ERI® Electronics Research, Inc.
Electronics Research, Inc. 7777 Gardner Rd. Chandler, In 47610 Phone (812) 925-6000 Fax (812) 925-4030 http://www.eriinc.com/

Directional Antenna System for WJWD, Marshall, Wisconsin

October 23, 2001

Electronics Research Inc. is providing a custom fabricated antenna system that is specially designed to meet the FCC requirements and the general needs of radio station WJWD.

The antenna is the ERI model P300-5B-DA/FM-11-SP configuration. The vertically polarized system consists of 5 full-wavelength bays using one driven vertical dipole and two vertical parasitic elements per bay. The FM-11A omni direction horizontally polarized antenna consists of one bay, which is located at the center of bay 3 of the vertically polarized array. A power divider was used near the bottom of the antenna to feed the system.

The antenna was mounted on the North 114 degrees East tower face with bracketry to provide an antenna orientation of North 114 degrees East. The antenna was tested on a 24" ERI® λ *MOUNTING SYSTEM,* which is the structure the station plans to use to support the array. All tests were performed on a frequency of 90.3 megahertz which is the center of the FM broadcast channel assigned to WJWD.

Pattern measurements were made on a sixty-acre antenna pattern range that is owned and operated by Electronics Research, Inc. The tests were performed under the direction of Thomas B. Silliman, president of Electronics Research, Inc. Mr. Silliman has the Bachelor of Electrical Engineering and the Master of Electrical Engineering degrees from Cornell University and is a registered professional engineer in the states of Indiana, Maryland and Minnesota.

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DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of two bay levels of the vertically polarized system with the associated vertical parasitic elements. The elements and brackets that were used in this test are electrically equivalent to those that will be supplied with the antenna. Sections of 3 1/8 inch o.d. rigid coaxial line were used to feed the test antenna and sections of 3 1/8 inch o.d. rigid outer conductor only were attached above the test antenna. The lines were properly grounded during all tests.

The power distribution and phase relationship to the antenna elements was adjusted in order to achieve the directional radiation patterns for both horizontal and vertical polarization components.

The proof-of-performance was accomplished using a 24" ***ERI® λ MOUNTING SYSTEM,*** with identical dimension and configuration including all braces, ladders, conduits, coaxial lines and other appurtenances that are included in the actual aperture at which the antenna will be installed. The structure was erected vertically on a turntable mounted on a non-metallic building with the antenna centered vertically on the structure, making the center of radiation of the test approximately 30 feet above ground. The turntable is equipped with a motor drive and azimuth indicating mechanism, resolution of this azimuth measuring device is one-tenth of a degree.

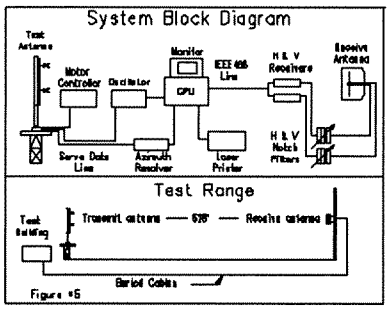

Figure #5

The antenna under test was operated in the transmitting mode and fed from a Wavetek Model 3000 signal generator. The frequency of the signal source was set at 90.3 MHz and was constantly monitored by an Anritsu Model ML521B measuring receiver.

A broad-band horizontal and vertical dipole system, located approximately 628 feet from the test antenna, was used to receive the emitted test signals. The dipole system was mounted at the same height above terrain as the center of the antenna under test. The signals received by the dipole system were fed to the test building by way of two buried Heliax cables to an Anritsu Model ML521B measuring receiver.

This data was interfaced to a Hewlett-Packard Laser Jet 4P printer by means of a Pentium computer system. Relative field strength was plotted as a function of azimuth.

The measurements were performed by rotating the test antenna in a counter-clockwise direction and plotting the received signal on polar co-ordinated graph paper in a clockwise direction. Both horizontal and vertical components were recorded separately.

CONCLUSIONS

The vertically polarized system consists of 5 full-wavelength bays using one driven vertical dipole, two driven horizontal dipoles and two vertical parasitic elements per bay. The FM-11A omni direction horizontally polarized antenna consists of one bay, which is located at the center of bay 3 of the vertically polarized array. A power divider was used near the bottom of the antenna to feed the system.

The power distribution and phase relationship will be fixed when antenna is manufactured. Proper maintenance of the elements should be all that is required to maintain the pattern in adjustment.

The P300-5B-DA/FM-11-SP array is to be mounted on the North 114 degrees East tower face of the 24" ERI® λ ***MOUNTING SYSTEM,*** at a bearing of North 114 degrees East. Blue prints provided with the antenna will show the proper antenna orientation alignment. The antenna alignment procedure should be directed by a licensed surveyor as prescribed by the FCC.

Figure #1 represents the maximum value of the vertical component at any azimuth. The measured horizontal plane relative field pattern, for the vertical polarization component, is shown on Figure #2 attached. The actual measured pattern does not exceed the authorized FCC composite pattern at any azimuth. A calculated vertical plane relative field pattern for the vertically polarized component is shown on Figure #3 attached. A calculated vertical plane relative field pattern for the vertically polarized component is shown on Figure #3 attached. A calculated vertical plane relative field pattern for the horizontally polarized component is shown on Figure #3A attached. The power in the maximum will reach 9.9 kilowatts (9.956 dBk).

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The power at North 270-280 degrees East does not exceed 0.31 kilowatts (-5.086 dBk).

The vertical maximum relative field pattern obtained from the measured data as shown on Figure #1 has an RMS that is greater that 85% of the filed composite pattern.

The clear vertical length of the structure required to support the antenna is 64 feet if the antenna is to be top mounted.

The directional antenna should not be mounted on the top of an antenna tower that includes a top-mounted platform larger than the cross-sectional area of the tower in the horizontal plane. No obstructions other than those that are specified by the blue prints supplied with the antenna are to be mounted within 75 ft. horizontally of the system. The vertical distance to the nearest obstruction should be a minimum of 10 ft. from the directional antenna. Metallic guy wires should be a minimum distance of forty feet horizontally from the antenna.

ELECTRONICS RESEARCH, INC.

ERI® Horizontal Plane Relative Field Pattern

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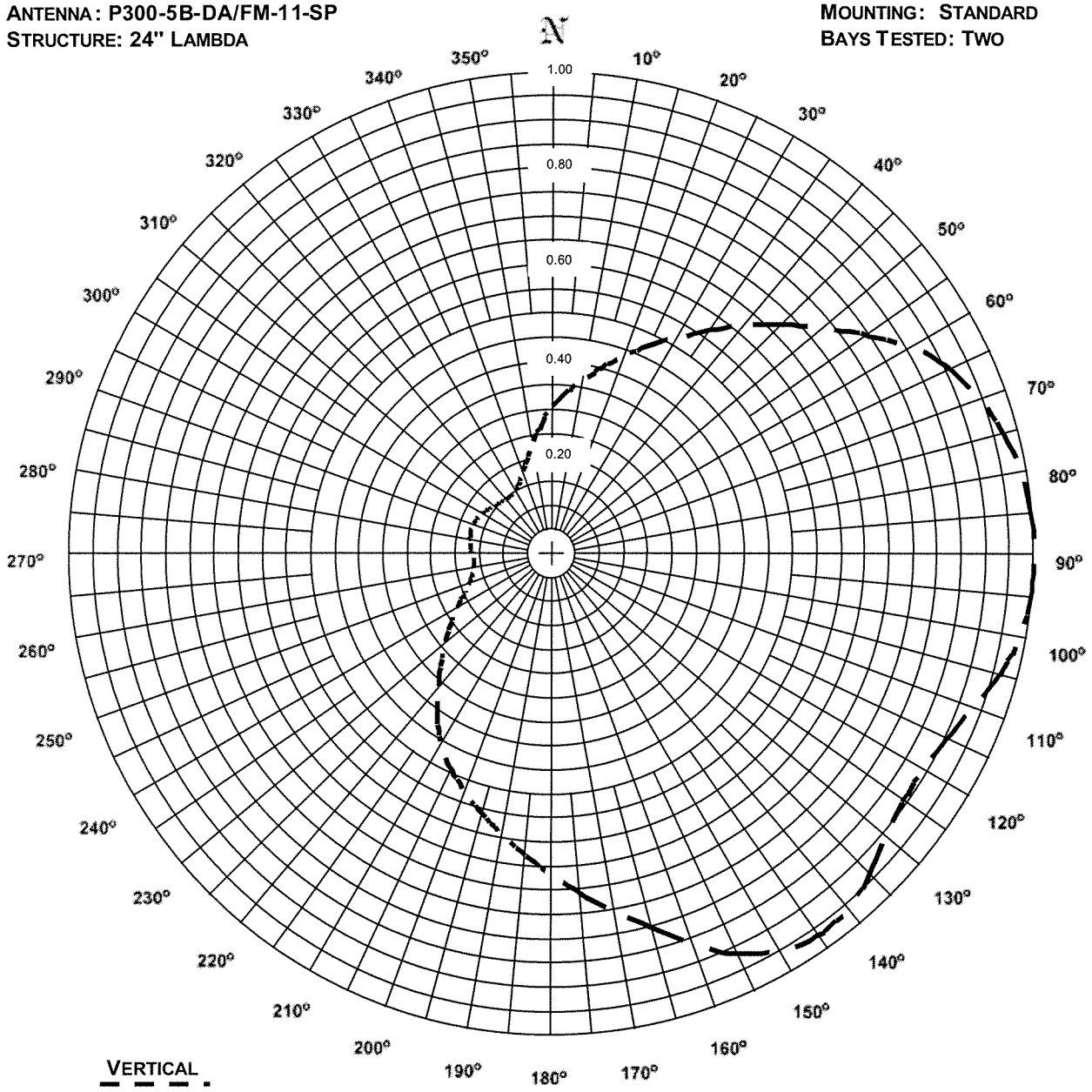
FIGURE NO: 1
STATION: WJWD
LOCATION: MARSHALL, WI
ANTENNA: P300-5B-DA/FM-11-SP
STRUCTURE: 24" LAMBDA

DATE: 10/23/2001
FREQUENCY: 90.3 MHZ
ORIENTATION: 114° TRUE
MOUNTING: STANDARD
BAYS TESTED: TWO



VERTICAL

RMS: 0.617
MAXIMUM: 1.000 @ 88° TRUE
MINIMUM: 0.150 @ 325° TRUE

COMMENTS: MEASURED PATERN OF THE HORIZONTAL AND VERTICAL COMPONENTS.

ERI® Horizontal Plane Relative Field List

Electronics Research, Inc. 7777 Gardner Rd. Chandler, In 47610 Phone (812) 925-6000 Fax (812) 925-4030 http://www.eriinc.com/

Station: WJWD
Location: Marshall, WI.
Frequency: 90.3 MHz

Antenna: P300-5B-DA/FM-11-SP
Orientation: 114° True
Tower: 24" Lambda

Figure: 1
Date: 10/23/2001
Reference: wjwd1m.fig

Angle	Pattern Data			Polarization	Angle	Pattern Data			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.310	0.95	-0.22	Vertical	180°	0.662	4.34	6.37	Vertical
5°	0.339	1.14	0.57	Vertical	185°	0.624	3.85	5.86	Vertical
10°	0.372	1.37	1.36	Vertical	190°	0.588	3.42	5.34	Vertical
15°	0.407	1.64	2.16	Vertical	195°	0.555	3.05	4.84	Vertical
20°	0.446	1.97	2.95	Vertical	200°	0.523	2.71	4.33	Vertical
25°	0.485	2.33	3.68	Vertical	205°	0.492	2.39	3.79	Vertical
30°	0.526	2.74	4.38	Vertical	210°	0.457	2.07	3.16	Vertical
35°	0.574	3.27	5.14	Vertical	215°	0.412	1.68	2.26	Vertical
40°	0.627	3.89	5.90	Vertical	220°	0.367	1.34	1.26	Vertical
45°	0.680	4.58	6.61	Vertical	225°	0.327	1.06	0.26	Vertical
50°	0.738	5.40	7.32	Vertical	230°	0.292	0.84	-0.74	Vertical
55°	0.801	6.35	8.03	Vertical	235°	0.260	0.67	-1.74	Vertical
60°	0.867	7.45	8.72	Vertical	240°	0.232	0.53	-2.74	Vertical
65°	0.914	8.26	9.17	Vertical	245°	0.206	0.42	-3.78	Vertical
70°	0.947	8.87	9.48	Vertical	250°	0.186	0.34	-4.67	Vertical
75°	0.972	9.34	9.71	Vertical	255°	0.172	0.29	-5.33	Vertical
80°	0.989	9.68	9.86	Vertical	260°	0.164	0.27	-5.72	Vertical
85°	0.998	9.86	9.94	Vertical	265°	0.163	0.26	-5.79	Vertical
90°	1.000	9.90	9.96	Vertical	270°	0.165	0.27	-5.68	Vertical
95°	0.997	9.85	9.93	Vertical	275°	0.170	0.28	-5.46	Vertical
100°	0.984	9.59	9.82	Vertical	280°	0.174	0.30	-5.25	Vertical
105°	0.960	9.12	9.60	Vertical	285°	0.176	0.31	-5.15	Vertical
110°	0.927	8.51	9.30	Vertical	290°	0.176	0.31	-5.15	Vertical
115°	0.903	8.07	9.07	Vertical	295°	0.174	0.30	-5.26	Vertical
120°	0.890	7.84	8.94	Vertical	300°	0.170	0.29	-5.45	Vertical
125°	0.889	7.82	8.93	Vertical	305°	0.164	0.27	-5.74	Vertical
130°	0.904	8.10	9.08	Vertical	310°	0.158	0.25	-6.07	Vertical
135°	0.934	8.64	9.36	Vertical	315°	0.154	0.23	-6.32	Vertical
140°	0.956	9.04	9.56	Vertical	320°	0.151	0.22	-6.48	Vertical
145°	0.961	9.15	9.61	Vertical	325°	0.150	0.22	-6.54	Vertical
150°	0.945	8.85	9.47	Vertical	330°	0.154	0.23	-6.31	Vertical
155°	0.910	8.19	9.13	Vertical	335°	0.164	0.27	-5.72	Vertical
160°	0.854	7.22	8.59	Vertical	340°	0.182	0.33	-4.84	Vertical
165°	0.798	6.30	7.99	Vertical	345°	0.206	0.42	-3.76	Vertical
170°	0.745	5.49	7.40	Vertical	350°	0.237	0.56	-2.54	Vertical
175°	0.702	4.88	6.89	Vertical	355°	0.274	0.74	-1.30	Vertical

Polarization: **Envelope**
Maximum Field: **1.000 @ 88° True**
Minimum Field: **0.150 @ 325° True**
RMS: **0.617**
Maximum ERP: **9.900 kW**
Maximum Power Gain: **12.847 (11.088 dB)**

Total Input Power: 0.771 kW

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7777 GARDNER ROAD
CHANDLER, IN. 47610

FIGURE 3

----THEORETICAL----
VERTICAL PLANE RELATIVE FIELD

ERI TYPE P-300-5BE-DA
VERTICALLY POLARIZED ANTENNA
0 DEGREE(S) ELECTRICAL BEAM TILT
0 PERCENT FIRST NULL FILL
0 PERCENT SECOND NULL FILL

APRIL 5, 2002

ELEMENT SPACING:
1.0 WAVELENGTH

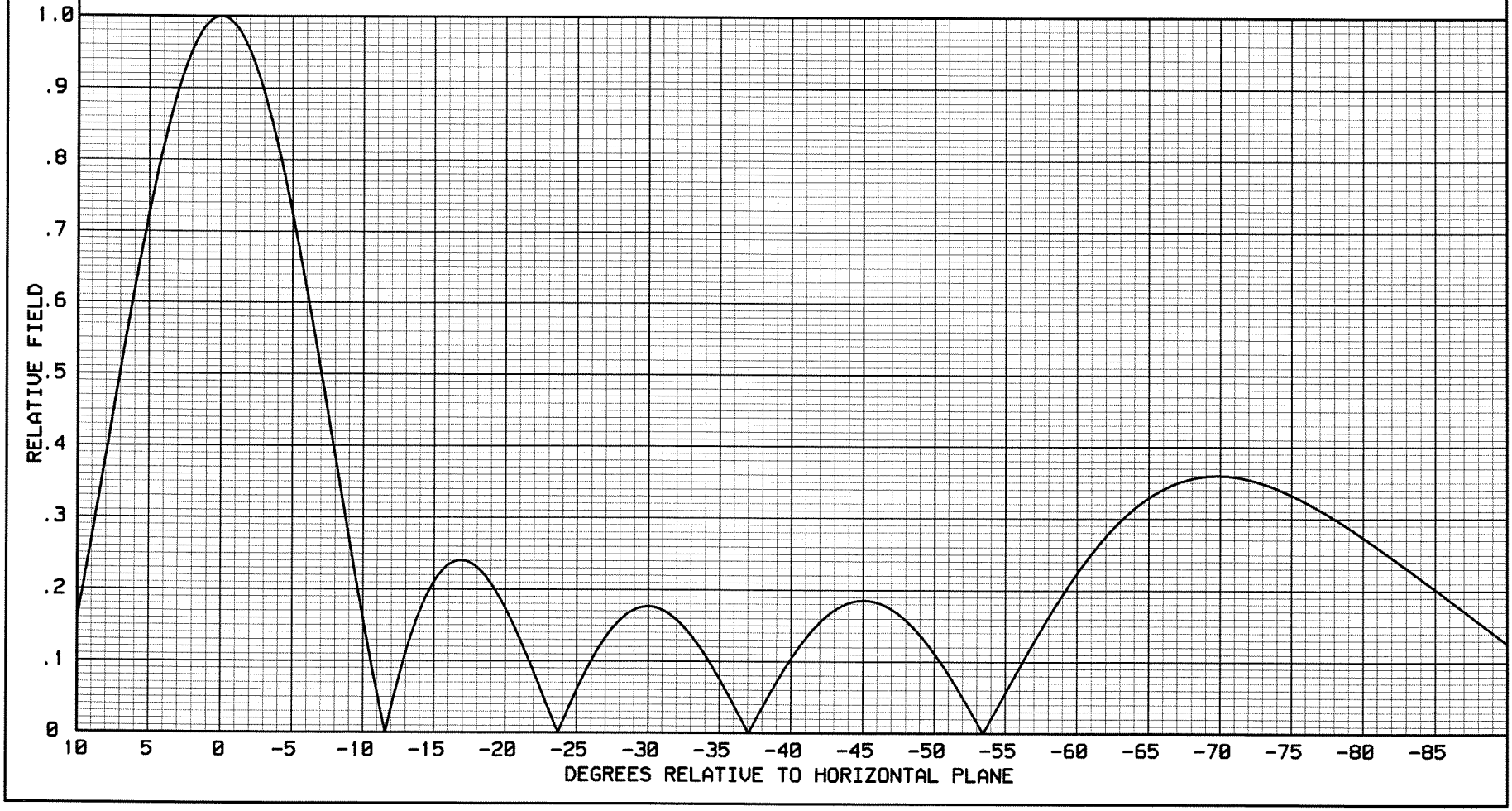

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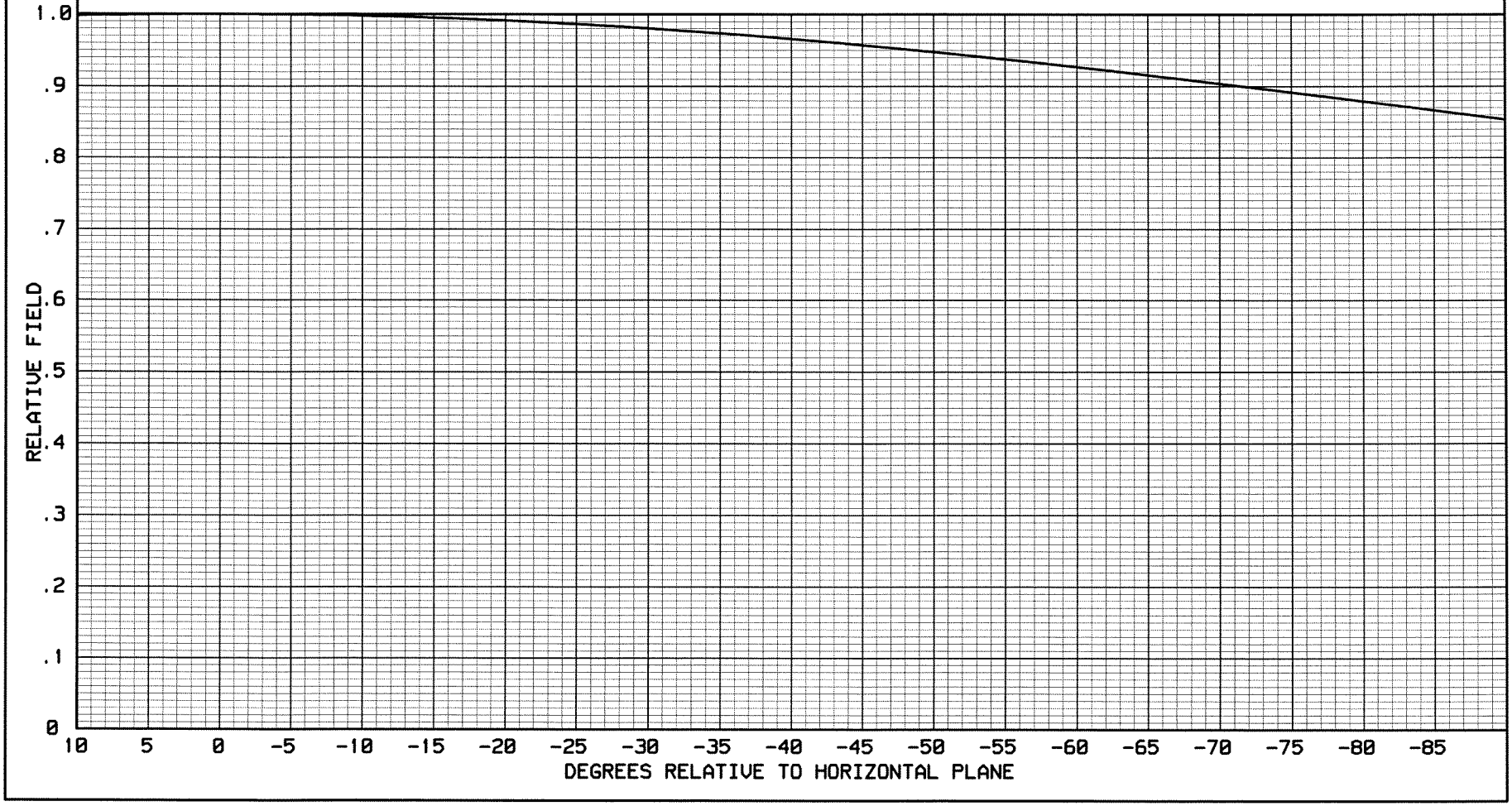
FIGURE 3A

----THEORETICAL----
VERTICAL PLANE RELATIVE FIELD

ERI TYPE FM11A SINGLE BAY
HORIZONTALLY POLARIZED FM ANTENNA



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(Continued)

SPECIFICATIONS

Antenna Type:	P300-5B-DA/FM-11-SP
Frequency:	90.3 MHz
Number of Bays:	5

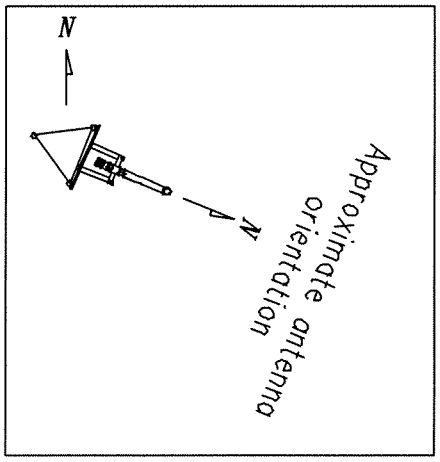
MECHANICAL SPECIFICATIONS

Mounting:	Standard
System length:	52 ft 3 in
Aperture length required:	59 ft.
Orientation:	114° true

Input flange to the antenna 3 1/8 inch female

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum vertical ERP:	9.9 kW (9.956 dBk)
Vertical maximum power gain:	12.847 (11.088 dB)
Total input power:	0.771 kW (1.132 dBk)[1]



[1] Gain figure have been calculated to include the FM-11A antenna.

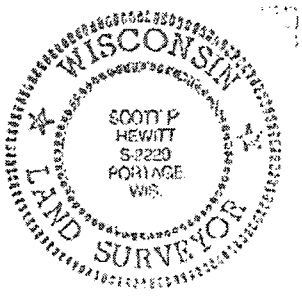
GROTHMAN & ASSOCIATES, S.C.

LAND SURVEYORS

I have examined the antenna installation on the tower owned by CSN International and located at the corner of Highway 60 and Wendt Road near Columbus, WI and have found the azimuth of the existing antenna base to be 219.146 degrees with respect to true north. The margin of error on this study is less than +/- 0.49 degrees. I have also found the average azimuth of the booms located on the upper section of the existing tower to be 113.644 degrees with respect to true north. The margin of error on this study is less than +/- 3 degrees.

Scott P. Hewitt

SCOTT P. HEWITT
Registered Land Surveyor, No. 2229
Dated: February 3, 2003
File No. 601-658



P.O. BOX 373 825 E. SLIFER STREET PORTAGE, WISCONSIN 53901 (608) 742-7788 FAX: (608) 742-0434

Certification of Managing Engineer

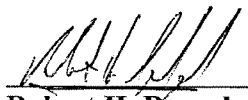
WJWD, Marshall, WI, BMPED20010125ACD

This exhibit fulfills, in part, the special operating conditions listed on the construction permit of WJWD, Marshall, WI, BMPED20010125ACD.

Certification of Managing Engineer

I certify that the WJWD Facilities are constructed as proposed under the current construction permit. The antenna manufacturer's instructions were followed specifically with regard to this project. I have personally managed this project and have overseen all work done.

I, Robert H. Branch, Jr. certify that I am an experienced Broadcast Engineer and am familiar with the FCC regulations pertinent to this FM directional antenna installation. I hold a Television and Radio Engineer Certification with the Society of Broadcast Engineers CBRTE #3786. The above information is true and correct to the best of my knowledge.



Robert H. Branch, Jr.

2-7-03

Date