

TECHNICAL APPENDIX

2.4m ST5000-2.4 ESV Terminal (Ka-band) “CapRock1”

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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 and has years of proven experience in the field. The reflector antenna has been tested extensively for RF performance, the comprehensive results of which are presented herein in conformance with the Commission’s Rules. Thus, the FCC can be assured that ST5000-2.4 will operate as designed to avoid potential interference to other spectrum users, including users of the Ka-band frequencies that are the subject of this application.

SUMMARY OF TECHNICAL PARAMETERS – ST5000-2.4

Characteristic	Ka-band
Antenna diameter	2.4m
Type of Antenna	Circular reflector
Peak Power (SSPA)	40 Watts
Transmit Bandwidth	1 MHz to 216 MHz
Transmit Gain	54.7 dBi
EIRP	68.9 dBW
Data Rate	40 Mbps Tx/ 300 Mbps Rx
Emission Designators	1M00G7D to 40M0G7D
Transmit Polarization	LHCP/RHCP
Transmit Max PSD	29.0 dBW/4kHz
Transmit Beamwidth	.14 degrees
Receive G/T	26.5 dB/K
Receive Bandwidth	Up to 216 MHz
Receive Polarization	LHCP and RHCP
Feed Flange Power	26.4 Watts
ERP	4.7 MW
Signal Modulation	Up to 32APSK

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. Based on well-proven ST4000 antenna control technologies, the ST5000-2.4 has been tested and demonstrated extensively in fixed locations and in real-world maritime conditions. There have been no reported cases of interference in connection with recent test ST-5000-2.4 operations or ongoing ST4000 commercial maritime operations.

Harris CapRock demonstrates that the ST5000-2.4 terminal will not exceed the off-axis EIRP levels set forth in Section 25.138 of the Commission’s Rules governing Ka-band GSO FSS earth stations.¹ Furthermore, Harris CapRock’s ST5000-2.4 terminal is designed to meet the FCC’s requirements for Ku-band earth station onboard vessel (“ESV”) operations, including: (i) pointing accuracy of 0.2° or better; (ii) automatic cessation of emissions within 100 ms if pointing offset exceeds 0.5°; and (iii) 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 360°
Elevation	0 to 90° antenna elevation
Position accuracy	Better than 0.2° (auto-disable at 0.5° offset)
Tracking capability	8°/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, V., “Tracking Report”) As indicated in the *Tracking Report*, the 1 dB contour (i.e., a 1 dB reduction from peak boresite power) represents a 0.19° 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 0.2°.

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

¹ Harris CapRock acknowledges that the Commission has not adopted technical rules for Ka-band ESV operations. Accordingly, to the extent applicable, Harris CapRock demonstrates compliance with Sections 25.138 (Ka-band GSO FSS earth station operations) and 25.222 (Ku-band GSO FSS ESV operations) of the Commission’s Rules.

transmissions if pointing offset exceeds 0.5° and will not recommence transmissions until pointing offset is within 0.2°.

Sections 25.138 Off-Axis EIRP Spectral Density Limits. The ST5000-2.4 will operate in accordance with the off-axis EIRP spectral density limits for Ka-band GSO FSS earth stations set forth the Commission's Rules.² In the Technical Appendix, Harris CapRock provides a series of radiation patterns at the bottom, middle and top of Ka-band demonstrating that the ST5000-2.4 terminal will comply with the EIRP spectral density limits in Section 25.138 of the Commission's Rules and the Commission's two-degree spacing policies during Ka-band operations. Specifically, Harris CapRock provides co-polarized patterns in the azimuth plane at plus and minus 10 degrees and plus and minus 180 degrees, and in the elevation plane at plus and minus 30 degrees. Furthermore, Harris CapRock provides cross-polarized patterns at plus and minus 10 degrees in the azimuth and elevation planes.

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 Ka-band at certain off-axis angles³ and hereby submits range test plots of the antenna gain patterns at the bottom, middle and top of the Ka-band. Harris CapRock will reduce transmit power spectral density to ensure that the off-axis EIRP spectral density limits set forth in Section 25.138 are satisfied. In addition, while Harris CapRock will operate in accordance with the Commission's Ka-band plan in certain frequencies while stationary, in no case will Harris CapRock seek receive protection greater than that of a Section 25.209-compliant antenna where any such protection be afforded to ST5000-2.4 receive operations.⁴

Pursuant to Section 25.138(e) of the Commission's Rules, Harris CapRock provides co-polarized and cross-polarization plots versus the FCC Section 25.209 gain mask in the E and H planes at 27.6520 GHz (bottom of band), 28.3615 GHz (middle of band) and 29.0710 GHz (top of band). (See Technical Appendix, II.) Consistent with the format identified in Section 25.138(d), Harris CapRock also provides the measured gain data for the ESV terminal in the azimuth plane at plus and minus 10 degrees and plus and minus 180 degrees, and in the elevation plane at plus and minus 30 degrees. Harris CapRock complies with Section 25.138(e) of the Commission's Rules by providing measured gain pattern values at the bottom, middle and top of the Ka-band.

In the following appendices, and draft Form 312 and Schedule B, Harris CapRock provides additional operational and technical information relating to the ST5000-2.4 terminal.

² See 47 C.F.R. § 25.138. The ST5000-2.4 terminal complies with off-axis EIRP spectral density limits in both the azimuth and elevation plane in the Ka-band.

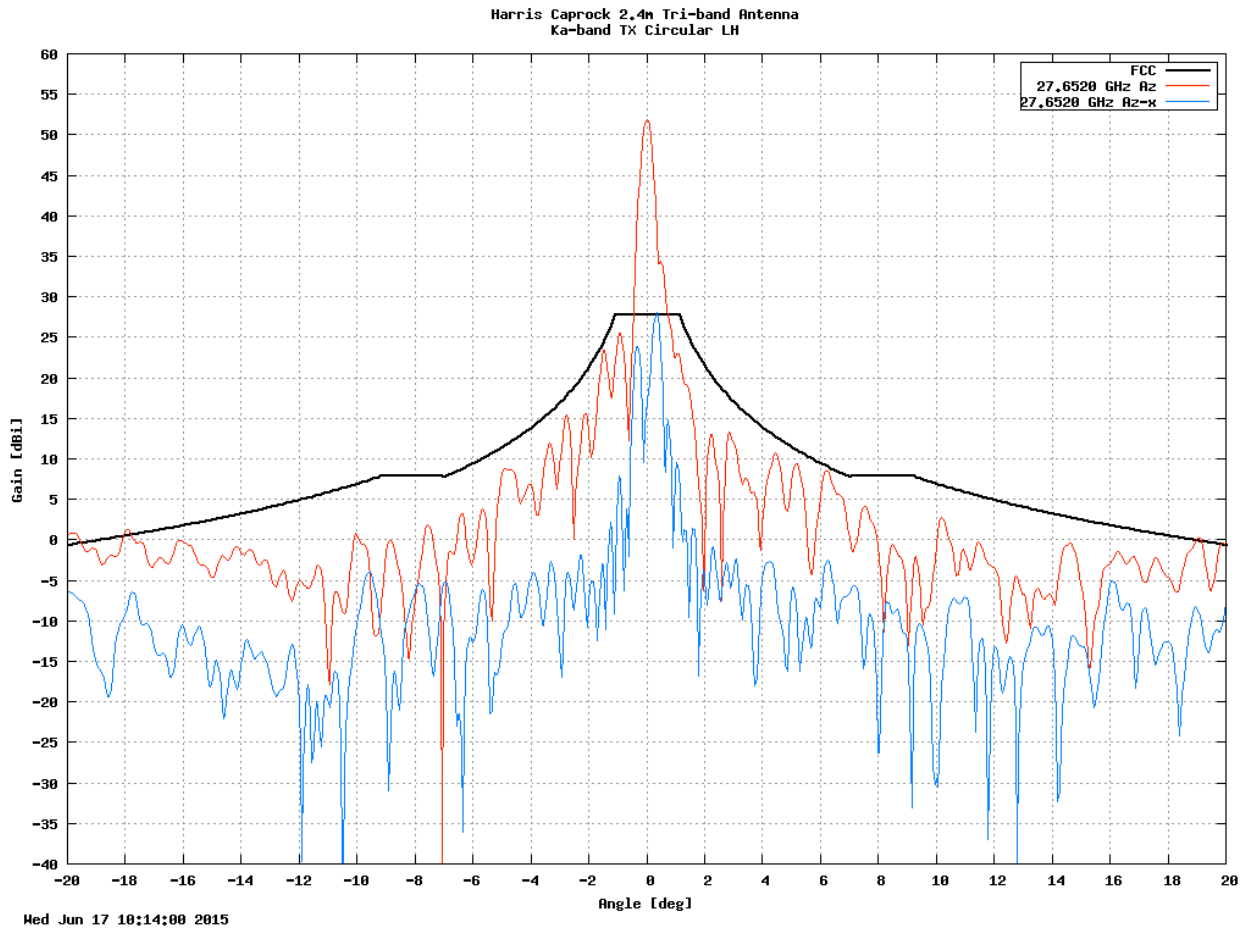
³ See 47 C.F.R. § 25.209.

⁴ Of course, no receive protection will be afforded to ST5000-2.4 terminal operations to the extent conducted on a non-conforming basis.

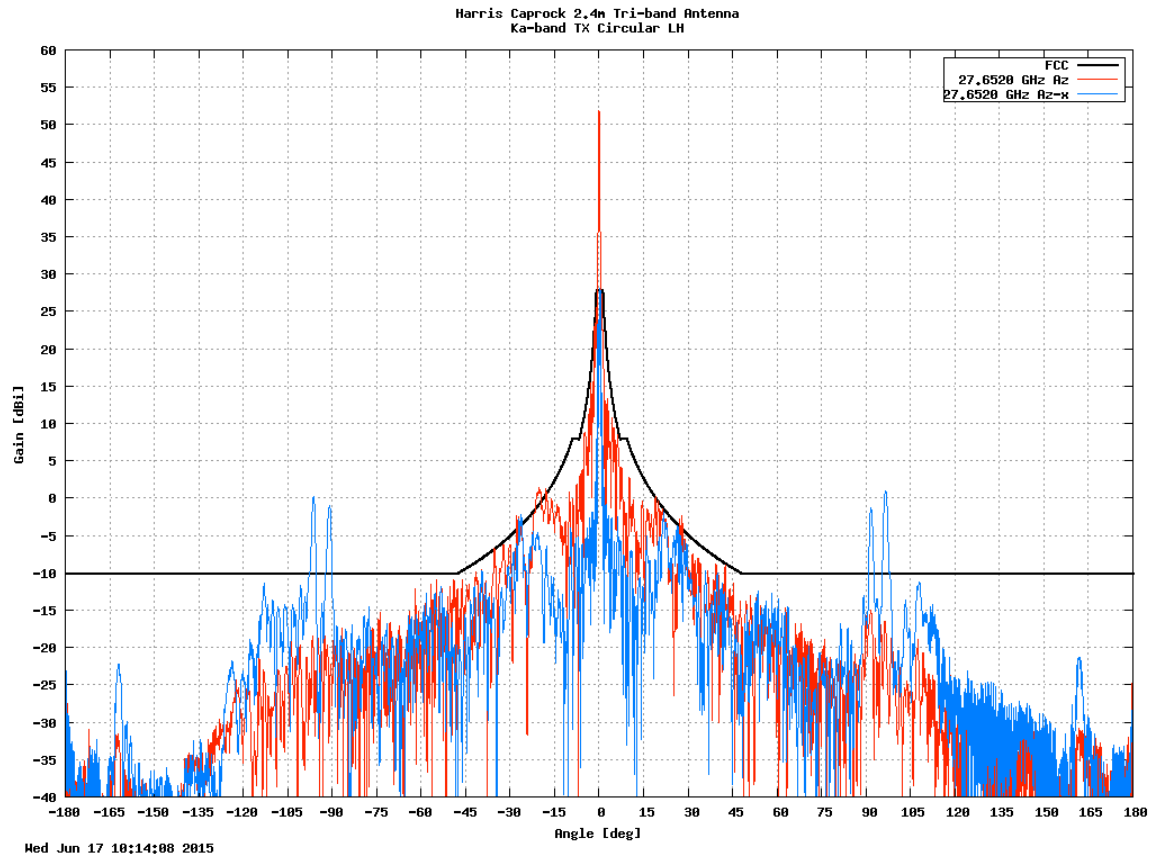
II. Ka-band Antenna Gain Patterns & Associated Data

Bottom of band – 27.6520 GHz

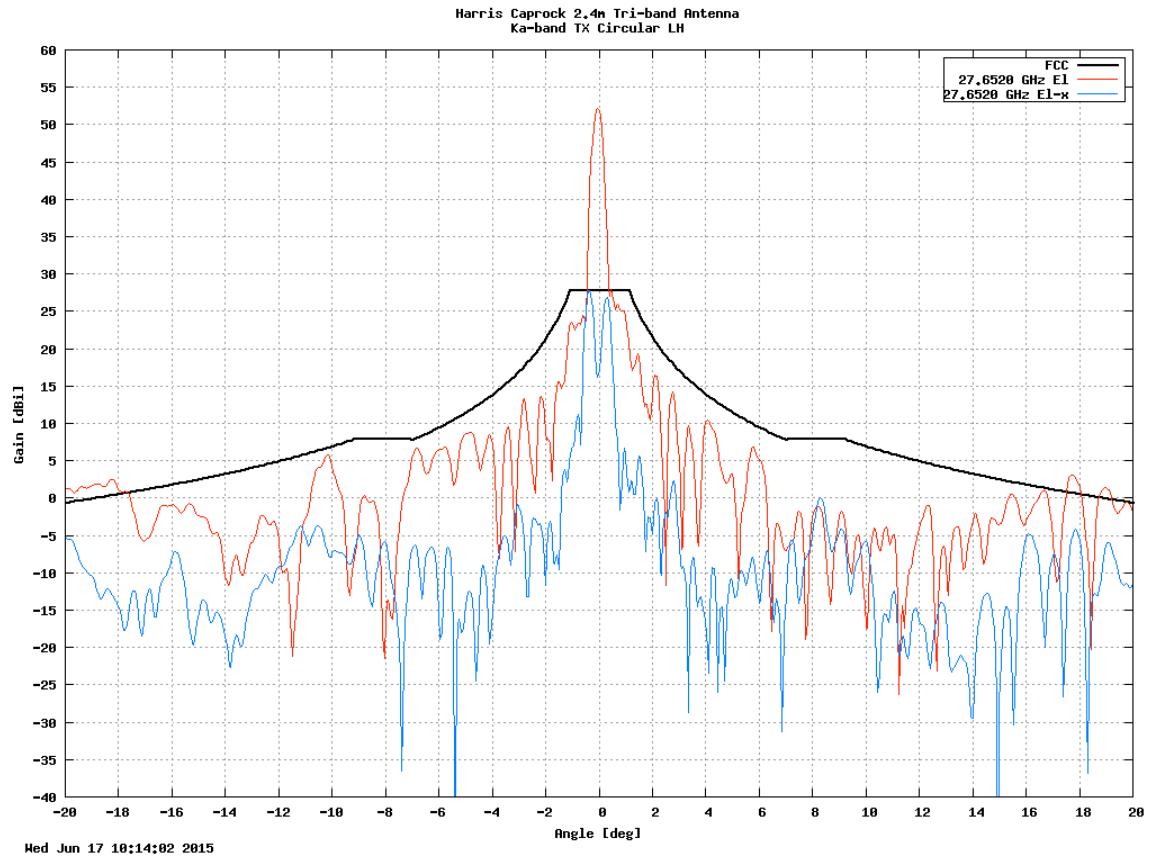
Azimuth (Narrow)



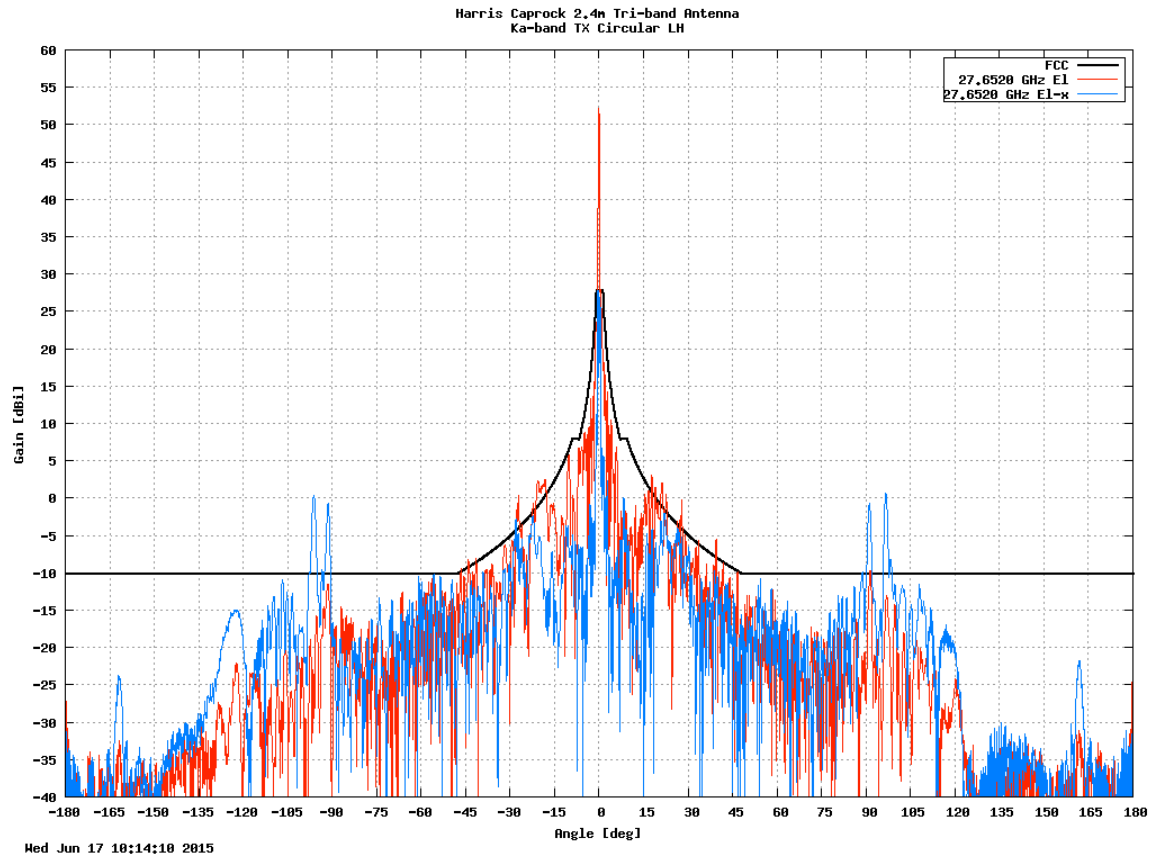
Azimuth (Wide)



Elevation (Narrow)

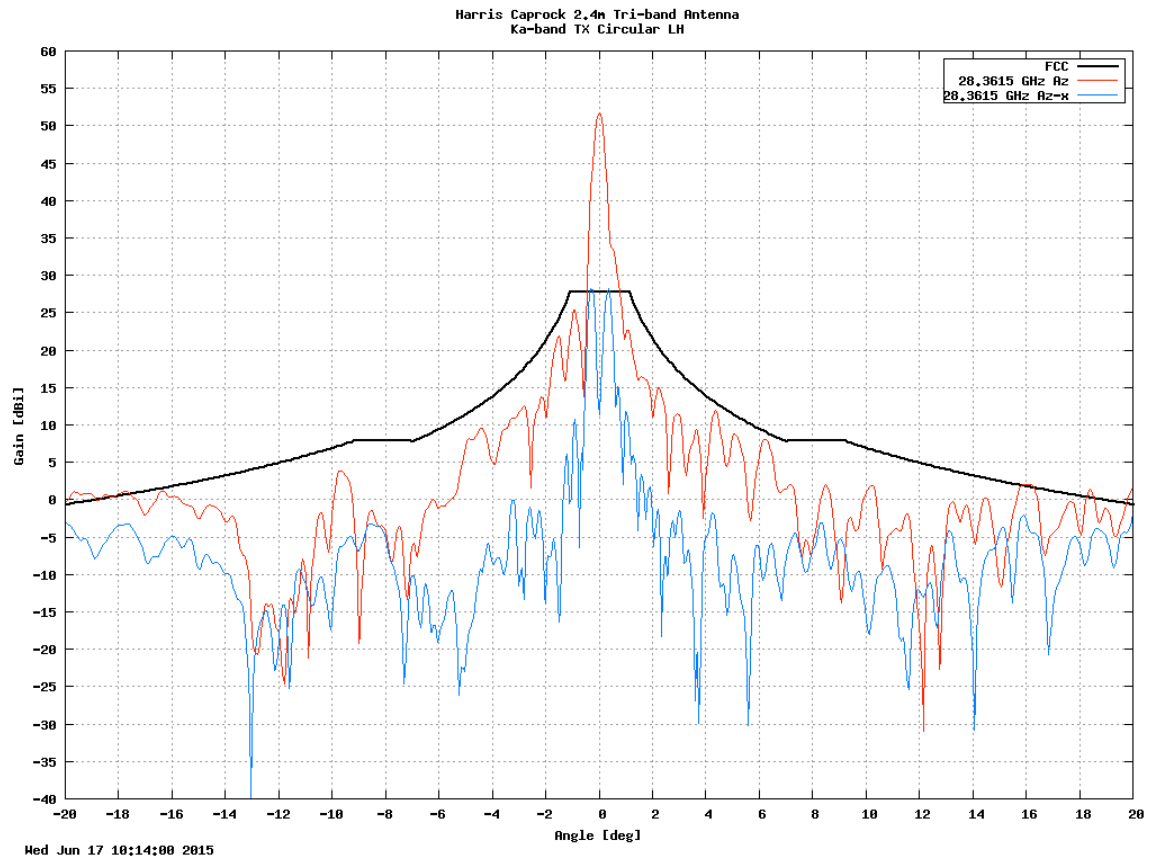


Elevation (Wide)

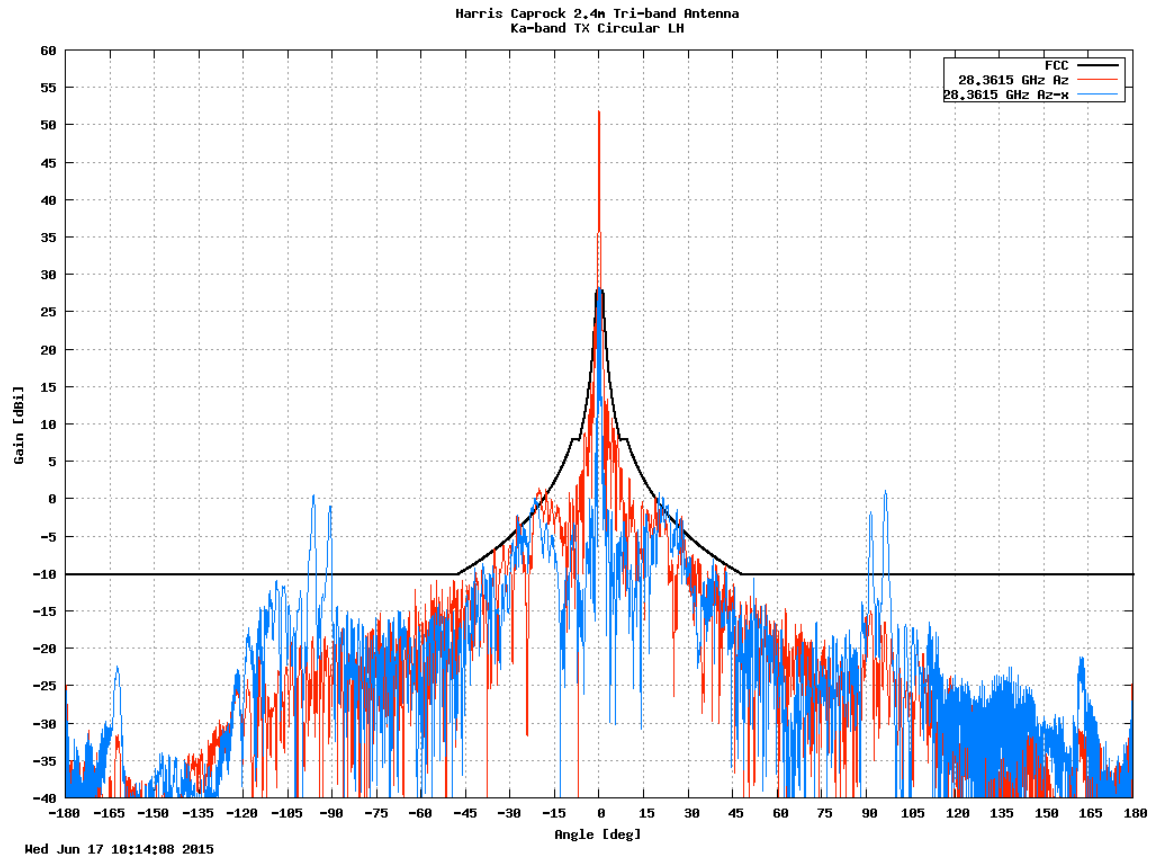


Middle of band – 28.3615 GHz

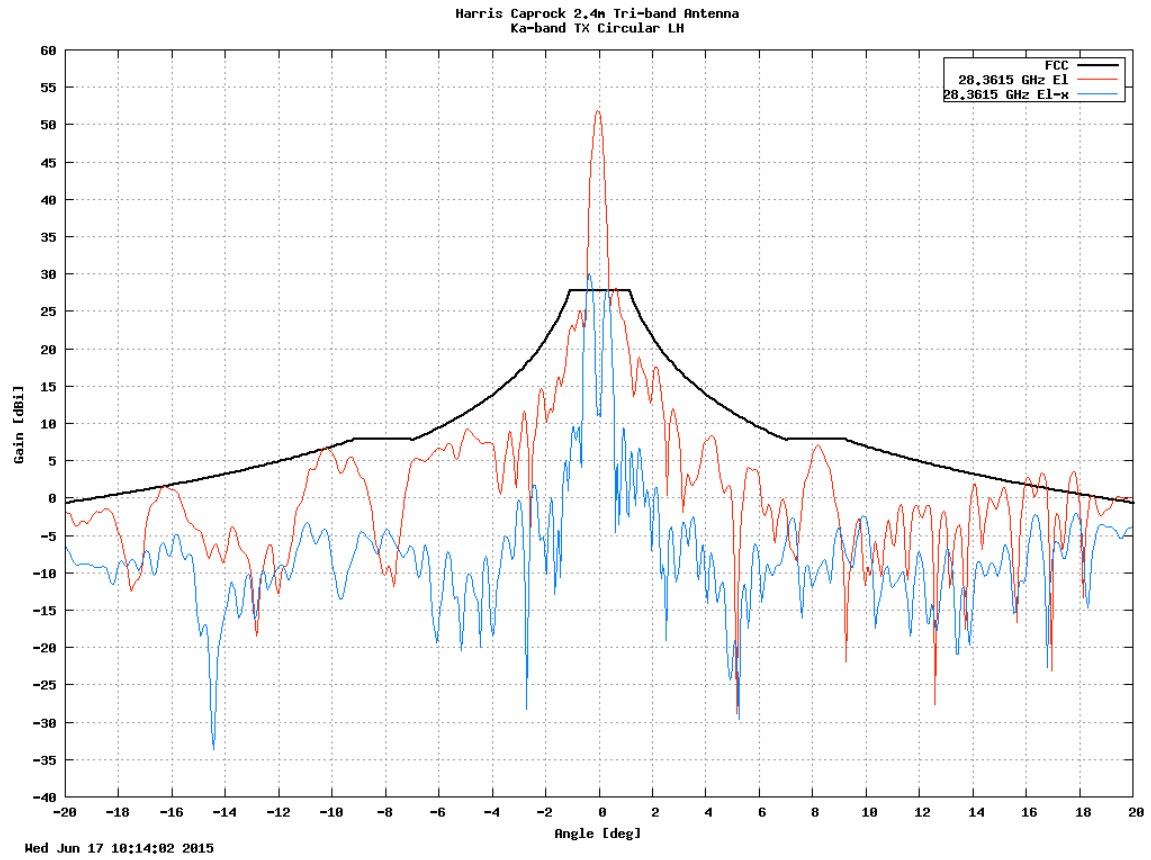
Azimuth (Narrow)



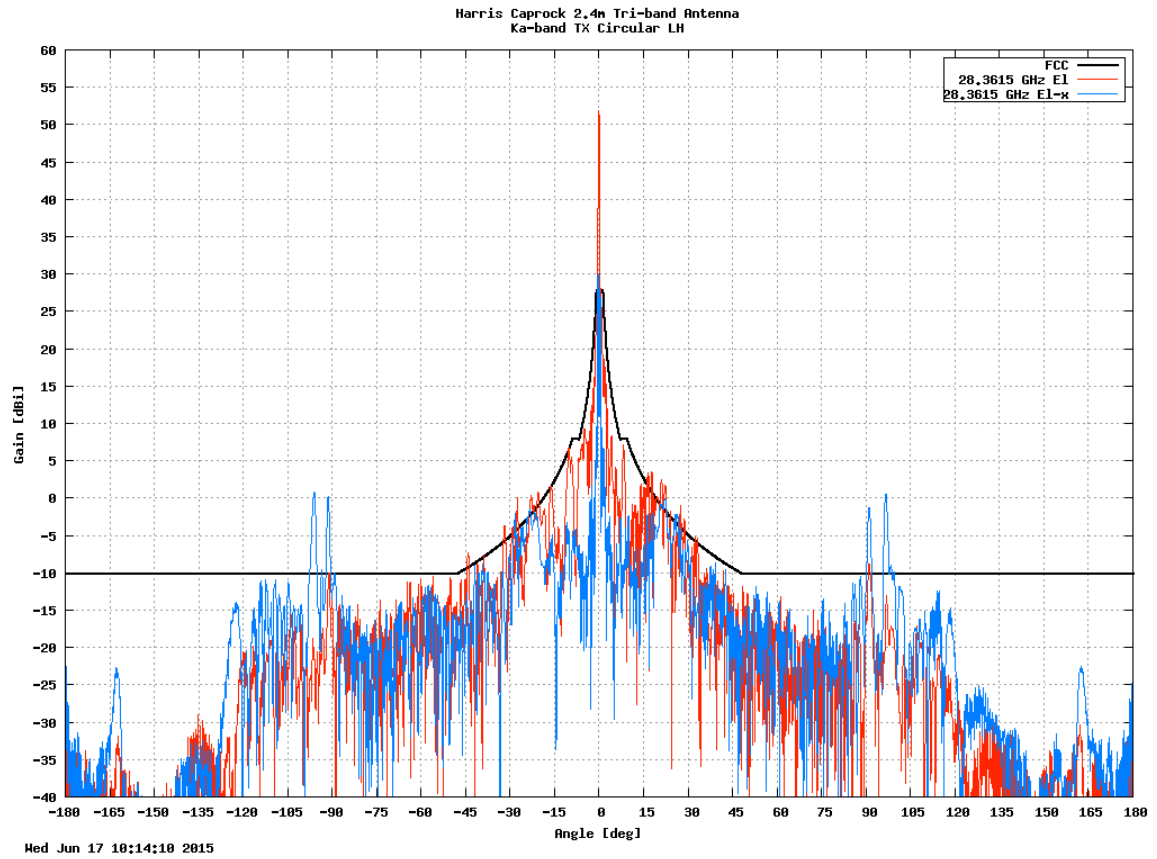
Azimuth (Wide)



Elevation (Narrow)

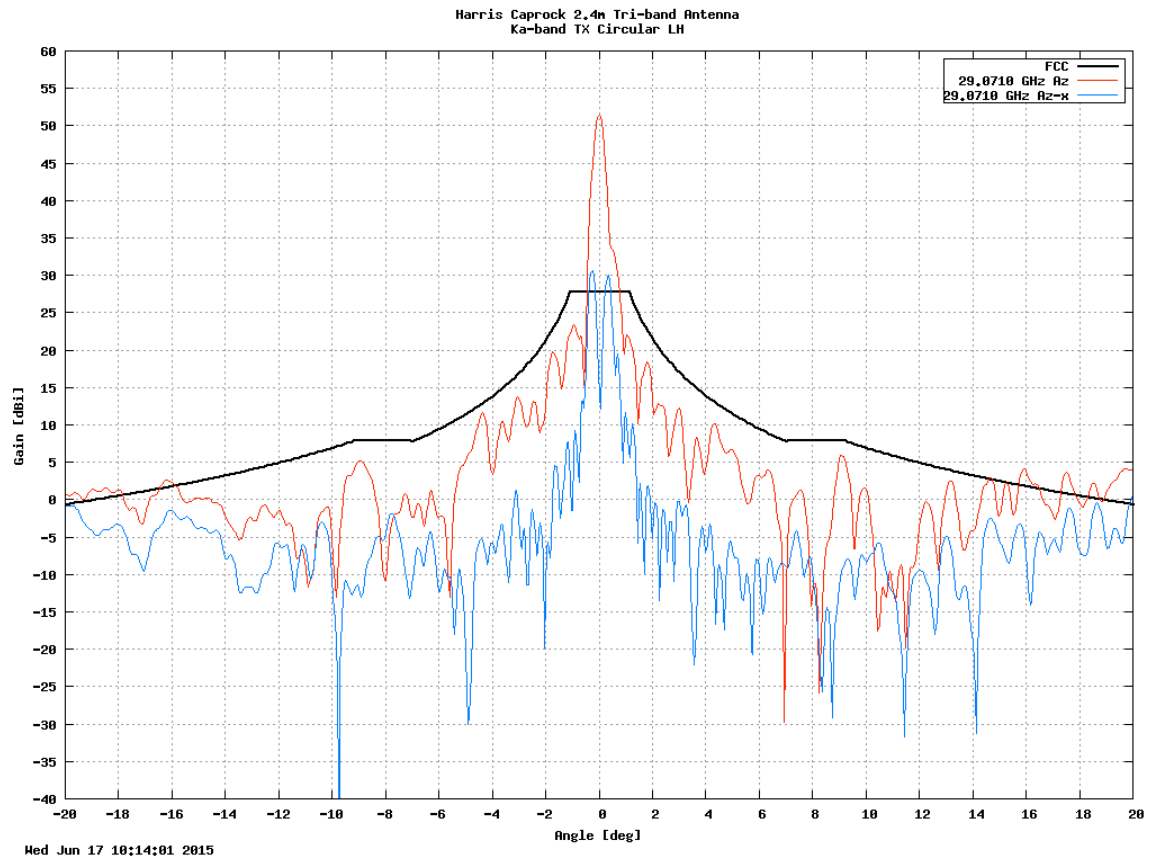


Elevation (Wide)

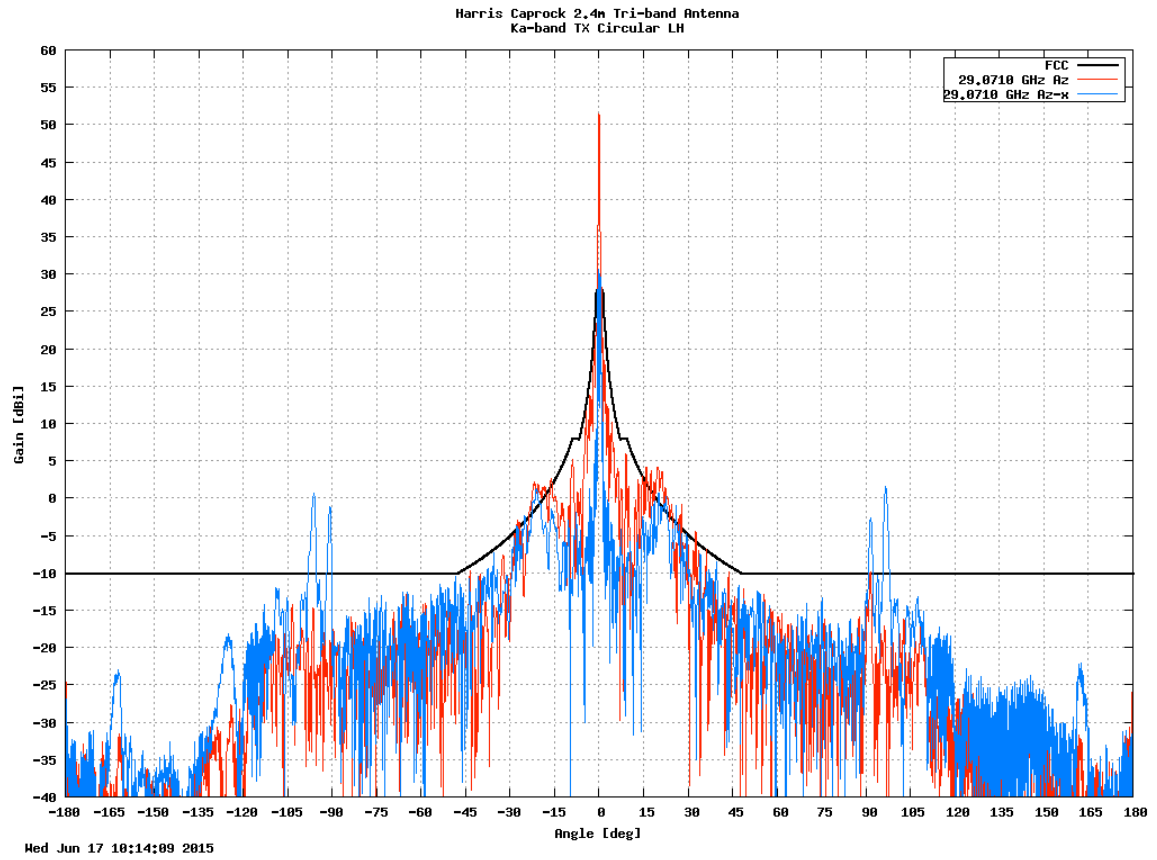


Top of band – 29.0710 GHz

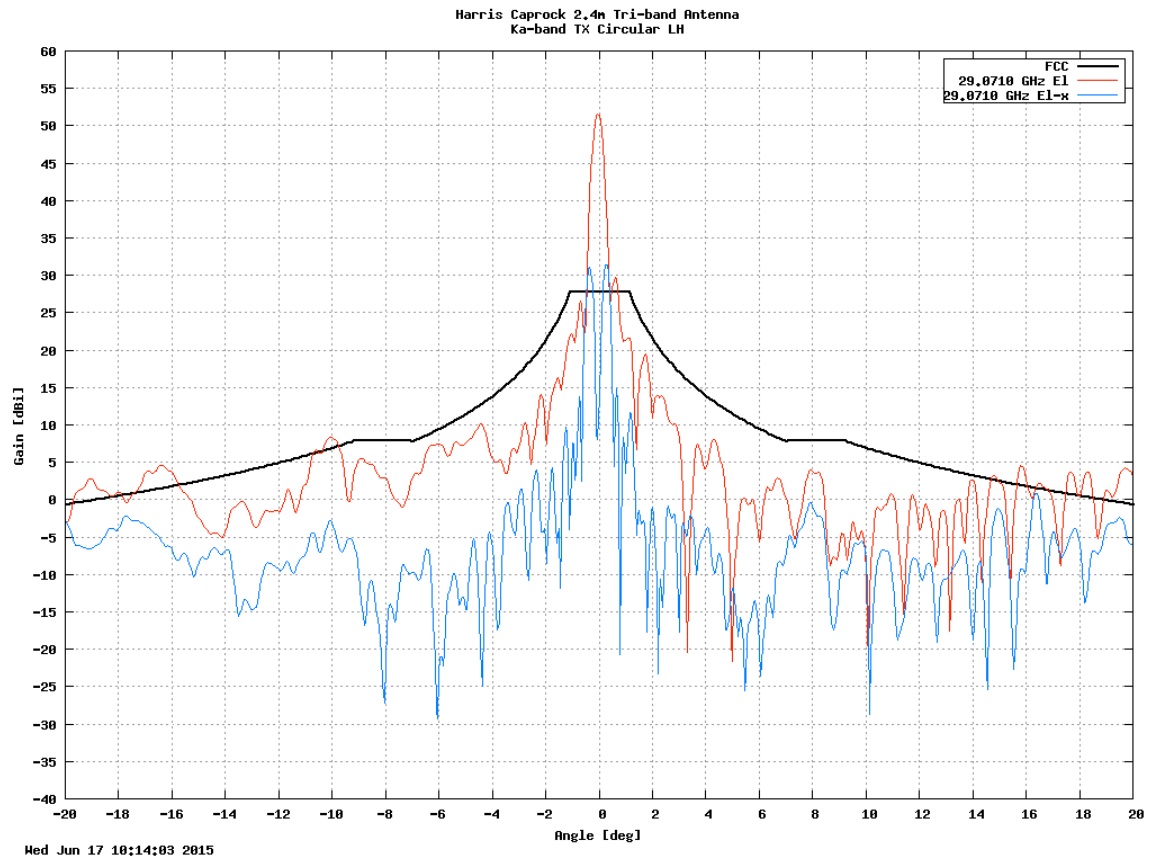
Azimuth (Narrow)



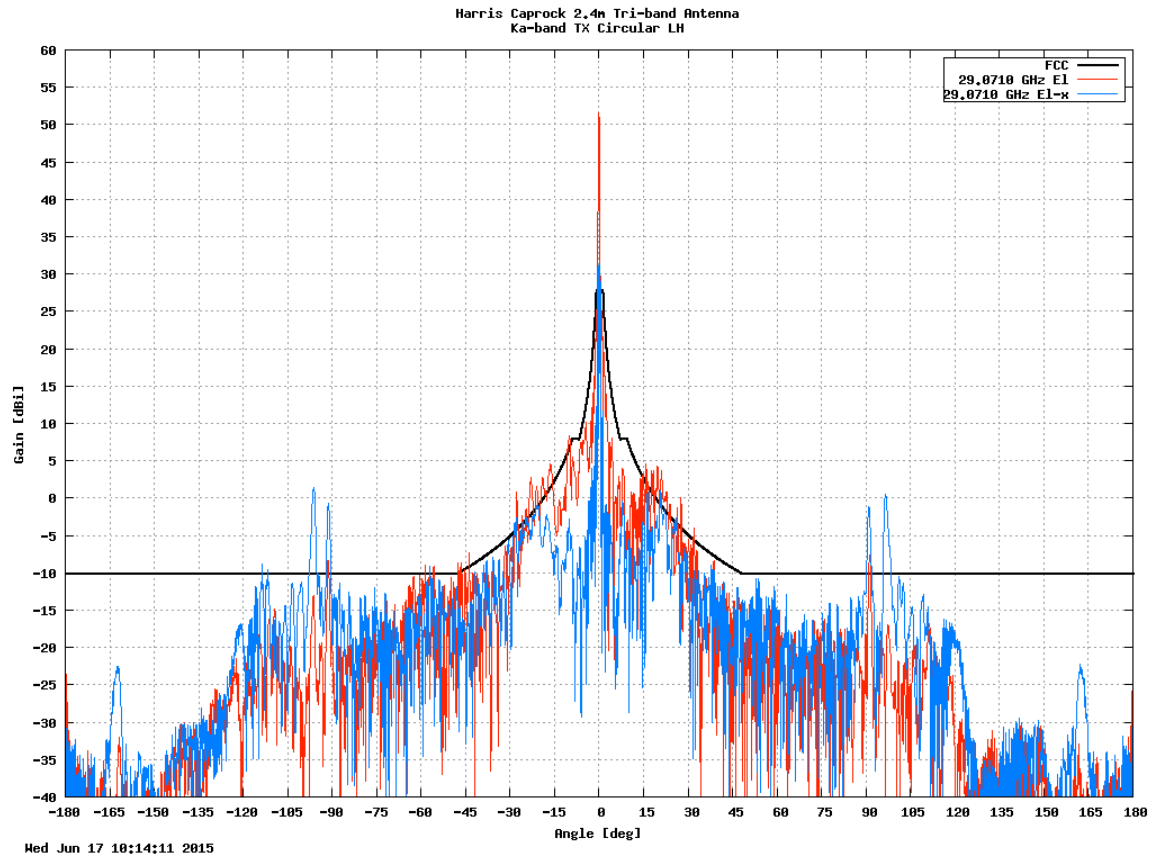
Azimuth (Wide)



Elevation (Narrow)



Elevation (Wide)



Harris Caprock 2.4m Tri-band Antenna.
Harris Corp / MUAP / NoCert / NoAprvl
MI3000 DP| Copol (dB,deg) & Xpol (dB,deg)

200	1	1	28.3615	
2				
0				
7201	5			<u>AZIMUTH</u>
-180	-34.244	22.5317	-16.387	179.9374
-179	-41.809	110.3255	-34.325	174.8066
-178	-39.971	176.8293	-43.577	-170.817
-177	-38.246	-151.7858	-32.175	147.6748
-176	-39.953	155.9536	-34.13	141.5421
-175	-41.493	101.6181	-40.376	-175.3671
-174	-42.717	120.9149	-46.924	64.1725
-173	-41.537	136.4089	-42.433	19.8855
-172	-41.082	131.4617	-39.829	101.7995
-171	-41.231	26.9448	-43.592	135.0678
-170	-44.705	36.5074	-38.642	81.9332
-169	-41.625	24.9609	-36.167	26.5422
-168	-35.795	-25.2436	-34.947	4.783
-167	-36.502	-41.8572	-36.971	-77.6771
-166	-39.943	-75.0268	-32.41	-114.3419
-165	-46.126	104.3388	-32.285	-176.9993
-164	-41.55	15.1904	-30.642	100.7794
-163	-36.108	-77.026	-23.425	56.4995
-162	-34.264	-77.838	-23.129	32.2623
-161	-42.045	-50.426	-32.239	39.8111
-160	-34.381	3.1205	-36.628	104.5554
-159	-40.639	-142.1172	-42.346	169.3392
-158	-38.856	89.8373	-39.41	-44.0212
-157	-38.229	-84.5341	-40.882	-106.2327
-156	-39.413	62.4241	-41.912	30.2764
-155	-44.199	-95.542	-40.618	129.5964
-154	-55.284	79.8953	-45.36	-71.549
-153	-61.763	-33.3019	-41.049	30.3454
-152	-44.389	129.2886	-41.156	124.5959
-151	-39.006	-74.4993	-37.814	-80.9457
-150	-39.1	24.7533	-40.128	38.492
-149	-35.848	151.955	-37.219	144.4899
-148	-34.37	-126.2521	-35.226	-139.7003
-147	-36.749	-34.0995	-36.581	-55.9217
-146	-34.64	44.831	-36.589	41.9613
-145	-34.473	124.02	-34.58	116.521
-144	-39.862	-160.3256	-43.623	170.7536
-143	-36.895	-134.1774	-34.734	-134.7014
-142	-38.721	-127.2393	-38.727	-105.7362
-141	-36.493	-54.9864	-39.366	-85.105
-140	-39.648	-44.1352	-38.667	-64.4263
-139	-40.106	-36.5081	-37.44	-61.747

-138	-46.297	-31.1645	-37.863	-65.7718
-137	-40.461	-49.165	-39.324	-101.9541
-136	-51.903	-115.3037	-42.226	-142.8084
-135	-44.07	-142.4374	-40.598	-174.5951
-134	-36.436	162.8586	-37.642	151.7513
-133	-36.184	100.6256	-35.656	93.0483
-132	-32.371	20.7089	-40.763	-17.6678
-131	-34.067	-120.6178	-44.798	-80.8776
-130	-31.558	154.0229	-39.525	-176.4962
-129	-30.129	29.8145	-35.665	169.1929
-128	-28.419	-106.1786	-35.501	26.2888
-127	-28.781	125.6148	-30.819	-87.1502
-126	-28.197	-19.7865	-31.573	167.087
-125	-29.464	-177.6633	-30.061	56.9819
-124	-36.769	-18.5825	-31.257	-63.7308
-123	-43.631	-101.8398	-26.449	-179.0424
-122	-35.471	162.3785	-25.624	27.9894
-121	-27.645	3.2109	-30.09	-110.0175
-120	-46.821	-91.5839	-27.502	-167.5837
-119	-29.64	-174.8779	-20.572	48.1529
-118	-29.872	-7.3262	-18.011	-144.1625
-117	-38.76	-41.2154	-19.667	57.533
-116	-24.097	-43.042	-31.73	-85.1093
-115	-28.172	128.3445	-20.32	-89.5965
-114	-30.104	121.5267	-14.823	4.4222
-113	-35.642	93.8496	-25.016	-3.0211
-112	-27.722	-138.8242	-18.602	16.8003
-111	-22.246	153.5808	-12.325	21.2855
-110	-21.288	156.8014	-18.932	45.7532
-109	-26.167	-127.9998	-12.052	-6.4978
-108	-24.003	102.3801	-13.55	14.577
-107	-21.505	143.4002	-13.432	-94.1709
-106	-21.016	36.0318	-11.809	-58.8405
-105	-27.221	-22.7976	-19.782	-121.8577
-104	-28.326	124.9359	-18.832	-91.2297
-103	-25.709	15.3732	-17.241	-124.8294
-102	-20.241	-123.7265	-17.152	109.936
-101	-18.907	41.5689	-13.904	-163.7929
-100	-23.531	-76.6807	-34.312	-114.9249
-99	-26.713	-15.9901	-20.015	-103.7902
-98	-23.684	-73.6929	-9.377	38.5822
-97	-23.456	33.1929	-3.419	91.8344
-96	-20.935	-143.1507	-0.538	63.9899
-95	-22.209	-78.5872	-22.424	11.4174
-94	-27.295	102.7949	-20.609	-39.8937
-93	-22.553	-171.263	-12.975	160.1133
-92	-32.264	122.9351	-10.187	-145.8266
-91	-21.935	85.893	-1.695	-162.0016
-90	-22.78	-36.0425	-13.779	-146.0349

-89	-30.801	2.7137	-29.704	22.4749
-88	-23.741	-159.6593	-17.54	78.4155
-87	-24.078	96.6239	-18.289	-62.3324
-86	-26.945	176.9879	-19.402	-61.444
-85	-40.194	-176.4422	-15.839	-101.317
-84	-25.809	-62.8607	-21.333	-65.8382
-83	-17.236	-21.9714	-23.327	-151.6143
-82	-22.36	37.8085	-22.301	25.7063
-81	-29.395	-94.5969	-16.089	82.2088
-80	-29.51	41.0207	-23.273	53.921
-79	-18.309	137.8323	-32.587	139.696
-78	-38.733	-161.7065	-27.244	-160.6546
-77	-29.52	77.2284	-23.416	164.6986
-76	-16.064	-136.6817	-18.327	-72.7796
-75	-23.768	-73.7501	-23.899	27.6893
-74	-23.726	-19.5642	-25.38	47.3809
-73	-41.065	13.2692	-20.621	-0.5141
-72	-23.176	50.6253	-21.239	71.4633
-71	-24.414	86.8356	-16.495	130.1553
-70	-20.304	147.7741	-21.156	-89.8807
-69	-14.756	-143.2256	-24.566	-6.1242
-68	-24.515	-60.7614	-27.289	53.5372
-67	-30.738	-50.251	-15.137	-104.415
-66	-22.632	6.0354	-16.684	41.7043
-65	-33.634	-94.9238	-19.312	167.5553
-64	-28.173	-158.147	-18.597	-4.044
-63	-33.472	-144.4964	-22.525	110.8855
-62	-18.507	87.4092	-20.063	-126.7728
-61	-20.813	-163.57	-25.669	-163.0057
-60	-14.429	-82.904	-23.289	-21.9221
-59	-20.644	33.4154	-18.297	45.6294
-58	-16.214	100.2631	-18.424	117.4162
-57	-17.756	131.2644	-17.182	-165.7572
-56	-17.899	-63.2585	-15.889	-49.8117
-55	-25.805	3.3477	-17.396	-4.5594
-54	-17.713	174.1981	-18.421	153.1395
-53	-34.367	152.8323	-27.868	-139.5117
-52	-18.655	-68.9181	-30.783	23.4454
-51	-34.564	-17.0861	-23.198	20.4785
-50	-20.097	79.8794	-22.641	98.1359
-49	-24.284	-43.4068	-16.899	-127.7898
-48	-27.918	134.4215	-26.414	100.7577
-47	-19.329	-130.64	-19.119	76.5623
-46	-22.789	-130.9094	-26.565	115.6749
-45	-20.901	0.0184	-18.431	-101.3515
-44	-11.893	27.7794	-16.936	37.1715
-43	-13.159	167.9157	-12.656	139.8822
-42	-12.668	-126.1316	-9.647	-70.5179
-41	-13.439	55.5176	-14.525	68.3359

-40	-26.759	145.6698	-13.619	-152.595
-39	-18.155	-47.1178	-9.614	15.5909
-38	-11.825	140.6896	-10.85	156.9427
-37	-19.824	-146.8132	-12.191	-52.9503
-36	-9.235	24.594	-9.994	79.2271
-35	-14.649	-124.0241	-21.969	-77.3169
-34	-16.252	2.0299	-14.847	55.0828
-33	-9.106	134.7599	-16.625	-161.4585
-32	-9.391	-2.5575	-15.441	-8.3846
-31	-7.825	148.2083	-12.36	-151.6788
-30	-8.189	-16.844	-10.277	-1.8812
-29	-9.465	125.8608	-5.924	-166.4495
-28	-4.434	-42.8951	-6.741	8.2478
-27	-6.311	-169.5398	-7.312	-92.3545
-26	-2.277	58.273	-7.081	84.4862
-25	-18.437	-64.5282	-4.195	-50.323
-24	-8.102	35.7228	-9.844	148.422
-23	-2.791	-96.5241	-1.629	2.1861
-22	-0.741	139.2215	-0.664	-116.073
-21	0.671	11.8583	-0.523	137.4193
-20	-0.242	-94.1029	-3	13.2249
-19	0.711	142.7684	-7.229	-98.1538
-18	0.771	24.2404	-3.491	138.8127
-17	-2.099	-94.1108	-7.973	34.1448
-16	0.374	158.9264	-4.872	-94.733
-15	-2.507	39.1689	-9.255	168.4341
-14	-2.909	-34.1419	-9.83	84.253
-13	-17.898	-155.8476	-31.85	-155.8442
-12	-17.993	47.9582	-18.523	-157.3538
-11	-10.128	110.3849	-11.295	141.2244
-10	-2.351	-128.981	-16.322	-89.9509
-9.9	1.293	-132.8541	-10.952	-48.077
-9.8	3.324	-134.5728	-7.525	-37.0067
-9.7	3.874	-133.8184	-6.33	-37.7329
-9.6	3.607	-129.7513	-6.136	-43.6503
-9.5	3.247	-126.0398	-5.795	-49.7353
-9.4	2.732	-128.4414	-5.15	-53.82
-9.3	1.441	-137.3537	-4.889	-58.5405
-9.2	-1.35	-148.8674	-5.486	-66.8902
-9.1	-6.962	-160.662	-6.511	-79.0271
-9	-19.276	157.8793	-6.874	-90.1682
-8.9	-12.783	62.6638	-6.124	-96.5478
-8.8	-6.79	57.332	-4.852	-102.4765
-8.7	-3.46	49.2453	-3.825	-111.8176
-8.6	-1.76	36.5513	-3.322	-123.7817
-8.5	-1.477	25.5981	-3.269	-136.1308
-8.4	-2.395	21.8026	-3.423	-147.8482
-8.3	-3.407	25.3225	-3.53	-159.2564
-8.2	-3.519	25.0055	-3.645	-170.5173

-8.1	-3.546	13.1458	-4.146	179.0644
-8	-4.316	-6.1305	-5.307	170.9172
-7.9	-6.105	-28.7718	-6.908	167.0782
-7.8	-8.05	-56.3695	-8.271	167.1598
-7.7	-7.483	-84.9338	-9.2	164.624
-7.6	-4.962	-102.0674	-10.407	153.6865
-7.5	-3.517	-112.2563	-12.396	135.5909
-7.4	-4.636	-121.0489	-16.098	115.0209
-7.3	-8.805	-127.5251	-24.62	64.766
-7.2	-13.367	-112.9654	-17.89	-24.2905
-7.1	-9.803	-92.2879	-12.162	-32.0821
-7	-6.196	-90.7219	-10.178	-33.721
-6.9	-6.375	-81.6808	-10.895	-38.5417
-6.8	-7.669	-46.6142	-13.881	-43.0788
-6.7	-4.95	-21.076	-17.13	-22.0503
-6.6	-2.807	-25.6272	-13.92	10.4954
-6.5	-1.612	-35.4561	-11.302	12.8837
-6.4	-0.964	-33.8885	-13.002	-0.5933
-6.3	-0.312	-23.6947	-17.757	-47.9438
-6.2	0.015	-21.5085	-16.794	-98.3316
-6.1	-0.738	-36.3924	-17.979	-95.28
-6	-1.159	-62.8266	-18.762	-54.1126
-5.9	-0.878	-80.15	-16.73	-41.7762
-5.8	-0.869	-84.6629	-15.887	-60.0423
-5.7	-0.617	-89.8731	-14.132	-76.0132
-5.6	-0.12	-106.8789	-12.559	-74.0289
-5.5	0.198	-134.0257	-12.15	-66.7012
-5.4	0.477	-167.2085	-14.421	-65.9423
-5.3	1.714	163.754	-22.119	-88.783
-5.2	3.542	151.8342	-23.964	-179.218
-5.1	5.466	152.6125	-22.602	178.9164
-5	7.178	153.2371	-21.678	-140.6266
-4.9	8.029	147.8921	-18.453	-134.6254
-4.8	8.084	138.4815	-16.781	-149.3322
-4.7	8.04	130.4573	-15.795	-144.5365
-4.6	8.491	126.7679	-12.871	-117.1147
-4.5	9.271	122.7143	-9.695	-110.3414
-4.4	9.619	113.4621	-9.642	-132.1446
-4.3	9.163	100.0139	-8.593	179.8018
-4.2	7.946	88.1523	-5.952	153.2226
-4.1	6.232	83.9133	-6.36	150.8661
-4	4.96	82.6826	-8.455	168.7102
-3.9	4.713	66.5611	-8.333	-177.5346
-3.8	6.12	35.2481	-7.746	168.547
-3.7	8.231	9.5342	-8.222	142.0199
-3.6	9.246	-5.6825	-9.895	108.9871
-3.5	9.427	-11.6887	-9.36	87.3631
-3.4	9.938	-11.6633	-5.464	101.5788
-3.3	10.778	-15.2972	-1.092	116.2127

-3.2	10.974	-29.1455	-0.022	124.7921
-3.1	10.982	-51.3555	-3.959	139.597
-3	11.595	-66.2086	-11.523	-144.6877
-2.9	12.139	-61.9692	-9.186	-83.3153
-2.8	12.575	-47.5249	-13.405	6.2544
-2.7	11.438	-39.3631	-3.589	59.8508
-2.6	5.046	-55.8069	-1.039	64.9856
-2.5	6.096	-151.785	-2.986	70.9709
-2.4	11.23	-156.5621	-5.216	101.289
-2.3	11.907	-129.3787	-2.411	124.5047
-2.2	13.209	-89.9455	-1.522	125.6064
-2.1	13.679	-59.9501	-6.32	128.1995
-2	11.114	-15.846	-13.976	-133.5523
-1.9	13.168	54.8148	-7.407	-120.8732
-1.8	17.165	92.4094	-7.468	-172.0131
-1.7	19.198	123.9092	-5.212	141.1616
-1.6	21.105	152.2208	-8.858	114.4798
-1.5	21.939	167.2939	-16.322	40.5054
-1.4	19.954	167.4419	-7.902	92.9774
-1.3	15.867	138.9987	3.263	112.9129
-1.2	17.781	107.4788	6.156	120.4354
-1.1	21.548	119.1828	-0.599	155.9979
-1	24.64	134.9556	6.734	-90.5406
-0.9	25.322	138.4415	10.751	-76.5324
-0.8	23.045	124.2468	4.337	-60.3219
-0.7	20.622	93.9146	3.925	95.7753
-0.6	15.768	102.4258	4.021	156.8162
-0.5	22.671	-128.6813	17.619	-106.9209
-0.4	33.921	-94.7766	25.522	-96.4407
-0.3	41.578	-73.3677	28.184	-93.4477
-0.2	47.046	-60.8081	26.824	-91.9673
-0.1	50.383	-54.3683	20.37	-86.0637
0	51.654	-52.0381	11.341	-13.1958
0.1	50.834	126.6851	17.768	168.9872
0.2	47.67	120.3483	23.953	133.3167
0.3	41.597	101.8351	27.697	116.6523
0.4	34.423	45.1127	27.651	106.9707
0.5	33.703	-15.7672	23.266	94.8592
0.6	31.92	-54.9085	12.483	41.4265
0.7	29.801	-94.7015	15.091	-46.8995
0.8	27.553	-114.3221	12.2	-67.891
0.9	22.796	-97.3628	2.067	162.275
1	21.937	-50.188	11.759	120.3229
1.1	22.616	-40.4108	9.872	99.1657
1.2	20.816	-54.956	4.803	35.8391
1.3	18.831	-74.0614	5.975	-16.425
1.4	16.801	-71.4353	0.699	-48.7046
1.5	15.981	-47.7362	-0.534	-160.6295
1.6	16.481	-39.5634	3.408	171.51

1.7	16.163	-57.0501	-0.519	141.2428
1.8	15.961	-86.252	-0.759	62.8434
1.9	14.517	-115.3196	1.675	35.8017
2	11.064	-165.6823	-2.708	10.3321
2.1	12.957	130.285	-4.448	-78.2723
2.2	14.964	97.6161	-1.314	-106.6708
2.3	14.486	67.8751	-7.284	-121.2665
2.4	13.392	37.2588	-11.871	88.1782
2.5	10.55	20.6473	-7.647	57.5226
2.6	0.879	51.7994	-9.761	-30.9198
2.7	7.39	137.3105	-3.236	-80.9264
2.8	10.901	130.9359	-3.698	-112.7602
2.9	11.313	107.9087	-4.379	-178.4965
3	11.399	87.4928	-1.517	143.2537
3.1	9.593	85.015	-3.299	122.6343
3.2	4.704	112.8629	-8.498	75.481
3.3	4.286	171.9084	-7.092	29.0548
3.4	6.506	-173.1335	-7.516	28.4159
3.5	7.625	175.6183	-12.734	37.1383
3.6	9.126	163.7437	-26.823	-34.9063
3.7	9.112	162.7164	-20.437	-89.0708
3.8	5.509	172.3385	-19.934	73.2692
3.9	-2.521	-131.3852	-7.734	75.1082
4	2.839	-71.4825	-4.989	59.844
4.1	6.653	-79.8371	-4.285	25.3304
4.2	9.7	-94.8043	-2.301	-5.0265
4.3	11.67	-99.7468	-2.048	-18.1834
4.4	11.827	-97.5877	-4.973	-26.9956
4.5	10.332	-93.807	-10.261	-51.9471
4.6	7.793	-91.7596	-11.465	-94.5321
4.7	5.316	-86.6176	-11.732	-114.7591
4.8	4.421	-65.2381	-15.48	-158.9572
4.9	6.282	-38.2361	-10.99	136.5433
5	8.292	-24.3606	-7.482	117.9662
5.1	8.791	-21.4865	-7.934	103.2877
5.2	8.181	-25.1632	-10.702	77.8197
5.3	7.181	-28.4892	-13.01	42.9582
5.4	5.629	-24.1229	-14.813	19.8594
5.5	2.792	-9.076	-18.988	16.0208
5.6	-1.495	23.9324	-30.248	99.6445
5.7	-2.323	76.8345	-15.158	179.2213
5.8	0.773	97.8641	-8.575	-167.5603
5.9	3.564	97.7433	-6.102	-160.965
6	5.869	97.2267	-7.023	-161.3492
6.1	7.382	101.4562	-10.203	-178.3421
6.2	8.065	107.292	-10.225	159.4692
6.3	7.95	110.8488	-7.987	172.2045
6.4	7.027	111.4494	-6.128	-160.7427
6.5	5.329	112.4315	-6.214	-133.0694

6.6	3.1	119.4587	-8.635	-97.4424
6.7	1.351	135.5162	-10.829	-56.194
6.8	1.024	154.1285	-13.095	-49.3293
6.9	1.289	171.6415	-11.655	-86.675
7	1.468	-166.2732	-7.701	-89.7962
7.1	1.82	-138.9915	-6.47	-66.5797
7.2	2.004	-112.8717	-5.558	-32.3379
7.3	1.063	-90.3847	-4.478	-7.2478
7.4	-1.428	-72.5136	-4.724	4.5239
7.5	-5.371	-68.9822	-6.294	7.7846
7.6	-7.683	-96.4927	-8.234	7.609
7.7	-5.862	-118.364	-9.57	5.6836
7.8	-5.685	-127.9144	-9.531	-1.6891
7.9	-7.386	-148.6738	-8.08	-7.5111
8	-6.854	177.2915	-6.85	1.1815
8.1	-4.317	157.6599	-6.114	28.1879
8.2	-2.13	147.6446	-4.448	61.1659
8.3	-0.102	143.104	-3.121	84.1599
8.4	1.449	146.3182	-3.609	98.5668
8.5	1.95	156.9129	-5.798	105.9741
8.6	1.271	172.2568	-8.48	100.2138
8.7	-0.461	-172.3979	-9.286	77.7636
8.8	-3.275	-164.7286	-7.877	54.5973
8.9	-7.042	-173.5015	-6.233	39.5746
9	-11.083	157.9212	-5.322	35.5222
9.1	-13.798	92.6203	-5.53	43.9137
9.2	-7.552	41.8756	-6.754	62.4508
9.3	-3.429	30.8121	-9.033	87.65
9.4	-2.393	26.1819	-11.815	122.692
9.5	-3.223	19.2939	-11.938	156.16
9.6	-4.164	13.7621	-10.487	162.6234
9.7	-3.88	22.849	-9.517	154.5408
9.8	-2.061	41.7285	-10.034	144.6918
9.9	-0.095	54.8501	-12.677	131.8345
10	0.959	60.5218	-16.087	111.6741
11	-4.38	-131.235	-10.511	165.7274
12	-16.731	-26.6941	-12.148	21.0286
13	-4.174	-1.9191	-5.426	170.5695
14	-4.613	115.6188	-21.209	-174.18
15	-10.983	156.2453	-4.522	-31.5023
16	2.063	-39.6372	-2.718	95.059
17	-4.451	108.8136	-14.561	-136.4763
18	-4.4	-174.9311	-6.16	-80.8447
19	-1.12	-26.5991	-4.982	64.0809
20	1.524	74.0513	-1.805	-146.912
21	-2.834	-153.0514	-2.682	-36.6175
22	-3.504	-21.8648	-2.974	72.1171
23	-3.899	101.859	-1.304	179.6504
24	-5.753	-97.2959	-4.631	-39.2114

25	-8.28	47.4869	-4.98	133.6196
26	-9.223	-160.4653	-3.958	-75.5655
27	-7.389	46.1945	-6.128	71.6339
28	-5.766	153.8494	-7.66	-158.4651
29	-5.786	-22.2964	-8.052	29.4122
30	-7.686	156.8452	-8.955	169.2853
31	-8.945	-0.415	-10.426	-6.3337
32	-9.669	172.0007	-12.595	-142.0838
33	-6.12	-20.4755	-17.872	73.8987
34	-10.695	123.1167	-20.41	-153.3154
35	-17.479	49.963	-14.685	95.524
36	-15.552	-100.5798	-13.173	-76.9441
37	-18.667	85.8806	-14.629	104.9538
38	-14.623	26.1417	-15.181	14.8606
39	-10.716	154.8962	-17.202	-123.6963
40	-18.382	-93.0302	-11.066	19.9147
41	-14.295	-72.6559	-15.299	-92.1815
42	-17.582	133.7141	-15.108	93.1987
43	-18.778	3.961	-10.635	-39.7564
44	-17.091	-166.0525	-15.139	-147.9263
45	-22.475	140.9314	-14.271	112.4428
46	-20.31	-14.8372	-16.74	-61.4004
47	-20.908	-64.01	-22.072	-98.2396
48	-21.597	118.3634	-16.073	145.1993
49	-25.47	-142.4808	-19.999	177.9853
50	-18.54	-64.0843	-25.457	-98.9982
51	-17.997	31.1826	-23.688	-37.1969
52	-14.712	148.0619	-15.242	146.7554
53	-14.626	-52.7534	-20.13	44.8218
54	-18.517	-26.6686	-17.09	-75.9864
55	-16.713	176.148	-17.615	179.9802
56	-29.467	-138.7688	-14.678	53.1004
57	-19.09	42.6682	-25.307	-3.3704
58	-22.907	-10.0504	-18.364	-94.4907
59	-22.728	-76.5509	-25.314	-81.4642
60	-22.473	-173.7587	-19.715	151.0799
61	-28.668	-134.5437	-21.871	168.7888
62	-17.808	55.6611	-23.374	23.8947
63	-19.487	-78.2681	-33.261	-176.0919
64	-27.58	-101.6242	-29.551	-166.0978
65	-24.142	-111.9487	-40.755	13.2341
66	-26.995	-58.2116	-33.154	-91.3166
67	-18.348	112.8194	-22.723	130.9648
68	-20.244	24.9739	-27.055	152.4495
69	-30.07	97.6026	-27.103	80.9511
70	-20.453	-46.7369	-26.313	33.2895
71	-45.227	77.3896	-31.993	-2.687
72	-26.522	-137.4418	-19.175	-81.1944
73	-19	118.6564	-19.16	-58.5282

74	-22.375	-134.2212	-24.794	176.3435
75	-26.194	81.3748	-25.541	115.7147
76	-23.853	85.7733	-24.311	126.093
77	-27.04	-33.785	-37.498	93.5217
78	-22.616	5.6629	-24.534	20.1049
79	-30.515	-22.2146	-19.272	-58.8523
80	-32.955	156.6523	-19.794	-36.8176
81	-20.359	-126.8091	-29.971	-147.8243
82	-19.951	-141.498	-22.092	169.0463
83	-29.08	-143.5772	-19.78	-161.2806
84	-33.193	126.7211	-24	139.6317
85	-23.047	54.2611	-21.689	118.8983
86	-20.772	49.4567	-20.768	75.0425
87	-32.296	-124.0693	-23.334	6.1263
88	-36.013	-179.0854	-35.988	10.98
89	-20.618	35.4733	-16.424	128.5661
90	-22.261	-63.9296	-21.667	57.9867
91	-13.656	-124.4937	-8.375	-53.4367
92	-14.847	-111.5466	-3.446	-19.616
93	-30.135	148.6619	-15.166	-79.7496
94	-24.115	-2.9642	-13.377	-131.6473
95	-20.992	-127.0675	-14.076	126.8543
96	-23.174	97.324	-2.712	59.6123
97	-26.198	18.9663	-0.729	94.871
98	-26.984	-38.983	-12.041	62.214
99	-20.358	-143.4076	-22.338	-50.66
100	-20.839	121.185	-42.561	-30.3582
101	-35.18	70.3258	-18.287	151.6044
102	-24.827	15.8065	-44.672	-48.1374
103	-20.06	-92.6148	-19.226	-135.6425
104	-29.228	-14.0801	-21.976	-176.533
105	-24.754	172.5713	-34.19	158.857
106	-22.682	13.6007	-18.642	-149.5085
107	-23.676	35.1268	-20.521	-123.189
108	-21.786	43.0416	-25.05	-120.835
109	-26.022	130.9878	-22.502	-98.8196
110	-19.281	91.428	-24.598	-12.6315
111	-21.861	110.7236	-20.987	-93.2264
112	-23.446	106.4699	-22.701	-95.1495
113	-23.833	97.2089	-28.419	-57.9872
114	-24.858	6.7046	-21.728	-178.3112
115	-47.495	140.1477	-30.015	109.1675
116	-25.842	20.0681	-30.763	171.1843
117	-29.385	-90.8287	-32.088	-93.3804
118	-30.793	-48.1005	-25.82	-38.1015
119	-35.471	-44.9587	-32.808	-81.1669
120	-35.827	-59.8421	-29.92	-152.7491
121	-30.167	-155.0885	-30.104	-155.8348
122	-31.689	-134.1275	-27.006	147.6811

123	-43.821	-42.5901	-30.709	-150.9956
124	-34.114	46.3753	-27.493	27.5691
125	-27.866	65.9851	-29.287	93.864
126	-24.377	101.1305	-27.508	74.0435
127	-29.915	112.1256	-27.06	55.7665
128	-30.402	78.2719	-26.545	50.3721
129	-37.804	62.2178	-29.724	11.0218
130	-34.468	19.9973	-27.521	13.8196
131	-33.739	-23.302	-35.223	-45.9901
132	-34.307	-56.8617	-28.463	-104.6768
133	-28.476	-104.5117	-26.922	-137.7244
134	-32.091	170.5854	-25.164	136.6491
135	-27.919	103.189	-23.665	77.7425
136	-29.794	34.0386	-26.274	7.3979
137	-37.746	-102.0048	-27.885	-110.7416
138	-38.752	-102.2252	-31.9	-154.4271
139	-28.265	-118.607	-24.51	-145.4679
140	-28.458	132.1345	-28.118	97.9403
141	-33.666	-53.6594	-33.438	-109.0361
142	-31.824	84.3345	-32.28	-9.1839
143	-28.318	-118.471	-26.406	-167.4541
144	-32.193	37.8447	-44.216	-19.6339
145	-27.867	111.5211	-25.337	71.5192
146	-28.983	-120.1384	-31.809	-153.5371
147	-28.29	-60.091	-27.508	-85.5239
148	-33.411	20.2156	-34.283	-39.3142
149	-31.288	64.4508	-31.042	14.5064
150	-31.657	55.407	-29.591	20.8861
151	-30.356	63.0666	-31.906	32.1993
152	-32.819	44.46	-30.649	7.7146
153	-33.079	61.7416	-34.265	1.2406
154	-32.652	7.5321	-31.667	-38.5509
155	-34.011	-106.2595	-29.294	-126.8388
156	-37.009	144.1988	-31.445	96.302
157	-36.53	49.6993	-34.034	5.6286
158	-38.682	-63.7291	-41.621	-72.7159
159	-39.042	148.6924	-36.807	106.2266
160	-35.711	-135.3132	-29.031	-50.243
161	-39.843	121.2694	-32.751	-122.2955
162	-31.047	138.6887	-21.693	-148.0621
163	-48.664	138.6592	-24.287	-106.9926
164	-35.101	-75.7051	-25.472	-70.1424
165	-39.527	100.4985	-31.255	82.0052
166	-41.543	145.0713	-33.253	26.9589
167	-35.236	163.3414	-30.251	178.3362
168	-37.432	-136.651	-36.741	-136.095
169	-43.44	30.3177	-38.336	-132.5206
170	-46.255	-121.1096	-39.248	-118.0405
171	-37.851	7.0648	-37.834	50.5924

172	-42.569	-82.6821	-38.002	-3.5571
173	-41.051	95.7037	-40.425	70.9364
174	-38.886	107.983	-40.309	45.8287
175	-52.5	156.2451	-36.402	86.9924
176	-40.579	166.39	-41.579	54.7346
177	-36.94	157.4196	-39.201	10.6918
178	-40.319	115.2402	-43.274	95.5959
179	-41.953	27.0744	-33.689	13.3072
180	-36.244	-157.4682	-18.387	-0.0626

7201	5			<u>ELEVATION</u>
-30	-8.891	-83.7048	-8.425	-168.8011
-29.5	-5.48	-142.4019	-16.719	77.4067
-29	-4.596	161.7489	-6.819	-25.7319
-28.5	-10.884	75.0101	-3.141	-70.7695
-28	-2.531	-50.8963	-7.314	-139.6248
-27.5	0.018	-86.5115	-6.08	138.7937
-27	-5.157	-114.9453	-8.537	60.1662
-26.5	-10.58	133.622	-6.693	-32.1459
-26	-10.174	19.5375	-5.677	-105.5246
-25.5	-12.171	-41.8216	-5.431	-174.2638
-25	-8.587	172.0992	-5.491	101.5354
-24.5	-8.052	129.9509	-3.091	40.5049
-24	-5.953	53.051	-2.711	-31.4451
-23.5	-1.899	-29.5073	-1.694	-96.2276
-23	0.339	-83.3022	-2.746	-152.0493
-22.5	-0.568	-134.4545	-4.079	144.5788
-22	-1	172.3009	-2.911	82.1148
-21.5	-2.377	90.6041	-2.306	16.0172
-21	-0.941	33.9505	-2.849	-52.2799
-20.5	0.782	-12.534	-3.831	-101.581
-20	-1.819	-83.3529	-6.403	-138.7507
-19.5	-3.562	-157.0164	-8.911	172.3595
-19	-2.511	150.7411	-9.019	77.2447
-18.5	-1.47	96.6814	-9.317	0.4735
-18	-4.615	43.4282	-9.014	-78.8881
-17.5	-12.438	-42.9324	-8.216	-126.7188
-17	-4.777	-136.2585	-7.165	-168.0496
-16.5	0.431	-166.1075	-7.775	142.1006
-16	1.153	156.8038	-6.689	91.0579
-15.5	-2.292	113.391	-8.233	42.8967
-15	-4.267	78.9124	-17.302	-17.1063
-14.5	-7.223	26.0936	-30.876	-84.9398
-14	-7.754	-67.336	-15.339	-104.6711
-13.5	-6.145	-148.3164	-16.023	-146.8358
-13	-11.176	151.077	-13.083	150.2983
-12.5	-7.858	-10.3504	-10.763	84.8668
-12	-12.752	-56.524	-9.179	10.0354
-11.5	-5.68	-1.0598	-9.749	-70.6863

-11	1.557	-47.3093	-3.461	-122.9794
-10.5	5.229	-100.9798	-5.562	-172.0059
-10	6.04	-143.5309	-8.475	-172.7646
-9.9	5.271	-153.2447	-10.541	-168.7222
-9.8	4.114	-169.0579	-12.524	179.0185
-9.7	3.349	169.9852	-13.546	152.5648
-9.6	3.548	152.4384	-13.011	128.06
-9.5	4.306	143.1629	-11.601	111.6291
-9.4	5.131	138.5633	-9.901	98.1089
-9.3	5.529	133.9066	-8.683	80.4996
-9.2	5.163	127.2763	-7.888	54.284
-9.1	4.208	118.9127	-6.512	25.0082
-9	3.291	110.2272	-5.041	3.8156
-8.9	2.789	101.7963	-4.498	-9.241
-8.8	2.326	91.5894	-4.787	-19.0828
-8.7	1.388	77.9367	-5.255	-29.3174
-8.6	-0.139	63.5563	-5.581	-39.7582
-8.5	-2.348	56.0262	-6.106	-47.4535
-8.4	-5.011	62.4731	-7.011	-49.5087
-8.3	-6.876	77.8806	-7.437	-45.404
-8.2	-8.318	88.1224	-6.503	-42.206
-8.1	-9.971	96.1079	-5.094	-46.0885
-8	-10.106	105.0067	-4.29	-55.3076
-7.9	-9.161	102.0129	-4.348	-67.151
-7.8	-9.79	82.129	-4.997	-79.9317
-7.7	-11.82	35.3077	-5.787	-92.2028
-7.6	-9.35	-21.2853	-6.455	-102.7082
-7.5	-5.848	-43.2578	-7.085	-110.8682
-7.4	-3.451	-44.821	-7.714	-116.9115
-7.3	-0.864	-41.298	-7.896	-122.2769
-7.2	1.748	-43.2199	-7.263	-129.2725
-7.1	3.722	-49.293	-6.468	-138.5074
-7	4.87	-54.6418	-6.604	-149.3121
-6.9	5.291	-57.0803	-8.119	-160.5027
-6.8	5.278	-58.1322	-10.214	-164.9416
-6.7	5.112	-60.4109	-10.22	-152.1137
-6.6	4.956	-63.2164	-7.597	-140.7296
-6.5	4.932	-63.322	-6.308	-141.0681
-6.4	5.195	-61.9031	-8.033	-150.3271
-6.3	5.63	-65.8747	-12.673	-174.5796
-6.2	6.039	-79.0018	-16.727	149.2404
-6.1	6.508	-96.4474	-19.434	156.4342
-6	6.735	-110.2103	-16.765	-170.3605
-5.9	6.511	-117.1145	-13.366	-179.9659
-5.8	6.459	-119.3869	-10.144	154.7489
-5.7	6.984	-123.1311	-7.571	141.2227
-5.6	7.349	-131.8718	-7.637	141.5645
-5.5	6.772	-145.8825	-10.829	159.2442
-5.4	5.548	-165.8163	-13.504	-155.1444

-5.3	5.257	173.1406	-13.487	-131.9353
-5.2	6.462	161.294	-18.307	-156.2811
-5.1	8.06	155.8413	-16.939	106.6242
-5	9.072	149.4294	-11.796	68.1638
-4.9	9.222	140.7458	-10.241	41.6835
-4.8	8.81	133.0022	-10.531	26.9253
-4.7	8.311	129.2404	-12.381	36.6546
-4.6	7.985	126.2746	-13.211	61.4358
-4.5	7.607	116.8445	-16.495	55.7139
-4.4	7.262	99.426	-15.81	-44.5441
-4.3	7.329	83.6226	-8.601	-71.9333
-4.2	7.412	79.3853	-8.235	-83.1837
-4.1	7.497	83.7671	-13.041	-101.1073
-4	7.318	84.5977	-18.447	-137.7668
-3.9	5.765	73.9997	-16.016	-130.495
-3.8	2.443	46.495	-11.163	-125.8047
-3.7	0.5	-1.0319	-8.809	-147.9292
-3.6	2.54	-25.3805	-6.376	-175.196
-3.5	5.465	-18.0268	-5.004	177.9764
-3.4	8.288	-7.7842	-5.661	-170.2559
-3.3	8.7	-5.7333	-7.254	-162.2747
-3.2	5.08	-16.7375	-7.781	160.3434
-3.1	1.377	-71.6752	-2.48	128.3502
-3	6.054	-89.5532	-0.26	126.0293
-2.9	9.739	-70.2013	-2.467	138.3549
-2.8	11.649	-53.6567	-8.698	171.8938
-2.7	9.584	-43.3495	-28.24	-81.8577
-2.6	-3.745	-27.0929	-5.031	38.4637
-2.5	4.354	151.0585	0.901	46.6415
-2.4	8.58	-178.9294	1.646	49.3704
-2.3	11.633	-137.9879	-1.431	57.8037
-2.2	14.448	-113.3044	-5.633	96.763
-2.1	14.102	-95.1271	-5.155	136.5884
-2	10.743	-57.3512	-9.536	174.7914
-1.9	11.106	3.5449	-4.698	-86.6362
-1.8	11.989	42.7406	0.019	-70.2478
-1.7	11.938	95.7862	-4.211	-58.1375
-1.6	15.338	131.9722	-8.94	79.0314
-1.5	16.14	133.672	-4.521	105.9323
-1.4	15.04	107.8876	-6.263	-119.1219
-1.3	16.915	85.9635	4.354	-101.1416
-1.2	19.606	97.8872	3.439	-117.9736
-1.1	22.359	115.2375	3.951	155.8537
-1	23.165	115.5926	9.559	137.3803
-0.9	22.321	88.9514	8.144	165.2083
-0.8	24.27	60.1199	9.324	-130.619
-0.7	25.113	67.7461	4.991	-117.8517
-0.6	23.441	112.8592	16.525	90.2194
-0.5	24.268	-144.8625	26.158	90.0788

-0.4	36.474	-81.1316	29.715	90.884
-0.3	44.675	-63.1798	29.373	90.5948
-0.2	49.437	-55.7262	24.702	86.344
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0	51.654	-52.0381	11.341	-13.1958
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0.2	44.414	118.8871	25.61	-85.6342
0.3	35.399	98.4355	27.967	-80.5685
0.4	25.042	5.7145	26.071	-77.3924
0.5	27.336	-67.8292	19.162	-73.3764
0.6	28.142	-107.5953	-4.614	-20.1393
0.7	27.499	-120.103	4.507	96.0586
0.8	24.895	-102.753	-0.997	-66.1589
0.9	23.865	-72.9865	9.405	-72.6665
1	22.771	-66.7247	6.057	-78.0678
1.1	19.936	-83.8762	-2.446	148.7539
1.2	17.099	-101.5993	6.298	121.2661
1.3	13.605	-75.4801	2.52	98.8115
1.4	16.687	-29.7389	2.156	3.7972
1.5	18.815	-25.9706	6.71	-19.904
1.6	17.678	-46.1667	4.547	-33.3706
1.7	16.494	-84.9168	-1.117	-87.9985
1.8	15.537	-121.0003	1.169	-141.541
1.9	12.691	-171.1016	-1.916	-164.2849
2	14.923	126.0013	-5.391	91.7044
2.1	17.456	97.5985	1.248	60.4947
2.2	16.871	75.3713	-0.269	50.8763
2.3	14.76	46.0993	-9.554	9.708
2.4	12.267	20.7439	-9.024	-79.2469
2.5	5.361	23.794	-19.133	-122.4335
2.6	5.649	126.4809	-6.95	102.4195
2.7	11.443	133.9145	-3.825	94.8768
2.8	11.705	120.0934	-7.584	78.902
2.9	10.173	96.5098	-11.16	40.0661
3	7.742	80.5898	-9.047	57.1849
3.1	1.597	94.6599	-4.43	86.2131
3.2	-0.229	176.6609	-3.314	91.3761
3.3	3.152	-158.7974	-6.172	66.8409
3.4	2.459	-160.347	-4.771	19.0723
3.5	1.763	-170.7699	-2.554	8.828
3.6	2.291	-164.5395	-4.207	9.1873
3.7	2.723	-133.6005	-10.292	-17.2793
3.8	4.725	-95.0172	-8.211	-87.086
3.9	6.93	-74.8043	-6.241	-103.8122
4	7.636	-73.5851	-11.538	-131.563
4.1	7.876	-83.9243	-10.742	136.3864
4.2	8.339	-90.8902	-7.309	116.3334
4.3	8.012	-87.0281	-9.677	107.529
4.4	6.463	-75.7231	-13.723	90.2134

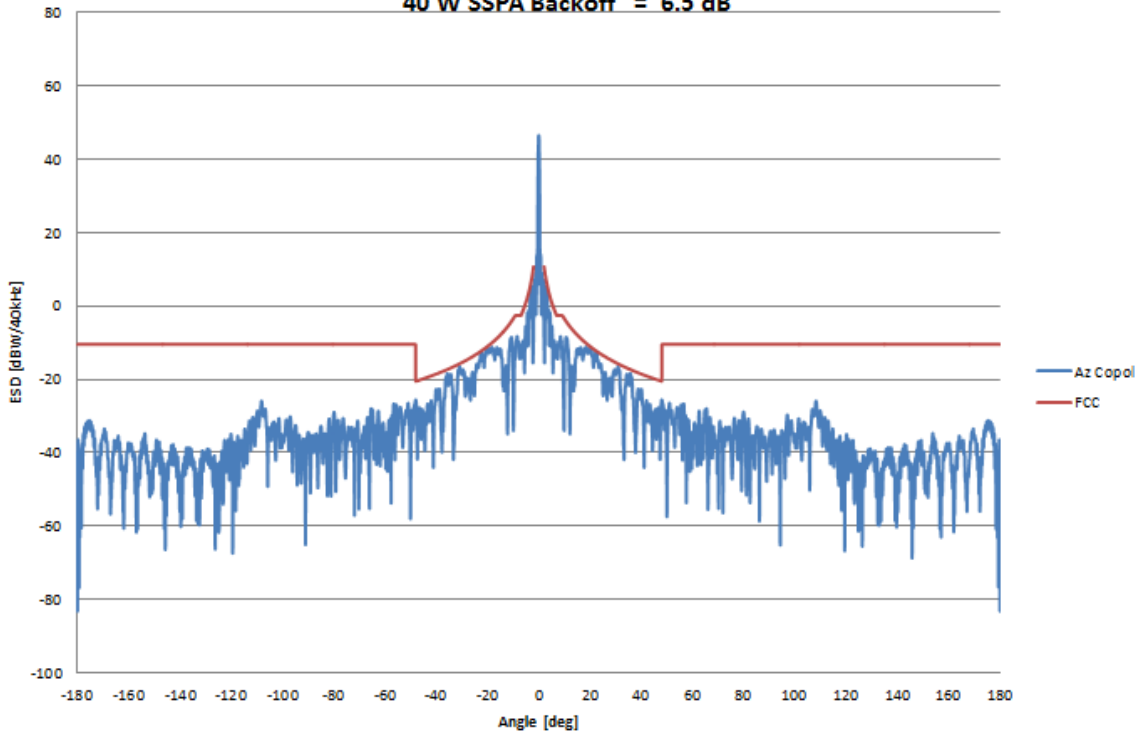
4.5	4.021	-62.7962	-13.077	86.2616
4.6	1.586	-51.5508	-11.24	100.0242
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4.8	1.459	-22.2365	-19.849	144.4663
4.9	1.562	-9.4032	-24.388	-155.7303
5	-1.234	-2.4545	-22.509	179.0139
5.1	-10.641	-5.8028	-19.039	158.3678
5.2	-13.933	177.1818	-26.331	150.8402
5.3	-5.119	147.2989	-18.398	-0.232
5.4	0.046	128.475	-11.887	5.8012
5.5	3.08	122.8244	-12.583	8.5239
5.6	4.054	120.0344	-17.4	-38.3611
5.7	3.846	111.3738	-10.309	-80.4705
5.8	3.787	96.3315	-6.598	-71.2638
5.9	3.826	84.6593	-6.306	-54.963
6	2.499	78.401	-9.049	-45.4611
6.1	-0.477	69.3741	-13.963	-74.2596
6.2	-2.371	49.955	-10.669	-111.4965
6.3	-1.285	38.7478	-8.76	-101.1696
6.4	-1.019	37.6818	-9.783	-68.3721
6.5	-3.672	28.9388	-10.347	-20.6481
6.6	-5.999	-8.8891	-9.418	15.8373
6.7	-3.063	-24.8596	-8.998	31.6076
6.8	-0.849	-10.5044	-8.847	28.0992
6.9	-0.058	4.6375	-7.642	14.1615
7	-1.615	7.4239	-5.682	2.5724
7.1	-5.175	-11.1979	-3.89	-3.8414
7.2	-6.846	-41.9195	-2.777	-5.4984
7.3	-7.667	-54.084	-2.959	-3.2484
7.4	-8.311	-67.1824	-5.2	0.5679
7.5	-4.993	-90.3492	-10.65	-2.9509
7.6	-0.641	-101.5531	-16.084	-61.5093
7.7	1.809	-107.8126	-10.7	-94.3201
7.8	2.976	-114.7365	-8.931	-97.3432
7.9	4.127	-119.256	-10.389	-108.3526
8	5.56	-116.8786	-12.05	-140.6785
8.1	6.736	-110.6236	-10.815	-168.5512
8.2	7.113	-106.2875	-9.792	178.8452
8.3	6.621	-107.0437	-9.144	167.1366
8.4	5.795	-111.3942	-8.336	154.6615
8.5	5.032	-112.7262	-8.567	143.3657
8.6	4.084	-107.0856	-10.636	123.5715
8.7	2.692	-98.6849	-10.571	87.2844
8.8	0.732	-95.8738	-7.03	73.1434
8.9	-1.399	-103.1845	-4.525	75.4743
9	-3.217	-112.8574	-3.959	76.7211
9.1	-6.3	-116.0885	-5.289	68.5977
9.2	-14.294	-123.9124	-7.15	48.0447
9.3	-16.427	119.8649	-8.023	27.2267

9.4	-9.165	104.4951	-8.885	13.9964
9.5	-6.793	91.4462	-9.243	-0.3287
9.6	-4.589	71.4841	-7.361	-12.657
9.7	-2.807	57.7375	-4.69	-15.7434
9.8	-3.758	46.6532	-2.931	-16.3948
9.9	-9.061	16.7747	-2.419	-21.2572
10	-10.594	-64.6931	-2.859	-31.5249
10.5	-9.346	116.106	-13.648	60.9675
11	-6.088	128.5784	-12.053	-61.1424
11.5	-8.81	80.9179	-11.951	155.3711
12	-1.838	-67.5425	-7.201	-153.1006
12.5	-5.765	-76.8849	-14.361	-134.5207
13	-2.883	-34.0607	-7.194	-11.9896
13.5	-3.6	54.9712	-16.534	26.3017
14	1.3	140.6614	-14.156	99.0104
14.5	-2.127	-154.6444	-10.388	115.6636
15	-0.296	-118.4293	-9.909	170.1127
15.5	-7.935	-158.7806	-13.676	-166.3593
16	2.455	-7.6907	-10.02	-50.9358
16.5	2.488	32.5867	-3.726	-61.9235
17	-9.575	148.5807	-7.389	66.7655
17.5	-1.817	-157.114	-7.522	102.3982
18	-1.15	144.8888	-3.041	114.5669
18.5	0.368	-93.6786	-7.342	-128.7775
19	-1.662	-24.1811	-3.801	-93.1414
19.5	0.2	28.4147	-5.307	-42.1969
20	-0.012	69.9566	-3.898	21.115
20.5	-1.441	170.9305	-1.115	93.3165
21	2.439	-143.2874	-0.812	134.9391
21.5	-3.408	-111.7968	-1.305	-172.5767
22	0.302	-9.1056	-0.439	-96.2929
22.5	0.833	38.7619	-0.356	-53.0871
23	-3.394	99.547	-3.609	-3.6488
23.5	-6.315	177.6704	-5.572	86.9011
24	-1.841	-108.7542	-7.997	129.0335
24.5	-26.048	-107.5956	-6.791	-103.7786
25	-5.795	73.4309	-5.172	-43.2514
25.5	-8.509	138.737	-2.422	32.8795
26	-5.688	-114.7137	-3.594	94.7463
26.5	-5.323	-57.3242	-2.664	155.323
27	-10.43	-7.8341	-7.776	-123.8686
27.5	-1.309	131.2589	-4.94	-44.402
28	-3.786	143.003	-8.709	27.7266
28.5	-5.858	-77.579	-11.001	137.0201
29	-5.577	-30.6904	-7.575	-137.8905
29.5	-12.476	54.7267	-8.046	-64.9674
30	-9.717	158.5716	-6.67	9.1635

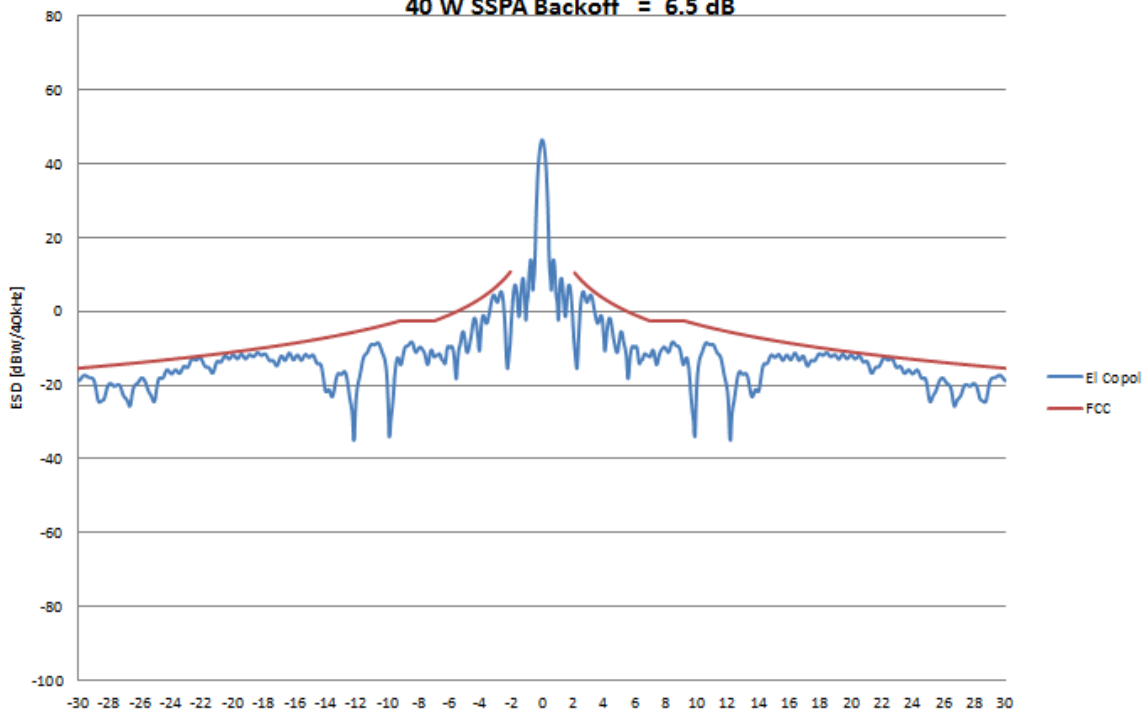
III. Ka-band Off-Axis EIRP Patterns

I. TOP OF BAND (29.071 GHz)

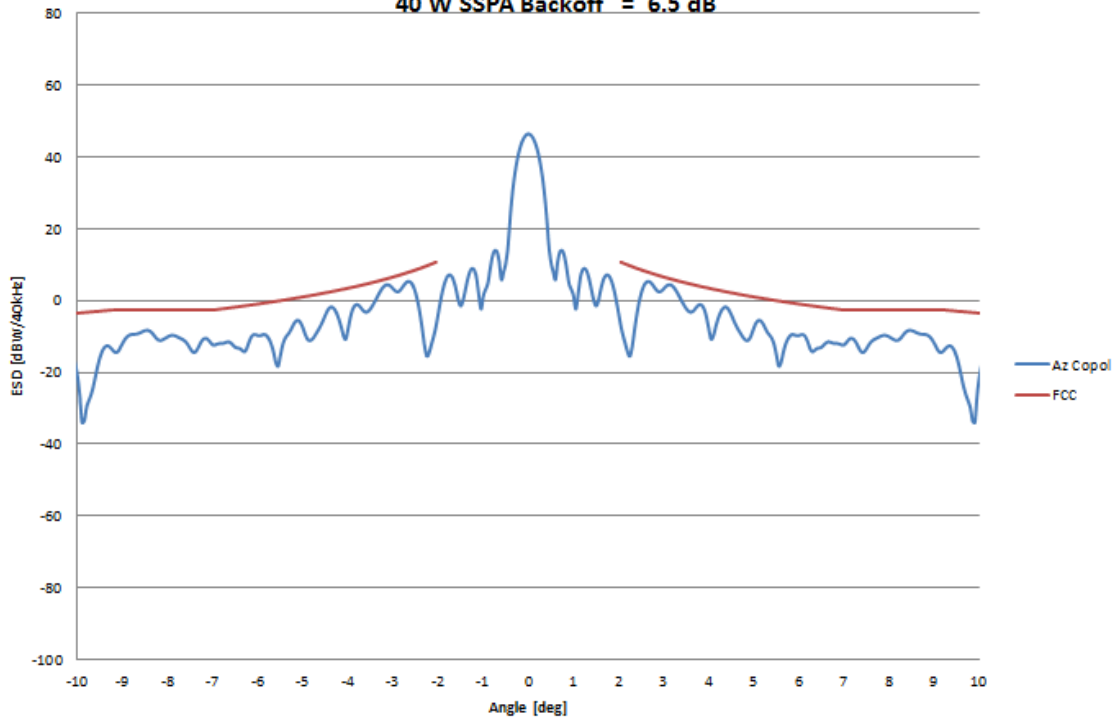
MUAP Predicted ESD: Copol/Az/29.071 GHz
Max Copol EIRP = 46.4488 dBW/4kHz
40 W SSPA Backoff = 6.5 dB



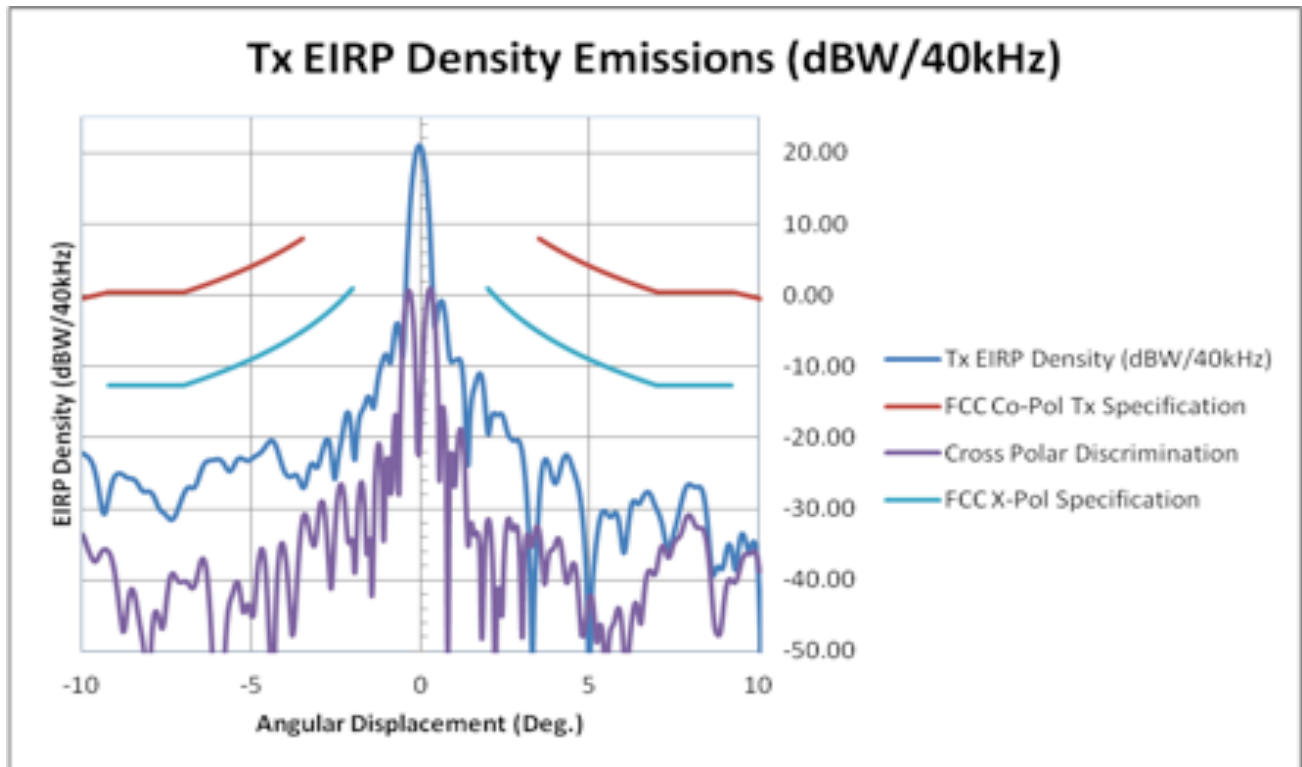
MUAP Predicted ESD: Copol/EI/29.071 GHz
Max Copol EIRP = 46.4488 dBW/4kHz
40 W SSPA Backoff = 6.5 dB



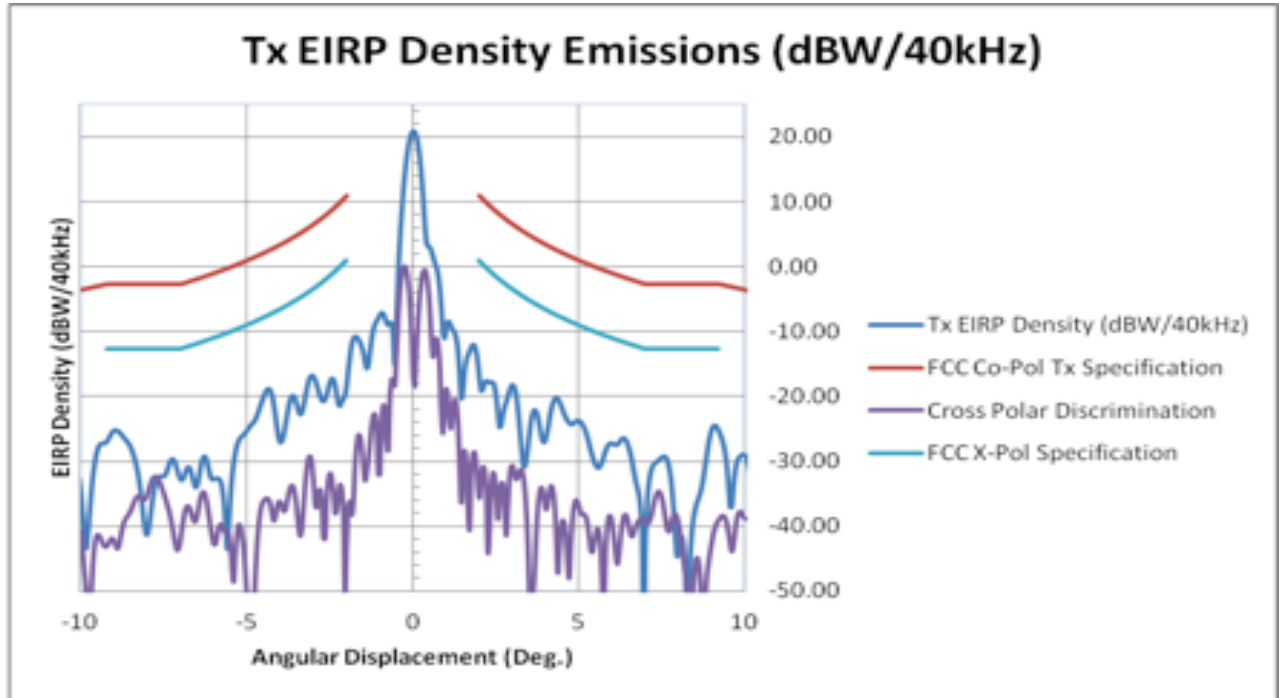
MUAP Predicted ESD: Copol/Az/29.071 GHz
Max Copol EIRP = 46.4488 dBW/4kHz
40 W SSPA Backoff = 6.5 dB



MUAP Predicted ESD: Xpol & Copol /EI/29.071 GHz

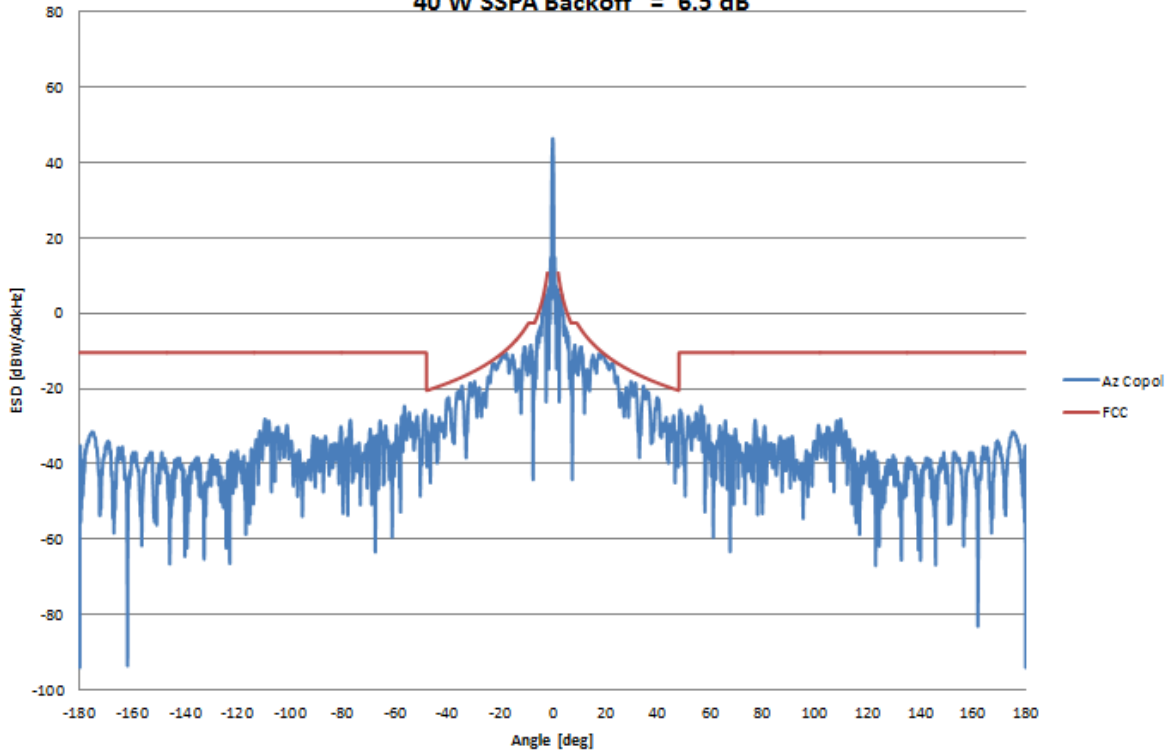


MUAP Predicted ESD: Xpol & Copol /Az/29.071 GHz

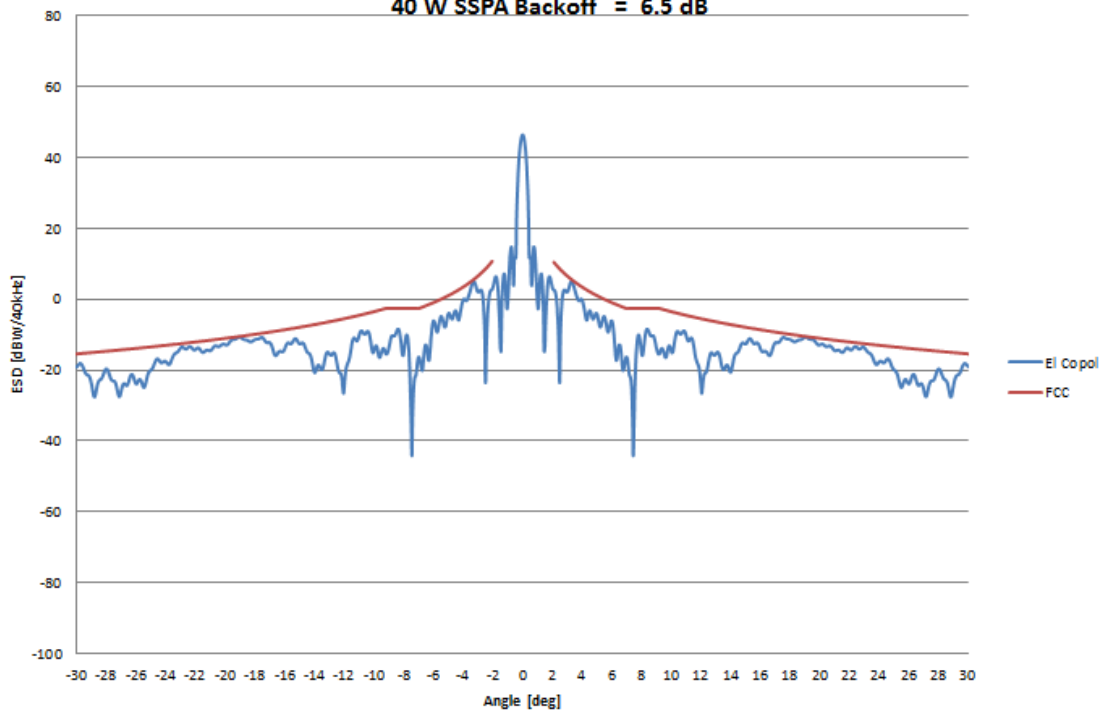


II. MIDDLE OF BAND (28.3615 GHz)

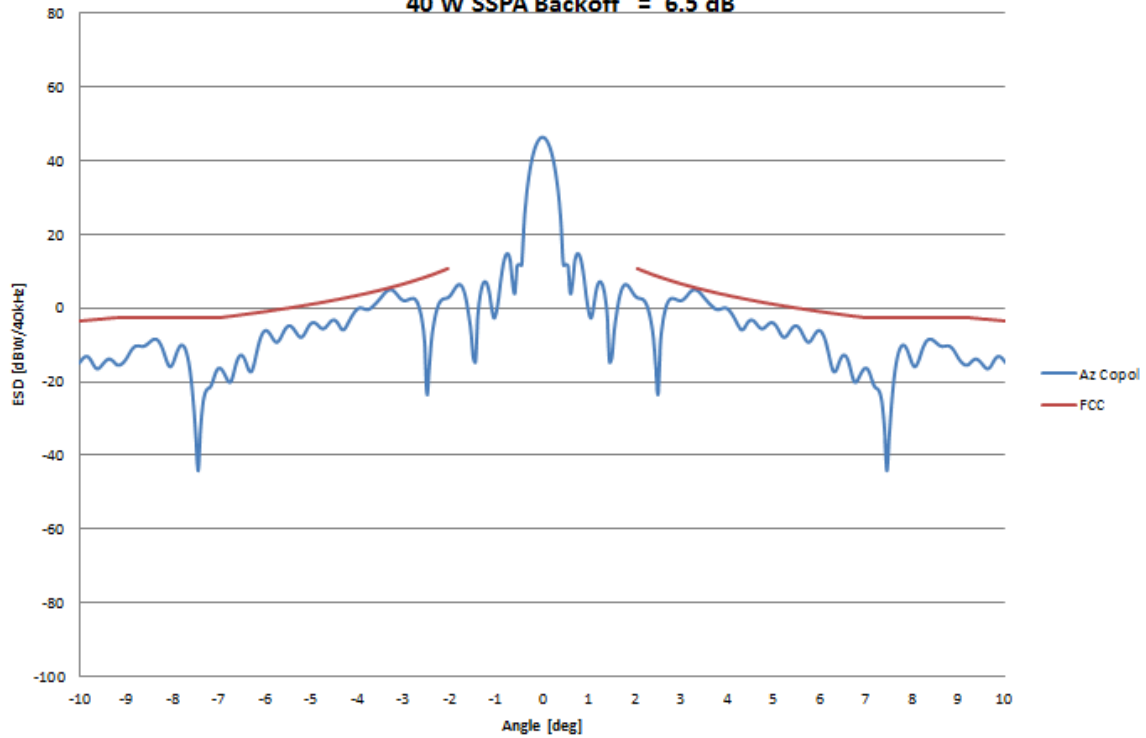
MUAP Predicted ESD: Copol/Az/28.3615 GHz
Max Copol EIRP = 46.3962 dBW/4kHz
40 W SSPA Backoff = 6.5 dB



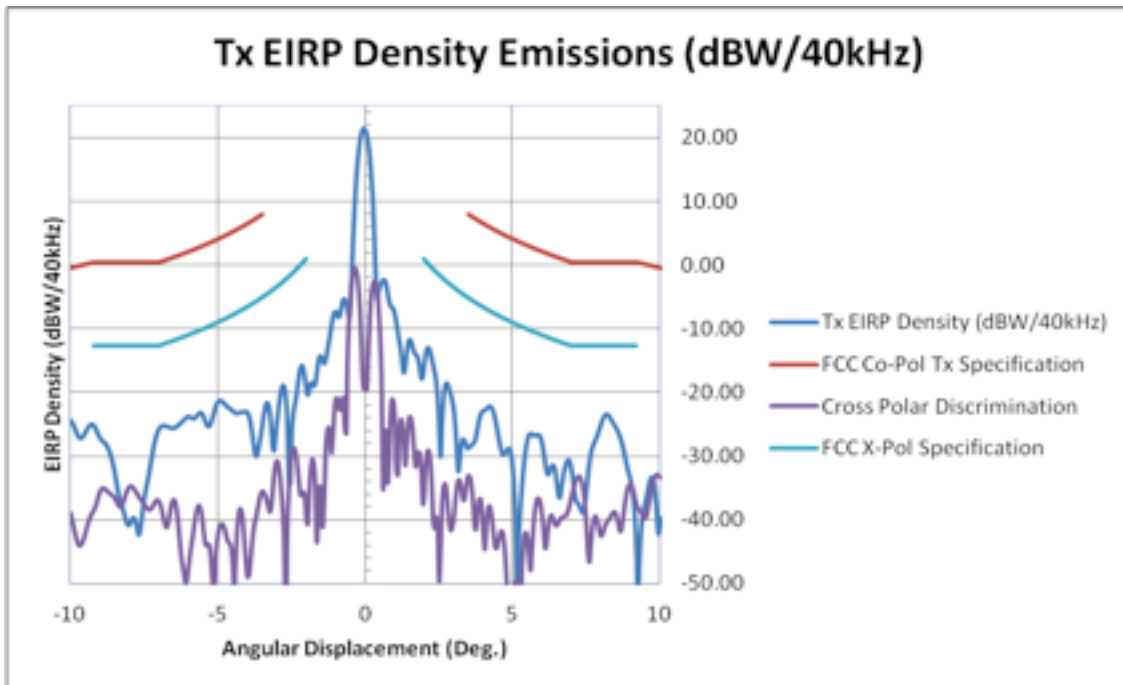
MUAP Predicted ESD: Copol/EI/28.3615 GHz
Max Copol EIRP = 46.3962 dBW/4kHz
40 W SSPA Backoff = 6.5 dB



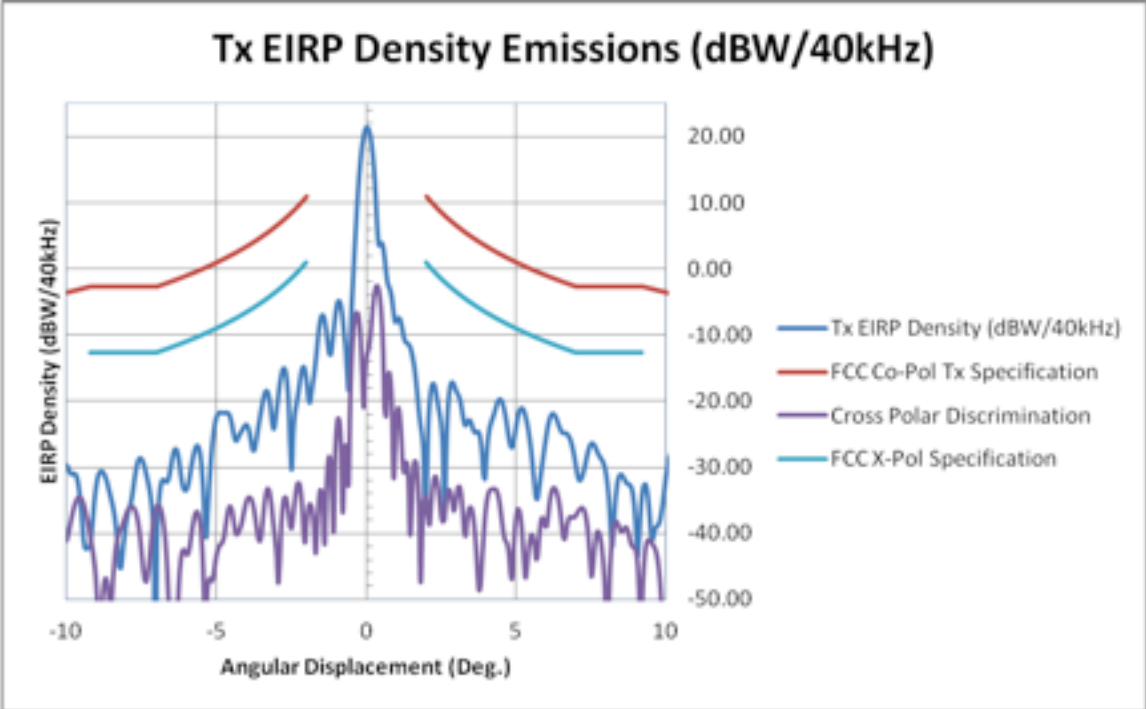
MUAP Predicted ESD: Copol/Az/28.3615 GHz
Max Copol EIRP = 46.3962 dBW/4kHz
40 W SSPA Backoff = 6.5 dB



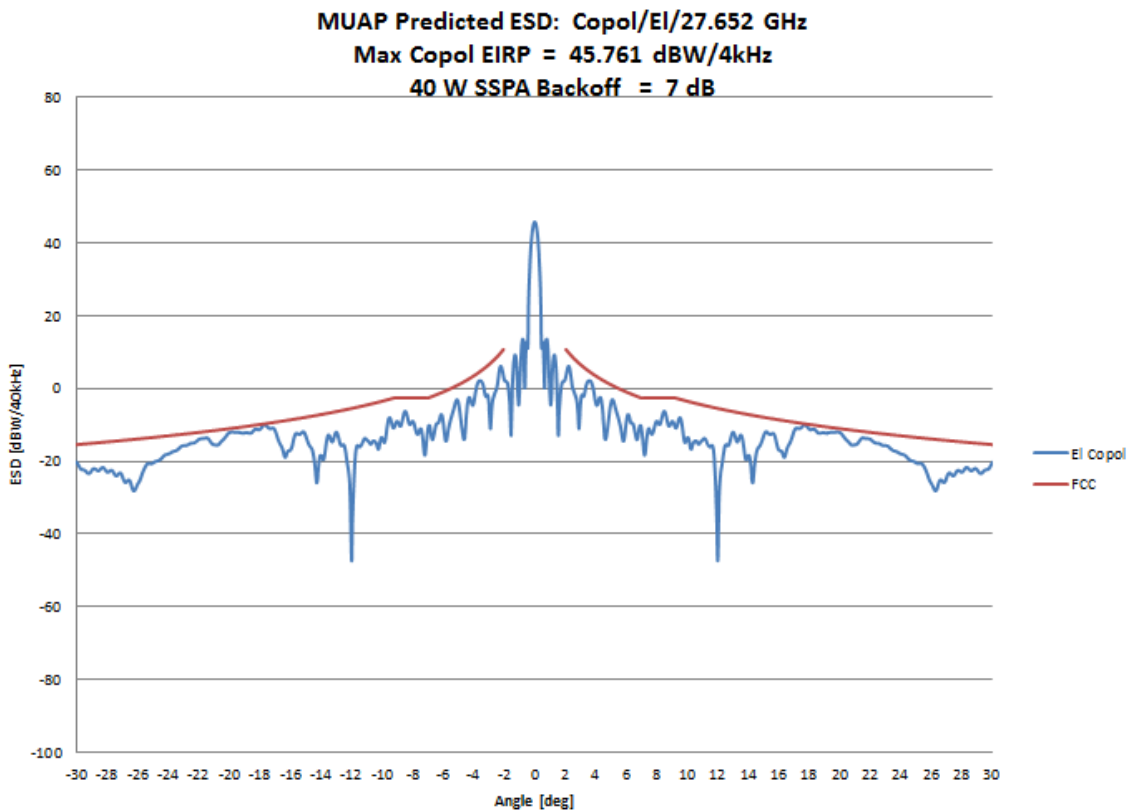
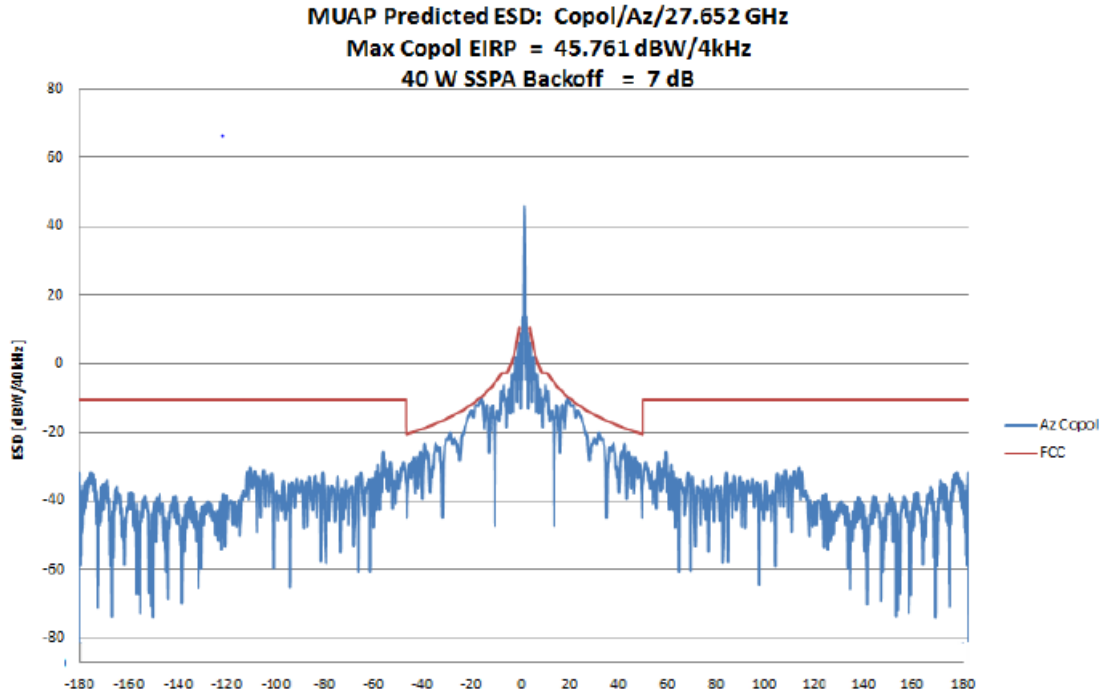
MUAP Predicted ESD: Xpol & Copol /EI/28.3615 GHz



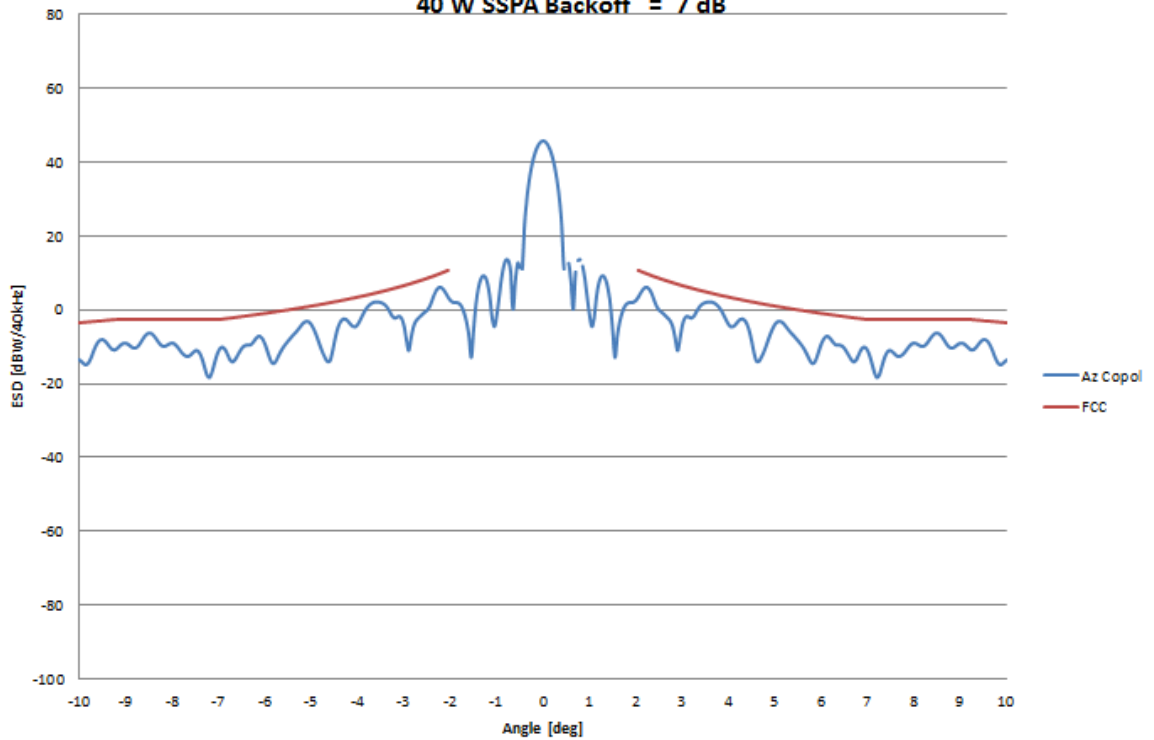
MUAP Predicted ESD: Xpol & Copol /Az/28.3615 GHz



III. BOTTOM OF BAND

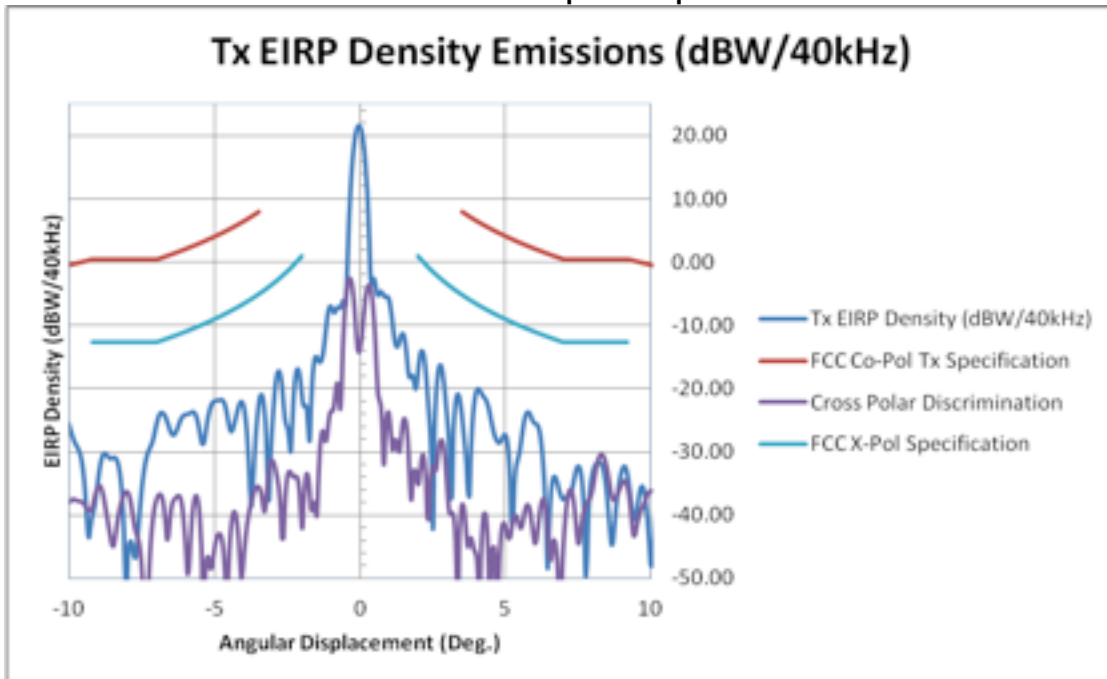


MUAP Predicted ESD: Copol/Az/27.652 GHz
Max Copol EIRP = 45.761 dBW/4kHz
40 W SSPA Backoff = 7 dB

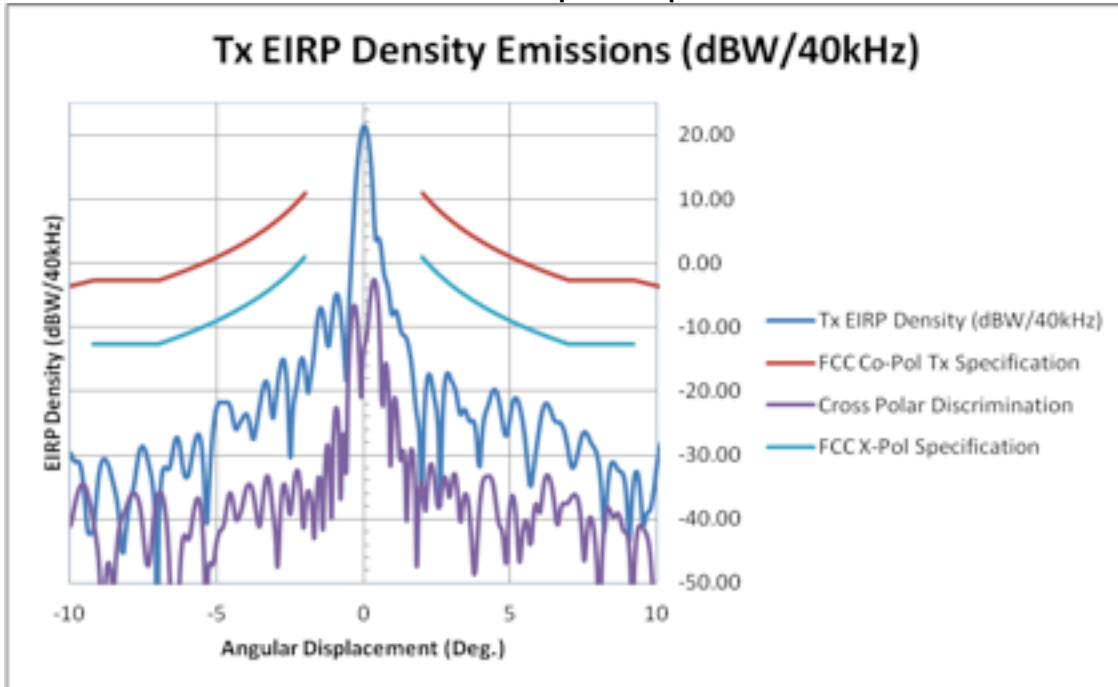


MUAP Predicted ESD: Xpol & Copol/EI/27.652 GHz

Tx EIRP Density Emissions (dBW/40kHz)



MUAP Predicted ESD: Xpol & Copol /Az/27.652 GHz



IV. FCC Declaration of Conformity



FCC Declaration of Conformity

1. Harris CapRock Communications, Inc. ("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 Earth Station onboard Vessel ("ESV") networks.
2. Section 25.138 of the Commission's rules, 47 C.F.R. § 25.138, defines the provisions for blanket licensing of earth stations operating in the Ka-band. Section 25.222 of the Commission's rules, 47 C.F.R. §§ 25.222, defines the provisions for blanket licensing of ESV terminals operating in the Ku-band. Because there are no technical rules governing ESV terminals operating in the Ka-band, Harris CapRock's Ka-band ESV terminals are designed to comply with the off-axis EIRP limits set forth in Section 25.138 and the pointing and cessation of emission requirements set forth in Section 25.222.
3. Harris CapRock hereby declares that the antennas listed below will meet the off-axis EIRP spectral density requirements of § 25.138(a)(1) with an N value of 1, when the following input power spectral density limitations are met:
 - 2.4 Meter Ka-Band, Model ST5000 is limited to: -3.0 dBW/4kHz
4. Harris CapRock further 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 Section 25.222(a)(1)(ii)(A).
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 Section 25.222(a)(1)(iii)(A).
6. Harris CapRock maintains all relevant test data, which is available upon request, to verify these declarations.

By: 

Name: ANDREW LUCAS

Title: CTO, CAPROCK

Harris CapRock Communications, Inc.

Date: 2015 Nov 2015

V. Tracking Report



Tracking Testing

Reference: 4E0248
Revision: 01
Produced: Feb 2015

Revision History

<i>Revision</i>	<i>Date</i>	<i>Description</i>	<i>Prepared by</i>
01	7/8/15	First Draft	D McCoig

Document Control

<i>Author</i>	<i>Reviewer</i>	<i>Approver</i>
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**

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3 MOTION TABLE PHOTOGRAPHS – SEA STATE 412

4 CONCLUSION.....14

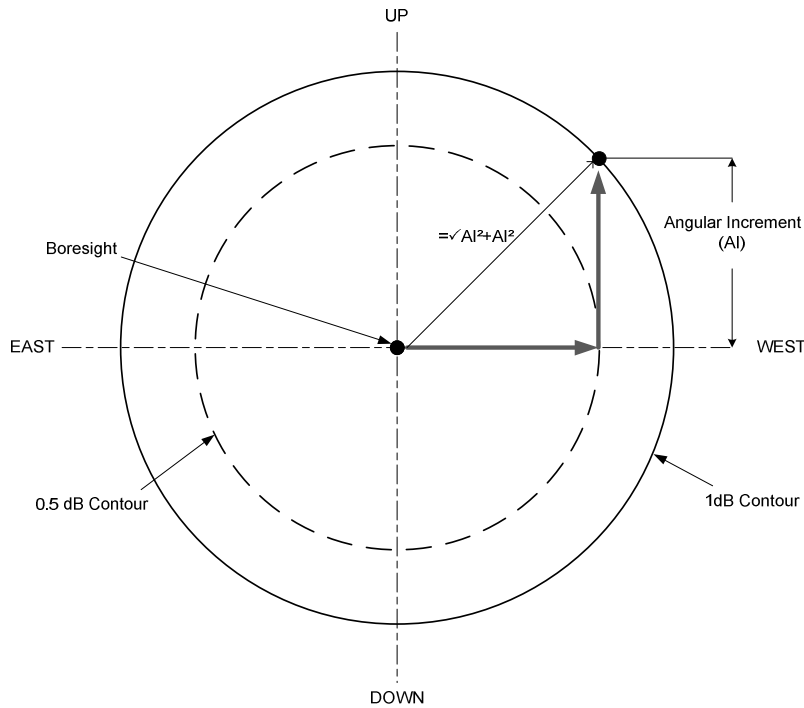
1 Overview

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 below:-



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 $d = 2.4\text{m}$ and $f = 12\text{GHz}$

$$AI = 0.138^\circ$$

Which in turn makes the angle to the 1dB contour = $\sqrt{AI^2 + AI^2}$ 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:

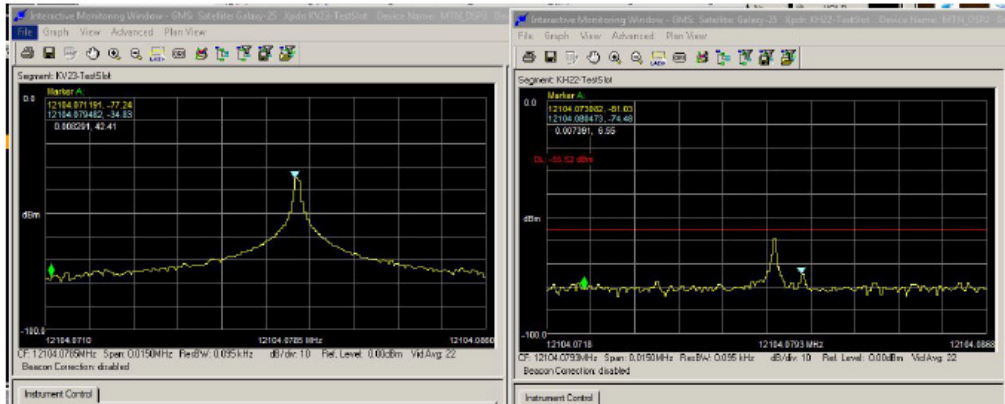
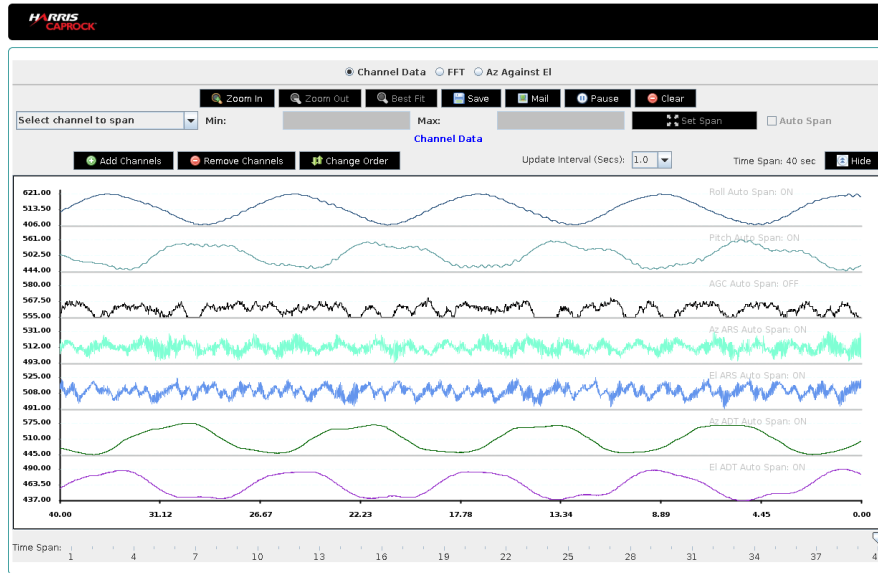


Figure E.1: Ku band cross pole isolation NOC data

2.2 Sea state 4 - 100m guided missile boat



Copyright © 2008-2013 Harris CapRock Communications

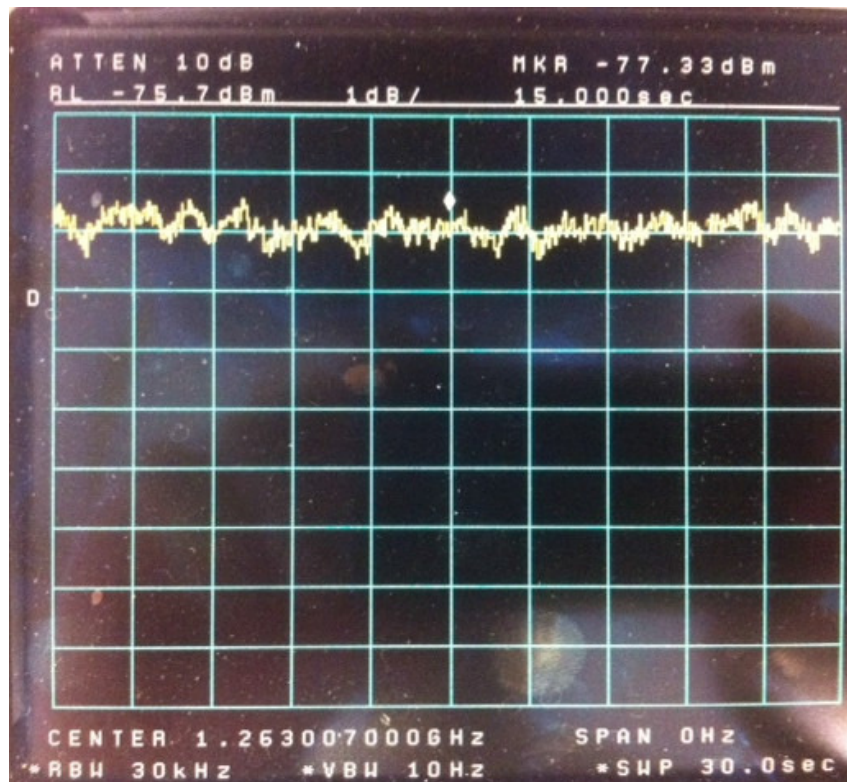


Figure E.3: 1/2 sea state 4, 17° Roll / 11 second period, 9.5° Pitch / 9 second period

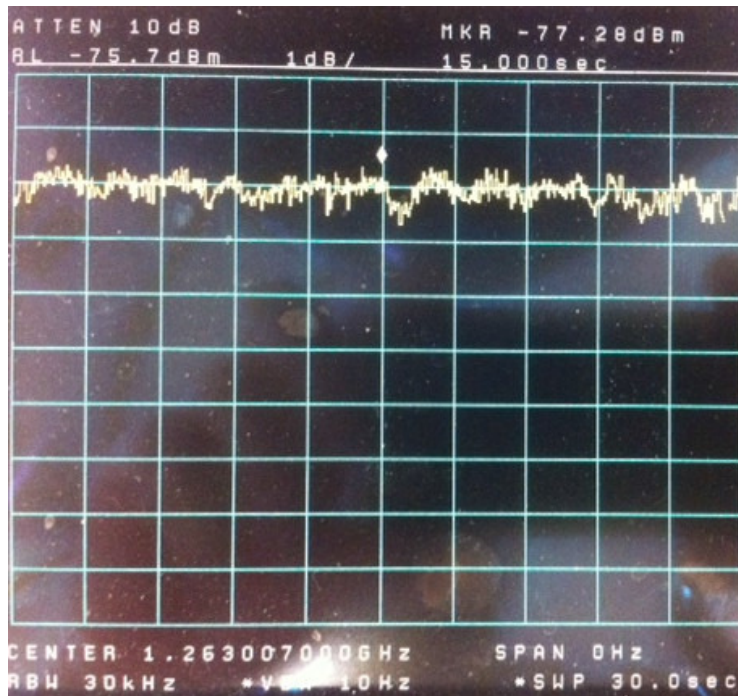


Figure E.4: Sea state 4, 17° Roll / 11 second period, 9.5° Pitch / 9 second period

2.3 Sea state 6 - 100m guided missile boat

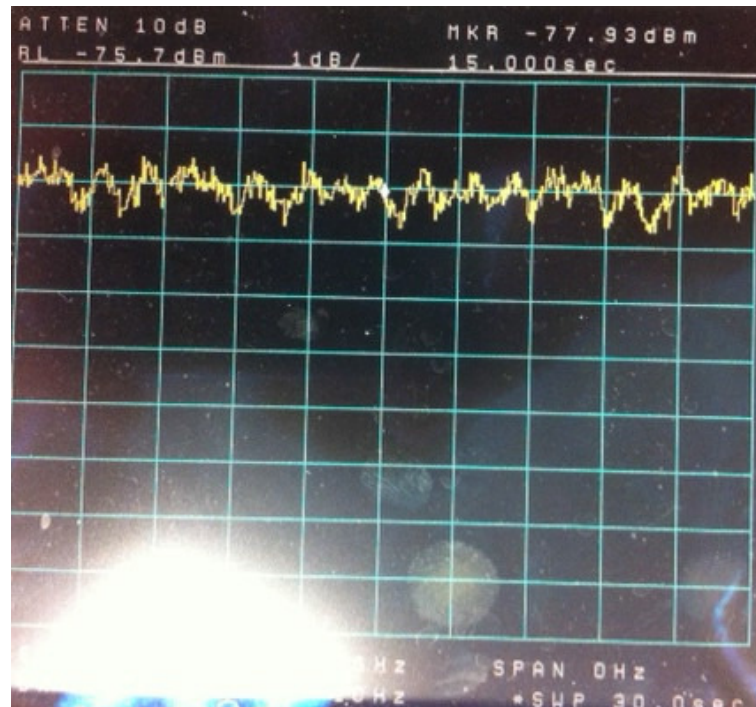


Figure E.5: Sea state 6, 41° Roll / 9 second period, 22° Pitch / 9 second period

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.

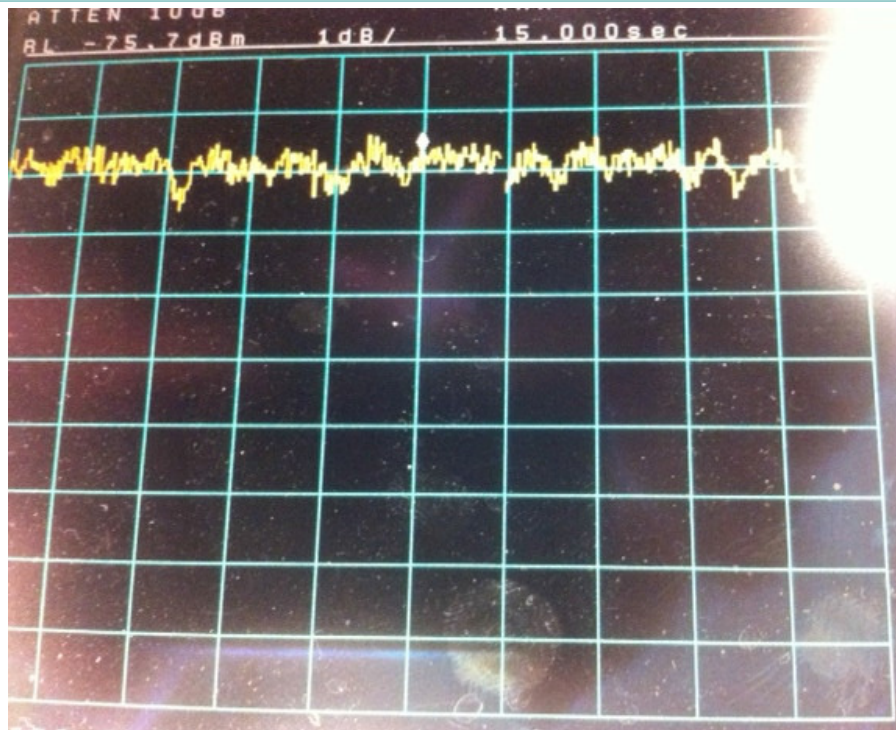
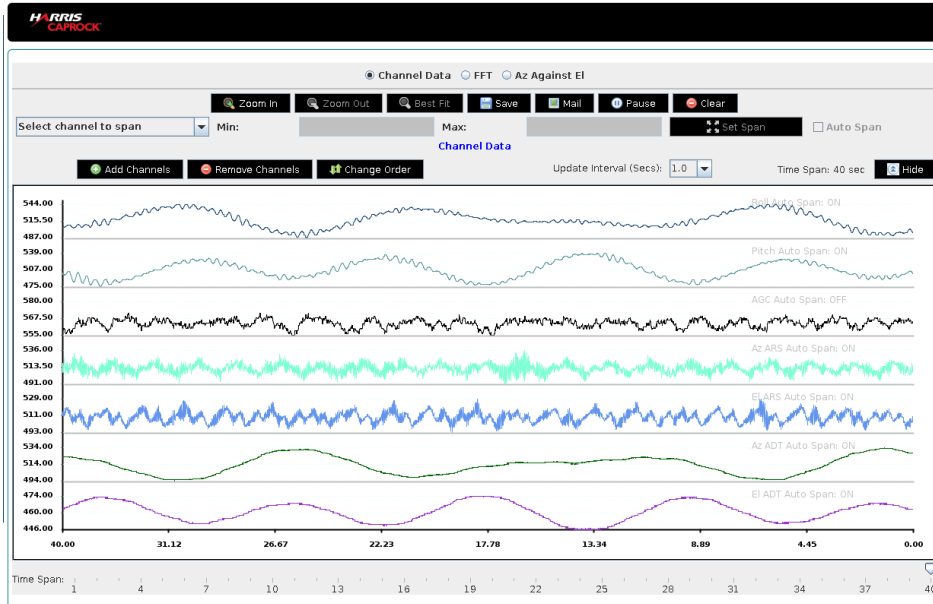


Figure E.7: Undefined sea state, PLC input 0.03/15, 0.05/10. 4.6° Roll / 9 second period, 5.21° Pitch / 14 second period

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.

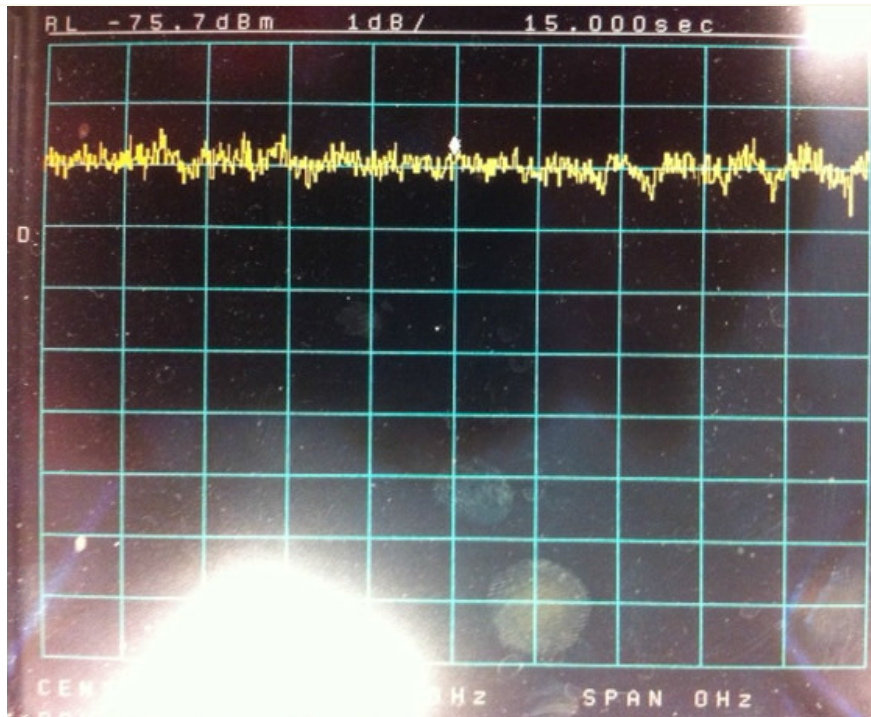
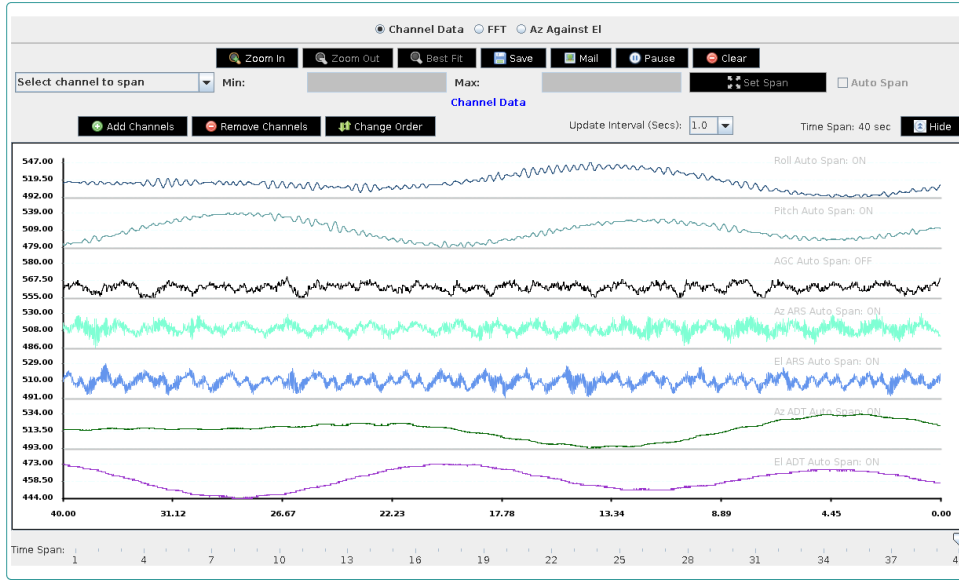
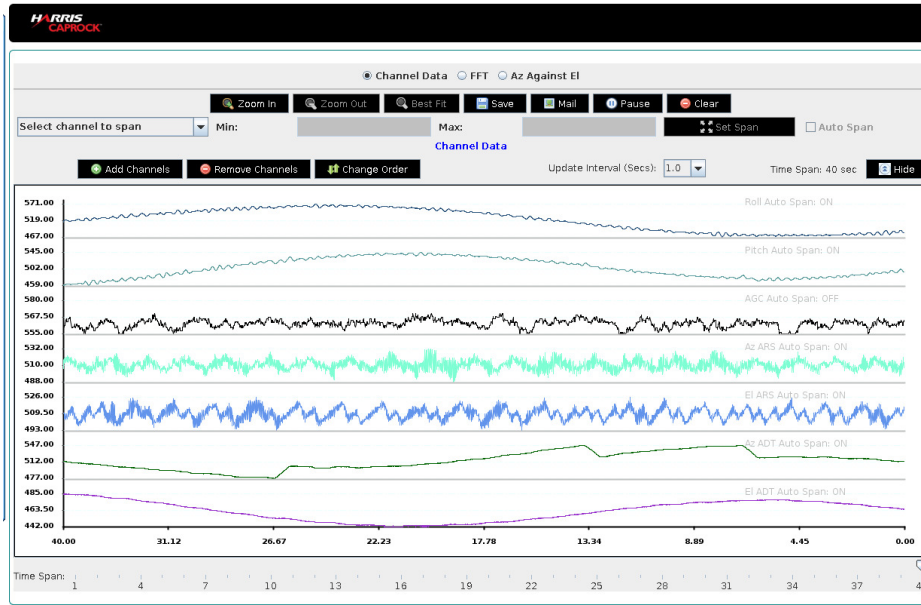


Figure E.8: Undefined sea state, PLC input 0.03/30, 0.05/20. 4.6° Roll / 18 second period, 5.21° Pitch / 28 second period

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.



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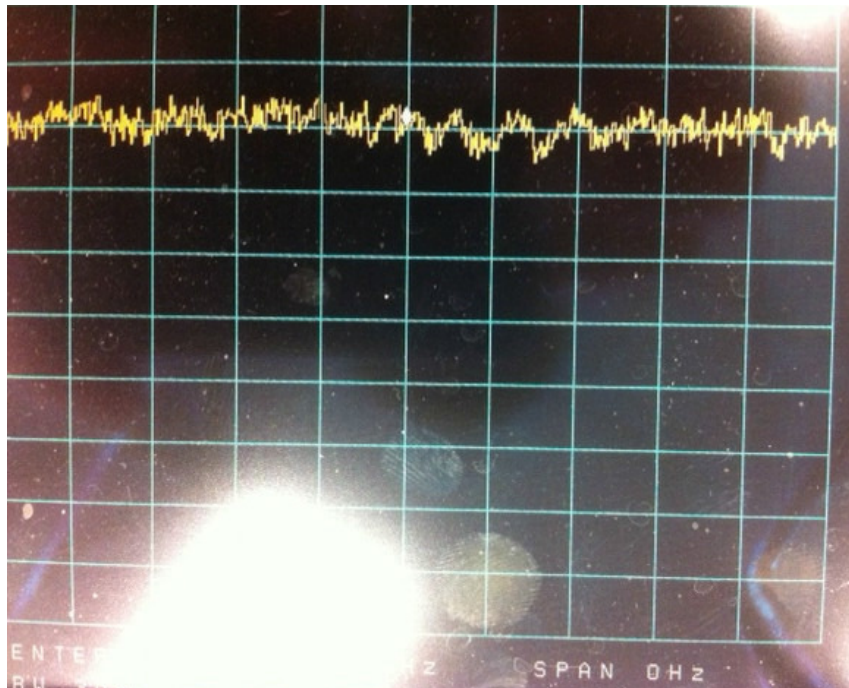
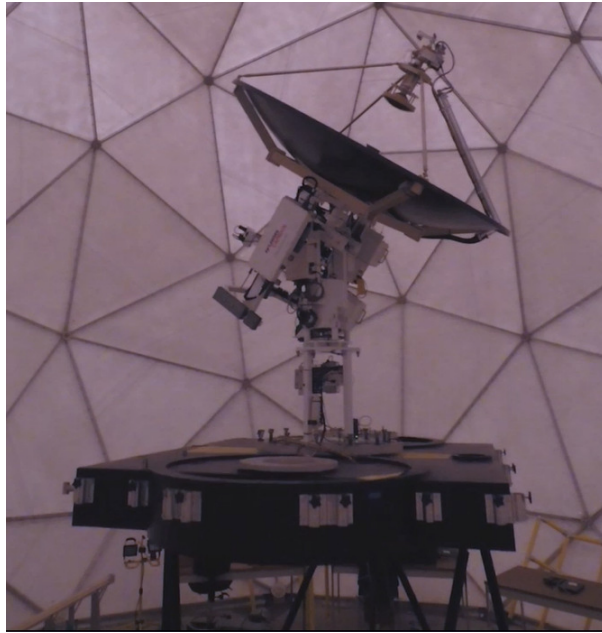
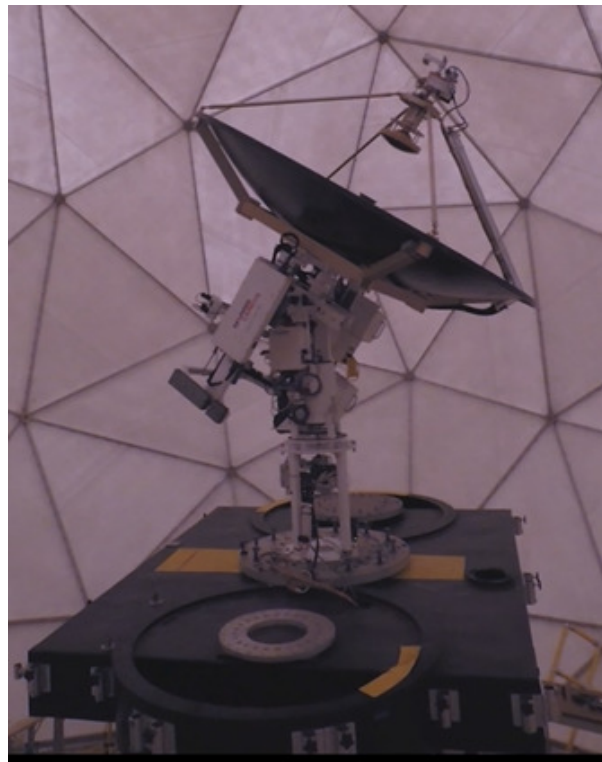


Figure E.9: Undefined sea state, PLC input 0.1/60, 0.1/40. 8.4° Roll / 40 second period, 7° Pitch / 40 second period

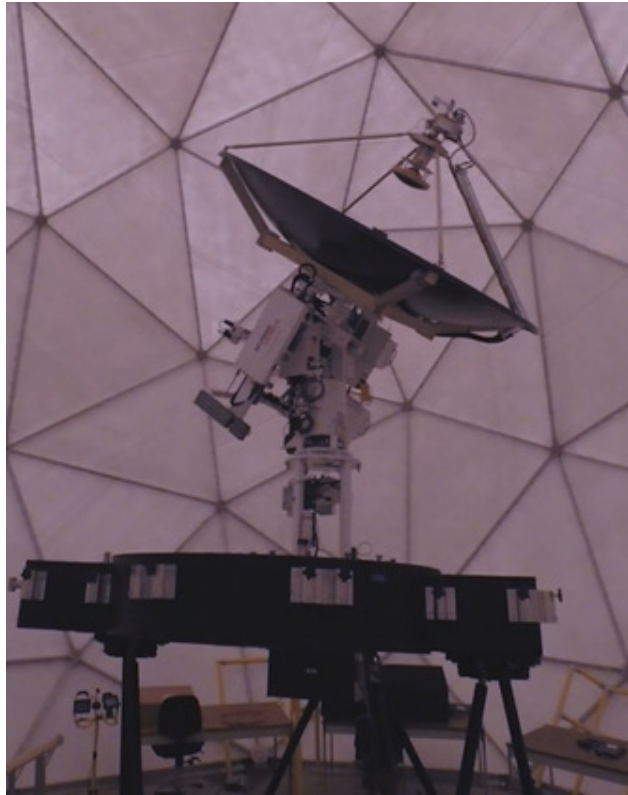
3.1 Motion Table Photographs – Sea State 4



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.

VI. Ka-band Radiation Hazard Study

Radiation Hazard Study

ST5000-2.4m

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 Permissible 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:

<u>Parameter</u>	<u>Value</u>	<u>Unit</u>	<u>Symbol</u>
Antenna Diameter:	2.4	m	<i>D</i>
Antenna Transmit Gain:	54.67	dBi	<i>G</i>
Transmit Frequency:	28360	MHz	<i>f</i>
Feed Flange Diameter:	6.00	cm	<i>d</i>
Power Input to the Antenna:	40.00	W	<i>P</i>

Calculated Parameters

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

<u>Parameter</u>	<u>Value</u>	<u>Unit</u>	<u>Symbol</u>	<u>Formula</u>
Antenna Surface Area:	4.52	m ²	<i>A</i>	$\pi D^2/4$
Area of Feed Flange:	28.27	cm ²	<i>a</i>	$\pi d^2/4$
Antenna Efficiency:	0.58		η	$G\lambda^2/(\pi^2 D^2)$
Gain Factor:	293001.00		<i>g</i>	$10^{G/10}$
Wavelength:	0.0106	m	λ	$300/f$

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.

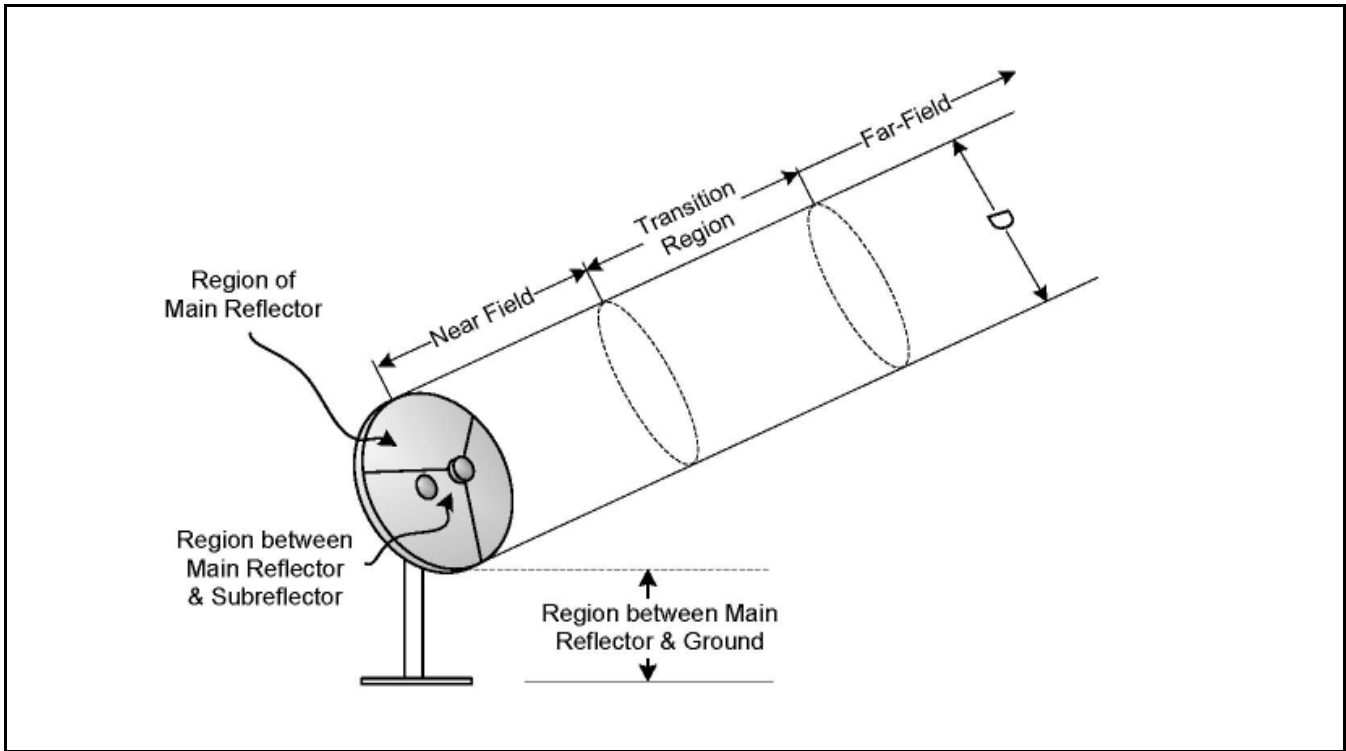


Figure 1. EM Fields as a Function of Distance

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:

<u>Parameter</u>	<u>Value</u>	<u>Unit</u>	<u>Formula</u>
Near Field Distance:	136.128	m	$R_{nf} = D^2/(4\lambda)$
Distance to Far Field:	326.707	m	$R_{ff} = 0.60D^2/(\lambda)$
Distance of Transition Region	136.128	m	$R_t = R_{nf}$

The distance in the transition region is between the near and far fields. Thus, $R_{nf} \leq R_t \leq R_{ff}$. 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.

<u>Parameter</u>	<u>Value</u>	<u>Unit</u>	<u>Symbol</u>	<u>Formula</u>
Power Density in the Near-Field	2.040	mW/cm ²	S_{nf}	$16.0 \eta P / (\pi D^2)$
Power Density in the Far-Field	0.874	mW/cm ²	S_{ff}	$GP / (4\pi R_{ff}^2)$
Power Density in the Trans. Region	2.040	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:

<u>Parameter</u>	<u>Value</u>	<u>Unit</u>	<u>Symbol</u>	<u>Formula</u>
Power Density at the Feed Flange	5658.8	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.

<u>Parameter</u>	<u>Value</u>	<u>Unit</u>	<u>Symbol</u>	<u>Formula</u>
Power Density at Main Reflector	3.537	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:

<u>Parameter</u>	<u>Value</u>	<u>Unit</u>	<u>Symbol</u>	<u>Formula</u>
Power Density between Reflector and Ground	0.884	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	0.874	Satisfies FCC Requirements
Near Field Calculation	2.040	Satisfies FCC Requirements
Transition Region	2.040	Satisfies FCC Requirements
Region between Main and Subreflector	5658.8	Exceeds Limitations
Main Reflector Region	3.537	Satisfies FCC Requirements
Region between Main Reflector and Ground	0.884	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.

VII. Frequency Coordination Reports

Ka-Band Earth Station – Miami, FL

Frequency Coordination Report

28 GHz



Prepared on Behalf of
Harris CapRock
Communications

February 15, 2016



COMSEARCH
A CommScope Company

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2. 28 GHz Common Carrier and LTTS Coordination	- 1 -
3. 28 GHz LMDS Coordination	- 2 -
4. Earth Station Coordination Data	- 3 -
5. Contact Information	- 7 -

1. Summary of Results

On behalf of Harris CapRock Communications, Comsearch performed a coordination notice for all existing and proposed terrestrial licenses within the coordination contours of their proposed Ka-Band earth station in Miami, Florida, which will transmit at 28 GHz¹. Prior-notification letters were sent to the licensees and a copy of the notification data is provided in section four of this report. The earth station coordination was finalized on February 15, 2016.

No objections were received from any of the incumbent 28 GHz licensees. Our notification to the LMDS incumbents was performed under the assumption that the earth station would be operating on a secondary basis to LMDS Block A operations and a contact at Harris CapRock Communications has been provided in case any concerns may arise in the future.

2. 28 GHz Common Carrier and LTTTS Coordination

In accordance with FCC Rules and Regulations, the Ka-Band earth station in Miami, Florida was prior-coordinated by Comsearch. A notification letter and datasheet for this earth station were sent to the following 28 GHz common carrier fixed microwave licensee on January 12, 2016. This licensee is authorized to operate temporary fixed operations from 27.5 to 29.5 GHz on a nationwide basis.

Licensee	Authorized Geographic Area
Verizon	Continental US

A notification letter and datasheets for the Ka-Band earth station in Miami, Florida were also sent to the following 28 GHz local television transmission licensee on January 12, 2016. This licensee is authorized to operate temporary fixed operations from 27.5 to 29.5 GHz on a nationwide basis.

Licensee	Authorized Geographic Area
Information Super Station, LLC	Continental US

No objections were received from the common carrier or local television transmission service incumbents.

¹ The proposed earth station will operate in the 27.6 – 29.1 GHz portion of the Ka-Band.

3. 28 GHz LMDS Coordination

A Notification letter was sent to the following 28 GHz LMDS licensees on January 12, 2016. The proposed earth station will operate on frequencies that overlap Block A of the LMDS service. The total frequency allocation for Block A of the LMDS spectrum appears below.

Block A: 27.500-28.350 GHz
29.100-29.250 GHz
31.075-31.225 GHz

Licensee	Market	Market Name
Nextlink/XO	BTA293 ²	Miami-Ft. Lauderdale, FL
T-Mobile ³	BTA293	Miami-Ft. Lauderdale, FL
Nextlink/XO	BTA469	West Palm Beach-Boca Raton, FL
T-Mobile ⁴	BTA469	West Palm Beach-Boca Raton, FL

No objections were received from the LMDS incumbents.

² The proposed earth station is located in BTA293.

³ T-Mobile has acquired spectrum from Nextlink/XO in the Miami-Ft. Lauderdale Basic Trading Area (BTA).

⁴ T-Mobile has acquired spectrum from Nextlink/XO in the West Palm Beach-Boca Raton BTA.

4. Earth Station Coordination Data

This section presents the data pertinent to the proposed Ka-Band earth station in Miami, Florida. This data was circulated to all incumbent licensees in the shared 28 GHz frequency ranges.

COMSEARCH**Earth Station Data Sheet**

19700 Janelia Farm Boulevard, Ashburn, VA 20147
 (703)726-5662 <http://www.comsearch.com>

Date: 01/06/2016
 Job Number: <PCNJobCode>

Administrative Information

Status ENGINEER PROPOSAL
 Call Sign <PCNCallSign>
 Licensee Code SPACKL
 Licensee Name Harris CapRock Communications

Site Information**MIAMI, FL**

Venue Name
 Latitude (NAD 83) 25° 46' 43.5" N
 Longitude (NAD 83) 80° 10' 40.4" W
 Climate Zone B
 Rain Zone 1
 Ground Elevation (AMSL) 0.0 m / 0.0 ft

Link Information

Satellite Type Medium Earth Orbit
 Mode TO - Transmit-Only
 Modulation Digital
 Minimum Elevation Angle 10.0°
 Azimuth Range 0.0° to 360°
 Antenna Centerline (AGL) 15.54 m / 51.0 ft

Antenna Information**Transmit - FCC32**

Manufacturer Harris
 Model ST5000-2.4
 Gain / Diameter 54.7 dBi / 2.4 m
 3-dB / 15-dB Beamwidth 0.14° / 0.32°

Max Available RF Power (dBW/4 kHz) -14.0
 (dBW/MHz) 10.0

Maximum EIRP (dBW/4 kHz) 40.7
 (dBW/MHz) 64.7

Interference Objectives: Long Term -151.0 dBW/4 kHz 20%
 Short Term -128.0 dBW/4 kHz 0.0025%

Frequency Information**Transmit 28.0 GHz**

Emission / Frequency Range (MHz)
 1M00G7D - 216MG7D / 27652.0 - 27868.0
 1M00G7D - 216MG7D / 27912.0 - 28128.0
 1M00G7D - 216MG7D / 28172.0 - 28388.0
 1M00G7D - 216MG7D / 28601.0 - 28817.0
 1M00G7D - 216MG7D / 28855.0 - 29071.0

Max Great Circle Coordination Distance 137.4 km / 85.4 mi
 Precipitation Scatter Contour Radius 100.0 km / 62.1 mi

COMSEARCH**Earth Station Data Sheet**

19700 Janelia Farm Boulevard, Ashburn, VA 20147
 (703)726-5662 <http://www.comsearch.com>

Coordination Values**MIAMI, FL**

Licensee Name Harris CapRock Communications
 Latitude (NAD 83) 25° 46' 43.5" N
 Longitude (NAD 83) 80° 10' 40.4" W
 Ground Elevation (AMSL) 0.0 m / 0.0 ft
 Antenna Centerline (AGL) 15.54 m / 51.0 ft
 Antenna Model Harris 2.4 Meter
 Antenna Mode Transmit 28.0 GHz
 Interference Objectives: Long Term -151.0 dBW/4 kHz 20%
 Short Term -128.0 dBW/4 kHz 0.0025%
 Max Available RF Power -14.0 (dBW/4 kHz)

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Transmit 28.0 GHz	
			Horizon Gain (dBi)	Coordination Distance (km)
0	0.00	94.31	-10.00	100.00
5	0.00	89.31	-10.00	100.00
10	0.00	84.31	-10.00	100.00
15	0.00	79.31	-10.00	100.00
20	0.00	74.31	-10.00	100.00
25	0.00	69.31	-10.00	100.00
30	0.00	64.31	-10.00	100.00
35	0.00	59.31	-10.00	100.00
40	0.00	54.31	-10.00	100.00
45	0.00	49.31	-10.00	100.00
50	0.00	44.31	-10.00	100.00
55	0.00	39.31	9.40	100.00
60	0.00	34.31	-8.18	100.00
65	0.00	29.31	-6.81	100.00
70	0.00	24.31	-5.26	100.10
75	0.00	19.31	-3.49	109.60
80	0.00	14.31	-1.45	116.40
85	0.00	9.31	0.91	123.80
90	0.00	4.31	3.53	131.30
95	0.00	0.71	5.95	134.90
100	0.00	5.69	6.87	137.40
105	0.00	10.69	5.44	133.50
110	0.00	15.69	2.88	129.50
115	0.00	20.69	0.31	121.90
120	0.00	25.69	-1.96	114.70
125	0.00	30.69	-3.84	108.30
130	0.00	35.69	-5.42	100.00
135	0.00	40.69	-6.77	100.00
140	0.00	45.69	-7.93	100.00
145	0.00	50.69	-8.95	100.00
150	0.00	55.69	-9.83	100.00
155	0.00	60.69	-9.86	100.00
160	0.00	65.69	-10.00	100.00
165	0.00	70.69	-10.00	100.00
170	0.00	75.69	-10.00	100.00
175	0.00	80.69	-10.00	100.00
180	0.00	85.69	-10.00	100.00
185	0.00	90.69	-10.00	100.00

COMSEARCH**Earth Station Data Sheet**

19700 Janelia Farm Boulevard, Ashburn, VA 20147
 (703)726-5662 <http://www.comsearch.com>

Coordination Values**MIAMI, FL**

Licensee Name Harris CapRock Communications
 Latitude (NAD 83) 25° 46' 43.5" N
 Longitude (NAD 83) 80° 10' 40.4" W
 Ground Elevation (AMSL) 0.0 m / 0.0 ft
 Antenna Centerline (AGL) 15.54 m / 51.0 ft
 Antenna Model Harris 2.4 Meter
 Antenna Mode Transmit 28.0 GHz
 Interference Objectives: Long Term -151.0 dBW/4 kHz 20%
 Short Term -128.0 dBW/4 kHz 0.0025%
 Max Available RF Power -14.0 (dBW/4 kHz)

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Transmit 28.0 GHz	
			Horizon Gain (dBi)	Coordination Distance (km)
190	0.00	95.69	-10.00	100.00
195	0.00	100.69	-10.00	100.00
200	0.00	105.69	-10.00	100.00
205	0.00	110.69	-9.86	100.00
210	0.00	115.69	-9.83	100.00
215	0.00	120.69	-8.95	100.00
220	0.00	125.69	-7.93	100.00
225	0.00	130.69	-6.77	100.00
230	0.00	135.69	-5.42	100.00
235	0.00	140.69	-3.84	108.30
240	0.00	145.69	-1.96	114.70
245	0.00	150.69	0.29	121.90
250	0.00	155.69	2.81	129.30
255	0.00	160.69	5.25	133.00
260	0.00	165.69	6.53	136.50
265	0.00	170.69	5.60	134.00
270	0.00	175.69	3.26	130.60
275	0.00	179.29	0.71	123.20
280	0.00	174.31	-1.60	115.90
285	0.00	169.31	-3.61	109.20
290	0.00	164.31	-5.35	100.00
295	0.00	159.31	-6.88	100.00
300	0.00	154.31	-8.24	100.00
305	0.00	149.31	-9.45	100.00
310	0.00	144.31	-10.00	100.00
315	0.00	139.31	-10.00	100.00
320	0.00	134.31	-10.00	100.00
325	0.00	129.31	-10.00	100.00
330	0.00	124.31	-10.00	100.00
335	0.00	119.31	-10.00	100.00
340	0.00	114.31	-10.00	100.00
345	0.00	109.31	-10.00	100.00
350	0.00	104.31	-10.00	100.00
355	0.00	99.31	-10.00	100.00



5. Contact Information

For questions or information regarding the 28 GHz Frequency Coordination Report, please contact:

Contact person:	Joanna Lynch
Title:	Manager, Spectrum & Data Solutions
Company:	Comsearch
Address:	19700 Janelia Farm Blvd., Ashburn, VA 20147
Telephone:	703-726-5711
Fax:	703-726-5599
Email:	jlynch@comsearch.com
Web site:	www.comsearch.com

Ka-Band Earth Station – Port Canaveral, FL

Frequency Coordination Report

28 GHz



Prepared on Behalf of
Harris CapRock
Communications

February 15, 2016



COMSEARCH
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1. Summary of Results

On behalf of Harris CapRock Communications, Comsearch performed a coordination notice for all existing and proposed terrestrial licenses within the coordination contours of their proposed Ka-Band earth station in Port Canaveral, Florida, which will transmit at 28 GHz¹. Prior-notification letters were sent to the licensees and a copy of the notification data is provided in section four of this report. The earth station coordination was finalized on February 15, 2016.

No objections were received from any of the incumbent 28 GHz licensees. Our notification to the LMDS incumbents was performed under the assumption that the earth station would be operating on a secondary basis to LMDS Block A operations and a contact at Harris CapRock Communications has been provided in case any concerns may arise in the future.

2. 28 GHz Common Carrier and LTTTS Coordination

In accordance with FCC Rules and Regulations, the Ka-Band earth station in Port Canaveral, Florida was prior-coordinated by Comsearch. A notification letter and datasheet for this earth station were sent to the following 28 GHz common carrier fixed microwave licensee on January 12, 2016. This licensee is authorized to operate temporary fixed operations from 27.5 to 29.5 GHz on a nationwide basis.

Licensee	Authorized Geographic Area
Verizon	Continental US

A notification letter and datasheets for the Ka-Band earth station in Port Canaveral, Florida were also sent to the following 28 GHz local television transmission licensee on January 12, 2016. This licensee is authorized to operate temporary fixed operations from 27.5 to 29.5 GHz on a nationwide basis.

Licensee	Authorized Geographic Area
Information Super Station, LLC	Continental US

No objections were received from the common carrier or local television transmission service incumbents.

¹ The proposed earth station will operate in the 27.6 – 29.1 GHz portion of the Ka-Band.

3. 28 GHz LMDS Coordination

A Notification letter was sent to the following 28 GHz LMDS licensees on January 12, 2016. The proposed earth station will operate on frequencies that overlap Block A of the LMDS service. The total frequency allocation for Block A of the LMDS spectrum appears below.

Block A: 27.500-28.350 GHz
29.100-29.250 GHz
31.075-31.225 GHz

Licensee	Market	Market Name
Nextlink/XO	BTA212	Jacksonville, FL
T-Mobile ²	BTA212	Jacksonville, FL
Wireless Distribution Services	BTA239	Lakeland-Winter Haven, FL
Rainier Connect	BTA326	Ocala, FL
Straight Path Spectrum	BTA336	Orlando, FL
T-Mobile ³	BTA336	Orlando, FL
Nextlink/XO	BTA440	Tampa-St. Petersburg-Clearwater, FL
T-Mobile ⁴	BTA440	Tampa-St. Petersburg-Clearwater, FL
Nextlink/XO	BTA469	West Palm Beach-Boca Raton, FL
T-Mobile ⁵	BTA469	West Palm Beach-Boca Raton, FL

No objections were received from the LMDS incumbents.

² T-Mobile has acquired spectrum from Nextlink/XO in the Jacksonville Basic Trading Area (BTA).

³ T-Mobile has acquired spectrum from Straight Path Spectrum in the Orlando BTA.

⁴ T-Mobile has acquired spectrum from Nextlink/XO in the Tampa—St. Petersburg—Clearwater BTA.

⁵ T-Mobile has acquired spectrum from Nextlink/XO in the West Palm Beach—Boca Raton BTA.



4. Earth Station Coordination Data

This section presents the data pertinent to the proposed Ka-Band earth station in Port Canaveral, Florida. This data was circulated to all incumbent licensees in the shared 28 GHz frequency ranges.

COMSEARCH**Earth Station Data Sheet**

19700 Janelia Farm Boulevard, Ashburn, VA 20147
 (703)726-5662 <http://www.comsearch.com>

Date: 01/06/2016
 Job Number: <PCNJobCode>

Administrative Information

Status ENGINEER PROPOSAL
 Call Sign <PCNCallSign>
 Licensee Code SPACKL
 Licensee Name Harris CapRock Communications

Site Information**PORT CANAVERAL, FL**

Venue Name
 Latitude (NAD 83) 28° 24' 40.2" N
 Longitude (NAD 83) 80° 37' 42.5" W
 Climate Zone B
 Rain Zone 1
 Ground Elevation (AMSL) 0.0 m / 0.0 ft

Link Information

Satellite Type Medium Earth Orbit
 Mode TO - Transmit-Only
 Modulation Digital
 Minimum Elevation Angle 10.0°
 Azimuth Range 0.0° to 360°
 Antenna Centerline (AGL) 15.54 m / 51.0 ft

Antenna Information**Transmit - FCC32**

Manufacturer Harris
 Model ST5000-2.4
 Gain / Diameter 54.7 dBi / 2.4 m
 3-dB / 15-dB Beamwidth 0.14° / 0.32°

Max Available RF Power (dBW/4 kHz) -14.0
 (dBW/MHz) 10.0

Maximum EIRP (dBW/4 kHz) 40.7
 (dBW/MHz) 64.7

Interference Objectives: Long Term -151.0 dBW/4 kHz 20%
 Short Term -128.0 dBW/4 kHz 0.0025%

Frequency Information**Transmit 28.0 GHz**

Emission / Frequency Range (MHz)
 1M00G7D - 216MG7D / 27652.0 - 27868.0
 1M00G7D - 216MG7D / 27912.0 - 28128.0
 1M00G7D - 216MG7D / 28172.0 - 28388.0
 1M00G7D - 216MG7D / 28601.0 - 28817.0
 1M00G7D - 216MG7D / 28855.0 - 29071.0

Max Great Circle Coordination Distance 136.7 km / 84.9 mi
 Precipitation Scatter Contour Radius 100.0 km / 62.1 mi

COMSEARCH**Earth Station Data Sheet**

19700 Janelia Farm Boulevard, Ashburn, VA 20147
 (703)726-5662 <http://www.comsearch.com>

Coordination Values	PORT CANAVER, FL
Licensee Name	Harris CapRock Communications
Latitude (NAD 83)	28° 24' 40.2" N
Longitude (NAD 83)	80° 37' 42.5" W
Ground Elevation (AMSL)	0.0 m / 0.0 ft
Antenna Centerline (AGL)	15.54 m / 51.0 ft
Antenna Model	Harris 2.4 Meter
Antenna Mode	Transmit 28.0 GHz
Interference Objectives: Long Term	-151.0 dBW/4 kHz 20%
Short Term	-128.0 dBW/4 kHz 0.0025%
Max Available RF Power	-14.0 (dBW/4 kHz)

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Transmit 28.0 GHz	
			Horizon Gain (dBi)	Coordination Distance (km)
0	0.00	94.49	-10.00	100.00
5	0.00	89.49	-10.00	100.00
10	0.00	84.49	-10.00	100.00
15	0.00	79.49	-10.00	100.00
20	0.00	74.49	-10.00	100.00
25	0.00	69.49	-10.00	100.00
30	0.00	64.49	-10.00	100.00
35	0.00	59.49	-10.00	100.00
40	0.00	54.49	-10.00	100.00
45	0.00	49.49	-10.00	100.00
50	0.00	44.49	-10.00	100.00
55	0.00	39.49	-9.67	100.00
60	0.00	34.49	-8.47	100.00
65	0.00	29.50	-7.14	100.00
70	0.00	24.50	-5.64	100.00
75	0.00	19.50	-3.93	100.00
80	0.00	14.50	-1.96	100.00
85	0.00	9.50	0.33	100.00
90	0.00	4.52	2.90	100.00
95	0.00	0.69	5.45	100.00
100	0.00	5.53	6.84	100.00
105	0.00	10.52	5.91	100.00
110	0.00	15.51	3.49	100.00
115	0.00	20.51	0.87	100.00
120	0.00	25.51	-1.46	100.00
125	0.00	30.51	-3.36	100.00
130	0.00	35.51	-4.95	100.00
135	0.00	40.51	-6.31	100.00
140	0.00	45.51	-7.47	100.00
145	0.00	50.51	-8.48	100.00
150	0.00	55.51	-9.35	100.00
155	0.00	60.51	-10.00	100.00
160	0.00	65.51	-10.00	100.00
165	0.00	70.51	-10.00	100.00
170	0.00	75.51	-10.00	100.00
175	0.00	80.51	-10.00	100.00
180	0.00	85.51	-10.00	100.00
185	0.00	90.51	-10.00	100.00

COMSEARCH**Earth Station Data Sheet**

19700 Janelia Farm Boulevard, Ashburn, VA 20147
 (703)726-5662 <http://www.comsearch.com>

Coordination Values	PORT CANAVER, FL
Licensee Name	Harris CapRock Communications
Latitude (NAD 83)	28° 24' 40.2" N
Longitude (NAD 83)	80° 37' 42.5" W
Ground Elevation (AMSL)	0.0 m / 0.0 ft
Antenna Centerline (AGL)	15.54 m / 51.0 ft
Antenna Model	Harris 2.4 Meter
Antenna Mode	Transmit 28.0 GHz
Interference Objectives: Long Term	-151.0 dBW/4 kHz 20%
Short Term	-128.0 dBW/4 kHz 0.0025%
Max Available RF Power	-14.0 (dBW/4 kHz)

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Transmit 28.0 GHz	
			Horizon Gain (dBi)	Coordination Distance (km)
190	0.00	95.51	-10.00	100.00
195	0.00	100.51	-10.00	100.00
200	0.00	105.51	-10.00	100.00
205	0.00	110.51	-10.00	100.00
210	0.00	115.51	-9.35	100.00
215	0.00	120.51	-8.48	100.00
220	0.00	125.51	-7.47	100.00
225	0.00	130.51	-6.31	100.00
230	0.00	135.51	-4.95	104.40
235	0.00	140.51	-3.36	110.00
240	0.00	145.51	-1.45	116.40
245	0.00	150.50	0.86	123.60
250	0.00	155.50	3.43	131.00
255	0.00	160.50	5.76	134.40
260	0.00	165.50	6.59	136.70
265	0.00	170.50	5.20	132.90
270	0.00	175.48	2.71	129.00
275	0.00	179.31	0.19	121.60
280	0.00	174.47	-2.06	114.40
285	0.00	169.48	-4.01	107.80
290	0.00	164.49	-5.70	100.00
295	0.00	159.49	-7.20	100.00
300	0.00	154.49	-8.52	100.00
305	0.00	149.49	-9.71	100.00
310	0.00	144.49	-10.00	100.00
315	0.00	139.49	-10.00	100.00
320	0.00	134.49	-10.00	100.00
325	0.00	129.49	-10.00	100.00
330	0.00	124.49	-10.00	100.00
335	0.00	119.49	-10.00	100.00
340	0.00	114.49	-10.00	100.00
345	0.00	109.49	-10.00	100.00
350	0.00	104.49	-10.00	100.00
355	0.00	99.49	-10.00	100.00



5. Contact Information

For questions or information regarding the 28 GHz Frequency Coordination Report, please contact:

Contact person:	Joanna Lynch
Title:	Manager, Spectrum & Data Solutions
Company:	Comsearch
Address:	19700 Janelia Farm Blvd., Ashburn, VA 20147
Telephone:	703-726-5711
Fax:	703-726-5599
Email:	jlynch@comsearch.com
Web site:	www.comsearch.com

Ka-Band Earth Station – Ft. Lauderdale, FL

Frequency Coordination Report

28 GHz



Prepared on Behalf of
Harris CapRock
Communications

February 15, 2016



COMSEARCH
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1. Summary of Results

On behalf of Harris CapRock Communications, Comsearch performed a coordination notice for all existing and proposed terrestrial licenses within the coordination contours of their proposed Ka-Band earth station in Ft. Lauderdale, Florida, which will transmit at 28 GHz¹. Prior-notification letters were sent to the licensees and a copy of the notification data is provided in section four of this report. The earth station coordination was finalized on February 15, 2016.

No objections were received from any of the incumbent 28 GHz licensees. Our notification to the LMDS incumbents was performed under the assumption that the earth station would be operating on a secondary basis to LMDS Block A operations and a contact at Harris CapRock Communications has been provided in case any concerns may arise in the future.

2. 28 GHz Common Carrier and LTTTS Coordination

In accordance with FCC Rules and Regulations, the Ka-Band earth station in Ft. Lauderdale, Florida was prior-coordinated by Comsearch. A notification letter and datasheet for this earth station were sent to the following 28 GHz common carrier fixed microwave licensee on January 12, 2016. This licensee is authorized to operate temporary fixed operations from 27.5 to 29.5 GHz on a nationwide basis.

Licensee	Authorized Geographic Area
Verizon	Continental US

A notification letter and datasheets for the Ka-Band earth station in Ft. Lauderdale, Florida were also sent to the following 28 GHz local television transmission licensee on January 12, 2016. This licensee is authorized to operate temporary fixed operations from 27.5 to 29.5 GHz on a nationwide basis.

Licensee	Authorized Geographic Area
Information Super Station, LLC	Continental US

No objections were received from the common carrier or local television transmission service incumbents.

¹ The proposed earth station will operate in the 27.6 – 29.1 GHz portion of the Ka-Band.

3. 28 GHz LMDS Coordination

A Notification letter was sent to the following 28 GHz LMDS licensees on January 12, 2016. The proposed earth station will operate on frequencies that overlap Block A of the LMDS service. The total frequency allocation for Block A of the LMDS spectrum appears below.

Block A: 27.500-28.350 GHz
29.100-29.250 GHz
31.075-31.225 GHz

Licensee	Market	Market Name
Nextlink/XO	BTA293 ²	Miami-Ft. Lauderdale, FL
T-Mobile ³	BTA293	Miami-Ft. Lauderdale, FL
Nextlink/XO	BTA469	West Palm Beach-Boca Raton, FL
T-Mobile ⁴	BTA469	West Palm Beach-Boca Raton, FL

No objections were received from the LMDS incumbents.

² The proposed earth station is located in BTA293.

³ T-Mobile has acquired spectrum from Nextlink/XO in the Miami-Ft. Lauderdale Basic Trading Area (BTA).

⁴ T-Mobile has acquired spectrum from Nextlink/XO in the West Palm Beach-Boca Raton BTA.



4. Earth Station Coordination Data

This section presents the data pertinent to the proposed Ka-Band earth station in Ft. Lauderdale, Florida. This data was circulated to all incumbent licensees in the shared 28 GHz frequency ranges.

COMSEARCH**Earth Station Data Sheet**

19700 Janelia Farm Boulevard, Ashburn, VA 20147
 (703)726-5662 <http://www.comsearch.com>

Date: 01/06/2016
 Job Number: <PCNJobCode>

Administrative Information

Status ENGINEER PROPOSAL
 Call Sign <PCNCallSign>
 Licensee Code SPACKL
 Licensee Name Harris CapRock Communications

Site Information FT LAUDERDALE, FL

Venue Name
 Latitude (NAD 83) 26° 5' 9.6" N
 Longitude (NAD 83) 80° 6' 52.2" W
 Climate Zone B
 Rain Zone 1
 Ground Elevation (AMSL) 0.0 m / 0.0 ft

Link Information

Satellite Type Medium Earth Orbit
 Mode TO - Transmit-Only
 Modulation Digital
 Minimum Elevation Angle 10.0°
 Azimuth Range 0.0° to 360°
 Antenna Centerline (AGL) 15.54 m / 51.0 ft

Antenna Information Transmit - FCC32

Manufacturer Harris
 Model ST5000-2.4
 Gain / Diameter 54.7 dBi / 2.4 m
 3-dB / 15-dB Beamwidth 0.14° / 0.32°

Max Available RF Power (dBW/4 kHz) -14.0
 (dBW/MHz) 10.0

Maximum EIRP (dBW/4 kHz) 40.7
 (dBW/MHz) 64.7

Interference Objectives: Long Term -151.0 dBW/4 kHz 20%
 Short Term -128.0 dBW/4 kHz 0.0025%

Frequency Information Transmit 28.0 GHz

Emission / Frequency Range (MHz)
 1M00G7D - 216MG7D / 27652.0 - 27868.0
 1M00G7D - 216MG7D / 27912.0 - 28128.0
 1M00G7D - 216MG7D / 28172.0 - 28388.0
 1M00G7D - 216MG7D / 28601.0 - 28817.0
 1M00G7D - 216MG7D / 28855.0 - 29071.0

Max Great Circle Coordination Distance 137.5 km / 85.4 mi
 Precipitation Scatter Contour Radius 100.0 km / 62.1 mi

COMSEARCH**Earth Station Data Sheet**

19700 Janelia Farm Boulevard, Ashburn, VA 20147
 (703)726-5662 <http://www.comsearch.com>

Coordination Values	FT LAUDERDAL, FL
Licensee Name	Harris CapRock Communications
Latitude (NAD 83)	26° 5' 9.6" N
Longitude (NAD 83)	80° 6' 52.2" W
Ground Elevation (AMSL)	0.0 m / 0.0 ft
Antenna Centerline (AGL)	15.54 m / 51.0 ft
Antenna Model	Harris 2.4 Meter
Antenna Mode	Transmit 28.0 GHz
Interference Objectives: Long Term	-151.0 dBW/4 kHz 20%
Short Term	-128.0 dBW/4 kHz 0.0025%
Max Available RF Power	-14.0 (dBW/4 kHz)

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Transmit 28.0 GHz	
			Horizon Gain (dBi)	Coordination Distance (km)
0	0.00	94.38	-10.00	100.00
5	0.00	89.38	-10.00	100.00
10	0.00	84.38	-10.00	100.00
15	0.00	79.38	-10.00	100.00
20	0.00	74.38	-10.00	100.00
25	0.00	69.38	-10.00	100.00
30	0.00	64.38	-10.00	100.00
35	0.00	59.38	-10.00	100.00
40	0.00	54.38	-10.00	100.00
45	0.00	49.38	-10.00	100.00
50	0.00	44.38	-10.00	100.00
55	0.00	39.38	-9.43	100.00
60	0.00	34.38	-8.21	100.00
65	0.00	29.38	-6.85	100.00
70	0.00	24.38	-5.31	100.00
75	0.00	19.38	-3.54	109.40
80	0.00	14.39	-1.51	116.20
85	0.00	9.39	0.84	123.60
90	0.00	4.39	3.46	131.10
95	0.00	0.64	5.90	134.80
100	0.00	5.62	6.87	137.50
105	0.00	10.62	5.50	133.70
110	0.00	15.62	2.95	129.70
115	0.00	20.62	0.37	122.10
120	0.00	25.62	-1.91	114.90
125	0.00	30.62	-3.79	108.50
130	0.00	35.62	-5.37	100.00
135	0.00	40.62	-6.71	100.00
140	0.00	45.62	-7.88	100.00
145	0.00	50.62	-8.90	100.00
150	0.00	55.62	-9.78	100.00
155	0.00	60.62	-10.00	100.00
160	0.00	65.62	-10.00	100.00
165	0.00	70.62	-10.00	100.00
170	0.00	75.62	-10.00	100.00
175	0.00	80.62	-10.00	100.00
180	0.00	85.62	-10.00	100.00
185	0.00	90.62	-10.00	100.00



5. Contact Information

For questions or information regarding the 28 GHz Frequency Coordination Report, please contact:

Contact person:	Joanna Lynch
Title:	Manager, Spectrum & Data Solutions
Company:	Comsearch
Address:	19700 Janelia Farm Blvd., Ashburn, VA 20147
Telephone:	703-726-5711
Fax:	703-726-5599
Email:	jlynch@comsearch.com
Web site:	www.comsearch.com

Ka-Band Earth Station – San Juan, PR

Frequency Coordination Report

28 GHz



Prepared on Behalf of
Harris CapRock
Communications

February 15, 2016



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1. Summary of Results

On behalf of Harris CapRock Communications, Comsearch performed a coordination notice for all existing and proposed terrestrial licenses within the coordination contours of their proposed Ka-Band earth station in San Juan, Puerto Rico, which will transmit at 28 GHz¹. Prior-notification letters were sent to the licensees and a copy of the notification data is provided in section four of this report. The earth station coordination was finalized on February 15, 2016.

No objections were received from any of the incumbent 28 GHz licensees. Our notification to the LMDS incumbents was performed under the assumption that the earth station would be operating on a secondary basis to LMDS Block A operations and a contact at Harris CapRock Communications has been provided in case any concerns may arise in the future.

2. 28 GHz Common Carrier and LTTTS Coordination

In accordance with FCC Rules and Regulations, the Ka-Band earth station in San Juan, Puerto Rico was prior-coordinated by Comsearch. A notification letter and datasheet for this earth station were sent to the following 28 GHz common carrier fixed microwave licensee on January 12, 2016. This licensee is authorized to operate temporary fixed operations from 27.5 to 29.5 GHz on a nationwide basis.

Licensee	Authorized Geographic Area
Verizon	Continental US

A notification letter and datasheets for the Ka-Band earth station in San Juan, Puerto Rico were also sent to the following 28 GHz local television transmission licensee on January 12, 2016. This licensee is authorized to operate temporary fixed operations from 27.5 to 29.5 GHz on a nationwide basis.

Licensee	Authorized Geographic Area
Information Super Station, LLC	Continental US

No objections were received from the common carrier or local television transmission service incumbents.

¹ The proposed earth station will operate in the 27.6 – 29.1 GHz portion of the Ka-Band.

3. 28 GHz LMDS Coordination

A Notification letter was sent to the following 28 GHz LMDS licensees on January 12, 2016. The proposed earth station will operate on frequencies that overlap Block A of the LMDS service. The total frequency allocation for Block A of the LMDS spectrum appears below.

Block A: 27.500-28.350 GHz
29.100-29.250 GHz
31.075-31.225 GHz

Licensee	Market	Market Name
Lightspeed PR	BTA488 ²	San Juan, PR
Lightspeed PR	BTA489	Mayaguez-Aguadilla-Ponce, PR

No objections were received from the LMDS incumbents.

² The proposed earth station is located in BTA488.

4. Earth Station Coordination Data

This section presents the data pertinent to the proposed Ka-Band earth station in San Juan, Puerto Rico. This data was circulated to all incumbent licensees in the shared 28 GHz frequency ranges.

COMSEARCH**Earth Station Data Sheet**

19700 Janelia Farm Boulevard, Ashburn, VA 20147
 (703)726-5662 <http://www.comsearch.com>

Date: 01/06/2016
 Job Number: <PCNJobCode>

Administrative Information

Status ENGINEER PROPOSAL
 Call Sign <PCNCallSign>
 Licensee Code SPACKL
 Licensee Name Harris CapRock Communications

Site Information SAN JUAN, PR

Venue Name
 Latitude (NAD 83) 18° 27' 32.4" N
 Longitude (NAD 83) 66° 5' 51.7" W
 Climate Zone B
 Rain Zone 1
 Ground Elevation (AMSL) 0.0 m / 0.0 ft

Link Information

Satellite Type Medium Earth Orbit
 Mode TO - Transmit-Only
 Modulation Digital
 Minimum Elevation Angle 10.0°
 Azimuth Range 0.0° to 360°
 Antenna Centerline (AGL) 15.54 m / 51.0 ft

Antenna Information**Transmit - FCC32**

Manufacturer Harris
 Model ST5000-2.4
 Gain / Diameter 54.7 dBi / 2.4 m
 3-dB / 15-dB Beamwidth 0.14° / 0.32°

Max Available RF Power (dBW/4 kHz) -14.0
 (dBW/MHz) 10.0

Maximum EIRP (dBW/4 kHz) 40.7
 (dBW/MHz) 64.7

Interference Objectives: Long Term -151.0 dBW/4 kHz 20%
 Short Term -128.0 dBW/4 kHz 0.0025%

Frequency Information**Transmit 28.0 GHz**

Emission / Frequency Range (MHz)
 1M00G7D - 216MG7D / 27652.0 - 27868.0
 1M00G7D - 216MG7D / 27912.0 - 28128.0
 1M00G7D - 216MG7D / 28172.0 - 28388.0
 1M00G7D - 216MG7D / 28601.0 - 28817.0
 1M00G7D - 216MG7D / 28855.0 - 29071.0

Max Great Circle Coordination Distance 136.1 km / 84.6 mi
 Precipitation Scatter Contour Radius 100.0 km / 62.1 mi

COMSEARCH**Earth Station Data Sheet**

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Coordination Values**SAN JUAN, PR**

Licensee Name Harris CapRock Communications
 Latitude (NAD 83) 18° 27' 32.4" N
 Longitude (NAD 83) 66° 5' 51.7" W
 Ground Elevation (AMSL) 0.0 m / 0.0 ft
 Antenna Centerline (AGL) 15.54 m / 51.0 ft
 Antenna Model Harris 2.4 Meter
 Antenna Mode Transmit 28.0 GHz
 Interference Objectives: Long Term -151.0 dBW/4 kHz 20%
 Short Term -128.0 dBW/4 kHz 0.0025%
 Max Available RF Power -14.0 (dBW/4 kHz)

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Transmit 28.0 GHz	
			Horizon Gain (dBi)	Coordination Distance (km)
0	0.00	97.75	-10.00	100.00
5	0.00	92.90	-10.00	100.00
10	0.00	88.05	-10.00	100.00
15	0.00	83.20	-10.00	100.00
20	0.00	78.36	-10.00	100.00
25	0.00	73.52	-10.00	100.00
30	0.00	68.69	-10.00	100.00
35	0.00	63.88	-10.00	100.00
40	0.00	59.07	-10.00	100.00
45	0.00	54.29	-10.00	100.00
50	0.00	49.54	-10.00	100.00
55	0.00	44.83	-9.29	100.00
60	0.00	40.17	-8.10	100.00
65	0.00	35.59	-6.78	100.00
70	0.00	31.11	-5.32	100.00
75	0.00	26.80	-3.70	108.80
80	0.00	22.75	-1.93	114.80
85	0.00	19.13	-0.04	120.90
90	0.00	16.23	1.74	126.20
95	0.00	14.48	2.98	129.80
100	0.00	14.31	3.11	130.20
105	0.00	15.78	2.05	127.10
110	0.00	18.50	0.32	122.00
115	0.00	22.00	-1.50	114.50
120	0.00	25.99	-3.37	110.00
125	0.00	30.25	-5.02	100.90
130	0.00	34.70	-6.51	100.00
135	0.00	39.26	-7.84	100.00
140	0.00	43.91	-9.01	100.00
145	0.00	48.61	-10.00	100.00
150	0.00	53.36	-10.00	100.00
155	0.00	58.13	-10.00	100.00
160	0.00	62.93	-10.00	100.00
165	0.00	67.75	-10.00	100.00
170	0.00	72.58	-10.00	100.00
175	0.00	77.41	-10.00	100.00
180	0.00	82.25	-10.00	100.00
185	0.00	87.10	-10.00	100.00

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Coordination Values**SAN JUAN, PR**

Licensee Name Harris CapRock Communications
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 Interference Objectives: Long Term -151.0 dBW/4 kHz 20%
 Short Term -128.0 dBW/4 kHz 0.0025%
 Max Available RF Power -14.0 (dBW/4 kHz)

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Transmit 28.0 GHz	
			Horizon Gain (dBi)	Coordination Distance (km)
190	0.00	91.95	-10.00	100.00
195	0.00	96.80	-10.00	100.00
200	0.00	101.64	-10.00	100.00
205	0.00	106.48	-10.00	100.00
210	0.00	111.31	-10.00	100.00
215	0.00	116.13	-10.00	100.00
220	0.00	120.93	-8.96	100.00
225	0.00	125.71	-7.84	100.00
230	0.00	130.46	-6.51	100.00
235	0.00	135.17	-4.96	104.40
240	0.00	139.83	-3.17	110.70
245	0.00	144.41	-1.09	124.90
250	0.00	148.89	1.28	132.10
255	0.00	153.20	3.83	134.90
260	0.00	157.25	5.97	136.10
265	0.00	160.87	6.38	134.50
270	0.00	163.77	4.70	127.50
275	0.00	165.52	2.18	120.10
280	0.00	165.69	-0.28	113.10
285	0.00	164.22	-2.46	100.00
290	0.00	161.50	-4.30	100.00
295	0.00	158.00	-5.96	100.00
300	0.00	154.01	-7.44	100.00
305	0.00	149.75	-8.73	100.00
310	0.00	145.30	-9.91	100.00
315	0.00	140.74	-10.00	100.00
320	0.00	136.09	-10.00	100.00
325	0.00	131.39	-10.00	100.00
330	0.00	126.64	-10.00	100.00
335	0.00	121.87	-10.00	100.00
340	0.00	117.07	-10.00	100.00
345	0.00	112.25	-10.00	100.00
350	0.00	107.42	-10.00	100.00
355	0.00	102.59	-10.00	100.00



5. Contact Information

For questions or information regarding the 28 GHz Frequency Coordination Report, please contact:

Contact person: Joanna Lynch
Title: Manager, Spectrum & Data Solutions
Company: Comsearch
Address: 19700 Janelia Farm Blvd., Ashburn, VA 20147
Telephone: 703-726-5711
Fax: 703-726-5599
Email: jlynch@comsearch.com
Web site: www.comsearch.com