# MEASUREMENT REPORT

## FCC PART 96

| | |
|---|---|
| **FCC ID:** | XMR2020EM120RGL |
| **Application:** | Quectel Wireless Solutions Company Limited |
| **Application Type:** | Certification |
| **Product:** | LTE-A Cat 12 M.2 Module |
| **Model No.:** | EM120R-GL |
| **Brand Name:** | QUECTEL |
| **FCC Rule Part(s):** | Part 96 |
| **Test Procedure(s):** | ANSI C63.26-2015, KDB 971168 D01v03r01, KDB 940660 D01v02 |
| **Test Date:** | June 19, 2020 ~ August 15, 2020 |

Reviewed By: ( Sunny Sun )

Approved By: ( Robin Wu )

ACCREDITED
TESTING LABORATORY
CERTIFICATE #3628.01

The test results relate only to the samples tested.
This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.26-2015. Test results reported herein relate only to the item(s) tested.
The test report shall not be reproduced except in full without the written approval of MRT Technology (Suzhou) Co., Ltd.

# Revision History

| Report No. | Version | Description | Issue Date | Note |
|---|---|---|---|---|
| 2006RSU085-U1 | Rev. 01 | Initial Report | 08-20-2020 | Valid |
| | | | | |

# CONTENTS

Description Page

**1. INTRODUCTION ..... 6**

1.1. Scope ..... 6
1.2. MRT Test Location ..... 6

**2. PRODUCT INFORMATION ..... 7**

2.1. Equipment Description ..... 7
2.2. Product Specification Subjective to this Report ..... 7
2.3. Description of Available Antennas ..... 8
2.4. EMI Suppression Device(s)/Modifications ..... 8
2.5. Maximum Power, Frequency Tolerance, and Emission Designator ..... 8
2.6. Configuration of Tested System ..... 9
2.7. Test Environment Condition ..... 9

**3. TEST EQUIPMENT CALIBRATION DATE ..... 10**

**4. MEASUREMENT UNCERTAINTY ..... 12**

**5. TEST RESULT ..... 13**

5.1. Summary ..... 13
5.2. Occupied Bandwidth ..... 14
5.2.1. Test Limit ..... 14
5.2.2. Test Procedure ..... 14
5.2.3. Test Setting ..... 14
5.2.4. Test Setup ..... 14
5.2.5. Test Result ..... 15
5.3. Frequency Stability Measurement ..... 18
5.3.1. Test Limit ..... 18
5.3.2. Test Procedures Used ..... 18
5.3.3. Test Setting ..... 18
5.3.4. Test Setup ..... 19
5.3.5. Test Result ..... 20
5.4. Equivalent Isotropically Radiated Power Measurement ..... 21
5.4.1. Test Limit ..... 21
5.4.2. Test Procedures Used ..... 21
5.4.3. Test Setting ..... 21
5.4.4. Test Setup ..... 22
5.4.5. Test Result ..... 23
5.5. Band Edge Measurement ..... 25

5.5.1. Test Limit ..... 25
5.5.2. Test Procedure Used ..... 25
5.5.3. Test Setting ..... 25
5.5.4. Test Setup ..... 26
5.5.5. Test Result ..... 27
5.6. Conducted Spurious Emissions ..... 36
5.6.1. Test Limit ..... 36
5.6.2. Test Procedure Used ..... 36
5.6.3. Test Setting ..... 36
5.6.4. Test Setup ..... 37
5.6.5. Test Result ..... 38
5.7. Radiated Spurious Emissions Measurements ..... 41
5.7.1. Test Limit ..... 41
5.7.2. Test Procedure Used ..... 41
5.7.3. Test Setting ..... 41
5.7.4. Test Setup ..... 41
5.7.5. Test Result ..... 43
5.8. End User Device Additional Requirement (CBSD Protocol) ..... 44
5.8.1. Test Limit ..... 44
5.8.2. Test Procedure Used ..... 44
5.8.3. Test Setting ..... 44
5.8.4. Test Result ..... 45

**6. CONCLUSION ..... 47**

**Appendix A - Test Setup Photograph ..... 48**

**Appendix B - EUT Photograph ..... 49**

## General Information

| | |
|---|---|
| **Applicant:** | Quectel Wireless Solutions Company Limited |
| **Applicant Address:** | Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233 |
| **Manufacturer:** | Quectel Wireless Solutions Company Limited |
| **Manufacturer Address:** | Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233 |
| **Test Site:** | MRT Technology (Suzhou) Co., Ltd |
| **Test Site Address:** | D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China |

**Test Facility / Accreditations**

**Measurements were performed at MRT Laboratory located in Tian'edang Rd., Suzhou, China.**

- **MRT facility is an FCC accredited testing laboratory (MRT Designation No. CN1166) on the FCC website.**
- **MRT facility is an ISED recognized testing laboratory (MRT Reg. No. CN0001) on the ISED website.**
- **MRT facility is a VCCI registered (R-20025, G-20034, C-20020, T-20020) test laboratory with the site description on file at VCCI Council.**
- **MRT Lab is accredited to ISO 17025 by the A2LA under the A2LA Program (Cert. No. 3628.01) and CNAS under the CNAS Program (Cert. No. L10551) in EMC, Safety, Radio, Telecommunications and SAR testing.**

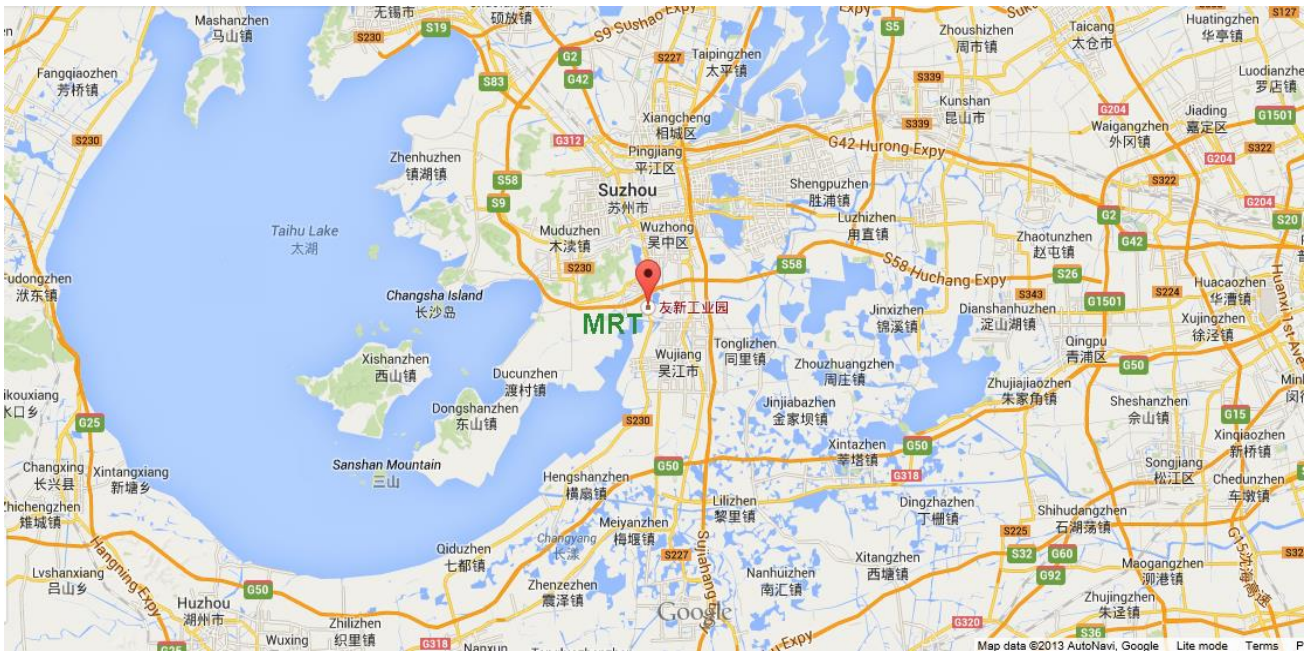
# 1. INTRODUCTION

## 1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada and Certification and Engineering Bureau.

## 1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taihu Lake. These measurement tests were conducted at the MRT Technology (Suzhou) Co., Ltd. Facility located at D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4-2009 on September 30, 2013.



# 2. PRODUCT INFORMATION

## 2.1. Equipment Description

| | |
|---|---|
| Product Name: | LTE-A Cat 12 M.2 Module |
| Model No.: | EM120R-GL |
| Brand Name: | QUECTEL |
| IMEI: | 860459050000725 |
| LTE Specification: | Band 2, 4, 5, 7, 12, 13, 14, 25, 26, 30, 38, 41, 48, 66 |
| Intra-Band: | CA_41C |
| Category: | Category 12 |
| Operating Temperature: | -25 ~ 75 °C |
| Power Type: | 3.1 ~ 4.4Vdc, type 3.7Vdc |

## 2.2. Product Specification Subjective to this Report

| | |
|---|---|
| Frequency Range: | TDD Band 48: 3550 ~ 3700 MHz |
| Device Type: | End User Device |
| Type of Modulation: | QPSK, 16QAM, 64QAM, 256QAM (DL) |

Note: For other features of this EUT, test report will be issued separately.

## 2.3. Description of Available Antennas

| Technology | Frequency Range (MHz) | Antenna Type | Max Peak Gain (dBi) |
|---|---|---|---|
| LTE Band 2 | 1850 ~ 1910 | Dipole Antenna | 1.15 |
| LTE Band 4 | 1710 ~ 1755 | | -0.50 |
| LTE Band 5 | 824 ~ 849 | | 1.85 |
| LTE Band 7 | 2500 ~ 2570 | | 1.32 |
| LTE Band 12 | 699 ~ 716 | | -2.43 |
| LTE Band 13 | 777 ~ 787 | | -0.10 |
| LTE Band 14 | 788 ~ 798 | | 2.40 |
| LTE Band 25 | 1850 ~ 1915 | | 1.15 |
| LTE Band 26 | 814 ~ 849 | | 1.85 |
| LTE Band 30 | 2305 ~ 2315 | | -3.64 |
| LTE Band 38 | 2570 ~ 2620 | | 0.93 |
| LTE Band 41 | 2496 ~ 2690 | | 0.93 |
| LTE Band 48 | 3550 ~ 3700 | | -3.37 |
| LTE Band 66 | 1710 ~ 1780 | | -0.50 |

Note: All antenna information (Antenna type and Peak Gain) is provided by the manufacturer.

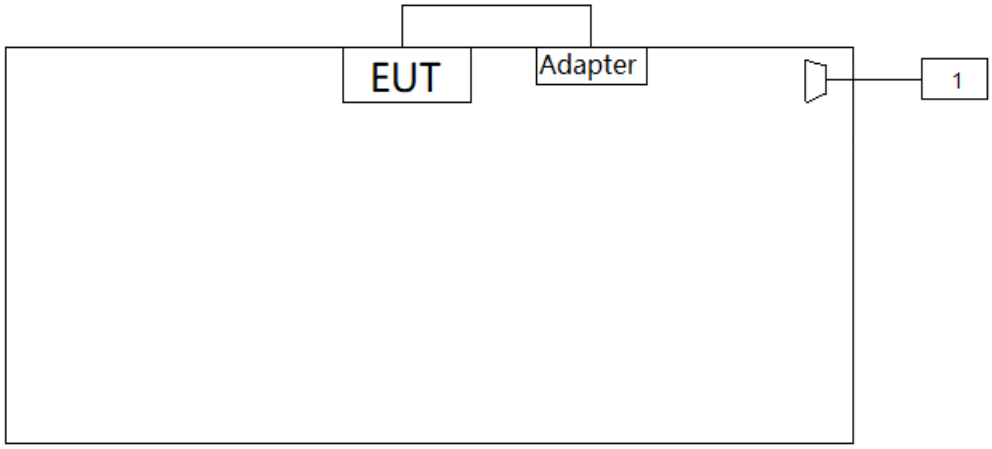
## 2.4. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

## 2.5. Maximum Power, Frequency Tolerance, and Emission Designator

| LTE Band 96 | | QPSK | | | 16QAM | | | 64QAM | | |
|---|---|---|---|---|---|---|---|---|---|---|
| BW (MHz) | Feq. (MHz) | Designator | Tolerance (ppm) | Max Power Density (W/10MHz) | Designator | Tolerance (ppm) | Max Power Density (W/10MHz) | Designator | Tolerance (ppm) | Max Power Density (W/10MHz) |
| 5 | 3552.5 ~ 3697.5 | 4M46G7D | - | 0.2009 | 4M46W7D | - | 0.1726 | 4M46W7D | - | 0.1256 |
| 10 | 3555.0 ~ 3695.0 | 8M95G7D | - | 0.1758 | 8M93W7D | - | 0.1578 | 8M95W7D | - | 0.1114 |
| 15 | 3557.5 ~ 3692.5 | 13M4G7D | - | 0.1479 | 13M4W7D | - | 0.1191 | 13M4W7D | - | 0.0920 |
| 20 | 3560.0 ~ 3690.0 | 17M9G7D | 0.0028 | 0.1059 | 17M9W7D | - | 0.0841 | 17M9W7D | - | 0.0697 |

## 2.6. Configuration of Tested System




| Product | | Manufacturer | Model No. |
|---|---|---|---|
| 1 | Wideband Radio Communication Tester | R&S | CMW 500 |

## 2.7. Test Environment Condition

| | |
|---|---|
| Ambient Temperature | 15°C~35°C |
| Relative Humidity | 20%RH ~75%RH |

# 3. TEST EQUIPMENT CALIBRATION DATE

Radiated Emission - AC1

| Instrument | Manufacturer | Type No. | Asset No. | Cali. Interval | Cali. Due Date |
|---|---|---|---|---|---|
| EMI Test Receiver | R&S | ESR7 | MRTSUE06001 | 1 year | 2021/08/01 |
| Wideband Radio Communication Tester | R&S | CMW 500 | MRTSUE06243 | 1 year | 2020/11/07 |
| PXA Signal Analyzer | Keysight | 9030B | MRTSUE06395 | 1 year | 2020/09/03 |
| Loop Antenna | Schwarzbeck | FMZB 1519 | MRTSUE06025 | 1 year | 2020/11/10 |
| Bilog Period Antenna | Schwarzbeck | VULB 9168 | MRTSUE06172 | 1 year | 2021/03/31 |
| Broad Band Horn Antenna | Schwarzbeck | BBHA 9120D | MRTSUE06023 | 1 year | 2020/10/13 |
| Broad Band Horn Antenna | Schwarzbeck | BBHA 9170 | MRTSUE06597 | 1 year | 2021/02/23 |
| Microwave System Amplifier | Agilent | 83017A | MRTSUE06076 | 1 year | 2020/11/15 |
| Preamplifier | Schwarzbeck | BBV 9721 | MRTSUE06121 | 1 year | 2021/06/11 |
| Thermohygrometer | Testo | 608-H1 | MRTSUE06403 | 1 year | 2021/08/08 |
| Anechoic Chamber | TDK | Chamber-AC1 | MRTSUE06212 | 1 year | 2021/04/30 |

Radiated Emission - AC2

| Instrument | Manufacturer | Type No. | Asset No. | Cali. Interval | Cali. Due Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | Keysight | N9038A | MRTSUE06125 | 1 year | 2021/08/01 |
| Wideband Radio Communication Tester | R&S | CMW 500 | MRTSUE06243 | 1 year | 2020/11/07 |
| Loop Antenna | Schwarzbeck | FMZB 1519 | MRTSUE06025 | 1 year | 2020/11/10 |
| Bilog Period Antenna | Schwarzbeck | VULB 9162 | MRTSUE06022 | 1 year | 2020/10/13 |
| Horn Antenna | Schwarzbeck | BBHA9120D | MRTSUE06171 | 1 year | 2020/10/27 |
| Broad Band Horn Antenna | Schwarzbeck | BBHA 9170 | MRTSUE06597 | 1 year | 2021/02/23 |
| Broadband Coaxial Preamplifier | Schwarzbeck | BBV 9718 | MRTSUE06176 | 1 year | 2020/11/15 |
| Preamplifier | Schwarzbeck | BBV 9721 | MRTSUE06121 | 1 year | 2021/06/11 |
| Temperature/Humidity Meter | Minggao | ETH529 | MRTSUE06170 | 1 year | 2020/12/15 |
| Anechoic Chamber | RIKEN | Chamber-AC2 | MRTSUE06213 | 1 year | 2021/04/30 |

Conducted Test Equipment

| Instrument | Manufacturer | Type No. | Asset No. | Cali. Interval | Cali. Due Date |
|---|---|---|---|---|---|
| EXA Signal Analyzer | Agilent | N9020A | MRTSUE06106 | 1 year | 2021/04/15 |
| EXA Signal Analyzer | Keysight | N9010B | MRTSUE06452 | 1 year | 2021/07/11 |
| Signal Analyzer | R&S | FSV40 | MRTSUE06218 | 1 year | 2021/04/15 |
| Wideband Radio Communication Tester | R&S | CMW 500 | MRTSUE06243 | 1 year | 2020/11/07 |
| Power Meter | Agilent | U2021XA | MRTSUE06030 | 1 year | 2020/11/18 |
| USB wideband power sensor | Keysight | U2021XA | MRTSUE06446 | 1 year | 2021/06/30 |
| USB wideband power sensor | Keysight | U2021XA | MRTSUE06447 | 1 year | 2021/06/30 |
| Bluetooth Test Set | Anritsu | MT8852B-042 | MRTSUE06389 | 1 year | 2021/06/13 |
| Audio Analyzer | Agilent | U8903B | MRTSUE06143 | 1 year | 2021/06/13 |
| Modulation Analyzer | HP | 8901A | MRTSUE06098 | 1 year | 2020/10/10 |
| Wideband Radio Communication Tester | R&S | CMW 500 | MRTSUE06243 | 1 year | 2020/11/07 |
| DC Power Supply | GWINSTEK | DPS-3303C | MRTSUE06064 | N/A | N/A |
| Temperature & Humidity Chamber | BAOYT | BYH-150CL | MRTSUE06051 | 1 year | 2020/11/07 |
| Thermohygrometer | testo | 608-H1 | MRTSUE06401 | 1 year | 2021/08/08 |

| Software | Version | Function |
|---|---|---|
| EMI Software | V3 | EMI Test Software |

# 4. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k = 2.

| Radiated Spurious Emissions |
|---|
| Measurement Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>Horizontal: 9kHz~300MHz: 5.04dB<br>300MHz~1GHz: 4.95dB<br>1GHz~40GHz: 6.40dB<br>Vertical: 9kHz~300MHz: 5.24dB<br>300MHz~1GHz: 6.03dB<br>1GHz~40GHz: 6.40dB |
| Conducted Spurious Emissions |
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>0.78dB |
| Output Power |
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>1.13dB |
| Occupied Bandwidth |
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>0.28% |
| Frequency Stability |
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>76.2Hz |

# 5. TEST RESULT

## 5.1. Summary

| FCC Part Section(s) | Test Description | Test Limit | Test Condition | Test Result | Reference |
|---|---|---|---|---|---|
| 2.1049 | Occupied Bandwidth | N/A | Conducted | Pass | Section 5.2 |
| 2.1055 | Frequency Stability | Refer to section 5.3 | | Pass | Section 5.3 |
| 96.41(b) | Equivalent Isotropic Radiated Power | Refer to section 5.4 | | Pass | Section 5.4 |
| 2.1051<br>96.41(e) | Spurious Emissions;<br>Band Edge Emissions | Refer to section 5.5, 5.6 | | Pass | Section 5.5, 5.6 |
| 2.1053, 96.41(e) | Spurious Emissions | Refer to section 5.7 | Radiated | Pass | Section 5.7 |
| 96.47 | End User Device Additional Requirements (CBSD Protocol) | Refer to section 5.8 | | Pass | Section 5.8 |

**Notes:**

1) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
2) Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations the worst-case was found.
3) All supported modulation types were evaluated. The worst-case emission of modulation was selected. Therefore, the Frequency Stability, Band Edge, Radiated & Conducted Spurious Emission were presented in the test report.
4) This report is supplemented to MRT Original “2006RSU008-U1” Report, FCC ID: XMR2020EM160RGL updating product name and model number.

## 5.2. Occupied Bandwidth

### 5.2.1. Test Limit

The occupied 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 shall be measured.

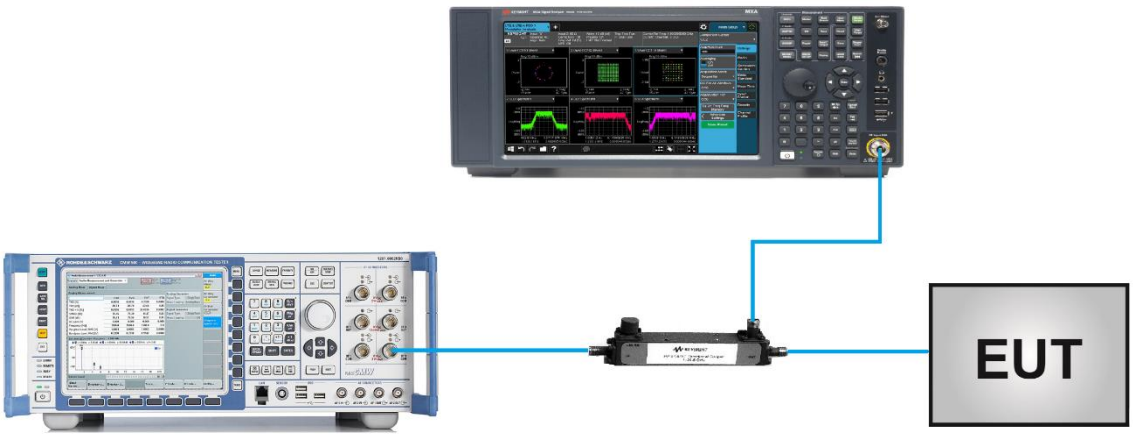
### 5.2.2. Test Procedure

ANSI C63.26-2015 - Section 5.4

### 5.2.3. Test Setting

1. Set center frequency to the nominal EUT channel center frequency
2. RBW = The nominal RBW shall be in the range of 1% to 5% of the anticipated OBW
3. VBW ≥ 3 × RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. Allow the trace to stabilize
8. Use the 99% power bandwidth function of the instrument and report the measured bandwidth.

### 5.2.4. Test Setup



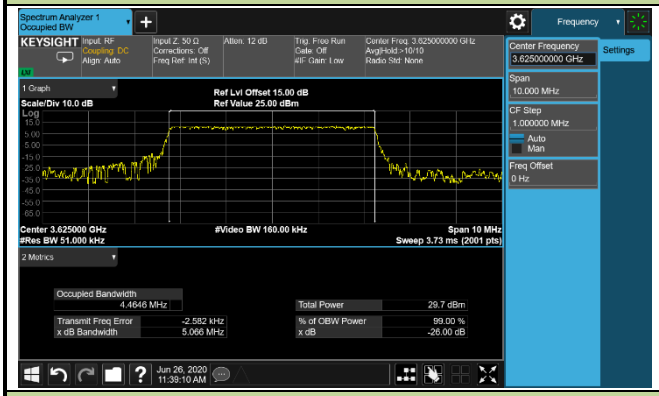
### 5.2.5. Test Result

| | | | |
|---|---|---|---|
| Product | LTE-A Cat 12 M.2 Module | Test Engineer | Candy Luo |
| Test Date | 2020/06/26 | Test Site | TR3 |

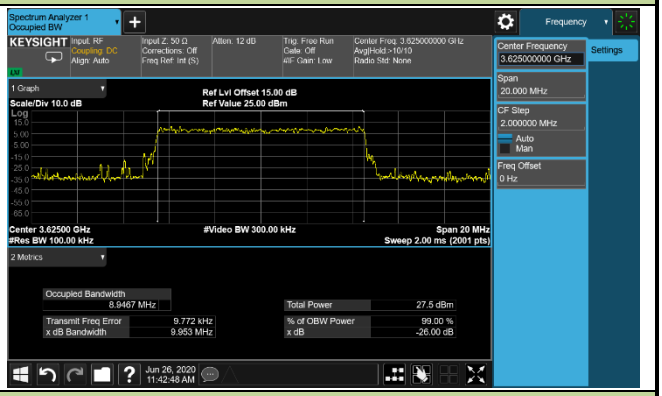
| Modulation | Frequency (MHz) | Bandwidth (MHz) | 99% Bandwidth (MHz) |
|---|---|---|---|
| QPSK | 3625.0 | 5 | 4.46 |
| | | 10 | 8.95 |
| | | 15 | 13.39 |
| | | 20 | 17.87 |
| 16QAM | 3625.0 | 5 | 4.46 |
| | | 10 | 8.93 |
| | | 15 | 13.43 |
| | | 20 | 17.88 |
| 64QAM | 3625.0 | 5 | 4.46 |
| | | 10 | 8.95 |
| | | 15 | 13.43 |
| | | 20 | 17.88 |

## 99% Bandwidth - QPSK

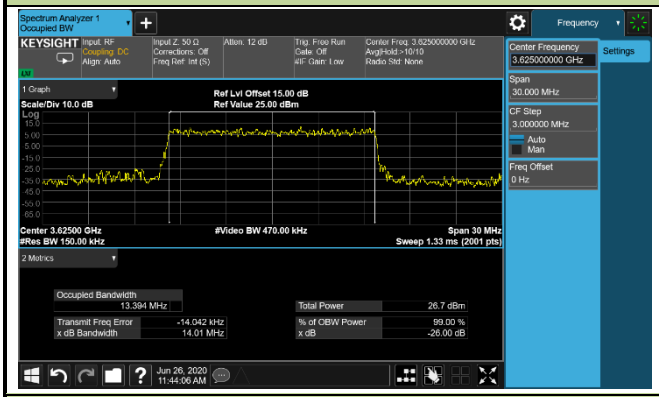
### 5MHz Channel Bandwidth



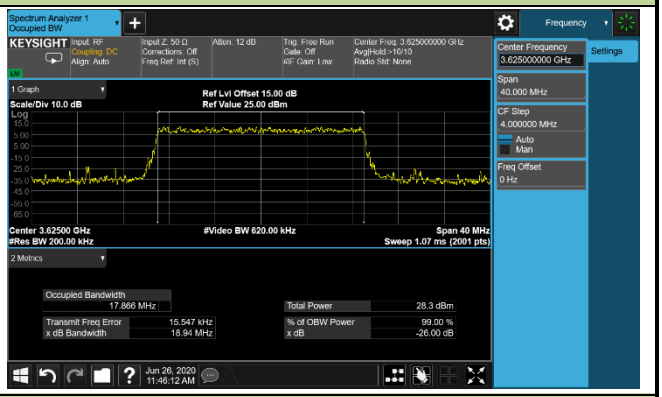

### 10MHz Channel Bandwidth




### 15MHz Channel Bandwidth

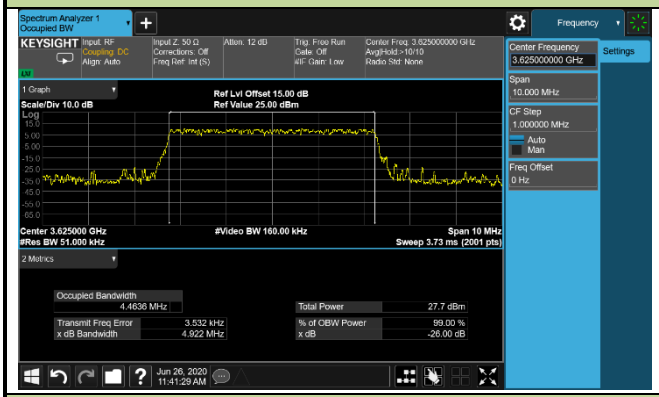



### 20MHz Channel Bandwidth

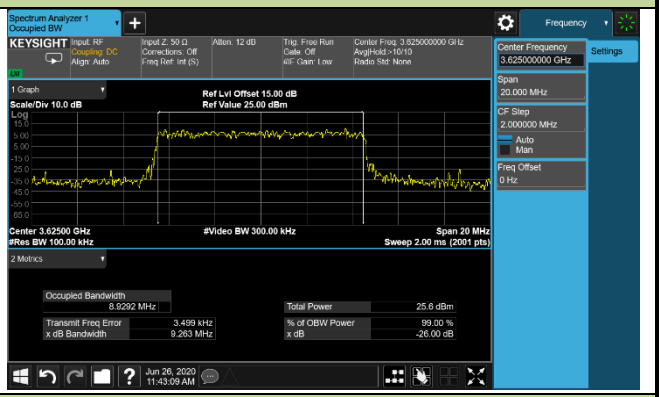



## 99% Bandwidth - 16QAM

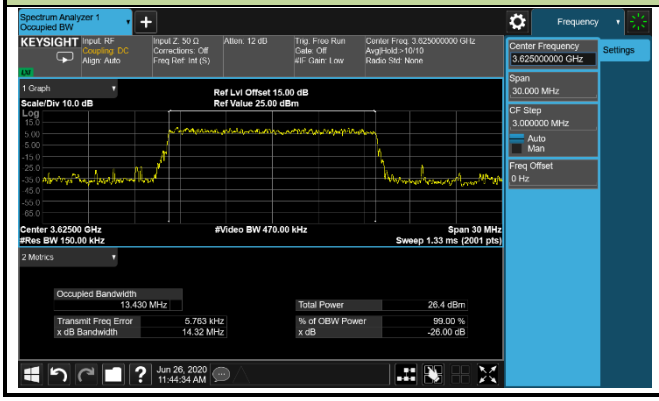
### 5MHz Channel Bandwidth



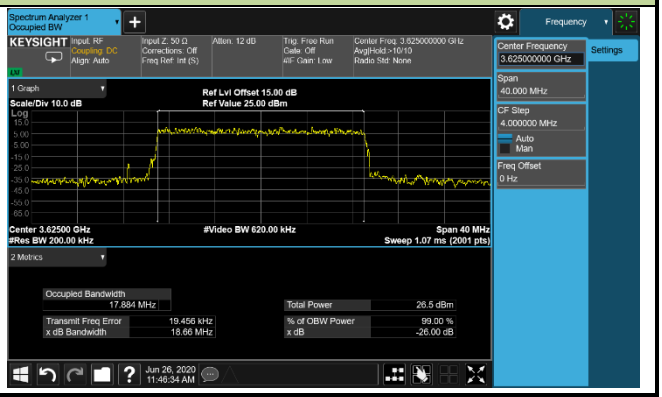

### 10MHz Channel Bandwidth

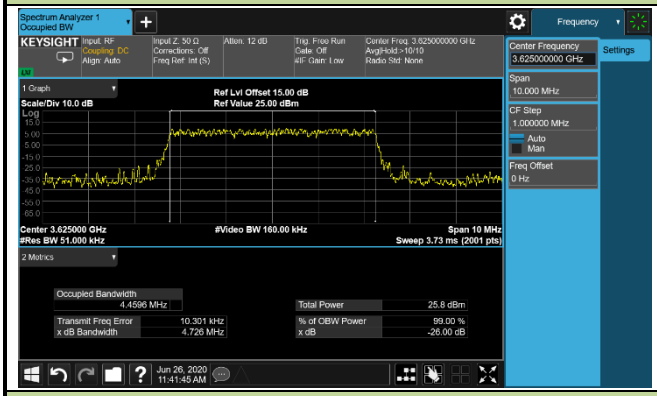
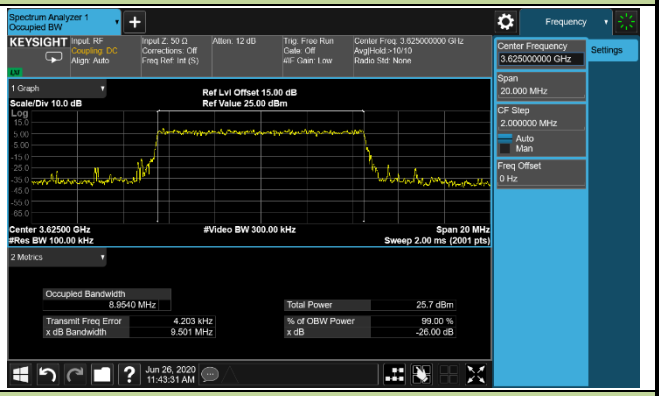
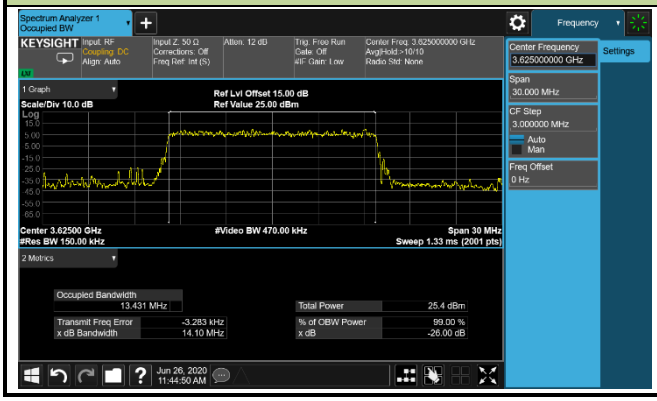
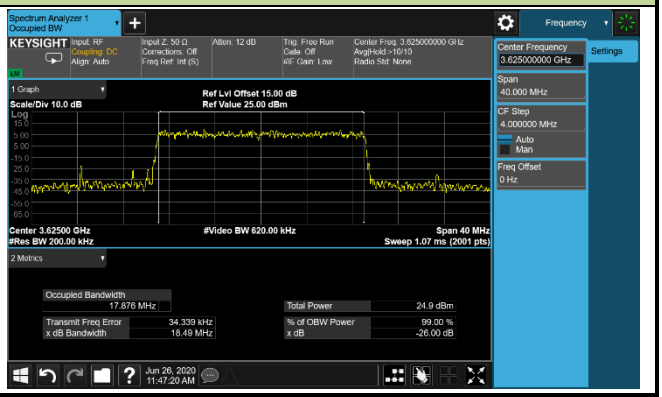



### 15MHz Channel Bandwidth




### 20MHz Channel Bandwidth



| 99% Bandwidth - 64QAM | |
|---|---|
| 5MHz Channel Bandwidth | 10MHz Channel Bandwidth |
|  |  |
| 15MHz Channel Bandwidth | 20MHz Channel Bandwidth |
|  |  |

## 5.3. Frequency Stability Measurement

### 5.3.1. Test Limit

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.

### 5.3.2. Test Procedures Used

ANSI C63.26-2015 - Section 5.6

### 5.3.3. Test Setting

**Frequency Stability Under Temperature Variations:**

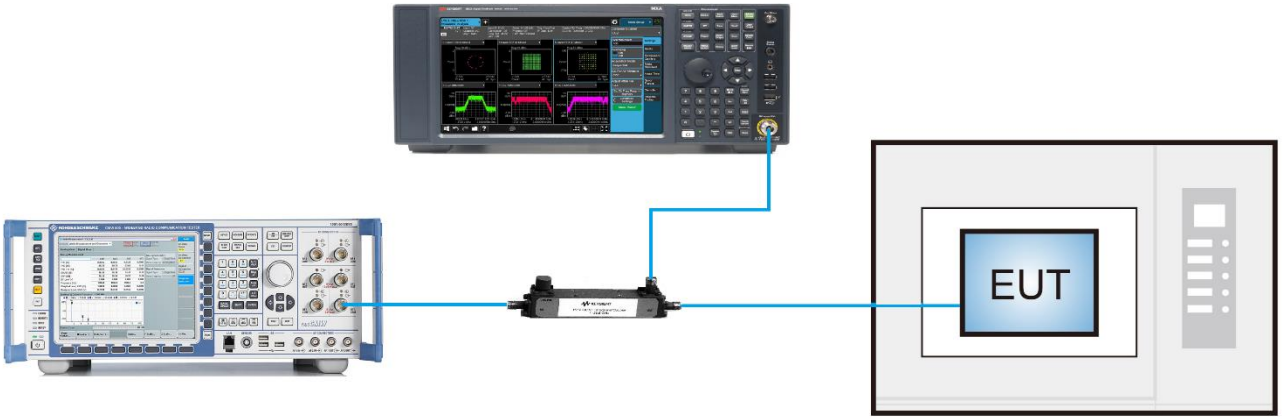
The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 20°C operating frequency as reference frequency. Turn EUT off and set the chamber temperature to highest. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure with 10°C decreased per stage until the lowest temperature reached.

**Frequency Stability Under Voltage Variations:**

Set chamber temperature to 20°C. Use a variable AC power supply / DC power source to power the EUT and set the voltage to rated voltage. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and recorded the frequency.

Reduce the input voltage to specify extreme voltage variation (±15%) and endpoint, recordthe maximum frequency change.

### 5.3.4. Test Setup



### 5.3.5. Test Result

| | | | |
|---|---|---|---|
| Product | LTE-A Cat 12 M.2 Module | Temperature | -30 ~ 50°C |
| Test Engineer | Candy Luo | Relative Humidity | 53% |
| Test Site | TR3 | Test Date | 2020/06/19 |

| Voltage (%) | Power (Vdc) | Temp. (°C) | Frequency Tolerance (ppm) |
|---|---|---|---|
| 100% | 3.7 | - 30 | 0.0023 |
| | | - 20 | 0.0024 |
| | | - 10 | 0.0027 |
| | | 0 | 0.0022 |
| | | + 10 | 0.0028 |
| | | + 20 (Ref) | 0.0023 |
| | | + 30 | 0.0021 |
| | | + 40 | 0.0020 |
| | | + 50 | 0.0023 |
| 115% | 4.3 | + 20 | 0.0026 |
| 85% | 3.2 | + 20 | 0.0018 |

## 5.4. Equivalent Isotropically Radiated Power Measurement

### 5.4.1. Test Limit

The maximum effective isotropic radiated power (EIRP) End User Device is 23dBm/10MHz

### 5.4.2. Test Procedures Used

ANSI C63.26-2015 - Section 5.2.4.4.2 & 5.2.5.5

### 5.4.3. Test Setting

When the fundamental condition for average power measurements cannot be realized (i.e., the EUT cannot be configured to transmit at full-power on a continuous basis (i.e., duty cycle < 98%) and the instrumentation cannot be configured to measure only during active full-power transmissions), then the following procedure can be used if the EUT duty cycle is constant (i.e., duty cycle variations are less than or equal to ±2%).

a) Set span to 2 × to 3 × the OBW.

b) Set RBW = 1% to 5% of the OBW.

c) Set VBW ≥ 3 × RBW.

d) Set number of measurement points in sweep ≥ 2 × span / RBW.

e) Sweep time:

1) Set = auto-couple, or

2) Set ≥ [10 × (number of points in sweep) × (transmission symbol period)] for single sweep (automation-compatible) measurement.

f) Detector = power averaging (rms).

g) Set sweep trigger to “free run.”

h) Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. To accurately determine the average power over the on and off time of the transmitter, it can be necessary to increase the number of traces to be averaged above 100, or if using a manually configured sweep time, increase the sweep time.

i) Using the marker function to identify the maximum PSD.

j) Add 10 log (1/duty cycle) to the measured power level to compute the average power during continuous transmission. For example, add [10 log (1/0.25)] = 6 dB if the duty cycle is a constant 25%.

The relevant equation for determining the maximum ERP or EIRP from the measured RF output

power is given in Equation (1) as follows:

ERP or EIRP = PMeas + GT (1)

where

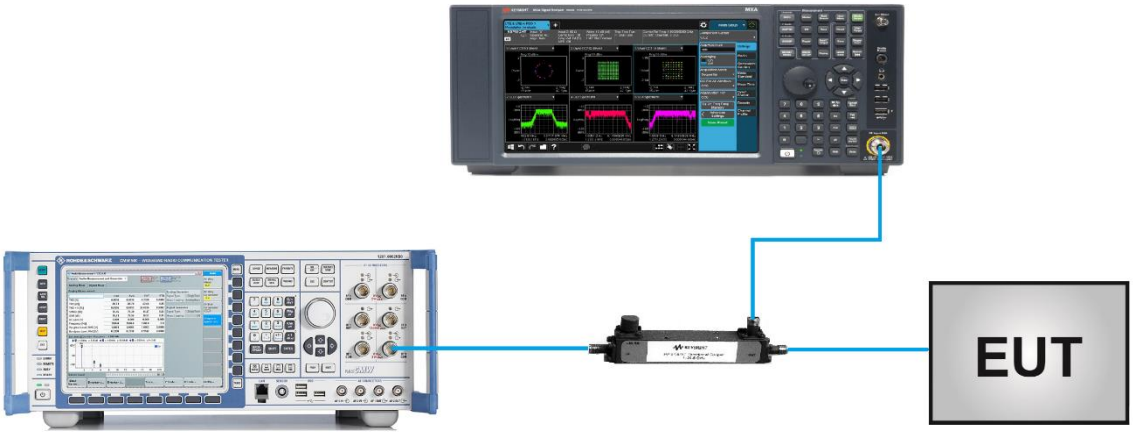
ERP or EIRP effective radiated power or equivalent isotropically radiated power, respectively (expressed in the same units as PMeas, e.g., dBm or dBW)

PMeas measured transmitter output power or PSD, in dBm or dBW

GT gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP)

For devices utilizing multiple antennas, see 6.4 for guidance with respect to determining the effective array transmit antenna gain term to be used in the above equation.

### 5.4.4. Test Setup



### 5.4.5. Test Result

| Product | LTE-A Cat 12 M.2 Module | Test Engineer | Candy Luo |
|---|---|---|---|
| Test Date | 2020/08/15 | Test Site | TR3 |

| Channel No. | Frequency (MHz) | Channel Bandwidth (MHz) | RB Size | RB Offset | Output Power (dBm/10MHz) | EIRP (dBm/ 10MHz) | Limit (dBm/ 10MHz) |
|---|---|---|---|---|---|---|---|
| QPSK | | | | | | | |
| 55265 | 3552.50 | 5 | 25 | 0 | 23.03 | 19.66 | < 23.00 |
| 55900 | 3625.00 | | | | 22.97 | 19.60 | < 23.00 |
| 56715 | 3697.50 | | | | 22.31 | 18.94 | < 23.00 |
| 55290 | 3555.00 | 10 | 50 | 0 | 22.45 | 19.08 | < 23.00 |
| 55900 | 3625.00 | | | | 22.60 | 19.23 | < 23.00 |
| 56690 | 3695.00 | | | | 22.85 | 19.48 | < 23.00 |
| 55315 | 3557.50 | 15 | 75 | 0 | 21.39 | 18.02 | < 23.00 |
| 55990 | 3625.00 | | | | 21.70 | 18.33 | < 23.00 |
| 56665 | 3692.50 | | | | 21.28 | 17.91 | < 23.00 |
| 55340 | 3560.00 | 20 | 100 | 0 | 20.25 | 16.88 | < 23.00 |
| 55990 | 3625.00 | | | | 20.20 | 16.83 | < 23.00 |
| 56640 | 3690.00 | | | | 19.98 | 16.61 | < 23.00 |
| 16QAM | | | | | | | |
| 55265 | 3552.50 | 5 | 25 | 0 | 21.84 | 18.47 | < 23.00 |
| 55900 | 3625.00 | | | | 22.37 | 19.00 | < 23.00 |
| 56715 | 3697.50 | | | | 21.83 | 18.46 | < 23.00 |
| 55290 | 3555.00 | 10 | 50 | 0 | 21.98 | 18.61 | < 23.00 |
| 55900 | 3625.00 | | | | 21.80 | 18.43 | < 23.00 |
| 56690 | 3695.00 | | | | 21.56 | 18.19 | < 23.00 |
| 55315 | 3557.50 | 15 | 75 | 0 | 20.76 | 17.39 | < 23.00 |
| 55990 | 3625.00 | | | | 20.73 | 17.36 | < 23.00 |
| 56665 | 3692.50 | | | | 20.27 | 16.90 | < 23.00 |
| 55340 | 3560.00 | 20 | 100 | 0 | 19.18 | 15.81 | < 23.00 |
| 55990 | 3625.00 | | | | 19.25 | 15.88 | < 23.00 |
| 56640 | 3690.00 | | | | 19.22 | 15.85 | < 23.00 |
| Note: The EIRP (dBm/10MHz) = Output Power (dBm/10MHz) + Antenna Gain (dBi) | | | | | | | |

| Channel No. | Frequency (MHz) | Channel Bandwidth (MHz) | RB Size | RB Offset | Output Power (dBm/10MHz) | EIRP (dBm/ 10MHz) | Limit (dBm/ 10MHz) |
|---|---|---|---|---|---|---|---|
| 64QAM | | | | | | | |
| 55265 | 3552.50 | 5 | 25 | 0 | 20.42 | 17.05 | < 23.00 |
| 55900 | 3625.00 | | | | 20.99 | 17.62 | < 23.00 |
| 56715 | 3697.50 | | | | 19.80 | 16.43 | < 23.00 |
| 55290 | 3555.00 | 10 | 50 | 0 | 20.47 | 17.10 | < 23.00 |
| 55900 | 3625.00 | | | | 20.43 | 17.06 | < 23.00 |
| 56690 | 3695.00 | | | | 19.15 | 15.78 | < 23.00 |
| 55315 | 3557.50 | 15 | 75 | 0 | 19.48 | 16.11 | < 23.00 |
| 55990 | 3625.00 | | | | 19.64 | 16.27 | < 23.00 |
| 56665 | 3692.50 | | | | 18.36 | 14.99 | < 23.00 |
| 55340 | 3560.00 | 20 | 100 | 0 | 18.43 | 15.06 | < 23.00 |
| 55990 | 3625.00 | | | | 18.29 | 14.92 | < 23.00 |
| 56640 | 3690.00 | | | | 17.32 | 13.95 | < 23.00 |
| Note: The EIRP (dBm/10MHz) = Output Power (dBm/10MHz) + Antenna Gain (dBi) | | | | | | | |

## 5.5. Band Edge Measurement

### 5.5.1. Test Limit

All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst-case configuration. All modes of operation were investigated, and the worst-case configuration results are reported in this section.

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

### 5.5.2. Test Procedure Used

ANSI C63.26-2015 - Section 5.7

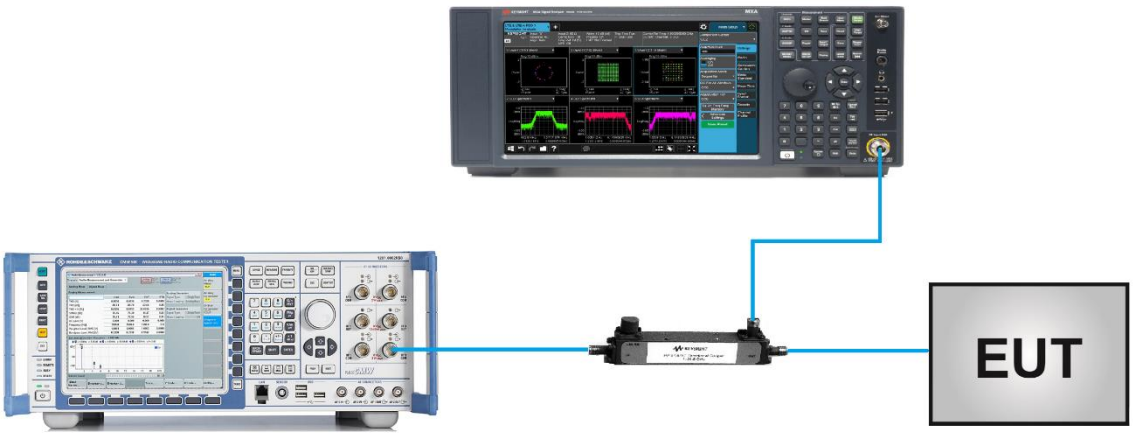
### 5.5.3. Test Setting

1. Set the analyzer frequency to low, middle, high channel.
2. RBW ≥ The nominal RBW shall be in the range of 1% of the anticipated OBW (in the 1MHz band immediately outside and adjacent to the band edge). For improvement of the accuracy in the measurement of the average power of a noise-like emission, a RBW narrower than the specified reference bandwidth can be used (generally limited to no less than 1% of the OBW), provided that a subsequent integration is performed over the full required measurement bandwidth. This integration should be performed using the spectrum analyzer's band power functions.
3. VBW ≥ 3*RBW
4. Sweep time = auto
5. Detector = power averaging (rms)
6. Set sweep trigger to "free run."
7. User gate triggered such that the analyzer only sweeps when the device is transmitting at full

power

8. Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. To accurately determine the average power over the on and off time of the transmitter, it can be necessary to increase the number of traces to be averaged above 100, or if using a manually configured sweep time, increase the sweep time.
9. Used power integration when using a measurement bandwidth smaller than the specified bandwidth.

### 5.5.4. Test Setup

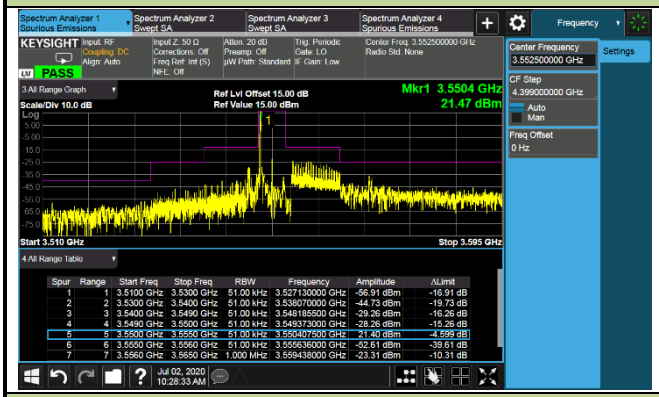


### 5.5.5. Test Result

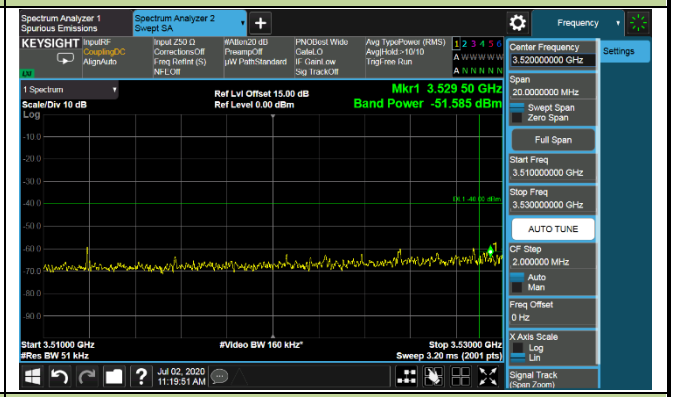
| | | | |
|---|---|---|---|
| Product | LTE-A Cat 12 M.2 Module | Test Engineer | Candy Luo |
| Test Date | 2020/07/02 | Test Site | TR3 |

5MHz Channel Bandwidth - 1RB

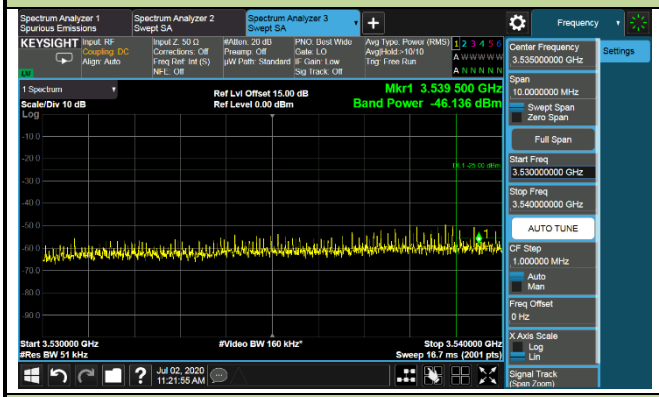
Low Channel ACP




Extended Band Edge

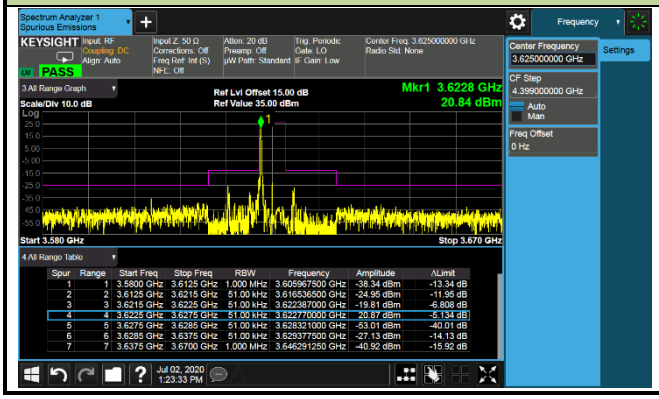



Extended Band Edge

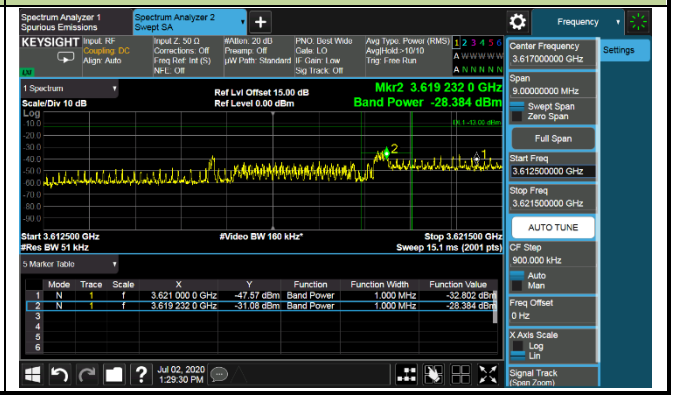



Extended Band Edge

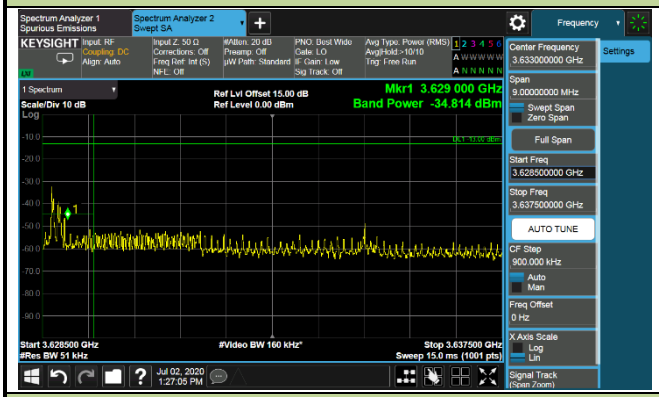
Middle Channel ACP – Low RB Position



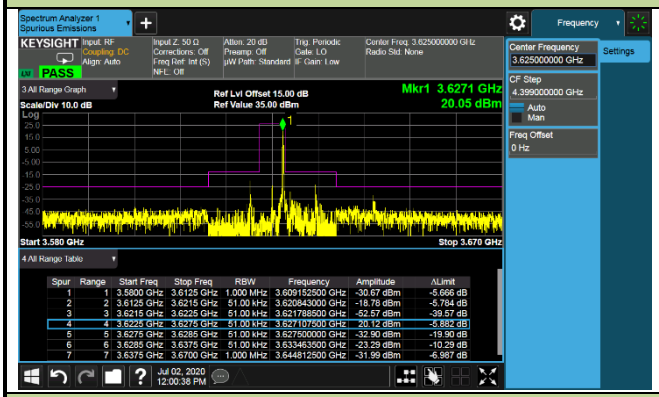

Extended Band Edge



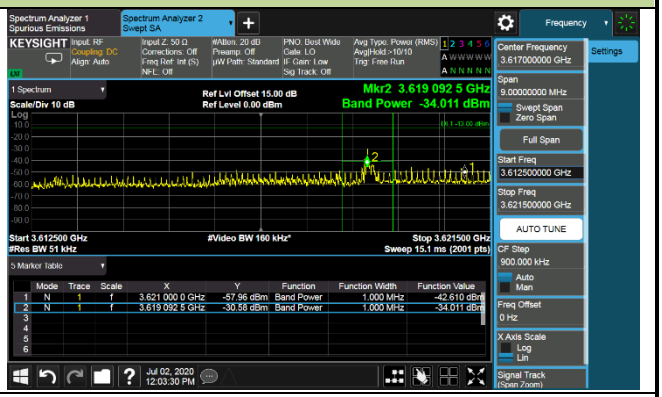
## Extended Band Edge



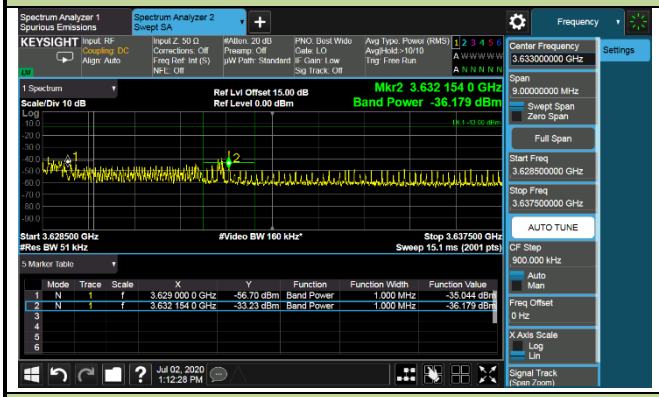

## Middle Channel ACP – High RB Position



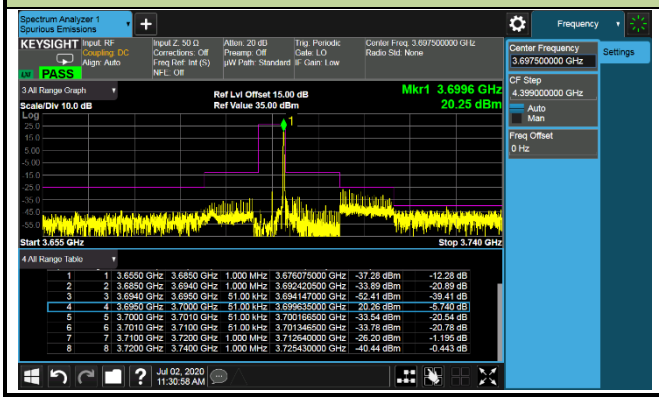

## Extended Band Edge




## Extended Band Edge



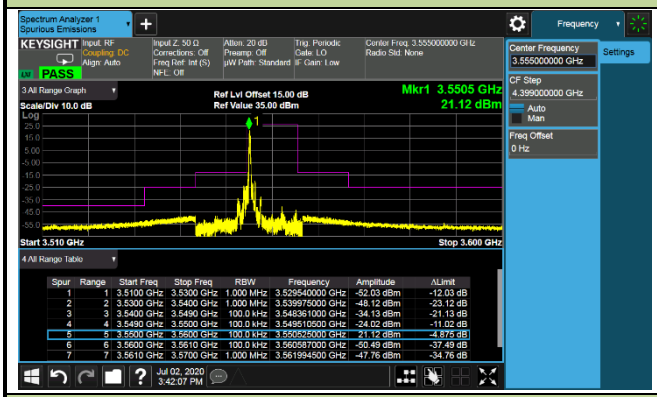

## High Channel ACP



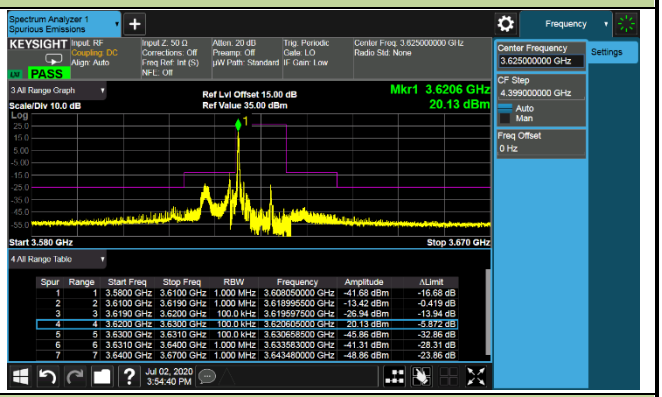

## Extended Band Edge

## 10MHz Channel Bandwidth – 1RB

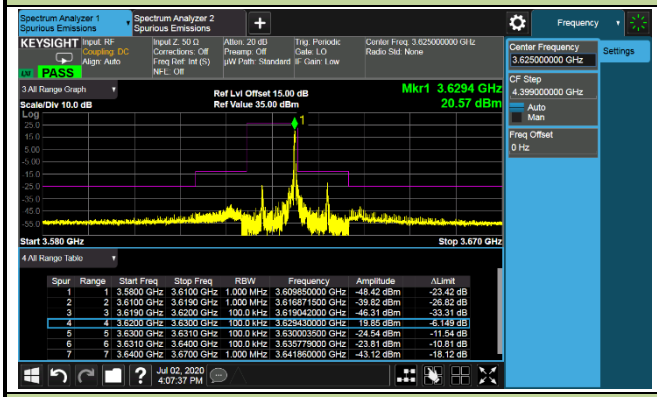
### Low Channel ACP



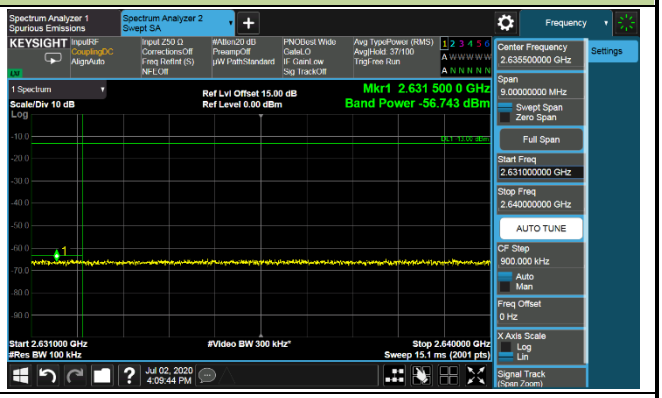

### Middle Channel ACP – Low RB Position



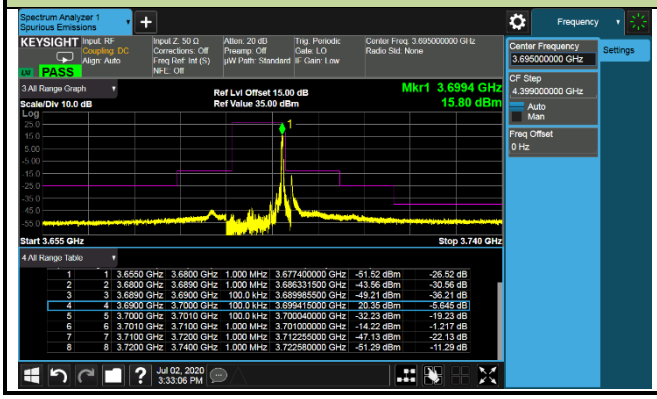

### Middle Channel ACP – High RB Position




### Extended Band Edge

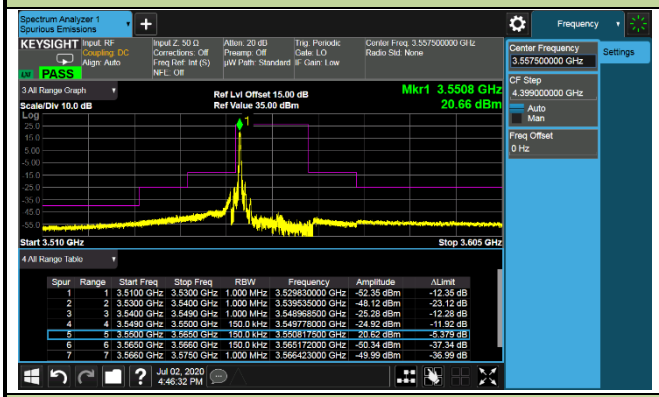



### High Channel ACP

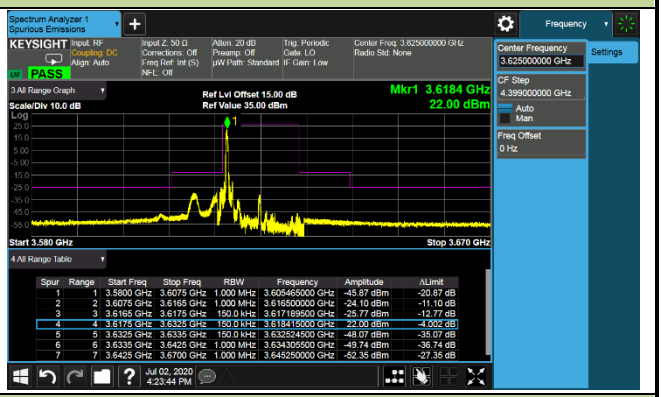


## 15MHz Channel Bandwidth – 1RB

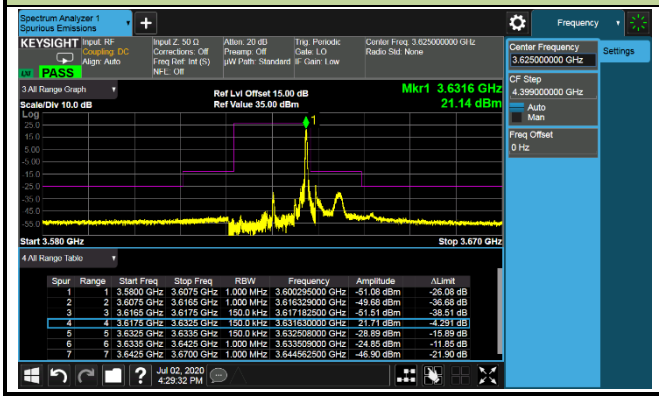
### Low Channel ACP



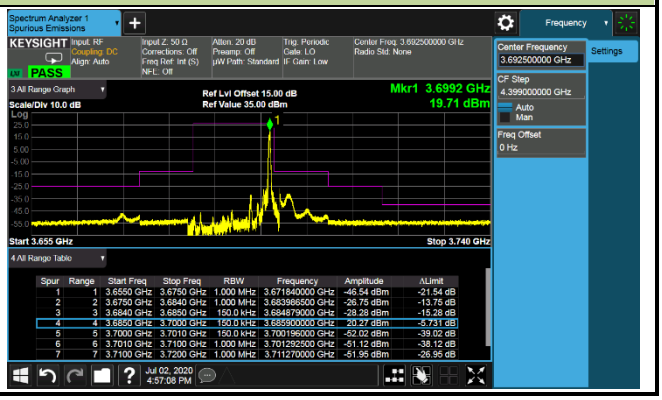

### Middle Channel ACP – Low RB Position




### Middle Channel ACP – High RB Position

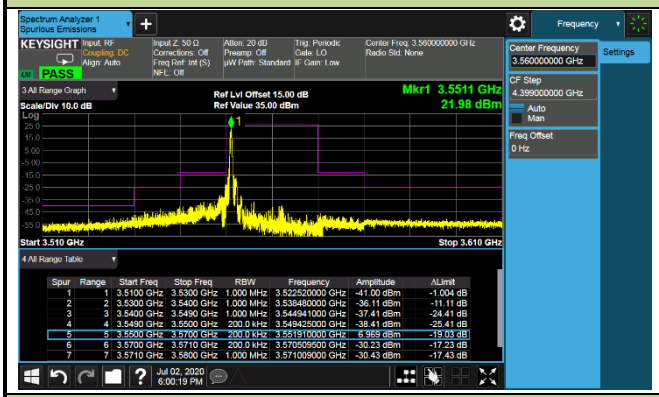



### High Channel ACP



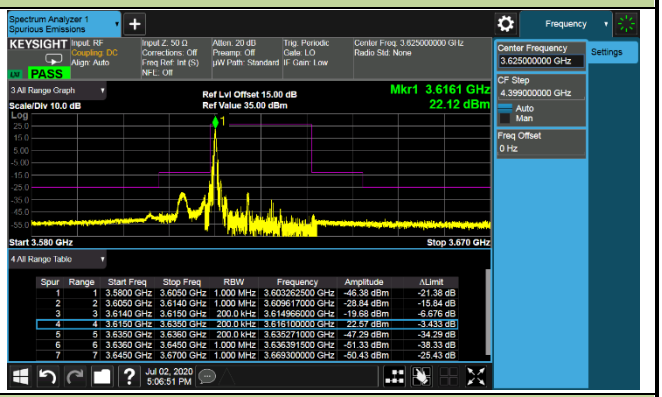
## 20MHz Channel Bandwidth – 1RB

### Low Channel ACP



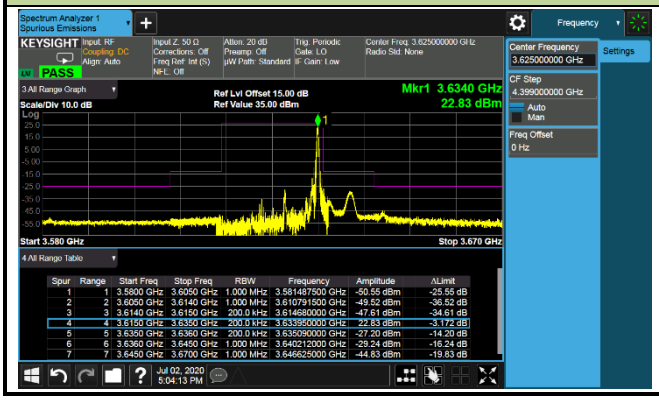

| Spur | Range | Start Freq | Stop Freq | RBW | Frequency | Amplitude | ΔLimit |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3.5100 GHz | 3.5300 GHz | 1.000 MHz | 3.522520000 GHz | -41.00 dBm | -1.004 dB |
| 2 | 2 | 3.5300 GHz | 3.5400 GHz | 1.000 MHz | 3.538480000 GHz | -36.11 dBm | -11.11 dB |
| 3 | 3 | 3.5400 GHz | 3.5490 GHz | 1.000 MHz | 3.544941000 GHz | -37.41 dBm | -24.41 dB |
| 4 | 4 | 3.5490 GHz | 3.5500 GHz | 200.0 kHz | 3.549425000 GHz | -38.41 dBm | -25.41 dB |
| 5 | 5 | 3.5500 GHz | 3.5700 GHz | 200.0 kHz | 3.551910000 GHz | 6.969 dBm | -19.03 dB |
| 6 | 6 | 3.5700 GHz | 3.5710 GHz | 200.0 kHz | 3.570509500 GHz | -30.23 dBm | -17.23 dB |
| 7 | 7 | 3.5710 GHz | 3.5800 GHz | 1.000 MHz | 3.571009000 GHz | -30.43 dBm | -17.43 dB |

### Middle Channel ACP – Low RB Position



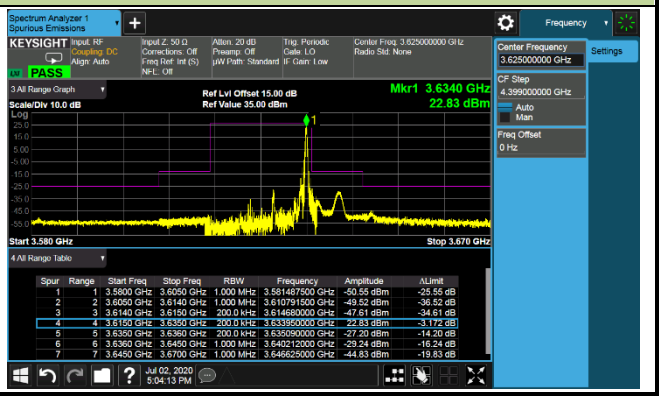

| Spur | Range | Start Freq | Stop Freq | RBW | Frequency | Amplitude | ΔLimit |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3.5800 GHz | 3.6050 GHz | 1.000 MHz | 3.603262500 GHz | -46.38 dBm | -21.38 dB |
| 2 | 2 | 3.6050 GHz | 3.6140 GHz | 1.000 MHz | 3.609617000 GHz | -28.84 dBm | -15.84 dB |
| 3 | 3 | 3.6140 GHz | 3.6150 GHz | 200.0 kHz | 3.614966000 GHz | -19.68 dBm | -6.676 dB |
| 4 | 4 | 3.6150 GHz | 3.6350 GHz | 200.0 kHz | 3.616100000 GHz | 22.57 dBm | -3.433 dB |
| 5 | 5 | 3.6350 GHz | 3.6360 GHz | 200.0 kHz | 3.635271000 GHz | -47.29 dBm | -34.29 dB |
| 6 | 6 | 3.6360 GHz | 3.6450 GHz | 1.000 MHz | 3.636391500 GHz | -51.33 dBm | -38.33 dB |
| 7 | 7 | 3.6450 GHz | 3.6700 GHz | 1.000 MHz | 3.669300000 GHz | -50.43 dBm | -25.43 dB |

### Middle Channel ACP – High RB Position




| Spur | Range | Start Freq | Stop Freq | RBW | Frequency | Amplitude | ΔLimit |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3.5800 GHz | 3.6050 GHz | 1.000 MHz | 3.581487500 GHz | -50.55 dBm | -25.55 dB |
| 2 | 2 | 3.6050 GHz | 3.6140 GHz | 1.000 MHz | 3.610791500 GHz | -49.52 dBm | -36.52 dB |
| 3 | 3 | 3.6140 GHz | 3.6150 GHz | 200.0 kHz | 3.614680000 GHz | -47.61 dBm | -34.61 dB |
| 4 | 4 | 3.6150 GHz | 3.6350 GHz | 200.0 kHz | 3.633950000 GHz | 22.83 dBm | -3.172 dB |
| 5 | 5 | 3.6350 GHz | 3.6360 GHz | 200.0 kHz | 3.635090000 GHz | -27.20 dBm | -14.20 dB |
| 6 | 6 | 3.6360 GHz | 3.6450 GHz | 1.000 MHz | 3.640212000 GHz | -29.24 dBm | -16.24 dB |
| 7 | 7 | 3.6450 GHz | 3.6700 GHz | 1.000 MHz | 3.646625000 GHz | -44.83 dBm | -19.83 dB |

### High Channel ACP




| Spur | Range | Start Freq | Stop Freq | RBW | Frequency | Amplitude | ΔLimit |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3.5800 GHz | 3.6050 GHz | 1.000 MHz | 3.581487500 GHz | -50.55 dBm | -25.55 dB |
| 2 | 2 | 3.6050 GHz | 3.6140 GHz | 1.000 MHz | 3.610791500 GHz | -49.52 dBm | -36.52 dB |
| 3 | 3 | 3.6140 GHz | 3.6150 GHz | 200.0 kHz | 3.614680000 GHz | -47.61 dBm | -34.61 dB |
| 4 | 4 | 3.6150 GHz | 3.6350 GHz | 200.0 kHz | 3.633950000 GHz | 22.83 dBm | -3.172 dB |
| 5 | 5 | 3.6350 GHz | 3.6360 GHz | 200.0 kHz | 3.635090000 GHz | -27.20 dBm | -14.20 dB |
| 6 | 6 | 3.6360 GHz | 3.6450 GHz | 1.000 MHz | 3.640212000 GHz | -29.24 dBm | -16.24 dB |
| 7 | 7 | 3.6450 GHz | 3.6700 GHz | 1.000 MHz | 3.646625000 GHz | -44.83 dBm | -19.83 dB |