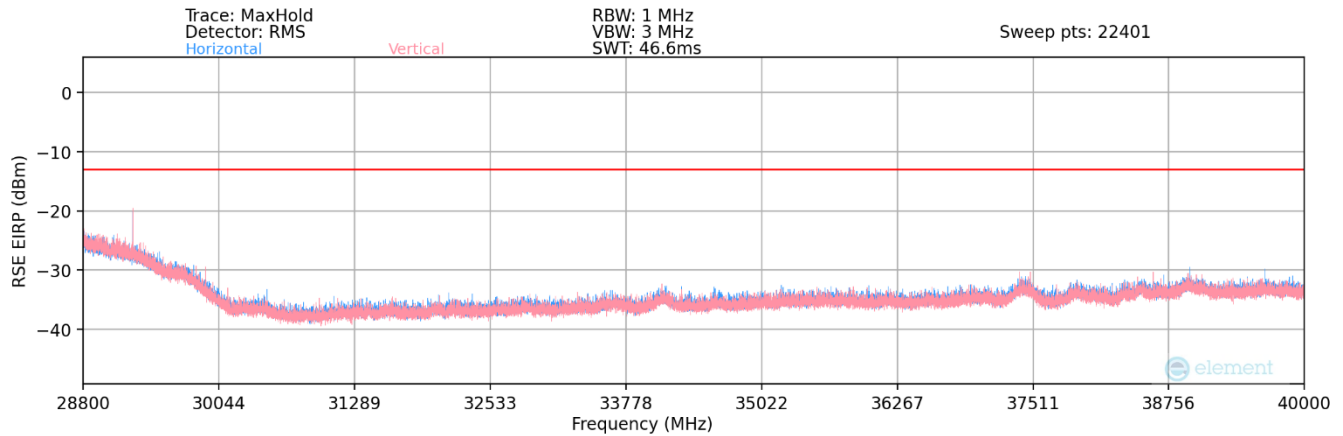


28.35GHz - 40GHz



Plot 7-106 n261 Radiated Spurious Plot (1CC QPSK Mid Channel) - SU

Spurious Emissions EIRP Sample Calculation (n261)

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]
29655.00	Low	50	MIMO	QPSK	52	354	-20.29	-13.00	-7.29
29255.00	Mid	50	MIMO	QPSK	146	353	-18.06	-13.00	-5.06
28855.00	High	50	MIMO	QPSK	335	354	-16.38	-13.00	-3.38

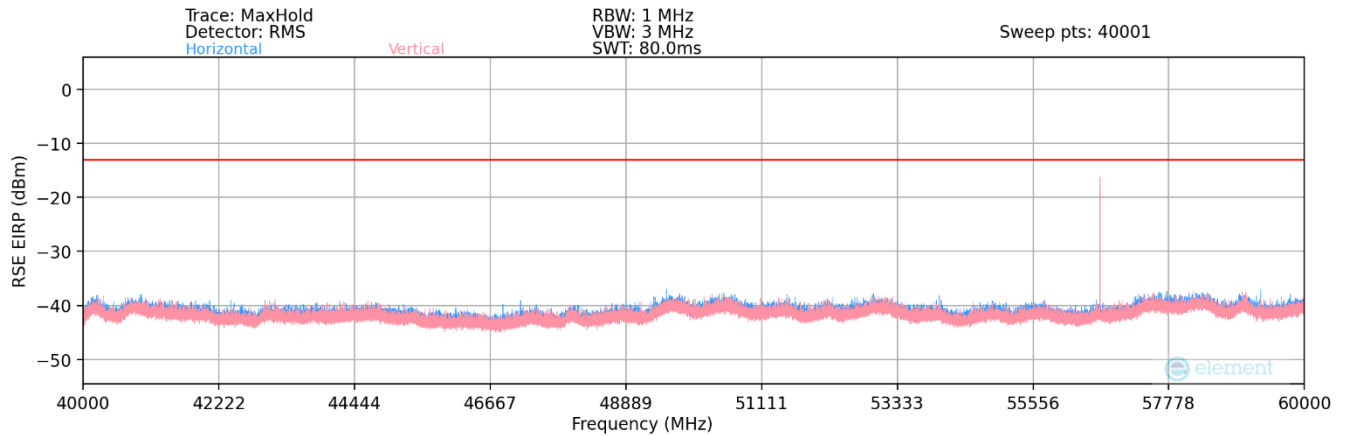
Table 7-24. n261 Radiated Spurious Emissions Table (28.35GHz - 40GHz) - SU

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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40GHz - 60GHz



Plot 7-107. n261 Radiated Spurious Plot (1CC QPSK Mid Channel) - SU

Spurious Emissions EIRP Sample Calculation (n261)

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.

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

Frequency [MHz]	Channel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [degrees]	Turntable Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
55050.00	Low	50	MIMO	QPSK	107	333	-16.65	-13.00	-3.65
55849.92	Mid	50	MIMO	QPSK	123	338	-16.29	-13.00	-3.29
56649.84	High	50	MIMO	QPSK	128	338	-14.58	-13.00	-1.58

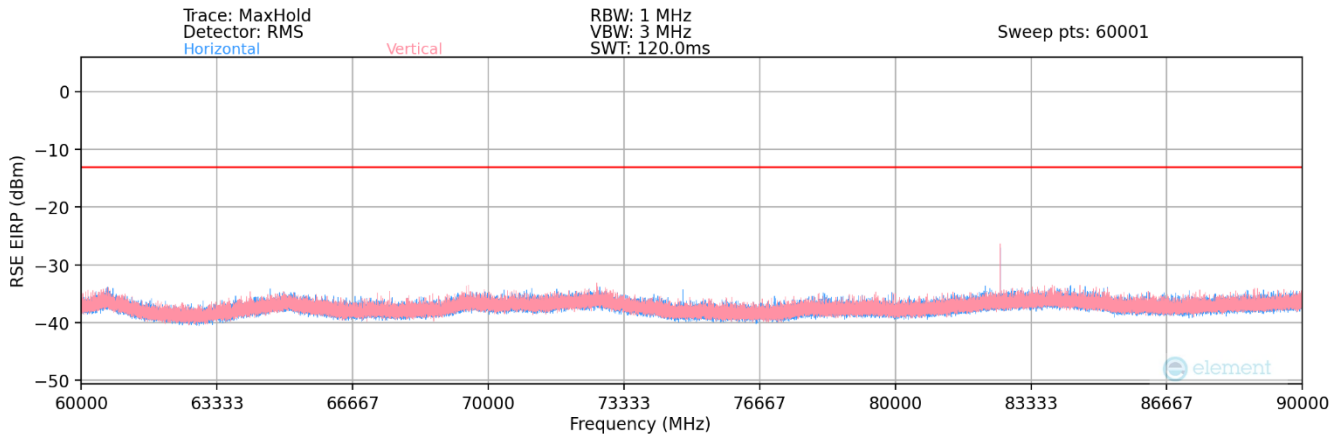
Table 7-25. n261 Radiated Spurious Emissions Table (40GHz - 60GHz) - SU

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 meters.

FCC ID: 2AUVU-5620-23-28		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
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60GHz - 90GHz



Plot 7-108. n261 Radiated Spurious Plot (1CC QPSK Mid Channel) - SU

Spurious Emissions EIRP Sample Calculation (n261)

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.

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

Frequency [MHz]	Channel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [degrees]	Turntable Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
82575.00	Low	50	MIMO	QPSK	99	0	-23.68	-13.00	-10.68
83774.88	Mid	50	MIMO	QPSK	95	1	-27.80	-13.00	-14.80
84974.76	High	50	MIMO	QPSK	97	0	-30.89	-13.00	-17.89

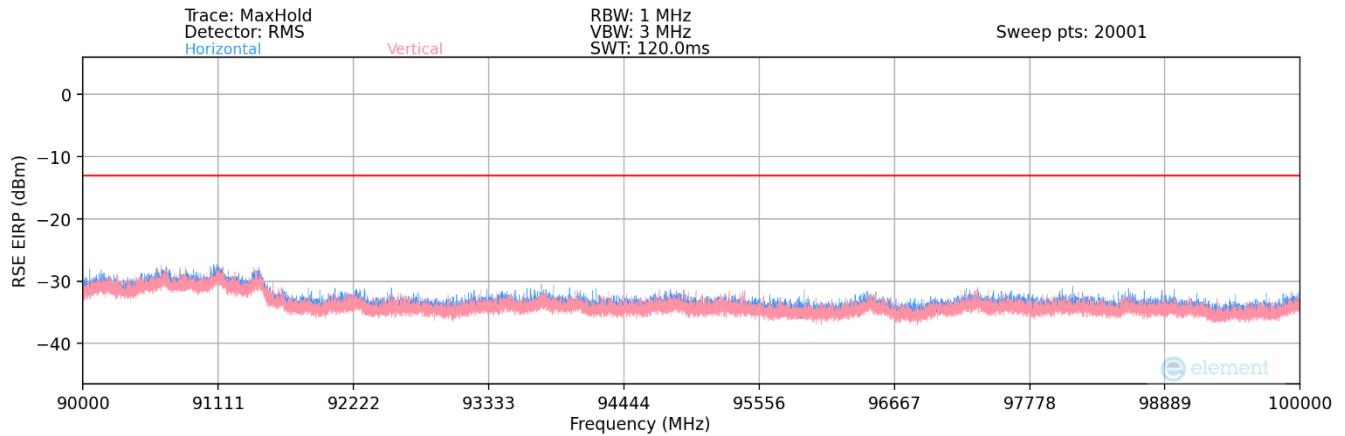
Table 7-26. n261 Radiated Spurious Emissions Table (60GHz - 90GHz) - SU

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.

FCC ID: 2AUVU-5620-23-28		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
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90GHz - 100GHz



Plot 7-109. n261 Radiated Spurious Plot (1CC QPSK Mid Channel) - SU

Spurious Emissions EIRP Sample Calculation (n261)

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.

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

Frequency [MHz]	Channel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [degrees]	Turntable Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
91154.00	Low	50	MIMO	QPSK	-	-	-26.16	-13.00	-13.16
95234.00	Mid	50	MIMO	QPSK	-	-	-30.75	-13.00	-17.75
99412.00	High	50	MIMO	QPSK	-	-	-31.31	-13.00	-18.31

Table 7-27. n261 Radiated Spurious Emissions Table (90GHz - 100GHz) - SU

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

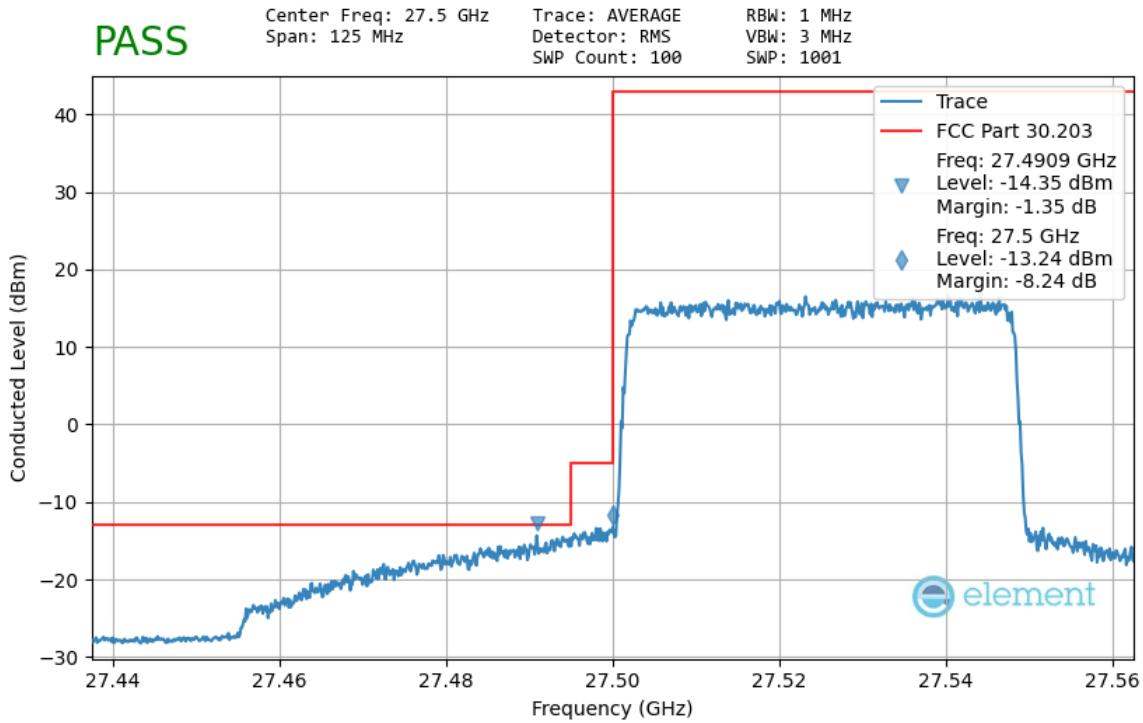
1. Start and stop frequency were set such that both upper and lower band edges are measured.
2. Span was set large enough so as to capture all out of band emissions near the band edge.
3. RBW = 1MHz
4. VBW $\geq 3 \times$ RBW
5. Detector = RMS
6. Trace mode = trace averaging (RMS) over 100 sweeps
7.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

Test Notes

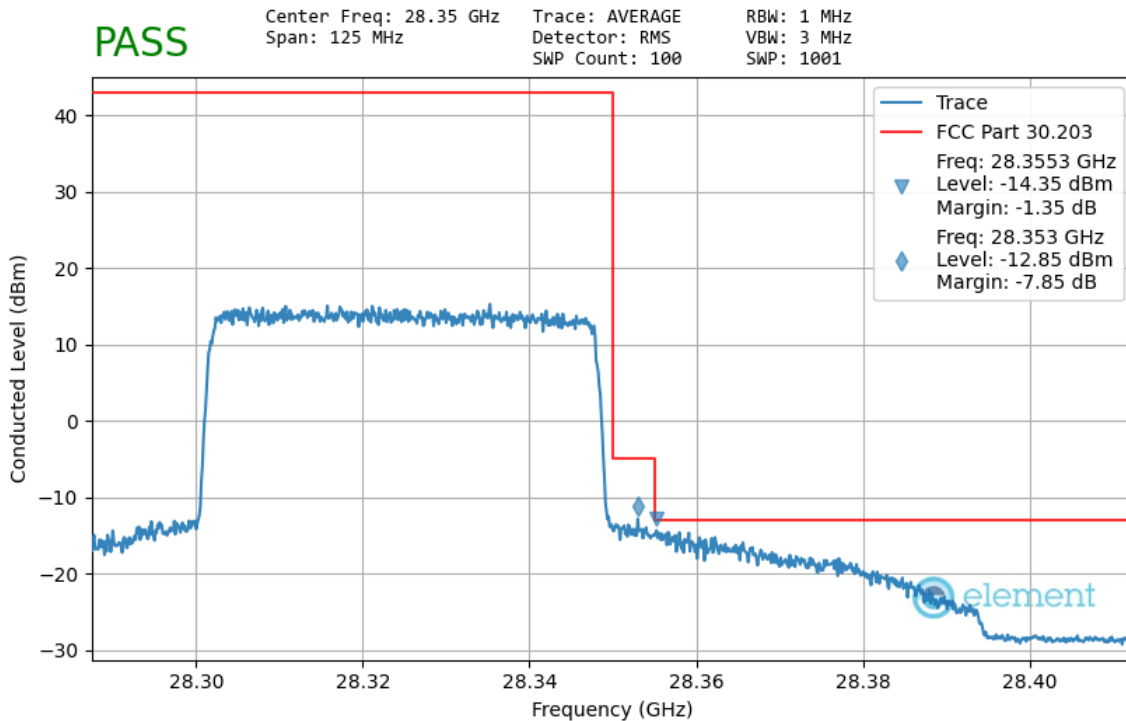
- 1) For FCC Part 30 compliance, all combinations of 5G NR component carriers, bandwidths, and RB allocations were fully investigated and only the worst case scenarios have been included in this section.
- 2) Per previous guidance from FCC specifically to Element lab, both stimulus conditions – a single 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).

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Band n261 – SU (DFT-s-OFDM)

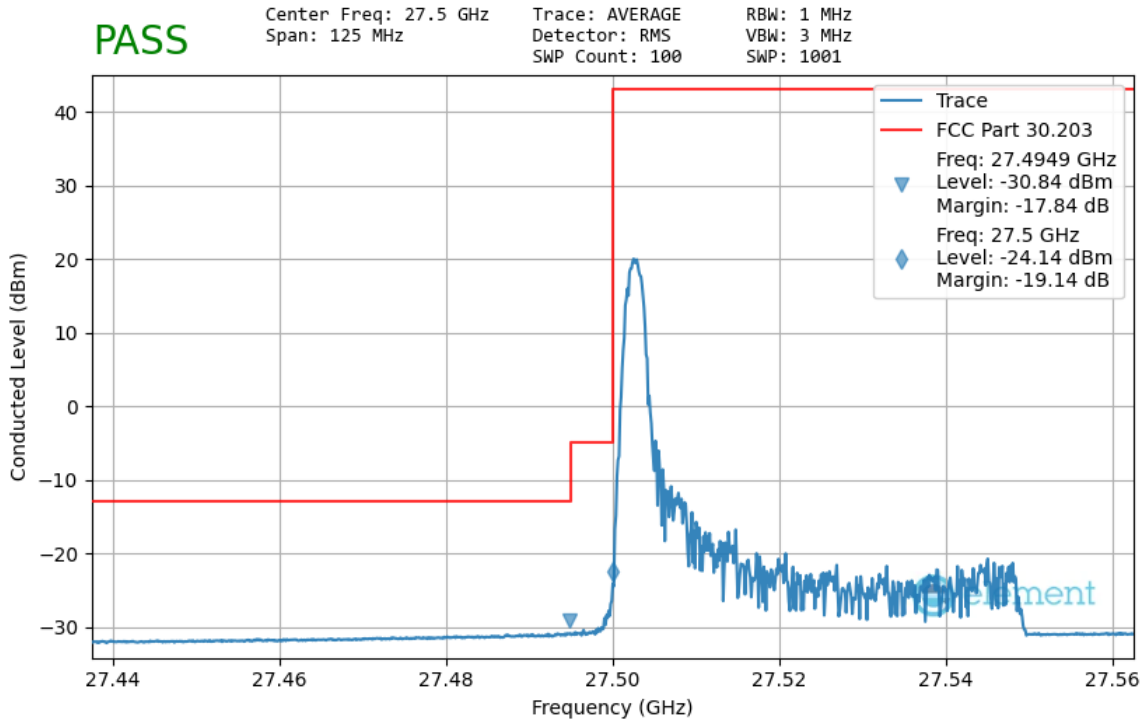


Plot 7-110. Lower Band Edge – DFT-s – MIMO-DL Polarization (50MHz-1CC – QPSK Full RB)

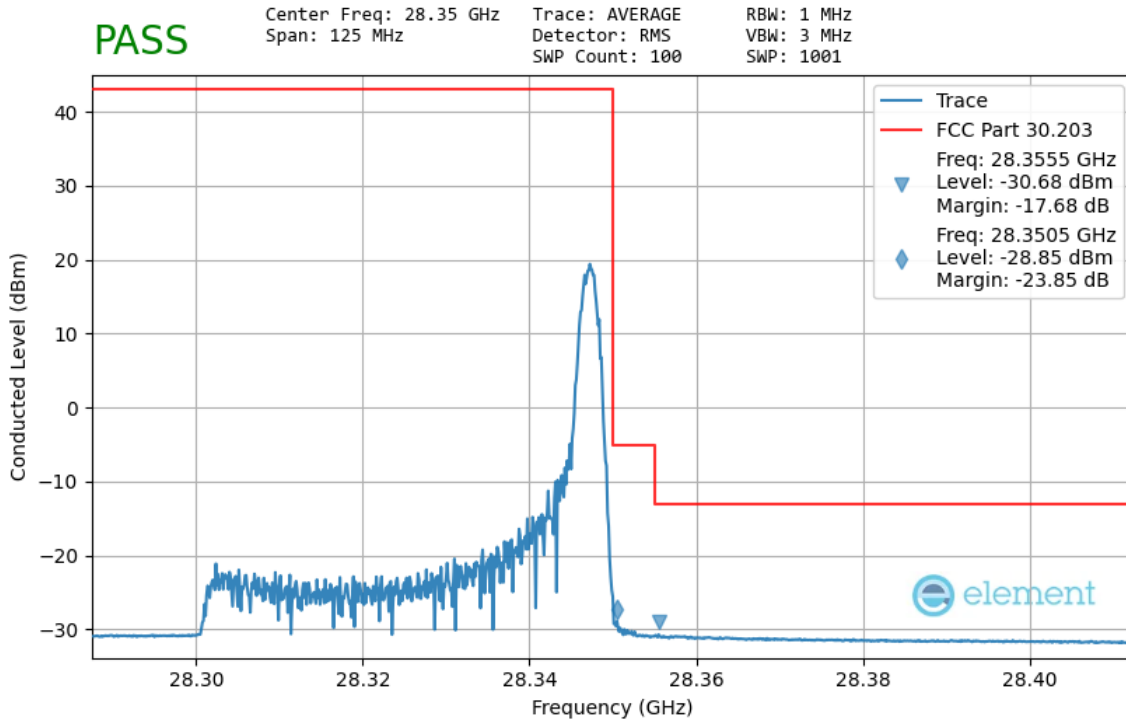


Plot 7-111. Upper Band Edge – DFT-s – MIMO-DL Polarization (50MHz-1CC – QPSK Full RB)

FCC ID: 2AUVU-5620-23-28		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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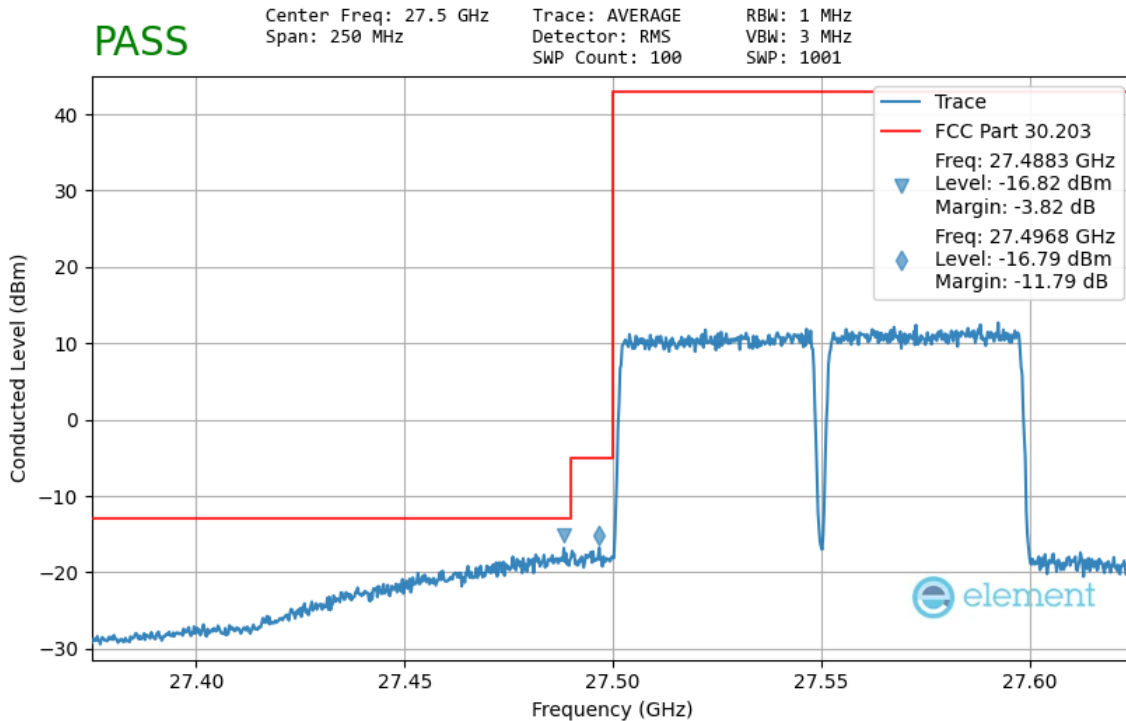


Plot 7-112. Lower Band Edge – DFT-s – MIMO-DL Polarization (50MHz-1CC – QPSK 1 RB)

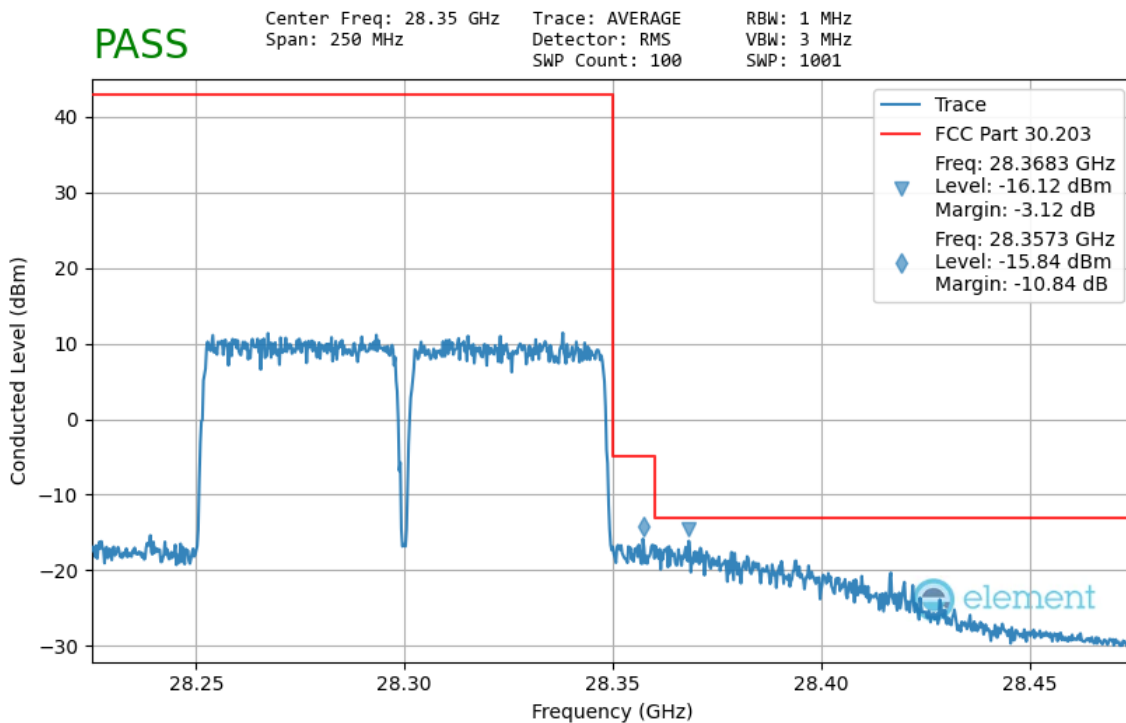


Plot 7-113. Upper Band Edge – DFT-s – MIMO-DL Polarization (50MHz-1CC – QPSK 1 RB)

FCC ID: 2AUVU-5620-23-28		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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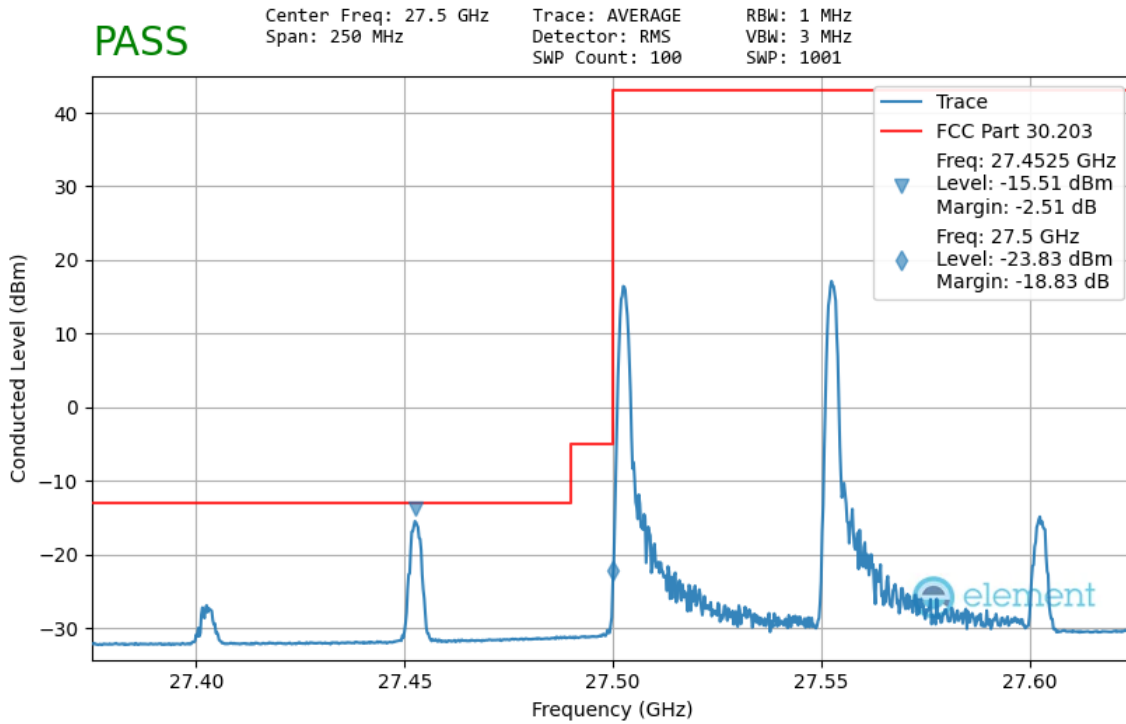


Plot 7-114. Lower Band Edge – DFT-s – MIMO-DL Polarization (50MHz-2CC – QPSK Full RB)

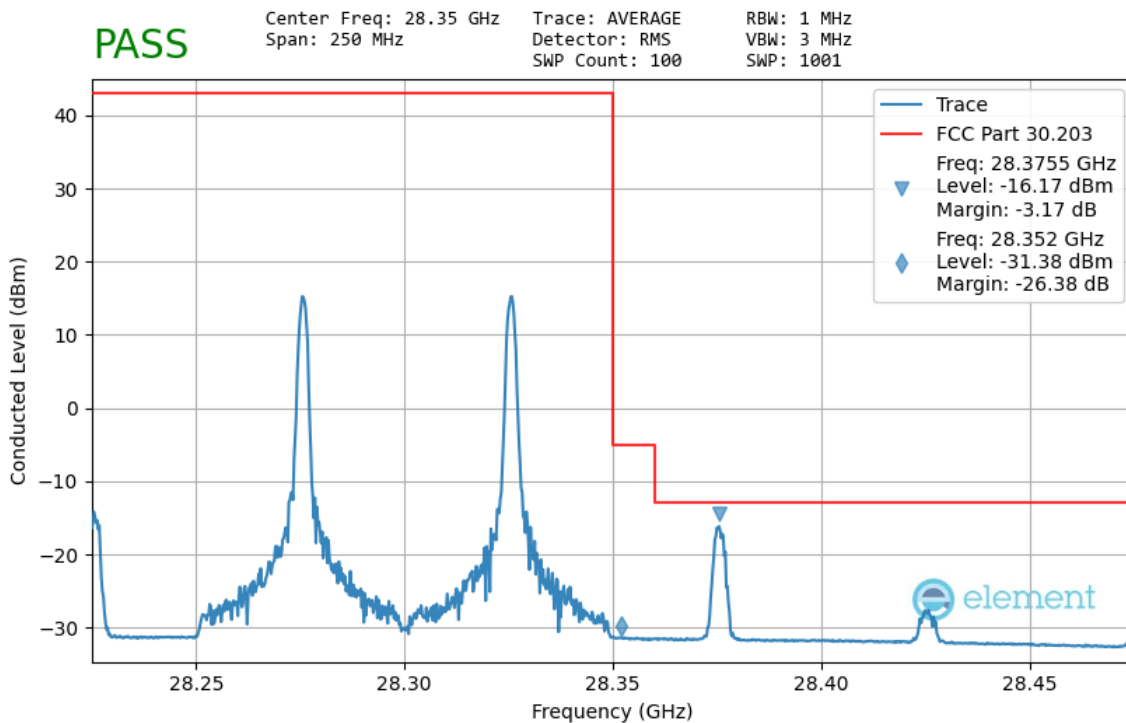


Plot 7-115. Upper Band Edge – DFT-s – MIMO-DL Polarization (50MHz-2CC – QPSK Full RB)

FCC ID: 2AUVU-5620-23-28		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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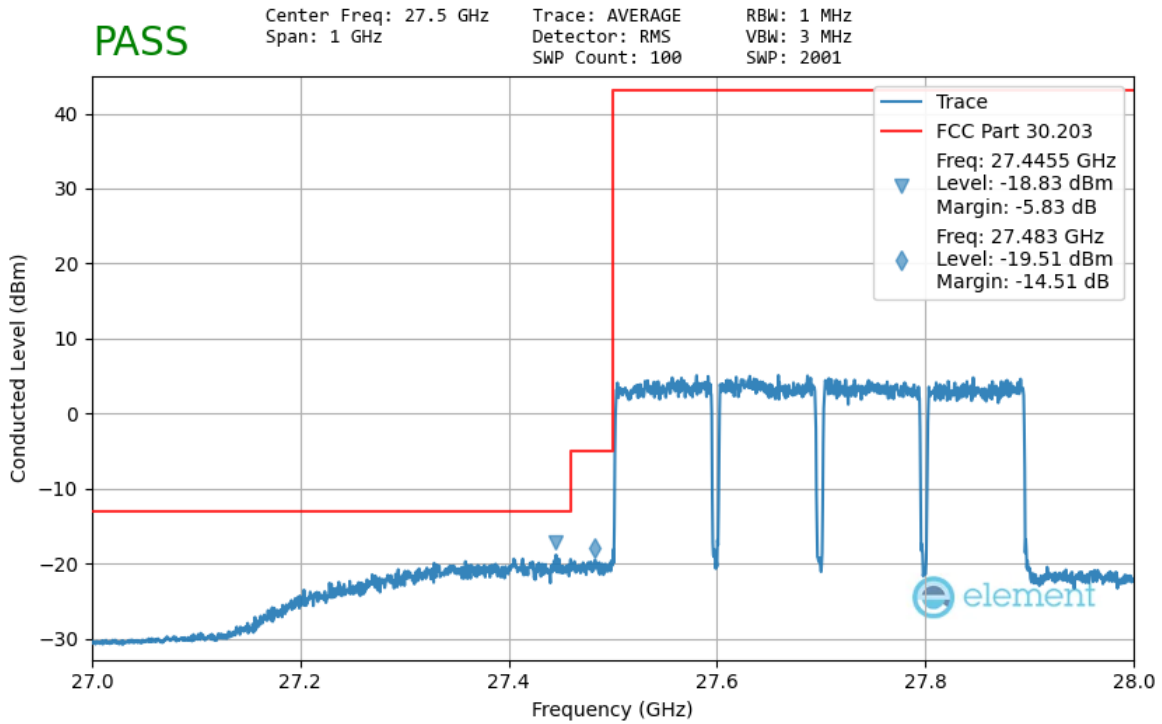


Plot 7-116. Lower Band Edge – DFT-s – MIMO-DL Polarization (50MHz-2CC – QPSK 1RB)

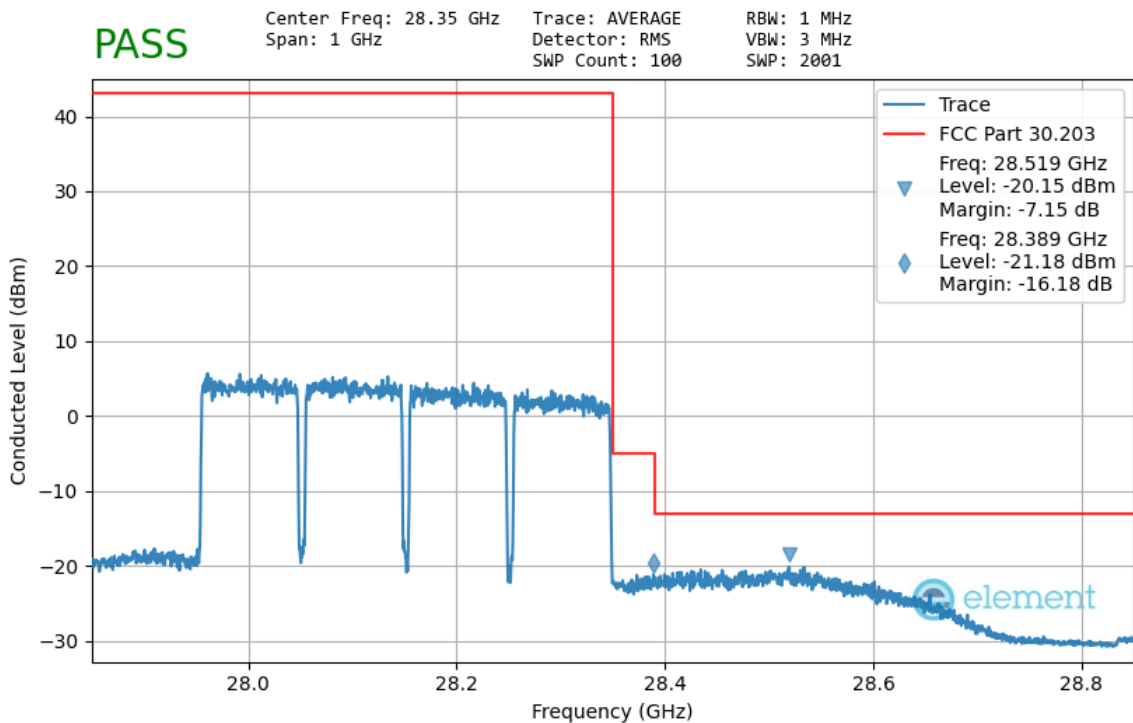


Plot 7-117. Upper Band Edge – DFT-s – MIMO-DL Polarization (50MHz-2CC – QPSK 1RB)

FCC ID: 2AUVU-5620-23-28		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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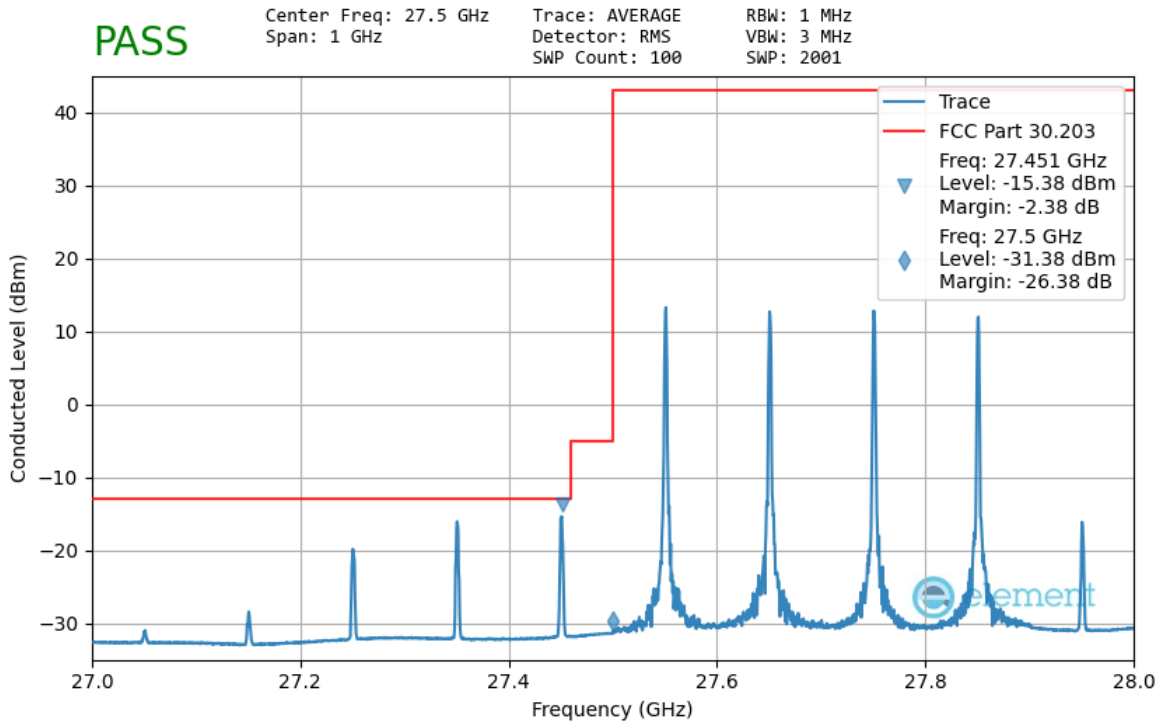


Plot 7-118. Lower Band Edge – DFT-s – MIMO-DL Polarization (100MHz-4CC – QPSK FULL RB)

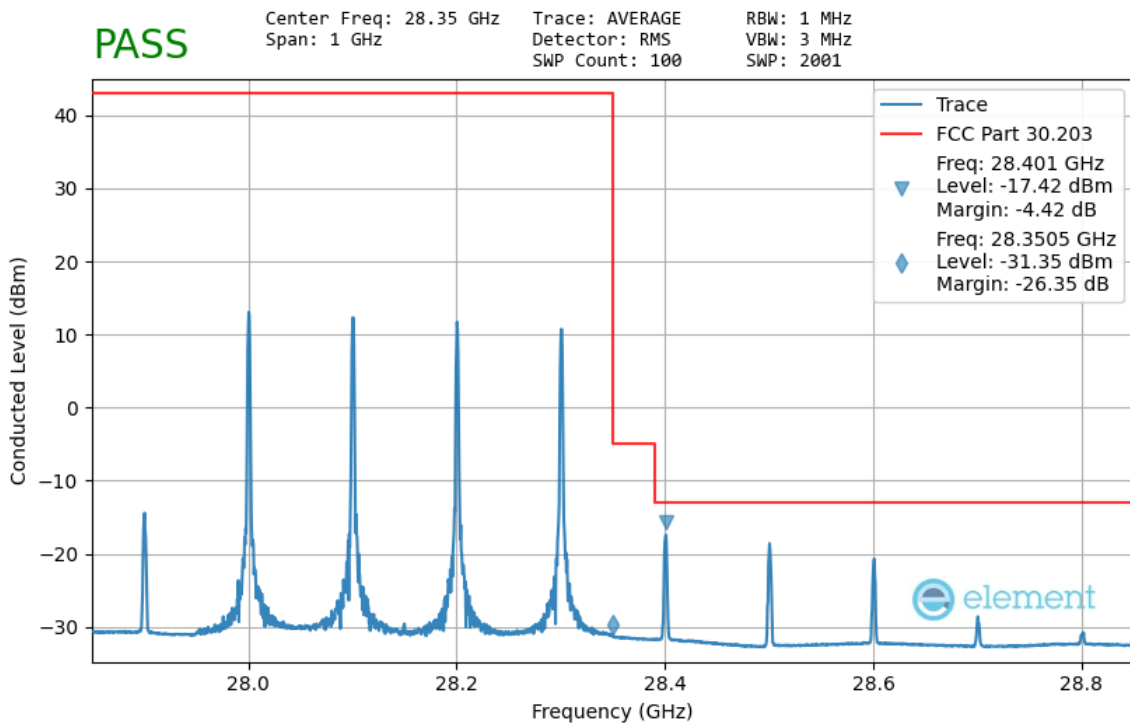


Plot 7-119. Upper Band Edge – DFT-s – MIMO-DL Polarization (100MHz-4CC – QPSK FULL RB)

FCC ID: 2AUVU-5620-23-28		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1M2303240041-01.2AUVU	Test Dates: 02/20/2023-03/31/2023	EUT Type: 5G mmWave Repeater	Page 102 of 129



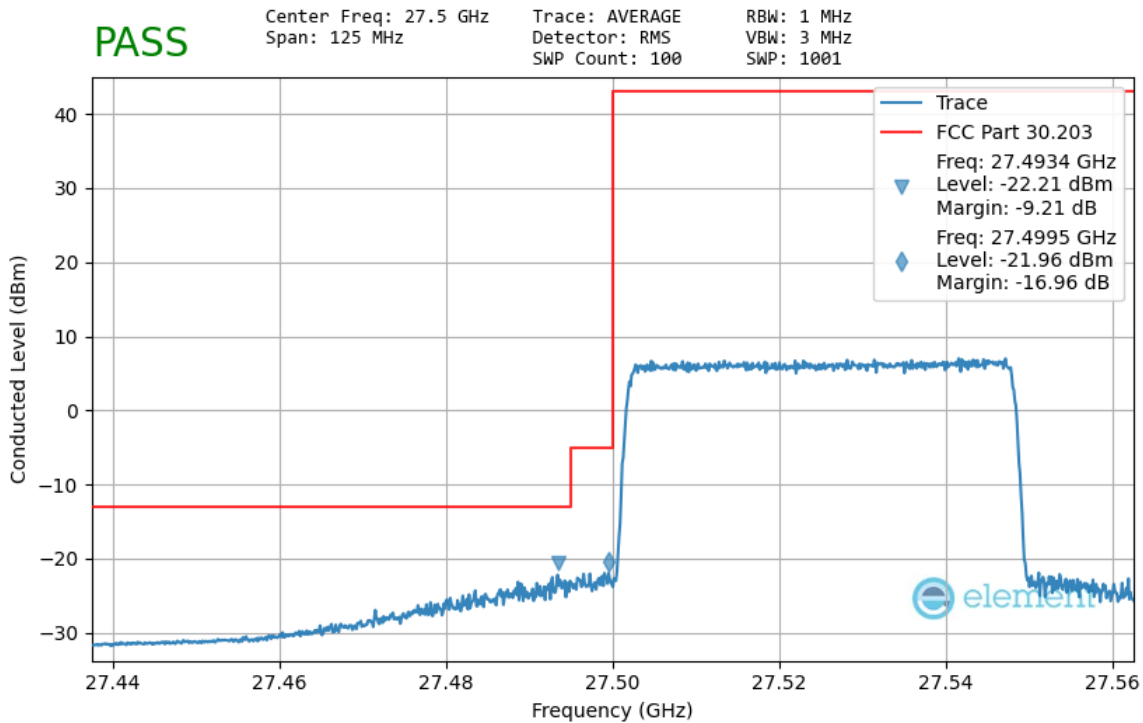
Plot 7-120. Lower Band Edge – DFT-s – MIMO-DL Polarization (100MHz-4CC – QPSK 1RB)



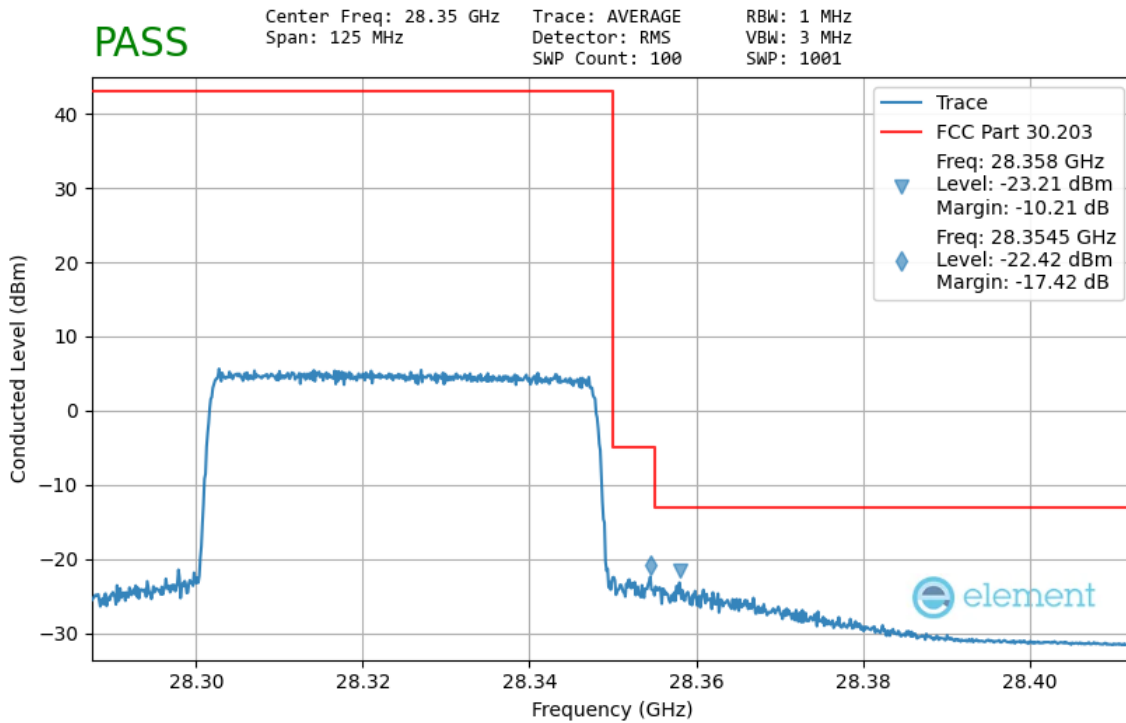
Plot 7-121. Upper Band Edge – DFT-s – MIMO-DL Polarization (100MHz-4CC – QPSK 1RB)

FCC ID: 2AUVU-5620-23-28		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Band n261 – SU (CP-OFDM)

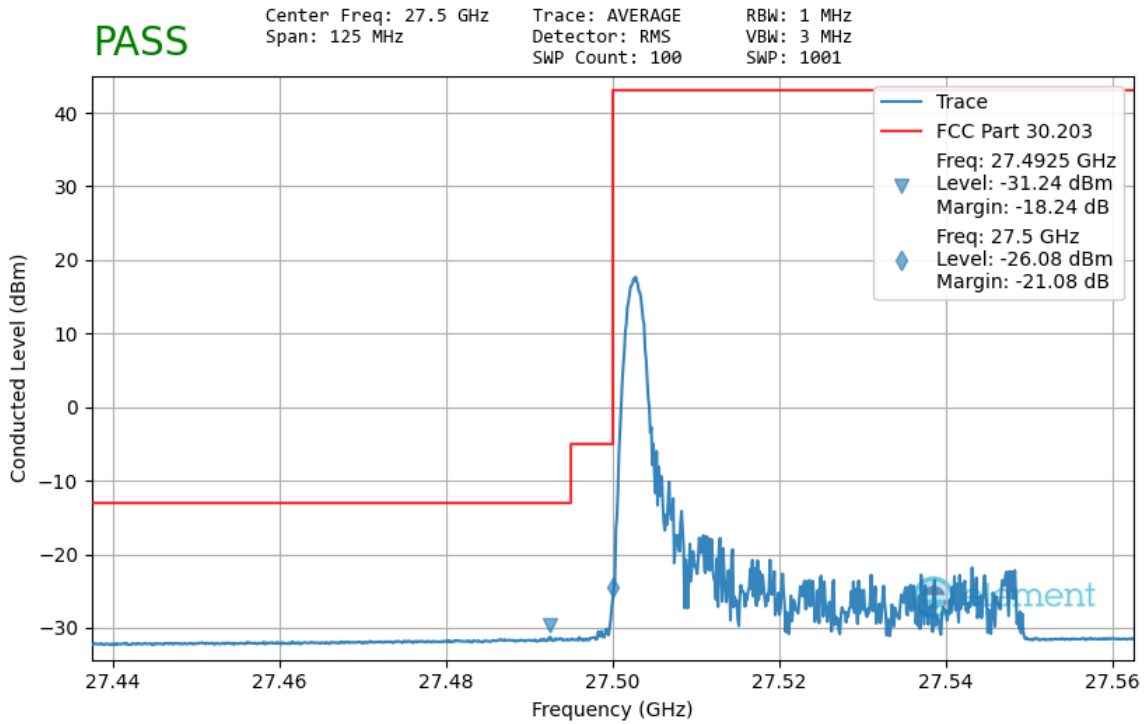


Plot 7-122. Lower Band Edge – CP – MIMO-DL Polarization (50MHz-1CC – QPSK Full RB)

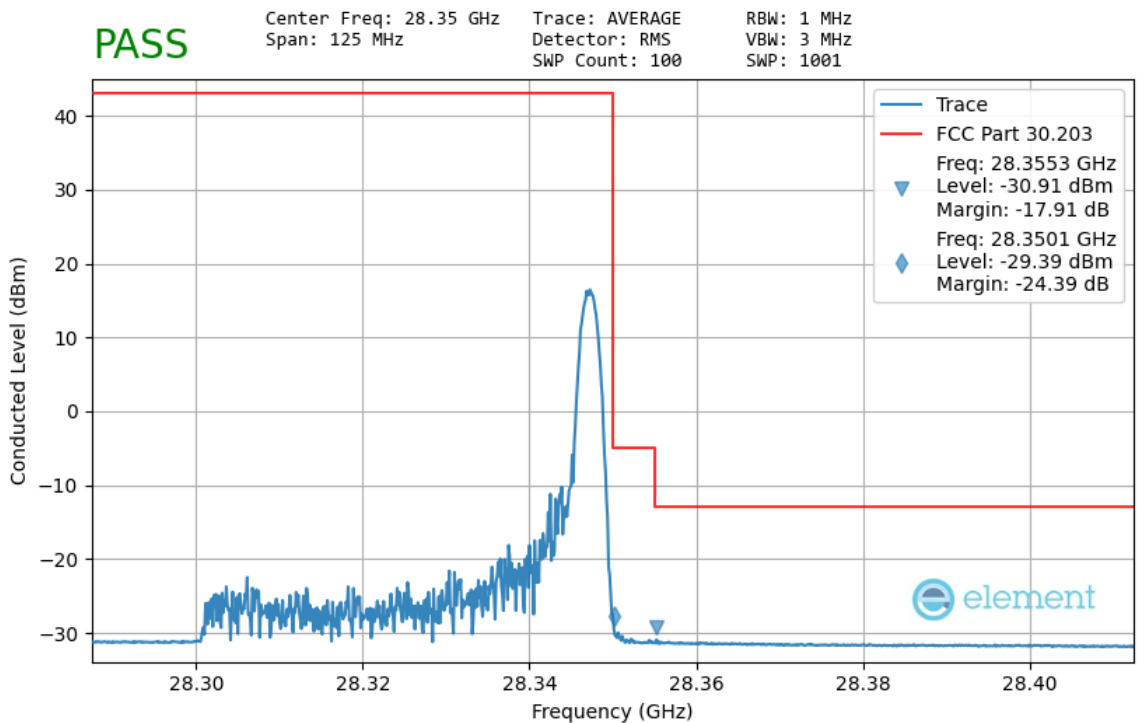


Plot 7-123. Upper Band Edge – CP – MIMO-DL Polarization (50MHz-1CC – QPSK Full RB)

FCC ID: 2AUVU-5620-23-28		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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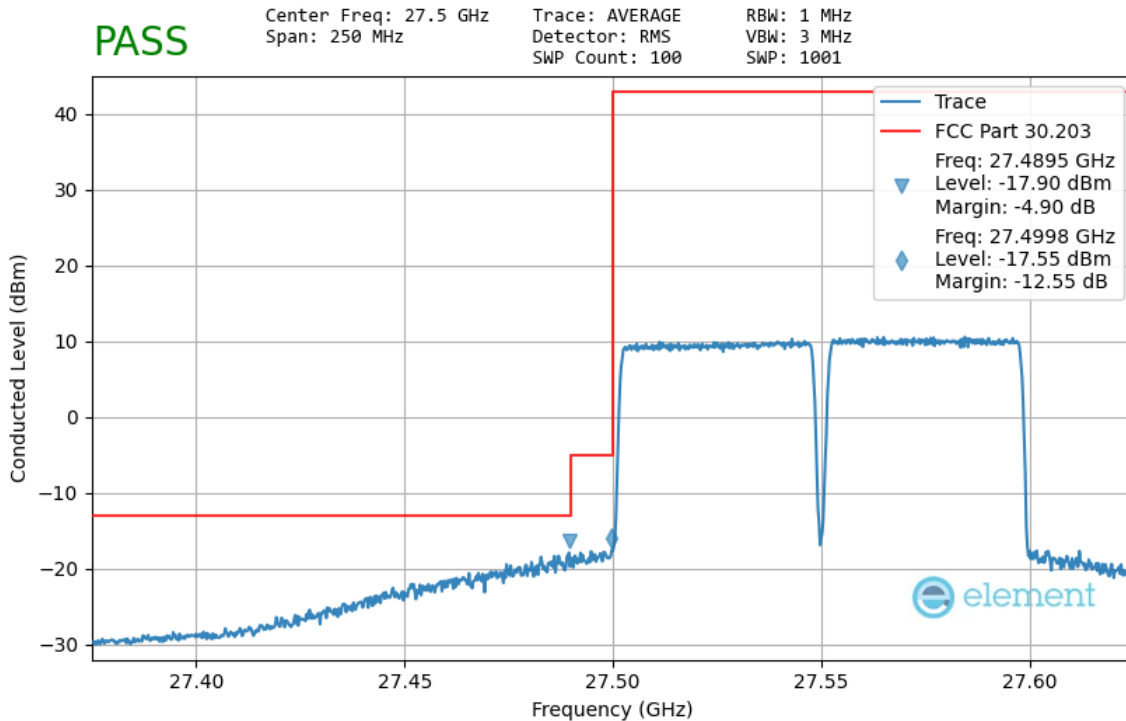


Plot 7-124. Lower Band Edge – CP – MIMO-DL Polarization (50MHz-1CC – QPSK 1 RB)

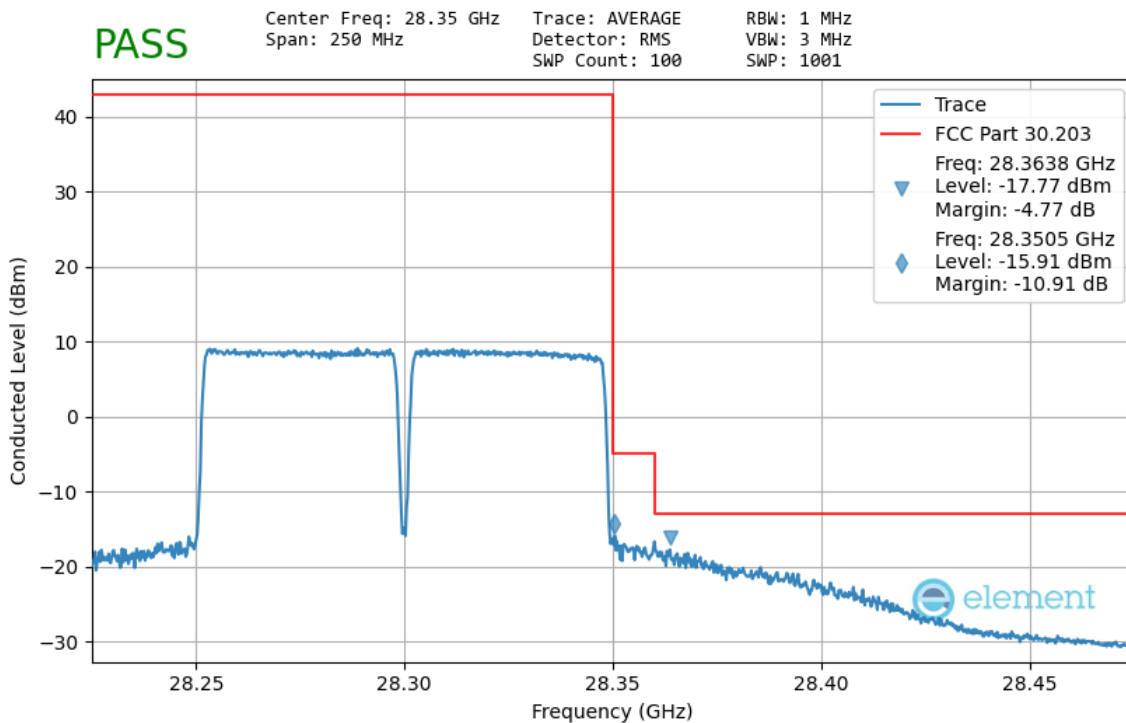


Plot 7-125. Upper Band Edge – CP – MIMO-DL Polarization (50MHz-1CC – QPSK 1 RB)

FCC ID: 2AUVU-5620-23-28		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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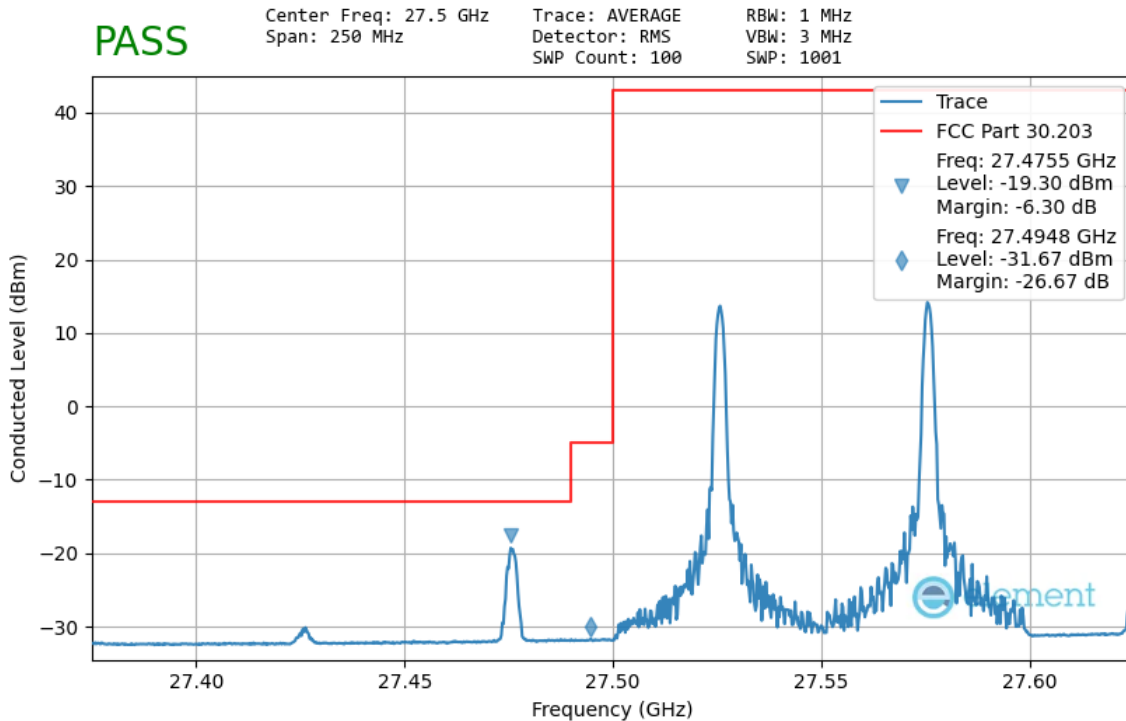


Plot 7-126. Lower Band Edge – CP – MIMO-DL Polarization (50MHz-2CC – QPSK Full RB)

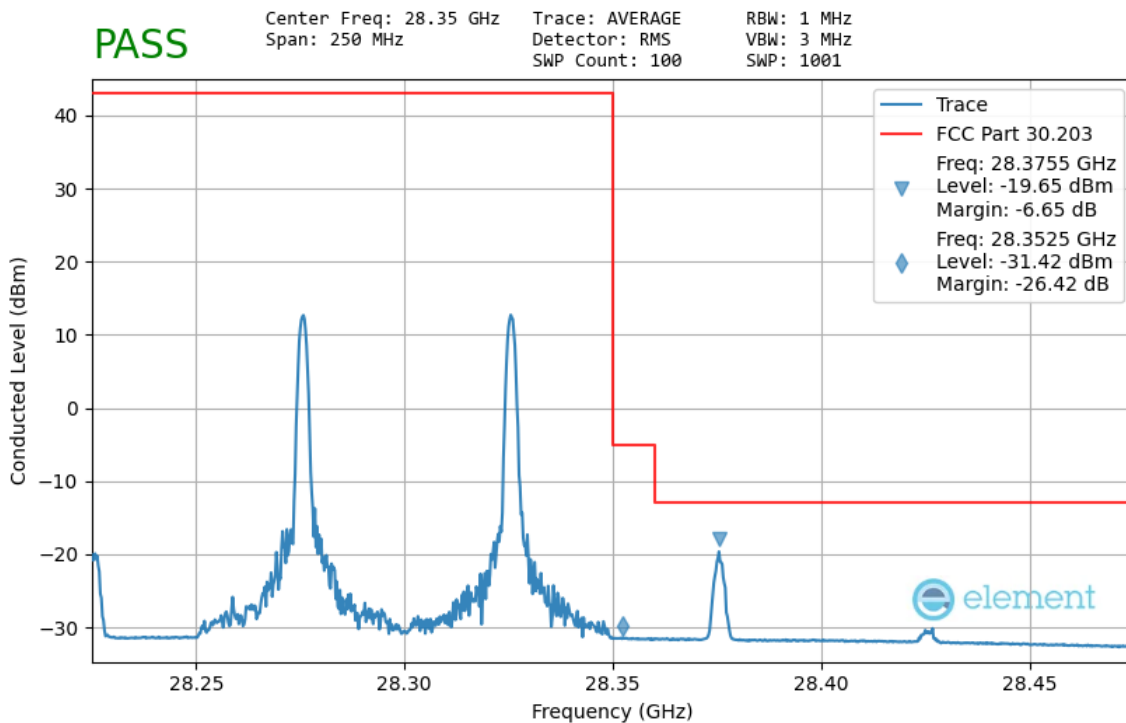


Plot 7-127. Upper Band Edge – CP – MIMO-DL Polarization (50MHz-2CC – QPSK Full RB)

FCC ID: 2AUVU-5620-23-28		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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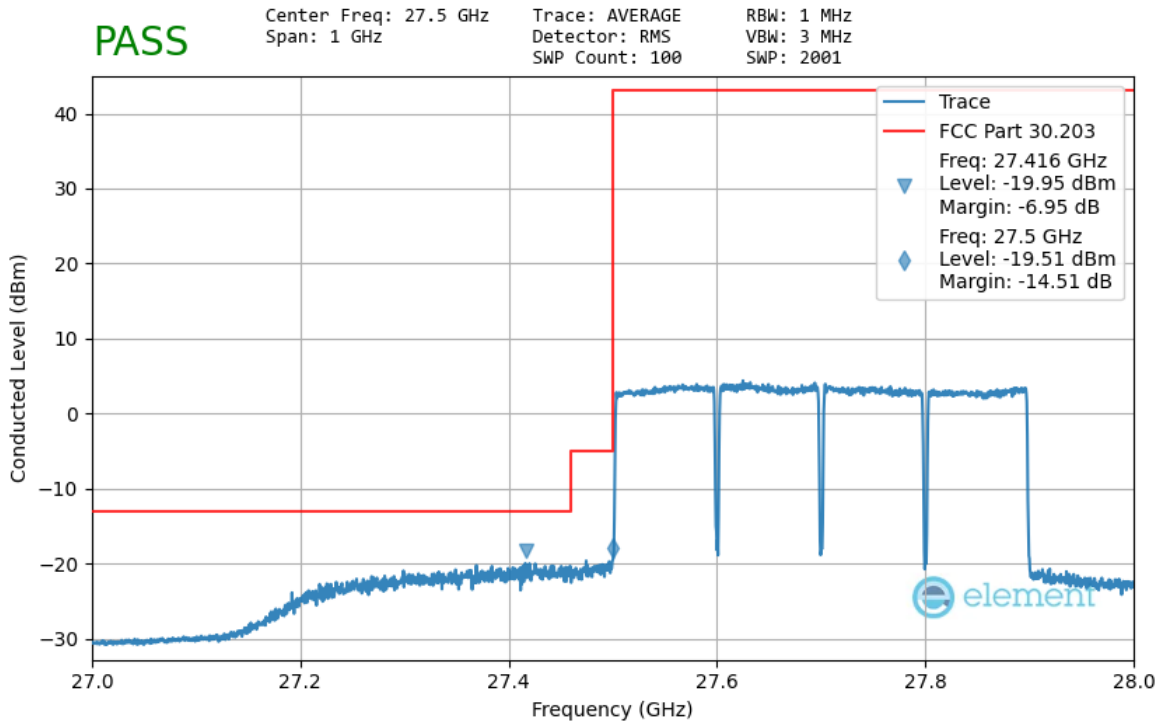


Plot 7-128. Lower Band Edge – CP – MIMO-DL Polarization (50MHz-2CC – QPSK 1RB)

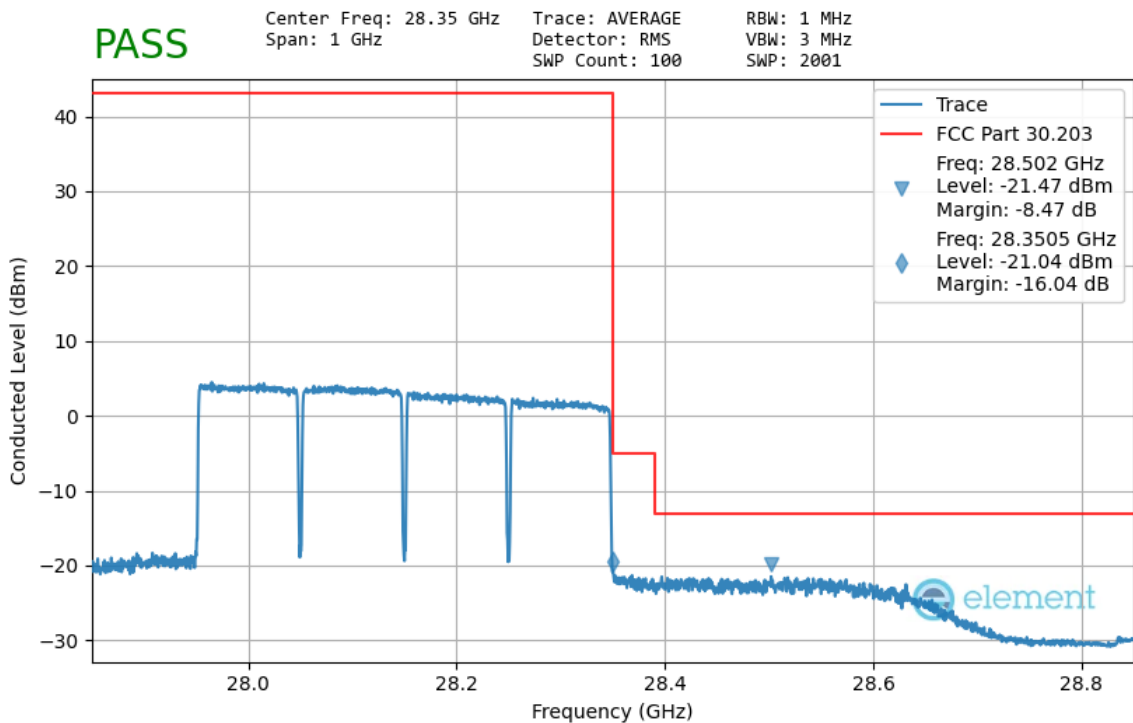


Plot 7-129. Upper Band Edge – CP – MIMO-DL Polarization (50MHz-2CC – QPSK 1RB)

FCC ID: 2AUVU-5620-23-28		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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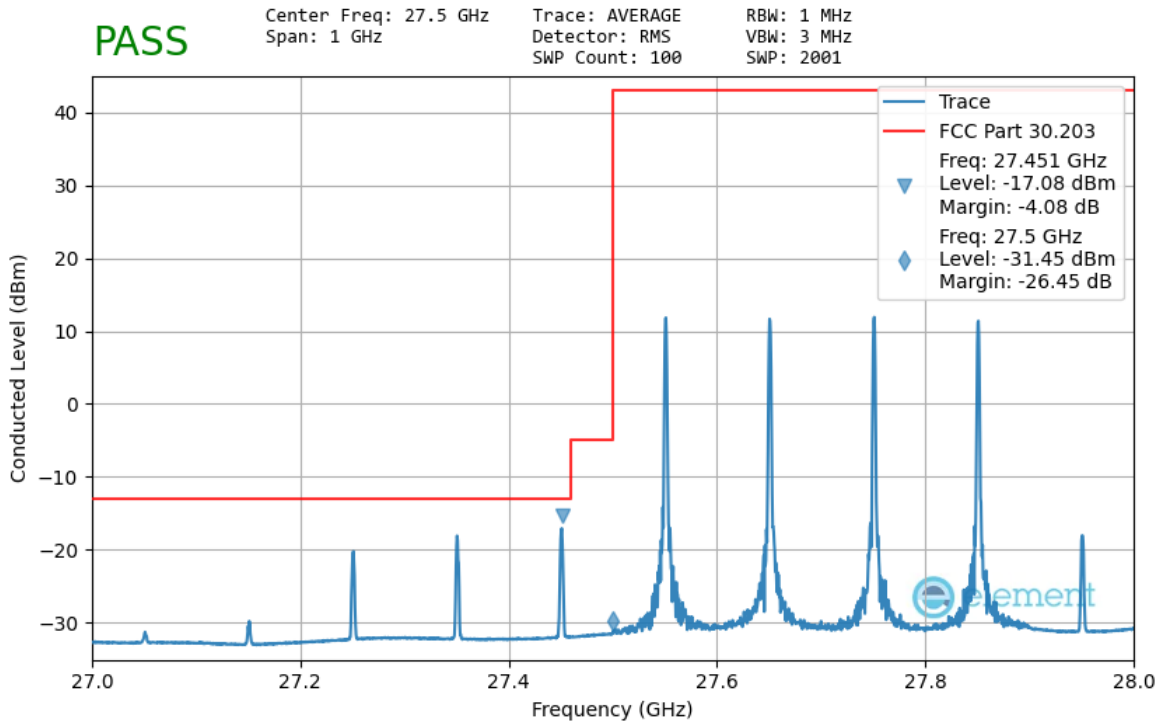


Plot 7-130. Lower Band Edge – CP – MIMO-DL Polarization (100MHz-4CC – QPSK FULL RB)

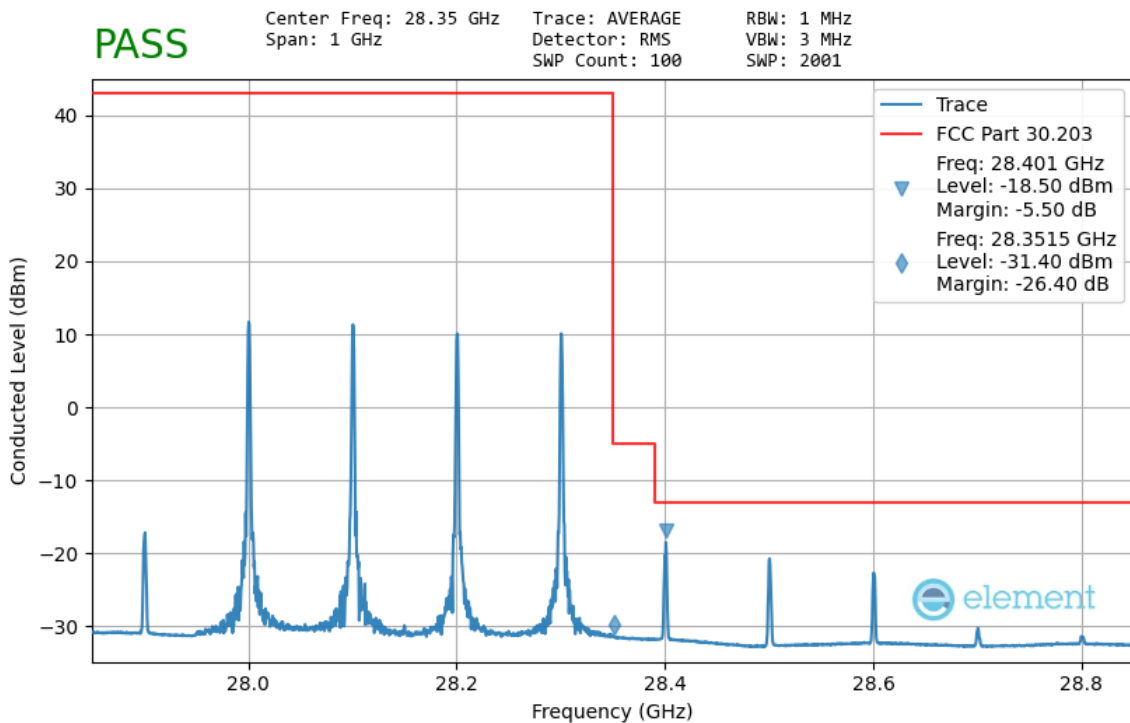


Plot 7-131. Upper Band Edge – CP – MIMO-DL Polarization (100MHz-4CC – QPSK FULL RB)

FCC ID: 2AUVU-5620-23-28		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Plot 7-132. Lower Band Edge – CP – MIMO-DL Polarization (100MHz-4CC – QPSK 1RB)



Plot 7-133. Upper Band Edge – CP – MIMO-DL Polarization (100MHz-4CC – QPSK 1RB)

FCC ID: 2AUVU-5620-23-28		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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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 n261 - SU

OPERATING FREQUENCY: 27,924,960,000 Hz
 CHANNEL: 2077915
 REFERENCE VOLTAGE: 48.00 VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	48.00	+ 20 (Ref)	27,925,692,138	0	0.0000000
100 %		- 30	27,925,699,889	7,751	0.0000278
100 %		- 20	27,925,719,203	27,065	0.0000969
100 %		- 10	27,925,682,886	-9,252	-0.0000331
100 %		0	27,925,735,032	42,895	0.0001536
100 %		+ 10	27,925,710,541	18,403	0.0000659
100 %		+ 30	27,925,696,629	4,491	0.0000161
100 %		+ 40	27,925,691,363	-775	-0.0000028
100 %		+ 50	27,925,689,234	-2,904	-0.0000104
85 %	40.80	+ 20	27,925,703,376	11,239	0.0000402
115 %	55.20	+ 20	27,925,674,303	-17,835	-0.0000639

Table 7-28. Frequency Stability Data – SU (n261)

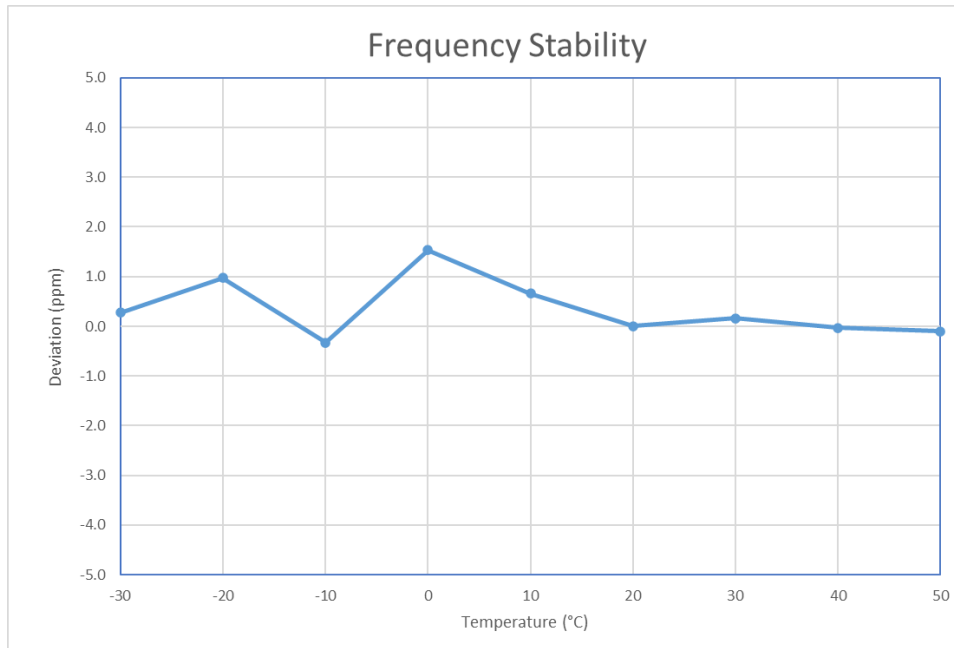



Figure 7-1. Frequency Stability Graph – SU (n261)


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.

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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-5620-23-28** complies with all the requirements of Part 20 and Part 30.

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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: 11/17/22	Today's Date: 11/21/22 PO Number: US37100165PO-1
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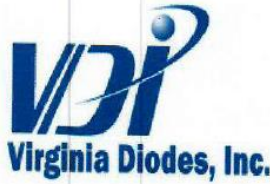
Quantity Shipped	Unit	Description	Order-Job Number
1	EA	RETEST-VDIWR19.0SAX-M-M4 WR19SAX / SN: SAX 679	220597-01
1	EA	RETEST-VDIWR12.0SAX-M-M6 WR12SAX / SN: SAX 680	220597-02

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-5620-23-28		PART 20 & 30 MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Virginia Diodes, Inc
 979 2nd St. SE
 Suite 309
 Charlottesville, VA 22902
 Phone: 434-297-3257
 Fax: 434-297-3258

Certificate of Conformance

To: 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: 230051	Today's Date: 01/05/23
Shipping Date: 01/05/23	PO Number: US37100165PO-1

<u>Quantity</u>	<u>Shipped</u>	<u>Unit</u>	<u>Description</u>	<u>Order-Job Number</u>
1		EA	RETEST-VDIWR8.0SAX-M-M9 WR5.1 Spectrum Analyzer Extender / 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



BSP

FCC ID: 2AUVU-5620-23-28		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

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

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Test Technology:

Test Method(s)²:

Transmitter/Receiver

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:

Test Method(s)²:

European Radio

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

Taiwan Radio

LP0002; DGT LP0002

Korean Radio

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

Australia/New Zealand Radio


AS/NZS 4268:2017

RF, Protocol, and RRM Conformance
5G NR

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 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

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<u>Test Technology:</u>	<u>Test Method(s)²:</u>
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 Report S/N: 1M2303240041-01.2AUVU	Test Dates: 02/20/2023-03/31/2023	EUT Type: 5G mmWave Repeater
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<u>Test Technology:</u>	<u>Test Method(s)²:</u>
UICC	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

<u>Test Technology:</u>	<u>Test Method(s)²:</u>
<i>Emissions</i> 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); 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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<u>Test Technology:</u>	<u>Test Method(s) ²:</u>
Radiated and Conducted (cont.)	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
Transmitter/Receiver	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
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)
European Radio	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
Taiwan Radio	LP0002 (2020); DGT LP0002
Korean Radio	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);

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


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<u>Test Technology:</u>	<u>Test Method(s) ²:</u>
Korean Radio (cont.)	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
Australia/New Zealand Radio	AS/NZS 4268:2017
OTA	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
<i>Wired and Wireless Conformance</i>	
CTIA IoT Security	CTIA Cybersecurity Certification Test Plan for IoT Devices
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

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

<u>Test Technology:</u>	<u>Test Method(s) ²:</u>
Battery Safety	<p>IEEE 1725 Standard for Rechargeable Batteries for Cellular Telephones; CTIA Certification Requirements for Battery System Compliance to IEEE 1725;</p> <ul style="list-style-type: none"> - Exclusions: Section 6.2 (DC-DC testing only); Section 7 (Certified Adapters only); <p>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;</p> <p>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</p> <p>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</p>
<p>UNDOT Battery Transportation Safety</p>	<p>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</p>
<p>Aerospace - Battery Performance and Safety</p>	<p>NASA Specification for Acceptance Testing of Commercial Lithium-Ion Cell Lots Engineering Directorate Propulsion & Power Division, EP-WI-031</p>
<p>Hardware Reliability</p>	<p>CTIA Device Hardware Reliability Test Plan</p>
<p>Determining Battery Life</p>	<p>CTIA Battery Life Test Plan</p>
<p>ESD Immunity</p>	<p>EN/IEC 61000-4-2</p>

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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.

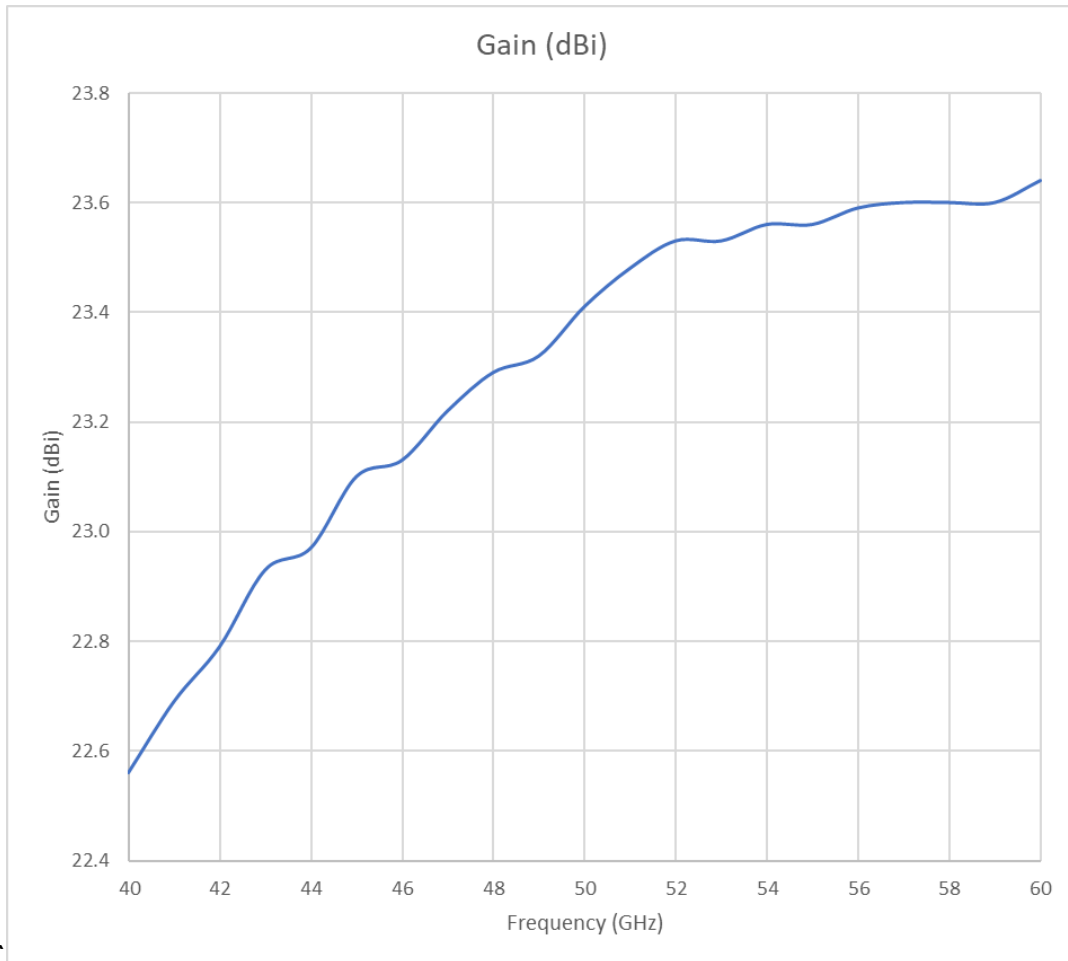
Mr. Trace McInturf, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2041.01
Valid to May 31, 2024


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

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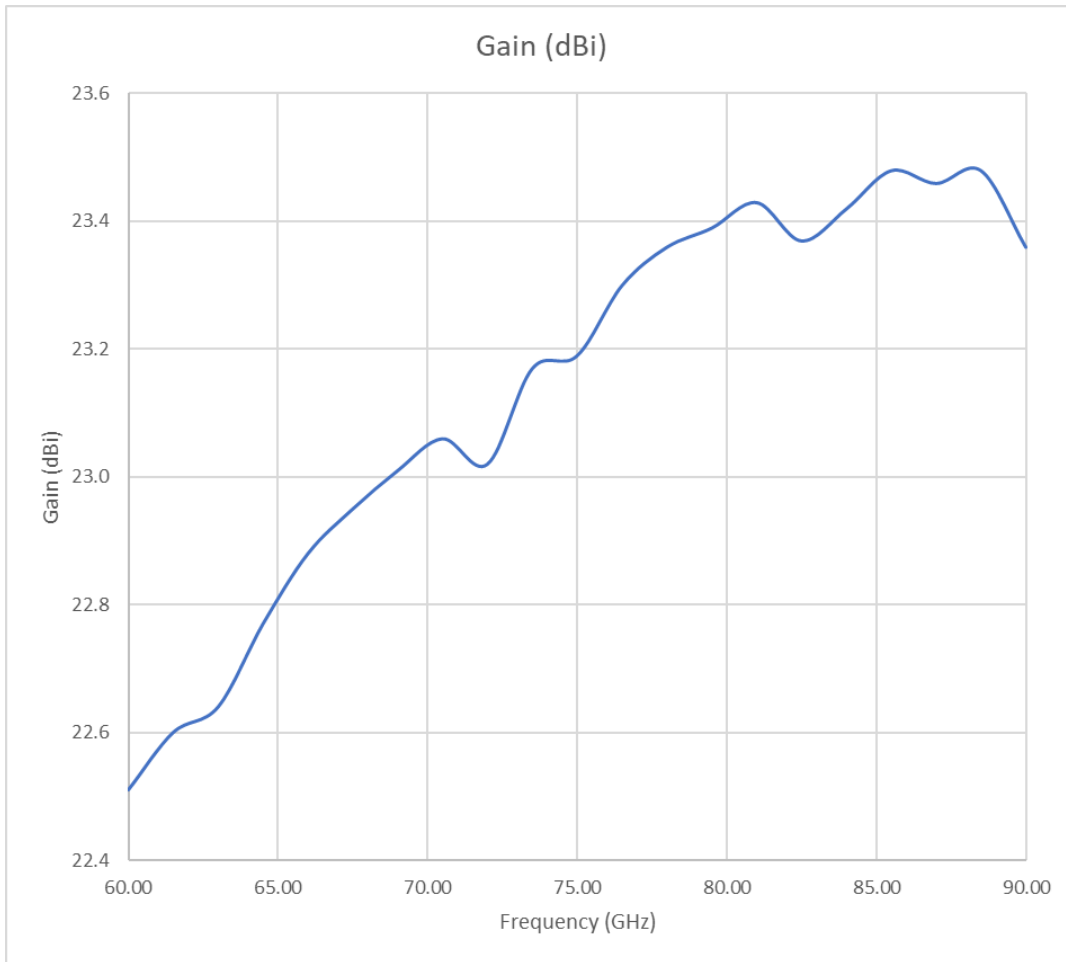
APPENDIX C – HORN ANTENNA GAIN CURVES


OML M19RH Horn Antenna Gain (40 – 60GHz)



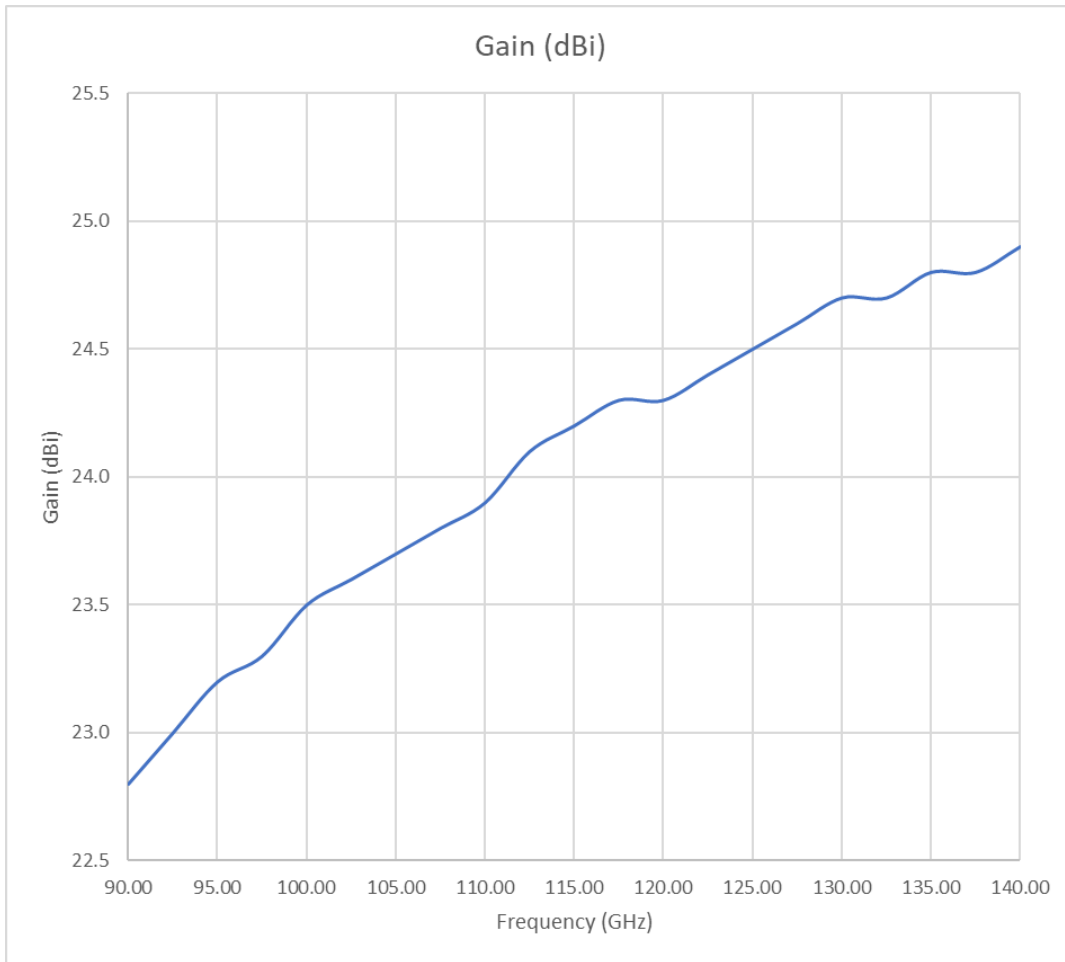
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OML M12RH Horn Antenna Gain (60 – 90GHz)



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OML M08RH Horn Antenna Gain (90 – 140GHz)



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