



Propagation Systems, Inc.

Quality Broadcast Antenna Systems

**Directional FM Antenna
Fairleigh Dickinson University
WFDU
Teaneck, NJ**

A standard model PSIFML antenna was used in conjunction with the customer's 4.5" diameter support mast to create the necessary directional radiation pattern. The final antenna consists of two radiating elements each secured to the mast with a custom mounting bracket. There are two horizontal and two vertical parasitic elements per bay. The antenna bays are half-wave spaced and each radiating element receives equal power and phase.

Pattern testing was performed using a 1/3 scale model element and mast. 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 mast 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 267.3 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 94.4% of the envelope RMS.

The antenna is to be mounted with the center of radiation at 77 meters (253 ft.) above ground level on the customer supplied support mast. At this elevation the antenna will be within the allowed +2m/-4m tolerance from the approved height above ground level as specified in permit file number BMPED-20150901AAZ. No other antenna can be installed within 10 ft of any radiating element. The antenna is to be positioned 150° True and certified by a licensed surveyor. It is recommended that a broadcast engineer is

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 1.42 kW will be required at the antenna input in order to reach the licensed 3.0 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	PSIFML-2C-50WS-H-DA
Type	2-bay directional FM antenna
Bay Spacing	Half-wave spaced elements with electrical deicers
Frequency	89.1 MHz
Polarization	Circular
Envelope RMS	.624
Composite RMS	.589
Gain (h-pol)	2.12 (3.26 dB)
Gain (V-pol)	2.107 (3.24 dB)
Antenna input power	1.42 kW
Input	7/8" EIA center fed input
Power rating	2.0 kW
Length	11.62 ft.
Antenna Weight	133 lbs.
Antenna Wind Area	12.8 sq. ft.

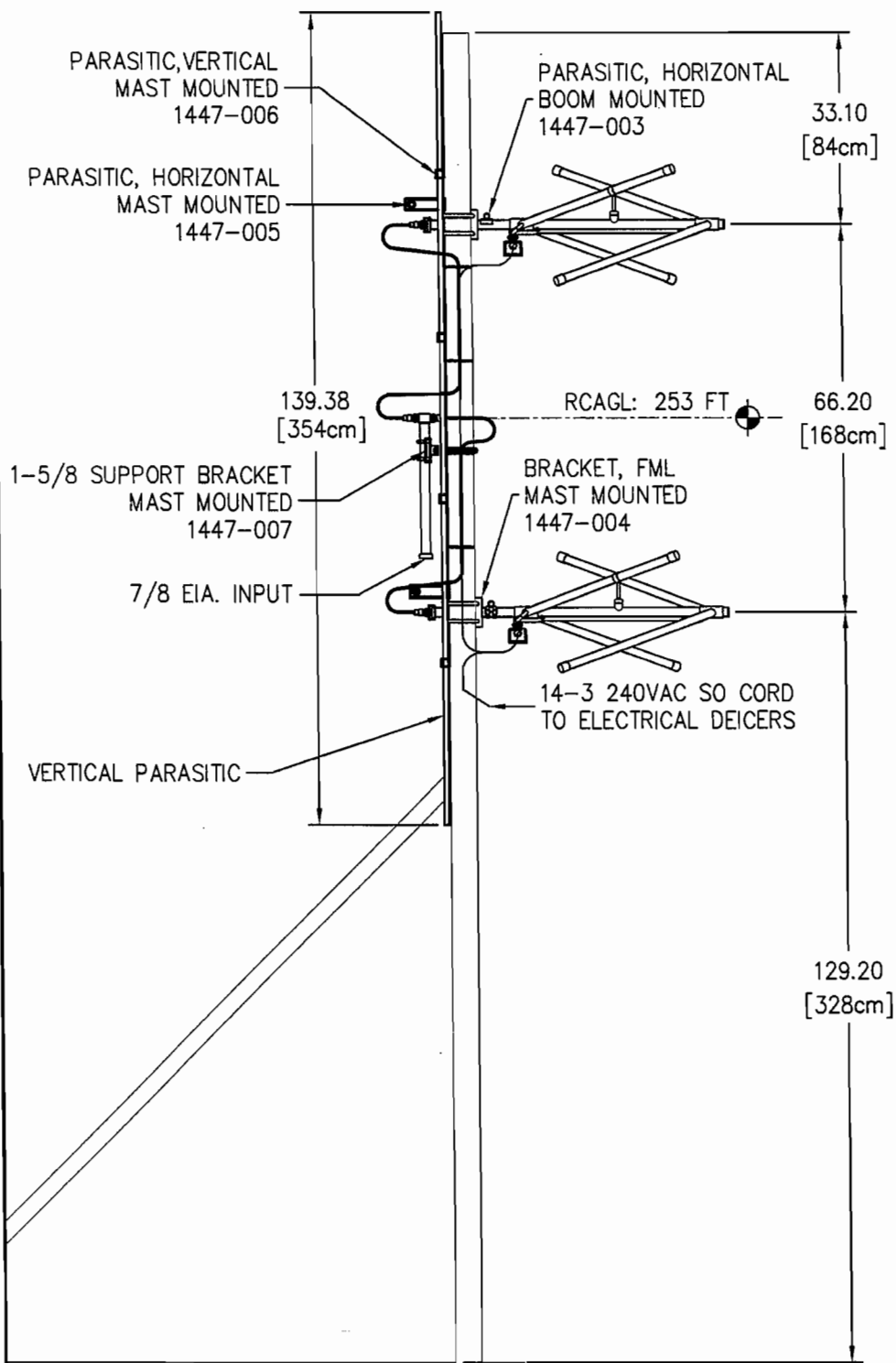
Statement of Certification

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.



9/10/2015

Douglas A. Ross
President
Propagation Systems Inc.



SPECIFICATIONS
SPACING: 0.50 λ
LENGTH: 11.62 FT
APERTURE: 5.52 FT
RATING: 2.0 kW
GAIN: 2.12 (3.26 dB)
WEIGHT: 133 LB [60.33 Kg]
WINDAREA: 12.8 FT ²
TIA-222-F (NO ICE)
NOTE:

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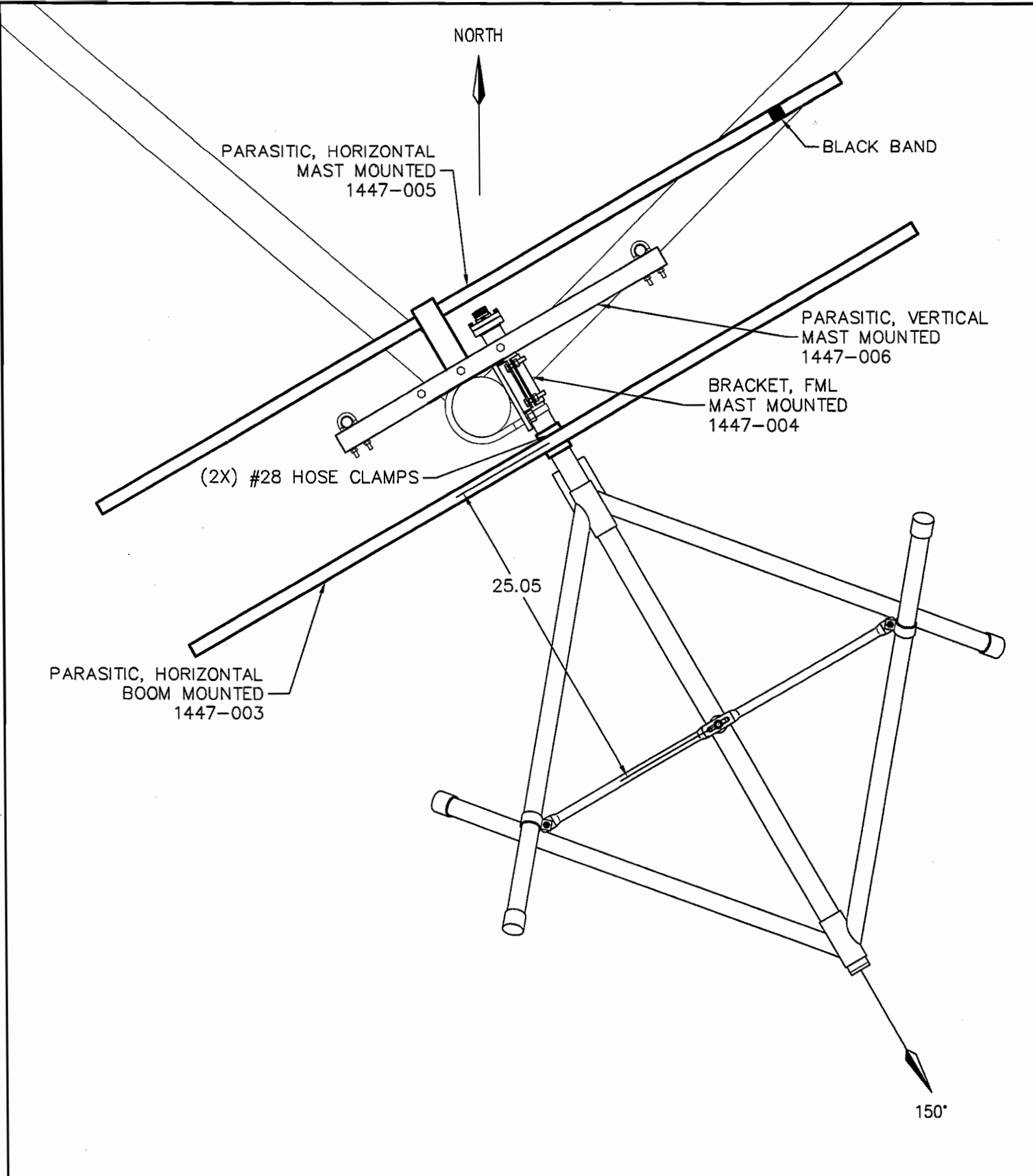
Ebensburg, Pennsylvania USA 814-472-5540

REV.	MADE BY	CHECKED BY	DATE	CHANGE

ANTENNA ELEVATION AND SPECIFICATIONS

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MODEL: PSIFML-2C-50WS-H-DA	DRAWN BY: B.K.SCHILLING	DATE: 6/4/15
CHANNEL/ FREQUENCY: 89.1 MHz	APPROVED BY:	DATE:
SCALE: 1:30	DRAWING NO.: 1447-001	REV.



REV.	MADE BY	CHECKED BY	DATE	CHANGE

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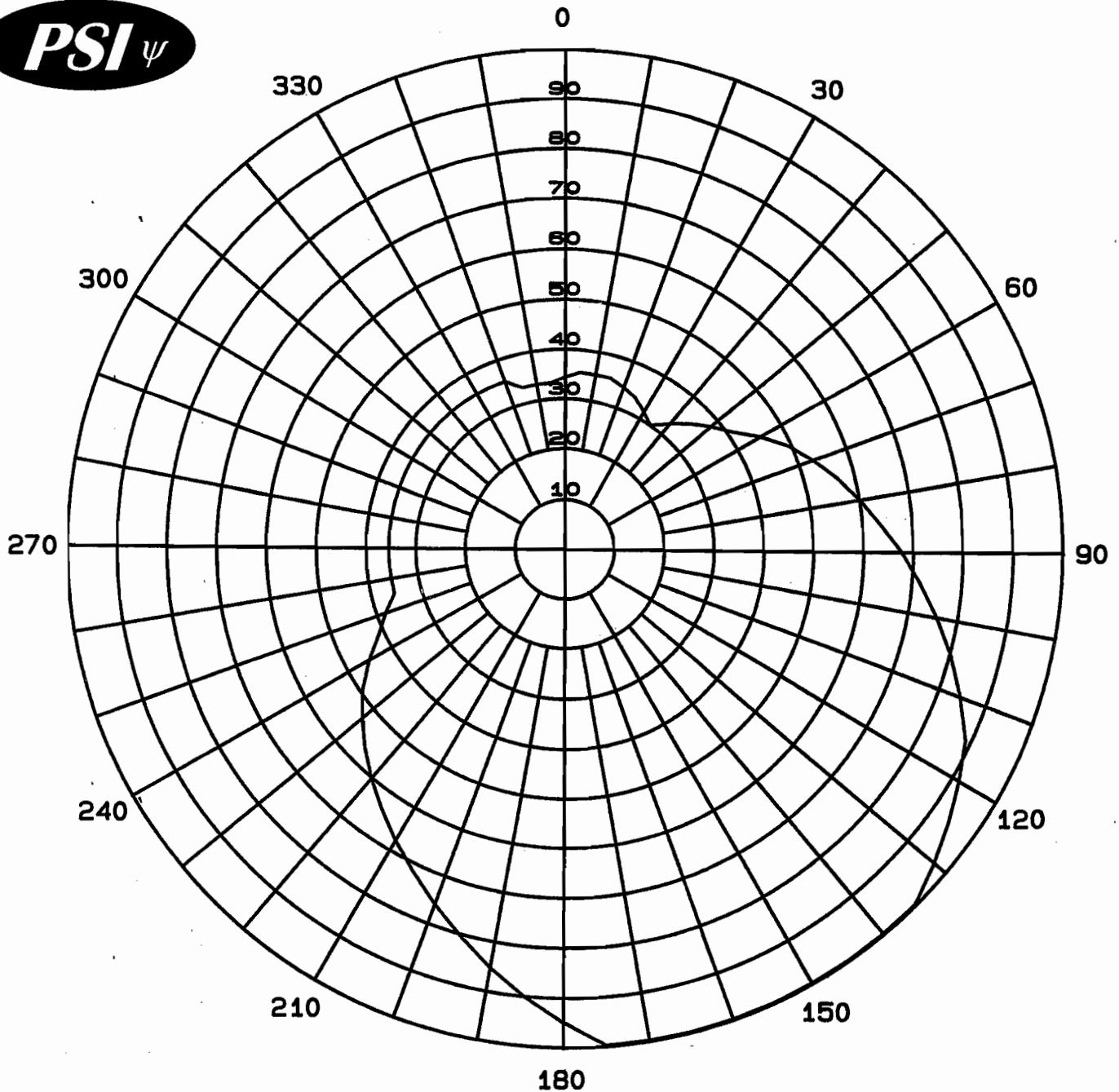
SIZE
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ANTENNA PLAN VIEW AND ORIENTATION

MODEL: PSIFML-2C-50WS-H-DA	DRAWN BY: B.K.SCHILLING	DATE: 6/2/15
CHANNEL/ FREQUENCY: 89.1 MHz	APPROVED BY:	DATE:
SCALE: 1:10	DRAWING NO.: 1447-002	REV.



Maximum Envelope
Azimuth Plane Pattern
Antenna: PSIFML-2C-50WS-H-DA
Type: 2-Bay Directional FM Antenna
ERP: 3.0 kW (4.77 dBk)
RMS Envelope: .624
Frequency: 89.1 MHz
WFDU Teaneck, NJ

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PO Box 113
Ebensburg, PA 15931

Maximum Envelope Tabulation

Antenna: PSIFML-2C-50WS-H-DA

Fairleigh Dickinson University

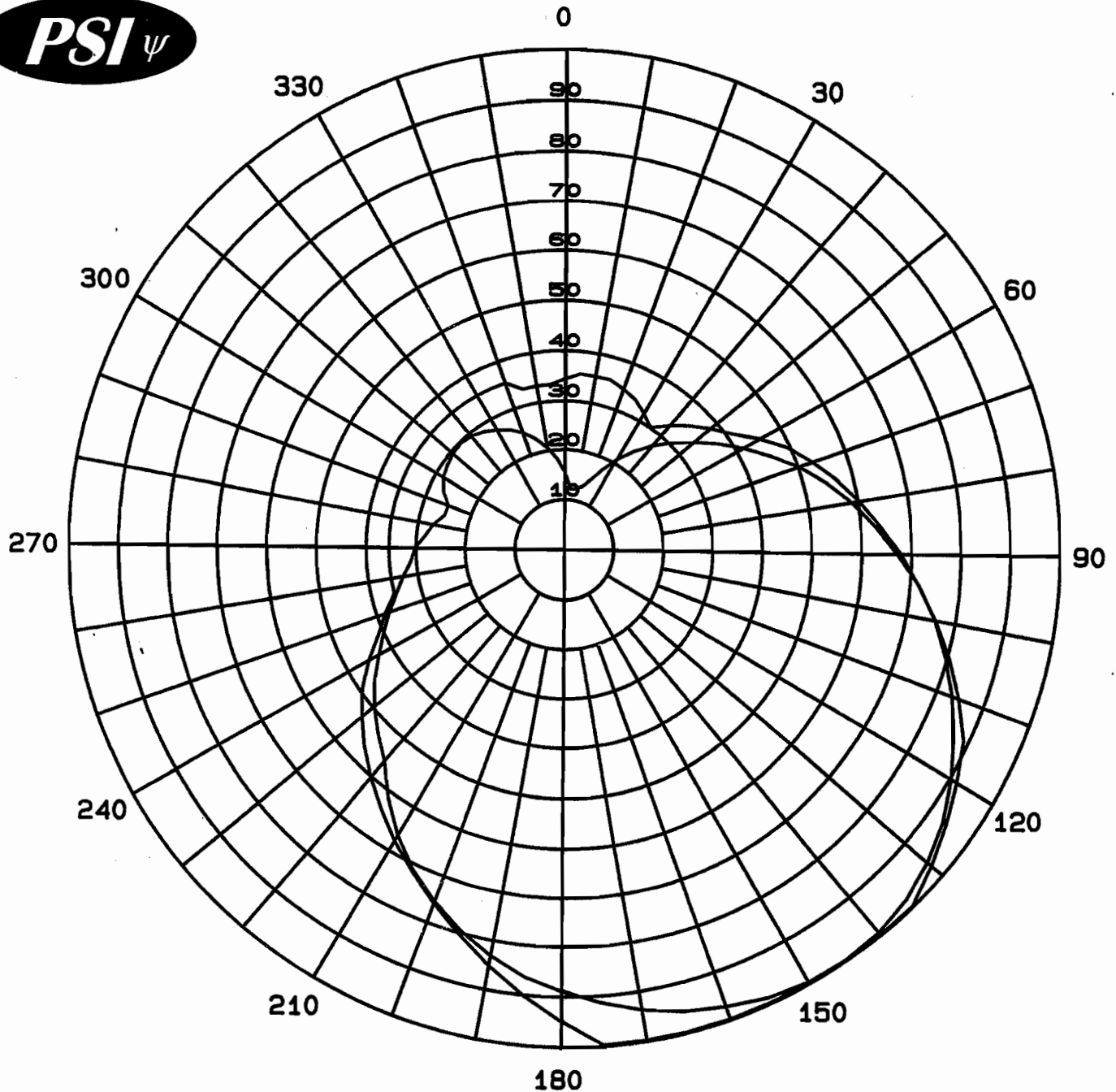
Station: WFDU

Frequency: 89.1 MHz

Location: Teaneck, NJ

Maximum ERP: 3.0 kW (4.77 dBk)

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.343	0.35	-4.52
10	0.354	0.38	-4.25
20	0.344	0.36	-4.50
30	0.317	0.30	-5.21
40	0.327	0.32	-4.94
50	0.382	0.44	-3.59
60	0.452	0.61	-2.13
70	0.530	0.84	-0.74
80	0.601	1.08	0.35
90	0.676	1.37	1.37
100	0.759	1.73	2.38
110	0.847	2.15	3.33
120	0.917	2.52	4.02
130	0.972	2.83	4.52
140	1.000	3.00	4.77
150	1.000	3.00	4.77
160	1.000	3.00	4.77
170	1.000	3.00	4.77
180	0.950	2.71	4.33
190	0.852	2.18	3.38
200	0.759	1.73	2.38
210	0.677	1.37	1.38
220	0.602	1.09	0.36
230	0.530	0.84	-0.74
240	0.453	0.62	-2.11
250	0.383	0.44	-3.56
260	0.354	0.38	-4.25
270	0.354	0.38	-4.25
280	0.354	0.38	-4.25
290	0.354	0.38	-4.25
300	0.354	0.38	-4.25
310	0.354	0.38	-4.25
320	0.354	0.38	-4.25
330	0.354	0.38	-4.25
340	0.343	0.35	-4.52
350	0.332	0.33	-4.81



Maximum Envelope and
Composite Pattern

Antenna: PSIFML-2C-50WS-H-DA

Type: 2-Bay Directional FM Antenna

ERP: 3.0 kW (4.77 dBk)

RMS Envelope: .624

RMS Composite: .589

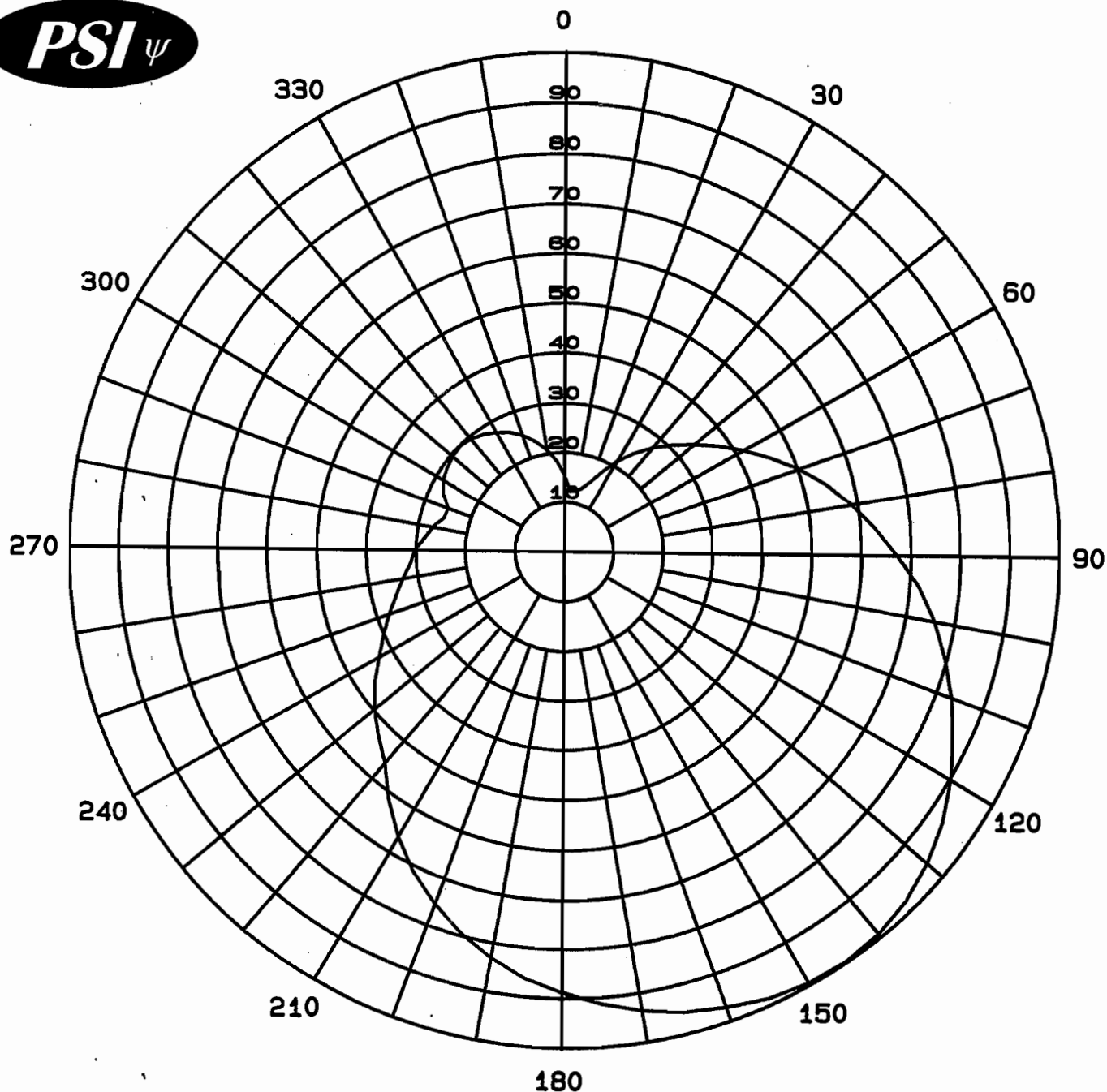
Frequency: 89.1 MHz

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WFDU Teaneck, NJ



Measured Composite
Azimuth Plane Pattern
Antenna: PSIFML-2C-50WS-H-DA
Type: 2-Bay Directional FM Antenna
ERP: 3.0 kW (4.77 dBk)
RMS Composite: .589
Frequency: 89.1 MHz
WFDU Teaneck, NJ

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Ebensburg, PA 15931

Composite Pattern Tabulation

Antenna: PSIFML-2C-50WS-H-DA

Fairleigh Dickinson University

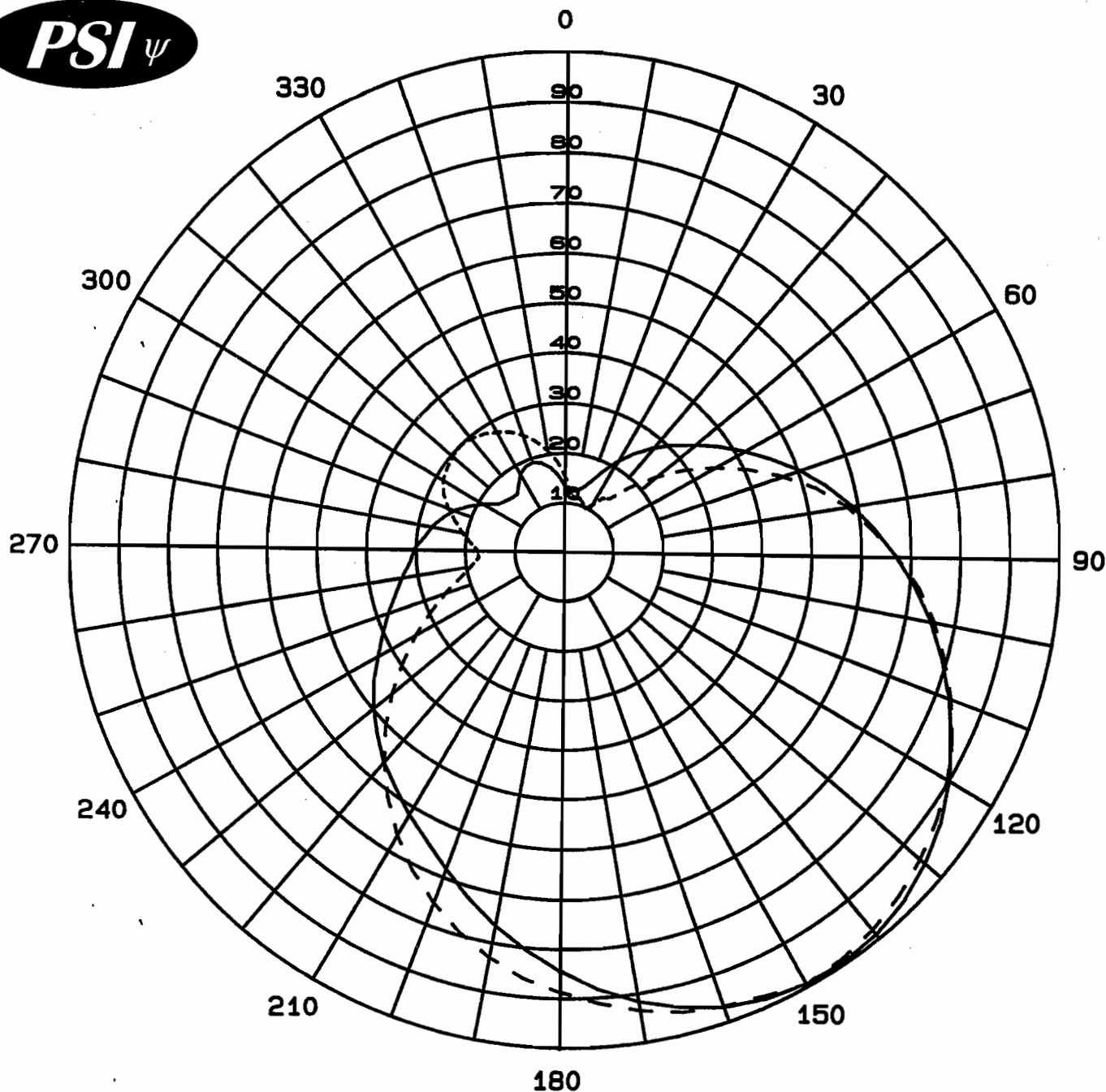
Station: WFDU

Frequency: 89.1 MHz

Location: Teaneck, NJ

Maximum ERP: 3.0 kW (4.77 dBk)

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.153	0.07	-11.53
10	0.124	0.05	-13.36
20	0.148	0.07	-11.82
30	0.210	0.13	-8.78
40	0.275	0.23	-6.44
50	0.340	0.35	-4.60
60	0.416	0.52	-2.85
70	0.502	0.76	-1.21
80	0.587	1.03	0.14
90	0.669	1.34	1.28
100	0.758	1.72	2.36
110	0.832	2.08	3.17
120	0.903	2.45	3.88
130	0.960	2.76	4.42
140	0.993	2.96	4.71
150	0.997	2.98	4.75
160	0.973	2.84	4.53
170	0.938	2.64	4.22
180	0.889	2.37	3.75
190	0.831	2.07	3.16
200	0.754	1.71	2.32
210	0.664	1.32	1.21
220	0.560	0.94	-0.27
230	0.498	0.74	-1.28
240	0.431	0.56	-2.54
250	0.376	0.42	-3.73
260	0.331	0.33	-4.83
270	0.302	0.27	-5.63
280	0.270	0.22	-6.60
290	0.250	0.19	-7.27
300	0.284	0.24	-6.16
310	0.295	0.26	-5.83
320	0.294	0.26	-5.86
330	0.276	0.23	-6.41
340	0.248	0.18	-7.34
350	0.207	0.13	-8.91



Measured Relative Field
Azimuth Plane Pattern
Antenna: PSIFML-2C-50WS-H-DA
Type: 2-Bay Directional FM Antenna
Gain H-pol (solid): 2.12 (3.26 dB)
Gain V-pol (dash): 2.11 (3.24 dB)
Frequency: 89.1 MHz
WFDU Teaneck, NJ

Propagation Systems Inc.
PO Box 113
Ebensburg, PA 15931

Measured Relative Field Tabulation

Antenna: PSIFML-2C-50WS-H-DA

Fairleigh Dickinson University

Station: WFDU

Frequency: 89.1 MHz

Location: Teaneck, NJ

Horizontal Polarization

Angle	Relative Field	Power Gain	Gain (dB)
0	0.133	0.038	-14.26
10	0.124	0.033	-14.87
20	0.148	0.046	-13.33
30	0.210	0.093	-10.29
40	0.275	0.160	-7.95
50	0.340	0.245	-6.11
60	0.416	0.367	-4.35
70	0.502	0.534	-2.72
80	0.587	0.730	-1.36
90	0.668	0.946	-0.24
100	0.751	1.196	0.78
110	0.829	1.457	1.63
120	0.903	1.729	2.38
130	0.960	1.954	2.91
140	0.993	2.090	3.20
150	0.997	2.107	3.24
160	0.973	2.007	3.03
170	0.920	1.794	2.54
180	0.846	1.517	1.81
190	0.765	1.241	0.94
200	0.682	0.986	-0.06
210	0.617	0.807	-0.93
220	0.560	0.665	-1.77
230	0.498	0.526	-2.79
240	0.431	0.394	-4.05
250	0.376	0.300	-5.23
260	0.331	0.232	-6.34
270	0.302	0.193	-7.14
280	0.270	0.155	-8.11
290	0.233	0.115	-9.39
300	0.184	0.072	-11.44
310	0.155	0.051	-12.93
320	0.148	0.046	-13.33
330	0.178	0.067	-11.73
340	0.190	0.077	-11.16
350	0.172	0.063	-12.03

Maximum Value

Field 1.000
Gain 2.12 (3.26 dB)
Azimuth Bearing 145 degrees

Minimum Field

Field 0.122
Gain .032 (-15.01 dB)
Azimuth Bearing 5 degrees

Vertical Polarization

Angle	Relative Field	Power Gain	Gain (dB)
0	0.153	0.050	-13.04
10	0.110	0.026	-15.91
20	0.105	0.023	-16.31
30	0.108	0.025	-16.07
40	0.141	0.042	-13.75
50	0.237	0.119	-9.24
60	0.348	0.257	-5.91
70	0.465	0.458	-3.39
80	0.577	0.706	-1.51
90	0.669	0.949	-0.23
100	0.758	1.218	0.86
110	0.832	1.468	1.67
120	0.898	1.710	2.33
130	0.946	1.897	2.78
140	0.980	2.036	3.09
150	0.997	2.107	3.24
160	0.970	1.995	3.00
170	0.938	1.865	2.71
180	0.889	1.675	2.24
190	0.831	1.464	1.66
200	0.754	1.205	0.81
210	0.664	0.935	-0.29
220	0.560	0.665	-1.77
230	0.451	0.431	-3.65
240	0.344	0.251	-6.01
250	0.253	0.136	-8.67
260	0.189	0.076	-11.21
270	0.175	0.065	-11.88
280	0.209	0.093	-10.33
290	0.250	0.133	-8.78
300	0.284	0.171	-7.67
310	0.295	0.184	-7.34
320	0.294	0.183	-7.37
330	0.276	0.161	-7.92
340	0.248	0.130	-8.85
350	0.207	0.091	-10.42

Maximum Value

Field 0.997
Gain 2.107 (3.24 dB)
Azimuth Bearing 150 degrees

Minimum Field

Field 0.097
Gain .020 (-17.00 dB)
Azimuth Bearing 25 degrees

ERP Tabulation

Antenna: PSIFML-2C-50WS-H-DA

Fairleigh Dickinson University

Station: WFDU

Frequency: 89.1 MHz

Location: Teaneck, NJ

Maximum ERP: 3.0 kW (4.77 dBk)

Horizontal Polarization

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.133	0.05	-12.75
10	0.124	0.05	-13.36
20	0.148	0.07	-11.82
30	0.210	0.13	-8.78
40	0.275	0.23	-6.44
50	0.340	0.35	-4.60
60	0.416	0.52	-2.85
70	0.502	0.76	-1.21
80	0.587	1.03	0.14
90	0.668	1.34	1.27
100	0.751	1.69	2.28
110	0.829	2.06	3.14
120	0.903	2.45	3.88
130	0.960	2.76	4.42
140	0.993	2.96	4.71
150	0.997	2.98	4.75
160	0.973	2.84	4.53
170	0.920	2.54	4.05
180	0.846	2.15	3.32
190	0.765	1.76	2.44
200	0.682	1.40	1.45
210	0.617	1.14	0.58
220	0.560	0.94	-0.27
230	0.498	0.74	-1.28
240	0.431	0.56	-2.54
250	0.376	0.42	-3.73
260	0.331	0.33	-4.83
270	0.302	0.27	-5.63
280	0.270	0.22	-6.60
290	0.233	0.16	-7.88
300	0.184	0.10	-9.93
310	0.155	0.07	-11.42
320	0.148	0.07	-11.82
330	0.178	0.10	-10.22
340	0.190	0.11	-9.65
350	0.172	0.09	-10.52

Maximum Value (H-pol)

Field 1.000
ERP 3.0 kW (4.77 dBk)
Azimuth Bearing 145 degrees

Minimum Field (H-pol)

Field 0.122
ERP .045 kW (-13.50 dBk)
Azimuth Bearing 5 degrees

Vertical Polarization

Angle	Relative Field	ERP (kW)	ERP (dBk)
0	0.153	0.07	-11.53
10	0.110	0.04	-14.40
20	0.105	0.03	-14.81
30	0.108	0.03	-14.56
40	0.141	0.06	-12.24
50	0.237	0.17	-7.73
60	0.348	0.36	-4.40
70	0.465	0.65	-1.88
80	0.577	1.00	-0.01
90	0.669	1.34	1.28
100	0.758	1.72	2.36
110	0.832	2.08	3.17
120	0.898	2.42	3.84
130	0.946	2.68	4.29
140	0.980	2.88	4.60
150	0.997	2.98	4.75
160	0.970	2.82	4.51
170	0.938	2.64	4.22
180	0.889	2.37	3.75
190	0.831	2.07	3.16
200	0.754	1.71	2.32
210	0.664	1.32	1.21
220	0.560	0.94	-0.27
230	0.451	0.61	-2.15
240	0.344	0.36	-4.50
250	0.253	0.19	-7.17
260	0.189	0.11	-9.70
270	0.175	0.09	-10.37
280	0.209	0.13	-8.83
290	0.250	0.19	-7.27
300	0.284	0.24	-6.16
310	0.295	0.26	-5.83
320	0.294	0.26	-5.86
330	0.276	0.23	-6.41
340	0.248	0.18	-7.34
350	0.207	0.13	-8.91

Maximum Value (V-pol)

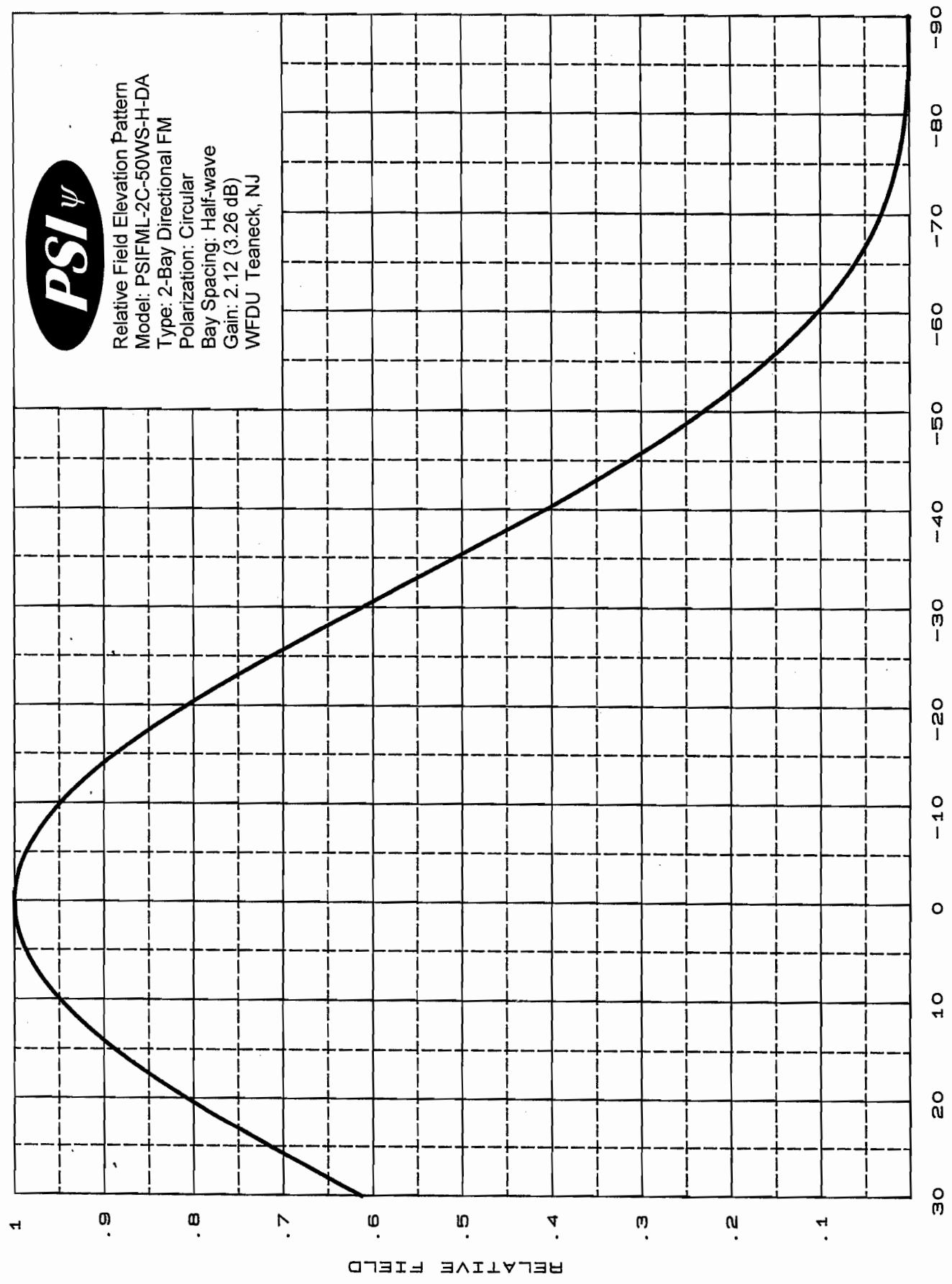
Field 0.997
ERP 2.98 kW (4.75 dBk)
Azimuth Bearing 150 degrees

Minimum Field (V-pol)

Field 0.097
ERP .028 kW (-15.49 dBk)
Azimuth Bearing 25 degrees



Relative Field Elevation Pattern
Model: PSIFML-2C-50WS-H-DA
Type: 2-Bay Directional FM
Polarization: Circular
Bay Spacing: Half-wave
Gain: 2.12 (3.26 dB)
WFDU Teaneck, NJ



DEGREES BELOW HORIZONTAL