

PART 20 & 30 MEASUREMENT REPORT**Applicant Name:**

Pivotal Commware
22215 26th Ave SE #100
Bothell WA 98021
UNITED STATES

Date of Testing:

08/09 - 10/02/2023

Test Report Issue Date:

10/20/2023

Test Site/Location:

Element lab., Columbia, MD, USA

Test Report Serial No.:

1M2308080090-01-R2.2AUVU

FCC ID:

2AUVU-5620-12-39

APPLICANT:

Pivotal Commware

Application Type:

Certification

Model:

5620-12-39

EUT Type:

5G mmWave Repeater

FCC Classification(s):

Part 20 Industrial Booster (CMRS) (B2I)

FCC Rule Part(s):

2, 20, 30

Test Procedure(s):

ANSI C63.26-2015, KDB 842590 D01 v01r02,
KDB 935210 D02 v04r02, KDB 935210 D05 v01r04

Note: This revised Test Report (S/N: 1M2308080090-01-R2.2AUVU) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

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.



RJ Ortanez
Executive Vice President



FCC ID: 2AUVU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1M2308080090-01-R2.2AUVU	Test Dates: 08/09 - 10/02/2023	EUT Type: 5G mmWave Repeater	Page 1 of 87

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Band	Antenna	Bandwidth [MHz]	Tx Frequency [MHz]	CCs Active	Mode	Modulation	EIRP		Emission Designator
							Max Power [W]	Max Power [dBm]	
n260	V_UL	50	37025 - 39975	1	SISO	QPSK	14.93	41.74	46M0G7D
					SISO	16QAM	13.00	41.14	46M0W7D
		100	37200 - 39800	4	SISO	QPSK	14.62	41.65	394MG7D
					SISO	16QAM	13.87	41.42	392MW7D
	H_UL	50	37025 - 39975	1	SISO	QPSK	13.59	41.33	46M0G7D
					SISO	16QAM	11.40	40.57	46M1W7D
		100	37200 - 39800	4	SISO	QPSK	13.46	41.29	393MG7D
					SISO	16QAM	11.25	40.51	393MW7D
	MIMO	50	37025 - 39975	1	MIMO	QPSK	27.67	44.42	-
					MIMO	16QAM	24.38	43.87	-
		100	37200 - 39800	4	MIMO	QPSK	28.05	44.48	-
					MIMO	16QAM	24.27	43.85	-

EUT Overview (Band n260)

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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.

1.2 Element Test Location

These measurement tests were conducted at the Element Laboratory 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 Element lab located in Columbia, MD 21046, U.S.A.

- Element Washington DC LLC is an ISO 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.
- Element Washington DC LLC 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).
- Element Washington DC LLC facility is a registered (2451B) test laboratory with the site description on file with ISED.
- Element Washington DC LLC is a Recognized U.S. Certification Assessment Body (CAB # US0110) for ISED Canada as designated by NIST under the U.S. and Canada Mutual Recognition Agreement.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Pivotal Commware 5G mmWave Repeater FCC ID: 2AUVU-5620-12-39**. The test data contained in this report pertains only to the emissions due to the 5G mmWave operation of the Service Unit.

The EUT is part of a two-unit repeater system consisting of a Donor Unit (DU) and a Service Unit (SU). Each unit is mounted on a pole and aligned to properly receive and boost 5G signals from a gNodeB. Both units are required for operation as neither can be operated in a standalone mode.

Both units are capable of transmitting boosted 5G mmWave signals. For transmission of such signals, the DU is installed and configured to communicate with a gNodeB. The SU receives the signal from the DU via an RF cable and then re-transmits the signal to provide 5G coverage to a target area. For each unit, the antenna configuration is comprised of two separate linearly polarized antenna feeds: one for horizontally polarized transmission and one for vertically polarized transmission.

Both the DU and the SU were fitted with RF connectors to allow for conducted measurements to compare with the FCC Part 30 limits. Throughout this report, the output data for the DU are labelled as “V-UL” and “H-UL” to represent the vertical and horizontal transmission components of the output.

The EUT does not generate its own RF. The EUT supports any combination of bandwidths, number of carriers, and modulations as input signals from a signal generator connected to its input. The EUT will transmit all signals within the 5G NR n260 band that are received.

Test Device Serial No.: 89000320201232500064, 89000320201233000006

2.2 Device Capabilities

This device contains the following capabilities:

5G FR2 (NR Band n260), LTE (B2, B4, B5, B12, B13, B25, B26, and B41)

2.3 Test Configuration

The EUT was tested per the guidance of ANSI C63.26-2015 and KDB 842590 D01 and KDB 935210 D05. See Section 7.0 of this test report for a description of the conducted and radiated tests.

All conducted testing was performed using a signal generator connected via coaxial cable to waveguide adapters on the input port of one unit of the EUT and measured via adapter connected to coaxial cable from the output port of the other unit. All radiated testing was performed by using a signal generator connected to a horn antenna to transmit to one unit of the EUT and then measuring the radiated output transmission from other unit.

For both conducted and radiated testing, the signal generator was set to transmit representative 5G mmWave NR signals in various sized bandwidths and modulations.

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2.4 Software and Firmware

The test was conducted with firmware version 0.6.0 installed on the EUT.

2.5 EMI Suppression Device(s)/Modifications

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

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V1.0

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) and the guidance provided in KDB 842590 D01 v01r02 were used in the measurement of the EUT. KDB 935210 D05 v01r04 was referenced for testing the EUT as well.

3.2 Radiated Power and Radiated Spurious Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary for radiated emissions measurements in the spurious domain. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. 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. An 80cm tall test table made of Styrodur is placed on top of the turn table. A Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m for measurements above 1GHz.

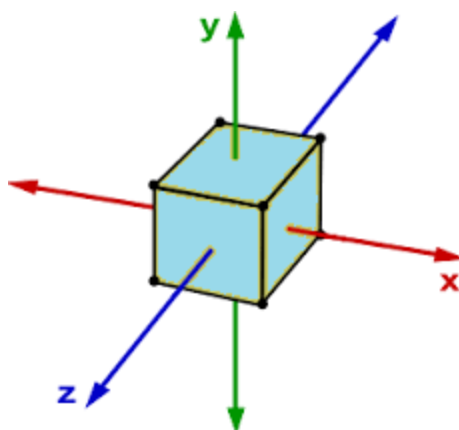


Figure 3-1. Rotation of the EUT Through Three Orthogonal Planes

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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. In this case, for RSE measurements, "D" is the largest dimension of the EUT which was roughly 29cm x 29cm x 7cm. The measurement antenna and harmonic mixer were manipulated around all faces and edges of the EUT to determine location of worst-case emissions.

Frequency Range (GHz)	Wavelength (cm)	Far Field Distance (m)	Measurement Distance (m)
18-40	0.749	0.54	2.00
40-60	0.500	1.44	2.00
60-90	0.333	0.96	2.00
90-140	0.214	0.63	2.00
140-200	0.150	0.39	2.00

Table 3-1. Far-Field Distance & Measurement Distance per Frequency Range

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 ANSI C63.26-2015.

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

= - 32.74 dBm + (40.7dB/m + 8.78dB) + 107 = 123.74dBuV/m

= $10^{(123.74/20)/1000000} = 1.54 \text{ V/m}$

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

= $10 * \log((1.54\text{V/m} * 1.00\text{m})^2/30) + 30\text{dB}$

= 18.98 dBm e.i.r.p.

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3.3 Industrial Booster Test Cases

Per the requirements of KDB 935210 D05 v01r04, the following test cases shall be investigated for Industrial Boosters under FCC Part 20.21:

1. AGC Threshold Level
2. Out-of-Band Rejection
3. Input-versus-Output Signal Comparison
4. Mean Output Power and Amplifier/Booster Gain
5. Out-of-Band/Out-of-Block Emissions and Spurious Emissions
6. Frequency Stability
7. Radiated Spurious Emissions

3.4 Environmental Conditions

The temperature is controlled within range of 15°C to 35°C. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).

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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 ($\pm$ dB)
Conducted Bench Top Measurements	1.13
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

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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
-	AP2-001	EMC Cable and Switch System	1/11/2023	Annual	1/11/2024	AP2-001
-	AP2-002	EMC Cable and Switch System	1/11/2023	Annual	1/11/2024	AP2-002
-	ETS-001	EMC Cable and Switch System	1/11/2023	Annual	1/11/2024	ETS-001
-	ETS-002	EMC Cable and Switch System	1/11/2023	Annual	1/11/2024	ETS-002
-	WL40-1	WLAN Cable Set (40GHz)	1/12/2023	Annual	1/12/2024	WL40-1
-	WL40-2	WLAN Cable Set (40GHz)	1/12/2023	Annual	1/12/2024	WL40-2
EMCO	3115	Horn Antenna (1-18GHz)	8/8/2022	Biennial	8/8/2024	9203-2178
EMCO	3116	Horn Antenna (18-40GHz)	7/5/2023	Biennial	7/5/2025	9203-2178
ESPEC	SU-241	Temperature Chamber	11/10/2022	Annual	11/10/2023	93011064
Narda	180-422-KF	Horn (Small)	8/30/2022	Biennial	8/30/2024	170WX50922
OML, Inc.	M05RH	Horn Antenna, 140 to 220 GHz	9/27/2022	Biennial	9/27/2024	180914-1
OML, Inc.	M08RH	Horn Antenna, 90 to 140 GHz	9/28/2022	Biennial	9/28/2024	180914-1
OML, Inc.	M12RH	Horn Antenna, 60 to 90 GHz	10/4/2022	Biennial	10/4/2024	18073001
OML, Inc.	M19RH	Horn Antenna, 40 to 60 GHz	10/5/2022	Biennial	10/5/2024	190823-1
Rohde & Schwarz	ESW44	EMI Test Receiver 2Hz - 44GHz	3/6/2023	Annual	3/6/2024	101867
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	1/13/2023	Annual	1/13/2024	101639
Rohde & Schwarz	SMW200A	Vector Signal Generator	8/16/2022	Biennial	8/16/2024	102130
Sunol Sciences	JB5	Bi-Log Antenna (30M-5GHz)	8/30/2022	Biennial	8/30/2024	A102416-1
Virginia Diodes, Inc.	SAX679	SAX Module (40 - 60GHz)	11/21/2022	Biennial	11/21/2024	SAX679
Virginia Diodes, Inc.	SAX680	SAX Module (60 - 90GHz)	11/21/2022	Biennial	11/21/2024	SAX680
Virginia Diodes, Inc.	SAX681	SAX Module (90 - 140GHz)	1/5/2023	Biennial	1/5/2025	SAX681
Virginia Diodes, Inc.	SAX682	SAX Module (140 - 220GHz)	3/1/2023	Biennial	3/1/2025	SAX682

Table 5-1. Test Equipment

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6.0 SAMPLE CALCULATIONS

Emission Designator

$\pi/2$ BPSK/ 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

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7.0 TEST RESULTS

7.1 Summary

Company Name: Pivotal Commware
 FCC ID: 2AUVU-5620-12-39
 FCC Classification(s): Part 20 Industrial Booster (CMRS) (B2I)
 Mode(s): TDD

FCC Part Section(s)	KDB 935210 D05 Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
2.1049, 20.21	3.4	Input-Versus-Output Signal Comparison	N/A	CONDUCTED	PASS	Section 7.2
20.21	3.3	Out-of-band Rejection	N/A		PASS	Section 7.3
2.1046, 20.21	3.2, 3.5	Measuring AGC Threshold Level, Mean Output Power & Amplifier/Booster Gain	N/A		PASS	Section 7.4
2.1049	-	Occupied Bandwidth	N/A		PASS	Section 7.5
2.1046, 30.202(c)	-	Conducted Power & Equivalent Isotropic Radiated Power	≤ 55 dBm		PASS	Section 7.6
2.1051, 20.21, 30.203	3.6	Band Edge / Out-of-Band Emissions	≤ -5dBm/MHz from the band edge up to 10% of the channel BW ≤ -13dBm/MHz for all out-of-band emissions		PASS	Section 7.8
2.1055, 20.21	3.7	Frequency Stability	Fundamental emissions stay within authorized frequency block	RADIATED	PASS	Section 7.9
2.1051, 20.21, 30.203	3.8	Radiated Spurious Emissions	≤ -13 dBm/MHz for spurious emissions		PASS	Section 7.7

Table 7-1. Summary of Radiated Test Results

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Notes:

1. Per 2.1057(a)(2), spurious emissions were investigated up to 200GHz.
2. Testing was completed with a signal generator creating a representative mmWave 5G NR signal, using CP-OFDM schemes, various modulations including QPSK, and QAM, 120kHz subcarrier spacing, 50MHz-single carrier, 50MHz-dual carrier, and 100MHz-four carrier bandwidths, and full and single resource block allocations.
3. The input signal was fed from the signal generator to the EUT via a coaxial cable and it was set at a level so as to produce the maximum output power of the AGC range.
4. Based upon investigations of all possible modulations, testing was mainly performed with QPSK modulation.
5. Unless otherwise specified, triggering from the signal generator was used in order to more accurately gate on the TDD signal with the analyzer.
6. For conducted testing only, the EUT was fitted with waveguide-to-coax RF adapters that allowed for direct measurements. With the exception of radiated spurious emissions, all measurements were performed in a conducted test setup.

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7.2 Input-Versus-Output Signal Comparison

Test Overview

The Input-versus-Output Signal Comparison checks for the change in occupied bandwidth of the output signal from the booster at 3dB above the AGC threshold level and just below the AGC threshold level while not more than 0.5dB below the threshold level. All modes of operation were investigated and the worst case configuration results are reported in this section. Per KDB 935210 D05 clause 3.4, this is to be measured on both the input signal and the output signal.

Test Procedure Used

ANSI C63.26-2015 – Section 5.4.3
KDB 935210 D05 – Section 3.4

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 $\geq 3 \times$ RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize

Test Notes

1. Per previous guidance from FCC specifically to Element lab, a 50MHz 5G NR mmWave signal was used as the input signal as opposed to the 4.1MHz AWGN required in KDB 935210 D05.

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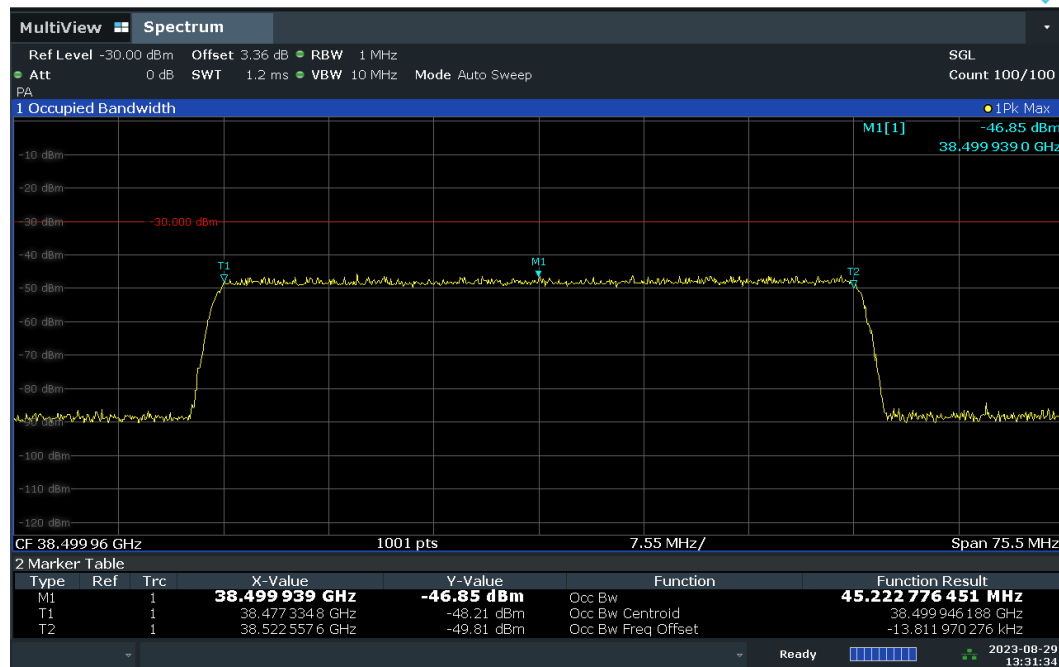
Band n260 – DU

AGC Threshold Level	EUT Antenna Polarization	Channel	Bandwidth [MHz]	Modulation	Input OBW [MHz]	Output OBW [MHz]
0.5dB below Threshold	V-UL	Mid	50	QPSK	45.22	45.85
3dB above Threshold	V-UL	Mid	50	QPSK	45.21	45.90
0.5dB below Threshold	H-UL	Mid	50	QPSK	45.30	45.96
3dB above Threshold	H-UL	Mid	50	QPSK	45.22	45.94

Table 7-2. n260 Occupied Bandwidth by AGC Threshold Level – DFT-s-OFDM

FCC ID: 2AUVU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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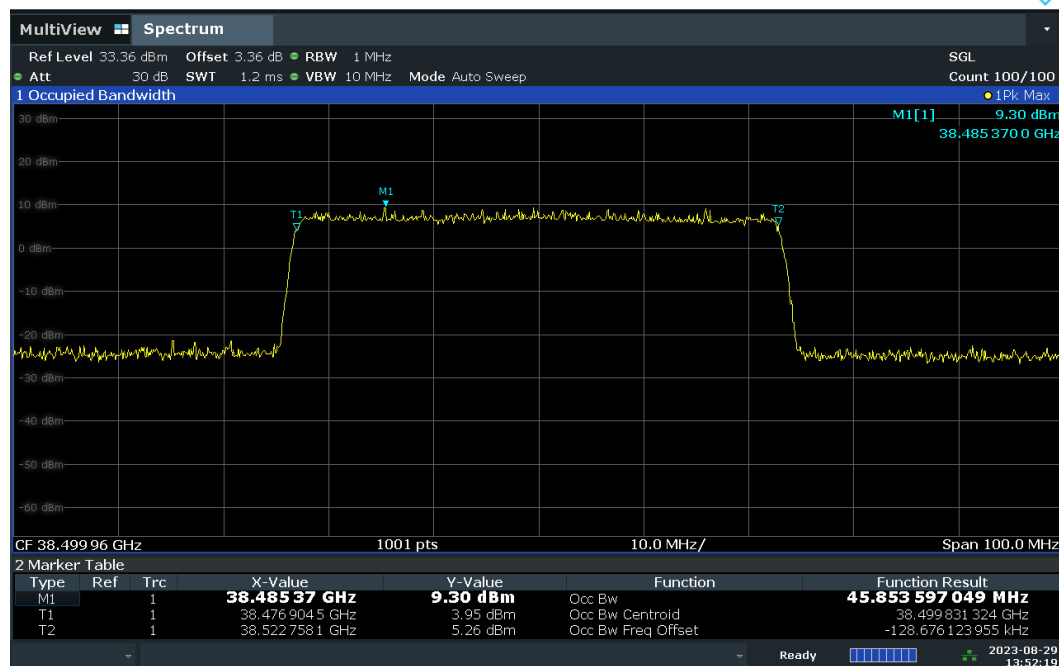
ACLRRResults



01:31:34 PM 08/29/2023

Plot 7-1. Occupied Bandwidth Input at 0.5dB below AGC Threshold – DFT-s – V-UL Polarization.

ACLRRResults



01:52:19 PM 08/29/2023

Plot 7-2. Occupied Bandwidth Output at 0.5dB below AGC Threshold – DFT-s – V-UL Polarization.

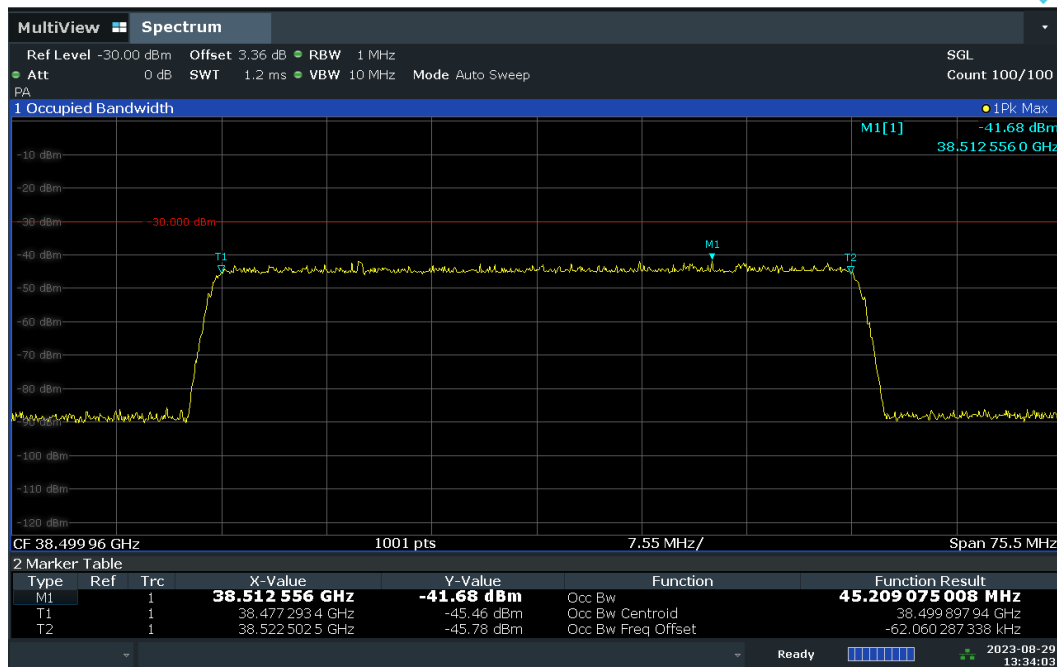
FCC ID: 2AUUVU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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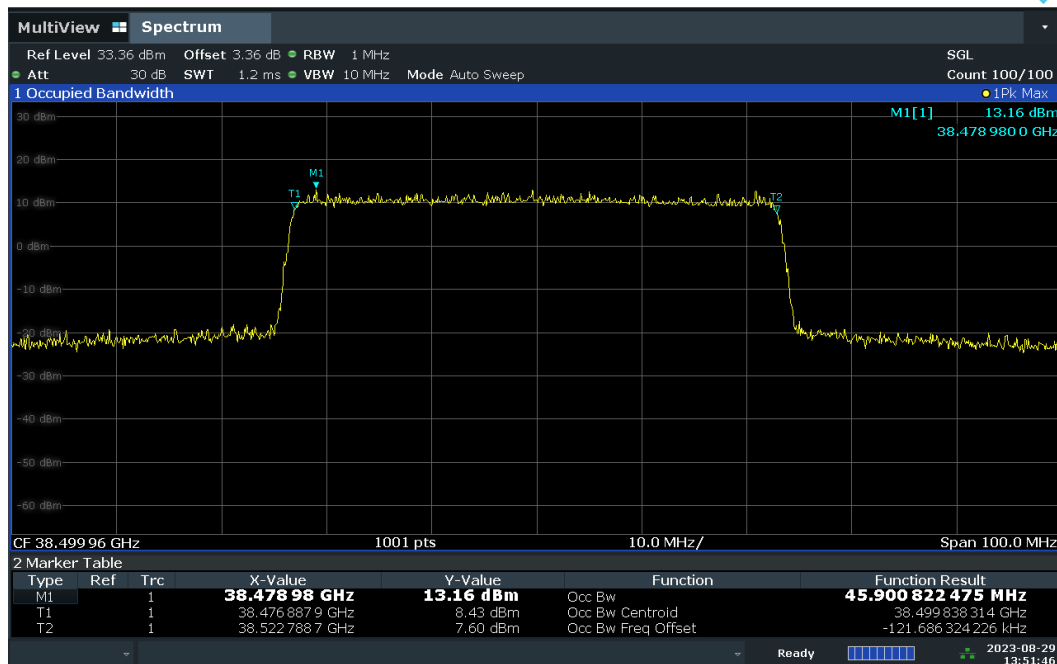
ACLRRResults



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Plot 7-3. Occupied Bandwidth Input at 3dB above AGC Threshold – DFT-s – V-UL Polarization.

ACLRRResults

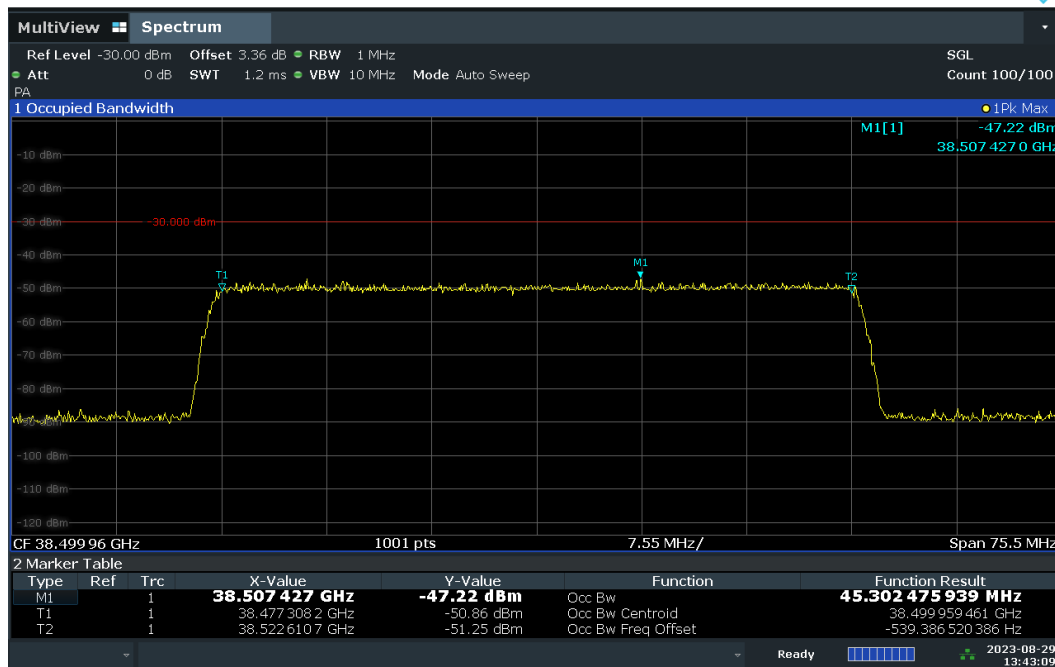


01:51:47 PM 08/29/2023

Plot 7-4. Occupied Bandwidth Output at 3dB above AGC Threshold – DFT-s – V-UL Polarization.

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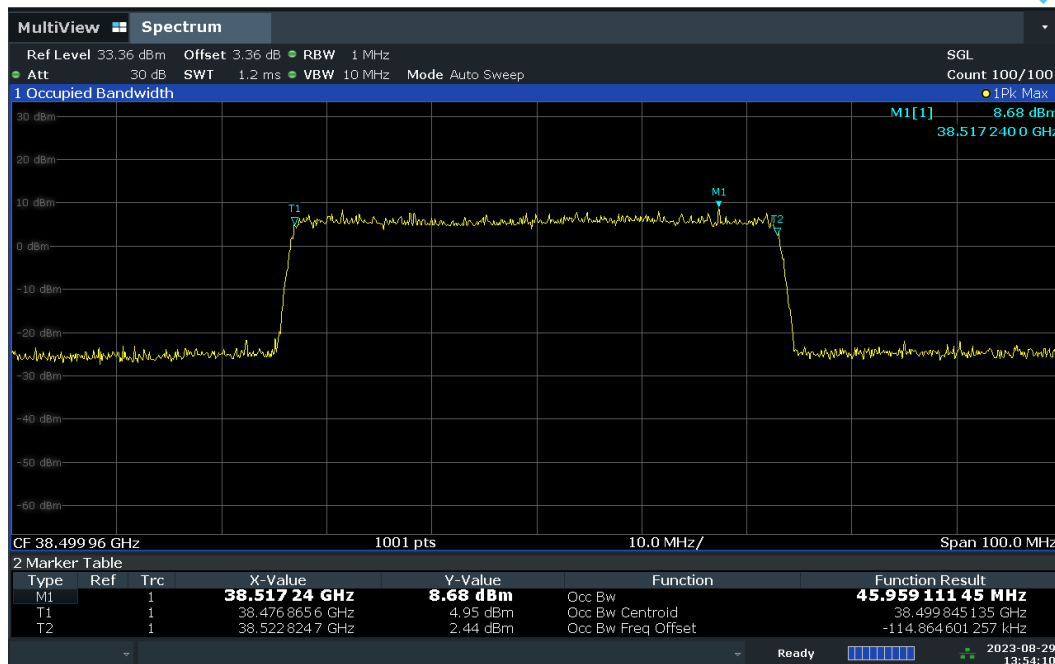
ACLRRResults



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Plot 7-5. Occupied Bandwidth Input at 0.5dB below AGC Threshold – DFT-s – H-UL Polarization.

ACLRRResults

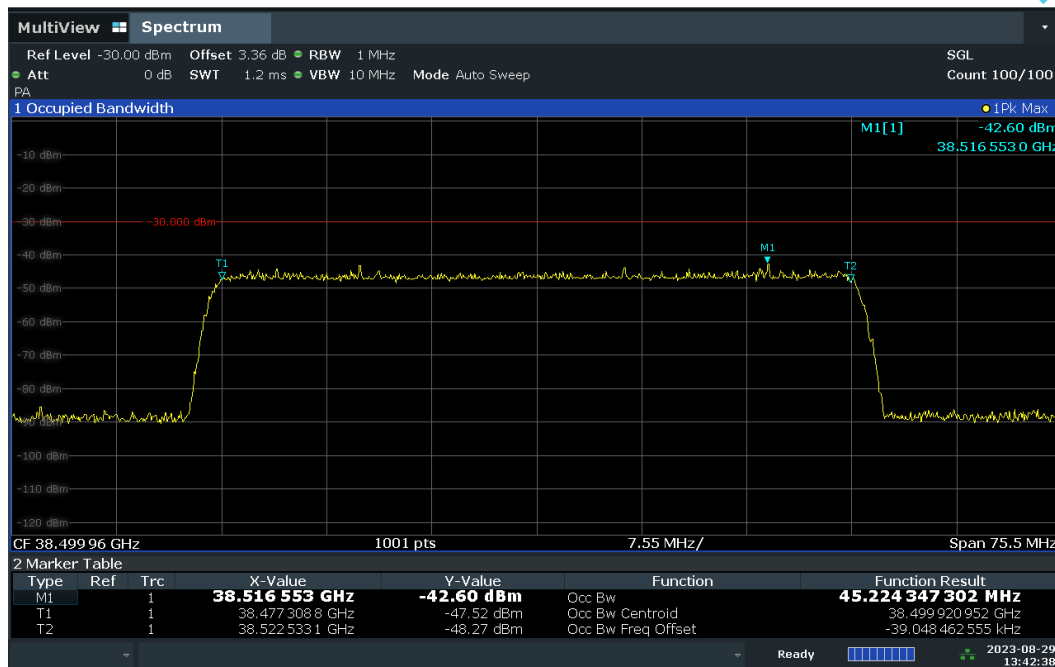


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Plot 7-6. Occupied Bandwidth Output at 0.5dB below AGC Threshold – DFT-s – H-UL Polarization.

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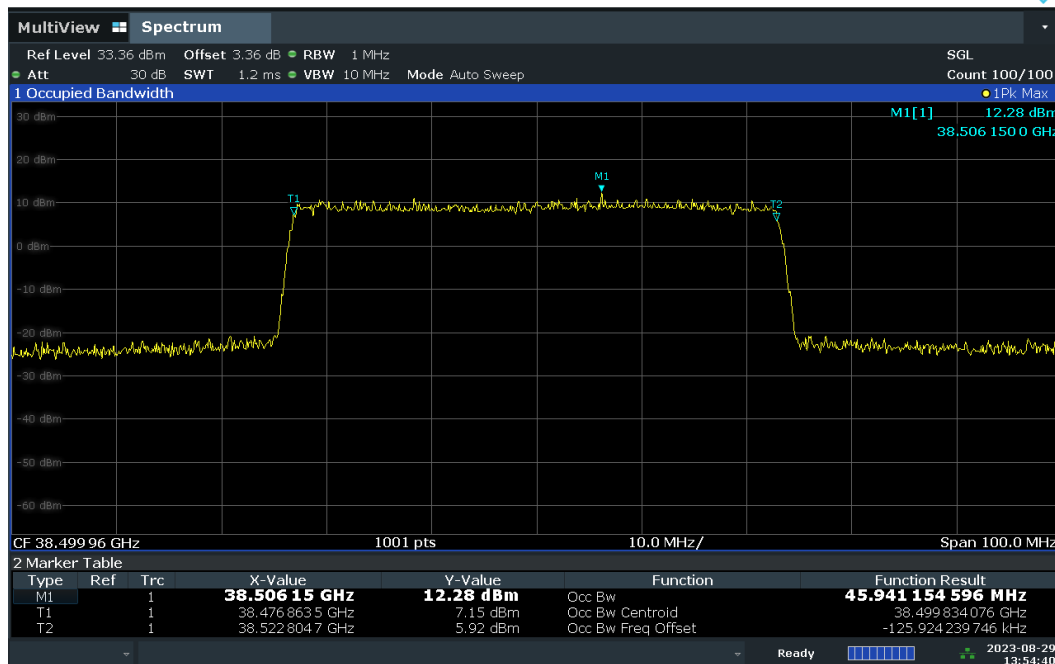
ACLRRResults



01:42:39 PM 08/29/2023

Plot 7-7. Occupied Bandwidth Input at 3dB above AGC Threshold – DFT-s – H-UL Polarization.

ACLRRResults



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Plot 7-8. Occupied Bandwidth Output at 3dB above AGC Threshold – DFT-s – H-UL Polarization.

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7.3 Out-of-band Rejection

Test Overview

A signal generator is set to the input port of the EUT, and the output of the EUT shall be connected to a spectrum analyzer. Per KDB 935210 D05 Section 3.3, the signal generator will sweep a CW signal to $\pm 250\%$ of the passband. Per FCC Part 20, an industrial booster shall have its 20dB bandwidth analyzed in order to assess the pass band of the booster.

Test Procedure Used

KDB 935210 D05 v01r04 – Section 3.3

Test Settings

1. Start and stop frequency of the signal generator shall be $\pm 250\%$ of the passband, for each applicable CMRS band
2. Span same as the frequency range of the signal generator
3. RBW $\geq 1\%$ to 5% of the EUT passband
4. VBW $\geq 3 \times$ RBW
5. Detector = Peak/Max Hold
6. Number of sweep points $\geq 2 \times$ Span/RBW
7. Trace mode = trace average for continuous emissions, max hold for pulse emissions
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Notes

1. The spectrum plots in this section show a CW signal sweeping across each input feed of each unit of the EUT. Per the guidance from Section 3.3 of KDB 935210 D05, the frequency range of the sweep should be from 29.65GHz to 47.35GHz [$250\% \times (39.975\text{GHz} - 37.025\text{GHz}) = 7.375\text{GHz}$ below and above lower and upper band edges, respectively].
2. In each plot, the marker “M1” is used to display the peak of the output frequency response. The “D1” and “D2” markers are provided to indicate the approximate lower and upper bounds of the 20dB bandwidth of the output frequency response.

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Band n260 – DU



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Plot 7-9. Out-Of-Band Rejection – V-UL Polarization



02:38:51 PM 08/29/2023

Plot 7-10. Out-Of-Band Rejection – H-UL Polarization

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7.4 Measuring AGC Threshold Level, Mean Output Power & Amplifier/Booster Gain

Test Overview

A signal generator supplies a 5G NR mmWave signal directly into the input port of the device. The output port of the EUT is connected to the input of a signal analyzer. The AGC threshold level is measured by output power of the EUT until a 1dB increase in the input signal power no longer causes a 1dB increase in the output signal power. The Booster Gain is measured by calculating the gain between the input and the output power of the EUT at the signal generator level just below the AGC threshold level, but not more than 0.5dB below.

Test Procedures Used

KDB 935210 D05 V01R04 – Section 3.2 - Measuring AGC threshold level

KDB 935210 D05 V01R04 – Section 3.5 - Mean output power and amplifier/booster gain

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 $\geq 3 \times$ RBW
4. Span = 2x to 3x the OBW
5. No. of sweep points $> 2 \times$ 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

Test Notes

1. Per previous guidance from FCC specifically to Element lab, a 50MHz 5G NR mmWave signal was used as the input signal as opposed to the 4.1MHz AWGN required in KDB 935210 D05.

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Band n260 – DU (DFT-s-OFDM)

Bandwidth [MHz]	Frequency [MHz]	Channel	Modulation	RB Size / Offset	EUT Input Power Level [dBm]	Conducted Power [dBm]	Output Power Step [dB]	Calculated Gain [dB]
50	38499.96	Mid	QPSK	Full RB	-48.51	11.92	-	60.43
50	38499.96	Mid	QPSK	Full RB	-47.51	12.92	1.00	60.43
50	38499.96	Mid	QPSK	Full RB	-46.51	13.88	0.96	60.39
50	38499.96	Mid	QPSK	Full RB	-45.51	14.84	0.96	60.35
50	38499.96	Mid	QPSK	Full RB	-44.51	15.76	0.92	60.27
50	38499.96	Mid	QPSK	Full RB	-43.51	16.74	0.98	60.25
50	38499.96	Mid	QPSK	Full RB	-42.51	17.70	0.96	60.21
50	38499.96	Mid	QPSK	Full RB	-41.51	18.64	0.94	60.15
50	38499.96	Mid	QPSK	Full RB	-40.51	19.55	0.91	60.06
50	38499.96	Mid	QPSK	Full RB	-39.51	20.41	0.86	59.92
50	38499.96	Mid	QPSK	Full RB	-38.51	20.18	-0.23	58.69
50	38499.96	Mid	QPSK	Full RB	-37.51	20.19	0.01	57.70
50	38499.96	Mid	QPSK	Full RB	-36.51	20.47	0.28	56.98
50	38499.96	Mid	QPSK	Full RB	-35.51	20.51	0.04	56.02
50	38499.96	Mid	QPSK	Full RB	-34.51	20.41	-0.10	54.92
50	38499.96	Mid	QPSK	Full RB	-33.51	20.40	-0.01	53.91

Table 7-3. Full RB AGC Threshold and Booster Gain – 50MHz 1CC – DFT-s – V-UL Polarization

Note: AGC Threshold is found at **-38.51dBm** EUT Input Power Level.

Bandwidth [MHz]	Frequency [MHz]	Channel	Modulation	RB Size / Offset	EUT Input Power Level [dBm]	Conducted Power [dBm]	Output Power Step [dB]	Calculated Gain [dB]
100	38499.96	Mid	QPSK	Full RB	-48.51	11.22	-	59.73
100	38499.96	Mid	QPSK	Full RB	-47.51	12.20	0.98	59.71
100	38499.96	Mid	QPSK	Full RB	-46.51	13.16	0.96	59.67
100	38499.96	Mid	QPSK	Full RB	-45.51	14.12	0.96	59.63
100	38499.96	Mid	QPSK	Full RB	-44.51	15.07	0.95	59.58
100	38499.96	Mid	QPSK	Full RB	-43.51	15.96	0.89	59.47
100	38499.96	Mid	QPSK	Full RB	-42.51	16.92	0.96	59.43
100	38499.96	Mid	QPSK	Full RB	-41.51	17.75	0.83	59.26
100	38499.96	Mid	QPSK	Full RB	-40.51	18.67	0.92	59.18
100	38499.96	Mid	QPSK	Full RB	-39.51	19.50	0.83	59.01
100	38499.96	Mid	QPSK	Full RB	-38.51	19.52	0.02	58.03
100	38499.96	Mid	QPSK	Full RB	-37.51	19.64	0.12	57.15
100	38499.96	Mid	QPSK	Full RB	-36.51	19.58	-0.06	56.09
100	38499.96	Mid	QPSK	Full RB	-35.51	19.61	0.03	55.12
100	38499.96	Mid	QPSK	Full RB	-34.51	19.55	-0.06	54.06
100	38499.96	Mid	QPSK	Full RB	-33.51	19.59	0.04	53.10

Table 7-4. Full RB AGC Threshold and Booster Gain – 100MHz 4CC – DFT-s – V-UL Polarization

Note: AGC Threshold is found at **-38.51dBm** EUT Input Power Level.

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Bandwidth [MHz]	Frequency [MHz]	Channel	Modulation	RB Size / Offset	EUT Input Power Level [dBm]	Conducted Power [dBm]	Output Power Step [dB]	Calculated Gain [dB]
50	38499.96	Mid	QPSK	Full RB	-48.51	12.41	-	60.92
50	38499.96	Mid	QPSK	Full RB	-47.51	13.39	0.98	60.90
50	38499.96	Mid	QPSK	Full RB	-46.51	14.34	0.95	60.85
50	38499.96	Mid	QPSK	Full RB	-45.51	15.30	0.96	60.81
50	38499.96	Mid	QPSK	Full RB	-44.51	16.21	0.91	60.72
50	38499.96	Mid	QPSK	Full RB	-43.51	17.19	0.98	60.70
50	38499.96	Mid	QPSK	Full RB	-42.51	18.12	0.93	60.63
50	38499.96	Mid	QPSK	Full RB	-41.51	19.01	0.89	60.52
50	38499.96	Mid	QPSK	Full RB	-40.51	19.48	0.47	59.99
50	38499.96	Mid	QPSK	Full RB	-39.51	19.82	0.34	59.33
50	38499.96	Mid	QPSK	Full RB	-38.51	19.57	-0.25	58.08
50	38499.96	Mid	QPSK	Full RB	-37.51	19.82	0.25	57.33
50	38499.96	Mid	QPSK	Full RB	-36.51	19.85	0.03	56.36
50	38499.96	Mid	QPSK	Full RB	-35.51	19.82	-0.03	55.33
50	38499.96	Mid	QPSK	Full RB	-34.51	19.81	-0.01	54.32
50	38499.96	Mid	QPSK	Full RB	-33.51	19.82	0.01	53.33

Table 7-5. Full RB AGC Threshold and Booster Gain – 50MHz 1CC– DFT-s – H-UL Polarization

Note: AGC Threshold is found at **-40.51dBm** EUT Input Power Level.

Bandwidth [MHz]	Frequency [MHz]	Channel	Modulation	RB Size / Offset	EUT Input Power Level [dBm]	Conducted Power [dBm]	Output Power Step [dB]	Calculated Gain [dB]
100	38499.96	Mid	QPSK	Full RB	-48.51	12.29	-	60.80
100	38499.96	Mid	QPSK	Full RB	-47.51	13.13	0.84	60.64
100	38499.96	Mid	QPSK	Full RB	-46.51	13.98	0.85	60.49
100	38499.96	Mid	QPSK	Full RB	-45.51	14.99	1.01	60.50
100	38499.96	Mid	QPSK	Full RB	-44.51	15.95	0.96	60.46
100	38499.96	Mid	QPSK	Full RB	-43.51	16.83	0.88	60.34
100	38499.96	Mid	QPSK	Full RB	-42.51	17.73	0.90	60.24
100	38499.96	Mid	QPSK	Full RB	-41.51	18.55	0.82	60.06
100	38499.96	Mid	QPSK	Full RB	-40.51	19.02	0.47	59.53
100	38499.96	Mid	QPSK	Full RB	-39.51	19.04	0.02	58.55
100	38499.96	Mid	QPSK	Full RB	-38.51	19.01	-0.03	57.52
100	38499.96	Mid	QPSK	Full RB	-37.51	18.98	-0.03	56.49
100	38499.96	Mid	QPSK	Full RB	-36.51	18.97	-0.01	55.48
100	38499.96	Mid	QPSK	Full RB	-35.51	19.01	0.04	54.52
100	38499.96	Mid	QPSK	Full RB	-34.51	18.98	-0.03	53.49
100	38499.96	Mid	QPSK	Full RB	-33.51	18.99	0.01	52.50

Table 7-6. Full RB AGC Threshold and Booster Gain – 100MHz 4CC – DFT-s – H-UL Polarization

Note: AGC Threshold is found at **-40.51dBm** EUT Input Power Level.

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7.5 Occupied Bandwidth

Test Overview

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers measured are each equal to 0.5 percent of the total mean power measured for a given emission. 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 $\geq 3 \times$ 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

Test Notes

1. The OBW was measured for multiple transmission schemes and modulations and the worst case results have been included in the report.
2. The plots shown in this section include the appropriate offsets to correct for the frequency-dependent cable loss of the coaxial cable that connects the output port of the EUT to the spectrum analyzer.

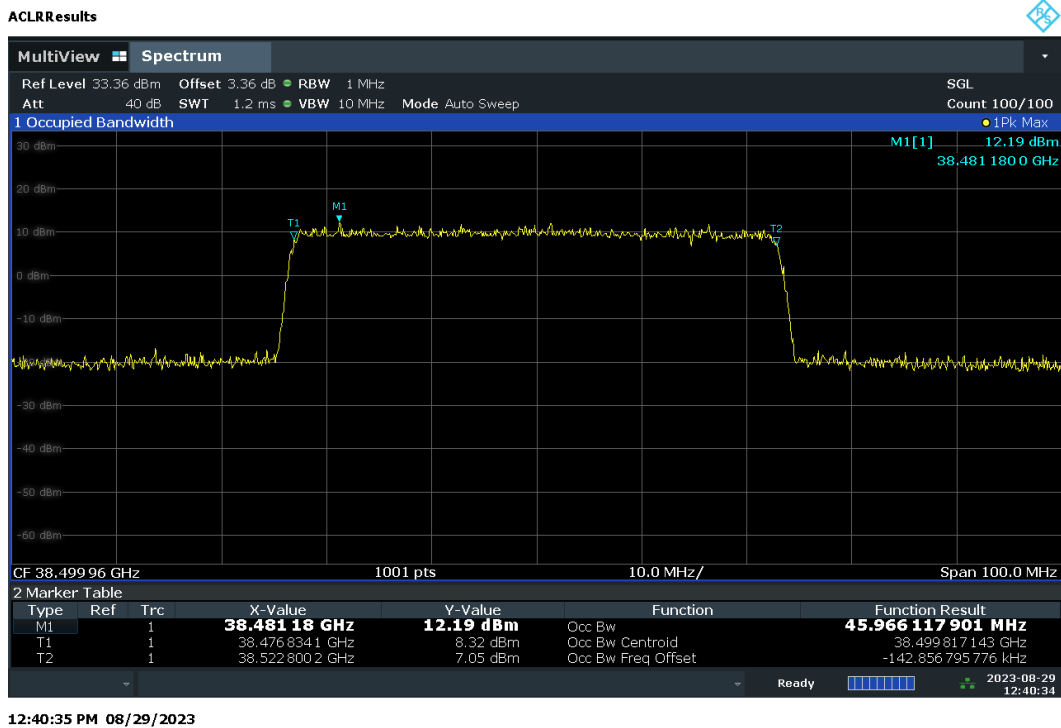
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Band n260 – DU (DFT-s-OFDM)

Antenna	Bandwidth [MHz]	CCs Active	Transmission Scheme	Modulation	OBW [MHz]
V_UL	50	1	DFT-s-OFDM	QPSK	45.97
			DFT-s-OFDM	16QAM	46.03
		2	DFT-s-OFDM	QPSK	96.00
			DFT-s-OFDM	16QAM	95.93
	100	4	DFT-s-OFDM	QPSK	393.51
			DFT-s-OFDM	16QAM	392.30
H_UL	50	1	DFT-s-OFDM	QPSK	46.03
			DFT-s-OFDM	16QAM	46.06
		2	DFT-s-OFDM	QPSK	96.21
			DFT-s-OFDM	16QAM	96.11
	100	4	DFT-s-OFDM	QPSK	393.15
			DFT-s-OFDM	16QAM	392.64

Table 7-7. Summary of DU Occupied Bandwidths – DFT-s-OFDM

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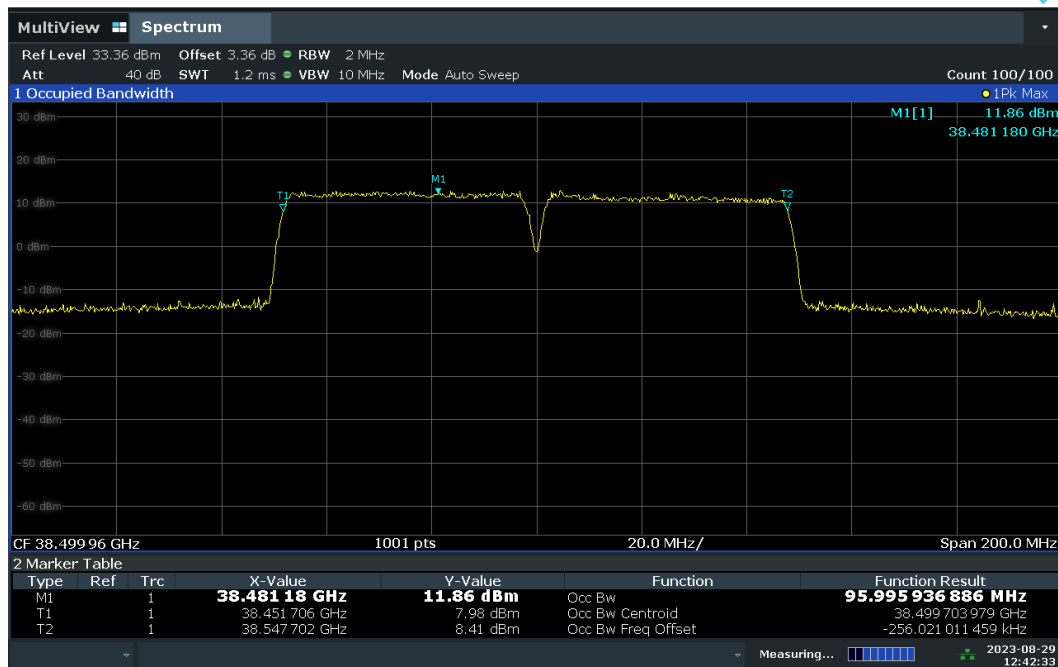
Plot 7-11. Occupied Bandwidth Plot – DFT-s – V-UL Polarization (50MHz-1CC – QPSK – Mid Channel)



Plot 7-12. Occupied Bandwidth Plot – DFT-s – V-UL Polarization (50MHz-1CC – 16QAM – Mid Channel)

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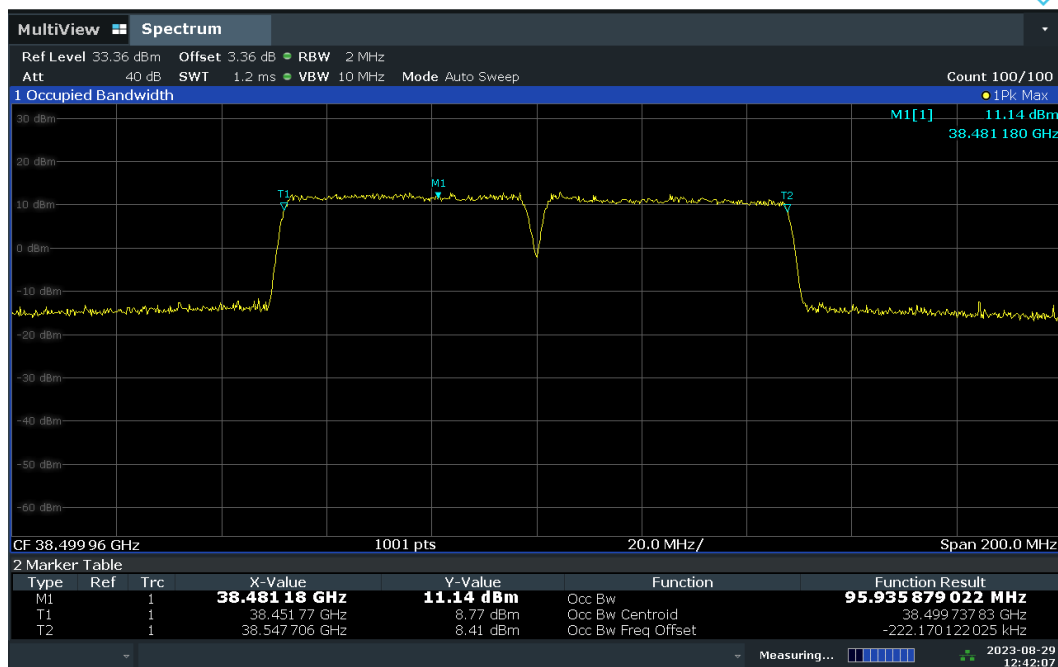
ACLRRResults



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Plot 7-13. Occupied Bandwidth Plot – DFT-s – V-UL Polarization (50MHz-2CC – QPSK – Mid Channel)

ACLRRResults



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Plot 7-14. Occupied Bandwidth Plot – DFT-s – V-UL Polarization (50MHz-2CC – 16QAM – Mid Channel)

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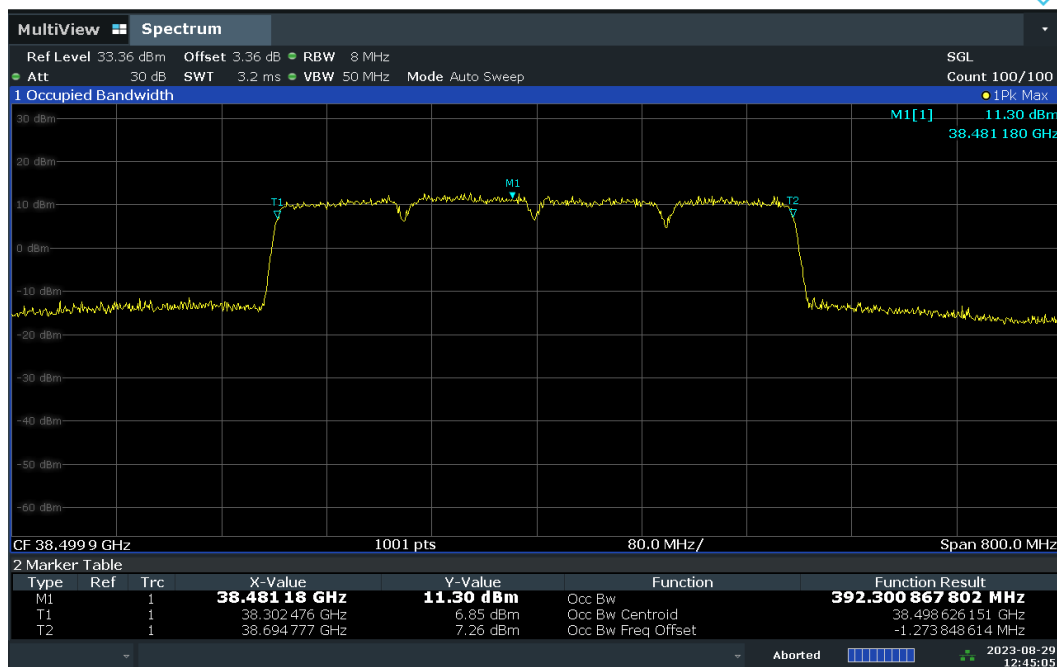
ACLRResults



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Plot 7-15. Occupied Bandwidth Plot – DFT-s – V-UL Polarization (100MHz-4CC – QPSK – Mid Channel)

ACLRResults



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Plot 7-16. Occupied Bandwidth Plot – DFT-s – V-UL Polarization (100MHz-4CC – 16QAM – Mid Channel)

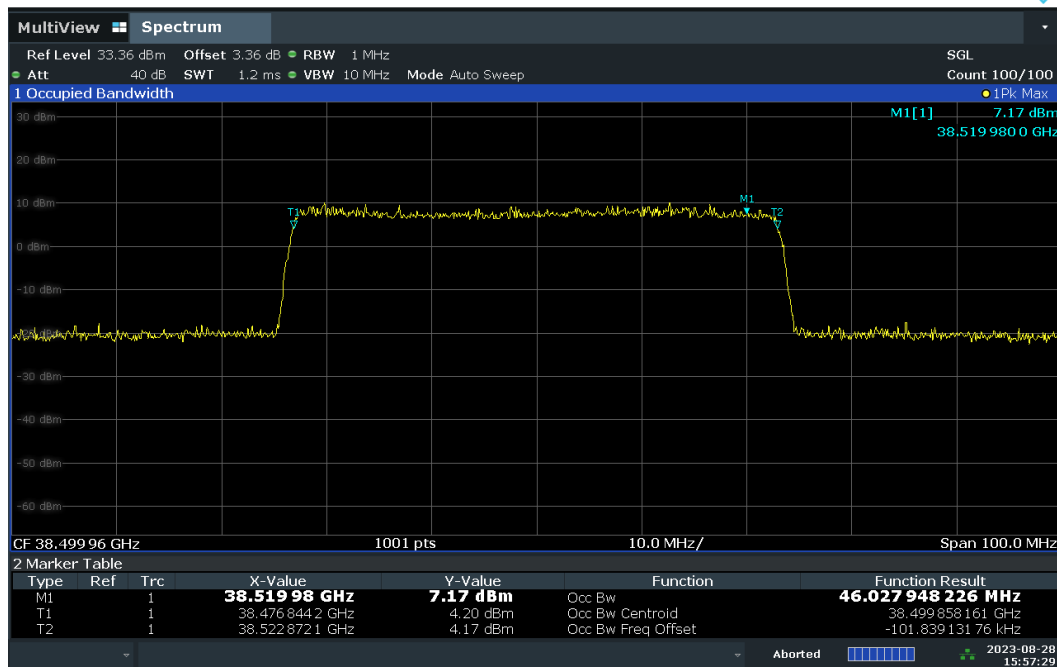
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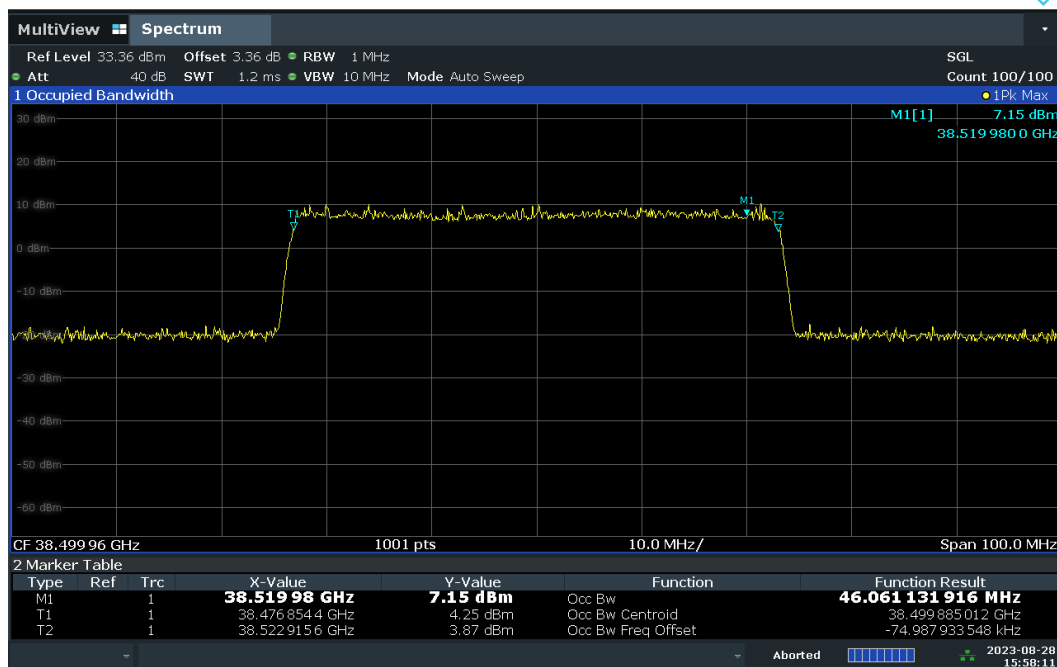
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Plot 7-17. Occupied Bandwidth Plot – DFT-s – H-UL Polarization (50MHz-1CC – QPSK – Mid Channel)

ACLRResults



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Plot 7-18. Occupied Bandwidth Plot – DFT-s – H-UL Polarization (50MHz-1CC – 16QAM – Mid Channel)

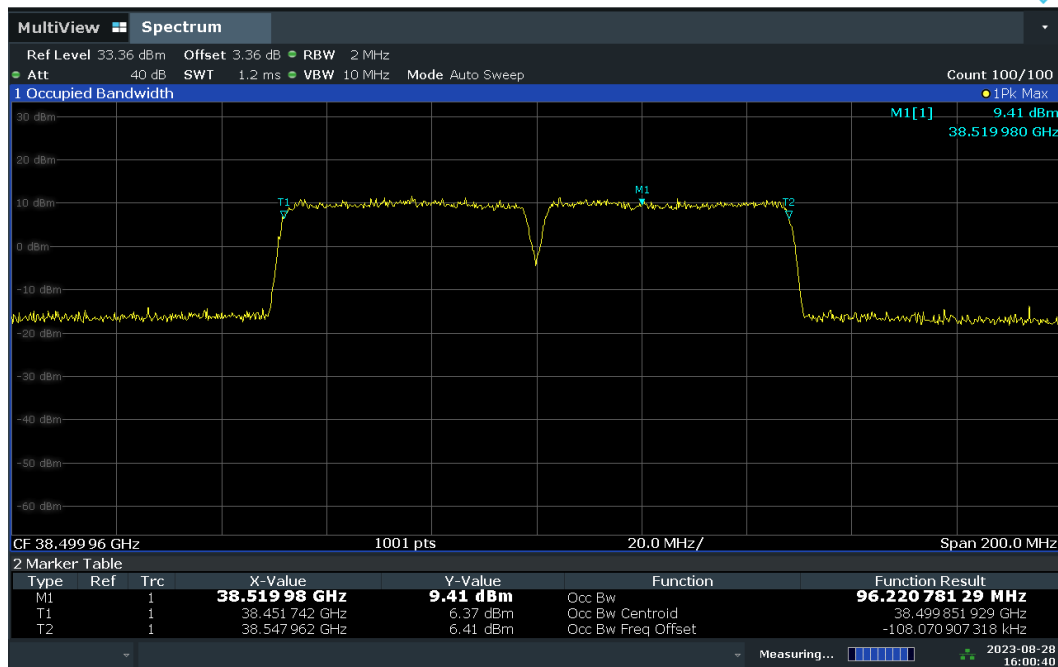
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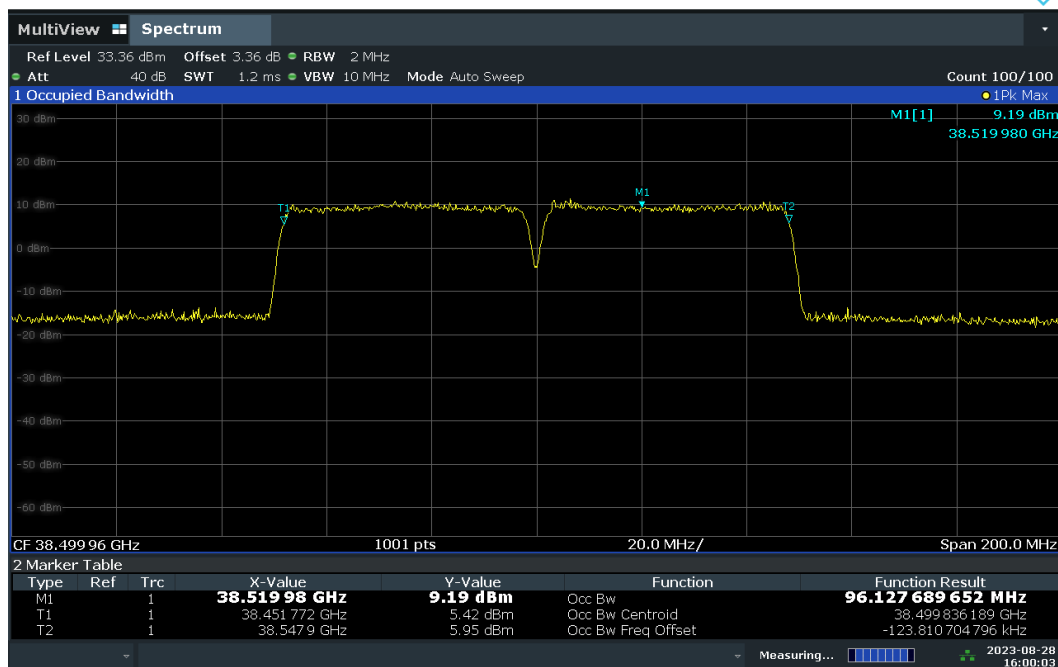
ACLRResults



04:00:42 PM 08/28/2023

Plot 7-19. Occupied Bandwidth Plot – DFT-s – H-UL Polarization (50MHz-2CC – QPSK – Mid Channel)

ACLRResults



04:00:03 PM 08/28/2023

Plot 7-20. Occupied Bandwidth Plot – DFT-s – H-UL Polarization (50MHz-2CC – 16QAM – Mid Channel)

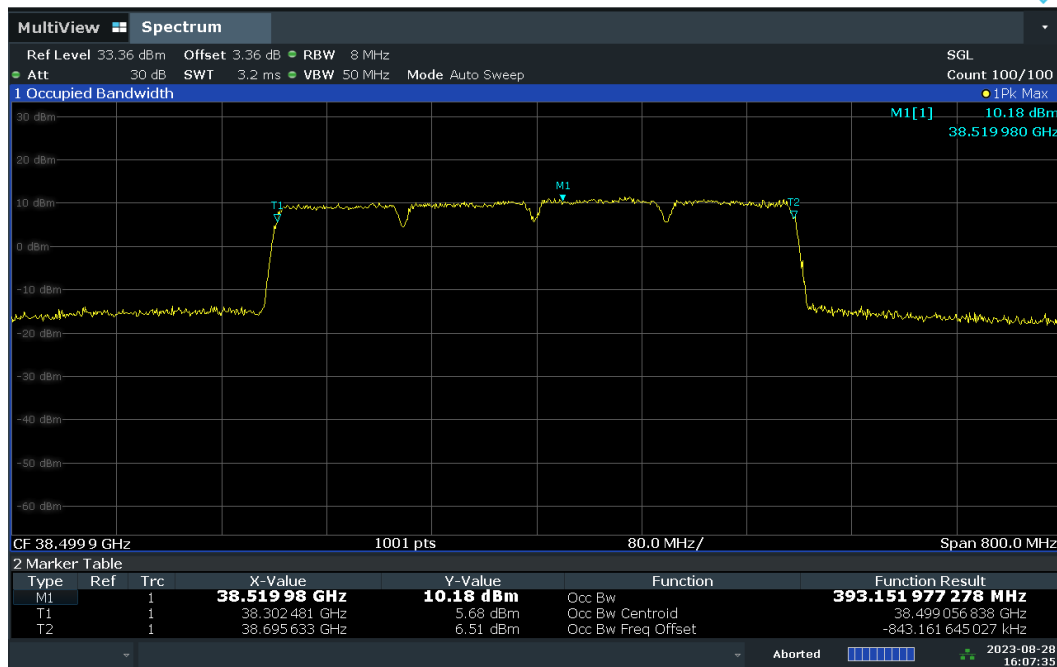
FCC ID: 2AUUU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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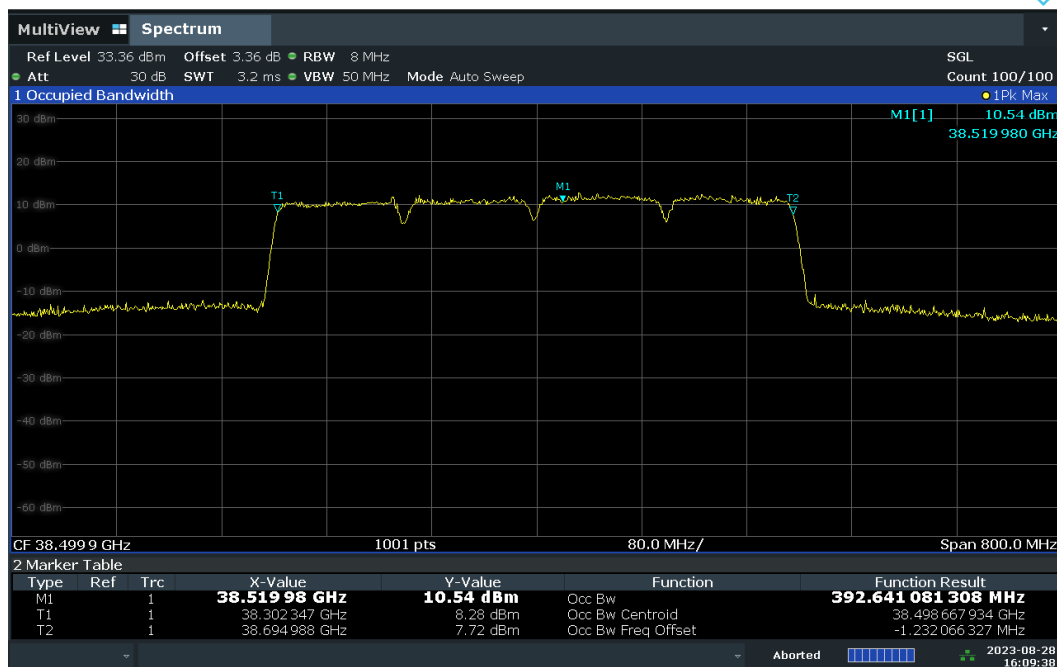
ACLRResults



04:07:36 PM 08/28/2023

Plot 7-21. Occupied Bandwidth Plot – DFT-s – H-UL Polarization (100MHz-4CC – QPSK – Mid Channel)

ACLRResults



04:09:39 PM 08/28/2023

Plot 7-22. Occupied Bandwidth Plot – DFT-s – H-UL Polarization (100MHz-4CC – 16QAM – Mid Channel)

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7.6 Conducted Power & Equivalent Isotropic Radiated Power

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 the appropriate frequencies with the max power condition as specified by the AGC software of the EUT. The Equivalent Isotropic Radiated Power (EIRP) is then calculated using these conducted power measurements.

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. Conducted power measurements are performed using the signal analyzer's "channel power" measurement capability.
2. For pulsed signals, triggering was set to enable measurements only during full power bursts, with the sweep time set less than or equal to the transmission burst duration. For continuously transmitted signals, triggering was set to Free Run.
3. RBW = 1 – 5% of the expected OBW, not to exceed 1MHz
4. VBW $\geq 3 \times$ RBW
5. Span = 2x to 3x the OBW
6. No. of sweep points $\geq 2 \times$ span / RBW
7. Detector = RMS
8. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation.
9. Trace mode = trace averaging (RMS) over 100 sweeps
10. The trace was allowed to stabilize.

Test Notes

- 1) The EUT was tested with all possible input signal configurations. The worst case emissions are reported with the regards to modulations, RB sizes and offsets, and channel bandwidth configurations as shown in the tables below. It was determined that full RB allocations provided the worst case results.
- 2) As the SU is only designed to boost 5G NR downlink signals, its power levels were only investigated with CP-OFDM transmission schemes. The power levels of the DU, which is designed to boost 5G NR uplink signals, were investigated with DFT-s-OFDM transmission schemes.
- 3) The input signal to the EUT was set in order to produce the maximum power allowed by the AGC software of the EUT.
- 4) The MIMO Conducted Powers 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 spectra were summed linearly and converted to dBm for comparison with the limit.

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- 5) The MIMO Conducted Powers shown in the tables in this section are the mathematical summations (in linear units) of the measured conducted powers of the horizontally polarized and vertically polarized antenna feeds of an individual unit (i.e either the SU or DU).
- 6) The single-polarization EIRP levels shown in the tables in this section are the mathematical summations (in logarithmic units) of the corresponding single-polarization conducted powers and the gain of the transmit antenna for that polarization.
- 7) Per the guidance of ANSI C63.26-2015 Section 6.4.5.3.3(a) for cross-polarized antennas, the MIMO EIRP levels shown in the tables in this section are the mathematical summations (in logarithmic units) of the corresponding MIMO conducted powers and the gain of an individual transmit antenna.
- 8) The gain of the transmit antenna for each unit is provided by the manufacturer.
- 9) The conducted power plots shown in this section include the appropriate offsets to correct for the frequency-dependent cable loss of the coaxial cable that connects the output port of the EUT to the spectrum analyzer.

Sample Conducted MIMO Calculation:

Antenna 1 + Antenna 2 = MIMO

$$(19.39\text{dBm} + 19.33\text{dBm}) = (86.90\text{mW} + 85.70\text{mW}) = 172.60\text{mW} = 22.37\text{dBm}$$

Sample EIRP Calculation:

Conducted Power + Antenna Gain = EIRP

$$22.37\text{dBm} + 22.0\text{dBi} = 44.37\text{dBm}$$

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Band n260 – DU (DFT-s-OFDM)

Channel	Center Frequency [MHz]	Ant. Pol.	Transmission Scheme	Modulation	Bandwidth [MHz]	# of Carriers (CCs)	RB Size/Offset	Conducted Power [dBm]	Tx Ant Gain [dBi]	EIRP [dBm]
Low	37025.04	V-UL	DFT-s-OFDM	QPSK	50	1	Full	19.39	22.0	41.39
Low	37025.04	V-UL	DFT-s-OFDM	QPSK	50	1	1/16	16.31	22.0	38.31
Low	37025.04	V-UL	DFT-s-OFDM	16-QAM	50	1	Full	19.14	22.0	41.14
Mid	38499.96	V-UL	DFT-s-OFDM	QPSK	50	1	Full	19.11	22.0	41.11
Mid	38499.96	V-UL	DFT-s-OFDM	QPSK	50	1	1/16	15.62	22.0	37.62
Mid	38499.96	V-UL	DFT-s-OFDM	16-QAM	50	1	Full	18.30	22.0	40.30
High	39975.00	V-UL	DFT-s-OFDM	QPSK	50	1	Full	19.74	22.0	41.74
High	39975.00	V-UL	DFT-s-OFDM	QPSK	50	1	1/16	15.73	22.0	37.73
High	39975.00	V-UL	DFT-s-OFDM	16-QAM	50	1	Full	18.92	22.0	40.92
Low	37199.94	V-UL	DFT-s-OFDM	QPSK	100	4	Full	19.65	22.0	41.65
Low	37199.94	V-UL	DFT-s-OFDM	QPSK	100	4	1/33	18.79	22.0	40.79
Low	37199.94	V-UL	DFT-s-OFDM	16-QAM	100	4	Full	19.42	22.0	41.42
Mid	38500.02	V-UL	DFT-s-OFDM	QPSK	100	4	Full	19.34	22.0	41.34
Mid	38500.02	V-UL	DFT-s-OFDM	QPSK	100	4	1/33	17.24	22.0	39.24
Mid	38500.02	V-UL	DFT-s-OFDM	16-QAM	100	4	Full	18.46	22.0	40.46
High	39799.98	V-UL	DFT-s-OFDM	QPSK	100	4	Full	19.00	22.0	41.00
High	39799.98	V-UL	DFT-s-OFDM	QPSK	100	4	1/33	17.94	22.0	39.94
High	39799.98	V-UL	DFT-s-OFDM	16-QAM	100	4	Full	18.86	22.0	40.86

Table 7-8. NR Band n260 - Conducted Power and EIRP – DFT-s – V-UL Polarization

Channel	Center Frequency [MHz]	Ant. Pol.	Transmission Scheme	Modulation	Bandwidth [MHz]	# of Carriers (CCs)	RB Size/Offset	Conducted Power [dBm]	Tx Ant Gain [dBi]	EIRP [dBm]
Low	37025.04	H-UL	DFT-s-OFDM	QPSK	50	1	Full	19.33	22.0	41.33
Low	37025.04	H-UL	DFT-s-OFDM	QPSK	50	1	1/16	15.36	22.0	37.36
Low	37025.04	H-UL	DFT-s-OFDM	16-QAM	50	1	Full	18.57	22.0	40.57
Mid	38499.96	H-UL	DFT-s-OFDM	QPSK	50	1	Full	18.78	22.0	40.78
Mid	38499.96	H-UL	DFT-s-OFDM	QPSK	50	1	1/16	15.77	22.0	37.77
Mid	38499.96	H-UL	DFT-s-OFDM	16-QAM	50	1	Full	18.01	22.0	40.01
High	39975.00	H-UL	DFT-s-OFDM	QPSK	50	1	Full	19.06	22.0	41.06
High	39975.00	H-UL	DFT-s-OFDM	QPSK	50	1	1/16	15.81	22.0	37.81
High	39975.00	H-UL	DFT-s-OFDM	16-QAM	50	1	Full	18.36	22.0	40.36
Low	37199.94	H-UL	DFT-s-OFDM	QPSK	100	4	Full	19.29	22.0	41.29
Low	37199.94	H-UL	DFT-s-OFDM	QPSK	100	4	1/33	15.96	22.0	37.96
Low	37199.94	H-UL	DFT-s-OFDM	16-QAM	100	4	Full	18.17	22.0	40.17
Mid	38500.02	H-UL	DFT-s-OFDM	QPSK	100	4	Full	18.75	22.0	40.75
Mid	38500.02	H-UL	DFT-s-OFDM	QPSK	100	4	1/33	16.33	22.0	38.33
Mid	38500.02	H-UL	DFT-s-OFDM	16-QAM	100	4	Full	17.63	22.0	39.63
High	39799.98	H-UL	DFT-s-OFDM	QPSK	100	4	Full	18.73	22.0	40.73
High	39799.98	H-UL	DFT-s-OFDM	QPSK	100	4	1/33	17.02	22.0	39.02
High	39799.98	H-UL	DFT-s-OFDM	16-QAM	100	4	Full	18.51	22.0	40.51

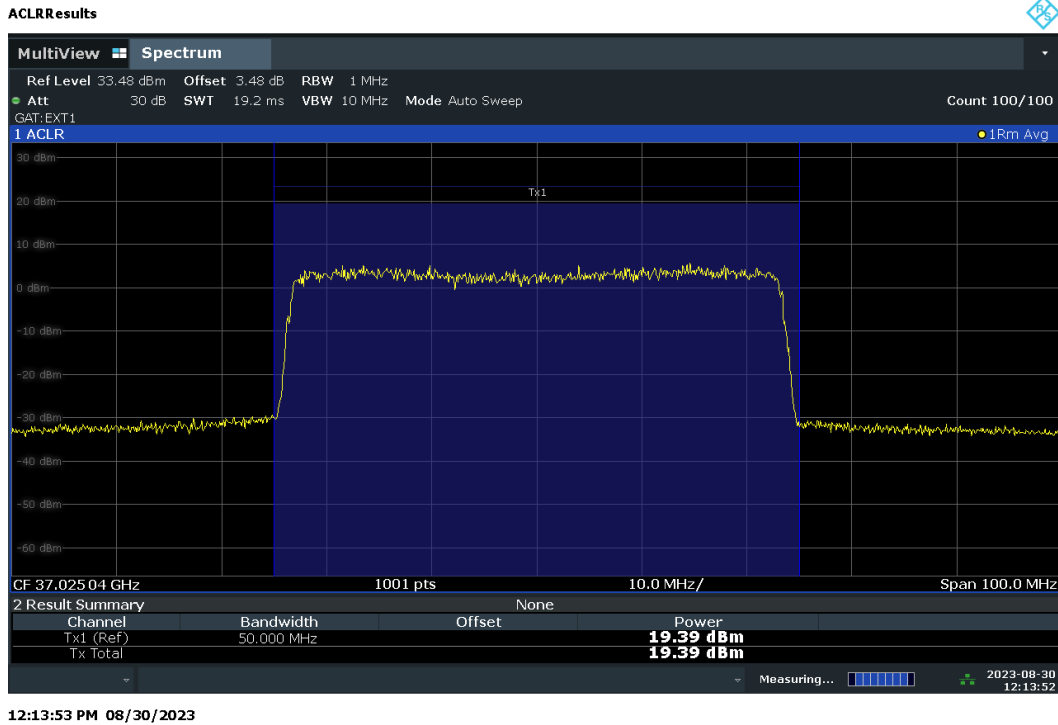
Table 7-9. NR Band n260 - Conducted Power and EIRP – DFT-s – H-UL Polarization

Channel	Center Frequency [MHz]	Ant. Pol.	Transmission Scheme	Modulation	Bandwidth [MHz]	# of Carriers (CCs)	RB Size/Offset	Conducted Power [dBm]	Tx Ant Gain [dBi]	EIRP [dBm]
Low	37025.04	MIMO	DFT-s-OFDM	QPSK	50	1	Full	22.37	22.0	44.37
Low	37025.04	MIMO	DFT-s-OFDM	QPSK	50	1	1/16	18.87	22.0	40.87
Low	37025.04	MIMO	DFT-s-OFDM	16-QAM	50	1	Full	21.87	22.0	43.87
Mid	38499.96	MIMO	DFT-s-OFDM	QPSK	50	1	Full	21.96	22.0	43.96
Mid	38499.96	MIMO	DFT-s-OFDM	QPSK	50	1	1/16	18.71	22.0	40.71
Mid	38499.96	MIMO	DFT-s-OFDM	16-QAM	50	1	Full	21.17	22.0	43.17
High	39975.00	MIMO	DFT-s-OFDM	QPSK	50	1	Full	22.42	22.0	44.42
High	39975.00	MIMO	DFT-s-OFDM	QPSK	50	1	1/16	18.78	22.0	40.78
High	39975.00	MIMO	DFT-s-OFDM	16-QAM	50	1	Full	21.66	22.0	43.66
Low	37199.94	MIMO	DFT-s-OFDM	QPSK	100	4	Full	22.48	22.0	44.48
Low	37199.94	MIMO	DFT-s-OFDM	QPSK	100	4	1/33	20.61	22.0	42.61
Low	37199.94	MIMO	DFT-s-OFDM	16-QAM	100	4	Full	21.85	22.0	43.85
Mid	38500.02	MIMO	DFT-s-OFDM	QPSK	100	4	Full	22.07	22.0	44.07
Mid	38500.02	MIMO	DFT-s-OFDM	QPSK	100	4	1/33	19.82	22.0	41.82
Mid	38500.02	MIMO	DFT-s-OFDM	16-QAM	100	4	Full	21.08	22.0	43.08
High	39799.98	MIMO	DFT-s-OFDM	QPSK	100	4	Full	21.88	22.0	43.88
High	39799.98	MIMO	DFT-s-OFDM	QPSK	100	4	1/33	20.51	22.0	42.51
High	39799.98	MIMO	DFT-s-OFDM	16-QAM	100	4	Full	21.70	22.0	43.70

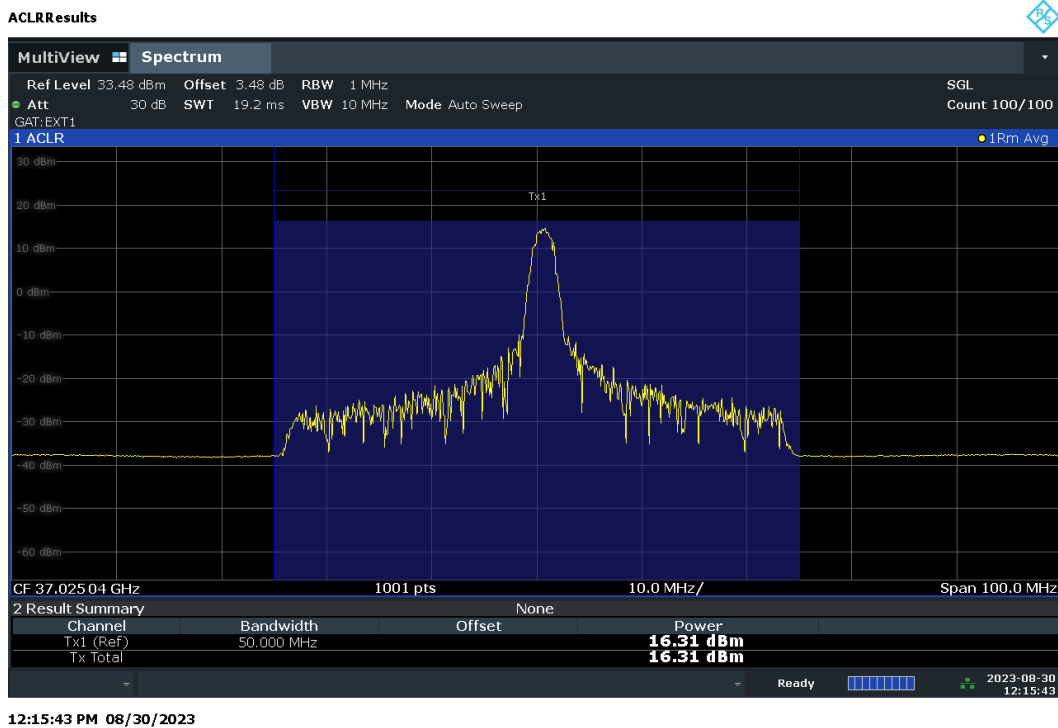
Table 7-10. NR Band n260 - Conducted Power – DFT-s – MIMO

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V-UL Polarization



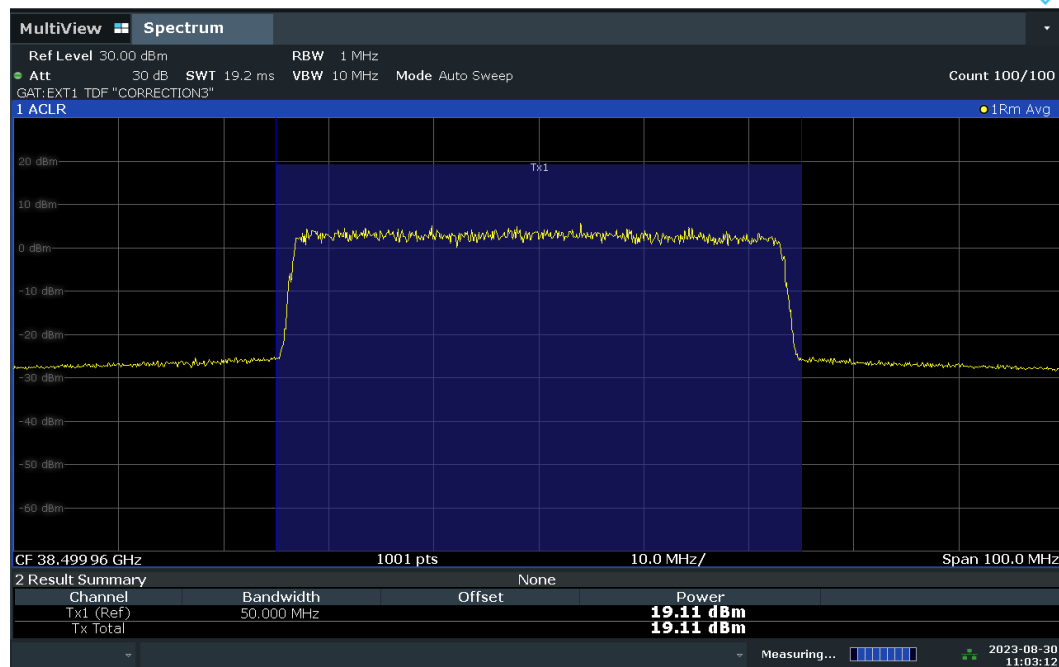
Plot 7-23. Conducted Power Plot – DFT-S – V-UL Polarization (50MHz-1CC – QPSK – Low Ch. – Full RB)



Plot 7-24. Conducted Power Plot – DFT-S – V-UL Polarization (50MHz-1CC – QPSK – Low Ch. – 1RB)

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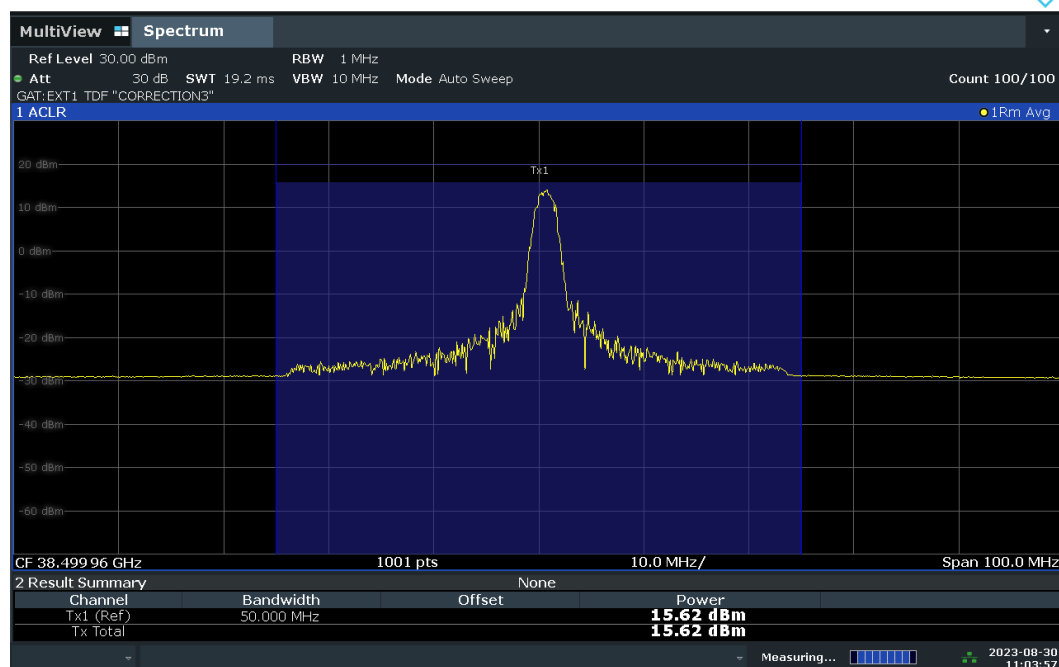
ACLRRResults



11:03:12 AM 08/30/2023

Plot 7-25. Conducted Power Plot – DFT-S – V-UL Polarization (50MHz-1CC – QPSK – Mid Ch. – Full RB)

ACLRRResults



11:03:58 AM 08/30/2023

Plot 7-26. Conducted Power Plot – DFT-S – V-UL Polarization (50MHz-1CC – QPSK – Mid Ch. – 1 RB)

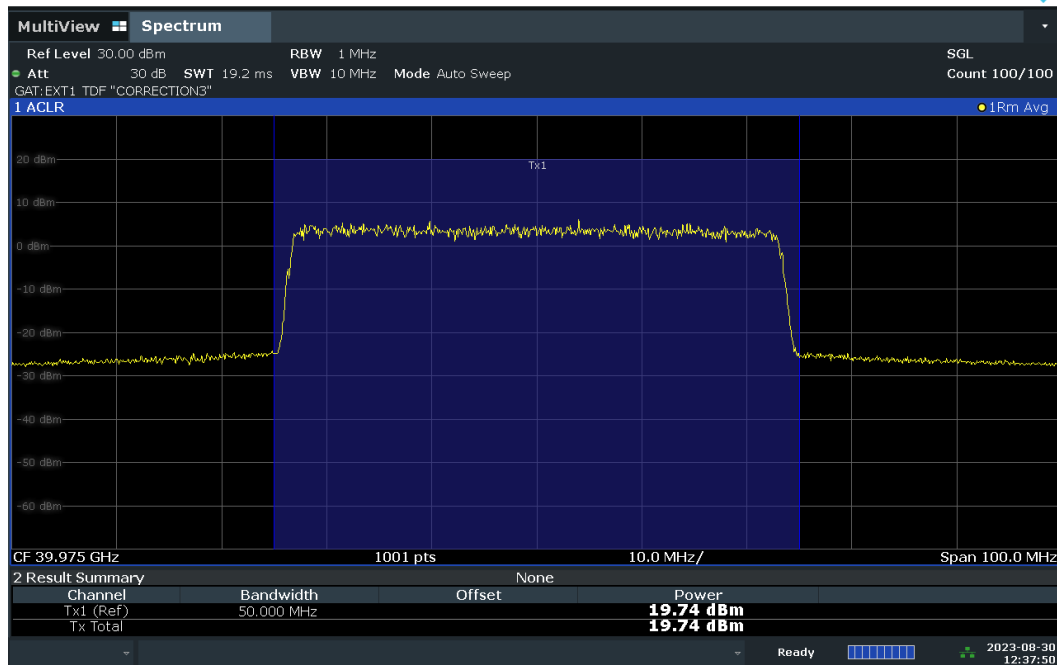
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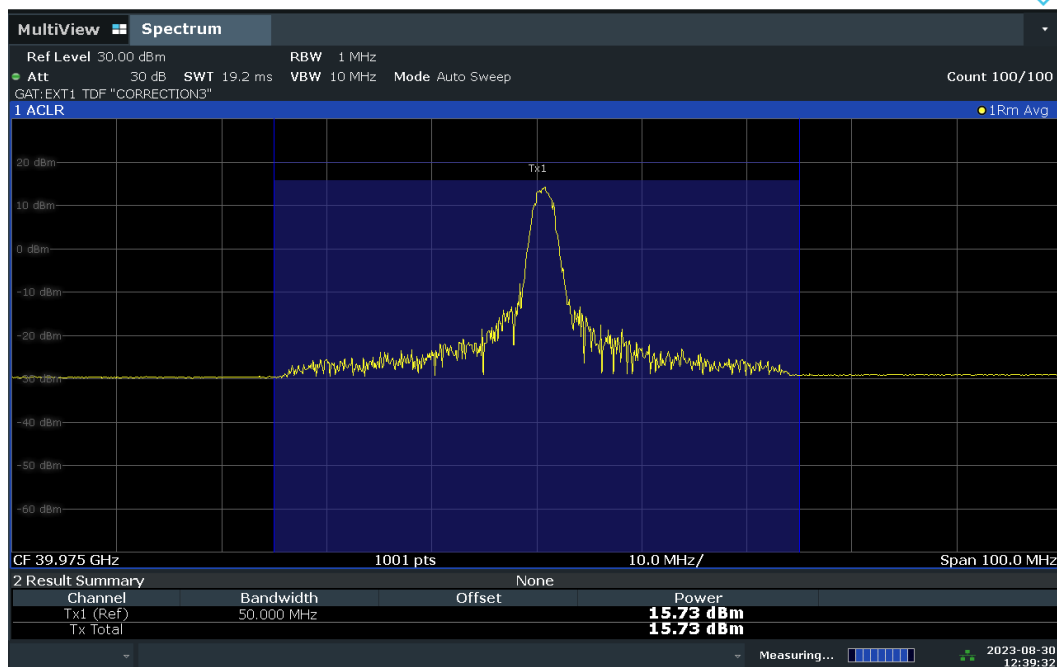
ACLRRResults



12:37:50 PM 08/30/2023

Plot 7-27. Conducted Power Plot – DFT-S – V-UL Polarization (50MHz-1CC – QPSK – High Ch. – Full RB)

ACLRRResults



12:39:33 PM 08/30/2023

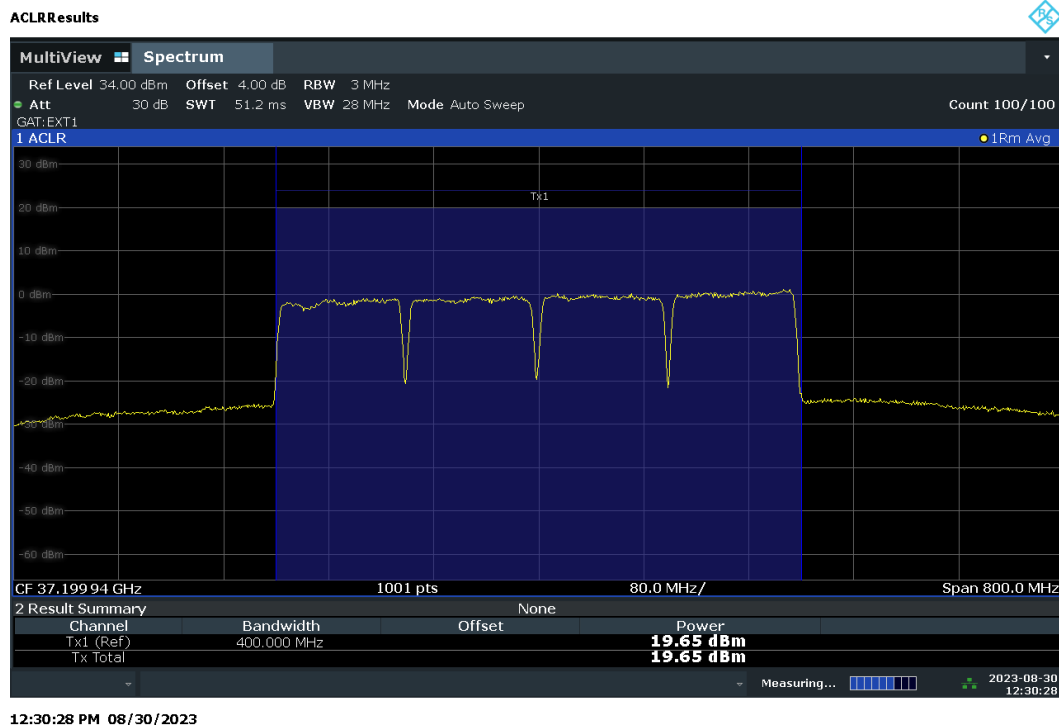
Plot 7-28. Conducted Power Plot – DFT-S – V-UL Polarization (50MHz-1CC – QPSK – High Ch. – 1 RB)

FCC ID: 2AUUU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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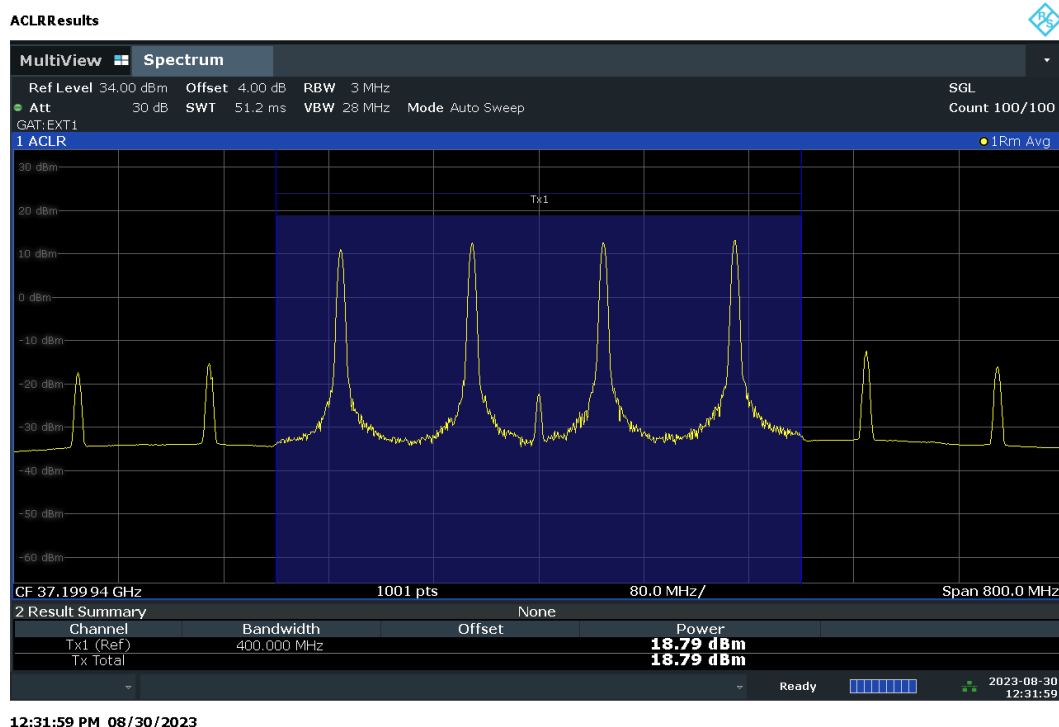
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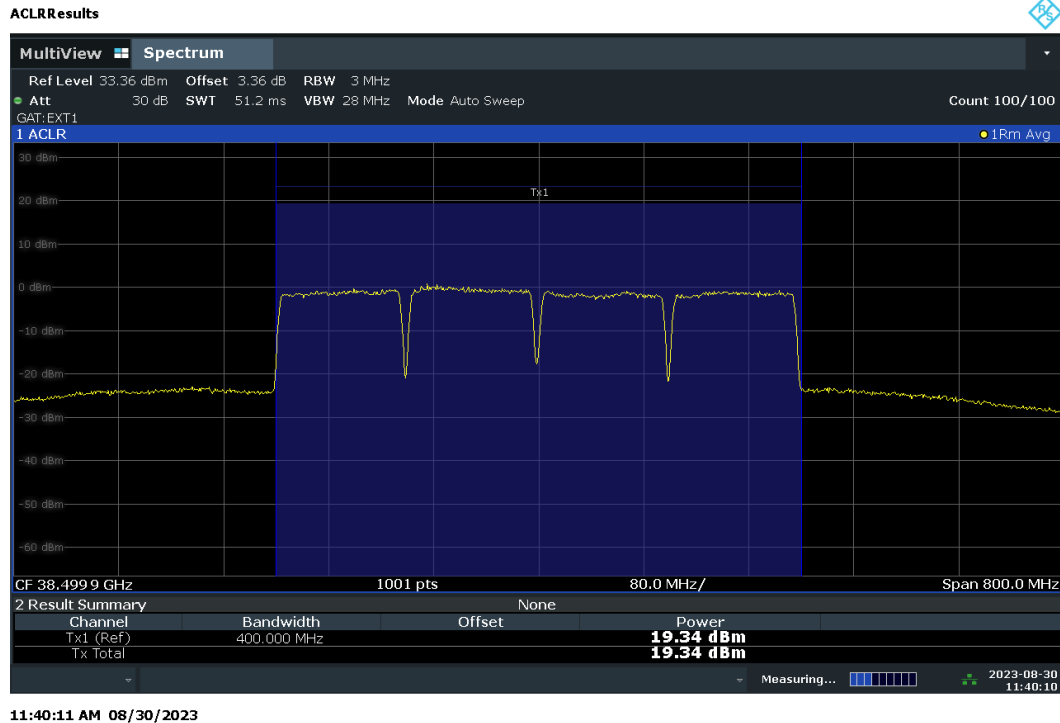


Plot 7-29. Conducted Power Plot – DFT-S – V-UL Polarization (100MHz-4CC – QPSK – Low Ch. – Full RB)

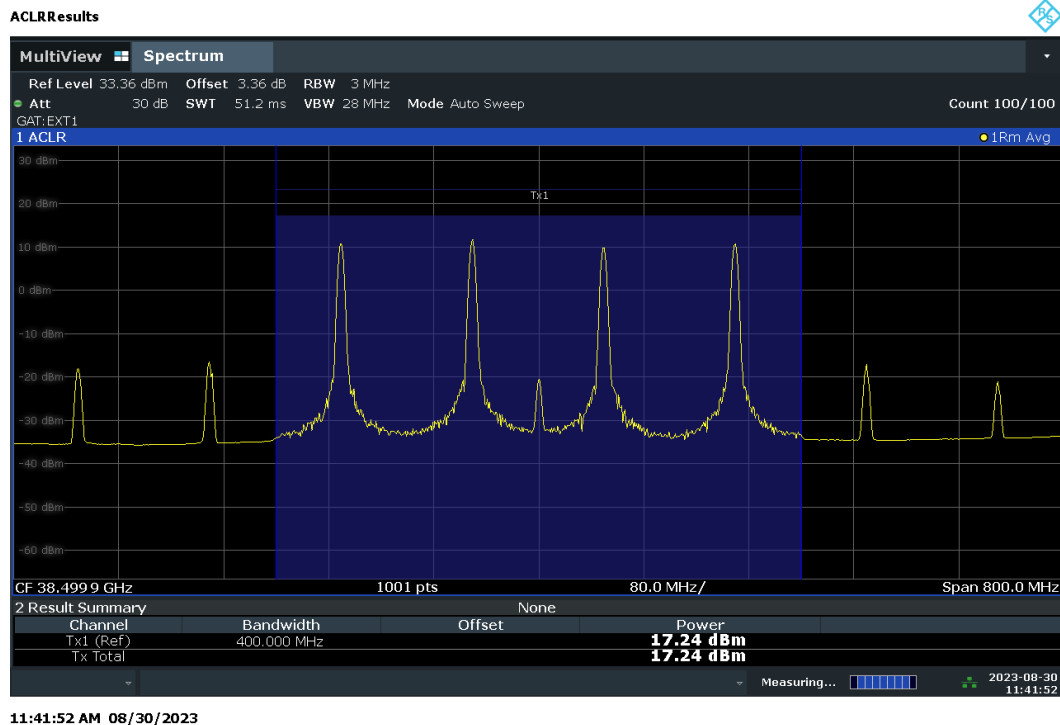


Plot 7-30. Conducted Power Plot – DFT-S – V-UL Polarization (100MHz-4CC – QPSK – Low Ch. – 1RB)

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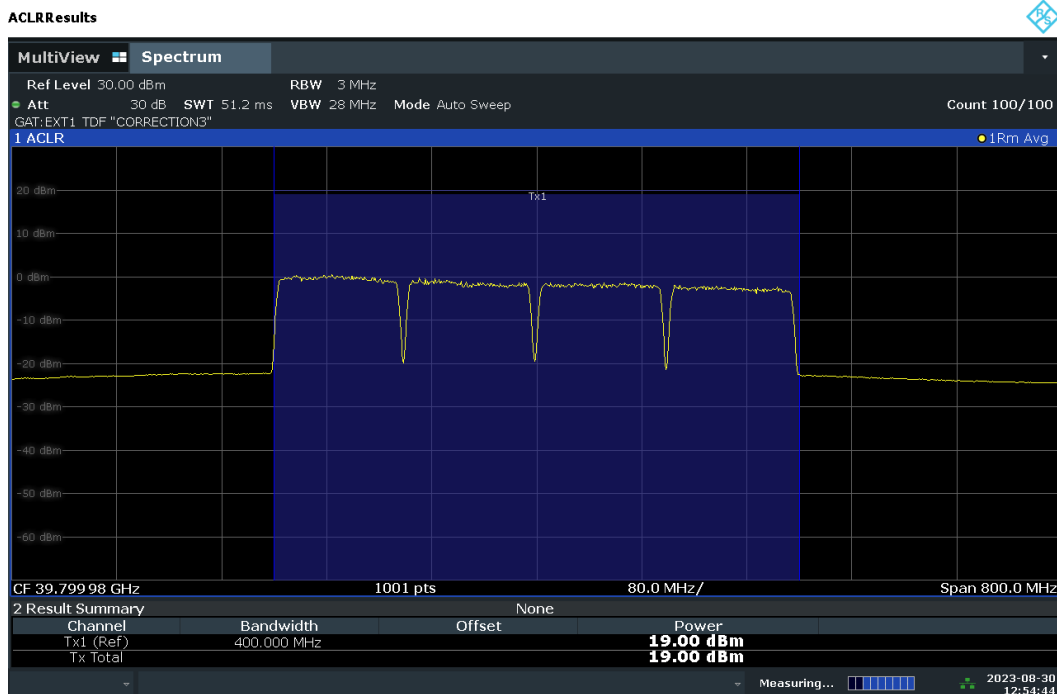


Plot 7-31. Conducted Power Plot – DFT-S – V-UL Polarization (100MHz-4CC – QPSK – Mid Ch. – Full RB)



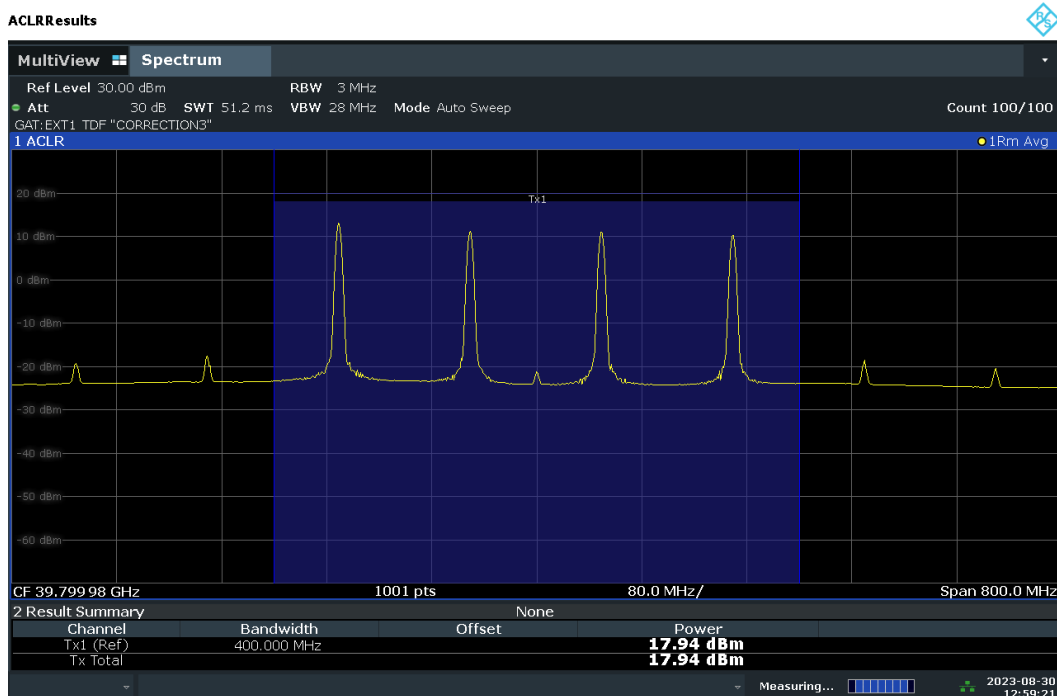
Plot 7-32. Conducted Power Plot – DFT-S – V-UL Polarization (100MHz-4CC – QPSK – Mid Ch. – 1 RB)

FCC ID: 2AUUU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Plot 7-33. Conducted Power Plot – DFT-S – V-UL Polarization (100MHz-4CC – QPSK – High Ch. – Full RB)

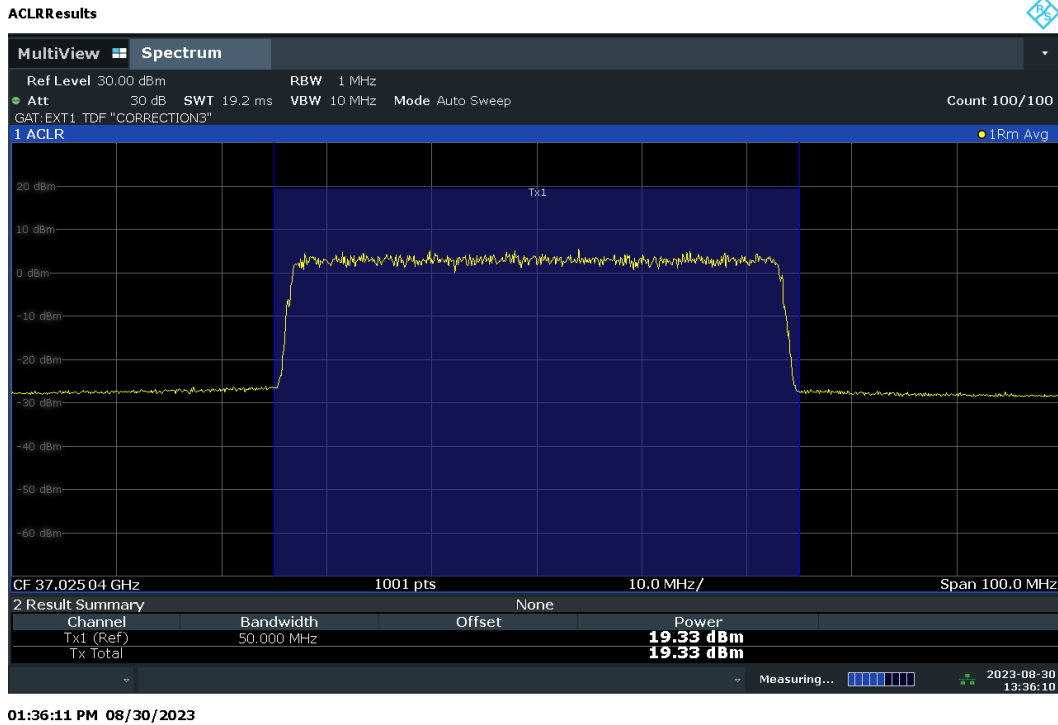


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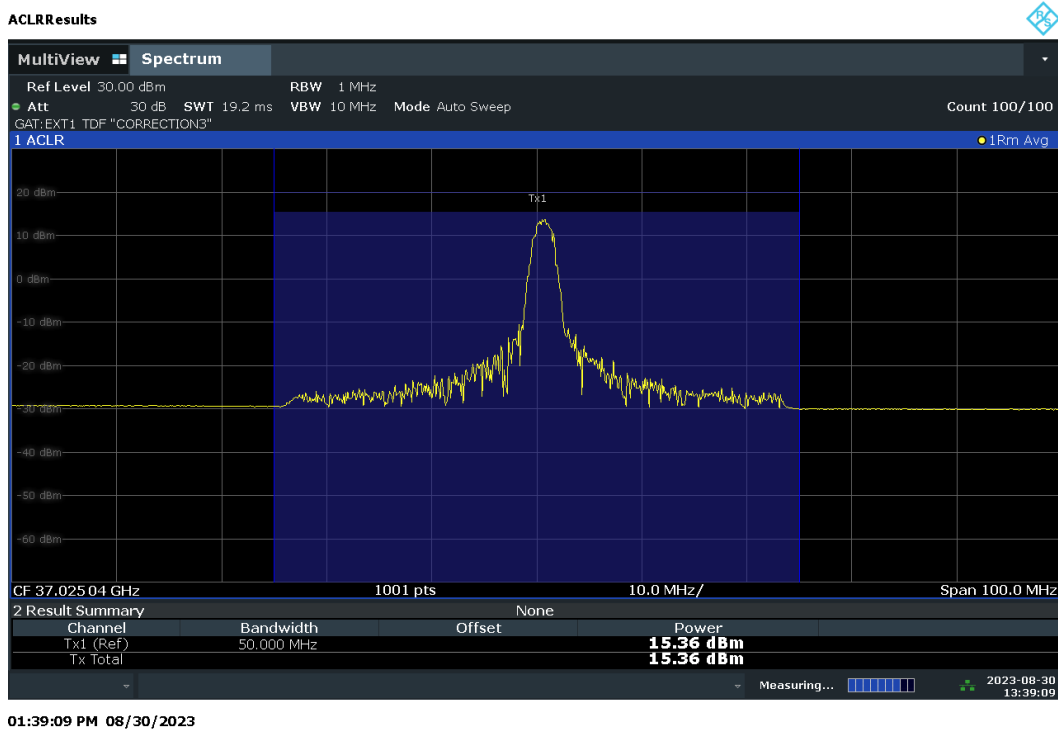
Plot 7-34. Conducted Power Plot – DFT-S – V-UL Polarization (100MHz-4CC – QPSK – High Ch. – 1 RB)

FCC ID: 2AUUVU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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H-UL Polarization



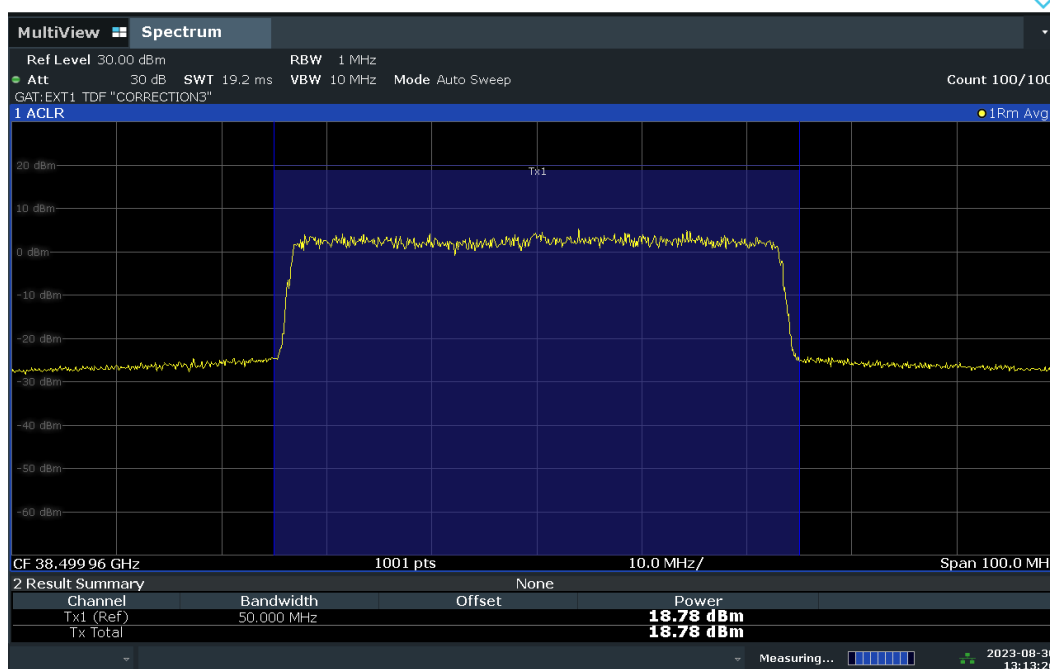
Plot 7-35. Conducted Power Plot – DFT-S – H-UL Polarization (50MHz-1CC – QPSK – Low Ch. – Full RB)



Plot 7-36. Conducted Power Plot – DFT-S – H-UL Polarization (50MHz-1CC – QPSK – Low Ch. – 1RB)

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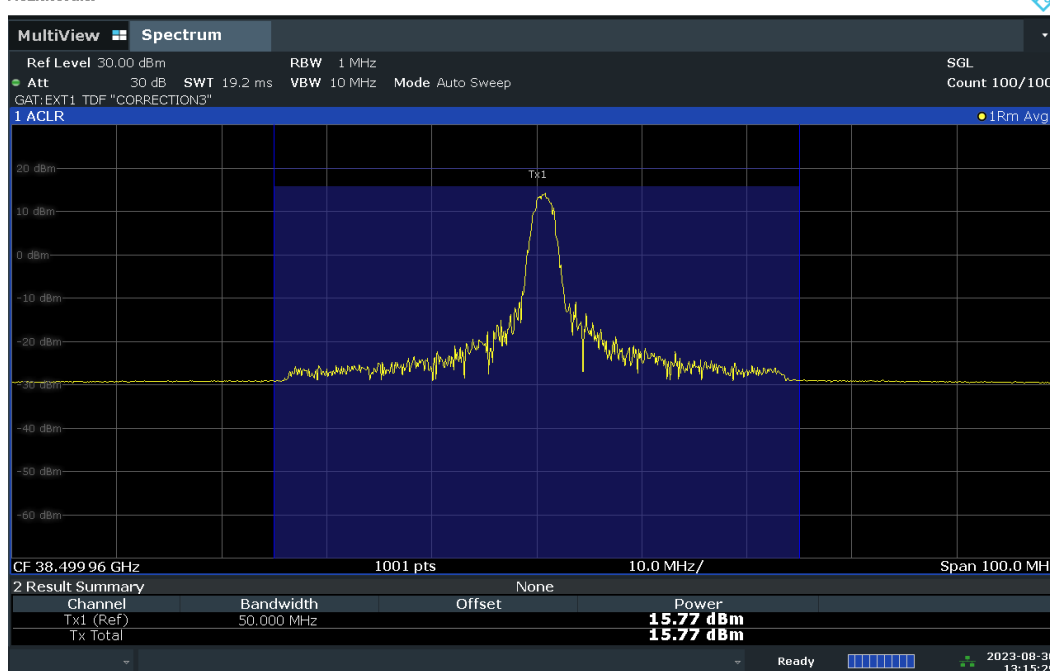
ACLRRResults



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Plot 7-37. Conducted Power Plot – DFT-S – H-UL Polarization (50MHz-1CC – QPSK – Mid Ch. – Full RB)

ACLRRResults

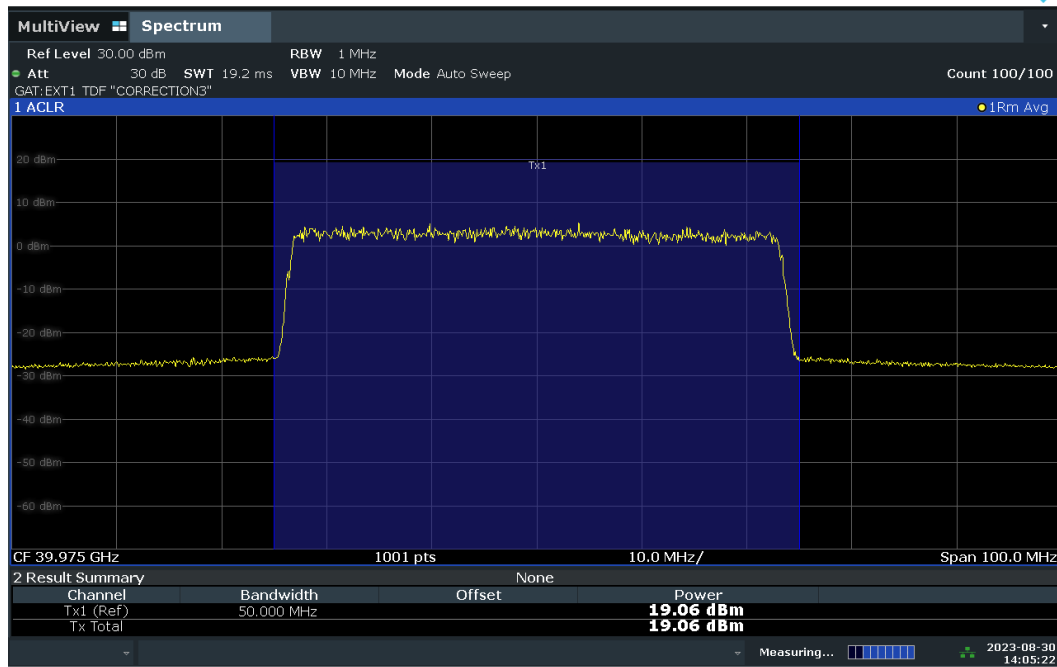


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Plot 7-38. Conducted Power Plot – DFT-S – H-UL Polarization (50MHz-1CC – QPSK – Mid Ch. – 1 RB)

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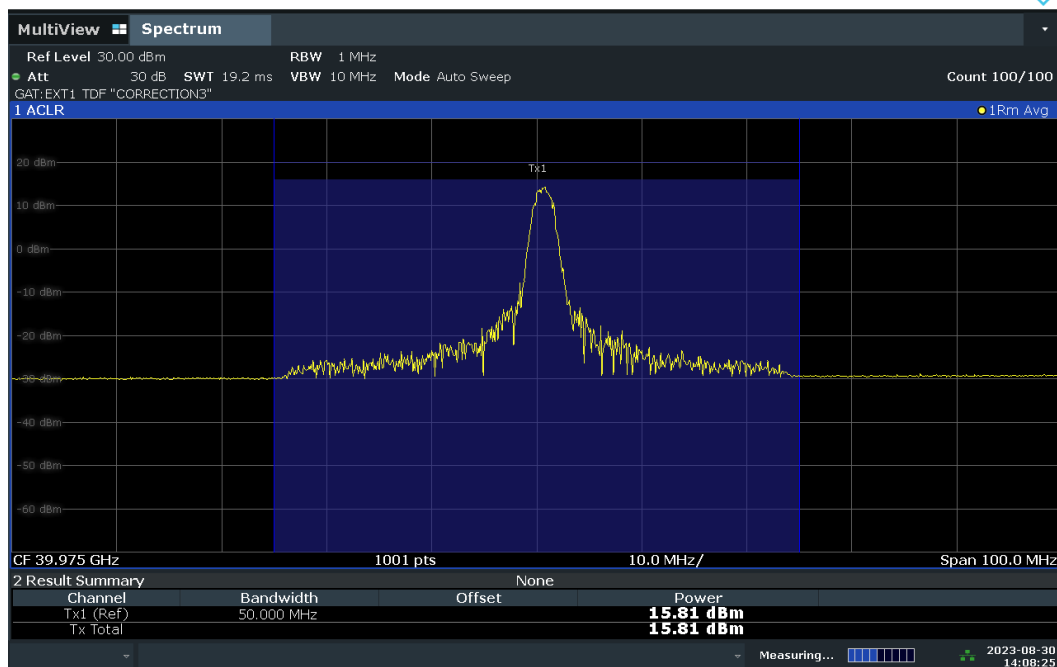
ACLRRResults



02:05:23 PM 08/30/2023

Plot 7-39. Conducted Power Plot – DFT-S – H-UL Polarization (50MHz-1CC – QPSK – High Ch. – Full RB)

ACLRRResults



02:08:26 PM 08/30/2023

Plot 7-40. Conducted Power Plot – DFT-S – H-UL Polarization (50MHz-1CC – QPSK – High Ch. – 1 RB)

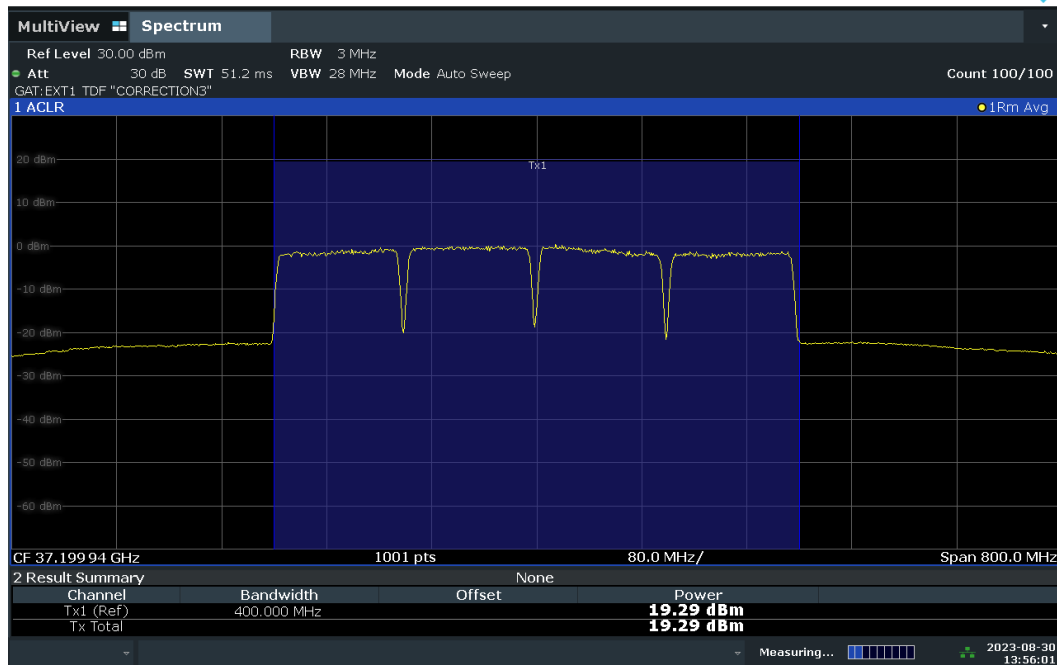
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V1.0

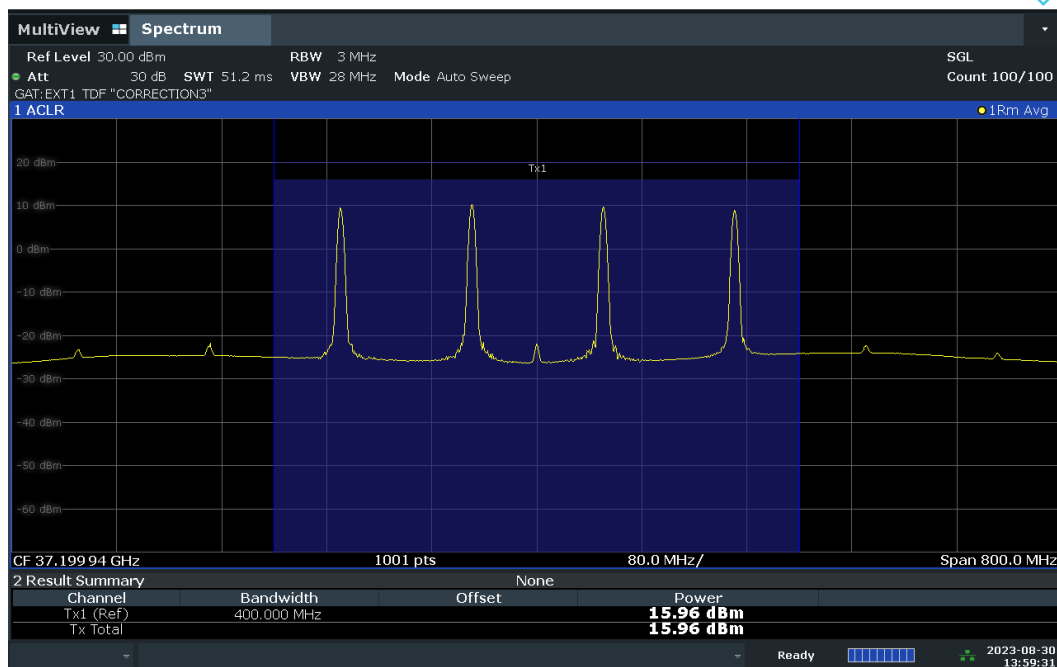
ACLRResults



01:56:01 PM 08/30/2023

Plot 7-41. Conducted Power Plot – DFT-S – H-UL Polarization (100MHz-4CC – QPSK – Low Ch. – Full RB)

ACLRResults



01:59:31 PM 08/30/2023

Plot 7-42. Conducted Power Plot – DFT-S – H-UL Polarization (100MHz-4CC – QPSK – Low Ch. – 1RB)

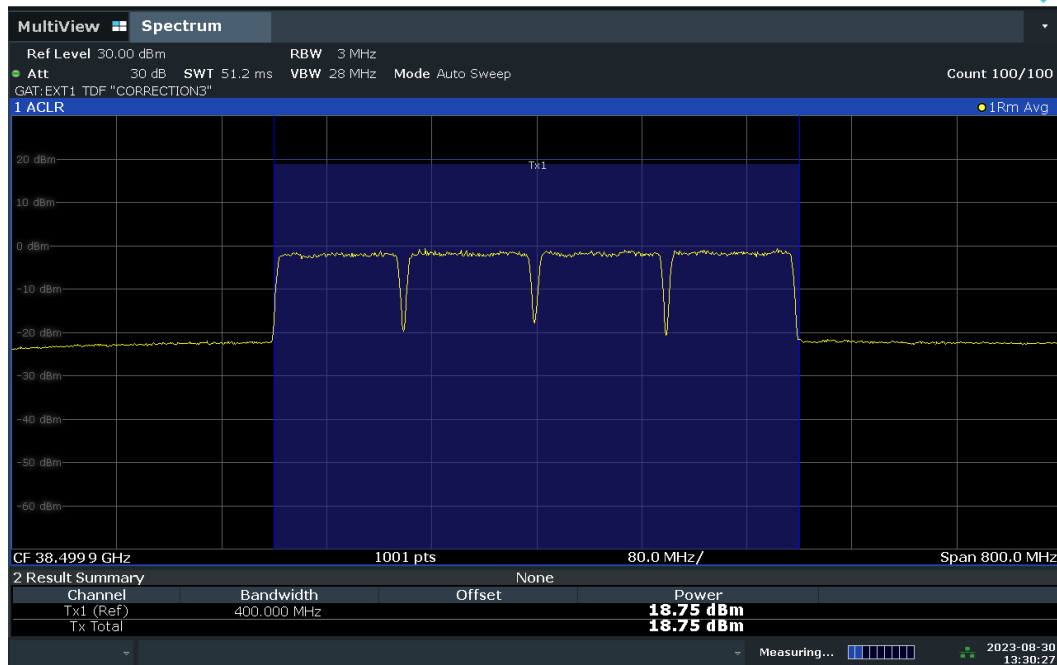
FCC ID: 2AUUVU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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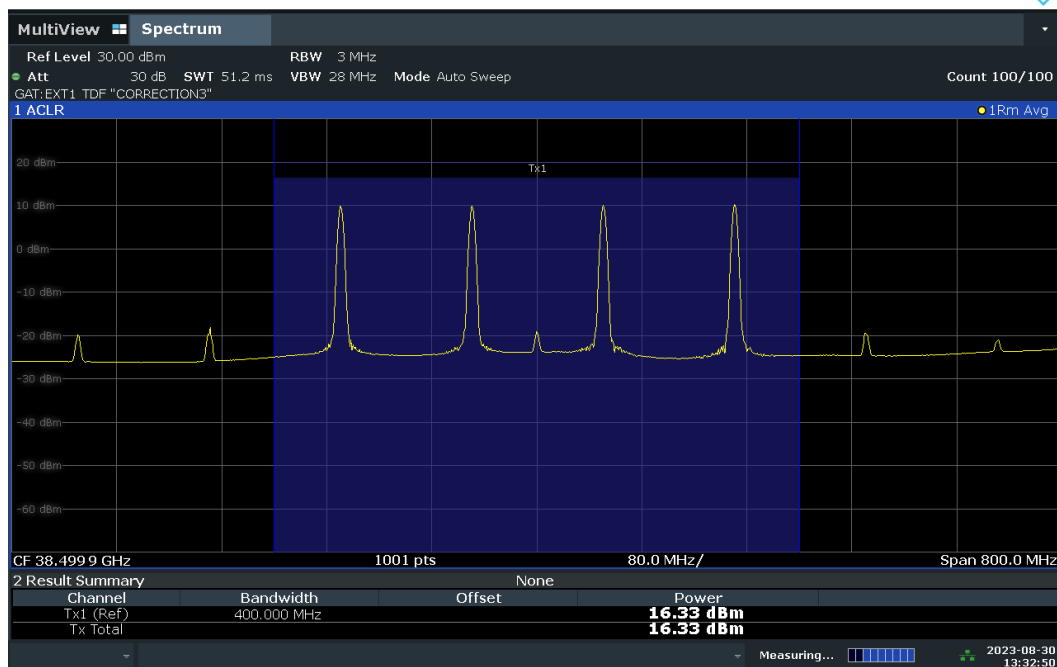
ACLRResults



01:30:28 PM 08/30/2023

Plot 7-43. Conducted Power Plot – DFT-S – H-UL Polarization (100MHz-4CC – QPSK – Mid Ch. – Full RB)

ACLRResults



01:32:50 PM 08/30/2023

Plot 7-44. Conducted Power Plot – DFT-S – H-UL Polarization (100MHz-4CC – QPSK – Mid Ch. – 1 RB)

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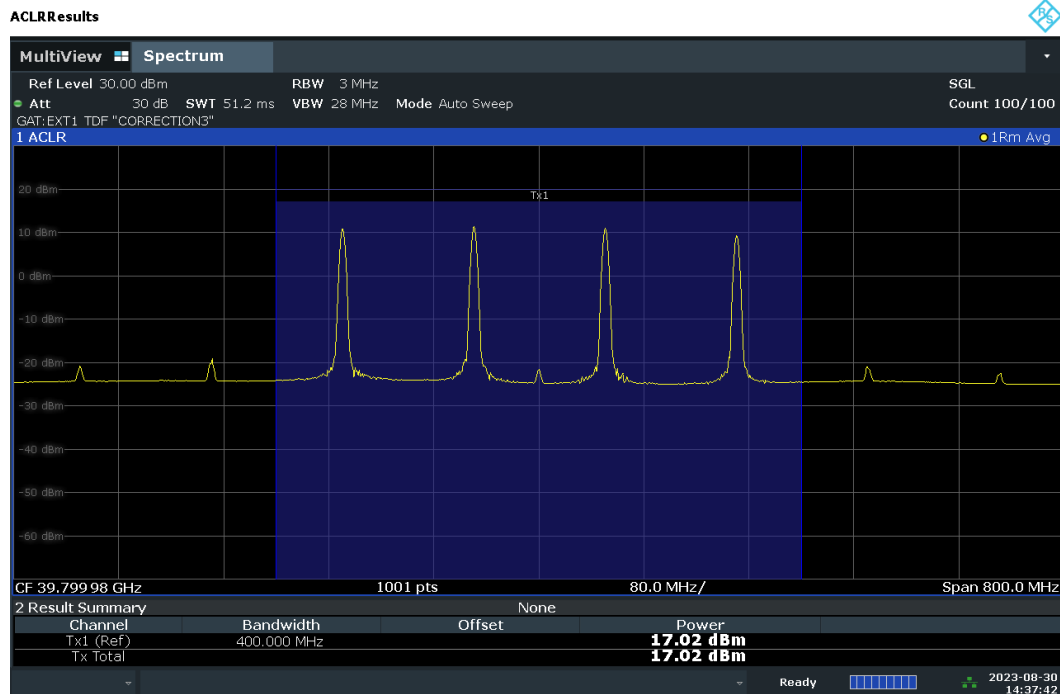
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V1.0



02:33:24 PM 08/30/2023

Plot 7-45. Conducted Power Plot – DFT-S – H-UL Polarization (100MHz-4CC – QPSK – High Ch. – Full RB)



02:37:43 PM 08/30/2023

Plot 7-46. Conducted Power Plot – DFT-S – H-UL Polarization (100MHz-4CC – QPSK – High Ch. – 1 RB)

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7.7 Radiated Spurious and Harmonic Emissions

Test Overview

Radiated spurious emissions measurements are performed using the field strength conversion method described in ANSI C63.26-2015 with the EUT transmitting into an integral antenna. Measurements on signals operating below 1GHz are performed using hybrid (biconical/log) antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed as RMS measurements while the EUT is operating at maximum power, and at the appropriate frequencies.

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 5.5.4
KDB 842590 D01 – Section 4.4.3

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 200 GHz . Several plots are used to show investigations in this entire span.
2. Detector = RMS
3. Trace mode = trace average
4. Sweep time = auto couple
5. Number of sweep points $\geq 2 \times \text{Span/RBW}$
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 50MHz-1CC bandwidth/component carrier, QPSK Modulation, with 1RB. The EUT was tested under such signaling conditions.
- 2) All radiated spurious emissions were measured as EIRP to compare with the §30.203 TRP limits.
- 3) The plots in this section were taken with the analyzer set to max hold. All final measurements shown in the tables that accompany the plots were taken with trace averaging performed over 100 sweeps while the analyzer was triggering on a specific emission of interest.
- 4) The plots from 1 – 200GHz show corrected average EIRP levels. The average EIRP reported below is calculated per section 5.2.7 of ANSI C63.26-2015 which states: $\text{EIRP (dBm)} = \text{E (dB}\mu\text{V/m)} + 20\log(\text{D}) - 104.8$; where D is the measurement distance (in the far field region) in m. The field strength E is calculated $\text{E (dB}\mu\text{V/m)} = \text{Spectrum Analyzer Level (dBm)} + \text{Antenna Factor (dB/m)} + \text{Cable Loss (dB)} + \text{Harmonic Mixer Conversion Loss (dB)} + 107$. All appropriate Antenna Factors and Cable Losses have been applied in the spectrum analyzer for each measurement. For measurements $> 40\text{GHz}$, a Harmonic Mixer Conversion Loss was also applied to the spectrum analyzer.

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- 5) 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: $R > 2D^2/\text{wavelength}$, where D is the larger between the dimension of the measurement antenna and the transmitting antenna of the EUT. In this case, for RSE measurements, "D" is the largest dimension of the EUT which was roughly 29cm x 29cm x 7cm. The measurement antenna and harmonic mixer were manipulated around all faces and edges of the EUT to determine location of worst-case emissions..

Frequency Range (GHz)	Wavelength (cm)	Far Field Distance (m)	Measurement Distance (m)
18-40	0.749	0.54	2.00
40-60	0.500	1.44	2.00
60-90	0.333	0.96	2.00
90-140	0.214	0.63	2.00
140-200	0.150	0.39	2.00

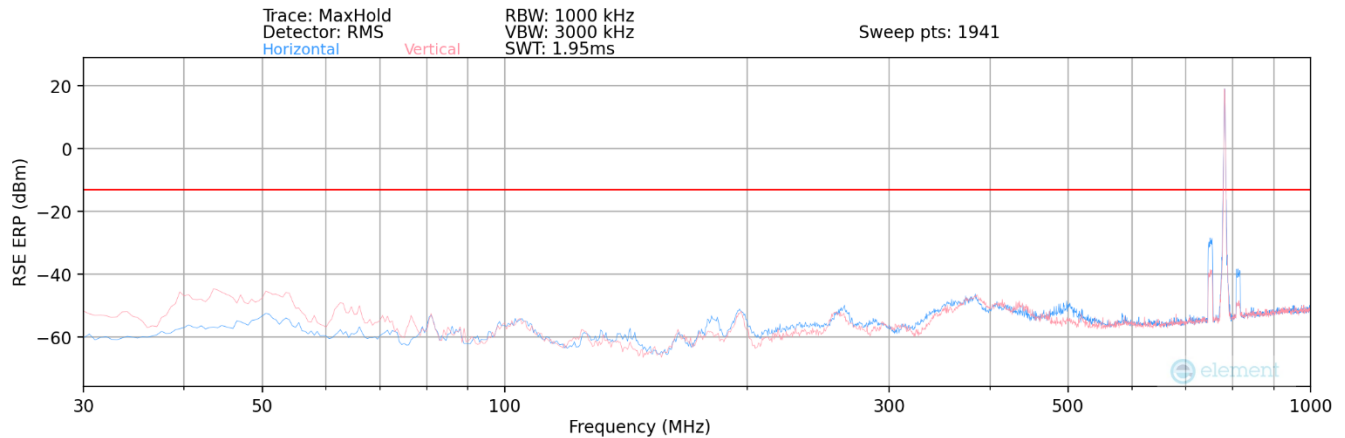
Table 7-11. Far-Field Distance & Measurement Distance per Frequency Range

- 6) 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.
- 7) To cover the simultaneous transmissions, the LTE module (FCC ID: XMR201906EG21G) was set to transmit at the same time as the mmWave functionality of the host.
- 8) The spectrum scan plots in this section are used for the purpose of signal identification. Each emission is subject to a unique limit based on the rule under which the transmitter operates. For instances where an emission is the product of co-located transmitters (i.e. an intermodulation product), the limit on that emission is the least strict between the rule parts under which each transmitter operates.
- 9) The limit lines on the spectrum scan plots in this section are displayed in regards to the part 30 limits for n260 mmWave spurious emissions. The limits for spurious emissions solely due to the other transmitters are not displayed on the plots. Instead, the applicable limits are displayed in the accompanying tables.
- 10) The fundamental emissions from multiple co-located transmitters may appear on spectrum scan plots. These are not investigated as spurious emissions.
- 11) The "-" shown in the following RSE tables are used to denote a noise floor measurement.

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Band n260 – DU

30MHz - 1GHz



Plot 7-47. n260 Radiated Spurious Plot (1CC QPSK Mid Channel) - DU

Spurious Emissions ERP Sample Calculation (n260)

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

$$\text{RSE ERP (dBm)} = \text{Analyzer Level (dBm)} + 107 + \text{AFCL (dB/m)} + 20\text{Log(Dm)} - 104.8 - 2.15 \text{ (dB)}$$

Frequency [MHz]	Channel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Height [cm]	Turntable Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
80.95	Low	50	V	QPSK	221	57	-53.40	-13.00	-40.40
520.00	Low	50	V	QPSK	108	69	-52.05	-13.00	-39.05
753.00	Low	50	V	QPSK	151	174	-31.92	-13.00	-18.92
83.00	Mid	50	V	QPSK	152	58	-55.70	-13.00	-42.70
584.00	Mid	50	V	QPSK	150	118	-52.70	-13.00	-39.70
751.00	Mid	50	V	QPSK	148	129	-30.51	-13.00	-17.51
83.45	High	50	V	QPSK	125	74	-59.28	-13.00	-46.28
519.00	High	50	V	QPSK	156	105	-53.59	-13.00	-40.59
749.00	High	50	V	QPSK	106	171	-32.54	-13.00	-19.54

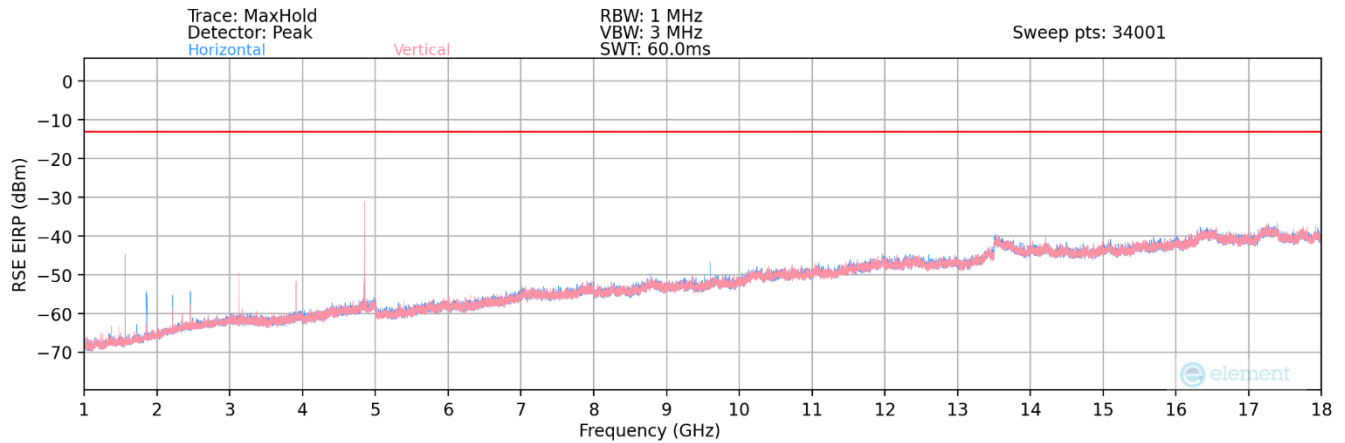
Table 7-12. n260 Radiated Spurious Emissions Table (30MHz - 1GHz) - DU

Notes

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 meters.

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1GHz - 18GHz



Plot 7-48. n260 Radiated Spurious Plot (1CC QPSK Mid Channel) - DU

Spurious Emissions EIRP Sample Calculation (n260)

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

$$\text{RSE EIRP (dBm)} = \text{Analyzer Level (dBm)} + 107 + \text{AFCL (dB/m)} + 20\text{Log(Dm)} - 104.8$$

Frequency [MHz]	Channel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Height [cm]	Turntable Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
3128.30	Low	50	V	QPSK	201	283	-40.31	-13.00	-27.31
1564.05	Mid	50	V	QPSK	150	31	-45.82	-13.00	-32.82
2211.78	Mid	50	V	QPSK	395	32	-44.18	-13.00	-31.18
3130.00	Mid	50	V	QPSK	190	277	-38.91	-13.00	-25.91
3910.00	Mid	50	V	QPSK	103	345	-38.19	-13.00	-25.19
4850.08	Mid	50	V	QPSK	107	320	-22.41	-13.00	-9.41
9600.00	Mid	50	V	QPSK	147	271	-36.36	-13.00	-23.36
5125.87	High	50	V	QPSK	164	318	-35.91	-13.00	-22.91

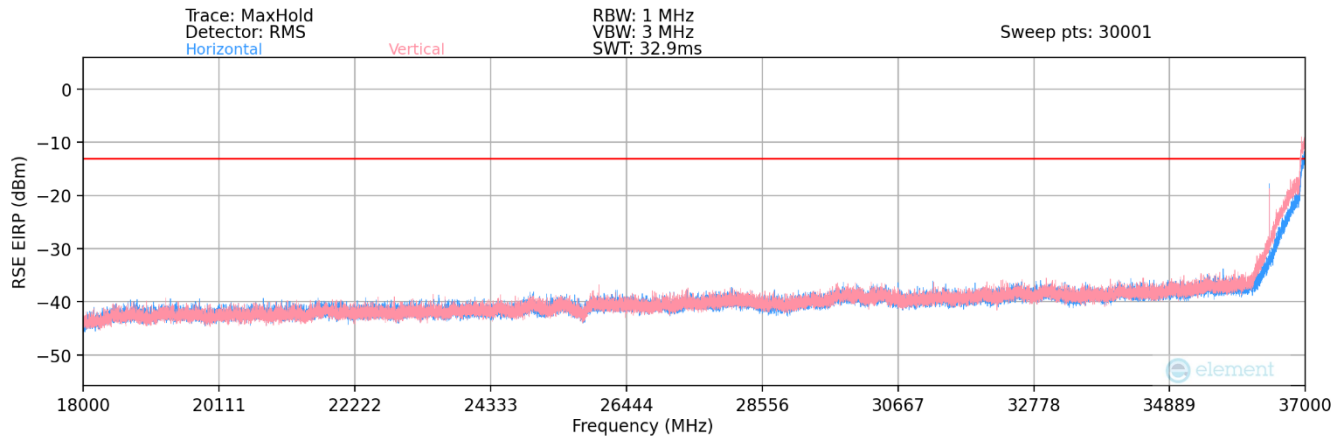
Table 7-13. n260 Radiated Spurious Emissions Table (1GHz - 18GHz) - DU

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 3 meters.

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18GHz - 37GHz



Plot 7-49 n260 Radiated Spurious Plot (1CC QPSK Low Channel) – DU

Spurious Emissions EIRP Sample Calculation (n260)

The raw radiated spurious level is converted to field strength in dBuV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 2 meter.

$$\text{RSE EIRP (dBm)} = \text{Analyzer Level (dBm)} + 107 + \text{AFCL (dB/m)} + 20\text{Log(Dm)} - 104.8$$

Frequency [MHz]	Channel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [degrees]	Turntable Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
36436.50	Low	50	V	QPSK	351	2	-20.79	-13.00	-7.79
36667.00	Mid	50	V	QPSK	-	-	-26.61	-13.00	-13.61
36898.00	High	50	V	QPSK	-	-	-29.11	-13.00	-16.11
36941.50	Low	50	V	QPSK	355	2	-14.58	-13.00	-1.58

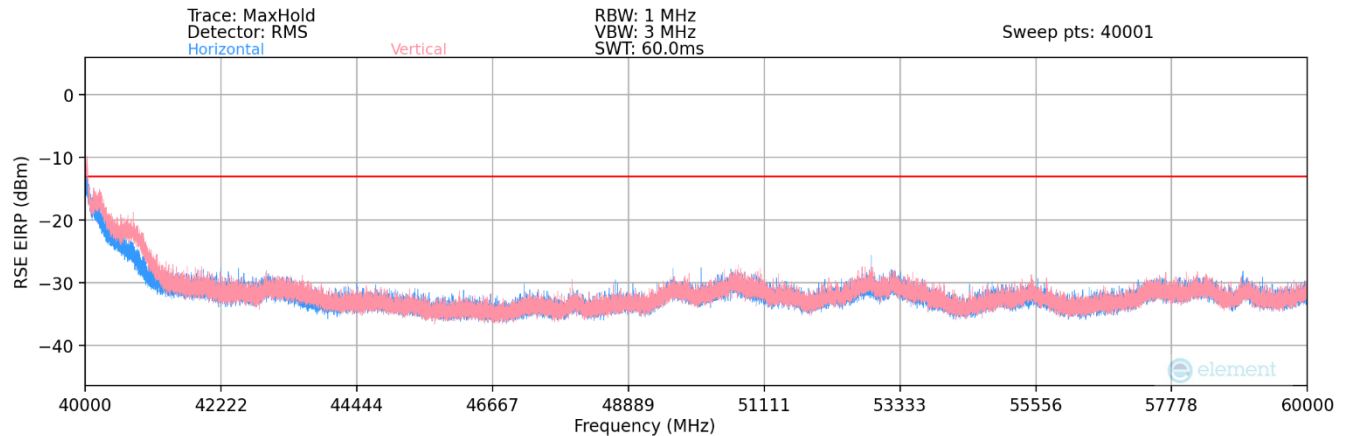
Table 7-14. n260 Radiated Spurious Emissions Table (18GHz - 37GHz) - DU

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 2 meter.
2. Even though the RSE at 36.9GHz seems to be failing on the pre-scan, when measured with Trace average and RMS, the RSE value is within limits.

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40GHz - 60GHz



Plot 7-50. n260 Radiated Spurious Plot (1CC QPSK High Channel) - DU

Spurious Emissions EIRP Sample Calculation (n260)

The raw radiated spurious level is converted to field strength in dBuV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 2 meter.

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

Frequency [MHz]	Channel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [degrees]	Turntable Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
49413.85	Low	50	H	QPSK	262	336	-27.35	-13.00	-14.35
49806.50	Low	50	H	QPSK	264	335	-25.98	-13.00	-12.98
49776.25	Mid	50	H	QPSK	263	347	-27.98	-13.00	-14.98
50913.00	Mid	50	H	QPSK	268	348	-16.88	-13.00	-3.88
49814.65	High	50	H	QPSK	251	346	-28.81	-13.00	-15.81
52714.00	High	50	H	QPSK	255	355	-23.12	-13.00	-10.12
40060.50	High	50	H	QPSK	272	346	-19.41	-13.00	-6.41

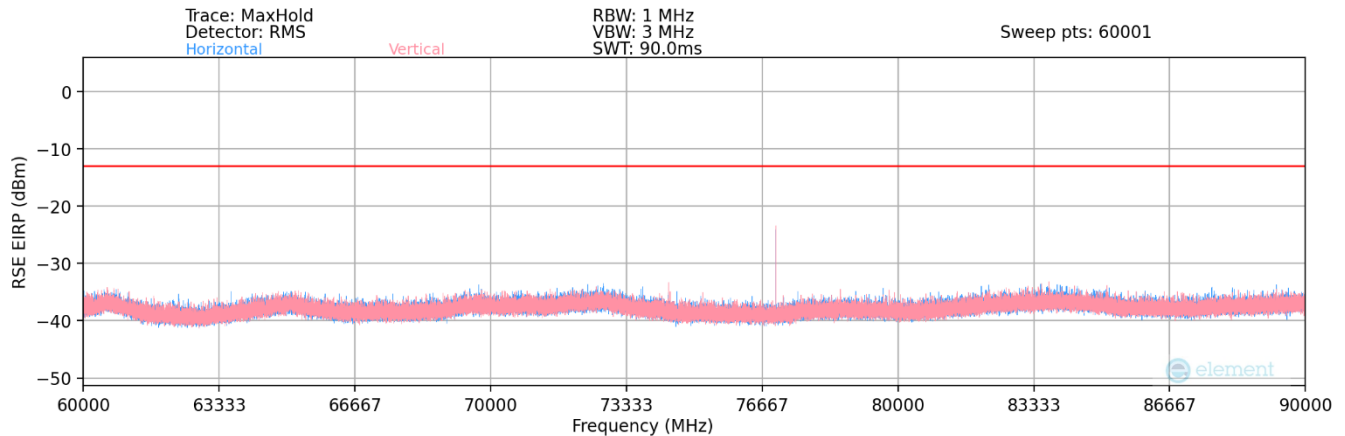
Table 7-15. n260 Radiated Spurious Emissions Table (40GHz - 60GHz) - DU

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 2 meter.
2. Even though the RSE at 40.06GHz seems to be failing on the pre-scan, when measured with Trace average and RMS, the RSE value is within limits.

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60GHz - 90GHz



Plot 7-51. n260 Radiated Spurious Plot (1CC QPSK Mid Channel) - DU

Spurious Emissions EIRP Sample Calculation (n260)

The raw radiated spurious level is converted to field strength in dBuV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 2 meter.

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

Frequency [MHz]	Channel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Positioner Roll [degrees]	Turntable Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
74050.08	Low	50	H	QPSK	90	334	-15.30	-13.00	-2.30
76999.92	Mid	50	H	QPSK	94	347	-22.02	-13.00	-9.02
79950.00	High	50	H	QPSK	96	356	-23.39	-13.00	-10.39

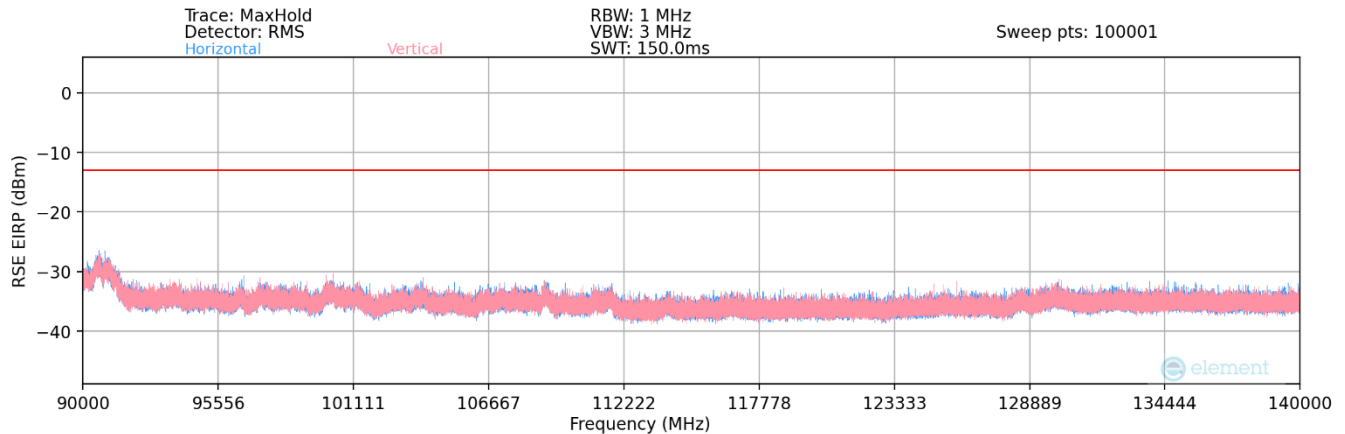
Table 7-16. n260 Radiated Spurious Emissions Table (60GHz - 90GHz) - DU

Notes

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 2 meter.

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90GHz - 140GHz



Plot 7-52. n260 Radiated Spurious Plot (1CC QPSK Mid Channel) - DU

Spurious Emissions EIRP Sample Calculation (n260)

The raw radiated spurious level is converted to field strength in dBuV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 2 meter.

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

Frequency [MHz]	Channel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Positioner Roll [degrees]	Turntable Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
111075.12	Low	50	H	QPSK	-	-	-30.85	-13.00	-17.85
115499.88	Mid	50	H	QPSK	-	-	-31.06	-13.00	-18.06
119925.00	High	50	H	QPSK	-	-	-31.80	-13.00	-18.80

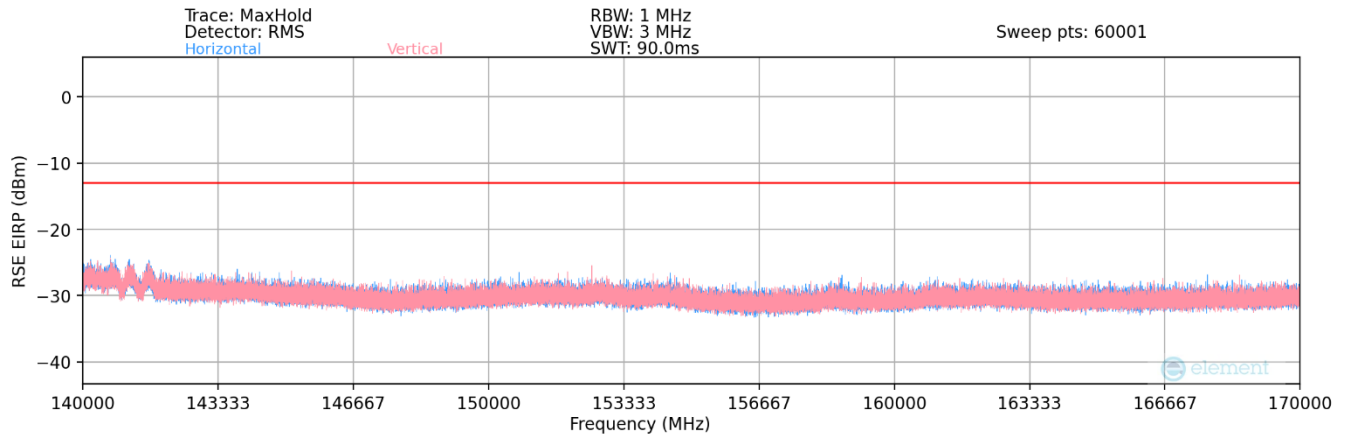
Table 7-17. n260 Radiated Spurious Emissions Table (90GHz - 140GHz) - DU

Notes

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 2 meter.

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140GHz - 170GHz



Plot 7-53. n260 Radiated Spurious Plot (1CC QPSK Mid Channel) - DU

Spurious Emissions EIRP Sample Calculation (n260)

The raw radiated spurious level is converted to field strength in dBuV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 2 meter.

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

Frequency [MHz]	Channel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Positioner Roll [degrees]	Turntable Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
148100.16	Low	50	H	QPSK	-	-	-26.13	-13.00	-13.13
153999.84	Mid	50	H	QPSK	-	-	-25.22	-13.00	-12.22
159900.00	High	50	H	QPSK	-	-	-26.06	-13.00	-13.06

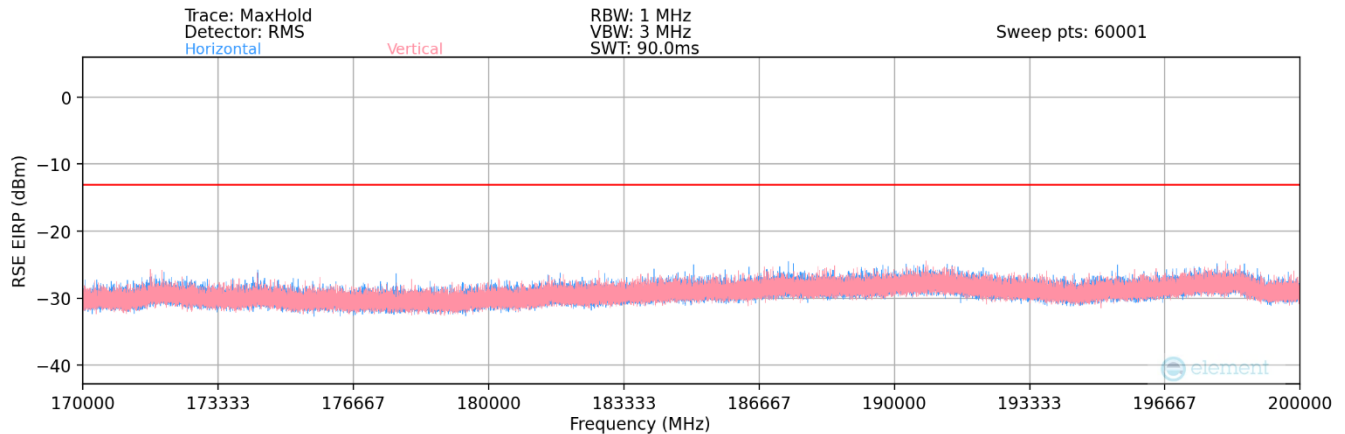
Table 7-18. n260 Radiated Spurious Emissions Table (140GHz - 170GHz) - DU

Notes

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 2 meter.

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170GHz - 200GHz



Plot 7-54. n260 Radiated Spurious Plot (1CC QPSK Mid Channel) - DU

Spurious Emissions EIRP Sample Calculation (n260)

The raw radiated spurious level is converted to field strength in dBuV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 2 meter.

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

Frequency [MHz]	Channel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Positioner Roll [degrees]	Turntable Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
185125.20	Low	50	H	QPSK	-	-	-23.97	-13.00	-10.97
192499.80	Mid	50	H	QPSK	-	-	-23.56	-13.00	-10.56
199875.00	High	50	H	QPSK	-	-	-24.59	-13.00	-11.59

Table 7-19. n260 Radiated Spurious Emissions Table (170GHz - 200GHz) - DU

Notes

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 2 meter.

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7.8 Band Edge / Out-of-Band Emissions

Test Overview

A signal generator is used to generate a 5G NR signal as an input to the EUT system via a coaxial cable. All out-of-band emissions are then measured in a conducted setup while the EUT is operating at its 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
KDB 842590 D01 Section 4.4.2.4
KDB 935210 D05 Section 3.6

Test Settings

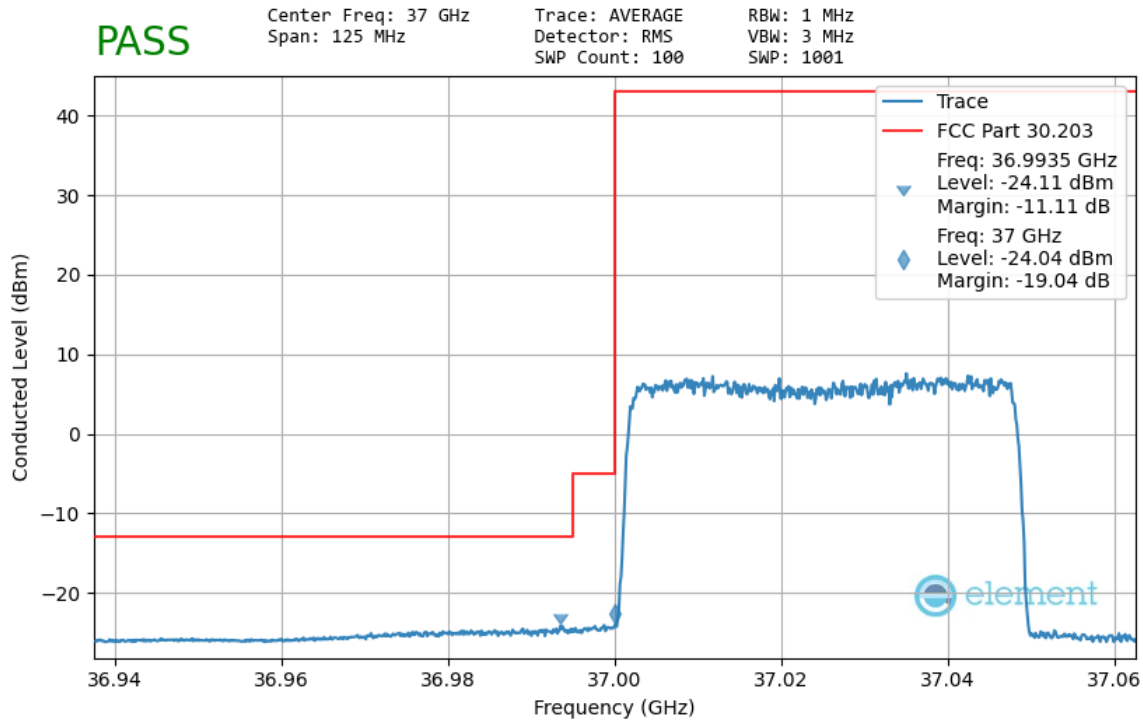
1. Start and stop frequency were set such that both upper and lower band edges are measured.
2. Span was set large enough so as to capture all out of band emissions near the band edge.
3. RBW = 1MHz
4. VBW $\geq 3 \times$ RBW
5. Detector = RMS
6. Trace mode = trace averaging (RMS) over 100 sweeps
7. Number of sweep points $\geq 2 \times$ Span/RBW
8. Sweep time = auto couple

Test Notes

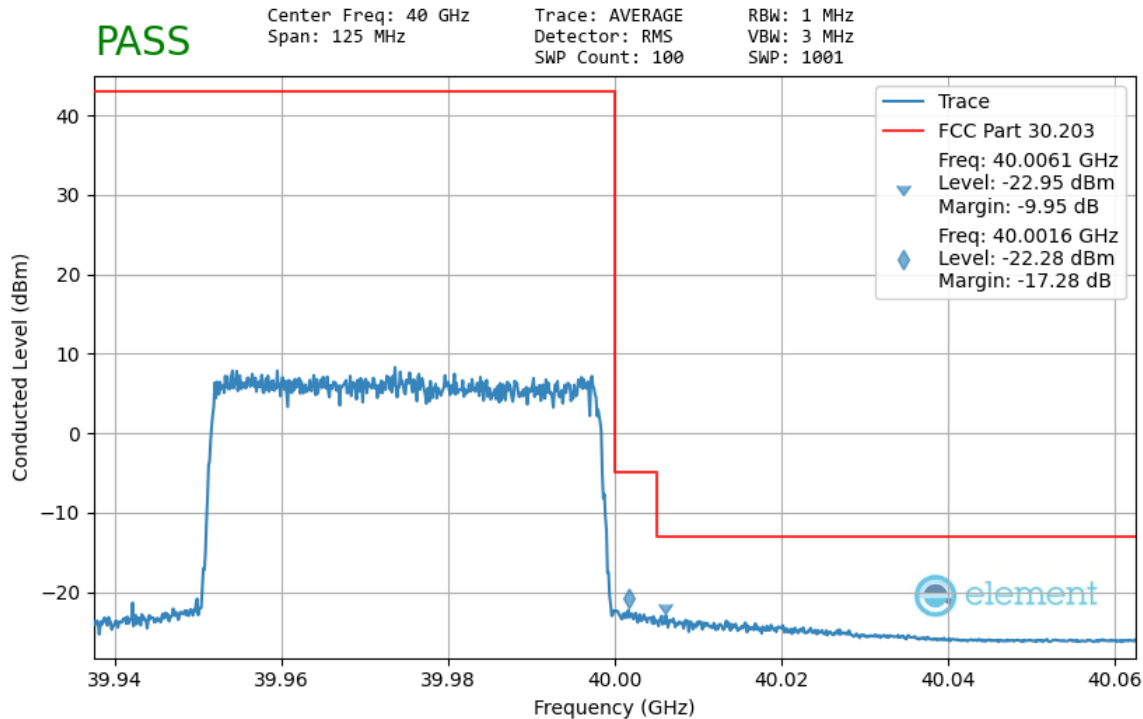
- 1) For FCC Part 30 compliance, all combinations of 5G NR component carriers, bandwidths, and RB allocations were fully investigated and only the worst case scenarios have been included in this section.
- 2) Per previous guidance from FCC specifically to Element lab, both stimulus conditions – a single test signal, and two adjacent test signals – were investigated with 50MHz 5G NR mmWave input signals as opposed to the 4.1MHz AWGN required in KDB 925210 D05.
- 3) For all the plots in this section, appropriate frequency-varying corrections were applied to compensate for cable loss in the conducted measurement setup.
- 4) The band edge emission plots in this section are the spectral sums of the H and V output ports per ANSI C63.26-2015 Section 6.4.3.2.2 (measure and sum the spectra across the outputs).

FCC ID: 2AUVU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1M2308080090-01-R2.2AUVU	Test Dates: 08/09 - 10/02/2023	EUT Type: 5G mmWave Repeater	Page 59 of 87

Band n260 – DU (DFT-s-OFDM)

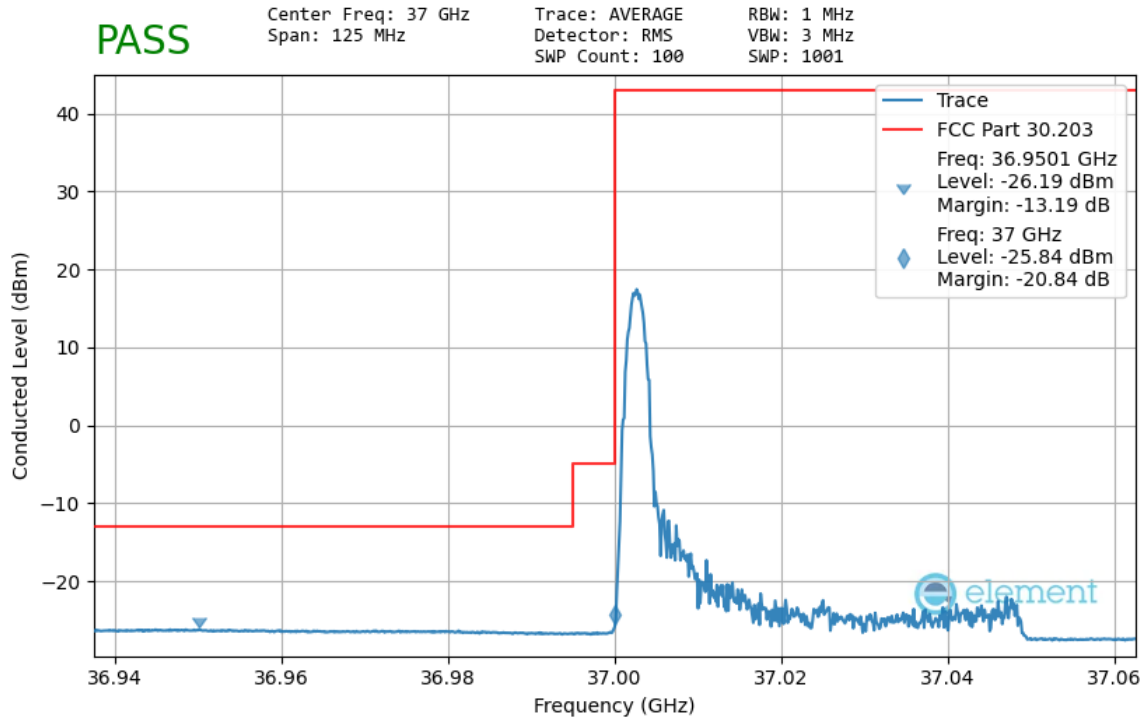


Plot 7-55. Lower Band Edge – DFT-s – MIMO-UL Polarization (50MHz-1CC – QPSK Full RB)

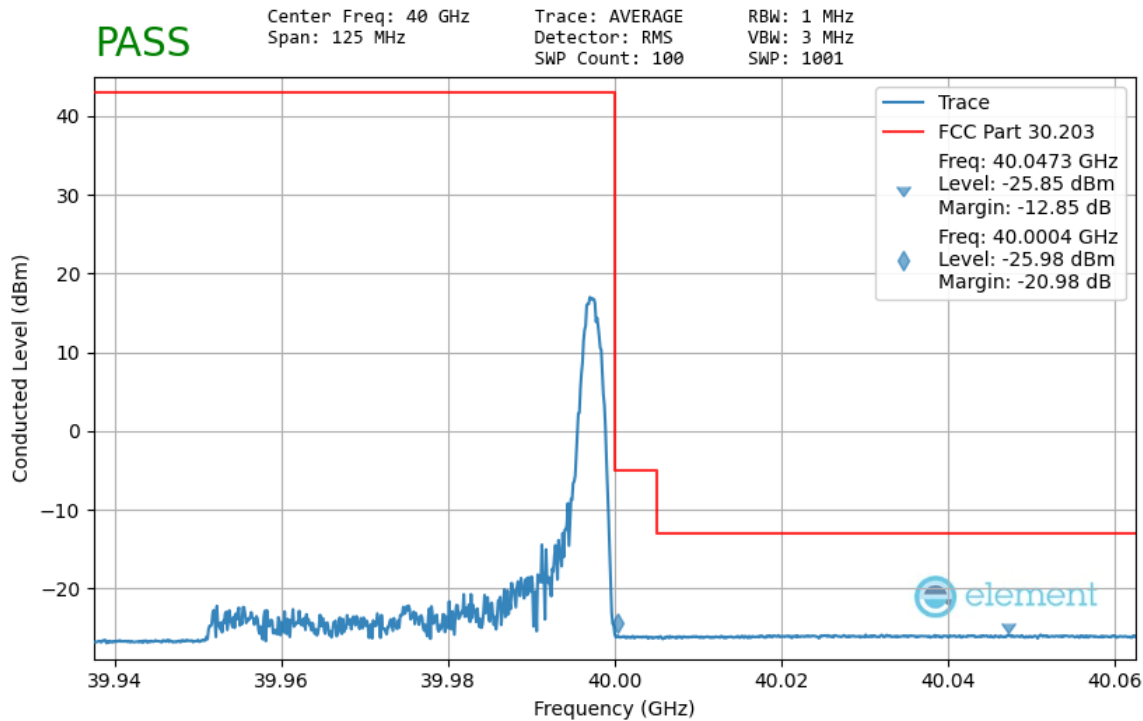


Plot 7-56. Upper Band Edge – DFT-s – MIMO-UL Polarization (50MHz-1CC – QPSK Full RB)

FCC ID: 2AUUU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1M2308080090-01-R2.2AUUU	Test Dates: 08/09 - 10/02/2023	EUT Type: 5G mmWave Repeater	Page 60 of 87

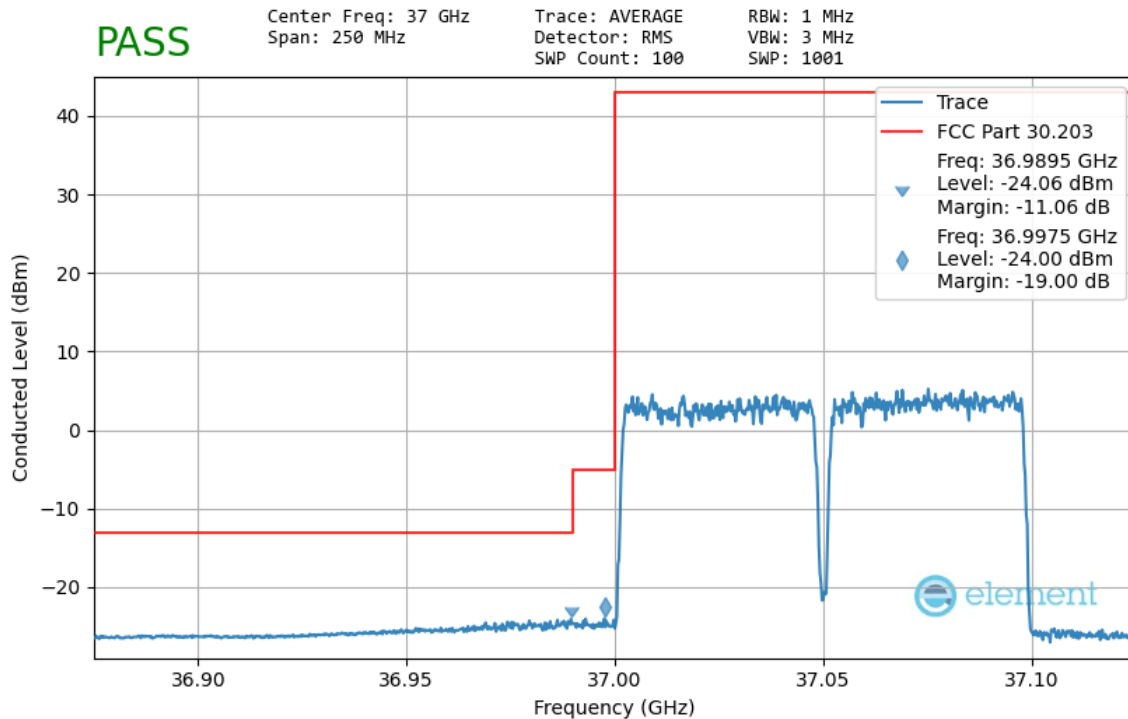


Plot 7-57. Lower Band Edge – DFT-s – MIMO-UL Polarization (50MHz-1CC – QPSK 1 RB)

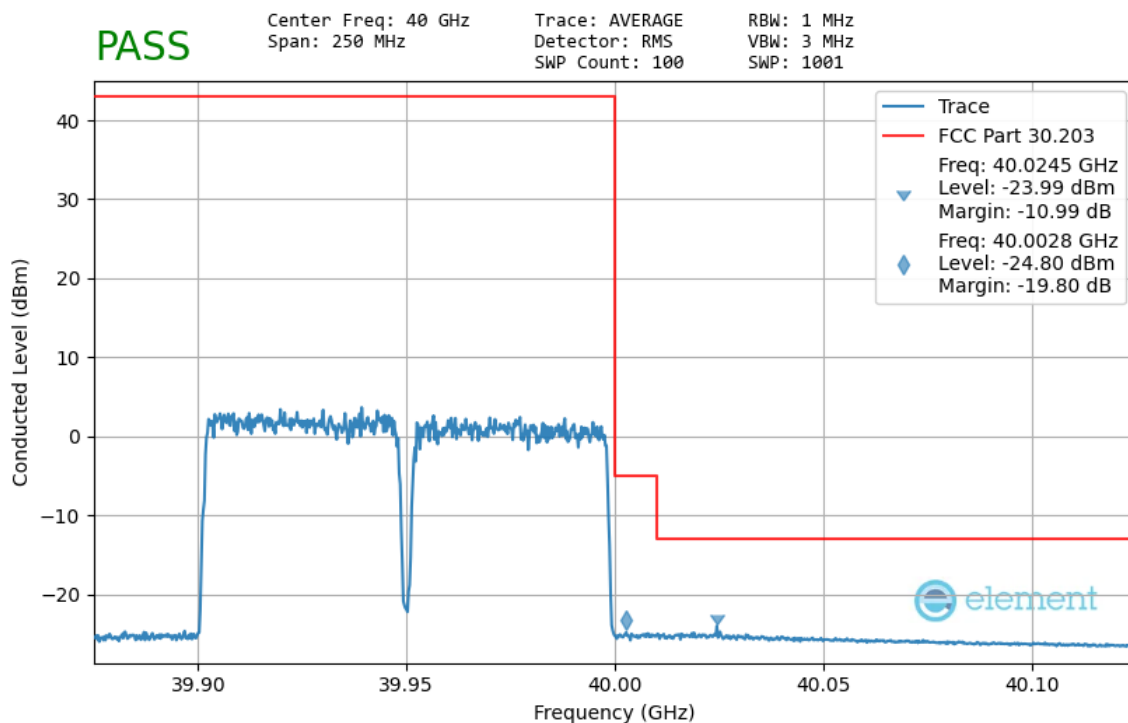


Plot 7-58. Upper Band Edge – DFT-s – MIMO-UL Polarization (50MHz-1CC – QPSK 1 RB)

FCC ID: 2AUVU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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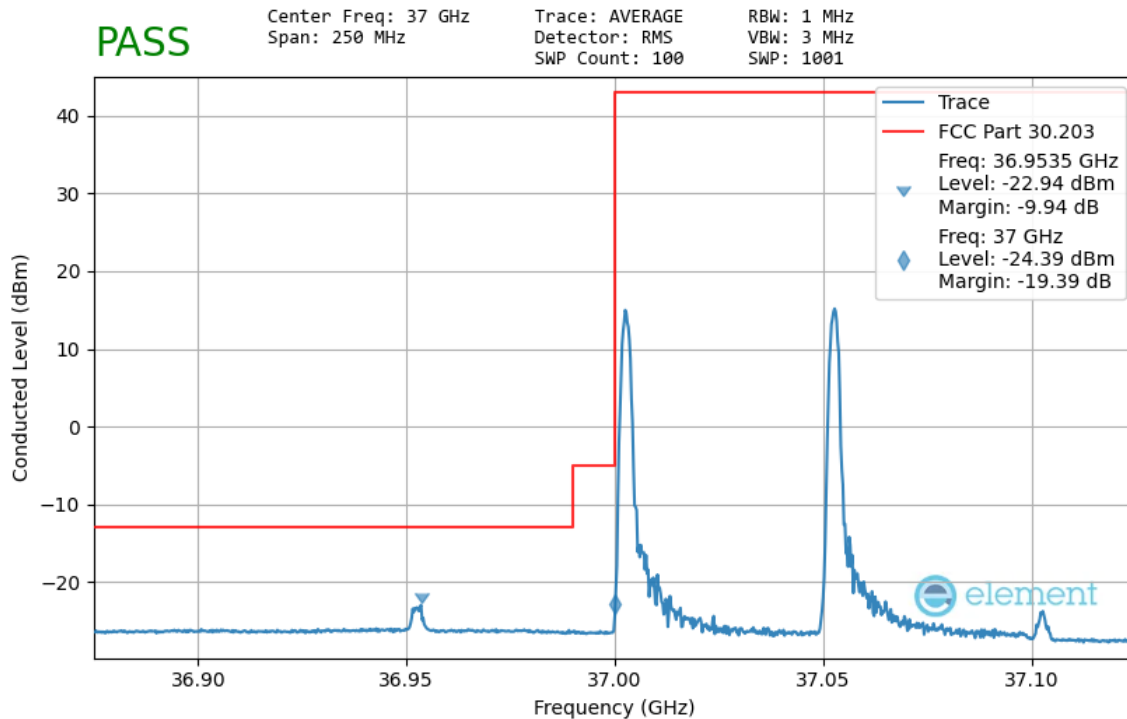


Plot 7-59. Lower Band Edge – DFT-s – MIMO-UL Polarization (50MHz-2CC – QPSK Full RB)

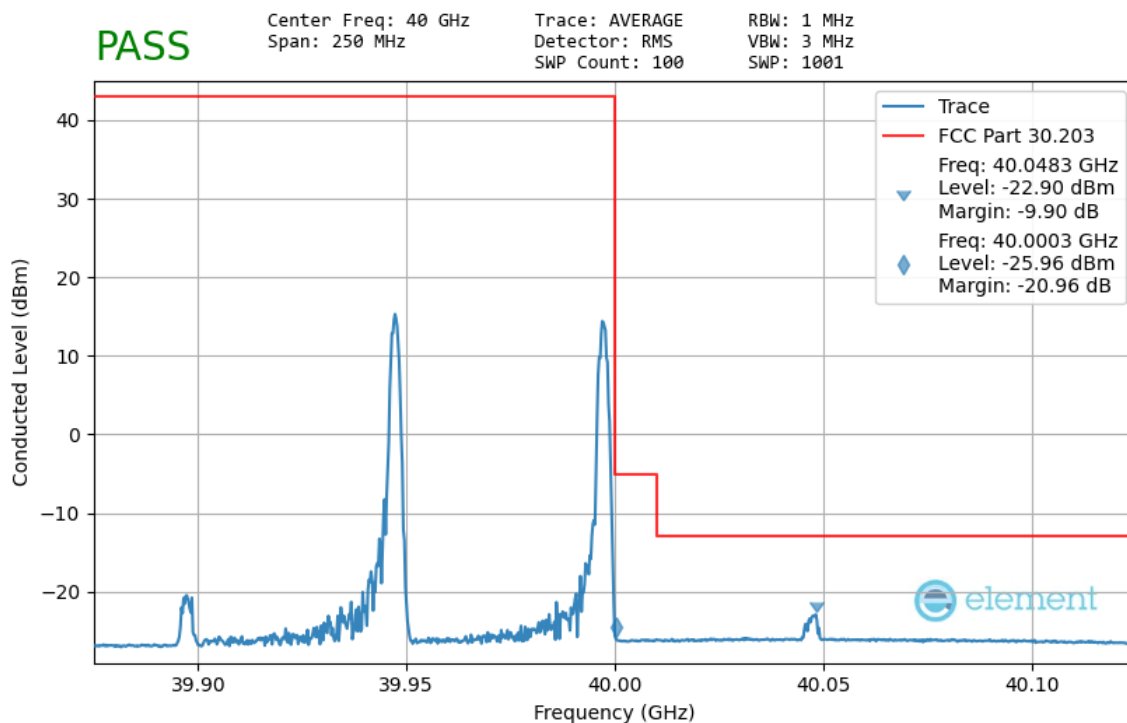


Plot 7-60. Upper Band Edge – DFT-s – MIMO-UL Polarization (50MHz-2CC – QPSK Full RB)

FCC ID: 2AUUU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1M2308080090-01-R2.2AUUU	Test Dates: 08/09 - 10/02/2023	EUT Type: 5G mmWave Repeater	Page 62 of 87

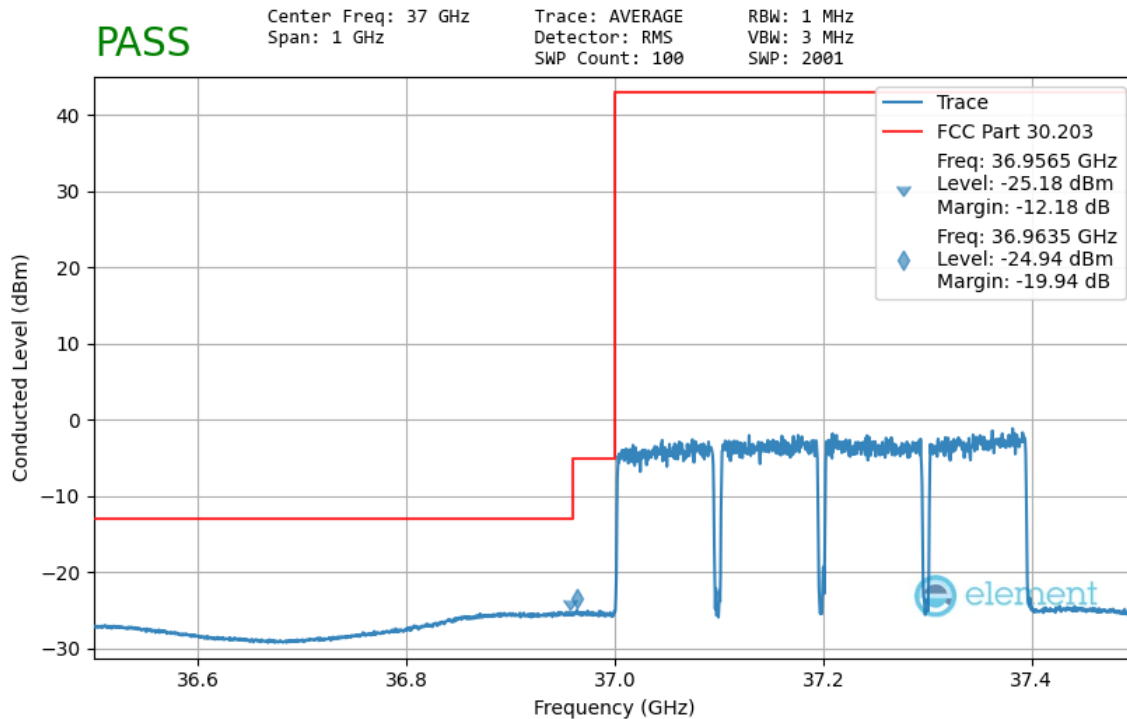


Plot 7-61. Lower Band Edge – DFT-s – MIMO-UL Polarization (50MHz-2CC – QPSK 1RB)

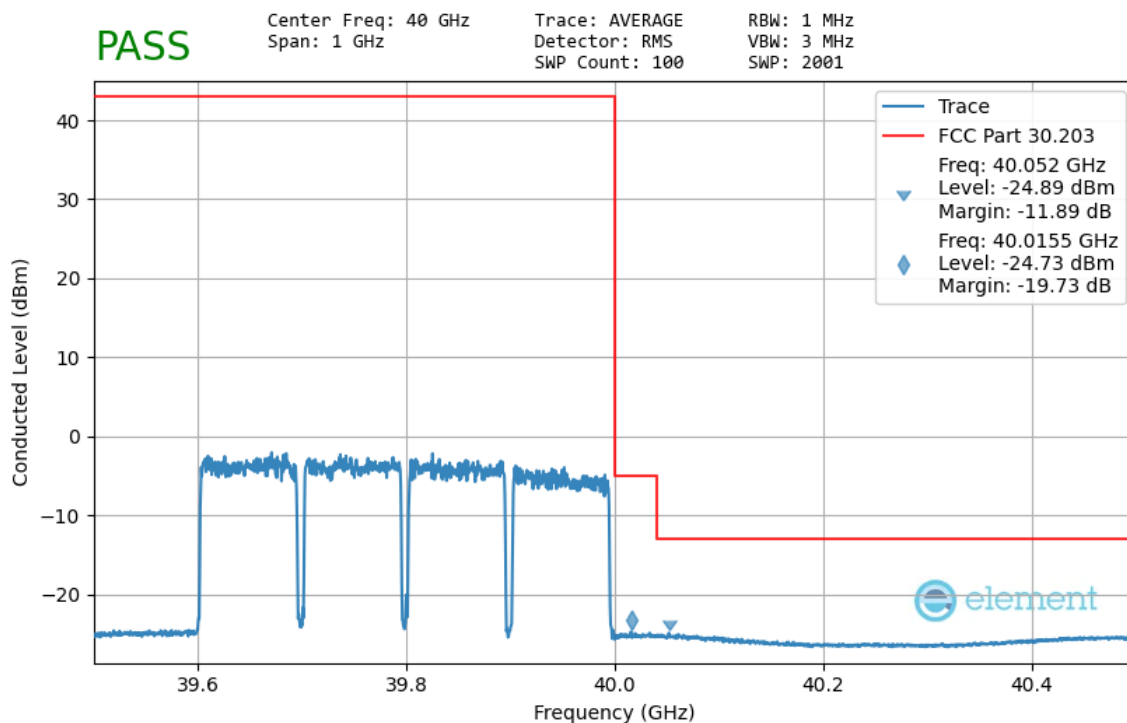


Plot 7-62. Upper Band Edge – DFT-s – MIMO-UL Polarization (50MHz-2CC – QPSK 1RB)

FCC ID: 2AUUU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1M2308080090-01-R2.2AUUU	Test Dates: 08/09 - 10/02/2023	EUT Type: 5G mmWave Repeater	Page 63 of 87

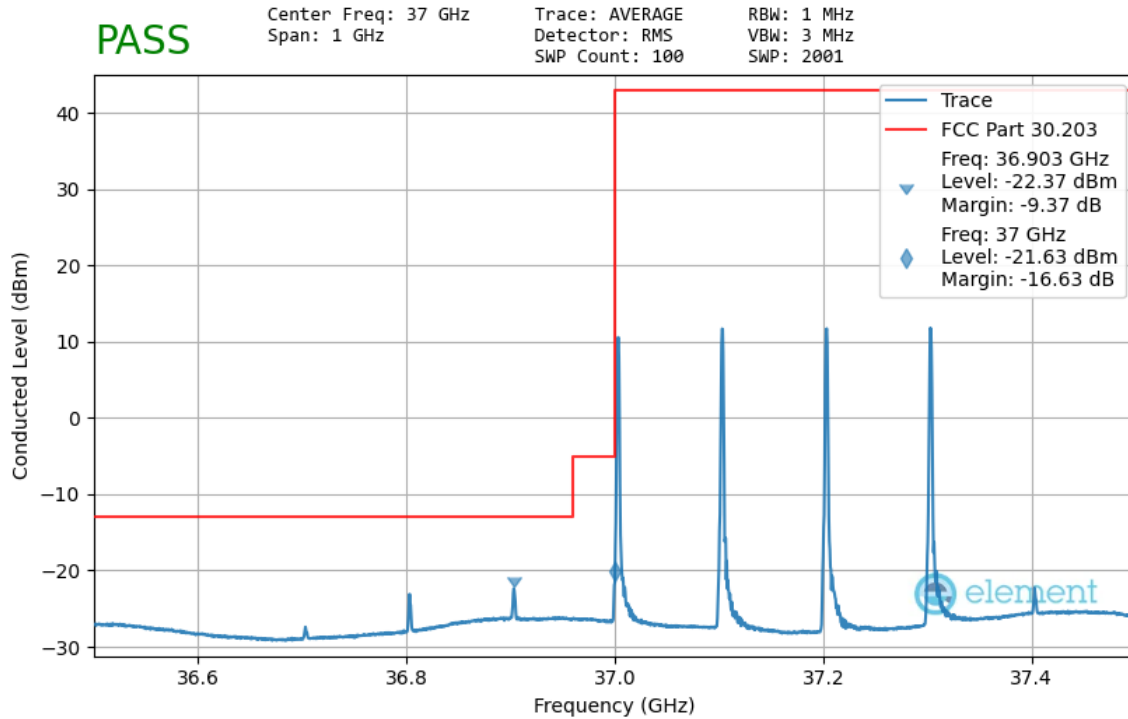


Plot 7-63. Lower Band Edge – DFT-s – MIMO-UL Polarization (100MHz-4CC – QPSK Full RB)

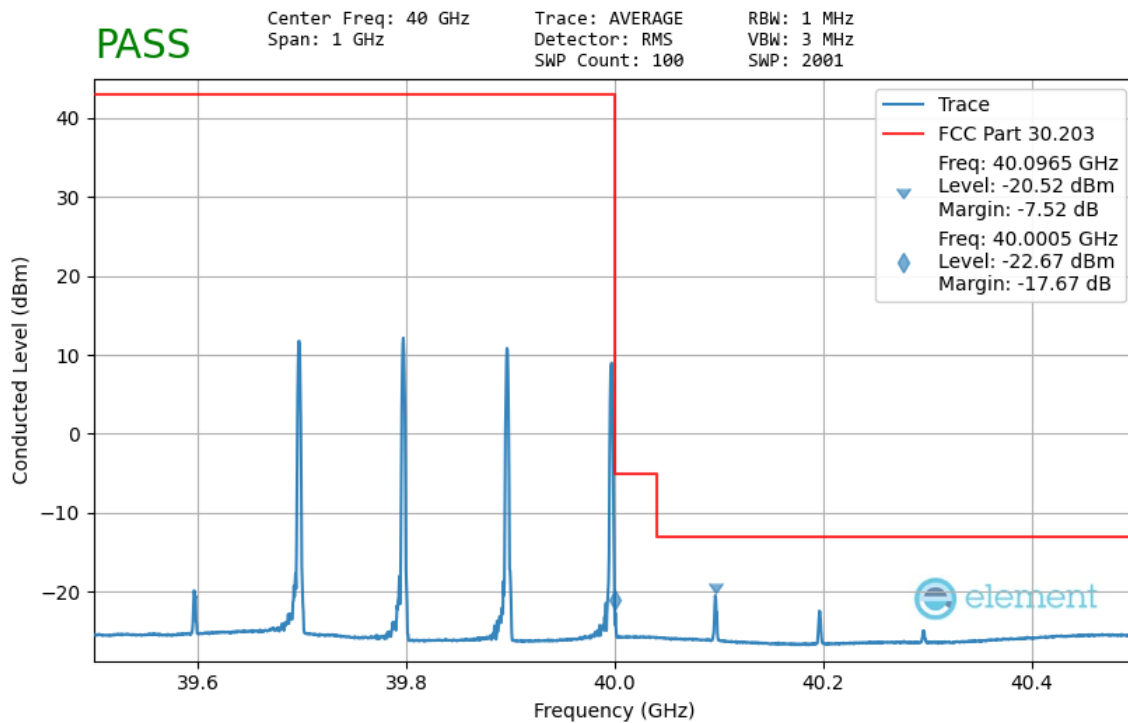


Plot 7-64. Upper Band Edge – DFT-s – MIMO-UL Polarization (100MHz-4CC – QPSK Full RB)

FCC ID: 2AUUU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1M2308080090-01-R2.2AUUU	Test Dates: 08/09 - 10/02/2023	EUT Type: 5G mmWave Repeater	Page 64 of 87



Plot 7-65. Lower Band Edge – DFT-s – MIMO-UL Polarization (100MHz-4CC – QPSK 1RB)



Plot 7-66. Upper Band Edge – DFT-s – MIMO-UL Polarization (100MHz-4CC – QPSK 1RB)

FCC ID: 2AUUV-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1M2308080090-01-R2.2AUUV	Test Dates: 08/09 - 10/02/2023	EUT Type: 5G mmWave Repeater	Page 65 of 87

7.9 Frequency Stability / Temperature Variation

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 C63.26-2015 Section 5.6
KDB 842590 D01 v01r02 Section 4.5

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 connected to a spectrum analyzer via a coaxial cable. The EUT was placed inside an environmental chamber, and the opening for the coaxial cable was sealed with a foam foam plug. The spectrum analyzer was then used to measure changes in the output fundamental frequency of the EUT as the temperature was varied.

Test Notes

The Frequency Deviation column in the table below is the amount of deviation measured from the center frequency of the indicated Reference measurement.

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Band n260 - DU

OPERATING FREQUENCY: 38,499,960,000 Hz
CHANNEL: 2254165
REFERENCE VOLTAGE: 48.00 VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	48.00	+ 20 (Ref)	38,500,661,084	0	0.0000000
100 %		- 30	38,500,659,592	-1,491	-0.0000039
100 %		- 20	38,500,659,094	-1,990	-0.0000052
100 %		- 10	38,500,662,070	986	0.0000026
100 %		0	38,500,658,998	-2,086	-0.0000054
100 %		+ 10	38,500,659,107	-1,977	-0.0000051
100 %		+ 30	38,500,660,817	-266	-0.0000007
100 %		+ 40	38,500,663,973	2,889	0.0000075
100 %		+ 50	38,500,661,592	509	0.0000013
85 %	40.80	+ 20	38,500,661,961	878	0.0000023
115 %	55.20	+ 20	38,500,662,558	1,474	0.0000038

Table 7-20. Frequency Stability Data – DU (n260)

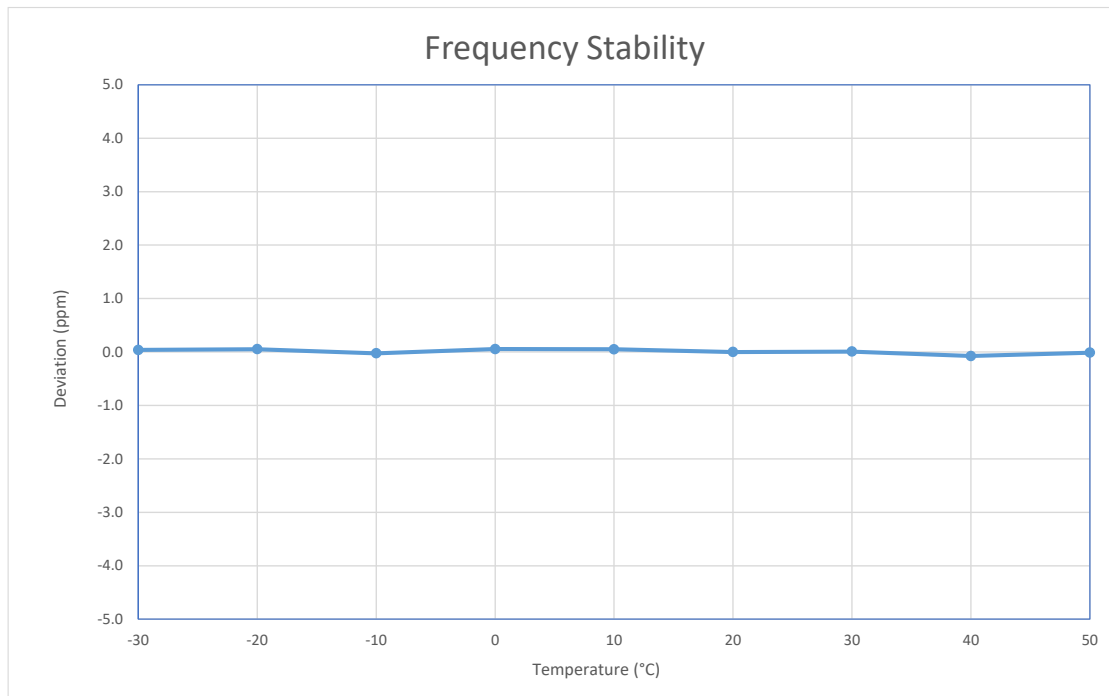


Figure 7-1. Frequency Stability Graph – DU (n260)

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.

FCC ID: 2AUVU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Pivotal Commware 5G mmWave Repeater FCC ID: 2AUVU-5620-12-39** complies with all the requirements of Part 20 and Part 30.

FCC ID: 2AUVU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1M2308080090-01-R2.2AUVU	Test Dates: 08/09 - 10/02/2023	EUT Type: 5G mmWave Repeater	Page 68 of 87

APPENDIX A – 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: Dan Pino
Element Materials Technology
7185 Oakland Mills Road
Columbia, MD 21046
United States

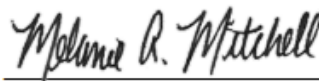
From: Virginia Diodes, Inc
979 2nd St. SE
Suite 309
Charlottesville, VA 22902

Packing List No: 224743
Shipping Date: 11/17/2022

Today's Date: 11/01/2023
PO Number: US37100165PO-1

<u>Quantity</u> <u>Shipped</u>	<u>Unit</u>	<u>Description</u>	<u>Order-Job</u> <u>Number</u>
1	EA	RETEST-VDIWR19.0SAX-M-M4 - WR19SAX (40-60 GHz) / SN: SAX 679	220597-01
1	EA	RETEST-VDIWR12.0SAX-M-M6 - WR12SAX (60-90 GHz) / SN: SAX 680	220597-02

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

FCC ID: 2AUVU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1M2308080090-01-R2.2AUVU	Test Dates: 08/09 - 10/02/2023	EUT Type: 5G mmWave Repeater	Page 69 of 87



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

Certificate of Conformance

To: Element Materials Technology
7185 Oakland Mills Road
Colombia, MD 21046
United States

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

Packing List No: 230051
Shipping Date: 1/5/2023

Today's Date: 11/08/2023
PO Number: US37100165PO-1

<u>Quantity</u>	<u>Unit</u>	<u>Description</u>	<u>Order-Job</u>
1	EA	RETEST-VDIWR8.0SAX-M-M9 - WR8.0SAX (90-140 GHz) / SN: SAX 681	220597-03

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

FCC ID: 2AUVU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1M2308080090-01-R2.2AUVU	Test Dates: 08/09 - 10/02/2023	EUT Type: 5G mmWave Repeater	Page 70 of 87



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

Certificate of Conformance

To: Element Materials Technology
7195 Oakland Mills Road
Columbia, MD 21046
United States

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

Packing List No: 230941
Shipping Date: 3/1/2023

Today's Date: 11/08/2023
PO Number: Warranty

<u>Quantity</u>	<u>Unit</u>	<u>Description</u>	<u>Order-Job</u>
1	EA	REPAIR-VDIWR5.1SAX-M-M18 - WR5.1SAX-M-M18 (140-220 GHz) / SN: SAX 682	R220106PCT

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

FCC ID: 2AUUU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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APPENDIX B – TEST SCOPE ACCREDITATION



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

ELEMENT MATERIALS TECHNOLOGY WASHINGTON DC LLC
(formerly PCTEST)
7185 Oakland Mills Road
Columbia, MD 21046
RJ Ortanez Phone: 410 290 6652

ELECTRICAL

Valid To: May 31, 2024

Certificate Number: 2041.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory at the location listed above, *as well as the three satellite laboratory locations listed below¹*, to perform the following Electromagnetic Compatibility, SAR, HAC, Telecommunications, OTA, Battery, RF, and Conformance and Protocol testing of wireless devices:

Test Technology:

Test Method(s)²:

Emissions

Radiated and Conducted

CFR 47, FCC Part 15B (using ANSI C63.4:2014);
CFR 47, FCC Part 18 (using MP-5:1986);
CFR 47, FCC Parts 15/C/E (without DFS)/F/G/H
(using ANSI C63.10:2013);
CFR 47, FCC Part 15E (with DFS)
(using FCC KDB 905462 D02 (v02));
CFR 47, FCC Part 15D (using ANSI C63.17:2013);
ANSI C63.10:2020; KDB 987594;
ETSI TS 134 124 Universal Mobile Telecommunications System
(UMTS); (3GPP TS 34.124); (3GPP TS38.124 NR;
Electromagnetic Compatibility (EMC) Requirements for Mobile
Terminals and Ancillary Equipment);
ETSI TS 136 124 LTE; Evolved Universal Terrestrial Radio Access
(E-UTRA); (3GPP TS 36.124);
ETSI TS 151 010-1 Digital Cellular Telecommunications System
(Phase 2+) (GSM);
3GPP TS 51.010-1, Section 12 (Conducted and Radiated Spurious
Emissions); EN55011; EN 55032; CNS 13438 (up to 6 GHz);
AS/NZS CISPR 11; IEC/CISPR 11; CISPR 32; FCC OET/MP-5;
ICES-003;
KS C 9811; KS C 9832;
VCCI V-3(2016.11);
VCCI V-3 (2015.04); VCCI 32-1: VCCI-CISPR 32

(A2LA Cert. No. 2041.01) 10/12/2022



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5202 Presidents Court, Suite 220 | Frederick, MD 21703-8515 | Phone: 301 644 3248 | Fax: 240 454 9449 | www.A2LA.org

FCC ID: 2AUVU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Test Technology:

Transmitter/Receiver

Test Method(s)²:

RSS-111; RSS-112; RSS-117; RSS-119; RSS-123; RSS-125;
RSS-127; RSS-130; RSS-131; RSS-132; RSS-133; RSS-134;
RSS-135; RSS-137; RSS-139; RSS-140; RSS-141; RSS-142;
RSS-170; RSS-181; RSS-182; RSS-191; RSS-192; RSS-194;
RSS-195; RSS-196; RSS-197; RSS-199; RSS-210; RSS-211;
RSS-213; RSS-215; RSS-216; RSS-220; RSS-222; RSS-236;
RSS-238; RSS-243; RSS-244; RSS-246; RSS-247; RSS-248;
RSS-251; RSS-252; RSS-287; RSS-288; RSS-310; RSS-Gen

SAR/RF Exposure

IEEE 1528-2013; RSS-102;
EN 50360-2017; EN 62209-1:2016; EN 62209-2:2010/A1:2019;
IEC 62209-1 2nd Edition 2016; IEC 62209-2 2010;
IEC PAS 63083-2017; EN 50566-2017; IEC 62209-2 AMD 1;
Australian Communications Authority Radio Communications
(Electromagnetic Radiation – Human Exposure) Standard 2014;
ARPANSA RPS S-1(Rev.1):2021; Australia Radiocommunications
Equipment (General) Rules 2021;
FCC KDB 447498 D01, D02, D03 and D04;
FCC KDB 616217 D04;
FCC KDB 643646 D01;
FCC KDB 865664 D01 and D02;
FCC KDB 941225 D01, D05, D05A, D06, and D07;
EN 50401:2017; EN 50385:2017; IEC 62311:2008;
IEC 62479:2010; EN 62479:2010; EN 50663:2017;
EN 62311:2007; EN 62232:2017; IEC 62232:2017;
IEEE C95.1-1992; IEEE C95.1-2005; IEEE C95.1: 2019;
IEEE C95.3-2002; IEEE C95.3-2021; IEC/IEEE 63195-1:2022;
RSS-102 Measurement (SAR, RF Exp., NS, LPD); SPR-003;
SPR-002; SPR-001; SPR-004; SPR-APD;
IEC TR 62630:2010; IEEE C95.3.1:2010; IEC TR 63170:2018;
AS/NZS 2772.2:2016; EN 62209-3: 2019; IEC 62209-3:2019;
ICNIRP (100kHz – 300 GHz):2020;
IEC 62311:2019; EN 62311:2020; IEC/IEEE 62209-1528:2020;
EN IEC/IEEE 62209-1528; IEC PAS 63184:2021;
RRA Public Notification 2018-18, December 7, 2018
KS C 3370-1, KS C 3370-2

Hearing Aid Compatibility

ANSI C63.19:2011; ANSI C63.19:2019;
CTIA Test Plan for Hearing Aid Compatibility v.3.1.1 (2017);
RSS-HAC; ANSI/TIA-5050-2018

United States Radio

47 CFR FCC Parts 20, 22, 24, 25, 27, 30, 73, 74, 80, 87, 90, 95,
96, 97, 101 (using ANSI/TIA-603-E, TIA-102.CAAA-E,
ANSI C63.26:2015)

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Test Technology:

European Radio

Taiwan Radio

Korean Radio

Australia/New Zealand Radio

RF, Protocol, and RRM Conformance
5G NR

Test Method(s)²:

ETSI EN 302 065-1; ETSI EN 302 065-2; ETSI EN 302 065-3;
ETSI EN 302 065-4; ETSI EN 302 291-1; ETSI EN 302 291-2;
ETSI EN 302 502; ETSI EN 302 510-1; ETSI EN 302 510-2;
ETSI EN 302 537; ETSI EN 301 511; ETSI EN 301 839;
ETSI EN 301 893; ETSI EN 301 893; ETSI EN 301 908-1;
ETSI EN 301 908-13; ETSI EN 300 220-2;
ETSI EN 300 220-3-1; ETSI EN 300 220-3-2;
ETSI EN 300 220-4; ETSI EN 300 328; ETSI EN 300 328;
ETSI EN 300 330; ETSI EN 300 440; ETSI EN 300 440-2

LP0002; DGT LP0002

Regulations on Radio Equipment
(MSIT Ordinance MSIT No. 86, Jan. 4, 2022);
Unlicensed Radio Equipment Established Without Notice
(MSIT Public Notification 2022-20, May 10, 2022);
Technical Requirements for the Human Protection against
Electromagnetic Waves
(MSIT Public Notification 2019-4, January 16, 2019);
Equipment to be Subject of the Test Procedure for Electromagnetic
Field Strength and Specific Absorption Rate
(RRA Public Notification (2021-16, October 12, 2021);
Technical Requirements for Radio Equipment for
Telecommunication Services
(RRA Public Notification 2022-15 July 29, 2022);
Technical Requirements for Measurement and Test Procedure of
Specific Absorption Rate
(RRA Public Notification 2018-18, Dec 7, 2018);
Technical Requirements for Measurement of Electromagnetic Field
Strength (RRA Public Notification 2021-22 Nov 29, 2021);
KS X 3123; KS X 3142; KS X 3270; KS X 3271

AS/NZS 4268:2017

3GPP TS 38.508-1; 3GPP TS 38.508-2; 3GPP TS 38.521-1;
3GPP TS 38.521-2; 3GPP TS 38.521-3; 3GPP TS 38.521-4;
3GPP TS 38.522; 3GPP TS 38.523-1; 3GPP TS 38.523-2;
3GPP TS 38.523-3; 3GPP TS 38.533; 3GPP TS 34.229-5;
VZW 5G NR FR2 RFOTA;
VZW 5G Protocol Pre-Conformance (TS 38.523-1);
VZW 5G NR FR1 Supp RF;
VZW 5G NR RF Pre Conformance (TS 38.521-3);
VZW 5G NR Radio Resource Management (RRM)
Pre-Conformance (TS 38.533); 5G NR FR1 Performance/DEMOM
Pre Conformance (TS 38.521-4); VZW 5G NR SA Data Retry;
VZW 5G NR SA Voice Services Fallback

(A2LA Cert. No. 2041.01) 10/12/2022

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FCC ID: 2AUVU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Test Technology:

Test Method(s)²:

5G NR (cont.)

VZW 5G NR SA Voice, VZW Video and Messaging; VZW 5G NR SA System Selection; VZW 5G WEA TP; VZW 5G Iconography AT&T 10776 Test Plans(5G/4G/3G/2G)

LTE

3GPP TS 36.521-1; 3GPP TS 36.521-3; 3GPP TS 36.523-1; 3GPP 37.571-1; 3GPP 37.571-2; 3GPP TS 34.229-1; ETSI EN 301 908-13 Version 13.1.1 (2019-11); 3GPP Carrier Aggregation; PTCRB NAPRD.03; PTCRB PPMD; PTCRB Cat-M (per RFT132 eMTC); PVG.09 LTE Data Throughput & TR 37.901 Data Throughput Performance; PVG.04 PTCRB Radiated Spurious Emissions; Global Certification Forum (GCF-CC) Certification / LTE Field Test (TS.11); 3GPP Cat-NB & Cat-M; MetroPCS Lab Conformance; AT&T LTE Conformance; AT&T IoT Accelerator Conformance, 19263; VZW Lab Conformance; VZW Supl RF; VZW FR2 Supplementary RF, VZW FR1 Supplementary RF; VZW Supl Signaling Conformance; VZW Supl RRM; VZW LTE LBS Performance; VZW Safe for Network (SFN), VZW Phase 1, VZW Open Development and Field Interoperability Testing (FIT) ³; VZW Network Extender; VZW PCO; VZW Data Retry; VZW Data Throughput; VZW SMS; VZW AT Commands; VZW CMAS; VZW eMBMS; VZW APN; VZW Cat-M VoLTE; Live Network Extender and Android Test Plan; USCC Lab Conformance; KDDI LTE Device Testing; SoftBank LTE Testing

WCDMA (UTRA)

3GPP TS 34.121-1; 3GPP TS 34.123-1; SoftBank Mobile WCDMA Testing

SVLTE / Multimode

E911 Data Call Processing; Stress Testing; RSSI for MM Devices; LTE LBS Performance; VZW Multimode Supl Signaling; VZW Multimode SMS; VZW Multimode Data Retry

VoLTE

IMS VoIP; Rich Communication Services (RCS); IMS Registration and Retry; ePDG Live Network; E911 for VoLTE; VZW hVoLTE; VZW VoIP and VT Performance; VZW Interband RRM and Protocol

Carrier Aggregation

VZW Carrier Aggregation Supplementary RF; VZW Carrier Aggregation Data Throughout

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Test Technology:

UICC

Test Method(s)²:

USIM/USAT/CSIM/ISIM Interaction Test Plan
(LTE/WCDMA/GSM/CDMA/MM);
3GPP TS 31.121; 3GPP TS 31.124;
ETSI TS 102 230;
SIM Application Interaction Test Plan;
UICC USIM ISIM Electrical;
UICC USIM ISIM Protocol
(LTE/WCDMA/GSM/CDMA);
SWP/HCI ETSI TS 102 694-1; ETSI TS 102 695-1

SunSpec Alliance

SunSpec – CSIP (Common Smart Inverter Profile) Conformance
Test Procedures;
SunSpec – Advanced Function Inverter Test Lab Specification;
SunSpec – UL1741 Supplement SA/Rule 21 Implementation
Guide;
IEEE 2030.5-2018 Smart Energy Profile Application Protocol

CBRS - OnGo/WinnForum

OnGo Alliance Certification Test Plan;
WinnForum Conformance and Performance Test Technical
Specification, WINNF-TS-0122

¹ This accreditation covers testing performed at the main laboratory listed above, and the three satellite laboratories listed below:

ELEMENT MATERIALS TECHNOLOGY WASHINGTON DC LLC
(formerly PCTEST)
7195 Oakland Mills Rd, Suite A
Columbia, MD

Test Technology:

Emissions
Radiated and Conducted

Test Method(s)²:

CFR 47, FCC Part 15B (using ANSI C63.4:2014);
CFR 47, FCC Part 18 (using MP-5:1986);
CFR 47, FCC Parts 15/C/E (without DFS)/F/G/H
(using ANSI C63.10:2013;
CFR 47, FCC Part 15E (with DFS)
(using FCC KDB 905462 D02 (v02));
CFR 47, FCC Part 15D (using ANSI C63.17:2013);
ANSI C63.10:2020; KDB 987594;
ETSI TS 134 124 Universal Mobile Telecommunications System
(UMTS); (3GPP TS 34.124);
ETSI TS 136 124 LTE; Evolved Universal Terrestrial Radio
Access (E-UTRA); (3GPP TS 36.124); (3GPP TS38.124 NR;
Electromagnetic Compatibility (EMC) Requirements for Mobile
Terminals and Ancillary Equipment);
ETSI TS 151 010-1 Digital Cellular Telecommunications System
(Phase 2+) (GSM); 3GPP TS 51.010-1, Section 12 (Conducted
and Radiated Spurious Emissions); EN55011; EN 55032;

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Test Technology:

Radiated and Conducted (cont.)

Transmitter/Receiver

Hearing Aid Compatibility

United States Radio

European Radio

Taiwan Radio

Korean Radio

Test Method(s) ²:

CNS 13438 (up to 6 GHz); AS/NZS CISPR 11; IEC/CISPR 11;
CISPR 32; FCC OET/MP-5; ICES-003;
KS C 9811; KS C 9832;
VCCI V-3(2016.11); VCCI V-3 (2015.04); VCCI 32-1;
VCCI-CISPR 32

RSS-111; RSS-112; RSS-117; RSS-119; RSS-123; RSS-125;
RSS-127; RSS-130; RSS-131; RSS-132; RSS-133; RSS-134;
RSS-135; RSS-137; RSS-139; RSS-140; RSS-141; RSS-142;
RSS-170; RSS-181; RSS-182; RSS-191; RSS-192; RSS-194;
RSS-195; RSS-196; RSS-197; RSS-199; RSS-210; RSS-211;
RSS-213; RSS-215; RSS-216; RSS-220; RSS-222; RSS-236;
RSS-238; RSS-243; RSS-244; RSS-246; RSS-247; RSS-248;
RSS-251; RSS-252; RSS-287; RSS-288; RSS-310; RSS-Gen
No IS

ANSI C63.19:2011; ANSI C63.19:2019;
CTIA Test Plan for Hearing Aid Compatibility v.3.1.1 (2017);
RSS-HAC; ANSI/TIA-5050-2018

47 CFR FCC Parts 20, 22, 24, 25, 27, 30, 73, 74, 80, 87, 90, 95,
96, 97, 101 (using ANSI/TIA-603-E, TIA-102.CAAA-E,
ANSI C63.26:2015)

ETSI EN 302 065-1; ETSI EN 302 065-2; ETSI EN 302 065-3;
ETSI EN 302 065-4; ETSI EN 302 291-1; ETSI EN 302 291-2;
ETSI EN 302 502; ETSI EN 302 510-1; ETSI EN 302 510-2;
ETSI EN 302 537; ETSI EN 301 511; ETSI EN 301 839;
ETSI EN 301 893; ETSI EN 301 893; ETSI EN 301 908-1;
ETSI EN 301 908-13; ETSI EN 300 220-1; ETSI EN 300 220-2;
ETSI EN 300 328; ETSI EN 300 328; ETSI EN 300 330;
ETSI EN 300 440; ETSI EN 300 440-2

LP0002 (2020); DGT LP0002

Regulations on Radio Equipment
(MSIT Ordinance MSIT No. 86, Jan. 4, 2022);
Unlicensed Radio Equipment Established Without Notice
(MSIT Public Notification
2022-20, May 10, 2022);
Technical Requirements for the Human Protection against
Electromagnetic Waves
(MSIT Public Notification 2019-4, January 16, 2019);
Equipment to be Subject of the Test Procedure for
Electromagnetic Field Strength and Specific Absorption Rate
(RRA Public Notification (2021-16, October 12, 2021);
Technical Requirements for Radio Equipment for
Telecommunication Services
(RRA Public Notification 2022-13 Jun 28, 2022);

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Test Technology:

Korean Radio (cont.)

Australia/New Zealand Radio

OTA

Wired and Wireless Conformance

CTIA IoT Security

SunSpec Alliance

CBRS - OnGo/WinnForum

Test Method(s) ²:

Technical Requirements for Measurement and Test Procedure of Specific Absorption Rate (RRA Public Notification 2018-18, Dec 7, 2018); Technical Requirements for Measurement of Electromagnetic Field Strength (RRA Public Notification 2021-22 Nov 29, 2021); KS X 3123; KS X 3142; KS X 3270; KS X 3271

AS/NZS 4268:2017

CTIA Test Plan for Wireless Device Over-the-Air Performance PTCRB NAPRD03; PTCRB PPMD; VZW OTA Radiated Performance for CDMA & LTE Multimode Devices; VZW LTE Over the Air Radiated Performance Test Plan; VZW Location Determination Test Plan; VZW LTE-LBS Performance Test Plan; T-Mobile Radiated Performance TRD; AT&T 13340 OTA; AT&T IoT Accelerator; USCC CDMA Over The Air Radiated Test Plan; USCC LTE Over The Air Radiated Test Plan; CTIA Test Plan for RF Performance Evaluation of Wi-Fi Mobile Converged Devices (Wi-Fi Alliance); GSMA TS.24 Operator Acceptance Values for Device Antenna Performance; 3GPP TS 34.114 Technical Specification UE/MS OTA Antenna Performance; 3GPP TS 37.544 Technical Specification UTRA & E-UTRA UE OTA Antenna Performance

CTIA Cybersecurity Certification Test Plan for IoT Devices

SunSpec – CSIP (Common Smart Inverter Profile) Conformance Test Procedures; SunSpec – Advanced Function Inverter Test Lab Specification; SunSpec – UL1741 Supplement SA/Rule 21 Implementation Guide; IEEE 2030.5-2018 Smart Energy Profile Application Protocol

OnGo Alliance Certification Test Plan; WinnForum Conformance and Performance Test Technical Specification, WINNF-TS-0122

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ELEMENT MATERIALS TECHNOLOGY WASHINGTON DC LLC
(formerly PCTEST)
9017-F/G Mendenhall Court
Columbia, MD 21045

Test Technology:

Battery Safety

Test Method(s) ²:

IEEE 1725 Standard for Rechargeable Batteries for Cellular Telephones;
CTIA Certification Requirements for Battery System Compliance to IEEE 1725;
- Exclusions: Section 6.2 (DC-DC testing only);
Section 7 (Certified Adapters only);
IEEE 1625 Standard for Rechargeable Batteries for Multi-Cell Mobile Computing Devices;
CTIA Certification Requirements for Battery System Compliance to IEEE 1625;
UL1642 Standard for Lithium Batteries;
UL 2054 Household and Commercial Batteries;

IEC 62133-2 Secondary Cells and Batteries containing Alkaline or other Non-Acid Electrolytes – Safety Requirements for Portable Sealed Secondary Cells & Batteries made from them, for use in Portable Applications

IEC 61960-3 Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium and batteries for portable applications – Part 3: Prismatic and cylindrical lithium secondary cells, and batteries made from them

UNDOT
Battery Transportation Safety

United Nations Document ST/SG/AC.10/11/Section 38.3
Recommendations on the Transport of Dangerous Goods;
Manual of Tests and Criteria;
IEC 62281 – Safety of Primary and Secondary Lithium Cells and Batteries During Transport

Aerospace - Battery Performance and Safety

NASA Specification for Acceptance Testing of Commercial Lithium-Ion Cell Lots Engineering Directorate Propulsion & Power Division, EP-WI-031

Hardware Reliability

CTIA Device Hardware Reliability Test Plan

Determining Battery Life

CTIA Battery Life Test Plan

ESD Immunity

EN/IEC 61000-4-2

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3801 E. Plano Parkway, Ste 150
Plano, TX 75074

<u>Test Technology:</u>	<u>Test Method(s) ²:</u>
Radiated Emissions (10 Meter Test Distance) (Frequency Range, 30 MHz – 1 GHz)	CFR 47, FCC Parts 15B (using ANSI C63.4:2014); EN55011; EN 55032; CNS 13438 (up to 6 GHz); AS/NZS CISPR 11; IEC/CISPR 11; CISPR 32; FCC OET/MP-5; ICES-003; KS C 9811; KS C 9832; VCCI V-3(2016.11); VCCI V-3 (2015.04); VCCI 32-1; VCCI-CISPR 32
EMC	ETSI EN 301 489-1; ETSI EN 301 489-3; ETSI EN 301 489-17; ETSI EN 301 489-19; ETSI EN 301 489-52; EN 55024
2.4 GHz Wi-Fi & BT RF	ETSI EN 300 328
5 GHz W-Fi	ETSI EN 301 893
GPS	ETSI EN 303 413
SRD1	ETSI EN 300 440; ETSI EN 300 330
LTE RF	ETSI EN 301 908-1; ETSI EN 301 908-13
WCDMA RF	ETSI EN 301 908-1; ETSI EN 301 908-2
GSM RF	ETSI EN 301 511

² When the date, edition, version, etc. is not identified in the scope of accreditation, laboratories may use the version that immediately precedes the current version for a period of one year from the date of publication of the standard measurement method, per part C., Section 1 of A2LA R101 - *General Requirements- Accreditation of ISO-IEC 17025 Laboratories*.

Testing Activities Performed in Support of FCC Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A. ³:

Rule Subpart/Technology	Test Method	Maximum Frequency
<u>Unintentional Radiators</u> Part 15B	ANSI C63.4:2014	40000 MHz
<u>Industrial, Scientific, and Medical Equipment</u> Part 18	FCC MP-5 (February 1986)	330000 MHz
<u>Intentional Radiators</u> Part 15C	ANSI C63.10:2013	330000 MHz
<u>Unlicensed Personal Communication</u>		

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Testing Activities Performed in Support of FCC Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A.³:

Rule Subpart/Technology	Test Method	Maximum Frequency
<u>Systems Devices</u>		
Part 15D	ANSI C63.17:2013	20000 MHz
<u>U-NII without DFS Intentional Radiators</u>		
Part 15E	ANSI C63.10:2013	40000 MHz
<u>U-NII with DFS Intentional Radiators</u>		
Part 15E	FCC KDB 905462 D02 (v02)	40000 MHz
<u>UWB Intentional Radiators</u>		
Part 15F	ANSI C63.10:2013	200000 MHz
<u>BPL Intentional Radiators</u>		
Part 15G	ANSI C63.10:2013	40000 MHz
<u>White Space Device Intentional Radiators</u>		
Part 15H	ANSI C63.10:2013	40000 MHz
<u>Commercial Mobile Services (FCC Licensed Radio Service Equipment)</u>		
Parts 22 (cellular), 24, 25 (below 3 GHz), and 27	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	330000 MHz
<u>General Mobile Radio Services (FCC Licensed Radio Service Equipment)</u>		
Parts 22 (non-cellular), 90 (below 3 GHz), 95 (below 3 GHz), 97 (below 3 GHz), and 101 (below 3 GHz)	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	330000 MHz
<u>Citizens Broadband Radio Services (FCC Licensed Radio Service Equipment)</u>		
Part 96	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	330000 MHz
<u>Maritime and Aviation Radio Services</u>		
Parts 80 and 87	ANSI/TIA-603-E; ANSI C63.26:2015	330000 MHz
<u>Microwave and Millimeter Bands Radio Services</u>		
Parts 25, 30, 74, 90 (above 3 GHz), 95 (above 3 GHz), 97 (above 3 GHz), and 101	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	330000 MHz
<u>Broadcast Radio Services</u>		
Parts 73 and 74 (below 3 GHz)	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	330000 MHz
<u>RF Exposure</u>		

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Testing Activities Performed in Support of FCC Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A.³:

Rule Subpart/Technology	Test Method	Maximum Frequency
Devices Subject to SAR Requirements	IEEE Std 1528:2013	6000 MHz
<u>Hearing Aid Compatibility</u> Part 20 (HAC for Commercial Mobile Services)	ANSI C63.19:2011	6000 MHz
<u>Signal Boosters</u> Part 20 (Wideband Consumer Signal Boosters, Provider-specific signal boosters, and Industrial Signal Boosters) Section 90.219	ANSI C63.26:2015	330000 MHz

³Accreditation does not imply acceptance to the FCC equipment authorization program. Please see the FCC website (<https://apps.fcc.gov/oetcf/eas/>) for a listing of FCC approved laboratories.

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Accredited Laboratory

A2LA has accredited

ELEMENT MATERIALS TECHNOLOGY WASHINGTON DC LLC

Columbia, MD

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 12th day of October 2022.



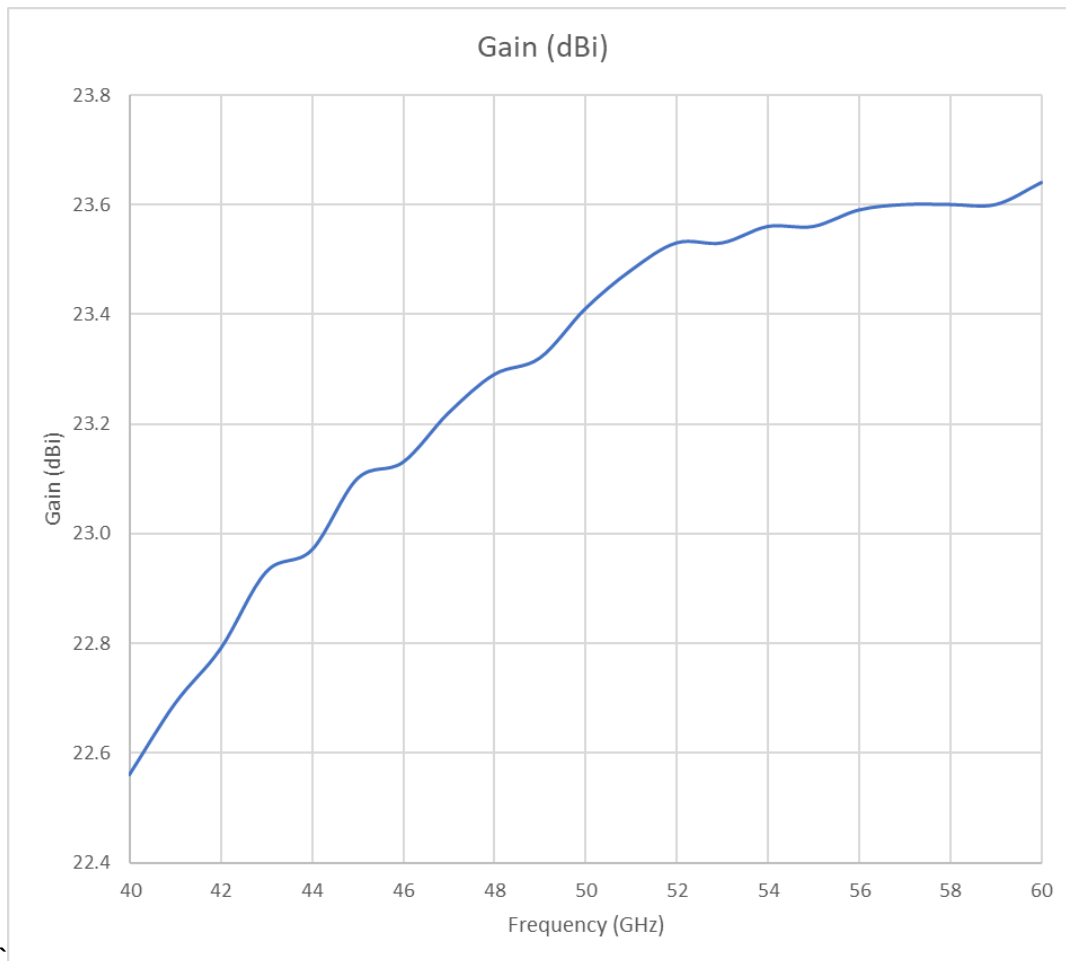
Mr. Trace McInturf, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2041.01
Valid to May 31, 2024

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

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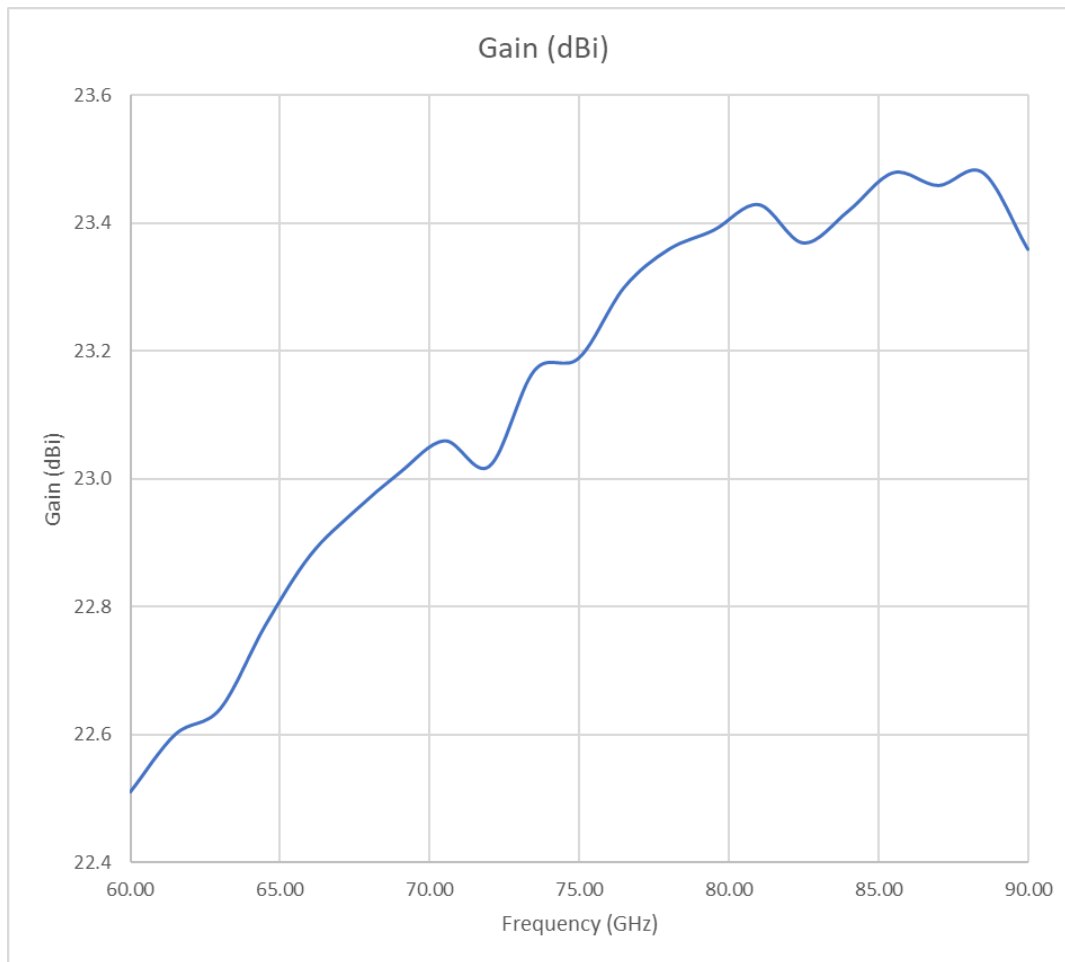
APPENDIX C – HORN ANTENNA GAIN CURVES

OML M19RH Horn Antenna Gain (40 – 60GHz)



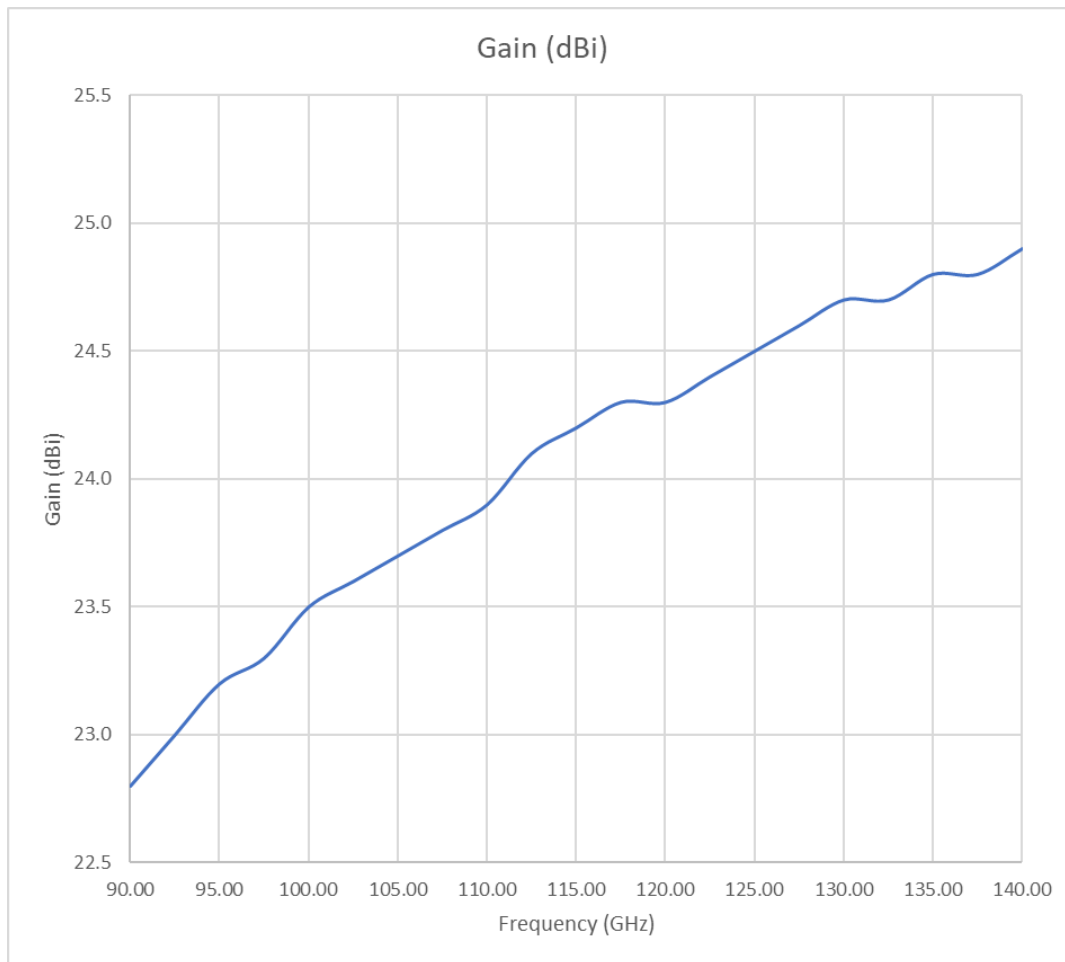
FCC ID: 2AUVU-5620-12-39		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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OML M12RH Horn Antenna Gain (60 – 90GHz)



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OML M08RH Horn Antenna Gain (90 – 140GHz)



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OML M05RH Horn Antenna Gain (140 – 220GHz)



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