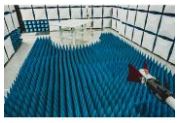
PCTEST
7185 Oakland Mills Road, Columbia, MD 21046 USA
Tel. 410.290.6652 / Fax 410.290.6654
http://www.pctest.com



# MEASUREMENT REPORT
## FCC Part 30 5G mmWave

**Applicant Name:**
Pivotal Commware
10801 120th Ave NE #200,
Kirkland, WA 98033
United States

**Date of Testing:**
9/17/2020-10/16/2020
**Test Site/Location:**
PCTEST Lab. Columbia, MD, USA
**Test Report Serial No.:**
1M2010120161-02.2AUVU

| | |
|---|---|
| **FCC ID:** | **2AUVU-P28SUGA1** |
| **APPLICANT:** | **Pivotal Commware** |

| | |
|---|---|
| **Application Type:** | Certification |
| **Model:** | PIV28SUGA1 |
| **EUT Type:** | 5G mmWave Repeater (Service Unit) |
| **FCC Classification:** | Part 30 Transportable Transmitter (5GT) |
| **FCC Rule Part(s):** | 2, 30 |
| **Test Procedure(s):** | ANSI C63.26-2015, KDB 842590 D01 v01, KDB 662911 D01 v02r01 |

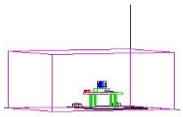
This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in §2.947. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

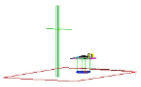
Randy Ortanez
President

ACCREDITED
CERT #2041.01

# TABLE OF CONTENTS



# MEASUREMENT REPORT
## FCC Part 30



| Band | Ant. Pol. | Bandwidth (MHz) | CCs Active | FCC Rule Part | Tx Frequency (MHz) | EIRP | | Emission Designator | Modulation |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Max. Power (W) | Max. Power (dBm) | | |
| n261 | H | 50 | 1 | 30 | 27500 - 28350 | 1.972 | 32.95 | 46M1G7D | QPSK |
| n261 | H | 50 | 1 | 30 | 27500 - 28350 | 1.626 | 32.11 | 46M1W7D | 16QAM |
| n261 | V | 50 | 4 | 30 | 27500 - 28350 | 1.811 | 32.58 | 46M0G7D | QPSK |
| n261 | H | 100 | 4 | 30 | 27500 - 28350 | 1.371 | 31.37 | 394MG7D | QPSK |
| n261 | V | 100 | 4 | 30 | 27500 - 28350 | 1.416 | 31.51 | 396MG7D | QPSK |
| n261 | V | 100 | 4 | 30 | 27500 - 28350 | 1.175 | 30.70 | 401MW7D | 16QAM |

**EUT Overview**

# 1.0 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.

## 1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST facility located at 7185 Oakland Mills Road, Columbia, MD 21046. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

## 1.3 Test Facility / Accreditations

**Measurements were performed at PCTEST located in Columbia, MD 21046, U.S.A.**

- PCTEST is an ISO/IEC 17025:2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).

- PCTEST facility is a registered (2451B) test laboratory with the site description on file with ISED.

# 2.0 PRODUCT INFORMATION

## 2.1 Equipment Description

The Equipment Under Test (EUT) is the **Pivotal Commware 5G mmWave Repeater (Service Unit) FCC ID: 2AUVU-P28SUGA1**. The test data contained in this report pertains only to the emissions due to the EUT's 5G mmWave function.

The EUT has an open-ended waveguide horn antenna. The antenna configuration is comprised of two separate antenna feeds - one for horizontally polarized transmission and one for vertically polarized transmission.

The EUT supports any combination of bandwidths, number of carriers, and modulations as input signals. It will transmit all signals within the 5G n261 band that are received.

**Test Device Serial No.:** 20008,10001

## 2.2 Device Capabilities

This device contains the following capabilities:

5G FR2 (mmWave), WIFI, LTE

## 2.3 Test Configuration

The EUT was tested per the guidance of ANSI C63.26-2015. See Section 7.0 of this test report for a description of the radiated tests.

All testing was performed using a signal generator connected to the input port of the EUT via waveguide adapters. The signal generator was set to transmit a simulated a 5G mmWave NR signal in various sized bandwidth and modulations.

## 2.4 EMI Suppression Device(s)/Modifications

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

# 3.0 DESCRIPTION OF TESTS

## 3.1 Measurement Procedure

The measurement procedures described in the document titled "American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services" (ANSI C63.26-2015) was used in the measurement of the EUT. KDB 842590 D01 v01 was referenced for testing the EUT as well.

## 3.2 Radiated Power and Radiated Spurious Emissions

**§30.202, §30.203**

The radiated test facilities consisted of an indoor 3 meter anechoic chamber used for final measurements and exploratory measurements, when necessary for radiated emissions measurements in the spurious domain. The test site conforms to the site validation requirements of CISPR 16-1-4. The measurement area is contained within the anechoic chamber which is shielded from any ambient interference. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. For measurements below 1GHz, the absorbers are removed. A raised turntable is used for radiated measurement. The turn table is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane.

A positioner was used to manipulate the EUT through several positions in space by rotating about the roll axis as shown in the figure below. The positioner was mounted on top of a turntable bringing the total EUT height to 1.5m.

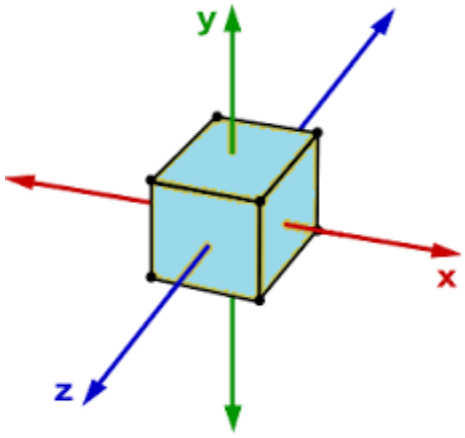



**Figure 3-1. Rotation of the EUT Through Three Orthogonal Planes**

The equipment under test was transmitting while connected to its patch or HBF antenna and is placed on a positioner. The measurement antenna is in the far field of the EUT per formula $2D^2/\lambda$ where D is the larger between the dimension of the measurement antenna and the transmitting antenna of the EUT. For radiated power and radiated spurious emission measurements, "D" is the largest dimension of the measurement antenna per KDB 842590 D01. The EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer.

Radiated power levels are investigated while the receive antenna was rotated through all angles to determine the worst case polarization/positioning. It was determined that H=0 degree and V=90 degree are the worst case positions when the EUT was transmitting horizontally and vertically polarized beams, respectively.

The maximized power level is recorded using the spectrum analyzer's "Channel Power" function with the integration bandwidth set to the emissions' occupied bandwidth. The EIRP is calculated from the raw power level measured with the spectrum analyzer using the formulas shown below.

## Effective Isotropic Radiated Power Sample Calculation

The measured e.i.r.p is converted to E-field in V/m. Then, the distance correction is applied before converting back to calculated e.i.r.p, as explained in KDB 971168 D01.

**Field Strength [dBμV/m]** = Measured Value [dBm] + AFCL [dB/m] + 107

= - 34.06 dBm + (40.6dB/m + 8.49dB) + 107 = 122.03dBuV/m

= 10^(122.03/20)/1000000 = 1.26 V/m

**e.i.r.p. [dBm]** = 10 * log((E-Field*$D_m$)^2/30) + 30dB

= 10*log((1.26V/m * 1.00m)^2/30) + 30dB

= **17.24 dBm e.i.r.p.**

# 4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4-2014. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the $U_{CISPR}$ measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

| Contribution | Expanded Uncertainty (±dB) |
|---|---|
| Conducted Bench Top Measurements | 1.13 |
| Radiated Disturbance (<1GHz) | 4.98 |
| Radiated Disturbance (>1GHz) | 5.07 |
| Radiated Disturbance (>18GHz) | 5.09 |

# 5.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to an accredited ISO/IEC 17025 calibration facility. Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

| Manufacturer | Model | Description | Cal Date | Cal Interval | Cal Due | Serial Number |
|---|---|---|---|---|---|---|
| Sunol | JB5 | Bi-Log Antenna (30M - 5GHz) | 7/27/2020 | Biennial | 7/27/2022 | A051107 |
| ETS Lindgren | 3117 | 1-18 GHz DRG Horn (Medium) | 2/14/2019 | Biennial | 2/14/2021 | 125518 |
| Agilent | N9030A | PXA Signal Analyzer (44GHz) | 8/17/2020 | Annual | 8/17/2021 | MY52350166 |
| Rohde & Schwarz | FSW67 | Signal / Spectrum Analyzer | 8/10/2020 | Annual | 8/10/2021 | 103200 |
| Virginia Diodes Inc | SAX253 | SAX Module (90 - 140GHz) | 9/30/2019 | Annual | 10/30/2020 | SAX253 |
| Virginia Diodes Inc | SAX252 | SAX Module (60 - 90GHz) | 9/30/2019 | Annual | 10/30/2020 | SAX252 |
| Virginia Diodes Inc | SAX411 | SAX Module (40 - 60GHz) | 10/2/2019 | Annual | 11/2/2020 | SAX411 |
| ETS-Lindgren | 3116C | DRG Horn Antenna | 3/11/2019 | Biennial | 3/11/2021 | 218893 |
| OML Inc. | M19RH | WR-19 Horn Antenna, 24dBi, 40 to 60 GHz | 7/30/2018 | Biennial | 10/30/2020 | 18073001 |
| OML Inc. | M12RH | WR-12 Horn Antenna, 24dBi, 60 to 90 GHz | 7/30/2018 | Biennial | 10/30/2020 | 18073001 |
| OML Inc. | M08RH | WR-08 Horn Antenna, 24dBi, 90 to 140 GHz | 7/30/2018 | Biennial | 10/30/2020 | 18073001 |
| Rohde & Schwarz | SMW200A | Vector Signal Generator | N/A | | | 105744 |

**Table 5-1. Test Equipment**

**Notes:**

For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

# 6.0 SAMPLE CALCULATIONS

## Emission Designator

### QPSK Modulation

**Emission Designator = 800MG7D**

BW = 800 MHz
G = Phase Modulation
7 = Quantized/Digital Info
D = Data transmission, telemetry, telecommand

### QAM Modulation

**Emission Designator = 802MW7D**

BW = 802 MHz
W = Amplitude/Angle Modulated
7 = Quantized/Digital Info
D = Data transmission, telemetry, telecommand

# 7.0 TEST RESULTS

## 7.1 Summary

Company Name: Pivotal Commware

FCC ID: 2AUVU-P28SUGA1

FCC Classification: Part 30 Transportable Transmitter (5GT)

| FCC Part Section(s) | Test Description | Test Limit | Test Condition | Test Result | Reference |
|---|---|---|---|---|---|
| 2.1049 | Occupied Bandwidth | N/A | CONDUCTED | PASS | Section 7.2 |
| 2.1046 | Conducted Power | N/A | | PASS | Section 7.3 |
| 2.1051, 30.203 | Out-of-Band Emissions at the Band Edge | -13dBm/MHz for all out-of-band emissions, -5dBm/MHz from the band edge up to 10% of the channel BW | | PASS | Section 7.6 |
| 30.202(c) | Equivalent Isotropic Radiated Power | 55dBm | RADIATED | PASS | Section 7.4 |
| 2.1051, 30.203 | Spurious Emissions | -13dBm/MHz for all out-of-band emissions | | PASS | Section 7.5 |
| 2.1055 | Frequency Stability | Fundamental emissions stay within authorized frequency block | | PASS | Section 7.7 |

**Table 7-1. Summary of Radiated Test Results**

**Notes:**

1) Per 2.1057(a)(2), spurious emissions were investigated up to 100GHz.
2) Testing was completed with a signal generator creating a representative mmWave 5G NR signal, using DFT-s-OFDM scheme, various modulations including QPSK, and QAM, 120kHz subcarrier spacing, with 50MHz single carrier and 100MHz bandwidths four carrieres, full and single resource block allocations.
3) The input signal to the EUT was set in order to produce the max power of the AGC range.
4) Based upon investigations of all possible modulations, testing was mainly performed with QPSK modulation.
5) The EUT was fitted with a waveguide-to-coax adapter to facilitate conducted measurements. Conducted testing was performed for Occupied Bandwidth,Conducted Power and Band Edge test cases as shown in the table above.
6) Triggering from the signal generator was used in order to more accurately gate on the TDD signal with the analyzer.

## 7.2 Occupied Bandwidth

**§2.1049**

**Test Overview**

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. All modes of operation were investigated and the worst case configuration results are reported in this section.

**Test Procedure Used**

ANSI C63.26-2015 Section 5.4.3

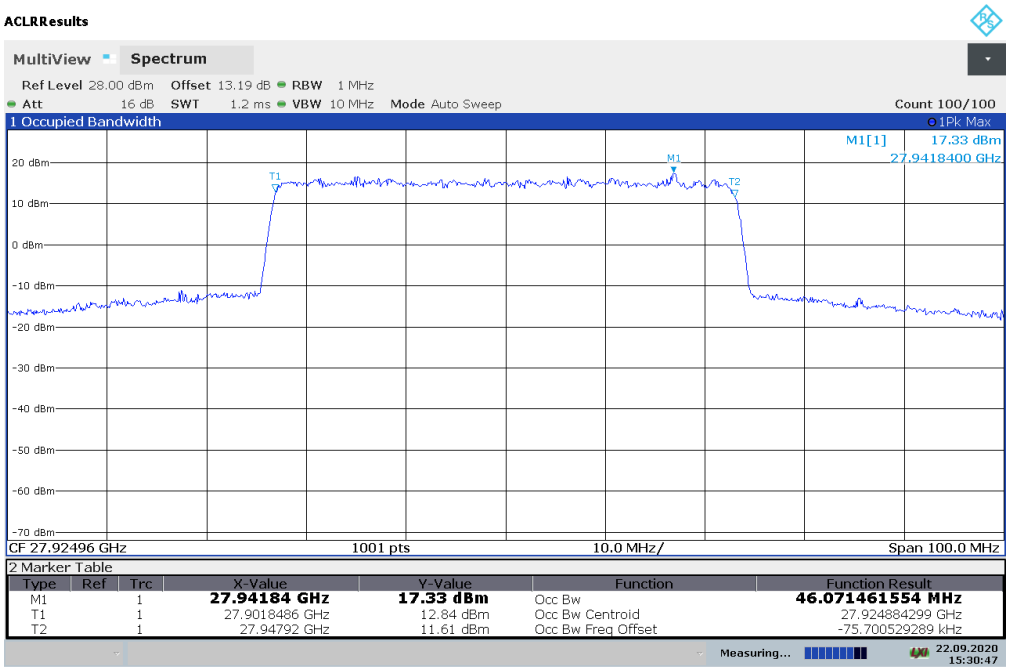
**Test Settings**

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% of the expected OBW
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7

## Occupied Bandwidth

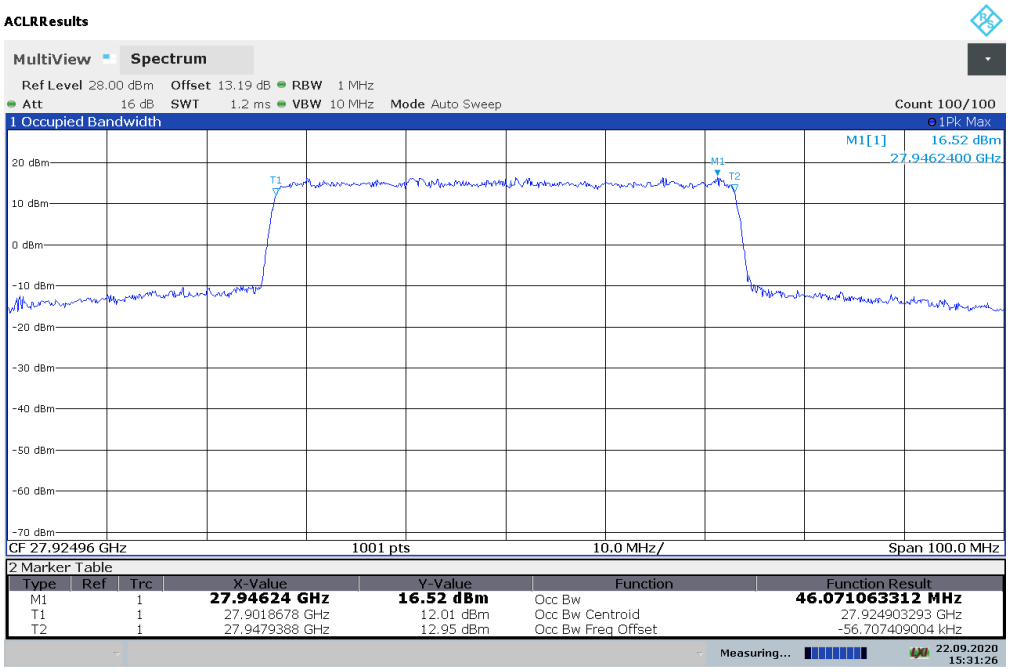
| Channel | Bandwidth | CCs Active | Beam Pol | Modulation | OBW [MHz] |
|---|---|---|---|---|---|
| Mid | 50 | 1 | H | QPSK | 46.07 |
| | | | H | 16QAM | 46.07 |
| | | | V | QPSK | 45.91 |
| | | | V | 16QAM | 46.02 |
| | 100 | 4 | H | QPSK | 394.39 |
| | | | H | 16QAM | 397.97 |
| | | | V | QPSK | 395.76 |
| | | | V | 16QAM | 400.95 |

**Table 7-2. Summary of HBF Antenna Occupied Bandwidths**




15:30:47 22.09.2020

**Plot 7-1. Occupied Bandwidth Plot (50MHz - QPSK - Mid Channel) – H**

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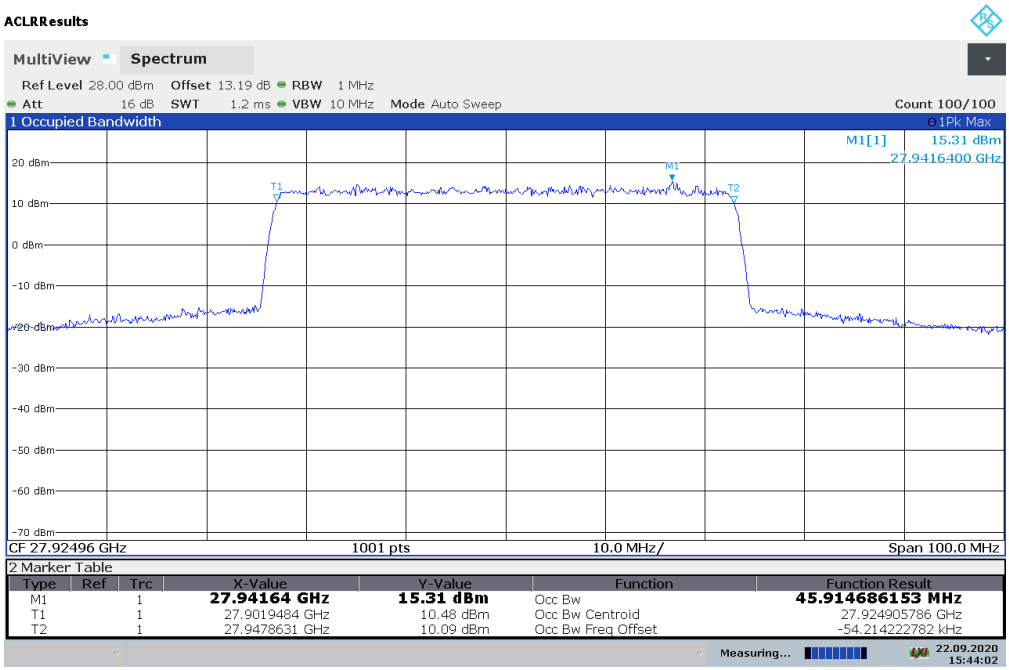
**Plot 7-2. Occupied Bandwidth Plot (50MHz - 16QAM - Mid Channel) – H**

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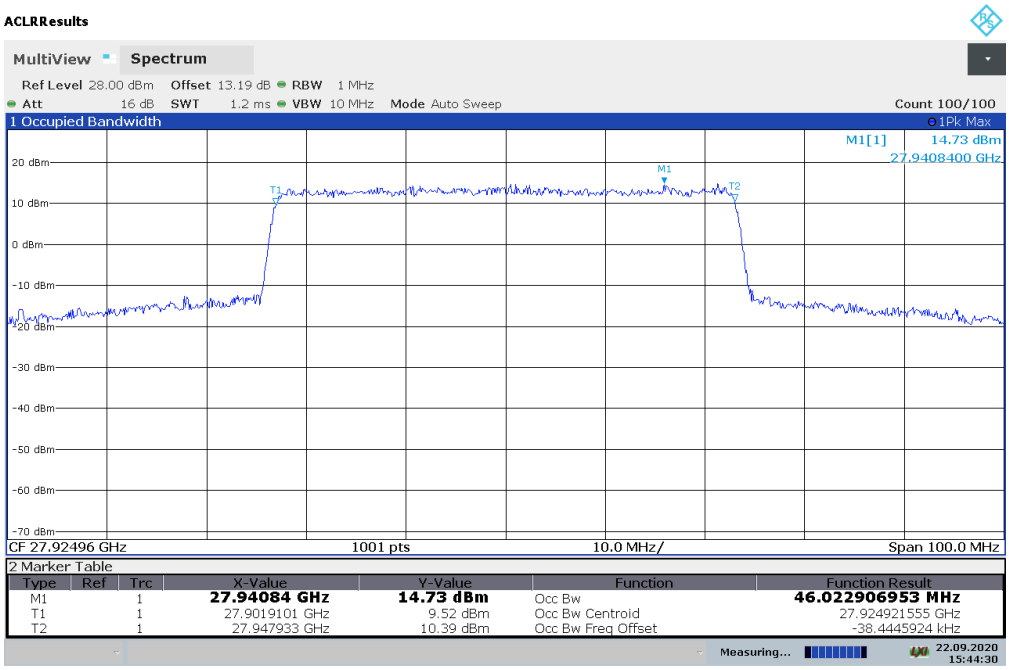
**Plot 7-3. Occupied Bandwidth Plot (50MHz - QPSK - Mid Channel) – V**

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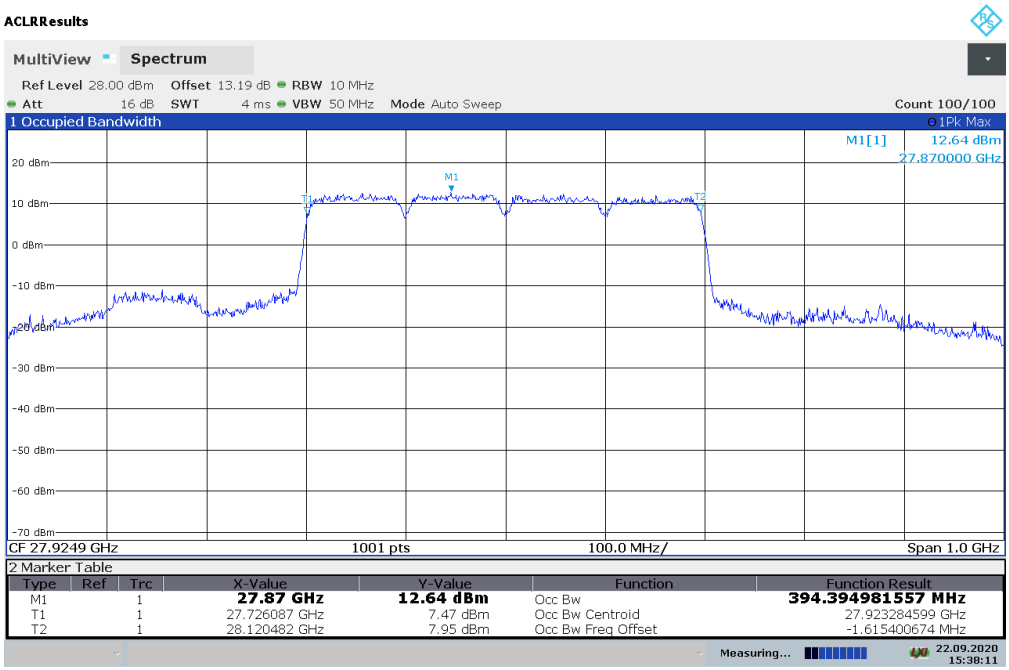
**Plot 7-4. Occupied Bandwidth Plot (50MHz - 16QAM - Mid Channel) – V**

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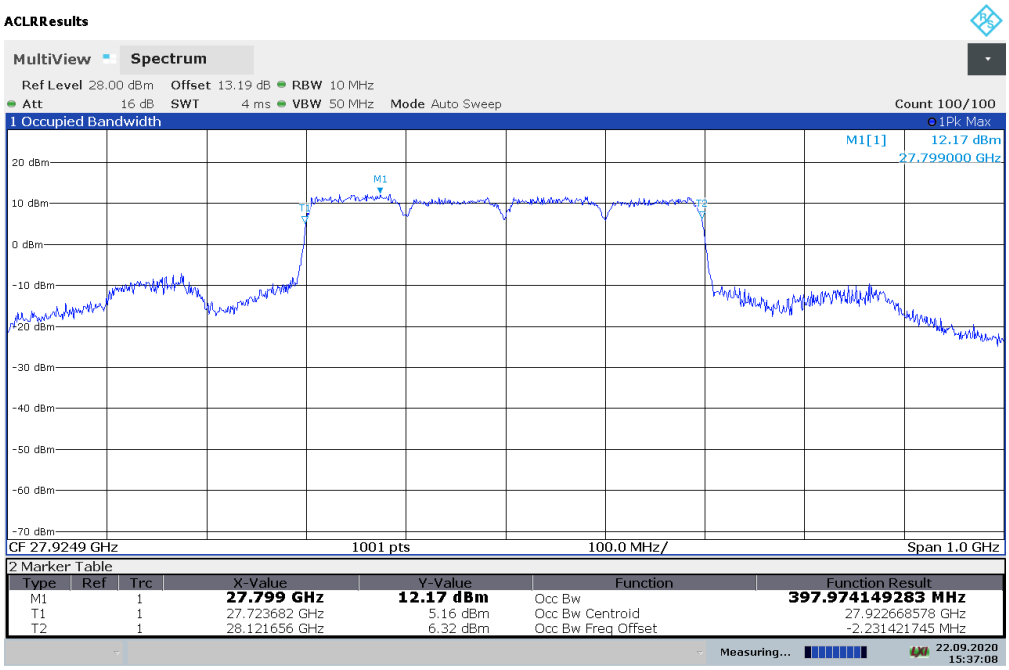
**Plot 7-5. Occupied Bandwidth Plot (100MHz 4CC- QPSK - Mid Channel) – H**

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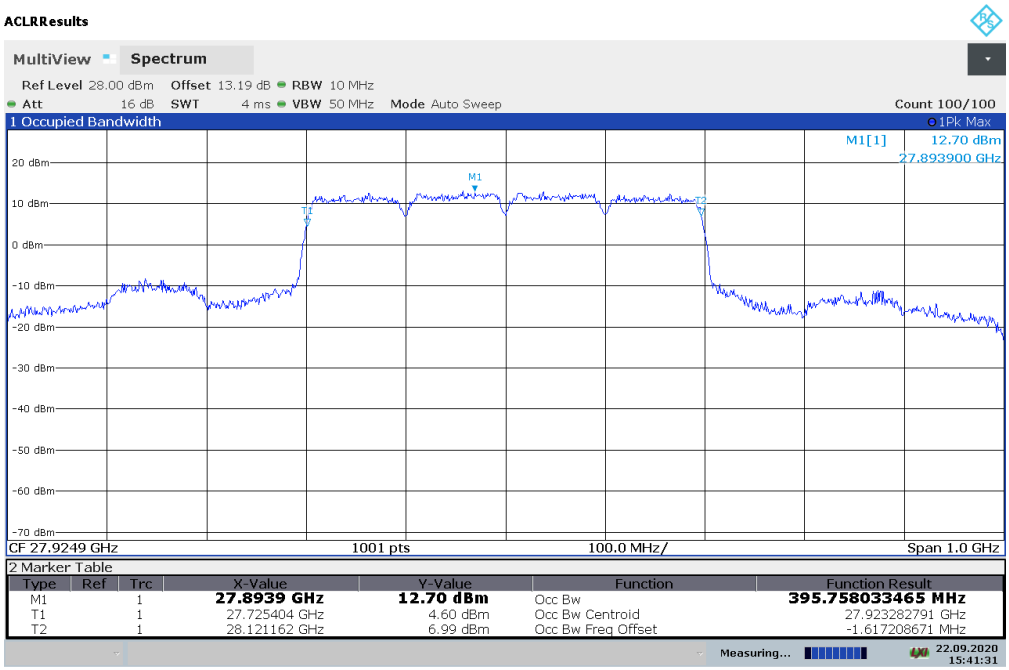
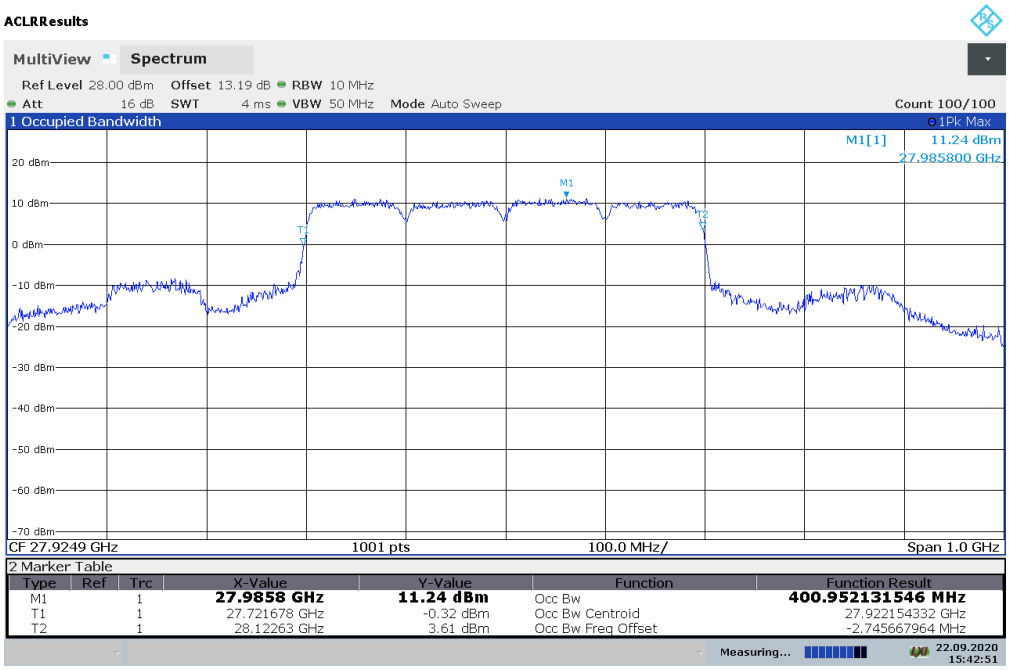
**Plot 7-6. Occupied Bandwidth Plot (100MHz 4CC- 16QAM - Mid Channel) – H**




15:41:31 22.09.2020

**Plot 7-7. Occupied Bandwidth Plot (100MHz 4CC- QPSK - Mid Channel) – V**




15:42:52 22.09.2020

**Plot 7-8. Occupied Bandwidth Plot (100MHz 4CC- 16QAM - Mid Channel) – V**

## 7.3 Conducted Power

**§2.1046**

**Test Overview**

A transmitter port of the EUT is connected to the input of a signal analyzer. A signal generator supplies a 5G NR signal directly into the input port of the device. All measurements are performed as RMS average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

**Test Procedures Used**

ANSI C63.26-2015 Section 5.2.4.4.1

**Test Settings**

1. Conducted power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation.
2. RBW = 1 – 5% of the expected OBW, not to exceed 1MHz
3. VBW ≥ 3 x RBW
4. Span = 2x to 3x the OBW
5. No. of sweep points ≥ 2 x span / RBW
6. Detector = RMS
7. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation.
8. Trace mode = trace averaging (RMS) over 100 sweeps
9. The trace was allowed to stabilize

**Test Notes**

1) The MIMO Conducted Power were calculated by using the "measure and sum the spectral maxima across the outputs" technique specified in Section 6.4.3.2.3 of ANSI C63.26-2015. The spectral were summed linearly and converted to dBm for comparison with the limit.

2) The MIMO Conducted Power shown below are mathematically summed conducted powers between measurements on H Beam and V Beam.

**Sample MIMO Calculation:**

Antenna 1 + Antenna 2 = MIMO

(21.32dBm + 21.39dBm) = (135.52mW + 137.72mW) =273.24mW = 24.37dBm

| Center Frequency (MHz) | Ant.Pol. | Access Scheme | Modulation | Bandwidth (MHz) | # of Carriers (CCs) | No. RBs | Conducted Power (dBm) |
|---|---|---|---|---|---|---|---|
| 27525.00 | V | DFT-s-OFDM | QPSK | 50 | 1 | Full | 18.59 |
| 27924.96 | V | DFT-s-OFDM | QPSK | 50 | 1 | Full | 19.03 |
| 28324.92 | V | DFT-s-OFDM | QPSK | 50 | 1 | Full | 19.19 |
| 27550.08 | V | DFT-s-OFDM | QPSK | 100 | 1 | Full | 18.73 |
| 27924.96 | V | DFT-s-OFDM | QPSK | 100 | 1 | Full | 18.88 |
| 28299.96 | V | DFT-s-OFDM | QPSK | 100 | 1 | Full | 18.70 |
| 27700.02 | V | DFT-s-OFDM | QPSK | 100 | 4 | Full | 16.95 |
| 27924.96 | V | DFT-s-OFDM | QPSK | 100 | 4 | Full | 16.84 |
| 28150.02 | V | DFT-s-OFDM | QPSK | 100 | 4 | Full | 16.51 |
| 27525.00 | H | DFT-s-OFDM | QPSK | 50 | 1 | Full | 18.29 |
| 27924.96 | H | DFT-s-OFDM | QPSK | 50 | 1 | Full | 19.12 |
| 28324.92 | H | DFT-s-OFDM | QPSK | 50 | 1 | Full | 19.43 |
| 27550.08 | H | DFT-s-OFDM | QPSK | 100 | 1 | Full | 18.33 |
| 27924.96 | H | DFT-s-OFDM | QPSK | 100 | 1 | Full | 18.61 |
| 28299.96 | H | DFT-s-OFDM | QPSK | 100 | 1 | Full | 19.07 |
| 27700.02 | H | DFT-s-OFDM | QPSK | 100 | 4 | Full | 16.87 |
| 27924.96 | H | DFT-s-OFDM | QPSK | 100 | 4 | Full | 17.05 |
| 28150.02 | H | DFT-s-OFDM | QPSK | 100 | 4 | Full | 16.84 |

**Table 7-3. Conducted Power - SISO**

| Center Frequency (MHz) | Ant.Pol. | Access Scheme | Modulation | Bandwidth (MHz) | # of Component Carriers (CCs) | No. RBs | MIMO Conducted Power (dBm) |
|---|---|---|---|---|---|---|---|
| 27525.00 | MIMO | DFT-s-OFDM | QPSK | 50 | 1 | Full | 21.45 |
| 27924.96 | MIMO | DFT-s-OFDM | QPSK | 50 | 1 | Full | 22.09 |
| 28324.92 | MIMO | DFT-s-OFDM | QPSK | 50 | 1 | Full | 22.32 |
| 27550.08 | MIMO | DFT-s-OFDM | QPSK | 100 | 1 | Full | 21.54 |
| 27924.96 | MIMO | DFT-s-OFDM | QPSK | 100 | 1 | Full | 21.76 |
| 28299.96 | MIMO | DFT-s-OFDM | QPSK | 100 | 1 | Full | 21.90 |
| 27700.02 | MIMO | DFT-s-OFDM | QPSK | 100 | 4 | Full | 19.92 |
| 27924.96 | MIMO | DFT-s-OFDM | QPSK | 100 | 4 | Full | 19.96 |
| 28150.02 | MIMO | DFT-s-OFDM | QPSK | 100 | 4 | Full | 19.69 |

**Table 7-4. Conducted Power - MIMO**

## 7.4 Equivalent Isotropic Radiated Power

**§30.202(c)**

**Test Overview**

Equivalent Isotropic Radiated Power (EIRP) measurements are performed using broadband horn antennas. All measurements are performed as RMS average measurements while the EUT is operating at the appropriate frequencies with the max power condition as specified by the AGC software of the EUT.

***The average power of the sum of all antenna elements is limited to a maximum EIRP of +55 dBm.***

**Test Procedures Used**

ANSI C63.26-2015 Section 5.2.4.4.1

**Test Settings**

1. Radiated power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation.
2. RBW = 1 – 5% of the expected OBW, not to exceed 1MHz
3. VBW ≥ 3 x RBW
4. Span = 2x to 3x the OBW
5. No. of sweep points ≥ 2 x span / RBW
6. Detector = RMS
7. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation.
8. Trace mode = trace averaging (RMS) over 100 sweeps
9. The trace was allowed to stabilize

**Test Notes**

1) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below.
2) The input signal to the EUT was set in order to produce the max power allowed by the AGC software of the EUT.
3) EIRP measurements were taken in the far field.
4) A signal generator fed a 5G NRmmWave signal into the EUT.
5) The average EIRP reported below is calculated per section 5.2.7 of ANSI C63.26-2015 which states: EIRP (dBm) = E (dBµV/m) + 20log(D) − 104.8; where D is the measurement distance (in the far field region) in m. The field strength E is calculated E (dBµV/m) = Spectrum Analyzer Channel Power Level (dBm) + Antenna Factor (dB/m) + Cable Loss (dB) + 107.

| CCs active | Bandwidth [MHz] | Frequency [MHz] | Channel | Beam Pol | Modulation | Ant. Pol. [H/V] | Turntable Azimuth [degrees] | Azimuth Roll [degrees] | RB Size/Offset | EIRP [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 50 | 27525.00 | Low | H | QPSK | H | 356 | 3 | Full RB | 31.73 | 55.00 | -23.27 |
| | | 27525.00 | Low | V | QPSK | V | 3 | 1 | Full RB | 31.18 | 55.00 | -23.82 |
| | | 27924.96 | Mid | H | QPSK | H | 356 | 2 | Full RB | 32.12 | 55.00 | -22.88 |
| | | 27924.96 | Mid | H | QPSK | H | 356 | 2 | 1 / 16 | 30.02 | 55.00 | -24.98 |
| | | 27924.96 | Mid | V | QPSK | V | 3 | 1 | Full RB | 31.76 | 55.00 | -23.24 |
| | | 27924.96 | Mid | V | QPSK | V | 3 | 1 | 1 / 16 | 29.65 | 55.00 | -25.35 |
| | | 28324.92 | High | H | QPSK | H | 356 | 2 | Full RB | 32.95 | 55.00 | -22.05 |
| | | 28324.92 | High | V | QPSK | V | 3 | 2 | Full RB | 32.58 | 55.00 | -22.42 |
| | | 28324.92 | High | H | 16QAM | H | 356 | 2 | Full RB | 32.11 | 55.00 | -22.89 |

**Table 7-5. EIRP - 50MHz Bandwidth 1CC Full RB**

| CCs active | Bandwidth [MHz] | Frequency [MHz] | Channel | Beam Pol | Modulation | Ant. Pol. [H/V] | Turntable Azimuth [degrees] | Azimuth Roll [degrees] | RB Size/Offset | EIRP [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 100 | 27700.02 | Low | H | QPSK | H | 356 | 2 | Full RB | 31.04 | 55.00 | -23.96 |
| | | 27700.02 | Low | V | QPSK | V | 3 | 2 | Full RB | 30.62 | 55.00 | -24.38 |
| | | 27924.96 | Mid | H | QPSK | H | 356 | 1 | Full RB | 31.31 | 55.00 | -23.69 |
| | | 27924.96 | Mid | V | QPSK | V | 3 | 2 | Full RB | 31.15 | 55.00 | -23.85 |
| | | 28150.02 | High | H | QPSK | H | 356 | 2 | Full RB | 31.37 | 55.00 | -23.63 |
| | | 28150.02 | High | V | QPSK | V | 3 | 2 | Full RB | 31.51 | 55.00 | -23.49 |
| | | 28150.02 | High | V | 16QAM | V | 3 | 2 | Full RB | 30.70 | 55.00 | -24.30 |

**Table 7-6. EIRP - 100MHz Bandwidth 4CC Full RB**

## 7.5 Radiated Spurious and Harmonic Emissions

**§2.1051, §30.203**

### Test Overview

The spectrum is scanned from 30MHz to 100GHz. All out of band emissions are measured in a radiated test setup while the EUT is operating at the appropriate frequencies with the max power condition as specified by the AGC software of the EUT. All modulations 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 conductive power or total radiated power of any emissions outside a licensee's frequency block shall be -13dBm/1MHz.***

### Test Procedure Used

ANSI C63.26-2015 Section 5.7.4

### Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 100 GHz. Several plots are used to show investigations in this entire span.
2. Detector = RMS
3. Trace mode = trace average (Max Hold for pulsed emissions)
4. Sweep time = auto couple
5. Number of sweep points ≥ 2 x Span/RBW
6. The trace was allowed to stabilize
7. RBW = 1MHz, VBW = 3MHz

### Test Notes

1) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below. The worst case found was QPSK, 1RB and was tested as such.

2) All radiated spurious emissions were measured as EIRP to compare with the §30.203 TRP limits.

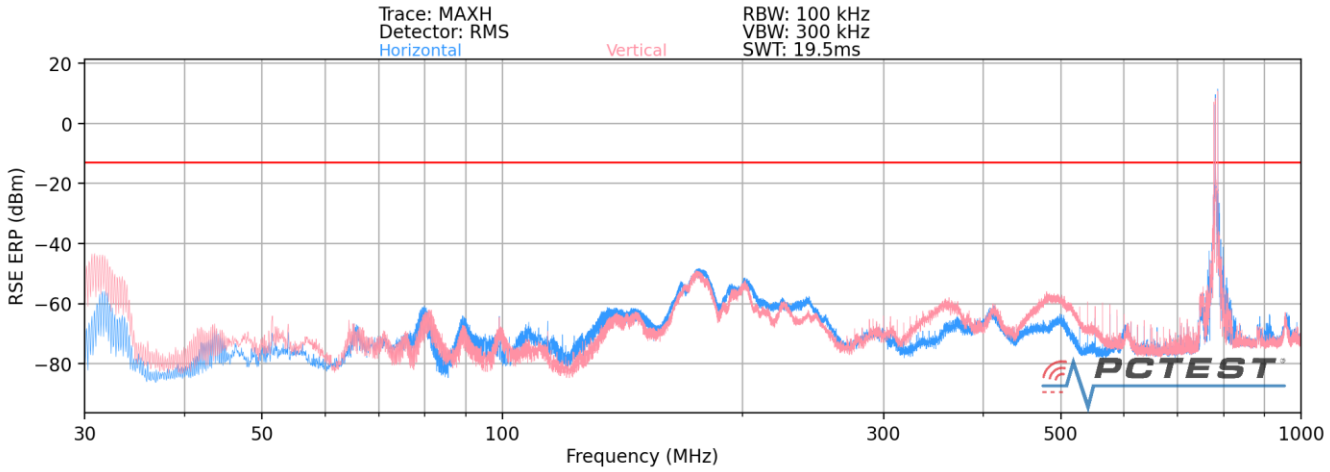
3) The plots from 1-100GHz show corrected average EIRP levels. Plots below 1GHz are corrected field strength levels. The average EIRP reported below is calculated per section 5.2.7 of ANSI C63.26-2015 which states: EIRP (dBm) = E (dBμV/m) + 20log(D) − 104.8; where D is the measurement distance (in the far field region) in m. The field strength E is calculated E (dBμV/m) = Spectrum Analyzer Level (dBm) + Antenna Factor (dB/m) + Cable Loss (dB) + Harmonic Mixer Conversion Loss (dB) + 107. All appropriate Antenna Factor and Cable Loss have been applied in the spectrum analyzer for each measurement. For measurements > 40GHz, Harmonic Mixer Conversion Loss was also applied to the spectrum analyzer.

4) Emissions below 18GHz were measured at a 3 meter test distance, while emissions above 18GHz were measured at the appropriate far field distance. The far field of the mmWave signal is based on formula: R > 2D^2/wavelength, where D is the larger between the dimension of the measurement antenna and the transmitting antenna of the EUT.
5) All emissions from 30MHz - 40GHz were measured using a spectrum analyzer with an internal preamplifier. Emissions >40GHz were measured using a harmonic mixer with the spectrum analyzer.

6) To cover the simultaneous transmissions, both the LTE module (FCC ID: 2AUVU-UBR410M) and WLAN module (FCC ID: Z64-WL18SBMOD) are set to transmit at the same time as the mmWave functionality of the host. EUT is transmitting WLAN at 2437MHz in 802.11b mode simultaneously with the LTE B13/ B4 signal.

7) The "-" shown in the following RSE tables are used to denote a noise floor measurement.

## 30MHz – 1GHz




**Plot 7-9. Radiated Spurious Plot 30 MHz - 1 GHz (1CC QPSK Mid Channel V Beam)**

## Spurious Emissions ERP Sample Calculation

The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE ERP level is calculated by applying the additional factors shown below for a test distance of 3 meter.

**RSE ERP [dBm]** = Analyzer Level [dBm] + 107 + AFCL [dB/m] + 20Log(Dm) – 104.8 – 2.15dB

| Frequency [MHz] | Channnel | Bandwidth (MHz) | EUT Beam Pol. | Modulation | Antenna Polarization [H/V] | Turntable Azimuth [degrees] | Positioner Azimuth [degrees] | Spurious Emission Level [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|---|
| 31.56 | Mid | 50 | V | QPSK | V | 110 | 319 | -35.34 | -13.00 | -22.34 |
| 179.68 | Mid | 50 | V | QPSK | V | 123 | 339 | -46.09 | -13.00 | -33.09 |
| 498.23 | Mid | 50 | V | QPSK | V | - | - | -57.19 | -13.00 | -44.19 |

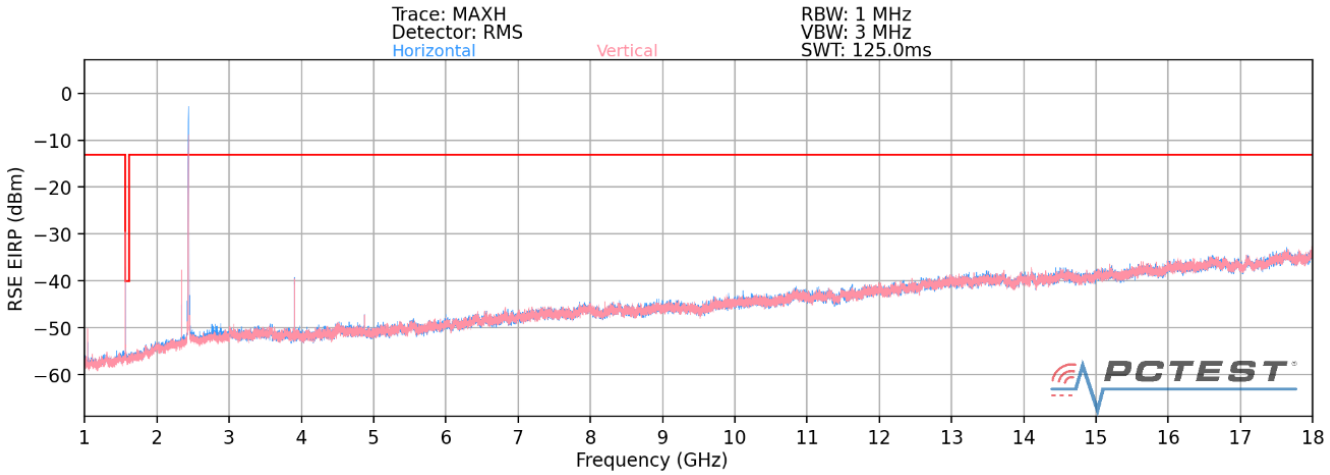
**Table 7-7. Spurious Emissions Table (30MHz-1GHz)**

**Notes**

1. The RSE ERP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses. Measurements were performed at a distance of 3 meter.

2. To cover the simultaneous transmissions, both the LTE module (FCC ID: 2AUVU-UBR410M) and WLAN module (FCC ID: Z64-WL18SBMOD) are set to transmit at the same time as the mmWave functionality of the host. EUT is transmitting WLAN at 2437MHz in 802.11b mode simultaneously with the LTE B13 signal.

**1 – 18GHz**




**Plot 7-10. Radiated Spurious Plot 1-18 GHz (1CC QPSK Mid Channel V Beam) - B13**

## Spurious Emissions EIRP Sample Calculation

The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 3 meter.

**RSE EIRP [dBm]** = Analyzer Level [dBm] + 107 + AFCL [dB/m] + 20Log(Dm) – 104.8

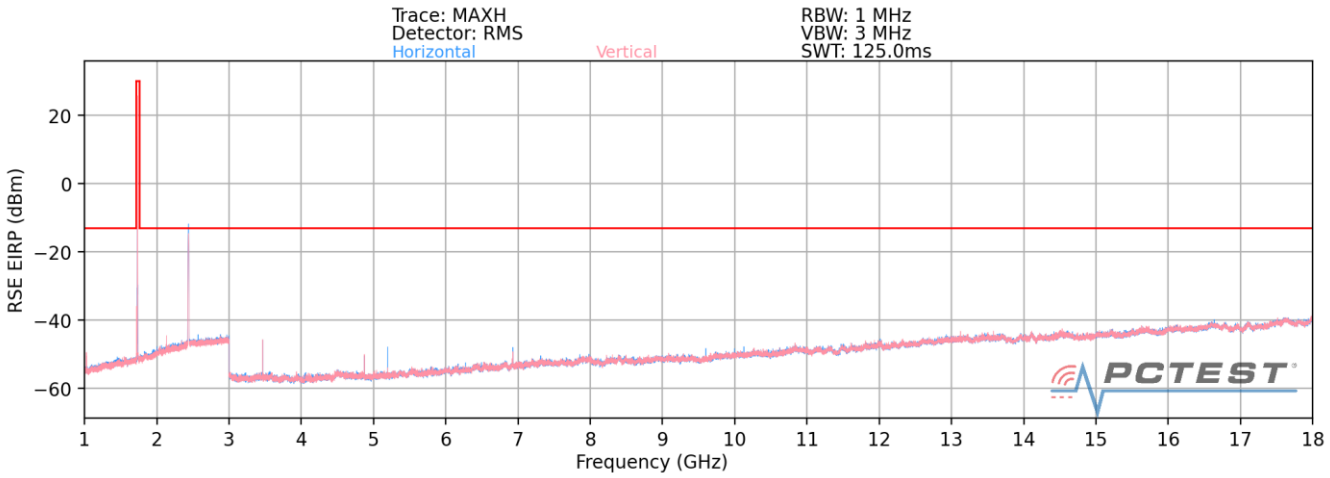
| Frequency [MHz] | Ant. Pol. [H/V] | Antenna Height [cm] | Turntable Azimuth [degree] | Level at Antenna Terminals [dBm] | Substitute Antenna Gain [dBi] | Spurious Emission Level [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|
| 1564.00 | V | 194 | 157 | -48.32 | 4.53 | -43.79 | -3.8 |
| 2346.00 | V | 109 | 223 | -47.50 | 4.88 | -42.62 | -29.6 |
| 3128.00 | V | 119 | 253 | -61.11 | 6.14 | -54.98 | -42.0 |
| 3910.00 | V | 102 | 51 | -50.95 | 7.23 | -43.72 | -30.7 |
| 4692.00 | V | - | - | -68.65 | 8.30 | -60.35 | -47.3 |

**Table 7-8. Spurious Emissions Table (1GHz-18GHz)**

**Notes**

1. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses. Measurements were performed at a distance of 3 meter.

2. To cover the simultaneous transmissions, both the LTE module (FCC ID: 2AUVU-UBR410M) and WLAN module (FCC ID: Z64-WL18SBMOD) are set to transmit at the same time as the mmWave functionality of the host. EUT is transmitting WLAN at 2437MHz in 802.11b mode simultaneously with the LTE B13 signal.
3. For 1564MHz measurement, the test procedure used was from ANSI C63.26-2015 Section 5.2.4.4.2. This method utilized an average trace mode and a calculated duty cycle correction factor which is calculated as DCCF = 10log(1/Duty Cycle). The duty cycle correction of 5.23dB is included in the -43.79dBm reading at the antenna terminal.




**Plot 7-11. Radiated Spurious Plot 1-18 GHz (1CC QPSK Mid Channel V Beam) – B4**

## Spurious Emissions EIRP Sample Calculation

The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 3 meter.

**RSE EIRP [dBm]** = Analyzer Level [dBm] + 107 + AFCL [dB/m] + 20Log(Dm) – 104.8

| Frequency [MHz] | Ant. Pol. [H/V] | Antenna Height [cm] | Turntable Azimuth [degree] | Level at Antenna Terminals [dBm] | Substitute Antenna Gain [dBi] | Spurious Emission Level [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|
| 3465.00 | H | 100 | 125 | -44.22 | 6.59 | -37.64 | -24.6 |
| 5197.50 | H | 100 | 138 | -54.42 | 8.61 | -45.81 | -32.8 |
| 6930.00 | H | 221 | 150 | -53.00 | 8.96 | -44.05 | -31.0 |
| 8662.50 | H | - | - | -63.83 | 9.84 | -53.99 | -41.0 |

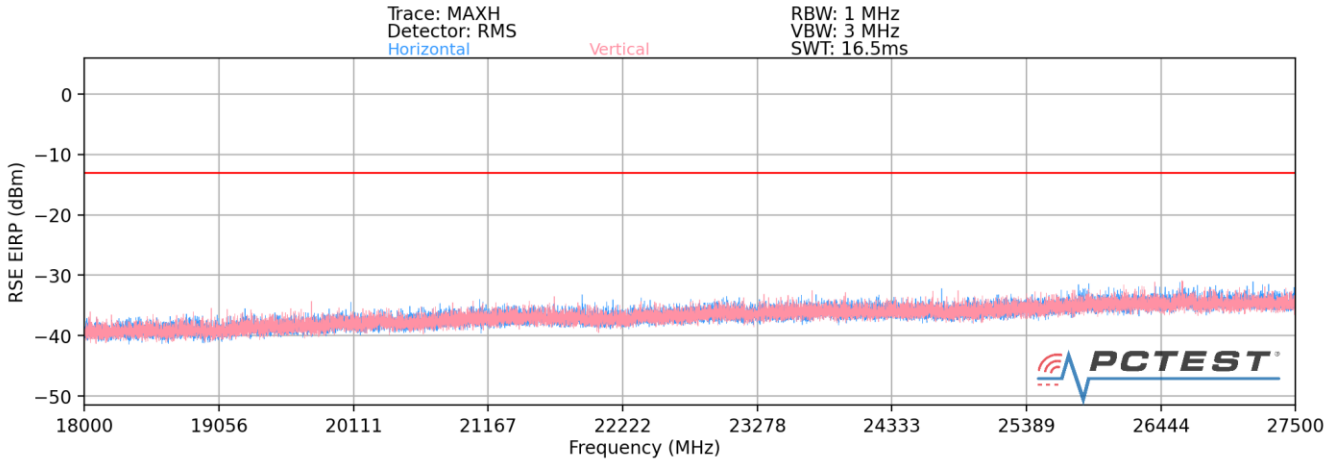
**Table 7-9. Spurious Emissions Table (1GHz-18GHz)**

**Notes**

1. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses. Measurements were performed at a distance of 3 meter.

2. To cover the simultaneous transmissions, both the LTE module (FCC ID: 2AUVU-UBR410M) and WLAN module (FCC ID: Z64-WL18SBMOD) are set to transmit at the same time as the mmWave functionality of the host. EUT is transmitting WLAN at 2437MHz in 802.11b mode simultaneously with the LTE B4 signal.

## 18 – 27.5GHz




**Plot 7-12. Radiated Spurious Plot 18-27.5 GHz (1CC QPSK Mid Channel V Beam)**

## Spurious Emissions EIRP Sample Calculation

The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

**RSE EIRP [dBm]** = Analyzer Level [dBm] + 107 + AFCL [dB/m] + 20Log(Dm) – 104.8

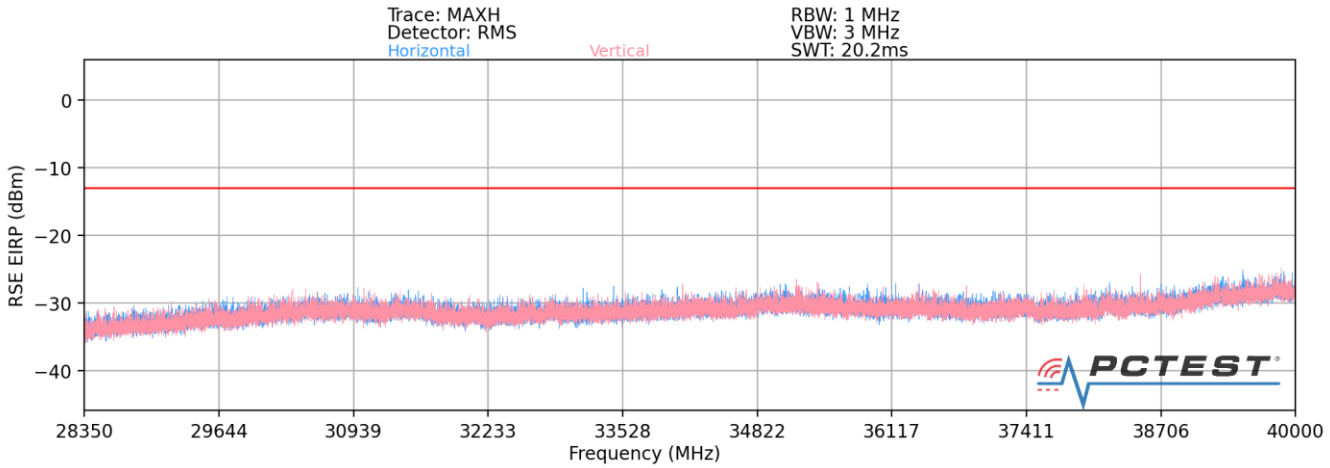
| Frequency [MHz] | Channnel | Bandwidth (MHz) | EUT Beam Pol. | Modulation | Antenna Polarization [H/V] | Turntable Azimuth [degrees] | Positioner Azimuth [degrees] | Spurious Emission Level [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|---|
| 27394.20 | Low | 50 | V | QPSK | V | - | - | -35.46 | -13.00 | -22.46 |
| 27379.40 | Mid | 50 | V | QPSK | V | - | - | -35.64 | -13.00 | -22.64 |
| 27309.20 | High | 50 | V | QPSK | V | - | - | -35.78 | -13.00 | -22.78 |

**Table 7-10. Spurious Emissions Table (18-27.5GHz)**

**Notes**

The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses. Measurements were performed at a distance of 1 meter.

## 28.35 – 40GHz




**Plot 7-13. Radiated Spurious Plot 28.475-40 GHz (1CC QPSK Mid Channel V Beam)**

## Spurious Emissions EIRP Sample Calculation

The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

**RSE EIRP [dBm]** = Analyzer Level [dBm] + 107 + AFCL [dB/m] + 20Log(Dm) – 104.8

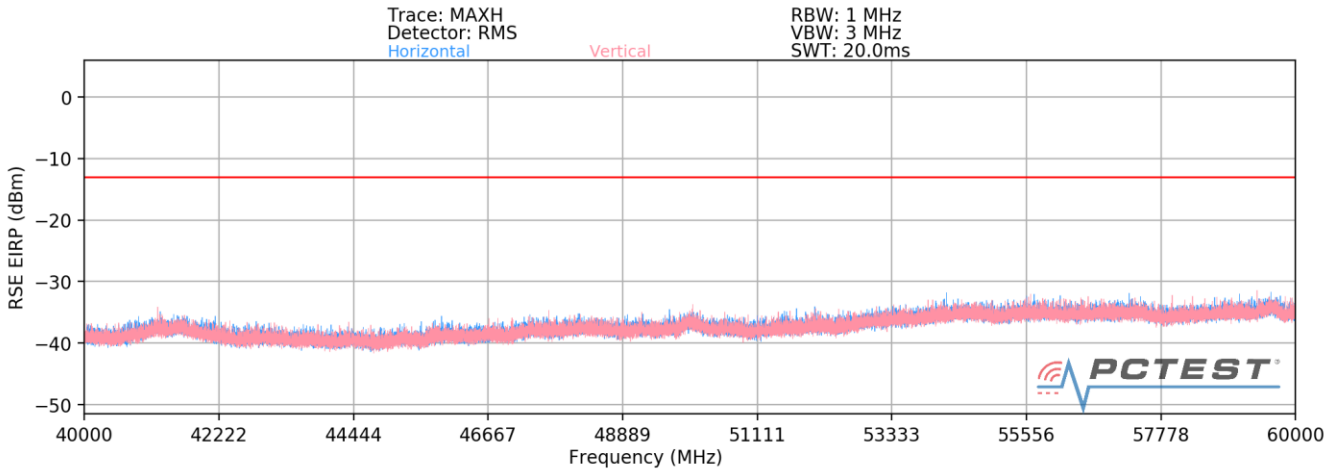
| Frequency [MHz] | Channnel | Bandwidth (MHz) | EUT Beam Pol. | Modulation | Antenna Polarization [H/V] | Turntable Azimuth [degrees] | Positioner Azimuth [degrees] | Spurious Emission Level [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|---|
| 28484.00 | Low | 50 | V | QPSK | V | - | - | -35.53 | -13.00 | -22.53 |
| 28547.40 | Mid | 50 | V | QPSK | V | - | - | -34.93 | -13.00 | -21.93 |
| 28516.60 | High | 50 | V | QPSK | V | - | - | -35.34 | -13.00 | -22.34 |

**Table 7-11. Spurious Emissions Table (28.35-40 GHz)**

**Notes**

The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses. Measurements were performed at a distance of 1 meter.

## 40 – 60GHz




**Plot 7-14. Spurious Plot 40-60 GHz (1CC QPSK Mid Channel V Beam)**

## Spurious Emissions EIRP Sample Calculation

The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1.5 meter.

**RSE EIRP [dBm]** = Analyzer Level [dBm] + 107 + AFCL [dB/m] + 20Log(Dm) + Harmonic Mixer Loss (dB) – 104.8

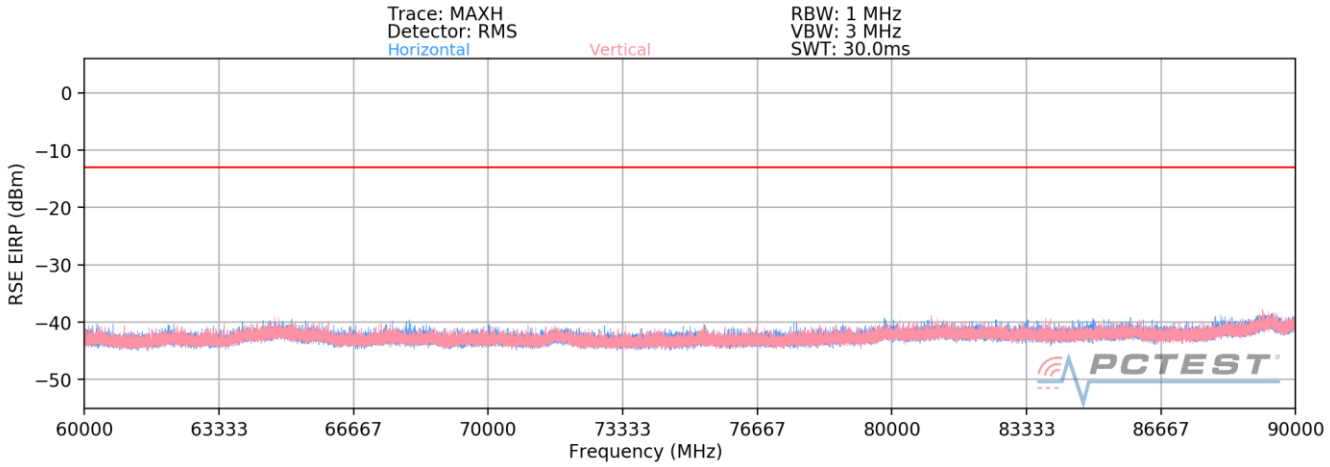
| Frequency [MHz] | Channnel | Bandwidth (MHz) | EUT Beam Pol. | Modulation | Antenna Polarization [H/V] | Turntable Azimuth [degrees] | Positioner Azimuth [degrees] | Spurious Emission Level [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|---|
| 55040.16 | Low | 50 | V | QPSK | V | - | - | -37.23 | -13.00 | -24.23 |
| 55849.98 | Mid | 50 | V | QPSK | V | 15 | 353 | -34.36 | -13.00 | -21.36 |
| 56641.56 | High | 50 | V | QPSK | V | 14 | 358 | -35.63 | -13.00 | -22.63 |

**Table 7-12. Spurious Emissions Table (40 - 60GHz)**

**Notes**

The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1.5 meter.

## 60 – 90GHz




**Plot 7-15. Radiated Spurious Plot 60-90 GHz (1CC QPSK Mid Channel V Beam)**

## Spurious Emissions EIRP Sample Calculation

The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

**RSE EIRP [dBm]** = Analyzer Level [dBm] + 107 + AFCL [dB/m] + 20Log(Dm) + Harmonic Mixer Loss (dB) – 104.8

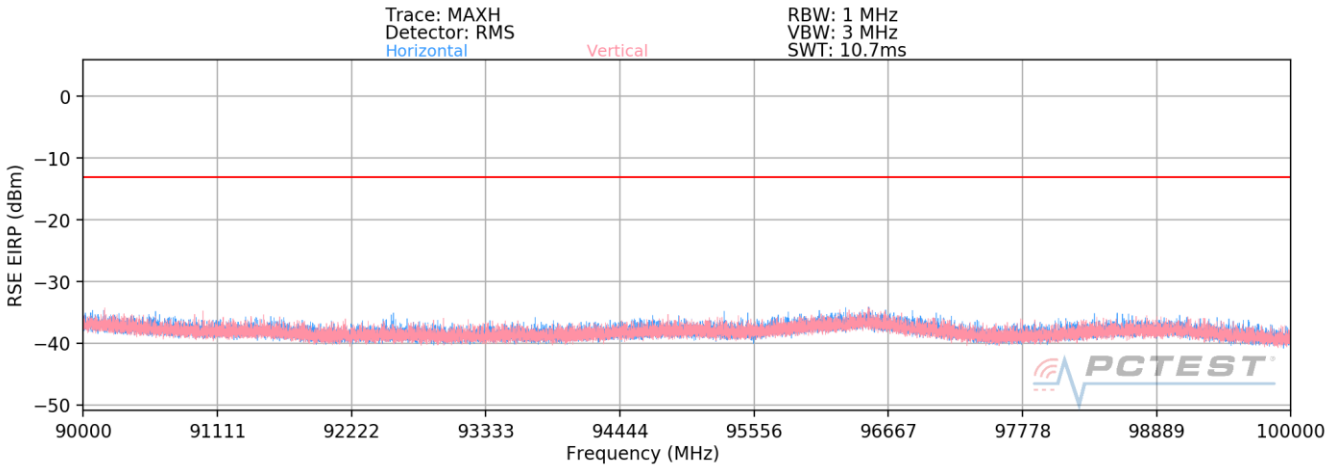
| Frequency [MHz] | Channnel | Bandwidth (MHz) | EUT Beam Pol. | Modulation | Antenna Polarization [H/V] | Turntable Azimuth [degrees] | Positioner Azimuth [degrees] | Spurious Emission Level [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|---|
| 82574.82 | Low | 50 | V | QPSK | V | - | - | -39.17 | -13.00 | -26.17 |
| 83782.25 | Mid | 50 | V | QPSK | V | - | - | -39.61 | -13.00 | -26.61 |
| 84978.24 | High | 50 | V | QPSK | V | - | - | -38.68 | -13.00 | -25.68 |

**Table 7-13. HBF Antenna Spurious Emissions Table (60-90GHz)**

**Notes**

The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.

## 90 – 100GHz




**Plot 7-16. Radiated Spurious Plot 90-100 GHz (1CC QPSK Mid Channel V Beam)**

## Spurious Emissions EIRP Sample Calculation

The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

**RSE EIRP [dBm]** = Analyzer Level [dBm] + 107 + AFCL[dB/m] + 20Log(Dm) + Harmonic Mixer Loss (dB) – 104.8

| Frequency [MHz] | Channnel | Bandwidth (MHz) | EUT Beam Pol. | Modulation | Antenna Polarization [H/V] | Turntable Azimuth [degrees] | Positioner Azimuth [degrees] | Spurious Emission Level [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|---|
| 96484.55 | Low | 50 | V | QPSK | V | - | - | -33.92 | -13.00 | -20.92 |
| 96499.05 | Mid | 50 | V | QPSK | V | - | - | -33.87 | -13.00 | -20.87 |
| 96477.80 | High | 50 | V | QPSK | V | - | - | -34.40 | -13.00 | -21.40 |

**Table 7-14. Spurious Emissions Table (90-100GHz)**

**Notes**

The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.

## 7.6 Band Edge Emissions

**§2.1051, §30.203**

### Test Overview

The EUT was fed a 5G NR mmWave representative signal via waveguide adapter. All out of band emissions are measured in a conducted setup while the EUT is operating at its maximum AGC level, at maximum power, and at the appropriate frequencies. All modes of operation were investigated and the worst case configuration results are reported in this section.

***The minimum permissible attenuation level of any spurious emission is -13dBm/1MHz. However, in the bands immediately outside and adjacent to the licensee's frequency block, having a bandwidth equal to 10 percent of the channel bandwidth, the conductive power or the total radiated power of any emission shall be −5 dBm/MHz or lower.***

### Test Procedure Used

ANSI C63.26-2015 Section 5 and ANSI C63.26-2015 Section 6.4

### Test Settings

1. Start and stop frequency were set such that both upper and lower band edges are measured.
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW = 1MHz
4. VBW $\geq$ 3 x RBW
5. Detector = RMS
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = trace average
8. Sweep time = auto couple
9. The trace was allowed to stabilize

## Test Notes

1) Band Edge measurements in this section are shown as conducted powers for direct comparison to the 30.203 limit. Band Edge measurements were performed using waveguide adapters to the input and output ports of the EUT which allowed for direct RF connection to the spectrum analyzer

2) The spectrum plots in this section show measurement of some emissions that may be considered as part of the spurious domain, extending beyond the band edges by more than 10% of the occupied bandwidth of the test signal. These measurements were made with a WR28 waveguide-to-RF adapter where the operating range of the WR28 waveguide is in the 26.5 – 40GHz range. Thus, all spurious emission measurements shown in the following plots remain valid.

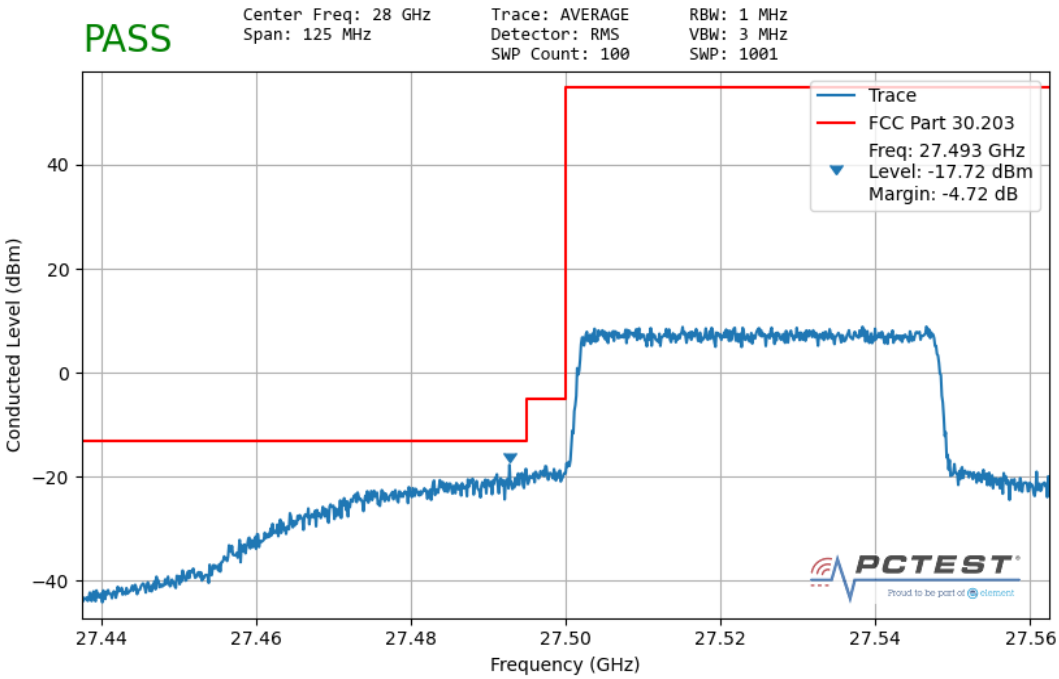
3) The MIMO Band Edges were calculated by using the "measure and sum the spectra across the outputs" technique specified in Section 6.4.3.2.2 of ANSI C63.26-2015. The spectra were summed linearly and converted to dBm for comparison with the limit.

4) The MIMO Band Edge plots shown below are mathematically summed conducted powers between spectrum analyzer measurements on H Beam and V Beam.

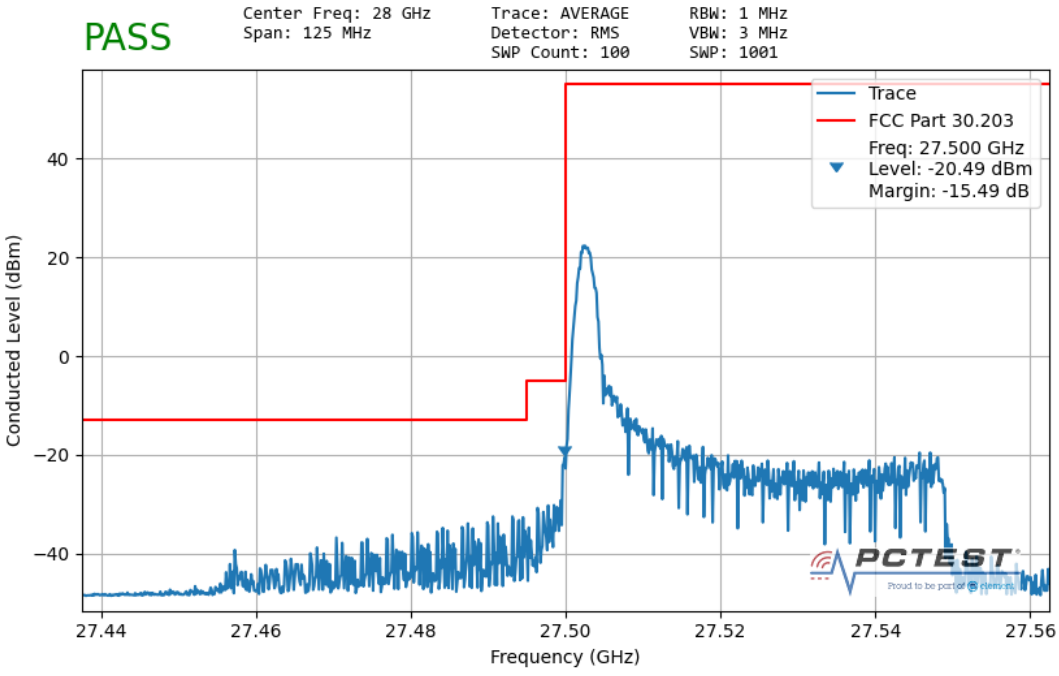
## Sample MIMO Calculation:

Antenna 1 + Antenna 2 = MIMO

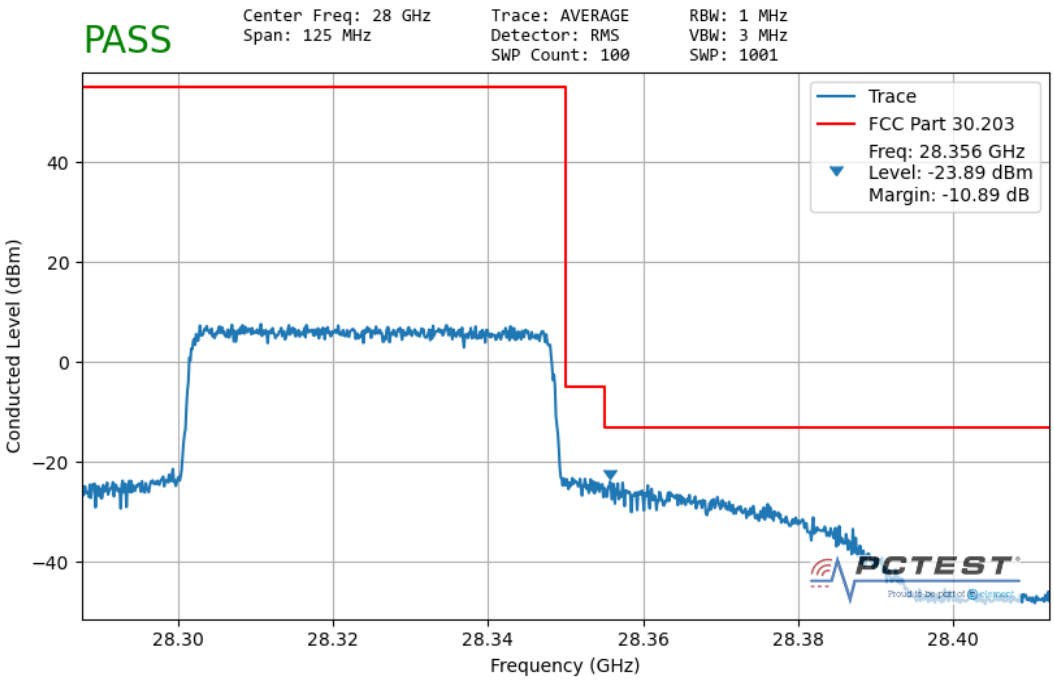
(-22.78 dBm + -25.23 dBm) = (0.00527mW + 0.00300mW) =0.00827mW = -20.83dBm



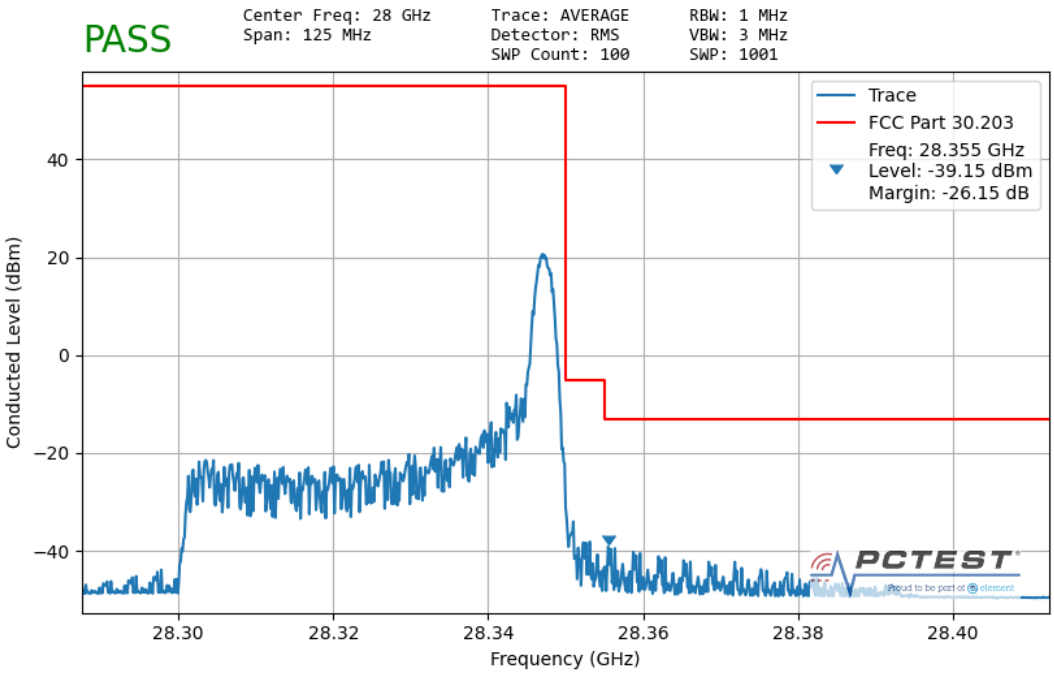

**Plot 7-17. Lower Band Edge Plot (50MHz QPSK Full RB)**



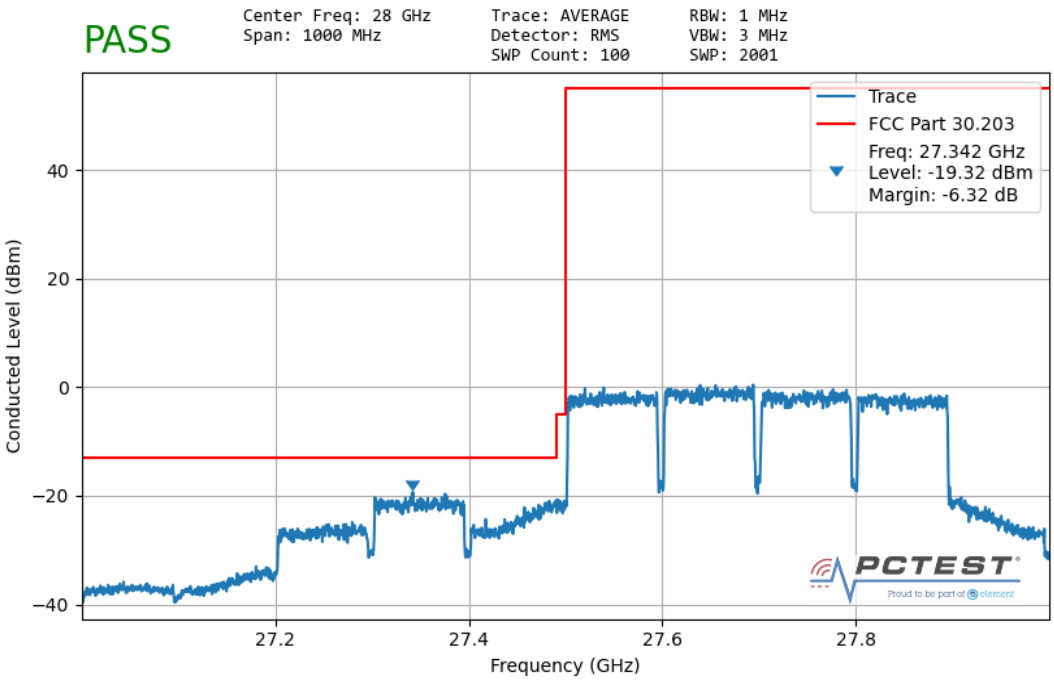

**Plot 7-18. Lower Band Edge Plot (50MHz QPSK 1 RB)**



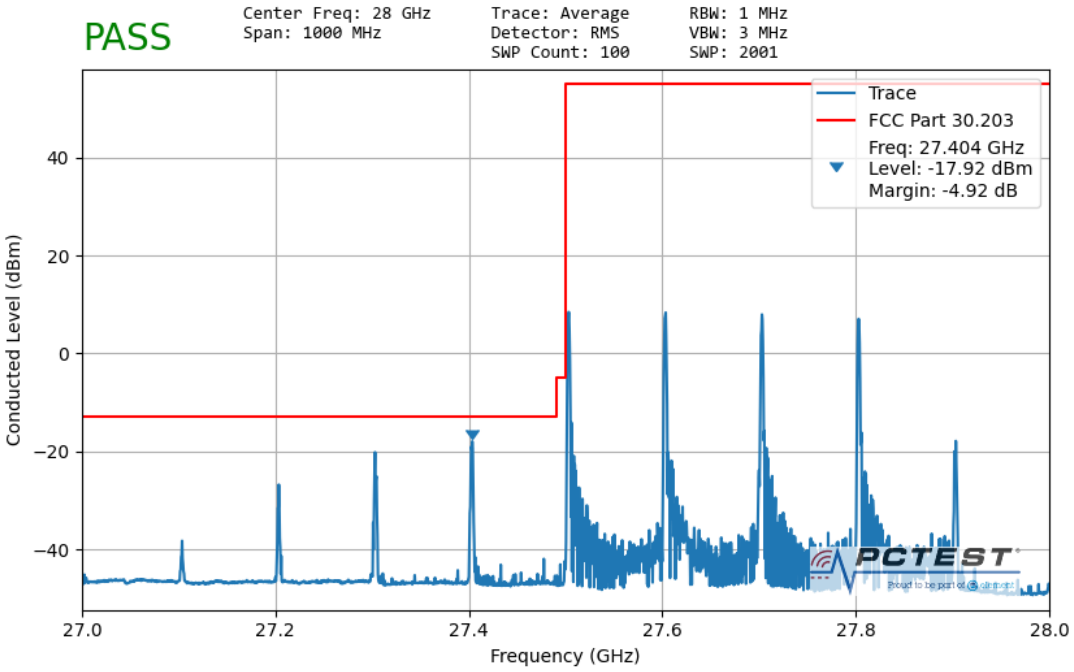

**Plot 7-19. Upper Band Edge Plot (50MHz QPSK Full RB)**



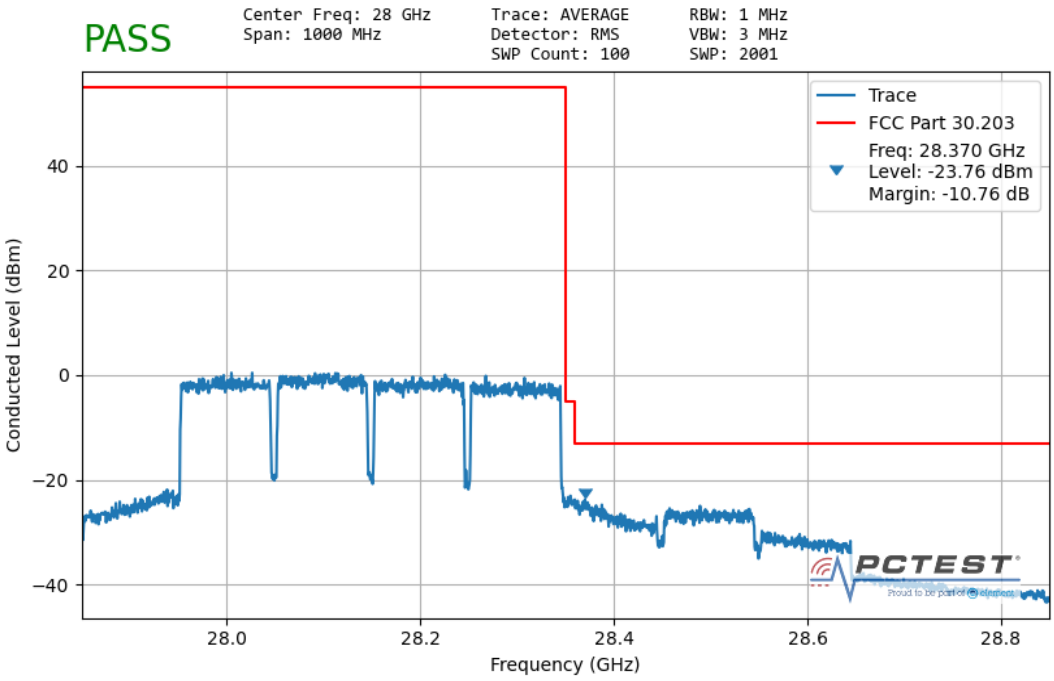

**Plot 7-20. Upper Band Edge Plot (50MHz QPSK 1 RB)**



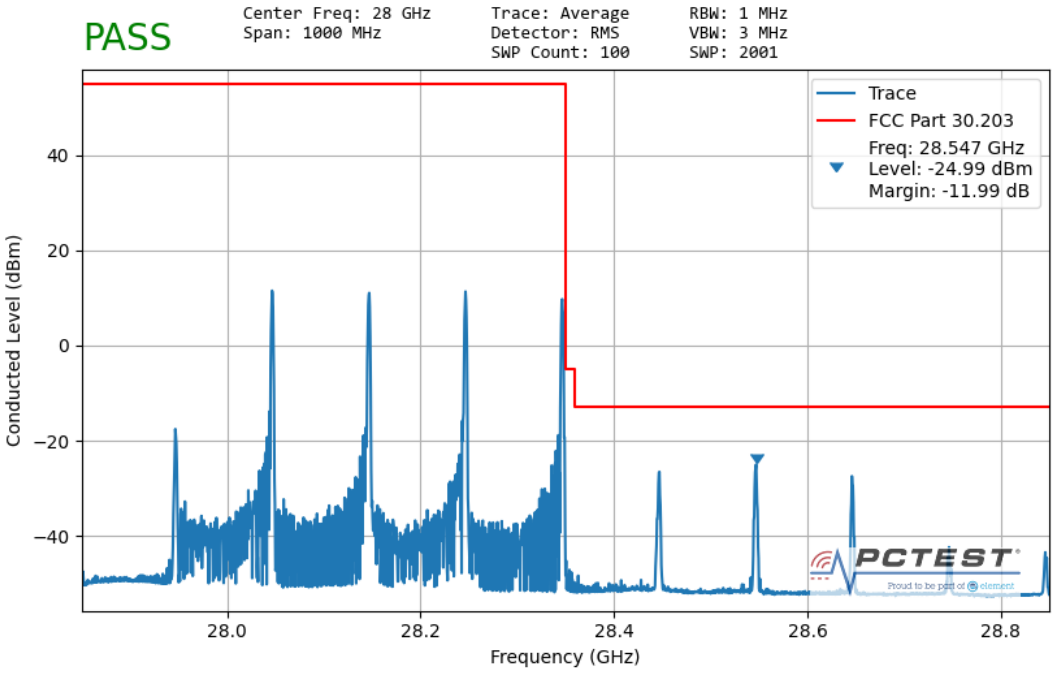

**Plot 7-21. Lower Band Edge Plot (100MHz 4CC QPSK Full RB)**




**Plot 7-22. Lower Band Edge Plot (100MHz 4CC QPSK 1 RB)**




**Plot 7-23. Upper Band Edge Plot (100MHz 4CC QPSK Full RB)**




**Plot 7-24. Upper Band Edge Plot (100MHz 4CC QPSK 1 RB)**

## 7.7 Frequency Stability / Temperature Variation

**§2.1055**

### Test Overview and Limit

Frequency stability testing is performed in accordance with the guidelines of ANSI C63.26-2015. The frequency stability of the transmitter is measured by:

a.) **Temperature:** The temperature is varied from -30°C to +50°C in 10°C increments using an environmental chamber.

b.) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

### Test Procedure Used

ANSI C63.5-2015 Section 5.6

### Test Settings

1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
2. The equipment is turned on in a "standby" condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

### Test Setup

The EUT was measured using horn antenna connected to a spectrum analyzer. The EUT was placed inside an environmental chamber. Using a foam plug, the horn antenna measured the frequency of the fundamental signal.

### Test Notes

The Frequency Deviation column in the table below is the amount of deviation measured from the center frequency of the Reference measurement (first row).

## Frequency Stability Measurements

**§2.1055**

OPERATING FREQUENCY: 27,924.96 MHz

REFERENCE VOLTAGE: -48.00 VDC

| VOLTAGE (%) | POWER (VDC) | TEMP (°C) | FREQUENCY (Hz) | Freq. Dev. (Hz) | Deviation (%) |
|---|---|---|---|---|---|
| 100 % | -48.00 | - 30 | 27,924,845,000 | 115,000 | 0.0004118 |
| 100 % | | - 20 | 27,924,915,000 | 45,000 | 0.0001611 |
| 100 % | | - 10 | 27,924,970,000 | -10,000 | -0.0000358 |
| 100 % | | 0 | 27,924,850,000 | 110,000 | 0.0003939 |
| 100 % | | + 10 | 27,924,890,000 | 70,000 | 0.0002507 |
| 100 % | | + 20 | 27,924,980,000 | -20,000 | -0.0000716 |
| 100 % | | + 30 | 27,924,945,000 | 15,000 | 0.0000537 |
| 100 % | | + 40 | 27,924,985,000 | -25,000 | -0.0000895 |
| 100 % | | + 50 | 27,924,995,000 | -35,000 | -0.0001253 |
| 85 % | -40.80 | + 20 | 27,924,925,000 | 35,000 | 0.0001253 |
| 115 % | -55.20 | +20 | 27,924,950,000 | 10,000 | 0.0000358 |

**Table 7-15. Frequency Stability Data**

**Note:**

Based on the results of the frequency stability test at the center channel the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

# Frequency Stability Measurements

**§2.1055**

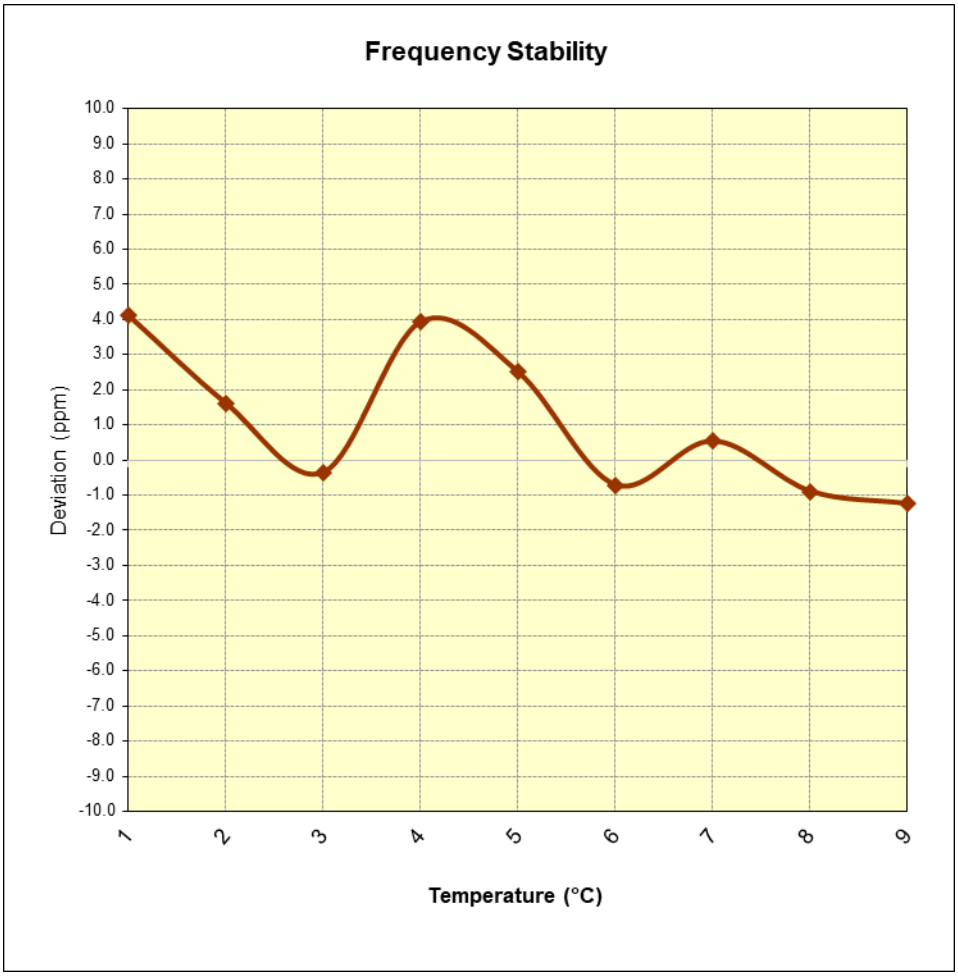



**Figure 7-1. Frequency Stability Graph**

# 8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Pivotal Commware 5G mmWave Repeater (Service Unit) FCC ID: 2AUVU-P28SUGA1** complies with all the requirements of Part 30.

# 9.0 APPENDIX A

## 9.1 VDI Mixer Verification Certificate


**Virginia Diodes, Inc**
979 2nd St. SE
Suite 309
Charlottesville, VA 22902
Phone: 434-297-3257
Fax: 434-297-3258

***Certificate of Conformance***

**To:** PCTEST Engineering Laboratory
7185 Oakland Mills Road
Columbia, MD 21046
United States

**From:** Virginia Diodes, Inc
979 2nd St. SE
Suite 309
Charlottesville, VA 22902

**Packing List No:** 193065 **Today's Date:** 10/02/19

| Quantity Shipped | Unit | Description | Order-Job Number |
|---|---|---|---|
| 1 | EA | VDIWR19.0SAX<br>WR19SAX / SN: SAX 411 | 19329-01 |

The VDI product(s) in this shipment meet(s) the guidelines for performance specifications established in accordance with the corresponding Purchase Order. Data presented in the User Guide, where applicable, has been obtained in accordance with VDI's Quality Management System. All instruments, used to obtain data, which require calibration have been calibrated with equipment traceable to the National Institute of Standards and Technology (NIST) and through NIST to the International System of Units (SI).

Authorized Signature
Virginia Diodes, Inc

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**Virginia Diodes, Inc**
979 2nd St. SE
Suite 309
Charlottesville, VA 22902
Phone: 434-297-3257
Fax: 434-297-3258

## *Certificate of Conformance*

**To:** PCTEST Engineering Laboratory
7185 Oakland Mills Road
Columbia, MD 21046
United States

**From:** Virginia Diodes, Inc
979 2nd St. SE
Suite 309
Charlottesville, VA 22902

**Packing List No:** 193037
**Shipping Date:** 09/30/19
**Today's Date:** 09/30/19
**PO Number:** 190719.DP1R

| Quantity Shipped | Unit | Description | Order-Job Number |
|---|---|---|---|
| 1 | EA | SAX RETEST-WR12SAX<br>WR12SAX / SN: SAX 252 | 19408-01 |
| 1 | EA | SAX RETEST-WR8.0SAX<br>WR8.0SAX / SN: SAX 253 | 19408-02 |
| 1 | EA | SAX RETEST-WR5.1SAX<br>WR5.1SAX / SN: SAX 254 | 19408-03 |

The VDI product(s) in this shipment meet(s) the guidelines for performance specifications established in accordance with the corresponding Purchase Order. Data presented in the User Guide, where applicable, has been obtained in accordance with VDI's Quality Management System. All instruments, used to obtain data, which require calibration have been calibrated with equipment traceable to the National Institute of Standards and Technology (NIST) and through NIST to the International System of Units (SI).

Authorized Signature
Virginia Diodes, Inc

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