



Propagation Systems, Inc.

Quality Broadcast Antenna Systems

**Directional FM Antenna
WXAF
Shofar Broadcasting Corporation
Charleston, WV**

A standard model PSIFML antenna with parasitic elements was used in conjunction with the customer's 36" face triangular tower to create the necessary directional radiation pattern. The final antenna consists of four radiating elements each secured to the tower with a custom mounting bracket and support mast. The antenna bays are full wave spaced and there are a total of two vertical parasitic elements per bay and one horizontal parasitic element per bay. The antenna array is center fed from an existing flexible transmission line. 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 272.7 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 88.6% of the envelope RMS.

The antenna is to be mounted 58 meters (190 ft.) +2/-4 meters above ground level on a the northeast tower face and positioned 75° 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 .924 kW will be required at the antenna input in order to reach the approved 4.0 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

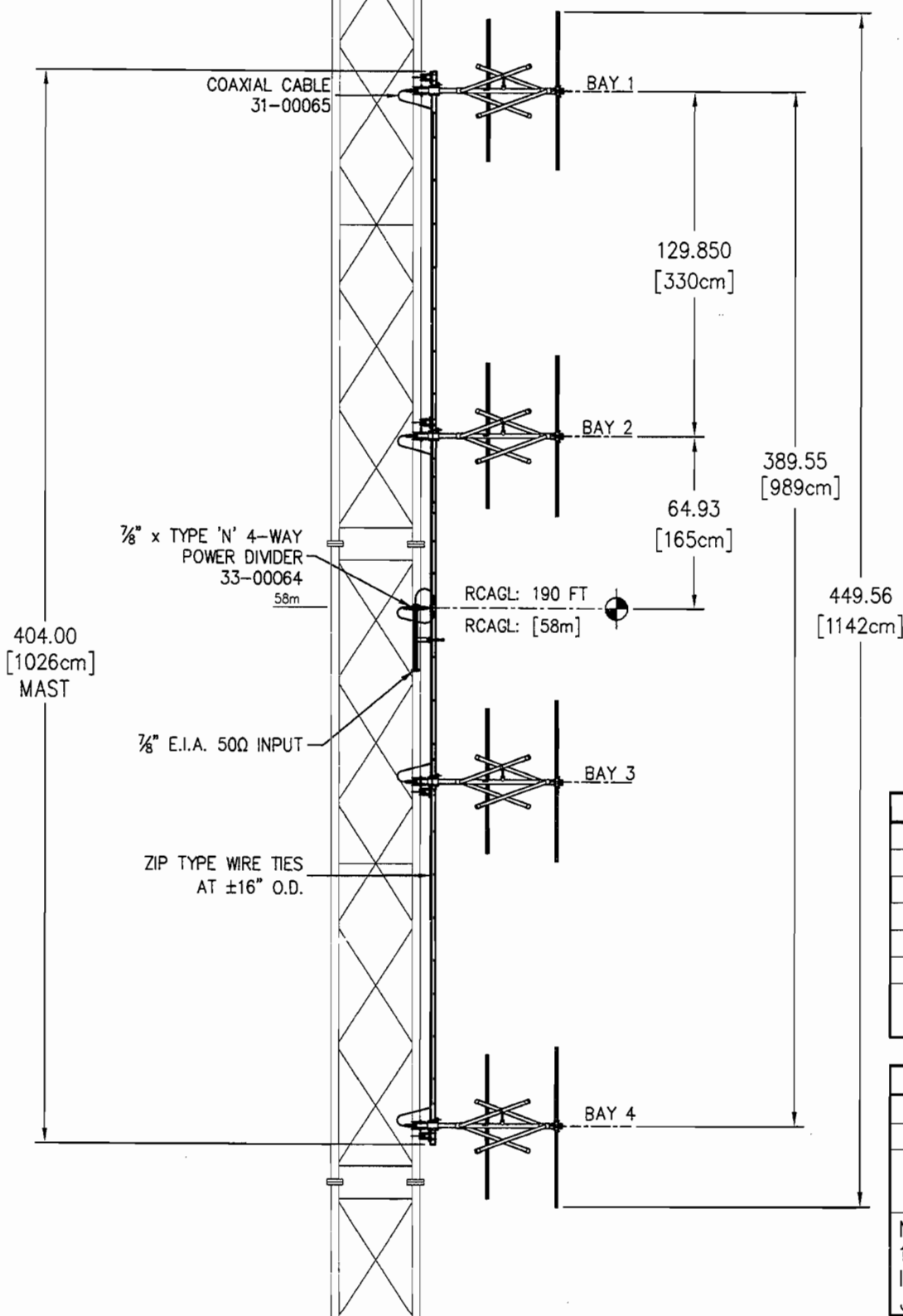
Antenna Model	PSIFML-4A-DA
Type	4-bay directional FM antenna
Bay Spacing	Full wave spaced elements
Frequency	90.9 MHz
Polarization	Circular
Envelope RMS	.773
Composite RMS	.685
Gain (h-pol)	4.33 (6.36 dB)
Gain (v-pol)	4.33 (6.36 dB)
ERP	4.0 kW
Antenna input power	.924 kW
Input	7/8" EIA center fed input
Power rating	3 kW
Length	37.46 ft.
Weight	155 lbs.
Wind Area	16 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.

 9/12/2013

Douglas A. Ross
President
Propagation Systems Inc.



SPECIFICATIONS
SPACING: 1.0λ
LENGTH: 37.46 FT [11.42m]
APERTURE: 32.46 FT [9.89m]
RATING: 3.0 kW
GAIN: 4.33 (6.36 dB)
WEIGHT: 155 LB [0 Kg]
WINDAREA: 16 FT ²
TIA-222-F (NO ICE)

MAST SPECIFICATIONS
LENGTH: 33.6 FT [10.3m]
WEIGHT: 129 LB [58.5 Kg]
WINDAREA: 7.58 FT ²
TIA-222-F (NO ICE)

NOTES:
 1. WEIGHT AND WINDAREA
 INCLUDE BRACKET
 J613FM-1177-003

REV.	MADE BY CHECKED BY	DATE	CHANGE

This drawing is loaned subject to the express understanding and agreement that the drawing and information therein contained are, and shall remain the property of PSI, and will not be otherwise utilized or disposed of, directly or indirectly, and will not be used in whole or in part or assist in making or finish any information for the making of drawings, prints or other reproductions hereof, or for the design or making of any item, parts, object, apparatus or parts thereof, except upon the written permissions of PSI first obtained. The acceptance of this drawing will be construed as an acceptance of the foregoing agreement.

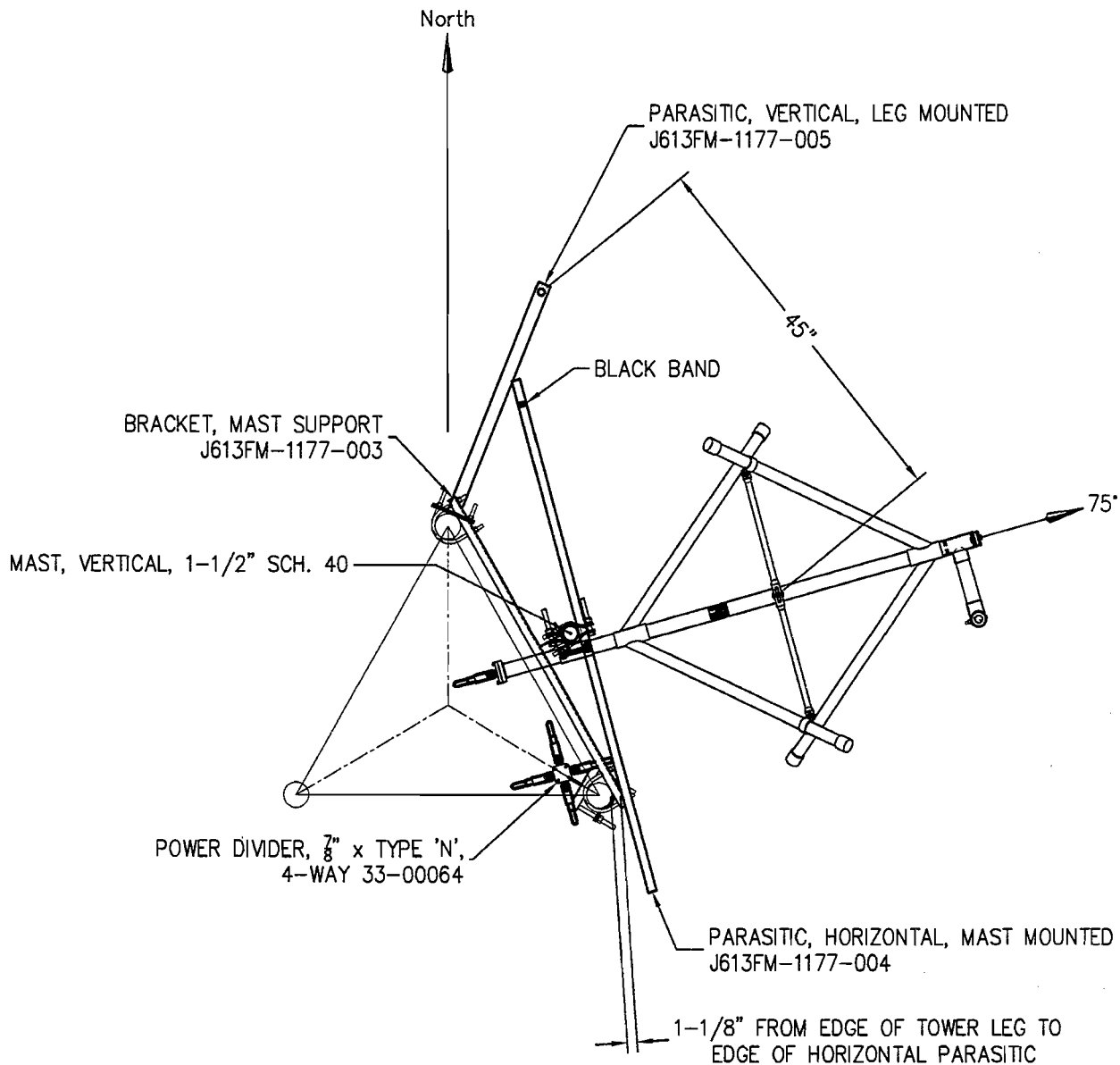
SIZE
A

PROPAGATION SYSTEMS, INC.

Ebensburg, Pennsylvania USA 814-472-5540

ELEVATIONS AND SPECIFICATIONS

MODEL: PSIFML-4A-DA	DRAWN BY: D.G. Kellar	DATE: 7/16/13
CHANNEL/FREQUENCY: 90.9 MHz	APPROVED BY:	DATE:
SCALE: 1:60	DRAWING NO.: J613FM-1177-001	REV.



REV.	MADE BY CHECKED BY	DATE	CHANGE	SIZE
				A

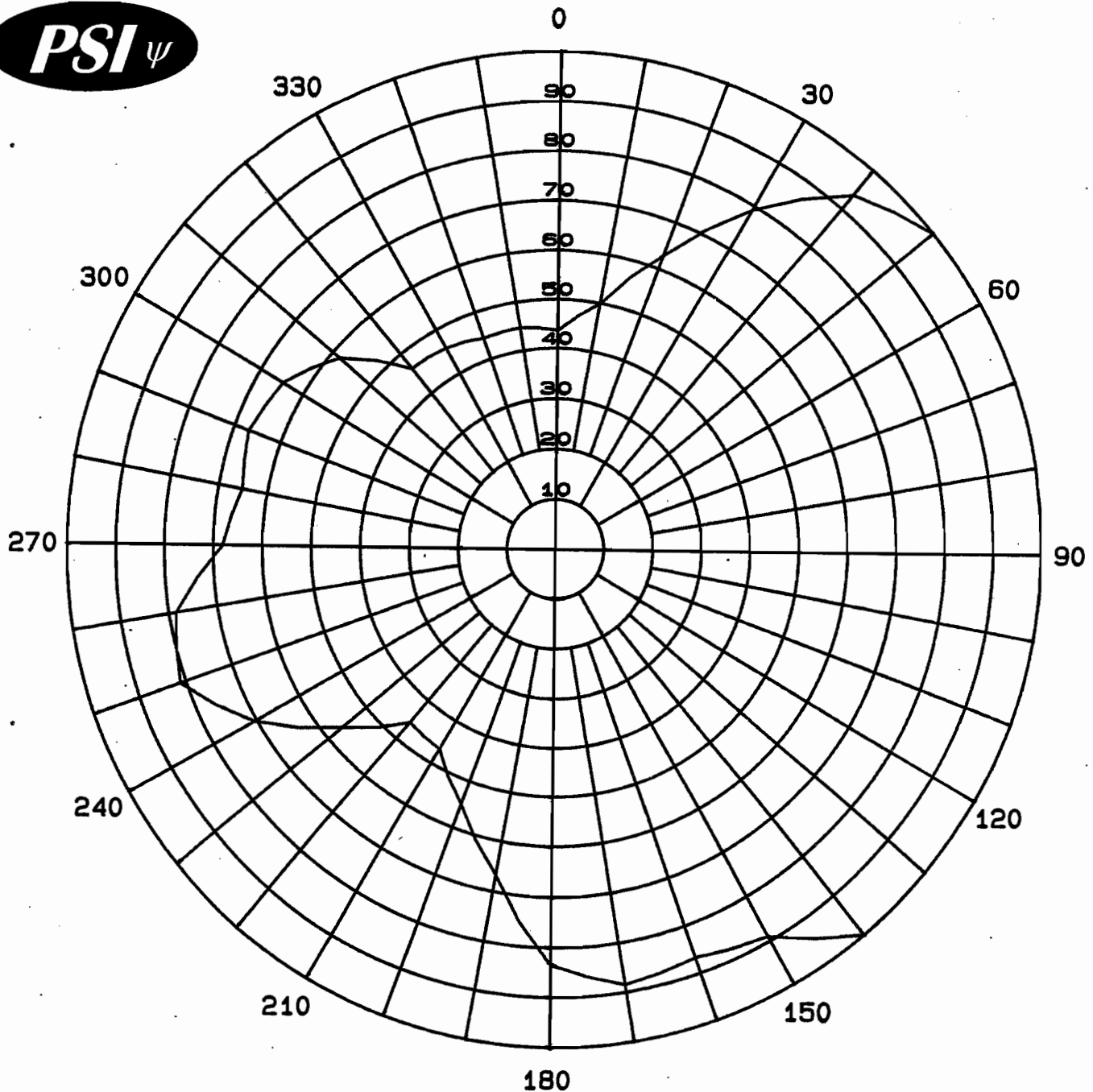
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PLAN VIEW AND ORIENTATION

MODEL:	PSIFML-4A-DA	DRAWN BY:	D.G. Kellar	DATE:	6/24/13
CHANNEL/ FREQUENCY:	90.9 MHz	APPROVED BY:		DATE:	
SCALE:	1:20	DRAWING NO.:	J613FM-1177-002	REV.	



Maximum Envelope
Azimuth Plane Pattern
Antenna: PSIFML-4A-DA
Type: 4-Bay Directional FM Antenna
ERP: 4.0 kW (6.02 dBk)
RMS Envelope: .773
Frequency: 90.9 MHz
WXAF Charleston, WV

Propagation Systems Inc.
PO Box 113
Ebensburg, PA 15931

Maximum Envelope Tabulation

Antenna: PSIFML-4A-DA

Shofar Broadcasting Corporation

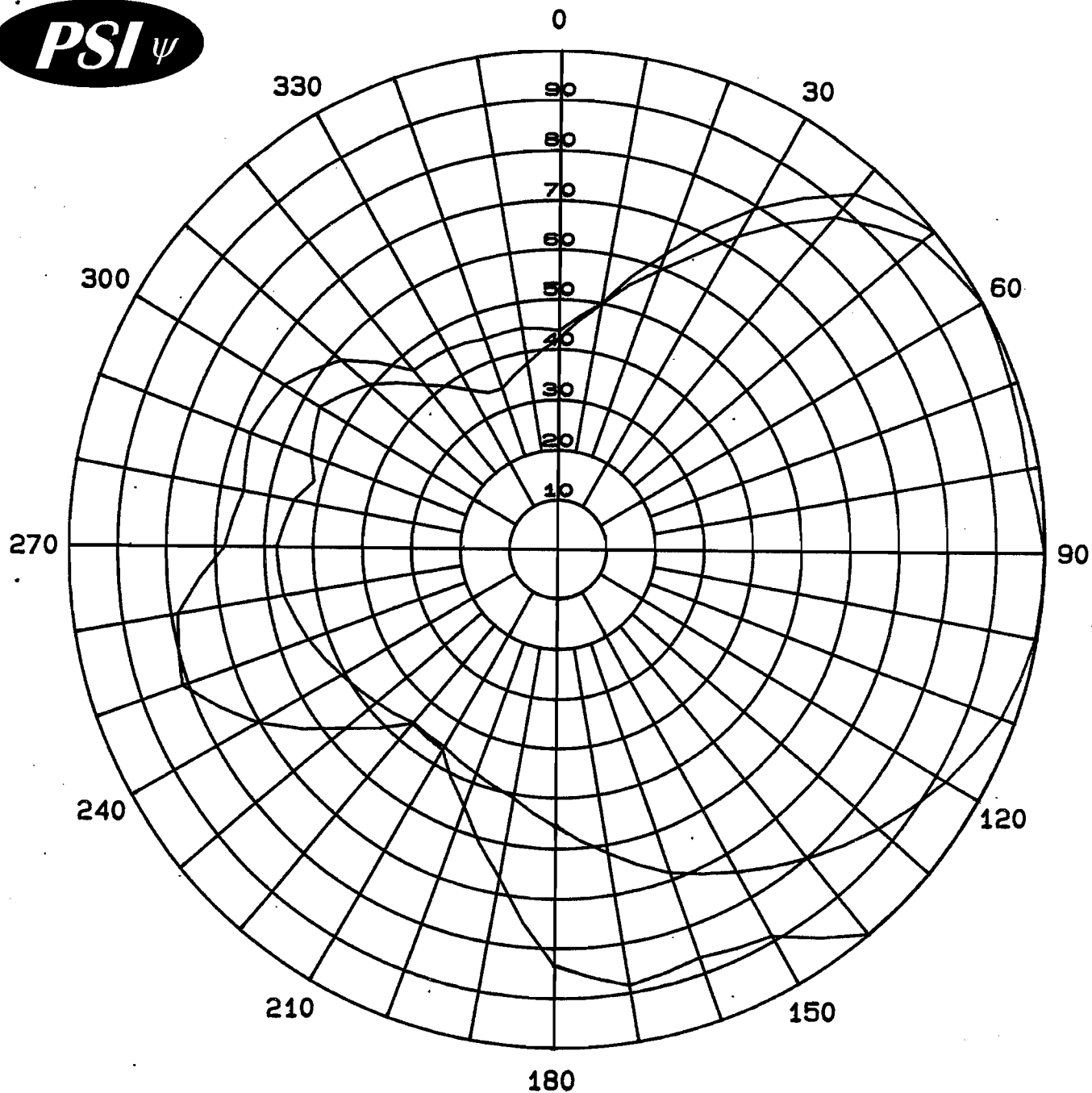
Station: WXAF

Frequency: 90.9 MHz

Location: Charleston, WV

Maximum ERP: 4.0 kW (6.02 dBk)

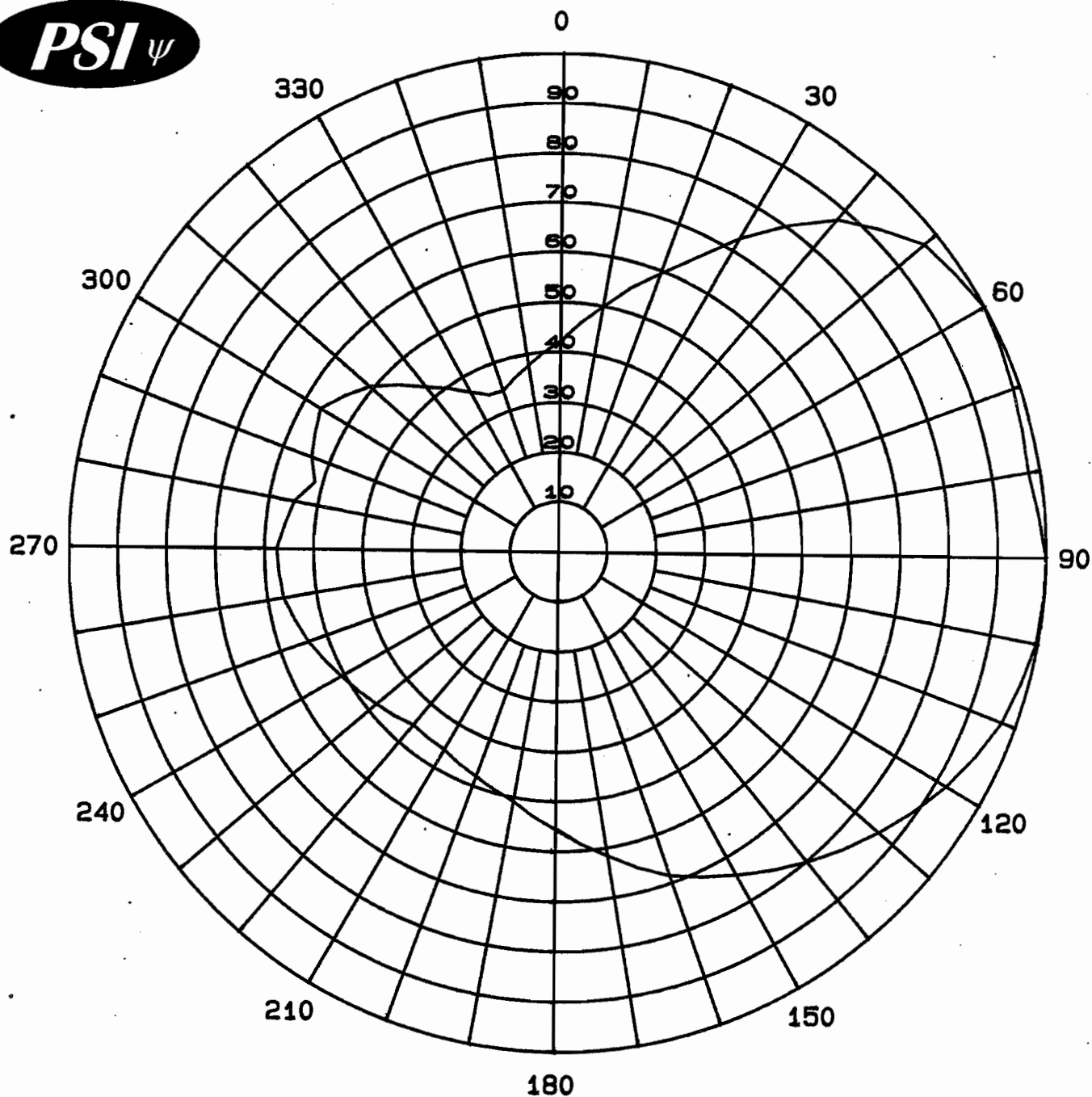
Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.437	0.76	-1.17
10	0.501	1.00	0.02
20	0.630	1.59	2.01
30	0.792	2.51	4.00
40	0.937	3.51	5.46
50	1.000	4.00	6.02
60	1.000	4.00	6.02
70	1.000	4.00	6.02
80	1.000	4.00	6.02
90	1.000	4.00	6.02
100	1.000	4.00	6.02
110	1.000	4.00	6.02
120	1.000	4.00	6.02
130	1.000	4.00	6.02
140	1.000	4.00	6.02
150	0.890	3.17	5.01
160	0.868	3.01	4.79
170	0.886	3.14	4.97
180	0.835	2.79	4.45
190	0.666	1.77	2.49
200	0.549	1.21	0.81
210	0.466	0.87	-0.61
220	0.457	0.84	-0.78
230	0.563	1.27	1.03
240	0.704	1.98	2.97
250	0.813	2.64	4.22
260	0.787	2.48	3.94
270	0.681	1.86	2.68
280	0.652	1.70	2.31
290	0.670	1.80	2.54
300	0.648	1.68	2.25
310	0.583	1.36	1.33
320	0.464	0.86	-0.65
330	0.459	0.84	-0.74
340	0.446	0.80	-0.99
350	0.448	0.80	-0.95



Maximum Envelope and
Composite Pattern
Antenna: PSIFML-4A-DA
Type: 4-Bay Directional FM Antenna
ERP: 4.0 kW (6.02 dBk)
RMS Envelope: .773
RMS Composite: .685
Frequency: 90.9 MHz

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Ebensburg, PA 15931

WXAF Charleston, WV



Measured Composite
Azimuth Plane Pattern
Antenna: PSIFML-4A-DA
Type: 4-Bay Directional FM Antenna
ERP: 4.0 kW (6.02 dBk)
RMS Composite: .685
Frequency: 90.9 MHz
WXAF Charleston, WV

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Ebensburg, PA 15931

Composite Pattern Tabulation

Antenna: PSIFML-4A-DA

Shofar Broadcasting Corporation

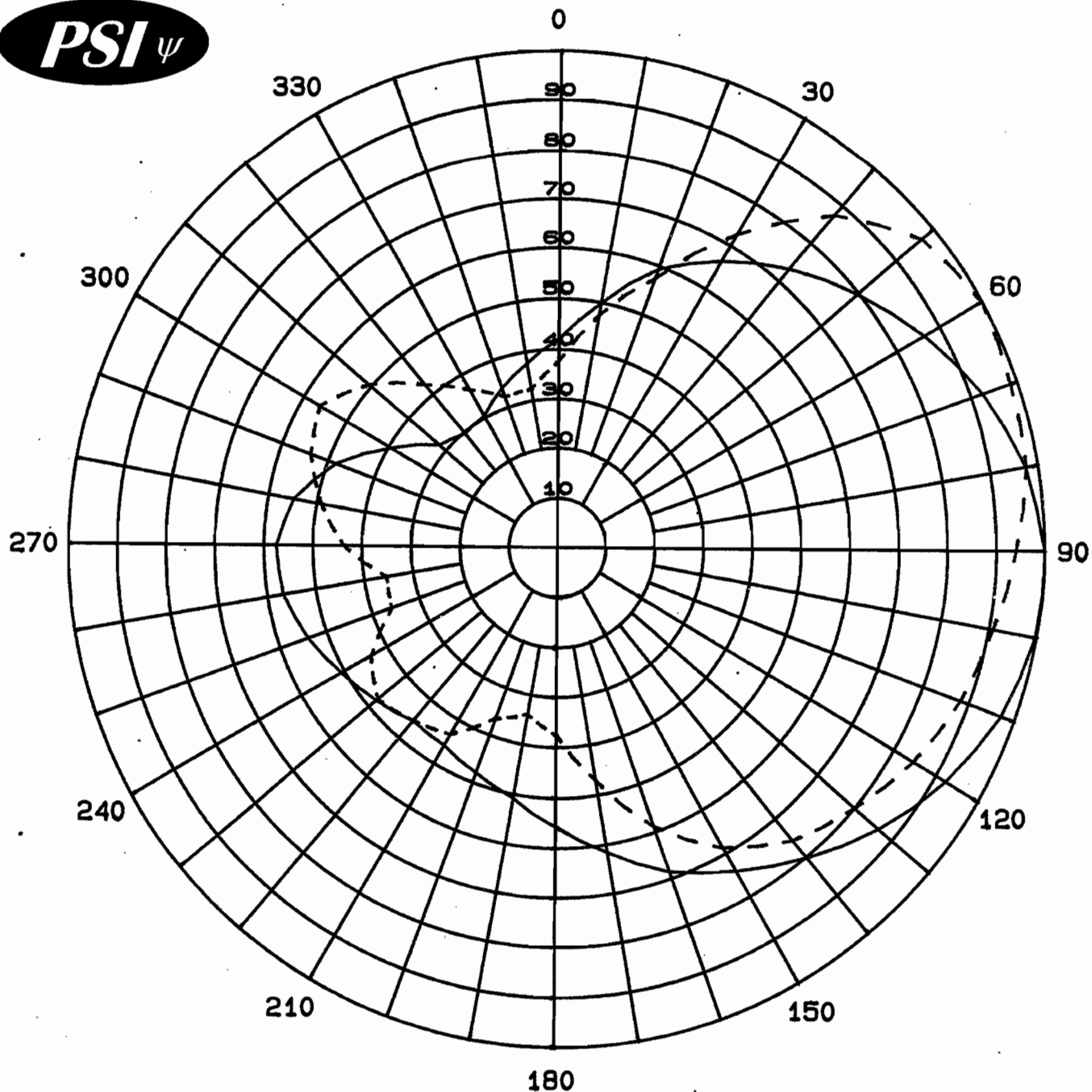
Station: WXAF

Frequency: 90.9 MHz

Location: Charleston, WV

Maximum ERP: 4.0 kW (6.02 dBk)

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.422	0.71	-1.47
10	0.500	1.00	0.00
20	0.595	1.42	1.51
30	0.728	2.12	3.26
40	0.876	3.07	4.87
50	0.969	3.76	5.75
60	1.000	4.00	6.02
70	0.986	3.89	5.90
80	0.976	3.81	5.81
90	1.000	4.00	6.02
100	0.997	3.98	5.99
110	0.971	3.77	5.76
120	0.923	3.41	5.32
130	0.864	2.99	4.75
140	0.802	2.57	4.10
150	0.742	2.20	3.43
160	0.687	1.89	2.76
170	0.617	1.52	1.83
180	0.556	1.24	0.92
190	0.507	1.03	0.12
200	0.479	0.92	-0.37
210	0.458	0.84	-0.76
220	0.455	0.83	-0.82
230	0.480	0.92	-0.35
240	0.507	1.03	0.12
250	0.539	1.16	0.65
260	0.567	1.29	1.09
270	0.575	1.32	1.21
280	0.548	1.20	0.80
290	0.538	1.16	0.64
300	0.564	1.27	1.05
310	0.508	1.03	0.14
320	0.427	0.73	-1.37
330	0.367	0.54	-2.69
340	0.342	0.47	-3.30
350	0.378	0.57	-2.43



Measured Relative Field
Azimuth Plane Pattern
Antenna: PSIFML-4A-DA
Type: 4-Bay Directional FM Antenna
Gain H-pol (solid): 4.33 (6.36 dB)
Gain V-pol (dash): 4.33 (6.36 dB)
Frequency: 90.9 MHz
WXAF Charleston, WV

Propagation Systems Inc.
PO Box 113
Ebensburg, PA 15931

Measured Relative Field Tabulation

Antenna: PSIFML-4A-DA

Shofar Broadcasting Corporation

Station: WXAF

Frequency: 90.9 MHz

Location: Charleston, WV

Horizontal Polarization

Angle	Relative Field	Power Gain	Gain (dB)
0	0.422	0.771	-1.13
10	0.500	1.083	0.34
20	0.595	1.533	1.86
30	0.665	1.915	2.82
40	0.733	2.326	3.67
50	0.798	2.757	4.40
60	0.865	3.240	5.11
70	0.925	3.705	5.69
80	0.974	4.108	6.14
90	1.000	4.330	6.36
100	0.997	4.304	6.34
110	0.971	4.083	6.11
120	0.923	3.689	5.67
130	0.864	3.232	5.10
140	0.802	2.785	4.45
150	0.742	2.384	3.77
160	0.687	2.044	3.10
170	0.617	1.648	2.17
180	0.556	1.339	1.27
190	0.507	1.113	0.47
200	0.479	0.993	-0.03
210	0.458	0.908	-0.42
220	0.455	0.896	-0.47
230	0.480	0.998	-0.01
240	0.507	1.113	0.47
250	0.539	1.258	1.00
260	0.567	1.392	1.44
270	0.575	1.432	1.56
280	0.548	1.300	1.14
290	0.484	1.014	0.06
300	0.395	0.676	-1.70
310	0.318	0.438	-3.59
320	0.298	0.385	-4.15
330	0.305	0.403	-3.95
340	0.342	0.506	-2.95
350	0.378	0.619	-2.09

Maximum Value

Field 1.00
Gain 4.33 (6.36 dB)
Azimuth Bearing 90-94 degrees

Minimum Field

Field 0.297
Gain .382 (-4.18 dB)
Azimuth Bearing 319 degrees

Vertical Polarization

Angle	Relative Field	Power Gain	Gain (dB)
0	0.377	0.615	-2.11
10	0.477	0.985	-0.06
20	0.576	1.437	1.57
30	0.728	2.295	3.61
40	0.876	3.323	5.21
50	0.969	4.066	6.09
60	1.000	4.330	6.36
70	0.986	4.210	6.24
80	0.976	4.125	6.15
90	0.941	3.834	5.84
100	0.908	3.570	5.53
110	0.882	3.368	5.27
120	0.846	3.099	4.91
130	0.799	2.764	4.42
140	0.756	2.475	3.94
150	0.688	2.050	3.12
160	0.589	1.502	1.77
170	0.472	0.965	-0.16
180	0.376	0.612	-2.13
190	0.338	0.495	-3.06
200	0.364	0.574	-2.41
210	0.433	0.812	-0.91
220	0.455	0.896	-0.47
230	0.477	0.985	-0.06
240	0.439	0.834	-0.79
250	0.359	0.558	-2.53
260	0.353	0.540	-2.68
270	0.436	0.823	-0.85
280	0.490	1.040	0.17
290	0.538	1.253	0.98
300	0.564	1.377	1.39
310	0.508	1.117	0.48
320	0.427	0.789	-1.03
330	0.367	0.583	-2.34
340	0.323	0.452	-3.45
350	0.325	0.457	-3.40

Maximum Value

Field 1.00
Gain 4.33 (6.36 dB)
Azimuth Bearing 59-62 degrees

Minimum Field

Field 0.322
Gain .449 (-3.48 dB)
Azimuth Bearing 342 degrees

ERP Tabulation

Antenna: PSIFML-4A-DA
Shofar Broadcasting Corporation
Station: WXAF
Frequency: 90.9 MHz
Location: Charleston, WV
Maximum ERP: 4.0 kW (6.02 dBk)

Horizontal Polarization

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.422	0.71	-1.47
10	0.500	1.00	0.00
20	0.595	1.42	1.51
30	0.665	1.77	2.48
40	0.733	2.15	3.32
50	0.798	2.55	4.06
60	0.865	2.99	4.76
70	0.925	3.42	5.34
80	0.974	3.79	5.79
90	1.000	4.00	6.02
100	0.997	3.98	5.99
110	0.971	3.77	5.76
120	0.923	3.41	5.32
130	0.864	2.99	4.75
140	0.802	2.57	4.10
150	0.742	2.20	3.43
160	0.687	1.89	2.76
170	0.617	1.52	1.83
180	0.556	1.24	0.92
190	0.507	1.03	0.12
200	0.479	0.92	-0.37
210	0.458	0.84	-0.76
220	0.455	0.83	-0.82
230	0.480	0.92	-0.35
240	0.507	1.03	0.12
250	0.539	1.16	0.65
260	0.567	1.29	1.09
270	0.575	1.32	1.21
280	0.548	1.20	0.80
290	0.484	0.94	-0.28
300	0.395	0.62	-2.05
310	0.318	0.40	-3.93
320	0.298	0.36	-4.50
330	0.305	0.37	-4.29
340	0.342	0.47	-3.30
350	0.378	0.57	-2.43

Maximum Value (H-pol)

Field 1.00
ERP 4.0 kW (5.02 dBk)
Azimuth Bearing 90-94 degrees

Minimum Field (H-pol)

Field 0.297
ERP .353 kW (-4.52 dBk)
Azimuth Bearing 319 degrees

Vertical Polarization

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.377	0.57	-2.45
10	0.477	0.91	-0.41
20	0.576	1.33	1.23
30	0.728	2.12	3.26
40	0.876	3.07	4.87
50	0.969	3.76	5.75
60	1.000	4.00	6.02
70	0.986	3.89	5.90
80	0.976	3.81	5.81
90	0.941	3.54	5.49
100	0.908	3.30	5.18
110	0.882	3.11	4.93
120	0.846	2.86	4.57
130	0.799	2.55	4.07
140	0.756	2.29	3.59
150	0.688	1.89	2.77
160	0.589	1.39	1.42
170	0.472	0.89	-0.50
180	0.376	0.57	-2.48
190	0.338	0.46	-3.40
200	0.364	0.53	-2.76
210	0.433	0.75	-1.25
220	0.455	0.83	-0.82
230	0.477	0.91	-0.41
240	0.439	0.77	-1.13
250	0.359	0.52	-2.88
260	0.353	0.50	-3.02
270	0.436	0.76	-1.19
280	0.490	0.96	-0.18
290	0.538	1.16	0.64
300	0.564	1.27	1.05
310	0.508	1.03	0.14
320	0.427	0.73	-1.37
330	0.367	0.54	-2.69
340	0.323	0.42	-3.80
350	0.325	0.42	-3.74

Maximum Value (V-pol)

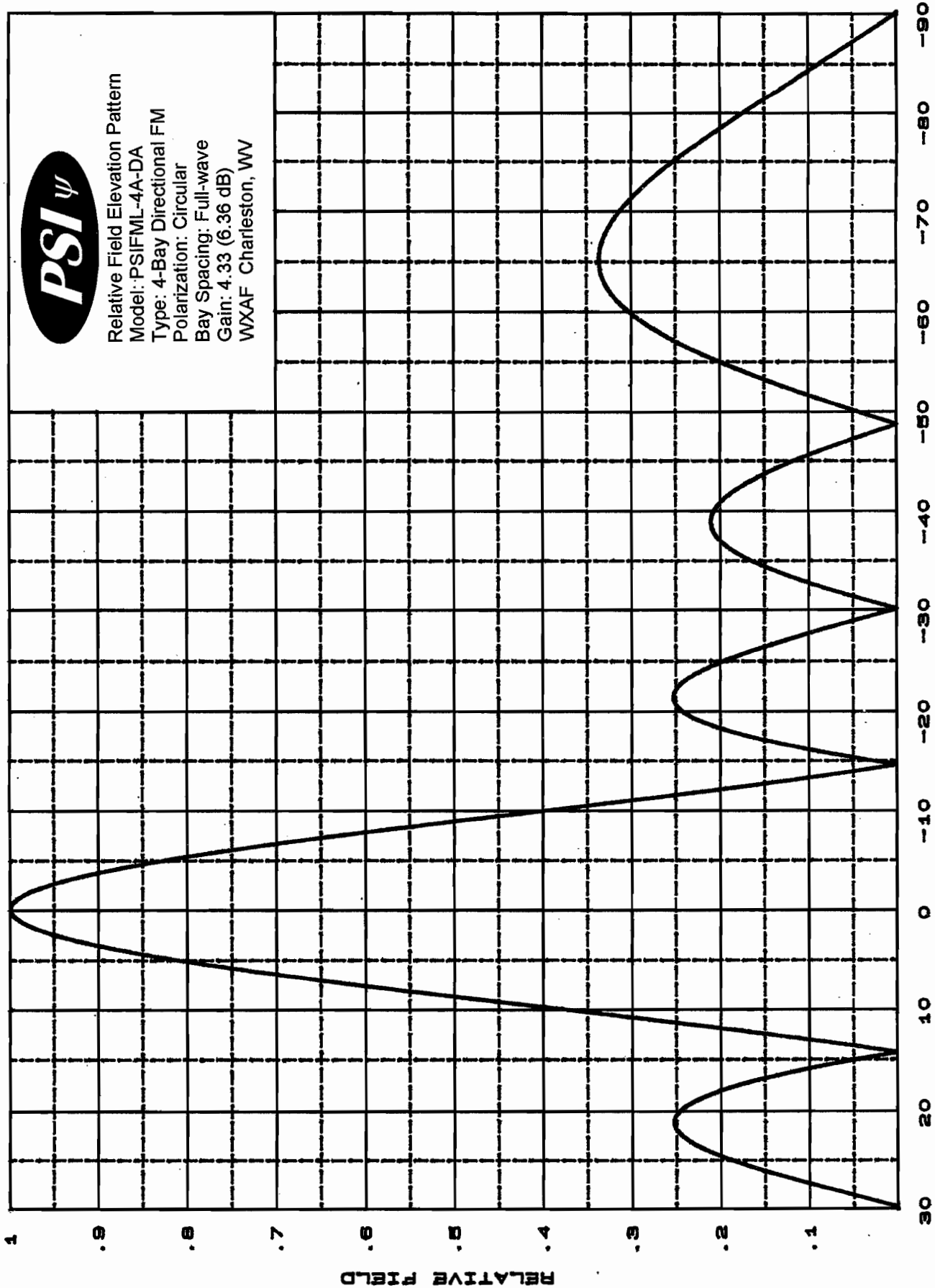
Field 1.00
ERP 4.0 kW (5.02 dBk)
Azimuth Bearing 59-62 degrees

Minimum Field (V-pol)

Field 0.322
ERP .415 kW (-3.82 dBk)
Azimuth Bearing 342 degrees



Relative Field Elevation Pattern
Model: PSIFML-4A-DA
Type: 4-Bay Directional FM
Polarization: Circular
Bay Spacing: Full-wave
Gain: 4.33 (6.36 dB)
WXAF Charleston, WV



DEGREES BELOW HORIZONTAL