# Technical Appendix
# 2.4m ST5000-2.4 ESV Terminal

## Order of Contents

# ST5000-2.4 – Technical Description and Parameters

The ST5000-2.4 terminal is comprised of a 2.4m circular reflector antenna, an antenna positioner, and an antenna control module. The antenna positioner and control module are the same as those used in Harris CapRock's SpaceTrack 4000 series of stabilized antennas. The SpaceTrack 4000 has been previously licensed by the FCC in C-band and Ku-band ESV configurations and has years of proven experience in the field. Thus, the FCC can be assured that ST5000-2.4 will operate as designed to avoid potential interference to adjacent satellites.

**SUMMARY OF TECHNICAL PARAMETERS – ST5000-2.4**

| **Characteristic** | **C-band** | **Ku-band** |
|---|---|---|
| Antenna diameter | 2.4m | 2.4m |
| Type of Antenna | Circular reflector | Circular reflector |
| Peak Power (SSPA) | 200 watts | 125 watts |
| Transmit Bandwidth | 1 MHz to 72 MHz | 1 MHz to 72 MHz |
| Transmit Gain | 38 dBi | 43 dBi |
| EIRP | 58.3 dBW | 62.2 dBW |
| Data Rate | 20 Mbps Tx / 100 Mbps Rx | 20 Mbps Tx / 100 Mbps Rx |
| Emission Designators | 1M00G7D to 20M0G7D | 1M00G7D to 20M0G7D |
| Transmit Polarization | LHCP/RHCP Horizontal/Vertical | Horizontal/Vertical |
| Transmit Max PSD | 21.3 dBW/4kHz | 25.2 dBW/4kHZ |
| Transmit Beamwidth | 0.57 degrees | 0.3 degrees |
| Receive G/T | 16.4 dB/K | 24.5 dB/K |
| Receive Bandwidth | Up to 72 MHz | Up to 72 MHz |
| Receive Polarization | LHCP/RHCP Horizontal/Vertical | Horizontal/Vertical |
| Feed Flange Power | 106.2 Watts | 74.5 Watts |
| ERP | 409 kW | 1.02 MW |
| Signal Modulation | Up to 32 APSK | Up to 32 APSK |

**Pointing Accuracy and Automatic Muting.** The ST5000-2.4 positioner system is designed to provide stable pointing to GSO satellites during range of motion associated with maritime operations, as well as track predictable NGSO satellite orbit paths under the same maritime operational conditions. There have been no reported cases of interference in connection with ST-5000-2.4 operations.

Harris CapRock's ST5000-2.4 terminal is designed to meet the FCC's requirements for ESV operations, including: (i) maintaining off-axis EIRP to the levels set forth in the applicable FCC mask (in the case of Ka-band, Section 25.138); (ii) pointing accuracy of 0.2° or better; (iii) automatic cessation of emissions within 100 ms if pointing offset exceeds 0.5°; and (iv) transmissions will not resume until pointing accuracy is within 0.2°. The technical characteristics of the terminal's positioner system are set forth in the follow tables.

**ANTENNA MOTION PARAMETERS - ST5000-2.4**

| | |
|---|---|
| Azimuth | Continuous coverage over 360º |
| Elevation | 0 to 90º antenna elevation |
| Position accuracy | Better than 0.2º (auto-disable at 0.5 º offset) |
| Tracking capability | 8º/sec |

Harris CapRock has tested the pointing accuracy of the ST5000-2.4 terminal and provided summary results in the ST5000-2.4 Tracking Testing report. (*See* Technical Appendix, Annex 6, "*Tracking Report*") As indicated in the *Tracking Report*, at the tested frequencies the 1 dB contour (i.e., a 1 dB reduction from peak boresite power) represents a 0.19º pointing offset. *See id.* at 4-5. In no case did the pointing offset of the ST5000-2.4 terminal exceed 1 dB (each "box" in the grids in the spectrum analyzer screen shots represents 1 dB). Thus, the tested pointing accuracy of the ST5000-2.4 terminal is better than 0.2º.

Compliant pointing accuracy is expected because the ST5000-2.4 terminal has the same positioner and pointing technology as Harris CapRock's licensed ST4000 series terminals. Similarly, because the ST5000-2.4 terminal employs the same automatic muting technology and functionality as the previously licensed ESV terminals, it complies with the requirement to mute transmissions if pointing offset exceeds 0.5º and will not recommence transmissions until pointing offset is within 0.2º.

**Sections 25.221 & 25.222 Off-Axis EIRP Spectral Density Limits.** The ST5000-2.4 will operate in accordance with the off-axis EIRP spectral density limits for C-band and Ku-band ESV terminals set forth the Commission's rules.[1] In the Technical Appendix Annex 1, Figures

[1] *See* 47 C.F.R. §§ 25.221 (a)(1)(i) and 25.222(a)(1)(i). The ST5000-2.4 terminal complies with off-axis EIRP spectral density limits in both the azimuth and elevation plane in the C-band and Ku-band.

1-3 Harris CapRock provides plots demonstrating that the ST5000-2.4 terminal will comply with the FCC Section 25.221 EIRP spectral density limits during C-band operations. Similarly, in Annex 2, Figures 4-6 Harris CapRock provides plots demonstrating that the ST5000-2.4 terminal will comply with the FCC Section 25.222 EIRP spectral density limits during Ku-band operations.

Annex 1, Tables 1 and 2 provide the C-band co-polarized and cross-polarized E and H plane antenna gain and EIRP values for the ST5000-2.4 from -180° to 180° in increments pursuant to Section 25.221(b)(1)(i) of the Commission's rules. Annex 2, Tables 3 and 4 provide the Ku-band co-polarized and cross-polarized E and H plane antenna gain and EIRP values for the ST5000-2.4 from -180° to 180° in increments pursuant to Section 25.222(b)(1)(i) of the Commission's rules. The off-axis EIRP spectral density patterns and tabular data demonstrate that the ST5000-2.4 terminal complies with the spectral density levels set forth in Sections 25.221 and 25.222 of the rules and the Commission's two-degree spacing policies.

**Section 25.209 Gain Envelopes**. Harris CapRock acknowledges that the ST5000-2.4 antenna will exceed the Commission's Section 25.209 gain envelopes at C-band and Ku-band at certain off-axis angles.[2] Accordingly, pursuant to Section 25.132(b)(3) of the Commission's rules, Harris CapRock hereby submits range test plots of the antenna gain patterns for each frequency band.

For C-band, Harris CapRock provides the co-polarized and cross-polarization patterns versus the FCC Section 25.209 gain mask in the E and H planes at 5.850 GHz (bottom of band), 6.1375 GHz (middle of band) and 6.4250 GHz (top of band). (*See* Technical Appendix, Annex 3.) For Ku-band, Harris CapRock provides the co-polarized and cross-polarized patterns versus the FCC Section 25.209 gain mask in the E and H planes at 13.75 GHz (bottom of band), 14.125 GHz (middle of band) and 14.50 GHz (top of band). (*See* Technical Appendix, Annex 4.) Accordingly, Harris CapRock complies with Section 25.132(b)(1)'s of the Commission's rules by providing measured gain pattern values at the bottom, middle and top of C-band and Ku band.[3]

Furthermore, in the following appendices, Form 312 and Schedule B, Harris CapRock provides additional operational and technical information relating to the ST5000-2.4 terminal, including the information required under Sections 25.221 and 25.222 of the Commission's rules. (*See* Order of Contents.)

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[2] *See* 47. C.F.R. § 25.209.

[3] In the interest of administrative convenience, Harris CapRock has provided gain pattern plots to satisfy Section 25.132(b)(1) of the Commission's rules. To the extent that the Commission wishes to review additional data, Harris CapRock will supply the related gain pattern tabular data for C-band and Ku-band.

# Annex 1
# C-band EIRP Spectral Density Plots & Tabular Data

**Figure 1:**
**6.1375 GHz**
**Azimuth Pattern for Co-pol (Wide Angle -180° ~ 180°)**

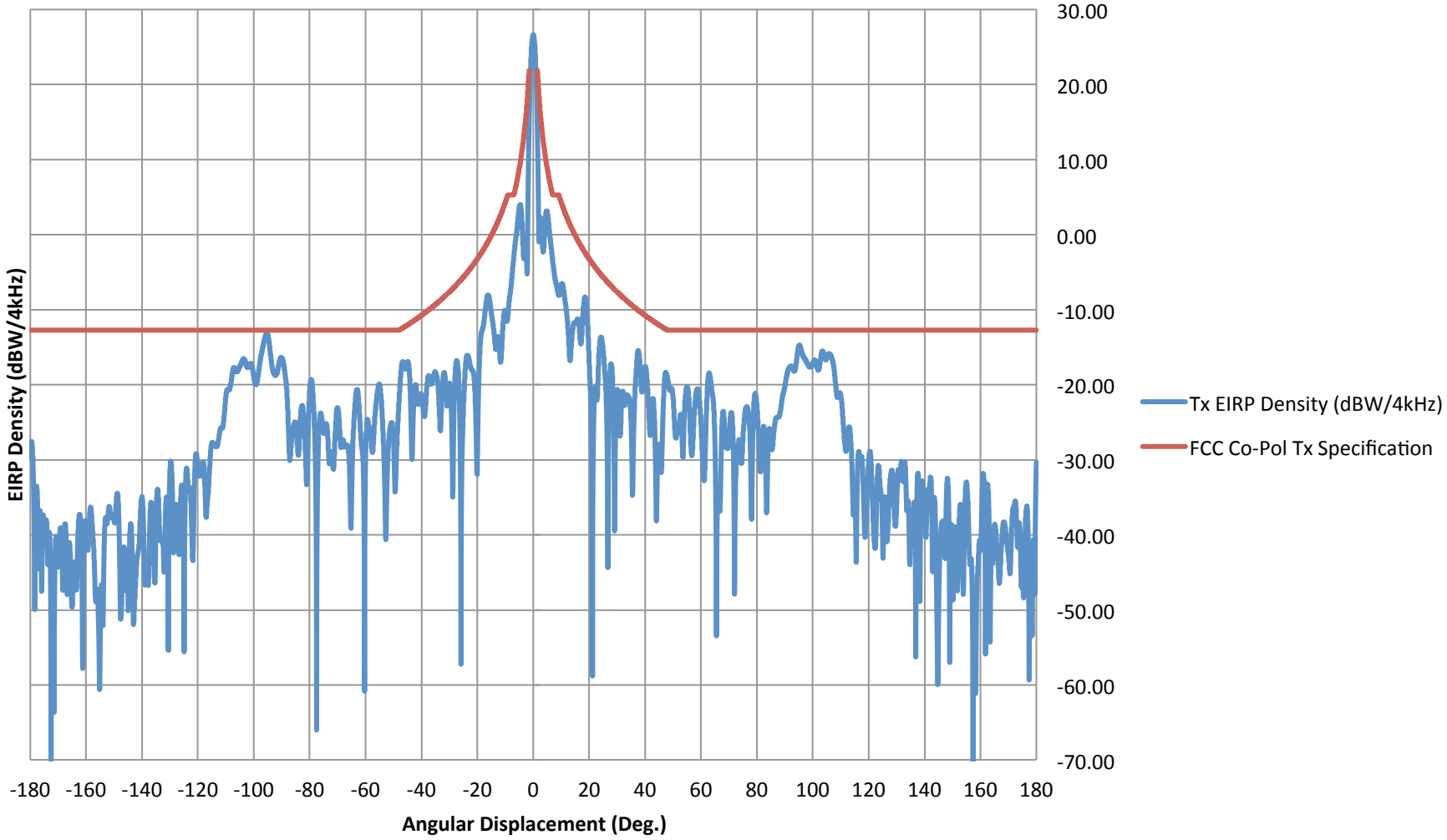


**Figure 2:**
**6.1375 GHz**
**Elevation Pattern for Co-pol (Wide Angle -180° ~ 180°)**

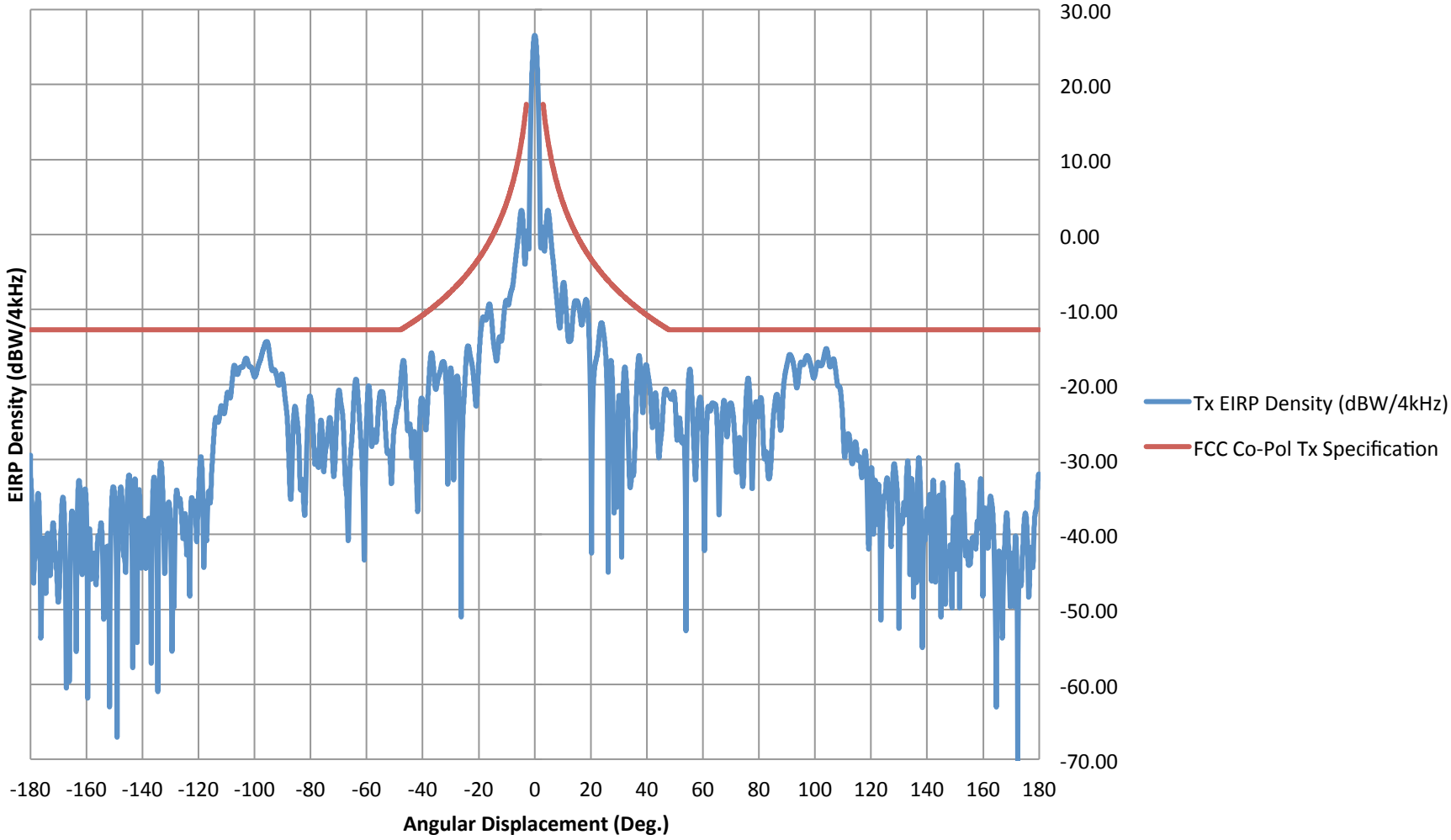
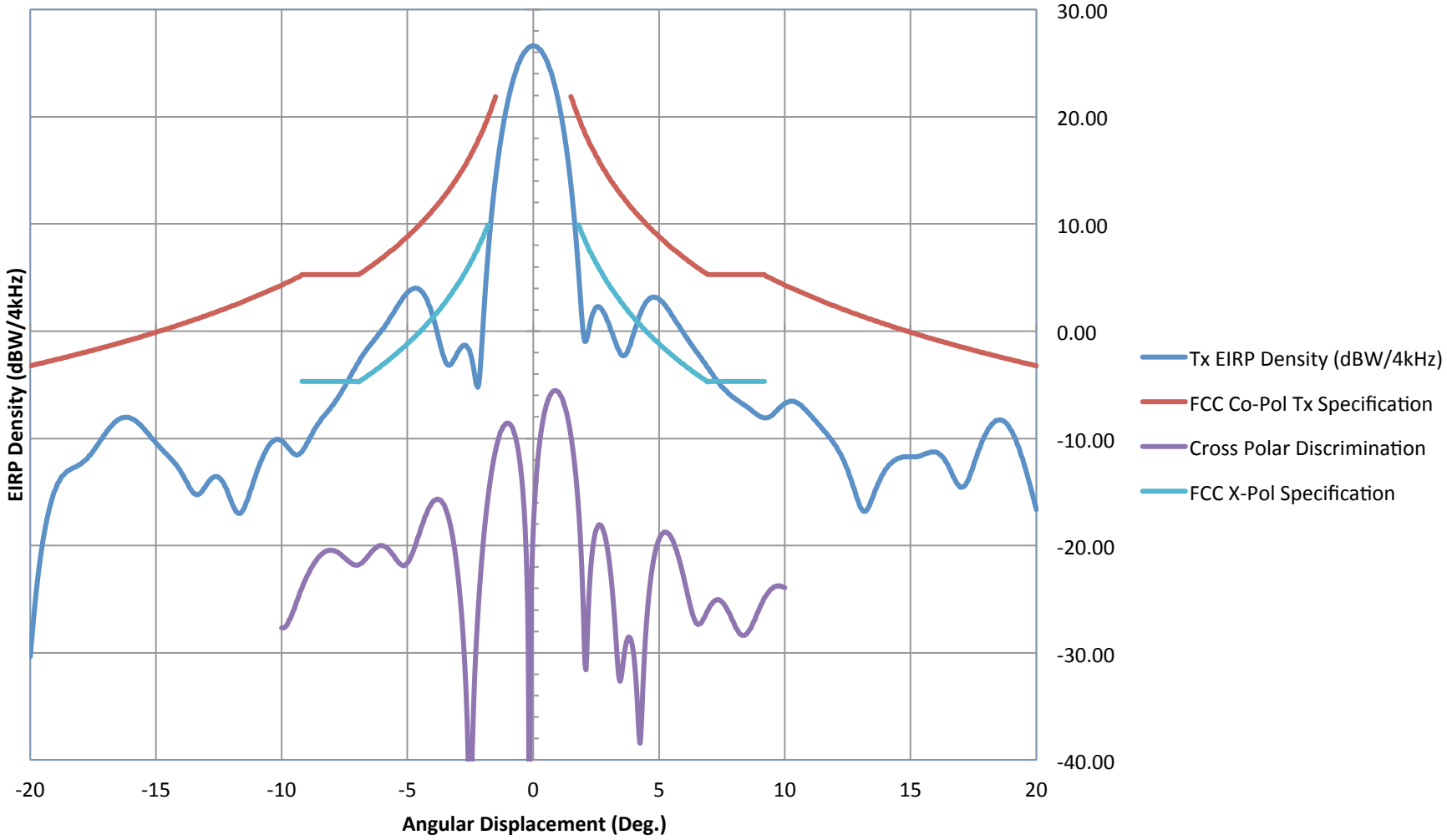


**Figure 3:**
**6.1375 GHz**
**Azimuth Pattern for Co-pol & Cross-pol (Narrow Angle -20° ~ 20°)**



## **Annex 1**: *Table 1 - Azimuth Pattern for Co-pol & Cross-pol (-180° ~ 180°)*

**(6.1375 GHz)** G = 0 dBi HPA = 400 W

HPA feeder loss = 1.5 dB

EIRPmax = -1.50 dBW/Hz = -37.50 dBW/4kHz

G - EIRPmax = 37.50 dB (=X)

| angle (Φ) | Gain (dBi) | EIRP (dBW/4 kHz) | FCC (dBW/4 kHz) | Cross Polar Transmission (dBi) | XP Transmission (dBW/4kHz) | X-Pol FCC (dBW/4kHz) |
|---|---|---|---|---|---|---|
| -180 | -16.266 | -53.77 | -12.70 | | | |
| -175 | -27.8 | -65.30 | -12.70 | | | |
| -170 | -32.818 | -70.32 | -12.70 | | | |
| -165 | -38.154 | -75.65 | -12.70 | | | |
| -160 | -27.611 | -65.11 | -12.70 | | | |
| -155 | -45.442 | -82.94 | -12.70 | | | |
| -150 | -26.505 | -64.01 | -12.70 | | | |
| -145 | -36.64 | -74.14 | -12.70 | | | |
| -140 | -23.478 | -60.98 | -12.70 | | | |
| -135 | -27.928 | -65.43 | -12.70 | | | |
| -130 | -20.288 | -57.79 | -12.70 | | | |
| -125 | -34.594 | -72.09 | -12.70 | | | |
| -120 | -19.436 | -56.94 | -12.70 | | | |
| -115 | -16.322 | -53.82 | -12.70 | | | |
| -110 | -10.179 | -47.68 | -12.70 | | | |
| -105 | -6.109 | -43.61 | -12.70 | | | |
| -100 | -7.384 | -44.88 | -12.70 | | | |
| -95 | -1.836 | -39.34 | -12.70 | | | |
| -90 | -4.872 | -42.37 | -12.70 | | | |
| -85 | -13.723 | -51.22 | -12.70 | | | |
| -80 | -9.426 | -46.93 | -12.70 | | | |
| -75 | -14.895 | -52.40 | -12.70 | | | |
| -70 | -11.57 | -49.07 | -12.70 | | | |
| -65 | -24.036 | -61.54 | -12.70 | | | |
| -60 | -18.922 | -56.42 | -12.70 | | | |
| -55 | -8.504 | -46.00 | -12.70 | | | |
| -50 | -16.06 | -53.56 | -12.70 | | | |
| -45 | -5.515 | -43.02 | -12.03 | | | |
| -40 | -9.88 | -47.38 | -10.75 | | | |
| -35 | -6.863 | -44.36 | -9.30 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| -30 | -8.283 | -45.78 | -7.63 | | | |
| -25 | -12.076 | -49.58 | -5.65 | | | |
| -20 | -18.889 | -56.39 | -3.23 | | | |
| -15 | 1.063 | -36.44 | -0.10 | | | |
| -10 | 1.246 | -36.25 | 4.30 | -16.201 | -53.701 | |
| -9.95 | 1.154 | -36.35 | 4.35 | -16.21 | -53.71 | |
| -9.9 | 1.043 | -36.46 | 4.41 | -16.165 | -53.665 | |
| -9.85 | 0.917 | -36.58 | 4.46 | -16.069 | -53.569 | |
| -9.8 | 0.779 | -36.72 | 4.52 | -15.925 | -53.425 | |
| -9.75 | 0.633 | -36.87 | 4.57 | -15.738 | -53.238 | |
| -9.7 | 0.486 | -37.01 | 4.63 | -15.513 | -53.013 | |
| -9.65 | 0.343 | -37.16 | 4.69 | -15.259 | -52.759 | |
| -9.6 | 0.211 | -37.29 | 4.74 | -14.98 | -52.48 | |
| -9.55 | 0.097 | -37.40 | 4.80 | -14.683 | -52.183 | |
| -9.5 | 0.008 | -37.49 | 4.86 | -14.374 | -51.874 | |
| -9.45 | -0.05 | -37.55 | 4.91 | -14.058 | -51.558 | |
| -9.4 | -0.072 | -37.57 | 4.97 | -13.739 | -51.239 | |
| -9.35 | -0.055 | -37.56 | 5.03 | -13.421 | -50.921 | |
| -9.3 | 0.001 | -37.50 | 5.09 | -13.108 | -50.608 | |
| -9.25 | 0.096 | -37.40 | 5.15 | -12.8 | -50.3 | |
| -9.2 | 0.225 | -37.28 | 5.30 | -12.502 | -50.002 | -4.7 |
| -9.15 | 0.385 | -37.12 | 5.30 | -12.213 | -49.713 | -4.7 |
| -9.1 | 0.569 | -36.93 | 5.30 | -11.934 | -49.434 | -4.7 |
| -9.05 | 0.772 | -36.73 | 5.30 | -11.667 | -49.167 | -4.7 |
| -9 | 0.986 | -36.51 | 5.30 | -11.412 | -48.912 | -4.7 |
| -8.95 | 1.208 | -36.29 | 5.30 | -11.17 | -48.67 | -4.7 |
| -8.9 | 1.432 | -36.07 | 5.30 | -10.939 | -48.439 | -4.7 |
| -8.85 | 1.655 | -35.85 | 5.30 | -10.72 | -48.22 | -4.7 |
| -8.8 | 1.873 | -35.63 | 5.30 | -10.514 | -48.014 | -4.7 |
| -8.75 | 2.084 | -35.42 | 5.30 | -10.32 | -47.82 | -4.7 |
| -8.7 | 2.287 | -35.21 | 5.30 | -10.138 | -47.638 | -4.7 |
| -8.65 | 2.481 | -35.02 | 5.30 | -9.968 | -47.468 | -4.7 |
| -8.6 | 2.667 | -34.83 | 5.30 | -9.81 | -47.31 | -4.7 |
| -8.55 | 2.843 | -34.66 | 5.30 | -9.665 | -47.165 | -4.7 |
| -8.5 | 3.011 | -34.49 | 5.30 | -9.533 | -47.033 | -4.7 |
| -8.45 | 3.172 | -34.33 | 5.30 | -9.413 | -46.913 | -4.7 |
| -8.4 | 3.326 | -34.17 | 5.30 | -9.306 | -46.806 | -4.7 |
| -8.35 | 3.476 | -34.02 | 5.30 | -9.213 | -46.713 | -4.7 |
| -8.3 | 3.622 | -33.88 | 5.30 | -9.133 | -46.633 | -4.7 |
| -8.25 | 3.765 | -33.74 | 5.30 | -9.067 | -46.567 | -4.7 |
| -8.2 | 3.907 | -33.59 | 5.30 | -9.015 | -46.515 | -4.7 |
| -8.15 | 4.05 | -33.45 | 5.30 | -8.977 | -46.477 | -4.7 |
| -8.1 | 4.195 | -33.31 | 5.30 | -8.953 | -46.453 | -4.7 |
| -8.05 | 4.342 | -33.16 | 5.30 | -8.943 | -46.443 | -4.7 |
| -8 | 4.493 | -33.01 | 5.30 | -8.948 | -46.448 | -4.7 |
| -7.95 | 4.648 | -32.85 | 5.30 | -8.966 | -46.466 | -4.7 |
| -7.9 | 4.809 | -32.69 | 5.30 | -8.998 | -46.498 | -4.7 |
| -7.85 | 4.975 | -32.53 | 5.30 | -9.043 | -46.543 | -4.7 |
| -7.8 | 5.148 | -32.35 | 5.30 | -9.1 | -46.6 | -4.7 |

| | | | | | | |
|---|---|---|---|---|---|---|
| -7.75 | 5.327 | -32.17 | 5.30 | -9.169 | -46.669 | -4.7 |
| -7.7 | 5.511 | -31.99 | 5.30 | -9.248 | -46.748 | -4.7 |
| -7.65 | 5.702 | -31.80 | 5.30 | -9.337 | -46.837 | -4.7 |
| -7.6 | 5.898 | -31.60 | 5.30 | -9.434 | -46.934 | -4.7 |
| -7.55 | 6.1 | -31.40 | 5.30 | -9.536 | -47.036 | -4.7 |
| -7.5 | 6.305 | -31.20 | 5.30 | -9.643 | -47.143 | -4.7 |
| -7.45 | 6.514 | -30.99 | 5.30 | -9.752 | -47.252 | -4.7 |
| -7.4 | 6.726 | -30.77 | 5.30 | -9.86 | -47.36 | -4.7 |
| -7.35 | 6.94 | -30.56 | 5.30 | -9.964 | -47.464 | -4.7 |
| -7.3 | 7.154 | -30.35 | 5.30 | -10.062 | -47.562 | -4.7 |
| -7.25 | 7.369 | -30.13 | 5.30 | -10.151 | -47.651 | -4.7 |
| -7.2 | 7.582 | -29.92 | 5.30 | -10.227 | -47.727 | -4.7 |
| -7.15 | 7.793 | -29.71 | 5.30 | -10.287 | -47.787 | -4.7 |
| -7.1 | 8.001 | -29.50 | 5.30 | -10.329 | -47.829 | -4.7 |
| -7.05 | 8.206 | -29.29 | 5.30 | -10.35 | -47.85 | -4.7 |
| -7 | 8.407 | -29.09 | 5.30 | -10.348 | -47.848 | -4.7 |
| -6.95 | 8.602 | -28.90 | 5.30 | -10.323 | -47.823 | -4.75 |
| -6.9 | 8.793 | -28.71 | 5.33 | -10.275 | -47.775 | -4.67 |
| -6.85 | 8.978 | -28.52 | 5.41 | -10.204 | -47.704 | -4.59 |
| -6.8 | 9.157 | -28.34 | 5.49 | -10.112 | -47.612 | -4.51 |
| -6.75 | 9.331 | -28.17 | 5.57 | -10.003 | -47.503 | -4.43 |
| -6.7 | 9.5 | -28.00 | 5.65 | -9.878 | -47.378 | -4.35 |
| -6.65 | 9.663 | -27.84 | 5.73 | -9.742 | -47.242 | -4.27 |
| -6.6 | 9.822 | -27.68 | 5.81 | -9.599 | -47.099 | -4.19 |
| -6.55 | 9.976 | -27.52 | 5.89 | -9.453 | -46.953 | -4.11 |
| -6.5 | 10.127 | -27.37 | 5.98 | -9.307 | -46.807 | -4.02 |
| -6.45 | 10.275 | -27.23 | 6.06 | -9.165 | -46.665 | -3.94 |
| -6.4 | 10.421 | -27.08 | 6.15 | -9.031 | -46.531 | -3.85 |
| -6.35 | 10.566 | -26.93 | 6.23 | -8.907 | -46.407 | -3.77 |
| -6.3 | 10.711 | -26.79 | 6.32 | -8.797 | -46.297 | -3.68 |
| -6.25 | 10.856 | -26.64 | 6.40 | -8.702 | -46.202 | -3.60 |
| -6.2 | 11.003 | -26.50 | 6.49 | -8.625 | -46.125 | -3.51 |
| -6.15 | 11.152 | -26.35 | 6.58 | -8.567 | -46.067 | -3.42 |
| -6.1 | 11.304 | -26.20 | 6.67 | -8.53 | -46.03 | -3.33 |
| -6.05 | 11.459 | -26.04 | 6.76 | -8.513 | -46.013 | -3.24 |
| -6 | 11.618 | -25.88 | 6.85 | -8.519 | -46.019 | -3.15 |
| -5.95 | 11.781 | -25.72 | 6.94 | -8.547 | -46.047 | -3.06 |
| -5.9 | 11.948 | -25.55 | 7.03 | -8.597 | -46.097 | -2.97 |
| -5.85 | 12.12 | -25.38 | 7.12 | -8.669 | -46.169 | -2.88 |
| -5.8 | 12.297 | -25.20 | 7.21 | -8.761 | -46.261 | -2.79 |
| -5.75 | 12.477 | -25.02 | 7.31 | -8.873 | -46.373 | -2.69 |
| -5.7 | 12.66 | -24.84 | 7.40 | -9.003 | -46.503 | -2.60 |
| -5.65 | 12.847 | -24.65 | 7.50 | -9.147 | -46.647 | -2.50 |
| -5.6 | 13.036 | -24.46 | 7.60 | -9.304 | -46.804 | -2.40 |
| -5.55 | 13.226 | -24.27 | 7.69 | -9.469 | -46.969 | -2.31 |
| -5.5 | 13.417 | -24.08 | 7.79 | -9.637 | -47.137 | -2.21 |
| -5.45 | 13.607 | -23.89 | 7.89 | -9.804 | -47.304 | -2.11 |
| -5.4 | 13.795 | -23.71 | 7.99 | -9.962 | -47.462 | -2.01 |
| -5.35 | 13.98 | -23.52 | 8.09 | -10.105 | -47.605 | -1.91 |

| | | | | | | |
|---|---|---|---|---|---|---|
| -5.3 | 14.161 | -23.34 | 8.19 | -10.227 | -47.727 | -1.81 |
| -5.25 | 14.336 | -23.16 | 8.30 | -10.319 | -47.819 | -1.70 |
| -5.2 | 14.505 | -23.00 | 8.40 | -10.376 | -47.876 | -1.60 |
| -5.15 | 14.664 | -22.84 | 8.50 | -10.391 | -47.891 | -1.50 |
| -5.1 | 14.814 | -22.69 | 8.61 | -10.36 | -47.86 | -1.39 |
| -5.05 | 14.953 | -22.55 | 8.72 | -10.281 | -47.781 | -1.28 |
| -5 | 15.078 | -22.42 | 8.83 | -10.154 | -47.654 | -1.17 |
| -4.95 | 15.19 | -22.31 | 8.93 | -9.98 | -47.48 | -1.07 |
| -4.9 | 15.286 | -22.21 | 9.05 | -9.763 | -47.263 | -0.95 |
| -4.85 | 15.365 | -22.14 | 9.16 | -9.508 | -47.008 | -0.84 |
| -4.8 | 15.426 | -22.07 | 9.27 | -9.222 | -46.722 | -0.73 |
| -4.75 | 15.467 | -22.03 | 9.38 | -8.909 | -46.409 | -0.62 |
| -4.7 | 15.487 | -22.01 | 9.50 | -8.577 | -46.077 | -0.50 |
| -4.65 | 15.484 | -22.02 | 9.61 | -8.231 | -45.731 | -0.39 |
| -4.6 | 15.459 | -22.04 | 9.73 | -7.877 | -45.377 | -0.27 |
| -4.55 | 15.408 | -22.09 | 9.85 | -7.52 | -45.02 | -0.15 |
| -4.5 | 15.332 | -22.17 | 9.97 | -7.166 | -44.666 | -0.03 |
| -4.45 | 15.229 | -22.27 | 10.09 | -6.817 | -44.317 | 0.09 |
| -4.4 | 15.097 | -22.40 | 10.21 | -6.478 | -43.978 | 0.21 |
| -4.35 | 14.937 | -22.56 | 10.34 | -6.153 | -43.653 | 0.34 |
| -4.3 | 14.747 | -22.75 | 10.46 | -5.844 | -43.344 | 0.46 |
| -4.25 | 14.526 | -22.97 | 10.59 | -5.554 | -43.054 | 0.59 |
| -4.2 | 14.274 | -23.23 | 10.72 | -5.286 | -42.786 | 0.72 |
| -4.15 | 13.99 | -23.51 | 10.85 | -5.042 | -42.542 | 0.85 |
| -4.1 | 13.674 | -23.83 | 10.98 | -4.824 | -42.324 | 0.98 |
| -4.05 | 13.327 | -24.17 | 11.11 | -4.635 | -42.135 | 1.11 |
| -4 | 12.949 | -24.55 | 11.25 | -4.476 | -41.976 | 1.25 |
| -3.95 | 12.542 | -24.96 | 11.39 | -4.35 | -41.85 | 1.39 |
| -3.9 | 12.11 | -25.39 | 11.52 | -4.258 | -41.758 | 1.52 |
| -3.85 | 11.656 | -25.84 | 11.66 | -4.202 | -41.702 | 1.66 |
| -3.8 | 11.186 | -26.31 | 11.81 | -4.185 | -41.685 | 1.81 |
| -3.75 | 10.709 | -26.79 | 11.95 | -4.207 | -41.707 | 1.95 |
| -3.7 | 10.236 | -27.26 | 12.09 | -4.271 | -41.771 | 2.09 |
| -3.65 | 9.781 | -27.72 | 12.24 | -4.379 | -41.879 | 2.24 |
| -3.6 | 9.359 | -28.14 | 12.39 | -4.533 | -42.033 | 2.39 |
| -3.55 | 8.988 | -28.51 | 12.54 | -4.735 | -42.235 | 2.54 |
| -3.5 | 8.686 | -28.81 | 12.70 | -4.988 | -42.488 | 2.70 |
| -3.45 | 8.465 | -29.04 | 12.85 | -5.296 | -42.796 | 2.85 |
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| -3.35 | 8.294 | -29.21 | 13.17 | -6.084 | -43.584 | 3.17 |
| -3.3 | 8.336 | -29.16 | 13.34 | -6.573 | -44.073 | 3.34 |
| -3.25 | 8.448 | -29.05 | 13.50 | -7.131 | -44.631 | 3.50 |
| -3.2 | 8.614 | -28.89 | 13.67 | -7.762 | -45.262 | 3.67 |
| -3.15 | 8.816 | -28.68 | 13.84 | -8.473 | -45.973 | 3.84 |
| -3.1 | 9.038 | -28.46 | 14.02 | -9.272 | -46.772 | 4.02 |
| -3.05 | 9.265 | -28.24 | 14.19 | -10.166 | -47.666 | 4.19 |
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| | | | | | | |
|---|---|---|---|---|---|---|
| -2.85 | 10.011 | -27.49 | 14.93 | -14.955 | -52.455 | 4.93 |
| -2.8 | 10.114 | -27.39 | 15.12 | -16.567 | -54.067 | 5.12 |
| -2.75 | 10.169 | -27.33 | 15.32 | -18.434 | -55.934 | 5.32 |
| -2.7 | 10.166 | -27.33 | 15.52 | -20.659 | -58.159 | 5.52 |
| -2.65 | 10.097 | -27.40 | 15.72 | -23.449 | -60.949 | 5.72 |
| -2.6 | 9.952 | -27.55 | 15.93 | -27.311 | -64.811 | 5.93 |
| -2.55 | 9.719 | -27.78 | 16.14 | -34.034 | -71.534 | 6.14 |
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| -2.35 | 7.712 | -29.79 | 17.02 | -22.094 | -59.594 | 7.02 |
| -2.3 | 7.001 | -30.50 | 17.26 | -19.279 | -56.779 | 7.26 |
| -2.25 | 6.411 | -31.09 | 17.50 | -16.935 | -54.435 | 7.50 |
| -2.2 | 6.251 | -31.25 | 17.74 | -14.893 | -52.393 | 7.74 |
| -2.15 | 6.838 | -30.66 | 17.99 | -13.071 | -50.571 | 7.99 |
| -2.1 | 8.178 | -29.32 | 18.24 | -11.422 | -48.922 | 8.24 |
| -2.05 | 9.958 | -27.54 | 18.51 | -9.918 | -47.418 | 8.51 |
| -2 | 11.865 | -25.64 | 18.77 | -8.539 | -46.039 | 8.77 |
| -1.95 | 13.727 | -23.77 | 19.05 | -7.272 | -44.772 | 9.05 |
| -1.9 | 15.48 | -22.02 | 19.33 | -6.107 | -43.607 | 9.33 |
| -1.85 | 17.109 | -20.39 | 19.62 | -5.034 | -42.534 | 9.62 |
| -1.8 | 18.618 | -18.88 | 19.92 | -4.047 | -41.547 | 9.92 |
| -1.75 | 20.017 | -17.48 | 20.22 | -3.141 | -40.641 | |
| -1.7 | 21.318 | -16.18 | 20.54 | -2.309 | -39.809 | |
| -1.65 | 22.531 | -14.97 | 20.86 | -1.548 | -39.048 | |
| -1.6 | 23.664 | -13.84 | 21.20 | -0.854 | -38.354 | |
| -1.55 | 24.726 | -12.77 | 21.54 | -0.224 | -37.724 | |
| -1.5 | 25.724 | -11.78 | 21.90 | 0.344 | -37.156 | |
| -1.45 | 26.662 | -10.84 | | 0.852 | -36.648 | |
| -1.4 | 27.545 | -9.96 | | 1.303 | -36.197 | |
| -1.35 | 28.378 | -9.12 | | 1.698 | -35.802 | |
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| -1.25 | 29.905 | -7.60 | | 2.322 | -35.178 | |
| -1.2 | 30.604 | -6.90 | | 2.552 | -34.948 | |
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| -1.1 | 31.886 | -5.61 | | 2.847 | -34.653 | |
| -1.05 | 32.472 | -5.03 | | 2.911 | -34.589 | |
| -1 | 33.024 | -4.48 | | 2.916 | -34.584 | |
| -0.95 | 33.542 | -3.96 | | 2.861 | -34.639 | |
| -0.9 | 34.029 | -3.47 | | 2.743 | -34.757 | |
| -0.85 | 34.484 | -3.02 | | 2.557 | -34.943 | |
| -0.8 | 34.91 | -2.59 | | 2.3 | -35.2 | |
| -0.75 | 35.306 | -2.19 | | 1.963 | -35.537 | |
| -0.7 | 35.674 | -1.83 | | 1.54 | -35.96 | |
| -0.65 | 36.015 | -1.49 | | 1.017 | -36.483 | |
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| -0.5 | 36.875 | -0.63 | | -1.324 | -38.824 | |
| -0.45 | 37.109 | -0.39 | | -2.466 | -39.966 | |

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|---|---|---|---|---|---|---|
| -0.4 | 37.318 | -0.18 | | -3.884 | -41.384 | |
| -0.35 | 37.502 | 0.00 | | -5.695 | -43.195 | |
| -0.3 | 37.661 | 0.16 | | -8.118 | -45.618 | |
| -0.25 | 37.796 | 0.30 | | -11.665 | -49.165 | |
| -0.2 | 37.905 | 0.41 | | -18.053 | -55.553 | |
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| -0.1 | 38.052 | 0.55 | | -16.149 | -53.649 | |
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| 0 | 38.102 | 0.60 | | -7.095 | -44.595 | |
| 0.05 | 38.091 | 0.59 | | -4.67 | -42.17 | |
| 0.1 | 38.055 | 0.56 | | -2.799 | -40.299 | |
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| 0.3 | 37.667 | 0.17 | | 1.911 | -35.589 | |
| 0.35 | 37.507 | 0.01 | | 2.681 | -34.819 | |
| 0.4 | 37.323 | -0.18 | | 3.342 | -34.158 | |
| 0.45 | 37.112 | -0.39 | | 3.91 | -33.59 | |
| 0.5 | 36.875 | -0.63 | | 4.393 | -33.107 | |
| 0.55 | 36.611 | -0.89 | | 4.802 | -32.698 | |
| 0.6 | 36.319 | -1.18 | | 5.142 | -32.358 | |
| 0.65 | 36 | -1.50 | | 5.418 | -32.082 | |
| 0.7 | 35.652 | -1.85 | | 5.635 | -31.865 | |
| 0.75 | 35.275 | -2.23 | | 5.795 | -31.705 | |
| 0.8 | 34.867 | -2.63 | | 5.9 | -31.6 | |
| 0.85 | 34.428 | -3.07 | | 5.952 | -31.548 | |
| 0.9 | 33.956 | -3.54 | | 5.953 | -31.547 | |
| 0.95 | 33.451 | -4.05 | | 5.902 | -31.598 | |
| 1 | 32.91 | -4.59 | | 5.801 | -31.699 | |
| 1.05 | 32.332 | -5.17 | | 5.649 | -31.851 | |
| 1.1 | 31.716 | -5.78 | | 5.445 | -32.055 | |
| 1.15 | 31.059 | -6.44 | | 5.188 | -32.312 | |
| 1.2 | 30.359 | -7.14 | | 4.876 | -32.624 | |
| 1.25 | 29.613 | -7.89 | | 4.508 | -32.992 | |
| 1.3 | 28.818 | -8.68 | | 4.081 | -33.419 | |
| 1.35 | 27.969 | -9.53 | | 3.59 | -33.91 | |
| 1.4 | 27.064 | -10.44 | | 3.032 | -34.468 | |
| 1.45 | 26.097 | -11.40 | | 2.4 | -35.1 | |
| 1.5 | 25.061 | -12.44 | 21.90 | 1.688 | -35.812 | |
| 1.55 | 23.952 | -13.55 | 21.54 | 0.886 | -36.614 | |
| 1.6 | 22.76 | -14.74 | 21.20 | -0.018 | -37.518 | |
| 1.65 | 21.479 | -16.02 | 20.86 | -1.04 | -38.54 | |
| 1.7 | 20.102 | -17.40 | 20.54 | -2.201 | -39.701 | |
| 1.75 | 18.622 | -18.88 | 20.22 | -3.532 | -41.032 | |
| 1.8 | 17.045 | -20.46 | 19.92 | -5.075 | -42.575 | 9.92 |
| 1.85 | 15.395 | -22.11 | 19.62 | -6.895 | -44.395 | 9.62 |
| 1.9 | 13.74 | -23.76 | 19.33 | -9.092 | -46.592 | 9.33 |
| 1.95 | 12.225 | -25.28 | 19.05 | -11.828 | -49.328 | 9.05 |
| 2 | 11.08 | -26.42 | 18.77 | -15.319 | -52.819 | 8.77 |

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|---|---|---|---|---|---|---|
| 2.05 | 10.516 | -26.98 | 18.51 | -19.287 | -56.787 | 8.51 |
| 2.1 | 10.542 | -26.96 | 18.24 | -20.069 | -57.569 | 8.24 |
| 2.15 | 10.957 | -26.54 | 17.99 | -16.906 | -54.406 | 7.99 |
| 2.2 | 11.529 | -25.97 | 17.74 | -13.957 | -51.457 | 7.74 |
| 2.25 | 12.104 | -25.40 | 17.50 | -11.793 | -49.293 | 7.50 |
| 2.3 | 12.612 | -24.89 | 17.26 | -10.206 | -47.706 | 7.26 |
| 2.35 | 13.025 | -24.48 | 17.02 | -9.025 | -46.525 | 7.02 |
| 2.4 | 13.34 | -24.16 | 16.79 | -8.145 | -45.645 | 6.79 |
| 2.45 | 13.563 | -23.94 | 16.57 | -7.499 | -44.999 | 6.57 |
| 2.5 | 13.7 | -23.80 | 16.35 | -7.042 | -44.542 | 6.35 |
| 2.55 | 13.763 | -23.74 | 16.14 | -6.746 | -44.246 | 6.14 |
| 2.6 | 13.758 | -23.74 | 15.93 | -6.592 | -44.092 | 5.93 |
| 2.65 | 13.695 | -23.81 | 15.72 | -6.566 | -44.066 | 5.72 |
| 2.7 | 13.581 | -23.92 | 15.52 | -6.66 | -44.16 | 5.52 |
| 2.75 | 13.422 | -24.08 | 15.32 | -6.867 | -44.367 | 5.32 |
| 2.8 | 13.226 | -24.27 | 15.12 | -7.187 | -44.687 | 5.12 |
| 2.85 | 12.997 | -24.50 | 14.93 | -7.619 | -45.119 | 4.93 |
| 2.9 | 12.741 | -24.76 | 14.74 | -8.166 | -45.666 | 4.74 |
| 2.95 | 12.462 | -25.04 | 14.55 | -8.832 | -46.332 | 4.55 |
| 3 | 12.165 | -25.34 | 14.37 | -9.627 | -47.127 | 4.37 |
| 3.05 | 11.854 | -25.65 | 14.19 | -10.559 | -48.059 | 4.19 |
| 3.1 | 11.532 | -25.97 | 14.02 | -11.643 | -49.143 | 4.02 |
| 3.15 | 11.204 | -26.30 | 13.84 | -12.894 | -50.394 | 3.84 |
| 3.2 | 10.874 | -26.63 | 13.67 | -14.323 | -51.823 | 3.67 |
| 3.25 | 10.549 | -26.95 | 13.50 | -15.931 | -53.431 | 3.50 |
| 3.3 | 10.235 | -27.27 | 13.34 | -17.673 | -55.173 | 3.34 |
| 3.35 | 9.941 | -27.56 | 13.17 | -19.389 | -56.889 | 3.17 |
| 3.4 | 9.676 | -27.82 | 13.01 | -20.709 | -58.209 | 3.01 |
| 3.45 | 9.454 | -28.05 | 12.85 | -21.178 | -58.678 | 2.85 |
| 3.5 | 9.287 | -28.21 | 12.70 | -20.756 | -58.256 | 2.70 |
| 3.55 | 9.187 | -28.31 | 12.54 | -19.874 | -57.374 | 2.54 |
| 3.6 | 9.163 | -28.34 | 12.39 | -18.939 | -56.439 | 2.39 |
| 3.65 | 9.222 | -28.28 | 12.24 | -18.146 | -55.646 | 2.24 |
| 3.7 | 9.362 | -28.14 | 12.09 | -17.561 | -55.061 | 2.09 |
| 3.75 | 9.577 | -27.92 | 11.95 | -17.196 | -54.696 | 1.95 |
| 3.8 | 9.856 | -27.64 | 11.81 | -17.054 | -54.554 | 1.81 |
| 3.85 | 10.185 | -27.32 | 11.66 | -17.136 | -54.636 | 1.66 |
| 3.9 | 10.548 | -26.95 | 11.52 | -17.449 | -54.949 | 1.52 |
| 3.95 | 10.932 | -26.57 | 11.39 | -18.014 | -55.514 | 1.39 |
| 4 | 11.323 | -26.18 | 11.25 | -18.865 | -56.365 | 1.25 |
| 4.05 | 11.712 | -25.79 | 11.11 | -20.055 | -57.555 | 1.11 |
| 4.1 | 12.089 | -25.41 | 10.98 | -21.657 | -59.157 | 0.98 |
| 4.15 | 12.448 | -25.05 | 10.85 | -23.721 | -61.221 | 0.85 |
| 4.2 | 12.785 | -24.72 | 10.72 | -25.985 | -63.485 | 0.72 |
| 4.25 | 13.097 | -24.40 | 10.59 | -26.933 | -64.433 | 0.59 |
| 4.3 | 13.381 | -24.12 | 10.46 | -25.111 | -62.611 | 0.46 |
| 4.35 | 13.636 | -23.86 | 10.34 | -22.262 | -59.762 | 0.34 |
| 4.4 | 13.861 | -23.64 | 10.21 | -19.682 | -57.182 | 0.21 |
| 4.45 | 14.057 | -23.44 | 10.09 | -17.542 | -55.042 | 0.09 |

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|---|---|---|---|---|---|---|
| 4.5 | 14.224 | -23.28 | 9.97 | -15.774 | -53.274 | -0.03 |
| 4.55 | 14.362 | -23.14 | 9.85 | -14.298 | -51.798 | -0.15 |
| 4.6 | 14.471 | -23.03 | 9.73 | -13.052 | -50.552 | -0.27 |
| 4.65 | 14.554 | -22.95 | 9.61 | -11.993 | -49.493 | -0.39 |
| 4.7 | 14.61 | -22.89 | 9.50 | -11.089 | -48.589 | -0.50 |
| 4.75 | 14.641 | -22.86 | 9.38 | -10.315 | -47.815 | -0.62 |
| 4.8 | 14.649 | -22.85 | 9.27 | -9.655 | -47.155 | -0.73 |
| 4.85 | 14.633 | -22.87 | 9.16 | -9.094 | -46.594 | -0.84 |
| 4.9 | 14.597 | -22.90 | 9.05 | -8.622 | -46.122 | -0.95 |
| 4.95 | 14.54 | -22.96 | 8.93 | -8.231 | -45.731 | -1.07 |
| 5 | 14.466 | -23.03 | 8.83 | -7.912 | -45.412 | -1.17 |
| 5.05 | 14.374 | -23.13 | 8.72 | -7.662 | -45.162 | -1.28 |
| 5.1 | 14.266 | -23.23 | 8.61 | -7.474 | -44.974 | -1.39 |
| 5.15 | 14.145 | -23.36 | 8.50 | -7.345 | -44.845 | -1.50 |
| 5.2 | 14.011 | -23.49 | 8.40 | -7.271 | -44.771 | -1.60 |
| 5.25 | 13.866 | -23.63 | 8.30 | -7.249 | -44.749 | -1.70 |
| 5.3 | 13.712 | -23.79 | 8.19 | -7.277 | -44.777 | -1.81 |
| 5.35 | 13.549 | -23.95 | 8.09 | -7.352 | -44.852 | -1.91 |
| 5.4 | 13.38 | -24.12 | 7.99 | -7.472 | -44.972 | -2.01 |
| 5.45 | 13.206 | -24.29 | 7.89 | -7.634 | -45.134 | -2.11 |
| 5.5 | 13.027 | -24.47 | 7.79 | -7.837 | -45.337 | -2.21 |
| 5.55 | 12.845 | -24.66 | 7.69 | -8.08 | -45.58 | -2.31 |
| 5.6 | 12.661 | -24.84 | 7.60 | -8.359 | -45.859 | -2.40 |
| 5.65 | 12.476 | -25.02 | 7.50 | -8.674 | -46.174 | -2.50 |
| 5.7 | 12.291 | -25.21 | 7.40 | -9.023 | -46.523 | -2.60 |
| 5.75 | 12.106 | -25.39 | 7.31 | -9.403 | -46.903 | -2.69 |
| 5.8 | 11.922 | -25.58 | 7.21 | -9.812 | -47.312 | -2.79 |
| 5.85 | 11.74 | -25.76 | 7.12 | -10.248 | -47.748 | -2.88 |
| 5.9 | 11.559 | -25.94 | 7.03 | -10.708 | -48.208 | -2.97 |
| 5.95 | 11.38 | -26.12 | 6.94 | -11.189 | -48.689 | -3.06 |
| 6 | 11.203 | -26.30 | 6.85 | -11.687 | -49.187 | -3.15 |
| 6.05 | 11.028 | -26.47 | 6.76 | -12.196 | -49.696 | -3.24 |
| 6.1 | 10.855 | -26.65 | 6.67 | -12.712 | -50.212 | -3.33 |
| 6.15 | 10.685 | -26.82 | 6.58 | -13.225 | -50.725 | -3.42 |
| 6.2 | 10.515 | -26.99 | 6.49 | -13.728 | -51.228 | -3.51 |
| 6.25 | 10.348 | -27.15 | 6.40 | -14.207 | -51.707 | -3.60 |
| 6.3 | 10.182 | -27.32 | 6.32 | -14.651 | -52.151 | -3.68 |
| 6.35 | 10.017 | -27.48 | 6.23 | -15.044 | -52.544 | -3.77 |
| 6.4 | 9.852 | -27.65 | 6.15 | -15.372 | -52.872 | -3.85 |
| 6.45 | 9.689 | -27.81 | 6.06 | -15.623 | -53.123 | -3.94 |
| 6.5 | 9.525 | -27.98 | 5.98 | -15.788 | -53.288 | -4.02 |
| 6.55 | 9.362 | -28.14 | 5.89 | -15.864 | -53.364 | -4.11 |
| 6.6 | 9.198 | -28.30 | 5.81 | -15.854 | -53.354 | -4.19 |
| 6.65 | 9.034 | -28.47 | 5.73 | -15.769 | -53.269 | -4.27 |
| 6.7 | 8.869 | -28.63 | 5.65 | -15.623 | -53.123 | -4.35 |
| 6.75 | 8.703 | -28.80 | 5.57 | -15.43 | -52.93 | -4.43 |
| 6.8 | 8.537 | -28.96 | 5.49 | -15.207 | -52.707 | -4.51 |
| 6.85 | 8.371 | -29.13 | 5.41 | -14.97 | -52.47 | -4.59 |
| 6.9 | 8.204 | -29.30 | 5.33 | -14.73 | -52.23 | -4.67 |

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|---|---|---|---|---|---|---|
| 6.95 | 8.036 | -29.46 | 5.30 | -14.498 | -51.998 | -4.75 |
| 7 | 7.869 | -29.63 | 5.30 | -14.283 | -51.783 | -4.7 |
| 7.05 | 7.703 | -29.80 | 5.30 | -14.089 | -51.589 | -4.7 |
| 7.1 | 7.537 | -29.96 | 5.30 | -13.922 | -51.422 | -4.7 |
| 7.15 | 7.373 | -30.13 | 5.30 | -13.785 | -51.285 | -4.7 |
| 7.2 | 7.212 | -30.29 | 5.30 | -13.681 | -51.181 | -4.7 |
| 7.25 | 7.052 | -30.45 | 5.30 | -13.61 | -51.11 | -4.7 |
| 7.3 | 6.897 | -30.60 | 5.30 | -13.573 | -51.073 | -4.7 |
| 7.35 | 6.745 | -30.76 | 5.30 | -13.57 | -51.07 | -4.7 |
| 7.4 | 6.597 | -30.90 | 5.30 | -13.602 | -51.102 | -4.7 |
| 7.45 | 6.454 | -31.05 | 5.30 | -13.667 | -51.167 | -4.7 |
| 7.5 | 6.316 | -31.18 | 5.30 | -13.764 | -51.264 | -4.7 |
| 7.55 | 6.184 | -31.32 | 5.30 | -13.891 | -51.391 | -4.7 |
| 7.6 | 6.057 | -31.44 | 5.30 | -14.047 | -51.547 | -4.7 |
| 7.65 | 5.935 | -31.57 | 5.30 | -14.229 | -51.729 | -4.7 |
| 7.7 | 5.82 | -31.68 | 5.30 | -14.434 | -51.934 | -4.7 |
| 7.75 | 5.709 | -31.79 | 5.30 | -14.659 | -52.159 | -4.7 |
| 7.8 | 5.604 | -31.90 | 5.30 | -14.899 | -52.399 | -4.7 |
| 7.85 | 5.504 | -32.00 | 5.30 | -15.15 | -52.65 | -4.7 |
| 7.9 | 5.408 | -32.09 | 5.30 | -15.406 | -52.906 | -4.7 |
| 7.95 | 5.316 | -32.18 | 5.30 | -15.662 | -53.162 | -4.7 |
| 8 | 5.227 | -32.27 | 5.30 | -15.911 | -53.411 | -4.7 |
| 8.05 | 5.142 | -32.36 | 5.30 | -16.146 | -53.646 | -4.7 |
| 8.1 | 5.059 | -32.44 | 5.30 | -16.361 | -53.861 | -4.7 |
| 8.15 | 4.978 | -32.52 | 5.30 | -16.547 | -54.047 | -4.7 |
| 8.2 | 4.898 | -32.60 | 5.30 | -16.7 | -54.2 | -4.7 |
| 8.25 | 4.818 | -32.68 | 5.30 | -16.813 | -54.313 | -4.7 |
| 8.3 | 4.739 | -32.76 | 5.30 | -16.883 | -54.383 | -4.7 |
| 8.35 | 4.658 | -32.84 | 5.30 | -16.907 | -54.407 | -4.7 |
| 8.4 | 4.577 | -32.92 | 5.30 | -16.885 | -54.385 | -4.7 |
| 8.45 | 4.494 | -33.01 | 5.30 | -16.818 | -54.318 | -4.7 |
| 8.5 | 4.409 | -33.09 | 5.30 | -16.708 | -54.208 | -4.7 |
| 8.55 | 4.323 | -33.18 | 5.30 | -16.559 | -54.059 | -4.7 |
| 8.6 | 4.234 | -33.27 | 5.30 | -16.377 | -53.877 | -4.7 |
| 8.65 | 4.143 | -33.36 | 5.30 | -16.166 | -53.666 | -4.7 |
| 8.7 | 4.052 | -33.45 | 5.30 | -15.933 | -53.433 | -4.7 |
| 8.75 | 3.959 | -33.54 | 5.30 | -15.682 | -53.182 | -4.7 |
| 8.8 | 3.868 | -33.63 | 5.30 | -15.42 | -52.92 | -4.7 |
| 8.85 | 3.778 | -33.72 | 5.30 | -15.151 | -52.651 | -4.7 |
| 8.9 | 3.693 | -33.81 | 5.30 | -14.88 | -52.38 | -4.7 |
| 8.95 | 3.613 | -33.89 | 5.30 | -14.611 | -52.111 | -4.7 |
| 9 | 3.541 | -33.96 | 5.30 | -14.347 | -51.847 | -4.7 |
| 9.05 | 3.48 | -34.02 | 5.30 | -14.092 | -51.592 | -4.7 |
| 9.1 | 3.431 | -34.07 | 5.30 | -13.848 | -51.348 | -4.7 |
| 9.15 | 3.397 | -34.10 | 5.30 | -13.618 | -51.118 | -4.7 |
| 9.2 | 3.38 | -34.12 | 5.30 | -13.403 | -50.903 | -4.7 |
| 9.25 | 3.381 | -34.12 | 5.15 | -13.204 | -50.704 | |
| 9.3 | 3.401 | -34.10 | 5.09 | -13.023 | -50.523 | |
| 9.35 | 3.441 | -34.06 | 5.03 | -12.861 | -50.361 | |

| | | | | | |
|---|---|---|---|---|---|
| 9.4 | 3.498 | -34.00 | 4.97 | -12.719 | -50.219 |
| 9.45 | 3.573 | -33.93 | 4.91 | -12.596 | -50.096 |
| 9.5 | 3.662 | -33.84 | 4.86 | -12.493 | -49.993 |
| 9.55 | 3.764 | -33.74 | 4.80 | -12.41 | -49.91 |
| 9.6 | 3.876 | -33.62 | 4.74 | -12.346 | -49.846 |
| 9.65 | 3.993 | -33.51 | 4.69 | -12.302 | -49.802 |
| 9.7 | 4.114 | -33.39 | 4.63 | -12.277 | -49.777 |
| 9.75 | 4.235 | -33.27 | 4.57 | -12.269 | -49.769 |
| 9.8 | 4.352 | -33.15 | 4.52 | -12.277 | -49.777 |
| 9.85 | 4.464 | -33.04 | 4.46 | -12.3 | -49.8 |
| 9.9 | 4.568 | -32.93 | 4.41 | -12.334 | -49.834 |
| 9.95 | 4.662 | -32.84 | 4.35 | -12.378 | -49.878 |
| 10 | 4.745 | -32.76 | 4.30 | -12.429 | -49.929 |
| 15 | -0.234 | -37.73 | -0.10 | | |
| 20 | -5.153 | -42.65 | -3.23 | | |
| 25 | -3.867 | -41.37 | -5.65 | | |
| 30 | -9.259 | -46.76 | -7.63 | | |
| 35 | -13.508 | -51.01 | -9.30 | | |
| 40 | -6.058 | -43.56 | -10.75 | | |
| 45 | -16.479 | -53.98 | -12.03 | | |
| 50 | -10.147 | -47.65 | -12.70 | | |
| 55 | -8.79 | -46.29 | -12.70 | | |
| 60 | -13.752 | -51.25 | -12.70 | | |
| 65 | -16.263 | -53.76 | -12.70 | | |
| 70 | -15.878 | -53.38 | -12.70 | | |
| 75 | -15.95 | -53.45 | -12.70 | | |
| 80 | -11.272 | -48.77 | -12.70 | | |
| 85 | -15.734 | -53.23 | -12.70 | | |
| 90 | -8.753 | -46.25 | -12.70 | | |
| 95 | -3.364 | -40.86 | -12.70 | | |
| 100 | -5.715 | -43.22 | -12.70 | | |
| 105 | -4.978 | -42.48 | -12.70 | | |
| 110 | -9.878 | -47.38 | -12.70 | | |
| 115 | -23.729 | -61.23 | -12.70 | | |
| 120 | -18.91 | -56.41 | -12.70 | | |
| 125 | -29.506 | -67.01 | -12.70 | | |
| 130 | -24.689 | -62.19 | -12.70 | | |
| 135 | -27.419 | -64.92 | -12.70 | | |
| 140 | -23.235 | -60.74 | -12.70 | | |
| 145 | -39.766 | -77.27 | -12.70 | | |
| 150 | -33.586 | -71.09 | -12.70 | | |
| 155 | -21.518 | -59.02 | -12.70 | | |
| 160 | -30.42 | -67.92 | -12.70 | | |
| 165 | -27.26 | -64.76 | -12.70 | | |
| 170 | -31.238 | -68.74 | -12.70 | | |
| 175 | -34.377 | -71.88 | -12.70 | | |
| 180 | -18.816 | -56.32 | -12.70 | | |

## **Annex 1**: *Table 2 - Elevation Pattern for Co-pol & Cross-pol (-180° ~ 180°)*

**(6.1375 GHz)** G = 38.07 dBi HPA = 400 W

HPA feeder loss = 1.5 dB

EIRPmax = 62.59 dBW/Hz = 26.59 dBW/4kHz

G - EIRPmax = 11.48 dB (=X)

| angle (Φ) | Gain (dBi) | EIRP (dBW/4 kHz) | FCC (dBW/4 kHz) | Cross Polar Transmission (dBi) | XP Transmission (dBW/4kHz) | FCC(dBW/4kHz) |
|---|---|---|---|---|---|---|
| -180 | -17.956 | -29.44 | -12.70 | | | |
| -175 | -29.287 | -40.77 | -12.70 | | | |
| -170 | -37.529 | -49.01 | -12.70 | | | |
| -165 | -25.602 | -37.08 | -12.70 | | | |
| -160 | -25.173 | -36.65 | -12.70 | | | |
| -155 | -27.494 | -38.97 | -12.70 | | | |
| -150 | -22.949 | -34.43 | -12.70 | | | |
| -145 | -20.915 | -32.40 | -12.70 | | | |
| -140 | -28.106 | -39.59 | -12.70 | | | |
| -135 | -26.325 | -37.81 | -12.70 | | | |
| -130 | -27.32 | -38.80 | -12.70 | | | |
| -125 | -26.177 | -37.66 | -12.70 | | | |
| -120 | -23.482 | -34.96 | -12.70 | | | |
| -115 | -18.206 | -29.69 | -12.70 | | | |
| -110 | -10.3 | -21.78 | -12.70 | | | |
| -105 | -6.168 | -17.65 | -12.70 | | | |
| -100 | -7.506 | -18.99 | -12.70 | | | |
| -95 | -3.525 | -15.01 | -12.70 | | | |
| -90 | -7.423 | -18.90 | -12.70 | | | |
| -85 | -12.654 | -24.13 | -12.70 | | | |
| -80 | -10.254 | -21.73 | -12.70 | | | |
| -75 | -18.847 | -30.33 | -12.70 | | | |
| -70 | -9.304 | -20.78 | -12.70 | | | |
| -65 | -13.928 | -25.41 | -12.70 | | | |
| -60 | -13.194 | -24.67 | -12.70 | | | |
| -55 | -9.563 | -21.04 | -12.70 | | | |
| -50 | -14.008 | -25.49 | -12.70 | | | |
| -45 | -14.302 | -25.78 | -12.03 | | | |
| -40 | -10.612 | -22.09 | -10.75 | | | |
| -35 | -8.733 | -20.21 | -9.30 | | | |
| -30 | -6.316 | -17.80 | -7.63 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| -25 | -8.648 | -20.13 | -5.65 | | | |
| -20 | -5.487 | -16.97 | -3.23 | | | |
| -15 | -1.815 | -13.30 | -0.10 | | | |
| -10 | 2.608 | -8.87 | 4.30 | -18.711 | -30.19 | |
| -9.95 | 2.557 | -8.92 | 4.35 | -18.44 | -29.92 | |
| -9.9 | 2.498 | -8.98 | 4.41 | -18.177 | -29.66 | |
| -9.85 | 2.434 | -9.05 | 4.46 | -17.929 | -29.41 | |
| -9.8 | 2.368 | -9.11 | 4.52 | -17.697 | -29.18 | |
| -9.75 | 2.302 | -9.18 | 4.57 | -17.483 | -28.96 | |
| -9.7 | 2.241 | -9.24 | 4.63 | -17.287 | -28.77 | |
| -9.65 | 2.188 | -9.29 | 4.69 | -17.109 | -28.59 | |
| -9.6 | 2.146 | -9.33 | 4.74 | -16.945 | -28.43 | |
| -9.55 | 2.117 | -9.36 | 4.80 | -16.795 | -28.28 | |
| -9.5 | 2.105 | -9.38 | 4.86 | -16.654 | -28.13 | |
| -9.45 | 2.11 | -9.37 | 4.91 | -16.522 | -28.00 | |
| -9.4 | 2.134 | -9.35 | 4.97 | -16.394 | -27.87 | |
| -9.35 | 2.177 | -9.30 | 5.03 | -16.268 | -27.75 | |
| -9.3 | 2.237 | -9.24 | 5.09 | -16.143 | -27.62 | |
| -9.25 | 2.313 | -9.17 | 5.15 | -16.017 | -27.50 | |
| -9.2 | 2.402 | -9.08 | 5.21 | -15.891 | -27.37 | -4.7 |
| -9.15 | 2.502 | -8.98 | 5.26 | -15.763 | -27.24 | -4.7 |
| -9.1 | 2.611 | -8.87 | 5.32 | -15.635 | -27.12 | -4.7 |
| -9.05 | 2.724 | -8.76 | 5.38 | -15.509 | -26.99 | -4.7 |
| -9 | 2.841 | -8.64 | 5.44 | -15.386 | -26.87 | -4.7 |
| -8.95 | 2.957 | -8.52 | 5.50 | -15.269 | -26.75 | -4.7 |
| -8.9 | 3.072 | -8.41 | 5.57 | -15.159 | -26.64 | -4.7 |
| -8.85 | 3.182 | -8.30 | 5.63 | -15.06 | -26.54 | -4.7 |
| -8.8 | 3.288 | -8.19 | 5.69 | -14.974 | -26.45 | -4.7 |
| -8.75 | 3.388 | -8.09 | 5.75 | -14.902 | -26.38 | -4.7 |
| -8.7 | 3.481 | -8.00 | 5.81 | -14.845 | -26.33 | -4.7 |
| -8.65 | 3.568 | -7.91 | 5.87 | -14.807 | -26.29 | -4.7 |
| -8.6 | 3.648 | -7.83 | 5.94 | -14.787 | -26.27 | -4.7 |
| -8.55 | 3.722 | -7.76 | 6.00 | -14.785 | -26.27 | -4.7 |
| -8.5 | 3.791 | -7.69 | 6.06 | -14.802 | -26.28 | -4.7 |
| -8.45 | 3.855 | -7.63 | 6.13 | -14.838 | -26.32 | -4.7 |
| -8.4 | 3.916 | -7.56 | 6.19 | -14.892 | -26.37 | -4.7 |
| -8.35 | 3.975 | -7.51 | 6.26 | -14.963 | -26.44 | -4.7 |
| -8.3 | 4.033 | -7.45 | 6.32 | -15.048 | -26.53 | -4.7 |
| -8.25 | 4.092 | -7.39 | 6.39 | -15.146 | -26.63 | -4.7 |
| -8.2 | 4.152 | -7.33 | 6.45 | -15.255 | -26.74 | -4.7 |
| -8.15 | 4.215 | -7.27 | 6.52 | -15.371 | -26.85 | -4.7 |
| -8.1 | 4.284 | -7.20 | 6.59 | -15.493 | -26.97 | -4.7 |
| -8.05 | 4.357 | -7.12 | 6.66 | -15.616 | -27.10 | -4.7 |
| -8 | 4.438 | -7.04 | 6.72 | -15.738 | -27.22 | -4.7 |
| -7.95 | 4.526 | -6.95 | 6.79 | -15.855 | -27.34 | -4.7 |
| -7.9 | 4.623 | -6.86 | 6.86 | -15.964 | -27.44 | -4.7 |
| -7.85 | 4.728 | -6.75 | 6.93 | -16.064 | -27.54 | -4.7 |
| -7.8 | 4.843 | -6.64 | 7.00 | -16.151 | -27.63 | -4.7 |
| -7.75 | 4.968 | -6.51 | 7.07 | -16.224 | -27.70 | -4.7 |

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|---|---|---|---|---|---|---|
| -7.7 | 5.102 | -6.38 | 7.14 | -16.282 | -27.76 | -4.7 |
| -7.65 | 5.246 | -6.23 | 7.21 | -16.325 | -27.81 | -4.7 |
| -7.6 | 5.398 | -6.08 | 7.28 | -16.352 | -27.83 | -4.7 |
| -7.55 | 5.559 | -5.92 | 7.35 | -16.363 | -27.84 | -4.7 |
| -7.5 | 5.728 | -5.75 | 7.42 | -16.361 | -27.84 | -4.7 |
| -7.45 | 5.903 | -5.58 | 7.50 | -16.344 | -27.82 | -4.7 |
| -7.4 | 6.084 | -5.40 | 7.57 | -16.314 | -27.79 | -4.7 |
| -7.35 | 6.269 | -5.21 | 7.64 | -16.273 | -27.75 | -4.7 |
| -7.3 | 6.458 | -5.02 | 7.72 | -16.221 | -27.70 | -4.7 |
| -7.25 | 6.65 | -4.83 | 7.79 | -16.16 | -27.64 | -4.7 |
| -7.2 | 6.842 | -4.64 | 7.87 | -16.089 | -27.57 | -4.7 |
| -7.15 | 7.035 | -4.45 | 7.94 | -16.011 | -27.49 | -4.7 |
| -7.1 | 7.227 | -4.25 | 8.02 | -15.926 | -27.41 | -4.7 |
| -7.05 | 7.416 | -4.06 | 8.10 | -15.836 | -27.32 | -4.7 |
| -7 | 7.604 | -3.88 | 8.17 | -15.742 | -27.22 | -4.7 |
| -6.95 | 7.787 | -3.69 | 8.25 | -15.646 | -27.13 | -4.75 |
| -6.9 | 7.967 | -3.51 | 8.33 | -15.549 | -27.03 | -4.67 |
| -6.85 | 8.143 | -3.34 | 8.41 | -15.453 | -26.93 | -4.59 |
| -6.8 | 8.315 | -3.17 | 8.49 | -15.362 | -26.84 | -4.51 |
| -6.75 | 8.482 | -3.00 | 8.57 | -15.276 | -26.76 | -4.43 |
| -6.7 | 8.646 | -2.83 | 8.65 | -15.2 | -26.68 | -4.35 |
| -6.65 | 8.805 | -2.68 | 8.73 | -15.134 | -26.61 | -4.27 |
| -6.6 | 8.961 | -2.52 | 8.81 | -15.083 | -26.56 | -4.19 |
| -6.55 | 9.115 | -2.37 | 8.89 | -15.047 | -26.53 | -4.11 |
| -6.5 | 9.266 | -2.21 | 8.98 | -15.03 | -26.51 | -4.02 |
| -6.45 | 9.417 | -2.06 | 9.06 | -15.034 | -26.51 | -3.94 |
| -6.4 | 9.567 | -1.91 | 9.15 | -15.06 | -26.54 | -3.85 |
| -6.35 | 9.717 | -1.76 | 9.23 | -15.11 | -26.59 | -3.77 |
| -6.3 | 9.869 | -1.61 | 9.32 | -15.185 | -26.67 | -3.68 |
| -6.25 | 10.022 | -1.46 | 9.40 | -15.286 | -26.77 | -3.60 |
| -6.2 | 10.179 | -1.30 | 9.49 | -15.413 | -26.89 | -3.51 |
| -6.15 | 10.338 | -1.14 | 9.58 | -15.566 | -27.05 | -3.42 |
| -6.1 | 10.502 | -0.98 | 9.67 | -15.744 | -27.22 | -3.33 |
| -6.05 | 10.67 | -0.81 | 9.76 | -15.945 | -27.43 | -3.24 |
| -6 | 10.842 | -0.64 | 9.85 | -16.167 | -27.65 | -3.15 |
| -5.95 | 11.019 | -0.46 | 9.94 | -16.406 | -27.89 | -3.06 |
| -5.9 | 11.201 | -0.28 | 10.03 | -16.659 | -28.14 | -2.97 |
| -5.85 | 11.387 | -0.09 | 10.12 | -16.918 | -28.40 | -2.88 |
| -5.8 | 11.577 | 0.10 | 10.21 | -17.179 | -28.66 | -2.79 |
| -5.75 | 11.77 | 0.29 | 10.31 | -17.435 | -28.92 | -2.69 |
| -5.7 | 11.966 | 0.49 | 10.40 | -17.68 | -29.16 | -2.60 |
| -5.65 | 12.164 | 0.68 | 10.50 | -17.908 | -29.39 | -2.50 |
| -5.6 | 12.364 | 0.88 | 10.60 | -18.117 | -29.60 | -2.40 |
| -5.55 | 12.564 | 1.08 | 10.69 | -18.305 | -29.79 | -2.31 |
| -5.5 | 12.763 | 1.28 | 10.79 | -18.476 | -29.96 | -2.21 |
| -5.45 | 12.96 | 1.48 | 10.89 | -18.635 | -30.12 | -2.11 |
| -5.4 | 13.154 | 1.67 | 10.99 | -18.79 | -30.27 | -2.01 |
| -5.35 | 13.343 | 1.86 | 11.09 | -18.954 | -30.43 | -1.91 |
| -5.3 | 13.526 | 2.05 | 11.19 | -19.14 | -30.62 | -1.81 |

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|---|---|---|---|---|---|---|
| -5.25 | 13.702 | 2.22 | 11.30 | -19.363 | -30.84 | -1.70 |
| -5.2 | 13.87 | 2.39 | 11.40 | -19.642 | -31.12 | -1.60 |
| -5.15 | 14.027 | 2.55 | 11.50 | -19.993 | -31.47 | -1.50 |
| -5.1 | 14.172 | 2.69 | 11.61 | -20.44 | -31.92 | -1.39 |
| -5.05 | 14.304 | 2.82 | 11.72 | -21.008 | -32.49 | -1.28 |
| -5 | 14.422 | 2.94 | 11.83 | -21.73 | -33.21 | -1.17 |
| -4.95 | 14.523 | 3.04 | 11.93 | -22.65 | -34.13 | -1.07 |
| -4.9 | 14.606 | 3.13 | 12.05 | -23.833 | -35.31 | -0.95 |
| -4.85 | 14.67 | 3.19 | 12.16 | -25.384 | -36.86 | -0.84 |
| -4.8 | 14.713 | 3.23 | 12.27 | -27.479 | -38.96 | -0.73 |
| -4.75 | 14.734 | 3.25 | 12.38 | -30.459 | -41.94 | -0.62 |
| -4.7 | 14.731 | 3.25 | 12.50 | -34.911 | -46.39 | -0.50 |
| -4.65 | 14.703 | 3.22 | 12.61 | -38.462 | -49.94 | -0.39 |
| -4.6 | 14.648 | 3.17 | 12.73 | -33.607 | -45.09 | -0.27 |
| -4.55 | 14.566 | 3.09 | 12.85 | -28.982 | -40.46 | -0.15 |
| -4.5 | 14.454 | 2.97 | 12.97 | -25.739 | -37.22 | -0.03 |
| -4.45 | 14.311 | 2.83 | 13.09 | -23.316 | -34.80 | 0.09 |
| -4.4 | 14.137 | 2.66 | 13.21 | -21.411 | -32.89 | 0.21 |
| -4.35 | 13.93 | 2.45 | 13.34 | -19.865 | -31.35 | 0.34 |
| -4.3 | 13.688 | 2.21 | 13.46 | -18.586 | -30.07 | 0.46 |
| -4.25 | 13.411 | 1.93 | 13.59 | -17.518 | -29.00 | 0.59 |
| -4.2 | 13.099 | 1.62 | 13.72 | -16.622 | -28.10 | 0.72 |
| -4.15 | 12.751 | 1.27 | 13.85 | -15.875 | -27.36 | 0.85 |
| -4.1 | 12.366 | 0.89 | 13.98 | -15.257 | -26.74 | 0.98 |
| -4.05 | 11.947 | 0.47 | 14.11 | -14.756 | -26.24 | 1.11 |
| -4 | 11.495 | 0.01 | 14.25 | -14.363 | -25.84 | 1.25 |
| -3.95 | 11.014 | -0.47 | 14.39 | -14.069 | -25.55 | 1.39 |
| -3.9 | 10.51 | -0.97 | 14.52 | -13.868 | -25.35 | 1.52 |
| -3.85 | 9.992 | -1.49 | 14.66 | -13.755 | -25.24 | 1.66 |
| -3.8 | 9.473 | -2.01 | 14.81 | -13.723 | -25.20 | 1.81 |
| -3.75 | 8.969 | -2.51 | 14.95 | -13.763 | -25.24 | 1.95 |
| -3.7 | 8.503 | -2.98 | 15.09 | -13.864 | -25.34 | 2.09 |
| -3.65 | 8.101 | -3.38 | 15.24 | -14.008 | -25.49 | 2.24 |
| -3.6 | 7.787 | -3.69 | 15.39 | -14.17 | -25.65 | 2.39 |
| -3.55 | 7.584 | -3.90 | 15.54 | -14.314 | -25.79 | 2.54 |
| -3.5 | 7.504 | -3.98 | 15.70 | -14.394 | -25.87 | 2.70 |
| -3.45 | 7.549 | -3.93 | 15.85 | -14.361 | -25.84 | 2.85 |
| -3.4 | 7.706 | -3.77 | 16.01 | -14.172 | -25.65 | 3.01 |
| -3.35 | 7.954 | -3.53 | 16.17 | -13.809 | -25.29 | 3.17 |
| -3.3 | 8.269 | -3.21 | 16.34 | -13.282 | -24.76 | 3.34 |
| -3.25 | 8.628 | -2.85 | 16.50 | -12.626 | -24.11 | 3.50 |
| -3.2 | 9.009 | -2.47 | 16.67 | -11.89 | -23.37 | 3.67 |
| -3.15 | 9.397 | -2.08 | 16.84 | -11.12 | -22.60 | 3.84 |
| -3.1 | 9.779 | -1.70 | 17.02 | -10.355 | -21.84 | 4.02 |
| -3.05 | 10.148 | -1.33 | 17.19 | -9.621 | -21.10 | 4.19 |
| -3 | 10.495 | -0.99 | 17.37 | -8.937 | -20.42 | 4.37 |
| -2.95 | 10.816 | -0.66 | | -8.314 | -19.79 | 4.55 |
| -2.9 | 11.107 | -0.37 | | -7.76 | -19.24 | 4.74 |
| -2.85 | 11.363 | -0.12 | | -7.28 | -18.76 | 4.93 |

| | | | | | |
|---|---|---|---|---|---|
| -2.8 | 11.581 | 0.10 | -6.877 | -18.36 | 5.12 |
| -2.75 | 11.757 | 0.28 | -6.554 | -18.03 | 5.32 |
| -2.7 | 11.885 | 0.40 | -6.315 | -17.80 | 5.52 |
| -2.65 | 11.96 | 0.48 | -6.163 | -17.64 | 5.72 |
| -2.6 | 11.976 | 0.50 | -6.103 | -17.58 | 5.93 |
| -2.55 | 11.926 | 0.45 | -6.141 | -17.62 | 6.14 |
| -2.5 | 11.804 | 0.32 | -6.288 | -17.77 | 6.35 |
| -2.45 | 11.602 | 0.12 | -6.553 | -18.03 | 6.57 |
| -2.4 | 11.318 | -0.16 | -6.954 | -18.43 | 6.79 |
| -2.35 | 10.952 | -0.53 | -7.514 | -18.99 | 7.02 |
| -2.3 | 10.521 | -0.96 | -8.264 | -19.74 | 7.26 |
| -2.25 | 10.07 | -1.41 | -9.253 | -20.73 | 7.50 |
| -2.2 | 9.692 | -1.79 | -10.551 | -22.03 | 7.74 |
| -2.15 | 9.548 | -1.93 | -12.264 | -23.74 | 7.99 |
| -2.1 | 9.827 | -1.65 | -14.532 | -26.01 | 8.24 |
| -2.05 | 10.627 | -0.85 | -17.344 | -28.82 | 8.51 |
| -2 | 11.872 | 0.39 | -19.22 | -30.70 | 8.77 |
| -1.95 | 13.377 | 1.90 | -17.258 | -28.74 | 9.05 |
| -1.9 | 14.974 | 3.49 | -13.786 | -25.27 | 9.33 |
| -1.85 | 16.557 | 5.08 | -10.773 | -22.25 | 9.62 |
| -1.8 | 18.076 | 6.60 | -8.335 | -19.82 | 9.92 |
| -1.75 | 19.511 | 8.03 | -6.332 | -17.81 | |
| -1.7 | 20.857 | 9.38 | -4.649 | -16.13 | |
| -1.65 | 22.117 | 10.64 | -3.208 | -14.69 | |
| -1.6 | 23.296 | 11.82 | -1.959 | -13.44 | |
| -1.55 | 24.401 | 12.92 | -0.865 | -12.35 | |
| -1.5 | 25.437 | 13.96 | 0.099 | -11.38 | |
| -1.45 | 26.41 | 14.93 | 0.951 | -10.53 | |
| -1.4 | 27.324 | 15.84 | 1.706 | -9.77 | |
| -1.35 | 28.184 | 16.70 | 2.374 | -9.11 | |
| -1.3 | 28.993 | 17.51 | 2.963 | -8.52 | |
| -1.25 | 29.756 | 18.28 | 3.479 | -8.00 | |
| -1.2 | 30.474 | 18.99 | 3.928 | -7.55 | |
| -1.15 | 31.15 | 19.67 | 4.313 | -7.17 | |
| -1.1 | 31.786 | 20.31 | 4.638 | -6.84 | |
| -1.05 | 32.384 | 20.90 | 4.904 | -6.58 | |
| -1 | 32.947 | 21.47 | 5.114 | -6.37 | |
| -0.95 | 33.474 | 21.99 | 5.269 | -6.21 | |
| -0.9 | 33.969 | 22.49 | 5.368 | -6.11 | |
| -0.85 | 34.431 | 22.95 | 5.413 | -6.07 | |
| -0.8 | 34.863 | 23.38 | 5.404 | -6.08 | |
| -0.75 | 35.264 | 23.78 | 5.339 | -6.14 | |
| -0.7 | 35.636 | 24.16 | 5.218 | -6.26 | |
| -0.65 | 35.98 | 24.50 | 5.04 | -6.44 | |
| -0.6 | 36.295 | 24.82 | 4.804 | -6.68 | |
| -0.55 | 36.584 | 25.10 | 4.506 | -6.97 | |
| -0.5 | 36.846 | 25.37 | 4.147 | -7.33 | |
| -0.45 | 37.081 | 25.60 | 3.723 | -7.76 | |
| -0.4 | 37.291 | 25.81 | 3.234 | -8.25 | |

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|---|---|---|---|---|---|
| -0.35 | 37.475 | 26.00 | 2.681 | -8.80 | |
| -0.3 | 37.634 | 26.15 | 2.066 | -9.41 | |
| -0.25 | 37.768 | 26.29 | 1.399 | -10.08 | |
| -0.2 | 37.878 | 26.40 | 0.697 | -10.78 | |
| -0.15 | 37.962 | 26.48 | -0.007 | -11.49 | |
| -0.1 | 38.023 | 26.54 | -0.66 | -12.14 | |
| -0.05 | 38.058 | 26.58 | -1.188 | -12.67 | |
| 0 | 38.07 | 26.59 | -1.507 | -12.99 | |
| 0.05 | 38.057 | 26.58 | -1.553 | -13.03 | |
| 0.1 | 38.02 | 26.54 | -1.315 | -12.80 | |
| 0.15 | 37.959 | 26.48 | -0.843 | -12.32 | |
| 0.2 | 37.873 | 26.39 | -0.218 | -11.70 | |
| 0.25 | 37.762 | 26.28 | 0.48 | -11.00 | |
| 0.3 | 37.626 | 26.15 | 1.19 | -10.29 | |
| 0.35 | 37.465 | 25.99 | 1.875 | -9.61 | |
| 0.4 | 37.279 | 25.80 | 2.512 | -8.97 | |
| 0.45 | 37.067 | 25.59 | 3.089 | -8.39 | |
| 0.5 | 36.829 | 25.35 | 3.602 | -7.88 | |
| 0.55 | 36.564 | 25.08 | 4.049 | -7.43 | |
| 0.6 | 36.272 | 24.79 | 4.432 | -7.05 | |
| 0.65 | 35.952 | 24.47 | 4.751 | -6.73 | |
| 0.7 | 35.604 | 24.12 | 5.008 | -6.47 | |
| 0.75 | 35.227 | 23.75 | 5.205 | -6.28 | |
| 0.8 | 34.82 | 23.34 | 5.343 | -6.14 | |
| 0.85 | 34.382 | 22.90 | 5.424 | -6.06 | |
| 0.9 | 33.912 | 22.43 | 5.449 | -6.03 | |
| 0.95 | 33.409 | 21.93 | 5.418 | -6.06 | |
| 1 | 32.872 | 21.39 | 5.331 | -6.15 | |
| 1.05 | 32.299 | 20.82 | 5.187 | -6.29 | |
| 1.1 | 31.688 | 20.21 | 4.987 | -6.49 | |
| 1.15 | 31.038 | 19.56 | 4.729 | -6.75 | |
| 1.2 | 30.346 | 18.87 | 4.411 | -7.07 | |
| 1.25 | 29.61 | 18.13 | 4.03 | -7.45 | |
| 1.3 | 28.827 | 17.35 | 3.583 | -7.90 | |
| 1.35 | 27.994 | 16.51 | 3.066 | -8.41 | |
| 1.4 | 27.107 | 15.63 | 2.474 | -9.01 | |
| 1.45 | 26.162 | 14.68 | 1.798 | -9.68 | |
| 1.5 | 25.154 | 13.67 | 1.032 | -10.45 | |
| 1.55 | 24.076 | 12.60 | 0.161 | -11.32 | |
| 1.6 | 22.923 | 11.44 | -0.829 | -12.31 | |
| 1.65 | 21.688 | 10.21 | -1.961 | -13.44 | |
| 1.7 | 20.363 | 8.88 | -3.265 | -14.75 | |
| 1.75 | 18.943 | 7.46 | -4.787 | -16.27 | |
| 1.8 | 17.427 | 5.95 | -6.598 | -18.08 | 9.92 |
| 1.85 | 15.824 | 4.34 | -8.82 | -20.30 | 9.62 |
| 1.9 | 14.17 | 2.69 | -11.676 | -23.16 | 9.33 |
| 1.95 | 12.55 | 1.07 | -15.663 | -27.14 | 9.05 |
| 2 | 11.127 | -0.35 | -22.073 | -33.55 | 8.77 |
| 2.05 | 10.122 | -1.36 | -26.53 | -38.01 | 8.51 |

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|---|---|---|---|---|---|---|
| 2.1 | 9.689 | -1.79 | | -19.202 | -30.68 | 8.24 |
| 2.15 | 9.774 | -1.71 | | -14.91 | -26.39 | 7.99 |
| 2.2 | 10.173 | -1.31 | | -12.236 | -23.72 | 7.74 |
| 2.25 | 10.684 | -0.80 | | -10.393 | -21.87 | 7.50 |
| 2.3 | 11.184 | -0.30 | | -9.059 | -20.54 | 7.26 |
| 2.35 | 11.615 | 0.14 | | -8.074 | -19.55 | 7.02 |
| 2.4 | 11.957 | 0.48 | | -7.348 | -18.83 | 6.79 |
| 2.45 | 12.208 | 0.73 | | -6.827 | -18.31 | 6.57 |
| 2.5 | 12.374 | 0.89 | | -6.476 | -17.96 | 6.35 |
| 2.55 | 12.462 | 0.98 | | -6.271 | -17.75 | 6.14 |
| 2.6 | 12.481 | 1.00 | | -6.196 | -17.68 | 5.93 |
| 2.65 | 12.44 | 0.96 | | -6.242 | -17.72 | 5.72 |
| 2.7 | 12.347 | 0.87 | | -6.4 | -17.88 | 5.52 |
| 2.75 | 12.21 | 0.73 | | -6.668 | -18.15 | 5.32 |
| 2.8 | 12.036 | 0.56 | | -7.043 | -18.52 | 5.12 |
| 2.85 | 11.83 | 0.35 | | -7.525 | -19.01 | 4.93 |
| 2.9 | 11.6 | 0.12 | | -8.116 | -19.60 | 4.74 |
| 2.95 | 11.35 | -0.13 | | -8.817 | -20.30 | 4.55 |
| 3 | 11.088 | -0.39 | 17.37 | -9.631 | -21.11 | 4.37 |
| 3.05 | 10.817 | -0.66 | 17.19 | -10.555 | -22.04 | 4.19 |
| 3.1 | 10.545 | -0.94 | 17.02 | -11.579 | -23.06 | 4.02 |
| 3.15 | 10.277 | -1.20 | 16.84 | -12.674 | -24.15 | 3.84 |
| 3.2 | 10.022 | -1.46 | 16.67 | -13.775 | -25.26 | 3.67 |
| 3.25 | 9.788 | -1.69 | 16.50 | -14.764 | -26.24 | 3.50 |
| 3.3 | 9.585 | -1.90 | 16.34 | -15.466 | -26.95 | 3.34 |
| 3.35 | 9.424 | -2.06 | 16.17 | -15.725 | -27.21 | 3.17 |
| 3.4 | 9.314 | -2.17 | 16.01 | -15.514 | -26.99 | 3.01 |
| 3.45 | 9.266 | -2.21 | 15.85 | -14.959 | -26.44 | 2.85 |
| 3.5 | 9.286 | -2.19 | 15.70 | -14.24 | -25.72 | 2.70 |
| 3.55 | 9.378 | -2.10 | 15.54 | -13.494 | -24.97 | 2.54 |
| 3.6 | 9.54 | -1.94 | 15.39 | -12.802 | -24.28 | 2.39 |
| 3.65 | 9.768 | -1.71 | 15.24 | -12.199 | -23.68 | 2.24 |
| 3.7 | 10.05 | -1.43 | 15.09 | -11.7 | -23.18 | 2.09 |
| 3.75 | 10.376 | -1.10 | 14.95 | -11.307 | -22.79 | 1.95 |
| 3.8 | 10.733 | -0.75 | 14.81 | -11.019 | -22.50 | 1.81 |
| 3.85 | 11.107 | -0.37 | 14.66 | -10.832 | -22.31 | 1.66 |
| 3.9 | 11.488 | 0.01 | 14.52 | -10.74 | -22.22 | 1.52 |
| 3.95 | 11.866 | 0.39 | 14.39 | -10.742 | -22.22 | 1.39 |
| 4 | 12.234 | 0.75 | 14.25 | -10.834 | -22.31 | 1.25 |
| 4.05 | 12.586 | 1.11 | 14.11 | -11.014 | -22.49 | 1.11 |
| 4.1 | 12.916 | 1.44 | 13.98 | -11.282 | -22.76 | 0.98 |
| 4.15 | 13.221 | 1.74 | 13.85 | -11.636 | -23.12 | 0.85 |
| 4.2 | 13.5 | 2.02 | 13.72 | -12.078 | -23.56 | 0.72 |
| 4.25 | 13.75 | 2.27 | 13.59 | -12.608 | -24.09 | 0.59 |
| 4.3 | 13.971 | 2.49 | 13.46 | -13.228 | -24.71 | 0.46 |
| 4.35 | 14.163 | 2.68 | 13.34 | -13.939 | -25.42 | 0.34 |
| 4.4 | 14.324 | 2.84 | 13.21 | -14.743 | -26.22 | 0.21 |
| 4.45 | 14.457 | 2.98 | 13.09 | -15.636 | -27.12 | 0.09 |
| 4.5 | 14.56 | 3.08 | 12.97 | -16.614 | -28.09 | -0.03 |

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|---|---|---|---|---|---|---|
| 4.55 | 14.635 | 3.16 | 12.85 | -17.66 | -29.14 | -0.15 |
| 4.6 | 14.682 | 3.20 | 12.73 | -18.745 | -30.23 | -0.27 |
| 4.65 | 14.702 | 3.22 | 12.61 | -19.813 | -31.29 | -0.39 |
| 4.7 | 14.697 | 3.22 | 12.50 | -20.778 | -32.26 | -0.50 |
| 4.75 | 14.668 | 3.19 | 12.38 | -21.536 | -33.02 | -0.62 |
| 4.8 | 14.615 | 3.14 | 12.27 | -21.999 | -33.48 | -0.73 |
| 4.85 | 14.54 | 3.06 | 12.16 | -22.146 | -33.63 | -0.84 |
| 4.9 | 14.444 | 2.96 | 12.05 | -22.04 | -33.52 | -0.95 |
| 4.95 | 14.329 | 2.85 | 11.93 | -21.784 | -33.26 | -1.07 |
| 5 | 14.196 | 2.72 | 11.83 | -21.479 | -32.96 | -1.17 |
| 5.05 | 14.047 | 2.57 | 11.72 | -21.194 | -32.67 | -1.28 |
| 5.1 | 13.883 | 2.40 | 11.61 | -20.972 | -32.45 | -1.39 |
| 5.15 | 13.705 | 2.23 | 11.50 | -20.834 | -32.31 | -1.50 |
| 5.2 | 13.516 | 2.04 | 11.40 | -20.787 | -32.27 | -1.60 |
| 5.25 | 13.317 | 1.84 | 11.30 | -20.832 | -32.31 | -1.70 |
| 5.3 | 13.11 | 1.63 | 11.19 | -20.961 | -32.44 | -1.81 |
| 5.35 | 12.895 | 1.42 | 11.09 | -21.161 | -32.64 | -1.91 |
| 5.4 | 12.676 | 1.20 | 10.99 | -21.412 | -32.89 | -2.01 |
| 5.45 | 12.452 | 0.97 | 10.89 | -21.683 | -33.16 | -2.11 |
| 5.5 | 12.226 | 0.75 | 10.79 | -21.936 | -33.42 | -2.21 |
| 5.55 | 11.999 | 0.52 | 10.69 | -22.126 | -33.61 | -2.31 |
| 5.6 | 11.771 | 0.29 | 10.60 | -22.206 | -33.69 | -2.40 |
| 5.65 | 11.545 | 0.06 | 10.50 | -22.144 | -33.62 | -2.50 |
| 5.7 | 11.32 | -0.16 | 10.40 | -21.929 | -33.41 | -2.60 |
| 5.75 | 11.098 | -0.38 | 10.31 | -21.579 | -33.06 | -2.69 |
| 5.8 | 10.879 | -0.60 | 10.21 | -21.129 | -32.61 | -2.79 |
| 5.85 | 10.663 | -0.82 | 10.12 | -20.624 | -32.10 | -2.88 |
| 5.9 | 10.451 | -1.03 | 10.03 | -20.103 | -31.58 | -2.97 |
| 5.95 | 10.242 | -1.24 | 9.94 | -19.598 | -31.08 | -3.06 |
| 6 | 10.037 | -1.44 | 9.85 | -19.131 | -30.61 | -3.15 |
| 6.05 | 9.837 | -1.64 | 9.76 | -18.717 | -30.20 | -3.24 |
| 6.1 | 9.639 | -1.84 | 9.67 | -18.363 | -29.84 | -3.33 |
| 6.15 | 9.445 | -2.04 | 9.58 | -18.075 | -29.56 | -3.42 |
| 6.2 | 9.253 | -2.23 | 9.49 | -17.857 | -29.34 | -3.51 |
| 6.25 | 9.064 | -2.42 | 9.40 | -17.707 | -29.19 | -3.60 |
| 6.3 | 8.877 | -2.60 | 9.32 | -17.628 | -29.11 | -3.68 |
| 6.35 | 8.692 | -2.79 | 9.23 | -17.618 | -29.10 | -3.77 |
| 6.4 | 8.507 | -2.97 | 9.15 | -17.676 | -29.16 | -3.85 |
| 6.45 | 8.323 | -3.16 | 9.06 | -17.801 | -29.28 | -3.94 |
| 6.5 | 8.138 | -3.34 | 8.98 | -17.993 | -29.47 | -4.02 |
| 6.55 | 7.954 | -3.53 | 8.89 | -18.248 | -29.73 | -4.11 |
| 6.6 | 7.768 | -3.71 | 8.81 | -18.564 | -30.04 | -4.19 |
| 6.65 | 7.581 | -3.90 | 8.73 | -18.938 | -30.42 | -4.27 |
| 6.7 | 7.392 | -4.09 | 8.65 | -19.364 | -30.84 | -4.35 |
| 6.75 | 7.201 | -4.28 | 8.57 | -19.836 | -31.32 | -4.43 |
| 6.8 | 7.009 | -4.47 | 8.49 | -20.342 | -31.82 | -4.51 |
| 6.85 | 6.814 | -4.67 | 8.41 | -20.869 | -32.35 | -4.59 |
| 6.9 | 6.617 | -4.86 | 8.33 | -21.398 | -32.88 | -4.67 |
| 6.95 | 6.419 | -5.06 | 8.25 | -21.906 | -33.39 | -4.75 |

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|---|---|---|---|---|---|---|
| 7 | 6.219 | -5.26 | 8.17 | -22.369 | -33.85 | -4.7 |
| 7.05 | 6.018 | -5.46 | 8.10 | -22.762 | -34.24 | -4.7 |
| 7.1 | 5.815 | -5.67 | 8.02 | -23.066 | -34.55 | -4.7 |
| 7.15 | 5.612 | -5.87 | 7.94 | -23.273 | -34.75 | -4.7 |
| 7.2 | 5.409 | -6.07 | 7.87 | -23.386 | -34.87 | -4.7 |
| 7.25 | 5.206 | -6.27 | 7.79 | -23.422 | -34.90 | -4.7 |
| 7.3 | 5.004 | -6.48 | 7.72 | -23.402 | -34.88 | -4.7 |
| 7.35 | 4.801 | -6.68 | 7.64 | -23.351 | -34.83 | -4.7 |
| 7.4 | 4.6 | -6.88 | 7.57 | -23.294 | -34.77 | -4.7 |
| 7.45 | 4.4 | -7.08 | 7.50 | -23.25 | -34.73 | -4.7 |
| 7.5 | 4.2 | -7.28 | 7.42 | -23.233 | -34.71 | -4.7 |
| 7.55 | 4.001 | -7.48 | 7.35 | -23.253 | -34.73 | -4.7 |
| 7.6 | 3.802 | -7.68 | 7.28 | -23.318 | -34.80 | -4.7 |
| 7.65 | 3.604 | -7.88 | 7.21 | -23.431 | -34.91 | -4.7 |
| 7.7 | 3.406 | -8.07 | 7.14 | -23.593 | -35.07 | -4.7 |
| 7.75 | 3.208 | -8.27 | 7.07 | -23.801 | -35.28 | -4.7 |
| 7.8 | 3.009 | -8.47 | 7.00 | -24.054 | -35.53 | -4.7 |
| 7.85 | 2.809 | -8.67 | 6.93 | -24.344 | -35.82 | -4.7 |
| 7.9 | 2.609 | -8.87 | 6.86 | -24.664 | -36.14 | -4.7 |
| 7.95 | 2.407 | -9.07 | 6.79 | -25.004 | -36.48 | -4.7 |
| 8 | 2.204 | -9.28 | 6.72 | -25.351 | -36.83 | -4.7 |
| 8.05 | 2 | -9.48 | 6.66 | -25.69 | -37.17 | -4.7 |
| 8.1 | 1.796 | -9.68 | 6.59 | -26.003 | -37.48 | -4.7 |
| 8.15 | 1.59 | -9.89 | 6.52 | -26.275 | -37.76 | -4.7 |
| 8.2 | 1.383 | -10.10 | 6.45 | -26.486 | -37.97 | -4.7 |
| 8.25 | 1.176 | -10.30 | 6.39 | -26.62 | -38.10 | -4.7 |
| 8.3 | 0.969 | -10.51 | 6.32 | -26.665 | -38.15 | -4.7 |
| 8.35 | 0.762 | -10.72 | 6.26 | -26.613 | -38.09 | -4.7 |
| 8.4 | 0.556 | -10.92 | 6.19 | -26.458 | -37.94 | -4.7 |
| 8.45 | 0.352 | -11.13 | 6.13 | -26.202 | -37.68 | -4.7 |
| 8.5 | 0.151 | -11.33 | 6.06 | -25.851 | -37.33 | -4.7 |
| 8.55 | -0.045 | -11.53 | 6.00 | -25.413 | -36.89 | -4.7 |
| 8.6 | -0.235 | -11.72 | 5.94 | -24.9 | -36.38 | -4.7 |
| 8.65 | -0.415 | -11.90 | 5.87 | -24.325 | -35.81 | -4.7 |
| 8.7 | -0.58 | -12.06 | 5.81 | -23.705 | -35.19 | -4.7 |
| 8.75 | -0.728 | -12.21 | 5.75 | -23.055 | -34.54 | -4.7 |
| 8.8 | -0.85 | -12.33 | 5.69 | -22.389 | -33.87 | -4.7 |
| 8.85 | -0.942 | -12.42 | 5.63 | -21.719 | -33.20 | -4.7 |
| 8.9 | -0.997 | -12.48 | 5.57 | -21.057 | -32.54 | -4.7 |
| 8.95 | -1.007 | -12.49 | 5.50 | -20.413 | -31.89 | -4.7 |
| 9 | -0.967 | -12.45 | 5.44 | -19.794 | -31.27 | -4.7 |
| 9.05 | -0.874 | -12.35 | 5.38 | -19.206 | -30.69 | -4.7 |
| 9.1 | -0.726 | -12.21 | 5.32 | -18.654 | -30.13 | -4.7 |
| 9.15 | -0.525 | -12.01 | 5.26 | -18.14 | -29.62 | -4.7 |
| 9.2 | -0.275 | -11.76 | 5.21 | -17.668 | -29.15 | -4.7 |
| 9.25 | 0.018 | -11.46 | 5.15 | -17.24 | -28.72 | |
| 9.3 | 0.345 | -11.14 | 5.09 | -16.856 | -28.34 | |
| 9.35 | 0.698 | -10.78 | 5.03 | -16.518 | -28.00 | |
| 9.4 | 1.067 | -10.41 | 4.97 | -16.227 | -27.71 | |

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|---|---|---|---|---|---|
| 9.45 | 1.445 | -10.04 | 4.91 | -15.983 | -27.46 |
| 9.5 | 1.823 | -9.66 | 4.86 | -15.786 | -27.27 |
| 9.55 | 2.195 | -9.29 | 4.80 | -15.637 | -27.12 |
| 9.6 | 2.556 | -8.92 | 4.74 | -15.537 | -27.02 |
| 9.65 | 2.901 | -8.58 | 4.69 | -15.487 | -26.97 |
| 9.7 | 3.227 | -8.25 | 4.63 | -15.486 | -26.97 |
| 9.75 | 3.531 | -7.95 | 4.57 | -15.537 | -27.02 |
| 9.8 | 3.811 | -7.67 | 4.52 | -15.64 | -27.12 |
| 9.85 | 4.065 | -7.42 | 4.46 | -15.798 | -27.28 |
| 9.9 | 4.293 | -7.19 | 4.41 | -16.012 | -27.49 |
| 9.95 | 4.494 | -6.99 | 4.35 | -16.285 | -27.77 |
| 10 | 4.666 | -6.81 | 4.30 | -16.62 | -28.10 |
| 15 | 2.614 | -8.87 | -0.10 | | |
| 20 | -14.183 | -25.66 | -3.23 | | |
| 25 | -3.075 | -14.56 | -5.65 | | |
| 30 | -10.282 | -21.76 | -7.63 | | |
| 35 | -20.521 | -32.00 | -9.30 | | |
| 40 | -6.118 | -17.60 | -10.75 | | |
| 45 | -15.763 | -27.24 | -12.03 | | |
| 50 | -10.518 | -22.00 | -12.70 | | |
| 55 | -7.254 | -18.73 | -12.70 | | |
| 60 | -16.434 | -27.91 | -12.70 | | |
| 65 | -13.247 | -24.73 | -12.70 | | |
| 70 | -11.004 | -22.48 | -12.70 | | |
| 75 | -14.671 | -26.15 | -12.70 | | |
| 80 | -12.442 | -23.92 | -12.70 | | |
| 85 | -13.623 | -25.10 | -12.70 | | |
| 90 | -5.893 | -17.37 | -12.70 | | |
| 95 | -5.56 | -17.04 | -12.70 | | |
| 100 | -7.232 | -18.71 | -12.70 | | |
| 105 | -5.625 | -17.11 | -12.70 | | |
| 110 | -14.328 | -25.81 | -12.70 | | |
| 115 | -17.666 | -29.15 | -12.70 | | |
| 120 | -20.118 | -31.60 | -12.70 | | |
| 125 | -23.291 | -34.77 | -12.70 | | |
| 130 | -39.888 | -51.37 | -12.70 | | |
| 135 | -29.469 | -40.95 | -12.70 | | |
| 140 | -25.088 | -36.57 | -12.70 | | |
| 145 | -35.965 | -47.45 | -12.70 | | |
| 150 | -33.194 | -44.67 | -12.70 | | |
| 155 | -32.539 | -44.02 | -12.70 | | |
| 160 | -35.016 | -46.50 | -12.70 | | |
| 165 | -37.148 | -48.63 | -12.70 | | |
| 170 | -34.174 | -45.65 | -12.70 | | |
| 175 | -25.753 | -37.23 | -12.70 | | |
| 180 | -20.506 | -31.99 | -12.70 | | |

# Annex 2
# Ku-band EIRP Spectral Density Plots & Tabular Data

**Figure 4:**
**14.125 GHz**
**Azimuth Pattern for Co-pol (Wide Angle, -180° ~ 180°)**

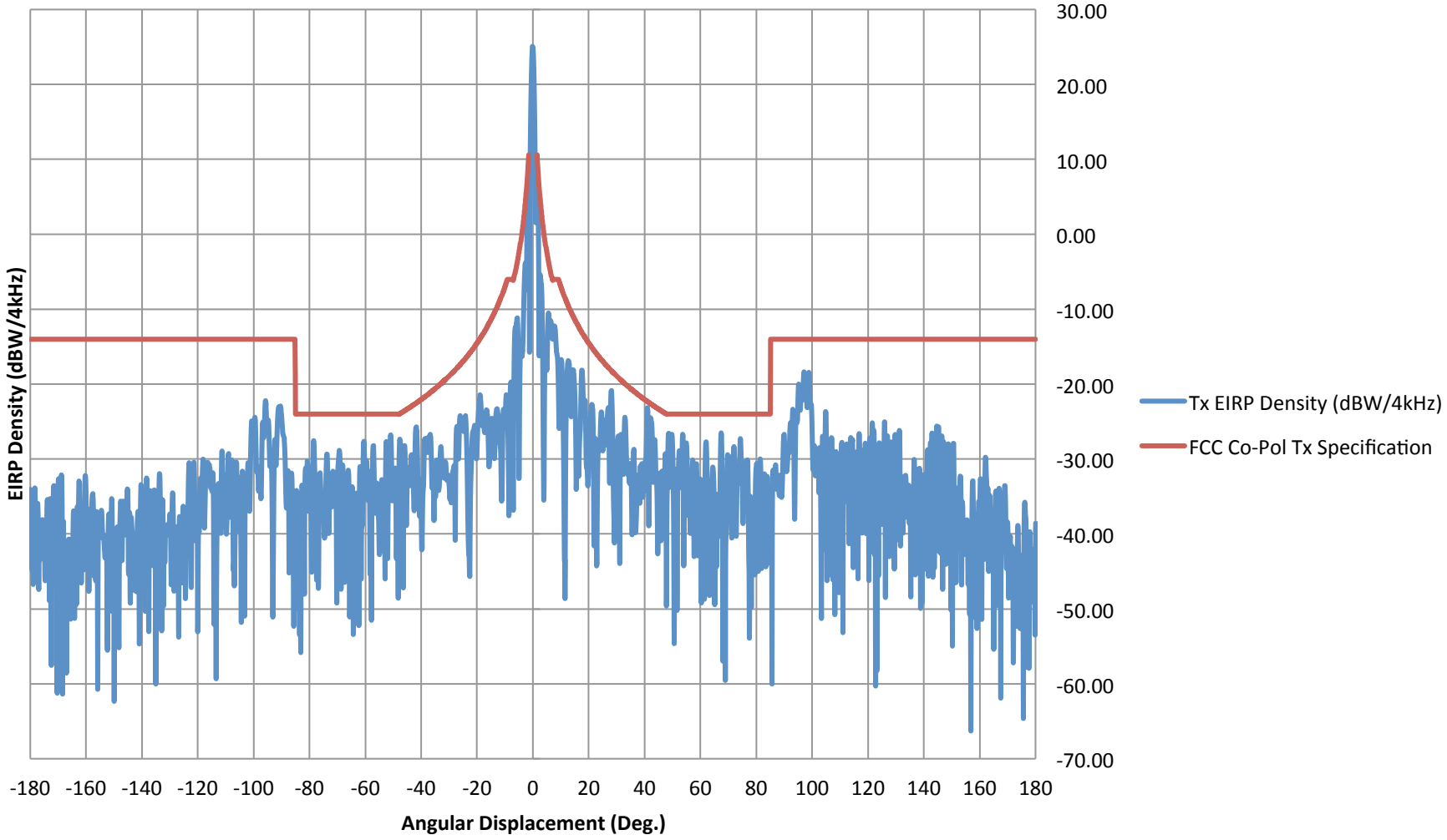


**Figure 5:**
**14.125 GHz**
**Elevation Pattern for Co-pol (Wide Angle -180° ~ 180°)**

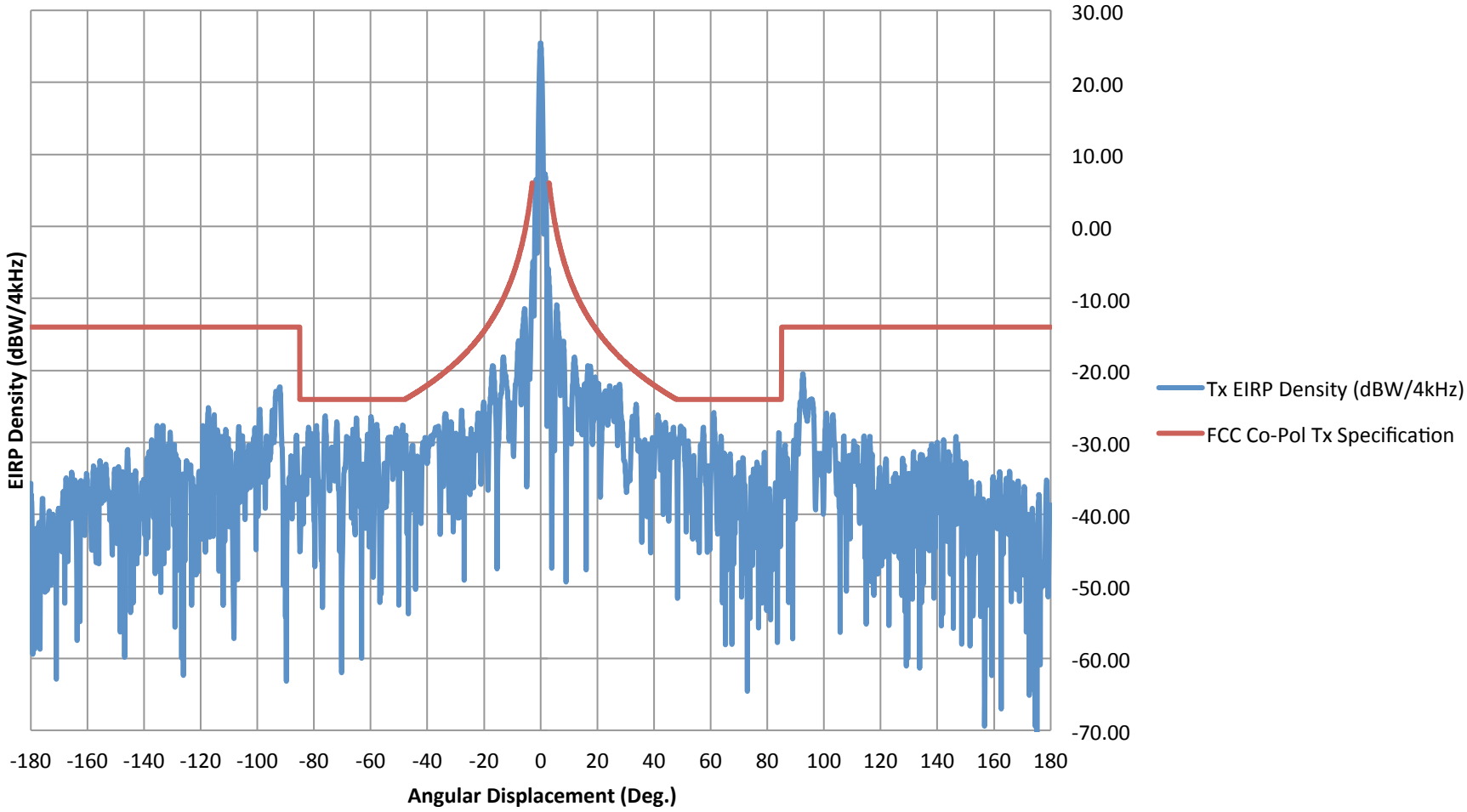
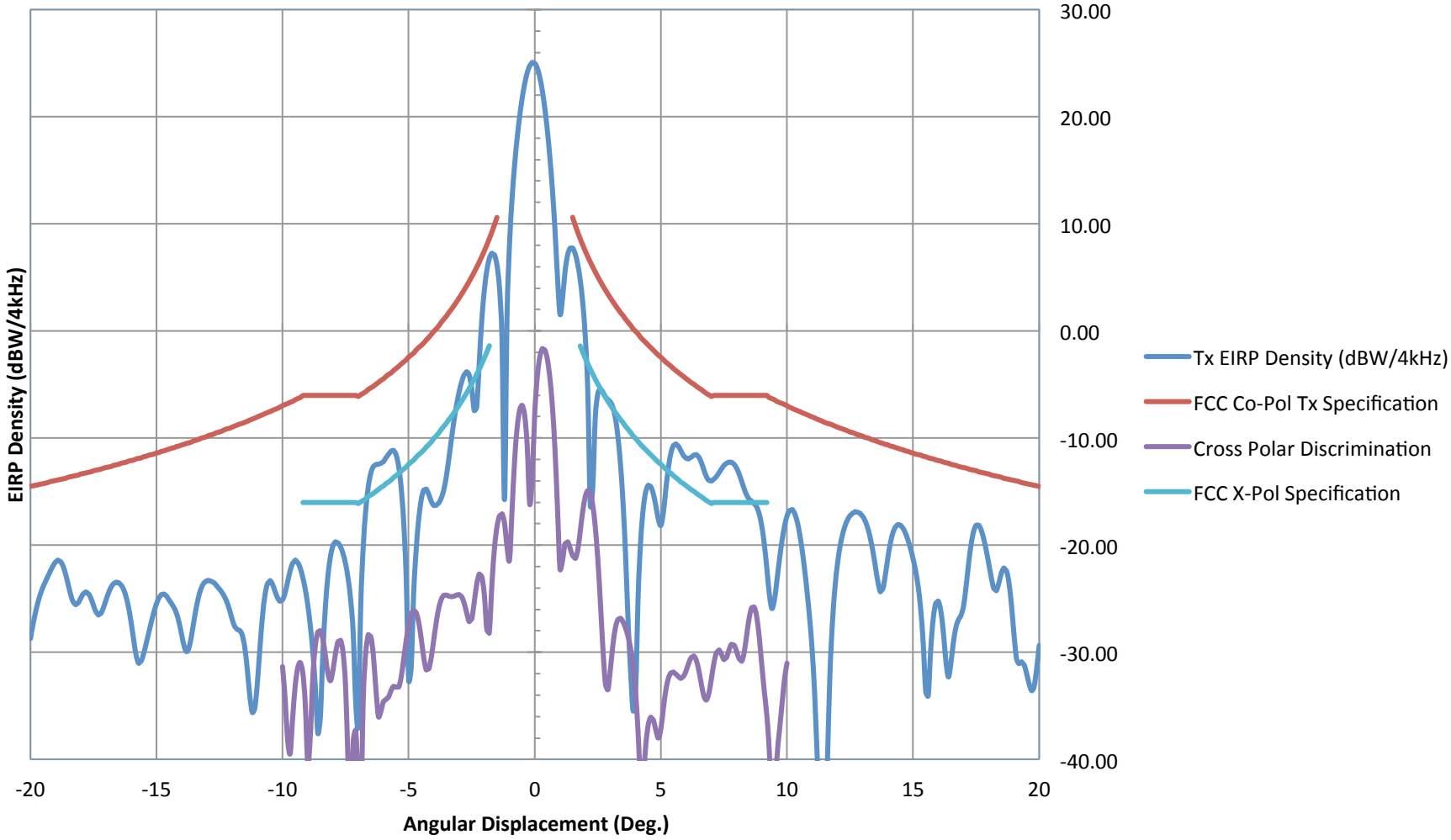


**Figure 6:**
**14.125 GHz**
**Azimuth Pattern for Co-pol & Cross-pol (Narrow Angle, -20° ~ 20°)**



## **Annex 2**: *Table 3 - Azimuth Pattern for Co-pol & Cross-pol (-180° ~ 180°)*

**(14.125 GHz)** G = 43.022 dBi HPA = 125 W

HPA feeder loss = 3.0 dB

EIRPmax = 60.99 dBW/Hz = 24.99 dBW/4kHz

G - EIRPmax = 18.03 dB (=X)

| angle (Φ) | Gain (dBi) | EIRP (dBW/4 kHz) | FCC (dBW/4 kHz) | Cross Polar Transmission (dBi) | XP Transmission (dBW/4kHz) | X-Pol FCC (dBW/4kHz) |
|---|---|---|---|---|---|---|
| -180 | -16.025 | -34.06 | -14.00 | | | |
| -175 | -20.961 | -38.99 | -14.00 | | | |
| -170 | -15.893 | -33.92 | -14.00 | | | |
| -165 | -27.597 | -45.63 | -14.00 | | | |
| -160 | -16.285 | -34.32 | -14.00 | | | |
| -155 | -22.422 | -40.45 | -14.00 | | | |
| -150 | -27.945 | -45.98 | -14.00 | | | |
| -145 | -17.282 | -35.31 | -14.00 | | | |
| -140 | -20.109 | -38.14 | -14.00 | | | |
| -135 | -41.996 | -60.03 | -14.00 | | | |
| -130 | -19.515 | -37.55 | -14.00 | | | |
| -125 | -19.723 | -37.75 | -14.00 | | | |
| -120 | -35.023 | -53.05 | -14.00 | | | |
| -115 | -14.933 | -32.96 | -14.00 | | | |
| -110 | -17.861 | -35.89 | -14.00 | | | |
| -105 | -18.332 | -36.36 | -14.00 | | | |
| -100 | -10.718 | -28.75 | -14.00 | | | |
| -95 | -7.946 | -25.98 | -14.00 | | | |
| -90 | -6.126 | -24.16 | -14.00 | | | |
| -85 | -24.15 | -42.18 | -24.00 | | | |
| -80 | -19.025 | -37.06 | -24.00 | | | |
| -75 | -17.219 | -35.25 | -24.00 | | | |
| -70 | -16.3 | -34.33 | -24.00 | | | |
| -65 | -21.984 | -40.01 | -24.00 | | | |
| -60 | -16.823 | -34.85 | -24.00 | | | |
| -55 | -24.695 | -42.73 | -24.00 | | | |
| -50 | -16.931 | -34.96 | -24.00 | | | |
| -45 | -14.79 | -32.82 | -23.33 | | | |
| -40 | -19.069 | -37.10 | -22.05 | | | |
| -35 | -15.519 | -33.55 | -20.60 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| -30 | -15.3 | -33.33 | -18.93 | | | |
| -25 | -6.952 | -24.98 | -16.95 | | | |
| -20 | -10.683 | -28.71 | -14.53 | | | |
| -15 | -7.452 | -25.48 | -11.40 | | | |
| -10 | -7.088 | -25.12 | -7.00 | -13.31 | -31.34 | |
| -9.9 | -6.439 | -24.47 | -6.89 | -16.192 | -34.22 | |
| -9.8 | -5.408 | -23.44 | -6.78 | -20.141 | -38.17 | |
| -9.7 | -4.374 | -22.40 | -6.67 | -21.445 | -39.48 | |
| -9.6 | -3.658 | -21.69 | -6.56 | -18.125 | -36.16 | |
| -9.5 | -3.389 | -21.42 | -6.44 | -15.158 | -33.19 | |
| -9.4 | -3.563 | -21.59 | -6.33 | -13.423 | -31.45 | |
| -9.3 | -4.107 | -22.14 | -6.21 | -12.921 | -30.95 | |
| -9.2 | -4.954 | -22.98 | -6.00 | -13.835 | -31.87 | -16.00 |
| -9.1 | -6.089 | -24.12 | -6.00 | -16.739 | -34.77 | -16.00 |
| -9 | -7.569 | -25.60 | -6.00 | -22.372 | -40.40 | -16.00 |
| -8.9 | -9.481 | -27.51 | -6.00 | -19.843 | -37.87 | -16.00 |
| -8.8 | -11.939 | -29.97 | -6.00 | -14.278 | -32.31 | -16.00 |
| -8.7 | -15.23 | -33.26 | -6.00 | -11.353 | -29.38 | -16.00 |
| -8.6 | -19.537 | -37.57 | -6.00 | -10.071 | -28.10 | -16.00 |
| -8.5 | -18.006 | -36.04 | -6.00 | -9.959 | -27.99 | -16.00 |
| -8.4 | -11.987 | -30.02 | -6.00 | -10.777 | -28.81 | -16.00 |
| -8.3 | -7.692 | -25.72 | -6.00 | -12.293 | -30.32 | -16.00 |
| -8.2 | -4.833 | -22.86 | -6.00 | -13.971 | -32.00 | -16.00 |
| -8.1 | -3.022 | -21.05 | -6.00 | -14.629 | -32.66 | -16.00 |
| -8 | -2.024 | -20.05 | -6.00 | -13.629 | -31.66 | -16.00 |
| -7.9 | -1.655 | -19.69 | -6.00 | -12.062 | -30.09 | -16.00 |
| -7.8 | -1.74 | -19.77 | -6.00 | -10.972 | -29.00 | -16.00 |
| -7.7 | -2.135 | -20.17 | -6.00 | -10.837 | -28.87 | -16.00 |
| -7.6 | -2.777 | -20.81 | -6.00 | -12.017 | -30.05 | -16.00 |
| -7.5 | -3.724 | -21.75 | -6.00 | -15.177 | -33.21 | -16.00 |
| -7.4 | -5.095 | -23.13 | -6.00 | -22.602 | -40.63 | -16.00 |
| -7.3 | -7.059 | -25.09 | -6.00 | -29.691 | -47.72 | -16.00 |
| -7.2 | -10.114 | -28.14 | -6.00 | -20.326 | -38.36 | -16.00 |
| -7.1 | -16.647 | -34.68 | -6.00 | -19.272 | -37.30 | -16.00 |
| -7 | -18.813 | -36.84 | -6.13 | -24.215 | -42.25 | -16.13 |
| -6.9 | -7.599 | -25.63 | -5.97 | -27.576 | -45.61 | -15.97 |
| -6.8 | -2.094 | -20.12 | -5.81 | -16.255 | -34.29 | -15.81 |
| -6.7 | 1.329 | -16.70 | -5.65 | -11.965 | -30.00 | -15.65 |
| -6.6 | 3.498 | -14.53 | -5.49 | -10.314 | -28.34 | -15.49 |
| -6.5 | 4.766 | -13.26 | -5.32 | -10.479 | -28.51 | -15.32 |
| -6.4 | 5.376 | -12.65 | -5.15 | -12.253 | -30.28 | -15.15 |
| -6.3 | 5.565 | -12.47 | -4.98 | -15.39 | -33.42 | -14.98 |
| -6.2 | 5.588 | -12.44 | -4.81 | -17.962 | -35.99 | -14.81 |
| -6.1 | 5.654 | -12.38 | -4.63 | -17.476 | -35.51 | -14.63 |
| -6 | 5.853 | -12.18 | -4.45 | -16.566 | -34.60 | -14.45 |
| -5.9 | 6.164 | -11.87 | -4.27 | -16.369 | -34.40 | -14.27 |
| -5.8 | 6.52 | -11.51 | -4.09 | -16.151 | -34.18 | -14.09 |
| -5.7 | 6.81 | -11.22 | -3.90 | -15.558 | -33.59 | -13.90 |
| -5.6 | 6.863 | -11.17 | -3.70 | -15.146 | -33.18 | -13.70 |

| | | | | | | |
|---|---|---|---|---|---|---|
| -5.5 | 6.471 | -11.56 | -3.51 | -15.215 | -33.25 | -13.51 |
| -5.4 | 5.417 | -12.61 | -3.31 | -15.236 | -33.27 | -13.31 |
| -5.3 | 3.464 | -14.57 | -3.11 | -14.339 | -32.37 | -13.11 |
| -5.2 | 0.269 | -17.76 | -2.90 | -12.65 | -30.68 | -12.90 |
| -5.1 | -4.907 | -22.94 | -2.69 | -10.898 | -28.93 | -12.69 |
| -5 | -14.566 | -32.60 | -2.47 | -9.456 | -27.49 | -12.47 |
| -4.9 | -13.387 | -31.42 | -2.25 | -8.466 | -26.50 | -12.25 |
| -4.8 | -6.371 | -24.40 | -2.03 | -8.035 | -26.07 | -12.03 |
| -4.7 | -2.31 | -20.34 | -1.80 | -8.261 | -26.29 | -11.80 |
| -4.6 | 0.5 | -17.53 | -1.57 | -9.191 | -27.22 | -11.57 |
| -4.5 | 2.301 | -15.73 | -1.33 | -10.733 | -28.76 | -11.33 |
| -4.4 | 3.176 | -14.85 | -1.09 | -12.483 | -30.51 | -11.09 |
| -4.3 | 3.248 | -14.78 | -0.84 | -13.623 | -31.65 | -10.84 |
| -4.2 | 2.754 | -15.28 | -0.58 | -13.528 | -31.56 | -10.58 |
| -4.1 | 2.098 | -15.93 | -0.32 | -12.38 | -30.41 | -10.32 |
| -4 | 1.728 | -16.30 | -0.05 | -10.717 | -28.75 | -10.05 |
| -3.9 | 1.767 | -16.26 | 0.22 | -9.067 | -27.10 | -9.78 |
| -3.8 | 2.03 | -16.00 | 0.51 | -7.782 | -25.81 | -9.49 |
| -3.7 | 2.468 | -15.56 | 0.79 | -6.986 | -25.02 | -9.21 |
| -3.6 | 3.26 | -14.77 | 1.09 | -6.639 | -24.67 | -8.91 |
| -3.5 | 4.55 | -13.48 | 1.40 | -6.606 | -24.64 | -8.60 |
| -3.4 | 6.225 | -11.81 | 1.71 | -6.706 | -24.74 | -8.29 |
| -3.3 | 8.019 | -10.01 | 2.04 | -6.768 | -24.80 | -7.96 |
| -3.2 | 9.7 | -8.33 | 2.37 | -6.717 | -24.75 | -7.63 |
| -3.1 | 11.145 | -6.89 | 2.72 | -6.607 | -24.64 | -7.28 |
| -3 | 12.329 | -5.70 | 3.07 | -6.582 | -24.61 | -6.93 |
| -2.9 | 13.266 | -4.76 | 3.44 | -6.8 | -24.83 | -6.56 |
| -2.8 | 13.937 | -4.09 | 3.82 | -7.377 | -25.41 | -6.18 |
| -2.7 | 14.226 | -3.80 | 4.22 | -8.292 | -26.32 | -5.78 |
| -2.6 | 13.899 | -4.13 | 4.63 | -9.114 | -27.14 | -5.37 |
| -2.5 | 12.654 | -5.38 | 5.05 | -8.841 | -26.87 | -4.95 |
| -2.4 | 10.601 | -7.43 | 5.49 | -7.278 | -25.31 | -4.51 |
| -2.3 | 10.96 | -7.07 | 5.96 | -5.593 | -23.62 | -4.04 |
| -2.2 | 15.172 | -2.86 | 6.44 | -4.657 | -22.69 | -3.56 |
| -2.1 | 19.056 | 1.03 | 6.94 | -4.874 | -22.90 | -3.06 |
| -2 | 21.831 | 3.80 | 7.47 | -6.594 | -24.62 | -2.53 |
| -1.9 | 23.69 | 5.66 | 8.03 | -9.917 | -27.95 | -1.97 |
| -1.8 | 24.811 | 6.78 | 8.62 | -10.199 | -28.23 | -1.38 |
| -1.7 | 25.287 | 7.26 | 9.24 | -5.682 | -23.71 | |
| -1.6 | 25.122 | 7.09 | 9.90 | -2.3 | -20.33 | |
| -1.5 | 24.189 | 6.16 | 10.60 | -0.282 | -18.31 | |
| -1.4 | 22.073 | 4.04 | | 0.755 | -17.28 | |
| -1.3 | 17.365 | -0.67 | | 0.935 | -17.10 | |
| -1.2 | 2.284 | -15.75 | | 0.081 | -17.95 | |
| -1.1 | 19.419 | 1.39 | | -2.118 | -20.15 | |
| -1 | 26.173 | 8.14 | | -3.329 | -21.36 | |
| -0.9 | 30.389 | 12.36 | | 1.31 | -16.72 | |
| -0.8 | 33.508 | 15.48 | | 5.931 | -12.10 | |
| -0.7 | 35.997 | 17.97 | | 8.96 | -9.07 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| -0.6 | 38.049 | 20.02 | | 10.64 | -7.39 | |
| -0.5 | 39.744 | 21.71 | | 11.079 | -6.95 | |
| -0.4 | 41.104 | 23.07 | | 10.144 | -7.89 | |
| -0.3 | 42.124 | 24.09 | | 7.304 | -10.73 | |
| -0.2 | 42.793 | 24.76 | | 1.866 | -16.16 | |
| -0.1 | 43.096 | 25.07 | | 4.495 | -13.54 | |
| 0 | 43.022 | 24.99 | | 10.378 | -7.65 | |
| 0.1 | 42.561 | 24.53 | | 13.755 | -4.28 | |
| 0.2 | 41.703 | 23.67 | | 15.602 | -2.43 | |
| 0.3 | 40.445 | 22.42 | | 16.38 | -1.65 | |
| 0.4 | 38.782 | 20.75 | | 16.282 | -1.75 | |
| 0.5 | 36.709 | 18.68 | | 15.371 | -2.66 | |
| 0.6 | 34.202 | 16.17 | | 13.624 | -4.41 | |
| 0.7 | 31.194 | 13.16 | | 10.925 | -7.11 | |
| 0.8 | 27.522 | 9.49 | | 7.019 | -11.01 | |
| 0.9 | 23.058 | 5.03 | | 1.506 | -16.52 | |
| 1 | 19.584 | 1.55 | | -4.19 | -22.22 | |
| 1.1 | 21.058 | 3.03 | | -3.43 | -21.46 | |
| 1.2 | 23.567 | 5.54 | | -1.821 | -19.85 | |
| 1.3 | 25.099 | 7.07 | | -1.648 | -19.68 | |
| 1.4 | 25.757 | 7.73 | | -2.246 | -20.28 | |
| 1.5 | 25.758 | 7.73 | 10.60 | -2.962 | -20.99 | |
| 1.6 | 25.246 | 7.22 | 9.90 | -3.234 | -21.26 | |
| 1.7 | 24.282 | 6.25 | 9.24 | -2.475 | -20.51 | |
| 1.8 | 22.829 | 4.80 | 8.62 | -0.719 | -18.75 | -1.38 |
| 1.9 | 20.722 | 2.69 | 8.03 | 1.173 | -16.86 | -1.97 |
| 2 | 17.594 | -0.44 | 7.47 | 2.537 | -15.49 | -2.53 |
| 2.1 | 12.554 | -5.48 | 6.94 | 3.127 | -14.90 | -3.06 |
| 2.2 | 1.806 | -16.22 | 6.44 | 2.873 | -15.16 | -3.56 |
| 2.3 | 3.455 | -14.58 | 5.96 | 1.742 | -16.29 | -4.04 |
| 2.4 | 10.018 | -8.01 | 5.49 | -0.305 | -18.34 | -4.51 |
| 2.5 | 12.175 | -5.86 | 5.05 | -3.309 | -21.34 | -4.95 |
| 2.6 | 12.645 | -5.39 | 4.63 | -7.217 | -25.25 | -5.37 |
| 2.7 | 12.339 | -5.69 | 4.22 | -11.552 | -29.58 | -5.78 |
| 2.8 | 11.885 | -6.15 | 3.82 | -14.889 | -32.92 | -6.18 |
| 2.9 | 11.615 | -6.42 | 3.44 | -15.457 | -33.49 | -6.56 |
| 3 | 11.392 | -6.64 | 3.07 | -13.529 | -31.56 | -6.93 |
| 3.1 | 10.878 | -7.15 | 2.72 | -11.231 | -29.26 | -7.28 |
| 3.2 | 9.822 | -8.21 | 2.37 | -9.649 | -27.68 | -7.63 |
| 3.3 | 8.081 | -9.95 | 2.04 | -8.898 | -26.93 | -7.96 |
| 3.4 | 5.531 | -12.50 | 1.71 | -8.806 | -26.84 | -8.29 |
| 3.5 | 1.98 | -16.05 | 1.40 | -9.145 | -27.18 | -8.60 |
| 3.6 | -2.887 | -20.92 | 1.09 | -9.728 | -27.76 | -8.91 |
| 3.7 | -9.079 | -27.11 | 0.79 | -10.509 | -28.54 | -9.21 |
| 3.8 | -13.772 | -31.80 | 0.51 | -11.61 | -29.64 | -9.49 |
| 3.9 | -17.455 | -35.49 | 0.22 | -13.269 | -31.30 | -9.78 |
| 4 | -15.44 | -33.47 | -0.05 | -15.807 | -33.84 | -10.05 |
| 4.1 | -6.576 | -24.61 | -0.32 | -19.64 | -37.67 | -10.32 |
| 4.2 | -1.527 | -19.56 | -0.58 | -24.361 | -42.39 | -10.58 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4.3 | 1.418 | -16.61 | -0.84 | -23.966 | -42.00 | -10.84 |
| 4.4 | 3.014 | -15.02 | -1.09 | -20.671 | -38.70 | -11.09 |
| 4.5 | 3.63 | -14.40 | -1.33 | -18.727 | -36.76 | -11.33 |
| 4.6 | 3.505 | -14.53 | -1.57 | -18.024 | -36.05 | -11.57 |
| 4.7 | 2.815 | -15.22 | -1.80 | -18.291 | -36.32 | -11.80 |
| 4.8 | 1.703 | -16.33 | -2.03 | -19.24 | -37.27 | -12.03 |
| 4.9 | 0.431 | -17.60 | -2.25 | -19.98 | -38.01 | -12.25 |
| 5 | -0.124 | -18.15 | -2.47 | -19.134 | -37.16 | -12.47 |
| 5.1 | 1.106 | -16.92 | -2.69 | -17.189 | -35.22 | -12.69 |
| 5.2 | 3.333 | -14.70 | -2.90 | -15.465 | -33.50 | -12.90 |
| 5.3 | 5.315 | -12.72 | -3.11 | -14.38 | -32.41 | -13.11 |
| 5.4 | 6.652 | -11.38 | -3.31 | -13.891 | -31.92 | -13.31 |
| 5.5 | 7.339 | -10.69 | -3.51 | -13.835 | -31.87 | -13.51 |
| 5.6 | 7.484 | -10.55 | -3.70 | -14.031 | -32.06 | -13.70 |
| 5.7 | 7.245 | -10.79 | -3.90 | -14.288 | -32.32 | -13.90 |
| 5.8 | 6.812 | -11.22 | -4.09 | -14.41 | -32.44 | -14.09 |
| 5.9 | 6.381 | -11.65 | -4.27 | -14.222 | -32.25 | -14.27 |
| 6 | 6.11 | -11.92 | -4.45 | -13.696 | -31.73 | -14.45 |
| 6.1 | 6.073 | -11.96 | -4.63 | -13.012 | -31.04 | -14.63 |
| 6.2 | 6.23 | -11.80 | -4.81 | -12.465 | -30.50 | -14.81 |
| 6.3 | 6.431 | -11.60 | -4.98 | -12.308 | -30.34 | -14.98 |
| 6.4 | 6.491 | -11.54 | -5.15 | -12.69 | -30.72 | -15.15 |
| 6.5 | 6.28 | -11.75 | -5.32 | -13.618 | -31.65 | -15.32 |
| 6.6 | 5.777 | -12.25 | -5.49 | -14.89 | -32.92 | -15.49 |
| 6.7 | 5.092 | -12.94 | -5.65 | -16.022 | -34.05 | -15.65 |
| 6.8 | 4.451 | -13.58 | -5.81 | -16.429 | -34.46 | -15.81 |
| 6.9 | 4.074 | -13.96 | -5.97 | -15.832 | -33.86 | -15.97 |
| 7 | 4.011 | -14.02 | -6.13 | -14.475 | -32.51 | -16.13 |
| 7.1 | 4.166 | -13.86 | -6.00 | -13.003 | -31.03 | -16.00 |
| 7.2 | 4.439 | -13.59 | -6.00 | -12.008 | -30.04 | -16.00 |
| 7.3 | 4.778 | -13.25 | -6.00 | -11.756 | -29.79 | -16.00 |
| 7.4 | 5.136 | -12.89 | -6.00 | -12.161 | -30.19 | -16.00 |
| 7.5 | 5.453 | -12.58 | -6.00 | -12.661 | -30.69 | -16.00 |
| 7.6 | 5.68 | -12.35 | -6.00 | -12.482 | -30.51 | -16.00 |
| 7.7 | 5.789 | -12.24 | -6.00 | -11.745 | -29.78 | -16.00 |
| 7.8 | 5.765 | -12.27 | -6.00 | -11.219 | -29.25 | -16.00 |
| 7.9 | 5.585 | -12.45 | -6.00 | -11.283 | -29.31 | -16.00 |
| 8 | 5.228 | -12.80 | -6.00 | -11.859 | -29.89 | -16.00 |
| 8.1 | 4.689 | -13.34 | -6.00 | -12.576 | -30.61 | -16.00 |
| 8.2 | 4.013 | -14.02 | -6.00 | -12.821 | -30.85 | -16.00 |
| 8.3 | 3.307 | -14.72 | -6.00 | -12.023 | -30.05 | -16.00 |
| 8.4 | 2.712 | -15.32 | -6.00 | -10.393 | -28.42 | -16.00 |
| 8.5 | 2.323 | -15.71 | -6.00 | -8.78 | -26.81 | -16.00 |
| 8.6 | 2.107 | -15.92 | -6.00 | -7.804 | -25.83 | -16.00 |
| 8.7 | 1.92 | -16.11 | -6.00 | -7.734 | -25.76 | -16.00 |
| 8.8 | 1.583 | -16.45 | -6.00 | -8.667 | -26.70 | -16.00 |
| 8.9 | 0.929 | -17.10 | -6.00 | -10.572 | -28.60 | -16.00 |
| 9 | -0.182 | -18.21 | -6.00 | -13.131 | -31.16 | -16.00 |
| 9.1 | -1.857 | -19.89 | -6.00 | -15.613 | -33.64 | -16.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 9.2 | -4.104 | -22.13 | -6.00 | -17.872 | -35.90 | -16.00 |
| 9.3 | -6.547 | -24.58 | -6.21 | -21.307 | -39.34 | |
| 9.4 | -7.886 | -25.92 | -6.33 | -27.573 | -45.60 | |
| 9.5 | -7.114 | -25.14 | -6.44 | -26.516 | -44.55 | |
| 9.6 | -5.273 | -23.30 | -6.56 | -21.863 | -39.89 | |
| 9.7 | -3.331 | -21.36 | -6.67 | -19.311 | -37.34 | |
| 9.8 | -1.602 | -19.63 | -6.78 | -16.889 | -34.92 | |
| 9.9 | -0.221 | -18.25 | -6.89 | -14.502 | -32.53 | |
| 10 | 0.742 | -17.29 | -7.00 | -12.985 | -31.02 | |
| 15 | -3.249 | -21.28 | -11.40 | | | |
| 20 | -11.331 | -29.36 | -14.53 | | | |
| 25 | -10.882 | -28.91 | -16.95 | | | |
| 30 | -10.597 | -28.63 | -18.93 | | | |
| 35 | -12.526 | -30.56 | -20.60 | | | |
| 40 | -14.619 | -32.65 | -22.05 | | | |
| 45 | -19.815 | -37.85 | -23.33 | | | |
| 50 | -10.315 | -28.35 | -24.00 | | | |
| 55 | -9.991 | -28.02 | -24.00 | | | |
| 60 | -15.105 | -33.14 | -24.00 | | | |
| 65 | -23.003 | -41.03 | -24.00 | | | |
| 70 | -13.128 | -31.16 | -24.00 | | | |
| 75 | -16.599 | -34.63 | -24.00 | | | |
| 80 | -12.931 | -30.96 | -24.00 | | | |
| 85 | -17.958 | -35.99 | -24.00 | | | |
| 90 | -9.162 | -27.19 | -14.00 | | | |
| 95 | -2.845 | -20.88 | -14.00 | | | |
| 100 | -8.856 | -26.89 | -14.00 | | | |
| 105 | -7.588 | -25.62 | -14.00 | | | |
| 110 | -15.755 | -33.79 | -14.00 | | | |
| 115 | -16.588 | -34.62 | -14.00 | | | |
| 120 | -11.924 | -29.95 | -14.00 | | | |
| 125 | -15.409 | -33.44 | -14.00 | | | |
| 130 | -20.69 | -38.72 | -14.00 | | | |
| 135 | -17.03 | -35.06 | -14.00 | | | |
| 140 | -16.916 | -34.95 | -14.00 | | | |
| 145 | -13.942 | -31.97 | -14.00 | | | |
| 150 | -16.724 | -34.75 | -14.00 | | | |
| 155 | -21.294 | -39.32 | -14.00 | | | |
| 160 | -18.651 | -36.68 | -14.00 | | | |
| 165 | -37.363 | -55.39 | -14.00 | | | |
| 170 | -20.605 | -38.64 | -14.00 | | | |
| 175 | -27.654 | -45.68 | -14.00 | | | |
| 180 | -20.54 | -38.57 | -14.00 | | | |

## **Annex 2**: *Table 4 - Elevation Pattern for Co-pol & Cross-pol (-180° ~ 180°)*

**(14.125 GHz)** G = 43.504 dBi HPA = 125 W

HPA feeder loss = 3.0 dB

EIRPmax = 61.47 dBW/Hz = 25.47 dBW/4kHz

G - EIRPmax = 18.03 dB (=X)

| angle (Φ) | Gain (dBi) | EIRP (dBW/4 kHz) | FCC (dBW/4 kHz) | Cross Polar Transmission (dBI) | XP Transmission (dBW/4kHz) | X-Pol FCC (dBW/4kHz) |
|---|---|---|---|---|---|---|
| -180 | -17.639 | -35.67 | -14.00 | | | |
| -175 | -32.295 | -50.33 | -14.00 | | | |
| -170 | -21.748 | -39.78 | -14.00 | | | |
| -165 | -22.339 | -40.37 | -14.00 | | | |
| -160 | -17.736 | -35.77 | -14.00 | | | |
| -155 | -20.312 | -38.34 | -14.00 | | | |
| -150 | -21.037 | -39.07 | -14.00 | | | |
| -145 | -19.553 | -37.58 | -14.00 | | | |
| -140 | -17.63 | -35.66 | -14.00 | | | |
| -135 | -15.949 | -33.98 | -14.00 | | | |
| -130 | -16.712 | -34.74 | -14.00 | | | |
| -125 | -14.523 | -32.55 | -14.00 | | | |
| -120 | -20.895 | -38.93 | -14.00 | | | |
| -115 | -15.386 | -33.42 | -14.00 | | | |
| -110 | -20.481 | -38.51 | -14.00 | | | |
| -105 | -13.447 | -31.48 | -14.00 | | | |
| -100 | -15.329 | -33.36 | -14.00 | | | |
| -95 | -10.931 | -28.96 | -14.00 | | | |
| -90 | -33.697 | -51.73 | -14.00 | | | |
| -85 | -26.666 | -44.70 | -24.00 | | | |
| -80 | -22.755 | -40.79 | -24.00 | | | |
| -75 | -13.513 | -31.54 | -24.00 | | | |
| -70 | -28.298 | -46.33 | -24.00 | | | |
| -65 | -8.547 | -26.58 | -24.00 | | | |
| -60 | -9.356 | -27.39 | -24.00 | | | |
| -55 | -16.385 | -34.42 | -24.00 | | | |
| -50 | -34.178 | -52.21 | -24.00 | | | |
| -45 | -13.356 | -31.39 | -23.33 | | | |
| -40 | -14.894 | -32.92 | -22.05 | | | |
| -35 | -12.979 | -31.01 | -20.60 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| -30 | -11.007 | -29.04 | -18.93 | | | |
| -25 | -19.249 | -37.28 | -16.95 | | | |
| -20 | -6.621 | -24.65 | -14.53 | | | |
| -15 | -12.36 | -30.39 | -11.40 | | | |
| -10 | -7.954 | -25.98 | -7.00 | -14.215 | -32.25 | |
| -9.95 | -8.488 | -26.52 | -6.95 | -14.319 | -32.35 | |
| -9.9 | -9.204 | -27.23 | -6.89 | -14.613 | -32.64 | |
| -9.85 | -10.091 | -28.12 | -6.84 | -15.095 | -33.13 | |
| -9.8 | -11.104 | -29.13 | -6.78 | -15.742 | -33.77 | |
| -9.75 | -12.148 | -30.18 | -6.73 | -16.506 | -34.54 | |
| -9.7 | -13.072 | -31.10 | -6.67 | -17.297 | -35.33 | |
| -9.65 | -13.706 | -31.74 | -6.61 | -17.987 | -36.02 | |
| -9.6 | -13.946 | -31.98 | -6.56 | -18.446 | -36.48 | |
| -9.55 | -13.811 | -31.84 | -6.50 | -18.611 | -36.64 | |
| -9.5 | -13.377 | -31.41 | -6.44 | -18.518 | -36.55 | |
| -9.45 | -12.703 | -30.73 | -6.39 | -18.255 | -36.29 | |
| -9.4 | -11.819 | -29.85 | -6.33 | -17.878 | -35.91 | |
| -9.35 | -10.764 | -28.79 | -6.27 | -17.39 | -35.42 | |
| -9.3 | -9.613 | -27.64 | -6.21 | -16.76 | -34.79 | |
| -9.25 | -8.453 | -26.48 | -6.15 | -15.972 | -34.00 | |
| -9.2 | -7.362 | -25.39 | -6.09 | -15.056 | -33.09 | -16.00 |
| -9.15 | -6.395 | -24.43 | -6.04 | -14.086 | -32.12 | -16.00 |
| -9.1 | -5.581 | -23.61 | -5.98 | -13.141 | -31.17 | -16.00 |
| -9.05 | -4.93 | -22.96 | -5.92 | -12.288 | -30.32 | -16.00 |
| -9 | -4.443 | -22.47 | -5.86 | -11.566 | -29.60 | -16.00 |
| -8.95 | -4.108 | -22.14 | -5.80 | -10.995 | -29.03 | -16.00 |
| -8.9 | -3.907 | -21.94 | -5.73 | -10.576 | -28.61 | -16.00 |
| -8.85 | -3.816 | -21.85 | -5.67 | -10.302 | -28.33 | -16.00 |
| -8.8 | -3.805 | -21.84 | -5.61 | -10.157 | -28.19 | -16.00 |
| -8.75 | -3.837 | -21.87 | -5.55 | -10.12 | -28.15 | -16.00 |
| -8.7 | -3.87 | -21.90 | -5.49 | -10.173 | -28.20 | -16.00 |
| -8.65 | -3.862 | -21.89 | -5.43 | -10.299 | -28.33 | -16.00 |
| -8.6 | -3.771 | -21.80 | -5.36 | -10.491 | -28.52 | -16.00 |
| -8.55 | -3.57 | -21.60 | -5.30 | -10.75 | -28.78 | -16.00 |
| -8.5 | -3.246 | -21.28 | -5.24 | -11.089 | -29.12 | -16.00 |
| -8.45 | -2.806 | -20.84 | -5.17 | -11.521 | -29.55 | -16.00 |
| -8.4 | -2.274 | -20.30 | -5.11 | -12.053 | -30.08 | -16.00 |
| -8.35 | -1.685 | -19.72 | -5.04 | -12.673 | -30.70 | -16.00 |
| -8.3 | -1.075 | -19.11 | -4.98 | -13.327 | -31.36 | -16.00 |
| -8.25 | -0.479 | -18.51 | -4.91 | -13.905 | -31.94 | -16.00 |
| -8.2 | 0.077 | -17.95 | -4.85 | -14.261 | -32.29 | -16.00 |
| -8.15 | 0.574 | -17.46 | -4.78 | -14.291 | -32.32 | -16.00 |
| -8.1 | 1.001 | -17.03 | -4.71 | -14.023 | -32.05 | -16.00 |
| -8.05 | 1.354 | -16.68 | -4.64 | -13.602 | -31.63 | -16.00 |
| -8 | 1.635 | -16.40 | -4.58 | -13.197 | -31.23 | -16.00 |
| -7.95 | 1.849 | -16.18 | -4.51 | -12.93 | -30.96 | -16.00 |
| -7.9 | 2.003 | -16.03 | -4.44 | -12.861 | -30.89 | -16.00 |
| -7.85 | 2.105 | -15.93 | -4.37 | -13 | -31.03 | -16.00 |
| -7.8 | 2.162 | -15.87 | -4.30 | -13.297 | -31.33 | -16.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| -7.75 | 2.177 | -15.85 | -4.23 | -13.632 | -31.66 | -16.00 |
| -7.7 | 2.15 | -15.88 | -4.16 | -13.806 | -31.84 | -16.00 |
| -7.65 | 2.076 | -15.95 | -4.09 | -13.63 | -31.66 | -16.00 |
| -7.6 | 1.95 | -16.08 | -4.02 | -13.066 | -31.10 | -16.00 |
| -7.55 | 1.766 | -16.26 | -3.95 | -12.267 | -30.30 | -16.00 |
| -7.5 | 1.519 | -16.51 | -3.88 | -11.448 | -29.48 | -16.00 |
| -7.45 | 1.203 | -16.83 | -3.80 | -10.766 | -28.80 | -16.00 |
| -7.4 | 0.816 | -17.21 | -3.73 | -10.314 | -28.34 | -16.00 |
| -7.35 | 0.356 | -17.67 | -3.66 | -10.138 | -28.17 | -16.00 |
| -7.3 | -0.18 | -18.21 | -3.58 | -10.266 | -28.30 | -16.00 |
| -7.25 | -0.802 | -18.83 | -3.51 | -10.715 | -28.75 | -16.00 |
| -7.2 | -1.525 | -19.56 | -3.43 | -11.5 | -29.53 | -16.00 |
| -7.15 | -2.37 | -20.40 | -3.36 | -12.612 | -30.64 | -16.00 |
| -7.1 | -3.359 | -21.39 | -3.28 | -13.976 | -32.01 | -16.00 |
| -7.05 | -4.49 | -22.52 | -3.20 | -15.324 | -33.35 | -16.00 |
| -7 | -5.675 | -23.71 | -3.13 | -16.089 | -34.12 | -16.13 |
| -6.95 | -6.614 | -24.64 | -3.05 | -15.81 | -33.84 | -16.05 |
| -6.9 | -6.772 | -24.80 | -2.97 | -14.781 | -32.81 | -15.97 |
| -6.85 | -5.87 | -23.90 | -2.89 | -13.61 | -31.64 | -15.89 |
| -6.8 | -4.308 | -22.34 | -2.81 | -12.64 | -30.67 | -15.81 |
| -6.75 | -2.62 | -20.65 | -2.73 | -11.978 | -30.01 | -15.73 |
| -6.7 | -1.081 | -19.11 | -2.65 | -11.64 | -29.67 | -15.65 |
| -6.65 | 0.226 | -17.80 | -2.57 | -11.614 | -29.64 | -15.57 |
| -6.6 | 1.293 | -16.74 | -2.49 | -11.881 | -29.91 | -15.49 |
| -6.55 | 2.138 | -15.89 | -2.41 | -12.424 | -30.45 | -15.41 |
| -6.5 | 2.788 | -15.24 | -2.32 | -13.224 | -31.25 | -15.32 |
| -6.45 | 3.269 | -14.76 | -2.24 | -14.253 | -32.28 | -15.24 |
| -6.4 | 3.614 | -14.42 | -2.15 | -15.475 | -33.51 | -15.15 |
| -6.35 | 3.855 | -14.18 | -2.07 | -16.836 | -34.87 | -15.07 |
| -6.3 | 4.028 | -14.00 | -1.98 | -18.271 | -36.30 | -14.98 |
| -6.25 | 4.171 | -13.86 | -1.90 | -19.728 | -37.76 | -14.90 |
| -6.2 | 4.317 | -13.71 | -1.81 | -21.215 | -39.25 | -14.81 |
| -6.15 | 4.494 | -13.54 | -1.72 | -22.834 | -40.86 | -14.72 |
| -6.1 | 4.713 | -13.32 | -1.63 | -24.801 | -42.83 | -14.63 |
| -6.05 | 4.976 | -13.05 | -1.54 | -27.464 | -45.49 | -14.54 |
| -6 | 5.27 | -12.76 | -1.45 | -31.283 | -49.31 | -14.45 |
| -5.95 | 5.575 | -12.46 | -1.36 | -34.884 | -52.91 | -14.36 |
| -5.9 | 5.871 | -12.16 | -1.27 | -31.767 | -49.80 | -14.27 |
| -5.85 | 6.14 | -11.89 | -1.18 | -27.442 | -45.47 | -14.18 |
| -5.8 | 6.364 | -11.67 | -1.09 | -24.362 | -42.39 | -14.09 |
| -5.75 | 6.531 | -11.50 | -0.99 | -22.139 | -40.17 | -13.99 |
| -5.7 | 6.629 | -11.40 | -0.90 | -20.452 | -38.48 | -13.90 |
| -5.65 | 6.644 | -11.39 | -0.80 | -19.11 | -37.14 | -13.80 |
| -5.6 | 6.565 | -11.47 | -0.70 | -17.993 | -36.02 | -13.70 |
| -5.55 | 6.377 | -11.65 | -0.61 | -17.034 | -35.06 | -13.61 |
| -5.5 | 6.064 | -11.97 | -0.51 | -16.203 | -34.23 | -13.51 |
| -5.45 | 5.608 | -12.42 | -0.41 | -15.499 | -33.53 | -13.41 |
| -5.4 | 4.989 | -13.04 | -0.31 | -14.937 | -32.97 | -13.31 |
| -5.35 | 4.182 | -13.85 | -0.21 | -14.542 | -32.57 | -13.21 |

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|---|---|---|---|---|---|---|
| -5.3 | 3.16 | -14.87 | -0.11 | -14.342 | -32.37 | -13.11 |
| -5.25 | 1.889 | -16.14 | 0.00 | -14.363 | -32.39 | -13.00 |
| -5.2 | 0.328 | -17.70 | 0.10 | -14.633 | -32.66 | -12.90 |
| -5.15 | -1.576 | -19.61 | 0.20 | -15.176 | -33.21 | -12.80 |
| -5.1 | -3.893 | -21.92 | 0.31 | -16.019 | -34.05 | -12.69 |
| -5.05 | -6.719 | -24.75 | 0.42 | -17.179 | -35.21 | -12.58 |
| -5 | -10.173 | -28.20 | 0.53 | -18.636 | -36.67 | -12.47 |
| -4.95 | -14.311 | -32.34 | 0.63 | -20.251 | -38.28 | -12.37 |
| -4.9 | -18.141 | -36.17 | 0.75 | -21.61 | -39.64 | -12.25 |
| -4.85 | -17.815 | -35.85 | 0.86 | -22.074 | -40.10 | -12.14 |
| -4.8 | -14.467 | -32.50 | 0.97 | -21.502 | -39.53 | -12.03 |
| -4.75 | -11.1 | -29.13 | 1.08 | -20.471 | -38.50 | -11.92 |
| -4.7 | -8.16 | -26.19 | 1.20 | -19.502 | -37.53 | -11.80 |
| -4.65 | -5.656 | -23.69 | 1.31 | -18.8 | -36.83 | -11.69 |
| -4.6 | -3.57 | -21.60 | 1.43 | -18.403 | -36.43 | -11.57 |
| -4.55 | -1.877 | -19.91 | 1.55 | -18.289 | -36.32 | -11.45 |
| -4.5 | -0.546 | -18.58 | 1.67 | -18.413 | -36.44 | -11.33 |
| -4.45 | 0.452 | -17.58 | 1.79 | -18.718 | -36.75 | -11.21 |
| -4.4 | 1.14 | -16.89 | 1.91 | -19.126 | -37.16 | -11.09 |
| -4.35 | 1.54 | -16.49 | 2.04 | -19.545 | -37.58 | -10.96 |
| -4.3 | 1.668 | -16.36 | 2.16 | -19.868 | -37.90 | -10.84 |
| -4.25 | 1.542 | -16.49 | 2.29 | -20.003 | -38.03 | -10.71 |
| -4.2 | 1.179 | -16.85 | 2.42 | -19.897 | -37.93 | -10.58 |
| -4.15 | 0.606 | -17.42 | 2.55 | -19.557 | -37.59 | -10.45 |
| -4.1 | -0.136 | -18.17 | 2.68 | -19.045 | -37.08 | -10.32 |
| -4.05 | -0.982 | -19.01 | 2.81 | -18.444 | -36.47 | -10.19 |
| -4 | -1.83 | -19.86 | 2.95 | -17.839 | -35.87 | -10.05 |
| -3.95 | -2.552 | -20.58 | 3.09 | -17.299 | -35.33 | -9.91 |
| -3.9 | -3.024 | -21.05 | 3.22 | -16.874 | -34.90 | -9.78 |
| -3.85 | -3.175 | -21.21 | 3.36 | -16.59 | -34.62 | -9.64 |
| -3.8 | -3.01 | -21.04 | 3.51 | -16.445 | -34.48 | -9.49 |
| -3.75 | -2.571 | -20.60 | 3.65 | -16.397 | -34.43 | -9.35 |
| -3.7 | -1.9 | -19.93 | 3.79 | -16.354 | -34.38 | -9.21 |
| -3.65 | -1.034 | -19.06 | 3.94 | -16.171 | -34.20 | -9.06 |
| -3.6 | -0.012 | -18.04 | 4.09 | -15.707 | -33.74 | -8.91 |
| -3.55 | 1.116 | -16.91 | 4.24 | -14.916 | -32.95 | -8.76 |
| -3.5 | 2.297 | -15.73 | 4.40 | -13.887 | -31.92 | -8.60 |
| -3.45 | 3.484 | -14.55 | 4.55 | -12.774 | -30.80 | -8.45 |
| -3.4 | 4.642 | -13.39 | 4.71 | -11.707 | -29.74 | -8.29 |
| -3.35 | 5.747 | -12.28 | 4.87 | -10.764 | -28.79 | -8.13 |
| -3.3 | 6.782 | -11.25 | 5.04 | -9.979 | -28.01 | -7.96 |
| -3.25 | 7.738 | -10.29 | 5.20 | -9.354 | -27.38 | -7.80 |
| -3.2 | 8.608 | -9.42 | 5.37 | -8.874 | -26.90 | -7.63 |
| -3.15 | 9.391 | -8.64 | 5.54 | -8.507 | -26.54 | -7.46 |
| -3.1 | 10.089 | -7.94 | 5.72 | -8.216 | -26.25 | -7.28 |
| -3.05 | 10.707 | -7.32 | 5.89 | -7.961 | -25.99 | -7.11 |
| -3 | 11.252 | -6.78 | 6.07 | -7.713 | -25.74 | -6.93 |
| -2.95 | 11.732 | -6.30 | | -7.459 | -25.49 | -6.75 |
| -2.9 | 12.156 | -5.87 | | -7.209 | -25.24 | -6.56 |

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|---|---|---|---|---|---|
| -2.85 | 12.526 | -5.50 | -6.989 | -25.02 | -6.37 |
| -2.8 | 12.837 | -5.19 | -6.828 | -24.86 | -6.18 |
| -2.75 | 13.075 | -4.96 | -6.742 | -24.77 | -5.98 |
| -2.7 | 13.212 | -4.82 | -6.722 | -24.75 | -5.78 |
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| -2.5 | 11.837 | -6.19 | -5.801 | -23.83 | -4.95 |
| -2.45 | 10.643 | -7.39 | -4.997 | -23.03 | -4.73 |
| -2.4 | 8.903 | -9.13 | -4.056 | -22.09 | -4.51 |
| -2.35 | 6.727 | -11.30 | -3.11 | -21.14 | -4.28 |
| -2.3 | 5.581 | -12.45 | -2.261 | -20.29 | -4.04 |
| -2.25 | 7.655 | -10.38 | -1.572 | -19.60 | -3.80 |
| -2.2 | 11.01 | -7.02 | -1.075 | -19.11 | -3.56 |
| -2.15 | 13.973 | -4.06 | -0.78 | -18.81 | -3.31 |
| -2.1 | 16.37 | -1.66 | -0.679 | -18.71 | -3.06 |
| -2.05 | 18.3 | 0.27 | -0.748 | -18.78 | -2.79 |
| -2 | 19.862 | 1.83 | -0.941 | -18.97 | -2.53 |
| -1.95 | 21.127 | 3.10 | -1.185 | -19.22 | -2.25 |
| -1.9 | 22.146 | 4.12 | -1.386 | -19.42 | -1.97 |
| -1.85 | 22.954 | 4.92 | -1.463 | -19.49 | -1.68 |
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| -1.65 | 24.493 | 6.46 | -0.903 | -18.93 | |
| -1.6 | 24.5 | 6.47 | -0.988 | -19.02 | |
| -1.55 | 24.352 | 6.32 | -1.297 | -19.33 | |
| -1.5 | 24.031 | 6.00 | -1.812 | -19.84 | |
| -1.45 | 23.509 | 5.48 | -2.392 | -20.42 | |
| -1.4 | 22.738 | 4.71 | -2.708 | -20.74 | |
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| -1.3 | 20.135 | 2.11 | -1.257 | -19.29 | |
| -1.25 | 18.073 | 0.04 | 0.197 | -17.83 | |
| -1.2 | 15.567 | -2.46 | 1.628 | -16.40 | |
| -1.15 | 14.312 | -3.72 | 2.831 | -15.20 | |
| -1.1 | 16.678 | -1.35 | 3.729 | -14.30 | |
| -1.05 | 20.227 | 2.20 | 4.295 | -13.74 | |
| -1 | 23.33 | 5.30 | 4.514 | -13.52 | |
| -0.95 | 25.903 | 7.87 | 4.366 | -13.66 | |
| -0.9 | 28.077 | 10.05 | 3.812 | -14.22 | |
| -0.85 | 29.96 | 11.93 | 2.789 | -15.24 | |
| -0.8 | 31.625 | 13.60 | 1.188 | -16.84 | |
| -0.75 | 33.121 | 15.09 | -1.155 | -19.19 | |
| -0.7 | 34.482 | 16.45 | -4.308 | -22.34 | |
| -0.65 | 35.728 | 17.70 | -6.824 | -24.85 | |
| -0.6 | 36.872 | 18.84 | -5.201 | -23.23 | |
| -0.55 | 37.923 | 19.89 | -2.127 | -20.16 | |
| -0.5 | 38.883 | 20.85 | 0.181 | -17.85 | |
| -0.45 | 39.755 | 21.73 | 1.642 | -16.39 | |

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|---|---|---|---|---|---|
| -0.4 | 40.537 | 22.51 | 2.386 | -15.64 | |
| -0.35 | 41.231 | 23.20 | 2.471 | -15.56 | |
| -0.3 | 41.834 | 23.80 | 1.867 | -16.16 | |
| -0.25 | 42.346 | 24.32 | 0.432 | -17.60 | |
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| -0.15 | 43.091 | 25.06 | -5.887 | -23.92 | |
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| 0 | 43.504 | 25.47 | 3.064 | -14.97 | |
| 0.05 | 43.453 | 25.42 | 5.906 | -12.12 | |
| 0.1 | 43.307 | 25.28 | 8 | -10.03 | |
| 0.15 | 43.066 | 25.04 | 9.56 | -8.47 | |
| 0.2 | 42.731 | 24.70 | 10.709 | -7.32 | |
| 0.25 | 42.303 | 24.27 | 11.519 | -6.51 | |
| 0.3 | 41.782 | 23.75 | 12.036 | -5.99 | |
| 0.35 | 41.168 | 23.14 | 12.288 | -5.74 | |
| 0.4 | 40.463 | 22.43 | 12.289 | -5.74 | |
| 0.45 | 39.667 | 21.64 | 12.048 | -5.98 | |
| 0.5 | 38.78 | 20.75 | 11.562 | -6.47 | |
| 0.55 | 37.801 | 19.77 | 10.825 | -7.21 | |
| 0.6 | 36.726 | 18.70 | 9.819 | -8.21 | |
| 0.65 | 35.549 | 17.52 | 8.519 | -9.51 | |
| 0.7 | 34.259 | 16.23 | 6.89 | -11.14 | |
| 0.75 | 32.837 | 14.81 | 4.885 | -13.15 | |
| 0.8 | 31.257 | 13.23 | 2.473 | -15.56 | |
| 0.85 | 29.476 | 11.45 | -0.268 | -18.30 | |
| 0.9 | 27.436 | 9.41 | -2.817 | -20.85 | |
| 0.95 | 25.056 | 7.03 | -3.971 | -22.00 | |
| 1 | 22.263 | 4.23 | -3.471 | -21.50 | |
| 1.05 | 19.186 | 1.16 | -2.52 | -20.55 | |
| 1.1 | 16.951 | -1.08 | -1.848 | -19.88 | |
| 1.15 | 17.391 | -0.64 | -1.607 | -19.64 | |
| 1.2 | 19.361 | 1.33 | -1.76 | -19.79 | |
| 1.25 | 21.232 | 3.20 | -2.218 | -20.25 | |
| 1.3 | 22.666 | 4.64 | -2.841 | -20.87 | |
| 1.35 | 23.707 | 5.68 | -3.444 | -21.47 | |
| 1.4 | 24.433 | 6.40 | -3.839 | -21.87 | |
| 1.45 | 24.91 | 6.88 | -3.95 | -21.98 | |
| 1.5 | 25.187 | 7.16 | -3.872 | -21.90 | |
| 1.55 | 25.298 | 7.27 | -3.787 | -21.82 | |
| 1.6 | 25.267 | 7.24 | -3.852 | -21.88 | |
| 1.65 | 25.108 | 7.08 | -4.153 | -22.18 | |
| 1.7 | 24.829 | 6.80 | -4.696 | -22.73 | |
| 1.75 | 24.427 | 6.40 | -5.366 | -23.40 | |
| 1.8 | 23.896 | 5.87 | -5.878 | -23.91 | -1.38 |
| 1.85 | 23.218 | 5.19 | -5.832 | -23.86 | -1.68 |
| 1.9 | 22.372 | 4.34 | -5.08 | -23.11 | -1.97 |
| 1.95 | 21.324 | 3.29 | -3.91 | -21.94 | -2.25 |
| 2 | 20.028 | 2.00 | -2.706 | -20.74 | -2.53 |

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|---|---|---|---|---|---|---|
| 2.05 | 18.418 | 0.39 | | -1.694 | -19.72 | -2.79 |
| 2.1 | 16.385 | -1.65 | | -0.965 | -19.00 | -3.06 |
| 2.15 | 13.74 | -4.29 | | -0.548 | -18.58 | -3.31 |
| 2.2 | 10.082 | -7.95 | | -0.452 | -18.48 | -3.56 |
| 2.25 | 4.26 | -13.77 | | -0.687 | -18.72 | -3.80 |
| 2.3 | -9.75 | -27.78 | | -1.269 | -19.30 | -4.04 |
| 2.35 | 0.637 | -17.39 | | -2.232 | -20.26 | -4.28 |
| 2.4 | 6.383 | -11.65 | | -3.638 | -21.67 | -4.51 |
| 2.45 | 9.199 | -8.83 | | -5.592 | -23.62 | -4.73 |
| 2.5 | 10.791 | -7.24 | | -8.284 | -26.31 | -4.95 |
| 2.55 | 11.68 | -6.35 | | -12.029 | -30.06 | -5.16 |
| 2.6 | 12.102 | -5.93 | | -16.725 | -34.76 | -5.37 |
| 2.65 | 12.194 | -5.84 | | -17.404 | -35.43 | -5.58 |
| 2.7 | 12.054 | -5.98 | | -13.807 | -31.84 | -5.78 |
| 2.75 | 11.763 | -6.27 | | -11.102 | -29.13 | -5.98 |
| 2.8 | 11.397 | -6.63 | | -9.453 | -27.48 | -6.18 |
| 2.85 | 11.018 | -7.01 | | -8.534 | -26.56 | -6.37 |
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| 2.95 | 10.353 | -7.68 | | -8.127 | -26.16 | -6.75 |
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| 3.2 | 8.297 | -9.73 | 5.37 | -10.825 | -28.86 | -7.63 |
| 3.25 | 7.551 | -10.48 | 5.20 | -11.384 | -29.41 | -7.80 |
| 3.3 | 6.644 | -11.39 | 5.04 | -11.838 | -29.87 | -7.96 |
| 3.35 | 5.565 | -12.47 | 4.87 | -12.165 | -30.20 | -8.13 |
| 3.4 | 4.302 | -13.73 | 4.71 | -12.345 | -30.38 | -8.29 |
| 3.45 | 2.839 | -15.19 | 4.55 | -12.359 | -30.39 | -8.45 |
| 3.5 | 1.151 | -16.88 | 4.40 | -12.215 | -30.25 | -8.60 |
| 3.55 | -0.797 | -18.83 | 4.24 | -11.962 | -29.99 | -8.76 |
| 3.6 | -3.064 | -21.09 | 4.09 | -11.682 | -29.71 | -8.91 |
| 3.65 | -5.734 | -23.76 | 3.94 | -11.469 | -29.50 | -9.06 |
| 3.7 | -8.935 | -26.97 | 3.79 | -11.405 | -29.44 | -9.21 |
| 3.75 | -12.855 | -30.89 | 3.65 | -11.554 | -29.58 | -9.35 |
| 3.8 | -17.755 | -35.79 | 3.51 | -11.973 | -30.00 | -9.49 |
| 3.85 | -23.812 | -41.84 | 3.36 | -12.713 | -30.74 | -9.64 |
| 3.9 | -29.438 | -47.47 | 3.22 | -13.836 | -31.87 | -9.78 |
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| 4 | -22.117 | -40.15 | 2.95 | -17.623 | -35.65 | -10.05 |
| 4.05 | -16.923 | -34.95 | 2.81 | -20.673 | -38.70 | -10.19 |
| 4.1 | -12.867 | -30.90 | 2.68 | -25.045 | -43.08 | -10.32 |
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| 4.2 | -7.341 | -25.37 | 2.42 | -31.13 | -49.16 | -10.58 |
| 4.25 | -5.512 | -23.54 | 2.29 | -27.198 | -45.23 | -10.71 |
| 4.3 | -4.159 | -22.19 | 2.16 | -25.042 | -43.07 | -10.84 |
| 4.35 | -3.215 | -21.25 | 2.04 | -24.304 | -42.33 | -10.96 |
| 4.4 | -2.638 | -20.67 | 1.91 | -24.686 | -42.72 | -11.09 |
| 4.45 | -2.397 | -20.43 | 1.79 | -26.202 | -44.23 | -11.21 |

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|---|---|---|---|---|---|---|
| 4.5 | -2.478 | -20.51 | 1.67 | -29.216 | -47.25 | -11.33 |
| 4.55 | -2.871 | -20.90 | 1.55 | -34.646 | -52.68 | -11.45 |
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| 4.65 | -4.601 | -22.63 | 1.31 | -30.349 | -48.38 | -11.69 |
| 4.7 | -5.96 | -23.99 | 1.20 | -26.474 | -44.50 | -11.80 |
| 4.75 | -7.668 | -25.70 | 1.08 | -24.217 | -42.25 | -11.92 |
| 4.8 | -9.713 | -27.74 | 0.97 | -22.974 | -41.00 | -12.03 |
| 4.85 | -11.869 | -29.90 | 0.86 | -22.5 | -40.53 | -12.14 |
| 4.9 | -13.15 | -31.18 | 0.75 | -22.718 | -40.75 | -12.25 |
| 4.95 | -12.142 | -30.17 | 0.63 | -23.666 | -41.70 | -12.37 |
| 5 | -9.566 | -27.60 | 0.53 | -25.531 | -43.56 | -12.47 |
| 5.05 | -6.808 | -24.84 | 0.42 | -28.755 | -46.79 | -12.58 |
| 5.1 | -4.316 | -22.35 | 0.31 | -33.551 | -51.58 | -12.69 |
| 5.15 | -2.145 | -20.18 | 0.20 | -32.13 | -50.16 | -12.80 |
| 5.2 | -0.27 | -18.30 | 0.10 | -26.592 | -44.62 | -12.90 |
| 5.25 | 1.339 | -16.69 | 0.00 | -22.721 | -40.75 | -13.00 |
| 5.3 | 2.708 | -15.32 | -0.11 | -19.981 | -38.01 | -13.11 |
| 5.35 | 3.859 | -14.17 | -0.21 | -17.93 | -35.96 | -13.21 |
| 5.4 | 4.811 | -13.22 | -0.31 | -16.339 | -34.37 | -13.31 |
| 5.45 | 5.579 | -12.45 | -0.41 | -15.08 | -33.11 | -13.41 |
| 5.5 | 6.178 | -11.85 | -0.51 | -14.071 | -32.10 | -13.51 |
| 5.55 | 6.622 | -11.41 | -0.61 | -13.263 | -31.29 | -13.61 |
| 5.6 | 6.922 | -11.11 | -0.70 | -12.621 | -30.65 | -13.70 |
| 5.65 | 7.092 | -10.94 | -0.80 | -12.125 | -30.16 | -13.80 |
| 5.7 | 7.142 | -10.89 | -0.90 | -11.764 | -29.79 | -13.90 |
| 5.75 | 7.085 | -10.95 | -0.99 | -11.532 | -29.56 | -13.99 |
| 5.8 | 6.934 | -11.10 | -1.09 | -11.433 | -29.46 | -14.09 |
| 5.85 | 6.702 | -11.33 | -1.18 | -11.475 | -29.51 | -14.18 |
| 5.9 | 6.406 | -11.62 | -1.27 | -11.671 | -29.70 | -14.27 |
| 5.95 | 6.06 | -11.97 | -1.36 | -12.038 | -30.07 | -14.36 |
| 6 | 5.682 | -12.35 | -1.45 | -12.602 | -30.63 | -14.45 |
| 6.05 | 5.291 | -12.74 | -1.54 | -13.399 | -31.43 | -14.54 |
| 6.1 | 4.904 | -13.13 | -1.63 | -14.479 | -32.51 | -14.63 |
| 6.15 | 4.536 | -13.49 | -1.72 | -15.923 | -33.95 | -14.72 |
| 6.2 | 4.201 | -13.83 | -1.81 | -17.861 | -35.89 | -14.81 |
| 6.25 | 3.903 | -14.13 | -1.90 | -20.53 | -38.56 | -14.90 |
| 6.3 | 3.639 | -14.39 | -1.98 | -24.338 | -42.37 | -14.98 |
| 6.35 | 3.399 | -14.63 | -2.07 | -28.932 | -46.96 | -15.07 |
| 6.4 | 3.163 | -14.87 | -2.15 | -27.455 | -45.49 | -15.15 |
| 6.45 | 2.907 | -15.12 | -2.24 | -22.889 | -40.92 | -15.24 |
| 6.5 | 2.607 | -15.42 | -2.32 | -19.585 | -37.62 | -15.32 |
| 6.55 | 2.238 | -15.79 | -2.41 | -17.232 | -35.26 | -15.41 |
| 6.6 | 1.776 | -16.25 | -2.49 | -15.483 | -33.51 | -15.49 |
| 6.65 | 1.202 | -16.83 | -2.57 | -14.143 | -32.17 | -15.57 |
| 6.7 | 0.503 | -17.53 | -2.65 | -13.104 | -31.13 | -15.65 |
| 6.75 | -0.329 | -18.36 | -2.73 | -12.299 | -30.33 | -15.73 |
| 6.8 | -1.287 | -19.32 | -2.81 | -11.689 | -29.72 | -15.81 |
| 6.85 | -2.342 | -20.37 | -2.89 | -11.247 | -29.28 | -15.89 |
| 6.9 | -3.428 | -21.46 | -2.97 | -10.96 | -28.99 | -15.97 |

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|---|---|---|---|---|---|---|
| 6.95 | -4.421 | -22.45 | -3.05 | -10.817 | -28.85 | -16.05 |
| 7 | -5.152 | -23.18 | -3.13 | -10.816 | -28.85 | -16.13 |
| 7.05 | -5.478 | -23.51 | -3.20 | -10.955 | -28.99 | -16.00 |
| 7.1 | -5.383 | -23.41 | -3.28 | -11.233 | -29.26 | -16.00 |
| 7.15 | -4.982 | -23.01 | -3.36 | -11.65 | -29.68 | -16.00 |
| 7.2 | -4.429 | -22.46 | -3.43 | -12.206 | -30.24 | -16.00 |
| 7.25 | -3.834 | -21.86 | -3.51 | -12.893 | -30.92 | -16.00 |
| 7.3 | -3.255 | -21.29 | -3.58 | -13.695 | -31.73 | -16.00 |
| 7.35 | -2.708 | -20.74 | -3.66 | -14.579 | -32.61 | -16.00 |
| 7.4 | -2.193 | -20.22 | -3.73 | -15.489 | -33.52 | -16.00 |
| 7.45 | -1.7 | -19.73 | -3.80 | -16.334 | -34.36 | -16.00 |
| 7.5 | -1.222 | -19.25 | -3.88 | -17.001 | -35.03 | -16.00 |
| 7.55 | -0.751 | -18.78 | -3.95 | -17.395 | -35.43 | -16.00 |
| 7.6 | -0.288 | -18.32 | -4.02 | -17.49 | -35.52 | -16.00 |
| 7.65 | 0.162 | -17.87 | -4.09 | -17.339 | -35.37 | -16.00 |
| 7.7 | 0.592 | -17.44 | -4.16 | -17.036 | -35.07 | -16.00 |
| 7.75 | 0.99 | -17.04 | -4.23 | -16.663 | -34.69 | -16.00 |
| 7.8 | 1.345 | -16.69 | -4.30 | -16.269 | -34.30 | -16.00 |
| 7.85 | 1.644 | -16.39 | -4.37 | -15.87 | -33.90 | -16.00 |
| 7.9 | 1.875 | -16.16 | -4.44 | -15.457 | -33.49 | -16.00 |
| 7.95 | 2.026 | -16.00 | -4.51 | -15.015 | -33.05 | -16.00 |
| 8 | 2.087 | -15.94 | -4.58 | -14.527 | -32.56 | -16.00 |
| 8.05 | 2.048 | -15.98 | -4.64 | -13.987 | -32.02 | -16.00 |
| 8.1 | 1.903 | -16.13 | -4.71 | -13.405 | -31.44 | -16.00 |
| 8.15 | 1.645 | -16.39 | -4.78 | -12.799 | -30.83 | -16.00 |
| 8.2 | 1.269 | -16.76 | -4.85 | -12.199 | -30.23 | -16.00 |
| 8.25 | 0.769 | -17.26 | -4.91 | -11.635 | -29.67 | -16.00 |
| 8.3 | 0.142 | -17.89 | -4.98 | -11.134 | -29.16 | -16.00 |
| 8.35 | -0.615 | -18.65 | -5.04 | -10.72 | -28.75 | -16.00 |
| 8.4 | -1.505 | -19.54 | -5.11 | -10.412 | -28.44 | -16.00 |
| 8.45 | -2.53 | -20.56 | -5.17 | -10.226 | -28.26 | -16.00 |
| 8.5 | -3.695 | -21.73 | -5.24 | -10.172 | -28.20 | -16.00 |
| 8.55 | -5.003 | -23.03 | -5.30 | -10.26 | -28.29 | -16.00 |
| 8.6 | -6.462 | -24.49 | -5.36 | -10.498 | -28.53 | -16.00 |
| 8.65 | -8.089 | -26.12 | -5.43 | -10.889 | -28.92 | -16.00 |
| 8.7 | -9.913 | -27.94 | -5.49 | -11.438 | -29.47 | -16.00 |
| 8.75 | -11.996 | -30.03 | -5.55 | -12.145 | -30.18 | -16.00 |
| 8.8 | -14.47 | -32.50 | -5.61 | -13.006 | -31.04 | -16.00 |
| 8.85 | -17.627 | -35.66 | -5.67 | -14.013 | -32.04 | -16.00 |
| 8.9 | -22.245 | -40.28 | -5.73 | -15.147 | -33.18 | -16.00 |
| 8.95 | -31.353 | -49.38 | -5.80 | -16.372 | -34.40 | -16.00 |
| 9 | -29.387 | -47.42 | -5.86 | -17.619 | -35.65 | -16.00 |
| 9.05 | -21.409 | -39.44 | -5.92 | -18.768 | -36.80 | -16.00 |
| 9.1 | -17.193 | -35.22 | -5.98 | -19.617 | -37.65 | -16.00 |
| 9.15 | -14.366 | -32.40 | -6.04 | -19.931 | -37.96 | -16.00 |
| 9.2 | -12.286 | -30.32 | -6.09 | -19.587 | -37.62 | -16.00 |
| 9.25 | -10.7 | -28.73 | -6.15 | -18.697 | -36.73 | |
| 9.3 | -9.486 | -27.52 | -6.21 | -17.517 | -35.55 | |
| 9.35 | -8.577 | -26.61 | -6.27 | -16.27 | -34.30 | |

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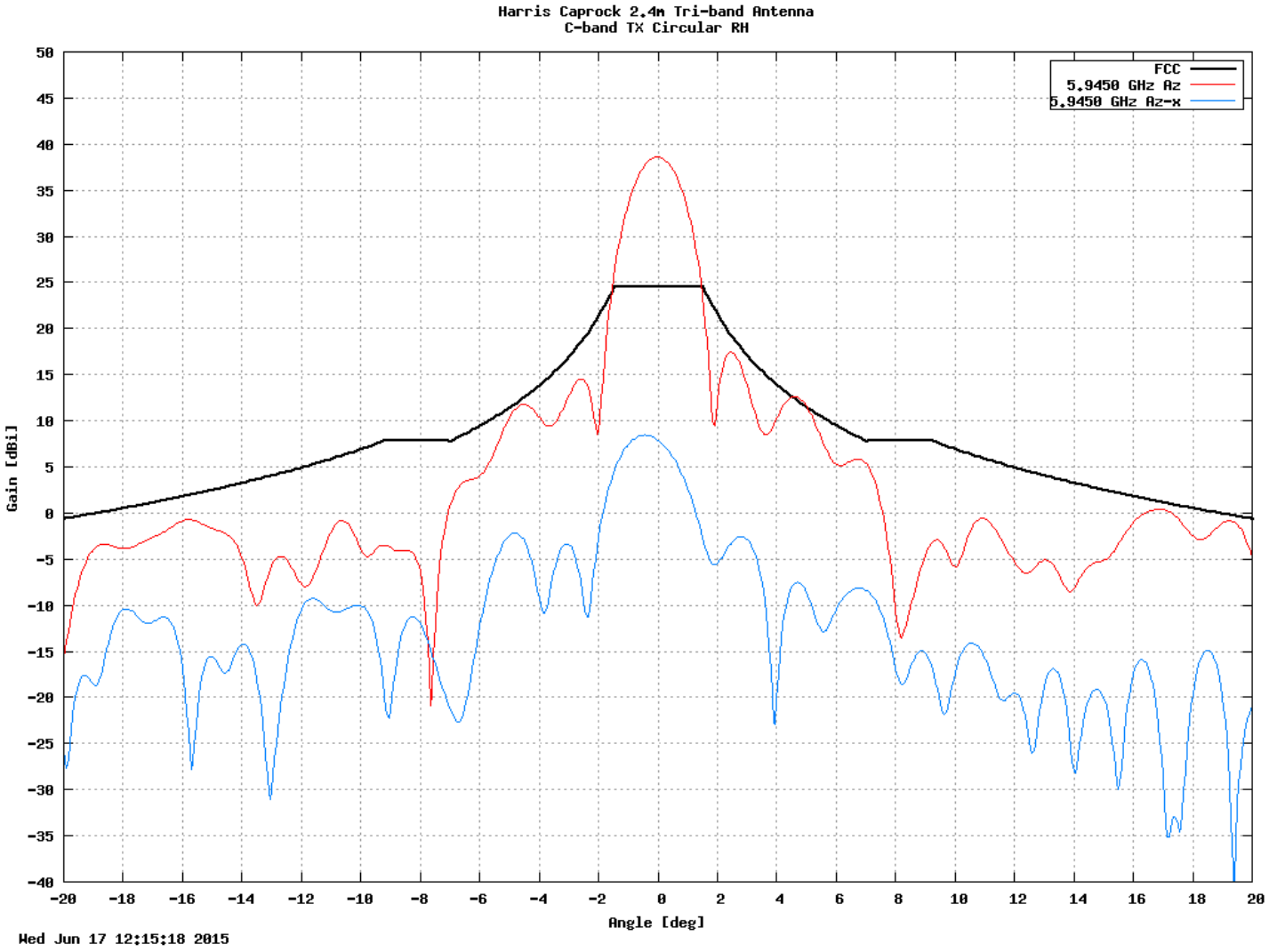
|---|---|---|---|---|---|
| 9.4 | -7.933 | -25.96 | -6.33 | -15.091 | -33.12 |
| 9.45 | -7.526 | -25.56 | -6.39 | -14.049 | -32.08 |
| 9.5 | -7.338 | -25.37 | -6.44 | -13.176 | -31.21 |
| 9.55 | -7.351 | -25.38 | -6.50 | -12.481 | -30.51 |
| 9.6 | -7.549 | -25.58 | -6.56 | -11.967 | -30.00 |
| 9.65 | -7.909 | -25.94 | -6.61 | -11.629 | -29.66 |
| 9.7 | -8.403 | -26.43 | -6.67 | -11.459 | -29.49 |
| 9.75 | -8.989 | -27.02 | -6.73 | -11.447 | -29.48 |
| 9.8 | -9.607 | -27.64 | -6.78 | -11.577 | -29.61 |
| 9.85 | -10.177 | -28.21 | -6.84 | -11.831 | -29.86 |
| 9.9 | -10.61 | -28.64 | -6.89 | -12.182 | -30.21 |
| 9.95 | -10.832 | -28.86 | -6.95 | -12.6 | -30.63 |
| 10 | -10.81 | -28.84 | -7.00 | -13.049 | -31.08 |
| 15 | -7.557 | -25.59 | -11.40 | | |
| 20 | -7.954 | -25.98 | -14.53 | | |
| 25 | -7.65 | -25.68 | -16.95 | | |
| 30 | -17.019 | -35.05 | -18.93 | | |
| 35 | -12.788 | -30.82 | -20.60 | | |
| 40 | -16.7 | -34.73 | -22.05 | | |
| 45 | -15.843 | -33.87 | -23.33 | | |
| 50 | -10.886 | -28.92 | -24.00 | | |
| 55 | -20.175 | -38.21 | -24.00 | | |
| 60 | -17.544 | -35.57 | -24.00 | | |
| 65 | -17.186 | -35.22 | -24.00 | | |
| 70 | -14.976 | -33.01 | -24.00 | | |
| 75 | -16.772 | -34.80 | -24.00 | | |
| 80 | -32.143 | -50.17 | -24.00 | | |
| 85 | -15.91 | -33.94 | -24.00 | | |
| 90 | -17.987 | -36.02 | -14.00 | | |
| 95 | -6.108 | -24.14 | -14.00 | | |
| 100 | -17.936 | -35.97 | -14.00 | | |
| 105 | -14.972 | -33.00 | -14.00 | | |
| 110 | -16.936 | -34.97 | -14.00 | | |
| 115 | -22.611 | -40.64 | -14.00 | | |
| 120 | -23.025 | -41.06 | -14.00 | | |
| 125 | -20.408 | -38.44 | -14.00 | | |
| 130 | -17.173 | -35.20 | -14.00 | | |
| 135 | -30.315 | -48.35 | -14.00 | | |
| 140 | -11.981 | -30.01 | -14.00 | | |
| 145 | -18.143 | -36.17 | -14.00 | | |
| 150 | -14.779 | -32.81 | -14.00 | | |
| 155 | -20.374 | -38.40 | -14.00 | | |
| 160 | -17.347 | -35.38 | -14.00 | | |
| 165 | -24.322 | -42.35 | -14.00 | | |
| 170 | -21.057 | -39.09 | -14.00 | | |
| 175 | -29.421 | -47.45 | -14.00 | | |
| 180 | -20.639 | -38.67 | -14.00 | | |

# Annex 3
# C-band Antenna Gain Plots

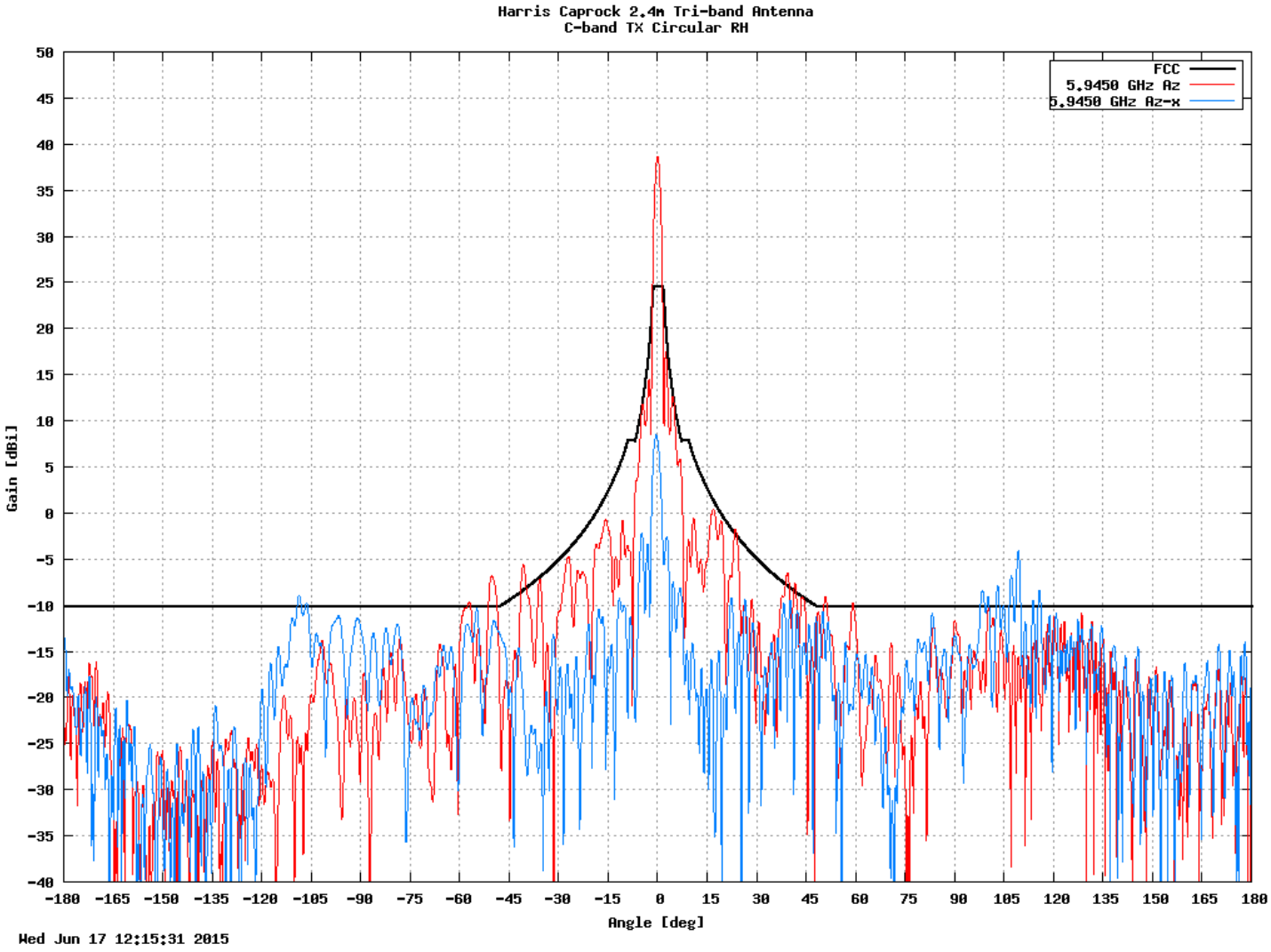
## C Band - 5.9450 GHz (Bottom of band)

**Figure 1: Azimuth (Narrow)**



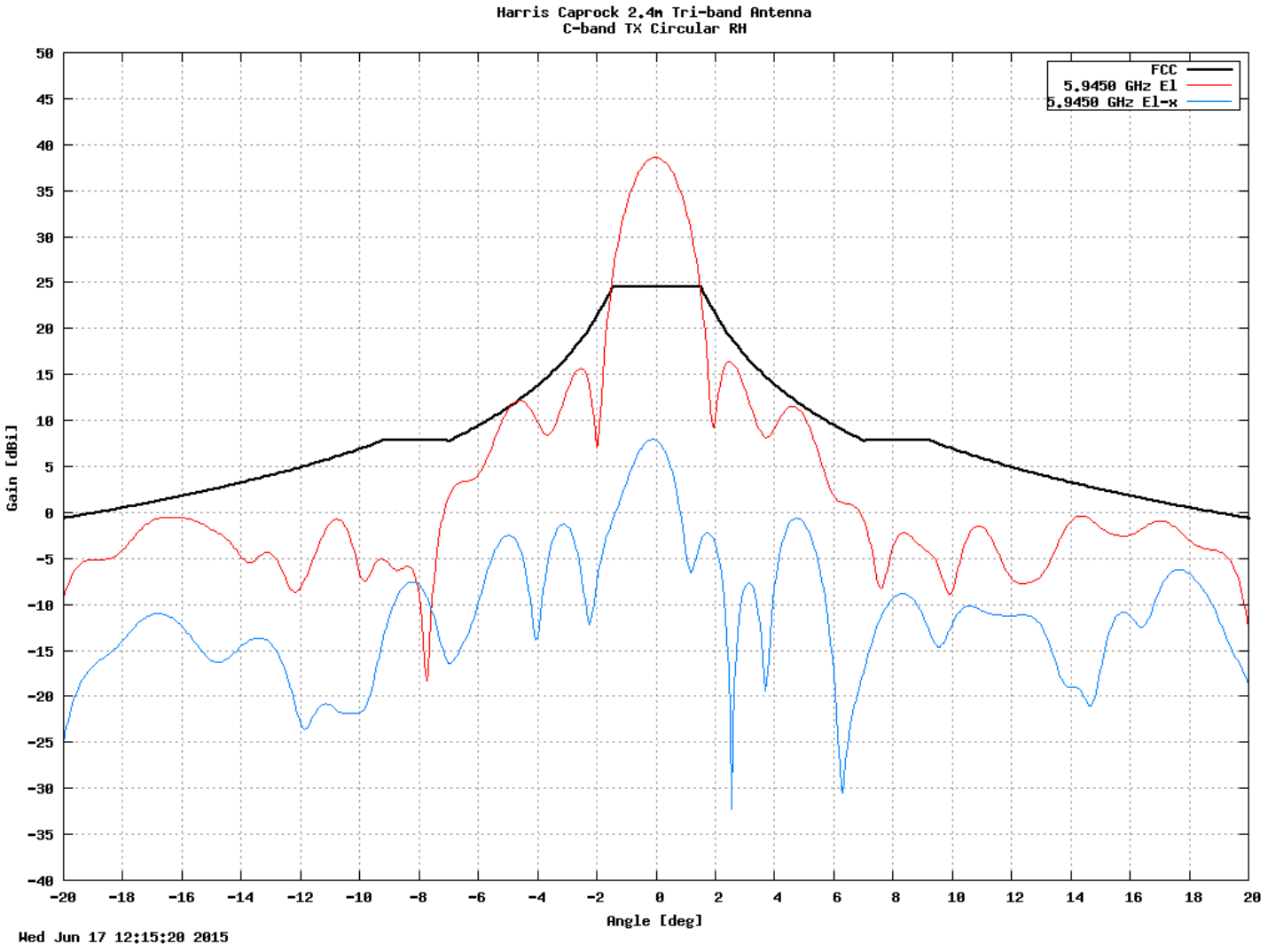
## C Band - 5.9450 GHz (Bottom of band)

### Azimuth (Wide)



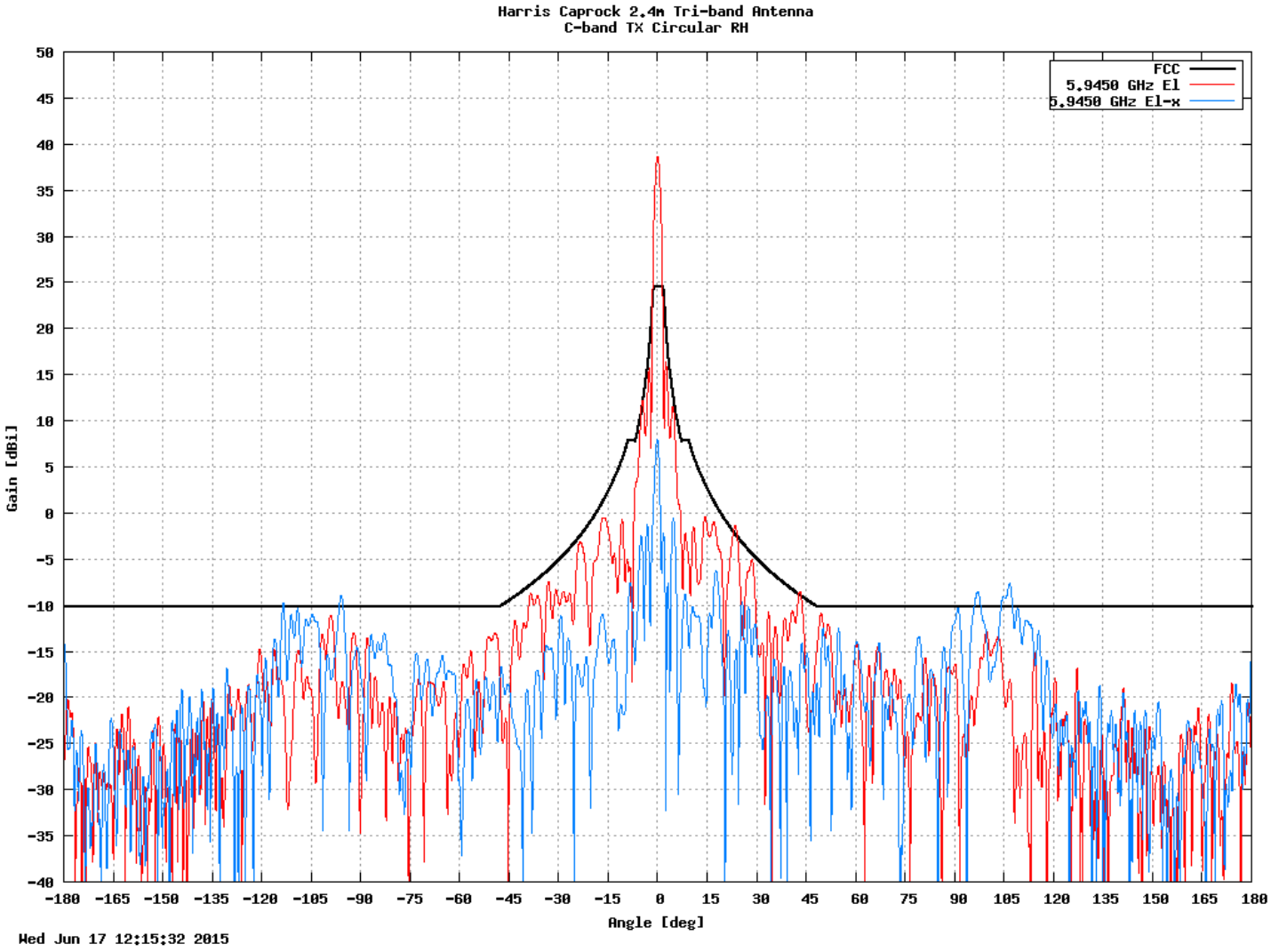
## C Band - 5.9450 GHz (Bottom of band)

### Elevation (Narrow)



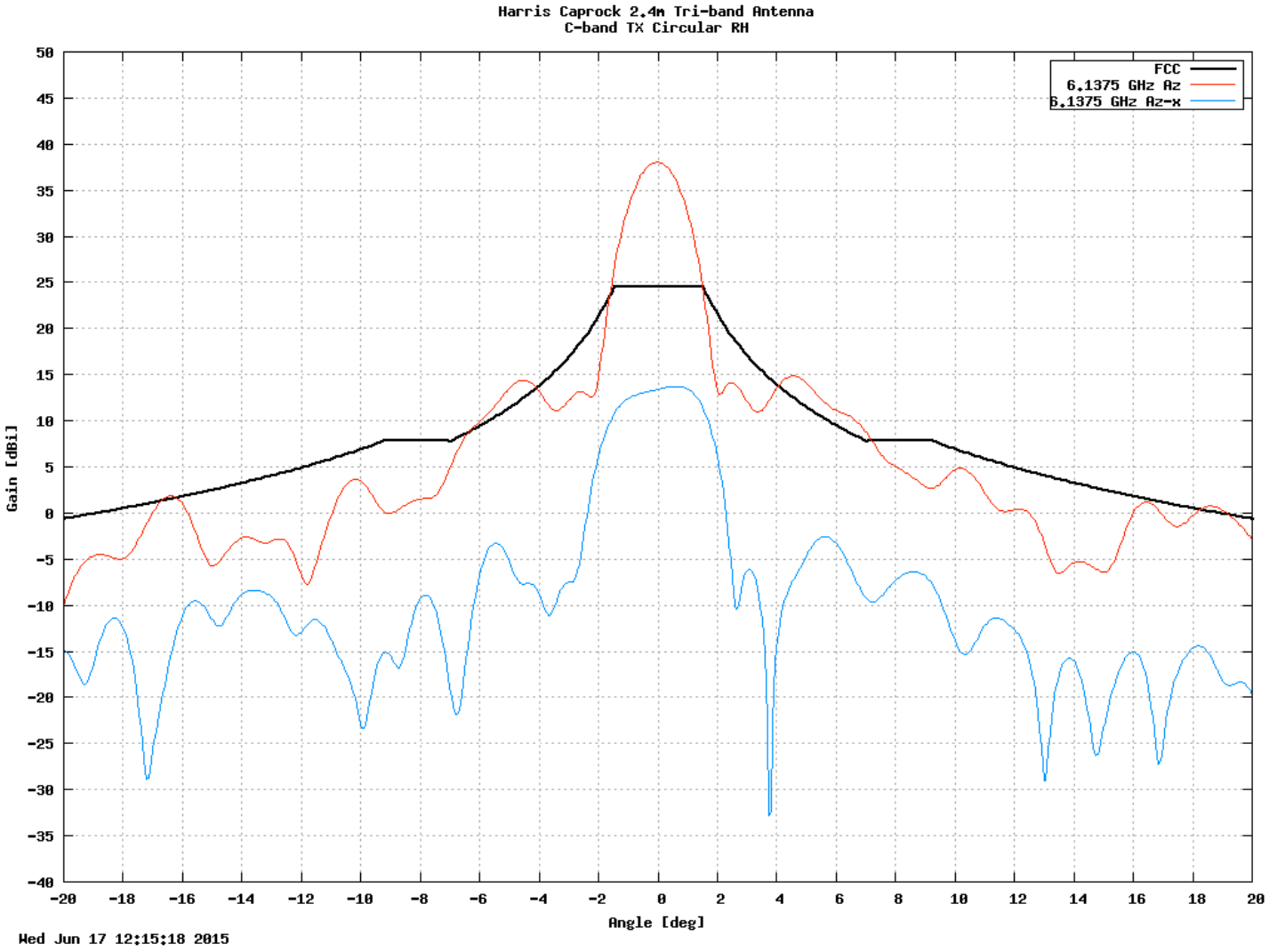
## C Band - 5.9450 GHz (Bottom of band)

### Elevation (Wide)



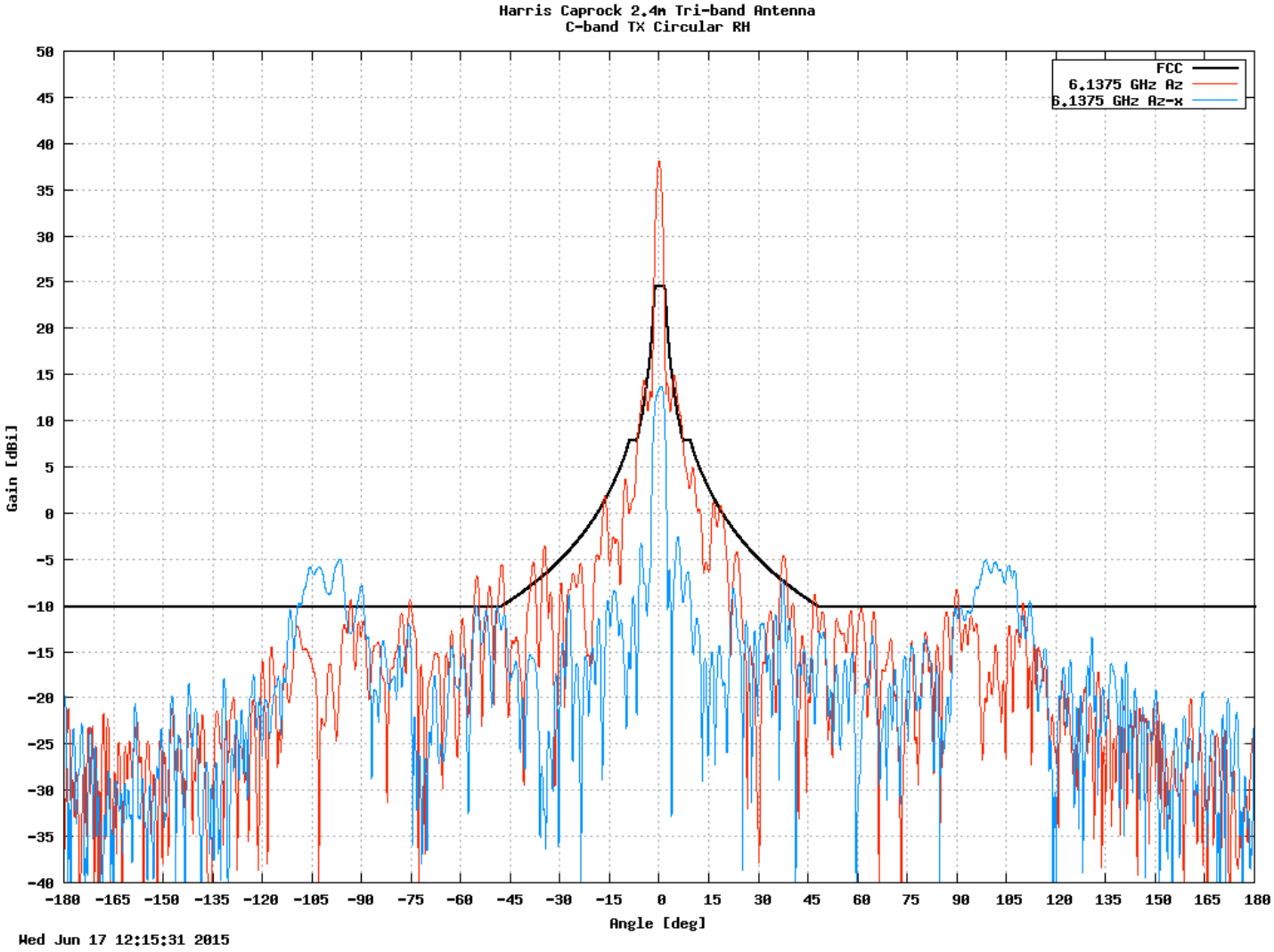
## C Band - 6.1375 GHz (Mid-band)

### Azimuth (Narrow)



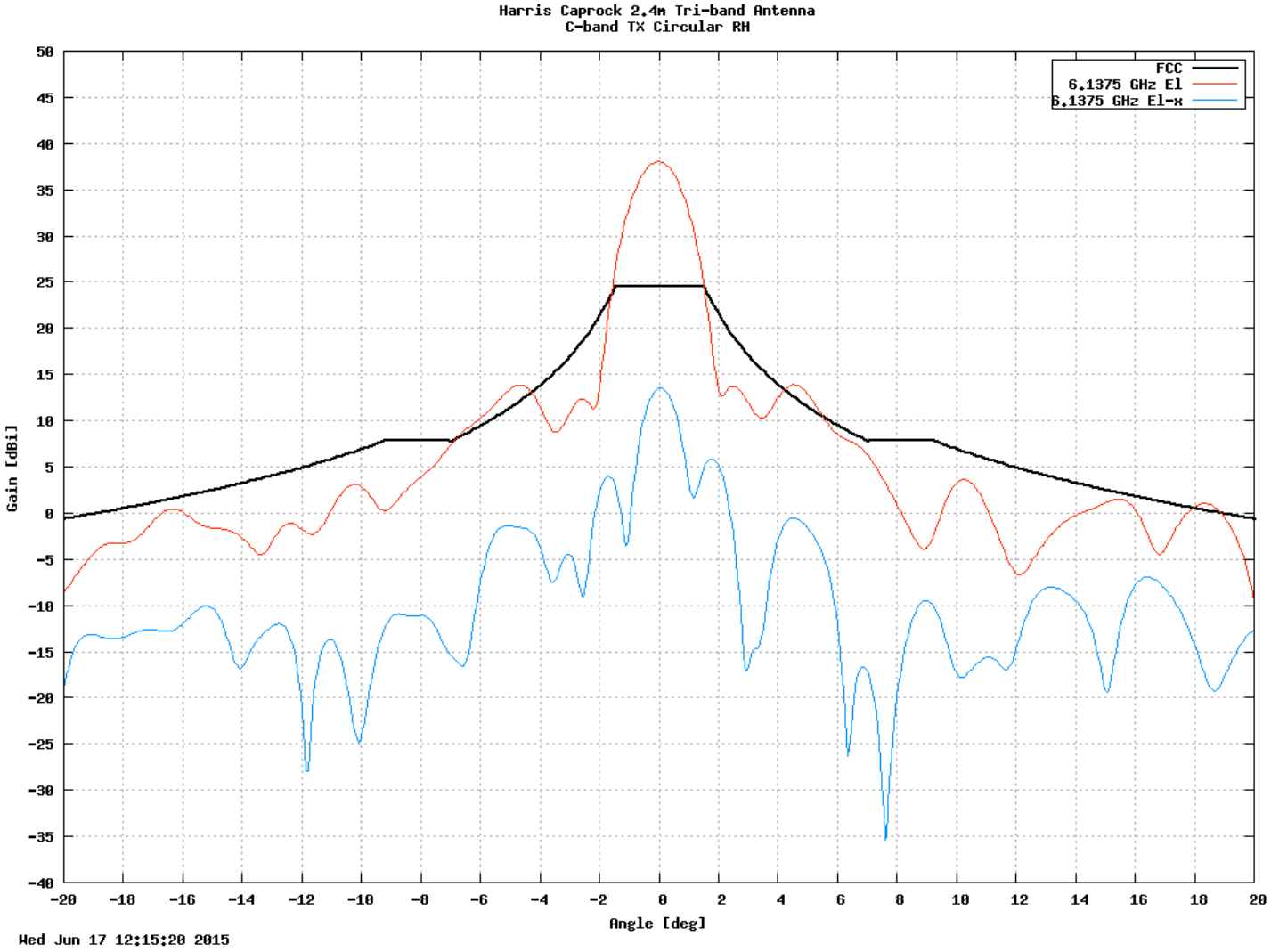
## C Band - 6.1375 GHz (Mid-band)

### Azimuth (Wide)



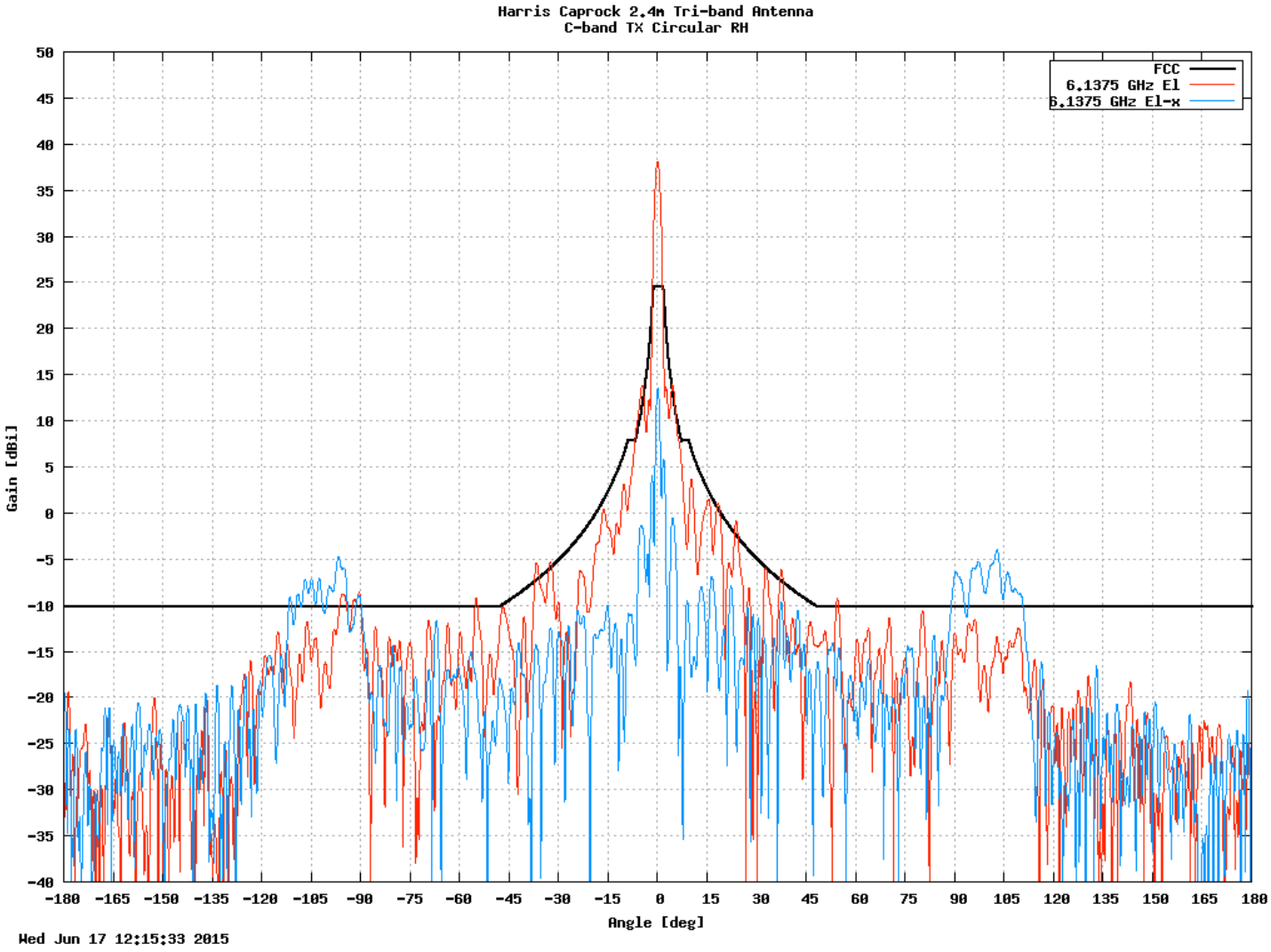
## C Band - 6.1375 GHz (Mid-band)

### Elevation (Narrow)



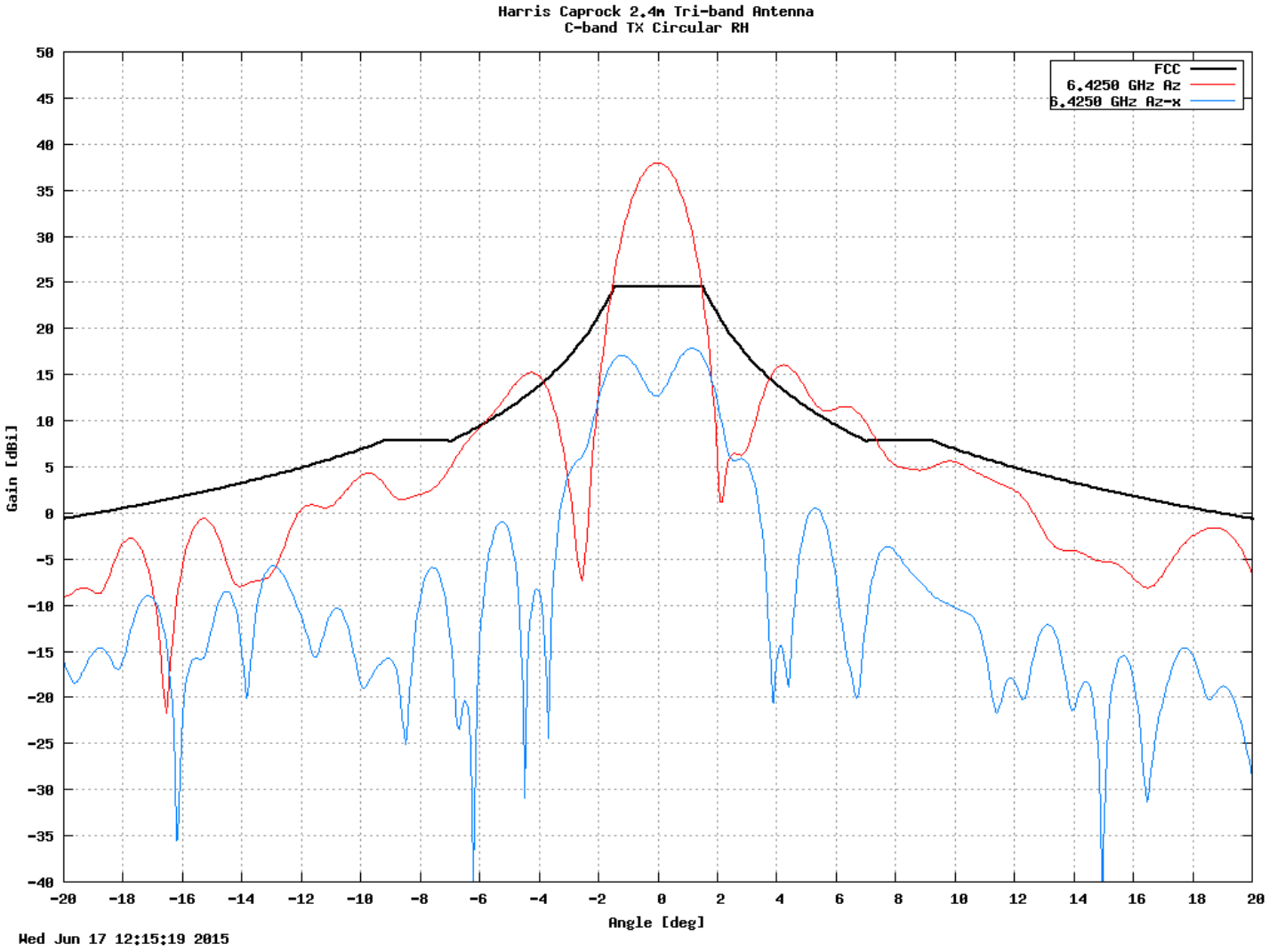
## C Band - 6.1375 GHz (Mid-band)

**Figure 4: Elevation (Wide)**



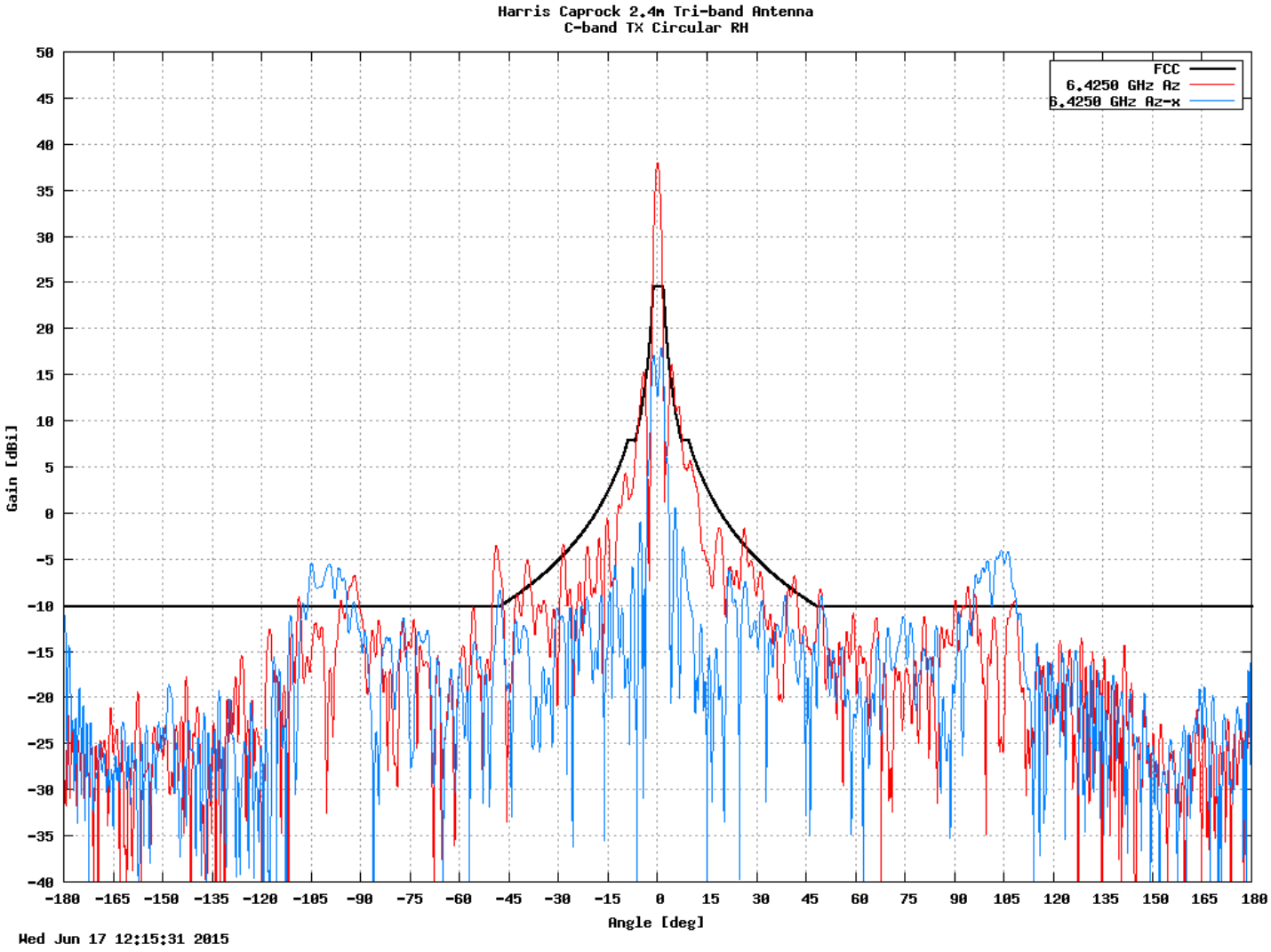
## C Band - 6.4250 GHz (Top of band)

### Azimuth (Narrow)



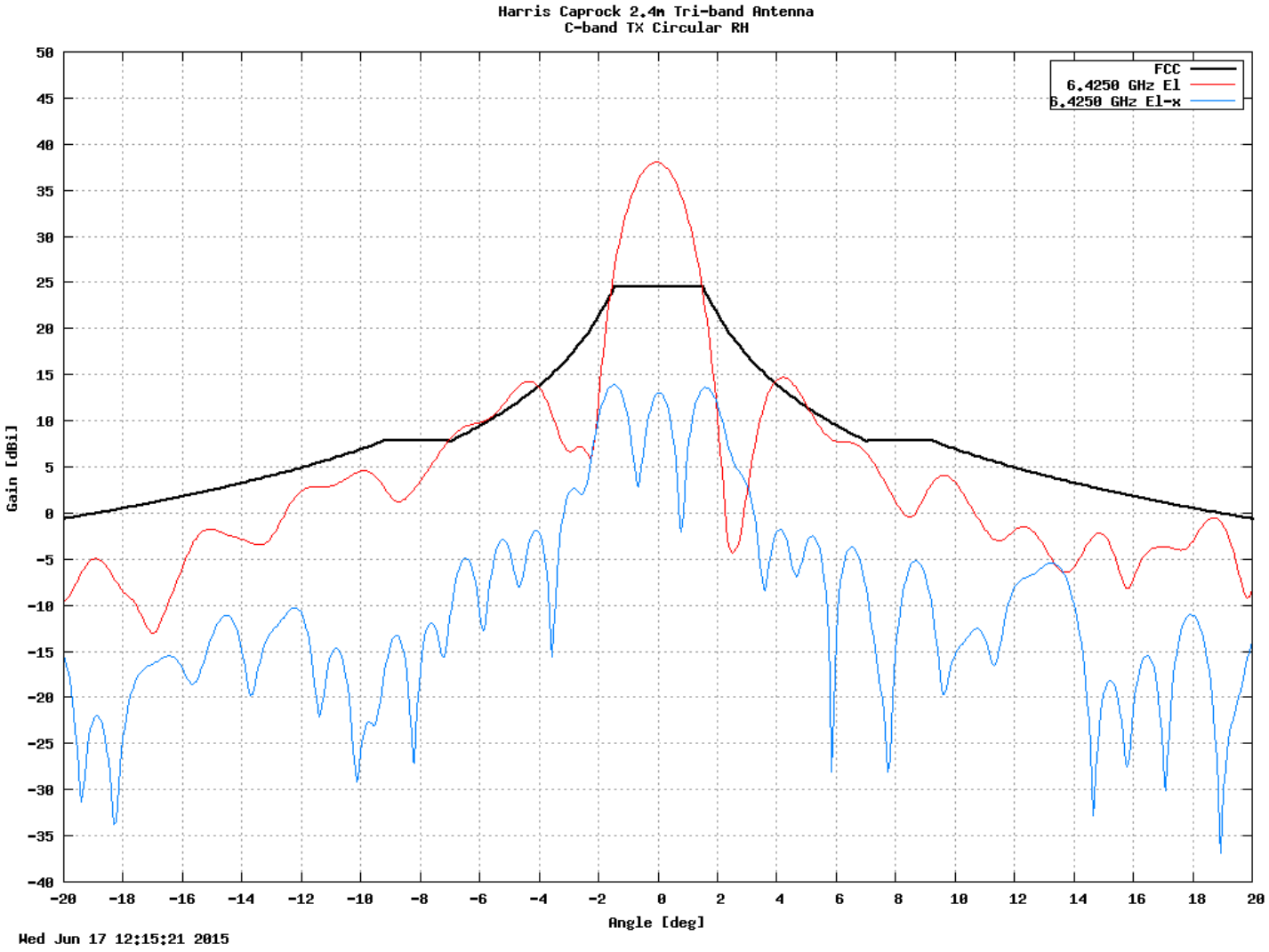
## C Band - 6.4250 GHz (Top of band)

### Azimuth (Wide)



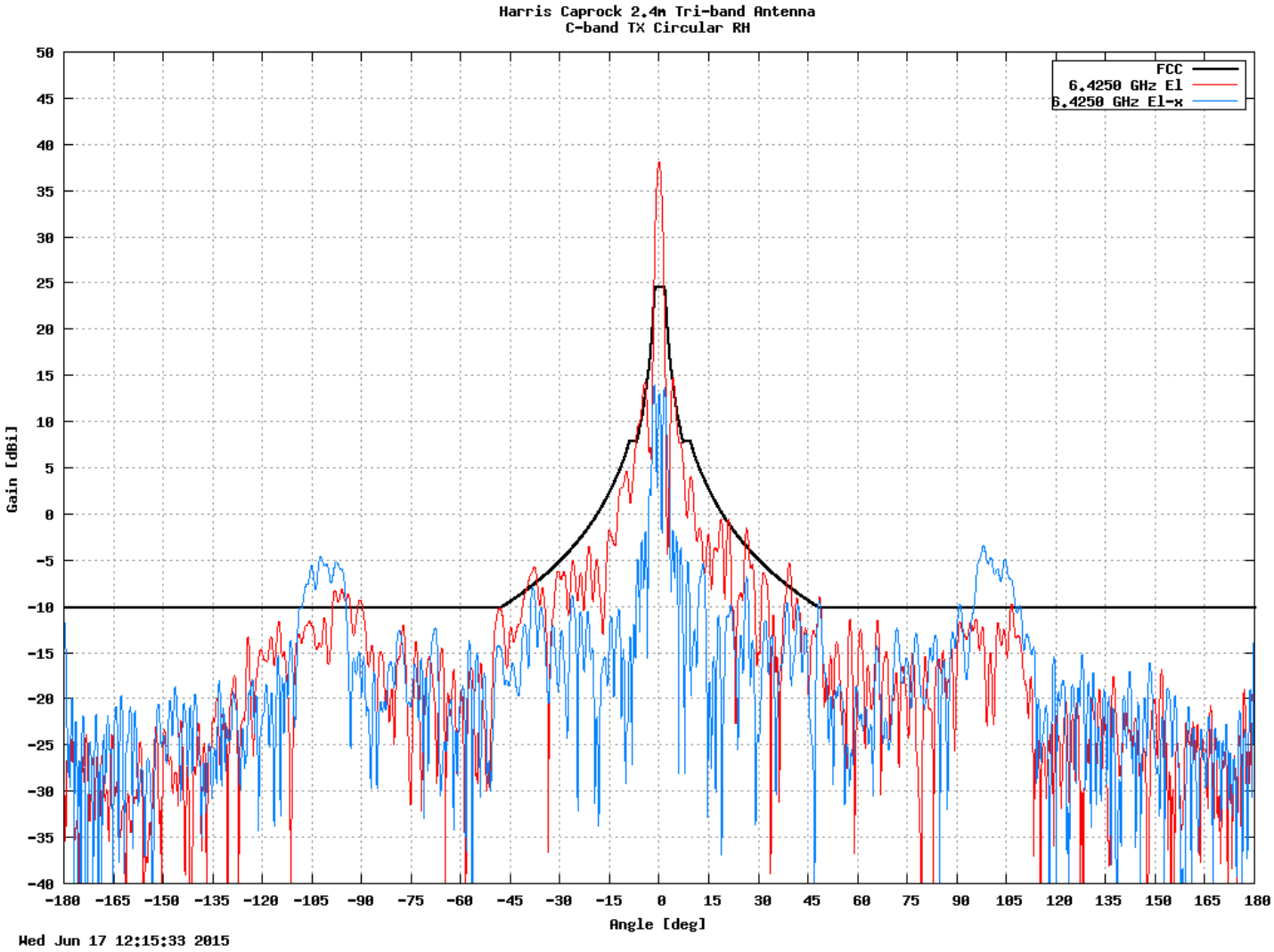
## C Band - 6.4250 GHz (Top of band)

### Elevation (Narrow)



## C Band - 6.4250 GHz (Top of band)

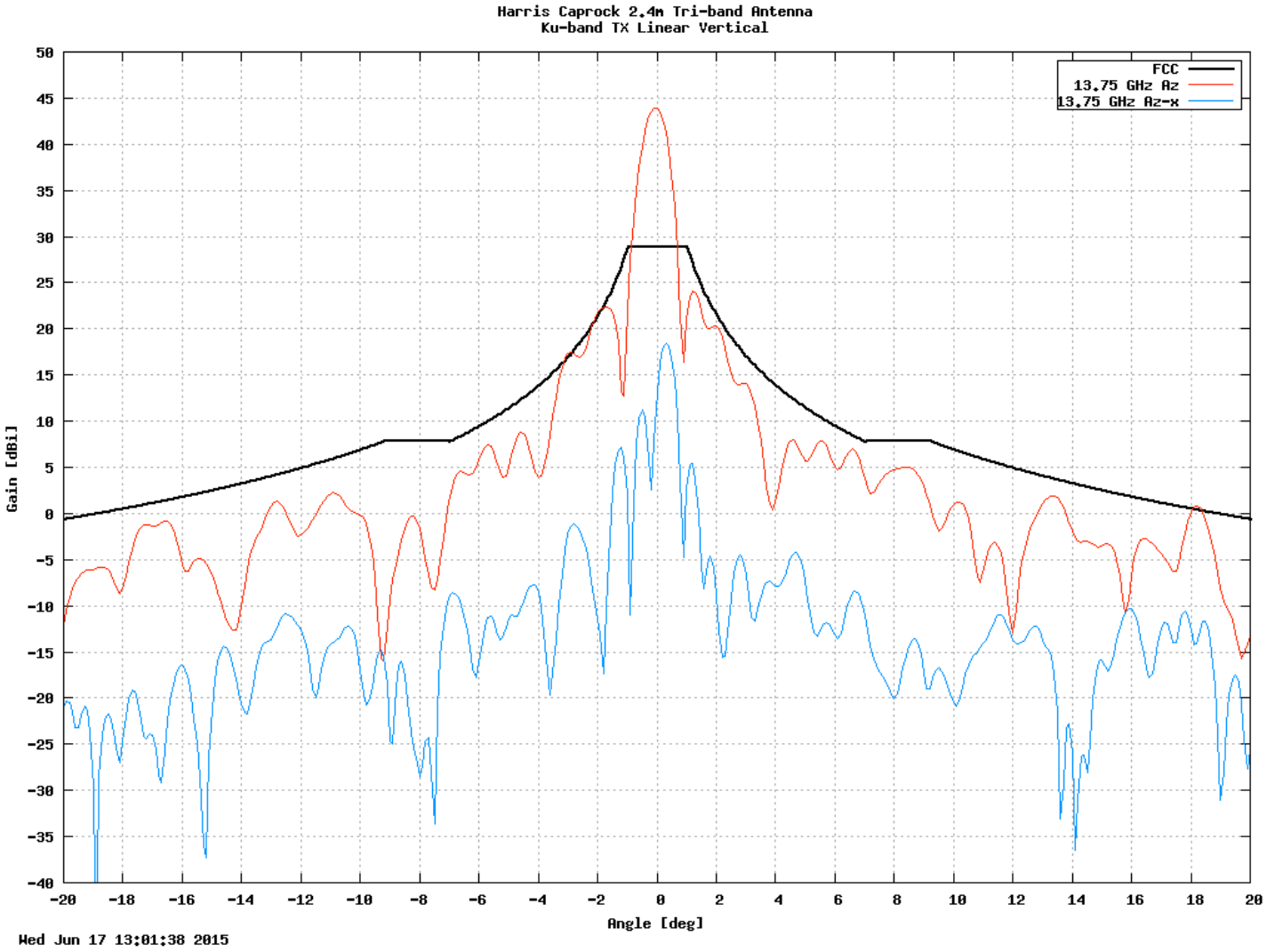
### Elevation (Wide)



# Annex 4
# Ku-band Antenna Gain Plots

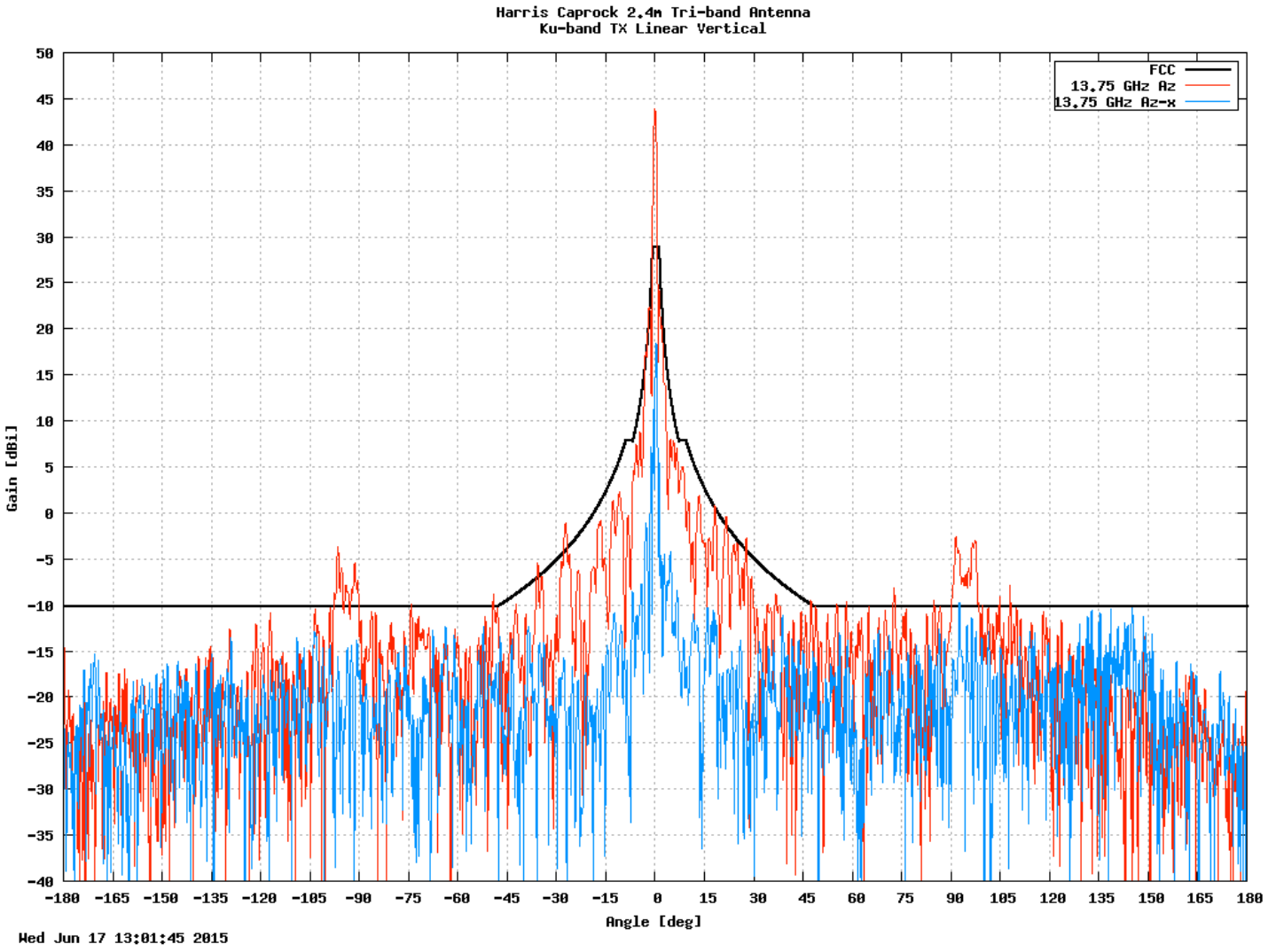
## Ku Band - 13.75 GHz (Bottom of band)

### Azimuth (Narrow)



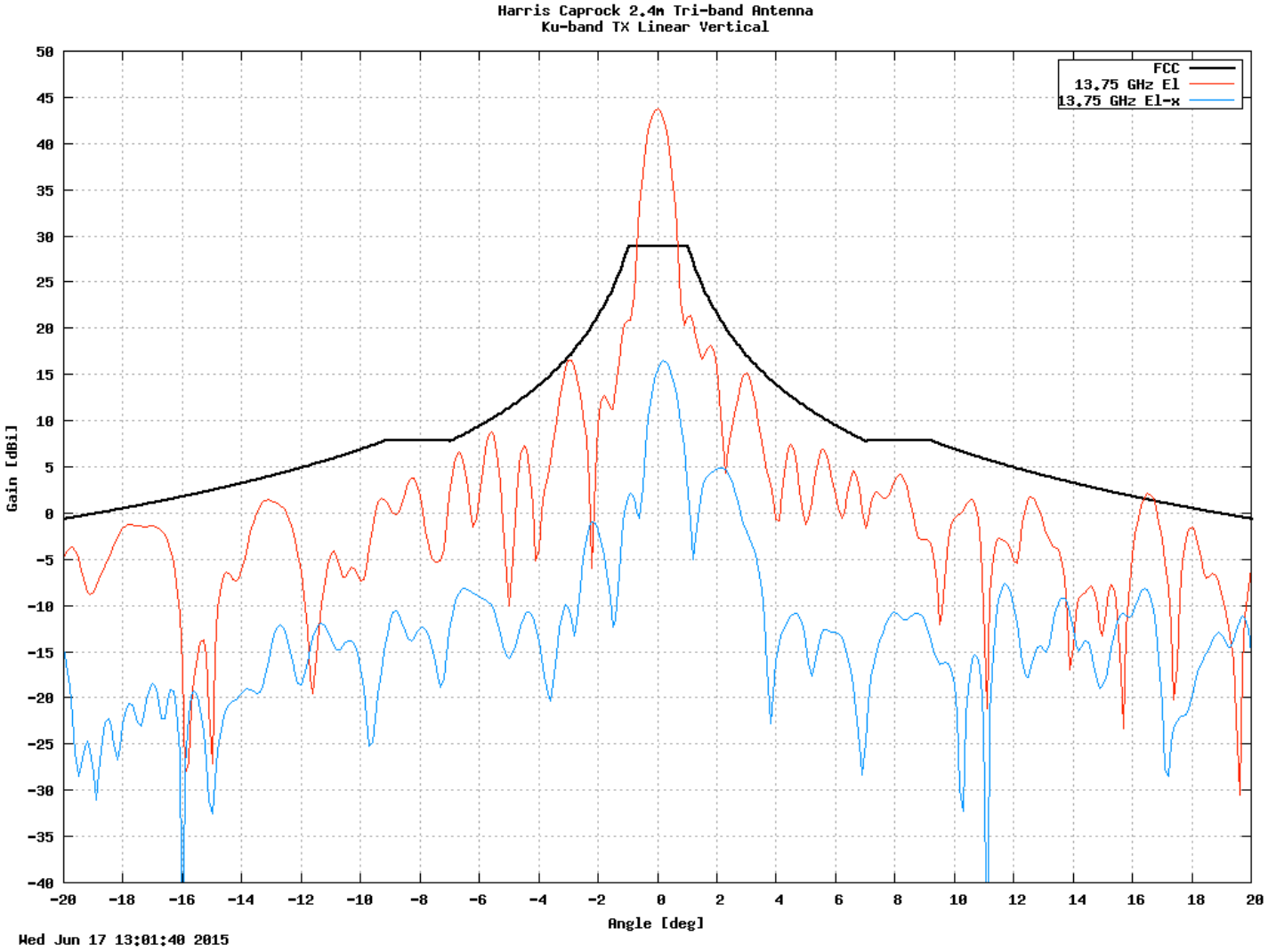
## Ku Band - 13.75 GHz (Bottom of band)

### Azimuth (Wide)



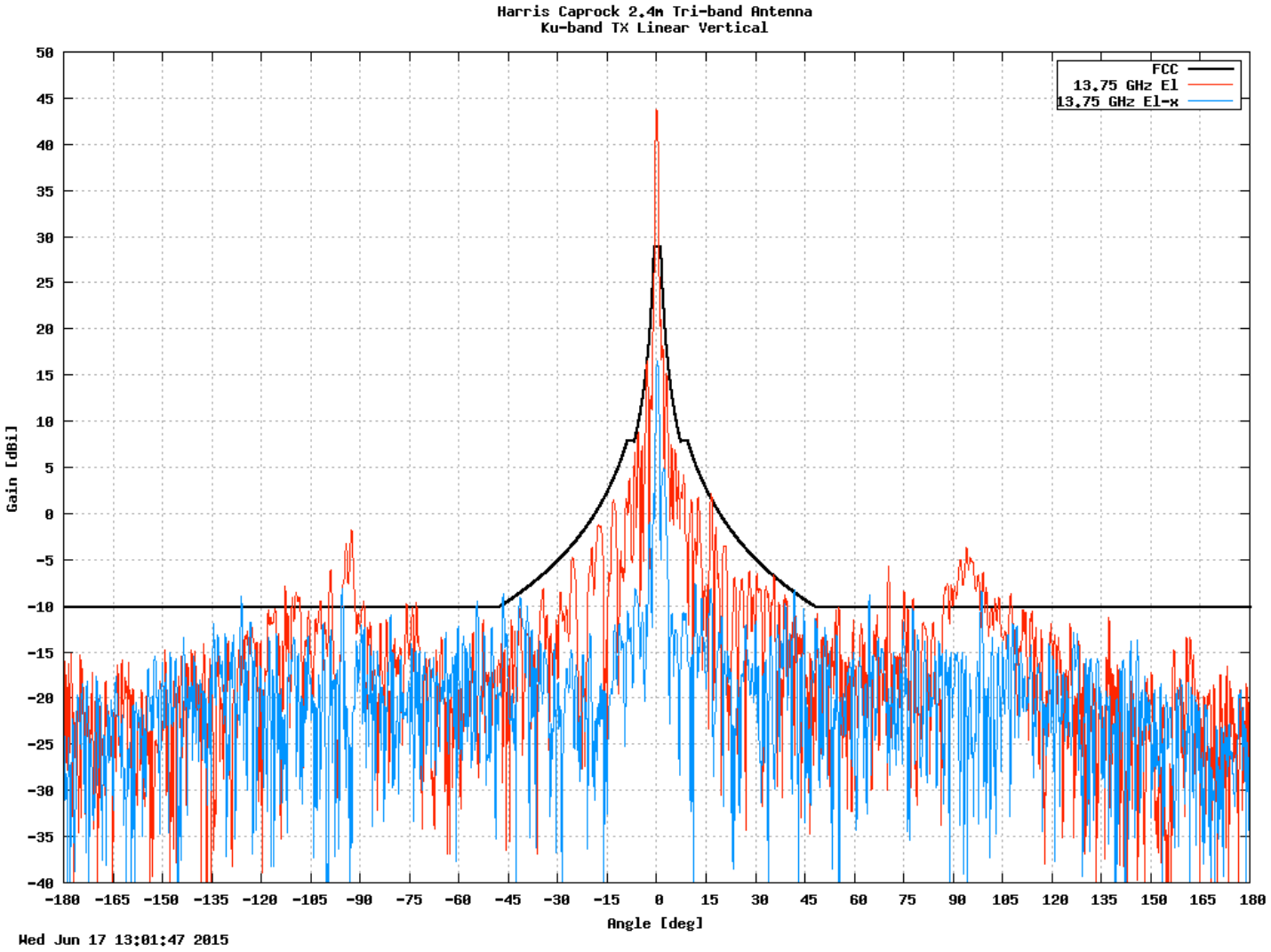
## Ku Band - 13.75 GHz (Bottom of band)

### Elevation (Narrow)



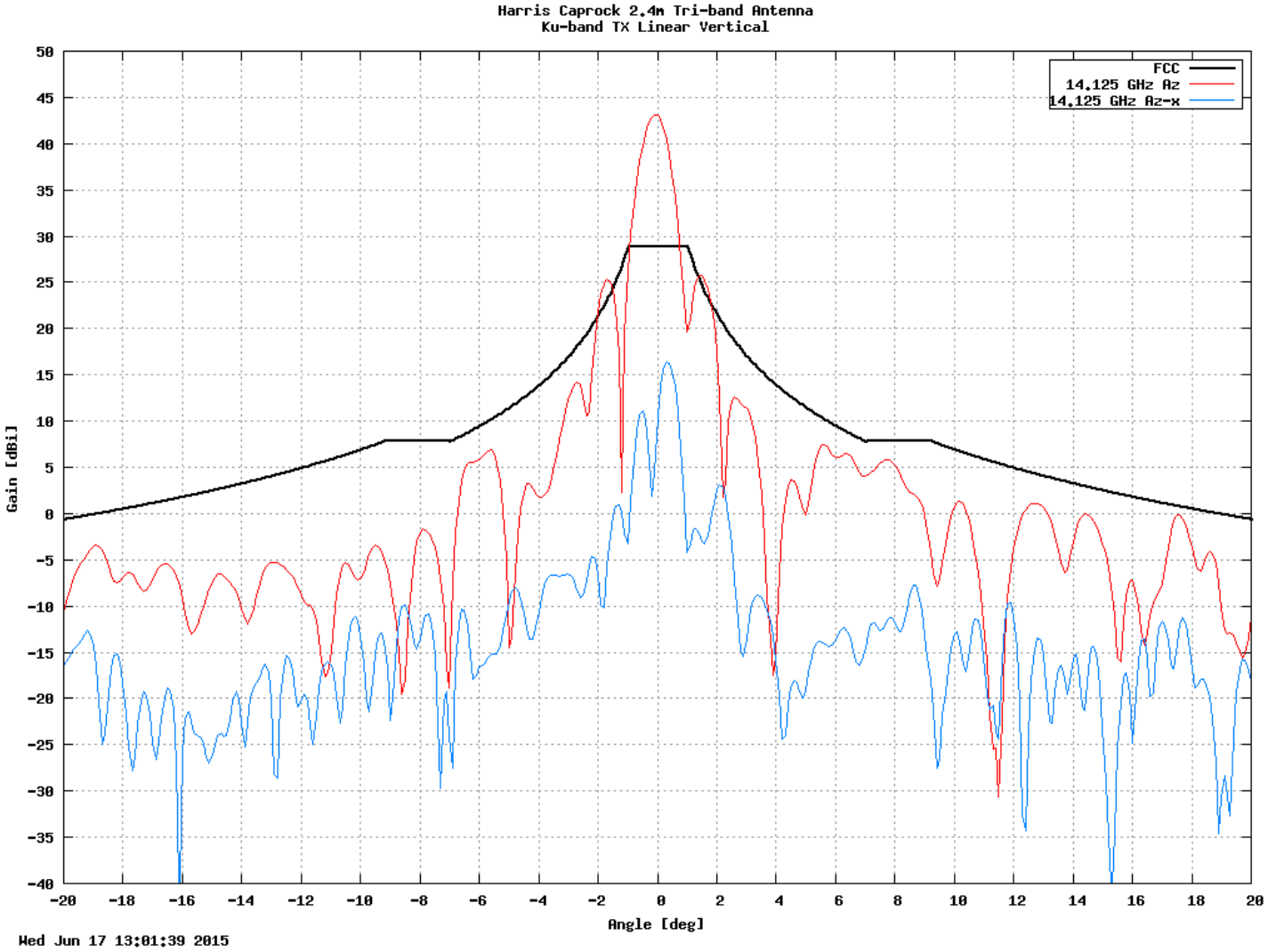
## Ku Band - 13.75 GHz (Bottom of band)

### Elevation (Wide)



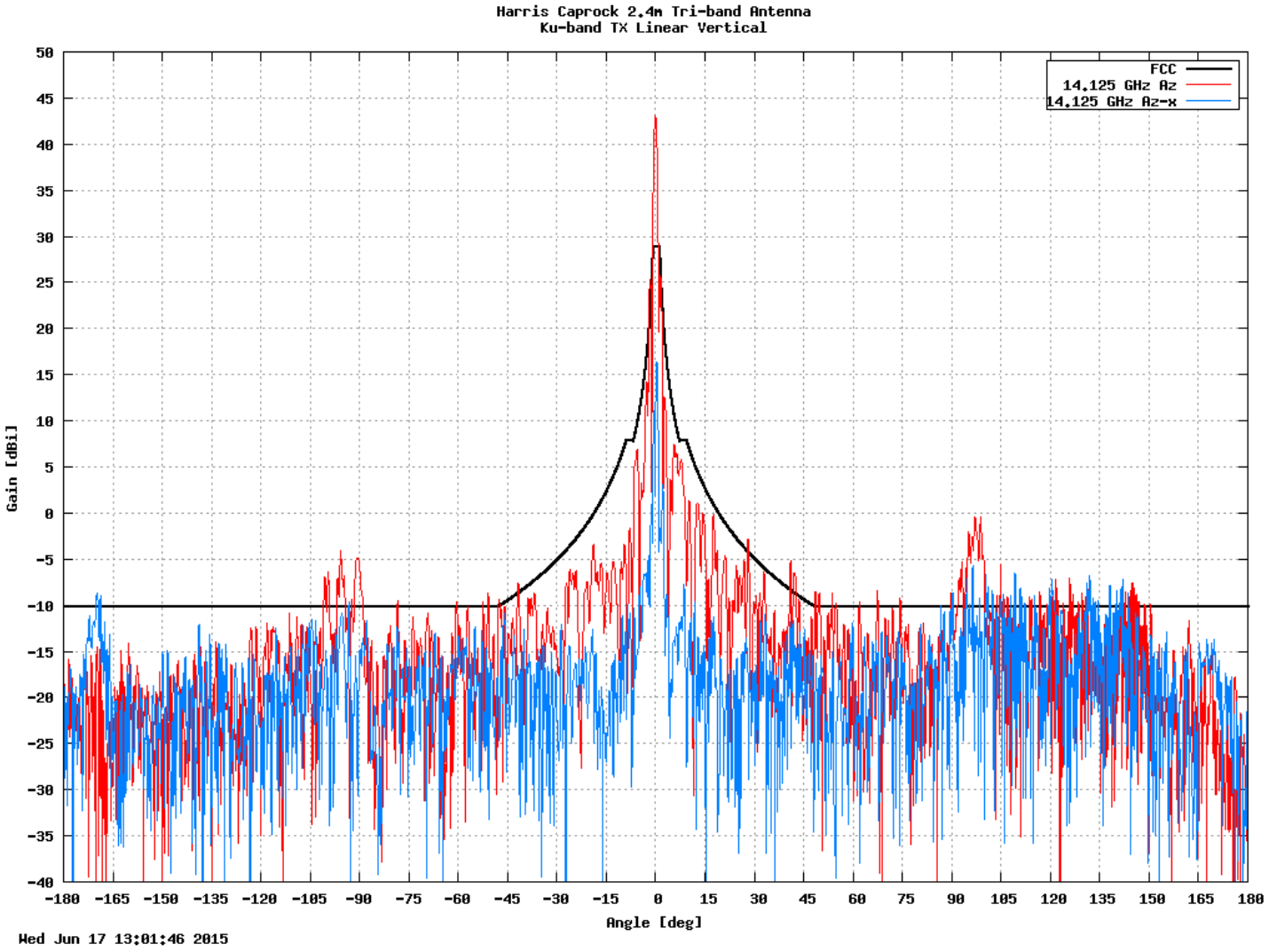
## Ku Band - 14.125 GHz (Mid-band)

### Azimuth (Narrow)



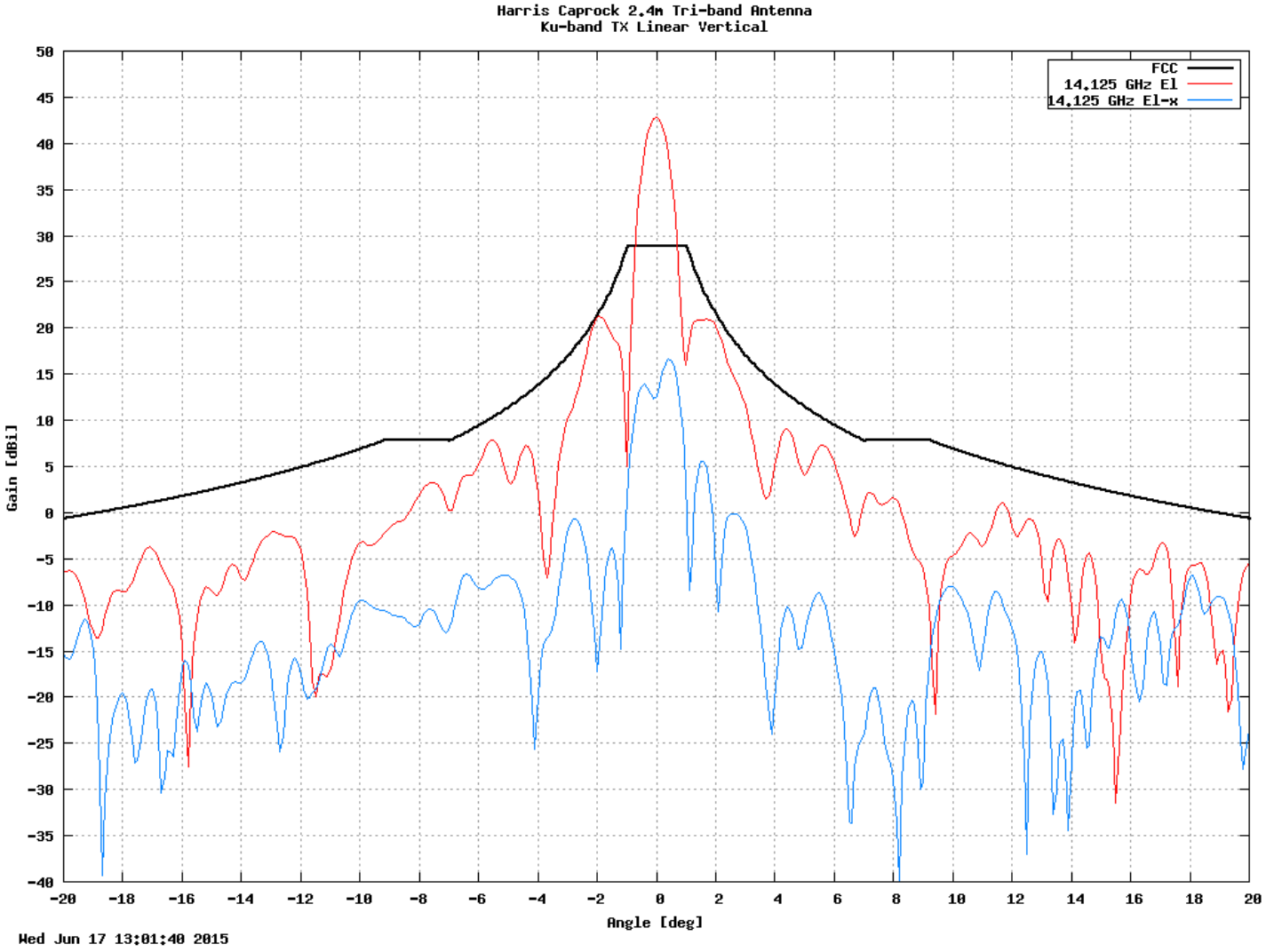
## Ku Band - 14.125 GHz (Mid-band)

### Azimuth (Wide)



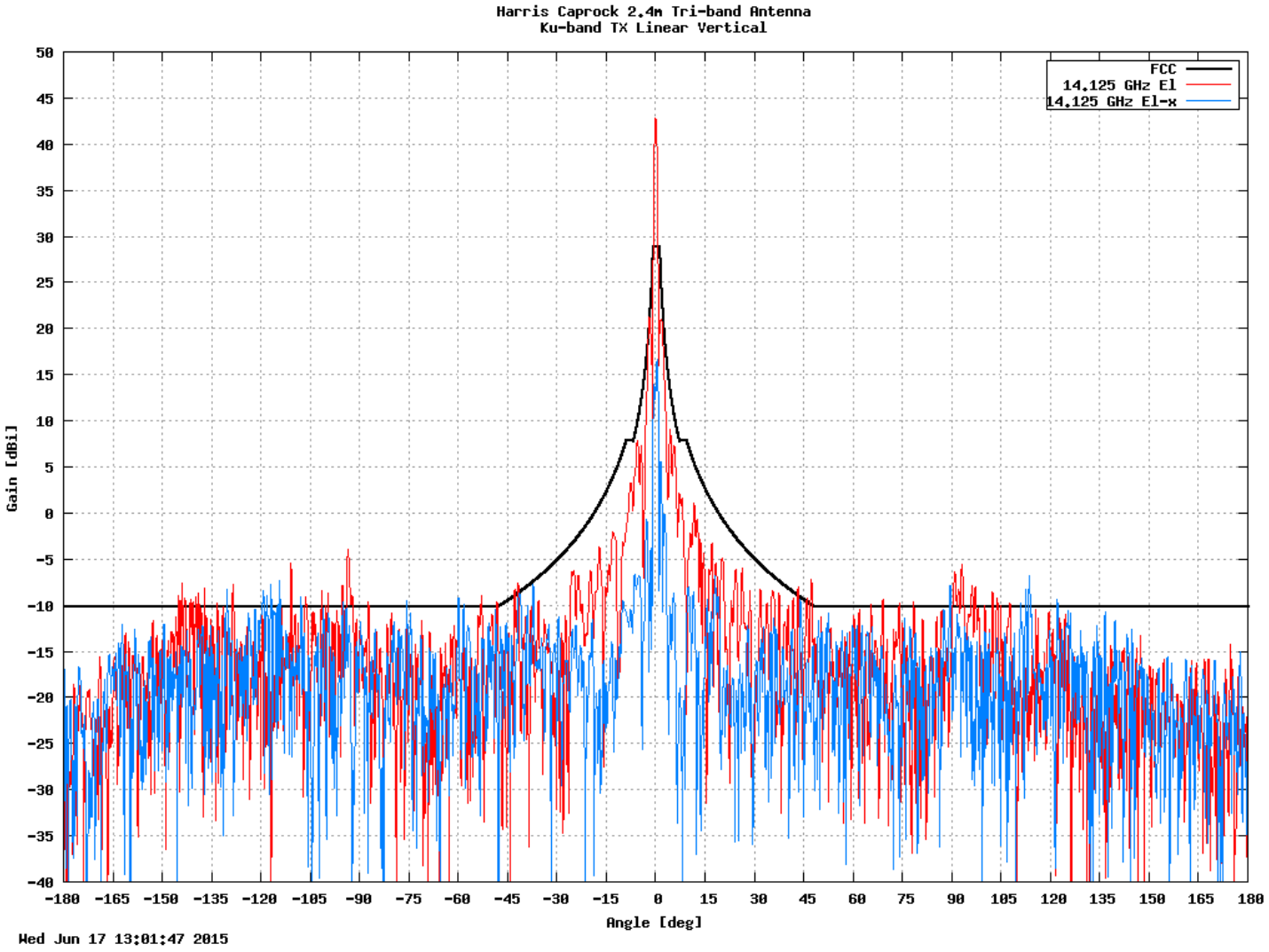
## Ku Band - 14.125 GHz (Mid-band)

### Elevation (Narrow)



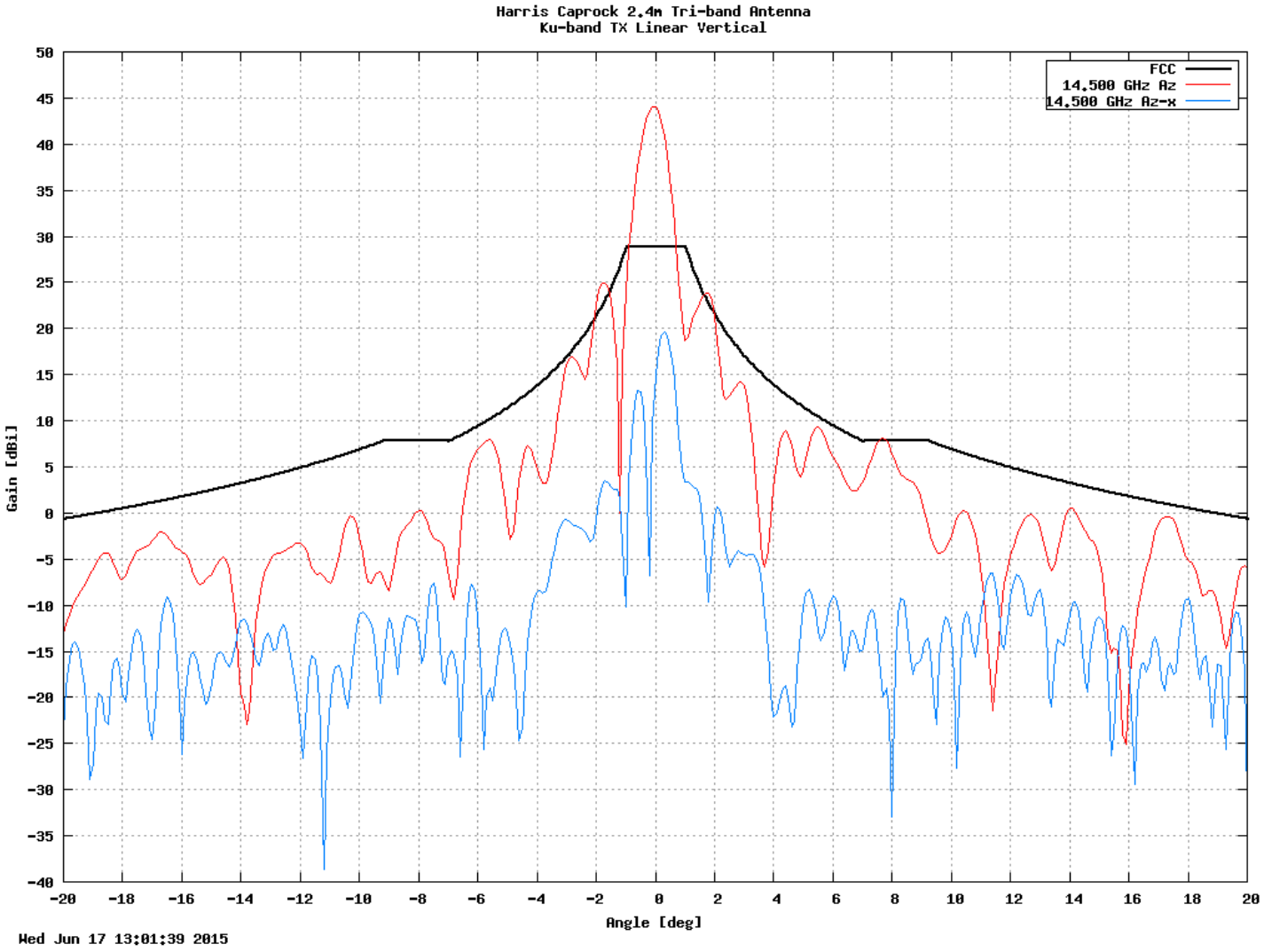
## Ku Band - 14.125 GHz (Mid-band)

### Elevation (Wide)



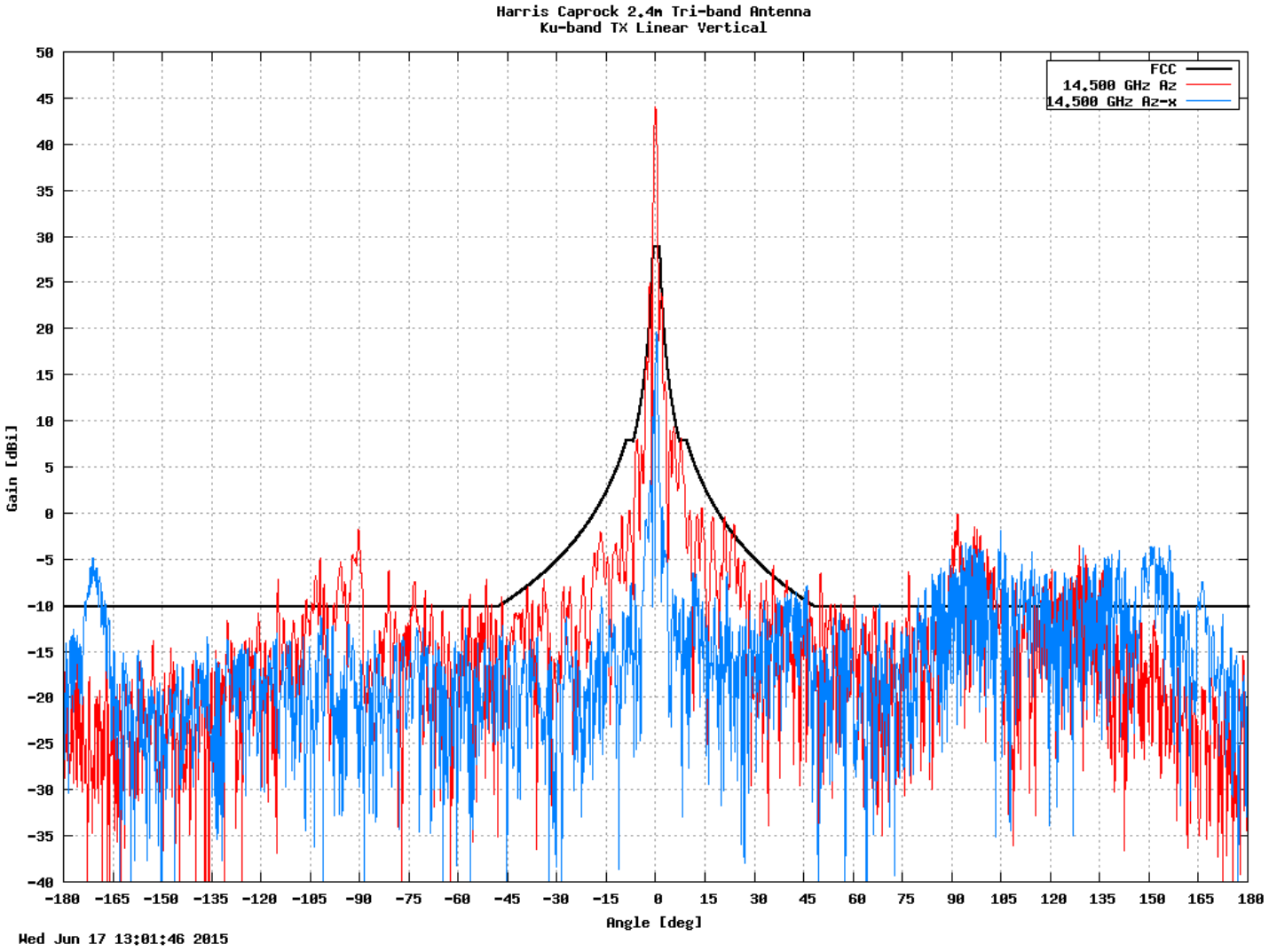
## Ku Band - 14.500 GHz (Top of band)

### Azimuth (Narrow)



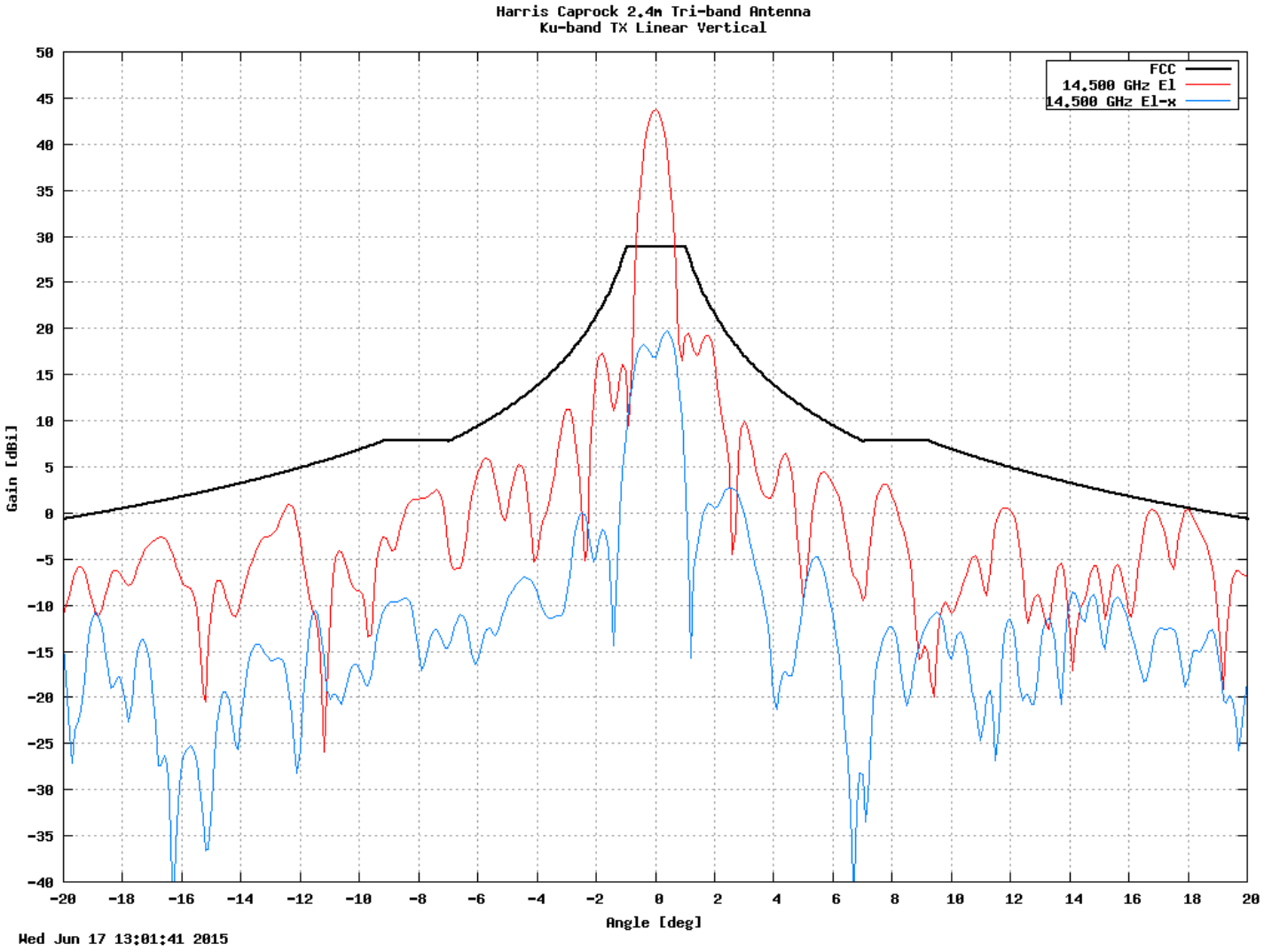
## Ku Band - 14.500 GHz (Top of band)

### Azimuth (Wide)



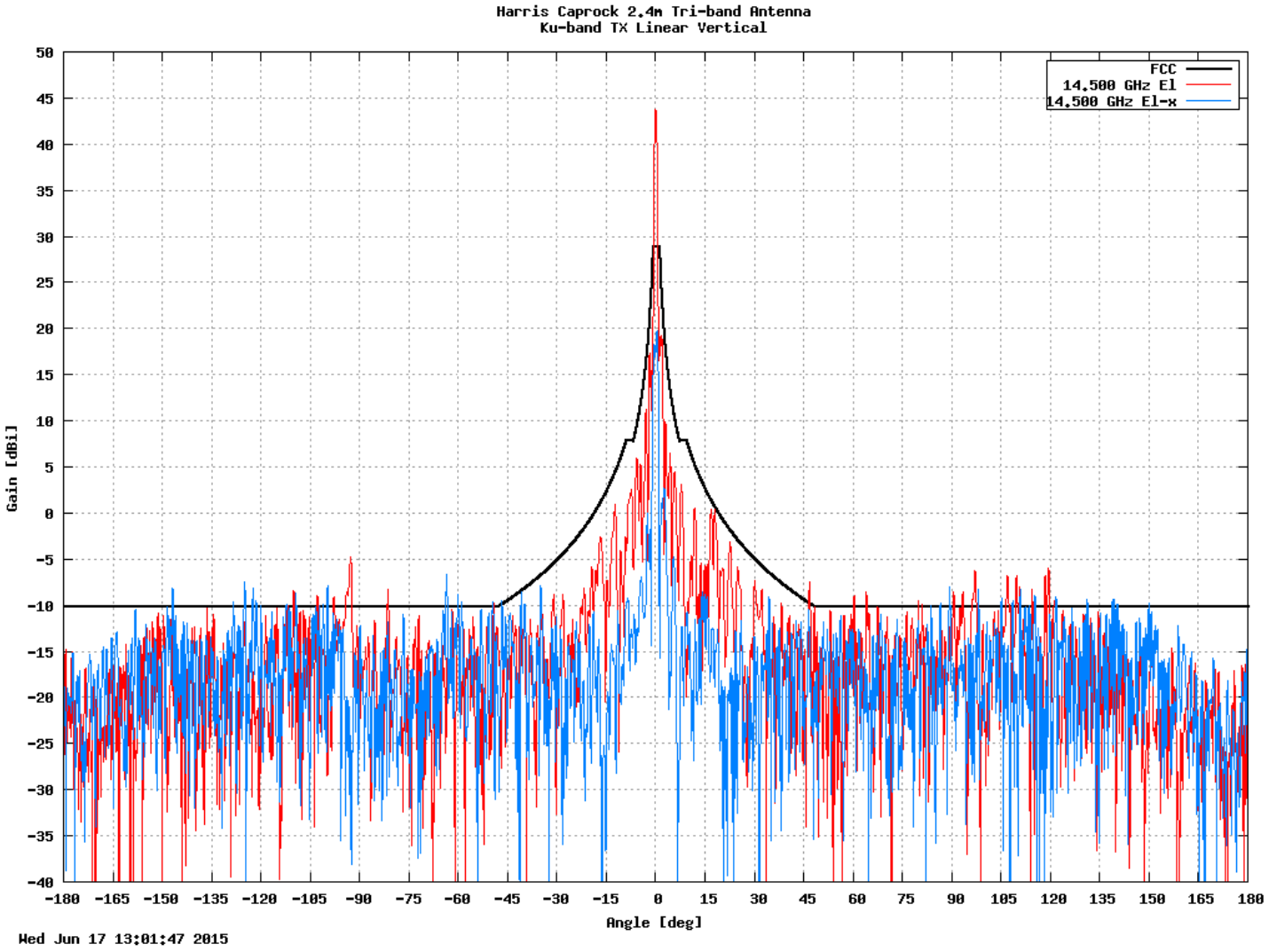
## Ku Band - 14.500 GHz (Top of band)

### Elevation (Narrow)



## Ku Band - 14.500 GHz (Top of band)

### Elevation (Wide)



# Annex 5
# FCC Declarations of Conformity

HARRIS CAPROCK COMMUNICATIONS

1025 West NASA Boulevard
Melbourne, FL USA 32919

www.harriscaprock.com

# FCC Declaration of Conformity

1. Harris CapRock Corporation ("Harris CapRock") designs, develops and manufactures marine stabilized antenna systems for satellite communications at sea. These products are then used by our customers as part of their C-band Earth Station on Vessel ("ESV") networks.

2. Section 25.221 of the Commission's rules, 47 C.F.R. § 25.221, defines the provisions for blanket licensing of ESV antennas operating in the C-band. This declaration covers the requirements for meeting § 25.221(a)(1) by the demonstrations outlined in paragraphs (b)(1)(i) and (b)(1)(iii). The requirements for meeting § 25.221(a)(3)-(a)(13) are left to the applicant. The paragraph numbers in this declaration refer to the 2009 version of FCC 47 C.F.R. § 25.221.

3. Harris CapRock hereby declares that the antennas listed below will meet the off-axis EIRP spectral density requirements of § 25.221(a)(1)(i) with an N value of 1, when the following Input Power spectral density limitations are met:

   - 2.4 Meter C-Band, Model ST5000 is limited to: -2.7 dBW/4kHz

4. Harris CapRock hereby declares that the antenna referenced in paragraph 3 above, will maintain a stabilization pointing accuracy of better than 0.2 degrees under specified ship motion conditions, thus meeting the requirements of § 25.221(a)(1)(ii)(A). The Input Power spectral density limits for this antenna have been adjusted to meet the requirements of § 25.221(a)(1)(ii)(B).

5. Harris CapRock hereby declares that the antenna referenced in paragraph 3 above, will automatically cease transmission within 100 milliseconds if the pointing error should exceed 0.5 degrees and will not resume transmission until the error drops below 0.2 degrees, thus meeting the requirements of § 25.221(a)(1)(iii).

6. Harris CapRock maintains all relevant test data, which is available upon request, to verify these declarations.

By: _____

Name: ANDREW LUCAS

Title: CTO

Harris CapRock Corporation

Date: 28th AUGUST 2015

HARRIS CAPROCK COMMUNICATIONS

1025 West NASA Boulevard
Melbourne, FL USA 32919

www.harriscaprock.com

## FCC Declaration of Conformity

1. Harris CapRock designs, develops and manufactures marine stabilized antenna systems for satellite communications at sea. These products are then used by our customers as part of their Ku-band Earth Station on Vessel ("ESV") networks.

2. Section 25.222 of the Commission's rules, 47 C.F.R. § 25.222, defines the provisions for blanket licensing of ESV antennas operating in the Ku-band. This declaration covers the requirements for meeting § 25.222(a)(1) by the demonstrations outlined in paragraphs (b)(1)(i) and (b)(1)(iii). The requirements for meeting § 25.222(a)(3)-(a)(7) are left to the applicant. The paragraph numbers in this declaration refer to the 2009 version of FCC 47 C.F.R. § 25.222.

3. Harris CapRock hereby declares that the antennas listed below will meet the off-axis EIRP spectral density requirements of § 25.222(a)(1)(i) with an N value of 1, when the following Input Power spectral density limitations are met:

    - 2.4 Meter Ku-Band, Model ST5000 is limited to: -14.0 dBW/4kHz

4. Harris CapRock hereby declares that the antenna referenced in paragraph 3 above, will maintain a stabilization pointing accuracy of better than 0.2 degrees under specified ship motion conditions, thus meeting the requirements of § 25.222(a)(1)(ii)(A). The Input Power spectral density limits for this antenna have been adjusted to meet the requirements of § 25.222(a)(1)(ii)(B).

5. Harris CapRock hereby declares that the antenna referenced in paragraph 3 above, will automatically cease transmission within 100 milliseconds if the pointing error should exceed 0.5 degrees and will not resume transmission until the error drops below 0.2 degrees, thus meeting the requirements of § 25.222(a)(1)(iii).

6. Harris CapRock maintains all relevant test data, which is available upon request, to verify these declarations.

By: _____

Name: ANDREW LUCAS

Title: CTO

Harris CapRock Corporation

Date: 28th August 2015

# Annex 6
# Tracking Report


# Tracking Testing

*Reference:* *4E0248*
*Revision:* *01*
*Produced:* *Feb 2015*

# Revision History

| *Revision* | *Date* | *Description* | *Prepared by* |
|---|---|---|---|
| *01* | *7/8/15* | *First Draft* | *D McCoig* |
| | | | |
| | | | |

# Document Control

| *Author* | *Reviewer* | *Approver* |
|---|---|---|
| *D McCoig* | | *A Lucas* |

# Health, Safety and Environment

Our dedication to employee safety is fundamental to the culture of our organization. We protect our employees by minimizing workplace risk and above all promoting a positive work ethos. We're dedicated to conducting business as responsible corporate citizens and are committed to business practices that support a sustainable global environment. Harris CapRock fulfils this commitment globally through compliance with applicable laws and regulations of the countries in which we operate.

**We strive to:**

- Improve the efficiency of our operations and processes
- Instruct and encourage employees to work in a safe, healthy and environmentally responsible manner
- Engage Harris CapRock supply chain partners to support our sustainability objectives through similar practices
- Enhance our customers' experience with our products and services by improving their eco-efficiency, while maintaining our high standards of quality, reliability and performance

**Management Commitment**

Paramount to our operation here at Harris CapRock is the health, safety and well-being of all our staff, contractors and clients. We aim for a no injury working environment and strive to demonstrate that "zero harm" is an achievable objective in all parts of our organization.

"At Harris CapRock, protecting the health and safety of our workforce, business partners and general public is our highest priority. We are fostering an increasingly proactive and vigilant HSE culture that is unwilling to accept any harm to people and our environment. If we cannot do business safely, we will not do business – no exceptions." ***President, Harris CapRock Communications***

Table of Contents

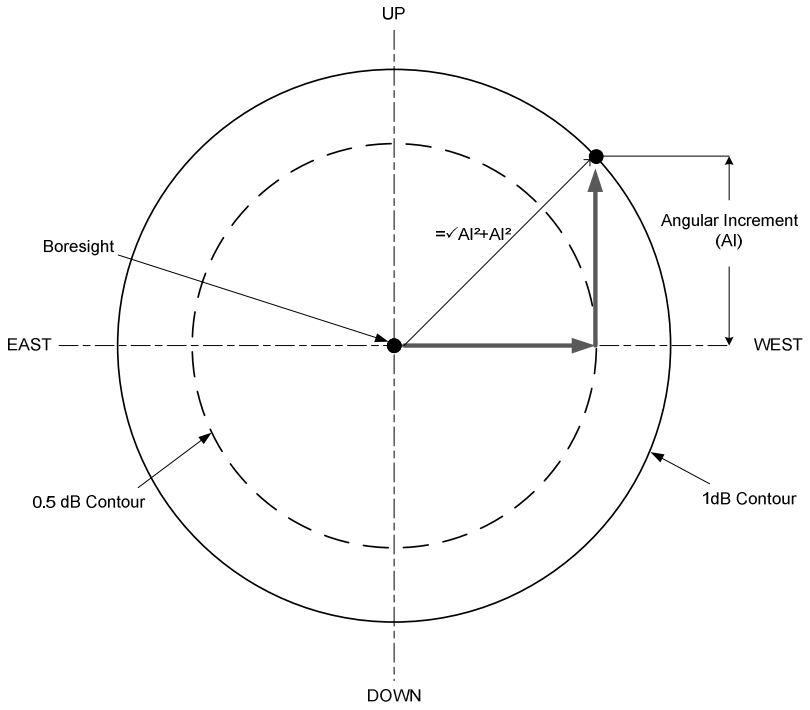
# 1 Overview

The motion tests were performed on a 6 axis motion table to verify the performance of the ST5024 system under motion at Ku band. The motion table was set up with motion parameters that mimic the expected range of motions that the Antenna will encounter during service on the various target vessels. The test data is derived from DOD-STD-1399(NAVY) sections 5.2.1.2 Loading factors, tables II, III and IV.

A range of roll periods are produced which reflect the uncertainty in the metacentric heights of the vessels. The worst case, (shortest), period was chosen for each test.

The results show the tracking performance in relations to the signal level received on a scale where each division on the spectrum analyser represents 1dB.

The principle in monitoring the tracking performance to be within +/- 1dB is the direct relationship between the signal level and the angular pointing accuracy with regard to bore sight and the 1dB contour as explained bellow:-




The angular increment (AI) for circular aperture antennas (as is the case with the ST5024) is represented by the following expression

$$AI = \frac{3.978}{d \cdot f}$$

where: d: Antenna diameter [m]
f: Frequency [GHz]
(Ref.: CCIR Handbook on Satellite Communications).

Therefore in the case of the antenna under test the d = 2.4m and f = 12GHz

$$Al = 0.138°$$

Which in turn makes the angle to the 1dB contour = $\checkmark Al^2+Al^2$ which equals 0.19°.

Therefore tracking within the 1dB division as shown on the spectrum analyser represents pointing accuracy better than 0.19°

The motion testing was performed at the GCSD R2 facility in Melbourne, FL. The tests were performed at Ku band on Intelsat GC3 95W Ku tracking an advanced VSAT network. The system was equipped with a 100W Ku LPOD, 200W C LPOD, 40W Ka CPI, E.2.

System on Motion Table

# 2 Motion tests results

## 2.1 Cross Polarisation Results:

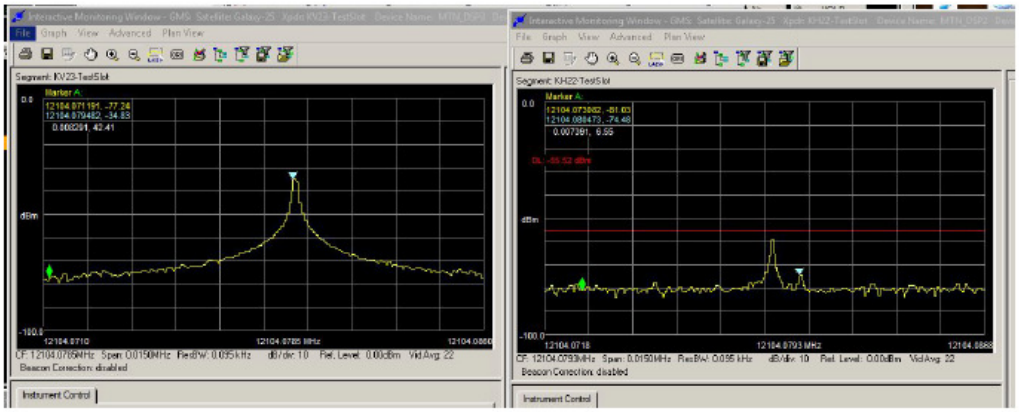
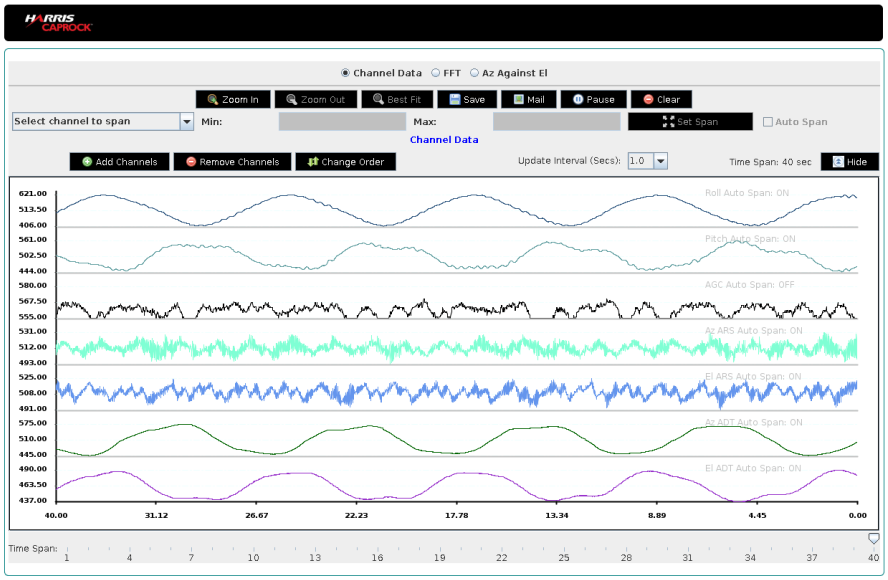


Figure E.1: Ku band cross pole isolation NOC data

## 2.2 Sea state 4 - 100m guided missile boat





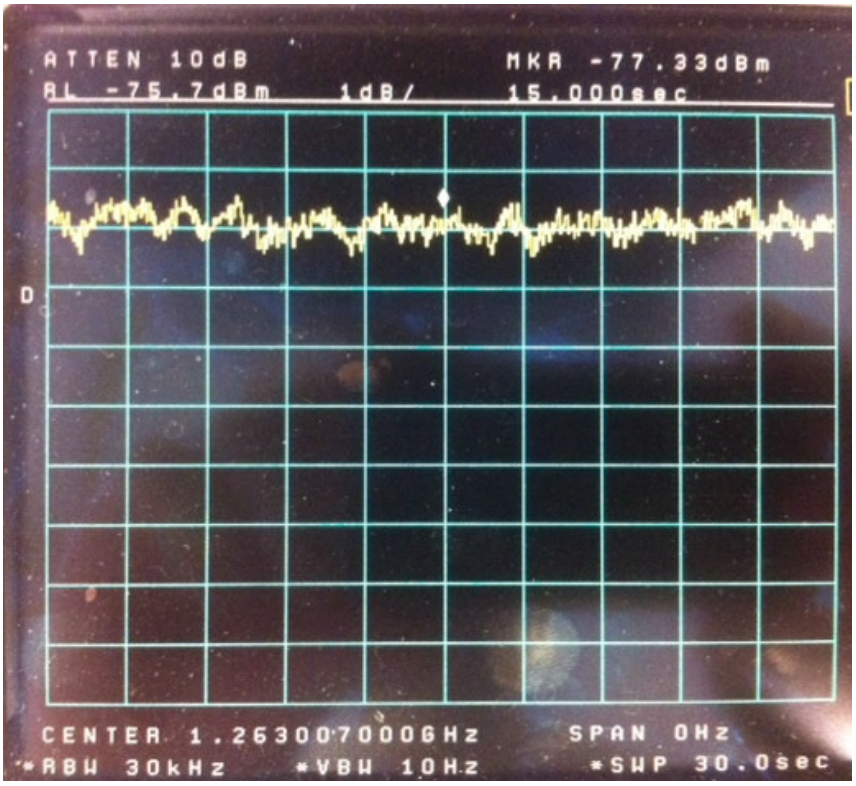




Figure E.3: 1/2 sea state 4, 17° Roll / 11 second period, 9.5° Pitch / 9 second period

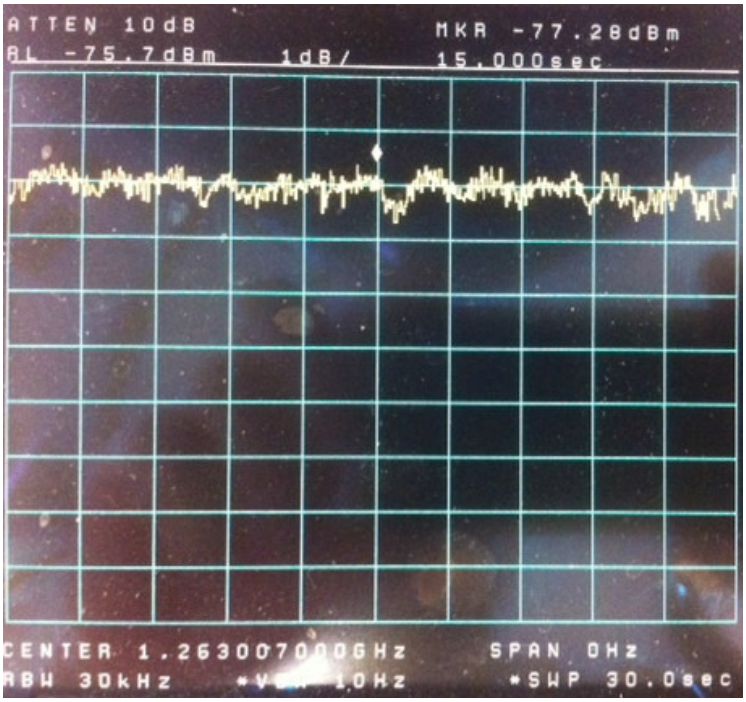



Figure E.4: Sea state 4, 17° Roll / 11 second period, 9.5° Pitch / 9 second period

## 2.3 Sea state 6 - 100m guided missile boat

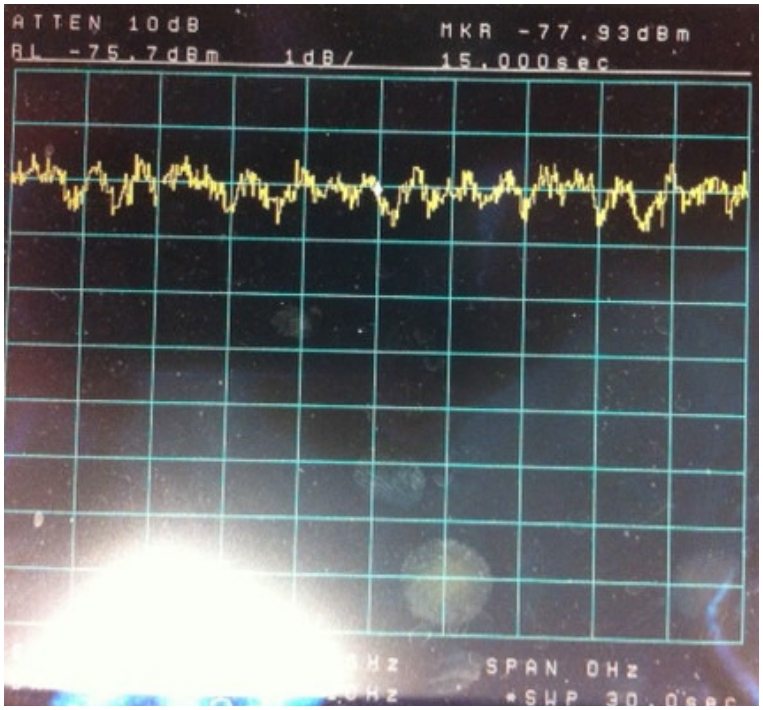
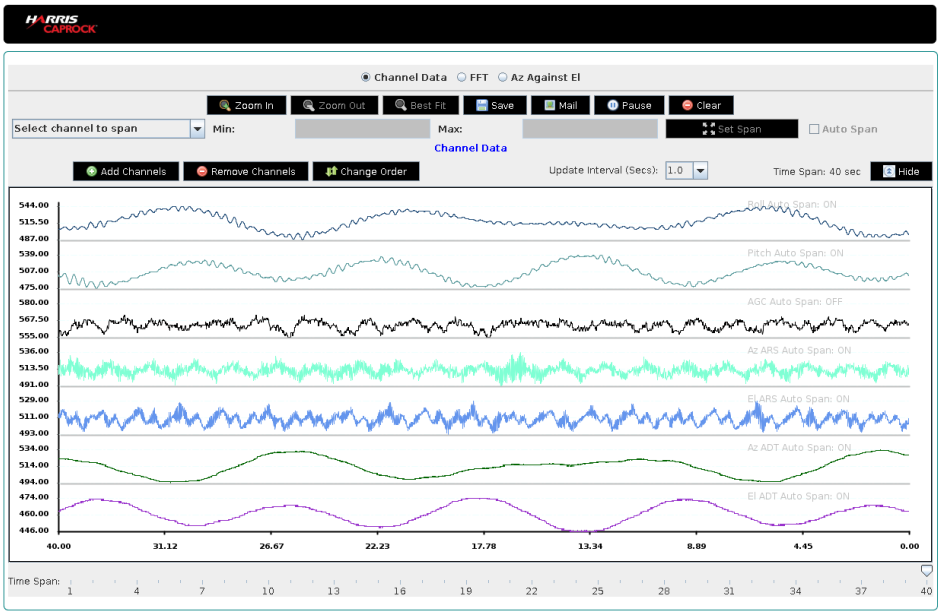



Figure E.5: Sea state 6, 41° Roll / 9 second period, 22° Pitch / 9 second period

## 2.4 Sea state 4 - 74m Supply Vessel, excessive pitch

The table can be seen to oscillate around the set point due to the high frequency biased tuning applied to the PLC. This provided a challenging, juddering, type motion for the system to track through.



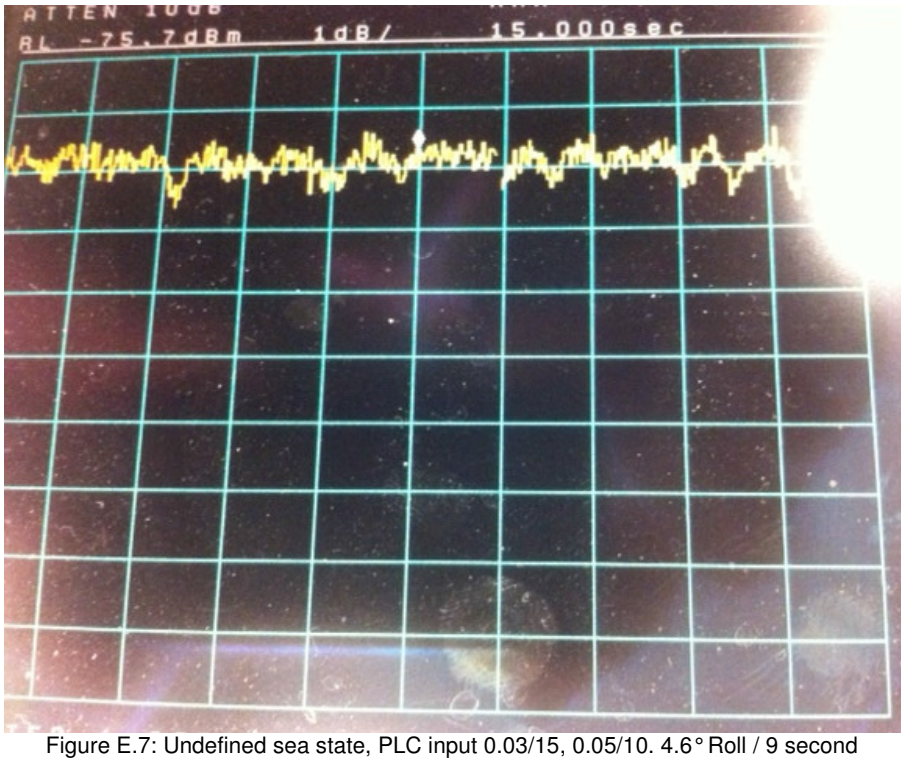
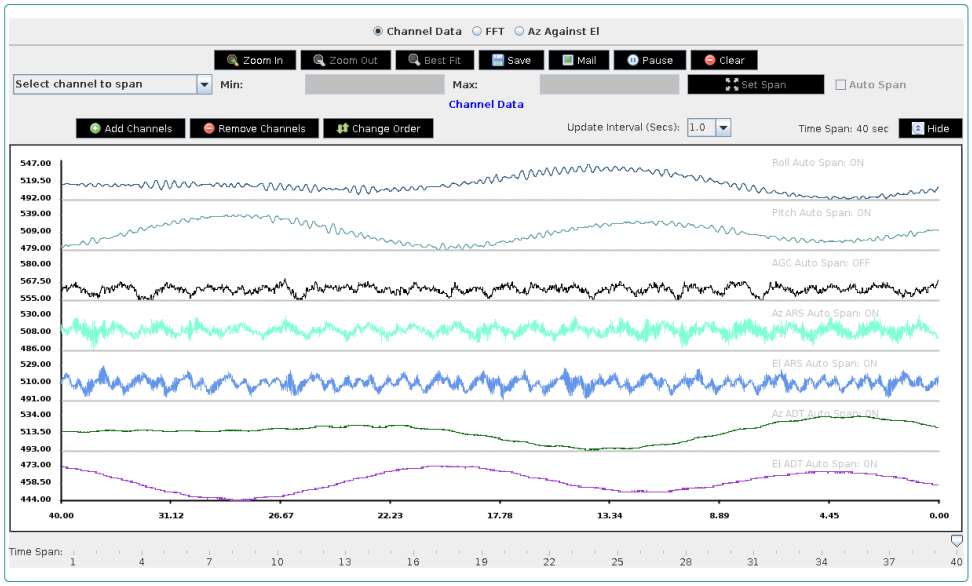




Figure E.7: Undefined sea state, PLC input 0.03/15, 0.05/10. 4.6° Roll / 9 second period, 5.21° Pitch / 14 second period

## 2.5 Sea state 4 - 360m Cruise Liner, excessive pitch

The table can be seen to oscillate around the set point due to the high frequency biased tuning applied to the PLC. This provided a challenging, juddering, type motion for the system to track through. The table did not appear to perform the motion correctly with regard to period.



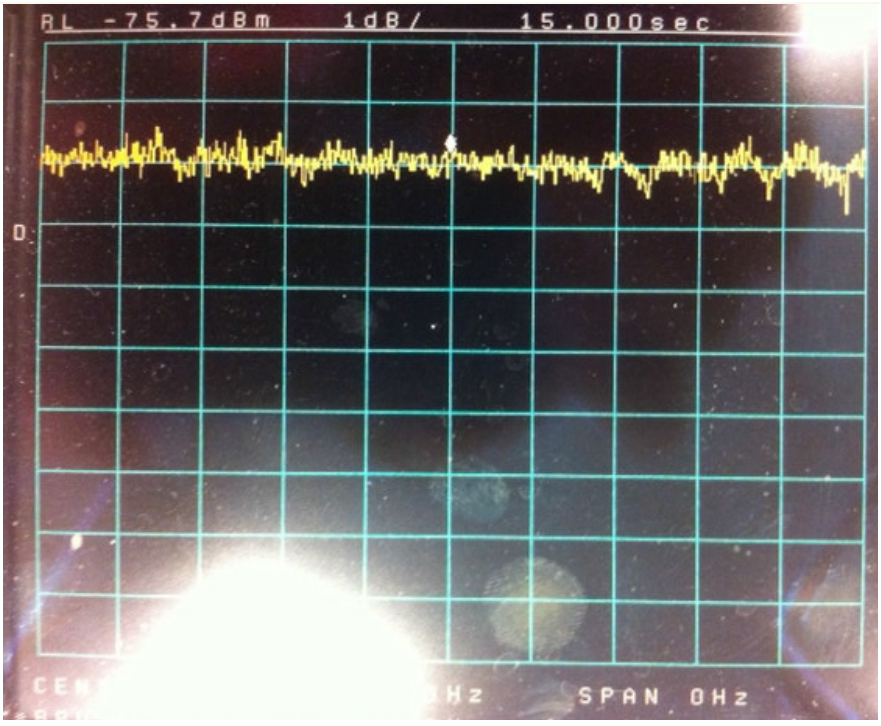
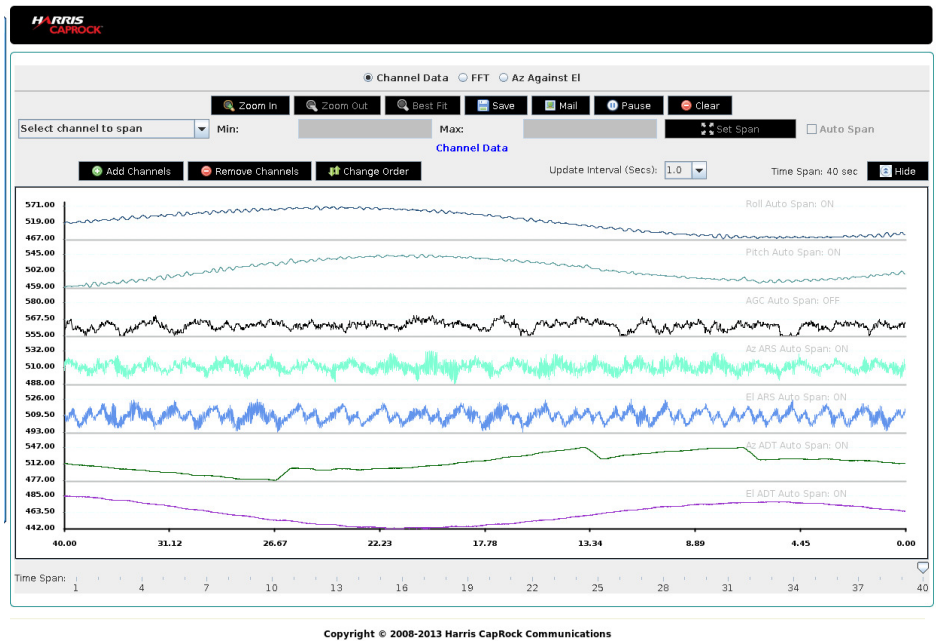




Figure E.8: Undefined sea state, PLC input 0.03/30, 0.05/20. 4.6° Roll / 18 second period, 5.21° Pitch / 28 second period

## 2.6 Sea state 5 - 360m Cruise Liner, excessive roll period, excessive pitch

The table can be seen to oscillate around the set point due to the high frequency biased tuning applied to the PLC. This provided a challenging, juddering, type motion for the system to track through. The table did not appear to perform the motion correctly with regard to period.





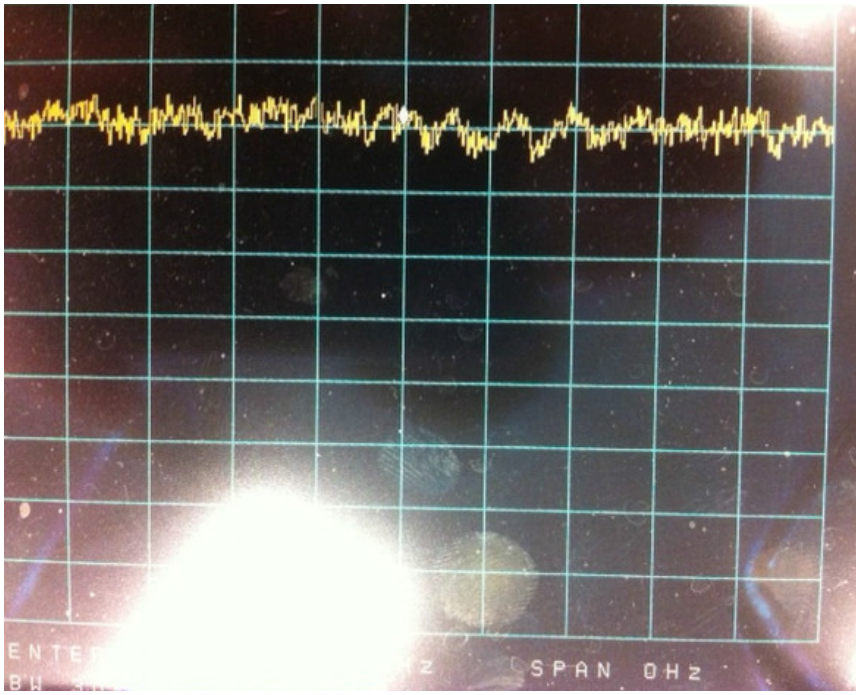
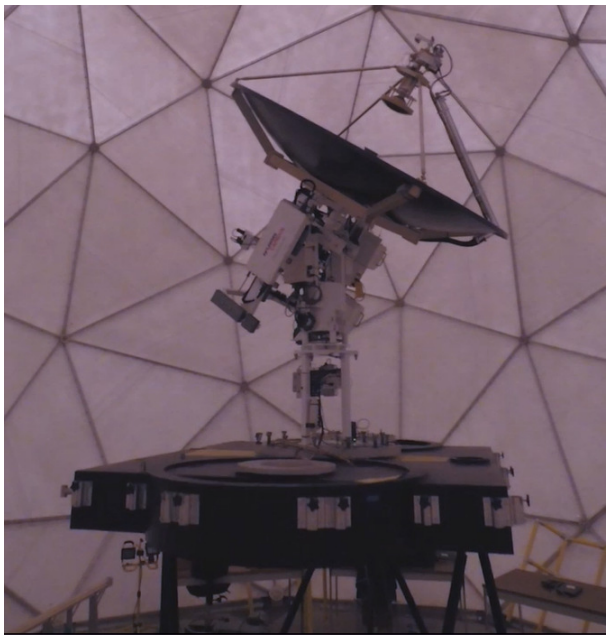
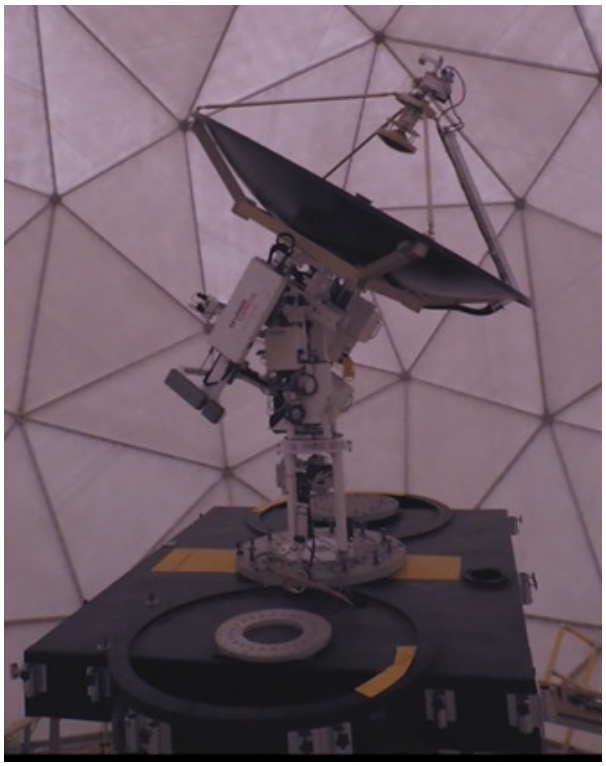




Figure E.9: Undefined sea state, PLC input 0.1/60, 0.1/40. 8.4° Roll / 40 second period, 7° Pitch / 40 second period

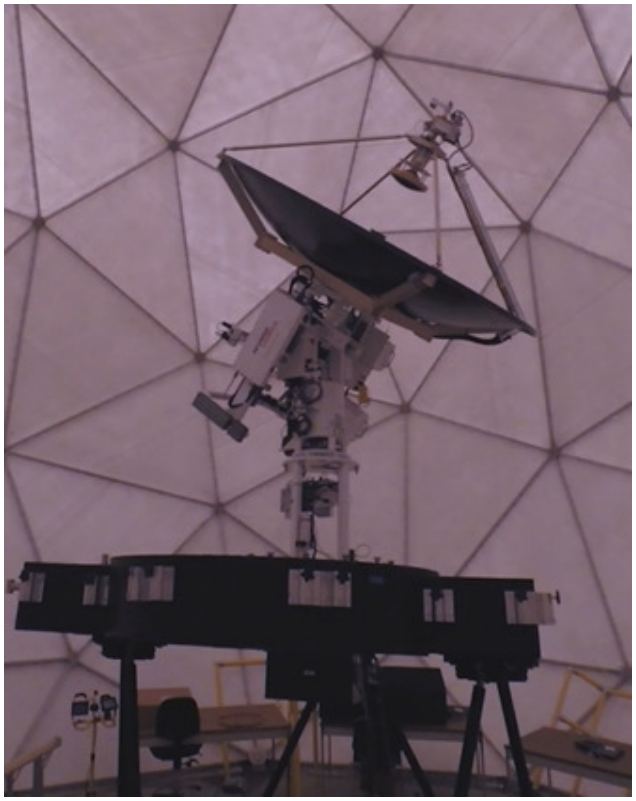
## 3.1 Motion Table Photographs – Sea State 4



Start (mid) position



Bow Pitch Up



Bow Pitch Down

## 4.0 Conclusion

As can be seen from the motion testing results the system is able to maintain the 1dB tracking under the various sea states tested.

In each case the system performed well within the 1dB limit and therefore had a pointing accuracy of better than the 0.2° requirement.

# Annex 7
# Radiation Hazard Studies

# Radiation Hazard Study

ST5000 C

This study analyzes the potential Radio Frequency (RF) human exposure levels caused by the Electro Magnetic (EM) fields of the above-captioned antenna. The mathematical analysis performed below complies with the methods described in the Federal Communications Commission Office of Engineering and Technology Bulletin No. 65 (1985 rev. 1997) R&O 96-326.

***Maximum Permisible Exposure***

There are two separate levels of exposure limits. The first applies to persons in the general population who are in an uncontrolled environment. The second applies to trained personnel in a controlled environment. According to 47 C.F.R. § 1.1310, the Maximum Permissible Exposure (MPE) limits for frequencies above 1.5 GHz are as follows:

- General Population / Uncontrolled Exposure 1.0 mW/cm2
- Occupational / Controlled Exposure 5.0 mW/cm2

The purpose of this study is to determine the power flux density levels for the earth station under study as compared with the MPE limits. This comparison is done in each of the following regions:

1. Far-field region
2. Near-field region
3. Transition region
4. The region between the feed and the antenna surface
5. The main reflector region
6. The region between the antenna edge and the ground

***Input Parameters***

The following input parameters were used in the calculations:

| Parameter | Value | Unit | Symbol |
|---|---|---|---|
| Atenna Diameter: | 2.4 | m | $D$ |
| Antenna Transmit Gain: | 38.00 | dBi | $G$ |
| Trasmit Frequency: | 6175 | MHz | $f$ |
| Feed Flange Diameter: | 10.00 | cm | $d$ |
| Power Input to the Antenna: | 55.00 | W | $P$ |

***Calculated Parameters***

The following values were calculated using the above input parameters and the corresponding formulas.

| Parameter | Value | Unit | Symbol | Formula |
|---|---|---|---|---|
| Antenna Surface Area: | 4.52 | $\mathrm{m}^2$ | $A$ | $\pi D^2/4$ |
| Area of Feed Flange: | 78.54 | $\mathrm{cm}^2$ | $a$ | $\pi d^2/4$ |
| Antenna Efficiency: | 0.26 | | $\eta$ | $G\lambda^2/(\pi^2 D^2)$ |
| Gain Factor: | 6309.57 | | $g$ | $10^{G/10}$ |
| Wavelength: | 0.0486 | m | $\lambda$ | $300/f$ |

***Behavior of EM Fields as a Function of Distance***

The behavior of the characteristics of EM fields varies depending on the distance from the radiating antenna. These characteristics are analyzed in three primary regions: the near-field region, the far-field region and the transition region. Of interest also are the region between the antenna main reflector and the subreflector, the region of the main reflector area and the region between the main reflector and ground.

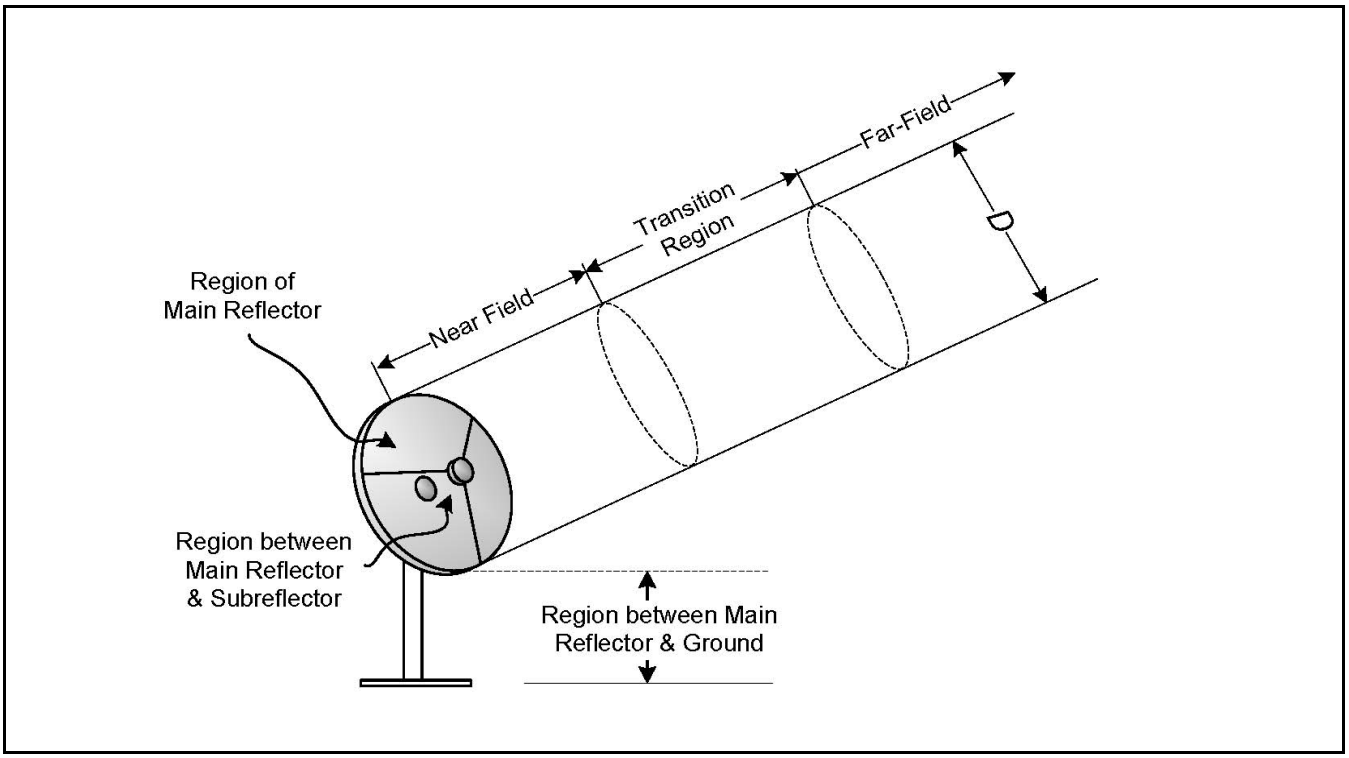



*Figure 1. EM Fields as a Function of Distance*

For parabolic aperture antennas with circular cross sections, such as the antenna under study, the near-field, far-field and transition region distances are calculated as follows:

| Parameter | Value | Unit | Formula |
|---|---|---|---|
| Near Field Distance: | 29.640 | m | $R_{nf} = D^2/(4\lambda)$ |
| Distance to Far Field: | 71.136 | m | Rff = 0.60D2/(λ) |
| Distance of Trasition Region | 29.640 | m | Rt = Rnf |

The distance in the transition region is between the near and far fields. Thus, Rnf ≤ Rt ≤ Rff . However, the power density in the transition region will not exceed the power density in the near-field. Therefore, for purposes of the present analysis, the distance of the transition region can equate the distance to the near-field.

***Power Flux Density Calculations***

The power flux density is considered to be at a maximum through the entire length of the near-field. This region is contained within a cylindrical volume with a diameter, D, equal to the diameter of the antenna. In the transition region and the far-field, the power density decreases inversely with the square of the distance. The following equations are used to calculate power density in these regions.

| Parameter | Value | Unit | Symbol | Formula |
|---|---|---|---|---|
| Power Density in the Near-Field | 1.274 | $mW/cm^2$ | $S_{nf}$ | $16.0\ \eta\ P/(\pi D^2)$ |
| Power Density in the Far-Field | 0.546 | $mW/cm^2$ | $S_{ff}$ | $GP/(4\pi R_{ff}^2)$ |
| Power Density in the Trans. Region | 1.274 | $mW/cm^2$ | $S_t$ | $S_{nf} R_{nf} /(R_t)$ |

The region between the main reflector and the subreflector is confined within a conical shape defined by the feed assembly. The most common feed assemblies are waveguide flanges. This energy is determined as follows:

| Parameter | Value | Unit | Symbol | Formula |
|---|---|---|---|---|
| Power Density at the Feed Flange | 2801.1 | $mW/cm^2$ | $S_{fa}$ | $4P / a$ |

The power density in the main reflector is determined similarly to the power density at the feed flange; except that the area of the reflector is used.

| Parameter | Value | Unit | Symbol | Formula |
|---|---|---|---|---|
| Power Density at Main Reflector | 4.863 | $mW/cm^2$ | $S_{surface}$ | $4P / A$ |

The power density between the reflector and ground, assuming uniform illumination of the reflector surface, is calculated as follows:

| Parameter | Value | Unit | Symbol | Formula |
|---|---|---|---|---|
| Power Density between Reflector and Ground | 1.216 | $mW/cm^2$ | $S_g$ | $P / A$ |

Table 1 summarizes the calculated power flux density values for each region. In a controlled environment, the only regions that exceed FCC limitations are shown below. These regions are only accessible by trained technicians who, as a matter of procedure, turn off transmit power before performing any work in these areas.

| **Power Densities** | **mW/cm2** | **Controlled Environment (5 mW/cm2)** |
|---|---|---|
| Far Field Calculation | 0.546 | Satisfies FCC Requirements |
| Near Field Calculation | 1.274 | Satisfies FCC Requirements |
| Transition Region | 1.274 | Satisfies FCC Requirements |
| Region between Main and Subreflector | 2801.1 | Exceeds Limitations |
| Main Reflector Region | 4.863 | Satisfies FCC Requirements |
| Region between Main Reflector and Ground | 1.216 | Satisfies FCC Requirements |

*Table 1. Power Flux Density for Each Region*

In conclusion, the results show that the antenna, in a controlled environment, and under the proper mitigation procedures, meets the guidelines specified in 47 C.F.R. § 1.1310.

# Radiation Hazard Study

ST5000 Ku

This study analyzes the potential Radio Frequency (RF) human exposure levels caused by the Electro Magnetic (EM) fields of the above-captioned antenna. The mathematical analysis performed below complies with the methods described in the Federal Communications Commission Office of Engineering and Technology Bulletin No. 65 (1985 rev. 1997) R&O 96-326.

***Maximum Permisible Exposure***

There are two separate levels of exposure limits. The first applies to persons in the general population who are in an uncontrolled environment. The second applies to trained personnel in a controlled environment. According to 47 C.F.R. § 1.1310, the Maximum Permissible Exposure (MPE) limits for frequencies above 1.5 GHz are as follows:

- General Population / Uncontrolled Exposure 1.0 mW/cm2
- Occupational / Controlled Exposure 5.0 mW/cm2

The purpose of this study is to determine the power flux density levels for the earth station under study as compared with the MPE limits. This comparison is done in each of the following regions:

1. Far-field region
2. Near-field region
3. Transition region
4. The region between the feed and the antenna surface
5. The main reflector region
6. The region between the antenna edge and the ground

***Input Parameters***

The following input parameters were used in the calculations:

| Parameter | Value | Unit | Symbol |
|---|---|---|---|
| Atenna Diameter: | 2.4 | m | $D$ |
| Antenna Transmit Gain: | 43.50 | dBi | $G$ |
| Trasmit Frequency: | 14250 | MHz | $f$ |
| Feed Flange Diameter: | 10.00 | cm | $d$ |
| Power Input to the Antenna: | 55.00 | W | $P$ |

***Calculated Parameters***

The following values were calculated using the above input parameters and the corresponding formulas.

| Parameter | Value | Unit | Symbol | Formula |
|---|---|---|---|---|
| Antenna Surface Area: | 4.52 | $\mathrm{m}^2$ | $A$ | $\pi D^2/4$ |
| Area of Feed Flange: | 78.54 | $\mathrm{cm}^2$ | $a$ | $\pi d^2/4$ |
| Antenna Efficiency: | 0.17 | | $\eta$ | $G\lambda^2/(\pi^2 D^2)$ |
| Gain Factor: | 22387.21 | | $g$ | $10^{G/10}$ |
| Wavelength: | 0.0211 | m | $\lambda$ | $300/f$ |

***Behavior of EM Fields as a Function of Distance***

The behavior of the characteristics of EM fields varies depending on the distance from the radiating antenna. These characteristics are analyzed in three primary regions: the near-field region, the far-field region and the transition region. Of interest also are the region between the antenna main reflector and the subreflector, the region of the main reflector area and the region between the main reflector and ground.

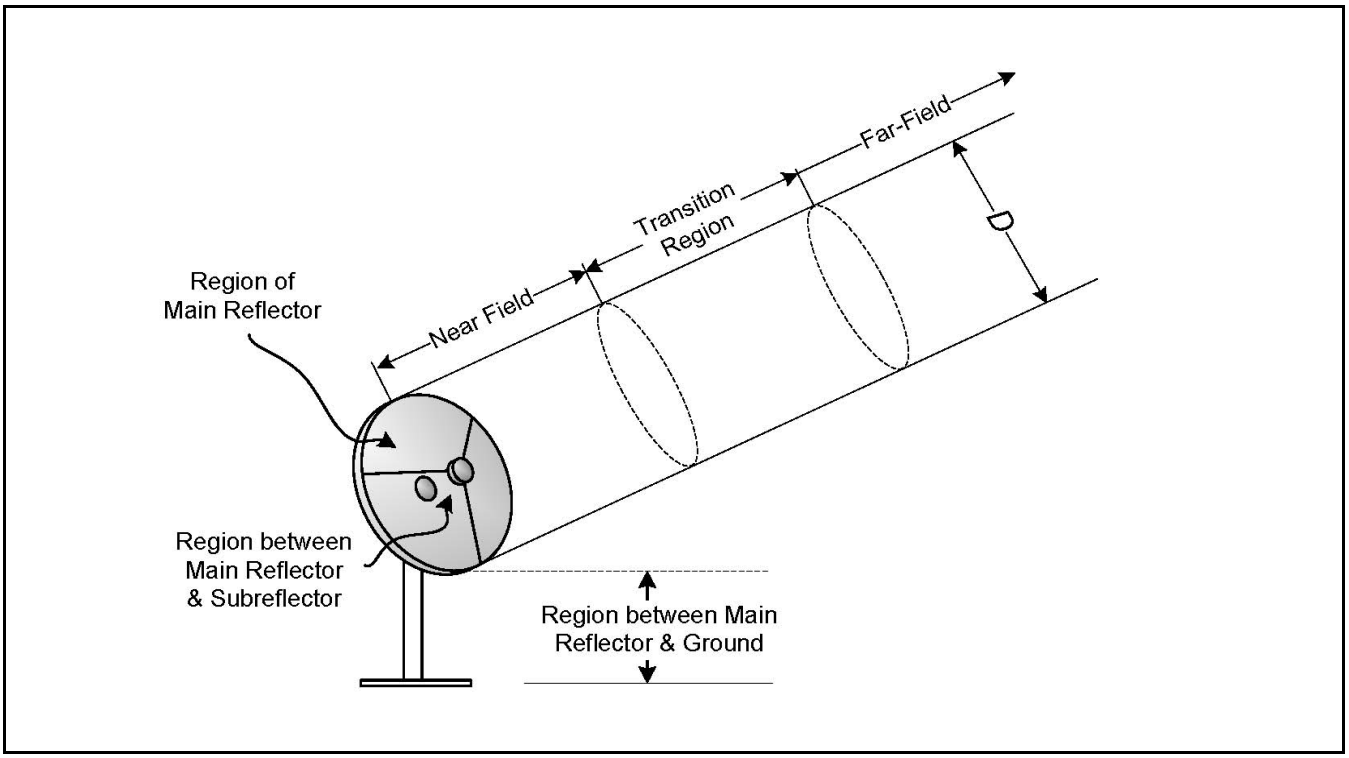



*Figure 1. EM Fields as a Function of Distance*

For parabolic aperture antennas with circular cross sections, such as the antenna under study, the near-field, far-field and transition region distances are calculated as follows:

| Parameter | Value | Unit | Formula |
|---|---|---|---|
| Near Field Distance: | 68.400 | m | $R_{nf} = D^2/(4\lambda)$ |
| Distance to Far Field: | 164.160 | m | Rff = 0.60D2/(λ) |
| Distance of Trasition Region | 68.400 | m | Rt = Rnf |

The distance in the transition region is between the near and far fields. Thus, Rnf ≤ Rt ≤ Rff . However, the power density in the transition region will not exceed the power density in the near-field. Therefore, for purposes of the present analysis, the distance of the transition region can equate the distance to the near-field.

***Power Flux Density Calculations***

The power flux density is considered to be at a maximum through the entire length of the near-field. This region is contained within a cylindrical volume with a diameter, D, equal to the diameter of the antenna. In the transition region and the far-field, the power density decreases inversely with the square of the distance. The following equations are used to calculate power density in these regions.

| Parameter | Value | Unit | Symbol | Formula |
|---|---|---|---|---|
| Power Density in the Near-Field | 0.849 | $mW/cm^2$ | $S_{nf}$ | $16.0\ \eta\ P/(\pi D^2)$ |
| Power Density in the Far-Field | 0.364 | $mW/cm^2$ | $S_{ff}$ | $GP/(4\pi R_{ff}^2)$ |
| Power Density in the Trans. Region | 0.849 | $mW/cm^2$ | $S_t$ | $S_{nf} R_{nf} /(R_t)$ |

The region between the main reflector and the subreflector is confined within a conical shape defined by the feed assembly. The most common feed assemblies are waveguide flanges. This energy is determined as follows:

| Parameter | Value | Unit | Symbol | Formula |
|---|---|---|---|---|
| Power Density at the Feed Flange | 2801.1 | $mW/cm^2$ | $S_{fa}$ | $4P / a$ |

The power density in the main reflector is determined similarly to the power density at the feed flange; except that the area of the reflector is used.

| Parameter | Value | Unit | Symbol | Formula |
|---|---|---|---|---|
| Power Density at Main Reflector | 4.863 | $mW/cm^2$ | $S_{surface}$ | $4P / A$ |

The power density between the reflector and ground, assuming uniform illumination of the reflector surface, is calculated as follows:

| Parameter | Value | Unit | Symbol | Formula |
|---|---|---|---|---|
| Power Density between Reflector and Ground | 1.216 | $mW/cm^2$ | $S_g$ | $P / A$ |

Table 1 summarizes the calculated power flux density values for each region. In a controlled environment, the only regions that exceed FCC limitations are shown below. These regions are only accessible by trained technicians who, as a matter of procedure, turn off transmit power before performing any work in these areas.

| **Power Densities** | **mW/cm2** | **Controlled Environment (5 mW/cm2)** |
|---|---|---|
| Far Field Calculation | 0.364 | Satisfies FCC Requirements |
| Near Field Calculation | 0.849 | Satisfies FCC Requirements |
| Transition Region | 0.849 | Satisfies FCC Requirements |
| Region between Main and Subreflector | 2801.1 | Exceeds Limitations |
| Main Reflector Region | 4.863 | Satisfies FCC Requirements |
| Region between Main Reflector and Ground | 1.216 | Satisfies FCC Requirements |

*Table 1. Power Flux Density for Each Region*

In conclusion, the results show that the antenna, in a controlled environment, and under the proper mitigation procedures, meets the guidelines specified in 47 C.F.R. § 1.1310.

# Annex 8
## Section 25.221 Compliance Statement

## § 25.221 Compliance Statement

As part of its application to modify its existing commercial earth station onboard vessel ("ESV") blanket license (Call Sign: E060157) to add a new multi-band terminal – the ST5000-2.4 – Harris CapRock Corporation ("Harris CapRock") certifies in the following section and associated appendices that the proposed C-band ESV terminal operations of the ST5000-2.4 comply with the relevant requirements of Section 25.221 of the Commission's Rules, 47 C.F.R. § 25.221.

(a)(1)(i)(A-C): Comply. (*See* Technical Appendix, Annex 1.)

(a)(1)(ii): The ST5000-2.4 uses the same positioner technology and algorithms used by previously authorized SpaceTrack ESV terminals, and Harris CapRock certifies that the terminal will maintain a pointing error of less than or equal to 0.2° between the orbital location of the target satellite and the axis of the main lobe of the ESV antenna. (*See* Annexes 5 & 6.)

(a)(1)(iii): In addition to the foregoing, the ST5000-2.4 uses the same automated antenna control and transmit mute functionalities used by previously authorized SpaceTrack ESV terminals, and Harris CapRock certifies that all emissions from the ESV will automatically cease within 100 ms if the angle between the orbital location of the target satellite and the axis of the main lobe of the ESV antenna exceeds 0.5°, and transmission will not resume until such angle is less than or equal to 0.2. (*See* Annex 5.)

(a)(2): Not applicable.

(a)(3): Not applicable.

(a)(4): Comply. The primary contact for Harris CapRock ESV operational issues is the Harris CapRock Network Control Center, which is available 24 hours a day, seven days a week:

Harris CapRock Network Control Center
Managed Network Services 24x7 support
4400 S. Sam Houston Pkwy, E.
Houston, Texas 77046
Office: (832) 668-2775
Fax: (713) 987-2894
Email Address: hcc-hou-csc@harris.com

(a)(5): Comply. Harris CapRock has designed a system to record the vessel's location, transmit frequency, channel bandwidth and satellite. The system records this information every 20 minutes; this data will be stored locally and will be uploaded to Harris CapRock's Network Management System (NMS) on a regular basis. Harris CapRock can make this data available within 24 hours of a request by a coordinator, fixed system operator, fixed-satellite system operator, NTIA, or the Commission.

(a)(6): Comply. In the event Harris CapRock must communicate with vessels of foreign registry, it will maintain detailed information on each vessel as well as a point of contact for the relevant administration responsible for licensing the ESV.

(a)(7): Comply. The proposed ESV terminal operated by Harris CapRock will be controlled by various hub earth stations located in the United States and licensed to Harris CapRock.

(a)(8): Not applicable. Harris CapRock is not seeking to coordinate route or port operations in the context of this application.

(a)(9): Comply. Harris CapRock certifies it will not operate ESVs in the 5.925-6.425 GHz and 3.700-4.200 GHz bands on vessels smaller than 300 gross tons.

(a)(10): Not applicable. Harris CapRock does not seek receive protection for in-port C-band ESV terminal operations in this application.

(a)(11): Comply. When operating ESVs in motion, Harris CapRock will not claim protection from harmful interference from any authorized terrestrial stations or lawfully operating satellites to which frequencies are either already assigned, or may be assigned in the future in the 3.700-4.200 GHz band.

(a)(12): Not applicable. Harris CapRock is not seeking to coordinate route or port operations in the context of this application. However, Harris CapRock is in the process of coordinating certain C-band ESV routes with potentially affected U.S.-licensed fixed service operators and anticipates filing a separate application for authority to operate U.S.-licensed ESV terminals on these routes pursuant to established Commission procedures.

(a)(13): Not applicable. See above.

(b)(1)(i)(A-C): Comply. (*See* Technical Appendix, Annex 1.)

(b)(1)(ii): Harris CapRock acknowledges that the ST5000-2.4 antenna does not meet the Commission's Section 25.209 gain pattern for C- or Ku-band operations. Accordingly, pursuant to Section 25.132(b)(3) of the Commission's rules, Harris CapRock hereby submits range test plots of the antenna gain patterns in both C-band and Ku-band. (*See* Technical Appendix, Annex 3.)

(b)(1)(iii): Harris CapRock certifies that the terminal will maintain a pointing error of less than or equal to 0.2° between the orbital location of the target satellite and the axis of the main lobe of the ESV antenna and that that all emissions will automatically cease within 100 ms if the angle between the orbital location of the target satellite and the axis of the main lobe of the ESV antenna exceeds 0.5°. (*See* Annexes 5 & 6.)

(b)(2): Not Applicable.

(b)(3): Not Applicable.

(b)(4): Not Applicable. There is no change to the proposed area of operations. The geographic area where the ESVs will operate includes U.S. territorial waters and waterways, the Gulf of Mexico, Caribbean Sea, Atlantic Ocean, and Pacific Ocean. (Also note discussion of 25.221(a)(12), above, with respect to limitation on C-band operations of the ST5000-2.4 terminal.)

(b)(5): Comply. (Also note discussion of 25.221(a)(4).)

(b)(6): Comply. (*See* Annex 7.)

# Annex 9
## Section 25.222 Compliance Statement

## § 25.222 Compliance Statement

As part of its application to modify its existing commercial earth station onboard vessel ("ESV") blanket license (Call Sign: E060157) to add a new multi-band terminal – the ST5000-2.4 – Harris CapRock Corporation ("Harris CapRock") certifies in the following section and associated appendices that the proposed Ku-band ESV terminal operations of the ST5000-2.4 comply with the relevant requirements of Section 25.222 of the Commission's Rules, 47 C.F.R. § 25.222.

(a)(1)(i)(A-C): Comply. (*See* Technical Appendix, Annex 2.)

(a)(1)(ii): The ST5000-2.4 uses the same positioner technology and algorithms used by previously authorized SpaceTrack ESV terminals, and Harris CapRock certifies that the terminal will maintain a pointing error of less than or equal to 0.2° between the orbital location of the target satellite and the axis of the main lobe of the ESV antenna. (*See* Annexes 5 & 6.)

(a)(1)(iii): In addition to the foregoing, the ST5000-2.4 uses the same automated antenna control and transmit mute functionalities used by previously authorized SpaceTrack ESV terminals, and Harris CapRock certifies that all emissions from the ESV will automatically cease within 100 ms if the angle between the orbital location of the target satellite and the axis of the main lobe of the ESV antenna exceeds 0.5°, and transmission will not resume until such angle is less than or equal to 0.2. (*See* Annex 5.)

(a)(2): Not applicable.

(a)(3): Not applicable.

(a)(4): Comply. The primary contact for Harris CapRock ESV operational issues is the Harris CapRock Network Control Center, which is available 24 hours a day, seven days a week:

Harris CapRock Network Control Center
Managed Network Services 24x7 support
4400 S. Sam Houston Pkwy, E.
Houston, Texas 77046
Office: (832) 668-2775
Fax: (713) 987-2894
Email Address: hcc-hou-csc@harris.com

(a)(5): Comply. Harris CapRock has designed a system to record the vessel's location, transmit frequency, channel bandwidth and satellite. The system records this information every 20 minutes; this data will be stored locally and will be uploaded to Harris CapRock's Network Management System (NMS) on a regular basis. Harris CapRock can make this data available within 24 hours of a request by a coordinator, fixed system operator, fixed-satellite system operator, NTIA, or the Commission.

(a)(6): Comply. In the event Harris CapRock must communicate with vessels of foreign registry, it will maintain detailed information on each vessel as well as a point of contact for the relevant administration responsible for licensing the ESV.

(a)(7): Comply. The proposed ESV terminal operated by Harris CapRock will be controlled by various hub earth stations located in the United States and licensed to Harris CapRock.

(a)(8): Comply. Harris CapRock certifies that not claim protection from interference from any authorized terrestrial stations to which frequencies are either already assigned, or may be assigned in the future in the 10.95-11.2 GHz (space-to-Earth) and 11.45-11.7 GHz (space-to-Earth) frequency bands.

(b)(1)(i)(A-C): Comply. (*See* Technical Appendix, Annex 2.)

(b)(1)(ii): Harris CapRock acknowledges that the ST5000-2.4 antenna does not meet the Commission's Section 25.209 gain pattern for Ku-band operations. Accordingly, pursuant to Section 25.132(b)(3) of the Commission's rules, Harris CapRock hereby

submits range test plots of the antenna gain patterns in both C-band and Ku-band. (*See* Technical Appendix, Annex 4.)

(b)(1)(iii): Harris CapRock certifies that the terminal will maintain a pointing error of less than or equal to 0.2° between the orbital location of the target satellite and the axis of the main lobe of the ESV antenna and that that all emissions will automatically cease within 100 ms if the angle between the orbital location of the target satellite and the axis of the main lobe of the ESV antenna exceeds 0.5°. (*See* Annexes 5 & 6.)

(b)(2): Not Applicable.

(b)(3): Not Applicable.

(b)(4): Not Applicable. There is no change to the proposed area of operations. The geographic area where the ESVs will operate includes U.S. territorial waters and waterways, the Gulf of Mexico, Caribbean Sea, Atlantic Ocean, and Pacific Ocean.

(b)(5) Comply. (Also note discussion of 25.222(a)(4).)

(b)(6): Comply. (*See* Annex 7.)

(c): Harris CapRock certifies that it does not anticipate conducting operations in the 14.0-14.2 GHz band within: 125 km of the NASA TDRSS facilities on Guam (located at latitude: 13°36′55″ N, longitude 144°51′22″ E) or White Sands, New Mexico (latitude: 32°20′59″ N, longitude 106°36′31″ W and latitude: 32°32′40″ N, longitude 106°36′48″ W). Furthermore, Harris CapRock certifies that it does not plan to conduct operations in the 14.0-14.2 GHz band within 125 km of the NASA TDRSS facilities in Blossom Point, MD (latitude: 38°25’44” N, longitude: 77°05’02” W).[1] Harris CapRock acknowledges that operations within the regions defined above are subject to coordination with relevant federal agencies and may pursue such coordination in the future.

[1] *See* Public Notice, DA 14-992 (July 11, 2014).

(d): Harris CapRock certifies that it does not anticipate conducting operations during observations in the 14.47-14.5 GHz band within: (a) 45 km of the radio observatory on St. Croix, Virgin Islands (latitude 17°46′ N, longitude 64°35′ W); (b) 125 km of the radio observatory on Mauna Kea, Hawaii (at latitude 19°48′ N, longitude 155°28′ W); and (c) 90 km of the Arecibo Observatory on Puerto Rico (latitude 18°20′46″ W, longitude 66°45′11″ N). Harris CapRock acknowledges that operations within the regions defined above are subject to coordination with relevant federal agencies and may pursue such coordination in the future.