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
KLRD, Yucaipa, California

June 8, 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 KLRD.

The antenna is the ERI model LP-5C-DA-HW-SP configuration. The circular polarized system consists of 5 half-wavelength spaced bays using one driven circular polarized radiating element per bay and two horizontal parasitic elements per bay. The antenna was mounted on the North 312.25 degrees East tower face with bracketry to provide an antenna orientation of North 312.25 degrees East. The antenna was tested on a 18" 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 90.1 megahertz which is the center of the FM broadcast channel assigned to KLRD.

Pattern measurements were made on a sixty-acre antenna pattern range which 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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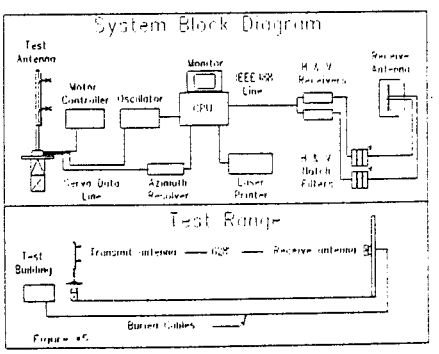
(Continued)

DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of two bay levels of the circular polarized system with the associated horizontal 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 18" ***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.



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 90.1 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.

(Continued)

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 circular polarized system consists of 5 half-wavelength spaced bays using one driven circular polarized radiating element per bay and two horizontal parasitic elements per bay. The complete array will included –2 degrees of beam tilt. 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-5C-DA-HW-SP array is to be mounted on the North 312.25 degrees East tower face of the 18" ERI®λ *MOUNTING SYSTEM,* at a bearing of North 312.25 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 0.560 kilowatts (-2.518 dBk).

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

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.

Directional Antenna System
For
KLRD, Yucaipa, California

(Continued)

The directional antenna should not be mounted on the top of an antenna tower which 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.

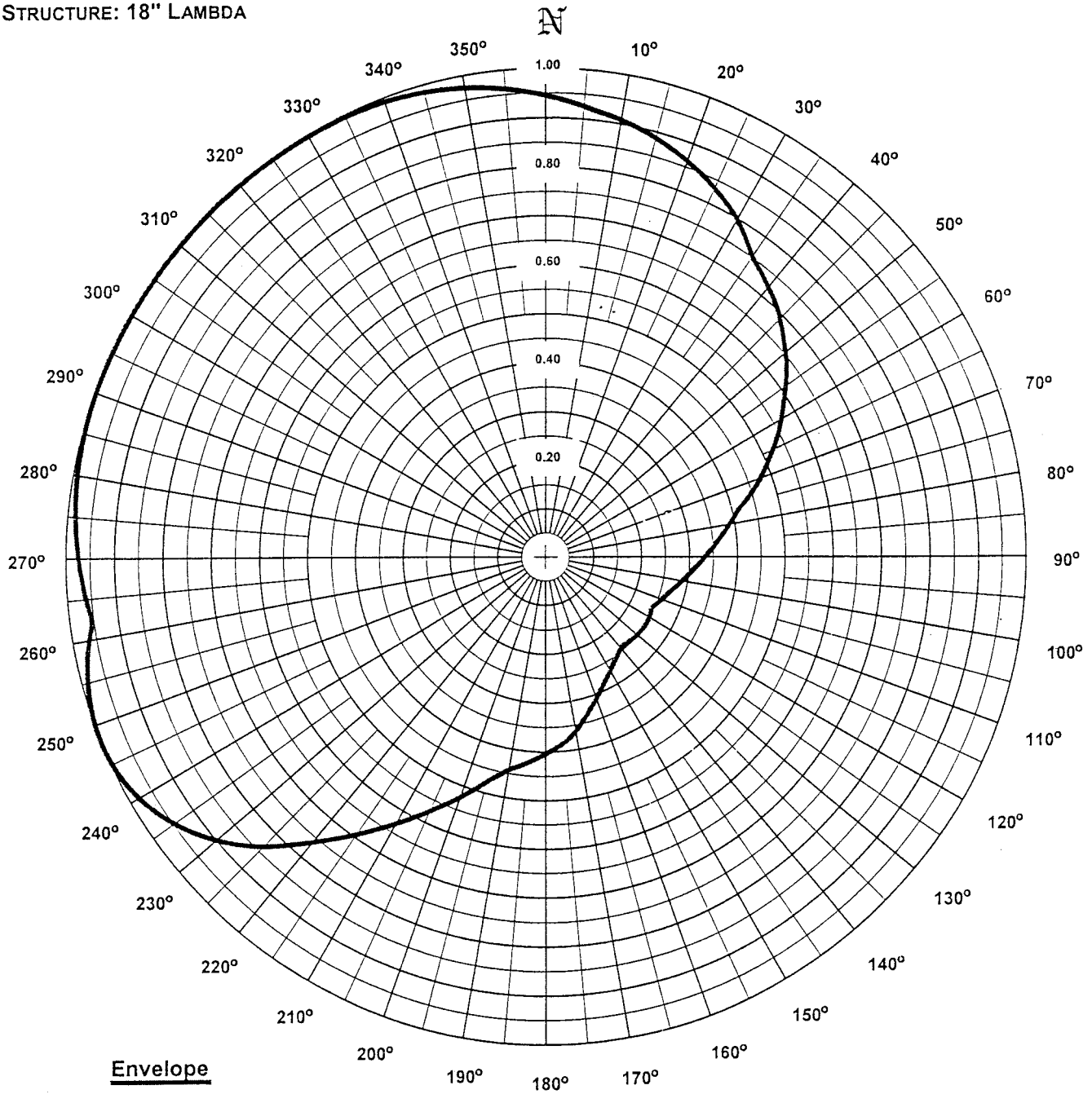
Tom Schaaf jpc

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: KLRD
LOCATION: YUCAIPA, CA
ANTENNA TYPE: LP-5C-DA-HW-SP
STRUCTURE: 18" LAMBDA

DATE: 06/06/2001
FREQUENCY: 90.1 MHz
ORIENTATION: 312.25° TRUE
MOUNTING: STANDARD



Envelope

RMS: 0.739
Maximum: 1.000 @ 248° True
Minimum: 0.240 @ 138° True

COMMENTS: COMPOSITE PATTERN: THIS PATTERN SHOWS THE MAXIMUM OF EITHER THE H OR V AZIMUTH VALUES.

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: KLRD
Location: Yucaipa, CA
Frequency: 90.1 MHz

Antenna: LP-5C-DA-HW-SP
Orientation: 312.25° True
Tower: 18" Lambda

Figure: 1
Date: 06/06/2001
Reference: klrd1m.fig

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.948	0.50	-2.98	H (and/or) V	180°	0.400	0.09	-10.48	H (and/or) V
5°	0.929	0.48	-3.16	H (and/or) V	185°	0.419	0.10	-10.08	H (and/or) V
10°	0.911	0.46	-3.33	H (and/or) V	190°	0.439	0.11	-9.68	H (and/or) V
15°	0.891	0.44	-3.53	H (and/or) V	195°	0.472	0.12	-9.03	H (and/or) V
20°	0.865	0.42	-3.77	H (and/or) V	200°	0.518	0.15	-8.23	H (and/or) V
25°	0.835	0.39	-4.08	H (and/or) V	205°	0.569	0.18	-7.42	H (and/or) V
30°	0.800	0.36	-4.45	H (and/or) V	210°	0.625	0.22	-6.59	H (and/or) V
35°	0.753	0.32	-4.99	H (and/or) V	215°	0.688	0.26	-5.77	H (and/or) V
40°	0.724	0.29	-5.32	H (and/or) V	220°	0.756	0.32	-4.95	H (and/or) V
45°	0.692	0.27	-5.72	H (and/or) V	225°	0.831	0.39	-4.12	H (and/or) V
50°	0.653	0.24	-6.22	H (and/or) V	230°	0.895	0.45	-3.48	H (and/or) V
55°	0.610	0.21	-6.81	H (and/or) V	235°	0.944	0.50	-3.02	H (and/or) V
60°	0.566	0.18	-7.46	H (and/or) V	240°	0.978	0.54	-2.71	H (and/or) V
65°	0.520	0.15	-8.20	H (and/or) V	245°	0.996	0.56	-2.55	H (and/or) V
70°	0.474	0.13	-9.00	H (and/or) V	250°	0.999	0.56	-2.53	H (and/or) V
75°	0.421	0.10	-10.03	H (and/or) V	255°	0.988	0.55	-2.62	H (and/or) V
80°	0.386	0.08	-10.79	H (and/or) V	260°	0.967	0.52	-2.81	H (and/or) V
85°	0.356	0.07	-11.50	H (and/or) V	265°	0.961	0.52	-2.86	H (and/or) V
90°	0.329	0.06	-12.19	H (and/or) V	270°	0.974	0.53	-2.75	H (and/or) V
95°	0.305	0.05	-12.84	H (and/or) V	275°	0.984	0.54	-2.66	H (and/or) V
100°	0.284	0.05	-13.44	H (and/or) V	280°	0.992	0.55	-2.59	H (and/or) V
105°	0.267	0.04	-13.97	H (and/or) V	285°	0.997	0.56	-2.54	H (and/or) V
110°	0.254	0.04	-14.44	H (and/or) V	290°	1.000	0.56	-2.52	H (and/or) V
115°	0.243	0.03	-14.80	H (and/or) V	295°	1.000	0.56	-2.52	H (and/or) V
120°	0.247	0.03	-14.65	H (and/or) V	300°	1.000	0.56	-2.52	H (and/or) V
125°	0.248	0.03	-14.64	H (and/or) V	305°	1.000	0.56	-2.52	H (and/or) V
130°	0.246	0.03	-14.71	H (and/or) V	310°	1.000	0.56	-2.52	H (and/or) V
135°	0.242	0.03	-14.83	H (and/or) V	315°	1.000	0.56	-2.52	H (and/or) V
140°	0.242	0.03	-14.84	H (and/or) V	320°	1.000	0.56	-2.52	H (and/or) V
145°	0.253	0.04	-14.46	H (and/or) V	325°	1.000	0.56	-2.52	H (and/or) V
150°	0.267	0.04	-13.99	H (and/or) V	330°	1.000	0.56	-2.52	H (and/or) V
155°	0.285	0.05	-13.43	H (and/or) V	335°	0.999	0.56	-2.52	H (and/or) V
160°	0.306	0.05	-12.80	H (and/or) V	340°	0.995	0.55	-2.56	H (and/or) V
165°	0.331	0.06	-12.13	H (and/or) V	345°	0.988	0.55	-2.62	H (and/or) V
170°	0.359	0.07	-11.41	H (and/or) V	350°	0.978	0.54	-2.71	H (and/or) V
175°	0.382	0.08	-10.88	H (and/or) V	355°	0.965	0.52	-2.83	H (and/or) V

Polarization: Envelope
Maximum Field: 1.000 @ 248° True
Minimum Field: 0.240 @ 138° True
RMS: 0.739
Maximum ERP: 0.560 kW
Maximum Power Gain: 3.002 (4.774 dB)
Horizontal Plane Gain: 2.921 (4.656 dB)

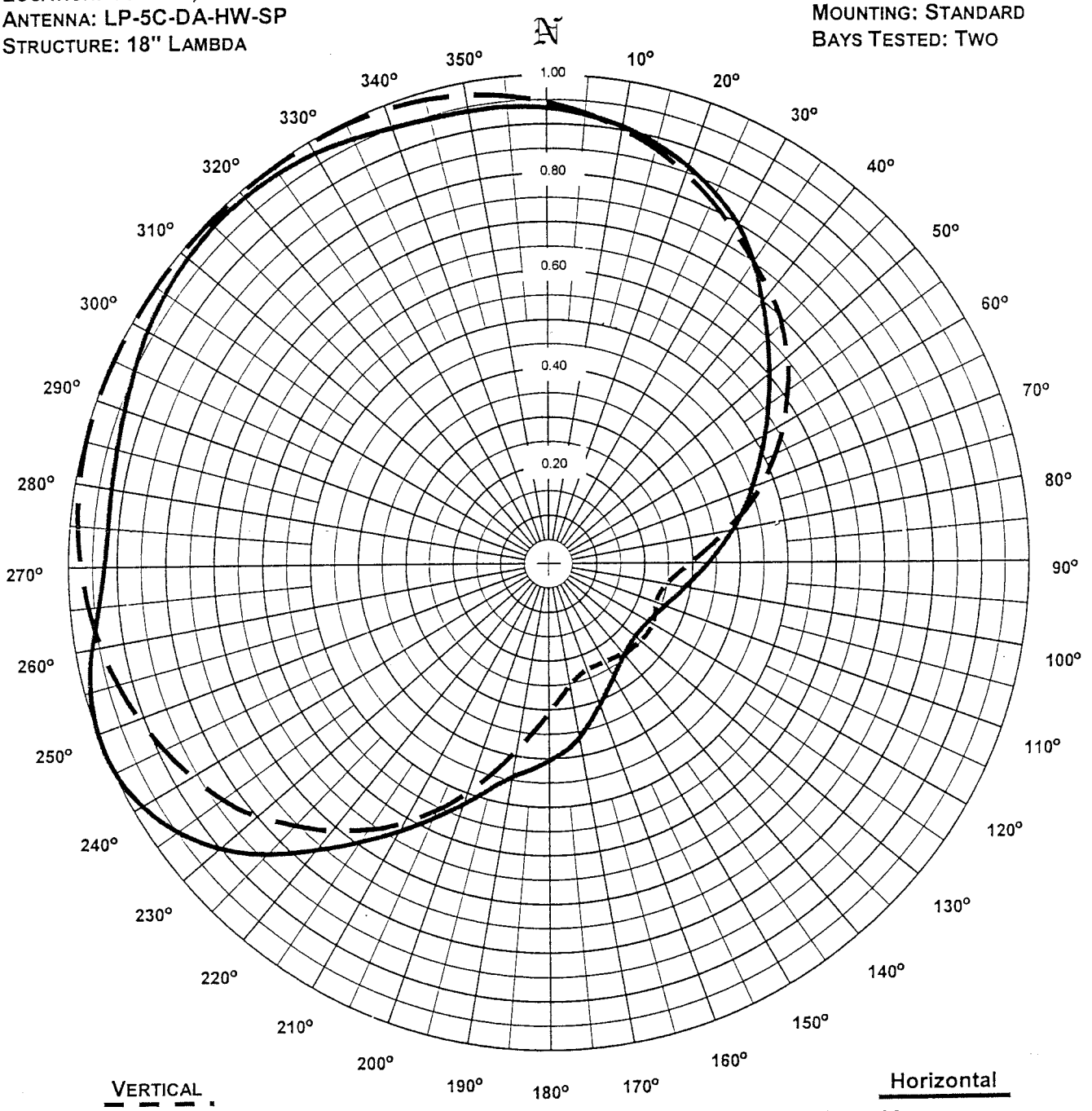
Total Input Power: 0.187 kW

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: KLRD
LOCATION: YUCAIPA, CA
ANTENNA: LP-5C-DA-HW-SP
STRUCTURE: 18" LAMBDA

DATE: 06/06/2001
FREQUENCY: 90.1 MHz
ORIENTATION: 312.25° TRUE
MOUNTING: STANDARD
BAYS TESTED: TWO



VERTICAL

RMS: 0.718
MAXIMUM: 1.000 @ 292° TRUE
MINIMUM: 0.227 @ 158° TRUE

Horizontal

RMS: 0.723
Maximum: 1.000 @ 248° True
Minimum: 0.231 @ 128° True

COMMENTS: MEASURED PATTERNS OF THE HORIZONTAL ANAD VERTICAL COMPONENTS.

ERI® Horizontal Plane Relative Field List

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Station: KLRD
Location: Yucaipa, CA
Frequency: 90.1 MHz

Antenna: LP-5C-DA-HW-SP
Orientation: 312.25° True
Tower: 18" Lambda

Figure: 2
Date: 06/06/2001
Reference: klrd1m.fig

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.937	0.49	-3.08	0.948	0.50	-2.98	180°	0.400	0.09	-10.48	0.302	0.05	-12.93
5°	0.926	0.48	-3.18	0.929	0.48	-3.16	185°	0.419	0.10	-10.08	0.338	0.06	-11.93
10°	0.911	0.46	-3.33	0.906	0.46	-3.38	190°	0.439	0.11	-9.68	0.383	0.08	-10.86
15°	0.891	0.44	-3.53	0.880	0.43	-3.63	195°	0.472	0.12	-9.03	0.434	0.11	-9.76
20°	0.865	0.42	-3.77	0.851	0.41	-3.92	200°	0.518	0.15	-8.23	0.493	0.14	-8.66
25°	0.835	0.39	-4.08	0.818	0.37	-4.26	205°	0.569	0.18	-7.42	0.550	0.17	-7.71
30°	0.800	0.36	-4.45	0.783	0.34	-4.64	210°	0.625	0.22	-6.59	0.607	0.21	-6.86
35°	0.751	0.32	-5.00	0.753	0.32	-4.99	215°	0.688	0.26	-5.77	0.658	0.24	-6.16
40°	0.698	0.27	-5.64	0.724	0.29	-5.32	220°	0.756	0.32	-4.95	0.705	0.28	-5.56
45°	0.649	0.24	-6.27	0.692	0.27	-5.72	225°	0.831	0.39	-4.12	0.750	0.31	-5.02
50°	0.604	0.20	-6.90	0.653	0.24	-6.22	230°	0.895	0.45	-3.48	0.794	0.35	-4.52
55°	0.561	0.18	-7.54	0.610	0.21	-6.81	235°	0.944	0.50	-3.02	0.831	0.39	-4.13
60°	0.522	0.15	-8.17	0.566	0.18	-7.46	240°	0.978	0.54	-2.71	0.859	0.41	-3.84
65°	0.485	0.13	-8.81	0.520	0.15	-8.20	245°	0.996	0.56	-2.55	0.885	0.44	-3.58
70°	0.451	0.11	-9.44	0.474	0.13	-9.00	250°	0.999	0.56	-2.53	0.908	0.46	-3.36
75°	0.419	0.10	-10.08	0.421	0.10	-10.03	255°	0.988	0.55	-2.62	0.928	0.48	-3.17
80°	0.386	0.08	-10.79	0.369	0.08	-11.19	260°	0.967	0.52	-2.81	0.946	0.50	-3.00
85°	0.356	0.07	-11.50	0.325	0.06	-12.29	265°	0.942	0.50	-3.04	0.961	0.52	-2.86
90°	0.329	0.06	-12.19	0.290	0.05	-13.28	270°	0.927	0.48	-3.18	0.974	0.53	-2.75
95°	0.305	0.05	-12.84	0.263	0.04	-14.11	275°	0.923	0.48	-3.22	0.984	0.54	-2.66
100°	0.284	0.05	-13.44	0.246	0.03	-14.71	280°	0.925	0.48	-3.19	0.992	0.55	-2.59
105°	0.267	0.04	-13.97	0.237	0.03	-15.02	285°	0.931	0.49	-3.14	0.997	0.56	-2.54
110°	0.254	0.04	-14.44	0.237	0.03	-15.02	290°	0.940	0.50	-3.05	1.000	0.56	-2.52
115°	0.243	0.03	-14.80	0.243	0.03	-14.82	295°	0.953	0.51	-2.94	1.000	0.56	-2.52
120°	0.236	0.03	-15.07	0.247	0.03	-14.65	300°	0.966	0.52	-2.82	1.000	0.56	-2.52
125°	0.232	0.03	-15.21	0.248	0.03	-14.64	305°	0.977	0.53	-2.72	1.000	0.56	-2.52
130°	0.232	0.03	-15.23	0.246	0.03	-14.71	310°	0.984	0.54	-2.66	1.000	0.56	-2.52
135°	0.235	0.03	-15.09	0.242	0.03	-14.83	315°	0.988	0.55	-2.62	1.000	0.56	-2.52
140°	0.242	0.03	-14.84	0.238	0.03	-15.00	320°	0.988	0.55	-2.62	1.000	0.56	-2.52
145°	0.253	0.04	-14.46	0.233	0.03	-15.19	325°	0.984	0.54	-2.65	1.000	0.56	-2.52
150°	0.267	0.04	-13.99	0.229	0.03	-15.31	330°	0.977	0.53	-2.72	1.000	0.56	-2.52
155°	0.285	0.05	-13.43	0.227	0.03	-15.38	335°	0.966	0.52	-2.82	0.999	0.56	-2.52
160°	0.306	0.05	-12.80	0.228	0.03	-15.36	340°	0.955	0.51	-2.91	0.995	0.55	-2.56
165°	0.331	0.06	-12.13	0.235	0.03	-15.09	345°	0.948	0.50	-2.98	0.988	0.55	-2.62
170°	0.359	0.07	-11.41	0.250	0.03	-14.56	350°	0.944	0.50	-3.01	0.978	0.54	-2.71
175°	0.382	0.08	-10.88	0.272	0.04	-13.82	355°	0.943	0.50	-3.03	0.965	0.52	-2.83

Polarization:	Horizontal	Vertical
Maximum Field:	1.000 @ 248° True	1.000 @ 292° True
Minimum Field:	0.231 @ 128° True	0.227 @ 158° True
RMS:	0.723	0.718
Maximum ERP:	0.560 kW	0.560 kW
Maximum Power Gain:	3.002 (4.774 dB)	3.002 (4.774 dB)
Horizontal Plane Gain:	2.9212 (4.656 dB)	2.9212 (4.656 dB)

Total Input Power: 0.187 kW

ANTENNA SPECIFICATIONS

Antenna Type:	LP-5C-DA-HW-SP
Frequency:	90.1 MHz
Number of Bays:	5

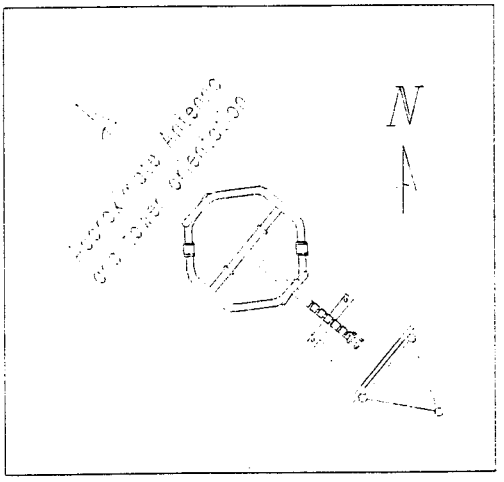
MECHANICAL SPECIFICATIONS

Mounting:	Standard
System length:	26 ft 6 in
Aperture length required:	41 ft 6 in ft.
Orientation:	312.25° true

Input flange to the antenna 1 5/8 inch female

ELECTRICAL SPECIFICATIONS
(Using –2 degrees of beam tilt)

Maximum horizontal ERP:	0.56 kW (-2.518 dBk)
Maximum vertical ERP:	0.56 kW (-2.518 dBk)
H pol horizontal plane ERP:	0.545 kW (–2.636 dB)
V pol horizontal plane ERP:	0.545 kW (–2.636 dB)
Horizontal maximum power gain:	3.002 (4.774 dB)
Vertical maximum power gain:	3.002 (4.774 dB)
H pol horizontal plane power gain:	2.921 (4.646 dB)
V pol horizontal plane power gain:	2.921 (4.646 dB)
Total input power:	0.187 kW (7.292 dBk)



ELECTRONICS RESEARCH, INC.
7777 GARDNER ROAD
CHANDLER, IN. 47610

FIGURE 3

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

ERI TYPE LP-5C-DA-HW-SP ANTENNA
-2.0 DEGREES ELECTRICAL BEAM TILT

MARCH 6, 2001

99.1 MHz

ELEMENT SPACING:
HALF-WAVE