



---

**Choose certainty.  
Add value.**

# Report On

Application for Grant of Equipment Authorization of the  
Inseego Corp.

M1000 Wireless Hotspot Modem

FCC CFR 47 Part 2, 90 and 96

RSS-192 Issue 3 January 2008

RSS-197 Issue 1 February 2010

**Report No. 72146272F**

**May 2019**



|                           |                                                                                                                                                                                                           |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>REPORT ON</b>          | Radio Testing of the<br>Inseego Corp.<br>M1000 Wireless Hotspot Modem                                                                                                                                     |
| <b>TEST REPORT NUMBER</b> | 72146272F                                                                                                                                                                                                 |
| <b>PREPARED FOR</b>       | Inseego Corp.<br>9605 Scranton Road, Suite 300<br>San Diego, CA 92121<br>USA                                                                                                                              |
| <b>CONTACT PERSON</b>     | Roman Olmos<br>Senior Regulatory Engineer<br>(858) 812-0606<br>roman.olmos@inseego.com                                                                                                                    |
| <b>PREPARED BY</b>        | <br>Xiaoying Zhang<br><b>Name</b><br>Authorized Signatory<br>Title: EMC/Wireless Test Engineer                           |
| <b>APPROVED BY</b>        | <br>Ferdinand S. Custodio<br><b>Name</b><br>Authorized Signatory<br>Title: Senior EMC Test Engineer/Wireless Team Lead |
| <b>DATED</b>              | May 30, 2019                                                                                                                                                                                              |



## Revision History

| 72146272F<br>Inseego Corp.<br>M1000 Wireless Hotspot Modem |              |                 |        |                   |                       |
|------------------------------------------------------------|--------------|-----------------|--------|-------------------|-----------------------|
| DATE                                                       | OLD REVISION | NEW REVISION    | REASON | PAGES<br>AFFECTED | APPROVED BY           |
| 05/30/2019                                                 | -            | Initial Release |        |                   | Ferdinand S. Custodio |
|                                                            |              |                 |        |                   |                       |
|                                                            |              |                 |        |                   |                       |
|                                                            |              |                 |        |                   |                       |
|                                                            |              |                 |        |                   |                       |

## CONTENTS

| Section  | Page No                                                               |
|----------|-----------------------------------------------------------------------|
| <b>1</b> | <b>REPORT SUMMARY..... 5</b>                                          |
| 1.1      | Introduction..... 6                                                   |
| 1.2      | Brief Summary of Results..... 7                                       |
| 1.3      | Product Information ..... 8                                           |
| 1.4      | EUT Test Configuration ..... 10                                       |
| 1.5      | Deviations from the Standard..... 12                                  |
| 1.6      | Modification Record ..... 12                                          |
| 1.7      | Test Methodology..... 12                                              |
| 1.8      | Test Facility Location..... 12                                        |
| 1.9      | Test Facility Registration ..... 12                                   |
| 1.10     | Sample Calculations ..... 14                                          |
| <b>2</b> | <b>TEST DETAILS ..... 15</b>                                          |
| 2.1      | Transmitter Conducted Power Measurements ..... 16                     |
| 2.2      | Effective Isotropic Radiated Power and Power Spectral Density..... 20 |
| 2.3      | Occupied Bandwidth..... 27                                            |
| 2.4      | Spurious Emission at Band Edge ..... 31                               |
| 2.5      | Conducted Spurious Emissions ..... 50                                 |
| 2.6      | Field Strength of Spurious Radiation ..... 77                         |
| 2.7      | Frequency Stability ..... 90                                          |
| 2.8      | Conducted Emissions..... 95                                           |
| <b>3</b> | <b>TEST EQUIPMENT USED ..... 99</b>                                   |
| 3.1      | Test Equipment Used..... 100                                          |
| 3.2      | Measurement Uncertainty ..... 102                                     |
| <b>4</b> | <b>DIAGRAM OF TEST SETUP ..... 104</b>                                |
| 4.1      | Test Setup Diagram..... 105                                           |
| <b>5</b> | <b>ACCREDITATION, DISCLAIMERS AND COPYRIGHT ..... 109</b>             |
| 5.1      | Accreditation, Disclaimers and Copyright..... 110                     |



## **SECTION 1**

### **REPORT SUMMARY**

Radio Testing of the  
Inseego Corp.  
M1000 Wireless Hotspot Modem



## 1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Inseego Corp. M1000 Wireless Hotspot Modem to the requirements of the following:

- FCC CFR 47 Part 2, 90 and 96
- RSS-192 Issue 3 January 2008
- RSS-197 Issue 1 February 2010

|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Objective                     | To perform Radio Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Manufacturer                  | Inseego Corp.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Product Marketing Name        | 5G MiFi 1000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Model Number(s)               | M1000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| FCC ID Number                 | PKRISGM1000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| IC Number                     | 3229A-M1000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Serial Number(s)              | 990013090027496, 990013090023966 (IMEI)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Number of Samples Tested      | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Test Specification/Issue/Date | <ul style="list-style-type: none"><li>• FCC CFR 47 Part 2, 90 and 96 (October 1, 2018)</li><li>• KDB412172 D01 Determining ERP and EIRP v01r01 August 07, 2015: Guidelines for determining the Effective Radiated Power (ERP) and Equivalent Isotropically Radiated Power (EIRP) of an RF transmitting system</li><li>• KDB971168 D01 Power Meas License Digital Systems v03r01: April 9 2018: Measurement guidance for certification of licensed digital transmitters</li><li>• RSS-192 Issue 3 January 2008 - Fixed Wireless Access Equipment Operating in the Band 3450-3650 MHz</li><li>• RSS-197 Issue 1 February 2010 – Wireless Broadband Access Equipment Operating in the Band 3650-3700 MHz</li><li>• RSS-Gen Issue 5 Amendment 1: March 2019 - General Requirements for Compliance of Radio Apparatus</li><li>• ANSI C63.26-2015: American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services</li></ul> |
| Start of Test                 | April 26, 2019                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Finish of Test                | May 24, 2019                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Name of Engineer(s)           | Xiaoying Zhang                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Related Document(s)           | Supporting documents for EUT certification are separate exhibits.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## 1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC CFR 47 Part 2, 90 and 96 with cross-reference to the corresponding ISSED RSS standard is shown below.

| Section | FCC Part Sections(s)                      | RSS Section(s)                                | Test Description                                              | Result    |
|---------|-------------------------------------------|-----------------------------------------------|---------------------------------------------------------------|-----------|
| 2.1     | 2.1046                                    | RSS-192: 5.4                                  | Transmitter Conducted Output Power                            | Compliant |
| 2.2     | 2.1046<br>96.41(b)<br>90.1321(c)          | RSS-192: 5.4<br>RSS-197: 5.6                  | Effective Isotropic Radiated Power and Power Spectral Density | Compliant |
| -       | 96.41(g)                                  | -                                             | Peak-Average Ratio                                            | N/A*      |
| 2.3     | 2.1049<br>96.41(e)(3)<br>90.1323(a)       | RSS-Gen: 6.7<br>RSS-192: 5.5<br>RSS-197: 5.7  | Occupied Bandwidth                                            | Compliant |
| 2.4     | 2.1051<br>96.41(e)(1)(3)<br>90.1323(a)    | RSS-192: 5.5<br>RSS-197: 5.7                  | Band Edge and Emission Mask                                   | Compliant |
| 2.5     | 2.1051<br>96.41(e)(1)(2)(3)<br>90.1323(a) | RSS-192: 5.5<br>RSS-197: 5.7                  | Conducted Spurious Emissions                                  | Compliant |
| 2.6     | 2.1053<br>96.41(e)<br>90.1323(a)          | RSS-192: 5.5<br>RSS-197: 5.7                  | Field Strength of Spurious Radiation                          | Compliant |
| 2.7     | 2.1055<br>90.213                          | RSS-192: 5.3<br>RSS-197: 5.3                  | Frequency Stability                                           | Compliant |
| -       | -                                         | RSS-192 (5.6)<br>RSS-197 (5.8)<br>RSS-Gen 7.4 | Receiver Spurious Emissions                                   | N/A**     |
| 2.8     | -                                         | RSS-GEN 8.8                                   | Power Line Conducted Emissions                                | Compliant |

N/A\* Not applicable. For CBSD only.

N/A\*\* Not applicable. No stand-alone receiver.



### 1.3 PRODUCT INFORMATION

#### 1.3.1 EUT General Description

The Equipment Under Test (EUT) was an Inseego Corp. M1000 Wireless Hotspot Modem. The EUT is a Wireless Hotspot Modem supporting 3G/4G/5G/WLAN Technologies. The EUT is also equipped with a USB Port and AC Wall Power Adaptor.

#### 1.3.2 Technical Description

|                                     |                                                                                                                                   |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| EUT Description                     | Wireless Hotspot Modem                                                                                                            |
| Product Marketing Name              | 5G MiFi 1000                                                                                                                      |
| Model Number(s)                     | M1000                                                                                                                             |
| Rated Voltage                       | 3.8V, 4400mAh (Rechargeable Li-Ion battery pack)<br>Input 100-240VAC, Output 5V (External AC-DC Power Adapter)                    |
| Mode Verified                       | LTE Band 48: 3550-3700 MHz                                                                                                        |
| Capability                          | WCDMA Band 2, 4, 5, LTE Band 2, 4, 5, 13, 66, 5G Band n261,<br>and 802.11 a/b/g/n/ac                                              |
| Primary Unit (EUT)                  | <input type="checkbox"/> Production<br><input checked="" type="checkbox"/> Pre-Production<br><input type="checkbox"/> Engineering |
| Manufacturer Declared Rated Power   | 22 dBm                                                                                                                            |
| Manufacturer Declared Voltage Range | 3.3 V – 4.2 VDC                                                                                                                   |

(Client declaration, max. antenna gain covered under this test report)

| LTE Bands | Frequency(ies) | Antenna Gains |
|-----------|----------------|---------------|
| Band 48   | 3550-3700 MHz  | 3.6 dBi       |

### 1.3.3 Transmit Frequency Table

| LTE Band 48 |                 |                    |                     |                 |                   |
|-------------|-----------------|--------------------|---------------------|-----------------|-------------------|
| Modulation  | Bandwidth (MHz) | Tx Frequency (MHz) | Emission Designator | EIRP / 10 MHz   |                   |
|             |                 |                    |                     | Max Power (dBm) | Max Power (Watts) |
| QPSK        | 5               | 3550 - 3650        | 4M47G7D             | 22.06           | 0.16              |
|             | 10              |                    | 8M94G7D             | 21.88           | 0.15              |
|             | 15              |                    | 13M4G7D             | 22.90           | 0.19              |
|             | 20              |                    | 17M9G7D             | 22.87           | 0.19              |
| 16QAM       | 5               |                    | 4M48W7D             | 21.33           | 0.14              |
|             | 10              |                    | 8M94W7D             | 20.92           | 0.12              |
|             | 15              |                    | 13M4W7D             | 22.04           | 0.16              |
|             | 20              |                    | 17M9W7D             | 22.18           | 0.17              |

| LTE Band 48 |                 |                    |                     |                 |                   |
|-------------|-----------------|--------------------|---------------------|-----------------|-------------------|
| Modulation  | Bandwidth (MHz) | Tx Frequency (MHz) | Emission Designator | EIRP / 25 MHz   |                   |
|             |                 |                    |                     | Max Power (dBm) | Max Power (Watts) |
| QPSK        | 5               | 3650 - 3700        | 4M47G7D             | 22.22           | 0.17              |
|             | 10              |                    | 8M95G7D             | 22.09           | 0.16              |
|             | 15              |                    | 13M4G7D             | 22.55           | 0.18              |
|             | 20              |                    | 17M9G7D             | 22.44           | 0.18              |
| 16QAM       | 5               |                    | 4M49W7D             | 21.48           | 0.14              |
|             | 10              |                    | 8M94W7D             | 21.21           | 0.13              |
|             | 15              |                    | 13M4W7D             | 21.58           | 0.14              |
|             | 20              |                    | 17M9W7D             | 21.63           | 0.15              |

## 1.4 EUT TEST CONFIGURATION

### 1.4.1 Test Configuration Description

| Test Configuration | Description                                                                                                                                                                  |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A                  | Conducted antenna port measurement. EUT Transmits at maximum power and is powered by the internal battery and/or USB via AC Adapter.                                         |
| B                  | Radiated test setup / case spurious emissions. The EUT is connected to the call box in radiated way or connect to the call box with antenna port terminated by the call box. |

### 1.4.2 EUT Exercise Software

EUT is controlled by a CMW 500 Wideband Radio Communication Tester. There are no other test software used during verification.

### 1.4.3 Support Equipment and I/O cables

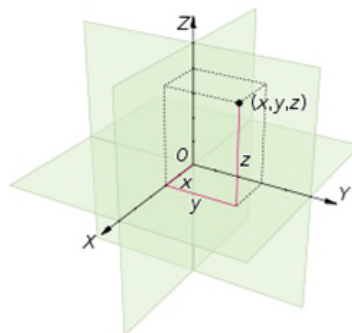
| Manufacturer  | Equipment/Cable              | Description                                                                                   |
|---------------|------------------------------|-----------------------------------------------------------------------------------------------|
| Inseego Corp. | USB Cable                    | Type A to Type C USB Cable. M/N: NOV7000USB                                                   |
| Inseego Corp. | External AC-DC Power Adapter | Model: SSW-2783, PN: 40123126.01<br>Input: 100-240VAC, 50/60Hz, 0.5A<br>Output: 5VDC, max. 2A |

### 1.4.4 Worst Case Configuration

Worst-case configuration used in this test report as per output power measurements:

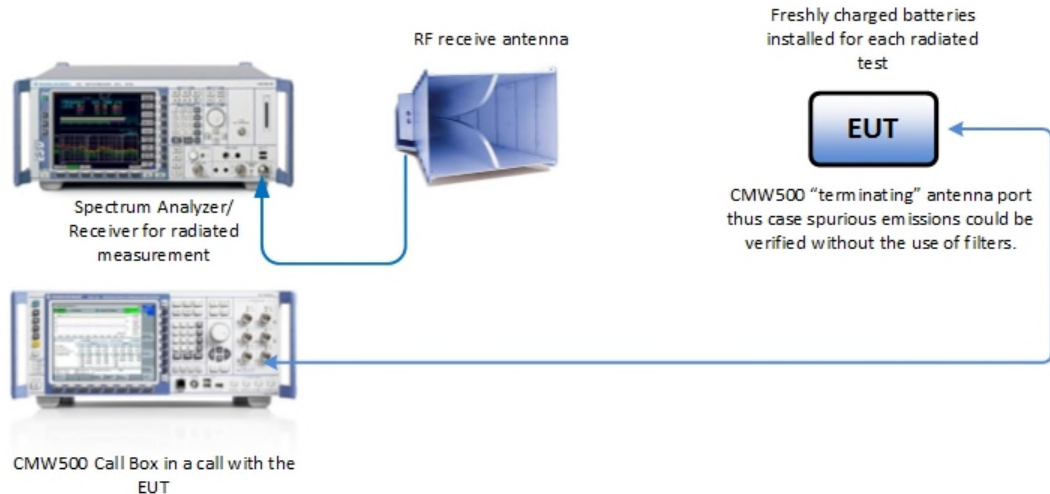
| Band                      | Channel BW | Modulation | RB Size/Offset |
|---------------------------|------------|------------|----------------|
| Band 48 (3450 – 3650 MHz) | 5 MHz      | QPSK       | 1/12           |
| Band 48 (3650 – 3700 MHz) | 15 MHz     | QPSK       | 1/37           |

For radiated measurements X, Y, and Z orientations were verified. The verification was determined “Y” as worst case configuration.

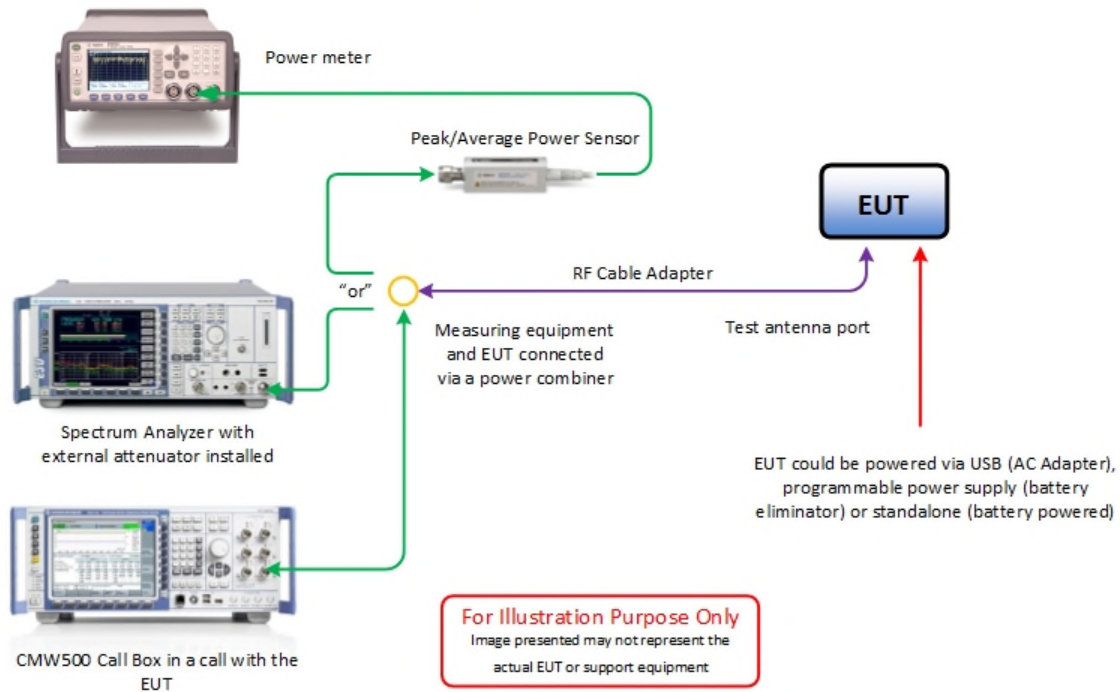


#### 1.4.5 Simplified Test Configuration Diagram

##### Radiated Test Configuration



##### Conducted (Antenna Port) Test Configuration





## 1.5 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

## 1.6 MODIFICATION RECORD

| Description of Modification                               | Modification Fitted By | Date Modification Fitted |
|-----------------------------------------------------------|------------------------|--------------------------|
| Serial Number: 990013090027496 and 990013090023966 (IMEI) |                        |                          |
| None                                                      | —                      | —                        |

The table above details modifications made to the EUT during the test programme. The modifications incorporated during each test (if relevant) are recorded on the appropriate test pages.

## 1.7 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.26-2015, American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services.

For conducted and radiated emissions the equipment under test (EUT) was configured to measure its highest possible emission level. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

## 1.8 TEST FACILITY LOCATION

### 1.8.1 TÜV SÜD America Inc. (Mira Mesa)

10040 Mesa Rim Road, San Diego, CA 92121-2912 (32.901268,-117.177681). Phone: (858) 678-1400 Fax: (858) 546-0364.

### 1.8.2 TÜV SÜD America Inc. (Rancho Bernardo)

16936 Via Del Campo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: (858) 678-1400 Fax: (858) 546-0364.

## 1.9 TEST FACILITY REGISTRATION

### 1.9.1 FCC – Designation No.: US1146

TUV SUD America Inc. (San Diego), is an accredited test facility with the site description report on file and has met all the requirements specified in §2.948 of the FCC rules. The acceptance letter from the FCC is maintained in our files and the Designation is US1146.



**1.9.2 Innovation, Science and Economic Development Canada (IC) Registration No.: 3067A-1 & 22806-1**

The 10m Semi-anechoic chamber of TUV SUD America Inc. (San Diego Rancho Bernardo) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada for radio equipment testing with Registration No. 3067A-1.

The 3m Semi-anechoic chamber of TUV SUD America Inc. (San Diego Mira Mesa) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada for radio equipment testing with Registration No. 22806-1.

**1.9.3 BSMI – Laboratory Code: SL2-IN-E-028R (US0102)**

TUV Product Service Inc. (San Diego) is a recognized EMC testing laboratory by the BSMI under the MRA (Mutual Recognition Arrangement) with the United States. Accreditation includes CNS 13438 up to 6GHz.

**1.9.4 NCC (National Communications Commission - US0102)**

TUV SUD America Inc. (San Diego) is listed as a Foreign Recognized Telecommunication Equipment Testing Laboratory and is accredited to ISO/IEC 17025 (A2LA Certificate No.2955.13) which under APEC TEL MRA Phase 1 was designated as a Conformity Assessment Body competent to perform testing of equipment subject to the Technical Regulations covered under its scope of accreditation including RTTE01, PLMN01 and PLMN08 for TTE type of testing and LP002 for Low-Power RF Device type of testing.

**1.9.5 VCCI – Registration No. A-0280 and A-0281**

TUV SUD America Inc. (San Diego) is a VCCI registered measurement facility which includes radiated field strength measurement, radiated field strength measurement above 1GHz, mains port interference measurement and telecommunication port interference measurement.

**1.9.6 RRA – Identification No. US0102**

TUV SUD America Inc. (San Diego) is National Radio Research Agency (RRA) recognized laboratory under Phase I of the APEC Tel MRA.

**1.9.7 OFCA – U.S. Identification No. US0102**

TUV SUD America Inc. (San Diego) is recognized by Office of the Communications Authority (OFCA) under Appendix B, Phase I of the APEC Tel MRA.

## 1.10 SAMPLE CALCULATIONS

### 1.10.1 LTE Emission Designator (QPSK)

Emission Designator = 4M51G7D  
 G = Phase Modulation  
 7= Quantized/Digital Info  
 D = Data Transmission, telemetry, telecommand

### 1.10.2 LTE Emission Designator (16QAM)

Emission Designator = 4M50W7D  
 W = Frequency Modulation  
 7= Quantized/Digital Info  
 D = Data Transmission, telemetry, telecommand

### 1.10.3 Spurious Radiated Emission (below 1GHz)

|                                                       |                            |       |       |
|-------------------------------------------------------|----------------------------|-------|-------|
| Measuring equipment raw measurement (dBμV) @ 30 MHz   |                            |       | 24.4  |
| Correction Factor (dB)                                | Asset# 1066 (cable)        | 0.3   | -12.6 |
|                                                       | Asset# 1172 (cable)        | 0.3   |       |
|                                                       | Asset# 1016 (preamplifier) | -30.7 |       |
|                                                       | Asset# 1175(cable)         | 0.3   |       |
|                                                       | Asset# 1002 (antenna)      | 17.2  |       |
| Reported QuasiPeak Final Measurement (dBμV/m) @ 30MHz |                            |       | 11.8  |

### 1.10.4 Spurious Radiated Emission – Substitution Method

Example = 84dBμV/m @ 1413 MHz (numerical sample only)

The field strength reading of 84dBμV/m @ 1413 MHz (2<sup>nd</sup> Harmonic of 706.5 MHz) is the maximized measurement when the EUT is on the turntable measured at 3 meters. The gain of the substituted antenna is 7.8dBi while the transmit cable loss is 1.0 dB (cable between signal generator and the substituted antenna). The signal generator level is adjusted until the 84dBμV/m level at the receiving end is replicated (identical test setup, i.e. same antenna, cable/s and preamp). If the adjusted signal generator level is -18dBm, then we have the following for both EIRP and ERP as required:

$$\begin{aligned}
 P_{\text{EIRP}} &= -18 \text{ dBm} + 7.8 \text{ dBi} - 1 \text{ dB} \\
 &= 11.2 \text{ dBm} \\
 P_{\text{ERP}} &= P_{\text{EIRP}} - 2.15 \text{ dB} \\
 &= 11.2 \text{ dBm} - 2.15 \text{ dB} \\
 &= 9.05 \text{ dBm}
 \end{aligned}$$



## **SECTION 2**

### **TEST DETAILS**

Radio Testing of the  
Inseego Corp.  
M1000 Wireless Hotspot Modem



## **2.1 TRANSMITTER CONDUCTED POWER MEASUREMENTS**

### **2.1.1 Specification Reference**

FCC 47 CFR Part 2, Clause 2.1046  
RSS-192, Clause 5.4

### **2.1.2 Standard Applicable**

The conducted power measurements were made in accordance to FCC Part 2 Clause 2.1046 and RSS-192 Clause 5.4.

RSS-192, Clause 5.4:

The average output power,  $P_{\text{mean}}$ , shall be within  $\pm 2.0$  dB of the manufacturer's rated power. The e.i.r.p shall comply with the limits specified in SRSP-303.4.

### **2.1.3 Equipment Under Test and Modification State**

Serial No: 990013090027496 and 990013090023966 (IMEI) / Test Configuration A

### **2.1.4 Date of Test/Initial of test personnel who performed the test**

May 21, 2019 / XYZ

### **2.1.5 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.1.6 Environmental Conditions/ Test Location**

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

|                     |          |
|---------------------|----------|
| Ambient Temperature | 24.5 °C  |
| Relative Humidity   | 44.1 %   |
| ATM Pressure        | 98.9 kPa |

### **2.1.7 Additional Observations**

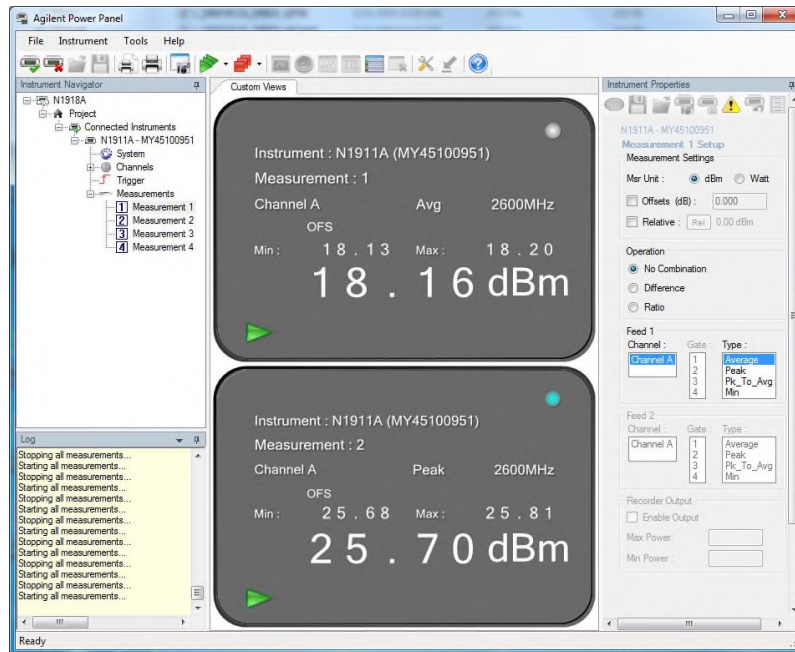
- This is a conducted test using Power Meter.
- The path loss were measured and entered as a level offset.
- Low, Middle and High channels for all bandwidths with different RB size and RB offset and modulations were verified and reported.

## 2.1.8 Test Results

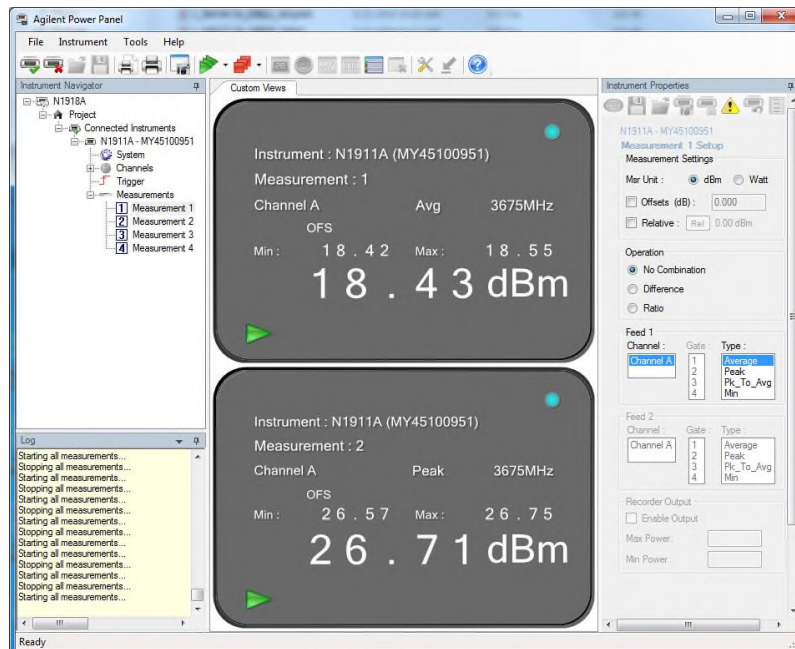
| LTE Band 48 (3550-3650 MHz) according to FCC Part 96 / RSS-192 |         |                 |            |        |          |                     |                  |
|----------------------------------------------------------------|---------|-----------------|------------|--------|----------|---------------------|------------------|
| Bandwidth (MHz)                                                | Channel | Frequency (MHz) | Modulation | No. RB | RB Start | Average Power (dBm) | Peak Power (dBm) |
| 5                                                              | 55265   | 3552.5          | QPSK       | 1      | 12       | 18.07               | 25.49            |
|                                                                | 55740   | 3600            |            | 1      | 12       | 18.16               | 25.70            |
|                                                                | 56215   | 3647.5          |            | 1      | 12       | 18.46               | 25.84            |
|                                                                | 55265   | 3552.5          | 16QAM      | 1      | 12       | 17.44               | 25.39            |
|                                                                | 55740   | 3600            |            | 1      | 12       | 17.38               | 25.52            |
|                                                                | 56215   | 3647.5          |            | 1      | 12       | 17.73               | 25.66            |
| 10                                                             | 55290   | 3555            | QPSK       | 1      | 25       | 18.06               | 25.68            |
|                                                                | 55740   | 3600            |            | 1      | 25       | 18.19               | 25.79            |
|                                                                | 56190   | 3645            |            | 1      | 25       | 18.28               | 25.96            |
|                                                                | 55290   | 3555            | 16QAM      | 1      | 25       | 17.24               | 25.42            |
|                                                                | 55740   | 3600            |            | 1      | 25       | 17.23               | 25.65            |
|                                                                | 56190   | 3645            |            | 1      | 25       | 17.32               | 25.83            |
| 15                                                             | 55315   | 3557.5          | QPSK       | 1      | 37       | 18.02               | 25.74            |
|                                                                | 55740   | 3600            |            | 1      | 37       | 18.25               | 25.74            |
|                                                                | 56165   | 3642.5          |            | 1      | 37       | 18.31               | 25.98            |
|                                                                | 55315   | 3557.5          | 16QAM      | 1      | 37       | 17.20               | 25.62            |
|                                                                | 55740   | 3600            |            | 1      | 37       | 17.42               | 25.72            |
|                                                                | 56165   | 3642.5          |            | 1      | 37       | 17.36               | 25.78            |
| 20                                                             | 55340   | 3560            | QPSK       | 1      | 99       | 18.11               | 25.67            |
|                                                                | 55740   | 3600            |            | 1      | 99       | 18.45               | 25.86            |
|                                                                | 56140   | 3640            |            | 1      | 99       | 18.37               | 25.90            |
|                                                                | 55340   | 3560            | 16QAM      | 1      | 99       | 17.25               | 25.56            |
|                                                                | 55740   | 3600            |            | 1      | 99       | 17.63               | 25.70            |
|                                                                | 56140   | 3640            |            | 1      | 99       | 17.39               | 25.76            |

| LTE Band 48 (3650-3700 MHz) according to FCC Part 90 / RSS-197 |         |                 |            |        |          |                     |                  |
|----------------------------------------------------------------|---------|-----------------|------------|--------|----------|---------------------|------------------|
| Bandwidth (MHz)                                                | Channel | Frequency (MHz) | Modulation | No. RB | RB Start | Average Power (dBm) | Peak Power (dBm) |
| 5                                                              | 56265   | 3652.5          | QPSK       | 1      | 12       | 18.62               | 26.21            |
|                                                                | 56490   | 3675            |            | 1      | 12       | 18.43               | 26.71            |
|                                                                | 56715   | 3697.5          |            | 1      | 12       | 18.03               | 26.72            |
|                                                                | 56265   | 3652.5          | 16QAM      | 1      | 12       | 17.88               | 26.04            |
|                                                                | 56490   | 3675            |            | 1      | 12       | 17.52               | 26.15            |
|                                                                | 56715   | 3697.5          |            | 1      | 12       | 17.15               | 26.39            |
| 10                                                             | 56290   | 3655            | QPSK       | 1      | 25       | 18.49               | 26.21            |
|                                                                | 56490   | 3675            |            | 1      | 25       | 18.30               | 26.27            |
|                                                                | 56690   | 3695            |            | 1      | 25       | 18.10               | 27.35            |
|                                                                | 56290   | 3655            | 16QAM      | 1      | 25       | 17.61               | 26.12            |
|                                                                | 56490   | 3675            |            | 1      | 25       | 17.33               | 26.00            |
|                                                                | 56690   | 3695            |            | 1      | 25       | 17.42               | 26.89            |
| 15                                                             | 56315   | 3657.5          | QPSK       | 1      | 37       | 18.80               | 26.39            |
|                                                                | 56490   | 3675            |            | 1      | 37       | 18.95               | 26.77            |
|                                                                | 56665   | 3692.5          |            | 1      | 37       | 18.36               | 28.50            |
|                                                                | 56315   | 3657.5          | 16QAM      | 1      | 37       | 17.98               | 26.24            |
|                                                                | 56490   | 3675            |            | 1      | 37       | 17.76               | 26.23            |
|                                                                | 56665   | 3692.5          |            | 1      | 37       | 17.43               | 28.21            |
| 20                                                             | 56340   | 3660            | QPSK       | 1      | 50       | 18.84               | 26.35            |
|                                                                | 56490   | 3675            |            | 1      | 50       | 18.51               | 26.42            |
|                                                                | 56640   | 3690            |            | 1      | 50       | 18.13               | 25.97            |
|                                                                | 56340   | 3660            | 16QAM      | 1      | 50       | 18.03               | 26.15            |
|                                                                | 56490   | 3675            |            | 1      | 50       | 17.86               | 26.18            |
|                                                                | 56640   | 3690            |            | 1      | 50       | 17.66               | 26.20            |

## 2.1.9 Sample Test Measurement Screen



LTE Band 48 (3550 – 3650 MHz)\_5M Bandwidth Middle Channel QPSK 1 RB 12 offset



LTE Band 48 (3650 – 3700 MHz)\_5 MHz Bandwidth\_Middle Channel QPSK 1 RB 12 offset

## 2.2 EFFECTIVE ISOTROPIC RADIATED POWER AND POWER SPECTRAL DENSITY

### 2.2.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1046  
FCC 47 CFR Part 96, Clause 96.41(b)  
FCC 47 CFR Part 90, Clause 90.1321(c)  
RSS-192, Clause 5.4  
RSS-197, Clause 5.6

### 2.2.2 Standard Applicable

FCC 47 CFR Part 96, Clause 96.41:

(b) Unless otherwise specified in this section, the maximum effective isotropic radiated power (EIRP) and maximum Power Spectral Density (PSD) of any CBSD and End User Device must comply with the limits shown in the table below:

| Device          | Maximum EIRP (dBm/10 MHz) | Maximum PSD (dBm/MHz) |
|-----------------|---------------------------|-----------------------|
| End User Device | 23                        | N/A                   |
| Category A CBSD | 30                        | 20                    |
| Category B CBSD | 47                        | 37                    |

RSS-192, Clause 5.4:

The average output power,  $P_{\text{mean}}$ , shall be within 2.0 dB of the manufacturer's rated power. The e.i.r.p shall comply with the limits specified in SRSP-303.4.

FCC 47 CFR Part 90, Clause 90.1321:

(c) Mobile and portable stations are limited to 1 watt/25 MHz EIRP. In any event, the peak EIRP density shall not exceed 40 milliwatts in any one-mega-hertz slice of spectrum.

RSS-197, Clause 5.6;

The maximum e.i.r.p density of mobile equipment shall not exceed 40 mW in any 1 MHz bandwidth.

### 2.2.3 Equipment Under Test and Modification State

Serial No: 990013090027496 and 990013090023966 (IMEI) / Test Configuration A

### 2.2.4 Date of Test/Initial of test personnel who performed the test

May 21, 2019 / XYZ

### 2.2.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.



## 2.2.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

|                     |          |
|---------------------|----------|
| Ambient Temperature | 24.5 °C  |
| Relative Humidity   | 44.1 %   |
| ATM Pressure        | 98.9 kPa |

## 2.2.7 Additional Observations

- EIRP was calculated as per Section 1.2 and 1.3 of KDB412172 D01 (Determining ERP and EIRP v01r01).
- Calculation formula in logarithmic terms:

$$\text{EIRP} = P_T + G_T - L_c$$

Where:

$P_T$  = transmitter conducted output power dBm (Section 2.1 of this test report)

$G_T$  = gain of the transmitting antenna, in dBi (EIRP);

$L_c$  = signal attenuation in the connecting cable between the transmitter and antenna, in dB (EUT poses an internal Antenna. The loss between the EUT and the antenna port is considered negligible).

- Conducted EIRP Density is tested in any 1 MHz
- The path loss were measured and entered as a level offset.
- Low, Middle and High channels for all modulations were verified and reported.

## 2.2.8 Test Results

| LTE Band 48 (3550 – 3650 MHz) EIRP according to FCC Part 96 / RSS-192 |                 |                |          |                 |                     |                    |            |             |            |
|-----------------------------------------------------------------------|-----------------|----------------|----------|-----------------|---------------------|--------------------|------------|-------------|------------|
| Modulation                                                            | Bandwidth (MHz) | RB Size/Offset | Channels | Frequency (MHz) | Average Power (dBm) | Antenna Gain (dBi) | EIRP (dBm) | Limit (dBm) | Compliance |
| QPSK                                                                  | 5               | 1 / 12         | 55265    | 3552.5          | 18.07               | 3.6                | 21.67      | 22 ± 2      | Yes        |
|                                                                       |                 | 1 / 12         | 55740    | 3600            | 18.16               | 3.6                | 21.76      | 22 ± 2      | Yes        |
|                                                                       |                 | 1 / 12         | 56215    | 3647.5          | 18.46               | 3.6                | 22.06      | 22 ± 2      | Yes        |
|                                                                       | 10              | 1 / 25         | 55290    | 3555            | 18.06               | 3.6                | 21.66      | 22 ± 2      | Yes        |
|                                                                       |                 | 1 / 25         | 55740    | 3600            | 18.19               | 3.6                | 21.79      | 22 ± 2      | Yes        |
|                                                                       |                 | 1 / 25         | 56190    | 3645            | 18.28               | 3.6                | 21.88      | 22 ± 2      | Yes        |
|                                                                       | 15              | 1 / 37         | 55315    | 3557.5          | 18.02               | 3.6                | 21.62      | 22 ± 2      | Yes        |
|                                                                       |                 | 1 / 37         | 55740    | 3600            | 18.25               | 3.6                | 21.85      | 22 ± 2      | Yes        |
|                                                                       |                 | 1 / 37         | 56165    | 3642.5          | 18.31               | 3.6                | 21.91      | 22 ± 2      | Yes        |
|                                                                       | 20              | 1 / 99         | 55340    | 3560            | 18.11               | 3.6                | 21.71      | 22 ± 2      | Yes        |
|                                                                       |                 | 1 / 99         | 55740    | 3600            | 18.45               | 3.6                | 22.05      | 22 ± 2      | Yes        |
|                                                                       |                 | 1 / 99         | 56140    | 3640            | 18.37               | 3.6                | 21.97      | 22 ± 2      | Yes        |
| 16QAM                                                                 | 5               | 1 / 12         | 55265    | 3552.5          | 17.44               | 3.6                | 21.04      | 22 ± 2      | Yes        |
|                                                                       |                 | 1 / 12         | 55740    | 3600            | 17.38               | 3.6                | 20.98      | 22 ± 2      | Yes        |
|                                                                       |                 | 1 / 12         | 56215    | 3647.5          | 17.73               | 3.6                | 21.33      | 22 ± 2      | Yes        |
|                                                                       | 10              | 1 / 25         | 55290    | 3555            | 17.24               | 3.6                | 20.84      | 22 ± 2      | Yes        |
|                                                                       |                 | 1 / 25         | 55740    | 3600            | 17.23               | 3.6                | 20.83      | 22 ± 2      | Yes        |
|                                                                       |                 | 1 / 25         | 56190    | 3645            | 17.32               | 3.6                | 20.92      | 22 ± 2      | Yes        |
|                                                                       | 15              | 1 / 37         | 55315    | 3557.5          | 17.20               | 3.6                | 20.80      | 22 ± 2      | Yes        |
|                                                                       |                 | 1 / 37         | 55740    | 3600            | 17.42               | 3.6                | 21.02      | 22 ± 2      | Yes        |
|                                                                       |                 | 1 / 37         | 56165    | 3642.5          | 17.36               | 3.6                | 20.96      | 22 ± 2      | Yes        |
|                                                                       | 20              | 1 / 99         | 55340    | 3560            | 17.25               | 3.6                | 20.85      | 22 ± 2      | Yes        |
|                                                                       |                 | 1 / 99         | 55740    | 3600            | 17.63               | 3.6                | 21.23      | 22 ± 2      | Yes        |
|                                                                       |                 | 1 / 99         | 56140    | 3640            | 17.39               | 3.6                | 20.99      | 22 ± 2      | Yes        |



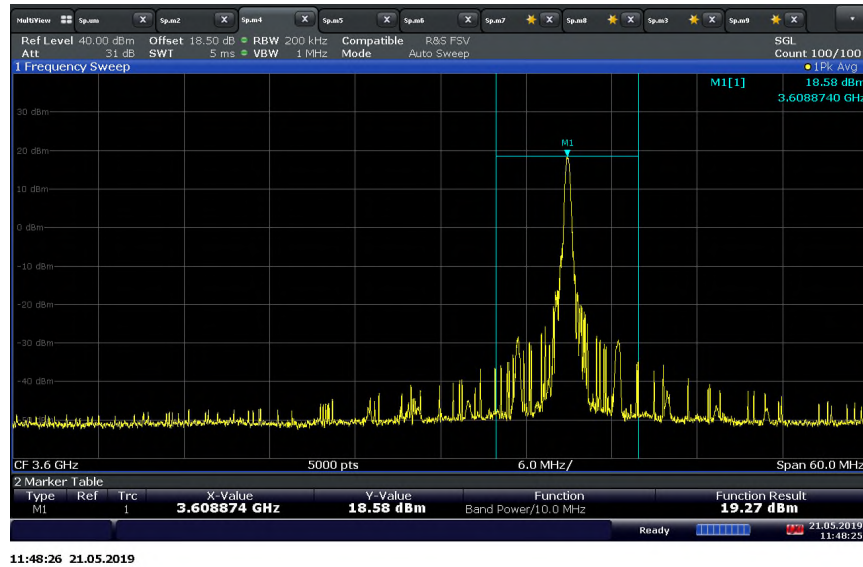
| LTE Band 48 (3550 – 3650 MHz) EIRP/10 MHz according to FCC Part 96 / RSS-192 |                 |              |                 |                  |                    |                   |                    |              |
|------------------------------------------------------------------------------|-----------------|--------------|-----------------|------------------|--------------------|-------------------|--------------------|--------------|
| Modulation                                                                   | Bandwidth (MHz) | Channels     | Frequency (MHz) | Peak Power (dBm) | Antenna Gain (dBi) | EIRP (dBm/10 MHz) | Limit (dBm/10 MHz) | Margin (dBm) |
| QPSK                                                                         | 5               | 55265        | 3552.5          | 18.07            | 3.6                | 21.67             | 23                 | 1.33         |
|                                                                              |                 | 55740        | 3600            | 18.16            | 3.6                | 21.76             | 23                 | 1.24         |
|                                                                              |                 | <b>56215</b> | <b>3647.5</b>   | <b>18.46</b>     | <b>3.6</b>         | <b>22.06</b>      | <b>23</b>          | <b>0.94</b>  |
|                                                                              | 10              | 55290        | 3555            | 18.06            | 3.6                | 21.66             | 23                 | 1.34         |
|                                                                              |                 | 55740        | 3600            | 18.19            | 3.6                | 21.79             | 23                 | 1.21         |
|                                                                              |                 | <b>56190</b> | <b>3645</b>     | <b>18.28</b>     | <b>3.6</b>         | <b>21.88</b>      | <b>23</b>          | <b>1.12</b>  |
|                                                                              | 15              | 55315        | 3557.5          | 19.06            | 3.6                | 22.66             | 23                 | 0.34         |
|                                                                              |                 | <b>55740</b> | <b>3600</b>     | <b>19.30</b>     | <b>3.6</b>         | <b>22.90</b>      | <b>23</b>          | <b>0.1</b>   |
|                                                                              |                 | 56165        | 3642.5          | 19.17            | 3.6                | 22.77             | 23                 | 0.23         |
|                                                                              | 20              | 55340        | 3560            | 19.08            | 3.6                | 22.68             | 23                 | 0.32         |
|                                                                              |                 | <b>55740</b> | <b>3600</b>     | <b>19.27</b>     | <b>3.6</b>         | <b>22.87</b>      | <b>23</b>          | <b>0.13</b>  |
|                                                                              |                 | 56140        | 3640            | 19.19            | 3.6                | 22.79             | 23                 | 0.21         |
| 16QAM                                                                        | 5               | 55265        | 3552.5          | 17.44            | 3.6                | 21.04             | 23                 | 1.96         |
|                                                                              |                 | 55740        | 3600            | 17.38            | 3.6                | 20.98             | 23                 | 2.02         |
|                                                                              |                 | <b>56215</b> | <b>3647.5</b>   | <b>17.73</b>     | <b>3.6</b>         | <b>21.33</b>      | <b>23</b>          | <b>1.67</b>  |
|                                                                              | 10              | 55290        | 3555            | 17.24            | 3.6                | 20.84             | 23                 | 2.16         |
|                                                                              |                 | 55740        | 3600            | 17.23            | 3.6                | 20.83             | 23                 | 2.17         |
|                                                                              |                 | <b>56190</b> | <b>3645</b>     | <b>17.32</b>     | <b>3.6</b>         | <b>20.92</b>      | <b>23</b>          | <b>2.08</b>  |
|                                                                              | 15              | 55315        | 3557.5          | 18.14            | 3.6                | 21.74             | 23                 | 1.26         |
|                                                                              |                 | 55740        | 3600            | 18.11            | 3.6                | 21.71             | 23                 | 1.29         |
|                                                                              |                 | <b>56165</b> | <b>3642.5</b>   | <b>18.44</b>     | <b>3.6</b>         | <b>22.04</b>      | <b>23</b>          | <b>0.96</b>  |
|                                                                              | 20              | 55340        | 3560            | 18.14            | 3.6                | 21.74             | 23                 | 1.26         |
|                                                                              |                 | <b>55740</b> | <b>3600</b>     | <b>19.02</b>     | <b>3.6</b>         | <b>22.62</b>      | <b>23</b>          | <b>0.38</b>  |
|                                                                              |                 | 56140        | 3640            | 18.58            | 3.6                | 22.18             | 23                 | 0.82         |



| LTE Band 48 (3650 – 3700 MHz) EIRP/25 MHz according to FCC Part 90 / RSS-197 |                 |                |          |                 |                        |                    |            |             |              |
|------------------------------------------------------------------------------|-----------------|----------------|----------|-----------------|------------------------|--------------------|------------|-------------|--------------|
| Modulation                                                                   | Bandwidth (MHz) | RB Size/Offset | Channels | Frequency (MHz) | Tx Average Power (dBm) | Antenna Gain (dBi) | EIRP (dBm) | Limit (dBm) | Margin (dBm) |
| QPSK                                                                         | 5               | 1 / 12         | 56265    | 3652.5          | 18.62                  | 3.6                | 22.22      | 30          | 7.78         |
|                                                                              |                 | 1 / 12         | 56490    | 3675            | 18.43                  | 3.6                | 22.03      | 30          | 7.97         |
|                                                                              |                 | 1 / 12         | 56715    | 3697.5          | 18.03                  | 3.6                | 21.63      | 30          | 8.37         |
|                                                                              | 10              | 1 / 25         | 56290    | 3655            | 18.49                  | 3.6                | 22.09      | 30          | 7.91         |
|                                                                              |                 | 1 / 25         | 56490    | 3675            | 18.30                  | 3.6                | 21.90      | 30          | 8.1          |
|                                                                              |                 | 1 / 25         | 56690    | 3695            | 18.10                  | 3.6                | 21.70      | 30          | 8.3          |
|                                                                              | 15              | 1 / 37         | 56315    | 3675.5          | 18.80                  | 3.6                | 22.40      | 30          | 7.6          |
|                                                                              |                 | 1 / 37         | 56490    | 3675            | 18.95                  | 3.6                | 22.55      | 30          | 7.45         |
|                                                                              |                 | 1 / 37         | 56665    | 3692.5          | 18.36                  | 3.6                | 21.96      | 30          | 8.04         |
|                                                                              | 20              | 1 / 50         | 56340    | 3660            | 18.84                  | 3.6                | 22.44      | 30          | 7.56         |
|                                                                              |                 | 1 / 50         | 56490    | 3675            | 18.51                  | 3.6                | 22.11      | 30          | 7.89         |
|                                                                              |                 | 1 / 50         | 56640    | 3690            | 18.13                  | 3.6                | 21.73      | 30          | 8.27         |
| 16QAM                                                                        | 5               | 1 / 12         | 56265    | 3652.5          | 17.88                  | 3.6                | 21.48      | 30          | 8.52         |
|                                                                              |                 | 1 / 12         | 56490    | 3675            | 17.52                  | 3.6                | 21.12      | 30          | 8.88         |
|                                                                              |                 | 1 / 12         | 56715    | 3697.5          | 17.15                  | 3.6                | 20.75      | 30          | 9.25         |
|                                                                              | 10              | 1 / 25         | 56290    | 3655            | 17.61                  | 3.6                | 21.21      | 30          | 8.79         |
|                                                                              |                 | 1 / 25         | 56490    | 3675            | 17.33                  | 3.6                | 20.93      | 30          | 9.07         |
|                                                                              |                 | 1 / 25         | 56690    | 3695            | 17.42                  | 3.6                | 21.02      | 30          | 8.98         |
|                                                                              | 15              | 1 / 37         | 56315    | 3675.5          | 17.98                  | 3.6                | 21.58      | 30          | 8.42         |
|                                                                              |                 | 1 / 37         | 56490    | 3675            | 17.76                  | 3.6                | 21.36      | 30          | 8.64         |
|                                                                              |                 | 1 / 37         | 56665    | 3692.5          | 17.43                  | 3.6                | 21.03      | 30          | 8.97         |
|                                                                              | 20              | 1 / 50         | 56340    | 3660            | 18.03                  | 3.6                | 21.63      | 30          | 8.37         |
|                                                                              |                 | 1 / 50         | 56490    | 3675            | 17.86                  | 3.6                | 21.46      | 30          | 8.54         |
|                                                                              |                 | 1 / 50         | 56640    | 3690            | 17.66                  | 3.6                | 21.26      | 30          | 8.74         |

| LTE Band 48 (3650 – 3700 MHz) EIRP Density according to FCC Part 90 / RSS-197 |                 |          |                 |                                  |                    |                            |             |              |
|-------------------------------------------------------------------------------|-----------------|----------|-----------------|----------------------------------|--------------------|----------------------------|-------------|--------------|
| Modulation                                                                    | Bandwidth (MHz) | Channels | Frequency (MHz) | Peak Power Density (dBm / 1 MHz) | Antenna Gain (dBi) | EIRP Density (dBm / 1 MHz) | Limit (dBm) | Margin (dBm) |
| QPSK                                                                          | 5               | 56265    | 3652.5          | 10.93                            | 3.6                | 14.53                      | 16.02       | 1.49         |
|                                                                               |                 | 56490    | 3675            | 11.11                            | 3.6                | 14.71                      | 16.02       | 1.31         |
|                                                                               |                 | 56715    | 3697.5          | 11.58                            | 3.6                | 15.18                      | 16.02       | 0.84         |
|                                                                               | 10              | 56290    | 3655            | 8.35                             | 3.6                | 11.95                      | 16.02       | 4.07         |
|                                                                               |                 | 56490    | 3675            | 9.06                             | 3.6                | 12.66                      | 16.02       | 3.36         |
|                                                                               |                 | 56690    | 3695            | 8.05                             | 3.6                | 11.65                      | 16.02       | 4.37         |
|                                                                               | 15              | 56315    | 3657.5          | 8.63                             | 3.6                | 12.23                      | 16.02       | 3.79         |
|                                                                               |                 | 56490    | 3675            | 8.38                             | 3.6                | 11.98                      | 16.02       | 4.04         |
|                                                                               |                 | 56665    | 3692.5          | 8.79                             | 3.6                | 12.39                      | 16.02       | 3.63         |
|                                                                               | 20              | 56340    | 3660            | 7.11                             | 3.6                | 10.71                      | 16.02       | 5.31         |
|                                                                               |                 | 56490    | 3675            | 6.33                             | 3.6                | 9.93                       | 16.02       | 6.09         |
|                                                                               |                 | 56640    | 3690            | 7.70                             | 3.6                | 11.3                       | 16.02       | 4.72         |
| 16QAM                                                                         | 5               | 56265    | 3652.5          | 9.58                             | 3.6                | 13.18                      | 16.02       | 2.84         |
|                                                                               |                 | 56490    | 3675            | 9.63                             | 3.6                | 13.23                      | 16.02       | 2.79         |
|                                                                               |                 | 56715    | 3697.5          | 10.43                            | 3.6                | 14.03                      | 16.02       | 1.99         |
|                                                                               | 10              | 56290    | 3655            | 7.42                             | 3.6                | 11.02                      | 16.02       | 5.0          |
|                                                                               |                 | 56490    | 3675            | 7.02                             | 3.6                | 10.62                      | 16.02       | 5.40         |
|                                                                               |                 | 56690    | 3695            | 7.25                             | 3.6                | 10.85                      | 16.02       | 5.17         |
|                                                                               | 15              | 56315    | 3657.5          | 7.34                             | 3.6                | 10.94                      | 16.02       | 5.08         |
|                                                                               |                 | 56490    | 3675            | 7.85                             | 3.6                | 11.45                      | 16.02       | 4.57         |
|                                                                               |                 | 56665    | 3692.5          | 6.88                             | 3.6                | 10.48                      | 16.02       | 5.54         |
|                                                                               | 20              | 56340    | 3660            | 6.14                             | 3.6                | 9.74                       | 16.02       | 6.28         |
|                                                                               |                 | 56490    | 3675            | 5.32                             | 3.6                | 8.92                       | 16.02       | 7.10         |
|                                                                               |                 | 56640    | 3690            | 6.09                             | 3.6                | 9.69                       | 16.02       | 6.33         |

## 2.2.9 Sample Test Measurement Screen



LTE Band 48 (3550 – 3650 MHz) 20 MHz Bandwidth Middle Channel 3600 MHz 1RB 99 offset QPSK EIRP/10 MHz



LTE Band 48 (3650 – 3700 MHz) 5 MHz Bandwidth Middle Channel 3675 MHz QPSK Power Spectral Density



## **2.3 OCCUPIED BANDWIDTH**

### **2.3.1 Specification Reference**

FCC 47 CFR Part 2, Clause 2.1049  
FCC 47 CFR Part 96, Clause 96.41 (e)(3)  
FCC 47 CFR Part 90, Clause 90.1323 (a)  
RSS-192, Clause 5.5  
RSS-197, Clause 5.7  
RSS-GEN, Clause 6.7

### **2.3.2 Standard Applicable**

The transmitted signal bandwidth shall be reported as the 99% emission bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

26dB 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 by at least 26 dB below the transmitter power.

Using the occupied bandwidth measurement function in the spectrum analyzer, the 99% occupied bandwidth was measured.

In addition, the 26dB bandwidth was measured in accordance with FCC KDB 971168 D01 v03r01 Clause 4.1 using the ndB measurement function in the spectrum analyzer.

### **2.3.3 Equipment Under Test and Modification State**

Serial No: 990013090027496 (IMEI) / Test Configuration A

### **2.3.4 Date of Test/Initial of test personnel who performed the test**

March 17 and 18, 2019 / XYZ

### **2.3.5 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.3.6 Environmental Conditions/ Test Location**

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

|                     |                 |
|---------------------|-----------------|
| Ambient Temperature | 25.1 - 25.6 °C  |
| Relative Humidity   | 41.3 - 44.8 %   |
| ATM Pressure        | 98.8 - 99.1 kPa |

### 2.3.7 Additional Observations

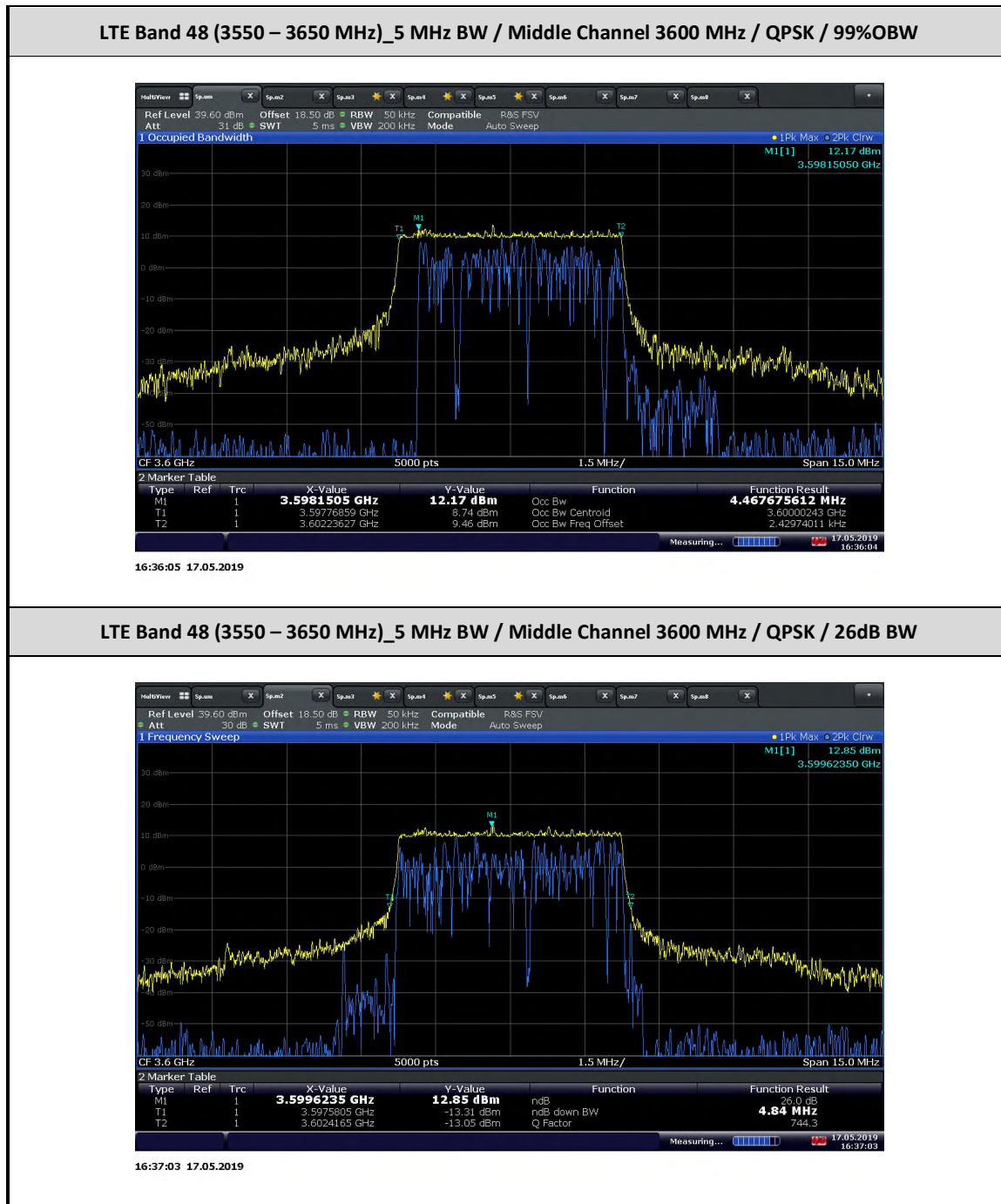
- This is a conducted test. Both 26dB bandwidth and 99% bandwidth presented.
- Using the occupied bandwidth measurement function in the spectrum analyzer, the 99% occupied bandwidth was measured.
- The 26dB bandwidth was measured in accordance with ANSI C63.26 clause 5.4.3 using the ndB measurement function in the spectrum analyzer.
- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

### 2.3.8 Test Results

| LTE Band 48 (3550 – 3650 MHz) |                 |         |                 |               |               |
|-------------------------------|-----------------|---------|-----------------|---------------|---------------|
| Modulation                    | Bandwidth (MHz) | Channel | Frequency (MHz) | 99% OBW (MHz) | 26dB BW (MHz) |
| QPSK                          | 5               | 55740   | 3600            | 4.47          | 4.84          |
|                               | 10              |         |                 | 8.94          | 9.61          |
|                               | 15              |         |                 | 13.44         | 14.49         |
|                               | 20              |         |                 | 17.88         | 19.04         |
| 16QAM                         | 5               | 55740   | 3600            | 4.48          | 4.84          |
|                               | 10              |         |                 | 8.94          | 9.69          |
|                               | 15              |         |                 | 13.44         | 14.66         |
|                               | 20              |         |                 | 17.86         | 19.13         |

| LTE Band 48 (3650 – 3700 MHz) |                 |         |                 |               |               |
|-------------------------------|-----------------|---------|-----------------|---------------|---------------|
| Modulation                    | Bandwidth (MHz) | Channel | Frequency (MHz) | 99% OBW (MHz) | 26dB BW (MHz) |
| QPSK                          | 5               | 56490   | 3675            | 4.47          | 4.85          |
|                               | 10              |         |                 | 8.95          | 9.67          |
|                               | 15              |         |                 | 13.43         | 14.44         |
|                               | 20              |         |                 | 17.86         | 19.12         |
| 16QAM                         | 5               | 56490   | 3675            | 4.49          | 4.87          |
|                               | 10              |         |                 | 8.94          | 9.62          |
|                               | 15              |         |                 | 13.44         | 14.42         |
|                               | 20              |         |                 | 17.87         | 19.16         |

### 2.3.9 Example Test Plots



**LTE Band 48 (3650 – 3700 MHz)\_5 MHz BW / Middle Channel 3675 MHz / QPSK / 99%OBW**



16:46:19 17.05.2019

**LTE Band 48 (3650 – 3700 MHz)\_5 MHz BW / Middle Channel 3675 MHz / QPSK / 26dB BW**



16:45:39 17.05.2019

## **2.4 SPURIOUS EMISSION AT BAND EDGE**

### **2.4.1 Specification Reference**

FCC 47 CFR Part 2, Clause 2.1051  
FCC 47 CFR Part 96, Clause 96.41(e)(1)(3)  
FCC 47 CFR Part 90, Clause 90.1323(a)  
RSS-192, Clause 5.5  
RSS-197, Clause 5.7

### **2.4.2 Standard Applicable**

FCC 47 CFR Part 96.41:

(e) 3.5 GHz Emissions and Interference Limits - (1) General protection levels. Except as otherwise specified in paragraph (e)(2) of this section, for channel and frequency assignments made by the SAS to CBSDs, the conducted power of any emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed -13 dBm/MHz within 0-10 megahertz above the upper SAS-assigned channel edge and within 0-10 megahertz below the lower SAS-assigned channel edge. At all frequencies greater than 10 megahertz above the upper SAS assigned channel edge and less than 10 MHz below the lower SAS assigned channel edge, the conducted power of any emission shall not exceed -25 dBm/MHz. The upper and lower SAS assigned channel edges are the upper and lower limits of any channel assigned to a CBSD by an SAS, or in the case of multiple contiguous channels, the upper and lower limits of the combined contiguous channels.

RSS-192, Clause 5.5:

The unwanted emissions shall comply with the following limits:

(i) In any 30 kHz bandwidth, the unwanted emission spectral density that is relative to the inband spectral density shall be attenuated at least to the limits shown in Table 1 according to the equipment modulation. The attenuation shall be linearly interpolated between the turning point attenuation limits.

**Table 1: Attenuation of Unwanted Emission Limits for Various Access Schemes**

**Orthogonal Frequency Division Multiple Access (OFDMA)**

| Turning Point (F/ChS) | 0    | 0.21  | 0.56  | 1.5   | 2     |
|-----------------------|------|-------|-------|-------|-------|
| EMO = 2               | 8 dB | 25 dB | 27 dB | 50 dB | 50 dB |
| EMO = 4               | 8 dB | 27 dB | 32 dB | 50 dB | 50 dB |
| EMO = 6               | 8 dB | 32 dB | 38 dB | 50 dB | 50 dB |

**Code Division Multiple Access (CDMA)**

| Turning Point (F/ChS) | 0    | 0.3   | 0.5   | 1     | 2     |
|-----------------------|------|-------|-------|-------|-------|
| EMO Not applicable    | 0 dB | 25 dB | 25 dB | 45 dB | 45 dB |

**Frequency Division Multiple Access (FDMA)**

| Turning Point (F/ChS) | 0     | 0.1   | 0.35  | 1     | 2     |
|-----------------------|-------|-------|-------|-------|-------|
| EMO = 2               | 23 dB | 25 dB | 25 dB | 45 dB | 45 dB |
| EMO = 3               | 27 dB | 29 dB | 29 dB | 45 dB | 45 dB |
| EMO = 4 or 6          | 31 dB | 33 dB | 33 dB | 45 dB | 45 dB |

**Time Division Multiple Access (TDMA)**

| Turning Point (F/ChS) | 0              | 0.3   | 0.56  | 1.5   | 2     |
|-----------------------|----------------|-------|-------|-------|-------|
| EMO = 2               | Not applicable | 25 dB | 25 dB | 45 dB | 45 dB |
| EMO = 4               | Not applicable | 32 dB | 37 dB | 45 dB | 45 dB |
| EMO = 6               | 13 dB          | 34 dB | 42 dB | 45 dB | 45 dB |

The offset frequency from the block edge, F, at each turning point can be determined as follows:  
 $F = \text{ChS} * (\text{Turning Point})$ ; where ChS is defined as the frequency spacing between the centre frequencies of two adjacent channels.

EMO is the equivalent modulation order of the transmitter, defined as  $\log_2(\text{number of discrete states which may be assigned to each symbol})$ . For example, for quadrature amplitude modulation (QAM):

- 2 = 4 QAM
- 4 = 16 QAM
- 6 = 64 QAM

(ii) In any 1.0 MHz band that is removed from the assigned centre frequency by more than  $\pm 250\%$  of the necessary bandwidth, the power of any emission must be attenuated below  $P_{\text{mean}}$  by at least  $43 + 10 \log_{10}(P_{\text{mean}})$  dB, or 70 dB, whichever is less stringent.  $P_{\text{mean}}$  is the mean output power of the transmitter in watts.



FCC 47 CFR Part 90.1323:

(a) 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. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or less, but at least one percent of the emission bandwidth of the fundamental emission of the transmitter, provided the measured energy is integrated over a 1 MHz bandwidth.

RSS-197, Clause 5.7:

The unwanted emissions shall be measured at the frequencies of the highest and lowest channel of all bandwidths and types of modulation that the equipment can operate with a resolution bandwidth of 1 MHz or less, but at least 1% of the occupied bandwidth of the transmitter, provided that the measured power is integrated over a 1 MHz bandwidth.

The power of any emissions outside the frequency band 3650-3700 MHz shall be attenuated below the channel transmitter power P (dBW) by  $43 + 10 \log(p)$ , where p is measured in watts.

#### **2.4.3 Equipment Under Test and Modification State**

Serial No: 990013090027496 and 990013090023966 (IMEI) / Test Configuration A

#### **2.4.4 Date of Test/Initial of test personnel who performed the test**

May 21, 2019 / XYZ

#### **2.4.5 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

#### **2.4.6 Environmental Conditions/ Test Location**

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

|                     |          |
|---------------------|----------|
| Ambient Temperature | 24.5 °C  |
| Relative Humidity   | 44.1 %   |
| ATM Pressure        | 98.9 kPa |

#### **2.4.7 Additional Observations**

- This is a conducted test.
- The path loss were measured and entered as a level offset.
- All channel bandwidth, RB Size and offset and modulation are verified. Only the worst case modulation (QPSK) for band edge verification presented in this test report.

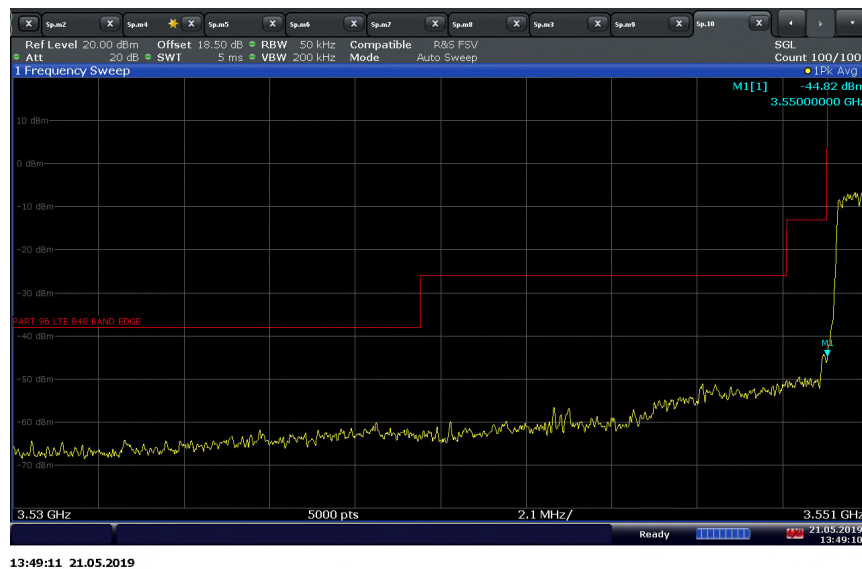
#### **2.4.8 Test Results**

See attached test plots.

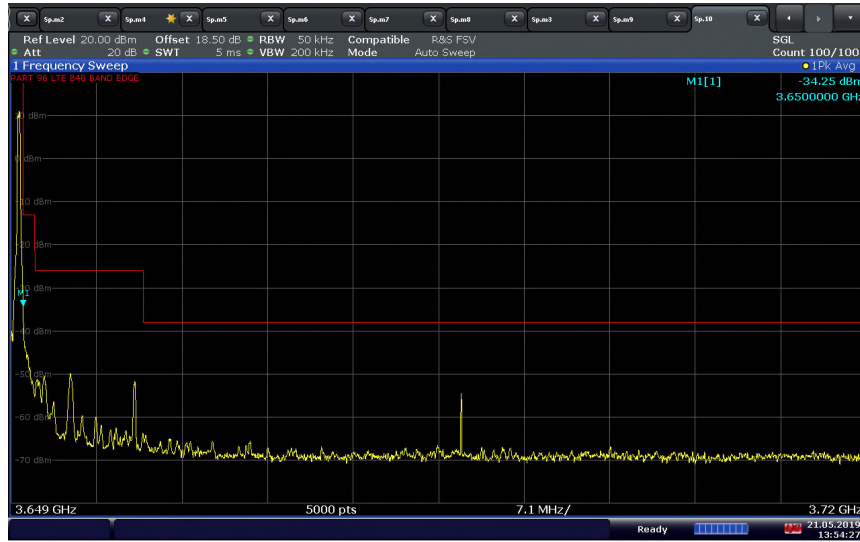
**LTE Band 48 (3550 – 3650 MHz)\_5 MHz BW / QPSK / Low Channel 3552.5 MHz 1 RB 0 offset**  
**Low Band Edge**



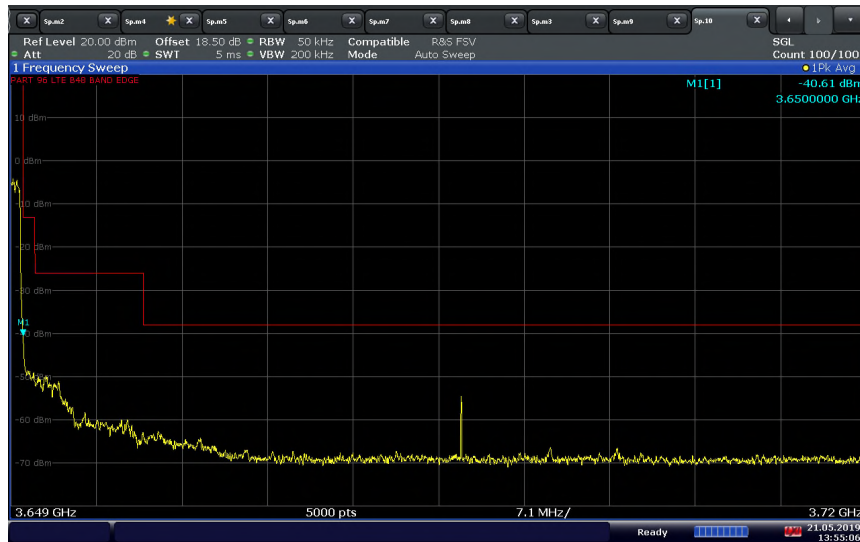
**LTE Band 48 (3550 – 3650 MHz)\_5 MHz BW / QPSK / Low Channel 3552.5 MHz Full RB**  
**Low Band Edge**



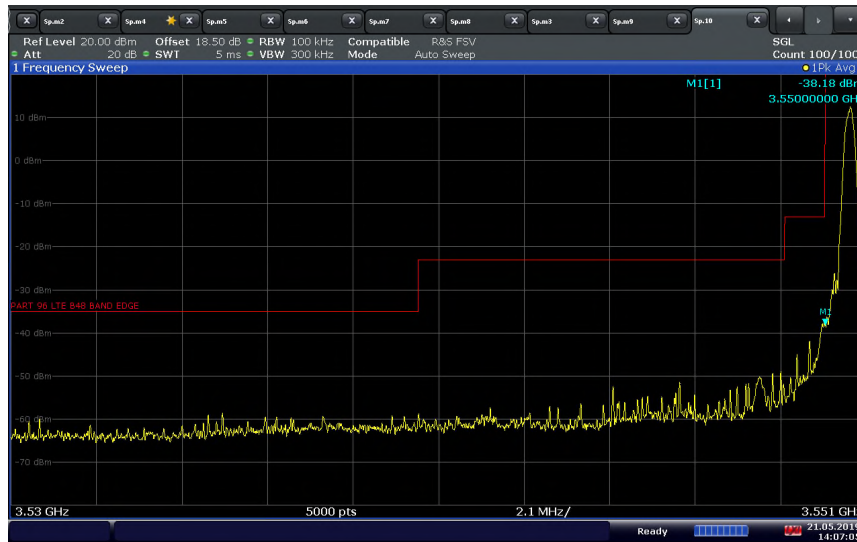
**LTE Band 48 (3550 – 3650 MHz)\_5 MHz BW / QPSK / High Channel 3647.5 MHz 1 RB 24 offset**  
**High Band Edge**



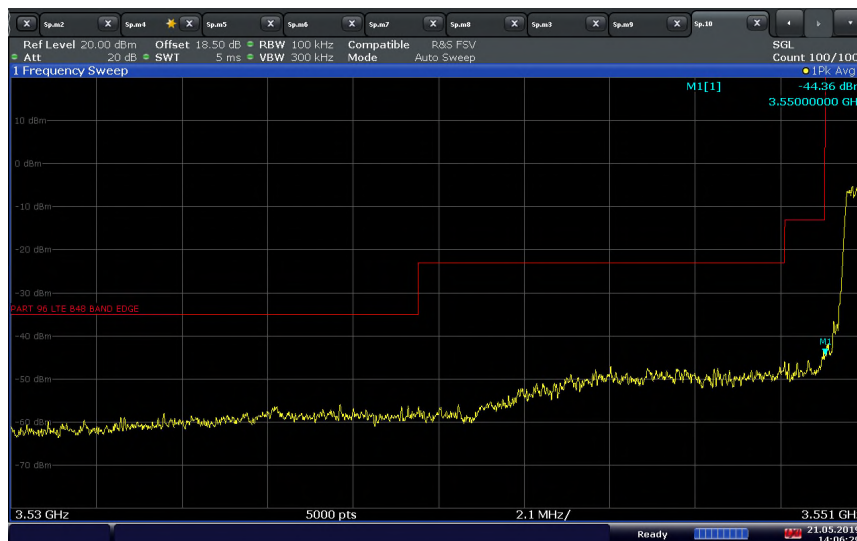
**LTE Band 48 (3550 – 3650 MHz)\_5 MHz BW / QPSK / High Channel 3647.5 MHz Full RB**  
**High Band Edge**



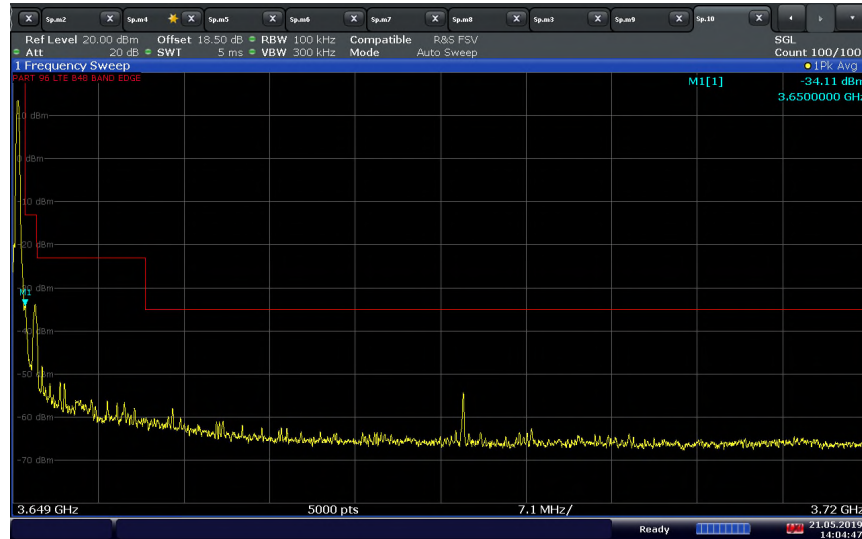
**LTE Band 48 (3550 – 3650 MHz)\_10 MHz BW / QPSK / Low Channel 3555 MHz 1 RB 0 offset**  
**Low Band Edge**



**LTE Band 48 (3550 – 3650 MHz)\_10 MHz BW / QPSK / Low Channel 3555 MHz Full RB**  
**Low Band Edge**

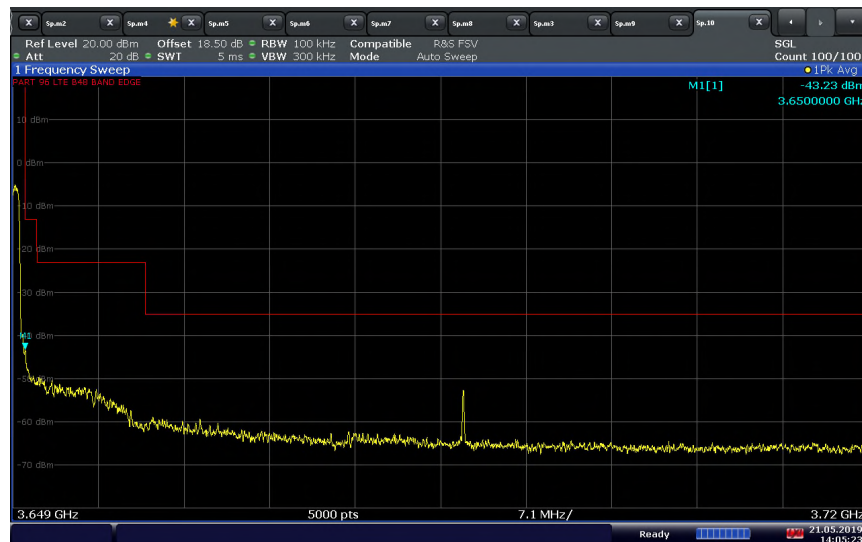


**LTE Band 48 (3550 – 3650 MHz)\_10 MHz BW / QPSK / High Channel 3645 MHz 1 RB 49 offset  
High Band Edge**



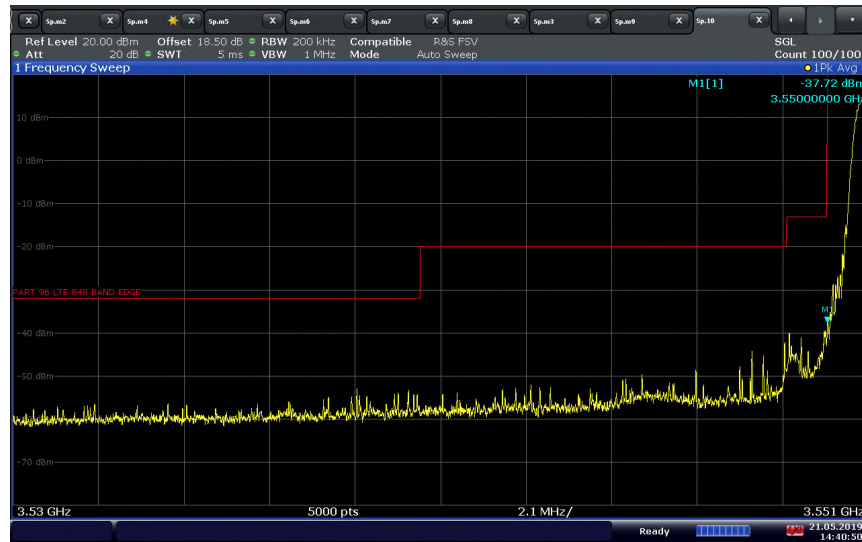
14:04:47 21.05.2019

**LTE Band 48 (3550 – 3650 MHz)\_10 MHz BW / QPSK / High Channel 3645 MHz Full RB  
High Band Edge**



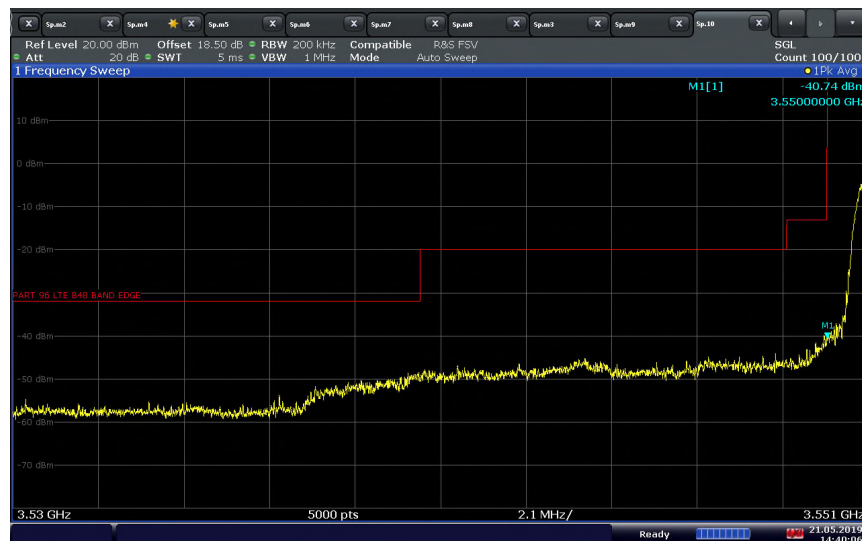
14:05:24 21.05.2019

**LTE Band 48 (3550 – 3650 MHz)\_15 MHz BW / QPSK / Low Channel 3557.5 MHz 1 RB 0 offset**  
**Low Band Edge**



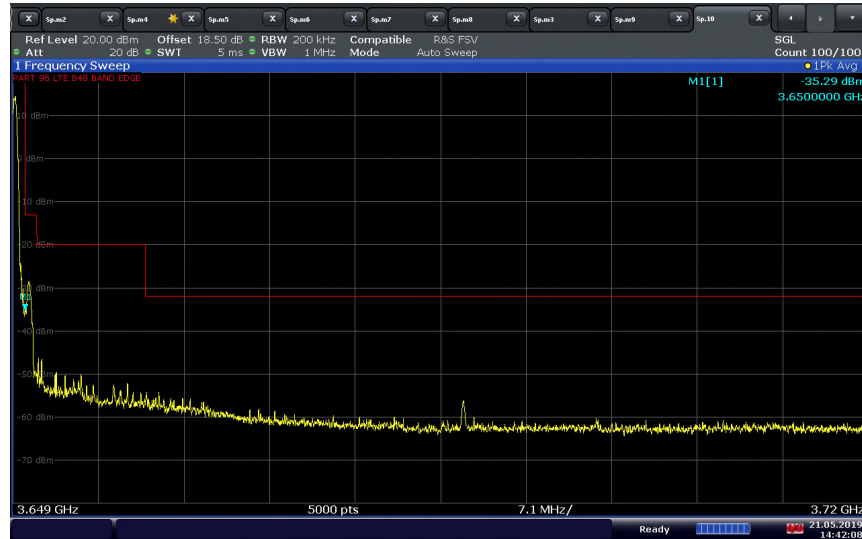
14:40:51 21.05.2019

**LTE Band 48 (3550 – 3650 MHz)\_15 MHz BW / QPSK / Low Channel 3557.5 MHz Full RB**  
**Low Band Edge**



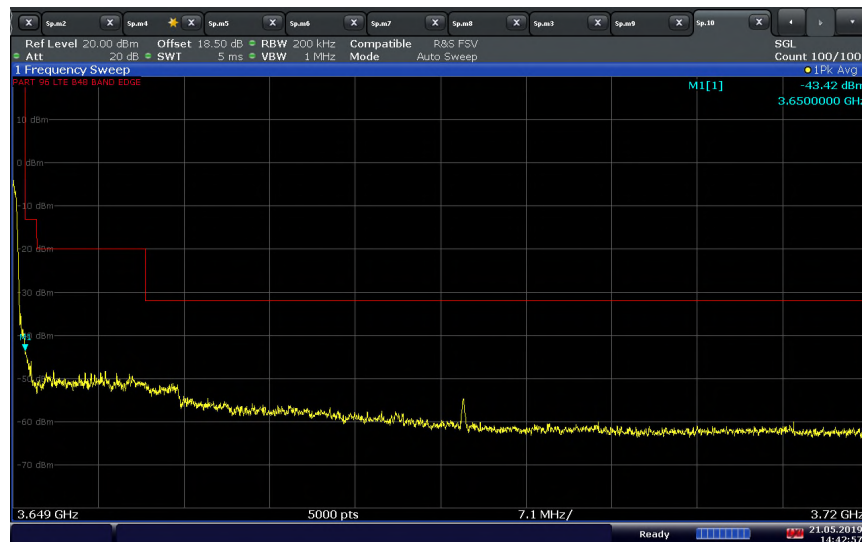
14:40:07 21.05.2019

**LTE Band 48 (3550 – 3650 MHz)\_15 MHz BW / QPSK / High Channel 3642.5 MHz 1 RB 74 offset**  
**High Band Edge**



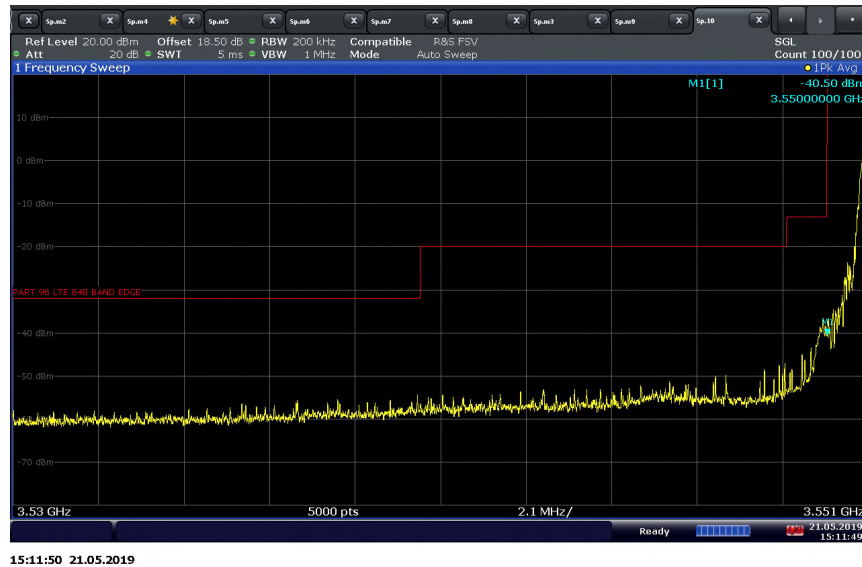
14:42:08 21.05.2019

**LTE Band 48 (3550 – 3650 MHz)\_15 MHz BW / QPSK / High Channel 3642.5 MHz Full RB**  
**High Band Edge**

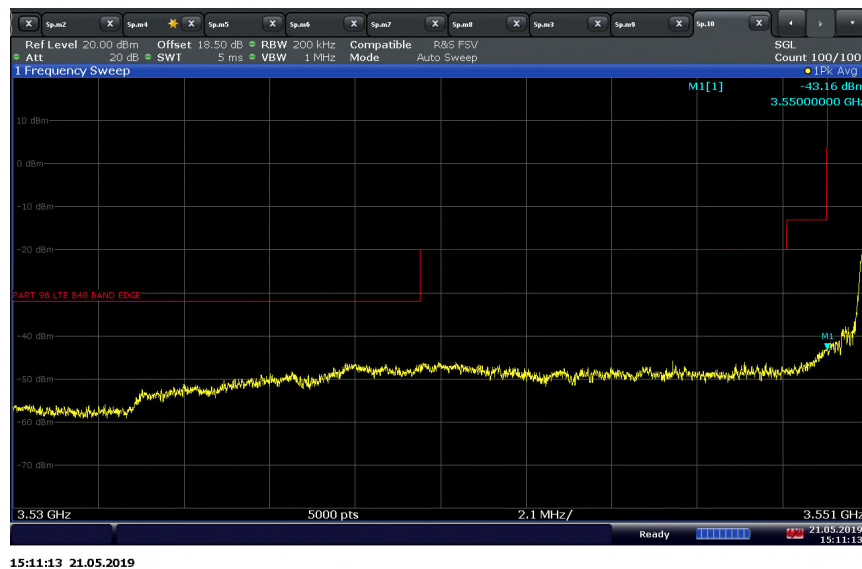


14:42:57 21.05.2019

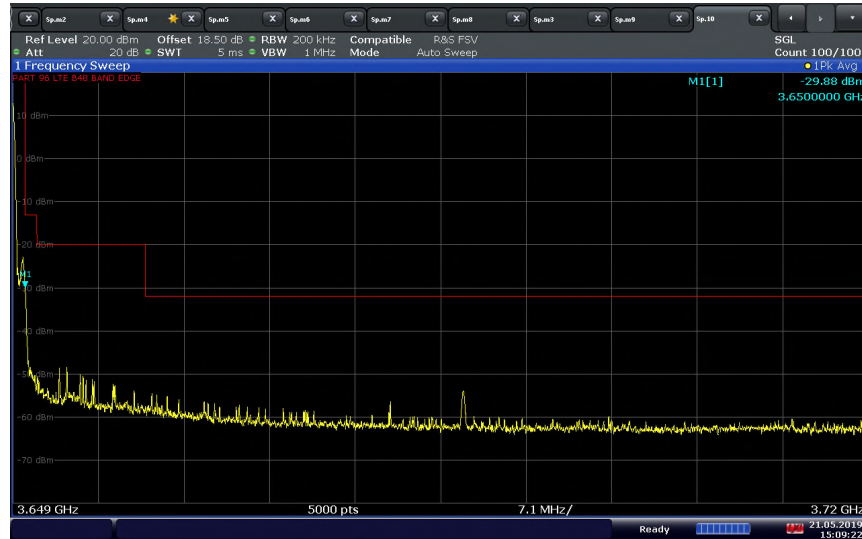
**LTE Band 48 (3550 – 3650 MHz)\_20 MHz BW / QPSK / Low Channel 3560 MHz 1 RB 0 offset**  
**Low Band Edge**



**LTE Band 48 (3550 – 3650 MHz)\_20 MHz BW / QPSK / Low Channel 3560 MHz Full RB**  
**Low Band Edge**

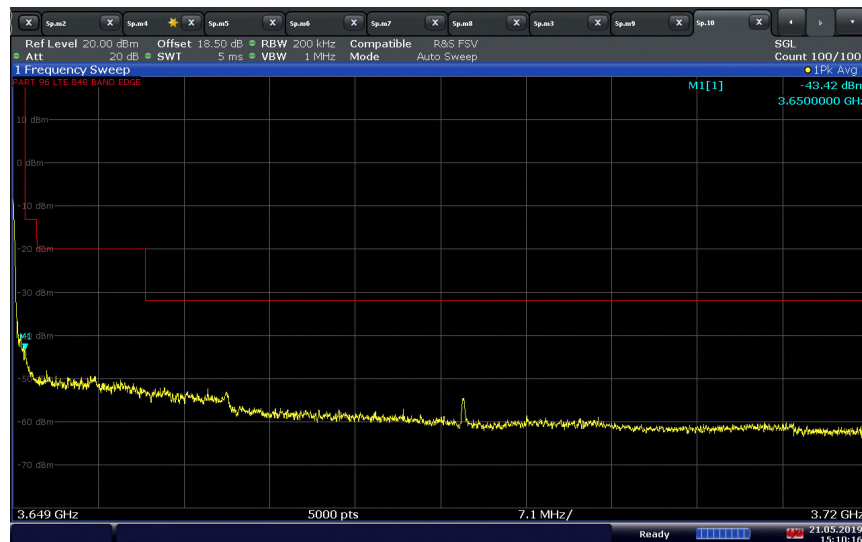


**LTE Band 48 (3550 – 3650 MHz)\_20 MHz BW / QPSK / High Channel 3640 MHz 1 RB 99 offset**  
**High Band Edge**



15:09:23 21.05.2019

**LTE Band 48 (3550 – 3650 MHz)\_20 MHz BW / QPSK / High Channel 3640 MHz Full RB**  
**High Band Edge**

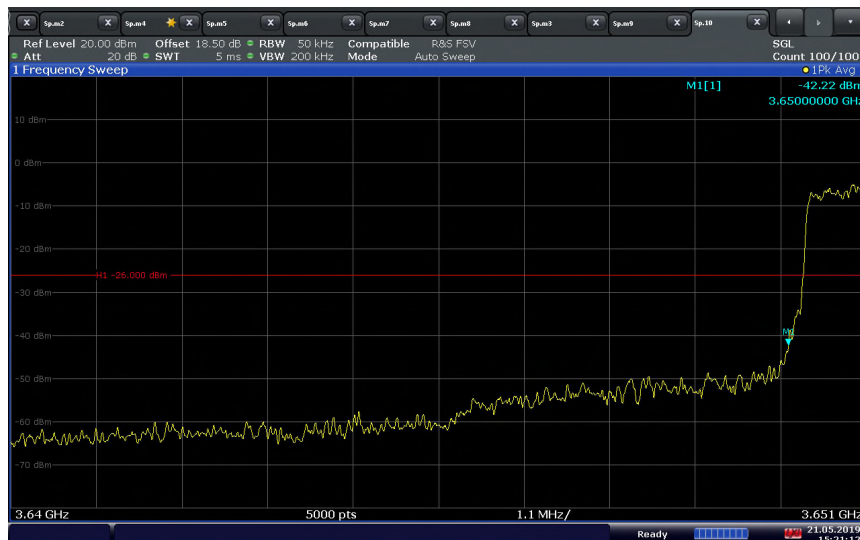


15:10:16 21.05.2019

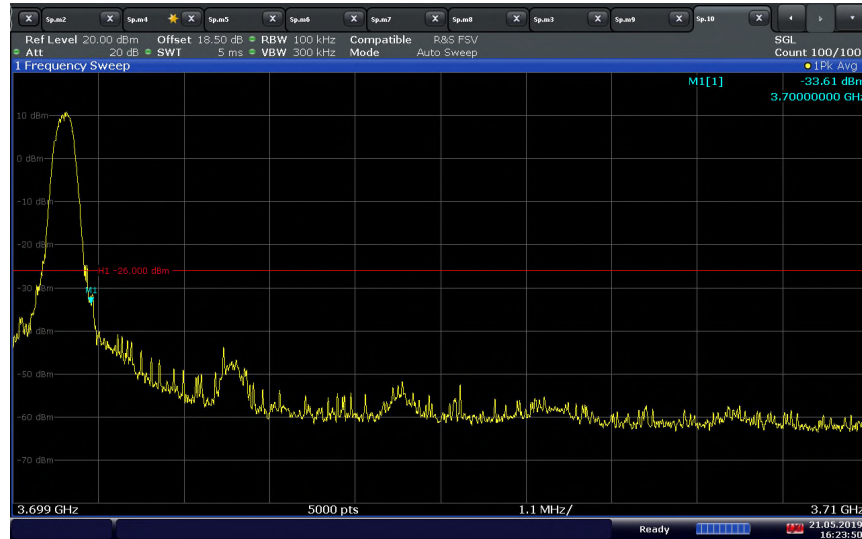
**LTE Band 48 (3650 – 3700 MHz)\_5 MHz BW / QPSK / Low Channel 3652.5 MHz 1 RB 0 offset**  
**Low Band Edge**



**LTE Band 48 (3650 – 3700 MHz)\_5 MHz BW / QPSK / Low Channel 3652.5 MHz Full RB**  
**Low Band Edge**



**LTE Band 48 (3650 – 3700 MHz)\_5 MHz BW / QPSK / High Channel 3697.5 MHz 1 RB 24 offset  
High Band Edge**



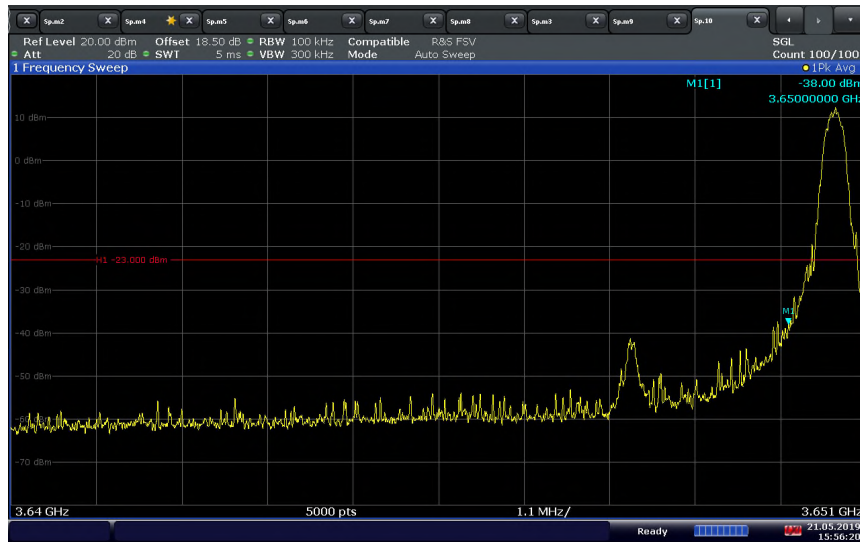
16:23:50 21.05.2019

**LTE Band 48 (3650 – 3700 MHz)\_5 MHz BW / QPSK / High Channel 3697.5 MHz Full RB  
High Band Edge**



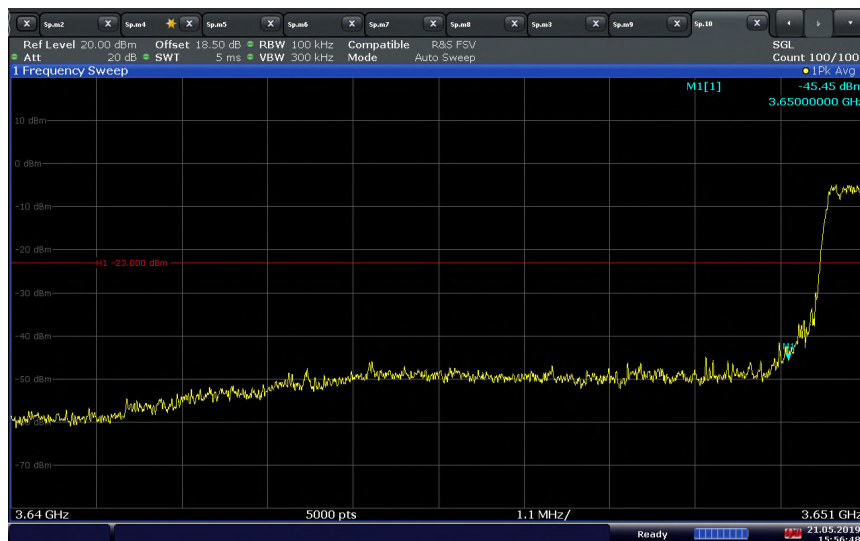
15:51:21 21.05.2019

**LTE Band 48 (3650 – 3700 MHz)\_10 MHz BW / QPSK / Low Channel 3655 MHz 1 RB 0 offset**  
**Low Band Edge**



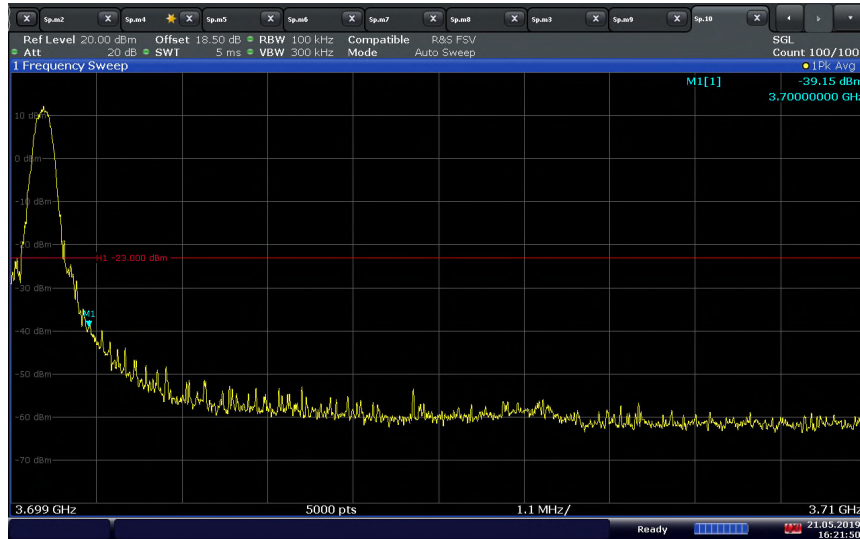
15:56:21 21.05.2019

**LTE Band 48 (3650 – 3700 MHz)\_10 MHz BW / QPSK / Low Channel 3655 MHz Full RB**  
**Low Band Edge**

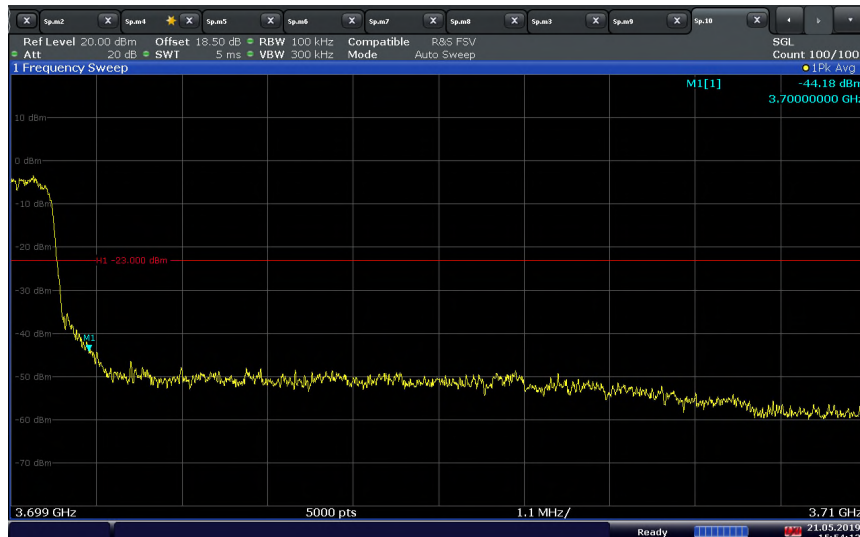


15:56:48 21.05.2019

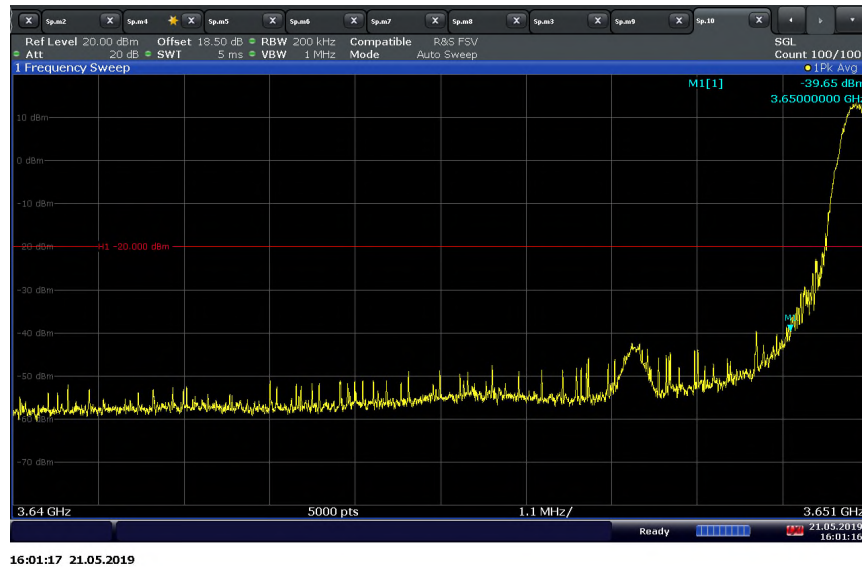
**LTE Band 48 (3650 – 3700 MHz)\_10 MHz BW / QPSK / High Channel 3695 MHz 1 RB 49 offset**  
**High Band Edge**



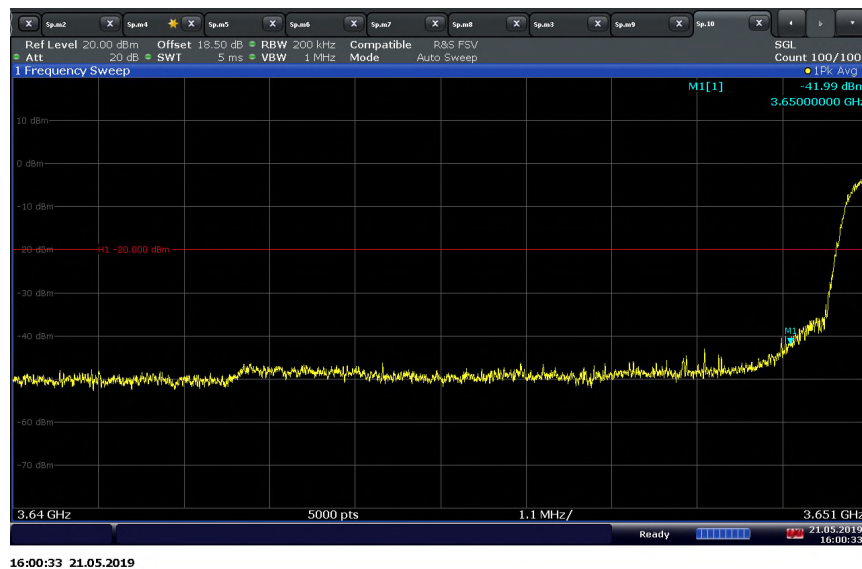
**LTE Band 48 (3650 – 3700 MHz)\_10 MHz BW / QPSK / High Channel 3695 MHz Full RB**  
**High Band Edge**



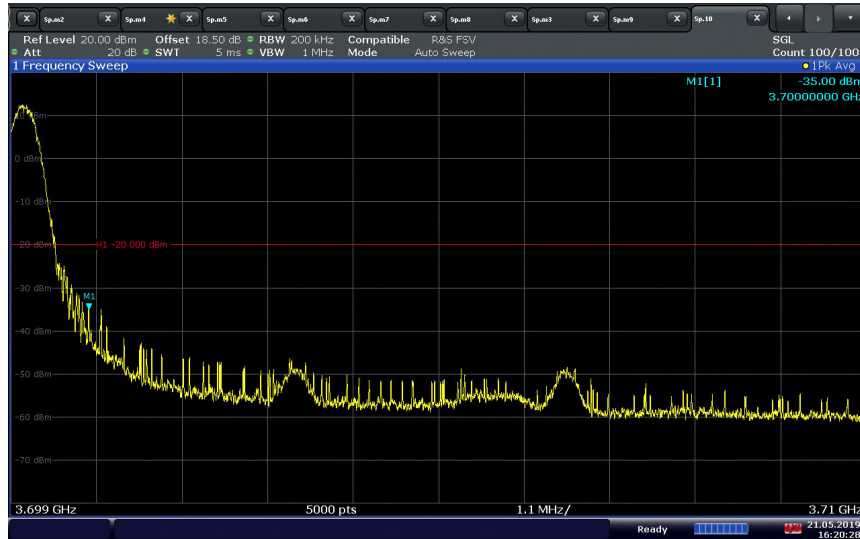
**LTE Band 48 (3650 – 3700 MHz)\_15 MHz BW / QPSK / Low Channel 3657.5 MHz 1 RB 0 offset**  
**Low Band Edge**



**LTE Band 48 (3650 – 3700 MHz)\_15 MHz BW / QPSK / Low Channel 3657.5 MHz Full RB**  
**Low Band Edge**

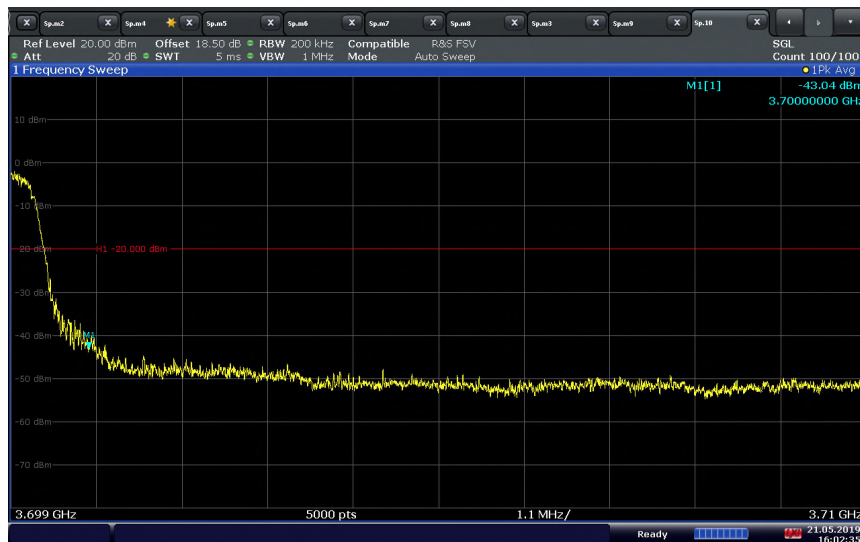


**LTE Band 48 (3650 – 3700 MHz)\_15 MHz BW / QPSK / High Channel 3692.5 MHz 1 RB 74 offset**  
**High Band Edge**



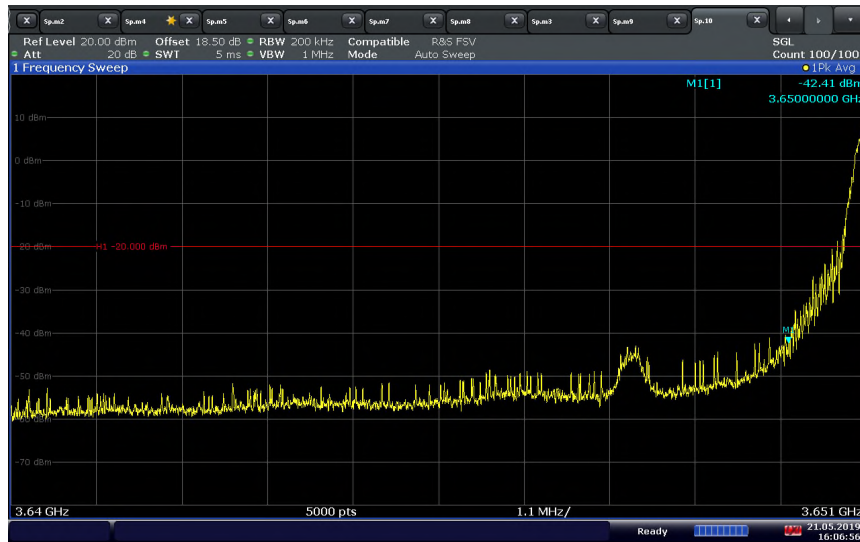
16:20:28 21.05.2019

**LTE Band 48 (3650 – 3700 MHz)\_15 MHz BW / QPSK / High Channel 3692.5 MHz Full RB**  
**High Band Edge**



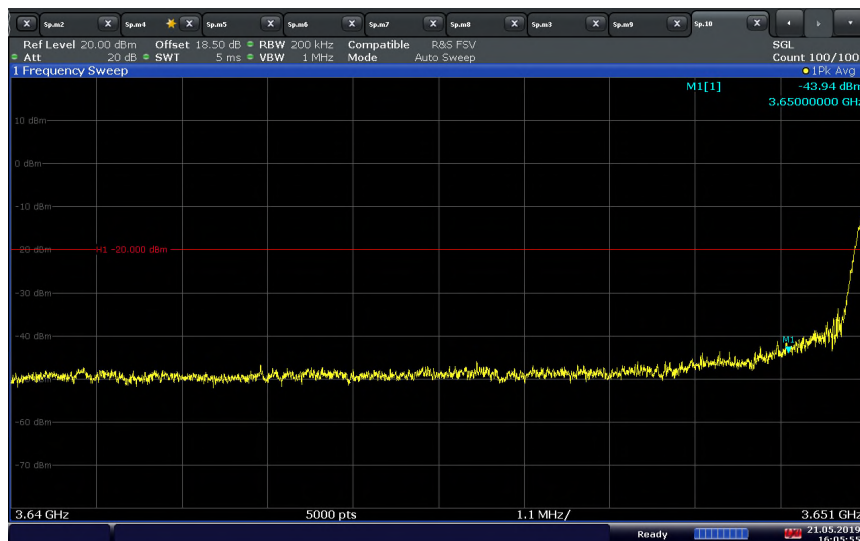
16:02:36 21.05.2019

**LTE Band 48 (3650 – 3700 MHz)\_20 MHz BW / QPSK / Low Channel 3660 MHz 1 RB 0 offset**  
**Low Band Edge**



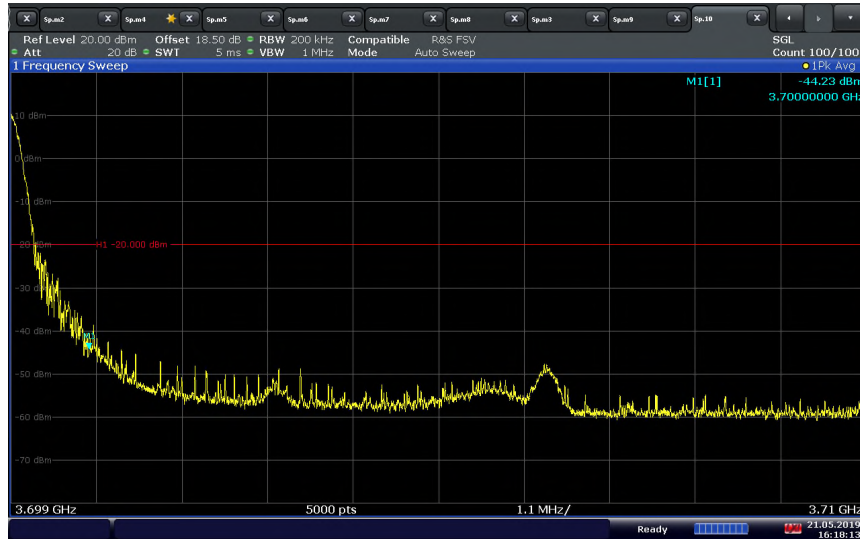
16:06:57 21.05.2019

**LTE Band 48 (3650 – 3700 MHz)\_20 MHz BW / QPSK / Low Channel 3660 MHz Full RB**  
**Low Band Edge**



16:05:55 21.05.2019

**LTE Band 48 (3650 – 3700 MHz)\_20 MHz BW / QPSK / High Channel 3690 MHz 1 RB 99 offset**  
**High Band Edge**



**LTE Band 48 (3650 – 3700 MHz)\_20 MHz BW / QPSK / High Channel 3690 MHz Full RB**  
**High Band Edge**

