



# Propagation Systems, Inc.

Quality Broadcast Antenna Systems

**Directional FM Antenna  
The Power Foundation  
WWQS  
Spring City, TN**

A standard model PSIFM series antenna was used in conjunction with the customer's triangular tower to create the necessary directional radiation pattern. The final antenna consists of two radiating elements secured to the tower with custom-mounting brackets. The antenna bays are full-wave spaced and there are a total of two horizontal and two vertical parasitic elements per bay. The antenna array is end fed and 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 265.5 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 87.8% of the envelope RMS.

The antenna is to be mounted 44 meters (144.4 ft.) +2/-4 meters above ground level on the west tower face and positioned 270° True. No other antenna can be installed within 10 ft of any radiating element. Any guy wire that passes within 20 ft. of a radiating element must be changed to the appropriate non-metallic substitute. 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 instructions.

An input power level of 2.75 kW will be required at the antenna input in order to reach the approved 6.0 kW ERP. The transmitter output power requirements are dependent upon the transmission line size and length used to feed the antenna.

### Antenna Specifications

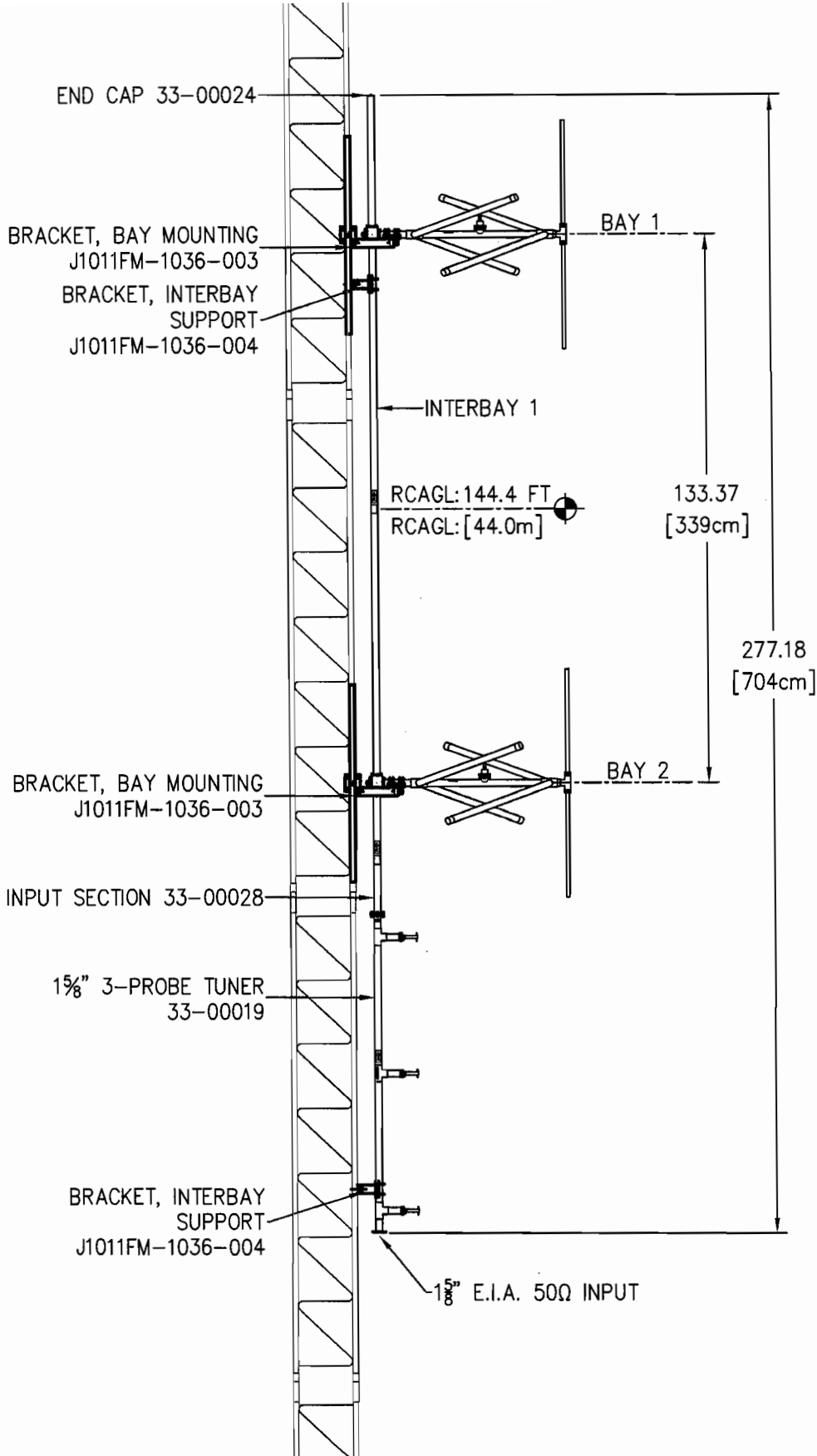
Antenna Model	PSIFM-2-DA
Type	2-bay directional FM antenna
Bay Spacing	Full-wave spaced elements
Frequency	88.5 MHz
Polarization	Circular
Envelope RMS	.736
Composite RMS	.646
Gain (h-pol)	2.18 (3.38 dB)
Gain (v-pol)	2.18 (3.38 dB)
Antenna Input	1-5/8" EIA end fed input
Power rating	6 kW
Length	23.1 ft.
Weight	164 lbs.
Wind Area	14.4 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.



Douglas A. Ross  
President  
Propagation Systems Inc.



SPECIFICATIONS	
SPACING:	1.0λ
LENGTH:	23.1 FT [7.04m]
APERTURE:	11.1 FT [3.39m]
RATING:	6 kW
GAIN:	2.18 (3.38 dB)
WEIGHT:	164 LB [75 Kg]
WINDAREA:	14.4 FT <sup>2</sup>
TIA-222-F	(NO ICE)
NOTE:	
1. 1 5/8" 3-PROBE TUNER SHOWN ROTATED FOR DRAWING CLARITY	

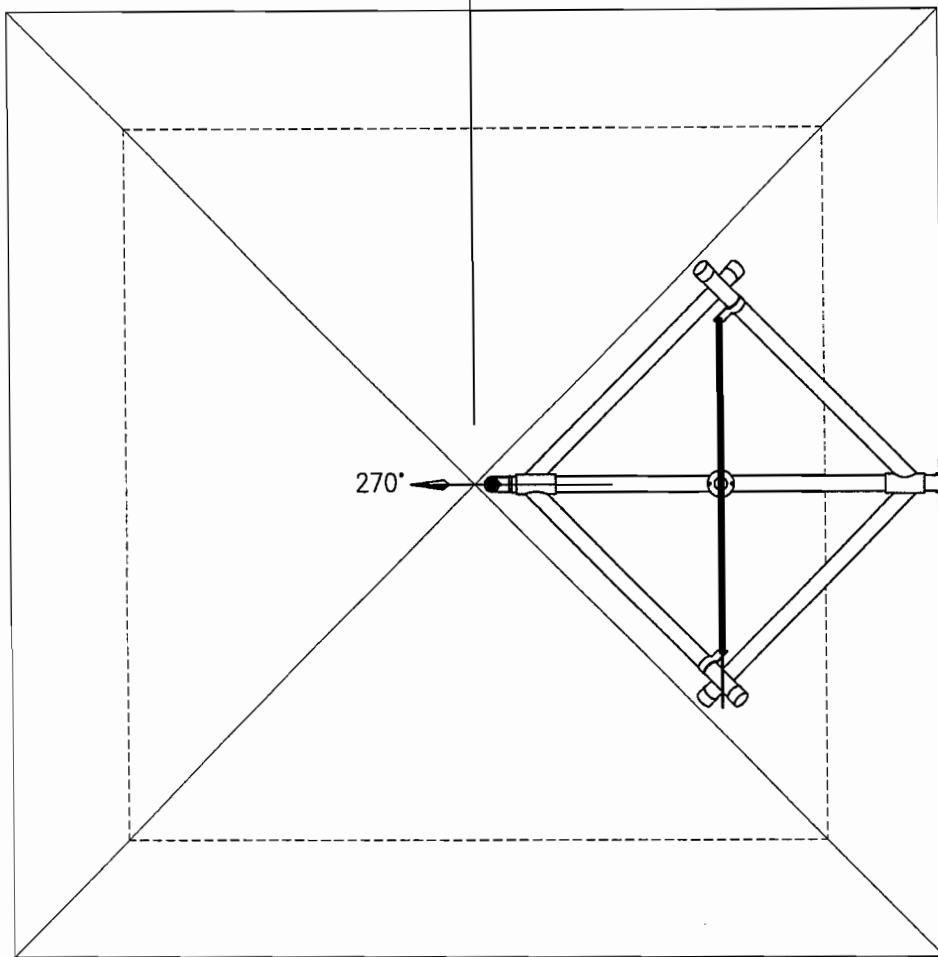
REV.	MADE BY CHECKED BY	DATE	CHANGE	SIZE
				A
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# **PROPAGATION SYSTEMS, INC.**

Ebensburg, Pennsylvania USA 814-472-5540

## **ANTENNA ELEVATIONS AND SPECIFICATIONS**

MODEL:	PSIFM-2-DA	DRAWN BY:	D.G. Kellar	DATE:	11/07/11
CHANNEL/ FREQUENCY:	88.5 MHz	APPROVED BY:		DATE:	
SCALE:	1:40	DRAWING NO.:	J1011FM-1036-001	REV.	



PARASITIC, VERTICAL, LEG  
MOUNTED J1011FM-1036-008

SUPPORT BRACKET  
J1011FM-1036-003  
BAY MOUNTING BRACKET  
J1011FM-1036-004

BLACK BAND

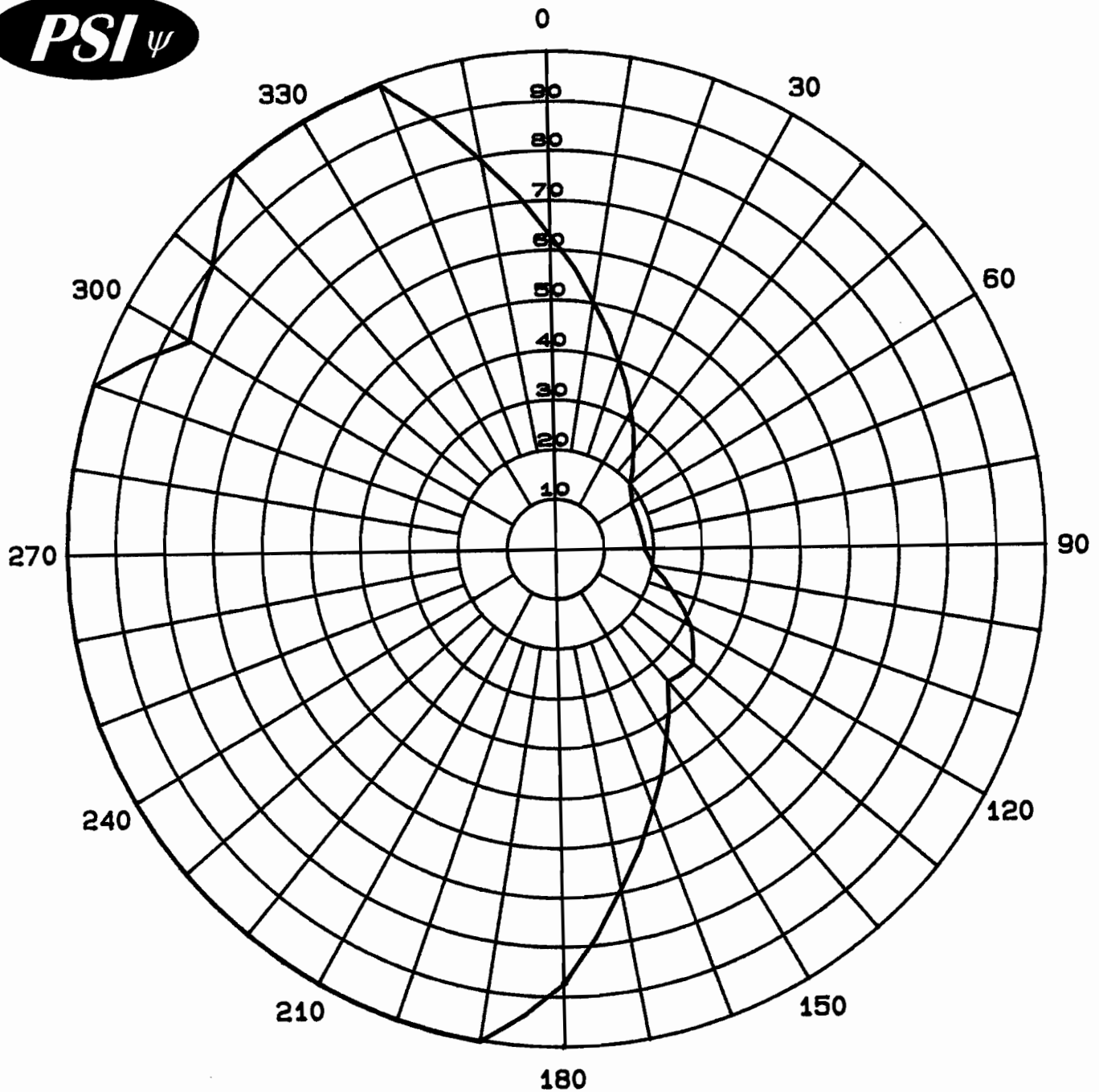
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Ebensburg, Pennsylvania USA 814-472-5540

## PLAN VIEW AND ORIENTATION

REV.	MADE BY	CHECKED BY	DATE	CHANGE
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				SIZE  A

MODEL:	PSIFM-2-DA	DRAWN BY:	D.G. Kellar	DATE:	11/30/11
CHANNEL/ FREQUENCY:	88.5 MHz	APPROVED BY:		DATE:	
SCALE:	1:20	DRAWING NO.:	J1011FM-1036-002	REV.	



Maximum Envelope  
Azimuth Plane Pattern  
Antenna: PSIFM-2-DA  
Type: 2-Bay Directional FM Antenna  
ERP: 6.0 kW (7.78 dBk)  
RMS Envelope: .736  
Frequency: 88.5 MHz  
WWQS Spring City, TN

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**PO Box 113**  
**Ebensburg, PA 15931**

## Maximum Envelope Tabulation

Antenna: PSIFM-2-DA

The Power Foundation

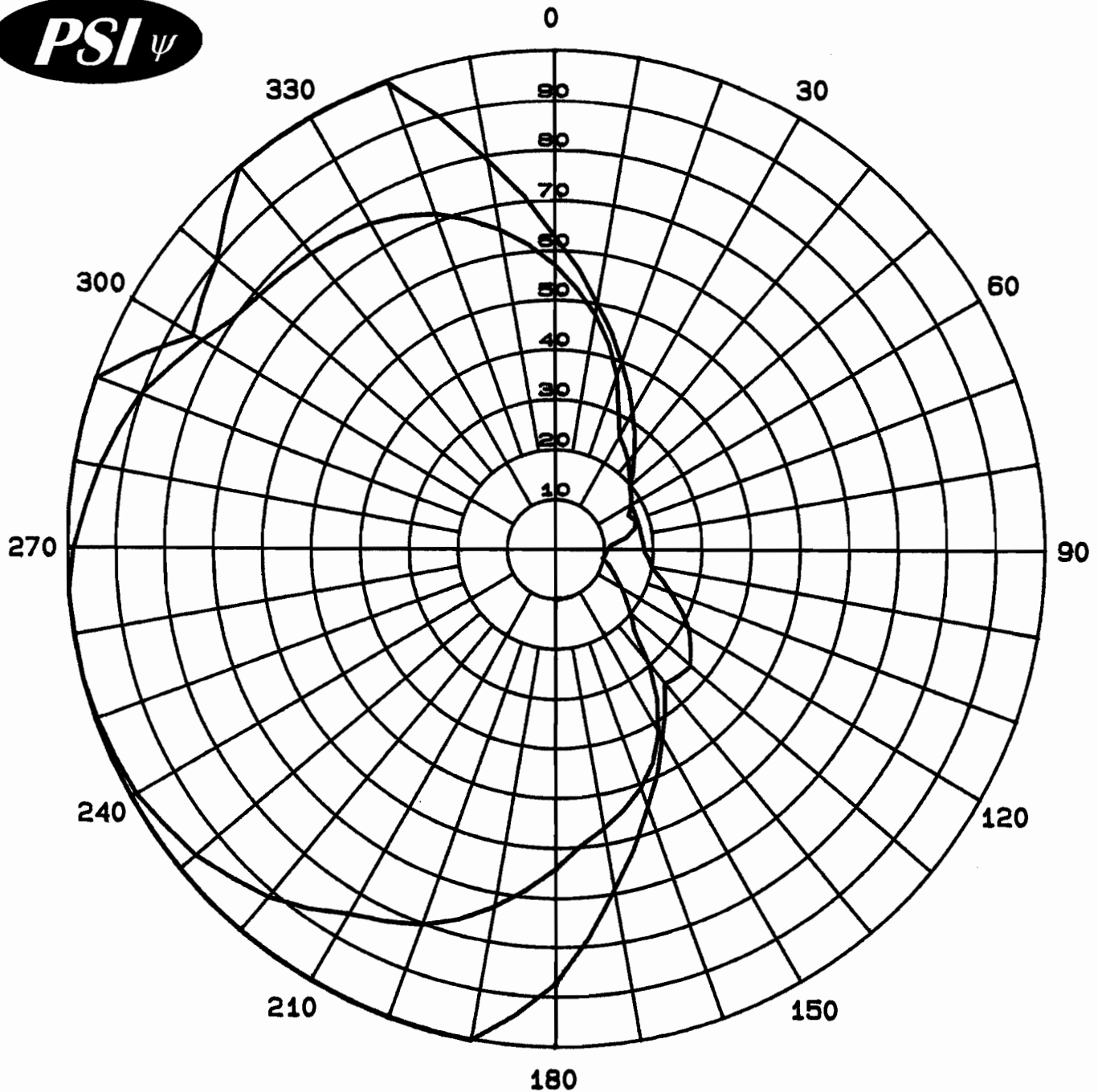
Station: WWQS

Frequency: 88.5 MHz

Location: Spring City, TN

Maximum ERP: 6.0 kW (7.78 dBk)

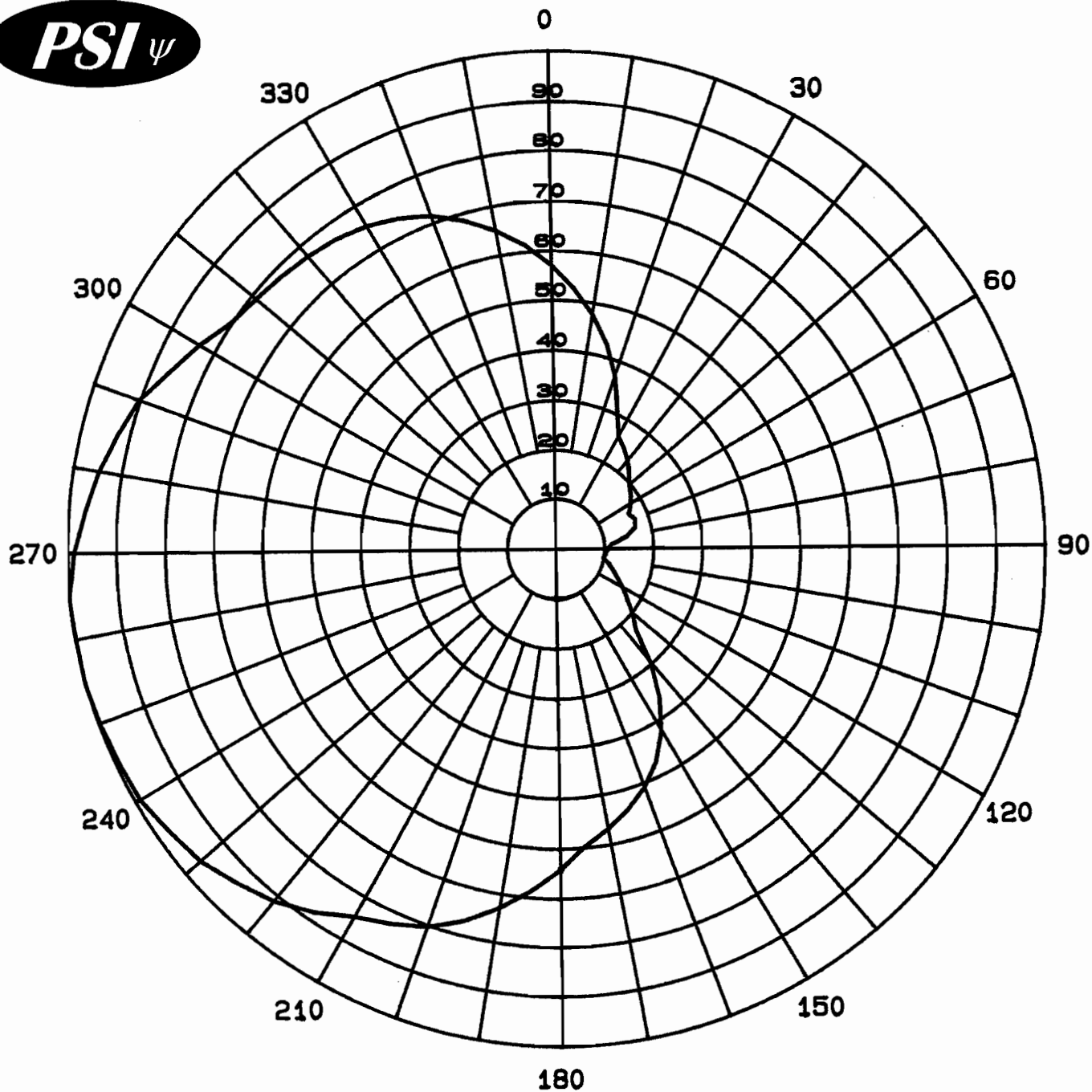
Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.632	2.40	3.80
10	0.502	1.51	1.80
20	0.399	0.96	-0.20
30	0.317	0.60	-2.20
40	0.252	0.38	-4.19
50	0.200	0.24	-6.20
60	0.180	0.19	-7.11
70	0.178	0.19	-7.21
80	0.178	0.19	-7.21
90	0.181	0.20	-7.06
100	0.200	0.24	-6.20
110	0.252	0.38	-4.19
120	0.317	0.60	-2.20
130	0.360	0.78	-1.09
140	0.347	0.72	-1.41
150	0.437	1.15	0.59
160	0.550	1.82	2.59
170	0.692	2.87	4.58
180	0.871	4.55	6.58
190	1.000	6.00	7.78
200	1.000	6.00	7.78
210	1.000	6.00	7.78
220	1.000	6.00	7.78
230	1.000	6.00	7.78
240	1.000	6.00	7.78
250	1.000	6.00	7.78
260	1.000	6.00	7.78
270	1.000	6.00	7.78
280	1.000	6.00	7.78
290	1.000	6.00	7.78
300	0.856	4.40	6.43
310	0.902	4.88	6.89
320	1.000	6.00	7.78
330	1.000	6.00	7.78
340	1.000	6.00	7.78
350	0.796	3.80	5.80



Maximum Envelope and  
Composite Pattern  
Antenna: PSIFM-2-DA  
Type: 2-Bay Directional FM Antenna  
ERP: 6.0 kW (7.78 dBk)  
RMS Envelope: .736  
RMS Composite: .646  
Frequency: 88.5 MHz

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**Ebensburg, PA 15931**

WWQS Spring City, TN



Measured Composite  
Azimuth Plane Pattern  
Antenna: PSIFM-2-DA  
Type: 2-Bay Directional FM Antenna  
ERP: 6.0 kW (7.78 dBk)  
RMS Composite: .646  
Frequency: 88.5 MHz  
WWQS Spring City, TN

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## Composite Pattern Tabulation

Antenna: PSIFM-2-DA

The Power Foundation

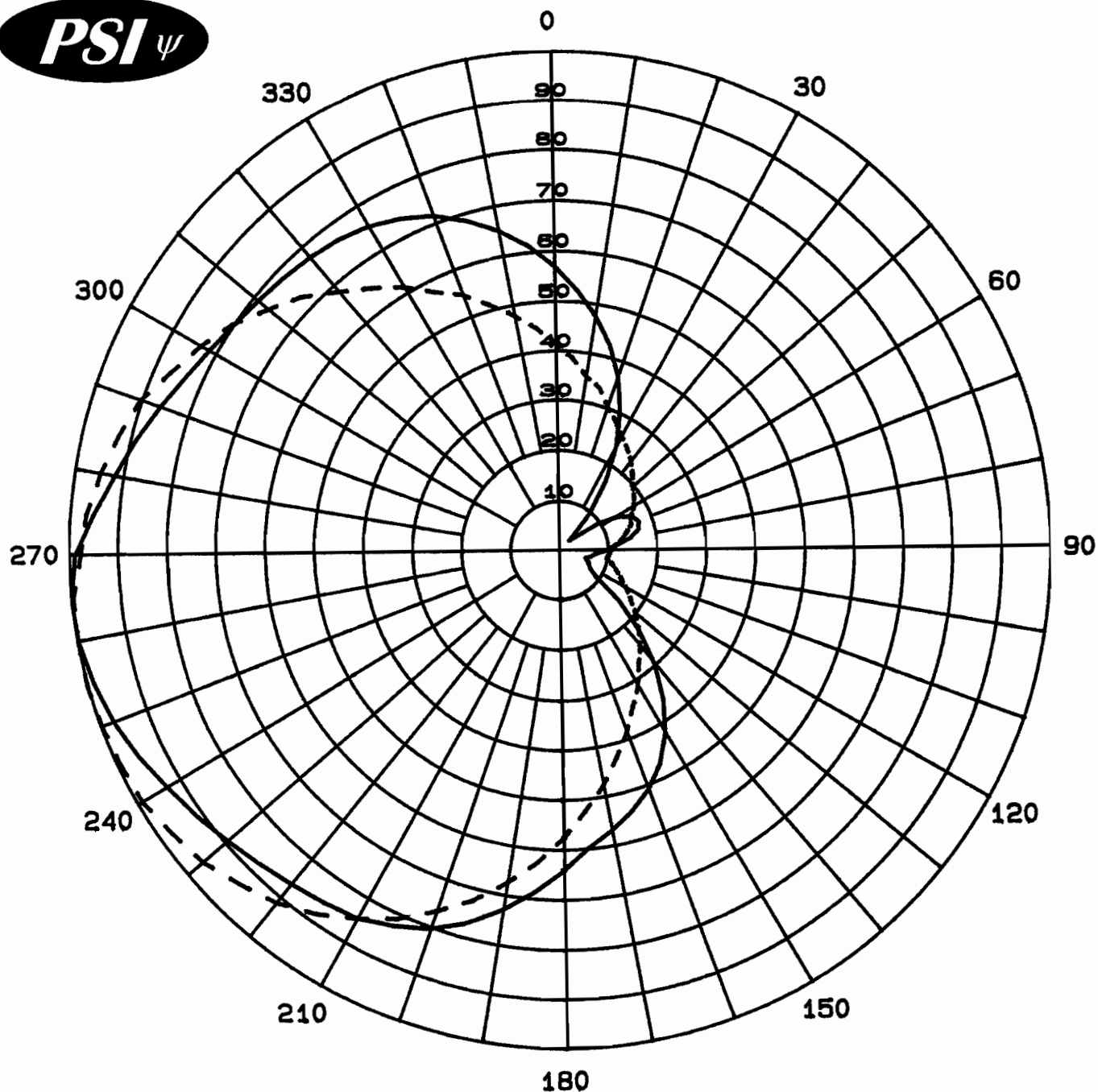
Station: WWQS

Frequency: 88.5 MHz

Location: Spring City, TN

Maximum ERP: 6.0 kW (7.78 dBk)

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.573	1.97	2.94
10	0.478	1.37	1.37
20	0.370	0.82	-0.85
30	0.264	0.42	-3.79
40	0.233	0.33	-4.87
50	0.200	0.24	-6.20
60	0.179	0.19	-7.16
70	0.175	0.18	-7.36
80	0.148	0.13	-8.81
90	0.106	0.07	-11.71
100	0.099	0.06	-12.31
110	0.125	0.09	-10.28
120	0.158	0.15	-8.25
130	0.202	0.24	-6.11
140	0.297	0.53	-2.76
150	0.422	1.07	0.29
160	0.509	1.55	1.92
170	0.568	1.94	2.87
180	0.640	2.46	3.91
190	0.726	3.16	5.00
200	0.801	3.85	5.85
210	0.844	4.27	6.31
220	0.911	4.98	6.97
230	0.958	5.51	7.41
240	0.988	5.86	7.68
250	0.996	5.95	7.75
260	0.998	5.98	7.76
270	0.987	5.85	7.67
280	0.947	5.38	7.31
290	0.903	4.89	6.90
300	0.835	4.18	6.22
310	0.790	3.74	5.73
320	0.775	3.60	5.57
330	0.756	3.43	5.35
340	0.718	3.09	4.90
350	0.654	2.57	4.09



Measured Relative Field  
Azimuth Plane Pattern  
Antenna: PSIFM-2-DA  
Type: 2-Bay Directional FM Antenna  
Gain H-pol (solid): 2.18 (3.38 dB)  
Gain V-pol (dash): 2.18 (3.38 dB)  
Frequency: 88.5 MHz  
WWQS Spring City, TN

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**PO Box 113**  
**Ebensburg, PA 15931**

## Measured Relative Field Tabulation

Antenna: PSIFM-2-DA

The Power Foundation

Station: WWQS

Frequency: 88.5 MHz

Location: Spring City, TN

### Horizontal Polarization

Angle	Relative Field	Power Gain	Gain (dB)
0	0.573	0.716	-1.45
10	0.478	0.498	-3.03
20	0.370	0.298	-5.25
30	0.242	0.128	-8.94
40	0.099	0.021	-16.70
50	0.045	0.004	-23.55
60	0.140	0.043	-13.69
70	0.175	0.067	-11.75
80	0.148	0.048	-13.21
90	0.095	0.020	-17.06
100	0.067	0.010	-20.09
110	0.062	0.008	-20.77
120	0.072	0.011	-19.47
130	0.155	0.052	-12.81
140	0.297	0.192	-7.16
150	0.422	0.388	-4.11
160	0.509	0.565	-2.48
170	0.568	0.703	-1.53
180	0.640	0.893	-0.49
190	0.726	1.149	0.60
200	0.801	1.399	1.46
210	0.843	1.549	1.90
220	0.863	1.624	2.10
230	0.891	1.731	2.38
240	0.929	1.881	2.74
250	0.970	2.051	3.12
260	0.997	2.167	3.36
270	0.987	2.124	3.27
280	0.918	1.837	2.64
290	0.861	1.616	2.08
300	0.816	1.452	1.62
310	0.790	1.361	1.34
320	0.775	1.309	1.17
330	0.756	1.246	0.96
340	0.718	1.124	0.51
350	0.654	0.932	-0.30

#### Maximum Value

Field 1.00  
Gain 2.18 (3.38 dB)

Azimuth Bearing 265 degrees

#### Minimum Field

Field 0.030  
Gain .002 (-27.07 dB)

Azimuth Bearing 45 degrees

### Vertical Polarization

Angle	Relative Field	Power Gain	Gain (dB)
0	0.418	0.381	-4.19
10	0.355	0.275	-5.61
20	0.305	0.203	-6.93
30	0.264	0.152	-8.18
40	0.233	0.118	-9.27
50	0.200	0.087	-10.59
60	0.179	0.070	-11.56
70	0.158	0.054	-12.64
80	0.131	0.037	-14.27
90	0.106	0.024	-16.11
100	0.099	0.021	-16.70
110	0.125	0.034	-14.68
120	0.158	0.054	-12.64
130	0.202	0.089	-10.51
140	0.254	0.141	-8.52
150	0.314	0.215	-6.68
160	0.387	0.326	-4.86
170	0.478	0.498	-3.03
180	0.574	0.718	-1.44
190	0.673	0.987	-0.06
200	0.763	1.269	1.04
210	0.844	1.553	1.91
220	0.911	1.809	2.57
230	0.958	2.001	3.01
240	0.988	2.128	3.28
250	0.996	2.163	3.35
260	0.998	2.171	3.37
270	0.975	2.072	3.16
280	0.947	1.955	2.91
290	0.903	1.778	2.50
300	0.835	1.520	1.82
310	0.763	1.269	1.04
320	0.685	1.023	0.10
330	0.616	0.827	-0.82
340	0.550	0.659	-1.81
350	0.481	0.504	-2.97

#### Maximum Value

Field 1.00  
Gain 2.18 (3.38 dB)

Azimuth Bearing 255 degrees

#### Minimum Field

Field 0.099  
Gain .021 (-16.70 dB)

Azimuth Bearing 100 degrees

## ERP Tabulation

Antenna: PSIFM-2-DA

The Power Foundation

Station: WWQS

Frequency: 88.5 MHz

Location: Spring City, TN

Maximum ERP: 6.0 kW (7.78 dBk)

### Horizontal Polarization

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.573	1.97	2.94
10	0.478	1.37	1.37
20	0.370	0.82	-0.85
30	0.242	0.35	-4.54
40	0.099	0.06	-12.31
50	0.045	0.01	-19.15
60	0.140	0.12	-9.30
70	0.175	0.18	-7.36
80	0.148	0.13	-8.81
90	0.095	0.05	-12.66
100	0.067	0.03	-15.70
110	0.062	0.02	-16.37
120	0.072	0.03	-15.07
130	0.155	0.14	-8.41
140	0.297	0.53	-2.76
150	0.422	1.07	0.29
160	0.509	1.55	1.92
170	0.568	1.94	2.87
180	0.640	2.46	3.91
190	0.726	3.16	5.00
200	0.801	3.85	5.85
210	0.843	4.26	6.30
220	0.863	4.47	6.50
230	0.891	4.76	6.78
240	0.929	5.18	7.14
250	0.970	5.65	7.52
260	0.997	5.96	7.76
270	0.987	5.85	7.67
280	0.918	5.06	7.04
290	0.861	4.45	6.48
300	0.816	4.00	6.02
310	0.790	3.74	5.73
320	0.775	3.60	5.57
330	0.756	3.43	5.35
340	0.718	3.09	4.90
350	0.654	2.57	4.09

#### Maximum Value (H-pol)

Field 1.00  
ERP 6.0 kW (7.78 dBk)

Azimuth Bearing 265 degrees

#### Minimum Field (H-pol)

Field 0.030  
ERP .005 kW (-22.68 dBk)

Azimuth Bearing 45 degrees

### Vertical Polarization

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.418	1.05	0.21
10	0.355	0.76	-1.21
20	0.305	0.56	-2.53
30	0.264	0.42	-3.79
40	0.233	0.33	-4.87
50	0.200	0.24	-6.20
60	0.179	0.19	-7.16
70	0.158	0.15	-8.25
80	0.131	0.10	-9.87
90	0.106	0.07	-11.71
100	0.099	0.06	-12.31
110	0.125	0.09	-10.28
120	0.158	0.15	-8.25
130	0.202	0.24	-6.11
140	0.254	0.39	-4.12
150	0.314	0.59	-2.28
160	0.387	0.90	-0.46
170	0.478	1.37	1.37
180	0.574	1.98	2.96
190	0.673	2.72	4.34
200	0.763	3.49	5.43
210	0.844	4.27	6.31
220	0.911	4.98	6.97
230	0.958	5.51	7.41
240	0.988	5.86	7.68
250	0.996	5.95	7.75
260	0.998	5.98	7.76
270	0.975	5.70	7.56
280	0.947	5.38	7.31
290	0.903	4.89	6.90
300	0.835	4.18	6.22
310	0.763	3.49	5.43
320	0.685	2.82	4.50
330	0.616	2.28	3.57
340	0.550	1.82	2.59
350	0.481	1.39	1.42

#### Maximum Value (V-pol)

Field 1.00  
ERP 6.0 kW (7.78 dBk)

Azimuth Bearing 255 degrees

#### Minimum Field (V-pol)

Field 0.099  
ERP .059 kW (-12.31 dBk)

Azimuth Bearing 100 degrees



Relative Field Elevation Pattern  
Model: PSIFM-2-DA  
Type: 2-Bay FM Directional  
Polarization: Circular  
Gain: 2.18 (3.38 dB)  
Station: WWQS  
Spring City, TN

