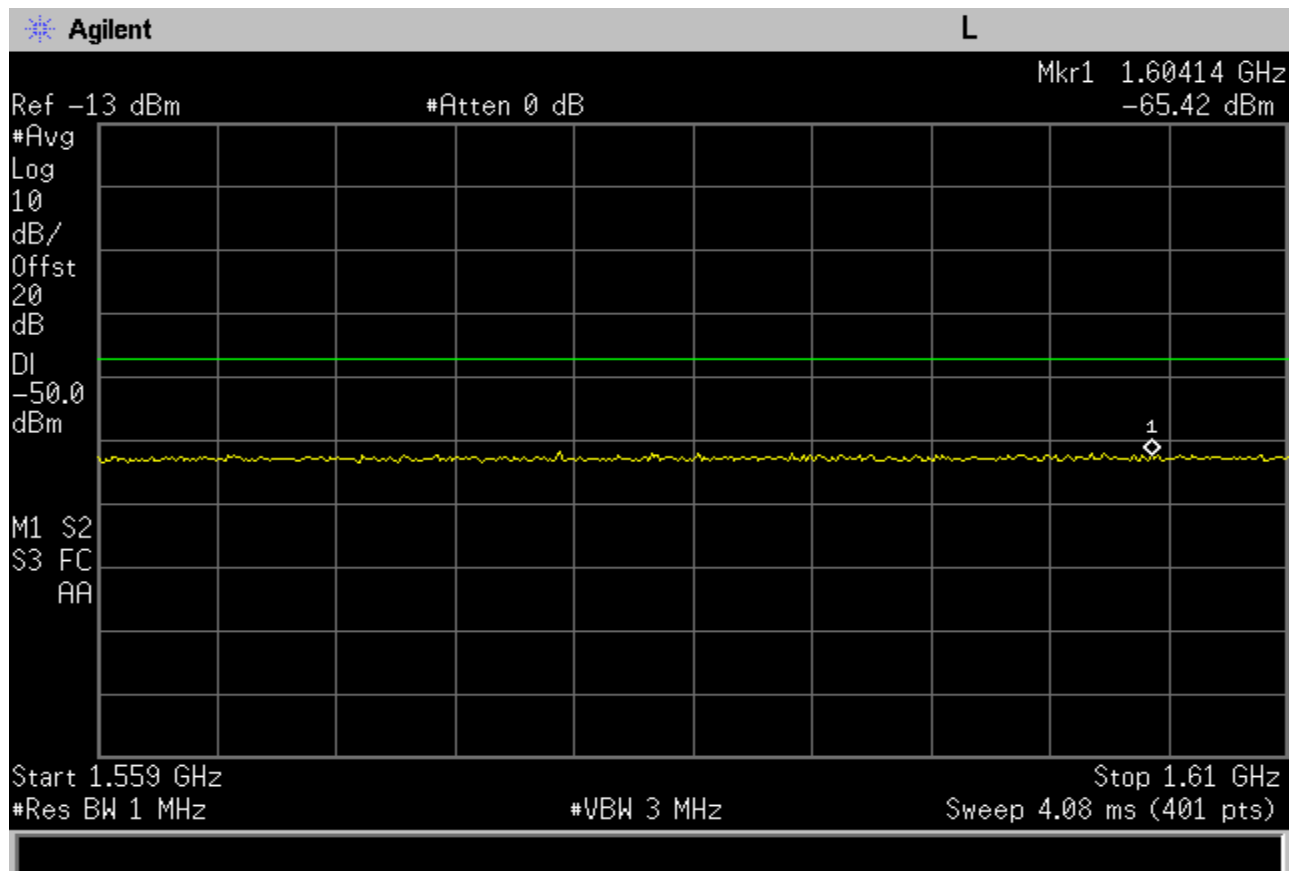




25.216(g) 1618.25 MHz



25.216(i)



## Frequency Tolerance (Temperature Variation)

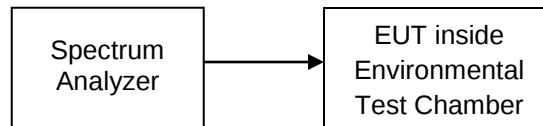
**Test Engineer:** Poona Saber

**Test Date:** 8/22/2017

### Test Procedure

The EUT was placed inside an environmental test chamber, and connected to a spectrum analyzer. The span and RBW was adjusted for narrowband operation to ensure an accurate measurement of the CW signal. The temperature was varied from -30 to +50°C in 10°C increments. After a 30-minute soak time the output frequency was measured. At 20°C the voltage was varied +/- 15% from the nominal voltage.

### Test Setup



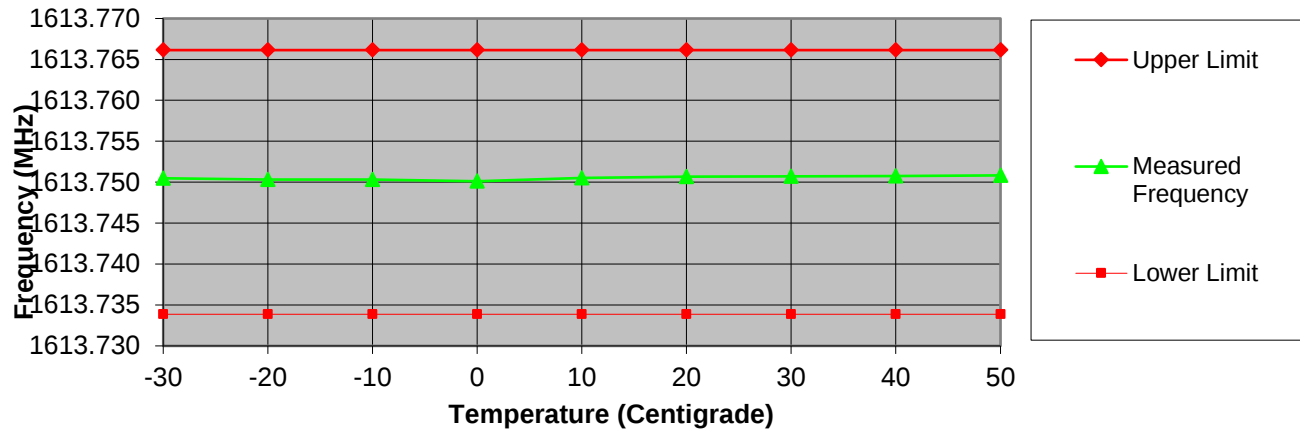
### Frequency Versus Temperature

| Tuned Frequency (MHz) | Frequency Tolerance % | Upper Limit (MHz) | Lower Limit (MHz) | Temperature centigrade | Measured Frequency (MHz) | Upper Margin (MHz) | Lower Margin (MHz) |
|-----------------------|-----------------------|-------------------|-------------------|------------------------|--------------------------|--------------------|--------------------|
| 1613.75               | 0.0010                | 1613.7661375      | 1613.7338625      | -30                    | 1,613.750462             | 0.0156755          | 0.0165995          |
|                       |                       | 1613.7661375      | 1613.7338625      | -20                    | 1,613.750332             | 0.0158055          | 0.0164695          |
|                       |                       | 1613.7661375      | 1613.7338625      | -10                    | 1,613.750314             | 0.0158235          | 0.0164515          |
|                       |                       | 1613.7661375      | 1613.7338625      | 0                      | 1,613.750113             | 0.0160245          | 0.0162505          |
|                       |                       | 1613.7661375      | 1613.7338625      | 10                     | 1,613.750522             | 0.0156155          | 0.0166595          |
|                       |                       | 1613.7661375      | 1613.7338625      | 20                     | 1,613.750691             | 0.0154465          | 0.0168285          |
|                       |                       | 1613.7661375      | 1613.7338625      | 30                     | 1,613.750728             | 0.0154095          | 0.0168655          |
|                       |                       | 1613.7661375      | 1613.7338625      | 40                     | 1,613.750754             | 0.0153835          | 0.0168915          |
|                       |                       | 1613.7661375      | 1613.7338625      | 50                     | 1,613.750832             | 0.0153055          | 0.0169695          |

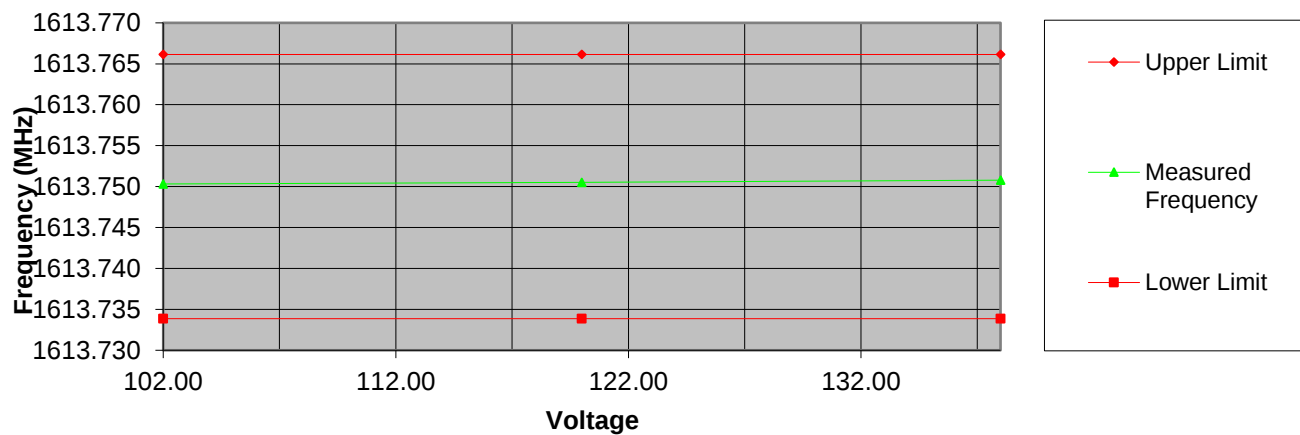
### Frequency Versus Voltage

| Tuned Frequency (MHz) | Frequency Tolerance % | Upper Limit (MHz) | Lower Limit (MHz) | Nominal Voltatge | Voltage | Measured Frequency (MHz) | Upper Margin (MHz) | Lower Margin (MHz) |
|-----------------------|-----------------------|-------------------|-------------------|------------------|---------|--------------------------|--------------------|--------------------|
| 1613.750              | 0.0010                | 1613.7661375      | 1613.7338625      | 120.00           | 102.00  | 1613.750320              | 0.0158175          | 0.016458           |
|                       |                       | 1613.7661375      | 1613.7338625      |                  | 120.00  | 1613.750500              | 0.0156375          | 0.016638           |
|                       |                       | 1613.7661375      | 1613.7338625      |                  | 138.00  | 1613.750783              | 0.0153545          | 0.016920           |

**Frequency Stability vs. Temperature**



**Frequency Stability vs. Voltage**



## Field Strength of Spurious Radiation

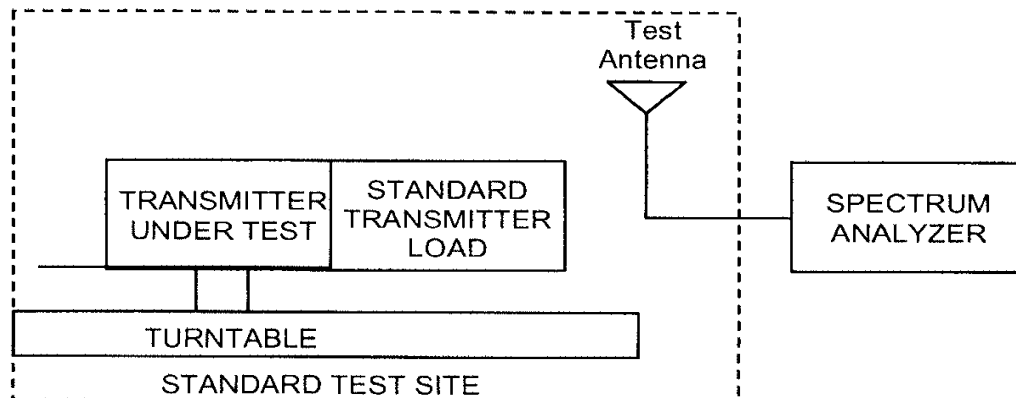
Engineer: Poona Saber

Test Date: 8/21/2017

### Test Procedure

- A) Connect the equipment as illustrated
- B) Adjust the spectrum analyzer for the following settings:
  - 1) Resolution Bandwidth 100 kHz (< 1 GHz), 1 MHz (> 1GHz)
  - 2) Video Bandwidth  $\geq 3$  times Resolution Bandwidth, or 30 kHz
  - 3) Sweep Speed  $\leq 2000$  Hz/second
  - 4) Detector Mode = Mean or Average Power
- C) Place the transmitter to be tested on the turntable in the standard test site. The transmitter is transmitting into a non- radiating load that is placed on the turntable. The RF cable to this load should be of minimum length.
- D) For each spurious measurement, the test antenna should be adjusted to the correct length for the frequency involved. This length may be determined from a calibration ruler supplied with the equipment. Measurements shall be made from the lowest radio frequency generated in the equipment to the tenth harmonic of the carrier, except for the region close to the carrier equal to  $\pm$  the test bandwidth (see section 1.3.4.4).
- E) For each spurious frequency, raise and lower the test antenna from 1 m to 4 m to obtain a maximum reading on the spectrum analyzer with the test antenna at horizontal polarity. Repeat this procedure to obtain the highest possible reading. Record this maximum reading.
- F) Repeat Step E) for each spurious frequency with the test antenna polarized vertically.

### Test Setup



See Annex A for test plots

## Test Equipment Utilized

| Description                   | Manufacturer | Model #                       | CT Asset # | Last Cal Date        | Cal Due Date |
|-------------------------------|--------------|-------------------------------|------------|----------------------|--------------|
| Horn Antenna                  | ARA          | DRG-118/A                     | i00271     | 6/16/16              | 6/16/18      |
| Horn Antenna, Amplified       | ARA          | MWH-1826/B                    | i00273     | 4/22/15              | 4/22/18      |
| Humidity / Temp Meter         | Newport      | IBTHX-W-5                     | i00282     | 6/9/17               | 6/9/18       |
| Spectrum Analyzer             | Agilent      | E4407B                        | i00331     | 10/19/16             | 10/19/17     |
| Bi-Log Antenna                | Schaffner    | CBL 6111D                     | i00349     | 8/3/16               | 8/3/18       |
| EMI Analyzer                  | Agilent      | E7405A                        | i00379     | 2/22/17              | 2/22/18      |
| 3 Meter Semi-Anechoic Chamber | Panashield   | 3 Meter Semi-Anechoic Chamber | i00428     | 8/15/16              | 8/15/19      |
| PSA Spectrum Analyzer         | Agilent      | E4445A                        | i00471     | 8/30/16              | 8/30/17      |
| Temperature Chamber           | Tenney       | Tenney Jr                     | i00027     | Verified on: 8/22/17 |              |
| Preamplifier                  | Miteq        | AFS44 00101 400 23-10P-44     | i00509     | N/A                  | N/A          |

In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

END OF TEST REPORT