A proposed HF receiving antenna for HMCS bonaventure

Wong, J.Y.

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A PROPOSED HF RECEIVING ANTENNA FOR HMCS BONAVENTURE

J. Y. WONG

OTTAWA

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ABSTRACT

A two-element co-phased fan-type receiving antenna located on the island structure has been developed for HMCS Bonaventure. The antenna which will be used in conjunction with a multicoupler is intended to replace the present 28-foot receiving whips.

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1. Proposed fan-antenna located on island superstructure

2. Figure of merit of fan-antenna and 28-foot whip

PLATE

I. 1/48 scale model of HMCS Bonaventure island

RADIATION PATTERNS

36 patterns of fan-antenna

36 patterns of 28-foot whip

A PROPOSED HF RECEIVING ANTENNA FOR HMCS BONAVENTURE

- J.Y. Wong -

INTRODUCTION

The existing HF receiving antenna system for the aircraft carrier HMCS Bonaventure consists of a number of 28-foot whips located on the island superstructure. As part of an effort to improve the communications performance on the Bonaventure, DGE(SEA)/RCN has suggested the removal of all the whips and replacing them by a single antenna/multi-coupler arrangement.

In the development of an HF antenna system for the DDH205 destroyer escort class [1], a very satisfactory receiving antenna was designed which employed 2 co-phased fan-type radiators. It was decided therefore to adopt this form of antenna for the Bonaventure, and the problem became one of establishing the optimum antenna location by a radiation pattern study. Owing to rigid space restrictions on the carrier, the antenna was necessarily confined to the island structure.

RADIATION PATTERN MEASUREMENTS

Radiation pattern measurements were carried out on a 1/48 scale model of the Bonaventure. Plate I is a photograph of the model, showing the island. During the initial phases of the study only principal plane patterns of the antenna were measured. Three different locations were investigated, and the one shown in Fig. 1 looked the most promising and was selected for further study. The antenna consists of two fan-type radiators — one radiator is located outboard on the island and the other inboard. The four conductors which comprise each fan are electrically bonded to the island just above the flight deck. The feed point is located on a sponson-like compartment between the mainmast and foremast. The two fans are connected together to form a two-element co-phased antenna.

Three-dimensional patterns of the antenna were measured at the following full-scale frequencies: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, and 24 MHz. For each frequency E_θ and E_ϕ components were measured for the following elevation angles: $\theta = 0°$, 6°, 12°, 18°, 25°, 37°, 45°, 53°, 65°, and 90°. Consequently, for each frequency there is a total of 25 patterns — 5 principal-plane and 20 conical-plane. These are included in the report.

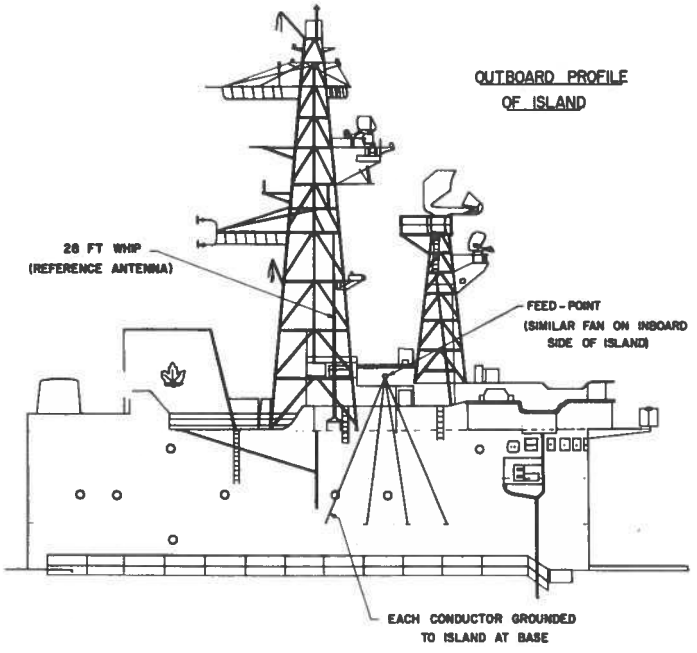

Fig. 1 Proposed fan-antenna located on island superstructure

To obtain a basis of comparison a similar set of patterns was obtained for a 28-foot whip. The reference whip is located at about mid-point and outboard of the island, as illustrated in Fig. 1.

RESULTS

The figure of merit which is a measure of the radiation performance was computed for both the fan antenna and the reference 28-foot whip. The calculations were carried out in accordance with the procedure [2] given in Report ERB-647. The results are given in Fig. 2. It is seen that the fan is significantly superior to the 28-foot whip between 2 MHz and about 18 MHz. From 18 MHz to 24 MHz the whip is somewhat better than the fan.

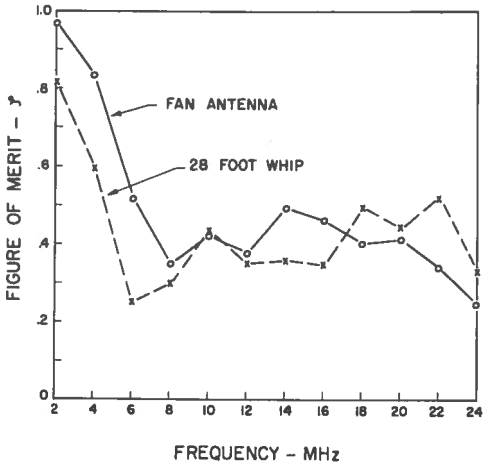

Fig. 2 Figure of merit of fan-antenna and 28-foot whip

CONCLUSION

A radiation pattern analysis demonstrates that a configuration of 2 co-phased fans is feasible for a receiving antenna and should provide superior over-all performance compared with an island-mounted 28-foot whip.

Our proposed design was submitted to DGE(SEA)/RCN for consideration, and it is planned to fit the Bonaventure with the antenna during the next refit program scheduled for early 1966.

REFERENCES

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

2. J.Y. Wong, "A proposed method for evaluating the performance of an HF shipborne transmitting antenna", NRC Report ERB-647, September 1963

RADIATION PATTERNS OF FAN-ANTENNA

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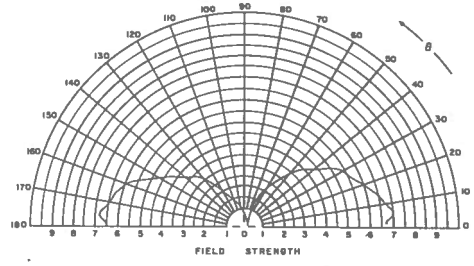

E_θ

FWD-AFT

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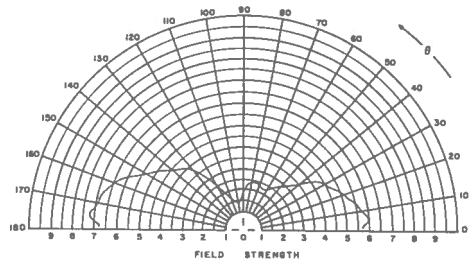
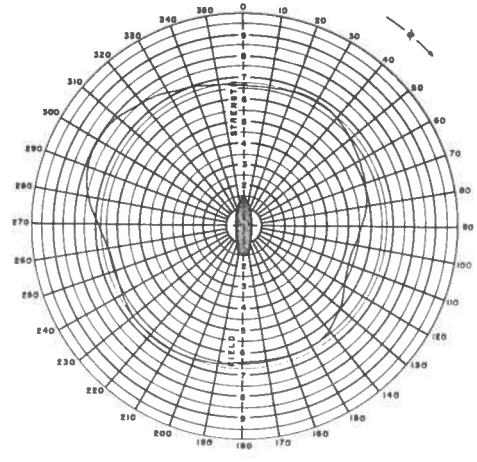


PORT-STBD



$\theta = 0°$

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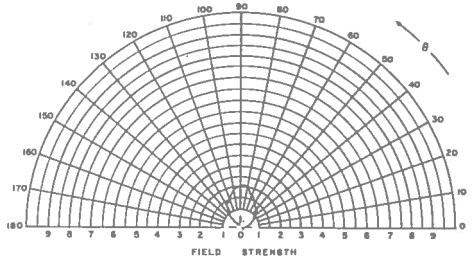

E_ϕ

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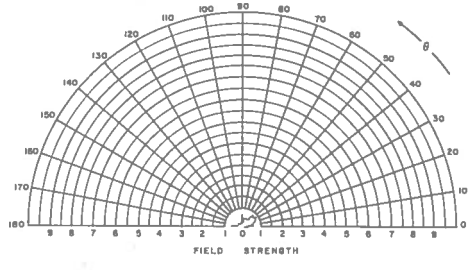


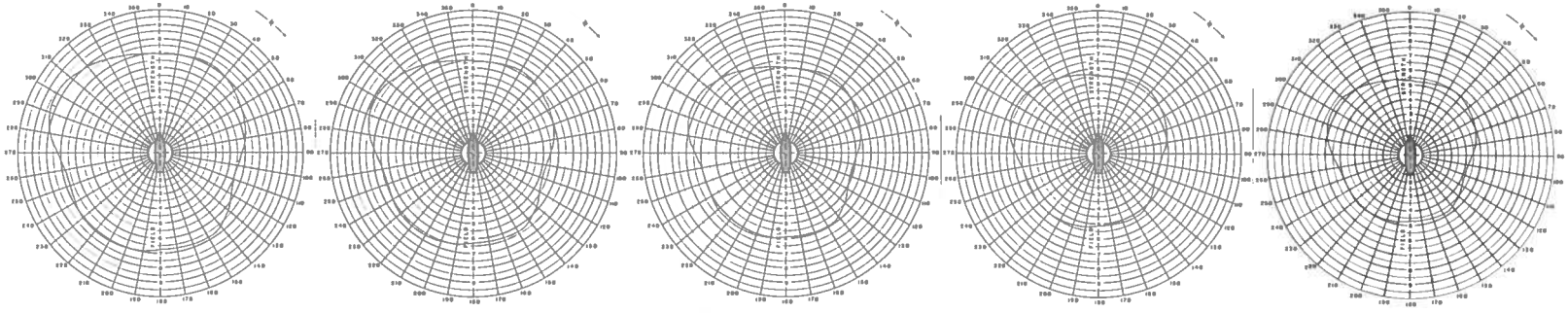
ANTENNA : PROPOSED ISLAND R_X FANS

FREQ. : 2 Mc/s

REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS – 50Ω

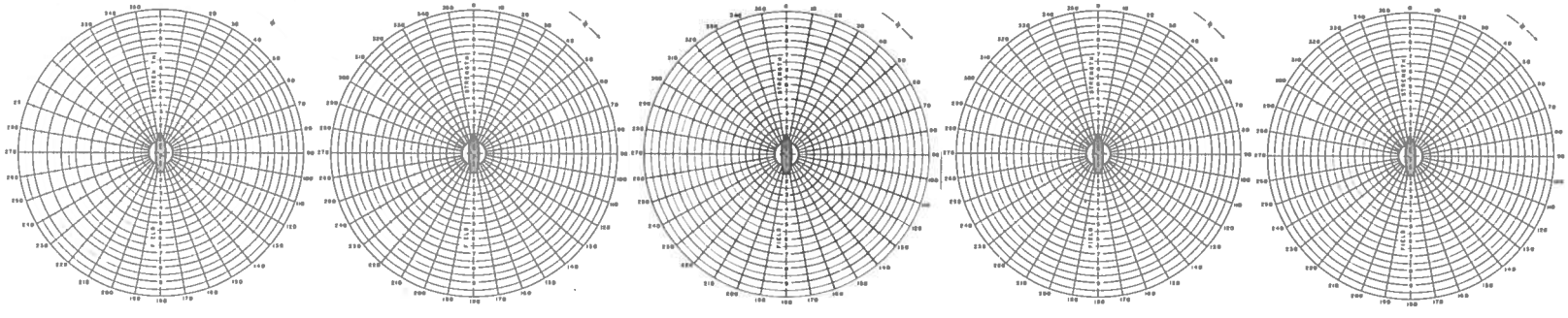
$\zeta = .97$
$\eta = 1.06$

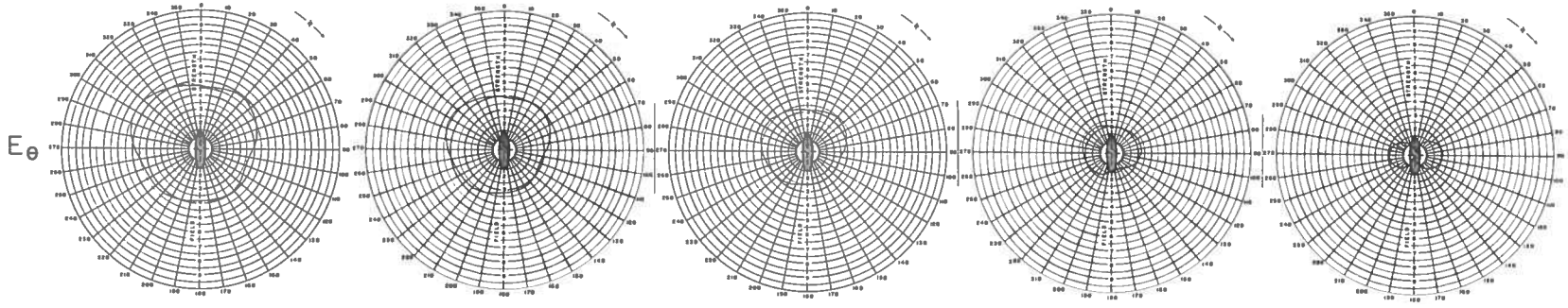
E_θ

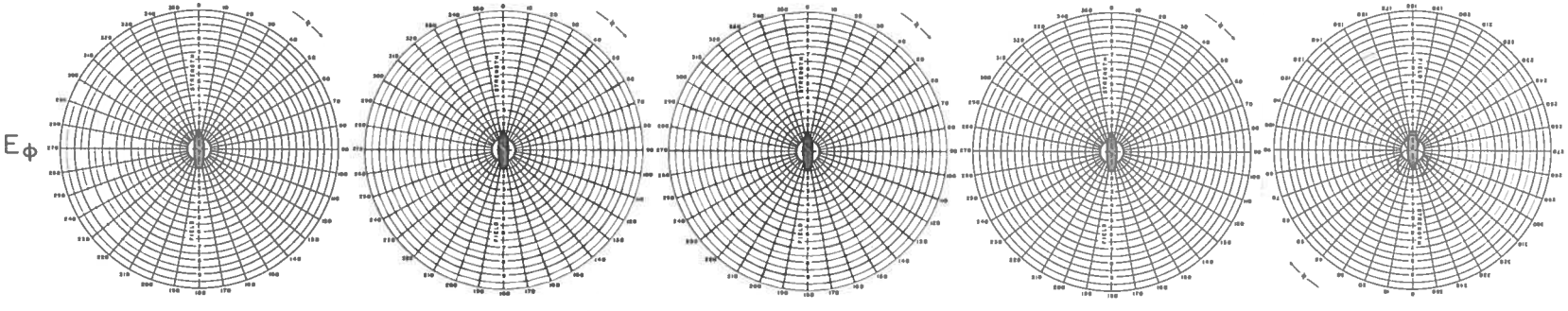


$\theta = 6°$ $\theta = 12°$ $\theta = 18°$ $\theta = 25°$ $\theta = 30°$

E_ϕ




E_θ
θ = 37°
θ = 45°
θ = 53°
θ = 65°
θ = 90°


E_ϕ

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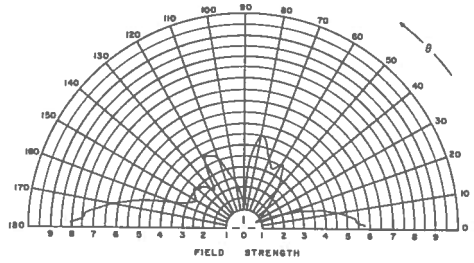

E_θ

FWD-AFT

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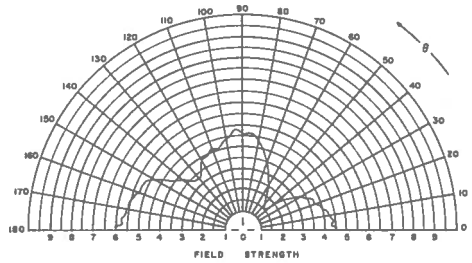
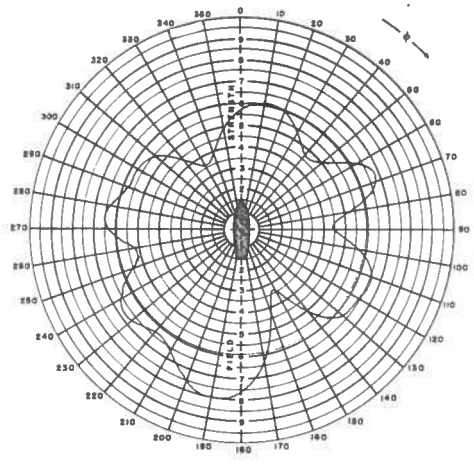


PORT-STBD



$\theta = 0°$

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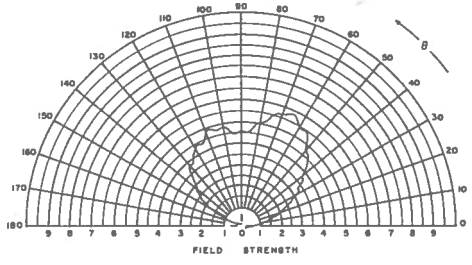

E_ϕ

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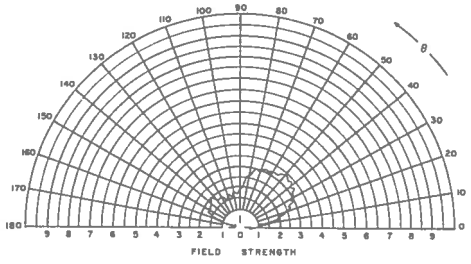


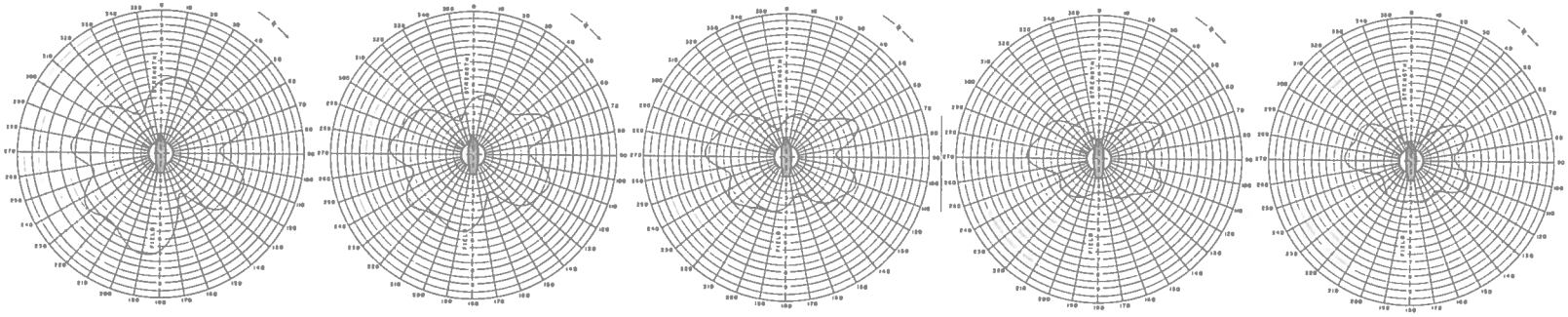
ANTENNA : PROPOSED ISLAND R_X FANS

FREQ. : 4 Mc/s

REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS - 50Ω

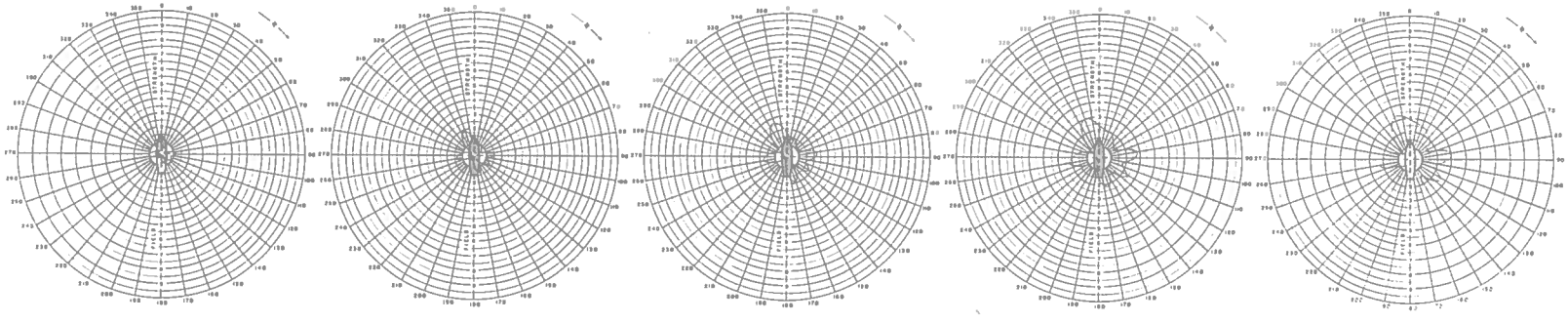
$\zeta = .84$
$\eta = .99$

E_θ

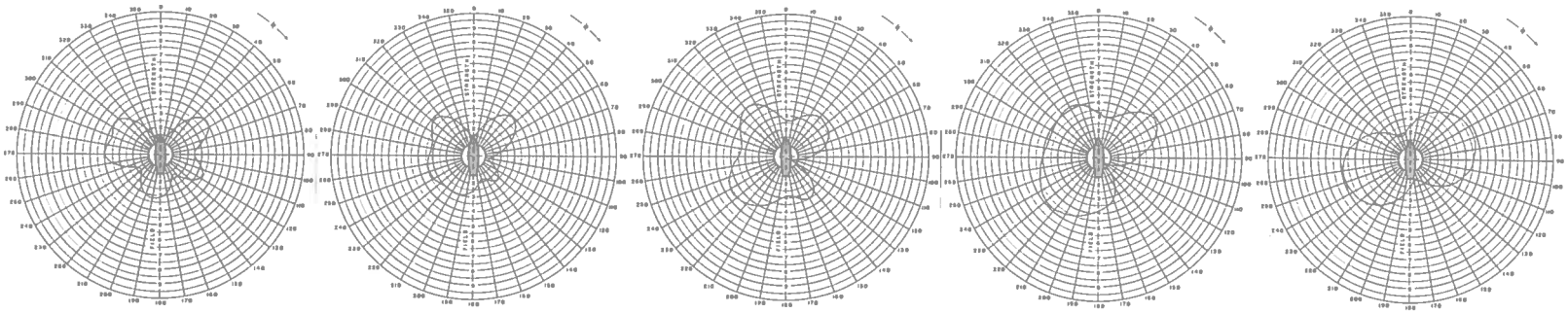


θ = 6°　　θ = 12°　　θ = 18°　　θ = 25°　　θ = 30°

E_ϕ

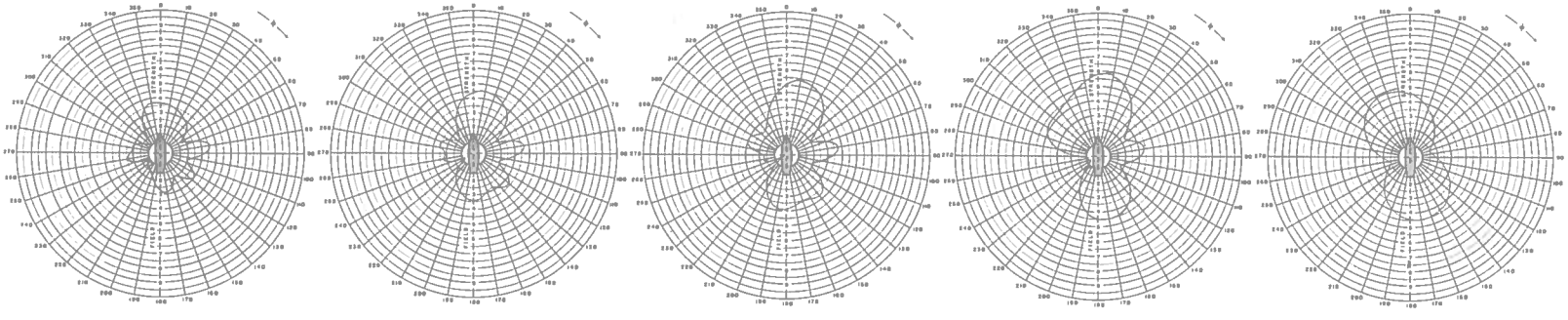


E_θ



θ = 37°　　θ = 45°　　θ = 53°　　θ = 65°　　θ = 90°

E_ϕ



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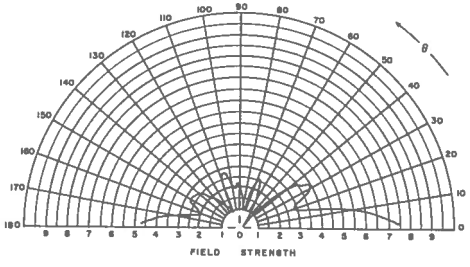
E_θ



FWD - AFT

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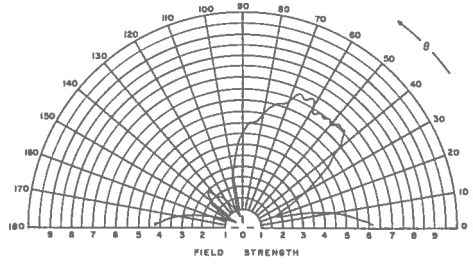
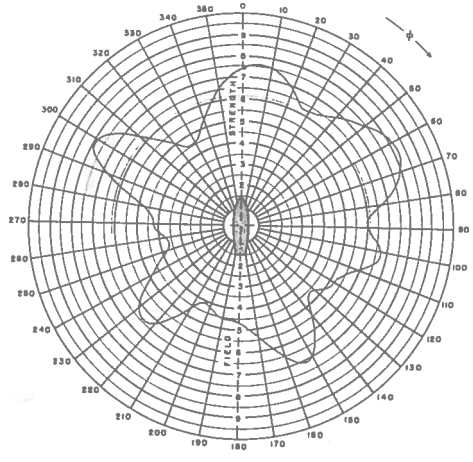


PORT - STBD



Θ = 0°

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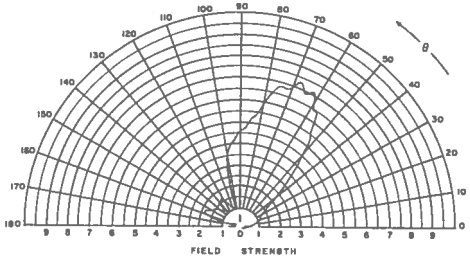
E_ϕ



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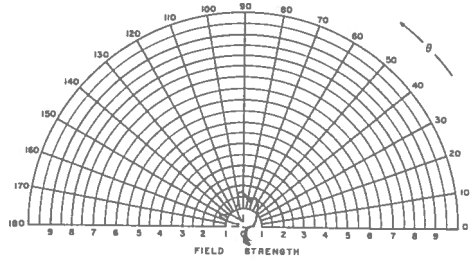


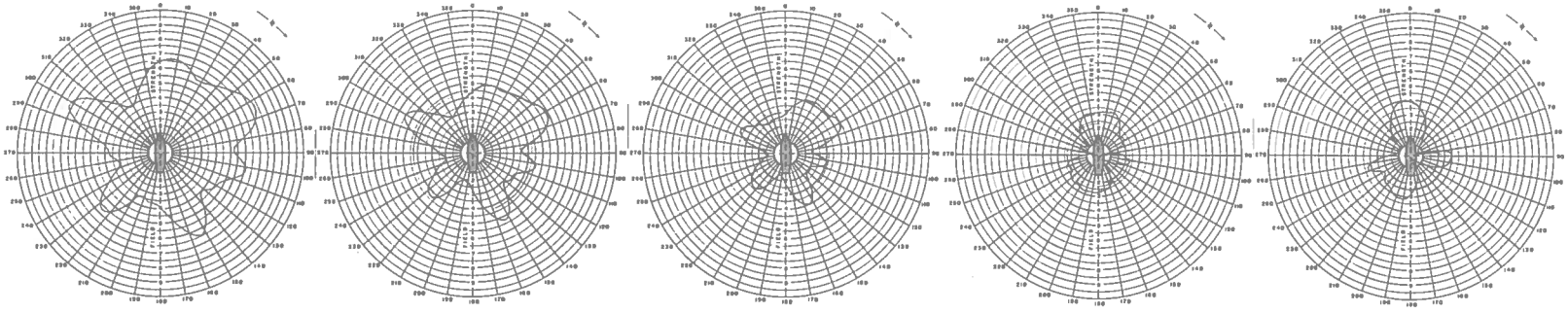
ANTENNA : PROPOSED ISLAND R_X FANS

FREQ. : 6 Mc/s

REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS – 50Ω

ζ = .52
η = .67

E_θ



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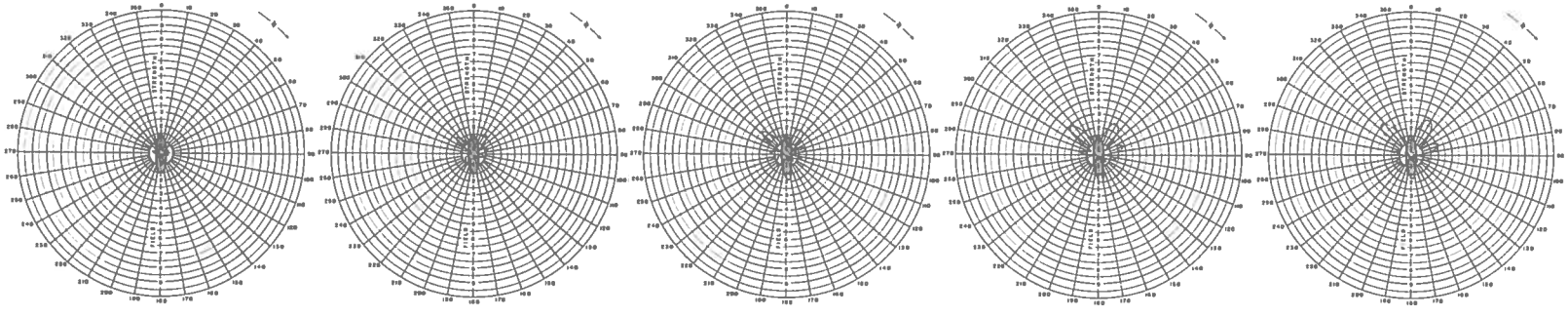
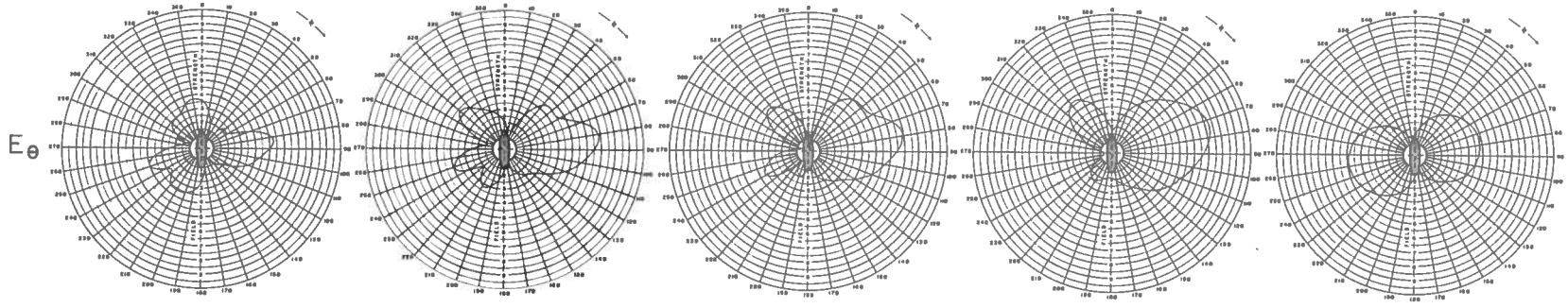
E_ϕ




E_θ
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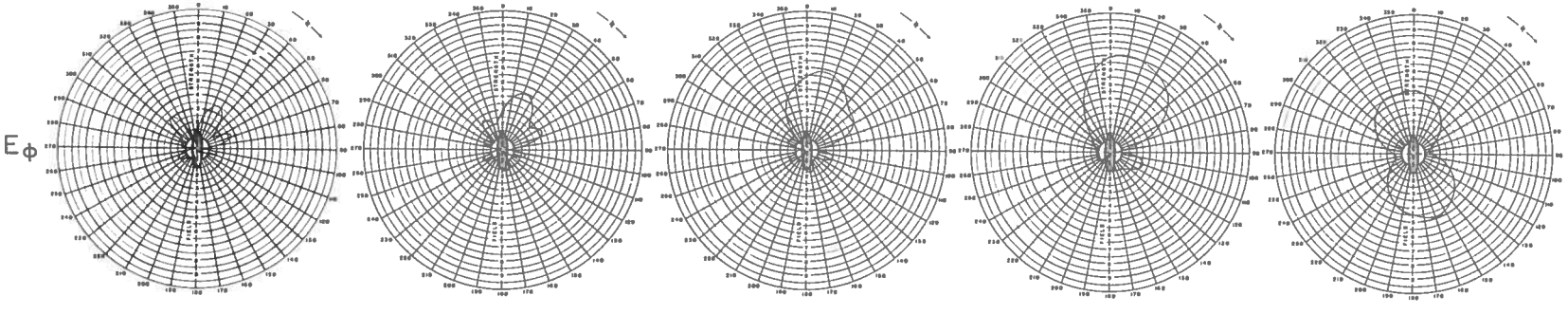
θ = 45°
θ = 53°
θ = 65°
θ = 90°


E_ϕ

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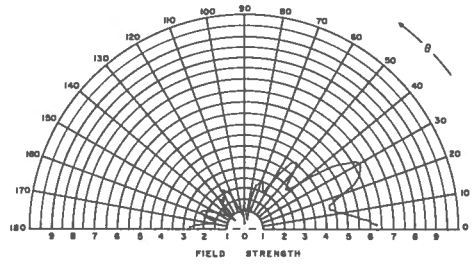

E_θ

FWD-AFT

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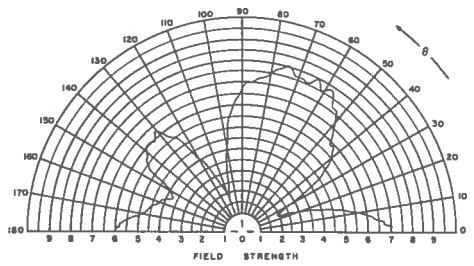

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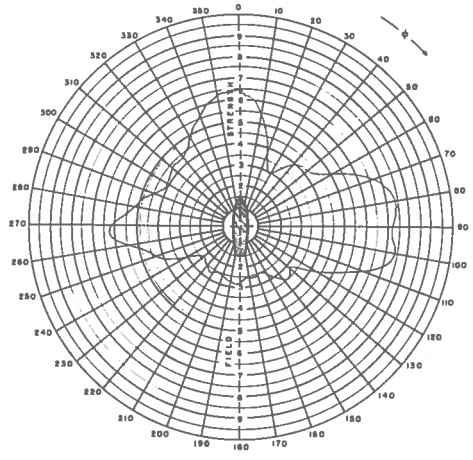

θ = 0°

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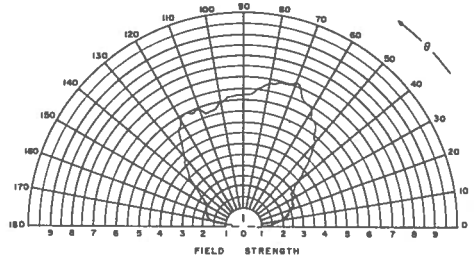

E_ϕ

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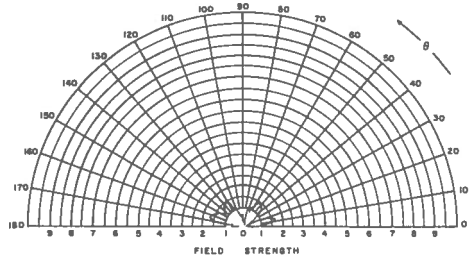


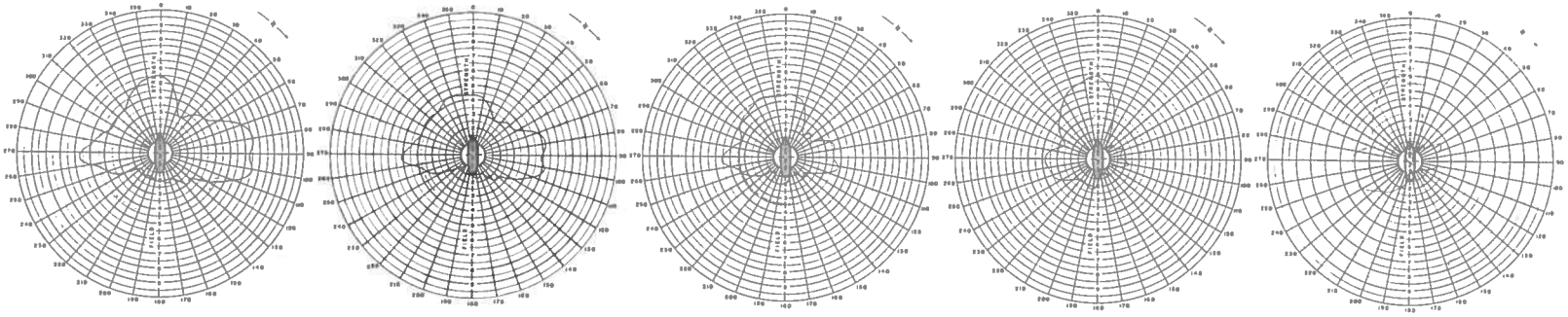
ANTENNA : PROPOSED ISLAND R_x FANS

FREQ. : 8 Mc/s

REMARKS : ALL R_x 28 FT WHIPS REMOVED
ALL T_x 35 FT WHIPS - 50Ω

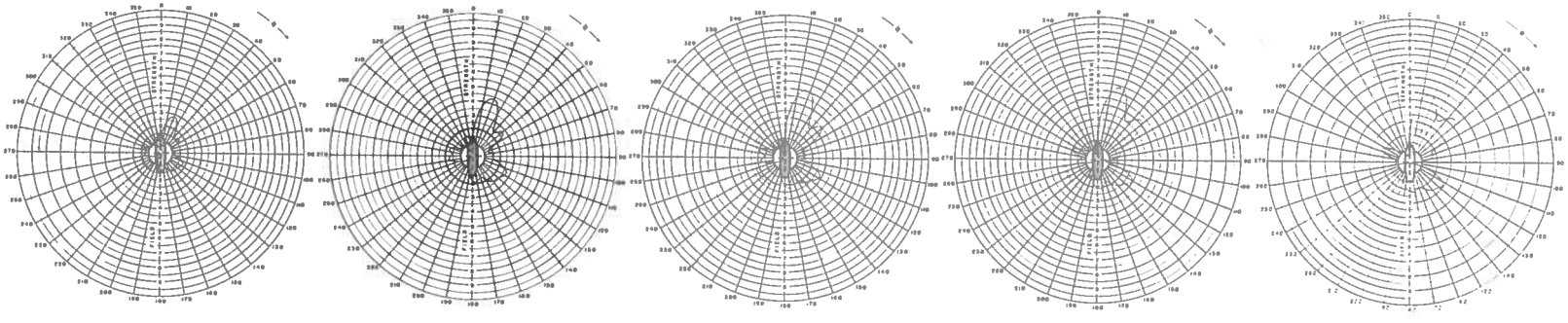
ζ = .35
η = .48

E_θ

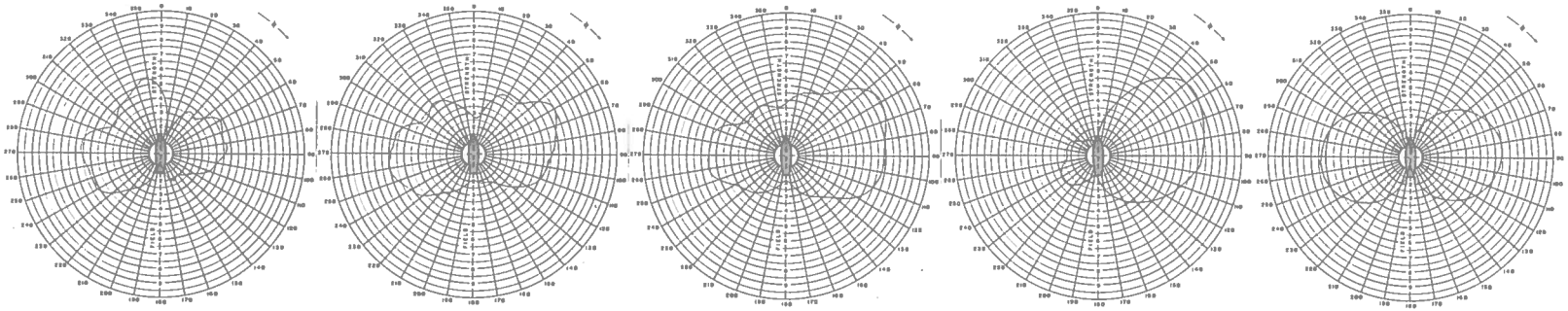


θ = 6° θ = 12° θ = 18° θ = 25° θ = 30°

E_ϕ

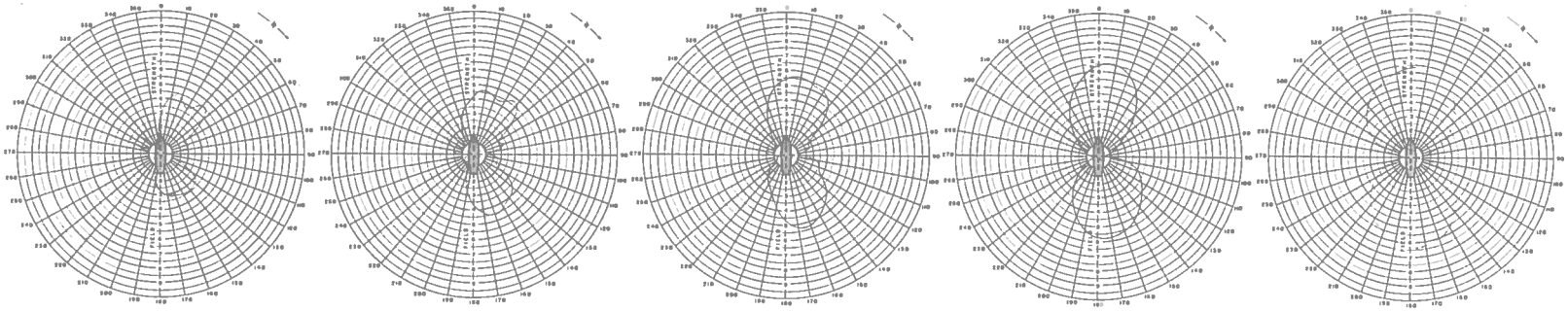


E_θ



θ = 37°　　θ = 45°　　θ = 53°　　θ = 65°　　θ = 90°

E_ϕ



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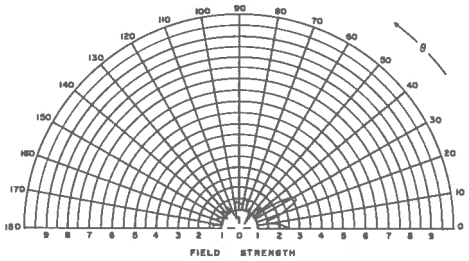

E_θ

FWD-AFT

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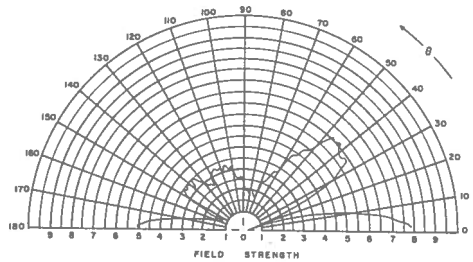
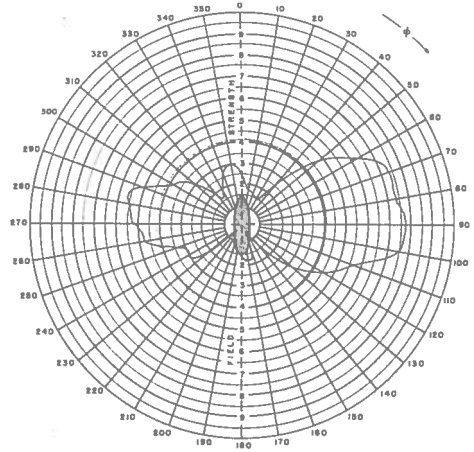


PORT-STBD



θ = 0°

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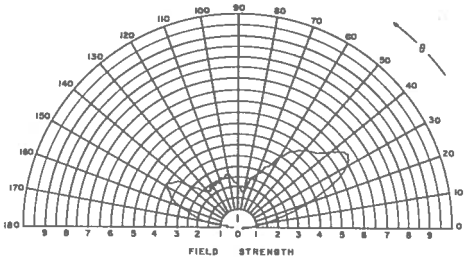

E_ϕ

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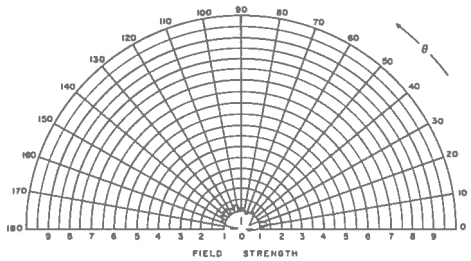


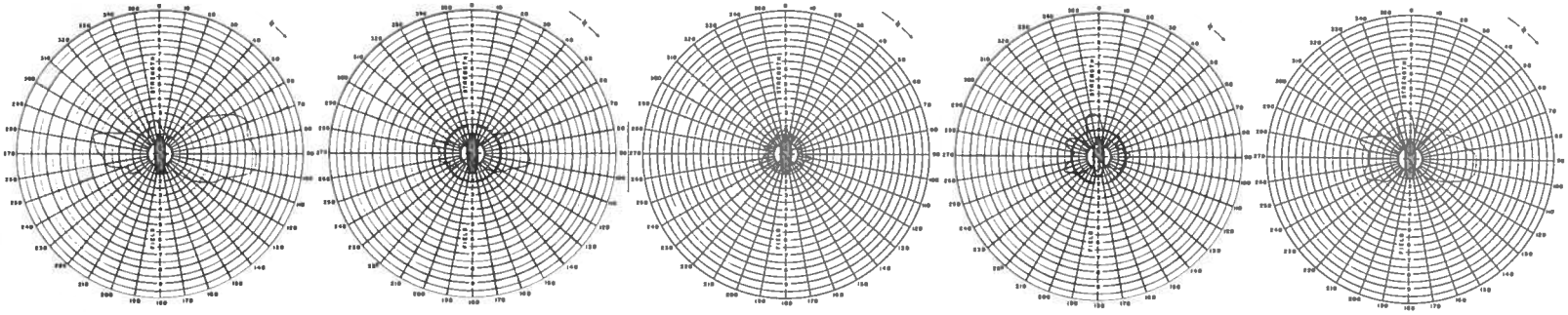
ANTENNA : PROPOSED ISLAND R_X FANS

FREQ. : 10 Mc/s

REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS – 50Ω

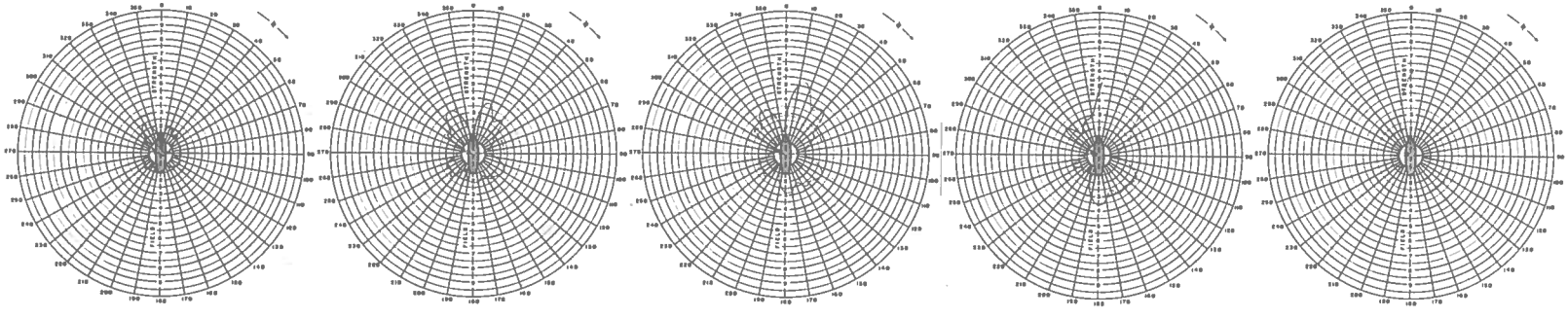
δ = .43
η = .69

E_θ

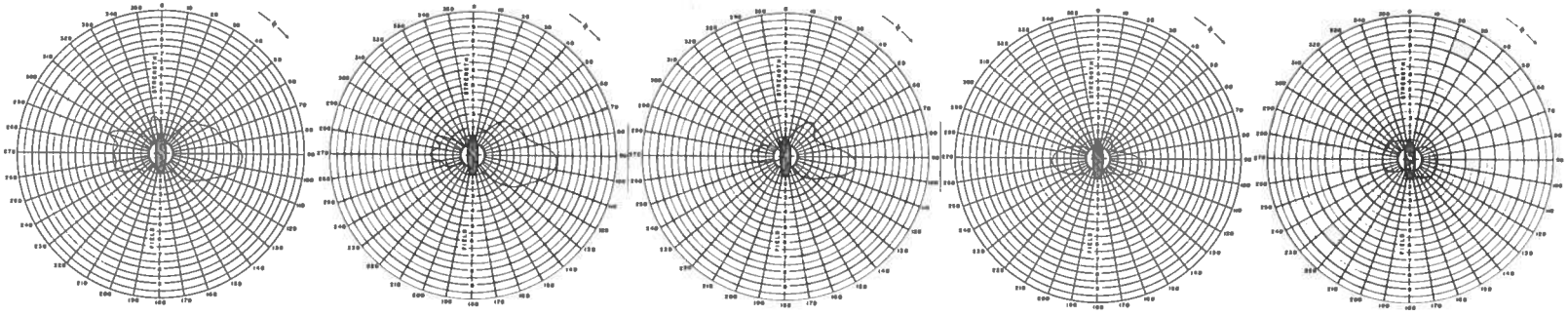


θ = 6°　　θ = 12°　　θ = 18°　　θ = 25°　　θ = 30°

E_ϕ

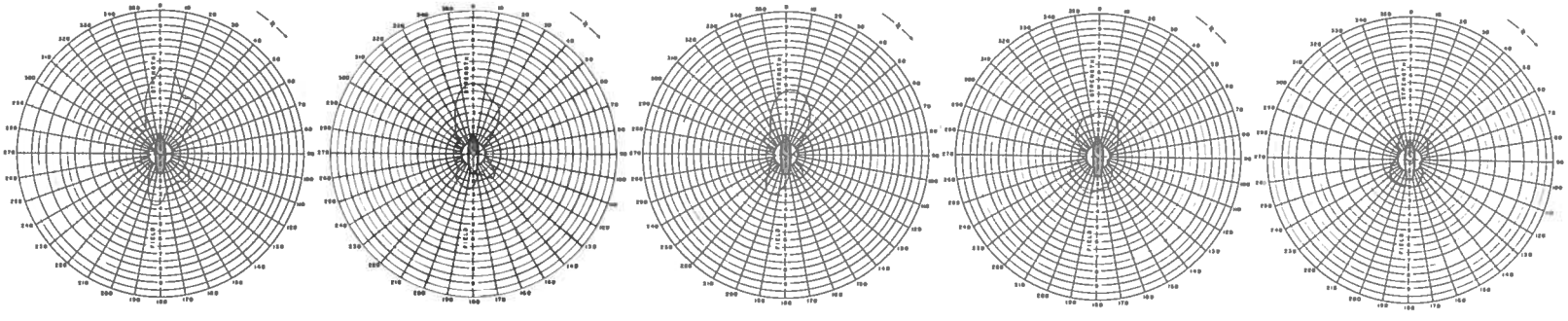


E_θ

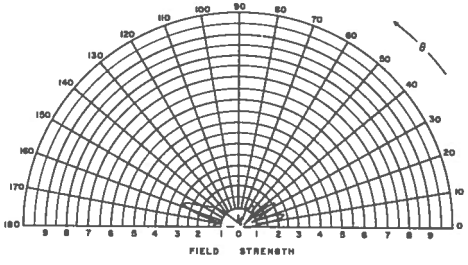


θ = 37°　　θ = 45°　　θ = 53°　　θ = 65°　　θ = 90°

E_ϕ



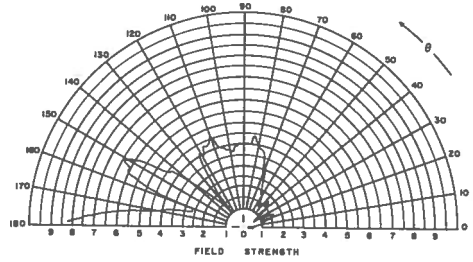
NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



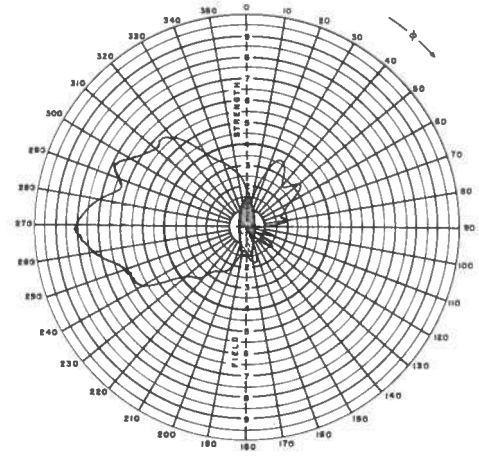
E_θ

FWD-AFT

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION

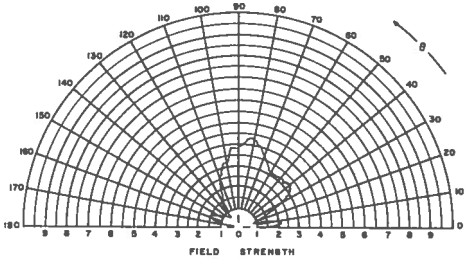


PORT-STBD



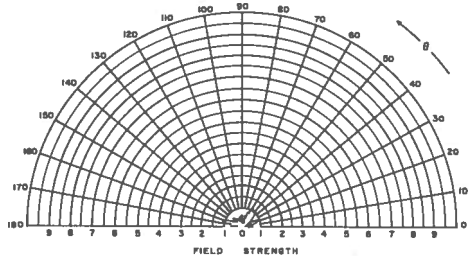
θ = 0°

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



E_ϕ

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



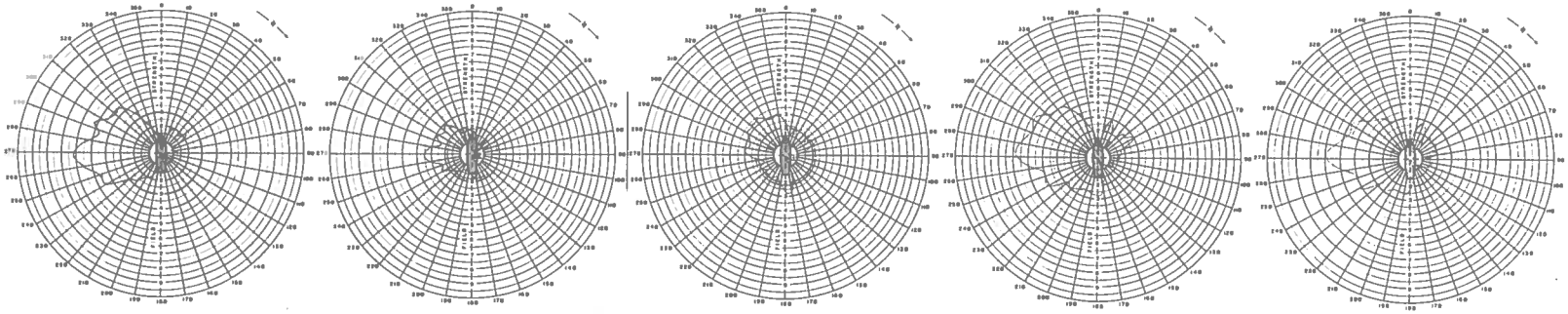
ANTENNA : PROPOSED ISLAND R_X FANS

FREQ. : 12 Mc/s

REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS - 50Ω

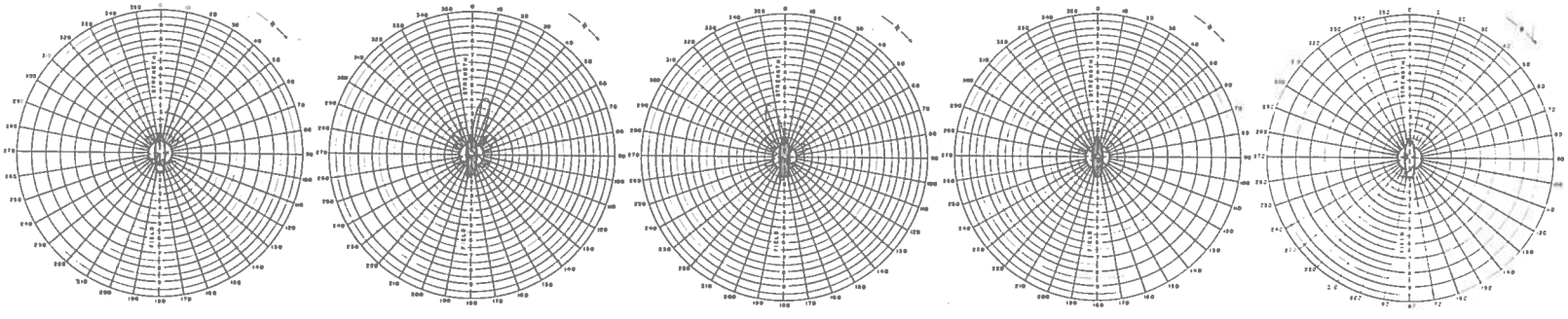
ζ = .38
η = .75

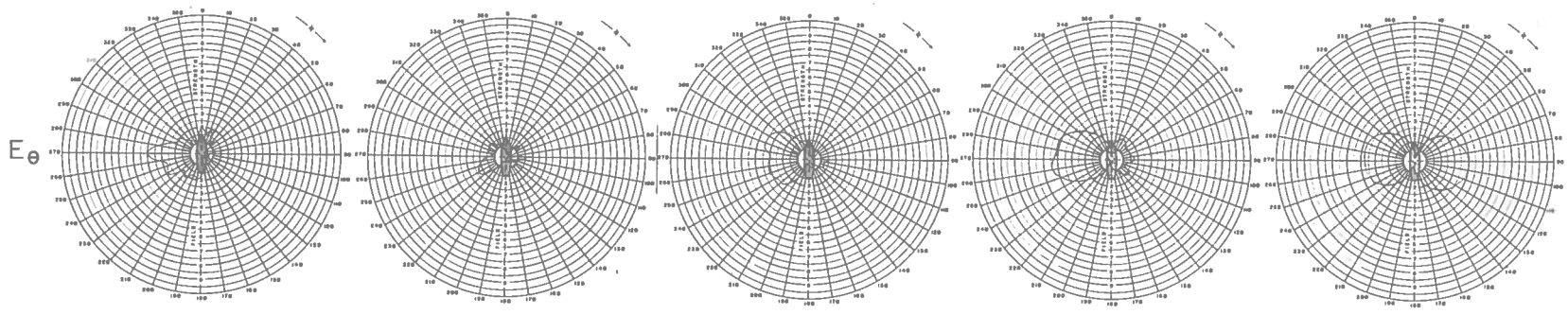
E_θ



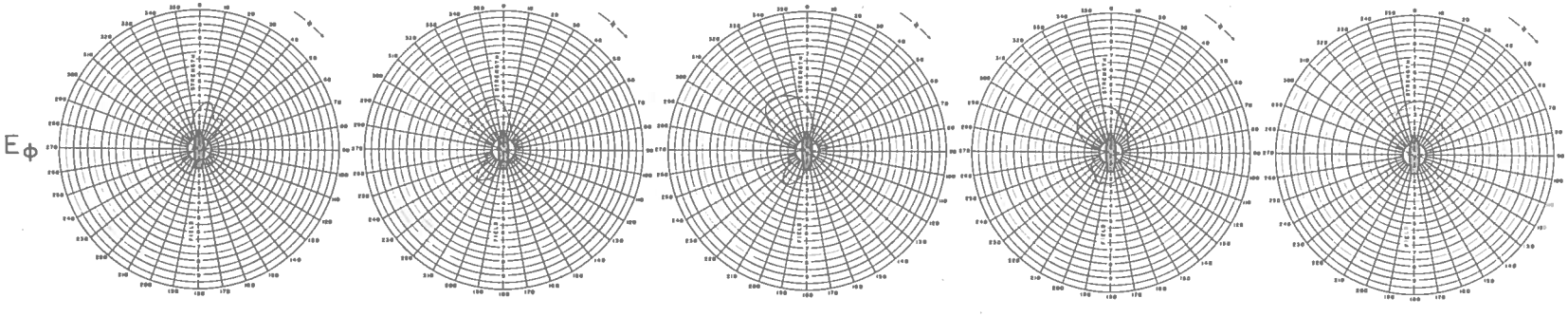
θ = 6°　　θ = 12°　　θ = 18°　　θ = 25°　　θ = 30°

E_ϕ





θ = 37°　　θ = 45°　　θ = 53°　　θ = 65°　　θ = 90°



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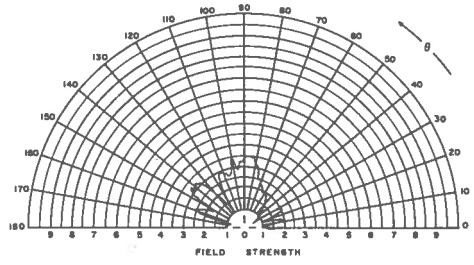
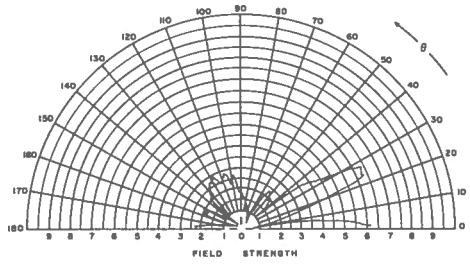
RADIO AND ELECTRICAL ENGINEERING DIVISION



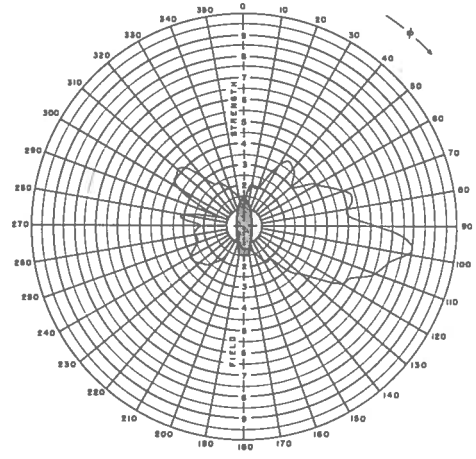
E_θ

FWD-AFT

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



PORT-STBD



$\theta = 0°$

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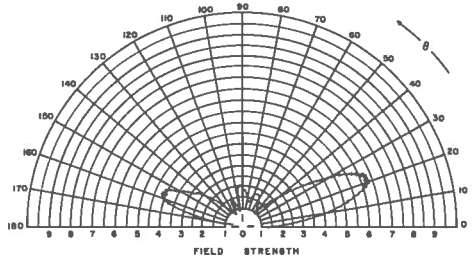
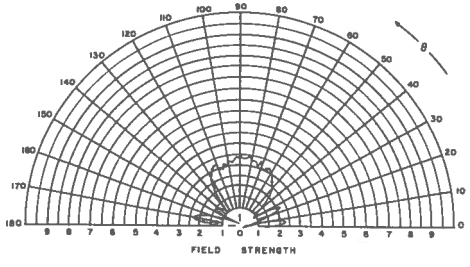
RADIO AND ELECTRICAL ENGINEERING DIVISION



E_ϕ

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



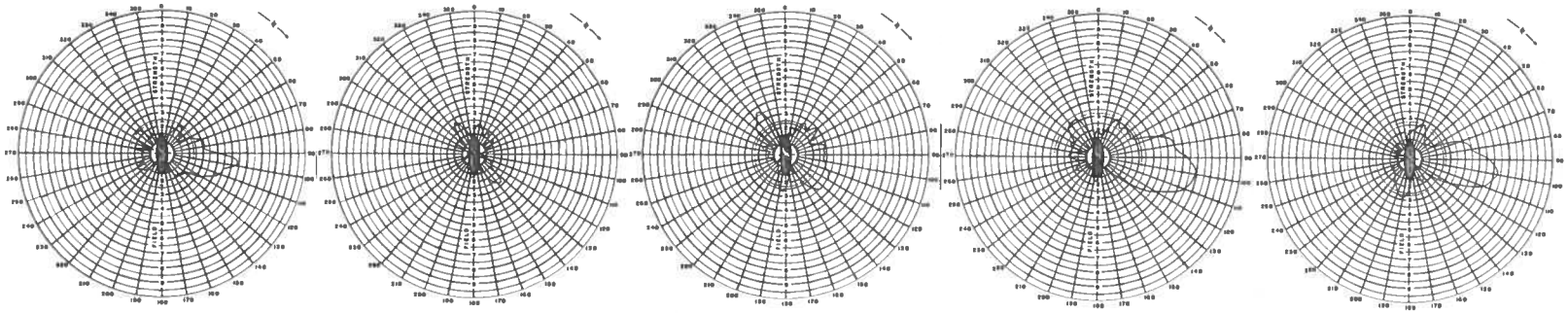
ANTENNA : PROPOSED ISLAND R_X FANS

FREQ. : 14 Mc/s

REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS - 50Ω

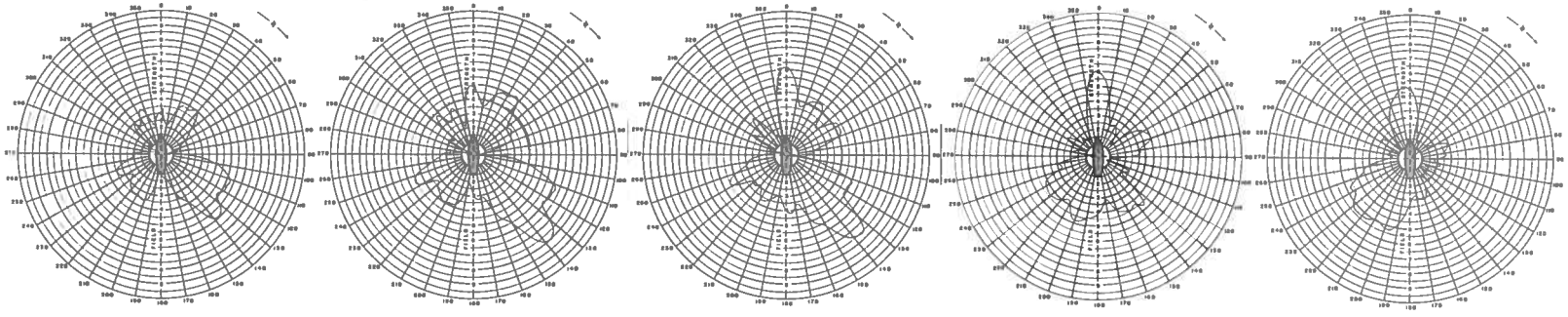
$\sigma = .50$
$\eta = .78$

E_θ

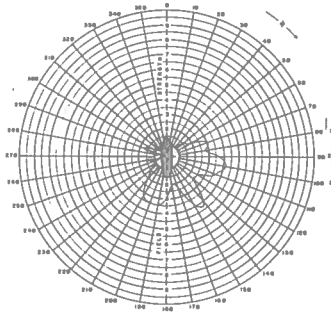
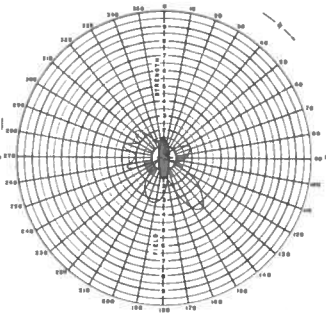
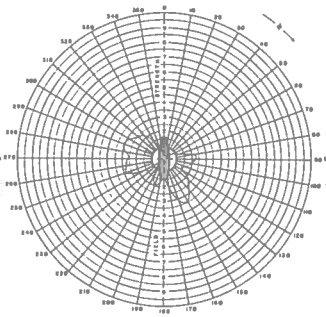
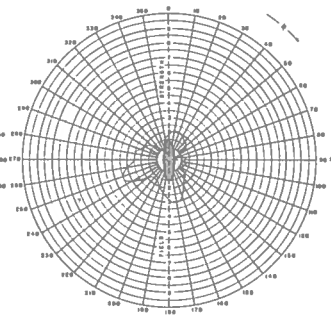
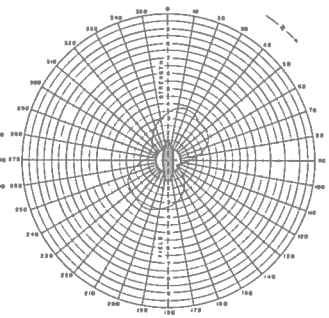


θ = 6°　　θ = 12°　　θ = 18°　　θ = 25°　　θ = 30°

E_ϕ

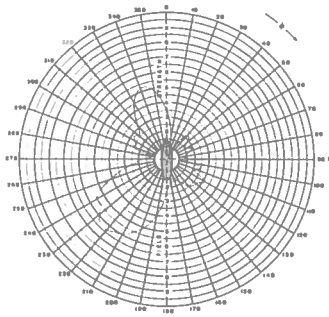
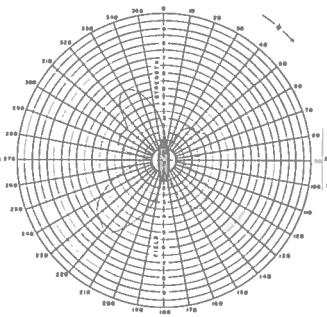
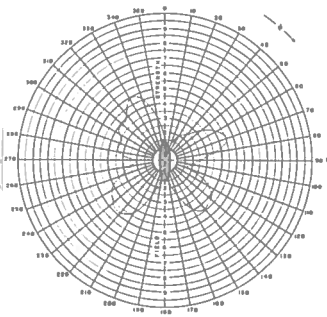
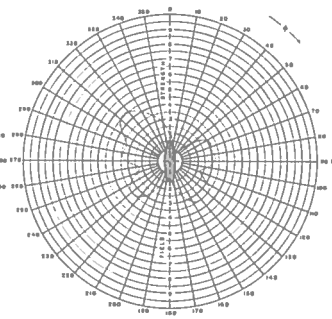
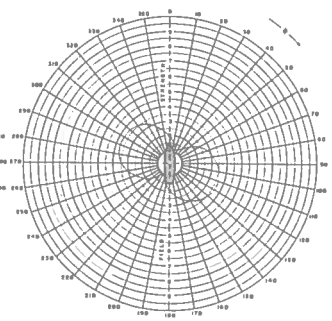


E_θ

θ = 37° θ = 45° θ = 53° θ = 65° θ = 90°

E_ϕ

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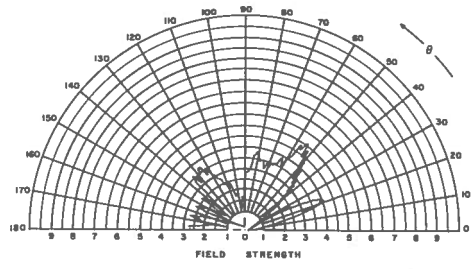
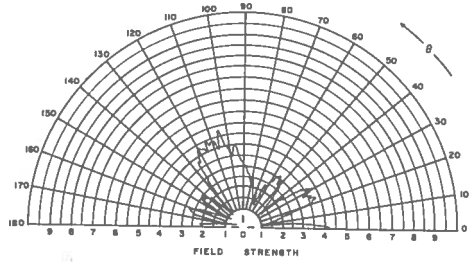
RADIO AND ELECTRICAL ENGINEERING DIVISION



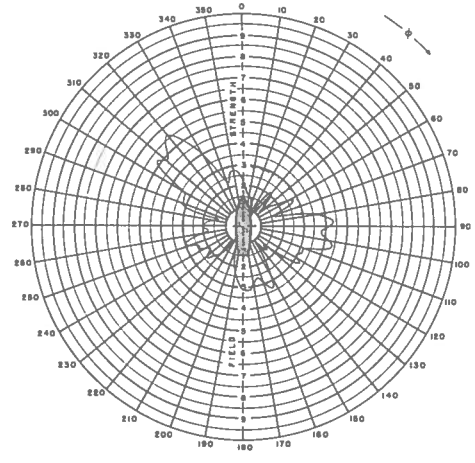
E_θ

FWD-AFT

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



PORT-STBD



Θ = 0°

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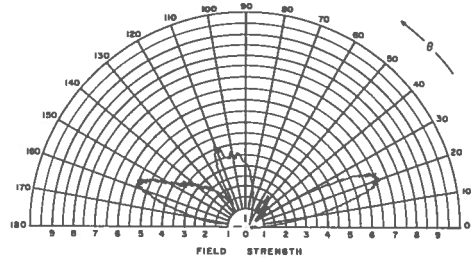
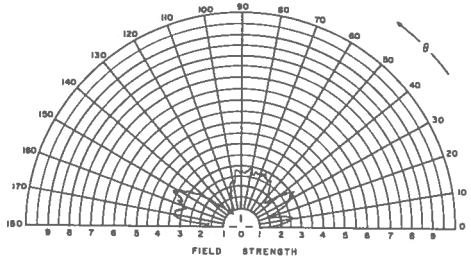
RADIO AND ELECTRICAL ENGINEERING DIVISION



E_ϕ

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



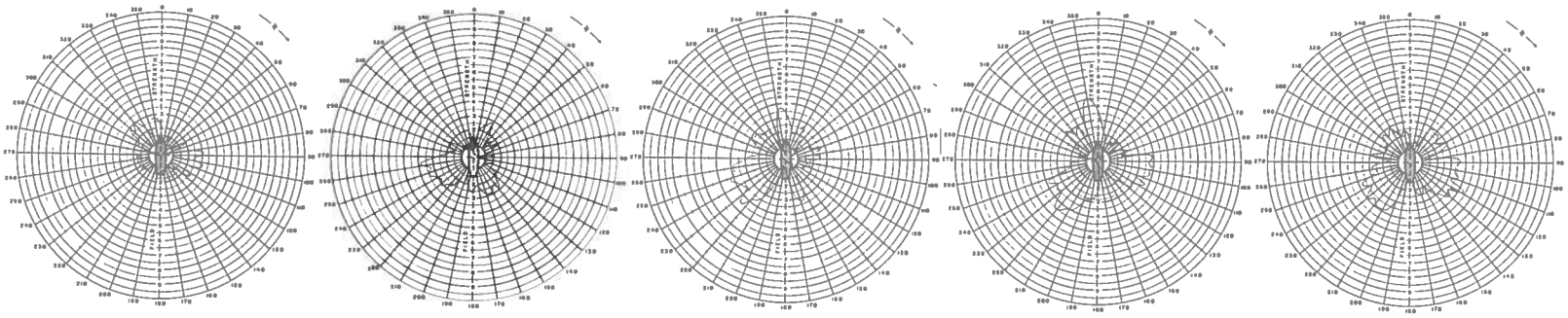
ANTENNA : PROPOSED ISLAND R_X FANS

FREQ. : 16 Mc/s

REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS – 50Ω

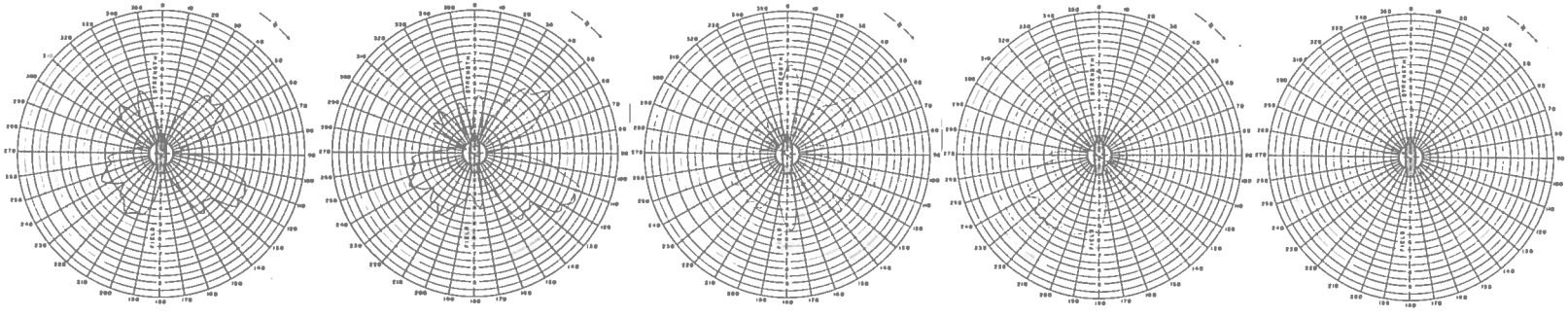
ζ = .47
η = .75

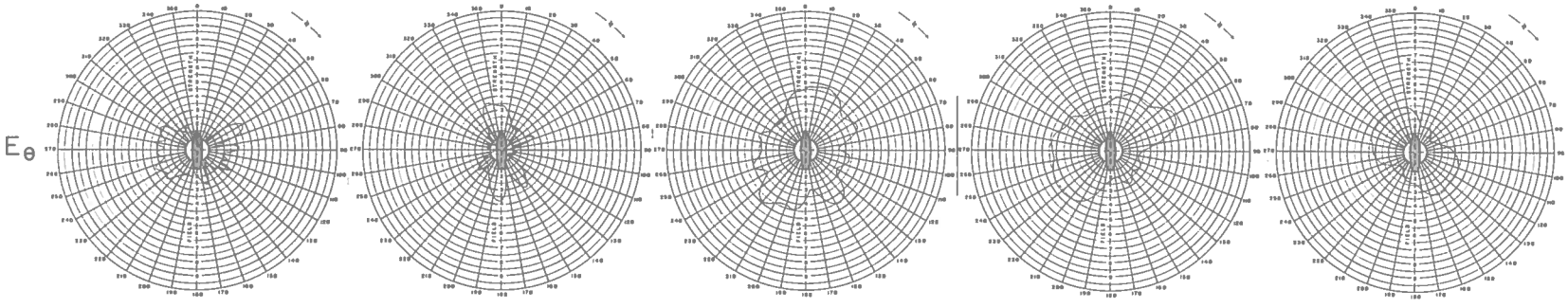
E_θ

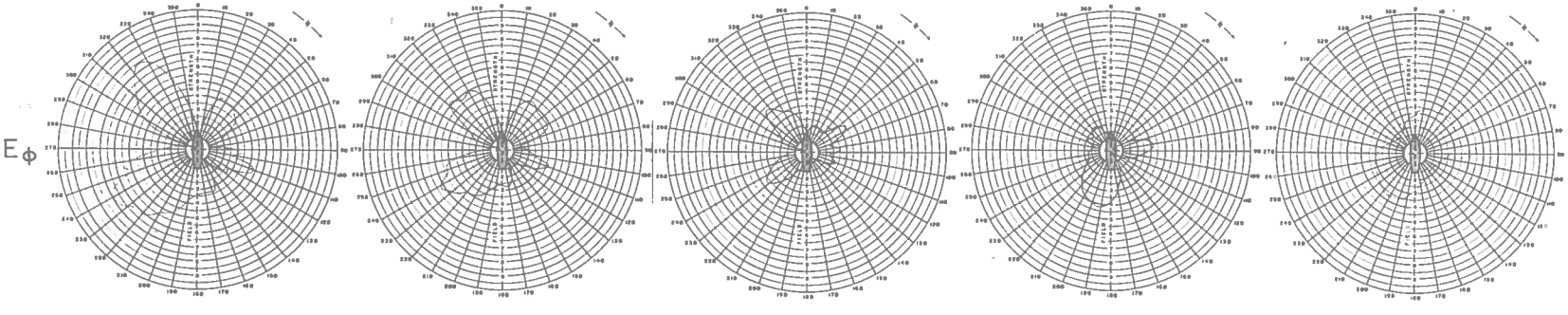


θ = 6°　　θ = 12°　　θ = 18°　　θ = 25°　　θ = 30°

E_ϕ




E_θ
θ = 37°
θ = 45°
θ = 53°
θ = 65°
θ = 90°


E_ϕ

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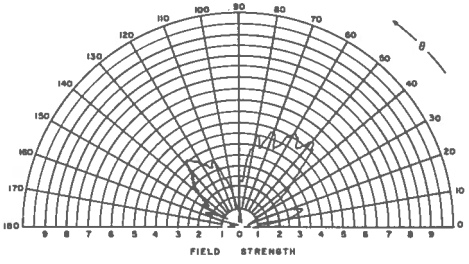
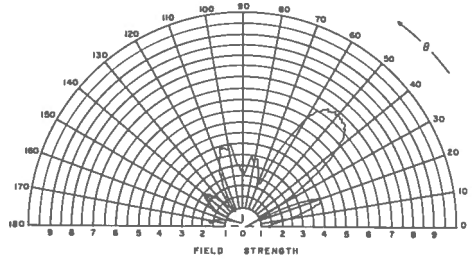
RADIO AND ELECTRICAL ENGINEERING DIVISION



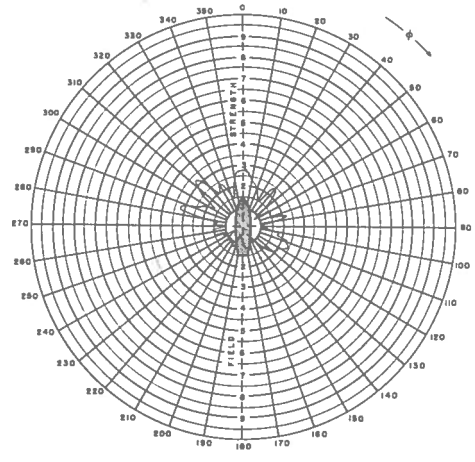
E_θ

FWD-AFT

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



PORT-STBD



$\theta = 0°$

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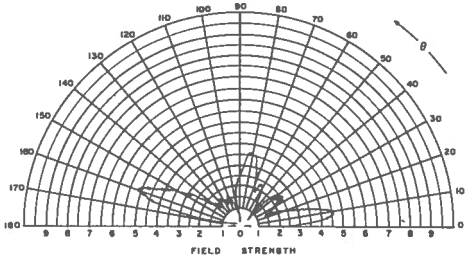
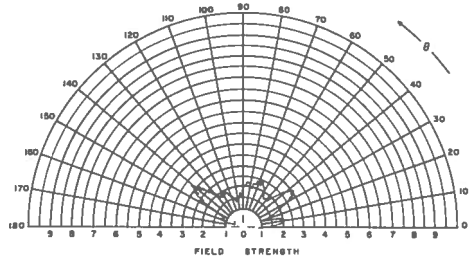
RADIO AND ELECTRICAL ENGINEERING DIVISION



E_ϕ

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



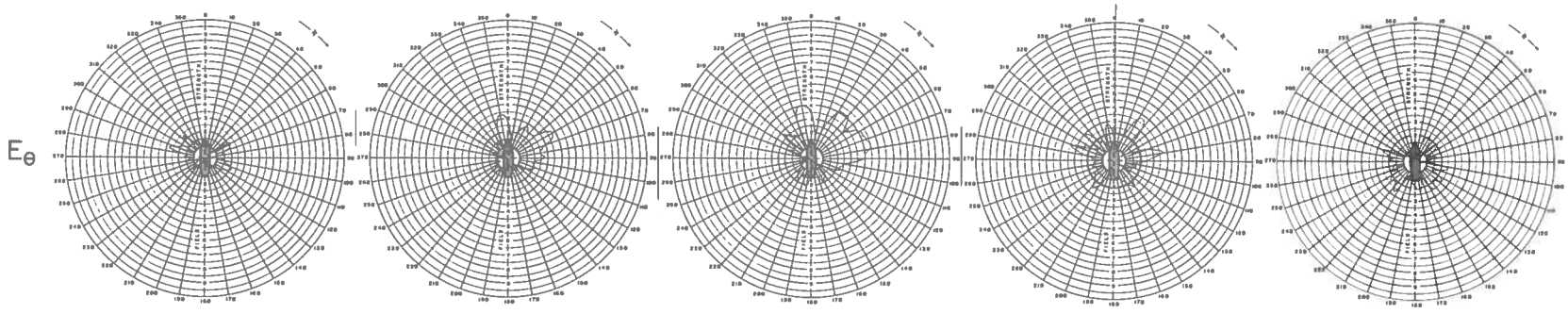
ANTENNA : PROPOSED ISLAND R_x FANS

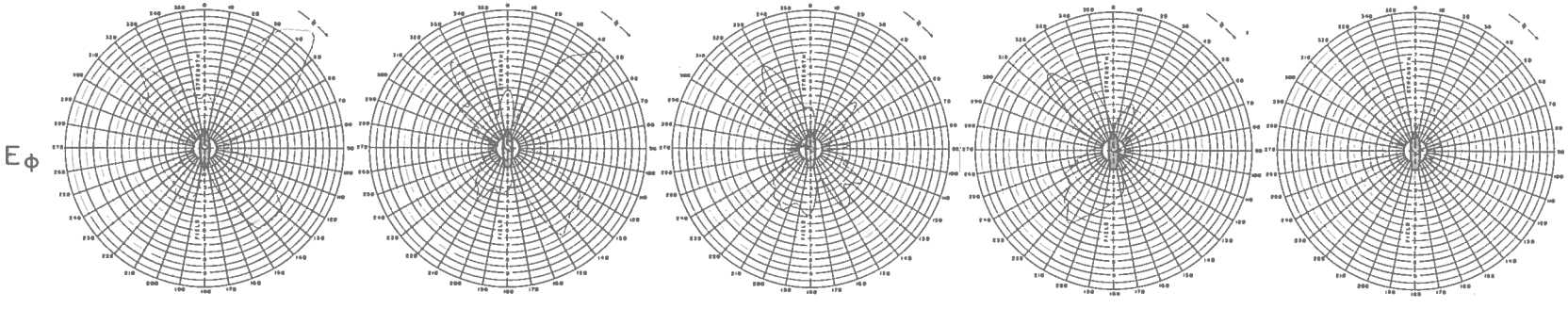
FREQ. : 18 Mc/s

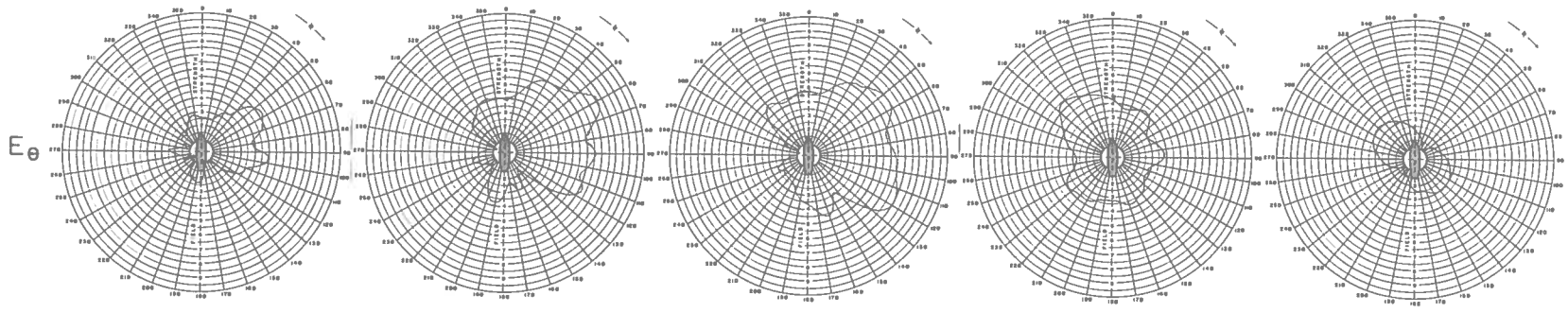
REMARKS : ALL R_x 28 FT WHIPS REMOVED
ALL T_x 35 FT WHIPS – 50Ω

$\zeta = .41$

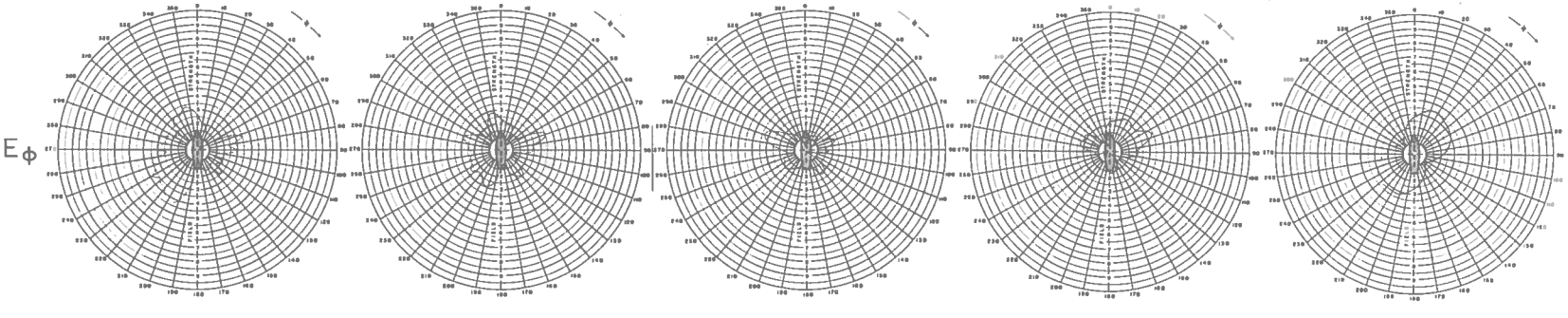
$\eta = .61$


E_θ
θ = 6°
θ = 12°
θ = 18°
θ = 25°
θ = 30°


E_ϕ



θ = 37°　　θ = 45°　　θ = 53°　　θ = 65°　　θ = 90°



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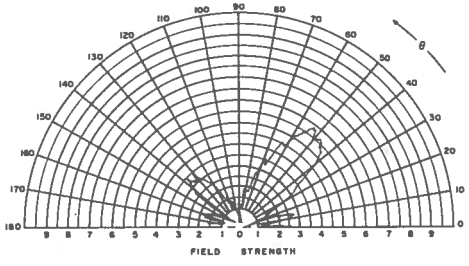
E_θ



FWD-AFT

NATIONAL RESEARCH COUNCIL OF CANADA
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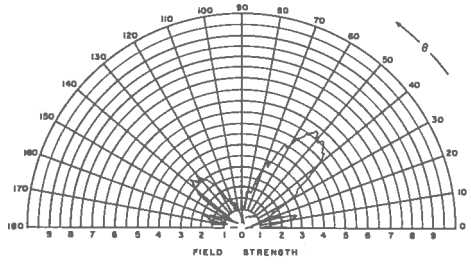
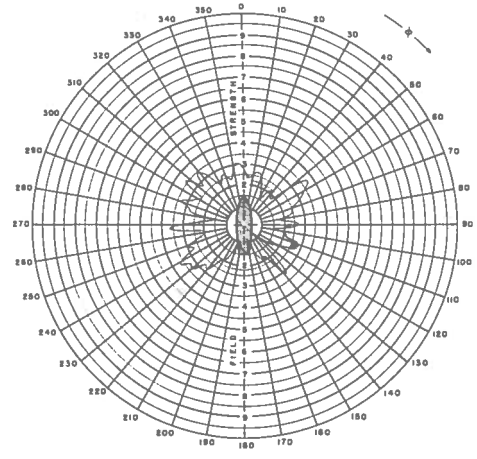


PORT-STBD



θ = 0°

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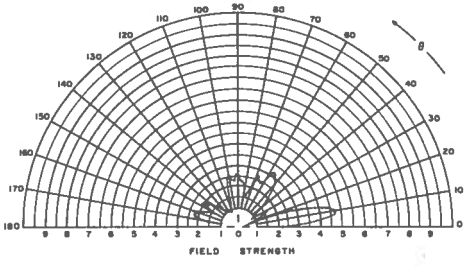
E_ϕ



NATIONAL RESEARCH COUNCIL OF CANADA
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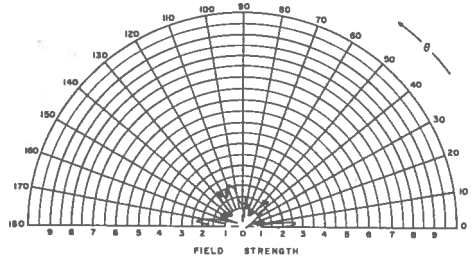
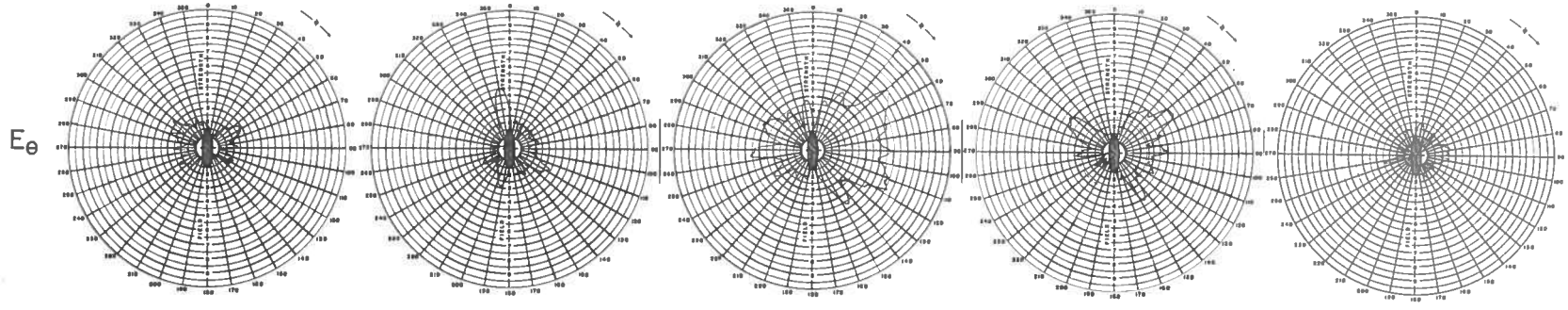


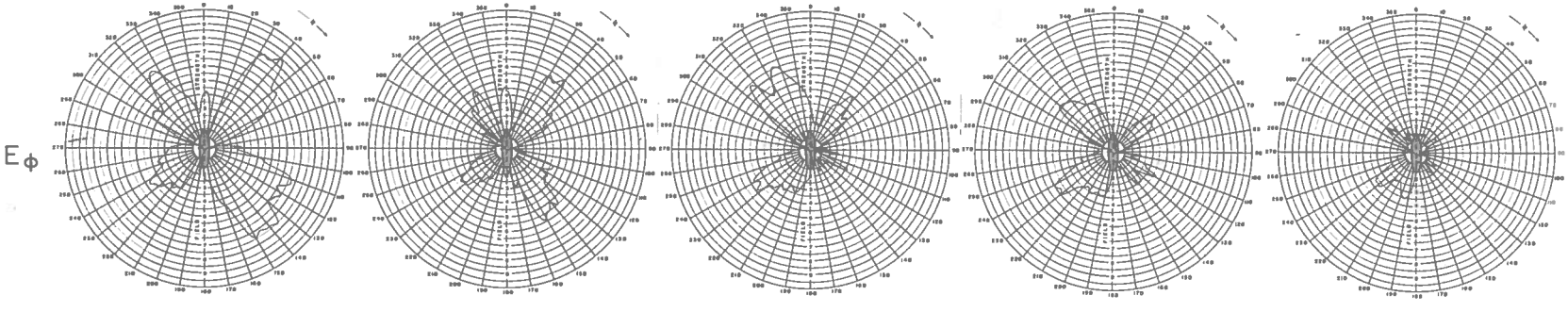
ANTENNA : PROPOSED ISLAND R_X FANS

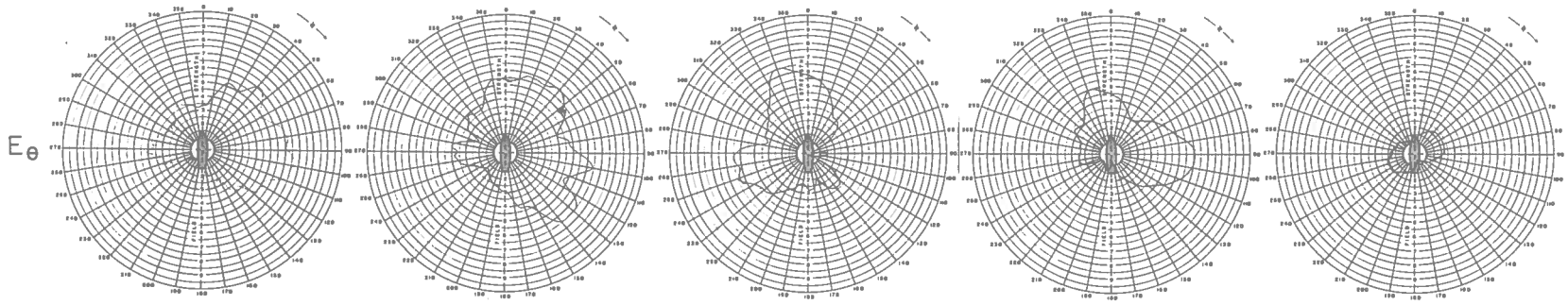
FREQ. : 20 Mc/s

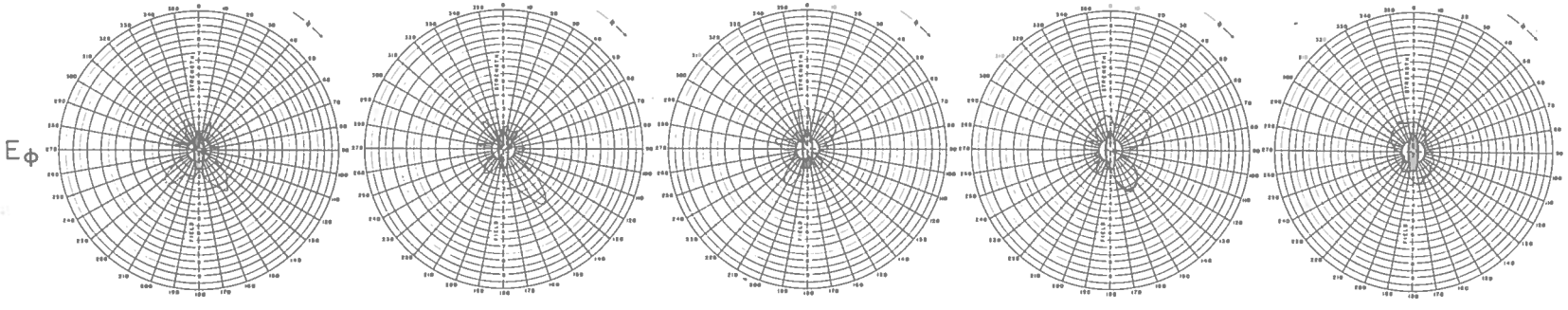
REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS - 50Ω

ζ = .41
η = .72


E_θ
θ = 6°
θ = 12°
θ = 18°
θ = 25°
θ = 30°


E_ϕ


E_θ
θ = 37°
θ = 45°
θ = 53°
θ = 65°
θ = 90°


E_ϕ

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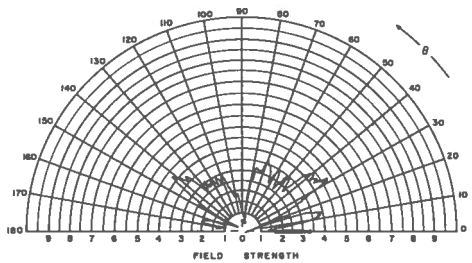
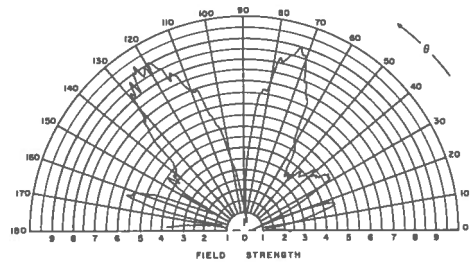
RADIO AND ELECTRICAL ENGINEERING DIVISION



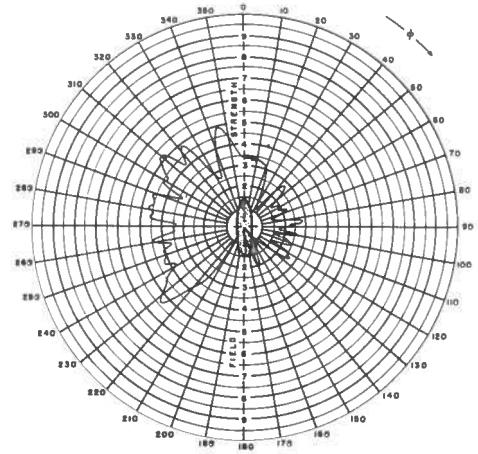
E_θ

FWD-AFT

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



PORT-STBD



θ = 0°

NATIONAL RESEARCH COUNCIL OF CANADA
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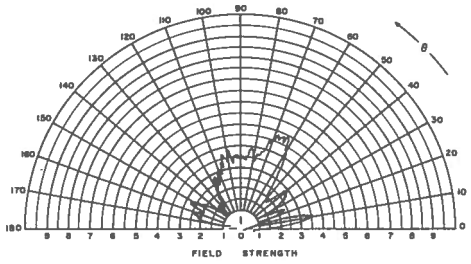
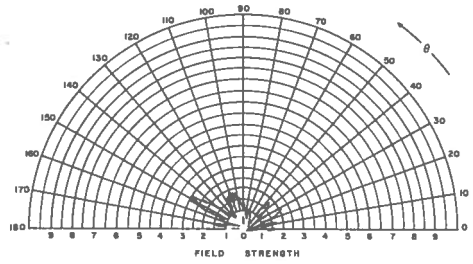


E_ϕ

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION

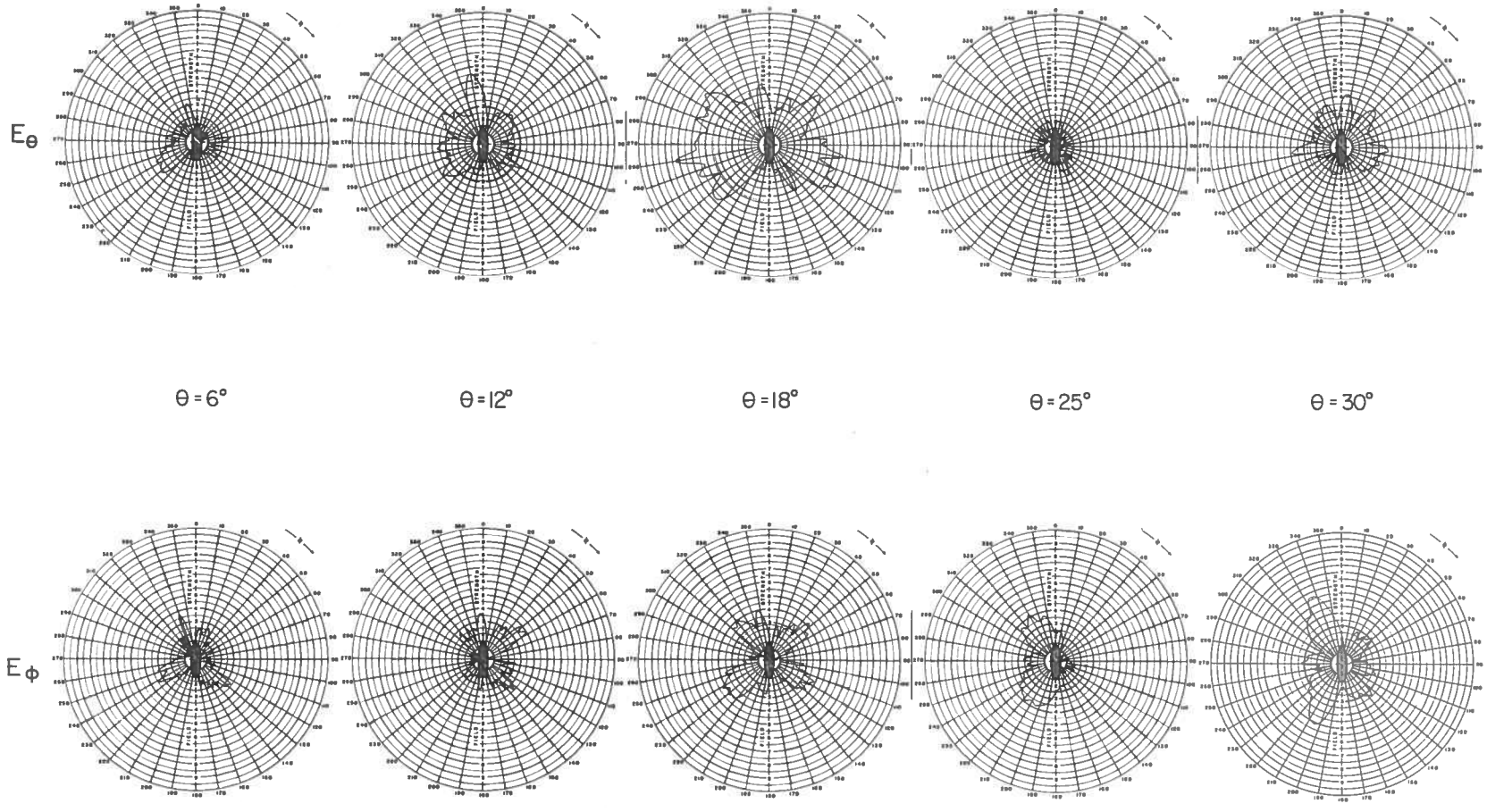


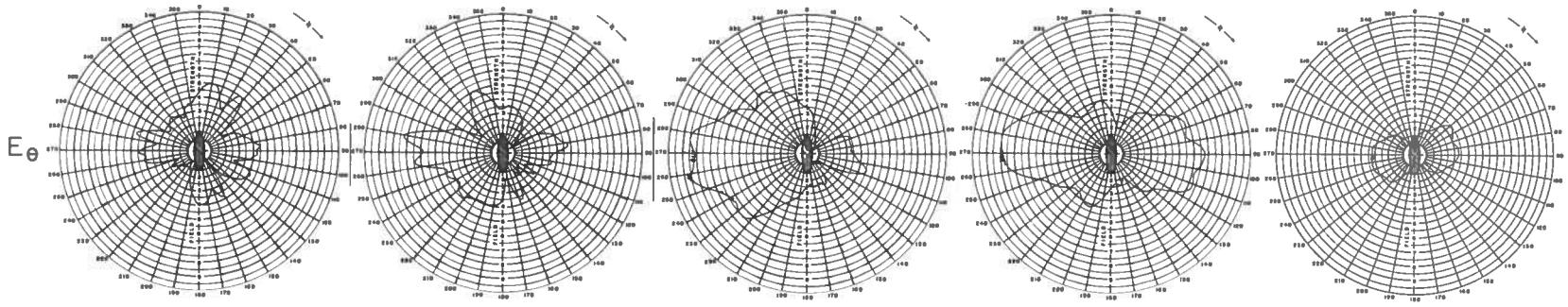
ANTENNA : PROPOSED ISLAND R_X FANS

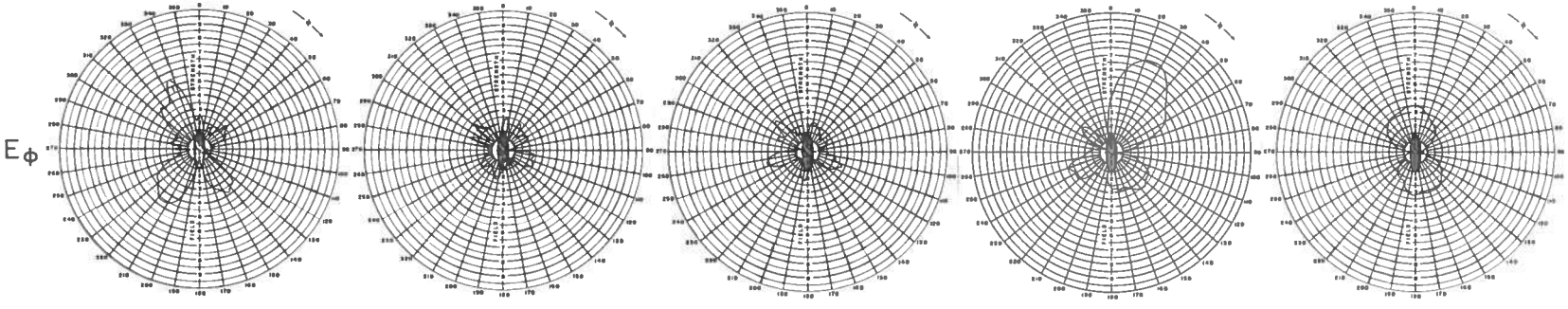
FREQ. : 22 Mc/s

REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS – 50Ω

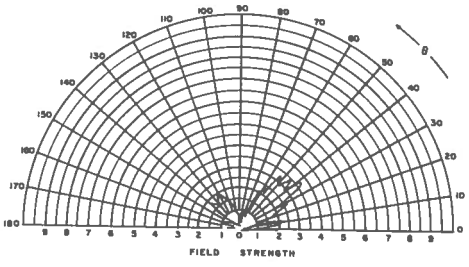
ζ = .35
η = .51


E_θ
E_ϕ
θ = 6°
θ = 12°
θ = 18°
θ = 25°
θ = 30°


E_θ
θ = 37°
θ = 45°
θ = 53°
θ = 65°
θ = 90°


E_ϕ

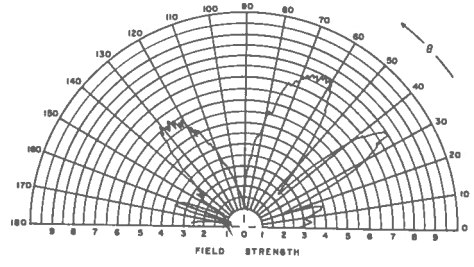
NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



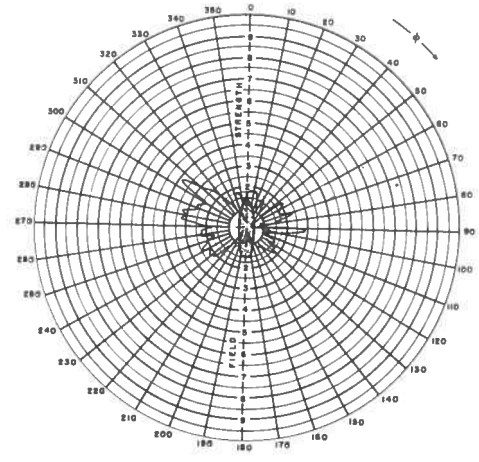
E_θ

FWD-AFT

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION

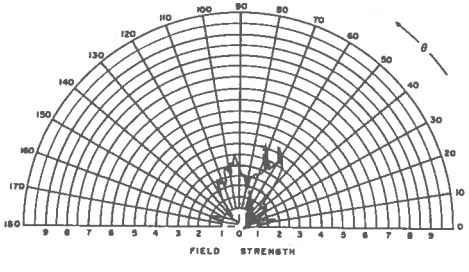


PORT-STBD



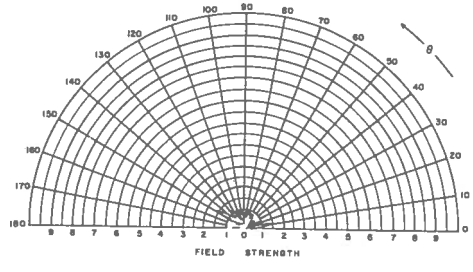
θ = 0°

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



E_ϕ

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



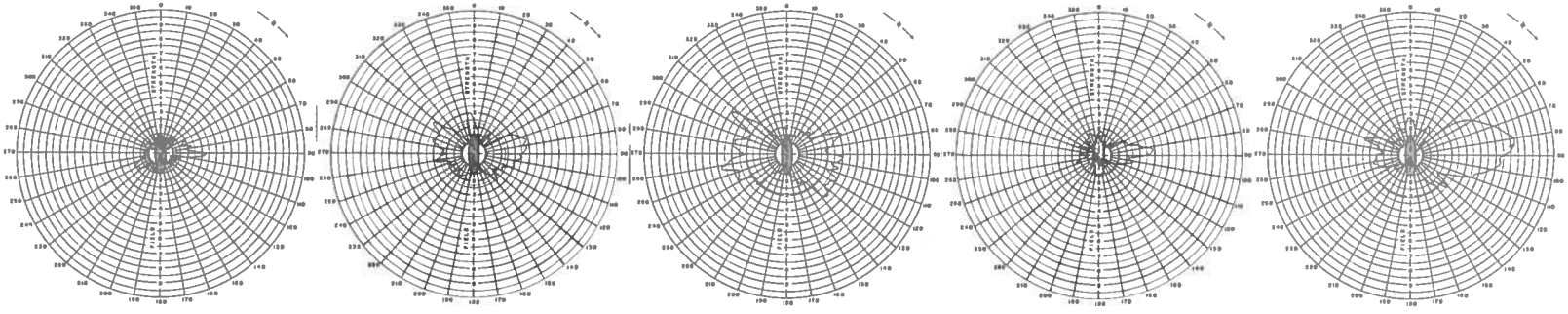
ANTENNA : PROPOSED ISLAND R_X FANS

FREQ. : 24 Mc/s

REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS – 50Ω

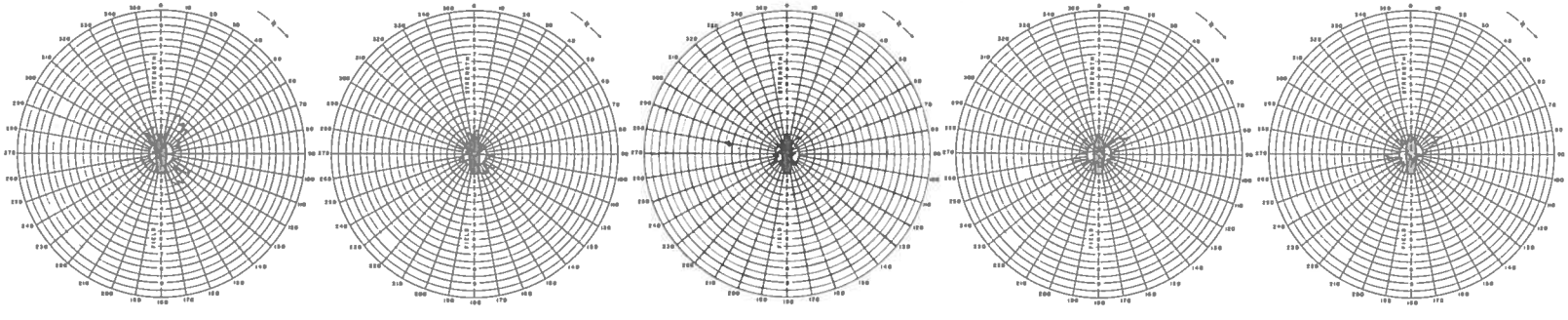
ζ = .25
η = .39

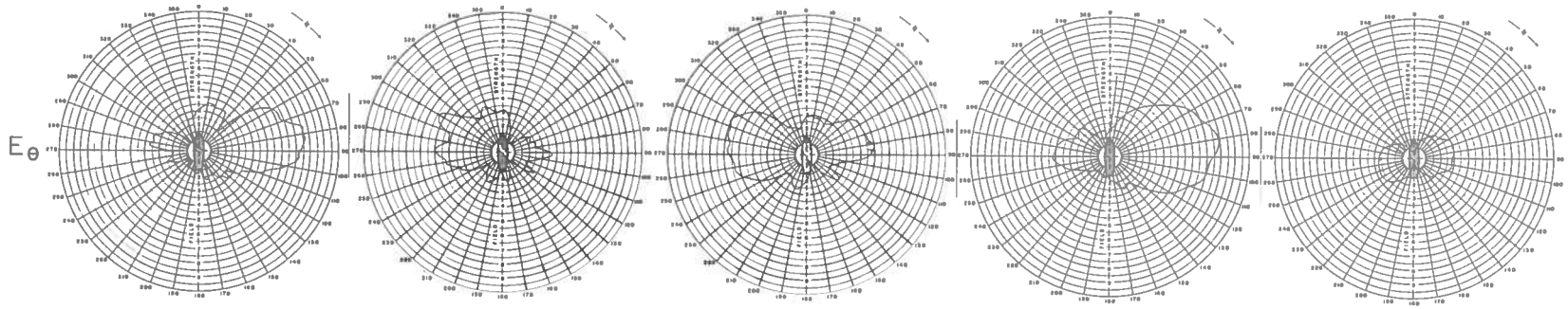
E_θ

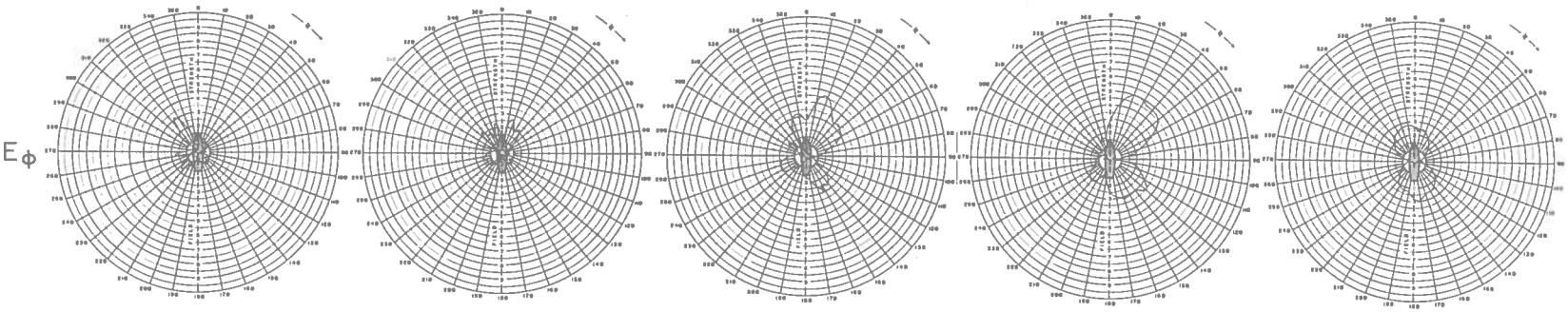


θ = 6°　　θ = 12°　　θ = 18°　　θ = 25°　　θ = 30°

E_ϕ

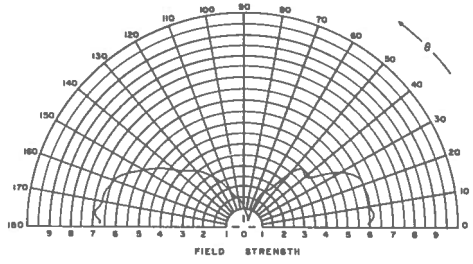



E_θ
θ = 37°
θ = 45°
θ = 53°
θ = 65°
θ = 90°


E_ϕ

RADIATION PATTERNS OF 28-FOOT WHIP

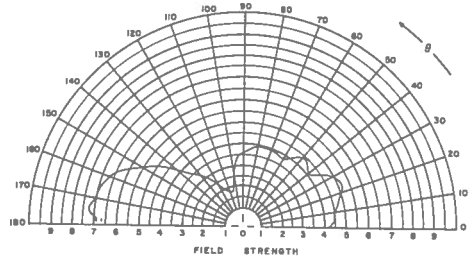
NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



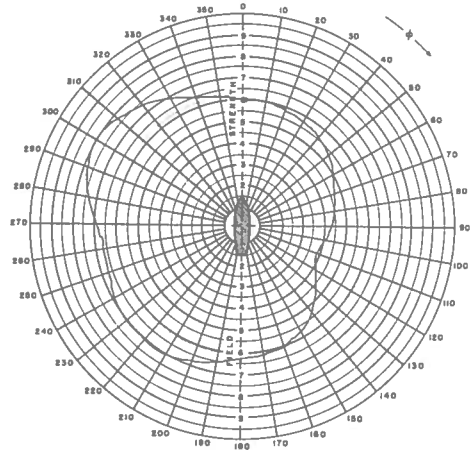
E_θ

FWD-AFT

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



PORT-STBD



θ = 0°

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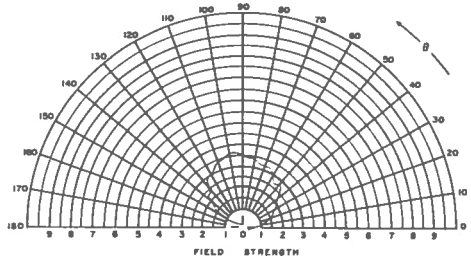

E_ϕ

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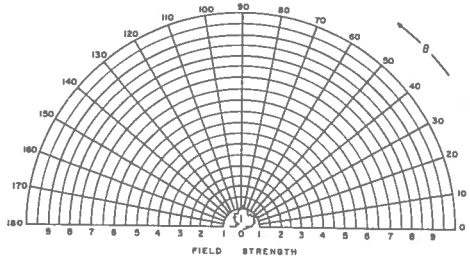


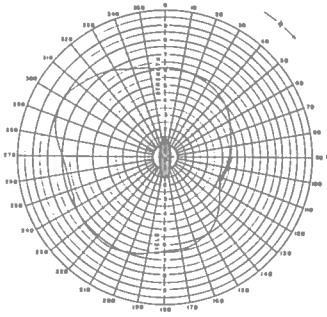
ANTENNA : MID-ISLAND INBOARD R_X
28 FT WHIP

FREQ. : 2 Mc/s

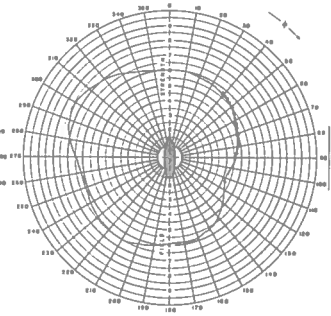
REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS - 50Ω

ζ = .82
η = .96

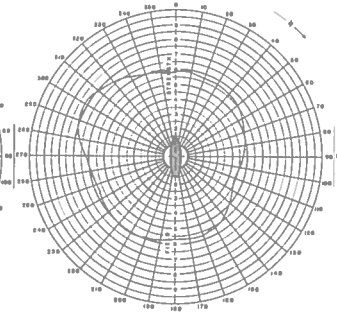
E_θ



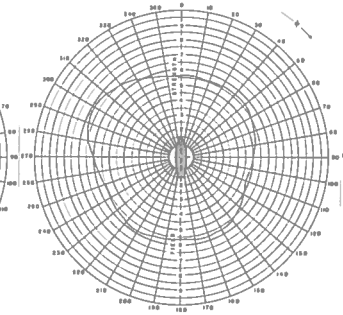
θ = 6°



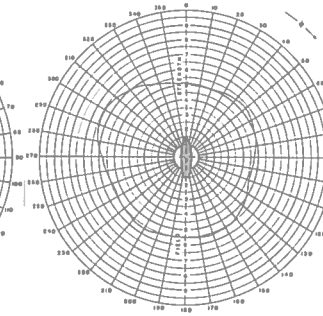
θ = 12°



θ = 18°

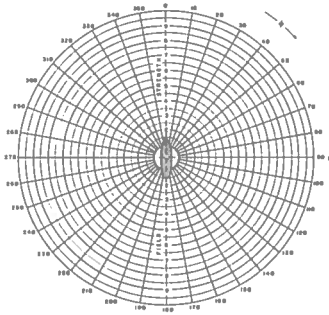


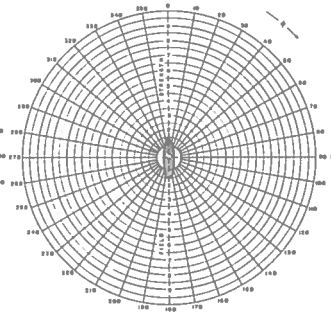
θ = 25°

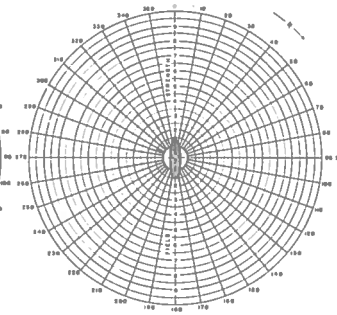


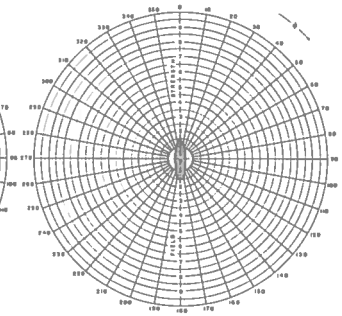
θ = 30°

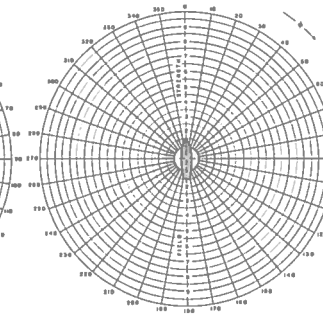
E_ϕ

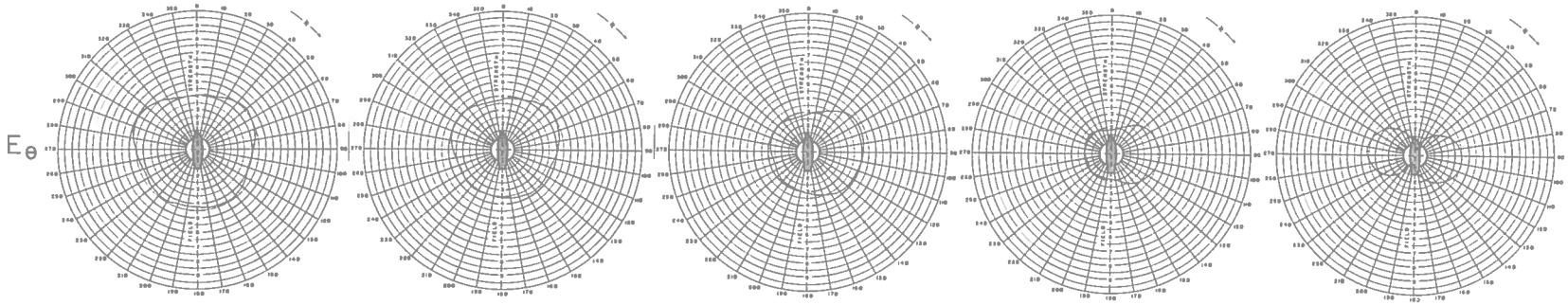




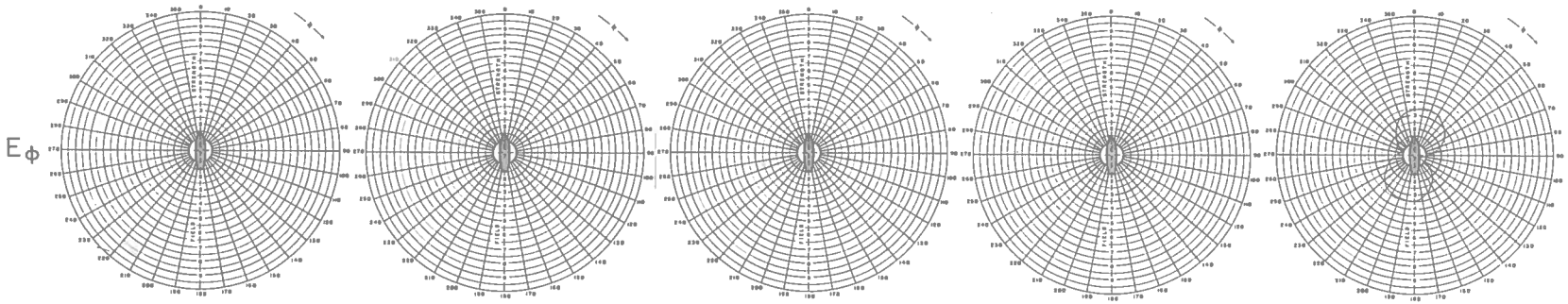








θ = 37°　　θ = 45°　　θ = 53°　　θ = 65°　　θ = 90°



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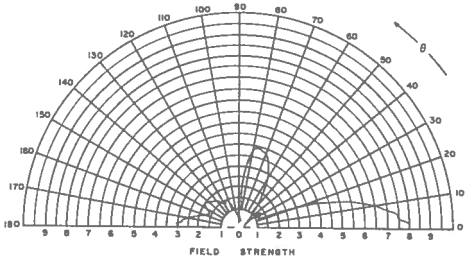
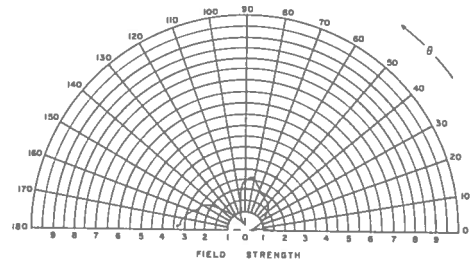
RADIO AND ELECTRICAL ENGINEERING DIVISION



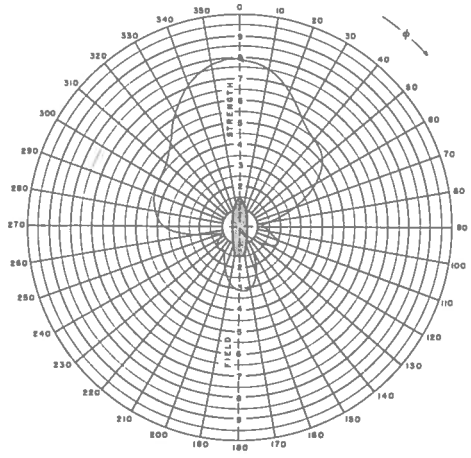
E_θ

FWD-AFT

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION

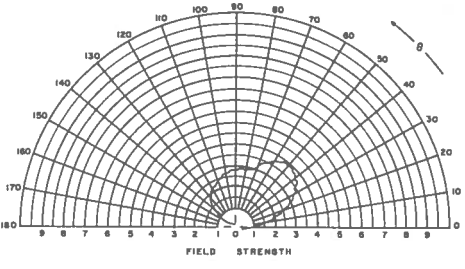


PORT-STBD



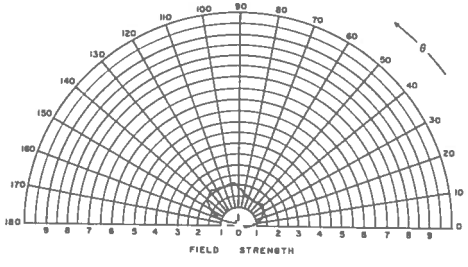
θ = 0°

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



E_ϕ

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



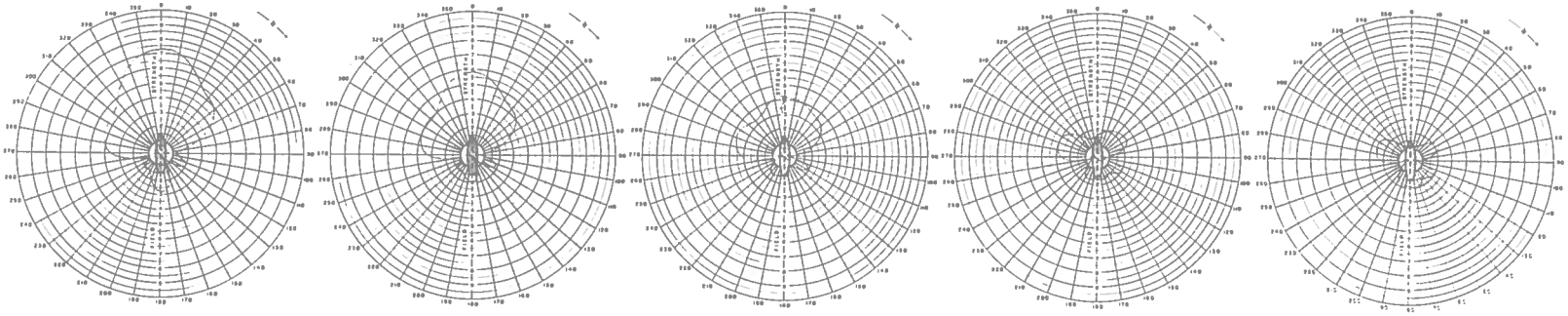
ANTENNA : MID - ISLAND INBOARD R_X
28 FT WHIP

FREQ. : 4 Mc/s

REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS - 50Ω

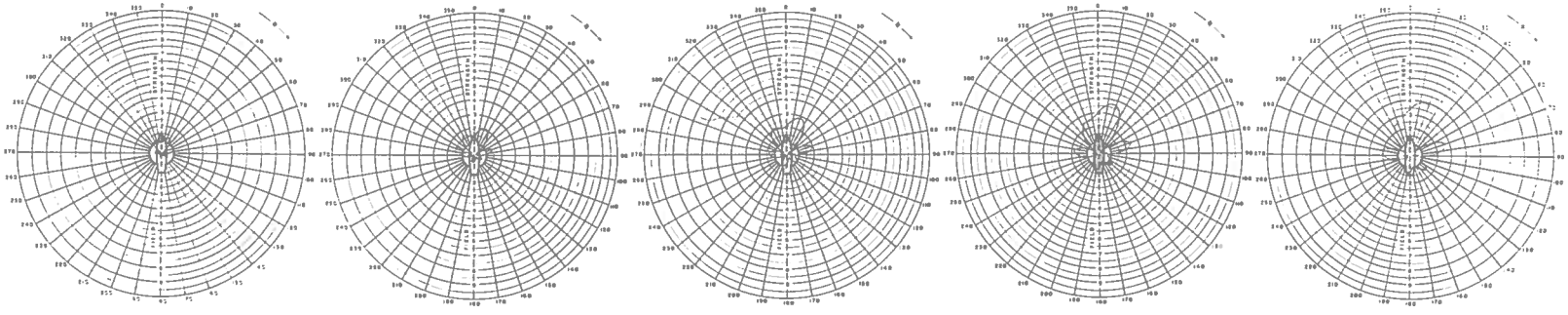
ζ = .59
η = 1.02

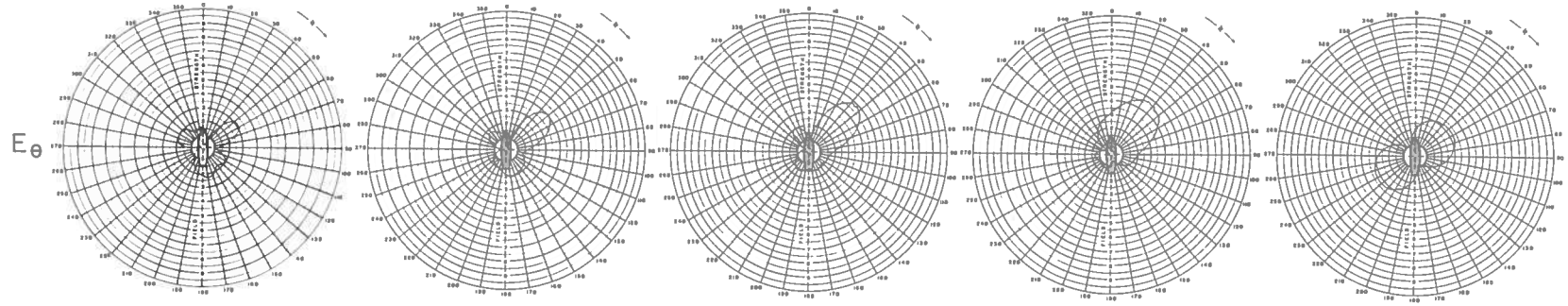
E_θ



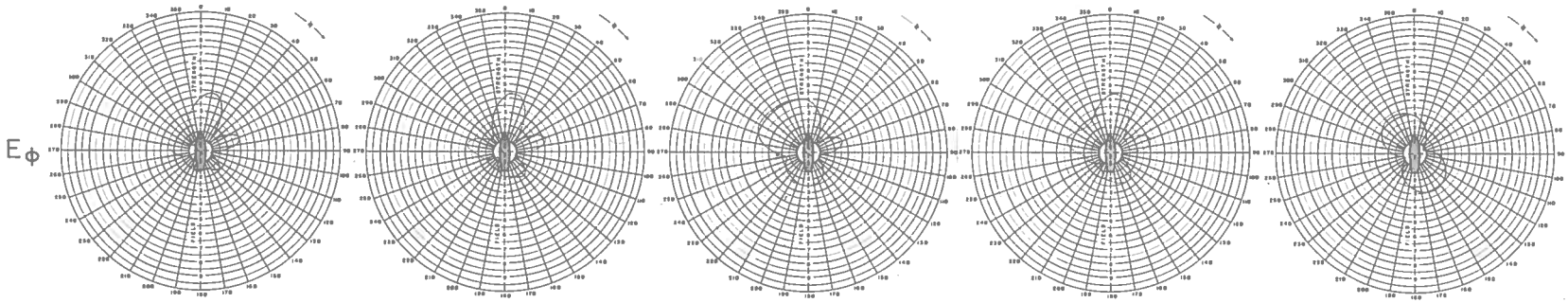
θ = 6°　　θ = 12°　　θ = 18°　　θ = 25°　　θ = 30°

E_ϕ





θ = 37°　　θ = 45°　　θ = 53°　　θ = 65°　　θ = 90°



NATIONAL RESEARCH COUNCIL OF CANADA
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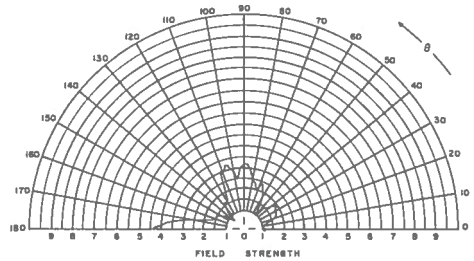
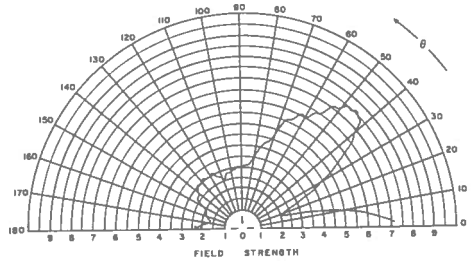


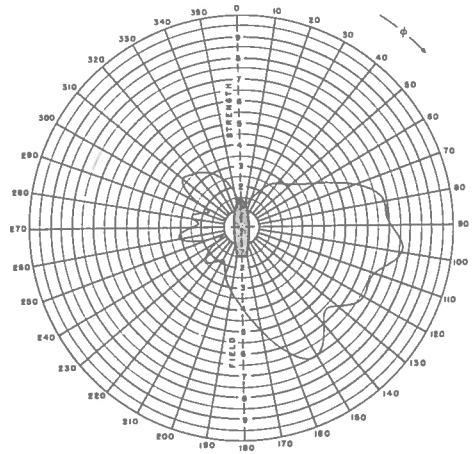
E_θ

FWD-AFT

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION

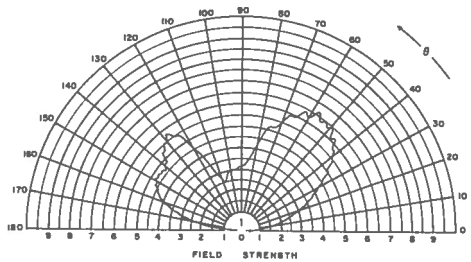


PORT-STBD



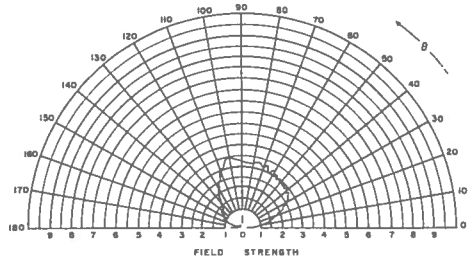
$\theta = 0°$

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



E_ϕ

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION

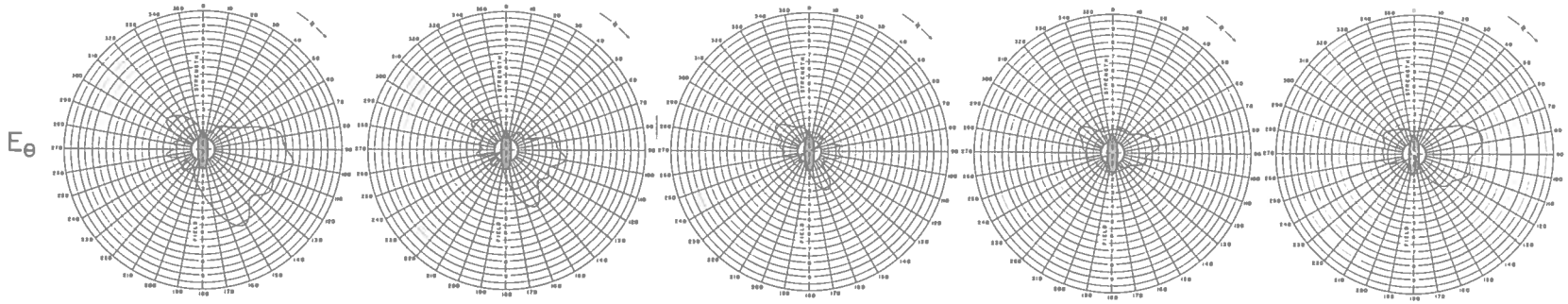


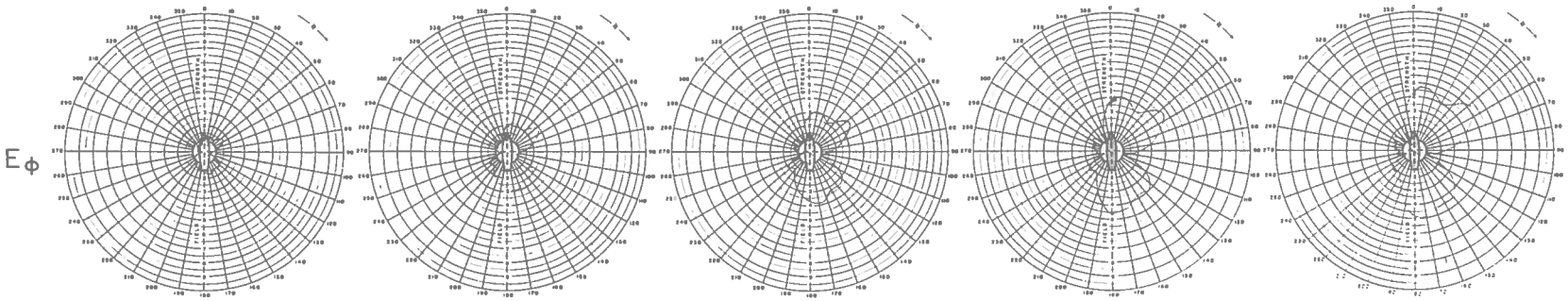
ANTENNA : MID-ISLAND INBOARD R_X
28 FT WHIP

FREQ. : 6 Mc/s

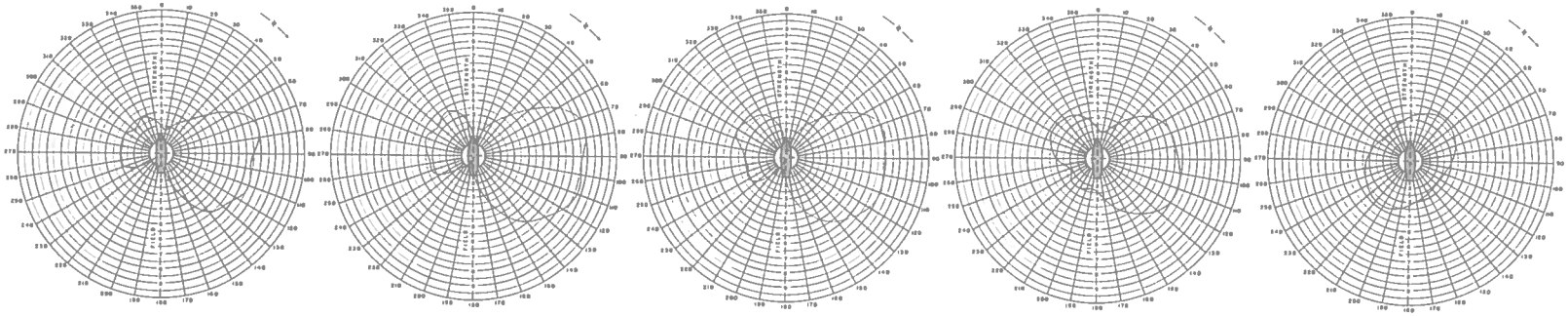
REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS - 50Ω

$\zeta = .25$
$\eta = .42$


E_θ
θ = 6°
θ = 12°
θ = 18°
θ = 25°
θ = 30°

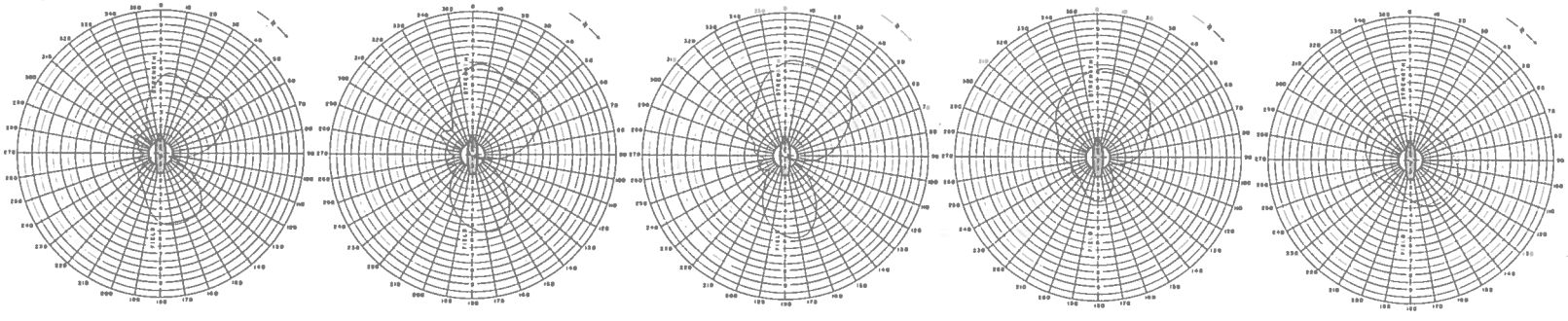

E_ϕ

E_θ

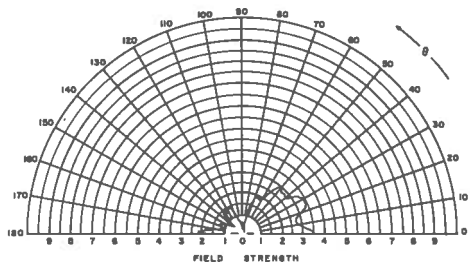


θ = 37°　　θ = 45°　　θ = 53°　　θ = 65°　　θ = 90°

E_ϕ



NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



E_θ

FWD-AFT

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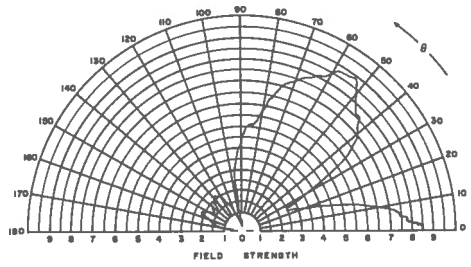
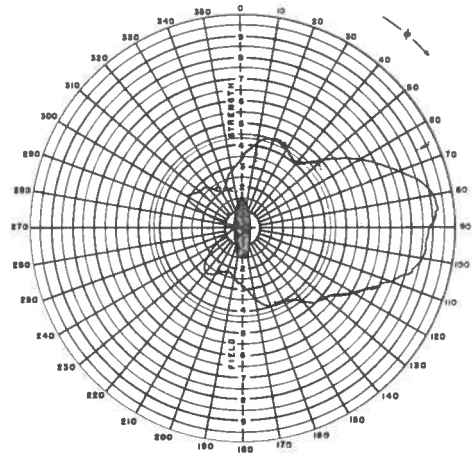
RADIO AND ELECTRICAL ENGINEERING DIVISION



PORT-STBD



$\theta = 0°$

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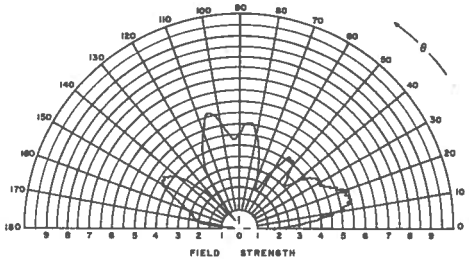
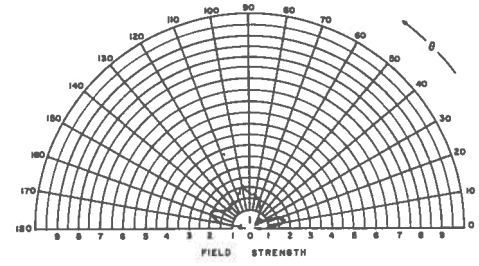


E_ϕ

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION

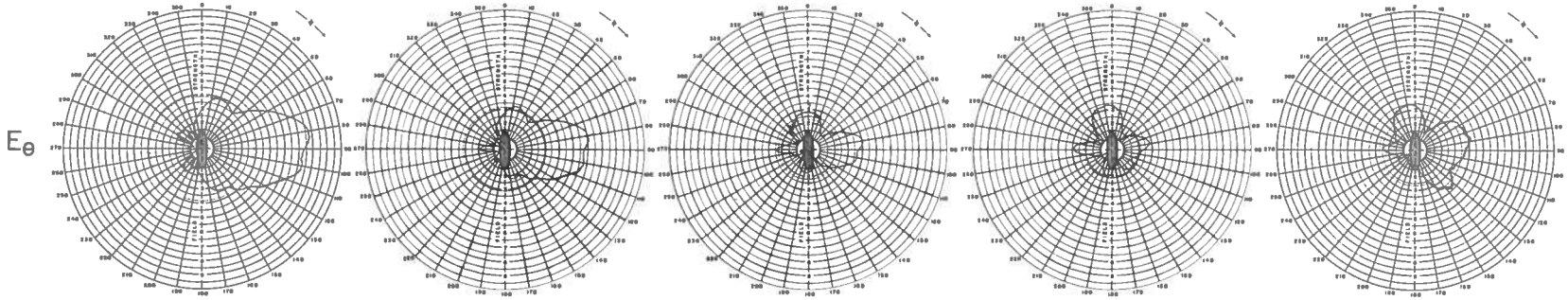


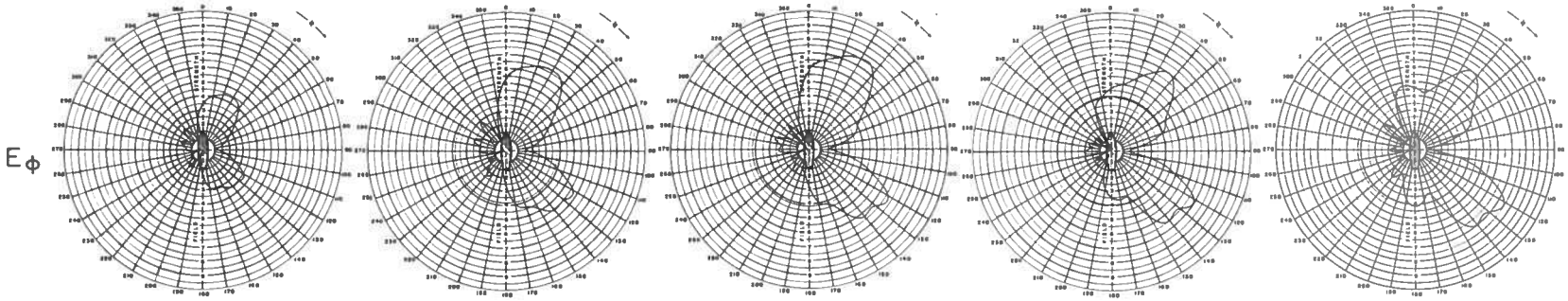
ANTENNA : MID-ISLAND INBOARD R_X
28 FT WHIP

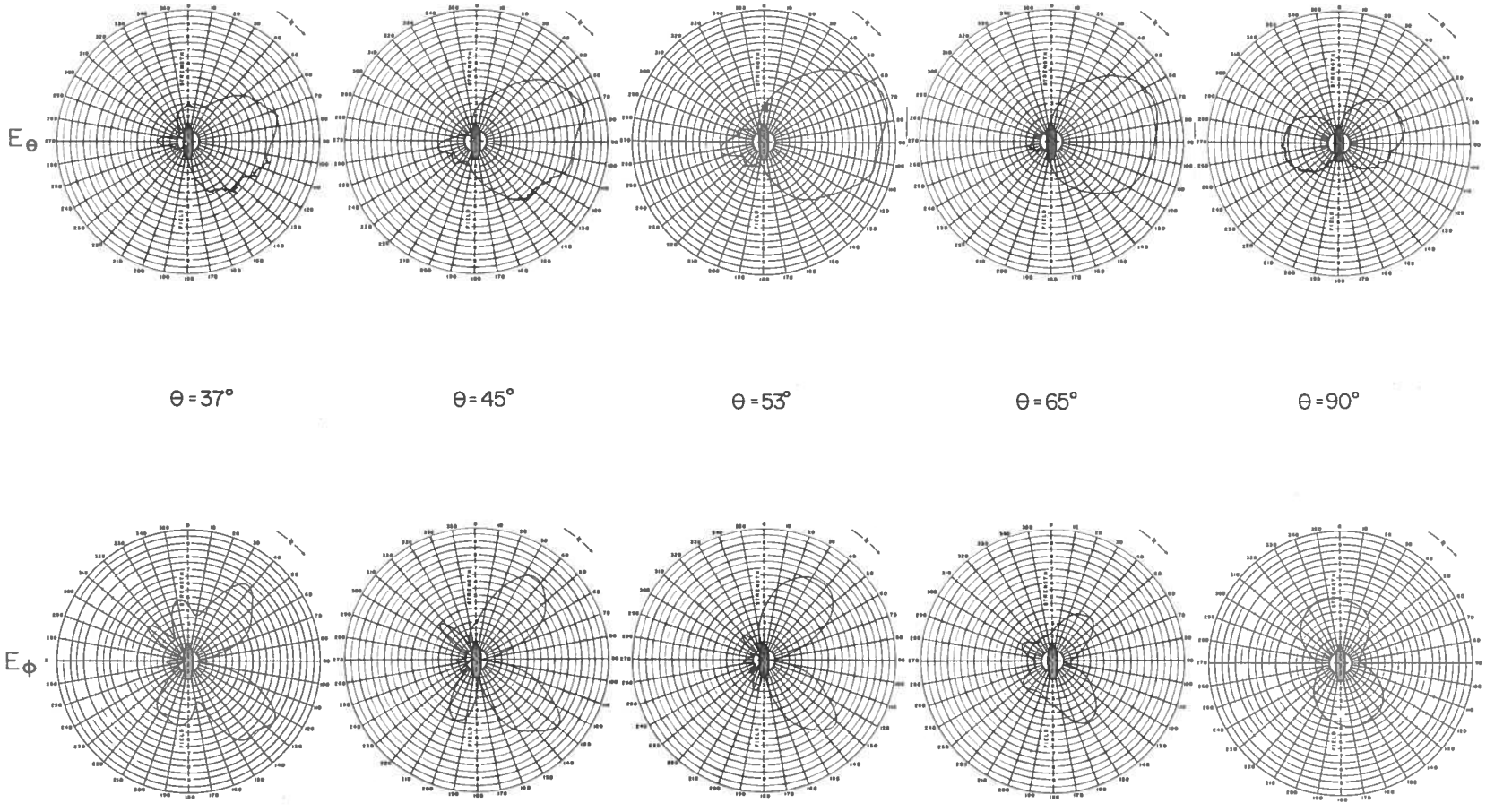
FREQ. : 8 Mc/s

REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS - 50Ω

$\zeta = .30$
$\eta = .51$


E_θ
$\theta = 6°$
$\theta = 12°$
$\theta = 18°$
$\theta = 25°$
$\theta = 30°$


E_ϕ


E_θ
E_ϕ
θ = 37°
θ = 45°
θ = 53°
θ = 65°
θ = 90°

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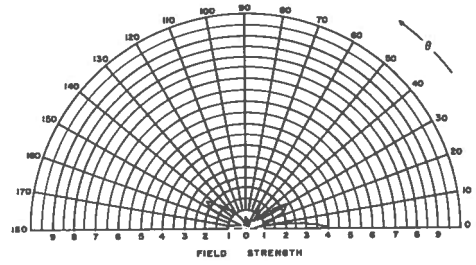
RADIO AND ELECTRICAL ENGINEERING DIVISION

E_θ



FWD-AFT

NATIONAL RESEARCH COUNCIL OF CANADA
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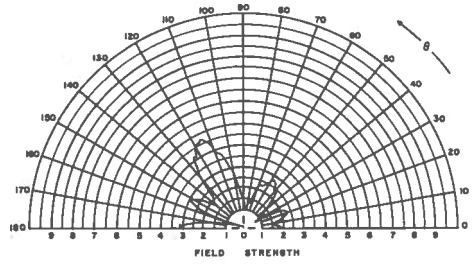
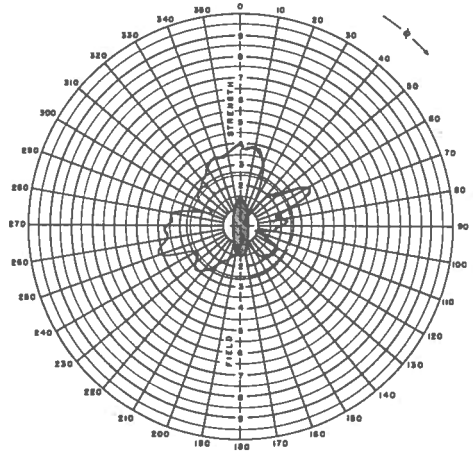


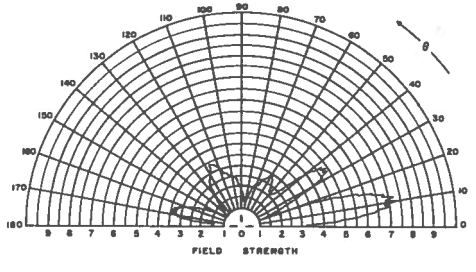
PORT-STBD



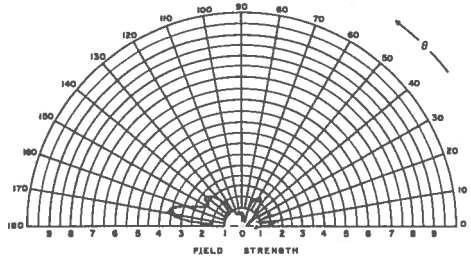
θ = 0°

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION

E_ϕ



NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION

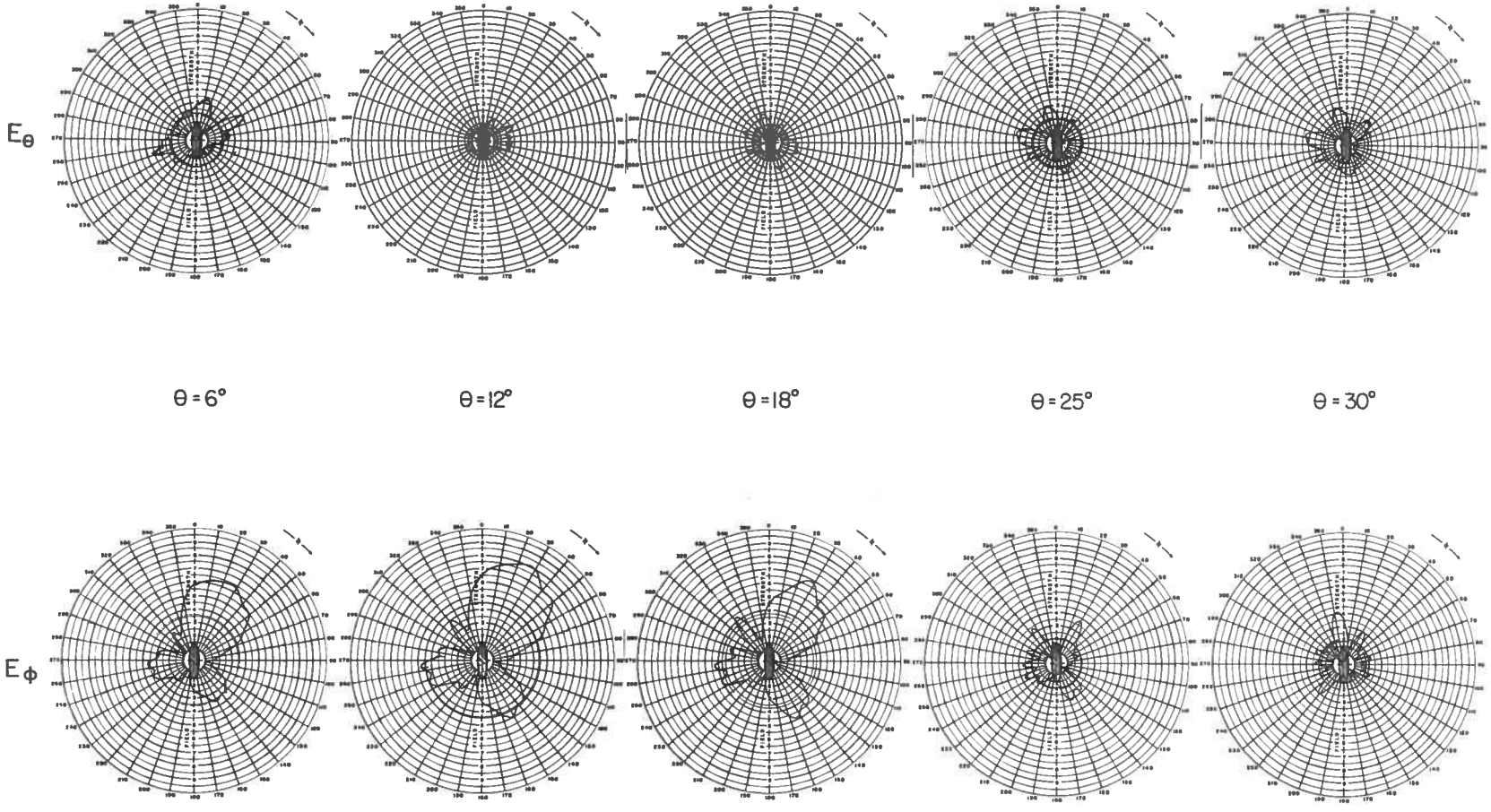


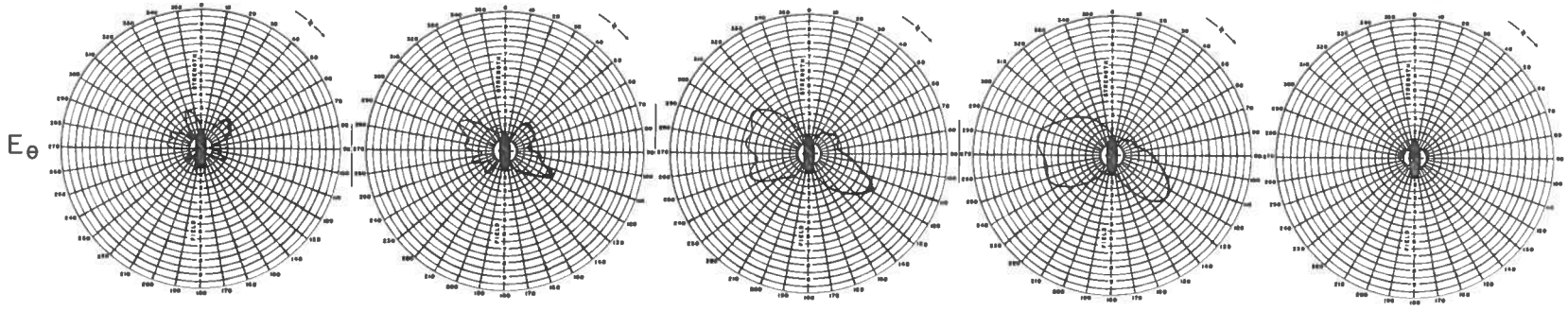
ANTENNA : MID - ISLAND INBOARD R_X
28 FT WHIP

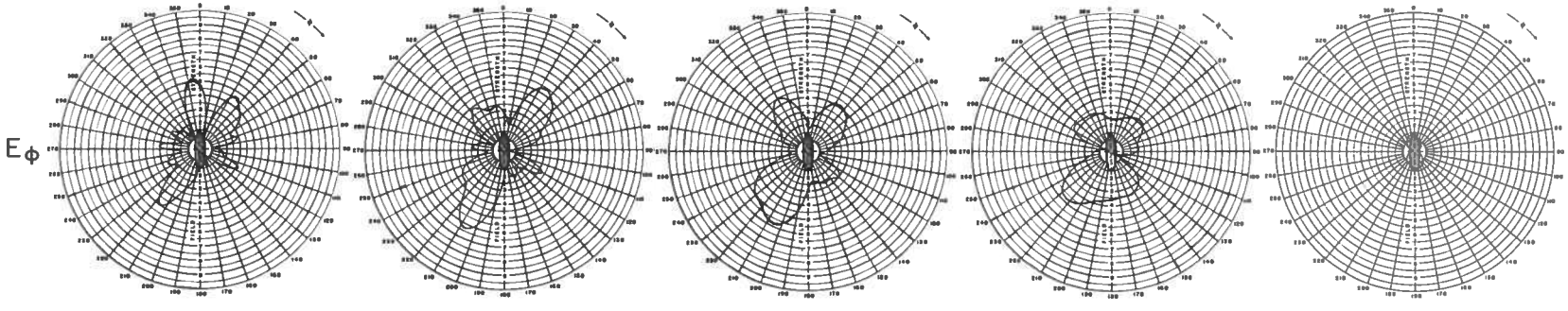
FREQ. : 10 Mc/s

REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS - 50Ω

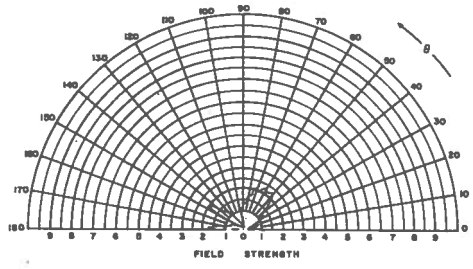
$\xi = .44$
$\eta = .67$


E_θ
E_ϕ
θ = 6°
θ = 12°
θ = 18°
θ = 25°
θ = 30°


E_θ
θ = 37°
θ = 45°
θ = 53°
θ = 65°
θ = 90°


E_ϕ

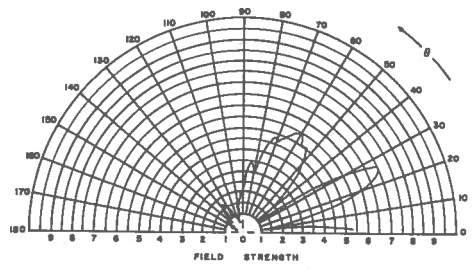
NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



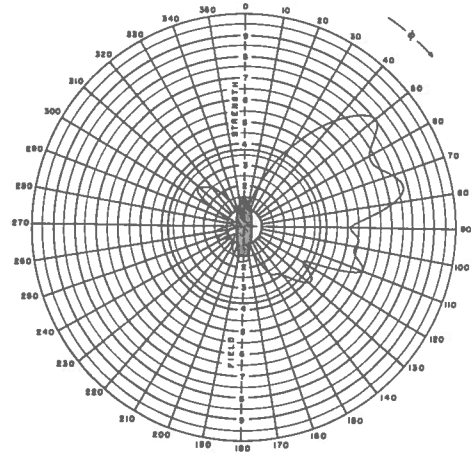
E_θ

FWD-AFT

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



PORT-STBD



$\Theta = 0°$

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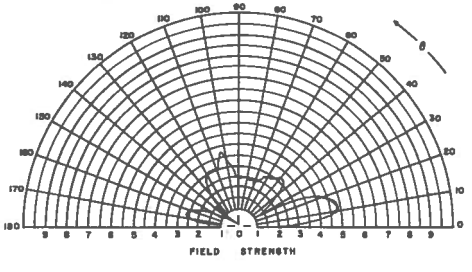
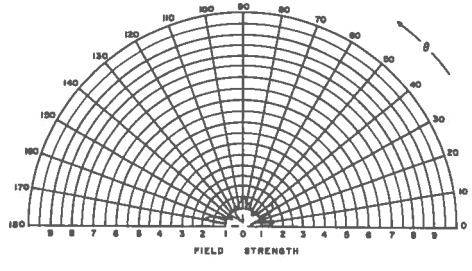


E_ϕ

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



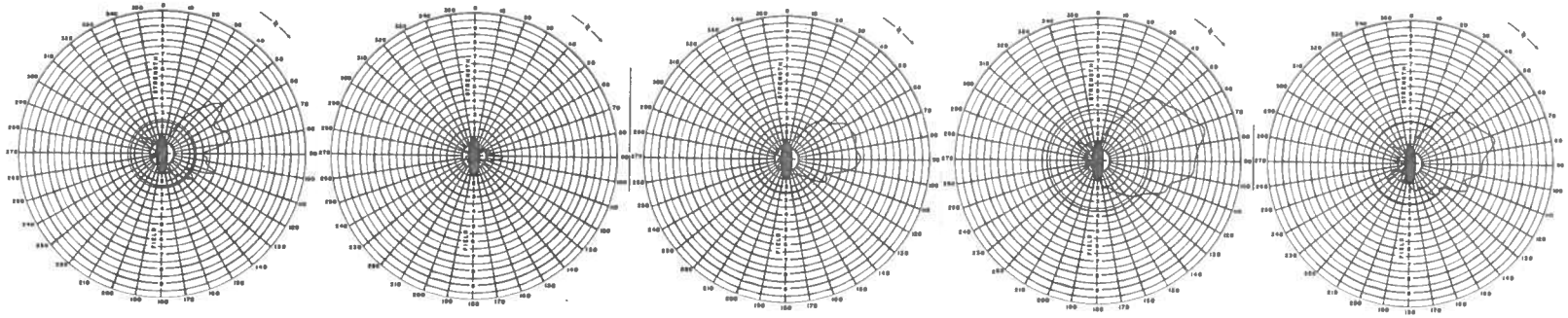
ANTENNA : MID-ISLAND INBOARD R_X
28 FT WHIP

FREQ. : 12 Mc/s

REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS - 50Ω

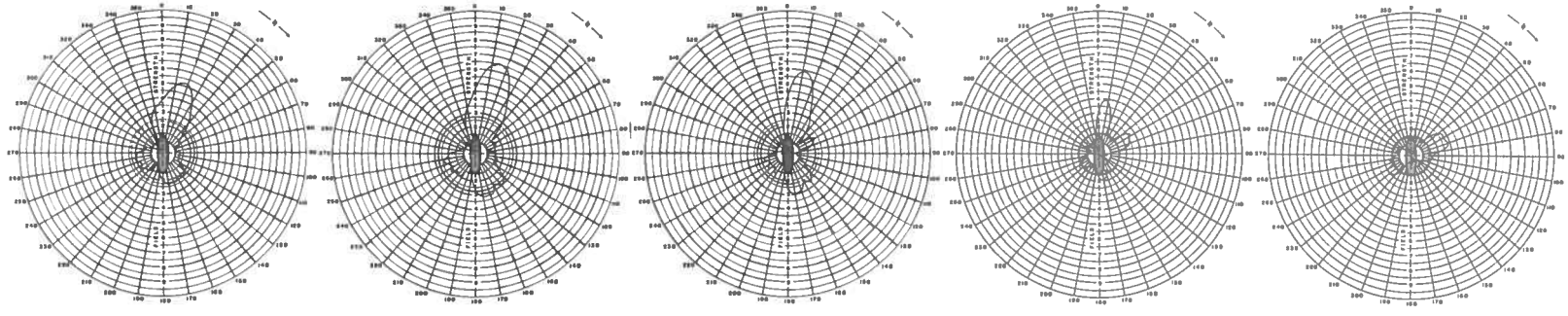
$\zeta = .35$
$\eta = .74$

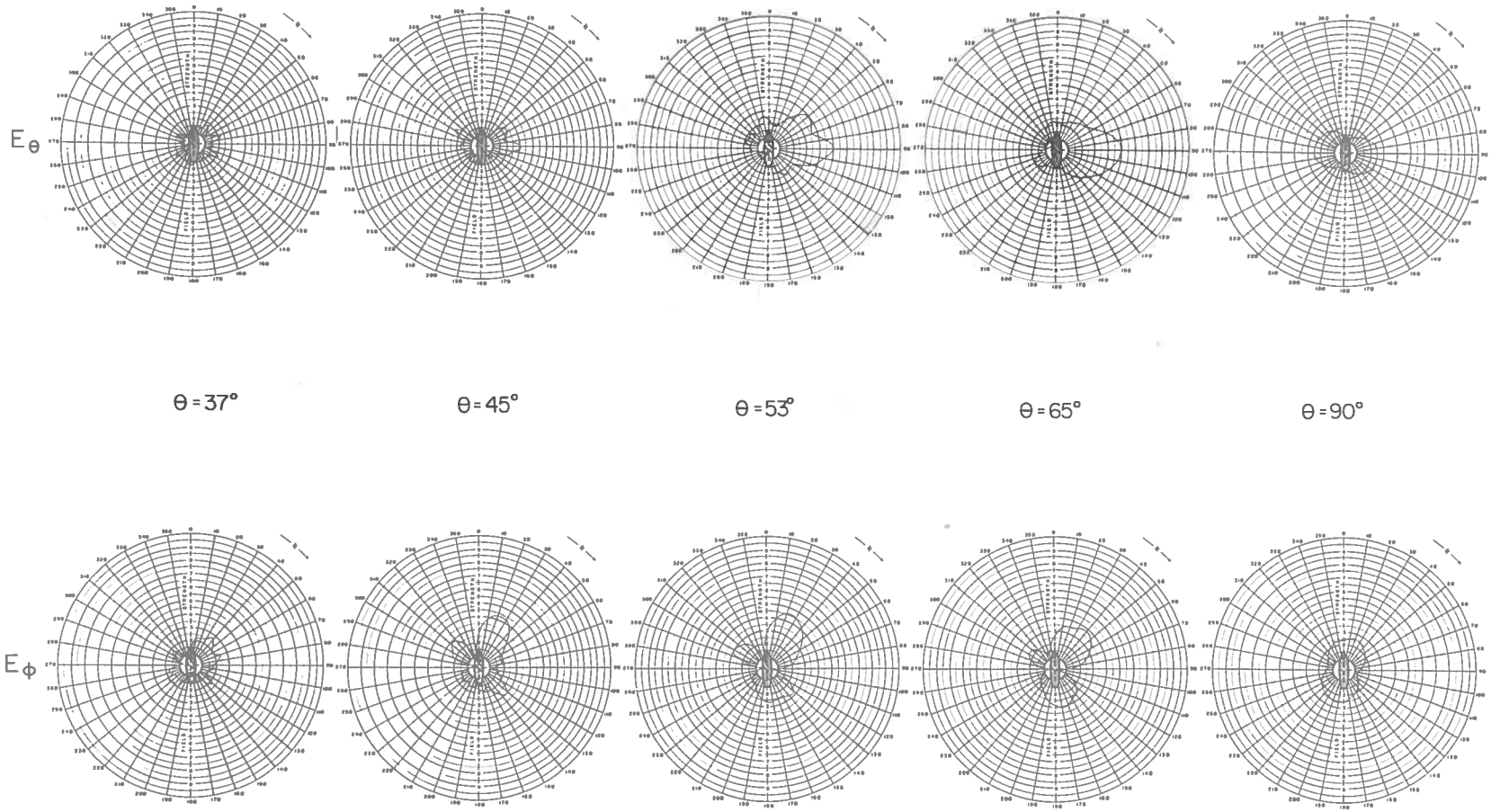
E_θ



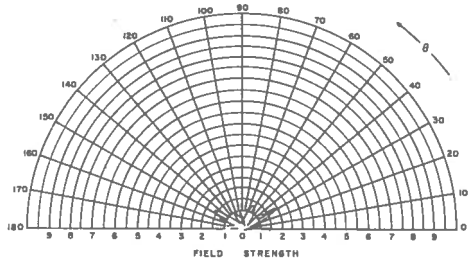
θ = 6°　　θ = 12°　　θ = 18°　　θ = 25°　　θ = 30°

E_ϕ




E_θ
E_ϕ
θ = 37°
θ = 45°
θ = 53°
θ = 65°
θ = 90°

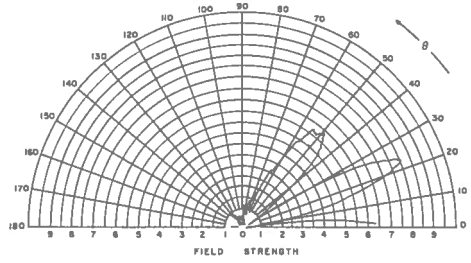
NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



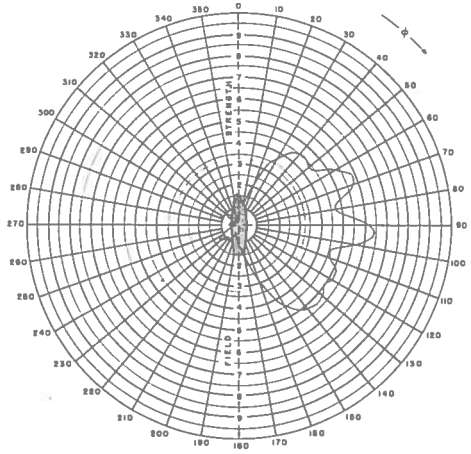
E_θ

FWD-AFT

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION

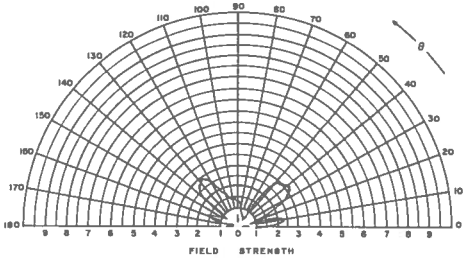


PORT-STBD



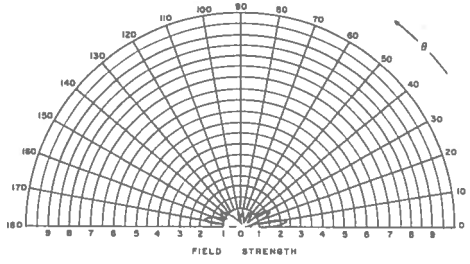
θ = 0°

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



E_ϕ

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



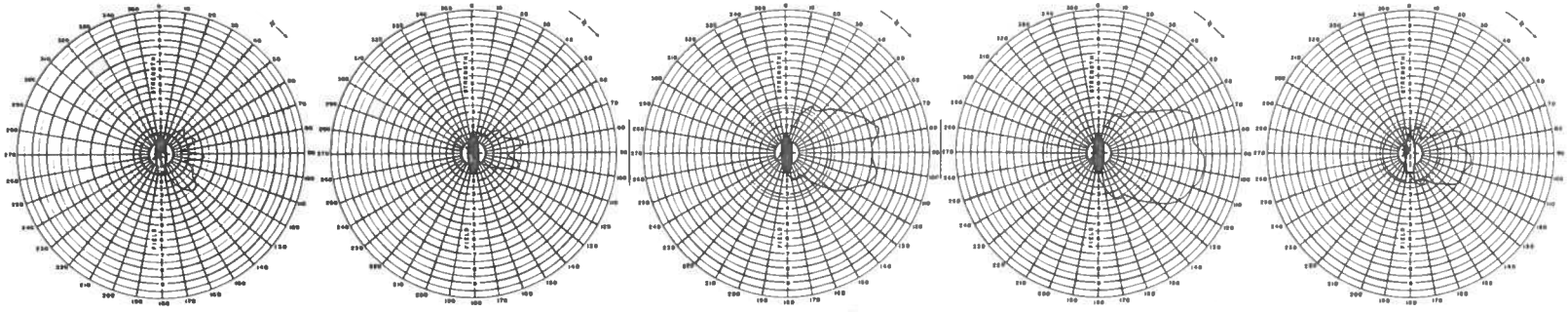
ANTENNA : MID - ISLAND INBOARD R_X
28 FT WHIP

FREQ. : 14 Mc/s

REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS - 50Ω

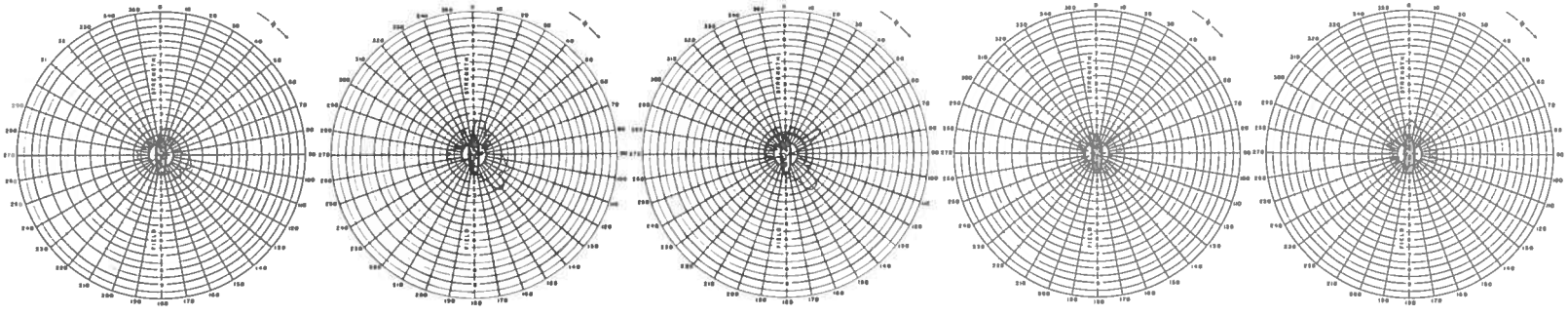
ζ = .37
η = .79

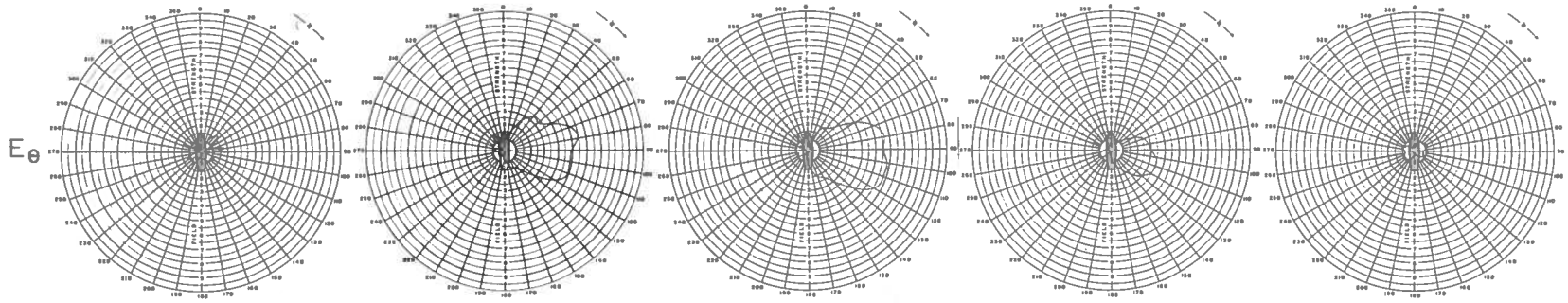
E_θ



θ = 6°　　θ = 12°　　θ = 18°　　θ = 25°　　θ = 30°

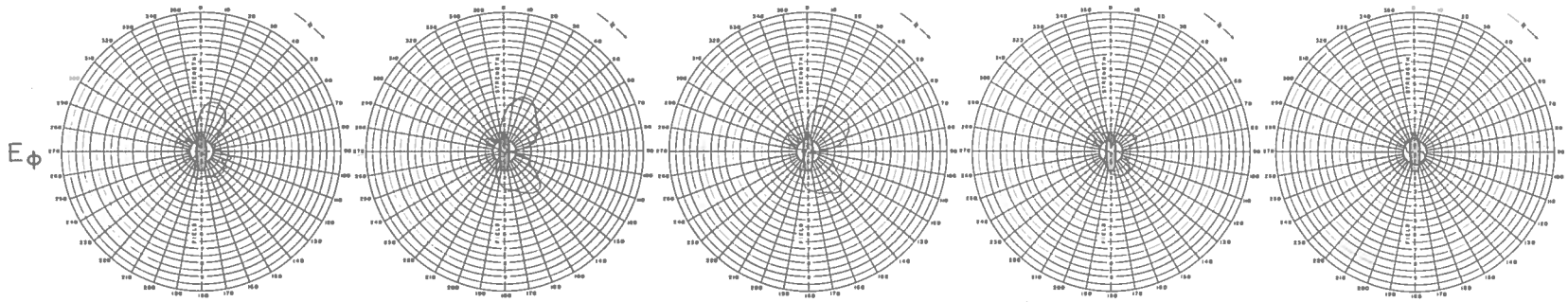
E_ϕ





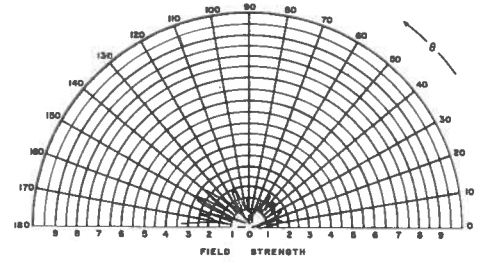
E_θ

θ = 37°　　θ = 45°　　θ = 53°　　θ = 65°　　θ = 90°



E_ϕ

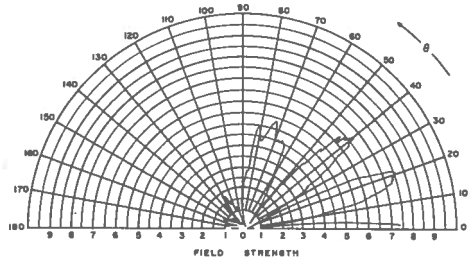
NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



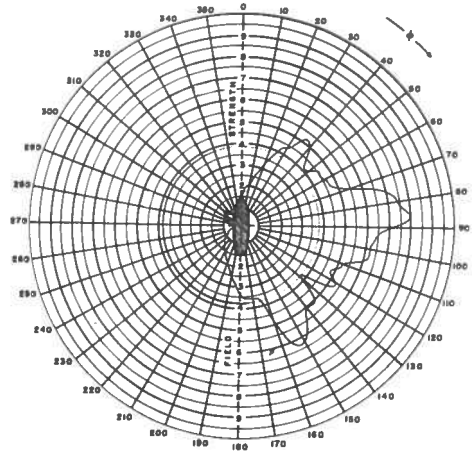
E_θ

FWD-AFT

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION

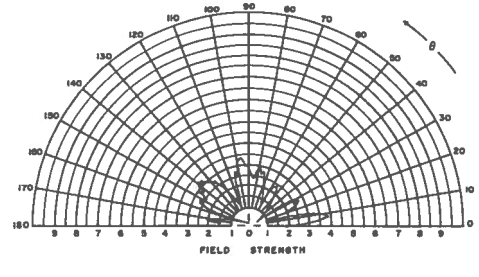


PORT-STBD



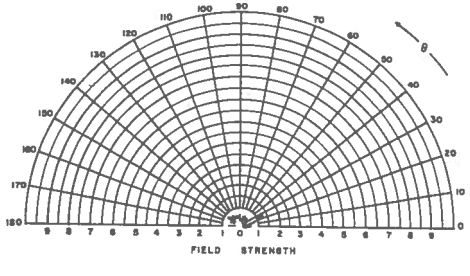
θ = 0°

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



E_ϕ

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



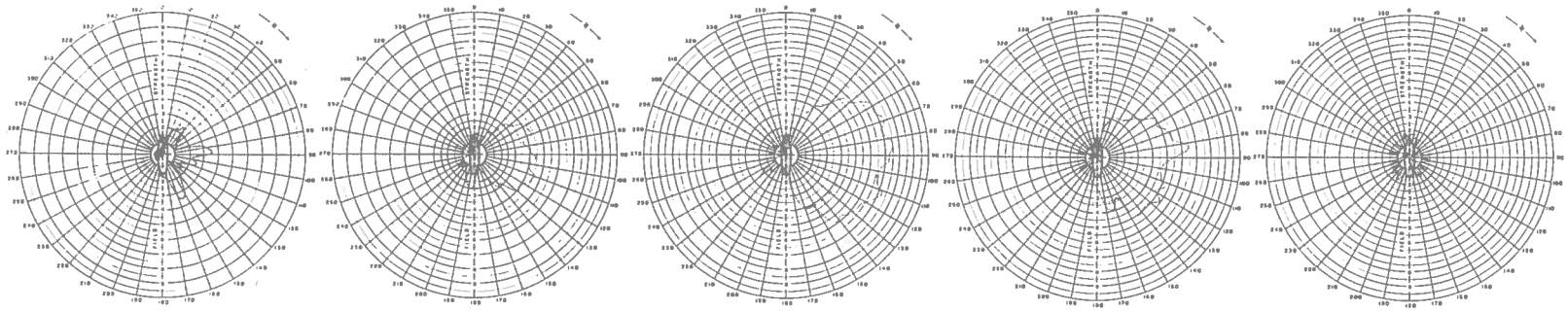
ANTENNA : MID-ISLAND INBOARD R_X
28 FT WHIP

FREQ. : 16 Mc/s

REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS - 50Ω

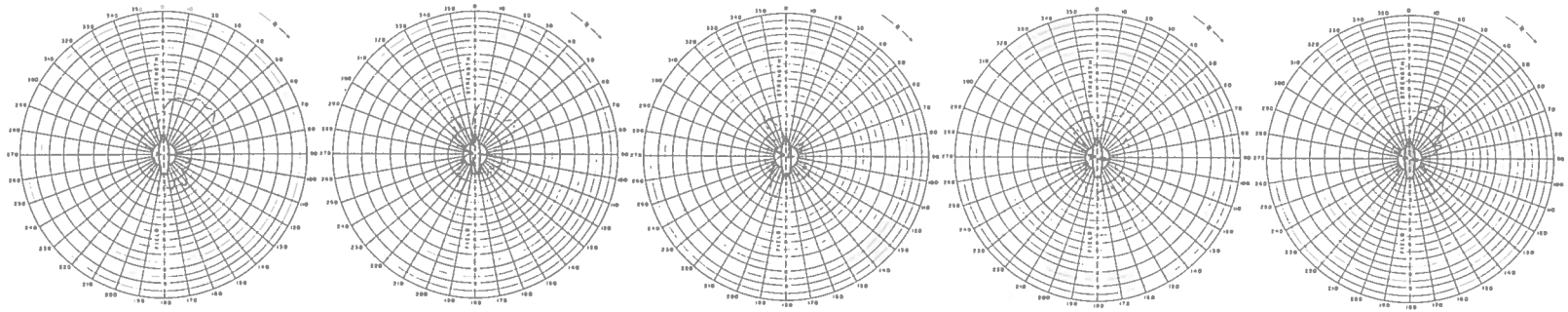
ζ = .35
η = .81

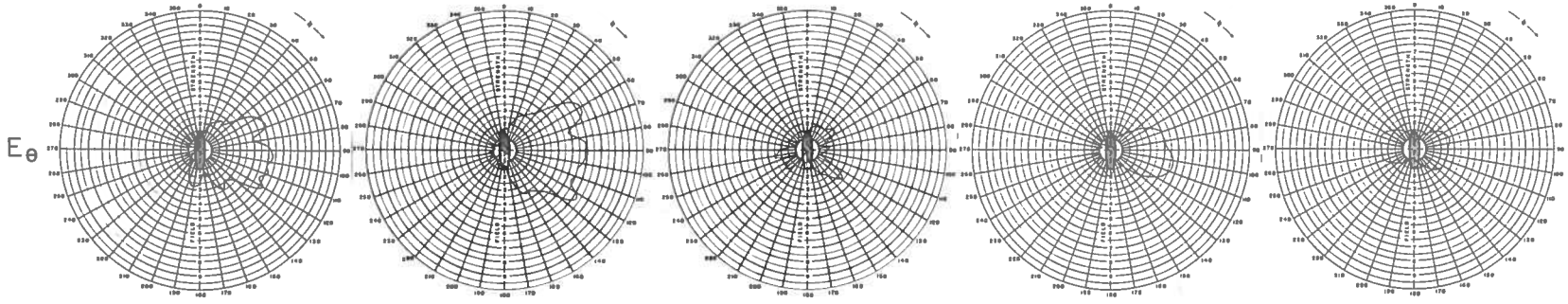
E_θ



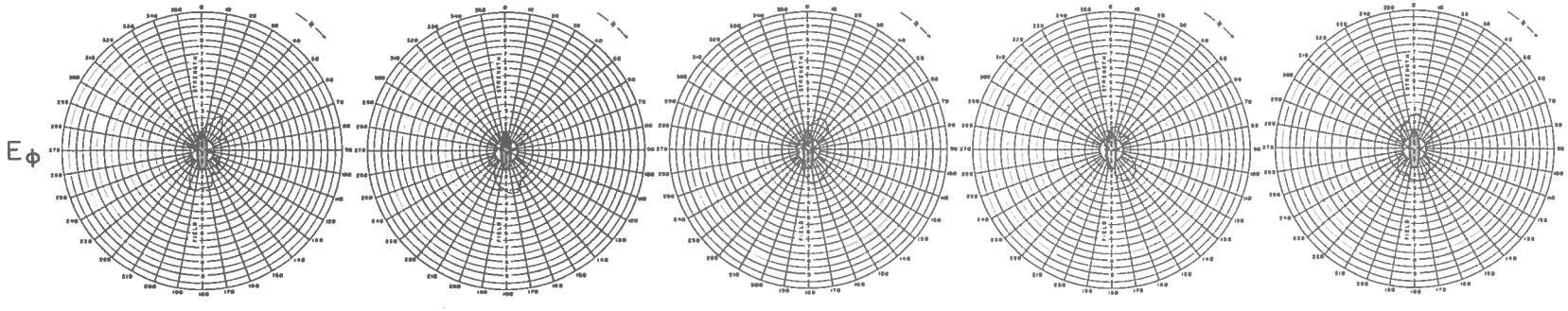
θ = 6°　　θ = 12°　　θ = 18°　　θ = 25°　　θ = 30°

E_ϕ

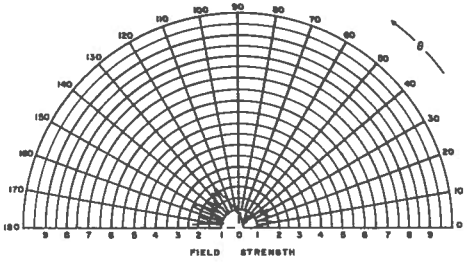




θ = 37°　　θ = 45°　　θ = 53°　　θ = 65°　　θ = 90°



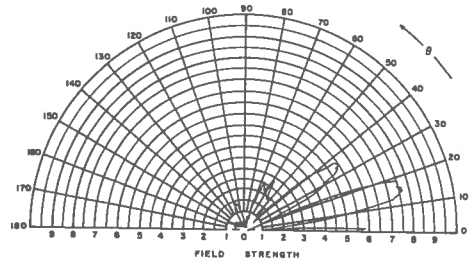
NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



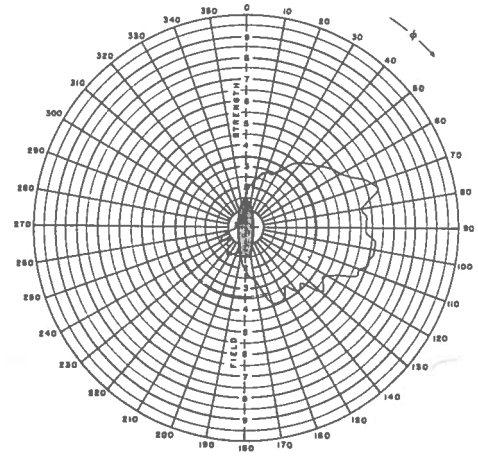
E_θ

FWD-AFT

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



PORT-STBD



$\Theta = 0°$

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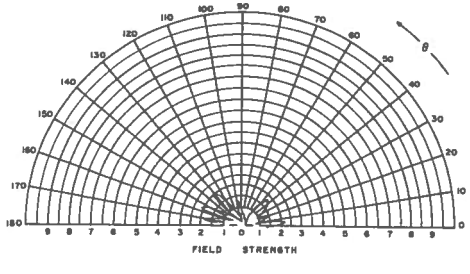
RADIO AND ELECTRICAL ENGINEERING DIVISION



E_ϕ

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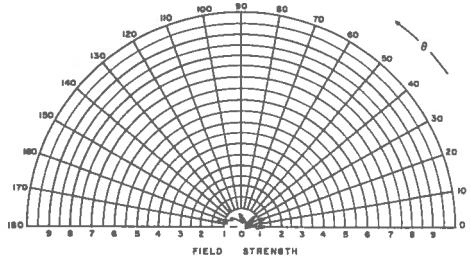
RADIO AND ELECTRICAL ENGINEERING DIVISION

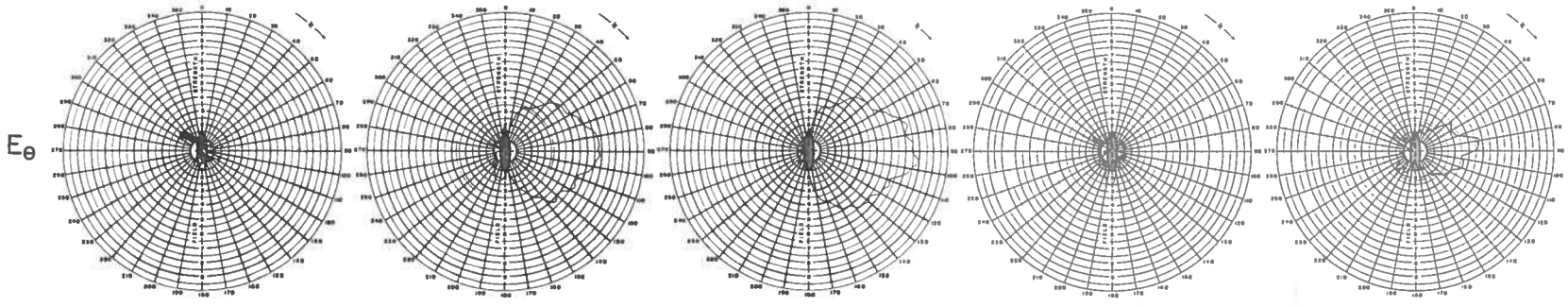


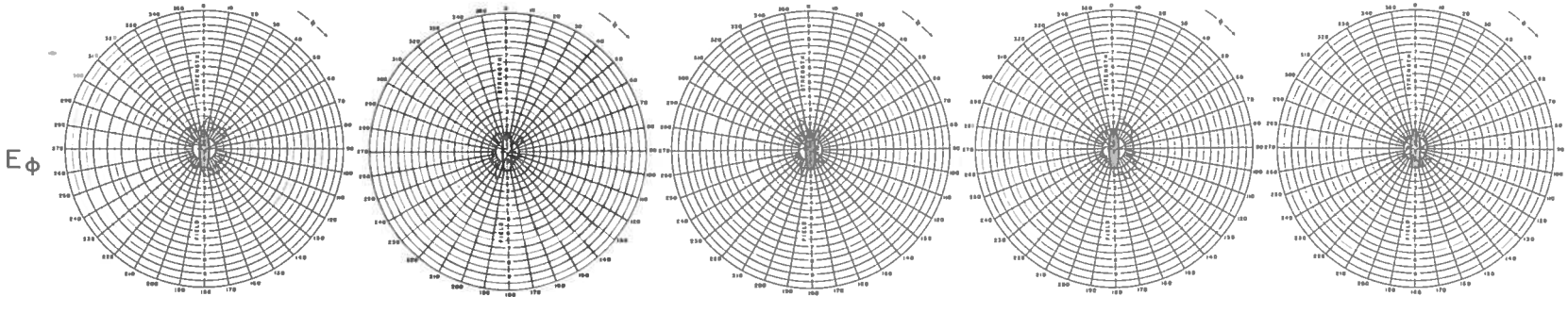
ANTENNA : MID - ISLAND INBOARD R_X
28 FT WHIP

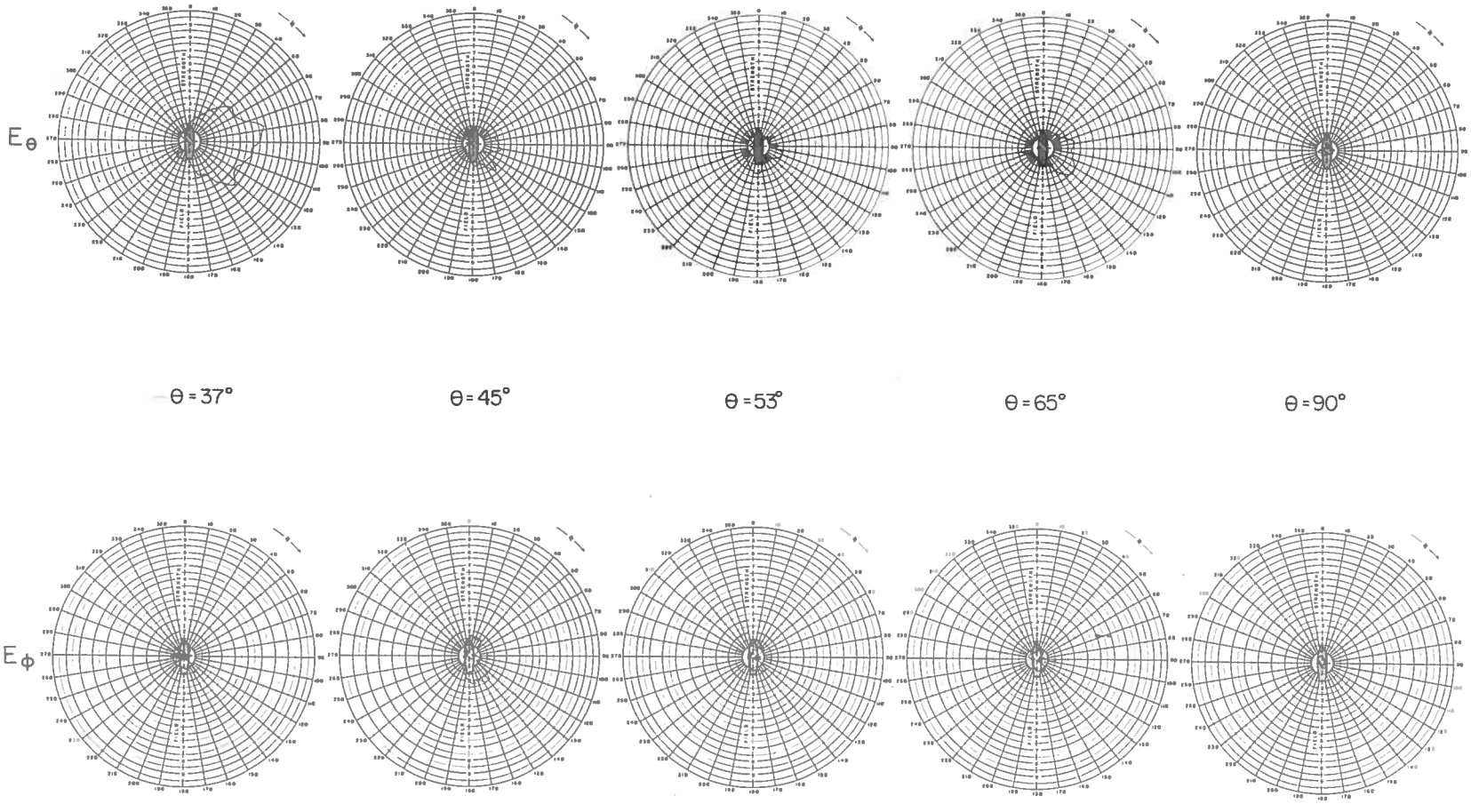
FREQ. : 18 Mc/s

REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS - 50Ω

$\zeta = .50$
$\eta = .96$


E_θ
θ = 6°
θ = 12°
θ = 18°
θ = 25°
θ = 30°


E_ϕ


E_θ
E_ϕ
θ = 37°
θ = 45°
θ = 53°
θ = 65°
θ = 90°

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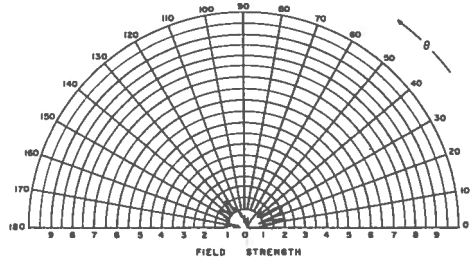
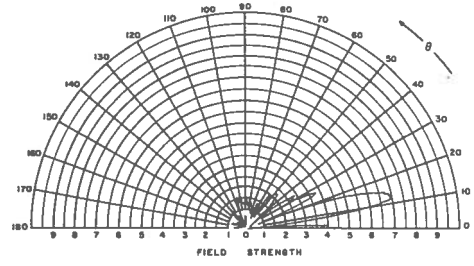


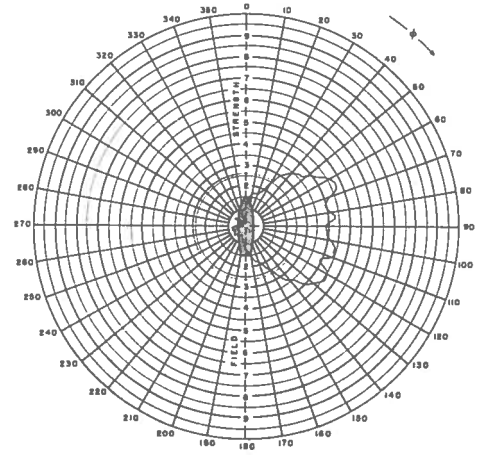
E_θ

FWD-AFT

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



PORT-STBD



$\theta = 0°$

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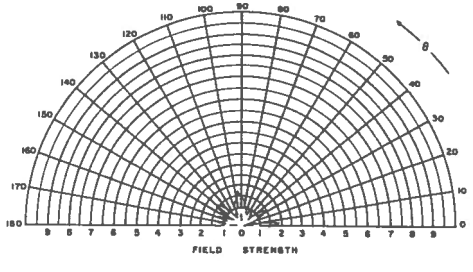
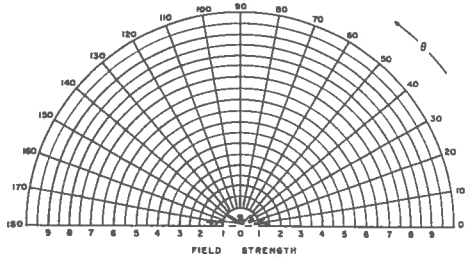
RADIO AND ELECTRICAL ENGINEERING DIVISION



E_ϕ

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION

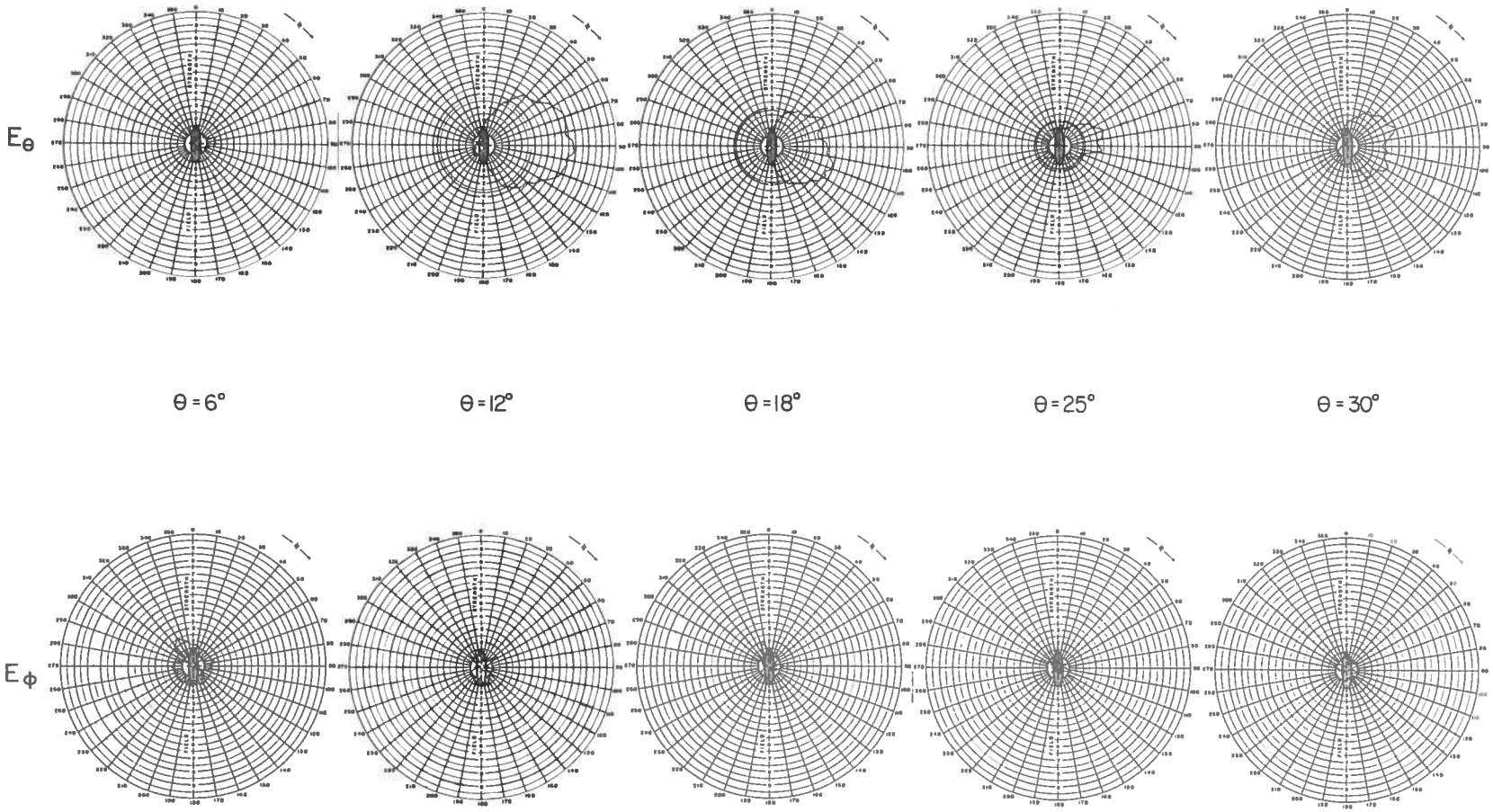


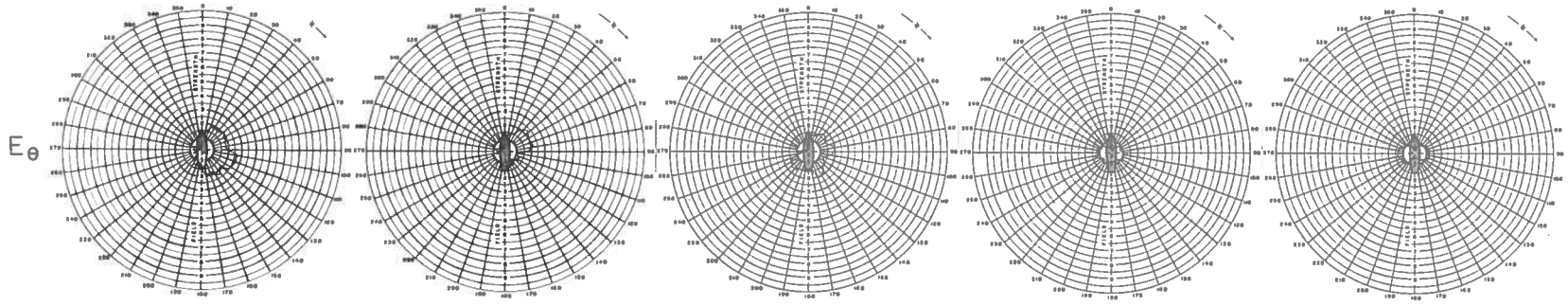
ANTENNA : MID-ISLAND INBOARD R_X
28 FT WHIP

FREQ. : 20 Mc/s

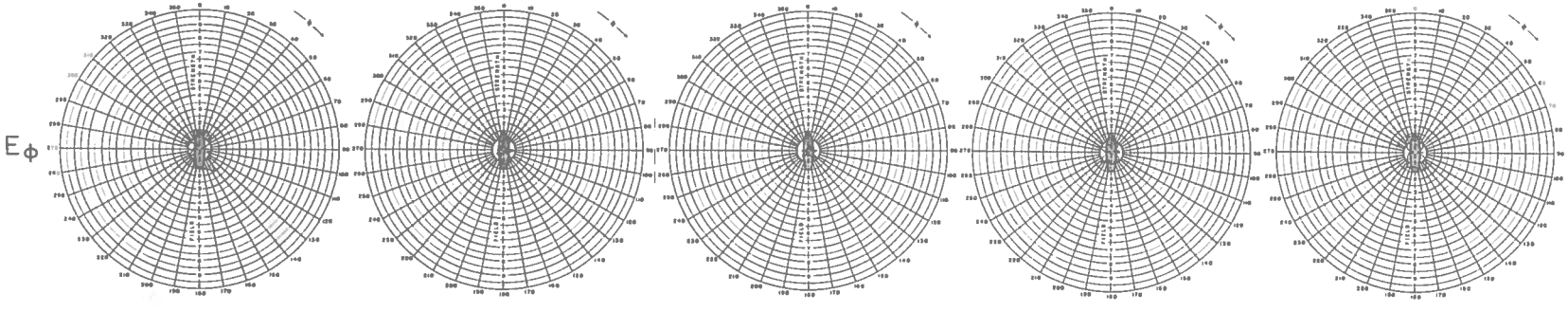
REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS - 50Ω

$\zeta = .44$
$\eta = .99$


E_θ
E_ϕ
θ = 6°
θ = 12°
θ = 18°
θ = 25°
θ = 30°

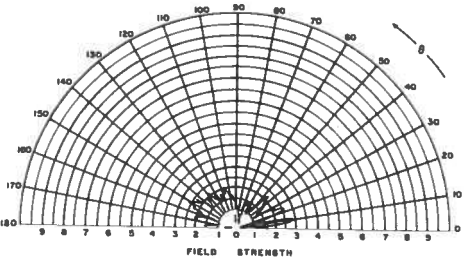


θ = 37°　　θ = 45°　　θ = 53°　　θ = 65°　　θ = 90°



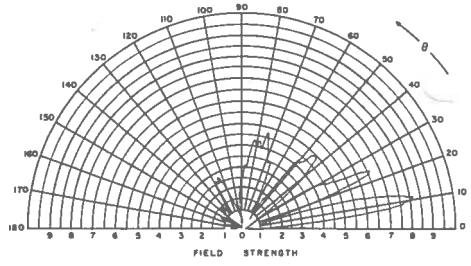
NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION

E_θ

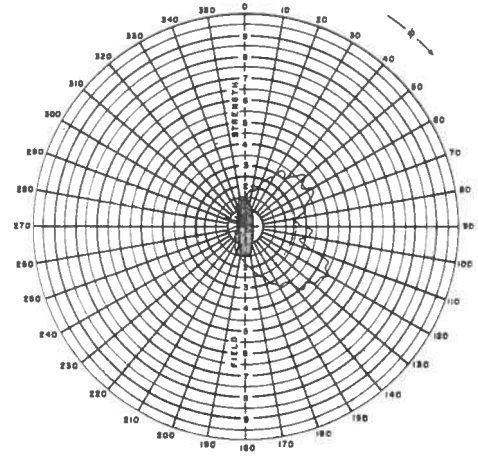


FWD-AFT

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



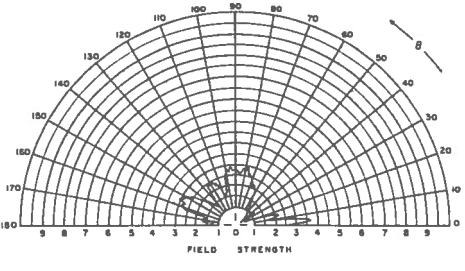
PORT-STBD



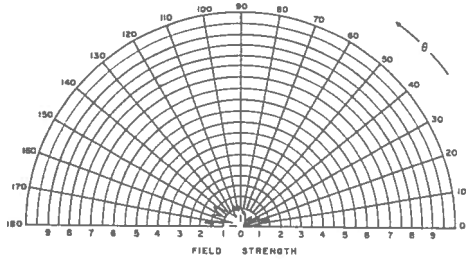
$\theta = 0°$

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION

E_ϕ



NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION

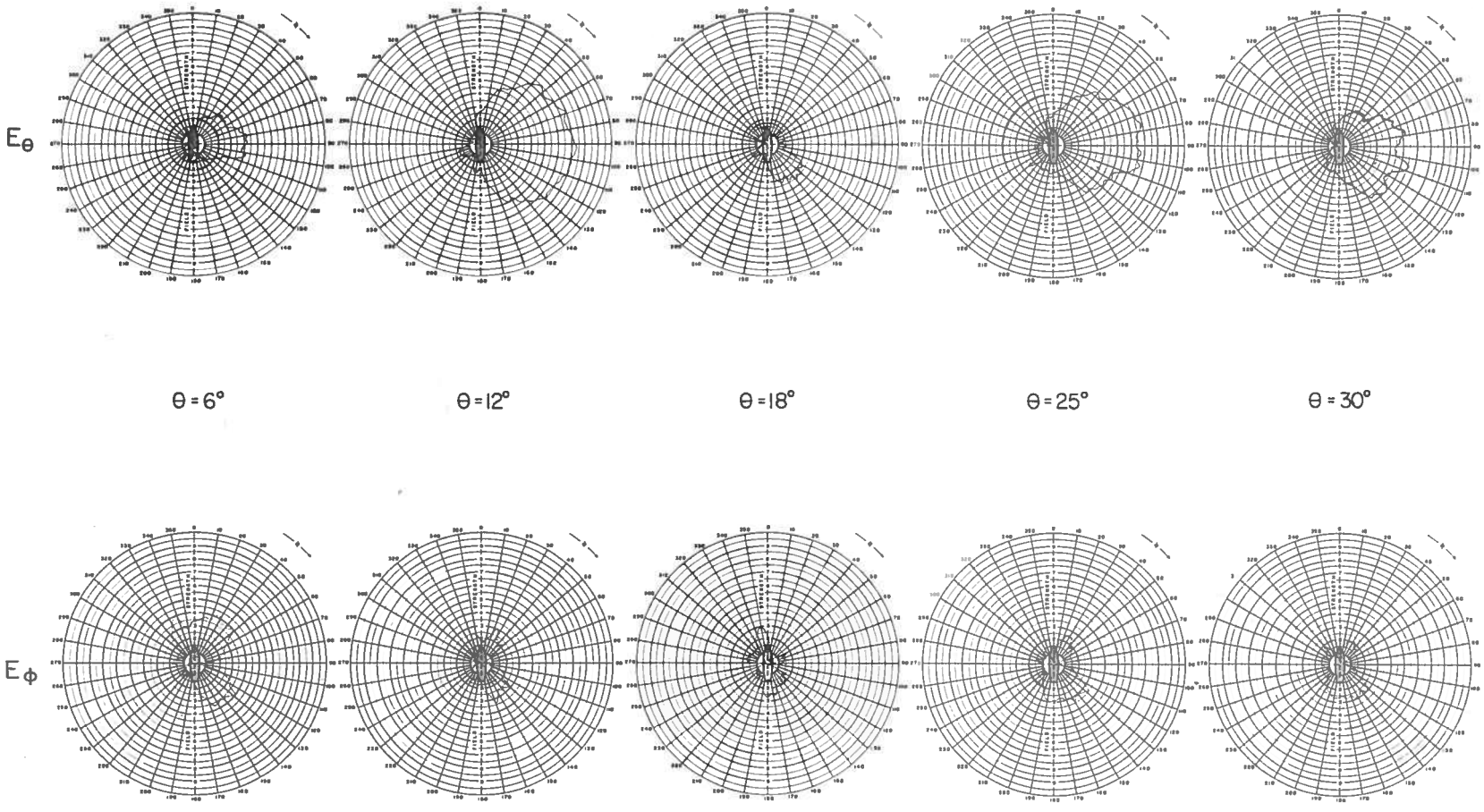


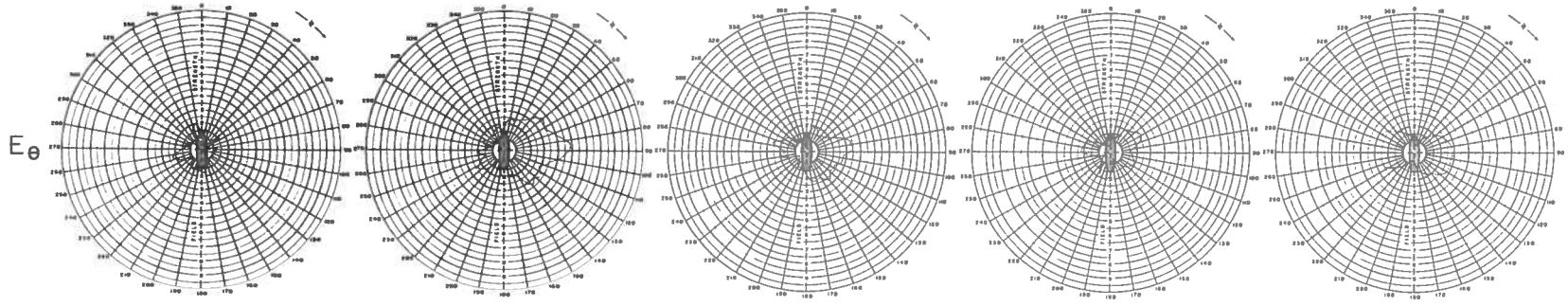
ANTENNA : MID-ISLAND INBOARD R_x
28 FT WHIP

FREQ. : 22 Mc/s

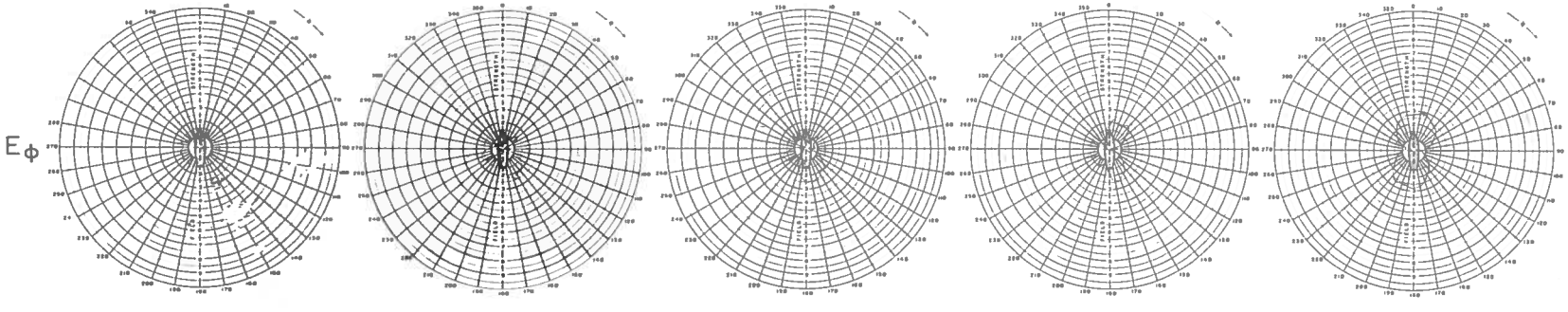
REMARKS : ALL R_x 28 FT WHIPS REMOVED
ALL T_x 35 FT WHIPS - 50Ω

$\zeta = .53$
$\eta = .94$

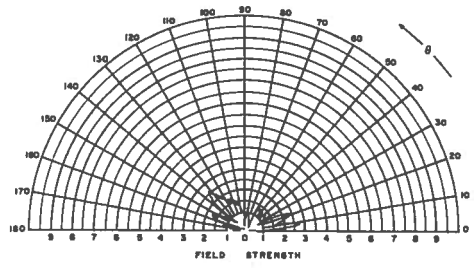

E_θ
E_ϕ
θ = 6°
θ = 12°
θ = 18°
θ = 25°
θ = 30°



θ = 37°　　θ = 45°　　θ = 53°　　θ = 65°　　θ = 90°



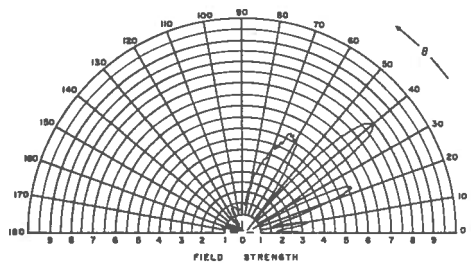
NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



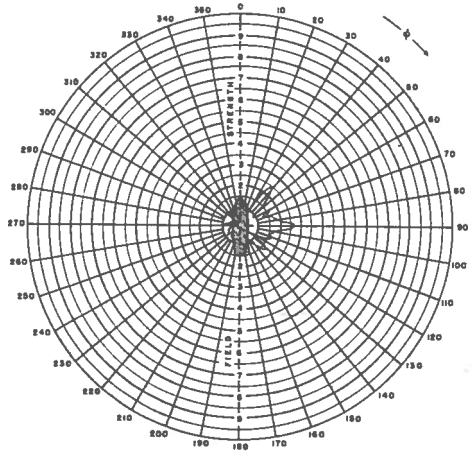
E_θ

FWD-AFT

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



PORT-STBD



θ = 0°

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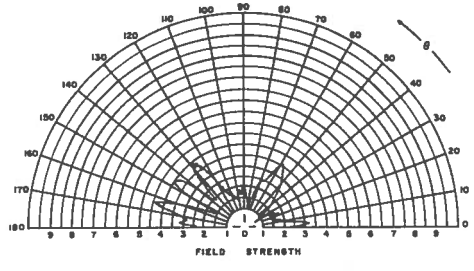
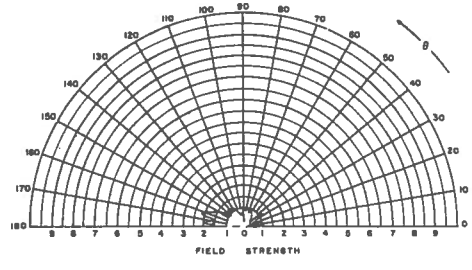
RADIO AND ELECTRICAL ENGINEERING DIVISION



E_ϕ

NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



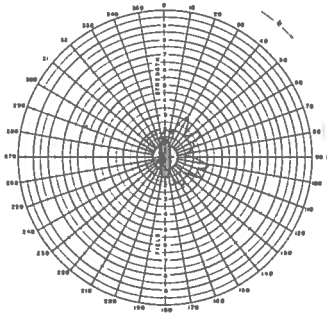
ANTENNA : MID-ISLAND INBOARD R_X
28 FT WHIP

FREQ. : 24 Mc/s

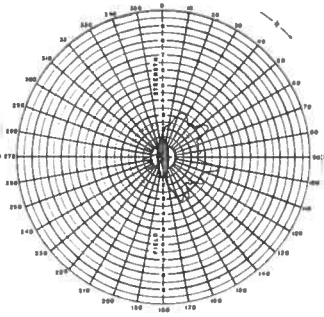
REMARKS : ALL R_X 28 FT WHIPS REMOVED
ALL T_X 35 FT WHIPS - 50Ω

ζ = .34
η = .61

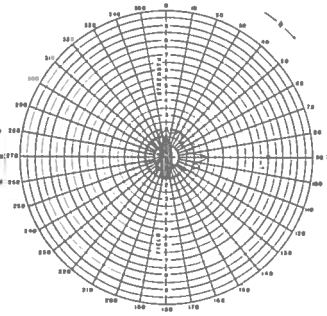
E_θ



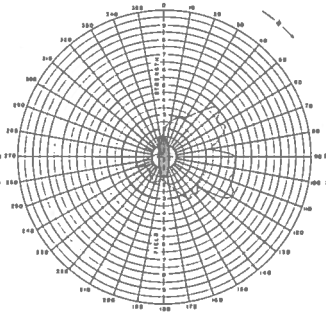
$\theta = 6°$



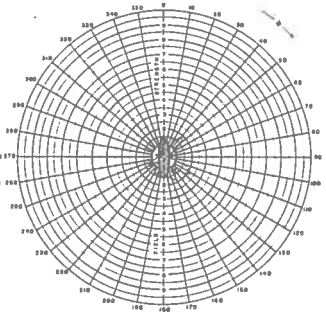
$\theta = 12°$



$\theta = 18°$

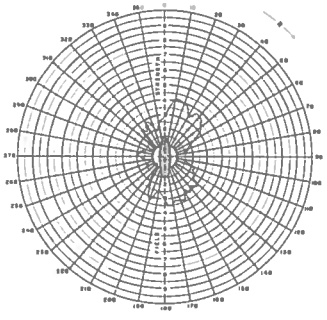


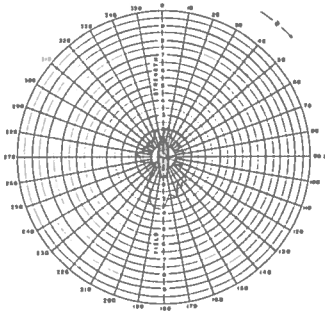
$\theta = 25°$

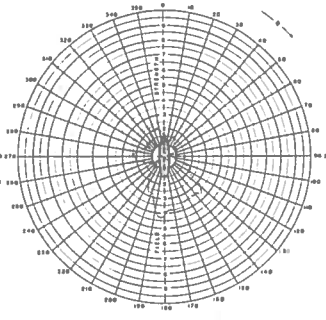


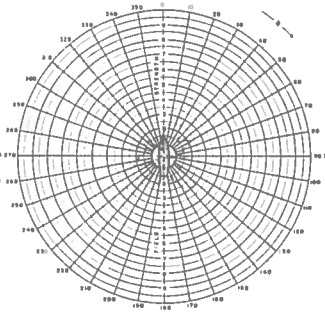
$\theta = 30°$

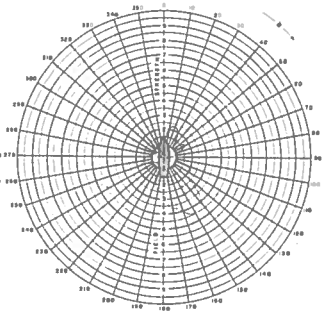
E_ϕ

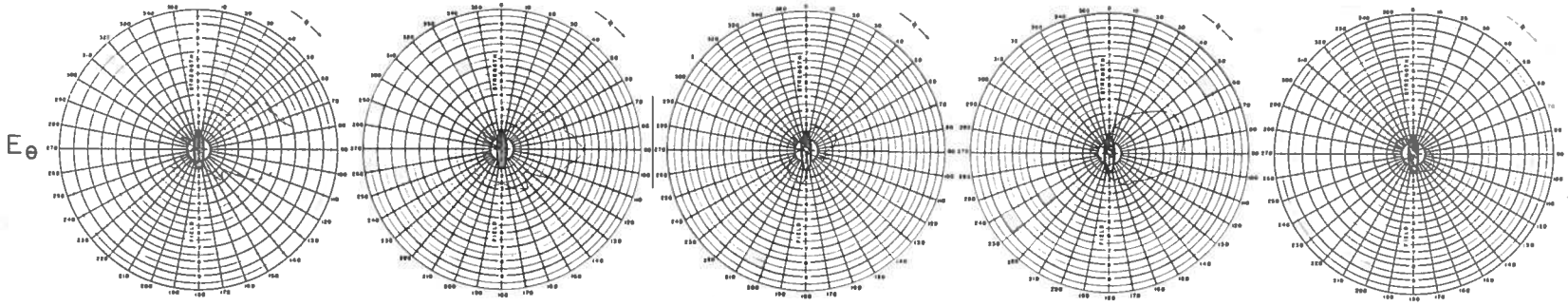












θ = 37° θ = 45° θ = 53° θ = 65° θ = 90°

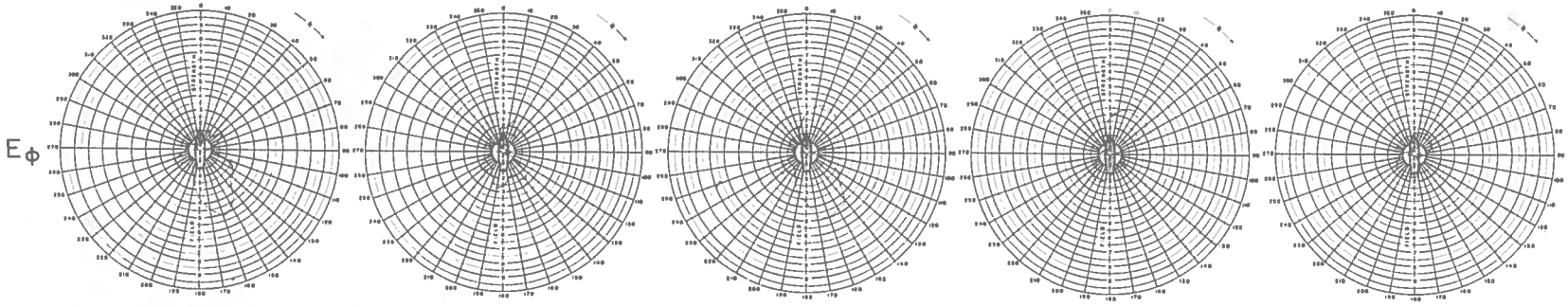


PLATE I — 1/48 scale model of HMCS Bonaventure island