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S.O. 21,556

Report of Test - Scala 3/CA5-FM/CP/RM

for

NASHVILLE PUBLIC RADIO

990903MF TULLAHOMA, TN

OBJECTIVE:

The objective of this test was to demonstrate the directional characteristics of a Scala 3/CA5-FM/CP/RM to meet the needs of 990903MF and to comply with the requirements of the FCC construction permit, file number BPED-19990903MF.

RESULTS:

The measured azimuth pattern for the Scala 3/CA5-FM/CP/RM is shown in Figure 1. Figure 1A shows the Tabulation of the Horizontal Polarization. Figure 1B shows the Tabulation of the Vertical Polarization. The calculated elevation pattern of the antenna is shown in Figure 3. Construction permit file number BPED-19990903MF indicates that the Horizontal radiation component shall not exceed 1.55 kW at any azimuth and is restricted to the following values at the azimuths specified:

45-140 Degrees T: 0.100 kW
290-300 Degrees T: 0.502 kW

From Figure 1, the maximum radiation of the Horizontal component occurs at 242 Degrees T to 244 Degrees T. At the restricted azimuth of 45-140 Degrees T the Horizontal component is 12.396 dB down from the maximum of 1.55 kW, or 0.089 kW.

At the restricted azimuth of 290-300 Degrees T, the Vertical component is 5.036 dB down from the maximum of 1.55 kW, or 0.486 kW at 296 degrees.
The R.M.S. of the Horizontal component is 0.530. The total Horizontal power gain is 3.613. The R.M.S. of the Vertical component is 0.520. The total Vertical power gain is 3.537. See Figure Four for calculations. The R.M.S. of the FCC composite pattern is 0.590. Therefore this Pattern complies with the FCC requirement of 73.316(c)(2)(ix)(A).

METHOD OF DIRECTIONALIZATION:

One level of the Scala 3/CA5-FM/CP/RM was mounted on a tower of exact scale to a Central 24". The spacing of the antenna to the tower was varied to achieve the horizontal and vertical patterns shown in Figure 1. See Figure 2 for mechanical details.

METHOD OF MEASUREMENT:

As allowed by the construction permit, file number BPED-19990903MF, a single level of the Scala 3/CA5-FM/CP/RM was set up on the Howell Laboratories scale model antenna pattern measuring range. A scale of 4.5:1 was used.

SUPERVISION:

The tests were carried out under the direction of Robert A. Surette, Manager of RF Engineering. Mr. Surette was graduated from Lowell Technological Institute, Lowell, Massachusetts in 1973 with the degree of Bachelor of Science in Electrical Engineering. He has been directly involved with both full size and scale model pattern measurements since 1974 as an RF Engineer with Shively Labs and with Dielectric Communications (a unit of General Signal). He is currently an Associate Member of the Association of Federal Communications Consulting Engineers and a Member of IEEE.

EQUIPMENT:

The scale model pattern range consists of a wooden rotating pedestal equipped with a position indicator. The scale model bay is placed on the top of this pedestal and is used in the transmission mode at approximately 20 feet above ground level. The receiving corner reflector is spaced 50 feet away from the rotating pedestal at the same level above ground as the transmitting model. The transmitting and receiving signals are carried to a control building by means of RG-9/U double shielded coax cable.

The control building is equipped with:

Hewlett Packard Model 8505 Network Analyzer
PC Based Controller
Hewlett Packard 7550A Graphics Plotter

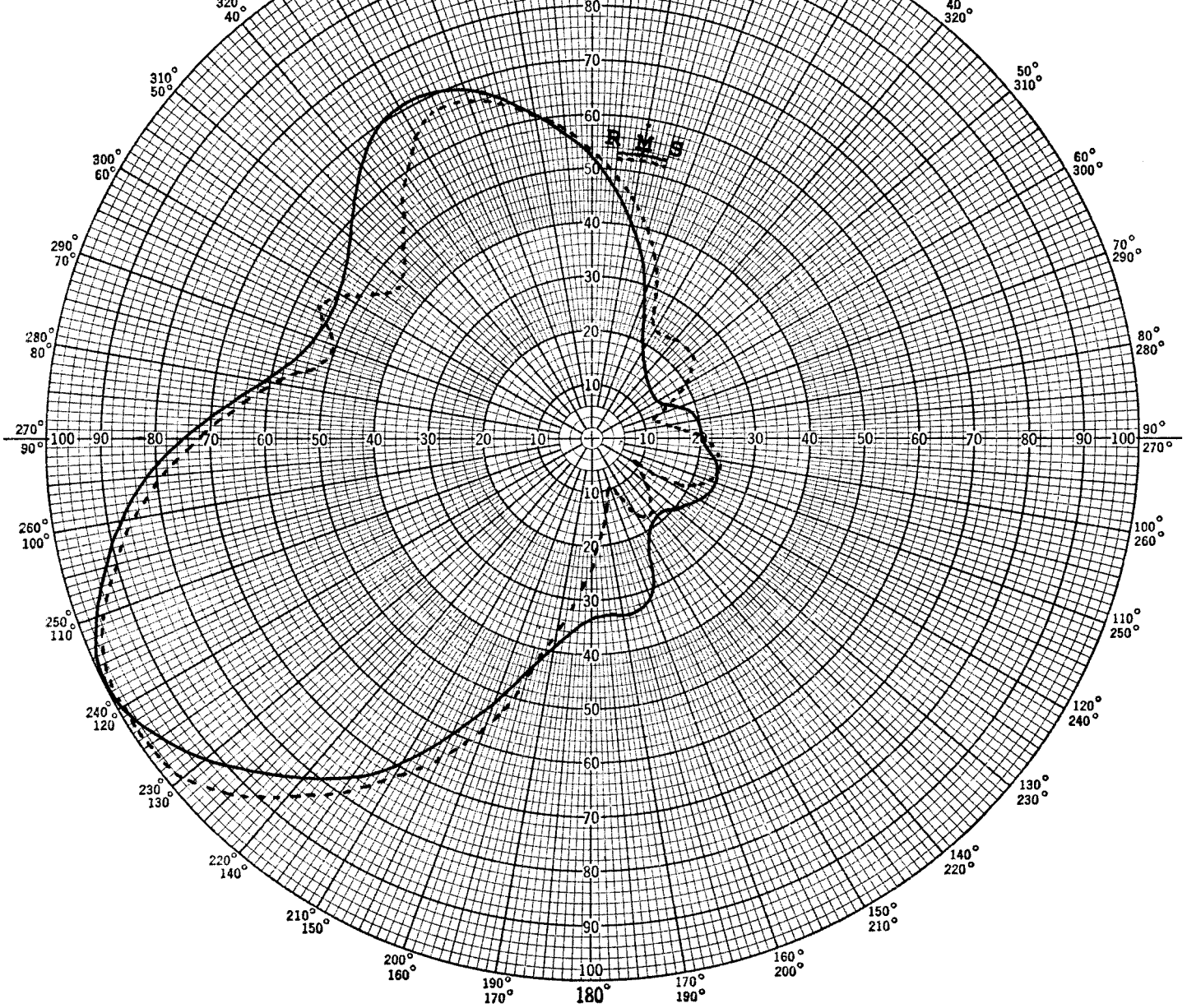
The test equipment is calibrated to MIL-STD-45662.

TEST PROCEDURES:

The corner reflector is mounted so that the horizontal and vertical azimuth patterns are measured independently by rotating the corner reflector by 90 degrees. The network analyzer was set to 411.75 MHz. Calibrated pads are used to check the linearity of the measuring system. For example, 6 dB padding yields a scale reading of 50 from an unpadded reading of 100 in voltage. From the recorded patterns, the R.M.S. values are calculated and recorded as shown in Figure 1.

Respectfully submitted by:

Robert A. Surette
Manager of RF Engineering
S/O 21,556
December 18, 2000



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PROJECT NAME 990903MF TULLAHOMA, TN

PROJECT NUMBER 21,556 DATE 9/19/00

MODEL (X) FULL SCALE ( ) FREQUENCY 411.75/91.5 MHz

POLARIZATION HORIZ (———); VERT (----)

CURVE PLOTTED IN: VOLTAGE (X) POWER( ) DB( )

ANTENNA TYPE SCALA 3/CA5-FM/CP/RM

PATTERN TYPE DIRECTIONAL AZIMUTH

REMARKS: SEE FIGURE 2 FOR MECHANICAL DETAILS

Figure 1A

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TABULATION OF HORIZONTAL POLARIZATION
990903MF TULLAHOMA, TN

DEGREE	RELATIVE FIELD	DEGREE	RELATIVE FIELD
0	0.510	180	0.335
10	0.410	190	0.395
20	0.280	200	0.520
30	0.190	210	0.690
40	0.155	220	0.820
45	0.135	225	0.870
50	0.140	230	0.920
60	0.140	240	0.990
63	0.140	243	1.000
70	0.170	250	0.970
80	0.200	260	0.875
90	0.205	270	0.750
100	0.235	280	0.620
110	0.240	290	0.540
120	0.230	300	0.540
130	0.205	310	0.580
135	0.190	315	0.620
140	0.190	320	0.660
150	0.210	330	0.710
160	0.320	340	0.690
170	0.335	350	0.610

Figure 1B

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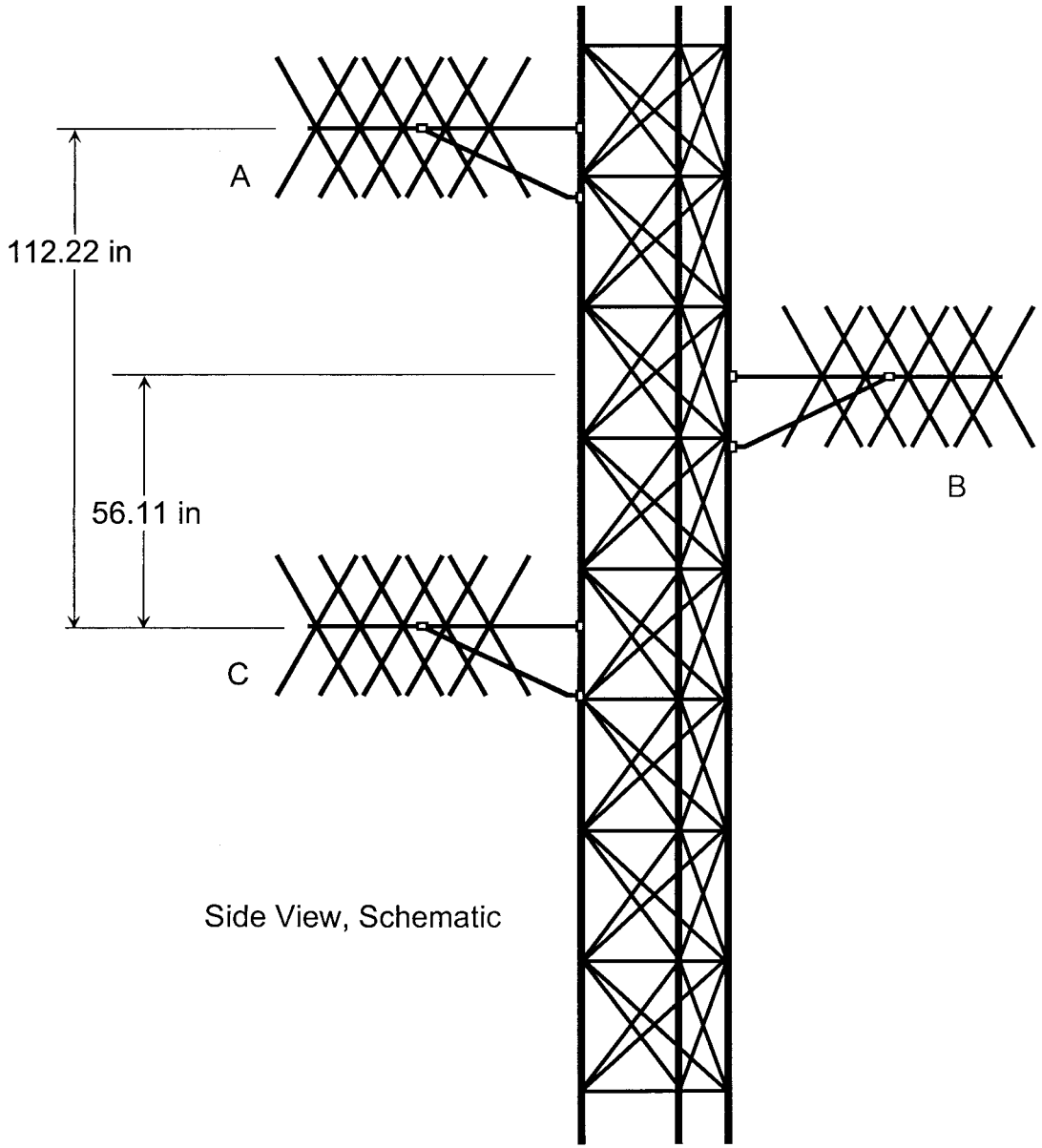
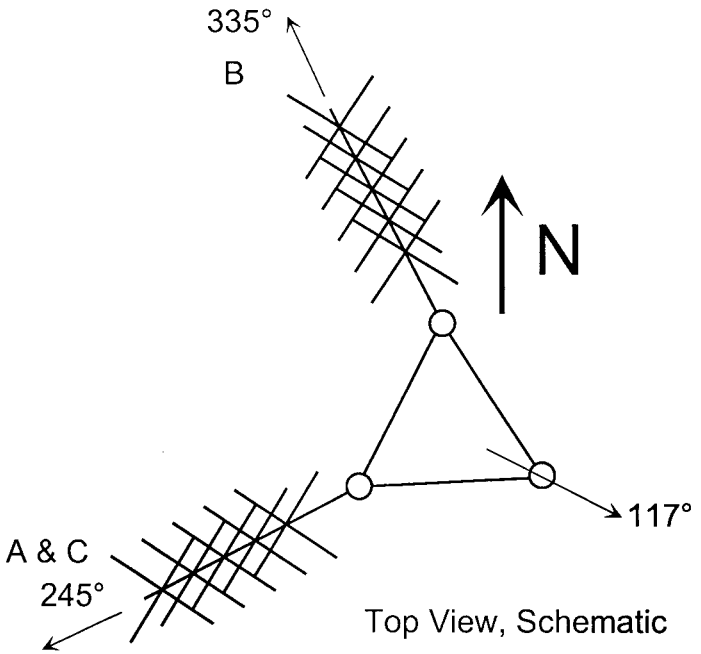
TABULATION OF VERTICAL POLARIZATION
990903MF TULLAHOMA, TN

DEGREE	RELATIVE FIELD	DEGREE	RELATIVE FIELD
0	0.535	180	0.240
10	0.450	190	0.360
20	0.340	200	0.570
30	0.230	210	0.720
40	0.240	220	0.860
45	0.240	225	0.930
50	0.240	230	0.980
60	0.190	240	0.990
70	0.130	250	0.950
80	0.140	260	0.850
90	0.200	270	0.720
100	0.240	280	0.590
110	0.230	290	0.500
120	0.120	300	0.530
130	0.110	310	0.460
135	0.150	315	0.490
140	0.175	320	0.540
150	0.170	330	0.650
160	0.100	340	0.665
170	0.150	350	0.610

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



Side View, Schematic



Top View, Schematic

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SHOP ORDER:	FREQUENCY:	SCALE:	DRAWN BY: AGF
21556	91.5 MHz	none	APPROVED BY:

TITLE: Antenna Layout
Figure 2

DATE:		
10/06/2000		1

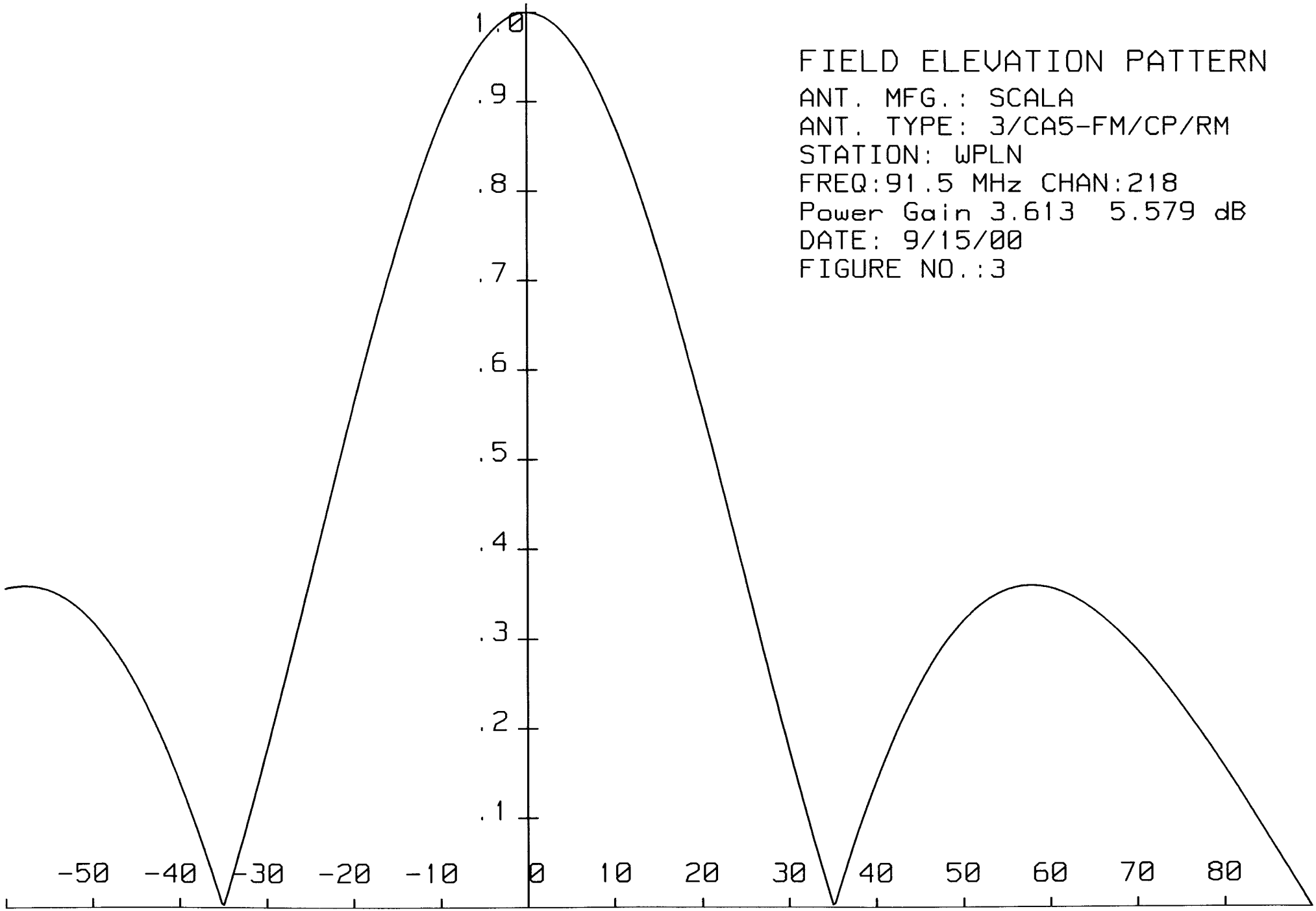
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
70
80
FIELD ELEVATION PATTERN
ANT. MFG.: SCALA
ANT. TYPE: 3/CA5-FM/CP/RM
STATION: WPLN
FREQ:91.5 MHz CHAN:218
Power Gain 3.613 5.579 dB
DATE: 9/15/00
FIGURE NO.:3

FIGURE 4

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VALIDATION OF GAIN CALCULATION

990903MF TULLAHOMA, TN

SCALA 3/CA5-FM/CP/RM

Elevation Gain of Scala 3/CA5-FM/CP/RM equals 0.996

The RMS values are calculated utilizing the data of a planimeter.

Horizontal RMS divided by Vertical RMS equals
$0.530 \div 0.520 = 1.019$

Elevation Gain of Horizontal Component equals
$0.996 \times 1.019 = 1.015$

Elevation Gain of Vertical Component equals
$0.996 \times 0.981 = 0.977$

Horizontal Azimuth Gain equals $1/(RMS)^2$
$1/(0.530)^2 = 3.56$

Vertical Azimuth Gain equals $1/(RMS \div Max\ Vert)^2$
$1/(0.52 \div 0.99)^2 = 3.62$

*** Total Horizontal Gain is Elevation Gain times Azimuth Gain**
1.015 x 3.56 = 3.613

*** Total Vertical Gain is Elevation Gain times Azimuth Gain**
0.977 x 3.62 = 3.537

ERP divided by Horizontal Gain equals Antenna Input Power
$1.55\ kW \div 3.613 = 0.429$

Antenna Input Power times Vertical Gain equals Vertical ERP
$0.429 \times 3.537 = 1.517$

Maximum Value of the Vertical Component squared times the Maximum ERP equals the Vertical ERP
$(0.99)^2 \times 1.55\ kW = 1.519$

NOTE: Calculating the ERP of the Vertical Component by two methods validates the total antenna gain calculations