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RADIO ENGINEERING
MICROWAVE RADIO
ANTENNA SPECIFICATIONS
KS-15676 HORN REFLECTOR

CONTENTS PAGE

1. INTRODUCTION

A. Purpose

1.01 This section is issued to provide engineering specifications for the KS-15676 horn reflector antenna.

1.02 These specifications present the physical and transmission characteristics of the KS-15676 antenna.

B. General Design Characteristics

1.03 The KS-15676 antenna (Fig. 1) is designed to transmit and receive horizontally and vertically polarized signals in three currently used common carrier bands (4 GHz, 6 GHz, and 11 GHz).

1.04 The horn reflector is a paraboloidal reflector designed to reflect and convert the spherical wave front, fed into the horn by the circular waveguide, to a uniphase or plane wave front. Conversely, it will receive a plane wave front from the direction of the transmitter and focus the energy into a spherical wave front and couple into the circular waveguide through the feed horn. The electrical characteristics such as gain radiation pattern etc., are the same for receiving as for transmitting.

1.05 The KS-15676 antenna is designed to withstand ice and snow or wind loads of 100 pounds per square foot. An option for hardened sites (Fig. 2) provides strengthening for an overpressure of 2 pounds per square inch to withstand nuclear blast shock waves.

2. PHYSICAL SPECIFICATIONS

A. Description

2.01 The antenna assembly consists of a tapered from the bottom, square cross-section, pyramidal horn capped by a section of a paraboloidal reflector. The circular waveguide feeds into the circular-to-square feed horn. The front face of the antenna has a window through which the reflected waves are transmitted or received. The sides of the antenna are constructed of aluminum alloy sheets reinforced by extruded stiffeners. The reflector is reinforced by longitudinal spars and horizontal ribs. The front of the antenna is protected

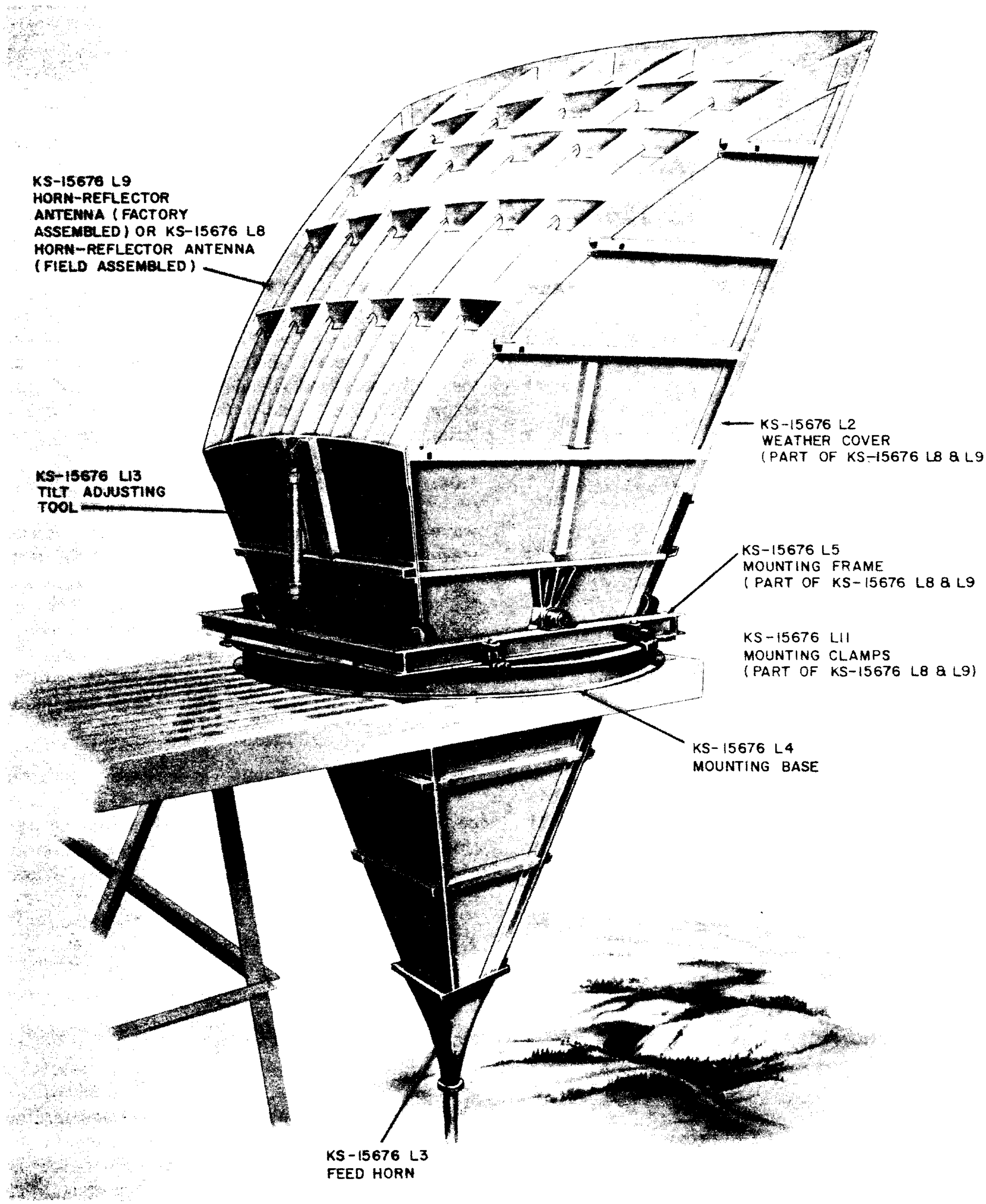

Fig. 1—KS-15676 L8, L9 Horn Reflector Antenna

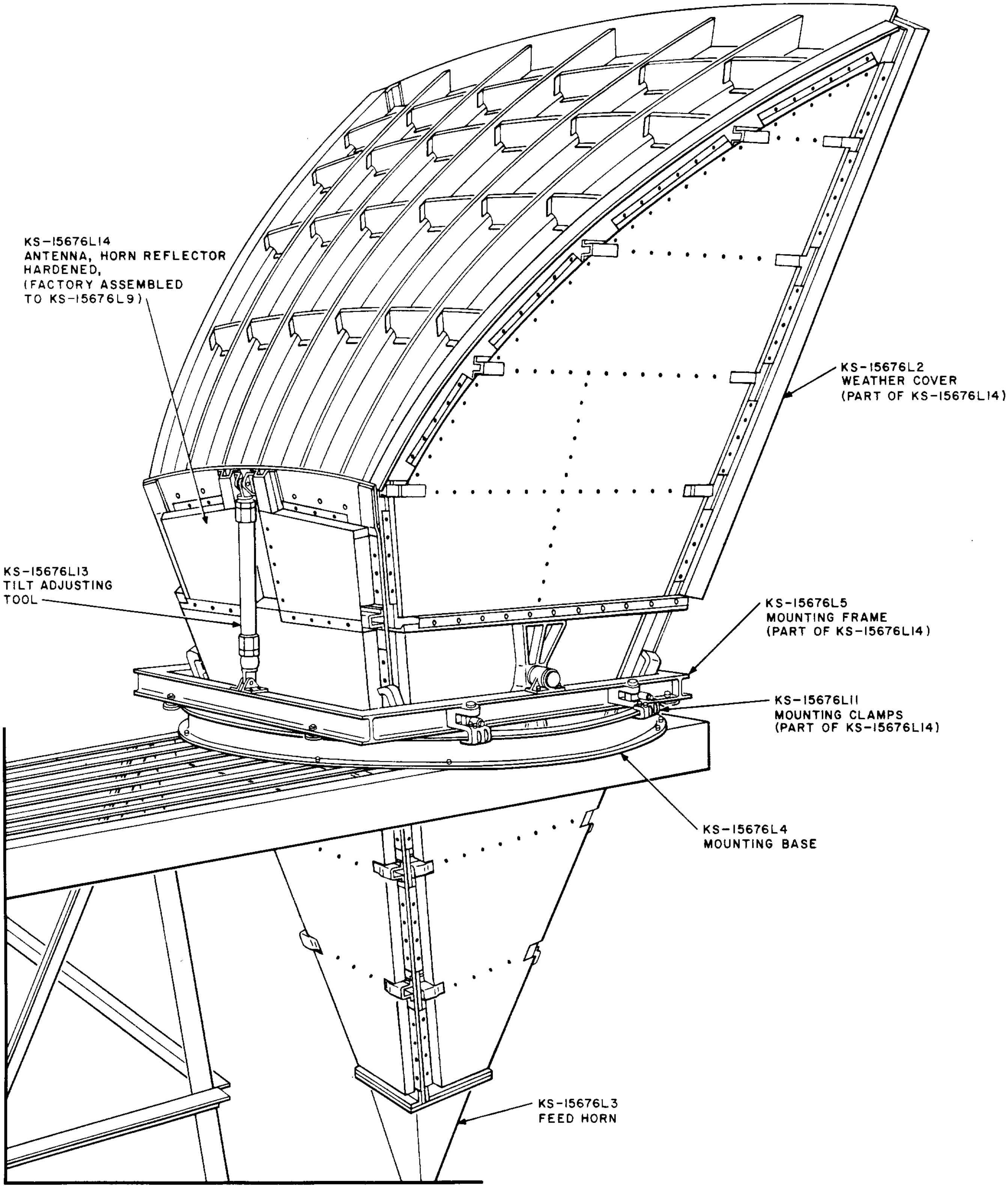

Fig. 2—KS-15676 L14 Hardened Horn Reflector Antenna

from the weather by the window made of 4-ply polyester-impregnated fiber glass laminate 0.040-inch thick. Additional plys are added to the edges and corners to provide the strength for the 100 pounds per square foot wind load requirement.

2.02 The antenna dimensions are approximately 20-1/2 feet high, 11 feet wide, and 9 feet deep.

2.03 The assembled nonhardened antenna weighs approximately 2000 pounds. When shipped assembled, the antenna and packing crate weigh approximately 3500 pounds. When ordered unassembled, the equipment will be shipped in three crates weighing 700, 1300, and 2200 pounds, and one box weighing 300 pounds.

B. Equipment Ordering

2.04 Table A contains necessary information for ordering the antenna assembly. The basic antenna is the List 8, 9, or 14 depending on whether the antenna is shipped unassembled or assembled and whether it is for a hardened installation. List 15 hardening modification kit is available for modifying existing installations.

3. TRANSMISSION SPECIFICATIONS

A. Polarization

3.01 The antenna, in conjuction with a 2.812-inch inside diameter circular waveguide operating in the $TE_{1,1}$ dominant mode of vertically and horizontally polarized signals, has sufficient cross

TABLE A

EQUIPMENT ORDERING INFORMATION

KS-15676 — HORN REFLECTOR ANTENNA

LIST NO.	DESCRIPTION
2	Weather cover (Furnished with List 8, 9, or 14)
3	Feed horn. Required in addition to List 8, 9, or 14.
4	Mounting base — one required per List 8, 9, or 14
5	Mounting frame — (Furnished with List 8, 9, or 14)
7	Sealing kit
8	Horn reflector antenna shipped unassembled (Includes Lists 2, 5, 7, 11)
9	Horn reflector antenna shipped assembled (Includes Lists 2, 5, 7, 11)
10	Repair kit — optional for repair of aluminum skin and weather cover
11	Four mounting clamps — (Furnished with Lists 8, 9, or 14)
13	Tilt adjusting tool
15	Hardening modification kit for field modification
17	Azimuth adjusting

polarization discrimination to permit use of adjacent radio channels. This provides for greater efficiency of the frequency spectrum.

3.02 The dual polarization and adequate frequency separation possible permit transmitting and receiving on the same antenna either by frequency separation or by alternate polarization.

3.03 The cross-polarization discrimination of the horn reflector antenna is maximum at the main lobe. When oriented precisely on the center of the main lobe, a cross-polarization discrimination of antenna, circular waveguide, and coupling network of about 30 dB or greater can usually be achieved. The minimum cross-polarization requirement for a given system will be found in the system engineering practices for that system.

3.04 Cross-polarization discrimination for signals in the vicinity of the main lobe is shown in Fig. 3, 4, and 5 for the three frequency bands. The graphs are plotted with three curves. The horizontal axis represents the degrees azimuth from the main lobe, with the vertical axis representing dB down from the main lobe. Curve A is the horizontal directivity for the horizontal (E →) or vertical (E ↑) polarized signal. Curve B is the response to the cross-polarized signal and curve C the cross-polarization discrimination plot.

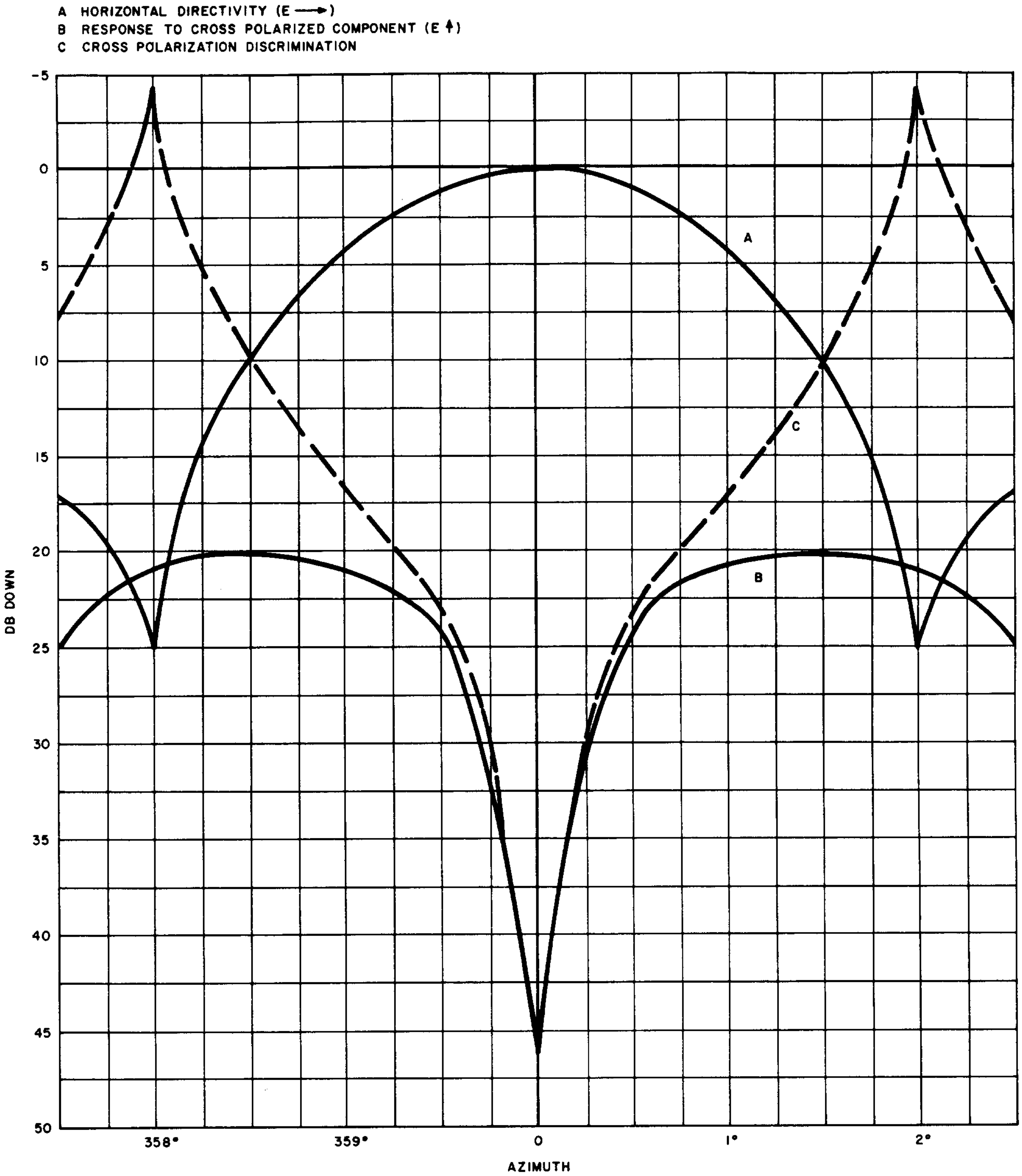

Fig. 3—Horizontal Polarization—Cross-Polarization Discrimination with Azimuth (±2.5 Degrees)—3740 MHz

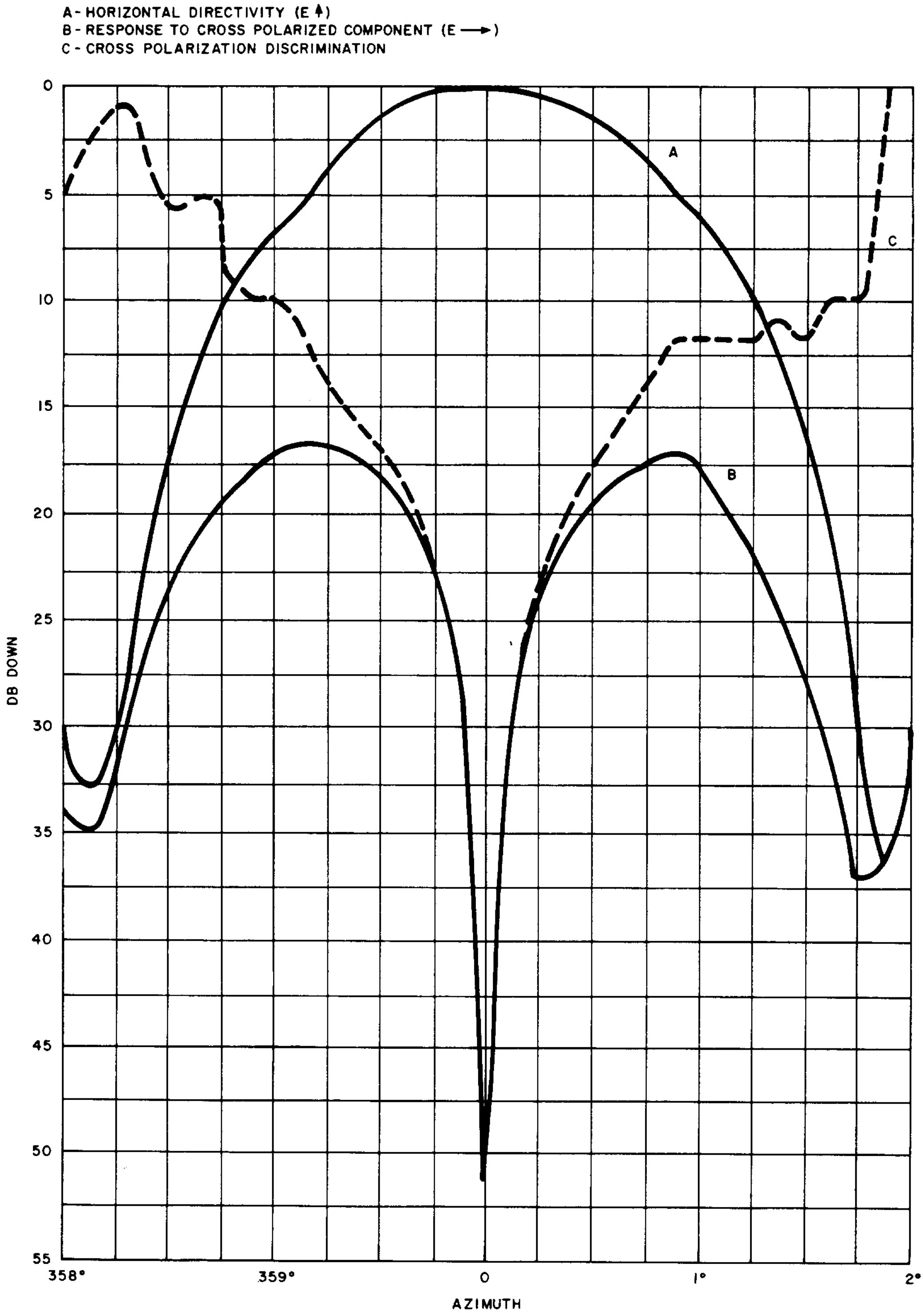

Fig. 4—Horizontal Polarization—Cross-Polarization Discrimination with Azimuth (±2.5 Degrees)—6325 MHz

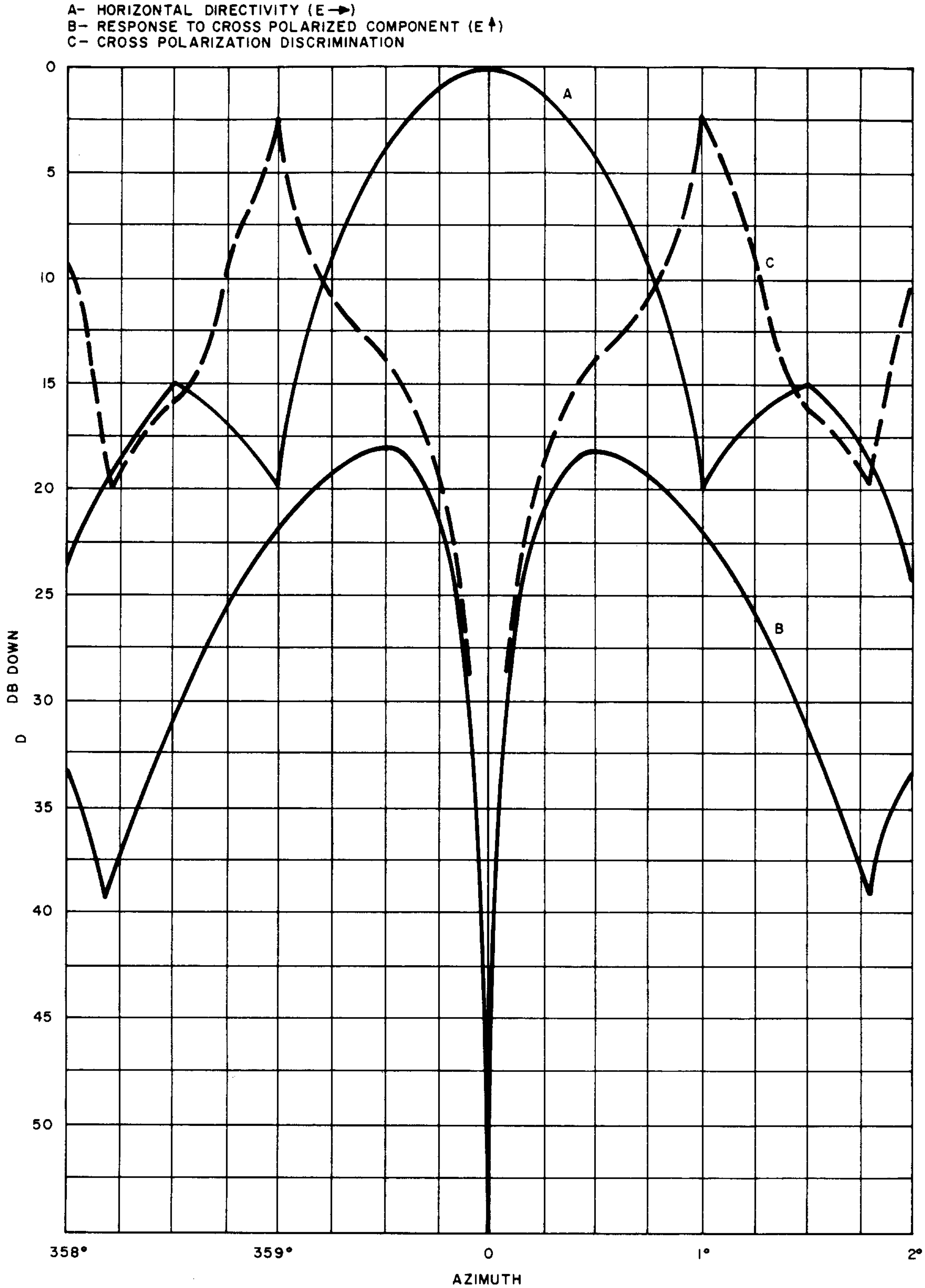

Fig. 5—Horizontal Polarization—Cross-Polarization Discrimination with Azimuth (±2 degrees)—10.960 MHz

B. Gain

3.05 The gain of the antenna for the three midband frequencies for both horizontally and vertically polarized signals is as follows:

MIDBAND FREQUENCY (GHZ)	GAIN (DB)	
	HORIZONTAL	VERTICAL
3.95	39.4	39.6
6.175	43.0	43.2
11.20	47.4	48.0

3.06 A graph of gain versus frequency is contained in Fig. 6 for the three frequency bands for horizontal and vertical polarization.

3.07 The horn reflector antenna has a minimum return loss of 40 dB which is equivalent to a VSWR (voltage standing wave ratio) of 1.02 to 1.

C. Directivity And Beam Width

3.08 The directivity of the horn reflector antenna is best described by a graphical representation. Full 360-degree polar graphs are shown in Fig. 7 through 12 for horizontal directivity in the three frequency bands. The vertical directivity is shown in Fig. 13 through 16.

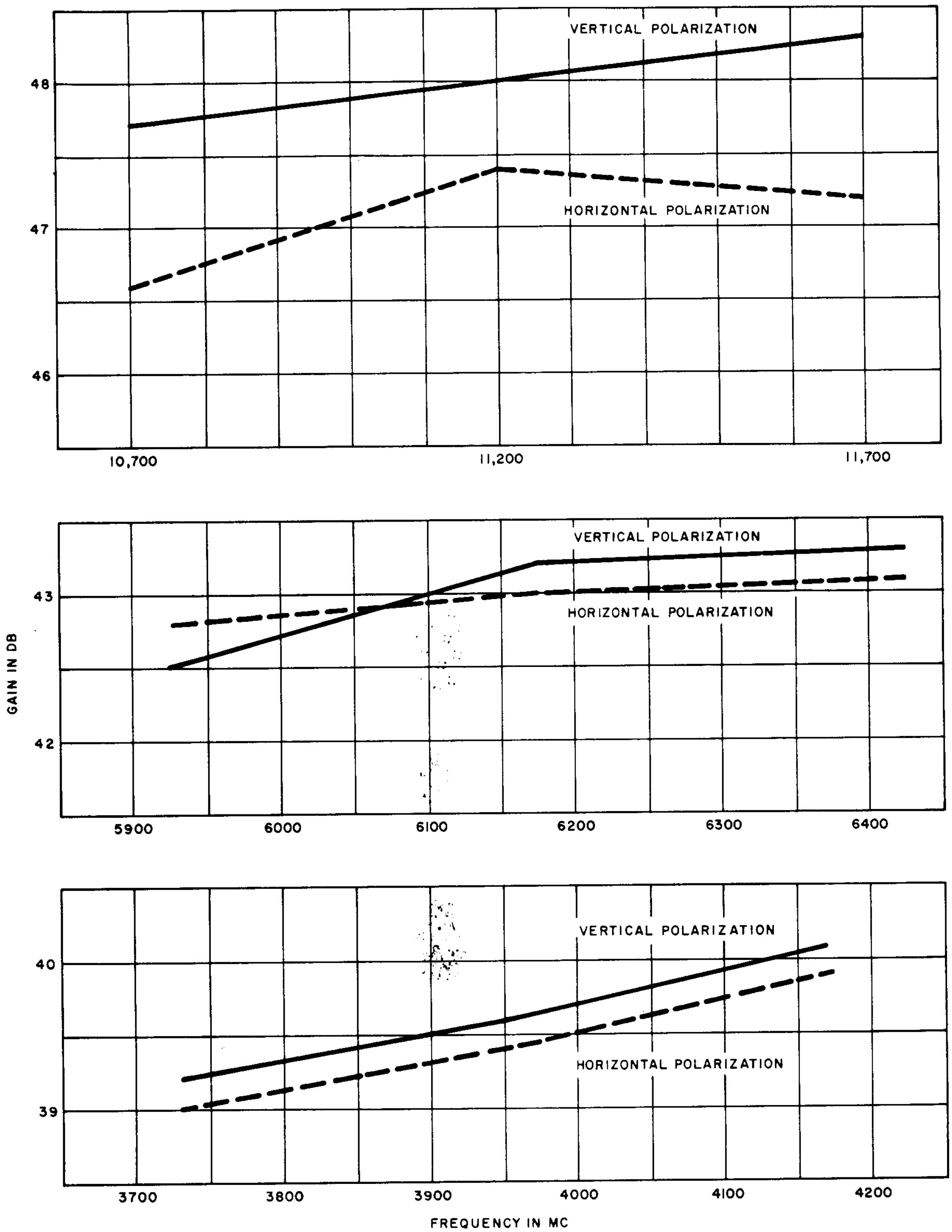

Fig. 6—Gain Versus Frequency

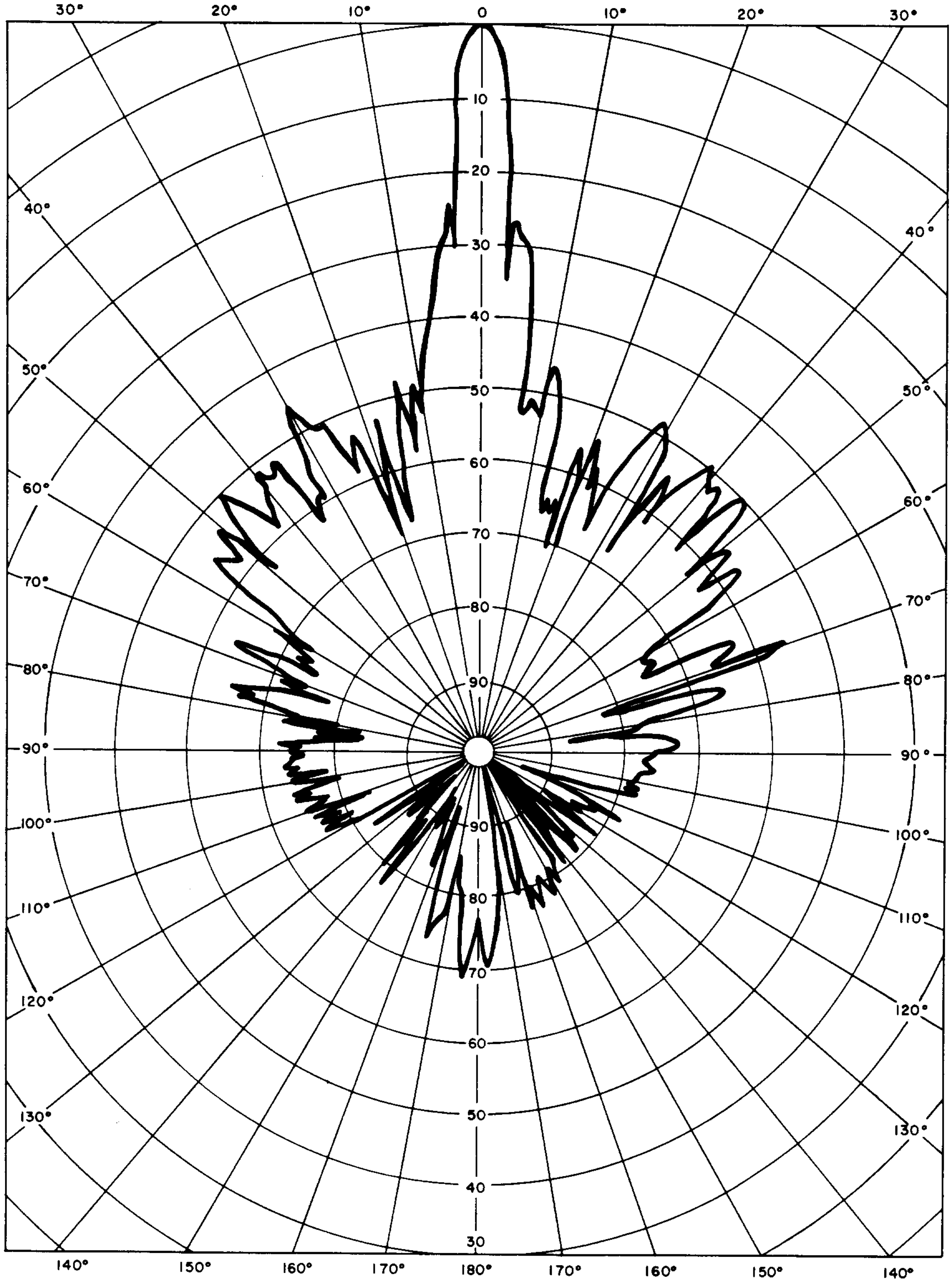

Fig. 7—Horizontal Directivity—Vertical Polarization—3740 MHz (360 Degrees)

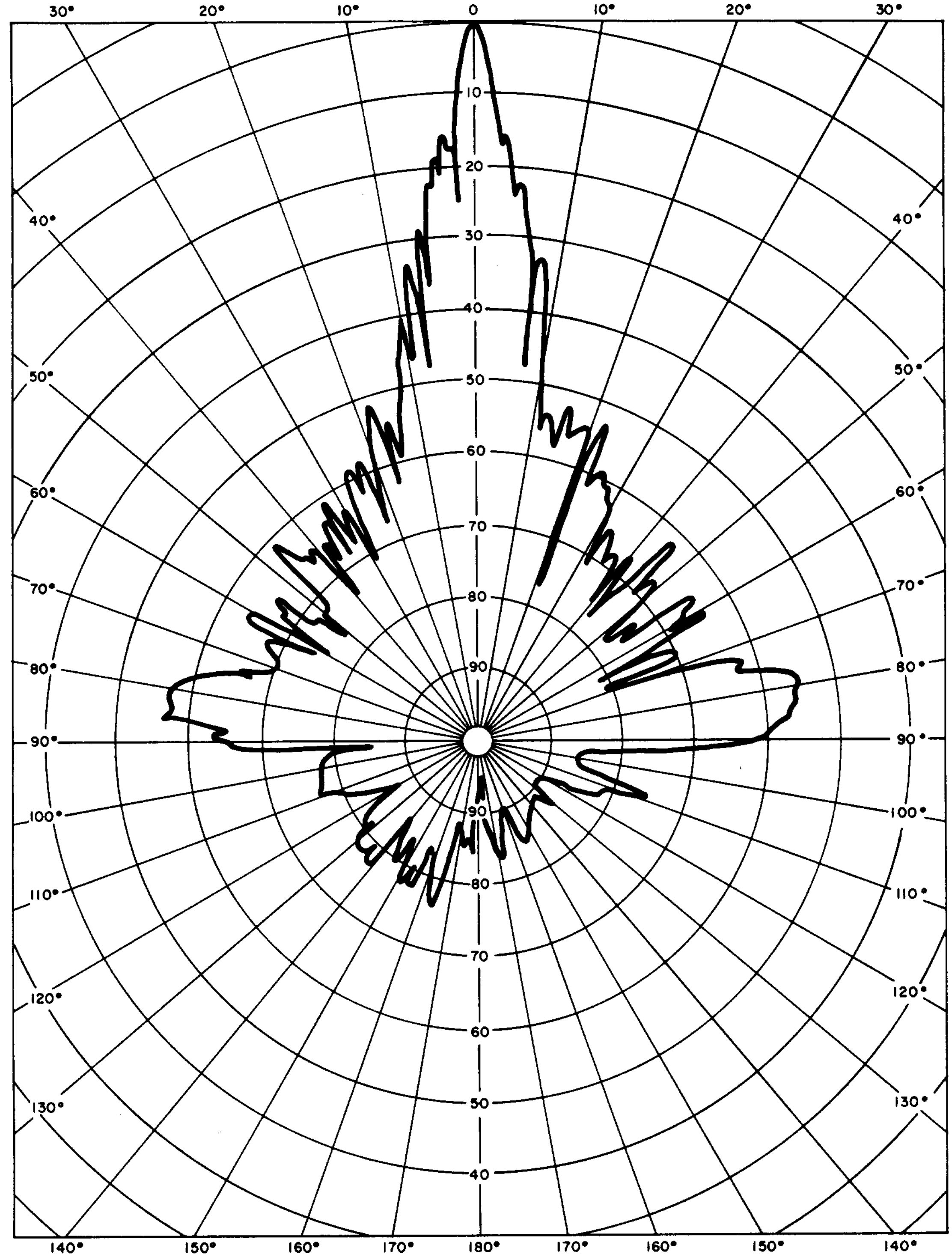

Fig. 8—Horizontal Directivity—Horizontal Polarization—3740 MHz (360 Degrees)

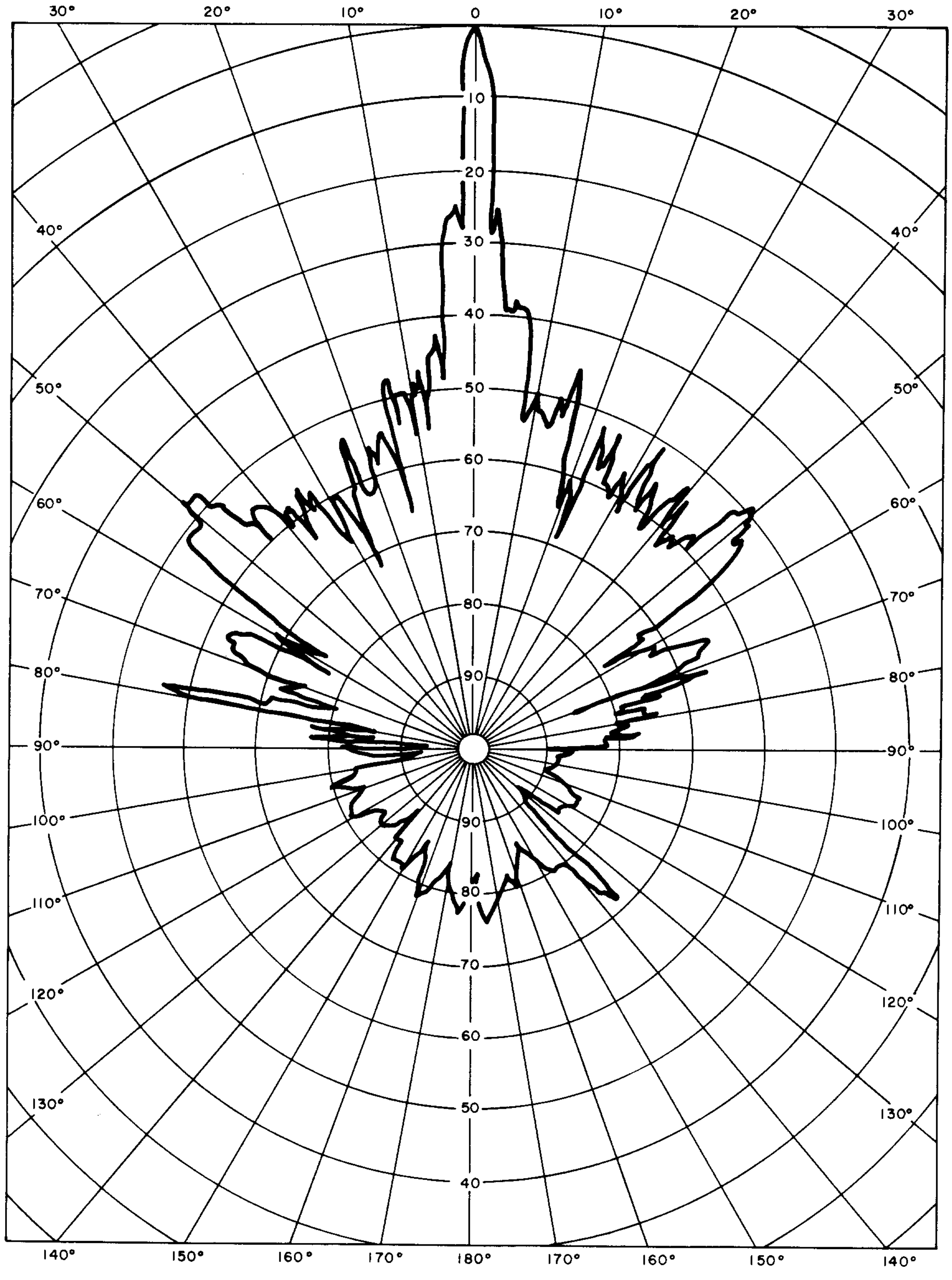

Fig. 9—Horizontal Directivity—Vertical Polarization—6325 MHz (360 Degrees)

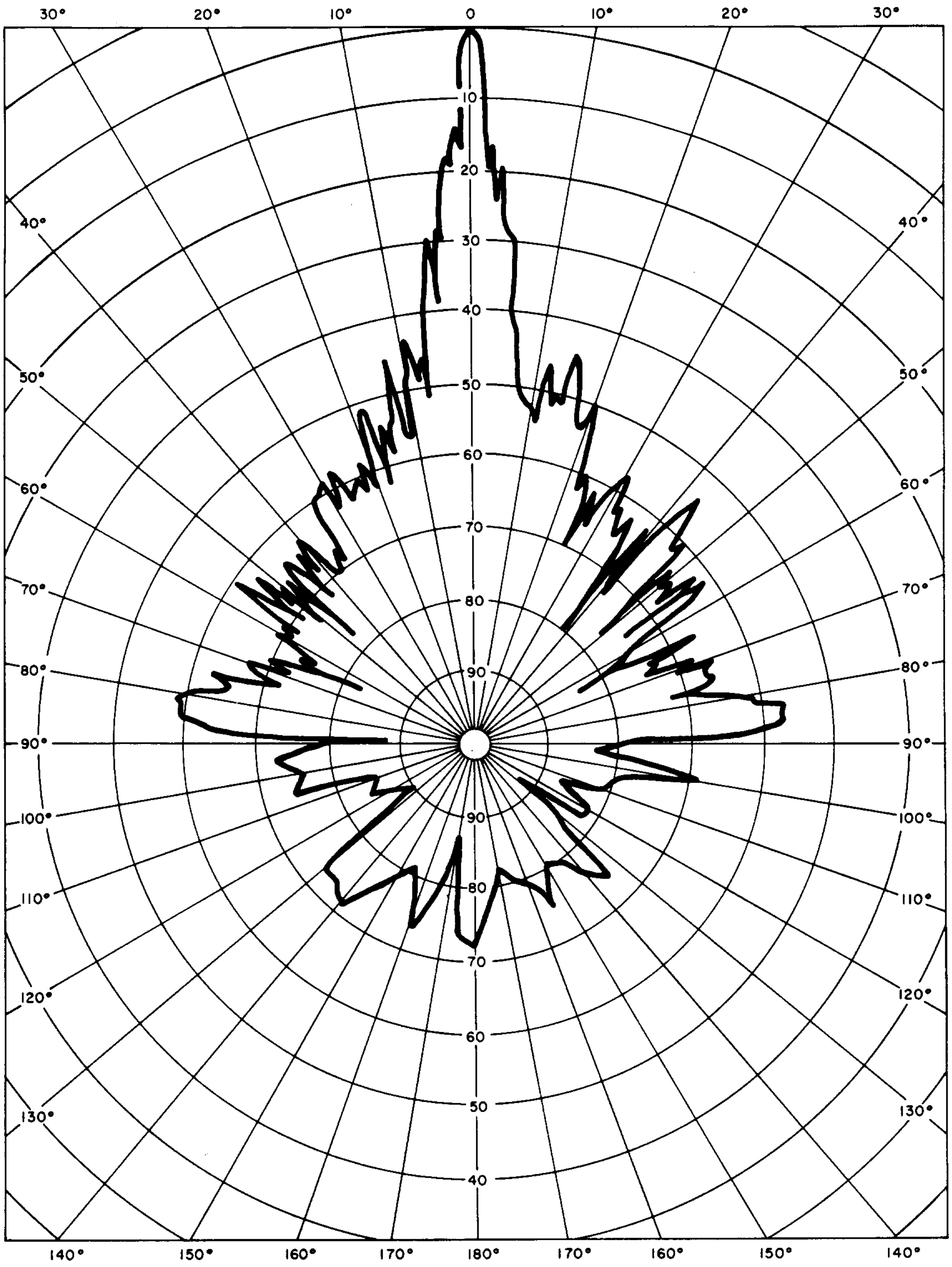

Fig. 10—Horizontal Directivity—Horizontal Polarization—6325 MHz (360 Degrees)

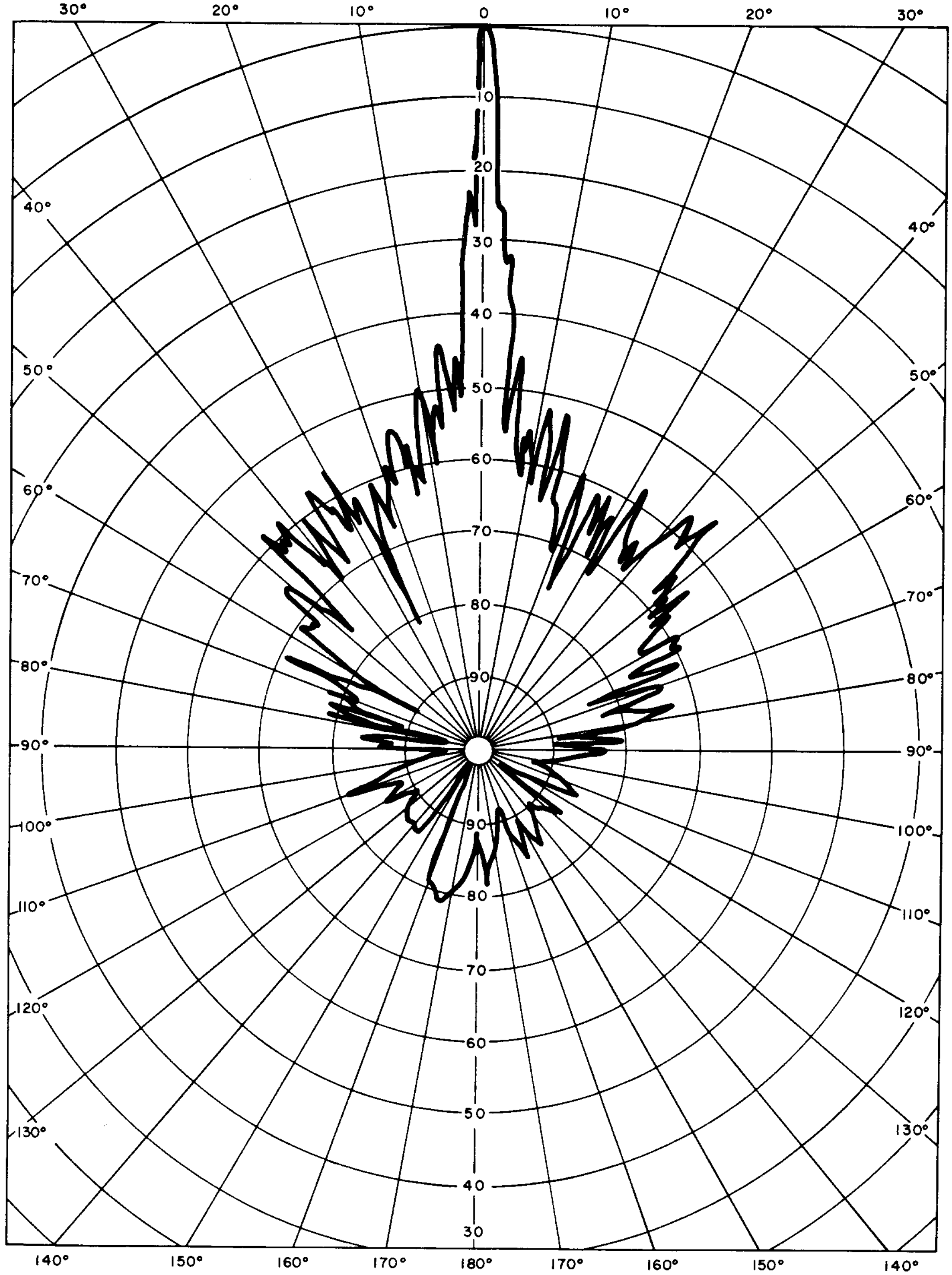

Fig. 11—Horizontal Directivity—Vertical Polarization—10,960 MHz (360 Degrees)

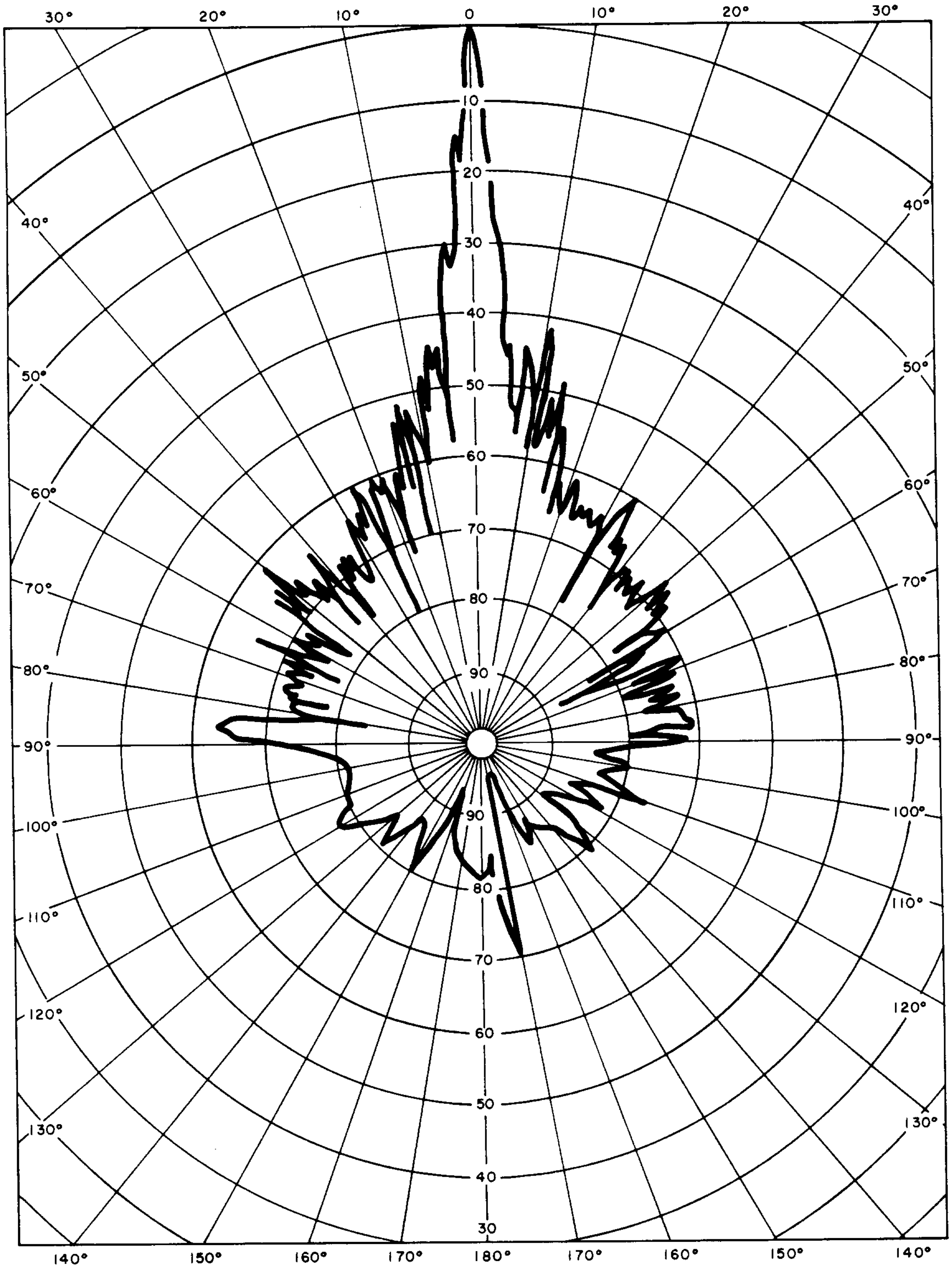

Fig. 12—Horizontal Directivity—Horizontal Polarization—10,960 MHz (360 Degrees)

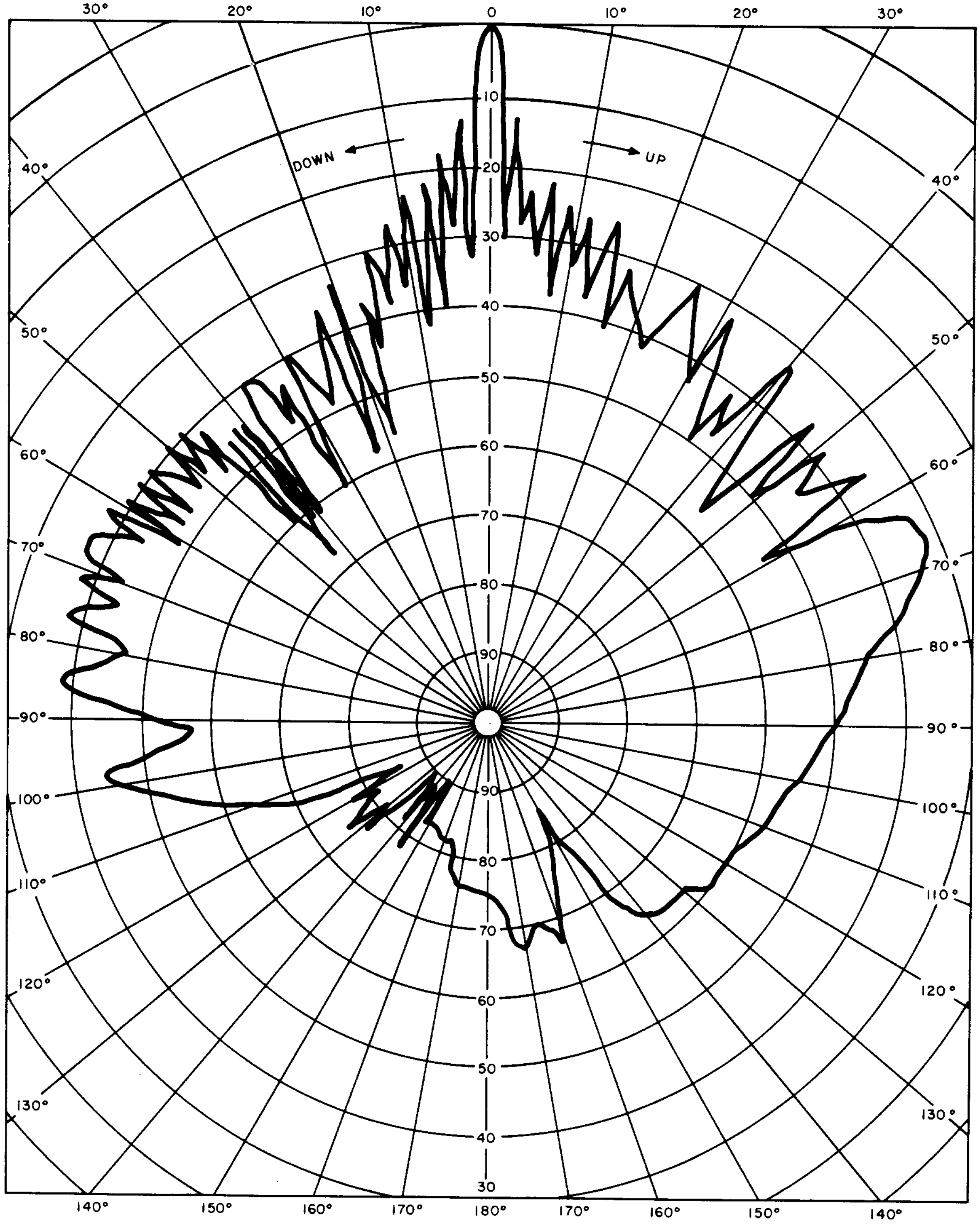

Fig. 13—Vertical Directivity—Vertical Polarization—3740 MHz (360 Degrees)

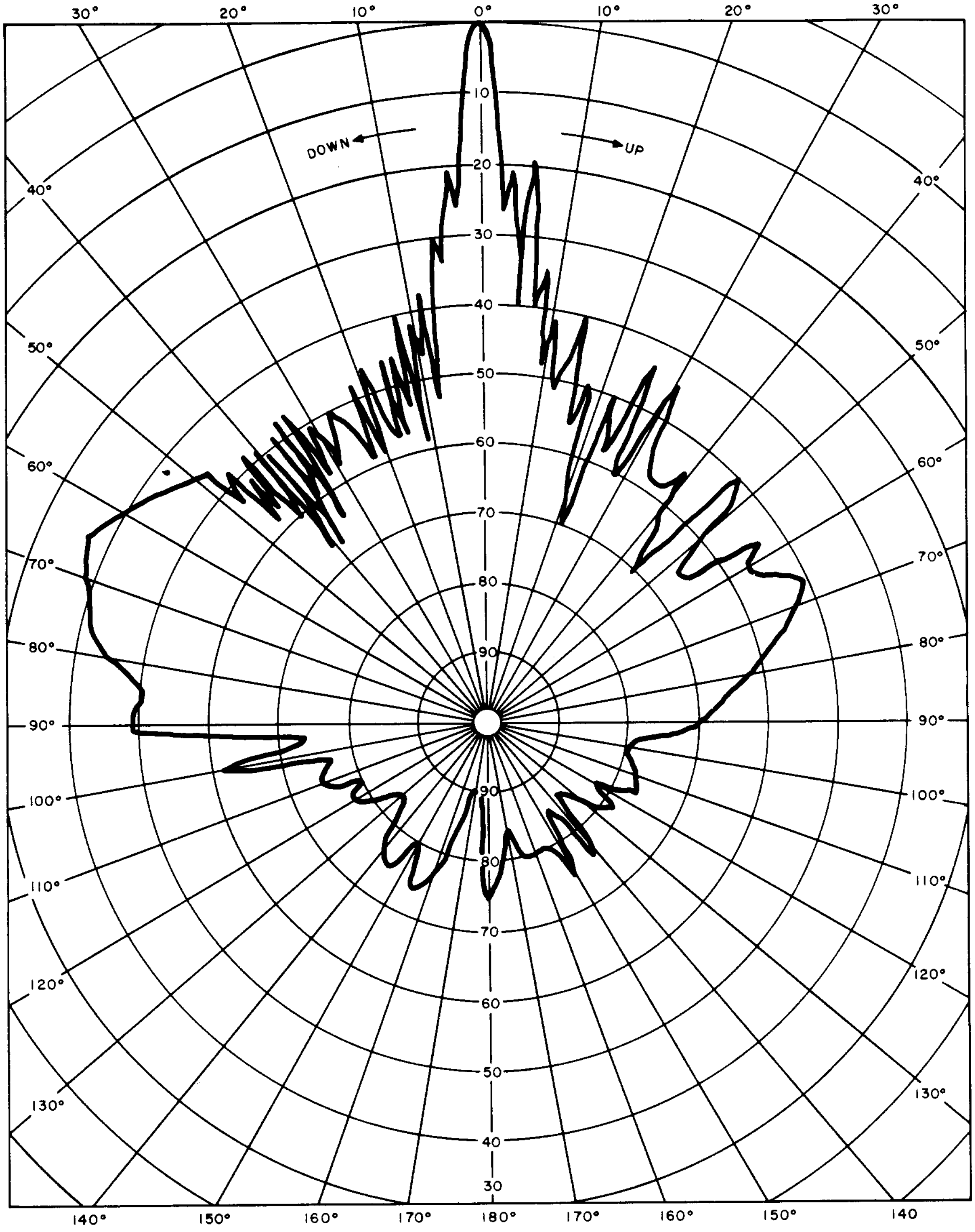

Fig. 14—Vertical Directivity—Horizontal Polarization—3740 MHz (360 Degrees)

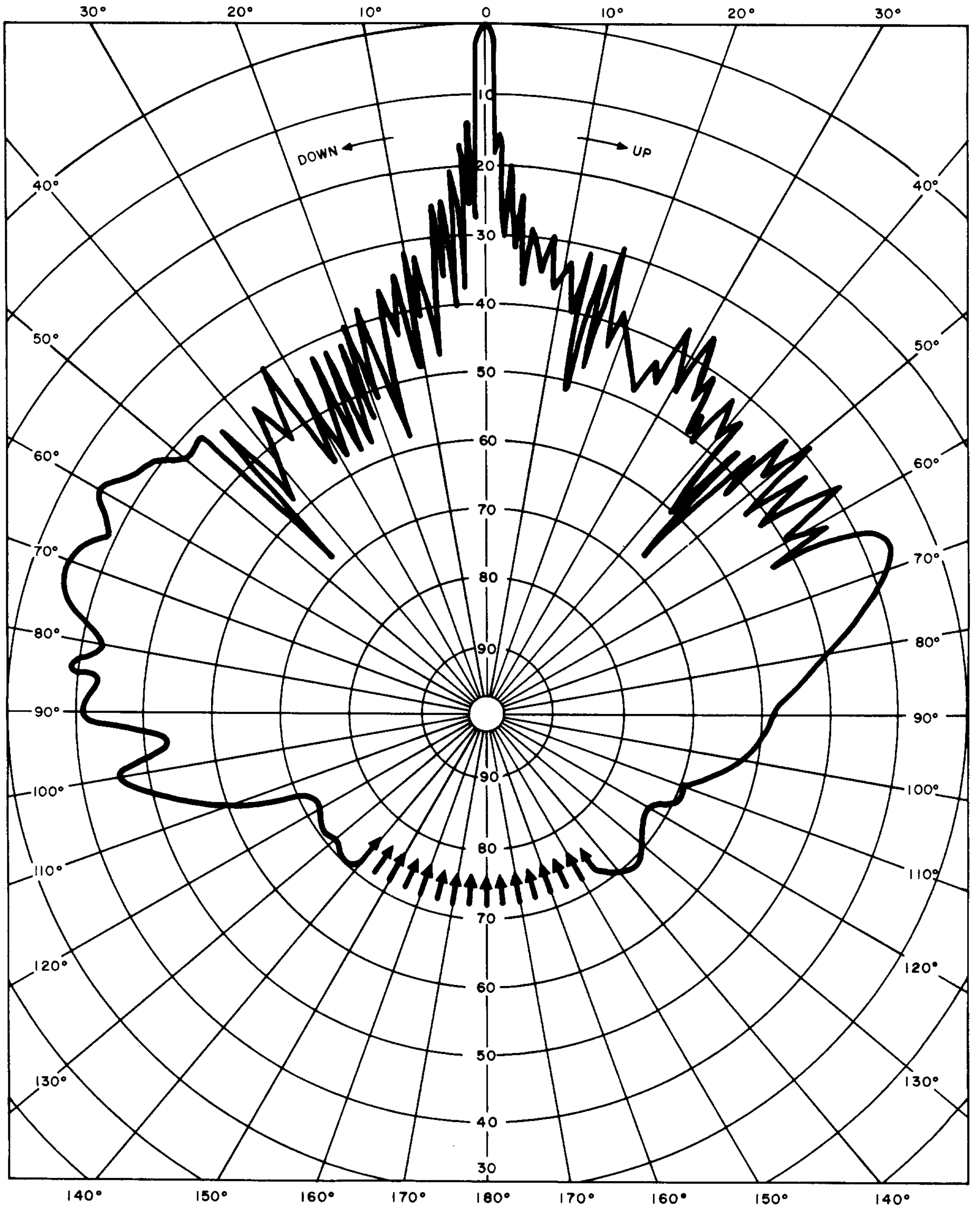

Fig. 15—Vertical Directivity—Vertical Polarization—6325 MHz (360 Degrees)

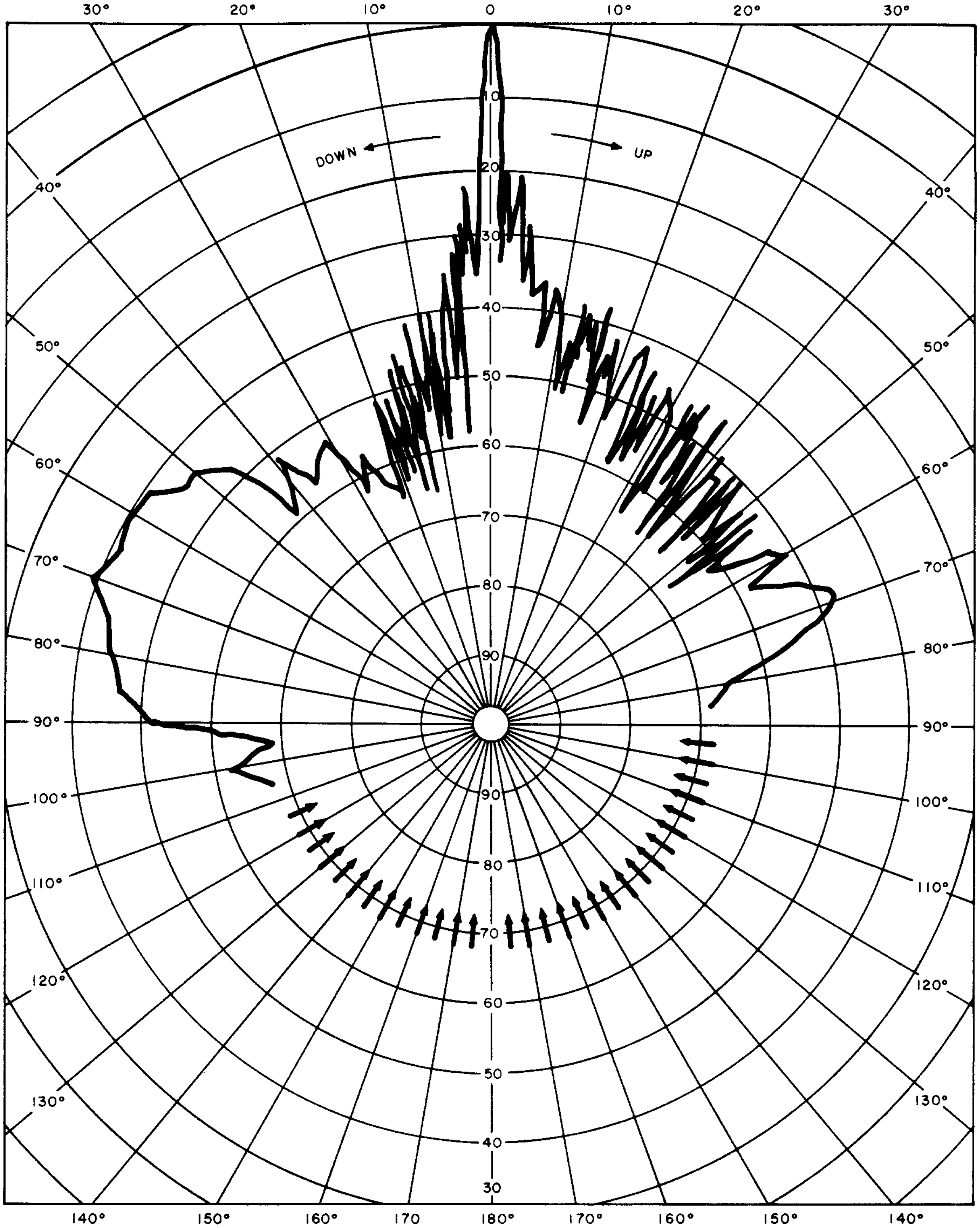

Fig. 16—Vertical Directivity—Vertical Polarization—10,960 MHz (360 Degrees)

3.09 The horizontal 3-dB or half-power beam width, along with the minimum side lobe suppression for the various frequencies, are shown as follows:

HORIZONTAL HALF-POWER BEAM WIDTH				
	HALF-POWER BEAM WIDTH (DEGREES)		MINIMUM SIDE LOBE SUPPRESSION (DB)	
FREQUENCY (MHZ)	VERTICAL POLARIZATION	HORIZONTAL POLARIZATION	VERTICAL POLARIZATION	HORIZONTAL POLARIZATION
3740	2.5	1.6	24	14
6325	1.5	1.25	19	14
10,960	1.0	0.8	21	14

3.10 The vertical or elevation half-power beam width is shown as follows:

ELEVATION HALF-POWER BEAM WIDTH		
	ELEVATION HALF-POWER WIDTH (DEGREES)	
FREQUENCY (MHZ)	VERTICAL POLARIZATION	HORIZONTAL POLARIZATION
3740	2.0	2.13
6325	1.25	1.38
10,960	0.75	0.88

D. Interference Considerations

3.11 The interference considerations discussed in this section are concerned mainly with the interference at the receiving antenna resulting from the side lobe radiation of an adjacent transmitting antenna and the receiving antenna's response to an off axis signal of either polarization. Side-to-side and back-to-back coupling loss between antennas on the same tower or platform is also an important consideration.

3.12 Figures 17, 18, and 19 show the antenna coupling for the several angular positions of the transmitting and receiving antennas. The degree of coupling can be read from the chart of typical data for side-by-side, back-to-back, and intermediate angles of operational positioning.

3.13 Typical side-by-side and back-to-back coupling losses for the indicated frequencies are as follows:

FREQUENCY (MHZ)	BACK-TO-BACK (DB)		SIDE-BY-SIDE (DB)	
	VERTICAL	HORIZONTAL	VERTICAL	HORIZONTAL
3740	140	122	81	89
6325	140	127	120	122
10,960	139	140	94	112

3.14 The side-by-side and back-to-back coupling loss between antennas may vary considerably from location to location. They will vary with distance and relative position. Foreground reflections and leakage of energy from the joints of the waveguide feeding the antennas will affect the coupling factor.

3.15 Figures 20 through 25 show smoothed curves of the antenna response pattern. The curves are smoothed to the peaks of the side lobes for a sample antenna. The dashed curve represents antenna response to the cross-polarized signal and are used for interference coordination calculations.

3.16 Interference factors discussed in this section pertain only to those relative to the antenna. Overall interference considerations will require reference to the particular type microwave system employed.

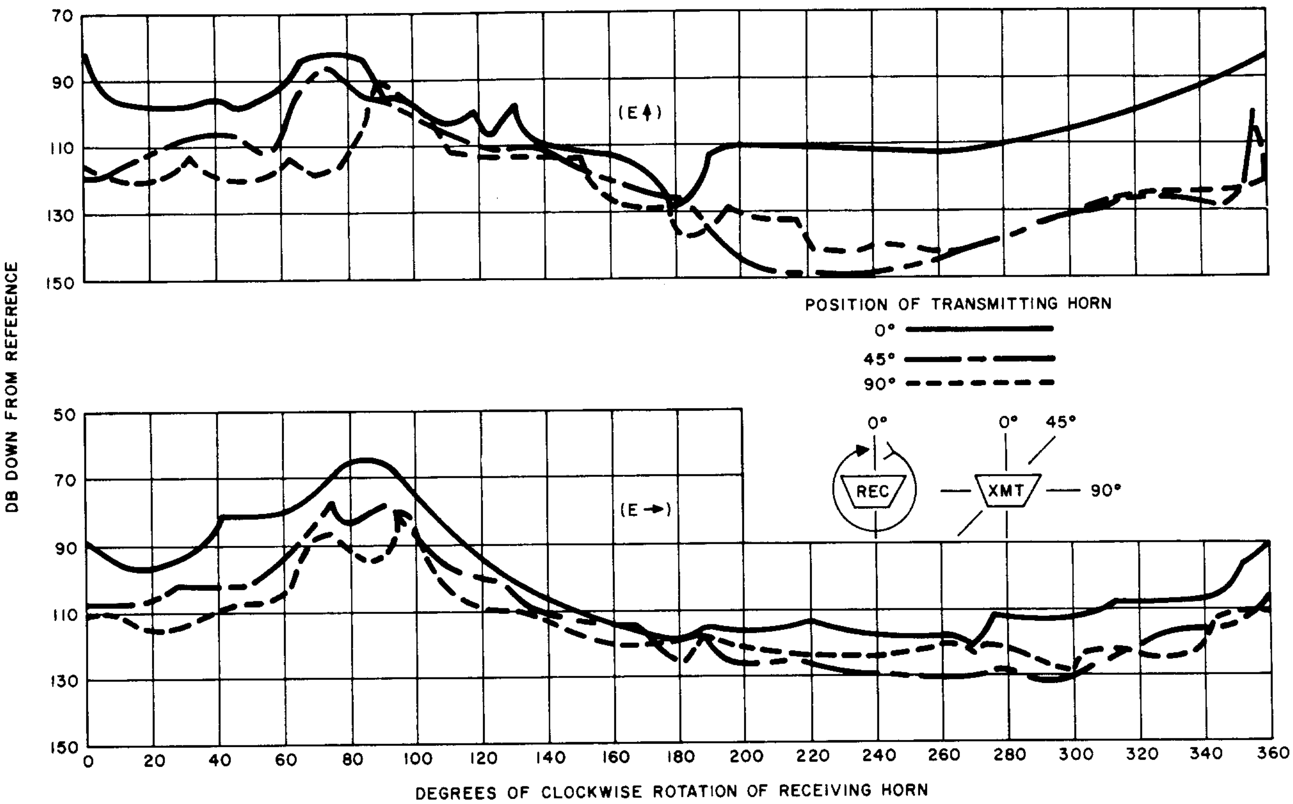

Fig. 17—Coupling—3740 MHz

4. SYSTEM APPLICATION

4.01 The horn reflector antenna is especially adaptable to the heavy, backbone, long-haul routes. It has very good impedance, broadband and dual polarization capability, high gain, and good directivity with low side lobe radiation.

4.02 The construction of the antenna with its shielding design gives it adequate coupling and a front-to-back ratio required for the heavily loaded long-haul routes.

4.03 Tower selection for the horn reflector is a significant consideration because of the heavy weight and relatively large size of the antenna. A typical tower installation is shown in Fig. 26.

4.04 Table B is a summary of the transmission characteristics.

5. REFERENCE

SECTION	TITLE
402-421-100	KS-15676—Horn Reflector and Waveguide System Description

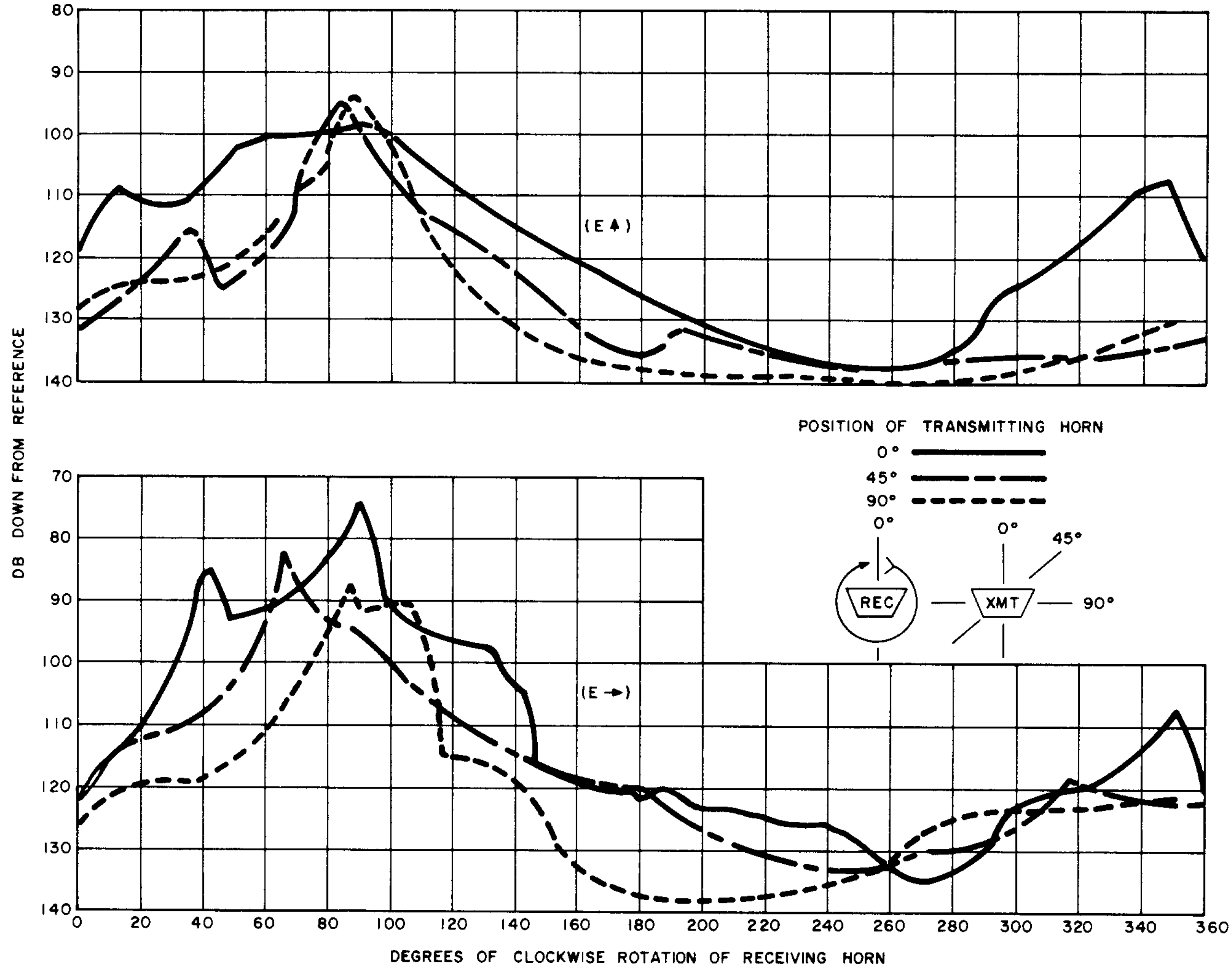

Fig. 18—Coupling—6325 MHz

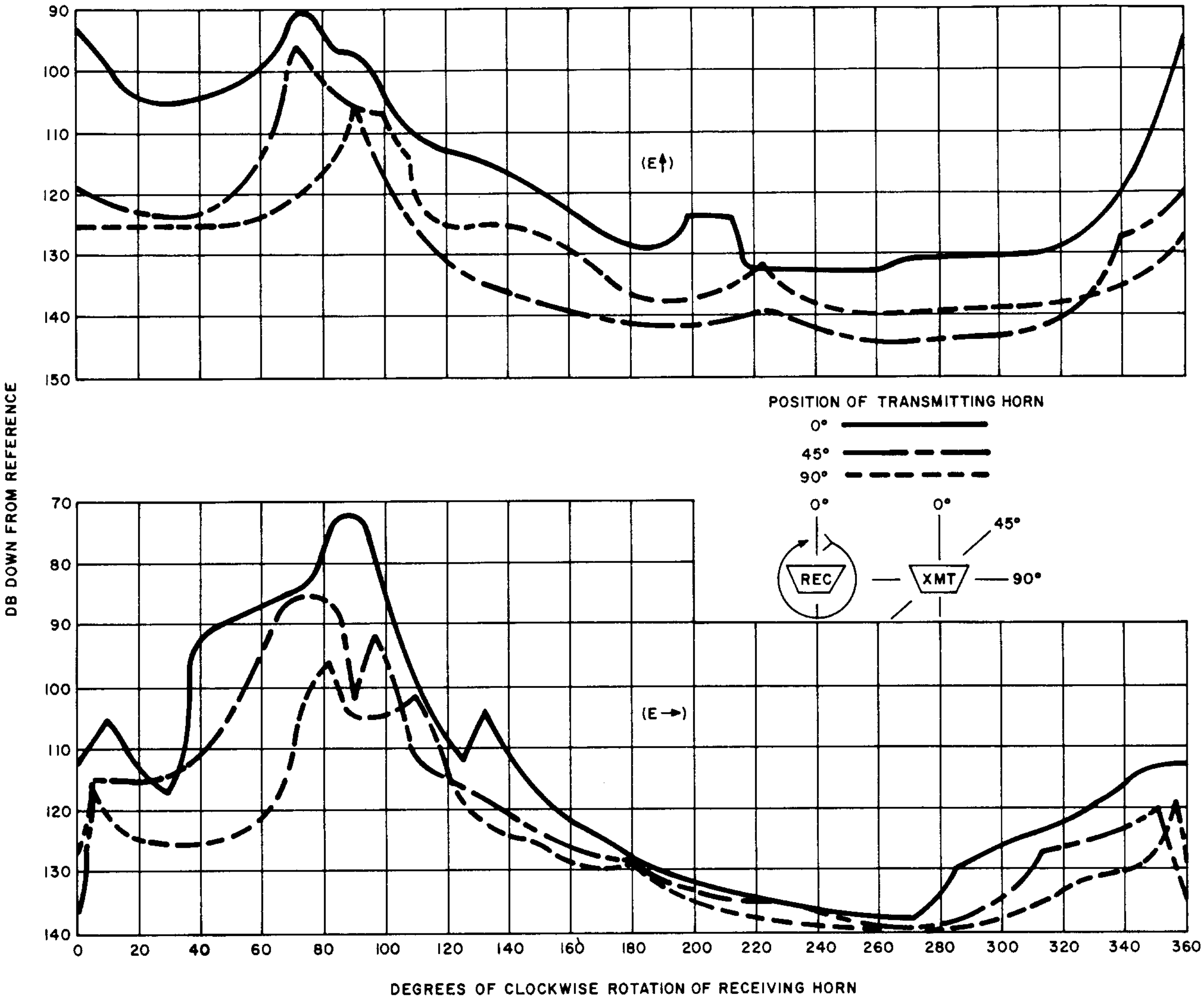

Fig. 19—Coupling—10,960 MHz

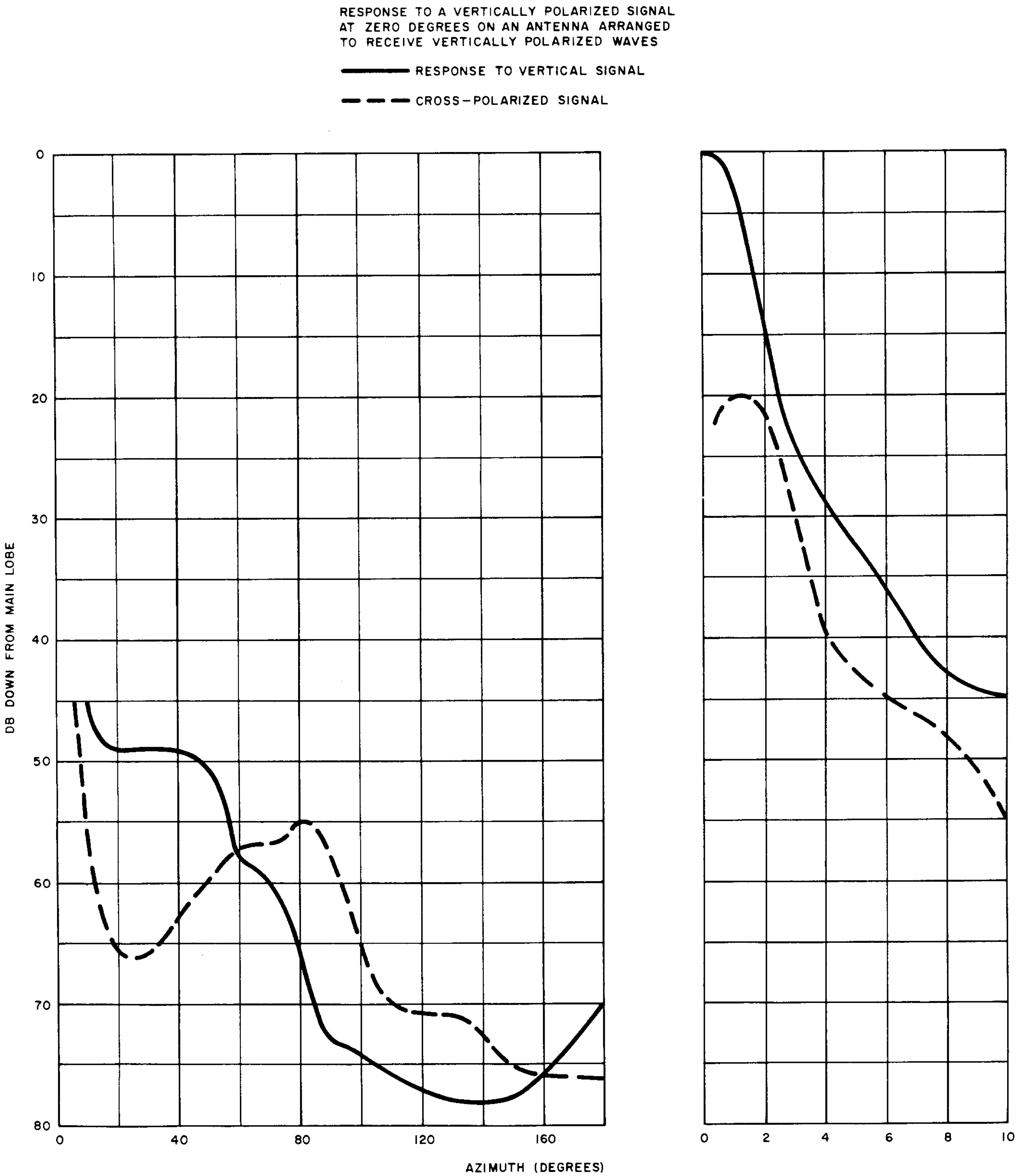

Fig. 20—Smoothed Horizontal Directivity—Vertical Polarization—4 GHz

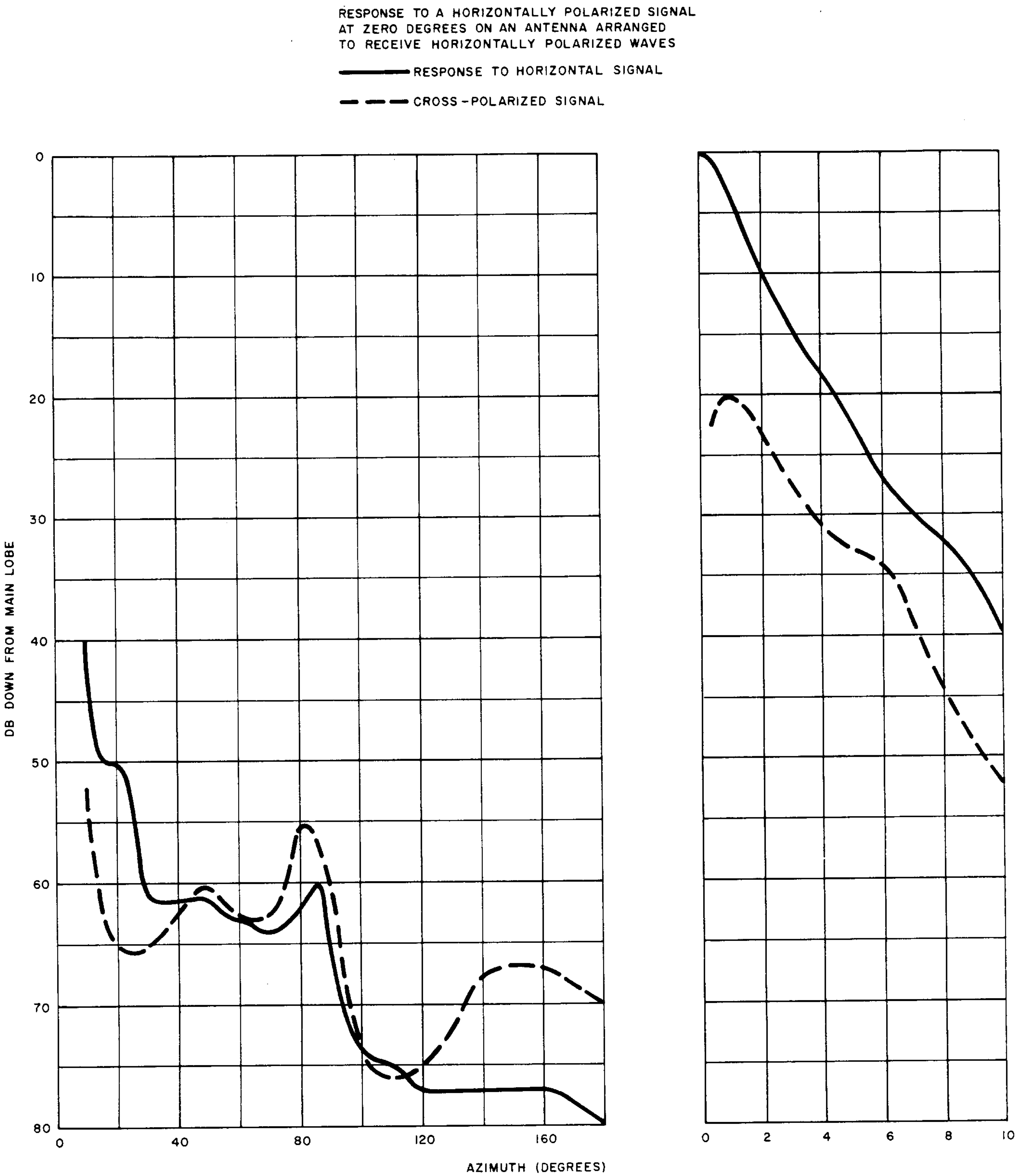

Fig. 21—Smoothed Horizontal Directivity—Horizontal Polarization—4 GHz

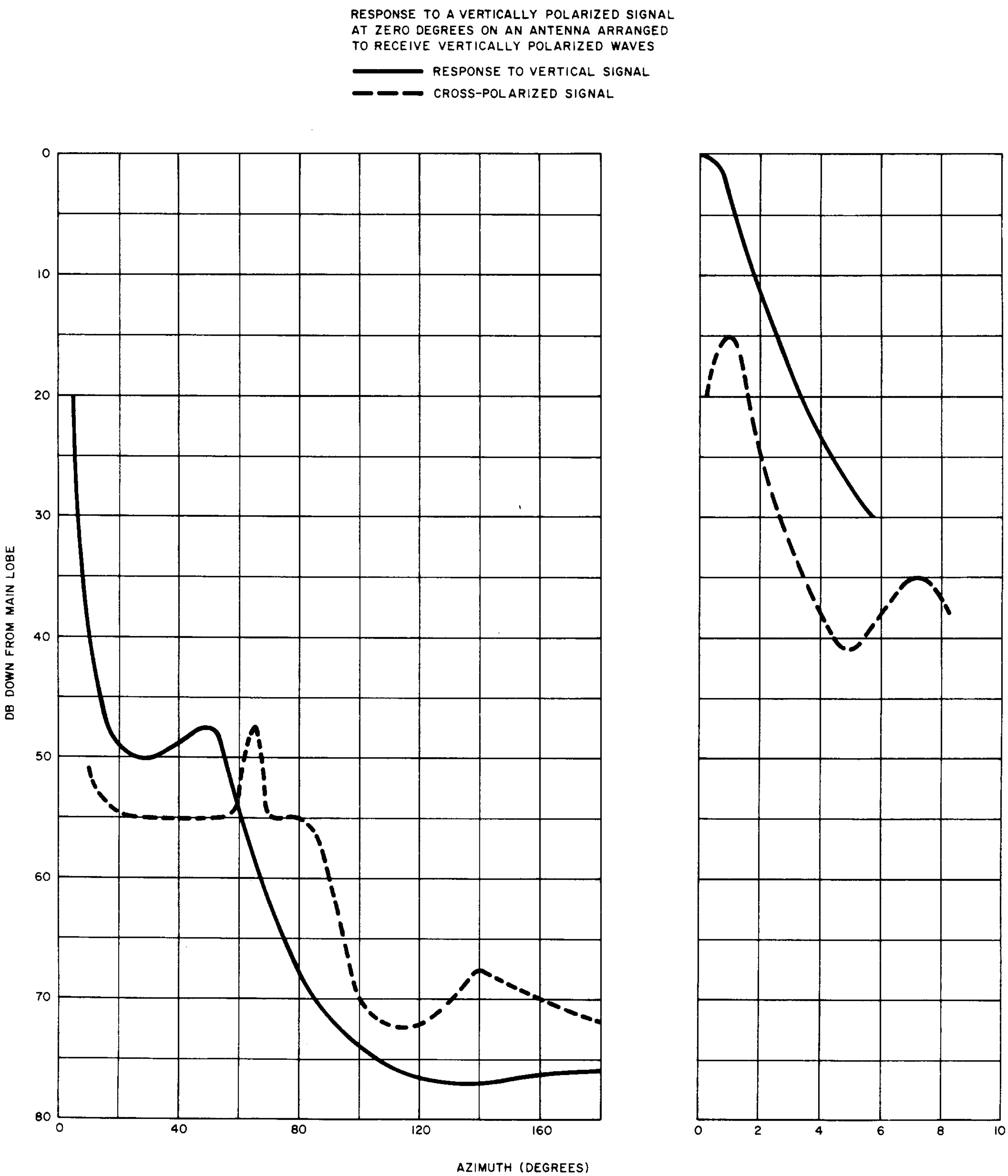

Fig. 22—Smoothed Horizontal Directivity—Vertical Polarization—6 GHz

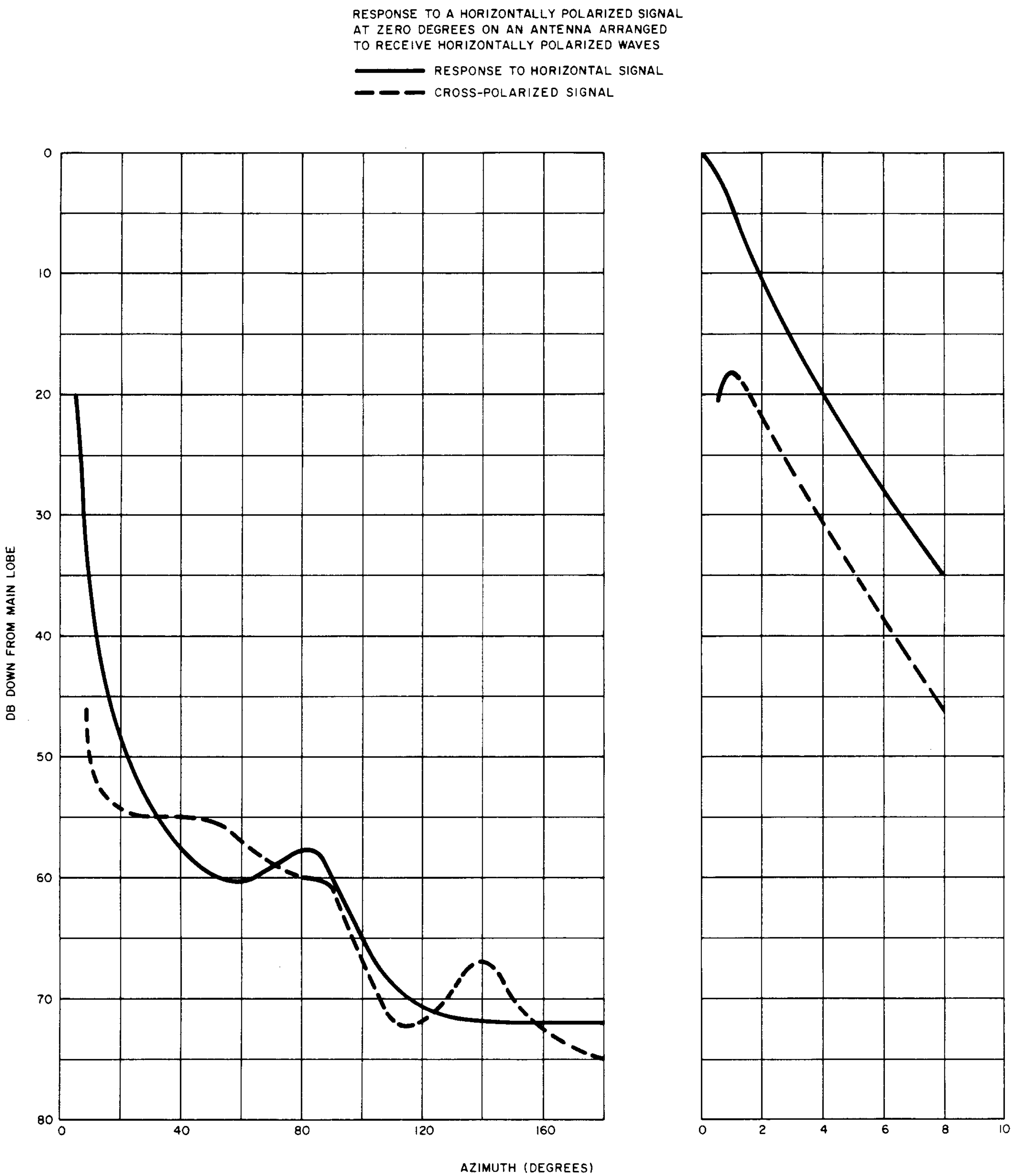

Fig. 23—Smoothed Horizontal Directivity—Horizontal Polarization—6 GHz

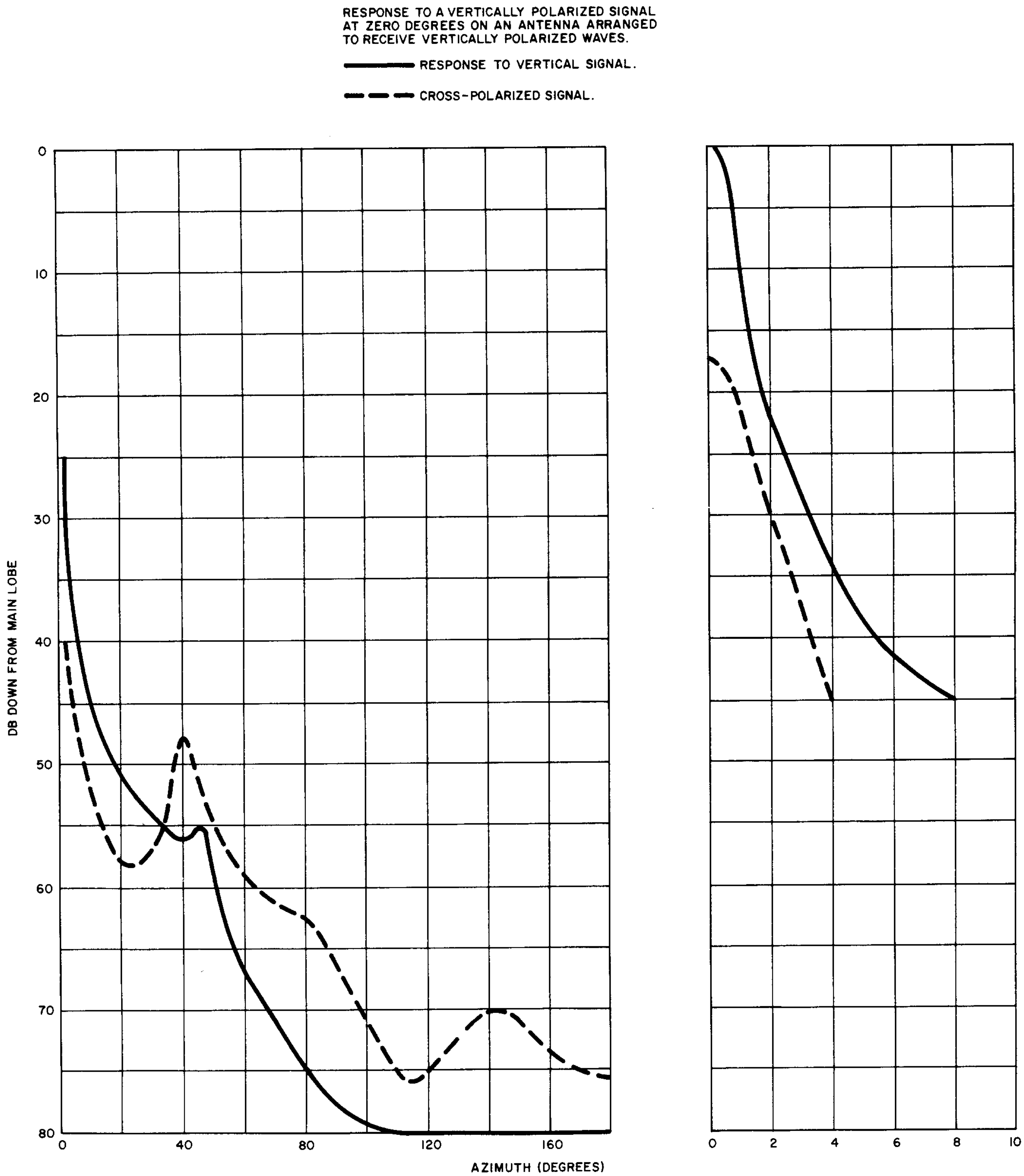

Fig. 24—Smoothed Horizontal Directivity—Vertical Polarization—11 GHz

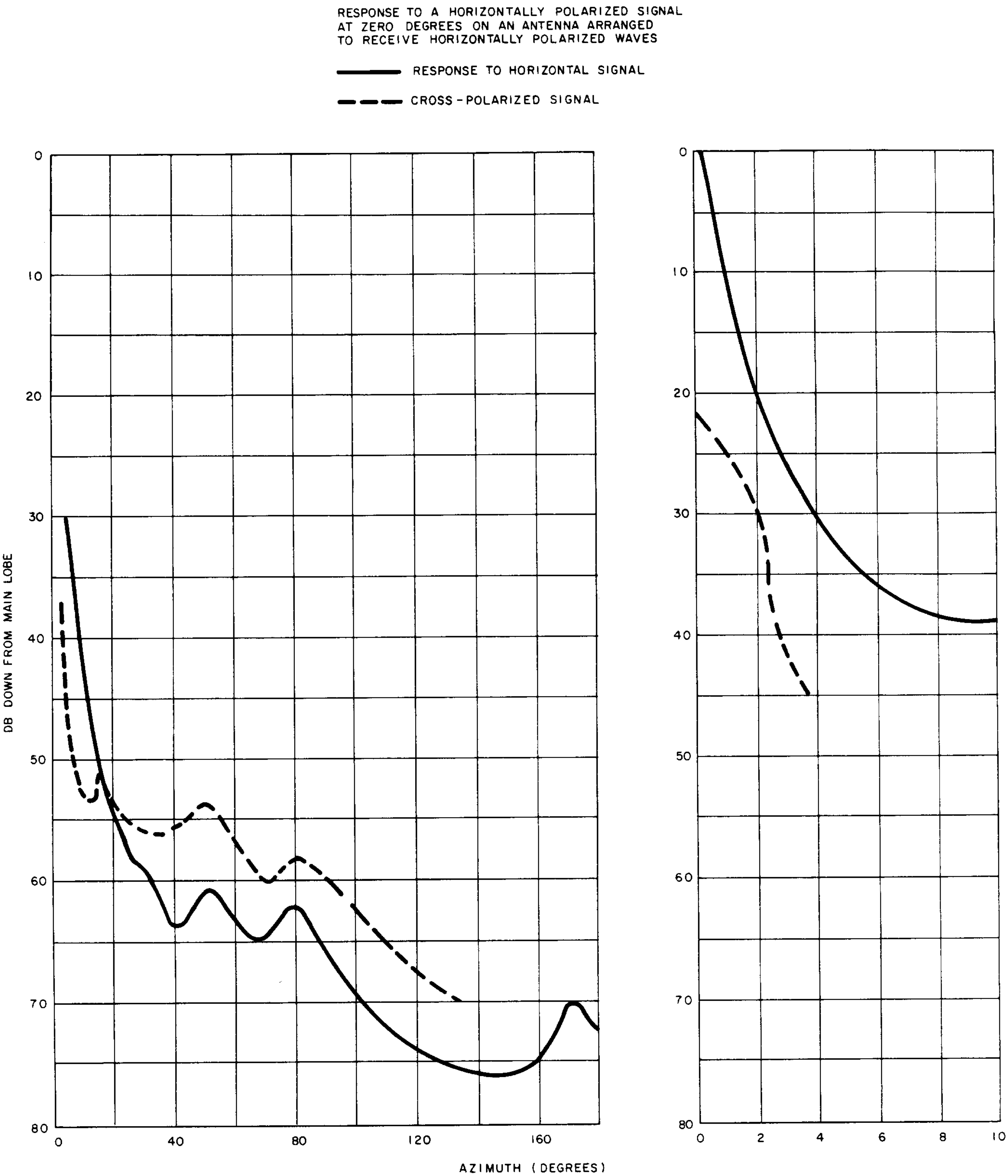

Fig. 25—Smoothed Horizontal Directivity—Horizontal Polarization—11 GHz

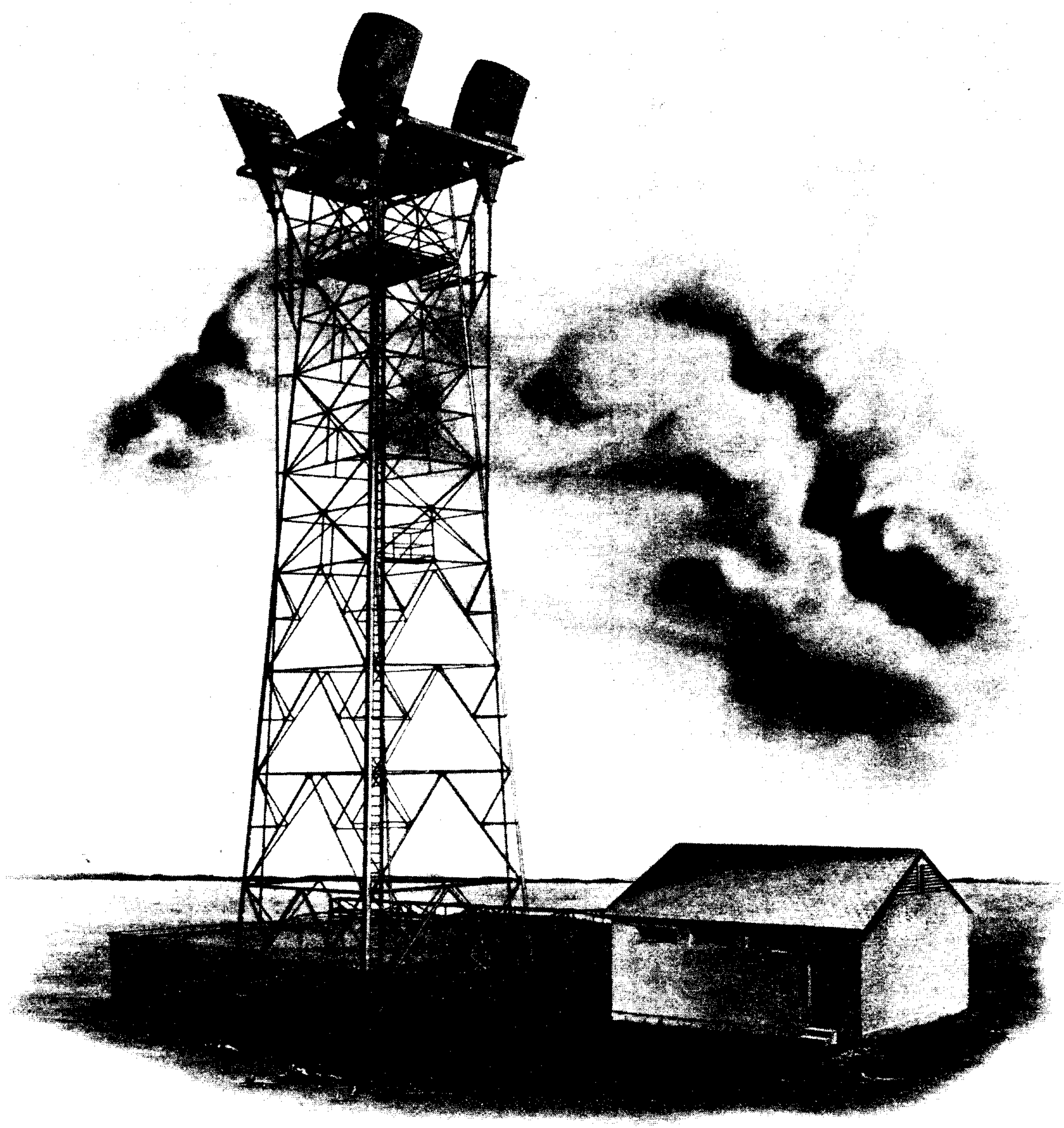

Fig. 26—Typical Installation, 100-Foot Type A Tower

TABLE B

REPRESENTATIVE TRANSMISSION CHARACTERISTICS

	GAIN, DB		FRONT-TO-BACK RATIO, DB		HALF-POWER BEAM-WIDTH, DEGREES: VERTICAL PLANE		HALF-POWER BEAM-WIDTH, DEGREES: HORIZONTAL PLANE		MAJOR SIDE LOBES DB DOWN		MINOR SIDE LOBES DB DOWN		CROSS POLARIZATION DISCRIMINATION ON BEAM, DB		CROSSTALK, DB: SIDE-BY-SIDE		CROSSTALK, DB: BACK-TO-BACK	
POLARIZATION	VERT	HOR	VERT	HOR	VERT	HOR	VERT	HOR	VERT	HOR	VERT	HOR	VERT	HOR	VERT	HOR	VERT	HOR	VERT	HOR
3730 MHz	39.2	39.0																		
3740 MHz			71	77	2.0	2.13	2.5	1.6	24	14	49	54	50	46	81	89	140	122
3950 MHz	39.6	39.4																		
4170 MHz	40.1	39.9																		
5925 MHz	42.5	42.8																		
6175 MHz	43.2	43.0																		
6325 MHz			71	71	1.25	1.38	1.5	1.25	19	14	49	57	51	51	120	122	140	127
6425 MHz	43.3	43.1																		
10,700 MHz	47.7	46.6																		
10,960 MHz			78	71	0.75	0.88	1.0	0.8	21	14	54	61	57	53	94	112	139	140
11,200 MHz	48.0	47.4																		
11,700 MHz	48.3	47.2																		