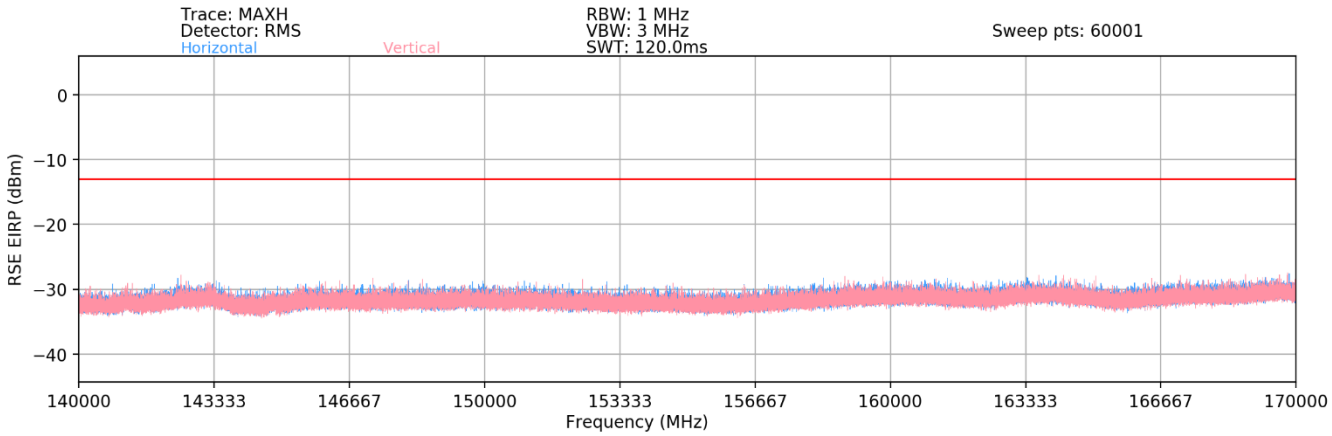
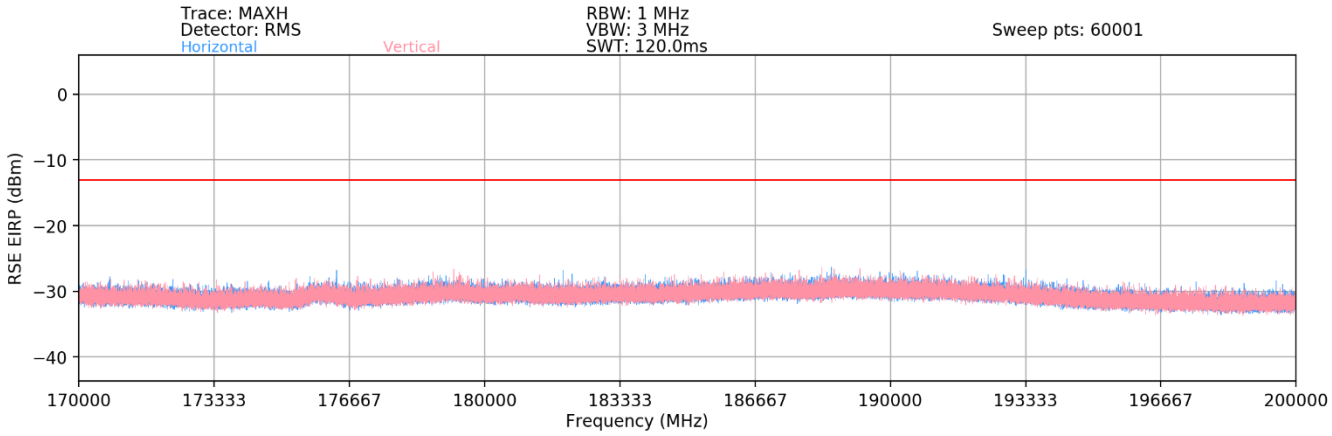
140GHz - 170GHz



Plot 7-69. Ant1 - n260 Radiated Spurious Plot (1CC QPSK Mid Channel 2Tx − EN-DC Anchor Band 2)

170GHz - 200GHz



Plot 7-70. Ant1 - n260 Radiated Spurious Plot (1CC QPSK Mid Channel 2Tx − EN-DC Anchor Band 2)

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 1 meter.

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

Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [H/V]	Turntable Azimuth [degrees]	Positioner Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
149273.46	Low	50	2Tx	QPSK	V	-	-	-55.98	-13.00	-42.98
154017.86	Mid	50	2Tx	QPSK	V	-	-	-55.64	-13.00	-42.64
199872.99	High	50	2Tx	QPSK	V	-	-	-55.83	-13.00	-42.83

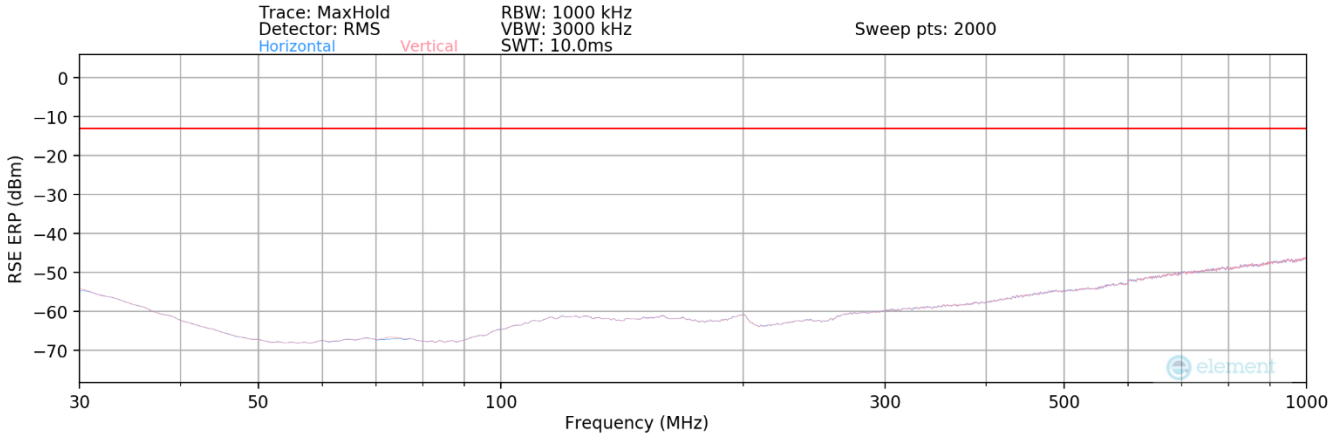
Table 7-36. Ant1 - n260 Radiated Spurious Emissions Table (140GHz - 200GHz)

Notes

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

Band n260 – Ant2

30MHz - 1GHz



Plot 7-71. Ant2 - n260 Radiated Spurious Plot (1CC QPSK Mid Channel 2Tx − EN-DC Anchor Band 2)

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.

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

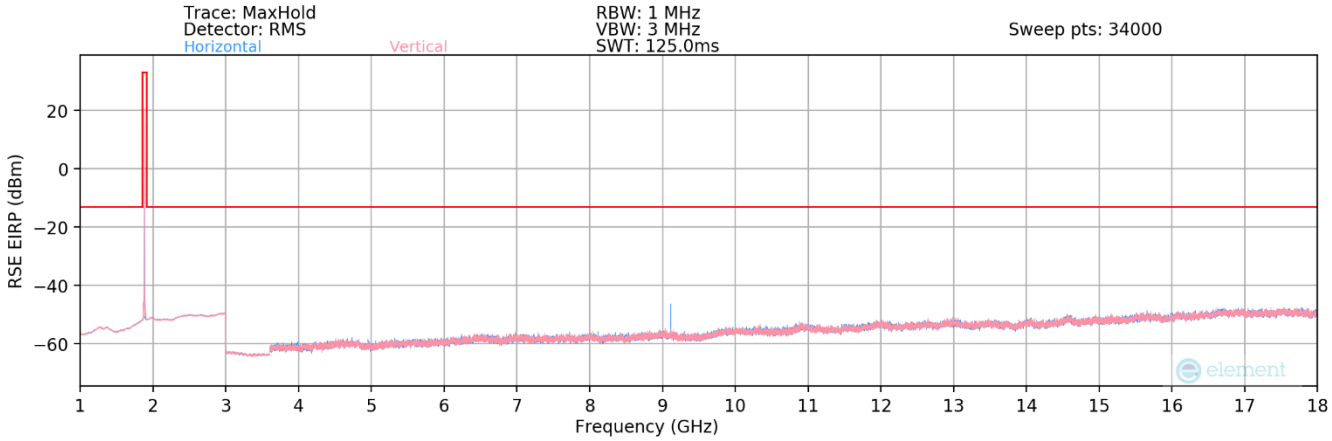
Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [H/V]	Turntable Azimuth [degrees]	Antenna Height [cm]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
158.97	Low	50	2Tx	QPSK	H	-	-	-59.14	-13.00	-46.14
520.38	Mid	50	2Tx	QPSK	H	-	-	-52.66	-13.00	-39.66
895.57	High	50	2Tx	QPSK	H	-	-	-46.67	-13.00	-33.67

Table 7-85. Ant2 - 2Tx - Spurious Emissions Table (30MHz - 1GHz)

Notes

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

1GHz - 18GHz



Plot 7-72. Ant2 - n260 Radiated Spurious Plot (1CC QPSK Mid Channel 2Tx − EN-DC Anchor Band 2)

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.

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

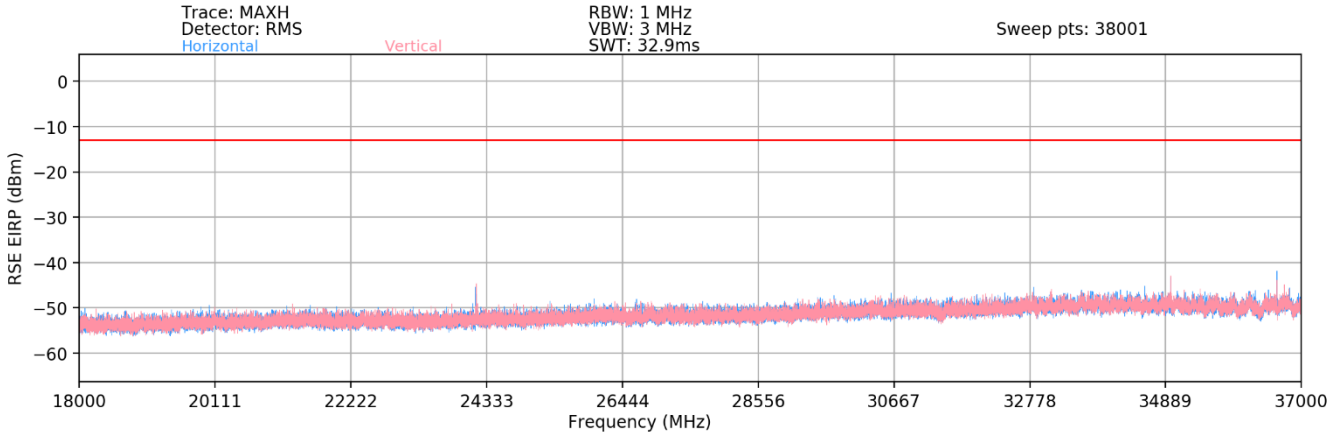
Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [H/V]	Turntable Azimuth [degrees]	Antenna Height [cm]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
3990.54	Low	50	2Tx	QPSK	H	-	-	-61.77	-13.00	-48.77
9111.57	Mid	50	2Tx	QPSK	H	282	397	-44.84	-13.00	-31.84
11993.07	High	50	2Tx	QPSK	H	-	-	-53.81	-13.00	-40.81

Table 7-86. Ant2 - 2Tx - Spurious Emissions Table (1GHz - 18GHz)

Notes

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

18GHz - 37GHz



Plot 7-73. Ant2 - n260 Radiated Spurious Plot (1CC QPSK Mid Channel 2Tx − EN-DC Anchor Band 2)

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 1 meter.

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

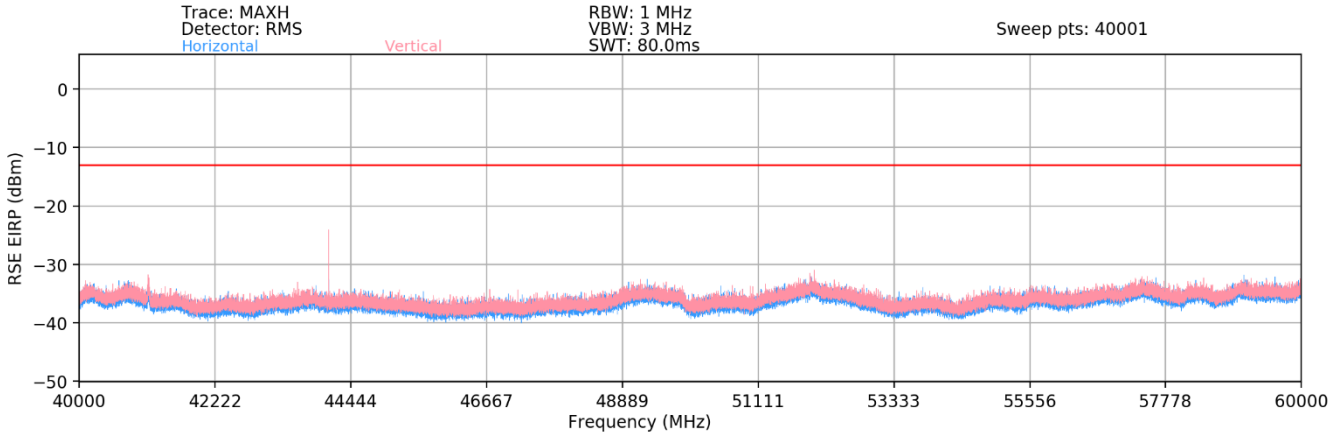
Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [H/V]	Turntable Azimuth [degrees]	Antenna Height [cm]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
18991.00	Low	50	2Tx	QPSK	H	156	150	-57.85	-13.00	-44.85
24173.00	Mid	50	2Tx	QPSK	H	2	150	-57.74	-13.00	-44.74
34900.00	High	50	2Tx	QPSK	H	161	150	-59.74	-13.00	-46.74
36619.00	High	50	2Tx	QPSK	H	205	150	-52.30	-13.00	-39.30

Table 7-37. Ant2 - n260 Radiated Spurious Emissions Table (18GHz - 37GHz)

Notes

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

40GHz - 60GHz



Plot 7-74. Ant2 - n260 Radiated Spurious Plot (1CC QPSK Mid Channel 2Tx − EN-DC Anchor Band 2)

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 1.5 meter.

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

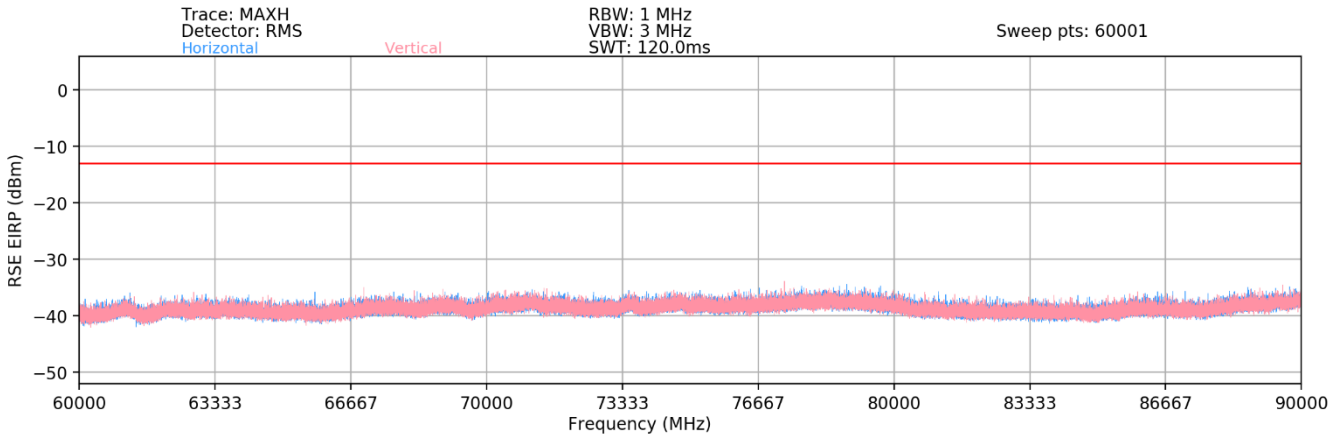
Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [H/V]	Turntable Azimuth [degrees]	Positioner Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
42931.20	Low	50	2Tx	QPSK	V	53	69	-22.18	-13.00	-9.18
44083.18	Mid	50	2Tx	QPSK	V	49	65	-24.70	-13.00	-11.70
45971.88	High	50	2Tx	QPSK	V	45	65	-47.36	-13.00	-34.36

Table 7-38. Ant2 - n260 Radiated Spurious Emissions Table (40GHz - 60GHz)

Notes

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

60GHz - 90GHz



Plot 7-75. Ant2 - n260 Radiated Spurious Plot (1CC QPSK Mid Channel 2Tx − EN-DC Anchor Band 2)

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 1 meter.

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

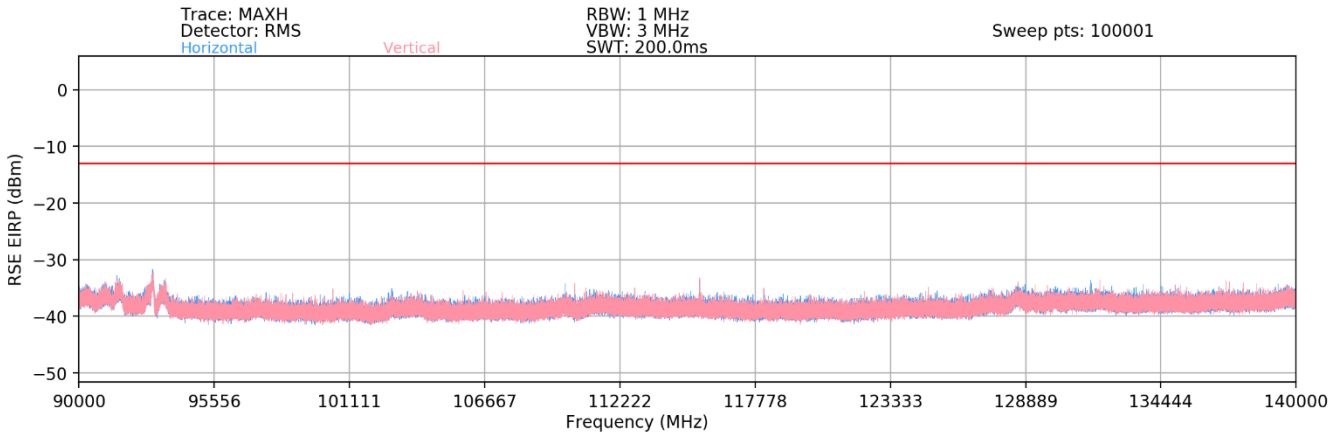
Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [H/V]	Turntable Azimuth [degrees]	Positioner Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
74051.25	Low	50	2Tx	QPSK	V	139	8	-37.90	-13.00	-24.90
77000.52	Mid	50	2Tx	QPSK	V	145	3	-37.54	-13.00	-24.54
79951.35	High	50	2Tx	QPSK	V	142	12	-42.72	-13.00	-29.72

Table 7-39. Ant2 - n260 Radiated Spurious Emissions Table (60GHz - 90GHz)

Notes

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

90GHz - 140GHz



Plot 7-76. Ant2 - n260 Radiated Spurious Plot (1CC QPSK Mid Channel 2Tx − EN-DC Anchor Band 2)

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 1 meter.

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

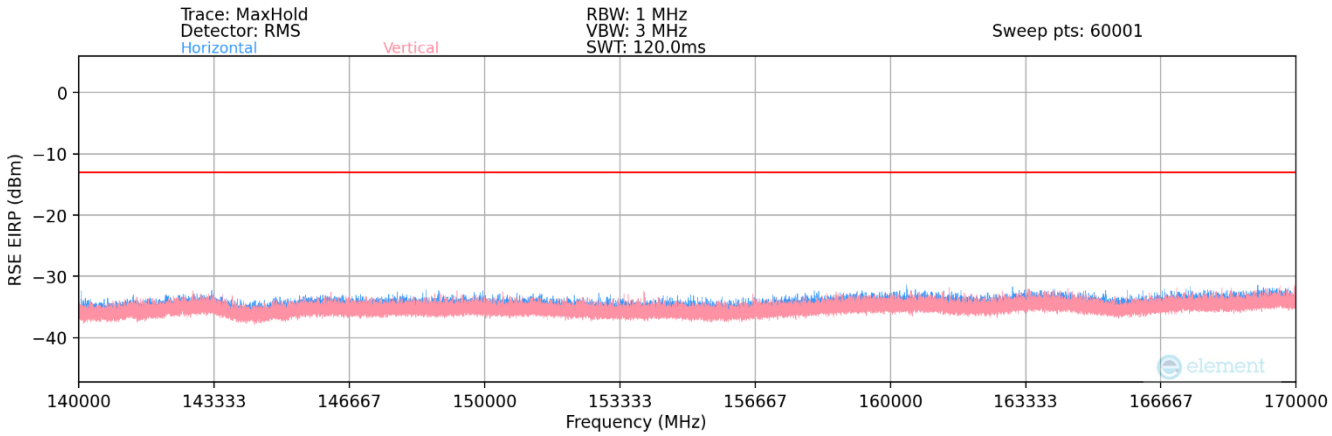
Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [H/V]	Turntable Azimuth [degrees]	Positioner Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
111076.92	Low	50	2Tx	QPSK	V	29	103	-28.69	-13.00	-15.69
115501.51	Mid	50	2Tx	QPSK	V	42	100	-31.68	-13.00	-18.68
118136.71	High	50	2Tx	QPSK	V	74	121	-37.39	-13.00	-24.39

Table 7-40. Ant2 - n260 Radiated Spurious Emissions Table (90GHz - 140GHz)

Notes

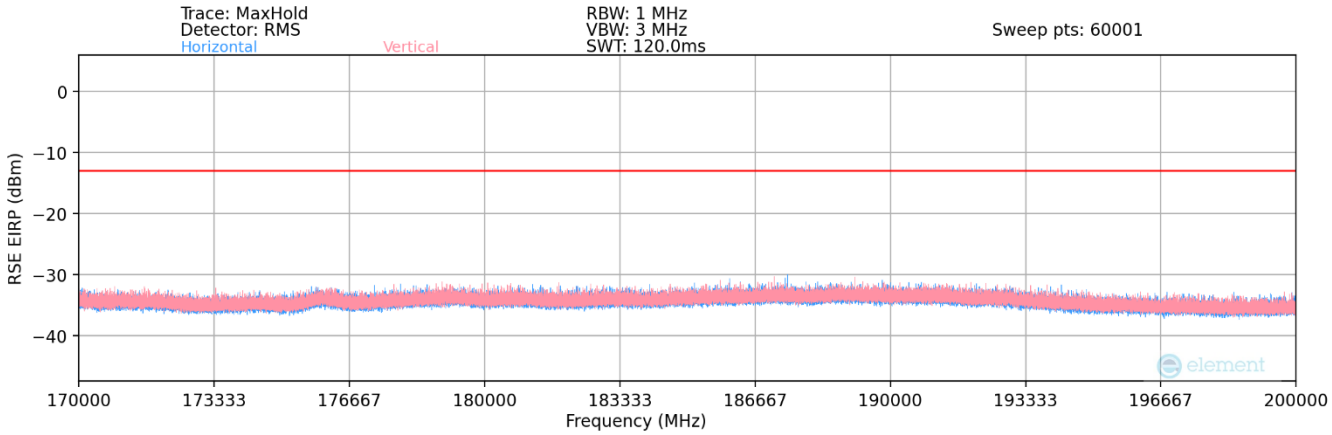
The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.

140GHz - 170GHz



Plot 7-77. Ant2 - n260 Radiated Spurious Plot (1CC QPSK Mid Channel 2Tx − EN-DC Anchor Band 2)

170GHz - 200GHz



Plot 7-78. Ant2 - n260 Radiated Spurious Plot (1CC QPSK Mid Channel 2Tx − EN-DC Anchor Band 2)

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 1 meter.

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

Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [H/V]	Turntable Azimuth [degrees]	Positioner Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
149273.46	Low	50	2Tx	QPSK	V	-	-	-54.98	-13.00	-41.98
154017.86	Mid	50	2Tx	QPSK	V	-	-	-55.64	-13.00	-42.64
199872.99	High	50	2Tx	QPSK	V	-	-	-55.56	-13.00	-42.56

Table 7-41. Ant2 - n260 Radiated Spurious Emissions Table (140GHz - 200GHz)

Notes

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

7.5 Band Edge Emissions

Test Overview

All out of band emissions are measured in a radiated setup while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All modulations were investigated to determine the worst-case configuration. All modes of operation were investigated and the worst-case configuration results are reported in this section.

The 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

Test Settings

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

Test Notes

1) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning.

2) Band Edge emissions were measured at a 1 meter distance.

3) The spectrum analyzer for each measurement shows an offset value that was determined using the measurement antenna factor, cable loss, far field measurement distance. A sample calculation is shown on the following page.

4) This device supports transmission of H-polarized and V-polarized beams from the antenna array in both CP-OFDM and DFT-s-OFDM transmission schemes. SISO and MIMO operation is also supported for some configurations. As part of the testing, all modes were fully investigated and only the worst case has been included in this report.

5) All combinations of 1CC and 2CC were fully investigated, and only the worst case has been included in this report.

6) All 2CC cases were investigated with PCC prioritization feature, which has the higher power PCC at the band edge for the worst case.

7) Unless otherwise specified, the radiated band edge plots in this section display the worst case EIRP measurements for the indicated bandwidth−component carrier configuration.

8) The plots in this section that display Total Radiated Power (TRP) were obtained from measurements that were performed in accordance with the guidance of Section 4.4.2.4 of KDB 842590 D01 for the Spherical Method.

Sample Analyzer Offset Calculation (at 27.5GHz)

Measurement Antenna Factor = 40.70dB/m

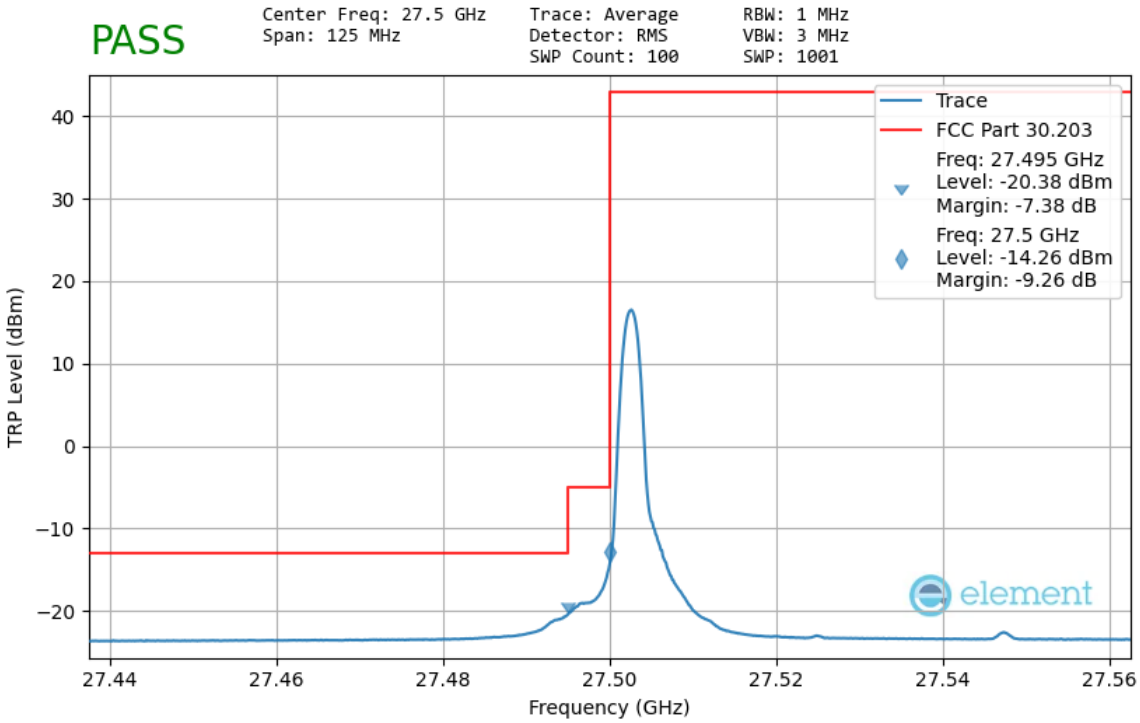
Cable Loss = 8.82dB

Analyzer Offset (dB) = AF (dB/m) + CL (dB) + 107 + $20\log_{10}$(D) – 104.8dB, where D = 1m

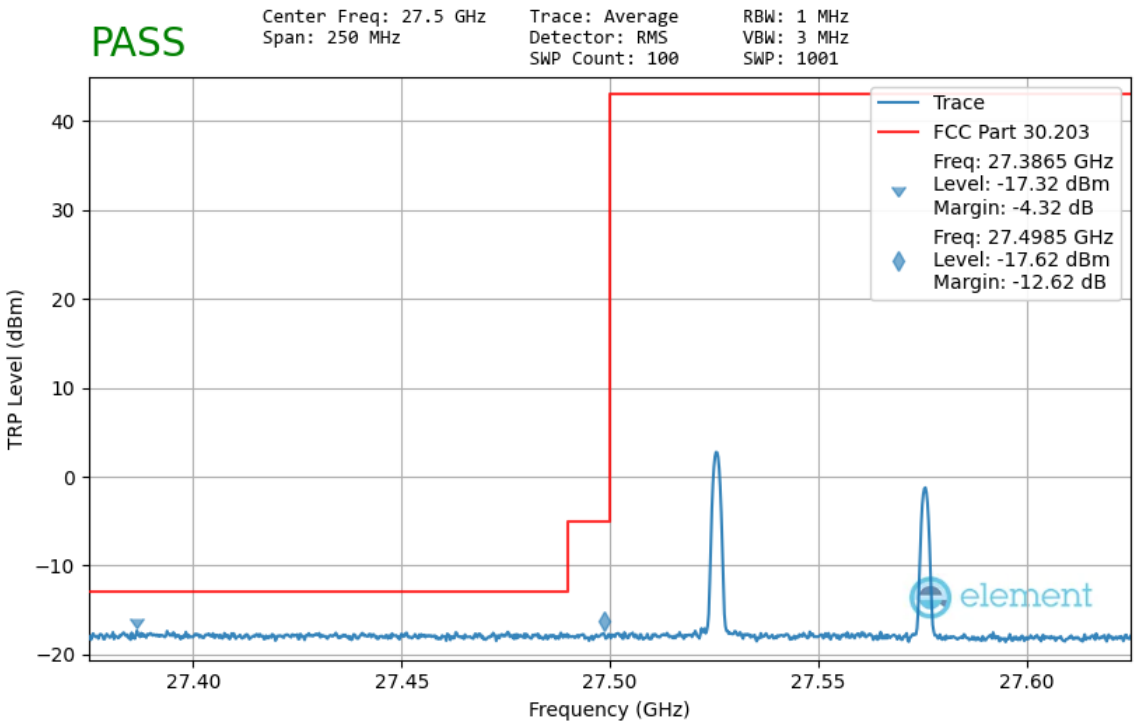
= 40.70dB/m + 8.82dB + 107 + $20\log_{10}$(1m) – 104.8dB

= 51.72dB

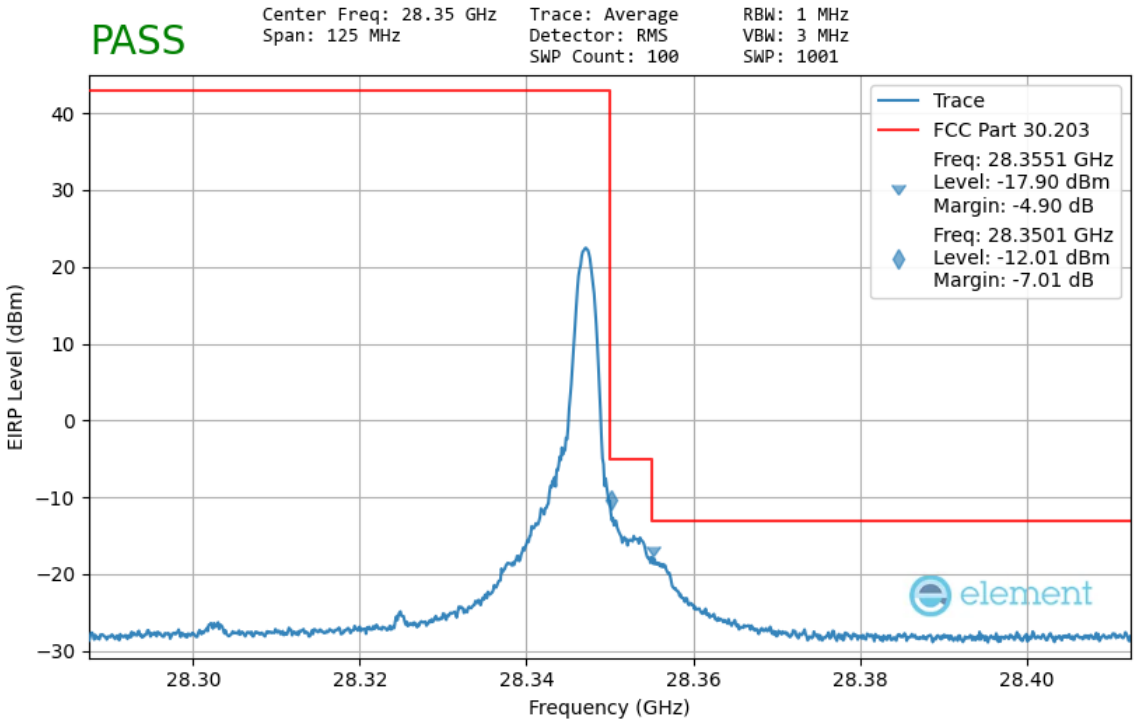
Band n261 – Worst-Case



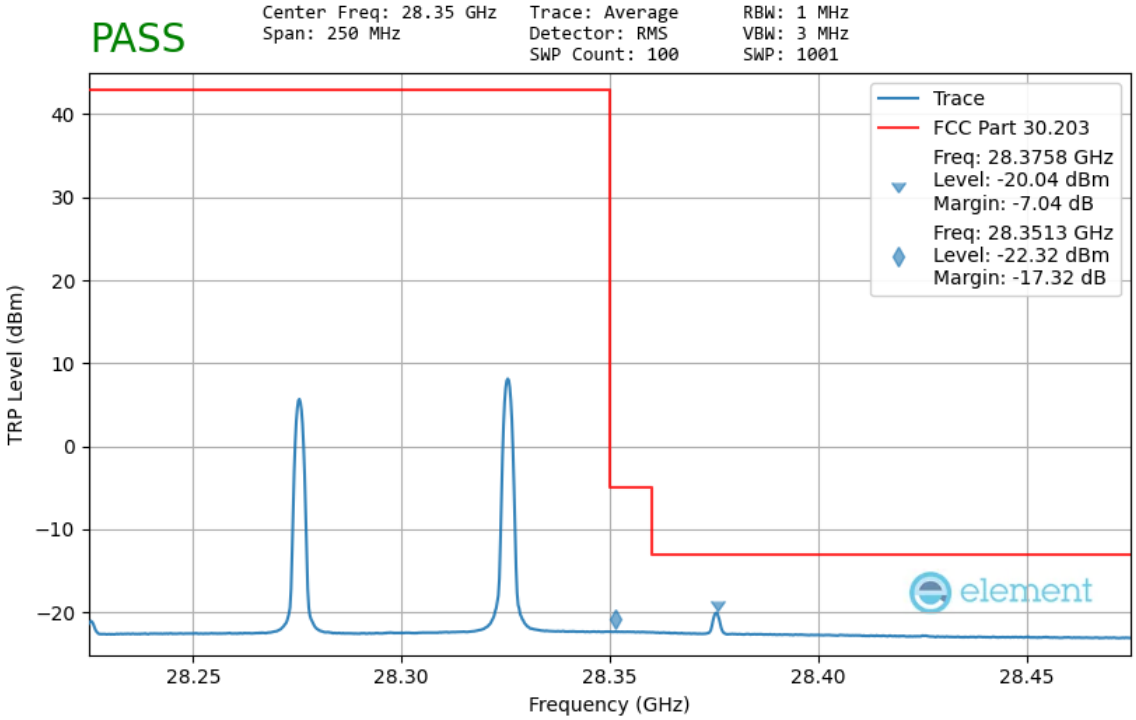
Plot 7-79. Ant1 Lower Band Edge TRP (50MHz-1CC – QPSK 1 RB)



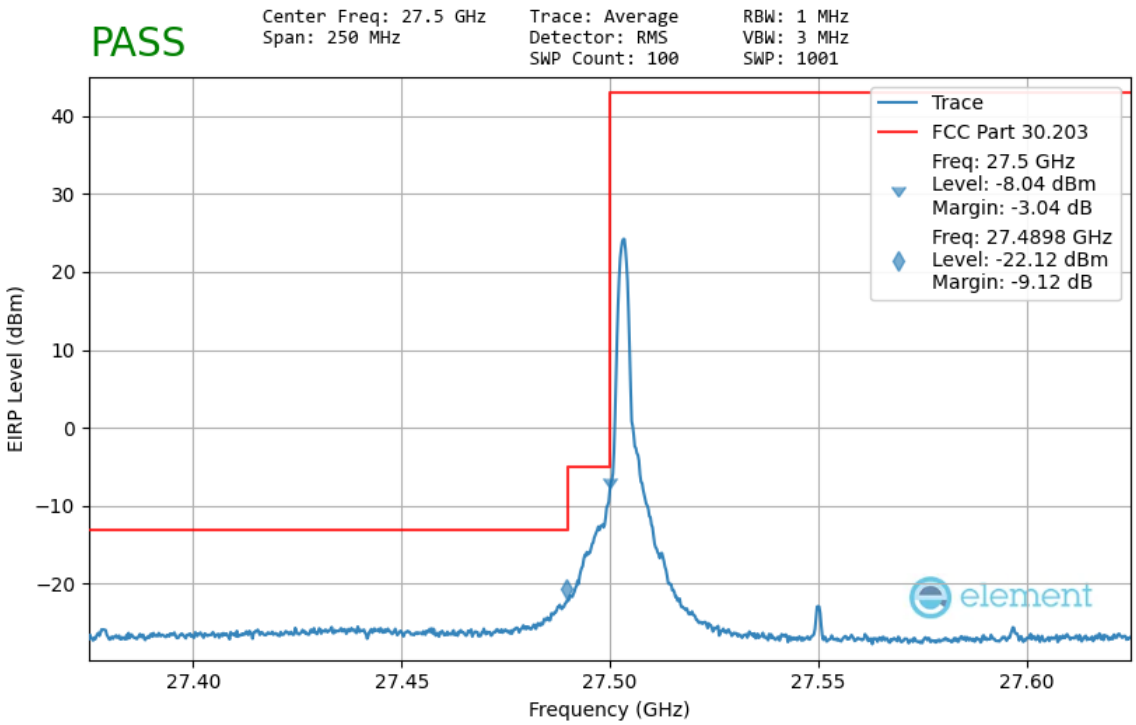
Plot 7-80. Ant1 Lower Band Edge TRP (50MHz-2CC – QPSK 1 RB)



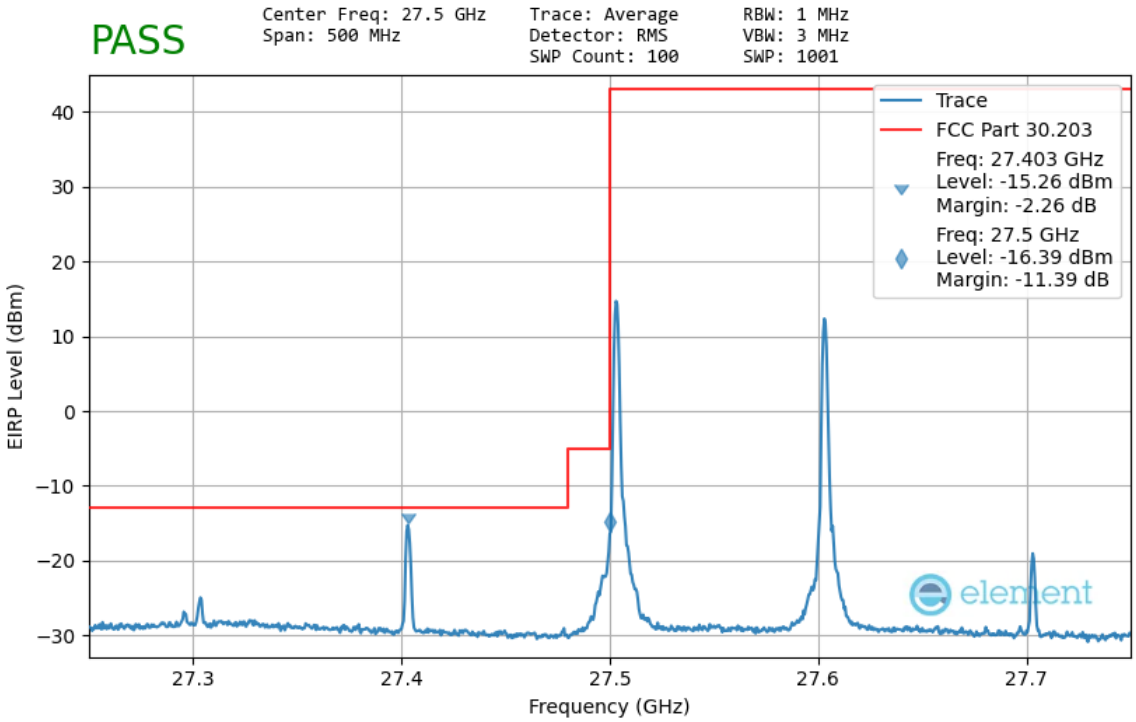
Plot 7-81. Ant1 Upper Band Edge (50MHz-1CC – QPSK Full RB)



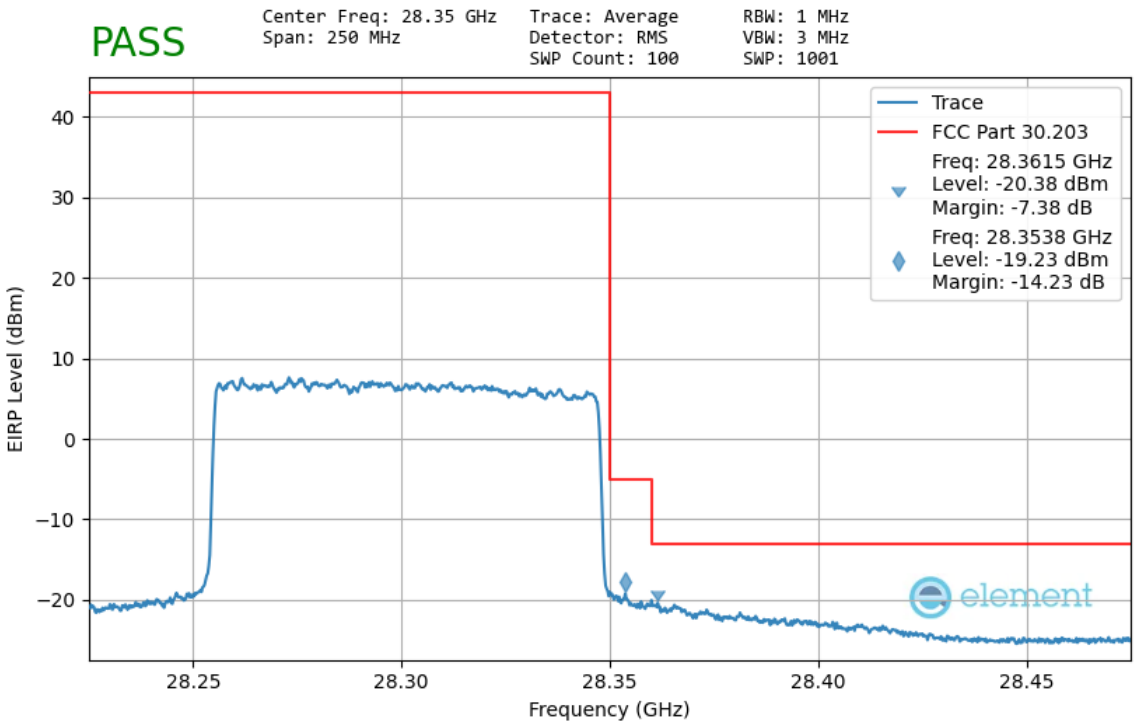
Plot 7-82. Ant1 Upper Band Edge TRP (50MHz-2CC – QPSK 1 RB)



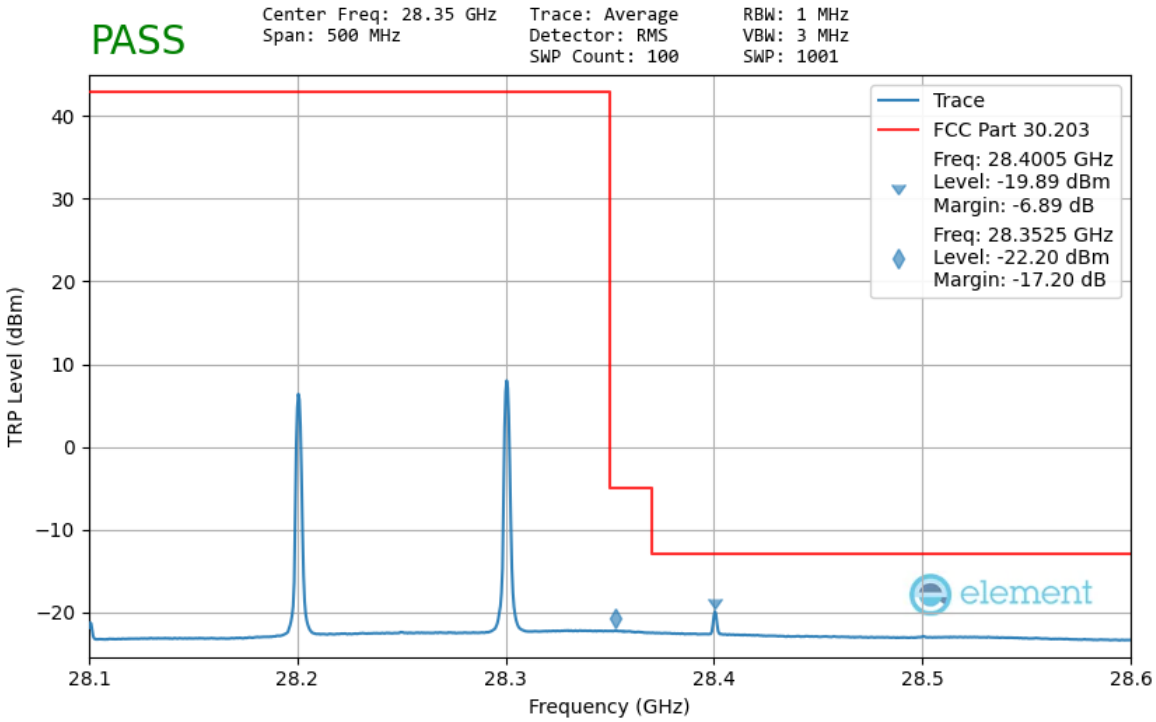
Plot 7-83. Ant1 Lower Band Edge (100MHz-1CC – QPSK 1 RB)



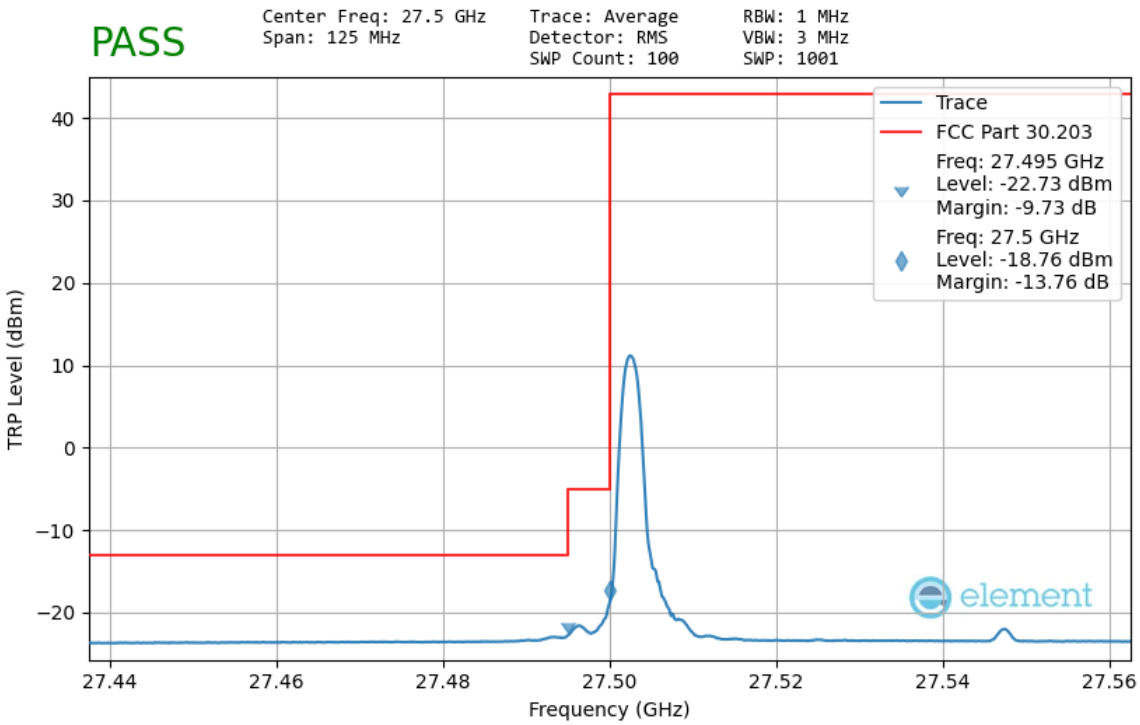
Plot 7-84. Ant1 Lower Band Edge (100MHz-2CC – QPSK 1 RB)



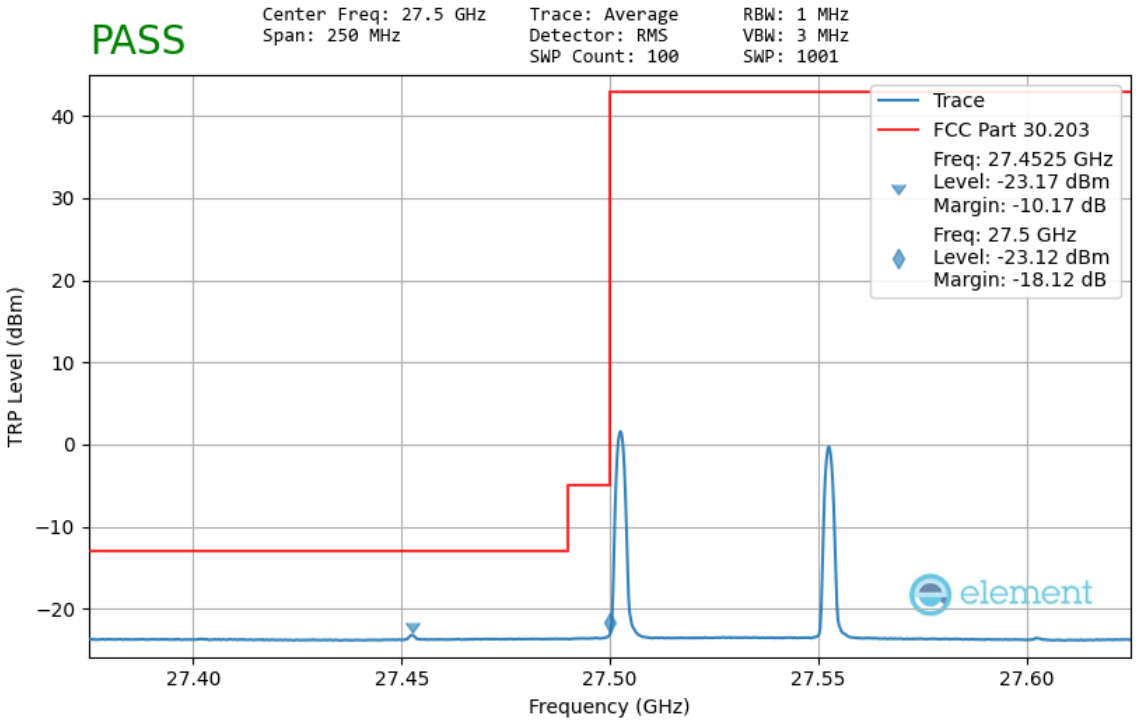
Plot 7-85. Ant1 Upper Band Edge (100MHz-1CC – QPSK Full RB)



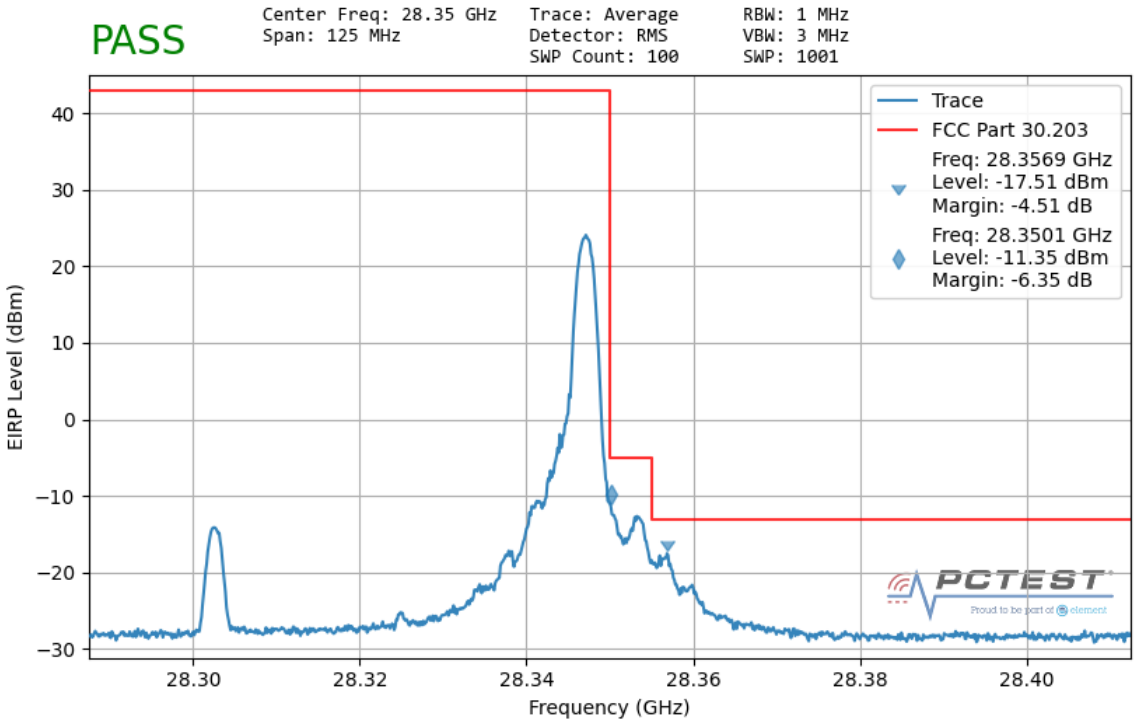
Plot 7-86. Ant1 Upper Band Edge TRP (100MHz-2CC – QPSK 1 RB)



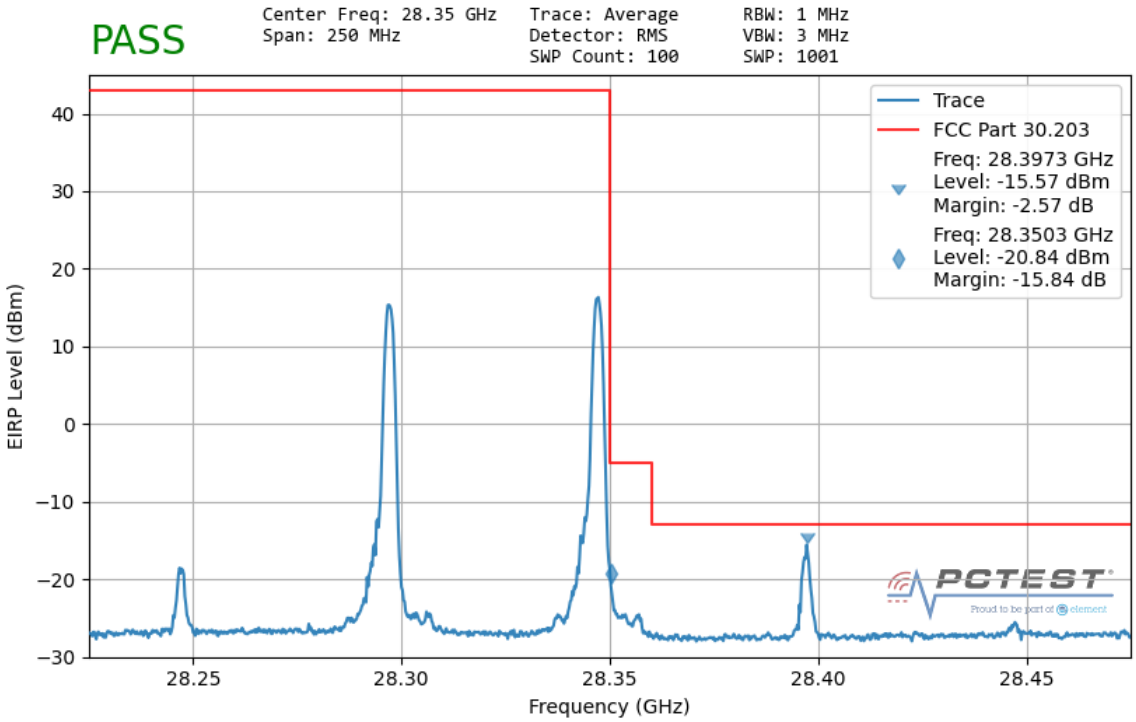
Plot 7-87. Ant2 Lower Band Edge TRP (50MHz-1CC – QPSK 1 RB)



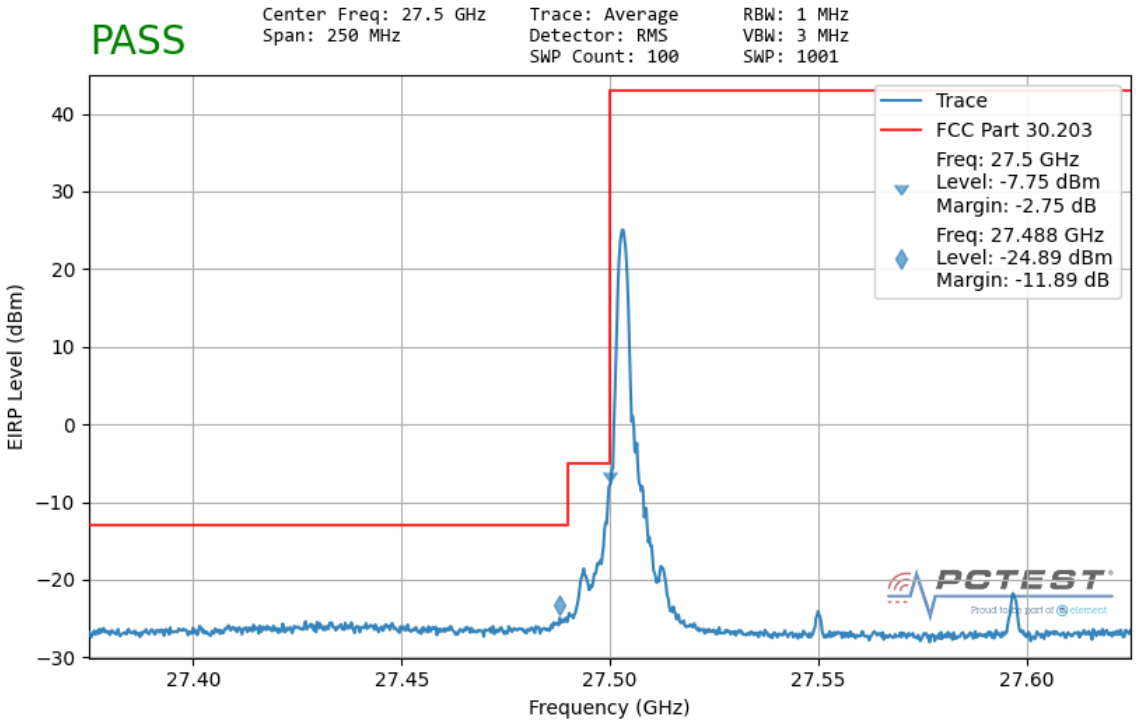
Plot 7-88. Ant2 Lower Band Edge TRP (50MHz-2CC – QPSK 1 RB)



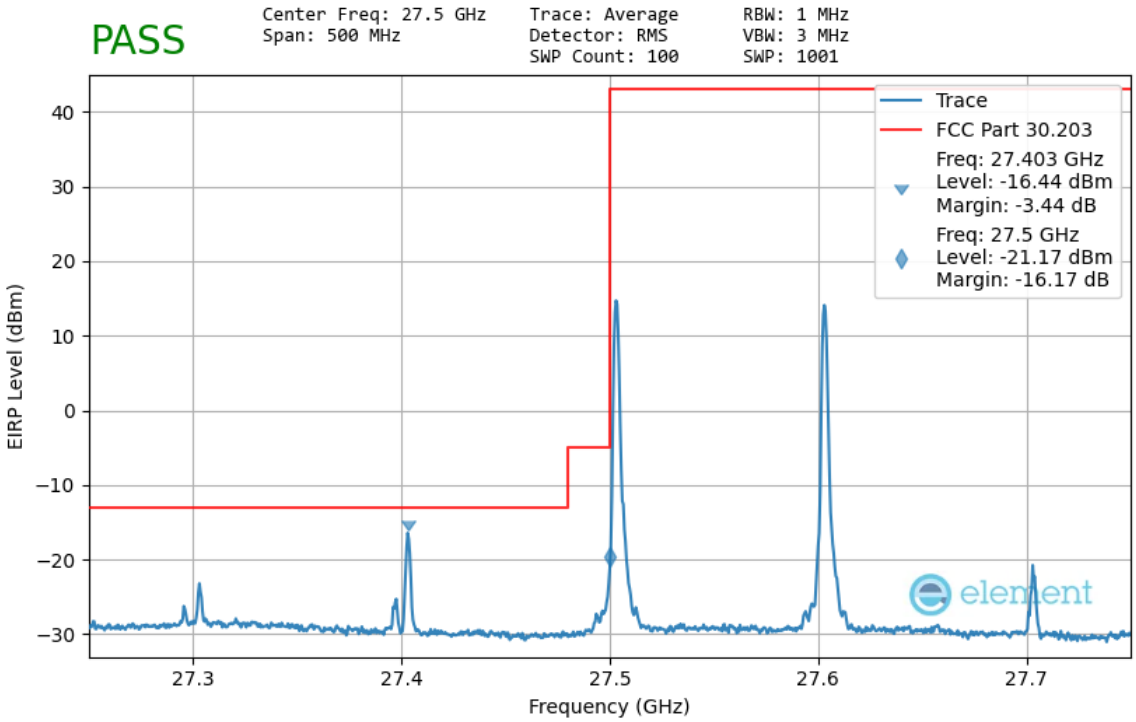
Plot 7-89. Ant2 Upper Band Edge (50MHz-1CC – QPSK Full RB)



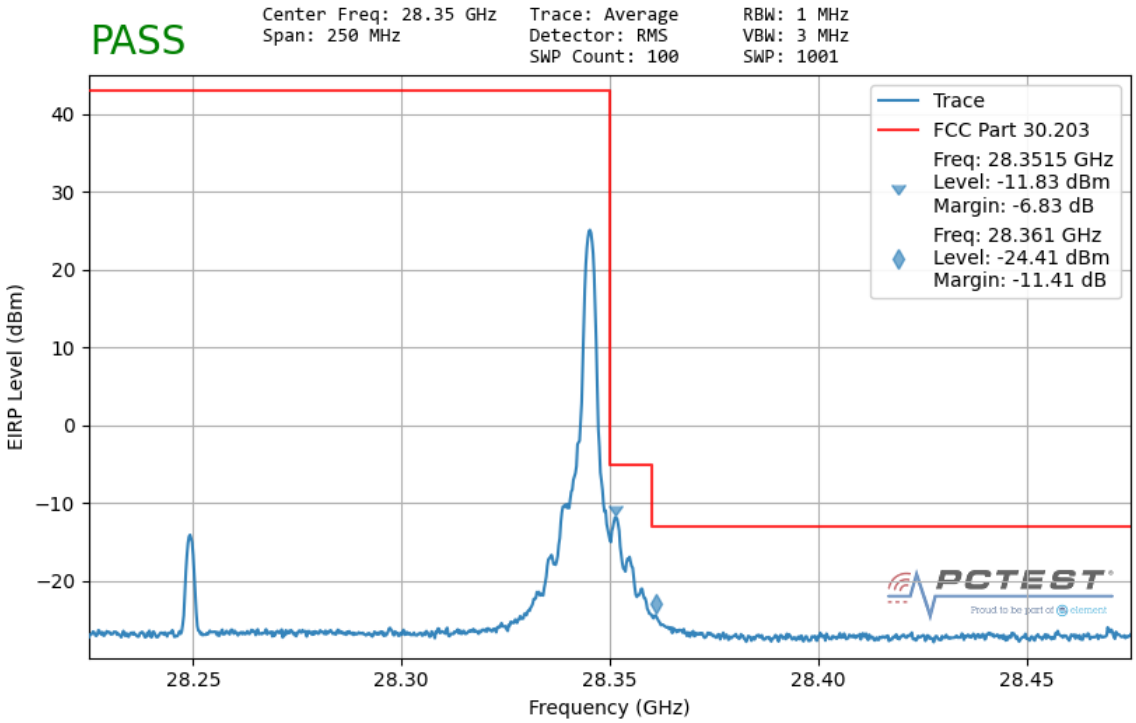
Plot 7-90. Ant2 Upper Band Edge (50MHz-2CC – QPSK 1 RB)



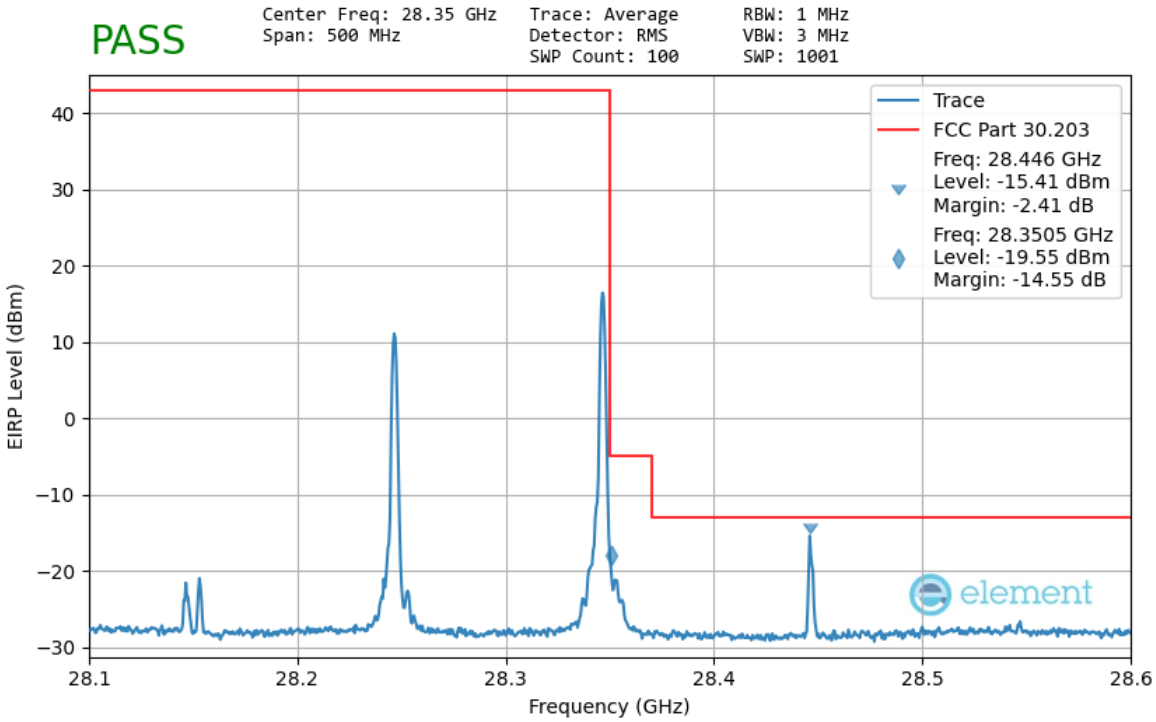
Plot 7-91. Ant2 Lower Band Edge (100MHz-1CC – QPSK 1 RB)



Plot 7-92. Ant2 Lower Band Edge (100MHz-2CC – QPSK 1 RB)

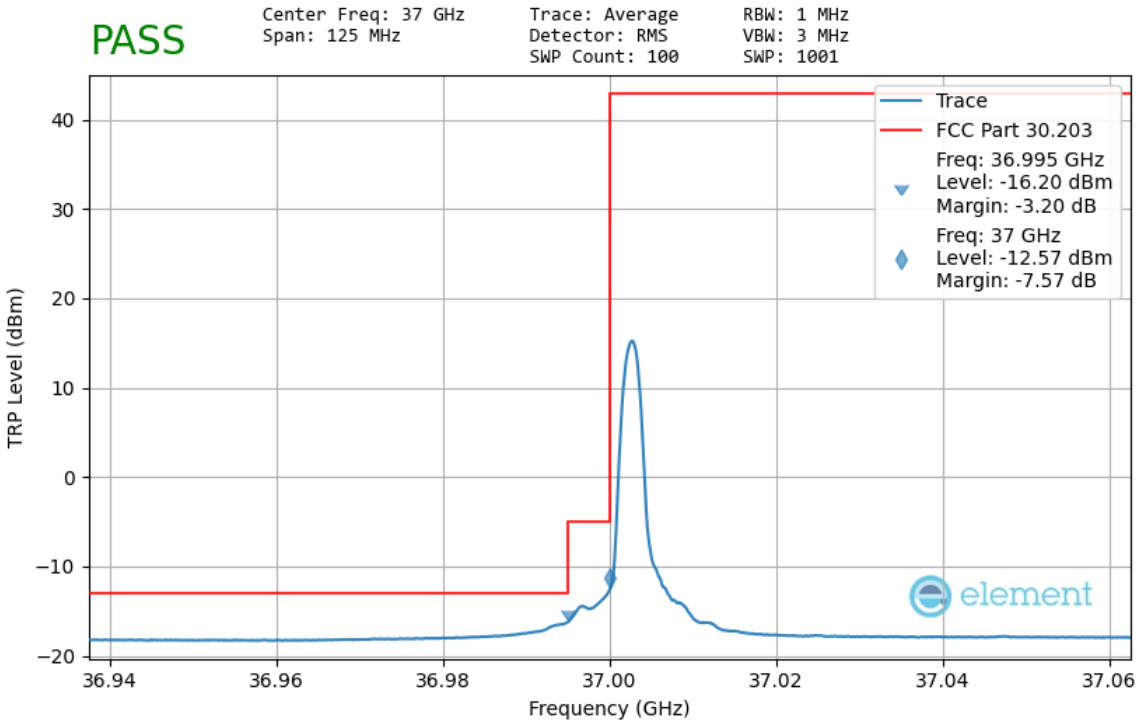


Plot 7-93. Ant2 Upper Band Edge (100MHz-1CC – BPSK 1 RB)

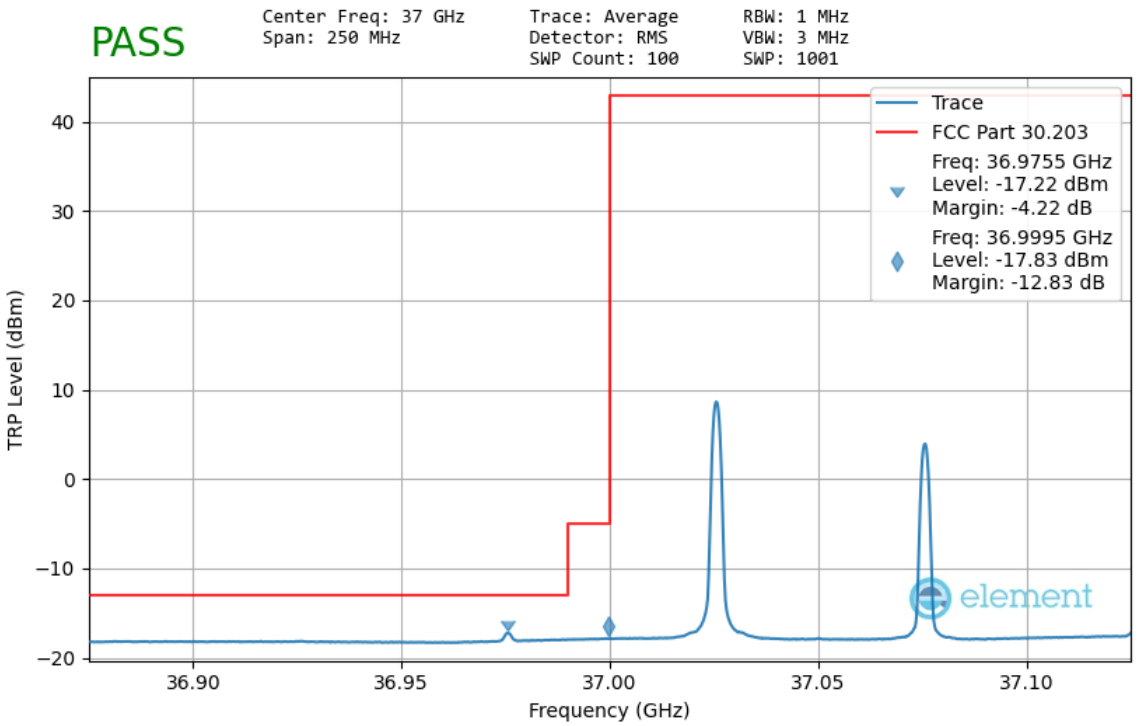


Plot 7-94. Ant2 Upper Band Edge (100MHz-2CC – QPSK 1 RB)

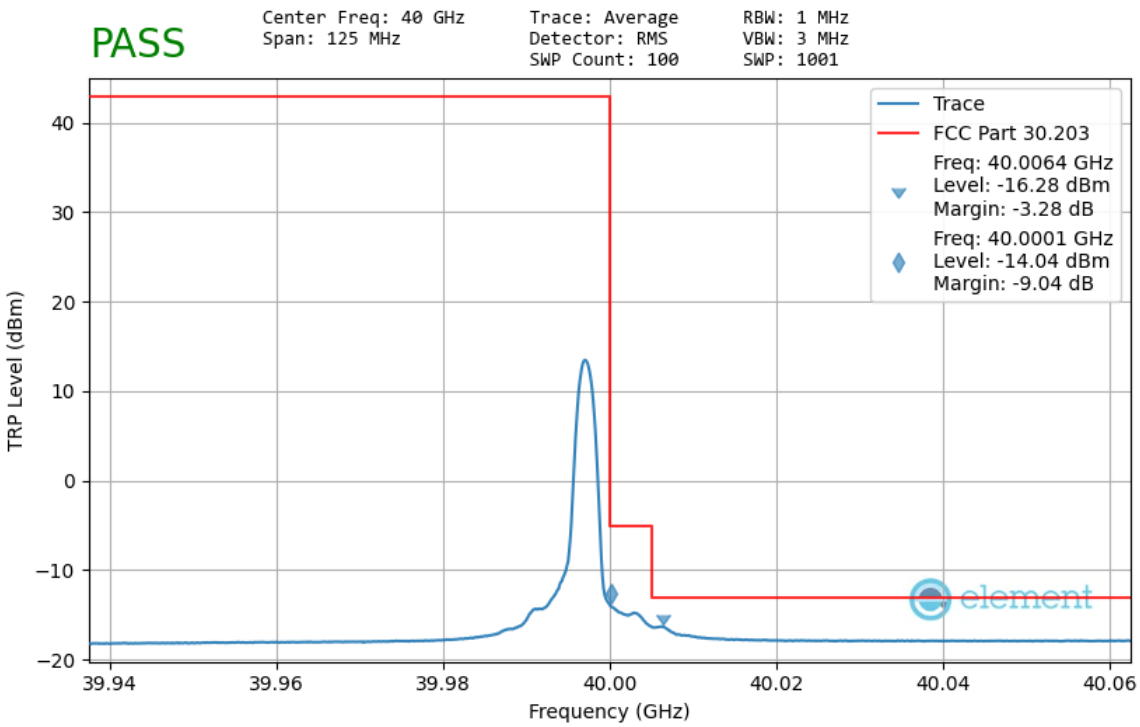
Band n260 – Worst Case



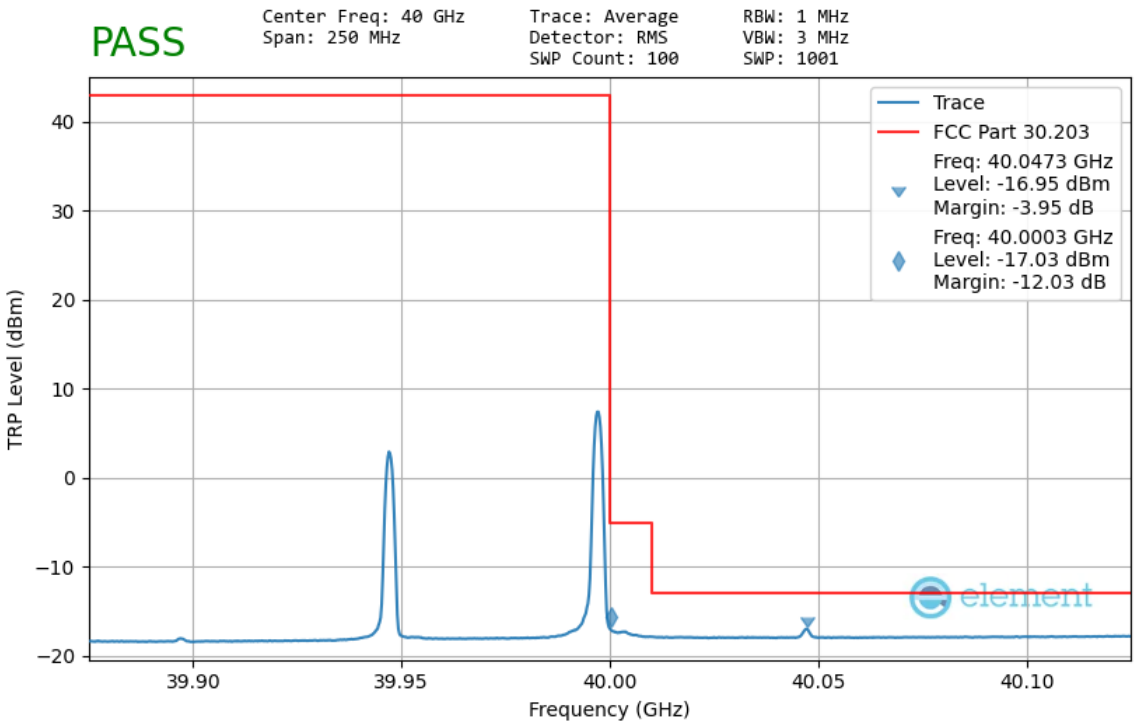
Plot 7-95. Ant1 Lower Band Edge TRP (50MHz-1CC QPSK 1 RB)



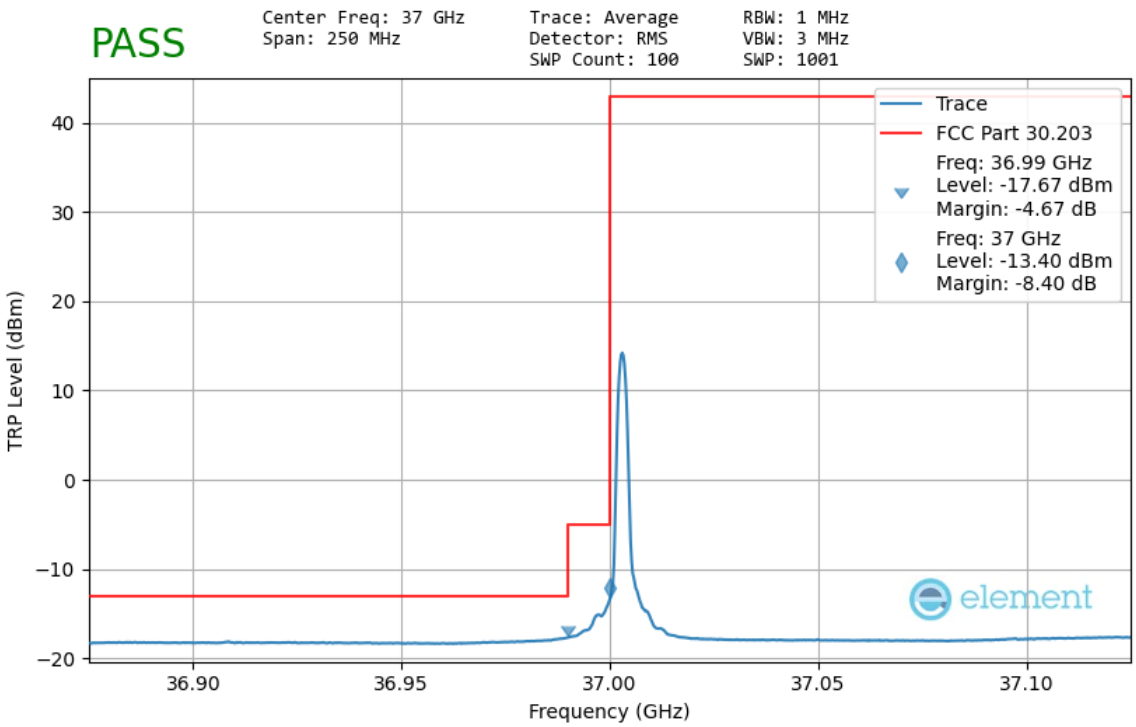
Plot 7-96. Ant1 Lower Band Edge TRP (50MHz-2CC – QPSK 1 RB)



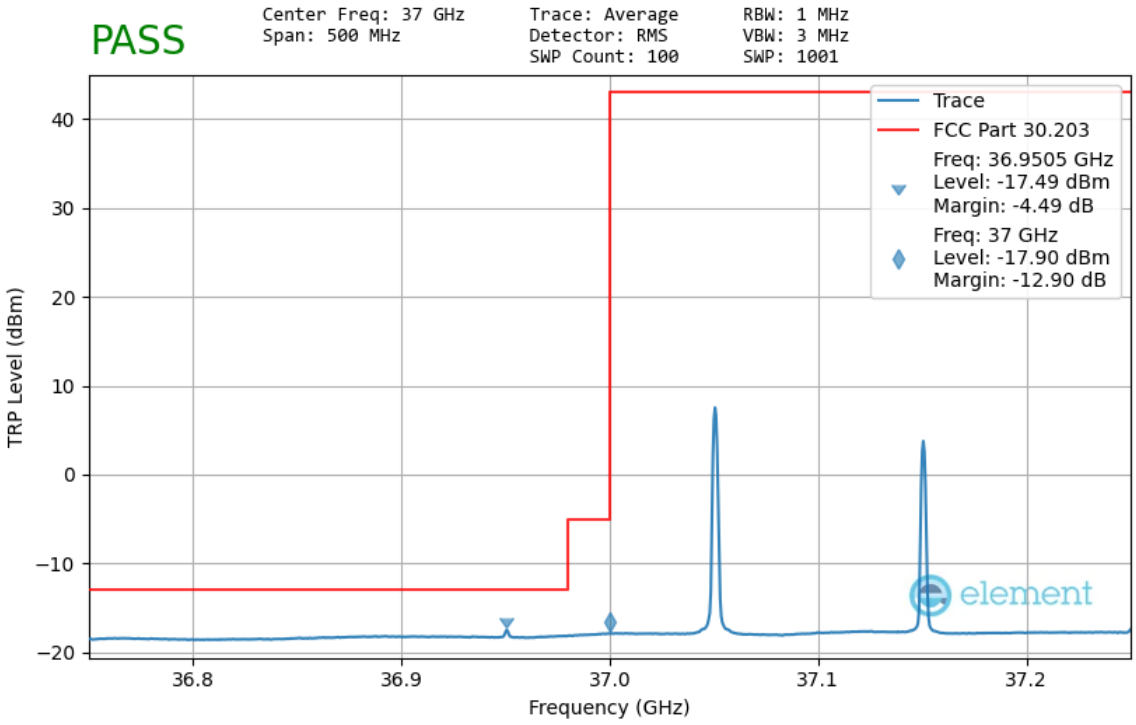
Plot 7-97. Ant1 Upper Band Edge TRP (50MHz-1CC – QPSK 1 RB)



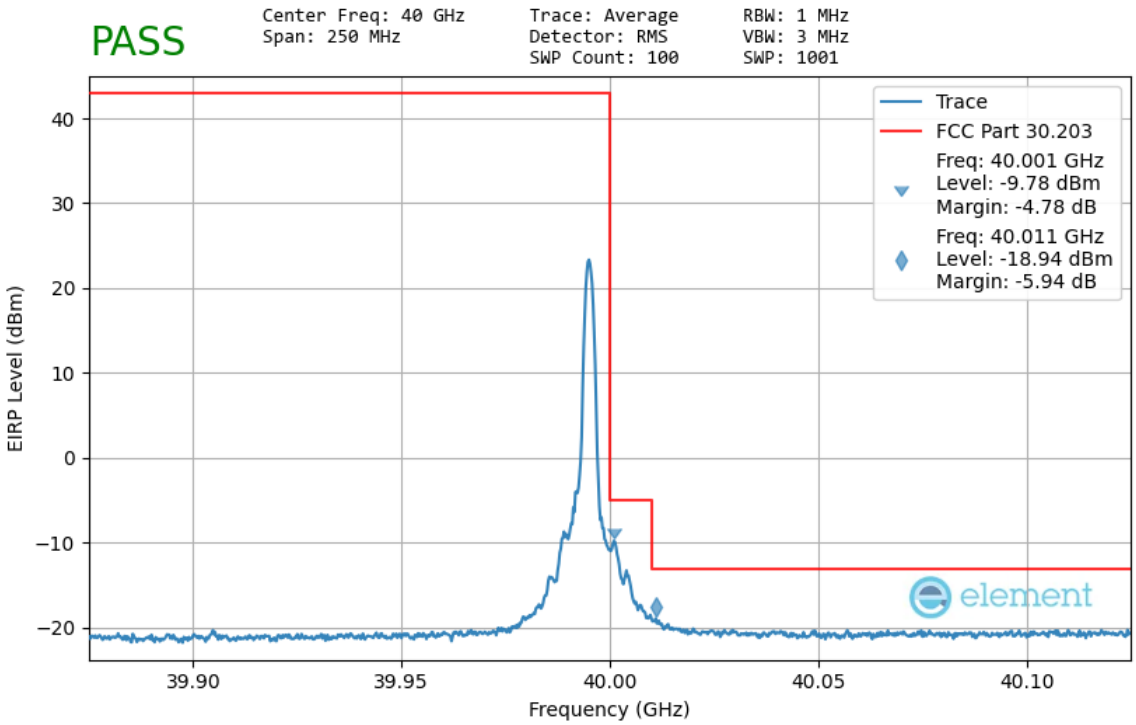
Plot 7-98. Ant1 Upper Band Edge TRP (50MHz-2CC – QPSK 1 RB)



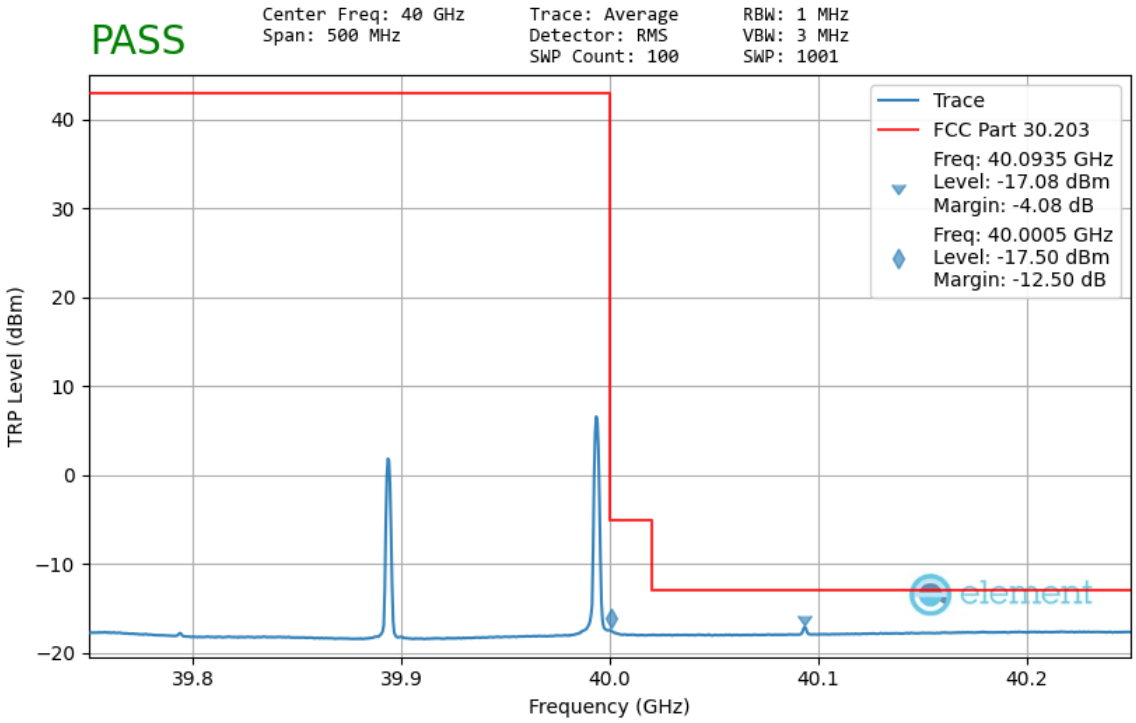
Plot 7-99. Ant1 Lower Band Edge TRP (100MHz-1CC – BPSK Full RB)



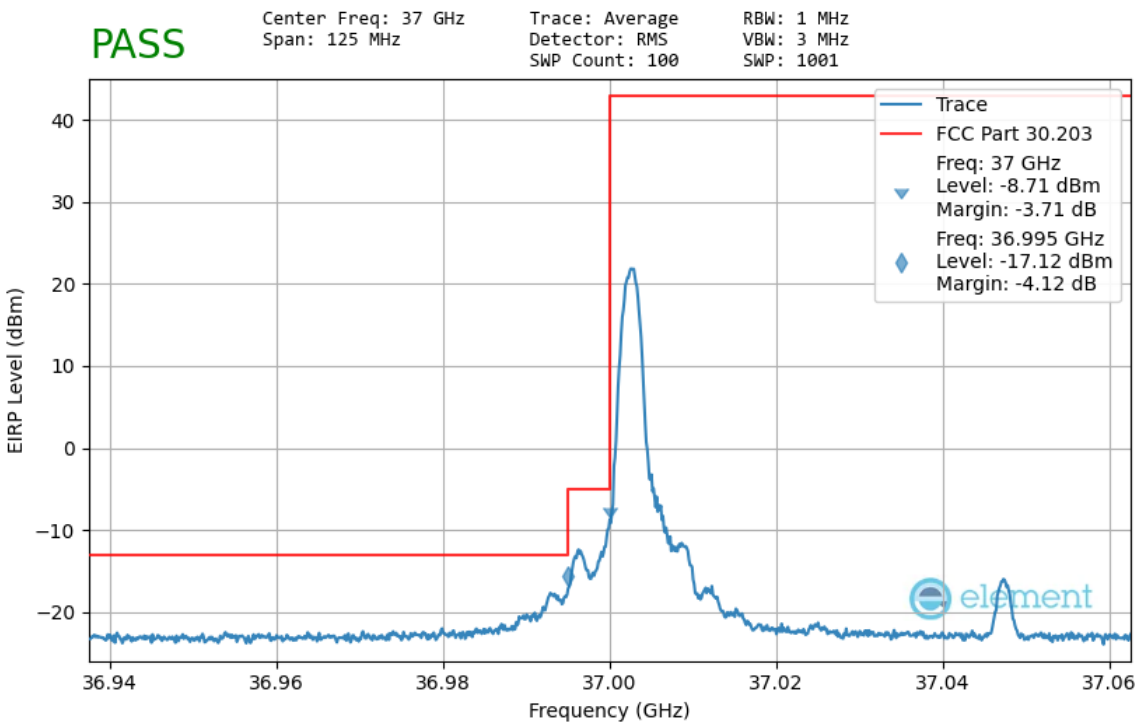
Plot 7-100. Ant1 Lower Band Edge TRP (100MHz-2CC – QPSK 1 RB)



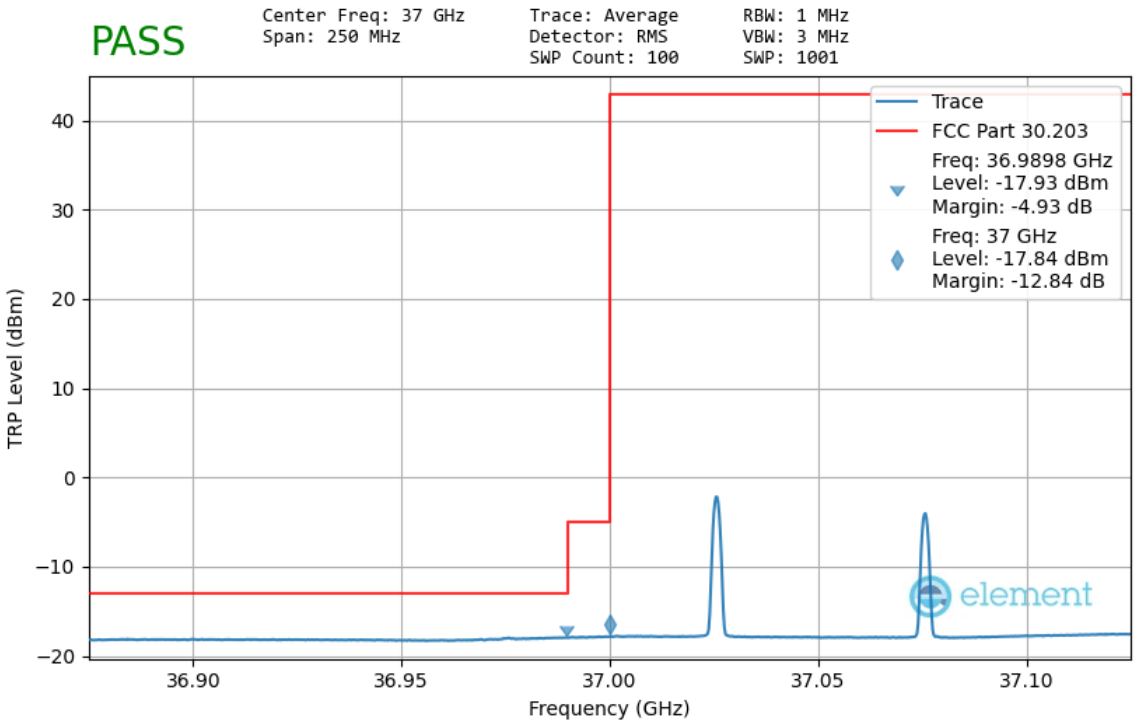
Plot 7-101. Ant1 Upper Band Edge (100MHz-1CC – QPSK Full RB)



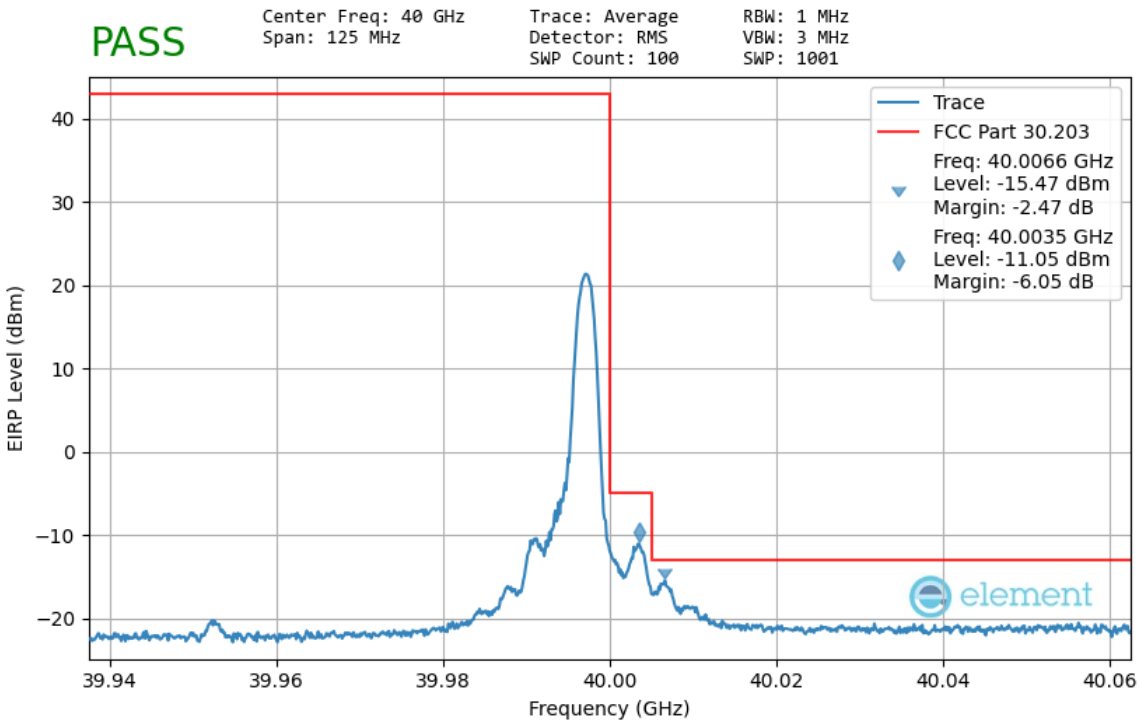
Plot 7-102. Ant1 Upper Band Edge TRP (100MHz-2CC – QPSK 1 RB)



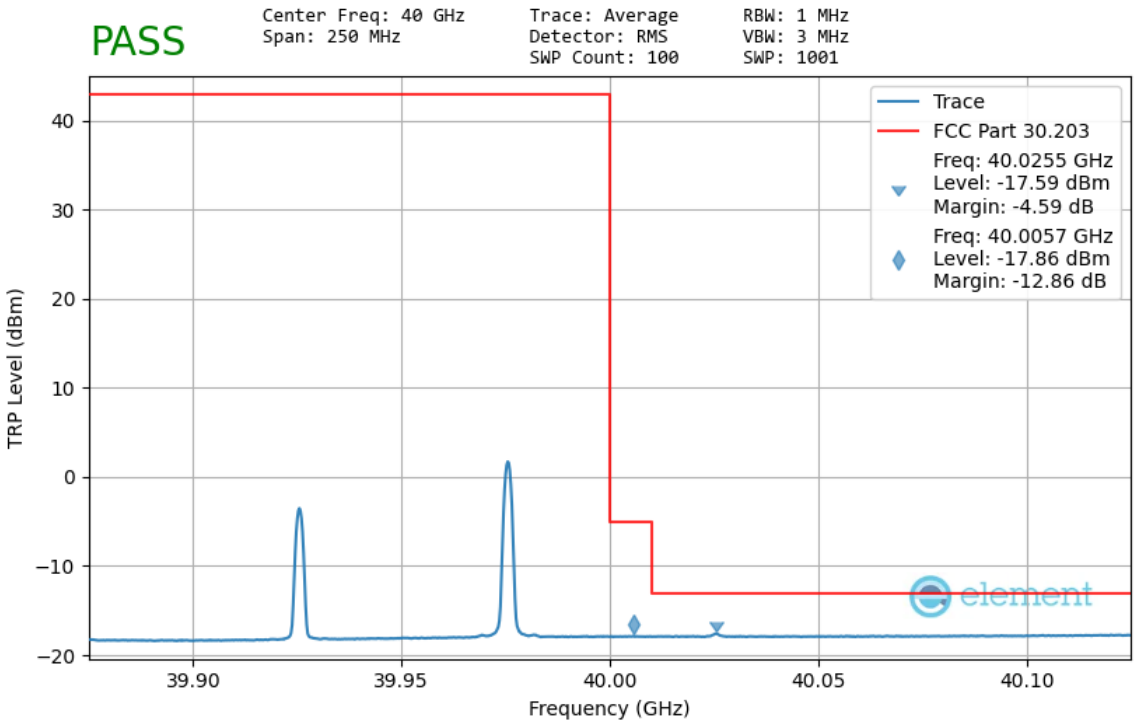
Plot 7-103. Ant2 Lower Band Edge (50MHz-1CC – BPSK 1 RB)



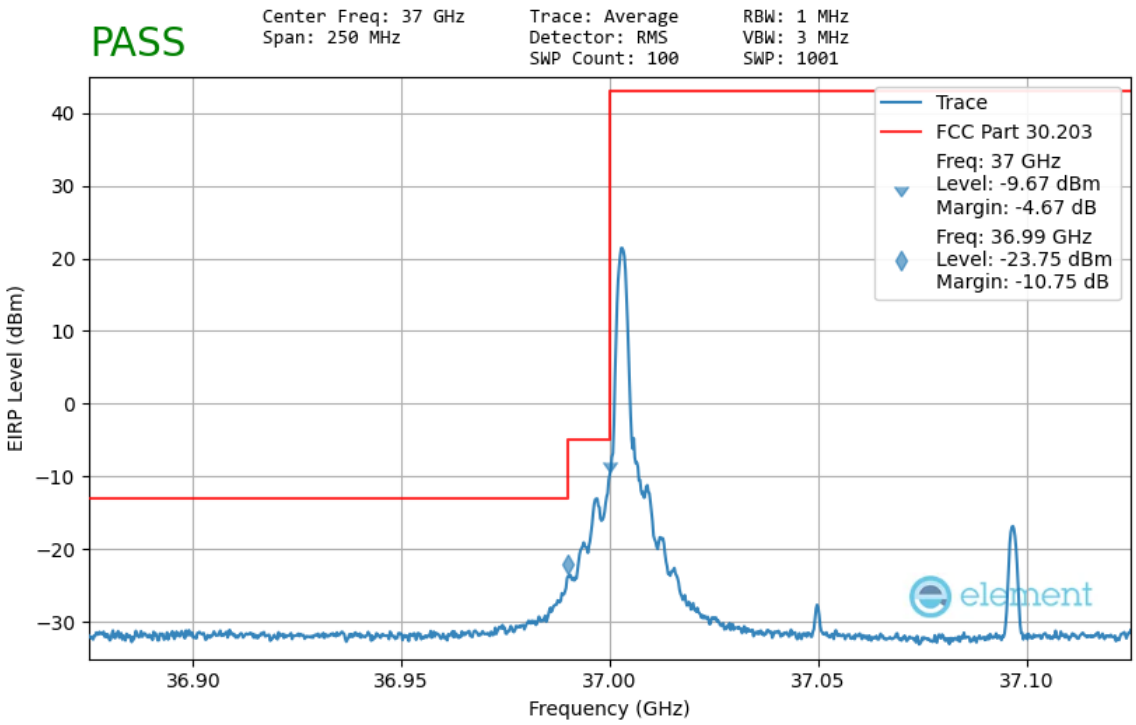
Plot 7-104. Ant2 Lower Band Edge TRP (50MHz-2CC – QPSK 1 RB)



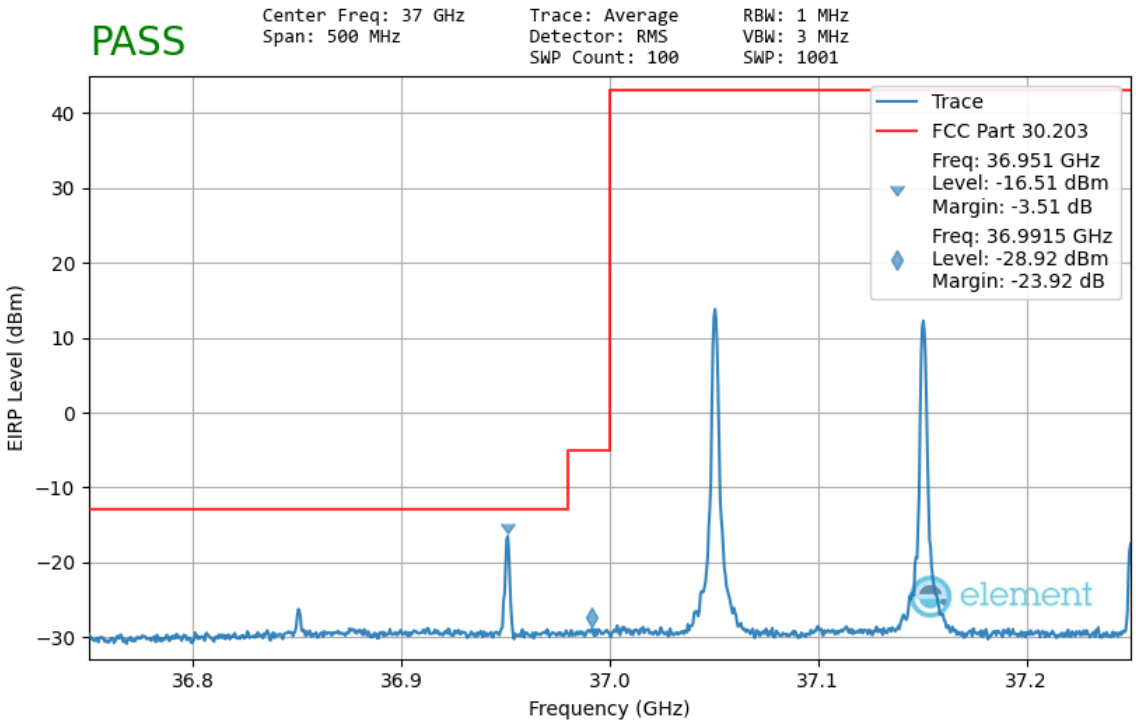
Plot 7-105. Ant2 Upper Band Edge (50MHz-1CC – BPSK 1 RB)



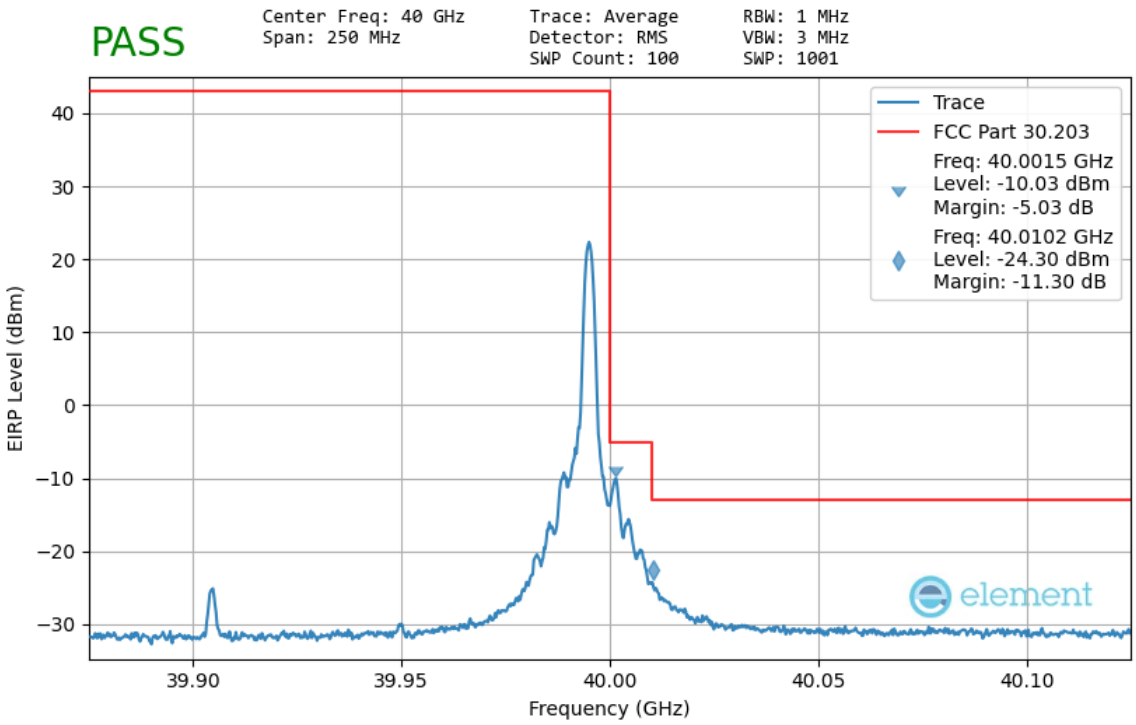
Plot 7-106. Ant2 Upper Band Edge (50MHz-2CC – QPSK 1 RB)



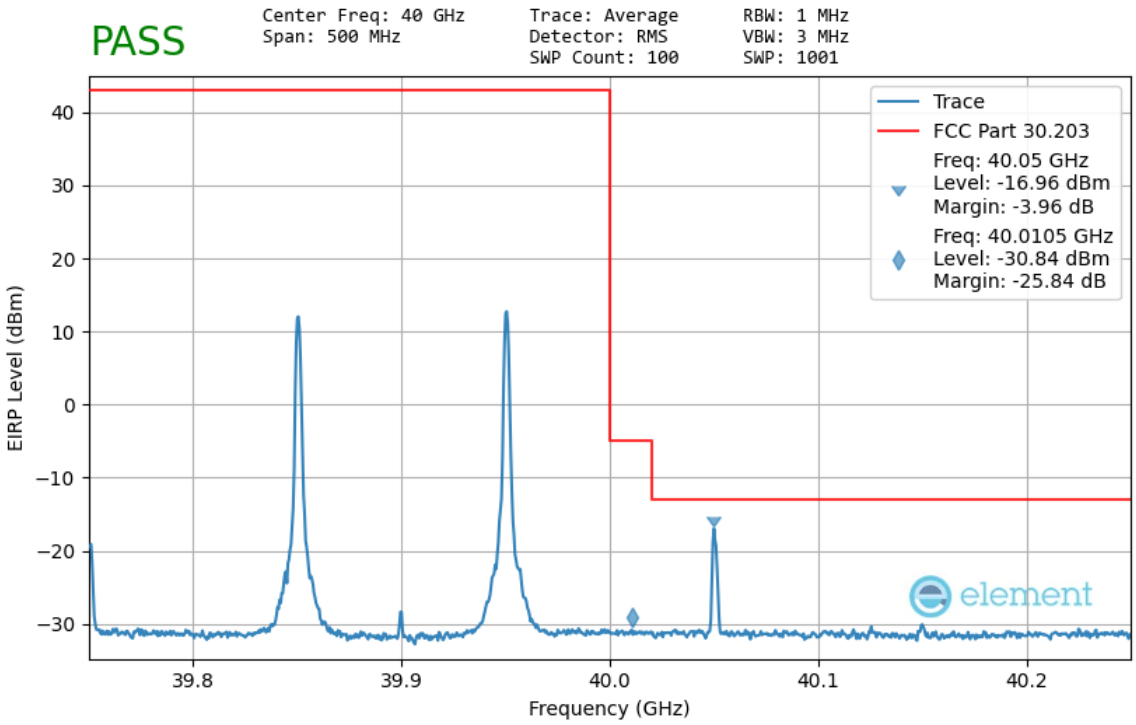
Plot 7-107. Ant2 Lower Band Edge (100MHz-1CC – BPSK 1 RB)



Plot 7-108. Ant2 Lower Band Edge (100MHz-2CC – QPSK 1 RB)



Plot 7-109. Ant2 Upper Band Edge (100MHz-1CC – BPSK 1 RB)



Plot 7-110. Ant2 Upper Band Edge (100MHz-2CC – QPSK 1 RB)

7.6 Frequency Stability / Temperature Variation

§2.1055

Test Overview and Limit

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

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

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

Test Procedure Used

ANSI C63.26-2015 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 measured using horn antenna connected to a spectrum analyzer. The EUT was placed inside an environmental chamber that uses a foam plug to maintain the temperature condition inside the chamber. The horn antenna measured the frequency of the fundamental signal.

Test Notes

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

Frequency Stability Measurements (Band n261)

§2.1055

OPERATING FREQUENCY:	27,924,960,000	Hz
CHANNEL:	2077915	
REFERENCE VOLTAGE:	7.60	VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	7.60	+ 20 (Ref)	27,925,537,496	0	0.0000000
100 %		- 30	27,925,585,853	-48,357	-0.1731663
100 %		- 20	27,925,585,763	-48,267	-0.1728440
100 %		- 10	27,925,803,007	-265,511	-0.9508013
100 %		0	27,925,738,182	-200,685	-0.7186593
100 %		+ 10	27,925,626,948	-89,451	-0.3203279
100 %		+ 20	27,925,537,496	0	0.0000000
100 %		+ 30	27,925,498,113	39,383	0.1410319
100 %		+ 40	27,925,453,501	83,995	0.3007892
100 %		+ 50	27,925,419,356	118,140	0.4230633
BATT. ENDPOINT	7.20	+ 20	27,925,637,581	-100,085	-0.3584060

Table 7-42. Frequency Stability Data (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.

Frequency Stability Measurements (Band n261)

§2.1055

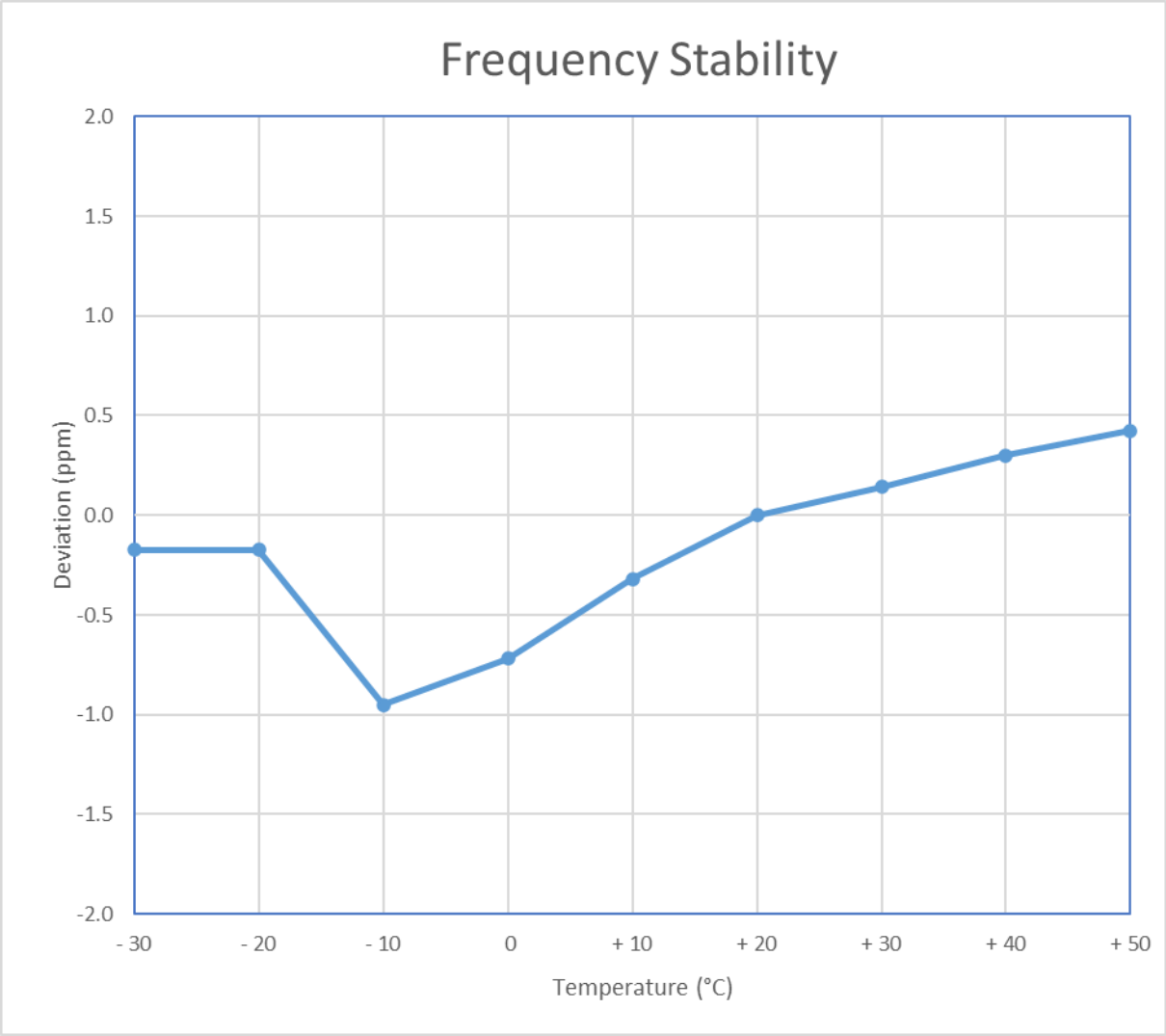


Figure 7-1. Frequency Stability Graph (n261)

Frequency Stability Measurements (Band n260)

§2.1055

OPERATING FREQUENCY:	38,495,520,000	Hz
CHANNEL:	2254091	
REFERENCE VOLTAGE:	7.60	VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	7.60	+ 20 (Ref)	38,500,566,479	0	0.0000000
100 %		- 30	38,500,805,840	239,361	0.6217105
100 %		- 20	38,500,805,957	239,478	0.6220147
100 %		- 10	38,500,855,263	288,784	0.7500800
100 %		0	38,500,810,252	243,774	0.6331710
100 %		+ 10	38,500,701,275	134,797	0.3501172
100 %		+ 20	38,500,566,479	0	0.0000000
100 %		+ 30	38,500,443,484	-122,995	-0.3194632
100 %		+ 40	38,500,369,966	-196,513	-0.5104167
100 %		+ 50	38,500,391,069	-175,410	-0.4556043
BATT. ENDPOINT	7.20	+ 20	38,500,391,001	-175,478	-0.4557809

Table 7-43. Frequency Stability Data (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.

Frequency Stability Measurements (Band n260)

§2.1055

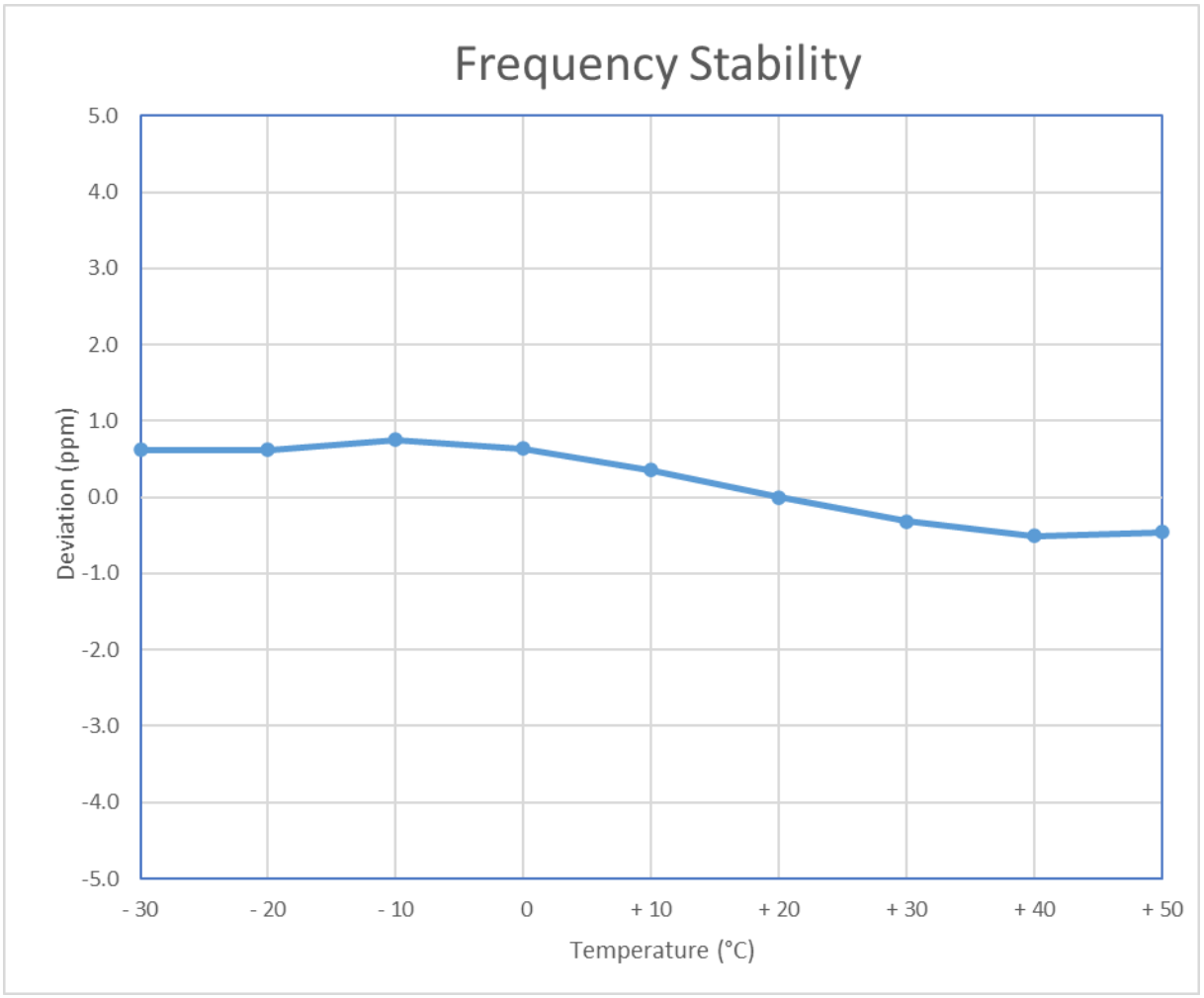


Figure 7-2. Frequency Stability Graph (n260)

8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Microsoft Corporation Portable Computing Device FCC ID: C3K1997** complies with all the requirements of Part 30.

9.0 APPENDIX A

9.1 VDI Mixer Verification Certificate

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

Certificate of Conformance

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

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

Packing List No: 202943 **Today's Date:** 08/28/20
Shipping Date: 08/28/20 **PO Number:** 200414.DP2

Quantity Shipped	Unit	Description	Order-Job Number
1	EA	VDIWR19.0SAX-M-M4 WR19SAX-M-M4 / SN: SAX 679	20177A-01

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

Authorized Signature
Virginia Diodes, Inc

Page 1 of 1

Virginia Diodes, Inc
979 2nd St. SE
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Phone: 434-297-3257
Fax: 434-297-3258

Certificate of Conformance

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

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

Packing List No: 202695
Shipping Date: 08/12/20
Today's Date: 08/14/20
PO Number: 200414.DP2

Quantity Shipped	Unit	Description	Order-Job Number
1	EA	VDIWR12.0SAX-M-M6 S/N: SAX 680	20177B-01

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

Authorized Signature
Virginia Diodes, Inc

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Charlottesville, VA 22902
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Certificate of Conformance

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

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

Packing List No: 203623
Shipping Date: 10/22/20
Today's Date: 10/22/20
PO Number: 200414.DP2

Quantity Shipped	Unit	Description	Order-Job Number
1	EA	VDIWR8.0SAX-M-M9 S/N: SAX 681	20177C-01

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

Authorized Signature
Virginia Diodes, Inc

Page 1 of 1

Virginia Diodes, Inc
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Fax: 434-297-3258

Certificate of Conformance

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

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

Packing List No: 203281 **Today's Date:** 09/24/20
Shipping Date: 09/24/20 **PO Number:** 200414.DP2

Quantity Shipped	Unit	Description	Order-Job Number
1	EA	VDIWR5.1SAX-M-M18 WR5.1SAX-M-M18 - Mini Spectrum Analyzer Extension Module; SN: SAX 682.	20177D-01

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

Authorized Signature
Virginia Diodes, Inc

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9.2 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
Randy Ortanez Phone: 410 290 6652

ELECTRICAL[1]

Valid To: September 30, 2022 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 below***, 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 Parts 15B/C/D/E/F/G/H (using ANSI C63.4:2014, ANSI C63.10:2013, ANSI C63.17:2013, and FCC KDB 905462 D02 (v02)), 18 (using MP-5:1986); 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; KN 11; KN 32; VCCI V-3(2016.11); VCCI V-3 (2015.04); VCCI 32-1: VCCI-CISPR 32
Accessibility	CFR 47, FCC Part 14
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

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

Test Technology:	Test Method(s) [2]:
SAR/RF Exposure	IEEE 1528-2013; RSS 102 Issue 5 (2015); EN 50360-2017; EN 62209-1:2016; EN 62209-2:2010; 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; FCC KDB 248227 D01; FCC KDB 447498 D01, D02, and D03; FCC KDB 615223 D01; FCC KDB 616217 D04; FCC KDB 643646 D01; FCC KDB 648474 D03 and D04; FCC KDB 680106 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 C95.1-2005; IEEE C95.1-1992; IEEE C95.3-2002; RSS-102 (SAR. RF Exposure, NS), SPR-003; SPR-002; SPR-001; SPR-004; 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; C95.1: 2019; ICNIRP (100KHz – 300 GHz): 2020; IEC 62311:2019; EN 62311:2020; IEC/IEEE 62209-1528:2020; RRA Public Notification 2018-18, December 7, 2018
Hearing Aid Compatibility	ANSI C63.19:2007; ANSI C63.19:2011; ANSI C63.19:2019; CTIA Test Plan for Hearing Aid Compatibility v.3.1.1 (2017); FCC KDB 285076, D01 & D02; RSS-HAC
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); ANSI/TIA-603-D; TIA-102.CAAA-D; FCC KDB 935210 D03 (v04); FCC KDB 935210 D04 (v02); FCC KDB 935210 D05 (v01)
European Radio	ETSI EN 302 065-1 Version 2.1.1 (2016-11); ETSI EN 302 065-2 Version 2.1.1 (2016-11); ETSI EN 302 065-3 Version 2.1.1 (2016-11); ETSI EN 302 065-4 Version 1.1.1 (2016-11); ETSI EN 302 291-1 Version 1.1.1 (2005-07); ETSI EN 302 291-2 Version 1.1.1 (2005-07); ETSI EN 302 502 Version 2.1.3 (2017-07); ETSI EN 302 510-1 Version 1.1.1; ETSI EN 302 510-2 Version 1.1.1; ETSI EN 302 537 Version 2.1.1 (2016-10); ETSI EN 301 511 Version 12.5.1 (2017-03); ETSI EN 301 839 Version 2.1.1 (2016-04); ETSI EN 301 893 Version 2.1.1 (2017-05); ETSI EN 301 893 Version 1.8.1 (2015-03); ETSI EN 301 908-1 Version 13.1.1 (2019-11); ETSI EN 301 908-13 Version 13.1.1 (2019-11);

Test Technology:	Test Method(s) [2]:
European Radio (cont'd)	ETSI EN 300 220-1 Version 3.1.1 (2017-02); ETSI EN 300 220-2 Version 3.2.1 (2018-06); ETSI EN 300 328 Version 2.1.1 (2016-11); ETSI EN 300 328 Version 2.2.2 (2019-07); ETSI EN 300 330 Version 2.1.1 (2017-02); ETSI EN 300 440 Version 2. (22.1 (2018-07); ETSI EN 300 440-2 Version 1.4.1 (2010-08); KS X 3123, KS X 3142, KS X 3270, KS X 3271; LP0002; DGT LP0002;
Korean Radio	Regulations on Radio Equipment (MSIT Ordinance MSIT No. 63, Dec. 24, 2020); Unlicensed Radio Equipment Established Without Notice (MSIT Public Notification 2020-59, Oct. 16, 2020); 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 2019-1, January 17, 2019); Technical Requirements for Radio Equipment for Telecommunication Services (RRA Public Notification 2019-9, June 3, 2019); 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 2019-3, March 4, 2019)
Australia/New Zealand Radio	AS/NZS 4268:2017
Licensed Wireless Devices	ANSI C63.26:2015
Wired and Wireless 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; 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-Confromance (TS 38.533)

Test Technology:	Test Method(s) [2]:
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; 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) [3]; 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; Sprint LTE Test Plan; Sprint LTE Safe for Network (SFN); Sprint LTE Conformance; Sprint LTE IoT; Sprint Lab Conformance; 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	CDMA-LTE Inter-RAT (iRAT); CDMA-LTE Inter-RAT SVD; SVLTE: 1x RF with LTE Data Cal; SVLTE: LTE RF with 1x Voice Call; SVD and SVLTE: LTE Data Throughput with 1x Voice Call; eHRPD; GMSS; SVD GMSS; E911 Data Call Processing; Stress Testing; RSSI for MM Devices; SVD Interband; LTE LBS Performance; VZW Multimode Supl Signaling; VZW Multimode SMS; VZW Multimode Data Retry
VoLTE	IMS VoIP; Rich Communication Services (RCS); VoLTE to 1xRTT Fallback for SVLTE (1xRTT Fallback); IMS Registration and Retry; ePDG Live Network; E911 for VoLTE; VZW hVoLTE; VZW VoIP and VT Performance; VZW Interband RRM and Protocol

Test Technology:	Test Method(s) [2]:
Carrier Aggregation	VZW Carrier Aggregation Supplementary RF; VZW Carrier Aggregation Data Throughout
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	CBRS Alliance Certification Test Plan; WInnForum Conformance and Performance Test Technical Standards

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

Test Technology:	**Test Method(s) [2]:**
Wireless	3GPP2 C.S0011-C 20-Feb-2006 (TIA-98D/E/F) (*excluding Sections 3.2.1.3, 3.2.3.2, 3.3.3, 3.3.4, 3.3.5, 3.3.6, 3.4.6, 3.4.8, 3.4.10, 3.4.11, 3.4.12, 3.4.13, 3.7.2, 4.4.8, 4.4.9.2.1, 4.4.10, 4.4.11*); 3GPP2 C.S0043-0 24-Sep-2004 (TIA-1035); 3GPP2 C.S0036-0 11-Mar-2002 (TIA-916); 3GPP2 C.S0036-A 23-May-2011 (TIA-916-A); 3GPP2 C.S0037-0 19-Apr-2002 (TIA-918); 3GPP2 C.S0056-0 22-Jul-2005 (TIA-1042); 3GPP2 C.S0059-0 20-Aug-2008 (TIA-1038); 3GPP2 C.S0060-0 06-Dec-2005 (TIA-1044); 3GPP2 C.S0061-0 22-Jun-2005 (TIA-1045); 3GPP2 C.S0062-0 14-May-2007 (TIA-1046); 3GPP2 C.S0073-0 26-Sep-2005 (TIA-1084); 3GPP2 C.S0073-B 21-Aug-2009 (TIA n/a); 3GPP2 C.S0094-0 30-Oct-2008 (TIA-1157); CTIA Conformance Test Plan for CDMA Wireless Devices; GCF Certification Criteria 2 (CAG2) Test Plan; VZW Wireless Priority Services (WPS); VZW Safe for Network (SFN); VZW Open Development (OD) Device Specifications; VZW Location Based Services (LBS); VZW CMAS; VZW NBPCD; VZW Phase 1
EVDO	3GPP2 C.S0033-0 12-Dec-2003 (TIA-866); 3GPP2 C.S0033-A 14-Dec-2005 (TIA-866); 3GPP2 C.S0038-0 19-Apr-2002 (TIA-919); 3GPP2 C.S0038-A 26-Sep-2005 (TIA-919); 3GPP2 C.S0038-B 30-Mar-2009 (TIA n/a); 3GPP2 C.S0037-0 19-Apr-2002 (TIA-918); CTIA Conformance Test Plan for CDMA Wireless Devices; GCF Certification Criteria 2 (CAG2) Test Plan

Test Technology:	Test Method(s) [2]:
Emissions Radiated and Conducted	CFR 47, FCC Parts 15B/C/D/E/F/G/H (using ANSI C63.4:2014, ANSI C63.10:2020, ANSI C63.10:2013; ANSI C63.17:2013, FCC KDB 905462, and KDB 987594, 18 (using MP-5:1986); ANSI C63.10:2013; 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; CNS 13438 (up to 6 GHz); AS/NZS CISPR 11; IEC/CISPR 11; CISPR 32; FCC OET/MP-5; ICES-003; KN 11; KN 32; VCCI V-3(2016.11); VCCI V-3 (2015.04); VCCI 32-1: VCCI-CISPR 32
Accessibility	CFR 47, FCC Part 14
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
Hearing Aid Compatibility	ANSI C63.19:2007; ANSI C63.19:2011; ANSI C63.19:2019; CTIA Test Plan for Hearing Aid Compatibility v.3.1.1 (2017); FCC KDB 285076, D01 & D02; RSS-HAC
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); FCC KDB 935210;
European Radio	ETSI EN 302 065-1 Version 2.1.1 (2016-11); ETSI EN 302 065-2 Version 2.1.1 (2016-11); ETSI EN 302 065-3 Version 2.1.1 (2016-11); ETSI EN 302 065-4 Version 1.1.1 (2016-11); ETSI EN 302 291-1 Version 1.1.1 (2005-07); ETSI EN 302 291-2 Version 1.1.1 (2005-07); ETSI EN 302 502 Version 2.1.3 (2017-07); ETSI EN 302 510-1 Version 1.1.1; ETSI EN 302 510-2 Version 1.1.1; ETSI EN 302 537 Version 2.1.1 (2016-10); ETSI EN 301 511 Version 12.5.1 (2017-03); ETSI EN 301 839 Version 2.1.1 (2016-04); ETSI EN 301 893 Version 2.1.1 (2017-05); ETSI EN 301 893 Version 1.8.1 (2015-03);