Directional FM Antenna
WPJC
2820 Communications Inc.
Pontiac, IL

A standard model PSIFMR antenna with parasitic elements was used in conjunction with a model of the customer's 40" triangular angled leg tower to create the necessary directional radiation pattern. The final antenna consists of four radiating elements full wavelength spaced with two horizontal and two vertical parasitic elements per bay. The antenna array is center fed. Each radiating element receives equal power and phase.

Pattern testing was performed using a 1/3-scale model element and tower. The azimuth plane measurements were taken on a ground reflection test range. This type of test range utilizes the reflected signal and direct signal from the source antenna to form an interference pattern on the antenna under test. The antenna and tower under test was mounted to a turntable that allowed the structure to be rotated 360° in the azimuth plane. The source antenna was located approximately 75 ft. from the antenna under test. The source height above ground was adjusted to peak the first lobe of the interference pattern at the antenna under test.

The test antenna was mounted in the center of rotation of the turntable. The antenna and mounting structure were rotated clockwise while data was recorded in a counter clockwise direction. All feed cables to the antenna were secured and grounded during pattern measurements. A Hewlett Packard 8753E-network analyzer operating at 264.9 MHz was used as both the source and receiver. The level of the received signal was compared with a standard dipole to establish the directivity of the final pattern. The final pattern measured does not exceed the envelope pattern and is 86.3% of the envelope RMS.

The antenna is to be mounted 44 meters (144.3 ft.) above ground level per the construction permit. A deviation of +2/-4 meters from the approved center of radiation is allowed. No other antenna can be installed within 10 ft of any radiating element. The antenna is to be mounted to a support mast that mounts to the northeast tower leg. The antenna bay is to be positioned 40° True and certified by a licensed surveyor. It is recommended that a broadcast engineer is present to supervise the installation of the antenna and that he or she certifies the antenna has been installed according to the enclosed instructions.

An input power level of 3.926 kW will be required at the antenna input in order to reach the licensed 20 kW ERP. The transmitter output power requirements are dependent upon the transmission line size and length used to feed the antenna. The final length of transmission line must be determined after installation.

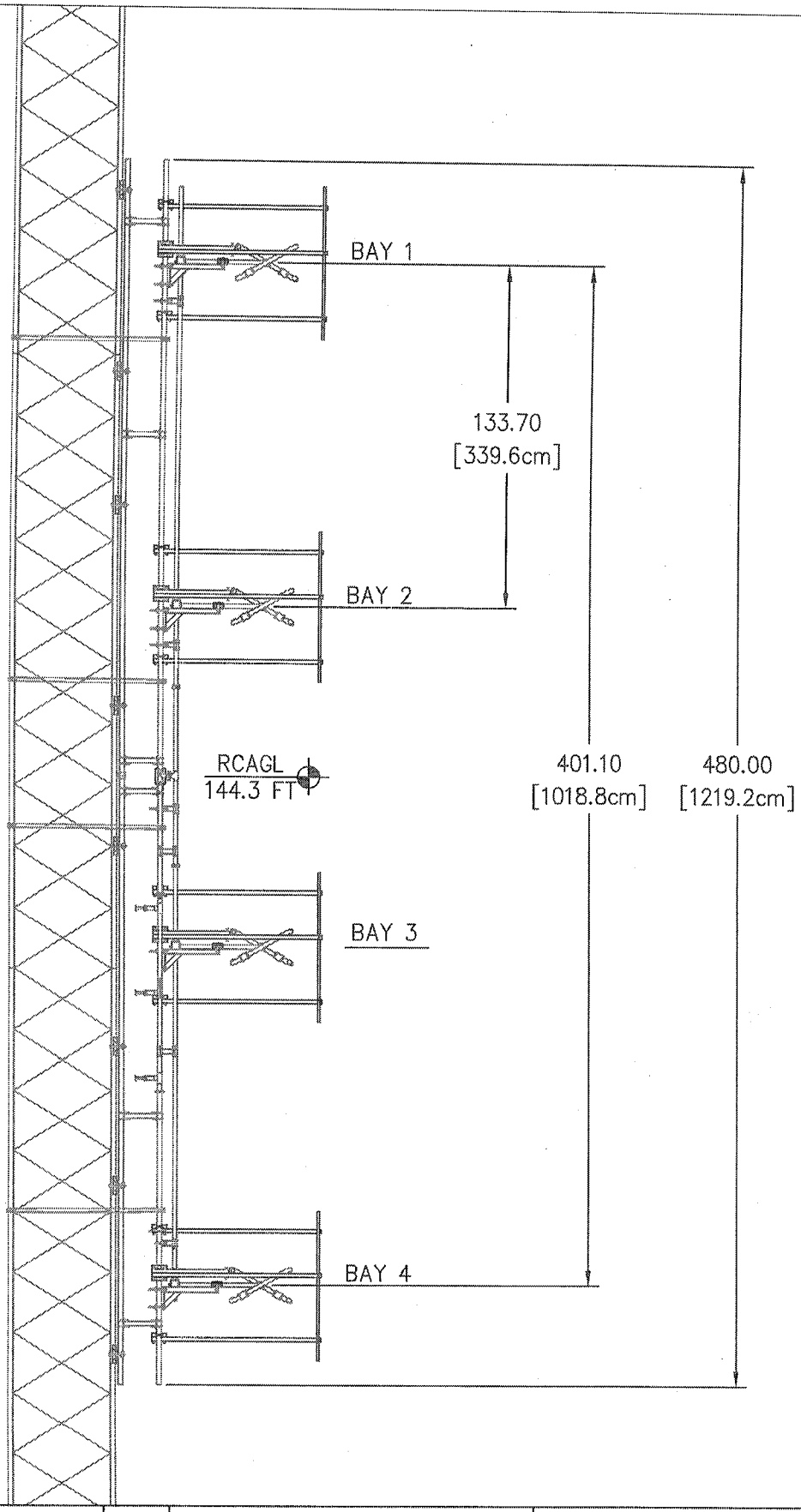
Antenna Specifications

Antenna Model	PSIFMR-4C-DA
Type	4-bay Directional FM antenna
Bay Spacing	Full wavelength spaced elements
Frequency	88.3 MHz
Polarization	Circular
Envelope RMS	.693
Composite RMS	.598
Gain (H-pol)	5.10 (7.08 dB)
Gain (V-pol)	4.77 (6.79 dB)
Input	1-5/8" EIA center fed input
Input power	3.962 kW
Power rating	9 kW
Length	40.0 ft.
Weight	695 lbs.
Wind Area	55.2 sq. ft.

Statement of Certification

This is to certify the antenna has been designed, fabricated and tested under my supervision and it meets the required envelope pattern limitations set forth in the station's construction permit.

Douglas A. Ross
President
Propagation Systems Inc.



SPECIFICATIONS	
SPACING:	λ
BAY SPACING ('S'):	133.7 IN (339.6cm)
APERTURE ('A'):	33.4 FT (10.2 M)
LENGTH ('L'):	40 FT (12.2 M)
RCAGL:	144.3 FT (44 M)
WEIGHT:	695 LB (315.2 Kg)
WIND AREA:	55.2 FT^2 (5.1 M^2)
POWER RATING:	9 kW
GAIN:	5.10 (7.08 dB)
POLARIZATION	CIRCULAR

NOTE: 1. WEIGHT AND WIND AREA ARE ESTIMATED. WIND AREA IN ACCORDANCE WITH TIA/EIA-222-F Σ(CaAc)
2. TIE WRAP COAX. CABLE AT ±16" O.C.

REV.	MADE BY / CHECKED BY	DATE	CHANGE

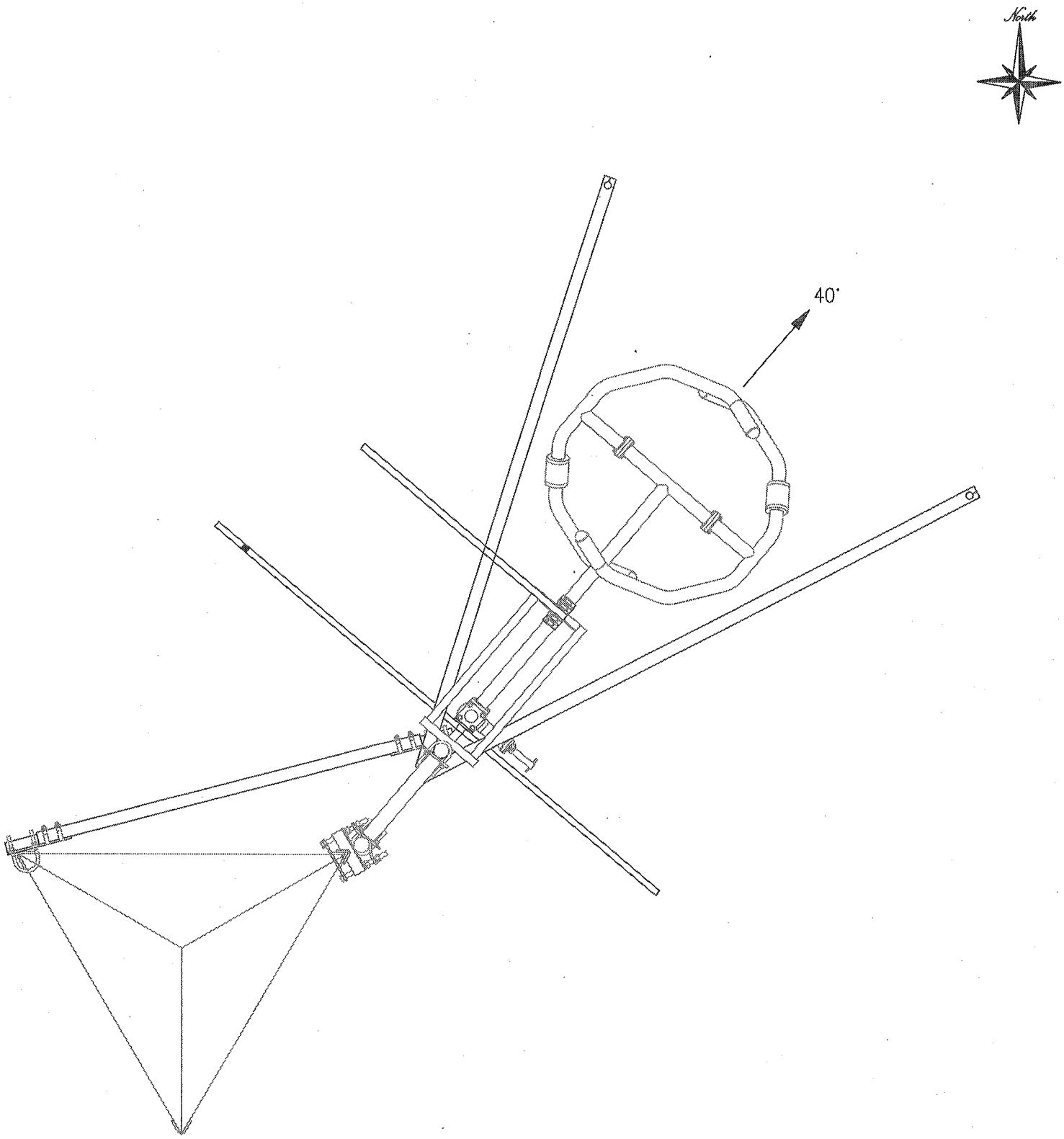
SIZE: A

PROPAGATION SYSTEMS, INC.

Ebensburg, Pennsylvania USA 814-472-5540

ANTENNA ELEVATION AND SPECIFICATIONS

MODEL:	DRAWN BY:	DATE:
PSIFMR-4C-DA	G. LINK	5/18/22
CHANNEL / FREQUENCY: 88.3 MHz	APPROVED BY:	DATE:
SCALE:	DRAWING NO.: 2360-001	REV.



REV.	MADE BY / CHECKED BY	DATE	CHANGE

SIZE: A

PROPAGATION SYSTEMS, INC.

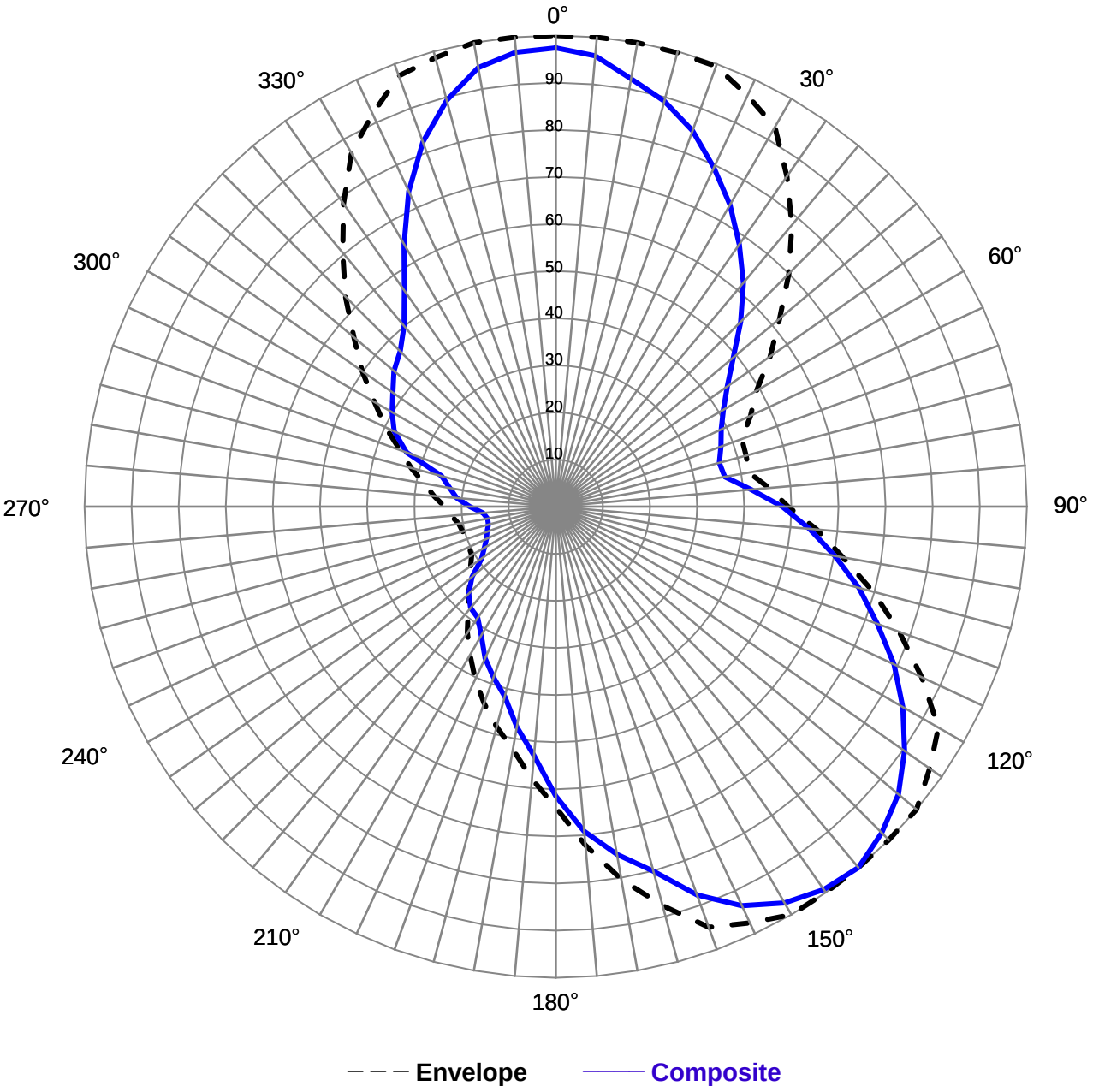
Ebensburg, Pennsylvania USA 814-472-5540

ANTENNA ORIENTATION DETAILS

MODEL:	DRAWN BY:	DATE:
PSIFMR-4C-DA -	G. LINK	5/18/22
CHANNEL/ FREQUENCY: 88.3 MHz	APPROVED BY:	DATE:
SCALE:	DRAWING NO.: 2360-002	REV.

Propagation Systems, Inc.

Relative Field
Azimuth Plane Pattern



Pattern Type:	**Measured Composite**	Tower:	**Triangular 40" Face**
Antenna Model:	**PSIFMR-4C-DA**	Orientation:	**40°**
Polarization:	**Circular**	Frequency:	**88.3 MHz**
RMS (envelope)	**0.693**	Station:	**WPJC**
RMS (composite)	**0.598**	Date:	**3/23/2022**

Maximum Envelope Tabulation

Antenna Model: PSIFMR-4C-DA
2820 Communications, Inc.
Station: WPJC
Frequency: 88.3 MHz
Location: Pontiac, IL
Maximum ERP: 20 kW

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	1.000	20.000	13.01
10	1.000	20.000	13.01
20	0.995	19.801	12.97
30	0.931	17.335	12.39
40	0.780	12.168	10.85
50	0.620	7.688	8.86
60	0.492	4.841	6.85
70	0.420	3.528	5.48
80	0.417	3.478	5.41
90	0.493	4.861	6.87
100	0.619	7.663	8.84
110	0.776	12.044	10.81
120	0.938	17.597	12.45
130	1.000	20.000	13.01
140	1.000	20.000	13.01
150	1.000	20.000	13.01
160	0.950	18.050	12.56
170	0.804	12.928	11.12
180	0.638	8.141	9.11
190	0.523	5.471	7.38
200	0.444	3.943	5.96
210	0.364	2.650	4.23
220	0.289	1.670	2.23
230	0.235	1.105	0.43
240	0.206	0.849	-0.71
250	0.200	0.800	-0.97
260	0.209	0.874	-0.59
270	0.236	1.114	0.47
280	0.283	1.602	2.05
290	0.352	2.478	3.94
300	0.444	3.943	5.96
310	0.559	6.250	7.96
320	0.703	9.884	9.95
330	0.867	15.034	11.77
340	0.973	18.935	12.77
350	1.000	20.000	13.01

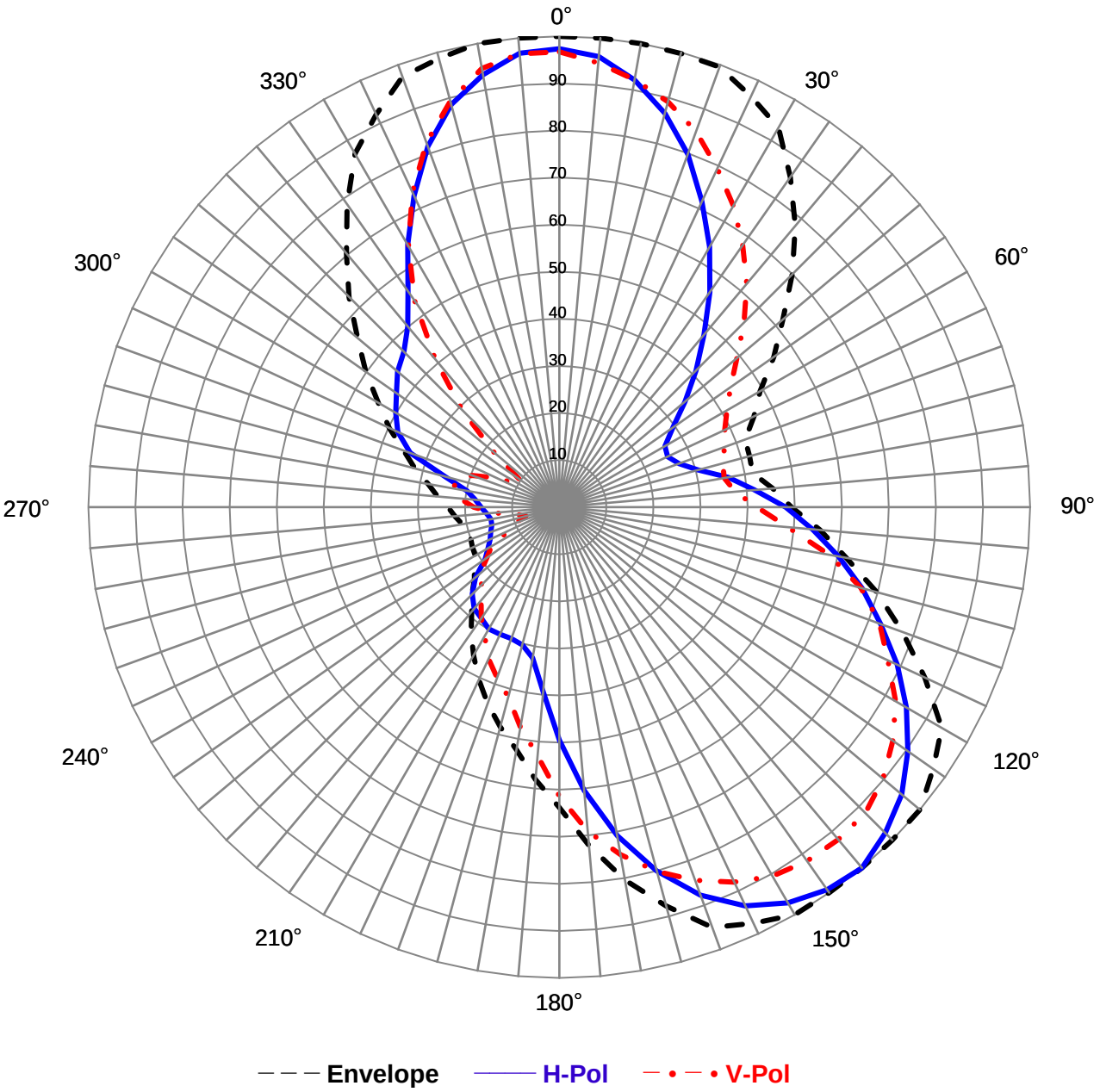
Composite Pattern Tabulation

Antenna Model: PSIFMR-4C-DA
2820 Communications, Inc.
Station: WPJC
Frequency: 88.3 MHz
Location: Pontiac, IL
Maximum ERP: 20 kW

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.974	18.964	12.78
10	0.922	16.995	12.30
20	0.849	14.425	11.59
30	0.740	10.945	10.39
40	0.620	7.679	8.85
50	0.492	4.842	6.85
60	0.411	3.384	5.29
70	0.373	2.787	4.45
80	0.365	2.657	4.24
90	0.481	4.623	6.65
100	0.602	7.237	8.60
110	0.727	10.557	10.24
120	0.851	14.482	11.61
130	0.950	18.031	12.56
140	1.000	20.000	13.01
150	0.971	18.855	12.75
160	0.877	15.383	11.87
170	0.749	11.233	10.51
180	0.614	7.543	8.78
190	0.475	4.510	6.54
200	0.386	2.978	4.74
210	0.316	2.000	3.01
220	0.281	1.579	1.98
230	0.232	1.076	0.32
240	0.175	0.613	-2.13
250	0.155	0.481	-3.18
260	0.147	0.432	-3.64
270	0.182	0.663	-1.79
280	0.228	1.044	0.19
290	0.337	2.271	3.56
300	0.401	3.216	5.07
310	0.448	4.014	6.04
320	0.500	5.005	6.99
330	0.644	8.293	9.19
340	0.824	13.590	11.33
350	0.946	17.911	12.53

Propagation Systems, Inc.

Relative Field
Azimuth Plane Pattern



Pattern Type:	**Measured Field**	Tower:	**Triangular 40" Face**
Antenna Model:	**PSIFMR-4C-DA**	Orientation:	**40°**
Polarization:	**Circular**	Configuration:	**88.3 MHz**
Gain (H-pol):	**5.10 (7.08 dB)**	Station:	**WPJC**
Gain (V-pol):	**4.77 (6.79 dB)**	Date:	**3/23/2022**

Measured Relative Field Tabulation

Antenna Model: PSIFMR-4C-DA

2820 Communications, Inc.

Station: WPJC

Frequency: 88.3 MHz

Location: Pontiac, IL

Horizontal Polarization

Angle	Relative Field	Power Gain	Gain (dB)
0	0.974	4.836	6.84
10	0.921	4.329	6.36
20	0.798	3.245	5.11
30	0.639	2.082	3.18
40	0.479	1.169	0.68
50	0.349	0.620	-2.08
60	0.259	0.343	-4.65
70	0.270	0.373	-4.29
80	0.365	0.678	-1.69
90	0.481	1.179	0.71
100	0.602	1.845	2.66
110	0.727	2.692	4.30
120	0.851	3.693	5.67
130	0.950	4.598	6.63
140	1.000	5.100	7.08
150	0.971	4.808	6.82
160	0.877	3.923	5.94
170	0.709	2.561	4.08
180	0.494	1.247	0.96
190	0.325	0.538	-2.69
200	0.297	0.450	-3.47
210	0.299	0.456	-3.41
220	0.281	0.403	-3.95
230	0.232	0.275	-5.61
240	0.175	0.156	-8.06
250	0.155	0.123	-9.12
260	0.147	0.110	-9.58
270	0.166	0.141	-8.52
280	0.199	0.202	-6.95
290	0.337	0.579	-2.37
300	0.401	0.820	-0.86
310	0.448	1.024	0.10
320	0.500	1.276	1.06
330	0.644	2.115	3.25
340	0.816	3.392	5.30
350	0.932	4.434	6.47

Maximum Value

Field	1.000
Gain	5.10 (7.08 dB)
Azimuth Bearing	140 degrees

Minimum Field

Field	0.147
Gain	.110 (-9.58 dB)
Azimuth Bearing	260 degrees

Vertical Polarization

Angle	Relative Field	Power Gain	Gain (dB)
0	0.967	4.770	6.79
10	0.922	4.334	6.37
20	0.849	3.678	5.66
30	0.740	2.791	4.46
40	0.620	1.958	2.92
50	0.492	1.235	0.92
60	0.411	0.863	-0.64
70	0.373	0.711	-1.48
80	0.356	0.646	-1.90
90	0.420	0.899	-0.46
100	0.582	1.729	2.38
110	0.724	2.676	4.28
120	0.825	3.471	5.40
130	0.898	4.108	6.14
140	0.922	4.334	6.37
150	0.905	4.180	6.21
160	0.844	3.629	5.60
170	0.749	2.865	4.57
180	0.614	1.924	2.84
190	0.475	1.150	0.61
200	0.386	0.759	-1.20
210	0.316	0.510	-2.92
220	0.258	0.340	-4.68
230	0.220	0.246	-6.09
240	0.166	0.141	-8.50
250	0.101	0.052	-12.80
260	0.090	0.041	-13.89
270	0.182	0.169	-7.72
280	0.228	0.266	-5.75
290	0.197	0.198	-7.03
300	0.095	0.046	-13.37
310	0.181	0.167	-7.78
320	0.410	0.856	-0.67
330	0.640	2.092	3.21
340	0.824	3.465	5.40
350	0.946	4.567	6.60

Maximum Value

Field	0.967
Gain	4.77 (6.79 dB)
Azimuth Bearing	0 degrees

Minimum Field

Field	0.073
Gain	.027 (-15.66 dB)
Azimuth Bearing	255 degrees

ERP Tabulation

Antenna Model: PSIFMR-4C-DA
2820 Communications, Inc.
Station: WPJC
Frequency: 88.3 MHz
Location: Pontiac, IL
Maximum ERP: 20 kW

Horizontal Polarization

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.974	18.96	12.78
10	0.921	16.98	12.30
20	0.798	12.73	11.05
30	0.639	8.16	9.12
40	0.479	4.58	6.61
50	0.349	2.43	3.86
60	0.259	1.35	1.29
70	0.270	1.46	1.65
80	0.365	2.66	4.24
90	0.481	4.62	6.65
100	0.602	7.24	8.60
110	0.727	10.56	10.24
120	0.851	14.48	11.61
130	0.950	18.03	12.56
140	1.000	20.00	13.01
150	0.971	18.86	12.75
160	0.877	15.38	11.87
170	0.709	10.04	10.02
180	0.494	4.89	6.89
190	0.325	2.11	3.25
200	0.297	1.76	2.47
210	0.299	1.79	2.52
220	0.281	1.58	1.98
230	0.232	1.08	0.32
240	0.175	0.61	-2.13
250	0.155	0.48	-3.18
260	0.147	0.43	-3.64
270	0.166	0.55	-2.59
280	0.199	0.79	-1.01
290	0.337	2.27	3.56
300	0.401	3.22	5.07
310	0.448	4.01	6.04
320	0.500	5.01	6.99
330	0.644	8.29	9.19
340	0.816	13.30	11.24
350	0.932	17.39	12.40

Maximum Value (H-pol)

Field 1.000
ERP 20 kW (13.01 dB)
Azimuth Bearing 140 degrees

Minimum Field (H-pol)

Field 0.147
ERP .43 kW (-3.64 dBk)
Azimuth Bearing 260 degrees

Vertical Polarization

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.967	18.71	12.72
10	0.922	16.99	12.30
20	0.849	14.42	11.59
30	0.740	10.94	10.39
40	0.620	7.68	8.85
50	0.492	4.84	6.85
60	0.411	3.38	5.29
70	0.373	2.79	4.45
80	0.356	2.53	4.04
90	0.420	3.52	5.47
100	0.582	6.78	8.31
110	0.724	10.49	10.21
120	0.825	13.61	11.34
130	0.898	16.11	12.07
140	0.922	16.99	12.30
150	0.905	16.39	12.15
160	0.844	14.23	11.53
170	0.749	11.23	10.51
180	0.614	7.54	8.78
190	0.475	4.51	6.54
200	0.386	2.98	4.74
210	0.316	2.00	3.01
220	0.258	1.33	1.25
230	0.220	0.96	-0.16
240	0.166	0.55	-2.57
250	0.101	0.21	-6.87
260	0.090	0.16	-7.95
270	0.182	0.66	-1.79
280	0.228	1.04	0.19
290	0.197	0.78	-1.09
300	0.095	0.18	-7.43
310	0.181	0.65	-1.84
320	0.410	3.36	5.26
330	0.640	8.20	9.14
340	0.824	13.59	11.33
350	0.946	17.91	12.53

Maximum Value (V-pol)

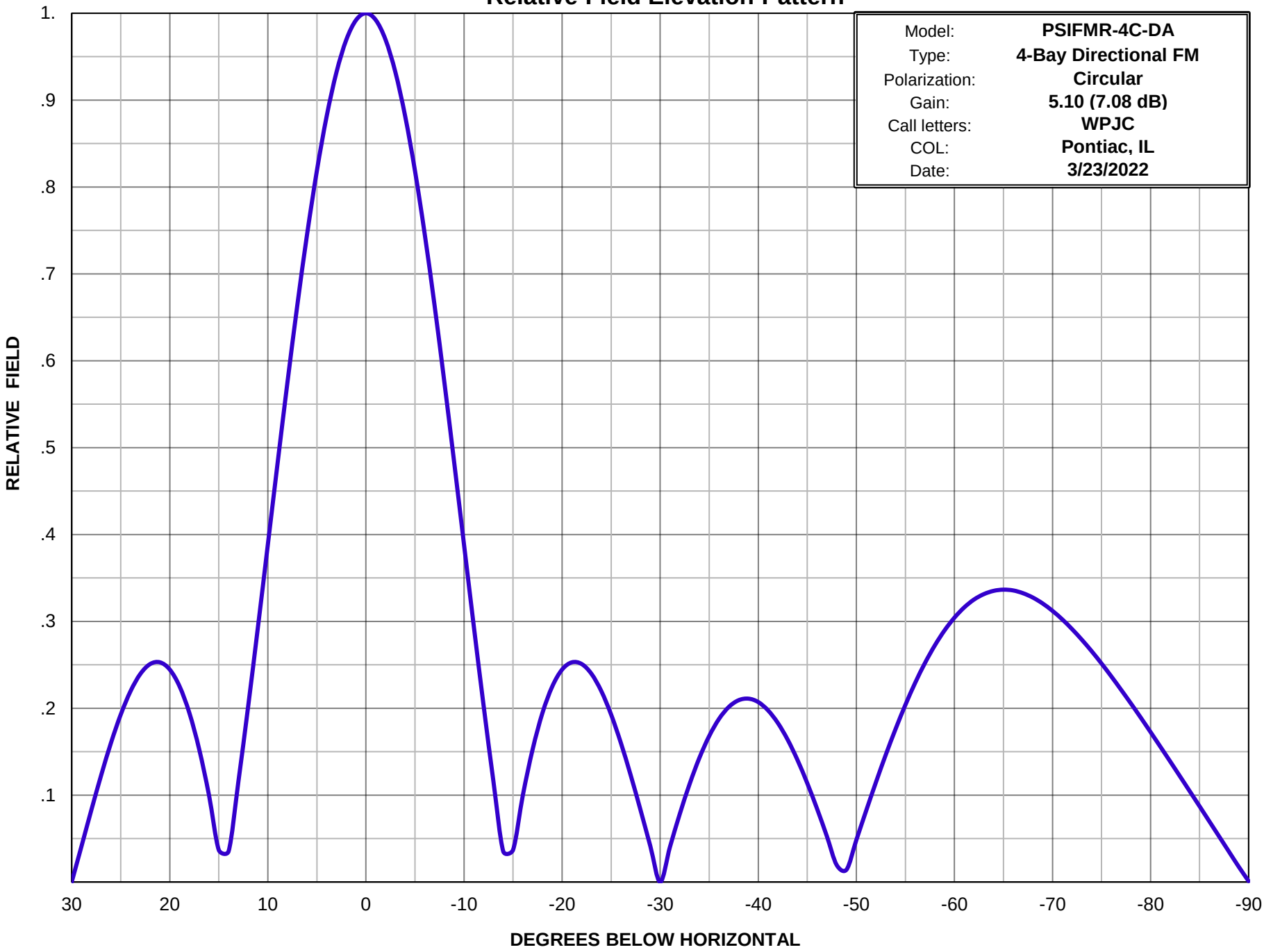
Field 0.967
ERP 18.7 kW (12.72 dBk)
Azimuth Bearing 0 degrees

Minimum Field (V-pol)

Field 0.073
ERP .107 kW (-9.72 dBk)
Azimuth Bearing 255 degrees

Propagation Systems, Inc.

Relative Field Elevation Pattern



Propagation Systems Inc.

Relative Field Tabulation Elevation Pattern

Antenna Model: PSIFMR-4C-DA

Gain 5.10 (7.08 dB)

Station: WPJC

Angle	Field	dB	Angle	Field	dB	Angle	Field	dB
-90	0.001	-60.00	-50	0.048	-26.32	-10	0.388	-8.22
-89	0.017	-35.18	-49	0.014	-36.93	-9	0.483	-6.33
-88	0.035	-29.16	-48	0.020	-34.18	-8	0.575	-4.80
-87	0.052	-25.63	-47	0.053	-25.58	-7	0.663	-3.56
-86	0.070	-23.14	-46	0.084	-21.49	-6	0.745	-2.55
-85	0.087	-21.20	-45	0.114	-18.89	-5	0.819	-1.74
-84	0.104	-19.63	-44	0.140	-17.05	-4	0.882	-1.10
-83	0.122	-18.30	-43	0.164	-15.71	-3	0.932	-0.61
-82	0.139	-17.15	-42	0.183	-14.75	-2	0.970	-0.27
-81	0.156	-16.15	-41	0.198	-14.09	-1	0.992	-0.07
-80	0.173	-15.26	-40	0.207	-13.68	0	1.000	0.00
-79	0.189	-14.46	-39	0.211	-13.51	1	0.992	-0.07
-78	0.205	-13.75	-38	0.209	-13.59	2	0.970	-0.27
-77	0.221	-13.10	-37	0.202	-13.91	3	0.932	-0.61
-76	0.237	-12.52	-36	0.188	-14.53	4	0.882	-1.09
-75	0.252	-11.99	-35	0.168	-15.49	5	0.819	-1.74
-74	0.266	-11.52	-34	0.143	-16.90	6	0.745	-2.55
-73	0.279	-11.09	-33	0.113	-18.96	7	0.664	-3.56
-72	0.291	-10.72	-32	0.078	-22.12	8	0.575	-4.80
-71	0.302	-10.39	-31	0.040	-27.86	9	0.483	-6.32
-70	0.312	-10.11	-30	0.001	-60.00	10	0.388	-8.21
-69	0.321	-9.88	-29	0.041	-27.70	11	0.294	-10.62
-68	0.327	-9.70	-28	0.083	-21.65	12	0.203	-13.86
-67	0.332	-9.57	-27	0.123	-18.22	13	0.116	-18.72
-66	0.336	-9.48	-26	0.160	-15.93	14	0.035	-29.01
-65	0.337	-9.46	-25	0.193	-14.30	15	0.037	-28.68
-64	0.335	-9.50	-24	0.220	-13.16	16	0.100	-20.01
-63	0.331	-9.59	-23	0.240	-12.41	17	0.153	-16.32
-62	0.325	-9.76	-22	0.251	-12.01	18	0.195	-14.22
-61	0.316	-10.00	-21	0.253	-11.94	19	0.225	-12.95
-60	0.304	-10.34	-20	0.245	-12.23	20	0.245	-12.23
-59	0.290	-10.76	-19	0.225	-12.95	21	0.253	-11.94
-58	0.272	-11.30	-18	0.195	-14.21	22	0.251	-12.01
-57	0.252	-11.97	-17	0.153	-16.31	23	0.240	-12.41
-56	0.229	-12.79	-16	0.100	-20.00	24	0.220	-13.16
-55	0.204	-13.82	-15	0.037	-28.64	25	0.193	-14.30
-54	0.176	-15.09	-14	0.035	-29.04	26	0.160	-15.92
-53	0.146	-16.69	-13	0.116	-18.73	27	0.123	-18.22
-52	0.115	-18.80	-12	0.203	-13.86	28	0.083	-21.65
-51	0.082	-21.73	-11	0.294	-10.63	29	0.041	-27.70