# FCC RF Test Report

| | | |
|---|---|---|
| **APPLICANT** | : | **Nokia Shanghai Bell Co., Ltd.** |
| **EQUIPMENT** | : | **NOK 5G21 GATEWAY GRY KIT** |
| **BRAND NAME** | : | **T-Mobile** |
| **MODEL NAME** | : | **5G21-12W-A** |
| **FCC ID** | : | **2ADZR5G2112WA** |
| **STANDARD** | : | **47 CFR Part 2, 96** |
| **CLASSIFICATION** | : | **Citizens Band End User Devices (CBE)** |
| **EQUIPMENT TYPE** | : | **End User Equipment** |

**The product was received on Mar. 11, 2020 and completely tested on Aug. 01, 2020. We, Sporton International (Kunshan) Inc., would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.26 and shown compliance with the applicable technical standards.**

**The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (Kunshan) Inc., the test report shall not be reproduced except in full.**

Jason Jia

**Reviewed by: Jason Jia / Supervisor**

James Huang

**Approved by: James Huang / Manager**

ACCREDITED Cert #5145.02

***Sporton International (Kunshan) Inc.***

***No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China***

# Table of Contents

# History of this test report

| Report No. | Version | Description | Issued Date |
|---|---|---|---|
| FG9D2703B | 01 | Initial issue of report | Aug. 03, 2020 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

# Summary of Test Result

| Report Clause | Ref Std. Clause | Test Items | Result (PASS/FAIL) | Remark |
|---|---|---|---|---|
| - | §96.41 | Peak-to-Average Ratio | Not Required | Not applicable for End User Devices |
| 3.2 | §96.41 | Maximum E.I.R.P | Pass | - |
| | | Maximum Power Spectral Density | Not Required | Not applicable for End User Devices |
| 3.3 | §2.1049 §96.41 | Occupied Bandwidth | Reporting only | - |
| 3.4 | §2.1051 §96.41 | Conducted Band Edge Measurement | Pass | - |
| 3.5 | §2.1051 §96.41 | Conducted Spurious Emission | Pass | - |
| 3.6 | §2.1055 | Frequency Stability for Temperature & Voltage | Pass | - |
| 4.4 | §2.1051 §96.41 | Radiated Spurious Emission | Pass | Under limit 4.77 dB at 7230.00 MHz |

| **Declaration of Conformity:** |
|---|
| The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers. |
| **Comments and Explanations:** |
| The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification. |

# 1 General Description

## 1.1 Applicant

**Nokia Shanghai Bell Co., Ltd.**
388#, Ningqiao Road, China (Shanghai) Pilot Free Trade Zone, Shanghai 201206, China

## 1.2 Manufacturer

**Nokia Solutions and Networks Oy**
Karakaari 7, 02610 Espoo, Finland

## 1.3 Feature of Equipment Under Test

| Product Feature | |
|---|---|
| **Equipment** | NOK 5G21 GATEWAY GRY KIT |
| **Brand Name** | T-Mobile |
| **Model Name** | 5G21-12W-A |
| **FCC ID** | 2ADZR5G2112WA |
| **Tx Frequency** | LTE Band 48: 3552.5 MHz ~ 3697.5 MHz |
| **Rx Frequency** | LTE Band 48: 3552.5 MHz ~ 3697.5 MHz |
| **Bandwidth** | 5MHz / 10MHz / 15MHz / 20MHz |
| **Uplink CA Band(s)** | 48C |
| **Antenna Gain** | 4.1 dBi |
| **Type of Modulation** | QPSK / 16QAM / 64QAM / 256QAM |
| **HW Version** | 3TG00739A |
| **SW Version** | HB5GGW_D010000B42T0101E0379.tar |
| **EUT Stage** | Identical Prototype |

**Remark:**
The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

| Specification of Accessory | | | | |
|---|---|---|---|---|
| **AC Adapter 1** | **Brand Name** | DELTA | **Model Name** | UPD-480WNAB B |
| | **Power Rating** | I/P: 100-240Vac, 1600mA, O/P:12Vdc, 4000mA | | |
| **AC Adapter 2** | **Brand Name** | FSP | **Model Name** | FSP048-A12U01 |
| | **Power Rating** | I/P: 100-240Vac, 1300mA, O/P:12Vdc, 4000mA | | |

Remark：Use adapter 1 for all tests.

## 1.4 Maximum ERP Power, Frequency Tolerance, and Emission Designator

| LTE Band 48 | | QPSK | | | 16QAM | | |
|---|---|---|---|---|---|---|---|
| BW (MHz) | Frequency Range (MHz) | Emission Designator (99%OBW) | Frequency Tolerance (ppm) | Maximum EIRP (W) | Emission Designator (99%OBW) | Frequency Tolerance (ppm) | Maximum EIRP (W) |
| 5 | 3552.5~3697.5 | 4M50G7D | - | 0.1603 | 4M50W7D | - | 0.1742 |
| 10 | 3555~3695 | 9M03G7D | 0.0019 | 0.1521 | 9M05W7D | - | 0.1679 |
| 15 | 3557.5~3692.5 | 13M5G7D | - | 0.1560 | 13M6W7D | - | 0.1694 |
| 20 | 3560~3690 | 17M9G7D | - | 0.1531 | 17M9W7D | - | 0.1656 |
| LTE Band 48 | | 64QAM | | | 256QAM | | |
| BW (MHz) | Frequency Range (MHz) | Emission Designator (99%OBW) | Frequency Tolerance (ppm) | Maximum EIRP (W) | Emission Designator (99%OBW) | Frequency Tolerance (ppm) | Maximum EIRP (W) |
| 5 | 3552.5~3697.5 | 4M49W7D | - | 0.1897 | 4M49W7D | - | 0.1866 |
| 10 | 3555~3695 | 9M05W7D | - | 0.1807 | 9M03W7D | - | 0.1820 |
| 15 | 3557.5~3692.5 | 13M5W7D | - | 0.1722 | 13M5W7D | - | 0.1795 |
| 20 | 3560~3690 | 17M9W7D | - | 0.1714 | 18M0W7D | - | 0.1702 |

| LTE Band 48 CA | QPSK | | | 16QAM | | |
|---|---|---|---|---|---|---|
| BW (MHz) | Emission Designator (99%OBW) | Frequency Tolerance (ppm) | Maximum EIRP(W) | Emission Designator (99%OBW) | Frequency Tolerance (ppm) | Maximum EIRP(W) |
| 5MHz+20MHz | 23M4G7D | - | 0.0388 | 23M3W7D | - | 0.0351 |
| 10MHz+20MHz | 28M1G7D | - | 0.0387 | 28M1W7D | - | 0.0342 |
| 15MHz+20MHz | 32M9G7D | - | 0.0382 | 32M9W7D | - | 0.0335 |
| 20MHz+5MHz | 23M4G7D | - | 0.0388 | 23M3W7D | - | 0.0334 |
| 20MHz+10MHz | 28M1G7D | - | 0.0390 | 28M1W7D | - | 0.0333 |
| 20MHz+15MHz | 32M9G7D | - | 0.0387 | 32M9W7D | - | 0.0328 |
| 20MHz+20MHz | 37M8G7D | - | 0.0379 | 37M7W7D | - | 0.0336 |
| LTE Band 48 CA | 64QAM | | | 256QAM | | |
| BW (MHz) | Emission Designator (99%OBW) | Frequency Tolerance (ppm) | Maximum EIRP(W) | Emission Designator (99%OBW) | Frequency Tolerance (ppm) | Maximum EIRP(W) |
| 5MHz+20MHz | 23M3W7D | - | 0.0320 | 23M1W7D | - | 0.0335 |
| 10MHz+20MHz | 28M2W7D | - | 0.0324 | 28M1W7D | - | 0.0337 |
| 15MHz+20MHz | 32M9W7D | - | 0.0327 | 32M6W7D | - | 0.0334 |
| 20MHz+5MHz | 23M4W7D | - | 0.0325 | 23M3W7D | - | 0.0333 |
| 20MHz+10MHz | 28M1W7D | - | 0.0323 | 27M9W7D | - | 0.0338 |
| 20MHz+15MHz | 32M8W7D | - | 0.0327 | 32M7W7D | - | 0.0333 |
| 20MHz+20MHz | 37M7W7D | - | 0.0327 | 37M5W7D | - | 0.0333 |

## 1.5 Testing Site

Sporton International (Kunshan) Inc. is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

| | | | |
|---|---|---|---|
| **Test Firm** | Sporton International (Kunshan) Inc. | | |
| **Test Site Location** | No. 1098, Pengxi North Road, Kunshan Economic Development Zone<br>Jiangsu Province 215300 People's Republic of China<br>TEL : +86-512-57900158<br>FAX : +86-512-57900958 | | |
| **Test Site No.** | **Sporton Site No.** | **FCC Designation No.** | **FCC Test Firm Registration No.** |
| | 03CH04-KS<br>TH01-KS | CN1257 | 314309 |

## 1.6 Test Software

| Item | Site | Manufacture | Name | Version |
|---|---|---|---|---|
| 1. | 03CH04-KS | AUDIX | E3 | 6.2009-8-24a |

## 1.7 Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ANSI C63.26-2015
- ANSI / TIA-603-E
- 47 CFR Part 2, 96
- FCC KDB 971168 D01 Power Meas. License Digital Systems v03r01
- FCC KDB 940660 D01 Part 96 CBRS v02
- FCC KDB 412172 D01 Determining ERP and EIRP v01r01

**Remark:**

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

# 2 Test Configuration of Equipment Under Test

## 2.1 Test Mode

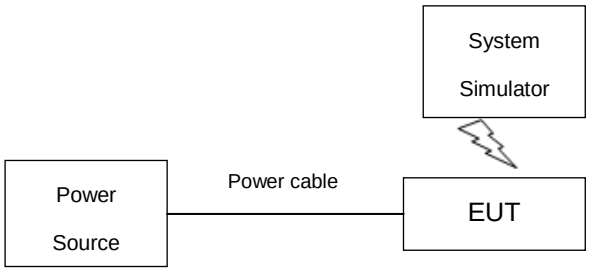
Antenna port conducted and radiated test items listed below are performed according to KDB 971168 D01 Power Meas. License Digital Systems v03r01 with maximum output power.

For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Y plane) were recorded in this report.

| Test Items | Band | Bandwidth (MHz) | | | | | | Modulation | | | | RB # | | | Test Channel | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1.4 | 3 | 5 | 10 | 15 | 20 | QPSK | 16QAM | 64 QAM | 256 QAM | 1 | Half | Full | L | M | H |
| Max. Output Power | 48 | - | - | v | v | v | v | v | v | v | v | v | v | v | v | v | v |
| 26dB and 99% Bandwidth | 48 | - | - | v | v | v | v | v | v | v | v | | | v | v | v | v |
| Conducted Band Edge | 48 | - | - | v | v | v | v | v | v | v | v | v | | v | v | | v |
| Conducted Spurious Emission | 48 | - | - | v | v | v | v | v | v | v | v | v | | v | v | v | v |
| E.R.P / E.I.R.P | 48 | - | - | v | v | v | v | v | v | v | v | v | | | v | v | v |
| Frequency Stability | 48 | - | - | | v | | | v | v | v | v | v | | | v | v | v |
| Radiated Spurious Emission | 48 | Worst Case | | | | | | | | | | | | | | v | |
| Remark | 1. 2. The mark "**v** " means that this configuration is chosen for testing<br>3. The mark "-" means that this bandwidth is not supported.<br>4. The device is investigated from 30MHz to 10 times of fundamental signal for radiated spurious emission test under different RB size/offset and modulations in exploratory test. Subsequently, only the worst case emissions are reported.<br>5. All the radiated test cases were performed with Adapter 1. | | | | | | | | | | | | | | | | |

| Test Items | Band | Bandwidth (MHz) | | | | | | | Modulation | | | | RB # | | | Test Channel | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 20+20 | 20+15 | 15+20 | 20+10 | 10+20 | 20+5 | 5+20 | QPSK | 16QAM | 64QAM | 256QAM | 1 | Half | Full | L | M | H |
| Max. Output Power | 48C | v | v | v | v | v | v | v | v | v | v | v | | | v | v | v | v |
| 26dB and 99% Bandwidth | 48C | v | v | v | v | v | v | v | v | v | v | v | | | v | v | v | v |
| Conducted Band Edge | 48C | v | v | v | v | v | v | v | v | v | v | v | | | v | v | | v |
| Conducted Spurious Emission | 48C | v | v | v | v | v | v | v | v | v | v | v | | | v | v | v | v |
| E.R.P / E.I.R.P | 48C | v | v | v | v | v | v | v | v | v | v | v | | | v | v | v | v |
| Radiated Spurious Emission | 48C | Worst Case | | | | | | | | | | | | | | | v | |
| Note | 1. The mark "**v** " means that this configuration is chosen for testing<br>2. The mark "-" means that this bandwidth is not supported.<br>3. The device is investigated from 30MHz to 10 times of fundamental signal for radiated spurious emission test under different RB size/offset and modulations in exploratory test. Subsequently, only the worst case emissions are reported.<br>4. All the radiated test cases were performed with Adapter 1.<br>5. Frequency stability only shows the worst case of LTE band 48/48C.<br>6. LTE band41C supports full RB only. | | | | | | | | | | | | | | | | | |

## 2.2 Connection Diagram of Test System




This example is connection diagram of EUT test configurations.

. For detail, please refer to test mode configuration and setup photographs for each

## 2.3 Support Unit used in test configuration

| Item | Equipment | Trade Name | Model No. | FCC ID | Data Cable | Power Cord |
|---|---|---|---|---|---|---|
| 1. | Power Supply | GWINSTEK | PSS-2002 | N/A | N/A | Unshielded, 1.8 m |
| 2. | LTE Base Station | Anritsu | MT8821C | N/A | N/A | Unshielded, 1.8 m |

## 2.4 Measurement Results Explanation Example

**For all conducted test items:**

The offset level is set in the spectrum analyzer to compensate the RF cable loss between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

The spectrum analyzer offset is derived from RF cable loss.

*Offset = RF cable loss.*

Following shows an offset computation example with cable loss 9.98 dB.

Example :

*Offset(dB) = RF cable loss(dB).*

= 9.98 (dB)

## 2.5 Frequency List of Low/Middle/High Channels

| LTE Band 48 Channel and Frequency List | | | | |
|---|---|---|---|---|
| **BW [MHz]** | **Channel/Frequency(MHz)** | **Lowest** | **Middle** | **Highest** |
| 20 | Channel | 55340 | 55990 | 56640 |
| | Frequency | 3560.0 | 3625.0 | 3690.0 |
| 15 | Channel | 55315 | 55990 | 56665 |
| | Frequency | 3557.5 | 3625.0 | 3692.5 |
| 10 | Channel | 55290 | 55990 | 56690 |
| | Frequency | 3555.0 | 3625.0 | 3695.0 |
| 5 | Channel | 55265 | 55990 | 56715 |
| | Frequency | 3552.5 | 3625.0 | 3697.5 |

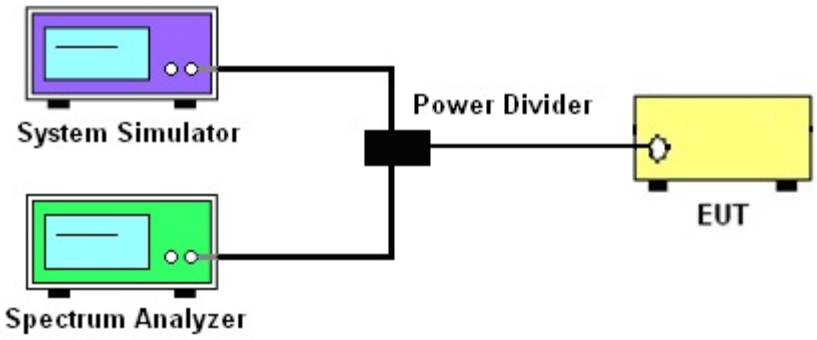
# 3 Conducted Test Items

## 3.1 Measuring Instruments

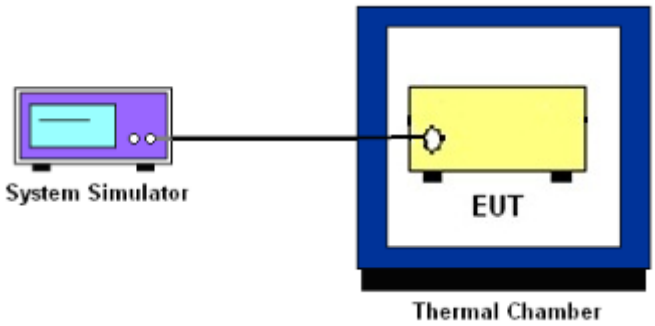
See list of measuring instruments of this test report.

### 3.1.1 Test Setup

### 3.1.2 EIRP, Occupied Bandwidth, Conducted Band-Edge and Conducted Spurious Emission




### 3.1.3 Frequency Stability




### 3.1.4 Test Result of Conducted Test

Please refer to Appendix A.

## 3.2 EIRP

### 3.2.1 Description of the EIRP Measurement

EIRP and PSD limits for CBRS equipment as below table:

| 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 |

**Remark**: Maximum PSD values are radiated. Measurements can be done conducted and add antenna gain back in.

1. Set instrument center frequency to OBW center frequency.
2. Set span to at least 2 times the OBW.
3. Set the RBW to the specified reference bandwidth (often 1 MHz).
4. Set VBW ≥ 3 × RBW.
5. Detector = RMS (power averaging).
6. Ensure that the number of measurement points in the sweep ≥ 2 × span/RBW.
7. Sweep time = auto couple.
8. Employ trace averaging (RMS) mode over a minimum of 100 traces.
9. Use the peak marker function to determine the maximum amplitude level within the reference bandwidth (PSD).
10. Determine the EIRP by adding the effective antenna gain to the adjusted power level.
11. Add 10 log (1/duty cycle) to the measured power level to compute the average power during continuous transmission.

The testing follows ANSI C63.26-2015 Section 5.2.5.5

According to KDB 412172 D01 Power Approach,

EIRP = $P_T + G_T – L_C$, where

$P_T$ = transmitter output power in dBm

$G_T$ = gain of the transmitting antenna in dBi

LC = signal attenuation in the connecting cable between the transmitter and antenna in dB

# 3.3 Occupied Bandwidth

## 3.3.1 Description of Occupied Bandwidth Measurement

The occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5% of the total mean transmitted power.

The 26 dB emission bandwidth is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated 26 dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth equal to approximately 1.0% of the emission bandwidth.

## 3.3.2 Test Procedures

The testing follows ANSI C63.26-2015 Section 5.4.3 (26dB) and Section 5.4.4 (99OB)

1. The EUT was connected to spectrum analyzer and system simulator via a power divider.
2. The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be between two and five times the anticipated OBW.
3. The nominal resolution bandwidth (RBW) shall be in the range of 1 to 5 % of the anticipated OBW, and the VBW shall be at least 3 times the RBW.
4. Set the detection mode to peak, and the trace mode to max hold.
5. Determine the reference value: Set the EUT to transmit a modulated signal. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace. (this is the reference value)
6. Determine the “-26 dB down amplitude” as equal to (Reference Value – X).
7. Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display such that each marker is at or slightly below the “–X dB down amplitude” determined in step 6. If a marker is below this “-X dB down amplitude” value it shall be placed as close as possible to this value. The OBW is the positive frequency difference between the two markers.
8. Use the 99 % power bandwidth function of the spectrum analyzer and report the measured bandwidth.

# 3.4 Conducted Band Edge

## 3.4.1 Description of Conducted Band Edge Measurement

Part 96.41 (e) (1) (i)

For CBSD the emission limits outside the fundamental are as follows:

Within 0 MHz to 10 MHz above and below the assigned channel ≤ −13 dBm/MHz

Greater than 10 MHz above and below the assigned channel ≤ −25 dBm/MHz

Part 96.41 (e) (1) (ii)

For End User Devices the emission limits outside the fundamental are as follows:

Within 0 MHz to B MHz above and below the assigned channel ≤ −13 dBm/MHz

Greater than B MHz above and below the assigned channel ≤ −25 dBm/MHz

where B is the bandwidth in megahertz of the assigned channel or multiple contiguous channels of the End User Device.

Part 96.41 (e) (2)

For CBSDs and End User Devices, the conducted power of emissions below 3540 MHz or above 3710 MHz shall not exceed −25 dBm/MHz, and the conducted power of emissions below 3530 MHz or above 3720 MHz shall not exceed −40dBm/MHz

## 3.4.2 Test Procedures

The testing follows FCC KDB 971168 D01 v03r01 Section 6.1.

1. The EUT was connected to spectrum analyzer and system simulator via a power divider.
2. The band edges of low and high channels for the highest RF powers were measured.
3. Set RBW >= 1% EBW in the 1MHz band immediately outside and adjacent to the band edge.
4. Beyond the 1 MHz band from the band edge, RBW=1MHz was used
5. Offset has included the duty factor for LTE Band 48. Duty factor =10 log (1/x), where x is the measured duty cycle.
6. Set spectrum analyzer with RMS detector.
7. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

# 3.5 Conducted Spurious Emission

## 3.5.1 Description of Conducted Spurious Emission Measurement

96.41 (e)(2)

The conducted power of any emissions below 3530 MHz or above 3720 MHz shall not exceed −40dBm/MHz.

## 3.5.2 Test Procedures

The testing follows FCC KDB 971168 D01 v03r01 Section 6.1.

1. The EUT was connected to spectrum analyzer and system simulator via a power divider.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. The middle channel for the highest RF power within the transmitting frequency was measured.
4. The conducted spurious emission for the whole frequency range was taken.
5. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz.
6. Set spectrum analyzer with RMS detector.
7. Taking the record of maximum spurious emission.
8. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
9. The limit line is −40dBm/MHz.

# 3.6 Frequency Stability

## 3.6.1 Description of Frequency Stability Measurement

The frequency stability shall be measured by variation of ambient temperature and variation of primary supply voltage to ensure that the fundamental emission stays within the authorized frequency block. The frequency stability of the transmitter shall be maintained within ±0.00025% (±2.5ppm) of the center frequency

## 3.6.2 Test Procedures for Temperature Variation

The testing follows FCC KDB 971168 D01 v03r01 Section 9.0.

1. The EUT was set up in the thermal chamber and connected with the system simulator.
2. With power OFF, the temperature was decreased to -30°C and the EUT was stabilized before testing. Power was applied and the maximum change in frequency was recorded within one minute.
3. With power OFF, the temperature was raised in 10°C step up to 50°C. The EUT was stabilized at each step for at least half an hour. Power was applied and the maximum frequency change was recorded within one minute.

## 3.6.3 Test Procedures for Voltage Variation

The testing follows FCC KDB 971168 D01 v03r01 Section 9.0.

1. The EUT was placed in a temperature chamber at 25±5° C and connected with the system simulator.
2. The power supply voltage to the EUT was varied from 85% to 115% of the nominal value measured at the input to the EUT.
3. The variation in frequency was measured for the worst case.

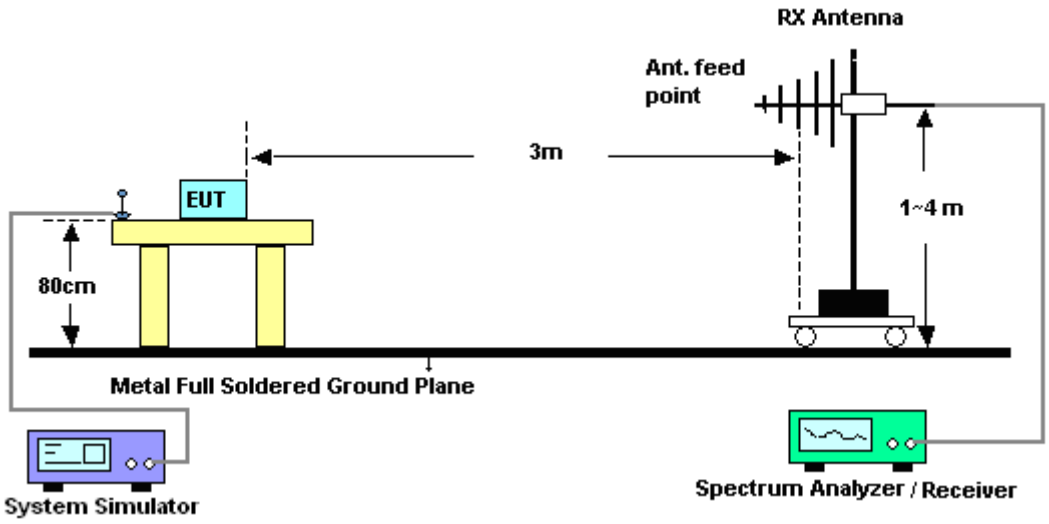
# 4 Radiated Test Items

## 4.1 Measuring Instruments

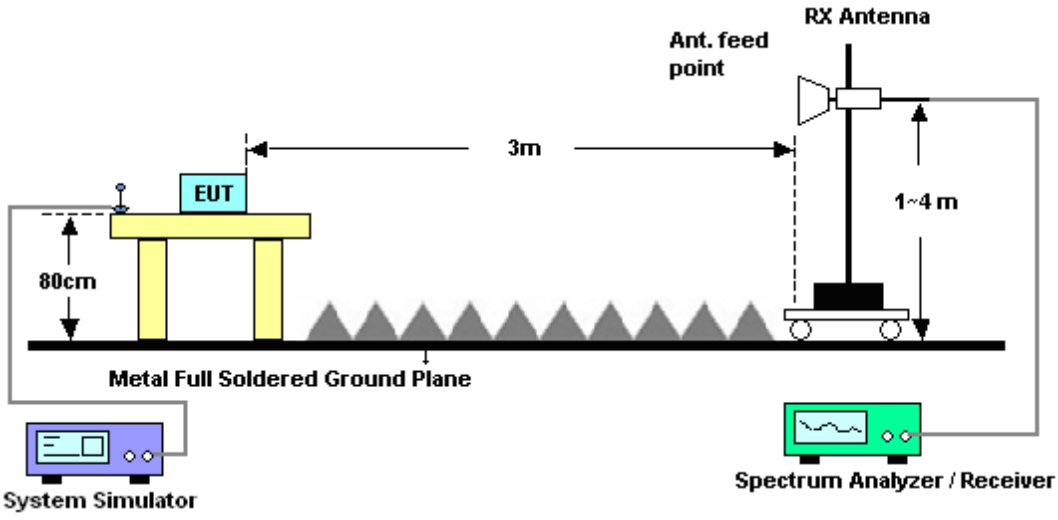
See list of measuring instruments of this test report.

## 4.2 Test Setup

**For radiated emissions from 30MHz to 1GHz**




**For radiated emissions above 1GHz**




## 4.3 Test Result of Radiated Test

Please refer to Appendix B.

# 4.4 Radiated Spurious Emission

## 4.4.1 Description of Radiated Spurious Emission Measurement

The radiated spurious emission was measured by substitution method according to ANSI / TIA-603-E. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitter power (P) by a factor of at least -40dBm / MHz.

The spectrum is scanned from 30 MHz up to a frequency including its 10th harmonic.

## 4.4.2 Test Procedures

1. The EUT was placed on a turntable with 0.8 meter height for frequency below 1GHz and 1.5 meter height for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the receiving antenna mounted on the antenna tower.
3. The table was rotated 360 degrees to determine the position of the highest spurious emission.
4. The height of the receiving antenna is varied between 1m to 4m to search the maximum spurious emission for both horizontal and vertical polarizations.
5. During the measurement, the system simulator parameters were set to force the EUT transmitting at maximum output power.
6. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, taking the record of maximum spurious emission.
7. A horn antenna was substituted in place of the EUT and was driven by a signal generator.
   Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.
   EIRP (dBm) = S.G. Power – Tx Cable Loss + Tx Antenna Gain
   ERP (dBm) = EIRP - 2.15
8. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
   The limit line is −40dBm/MHz

# 5 List of Measuring Equipment

| Instrument | Manufacturer | Model No. | Serial No. | Characteristics | Calibration Date | Test Date | Due Date | Remark |
|---|---|---|---|---|---|---|---|---|
| Spectrum Analyzer | R&S | FSV40 | 101040 | 10Hz~40GHz | Nov. 02, 2019 | Apr. 07, 2020~ Aug. 01, 2020 | Nov. 01, 2020 | Conducted (TH01-KS) |
| Thermal Chamber | Ten Billion | TTC-B3S | TBN-960502 | -40~+150°C | Oct. 28, 2019 | Apr. 07, 2020~ Aug. 01, 2020 | Oct. 27, 2020 | Conducted (TH01-KS) |
| EXA Spectrum Analyzer | Keysight | N9010A | MY55150244 | 10Hz-44G,MAX 30dB | Apr. 15, 2020 | May 21, 2020 | Apr. 14, 2021 | Radiation (03CH04-KS) |
| Bilog Antenna | TeseQ | CBL6111D | 49922 | 30MHz-1GHz | May 30, 2019 | May 21, 2020 | May 29, 2020 | Radiation (03CH04-KS) |
| Horn Antenna | Schwarzbeck | BBHA9120D | 1356 | 1GHz~18GHz | Apr. 20, 2020 | May 21, 2020 | Apr. 19, 2021 | Radiation (03CH04-KS) |
| SHF-EHF Horn | Com-power | AH-840 | 101115 | 18GHz~40GHz | Nov. 10, 2019 | May 21, 2020 | Nov. 09, 2020 | Radiation (03CH04-KS) |
| Amplifier | SONOMA | 310N | 187289 | 9KHz-1GHz | Aug. 06, 2019 | May 21, 2020 | Aug. 05, 2020 | Radiation (03CH04-KS) |
| Amplifier | MITEQ | EM18G40GGA | 060728 | 18~40GHz | Jan. 08, 2020 | May 21, 2020 | Jan. 07, 2021 | Radiation (03CH04-KS) |
| high gain Amplifier | MITEQ | AMF-7D-00101800-30-10P | 2025788 | 1Ghz-18Ghz | Aug. 16, 2019 | May 21, 2020 | Aug. 15, 2020 | Radiation (03CH04-KS) |
| Amplifier | Keysight | 83017A | MY57280106 | 500MHz~26.5GHz | Oct. 15, 2019 | May 21, 2020 | Oct. 14, 2020 | Radiation (03CH04-KS) |
| AC Power Source | Chroma | 61601 | F104090004 | N/A | NCR | May 21, 2020 | NCR | Radiation (03CH04-KS) |
| Turn Table | ChamPro | EM 1000-T | 060762-T | 0~360 degree | NCR | May 21, 2020 | NCR | Radiation (03CH04-KS) |
| Antenna Mast | ChamPro | EM 1000-A | 060762-A | 1 m~4 m | NCR | May 21, 2020 | NCR | Radiation (03CH04-KS) |

NCR: No Calibration Required

# 6 Uncertainty of Evaluation

**Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)**

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | 3.3dB |

**Uncertainty of Radiated Emission Measurement (1 GHz ~ 40 GHz)**

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | 2.8dB |

# Appendix A. Test Results of Conducted Test

## A1. LTE Band 48

### A1.1. EIRP

#### 1RB0

| Mode | LTE Band 48 : Conducted EIRP (dBm/10MHz) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BW | 5MHz | | 10MHz | | 15MHz | | 20MHz | | 5MHz | 10MHz | 15MHz | 20MHz |
| Mod. | QPSK | 16QAM | QPSK | 16QAM | QPSK | 16QAM | QPSK | 16QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Lowest CH | 22.05 | 22.26 | 21.70 | 22.20 | 21.73 | 22.07 | 21.85 | 22.05 | 22.18 | 22.25 | 21.82 | 22.03 |
| Middle CH | 21.63 | 22.08 | 21.69 | 22.25 | 21.93 | 22.10 | 21.47 | 22.19 | 22.59 | 21.96 | 22.36 | 21.99 |
| Highest CH | 21.57 | 22.23 | 21.82 | 21.73 | 21.27 | 22.27 | 21.29 | 22.07 | 21.99 | 21.91 | 22.00 | 22.08 |
| Limit | 23dBm /10MHz | | | | | | | | | | | |
| Result | Pass | | | | | | | | | | | |

#### 1RB Max

| Mode | LTE Band 48 : Conducted EIRP (dBm/10MHz) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BW | 5MHz | | 10MHz | | 15MHz | | 20MHz | | 5MHz | 10MHz | 15MHz | 20MHz |
| Mod. | QPSK | 16QAM | QPSK | 16QAM | QPSK | 16QAM | QPSK | 16QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Lowest CH | 21.63 | 22.03 | 21.58 | 21.77 | 21.13 | 21.80 | 21.49 | 22.00 | 22.18 | 21.87 | 22.00 | 21.76 |
| Middle CH | 21.50 | 22.41 | 21.80 | 22.21 | 21.73 | 22.29 | 21.78 | 22.10 | 22.78 | 22.57 | 22.16 | 22.34 |
| Highest CH | 21.58 | 22.03 | 21.49 | 22.17 | 21.62 | 22.07 | 21.54 | 21.91 | 22.16 | 22.34 | 21.78 | 22.05 |
| Limit | 23dBm /10MHz | | | | | | | | | | | |
| Result | Pass | | | | | | | | | | | |

#### Full RB0

| Mode | LTE Band 48 : Conducted EIRP (dBm/10MHz) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BW | 5MHz | | 10MHz | | 15MHz | | 20MHz | | 5MHz | 10MHz | 15MHz | 20MHz |
| Mod. | QPSK | 16QAM | QPSK | 16QAM | QPSK | 16QAM | QPSK | 16QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Lowest CH | 21.46 | 21.61 | 20.78 | 21.03 | 19.76 | 20.15 | 19.10 | 19.27 | 21.74 | 21.13 | 20.38 | 19.53 |
| Middle CH | 21.44 | 22.06 | 21.13 | 20.91 | 20.40 | 20.15 | 19.41 | 19.48 | 21.48 | 21.15 | 20.54 | 19.56 |
| Highest CH | 21.33 | 21.56 | 20.65 | 21.13 | 19.89 | 19.96 | 19.31 | 19.49 | 21.59 | 21.20 | 20.36 | 19.47 |
| Limit | 23dBm /10MHz | | | | | | | | | | | |
| Result | Pass | | | | | | | | | | | |

# 1RB0

| Mode | LTE Band 48 : Conducted EIRP (dBm/10MHz) | | | |
|---|---|---|---|---|
| BW | 5MHz | 10MHz | 15MHz | 20MHz |
| Mod. | 256QAM | 256QAM | 256QAM | 256QAM |
| Lowest CH | 22.35 | 22.54 | 22.02 | 22.14 |
| Middle CH | 22.71 | 22.60 | 22.54 | 22.30 |
| Highest CH | 22.47 | 22.14 | 21.63 | 21.95 |
| Limit | 23dBm /10MHz | | | |
| Result | Pass | | | |

# 1RB Max

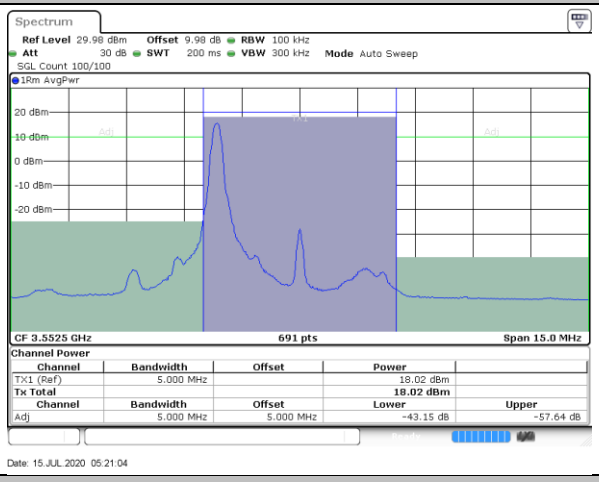
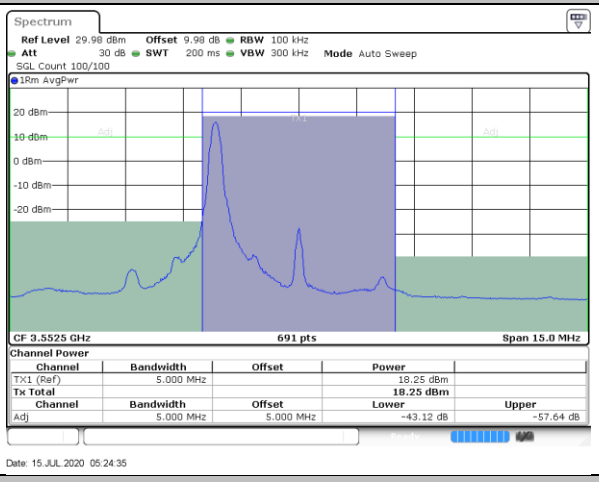
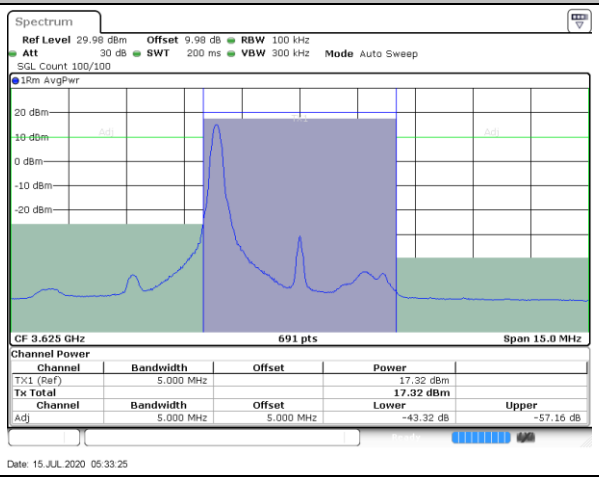
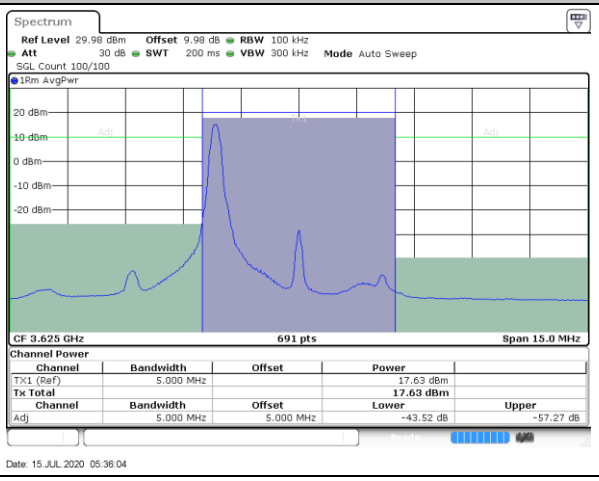
| Mode | LTE Band 48 : Conducted EIRP (dBm/10MHz) | | | |
|---|---|---|---|---|
| BW | 5MHz | 10MHz | 15MHz | 20MHz |
| Mod. | 256QAM | 256AM | 256QAM | 256QAM |
| Lowest CH | 22.16 | 22.03 | 21.93 | 21.88 |
| Middle CH | 22.64 | 22.28 | 22.18 | 22.31 |
| Highest CH | 21.85 | 22.16 | 22.16 | 21.90 |
| Limit | 23dBm /10MHz | | | |
| Result | Pass | | | |

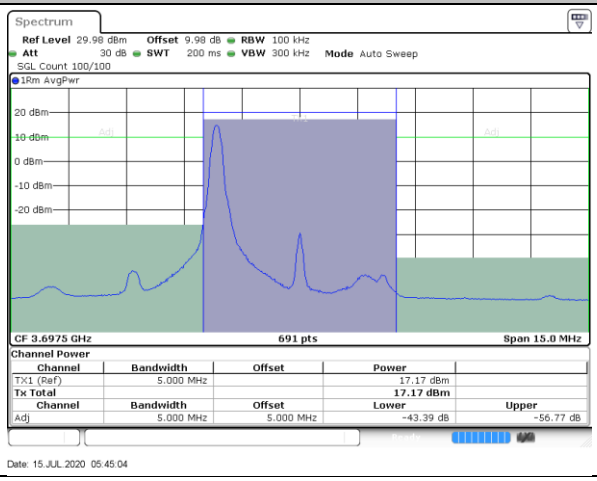
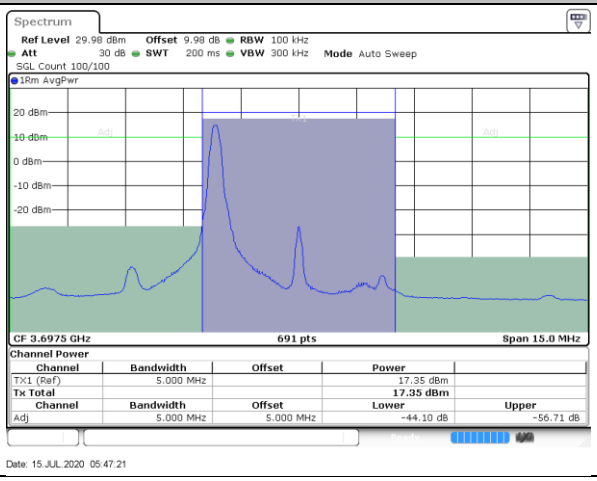
# Full RB0

| Mode | LTE Band 48 : Conducted EIRP (dBm/10MHz) | | | |
|---|---|---|---|---|
| BW | 5MHz | 10MHz | 15MHz | 20MHz |
| Mod. | 256QAM | 256QAM | 256QAM | 256QAM |
| Lowest CH | 21.86 | 20.83 | 20.09 | 19.32 |
| Middle CH | 21.74 | 21.11 | 19.98 | 19.56 |
| Highest CH | 21.64 | 20.92 | 20.07 | 19.22 |
| Limit | 23dBm /10MHz | | | |
| Result | Pass | | | |

# ACLR

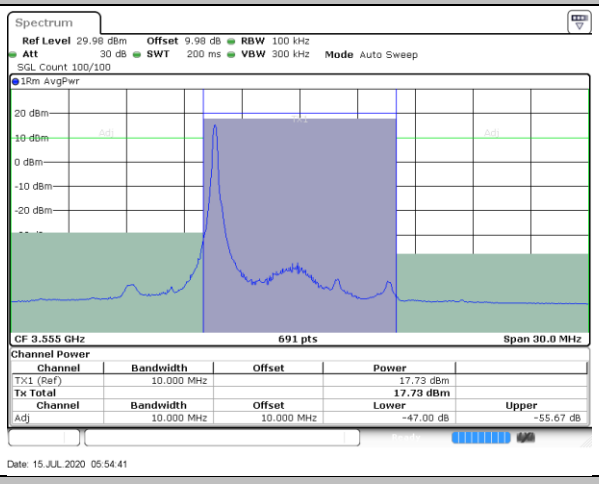
## 1RB0

| LTE Band 48 | |
|---|---|
| Lowest Channel / 5MHz / QPSK | Lowest Channel / 5MHz / 16QAM |
|  |  |
| Middle Channel / 5MHz / QPSK | Middle Channel / 5MHz / 16QAM |
|  |  |

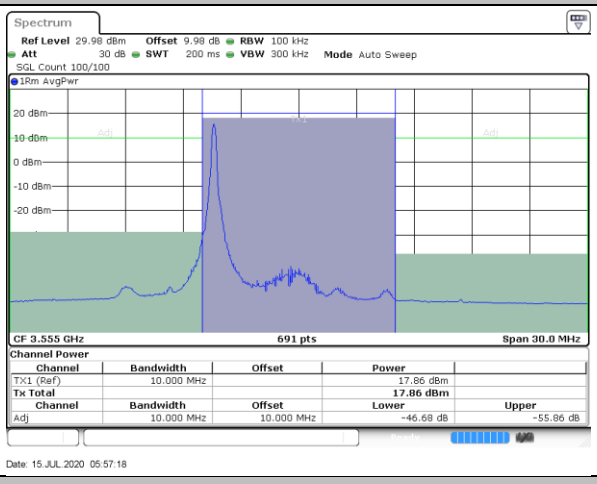
| Highest Channel / 5MHz / QPSK | Highest Channel / 5MHz / 16QAM |
|---|---|
|  |  |

## LTE Band 48

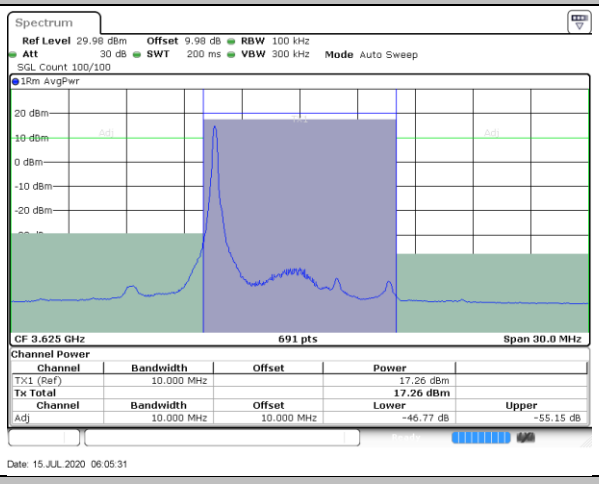
### Lowest Channel / 10MHz / QPSK



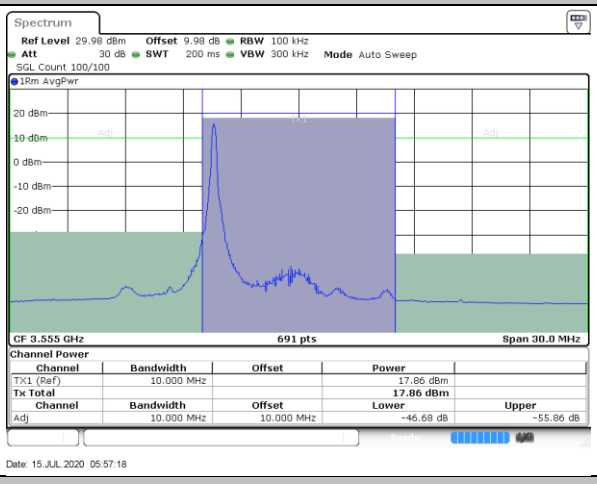

### Lowest Channel / 10MHz / 16QAM



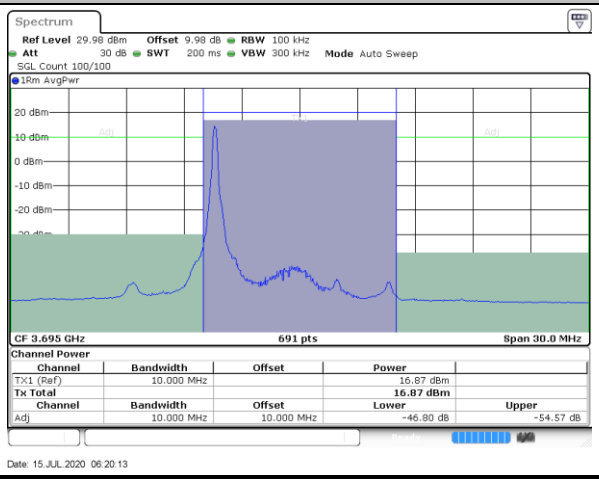

### Middle Channel / 10MHz / QPSK



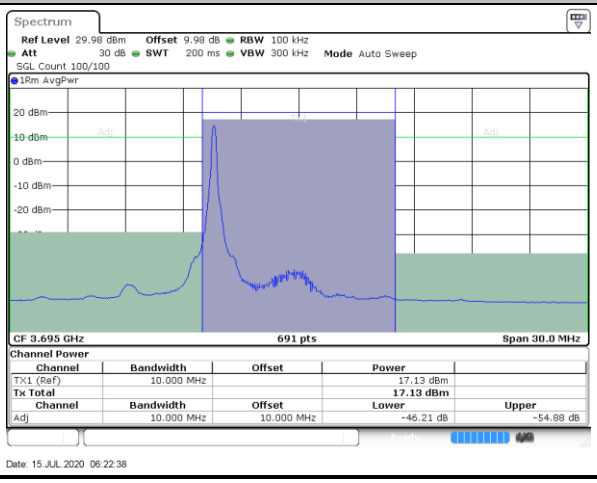

### Middle Channel / 10MHz / 16QAM




### Highest Channel / 10MHz / QPSK

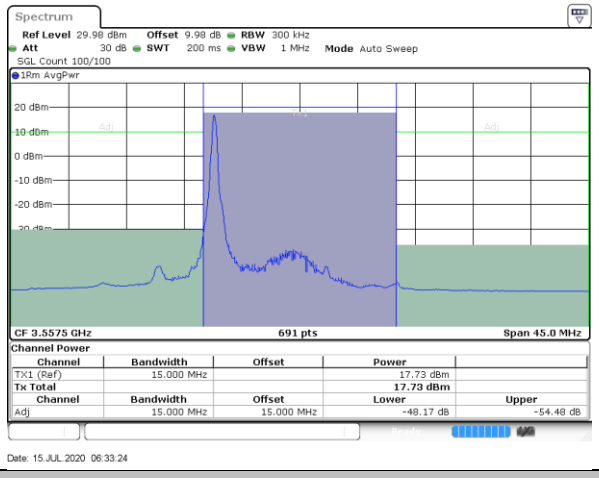



### Highest Channel / 10MHz / 16QAM

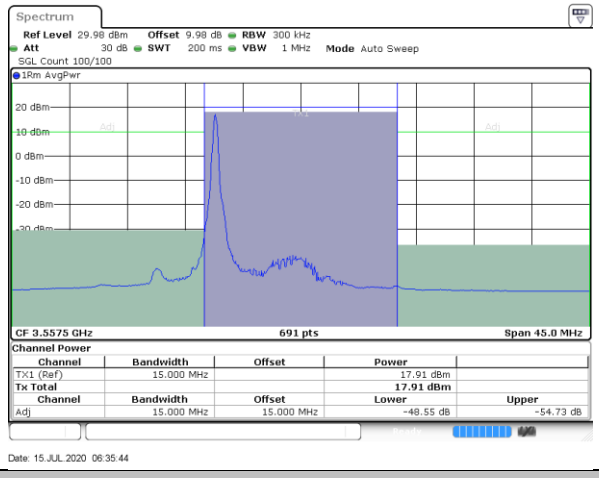


## LTE Band 48

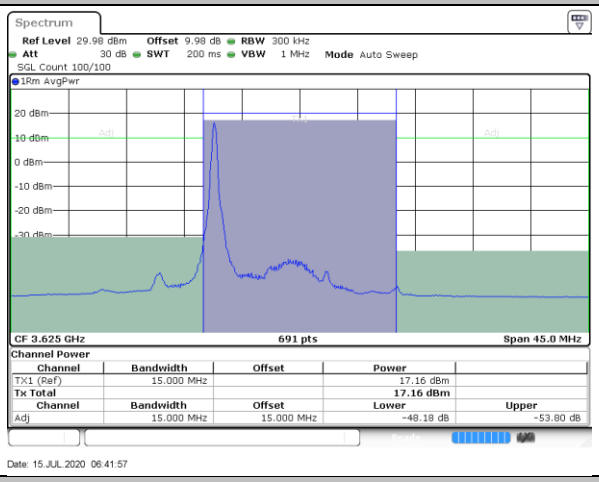
### Lowest Channel / 15MHz / QPSK



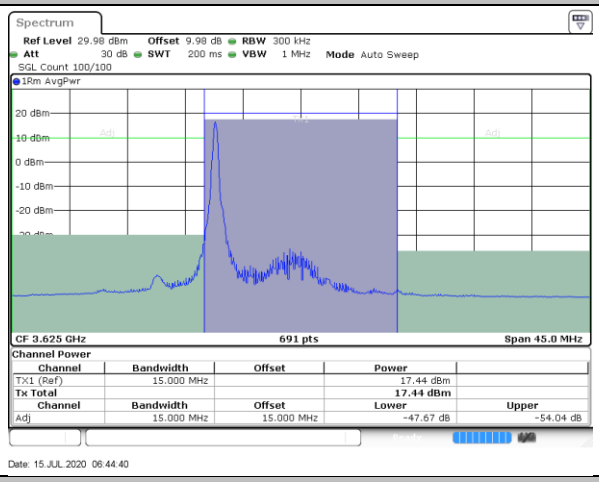

### Lowest Channel / 15MHz / 16QAM



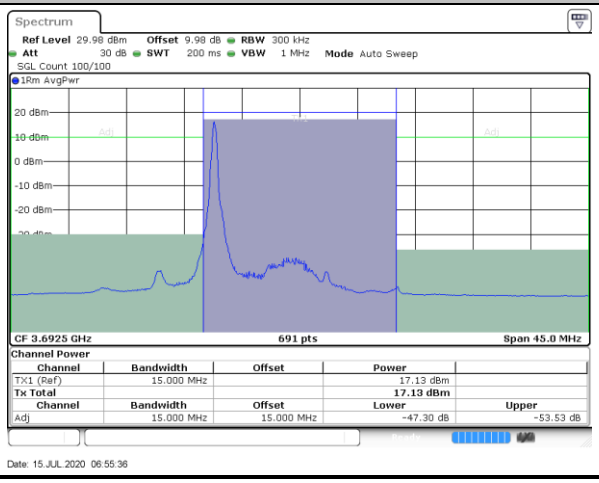

### Middle Channel / 15MHz / QPSK



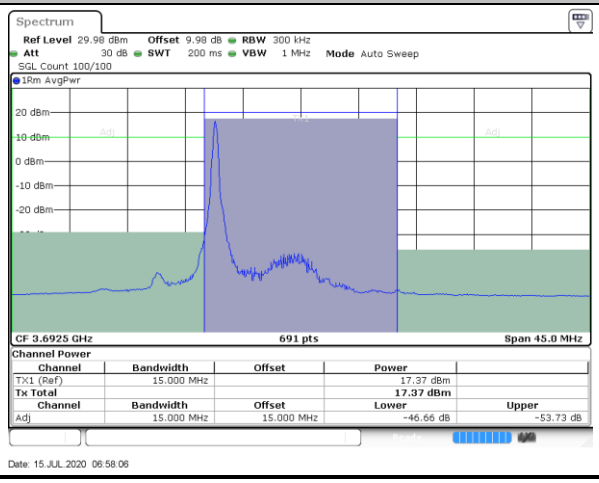

### Middle Channel / 15MHz / 16QAM




### Highest Channel / 15MHz / QPSK

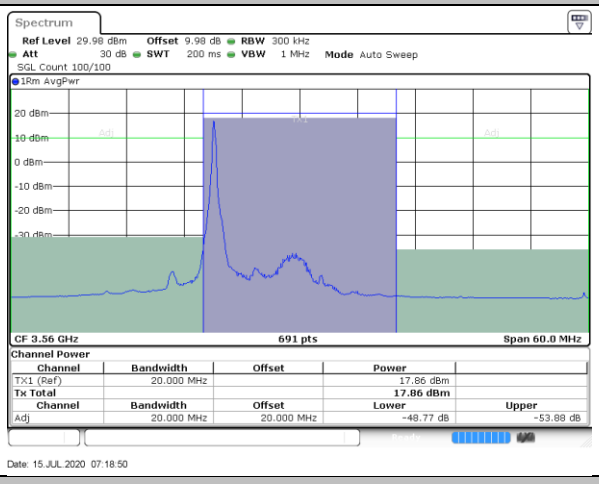



### Highest Channel / 15MHz / 16QAM

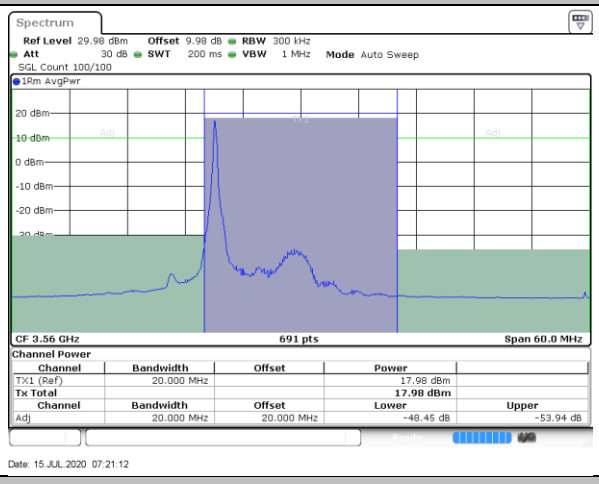


## LTE Band 48

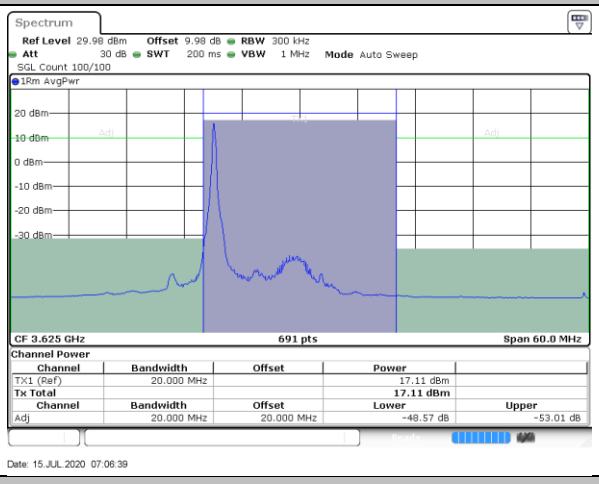
### Lowest Channel / 20MHz / QPSK



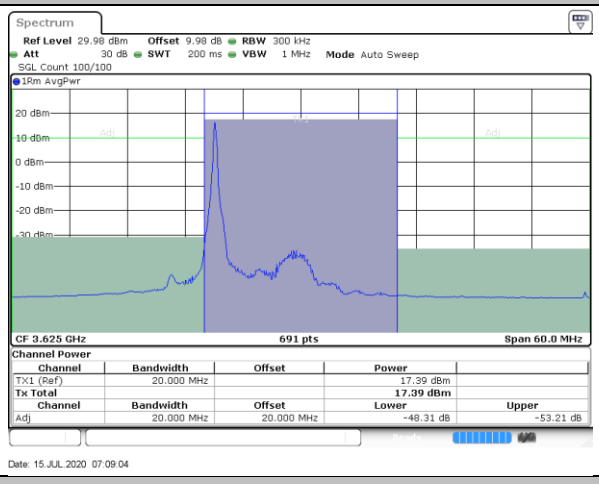

### Lowest Channel / 20MHz / 16QAM



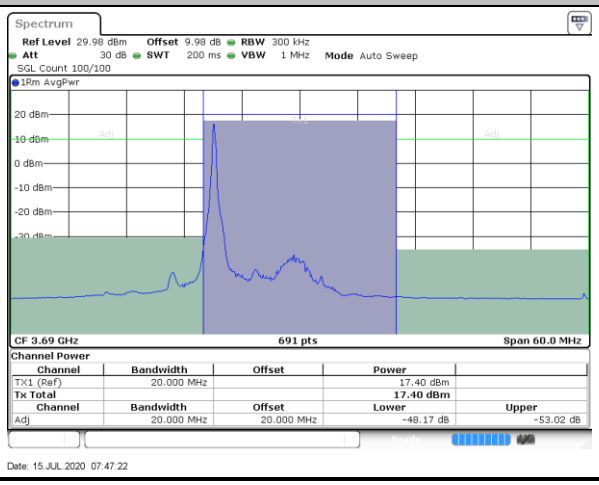

### Middle Channel / 20MHz / QPSK



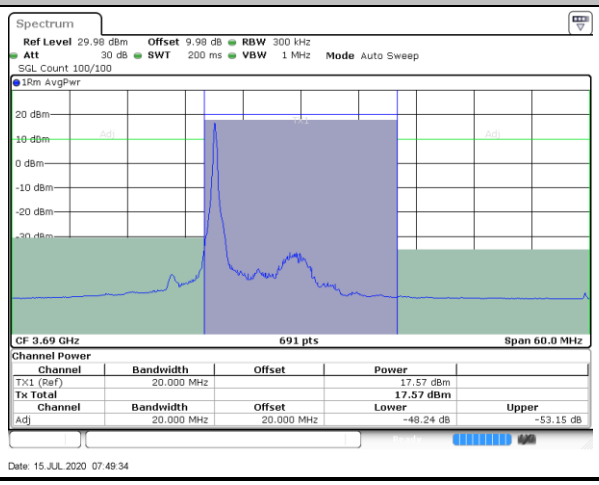

### Middle Channel / 20MHz / 16QAM




### Highest Channel / 20MHz / QPSK

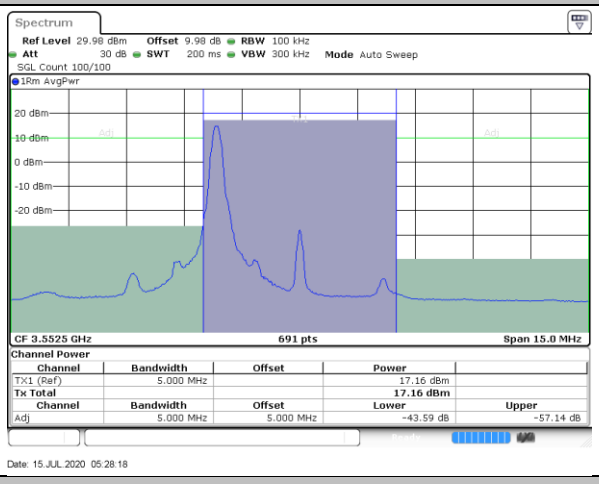



### Highest Channel / 20MHz / 16QAM

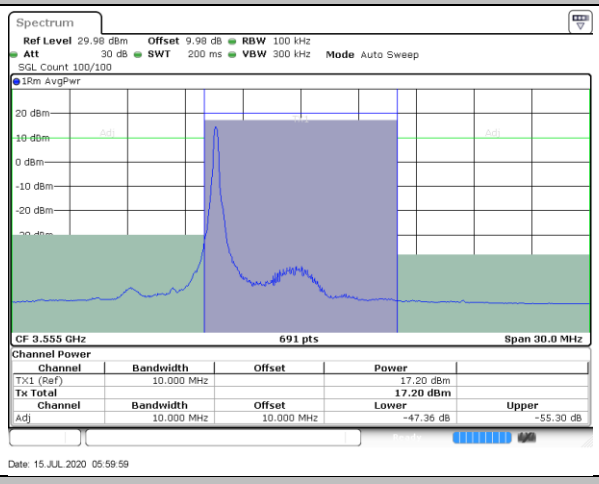


## LTE Band 48

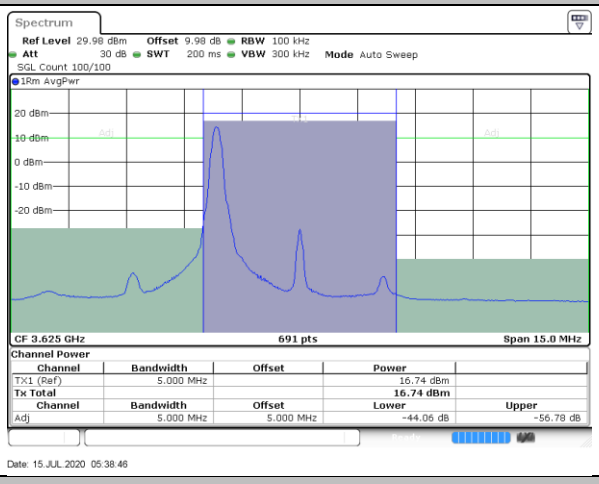
### Lowest Channel / 5MHz / 64QAM



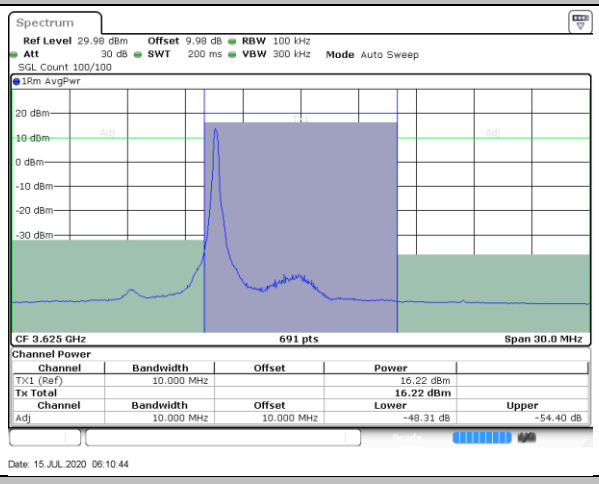

### Lowest Channel / 10MHz / 64QAM



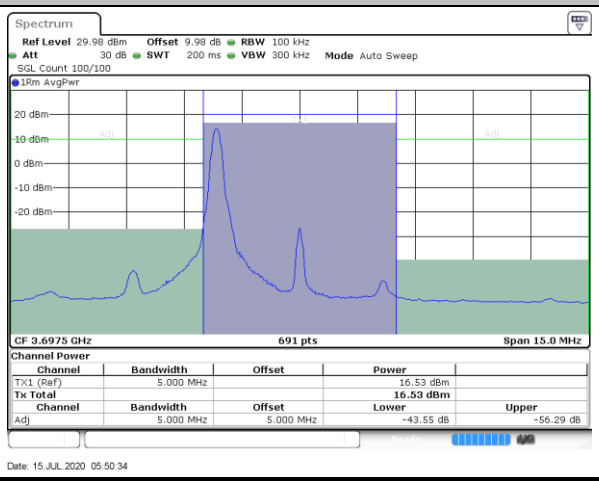

### Middle Channel / 5MHz / 64QAM



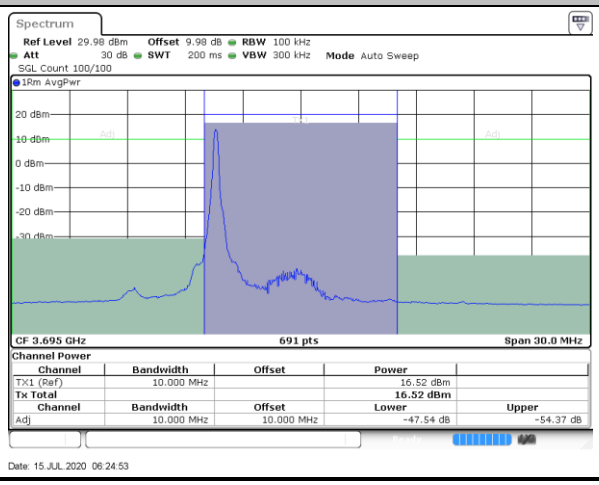

### Middle Channel / 10MHz / 64QAM




### Highest Channel / 5MHz / 64QAM

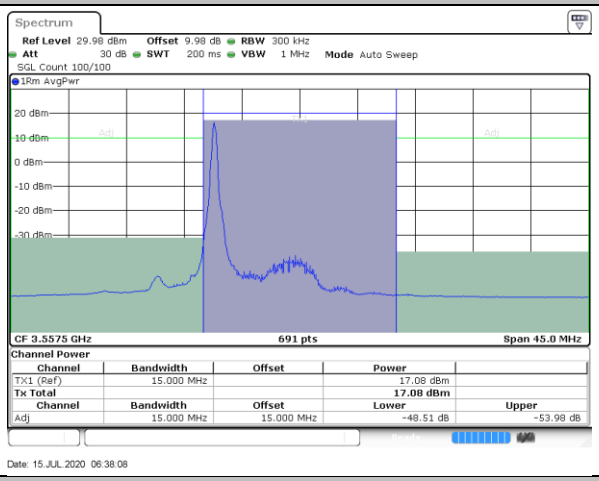



### Highest Channel / 10MHz / 64QAM

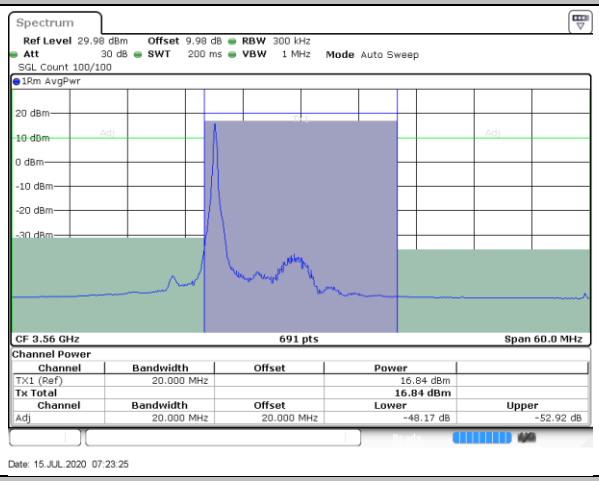


## LTE Band 48

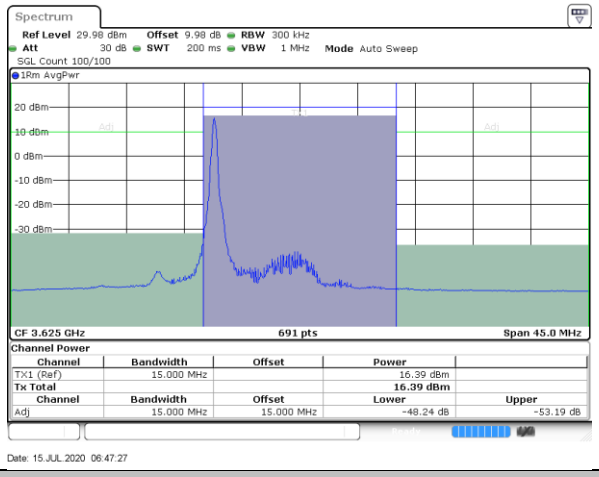
### Lowest Channel / 15MHz / 64QAM



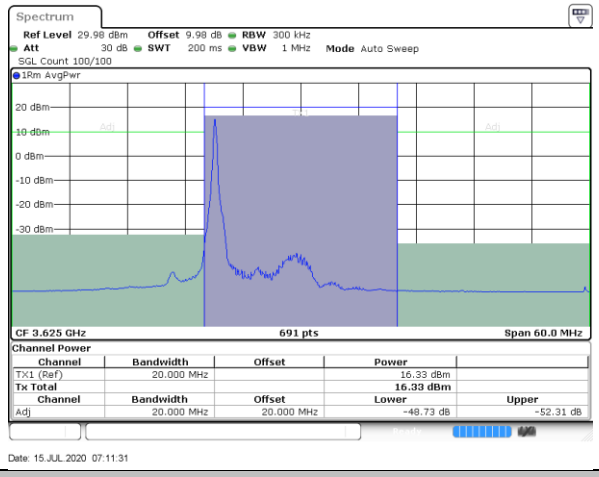

### Lowest Channel / 20MHz / 64QAM



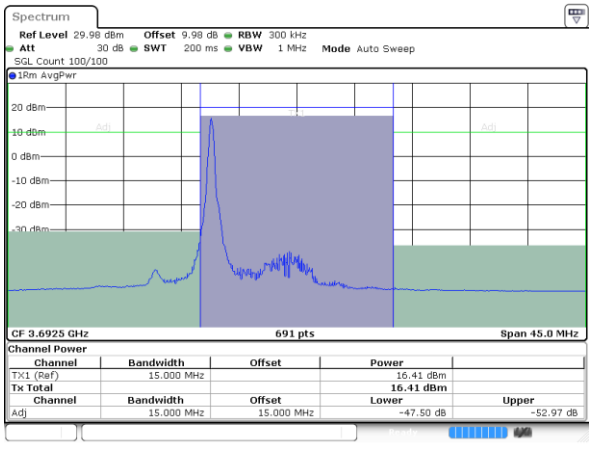

### Middle Channel / 15MHz / 64QAM



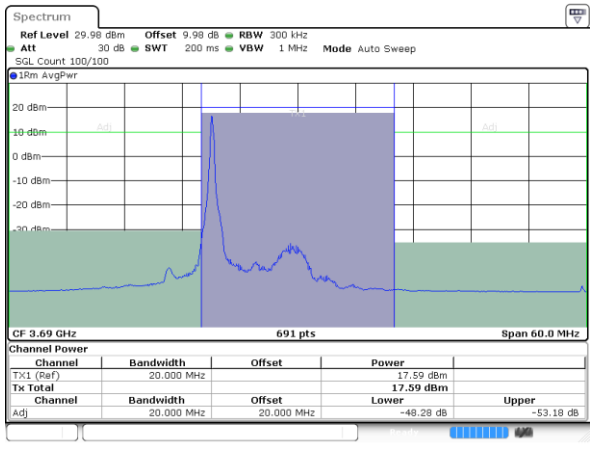

### Middle Channel / 20MHz / 64QAM




### Highest Channel / 15MHz / 64QAM

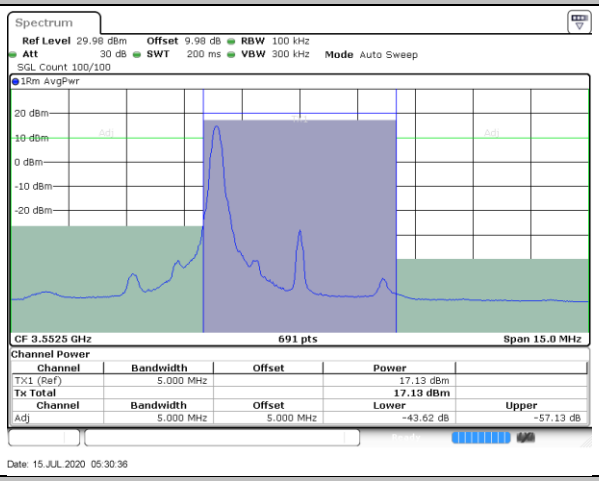



### Highest Channel / 20MHz / 64QAM

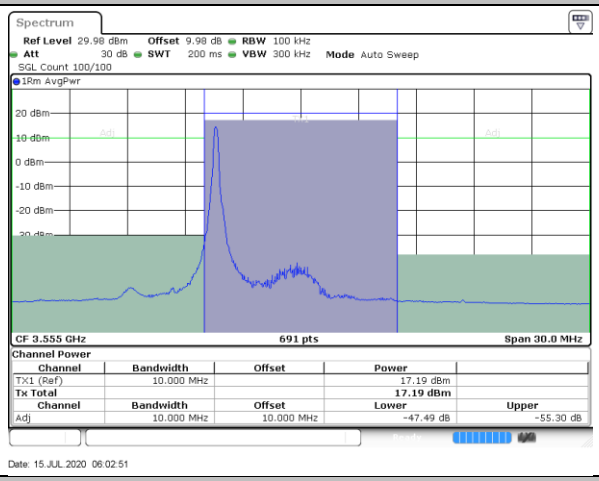


## LTE Band 48

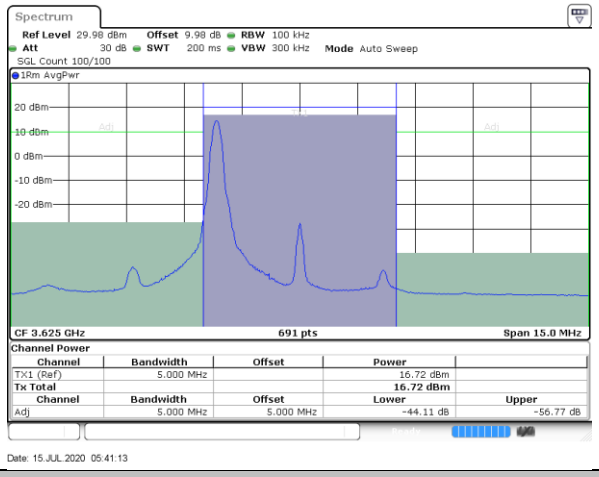
### Lowest Channel / 5MHz / 256QAM



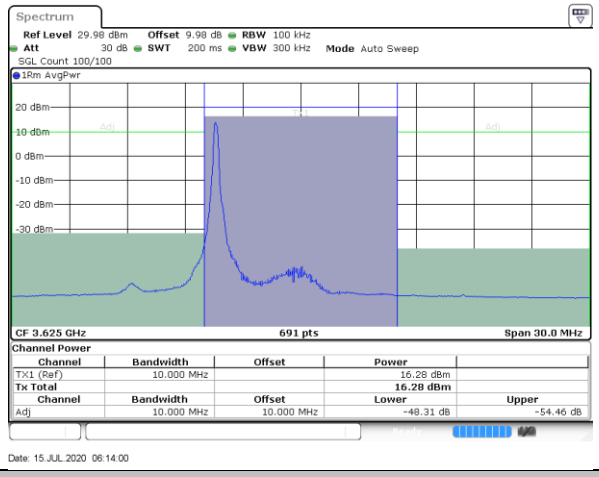

### Lowest Channel / 10MHz / 256QAM



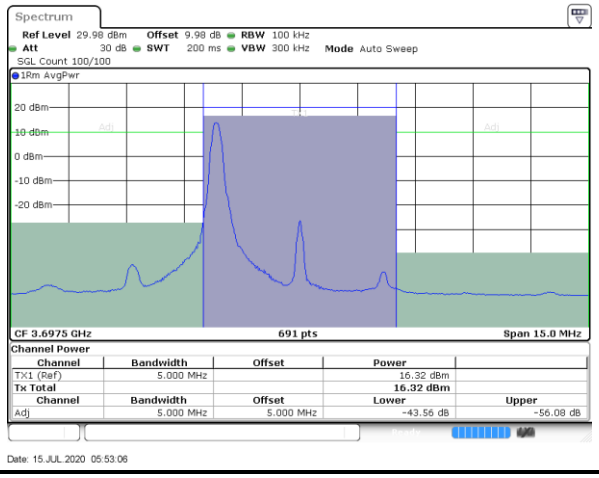

### Middle Channel / 5MHz / 256QAM



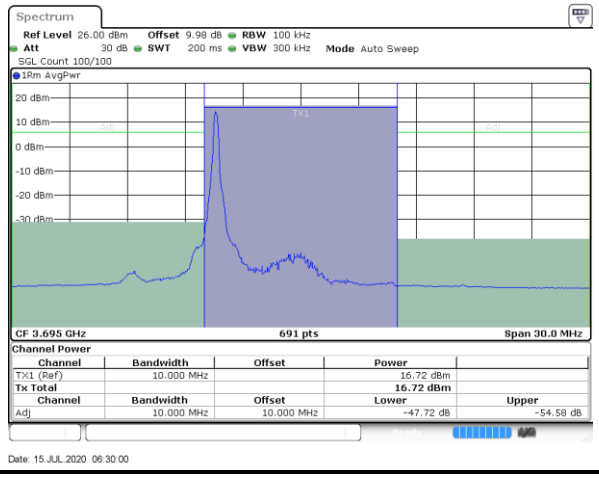

### Middle Channel / 10MHz / 256QAM




### Highest Channel / 5MHz / 256QAM

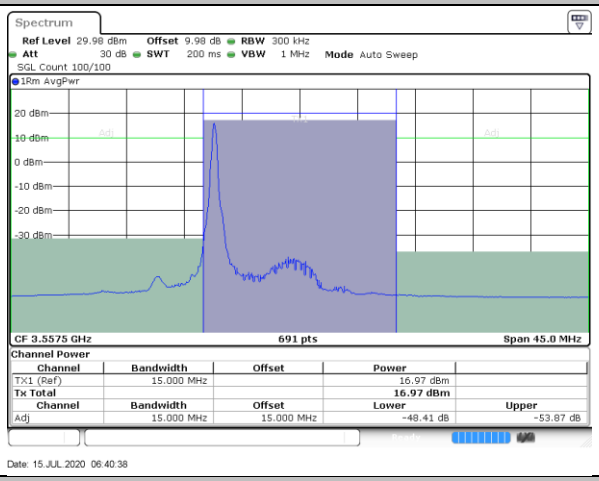



### Highest Channel / 10MHz /256QAM

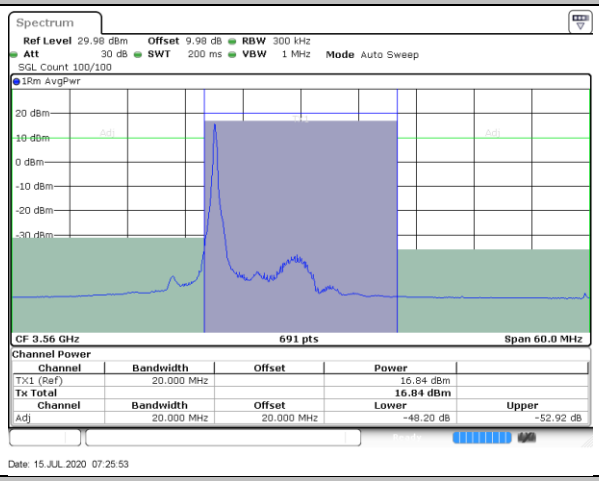


## LTE Band 48

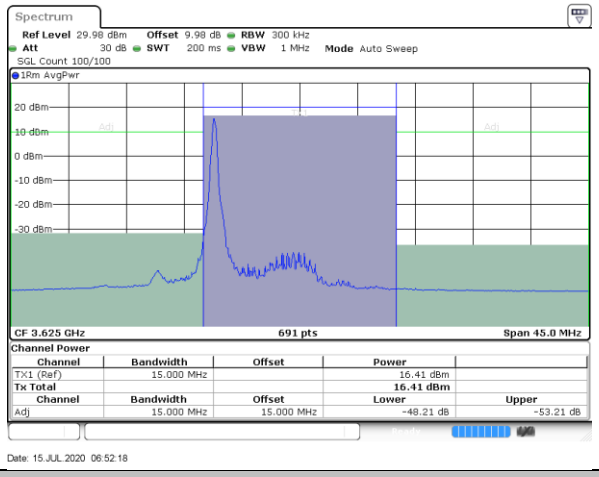
### Lowest Channel / 15MHz / 256QAM



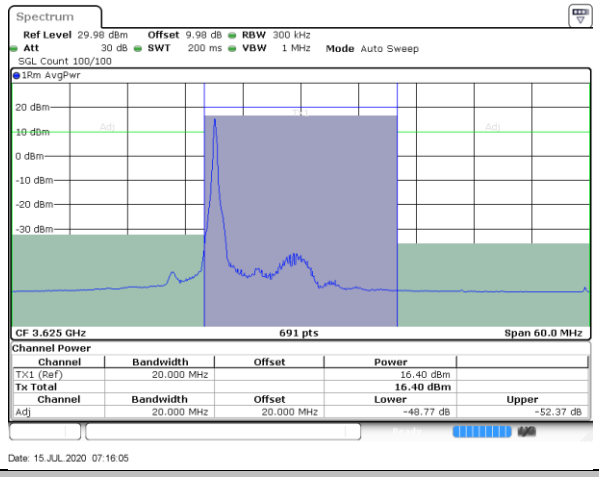

### Lowest Channel / 20MHz / 256QAM



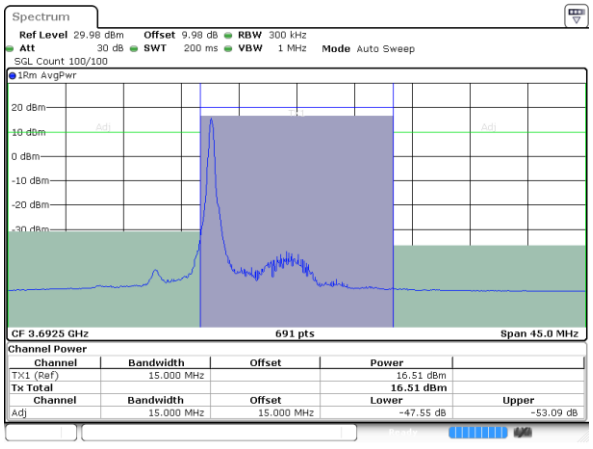

### Middle Channel / 15MHz / 256QAM



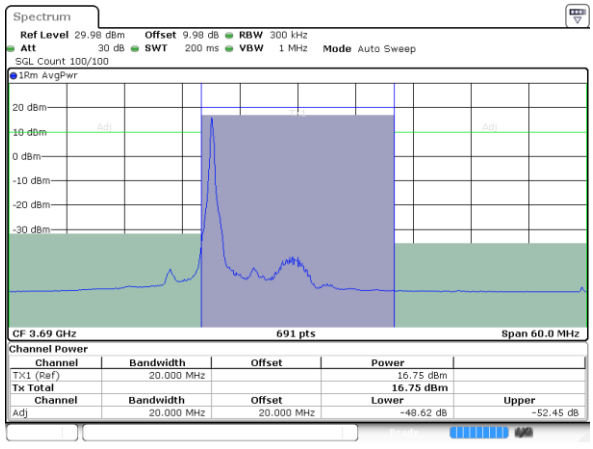

### Middle Channel / 20MHz / 256QAM




### Highest Channel / 15MHz / 256QAM



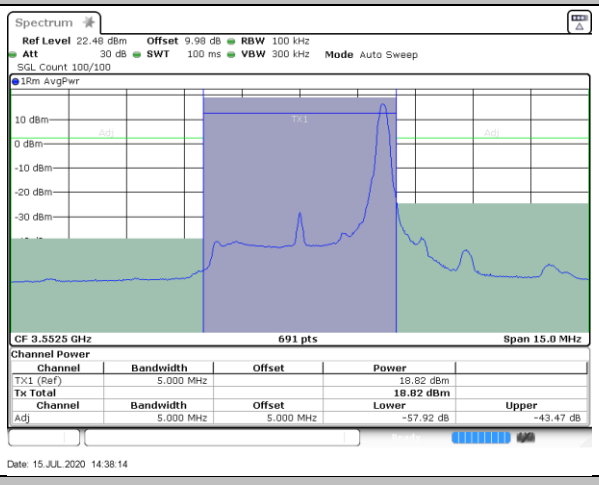

### Highest Channel / 20MHz /256QAM



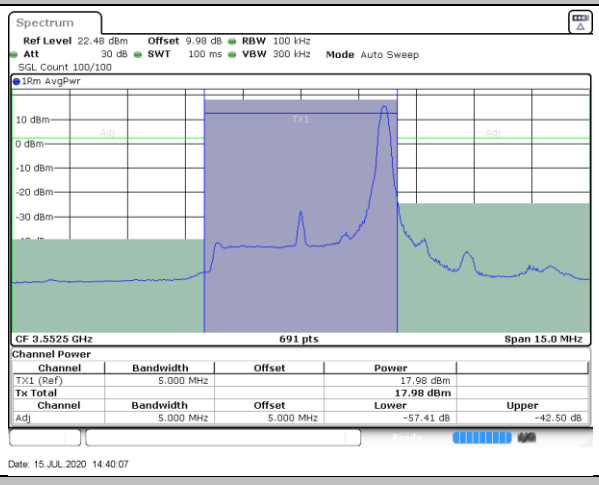
# 1RB Max

## LTE Band 48

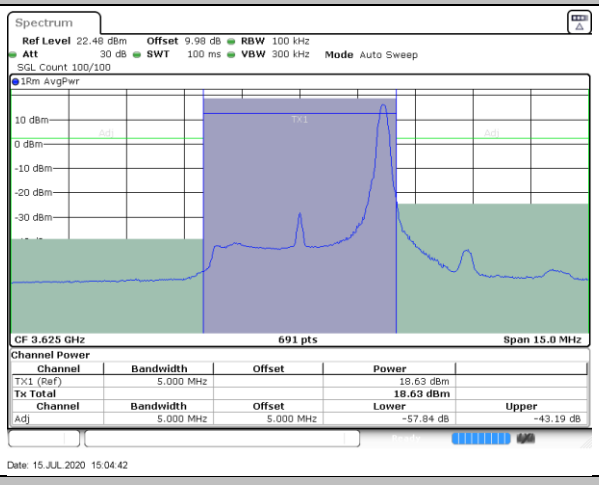
### Lowest Channel / 5MHz / QPSK



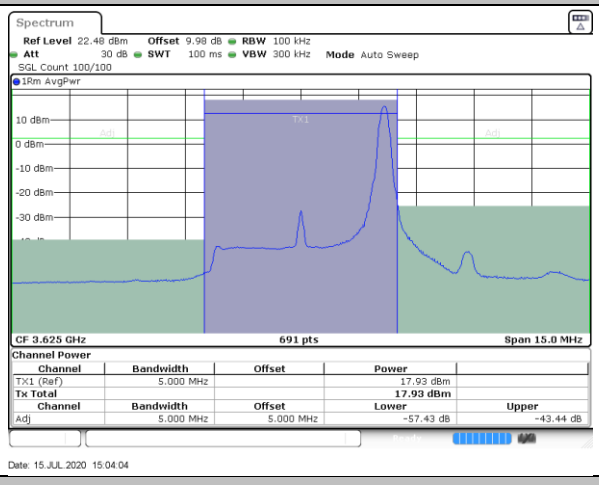

### Lowest Channel / 5MHz / 16QAM



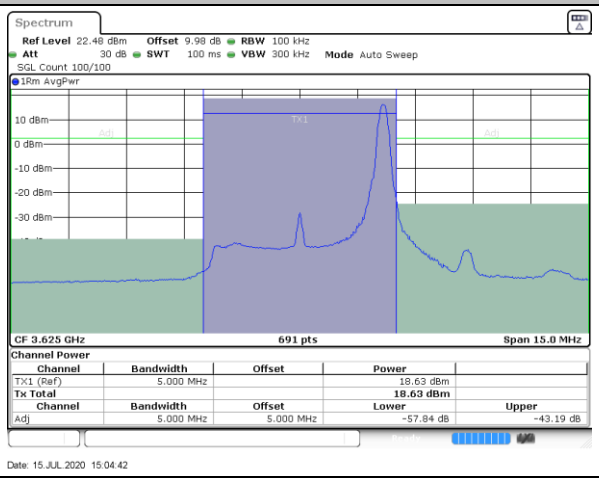

### Middle Channel / 5MHz / QPSK



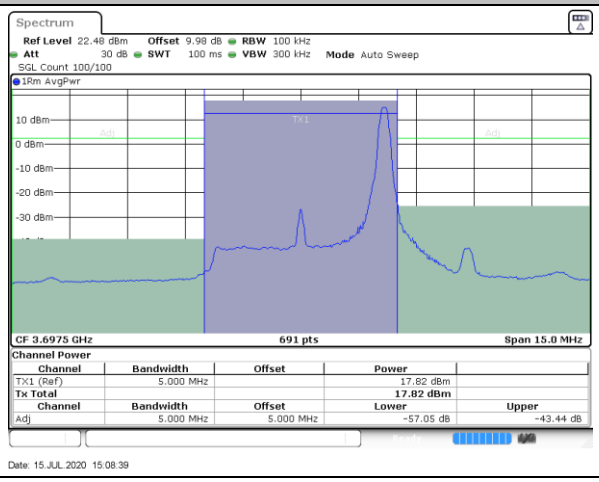

### Middle Channel / 5MHz / 16QAM




### Highest Channel / 5MHz / QPSK

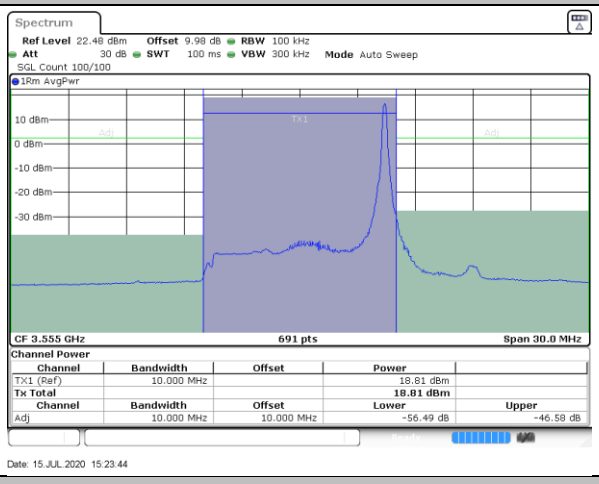



### Highest Channel / 5MHz / 16QAM

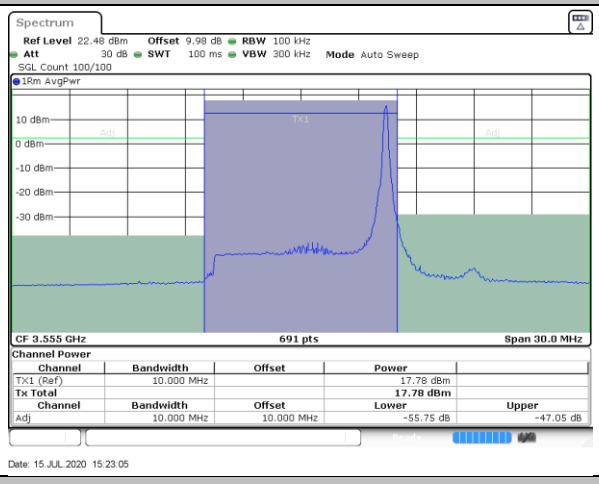


## LTE Band 48

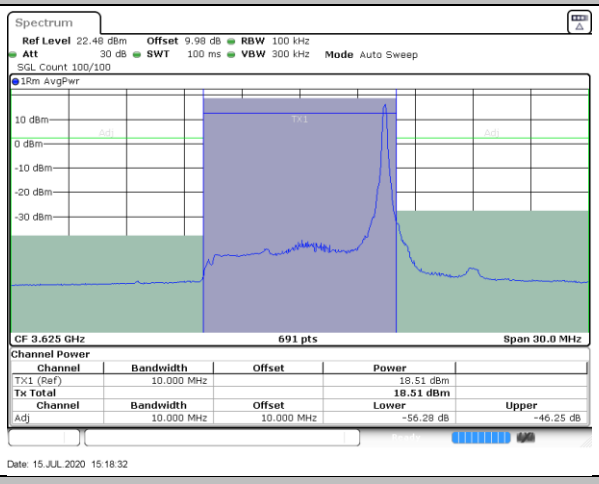
### Lowest Channel / 10MHz / QPSK



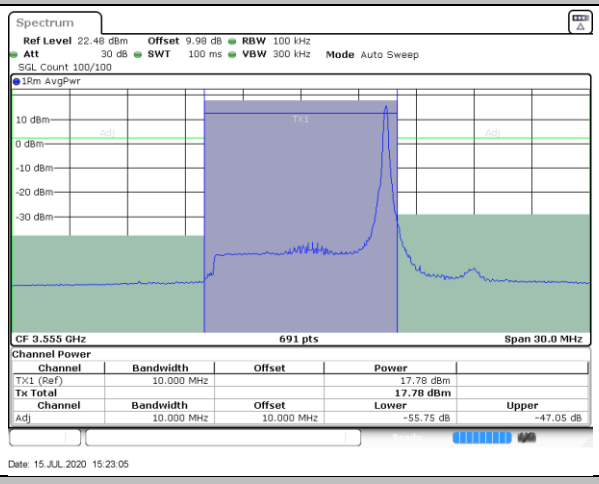

### Lowest Channel / 10MHz / 16QAM



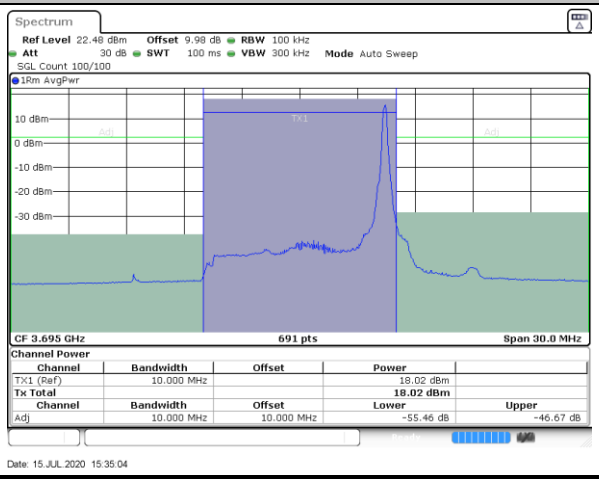

### Middle Channel / 10MHz / QPSK



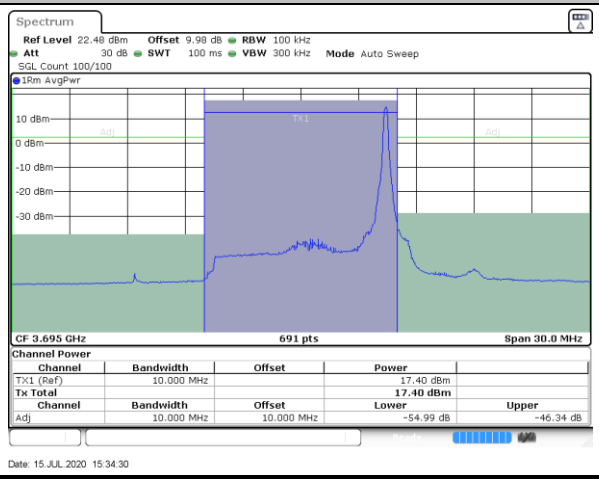

### Middle Channel / 10MHz / 16QAM




### Highest Channel / 10MHz / QPSK

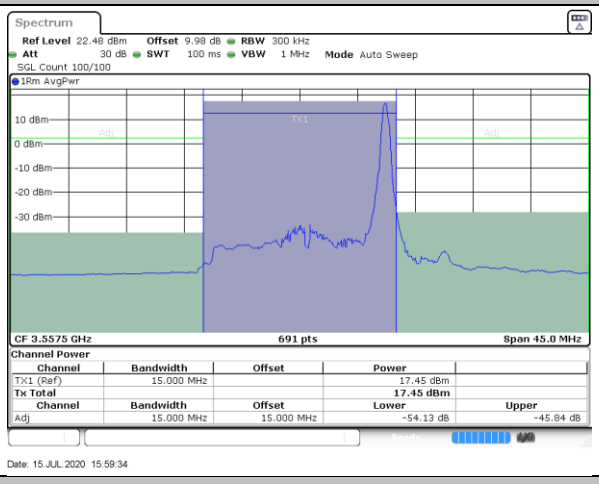



### Highest Channel / 10MHz / 16QAM

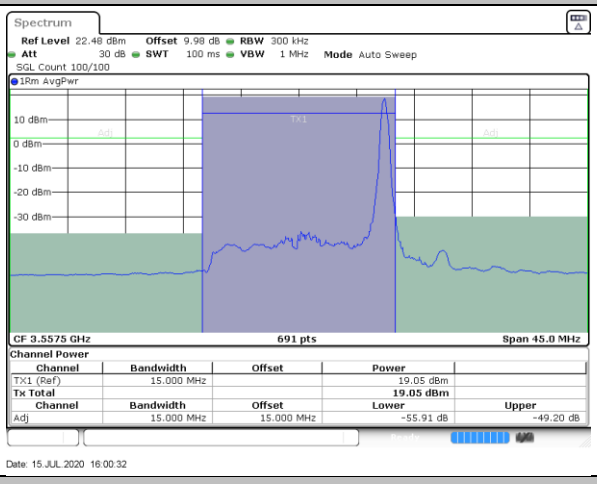


## LTE Band 48

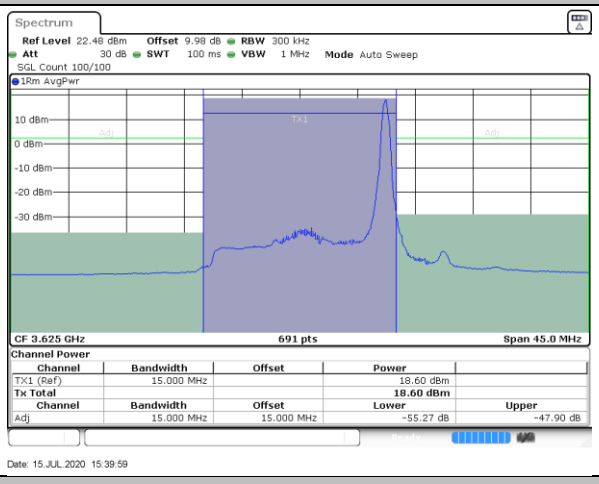
### Lowest Channel / 15MHz / QPSK



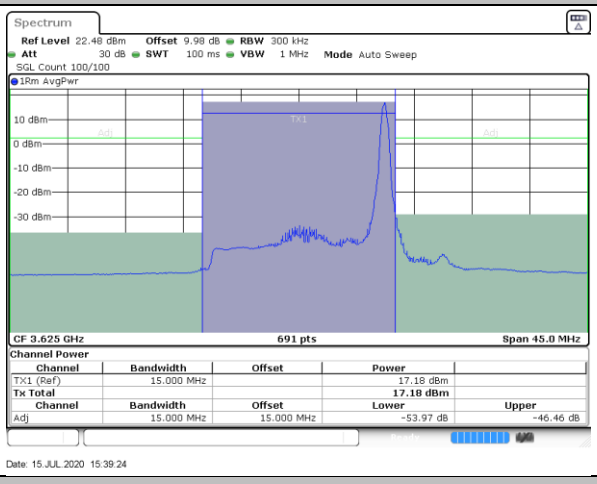

### Lowest Channel / 15MHz / 16QAM



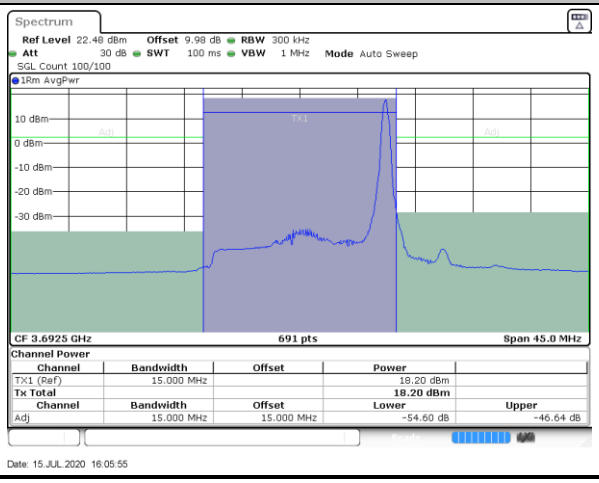

### Middle Channel / 15MHz / QPSK



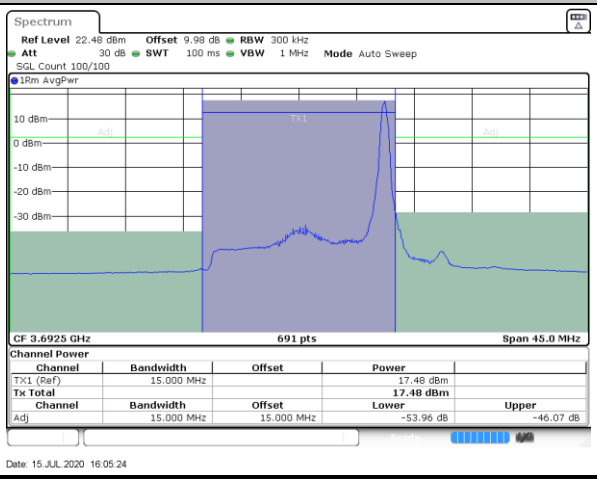

### Middle Channel / 15MHz / 16QAM




### Highest Channel / 15MHz / QPSK

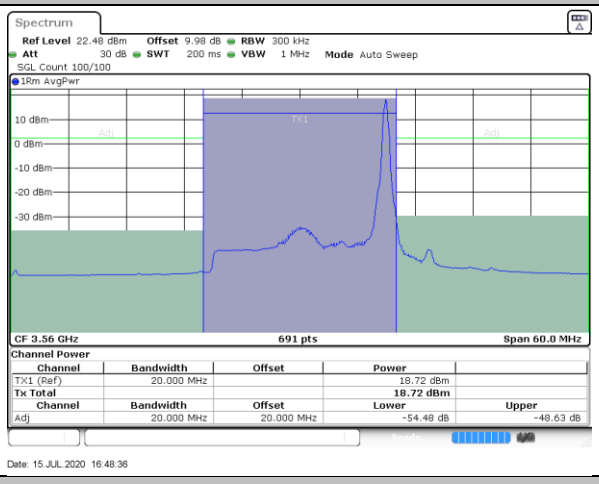



### Highest Channel / 15MHz / 16QAM

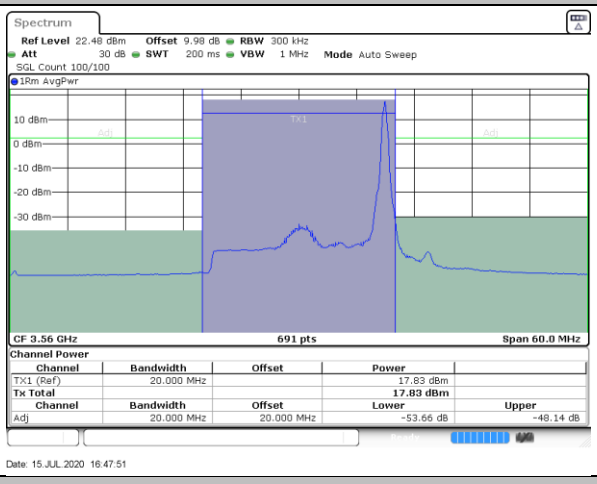


## LTE Band 48

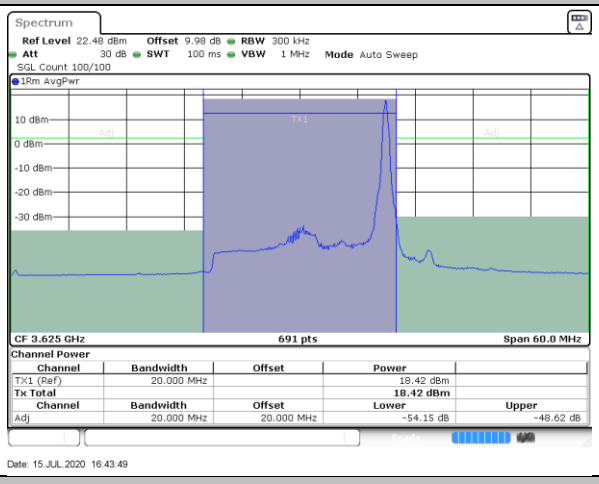
### Lowest Channel / 20MHz / QPSK



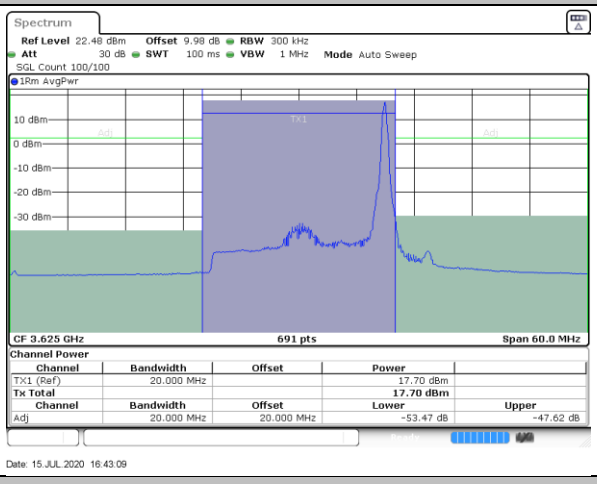

### Lowest Channel / 20MHz / 16QAM



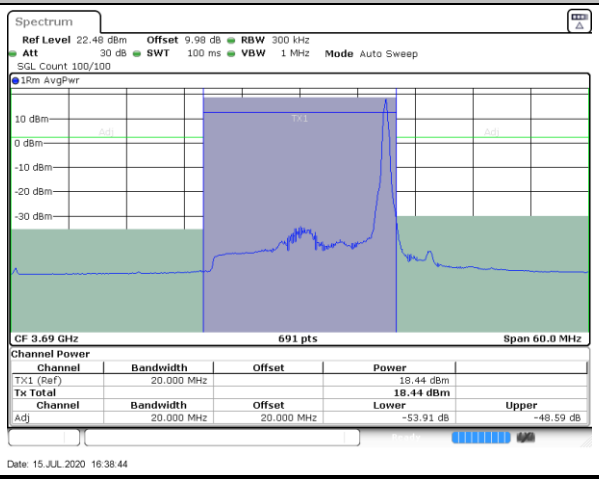

### Middle Channel / 20MHz / QPSK



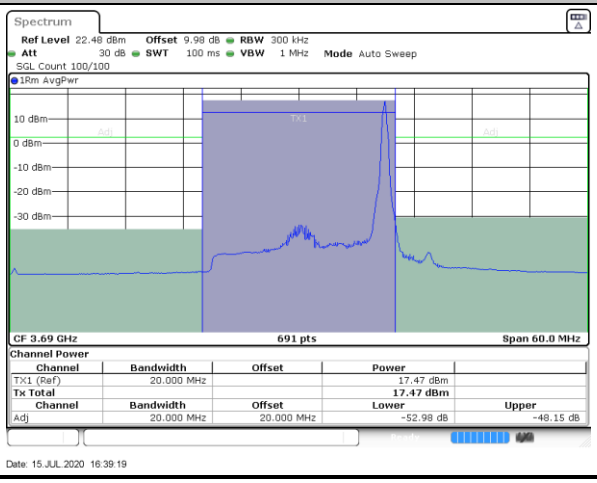

### Middle Channel / 20MHz / 16QAM




### Highest Channel / 20MHz / QPSK

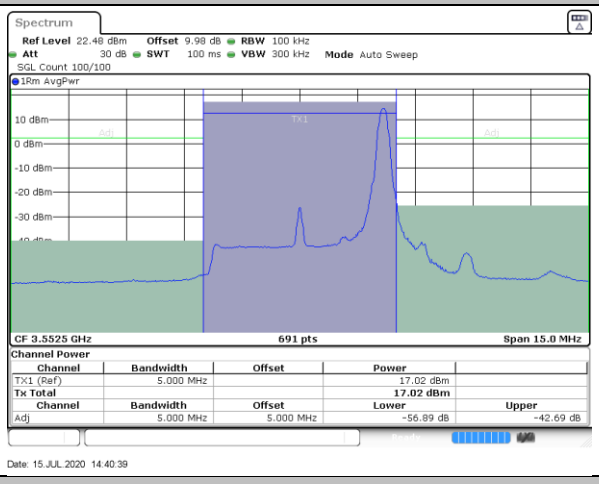



### Highest Channel / 20MHz / 16QAM

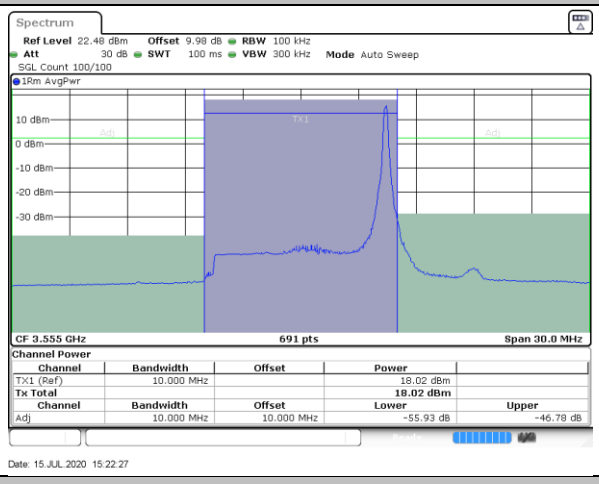


## LTE Band 48

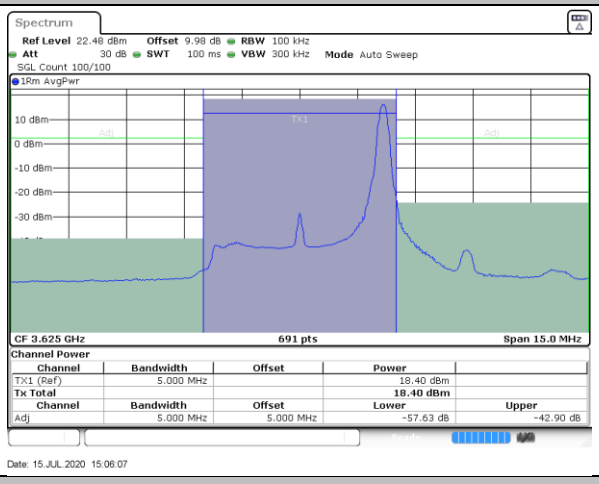
### Lowest Channel / 5MHz / 64QAM



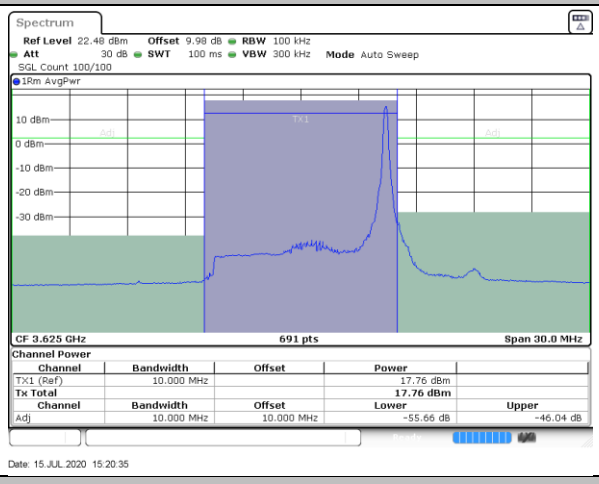

### Lowest Channel / 10MHz / 64QAM



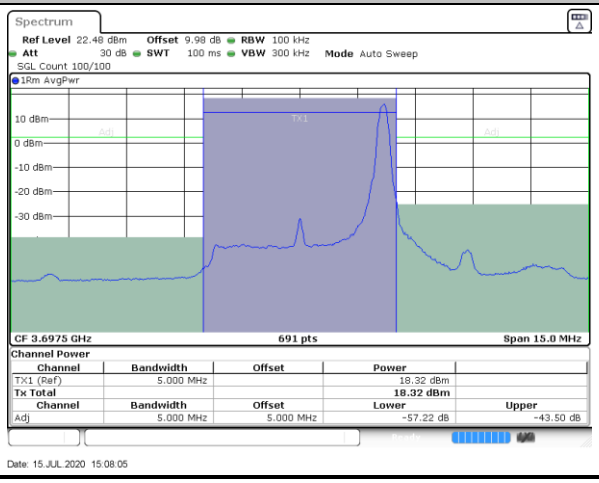

### Middle Channel / 5MHz / 64QAM



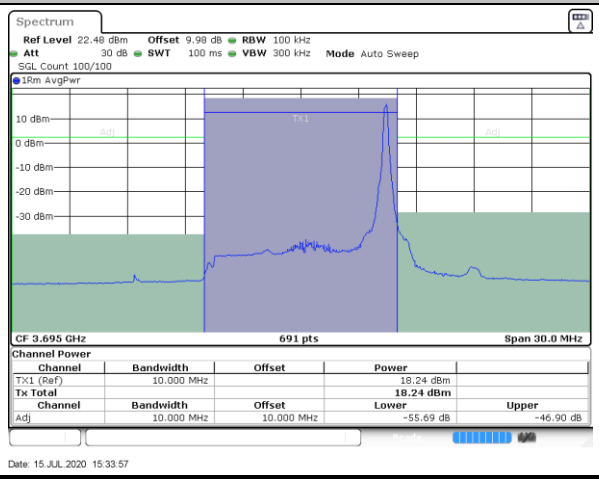

### Middle Channel / 10MHz / 64QAM




### Highest Channel / 5MHz / 64QAM

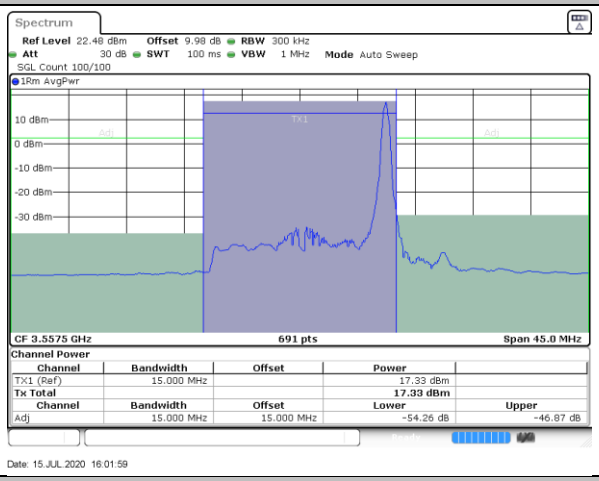



### Highest Channel / 10MHz / 64QAM

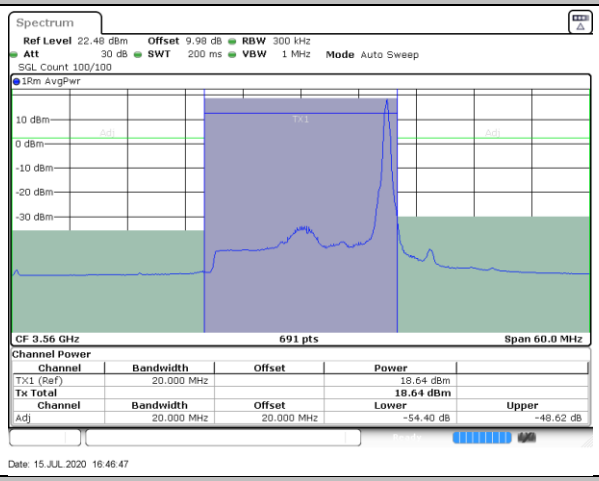


## LTE Band 48

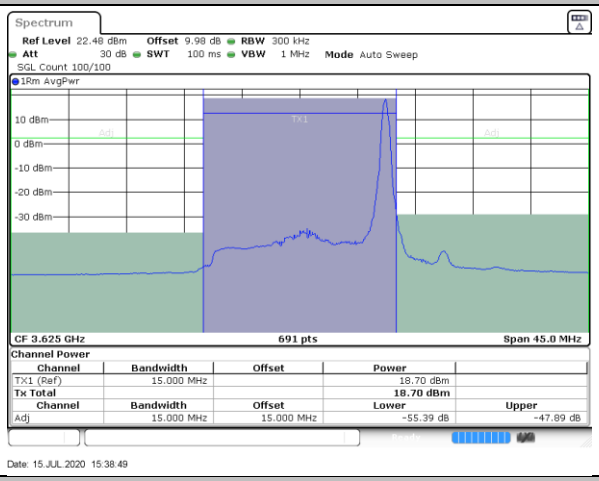
### Lowest Channel / 15MHz / 64QAM



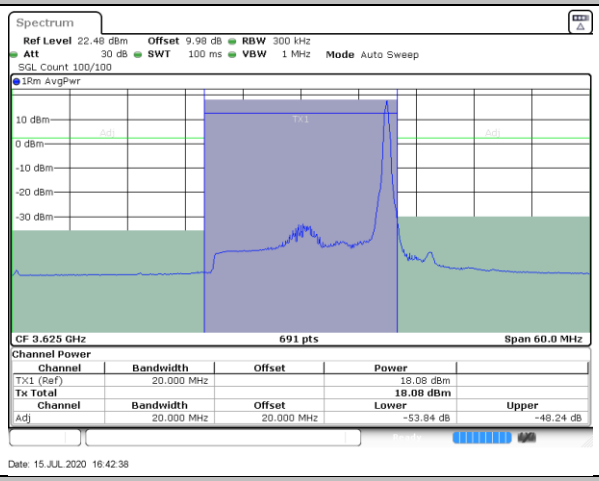

### Lowest Channel / 20MHz / 64QAM



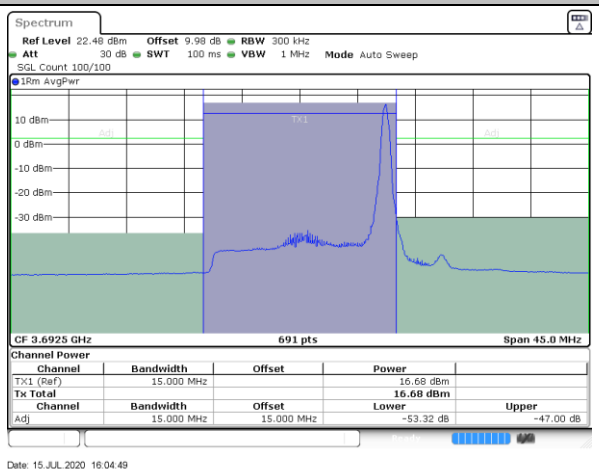

### Middle Channel / 15MHz / 64QAM



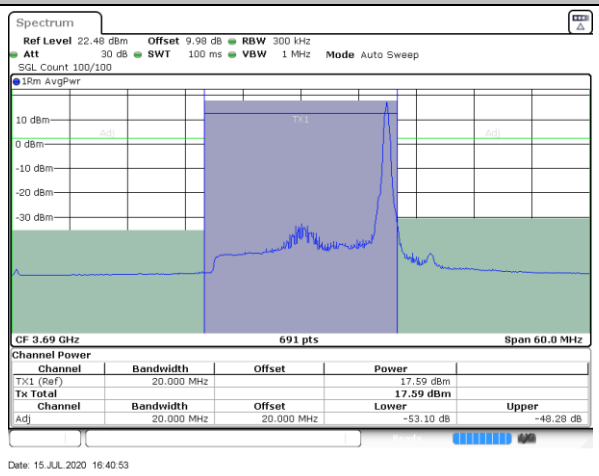

### Middle Channel / 20MHz / 64QAM




### Highest Channel / 15MHz / 64QAM

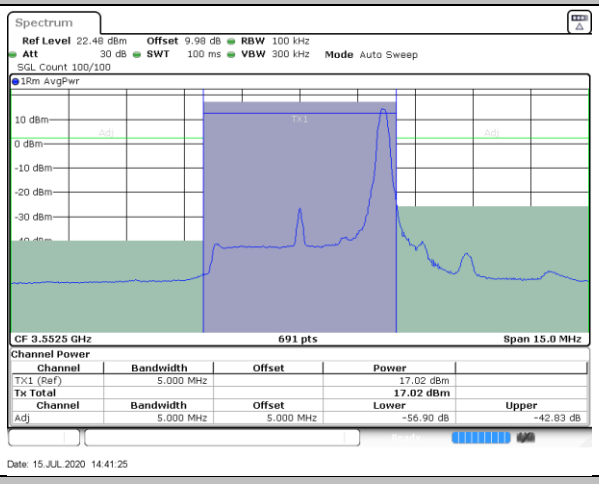



### Highest Channel / 20MHz / 64QAM

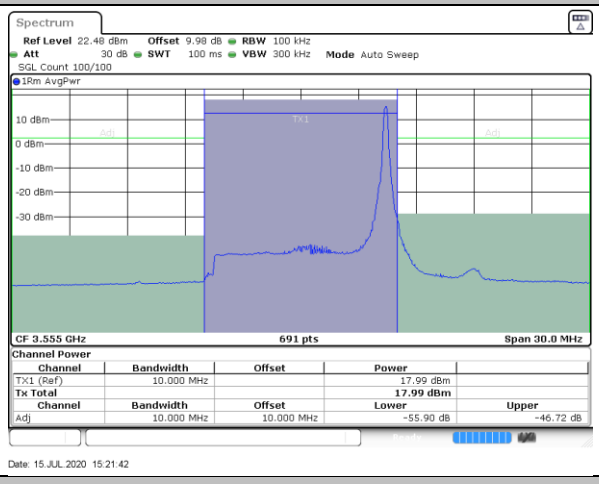


## LTE Band 48

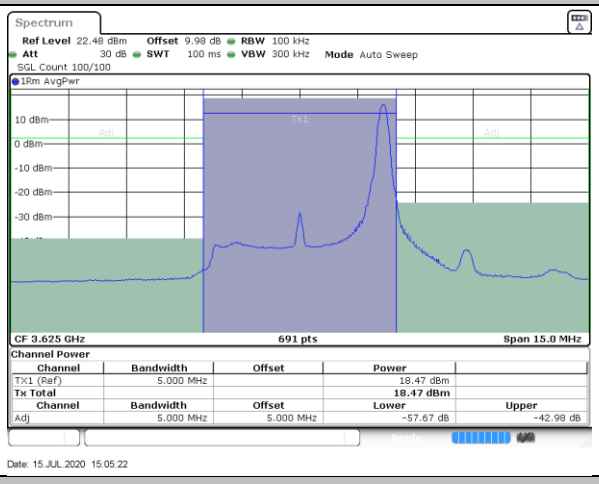
### Lowest Channel / 5MHz / 256QAM



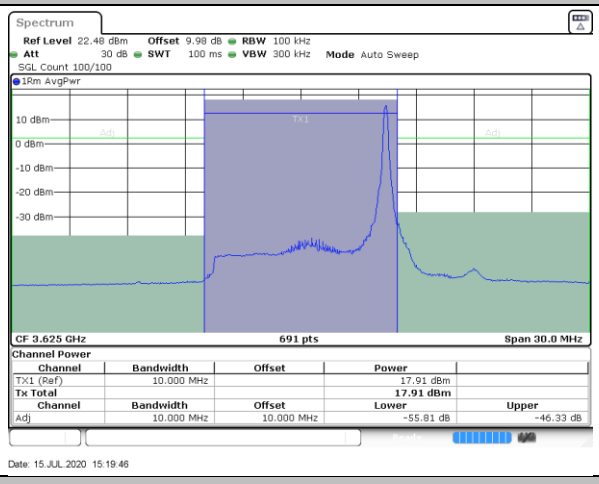

### Lowest Channel / 10MHz / 256QAM



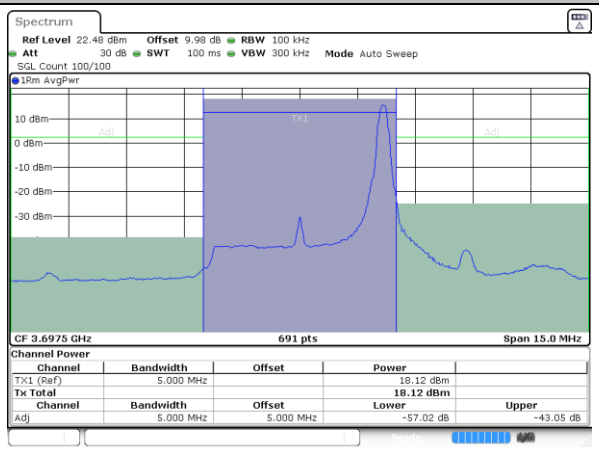

### Middle Channel / 5MHz / 256QAM



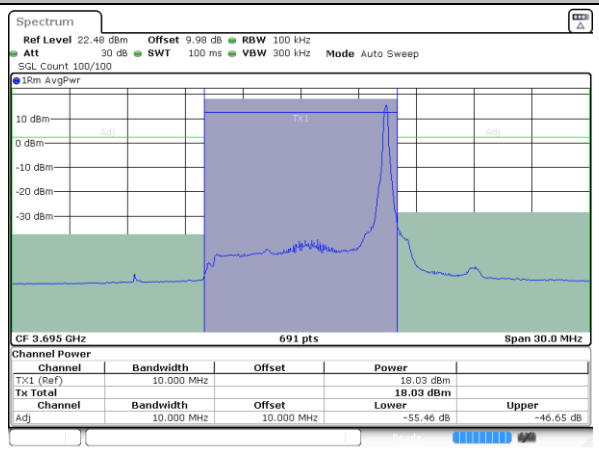

### Middle Channel / 10MHz / 256QAM




### Highest Channel / 5MHz / 256QAM

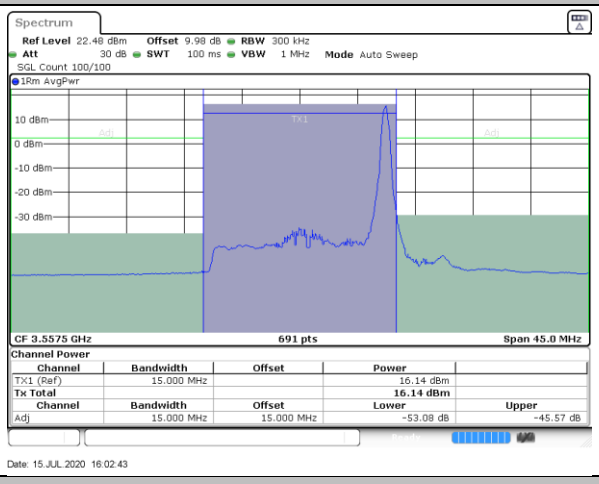



### Highest Channel / 10MHz /256QAM

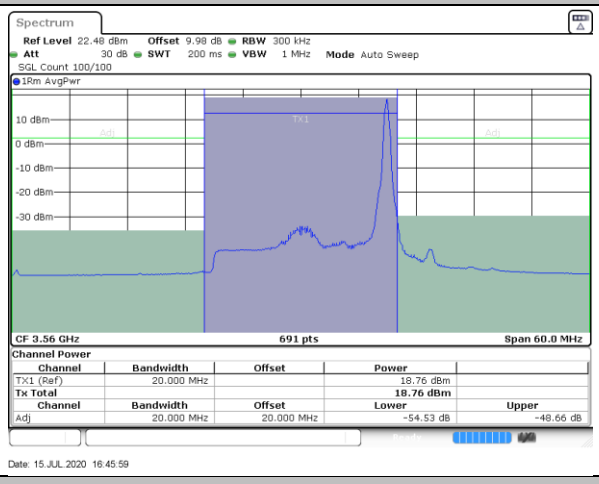


## LTE Band 48

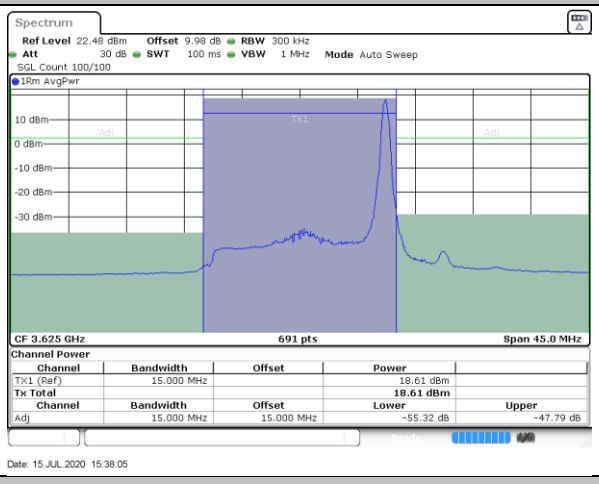
### Lowest Channel / 15MHz / 256QAM



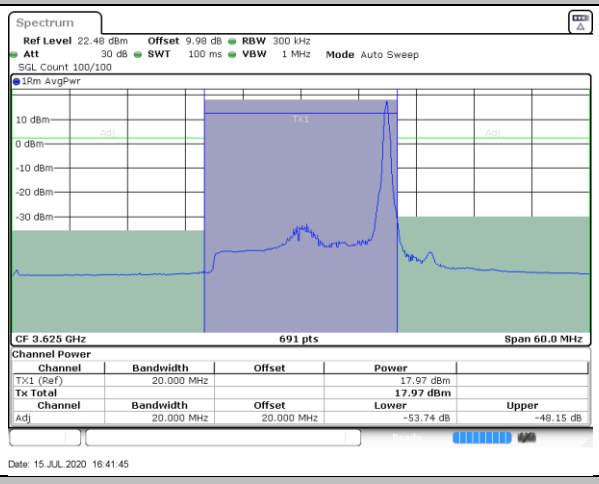

### Lowest Channel / 20MHz / 256QAM



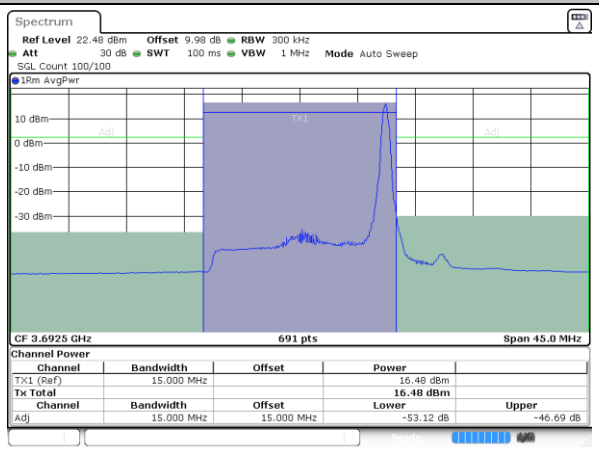

### Middle Channel / 15MHz / 256QAM



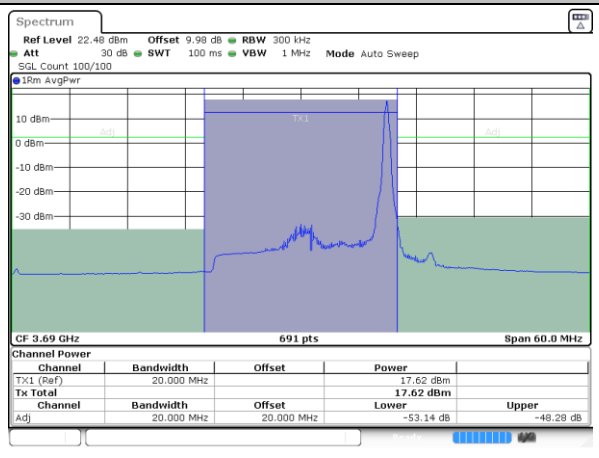

### Middle Channel / 20MHz / 256QAM




### Highest Channel / 15MHz / 256QAM



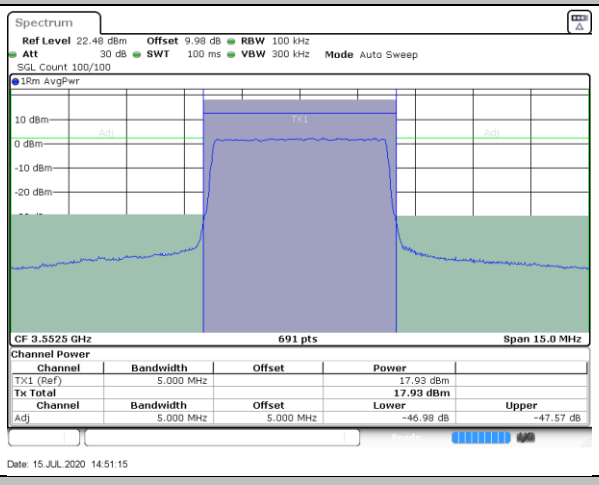

### Highest Channel / 20MHz /256QAM



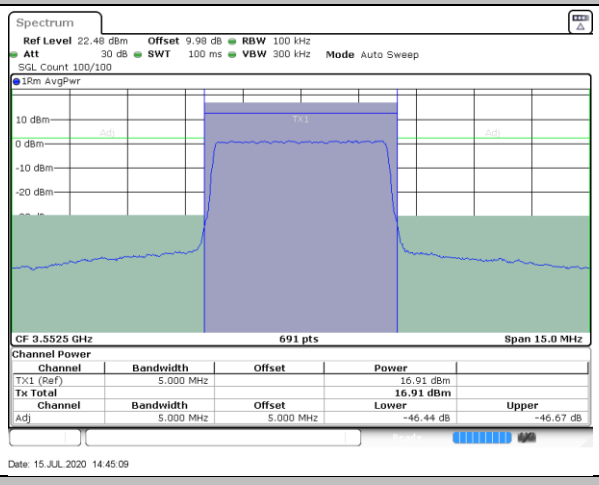
# Full RB

## LTE Band 48

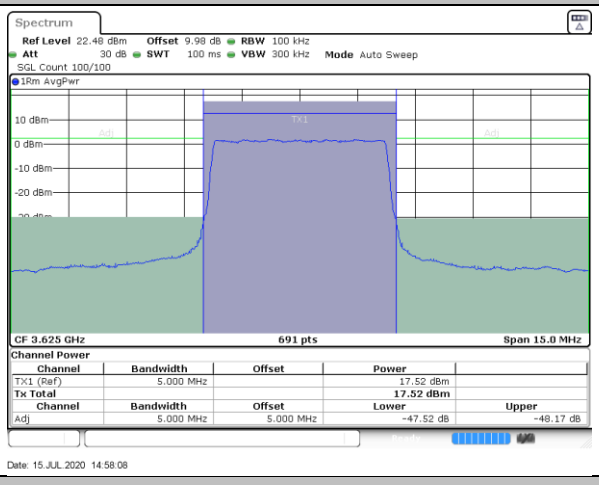
### Lowest Channel / 5MHz / QPSK



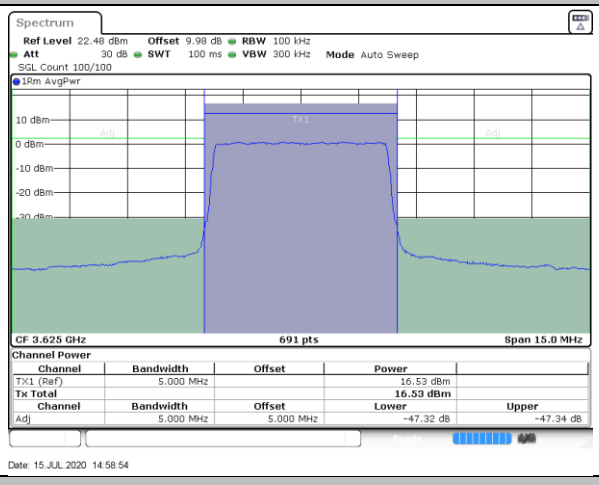

### Lowest Channel / 5MHz / 16QAM



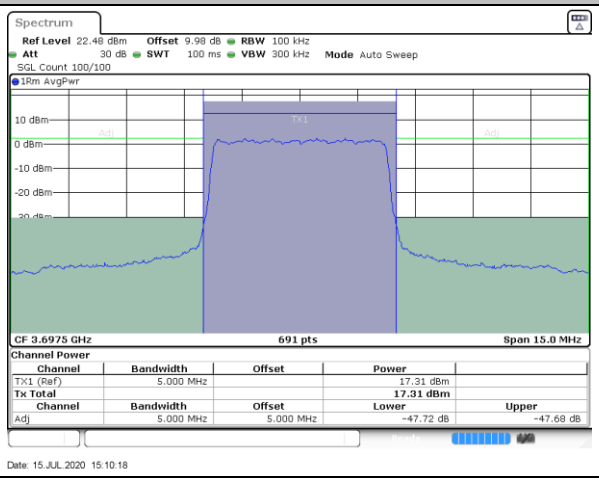

### Middle Channel / 5MHz / QPSK



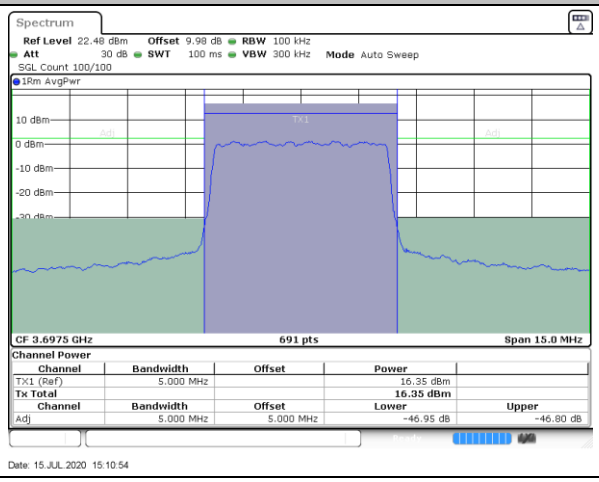

### Middle Channel / 5MHz / 16QAM




### Highest Channel / 5MHz / QPSK

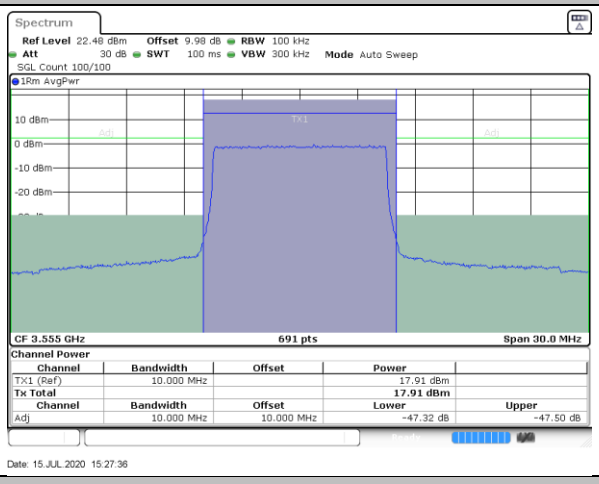



### Highest Channel / 5MHz / 16QAM

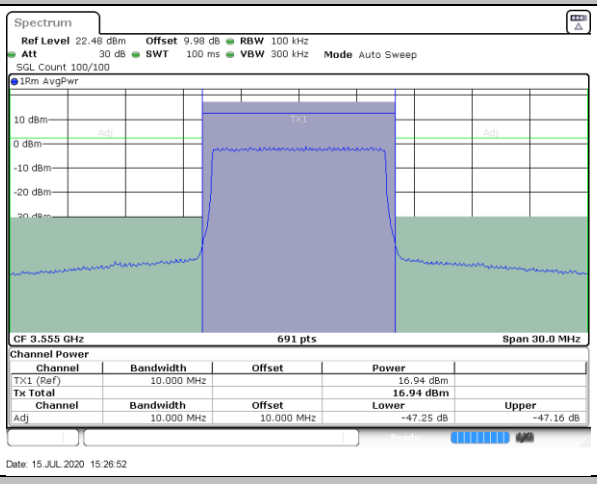


## LTE Band 48

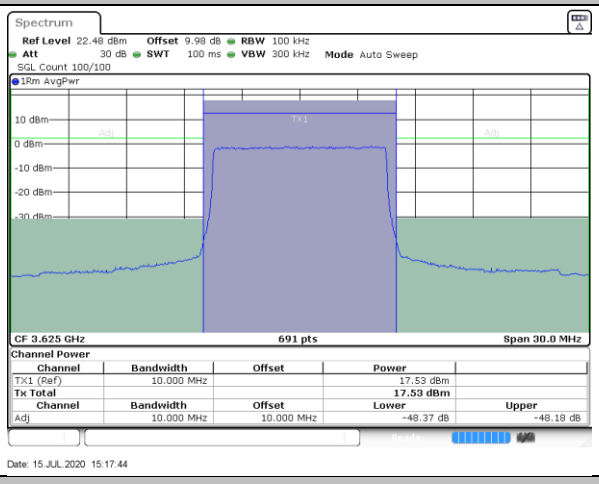
### Lowest Channel / 10MHz / QPSK



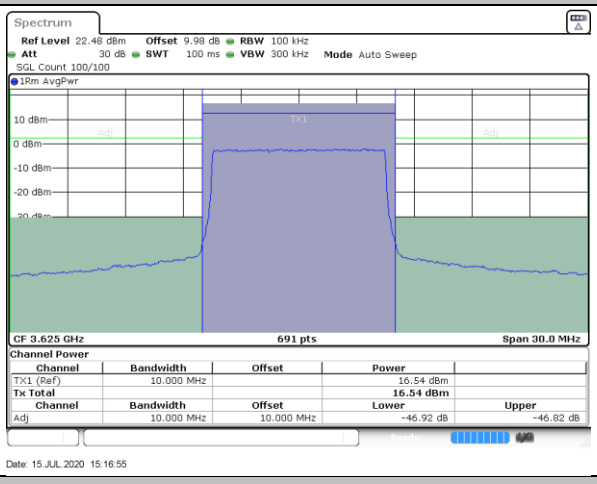

### Lowest Channel / 10MHz / 16QAM



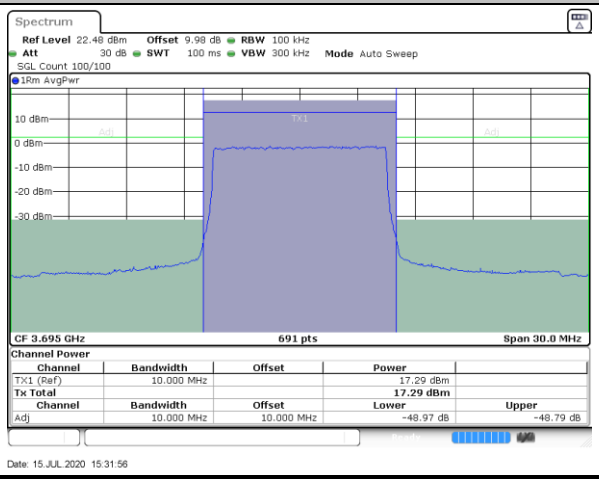

### Middle Channel / 10MHz / QPSK



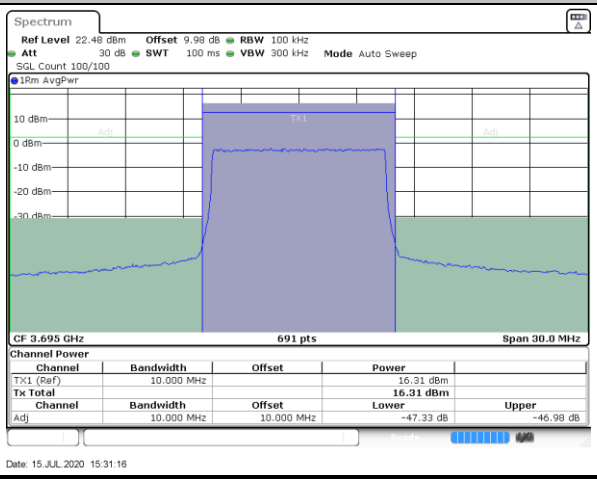

### Middle Channel / 10MHz / 16QAM




### Highest Channel / 10MHz / QPSK

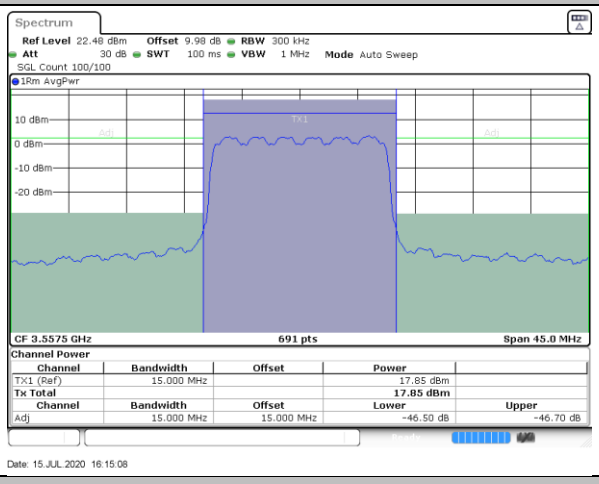



### Highest Channel / 10MHz / 16QAM



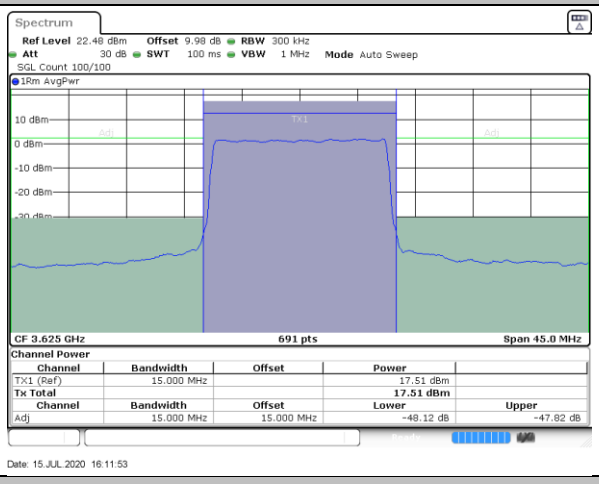
## LTE Band 48

### Lowest Channel / 15MHz / QPSK

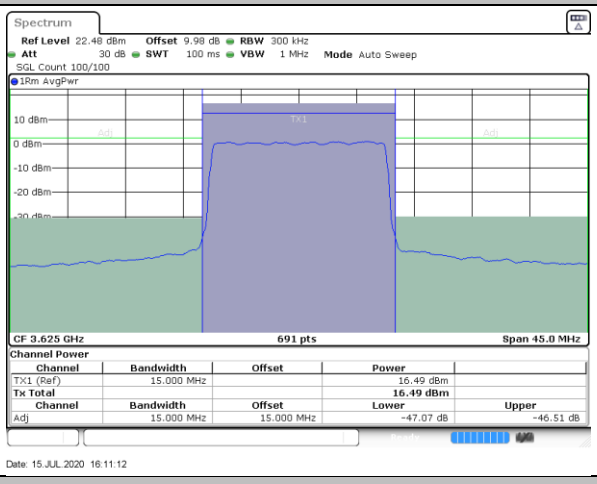



### Lowest Channel / 15MHz / 16QAM

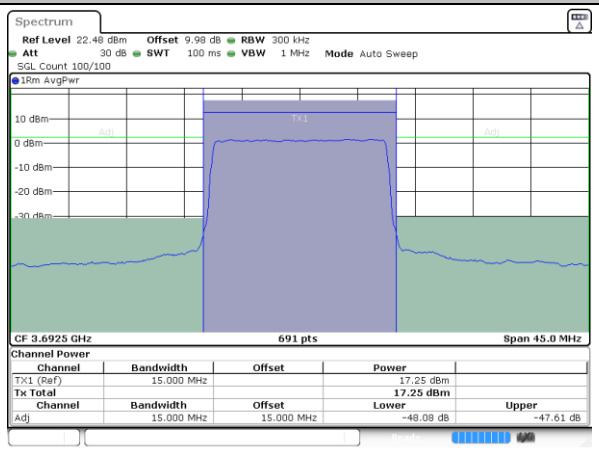

### Middle Channel / 15MHz / QPSK



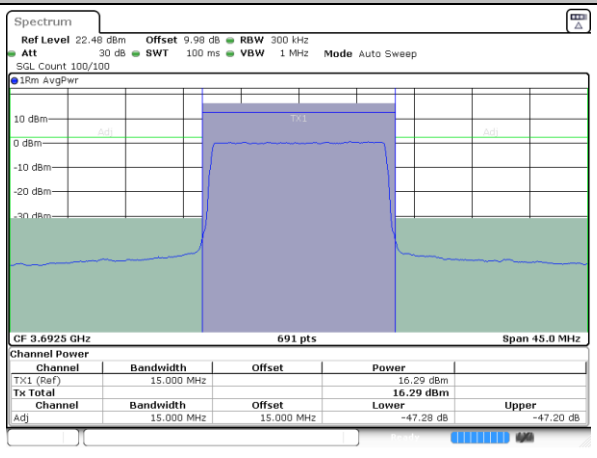

### Middle Channel / 15MHz / 16QAM




### Highest Channel / 15MHz / QPSK

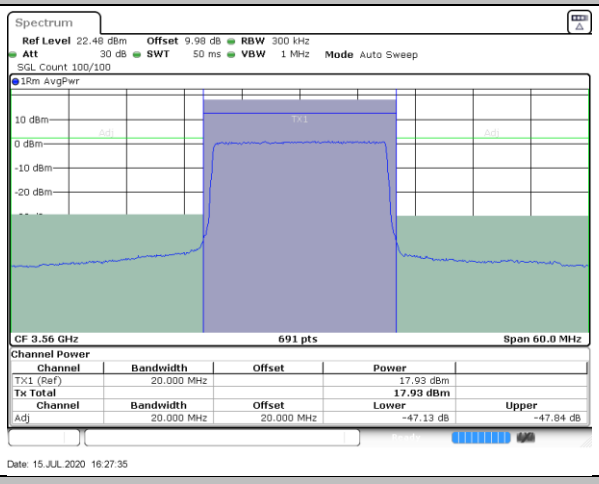



### Highest Channel / 15MHz / 16QAM

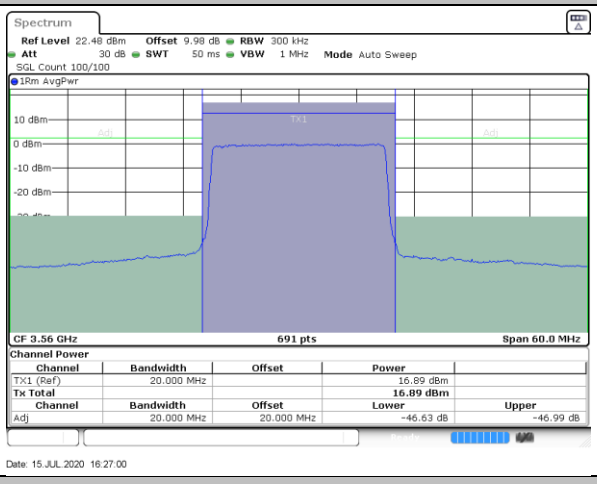


## LTE Band 48

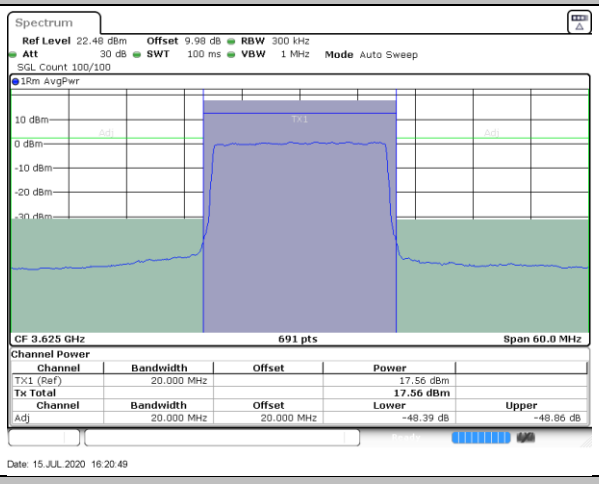
### Lowest Channel / 20MHz / QPSK



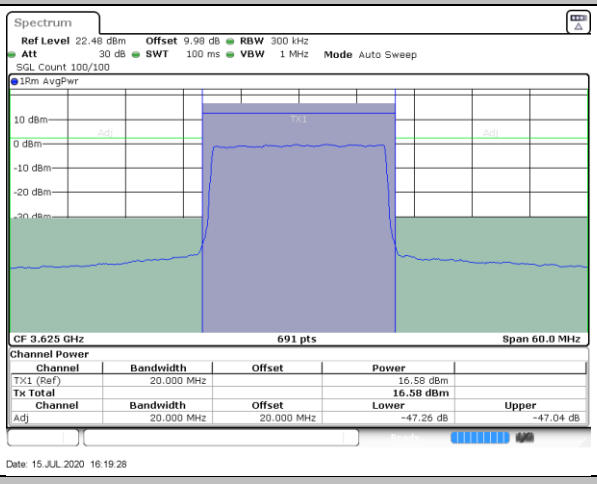

### Lowest Channel / 20MHz / 16QAM



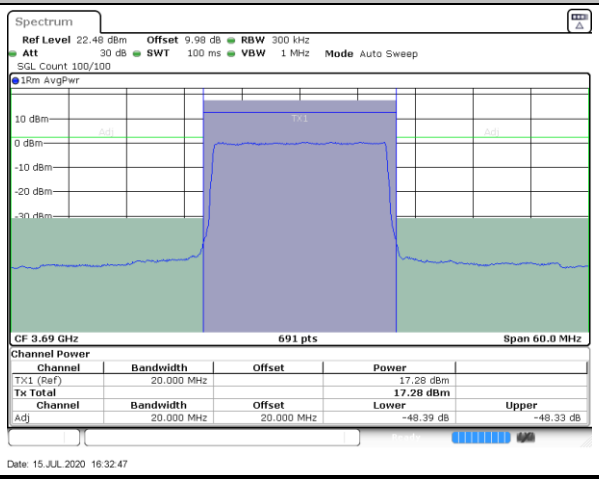

### Middle Channel / 20MHz / QPSK



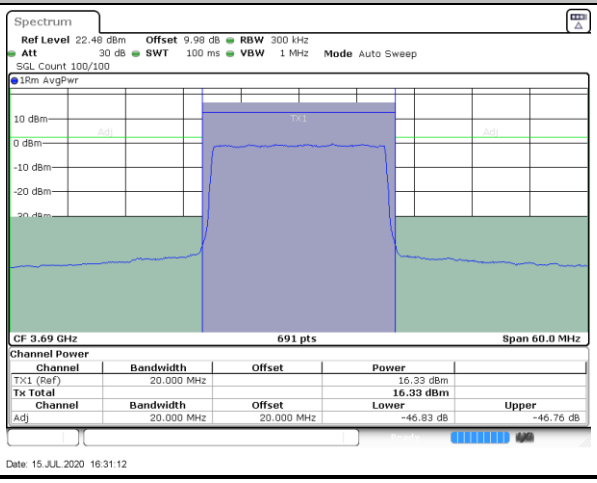

### Middle Channel / 20MHz / 16QAM




### Highest Channel / 20MHz / QPSK

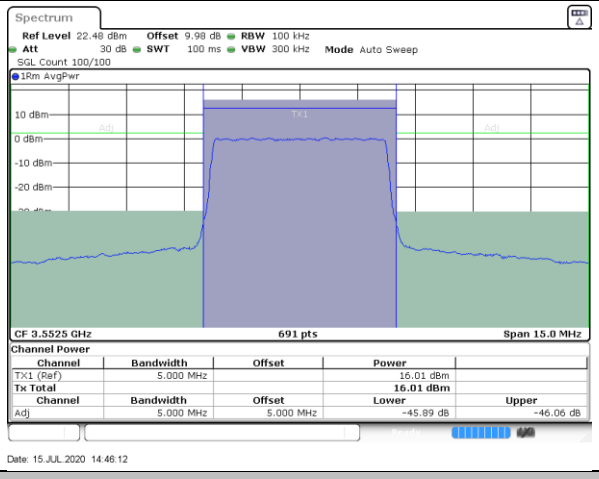



### Highest Channel / 20MHz / 16QAM

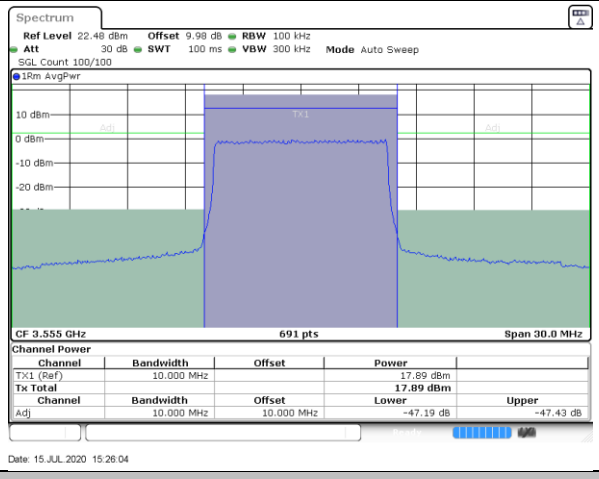


## LTE Band 48

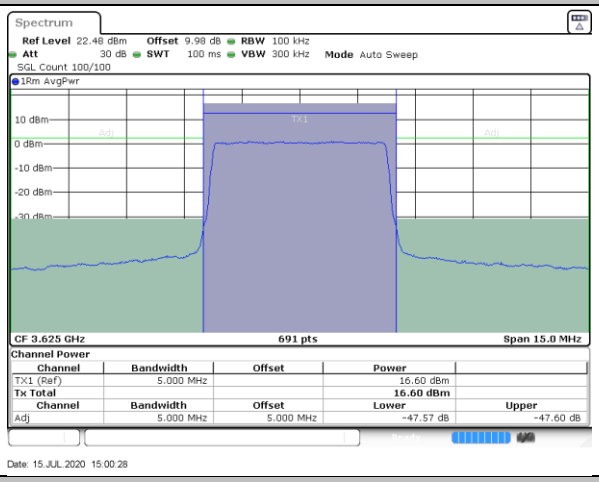
### Lowest Channel / 5MHz / 64QAM



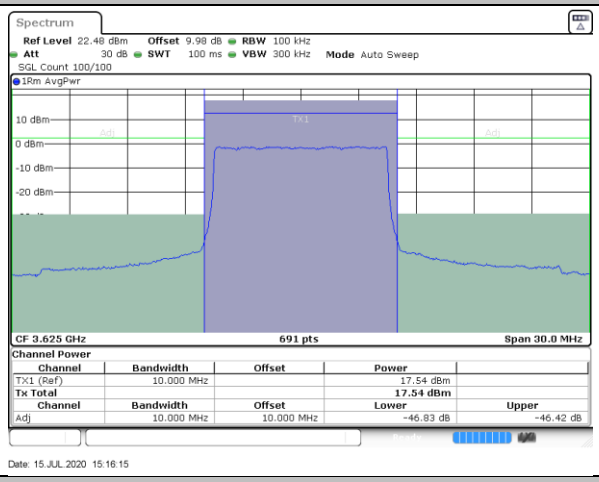

### Lowest Channel / 10MHz / 64QAM



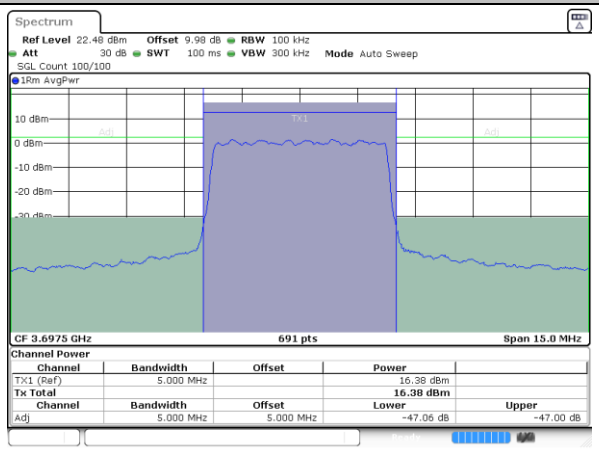

### Middle Channel / 5MHz / 64QAM



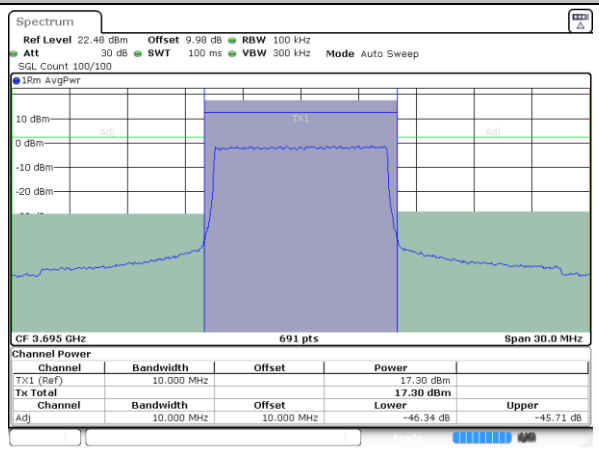

### Middle Channel / 10MHz / 64QAM




### Highest Channel / 5MHz / 64QAM



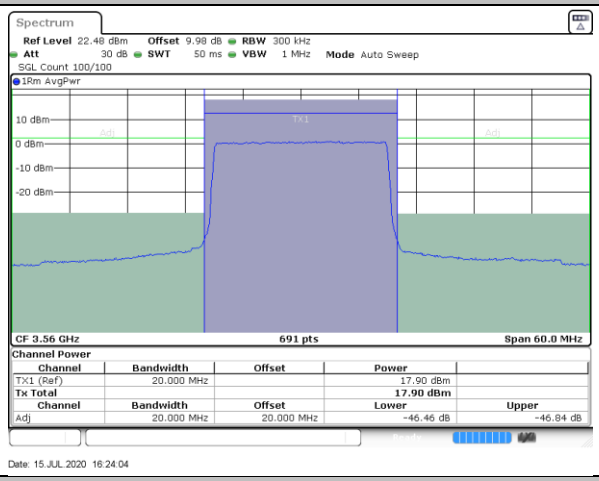

### Highest Channel / 10MHz / 64QAM



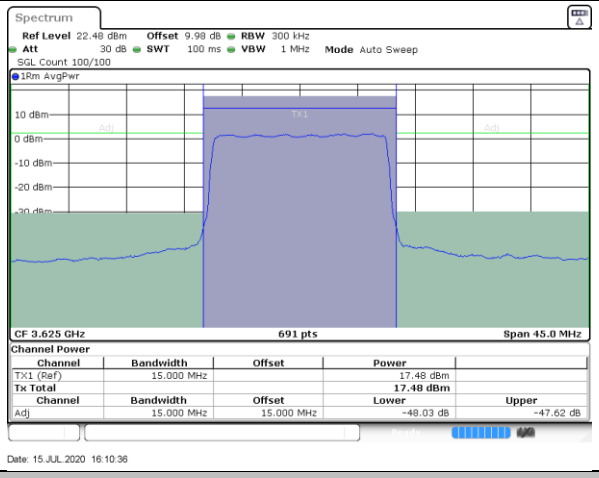
## LTE Band 48

### Lowest Channel / 15MHz / 64QAM

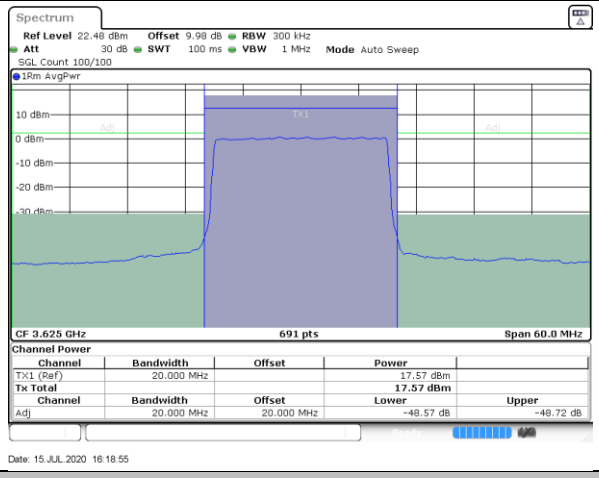

### Lowest Channel / 20MHz / 64QAM



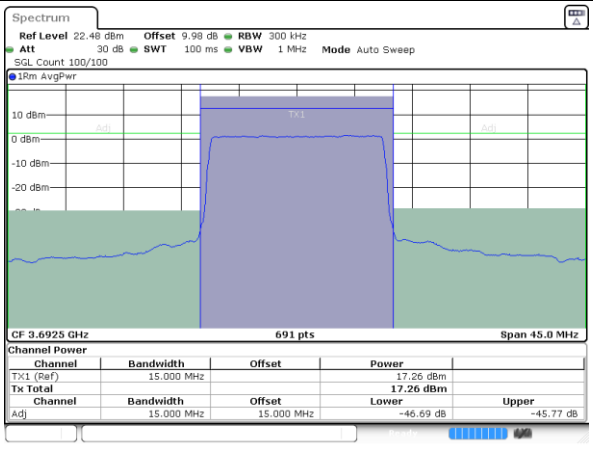

### Middle Channel / 15MHz / 64QAM




### Middle Channel / 20MHz / 64QAM




### Highest Channel / 15MHz / 64QAM




### Highest Channel / 20MHz / 64QAM