

Directional Antenna System for WNSH, Newark, New Jersey

May 21, 2021

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

The antenna is the ERI model 1183-4CP-DA-SP configuration. The circular polarized system consists of four 92 inch spaced bays using three driven circular polarized radiating elements per bay. The antenna was tested on a full scale model of a Central triangular tower with a 48" face width, which is the structure the station plans to use to support the array. All tests were performed on a frequency of 94.7 megahertz, which is the center of the FM broadcast channel assigned to WNSH. The design of the system will include any of nine additional stations: WNYL, 92.3 MHz, WHTZ, 100.3 MHz, WCBS-FM 101.1 MHz, WFAN-FM 101.9 MHz, WNEW-FM 102.7 MHz, WKTU, 103.5 MHz, WAXQ, 104.3 MHz, WWPR-FM, 105.1 MHz or WLTW, 106.7 MHz combined into the input of each element of the four bay system.

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 WNSH, Newark, New Jersey

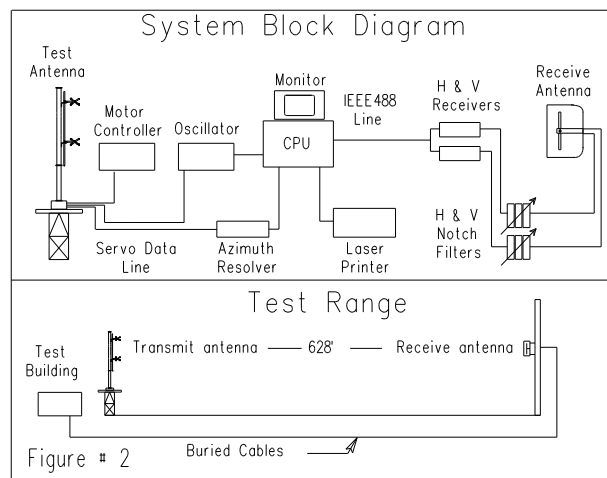
(Continued)

DESCRIPTION OF THE TEST PROCEDURE

The test antenna consisted of one bay level of the circular polarized system. The elements and brackets that were used in this test are electrically equivalent to those that will be supplied with the 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 full scale model of a Central triangular tower with a 48" face width 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.



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 94.7 MHz and was constantly monitored by a Rohde & Schwarz ESVD measuring receiver.

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.

Directional Antenna System For WNSH, Newark, New Jersey

(Continued)

The signals received by the dipole system were fed to the test building by way of two buried Heliac 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 coordinated graph paper in a clockwise direction. Both horizontal and vertical components were recorded separately.

CONCLUSIONS

The circular polarized system consists of four 92 inch spaced bays using three driven circular polarized radiating element per bay. 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.

The 1183-4CP-DA-SP array is to be mounted on the 48" Central triangular tower at a bearing of North 3 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 #1M represents the measured individual horizontal and vertical components, the composite maximum of either the horizontal or vertical component at any azimuth and the FCC filed envelope pattern. The horizontal plane relative field list for the composite pattern and the individual H & V components are shown as Figure #1M & 1MA respectively. 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 40 kilowatts (16.021 dBk).

The power at North 85 degrees East does not exceed 34.596 kilowatts (15.390 dBk).

The power at North 95 degrees East does not exceed 33.970 kilowatts (15.220 dBk).

Directional Antenna System
For
WNSH, Newark, New Jersey

(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 #1M has an RMS that is greater than 85% of the filed composite pattern.

The clear vertical length of the structure required to support the antenna is 35 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.



Dan Dowdle
Test Range Director ERI

The Microsoft Word document on file electronically at Electronic Research, Inc. governs the specifications, scope, and configuration of the product described. All other representations whether verbal, printed, or electronic are subordinate to the master copy of this document on file at ERI.

Directional Antenna System for WNSH, Newark, New Jersey

(Continued)

ANTENNA SPECIFICATIONS

Antenna Type: 1183-4CP-DA-SP
Frequency: 94.7 MHz
Number of Bays: Four

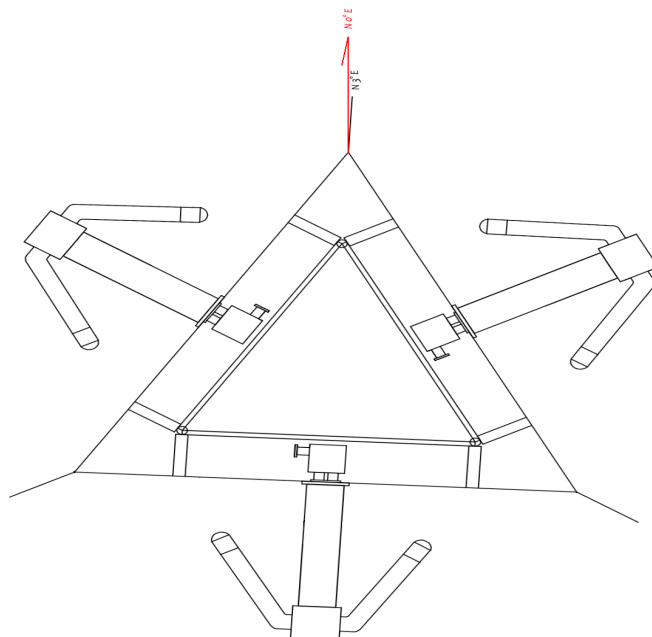
MECHANICAL SPECIFICATIONS

Mounting: Custom
System length: 30 ft 8 in
Aperture length required: 35
Orientation: 3° true
Input flange to the antenna 6-1/8-inch EIA, 50-ohm.

ELECTRICAL SPECIFICATIONS

(For directional use)

Maximum horizontal ERP: 40.000 kW (16.021 dBk)
Horizontal maximum power gain: 2.253 (3.528 dB)
Horizontal H Plane power gain: 2.253 (3.528 dB)
Maximum vertical ERP: 40.000 kW (16.021 dBk)
Vertical maximum power gain: 2.196 (3.146 dB)
Vertical H plane power gain: 2.196 (3.146 dB)
Total input power: 17.757 kW (12.494 dBk)

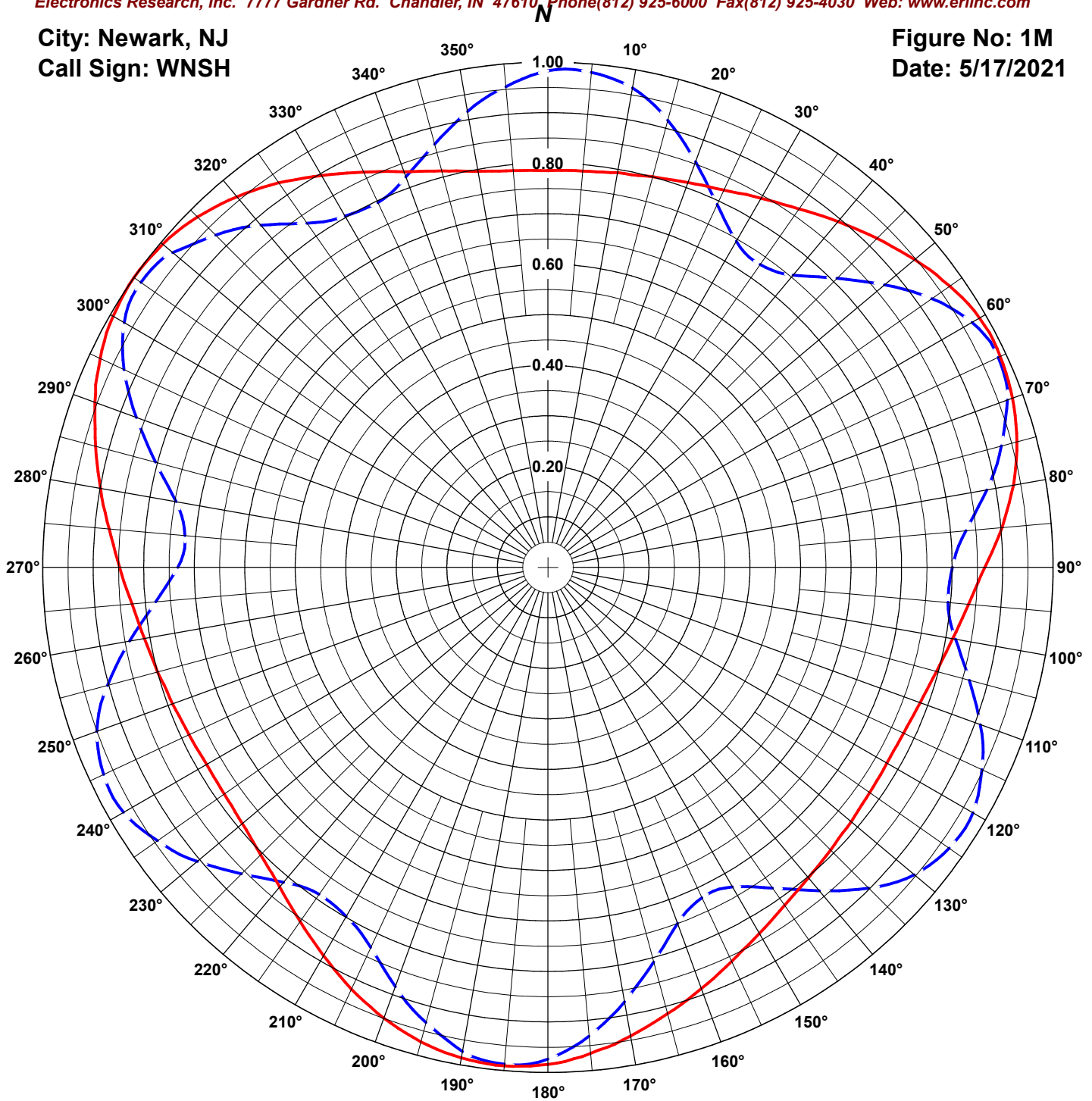


ERI[®] Horizontal Plane Relative Field Pattern

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

City: Newark, NJ
Call Sign: WNSH

Figure No: 1M
Date: 5/17/2021



Frequency: 94.7 MHz
Antenna Type: 1183-4CP-DA-SP
Antenna Orientation: 3° True
Antenna Mounting: Custom
Tower Type 48" Central

VERTICAL

RMS: .877
Maximum: .987 @ 184°
Minimum: .72 @ 274°

HORIZONTAL

RMS: .877
Maximum: 1 @ 306°
Minimum: .775 @ 119°

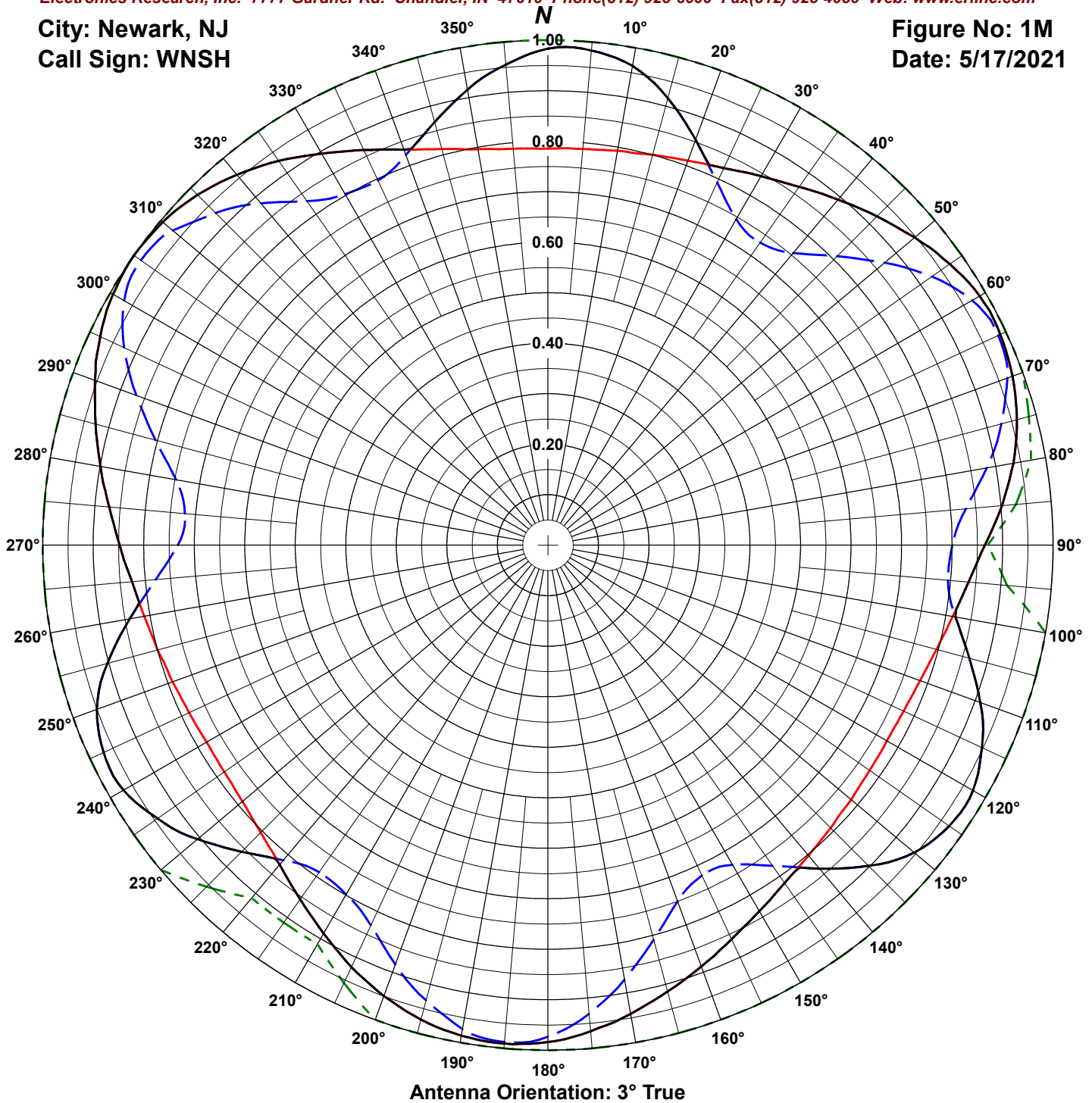
Measured pattern. Elements at 63°, 183° and 303°.

ERI[®] Horizontal 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

City: Newark, NJ
Call Sign: WNSH

Figure No: 1M
Date: 5/17/2021



Frequency: 94.7 MHz

Antenna Type: 1183-4CP-DA-SP

Antenna Mounting: Custom

Tower Type: 48" Central

HORIZONTAL

RMS: .877

Maximum: 1 @ 306°

Minimum: .775 @ 119°

VERTICAL

RMS: .877

Maximum: .987 @ 184°

Minimum: .72 @ 274°

COMPOSITE

RMS: .918

Maximum: 1 @ 306°

Minimum: .81 @ 142°

FCC ENVELOPE

RMS: .991

Maximum: 1 @ 0°

Minimum: .87 @ 90°

Measured pattern. Elements at 63°, 183° and 303°.

ERI® Horizontal 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# 1

Date: 5/17/2021

Station: WNSH

Antenna: 1183-4CP-DA-SP

Location: Newark, NJ

Antenna Orientation: 3° True

Frequency: 94.7 MHz

Number of Bays: 4

Azimuth	Envelope			Polarization	Azimuth	Envelope			Polarization
	Field	kW	dBk			Field	kW	dBk	
0°	0.983	38.644	15.871	Vertical	180°	0.984	38.729	15.880	Horizontal
5°	0.983	38.680	15.875	Vertical	185°	0.991	39.256	15.939	Horizontal
10°	0.964	37.137	15.698	Vertical	190°	0.986	38.904	15.900	Horizontal
15°	0.916	33.593	15.263	Vertical	195°	0.972	37.815	15.777	Horizontal
20°	0.854	29.202	14.654	Vertical	200°	0.950	36.068	15.571	Horizontal
25°	0.824	27.149	14.338	Horizontal	205°	0.921	33.960	15.310	Horizontal
30°	0.844	28.469	14.544	Horizontal	210°	0.888	31.528	14.987	Horizontal
35°	0.866	30.002	14.772	Horizontal	215°	0.856	29.279	14.666	Horizontal
40°	0.893	31.917	15.040	Horizontal	220°	0.826	27.275	14.358	Horizontal
45°	0.921	33.917	15.304	Horizontal	225°	0.858	29.459	14.692	Vertical
50°	0.948	35.921	15.554	Horizontal	230°	0.906	32.810	15.160	Vertical
55°	0.971	37.694	15.763	Horizontal	235°	0.943	35.594	15.514	Vertical
60°	0.987	38.941	15.904	Horizontal	240°	0.970	37.638	15.756	Vertical
65°	0.988	39.049	15.916	Horizontal	245°	0.970	37.660	15.759	Vertical
70°	0.979	38.300	15.832	Horizontal	250°	0.950	36.107	15.576	Vertical
75°	0.961	36.945	15.676	Horizontal	255°	0.903	32.585	15.130	Vertical
80°	0.936	35.017	15.443	Horizontal	260°	0.841	28.269	14.513	Vertical
85°	0.902	32.566	15.128	Horizontal	265°	0.826	27.317	14.364	Horizontal
90°	0.865	29.935	14.762	Horizontal	270°	0.848	28.754	14.587	Horizontal
95°	0.836	27.966	14.466	Horizontal	275°	0.872	30.385	14.827	Horizontal
100°	0.819	26.861	14.291	Vertical	280°	0.899	32.348	15.098	Horizontal
105°	0.864	29.838	14.748	Vertical	285°	0.927	34.348	15.359	Horizontal
110°	0.911	33.199	15.211	Vertical	290°	0.954	36.417	15.613	Horizontal
115°	0.948	35.925	15.554	Vertical	295°	0.978	38.243	15.826	Horizontal
120°	0.972	37.753	15.770	Vertical	300°	0.994	39.505	15.966	Horizontal
125°	0.969	37.591	15.751	Vertical	305°	1.000	39.998	16.020	Horizontal
130°	0.947	35.867	15.547	Vertical	310°	0.995	39.628	15.980	Horizontal
135°	0.898	32.268	15.088	Vertical	315°	0.981	38.480	15.852	Horizontal
140°	0.836	27.953	14.464	Vertical	320°	0.958	36.678	15.644	Horizontal
145°	0.817	26.681	14.262	Horizontal	325°	0.929	34.547	15.384	Horizontal
150°	0.837	28.022	14.475	Horizontal	330°	0.895	32.067	15.061	Horizontal
155°	0.861	29.626	14.717	Horizontal	335°	0.863	29.811	14.744	Horizontal
160°	0.887	31.506	14.984	Horizontal	340°	0.833	27.779	14.437	Horizontal
165°	0.915	33.487	15.249	Horizontal	345°	0.867	30.085	14.783	Vertical
170°	0.942	35.522	15.505	Horizontal	350°	0.916	33.568	15.259	Vertical
175°	0.966	37.355	15.723	Horizontal	355°	0.955	36.489	15.622	Vertical

Horizontal Polarization:

Maximum: 2.253 (3.527 dB)

Horizontal Plane: 2.253 (3.527 dB)

Maximum ERP: 40.000 kW

Vertical Polarization:

Maximum: 2.196 (3.416 dB)

Horizontal Plane: 2.196 (3.416 dB)

Maximum ERP: 38.992 kW

Total Input Power: 17.757 kW

Reference: WNSH1M.FIG

Measured pattern. Elements at 63°, 183° and 303°.

ERI[®] Horizontal 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# 1M

Date: 5/17/2021

Station: WNSH

Antenna: 1183-4CP-DA-SP

Location: Newark, NJ

Antenna Orientation: 3° True

Frequency: 94.7 MHz

Number of Bays: 4

Azimuth	Horizontal			Vertical			Azimuth	Horizontal			Vertical		
	Field	kW	dBk	Field	kW	dBk		Field	kW	dBk	Field	kW	dBk
0°	0.785	24.677	13.923	0.983	38.644	15.871	180°	0.984	38.729	15.880	0.973	37.908	15.787
5°	0.787	24.800	13.945	0.983	38.680	15.875	185°	0.991	39.256	15.939	0.987	38.988	15.909
10°	0.793	25.169	14.009	0.964	37.137	15.698	190°	0.986	38.904	15.900	0.973	37.876	15.784
15°	0.801	25.635	14.088	0.916	33.593	15.263	195°	0.972	37.815	15.777	0.933	34.809	15.417
20°	0.810	26.270	14.195	0.854	29.202	14.654	200°	0.950	36.068	15.571	0.883	31.205	14.942
25°	0.824	27.149	14.338	0.793	25.131	14.002	205°	0.921	33.960	15.310	0.830	27.559	14.403
30°	0.844	28.469	14.544	0.745	22.226	13.469	210°	0.888	31.528	14.987	0.798	25.489	14.063
35°	0.866	30.002	14.772	0.732	21.419	13.308	215°	0.856	29.279	14.666	0.790	24.970	13.974
40°	0.893	31.917	15.040	0.755	22.796	13.579	220°	0.826	27.275	14.358	0.814	26.506	14.233
45°	0.921	33.917	15.304	0.809	26.186	14.181	225°	0.804	25.874	14.129	0.858	29.459	14.692
50°	0.948	35.921	15.554	0.870	30.277	14.811	230°	0.789	24.930	13.967	0.906	32.810	15.160
55°	0.971	37.694	15.763	0.928	34.416	15.368	235°	0.782	24.470	13.886	0.943	35.594	15.514
60°	0.987	38.941	15.904	0.970	37.604	15.752	240°	0.780	24.349	13.865	0.970	37.638	15.756
65°	0.988	39.049	15.916	0.983	38.684	15.875	245°	0.784	24.558	13.902	0.970	37.660	15.759
70°	0.979	38.300	15.832	0.968	37.500	15.740	250°	0.791	25.010	13.981	0.950	36.107	15.576
75°	0.961	36.945	15.676	0.929	34.538	15.383	255°	0.800	25.584	14.080	0.903	32.585	15.130
80°	0.936	35.017	15.443	0.882	31.114	14.930	260°	0.811	26.312	14.202	0.841	28.269	14.513
85°	0.902	32.566	15.128	0.831	27.599	14.409	265°	0.826	27.317	14.364	0.779	24.291	13.854
90°	0.865	29.935	14.762	0.801	25.641	14.089	270°	0.848	28.754	14.587	0.733	21.468	13.318
95°	0.836	27.966	14.466	0.795	25.266	14.025	275°	0.872	30.385	14.827	0.721	20.799	13.181
100°	0.814	26.482	14.229	0.819	26.861	14.291	280°	0.899	32.348	15.098	0.747	22.326	13.488
105°	0.796	25.362	14.042	0.864	29.838	14.748	285°	0.927	34.348	15.359	0.804	25.873	14.128
110°	0.784	24.586	13.907	0.911	33.199	15.211	290°	0.954	36.417	15.613	0.867	30.071	14.781
115°	0.777	24.140	13.827	0.948	35.925	15.554	295°	0.978	38.243	15.826	0.926	34.275	15.350
120°	0.775	24.024	13.806	0.972	37.753	15.770	300°	0.994	39.505	15.966	0.968	37.508	15.741
125°	0.777	24.168	13.832	0.969	37.591	15.751	305°	1.000	39.998	16.020	0.983	38.675	15.874
130°	0.784	24.572	13.904	0.947	35.867	15.547	310°	0.995	39.628	15.980	0.969	37.597	15.751
135°	0.792	25.072	13.992	0.898	32.268	15.088	315°	0.981	38.480	15.852	0.930	34.594	15.390
140°	0.802	25.755	14.109	0.836	27.953	14.464	320°	0.958	36.678	15.644	0.884	31.241	14.947
145°	0.817	26.681	14.262	0.775	24.038	13.809	325°	0.929	34.547	15.384	0.832	27.663	14.419
150°	0.837	28.022	14.475	0.731	21.356	13.295	330°	0.895	32.067	15.061	0.803	25.785	14.114
155°	0.861	29.626	14.717	0.722	20.838	13.189	335°	0.863	29.811	14.744	0.797	25.380	14.045
160°	0.887	31.506	14.984	0.750	22.506	13.523	340°	0.833	27.779	14.437	0.822	27.038	14.320
165°	0.915	33.487	15.249	0.809	26.170	14.178	345°	0.812	26.388	14.214	0.867	30.085	14.783
170°	0.942	35.522	15.505	0.874	30.522	14.846	350°	0.796	25.351	14.040	0.916	33.568	15.259
175°	0.966	37.355	15.723	0.932	34.732	15.407	355°	0.788	24.840	13.952	0.955	36.489	15.622

Horizontal Polarization:

Maximum: 2.253 (3.527 dB)

Horizontal Plane: 2.253 (3.527 dB)

Maximum ERP: 40.000 kW

Vertical Polarization:

Maximum: 2.196 (3.416 dB)

Horizontal Plane: 2.196 (3.416 dB)

Maximum ERP: 38.992 kW

Total Input Power: 17.757 kW

Reference: WNSH1M.FIG

Measured pattern. Elements at 63°, 183° and 303°.

ERI[®] 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: WNSH

Location: Newark, NJ

Frequency: 94.7 MHz

Antenna: 4 bay 1183-4CP-DA-SP

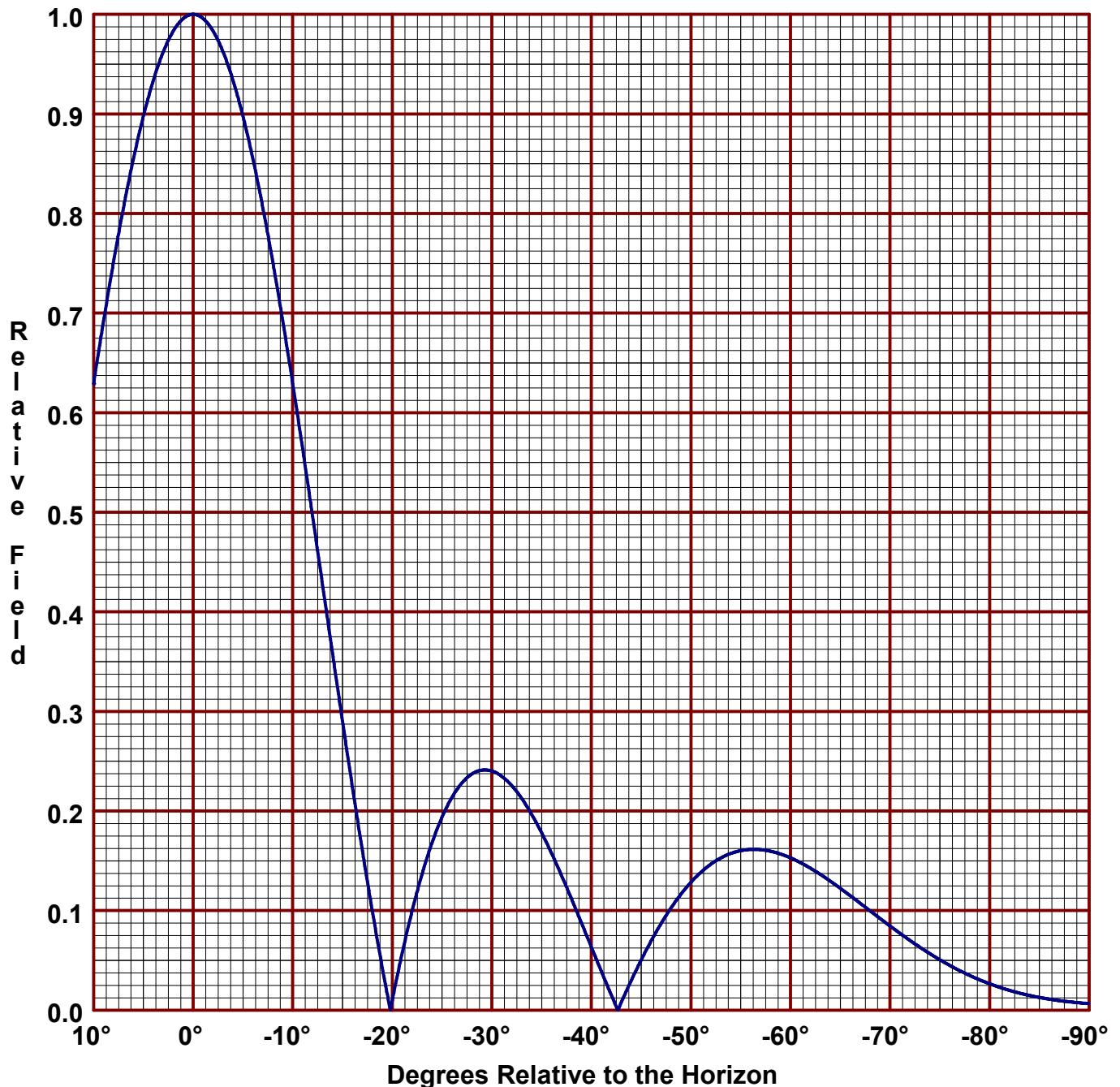
Date: 5/17/2021

H/V Power Ratio: 1

.741 Wave-length Spacing

0° Beam Tilt

0% First Null Fill



Horizontal Polarization:

Maximum: 2.253 (3.527 dB)

Horizontal Plane: 2.253 (3.527 dB)

Maximum ERP: 40.000 kW

Measured pattern. Elements at 63°, 183° and 303°.

Vertical Polarization:

Maximum: 2.196 (3.416 dB)

Horizontal Plane: 2.196 (3.416 dB)

Maximum ERP: 38.992 kW