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### Effect of the supporting mast for the AN/URN-20 Tacan antenna on the DDH205 HF antenna system

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RADIO AND ELECTRICAL ENGINEERING DIVISION

CANADA INSTITUTE FOR S.T.I.  
N R C C.

FEB 23 1992

INSTITUT CANADIEN DE L'I.S.T.  
C.N.R.C.

EFFECT OF THE SUPPORTING MAST  
FOR THE AN/URN - 20 TACAN ANTENNA  
ON THE DDH205 HF ANTENNA SYSTEM

ANALYZED

- J.Y. WONG, J. G. DUNN, A. GRUNWALD-

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Authority: S. A. MAYMAN

Date: NOV 26 1992

OTTAWA

SEPTEMBER 1969

NRC # 35690

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### ABSTRACT

Model studies show that the proposed mast installation for the AN/URN-20 Tacan antenna will seriously affect the impedance characteristics of the two funnel whip antennas. Minor changes in the impedance of the monocone antenna and the forward whip are expected. There is a general deterioration in the radiation patterns due to spurious nulls created by the presence of the Tacan mast.

h17A69259 MM

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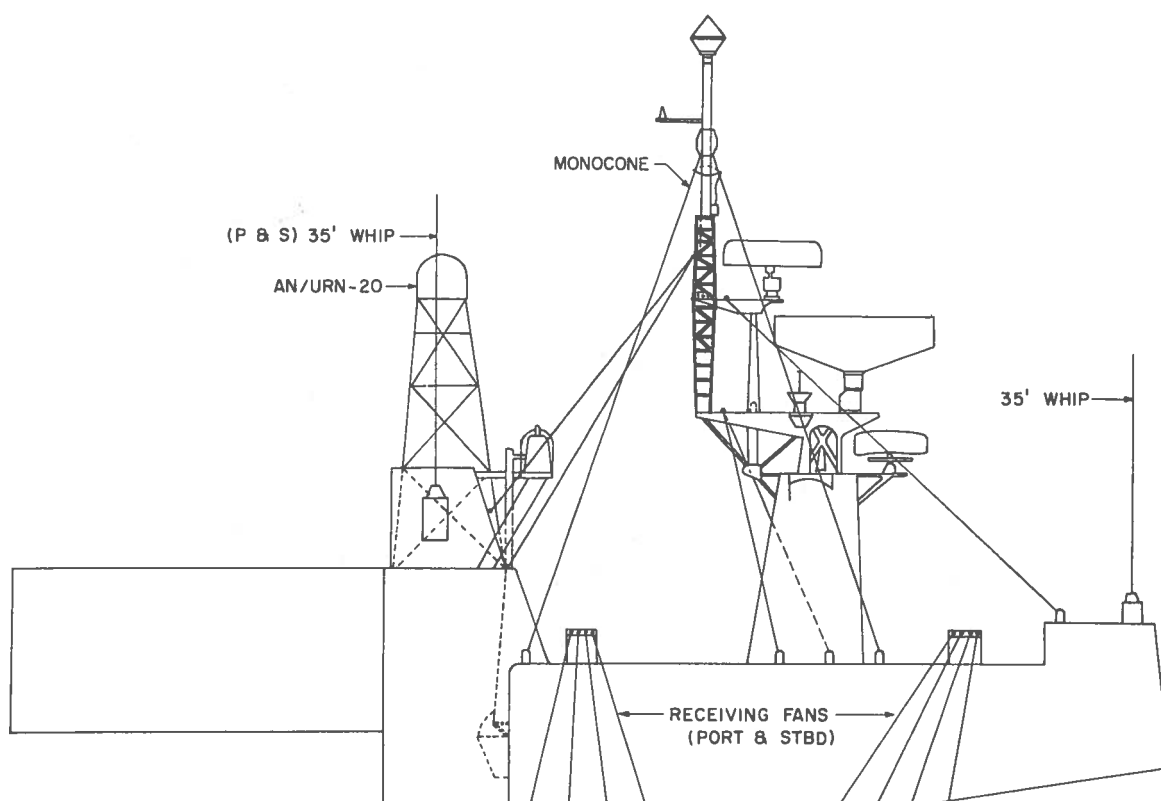
- I.  $\frac{1}{20}$  scale mock-up of DDH205 used in the impedance measurements

## EFFECT OF THE SUPPORTING MAST FOR THE AN/URN-20 TACAN ANTENNA ON THE DDH205 HF ANTENNA SYSTEM

— J.Y. Wong, J.G. Dunn, and A. Grunwald —

### Introduction

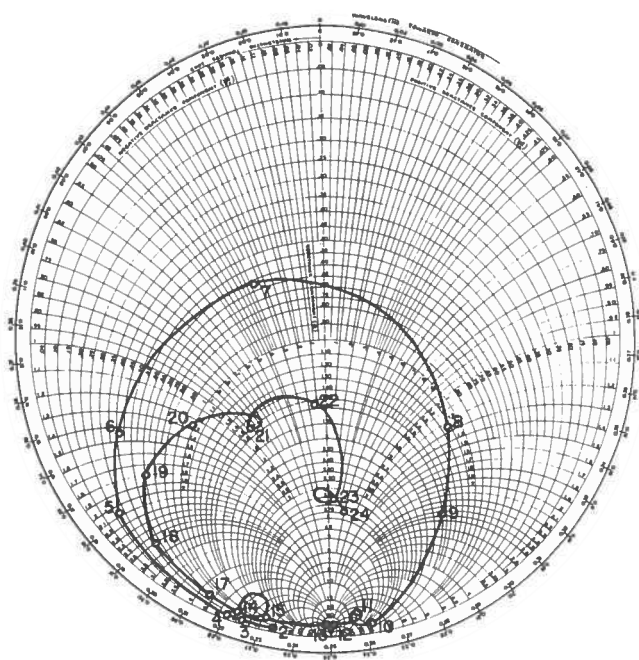
A decision was made recently by the Radar and Radiated Navigational Aids Section/DMCS of Canadian Forces Headquarters to provide the DDH205 class with Tacan capability. The plan calls for siting an AN/URN-20 antenna on top of a lattice tower which is situated between the ship's two funnels. A sketch of the proposed mast installation and the HF antenna arrangement [1] is shown in Fig. 1. The addition of the Tacan mast has made it necessary to carry out a further model study to determine its effect on the performance of the HF antenna system.



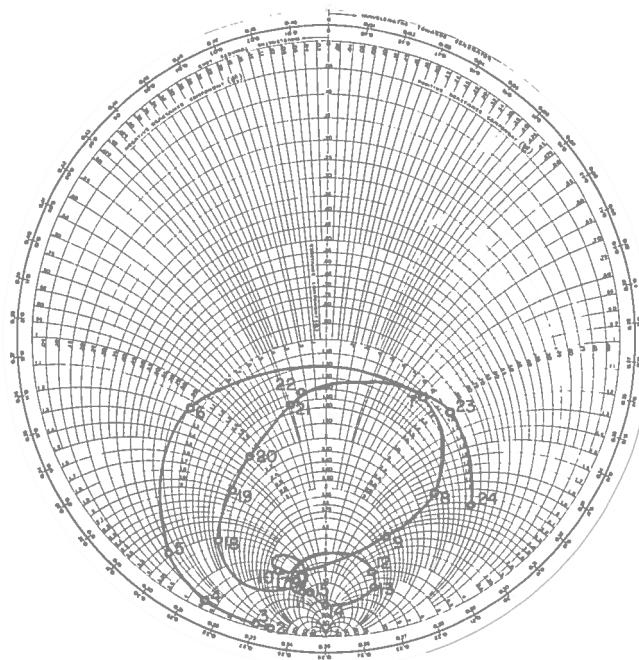
*Figure 1 HF antenna arrangement on DDH205 with Tacan mast*

## Impedance Measurements

Owing to the relatively large size of the tower and its proximity to the HF antennas, it is almost certain that the mast will have a significant undesirable effect, especially on the impedance of the two funnel whips. A Smith impedance chart of the starboard 35-foot whip measured on a 1/20 scale mock-up of the superstructure section of the DDH205 is shown in Fig. 2. A photograph of the mock-up used in the measurements is given in Plate I. In order to permit a ready comparison, the original whip impedance without the Tacan mast is also given. The main effect of the mast appears to be a large increase in the antenna VSWR between about 9 MHz and 20 MHz. Whether or not this problem is a serious one will depend on whether the AN/SRA-22 tuner is capable of tuning the whip over this frequency range. This problem can only be resolved by an actual shipboard measurement.



(a) WITH TACAN MAST



(b) WITHOUT TACAN MAST

Figure 2 Smith impedance chart of starboard 35-foot whip

The VSWR of the monocone antenna was measured using a swept frequency reflectometer technique. The results, given in Fig. 3, show that there is no significant change caused by the presence of the Tacan mast.

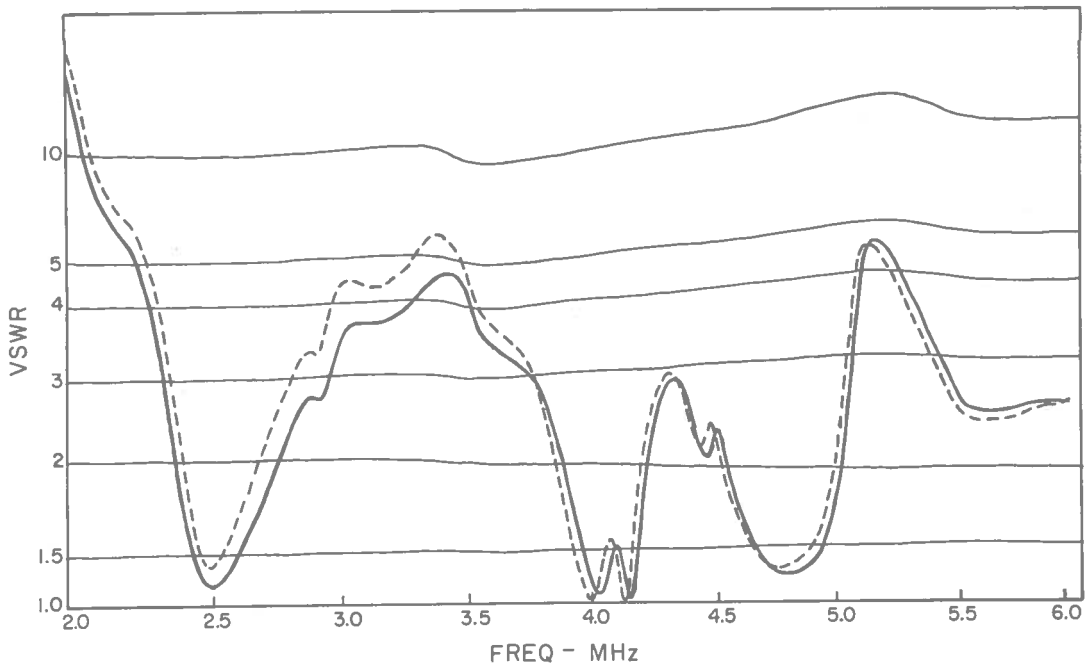
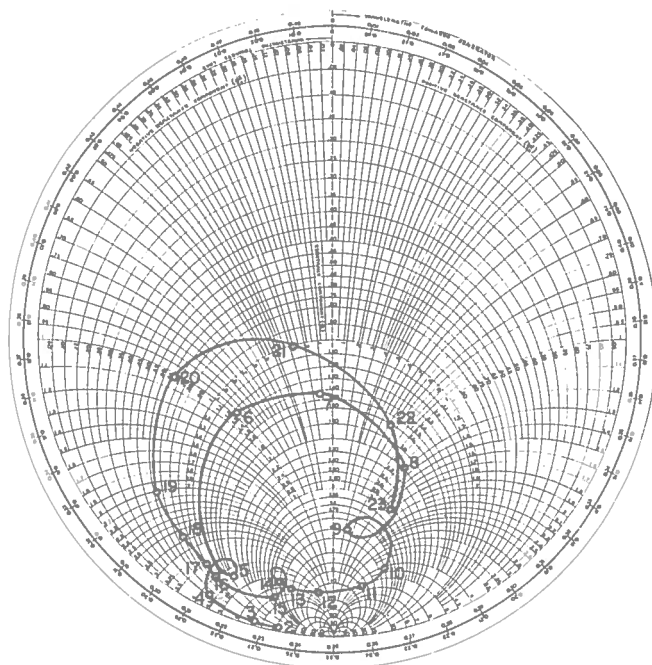
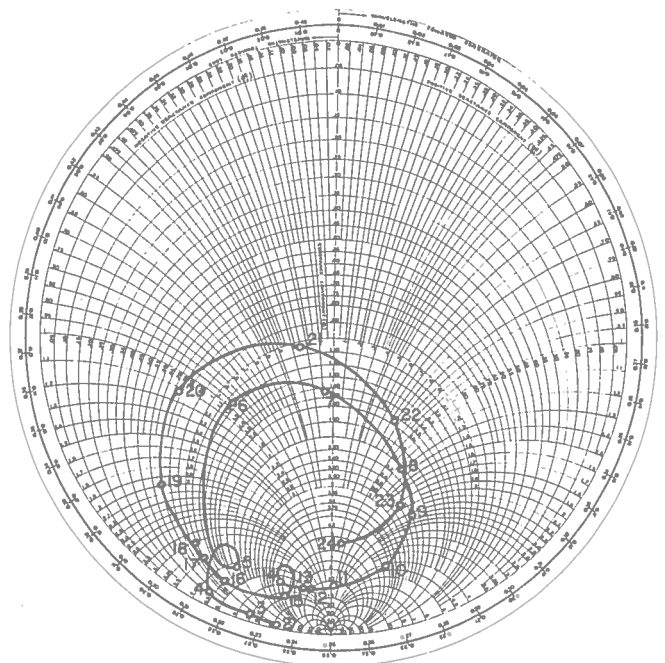


Figure 3 VSWR of monocone antenna; — without Tacan mast, --- with Tacan mast

Figure 4 shows the Smith impedance chart of the forward whip. As in the case of the monocone, the mast has virtually little or no effect on the whip impedance.



(a) WITH TACAN MAST



(b) WITHOUT TACAN MAST

Figure 4 Smith impedance chart of forward 35-foot whip

In an effort to minimize the mast effect on the funnel whips, the lattice tower was replaced with one made of fibreglas and the funnel whip measurements were repeated. Two sets of measurements were performed, one with the fibreglas mast only and the second with the addition of a simulated feed cable for the AN/URN-20 antenna located inside the mast. A plot of the VSWR for the two conditions is given in Fig. 5. The fibreglas mast itself has little effect on the whip VSWR; however, when the simulated feed cable is added, a larger increase in VSWR occurs between 12 and 16 MHz, due to a feed cable resonance. For comparison the VSWR is also given for the metal Tacan mast and the degradation in the antenna performance is clearly illustrated.

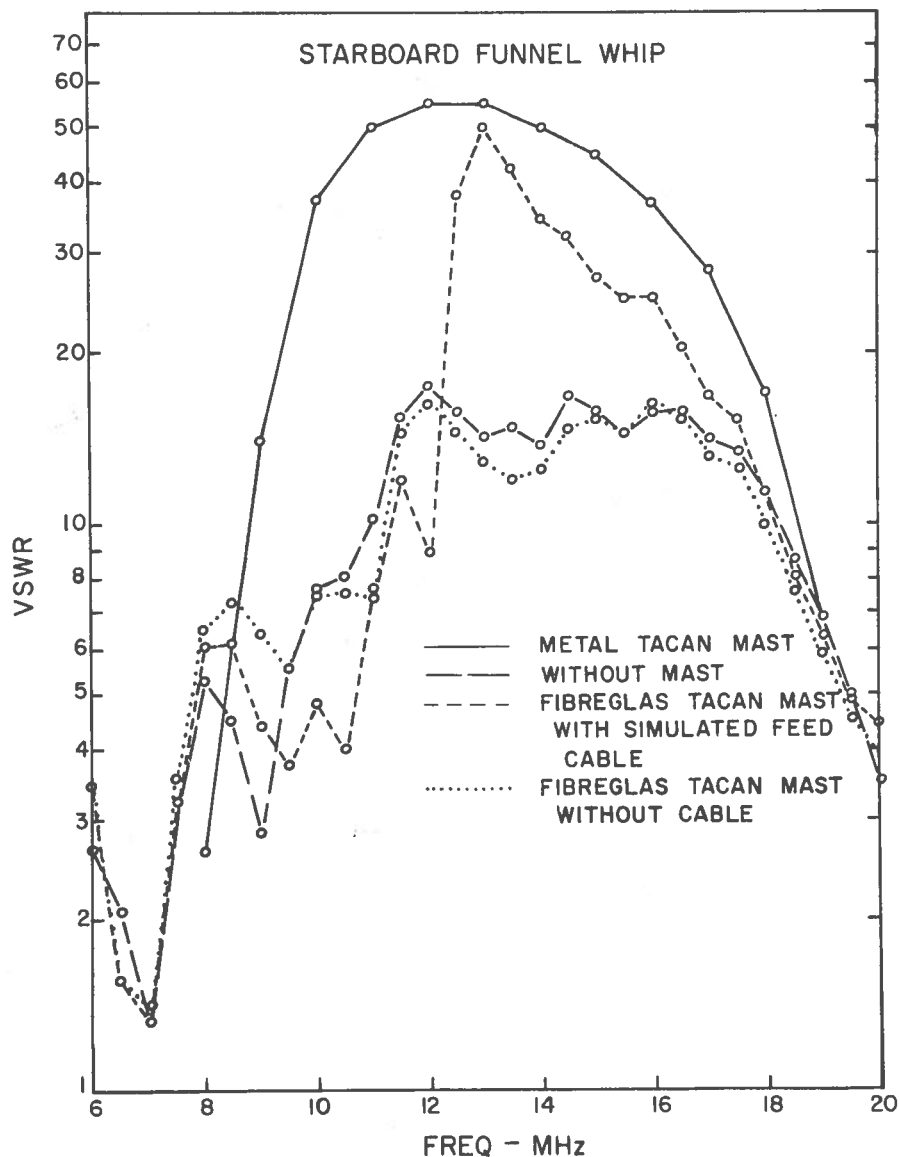


Figure 5 Effect of a fibreglas mast on the VSWR of the funnel whip



## Radiation Pattern Measurements

Three-dimensional patterns were obtained for all antennas. For each frequency both  $E_\theta$  and  $E_\phi$  components were measured for a 5-degree increment in  $\theta$ , but only the principal-plane patterns are included in this report. The figure of merit of each antenna is given in Figs. 6-10. In order to determine in greater detail the effect of the Tacan mast on the antenna patterns, a set of principal-plane patterns were measured for each antenna over the same frequencies with the mast removed. The results are summarized in Table I.

TABLE I

Antenna	Frequency MHz	Remarks
Monocone	3	For $\theta = 0^\circ$ pattern and with mast, 3 db more signal between $\phi = 160^\circ$ and $250^\circ$
	4	For $\theta = 0^\circ$ pattern and with mast, 3 db less signal between $\phi = 90^\circ$ and $270^\circ$
	5	For $\theta = 0^\circ$ pattern and with mast, a deep sharp null $>40$ db occurs at $\phi = 260^\circ$
Starboard funnel whip	4	For $\theta = 0^\circ$ pattern and with mast, null at $\phi = 65^\circ$ about 5 db deeper
	5	For $\theta = 0^\circ$ pattern and with mast, signal about 5 db higher between $\phi = 30^\circ$ and $200^\circ$ . Also more signal radiated overhead
	8 and 10	For $\theta = 0^\circ$ pattern large change in pattern shape. Also more signal radiated overhead
	12 to 24	Relatively minor changes in patterns
Forward whip	4	For $\theta = 0^\circ$ pattern and with mast, null at $\phi = 250^\circ$ increased from 20 db to 33 db
	5	For $\theta = 0^\circ$ pattern and with mast, null at $\phi = 100^\circ$ increased from 18 db to 28 db
	6	For $\theta = 0^\circ$ pattern and with mast null at $\phi = 220^\circ$ increased from 25 db to 33 db

## Conclusions

Model studies show that the proposed mast installation for the AN/URN-20 Tacan antenna will seriously affect the performance of the two adjacent funnel whip antennas. The impedance of the whips are changed drastically and the VSWR is increased significantly

between 9 MHz and 20 MHz. The effect of the mast on the monocone antenna and the forward whip is relatively minor and little degradation in electrical performance is expected. Insofar as the radiation patterns are concerned, the main effect of the mast is a general deterioration in the patterns due to spurious nulls.

### Reference

1. Wong, J.Y. A broad-band HF antenna system for the St. Laurent destroyer escort conversion class DDE205C. NRC report ERB-707, May 1965 (Confidential).

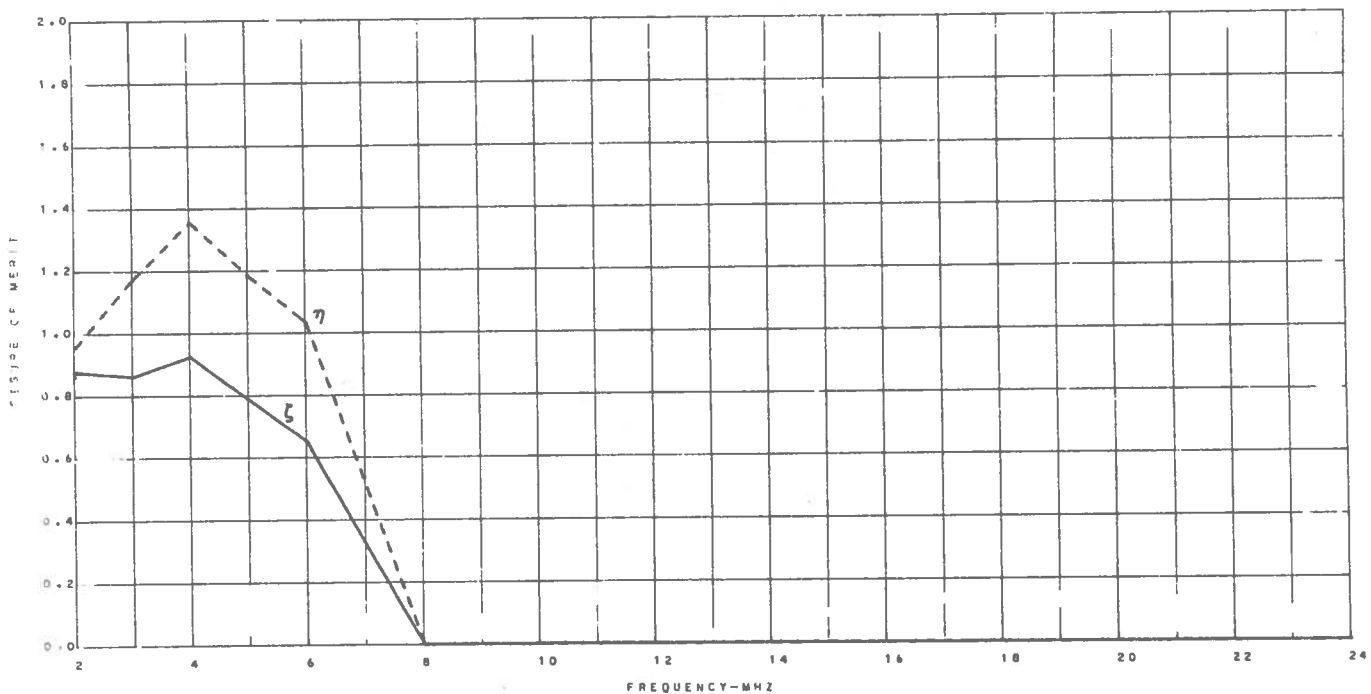


Figure 6 Figure of merit of monocone antenna

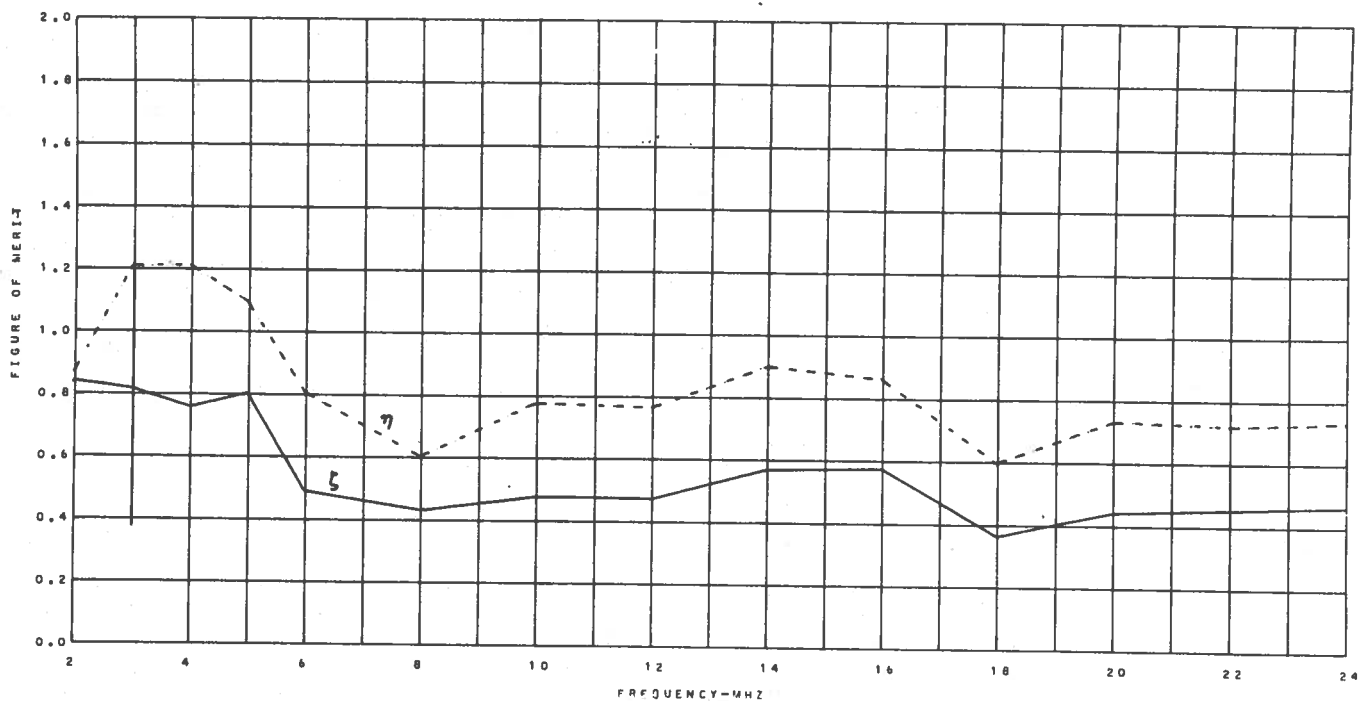


Figure 7 Figure of merit of starboard 35-foot whip

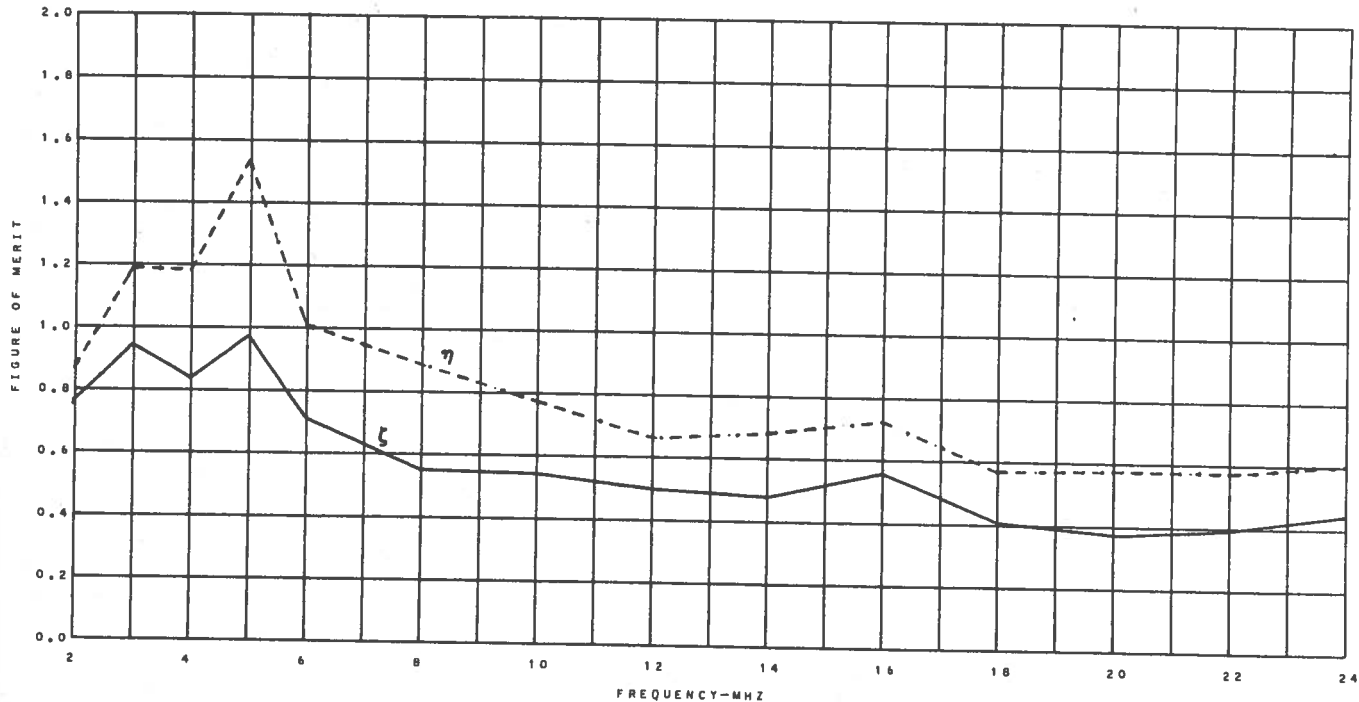


Figure 8 Figure of merit of forward 35-foot whip

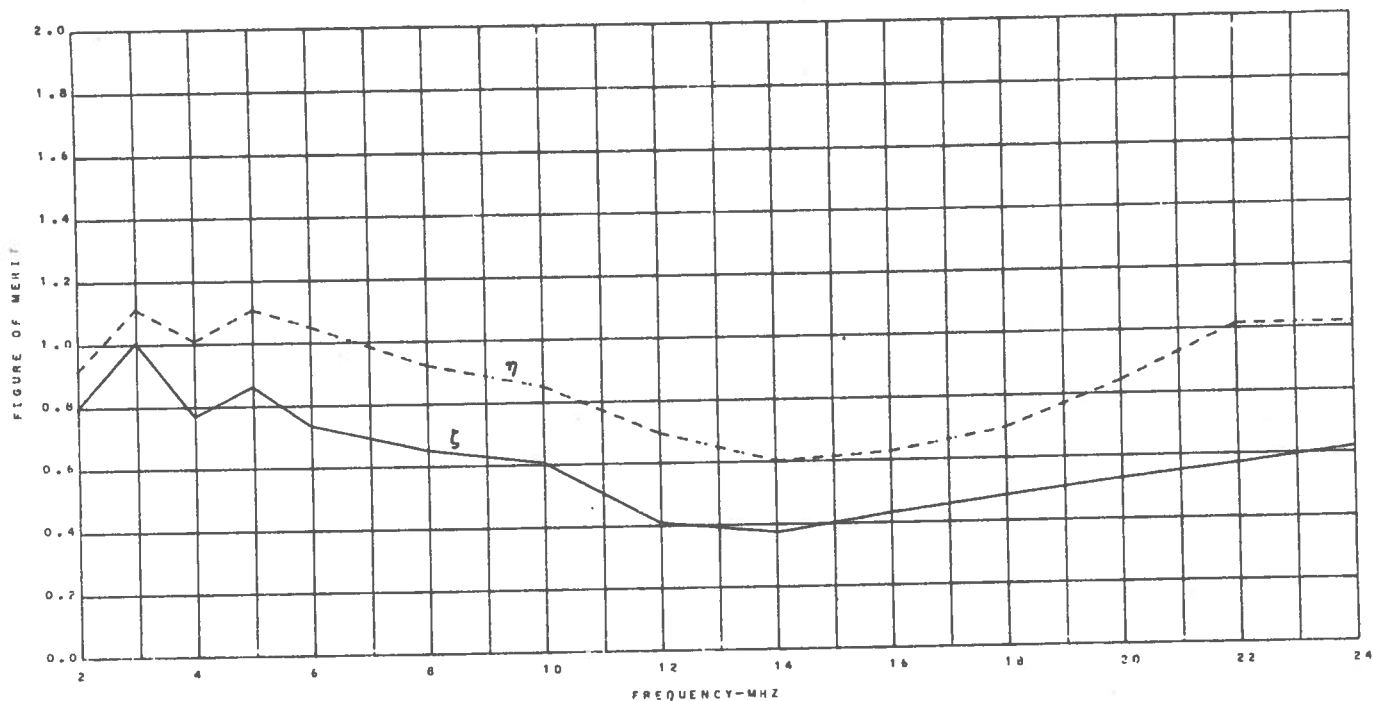


Figure 9 Figure of merit of forward receiving fan

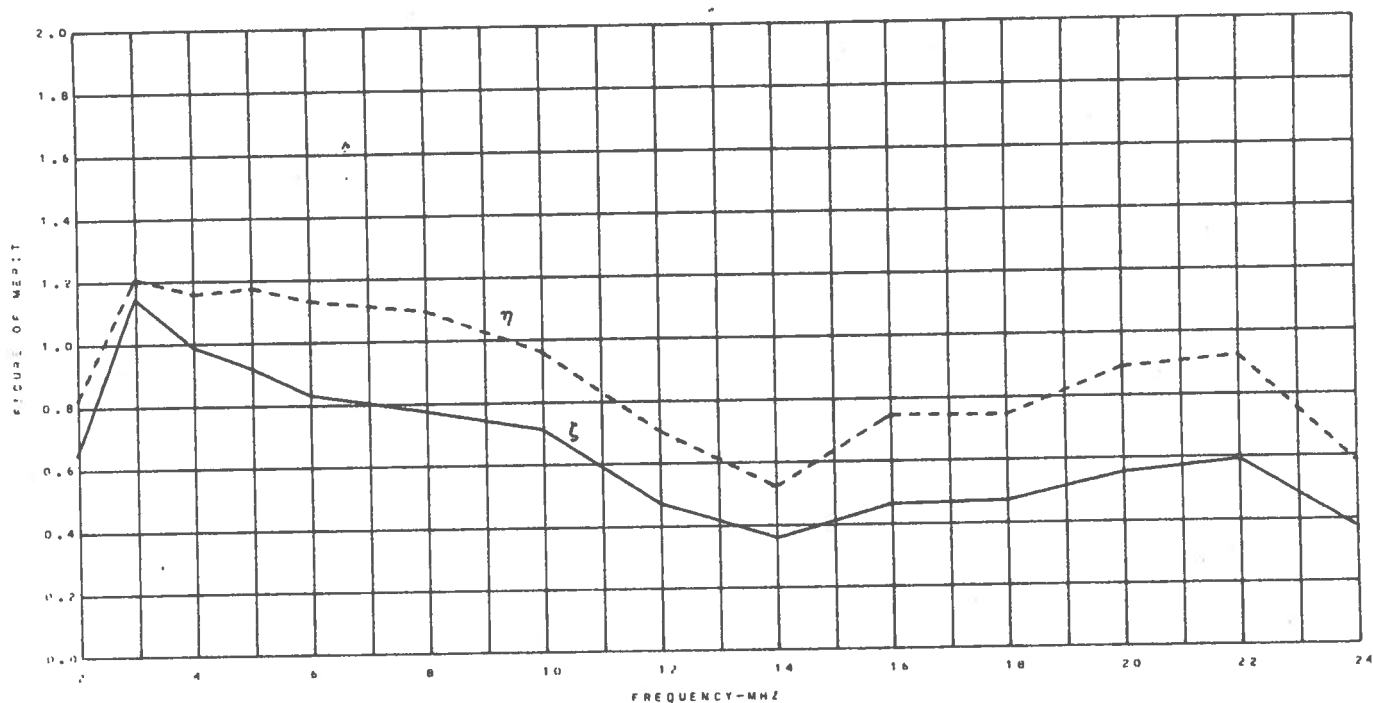
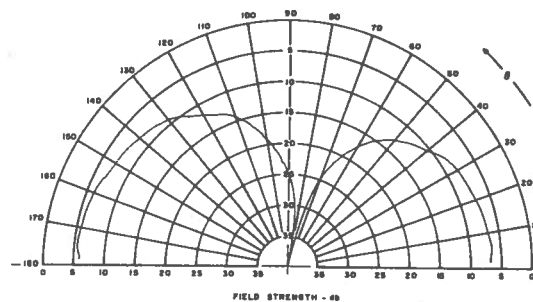


Figure 10 Figure of merit of aft receiving fan

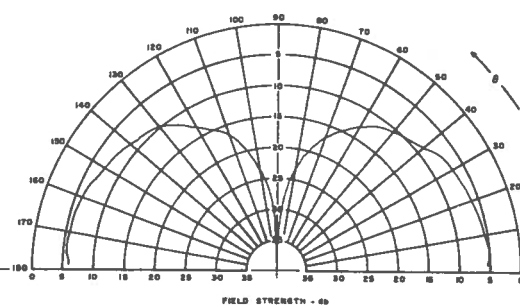
Confidential

## **RADIATION PATTERNS**

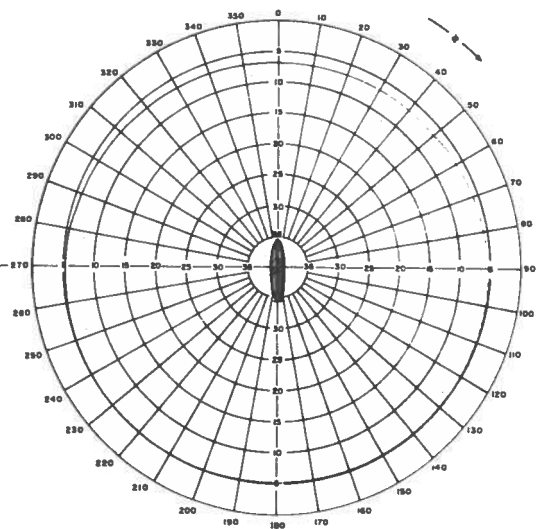
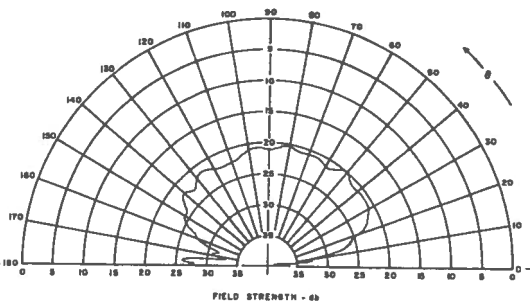
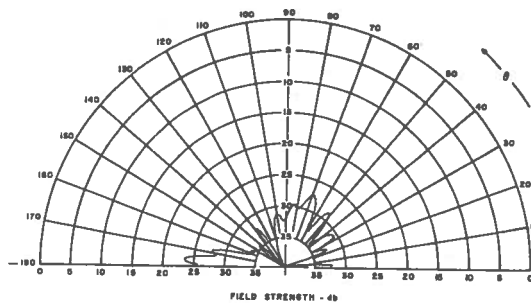
### **1. Monocone antenna**

$E_{\theta}$ 

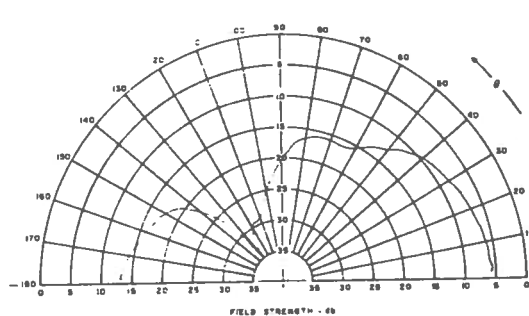
FWD-AFT



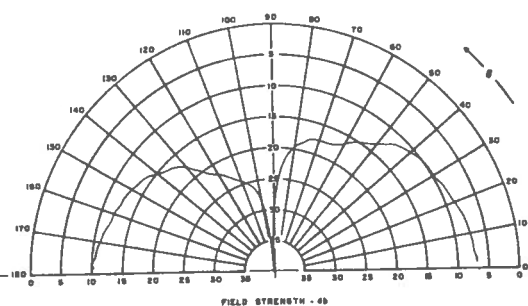
PORT-STBD

 $\theta = 0^\circ$  $E_{\phi}$ 

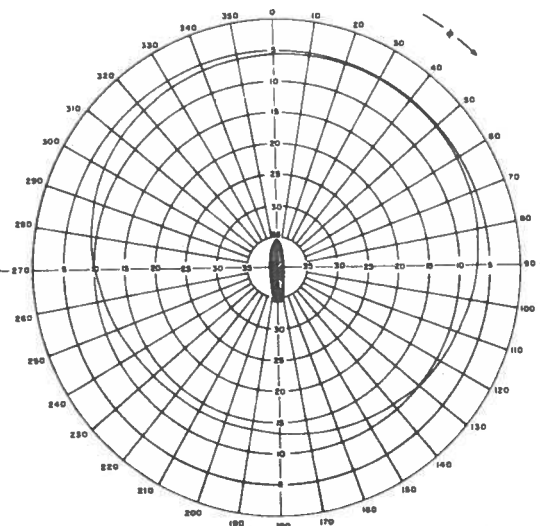
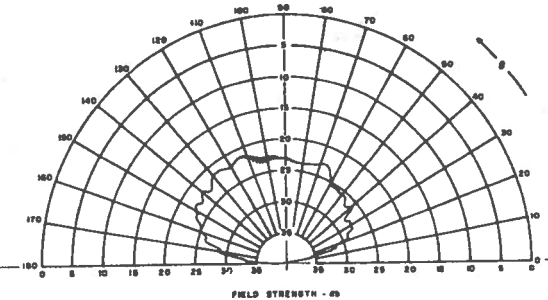
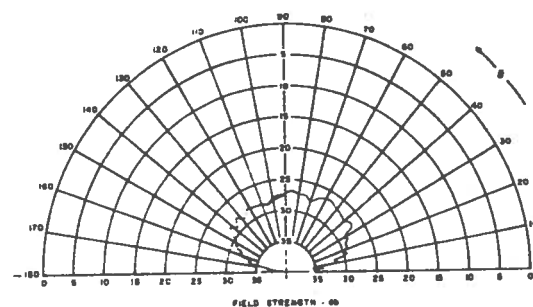
MODEL : DDH - 205  
ANTENNA : MONOCONIC  
FREQ. : 2 MHz.  
REMARKS : WITH TACAN MAST

$E_\theta$ 

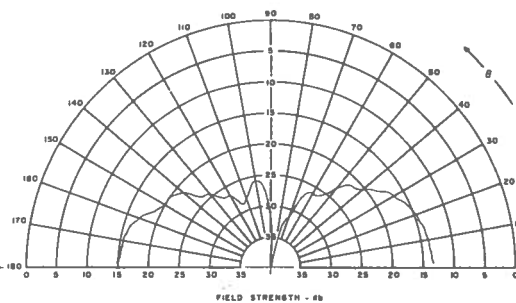
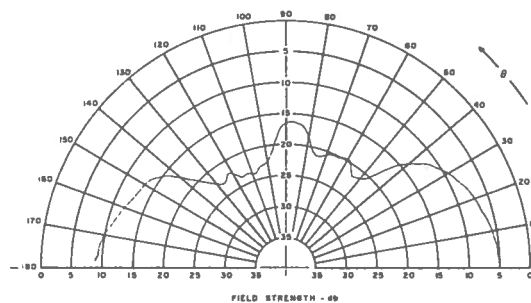
FWD-AFT



PORT-STBD

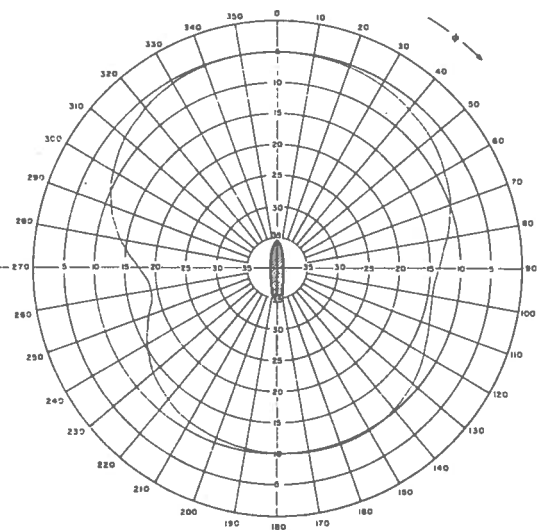
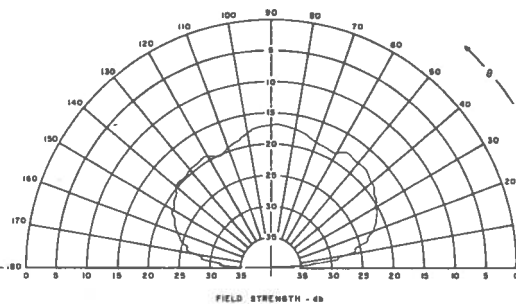
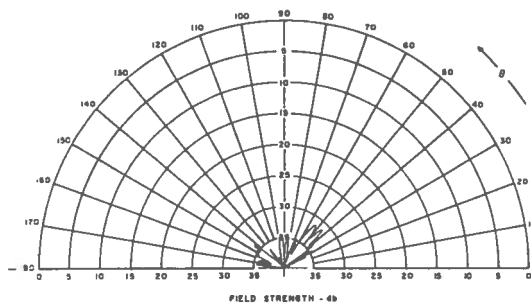
 $\theta = 0^\circ$  $E_\phi$ 

MODEL : DDH - 205  
ANTENNA : MONOCONE  
FREQ. : 3 MHz.  
REMARKS : WITH TACAN MAST

$E_{\theta}$ 

FWD-AFT

PORT-STBD

 $E_{\phi}$ 

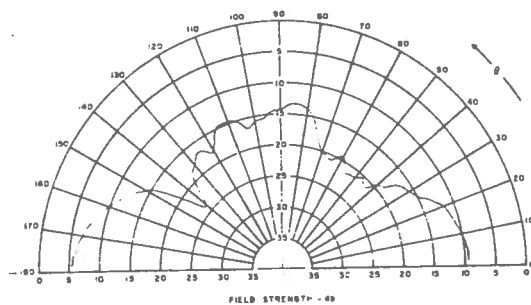
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ANTENNA : MONOCONe

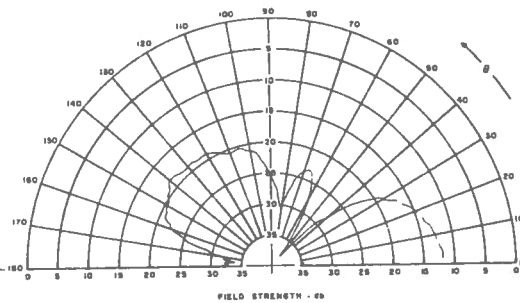
FREQ. : 4 MHz.

REMARKS : WITH TACAN MAST

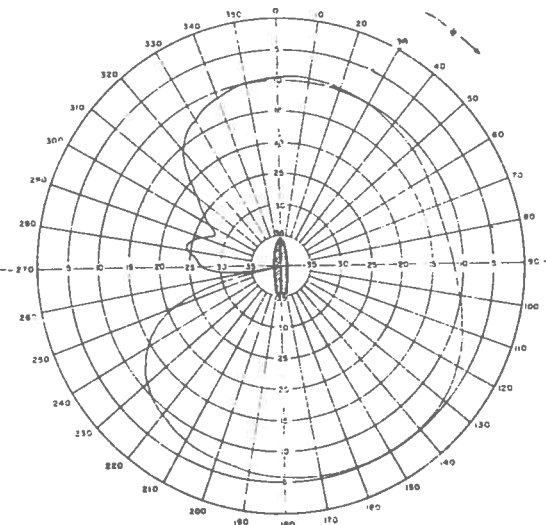
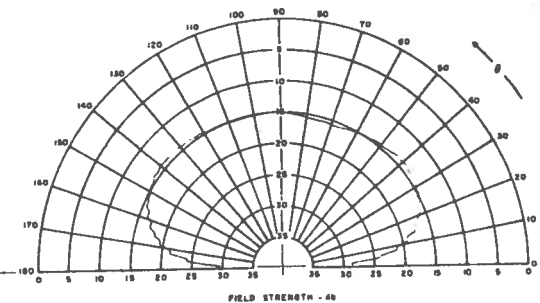
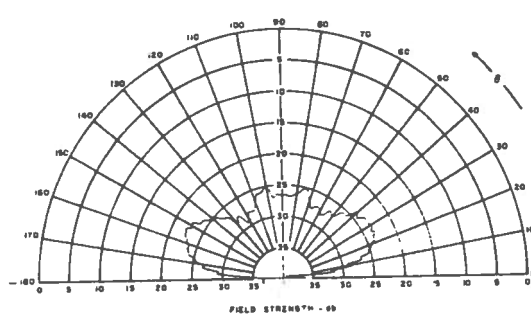


$E_{\theta}$ 

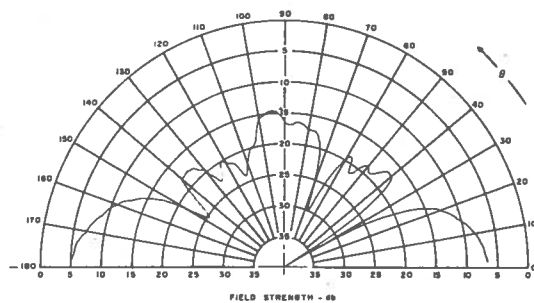
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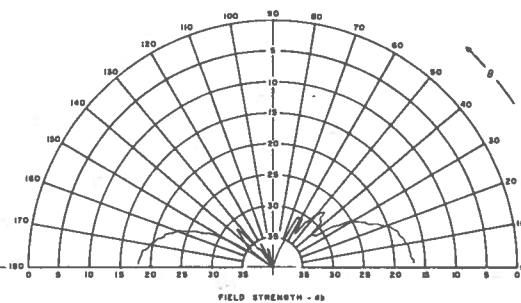
PORT-STBD

 $E_{\phi}$ 

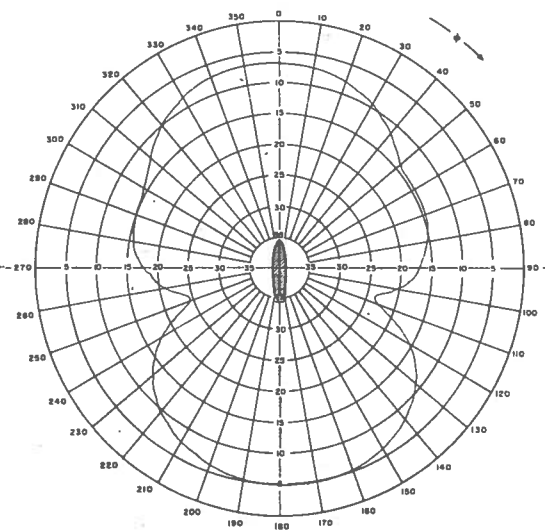
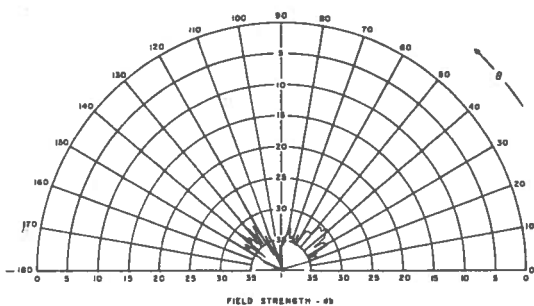
MODEL : DDH-205  
 ANTENNA : MONOCONE  
 FREQ. : 5 MHz.  
 REMARKS : WITH TACAN MAST

$E_\theta$ 

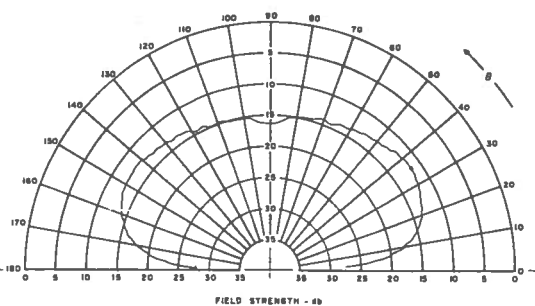
FWD-AFT



PORT-STBD

 $\theta = 0^\circ$  $E_\phi$ 

FIELD STRENGTH - dB

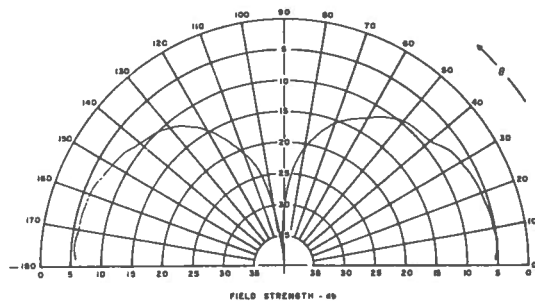


FIELD STRENGTH - dB

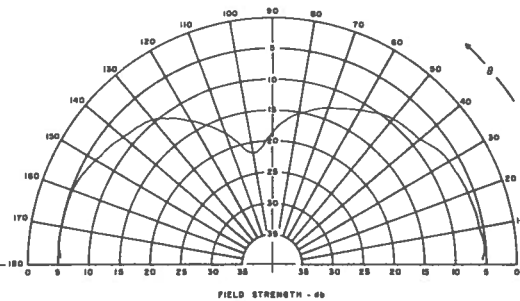
MODEL : DDH - 205  
ANTENNA : MONOCONE  
FREQ. : 6 MHz.  
REMARKS : WITH TACAN MAST

## **RADIATION PATTERNS**

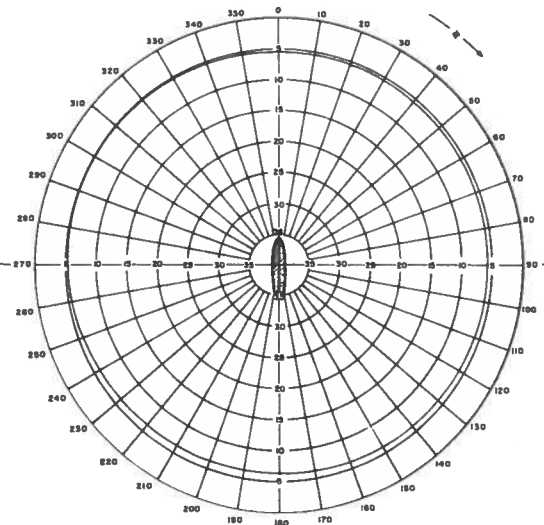
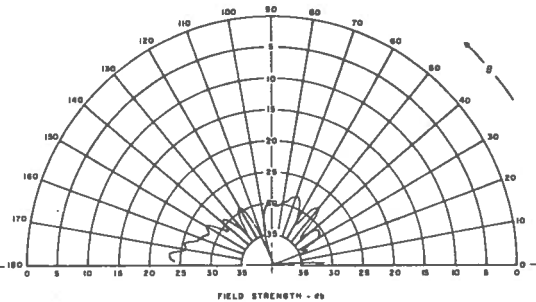
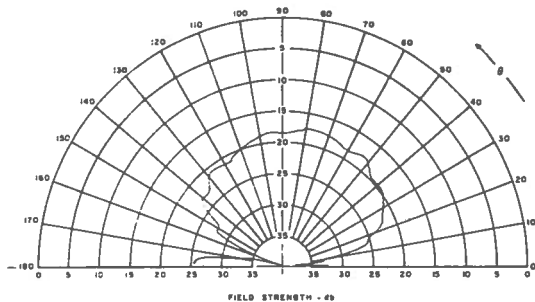
### **2. Starboard funnel 35-foot whip**

$E_{\theta}$ 

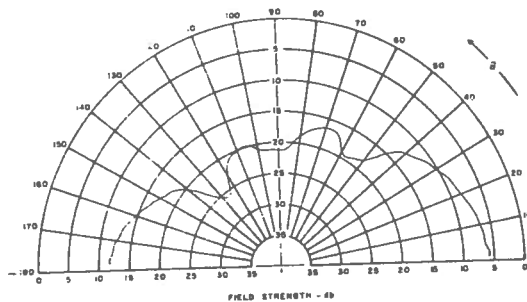
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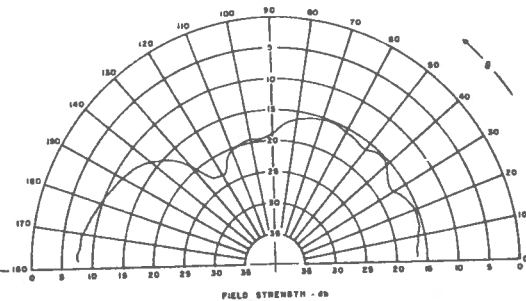
PORT-STBD

 $\theta = 0^\circ$  $E_{\phi}$ 

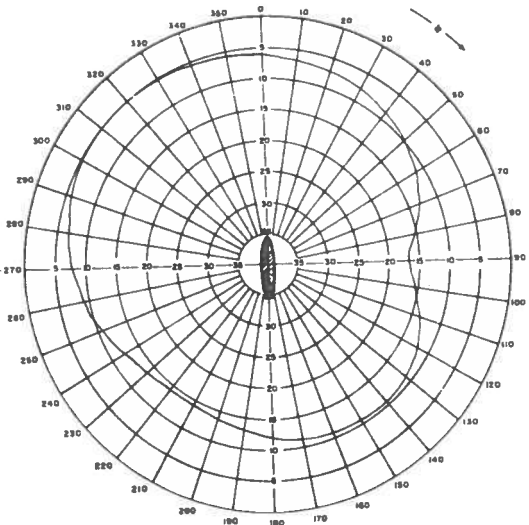
MODEL : DDH - 205  
ANTENNA : STBD FUNNEL WHIP  
FREQ. : 2 MHz.  
REMARKS : WITH TACAN MAST

$E_\theta$ 

FIELD STRENGTH - dB

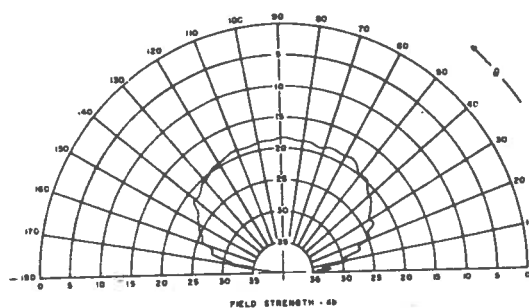


FIELD STRENGTH - dB

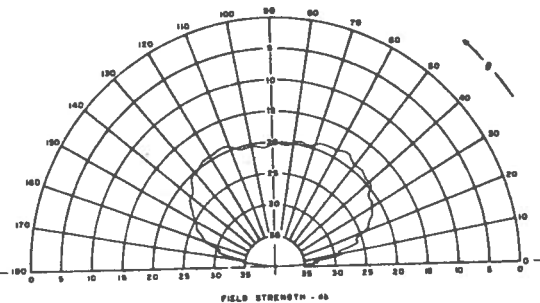
 $\theta = 0^\circ$ 

FWD-AFT

PORT-STBD

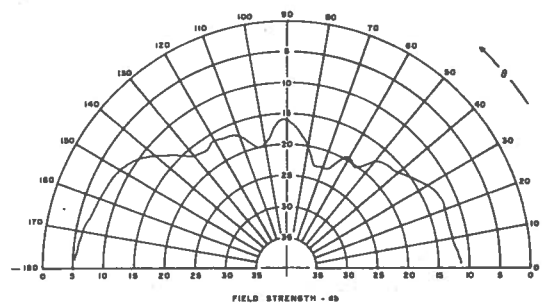
 $E_\phi$ 

FIELD STRENGTH - dB

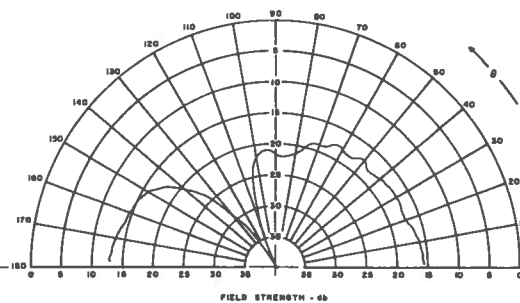


FIELD STRENGTH - dB

MODEL : DDH-205  
 ANTENNA : STBD FUNNEL WHIP  
 FREQ. : 3 MHz.  
 REMARKS : WITH TACAN MAST

$E_{\theta}$ 

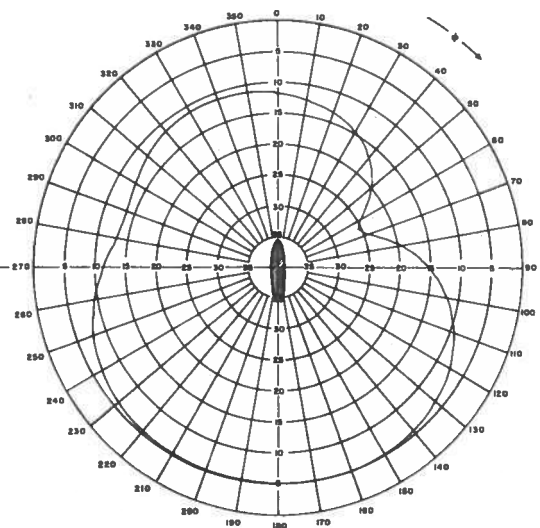
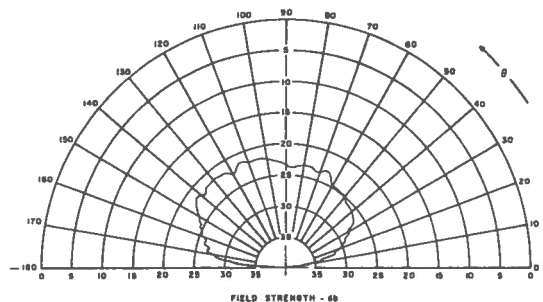
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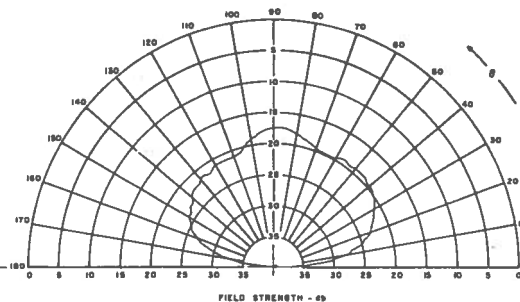
FIELD STRENGTH - dB

FWD-AFT

PORT-STBD

 $\theta = 0^\circ$  $E_{\phi}$ 

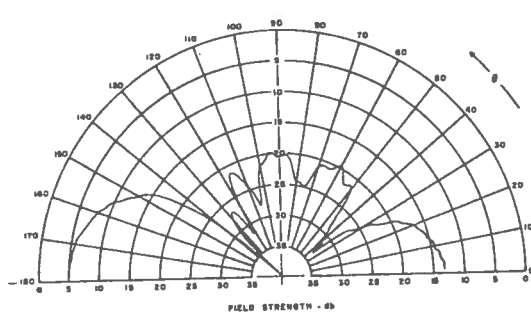
FIELD STRENGTH - dB



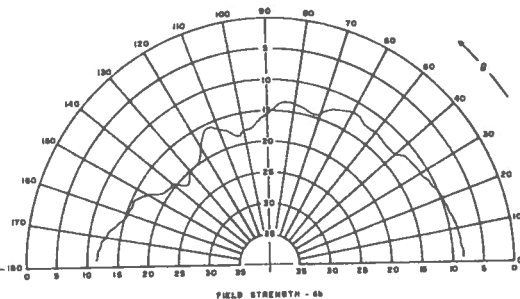
FIELD STRENGTH - dB

MODEL : DDH - 205  
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 FREQ. : 4 MHz.  
 REMARKS : WITH TACAN MAST

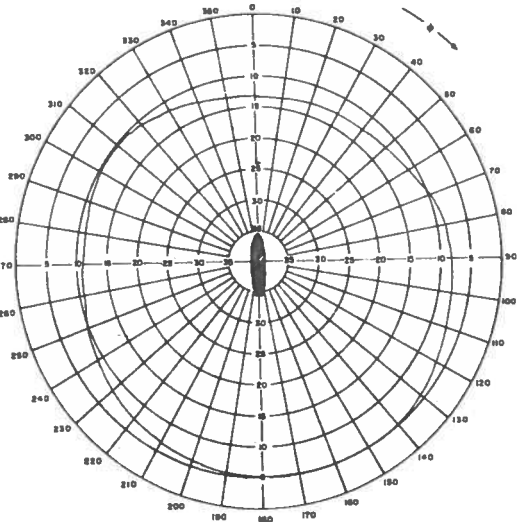
$E_{\theta}$



FWD-AFT

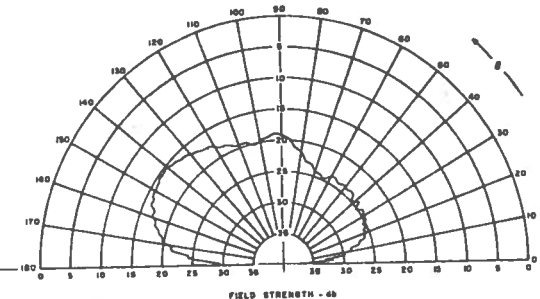
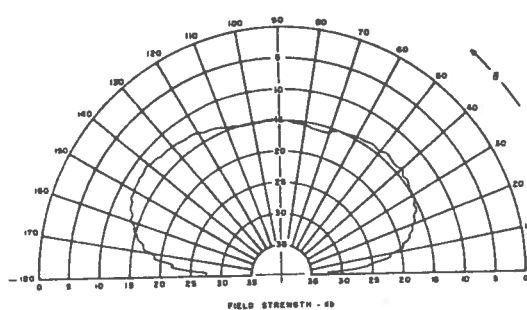


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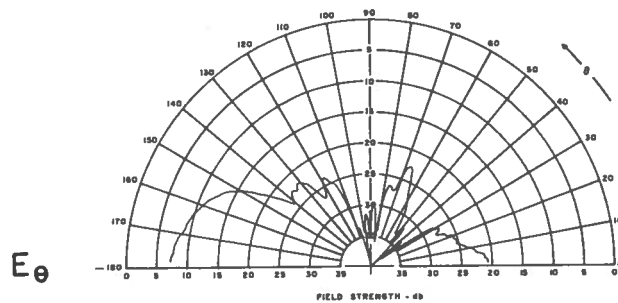


$\theta = 0^\circ$

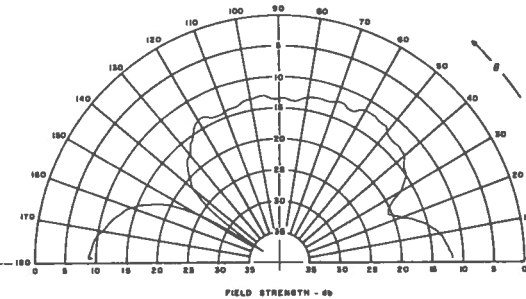
$E_{\phi}$



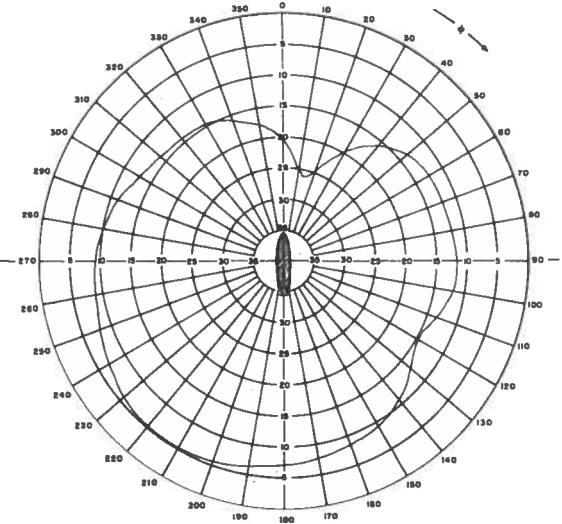
MODEL : DDH-205  
ANTENNA : STBD FUNNEL WHIP  
FREQ. : 5 MHz.  
REMARKS : WITH TACAN MAST



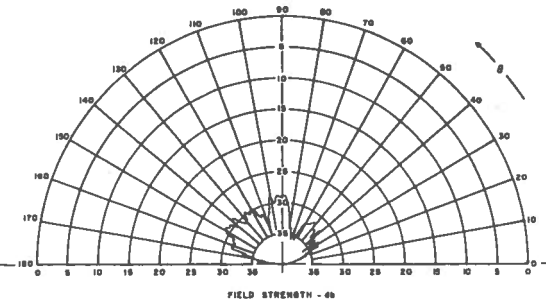
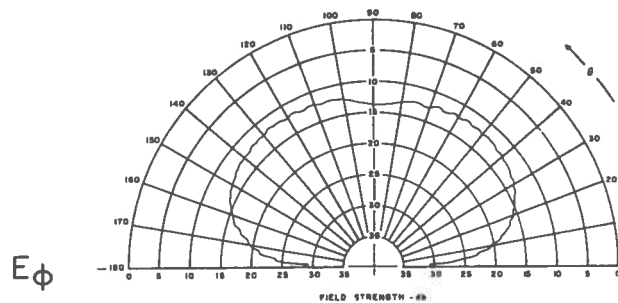
FWD-AFT



PORT-STBD

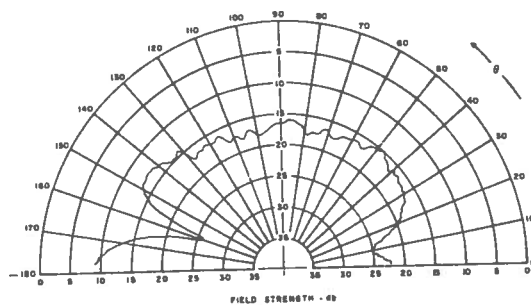


$\theta = 0^\circ$

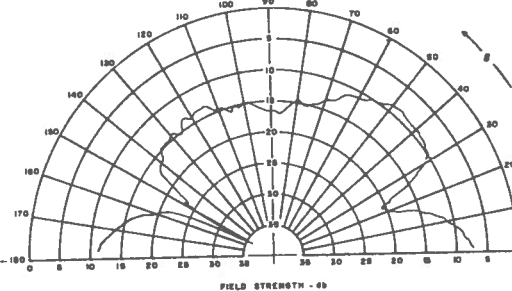


MODEL : DDH - 205  
 ANTENNA : STBD FUNNEL WHIP  
 FREQ. : 6 MHz.  
 REMARKS : WITH TACAN MAST

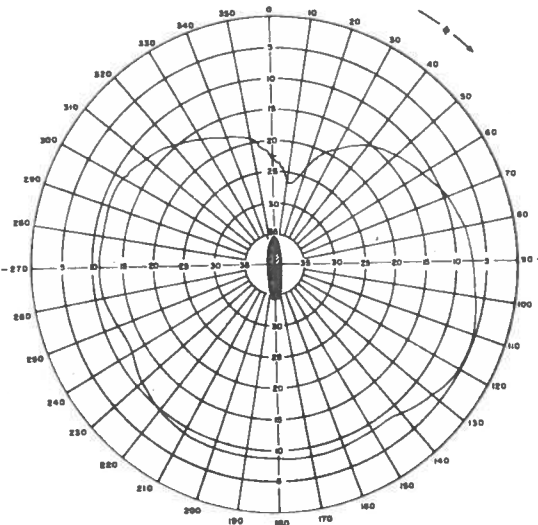
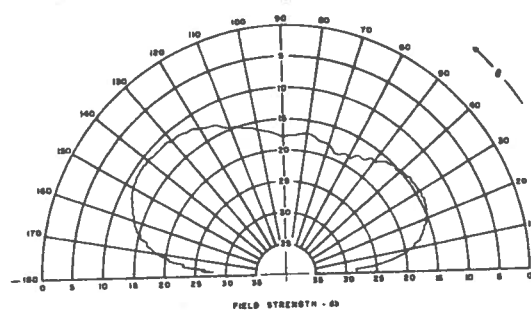


$E_{\theta}$ 

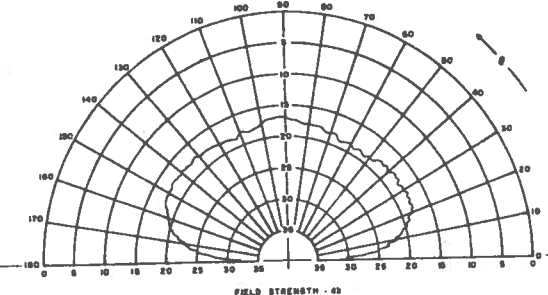
FWD-AFT



PORT-STBD

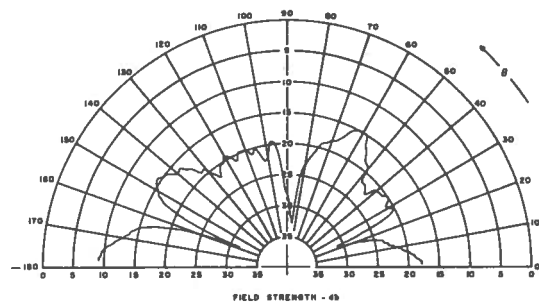
 $\theta = 0^\circ$  $E_{\phi}$ 

FIELD STRENGTH - dB

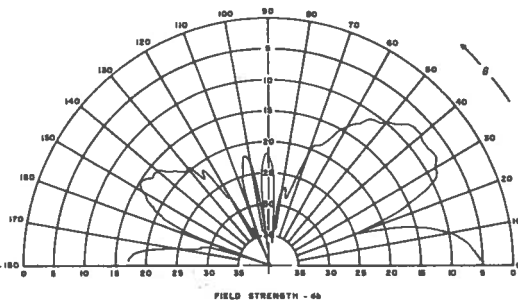


FIELD STRENGTH - dB

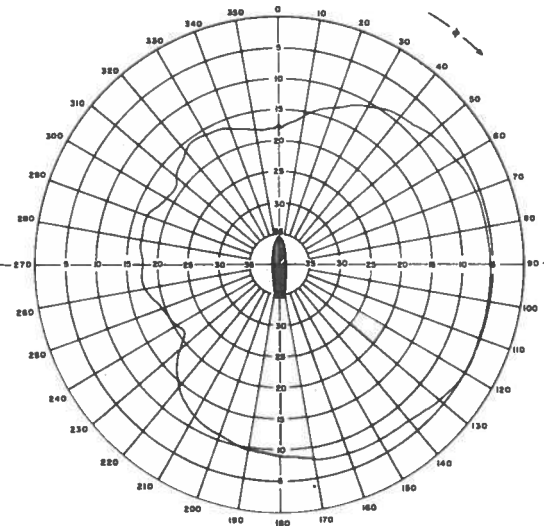
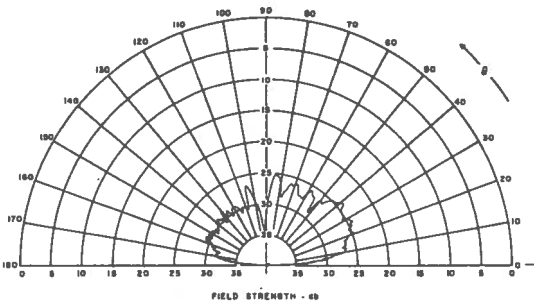
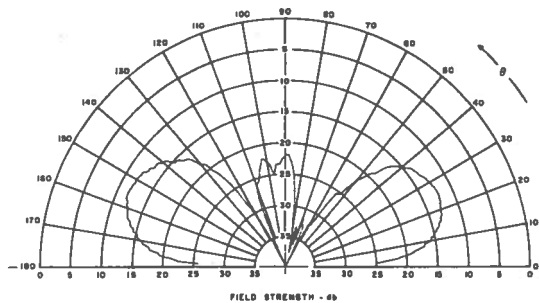
MODEL : DDH-205  
 ANTENNA : STBD FUNNEL WHIP  
 FREQ. : 8 MHz.  
 REMARKS : WITH TACAN MAST

$E_\theta$ 

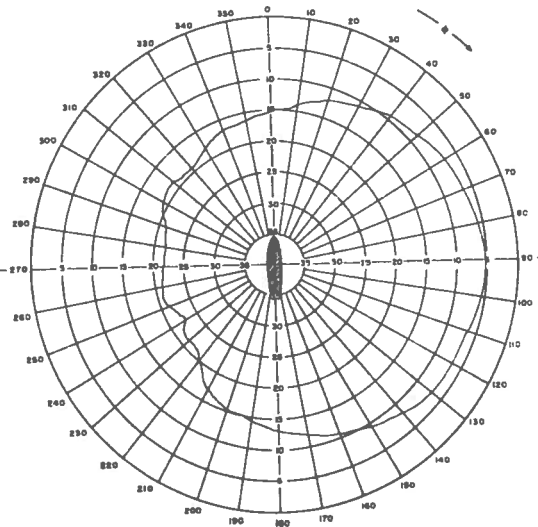
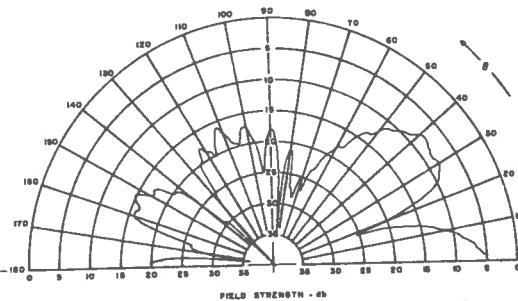
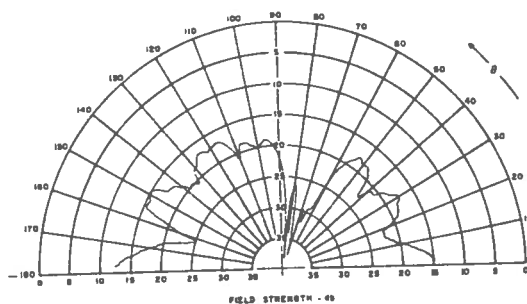
FWD-AFT



PORT-STBD

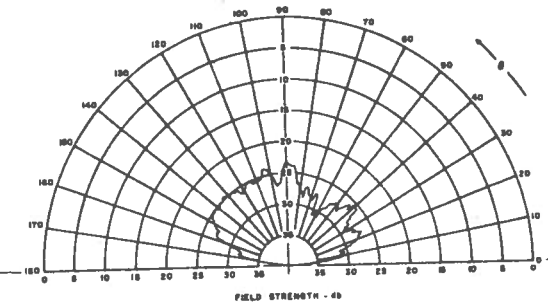
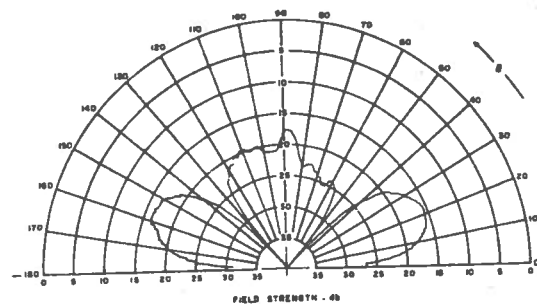
 $E_\phi$ 

MODEL : DDH - 205  
 ANTENNA : STBD FUNNEL WHIP  
 FREQ. : 10 MHz.  
 REMARKS : WITH TACAN MAST

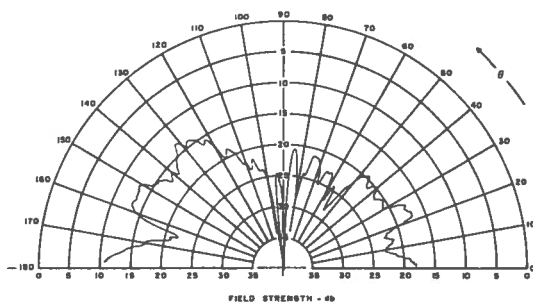
$E_{\theta}$ 

FWD-AFT

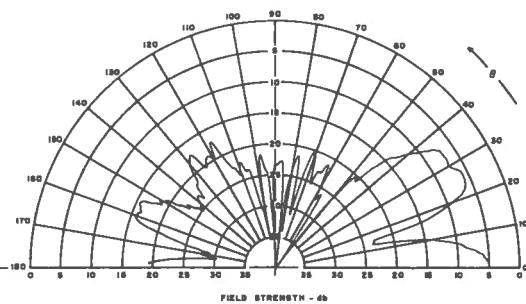
PORT-STBD

 $\theta = 0^\circ$  $E_{\phi}$ 

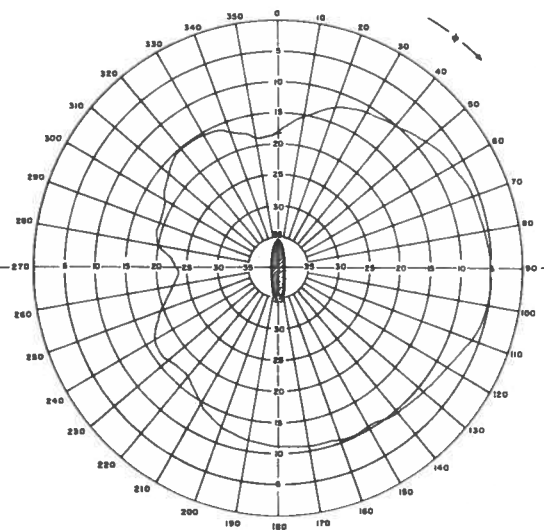
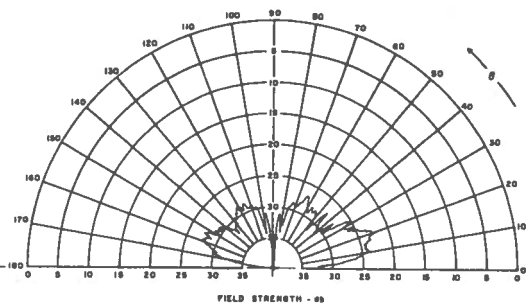
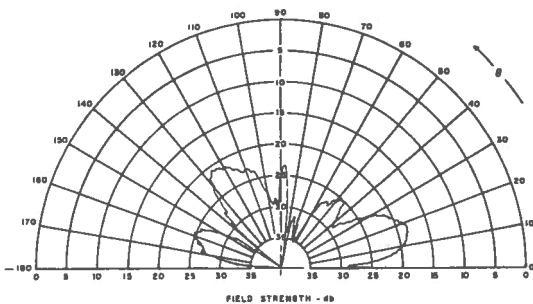
MODEL : DDH-205  
ANTENNA : STBD FUNNEL WHIP  
FREQ. : 12 MHz.  
REMARKS : WITH TACAN MAST

$E_{\theta}$ 

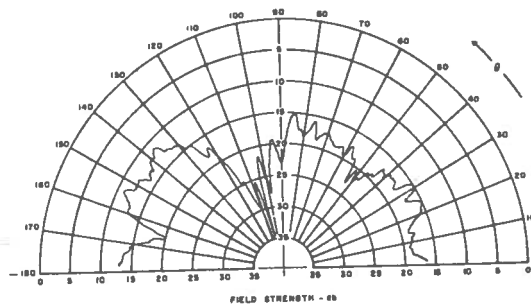
FWD-AFT



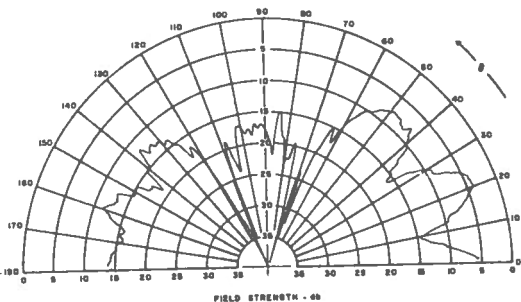
PORT-STBD

 $\theta = 0^\circ$  $E_{\phi}$ 

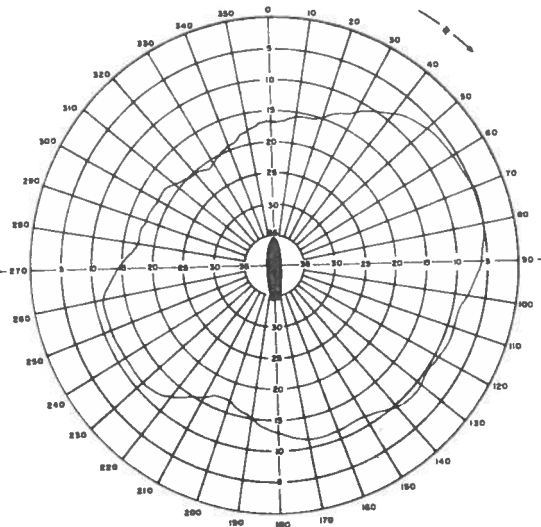
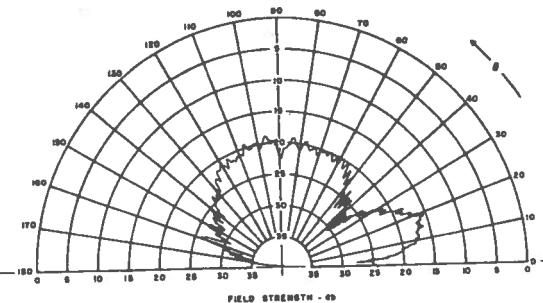
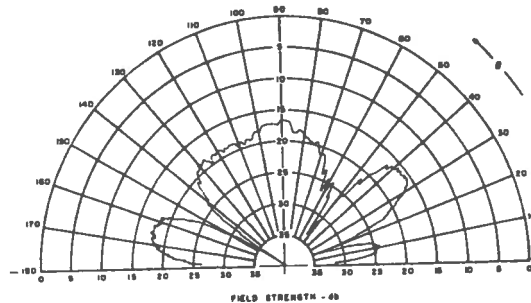
MODEL : DDH-205  
ANTENNA : STBD FUNNEL WHIP  
FREQ. : 14 MHz.  
REMARKS : WITH TACAN MAST

$E_{\theta}$ 

FWD-AFT



PORT-STBD

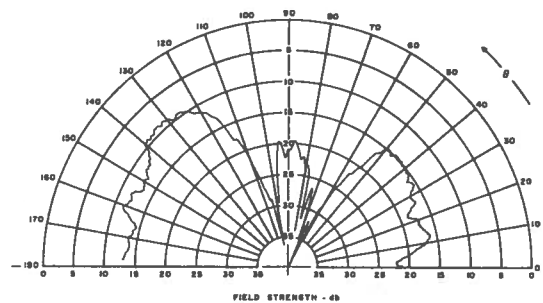
 $\theta = 0^\circ$  $E_{\phi}$ 

MODEL : DDH-205

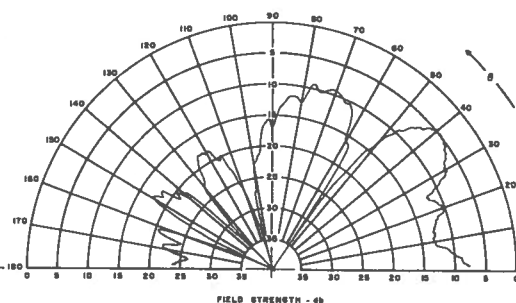
ANTENNA : STBD FUNNEL WHIP

FREQ. : 16 MHz.

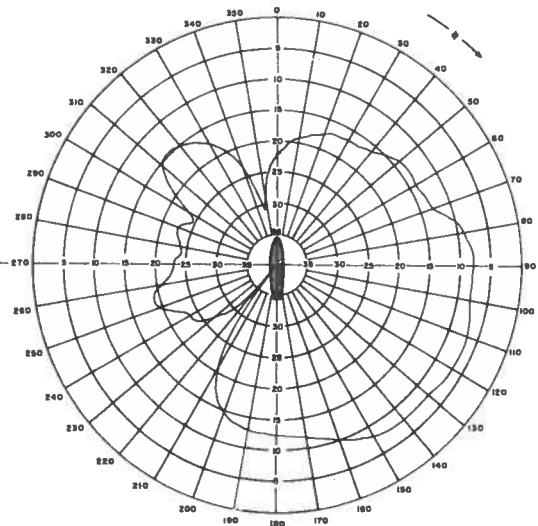
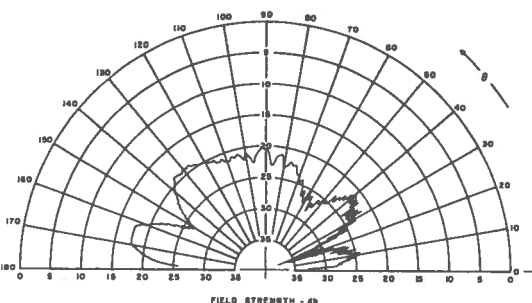
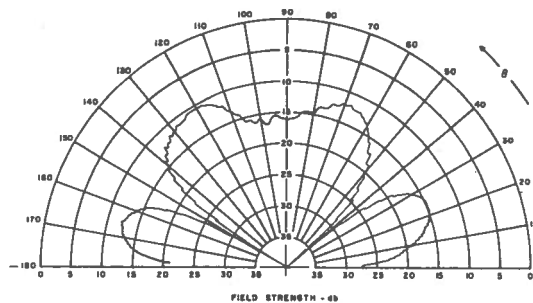
REMARKS : WITH TACAN MAST

$E_{\theta}$ 

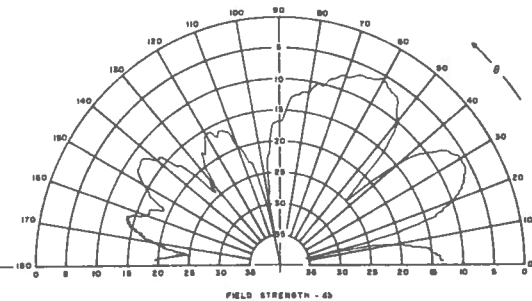
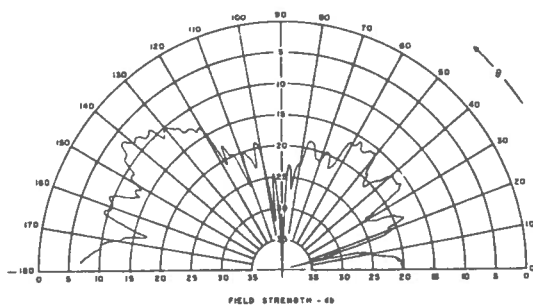
FWD-AFT



PORT-STBD

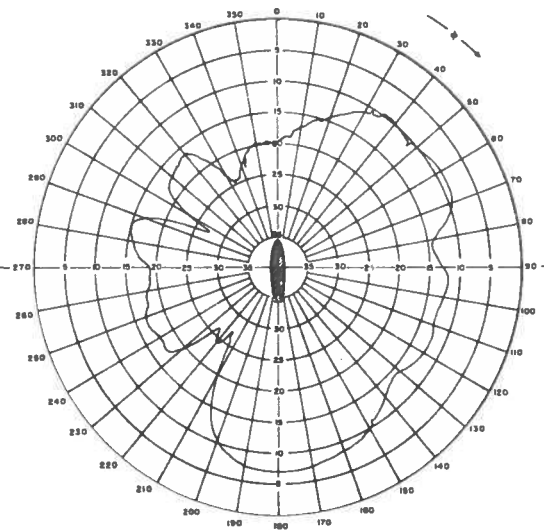
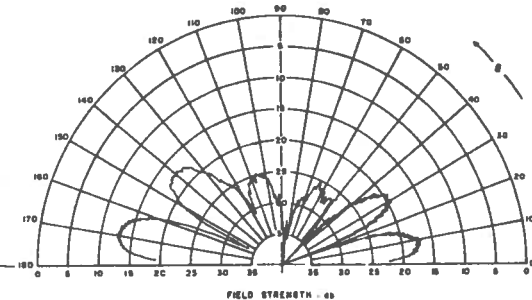
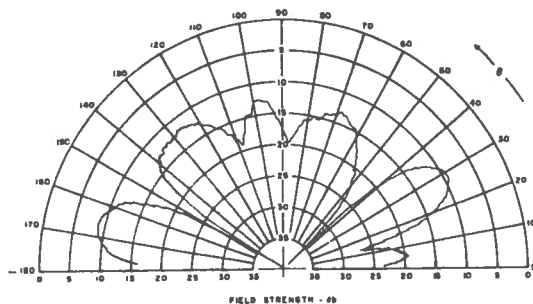
 $E_{\phi}$ 

MODEL : DDH - 205  
 ANTENNA : STBD FUNNEL WHIP  
 FREQ. : 18 MHz.  
 REMARKS : WITH TACAN MAST

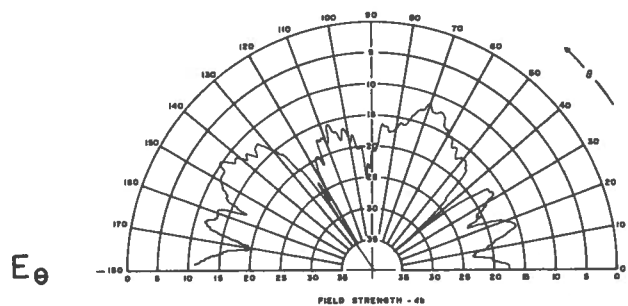
$E_{\theta}$ 

FWD-AFT

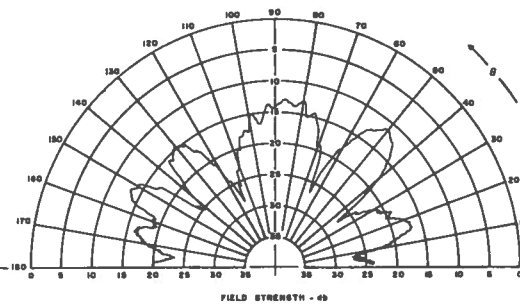
PORT-STBD

 $\theta = 0^\circ$  $E_{\phi}$ 

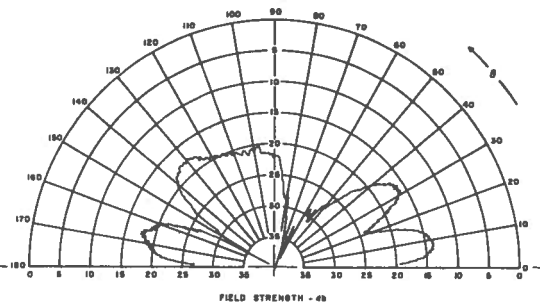
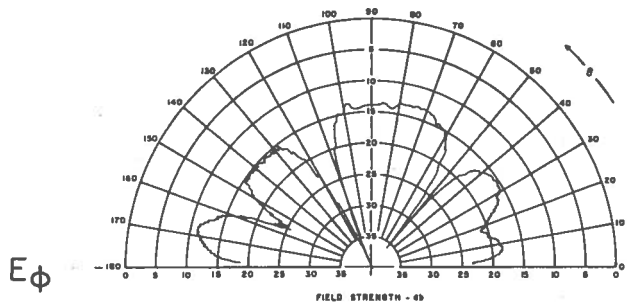
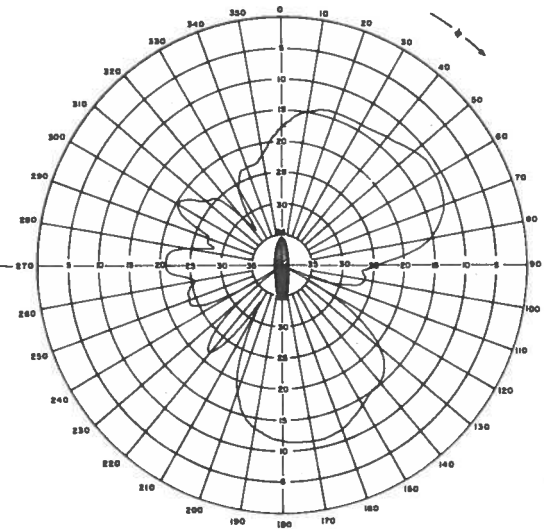
MODEL : DDH-205  
 ANTENNA : STBD FUNNEL WHIP  
 FREQ. : 20 MHz.  
 REMARKS : WITH TACAN MAST



FWD-AFT

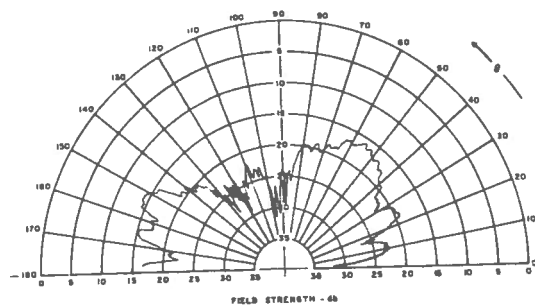


PORT-STBD

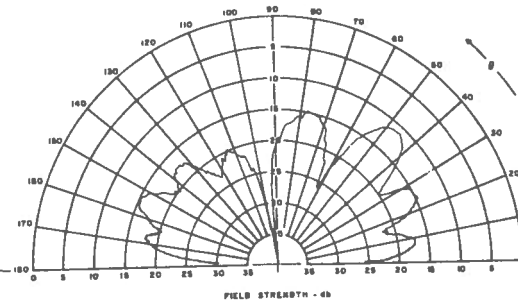


MODEL : DDH - 205  
 ANTENNA : STBD FUNNEL WHIP  
 FREQ. : 22 MHz.  
 REMARKS : WITH TACAN MAST

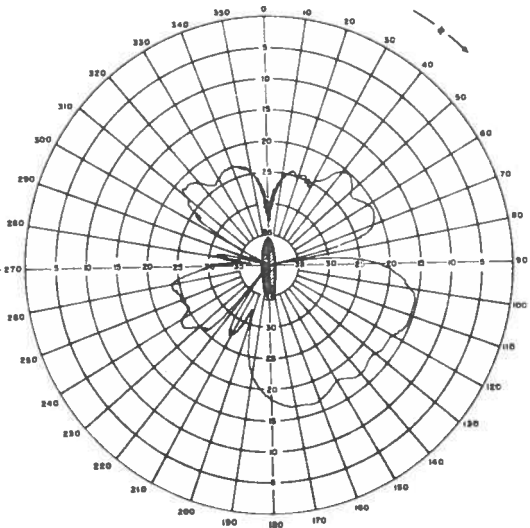
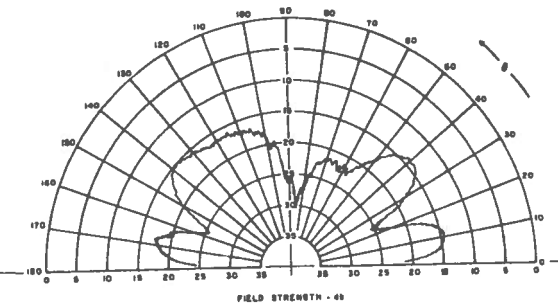
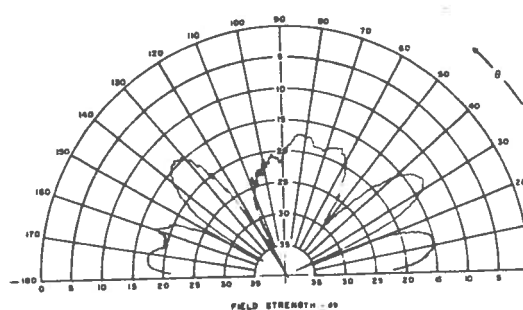


$E_{\theta}$ 

FWD-AFT



PORT-STBD

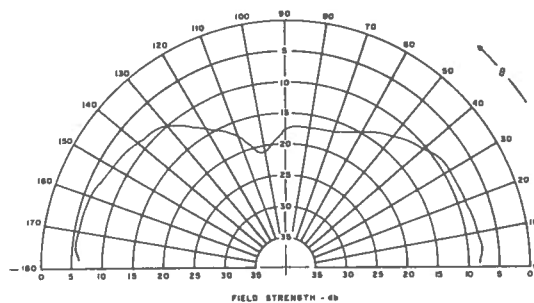
 $\theta = 0^\circ$  $E_{\phi}$ 

MODEL : DDH-205  
ANTENNA : STBD FUNNEL WHIP  
FREQ. : 24 MHz.  
REMARKS : WITH TACAN MAST

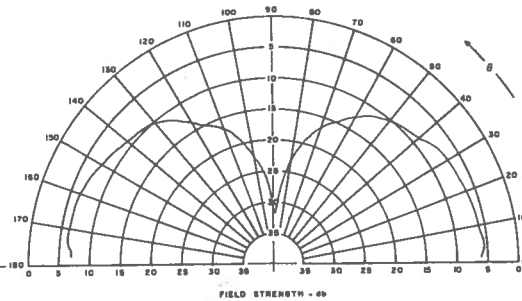
**Confidential**

## **RADIATION PATTERNS**

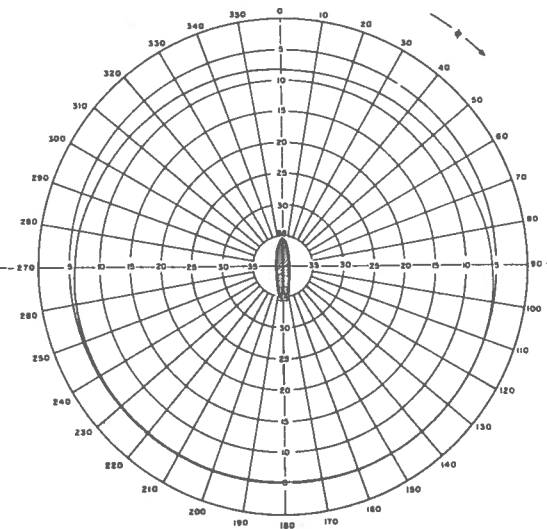
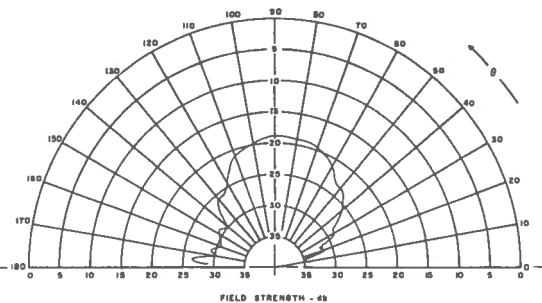
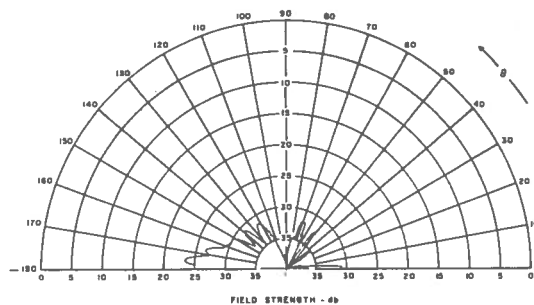
### **3. Forward 35-foot whip**

$E_\theta$ 

FWD-AFT

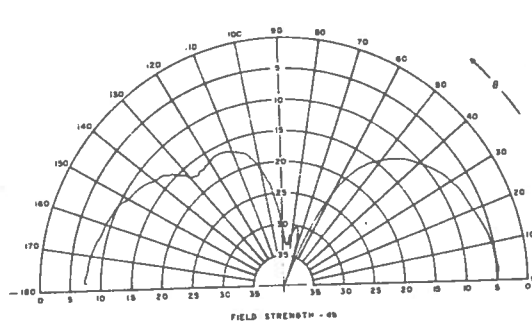


PORT-STBD

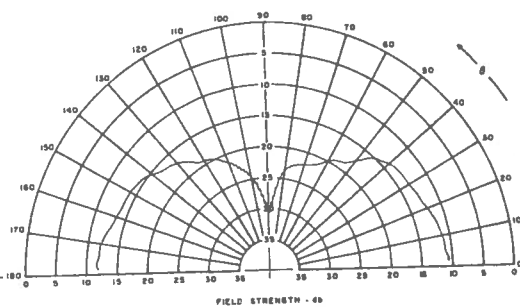
 $\theta = 0^\circ$  $E_\phi$ 

MODEL : DDH-205  
 ANTENNA : FWD WHIP  
 FREQ. : 2 MHz.  
 REMARKS : WITH TACAN MAST

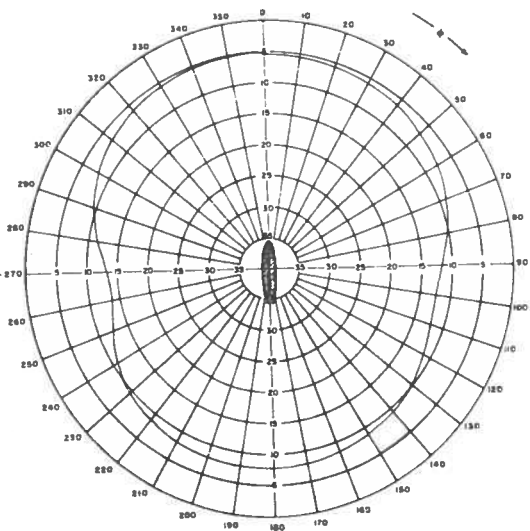
$E_{\theta}$



FWD-AFT



PORT-STBD



$\theta = 0^\circ$

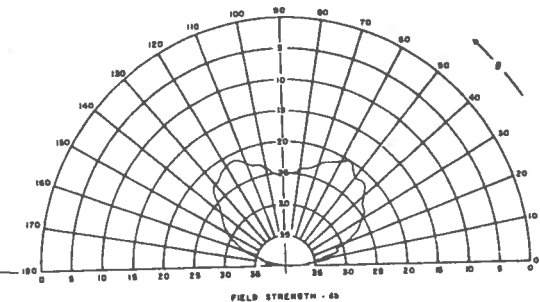
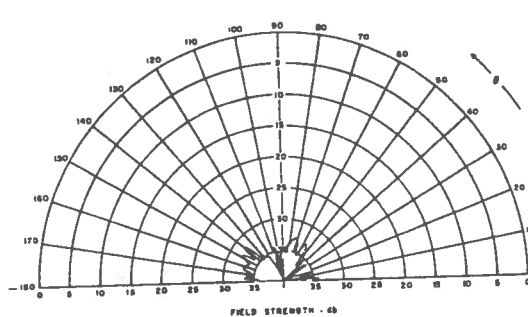
MODEL : DDH-205

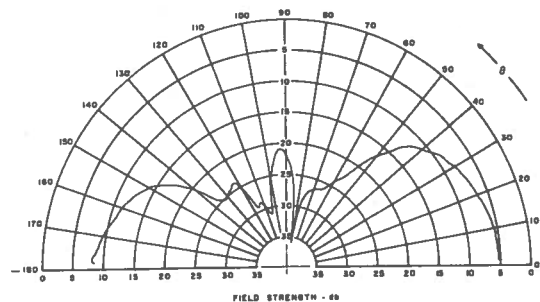
ANTENNA : FWD WHIP

FREQ. : 3 MHz.

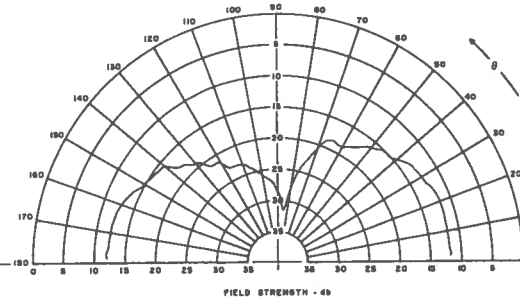
REMARKS : WITH TACAN MAST

$E_{\phi}$

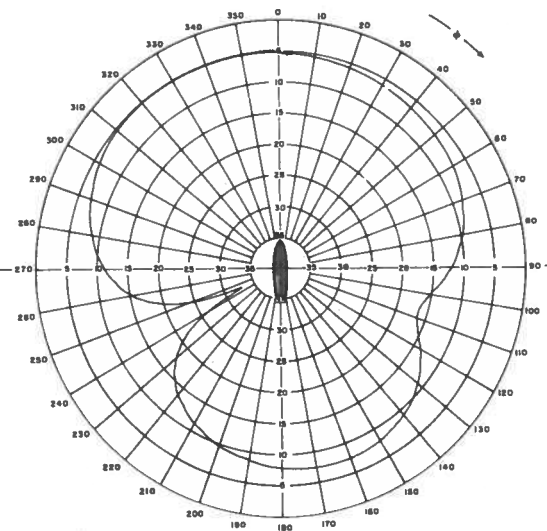
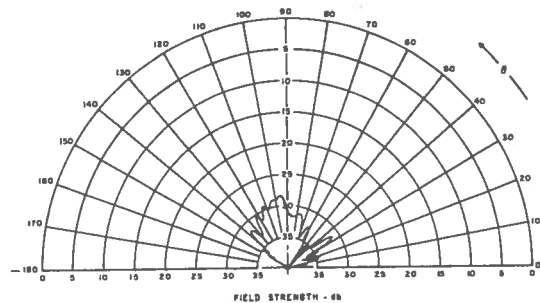


$E_\theta$ 

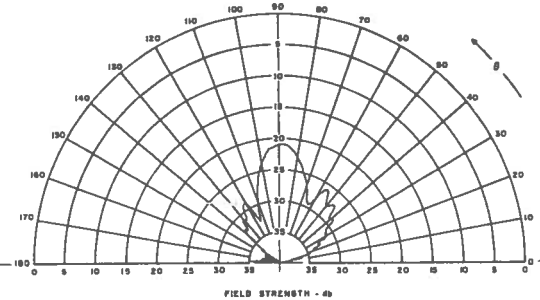
FWD-AFT



PORT-STBD

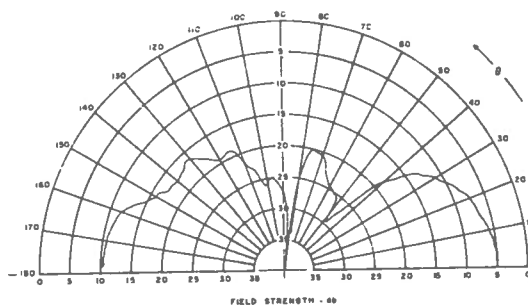
 $\theta = 0^\circ$  $E_\phi$ 

FIELD STRENGTH - dB

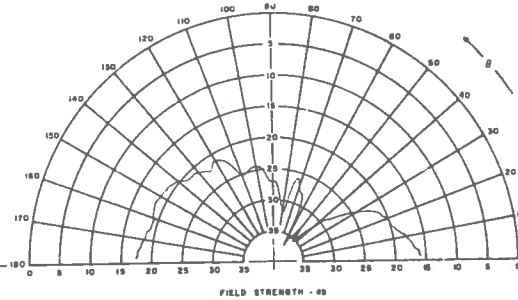


FIELD STRENGTH - dB

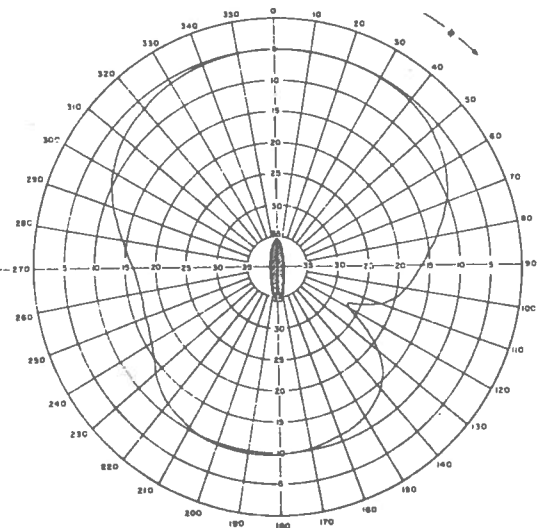
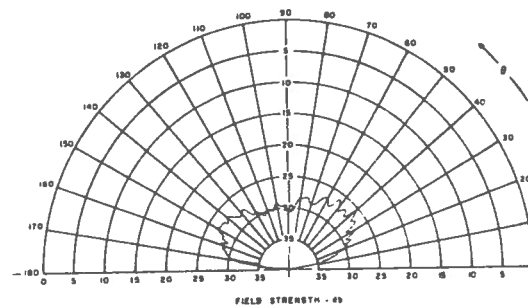
MODEL : DDH-205  
 ANTENNA : FWD WHIP  
 FREQ. : 4 MHz.  
 REMARKS : WITH TACAN MAST

$E_{\theta}$ 

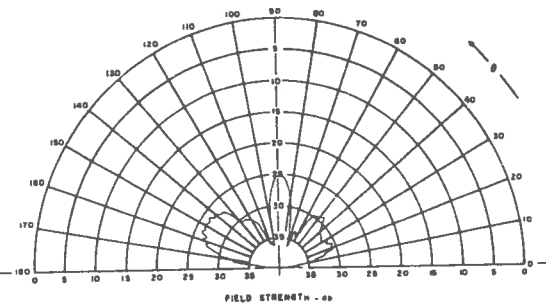
FWD-AFT



PORT-STBD

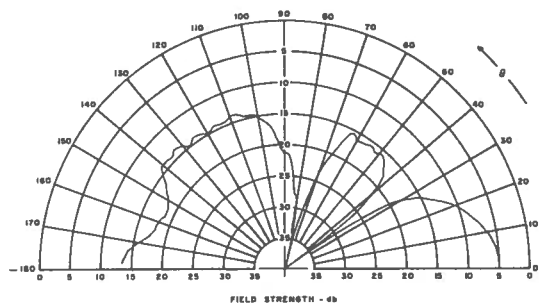
 $\theta = 0^\circ$  $E_{\phi}$ 

FIELD STRENGTH - dB

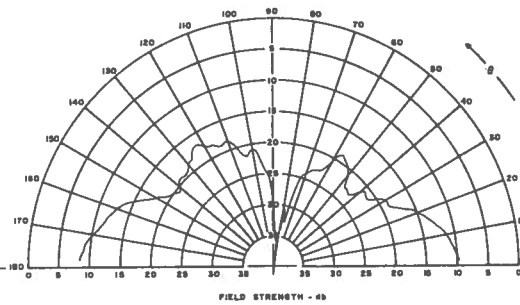


FIELD STRENGTH - dB

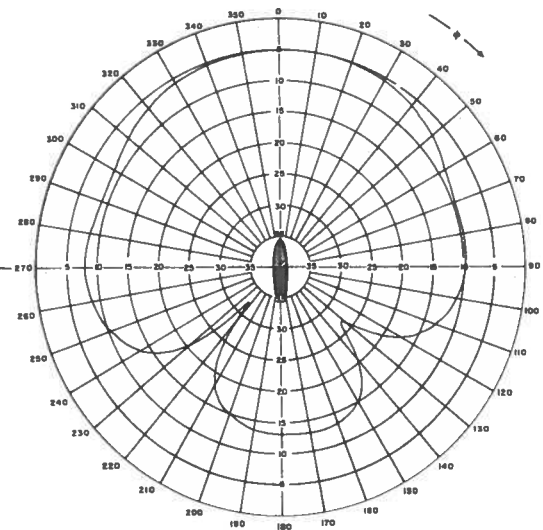
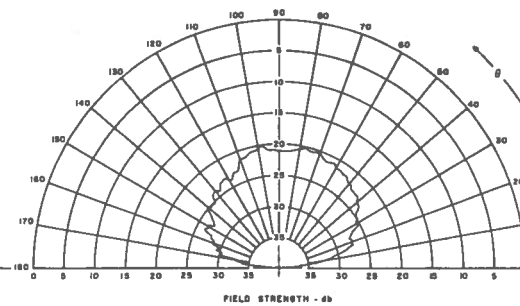
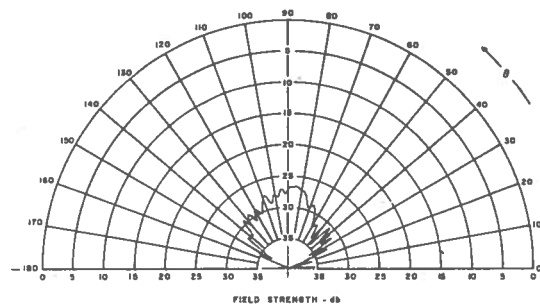
MODEL : DDH-205  
 ANTENNA : FWD WHIP  
 FREQ. : 5 MHz.  
 REMARKS : WITH TACAN MAST

$E_\theta$ 

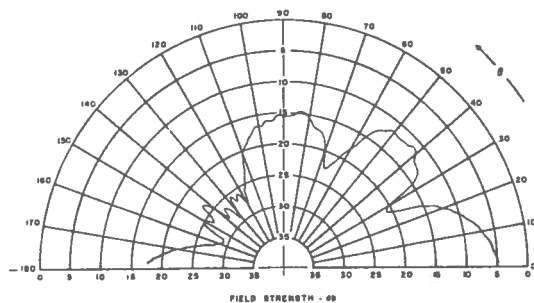
FWD-AFT



PORT-STBD

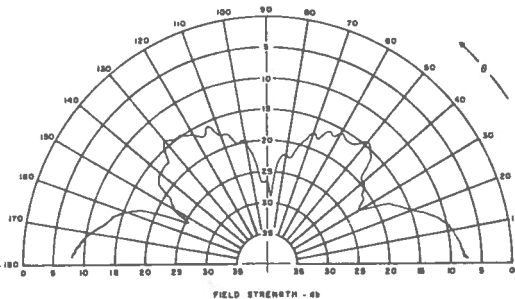
 $E_\phi$ 

MODEL : DDH-205  
 ANTENNA : FWD WHIP  
 FREQ. : 6 MHz.  
 REMARKS : WITH TACAN MAST

$E_\theta$ 

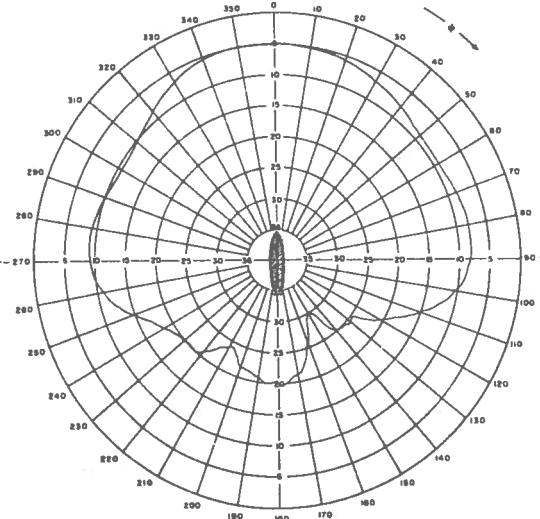
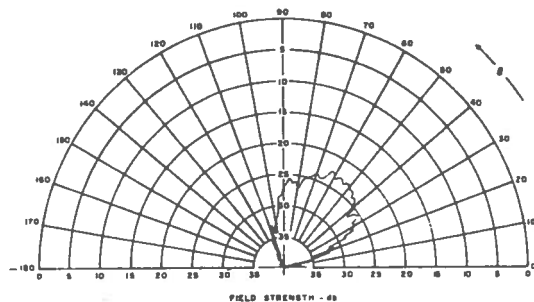
FIELD STRENGTH - dB

FWD-AFT

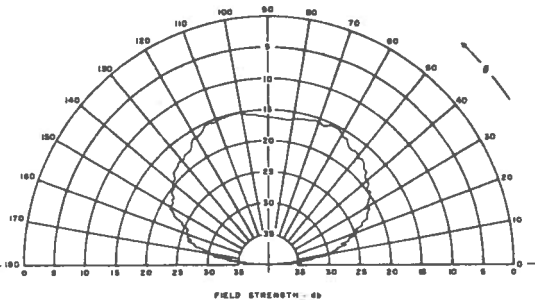


FIELD STRENGTH - dB

PORT-STBD

 $\theta = 0^\circ$  $E_\phi$ 

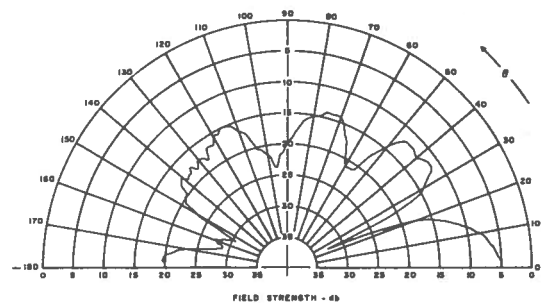
FIELD STRENGTH - dB



FIELD STRENGTH - dB

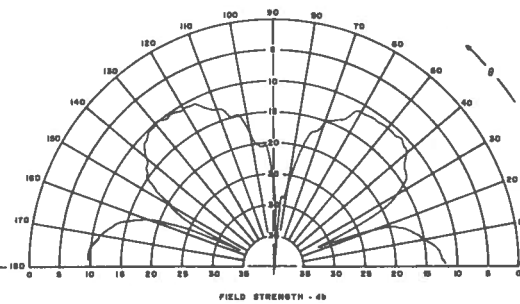
MODEL : DDH-205  
 ANTENNA : FWD WHIP  
 FREQ. : 8 MHz.  
 REMARKS : WITH TACAN MAST



$E_\theta$ 

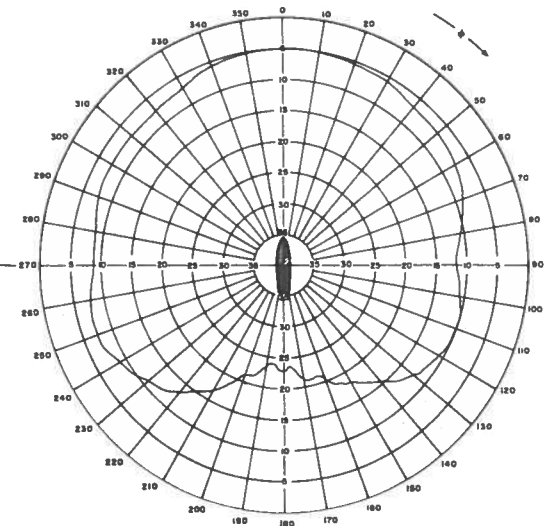
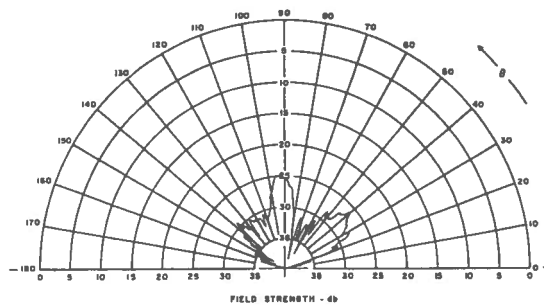
FIELD STRENGTH - dB

FWD-AFT

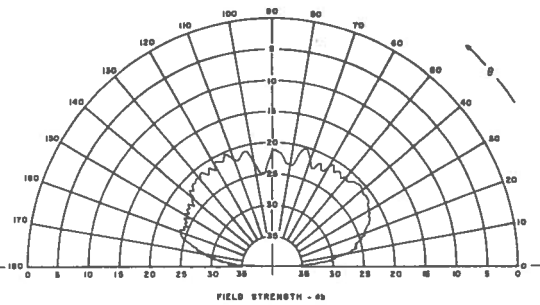


FIELD STRENGTH - dB

PORT-STBD

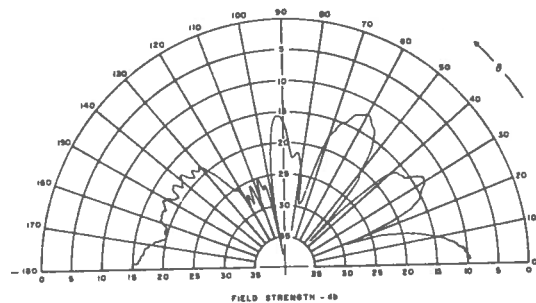
 $\theta = 0^\circ$  $E_\phi$ 

FIELD STRENGTH - dB

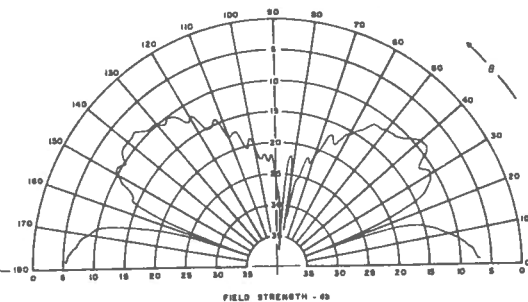


FIELD STRENGTH - dB

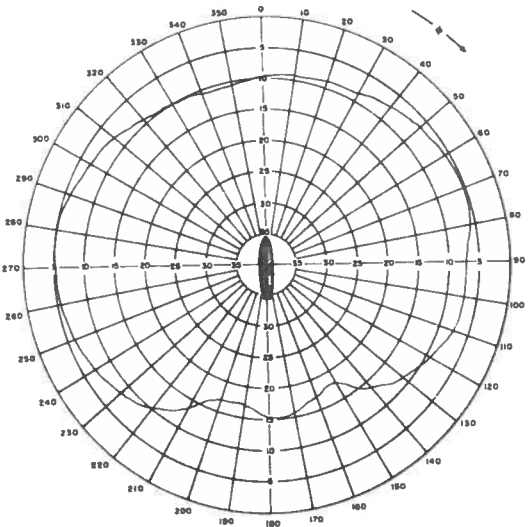
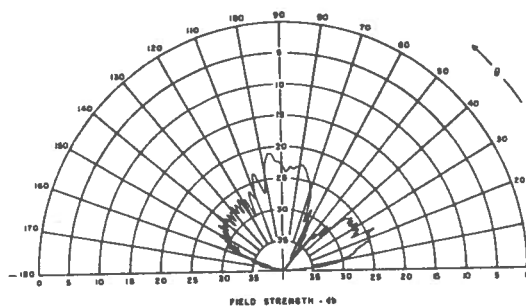
MODEL : DDH-205  
 ANTENNA : FWD WHIP  
 FREQ. : 10 MHz.  
 REMARKS : WITH TACAN MAST

$E_{\theta}$ 

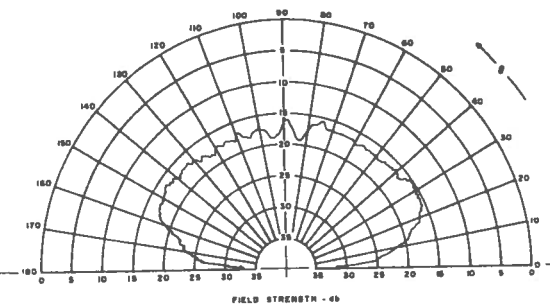
FWD-AFT



PORT-STBD

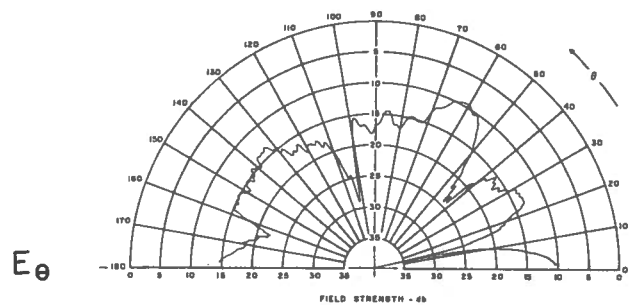
 $E_{\phi}$ 

FIELD STRENGTH - dB

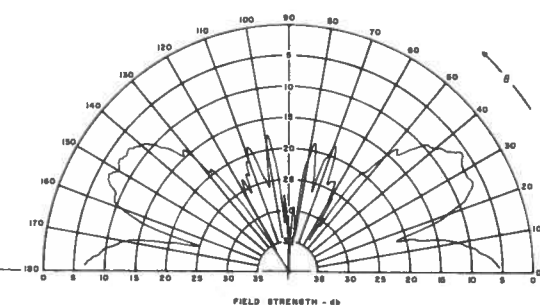


FIELD STRENGTH - dB

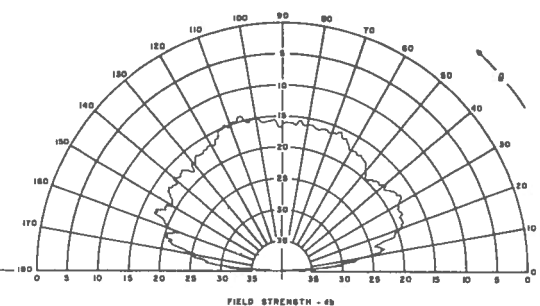
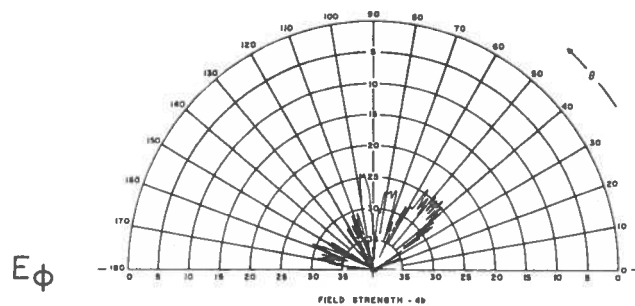
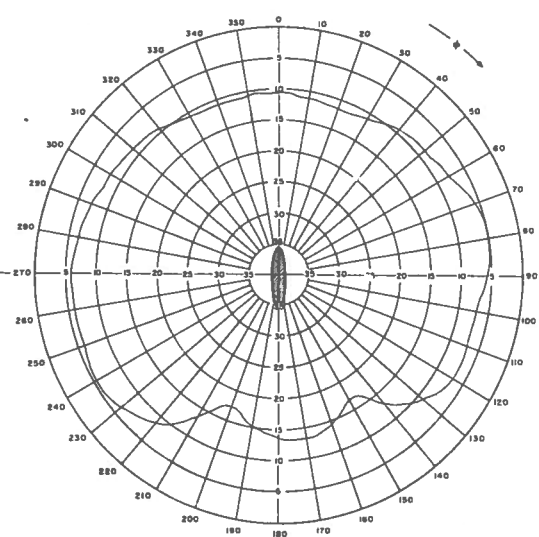
MODEL : DDH-205  
 ANTENNA : FWD WHIP  
 FREQ. : 12 MHz.  
 REMARKS : WITH TACAN MAST



FWD-AFT

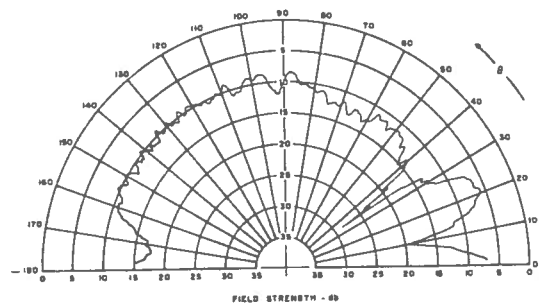


PORT-STBD

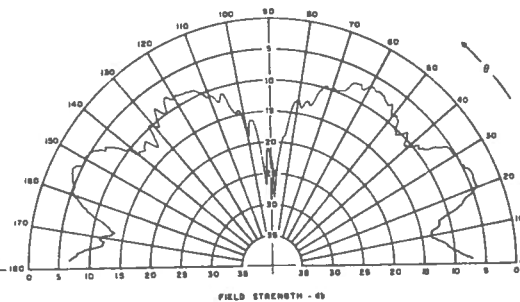


MODEL : DDH-205  
 ANTENNA : FWD WHIP  
 FREQ. : 14 MHz.  
 REMARKS : WITH TACAN MAST

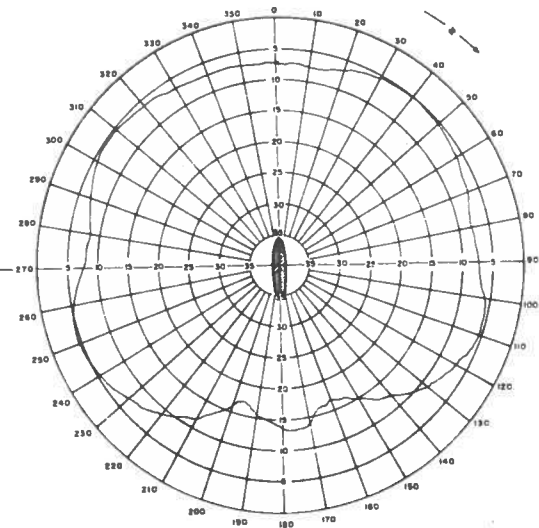
$E_{\theta}$



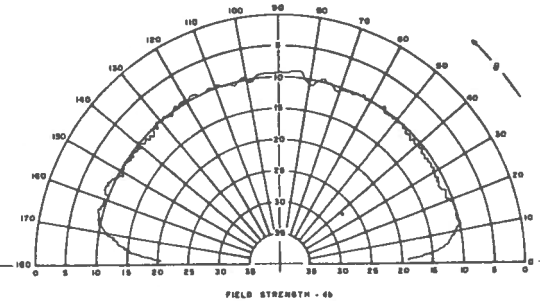
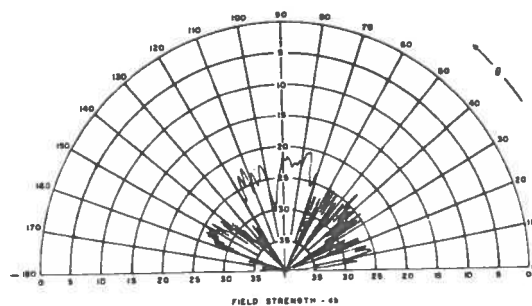
FWD-AFT



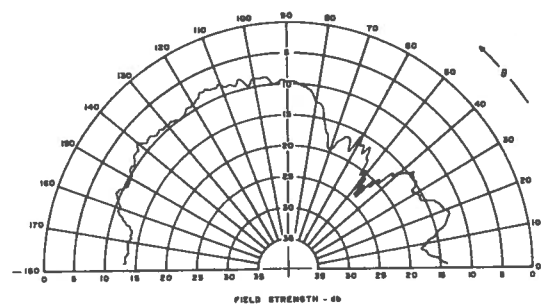
PORT-STBD



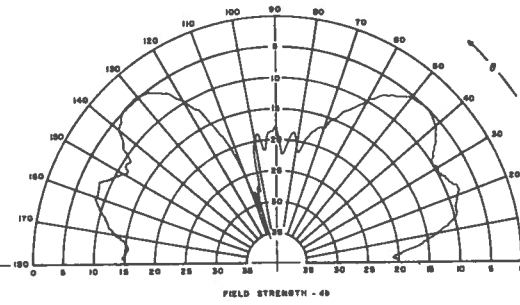
$E_{\phi}$



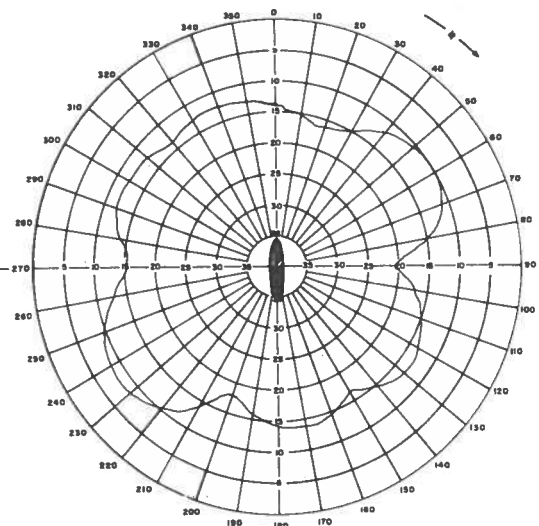
MODEL : DDH-205  
ANTENNA : FWD WHIP  
FREQ. : 16 MHz.  
REMARKS : WITH TACAN MAST

$E_\theta$ 

FIELD STRENGTH - dB

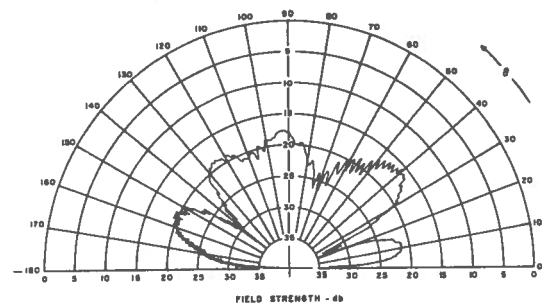


FIELD STRENGTH - dB

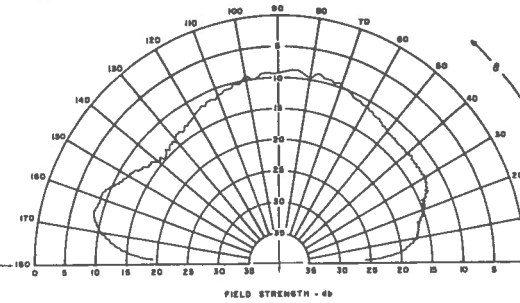


FWD-AFT

PORT-STBD

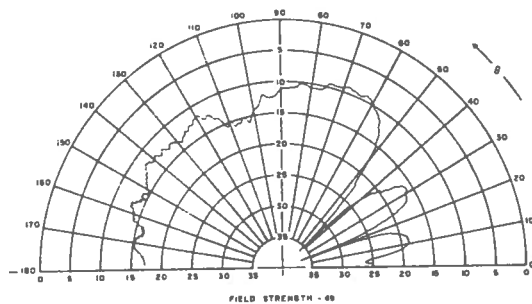
 $\theta = 0^\circ$  $E_\phi$ 

FIELD STRENGTH - dB

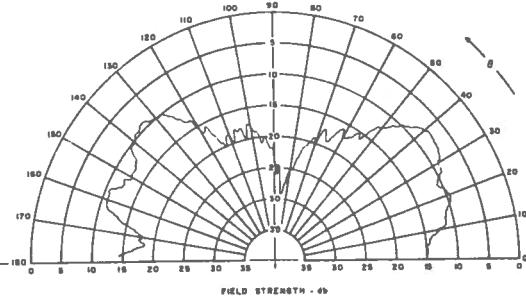


FIELD STRENGTH - dB

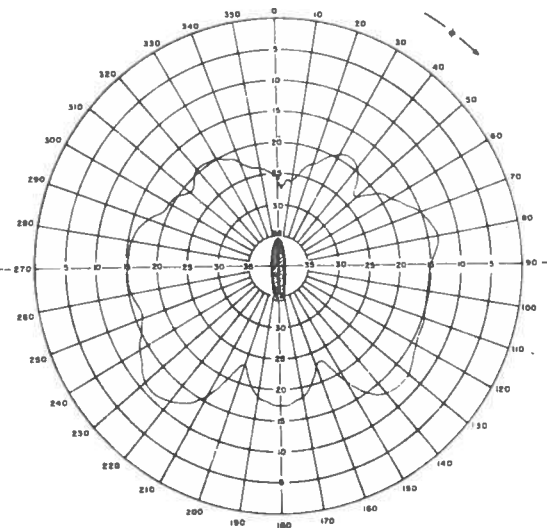
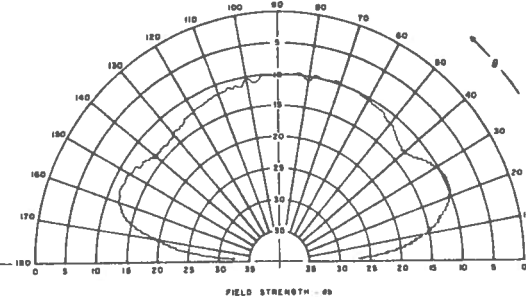
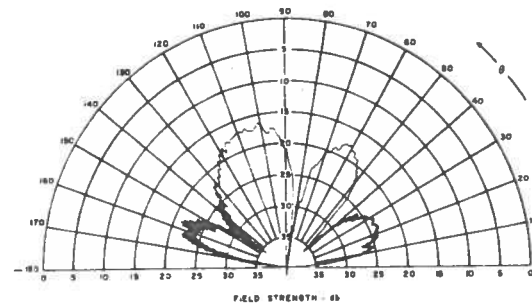
MODEL : DDH-205  
 ANTENNA : FWD WHIP  
 FREQ. : 18 MHz.  
 REMARKS : WITH TACAN MAST

$E_\theta$ 

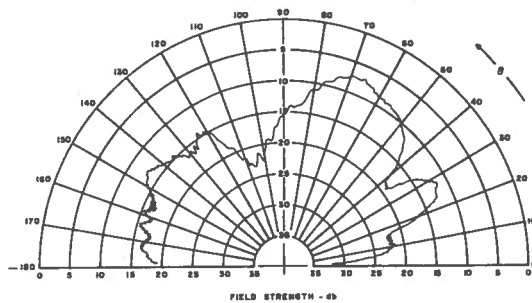
FWD-AFT



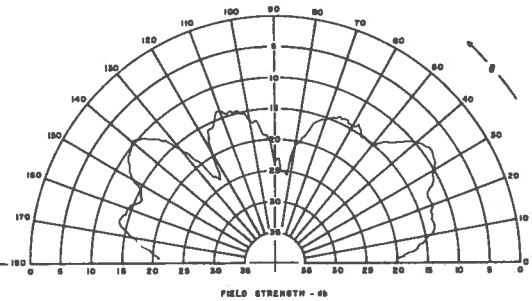
PORT-STBD

 $E_\phi$ 

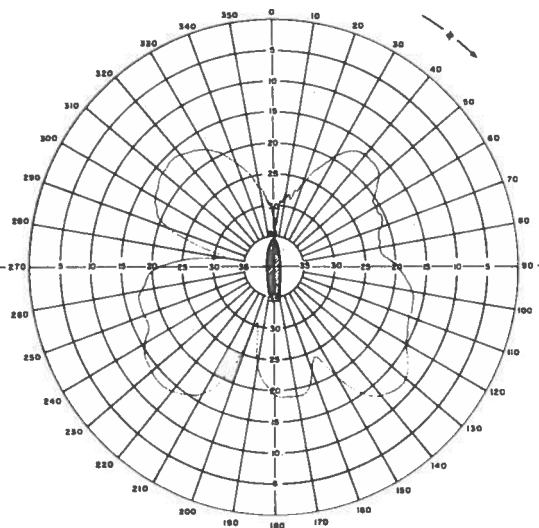
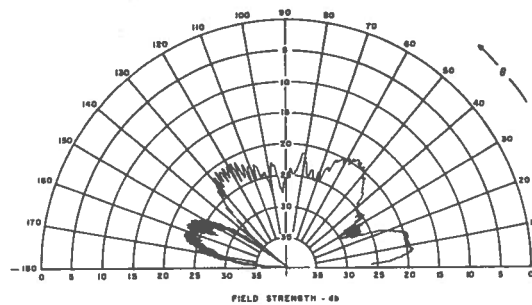
MODEL : DDH-205  
 ANTENNA : FWD WHIP  
 FREQ. : 20 MHz.  
 REMARKS : WITH TACAN MAST

$E_\theta$ 

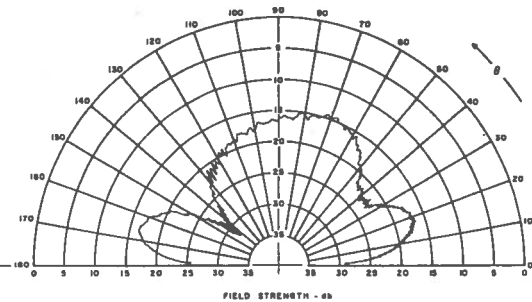
FWD-AFT



PORT-STBD

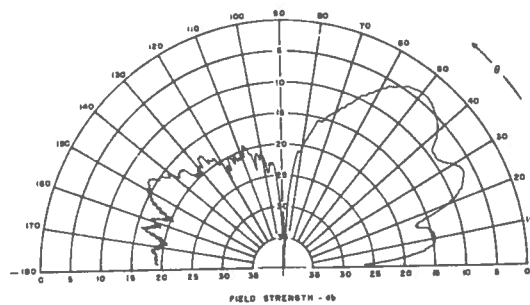
 $\theta = 0^\circ$  $E_\phi$ 

FIELD STRENGTH - db

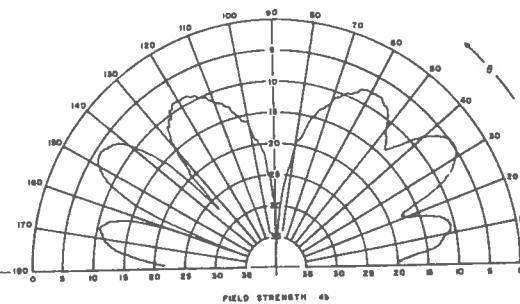


FIELD STRENGTH - db

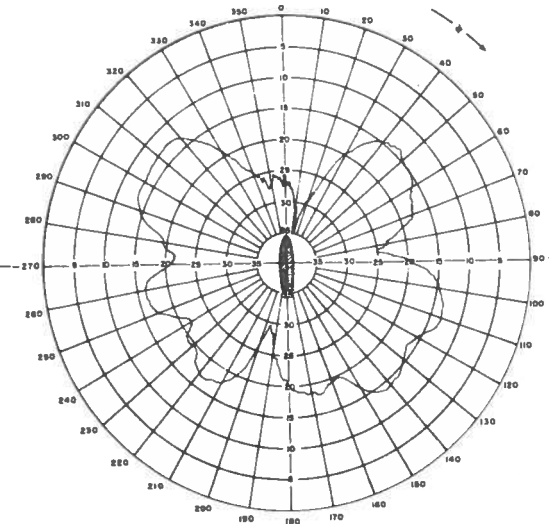
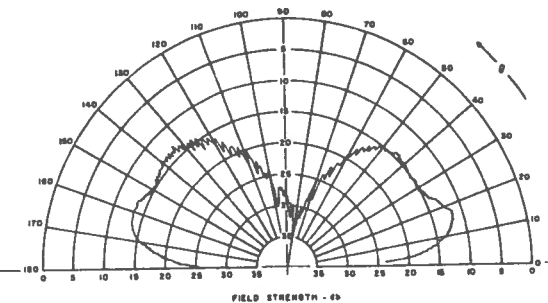
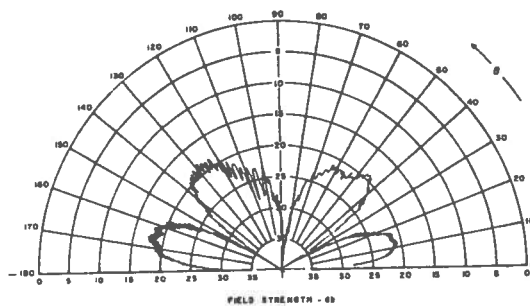
MODEL : DDH - 205  
 ANTENNA : FWD WHIP  
 FREQ. : 22 MHz.  
 REMARKS : WITH TACAN MAST

$E_{\theta}$ 

FWD-AFT



PORT-STBD

 $\theta = 0^\circ$  $E_{\phi}$ 

MODEL : DDH-205

ANTENNA : FWD WHIP

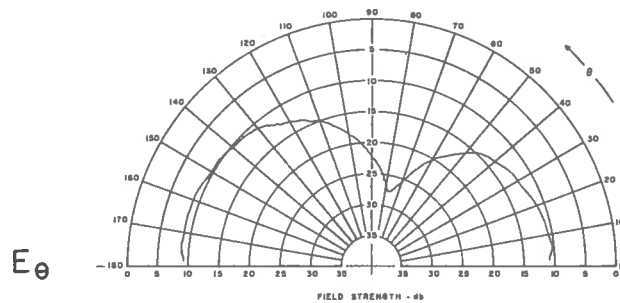
FREQ. : 24 MHz.

REMARKS : WITH TACAN MAST

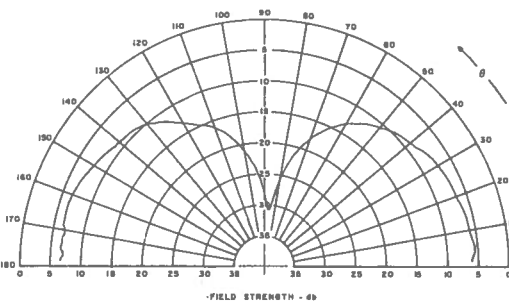


## **RADIATION PATTERNS**

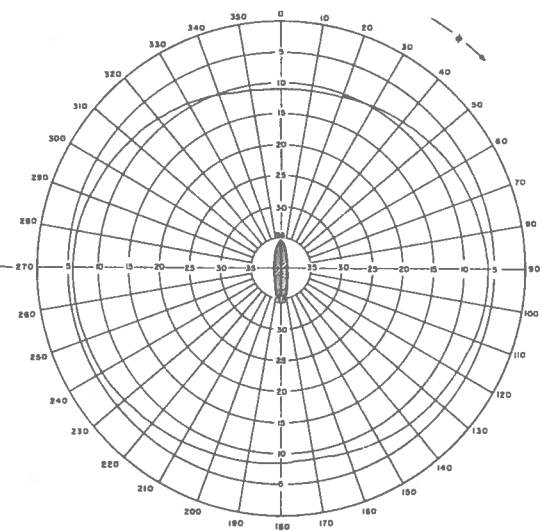
### **4. Forward receiving fan**



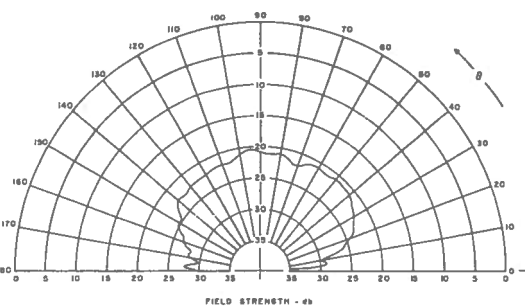
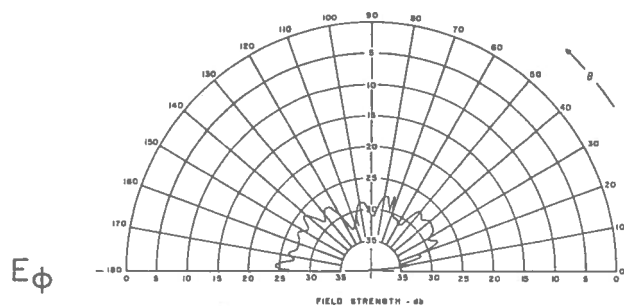
FWD-AFT



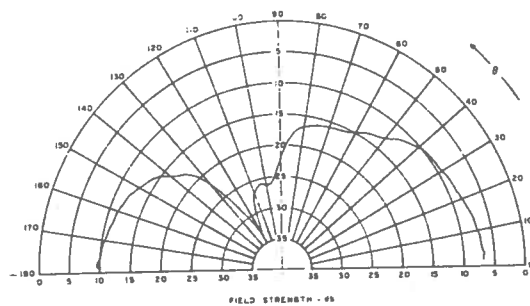
PORT-STBD



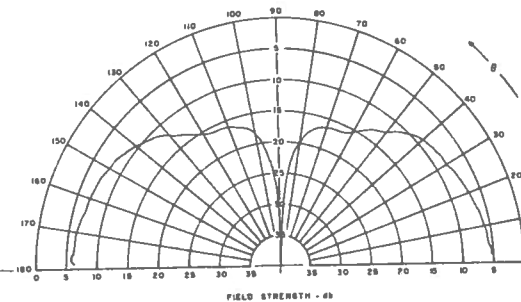
$\theta = 0^\circ$



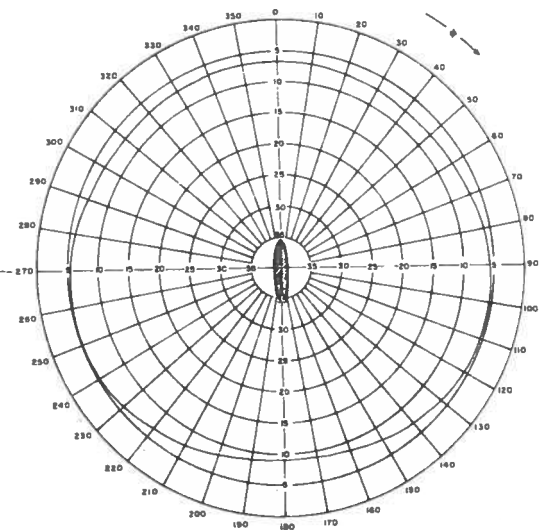
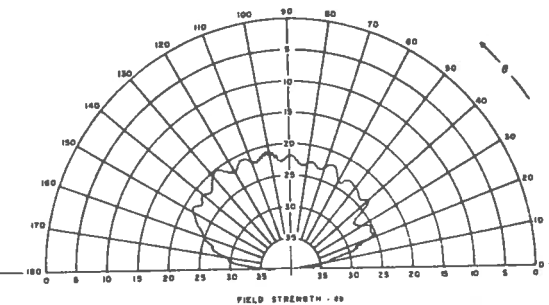
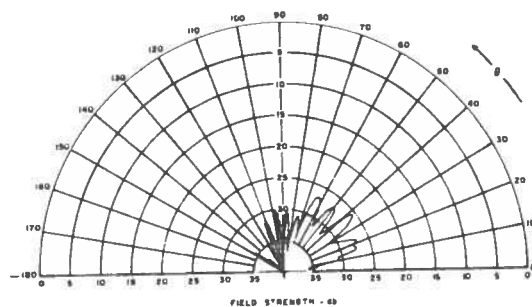
MODEL : DDH-205  
 ANTENNA : FWD FANS  
 FREQ. : 2 MHz.  
 REMARKS : WITH TACAN MAST

$E_\theta$ 

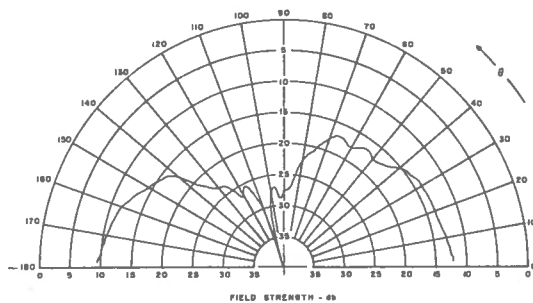
FWD-AFT



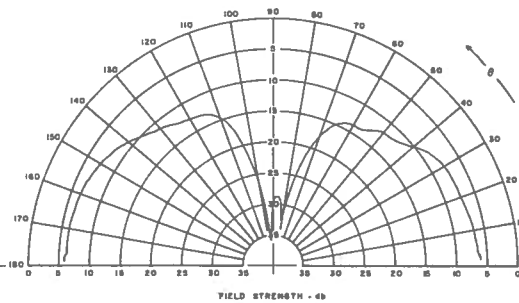
PORT-STBD

 $\theta = 0^\circ$  $E_\phi$ 

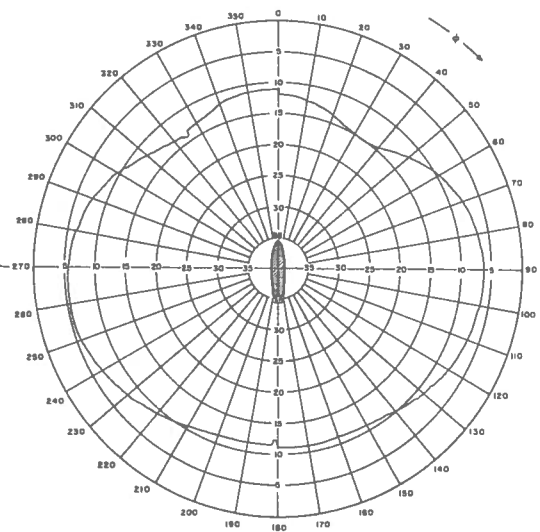
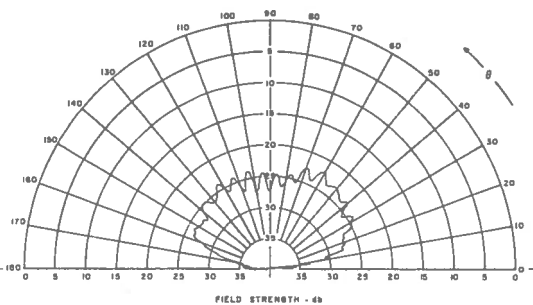
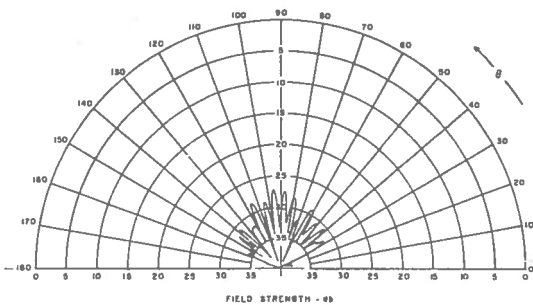
MODEL : DDH-205  
 ANTENNA : FWD FANS  
 FREQ. : 3 MHz.  
 REMARKS : WITH TACAN MAST

$E_\theta$ 

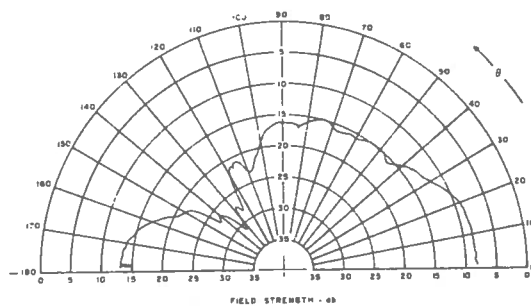
FWD-AFT



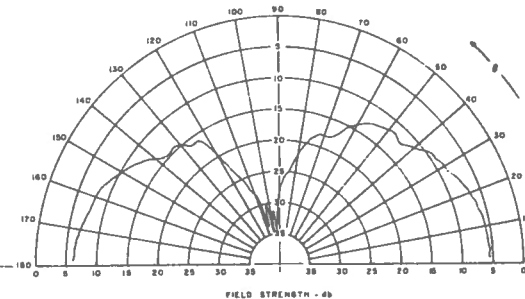
PORT-STBD

 $\theta = 0^\circ$  $E_\phi$ 

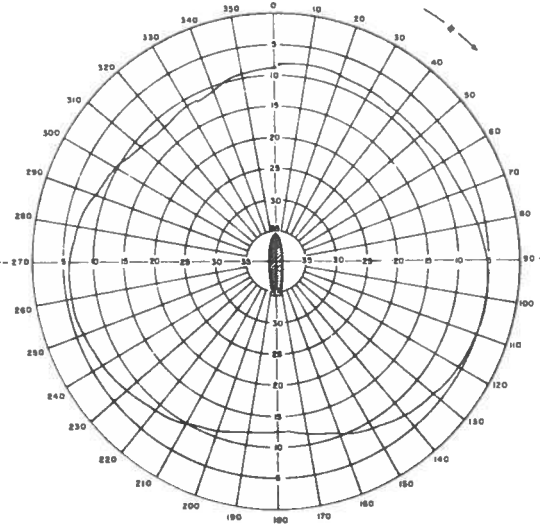
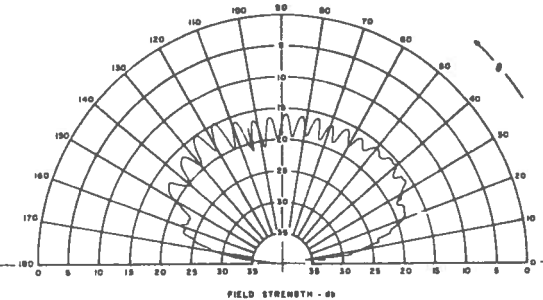
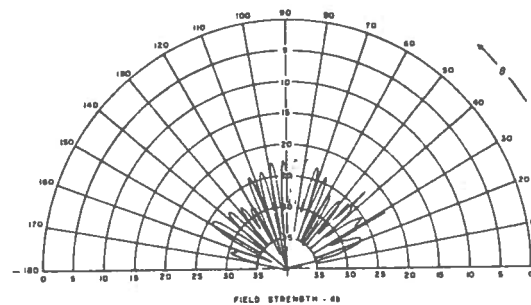
MODEL : DDH-205  
ANTENNA : FWD FANS  
FREQ. : 4 MHz.  
REMARKS : WITH TACAN MAST

$E_{\theta}$ 

FWD-AFT



PORT-STBD

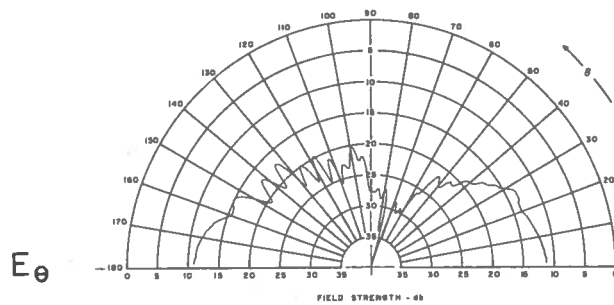
 $E_{\phi}$ 

MODEL : DDH-205

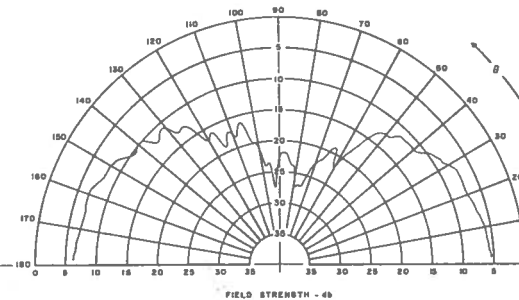
ANTENNA : FWD FANS

FREQ. : 5 MHz.

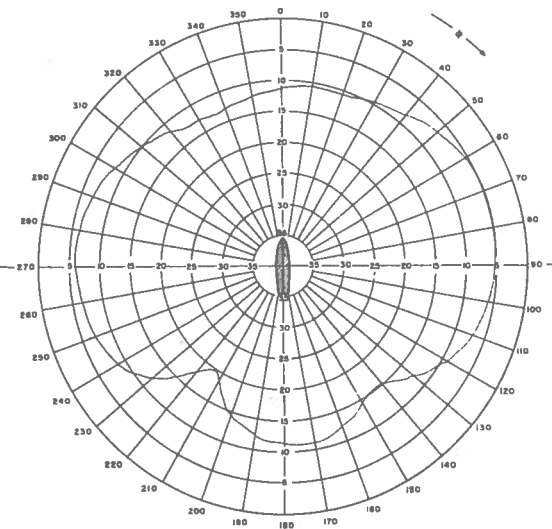
REMARKS : WITH TACAN MAST



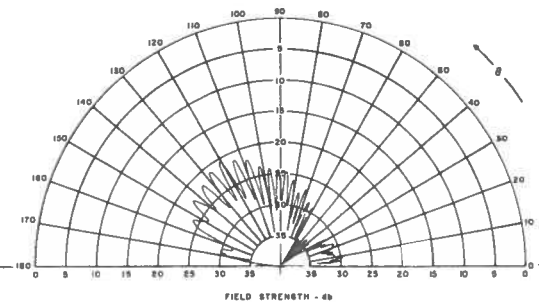
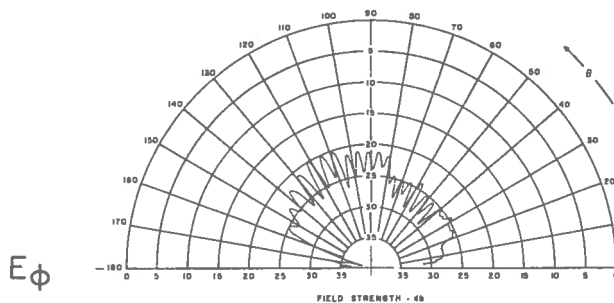
FWD-AFT



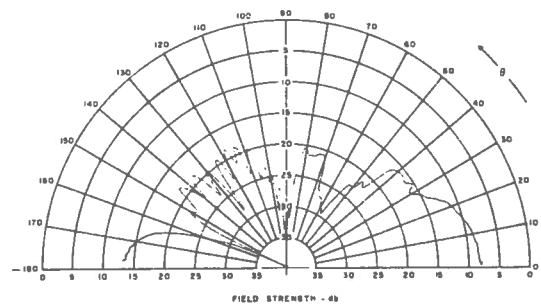
PORT-STBD



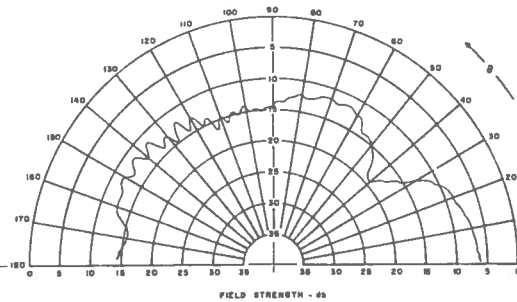
$\theta = 0^\circ$



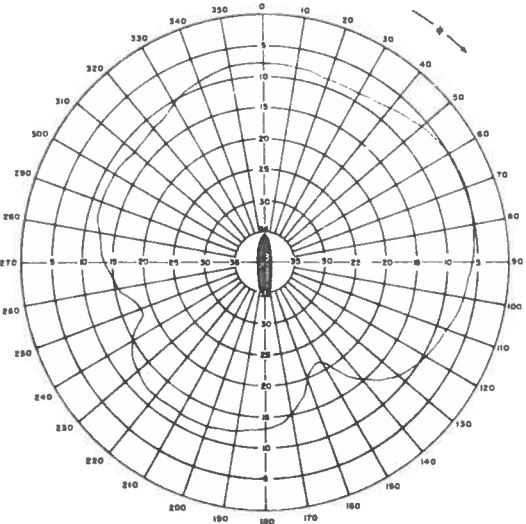
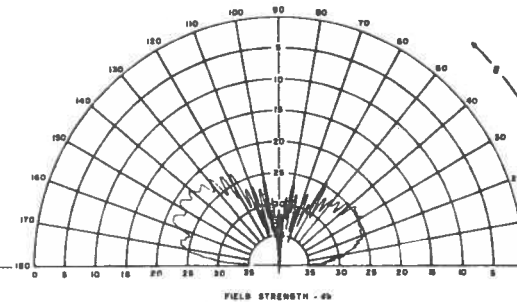
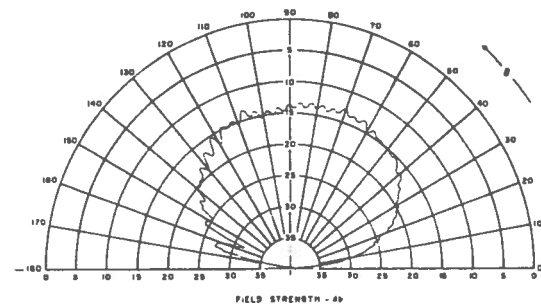
MODEL : DDH-205  
 ANTENNA : FWD FANS  
 FREQ. : 6 MHz.  
 REMARKS : WITH TACAN MAST

$E_{\theta}$ 

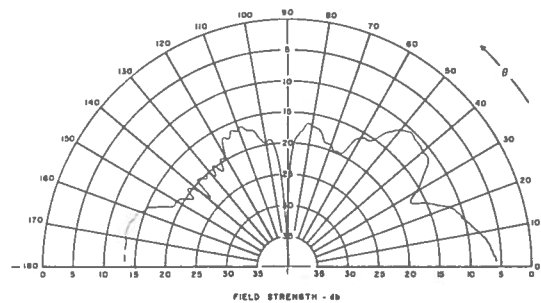
FWD-AFT



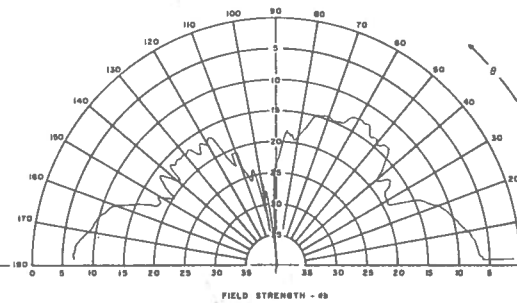
PORT-STBD

 $\theta = 0^\circ$  $E_{\phi}$ 

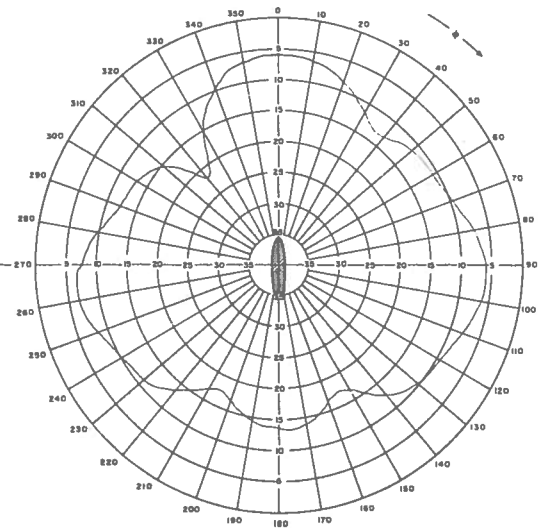
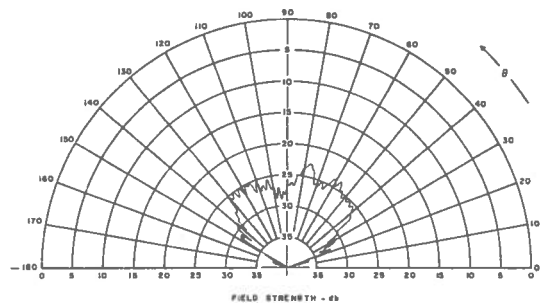
MODEL : DDH - 205  
ANTENNA : FWD FANS  
FREQ. : 8 MHz.  
REMARKS : WITH TACAN MAST

$E_{\theta}$ 

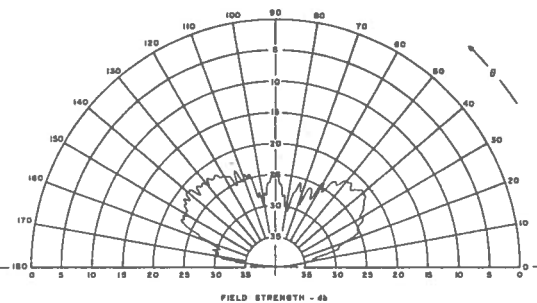
FWD-AFT



PORT-STBD

 $\theta = 0^\circ$  $E_{\phi}$ 

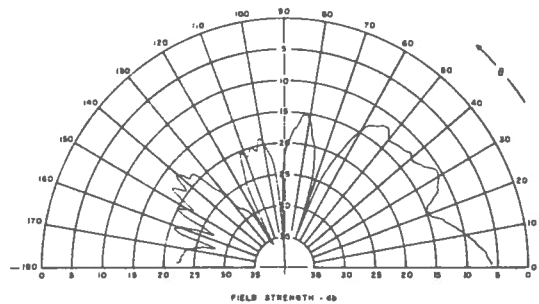
FIELD STRENGTH - dB



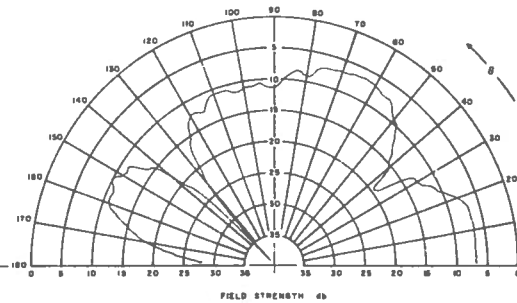
FIELD STRENGTH - dB

MODEL : DDH-205  
ANTENNA : FWD FANS  
FREQ. : 10 MHz.  
REMARKS : WITH TACAN MAST

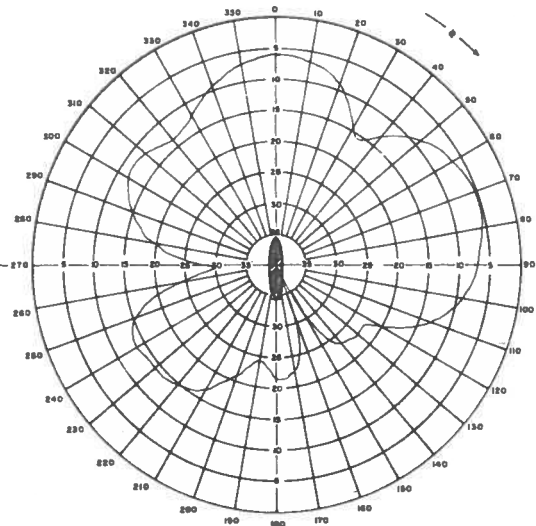
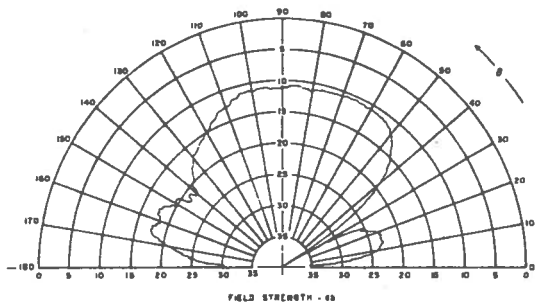


$E_{\theta}$ 

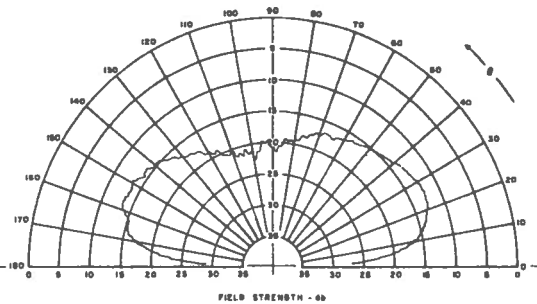
FWD-AFT



PORT-STBD

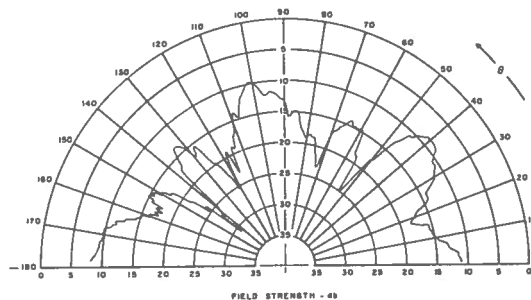
 $\theta = 0^\circ$  $E_{\phi}$ 

FIELD STRENGTH - dB

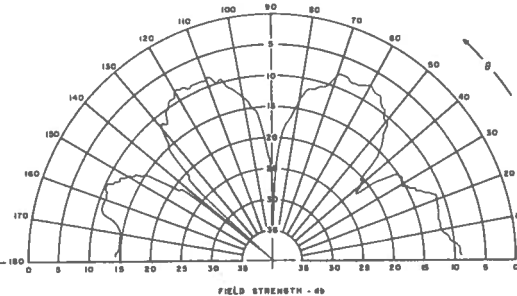


FIELD STRENGTH - dB

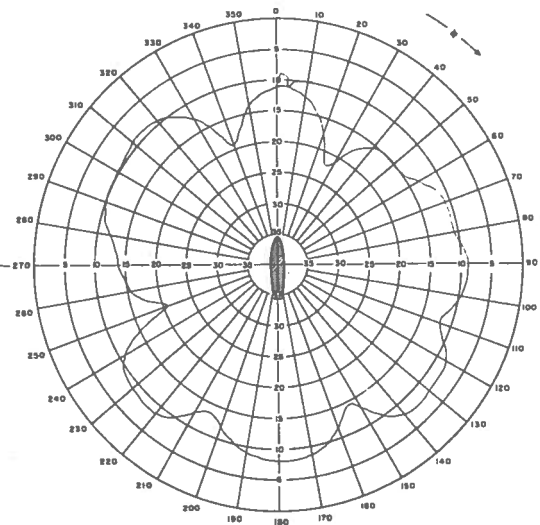
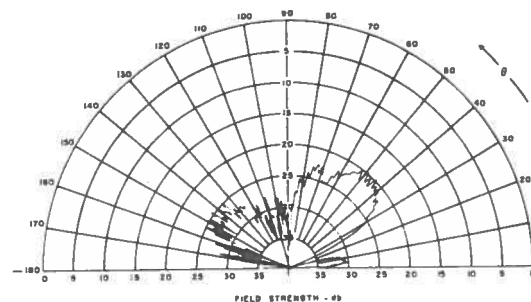
MODEL : DDH-205  
ANTENNA : FWD FANS  
FREQ. : 12 MHz.  
REMARKS : WITH TACAN MAST

$E_{\theta}$ 

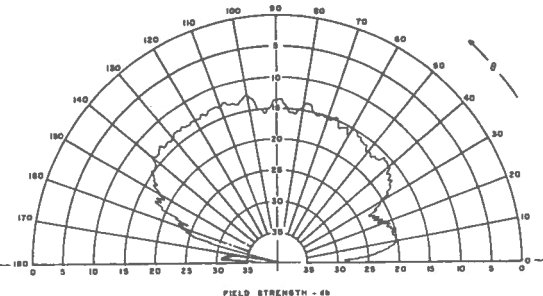
FWD-AFT



PORT-STBD

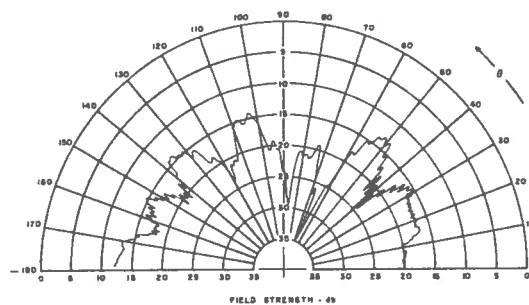
 $\theta = 0^\circ$  $E_{\phi}$ 

FWD-AFT

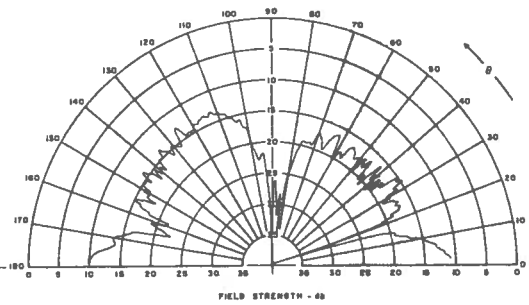


PORT-STBD

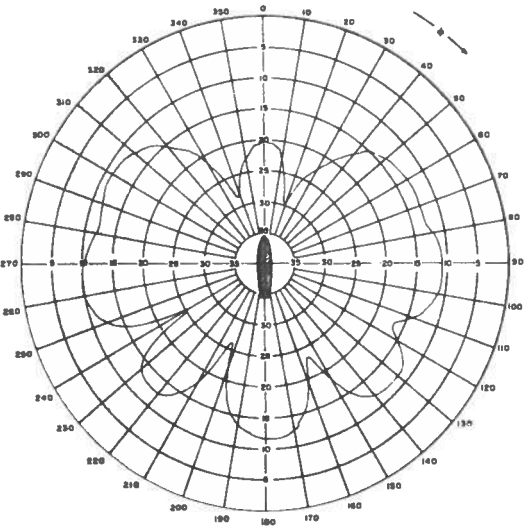
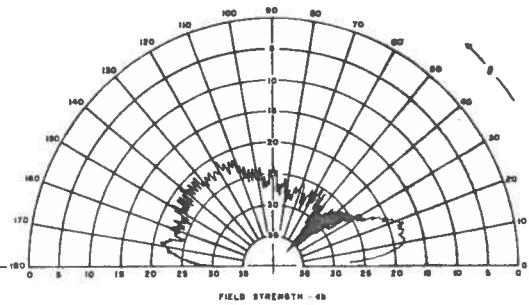
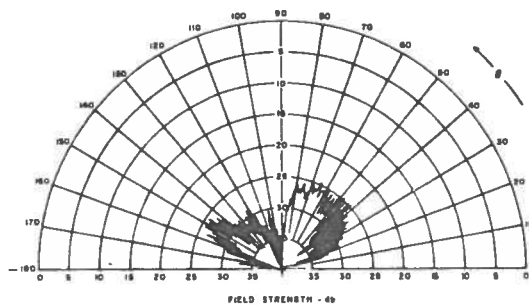
MODEL : DDH-205  
 ANTENNA : FWD FANS  
 FREQ. : 14 MHz.  
 REMARKS : WITH TACAN MAST

$E_{\theta}$ 

FWD-AFT



PORT-STBD

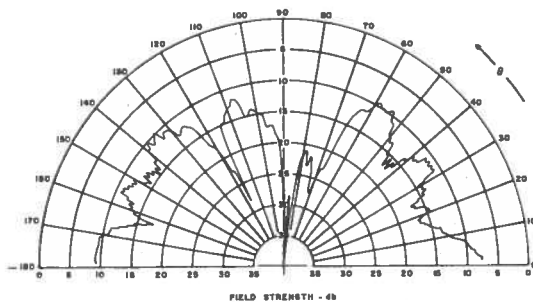
 $E_{\phi}$ 

MODEL : DDH-205

ANTENNA : FWD FANS

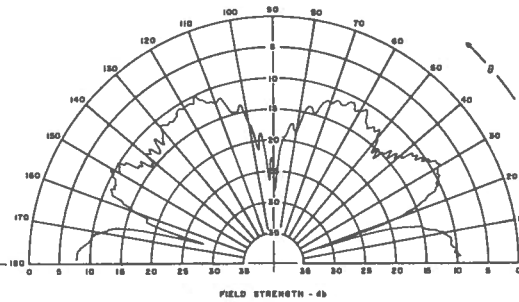
FREQ. : 16 MHz.

REMARKS : WITH TACAN MAST

$E_{\theta}$ 

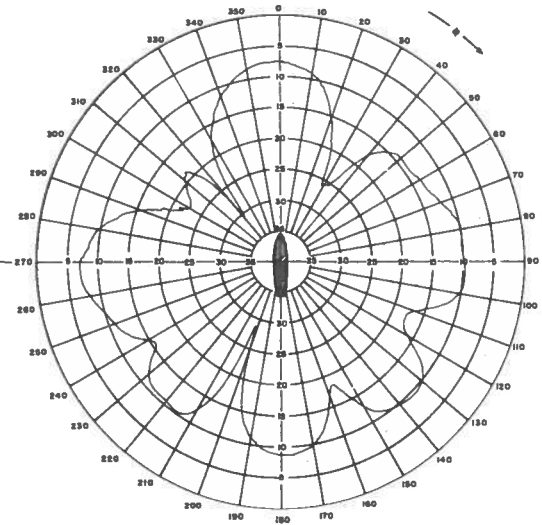
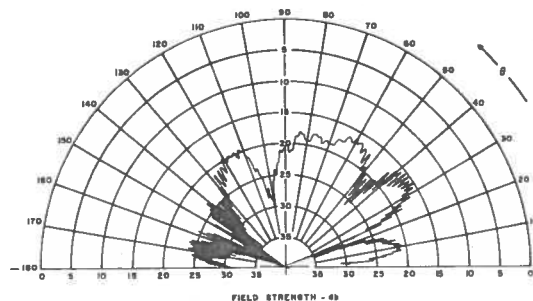
FIELD STRENGTH - dB

FWD-AFT

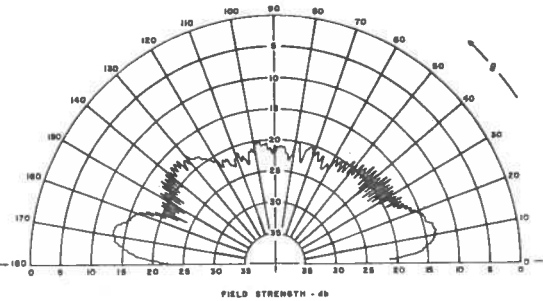


FIELD STRENGTH - dB

PORT-STBD

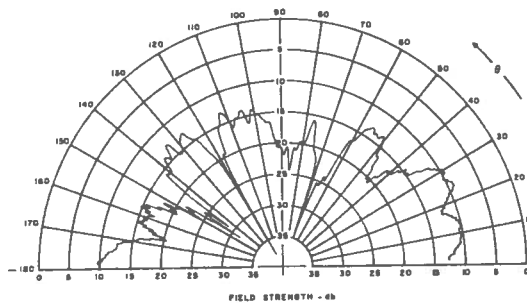
 $\theta = 0^\circ$  $E_{\phi}$ 

FIELD STRENGTH - dB

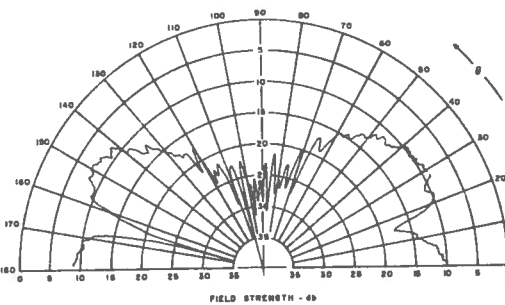


FIELD STRENGTH - dB

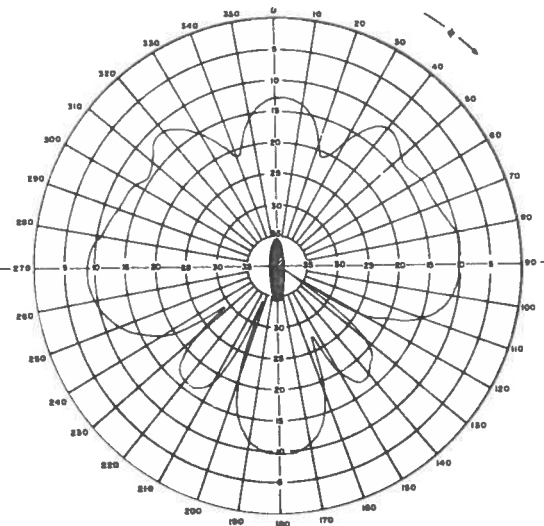
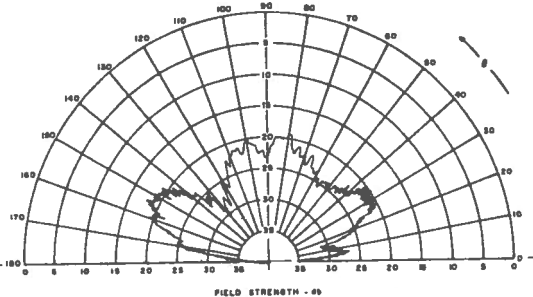
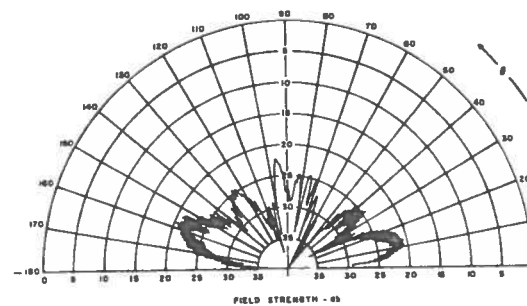
MODEL : DDH - 205  
 ANTENNA : FWD FANS  
 FREQ. : 18 MHz.  
 REMARKS : WITH TACAN MAST

$E_{\theta}$ 

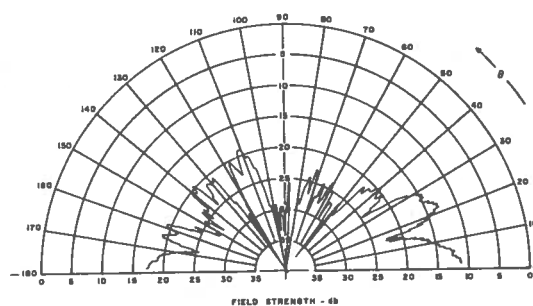
FWD-AFT



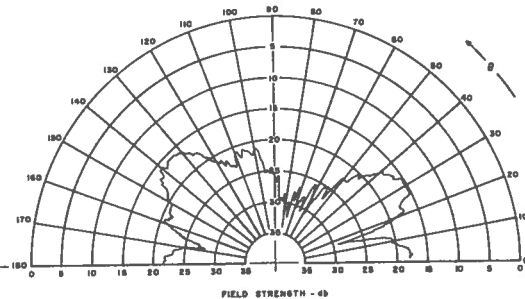
PORT-STBD

 $E_{\phi}$ 

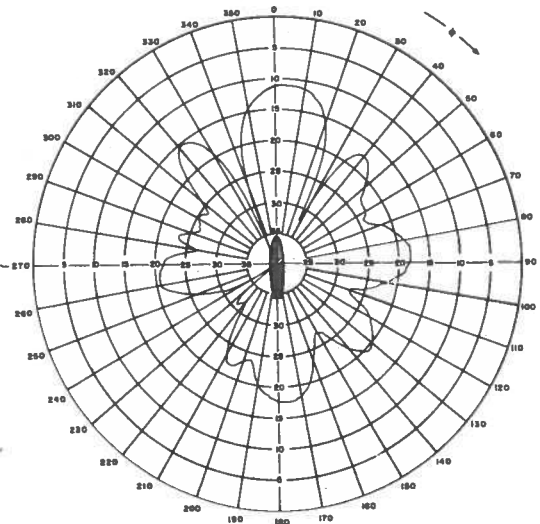
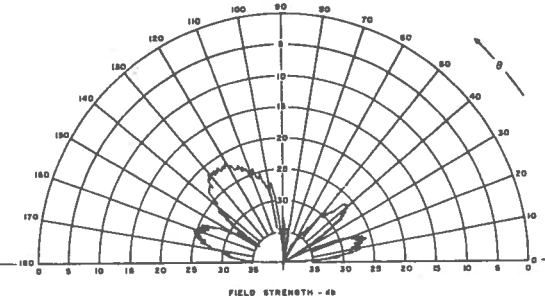
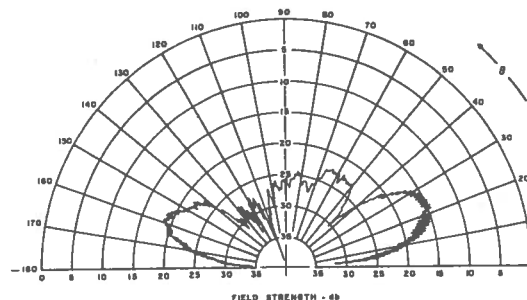
MODEL : DDH - 205  
 ANTENNA : FWD FANS  
 FREQ. : 20 MHz.  
 REMARKS : WITH TACAN MAST

$E_{\theta}$ 

FWD-AFT



PORT-STBD

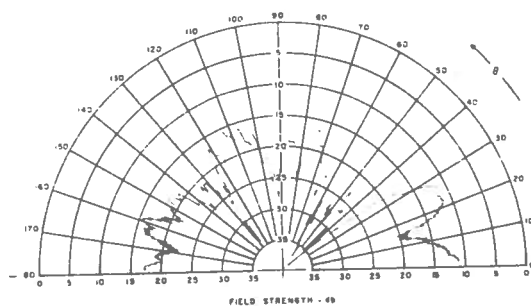
 $E_{\phi}$ 

MODEL : DDH-205

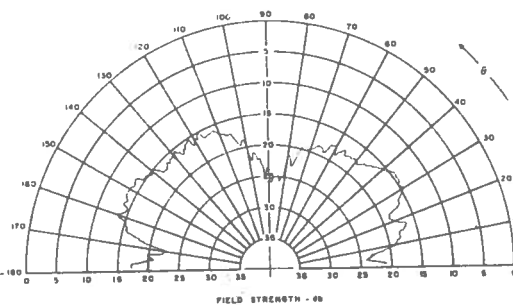
ANTENNA : FWD FANS

FREQ. : 22 MHz.

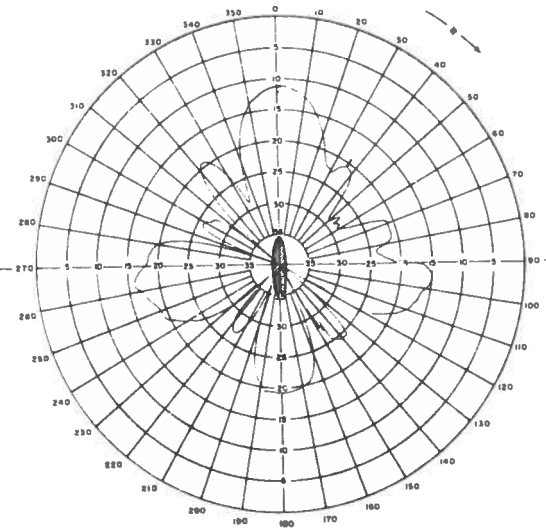
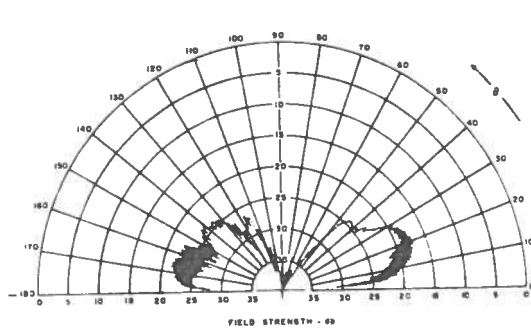
REMARKS : WITH TACAN MAST

$E_{\theta}$ 

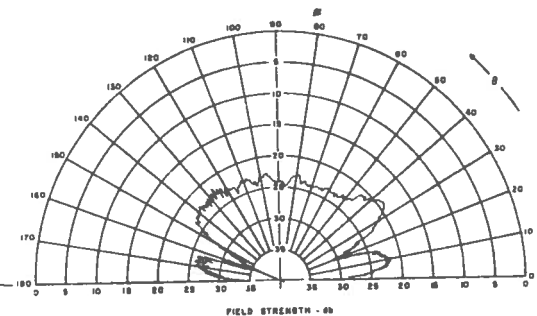
FWD-AFT



PORT-STBD

 $\theta = 0^\circ$  $E_{\phi}$ 

FIELD STRENGTH - dB



FIELD STRENGTH - dB

MODEL : DDH-205

ANTENNA : FWD FANS

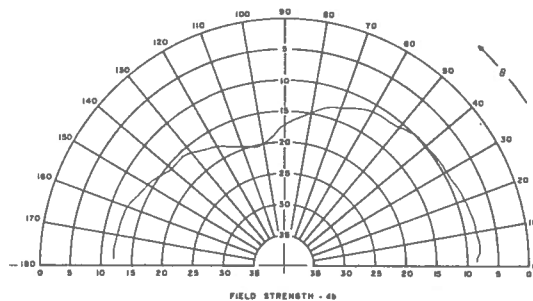
FREQ. : 24 MHz.

REMARKS : WITH TACAN MAST

## **RADIATION PATTERNS**

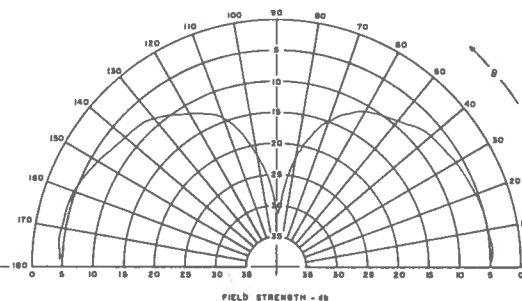
### **5. Aft receiving fan**



$E_{\theta}$ 

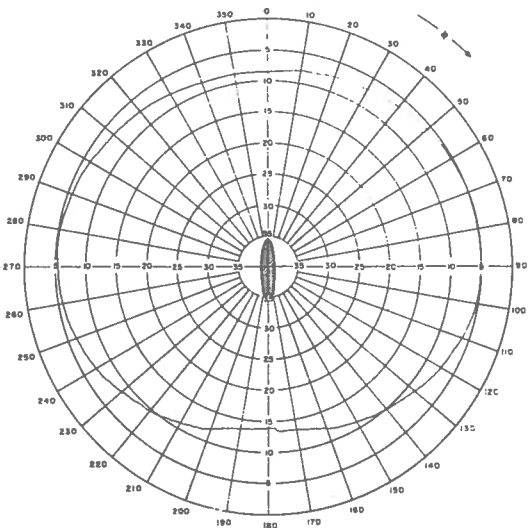
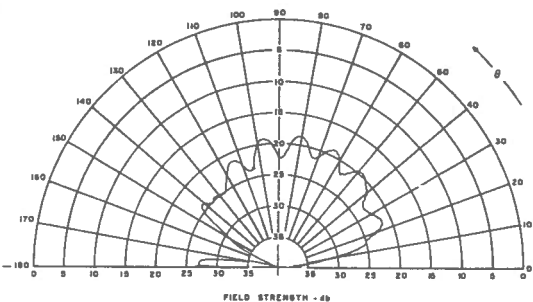
FIELD STRENGTH - dB

FWD-AFT

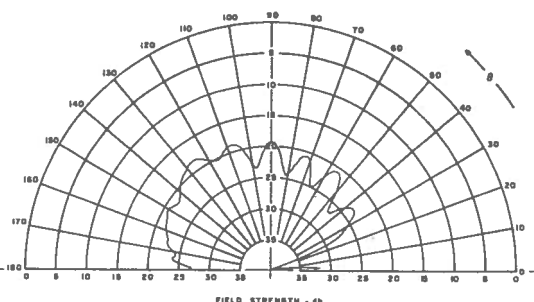


FIELD STRENGTH - dB

PORT-STBD

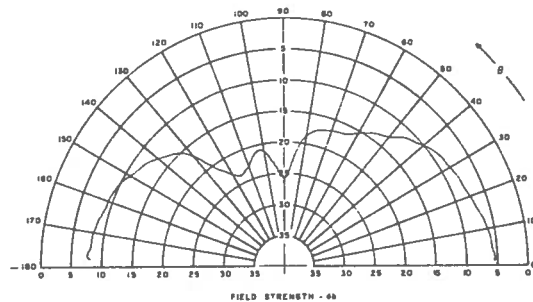
 $\theta = 0^\circ$  $E_{\phi}$ 

FIELD STRENGTH - dB

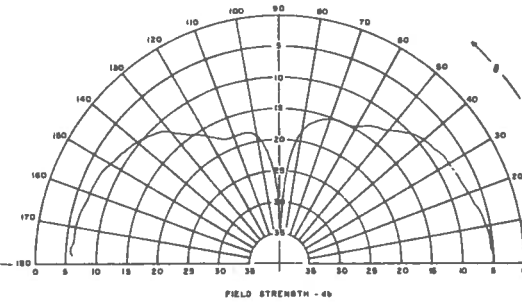


FIELD STRENGTH - dB

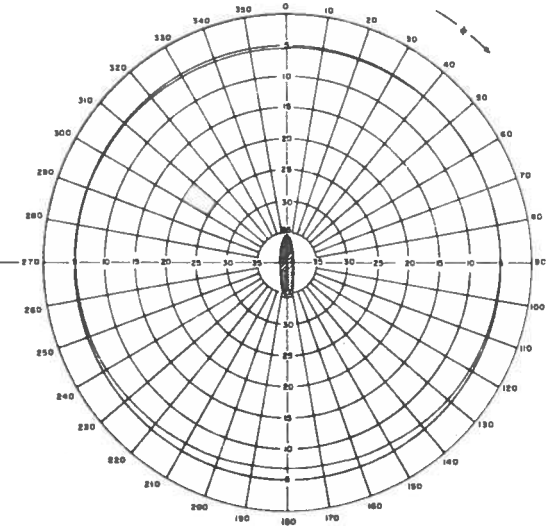
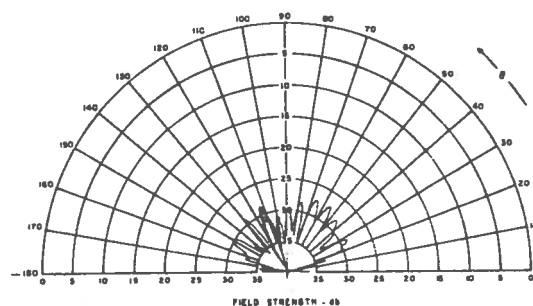
MODEL : DDH-205  
 ANTENNA : AFT FANS  
 FREQ. : 2 MHz.  
 REMARKS : WITH TACAN MAST

$E_\theta$ 

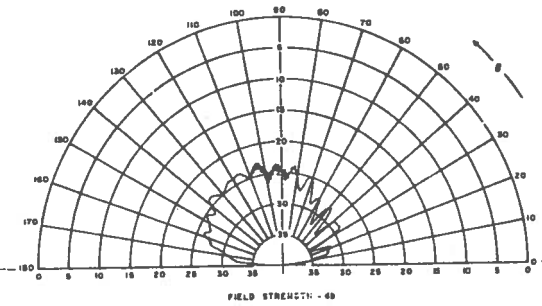
FWD-AFT



PORT-STBD

 $\theta = 0^\circ$  $E_\phi$ 

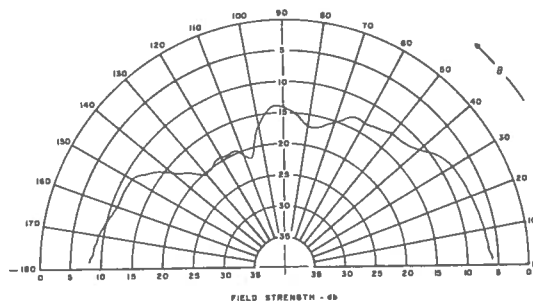
FIELD STRENGTH - dB



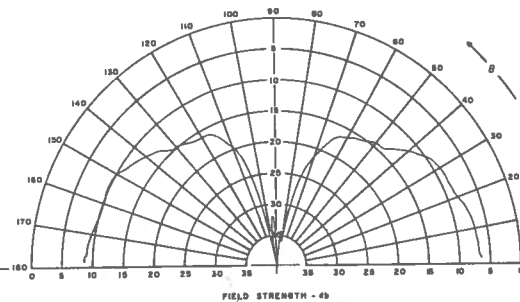
FIELD STRENGTH - dB

MODEL : DDH - 205  
 ANTENNA : AFT FANS  
 FREQ. : 3 MHz.  
 REMARKS : WITH TACAN MAST

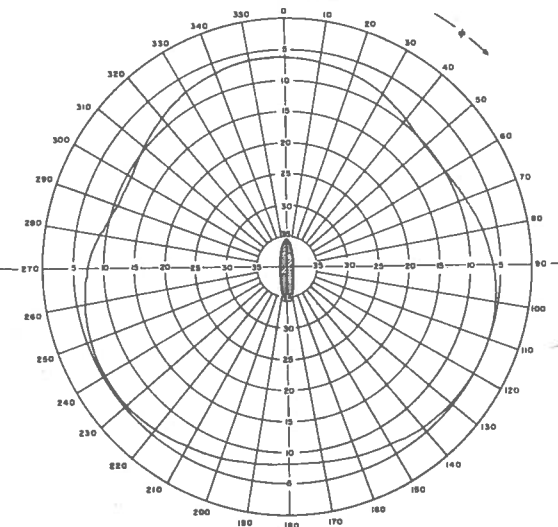
$E_{\theta}$



FWD-AFT

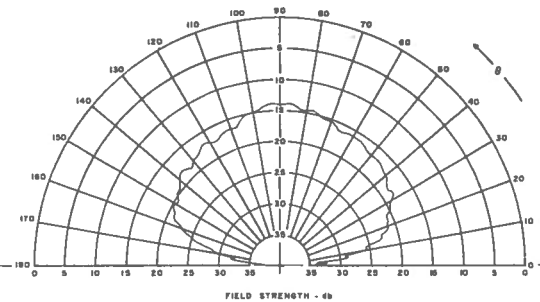
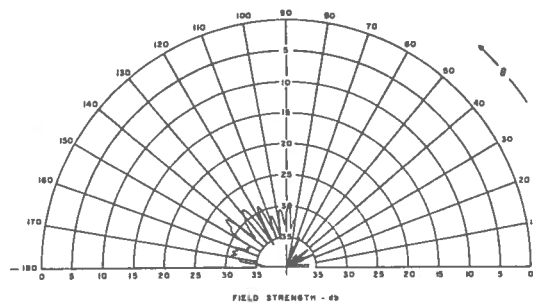


PORT-STBD



$\theta = 0^\circ$

$E_{\phi}$



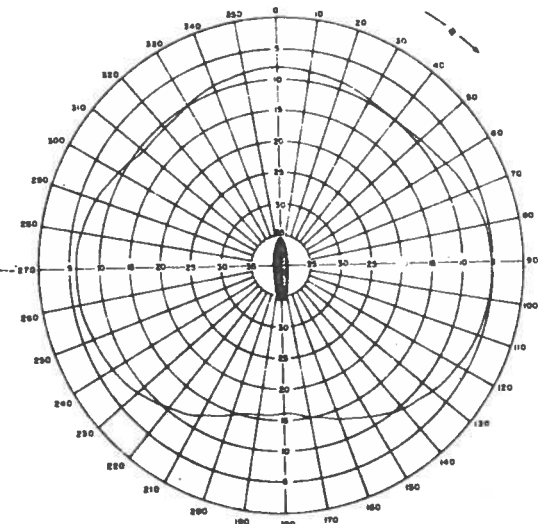
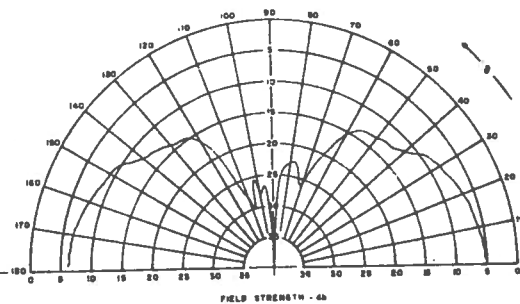
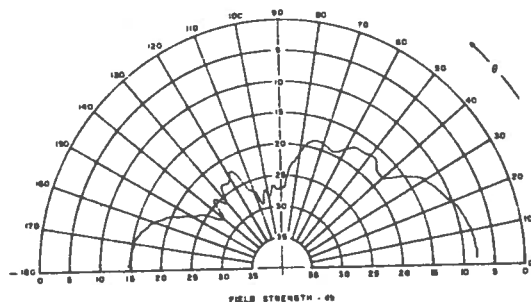
MODEL : DDH-205

ANTENNA : AFT FANS

FREQ. : 4 MHz.

REMARKS : WITH TACAN MAST

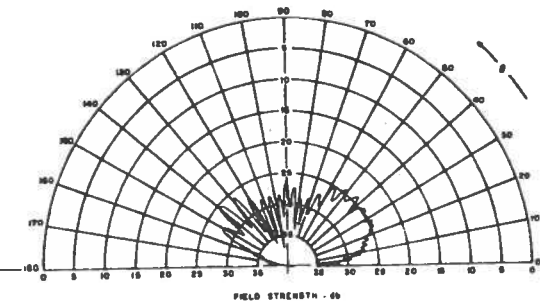
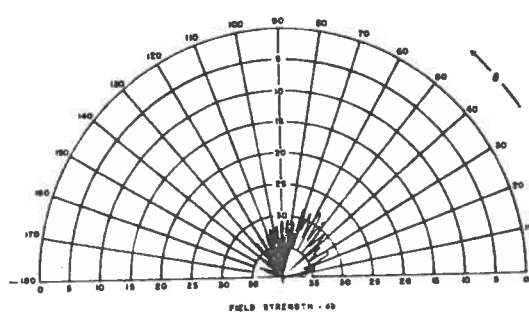
$E_{\theta}$



FWD-AFT

PORT-STBD

$E_{\phi}$



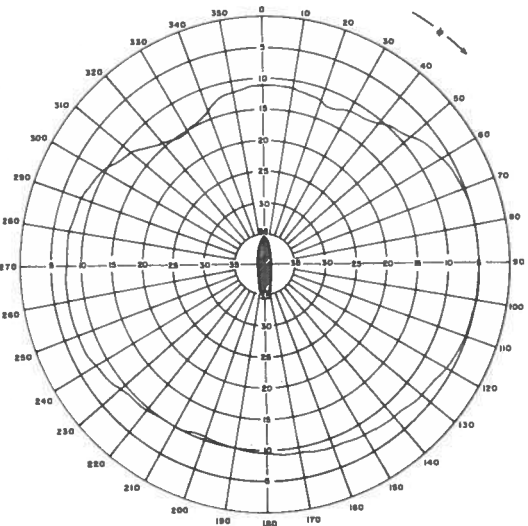
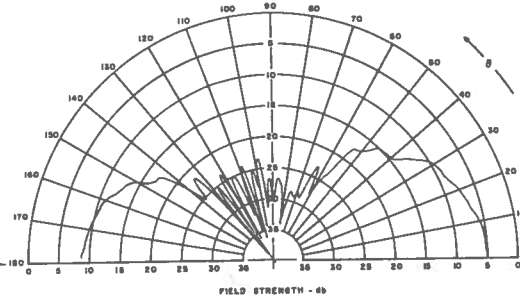
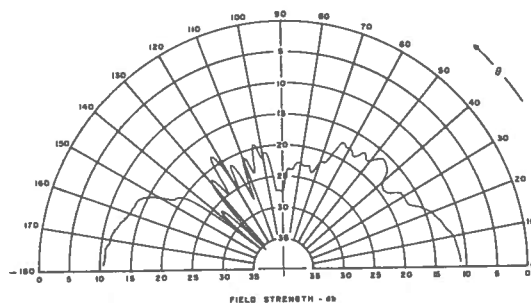
MODEL : DDH-205

ANTENNA : AFT FANS

FREQ : 5 MHz.

REMARKS : WITH TACAN MAST

$E_{\theta}$

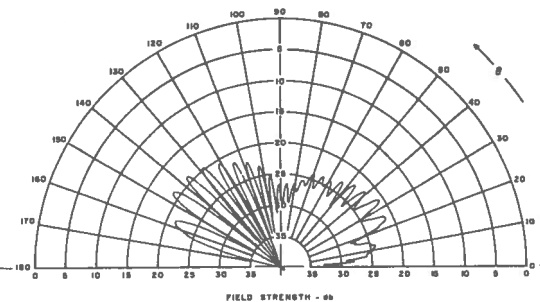
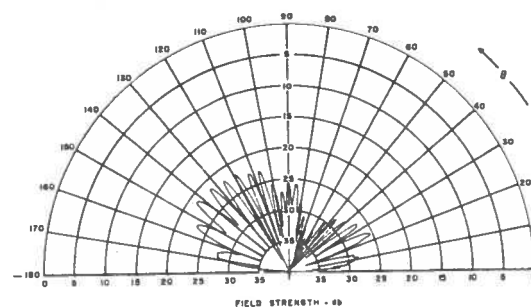


FWD-AFT

PORT-STBD

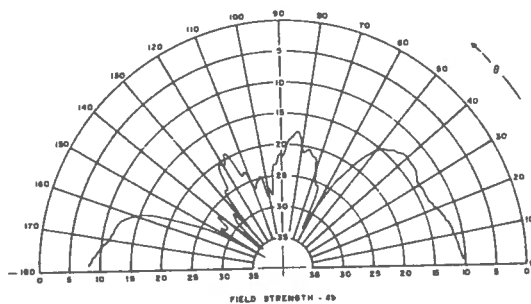
$\theta = 0^\circ$

$E_{\phi}$

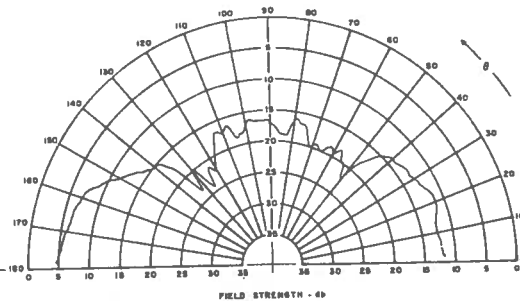


MODEL : DDH-205  
ANTENNA : AFT FANS  
FREQ. : 6 MHz.  
REMARKS : WITH TACAN MAST

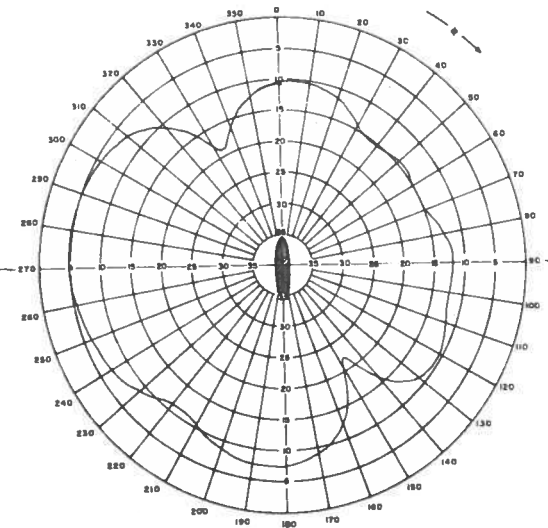
$E_{\theta}$



FWD-AFT

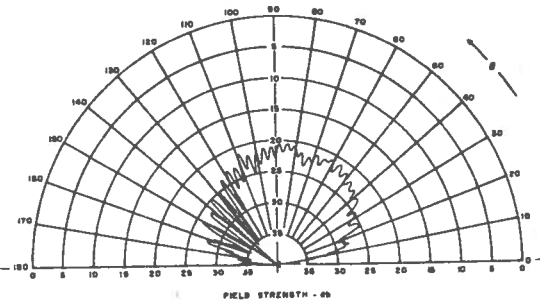
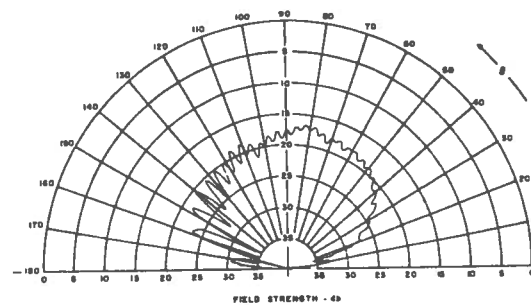


PORT-STBD



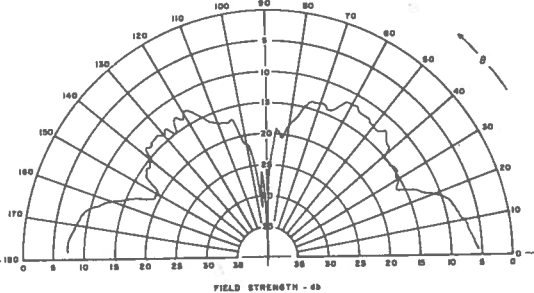
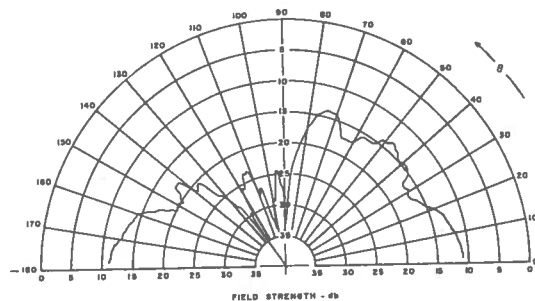
$\theta = 0^\circ$

$E_{\phi}$



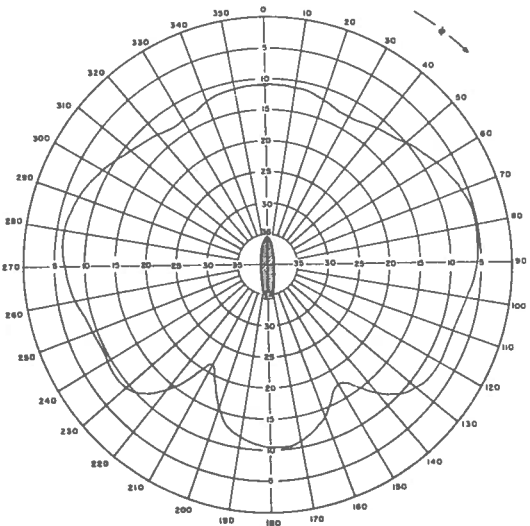
MODEL : DDH-205  
ANTENNA : AFT FANS  
FREQ. : 8 MHz.  
REMARKS : WITH TACAN MAST

$E_{\theta}$



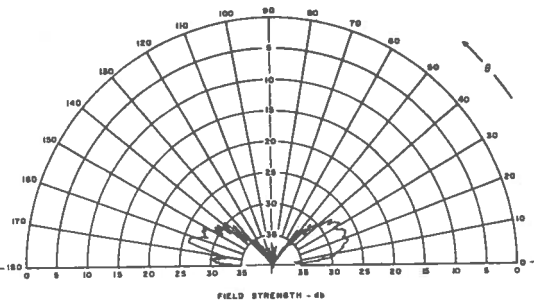
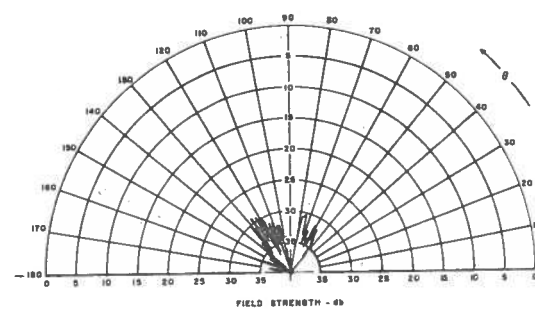
FWD-AFT

PORT-STBD



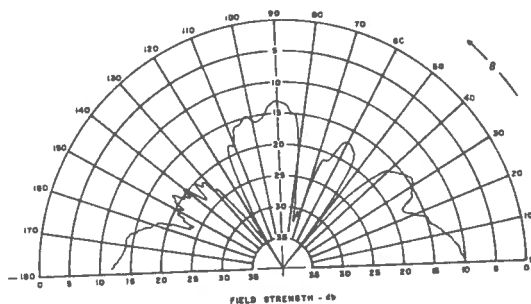
$\theta = 0^\circ$

$E_{\phi}$

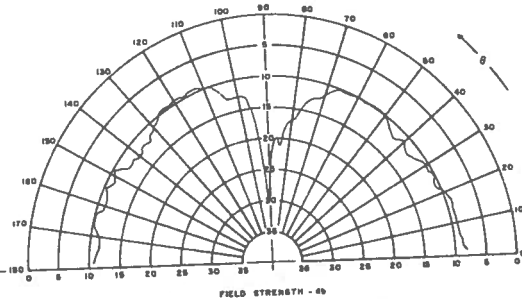


MODEL : DDH-205  
ANTENNA : AFT FANS  
FREQ. : 10 MHz.  
REMARKS : WITH TACAN MAST

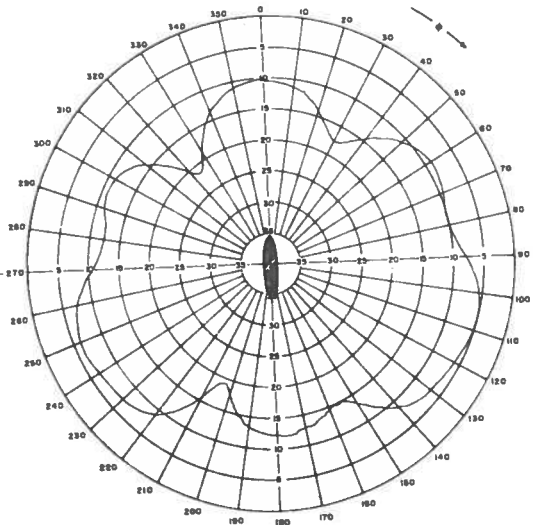
$E_\theta$



FWD-AFT

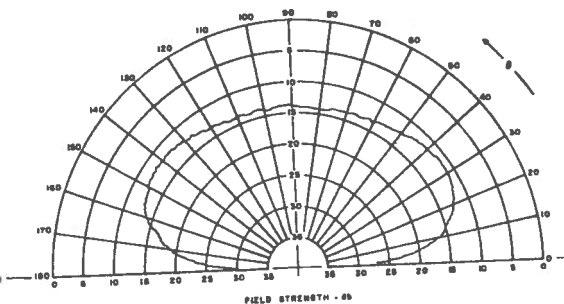
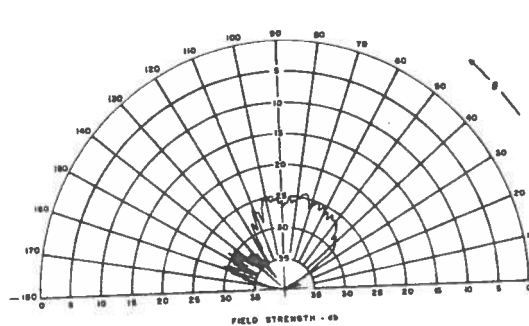


PORT-STBD



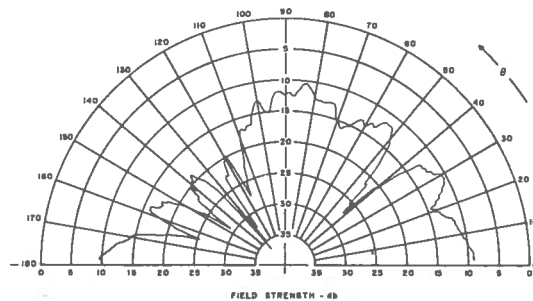
$\theta = 0^\circ$

$E_\phi$

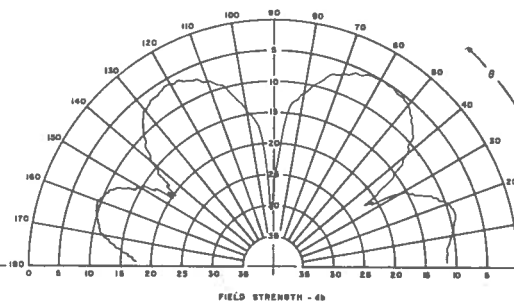


MODEL : DDH-205  
ANTENNA : AFT FANS  
FREQ. : 12 MHz.  
REMARKS : WITH TACAN MAST

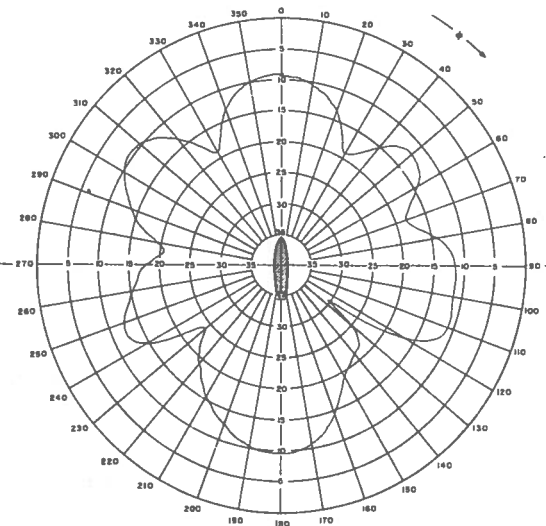
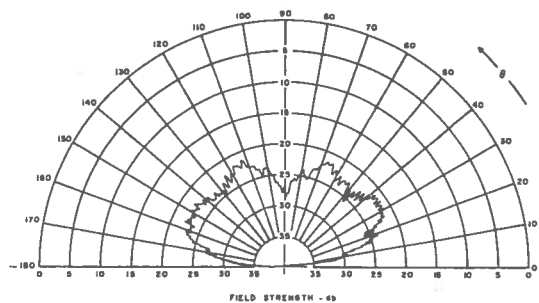


$E_{\theta}$ 

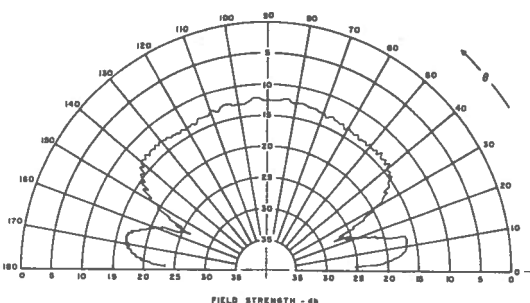
FWD-AFT



PORT-STBD

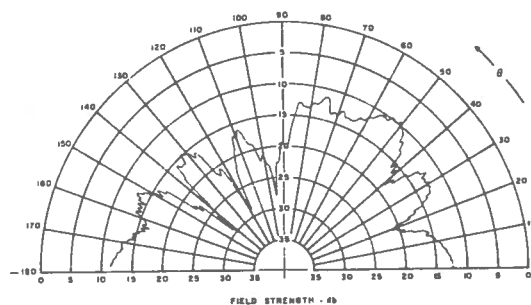
 $\theta = 0^\circ$  $E_{\phi}$ 

FIELD STRENGTH - dB

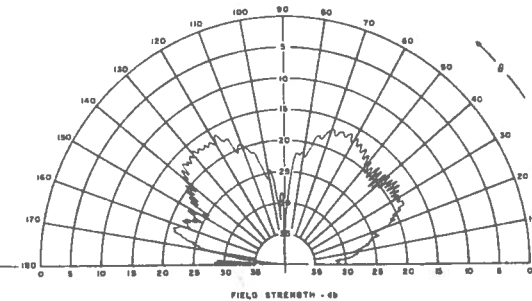


FIELD STRENGTH - dB

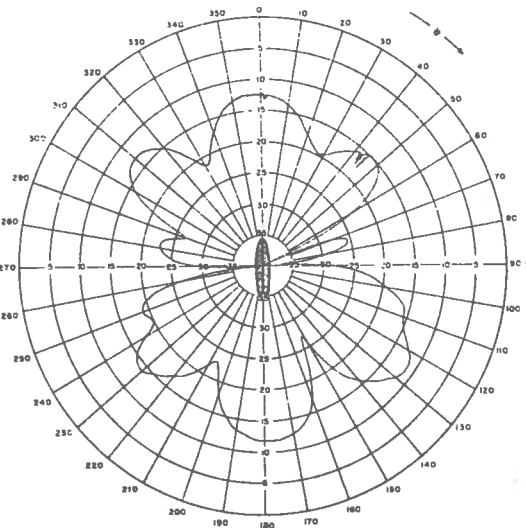
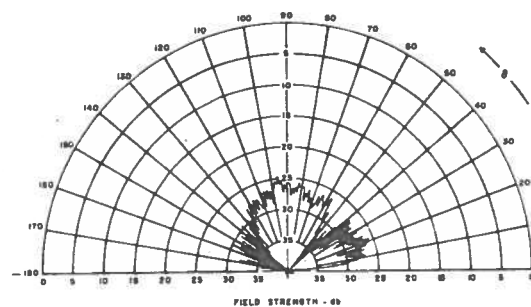
MODEL : DDH-205  
 ANTENNA : AFT FANS  
 FREQ. : 14 MHz.  
 REMARKS : WITH TACAN MAST

$E_{\theta}$ 

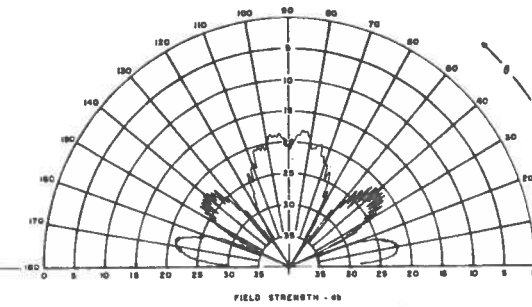
FWD-AFT



PORT-STBD

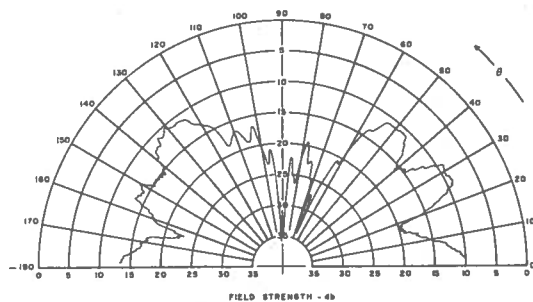
 $\theta = 0^\circ$  $E_{\phi}$ 

FIELD STRENGTH - dB

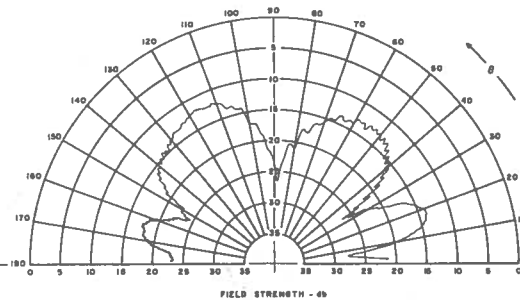


FIELD STRENGTH - dB

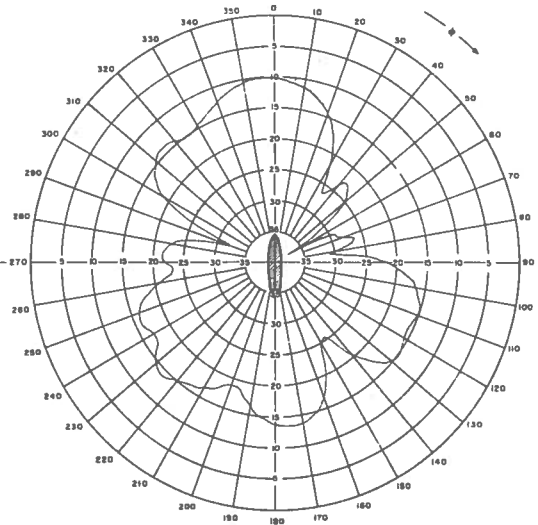
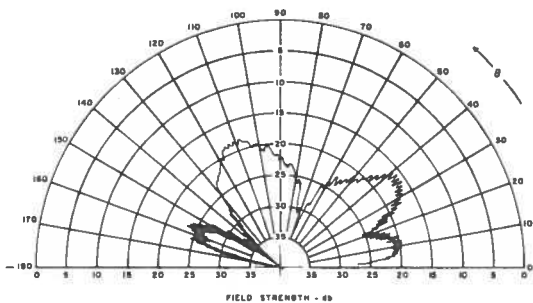
MODEL : DDH-205  
 ANTENNA : AFT FANS  
 FREQ. : 16 MHz.  
 REMARKS : WITH TACAN MAST

$E_{\theta}$ 

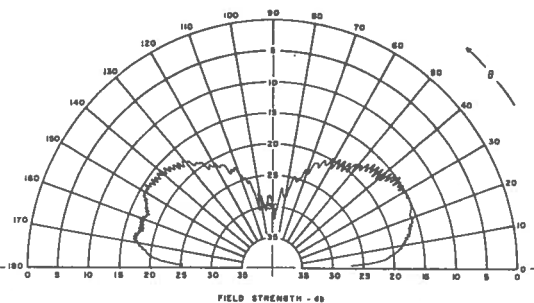
FWD-AFT



PORT-STBD

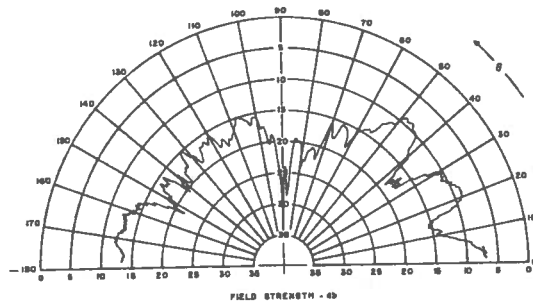
 $\theta = 0^\circ$  $E_{\phi}$ 

FIELD STRENGTH - dB

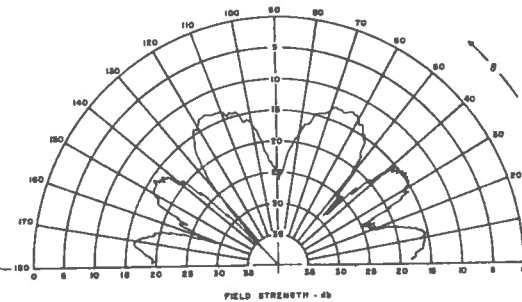


FIELD STRENGTH - dB

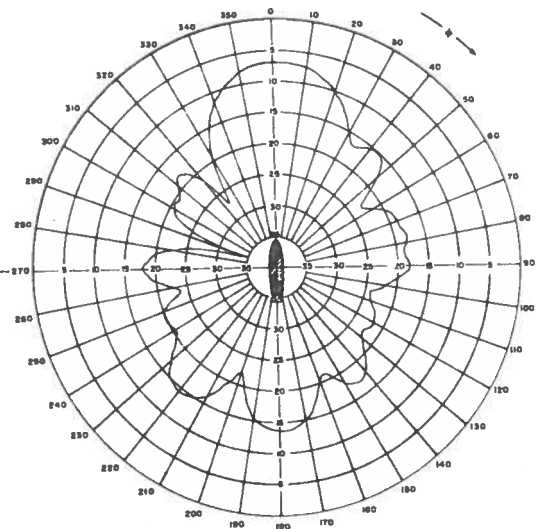
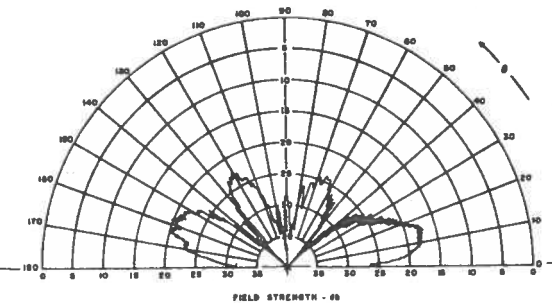
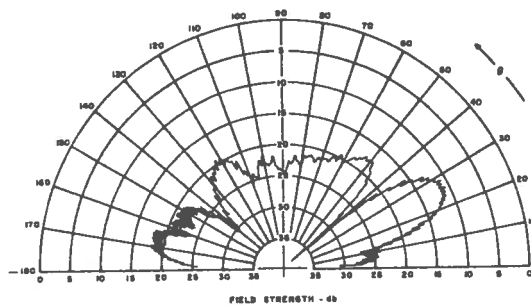
MODEL : DDH-205  
ANTENNA : AFT FANS  
FREQ. : 18 MHz.  
REMARKS : WITH TACAN MAST

$E_{\theta}$ 

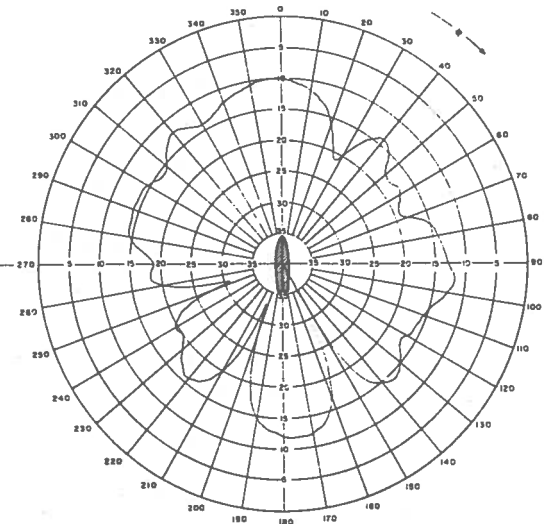
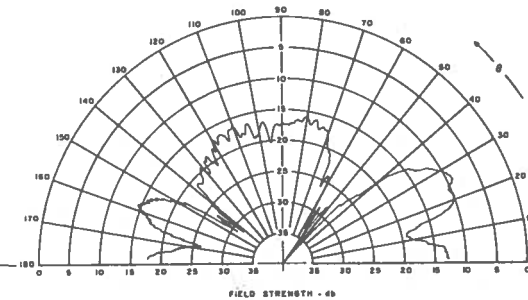
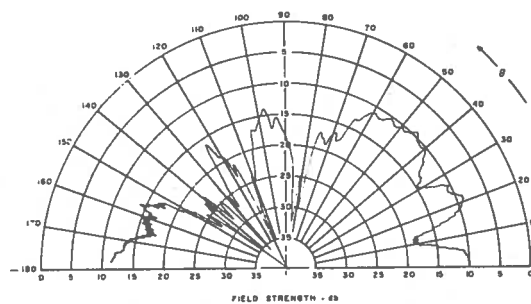
FWD-AFT



PORT-STBD

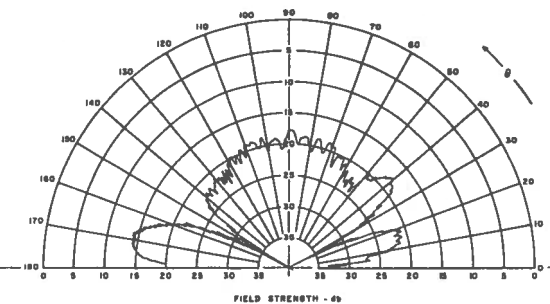
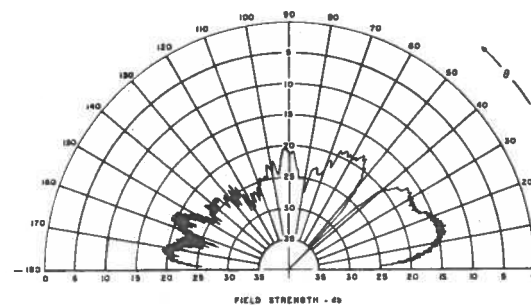
 $\theta = 0^\circ$  $E_{\phi}$ 

MODEL : DDH-205  
ANTENNA : AFT FANS  
FREQ. : 20 MHz.  
REMARKS : WITH TACAN MAST

$E_{\theta}$ 

FWD-AFT

PORT-STBD

 $\theta = 0^\circ$  $E_{\phi}$ 

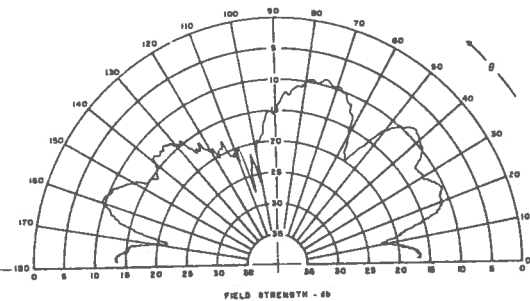
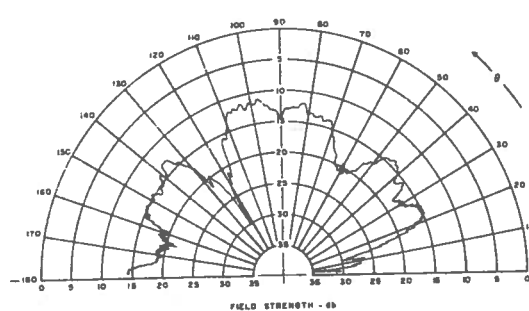
MODEL : DDH-205

ANTENNA : AFT FANS

FREQ. : 22 MHz.

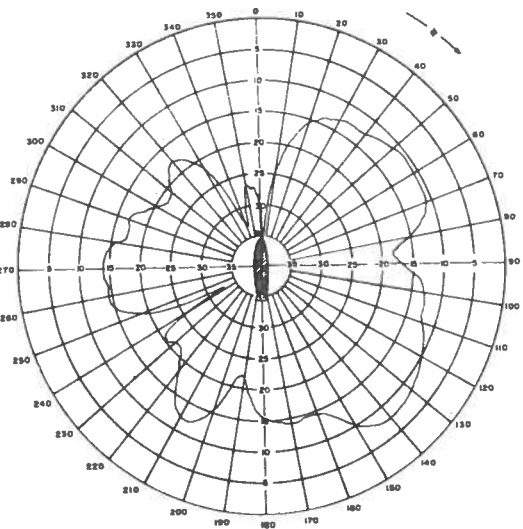
REMARKS : WITH TACAN MAST

$E_{\theta}$



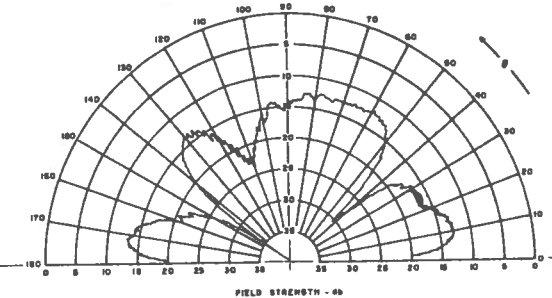
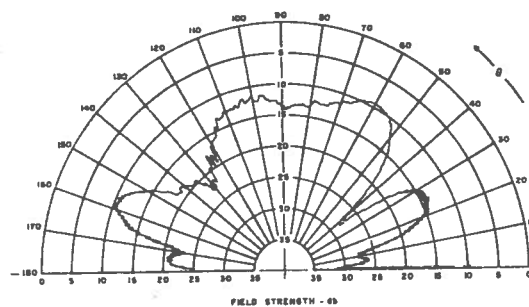
FWD-AFT

PORT-STBD



$\theta = 0^\circ$

$E_{\phi}$



MODEL : DDH-205  
ANTENNA : AFT FANS  
FREQ. : 24 MHz.  
REMARKS : WITH TACAN MAST



*Plate I 1/20 scale mock-up of DDH205 used in the impedance measurements*