

FEBRUARY 21, 1992

CIRCULARLY POLARIZED DIRECTIONAL ANTENNA SYSTEM  
PROPOSED FOR RADIO STATION WXXR  
LOCATED IN PORT CLINTON, OH

Electronics Research Inc. proposes to provide a custom fabricated directional antenna system that is specially designed to meet the F.C.C. requirements and the general needs of radio station WXXR.

The antenna is the Harris Corporation FML-6E-DA-HW configuration. The proposed circular polarized system consists of 6 half-wavelength spaced bays using one driven circular polarized radiating element per bay, 1 horizontal parasitic element per bay and 5 vertical parasitic elements interleaved between alternate bay pairs. The antenna was tested on a 14" o.d. pole, which is the structure the station plans to use to support the proposed array. All tests were performed on a frequency of 94.5 megahertz which is the center of the FM broadcast channel assigned to WXXR.

Pattern measurements were made on a fifty-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 both the Bachelor of Electrical Engineering and the Master of Electrical Engineering degrees from Cornell University, and is also a registered professional engineer in the states of Indiana, Maryland and Minnesota.

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 proposed antenna. Sections of 1 5/8 inch o.d. rigid coaxial line were used to feed the test antenna, and sections of 1 5/8 inch o.d. rigid outer conductor only were attached above the test antenna. All feed lines were over one half-wave in length. The lines were properly grounded during all tests.

The proof-of-performance was accomplished using a supporting structure of identical dimensions and configuration as the proposed 14" o.d. pole, including all braces, ladders, conduits,

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(Continued)

coaxial lines and other appurtenances that are included in the actual aperture at which the proposed antenna will be installed. The 14" o.d. pole 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 25 feet above ground. The turntable is equipped with a motor drive and azimuth indicating mechanism, resolution of this azimuth measuring system 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 94.5MHz 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, and mounted at the same height above terrain as the center of the antenna under test, was used to receive the emitted test signals. The signals received by the dipole system were fed to test building by way of two buried Heliac cables to an Anritsu Model ML521B measuring receiver. This data was interfaced to a Hewlett-Packard Model 9872C plotter by means of a Hewlett-Packard Model 86 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 proposed circular polarized system consists of 6 half-wavelength spaced bays using one driven circular polarized radiating element per bay, 1 horizontal parasitic element per bay and 5 vertical parasitic elements interleaved between alternate bay pairs. The power distribution and phase relationship will be fixed when the antenna is manufactured. Proper maintenance of the elements should be all that is required to maintain the pattern in adjustment.



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(Continued)

The FML-6E-DA-HW array is to be orientated on the 14" o.d. pole at a bearing of north 190 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.

Deicers are not supplied and are not available. The use of radomes is recommended if icing conditions will exist at the proposed site.

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. A calculated vertical plane relative field pattern is shown on Figure #3 attached. The power in the maximum will reach 30 kilowatts (14.771 DBK).

The power at north 0 degrees east does not exceed 3.3 kilowatts (5.185 dbk).

The power at north 180 degrees east does not exceed 7.1 kilowatts (8.513 dbk).

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

The envelope pattern obtained from the maximum individual horizontal or vertical components will not exceed a rate of change of 2 DB per any ten degree change in azimuth as measured in the horizontal plane.

The approximate weight of the antenna minus the mounting structure is 595 lbs. The approximate windload of the antenna minus the mounting structure is 1145 lbs based on 50/33 PSF (112 MPH wind) with no ice build up. The clear vertical length of the structure required to support the antenna is 41 feet if the antenna is to be top mounted.

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(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 other obstructions other than those that are specified by the blue prints supplied with the antenna are to be mounted at the same tower level as the directional antenna. No obstruction of any type is to be within 75ft horizontally of the antenna system. The vertical distance to the nearest obstruction should be a minimum of 10ft from the directional antenna.

The calculated maximum power gain of the horizontal component is 4.0386 (6.0624dB).

The calculated maximum power gain of the vertically polarized component is 4.03864749945 (6.0624dB).

The calculated input power to the antenna input flange is 7.4282 kilowatts (8.7089 DBK) to provide a maximum horizontal ERP of 30 kilowatts (14.771 DBK) and a maximum vertical ERP of 30 kilowatts (14.771 DBK). The input flange to the antenna is 1 5/8 inch male.

Dan Dowdle (BE)

ELECTRONICS RESEACH, INC.  
108 Market Street  
Newburgh, In 47630



ENVELOPE VALUES FOR FIGURE: 1      FEBRUARY 21, 1992  
 HORIZONTAL PLANE RELATIVE FIELD & DBK LIST  
 FOR RADIO STATION WKKR 94.5MHz

AZIMUTH	RELATIVE FIELD	DBK	POWER KW	POLARIZATION	AZIMUTH	RELATIVE FIELD	DBK	POWER KW	POLARIZATION
0.0	.318	4.81	3.03	VERTICAL	180.0	.465	8.12	6.49	VERTICAL
5.0	.325	5.02	3.18	VERTICAL	185.0	.455	7.94	6.22	VERTICAL
10.0	.329	5.11	3.24	VERTICAL	190.0	.462	8.06	6.40	HORIZONTAL
15.0	.324	4.97	3.14	VERTICAL	195.0	.478	8.36	6.65	HORIZONTAL
20.0	.312	4.66	2.93	VERTICAL	200.0	.500	8.75	7.50	HORIZONTAL
25.0	.304	4.43	2.77	VERTICAL	205.0	.538	9.22	8.36	HORIZONTAL
30.0	.325	5.01	3.17	HORIZONTAL	210.0	.552	9.76	9.47	HORIZONTAL
35.0	.349	5.62	3.65	HORIZONTAL	215.0	.601	10.35	10.85	HORIZONTAL
40.0	.374	6.24	4.21	HORIZONTAL	220.0	.653	11.06	12.78	HORIZONTAL
45.0	.407	6.97	4.82	HORIZONTAL	225.0	.717	11.89	15.44	HORIZONTAL
50.0	.443	7.70	5.89	HORIZONTAL	230.0	.779	12.60	18.21	HORIZONTAL
55.0	.488	8.54	7.15	HORIZONTAL	235.0	.832	13.18	20.79	HORIZONTAL
60.0	.538	9.39	8.58	HORIZONTAL	240.0	.877	13.63	23.08	HORIZONTAL
65.0	.593	10.23	10.54	HORIZONTAL	245.0	.913	13.98	25.03	HORIZONTAL
70.0	.659	11.15	13.03	HORIZONTAL	250.0	.941	14.24	26.57	HORIZONTAL
75.0	.736	12.14	16.35	HORIZONTAL	255.0	.960	14.42	27.66	HORIZONTAL
80.0	.819	13.04	20.15	HORIZONTAL	260.0	.971	14.51	28.28	HORIZONTAL
85.0	.887	13.73	23.59	HORIZONTAL	265.0	.971	14.51	28.28	HORIZONTAL
90.0	.934	14.18	26.17	HORIZONTAL	270.0	.963	14.44	27.82	VERTICAL
95.0	.969	14.49	28.14	HORIZONTAL	275.0	.953	14.35	27.26	VERTICAL
100.0	.991	14.69	29.44	HORIZONTAL	280.0	.930	14.14	25.98	VERTICAL
105.0	1.000	14.77	30.00	VERTICAL	285.0	.894	13.80	23.98	VERTICAL
110.0	1.000	14.77	30.00	VERTICAL	290.0	.845	13.31	21.41	VERTICAL
115.0	.991	14.69	29.45	VERTICAL	295.0	.782	12.64	18.37	VERTICAL
120.0	.969	14.50	28.19	VERTICAL	300.0	.714	11.85	15.29	HORIZONTAL
125.0	.936	14.19	26.26	VERTICAL	305.0	.653	11.03	12.81	HORIZONTAL
130.0	.890	13.76	23.75	VERTICAL	310.0	.595	10.26	10.61	HORIZONTAL
135.0	.831	13.17	20.74	VERTICAL	315.0	.532	9.38	8.53	HORIZONTAL
140.0	.761	12.40	17.37	VERTICAL	320.0	.478	8.35	6.84	HORIZONTAL
145.0	.699	11.66	14.66	VERTICAL	325.0	.429	7.43	5.53	HORIZONTAL
150.0	.644	10.95	12.45	VERTICAL	330.0	.383	6.43	4.40	HORIZONTAL
155.0	.598	10.31	10.74	VERTICAL	335.0	.343	5.47	3.52	HORIZONTAL
160.0	.561	9.74	9.43	VERTICAL	340.0	.315	4.73	2.97	VERTICAL
165.0	.528	9.23	8.37	VERTICAL	345.0	.303	4.41	2.76	VERTICAL
170.0	.502	8.78	7.55	VERTICAL	350.0	.302	4.38	2.74	VERTICAL
175.0	.486	8.40	6.93	VERTICAL	355.0	.308	4.54	2.84	VERTICAL

CITY OF LICENSE: PORT CLINTON, OH  
 MOUNTING STRUCTURE: 14" O.D. POLE  
 ANTENNA TYPE: FML-SE-DA-HW NUMBER OF BAYS: 6  
 ENVELOPE MAXIMUM RELATIVE FIELD= 1 AZIMUTH 105  
 ENVELOPE MINIMUM RELATIVE FIELD=.282 AZIMUTH 5.0  
 ENVELOPE R.M.S.=.68419  
 MAXIMUM E.R.P.= 30.0000KW  
 ANTENNA ORIENTATION: NORTH 190 DEGREES EAST



# HORIZONTAL PLANE RELATIVE FIELD PATTERN

Call &amp; Location:

WXKR

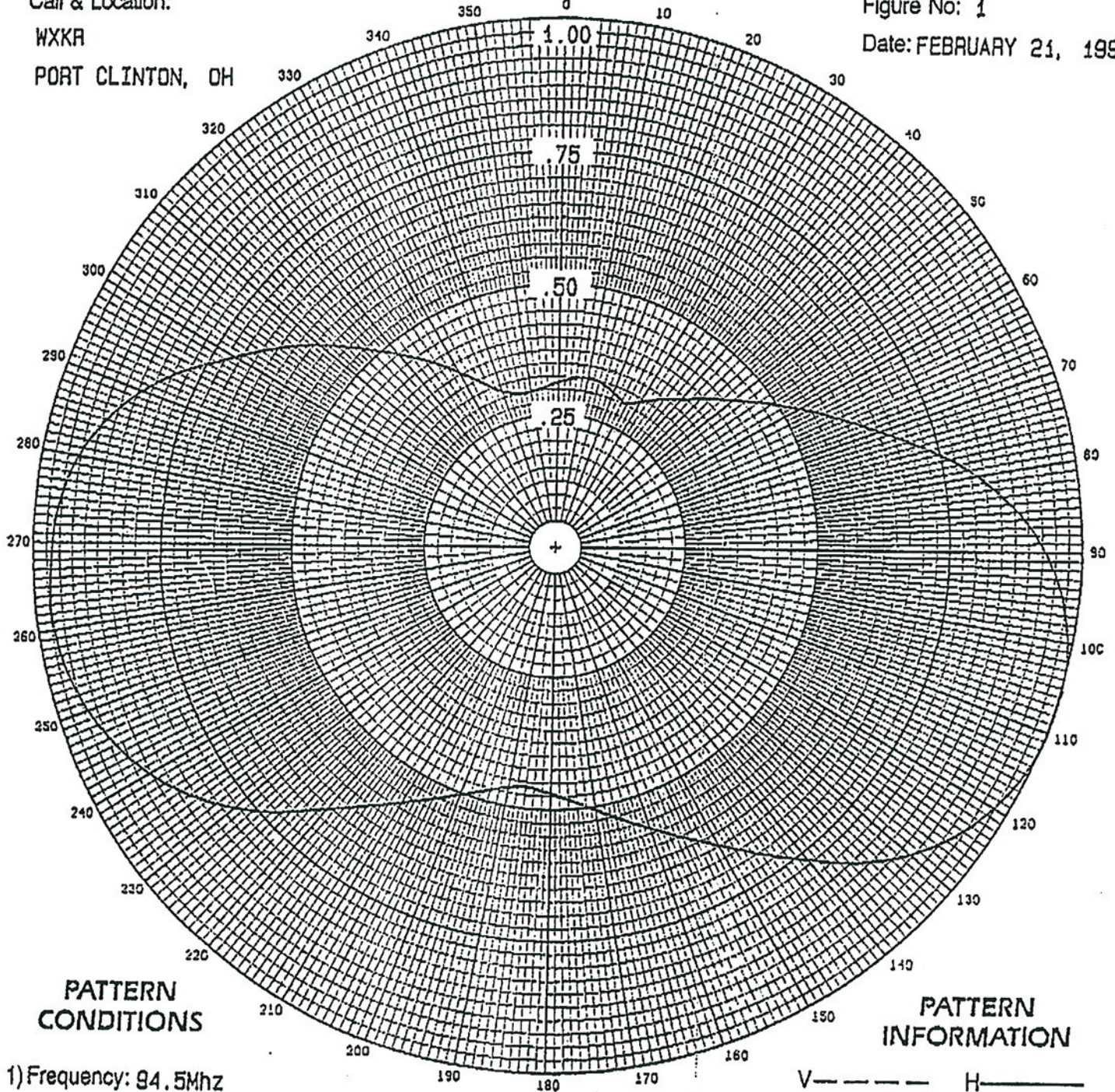
PORT CLINTON, OH

MEASURED

CALCULATED

Figure No: 1

Date: FEBRUARY 21, 1992



## PATTERN CONDITIONS

## PATTERN INFORMATION

1) Frequency: 94.5Mhz

2) Antenna Type: FML-BE-DA-HW

3) Antenna Orientation: North 190 Deg. East

4) Antenna Mounting: CUSTOM

5) Tower Type: 14" o.d. pole

6) Comments: MEASURED DATA- The composite maximum value of either horizontal or vertical component of Figure# 2.

### VERTICAL

Rms:

Maximum:

Minimum:

### HORIZONTAL

Rms: .68419

Maximum: 1 N105°E

Minimum: .30125 N348°E



FOR FIGURE: 2 FEBRUARY 21, 1992  
HORIZONTAL PLANE RELATIVE FIELD & DEK LIST  
FOR RADIO STATION WXXR 94.5MHZ

AZIMUTH	H POL RELATIVE FIELD	H POL DEK	H POL POWER KW	V POL RELATIVE FIELD	V POL DEK	V POL POWER KW	AZIMUTH	H POL RELATIVE FIELD	H POL DEK	H POL POWER KW	V POL RELATIVE FIELD	V POL DEK	V POL POWER KW
0.0	.264	3.20	2.087	.318	4.61	3.027	180.0	.447	7.78	5.994	.465	8.12	6.489
5.0	.262	3.13	2.055	.325	5.02	3.177	185.0	.451	7.85	5.113	.455	7.94	6.217
10.0	.265	3.24	2.110	.329	5.11	3.242	190.0	.462	8.06	6.395	.451	7.85	6.102
15.0	.273	3.50	2.240	.324	4.97	3.144	195.0	.478	8.36	6.851	.457	7.96	6.259
20.0	.286	3.90	2.453	.312	4.66	2.927	200.0	.500	8.75	7.498	.470	8.22	6.632
25.0	.303	4.41	2.753	.304	4.43	2.771	205.0	.528	9.22	8.360	.491	8.60	7.241
30.0	.325	5.01	3.167	.305	4.44	2.783	210.0	.562	9.76	9.465	.520	9.09	8.115
35.0	.349	5.62	3.650	.316	4.77	2.998	215.0	.601	10.35	10.651	.557	9.66	9.292
40.0	.374	6.24	4.266	.337	5.32	3.405	220.0	.653	11.06	12.776	.601	10.34	10.825
45.0	.407	6.97	4.978	.367	6.06	4.039	225.0	.717	11.89	15.436	.653	11.06	12.773
50.0	.443	7.70	5.890	.406	6.95	4.950	230.0	.779	12.60	18.210	.712	11.82	15.208
55.0	.488	8.54	7.151	.456	7.94	6.227	235.0	.852	13.18	20.785	.769	12.49	17.751
60.0	.538	9.39	8.683	.511	8.94	7.834	240.0	.877	13.63	23.080	.819	13.04	20.125
65.0	.593	10.23	10.537	.573	9.93	9.842	245.0	.913	13.98	25.026	.861	13.48	22.265
70.0	.659	11.15	13.028	.642	10.92	12.365	250.0	.941	14.24	26.567	.897	13.82	24.115
75.0	.738	12.14	16.350	.720	11.92	15.543	255.0	.966	14.42	27.660	.924	14.09	25.627
80.0	.819	13.04	20.146	.802	12.85	19.275	260.0	.971	14.51	28.278	.945	14.28	26.765
85.0	.897	13.73	23.590	.874	13.60	22.899	265.0	.971	14.51	28.276	.957	14.39	27.502
90.0	.934	14.13	26.168	.926	14.11	25.741	270.0	.960	14.42	27.651	.963	14.44	27.821
95.0	.969	14.49	28.142	.965	14.46	27.931	275.0	.941	14.24	26.543	.953	14.35	27.255
100.0	.991	14.69	29.435	.989	14.68	29.372	280.0	.913	13.98	24.983	.930	14.14	25.957
105.0	1.000	14.77	30.800	1.000	14.77	30.800	285.0	.876	13.62	23.015	.894	13.60	23.981
110.0	.991	14.78	29.485	1.000	14.77	30.800	290.0	.831	13.16	20.694	.845	13.31	21.413
115.0	.971	14.52	28.299	.991	14.69	29.451	295.0	.777	12.58	18.093	.782	12.64	18.369
120.0	.940	14.23	26.485	.969	14.50	28.190	300.0	.714	11.85	15.294	.707	11.76	14.995
125.0	.896	13.82	24.109	.936	14.19	26.263	305.0	.653	11.08	12.809	.631	10.77	11.941
130.0	.842	13.28	21.259	.890	13.76	23.747	310.0	.595	10.26	10.609	.563	9.78	9.509
135.0	.776	12.56	18.049	.831	13.17	20.740	315.0	.532	9.30	8.502	.502	8.79	7.567
140.0	.704	11.72	14.855	.761	12.40	17.374	320.0	.478	8.35	6.844	.448	7.80	6.021
145.0	.641	10.91	12.318	.699	11.66	14.657	325.0	.429	7.43	5.533	.401	6.84	4.831
150.0	.591	10.20	10.477	.644	10.95	12.447	330.0	.383	6.43	4.395	.364	5.98	3.964
155.0	.549	9.55	9.026	.598	10.31	10.745	335.0	.343	5.47	3.524	.335	5.26	3.359
160.0	.513	8.98	7.969	.561	9.74	9.426	340.0	.314	4.72	2.963	.315	4.73	2.969
165.0	.486	8.50	7.079	.528	9.23	8.371	345.0	.294	4.12	2.585	.303	4.41	2.763
170.0	.465	8.13	6.499	.502	8.78	7.547	350.0	.278	3.66	2.321	.302	4.38	2.743
175.0	.453	7.89	6.144	.480	8.40	6.926	355.0	.269	3.35	2.163	.308	4.54	2.844

CITY OF LICENSE: PORT CLINTON, OH

MOUNTING STRUCTURE: 14" O.D. POLE

ANTENNA TYPE: FML-6E-DA-HW NUMBER OF BAYS: 6

HORIZONTAL MAXIMUM RELATIVE FIELD= 1.00000 AZIMUTH 105

HORIZONTAL MINIMUM RELATIVE FIELD= .26175 AZIMUTH 5

VERTICAL MAXIMUM RELATIVE FIELD= 1.00000 AZIMUTH 105

VERTICAL MINIMUM RELATIVE FIELD= .30125 AZIMUTH 348

HORIZONTAL R.M.S.=.67252 VERTICAL R.M.S.=.68910

MAXIMUM HORIZONTAL E.R.P.= 30.0000KW MAXIMUM VERTICAL E.R.P.= 30.0000KW

TOTAL POWER INPUT= 7.4282KW

MAXIMUM HORIZONTAL GAIN OF COMPLETE ARRAY= 4.04 ( 8.082dB)

MAXIMUM VERTICAL GAIN OF COMPLETE ARRAY= 4.04 ( 8.082dB)

ANTENNA ORIENTATION: NORTH 190 DEGREES EAST

PATTERN REFERENCE #WXXRV3066



# HORIZONTAL PLANE RELATIVE FIELD PATTERN

Call &amp; Location:

WXXR

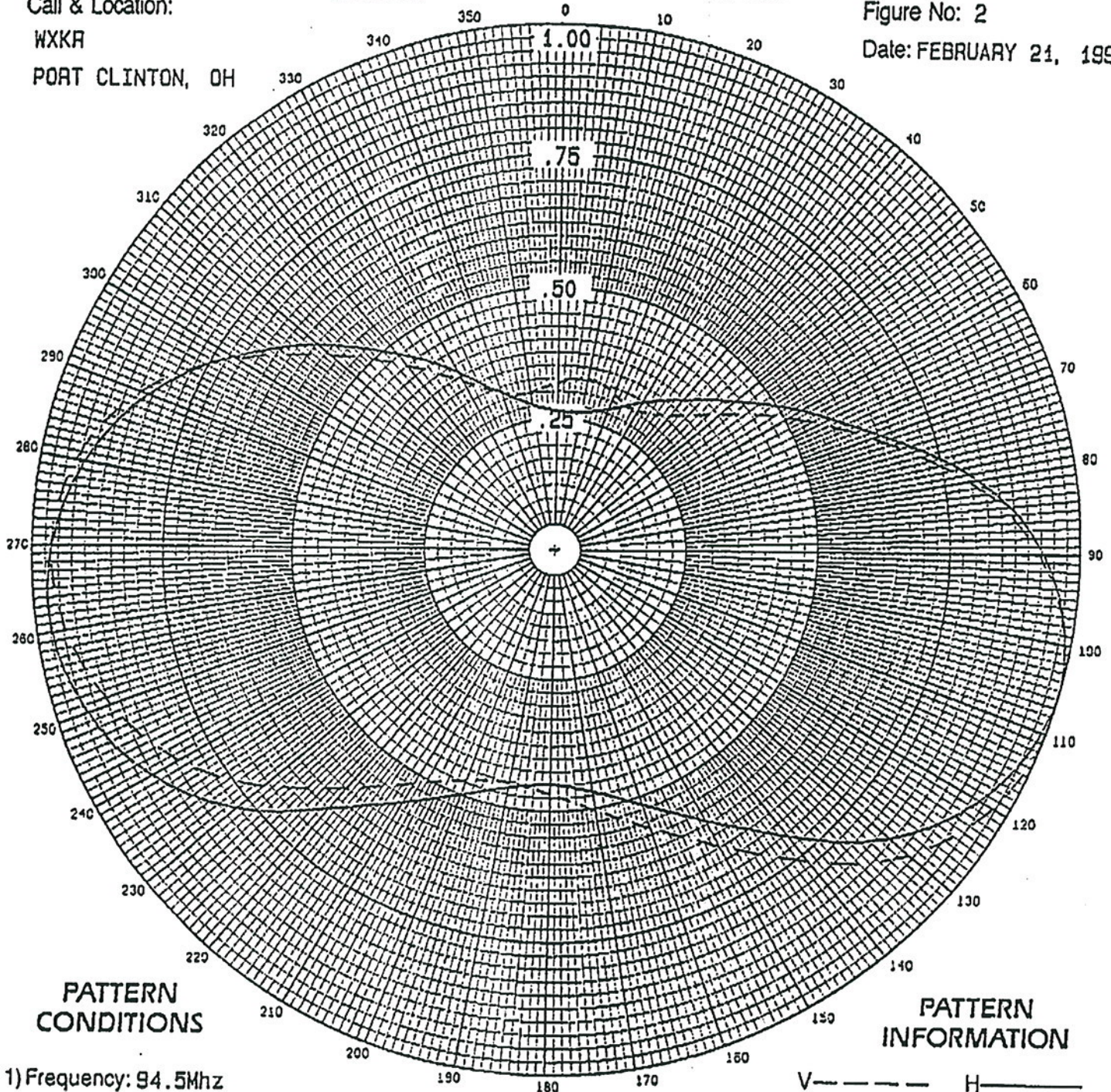
PORT CLINTON, OH

MEASURED

CALCULATED

Figure No: 2

Date: FEBRUARY 21, 1992



## PATTERN CONDITIONS

## PATTERN INFORMATION

- 1) Frequency: 94.5Mhz
- 2) Antenna Type: FML-6E-DA-HW
- 3) Antenna Orientation: North 190 Deg. East
- 4) Antenna Mounting: CUSTOM
- 5) Tower Type: 14" o.d. pole

### VERTICAL

Rms: .6691

Maximum: 1 N105°E

Minimum: .30125 N348°E

### HORIZONTAL

Rms: .67252

Maximum: 1 N105°E

Minimum: .26175 N5°E

6) Comments: MEASURED PATTERNS- The individual horizontal and vertical components.



ELECTRONICS RESEARCH, INC.  
108 MARKET STREET  
NEWBURGH, IN. 47630

FIGURE 3

THEORETICAL  
VERTICAL PLANE RELATIVE FIELD

6 ROTOTELLER ELEMENTS WITH 0 DEGREE(S) BEAM TILT  
0 PERCENT FIRST NULL FILL  
0 PERCENT SECOND NULL FILL

ELEMENT SPACING:  
0.5 WAVELENGTH

