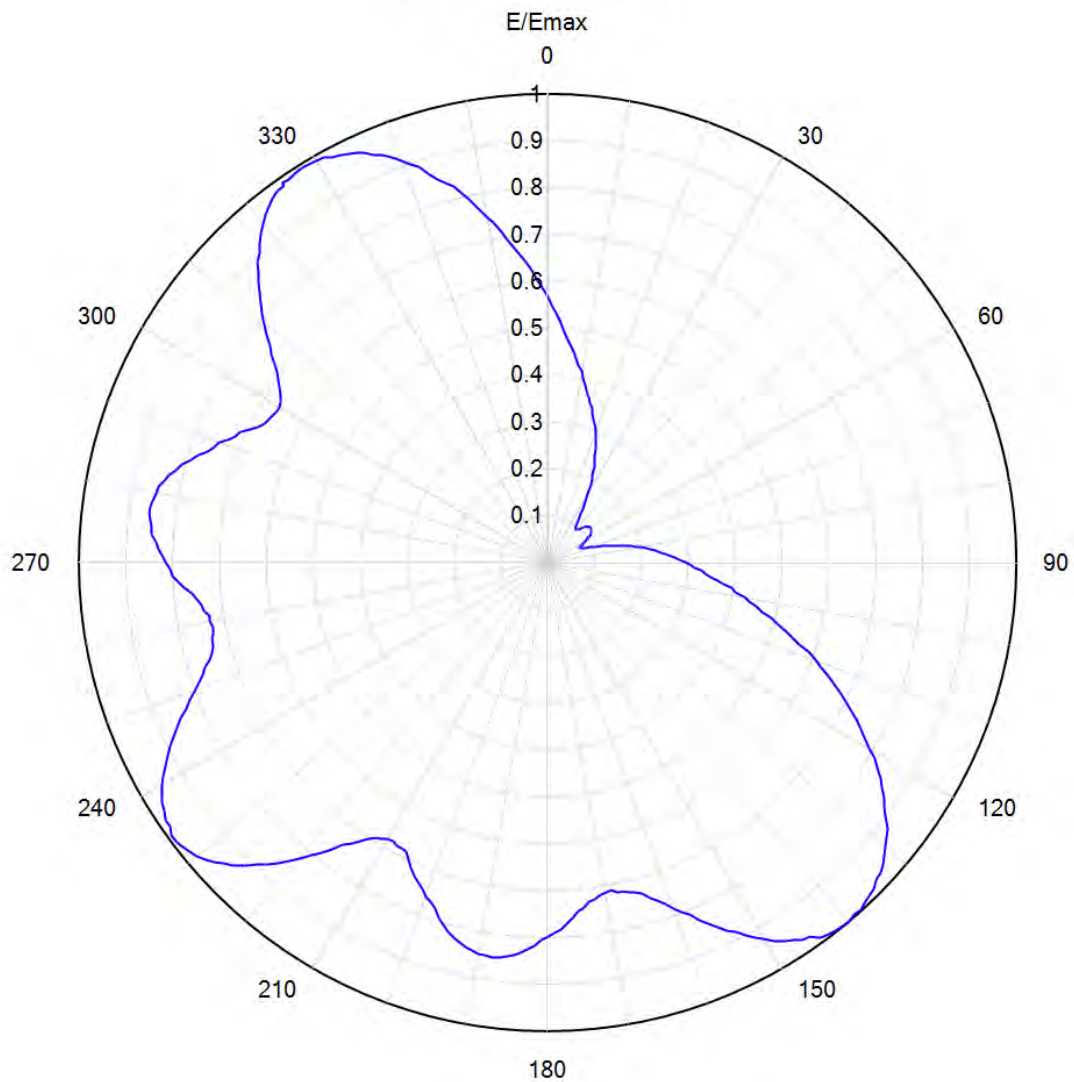




Azimuth Pattern



Model: PEPL24C
Location: Willis Tower - Chicago
Customer: Jeremy Ruck & Associates, Inc
Date: April 18, 2018
Rotation Angle: 145 degrees

Polarisation: Horizontal
Frequency: 503.00 MHz
Directivity: 2.0 (2.95 dB)
Elevation Angle: 0.75 degrees
Horizontal Unit Pattern:
File = az_h_imm_unit_503.pat

Note: Pattern Tolerance +/-5% of E_{max}

Model: **PEPL24C**
 Location: **Willis Tower - Chicago**
 Customer: **Jeremy Ruck & Associates, Inc**
 Date: **April 18, 2018**

Polarisation: **Horizontal**
 Frequency (MHz): **503.00**
 Directivity: **2.0 (2.95 dB)**
 Elevation Angle: **0.75 degrees**
 Rotation Angle: **145 degrees**

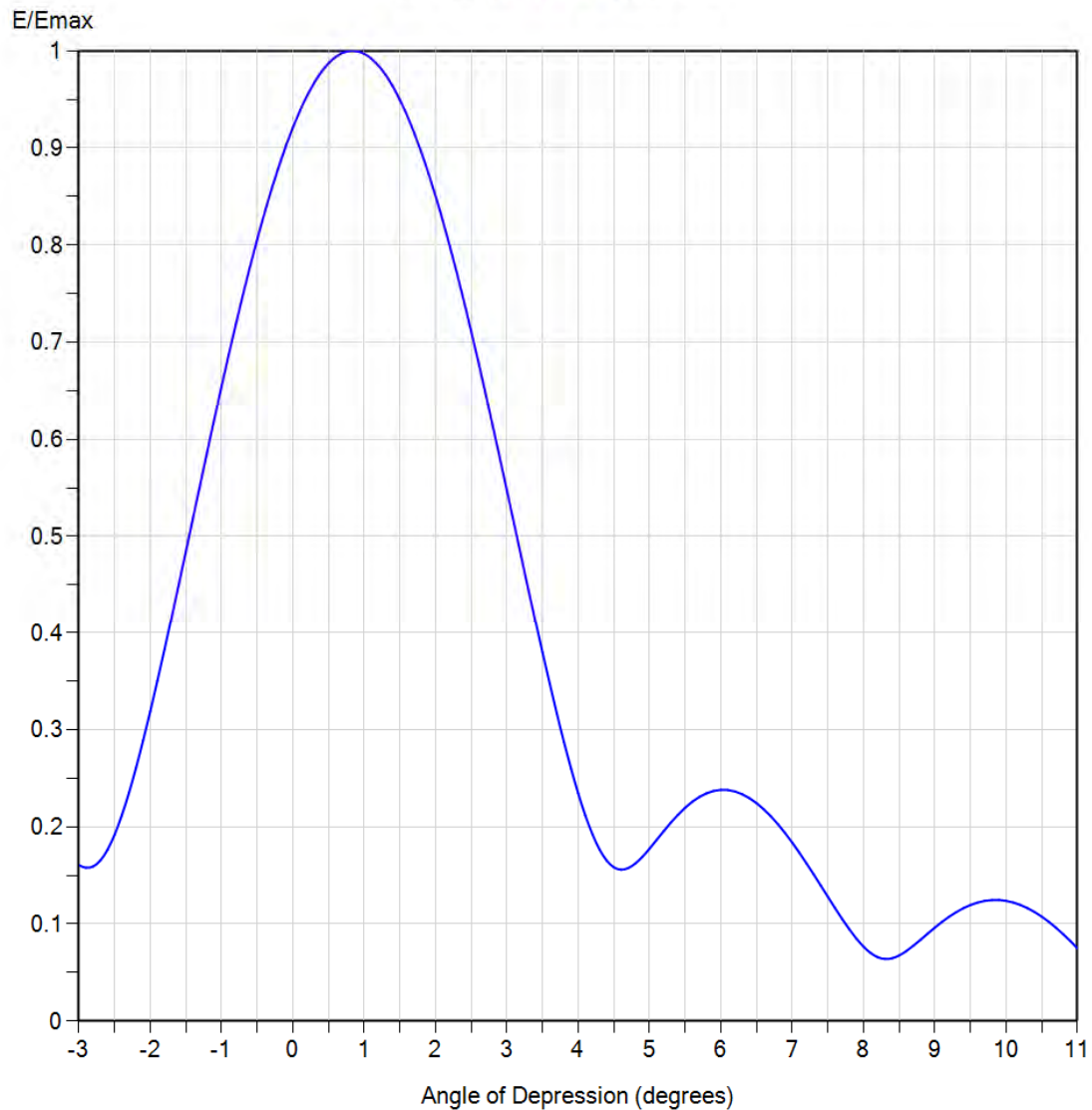


TABULATED AZIMUTH PATTERN

Angl	Field	Angl	Field	Angl	Field	Angl	Field	Angl	Field	Angl	Field	Angl	Field	Angl	Field
0	0.566	45	0.106	90	0.293	135	0.985	180	0.799	225	0.915	270	0.815	315	0.873
1	0.548	46	0.109	91	0.303	136	0.989	181	0.807	226	0.931	271	0.822	316	0.892
2	0.531	47	0.113	92	0.315	137	0.993	182	0.818	227	0.943	272	0.830	317	0.902
3	0.516	48	0.113	93	0.329	138	0.998	183	0.827	228	0.955	273	0.836	318	0.917
4	0.497	49	0.116	94	0.337	139	0.996	184	0.835	229	0.966	274	0.846	319	0.933
5	0.482	50	0.117	95	0.351	140	1.000	185	0.841	230	0.976	275	0.849	320	0.942
6	0.468	51	0.118	96	0.366	141	0.999	186	0.845	231	0.981	276	0.851	321	0.954
7	0.452	52	0.117	97	0.380	142	0.997	187	0.848	232	0.986	277	0.856	322	0.965
8	0.440	53	0.117	98	0.396	143	0.994	188	0.851	233	0.991	278	0.855	323	0.974
9	0.424	54	0.116	99	0.406	144	0.989	189	0.848	234	0.991	279	0.853	324	0.980
10	0.415	55	0.115	100	0.428	145	0.976	190	0.849	235	0.982	280	0.847	325	0.981
11	0.400	56	0.112	101	0.439	146	0.971	191	0.844	236	0.983	281	0.845	326	0.986
12	0.386	57	0.109	102	0.455	147	0.960	192	0.838	237	0.974	282	0.836	327	0.989
13	0.375	58	0.105	103	0.470	148	0.952	193	0.832	238	0.969	283	0.828	328	0.992
14	0.364	59	0.100	104	0.493	149	0.942	194	0.824	239	0.961	284	0.817	329	0.990
15	0.351	60	0.093	105	0.508	150	0.928	195	0.815	240	0.949	285	0.808	330	0.989
16	0.344	61	0.089	106	0.529	151	0.916	196	0.805	241	0.938	286	0.791	331	0.987
17	0.329	62	0.086	107	0.546	152	0.902	197	0.793	242	0.924	287	0.781	332	0.979
18	0.320	63	0.084	108	0.566	153	0.886	198	0.778	243	0.908	288	0.763	333	0.975
19	0.312	64	0.078	109	0.588	154	0.875	199	0.767	244	0.895	289	0.753	334	0.970
20	0.299	65	0.075	110	0.608	155	0.860	200	0.760	245	0.880	290	0.746	335	0.964
21	0.285	66	0.074	111	0.625	156	0.845	201	0.746	246	0.865	291	0.731	336	0.958
22	0.276	67	0.076	112	0.646	157	0.831	202	0.736	247	0.851	292	0.720	337	0.944
23	0.264	68	0.080	113	0.665	158	0.811	203	0.727	248	0.830	293	0.712	338	0.936
24	0.250	69	0.086	114	0.683	159	0.800	204	0.714	249	0.818	294	0.697	339	0.925
25	0.237	70	0.093	115	0.701	160	0.785	205	0.699	250	0.802	295	0.683	340	0.911
26	0.228	71	0.102	116	0.720	161	0.770	206	0.688	251	0.786	296	0.673	341	0.898
27	0.213	72	0.108	117	0.739	162	0.760	207	0.686	252	0.774	297	0.670	342	0.888
28	0.202	73	0.120	118	0.758	163	0.749	208	0.684	253	0.763	298	0.665	343	0.868
29	0.190	74	0.130	119	0.774	164	0.735	209	0.680	254	0.750	299	0.661	344	0.851
30	0.178	75	0.141	120	0.792	165	0.728	210	0.680	255	0.742	300	0.661	345	0.839
31	0.163	76	0.147	121	0.813	166	0.725	211	0.687	256	0.736	301	0.666	346	0.827
32	0.152	77	0.161	122	0.830	167	0.719	212	0.692	257	0.734	302	0.673	347	0.807
33	0.138	78	0.169	123	0.847	168	0.719	213	0.705	258	0.730	303	0.683	348	0.788
34	0.126	79	0.182	124	0.861	169	0.713	214	0.717	259	0.726	304	0.692	349	0.770
35	0.118	80	0.193	125	0.877	170	0.716	215	0.731	260	0.731	305	0.705	350	0.749
36	0.112	81	0.203	126	0.889	171	0.717	216	0.745	261	0.730	306	0.720	351	0.733
37	0.106	82	0.213	127	0.903	172	0.725	217	0.766	262	0.740	307	0.736	352	0.712
38	0.098	83	0.221	128	0.920	173	0.728	218	0.785	263	0.743	308	0.752	353	0.693
39	0.094	84	0.234	129	0.931	174	0.741	219	0.804	264	0.753	309	0.771	354	0.674
40	0.093	85	0.244	130	0.942	175	0.748	220	0.824	265	0.760	310	0.790	355	0.659
41	0.094	86	0.252	131	0.953	176	0.761	221	0.843	266	0.776	311	0.806	356	0.642
42	0.094	87	0.265	132	0.963	177	0.773	222	0.862	267	0.788	312	0.824	357	0.624
43	0.097	88	0.273	133	0.972	178	0.785	223	0.881	268	0.801	313	0.841	358	0.601
44	0.102	89	0.283	134	0.973	179	0.790	224	0.896	269	0.805	314	0.857	359	0.585



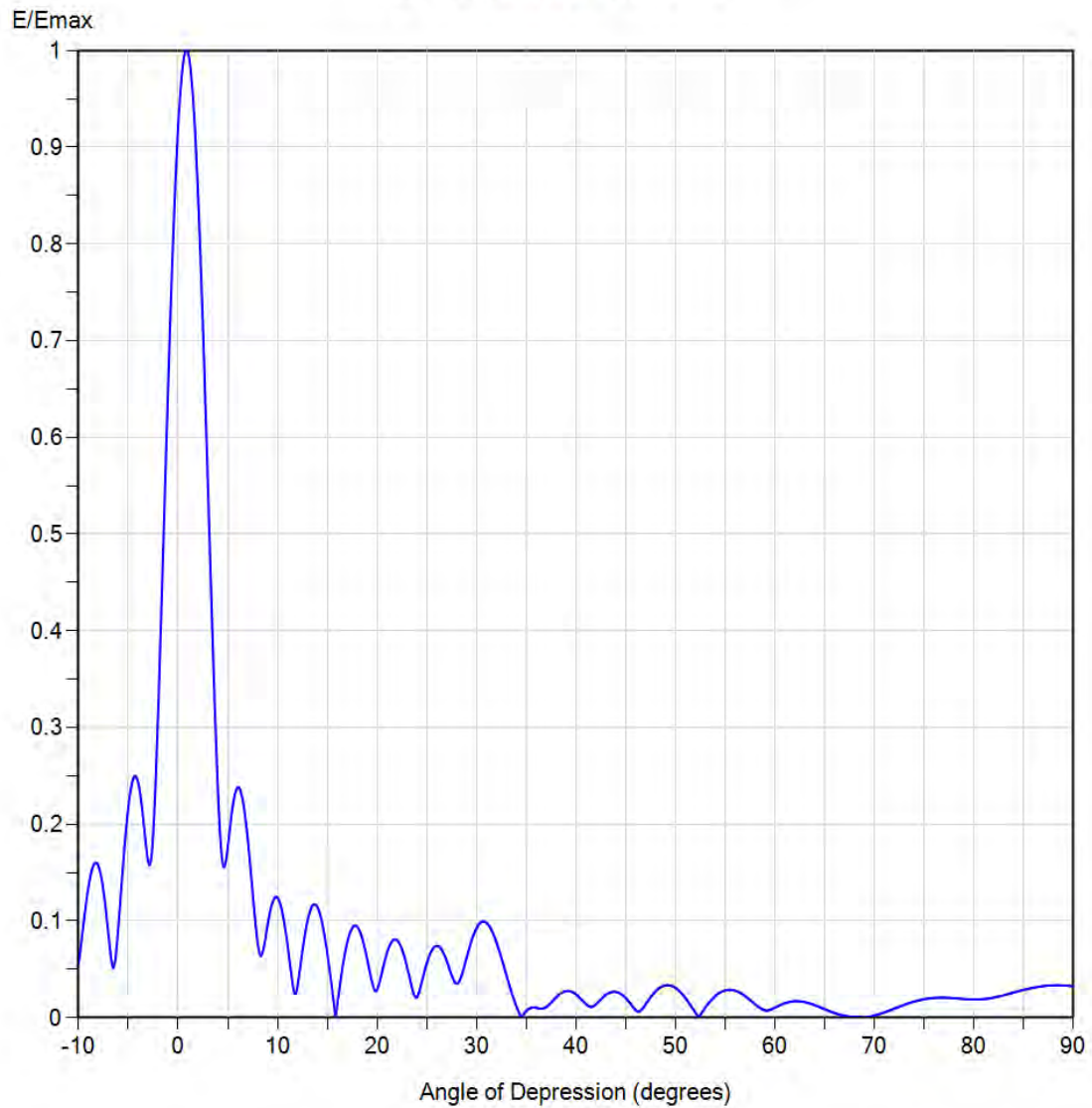
Elevation Pattern



Model:	PEPL24C	Frequency:	503.00 MHz
Polarisation:	<u>Horizontal</u>	Directivity (Main Lobe):	17.1 (12.34 dBd)
Location:	Willis Tower - Chicago	Directivity (At Horizon):	14.5 (11.62 dBd)
Customer:	Jeremy Ruck & Associates, Inc	Beam Tilt:	0.75 degrees
Date:	April 18, 2018	Azimuth Angle:	500 degrees



Elevation Pattern



Model:	PEPL24C	Frequency:	503.00 MHz
Polarisation:	<u>Horizontal</u>	Directivity (Main Lobe):	17.1 (12.34 dBd)
Location:	Willis Tower - Chicago	Directivity (At Horizon):	14.5 (11.62 dBd)
Customer:	Jeremy Ruck & Associates, Inc	Beam Tilt:	0.75 degrees
Date:	April 18, 2018	Azimuth Angle:	500 degrees

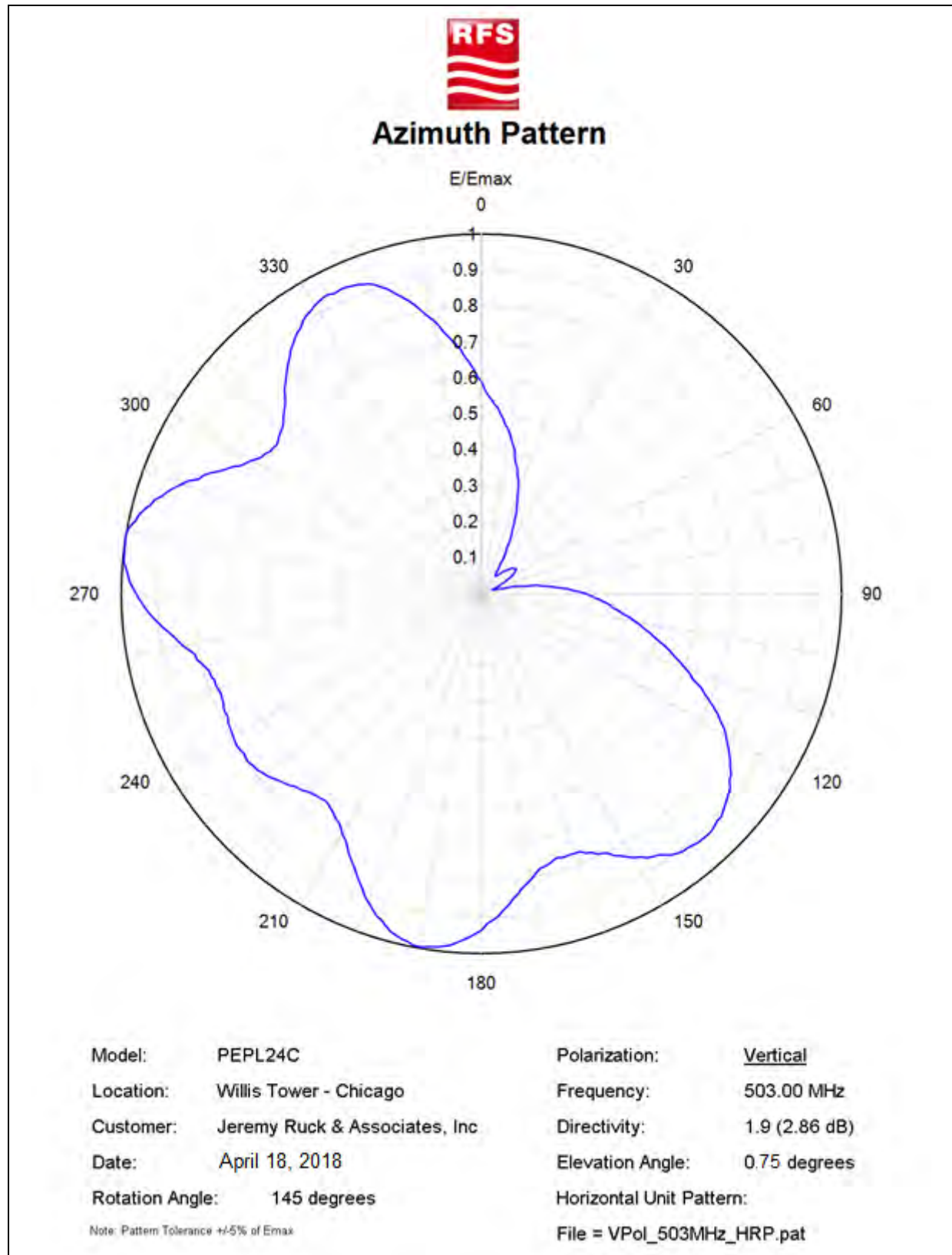
Model: **PEPL24C**
 Location: **Willis Tower - Chicago**
 Customer: **Jeremy Ruck & Associates, Inc**
 Date: **April 18, 2018**

Polarisation: **Horizontal**
 Frequency (MHz): **503.00**
 Directivity (Main Lobe): **17.1 (12.34 dB)**
 Directivity (At Horizon): **14.5 (11.62 dB)**
 Beam Tilt: **0.75 degrees**



TABULATED ELEVATION PATTERN

Angle	Field	Angle	Field	Angle	Field	Angle	Field	Angle	Field	Angle	Field
-10.0	0.056	2.4	0.741	10.6	0.102	30.5	0.099	51.0	0.020	71.5	0.007
-9.5	0.098	2.6	0.680	10.8	0.089	31.0	0.098	51.5	0.013	72.0	0.009
-9.0	0.136	2.8	0.615	11.0	0.075	31.5	0.090	52.0	0.005	72.5	0.011
-8.5	0.158	3.0	0.547	11.5	0.036	32.0	0.078	52.5	0.003	73.0	0.013
-8.0	0.156	3.2	0.479	12.0	0.033	32.5	0.061	53.0	0.010	73.5	0.015
-7.5	0.131	3.4	0.412	12.5	0.069	33.0	0.044	53.5	0.017	74.0	0.017
-7.0	0.085	3.6	0.348	13.0	0.100	33.5	0.027	54.0	0.022	74.5	0.018
-6.5	0.052	3.8	0.287	13.5	0.116	34.0	0.012	54.5	0.026	75.0	0.019
-6.0	0.095	4.0	0.234	14.0	0.114	34.5	0.000	55.0	0.028	75.5	0.020
-5.5	0.163	4.2	0.192	14.5	0.096	35.0	0.007	55.5	0.029	76.0	0.020
-5.0	0.218	4.4	0.165	15.0	0.066	35.5	0.010	56.0	0.028	76.5	0.021
-4.5	0.247	4.6	0.156	15.5	0.027	36.0	0.010	56.5	0.026	77.0	0.021
-4.0	0.242	4.8	0.162	16.0	0.014	36.5	0.009	57.0	0.022	77.5	0.020
-3.5	0.204	5.0	0.177	16.5	0.051	37.0	0.011	57.5	0.018	78.0	0.020
-3.0	0.161	5.2	0.196	17.0	0.078	37.5	0.016	58.0	0.014	78.5	0.020
-2.8	0.159	5.4	0.212	17.5	0.093	38.0	0.021	58.5	0.010	79.0	0.019
-2.6	0.176	5.6	0.226	18.0	0.094	38.5	0.025	59.0	0.008	79.5	0.019
-2.4	0.212	5.8	0.235	18.5	0.082	39.0	0.027	59.5	0.008	80.0	0.019
-2.2	0.261	6.0	0.238	19.0	0.060	39.5	0.027	60.0	0.010	80.5	0.019
-2.0	0.319	6.2	0.236	19.5	0.036	40.0	0.024	60.5	0.013	81.0	0.019
-1.8	0.383	6.4	0.230	20.0	0.029	40.5	0.019	61.0	0.015	81.5	0.020
-1.6	0.450	6.6	0.218	20.5	0.047	41.0	0.014	61.5	0.016	82.0	0.021
-1.4	0.519	6.8	0.203	21.0	0.067	41.5	0.011	62.0	0.017	82.5	0.022
-1.2	0.588	7.0	0.184	21.5	0.079	42.0	0.014	62.5	0.017	83.0	0.023
-1.0	0.655	7.2	0.162	22.0	0.080	42.5	0.019	63.0	0.016	83.5	0.025
-0.8	0.719	7.4	0.140	22.5	0.071	43.0	0.023	63.5	0.015	84.0	0.026
-0.6	0.778	7.6	0.116	23.0	0.053	43.5	0.026	64.0	0.013	84.5	0.027
-0.4	0.832	7.8	0.095	23.5	0.031	44.0	0.027	64.5	0.011	85.0	0.029
-0.2	0.880	8.0	0.077	24.0	0.021	44.5	0.024	65.0	0.009	85.5	0.030
0.0	0.921	8.2	0.066	24.5	0.037	45.0	0.020	65.5	0.007	86.0	0.031
0.2	0.954	8.4	0.065	25.0	0.056	45.5	0.014	66.0	0.005	86.5	0.032
0.4	0.978	8.6	0.072	25.5	0.070	46.0	0.008	66.5	0.003	87.0	0.033
0.6	0.994	8.8	0.084	26.0	0.074	46.5	0.007	67.0	0.002	87.5	0.033
0.8	1.000	9.0	0.096	26.5	0.070	47.0	0.014	67.5	0.001	88.0	0.033
1.0	0.997	9.2	0.107	27.0	0.059	47.5	0.021	68.0	0.001	88.5	0.033
1.2	0.985	9.4	0.116	27.5	0.044	48.0	0.027	68.5	0.001	89.0	0.033
1.4	0.963	9.6	0.122	28.0	0.035	48.5	0.031	69.0	0.000	89.5	0.033
1.6	0.934	9.8	0.125	28.5	0.044	49.0	0.033	69.5	0.001	90.0	0.000
1.8	0.896	10.0	0.124	29.0	0.062	49.5	0.033	70.0	0.002		
2.0	0.850	10.2	0.120	29.5	0.080	50.0	0.031	70.5	0.004		
2.2	0.799	10.4	0.112	30.0	0.093	50.5	0.026	71.0	0.005		



Model: **PEPL24C**
 Location: **Willis Tower - Chicago**
 Customer: **Jeremy Ruck & Associates,**
 Date: **April 18, 2018**

Polarization: **Vertical**
 Frequency (MHz): **503.00**
 Directivity: **1.9 (2.86 dB)**
 Elevation Angle: **0.75 degrees**
 Rotation Angle: **145 degrees**

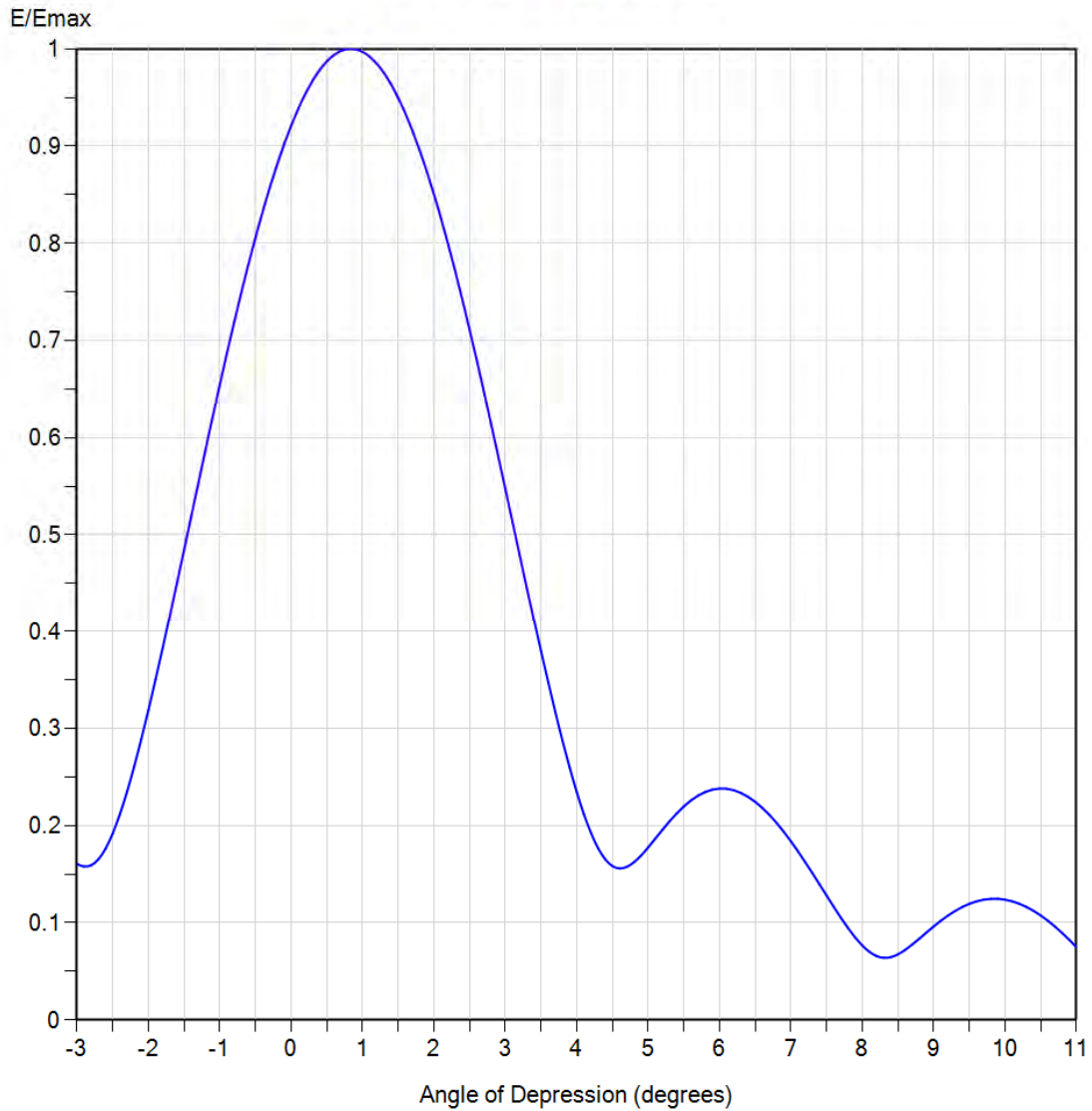


TABULATED AZIMUTH PATTERN

Angl	Field	Angl	Field	Angl	Field	Angl	Field	Angl	Field	Angl	Field	Angl	Field	Angl	Field
0	0.589	45	0.087	90	0.288	135	0.915	180	0.936	225	0.754	270	0.960	315	0.770
1	0.568	46	0.091	91	0.302	136	0.918	181	0.944	226	0.758	271	0.970	316	0.786
2	0.552	47	0.096	92	0.317	137	0.919	182	0.954	227	0.765	272	0.976	317	0.798
3	0.541	48	0.099	93	0.330	138	0.919	183	0.964	228	0.771	273	0.983	318	0.811
4	0.529	49	0.104	94	0.345	139	0.918	184	0.973	229	0.776	274	0.989	319	0.822
5	0.519	50	0.111	95	0.360	140	0.914	185	0.980	230	0.781	275	0.997	320	0.834
6	0.502	51	0.113	96	0.367	141	0.910	186	0.986	231	0.786	276	0.996	321	0.845
7	0.491	52	0.114	97	0.384	142	0.909	187	0.990	232	0.791	277	0.998	322	0.860
8	0.475	53	0.114	98	0.397	143	0.904	188	0.993	233	0.793	278	0.999	323	0.869
9	0.465	54	0.118	99	0.413	144	0.897	189	0.995	234	0.798	279	1.000	324	0.881
10	0.454	55	0.119	100	0.433	145	0.888	190	0.996	235	0.798	280	0.999	325	0.888
11	0.438	56	0.116	101	0.449	146	0.877	191	0.995	236	0.795	281	0.992	326	0.896
12	0.421	57	0.112	102	0.460	147	0.872	192	0.989	237	0.799	282	0.981	327	0.907
13	0.408	58	0.107	103	0.481	148	0.864	193	0.985	238	0.801	283	0.976	328	0.914
14	0.390	59	0.105	104	0.492	149	0.852	194	0.979	239	0.796	284	0.965	329	0.918
15	0.374	60	0.097	105	0.511	150	0.847	195	0.972	240	0.796	285	0.952	330	0.925
16	0.362	61	0.093	106	0.531	151	0.836	196	0.962	241	0.794	286	0.944	331	0.929
17	0.344	62	0.084	107	0.548	152	0.826	197	0.950	242	0.792	287	0.928	332	0.933
18	0.332	63	0.076	108	0.566	153	0.819	198	0.942	243	0.790	288	0.916	333	0.935
19	0.317	64	0.073	109	0.585	154	0.803	199	0.929	244	0.782	289	0.904	334	0.929
20	0.297	65	0.065	110	0.602	155	0.797	200	0.914	245	0.783	290	0.888	335	0.932
21	0.283	66	0.056	111	0.621	156	0.792	201	0.901	246	0.782	291	0.873	336	0.933
22	0.259	67	0.048	112	0.633	157	0.782	202	0.882	247	0.779	292	0.848	337	0.927
23	0.250	68	0.042	113	0.662	158	0.778	203	0.869	248	0.776	293	0.839	338	0.926
24	0.230	69	0.038	114	0.679	159	0.768	204	0.854	249	0.774	294	0.823	339	0.920
25	0.214	70	0.035	115	0.697	160	0.768	205	0.837	250	0.778	295	0.804	340	0.918
26	0.197	71	0.031	116	0.718	161	0.767	206	0.825	251	0.780	296	0.790	341	0.908
27	0.182	72	0.036	117	0.737	162	0.765	207	0.809	252	0.780	297	0.776	342	0.895
28	0.165	73	0.038	118	0.753	163	0.767	208	0.793	253	0.785	298	0.758	343	0.884
29	0.147	74	0.047	119	0.771	164	0.763	209	0.780	254	0.785	299	0.747	344	0.867
30	0.135	75	0.053	120	0.782	165	0.768	210	0.771	255	0.792	300	0.738	345	0.852
31	0.121	76	0.067	121	0.796	166	0.774	211	0.759	256	0.801	301	0.726	346	0.839
32	0.108	77	0.078	122	0.810	167	0.778	212	0.747	257	0.811	302	0.718	347	0.823
33	0.094	78	0.093	123	0.822	168	0.781	213	0.744	258	0.812	303	0.714	348	0.804
34	0.085	79	0.110	124	0.834	169	0.792	214	0.734	259	0.824	304	0.709	349	0.786
35	0.077	80	0.123	125	0.844	170	0.802	215	0.729	260	0.839	305	0.706	350	0.771
36	0.066	81	0.143	126	0.856	171	0.816	216	0.725	261	0.851	306	0.704	351	0.754
37	0.066	82	0.160	127	0.862	172	0.825	217	0.721	262	0.861	307	0.705	352	0.733
38	0.063	83	0.175	128	0.876	173	0.840	218	0.724	263	0.875	308	0.712	353	0.716
39	0.061	84	0.189	129	0.884	174	0.854	219	0.725	264	0.890	309	0.717	354	0.700
40	0.064	85	0.209	130	0.890	175	0.869	220	0.727	265	0.903	310	0.721	355	0.682
41	0.068	86	0.226	131	0.896	176	0.883	221	0.730	266	0.916	311	0.728	356	0.660
42	0.072	87	0.242	132	0.903	177	0.898	222	0.737	267	0.929	312	0.739	357	0.644
43	0.076	88	0.257	133	0.910	178	0.908	223	0.740	268	0.939	313	0.749	358	0.624
44	0.082	89	0.271	134	0.910	179	0.917	224	0.744	269	0.948	314	0.758	359	0.604



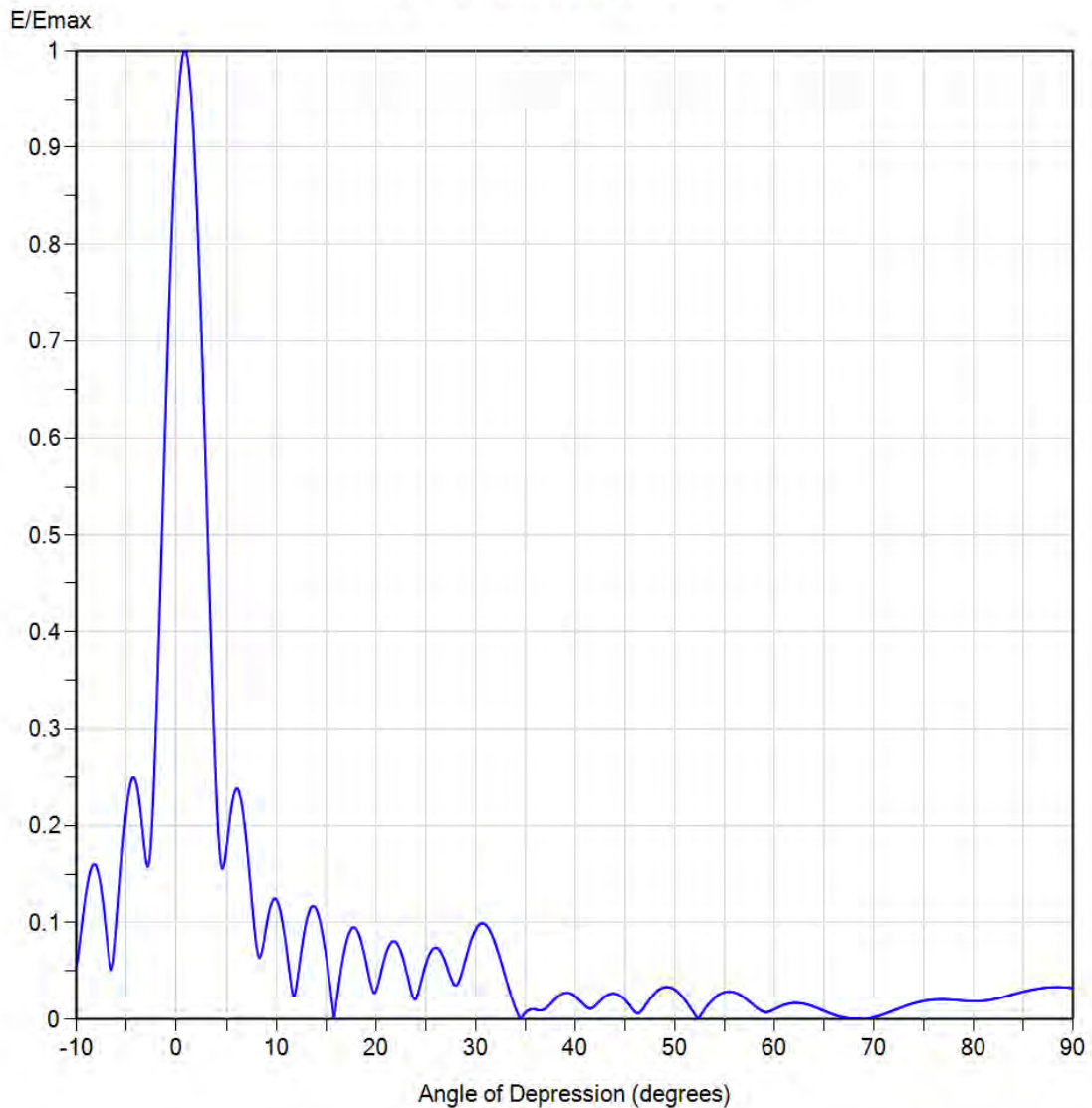
Elevation Pattern



Model:	PEPL24C	Frequency:	503.00 MHz
Polarisation:	<u>Vertical</u>	Directivity (Main Lobe):	17.1 (12.34 dBd)
Location:	Willis Tower - Chicago	Directivity (At Horizon):	14.5 (11.62 dBd)
Customer:	Jeremy Ruck & Associates, Inc	Beam Tilt:	0.75 degrees
Date:	April 18, 2018	Azimuth Angle:	279 degrees



Elevation Pattern



Model:	PEPL24C	Frequency:	503.00 MHz
Polarisation:	<u>Vertical</u>	Directivity (Main Lobe):	17.1 (12.34 dBd)
Location:	Willis Tower - Chicago	Directivity (At Horizon):	14.5 (11.62 dBd)
Customer:	Jeremy Ruck & Associates, Inc	Beam Tilt:	0.75 degrees
Date:	April 18, 2018	Azimuth Angle:	279 degrees

Model: **PEPL24C**
 Location: **Willis Tower - Chicago**
 Customer: **Jeremy Ruck & Associates, Inc**
 Date: **April 18, 2018**

Polarisation: **Vertical**
 Frequency (MHz): **503.00**
 Directivity (Main Lobe): **17.1 (12.34 dB)**
 Directivity (At Horizon): **14.5 (11.62 dB)**
 Beam Tilt: **0.75 degrees**



TABULATED ELEVATION PATTERN

Angle	Field	Angle	Field	Angle	Field	Angle	Field	Angle	Field	Angle	Field
-10.0	0.056	2.4	0.741	10.6	0.102	30.5	0.099	51.0	0.020	71.5	0.007
-9.5	0.098	2.6	0.680	10.8	0.089	31.0	0.098	51.5	0.013	72.0	0.009
-9.0	0.136	2.8	0.615	11.0	0.075	31.5	0.090	52.0	0.005	72.5	0.011
-8.5	0.158	3.0	0.547	11.5	0.036	32.0	0.078	52.5	0.003	73.0	0.013
-8.0	0.156	3.2	0.479	12.0	0.033	32.5	0.061	53.0	0.010	73.5	0.015
-7.5	0.131	3.4	0.412	12.5	0.069	33.0	0.044	53.5	0.017	74.0	0.017
-7.0	0.085	3.6	0.348	13.0	0.100	33.5	0.027	54.0	0.022	74.5	0.018
-6.5	0.052	3.8	0.287	13.5	0.116	34.0	0.012	54.5	0.026	75.0	0.019
-6.0	0.095	4.0	0.234	14.0	0.114	34.5	0.000	55.0	0.028	75.5	0.020
-5.5	0.163	4.2	0.192	14.5	0.096	35.0	0.007	55.5	0.029	76.0	0.020
-5.0	0.218	4.4	0.165	15.0	0.066	35.5	0.010	56.0	0.028	76.5	0.021
-4.5	0.247	4.6	0.156	15.5	0.027	36.0	0.010	56.5	0.026	77.0	0.021
-4.0	0.242	4.8	0.162	16.0	0.014	36.5	0.009	57.0	0.022	77.5	0.020
-3.5	0.204	5.0	0.177	16.5	0.051	37.0	0.011	57.5	0.018	78.0	0.020
-3.0	0.161	5.2	0.196	17.0	0.078	37.5	0.016	58.0	0.014	78.5	0.020
-2.8	0.159	5.4	0.212	17.5	0.093	38.0	0.021	58.5	0.010	79.0	0.019
-2.6	0.176	5.6	0.226	18.0	0.094	38.5	0.025	59.0	0.008	79.5	0.019
-2.4	0.212	5.8	0.235	18.5	0.082	39.0	0.027	59.5	0.008	80.0	0.019
-2.2	0.261	6.0	0.238	19.0	0.060	39.5	0.027	60.0	0.010	80.5	0.019
-2.0	0.319	6.2	0.236	19.5	0.036	40.0	0.024	60.5	0.013	81.0	0.019
-1.8	0.383	6.4	0.230	20.0	0.029	40.5	0.019	61.0	0.015	81.5	0.020
-1.6	0.450	6.6	0.218	20.5	0.047	41.0	0.014	61.5	0.016	82.0	0.021
-1.4	0.519	6.8	0.203	21.0	0.067	41.5	0.011	62.0	0.017	82.5	0.022
-1.2	0.588	7.0	0.184	21.5	0.079	42.0	0.014	62.5	0.017	83.0	0.023
-1.0	0.655	7.2	0.162	22.0	0.080	42.5	0.019	63.0	0.016	83.5	0.025
-0.8	0.719	7.4	0.140	22.5	0.071	43.0	0.023	63.5	0.015	84.0	0.026
-0.6	0.778	7.6	0.116	23.0	0.053	43.5	0.026	64.0	0.013	84.5	0.027
-0.4	0.832	7.8	0.095	23.5	0.031	44.0	0.027	64.5	0.011	85.0	0.029
-0.2	0.880	8.0	0.077	24.0	0.021	44.5	0.024	65.0	0.009	85.5	0.030
0.0	0.921	8.2	0.066	24.5	0.037	45.0	0.020	65.5	0.007	86.0	0.031
0.2	0.954	8.4	0.065	25.0	0.056	45.5	0.014	66.0	0.005	86.5	0.032
0.4	0.978	8.6	0.072	25.5	0.070	46.0	0.008	66.5	0.003	87.0	0.033
0.6	0.994	8.8	0.084	26.0	0.074	46.5	0.007	67.0	0.002	87.5	0.033
0.8	1.000	9.0	0.096	26.5	0.070	47.0	0.014	67.5	0.001	88.0	0.033
1.0	0.997	9.2	0.107	27.0	0.059	47.5	0.021	68.0	0.001	88.5	0.033
1.2	0.985	9.4	0.116	27.5	0.044	48.0	0.027	68.5	0.001	89.0	0.033
1.4	0.963	9.6	0.122	28.0	0.035	48.5	0.031	69.0	0.000	89.5	0.033
1.6	0.934	9.8	0.125	28.5	0.044	49.0	0.033	69.5	0.001	90.0	0.000
1.8	0.896	10.0	0.124	29.0	0.062	49.5	0.033	70.0	0.002		
2.0	0.850	10.2	0.120	29.5	0.080	50.0	0.031	70.5	0.004		
2.2	0.799	10.4	0.112	30.0	0.093	50.5	0.026	71.0	0.005		