



# Propagation Systems, Inc.

Quality Broadcast Antenna Systems

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## **Directional FM Antenna**

**WELH**

**The Wheeler School**

**Providence, RI**

A custom designed PSIFMDP antenna with custom mounting brackets and feed network was used in conjunction with the customer's 3 ft. face triangular tower to create the necessary directional radiation pattern. The final antenna consists of two panels secured to the tower with custom-mounting brackets. The antenna panels are fed from a power divider network that provides the necessary power and phase to each panel to produce the desired directional radiation pattern.

Pattern testing was performed using a 1/3 scale model antenna 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 8753A-network analyzer operating at 264.3 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 86.6% of the envelope RMS.

The antenna is to be mounted according to the enclosed drawings at the 39.6-meter (129.9 ft.) level above ground. At this elevation the antenna will be within the +2m/-4m deviation allowed from the 39.6-meter elevation specified in the construction permit. No other antenna can be installed within 10 ft of any radiating element. The antenna panels are to be positioned at 65° and 280°. Each element, cable, bracket and panel is identified for correct assembly. The tower has been erected with a leg positioned 6° west of true north. It is recommended that a broadcast engineer be present to supervise the installation of the antenna and that he or she certifies that the antenna has been installed according to the enclosed drawings.


An input power level of 2.68 kW will be necessary at the antenna input in order to reach the required 4 kW ERP. The transmitter output power requirements are dependent upon the transmission line size and length used to feed the antenna. For example, the length of 7/8" foam dielectric transmission line feeding the antenna is estimated to be 145 ft. The efficiency for this length of line is 88.7% with a resulting transmitter output power of 3.03 kW. The final length of transmission line must be determined after installation.

### **Antenna Specifications**

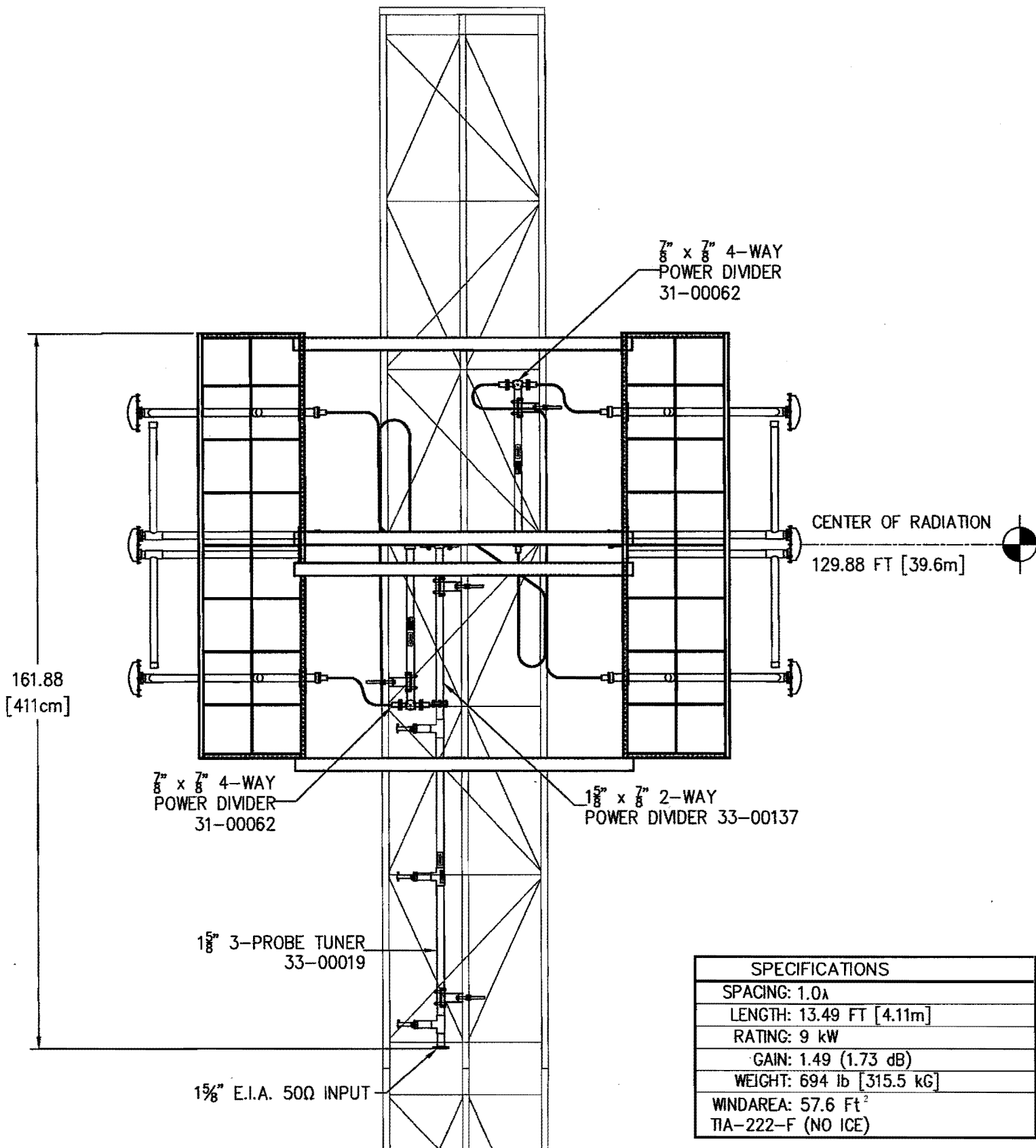
Antenna Model	PSIFMDP-1-DA Custom
Type	1-bay directional FM panel antenna
Frequency	88.1 MHz
Polarization	Circular
Envelope RMS	.681
Composite RMS	.590
Gain (h-pol)	1.49 (1.73 dB)
Gain (v-pol)	1.48 (1.71 dB)
ERP	4 kW
Antenna input power	2.68 kW
Input	7/8" EIA center fed input
Power rating	9 kW
Length	13.49 ft.
Weight	694 lbs.
Wind Area	57.6 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 stations construction permit.

 9/20/10

Douglas A. Ross  
President  
Propagation Systems Inc.



REV.	MADE BY CHECKED BY	DATE	CHANGE	SIZE
				A

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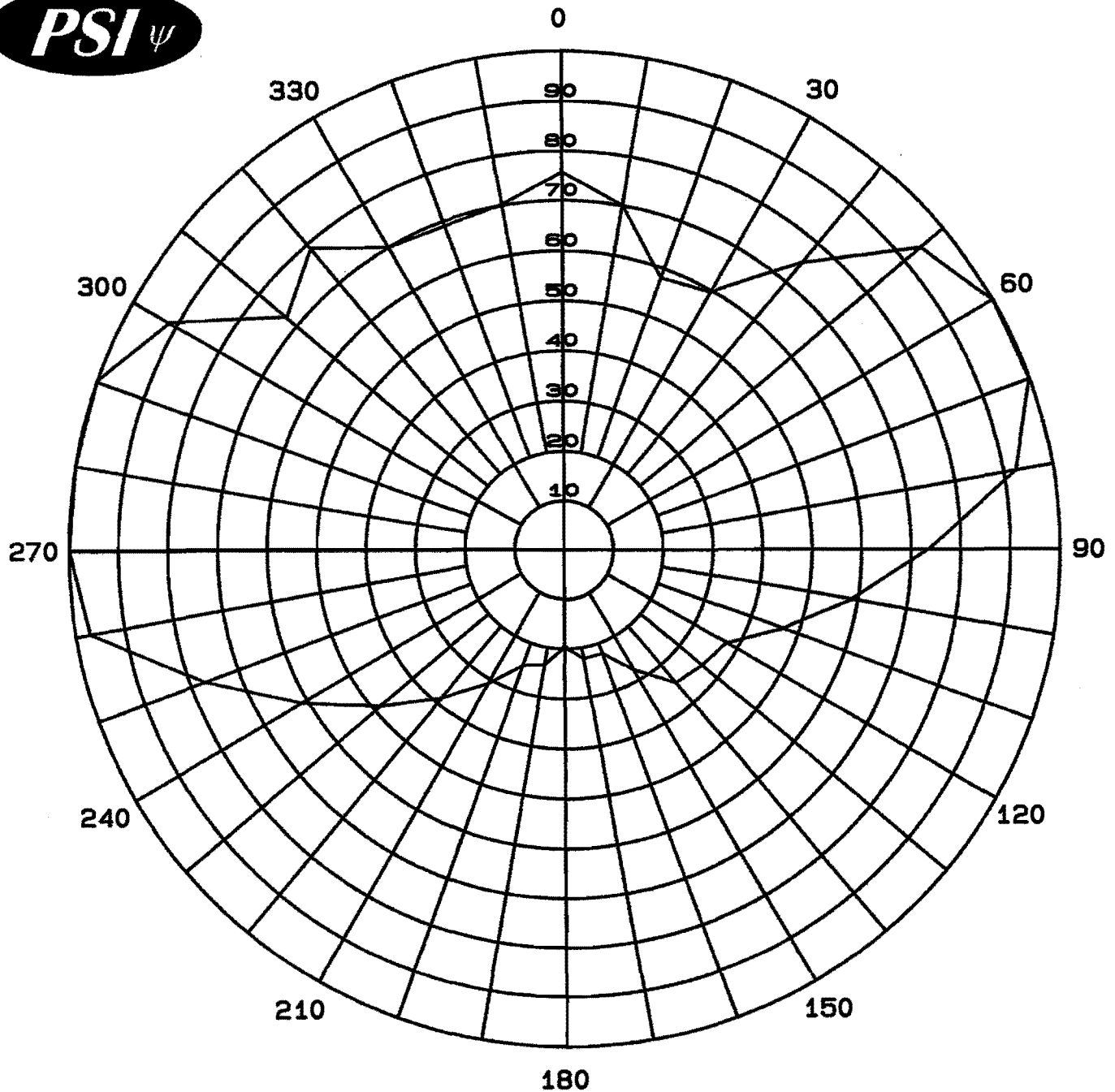
Ebensburg, Pennsylvania USA 814-472-5540

## **ANTENNA ELEVATIONS AND SPECIFICATIONS**

MODEL: PSIFMDP-1-DA CUSTOM	DRAWN BY: D.G. Kellar	DATE: 8/09/10
CHANNEL/ FREQUENCY: 88.1 MHz	APPROVED BY:	DATE:
SCALE: 1:30	DRAWING NO.: J610FM-880-001	REV.



10/20/2016 10:10:10 AM - 10/20/2016 10:10:10 AM - 10/20/2016 10:10:10 AM - 10/20/2016 10:10:10 AM - 10/20/2016 10:10:10 AM



Maximum Envelope  
Azimuth Plane Pattern  
Antenna: PSIFMDP-1-DA Custom  
Type: 1-Bay Directional FM Antenna  
ERP: 4.0 kW (6.02 dBk)  
RMS Envelope: .681  
Frequency: 88.1 MHz  
WELH Providence, RI

**Propagation Systems Inc.**  
**PO Box 113**  
**Ebensburg, PA 15931**

### Envelope Pattern

Antenna: PSIFMDP-1-DA Custom

The Wheeler School

Station: WELH

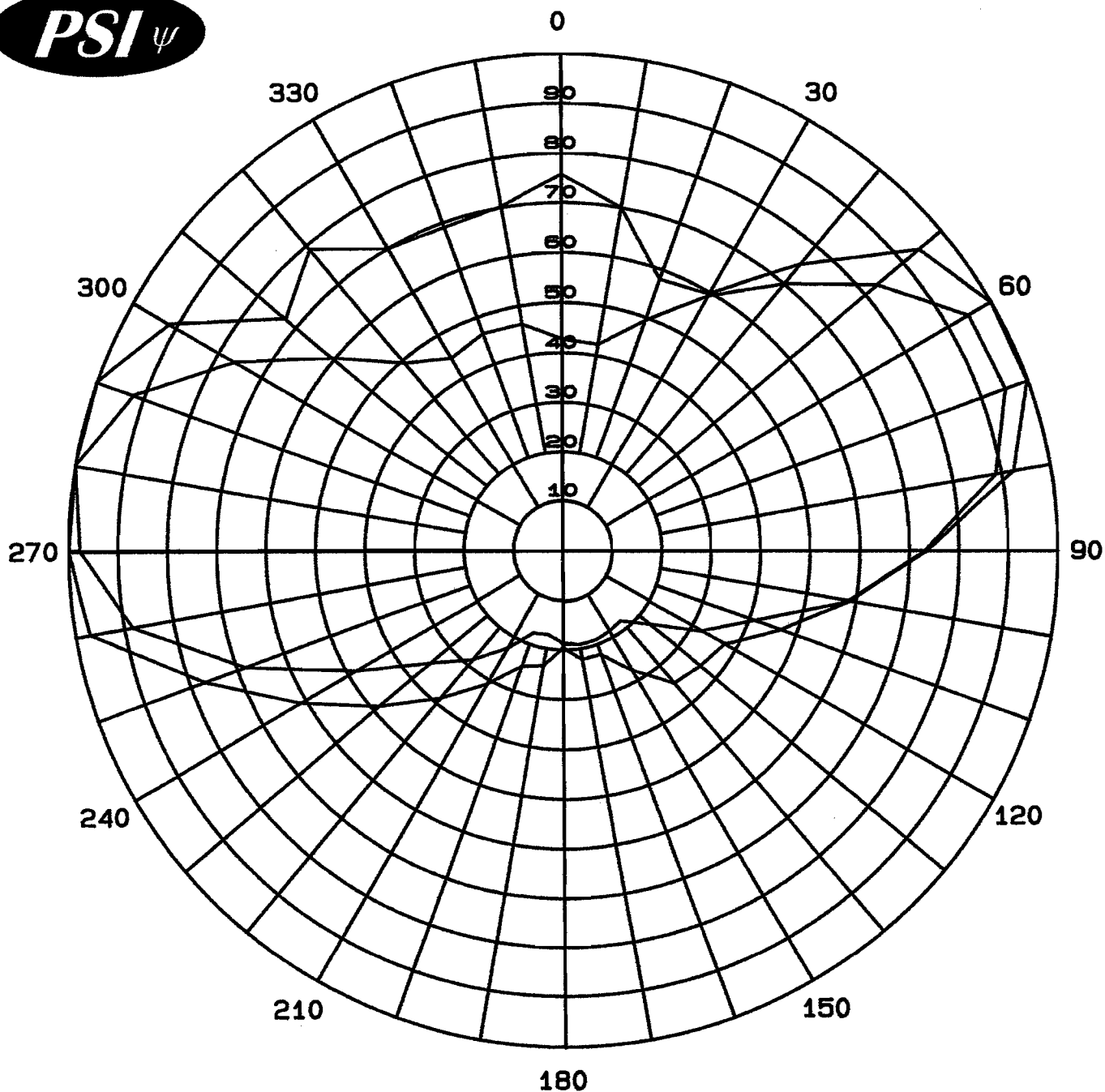
Frequency: 88.1 MHz

Location: Providence, RI

Maximum ERP: 4.0 kW (6.02 dBk)

Angle	Relative Field	ERP kW	ERP dBK
0	0.757	2.29	3.60
10	0.700	1.96	2.92
20	0.580	1.35	1.29
30	0.595	1.42	1.51
40	0.749	2.24	3.51
50	0.942	3.55	5.50
60	1.000	4.00	6.02
70	1.000	4.00	6.02
80	0.926	3.43	5.35
90	0.736	2.17	3.36
100	0.585	1.37	1.36
110	0.465	0.86	-0.63
120	0.375	0.56	-2.50
130	0.360	0.52	-2.85
140	0.349	0.49	-3.12
150	0.278	0.31	-5.10
160	0.221	0.20	-7.09
170	0.222	0.20	-7.05
180	0.194	0.15	-8.22
190	0.233	0.22	-6.63
200	0.245	0.24	-6.20
210	0.308	0.38	-4.21
220	0.387	0.60	-2.23
230	0.487	0.95	-0.23
240	0.613	1.50	1.77
250	0.771	2.38	3.76
260	0.970	3.76	5.76
270	1.000	4.00	6.02
280	1.000	4.00	6.02
290	1.000	4.00	6.02
300	0.915	3.35	5.25
310	0.727	2.11	3.25
320	0.790	2.50	3.97
330	0.700	1.96	2.92
340	0.690	1.90	2.80
350	0.700	1.96	2.92

Envelope RMS: .681



Maximum Envelope and  
Composite Pattern

Antenna: PSIFMDP-1-DA Custom  
Type: 1-Bay Directional FM Antenna

ERP: 4.0 kW (6.02 dBk)

RMS Envelope: .681

RMS Composite: .590

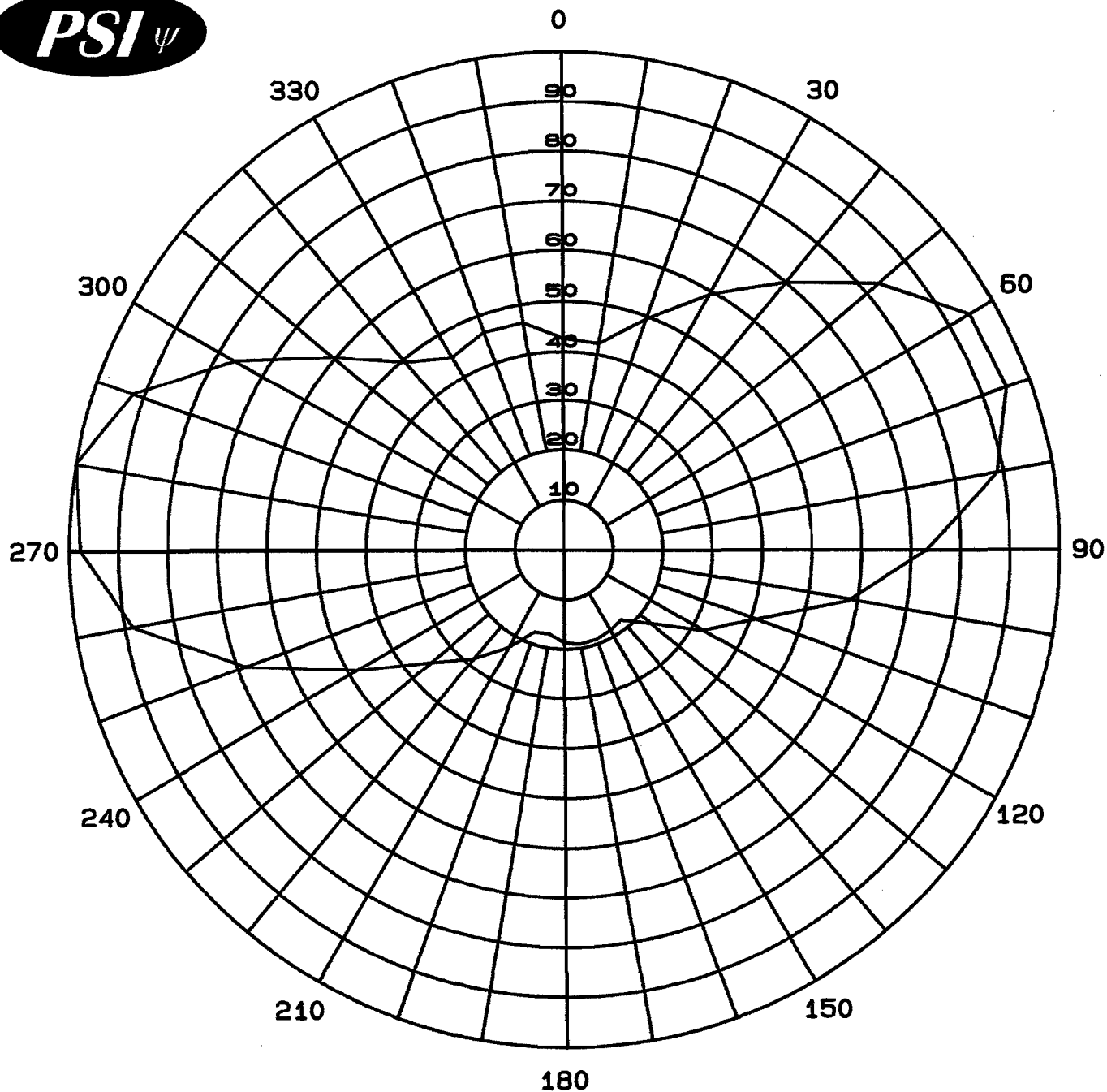
Frequency: 88.1 MHz

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**PO Box 113**

**Ebensburg, PA 15931**

WELH Providence, RI



Measured Composite  
Azimuth Plane Pattern  
Antenna: PSIFMDP-1-DA Custom  
Type: 1-Bay Directional FM Antenna  
ERP: 4.0 kW (6.02 dBk)  
RMS Composite: .590  
Frequency: 88.1 MHz  
WELH Providence, RI

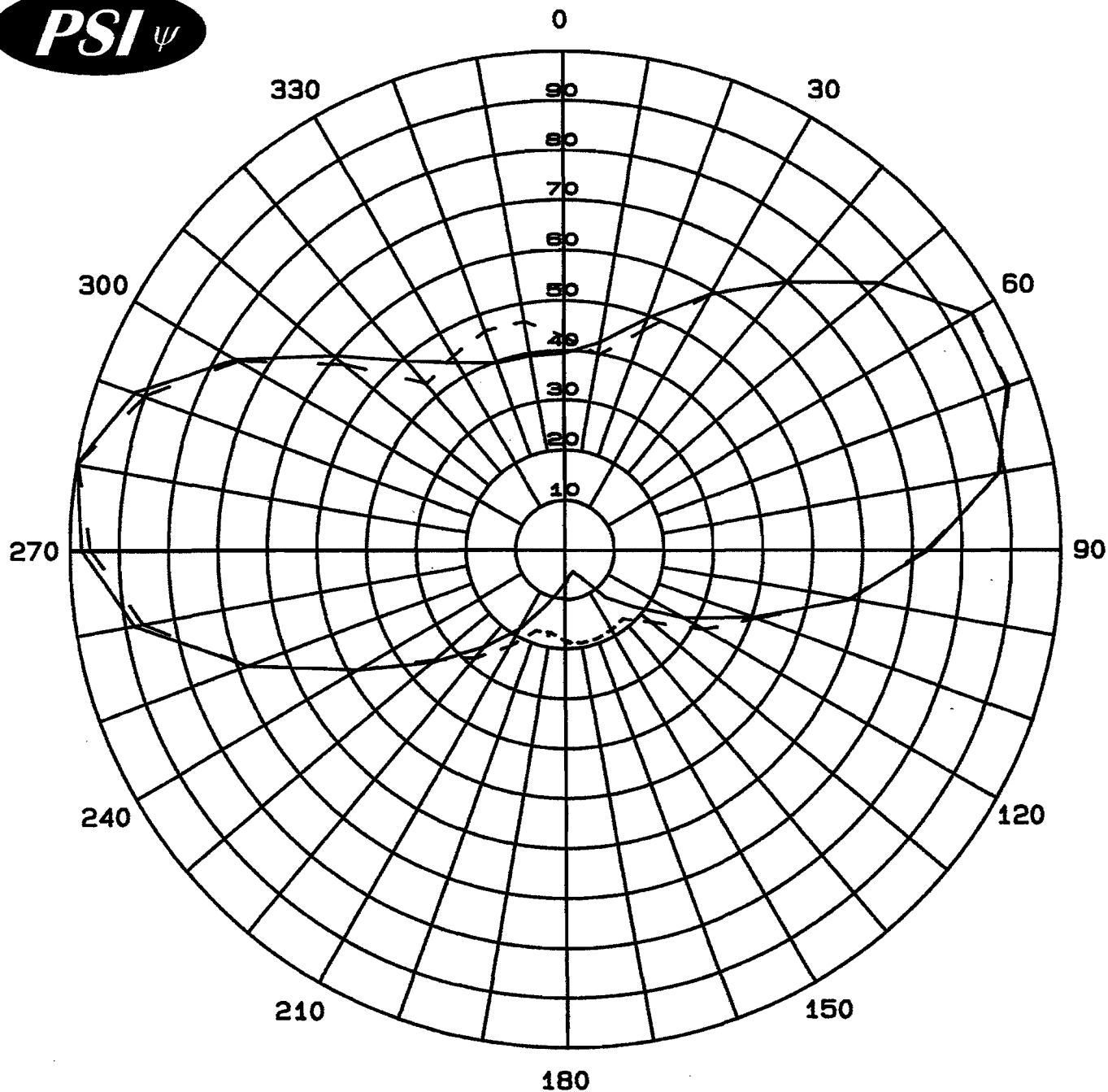
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**Ebensburg, PA 15931**



**Composite Pattern**  
**Maximum of H-pol or V-pol**  
 Antenna: PSIFMDP-1-DA Custom  
 The Wheeler School  
 Station: WELH  
 Frequency: 88.1 MHz  
 Location: Providence, RI  
 Maximum ERP: 4.0 kW (6.02 dBk)

Angle	Relative Field	ERP kW	ERP dBK
0	0.426	0.73	-1.39
10	0.421	0.71	-1.49
20	0.493	0.97	-0.12
30	0.592	1.40	1.47
40	0.702	1.97	2.95
50	0.833	2.78	4.43
60	0.948	3.59	5.56
70	0.953	3.63	5.60
80	0.889	3.16	5.00
90	0.731	2.14	3.30
100	0.582	1.35	1.32
110	0.407	0.66	-1.79
120	0.321	0.41	-3.85
130	0.227	0.21	-6.86
140	0.181	0.13	-8.83
150	0.185	0.14	-8.64
155	0.189	0.14	-8.45
160	0.190	0.14	-8.40
170	0.185	0.14	-8.64
180	0.169	0.11	-9.42
190	0.173	0.12	-9.22
200	0.223	0.20	-7.01
210	0.284	0.32	-4.91
220	0.349	0.49	-3.12
230	0.482	0.93	-0.32
240	0.683	1.87	2.71
250	0.882	3.11	4.93
260	0.976	3.81	5.81
270	1.000	4.00	6.02
280	0.921	3.39	5.31
290	0.762	2.32	3.66
300	0.605	1.46	1.66
310	0.493	0.97	-0.12
320	0.447	0.80	-0.97
330	0.466	0.87	-0.61
340	0.465	0.86	-0.63
350	0.082	0.03	-15.70

Composite RMS: .590



Measured Relative Field  
Azimuth Plane Pattern  
Antenna: PSIFMDP-1-DA Custom  
Type: 1-Bay Directional FM Antenna  
Gain H-pol (solid): 1.49 (1.73 dB)  
Gain V-pol (dash): 1.48 (1.71 dB)  
Frequency: 88.1 MHz  
WELH Providence, RI

**Propagation Systems Inc.**  
**PO Box 113**  
**Ebensburg, PA 15931**

# Measured Relative Field Tabulation

Antenna: PSIFMDP-1-DA Custom

The Wheeler School

Station: WELH

Frequency: 88.1 MHz

Location: Providence, RI

## Horizontal Polarization

Angle	Relative Field	Power Gain	Gain (dB)
0	0.3920	0.229	-6.40
10	0.4210	0.264	-5.78
20	0.4930	0.362	-4.41
30	0.5920	0.522	-2.82
40	0.7020	0.734	-1.34
50	0.8330	1.034	0.14
60	0.9470	1.336	1.26
70	0.9500	1.345	1.29
80	0.8870	1.172	0.69
90	0.7310	0.796	-0.99
100	0.5820	0.505	-2.97
110	0.4050	0.244	-6.12
120	0.2770	0.114	-9.42
130	0.1810	0.049	-13.11
140	0.1270	0.024	-16.19
150	0.0650	0.006	-22.01
160	0.0470	0.003	-24.83
170	0.0520	0.004	-23.95
180	0.0660	0.006	-21.88
190	0.0870	0.011	-19.48
200	0.1220	0.022	-16.54
210	0.1820	0.049	-13.07
220	0.2530	0.095	-10.21
230	0.3490	0.181	-7.41
240	0.4820	0.346	-4.61
250	0.6810	0.691	-1.61
260	0.8820	1.159	0.64
270	0.9760	1.419	1.52
280	1.0000	1.490	1.73
290	0.9210	1.264	1.02
300	0.7620	0.865	-0.63
310	0.6050	0.545	-2.63
320	0.4930	0.362	-4.41
330	0.4310	0.277	-5.58
340	0.3960	0.234	-6.31
350	0.3930	0.230	-6.38

### Maximum Value

Field 1.00  
Gain 1.49 (1.73 dB)

Azimuth Bearing 280 degrees

### Minimum Field

Field 0.047  
Gain .003 (-24.83 dB)

Azimuth Bearing 160 degrees

## Vertical Polarization

Angle	Relative Field	Power Gain	Gain (dB)
0	0.426	0.270	-5.68
10	0.394	0.231	-6.36
20	0.466	0.324	-4.90
30	0.591	0.520	-2.84
40	0.699	0.728	-1.38
50	0.831	1.029	0.12
60	0.948	1.339	1.27
70	0.953	1.353	1.31
80	0.889	1.178	0.71
90	0.727	0.788	-1.04
100	0.580	0.501	-3.00
110	0.407	0.247	-6.08
120	0.321	0.154	-8.14
130	0.227	0.077	-11.15
140	0.181	0.049	-13.11
150	0.185	0.051	-12.92
160	0.189	0.053	-12.74
170	0.190	0.054	-12.69
180	0.185	0.051	-12.92
190	0.169	0.043	-13.71
200	0.173	0.045	-13.51
210	0.223	0.074	-11.30
220	0.284	0.120	-9.20
230	0.343	0.175	-7.56
240	0.482	0.346	-4.61
250	0.683	0.695	-1.58
260	0.865	1.115	0.47
270	0.958	1.367	1.36
280	0.998	1.484	1.71
290	0.899	1.204	0.81
300	0.758	0.856	-0.67
310	0.577	0.496	-3.04
320	0.432	0.278	-5.56
330	0.447	0.298	-5.26
340	0.466	0.324	-4.90
350	0.465	0.322	-4.92

### Maximum Value

Field 1.00  
Gain 1.48 (1.71 dB)

Azimuth Bearing 280 degrees

### Minimum Field

Field 0.169  
Gain .043 (-13.51 dB)

Azimuth Bearing 190 degrees

## ERP Tabulation

Antenna: PSIFMDP-1-DA Custom  
 The Wheeler School  
 Station: WELH  
 Frequency: 88.1 MHz  
 Location: Providence, RI  
 Maximum ERP: 4.0 kW (6.02 dBk)

### Horizontal Polarization

Angle	Relative Field	ERP kW	ERP dBK
0	0.392	0.61	-2.11
10	0.421	0.71	-1.49
20	0.493	0.97	-0.12
30	0.592	1.40	1.47
40	0.702	1.97	2.95
50	0.833	2.78	4.43
60	0.947	3.59	5.55
70	0.950	3.61	5.58
80	0.887	3.15	4.98
90	0.731	2.14	3.30
100	0.582	1.35	1.32
110	0.405	0.66	-1.83
120	0.277	0.31	-5.13
130	0.181	0.13	-8.83
140	0.127	0.06	-11.90
150	0.065	0.02	-17.72
160	0.047	0.01	-20.54
170	0.052	0.01	-19.66
180	0.066	0.02	-17.59
190	0.087	0.03	-15.19
200	0.122	0.06	-12.25
210	0.182	0.13	-8.78
220	0.253	0.26	-5.92
230	0.349	0.49	-3.12
240	0.482	0.93	-0.32
250	0.681	1.86	2.68
260	0.882	3.11	4.93
270	0.976	3.81	5.81
280	1.000	4.00	6.02
290	0.921	3.39	5.31
300	0.762	2.32	3.66
310	0.605	1.46	1.66
320	0.493	0.97	-0.12
330	0.431	0.74	-1.29
340	0.396	0.63	-2.03
350	0.393	0.62	-2.09

#### Maximum Value (H-pol)

Field 1.00  
 ERP 4.0 kW (6.02 dBk)  
 Azimuth Bearing 280 degrees

#### Minimum Field (H-pol)

Field 0.047  
 ERP .01 kW (-20.54 dBk)  
 Azimuth Bearing 160 degrees

### Vertical Polarization

Angle	Relative Field	ERP kW	ERP dBK
0	0.426	0.73	-1.39
10	0.394	0.62	-2.07
20	0.466	0.87	-0.61
30	0.591	1.40	1.45
40	0.699	1.95	2.91
50	0.831	2.76	4.41
60	0.948	3.59	5.56
70	0.953	3.63	5.60
80	0.889	3.16	5.00
90	0.727	2.11	3.25
100	0.580	1.35	1.29
110	0.407	0.66	-1.79
120	0.321	0.41	-3.85
130	0.227	0.21	-6.86
140	0.181	0.13	-8.83
150	0.185	0.14	-8.64
160	0.189	0.14	-8.45
170	0.190	0.14	-8.40
180	0.185	0.14	-8.64
190	0.169	0.11	-9.42
200	0.173	0.12	-9.22
210	0.223	0.20	-7.01
220	0.284	0.32	-4.91
230	0.343	0.47	-3.27
240	0.482	0.93	-0.32
250	0.683	1.87	2.71
260	0.865	2.99	4.76
270	0.958	3.67	5.65
280	0.998	3.98	6.00
290	0.899	3.23	5.10
300	0.758	2.30	3.61
310	0.577	1.33	1.24
320	0.432	0.75	-1.27
330	0.447	0.80	-0.97
340	0.466	0.87	-0.61
350	0.465	0.86	-0.63

#### Maximum Value (V-pol)

Field 1.00  
 ERP 3.98 kW (6.0 dBk)  
 Azimuth Bearing 280 degrees

#### Minimum Field (V-pol)

Field 0.169  
 ERP .11 kW (-9.42 dBk)  
 Azimuth Bearing 190 degrees

