

# EMC Test Report

**Project Number:** 4175716

**Report Number:** 4175716EMC01

**Revision Level:** 1

**Client:** Wistron NeWeb Corporation

**Equipment Under Test:** LTE CAT-M1 Device

**Model:** IMS2

**FCC ID:** NKRIMS2

**FCC Rule Parts:** Part 2, Part 27, Part 24E

**Report issued on:** 05 September 2017

**Test Result:** Compliant

**Tested by:**

  
\_\_\_\_\_  
Jeremy Pickens, Senior EMC Engineer

**Reviewed by:**

  
\_\_\_\_\_  
David Schramm, Operations Manager

*Remarks: This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.*

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# 1 Summary of Test Results

| Reference Sections                                 | Test Description                         | Test Limit                                                                       | Test Condition | Test Result |
|----------------------------------------------------|------------------------------------------|----------------------------------------------------------------------------------|----------------|-------------|
| 2.1046                                             | Conducted Output Power                   | N/A                                                                              | Conducted      | Compliant   |
| 24.232(d)<br>27.50(d)(5)                           | Peak-to-Average Ratio                    | <13 dB                                                                           |                | Compliant   |
| 2.1049                                             | Occupied Bandwidth                       | N/A                                                                              |                | Reported    |
| 2.1051<br>24.238(a)<br>27.53(h)<br>27.53(g)        | Band Edge / Conducted Spurious Emissions | $< 43 + 10\log_{10}(P_{[Watts]})$ at band edge and for all out of band emissions |                | Compliant   |
| 27.50(c)(10)                                       | Effective Radiated Power                 | < 3 Watts max ERP                                                                | Radiated       | Compliant   |
| 24.232(c)                                          | Effective Isotropic Radiated Power       | < 2 Watts max EIRP                                                               |                | Compliant   |
| 27.50(d)(4)                                        | Effective Isotropic Radiated Power       | < 1 Watt max EIRP                                                                |                | Compliant   |
| 2.1053<br>24.238(a)<br>27.53(h)<br>27.53(g)        | Radiated Spurious Emissions              | $< 43 + 10\log_{10}(P_{[Watts]})$ at band edge and for all out of band emissions |                | Compliant   |
| 2.1055<br>24.238(a)<br>27.5(c)<br>27.5(h)<br>27.54 | Frequency Stability                      | <2.5 ppm                                                                         |                | Compliant   |

## 1.1 Modifications Required to Compliance

None

## 2 General Information

### 2.1 Client Information

Name: Wistron NeWeb Corporation  
Address: 3322 Route 22 West, Building 10, Suite 1007  
City, State, Zip, Country: Branchburg, NJ 08876, USA

### 2.2 Test Laboratory

Name: SGS North America, Inc.  
Address: 620 Old Peachtree Road NW, Suite 100  
City, State, Zip, Country: Suwanee, GA 30024, USA

### 2.3 General Information of EUT

Type of Product: Wireless Modem Module  
Model Number: IMS2  
Serial Number: 11  
IMEI: 353180080000345

Rated Voltage: 3.3 – 4.2 Vdc,  
Test Voltage: 3.8 Vdc,

Tx Frequency Range: 1850 - 1910 MHz (LTE Band 2)  
1710 – 1755 MHz (LTE Band 4)  
699 – 716MHz (LTE Band 12)

FCC Classification: PCS Licensed Transmitter PCB  
Type: Pre Production

Sample Received Date: 07 July 2017  
Dates of testing: 20 – 25 July 2017

### 2.4 Operating Modes and Conditions

The EUT was exercised by sending test commands to place the device into constant transmit mode. Low, middle, and high channels were investigated for each frequency band of operation.

### 3 RF Output Power

#### 3.1 Test Result

| Test Description | Basic Standards                                 | Test Result |
|------------------|-------------------------------------------------|-------------|
| RF Output Power  | 2.1046, 27.50(c)(10),<br>24.232(c), 27.50(d)(4) | Compliant   |

#### 3.2 Test Method

The EUT was configured for transmission at maximum power using test commands. Average power measurements were taken using a spectrum analyzer.

##### Limits:

Portable stations (hand-held devices) in the 600 MHz uplink band and the 698-746 MHz band, and fixed and mobile stations in the 600 MHz uplink band are limited to 3 watts ERP.

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.

For the 1850-1910MHz band, mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

#### 3.3 Test Site

SGS EMC Laboratory, Suwanee, GA

##### Environmental Conditions

Temperature: 24.5 °C

Relative Humidity: 51.0%

Atmospheric Pressure: 98.2 kPa

#### 3.4 Test Equipment

Test End Date: 20-Jul-2017

Tester: JOP

| Equipment        | Model | Manufacturer    | Asset Number | Cal Due Date |
|------------------|-------|-----------------|--------------|--------------|
| SIGNAL ANALYZER  | FSV30 | ROHDE & SCHWARZ | B085749      | 8-Oct-2017   |
| ATTENUATOR, 10DB | 10DB  | ROHDE & SCHWARZ | B095591      | 27-Jul-2017  |
| RF CABLE         | SF102 | HUBER & SUHNER  | B079822      | 27-Jul-2017  |

- Unless otherwise noted, equipment is on a 1 year calibration cycle.
- Based on manufacturer's specifications, the FSV is on a 2 year calibration cycle.

### 3.5 Test Data

Note: All quantities of resource blocks were measured (1 through 6). There was no appreciable difference in the test results. Results for 6 RBs are reported.

| Band | UpLink Channel | UL Frequency (MHz) | BW (MHz) | Measured Power (dBm) | Cable Loss (dB) | Conducted Power (dBm) |
|------|----------------|--------------------|----------|----------------------|-----------------|-----------------------|
| 2    | 18607          | 1850.7             | 1.4      | 15.2                 | 11.9            | 22.76                 |
| 2    | 18900          | 1880               | 1.4      | 15.4                 | 11.9            | 22.96                 |
| 2    | 19193          | 1909.3             | 1.4      | 15.5                 | 11.9            | 23.06                 |
| 4    | 19957          | 1710.7             | 1.4      | 15.4                 | 11.8            | 22.86                 |
| 4    | 20175          | 1732.5             | 1.4      | 15.3                 | 11.8            | 22.76                 |
| 4    | 20393          | 1754.3             | 1.4      | 15.4                 | 11.8            | 22.86                 |
| 12   | 23017          | 699.7              | 1.4      | 16.2                 | 11.1            | 22.96                 |
| 12   | 23095          | 707.5              | 1.4      | 16.2                 | 11.1            | 22.96                 |
| 12   | 23173          | 715.3              | 1.4      | 16.2                 | 11.1            | 22.96                 |

## 4 Peak to Average Ratio

### 4.1 Test Result

| Test Description      | Basic Standards          | Test Result |
|-----------------------|--------------------------|-------------|
| Peak to Average Ratio | 24.232(d)<br>27.50(d)(5) | Compliant   |

### 4.2 Test Method

KDB document 971168 D01 Power Meas License Digital Systems v02r02 was used to determine peak-to-average ratio. For the LTE measurements, Clause 5.7.1 was used which defined the measurement method using the CCDF function of the spectrum analyzer. Measurements were recorded at the mid channels and the worst-case setting was determined to be 1RB (center), and QPSK modulation.

### 4.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.5 °C

Relative Humidity: 51.0%

Atmospheric Pressure: 98.2 kPa

### 4.4 Test Equipment

Test End Date: 20-Jul-2017

Tester: JOP

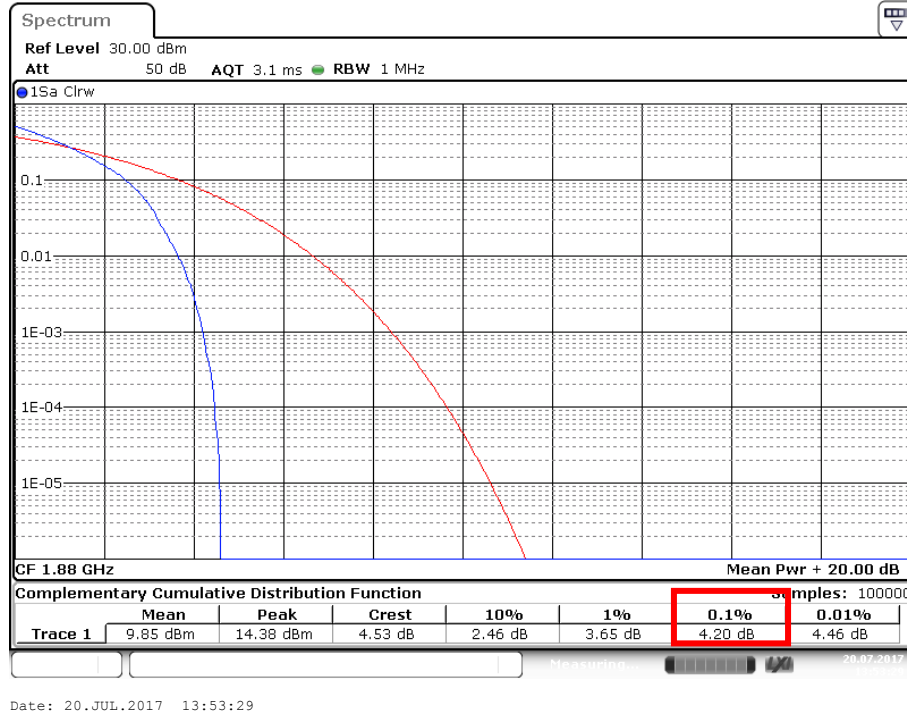
| Equipment        | Model | Manufacturer    | Asset Number | Cal Due Date |
|------------------|-------|-----------------|--------------|--------------|
| SIGNAL ANALYZER  | FSV30 | ROHDE & SCHWARZ | B085749      | 8-Oct-2017   |
| ATTENUATOR, 10DB | 10DB  | ROHDE & SCHWARZ | B095591      | 27-Jul-2017  |
| RF CABLE         | SF102 | HUBER & SUHNER  | B079822      | 27-Jul-2017  |

- Unless otherwise noted, equipment is on a 1 year calibration cycle.
- Based on manufacturer's specifications, the FSV is on a 2 year calibration cycle.

## 4.5 Test Data

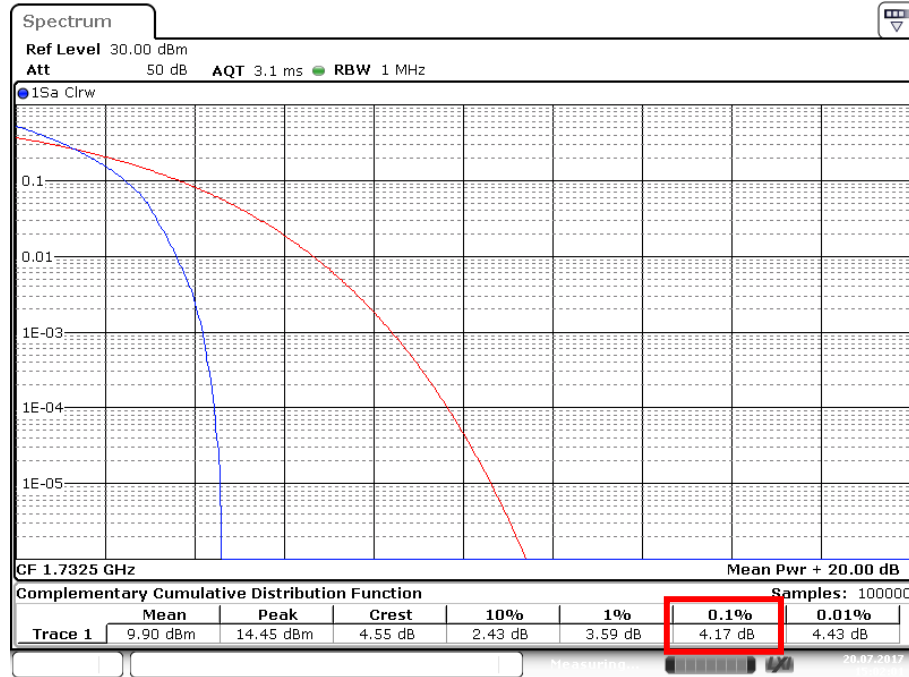
Note: All quantities of resource blocks were measured (1 through 6). There was no appreciable difference in the test results. Results for 6 RBs are reported.

**LTE Band 2, ULCH: 18900 (1880MHz)**  
**ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)**



Note: Mean power does not include the losses associated with the attenuator and cable (11.1dB)

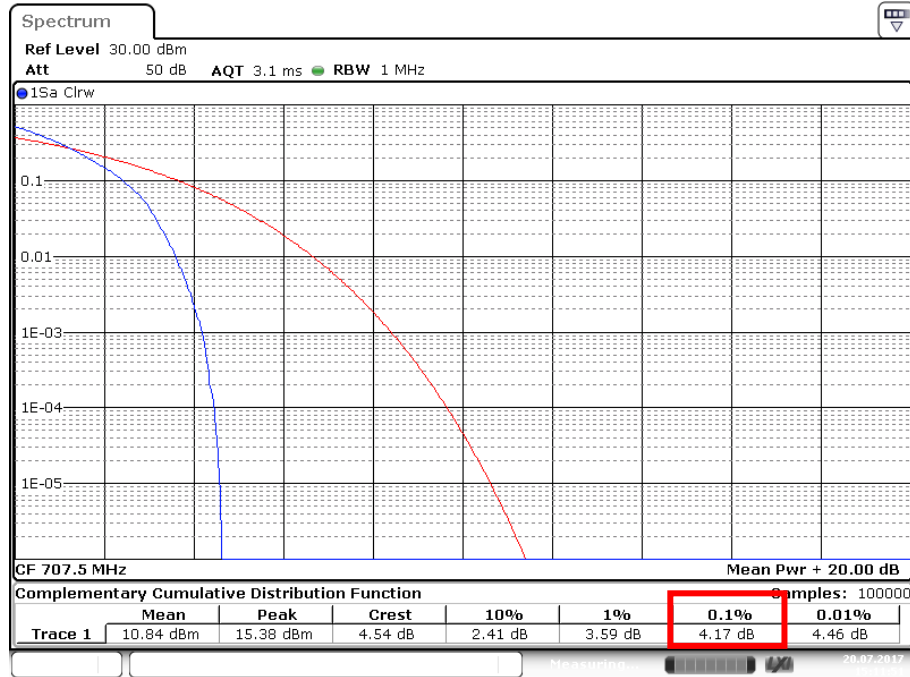
**LTE Band 4, ULCH: 20175 (1732.5MHz)**  
**ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)**



Date: 20.JUL.2017 15:02:02

Note: Mean power does not include the losses associated with the attenuator and cable (11.1dB)

**LTE Band 12, ULCH: 23095 (707.5MHz)**  
**ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)**



Date: 20.JUL.2017 15:11:51

Note: Mean power does not include the losses associated with the attenuator and cable (10.7dB)

## 5 Occupied Bandwidth

### 5.1 Test Result

| Test Description   | Basic Standards | Test Result |
|--------------------|-----------------|-------------|
| Occupied Bandwidth | 2.1049          | Reported    |

### 5.2 Test Method

The occupied bandwidth is the frequency bandwidth such that below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power by a given emission. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted.

The output power of the EUT was set to maximum value by test commands. The occupied bandwidth was measured using spectrum analyzer's occupied bandwidth measurement.

The bandwidth of 99% power can be read on spectrum analyzer.

The measurement was conducted at the center channel of each band. All resource blocks were explored. Worst-case results are reported.

### 5.3 Test Site

SGS EMC Laboratory, Suwanee, GA

#### Environmental Conditions

Temperature: 24.5 °C  
Relative Humidity: 51.0%  
Atmospheric Pressure: 98.2 kPa

### 5.4 Test Equipment

Test End Date: 20-Jul-2017

Tester: JOP

| Equipment        | Model | Manufacturer    | Asset Number | Cal Due Date |
|------------------|-------|-----------------|--------------|--------------|
| SIGNAL ANALYZER  | FSV30 | ROHDE & SCHWARZ | B085749      | 8-Oct-2017   |
| ATTENUATOR, 10DB | 10DB  | ROHDE & SCHWARZ | B095591      | 27-Jul-2017  |
| RF CABLE         | SF102 | HUBER & SUHNER  | B079822      | 27-Jul-2017  |

- Unless otherwise noted, equipment is on a 1 year calibration cycle.
- Based on manufacturer's specifications, the FSV is on a 2 year calibration cycle.

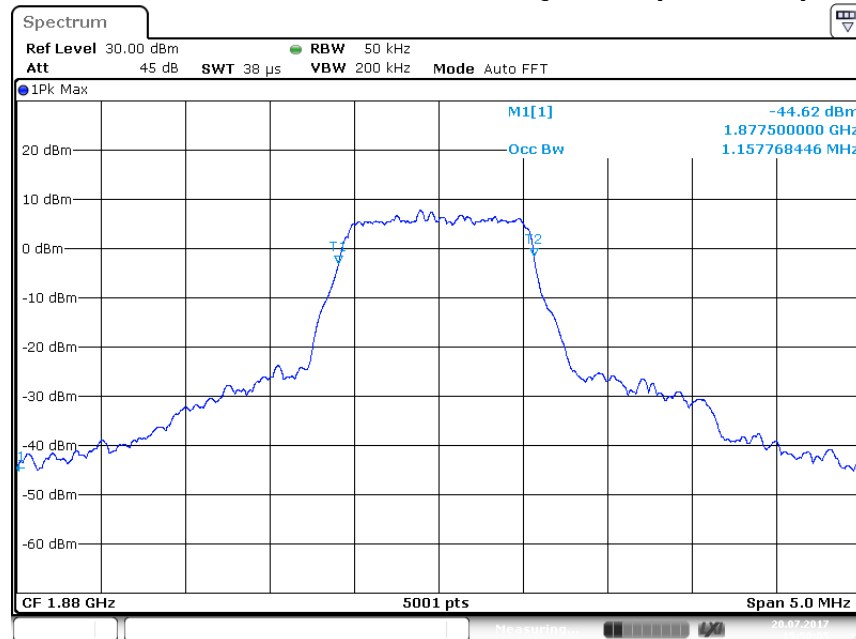
## 5.5 Test Data

Note: All quantities of resource blocks were measured (1 through 6). There was no appreciable difference in the test results. Results for 6 RBs are reported.

### LTE Band 2

Occupied Bandwidth: :@ULCH: 18900, BW: 1.4 MHz

ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

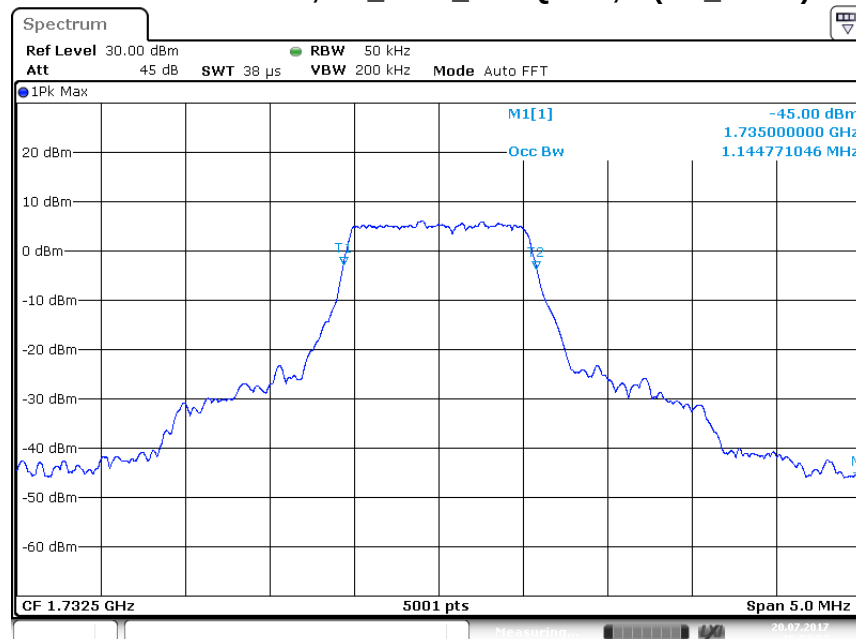


Date: 20.JUL.2017 15:50:05

### LTE Band 4

Occupied Bandwidth: :@ULCH: 20175, BW: 1.4 MHz ,

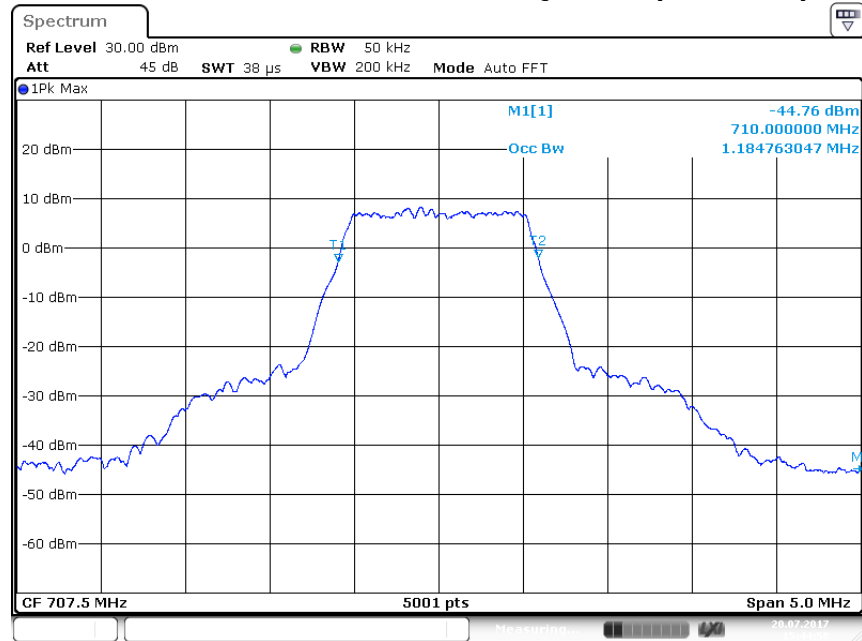
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)



Date: 20.JUL.2017 15:52:54

### LTE Band 12

Occupied Bandwidth: :@ULCH: 23095, BW: 1.4 MHz ,  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)



## 6 Band Edge and Conducted Spurious Emissions

### 6.1 Test Result

| Test Description                           | Basic Standards                             | Test Result |
|--------------------------------------------|---------------------------------------------|-------------|
| Conducted spurious emissions and Band Edge | 2.1051<br>24.238(a)<br>27.53(h)<br>27.53(g) | Compliant   |

### 6.2 Test Method

The levels of the carrier and the various conducted spurious and harmonics frequencies are measured by means of a calibrated spectrum analyzer. The emissions spectrum emanating from the EUT transmit antenna port is scanned from the lowest frequency generated in the equipment up to a frequency including its 10<sup>th</sup> harmonic. On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB. Compliance is based on the use of a spectrum analyzer employing a resolution bandwidth of 1 MHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of a least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emissions bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

### 6.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.5 °C

Relative Humidity: 51.0%

Atmospheric Pressure: 98.2 kPa

### 6.4 Test Equipment

Test End Date: 20-Jul-2017

Tester: JOP

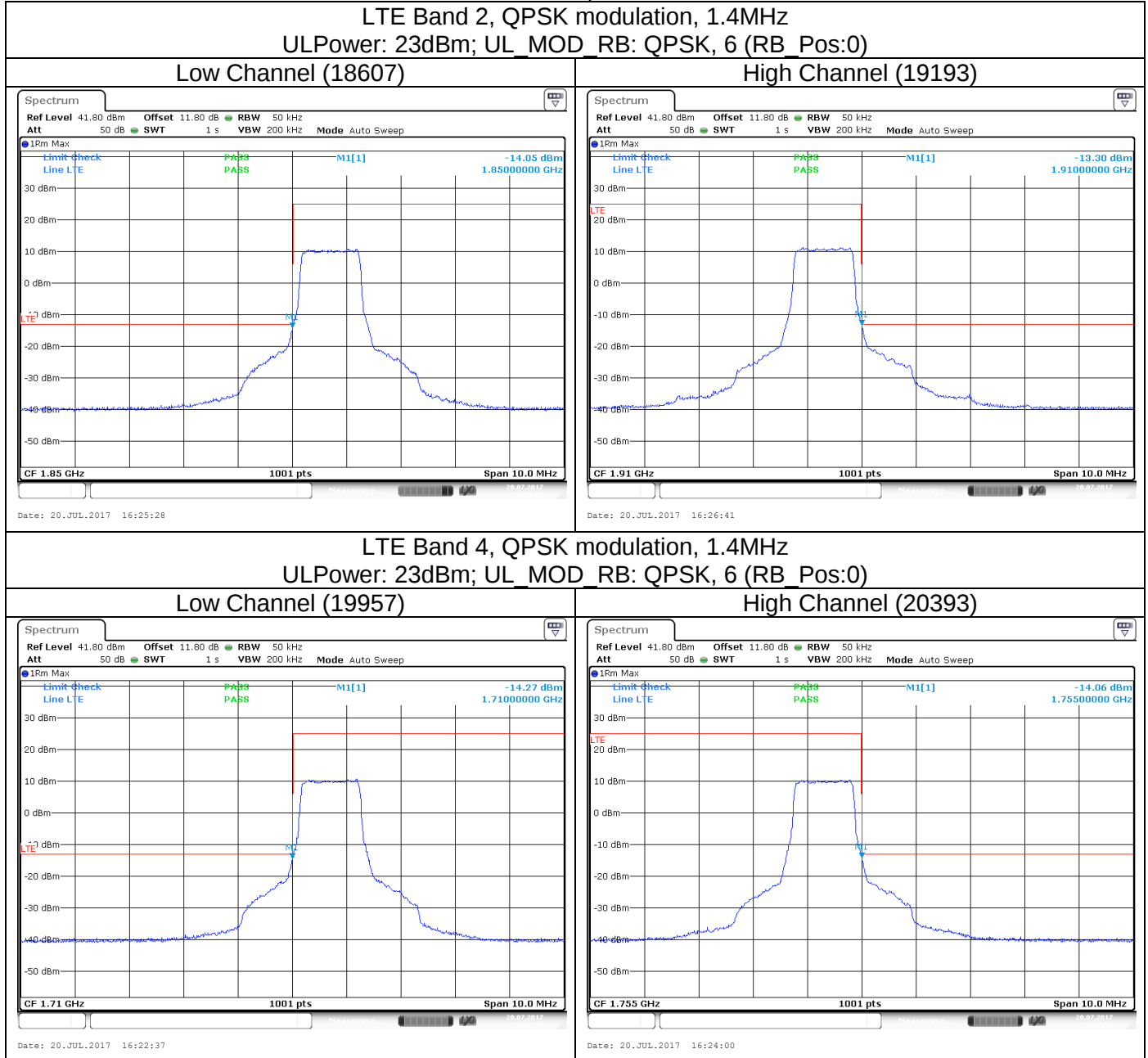
| Equipment        | Model | Manufacturer    | Asset Number | Cal Due Date |
|------------------|-------|-----------------|--------------|--------------|
| SIGNAL ANALYZER  | FSV30 | ROHDE & SCHWARZ | B085749      | 8-Oct-2017   |
| ATTENUATOR, 10DB | 10DB  | ROHDE & SCHWARZ | B095591      | 27-Jul-2017  |
| RF CABLE         | SF102 | HUBER & SUHNER  | B079822      | 27-Jul-2017  |

Unless otherwise noted, equipment is on a 1 year calibration cycle.

Based on manufacturer's specifications, the FSV is on a 2 year calibration cycle.

## 6.5 Test Data - Band Edge

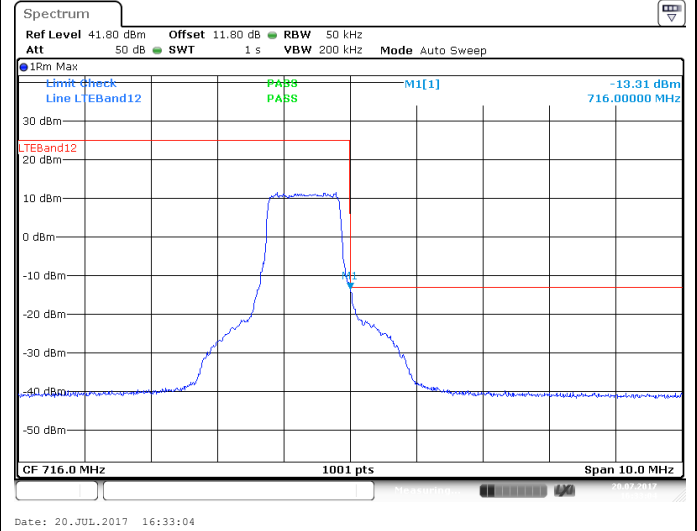
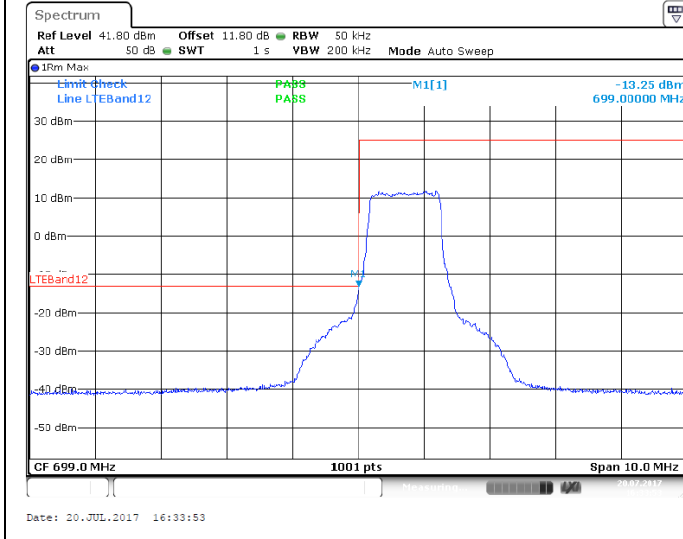
Note: All quantities of resource blocks were measured (1 through 6). There was no appreciable difference in the test results. Results for 6 RBs are reported.



LTE Band 12, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

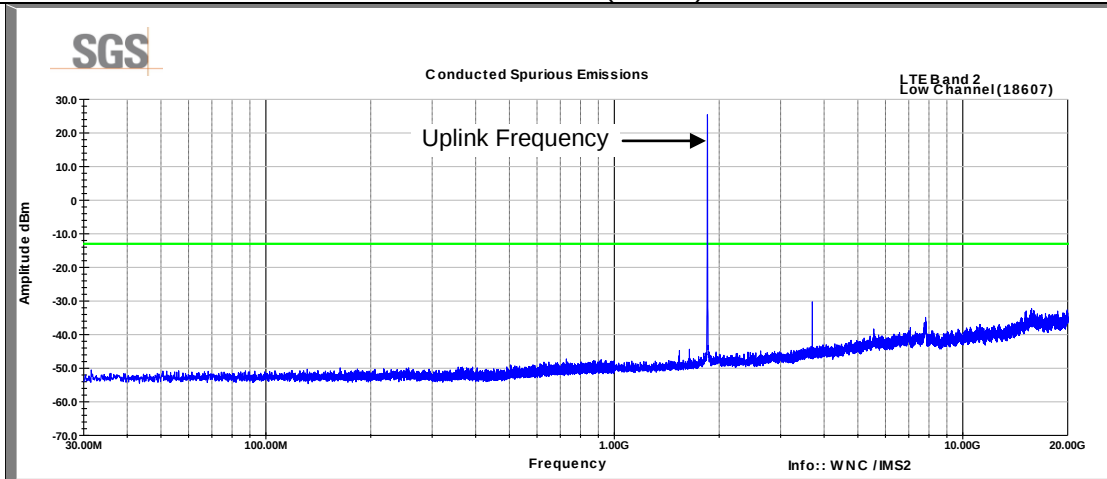
Low Channel (23017)

High Channel (23173)

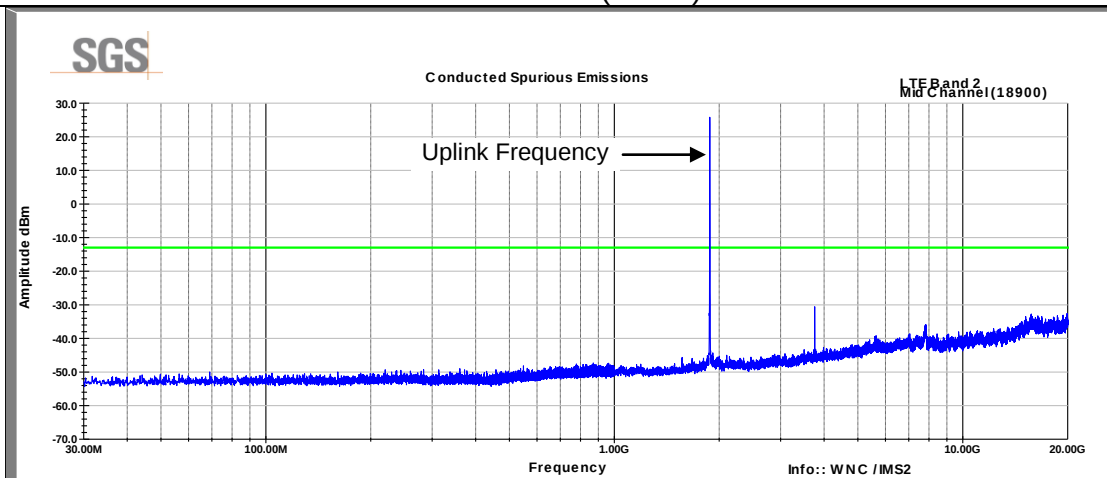


## 6.6 Test Data - Conducted Spurious Emissions

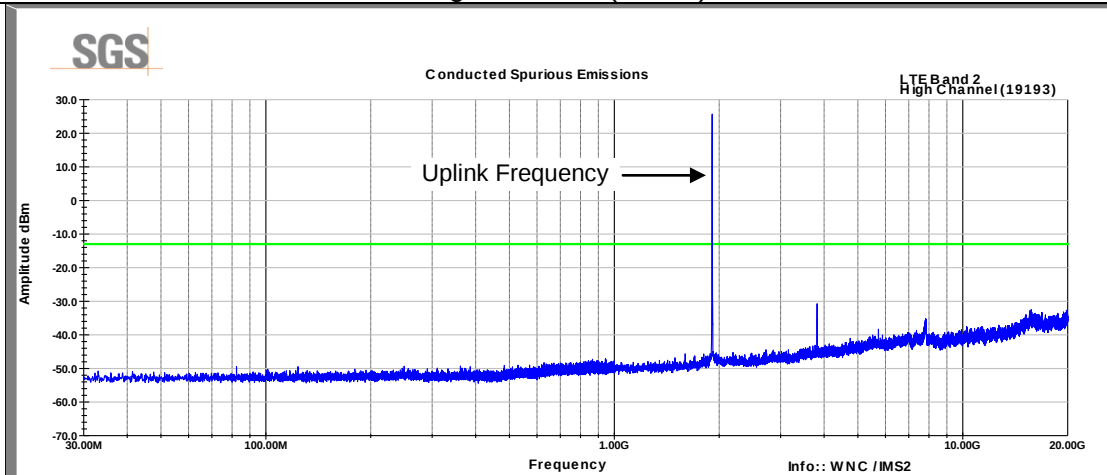
LTE Band 2, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)  
Low Channel (18607)



Mid Channel (18900)

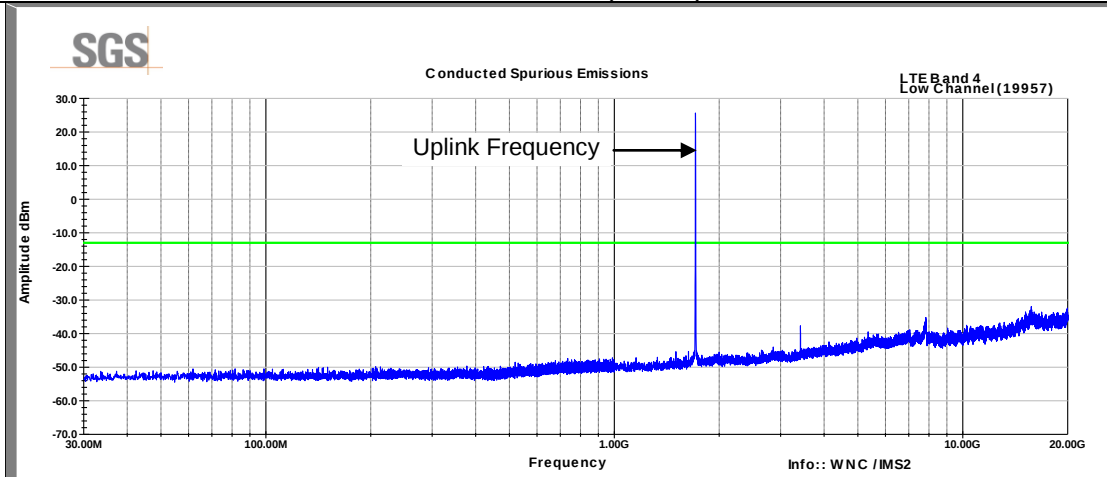


High Channel (19193)

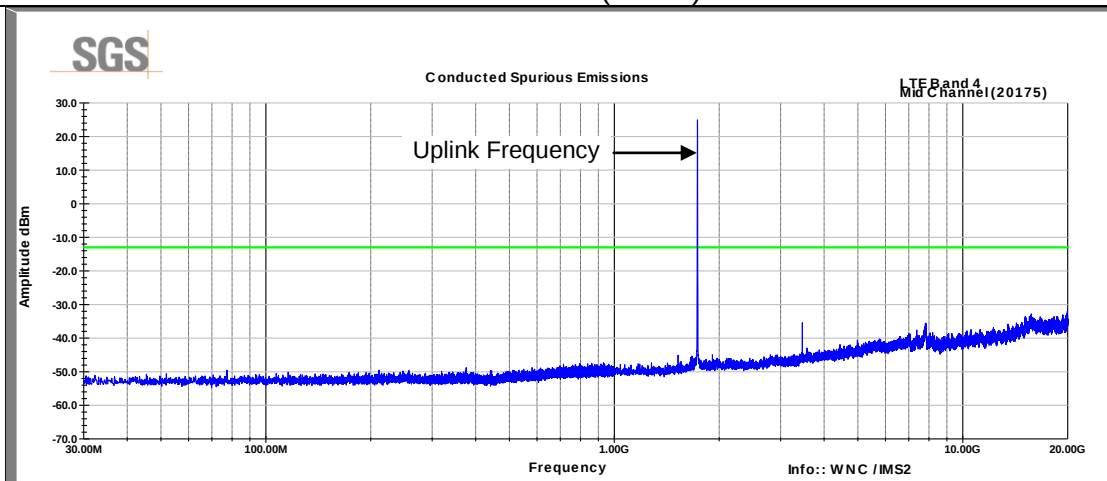


LTE Band 4, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

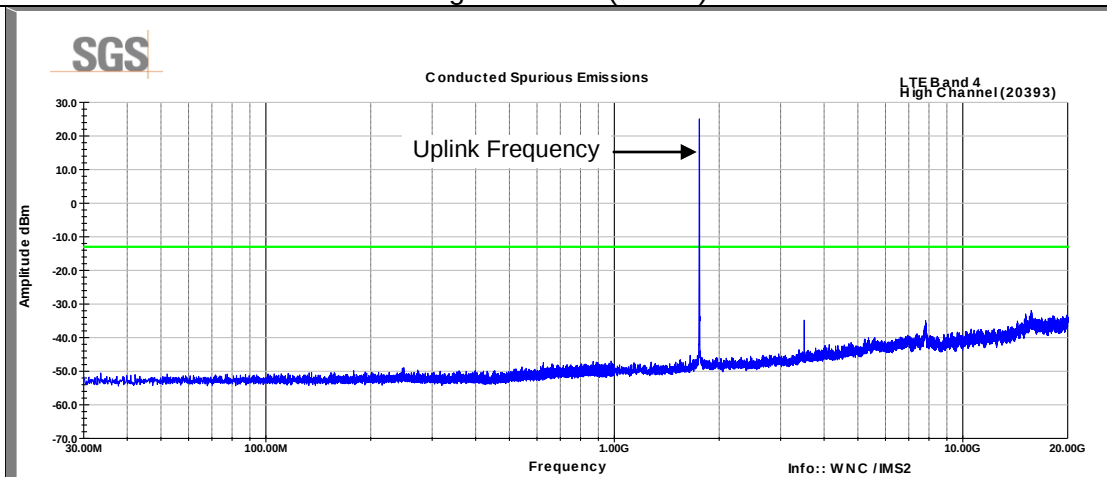
## Low Channel (19957)



## Mid Channel (20175)

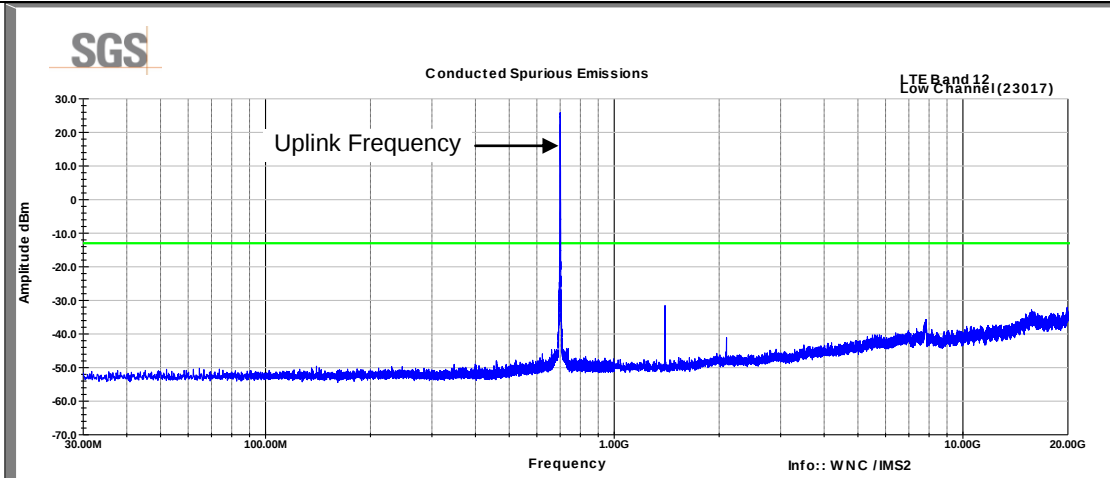


## High Channel (20393)

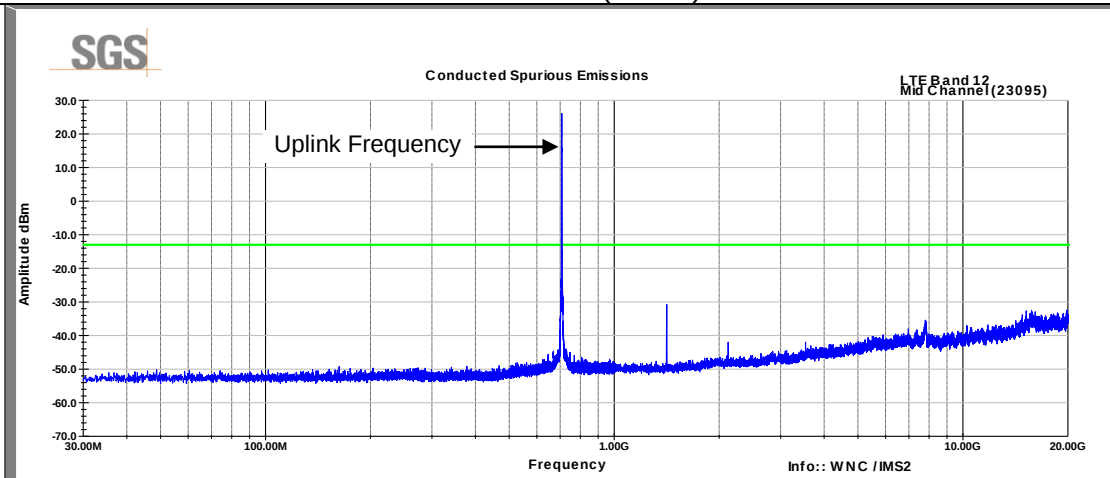


LTE Band 12, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

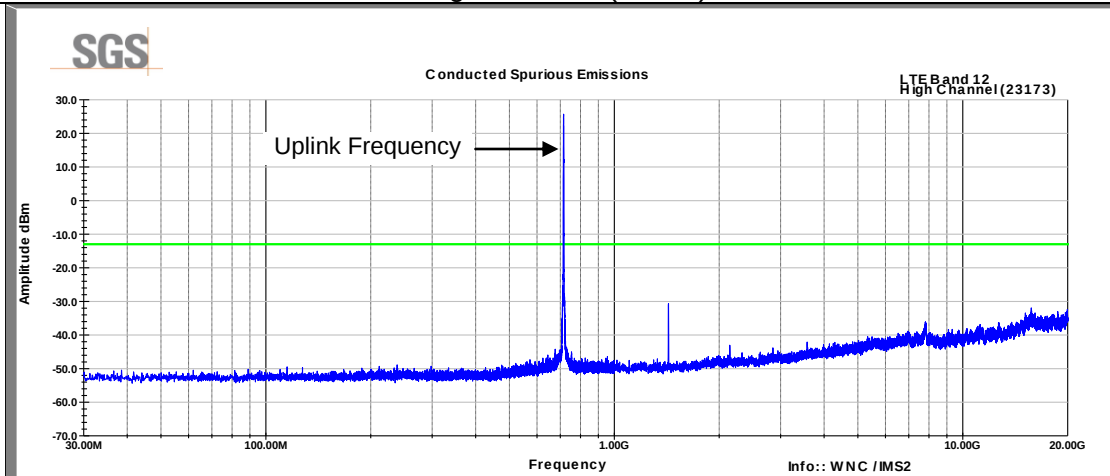
Low Channel (23017)



Mid Channel (23095)



High Channel (23173)



## 7 Effective Radiated Power

### 7.1.1 Test Result

| Test Description                   | Basic Standards | Test Result |
|------------------------------------|-----------------|-------------|
| Effective Radiated Power           | 27.50(c)(10)    | Compliant   |
| Effective Isotropic Radiated Power | 24.232(c)       | Compliant   |
| Effective Isotropic Radiated Power | 27.50(d)(4)     | Compliant   |

### 7.1.2 Test Method

Because the IMS2 is provided with a coaxial port but no antenna, ERP/EIRP measurements were taken by using the maximum tune-up limits and defining the maximum gain antenna that may be used while maintaining compliance with the applicable ERP/EIRP and RF Exposure limits.

### 7.2 Test Site

SGS EMC Laboratory, Suwanee, GA

### 7.3 Test Equipment

None

### 7.4 Test Data

| Band of Operation |           | Conducted Power | Antenna Gain | Cable Loss | Average EIRP |      | Distance (R) | Power Density                                 | FCC                | % of Limit | Verdict |
|-------------------|-----------|-----------------|--------------|------------|--------------|------|--------------|-----------------------------------------------|--------------------|------------|---------|
| Type              | MHz       | dBm             |              |            | dBm          | mW   | cm           | $EIRP_{avg}/(4\pi R^2)$<br>mW/cm <sup>2</sup> | mW/cm <sup>2</sup> |            |         |
| LTE Band 2        | 1850-1910 | 25.7            | 7.0          | 0.0        | 32.7         | 1862 | 20           | 0.370                                         | 1.00               | 37%        | Pass    |
| LTE Band 4        | 1710-1755 | 25.7            | 4.0          | 0.0        | 29.7         | 933  | 20           | 0.186                                         | 1.00               | 19%        | Pass    |
| LTE Band 12       | 699-716   | 25.7            | 7.0          | 0.0        | 32.7         | 1862 | 20           | 0.370                                         | 0.47               | 79%        | Pass    |

Note: Antenna gain was determined as maximum gain while still meeting the EIRP limits and RF exposure requirements at 20cm.

## 8 Radiated Spurious Emissions

### 8.1 Test Result

| Test Description            | Basic Standards                                                    | Test Result |
|-----------------------------|--------------------------------------------------------------------|-------------|
| Radiated Spurious Emissions | 2.1053<br>24.238(a)<br>27.53(h)<br>27.53(g)<br>ANSI/TIA-603-D-2010 | Compliant   |

### 8.2 Test Method

The levels are measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10<sup>th</sup> harmonic. On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log (P)$  dB. Compliance is based on the use of a spectrum analyzer employing a resolution bandwidth of 1 MHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of a least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emissions bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

The EUT was manipulated through each of its three orthogonal axes with the measurement oriented in both vertical and horizontal polarizations.

A radio link was established between EUT and Radio Communications Tester. The output power of the EUT was set to maximum value by using the maximum power setting on the Radio Communications Tester.

The measurements were performed at the low, middle, and high channels.

### 8.3 Test Site

SGS 10m Chamber, Suwanee, GA (validated to ANS C63.4: 2014 below and above 1GHz)

#### Environmental Conditions

Temperature: 27.7 C  
Relative Humidity: 38.3 %  
Atmospheric Pressure: 98.03 kpa

## 8.4 Test Equipment

Test End Date: 1-Aug-2017

Tester: ASF

| Equipment                  | Model             | Manufacturer    | Asset Number | Cal Due Date |
|----------------------------|-------------------|-----------------|--------------|--------------|
| EMI TEST RECEIVER          | ESU40             | ROHDE & SCHWARZ | B079629      | 25-Apr-2018  |
| RF CABLE                   | SUCOFLEX 100      | HUBER & SUHNER  | B108523      | 24-Jul-2018  |
| LOW NOISE AMPLIFIER        | TS-PR18           | ROHDE & SCHWARZ | B094463      | 22-Feb-2018  |
| NETWORK ANALYZER           | ZVL               | ROHDE & SCHWARZ | B079799      | 6-Mar-2018   |
| RF CABLE                   | SF106             | HUBER & SUHNER  | B079659      | 25-Jul-2018  |
| RF CABLE                   | SF106             | HUBER & SUHNER  | B079713      | 24-Jul-2018  |
| RF CABLE                   | SF106             | HUBER & SUHNER  | 17014        | 24-Jul-2018  |
| ANTENNA, BILOG             | JB6               | SUNOL           | B079690      | 10-Nov-2017  |
| RF CABLE                   | SF106             | HUBER & SUHNER  | B079712      | 24-Jul-2018  |
| ANTENNA, DRG HORN (MEDIUM) | 3117              | ETS LINDGREN    | B079699      | 16-May-2018  |
| LOW NOISE AMPLIFIER        | NSP1840-HG        | MITEQ           | B087572      | 28-Jul-2018  |
| RF CABLE                   | SF102             | HUBER & SUHNER  | B079822      | 27-Jul-2018  |
| RF CABLE                   | SF102             | HUBER & SUHNER  | B079823      | 26-Jul-2018  |
| HORN(SMALL)                | LB-180400-20-C-KF | A-INFO          | 15007        | 21-Mar-2018  |

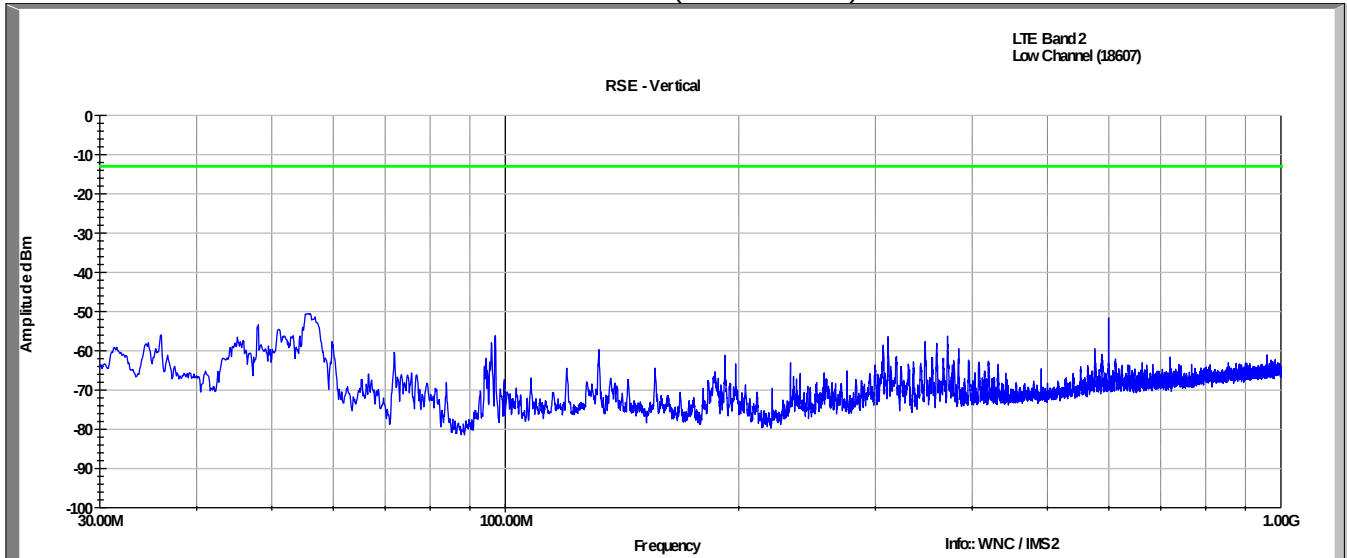
- Unless otherwise noted, equipment is on a 1 year calibration cycle.

## 8.5 Test Data

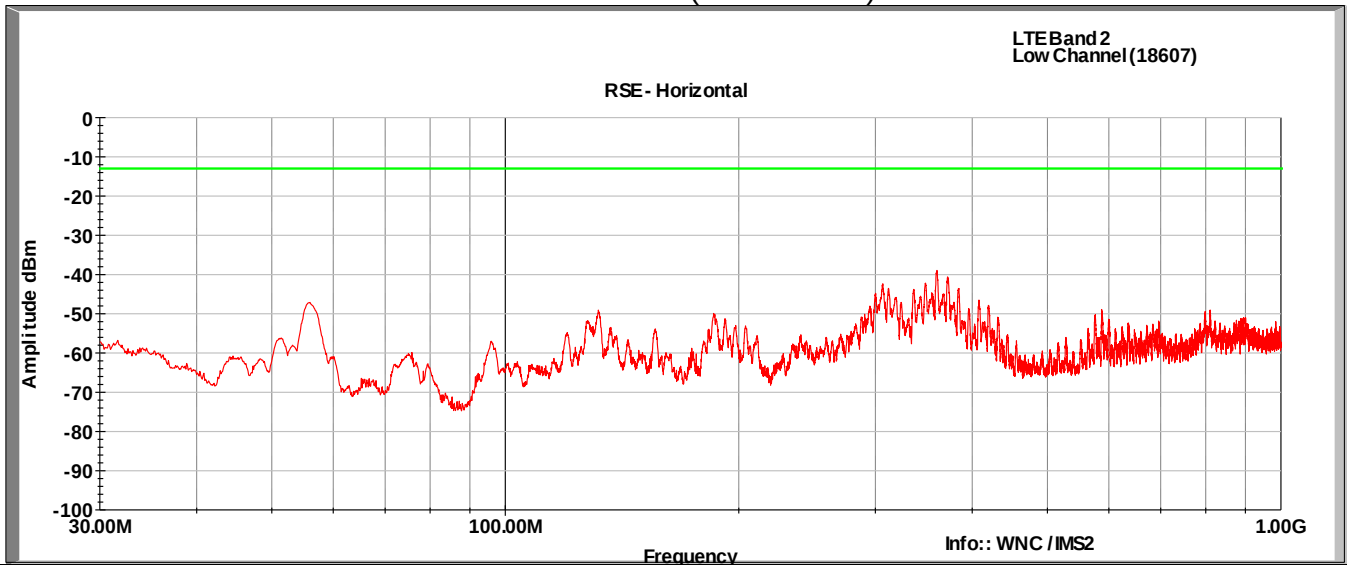
LTE Band 2, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

Low Channel (18607)

Vertical Data (30-1000MHz)

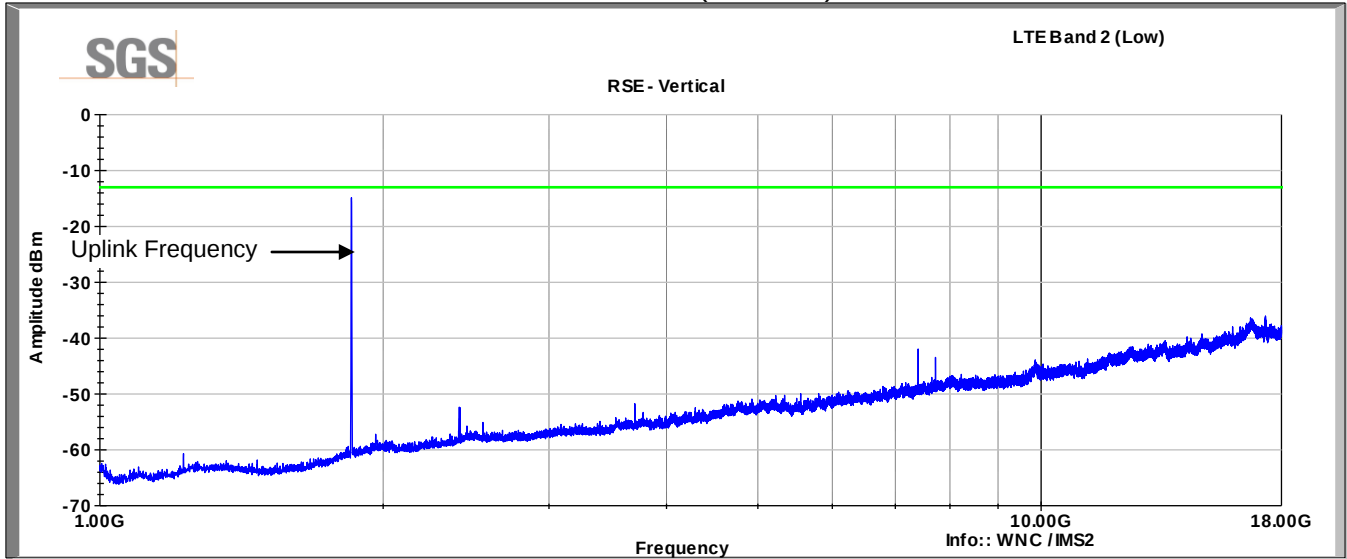


Horizontal Data (30-1000MHz)

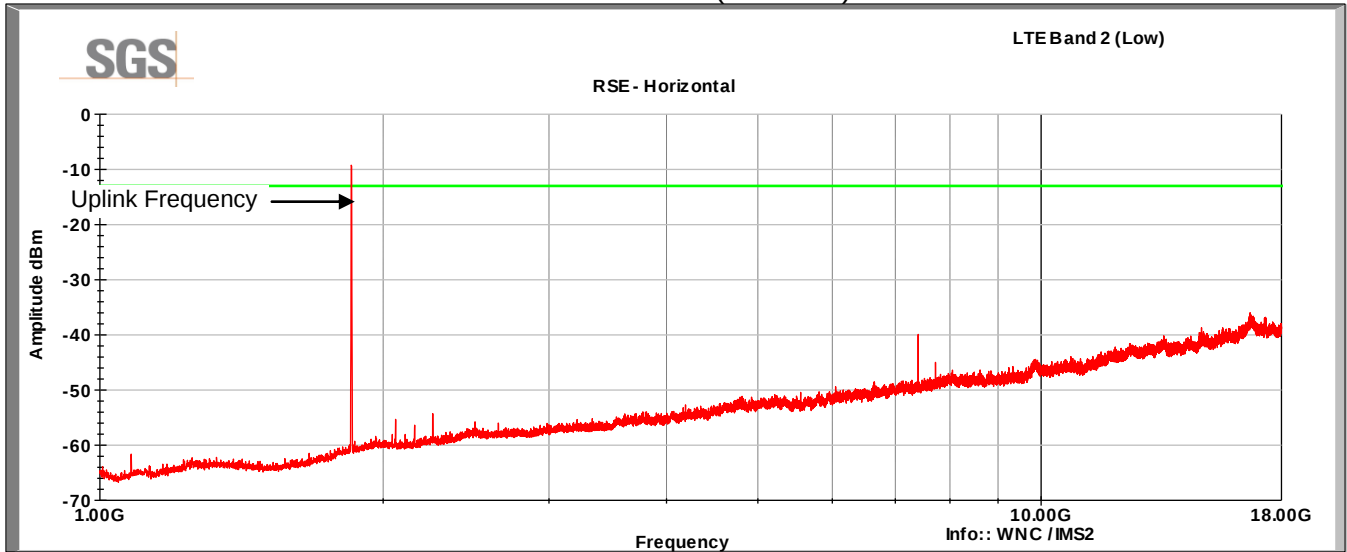


LTE Band 2, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

Low Channel (18607)  
Vertical Data (1-18GHz)

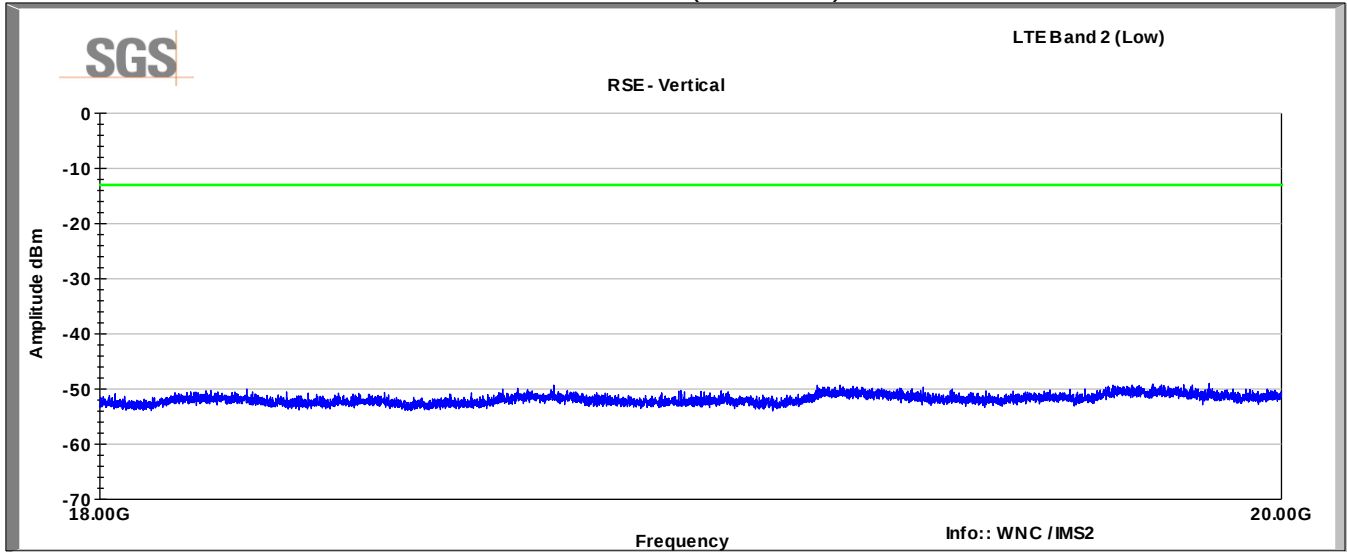


Horizontal Data (1-18GHz)

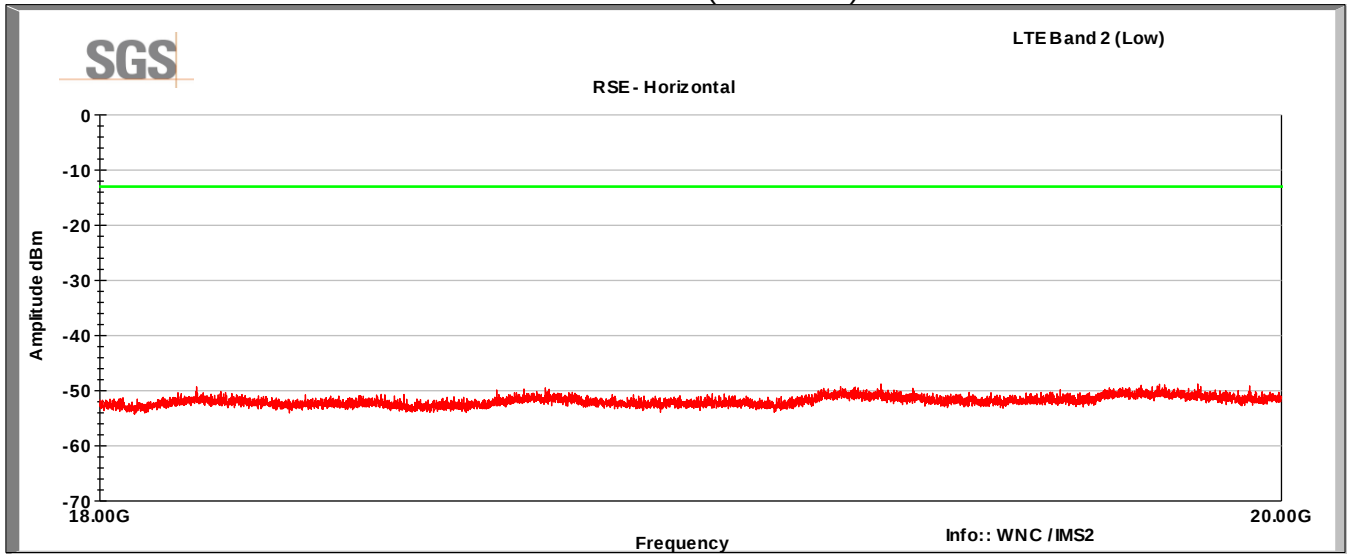


LTE Band 2, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

Low Channel (18607)  
Vertical Data (18-20GHz)

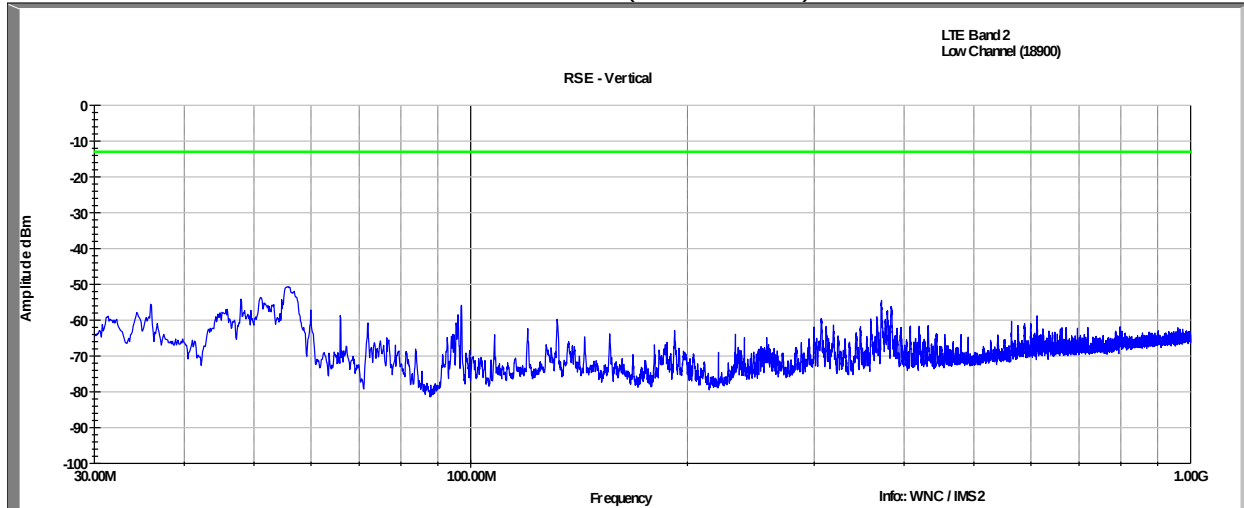


Horizontal Data (18-20GHz)

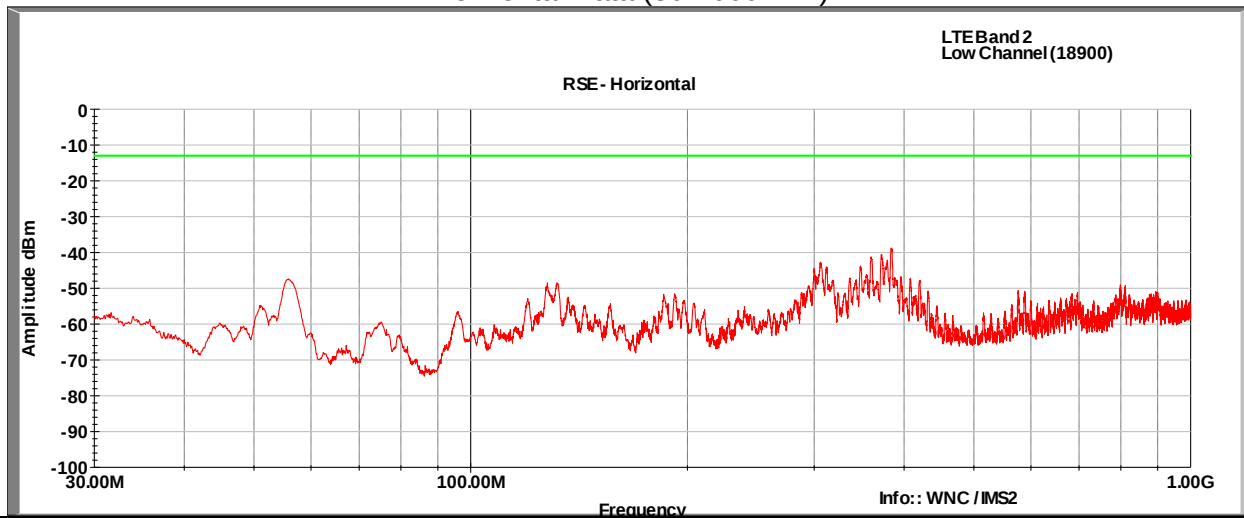


LTE Band 2, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

Mid Channel (18900)  
Vertical Data (30-1000MHz)

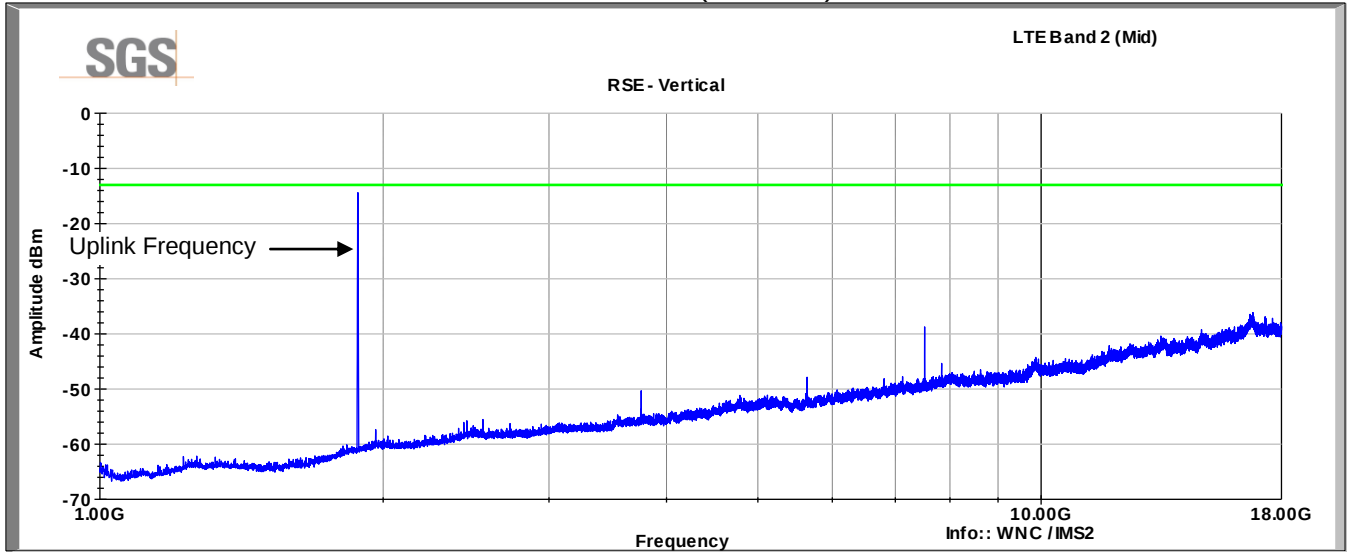


Horizontal Data (30-1000MHz)

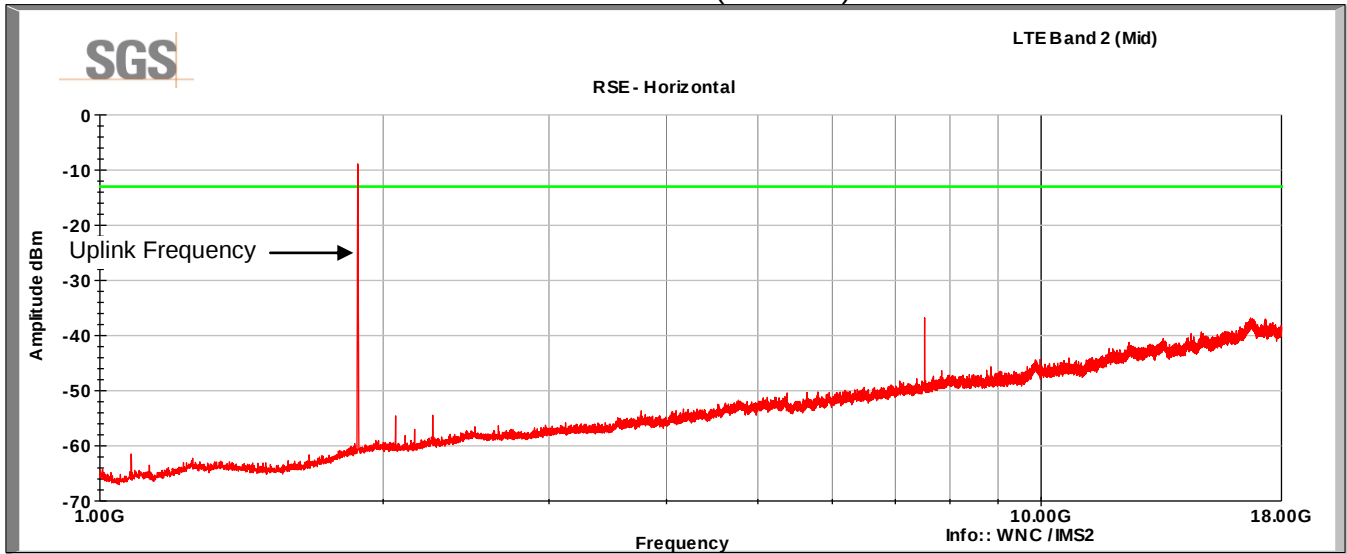


LTE Band 2, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

Mid Channel (18900)  
Vertical Data (1-18GHz)

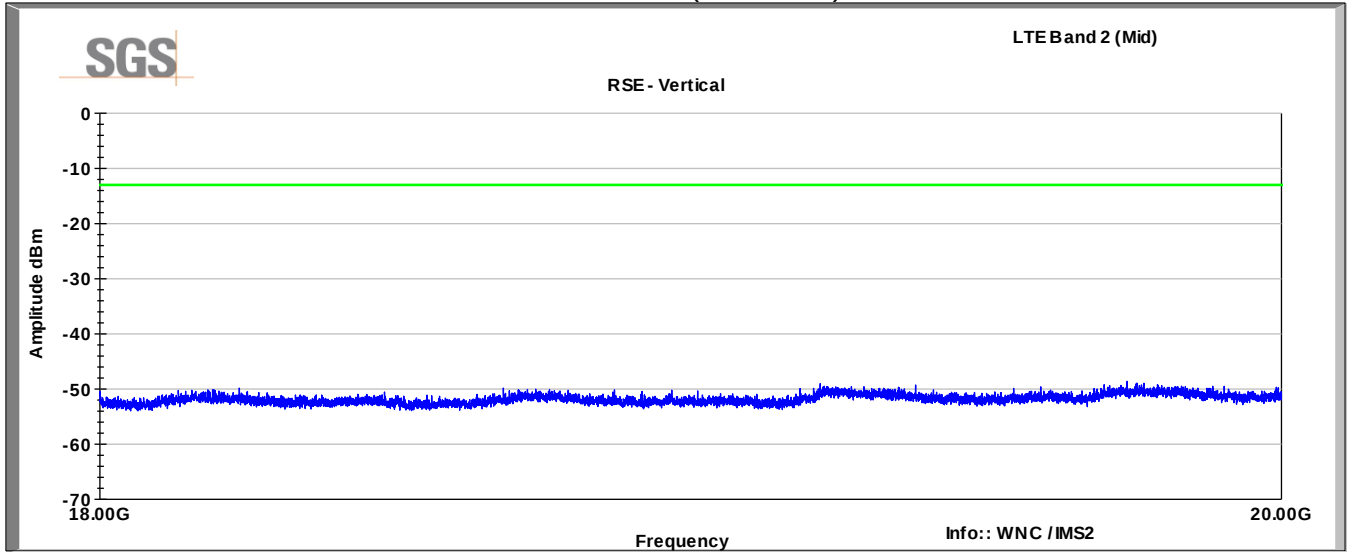


Horizontal Data (1-18GHz)

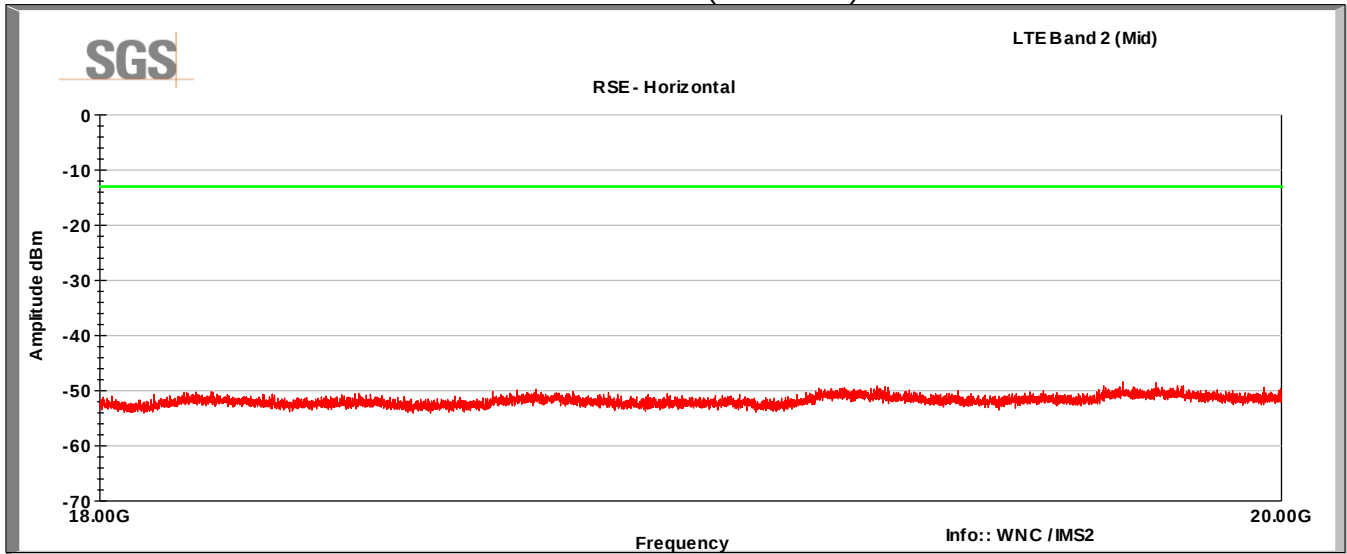


LTE Band 2, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

Mid Channel (18900)  
Vertical Data (18-20GHz)

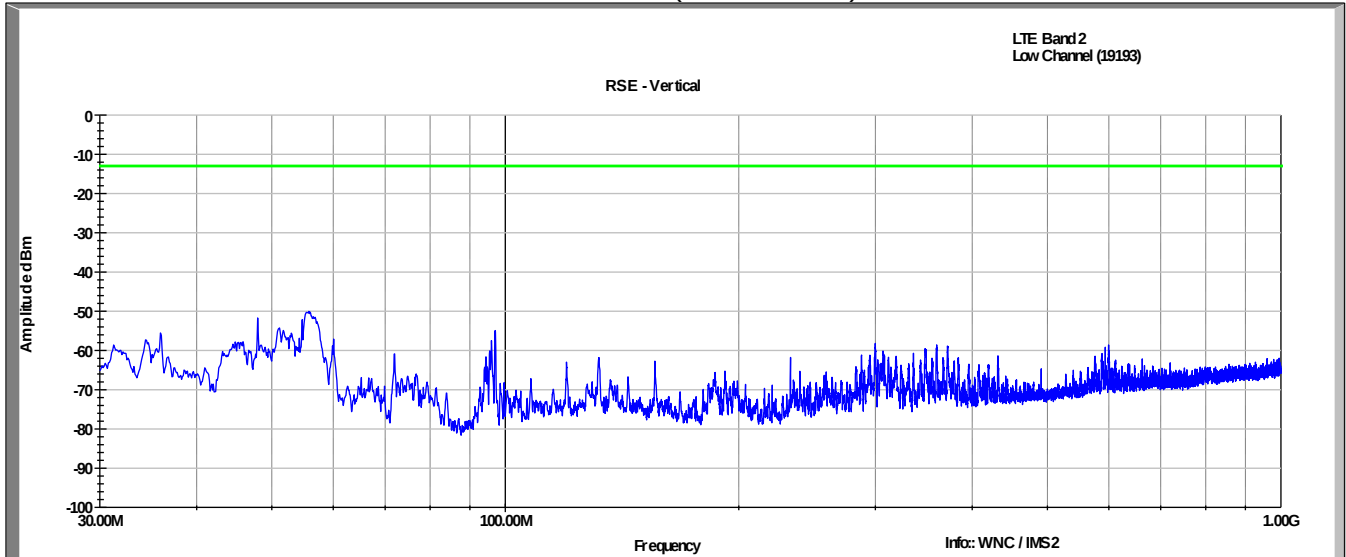


Horizontal Data (18-20GHz)

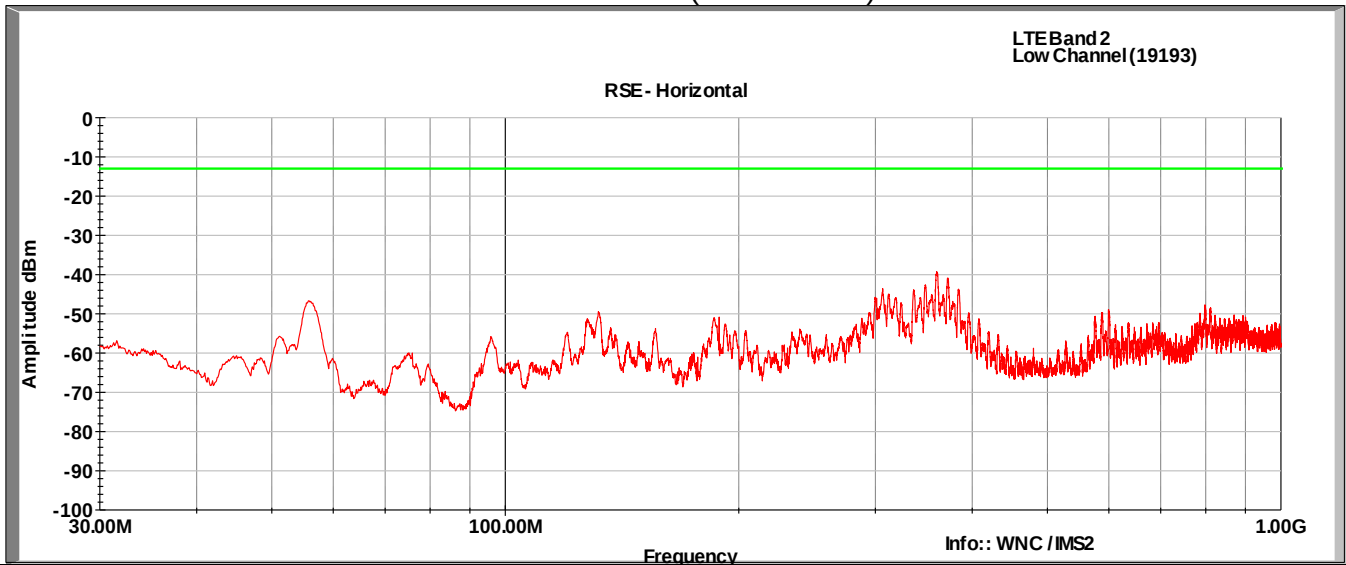


LTE Band 2, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

High Channel (19193)  
Vertical Data (30-1000MHz)



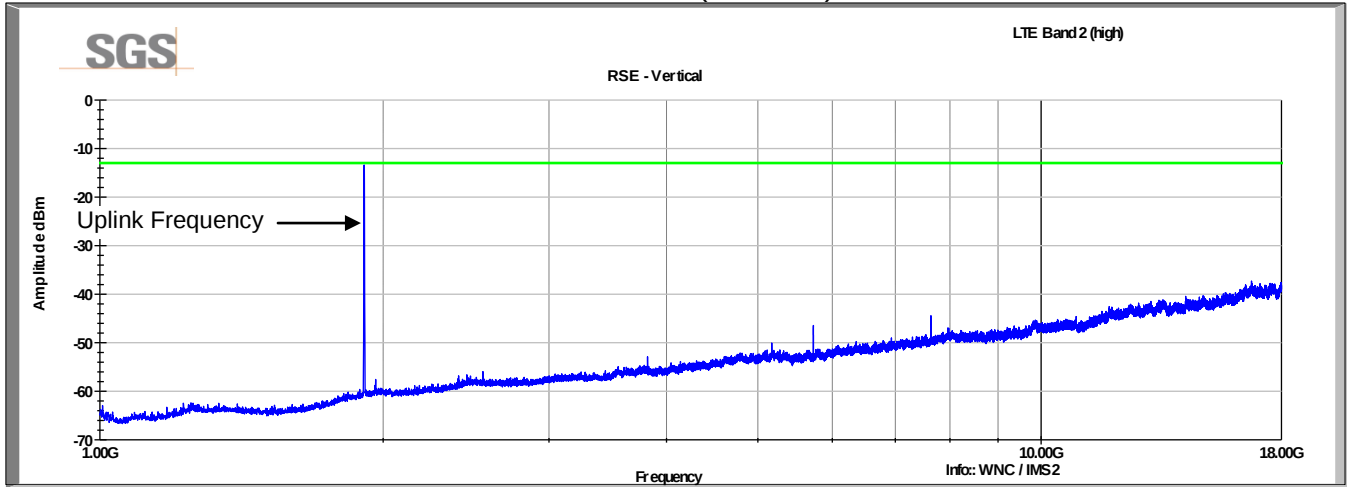
Horizontal Data (30-1000MHz)



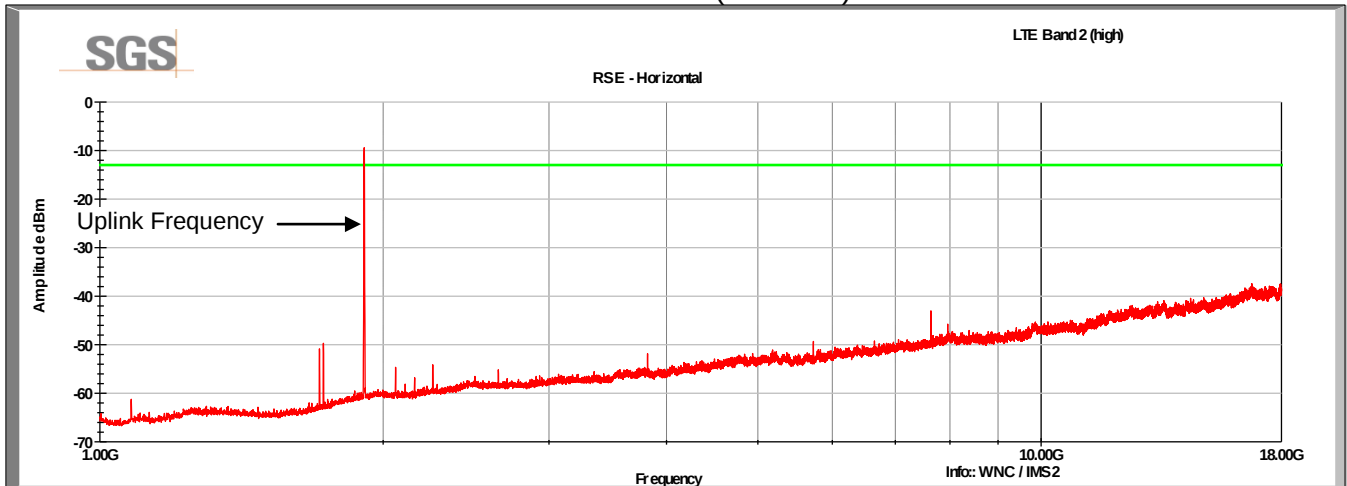
LTE Band 2, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

High Channel (19193)

Vertical Data (1-18GHz)



Horizontal Data (1-18GHz)

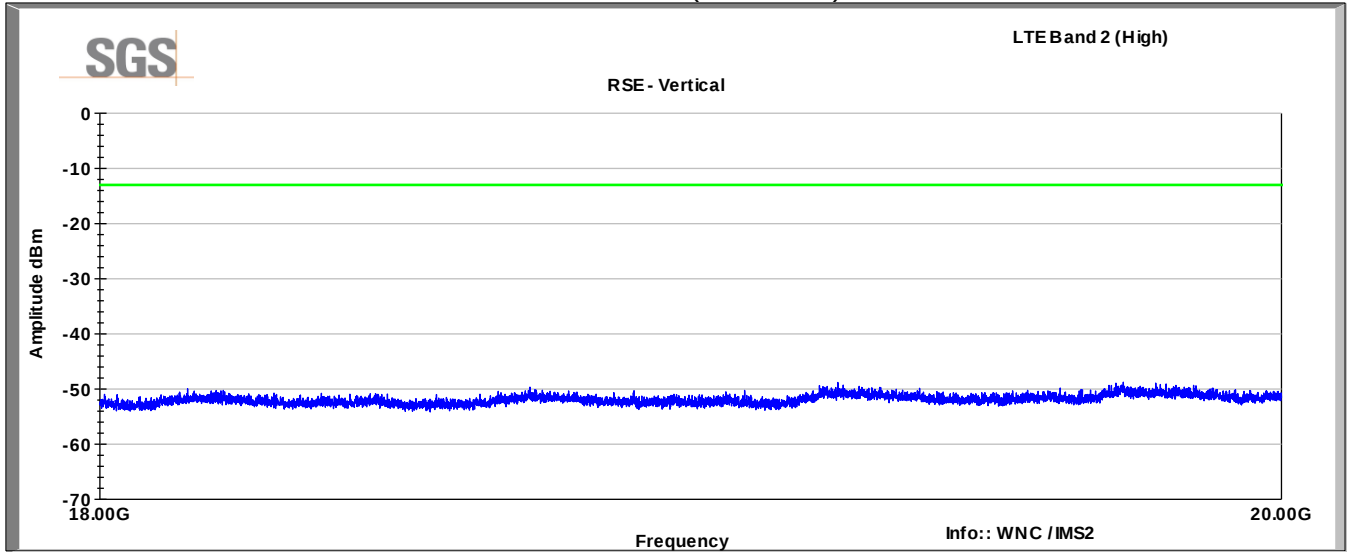


LTE Band 2, QPSK modulation, 1.4MHz

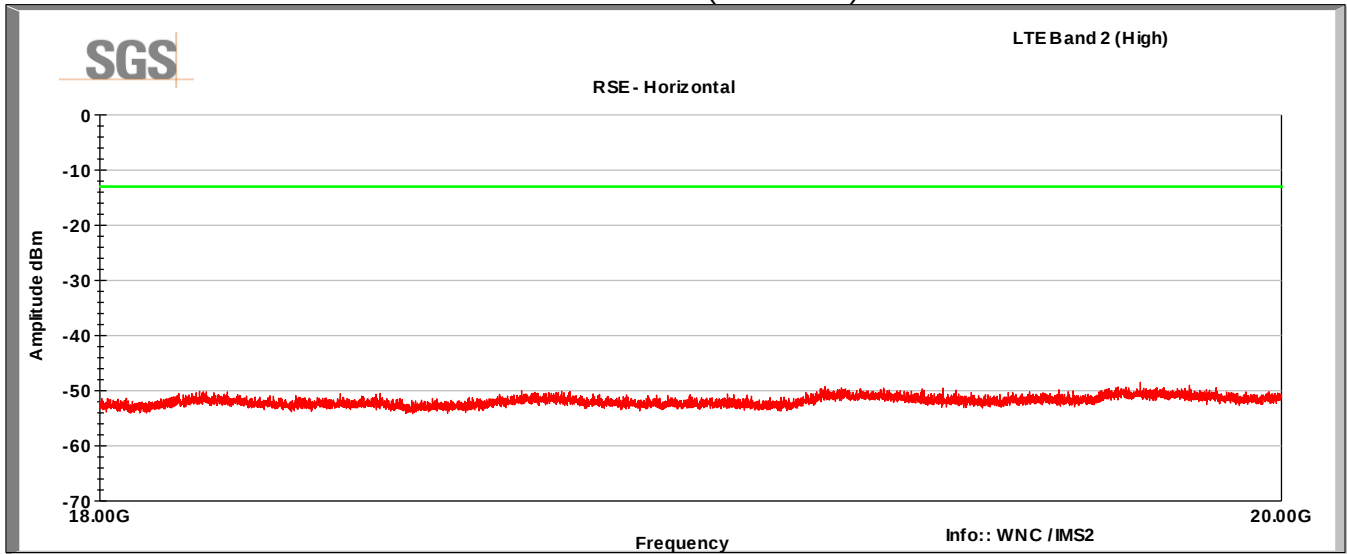
High Channel (19193)

ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

Vertical Data (18-20GHz)

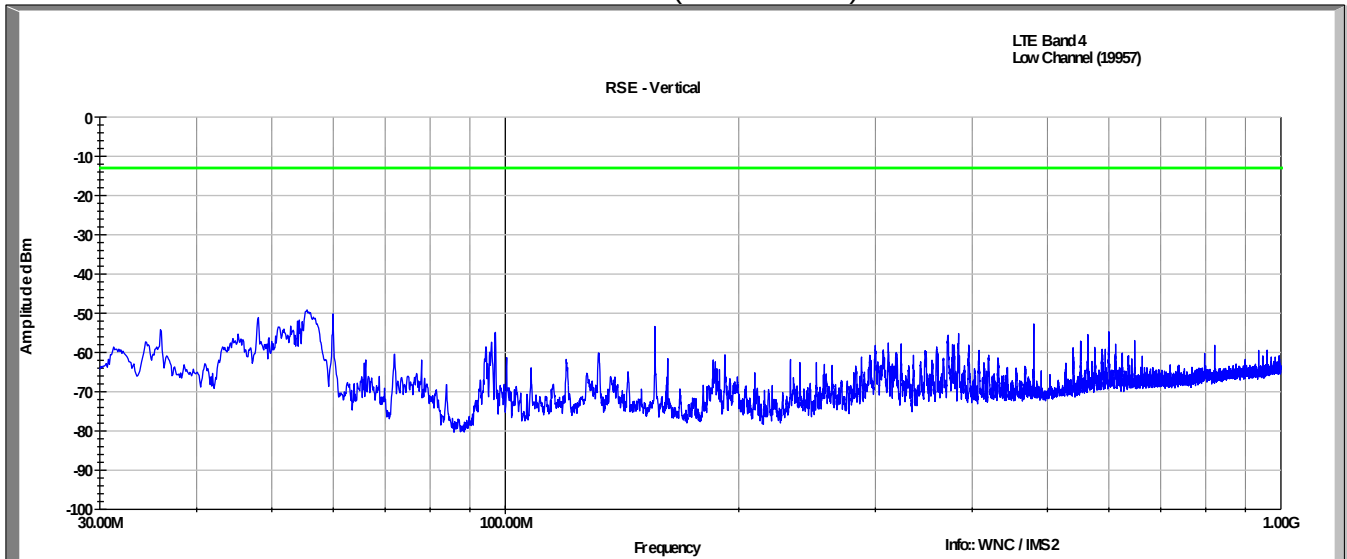


Horizontal Data (18-20GHz)

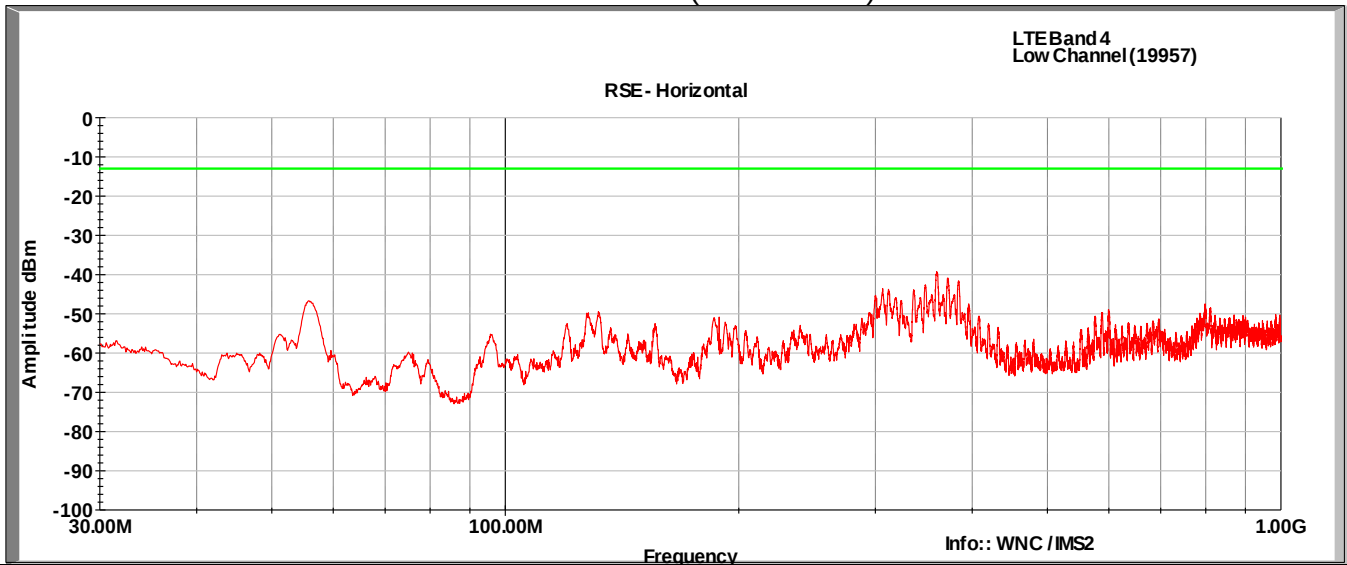


LTE Band 4, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

Low Channel (19957)  
Vertical Data (30-1000MHz)



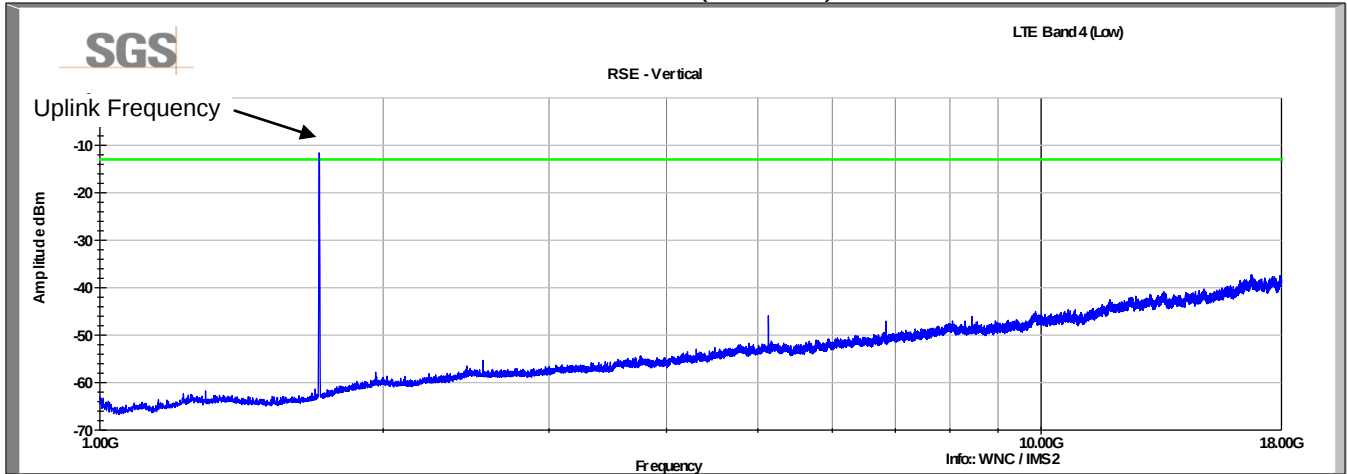
Horizontal Data (30-1000MHz)



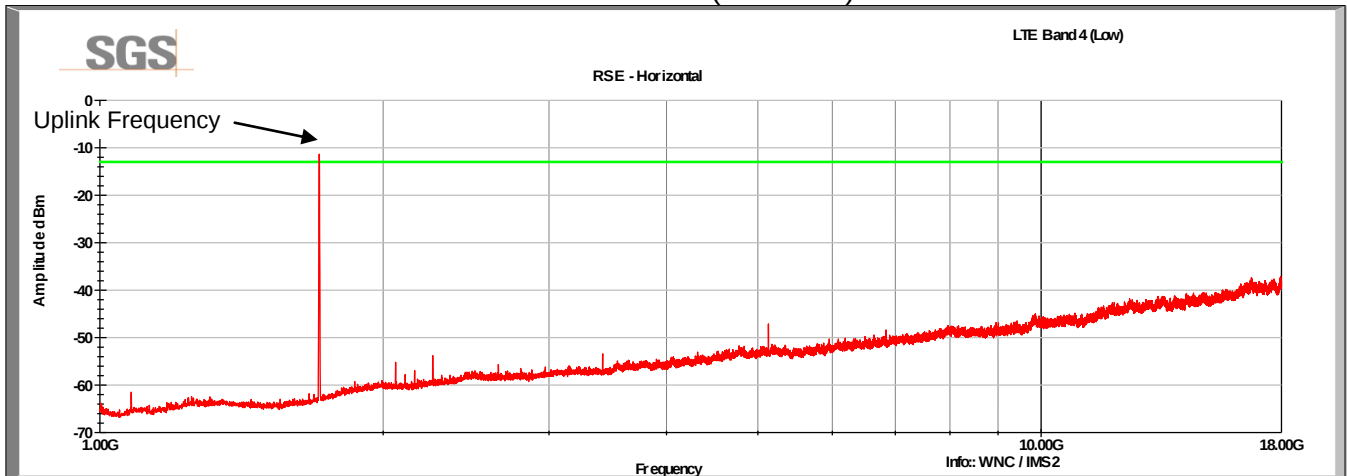
LTE Band 4, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

Low Channel (19957)

Vertical Data (1-18GHz)

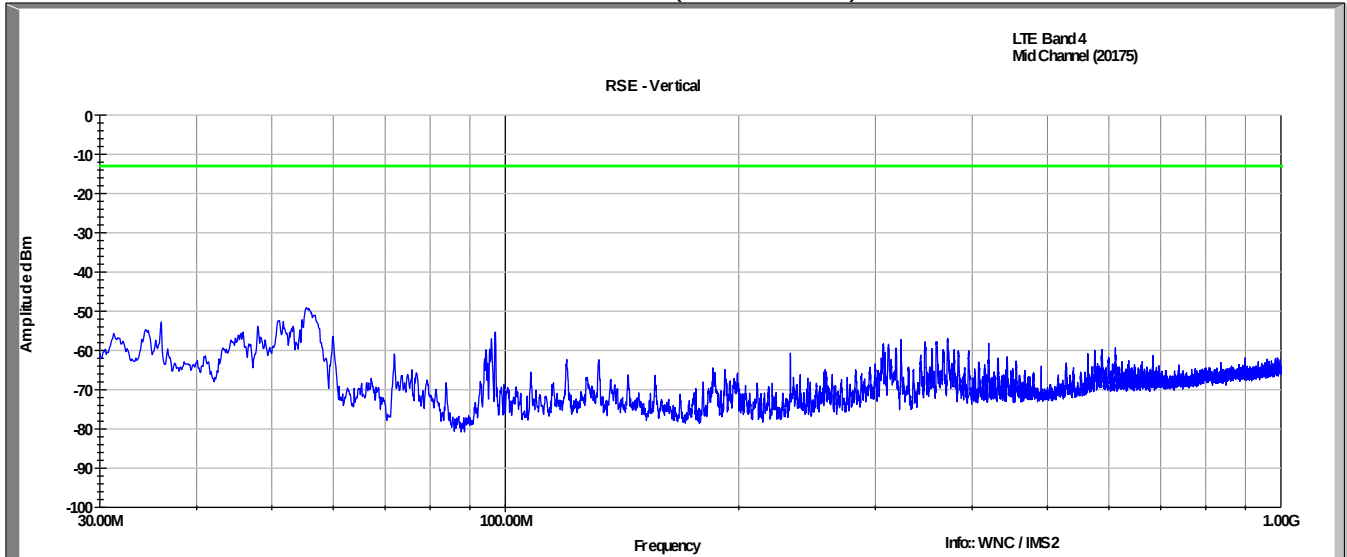


Horizontal Data (1-18G Hz)

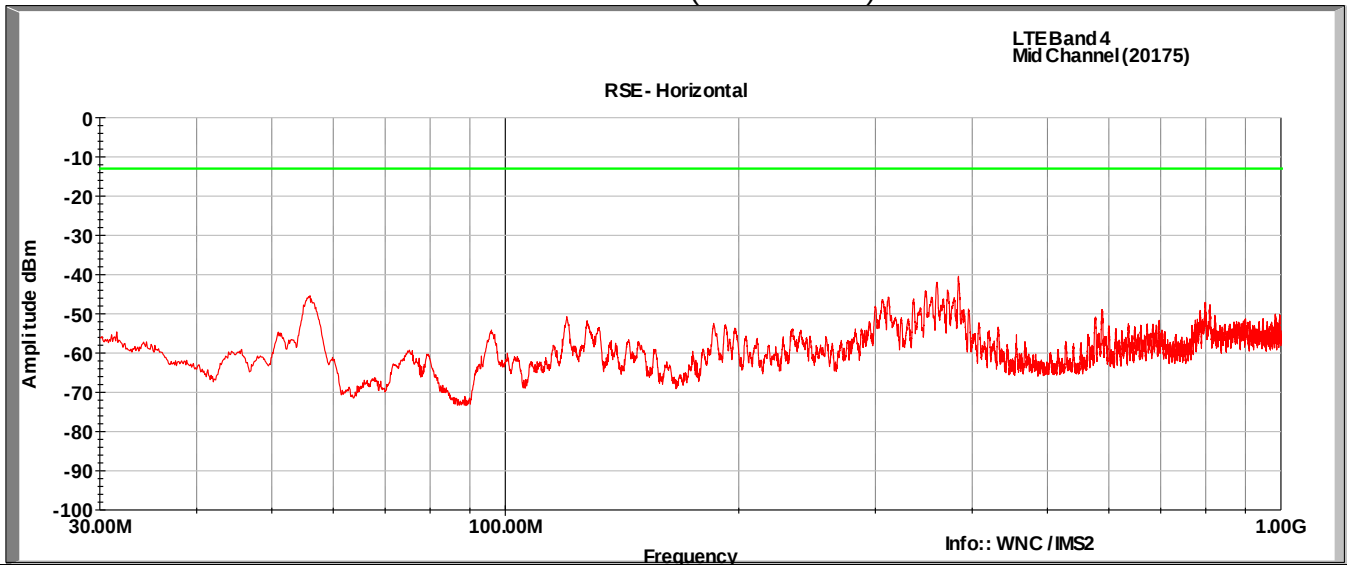


LTE Band 4, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

Mid Channel (20175)  
Vertical Data (30-1000MHz)

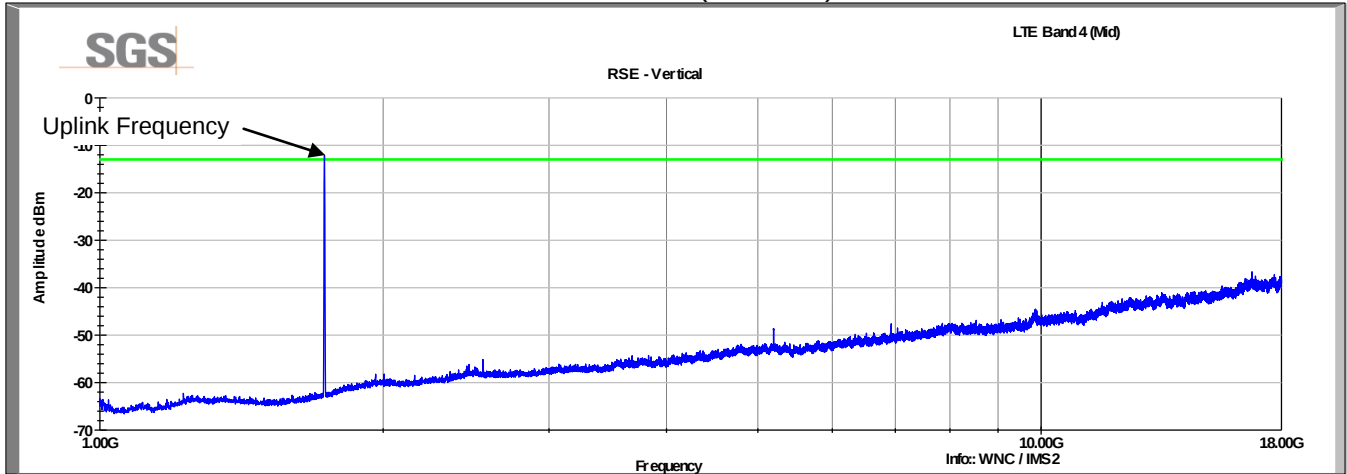


Horizontal Data (30-1000MHz)

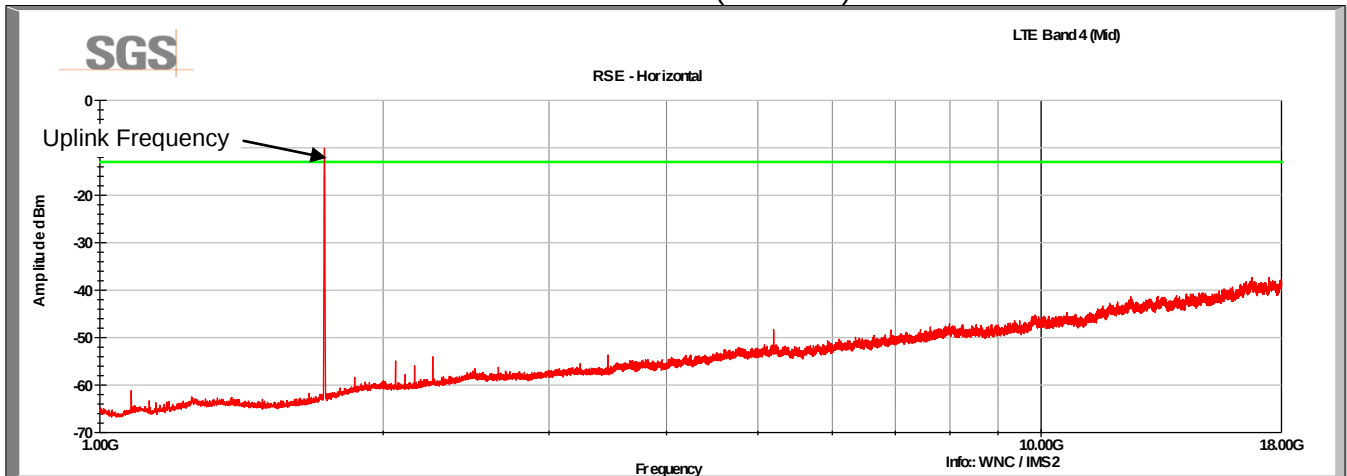


LTE Band 4, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

Mid Channel (20175)  
Vertical Data (1-18GHz)

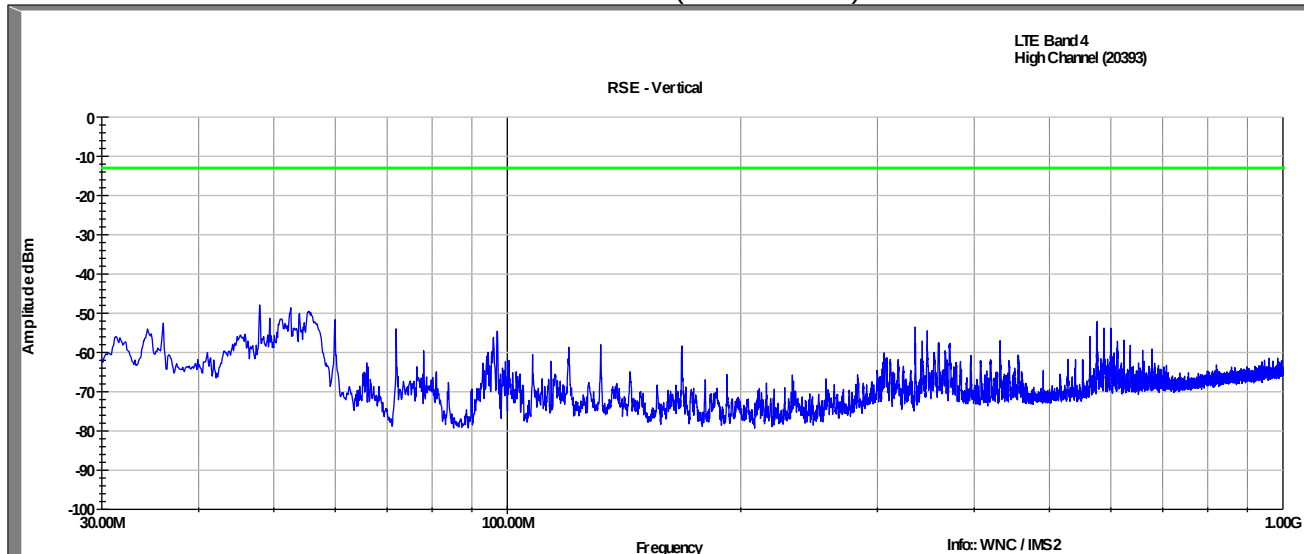


Horizontal Data (1-18GHz)

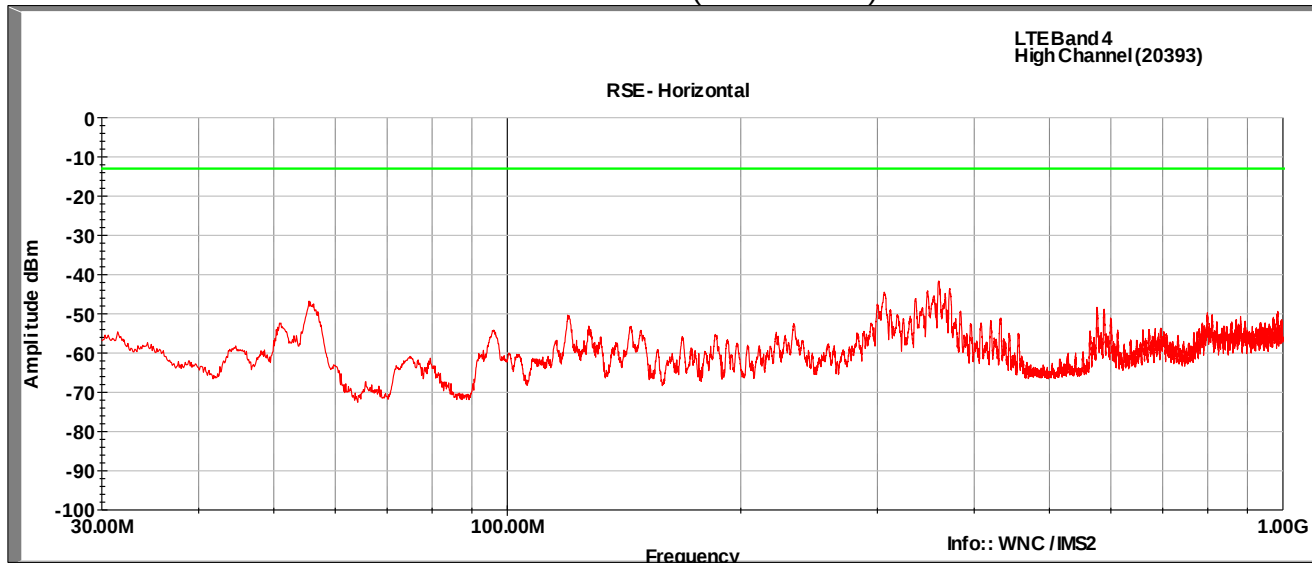


LTE Band 4, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

High Channel (20393)  
Vertical Data (30-1000MHz)



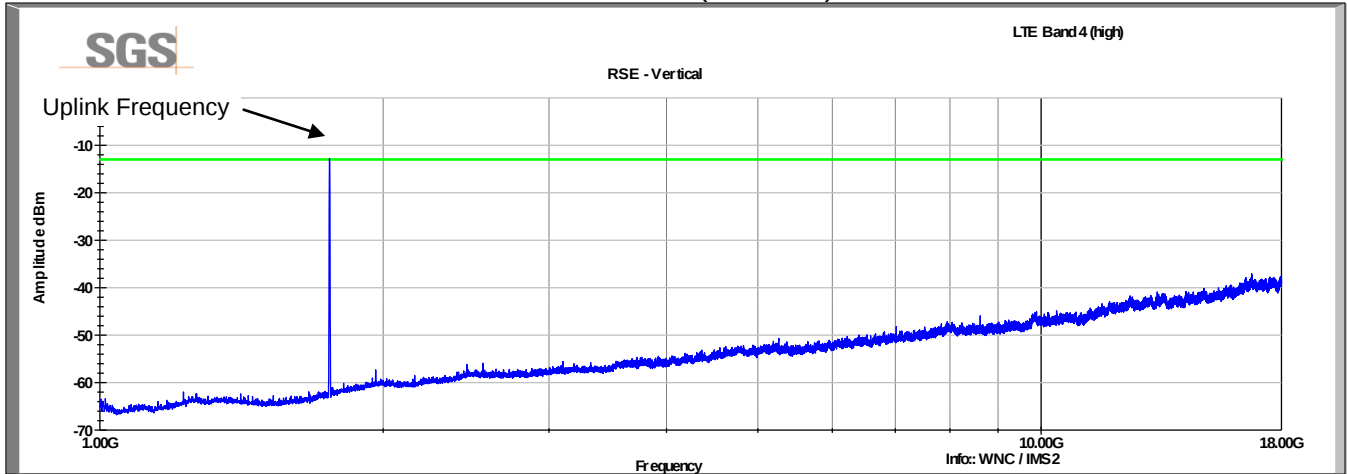
Horizontal Data (30-1000MHz)



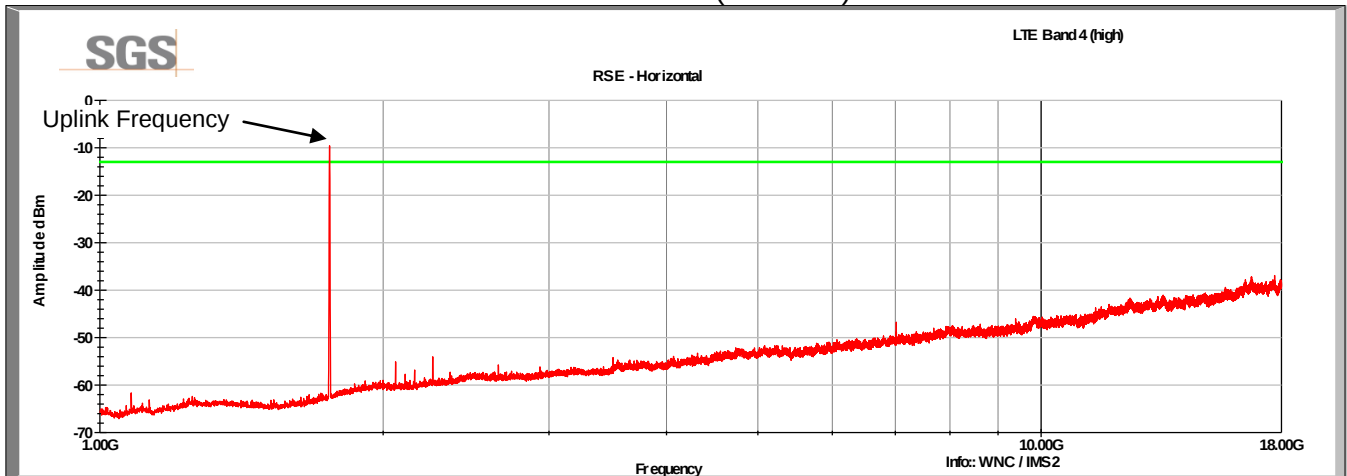
LTE Band 4, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

High Channel (20393)

Vertical Data (1-18GHz)

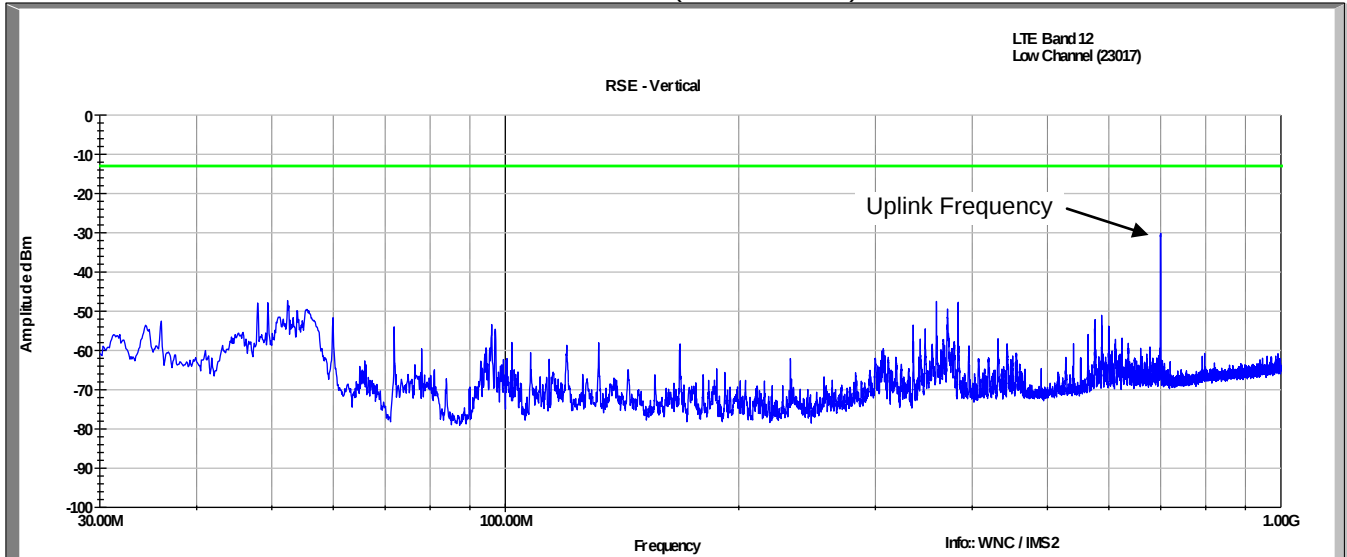


Horizontal Data (1-18GHz)

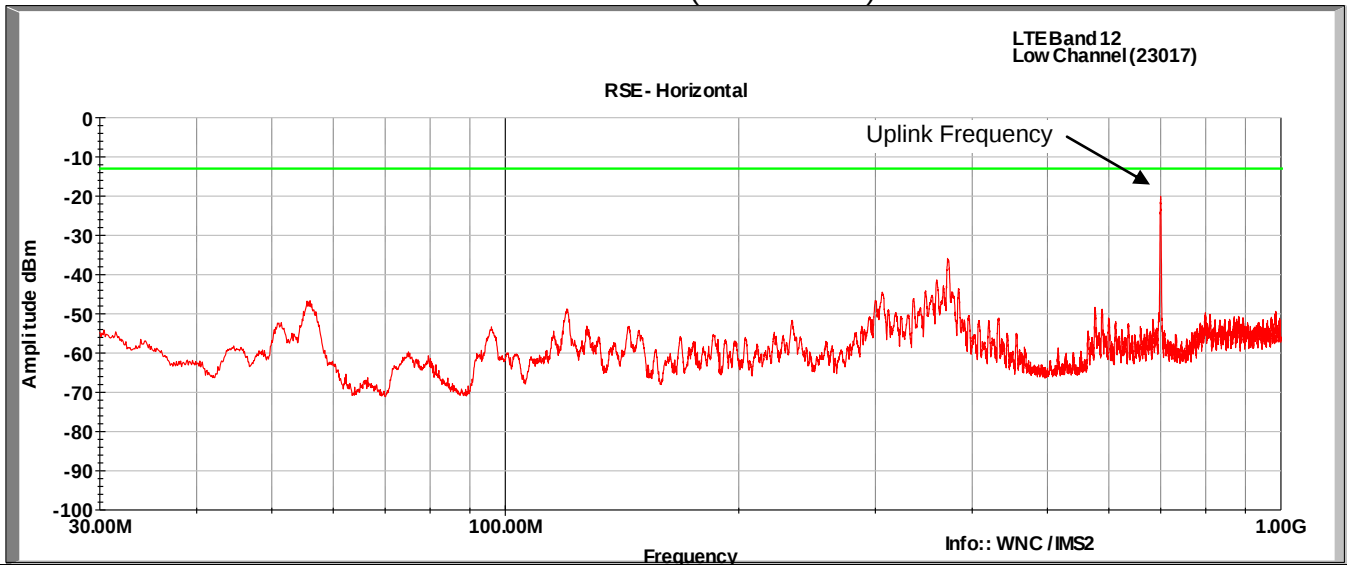


LTE Band 12, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

Low Channel (23017)  
Vertical Data (30-1000MHz)

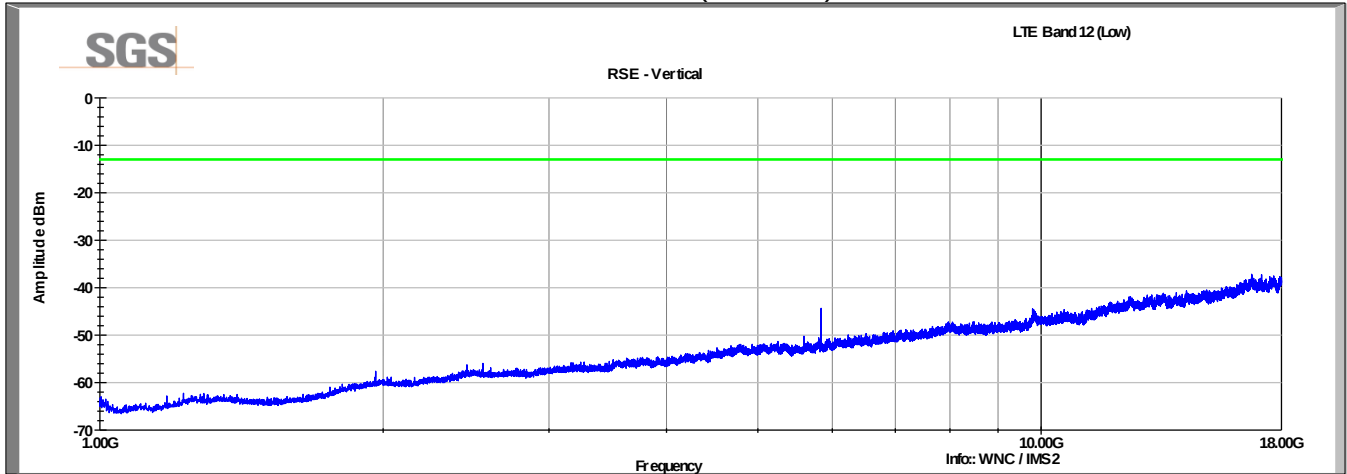


Horizontal Data (30-1000MHz)

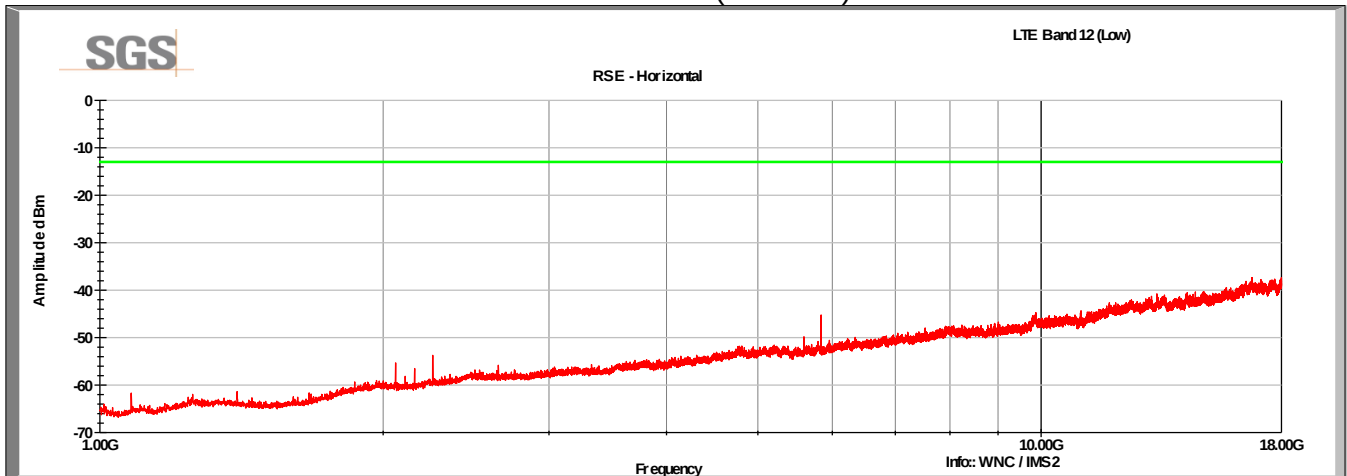


LTE Band 12, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

Low Channel (23017)  
Vertical Data (1-18GHz)

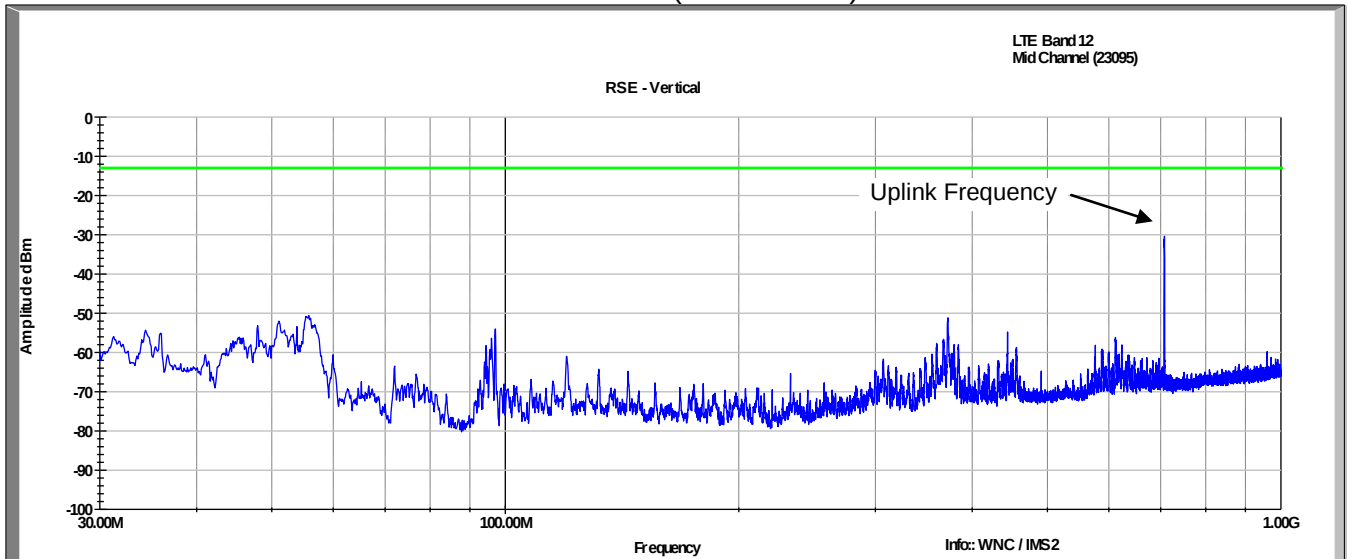


Horizontal Data (1-18GHz)

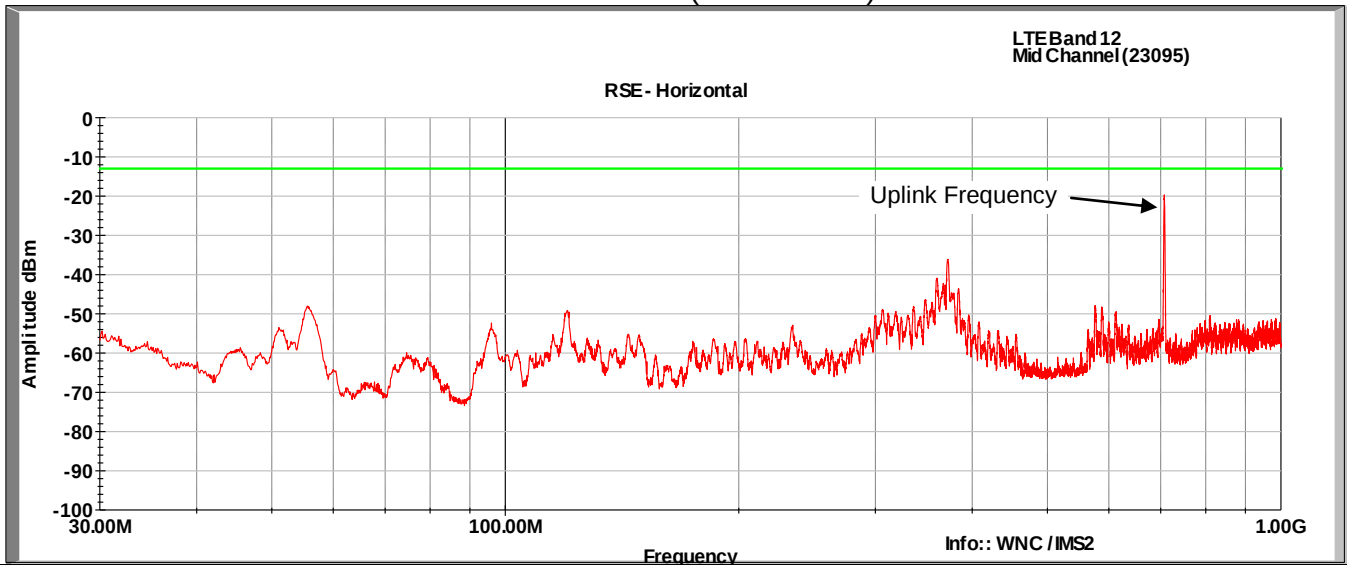


LTE Band 12, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

Mid Channel (23095)  
Vertical Data (30-1000MHz)

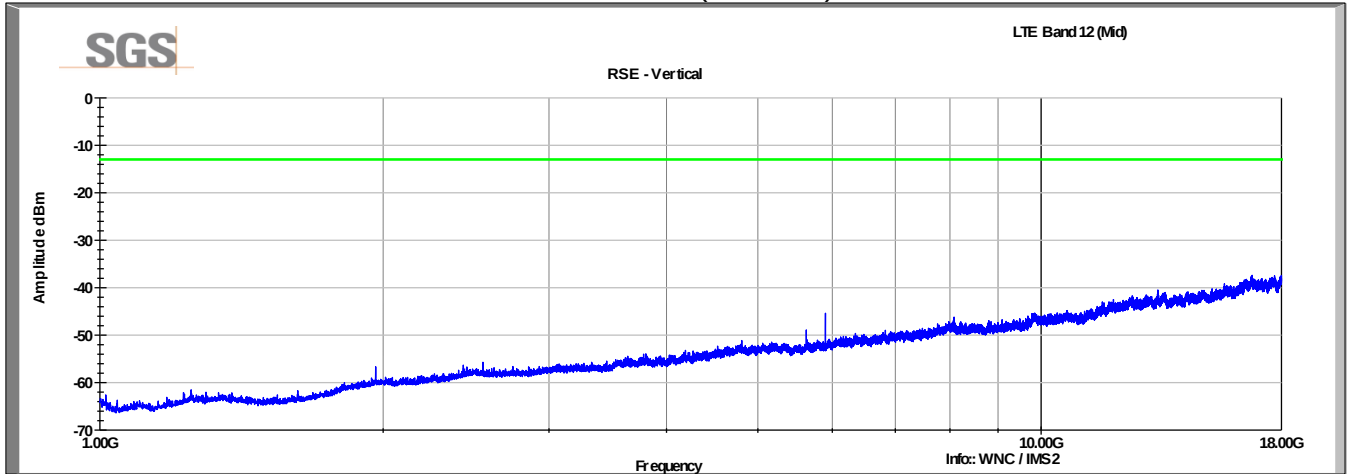


Horizontal Data (30-1000MHz)

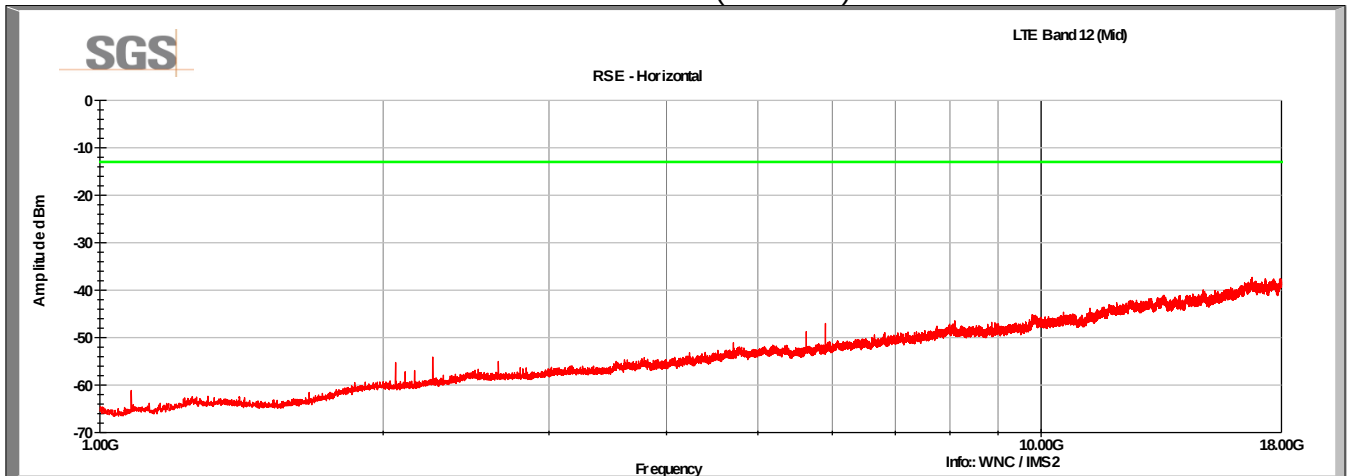


LTE Band 12, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

Mid Channel (23095)  
Vertical Data (1-18GHz)

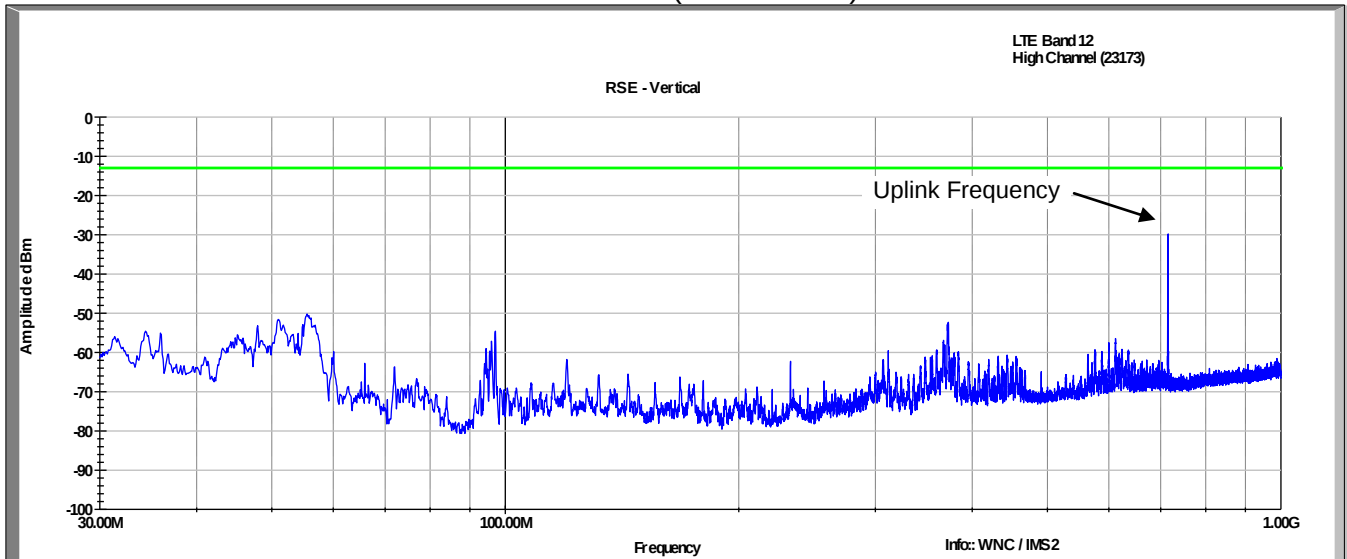


Horizontal Data (1-18GHz)

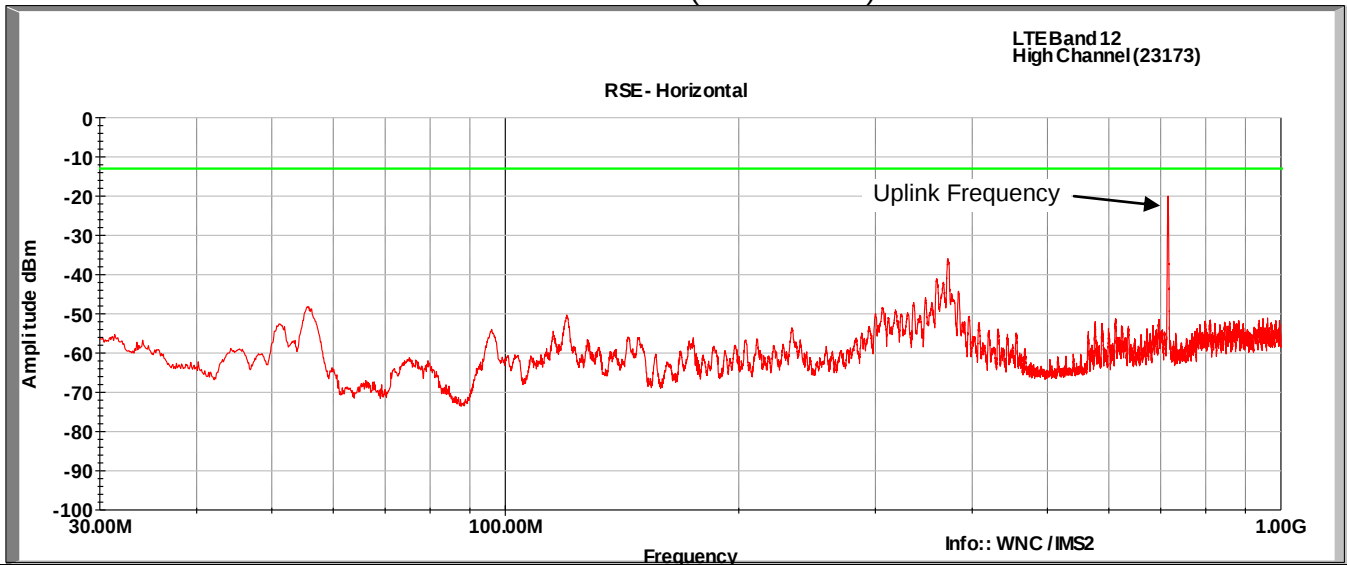


LTE Band 12, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

High Channel (23173)  
Vertical Data (30-1000MHz)



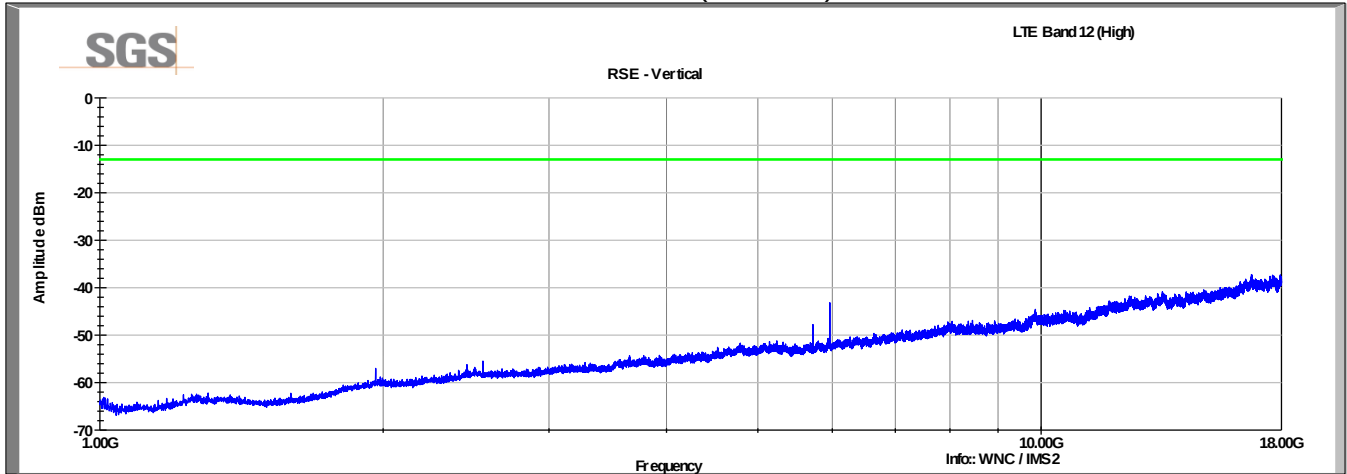
Horizontal Data (30-1000MHz)



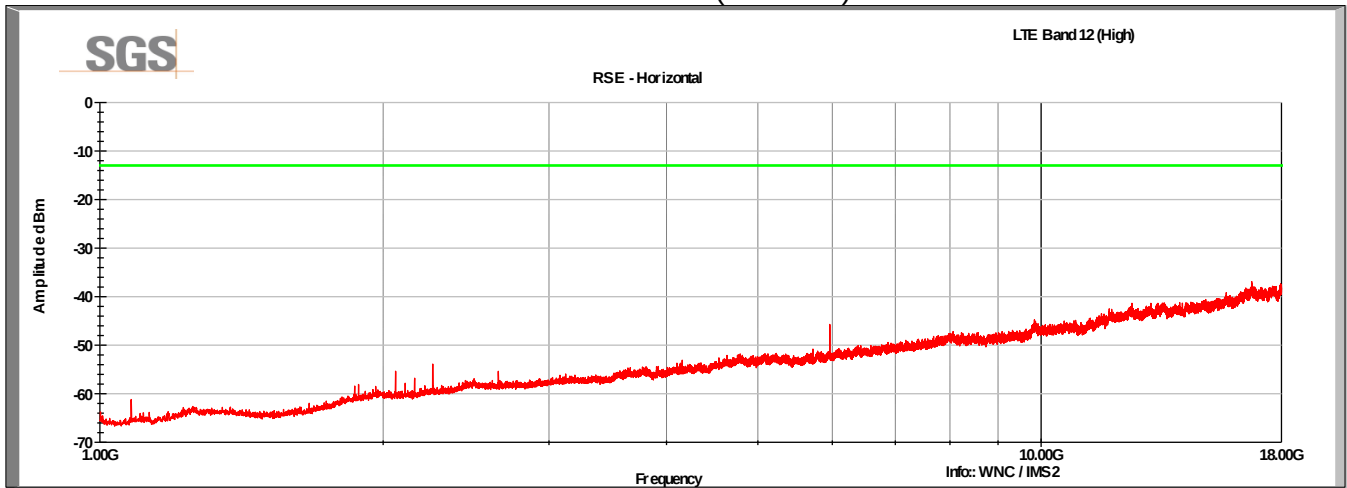
LTE Band 12, QPSK modulation, 1.4MHz  
ULPower: 23dBm; UL\_MOD\_RB: QPSK, 6 (RB\_Pos:0)

High Channel (23173)

Vertical Data (1-18GHz)



Horizontal Data (1-18GHz)



## 9 Frequency Stability

### 9.1 Test Result

| Test Description    | Basic Standards                                    | Test Result |
|---------------------|----------------------------------------------------|-------------|
| Frequency Stability | 2.1055<br>24.238(a)<br>27.5(c)<br>27.5(h)<br>27.54 | Compliant   |

### 9.2 Test Method

The EUT was placed inside the Environmental Chamber and was left inside chamber to stabilize to set temperature for minimum of thirty minutes before any measurements were made. The EUT was tested at the middle channel of Bands 2, 4, and 12.

### 9.3 Test Site

SGS EMC Laboratory, Suwanee, GA

### 9.4 Test Equipment

Test End Date: 24-Jul-2017

Tester: JOP

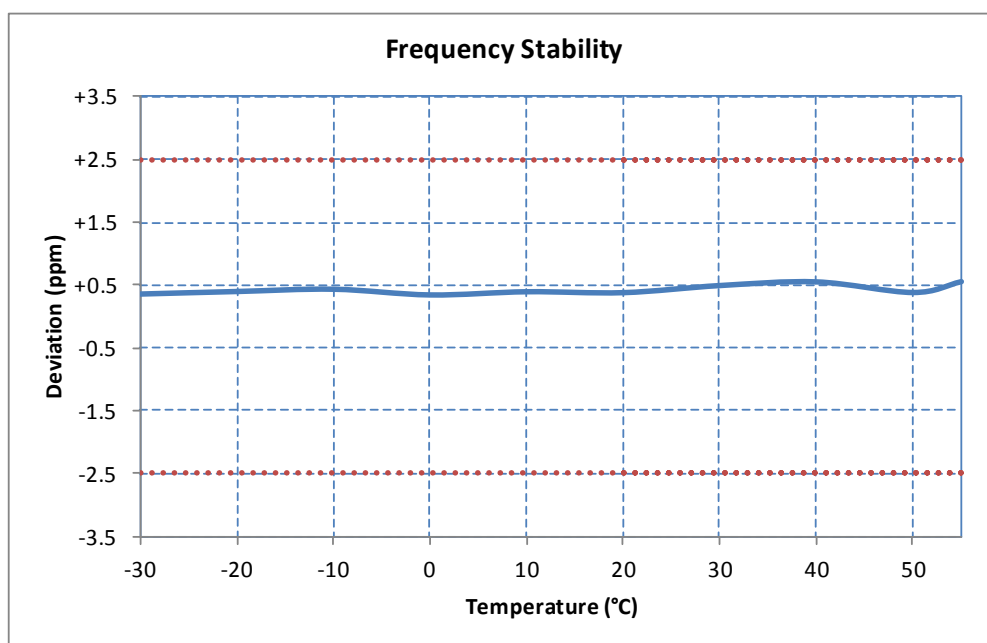
| Equipment                  | Model | Manufacturer         | Asset Number | Cal Due Date |
|----------------------------|-------|----------------------|--------------|--------------|
| SIGNAL ANALYZER            | FSV30 | ROHDE & SCHWARZ      | B085749      | 8-Oct-2017   |
| ATTENUATOR, 10DB           | 10DB  | ROHDE & SCHWARZ      | B095591      | 27-Jul-2017  |
| RF CABLE                   | SF102 | HUBER & SUHNER       | B079822      | 27-Jul-2017  |
| MULTIMETER                 | 87V   | FLUKE                | B079675      | 29-Jul-2017  |
| ENVIRONMENTAL TEST CHAMBER | T2RC  | TENNEY ENVIRONMENTAL | B094877      | CNR          |

- Unless otherwise noted, equipment is on a 1 year calibration cycle.
- Based on manufacturer's specifications, the FSV is on a 2 year calibration cycle.

## 9.5 Test Data

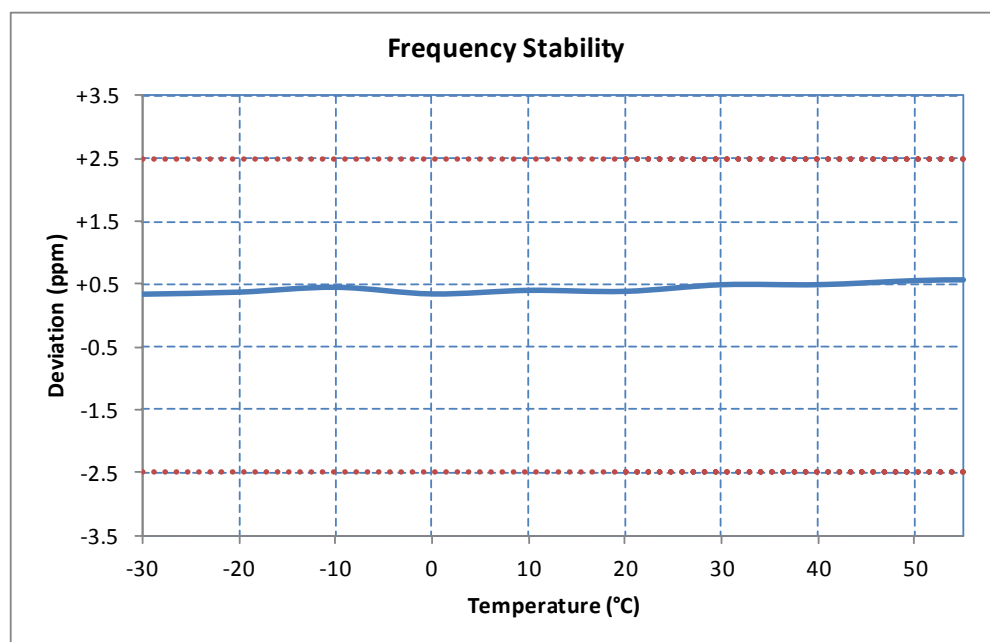
Band 2, Channel 18900

| Voltage % | Power V <sub>DC</sub> | Temp °C   | Frequency Hz  | Freq Dev | Freq Dev ppm | Deviation % |
|-----------|-----------------------|-----------|---------------|----------|--------------|-------------|
| 100%      | 3.80                  | +20 (Ref) | 1,880,000,702 | +702     | +0.37        | +0.000037   |
| 100%      | 3.80                  | -30       | 1,880,000,659 | +659     | +0.35        | +0.000035   |
| 100%      | 3.80                  | -20       | 1,880,000,738 | +738     | +0.39        | +0.000039   |
| 100%      | 3.80                  | -10       | 1,880,000,810 | +810     | +0.43        | +0.000043   |
| 100%      | 3.80                  | 0         | 1,880,000,630 | +630     | +0.33        | +0.000033   |
| 100%      | 3.80                  | +10       | 1,880,000,731 | +731     | +0.39        | +0.000039   |
| 100%      | 3.80                  | +20       | 1,880,000,702 | +702     | +0.37        | +0.000037   |
| 100%      | 3.80                  | +30       | 1,880,000,926 | +926     | +0.49        | +0.000049   |
| 100%      | 3.80                  | +40       | 1,880,001,042 | +1042    | +0.55        | +0.000055   |
| 100%      | 3.80                  | +50       | 1,880,000,707 | +707     | +0.38        | +0.000038   |
| 100%      | 3.80                  | +55       | 1,880,001,049 | +1049    | +0.56        | +0.000056   |
| 115%      | 4.37                  | +20       | 1,880,000,709 | +709     | +0.38        | +0.000038   |
| 85%       | 3.23                  | +20       | 1,880,000,702 | +702     | +0.37        | +0.000037   |



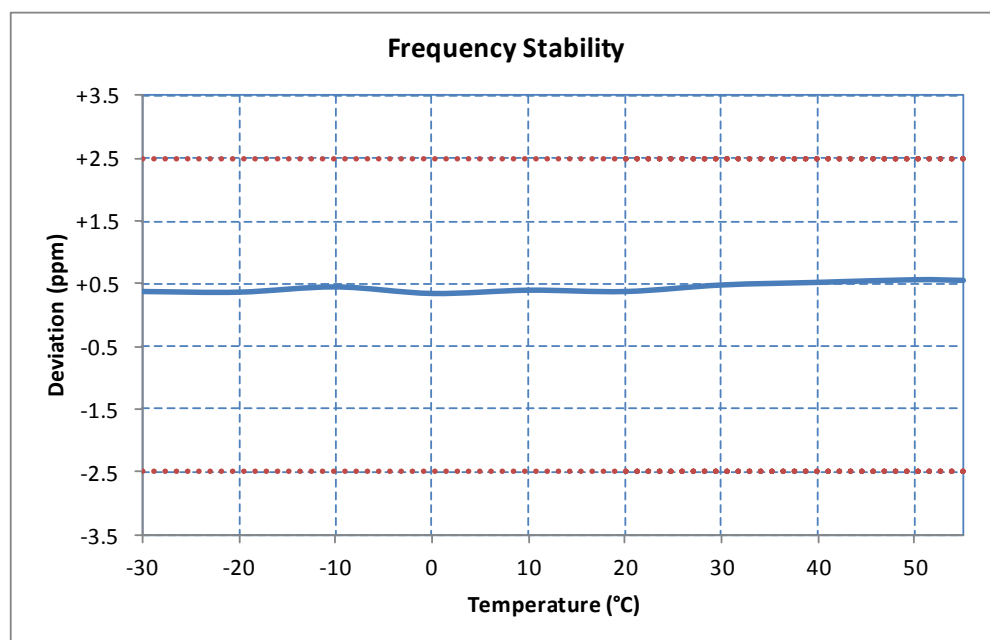
### Band 4, Channel 20175

| Voltage % | Power V <sub>DC</sub> | Temp °C   | Frequency Hz  | Freq Dev | Freq Dev ppm | Deviation % |
|-----------|-----------------------|-----------|---------------|----------|--------------|-------------|
| 100%      | 3.80                  | +20 (Ref) | 1,732,500,659 | +659     | +0.38        | +0.000038   |
| 100%      | 3.80                  | -30       | 1,732,500,579 | +579     | +0.33        | +0.000033   |
| 100%      | 3.80                  | -20       | 1,732,500,637 | +637     | +0.37        | +0.000037   |
| 100%      | 3.80                  | -10       | 1,732,500,774 | +774     | +0.45        | +0.000045   |
| 100%      | 3.80                  | 0         | 1,732,500,586 | +586     | +0.34        | +0.000034   |
| 100%      | 3.80                  | +10       | 1,732,500,687 | +687     | +0.40        | +0.000040   |
| 100%      | 3.80                  | +20       | 1,732,500,659 | +659     | +0.38        | +0.000038   |
| 100%      | 3.80                  | +30       | 1,732,500,847 | +847     | +0.49        | +0.000049   |
| 100%      | 3.80                  | +40       | 1,732,500,848 | +848     | +0.49        | +0.000049   |
| 100%      | 3.80                  | +50       | 1,732,500,962 | +962     | +0.56        | +0.000056   |
| 100%      | 3.80                  | +55       | 1,732,500,984 | +984     | +0.57        | +0.000057   |
| 115%      | 4.37                  | +20       | 1,732,500,651 | +651     | +0.38        | +0.000038   |
| 85%       | 3.23                  | +20       | 1,732,500,659 | +659     | +0.38        | +0.000038   |



### Band 12, Channel 23095

| Voltage % | Power $V_{DC}$ | Temp °C   | Frequency Hz | Freq Dev | Freq Dev ppm | Deviation % |
|-----------|----------------|-----------|--------------|----------|--------------|-------------|
| 100%      | 3.80           | +20 (Ref) | 707,500,268  | +268     | +0.38        | +0.000038   |
| 100%      | 3.80           | -30       | 707,500,268  | +268     | +0.38        | +0.000038   |
| 100%      | 3.80           | -20       | 707,500,261  | +261     | +0.37        | +0.000037   |
| 100%      | 3.80           | -10       | 707,500,318  | +318     | +0.45        | +0.000045   |
| 100%      | 3.80           | 0         | 707,500,246  | +246     | +0.35        | +0.000035   |
| 100%      | 3.80           | +10       | 707,500,282  | +282     | +0.40        | +0.000040   |
| 100%      | 3.80           | +20       | 707,500,268  | +268     | +0.38        | +0.000038   |
| 100%      | 3.80           | +30       | 707,500,340  | +340     | +0.48        | +0.000048   |
| 100%      | 3.80           | +40       | 707,500,369  | +369     | +0.52        | +0.000052   |
| 100%      | 3.80           | +50       | 707,500,398  | +398     | +0.56        | +0.000056   |
| 100%      | 3.80           | +55       | 707,500,391  | +391     | +0.55        | +0.000055   |
| 115%      | 4.37           | +20       | 707,500,268  | +268     | +0.38        | +0.000038   |
| 85%       | 3.23           | +20       | 707,500,268  | +268     | +0.38        | +0.000038   |



## 10 Revision History

| Revision Level | Description of changes                                                                     | Revision Date     |
|----------------|--------------------------------------------------------------------------------------------|-------------------|
| 0              | Initial release                                                                            | 24 August 2017    |
| 1              | - Updated ERP/EIRP table using maximum tune-up limits in lieu of measured conducted power. | 05 September 2017 |
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