DUAL POLARIZED DIRECTIONAL FM ANTENNA FOR WGLE, LIMA, OHIO

Electronics Research, Inc. is providing a dual polarized directional FM antenna to the Harris Corporation, Broadcast Products Division, which is specifically designed to meet the requirements of WGLE.

The antenna is the Harris Type FMD-3B and consists of three bays using two driven horizontal dipoles, one parasitic horizontal reflector, one driven vertical dipole and two parasitic vertical beam shaping elements per bay. The power distribution and phase relationship to the driven elements was fixed in order to achieve the directional radiation pattern for both the horizontal and vertical polarization components.

The tests were carried out on a flat forty acre antenna range owned and operated by Electronics Research, Inc. These tests were performed under the direction of Thomas B. Silliman; Director of Operations for 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 State of Indiana.

DESCRIPTION OF THE TEST PROCEDURE

A single layer, with horizontal and vertical parasites in place, was tested on a steel pole having an outside diameter of 10-3/4 inches, which is the pole diameter to be used to support the WGLE array. The elements and brackets used for the test are the same as those being supplied with the antenna. All measurements were made at the WGLE operating frequency of 90.7 MHz.

Sections of 3-1/8" rigid coaxial line were used to feed the test bay, and sections of 3-1/8 rigid outer conductor only were attached above the test bay, all these line sections being over one-half wavelength in length. The lines above and below the test bay were: properly grounded to the steel pole during all tests.

The test pole was erected vertically on a pedestal turntable to facilitate the taking of measurements in the XY, or horizontal plane, for both the horizontal and vertical polarization components. This pedestal turntable is located on the roof of a ten foot high non-metallic building on the antenna range, the test antenna bay being approximately twenty feet above ground. The turntable is equipped with a motor drive and azimuth indicating servo mechanism, the resolution of this azimuth measuring servo system being approximately one-tenth of a degree.

The antenna under test was operated in the transmitting mode and fed from a Type TSC497B/URR Signal Generator which was set at the frequency of 90.7 MHz. The frequency of this signal generator was constantly monitored by means of a Heathkit Model IM4110 Frequency Meter.

A corner reflector broad-band dipole receiving antenna was located approximately two hundred feet removed from the WGLE antenna, and mounted at the same height above average terrain as the radiation center of the antenna under test. The dipole receiving antenna is rotatable in its mount, thereby permitting the measurement of either the horizontal or vertical polarization component of the antenna under test. The signal received by the dipole was fed back, via a buried 50 ohm HELIAX cable, to a Scientific-Atlanta Series 1710 Portable Microwave Receiver used in conjunction with a Scientific-Atlanta Model 1720 Low Frequency Converter, this receiving equipment being located in the building. The relative field strength was plotted as a function of azimuth.

The measurements were performed by rotating the WGLE antenna in the counterclockwise direction and plotting the received signal on polar coordinate graph paper in the clockwise direction. The horizontally polarized component and the vertically polarized component of the signal radiated from the WGLE antenna were recorded separately.

METHOD OF ACHIEVING THE PATTERN

The directional horizontal plane radiation patterns were developed by using two driven horizontal dipole elements, one parasitic horizontal reflector, one driven vertical dipole and two parasitic vertical beam shaping elements per bay. A power divider is used near the bottom of the antenna to feed the system. The power distribution and phase relationship between the driven elements was fixed when the antenna

was manufactured. Proper maintenance of the elements in good condition should be all that is required to maintain the pattern in adjustment.

Deicers are not supplied. Due to the good bandwidth characteristics of the array, typical bandwidth being approximately 5 MHz between 1.5:1 VSWR points, the VSWR during minor icing conditions should not exceed 1.5:1.

The measured horizontal plane relative field pattern, for both the horizontal and vertical polarization components, is shown on Figure 1 attached.

The calculated vertical plane relative field pattern is shown in Figure 2, attached.

CONCLUSIONS

The directivity complies with the FCC requirement that the ratio of maximum to minimum radiation shall not exceed 15 decibels in the horizontal plane. In addition, the radiation change does not exceed 2 dB per 10 degrees of azimuth. The vertically polarized RMS does not exceed the horizontally polarized RMS.

The vertical polarization radiation component does exceed that of the horizontal polarization radiation component by up to 0.25 dB in certain areas, and this is less than the normal accepted accuracy achievable on an antenna range. The vertical polarization radiation component does not exceed the maximum allowable horizontal polarization radiation component at any azimuth.

The radiated field at N 90° E does not exceed 12.70 dBk (18.60 kilowatts) for either the horizontal or vertical polarization component.

The antenna system is to be mounted on the pole so that the antenna elements are facing N 280 E. This orientation is to be accurately established by a qualified licensed surveyor, as required by the FCC. The installation blueprint supplied with the antenna also shows the proper orientation for the antenna.

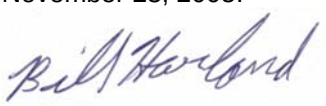
The calculated maximum power gain of the horizontally polarized horizontal plane measured pattern is 2.40 (3.80 db). The calculated maximum power gain of the vertically polarized horizontal plane measured pattern is 2.21 (3.44 db).

The required input power to the antenna input flange is calculated to be 20.84 kilowatts to give a maximum horizontal ERP of 50 kilowatts (16.99 dBk) and a maximum vertical ERP of 45.98 kilowatts (16.63 dBk).

The antenna input flange is 3-1/8 inch ETA 50 ohms female.

R. Carleton Greene,
Admin. Asst. to the President
Electronics Research, Inc.
May 1, 1981

The test data, component configuration, the original production drawings, and original bill of materials were used by Electronics Research, Inc. to build a replica of the original FMD-3B directional FM antenna built in 1981 on ERI Sales Order Number 15648. The production of the new antenna was completed on November 23, 2005.



Bill Harland
Director of Marketing
Electronics Research, Inc.
November 30, 2005

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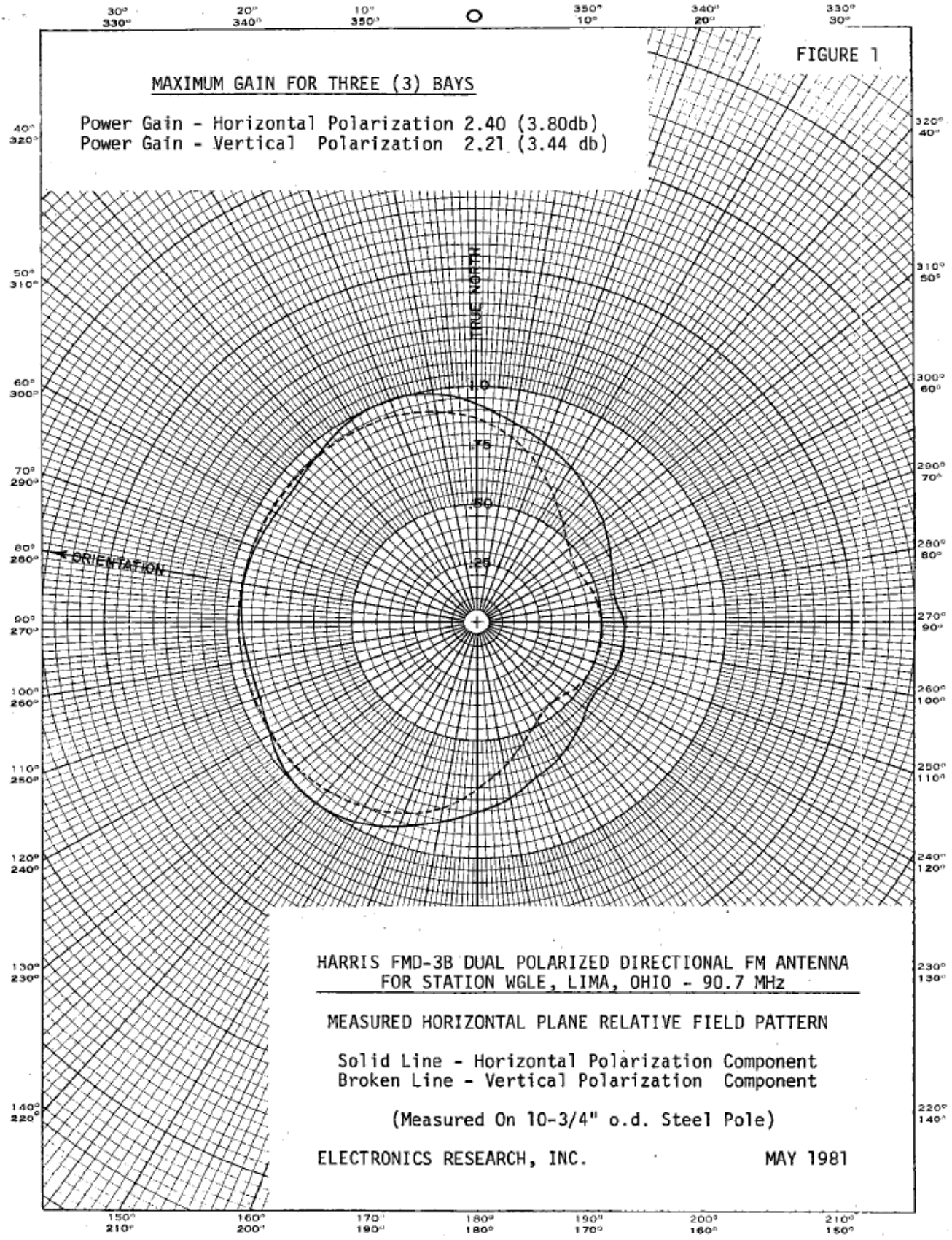

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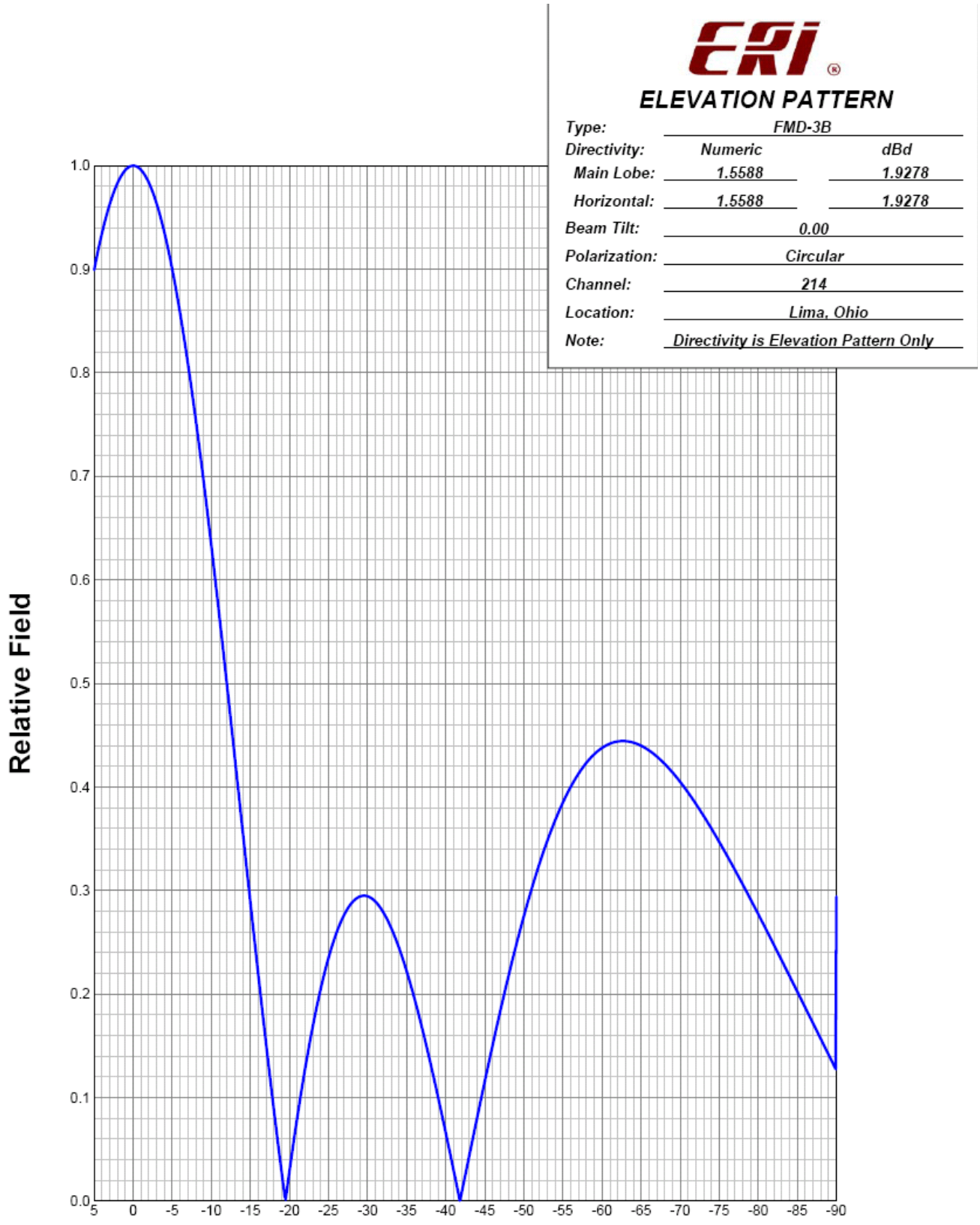

Figure 2 Calculated Vertical Plane Pattern.