ELECTRONICS RESEARCH, INC. ERI®

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 WTSX, Lehman Township, Pennsylvania

April 27, 2011

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 WTSX.

The antenna is the ERI model LP-2E-DA configuration. The circular polarized system consists of 2 full-wavelength spaced bays using one driven circular polarized radiating element, one horizontal parasitic elements placed one quarter wave above and below each bay and two vertical parasitic elements per bay. The antenna was mounted on the North 259 degrees East tower face with bracketry to provide an antenna orientation of North 280 degrees East. The antenna was tested on a tapered tower, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 96.7 megahertz, which is the center of the FM broadcast channel assigned to WTSX.

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
Proposed For
WTSX, Lehman Township, Pennsylvania

(Continued)

DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of two bay levels of the 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 tapered 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 a US Digital angle position indicator. The resolution of this angle position indicator is one-hundredth of a degree.

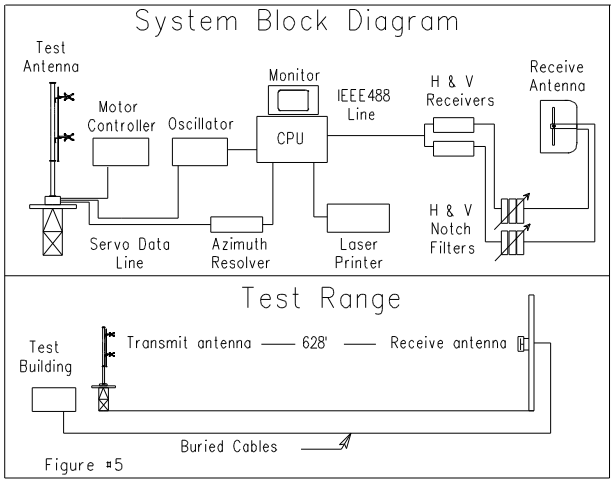


Figure #5

The antenna under test was operated in the transmitting mode and fed from a HP8657D signal generator. The frequency of the signal source was set at 96.7 MHz and was constantly monitored by a Rohde & Schwarz ESVD measuring receiver.

(Continued)

A broadband 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 a Rohde & Schwarz measuring receiver. This data was interfaced to a laser jet printer by means of a 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 2 full-wavelength spaced bays using one driven circular polarized radiating element, one horizontal parasitic elements placed one quarter wave above and below each bay and two vertical parasitic elements per bay. 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 array is to be mounted on the North 259 degrees East tower face of the tapered tower at a bearing of North 280 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 5 kilowatts (6.99 dBk).

The power at North 80 degrees East does not exceed 0.155 kilowatts (-8.097 dBk).

(Continued)

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.

The clear vertical length of the structure required to support the antenna is 26 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.

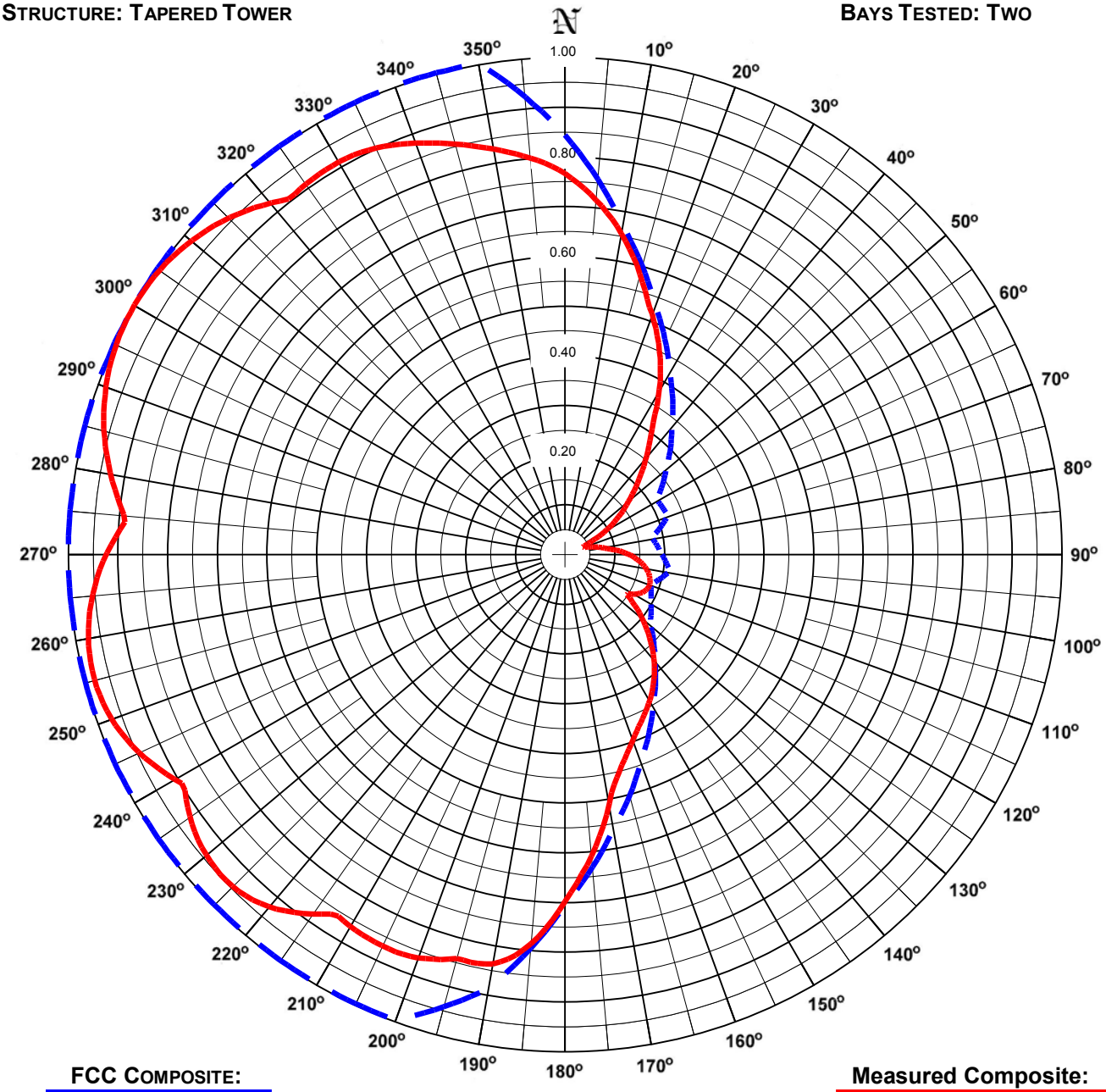
ELECTRONICS RESEARCH, INC.

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 NO: 1
STATION: WTSX
LOCATION: LEHMAN TOWNSHIP, PA.
ANTENNA: LP-2E-DA
STRUCTURE: TAPERED TOWER

DATE: 4/7/2011
FREQUENCY: 96.7 MHZ
ORIENTATION: 280° TRUE
MOUNTING: CUSTOM
BAYS TESTED: TWO



FCC COMPOSITE:

RMS: 0.747
MAXIMUM: 1.000 @ 200° TRUE
MINIMUM: 0.177 @ 80° TRUE

Measured Composite:

RMS: 0.691
Maximum: 1.000 @ 300° True
Minimum: 0.038 @ 72° True

COMMENTS: COMPOSITE PATTERN: THIS PATTERN SHOWS THE MAXIMUM OF EITHER THE H OR V AZIMUTH VALUES. THIS PATTERN IS GREATER THAN 85% OF THE FCC FILED COMPOSITE PATTERN BPH-20081104AFA.

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: WTSX
Location: Lehman Township, PA.
Frequency: 96.7 MHz

Antenna: LP-2E-DA
Orientation: 280° True
Tower: Tapered Tower

Figure: 1
Date: 4/7/2011
Reference: wtsx1m.fig

Angle	Envelope			Polarization	Angle	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0º	0.764	2.92	4.65	Vertical	180º	0.701	2.46	3.91	Horizontal
5º	0.713	2.54	4.05	Vertical	185º	0.790	3.12	4.94	Horizontal
10º	0.653	2.13	3.28	Vertical	190º	0.839	3.52	5.47	Horizontal
15º	0.582	1.69	2.28	Vertical	195º	0.844	3.57	5.52	Vertical
20º	0.511	1.31	1.16	Horizontal	200º	0.867	3.76	5.75	Vertical
25º	0.449	1.01	0.04	Horizontal	205º	0.872	3.80	5.80	Vertical
30º	0.380	0.72	-1.42	Horizontal	210º	0.867	3.76	5.75	Vertical
35º	0.306	0.47	-3.31	Vertical	215º	0.887	3.93	5.94	Horizontal
40º	0.255	0.32	-4.88	Vertical	220º	0.929	4.31	6.35	Horizontal
45º	0.211	0.22	-6.52	Vertical	225º	0.948	4.49	6.53	Horizontal
50º	0.172	0.15	-8.32	Vertical	230º	0.944	4.45	6.49	Horizontal
55º	0.137	0.09	-10.30	Vertical	235º	0.922	4.25	6.29	Horizontal
60º	0.103	0.05	-12.77	Vertical	240º	0.909	4.13	6.16	Vertical
65º	0.067	0.02	-16.45	Vertical	245º	0.948	4.49	6.52	Vertical
70º	0.041	0.01	-20.85	Vertical	250º	0.972	4.73	6.75	Vertical
75º	0.044	0.01	-20.19	Vertical	255º	0.981	4.81	6.83	Vertical
80º	0.067	0.02	-16.54	Vertical	260º	0.974	4.75	6.76	Vertical
85º	0.092	0.04	-13.76	Horizontal	265º	0.954	4.55	6.58	Vertical
90º	0.121	0.07	-11.36	Horizontal	270º	0.922	4.25	6.28	Vertical
95º	0.145	0.11	-9.77	Horizontal	275º	0.892	3.98	5.99	Horizontal
100º	0.163	0.13	-8.75	Horizontal	280º	0.930	4.32	6.36	Horizontal
105º	0.175	0.15	-8.13	Horizontal	285º	0.961	4.62	6.64	Horizontal
110º	0.182	0.16	-7.83	Horizontal	290º	0.983	4.83	6.84	Horizontal
115º	0.179	0.16	-7.95	Horizontal	295º	0.996	4.96	6.95	Horizontal
120º	0.165	0.14	-8.67	Horizontal	300º	1.000	5.00	6.99	Horizontal
125º	0.159	0.13	-8.98	Vertical	305º	0.994	4.95	6.94	Horizontal
130º	0.201	0.20	-6.95	Vertical	310º	0.979	4.79	6.81	Horizontal
135º	0.241	0.29	-5.38	Vertical	315º	0.954	4.55	6.58	Horizontal
140º	0.278	0.39	-4.12	Vertical	320º	0.919	4.23	6.26	Horizontal
145º	0.312	0.49	-3.12	Vertical	325º	0.907	4.11	6.14	Vertical
150º	0.341	0.58	-2.35	Vertical	330º	0.909	4.13	6.16	Vertical
155º	0.368	0.68	-1.69	Vertical	335º	0.899	4.04	6.07	Vertical
160º	0.400	0.80	-0.98	Vertical	340º	0.878	3.85	5.86	Vertical
165º	0.442	0.98	-0.10	Vertical	345º	0.852	3.63	5.59	Vertical
170º	0.512	1.31	1.17	Horizontal	350º	0.825	3.40	5.32	Vertical
175º	0.612	1.87	2.72	Horizontal	355º	0.797	3.18	5.02	Vertical

Polarization: **Envelope**
Maximum Field: **1.000 @ 300° True**
Minimum Field: **0.038 @ 72° True**
RMS: **0.691**
Maximum ERP: **5.000 kW**
Maximum Power Gain: **2.180 (3.384 dB)**

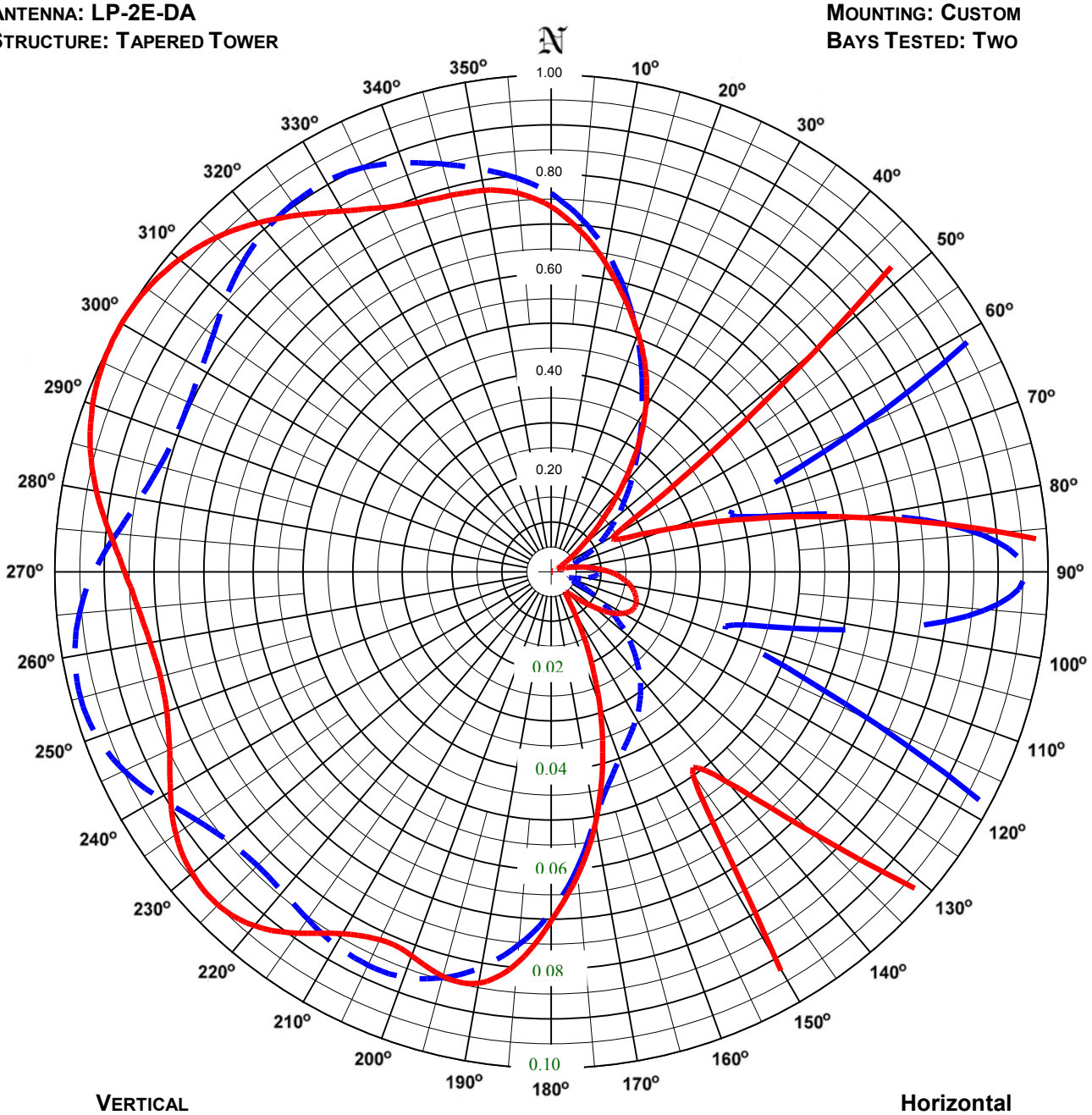
Total Input Power: 2.294 kW

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: WTSX
LOCATION: LEHMAN TOWNSHIP, PA.
ANTENNA: LP-2E-DA
STRUCTURE: TAPERED TOWER

DATE: 4/7/2011
FREQUENCY: 96.7 MHz
ORIENTATION: 280° TRUE
MOUNTING: CUSTOM
BAYS TESTED: TWO



VERTICAL

RMS: 0.659
MAXIMUM: 0.981 @ 255° TRUE
MINIMUM: 0.037 @ 107° TRUE

10X Scale

Horizontal

RMS: 0.659
Maximum: 1.000 @ 300° True
Minimum: 0.014 @ 61° True

COMMENTS: MEASURED PATTERNS OF THE HORIZONTAL AND VERTIL 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: WTSX
Location: Lehman Township, PA.
Frequency: 96.7 MHz

Antenna: LP-2E-DA
Orientation: 280° True
Tower: Tapered Tower

Figure: 2
Date: 4/7/2011
Reference: wtsx1m.fig

Angle	Horizontal			Vertical			Angle	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0º	0.737	2.71	4.34	0.764	2.92	4.65	180º	0.701	2.46	3.91	0.682	2.33	3.67
5º	0.689	2.38	3.76	0.713	2.54	4.05	185º	0.790	3.12	4.94	0.752	2.83	4.52
10º	0.632	2.00	3.00	0.653	2.13	3.28	190º	0.839	3.52	5.47	0.806	3.25	5.12
15º	0.571	1.63	2.12	0.582	1.69	2.28	195º	0.842	3.54	5.50	0.844	3.57	5.52
20º	0.511	1.31	1.16	0.506	1.28	1.07	200º	0.821	3.37	5.28	0.867	3.76	5.75
25º	0.449	1.01	0.04	0.432	0.93	-0.30	205º	0.816	3.33	5.22	0.872	3.80	5.80
30º	0.380	0.72	-1.42	0.365	0.66	-1.77	210º	0.840	3.53	5.47	0.867	3.76	5.75
35º	0.299	0.45	-3.50	0.306	0.47	-3.31	215º	0.887	3.93	5.94	0.853	3.64	5.61
40º	0.213	0.23	-6.43	0.255	0.32	-4.88	220º	0.929	4.31	6.35	0.840	3.53	5.48
45º	0.133	0.09	-10.51	0.211	0.22	-6.52	225º	0.948	4.49	6.53	0.836	3.49	5.43
50º	0.069	0.02	-16.27	0.172	0.15	-8.32	230º	0.944	4.45	6.49	0.845	3.57	5.53
55º	0.028	0.00	-24.04	0.137	0.09	-10.30	235º	0.922	4.25	6.29	0.870	3.78	5.78
60º	0.014	0.00	-29.92	0.103	0.05	-12.77	240º	0.886	3.92	5.94	0.909	4.13	6.16
65º	0.017	0.00	-28.56	0.067	0.02	-16.45	245º	0.848	3.60	5.56	0.948	4.49	6.52
70º	0.026	0.00	-24.60	0.041	0.01	-20.85	250º	0.824	3.39	5.31	0.972	4.73	6.75
75º	0.042	0.01	-20.53	0.044	0.01	-20.19	255º	0.815	3.32	5.21	0.981	4.81	6.83
80º	0.064	0.02	-16.90	0.067	0.02	-16.54	260º	0.820	3.36	5.26	0.974	4.75	6.76
85º	0.092	0.04	-13.76	0.087	0.04	-14.21	265º	0.835	3.48	5.42	0.954	4.55	6.58
90º	0.121	0.07	-11.36	0.095	0.05	-13.43	270º	0.859	3.69	5.66	0.922	4.25	6.28
95º	0.145	0.11	-9.77	0.088	0.04	-14.17	275º	0.892	3.98	5.99	0.880	3.87	5.88
100º	0.163	0.13	-8.75	0.066	0.02	-16.65	280º	0.930	4.32	6.36	0.843	3.55	5.51
105º	0.175	0.15	-8.13	0.041	0.01	-20.77	285º	0.961	4.62	6.64	0.818	3.35	5.25
110º	0.182	0.16	-7.83	0.041	0.01	-20.66	290º	0.983	4.83	6.84	0.806	3.24	5.11
115º	0.179	0.16	-7.95	0.072	0.03	-15.82	295º	0.996	4.96	6.95	0.806	3.25	5.11
120º	0.165	0.14	-8.67	0.115	0.07	-11.79	300º	1.000	5.00	6.99	0.815	3.32	5.21
125º	0.139	0.10	-10.15	0.159	0.13	-8.98	305º	0.994	4.95	6.94	0.832	3.46	5.39
130º	0.104	0.05	-12.69	0.201	0.20	-6.95	310º	0.979	4.79	6.81	0.856	3.67	5.64
135º	0.074	0.03	-15.67	0.241	0.29	-5.38	315º	0.954	4.55	6.58	0.880	3.88	5.88
140º	0.055	0.02	-18.23	0.278	0.39	-4.12	320º	0.919	4.23	6.26	0.897	4.03	6.05
145º	0.050	0.01	-19.11	0.312	0.49	-3.12	325º	0.879	3.86	5.87	0.907	4.11	6.14
150º	0.093	0.04	-13.69	0.341	0.58	-2.35	330º	0.841	3.54	5.49	0.909	4.13	6.16
155º	0.180	0.16	-7.91	0.368	0.68	-1.69	335º	0.810	3.28	5.16	0.899	4.04	6.07
160º	0.286	0.41	-3.88	0.400	0.80	-0.98	340º	0.792	3.14	4.97	0.878	3.85	5.86
165º	0.399	0.80	-1.00	0.442	0.98	-0.10	345º	0.786	3.09	4.90	0.852	3.63	5.59
170º	0.512	1.31	1.17	0.507	1.28	1.08	350º	0.781	3.05	4.85	0.825	3.40	5.32
175º	0.612	1.87	2.72	0.597	1.78	2.51	355º	0.767	2.94	4.68	0.797	3.18	5.02

Polarization:	**Horizontal**	**Vertical**
Maximum Field:	**1.000 @ 300° True**	**0.981 @ 255° True**
Minimum Field:	**0.014 @ 61° True**	**0.037 @ 107° True**
RMS:	**0.659**	**0.659**
Maximum ERP:	**5.000 kW**	**4.814 kW**
Maximum Power Gain:	**2.180 (3.384 dB)**	**2.099 (3.219 dB)**

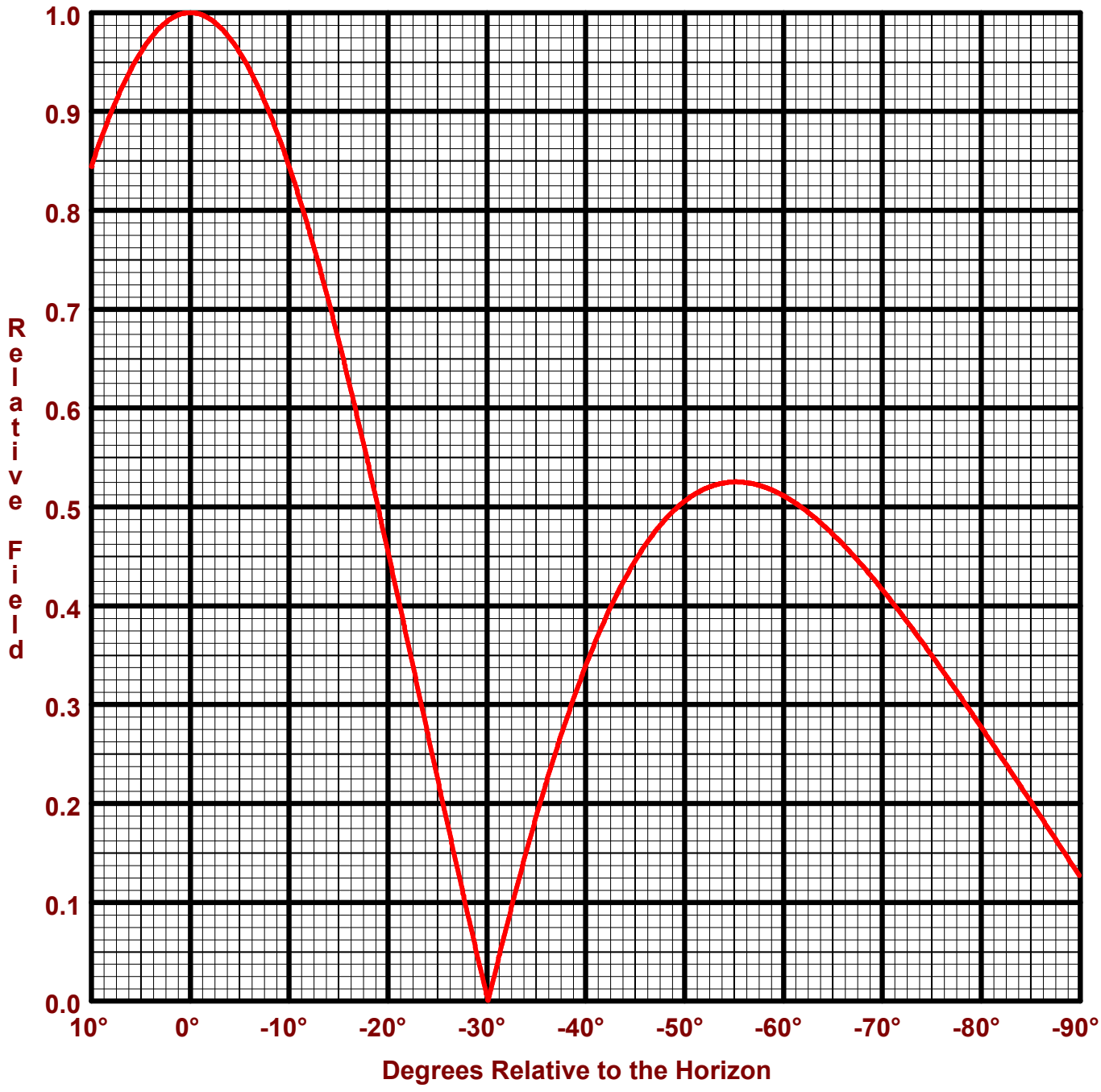
Total Input Power: 2.294 kW

Vertical Plane Relative Field Pattern

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

Figure No: 3
Call Sign: WTSX
Location: Lehman Township, PA.
Frequency: 96.7 MHz
2 bay LP-2E-DA antenna

Date: 4/7/2011
1 Wave-length Spacing
0° Beam Tilt
0% First Null Fill



Horizontal Polarization:
Maximum: 2.180 (3.385 dB)
Horizontal Plane: 2.180 (3.385 dB)
Maximum ERP: 5.000 kW

Vertical Polarization:
Maximum: 2.099 (3.220 dB)
Horizontal Plane: 2.099 (3.220 dB)
Maximum ERP: 4.814 kW

Directional Antenna System
for
WTSX, Lehman Township, Pennsylvania

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type:	LP-2E-DA
Frequency:	96.7MHz
Number of Bays:	Two

MECHANICAL SPECIFICATIONS

Mounting:	Custom
System length:	18 ft 10 in
Aperture length required:	25 ft 2 in
Orientation:	280° true

Input flange to the antenna 1 5/8” female.

ELECTRICAL SPECIFICATIONS
(For directional use)

Maximum horizontal ERP:	5.00 kW (6.99 dBk)
Horizontal maximum power gain:	2.180 (3.384 dB)
Maximum vertical ERP:	4.814 kW (6.825 dBk)
Vertical maximum power gain:	2.099 (3.219 dB)
Total input power:	2.294 kW (3.606 dBk)