



Propagation Systems, Inc.

Quality Broadcast Antenna Systems

Directional FM Antenna
Muskegon Community Radio Broadcast Company
WHEY
North Muskegon, MI
11-20-2008

A standard model PSIFML antenna with parasitic elements was used in conjunction with the customer's tower to create the necessary directional radiation pattern. The final antenna consists of three radiating elements each secured to the southwest tower leg with a factory installed mounting bracket. The antenna bays are $.9\lambda$ spaced and there are a total of three horizontal parasitic elements. The antenna array is branch fed and utilizes a 3-way power divider and $\frac{1}{2}$ " coaxial transmission lines to distribute equal power and phase to each radiating element.

Pattern testing was performed using a $\frac{1}{3}$ 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 structure 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 266.7 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 94% of the envelope RMS.


The antenna center of radiation approved in the construction permit is 41 meters above ground. With the antenna mounted to the tower as shown in drawing J908FM-717-001 rev A it will be within the $\pm 2/-4$ meter tolerance allowed by the FCC. No other antenna can be installed within 10 ft of any radiating element. The antenna is to be positioned 290° True. It is recommended that a broadcast engineer be 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 555.6 watts will be required at the antenna input in order to reach the licensed 1.0 kW ERP. The transmitter output power will be 641.4 watts with 175 ft. of 7/8" coaxial transmission line as supplied.

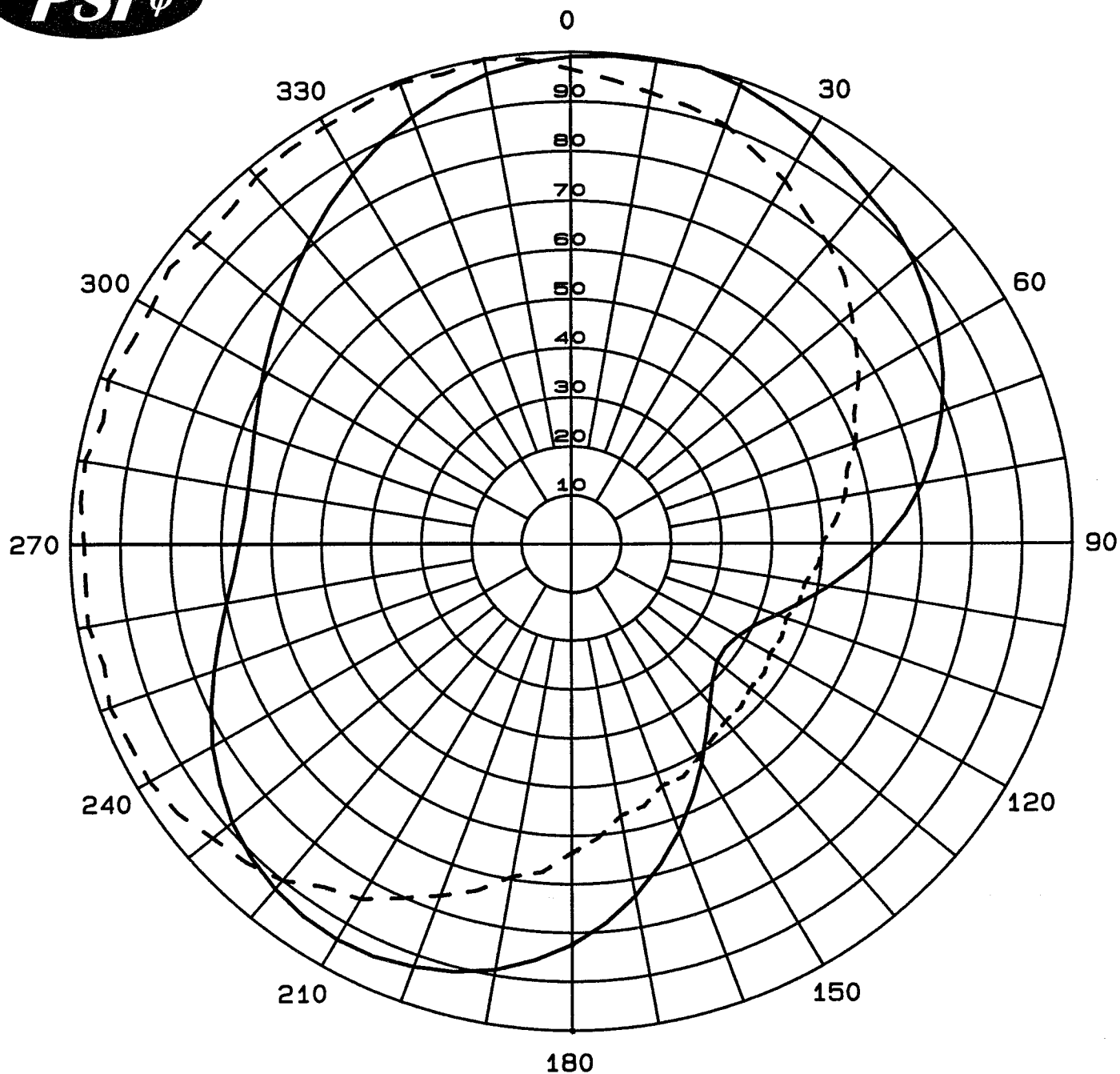
Antenna Specifications

Antenna Model	PSIFML-3-DA
Type	3-bay $.9\lambda$ spaced directional FM antenna
Frequency	88.9 MHz
Envelope RMS	.909
Composite RMS	.858
Gain (h-pol)	1.8 (2.55 dB)
RMS (h-pol)	.78
Gain (v-pol)	1.8 (2.55 dB)
RMS (v-pol)	.80
ERP	1.0 kW
Transmitter output	641.5 Watts
Transmission line	7/8' foam coaxial cable x 175 ft
Efficiency	86.6%
Power into antenna	555.6 Watts
Input	7/8" EIA center fed input
Power rating	1.5 kW
Length	19.9 ft.
Weight	178.1 lbs.

Prepared By



Douglas A. Ross
Propagation Systems Inc.
11-20-2008



Measured Relative Field
Azimuth Plane Pattern
Antenna: PSIFML-3-DA
Type: 3-Bay Directional Antenna
Polarization: Circular
Gain H-pol (solid): 1.8 (2.55 dB)
Gain V-pol (dash): 1.8 (2.55 dB)
WHEY-FM North Muskegon, MI

Propagation Systems Inc.
PO Box 113
Ebensburg, PA 15931

Measured Relative Field Tabulation

Antenna: PSIFML-3-DA
Muskegon Community Radio Broadcast Company
Station: WHEY
Frequency: 88.9 MHz
Location: North Muskegon, MI

Horizontal Polarization

Angle	Relative Field	Power Gain	Gain (dB)
0	0.990	1.76	2.46
10	0.994	1.78	2.50
20	0.988	1.76	2.45
30	0.957	1.65	2.17
40	0.922	1.53	1.85
50	0.891	1.43	1.55
60	0.846	1.29	1.10
70	0.788	1.12	0.48
80	0.712	0.91	-0.39
90	0.620	0.69	-1.61
100	0.520	0.49	-3.13
110	0.435	0.34	-4.68
120	0.384	0.26	-5.77
130	0.379	0.26	-5.87
140	0.430	0.33	-4.78
150	0.520	0.49	-3.13
160	0.629	0.71	-1.48
170	0.735	0.97	-0.13
180	0.824	1.22	0.87
190	0.890	1.43	1.54
200	0.926	1.54	1.89
210	0.940	1.59	2.01
220	0.924	1.54	1.87
230	0.887	1.42	1.51
240	0.830	1.24	0.93
250	0.761	1.04	0.18
260	0.701	0.88	-0.54
270	0.665	0.80	-0.99
280	0.657	0.78	-1.10
290	0.676	0.82	-0.85
300	0.710	0.91	-0.42
310	0.756	1.03	0.12
320	0.812	1.19	0.75
330	0.869	1.36	1.33
340	0.924	1.54	1.86
350	0.968	1.68	2.27

Maximum Value

Field 1.00
Gain 1.80 (2.55 dB)
Azimuth Bearing 15 degrees

Minimum Field

Field 0.375
Gain .253 (-5.98 dB)
Azimuth Bearing 125 degrees

Vertical Polarization

Angle	Relative Field	Power Gain	Gain (dB)
0	0.964	1.67	2.23
10	0.929	1.55	1.91
20	0.903	1.47	1.67
30	0.851	1.30	1.15
40	0.795	1.14	0.56
50	0.729	0.96	-0.20
60	0.662	0.79	-1.03
70	0.604	0.66	-1.83
80	0.553	0.55	-2.59
90	0.500	0.45	-3.46
100	0.473	0.40	-3.95
110	0.455	0.37	-4.29
120	0.456	0.37	-4.26
130	0.465	0.39	-4.11
140	0.478	0.41	-3.86
150	0.508	0.46	-3.33
160	0.528	0.50	-2.99
170	0.566	0.58	-2.39
180	0.634	0.72	-1.41
190	0.694	0.87	-0.62
200	0.770	1.07	0.28
210	0.844	1.28	1.08
220	0.902	1.46	1.66
230	0.939	1.59	2.00
240	0.974	1.71	2.32
250	0.981	1.73	2.38
260	0.980	1.73	2.37
270	0.973	1.71	2.32
280	0.985	1.75	2.42
290	0.982	1.74	2.40
300	0.966	1.68	2.25
310	0.962	1.67	2.21
320	0.977	1.72	2.35
330	0.980	1.73	2.37
340	0.995	1.78	2.51
350	1.000	1.80	2.55

Maximum Value

Field 1.00
Gain 1.8 (2.55 dB)
Azimuth Bearing 350 degrees

Minimum Field

Field 0.455
Gain .373 (-4.29 dB)
Azimuth Bearing 110 degrees

ERP Tabulation

Antenna: PSIFML-3-DA
Muskegon Community Radio Broadcast Company
Station: WHEY
Frequency: 88.9 MHz
Location: North Muskegon, MI
Maximum ERP: 1.0 kW (0.0 dBk)

Horizontal Polarization

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.990	0.979	-0.092
10	0.994	0.989	-0.050
20	0.988	0.976	-0.107
30	0.957	0.917	-0.378
40	0.922	0.851	-0.703
50	0.891	0.795	-0.999
60	0.846	0.716	-1.453
70	0.788	0.621	-2.071
80	0.712	0.508	-2.946
90	0.620	0.384	-4.158
100	0.520	0.270	-5.687
110	0.435	0.189	-7.234
120	0.384	0.147	-8.325
130	0.379	0.144	-8.420
140	0.430	0.185	-7.333
150	0.520	0.270	-5.682
160	0.629	0.395	-4.034
170	0.735	0.539	-2.680
180	0.824	0.679	-1.683
190	0.890	0.792	-1.014
200	0.926	0.858	-0.666
210	0.940	0.883	-0.540
220	0.924	0.855	-0.683
230	0.887	0.787	-1.040
240	0.830	0.689	-1.621
250	0.761	0.580	-2.369
260	0.701	0.491	-3.088
270	0.665	0.442	-3.544
280	0.657	0.432	-3.649
290	0.676	0.456	-3.406
300	0.710	0.505	-2.971
310	0.756	0.571	-2.431
320	0.812	0.660	-1.805
330	0.869	0.755	-1.220
340	0.924	0.853	-0.691
350	0.968	0.936	-0.287

Maximum Value (H-pol)

Field 1.00
ERP 1.0 kW (0.0 dBk)
Azimuth Bearing 15 degrees

Minimum Field (H-pol)

Field 0.375
ERP .140 kW (-8.83 dBk)
Azimuth Bearing 125 degrees

Vertical Polarization

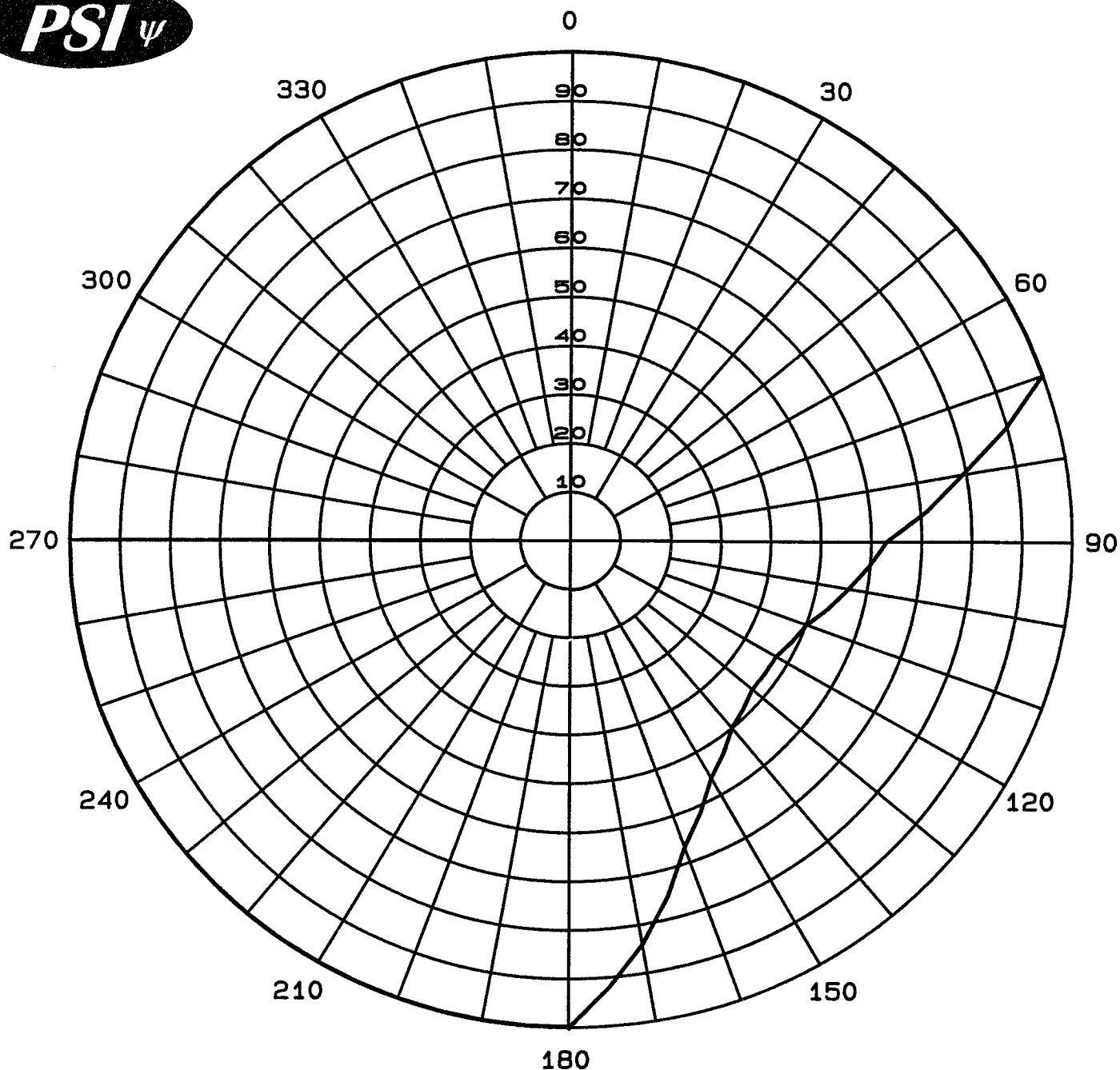
Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.964	0.929	-0.319
10	0.929	0.863	-0.638
20	0.903	0.816	-0.883
30	0.851	0.725	-1.399
40	0.795	0.632	-1.993
50	0.729	0.531	-2.750
60	0.662	0.438	-3.585
70	0.604	0.365	-4.379
80	0.553	0.306	-5.141
90	0.500	0.250	-6.017
100	0.473	0.224	-6.505
110	0.455	0.207	-6.838
120	0.456	0.208	-6.815
130	0.465	0.216	-6.658
140	0.478	0.228	-6.415
150	0.508	0.258	-5.883
160	0.528	0.279	-5.544
170	0.566	0.320	-4.947
180	0.634	0.402	-3.961
190	0.694	0.482	-3.173
200	0.770	0.593	-2.268
210	0.844	0.713	-1.472
220	0.902	0.814	-0.896
230	0.939	0.881	-0.551
240	0.974	0.948	-0.230
250	0.981	0.962	-0.170
260	0.980	0.960	-0.179
270	0.973	0.948	-0.234
280	0.985	0.971	-0.129
290	0.982	0.965	-0.156
300	0.966	0.933	-0.302
310	0.962	0.925	-0.338
320	0.977	0.954	-0.204
330	0.980	0.959	-0.180
340	0.995	0.991	-0.041
350	1.000	1.000	0.000

Maximum Value (V-pol)

Field 1.00
ERP 1.0 kW (0.0 dBk)
Azimuth Bearing 350 degrees

Minimum Field (V-pol)

Field 0.455
ERP .207 kW (-6.84 dBk)
Azimuth Bearing 110 degrees



Maximum Envelope
Azimuth Plane Pattern
Antenna: PSIFML-3-DA
Type: 3-Bay Directional Antenna
Polarization: Circular
ERP: 1.0 kW (0.0 dBk)
Frequency: 88.9 MHz
WHEY-FM North Muskegon, MI

Propagation Systems Inc.
PO Box 113
Ebensburg, PA 15931

Maximum Envelope Tabulation

Antenna: PSIFML-3-DA

Muskegon Community Radio Broadcast Company

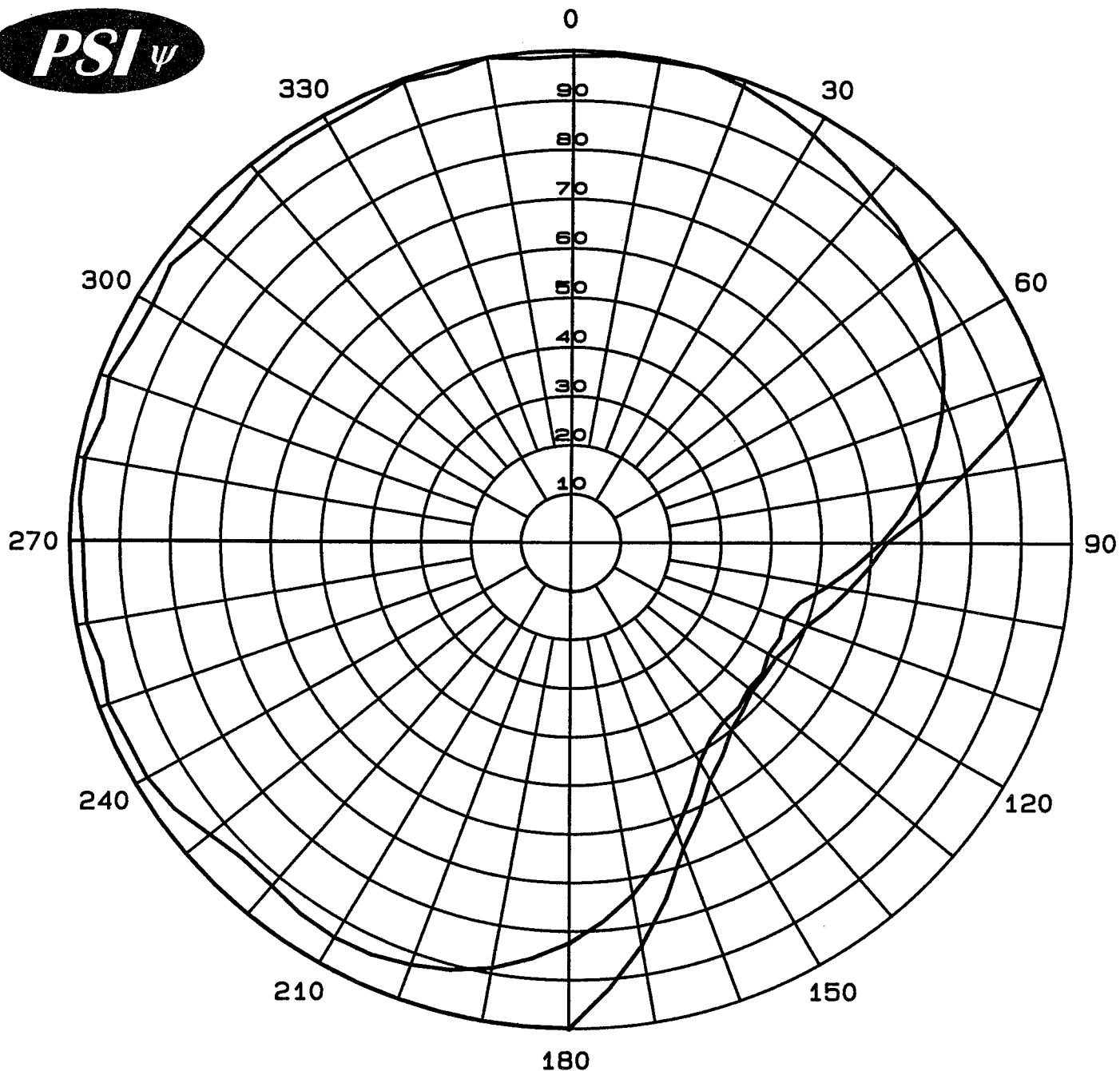
Station: WHEY

Frequency: 88.9 MHz

Location: North Muskegon, MI

Maximum ERP: 1.0 kW (0.0 dBk)

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	1.000	1.000	0.00
10	1.000	1.000	0.00
20	1.000	1.000	0.00
30	1.000	1.000	0.00
40	1.000	1.000	0.00
50	1.000	1.000	0.00
60	1.000	1.000	0.00
70	1.000	1.000	0.00
80	0.794	0.630	-2.00
90	0.631	0.398	-4.00
100	0.562	0.316	-5.01
110	0.501	0.251	-6.00
120	0.473	0.224	-6.50
130	0.473	0.224	-6.50
140	0.501	0.251	-6.00
150	0.562	0.316	-5.01
160	0.668	0.446	-3.50
170	0.841	0.707	-1.50
180	1.000	1.000	0.00
190	1.000	1.000	0.00
200	1.000	1.000	0.00
210	1.000	1.000	0.00
220	1.000	1.000	0.00
230	1.000	1.000	0.00
240	1.000	1.000	0.00
250	1.000	1.000	0.00
260	1.000	1.000	0.00
270	1.000	1.000	0.00
280	1.000	1.000	0.00
290	1.000	1.000	0.00
300	1.000	1.000	0.00
310	1.000	1.000	0.00
320	1.000	1.000	0.00
330	1.000	1.000	0.00
340	1.000	1.000	0.00
350	1.000	1.000	0.00



Maximum Envelope and
Measured Composite Pattern
Antenna: PSIFML-3-DA
Type: 3-Bay Directional Antenna
ERP: 1.0 kW (0.0 dBk)
RMS envelope: .909
RMS composite: .858
WHEY-FM North Muskegon, MI

Propagation Systems Inc.
PO Box 113
Ebensburg, PA 15931

Composite Pattern Tabulation

Antenna: PSIFML-3-DA
Muskegon Community Radio Broadcast Company
Station: WHEY
Frequency: 88.9 MHz
Location: North Muskegon, MI
Maximum ERP: 1.0 kW (0.0 dBk)

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.990	0.979	-0.09
10	0.994	0.989	-0.05
20	0.988	0.976	-0.11
30	0.957	0.917	-0.38
40	0.922	0.851	-0.70
50	0.891	0.795	-1.00
60	0.846	0.716	-1.45
70	0.788	0.621	-2.07
80	0.712	0.508	-2.95
90	0.620	0.384	-4.16
100	0.520	0.270	-5.69
110	0.455	0.207	-6.84
120	0.456	0.208	-6.81
130	0.465	0.216	-6.66
140	0.478	0.228	-6.42
150	0.520	0.270	-5.68
160	0.629	0.395	-4.03
170	0.735	0.539	-2.68
180	0.824	0.679	-1.68
190	0.890	0.792	-1.01
200	0.926	0.858	-0.67
210	0.940	0.883	-0.54
220	0.924	0.855	-0.68
230	0.939	0.881	-0.55
240	0.974	0.948	-0.23
250	0.981	0.962	-0.17
260	0.980	0.960	-0.18
270	0.973	0.948	-0.23
280	0.985	0.971	-0.13
290	0.982	0.965	-0.16
300	0.966	0.933	-0.30
310	0.962	0.925	-0.34
320	0.977	0.954	-0.20
330	0.980	0.959	-0.18
340	0.995	0.991	-0.04
350	1.000	1.000	0.00



Relative Field Elevation Pattern
Model: PSIFML-3-DA
Type: 3-Bay Directional FM Antenna
Bay Spacing: .9 wavelength
Call Letters: WHEY
Gain: 1.8 (2.55 dB)

