

## ETC Communications

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### Report Test of FM-4CP-DA For KOYR 88.5 MHz Yorktown, AR

#### OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of an FM-4CP-DA to meet the needs of KOYR and to comply with the requirements of the FCC construction permit, file number BMPED-20120718ACM. The KOYR antenna is to be mounted on a 36" Fort Worth Tower section.

#### RESULTS:

Figure 1 shows the Tabulations of the Horizontal and Vertical Polarizations. The polar azimuth pattern for the FM-4CP-DA is shown in Figure 3. The calculated elevation pattern of the antenna is shown in Figure 6. Construction permit file number BMPED-20120718ACM indicates that the Horizontal radiation component shall not exceed 4.5 kW at any azimuth and is restricted to the following values at the azimuths specified:

80 to 110 degrees True: 0.285 kilowatts

From Figure 1 the pattern at the restricted azimuth of 0 Degrees True component is 11.98 dB down from the maximum of 0.285 kW, or 0.283 kW. The maximum radiation of the Horizontal component occurs at 340 Degrees True. At zero Degrees True, it places a field of 0.912 toward the community of license.

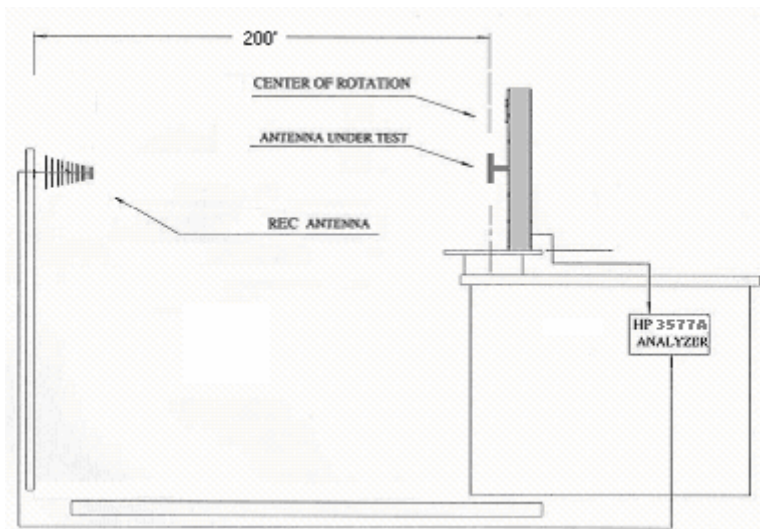
The R.M.S. of the Horizontal component is 0.7065. The total Horizontal power gain is 1.113. The R.M.S. of the Vertical component is 0.5851. The total Vertical power gain is 0.735. See Figure 2 for calculations. The measured composite pattern has an R.M.S. value of 0.6521. The R.M.S. of the modified theoretical composite pattern is 0.7715. Therefore this pattern complies with the FCC requirement of 73.316 (c)(2)(ix)(A).

#### METHOD OF DIRECTIONALIZATION:

One bay of the FM-4CP-DA Helix antenna was mounted on a tower of identical dimensions and configuration as the Fort Worth Tower at the KOYR site. The antenna's design, spacing, orientation and reflector were varied to achieve the azimuth pattern shown in Figure 3. See Figure 5 for mechanical details.

#### METHOD OF MEASUREMENT:

As allowed by the construction permit, file number BMPED-20120718ACM, a single level of the FM-4CP-DA was set up on a rural "quiet zone" 80-acre antenna pattern measuring range; a scale of 1:1 was used.



**EQUIPMENT:** The full-scale model pattern range consists of a rotating device equipped with an electronic position indicator. The full-scale tower section is placed on the top of rotating device and is used in the transmission mode at approximately 20 feet above ground level. A small diameter wooden support structure holds a broadband FM receiving yagi antenna that is spaced 200 feet away from the rotating device at the same level above ground as the transmitting antenna. The transmitting and receiving signals are carried to a control area by means of RG-8 type and RG-6 type double-shielded coax cables, respectively. The control area is equipped with: Hewlett Packard Model 3577A Network Analyzer. The test equipment is calibrated to ANSI/NCSL Z540-1-1994.

#### TEST PROCEDURES:

The yagi is mounted so that the horizontal and vertical azimuth patterns are measured independently by rotating the receive antenna by 90 degrees. The network analyzer was

set to the frequency of 88.5 MHz. Calibrated physical markers are used to check the linearity of the measuring system. From the recorded patterns, the R.M.S. values are calculated and recorded as shown in Figure 2.

Respectfully submitted by:

*Ed Czelada*

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FIGURE 1  
TABLE OF MEASURED FIELD VALUES  
KOYR Yorktown, AR  
MODEL FM-4CP-DA

Degrees	Horizontal Field	Vertical Field	Composite Field	FCC Field
0	0.912	0.501	0.912	1.000
10	0.741	0.457	0.741	0.900*
20	0.610	0.389	0.610	0.900*
30	0.525	0.305	0.525	0.794
40	0.462	0.216	0.462	0.501
50	0.398	0.150	0.398	0.398
60	0.313	0.143	0.313	0.315
70	0.251	0.176	0.251	0.251
80	0.182	0.211	0.211	0.251
90	0.092	0.243	0.243	0.251
100	0.044	0.251	0.251	0.251
110	0.012	0.243	0.243	0.251
120	0.050	0.216	0.216	0.282
130	0.155	0.186	0.186	0.355
140	0.266	0.166	0.266	0.447
150	0.372	0.186	0.372	0.562
160	0.447	0.245	0.447	0.708
170	0.513	0.320	0.513	0.891
180	0.569	0.389	0.569	0.900*
190	0.631	0.452	0.631	0.900*
200	0.676	0.495	0.676	0.900*
210	0.716	0.537	0.716	0.900*
220	0.716	0.543	0.716	0.900*
230	0.676	0.531	0.676	0.900*
240	0.617	0.525	0.617	0.900*
250	0.543	0.501	0.543	0.900*
260	0.537	0.479	0.537	0.900*
270	0.582	0.473	0.582	0.900*
280	0.668	0.468	0.668	0.900*
290	0.741	0.473	0.741	0.900*
300	0.822	0.490	0.822	0.900*
310	0.881	0.490	0.881	0.900*
320	0.944	0.513	0.944	1.000
330	0.989	0.531	0.989	1.000
340	1.000	0.537	1.000	1.000
350	0.955	0.531	0.955	1.000

\* Denotes fields reduced from a field of 1.000 to meet the 85% RMS requirement.

FIGURE 2  
VALIDATION OF GAIN CALCULATION  
KOYR Yorktown, AR  
MODEL FM-4CP-DA

Elevation Gain of FM-4CP-DA equals 2.00

The RMS values are calculated utilizing the data of field values.

Horizontal RMS divided by Vertical RMS equals  
 $0.612 / 0.402 = 1.520$

Elevation Gain of Horizontal Component equals  
 $2.00 \times 1.520 = 3.04$

Elevation Gain of Vertical Component equals  
 $2.00 / 1.520 = 1.316$

Horizontal Azimuth Gain equals  $1/(\text{RMS})^2$   
 $1/(0.612)^2 = 2.667$

Vertical Azimuth Gain equals  $1/(\text{RMS} / \text{Max Vert})^2$   
 $1/(0.402 / 0.543)^2 = 0.550$

**\* Total Horizontal Gain is Elevation Gain times Azimuth Gain**  
 **$3.04 \times 2.667 = 8.110$**

**\* Total Vertical Gain is Elevation Gain times Azimuth Gain**  
 **$1.316 \times 0.550 = 0.728$**

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ERP divided by Horizontal Gain equals Antenna Input Power  
 $4.5 \text{ kW} / 8.110 = 0.555 \text{ kW}$

FIGURE 3  
AZIMUTH PATTERN OF FIELD VALUES  
KOYR Yorktown, AR  
MODEL FM-4CP-DA

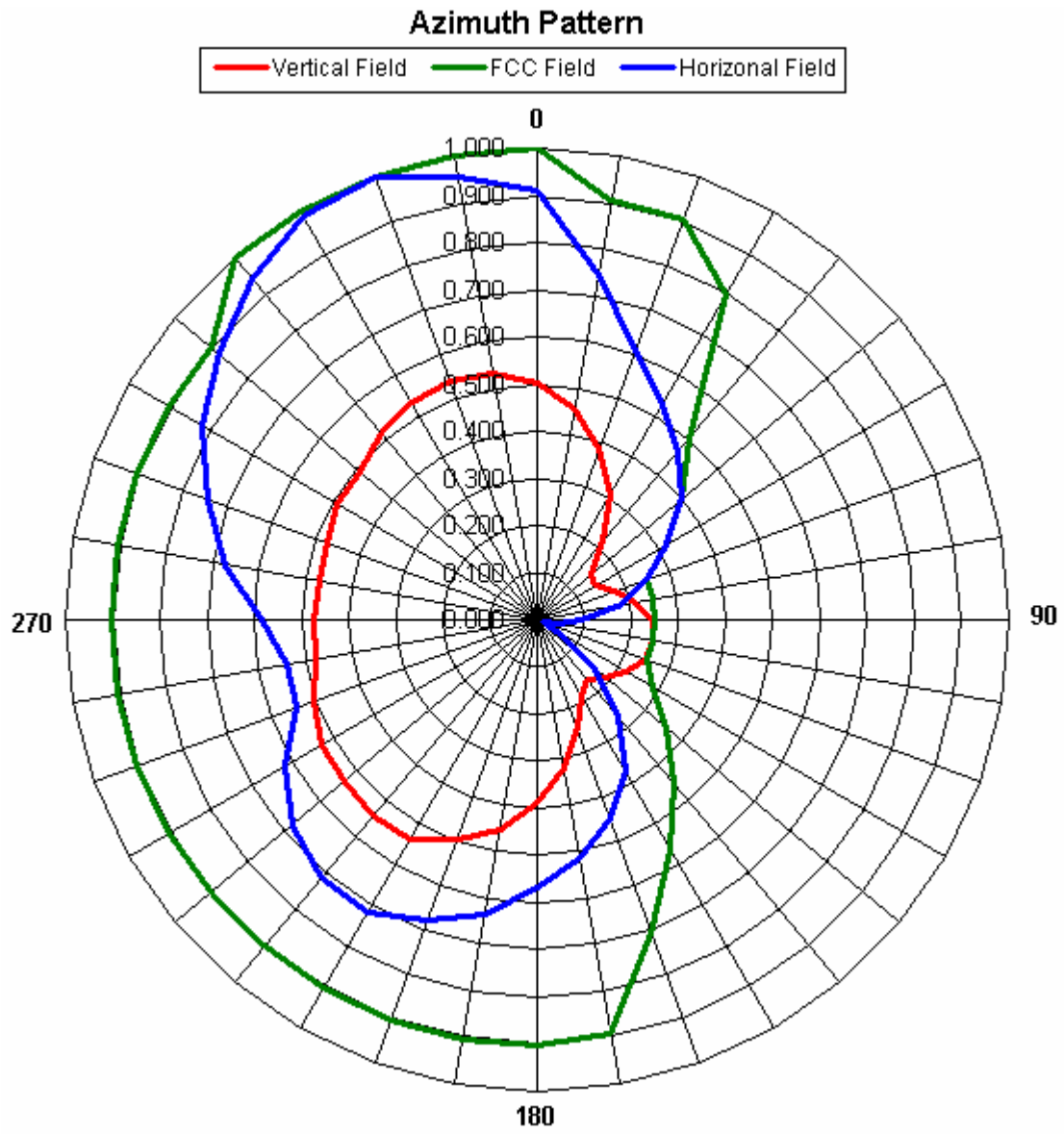


FIGURE 4  
COMPOSITE AZIMUTH PATTERN OF FIELD VALUES  
KOYR Yorktown, AR  
MODEL FM-4CP-DA

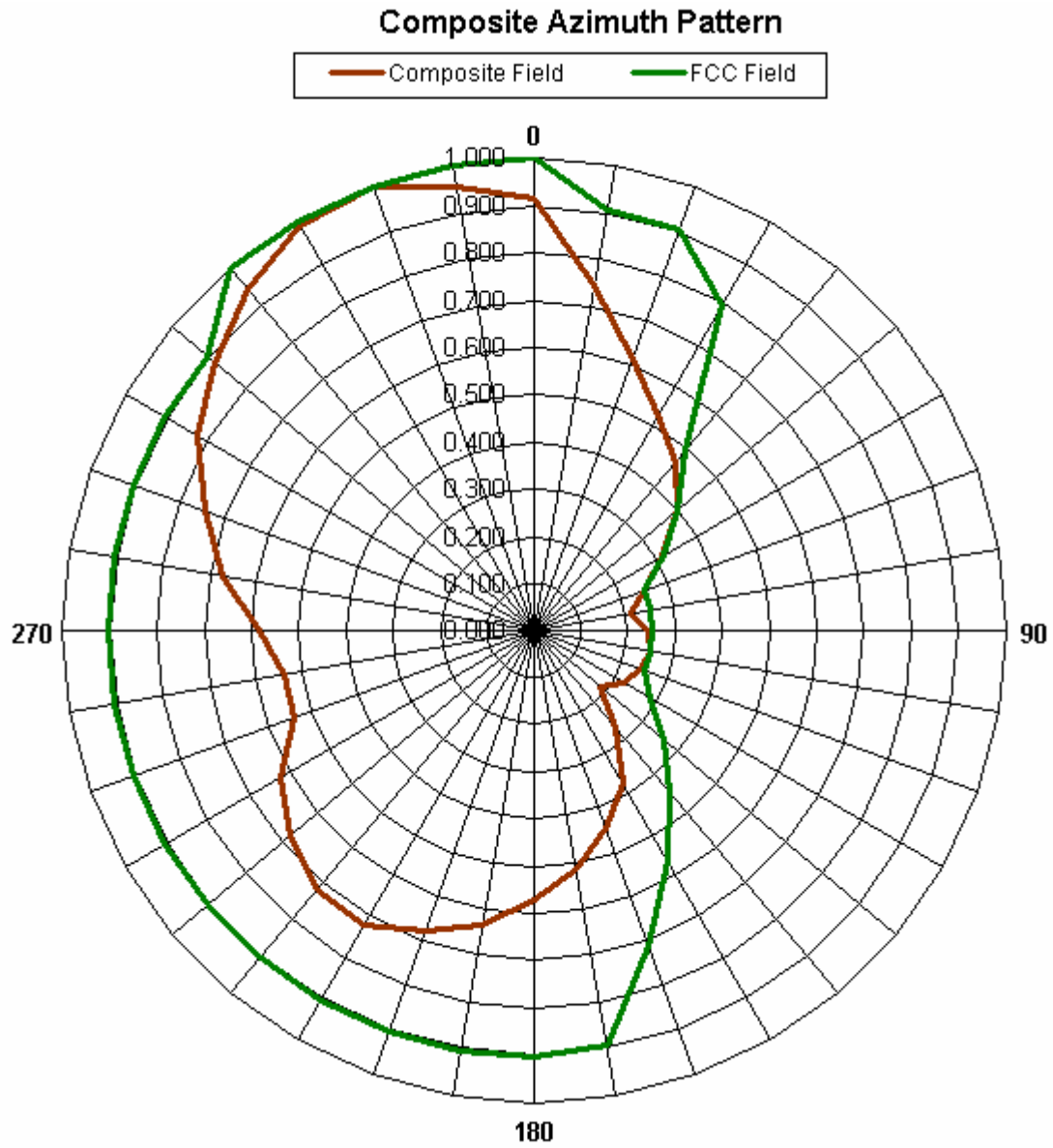


FIGURE 5  
 Antenna Mounting and Orientation  
 KOYR Yorktown, AR  
 MODEL FM-4CP-DA

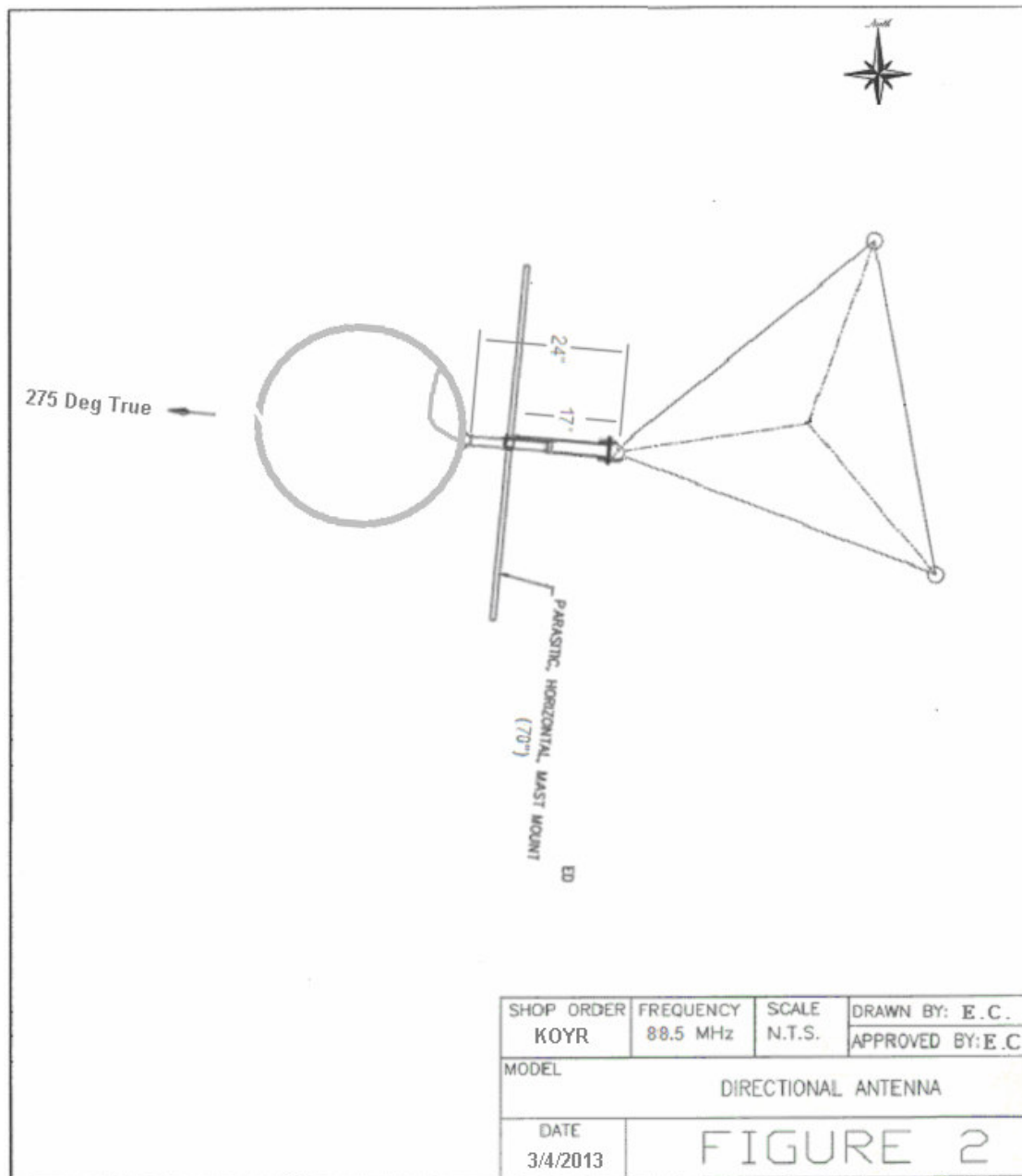




FIGURE 6  
Vertical Pattern  
KOYR Yorktown, AR  
MODEL FM-4CP-DA

