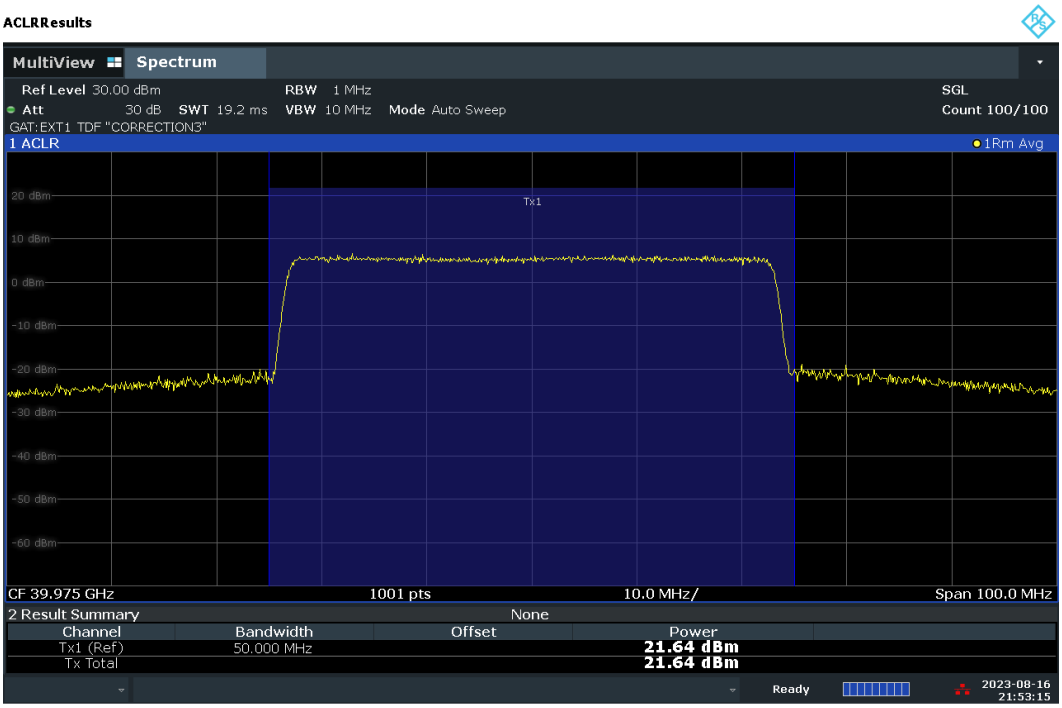
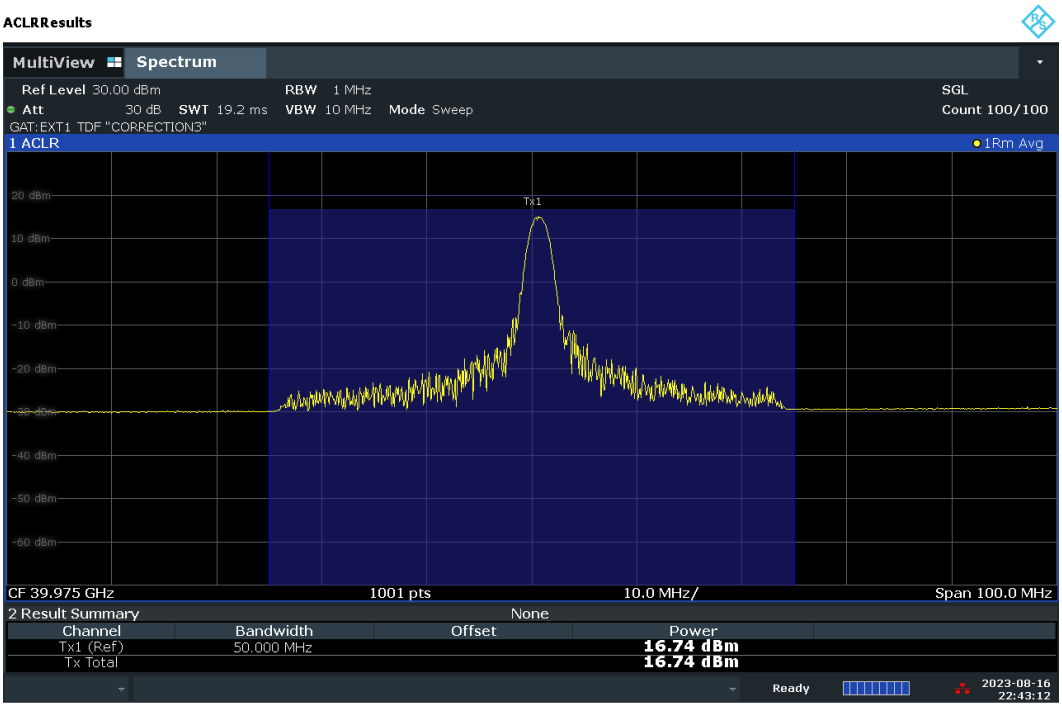


Plot 7-110. Conducted Power Plot – CP – H-DL Polarization (50MHz-1CC − QPSK – High Ch. – Full RB)



Plot 7-111. Conducted Power Plot – CP – H-DL Polarization (50MHz-1CC − QPSK – High Ch. – 1 RB)

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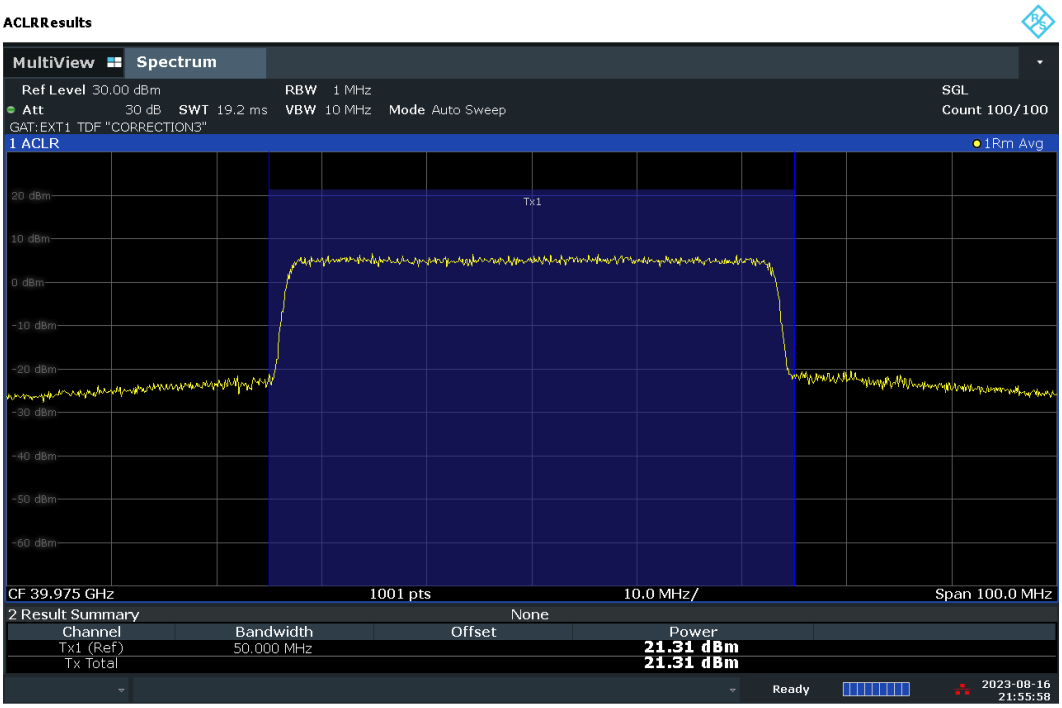
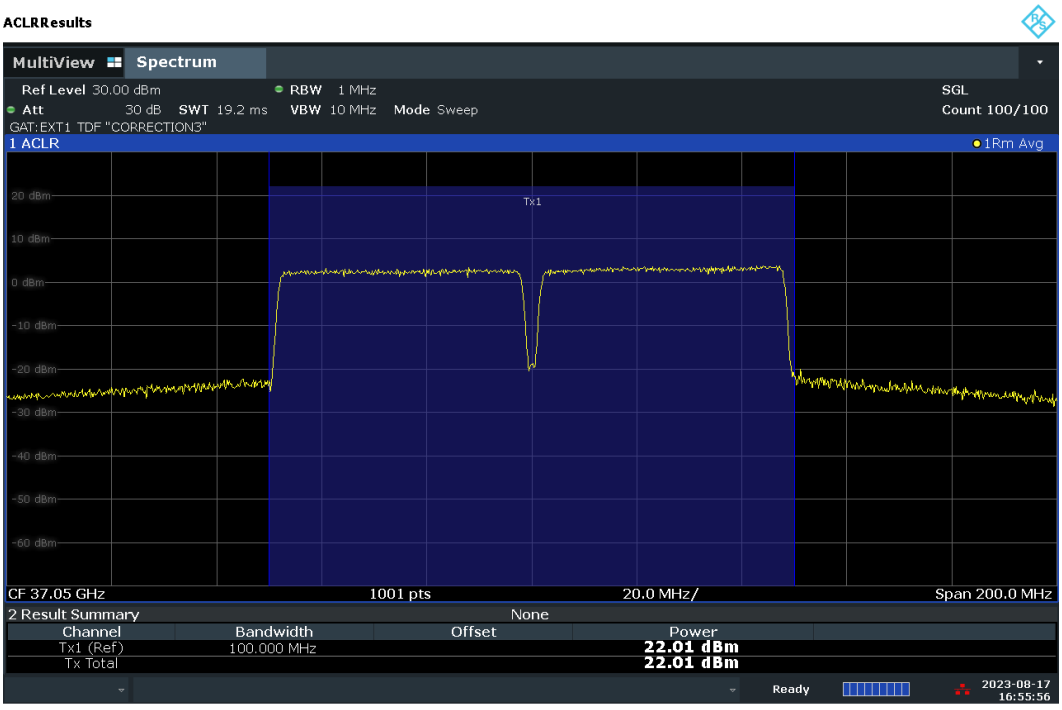


09:55:58 PM 08/16/2023

Plot 7-112. Conducted Power Plot – CP – H-DL Polarization (50MHz-1CC – 16QAM – High Ch. – Full RB)



04:55:57 PM 08/17/2023

Plot 7-113. Conducted Power Plot – CP – H-DL Polarization (50MHz-2CC − QPSK – Low Ch. – Full RB)

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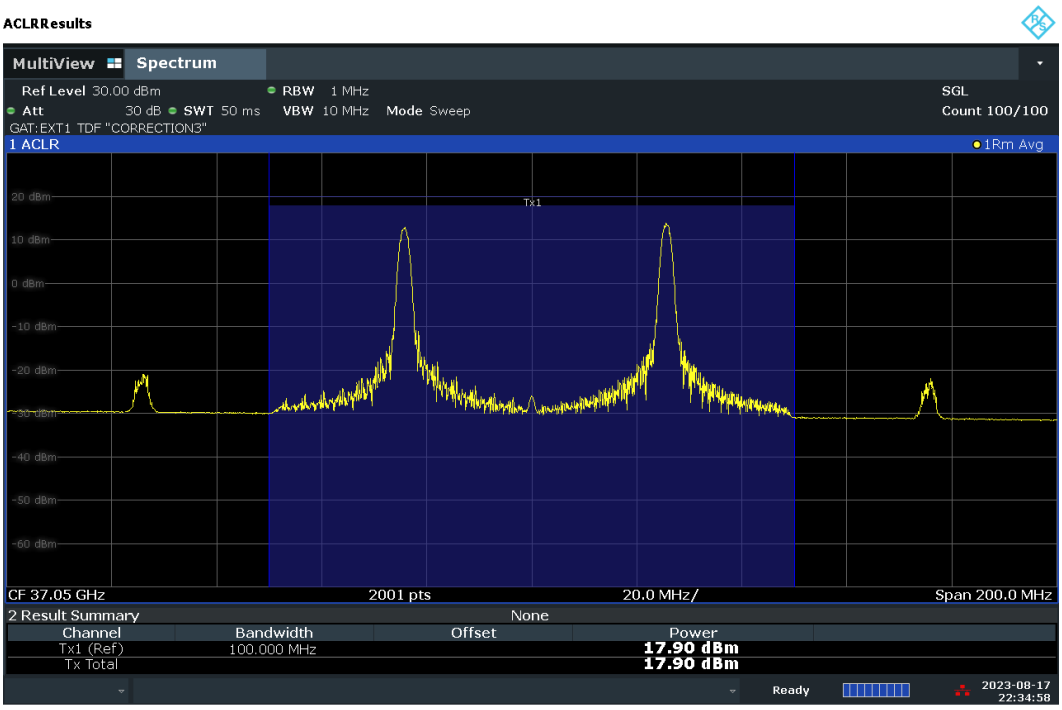
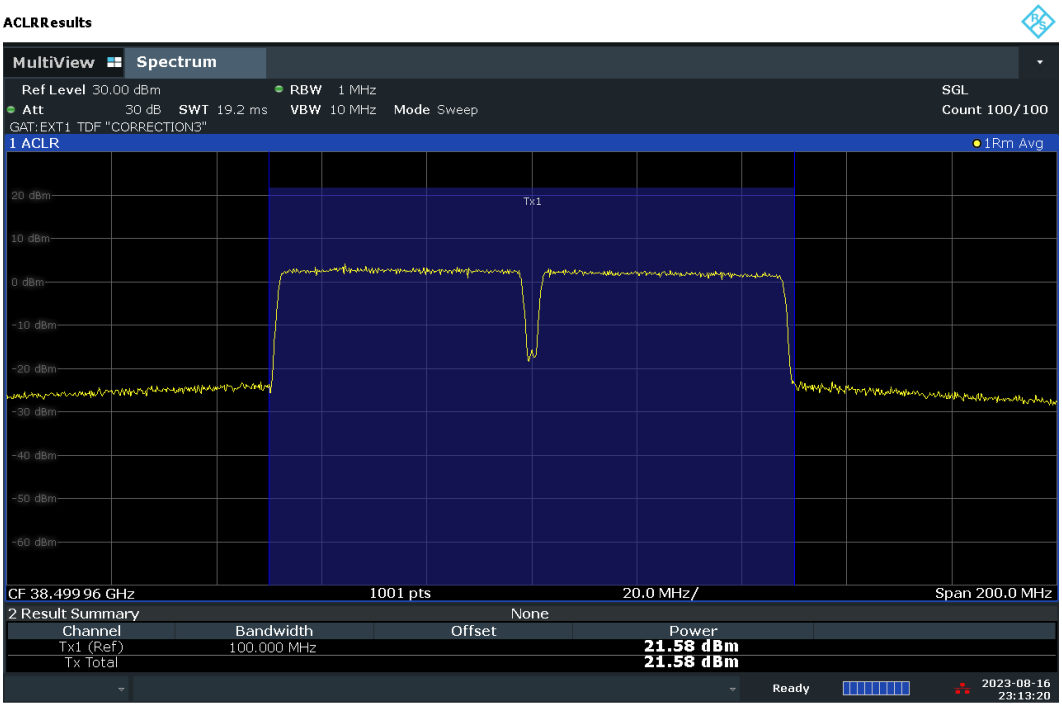


Plot 7-114. Conducted Power Plot – CP – H-DL Polarization (50MHz-2CC − QPSK – Low Ch. – 1RB)



Plot 7-115. Conducted Power Plot – CP – H-DL Polarization (50MHz-2CC − QPSK – Mid Ch. – Full RB)

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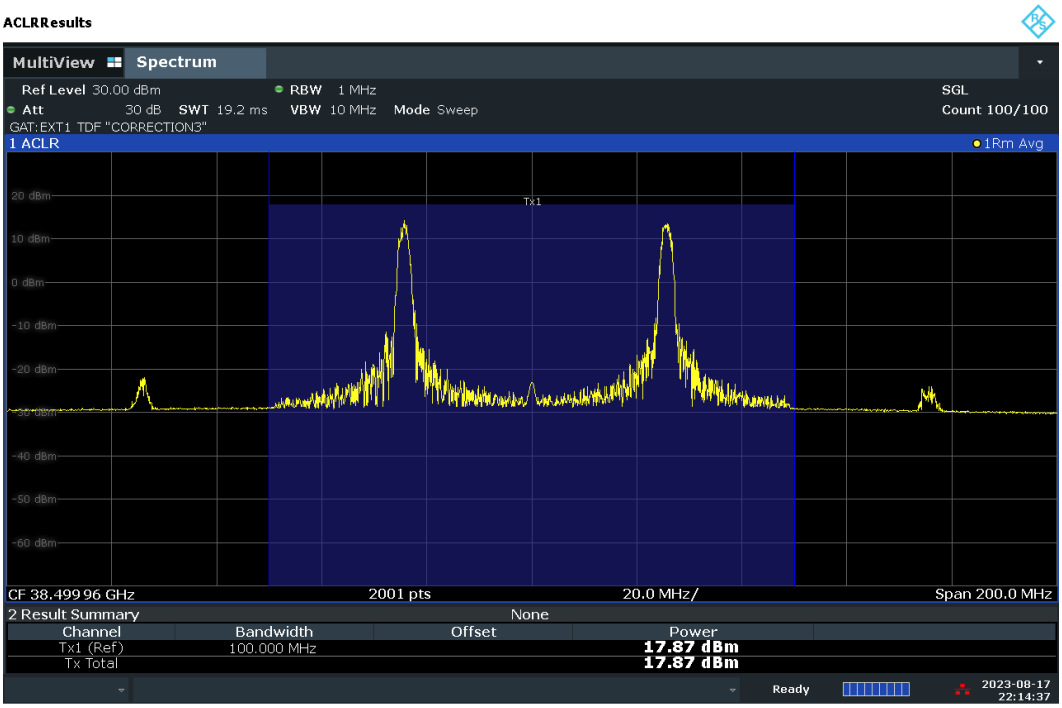
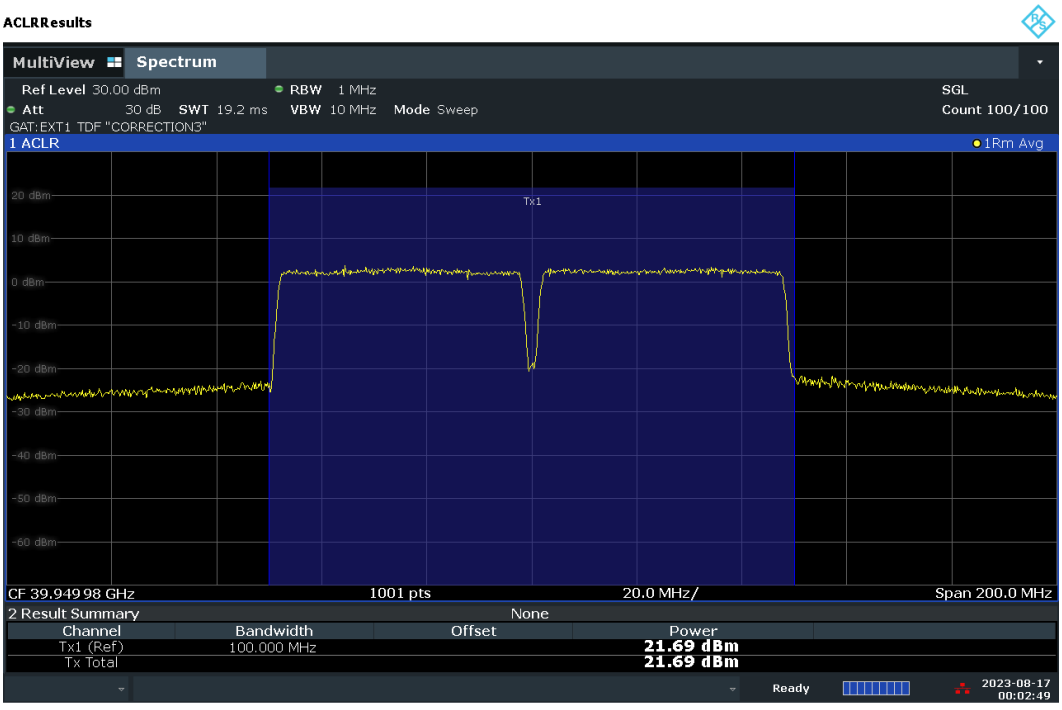


Plot 7-116. Conducted Power Plot – CP – H-DL Polarization (50MHz-2CC − QPSK – Mid Ch. – 1 RB)



Plot 7-117. Conducted Power Plot – CP – H-DL Polarization (50MHz-2CC − QPSK – High Ch. – Full RB)

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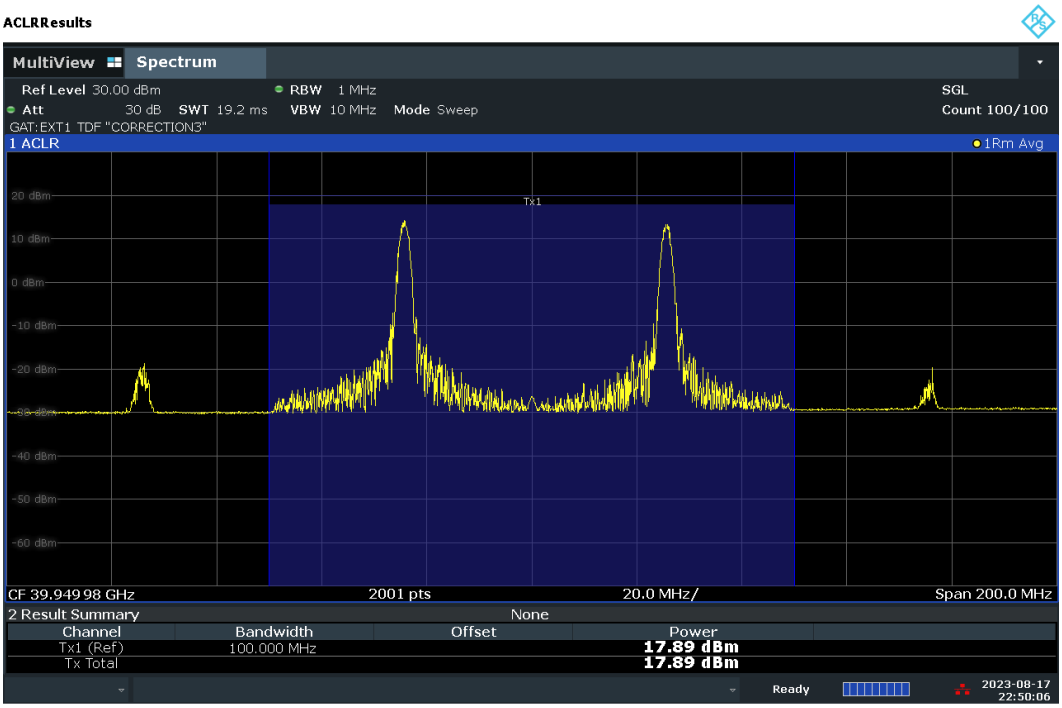
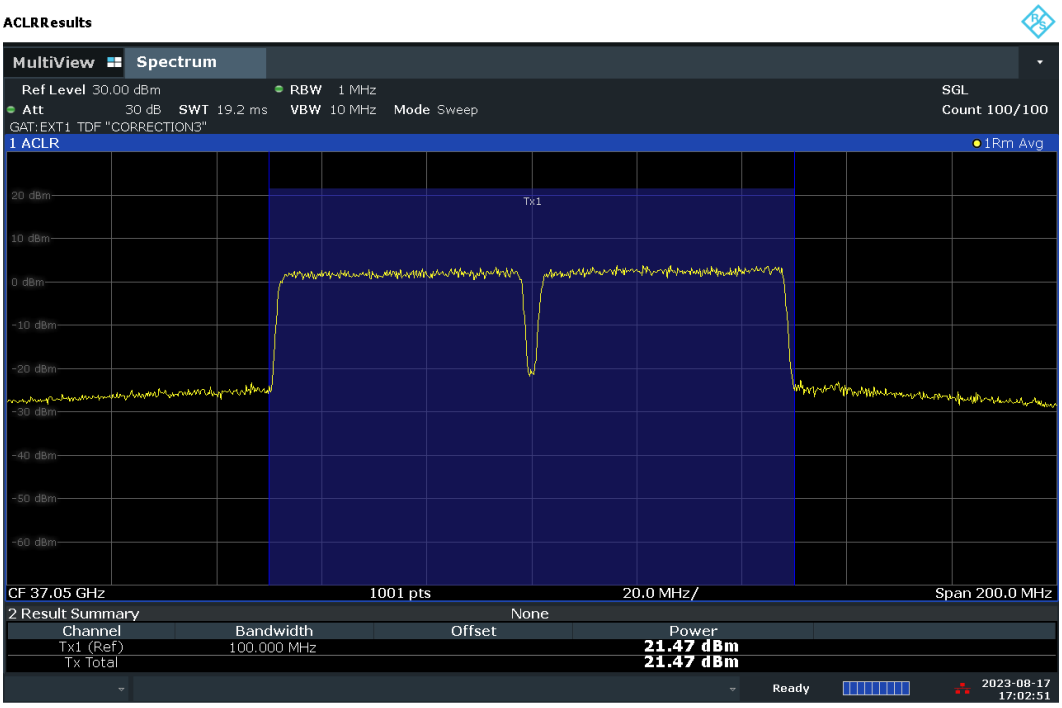


10:50:07 PM 08/17/2023

Plot 7-118. Conducted Power Plot – CP – H-DL Polarization (50MHz-2CC − QPSK – High Ch. – 1 RB)



05:02:52 PM 08/17/2023

Plot 7-119. Conducted Power Plot – CP – H-DL Polarization (50MHz-2CC – 16QAM – Low Ch. – Full RB)

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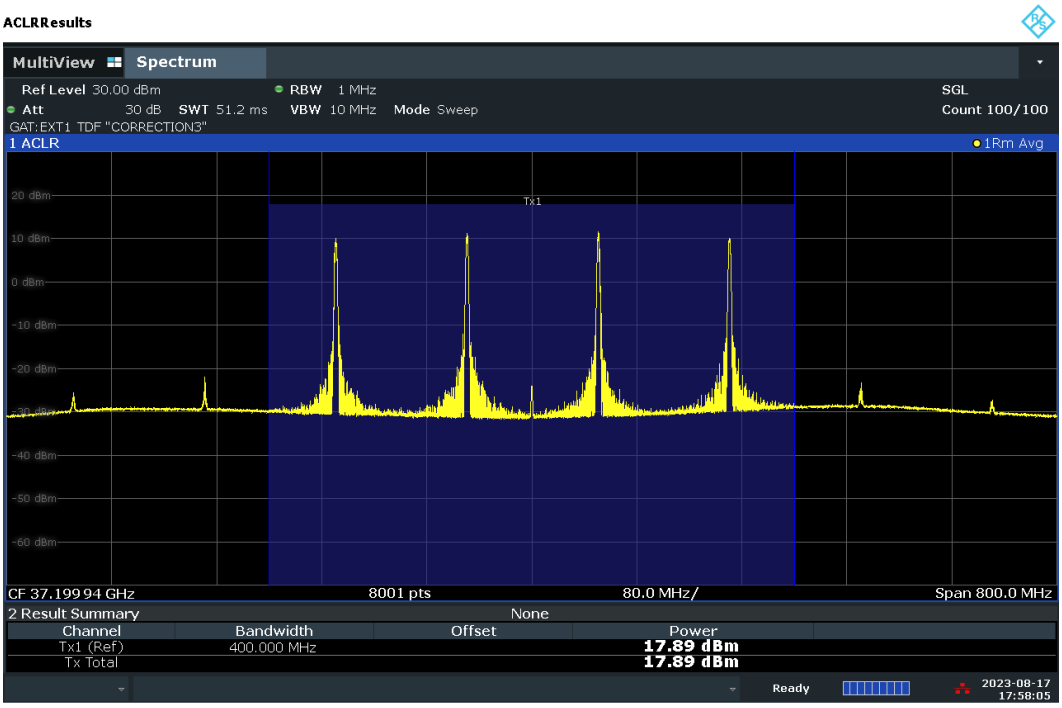
Plot 7-120. Conducted Power Plot – CP – H-DL Polarization (100MHz-4CC − QPSK – Low Ch. – Full RB)



05:58:06 PM 08/17/2023

Plot 7-121. Conducted Power Plot – CP – H-DL Polarization (100MHz-4CC − QPSK – Low Ch. – 1RB)

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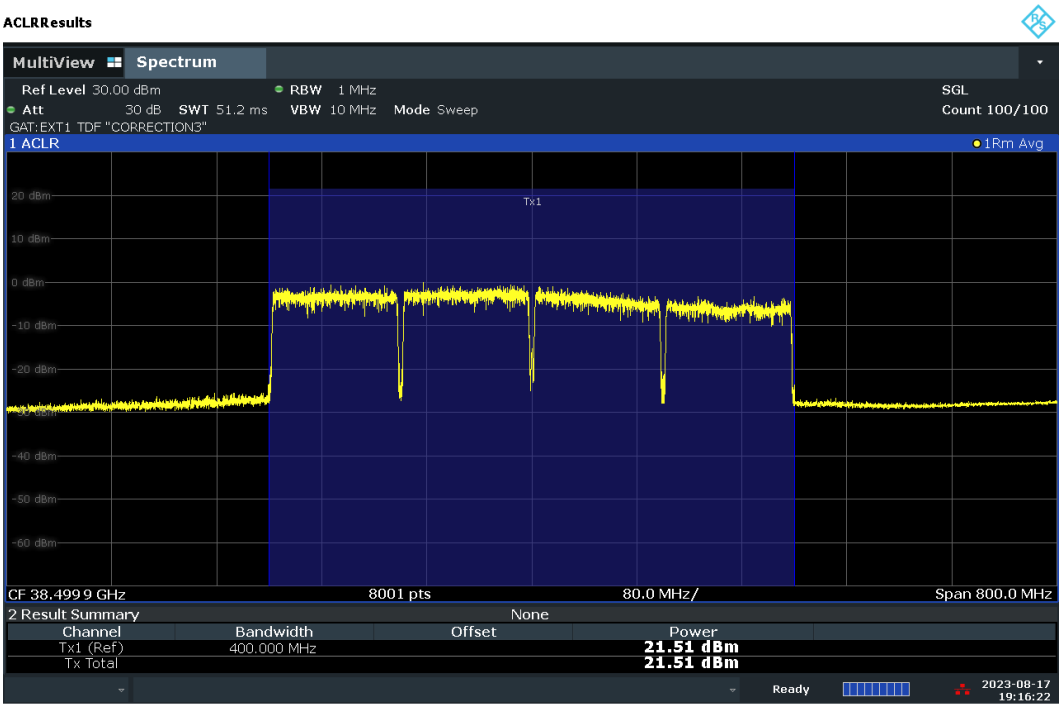
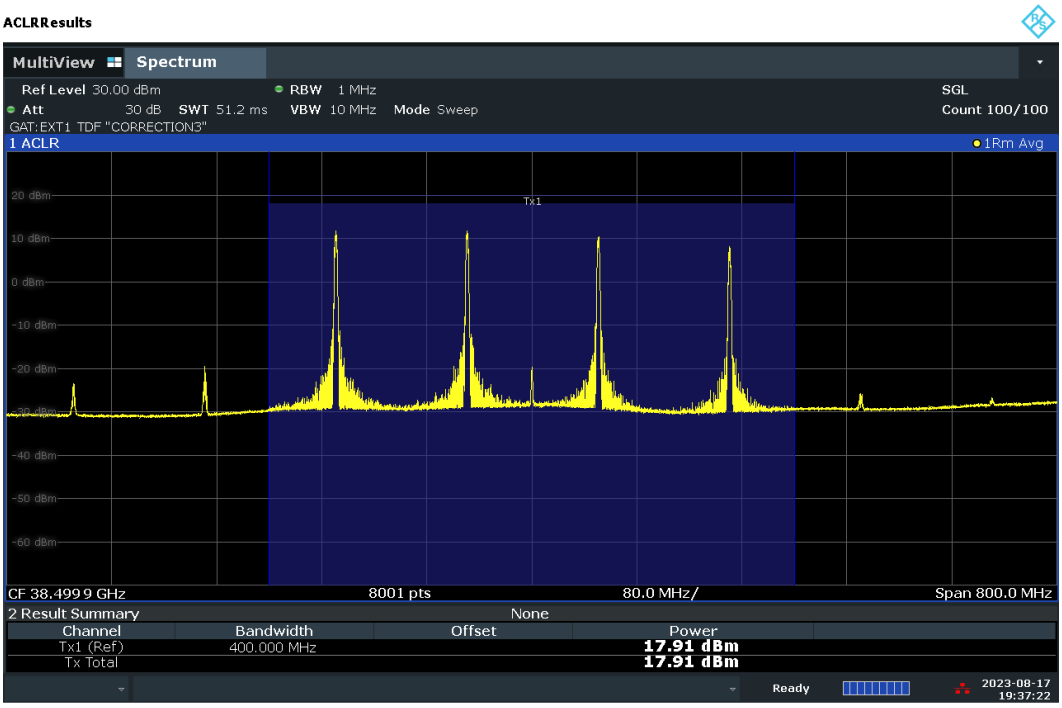


07:16:22 PM 08/17/2023

Plot 7-122. Conducted Power Plot – CP – H-DL Polarization (100MHz-4CC − QPSK – Mid Ch. – Full RB)



07:37:23 PM 08/17/2023

Plot 7-123. Conducted Power Plot – CP – H-DL Polarization (100MHz-4CC − QPSK – Mid Ch. – 1 RB)

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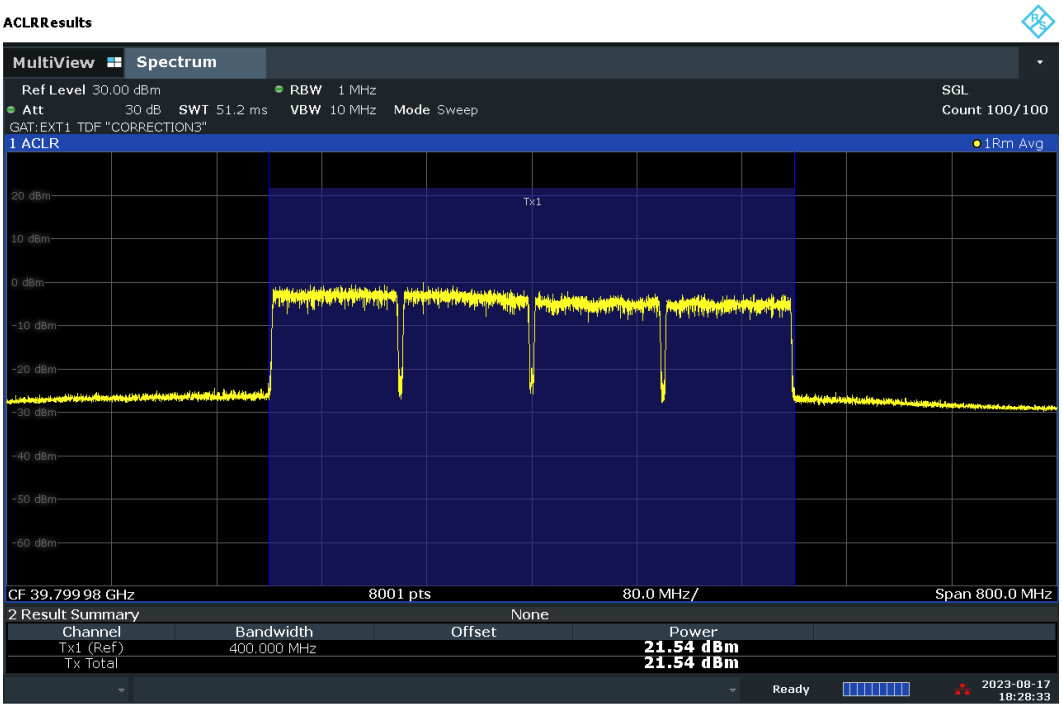
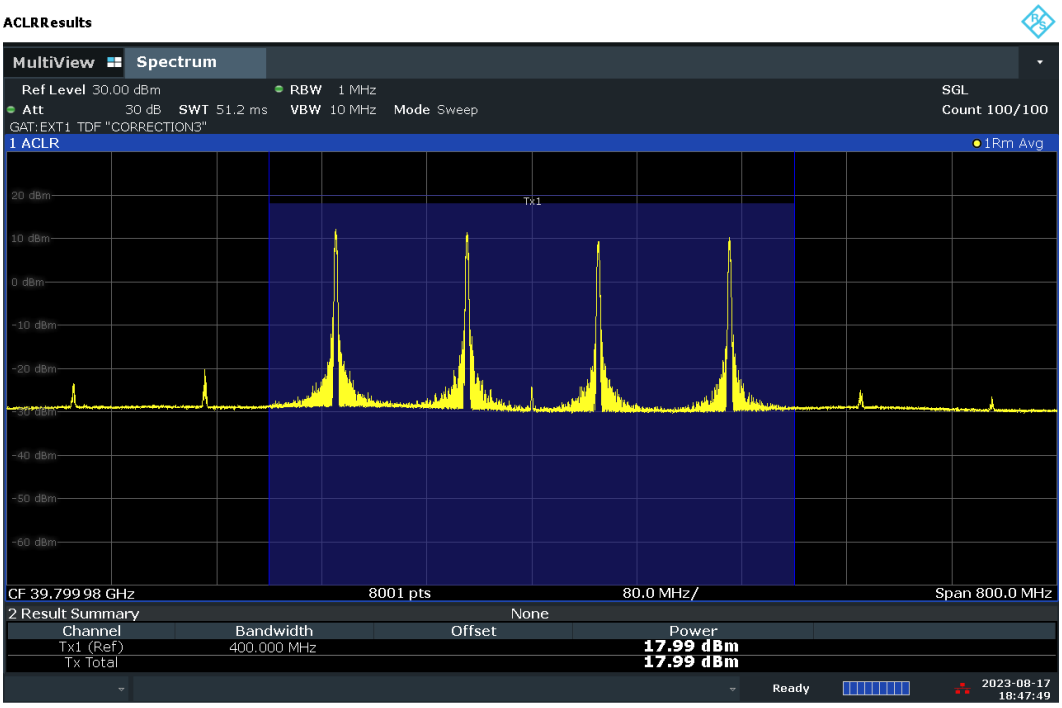


06:28:34 PM 08/17/2023

Plot 7-124. Conducted Power Plot – CP – H-DL Polarization (100MHz-4CC − QPSK – High Ch. – Full RB)



06:47:49 PM 08/17/2023

Plot 7-125. Conducted Power Plot – CP – H-DL Polarization (100MHz-4CC − QPSK – High Ch. – 1 RB)

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Plot 7-126. Conducted Power Plot – CP – H-DL Polarization (100MHz-4CC – 16QAM – High Ch. – Full RB)

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7.7 Radiated Spurious and Harmonic Emissions

Test Overview

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

The conductive power or total radiated power of any emissions outside a licensee's frequency block shall be -13dBm/1MHz.

Test Procedure Used

ANSI C63.26-2015 – Section 5.5.4
KDB 842590 D01 – Section 4.4.3

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 200 GHz . Several plots are used to show investigations in this entire span.
2. Detector = RMS
3. Trace mode = trace average
4. Sweep time = auto couple
5. Number of sweep points ≥ 2 x Span/RBW
6. The trace was allowed to stabilize
7. RBW = 1MHz, VBW = 3MHz

Test Notes

1) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst-case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below. The worst case found was 50MHz-1CC bandwidth/component carrier, QPSK Modulation, with 1RB. The EUT was tested under such signaling conditions.

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

3) The plots in this section were taken with the analyzer set to max hold. All final measurements shown in the tables that accompany the plots were taken with trace averaging performed over 100 sweeps while the analyzer was triggering on a specific emission of interest.

4) The plots from 1 – 200GHz show corrected average EIRP levels. The average EIRP reported below is calculated per section 5.2.7 of ANSI C63.26-2015 which states: EIRP (dBm) = E (dBμV/m) + 20log(D) − 104.8; where D is the measurement distance (in the far field region) in m. The field strength E is calculated E (dBμV/m) = Spectrum Analyzer Level (dBm) + Antenna Factor (dB/m) + Cable Loss (dB) + Harmonic Mixer Conversion Loss (dB) + 107. All appropriate Antenna Factors and Cable Losses have been applied in the spectrum analyzer for each measurement. For measurements > 40GHz, a Harmonic Mixer Conversion Loss was also applied to the spectrum analyzer.

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5) Emissions below 18GHz were measured at a 3 meter test distance, while emissions above 18GHz were measured at the appropriate far field distance. The far field of the mmWave signal is based on formula: R > 2D^2/wavelength, where D is the larger between the dimension of the measurement antenna and the transmitting antenna of the EUT. In this case, for RSE measurements, "D" is the largest dimension of the EUT which was roughly 29cm x 29cm x 7cm. The measurement antenna and harmonic mixer were manipulated around all faces and edges of the EUT to determine location of worst-case emissions..

·equency Range (GHz)	Wavelength (cm)	Far Field Distance (m)	Measurement Distance (m)
18 - 40	0.749	0.54	2
40 - 60	0.5	1.44	2
60 - 90	0.333	0.96	2
90 - 140	0.214	0.63	2
140 - 200	0.15	0.39	2

Table 7-20. Far-Field Distance & Measurement Distance per Frequency Range

6) All emissions from 30MHz - 40GHz were measured using a spectrum analyzer with an internal preamplifier. Emissions >40GHz were measured using a harmonic mixer with the spectrum analyzer.

7) The spectrum scan plots in this section are used for the purpose of signal identification. Each emission is subject to a unique limit based on the rule under which the transmitter operates. For instances where an emission is the product of co-located transmitters (i.e. an intermodulation product), the limit on that emission is the least strict between the rule parts under which each transmitter operates.

8) The limit lines on the spectrum scan plots in this section are displayed in regards to the part 30 limits for n260 mmWave spurious emissions. The limits for spurious emissions solely due to the other transmitters are not displayed on the plots. Instead, the applicable limits are displayed in the accompanying tables.

9) The fundamental emissions from multiple co-located transmitters may appear on spectrum scan plots. These are not investigated as spurious emissions.

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

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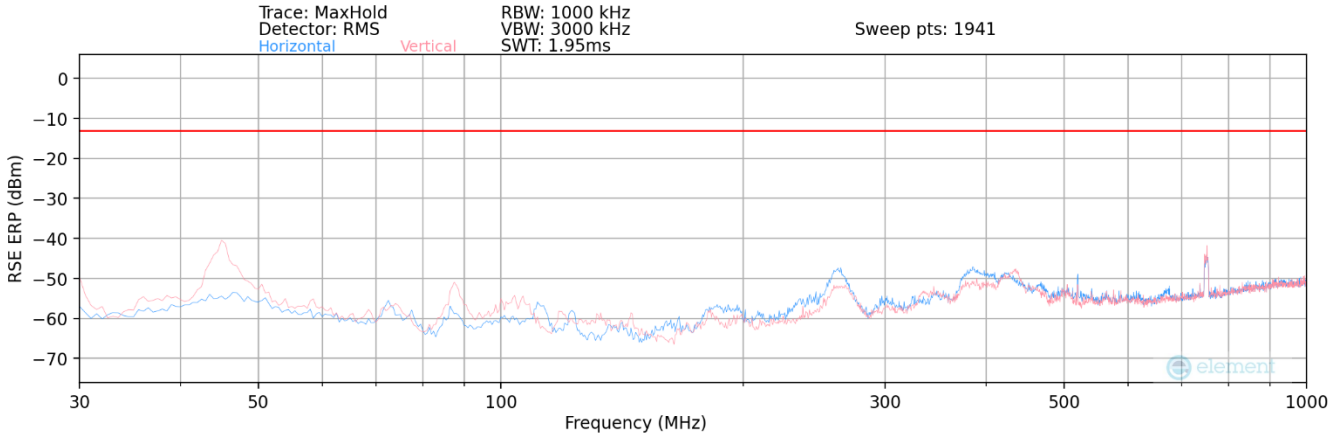
Band n260 – SU

30MHz - 1GHz



Plot 7-127. n260 Radiated Spurious Plot (1CC QPSK Mid Channel) - SU

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 Height [cm]	Turntable Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
43.06	Low	50	V	QPSK	114	314	-39.51	-13.00	-26.51
84.15	Low	50	V	QPSK	143	163	-48.19	-13.00	-35.19
264.08	Low	50	H	QPSK	250	141	-45.51	-13.00	-32.51
374.61	Low	50	H	QPSK	130	64	-49.84	-13.00	-36.84
45.79	Mid	50	V	QPSK	134	57	-38.63	-13.00	-25.63
87.80	Mid	50	V	QPSK	122	151	-46.77	-13.00	-33.77
106.84	Mid	50	V	QPSK	134	176	-51.72	-13.00	-38.72
262.84	Mid	50	H	QPSK	151	135	-44.13	-13.00	-31.13
380.59	Mid	50	H	QPSK	122	135	-46.08	-13.00	-33.08
520.13	Mid	50	H	QPSK	201	14	-50.07	-13.00	-37.07
752.65	Mid	50	H	QPSK	165	20	-38.36	-13.00	-25.36
48.94	High	50	V	QPSK	126	327	-38.93	-13.00	-25.93
83.39	High	50	V	QPSK	142	152	-50.63	-13.00	-37.63
268.99	High	50	V	QPSK	122	119	-49.26	-13.00	-36.26

Table 7-21. n260 Radiated Spurious Emissions Table (30MHz - 1GHz) - 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 3 meters.

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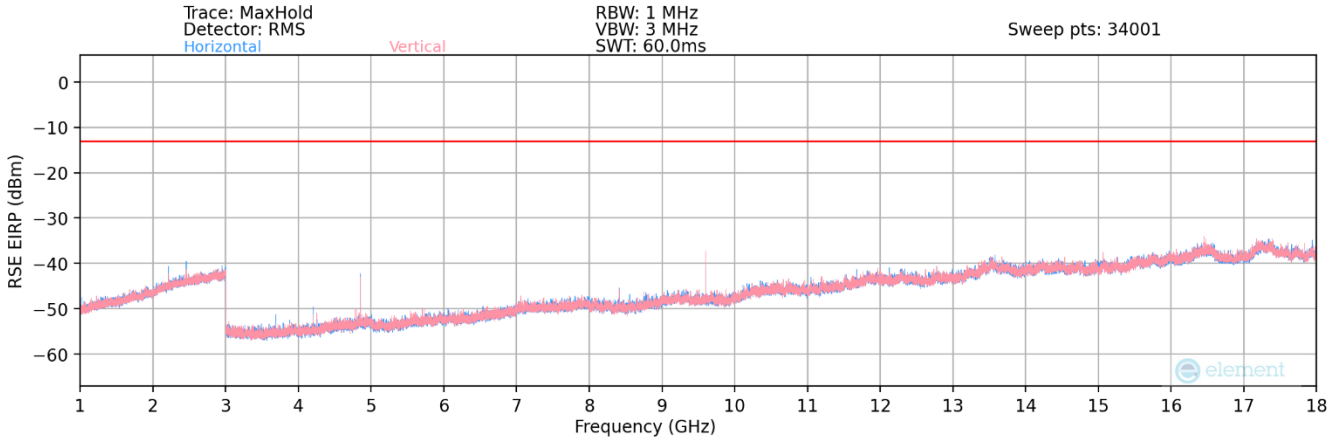
1GHz - 18GHz



Plot 7-128. n260 Radiated Spurious Plot (1CC QPSK Mid Channel) - SU

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 Height [cm]	Turntable Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
4375.50	Low	50	H	QPSK	188	248	-40.29	-13.00	-27.29
2211.00	Mid	50	H	QPSK	162	295	-42.59	-13.00	-29.59
2457.50	Mid	50	H	QPSK	261	345	-41.08	-13.00	-28.08
4850.00	Mid	50	V	QPSK	290	338	-38.41	-13.00	-25.41
9600.00	Mid	50	V	QPSK	191	273	-35.07	-13.00	-22.07
5126.00	High	50	V	QPSK	128	263	-38.45	-13.00	-25.45

Table 7-22. n260 Radiated Spurious Emissions Table (1GHz - 18GHz) - SU

Notes

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

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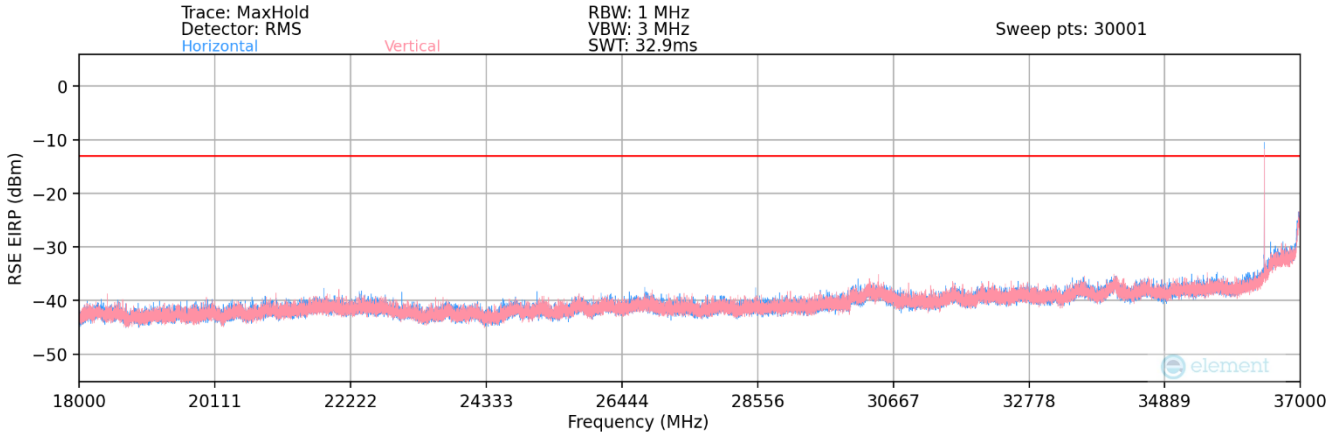
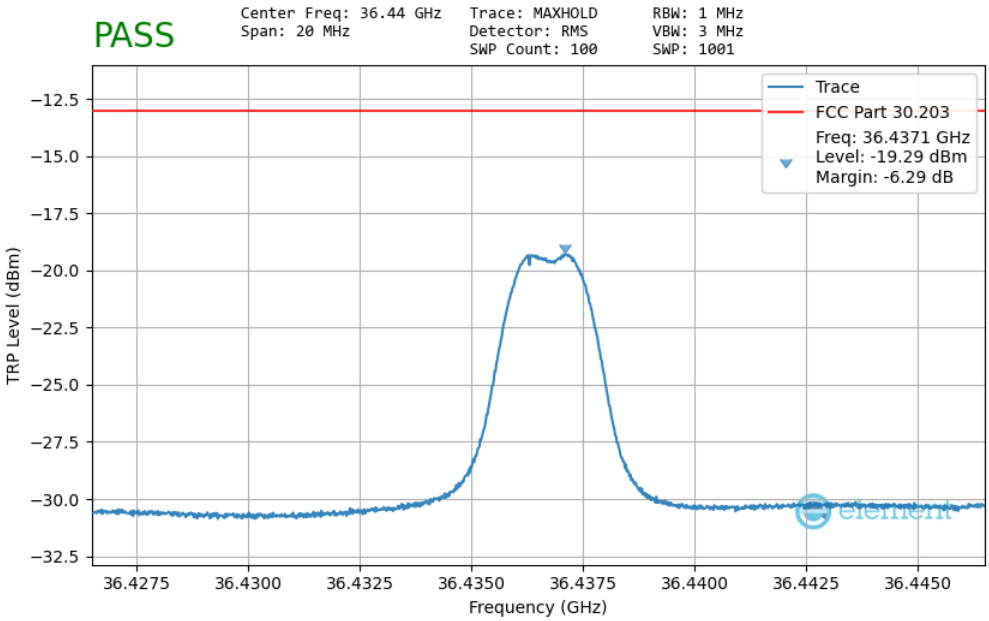
18GHz - 37.0GHz



Plot 7-129 n260 Radiated Spurious Plot (1CC QPSK Low Channel) – SU



Plot 7-130 n260 Radiated Spurious Plot (1CC QPSK Low Channel) - SU

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Spurious Emissions EIRP Sample Calculation (n260)

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

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

Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [degrees]	Turntable Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
36436.50	Low	50	H + V	QPSK	*	*	-19.29	-13.00	-6.29
36667.00	Mid	50	V	QPSK	-	-	-28.63	-13.00	-15.63
36898.00	High	50	H	QPSK	275	0	-15.81	-13.00	-2.81

Table 7-23. n260 Radiated Spurious Emissions Table (18GHz - 37GHz) - SU

Notes

1. The RSE ERP level & TRP Measurement is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses. Measurements were performed at a distance of 2 meter.
2. Due to failing EIRP RSE at ~36.465GHz, TRP measurements were taken and TRP Pre-scan plot for the same is included.

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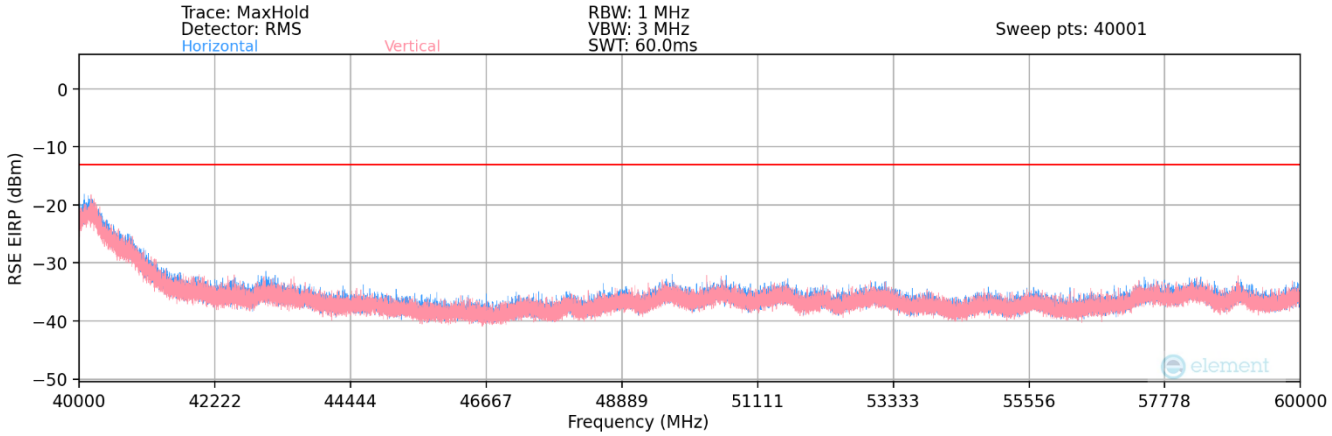
40GHz - 60GHz



Plot 7-131. n260 Radiated Spurious Plot (1CC QPSK High Channel) - SU

Spurious Emissions EIRP Sample Calculation (n260)

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

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

Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [degrees]	Turntable Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
40156.00	Low	50	H	QPSK	9	3	-25.69	-13.00	-12.69
49414.00	Low	50	H	QPSK	304	3	-29.55	-13.00	-16.55
40230.00	Mid	50	H	QPSK	8	2	-18.48	-13.00	-5.48
50913.00	Mid	50	H	QPSK	51	0	-29.53	-13.00	-16.53
40167.00	High	50	V	QPSK	90	2	-13.48	-13.00	-0.48
52714.00	High	50	H	QPSK	37	2	-30.41	-13.00	-17.41

Table 7-24. n260 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.

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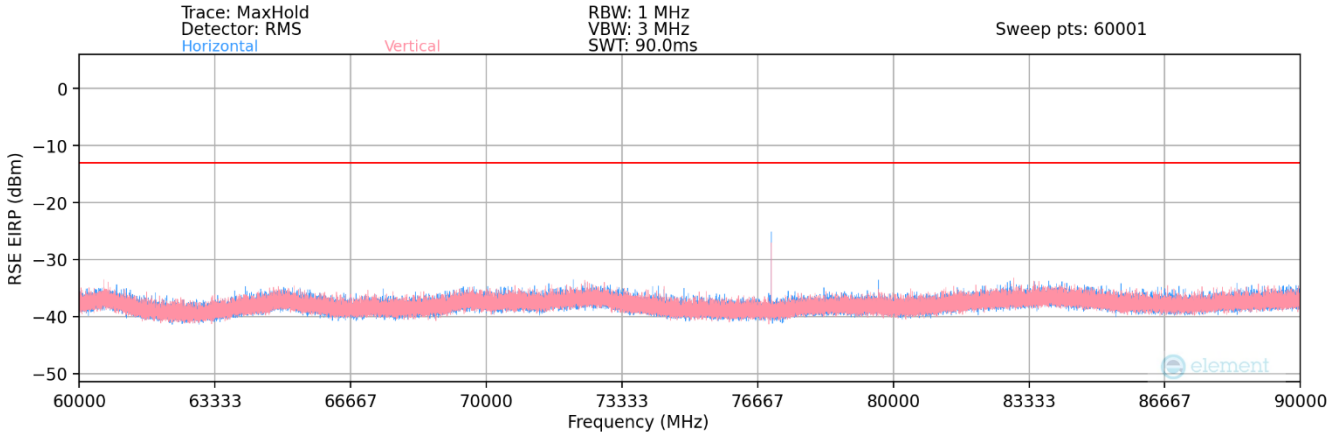
60GHz - 90GHz



Plot 7-132. n260 Radiated Spurious Plot (1CC QPSK Mid Channel) - SU

Spurious Emissions EIRP Sample Calculation (n260)

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

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

Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [degrees]	Turntable Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
74050.08	Low	50	H	QPSK	106	355	-27.30	-13.00	-14.30
76999.92	Mid	50	H	QPSK	118	358	-20.59	-13.00	-7.59
79950.00	High	50	V	QPSK	131	17	-27.09	-13.00	-14.09

Table 7-25. n260 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.

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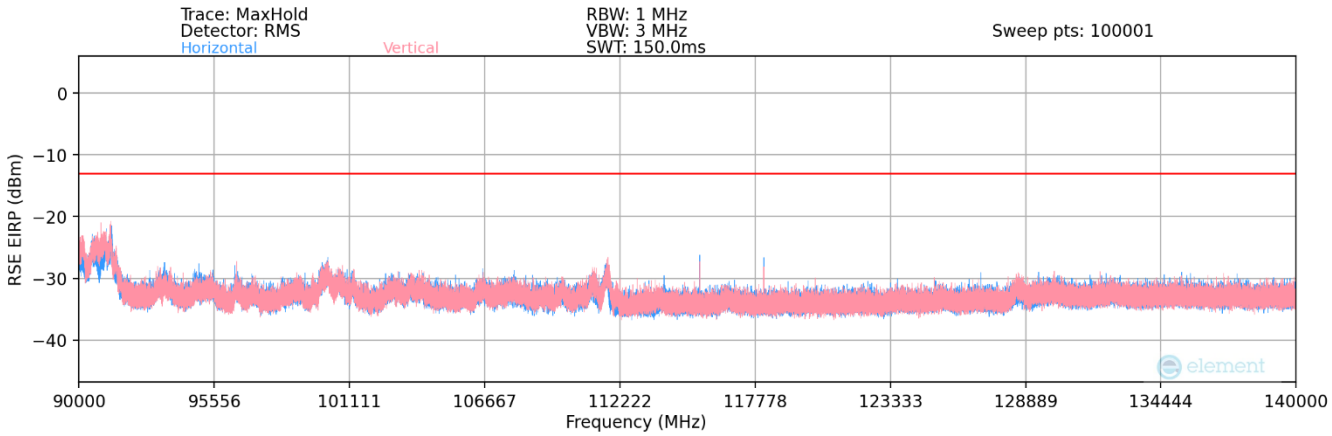
90GHz - 140GHz



Plot 7-133. n260 Radiated Spurious Plot (1CC QPSK Mid Channel) - SU

Spurious Emissions EIRP Sample Calculation (n260)

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

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

Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [degrees]	Turntable Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
111075.12	Low	50	H	QPSK	92	5	-23.76	-13.00	-10.76
115499.88	Mid	50	H	QPSK	83	7	-22.53	-13.00	-9.53
118136.00	Mid	50	H	QPSK	89	2	-22.31	-13.00	-9.31
119925.00	High	50	H	QPSK	95	3	-19.42	-13.00	-6.42
122560.00	High	50	H	QPSK	100	0	-20.05	-13.00	-7.05

Table 7-26. n260 Radiated Spurious Emissions Table (90GHz - 140GHz) - 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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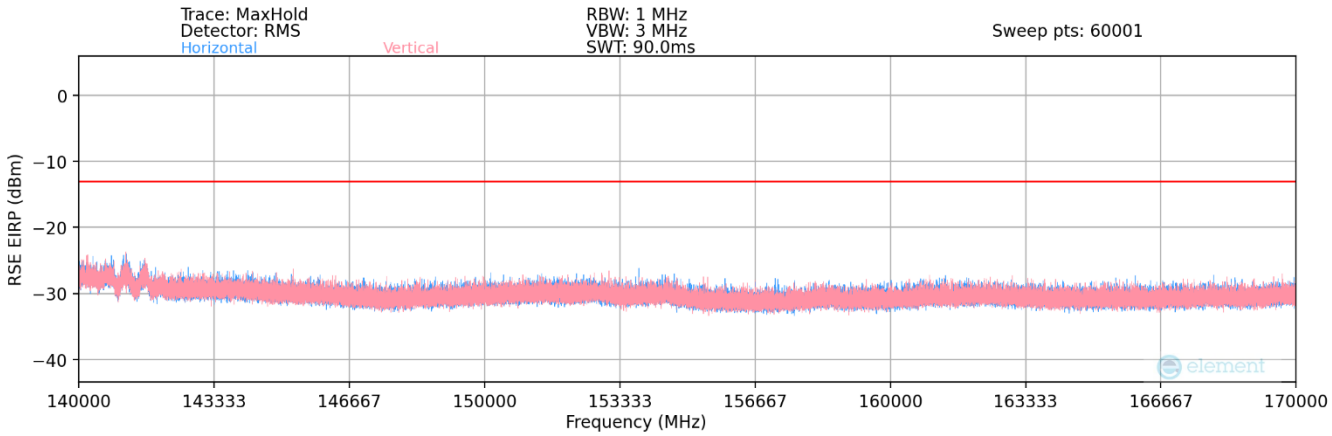
140GHz - 170GHz



Plot 7-134. n260 Radiated Spurious Plot (1CC QPSK Mid Channel) - SU

Spurious Emissions EIRP Sample Calculation (n260)

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

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

Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [degrees]	Turntable Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
148100.16	Low	50	V	QPSK	-	-	-25.59	-13.00	-12.59
153999.84	Mid	50	V	QPSK	-	-	-24.82	-13.00	-11.82
159900.00	High	50	H	QPSK	-	-	-24.10	-13.00	-11.10

Table 7-27. n260 Radiated Spurious Emissions Table (140GHz - 170GHz) - 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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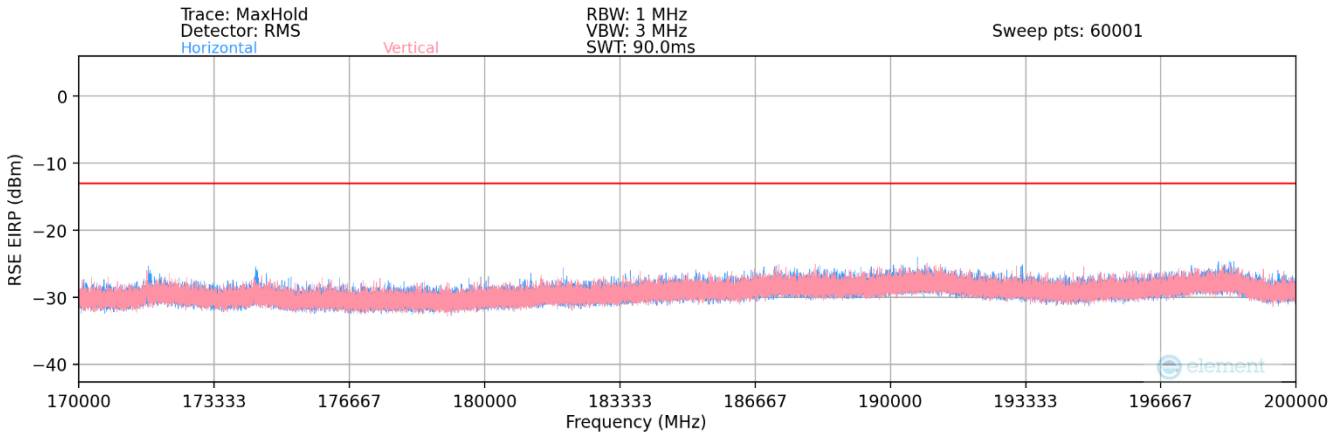
170GHz - 200GHz



Plot 7-135. n260 Radiated Spurious Plot (1CC QPSK Mid Channel) - SU

Spurious Emissions EIRP Sample Calculation (n260)

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

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

Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [degrees]	Turntable Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
185125.20	Low	50	H	QPSK	-	-	-23.73	-13.00	-10.73
192499.80	Mid	50	H	QPSK	-	-	-23.48	-13.00	-10.48
199875.00	High	50	V	QPSK	-	-	-23.92	-13.00	-10.92

Table 7-28. n260 Radiated Spurious Emissions Table (170GHz - 200GHz) - 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 outof-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 ≥ 3 x RBW
5. Detector = RMS
6. Trace mode = trace averaging (RMS) over 100 sweeps
7. Number of sweep points ≥ 2 x 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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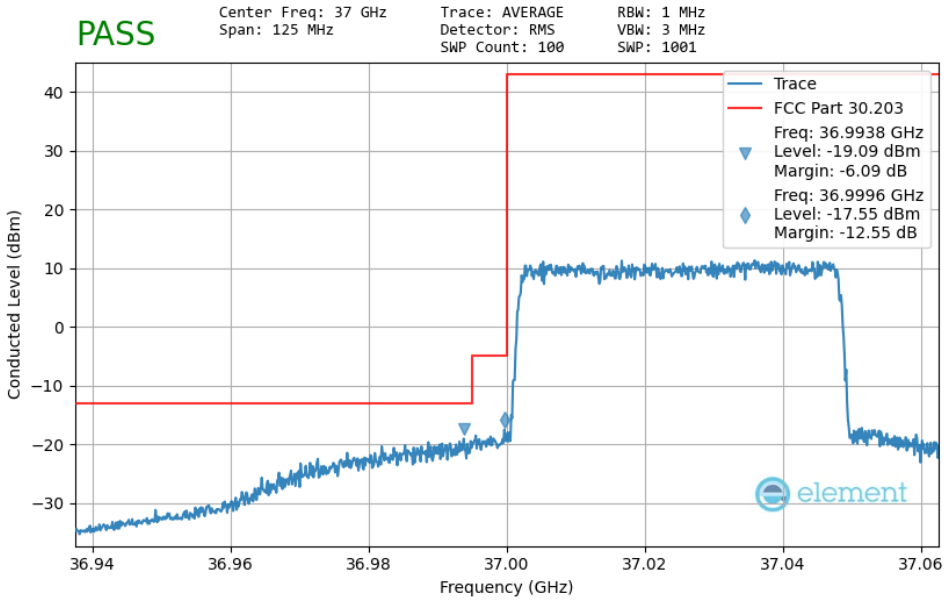
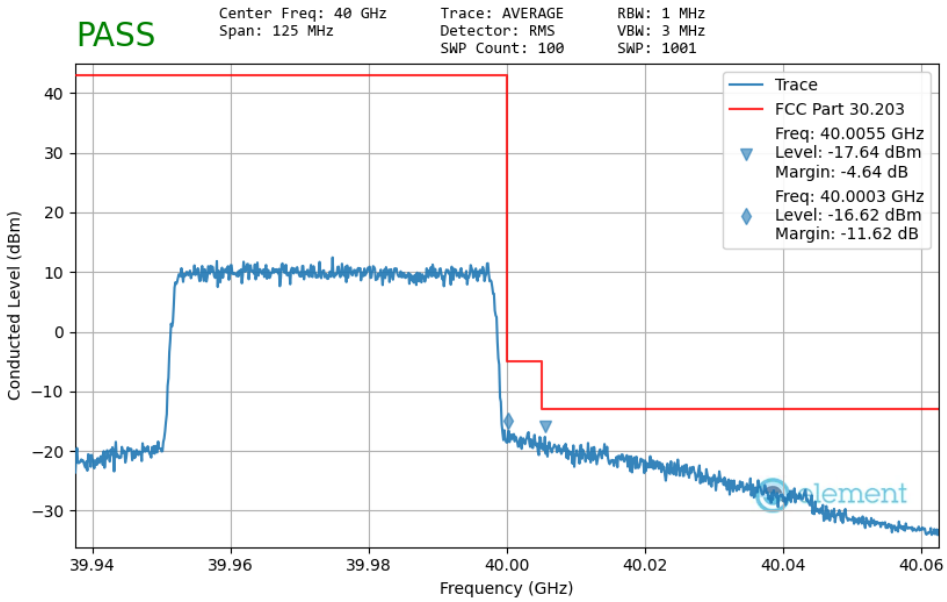
Band n260 – SU (DFT-s-OFDM)



Plot 7-136. Lower Band Edge − DFT-s – MIMO-DL Polarization (50MHz-1CC – QPSK Full RB)



Plot 7-137. Upper Band Edge − DFT-s – MIMO-DL Polarization (50MHz-1CC – QPSK Full RB)

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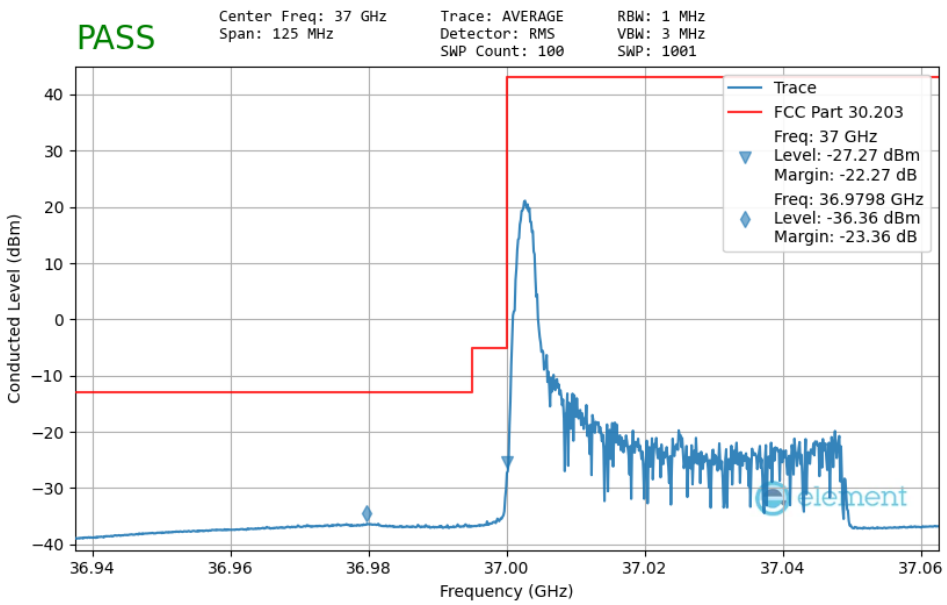
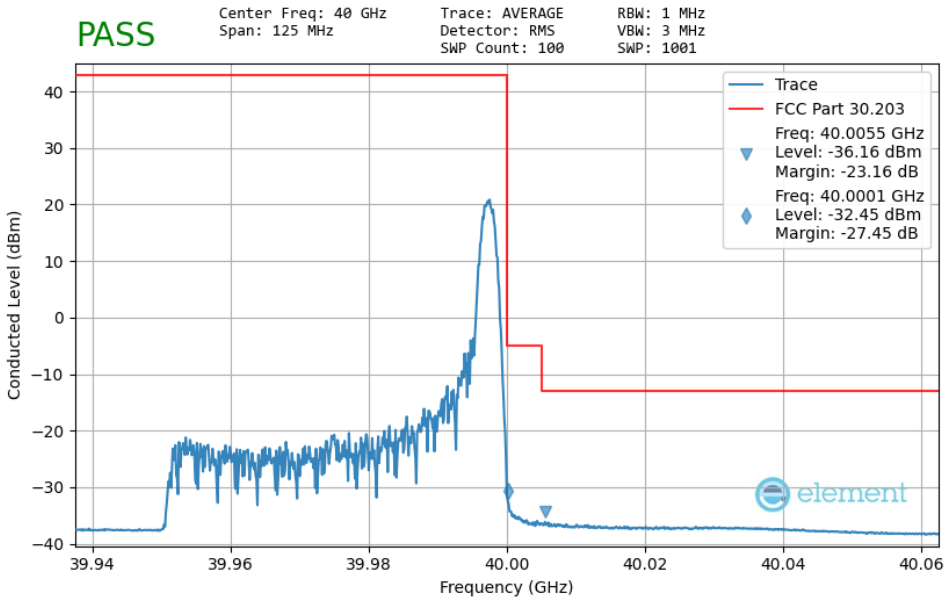


Plot 7-138. Lower Band Edge − DFT-s – MIMO-DL Polarization (50MHz-1CC – QPSK 1 RB)



Plot 7-139. Upper Band Edge − DFT-s – MIMO-DL Polarization (50MHz-1CC – QPSK 1 RB)

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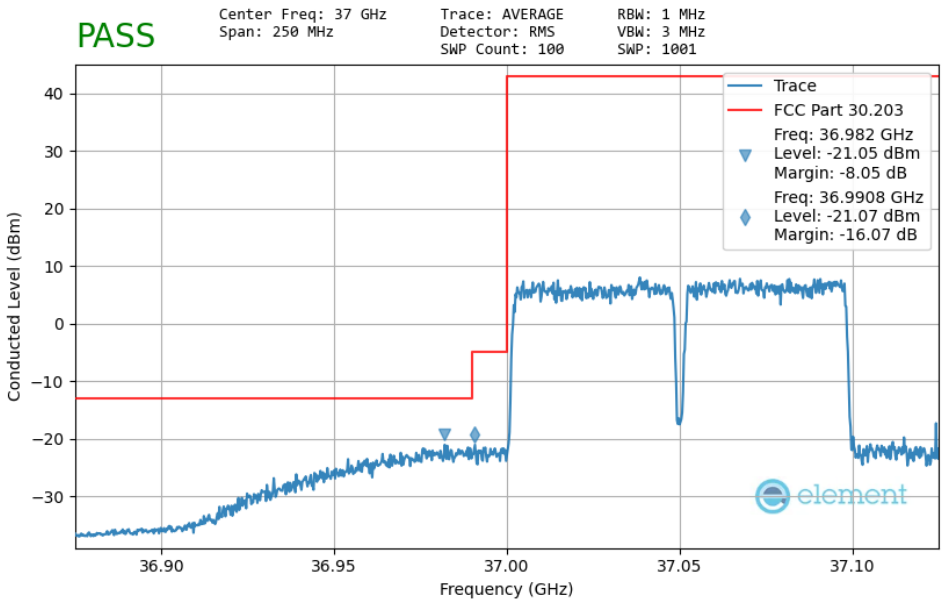
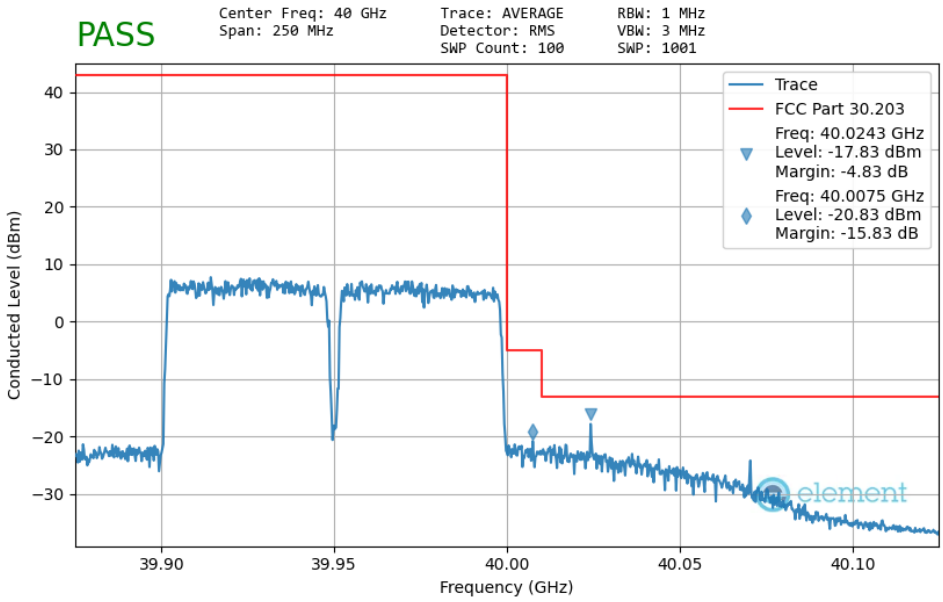


Plot 7-140. Lower Band Edge − DFT-s – MIMO-DL Polarization (50MHz-2CC – QPSK Full RB)



Plot 7-141. Upper Band Edge − DFT-s – MIMO-DL Polarization (50MHz-2CC – QPSK Full RB)

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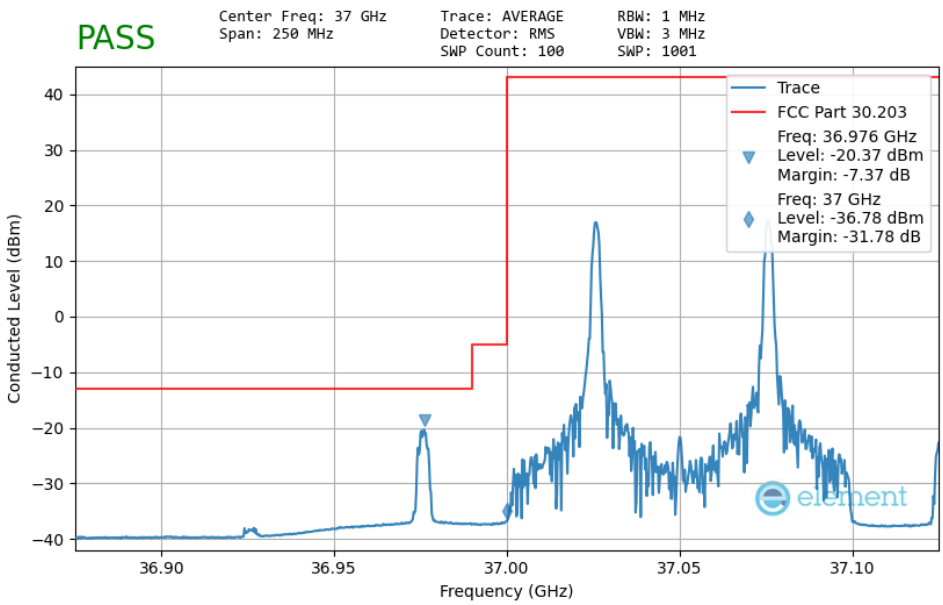
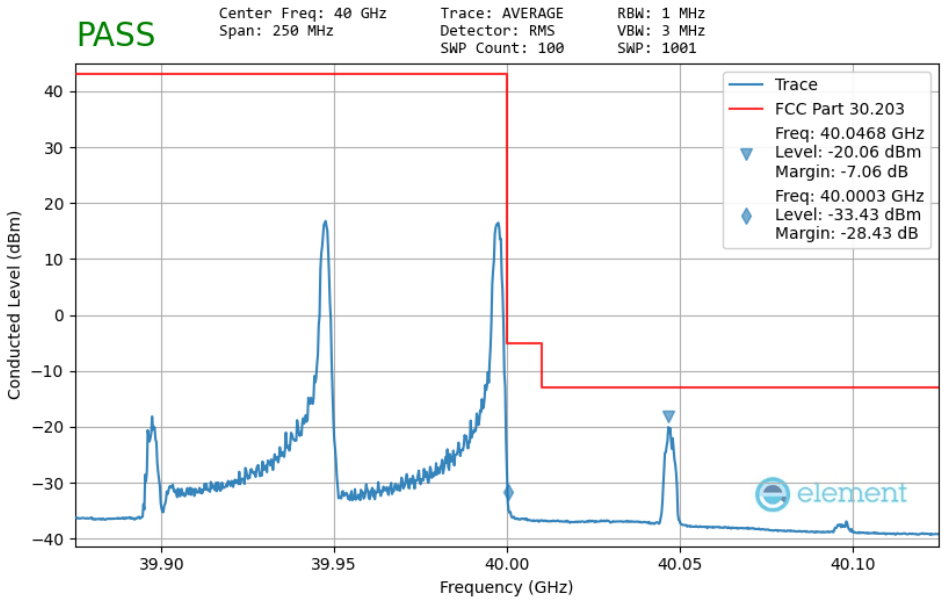


Plot 7-142. Lower Band Edge − DFT-s – MIMO-DL Polarization (50MHz-2CC – QPSK 1RB)



Plot 7-143. Upper Band Edge − DFT-s – MIMO-DL Polarization (50MHz-2CC – QPSK 1RB)

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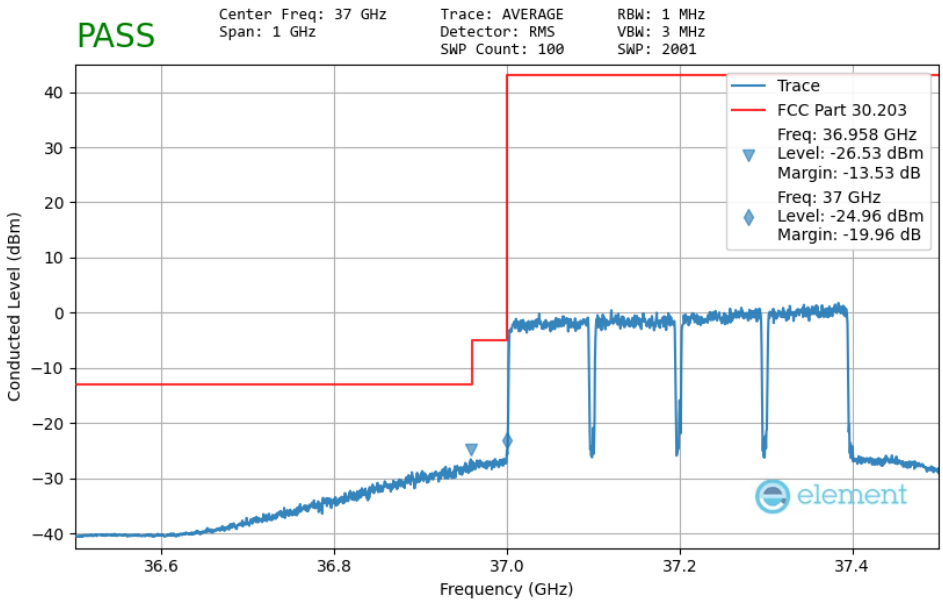
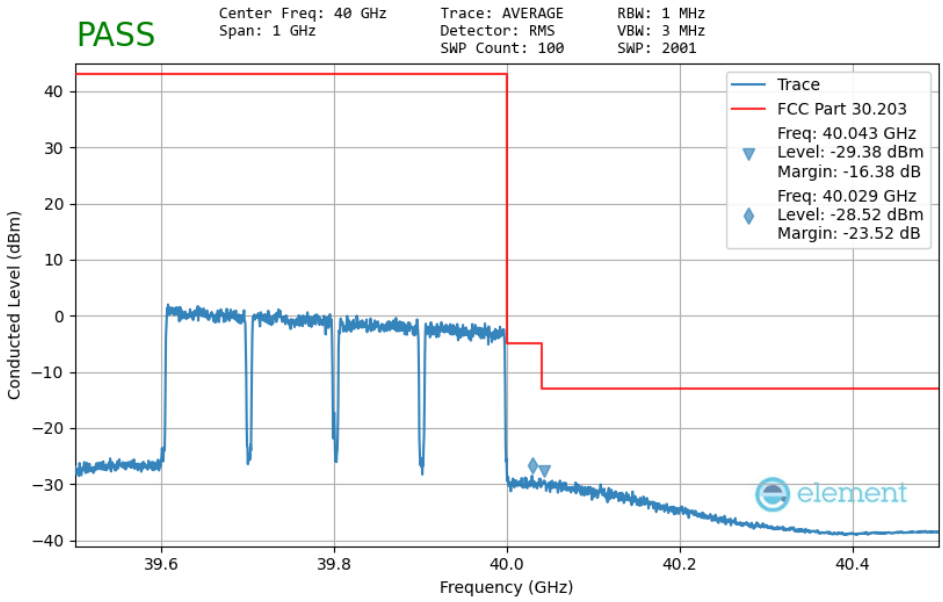


Plot 7-144. Lower Band Edge − DFT-s – MIMO-DL Polarization (100MHz-4CC – QPSK FULL RB)



Plot 7-145. Upper Band Edge − DFT-s – MIMO-DL Polarization (100MHz-4CC – QPSK FULL RB)

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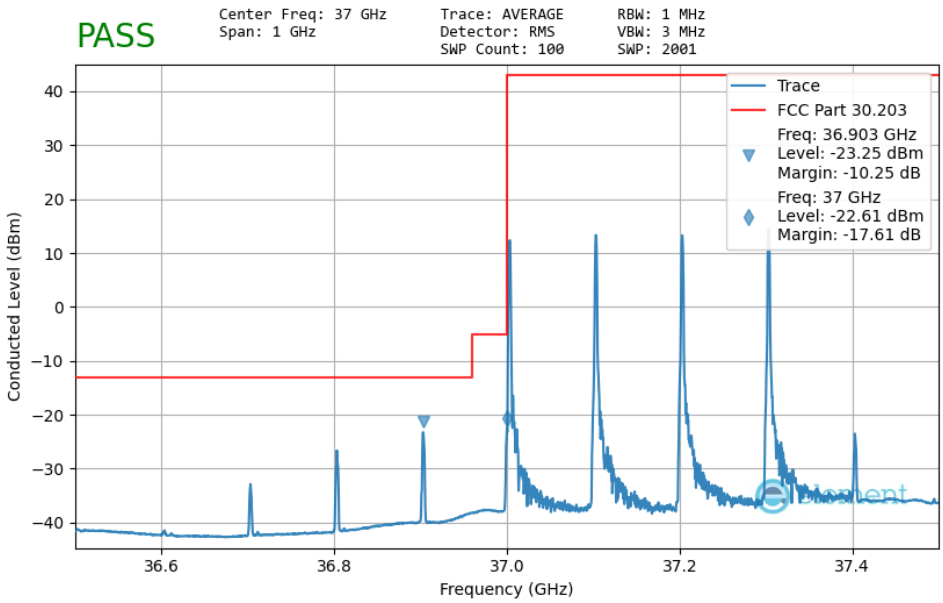
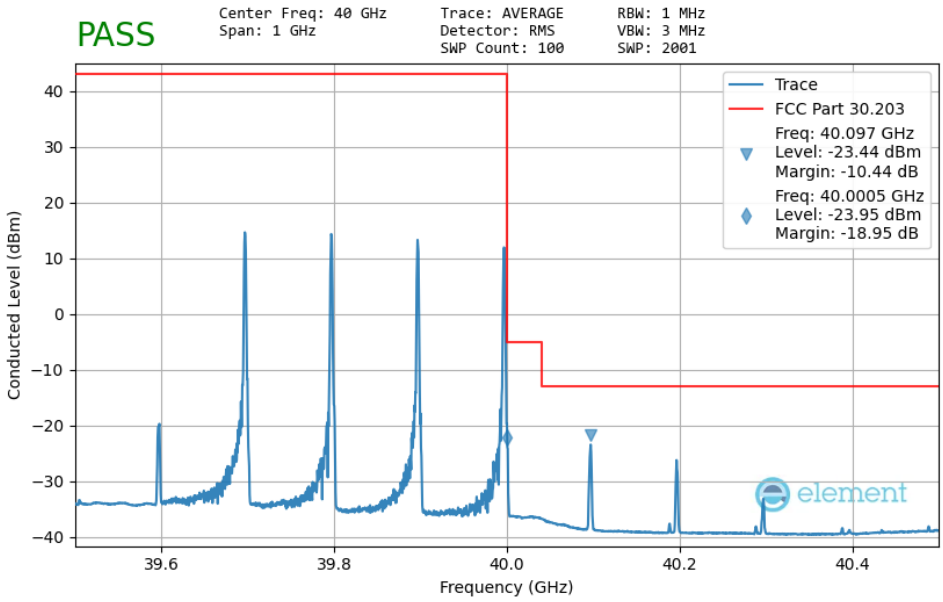


Plot 7-146. Lower Band Edge − DFT-s – MIMO-DL Polarization (100MHz-4CC – QPSK 1RB)



Plot 7-147. Upper Band Edge − DFT-s – MIMO-DL Polarization (100MHz-4CC – QPSK 1RB)

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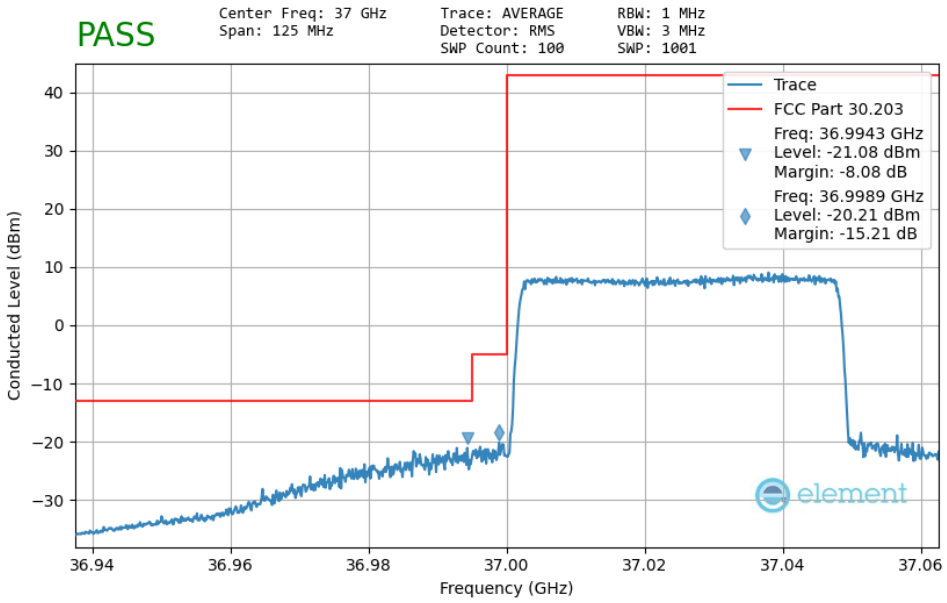
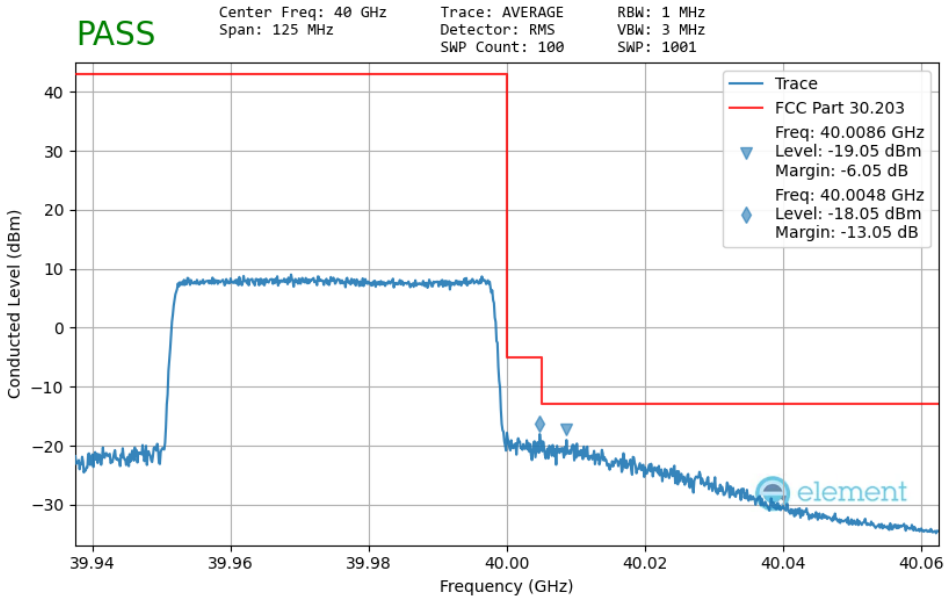
Band n260 – SU (CP-OFDM)



Plot 7-148. Lower Band Edge − CP – MIMO-DL Polarization (50MHz-1CC – QPSK Full RB)



Plot 7-149. Upper Band Edge − CP – MIMO-DL Polarization (50MHz-1CC – QPSK Full RB)

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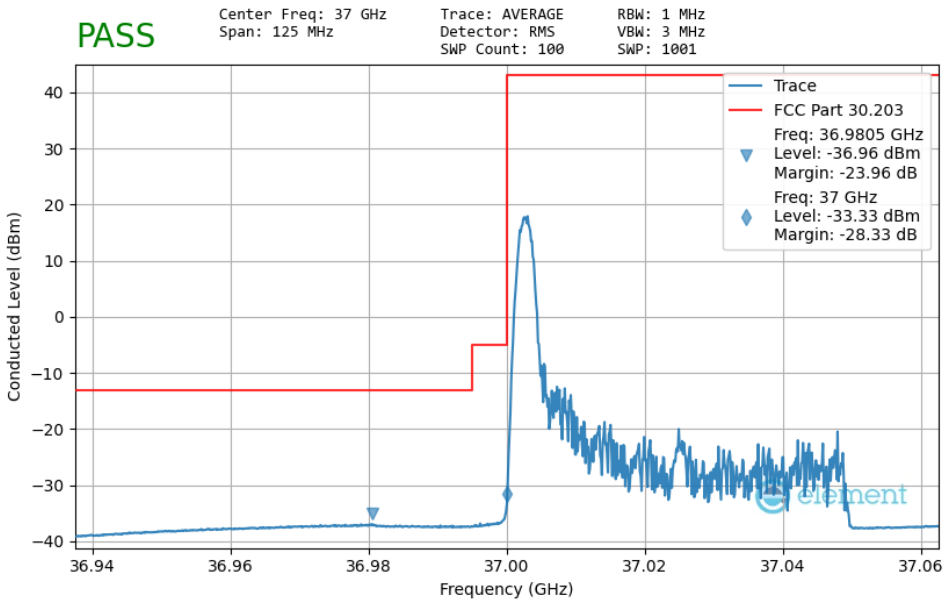
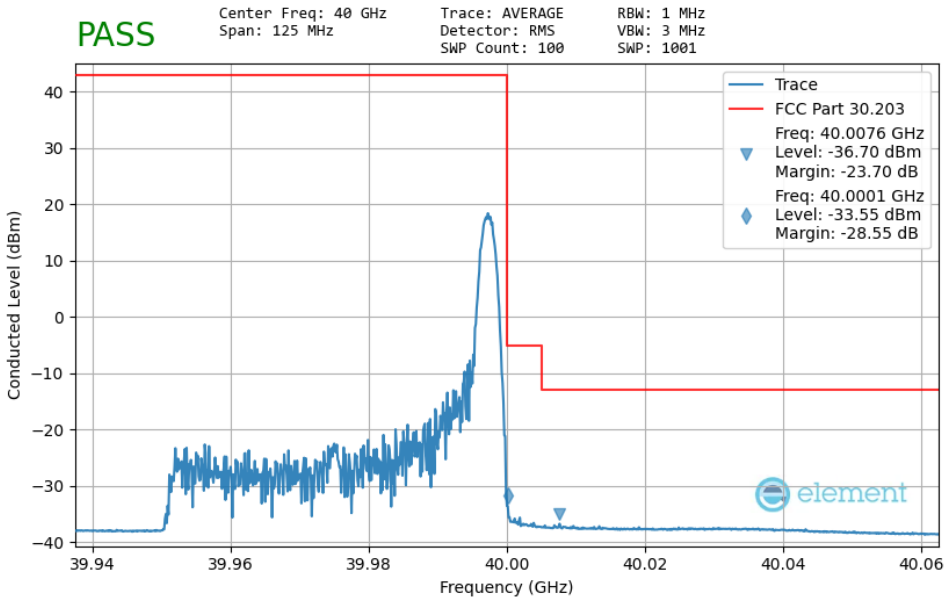


Plot 7-150. Lower Band Edge − CP – MIMO-DL Polarization (50MHz-1CC – QPSK 1 RB)



Plot 7-151. Upper Band Edge − CP – MIMO-DL Polarization (50MHz-1CC – QPSK 1 RB)

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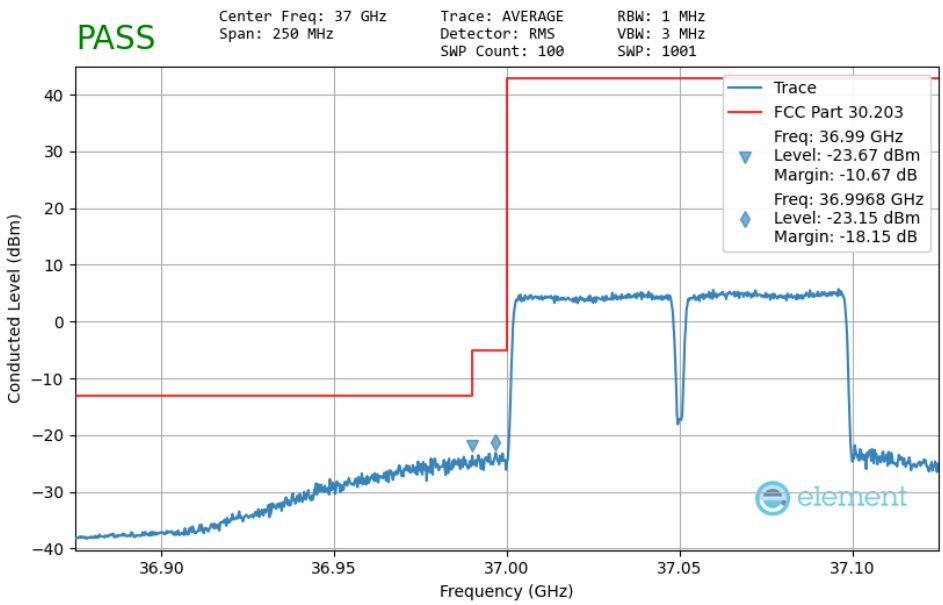
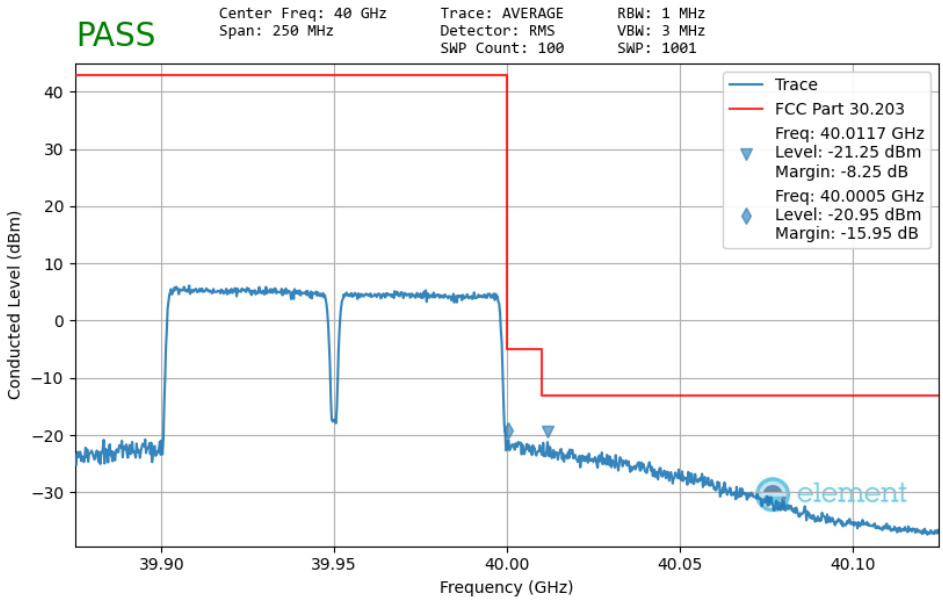


Plot 7-152. Lower Band Edge − CP – MIMO-DL Polarization (50MHz-2CC – QPSK Full RB)



Plot 7-153. Upper Band Edge − CP – MIMO-DL Polarization (50MHz-2CC – QPSK Full RB)

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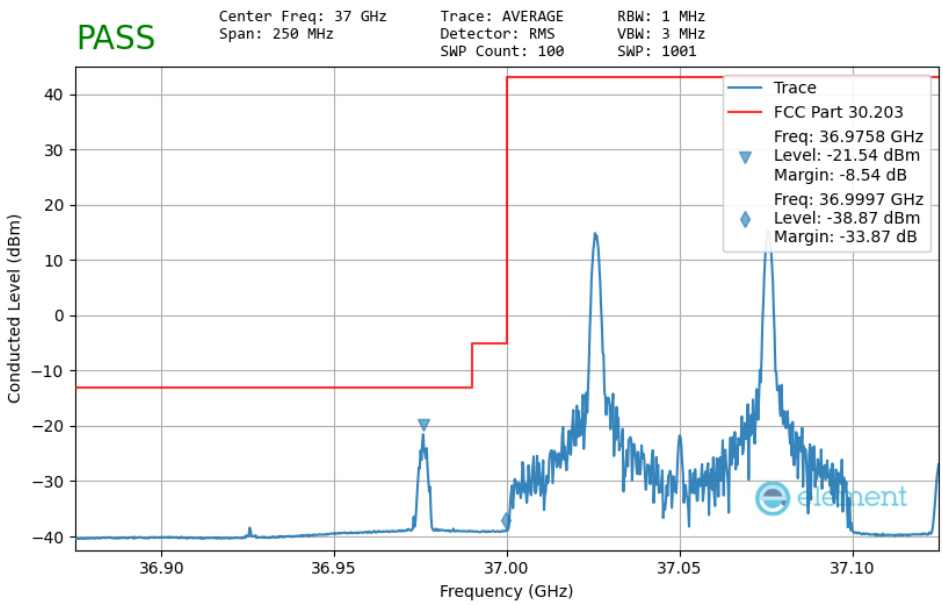
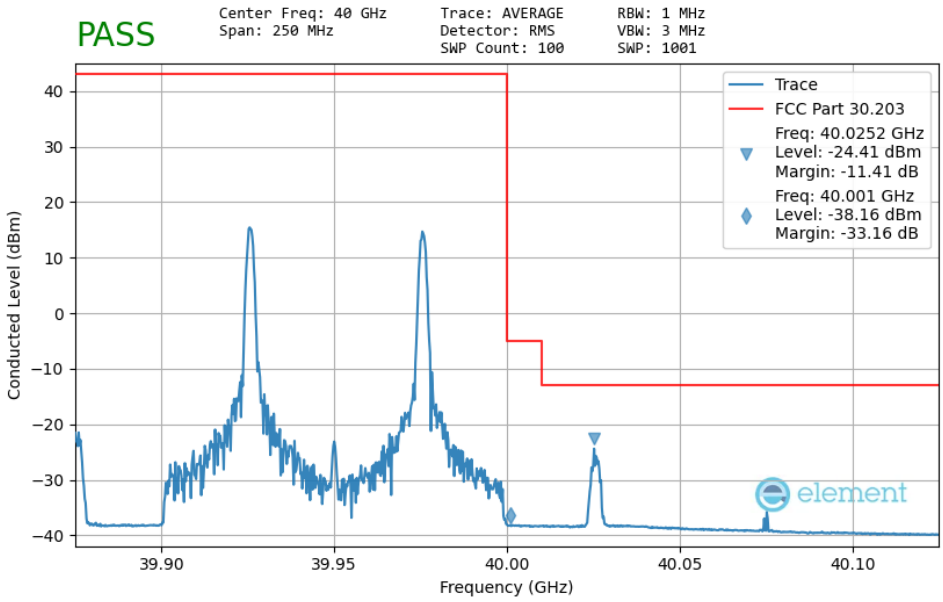


Plot 7-154. Lower Band Edge − CP – MIMO-DL Polarization (50MHz-2CC – QPSK 1RB)



Plot 7-155. Upper Band Edge − CP – MIMO-DL Polarization (50MHz-2CC – QPSK 1RB)

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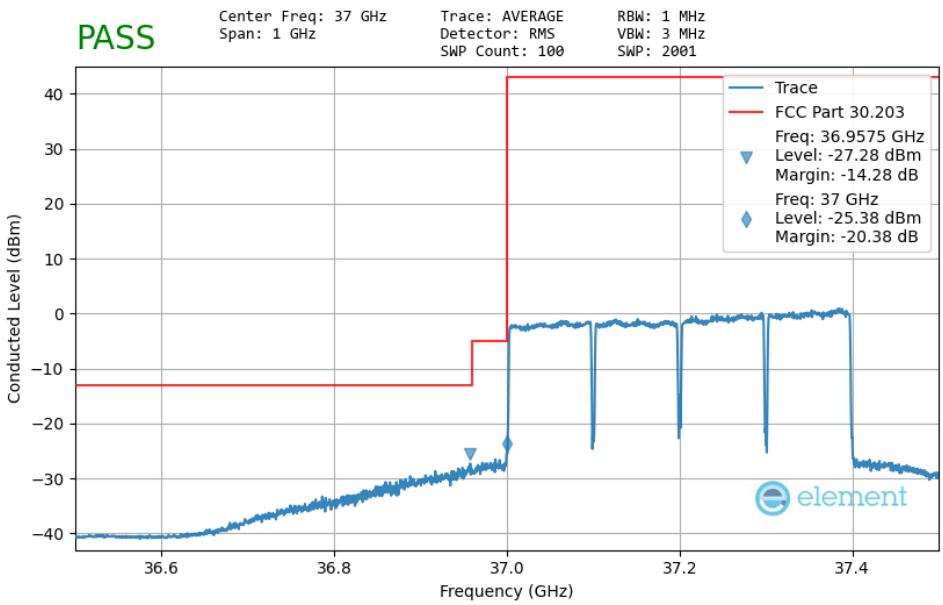
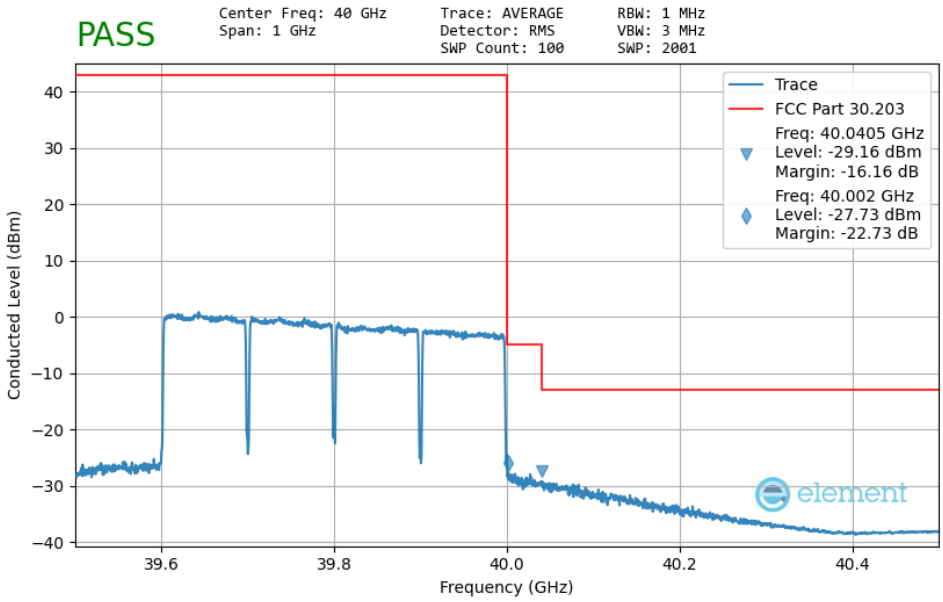


Plot 7-156. Lower Band Edge − CP – MIMO-DL Polarization (100MHz-4CC – QPSK FULL RB)



Plot 7-157. Upper Band Edge − CP – MIMO-DL Polarization (100MHz-4CC – QPSK FULL RB)

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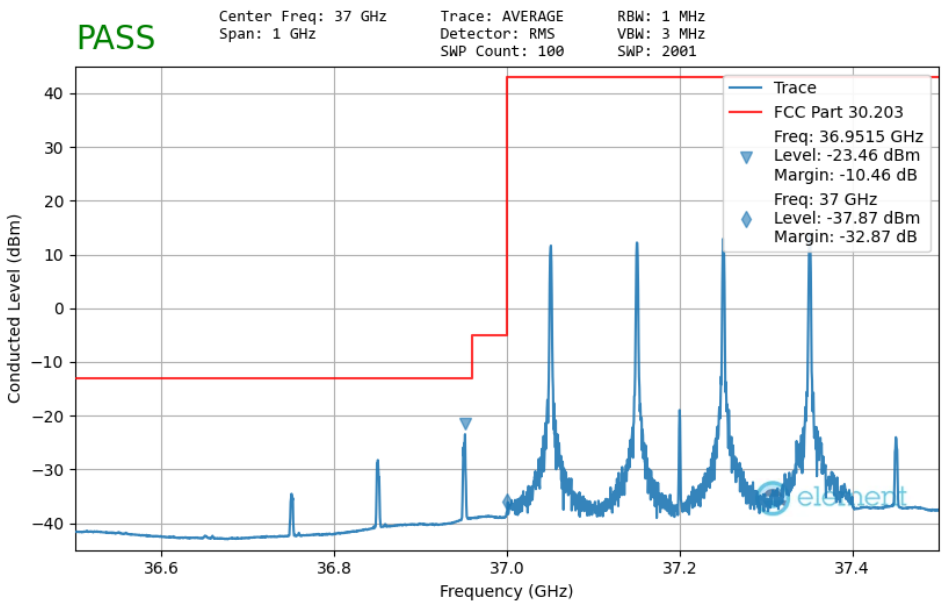
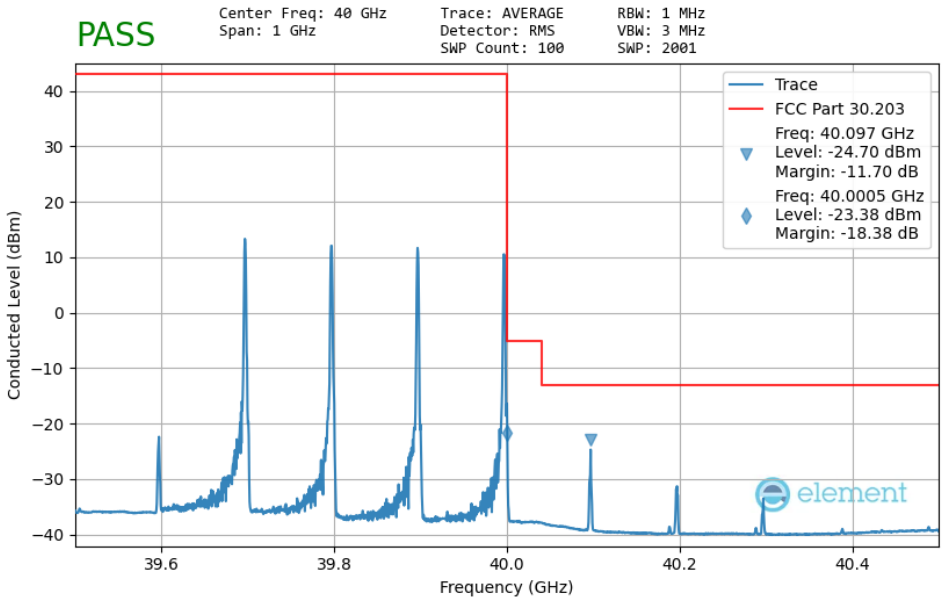


Plot 7-158. Lower Band Edge − CP – MIMO-DL Polarization (100MHz-4CC – QPSK 1RB)



Plot 7-159. Upper Band Edge − CP – MIMO-DL Polarization (100MHz-4CC – QPSK 1RB)

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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 n260 - SU

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

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	48.00	+ 20 (Ref)	38,500,658,609	0	0.0000000
100 %		- 30	38,500,658,492	-117	-0.0000003
100 %		- 20	38,500,661,075	2,467	0.0000064
100 %		- 10	38,500,654,364	-4,244	-0.0000110
100 %		0	38,500,655,790	-2,819	-0.0000073
100 %		+ 10	38,500,661,976	3,368	0.0000087
100 %		+ 30	38,500,659,778	1,169	0.0000030
100 %		+ 40	38,500,657,327	-1,281	-0.0000033
100 %		+ 50	38,500,652,593	-6,016	-0.0000156
85 %	40.80	+ 20	38,500,656,491	-2,118	-0.0000055
115 %	55.20	+ 20	38,500,660,370	1,761	0.0000046

Table 7-29. Frequency Stability Data – SU (n260)

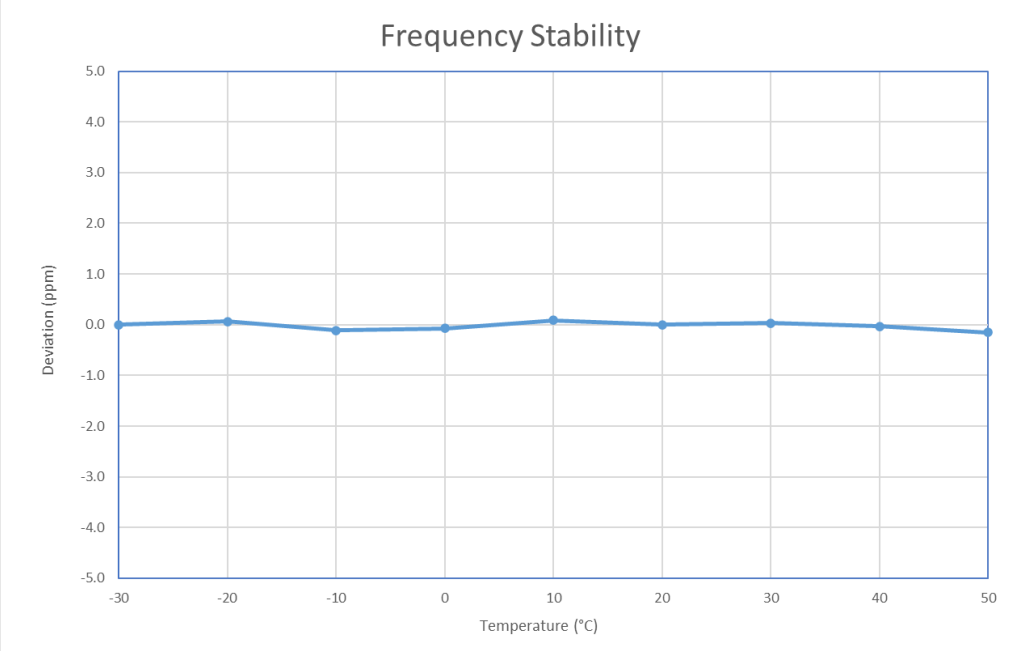

Figure 7-1. Frequency Stability Graph – SU (n260)

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.

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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-5620-23-39** 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 **Today's Date:** 11/21/22
Shipping Date: 11/17/22 **PO Number:** US37100165PO-1

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

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

Virginia Diodes, Inc.

Certificate of Conformance

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

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

Packing List No: 230051
Shipping Date: 01/05/23
Today's Date: 01/05/23
PO Number: US37100165PO-1

Quantity Shipped	Unit	Description	Order-Job Number
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

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Certificate of Conformance

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

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

Packing List No: 230941
Shipping Date: 03/01/23
Today's Date: 03/01/23
PO Number: Warranty

Quantity Shipped	Unit	Description	Order-Job Number
1	EA	REPAIR-VDIWR5.1SAX-M-M18 WR5.1SAX-M-M18 - Mini Spectrum Analyzer Extension Module / SN: SAX 682	R220106PCT-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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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 below*[1], 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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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/DEMOD Pre Conformance (TS 38.521-4); VZW 5G NR SA Data Retry; VZW 5G NR SA Voice Services Fallback

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Test Technology:	Test Method(s)[2]:
5G NR (cont.)	VZW 5G NR SA Voice, VZW Video and Messaging; VZW 5G NR SA System Selection; VZW 5G WEA TP; VZW 5G Iconography AT&T 10776 Test Plans(5G/4G/3G/2G)
LTE	3GPP TS 36.521-1; 3GPP TS 36.521-3; 3GPP TS 36.523-1; 3GPP 37.571-1; 3GPP 37.571-2; 3GPP TS 34.229-1; ETSI EN 301 908-13 Version 13.1.1 (2019-11); 3GPP Carrier Aggregation; PTCRB NAPRD.03; PTCRB PPMD; PTCRB Cat-M (per RFT132 eMTC); PVG.09 LTE Data Throughput & TR 37.901 Data Throughput Performance; PVG.04 PTCRB Radiated Spurious Emissions; Global Certification Forum (GCF-CC) Certification / LTE Field Test (TS.11); 3GPP Cat-NB & Cat-M; MetroPCS Lab Conformance; AT&T LTE Conformance; AT&T IoT Accelerator Conformance, 19263; VZW Lab Conformance; VZW Supl RF; VZW FR2 Supplementary RF, VZW FR1 Supplementary RF; VZW Supl Signaling Conformance; VZW Supl RRM; VZW LTE LBS Performance; VZW Safe for Network (SFN), VZW Phase 1, VZW Open Development and Field Interoperability Testing (FIT) [3]; VZW Network Extender; VZW PCO; VZW Data Retry; VZW Data Throughput; VZW SMS; VZW AT Commands; VZW CMAS; VZW eMBMS; VZW APN; VZW Cat-M VoLTE; Live Network Extender and Android Test Plan; USCC Lab Conformance; KDDI LTE Device Testing; SoftBank LTE Testing
WCDMA (UTRA)	3GPP TS 34.121-1; 3GPP TS 34.123-1; SoftBank Mobile WCDMA Testing
SVLTE / Multimode	E911 Data Call Processing; Stress Testing; RSSI for MM Devices; LTE LBS Performance; VZW Multimode Supl Signaling; VZW Multimode SMS; VZW Multimode Data Retry
VoLTE	IMS VoIP; Rich Communication Services (RCS); IMS Registration and Retry; ePDG Live Network; E911 for VoLTE; VZW hVoLTE; VZW VoIP and VT Performance; VZW Interband RRM and Protocol
Carrier Aggregation	VZW Carrier Aggregation Supplementary RF; VZW Carrier Aggregation Data Throughout

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Test Technology:	Test Method(s)[2]:
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

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); ETSI TS 136 124 LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); (3GPP TS 36.124); (3GPP TS38.124 NR; Electromagnetic Compatibility (EMC) Requirements for Mobile Terminals and Ancillary Equipment); ETSI TS 151 010-1 Digital Cellular Telecommunications System (Phase 2+) (GSM); 3GPP TS 51.010-1, Section 12 (Conducted and Radiated Spurious Emissions); EN55011; EN 55032;

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Test Technology:	Test Method(s) [2]:
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);

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Test Technology:	Test Method(s) [2]:
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
Wired and Wireless Conformance	
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

Test Technology:	Test Method(s) [2]:
Battery Safety	IEEE 1725 Standard for Rechargeable Batteries for Cellular Telephones; CTIA Certification Requirements for Battery System Compliance to IEEE 1725; - Exclusions: Section 6.2 (DC-DC testing only); Section 7 (Certified Adapters only); IEEE 1625 Standard for Rechargeable Batteries for Multi-Cell Mobile Computing Devices; CTIA Certification Requirements for Battery System Compliance to IEEE 1625; UL1642 Standard for Lithium Batteries; UL 2054 Household and Commercial Batteries; IEC 62133-2 Secondary Cells and Batteries containing Alkaline or other Non-Acid Electrolytes – Safety Requirements for Portable Sealed Secondary Cells & Batteries made from them, for use in Portable Applications IEC 61960-3 Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium and batteries for portable applications – Part 3: Prismatic and cylindrical lithium secondary cells, and batteries made from them
UNDOT Battery Transportation Safety	United Nations Document ST/SG/AC.10/11/Section 38.3 Recommendations on the Transport of Dangerous Goods; Manual of Tests and Criteria; IEC 62281 – Safety of Primary and Secondary Lithium Cells and Batteries During Transport
Aerospace - Battery Performance and Safety	NASA Specification for Acceptance Testing of Commercial Lithium-Ion Cell Lots Engineering Directorate Propulsion & Power Division, EP-WI-031
Hardware Reliability	CTIA Device Hardware Reliability Test Plan
Determining Battery Life	CTIA Battery Life Test Plan
ESD Immunity	EN/IEC 61000-4-2

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

Test Technology:	Test Method(s) [2]:
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
Unintentional Radiators Part 15B	ANSI C63.4:2014	40000 MHz
Industrial, Scientific, and Medical Equipment Part 18	FCC MP-5 (February 1986)	330000 MHz
Intentional Radiators Part 15C	ANSI C63.10:2013	330000 MHz
Unlicensed Personal Communication		

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

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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
Hearing Aid Compatibility Part 20 (HAC for Commercial Mobile Services)	ANSI C63.19:2011	6000 MHz
Signal Boosters Part 20 (Wideband Consumer Signal Boosters, Provider-specific signal boosters, and Industrial Signal Boosters) Section 90.219	ANSI C63.26:2015	330000 MHz

[3]Accreditation 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 McInturff, 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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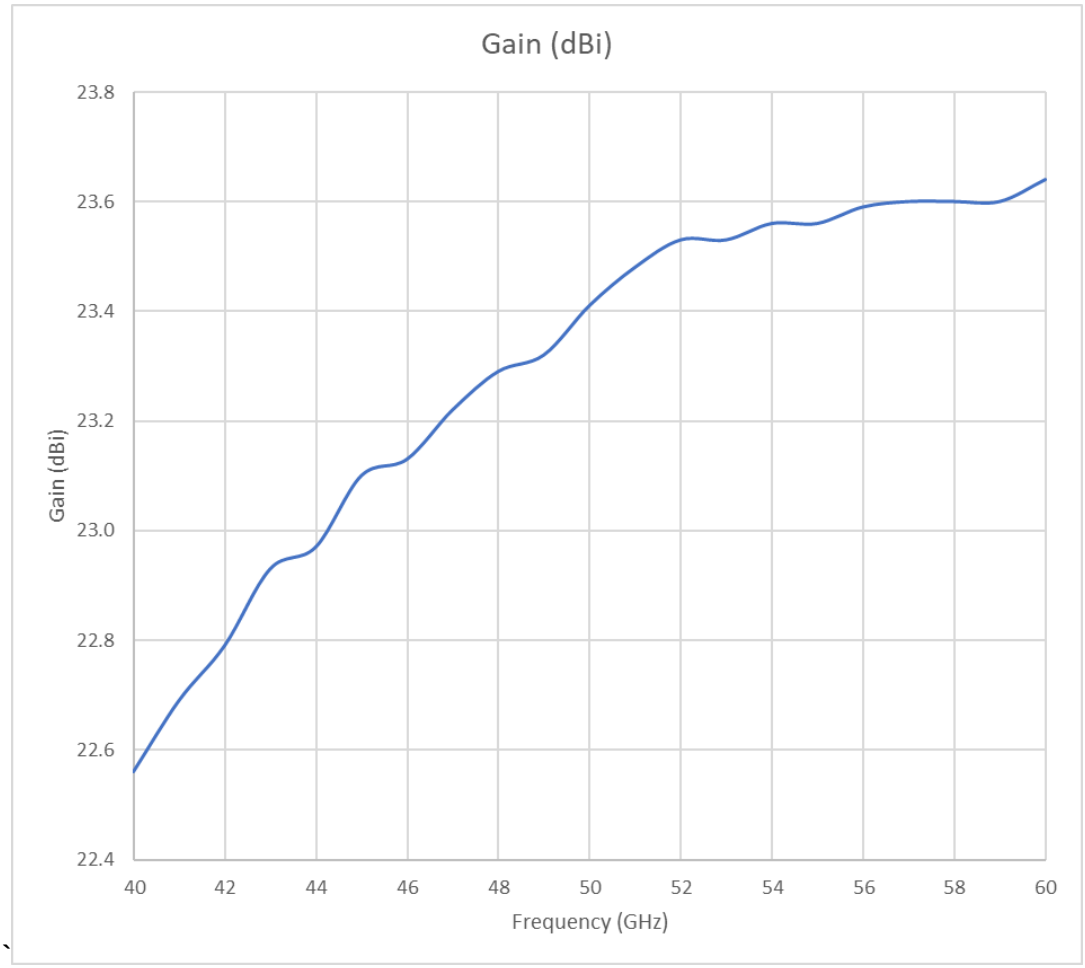
APPENDIX C – HORN ANTENNA GAIN CURVES

OML M19RH Horn Antenna Gain (40 – 60GHz)



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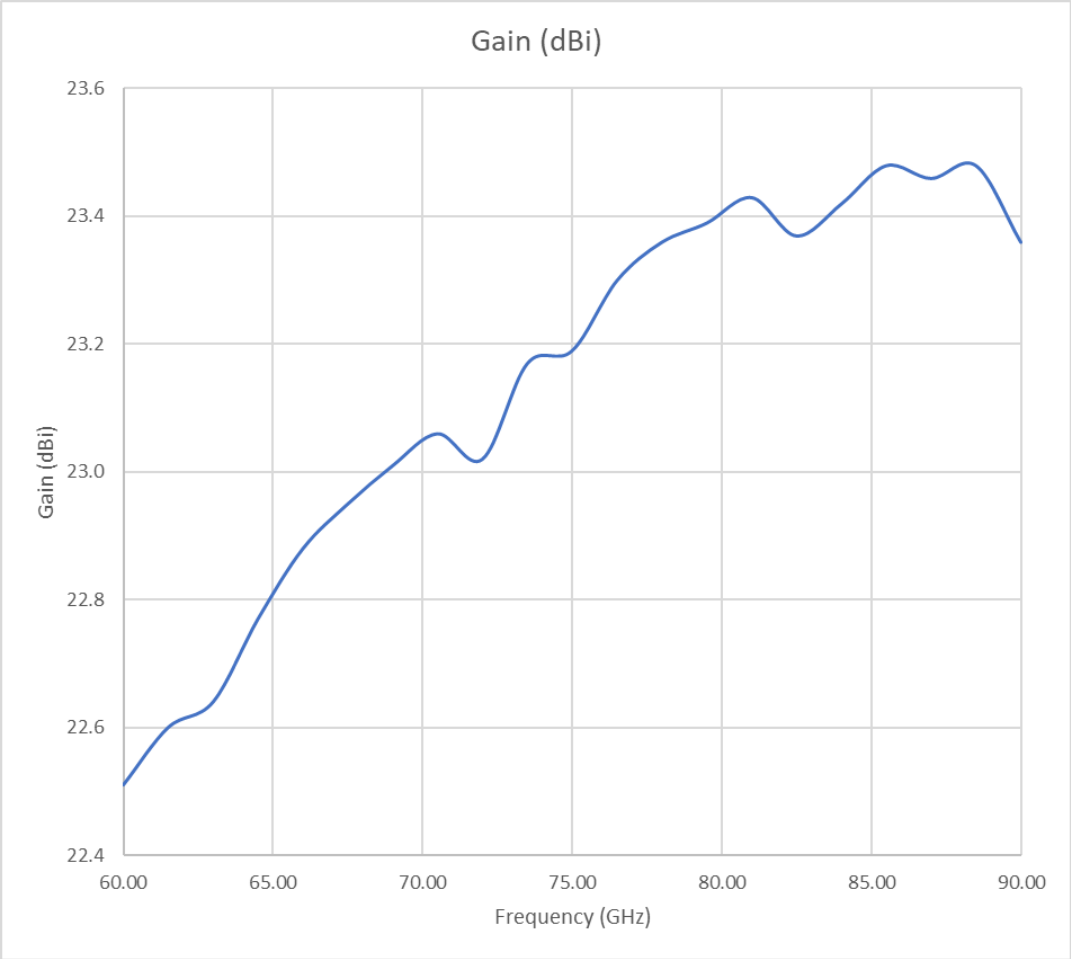
OML M12RH Horn Antenna Gain (60 – 90GHz)



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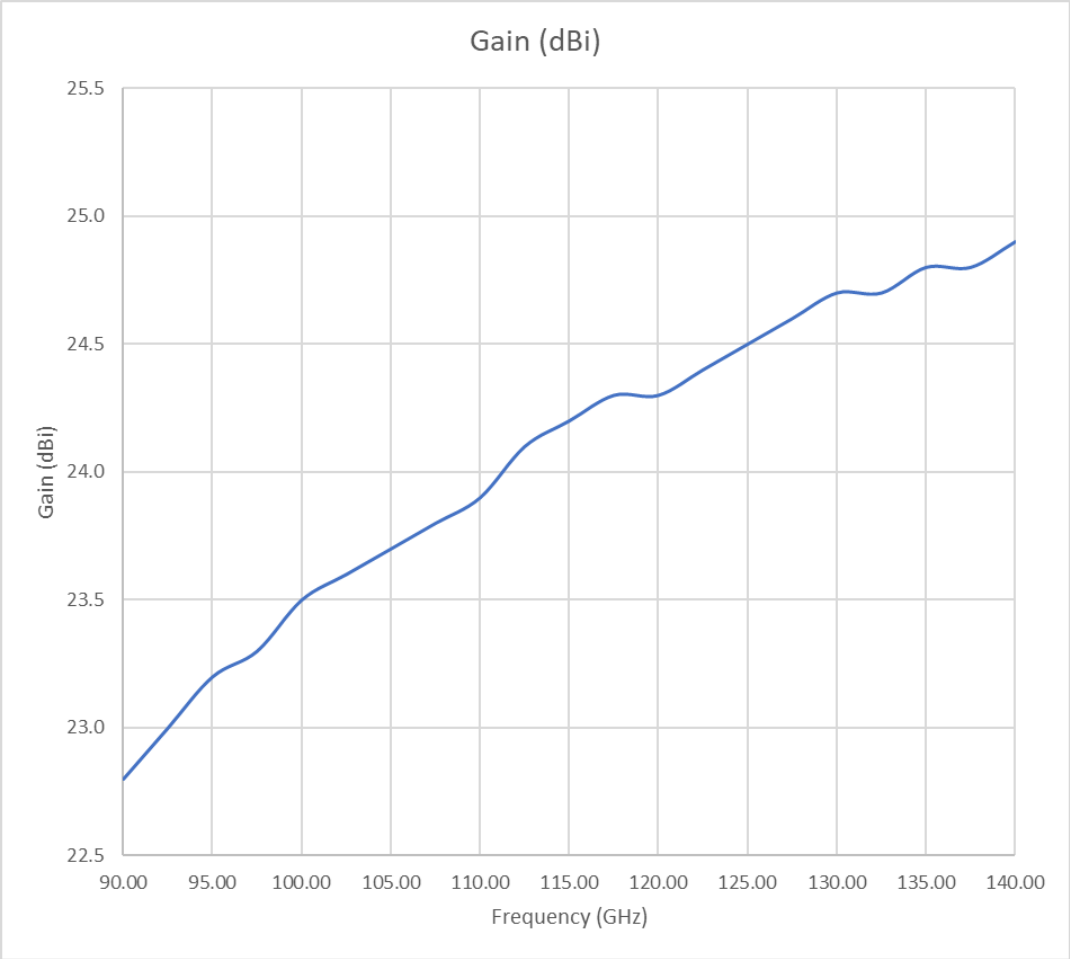
OML M08RH Horn Antenna Gain (90 – 140GHz)



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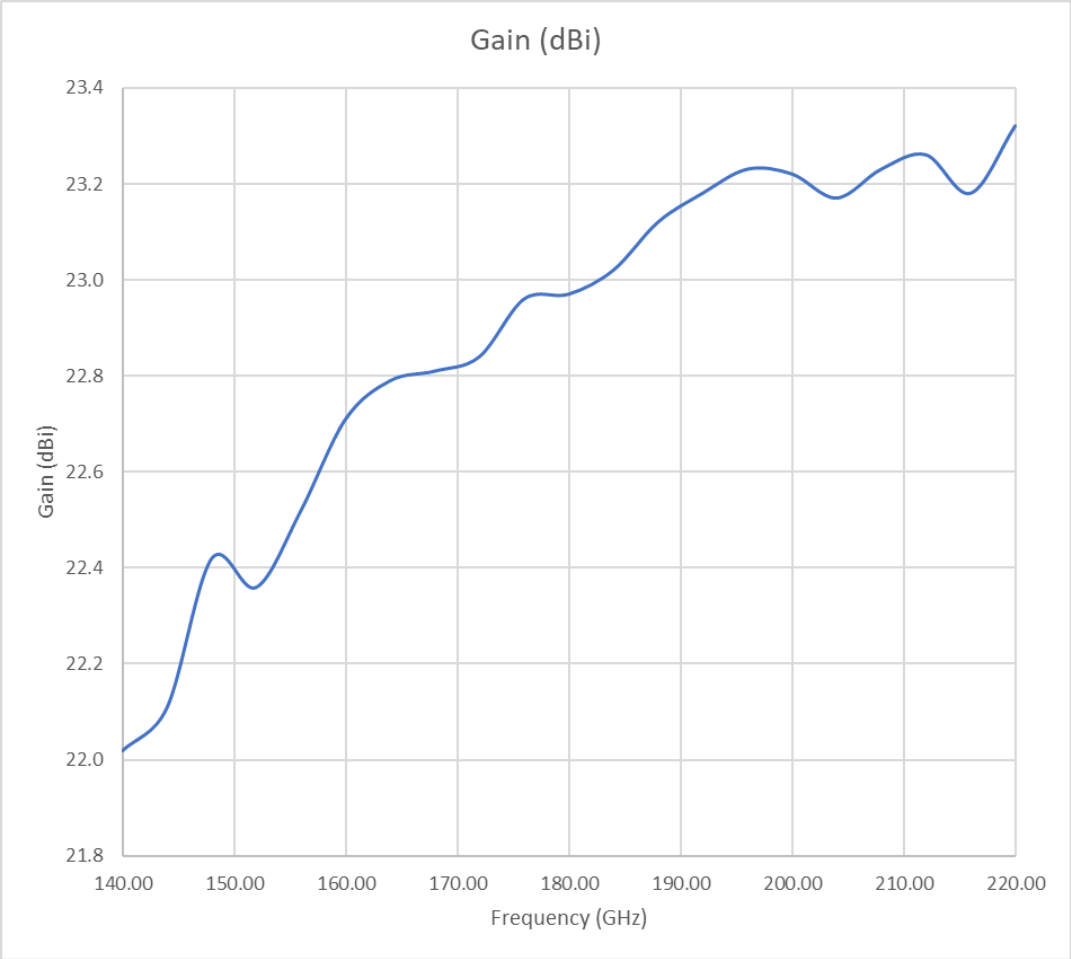
OML M05RH Horn Antenna Gain (140 – 220GHz)



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