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 Biltmore Forest, North Carolina

December 7, 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 new station.

The antenna is the ERI model LP-2E-DA-HW configuration. The circular polarized system consists of two half-wavelength spaced bays using one driven circular polarized radiating element per bay, two horizontal parasitic elements per bay and two vertical parasitic elements interleaved between the bays. The antenna was mounted on the North 90.6161 degrees East tower leg with bracketry to provide an antenna orientation of North 90.6161 degrees East. The antenna was tested on a 24" Central, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 96.5 megahertz which is the center of the FM broadcast channel assigned to new station.

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.

Directional Antenna System
For
Biltmore Forest, North Carolina

(Continued)

DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of a full scale model of the complete circular polarized system with the associated horizontal and 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. A section of 1 5/8 inch o.d. rigid coaxial line was used to feed the test antenna, and a section of 1 5/8 inch o.d. rigid outer conductor only was 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" Central tower 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.

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 96.5 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.

Directional Antenna System
For
Biltmore Forest, North Carolina

(Continued)

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 circular polarized system consists of two half-wavelength spaced bays using one driven circular polarized radiating element per bay, two horizontal parasitic elements per bay and two vertical parasitic elements interleaved between the bays. 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 LP-2E-DA-HW array is to be mounted on the North 90.6161 degrees East tower leg of the 24" Central at a bearing of North 90.6161 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 either the horizontal or vertical component at any azimuth. The measured horizontal plane relative field pattern, for both the horizontal and vertical polarization components, 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 is shown on Figure #3 attached. The power in the maximum will reach 1.85 kilowatts (2.672 dBk).

The power at North 200 degrees East does not exceed 1.13 kilowatts (0.531 dBk).

The power at North 240 degrees East does not exceed 1.13 kilowatts (0.531 dBk).

The power at North 330 degrees East does not exceed 1.15 kilowatts (0.607 dBk).

The RMS of the vertically polarized horizontal plane component does not exceed the RMS of the horizontally polarized horizontal plane component.

Directional Antenna System
For
Biltmore Forest, North Carolina

(Continued)

The composite horizontal and 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 21 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.

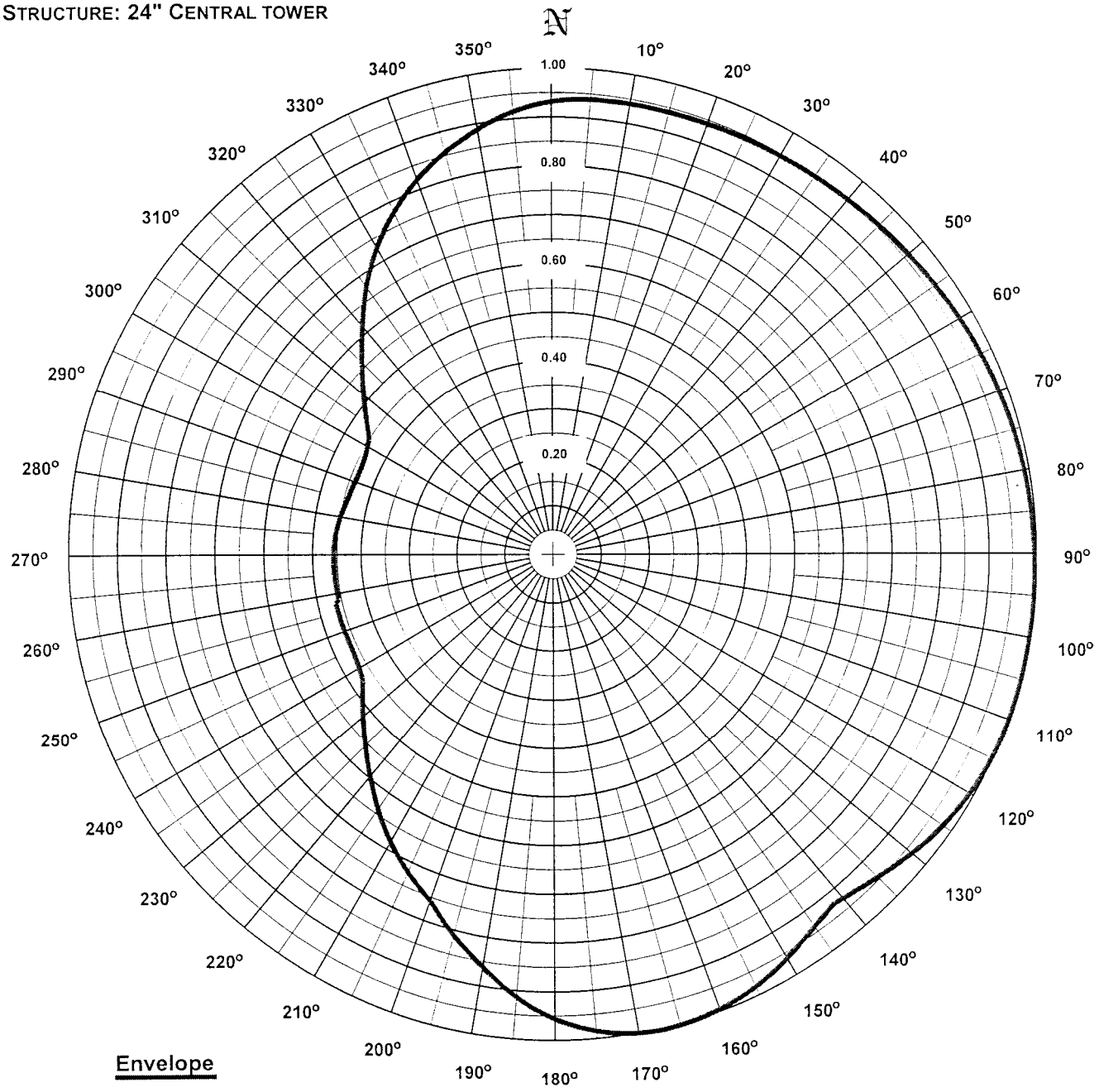
ELECTRONICS RESEARCH, INC.

ERI® Horizontal Plane Relative Field Pattern

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

FIGURE: 1
STATION: NEW STATION
LOCATION: BILTMORE FOREST, NC.
ANTENNA TYPE: LP-2E-DA-HW
STRUCTURE: 24" CENTRAL TOWER

DATE: 12/7/01
FREQUENCY: 96.5 MHZ
ORIENTATION: 90.6161° TRUE
MOUNTING: CUSTOM



Envelope

RMS: 0.822
Maximum: 1.000 @ 109° True
Minimum: 0.439 @ 294° True

COMMENTS: MEASURED PATTERNS OF THE HORIZONTAL AND VERTICAL COMPONETS.

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: New Station
Location: Biltmore Forest, NC.
Frequency: 96.5 MHz

Antenna: LP-2E-DA-HW
Orientation: 90.6161° True
Tower: 24" Central tower

Figure: 1
Date: 12/7/01
Reference: lib1m.fig

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.935	1.62	2.09	Vertical	180°	0.953	1.68	2.25	Vertical
5°	0.943	1.64	2.16	Vertical	185°	0.911	1.54	1.86	Vertical
10°	0.944	1.65	2.17	Horizontal	190°	0.859	1.36	1.35	Vertical
15°	0.944	1.65	2.17	Horizontal	195°	0.809	1.21	0.83	Vertical
20°	0.945	1.65	2.18	Horizontal	200°	0.755	1.05	0.23	Horizontal
25°	0.947	1.66	2.20	Horizontal	205°	0.720	0.96	-0.18	Horizontal
30°	0.949	1.67	2.21	Horizontal	210°	0.681	0.86	-0.66	Horizontal
35°	0.951	1.67	2.24	Horizontal	215°	0.639	0.76	-1.22	Horizontal
40°	0.954	1.69	2.27	Horizontal	220°	0.596	0.66	-1.83	Horizontal
45°	0.958	1.70	2.30	Horizontal	225°	0.555	0.57	-2.43	Horizontal
50°	0.962	1.71	2.34	Horizontal	230°	0.519	0.50	-3.02	Horizontal
55°	0.967	1.73	2.38	Horizontal	235°	0.487	0.44	-3.59	Horizontal
60°	0.973	1.75	2.43	Horizontal	240°	0.467	0.40	-3.95	Vertical
65°	0.978	1.77	2.48	Horizontal	245°	0.461	0.39	-4.05	Vertical
70°	0.983	1.79	2.52	Horizontal	250°	0.461	0.39	-4.05	Vertical
75°	0.987	1.80	2.56	Horizontal	255°	0.462	0.39	-4.04	Vertical
80°	0.990	1.81	2.59	Horizontal	260°	0.456	0.38	-4.15	Vertical
85°	0.993	1.83	2.61	Horizontal	265°	0.457	0.39	-4.14	Vertical
90°	0.996	1.83	2.63	Horizontal	270°	0.457	0.39	-4.13	Vertical
95°	0.998	1.84	2.65	Horizontal	275°	0.455	0.38	-4.16	Vertical
100°	0.999	1.85	2.66	Horizontal	280°	0.451	0.38	-4.25	Vertical
105°	1.000	1.85	2.67	Horizontal	285°	0.444	0.36	-4.38	Vertical
110°	1.000	1.85	2.67	Horizontal	290°	0.440	0.36	-4.46	Vertical
115°	0.996	1.84	2.64	Horizontal	295°	0.439	0.36	-4.48	Vertical
120°	0.989	1.81	2.57	Horizontal	300°	0.446	0.37	-4.33	Vertical
125°	0.977	1.76	2.47	Horizontal	305°	0.472	0.41	-3.85	Horizontal
130°	0.960	1.71	2.32	Horizontal	310°	0.513	0.49	-3.12	Horizontal
135°	0.941	1.64	2.14	Horizontal	315°	0.561	0.58	-2.35	Horizontal
140°	0.925	1.58	1.99	Horizontal	320°	0.616	0.70	-1.54	Horizontal
145°	0.935	1.62	2.09	Vertical	325°	0.676	0.84	-0.73	Horizontal
150°	0.959	1.70	2.31	Vertical	330°	0.731	0.99	-0.05	Horizontal
155°	0.979	1.77	2.49	Vertical	335°	0.781	1.13	0.52	Horizontal
160°	0.992	1.82	2.61	Vertical	340°	0.823	1.25	0.98	Horizontal
165°	0.999	1.85	2.66	Vertical	345°	0.860	1.37	1.36	Horizontal
170°	0.997	1.84	2.64	Vertical	350°	0.891	1.47	1.67	Vertical
175°	0.981	1.78	2.51	Vertical	355°	0.918	1.56	1.93	Vertical

Polarization: Envelope
Maximum Field: 1.000 @ 109° True
Minimum Field: 0.439 @ 294° True
RMS: 0.822
Maximum ERP: 1.850 kW
Maximum Power Gain: 1.042 (0.179 dB)

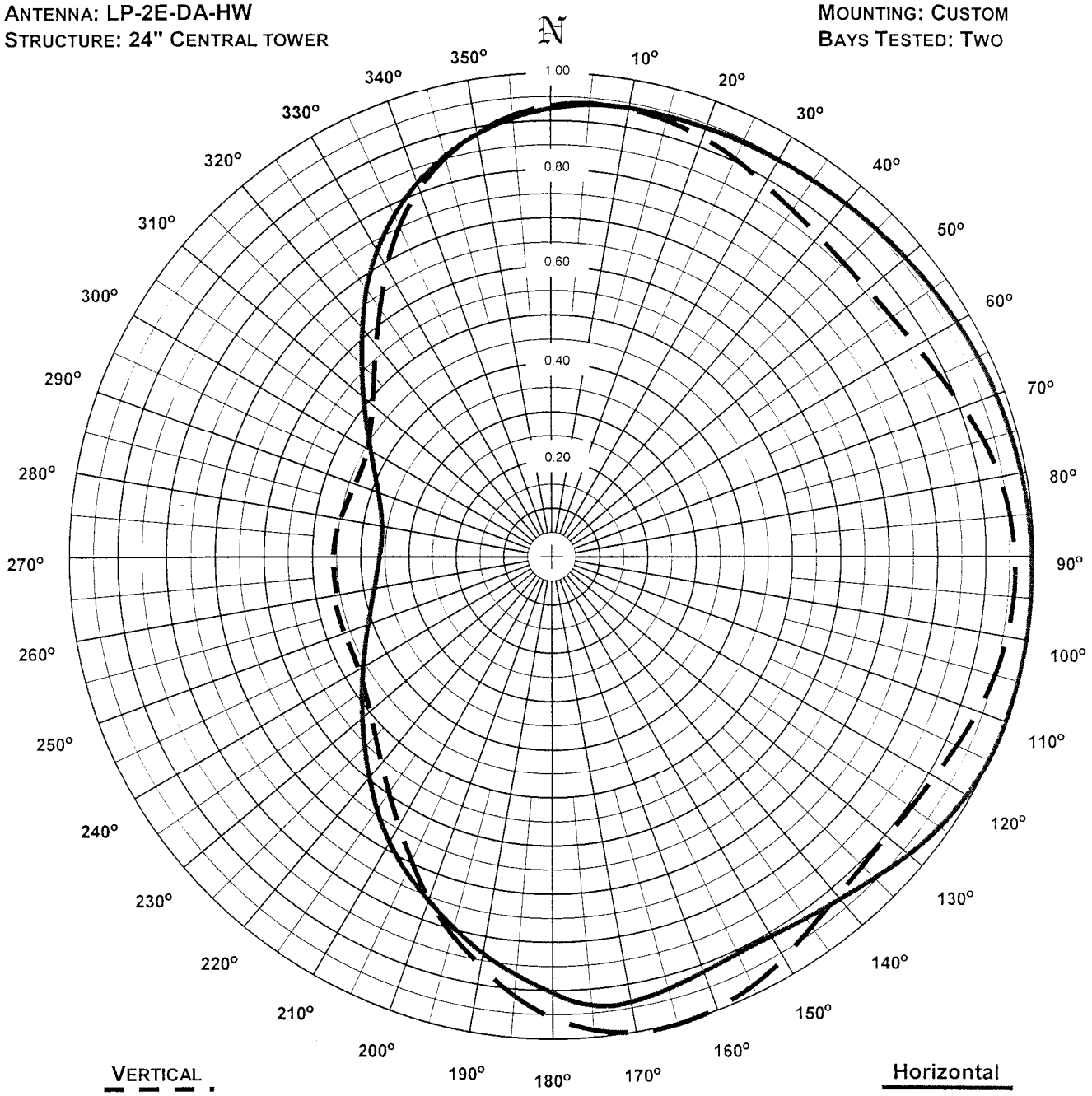
Total Input Power: 1.775 kW

ERI® Horizontal Plane Relative Field Pattern

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

FIGURE NO: 2
STATION: NEW STATION
LOCATION: BILTMORE FOREST, NC.
ANTENNA: LP-2E-DA-HW
STRUCTURE: 24" CENTRAL TOWER

DATE: 12/7/01
FREQUENCY: 96.5 MHz
ORIENTATION: 90.6161° TRUE
MOUNTING: CUSTOM
BAYS TESTED: TWO



VERTICAL

RMS: 0.792
MAXIMUM: 1.000 @ 167° TRUE
MINIMUM: 0.439 @ 294° TRUE

Horizontal

RMS: 0.808
Maximum: 1.000 @ 109° True
Minimum: 0.359 @ 276° True

COMMENTS: MEASURED PATTERNS OF THE HORIZONTAL AND VERTICAL COMPONETS.

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: New Station
Location: Biltmore Forest, NC.
Frequency: 96.5 MHz

Antenna: LP-2E-DA-HW
Orientation: 90.6161° True
Tower: 24" Central tower

Figure: 2
Date: 12/7/01
Reference: lib1m.fig

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.930	1.60	2.04	0.935	1.62	2.09	180°	0.901	1.50	1.77	0.953	1.68	2.25
5°	0.940	1.64	2.14	0.943	1.64	2.16	185°	0.867	1.39	1.43	0.911	1.54	1.86
10°	0.944	1.65	2.17	0.941	1.64	2.15	190°	0.833	1.28	1.08	0.859	1.36	1.35
15°	0.944	1.65	2.17	0.935	1.62	2.09	195°	0.793	1.16	0.66	0.809	1.21	0.83
20°	0.945	1.65	2.18	0.924	1.58	1.99	200°	0.755	1.05	0.23	0.754	1.05	0.22
25°	0.947	1.66	2.20	0.909	1.53	1.84	205°	0.720	0.96	-0.18	0.695	0.89	-0.49
30°	0.949	1.67	2.21	0.891	1.47	1.67	210°	0.681	0.86	-0.66	0.642	0.76	-1.18
35°	0.951	1.67	2.24	0.876	1.42	1.53	215°	0.639	0.76	-1.22	0.596	0.66	-1.83
40°	0.954	1.69	2.27	0.866	1.39	1.43	220°	0.596	0.66	-1.83	0.556	0.57	-2.42
45°	0.958	1.70	2.30	0.861	1.37	1.37	225°	0.555	0.57	-2.43	0.524	0.51	-2.95
50°	0.962	1.71	2.34	0.861	1.37	1.37	230°	0.519	0.50	-3.02	0.498	0.46	-3.39
55°	0.967	1.73	2.38	0.865	1.39	1.42	235°	0.487	0.44	-3.59	0.479	0.42	-3.73
60°	0.973	1.75	2.43	0.875	1.42	1.51	240°	0.458	0.39	-4.12	0.467	0.40	-3.95
65°	0.978	1.77	2.48	0.890	1.46	1.65	245°	0.432	0.35	-4.61	0.461	0.39	-4.05
70°	0.983	1.79	2.52	0.909	1.53	1.84	250°	0.411	0.31	-5.05	0.461	0.39	-4.05
75°	0.987	1.80	2.56	0.929	1.60	2.03	255°	0.393	0.29	-5.44	0.462	0.39	-4.04
80°	0.990	1.81	2.59	0.944	1.65	2.18	260°	0.379	0.27	-5.75	0.456	0.38	-4.15
85°	0.993	1.83	2.61	0.955	1.69	2.27	265°	0.369	0.25	-5.99	0.457	0.39	-4.14
90°	0.996	1.83	2.63	0.961	1.71	2.32	270°	0.362	0.24	-6.15	0.457	0.39	-4.13
95°	0.998	1.84	2.65	0.962	1.71	2.33	275°	0.359	0.24	-6.22	0.455	0.38	-4.16
100°	0.999	1.85	2.66	0.957	1.70	2.29	280°	0.362	0.24	-6.17	0.451	0.38	-4.25
105°	1.000	1.85	2.67	0.949	1.67	2.22	285°	0.371	0.25	-5.95	0.444	0.36	-4.38
110°	1.000	1.85	2.67	0.937	1.62	2.10	290°	0.386	0.28	-5.59	0.440	0.36	-4.46
115°	0.996	1.84	2.64	0.922	1.57	1.97	295°	0.408	0.31	-5.11	0.439	0.36	-4.48
120°	0.989	1.81	2.57	0.912	1.54	1.87	300°	0.437	0.35	-4.52	0.446	0.37	-4.33
125°	0.977	1.76	2.47	0.905	1.52	1.81	305°	0.472	0.41	-3.85	0.464	0.40	-4.01
130°	0.960	1.71	2.32	0.903	1.51	1.78	310°	0.513	0.49	-3.12	0.490	0.44	-3.52
135°	0.941	1.64	2.14	0.907	1.52	1.82	315°	0.561	0.58	-2.35	0.526	0.51	-2.91
140°	0.925	1.58	1.99	0.917	1.56	1.92	320°	0.616	0.70	-1.54	0.571	0.60	-2.19
145°	0.913	1.54	1.88	0.935	1.62	2.09	325°	0.676	0.84	-0.73	0.626	0.73	-1.39
150°	0.905	1.52	1.81	0.959	1.70	2.31	330°	0.731	0.99	-0.05	0.691	0.88	-0.54
155°	0.905	1.51	1.80	0.979	1.77	2.49	335°	0.781	1.13	0.52	0.755	1.05	0.23
160°	0.912	1.54	1.87	0.992	1.82	2.61	340°	0.823	1.25	0.98	0.810	1.21	0.84
165°	0.924	1.58	1.99	0.999	1.85	2.66	345°	0.860	1.37	1.36	0.855	1.35	1.32
170°	0.933	1.61	2.07	0.997	1.84	2.64	350°	0.890	1.46	1.66	0.891	1.47	1.67
175°	0.930	1.60	2.04	0.981	1.78	2.51	355°	0.913	1.54	1.88	0.918	1.56	1.93

Polarization:	**Horizontal**	**Vertical**
Maximum Field:	**1.000 @ 109° True**	**1.000 @ 167° True**
Minimum Field:	**0.359 @ 276° True**	**0.439 @ 294° True**
RMS:	**0.808**	**0.792**
Maximum ERP:	**1.850 kW**	**1.850 kW**
Maximum Power Gain:	**1.042 (0.179 dB)**	**1.042 (0.179 dB)**

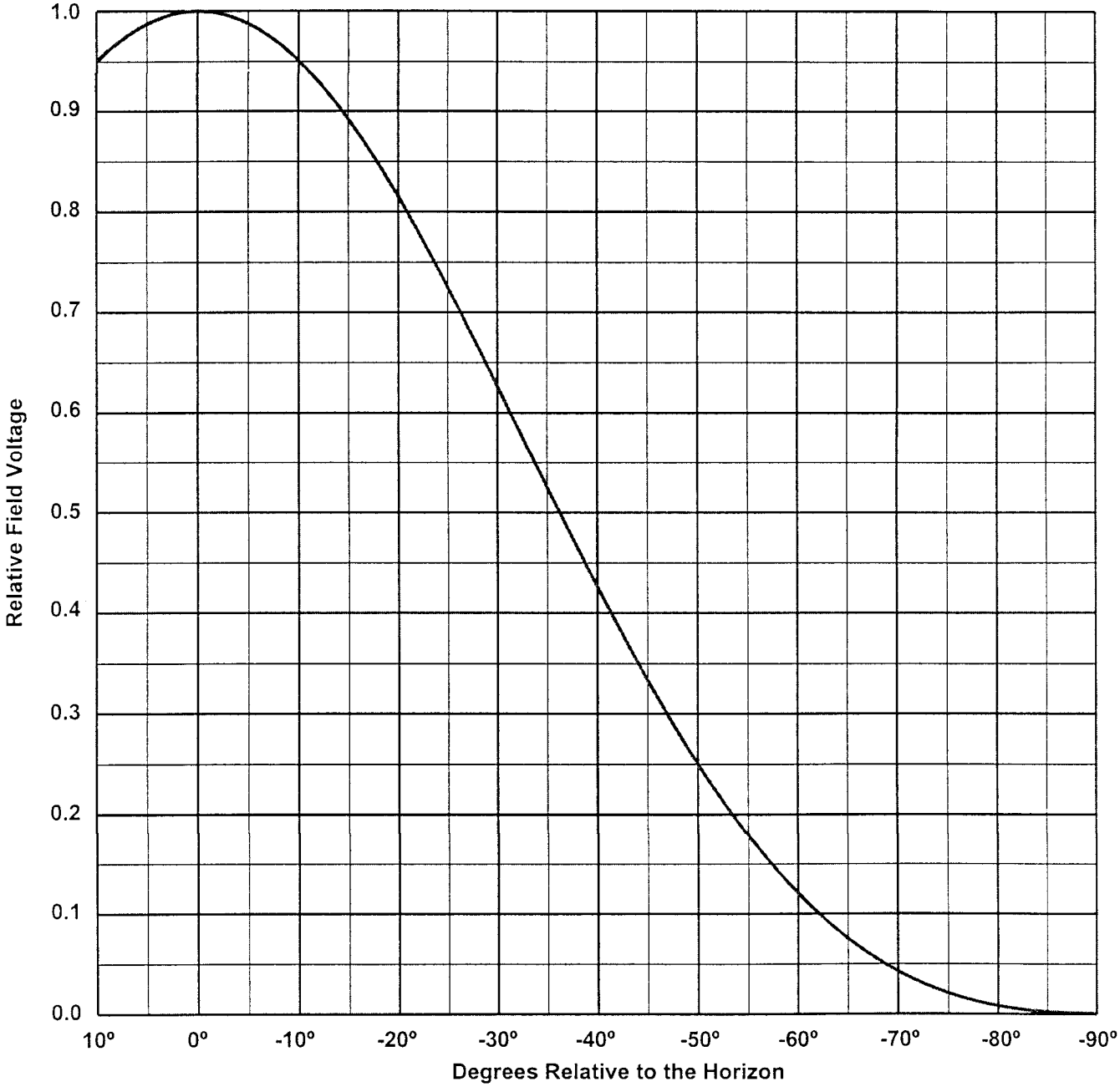
Total Input Power: 1.775 kW

ERI® Vertical Plane Relative Field Pattern

Biltmore Forest,NC., 96.5 MHz

Figure#: 3 Date: 12/7/01

A 2 level, .5 wave-length spaced LP-2E-HW directional antenna with 0° beam tilt, 0% null fill and a H/V maximum power ratio of 1.000



Vertical Polarization Gain:	Horizontal Polarization Gain:
Maximum: 1.042 (0.179 dB) Horizontal Plane: 1.042 (0.179 dB)	Maximum: 1.042 (0.179 dB) Horizontal Plane: 1.042 (0.179 dB)

Electronics Research, Inc. 7777 Gardner Rd. Chandler, IN 47601 Phone: (812) 925-6000 Fax: (812) 925-4030 http://www.eriinc.com/

Directional Antenna System
for
Biltmore Forest, North Carolina

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	LP-2E-DA-HW
Frequency:	96.5 MHz
Number of Bays:	2

MECHANICAL SPECIFICATIONS

Mounting:	Standard
System length:	13 ft 9 in
Aperture length required:	21 ft.
Orientation:	90.6161° true
Input flange to the antenna	1 5/8 inch female

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	1.85 kW (2.672 dBk)
Horizontal maximum power gain:	1.042 (0.179 dB)
Maximum vertical ERP:	1.85 kW (2.672 dBk)
Vertical maximum power gain:	1.042 (0.179 dB)
Total input power:	1.775 kW (2.492 dBk)

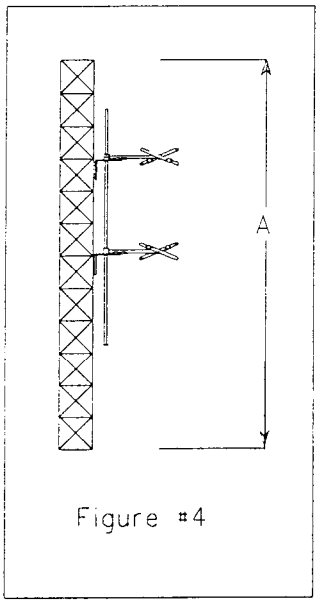
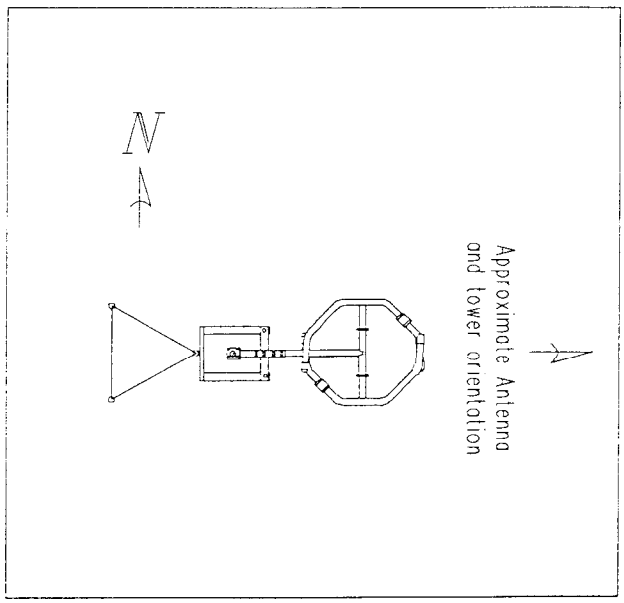
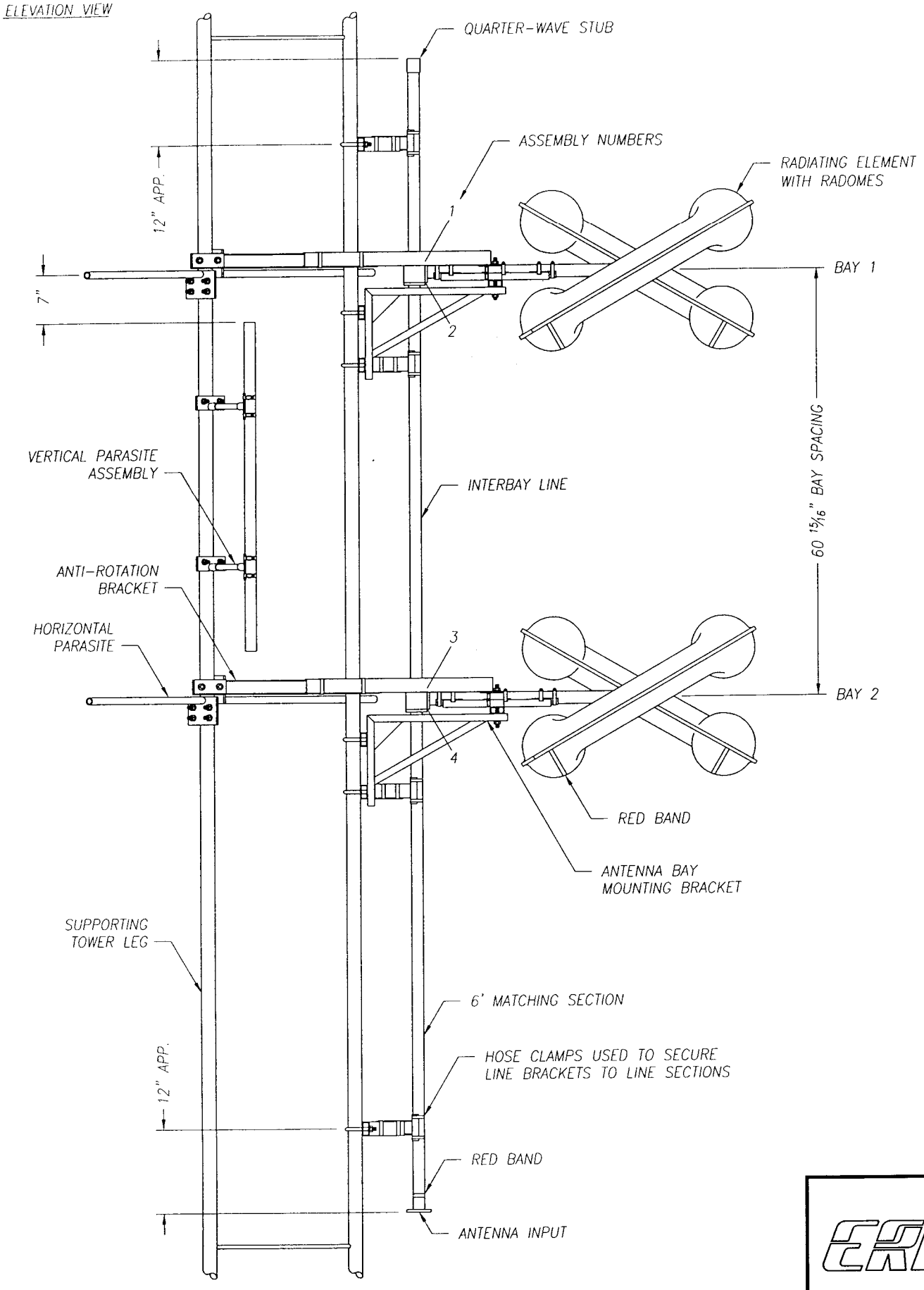
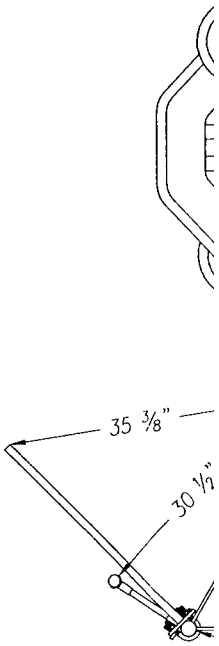


Figure #4



ELEVATION VIEW

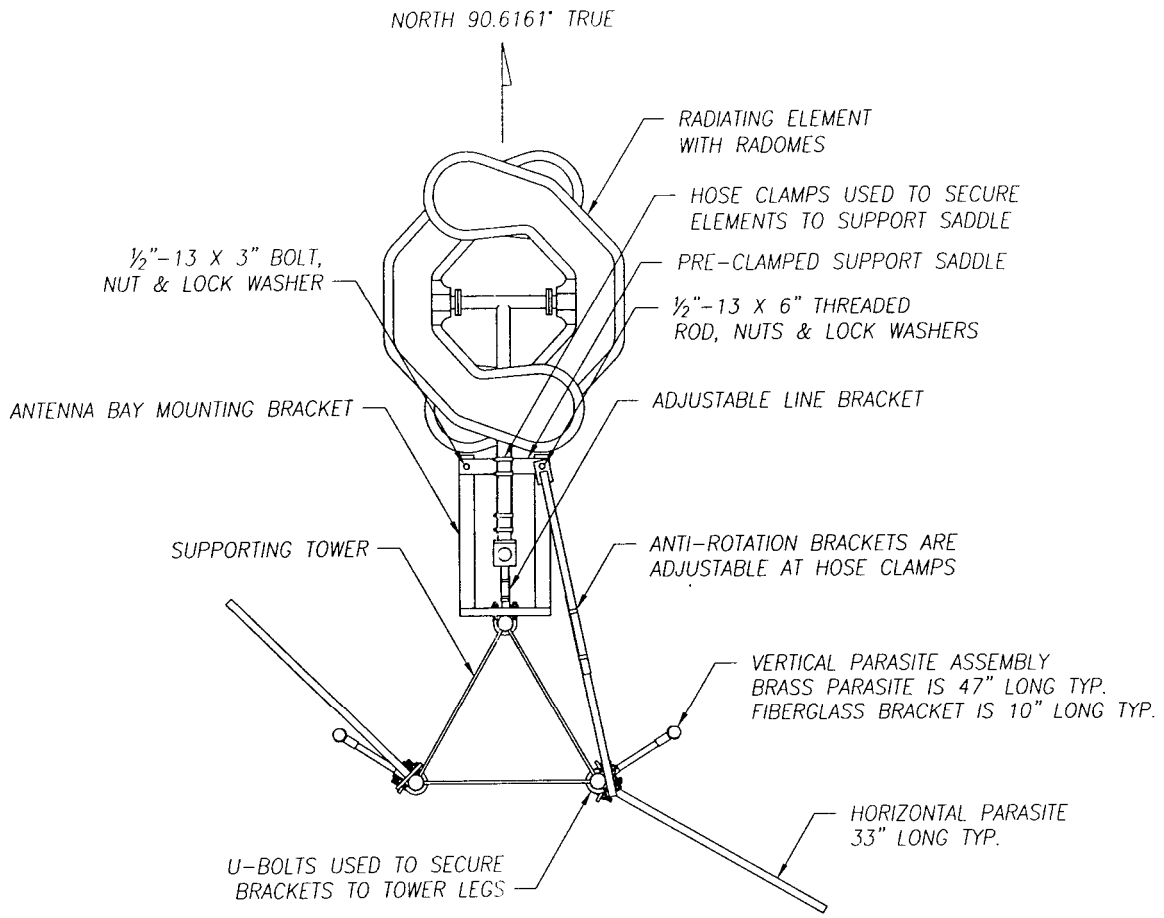


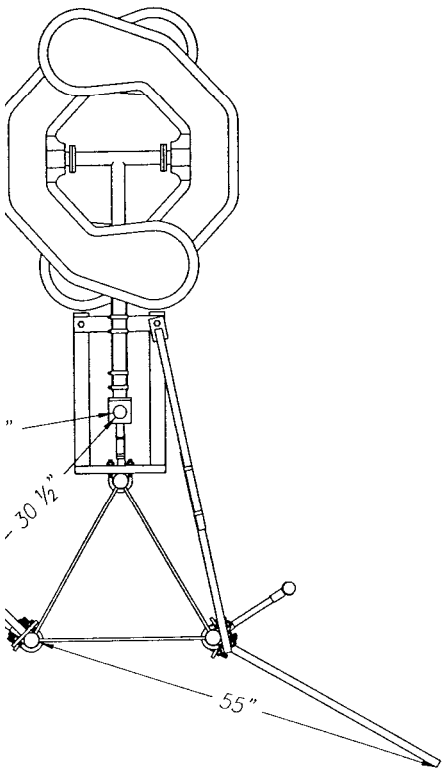


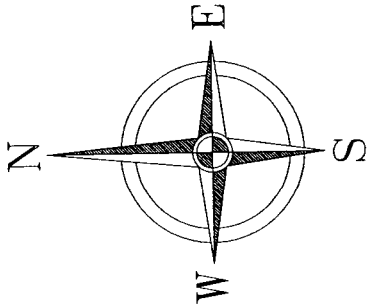
HORIZONTAL &
(DIMENSIONS F
TYPICAL FOR BOT

ELECTRONICS RESE
Established 1
7777 GARDNER
CHANDLER, IN.
PHONE: (812) 9
FAX: (812) 925-

TOP VIEW







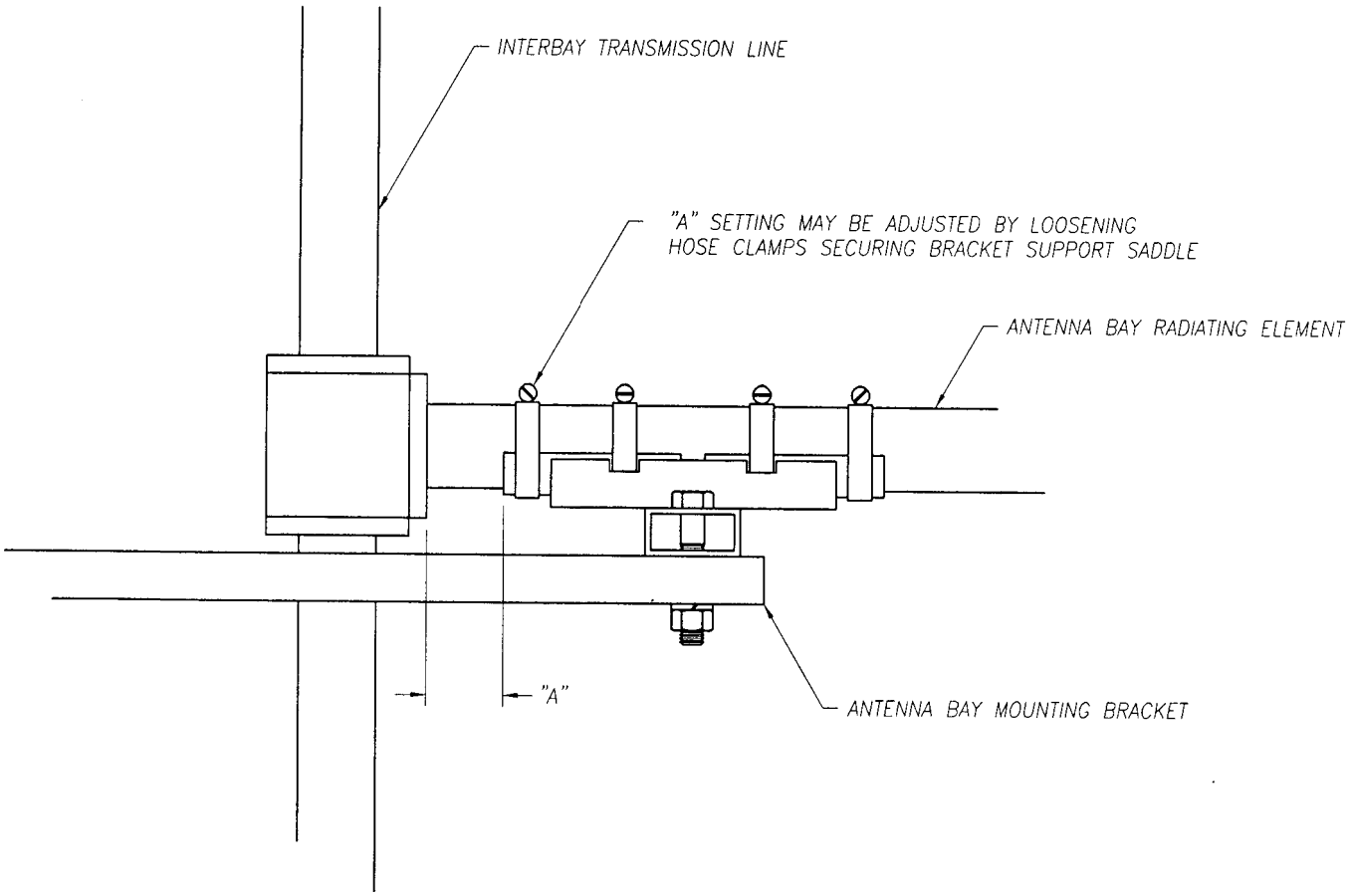
L & VERTICAL PARASITE LOCATIONS
NS FOR VERTICAL PARASITES ARE
BOTH SIDES OF ANTENNA SYSTEM)

NOTES:
1. ALL RED BANDS DESIGNATE SIDE TO BE MOUNTED DOWNWARD.
2. ASSEMBLE ANTENNA SYSTEM BY MATING CORRESPONDING NUMBERS.
3. OVERALL LENGTH OF ANTENNA SYSTEM IS 13'-9" APPROXIMATE.
4. ENSURE TO PLUMB ANTENNA VERTICALLY BY LOOSENING HOSE CLAMPS ON PRE-CLAMPED SUPPORT SADDLES AND ADJUSTABLE LINE BRACKETS.
5. TOWER INNER MEMBERS HAVE BEEN OMITTED FROM ELEVATION VIEW FOR CLARITY.
6. FINAL ORIENTATION TO BE DETERMINED BY A LICENSED SURVEYOR.

RESEARCH, INC.
ished 1943
NER RD.
IN. 47610-9637
12) 925-6000
925-4026

NO	REVISION	APP'D	DATE
6			
5			
4			
3			
2			
1			

NAME INSTALLATION DETAIL
STATION: BILTMORE FOREST, NC
FREQUENCY: 96.5 MHz PROJECT NO.: 08956/1
PATH G:\DRAFTING\ALL\PROJECTS\08956
FILE 1A — 1 DRAWN J.B.F. FACTOR NTS
DATE 01/03/02 APP'D BF DWG NO. 1A — 1
MODEL LP-2E-DA-HW



"A" SETTING CHART	
BAY NO.	"A" SETTING
1	7/8"
2	7/8"

ELECTRONICS RESEARCH, INC.
Established 1943
7777 GARDNER RD.
CHANDLER, IN. 47610-9637
PHONE: (812) 925-6000
FAX: (812) 925-4026

NO	REVISION	APP'D	DATE
6			
5			
4			
3			
2			
1			

NAME SUPPORTING SADDLE PLACEMENT
STATION: BILTMORE FOREST, NC
FREQUENCY: 96.5 MHz PROJECT NO.: 08956/1
PATH G:\DRAFTING\ALL\PROJECTS\08956
FILE 1A-2 DRAWN J.B.F. FACTOR NTS
DATE 01/03/02 APP'D SF DWG. NO.
MODEL LP-2E-DA-HW 1A-2