



# Propagation Systems, Inc.

Quality Broadcast Antenna Systems

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**Directional FM Antenna  
North End Woodward Community Coalition  
WNUC-LP  
Detroit, MI**

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 two radiating elements each secured to the northwest tower leg with a factory installed mounting bracket. The antenna bays are half-wave spaced and there are a total of two horizontal and two vertical parasitic elements. The antenna array is branch fed and utilizes a 2-way power divider and ½" coaxial transmission lines to distribute equal power and phase to each radiating element.

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 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 8753E-network analyzer operating at 290.1 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 89.2% of the envelope RMS.

The antenna center of radiation approved in the construction permit is 33 meters (108.2 ft.) above ground. The antenna is to be mounted to a tower which is mounted to the roof top of an existing building. No other antenna can be installed within 10 ft of any radiating element. The antenna is to be positioned 335° 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 46 watts will be required at the antenna input in order to reach the licensed .058 kW ERP. The transmitter output power requirements are dependent upon the transmission line size and length used to feed the antenna.

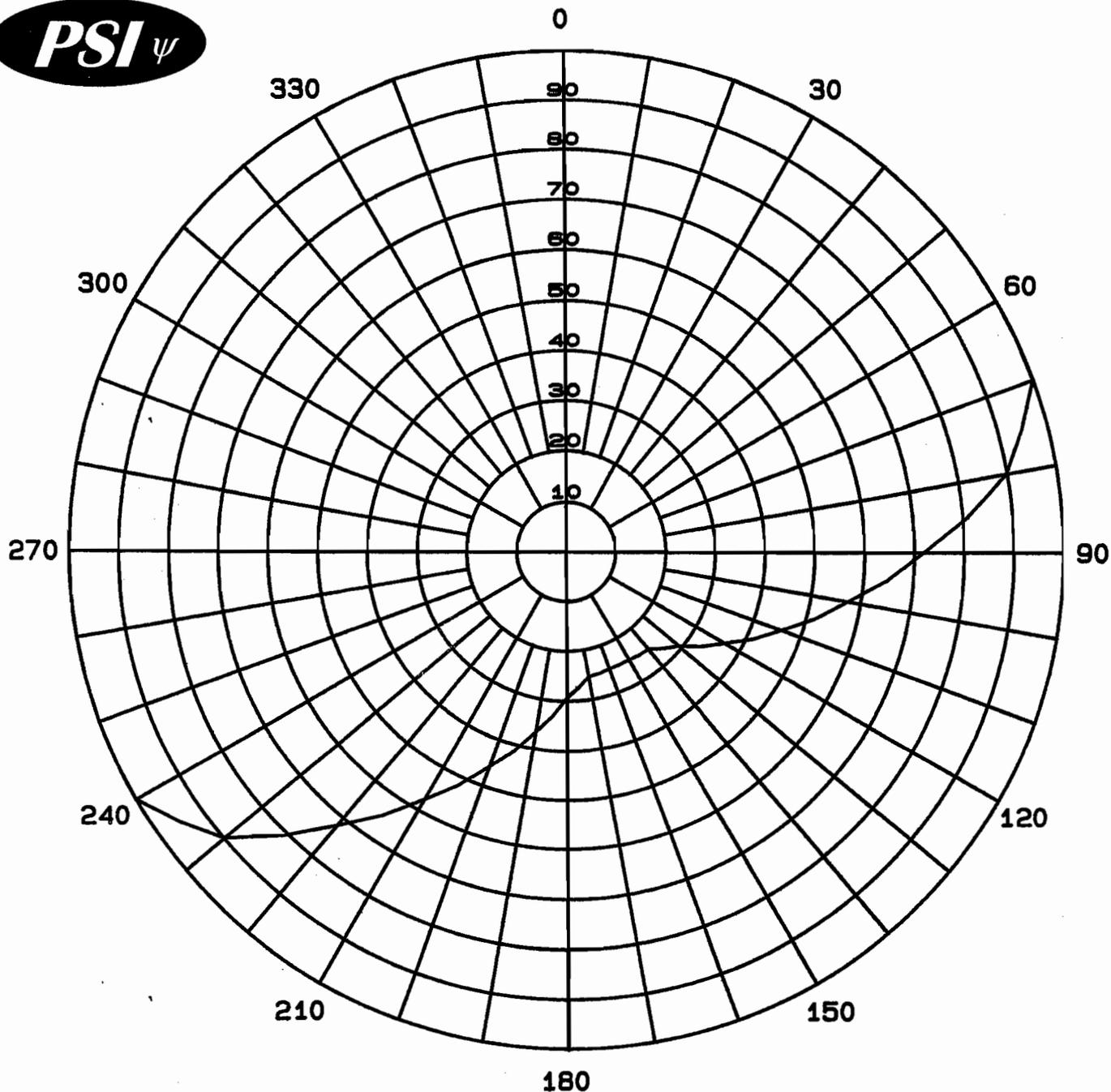
### **Antenna Specifications**

Antenna Model	PSIFML-2A-50WS-DA
Type	2-bay directional FM antenna
Bay Spacing	Half-wave spaced elements
Frequency	96.7 MHz
Envelope RMS	.823
Composite RMS	.734
Gain (h-pol)	1.26 (1.00 dB)
Gain (v-pol)	1.26 (1.00 dB)
ERP	.058 kW
Power into antenna	46 Watts
Input	7/8" EIA center fed input
Power rating	1.5 kW
Length	11.34 ft.
Weight	85.7 lbs.
Wind Area	24.14 ft <sup>2</sup>

### **Prepared By**

 11/4/2015

Douglas A. Ross  
Propagation Systems Inc.



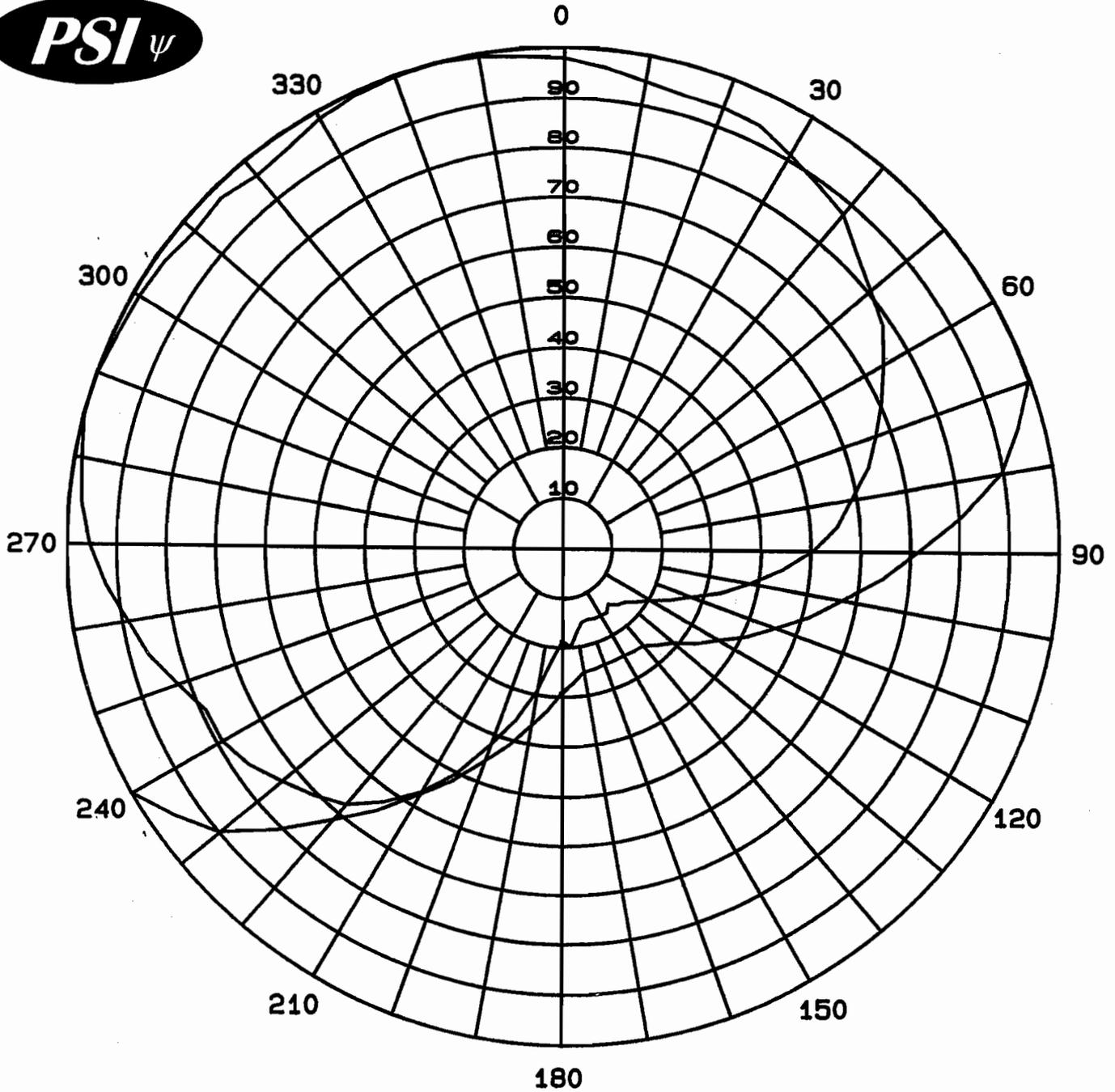
Maximum Envelope  
Azimuth Plane Pattern  
Antenna: PSIFML-2A-50WS-DA  
Type: 2-Bay Directional FM Antenna  
ERP: .058 kW (-12.37 dBk)  
RMS Envelope: .823  
Frequency: 96.7 MHz  
WNUC-LP Detroit, MI

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

## Maximum Envelope Tabulation

Antenna: PSIFML-2A-50WS-DA  
North End Woodward Community Coalition  
Station: WNUC-LP  
Frequency: 96.7 MHz  
Location: Detroit, MI  
Maximum ERP: .058 kW (-12.37 dBk)

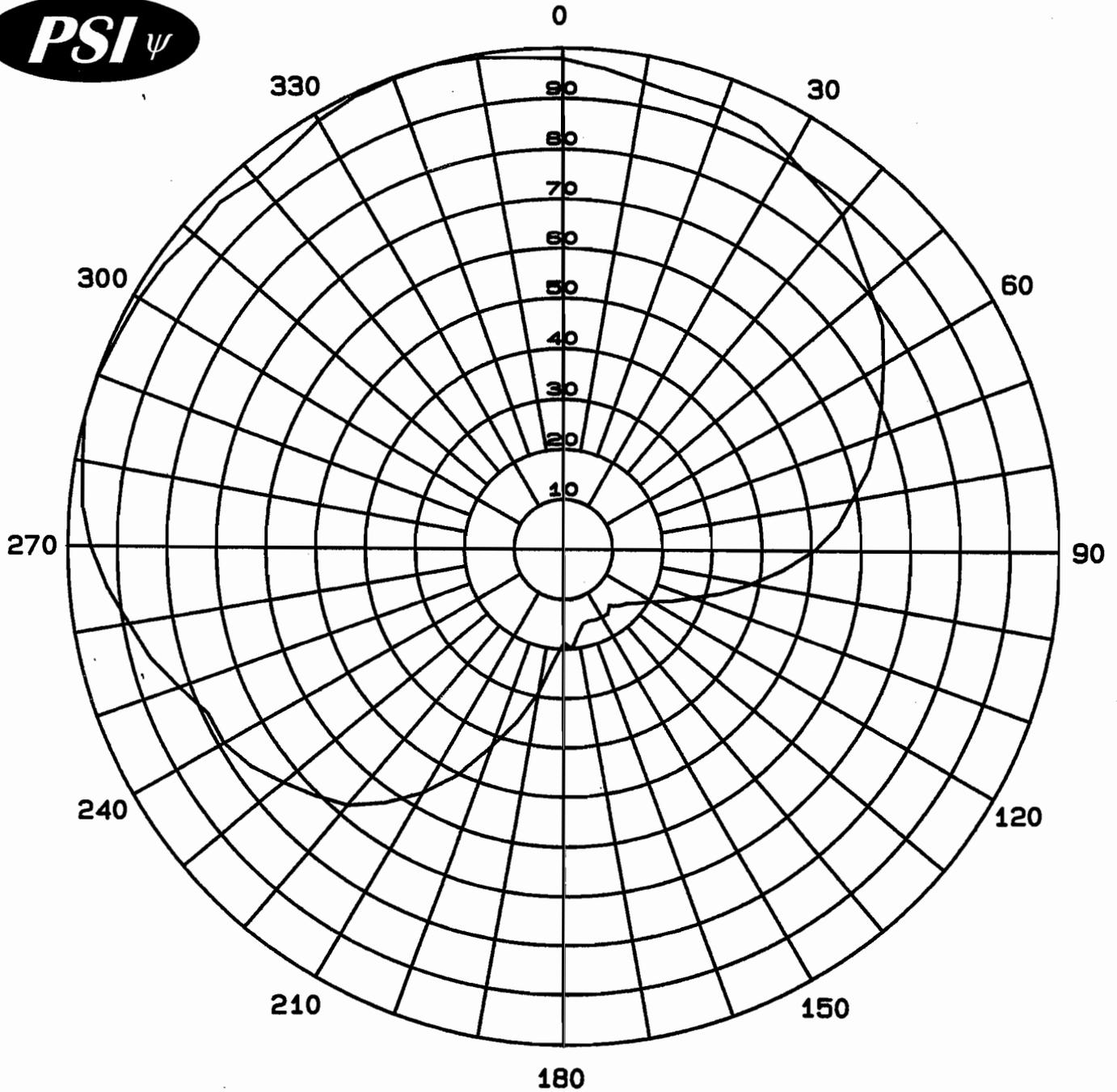
Angle	Relative Field	ERP (kW)	ERP (dBk)
0	1.000	0.058	-12.37
10	1.000	0.058	-12.37
20	1.000	0.058	-12.37
30	1.000	0.058	-12.37
40	1.000	0.058	-12.37
50	1.000	0.058	-12.37
60	1.000	0.058	-12.37
70	1.000	0.058	-12.37
80	0.899	0.047	-13.29
90	0.719	0.030	-15.23
100	0.574	0.019	-17.19
110	0.459	0.012	-19.13
120	0.366	0.008	-21.10
130	0.293	0.005	-23.03
140	0.255	0.004	-24.23
150	0.250	0.004	-24.41
160	0.250	0.004	-24.41
170	0.255	0.004	-24.23
180	0.293	0.005	-23.03
190	0.366	0.008	-21.10
200	0.459	0.012	-19.13
210	0.574	0.019	-17.19
220	0.719	0.030	-15.23
230	0.899	0.047	-13.29
240	1.000	0.058	-12.37
250	1.000	0.058	-12.37
260	1.000	0.058	-12.37
270	1.000	0.058	-12.37
280	1.000	0.058	-12.37
290	1.000	0.058	-12.37
300	1.000	0.058	-12.37
310	1.000	0.058	-12.37
320	1.000	0.058	-12.37
330	1.000	0.058	-12.37
340	1.000	0.058	-12.37
350	1.000	0.058	-12.37



Maximum Envelope and Composite Pattern  
Antenna: PSIFML-2A-50WS-DA  
Type: 2-Bay Directional FM Antenna  
ERP: .058 kW (-12.37 dBk)  
RMS Envelope: .823  
RMS Composite: .734  
Frequency: 96.7 MHz

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WNUC-LP Detroit, MI



Measured Composite  
Azimuth Plane Pattern  
Antenna: PSIFML-2A-50WS-DA  
Type: 2-Bay Directional FM Antenna  
ERP: .058 kW (-12.37 dBk)  
RMS Composite: .734  
Frequency: 96.7 MHz  
WNUC-LP Detroit, MI

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## Composite Pattern Tabulation

Antenna: PSIFML-2A-50WS-DA

North End Woodward Community Coalition

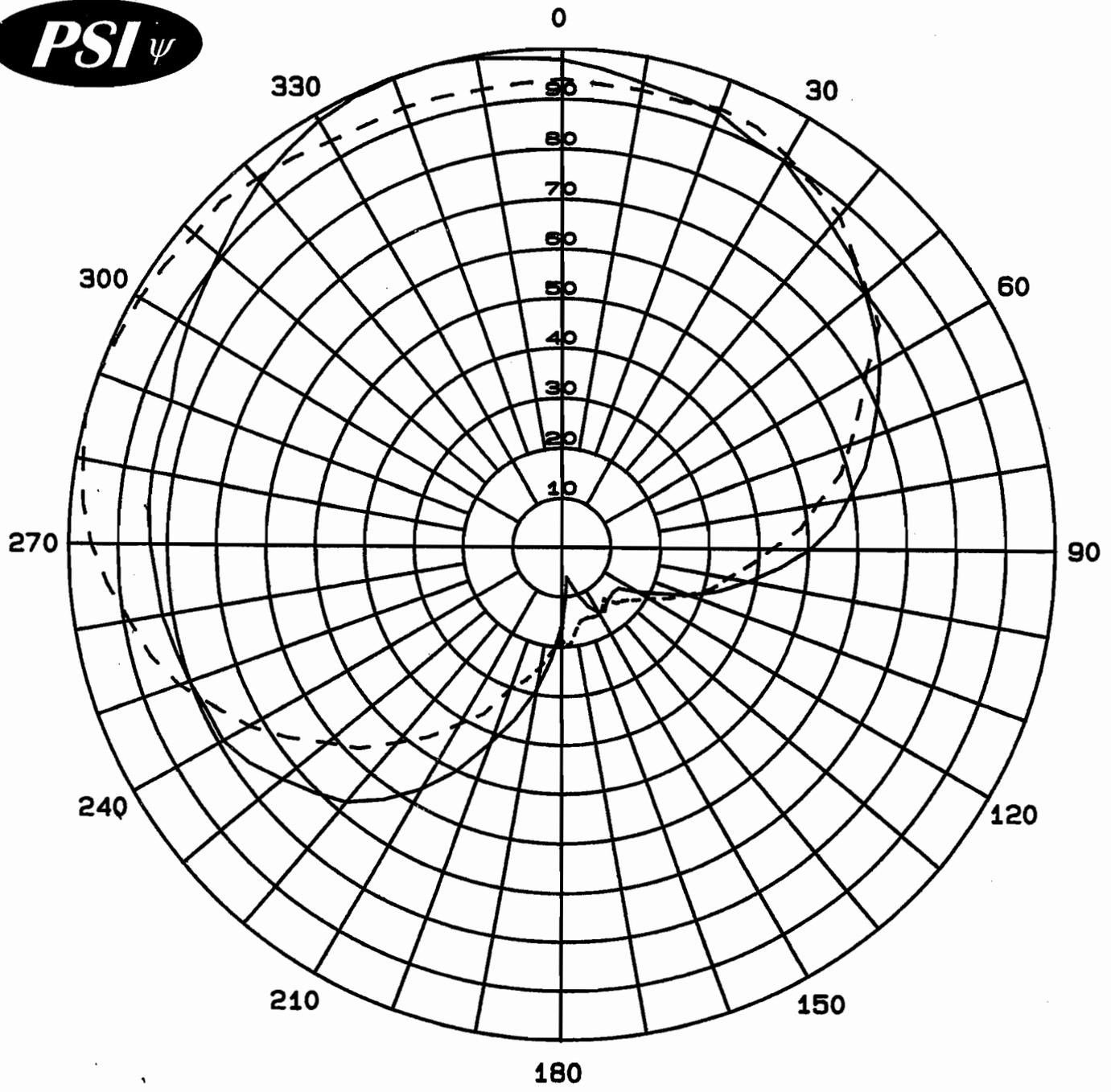
Station: WNUC-LP

Frequency: 96.7 MHz

Location: Detroit, MI

Maximum ERP: .058 kW (-12.37 dBk)

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.979	0.056	-12.55
10	0.948	0.052	-12.83
20	0.940	0.051	-12.90
30	0.911	0.048	-13.18
40	0.875	0.044	-13.53
50	0.807	0.038	-14.23
60	0.745	0.032	-14.92
70	0.671	0.026	-15.83
80	0.591	0.020	-16.93
90	0.506	0.015	-18.28
100	0.384	0.009	-20.68
110	0.277	0.004	-23.52
120	0.205	0.002	-26.13
130	0.166	0.002	-27.96
140	0.145	0.001	-29.14
150	0.155	0.001	-28.56
160	0.151	0.001	-28.79
170	0.171	0.002	-27.71
180	0.188	0.002	-26.88
190	0.293	0.005	-23.03
200	0.423	0.010	-19.84
210	0.568	0.019	-17.28
220	0.677	0.027	-15.75
230	0.736	0.031	-15.03
240	0.789	0.036	-14.42
250	0.823	0.039	-14.06
260	0.887	0.046	-13.41
270	0.953	0.053	-12.78
280	0.985	0.056	-12.50
290	0.999	0.058	-12.37
300	0.987	0.057	-12.48
310	0.970	0.055	-12.63
320	0.961	0.054	-12.71
330	0.985	0.056	-12.50
340	0.998	0.058	-12.38
350	0.995	0.057	-12.41



Measured Relative Field  
Azimuth Plane Pattern  
Antenna: PSIFML-2A-50WS-DA  
Type: 2-Bay Directional FM Antenna  
Gain H-pol (solid): 1.26 (1.00 dB)  
Gain V-pol (dash): 1.26 (1.00 dB)  
Frequency: 96.7 MHz  
WNUC-LP Detroit, MI

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**Ebensburg, PA 15931**

## Measured Relative Field Tabulation

Antenna: PSIFML-2A-50WS-DA  
 North End Woodward Community Coalition  
 Station: WNUC-LP  
 Frequency: 96.7 MHz  
 Location: Detroit, MI

### Horizontal Polarization

Angle	Relative Field	Power Gain	Gain (dB)
0	0.979	1.208	0.82
10	0.948	1.132	0.54
20	0.931	1.092	0.38
30	0.900	1.021	0.09
40	0.850	0.910	-0.41
50	0.803	0.812	-0.90
60	0.745	0.699	-1.55
70	0.671	0.567	-2.46
80	0.591	0.440	-3.56
90	0.506	0.323	-4.91
100	0.384	0.186	-7.31
110	0.277	0.097	-10.15
120	0.176	0.039	-14.09
130	0.139	0.024	-16.14
140	0.145	0.026	-15.77
150	0.150	0.028	-15.47
160	0.104	0.014	-18.66
170	0.061	0.005	-23.29
180	0.163	0.033	-14.75
190	0.293	0.108	-9.66
200	0.423	0.225	-6.47
210	0.568	0.407	-3.91
220	0.677	0.577	-2.38
230	0.736	0.683	-1.66
240	0.789	0.784	-1.05
250	0.800	0.806	-0.93
260	0.820	0.847	-0.72
270	0.833	0.874	-0.58
280	0.842	0.893	-0.49
290	0.842	0.893	-0.49
300	0.875	0.965	-0.16
310	0.907	1.037	0.16
320	0.952	1.142	0.58
330	0.985	1.222	0.87
340	0.998	1.255	0.99
350	0.995	1.247	0.96

**Maximum Value**

Field 1.00  
 Gain 1.26 (1.00 dB)  
 Azimuth Bearing 345 degrees

**Minimum Field**

Field 0.061  
 Gain .005 (-23.29 dB)  
 Azimuth Bearing 170 degrees

### Vertical Polarization

Angle	Relative Field	Power Gain	Gain (dB)
0	0.940	1.113	0.47
10	0.934	1.099	0.41
20	0.940	1.113	0.47
30	0.911	1.046	0.19
40	0.875	0.965	-0.16
50	0.807	0.821	-0.86
60	0.713	0.641	-1.93
70	0.623	0.489	-3.11
80	0.526	0.349	-4.58
90	0.428	0.231	-6.37
100	0.344	0.149	-8.27
110	0.275	0.095	-10.21
120	0.205	0.053	-12.76
130	0.166	0.035	-14.59
140	0.135	0.023	-16.39
150	0.155	0.030	-15.19
160	0.151	0.029	-15.42
170	0.171	0.037	-14.34
180	0.188	0.045	-13.51
190	0.244	0.075	-11.25
200	0.304	0.116	-9.34
210	0.412	0.214	-6.70
220	0.517	0.337	-4.73
230	0.618	0.481	-3.18
240	0.729	0.670	-1.74
250	0.823	0.853	-0.69
260	0.887	0.991	-0.04
270	0.953	1.144	0.59
280	0.985	1.222	0.87
290	0.999	1.257	1.00
300	0.987	1.227	0.89
310	0.970	1.186	0.74
320	0.961	1.164	0.66
330	0.938	1.109	0.45
340	0.937	1.106	0.44
350	0.933	1.097	0.40

**Maximum Value**

Field 1.00  
 Gain 1.26 (1.00 dB)  
 Azimuth Bearing 285 degrees

**Minimum Field**

Field 0.135  
 Gain .023 (-16.39 dB)  
 Azimuth Bearing 140 degrees

## ERP Tabulation

Antenna: PSIFML-2A-50WS-DA  
 North End Woodward Community Coalition  
 Station: WNUC-LP  
 Frequency: 96.7 MHz  
 Location: Detroit, MI  
 Maximum ERP: .058 kW (-12.37 dBk)

### Horizontal Polarization

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.979	0.056	-12.55
10	0.948	0.052	-12.83
20	0.931	0.050	-12.99
30	0.900	0.047	-13.28
40	0.850	0.042	-13.78
50	0.803	0.037	-14.27
60	0.745	0.032	-14.92
70	0.671	0.026	-15.83
80	0.591	0.020	-16.93
90	0.506	0.015	-18.28
100	0.384	0.009	-20.68
110	0.277	0.004	-23.52
120	0.176	0.002	-27.46
130	0.139	0.001	-29.51
140	0.145	0.001	-29.14
150	0.150	0.001	-28.84
160	0.104	0.001	-32.03
170	0.061	0.000	-36.66
180	0.163	0.002	-28.12
190	0.293	0.005	-23.03
200	0.423	0.010	-19.84
210	0.568	0.019	-17.28
220	0.677	0.027	-15.75
230	0.736	0.031	-15.03
240	0.789	0.036	-14.42
250	0.800	0.037	-14.30
260	0.820	0.039	-14.09
270	0.833	0.040	-13.95
280	0.842	0.041	-13.86
290	0.842	0.041	-13.86
300	0.875	0.044	-13.53
310	0.907	0.048	-13.21
320	0.952	0.053	-12.79
330	0.985	0.056	-12.50
340	0.998	0.058	-12.38
350	0.995	0.057	-12.41

Maximum Value (H-pol)

Field 1.00  
 ERP .058 kW (-12.37 dBk)  
 Azimuth Bearing 345 degrees

Minimum Field (H-pol)

Field 0.061  
 ERP .0002 kW (-36.66 dBk)  
 Azimuth Bearing 170 degrees

### Vertical Polarization

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.940	0.051	-12.90
10	0.934	0.051	-12.96
20	0.940	0.051	-12.90
30	0.911	0.048	-13.18
40	0.875	0.044	-13.53
50	0.807	0.038	-14.23
60	0.713	0.029	-15.30
70	0.623	0.023	-16.48
80	0.526	0.016	-17.95
90	0.428	0.011	-19.74
100	0.344	0.007	-21.63
110	0.275	0.004	-23.58
120	0.205	0.002	-26.13
130	0.166	0.002	-27.96
140	0.135	0.001	-29.76
150	0.155	0.001	-28.56
160	0.151	0.001	-28.79
170	0.171	0.002	-27.71
180	0.188	0.002	-26.88
190	0.244	0.003	-24.62
200	0.304	0.005	-22.71
210	0.412	0.010	-20.07
220	0.517	0.016	-18.10
230	0.618	0.022	-16.55
240	0.729	0.031	-15.11
250	0.823	0.039	-14.06
260	0.887	0.046	-13.41
270	0.953	0.053	-12.78
280	0.985	0.056	-12.50
290	0.999	0.058	-12.37
300	0.987	0.057	-12.48
310	0.970	0.055	-12.63
320	0.961	0.054	-12.71
330	0.938	0.051	-12.92
340	0.937	0.051	-12.93
350	0.933	0.050	-12.97

Maximum Value (V-pol)

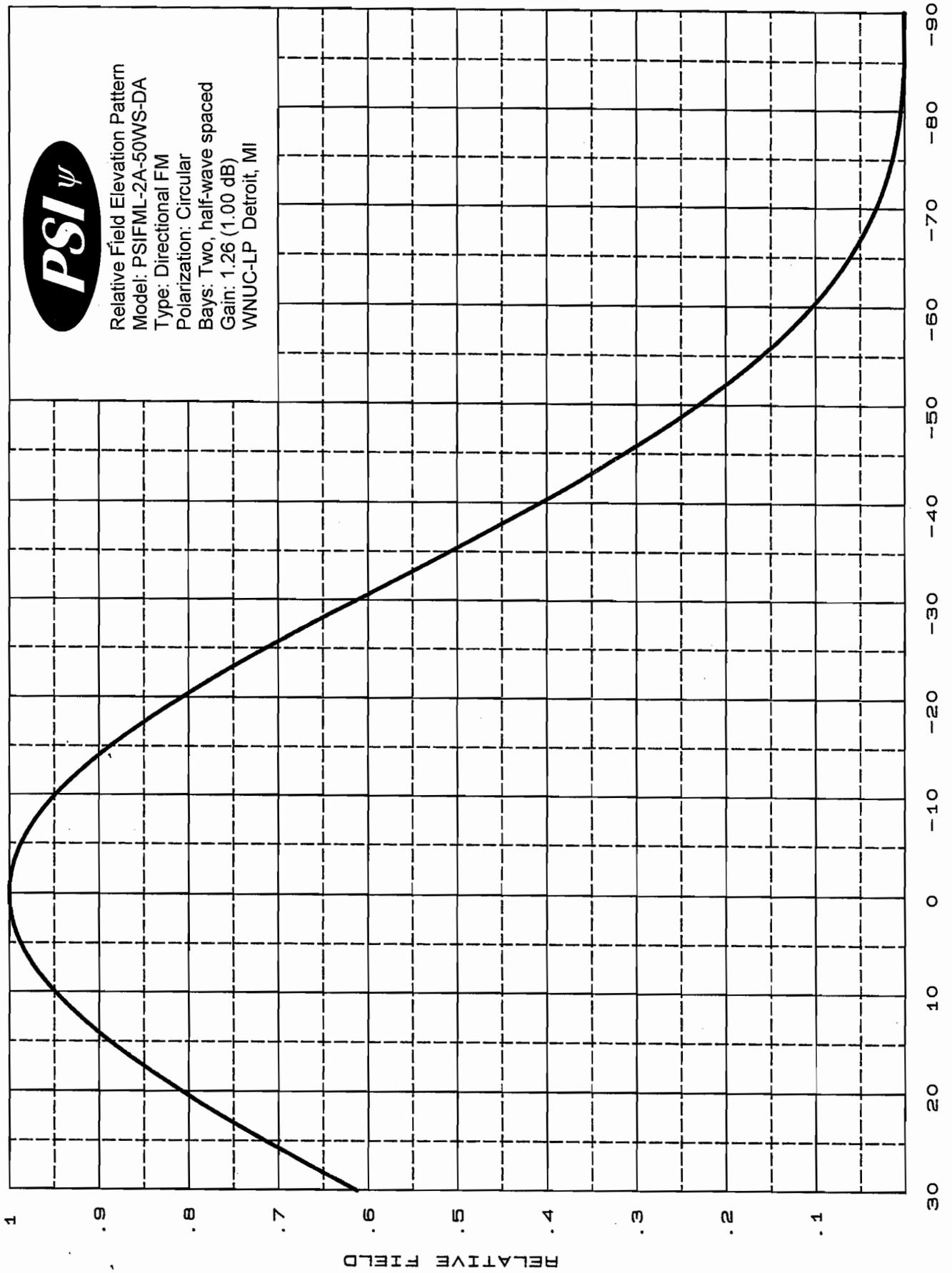
Field 1.00  
 ERP .058 kW (-12.37 dBk)  
 Azimuth Bearing 285 degrees

Minimum Field (V-pol)

Field 0.135  
 ERP .001 kW (-29.76 dBk)  
 Azimuth Bearing 140 degrees



Relative Field Elevation Pattern  
Model: PSIFML-2A-50WS-DA  
Type: Directional FM  
Polarization: Circular  
Bays: Two, half-wave spaced  
Gain: 1.26 (1.00 dB)  
WNUC-LP Detroit, MI



DEGREES BELOW HORIZONTAL